imagination at work

Hydran* 201*i* System

Transformer Gas Monitoring System

Instruction Manual

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Contents

1 PRELIMINARY INFORMATION

1.1 Safety Warnings in Six Languages

1.1.1 [EN] (In English) WARNINGS:

All procedures in this manual must be strictly adhered to.

Any deviation from these could cause irreversible damage to the transformer being monitored and/or the Hydran 201*i*, and could lead to property damage, personal injury and/or death.

Installation and maintenance of the Hydran 201*i* must be carried out by qualified personnel only.

For a maximum distance of 15 m (50 ft) from the power source, use a 2.08 mm^2 (14-AWG) cable and a 15A overcurrent protection.

1.1.2 [FR] (In French) ATTENTION:

Toutes les procédures dans ce manuel doivent être observées rigoureusement.

Tout écart par rapport à celles-ci pourrait causer des dommages irréversibles au transformateur surveillé et/ou au Hydran 201*i*, et pourrait entraîner des dommages à la propriété, des blessures corporelles et/ou la mort.

L'installation et l'entretien du Hydran 201*i* doivent être effectués par du personnel qualifié seulement.

Pour une distance maximale de 15 m (50 pi) de la source d'alimentation, utiliser un câble de 2,08 mm2 (14-AWG) et une protection maximale de 15A contre les surintensités.

1.1.3 [ES] (In Spanish) ADVERTENCIA:

Se debe cumplir estrictamente con todos los procedimientos señalados en este manual.

Cualquier desviación al respecto puede causar daños irreparables al transformador que está bajo monitoreo y/o al Hydran 201*i*, asimismo puede ser causa de daños materiales, lesiones corporales y/o muerte.

La instalación y mantenimiento del equipo Hydran 201*i* se reserva únicamente al personal perfectamente cualificado.

Para una distancia máxima de 15 m (50 pies) de la fuente de alimentación, utilice un cable de 2,08 mm2 (14-AWG) y una protección máxima 15A contra las sobrecargas de corriente.

1.1.4 [DE] (In German) WARNUNG:

Alle Abläufe in diesem Handbuch müssen strengstens befolgt werden.

Jede Abweichung davon könnte dem zu überwachenden Transformator und/oder dem Hydran 201*i* unwiderrufliche Schäden zufügen, und könnte zu Sachschaden, Personenverletzung und/oder Tod führen.

Installation und Wartung des Hydran 201*i* dürfen daher nur von qualifiziertem Personal durchgeführt werden.

Für eine maximale Entfernung von 15 m von der Spannungsquelle, verwenden Sie ein 2,08 mm2 Kabel (14 AWG) und einen 15A Maximalüberstromschutz.

1.1.5 [IT] (in Italian) ATTENZIONE:

- Tutte le procedure del presente manuale dovranno essere eseguite in totale conformità.
- Qualsiasi deviazione dallo stesso manuale potrebbe causare danni irreversibili al trasformatore sotto monitoraggio e/o all' Hydran 201*i*, e potrebbe causare danni alla proprietà, lesioni personali e/o alla morte.
- L'installazione e la manutenzione del Hydran 201*i* devono essere eseguite solo ed esclusivamente da personale qualificato.
- A una distanza massima di 15 m dalla fonte di energia usare un cavo 2.08 mm2 (14-AWG) e una protezione massima 15A di sovracorrente.

1.1.6 [SV] (In Swedish) VARNING:

Alla procedurer i manualen måste följas noggrant.

Varje avvikelse från dessa procedurer kan orsaka oåterkalleliga skador på den övervakade transformatorn och/eller på Hydran 201*i* samt leda till egendomsförlust, personskada och/eller livsfara.

Installation och underhåll av Hydran 201*i* måste utföras av behörig personal.

För ett maximalt avstånd på 15 m från kraftuttaget, använd 2,08 mm^2 kabel (14-AWG) och ett överströmsskydd på maximalt 15 A.

1.2 Safety Symbols Description

Description of safety symbols used on the Hydran 201*i* device:

Refer to the Instruction Manual to prevent injury or damage to equipment.

Hazardous voltages may be present.

Protective earth connection.

Hot surfaces may be present.

Description of safety messages used in this Instruction Manual:

CAUTION ***A procedure, practice, or condition that could cause equipment damage or permanent loss of data, if not adhered to.***

WARNING ***A procedure, practice, or condition that could cause bodily injury or death, if not adhered to.***

1.3 Preface

This manual provides a complete reference for the Hydran 201*i* System, which is a unique, continuous, on-line monitor of combustible gases and moisture in dielectric oils.

The information in this manual may be used by:

- Purchase or Specifications personnel
- Installation planner
- Operator
- Commissioning manager
- Person responsible for collecting the readings

- Maintenance technician
- Troubleshooting technician
- Field Service and/or Customer Service personnel

WARNING

- ***If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.***
- ***All procedures in this manual must be strictly adhered to. Any deviation from these may cause irreversible damage to the transformer being monitored and/or the Hydran 201i System and may lead to property damage, personal injury and/or death.***
- ***Installation and maintenance of the Hydran 201i System must be carried out by qualified personnel only.***

This manual is not a tutorial on combustible gases or water in dielectric oil. It is assumed that the reader is already familiar with these subjects

This manual applies to the Hydran 201T*i*, Hydran 201i System and to the Hydran 201R Model i. In this manual, the designation "Hydran 201i System" also applies to the Hydran 201R Model i and to any other combination of Hydran 201i components. The components of the Hydran 201i System are described in Section 2.2.

This Hydran 201i System Instruction Manual is included in PDF format in the folder **English/Manuals** of the Hydran 201i System installation CD, along with the Hydran 201i System Installation Guide and the Hydran Host Software Manual. A hard copy of all those manuals can be purchased from General Electric.

1.4 Standard General Electric Warranty

The products covered by this manual and manufactured by General Electric ("Products") are warranted to be free from defects in material, workmanship and title at the time of delivery. Any components of a Product or other products manufactured by persons other than General Electric carry only the warranty provided by the manufacturers thereof and General Electric gives no warranty on behalf of the manufacturers of such products.

General Electric warrants the Products until one (1) year from first use or eighteen months (18) months from delivery, whichever occurs first, except that software is warranted for ninety (90) days from delivery.

General Electric represents and warrants that any software and firmware covered by this manual is free from functional deficiencies. If any functional deficiencies are discovered and are reported to General Electric within the Warranty Period, General Electric agrees to use due diligence to correct such deficiencies within 30 days after receipt of such notification. Upon receiving such notice, General Electric may lend telephone support or patches. If the reported deficiencies cannot be eliminated within 30 days, the Buyer may request, and General Electric shall then furnish, monthly status reports to the Buyer regarding the progress of General Electric's efforts to correct such functional deficiencies.

If Products covered by this manual do not meet the above warranties during the applicable Warranty Period, the Buyer shall promptly notify General Electric in writing but not later than 30 days and make the Products available promptly for correction. General Electric shall thereupon correct any defect by, at its option, repairing the defective Products or making available necessary replacement parts.

Any failure which is the basis for a warranty claim shall not be cause for extension of the duration of the applicable Warranty Period. General Electric shall not be responsible for removal or replacement of systems, structures or other parts of the Buyer's facility. If a defect in Products or part thereof cannot be corrected by General Electric's reasonable efforts, the parties shall negotiate an equitable adjustment in price with respect to such Products or part thereof. All decontamination work necessary for the correction of defects shall be performed by the Buyer at the Buyer's expense. The condition of any tests shall be mutually agreed upon and General Electric shall be notified of and may be represented at all tests that may be made.

General Electric does not warrant Products or any repaired or replacement parts against normal wear and tear, including that due to environment or operation, including excessive operation at peak capability, frequent starting, type of fuel, detrimental air inlet conditions, or erosion, corrosion or material deposits from fluids, or which have been involved in an accident. The warranties and remedies set forth herein are further conditioned upon:

- Proper storage, installation, operation and maintenance of the Buyer's equipment and conformance with the instruction manuals (including revisions thereto) provided by General Electric and/or its subcontractors, as applicable.
- Repair or modification pursuant to General Electric's instructions or approval.

The Buyer shall keep proper records of operation and maintenance during the applicable Warranty Period. These records shall be kept in the form of log sheets and copies shall be submitted to General Electric upon its request in connection with a warranty claim by the Buyer. General Electric does not warrant any products or services of others designated by the Buyer where such products or services are not normally supplied by General Electric.

The preceding paragraphs set forth the exclusive remedies for all claims based on failure of or defect in Products covered by this manual, whether the failure or defect arises before or during the applicable Warranty Period and whether a claim, however instituted, is based on contract, indemnity, warranty, tort (including negligence) or civil liability, strict liability or otherwise. The foregoing warranties are exclusive and are in lieu of all other warranties and guarantees whether written, oral, implied or statutory. NO IMPLIED STATUTORY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL APPLY.

2 INTRODUCTION

This Chapter is an introduction to the Hydran 201*i* System. A description of the various components of the system is also provided.

2.1 The Hydran 201i System

The Hydran 201*i* System is a continuous, on-line, intelligent dissolved gas monitoring system. Its uncompromising accuracy and reliability, and its features are key to its worldwide acceptance as a true transformer fault prevention device:

- A direct and continuous combustible gas-in-oil digital reading (0–2,000 ppm H_2).
- An isolated, analog 4–20 mA output.
- Two adjustable gas alarm set points.
- A System Fail alarm.
- A sensor test feature.
- A very wide temperature range for all-weather outdoor operation.
- An extremely high immunity to electrical surge, radio-frequency interference and electrostatic discharge.

Besides these essential characteristics, the Hydran 201T*i* intelligent dissolved-gas monitor enjoys the benefits of full digital processing and is equipped with the following additional high-value features:

- Adjustable hourly and daily gas trend computation (ppm change during the target period) with alarming.
- History logging of data and events with date and time stamping.
- Serial communications with a host computer (USB or RS-485).
- Networking capabilities (up to 128 units) and modem control.
- Self-test on power-up.
- All-software calibration.
- Remote or local configuration and program upgrading.
- Hydran Host computer software available from General Electric.
- Full stand-alone capabilities when the host computer is not needed.
- Sensor self-test and sensor status.

The Hydran 201*i* System consists of an Intelligent Transmitter, named the Hydran 201T*i*, and a family of Controllers, collectively named the Hydran 201C*i* Controllers.

- When the Hydran 201T*i* (Intelligent Transmitter) is combined with the Hydran 201C*i* -1 (One-Channel Controller), it is called a Hydran 201R Model *i* (Incipient Fault Monitor).
- A Hydran 201T*i* being used alone or with other Hydran 201C*i* Controllers is named a Hydran 201*i* System Incipient Fault Monitor.

Both the Hydran 201R Model *i* and the Hydran 201*i* System Incipient Fault Monitors can be networked. The network can be tied to a Supervisory Control and Data

Acquisition (SCADA) computer with a single RS-232 line or USB link, either locally at the substation or remotely through a telephone line and modem.

2.2 Components of the Hydran 201i System

2.2.1 Hydran 201Ti Intelligent Transmitter

The Hydran 201T*i* Intelligent Transmitter (Figure 2-1 below) is the foundation upon which the Hydran 201*i* System is built. It consists of a small cylindrical enclosure which attaches directly to a transformer valve using a brass adaptor. This enclosure contains a standard Hydran sensor, a thermal conditioning system and a microprocessor-based intelligent electronic transmitter.

Figure 2-1: Hydran 201Ti Intelligent Transmitter

Terminal blocks are provided for easy connection of: AC power; alarm contacts (Gas High, Gas High- High and System Fail); supervisory link; and one isolated, analog 4–20 mA output. A USB type B connector is provided for local computer interface.

A membrane keypad and an alphanumeric backlit LCD display enable full interaction with the unit without requiring the use of an external computer.

The H201T*i* is described in detail in Chapter 3.

2.2.2 Hydran 201Ci Communications Controller

The Hydran 201C*i*- C unit (Figure 2-2 below) is a communications controller. It can supervise up to four (4) Hydran 201T*i* units through the isolated supervisory link, typically a transformer bank (A, B, C and auxiliary). The Hydran 201C*i*-C does not have a display, nor does it provide alarm or analog outputs. It is meant specifically to interface with a network of H201T*i* Intelligent Transmitters to a computer via an RS-232, RS-485 or USB link, or an optional modem.

Figure 2-2: Hydran 201Ci-C Communications Controller

The H201C*i*-C is built into the same heated Type NEMA 4X instrument cabinet as the H201C*i*-1 (next section), but without a display or alarms; it contains a single electronic digital circuit board that handles the communications tasks. Two terminal block stripes are provided for easy connection to AC power. Connectors are used for communications:

- RS-232 or USB to a computer or an optional modem;
- Isolated supervisory link to H201T*i* Intelligent Transmitters (four connectors);
- RS-485 to other H201C*i* Controllers.

The H201C*i*-C is described in detail in Section 4.1.

2.2.3 Hydran 201Ci-1 One Channel Controller

The Hydran 201C*i*-1 (Figure 2-3 below) is a full one-channel controller. When used with the Hydran 201T*i* Intelligent Transmitter, the combination is called a Hydran 201R Model *i* (see the picture on the front cover of this manual). It uses a heated Type NEMA 4X instrument cabinet and contains a single electronic circuit board. The digital/analog board handles communications tasks and provides display, alarm and analog output functions.

Figure 2-3: Hydran 201Ci-1 One-Channel Controller

Two terminal block stripes are provided for easy connection of: ac power; alarm contacts (Gas High, Gas High-High and System Fail); configurable isolated analog output; and isolated supervisory link to the Hydran 201T*i* Intelligent Transmitter. Connectors are used for communications: RS-232 or USB to a computer or optional modem, and RS-485 to other Hydran 201C*i* Controllers.

A large LED digital display shows the gas concentration in ppm. Two gas alarm indicators are mounted on the front door.

The H201C*i*-1 is described in detail in Section 4.2.

2.2.4 Hydran Host Software

General Electric's Hydran Host software provides a simple interface between one or more Hydran 201T*i* Intelligent Transmitters and an IBM PC (or compatible), through a standard USB communication port (Type B connector). Optional modems allow the communication to be carried over public telephone lines.

The Hydran Host software performs five basic tasks:

- A continuous, on-line survey of alarm status and basic information from one or several H201T*i*'s.
- Real-time logging of information from one or several H201T*i*'s.
- Continuous or programmed uploading of historical data (history download) from one or several H201T*i* network(s) with graphic display.
- Downloading and uploading of configuration data (H201T*i* set-up) to one or several H201T*i*'s from/to the host computer.
- H201T*i* embedded program upgrading of one or several H201T*i*'s

2.3 Networking and Communications Capabilities

Starting with the CPU FW v4.0, up to 32 Hydran 201T*i* Intelligent Transmitters can be connected in a single RS-485 network and monitored by a local computer using computer's USB communication port. This is accomplished by connecting the 201T*i*s to the computer via an RS-485 to USB converter. Such network can also be monitored remotely from a computer via modem. In this case the PC (equipped with modem) has to be connected to a Hydran 201 Ci-1 or Ci-C via either the USB port or the RS-232 port, and subsequently to up to max 32 201Tis that are connected in daisy chain via RS-485 port available in 201Ti.

Also is still offered the possibility of having up to 128 Hydran 201T*i* Intelligent Transmitters be connected in a single network and monitored and controlled by computer (either locally or remotely through a modem) using computer's RS-232 or USB communication port. This is accomplished by connecting groups of one to four H201T*i*'s to a Hydran 201C*i*-C Controller via an isolated supervisory link, and then connecting the many H201C*i* Controllers via an isolated RS-485 LAN.

Each supervisory link is isolated to a level of 2,000 V RMS, both at the H201T*i* end and at the H201C*i* end. Individual transmitters can be wired directly to their group controller if the total cable length does not exceed 1,200 m (4,000 ft).

The supervisory links and the RS-485 LAN are electrically isolated and all H201C*i*'s on a network share a single reference ground. The H201C*i*'s are networked together in a daisy-chain fashion. Usually, the H201C*i*'s are to be found in a well-defined area of a substation (such as a control building) but the RS-485 LAN can have a total length of 1,200 m (4,000 ft) if required. For 32 H201C*i*'s, this gives an average distance of 40 m (120 ft) between each H201C*i*.

Although the RS-485 LAN is electrically separate from the multiple supervisory links, the entire system forms a single logical network and each of the H201T*i*'s, up to a maximum of 128, can be called by the supervisory computer using the Gas Monitor Address of the transmitter (a user-defined number from 1 to 254 specific to each H201T*i*).

When the network option to use H201C*i*'s is required, the supervisory computer can be indifferently connected to the RS-232 or USB port of any of the H201C*i*'s since each H201C*i* automatically routes communications to and from its RS-232 or USB computer port, isolated supervisory link port and isolated RS-485 LAN port. More than one

computer can be connected to the network as long as only one is communicating at the same moment.

When an optional smart modem is installed in an H201C*i*, the network can be accessed through the public telephone system. The H201C*i* manages the modem operation to allow receiving and handling phone calls from distant modems, and properly ending the calls. Conversely, the modem is instructed to dial a distant modem if an alarm is sensed in an H201T*i* (unless this function is disabled by the user).

2.4 Description of the Hydran 201i systems

The Hydran 201*i* System is made up of different units assembled in several possible configurations to provide a variety of useful combinations for the detection and monitoring of failure conditions in oil-filled electrical equipment. The following vocabulary and abbreviations are used to describe the main components of this system:

- Hydran 201T*i* Intelligent Transmitter: The basic building block; includes the sensor; can be used in full stand-alone mode. Can be abbreviated as follows:
  - H201T*i* Intelligent Transmitter
  - H201T*i* Transmitter
  - H201T*i*

- Hydran 201Ci-1 One-Channel Controller: Combined with one H201Ti. Can be abbreviated as follows:
  - H201Ci-1 One-Channel Controller
  - H201Ci-1 Controller
  - H201Ci-1

- Hydran 201Ci-C Communications Controller: Allows computer supervision of up to four H201Ti's. Can be abbreviated as follows:
  - H201C*i*-C Communications Controller
  - H201C*i*-C Controller
  - H201C*i*-C

- Hydran 201Ci Controller: Generic designation of H201Ci-1 and/or H201Ci-C. Can be abbreviated as follows:
  - H201C*i* Controller
  - H201C*i*

- Hydran 201R Model i Incipient Fault Monitor: Made of an H201Ti plus an H201Ci-1. Can be abbreviated as follows:
  - Hydran 201R Model i

- Hydran 201i System Incipient Fault Monitor: Combination of H201Ti's and H201Ci's. Can be abbreviated as follows:
  - Hydran 201i System

- Hydran Host Software: Used for interface between the user and a network of H201Ti's when these are configured with the proprietary Hydran protocol. Can be abbreviated as follows:
  - Hydran Host

- Perception Software: Used for interface between the user and a network of H201Ti's when these are configured with the ModBus protocol. Can be abbreviated as follows:
  - Perception

2.5 Accessories

The following accessories are available for the Hydran 201*i* System. They may be ordered from General Electric with any of the Hydran 201*i* System components or separately.

2.5.1 Hydran 201TW Tube Wrench

The Hydran 201TW Tube Wrench (Figure 2-4 below) is required to properly install the Hydran 201 sensor. One Tube Wrench per site is recommended.

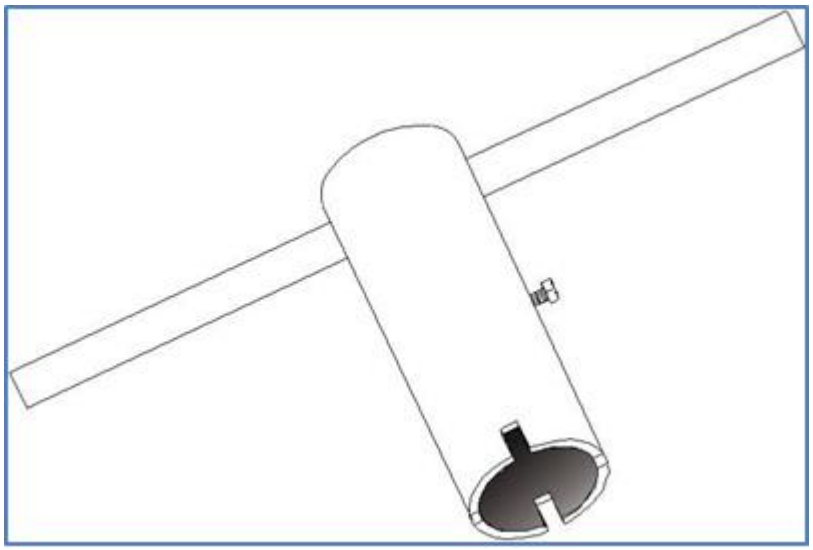


Figure 2-4: Hydran 201TW Tube Wrench

2.5.2 Vibration Absorbing Pads

If vibrations are present, rubber pads (which can be purchased from General Electric) are used on the back of the Hydran 201C*i* Controllers; an example is shown in Figure 2-5 below. Refer to Chapter 4.

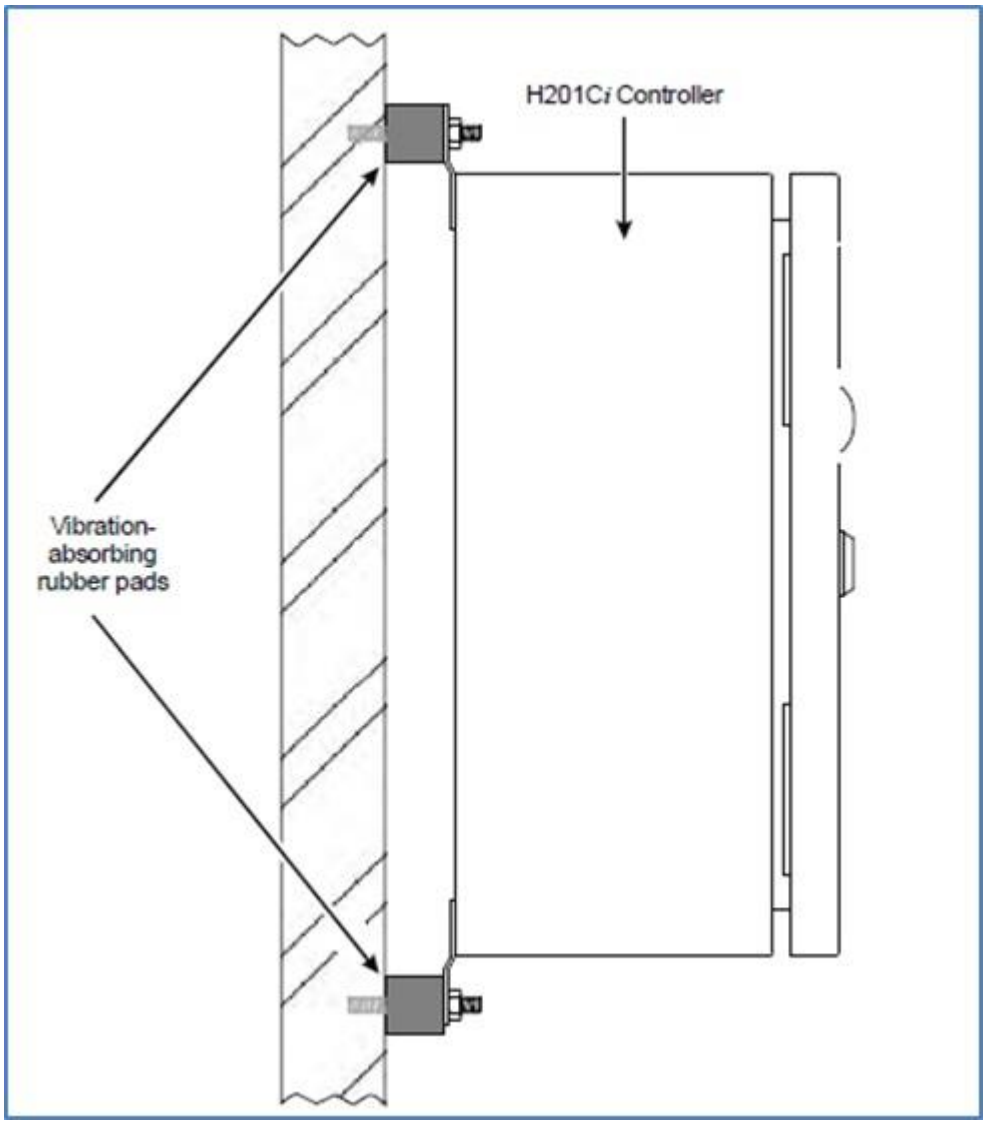


Figure 2-5: Vibration Absorbing Rubber Pads

3 HYDRAN 201TI INTELLIGENT TRANSMITTER

The Hydran 201T*i* is an intelligent, on-line monitoring system that measures the level of combustible gases in dielectric oil for the early detection and monitoring of incipient faults in transformers or any other oil-filled electrical equipment.

A picture of the H201T*i* is illustrated in Figure 2-1.

3.1 Features

The main features of the Hydran 201T*i* are:

- A Hydran 201 sensor that measures a composite value of the following dissolved gases in oil: hydrogen (H2), carbon monoxide (CO), acetylene (C2H2) and ethylene (C2H4).
- Easy installation on a valve of the equipment to be monitored.
- A six-key membrane keypad.
- A backlit, alphanumeric, liquid crystal display (LCD) to use the H201T*i* without a host computer. Provides the following on-line information:
  - Level of dissolved gases in oil.
  - Hourly trend (gas level variation during a period of time measured in hours).
  - Daily trend (gas level variation during a period of time measured in days).
  - Alarm messages.
- Three alarms:
  - Two gas alarms (High and High-High; levels are adjustable), triggered by the gas level, and the hourly and daily trends.
  - One system fail alarm, triggered by several conditions.
- Four historic data files (automatic recording of data):
  - Events (recording at the time of events; example: alarms).
  - Short Term and Long Term (recording at fixed, adjustable logging rates).
  - Service (recording at the time of the sensor tests).
- Semimonthly, automatic sensor test and state report.
- Digital calibration of the analog inputs and output.
- Isolated, analog 4–20 mA output.
- Immunity to electrical surge, radio-frequency interference and electrostatic discharge, as enumerated in the Technical specifications (section A-1).
- An isolated USB Type B connector for communication with a host computer running the Hydran Host software.
- Serial communication with a Hydran 201C*i* Controller through a supervisory link (communication cable between an H201T*i* and an H201C*i*).
- Full stand-alone capabilities when the host computer (running the Hydran Host software) is not used.
- Wide ambient temperature range for all-weather outdoor operation.
- A thermal regulating system.
- Communication protocols: proprietary Hydran protocol or ModBus RTU protocol
- Terminal blocks to connect the following components:
  - AC power supply.

  - Alarm contacts (gas High and High-High, and system fail alarms).
  - Analog output.
- A termination board to connect the H201Ci and the H201Ti with a supervisory link.

3.2 Enclosure

The Hydran 201T*i*'s enclosure (see Figure 2-1) is 186 mm (7.3 in) in diameter by 180 mm (7.125 in) in length; for details, see Figure B-1. It serves three functions:

- To provide mechanical and weather protections for the Hydran 201 sensor and the H201Ti's electronic circuits.
- To maintain the H201 sensor and the H201T*i* electronics between 25 and 50°C (77 and 122°F) under extreme ambient and oil temperatures.
- Using the dynamic oil sampling system, to stimulate oil movement in front of the H201 sensor to ensure representative sampling at all times.

3.3 External Components

Here is a description of the Hydran 201T*i*'s external components (see Figure 3-1 below):

1. **Display Window**: The aluminum cover has a window to see the LCD display. The display and the keypad are located on the CPU module (Section 3.4.4).
2. **Connection Box**: It is mounted on the external side of the heating plate, under the valve. It has a removable, watertight cover and two holes to install standard conduit fittings (for watertight, rigid or flexible steel conduits).
3. **Aluminum Cover**: It acts as a radiator, thus allowing the enclosure to maintain the temperature of the sensor and electronics between 25 and 50°C (77 and 122°F), regardless of the ambient or oil temperature. The H201T*i* controls the power input to the heating plate. The cover is easily removed for access to the H201 sensor and its oil sampling port.
4. **Breathing Membrane**: This Gore* porous membrane is impervious but allows oxygen to penetrate inside the H201T*i*. The H201 sensor requires oxygen to detect the dissolved gases in oil.
5. **Knob**: It maintains the aluminum cover in place.

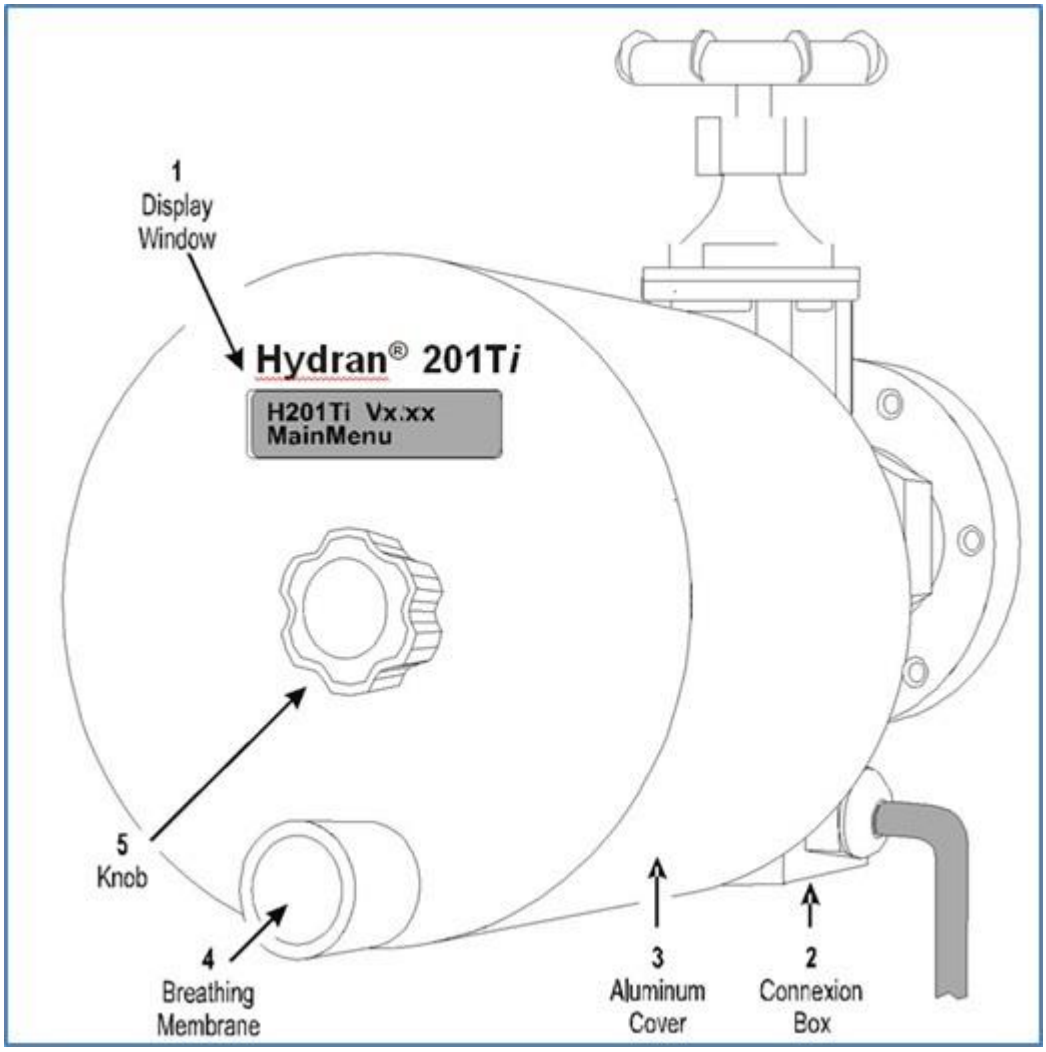


Figure 3-1: Hydran 201Ti's Enclosure (Mounted on a Valve)

3.4 Internal Components

An internal view of the Hydran 201T*i* is presented in Figure 3-2 below. The major components are described in this Section:

1. *Brass adaptor*: See Section 3.4.1.
2. *Heating plate*: See Section 3.4.2.
3. *Hydran 201 sensor*: See Section 3.4.3.
4. *CPU module*: See Section 3.4.4.
5. *USB Computer Port Connector, Type B*: See Section 3.4.5.
6. *I/O module*: See Section 3.4.6.
7. *Connection box*: See item 2.

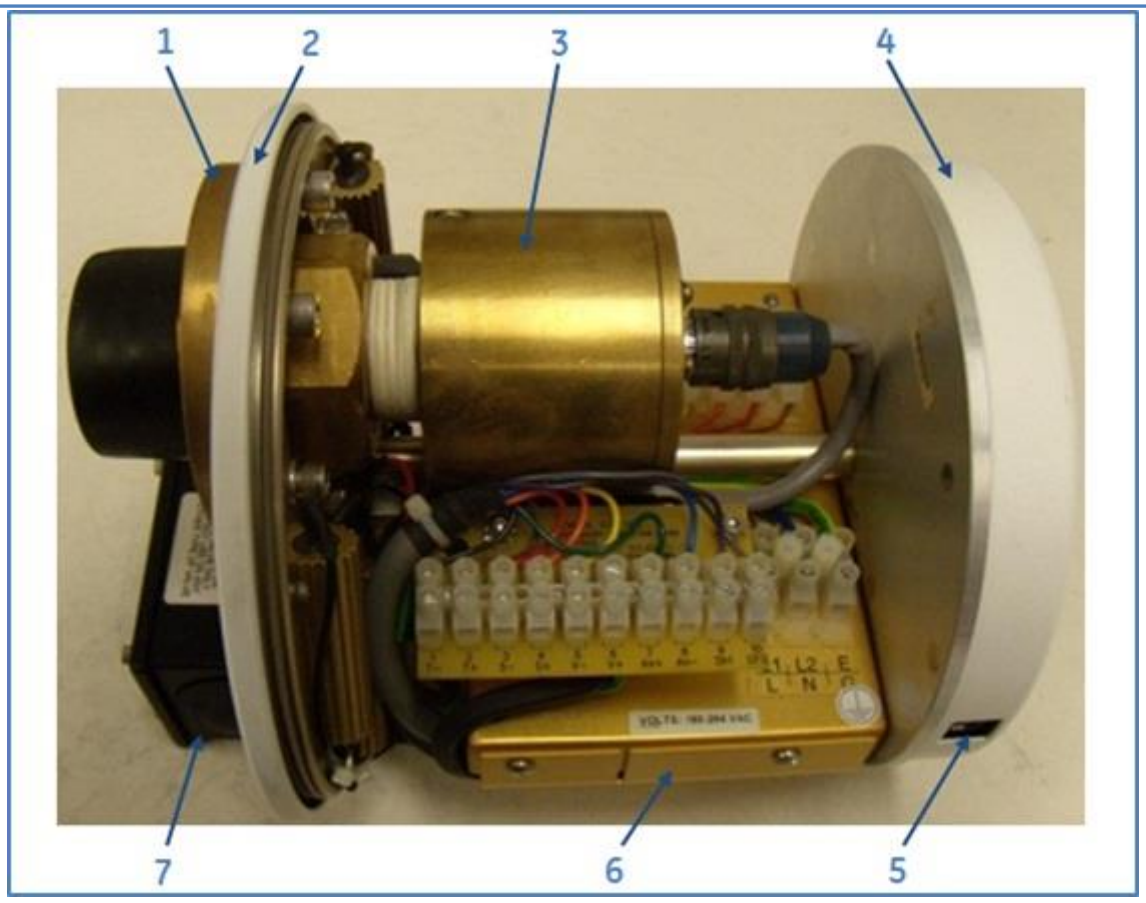


Figure 3-2: Internal View of Hydran 201Ti

3.4.1 Brass Adapter

The Hydran 201T*i* and the Hydran 201 sensor mount onto the valve of the transformer or other electrical equipment using a flanged brass adaptor (item 1 in Figure 3-2 above). This adaptor has male threads at one end that screw directly onto the transformer valve, and female threads at the other end to which the sensor is screwed. The heating plate of the H201T*i*'s enclosure bolts onto the adaptor flange. The H201T*i* can thus be installed or replaced without removing the adaptor and the sensor from the transformer valve.

The standard brass adaptor (Figure B-3 in Appendix B) has a 1.5-in NPT male thread (internal diameter of 38 mm) on the valve side. It can also be purchased from General Electric with 1- or 2-in NPT sizes (25 or 51 mm) male thread (Figure B-4 and Figure B-5 in Appendix B). The female threads of the adaptor are 1-in NPT (25 mm) to adapt to the threads of the H201 sensor.

A finned high-temperature adaptor (1.5-in NPT only) can also be purchased (see Figure B-6 in Appendix B) to increase the maximum operating temperature of the H201Ti.

3.4.2 Heating Plate

Heating resistors and a temperature-sensing thermistor are mounted on the heating plate (item 2 in Figure 3-2). The power input to the heating plate is controlled by the Hydran 201T*i* and the aluminum cover (item 3 in Figure 3-1) acts as a heat radiator. This allows the enclosure to maintain the temperature of the Hydran 201 sensor (and electronics) between 25 and 50°C (77 and 122°F), regardless of the ambient or oil temperatures. For details, see Section 3.6.

3.4.3 Hydran 201 Sensor

CAUTION

Mishandling of the H201 sensor (such as a perforation or scratch on the membrane or subjecting the sensor to paint or solvent) voids the warranty.

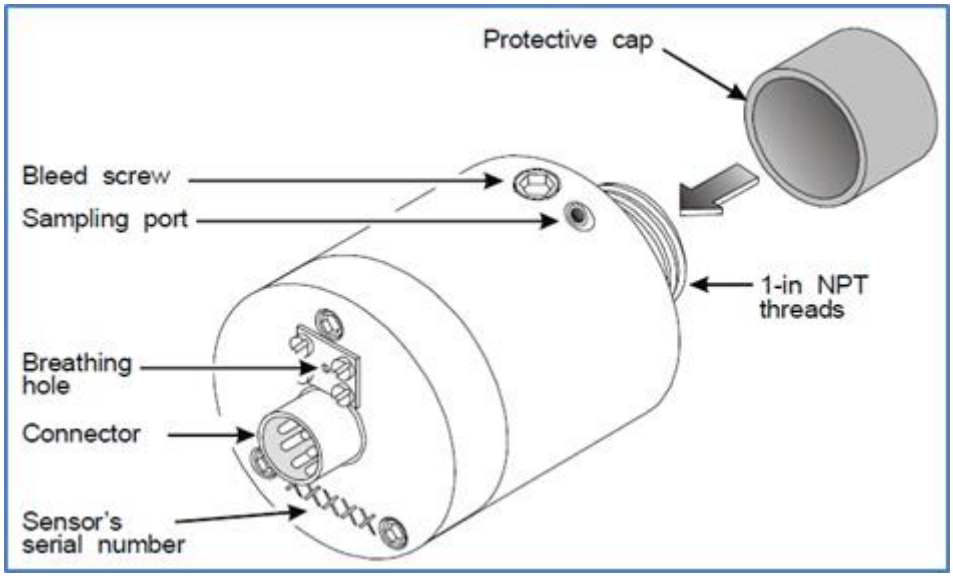


Figure 3-3: Hydran 201 Sensor

The Hydran 201 sensor (see Figure 3-3 above) consists of a brass body with the following components:

- 1-in NPT (25 mm) conical threads at one end.
- The male cable connector, the oxygen breathing hole and the sensor's serial number at the other end.
- On the top, a sampling port and a bleed screw allow easy sampling of the oil for Dissolved Gas Analysis (DGA). The sampling port fits the Luer stopcock valve of a syringe; this port is also used for purging during the installation.
- A thermistor is incorporated in the sensor's body to measure its temperature and, using mathematical computations, compensate the effect of the temperature on the detector's signal.

Combustible gases dissolved in the oil pass through a selectively-permeable membrane into an electrochemical gas detector (located inside the H201 sensor). Within

the detector, the gases combine with oxygen to produce an electrical signal that is then measured by an electronic circuit and converted to ppm. The H201 sensor is sensitive to hydrogen (H_2), carbon monoxide (CO), ethylene (C_2H_4) and acetylene (C_2H_2) which are the primary indicators of incipient faults in oil-filled electrical equipment.

3.4.4 CPU Module

The CPU module (item 4 in Figure 3-2) contains a microprocessor which is the brain of the Hydran 201T *i*. It is built as a circular, flat case. It fits snugly over the H201T*i*'s center post and attaches to the I/O module (Section 3.4.6) using only two screws. Should the need arise; the CPU module can be replaced very easily.

On the back side of the CPU module, an electrically isolated USB Type B connector supports a communication port, and a 36-pin connector mates with the I/O module.

A six-key membrane keypad and a liquid crystal display (LCD), consisting of two lines of 16 characters, are located on the front of the CPU module. Their operation and the menu system are explained in Chapter 5, as from section 5.1.

3.4.5 USB Type B Connector for Communication

Located on the side of the CPU module (item 5 in Figure 3-2), the USB Type B female connector allows local communications between the H201T*i* and a host computer. This connector is isolated from the main electronic circuitry. For wiring details, see Table D – 7 in Appendix D.

3.4.6 I/O Module

The Inputs/Outputs (I/O) module is built as an odd-shaped case that attaches to the Hydran 201T*i*'s heating plate by means of three screws accessed from the outside. It can thus be replaced rapidly, should it be required.

The I/O module consists of the following components:

- Regulated power supply.
- All I/O circuits.
- Hydran 201 sensor's analog circuit.
- Alarm relays.
- Supervisory link manager.

3.4.6.1 Top Side of the I/O Module

The top side of the I/O module supports five components:

8. *AC Power 3-Terminal Block* (in Figure 3-4): The terminal has a 300-V rating and accepts 22–14 AWG wires (2.5 mm2 nominal). For wiring details, see Table D – 1 in Appendix D.
9. *Supervisory Link and Analog Output Termination Board* (in Figure 3-4 below): The terminal has a 300-V rating and accepts 26–14 AWG wires (1.5 mm^2 nominal). It is protected against surge and electromagnetic interference. For wiring details, see Table D - 6 in Appendix D.

Note: The Hydran 201R Model i uses a 9-m (30-ft) 6-conductor cable for the supervisory link. Other configurations use either 4- or 6-conductor cables of varying lengths.

10. *AC Line EMI Filter* (in Figure 3-4 below): The line filter, located beneath the Supervisory Link and Analog Output Termination Board (item 9), blocks the electromagnetic interferences conducted in the ac power supply.

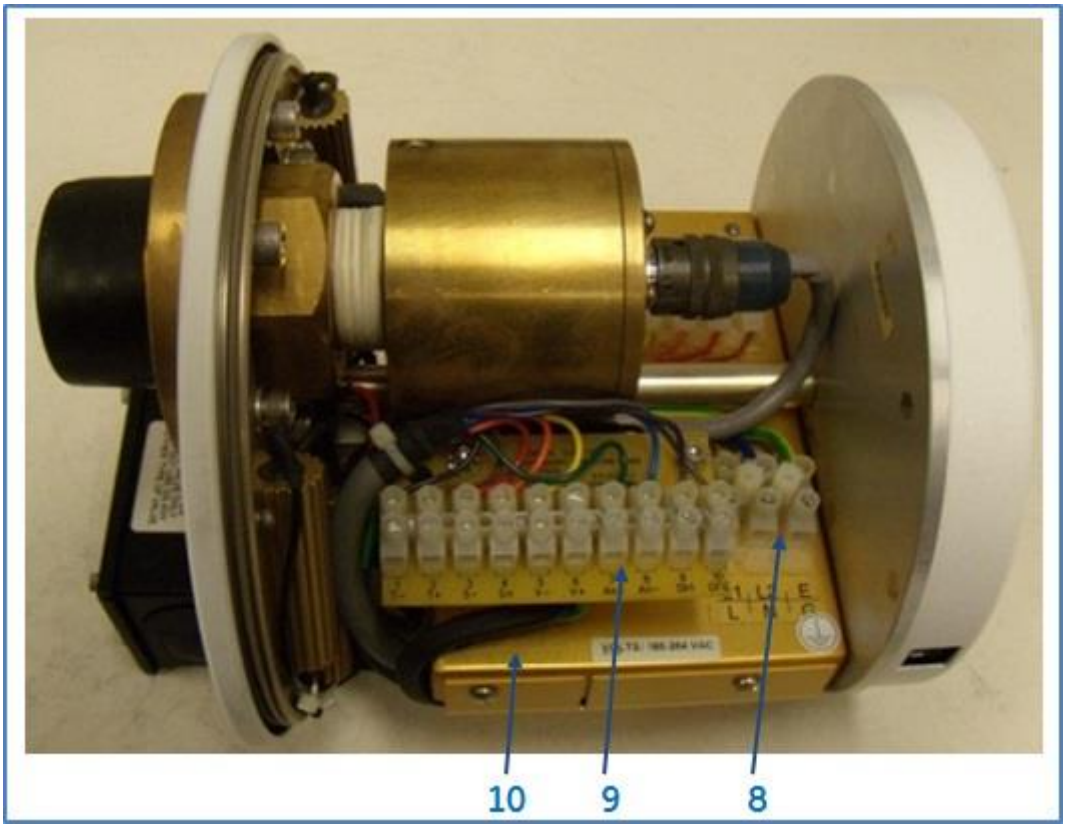


Figure 3-4: First View of the Top Side of the I/O Module

11. *Thermostat (*in Figure 3-5 below): It stops the heating whenever the base plate temperature exceeds 100 °C.

12. *Alarm Contacts 9-Terminal Block* (in Figure 3-5: The terminal has a 300-V rating and accepts 22–14 AWG wires (2.5 mm2 nominal). For wiring details, refer to Table D - 2 in Appendix D.

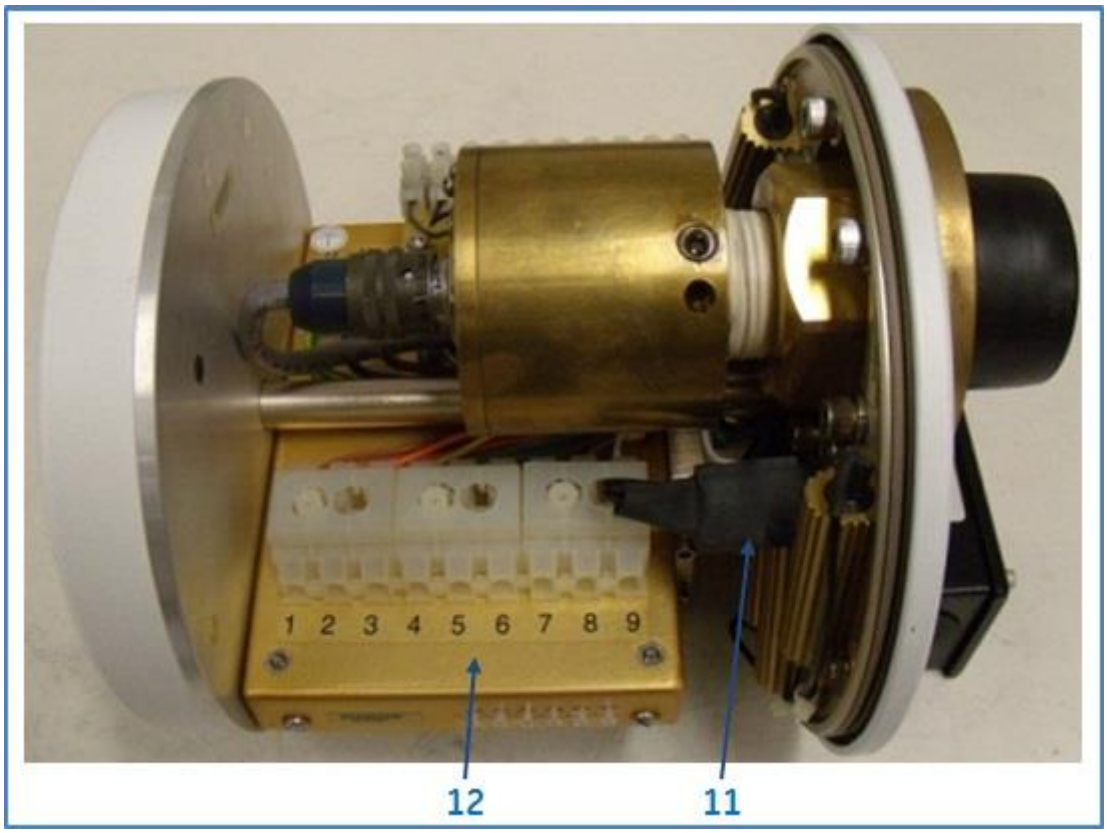


Figure 3-5: Second View of the Top Side of the I/O Module

3.4.6.2 Left Side of the I/O Module

The left side of the I/O module (Figure 3-6) supports plug connectors and the fuse. An extremely high degree of electrical and environmental protection is assured by a covering plate over the connecting zone.

13. *J2 Heater 6-Pin Connector*: This connector is factory-wired to the heating resistors of the Hydran 201T*i*'s heating plate. For wiring details, see Table D-4 in Appendix D .
14. *SW1 Voltage Selector*: For wiring details, see Table D-3 in Appendix D. This selector is used to choose between the following:
    - 115 V, corresponding to 100–120 VAC 50/60 Hz.
    - 230 V, corresponding to a 200–240 VAC 50/60 Hz.
15. *F3 AC Line Fuse*: The fuse holder is a standard 5 x 20 mm holder.
16. *J3 AC Line 3-Pin Connector*: This connector is factory-wired to the line filter.

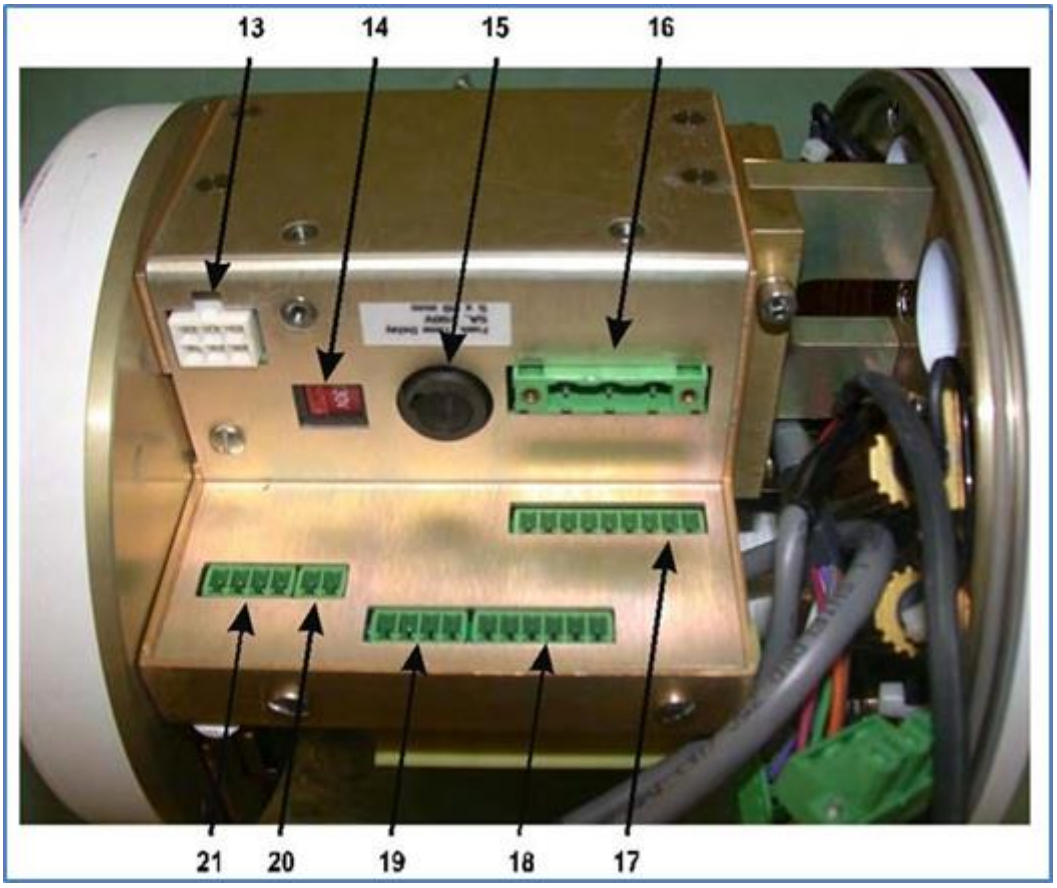


Figure 3-6: Left Side of the I/O Module

17. *J5 Alarm Relays 9-Pin Connector*: This connector is factory-wired to the alarm contacts terminal block.
18. *J4 Isolated Supervisory Link 6-Pin Connector*: This connector is wired to the termination board. For wiring details, see Table D - 6 in Appendix D.
19. *J3 Local Analog Output 4-Pin Connector*: This connector is wired to the supervisory link terminal block. The 4–20 mA output is isolated. For wiring details, see Table D - 6 in Appendix D.
20. *J2 Thermistor 2-Pin Connector*: This connector is factory-wired to the heating plate thermistor. For wiring details, see Table D - 5 in Appendix D.
21. *J1 Sensor 4-Pin Connector*: This connector is factory-wired to the Hydran 201 sensor. For wiring details, see Table D - 5 in Appendix D.

3.4.6.3 Right Side of the I/O Module

The right side of the I/O module (Figure 3-7) carries six small LED diagnostic indicators.

22. **°C Heating state LED**: This yellow LED flashes once every five seconds in proportion to the amount of power supplied to the heating plate.
    - The LED remains lit if the internal temperature is below the set point (adjustable **Temp SetPoint** parameter in the **Temperature; DynOil Sampl** submenu).

- It flashes if the internal temperature is close to the set point.
- It remains off if the internal temperature exceeds the set point.

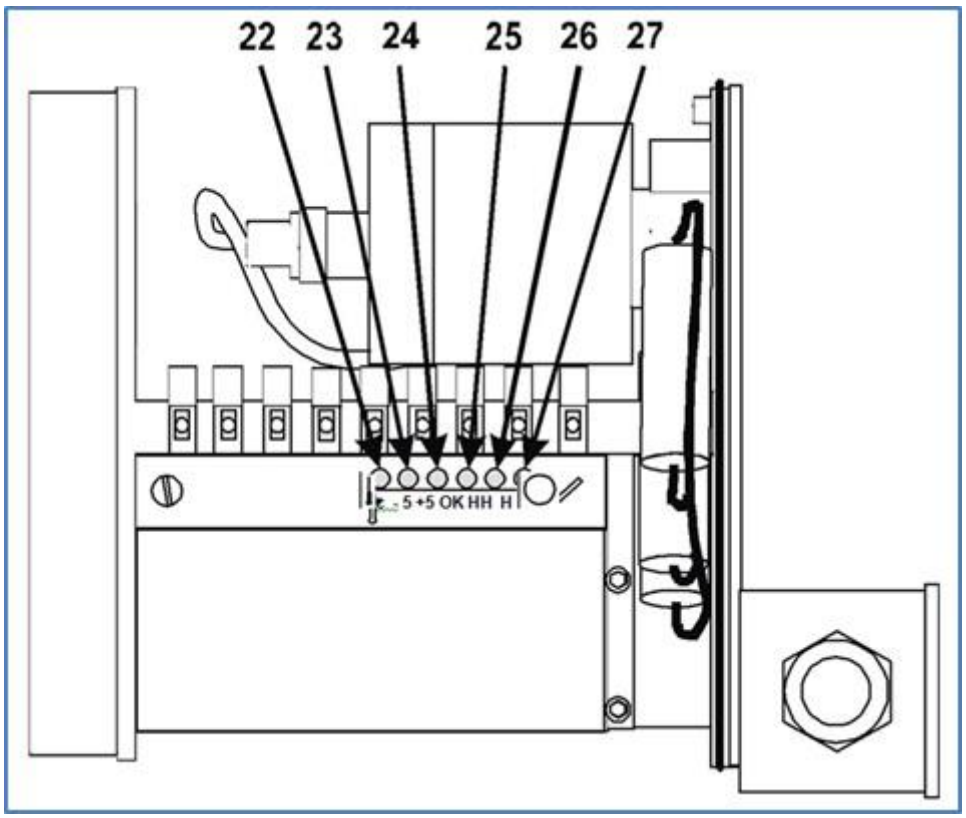


Figure 3-7: Right Side of the I/O Module

23. **-5 - Regulated -5 Vdc supply LED**: This dim, green LED confirms the presence of the -5 Vdc power supply.
24. **+5 - Regulated +5 Vdc supply LED**: This dim, green LED confirms the presence of the +5 Vdc power supply.
25. **OK - System status indicator LED**: This green LED confirms that the Hydran 201Ti is operating properly and that the fail alarm relay is energized. It turns off if a fail alarm condition is detected and if the fail alarm relay is de-energized.
26. **HH - High-High alarm LED**: This red LED is lit when a High-High alarm condition is detected and the High-High alarm relay is energized.
27. **H - High alarm LED**: This red LED is lit when a High alarm condition is detected and the High alarm relay is energized.

3.5 Analog Inputs and Output

3.5.1 Analog Inputs

The Hydran 201T*i* uses three analog inputs:

- Gas level reading (supplied by the Hydran 201 sensor).
- Temperature of the H201 sensor (supplied by the sensor thermistor).
- Temperature of the heating plate (supplied by the heating plate thermistor).

All H201T*i*'s inputs pass in a first level of processing which has the following functions:

- To protect the H201Ti against interferences and surges.
- To filter out (low-pass) the noise from signals.
- To convert the signals in voltage.
- To amplify the signals

Next, the signals go through an analog/digital converter so the microprocessor can use them.

- Two calibration constants (offset and slope) are used to convert the signal from the H201 sensor.
- Three calibration constants (short circuit, open circuit and a mid-scale value) are required to convert (nonlinear) the signals from the thermistors.

The sensor signal is in microvolt (µV). It is first divided in two scales; then, these two signals go through the analog/digital converter and finally the two digital values are read by the microprocessor. The two scales are:

- Low scale, which ranges from 0 to 4,000 µV.
- High scale, which ranges from 0 to 40,000 µV.

The thermistor signals are in ohms (Ω; 3,000 Ω at 25 °C). These two signals also go through the analog/digital converter and are then read by the microprocessor.

3.5.2 Analog Output

The isolated (up to 2,000 V RMS) analog 4–20 mA current output can supply a load ranging from 0 to 500Ω (10 V maximum). It is used with a SCADA system.

For details on how to use the analog output, see Appendix G; for wiring details, see Table D - 6 in Appendix D.

3.6 Heating System

The recommended operating temperature range of the Hydran 201 sensor is 15 to 65°C (59 to 149°F). The sensor temperature is a function of:

- The ambient air temperature surrounding the Hydran 201T*i*.
- The oil temperature behind the valve on which the H201T*i* is mounted.

Note: This temperature is always lower than the oil temperature at the top of the transformer tank.

- The thermal regulation of the H201Ti's temperature.

Regardless of the oil or ambient temperature, the H201T*i* is designed (heating and passive cooling) to maintain the sensor temperature between 25 and 45°C (77 and 113°F), if the set-point is set to the recommended temperature of 35°C (95°F). See **Temp SetPoint** parameter in the **Temperature and DynOil Sampl** submenu at Section 5.5.3.

The H201T*i*'s microprocessor measures the temperature and controls the heating power. A fail alarm is triggered when the sensor temperature is outside the operating limits. If on, see the **FaultTrig** parameters in Section 5.5.7.3.

Temperatures are obtained through thermistors incorporated in the sensor body and the heating plate. The heating plate power is controlled using a time-proportioning regulating method. The proportional algorithm maintains the sensor temperature near the desired set point, by modulating it with the dynamic oil sampling system. The heating plate temperature is limited to 100°C (212°F); its variation rate is also controlled to avoid sensor overheating.

Detection of an open thermistor shuts the heating power off. In addition, a thermostat (item 11 in Figure 3-5) with a 100°C (212°F) rating is located on the heating plate to protect against any fault from the heating system.

3.7 Battery

The Hydran 201T*i*'s battery is used to keep the real-time clock functioning when the unit is not connected to AC power or when AC power is not available. The system parameter values and historic data are stored in flash memory.

3.7.1 Estimated Life

The battery used is a 3V lithium/manganese dioxide coin cell with a capacity of 950 mAh.

- The battery used has an operating temperature range of -40 to +85˚C (-40 to +185˚F).
- Normal shelf life of the battery is approximately three (3) years @25˚C.
- Normal service life of the battery is approximately six (6) years @25˚C.

The battery is mounted in a battery holder and the recommended replacement model is CR2477N from Renata (operating temperature -40 to +85 °C).

3.7.2 Battery Specifications

For Hydran 201Ti units built as from August 2014 (S/N: 1408xxxxxx), the battery specifications are the following:

- GE part number: 18909.
- Battery size and type: Coin 24.5mm, CR2477N, Lithium 950 mAh.
- Recommended model: CR2477N (Renata).

For Hydran 201Ti units built from 2012 (S/N: 12xxxxxxxx) to July 2014 (S/N: 1407xxxxxx), the battery specifications are the following:

- GE part number: 18877.
- Battery size and type: Coin 24.5mm, CR2430, Lithium 285 mAh.
- Recommended model: CR2430 (Renata).

Note: For Hydran 201Ti units, built in 2012 or earlier, consult GE Customer Service ((the coordinates can be found at the bottom of page 2).

3.7.3 Removing the Battery

It is recommended to remove the battery from the Hydran 201T*i* if the unit has to be stored for three (3) months or more.

Notes:

When disconnecting the battery, only the system clock will be lost and once the battery has been replaced, the clock will be set to its default values (2000-01-01)

The system parameters, including the sensor parameters, the alarm set points and the historic data will all be preserved when the battery is disconnected.

CAUTION ***The removal of the battery must be executed by trained service personnel only.***

To remove the battery for storage, proceed as follows:

1. Power off the H201T*i*.
2. Disconnect the H201T*i*'s power supply at the external switch or circuit breaker.
3. Remove the cover of the H201T*i* unit.
4. Remove the two screws holding the CPU module (see item 4 of Figure 3-2).
5. Pull out the CPU module with care from the H201T*i*.
6. Remove the three remaining screws.
7. Carefully lift off the cover of the CPU module.
8. Remove the battery from its holder.
9. Store the battery in a plastic bag.

10. If required, reinstall the keypad flat cable into its connector J2.
11. Reinstall the cover back in place.
12. Reinstall the CPU module back into place.

3.7.4 Replacing the Battery

The battery is used to keep the real-time clock functioning when the Hydran 201T*i* unit is not powered. Every five (5) years, it is recommended to replace the Lithium battery used in the unit.

For the Hydran 201T*i*, the set points for the battery alarms are adjusted to provide warning lead times of nine months (Low Alarm = 2.75V) and three months (Low-Low Alarm = 2.45V) when operating at 60˚C (140˚F). See Service; Battery submenu in Section 5.5.4.3.

Note: When the battery becomes too weak, an alarm message will be displayed and broadcast. In this case, the battery has to be replaced as soon as possible.

CAUTION ***The replacement of the battery must be executed by trained service personnel only.***

To replace the battery, proceed as follows:

1. Power off the H201T*i*.
2. Disconnect the H201T*i*'s power supply at the external switch or circuit breaker.
3. Remove the cover of the H201T*i* unit.
4. Remove the two screws holding the CPU module (see item 4 of Figure 3-2).
5. Pull out the CPU module with care from the H201T*i*.
6. Remove the three remaining screws.
7. Carefully lift off the cover of the CPU module.
8. Remove the battery from its holder.
9. Install the new battery in the battery holder.
10. If required, reinstall the keypad flat cable into its connector J2.
11. Reinstall the cover back in place.
12. Reinstall the CPU module back into place.

3.7.5 Resetting the Clock

To reset the date and time, proceed as follows:

1. Reconnect the H201T*i*'s power supply.
2. Power on the H201T*i*. The H201T*i* executes the self-test sequence as described in Section 5.2.5.
3. When requested, use the H201T*i*'s keypad to enter the Date and Time.

3.7.6 Discarding the Battery

Do not dissemble, crush, puncture or incinerate the battery. Handle a damaged or leaking battery with extreme care. If you touch the electrolyte, wash the exposed skin with soap and water. If the electrolyte contacts your eye, flush the eye with water for 15 minutes. If you have inhaled the electrolyte, move to fresh air, and monitor breathing and circulation. In each case, seek immediate medical attention. When discarding a battery, follow applicable safety procedures or contact your local waste disposal provider regarding local restrictions on the disposal or recycling of batteries.

This product contains a battery that cannot be disposed of as unsorted municipal waste in the European Union. See the product documentation for specific battery information. The battery is marked with this symbol, which may include lettering to indicate cadmium (Cd), lead (Pb), or mercury (Hg). For proper recycling return the battery to your supplier or to a designated collection point. For more information see www.recyclethis.info

3.8 Internal Clock

An internal real-time clock (RTC) circuit provides a calendar and a permanent clock, unless the battery is disconnected. The clock uses a crystal oscillator as its time base; its 0.01 % accuracy (four minutes per month) is independent of the AC power supply frequency.

Note: The calendar accounts automatically for leap years (366 days). However, it does not include daylight saving functions.

The Hydran 201T*i*'s internal clock allows you to manage the following features:

- Historic data files (see Section 5.5.1).
- Delays of all alarm conditions (see Chapter 11 for details).
- Semimonthly, automatic sensor tests (see Section 5.5.4.2)

The H201T*i*'s date and time are set in the **Date&Time** submenu (see Section 5.5.5).

3.9 Nonvolatile Memory

The nonvolatile memory allows the Hydran 201T*i* to retain its data even during the following events:

- Disconnection of the H201T*i*'s battery.
- Failure of the H201T*i*'s power supply.
- Update of the H201T*i*'s embedded software using the Hydran Host software.

The H201T*i*'s nonvolatile memory is used to retain the following data:

- The ten parameters of the Hydran 201 sensor (see Section 5.5.4.1 and Section 5.5.8).
- The calibration data (see Section 5.5.9).

3.10 Additional Information

To obtain more information on the Hydran 201T*i*, please consult the following parts of this manual:

- Displays and menus: See Chapter 5.
- Before the installation: See Chapter 6.
- Installation: See Chapter 7.
- Communications and networking: See Chapter 10.
- Alarms: See Chapter 11.
- Operation: See Chapter 12.
- Troubleshooting: See Chapter 13.
- Maintenance: See Chapter 14.
- Technical specifications: See Appendix A.1.
- Mechanical drawings: See Appendix B.1.
- Functional block diagram: See Appendix C.1.
- Terminal blocks and connectors: See Appendix D.1.
- History file messages: See Appendix E.
- Default values of the parameters: See Appendix F.
- Calibration: See Section 5.5.8.
- Modbus protocol documentation and registries map: See Appendix I.

4 HYDRAN 201CI CONTROLLERS

4.1 Hydran 201Ci-C Communications Controller

Figure 3-1 shows one possible configuration of a Hydran 201*i* System. It consists of three components:

- A host computer.
- The Hydran 201C*i*-C Communications Controller, which is described here.
- The Hydran 201T*i* Intelligent Transmitter, already described in Chapter 3.

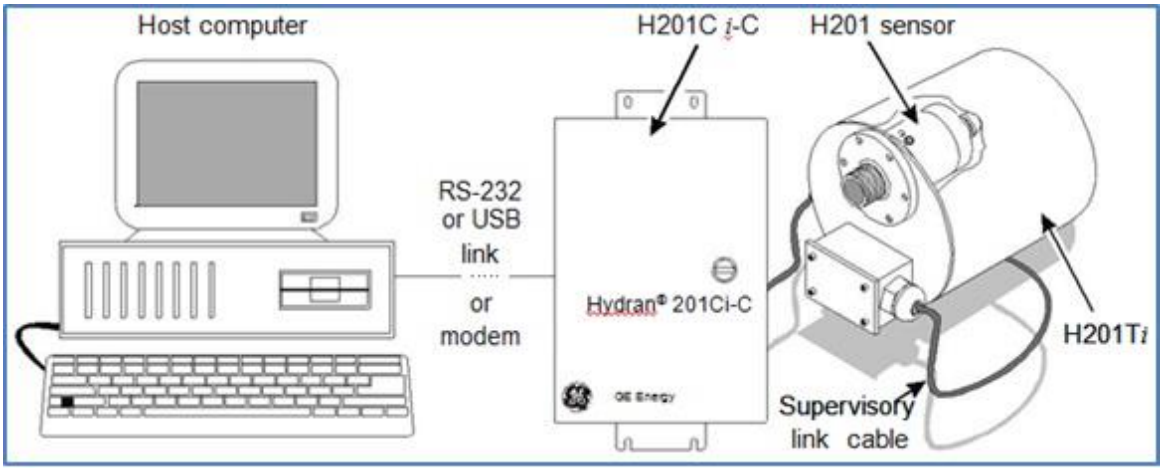


Figure 4-1: Typical Configuration of a Hydran 201i System

4.1.1 Features

The Hydran 201C*i*-C is meant specifically to interface a network of up to 128 Hydran 201T*i* 's to a computer via a single RS-232 or USB link, or an optional modem. As opposed to the Hydran 201C*i*-1 (Section 4.2), the H201C*i*-C does not have a display, nor does it provide alarms or analog outputs.

Up to four H201T*i*'s (typically, a transformer bank [A, B, and C] and sometimes an auxiliary) can be connected to each H201C*i*-C through the isolated supervisory link. A maximum of 32 H201Ci-C's (and/or Hydran 201Ci-1s) can be networked via an RS-485 Local Area Network (LAN).

The H201C*i*-C features:

- A digital circuit board to control all communications, including networking.
- A terminal block to connect the ac power supply.
- A terminal block to connect the H201C*i*-C and the H201T*i*'s with a supervisory link.
- Connectors for the communication cables:
  - RS-232 or USB link toward a host computer or a modem.
  - RS-485 link toward other H201C*i* Controllers to establish a network.

- Network and communication management. The H201C*i*-C (or any other Hydran 201C*i* Controller in a local network) is connected to the host computer with an RS-232 or USB link or a modem (optional) and to each H201T*i* with a supervisory link. A maximum of 32 H201C*i* Controllers (H201C*i*-C and/or H201C*i*-1) can be connected together with an RS-485 link to establish a local network that can contain up to 128 H201T*i*'s. For details on network configurations, see Chapter 10.

4.1.2 Description of Major Components

An internal view of the Hydran 201C*i*-C is presented in Figure 4-2 below.

1. *Enclosure*: The H201C*i*-C cabinet is rated Type NEMA 4X. With the standard internal heater, the instrument operating temperature ranges from -40 to +55 °C (-40 to +131 °F).
2. *DB-9 Male RS-232 Connector*: This standard DB-9 male serial communications connector, housed in a small connection box, allows the easy connection of an external PC.
3. *USB Computer Port Connector, Type B*: This standard USB (type-B) female serial communications connector allows easy connection to a PC.
4. *Electronic Circuit Board*: The circuit board incorporates all the electronic functions of the H201C*i*-C: Isolated supervisory link supply, communication ports and modem (optional) management, enclosure heater control, and AC supply voltage selector.
5. *Main Terminal Block*: The AC power supply, the supervisory link cables and the RS-485 LAN are connected to this 40-screw terminal block. For wiring details, see Table D - 8 in Appendix D.

WARNING

Voltage of 115 or 230VAC is present on several connecting screws of this terminal block.

6. *Perforated Openings*: Six perforated openings are present in the bottom plate of the cabinet for wiring purposes. Three holes have a 0.75-in diameter and three holes have a 0.5-in diameter.

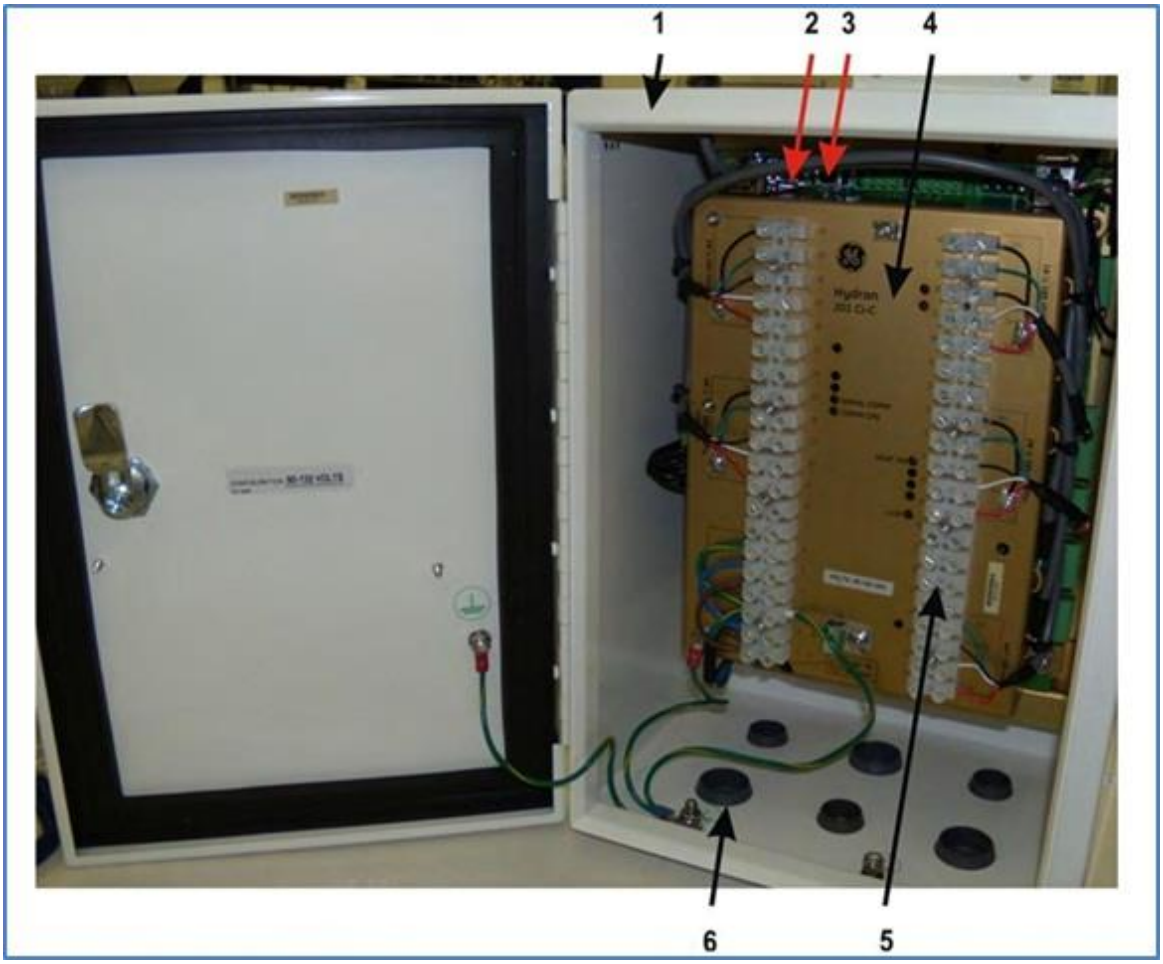


Figure 4-2: Internal View of the Hydran 201Ci-C

4.1.3 Description of Circuit Board

The circuit board of the H201C*i*-C is presented in Figure 4-3 below.

7. RS-232 Computer Port Connector, DB-9 Male (J10): This standard connector is used to interface the H201Ci-C directly to a PC or to a smart modem. For wiring details, see Table D-10 in Appendix D. The USB computer port (J16) is also available (item 8 in Figure 3-3.
8. USB Computer Port Connector, Type B (J16): This connector is available to interface the H201Ci-C directly to a PC or to a smart modem. The RS-232 computer port (J10) can also be used (item 7 in Figure 3-3.
9. *5-Vdc and 12-Vdc Power Supply Connector, 4 Pins (J6)*: This power source can be used for optional equipment. Each line is protected with a 1.35A fuse.
10. *Optional Modem Connector, 4 Pins (J9):* This connector is used to interface the H201Ci-C with a modem. The telephone line should be connected here. For more detail, refer to the modem procedure located in the **English/Procedures** folder of the Hydran 201i System installation CD.

11. *RS-485 LAN Connector, 3 Pins (J11):* To set up an H201Ti network, the H201Ci-Cs (and/or H201Ci-1s) are daisy-chained together into an RS-485 Local Area Network (LAN).

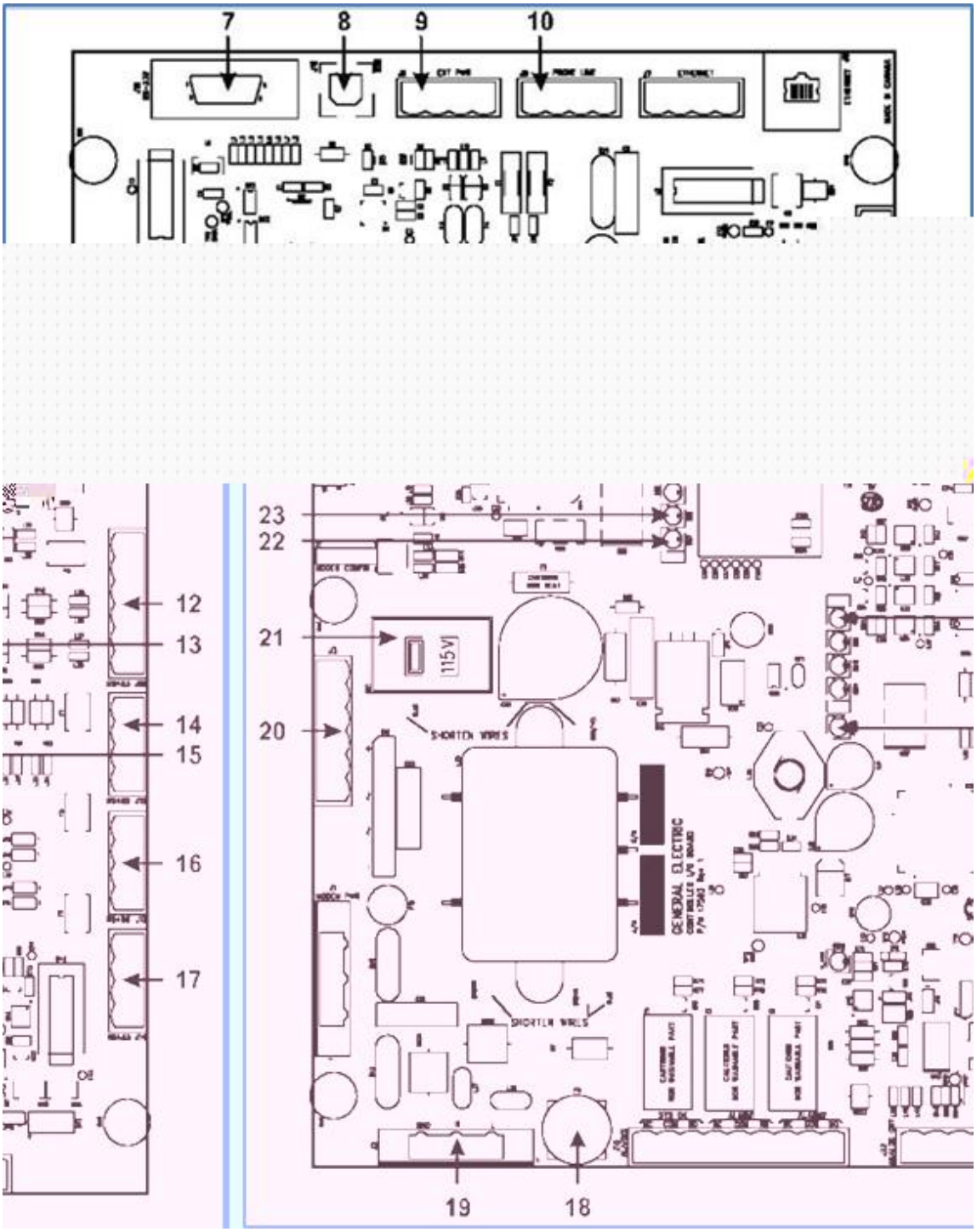


Figure 4-3: Circuit Board of the Hydran 201Ci-C

12. *Supervisory Link Connector to Termination Board No. 1, 4 Pins (J15)*: An isolated supervisory link cable coming from an H201T*i* (through the termination board) is connected here. The link cable carries serial data (communications) and isolated link supply (+15 Vdc, from the H201C*i*-C).

Note: The TDM pulse signal from the H201Ti (which uses a third pair when the supervisory link is connected to an H201Ci-1) is not used by the H201Ci-C. The TDM pulse signal only carries analog data and relay status, and it is not required for communications and networking functions.

13. *Heater Indicator, Yellow (DS8):* This LED indicator is lit when the enclosure heater is On. The enclosure temperature is controlled and the heater periodically turns on and off to maintain the temperature near 25°C (77°F).

14. *Supervisory Link Connector to Termination Board No. 2, 4 Pins (J12):* See item 12 above.

15. *Supervisory Link Supply Indicator, Green (DS12)*: This LED indicator is lit when the supervisory link power supply is On.

16. *Supervisory Link Connector to Termination Board No. 3, 4 Pins (J13):* See item 12 above.

17. *Supervisory Link Connector to Termination Board No. 4, 4 Pins (J14)*: See item 12 above.

18. *AC Supply Fuses (F11)*: There is one fuse holder for standard 5 x 20 mm fuses (the rating can be found in Section 14.9).

19. *AC Supply Connector, 3 Pins (J2)*: The AC line is factory-wired from the AC terminal block to this connector.

20. *Heater Connector, 6 Pins (J3)*: The enclosure heater is factory-wired to the connector J3. It consists of two 50-W resistors located under the support bracket of the electronic circuit board.

21. *Voltage Selector Switch (SW1):* For wiring details, see Table D - 9 in Appendix D. This selector is used to choose between the following:
    - 115 V, corresponding to 100–120 VAC 50/60 Hz
    - 230 V, corresponding to 200–240 VAC 50/60 Hz

22. *Configuration Communication Status Indicator, Yellow (DS7):* This LED, only used for programming purposes at the factory, indicates there is a configuration of the unit through one of the serial ports. It flickers as data bits pass through the H201Ci-C, whatever the direction and the port (RS-232, RS-485 LAN, USB or optional modem).

23. *Communication Status Indicator, Yellow (DS6)*: This LED indicates that serial communication activity is present. It flickers as data bits pass through the H201C*i*-C, whatever the direction and the port (RS-232, RS-485 LAN, USB or supervisory link).

4.1.4 Additional Information

To obtain more information on the Hydran 201C*i*-C, please consult the following parts of this manual:

- Before the installation: See Chapter 6.
- Installation: See Chapter 8.
- Communications and networking: See Chapter 10.
- Operation: See Chapter 12.
- Troubleshooting: See Chapter 13.
- Maintenance: See Chapter 14.
- Technical specifications: See Appendix A.2.
- Mechanical drawing: See Appendix B.2.
- Functional block diagram: See Appendix C.2.
- Terminal blocks and connectors: See Appendix D.2.

4.2 Hydran 201Ci-1 One Channel Controller

Figure 3-4 below shows a Hydran 201R Model *i*. It consists of two components:

- The Hydran 201C*i*-1 One-Channel Controller, which is described in detail in Section 4.2.
- The Hydran 201T*i* Intelligent Transmitter, already described in Chapter 3.

4.2.1 Features

The Hydran 201C*i*-1 is designed to supervise one Hydran 201T*i* and be used as an interface between this H201T*i* and a host computer.

The H201C*i*-1 features:

- A numerical display that indicates the dissolved gases-in-oil level in parts per million (ppm), measured by the connected H201T*i*.
- Two gas alarm contacts (High and High-High).
- One Fail alarm contact.
- Two illuminated push-buttons (alarm indicators) mounted on the door.
- One isolated, analog 4–20 mA output.
- A digital/analog circuit that controls all communications and also the display, analog outputs and alarm functions.

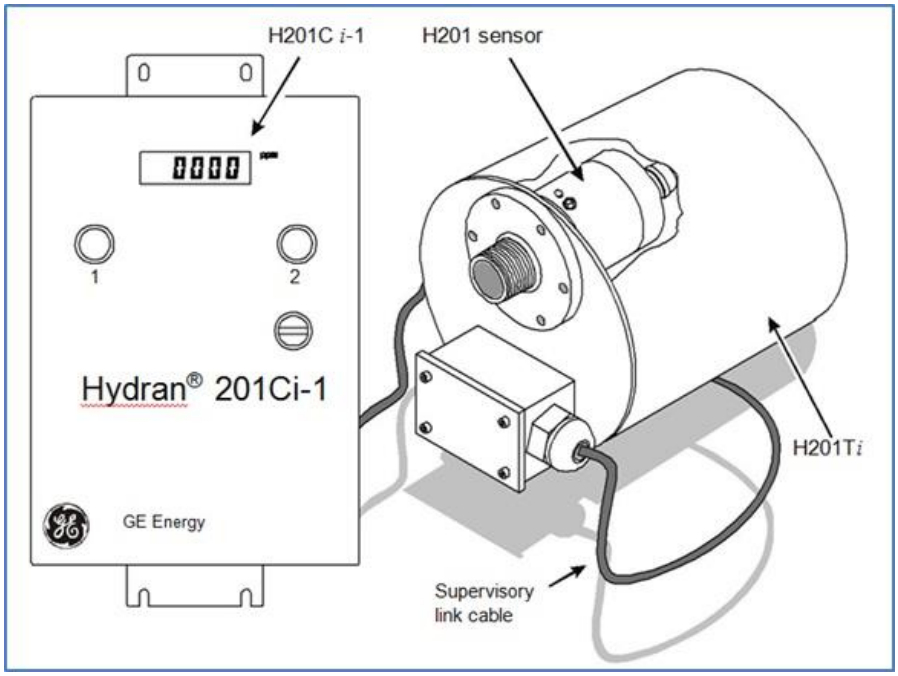


Figure 4-4: Hydran 201R Model i

- Network and communication management. The H201C*i*-1 (or any other Hydran 201C*i* Controller in a local network) is connected to the host computer with an RS-232 or USB link or a modem (optional) and to each H201T*i* with a supervisory link. A maximum of 32 H201C*i* Controllers (H201C*i*-C and/or H201C*i*-1) can be connected together with an RS-485 link to establish a local network that can contain up to 128 H201T*i*'s. For details on network configurations, see Chapter 10.

- A terminal block to connect the following components:
  - AC power supply
  - Supervisory link between the H201C*i*-1 and the H201T*i*
  - RS-485 link toward other H201C*i* controllers to establish a network
  - Alarm contacts (High, High-High and fail)
  - Isolated, analog output

- Connectors for the RS-232 or USB link toward a host computer.

4.2.2 Description of Major Components

An external view of the H201C*i*-1 is presented in Figure 4-5 below.

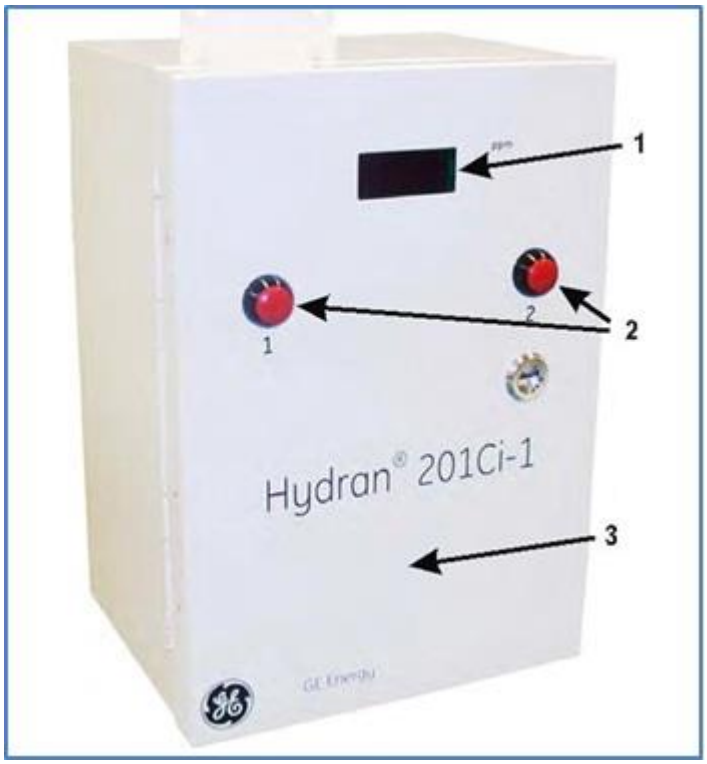


Figure 4-5: External View of Hydran 201Ci-1

1. *Digital Display*: The LED digital read-out displays the content of combustible gas in the oil. The standard range of the H201C*i*-1 display is 0 to 1,999 ppm (volume/volume). When the H201C*i*-1 is linked to a Hydran 201T*i*, the display reflects the actual H201T*i*'s reading. The display blanks when a system fault occurs at the H201T*i* level or in the H201C*i*-1 itself.

2. *Door-Mounted Alarm Indicators and Push-buttons*: The two illuminated push-buttons are mounted on the cabinet door of the instrument. Each local indicator latches on when the corresponding gas alarm relay is energized. The indicator remains on when the alarm relay turns off and it must be cleared (or "acknowledged") by pressing the illuminated indicator. The indicator clears only when the corresponding gas alarm relay has de-energized.

3. *Enclosure*: The H201C*i*-1 cabinet is rated Type NEMA 4X. With the standard internal heater, the instrument operating temperature ranges from -40 to +55°C (-40 to +131°F).

An internal view of the H201C*i*-1 is presented in Figure 4-6 below.

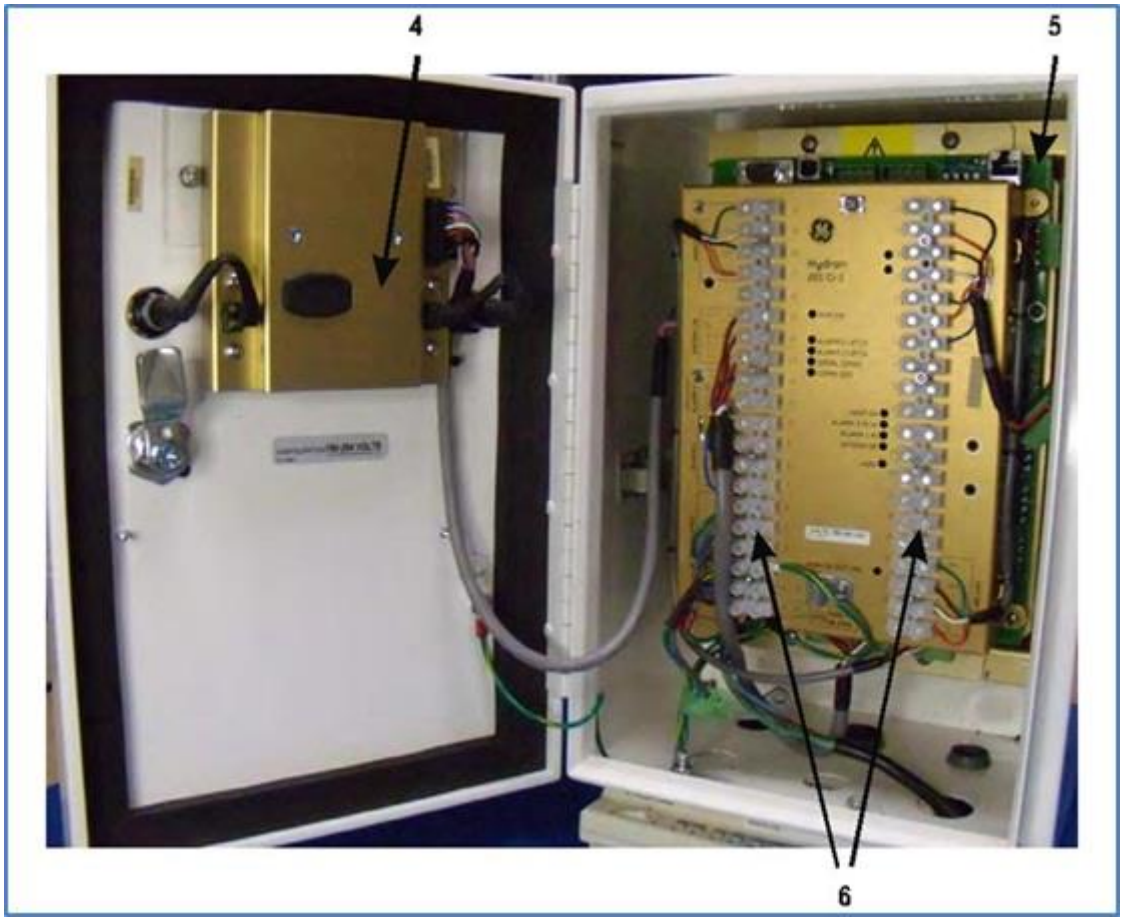


Figure 4-6: Internal View of Hydran 201Ci-1

4. *Digital Display Circuit Board Cover*: This cover protects the display circuit board, which includes the digital voltmeter and the connections of the two push-buttons.

5. *Electronic Circuit Board*: The circuit board incorporates all the electronic functions of the H201C*i*-1: H201T*i* TDM pulse decoder, alarm relay drivers, configurable analog output amplifiers, display signal conditioning, supervisory link supply, communication ports and modem (optional) management, enclosure heater control, and ac supply voltage selector. See Appendix C.3 for a simplified block diagram of the circuit.

6. *Main Terminal Block*: The ac power supply, the analog output, the three alarm relays (Alarm 1 = Gas High, Alarm 2 = Gas High-High, and System OK), the supervisory link cables and the RS-485 LAN are connected to this 40-screw terminal block. For wiring details, see Table D - 11 in Appendix D.

WARNING ***Voltage of 115 or 230VAC is present on several connecting screws of this terminal block.***

4.2.3 Description of Circuit Board

The circuit board of the Hydran 201C*i*-1 is presented in Figure 4-7 below.

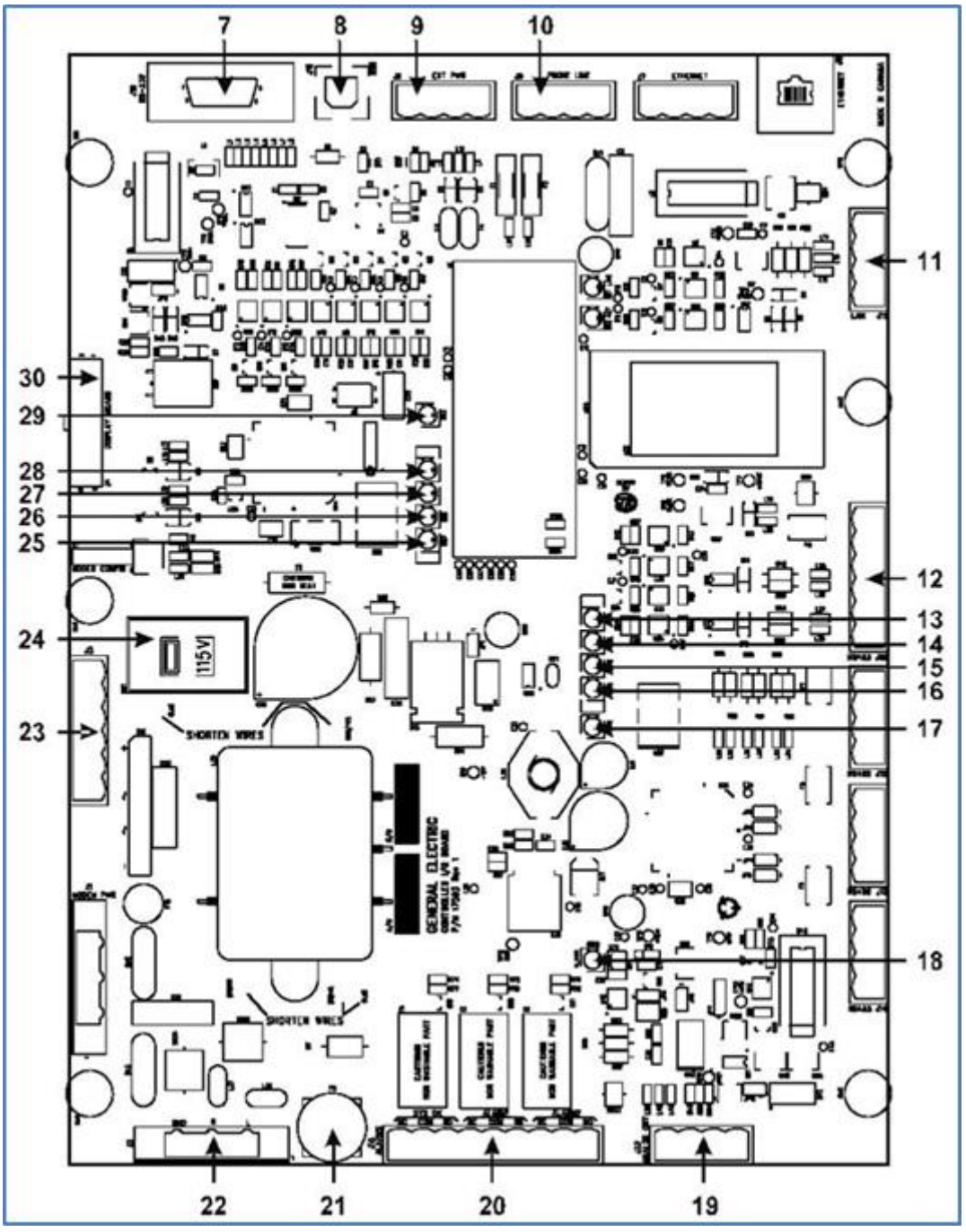


Figure 4-7: Circuit Board of the Hydran 201Ci-1

7. Figure 4-7 RS-232 Computer Port Connector, DB-9 Male (J10): This standard connector is used to interface the H201Ci-1 directly to a PC or to a smart modem. For wiring details, see Table D - 13. The J16 USB computer port (item 8 in Figure 4-7) is also available.

8. *USB Computer Port Connector, Type B (J16)*: This connector is available to interface the H201C*i*-1 directly to a PC or to a smart modem. The RS-232 computer port (J10) can also be used (item 7 in Figure 4-7.

9. *5-Vdc and 12-Vdc Power Supply Connector, 4 Pins (J6)*: This power source can be used for optional equipment. Each line is protected with a 1.35A fuse.

10. *Optional Modem Connector, 4 Pins (J9)*: This connector is used to interface the H201C*i*-1 with a modem. The telephone line should be connected here. For more detail, refer to the modem procedure located in the **English/Procedures** folder of the Hydran 201*i* System installation CD.

11. *RS-485 LAN Connector, 3 Pins (J11)*: To set up an H201T*i* network, the H201C*i*-1s (and/or H201C*i*-Cs) are daisy-chained together into an RS-485 Local Area Network (LAN).

12. *Supervisory Link Connector, 6 Pins (J15)*: The isolated supervisory link cable coming from the H201T*i* is connected here. The link cable carries the TDM pulse signal (analog data and relay status), serial data (communications) and isolated loop supply (+15 Vdc, from the H201C*i*-1).

13. *Heater Indicator, Yellow (DS8)*: This LED indicator is lit when the enclosure heater is on. The enclosure temperature is controlled and the heater periodically turns on and off to maintain the temperature near 25°C (77°F).

14. *Alarm 2 (Gas High-High) Indicator, Yellow (DS9)*: This LED indicator is lit when a Gas High-High alarm condition (level, hourly trend or daily trend) is detected by the H201T*i*. It turns off when the condition is cleared. The H201C*i*-1's Gas High-High relay tracks the equivalent relay in the H201T*i*.

15. *Alarm 1 (Gas High) Indicator, Yellow (DS10)*: This LED indicator is lit when a Gas High alarm condition (level, hourly trend or daily trend) is detected by the H201T*i*. It turns off when the condition is cleared. The H201C*i*-1's Gas High relay tracks the equivalent relay in the H201T*i*.

16. *System OK Indicator, Yellow (DS11)*: This LED indicator is lit when there is no system fault. It turns off when a system fault is detected by the H201T*i*, or when the link is broken between the H201T*i* and the H201C*i*-1, or if there is an ac. power loss in the H201T*i* or the H201C*i*-1. The H201C*i*-1's System Fail relay is de-energized when the System OK indicator is off.

17. *Supervisory Link Supply Indicator, Green (DS12)*: This LED indicator is lit when the supervisory link power supply is On.

18. *Analog Out Failure Indicator, Red-Orange (DS13)*: This LED indicator is lit when the analog output is not working properly, is unplugged or is not used.

19. *Analog Outputs (J22)*: This connector is factory-wired to the terminal block between pins 17 and 20.

20. *Alarm Contacts Connector, 9 Pins (J18)*: The Gas High, Gas High-High and System OK alarm relays are factory-wired from this connector to the terminal block between pins 7 and 15. A three-wire type-C (Normally Open + Normally Closed + Common) set of contacts is available for each alarm.

Note: The System OK alarm relay is normally energized. When a system fault occurs, it de-energizes the relay. Thus, the Normally Open (NO) contact actually opens on system failure or power loss. See Chapter 11 for a description of the Hydran alarms.

21. *AC Supply Fuses (F11)*: There is one fuse holder for standard 5 x 20 mm fuses (the rating can be found in Section 14.9).

22. *AC Supply Connector, 3 Pins (J2)*: The AC line is factory-wired from the AC terminal block to this connector.

23. *Heater Connector, 6 Pins (J3)*: The enclosure heater is factory-wired to the connector J3. It consists of two 50-W resistors located under the support bracket of the electronic circuit board.

24. *Voltage Selector Switch (SW1)*: For wiring details, see a: The voltage *selector is factory-selected and configured as per user requirements*
25. Table D - 12 in Appendix D. This selector is used to choose between the following:
    - 115 V, corresponding to 100–120 VAC 50/60 Hz
    - 230 V, corresponding to 200–240 VAC 50/60 Hz

26. *Configuration Communication Status Indicator, Yellow (DS7):* This LED, only used for programming purposes at the factory, indicates there is a configuration of the unit through one of the serial ports. It flickers as data bits pass through the H201Ci-1, whatever the direction and the port (RS-232, RS-485 LAN, USB or optional modem).

27. *Communication Status Indicator, Yellow (DS6)*: This LED indicates that serial communication activity is present. It flickers as data bits pass through the H201C*i*-1, whatever the direction and the port (RS-232, RS-485 LAN, USB or supervisory link).

28. *Alarm 1 High Latch Indicator, Red-Orange (DS5)*: This LED indicates that the operator did not acknowledge the alarm 1 (Gas High). It is impossible to acknowledge the alarm if it is still active.

29. *Alarm 2 High-High Latch Indicator, Red-Orange (DS4)*: This LED indicates that the operator did not acknowledge the alarm 2 (Gas High-High). It is impossible to acknowledge the alarm if it is still active.

30. *Digital Voltmeter Indicator, Yellow (DS3)*: This LED indicates that the digital voltmeter on the front panel is On. This means that the H201C*i*-1 has a valid TDM (Time Division Multiplexing) signal from the H201T*i*.

31. *Display Board Connector, 16 Pins (J4)*: This connector is factory-wired to the display board located on the door. This is the cable used for communication between the controller board and the display board.

4.2.4 Additional Information

To obtain more information on the Hydran 201C*i*-1, please consult the following parts of this manual:

- Before the installation: See Chapter 6.
- Installation: See Chapter 9.
- Communications and networking: See Chapter 10.
- Alarms: See Chapter 11.
- Operation: See Chapter 12.
- Troubleshooting: See Chapter 13.
- Maintenance: See Chapter 14.
- Technical specifications: See Appendix A.3.
- Mechanical drawing: See Appendix B.3.
- Functional block diagram: See Appendix C.3.
- Terminal blocks and connectors: See Appendix D.3.

5 HYDRAN 201TI DISPLAYS & MENUS

Note: It is recommended to use the Hydran Host software rather than the H201Ti's user interface (keypad and display). See the Hydran Host Software Manual.

All parameters and commands that can be accessed with the H201Ti's user interface can also be accessed with the Hydran Host software, except for the analog inputs/outputs calibration and the communication parameters. The first power-up (see Section 5.2.5) must also be performed using the H201Ti's keypad.

5.1 User Interface

The Hydran 201T*i*'s user interface is located on the front of the CPU module (item 4 in Figure 3-2 in section 3). It consists of the following (see Figure 5-1 below):

Figure 5-1: Hydran 201Ti's User Interface

- An alphanumeric LCD display, consisting of two lines of 16 characters. It requires no manual contrast adjustment and is equipped with temperature compensation. When the H201Ti is closed, the display remains visible through a window in the aluminum cover.

Note: Make a shadow over the display and observe the backlighting. Although it appears dim in daylight, the backlight allows easy reading of the display at night. The contrast of this thermally-compensated display is set automatically; it can thus operate over the full temperature range of the H201Ti and is perfectly readable under all ambient lighting

conditions. At low temperatures, the LCD display might not be legible, but all other functionalities are fully operational.

- A six-key keypad (see Section 5.3), also designed to function under an extremely wide temperature range.

The H201T*i*'s user interface has three main functions:

- *First priority*: To display all unacknowledged alarm messages requiring an action from the user. This task corresponds to the Unacknowledged Alarms mode (Section 5.2.1).
- *Second priority*: To execute commands requested through the keypad and to display the parameters from the Main Menu and the Extended Menu. These tasks correspond to the Menu Navigation mode (Section 5.2.3) and the Parameter Modification mode (Section 5.2.4).
- *Third priority*: If all active alarms have been acknowledged and if the keypad is not used, to display a list of messages at a rate of one message every five seconds. This task corresponds to the Main Display mode (Section 5.2.2).

5.2 User Interface Operating Modes

The Hydran 201T*i*'s user interface uses five operating modes:

- Unacknowledged Alarms mode (Section 5.2.1): The H201T*i* displays flashing messages of unacknowledged alarms. The user acknowledges an alarm by pressing the **ENTER** key while the corresponding alarm message is displayed on the display.
- Main Display mode (Section 5.2.2): In this basic, unattended operating mode (if all active alarms have been acknowledged and if the keypad is not used), the H201T*i* displays a list of four messages:
  - Gas level (in ppm).
  - Hourly trend (in ppm/x hours).
  - Daily trend (in ppm/x days).
  - Date and time.
- Menu Navigation mode (Section 5.2.3): This mode gives access to the H201T*i*'s parameters and commands.
- Parameter Modification mode (Section 5.2.4): This mode is used with the Menu Navigation mode to set the H201T*i*'s parameters (alarm levels, date and time, etc.).
- Power-up mode (Section 5.2.5): This mode is used only during the H201T*i*'s power-up. Three sequences can occur:
  - Normal power-up: Occurs if the AC power supply has been off for more than five minutes.
  - Short power-up: Occurs if the AC power supply has been off for less than five minutes.
  - First power-up: Occurs if the H201T*i*'s battery has been disconnected and reconnected.

5.2.1 Unacknowledged Alarms Mode

An alarm condition exists when a variable (such as gas level, gas trend or sensor temperature) has exceeded the predetermined limits ("alarm setting"). Alarms are explained in detail in Chapter 11; all alarm messages are given in Section 13.1.

The unacknowledged alarm messages are always displayed in priority. When an alarm occurs, the Main Display mode is immediately replaced by the Unacknowledged Alarms mode. If two or more unacknowledged alarms are present, the display scrolls through their messages at the rate of one every five seconds.

The user acknowledges each alarm by pressing the **ENTER** key for each alarm message. The flashing messages are then removed from the list one at a time. The H201T*i* returns to the Main Display mode when the user has acknowledged all alarms. Acknowledged alarms that are still active are shown as non-flashing messages in the Main Display list (see Table 5-1). When an alarm condition disappears, this message is removed from the Main Display list.

Almost all alarm messages are displayed as follows, whether the alarm is unacknowledged (flashing) or not (alarm condition still present):

- The top line displays the alarm message (the name of the parameter that triggered the alarm) followed by the alarm state: LL (Low-Low), L (Low), H (High) or HH (High-High).
- The bottom line displays the parameter's alarm set point (not the measured value). The LL, L, H and HH alarm set points can all be adjusted and turned off.

In this first example, the actual display is on the left and the comments are on the right:

Gas HH	Gas High-High alarm
300 PPM	Gas level above 300 ppm

5.2.2 Main Display Mode

When the H201T*i* is operating properly (no unacknowledged alarms, keypad unused), the messages shown in Table 5-1 below are displayed at the rate of one every five seconds.

Note: The display shows the alarm setting that was exceeded, NOT the actual value of the variable in alarm.

Display	Description
Alarm message	Displayed only if an alarm occurred, if it was acknowledged

Display	Description
(Alarm set point)	and if the alarm condition is still present. See Section 5.2.1.
Gas Level **xxx PPM**	• Gas level measured by the Hydran 201 sensor • Range: 0 to 2,000 ppm • Initial value[b]: 0 to 20 ppm
Hourly Trend **+xx/24h**	• Variation in ppm of the gas level for a period in hours. • Period adjustable from 1 to 99 hours. • Initial value[a]: 0 ppm/24 hours (default value of the period)
Daily Trend **+xx/30d**	• Variation in ppm of the gas level for a period in days. • Period adjustable from 1 to 99 days. • Initial value[a]: 0 ppm/30 days (default value of the period)
(Date)[a] **(Time)**	Date (year-month-day format) Time (24 hour format)

Table 5-1: Messages Displayed in the Main Display Mode

a: The H201*i*'s clock is set at the factory. Local time may differ from the displayed time; to set it see Section 7.2.3.
b: Sensor exposed to air; for example during initial verification or the installation.

5.2.3 Menu Navigation Mode

The Menu Navigation mode is used to access the Main Menu or the Extended Menu, and thus to all H201T*i*'s parameters and commands without requiring the use of a host computer.

- The Main Menu gives access to the *most frequently used* parameters and commands.
- The Extended Menu gives access to *all* parameters and commands.

Note: The H201Ti automatically returns to the Main Display mode if the keypad is not used for five minutes.

Each submenu of the Main Menu and Extended Menu is described in detail in Section 5.5.

5.2.4 Parameter Modification Mode

The Parameter Modification mode is accessed by pressing the **CHANGE** key when an adjustable parameter is displayed. In the Main Menu, a password is then requested; in the Extended Menu, a password is requested only for parameters requiring password No.

2 (because password No. 1 has already been entered to access the Extended Menu). For details on passwords, see Section 5.4.

The Parameter Modification mode is indicated with a colon displayed on the bottom line, at the left of the numerical value or choice to being modified. The value of the parameter can then be changed using the **UP** and **DOWN** keys; the modification is validated with **ENTER**.

5.2.5 Power Up Mode

Depending on start-up conditions, the H201T*i* executes one of the following sequences:

- Normal power-up (power-off longer than five minutes): See Section 5.2.5.1.
- Short power-up (power-off shorter than five minutes): See Section 5.2.5.2.
- First power-up (after reconnection of battery): See Section 5.2.5.3.

5.2.5.1 Normal Power Up (Power off Longer than Five Minutes)

This sequence begins with a self-test sequence that lasts approximately 40 seconds; then the Main Display mode is shown on the display. Table 5-2 below details the self-test sequence.

Display	Description
POWER DOWN	Is displayed for one second
SYSTEM HALTED	
System;Initialization	Verifies and prepares hardware
ABCDEFGHIJKLMNOP;QR...	Allows for a visual verification of the display
Testing RAM	Verifies data memory
Testing Histo Ram	Verifies historic data memory
Testing RTC	Verifies the real-time clock

Table 5-2: Self-Test Sequence during Normal Power up

5.2.5.2 Short Power Up (Power off Shorter than Five Minutes)

In this sequence, the self-test is not executed. After the message **System; Initialization,** the Main Display mode is immediately displayed.

5.2.5.3 First Power Up (After Reconnection of Battery)

In this sequence, the H201T*i* requests the values listed in Table 5-3 below before executing the self-test sequence. The Main Display mode is then displayed (the H201T*i* will not be in service until these values are entered).

Display	Data Entry	Action
Enter Date & Time	Is Press **Enter**	Start the dialog
Year	(Year)	
Month	(Month)	
Day	(Day)	
Hour	(Hour)	
Minute	(Minute)	
PowerStst. ID[a]	0	*Absolutely* enter a number (1 to 9999)
H201Ti ID[a]		*Absolutely* enter a number (1 to 254)

Table 5-3: Values Requested during the First Power up Sequence

a: For details of these parameters, see Section 5.5.6.6.

Note: The dialog of the first power-up can only be performed using the H201Ti's keypad, not the Hydran Host software.

5.3 Using the Keypad's Keys According to Each Mode

The Hydran 201T*i*'s keypad is shown in Figure 5-2 below.

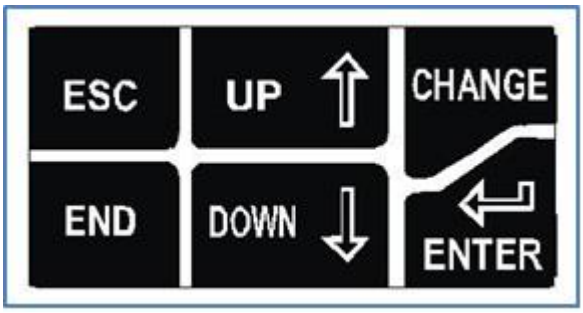


Figure 5-2: Hydran 201Ti's Keypad

Table 5-4 summarizes the functions of the keys according to the operating modes.

Key	Unacknowledged Alarms Mode	Main Display Mode	Menu Navigation Mode	Parameter Modification Mode
ENTER	Acknowledge alarms	Enters Menu Navigation Mode	Selects a submenu or an item	Validates a new value
CHANGE	Scrolls forward one step in unacknowledged alarms	Scrolls forward one step in Menu Display list	When allowed, enters Parameter Modification mode, otherwise no effect	Toggles choice between on and off, no effect on numerical value
DOWN			Scrolls forward in list	Decrements a numerical value[a]
UP			Scrolls backward in list	Increments a numerical value[a]
ESC			Returns to the preceding level	Quits the mode and cancels current modification
END			Returns to Main Display Mode	

Table 5-4: Functions of the Keypad's Keys, According to Operating Modes

*a: Press and hold the **UP** or **DOWN** key for more than one second to increase or decrease steadily the displayed value; hold it for more than three seconds to accelerate the rate of increase or decrease.*

5.4 Passwords

The H201T*i*'s user interface is protected by passwords. Entering a password is necessary to modify parameters or to access specific sections of menus:

- Password No. 1 (first level): This password is **1253**. It allows the user to modify almost all the H201T*i*'s parameters.
- Password No. 2 (second level): This password is **1231**. It allows the user to access the following items:
  - The **Calibration** submenu (to calibrate the H201T*i*).
  - The **NewSensor** submenu (to enter the parameters of the Hydran 201 sensor).
  - The three **Clear** commands in the **History** submenu (to erase the historic data files).

Password protection prevents accidental or unauthorized changes of the H201T*i*'s parameters. The passwords should be divulged to authorized personnel only, particularly password No. 2. The passwords are common to all H201T*i*'s and cannot be changed.

Note: Passwords used in the Hydran Host software are independent from those entered via the H201Ti's keypad, and they can be changed (see the Hydran Host Software Manual).

When the H201T*i* requests a password, one of the following two messages is displayed:

- **Password 1?**

:1247

- **Password 2?**

:1247

Use the **UP** or **DOWN** key (see Figure 5-2) to increment or decrement the displayed value, and press **ENTER** to accept the value. The user is now authorized to change the parameters until they quit the Menu Navigation mode. No password will be requested again unless a higher level password is required.

Note: All modifications are recorded in the historic data file Events (see Section 5.5.1).

5.5 Main and Extended Menus

The Main Menu gives access to the H201T*i*'s *most frequently used* parameters and commands. The Extended Menu gives access to *all* parameters and commands (including all parameters and commands from the Main Menu).

Note: Even if the H201Ti's menu system gives access to all its operation parameters, using a host computer and General Electric Canada's Hydran Host software simplifies the tasks. For more information, see the Hydran Host Software Manual.

Table 5-5 below summarizes the functions of each submenu of the H201T*i*'s embedded software.

Submenu	Functions

Submenu	Functions
History[a]	• To consult the four historic data files: - Events (recording at the time of events; example: alarms) - Short Term (recording at fixed logging rate; example: every 15 minutes) - Long Term (recording at fixed logging rates; example: every 6 hours) - Service (recording at the time of the semimonthly, automatic sensor test) • To set the logging rate of these files. • To clear the content of these files.
Gas[a]	• To set the parameters of the conditions that trigger the gas alarm: High and High-High gas level, hourly trend and daily trend. • To set the parameters of the conditions that trigger the fail alarm: Low and Low-Low gas level, hourly trend and daily trend.
Temperature[a]	• To read the current temperature of the Hydran 201 sensor. • To set the parameters of the sensor temperature alarm. • To adjust the set point of the sensor temperature. • To set periods A and B. • To read the actual set point, heating power and temperature of the heating plate. • To set the parameters of the dynamic oil sampling system.
Service[a]	• To read the value of the H201 sensor parameters. • To test the H201 sensor operation. • To read the battery voltage. • To set the parameters of the battery alarm. • To read the service data of the H201 sensor.
Date & Time (Extended Menu only)	• To set the date. • To set the time.
Communication (Extended Menu only)	• To select the communication channel: Local USB and Supervisory link for Hydran protocol, and Local USB MODBUS and SupervLink MODBUS for Modbus protocol. • To set the communications parameters. • To set Modbus parity and address

Submenu	Functions
Relays/Analog (Extended Menu only)	• To read the state of the alarm relays: **On** or **Off** • To set the operation mode of the three alarm relays [b]. • To select the triggering conditions of the fail alarm (**FaultTrig**) • To read the state of the analog output and TDM signal (in %). • To set the operation mode of the analog output and TDM signal.
New Sensor (Extended Menu only)	• To set the H201 sensor parameters. • To install a new H201 sensor.
Calibration (Extended Menu only)	• To calibrate the three analog inputs: - The H201 sensor signal - The H201 sensor temperature - The heating plate temperature • To calibrate the analog output.

Table 5-5: Functions of the Submenus of the H201T*i*'s Embedded Software

*a: These submenus can be accessed from both Menus (Main and Extended); except the **Service** submenu, they contain more parameters and commands in the Extended Menu.*

*b: There are four modes: **Latch**, **Normal**, **Force ON** and **Force OFF**.*

The following Sections describe the parameters and commands of each submenu.

5.5.1 History Submenu

The **History** submenu allows the user to:

- Consult the four historic data files:
  - Events (recording at the time of events; example: alarms).
  - Short Term (recording at fixed logging rate; example: every 15 minutes).
  - Long Term (recording at fixed logging rates; example: every 6 hours).
  - Service (recording at the time of the semimonthly, automatic sensor test).
- Set the logging rate of these files.
- Clear the content of these files.

5.5.1.1 Events History

When an event occurs, the date and time of occurrence, an event message and ten variables are stored in historic data file Events. Its capacity is 500 recordings; when the file is full and a new recording occurs, the oldest recording is deleted (first in, first out method). All event messages and their description are provided in Appendix E.

The following events are recorded:

- An alarm is triggered.
- An alarm is acknowledged by a user.
- An alarm is cancelled (the alarm condition has disappeared).
- A parameter is changed by a user.
- A new Hydran 201 sensor is installed.
- The H201T*i* is calibrated.
- A power-up or a power-down occurs.
- The H201T*i* is put in service (first power-up).
- The self-test sequence has failed during power-up.
- The microprocessor is reset by the internal watchdog.

Navigation is performed as follows:

- From **History;Events**, press **ENTER** to read the date and time of the last event recorded in the historic data file Events.
- Press **UP** or **DOWN** to read the date and time of previous or next events.
- Press **ENTER** to read a message describing the event that occurred at the selected date and time.
- Press **ENTER** and **UP** or **DOWN** to read the value of the variables at the time of this event.

The following ten variables are recorded in the historic data files Events (this list is identical for the Short Term and Long Term files):

- **GasLevel**
- **HourlyTrend**
- **HourlyTr Period** (period of the hourly trend)
- **DailyTrend**
- **DailyTr Period** (period of the daily trend)
- **SensorTemp** (temperature of the H201 sensor)
- *Extended Menu only*:
  - **HeaterTemp** (temperature of the heating plate)
  - **HeatPower**
  - **ServiceU** (value of the **ServiceU** variable)
  - **ServiceV** (value of the **ServiceV** variable)

5.5.1.2 Short Term History

At a certain logging rate (adjustable; see Section 5.5.1.5), the date and time plus ten variables are stored in the historic data file Short Term. Its capacity is 480 recordings; when the file is full and a new recording occurs, the oldest recording is deleted (first in, first out method).

Navigation is performed as follows:

- From **History; ShortTerm**, press **ENTER** to read the date and time of the last event recorded in the historic data file Short Term.
- Press **UP** or **DOWN** to read the date and time of previous or next recordings.
- Press **ENTER** and **UP** or **DOWN** to read the value of the variables at the selected date and time.

The ten variables recorded in the historic data file Short Term are the same as the ones recorded in the Events file (see Section 5.5.1.1).

5.5.1.3 Long Term History

From one to four times per day (adjustable; see Section 5.5.1.5), the date and time plus ten variables are stored in the historic data file Long Term. Its capacity is 480 recordings; when the file is full and a new recording occurs, the oldest recording is deleted (first in, first out method).

Navigation in this file is performed the same way than in the historic data file Short Term (see Section 5.5.1.2).

The ten variables recorded in the historic data file Long Term are the same as the ones recorded in the Events file (see Section 5.5.1.1).

5.5.1.4 Service History

A semimonthly, automatic test of the Hydran 201 sensor is performed the first and fifteenth days of each month at midnight (fixed logging rate, non-adjustable); for each test, the date and time of the test plus seven variables are recorded in the historic data file Service. Its capacity is 120 recordings (five years); when the file is full and a new recording occurs, the oldest recording is deleted (first in, first out method).

Navigation in this file is performed the same way than in the historic data file Short Term (see Section 5.5.1.2).

The following seven variables are recorded in the Service file:

- **Battery** (voltage of the battery).
- **ServiceL** (value of the **ServiceL** variable).
- **ServiceI** (value of the **ServiceI** variable).
- **ServiceA** (value of the **ServiceA** variable).
- **SensorTemp** (temperature of the H201 sensor).
- **SerialNumber** (serial number of the H201 sensor).
- **GasLevel**.

*Note: The **ServiceL**, **ServiceI** and **ServiceA** variables pertain to the H201 sensor automatic test and are reserved to the General Electric Customer Service. A defective H201 sensor immediately triggers the fail alarm (if this alarm condition is on; see the **FaultTrig.** parameter in Section 5.5.7.3).*

5.5.1.5 History Setup (Extended Menu Only)

This function gives access to the logging rate parameters of the Short Term and Long Term historic data files. Once set, the new value will only come into service after the current period is over.

- **ShrtTerm LogRate**: Logging rate for Short Term recordings. The total capacity is 480 recordings. For example:
  - The minimum logging rate of 1 minute provides a capacity of 480 minutes (8 hours).
  - A logging rate of 5 minutes provides a capacity of 40 hours.
  - The default logging rate of 15 minutes provides a capacity of 5 days.
  - A logging rate of 60 minutes provides a capacity of 20 days.
  - The maximum logging rate of 360 minutes (6 hours) provides a capacity of 120 days (4 months).
- **LongTermLog#1**, **#2**, **#3** and **#4**: Time of first, second, third and fourth Long Term recordings. The total capacity is 480 recordings. For example:
  - 1 recording per day allows a capacity of 480 days (1 year and 4 months).
  - 2 recordings per day allows a capacity of 240 days (8 months).
  - 3 recordings per day allows a capacity of 160 days (5 months).
  - 4 recordings per day allows a capacity of 120 days (4 months).

*Note: **LongTermLog#1** cannot be turned off; however, **LongTermLog#2**, **#3** and **#4** can each be turned off. The logging times must be set in chronological order, **LongTermLog#1** being the first of the day, **LongTermLog#2** preceding **LongTermLog#3**, etc.*

5.5.1.6 Clear Events (Extended Menu Only)

This function is used to delete all data from the historic data file Events. This command requires password No. 2.

5.5.1.7 Clear Short Term (Extended Menu Only)

This function is used to delete all data from the historic data file Short Term. This command requires password No. 2.

5.5.1.8 Clear Long Term (Extended Menu Only)

This function is used to delete all data from the historic data file Long Term. This command requires password No. 2.

5.5.2 Gas Submenu

The **Gas** submenu allows the user to set the parameters of the conditions that trigger:

- The gas alarm: A High or High-High alarm is triggered if an alarm condition (**GasLevel**, **HourlyTrend** or **DailyTrend**) *exceeds* the corresponding High or High-High alarm set point for a period of time greater than the delay.
- The fail alarm: It is triggered if an alarm condition (**GasLevel**, **HourlyTrend** or **DailyTrend**) *is below* the corresponding Low or Low-Low alarm set point for a period of time greater than the delay.

The operation of the alarms is explained in detail in Chapter 11.

5.5.2.1 Gas Level

This function gives access to the gas level High and High-High alarm parameters:

- **GasLevel**: Current reading of gas level, in ppm. Same value as the one shown in the Main Display mode.
- **GasAlr H**: Set point of gas level High alarm.
- **GasAlr HH**: Set point of gas level High-High alarm.
- **GasAlr Delay**: Alarm delay for all gas level alarms' set points.
- **GasAlr L** (Extended Menu only): Set point of gas level Low alarm.
- **GasAlr LL** (Extended Menu only): Set point of gas level Low-Low alarm.

5.5.2.2 Hourly Trend

This function gives access to the hourly trend High and High-High alarm parameters:

- **HourlyTrend**: Current reading of hourly trend, in ppm/x hours. Same value as the one shown in the Main Display mode.
- **HourTrAlr H**: Set point of hourly trend High alarm.
- **HourTrAlr HH**: Set point of hourly trend High-High alarm.
- **HourTrAlr Delay**: Alarm delay for all hourly trend alarms' set points, in % of the period.
- **HourlyTr Period** (Extended Menu only): Period of the hourly trend (number of hours used to calculate the gas level variation).
- **HourTrAlr L** (Extended Menu only): Set point of hourly trend Low alarm.
- **HourTrAlr LL** (Extended Menu only): Set point of hourly trend Low-Low alarm.

5.5.2.3 Daily Trend

This function gives access to the daily trend High and High-High alarm parameters:

- **DailyTrend**: Current reading of daily trend, in ppm/x days. Same value as the one shown in the Main Display mode.
- **DayTrAlr H**: Set point of daily trend High alarm.
- **DayTrAlr HH**: Set point of daily trend High-High alarm.
- **DayTrAlr Delay**: Alarm delay for all daily trend alarms' set points, in % of the period.

- **DailyTr Period** (Extended Menu only): Period of the daily trend (number of days used to calculate the gas level variation).
- **DayTrAlr L** (Extended Menu only): Set point of daily trend Low alarm.
- **DayTrAlr LL** (Extended Menu only): Set point of daily trend Low-Low alarm.

5.5.3 Temperature Submenu

The **Temperature** submenu allows the user to:

- Read the current temperature of the Hydran 201 sensor.
- Set the parameters of the sensor temperature alarm.
- Adjust the set point of the sensor temperature.
- Set the periods A and B.
- Read the actual set point, heating power and temperature of the heating plate.

Note: Temperatures displayed on the H201Ti's display are given in Celsius degrees.

For explanations on the H201T*i*'s heating system, see Section 3.6.

The **Temperature** submenu gives access to the following parameters:

- **SensorTemp**: Current temperature of the H201 sensor.
- **STempAlr LL**: Low-Low alarm set point of H201 sensor temperature.
- **STempAlr L**: Low alarm set point of H201 sensor temperature.
- **STempAlr H**: High alarm set point of H201 sensor temperature.
- **STempAlr HH**: High-High alarm set point of H201 sensor temperature.
- **TempoAlr Delay**: Alarm delay for all above set points.
- **Temp SetPoint** (Extended Menu only): Set point of the H201 sensor temperature (average target temperature).
- **SP Span** (Extended Menu only): Temperature variation according to **Temp SetPoint**. For example: the temperature varies between 30 and 40°C (86 and 104°F) if **Temp SetPoint** is set to the recommended temperature of 35°C (95°F) and **SP Span** to 10°C (18°F).
- **Period A** (Extended Menu only): Modulation period of the temperature variation.
- **Period B** (Extended Menu only): Reserved for General Electric's personnel. If the H201T*i* is powered up after a power-down longer than five minutes, the **Period B** ceases to affect the gas level fluctuations for two hours, whether its value has changed or not.
- **SP(Actual)** (Extended Menu only): Current temperature set point.
- **HeatPower** (Extended Menu only): Current heating power (in %) of the heating plate.
- **HeaterTemp** (Extended Menu only): Current temperature (in °C) of the heating plate.

5.5.4 Service Submenu

The **Service** submenu allows the user to:

- Read the value of the Hydran 201 sensor parameters.
- Test the H201 sensor operation.
- Read the battery voltage.
- Set the parameters of the battery alarm.
- Read the service data of the H201 sensor.

5.5.4.1 Sensor Cal Data

This function gives access to the Hydran 201 sensor parameters. Each sensor has its own set of parameter values; the values are indicated on the Test Certificate and Data Sheet supplied with the Hydran 201T*i*.

- **SerialNumber**: Serial number of the H201 sensor (engraved under the sensor connector).
- **B**, **M**, **N**, **S**, **A1**, **A2**, **A3**, **A4**, **A5** and **A6**: The ten parameters of the H201 sensor in a normalized format (integer numbers).
  - The H201T*i* calculates the gas level in ppm by performing two readings: The H201 sensor temperature (provided by the thermistor incorporated in the sensor body) and the sensor output (gas level). The calculation also requires these ten parameters (from **B** to **A6**).
  - These ten parameters characterize the behavior of the H201 sensor by modeling the offset, linearity and sensitivity fluctuations of the sensor according to the temperature.
- **CheckSum**: Checksum of the above values. This value is added to the list to avoid erroneous values from being entered.

This submenu does not allow you to modify the displayed values. To change the values, use the **NewSensor** submenu (Section 5.5.8).

The values of the H201 sensor's ten parameters are stored in the H201T*i*'s nonvolatile memory.

5.5.4.2 Force Sensor Test

This function is used to test the operation of the Hydran 201 sensor. The Hydran 201T*i* verifies the sensor by injecting a small dc current in the sensor for a few seconds and then reading the gas level. This test correlates strongly with the sensor response to dissolved gases and thus allows the H201T*i* to reliably assert the actual condition of the sensor. The result is immediately interpreted by the microprocessor as follows:

- If the sensor is operating properly, the message **Good** is displayed, but no message is recorded in the historic data file Events. The H201T*i*'s display returns to the Main Display mode (see Section 5.2.2) after the H201 sensor output signal has returned to normal (two minutes).

- If the sensor test fails (in other words, if an alarm condition is detected), the fail alarm is triggered, the test result is recorded in the historic data file Events and a message is displayed on the H201T*i*'s display.

Note: All alarms are ignored for two minutes following the H201 sensor test.

The messages that can be displayed following a sensor test are shown in Table 5-6 below. For the troubleshooting procedure for each of these alarms, see Section 13.1).

In addition to the manual tests, a semimonthly, automatic test of the H201 sensor is performed the first and fifteenth days of each month at midnight. For each automatic test, certain parameters are recorded in the historic data file Service (see Section 5.5.1.4) for further analysis by General Electric.

Note: Each H201Ti is configured for a specific H201 sensor. If you receive more than one H201Ti's, take the necessary precautions not to interchange the sensors and H201Ti's.

Message	Significance
Good	Hydran 201 sensor operating properly
Replace SensNOW	Damaged sensor, replace immediately
CableOpen	Cable disconnected, broken or misconnected
CableShort	Cable misconnected or short-circuited
Sensor Not Inst!	Unable to perform the test

Table 5-6: Messages that can be displayed following a Sensor Test

5.5.4.3 Battery

This function is used to read the battery voltage and set the battery's alarm parameters:

- **Battery**: Voltage reading at the battery's terminals.
- **Batt.Alr LL**: Set point of battery Low-Low alarm.
- **Batt.Alr L**: Set point of battery Low alarm.
- **Batt.Alr Delay**: Alarm delay for both set points.

A fail alarm is triggered if the voltage of the battery *gets below* the Low or Low-Low alarm set point for a period of time longer than the delay.

*Note: The **Batt.Alr Delay** parameter is reset each time the **Setup Lost** alarm condition is detected. This parameter must be set to its former operation value after the alarm condition has disappeared.*

For explanations pertaining to the H201T*i*'s battery, see Section 3.7.

5.5.4.4 Service Data

This function is used to read the value of six internal parameters used by the General Electric personnel during Hydran 201T*i* maintenance or troubleshooting procedures:

- **ServiceL**
- **ServiceI**
- **ServiceA**
- **ServiceU**
- **ServiceV**
- **ServiceF**

5.5.5 Date & Time Submenu (Extended Menu Only)

The **Date&Time** submenu is used to change the date and the time of the Hydran 201T*i*. The internal clock provides the date and time unless the battery is disconnected.

5.5.6 Communication Submenu (Extended Menu Only)

Note: The Hydran 201Ti's communication parameters can only be modified using the H201Ti's keypad and display. These parameters cannot be changed using the Hydran Host software.

This submenu is used to set the communication channel (H201T*i*-USB or supervisory link) and the communication parameters.

5.5.6.1 Comm Channel and Default Channel

The Hydran 201T*i* switches automatically from the communication channel indicated with the **CommChannel** parameter to the one indicated with the **DefaultChannel** parameter if the communications cease for five minutes.

- The **CommChannel** parameter is used to select a temporary channel, generally the H201T*i*-USB, for the purpose of connecting a host computer during installation, trouble-shooting or maintenance procedures.
- The **DefaultChannel** parameter is used to select the permanent channel, generally the supervisory link.

For each of these two channels, there are four available communication links:

- **Local USB** (USB link): Use this channel if the H201T*i* must be set to Hydran protocol and has to be connected directly to a host computer running the Hydran Host software. For this connection, use the H201T*i*'s USB female connector located on the side of the CPU module. The USB link is used only occasionally or for brief periods of time during the initial verification or maintenance procedures.

- **SupervisoryLink**: Use this channel if the H201T*i* must be set to Hydran protocol and has to communicate with an H201C*i* Controller.
- **LocalUSB MODBUS:** Use this channel if the H201T*i* must be set to ModBus protocol and has to be connected directly to a host computer running the Perception software. For this connection, use the H201T*i*'s USB female connector located on the side of the CPU module. The USB link is used only occasionally or for brief periods of time during the initial verification or maintenance procedures.
- **SupervLnk MODBUS:** Use this channel if the H201T*i* must be set to ModBus protocol and has to be connected via an USB to RS-485 converter to a host computer running the Perception software or to communicate with an H201C*i* Controller.

Note: The H201Ti's microprocessor only gives access to one channel at a time.

5.5.6.2 Comm Mode

This function is used to select the communication mode between the Hydran 201T*i* and the Hydran Host software. There are two possibilities:

- **Call OnAlarm**: In this mode, the H201T*i* communicates with the Hydran Host through a telephone line when a gas or fail alarm condition is detected. The operation of this mode can be tested using the **Communication; Force HostCall** command (see Section 5.5.6.5). The frequency and number of call attempts meet the normal regulations of telephone companies.
- **AnswerOnly**: In this mode, the H201T*i* remains inactive until being questioned by the host computer running the Hydran Host or any other SCADA system.

5.5.6.3 MODBUS Parity

This function is used to select the ModBus Parity communication setting and it can be set at None, Odd or Even.

This setting is relevant and shall be properly configured only when the Comm Channel and Default Channel are set to LocalUSB ModBus or SupervLnk MODBUS. Else, when 201Ti is set to Hydran protocol (Comm Channel and Default Channel are Local USB or Supervisory Link), this setting is ignored.

5.5.6.4 Baud Rate

This function is used to set the serial communication rate of the Hydran 201T*i*. The communication can be set at 1,200, 2,400, 4,800 or 9,600 bps (bits per second). All H201T*i*'s belonging to one network must be set to the same baud rate.

If the **BaudRate** parameter is changed and if the H201C*i* Controller is equipped with a modem, always execute the **Communication; Force HostCall** command (see Section 5.5.6.5 below) immediately after the modification.

Note: The communication rate of the H201Ti's must be the same as the one set in the Hydran Host software (see the Hydran Host Software Manual).

5.5.6.5 Force Host Call

This function is used to perform two actions:

- To initialize the modem in the H201C*i* Controller with the communication rate selected using the **BaudRate** parameter.
- To test the communications between the Hydran 201T*i* and the Hydran Host software by forcing the H201C*i* Controller's modem to call the modem of the host computer where the Hydran Host is running.

  *Note: In the versions 2.1 and prior of the H201Ti embedded software, in the **Call OnAlarm** mode, the telephone number set in the modem's register 0 is dialed automatically at midnight. This function does not exist in version 2.2.*

5.5.6.6 H201Ti ID and PowerStation ID

The **H201Ti ID** parameter is used to set the Hydran 201T*i*'s identification number. An exclusive identification number must be assigned to each H201T*i* in a local network.

The **PowerStat ID** parameter is used to set the power station's identification number. The same power station identification number must be assigned to all H201T*i*'s in a local network, but *each local network must have a different power station identification number*.

The default values of the **H201Ti ID** and **PowerStat. ID** parameters are therefore usually modified. Furthermore, the H201T*i* and power station's identification numbers must correspond to those assigned to the same H201T*i*'s and power station in the Hydran Host or Perception software.

CAUTION ***The identification number of at least one H201Ti in a local network must be set between 1 and 5 (inclusively).***

Note: The identification number of each H201Ti must be recorded during the configuration of the local network.

5.5.6.7 MODBUS Address

This function is used to select the Modbus address and must be set to a numeric value between 1 and 255.

This setting is relevant and shall be properly configured only when the Comm Channel and Default Channel are set to LocalUSB ModBus or SupervLnk MODBUS. Else, when 201Ti is set to Hydran protocol (Comm Channel and Default Channel are Local USB or Supervisory Link), this setting is ignored.

5.5.7 Relays/Analog Submenu (Extended Menu Only)

The **Relays/Analog** submenu is used to:

- Read the state of the alarm relays: **On** or **Off**.
- Set the operation mode of the three alarm relays.
- Select the triggering conditions of the fail alarm (**FaultTrig.**).
- Read the state of the analog output and TDM signal (in %).
- Set the operation mode of the analog output and TDM signal.

5.5.7.1 Gas H Relay

- **RelayH State**: Displays the status of the High alarm relay. The two possible states are explained in Section 11.2.2.
- **RelayMode**: Is used to set the operation mode of the High alarm relay. The four operation modes are explained in Section 11.2.3.

5.5.7.2 Gas HH Relay

- **Relay HH State**: Displays the status of the High-High alarm relay. The two possible states are explained in Section 11.2.2.
- **RelayMode**: Is used to set the operation mode of the High-High alarm relay. The four operation modes are explained in Section 11.2.3.

5.5.7.3 SysOK Relay

- **SysOK State**: Displays the status of the fail alarm relay. The two possible states are explained in Section 11.2.2.
- **RelayMode**: Is used to set the operation mode of the fail alarm relay. The four operation modes are explained in Section 11.2.3.
- **FaultTrig.**: Is used to set to **Off** or **On** each fail alarm condition. For details, see Section 11.5. Press **CHANGE** to turn on a condition (an asterisk [*****] is then displayed at the right of the parameter's name) or turn it off (only the parameter's name is displayed).

5.5.7.4 AnalogOut

- **AnalogState**: Displays the state of the Hydran 201T*i*'s analog output in percentage of the maximum electric current. The analog output provides the gas level being measured; the displayed percentage is thus directly proportional to the gas level. For details on the analog output, see Section 3.5.2.
- **AnalogMode**: Is used to set the operation mode of the analog output. The three **Force x %** modes are used only to test the operation of the Hydran 201*i* System.

Table 5-7 shows the electrical current generated for each mode.

Operation Mode	Analog 4–20 mA Output	Hydran 201C*i*-1 Display
Force 0%	4.00 ± 0.10 mA	0 ± 2 ppm
Force 50%	12.00 ± 0.20 mA	1000 ± 5 ppm

Force 100%	20.00 ± 0.40 mA	1999 ppm[a]

Table 5-7: Electrical Current Generated by the Analog Output for Each Operation Mode

The maximum value of the Hydran 201Ci-1's display scale is 1999 ppm. If the signal is over scale, the display indicates 1... when the operation mode is set to Force 100 %.

5.5.7.5 TDM Out

- **TDM State**: Displays the state of the Hydran 201T*i*'s TDM signal, in percentage.
  - Used with the H201C*i*-1 Controllers only, the TDM signal is integrated to the supervisory link and is used to transmit the state of the H201T*i*'s alarm relays and analog output. Only one pair of wires is necessary to transmit this information. For details on the supervisory link, see Section 10.1.
  - The TDM signal relates to the gas level being measured. The displayed percentage is thus directly proportional to the gas level (%output=ppm/20; 2,000 ppm = 100 %).
- **TDM Mode**: Is used to set the operation mode of the TDM signal. The three **Force x %** modes are used only to test the operation of the Hydran 201*i* System.

5.5.8 New Sensor Submenu (Extended Menu Only)

The **NewSensor** submenu is used to:

- Set the Hydran 201 sensor parameters.
- Install a new H201 sensor.

This submenu is very similar to the **Service;SensorCal Data** submenu (see Section 5.5.4.1), except that in the latter submenu the parameter values cannot be changed.

The **NewSensor** command requires password No. 2. The H201 sensor is then immediately tested and the result (**Good** or else) is displayed after three seconds. For details, see Section 5.5.4.2.

CAUTION

Use this submenu only to install a new H201 sensor, because it changes the "Service; ServiceData" parameters. These parameters are used to evaluate the state of the H201 sensor.

5.5.9 Calibration Submenu (Extended Menu Only)

The **Calibration** submenu is used to calibrate:

- The three analog inputs:
  - The Hydran 201 sensor signal.
  - The H201 sensor temperature.

  - The heating plate temperature.
- The analog output.

This command requires password No. 2.

CAUTION ***If you go further than the "CalibrateNow?" message in this submenu, the calibration is destroyed.***

There are five branches in this submenu:

- **LowRange**: Calibration of the H201 sensor signal's low range.
- **HighRange**: Calibration of the H201 sensor signal's high range.
- **SensorTemp**: Calibration of the H201 sensor temperature.
- **HeaterTemp**: Calibration of the heating plate temperature.
- **SignAnalog**: Calibration of the analog output.

6 BEFORE INSTALLATION

6.1 General Warnings

1. *Do not separate the Hydran 201Ti Intelligent Transmitters from their respective Hydran 201 sensor.* The H201Ti is set at the factory for a specific H201 sensor. To verify whether the two components are paired correctly, consult the serial numbers indicated on the shipping box and/or the Test Certificate and Data Sheet. The sensor's serial number is located below the connector (see Figure 3-3); while the H201Ti's serial number is located at the back of the heating plate (see Figure 6-1 below).

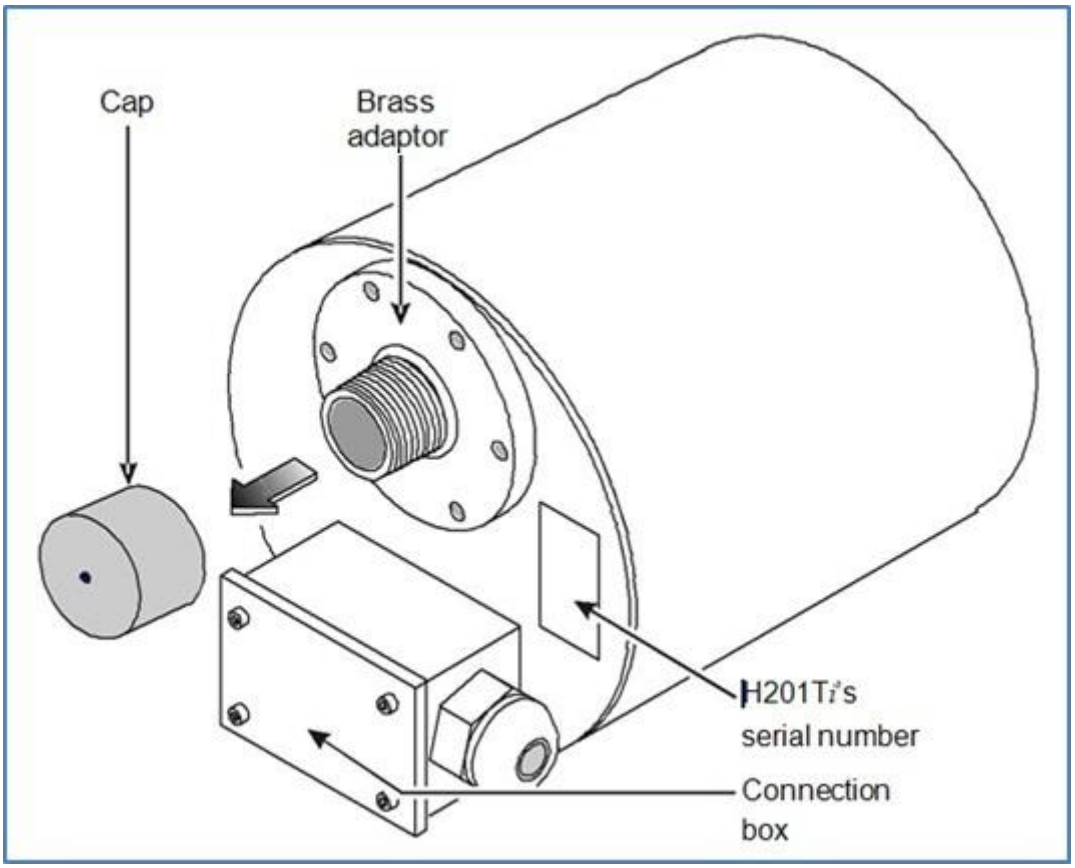


Figure 6-1: H201Ti's Serial Number and Protective Cap

2. *Do not remove the protective plastic caps* from the sensor and/or the brass adaptor's threaded extremity until ready to install on the transformer valve. These caps protect the adaptor threads (see Figure 6-1 above) and the sensor membrane from debris and sharp objects. If the sensor is dismounted, place immediately the supplied cap onto the sensor's threads.

CAUTION

Mishandling of the Hydran 201 sensor (such as a perforation or scratch on the membrane or subjecting the sensor to paint or solvent) voids the warranty.

3. *Do not touch the H201 sensor's membrane* (located inside the threaded extremity) with a finger or an object (see Figure 6-2 below). The membrane is easily damaged; this would impair the sensor permanently, thus voiding the warranty.

Figure 6-2: Do Not Touch the Membrane

4. *Do not block or puncture the sensor's breathing membrane*. Located above the sensor's connector (see Figure 3-1) this opening provides oxygen to the gas detector inside the sensor. Blocking or puncturing this membrane damages the sensor permanently, thus voiding the warranty.

5. *Do not paint the sensor* (see Figure 6-3). Paint fumes block the sensor's breathing membrane and damage the sensor permanently, thus voiding the warranty.

6. *Do not use hydrocarbon-based compounds near the sensor. Do not clean the sensor with any solvent or other products* (see Figure 6-3 below). The volatile fumes of these compounds can deteriorate sensor performances. Products to avoid include: Paint, liquid Teflon, vehicle exhaust, spray can, black pitch, thinner, RTV (Room Temperature Vulcanization; silicon-based mastic) and solvent.

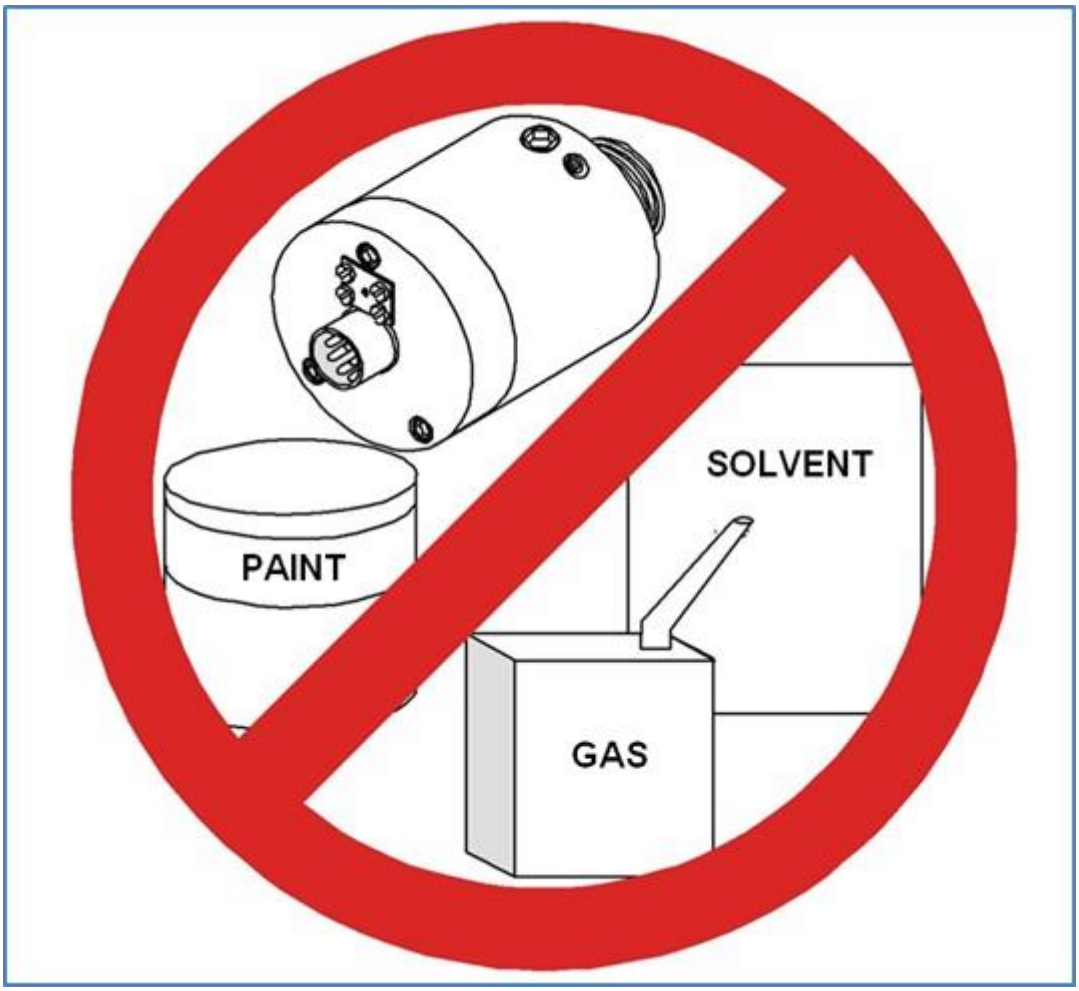


Figure 6-3: Do not paint the Sensor or do not clean it with any solvent

7. *Do not use a pipe wrench or chain wrench to install the sensor.* Doing so may cause serious damage to the sensor, thus voiding the warranty. It is recommended to use General Electric's Hydran 201TW tube wrench (see Figure 6-4 below) to correctly install the Hydran 201 sensor. One Hydran 201TW tube wrench per site is recommended.

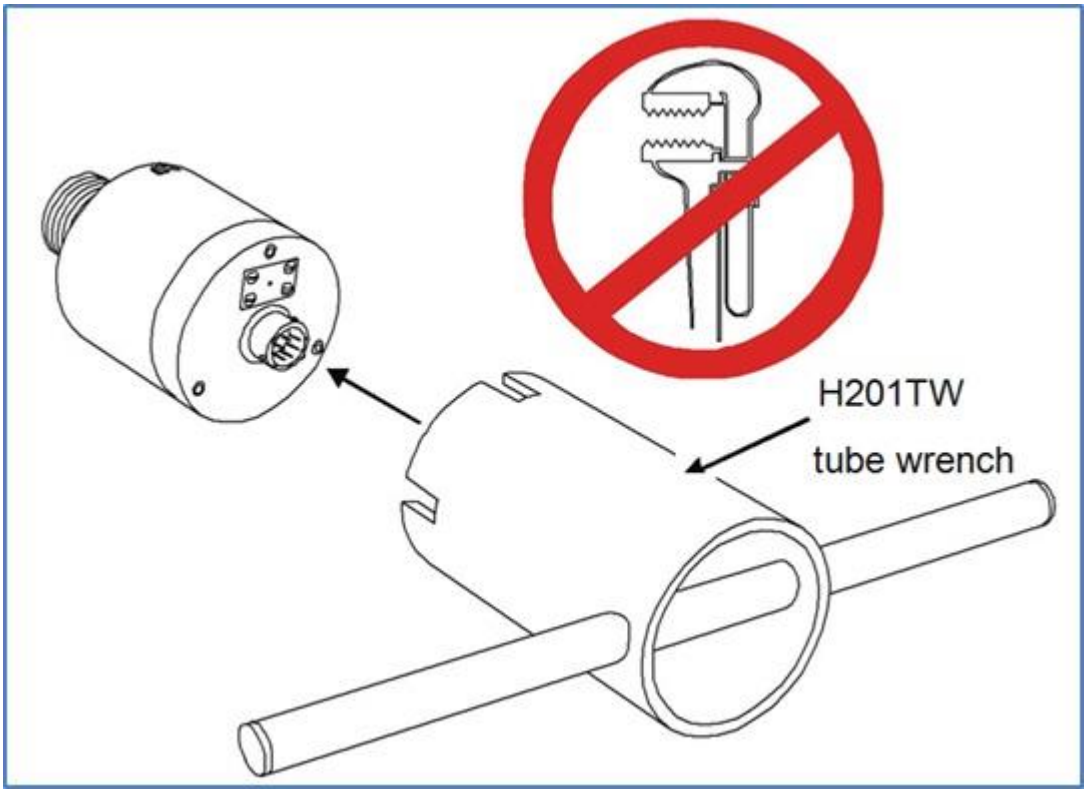


Figure 6-4: Use the Hydran 201TW instead of a Pipe Wrench

8. *Do not install the H201Ti on the inlet side of the radiator pump* (see Figure 6-5 below).

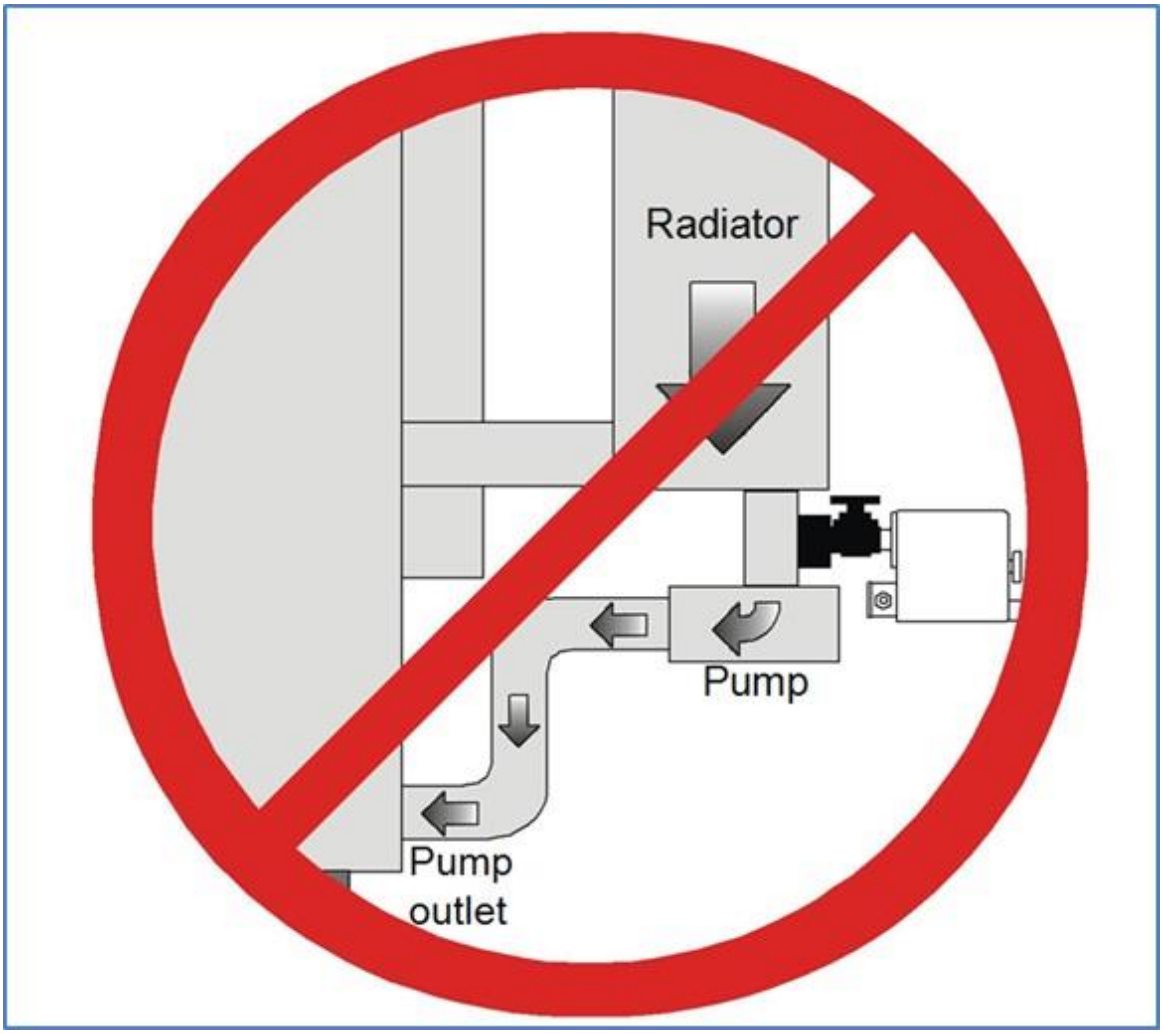


Figure 6-5: Do Not Install the H201T*i* on the Inlet Side of the Radiator Pump

9. *Do not use galvanized fittings to install the brass adaptor and the sensor*. Galvanized fittings (pipes, reducing bushings, rings, etc.) may react with the oil and produce elevated gas level readings. Similarly, do not use galvanized fittings on transformer valves used for oil sampling.

10. *Install the H201Ti horizontally; not at an angle, vertically or horizontally using an elbow* (see Figure 6-6 below). Elbows may cause turbulence that can reduce the accuracy of gas level readings. For details pertaining to the positioning of H201T*i*'s, see Section 6.2.2.3.

Figure 6-6: Do Not Install the H201T*i* on an Elbow

11. *Do not subject the H201Ti or its sensor to high-pressure water streams* (see Figure 6-7 below). Used during the cleaning of transformers, they may cause serious damage.

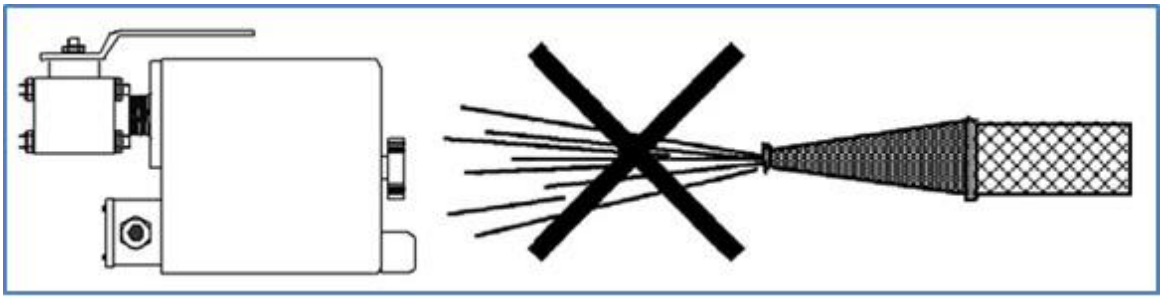


Figure 6-7: Avoid High Pressure Water Streams

12. *Do not punch additional openings in the H201Ci Controller's enclosure.* This enclosure already has openings for the various cables used with the Hydran 201*i* System. If additional openings must be made, apply a protective coating to the bare metal around the hole to prevent rust.
13. *Do not remove the watertight cap from unused openings of the H201Ci's enclosure.*

6.2 Installation Overview

A typical installation of the Hydran 201*i* System is shown in Figure 6-8 below. Here is a description of each component:

1. Optional Hydran 201C*i* Controller (Hydran 201C*i*-C Communications Controller or Hydran 201C*i*-1 One-Channel Controller) installed on vibration-absorbing rubber pads (see Figure 2-5).

2. Full-bore gate or ball valve.

3. Hydran 201T*i* Intelligent Transmitter.

4. H201T*i*'s supervisory link cable in a rigid or flexible steel conduit.

5. H201T*i*'s power supply cable in a rigid or flexible steel conduit.

6. Cable for communications and analog outputs in a rigid or flexible steel conduit (distinct from alarm cable conduit), toward a supervisory control and data acquisition (SCADA) system.

7. Cable for alarms in a rigid or flexible steel conduit, toward a SCADA system.

8. H201C*i* Controller's power supply cable in a rigid or flexible steel conduit.

WARNING

- ***All procedures in this manual must be strictly adhered to. Any deviation from these could cause irreversible damages to the transformer being monitored and/or the Hydran 201i System, and could lead to property damage, personal injury and/or death.***
- ***Installation and maintenance of the Hydran 201i System must be carried out by qualified personnel only.***

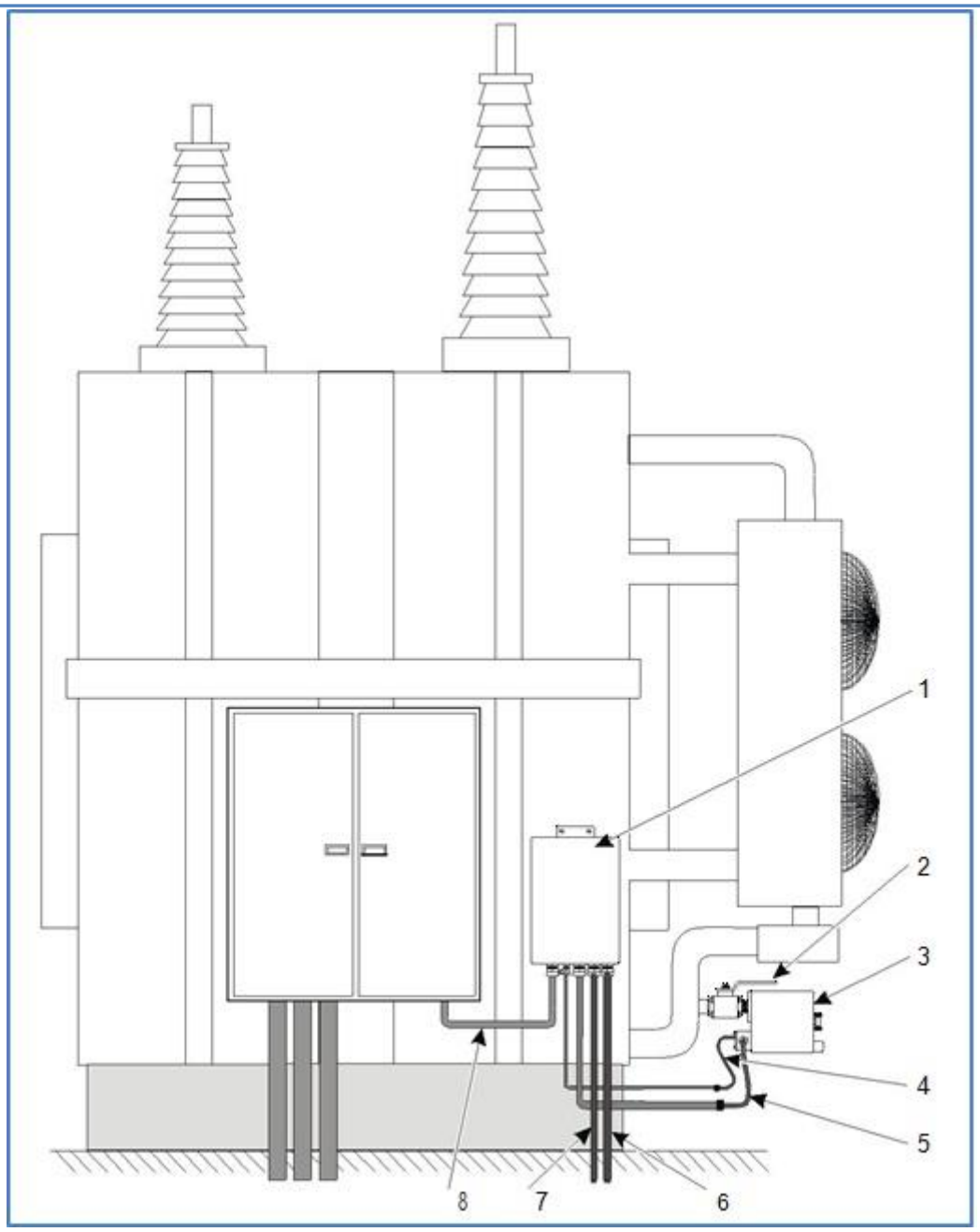


Figure 6-8: Typical Installation of the Hydran 201*i* System

6.2.1 Tools and Material Required

- Flat-blade screwdriver.
- General Electric's Hydran 201TW tube wrench to tighten the Hydran 201 sensor.
- Pipe wrench to tighten the brass adaptor onto the valve.
- Allen keys supplied with the Hydran 201T*i* (see Section 7.1.1).
- Bucket and oil-absorbing rags.
- Teflon tape and vinyl tape.
- Drill, bits and fasteners for mounting the Hydran 201C*i* Controller.
- If required, vibration-absorbing rubber pads, which can be purchased from General Electric.
- Conduits, fittings and cables for power supply, alarms, analog outputs and communications.
- Digital voltmeter/ammeter.

6.2.2 Mounting Location of the Hydran 201Ti

A Hydran H201Ti monitor can be installed on any available transformer valve. However, care must be taken in selecting a suitable location while respecting the overall dimensions and weight of the monitor. To achieve optimal performance from the monitor, ensure that:

- the monitor is mounted horizontally on the transformer valve
- there is no restriction between the Hydran and the main body of oil
- there is a good circulation of oil flowing towards the Hydran.

6.2.2.1 Requirements

1. Always mount the H201 sensor on a full-bore gate or ball valve where there is sufficient convective oil flow.
2. The H201T*i* is installed on a valve with a 1.5-in nominal diameter (NPT female threads). If necessary, use a reducing bushing.

Note: To ensure sufficient oil flow past the sensor's membrane, the nominal diameter of the valve should never *be less than 25 mm (1 in).*

3. The total distance between the H201T*i* and the mounting point of the valve *must not exceed six times the nominal diameter of the valve* (230mm [9 in] for a 38mm [1.5in] valve). See Figure B-1.
4. The body of the valve must be grounded.
5. The H201T*i* weighs 5.6kg (12lb). If the selected valve is subject to strong vibrations, install a supporting bracket to reduce the load on the valve. *In case of doubt, consult your engineering personnel.*
6. Ensure there is enough clearance above and below the Hydran H201Ti to separate it from its sensor.
7. The Hydran H201Ti must always be easily accessible.

6.2.2.2 Vertical Installations of the H201Ti

Regardless of the selected location, it is recommended to mount the Hydran H201Ti horizontally (as shown Figure 6-8). If no horizontal valve is available, a vertical installation may be acceptable; contact the General Electric Customer Service (the coordinates can be found at the bottom of page 2).

If the Hydran H201Ti is installed vertically, note the following points:

- The sensor's threaded extremity must be oriented upward.
- The oil temperature at this location must always be below 30 °C (86 °F).
- Do not use a 90° elbow to convert a vertical installation to a horizontal installation.
- It is recommended to set the temperature set point (parameter **Temp SetPoint** in the **Temperature** submenu) of the H201 sensor to 45 °C (113 °F).

6.2.2.3 Typical Locations

Figure 6-9 illustrates some 'typical' valve locations to install the Hydran 201T*i*. These locations vary between transformers, but there are some valve locations on a transformer where the oil circulation is much better due to the nature of a transformer's operation.

The circulation of oil is generally the same in all transformers — the natural convection of the oil circulates from warm to cool as the transformer warms up. The oil at the bottom is usually cooler than the top as it returns from the cooling system, as illustrated in Figure 6-9.

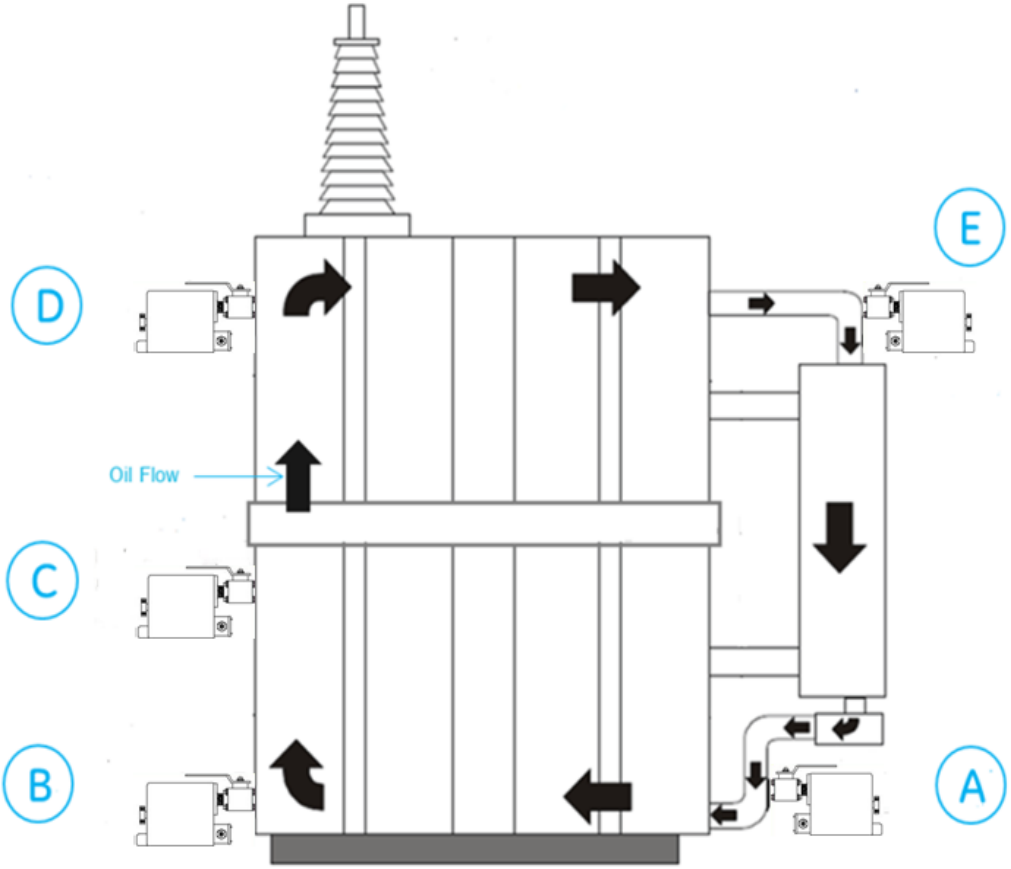


Figure 6-9: Typical Valve Locations on a Transformer

Location #A: Cooling Return

Some transformers may have a valve that is on the pipe that joins the bottom of the cooling system to the transformer main tank. This location has excellent circulation of oil. It offers easy access for installation and taking oil samples directly from the Hydran 201Ti.

Note: If a pump is part of the cooling system, it is recommended that the Hydran 201Ti be installed on the discharge side of the pump.

Location #B: Drain Valve

All transformers are equipped with a drain valve. This location offers easy access for installation and taking oil samples directly from the Hydran 201Ti. Oil flow is reduced compared to the other locations and overtime there can be a build up of sludge which can further impede the oil flow. Due to the availability of the valve this is an attractive location for an installation.

Note: A minimum distance of 12 in. between the ground and the valve is required so that the Hydran enclosure and cables can be properly installed.

Location #C: Main Tank

Some transformers are equipped with a valve that is mounted towards the middle portion of the transformer main tank. This location offers good oil circulation and is easily accessible for installation and taking oil samples directly from the Hydran 201Ti.

Location #D: Upper Filling Valve

Most transformers are equipped with an upper filling valve. This location offers an excellent circulation of oil; but is not easily accessible and may require an outage to install the Hydran 201Ti.

Location #E: Top of Cooling System

Some transformers may have a valve that is mounted on the pipe that joins the top tank of the transformer to the top of the cooling system. This location offers an excellent circulation of oil, but is not easily accessible and may require an outage to install the Hydran 201Ti.

CAUTION

If these five recommended locations cannot be used, contact the General Electric Customer Service (contact information can be found at the bottom of page 2) to help you determine an acceptable alternative location.

6.2.3 Mounting Location of Hydran 201Ci Controllers

The following points pertain to all H201C*i* Controllers (Hydran 201C*i*-C and Hydran 201C*i*-1):

1. All H201C*i* Controllers are equipped with Type NEMA 4X enclosures and can thus be installed outdoor.
2. The H201C*i* Controllers must be mounted on a vibration-free structure. If vibrations are present, use vibration-absorbing rubber pads (see Figure 2-5), which can be purchased from General Electric.
3. The enclosure must be placed at eye level.
4. Allow enough space to open the door completely.
5. Allow enough space to access easily the cable fittings under the enclosure.
6. Good grounding of the enclosure and its supporting structure is essential to protect the equipment against electromagnetic and radiofrequency interference.
7. Install the enclosure as far as possible from circuit breakers or any other strong source of radiofrequency noises. The enclosure can be installed up to 1,200m (4,000ft) from the Hydran 201T*i*. The *total* length of supervisory links (communication cable between the H201C*i* Controller and its H201T*i*'s) must not exceed 1,200m (4,000ft) per H201C*i* Controller.

8. Dimensions for the H201C*i*-C and H201C*i*-1 enclosures are shown in Figure B – 7 and Figure B – 8 in Appendix B.
9. The power supply source of the H201C*i* Controller must be protected by an adequate switch or circuit-breaking system as the means for disconnection:
   - The switch or circuit-breaking system must be included in the building installation.
   - It must be in close proximity to the equipment and within easy reach of the operator.
   - It must be marked as the disconnecting device for the equipment.
   - The installation shall be done in accordance with local wiring regulations.

6.2.4 Cabling and Network Configuration

Starting with the CPU FW 4.0, several Hydran 201Ti (max. 32) installed in a sub-station can be linked together using the RS-485 port, to form a local network and connect to a host computer through a converter RS-485 to USB.

The classical option is also supported: several Hydran 201C*i* Controllers installed in a station can be linked together using an RS-485 link to form a local network. A local network of Hydran 201*i* Systems can include up to 32 H201C*i* Controllers and 128 Hydran 201T*i*s. The H201C*i* Controllers (Hydran 201C*i*-Cs and/or Hydran 201C*i*-1s) can all be connected together. The network configuration is explained in Chapter 10.

Any H201C*i* Controller in a local network can be connected to a host computer (running the General Electric's Hydran Host or Perception software, depending on the protocol set on the unit) through an RS-232 or USB link to monitor all the H201T*i*s in the network. The host computer and the network can also communicate through a modem, thus allowing remote monitoring.

To maximize the benefits of a network, simple guidelines should be followed. Use the following rules to install and implement a network of Hydran 201*i* Systems.

6.2.4.1 Parameter Settings

1. The parameters of each H201T*i* (identification number, power station identification number, communication speed, alarm set points, operation mode of relays, etc.) must be selected before field installation.
2. Each H201T*i* of a local network must be set to an individual and exclusive identification number (parameter **H201T*i* ID** in the **Communication** submenu) selected between 1 and 254. The numbers can be assigned sequentially or using any other method preferred by the user. *If two H201Ti's share the same number in a local network, they are not able to communicate properly with the host computer.* It can be useful to assign numbers that correspond to the identification numbers of the transformers being monitored; for an example, see Table 6-1.
3. All H201T*i*s belonging to a local network must share a common power station identification number (parameter **PowerStat. ID** in the **Communication** submenu).

This number is used when accessing a station remotely, or when analyzing and displaying historic data in the Hydran Host software.

4. All H201T*i*s in a local network must be set to the same data communication speed (parameter **BaudRate** in the **Communication** submenu; 1,200, 2,400, 4,800 or 9,600 bps). The recommended speed is 9,600 bps.

Transformer	H201T*i* Identification Number
Reserved	1[a]
T1A	11
T1B	12
T1C	13
T2A	21
T2B	22
T2C	23

a. *At least one H201Ti in a local network must be set to an identification number between 1 and 5 (inclusive)*

Table 6-1: Example of H201Ti Identification Numbers

5. The serial number of each component of the Hydran 201*i* System, the value of the H201T*i*'s parameters and a general description of the installation (transformer number, power station number, etc.) should be logged and kept in a safe place.
6. The communication parameters must be identical at both ends of the communication channel. In addition the communication speed of both modems must be the same as the H201T*i*'s and the host computer. Refer to the *Hydran Host Software Manual*.

6.2.4.2 Cabling

1. The maximum length allowed for each cable is as follows:
   - The total maximum length for all supervisory links cables in a single Hydran 201*i* System (between an H201C*i* Controller and its H201T*i*s) is 1,200m (4,000ft).
   - The total maximum length for all RS-485 link cables between all H201Ti or between all H201C*i* Controllers in a local network is also 1,200m (4,000ft).
   - The length of the RS-232 link cable must not exceed 7.7m (25ft) or for USB link cable it must not exceed 5m (16.4ft).

2. All cables that connect the Hydran 201*i* System's components should be run in steel conduits. The shield of all cables should be grounded at one end only or at the indicated locations. Routing and shielding of the RS-485 link cable are

particularly important because all H201C*i* Controllers in a local network share a common reference with this link.

WARNING

Disconnect the power at the disconnect switch or circuit breaker before making any electrical connections, and ensure a proper ground connection is made before connecting line voltage. Failure to do so can result in property damage, personal injury and/or death.

3. Because the supervisory link is isolated electrically at both ends, use it rather than the RS-485 link to cover long distances.
4. Electrical noise is one of the most important factors when selecting the location and installing a modem.
5. If the analog outputs and relay contacts must be connected to a SCADA system, it is recommended to install the H201C*i* Controller near this system and use the supervisory links to cover the distance between the H201T*i*'s and the H201C*i* Controller.
   - Transmitting the information using a supervisory link requires only three shielded pairs of wires (two pairs for the H201C*i*-C).
   - Transmitting the information between the H201C*i* controller and the SCADA system requires one RS-485 or RS-232 link cable and/or the following pairs for each H201T*i*:
     - Three pairs for the alarm contacts (High, High-High and system fail alarms).
     - One or two pairs for the analog outputs.
   - Because of its digital nature, the supervisory link provides better protection against electrical noise.

6.3 Installation

To install the components of the Hydran 201*i* System, please consult the following parts of this manual:

- Hydran 201T*i*: See Chapter 7.
- Hydran 201C*i*-C: See Chapter 8.
- Hydran 201C*i*-1: See Chapter 9.
- Local network: See Section 10.5.
- Optional modem: See Section 10.6.

7 HYDRAN 201TI INSTALLATION

Please read the following Sections before proceeding with the installation:

- User interface, in Section 5.1.
- General warnings, in Section 6.1.
- Installation overview, in Section 6.2.

Note: It is recommended to use the Hydran Host software rather than the H201Ti's user interface (keypad and display). See the Hydran Host Software Manual.

7.1 Incoming Inspection and Verification

It is strongly recommended to verify the operation of the H201T*i*'s and Hydran 201C*i* Controllers before their installation. This verification also confirms that no damage occurred during shipping and allows the user to become familiar with the Hydran 201*i* System. The H201T*i* installation procedure is described in Section 7.3.

7.1.1 Receiving and Unpacking

Upon receipt, the shipping box contains one preassembled H201T*i*, complete with a transmitter enclosure, a Hydran 201 sensor, electronic modules (CPU and I/O), and a flanged brass adaptor. For the shipping list, see Section 7.1.2 below; for a detailed view of the component assembly of the H201T*i*, see Figure 7-2.

1. Open the shipping box.
2. Remove the documentation and the small bag containing accessories and tools.
3. Carefully remove the H201T*i* from the box.

CAUTION ***Do not remove the plastic cap from the flanged brass adaptor. This cap protects the adaptor's threads and membrane.***

Note: Keep the packing material for storage or further shipment of the H201Ti.

7.1.2 Shipping List

This Section lists all the items included in the shipment of a Hydran 201T*i*. If any item is missing, contact the General Electric Customer Service (the coordinates can be found at the bottom of page 2).

1. One pre-assembled H201T*i*, including:
   - One enclosure, with heating plate, aluminum cover and knob.
   - One Hydran 201 sensor.
   - One flanged brass adaptor.
   - One main (CPU) module, with display and keypad.

- One I/O module, with terminal blocks.

2. Two cables:
   - One USB 2.0 cable, Type A male to Type B male, 1.8m (6ft) long.
   - One supervisory link cable (30, 50 or 100ft [9, 15 or 30m]), with six wires and an overall shield.

   Note: This supervisory link cable is supplied only when the H201Ti is part of a Hydran 201Ti RS-485 network, Hydran 201R Model i or is ordered with any Hydran 201Ci Controller.

3. Software and manuals:
   - One installation CD-ROM that includes the following items:
     - The Hydran Host software.
     - Three manuals in PDF format: The *Hydran 201i System Instruction Manual* (the present manual), the *Hydran 201i System Installation Guide* and the *Hydran Host Software Manual.*
   - One printed *Hydran 201i System Installation Guide.*

4. One set of tools and accessories:
   - One 3/16in (4.75mm) Allen key with a 9in (229mm) T-shape handle (part number 11817).
   - One 5/32in (4mm) Allen key with a short L-shape handle (part number 10013).
   - One 7/64in (2.8mm) Allen key with a short L-shape handle (part number 10011).
   - One blue protective cap for the H201 sensor.
   - One roll of PTFE tape.

7.1.3 Inspecting

Verify the Hydran 201T*i* completely as outlined below.

1. Using the shipping list (see Section 7.1.2 above), ensure all items are present.
2. Inspect the following components for any visual damage (bump, scratch or others):
   - The enclosure.
   - The brass adaptor.
   - The Hydran 201 sensor.
   - The CPU module.
   - The input/output (I/O) module.
3. Verify the ac power supply voltage (indicated on the left side of the I/O module) corresponds to the power source voltage and the value on the Test Certificate

and Data Sheet (for an example, see Figure 7-1. The left side is determined by facing the H201T*i*'s display and keypad. There are two possibilities:

- 115 V, corresponding to 100–120 VAC 50/60 Hz
- 230 V, corresponding to 200–240 VAC 50/60 Hz

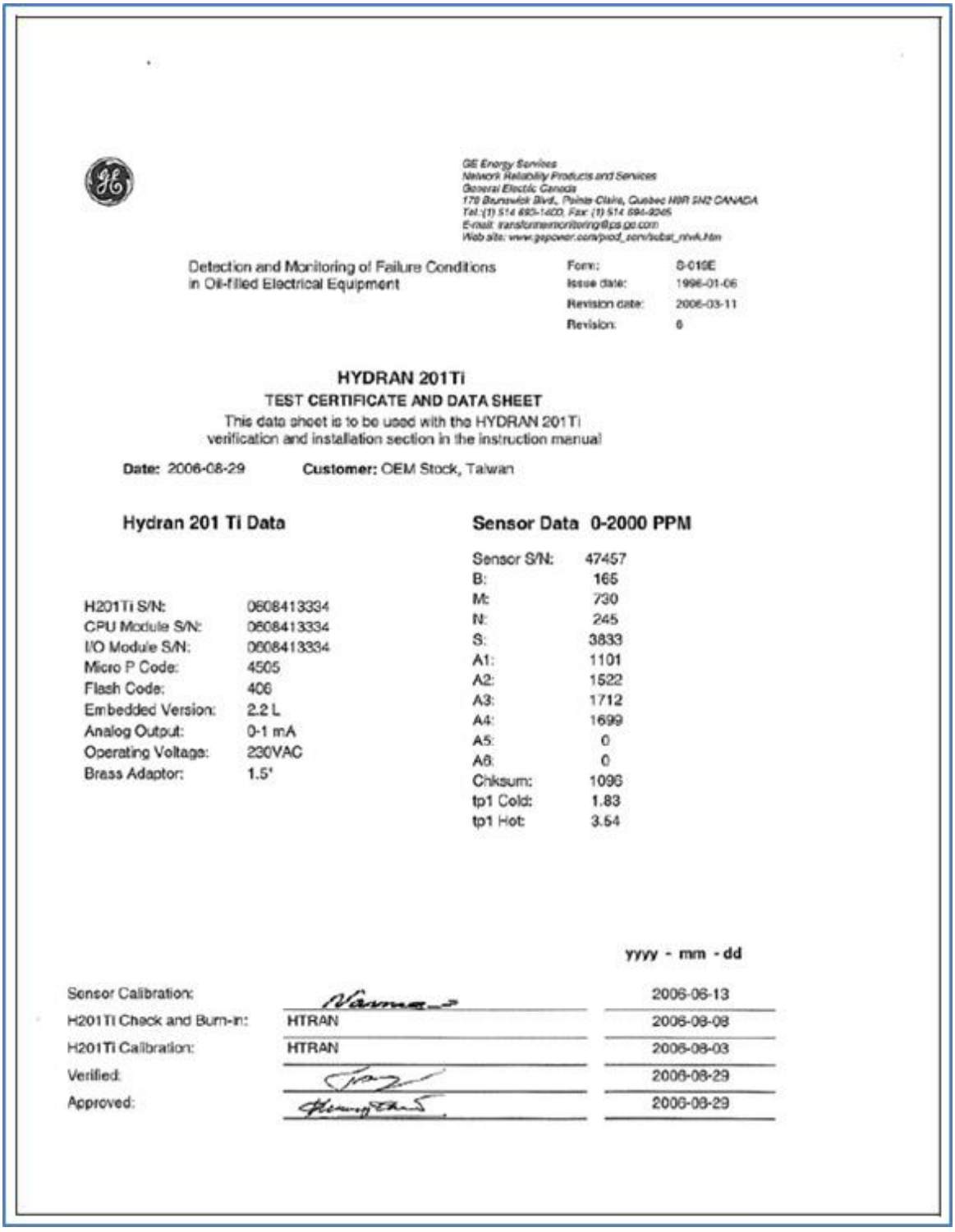
4. Verify the type and size of the supplied flanged brass adaptor:
   - 1-in NPT (outside diameter 1.25 in [32 mm]): See Figure B-4.
   - 1.5-in NPT (outside diameter 1.75 in [44 mm]): See Figure B-3.
   - 1.5-in NPT finned for high temperatures: See Figure B-6
   - 2-in NPT (outside diameter 2.25in [57mm]): See Figure B-5

5. Ensure the serial numbers of the following H201T*i*'s components correspond to those indicated on the Test Certificate and Data Sheet (for an example, see Figure 7-1 below) and on the shipping box:
   - Serial number of the H201T*i* (located on the back of the heating plate; see item 2 in Figure 3-2).
   - Serial number of the CPU module (located on the back of the module; see item 4 in Figure 3-2).
   - Serial number of the I/O module (located under the module; see item 6 in Figure 3-2).
   - Serial number of the sensor (located under the sensor's connector; see item 3 in Figure 3-2).

   Note: Each H201Ti is configured for a specific sensor. If several H201Ti's are received, take the necessary precautions not to swap the sensors and H201Tis.

6. Report any discrepancies to the company supervisor and the General Electric Customer Service (the coordinates can be found at the bottom of page 2).

   Note: Never return equipment without first contacting the General Electric Customer Service.



GE Energy Services
Network Reliability Products and Services
General Electric Canada
178 Brunswick Blvd., Pointe-Claire, Quebec H9R 5N2 CANADA
Tel.:(1) 514 695-1400, Fax: (1) 514 694-9265
E-mail: transformermonitoring@ps.ge.com
Web site: www.gepower.com/prod_serv/indst_mnt/

Detection and Monitoring of Failure Conditions
in Oil-filled Electrical Equipment

Form: S-019E
Issue date: 1996-01-06
Revision date: 2006-03-11
Revision: 6

HYDRAN 201Ti

TEST CERTIFICATE AND DATA SHEET

This data sheet is to be used with the HYDRAN 201Ti
verification and installation section in the instruction manual

Date: 2006-08-29 **Customer:** OEM Stock, Taiwan

Hydran 201 Ti Data

H201Ti S/N:	0608413334
CPU Module S/N:	0608413334
I/O Module S/N:	0608413334
Micro P Code:	4505
Flash Code:	406
Embedded Version:	2.2 L
Analog Output:	0-1 mA
Operating Voltage:	230VAC
Brass Adaptor:	1.5"

Sensor Data 0-2000 PPM

Sensor S/N:	47457
B:	165
M:	730
N:	245
S:	3833
A1:	1101
A2:	1522
A3:	1712
A4:	1699
A5:	0
A6:	0
Chksum:	1096
tp1 Cold:	1.83
tp1 Hot:	3.54

		yyyy - mm - dd
Sensor Calibration:	Varma	2006-06-13
H201Ti Check and Burn-in:	HTRAN	2006-08-08
H201Ti Calibration:	HTRAN	2006-08-03
Verified:		2006-08-29
Approved:		2006-08-29

Figure 7-1: Example of Test Certificate and Data Sheet for the Hydran 201T*i*

7.1.4 Storage and Battery Care

If the Hydran 201Ti is to be stored (or unpowered), it is recommended to keep the product in its original shipping box. The plastic cap must be left on the adaptor to protect its threads and the membrane. The product can be stored (or unpowered) for up to six months in a fully enclosed building that is free from damp and extremes in ambient temperature. The storage facility temperature should be between 5 °C and 45 °C (41 °F and 113 °F) with a non-condensing, relative humidity between 5 and 95%. If these limits are to be exceeded, please contact the General Electric Customer Service (the contact details can be found at the bottom of page 2). These restrictions do not apply to transportation.

When storing the H201T*i* for more than three months, it is recommended to disconnect the lithium battery located inside the CPU module (see item 4 in Figure 3-2); to disconnect and reconnect the battery, see Section 3.7.3. The battery has a shelf life (when unused) exceeding ten years; if the battery remains connected when the H201T*i* is not powered, operation of the real-time clock reduces its life to approximately three years.

7.2 Verification of Operation Prior to Installation

It is strongly recommended to verify the operation of the Hydran 201T*i*'s before installation in the field (for the installation procedure, see Section 7.3). The verification confirms that no damage occurred during shipping and allows the user to become familiar with the H201T*i*.

7.2.1 Preparation

1. Place the Hydran 201T*i* upward on its brass adaptor end.
2. Unscrew the knob on the front of the aluminum cover.
3. Remove the cover and place it aside.
4. Connect a three-wire power cord to the AC Power 3-Terminal Block on top of the I/O module (item 8 in Figure 3-4): The live side to **L1/L**, the other side to **L2/N**, and the ground to **E/G**. For additional wiring details, see Table D - 1.

Note: If a supervisory link cable is attached to the H201Ti, do not connect it to the Hydran 201Ci Controller now. It will be connected later when testing the H201Ci (if supplied).

CAUTION ***Strip each wire to a maximum of 8 mm before installing it. Be sure to insert all strands in the terminal.***

5. Ensure the ac power supply voltage indicated on the label near the terminal block corresponds to the power source voltage.
6. Power On the H201T*i*.

WARNING

Disconnect the power at the disconnect switch or circuit breaker before making any electrical connections, and ensure a proper ground connection is made before connecting line voltage. Failure to do so can result in property damage, personal injury and/or death.

7.2.2 Initial Observations

1. If the battery was just reconnected, the H201T*i* performs the first power-up sequence (see Section 5.2.5.3). Enter the requested parameters (date, time, etc.) using the H201T*i*'s keypad.
2. Observe the display and ensure the H201T*i* goes through the self-test sequence shown in Table 5-2.

Note: The self-test sequence is executed only if the power was down for more than five minutes. Otherwise, only the message ***System;Initialization*** *appears.*

Note: A sensor test is executed at the end of the self-test sequence only if the scheduled last sensor test was not performed. In this case, the H201Ti displays the message ***Sensor Good*** *and waits 120 seconds before resuming normal display.*

3. Verify that the H201T*i* displays the Main Display mode (the parameters shown in Table 5-1, at the rate of one every five seconds).
4. Verify the operation of the H201T*i* by observing the six small LED diagnostic indicators on the right side of the I/O module (from left to right in Figure 3-7):

-  **C Heating state LED**: This yellow LED flashes once every five seconds in proportion to the amount of power supplied to the heating plate.
  - The LED must remain lit if the internal temperature is below the set point (adjustable **Temp SetPoint** parameter in the **Temperature;DynOil Sampl** submenu).
  - The LED must flash if the internal temperature is close to the set point.
  - The LED must remain off if the internal temperature exceeds the set point.

- **-5 - Regulated -5 Vdc supply LED**: This dim, green LED must be lit to confirm the presence of the -5 Vdc power supply.
- **+5 - Regulated +5 Vdc supply LED**: This dim, green LED must be lit to confirm the presence of the +5 Vdc power supply.
- **OK - System state indicator LED**: This green LED must be lit to confirm that the H201Ti is operating properly and that the fail alarm relay is energized. It turns off if a fail alarm condition is detected and if the fail alarm relay is de-energized.
- **HH - High-High alarm state LED**: This red LED is lit when a High-High alarm condition is detected and the High-High alarm relay is energized. This LED must therefore be off.
- **H - High alarm state LED**: This red LED is lit when a High alarm condition is detected and the High alarm relay is energized. This LED must therefore be off.

- Wait a few minutes and touch the back of the heating plate (item 2 in Figure 3-2 in section 3). It should be warm if the LED I C (item 21 in Figure 3-7) is blinking. This indicates the sensor is being heated to the default temperature setting of the H201Ti (35°C or 95°F).

5. Press **ENTER** once on the membrane keypad. The following screen should be displayed:

H201Ti Vx.xx Main Menu

6. Press **END** or **ESC** to return to the Main Display mode. This confirms keypad operation.

Note: The membrane keys have no "feel," due to the extremely wide temperature range of this membrane keypad that prevents the use of clicking domes under the keys.

7. Make a shadow over the display and verify that the backlighting is functioning. Although it appears dim in daylight, the backlight allows easy reading of the display at night. This backlit LCD display, with automatic temperature-compensation of contrast, is perfectly readable under all ambient lighting conditions and over the full operating temperature range of the H201T*i*.

7.2.3 Adjusting the Data and Time

1. Access the main menu by pushing **ENTER**
2. Access the extended menu by pushing **CHANGE**
3. Enter the password #1 (**1253**) using the **UP** and **ENTER** keys.
4. Access the top of the extended menu by pushing **ENTER** twice (**History** appears).

   Note: Once accessed, the extended menu times out after 30 minutes of keypad inactivity. Repeat the steps 1 to 4 above if necessary.

5. Push **DOWN** four times until **Date&Time** appears.
6. Access this menu by pushing **ENTER**.
7. Select **Year** using the **DOWN** or **UP** key.
8. To be able to adjust this value, push **CHANGE**.
9. When asked to enter the password #1 (**1253**), use the **UP** and **ENTER** keys.
10. Modify the value using the **UP**, **DOWN** and **ENTER** keys.
11. Adjust the **Month**, **Day**, **Hour** and **Min** by repeating the steps 7 to 10 above.
12. When the **Date & Time** is adjusted, push **END**.
13. To abort an operation if needed, push **ESC**.

7.2.4 Verifying the Alarm Relays

The steps described in this Section may be used during the Hydran 201T*i* verification, maintenance and troubleshooting procedures; certain steps may therefore not apply to

your particular situation. Perform all of the procedures (from Section 7.2.4.1 below to Section 7.2.4.6).

To verify the relays using the alarm contacts, connect an ohmmeter to the Alarm Contacts 9-Terminal Block (item 12 in Figure 3-5). To identify each terminal, see Table D - 2.

7.2.4.1 Gas High Alarm

1. Access the top of the extended menu by pushing **ENTER** twice (**History** appears).

Note: Once accessed, the extended menu times out after 30 minutes of keypad inactivity.

2. Access the submenu **H201Ti Vx.xx; Relays/Analog**.
3. Access the submenu **Relays/Analog; GasH Relay**.
4. Access this relay by pushing **ENTER** (the state of the relay is now displayed).
5. Set this relay's parameter **RelayMode** to **Force ON**.
6. When asked to enter the password #1 (**1253**), use the **UP** and **ENTER** keys.
7. Ensure:
   - The High alarm state LED **H** (item 27 in Figure 3-7) is lit.
   - The NO contact of the High alarm is closed.
   - The NC contact of the High alarm is open.
   - The state of the other contacts and state LED's has not changed.
   - If connected, the supervisory control and data acquisition (SCADA) system has detected the alarm.

Note: The relay contacts can also be verified using an ohmmeter. Refer to Table D - 2 *for the terminal block wiring.*

7.2.4.2 Gas High-High Alarm

1. Access the submenu Relays/Analog;GasHH Relay.
2. Access this relay by pushing ENTER (the state of the relay is now displayed).
3. Set this relay's parameter RelayMode to Force ON.
4. Ensure:
   - The High-High alarm state LED **HH** (item 26 in Figure 3-7) is lit.
   - The NO contact of the High-High alarm is closed.
   - The NC contact of the High-High alarm is open.
   - The state of the other contacts and state LED's has not changed.
   - If connected, the SCADA system has detected the alarm.

7.2.4.3 Fail Alarm

1. Access the submenu Relays/Analog;SysOK Relay.
2. Access this relay by pushing ENTER (the state of the relay is now displayed).
3. Set this relay's parameter RelayMode to Force OFF.

4. Ensure:
   - The System state indicator LED OK (item 25 in Figure 3-7) is off.
   - The NO contact of the fail alarm is open.
   - The NC contact of the fail alarm is closed.
   - If connected, the SCADA system has detected the alarm.

7.2.4.4 Cancelling the Fail Alarm

1. Set the same parameter **RelayMode** to **Normal**.
2. Ensure:
   - The System state indicator LED **OK** (item 25 in Figure 3-7) is lit.
   - The NO contact of the fail alarm is closed.
   - The NC contact of the fail alarm is open.
   - If connected, the SCADA system has detected the state change of the fail alarm relay.

7.2.4.5 Cancelling the Gas Alarms

1. Access the submenu Relays/Analog;GasH Relay.
2. Set this relay's parameter RelayMode to Normal.
3. Access the submenu Relays/Analog;GasHH Relay.
4. Set this relay's parameter RelayMode to Normal.
5. Ensure:
   - The High alarm state LED H (item 27 in Figure 3-7) is off.
   - The High-High alarm state LED HH (item 26 in Figure 3-7) is off.
   - The System state indicator LED OK (item 25 in Figure 3-7) is lit.
   - The NO contact of the High alarm is open.
   - The NC contact of the High alarm is closed.
   - The NO contact of the High-High alarm is open.
   - The NC contact of the High-High alarm is closed.
   - The NO contact of the fail alarm is closed.
   - The NC contact of the fail alarm is open.
   - If connected, the SCADA system has detected the state change of both gas alarm relays.

7.2.4.6 Conclusion

1. If necessary, set the parameter **RelayMode** of each alarm relay to their initial mode.
2. When all three relays have been tested, push **END**.
3. To abort an operation if needed, push **ESC**.

7.2.5 Verifying the Backup Battery

1. Access the top of the extended menu by pushing **ENTER** twice (**History** appears).

   Note: Once accessed, the extended menu times out after 30 minutes of keypad inactivity.

2. Push **DOWN** three times until **Service** appears.
3. Access this menu by pushing **ENTER**.
4. Push **DOWN** twice until **Backup Battery** appears.
5. Read the battery voltage by pushing **ENTER**. The value must exceed 2.9 V.

   Note: The Hydran 201Ti requires a minimum of 2.2 V to operate correctly.

6. When all is done, push **END**.

7.2.6 Sensor Serial Number Verification and Sensor Test

1. Access the top of the extended menu by pushing **ENTER** twice (**History** appears).

Note: Once accessed, the extended menu times out after 30 minutes of keypad inactivity.

2. Push **DOWN** three times until **Service** appears.
3. Access this menu by pushing **ENTER**.
4. Read the serial number, by pushing **ENTER**.
5. Compare the serial number displayed with the one located under the sensor's connector (see item 3 in Figure 3-2).
6. Push **ESC** and **DOWN** to access **Force Sensor Test**.
7. Push **ENTER**. The message **AreYou Sure?;PressEnter..** is now displayed.
8. Push **ENTER** again to confirm.
9. When asked to enter the password #1 (**1253**), use the **UP** and **ENTER** keys.
10. The message **Please wait...** appears, the test is executed (during a four-second countdown), and the H201Ti's display should indicate the message **Good**. If another message is displayed, see Section 13.1.3.
11. When all is done, push **END**. The Hydran 201T*i* returns to the Main Display mode.

7.2.7 Adjusting the Temperature Set Point

1. Allow 30 minutes after power-up for the temperatures to stabilize.
2. Access the top of the extended menu by pushing **ENTER** twice (**History** appears).

Note: Once accessed, the extended menu times out after 30 minutes of keypad inactivity.

3. Push **DOWN** twice until **Temperatures** appears.
4. Access this menu by pushing **ENTER**.
5. Push **UP** until **Dyn Oil Sampl** appears.
6. Access this menu by pushing **ENTER**.
7. Select **Heater Power** using the **DOWN** or **UP** key.
8. Check the **Heater Power** is in the low percent range.
9. Select **Temp Setpoint** using the **DOWN** or **UP** key.
10. Check the **Temp Setpoint** is 35°C (95°F), the default value.
11. Modify the **Temp Setpoint** by pushing **CHANGE**.
12. When asked to enter the password #1 (**1253**), use the **UP** and **ENTER** keys.
13. Decrease the **Temp Setpoint** to 30°C (86°F) using the **UP** and **ENTER** keys.

14. Return to a previous level of the menu by pushing **ESC**.
15. Re-enter the menu using the **DOWN** or **UP** key.
16. Check the **Temp Setpoint** has changed to 30°C (86°F).
17. When all is done, push **END**.

*Note: Reset the **Temp Setpoint** to 35°C (95°F), the default value.*

7.2.8 Verifying the Analog Output (Optional)

Table 5-7 lists the values of the electrical current that should be generated for each operation mode.

1. Connect a suitable dc digital ammeter with a 1% accuracy and a 0.01 mA resolution to the terminal screws 7 (**+**) and 8 (**-**) of the Supervisory Link and Analog Output Termination Board (see item 9 in Figure 3-4). Refer to Table D - 6 in Appendix D for connection details.
2. Access the top of the extended menu by pushing **ENTER** twice (**History** appears).

Note: Once accessed, the extended menu times out after 30 minutes of keypad inactivity.

3. Push **DOWN** six times until **Relays/Analog** appears.
4. Access this menu by pushing **ENTER**.
5. Push **DOWN** three times until **Analog out** appears.
6. Read the analog output state by pushing **ENTER**. The value should be close to 0%.
7. Push **DOWN** to access **Analog Out Mode**. The value should be **Normal**.
8. Modify the **Analog Out Mode** by pushing **CHANGE**.
9. When asked to enter the password #1 (**1253**), use the **UP** and **ENTER** keys.
10. Push **DOWN** three times and **ENTER** to force the output to **0%**.
11. Allow about one minute for the output to stabilize.
12. Verify the ammeter reads 4.00 ± 0.10 mA.
13. Push **CHANGE**, **UP** and **ENTER** to force the output to **50%**.
14. Allow about one minute for the output to stabilize.
15. Verify the ammeter reads 12.00 ± 0.20 mA.
16. Push **CHANGE**, **UP** and **ENTER** to force the output to **100%**.
17. Allow about one minute for the output to stabilize.
18. Verify the ammeter reads 20.00 ± 0.40 mA.
19. Push **CHANGE**, **UP** and **ENTER** to return the output to **Normal**.
20. When all is done, push **END**.
21. Disconnect the ammeter.

7.2.9 Verifying the USB Communication (Optional)

This procedure requires the use of the Hydran Host software. Please refer to the *Hydran Host Software Manual*.

1. Using the supplied USB cable, connect the Hydran 201T*i* to a host computer through their USB connector. Refer to Table D - 7 in Appendix D for connection details.
2. Access the top of the extended menu by pushing **ENTER** twice (**History** appears).

   Note: Once accessed, the extended menu times out after 30 minutes of keypad inactivity.

3. Push **DOWN** five times until **Communication** appears.
4. Access this menu by pushing **ENTER**.
5. Modify the **Comm Channel** by pushing **CHANGE**.
6. When asked to enter the password #1 (**1253**), use the **UP** and **ENTER** keys.
7. Change the **Comm Channel** to **H201Ti-USB** using the **UP** and **ENTER** keys.
8. Modify the **Default Channel** by pushing **DOWN** and **CHANGE**.
9. Change the **Default Channel** to **H201Ti-USB** using the **UP** and **ENTER** keys.
10. Push **DOWN** four times and **ENTER** to modify the **Gas Monitor ID**.
11. Write down the current value of the **Gas Monitor ID**.
12. Change the **Gas Monitor ID** to **1** using the **UP**, **DOWN** and **ENTER** keys.
13. When all is done, push **END**.
14. Start the Hydran Host software. Please refer to the *Hydran Host Software Manual*.
15. In the opening window, go to the **Main Menu** and choose **Network Setting**.
16. Check [✓] the station No. 1 and uncheck [ ] all the other stations.
17. Return to the **Main Menu**.
18. Select the **Real-Time Logging** menu.
19. Set **H201Ti List** to **Same as Network** and set **Log Rate** to **5 seconds**.
20. Return to the **Main Menu** and then to the opening window.
21. Verify that a new line of information is logged on the PC screen once every five seconds.
22. When the testing is completed, repeat the steps 2 to 13 above but restore the original communication settings to the following:
    - **Comm Channel** = **Supervisory Link.**
    - **Default Channel** = **Supervisory Link.**
    - **Gas Monitor ID** = Initial value noted in the step 11 above**.**
23. Disconnect the USB cable.

7.2.10 Completing the Verification

This completes the incoming verification of the Hydran 201T*i*.

1. Disconnect the H201T*i* from the power outlet.
2. If a Hydran 201C*i*-C is available, perform the procedure in Section 8.2.
3. If a Hydran 201C*i*-1 is available, perform the procedure in Section 9.2.
4. If no H201C*i* Controller is available, remove the power and computer cables from the H201T*i*.
5. Close the H201T*i* cover.
6. Store the H201T*i* in its box, ready for installation.
7. If the H201T*i* is not installed immediately, refer to Section 7.1.4 (Storage and Battery Care).

7.3 Installation

This Section explains how to install the Hydran 201T*i*, the brass adaptor and the Hydran 201 sensor; it refers to Figure 7-2 below.

CAUTION ***Read all the warnings and recommendations in Section 6.1 (General Warnings) before proceeding with the installation.***

Note: It is strongly recommended that the operation of all H201Ti's and H201Ci Controllers be verified before installation of the equipment in the field. Verification also allows the user to become familiar with the Hydran 201i System.

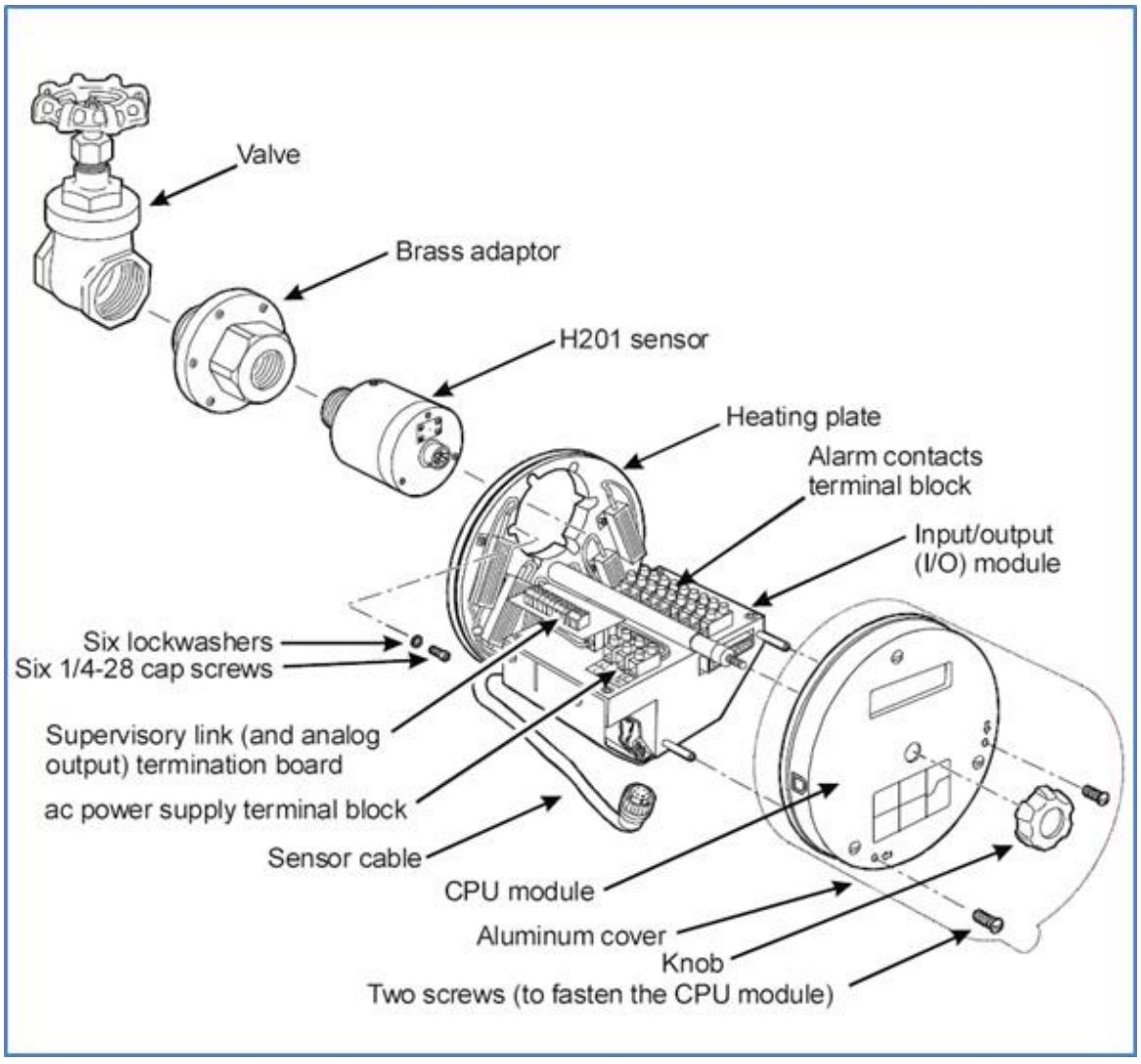


Figure 7-2: Hydran 201T*i* Assembly

WARNING

All procedures in this manual must be strictly adhered to. Any deviation from these could cause irreversible damage to the transformer being monitored and/or the Hydran 201i System, and could lead to property damage, personal injury and/or death.

Installation and maintenance of the Hydran 201i System must be carried out by qualified personnel only.

7.3.1 Verifying the AC Power Supply Voltage and the Serial Numbers

Ensure that the supply voltage setting (step 3 in section 7.1.3) and serial number verification (step 5 in section 7.1.3) have been performed.

7.3.2 Preparing the Hydran 201Ti

7.3.2.1 Removing the CPU Module

1. Unscrew the H201T*i*'s aluminum cover knob.
2. Remove the cover.
3. Remove *only* the two screws used to fasten the CPU module and identified with arrows (see Figure 3-7 below).

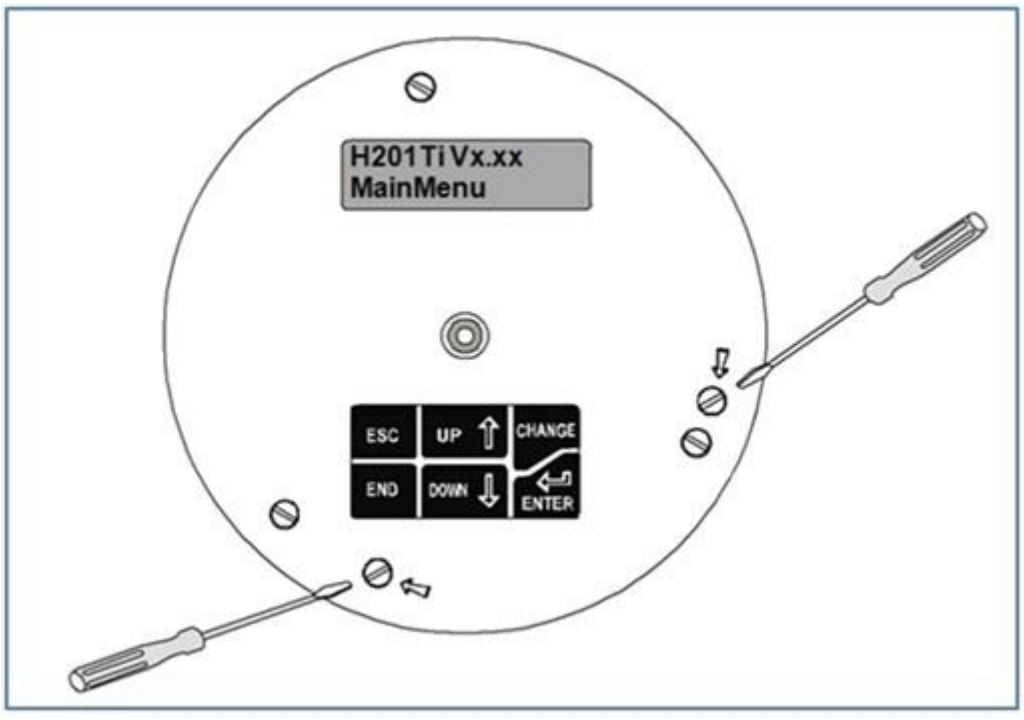


Figure 7-3: Screws used to fasten the CPU Module

4. Carefully pull out the CPU module.

CAUTION ***When removing the CPU module, make sure not to bend the pins of the connector located between the CPU and I/O modules.***

7.3.2.2 Separating the Brass Adapter from the Heating Plate

1. Disconnect the Hydran 201 sensor's connector.
2. Remove the six 1/4-28 cap screws from the adaptor using the supplied 3/16-in Allen key.
3. Separate the adaptor and the heating plate.
4. Protect the adaptor's threads with the supplied plastic cap.

7.3.2.3 Removing the Hydran 201 Sensor

1. Unscrew the sensor to separate it from the brass adaptor.

CAUTION ***Do not touch the H201 sensor's membrane for any reason.***

2. Inspect the sensor's membrane by looking at it. Its surface must be flat, without cuts or tears.
3. Protect the sensor's membrane by placing the supplied plastic cap over the sensor's threads.

7.3.2.4 Conclusion

1. Store the parts, the brass adaptor and the Hydran 201 sensor in a box and in a safe place until ready for installation.
2. Compare the contents to the list in Section 7.1.2.

Note: If the Hydran 201Ti has been in storage for more than six months, the battery located inside the cover of the CPU module might be disconnected, as recommended by General Electric. Reconnect the battery before installation; procedures to disconnect and reconnect the battery are given in Section 3.7.3 & 3.7.4.

7.3.3 Preparing the Valve

1. Wipe the inside of the valve.
2. Clean the valve's threads.
3. Wipe up any trace of oil and dispose of the collected oil according to company standards.

7.3.4 Installing the Brass Adapter onto the Valve

Cover the adaptor's threads with PTFE tape (see Figure 7-4 below).

CAUTION

Use only PTFE tape to seal the threads of both the adapter and the Hydran 201 sensor. Wrap at least 4 to 5 layers of tape around the threads.

Always wrap the tape counter to the treads.

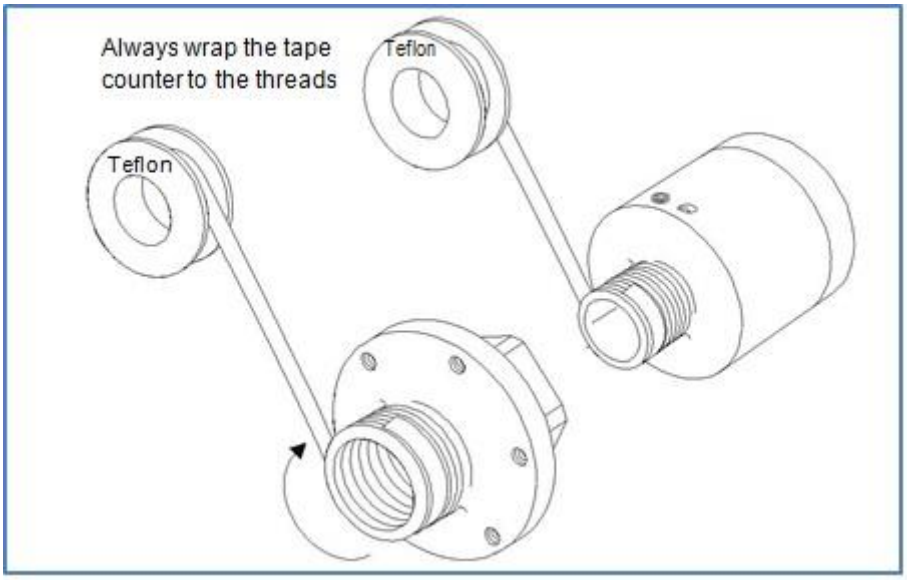


Figure 7-4: Wrap the Adapter and Sensor Threads with PTFE Tape

1. Screw the adaptor onto the valve and tighten it using a pipe wrench. Ensure two of the screw holes of the adaptor (used to fasten the Hydran 201T*i*'s heating plate) are level (horizontal); see Figure 7-5 below.

CAUTION

The H201Ti can be installed either on a horizontal (recommended) or vertical valve. If installed vertically, read the points listed in section 6.2.2.

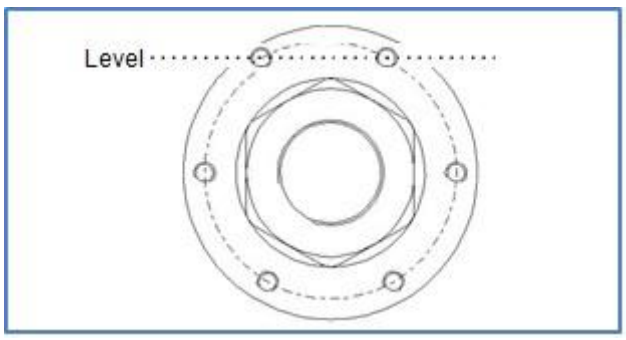


Figure 7-5: Ensure that Two Screw Holes are Horizontal

7.3.5 Installing the Hydran 201 Sensor

Cover the sensor's threads with Teflon tape (see Figure 7-4).

CAUTION

Use only PTFE tape to seal the threads of both the adapter and the Hydran 201 sensor. Wrap at least 4 to 5 layers of tape around the threads.

Always wrap the tape counter to the treads.

1. Slightly loosen the sensor's bleed screw, using the supplied 5/32-in Allen key.
2. Screw the sensor manually onto the adaptor.
3. Tighten the sensor using General Electric's Hydran 201TW tube wrench (see Figure 6-4) or a strap wrench. *Do not use a pipe wrench.* Do not use excessive force when tightening the H201 sensor onto the valve.

Note: If the H201 sensor is installed horizontally, ensure the bleed screw is on top (at the "12 o'clock" position); see Figure 7-6 below.

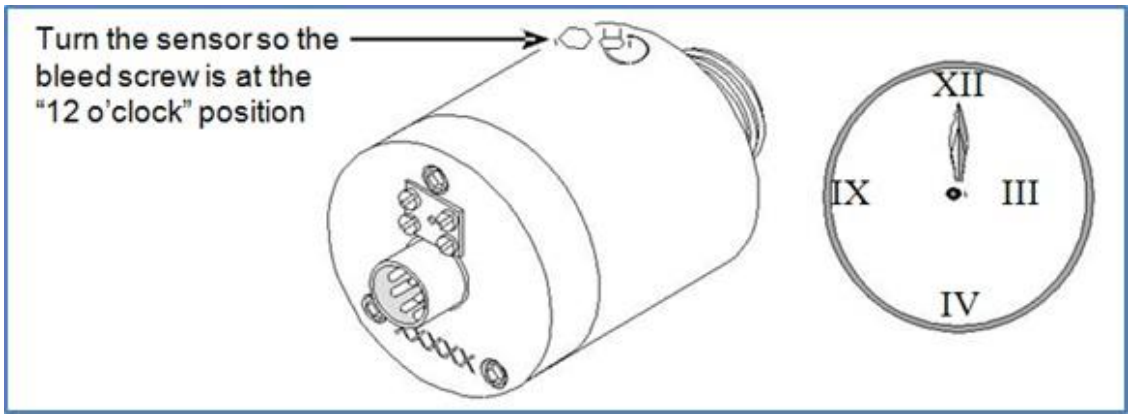


Figure 7-6: Bleed Screw must be on top, at the 12 O'clock position

4. Ensure the bleed screw is in place. *Do not* tighten it now.

7.3.6 Opening the Valve

CAUTION

This step should be performed according to company regulations. Proceed carefully to avoid introducing air into the transformer. Use a bucket to collect the oil.

1. Using the supplied 5/32-in Allen key, fully close the sensor's bleed screw and then open it *1/8 of turn*.
2. Slowly open the transformer valve until oil leaks out of the sensor's sampling port (see Figure 7-7)
3. When there are no more air bubbles present in the oil, shut the bleed screw tightly.
4. Open the valve completely.
5. Wipe all traces of oil from the sensor.

CAUTION ***Do not use any solvent.***

6. Inspect the adaptor and sensor for oil leaks.
7. Dispose of the collected oil according to company standards.

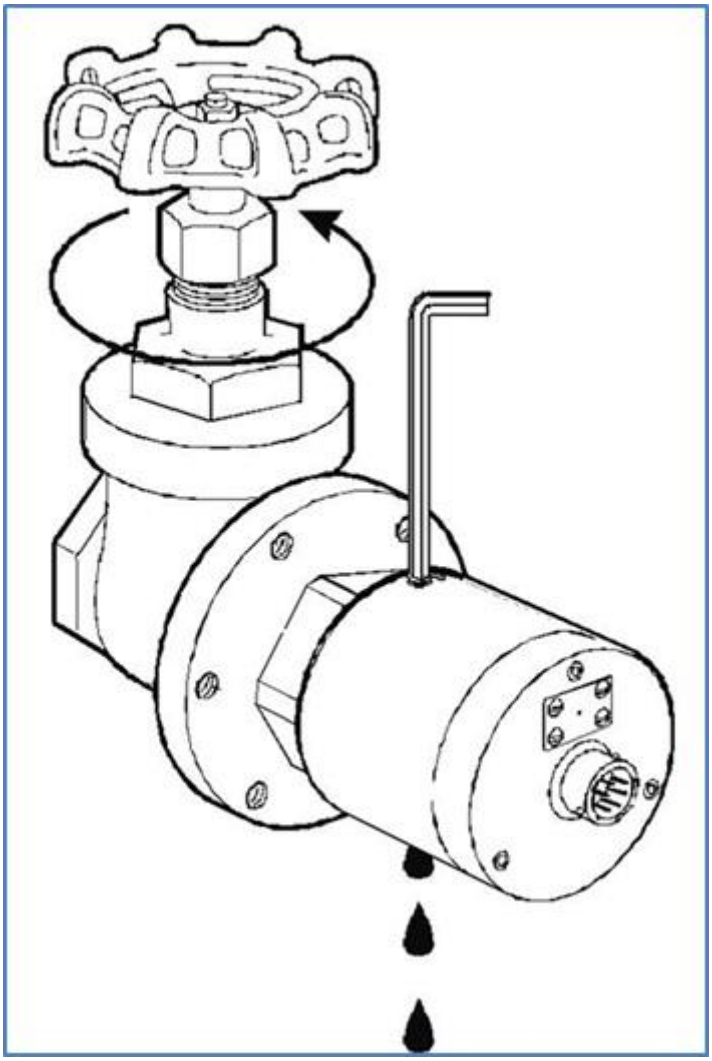


Figure 7-7: Purging Air from the Hydran 201 Sensor

7.3.7 Fastening the Hydran 201Ti to the Brass Adapter

1. Using the supplied 3/16-in Allen key, fasten the H201Ti's heating plate to the brass adaptor with the six 1/4-28 cap screws. See Figure 7-8 below.

CAUTION ***Be careful not to squeeze the nearby electrical wires between the lock washers and the heating plate or not to damage the supervisory link (and analog output) termination board.***

Note: When the H201Ti is installed horizontally, the terminals must be facing up and located under the sensor. Also, ensure that both the bleed screw and sampling port remain easy to access.

2. Plug the twist-lock female connector of the sensor cable to the male connector behind the Hydran 201 sensor,

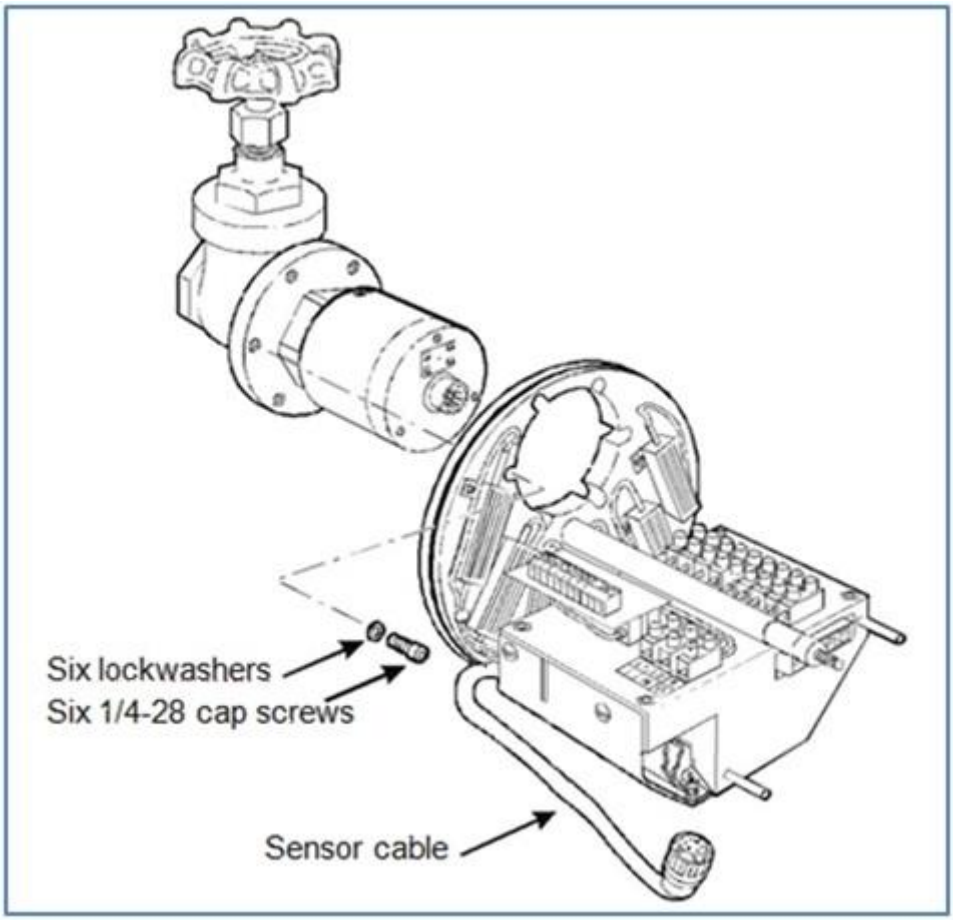


Figure 7-8: Fastening the Heating Plate to the Brass Adapter

7.3.8 Installing the Cable Conduits

Note the following considerations prior to installing:

- All cables connected to the Hydran 201T*i* must be run through steel conduits in accordance with local wiring regulations. Otherwise, armored cables can be used.

CAUTION ***All metallic conduits or cable shields must be connected to the ground at one point.***

- Flexible rather than rigid conduits should be used near the H201T*i* to ease installation and servicing.

- Conduits, or cable armors, should be made of steel to shield against magnetic fields.
- Non-conducting conduit fittings (made of plastic, for example) can be used on the connection box if ground loops through the conduits may cause problems (for example, if the transformer tank is grounded at a single point and monitored continuously for tank-to-ground currents).

The procedure is as follows:

1. Remove the cover from the connection box located under the brass adaptor.
2. As required, install one or two watertight conduit fittings (not supplied) onto the connection box.
   - One conduit is used to run the supervisory link cable (which connects the H201T*i* to the Hydran 201C*i* Controller) and, if used, the cable of the H201T*i*'s analog output.
   - One conduit is used to run the power supply cable and, if used, the cable of the H201T*i*'s alarm contacts.
3. Mount a conduit to each fitting.

Note: The AC power to the H201Ti can be supplied from the H201Ci-1 Controller (via terminals 4 to 6 of the main terminal block) or from a different source. The H201Ci-C does not have terminals used to supply power to the H201Ti.

4. Ground the conduits and/or cable shields at some point. Follow the company regulations meticulously.

WARNING

The H201Ti must always be grounded, even if the transformer tank is grounded at a single point and monitored for tank-to-ground currents.

7.3.9 Installing the Supervisory Link and Analog Output Cable

Note the following considerations prior to installing:

- The supervisory link cable is supplied only when the Hydran 201T*i* is part of a RS-485 daisy chain network or Hydran 201R Model *i* or is ordered with a Hydran 201C*i*-C Controller.
- A supervisory link cable connected to an H201C*i*-1 requires three twisted pairs and an overall shield.
- A supervisory link cable connected to an H201C*i*-C requires two twisted pairs and an overall shield.
- If, for special considerations, the H201T*i*'s analog output is used, select a cable with characteristics similar to the supervisory link cable but with an additional pair of wires.

The procedure is as follows:

1. Run the supervisory link cable into the conduit up to the H201C*i* Controller, where it will be connected later.
2. Ensure all wires are identified.
3. Connect the cable wires and shield to the H201T*i*'s supervisory link (and analog output) termination board. For wiring details, see Table D - 6 in Appendix D.
4. For the case when a local network of Hydran 201Ti has to be connected to the host computer: connect the RS-485 to USB converter to your PC USB port and to the Hydran 201 T*i* RS-485 port on the 201T*i* J4 Isolated Supervisory Link 6-Pin Connector: this connector is wired to the termination board. For wiring details, see Table D - 6 in Appendix D.

CAUTION

The H201Ti's operation may be affected if wires are not connected correctly. Be careful when installing and inserting each wire. Be sure to insert all strands in the terminal; strands that touch two terminals cause problems. Strip each wire to a maximum of 8 mm before installing it. Do not leave trims of metallic strands inside the H201Ti's enclosure.

5. Connect the analog output wires to the SCADA system.

7.3.10 Installing the Alarms Cable (Optional)

If the Hydran 201T*i*'s alarms are used, proceed as follows:

1. Run the alarms cable through the second conduit up to the H201T*i*.
2. Connect the cable to the H201T*i*'s Alarm Contacts 9-Terminal Block (item 12 in Figure 3-5). For wiring details, see Table D - 2 in Appendix D.
3. Connect the cable to the SCADA system.

7.3.11 Installing the AC Power Supply Cable

1. The power supply cable of the Hydran 201T*i* must be connected to an external circuit-breaker and the installation must comply with the regulations applicable for permanently connected equipment and in accordance with local wiring regulations.

CAUTION

The circuit-breaker must be located in close proximity to the equipment and must be easily accessible.

The circuit-breaker must be clearly identified with a label and marked as the disconnecting device for the equipment.

2. Run the three-wire ac power supply cable into the second conduit up to the Hydran 201T*i*.

3. Connect the cable to the H201T*i*'s terminals **L1/L**, **L2/N** and **E/G**. For wiring details, see Table D - 1.
4. Connect the other end of the cable to the power source.

*Note: The earth/ground terminal (**E/G**) must be connected to the power source ground (green wire) or directly to the transformer tank. See the special considerations regarding grounding at the beginning of Section 7.3.8.*

CAUTION

Never perform high-voltage tests (mega-ohm measurements using a Megger* instrument) on cables connected to an H201Ti or a Hydran 201Ci Controller. Never apply high voltages to the components of a Hydran 201i System, as they are equipped with surge protection devices that could be damaged by Megger* tests.

7.3.12 Installing the CPU Module

1. Align and carefully insert the CPU module on the central post of the Hydran 201T*i* until the connector (at the back of the module) is completely inserted in the mating connector.
2. Fasten the module with the two 6-32 screws (see Figure 7-9).

CAUTION

When fastening the CPU module, ensure not to bend the pins of the connector located between the CPU and I/O modules.

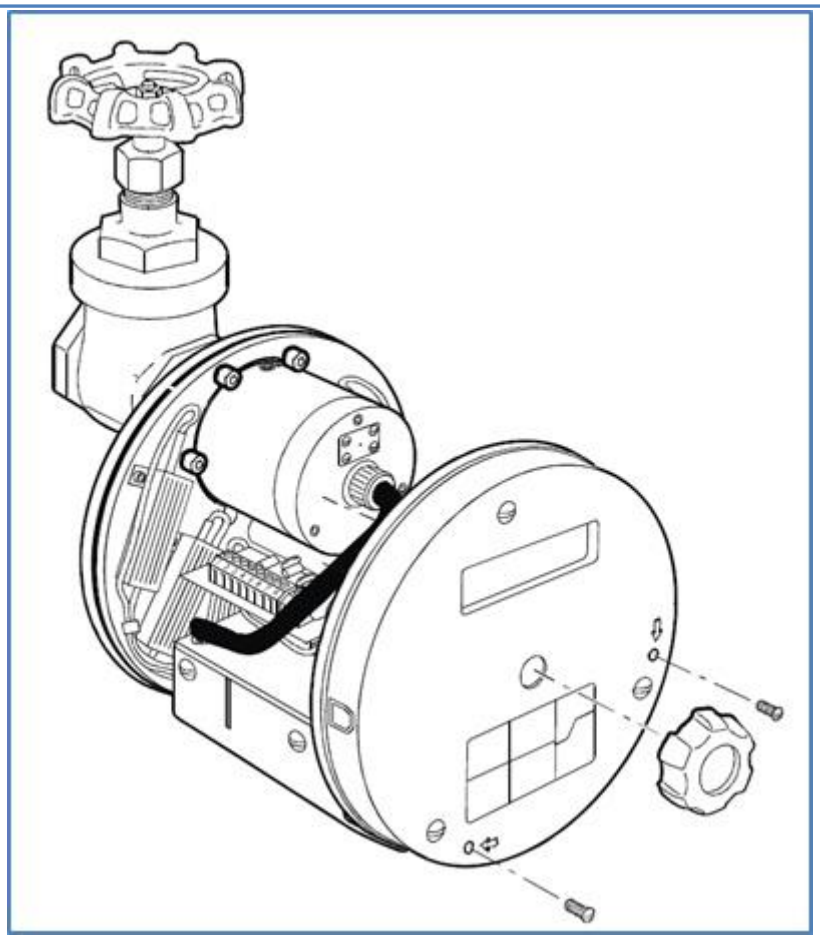


Figure 7-9: Installing the CPU Module

7.3.13 Verifying the Hydran 201Ti Operation

1. Power up the H201T*i*.
2. Perform the procedure described in Section 7.2.2.

7.4 Configuring the Hydran 201Ti

The H201T*i* can be configured using either its keypad or a host computer running the Hydran Host or Perception software (depending on the selected communication protocol). It is recommended to use the Hydran Host or Perception software because the configuration task is much easier. For details, see the *Hydran Host Software Manual or Perception User Manual*.

The H201T*i*'s user interface is described thoroughly in Section 5.1. The parameter verification detailed in the following pages is written for those who are using the H201T*i*'s keypad.

Note: The values indicated in this Section are only given as an indication and may differ from customer requirements. The value of the various parameters should be

decided during the planning stage of the installation. Ensure that all parameters are verified.

7.4.1 Setting the Comms Parameters for Hydran Host or Perception Software

Proceed as follows in order to use a host computer:

1. Connect the supplied USB cable to the Hydran 201T*i*'s USB Type B connector (see item 5 in Figure 3-2), located at the back of the CPU module.
2. Using the H201T*i*'s keypad, access the submenu **H201Ti Vx.xx; Communication**.
3. Press **ENTER** to access the parameter **CommChannel** (communication channel).
4. Set the parameter **CommChannel** to **Local USB** (for Hydran protocol) **or Local USB MODBUS** (for Modbus protocol).
5. Press **ENTER** to confirm the modification.
6. Press **END**.

*Note: Do not change the parameter **DefaultChannel**. The H201Ti unit will return automatically to the default channel if there is no communication during five minutes.*

7.4.2 Verifying and Setting Historical Data File Parameters

For details on the parameters and commands in the submenu **History**, see Section 5.5.1.

1. Access the submenu **H201Ti Vx.xx; History**.
2. Access the submenu **History; HistorySetup**.
3. Verify and set, as required, the Short Term logging rate and the four Long-Term logging hours.
4. Access **History; Clear Short Term**.
5. Press **ENTER** twice to erase the contents of the historic data file Short Term.
6. Access **History; Clear Long Term**.
7. Press **ENTER** twice to erase the contents of the historic data file Long Term.

CAUTION

Do not erase the contents of the historic data file Events, in order to keep a record of changes performed during the present configuration.

7.4.3 Verifying and Setting Gas and Trend Alarm Parameters

For details on the parameters and commands in the submenu **Gas**, see Section 5.5.2. The operation of the relays and alarms is explained in detail in Chapter 11.

1. Wait a minimum of 30 minutes after powering up the Hydran 201T*i* or until the level of dissolved gases in oil read by the H201T*i* is stable.

2. Access the submenu **H201Ti Vx.xx; Gas**.
3. Verify and set, as required, the 15 parameters (alarm set points and periods). Do not set the parameters **HourlyTr Period** and **DailyTr Period**

7.4.4 Resetting the Hourly Trend, Daily Trend and Period B

The hourly trend, daily trend and **Period B** are reset by changing the value of their *period* and then restoring them to their initial value after five minutes. Proceed as follows:

1. In the submenu **H201Ti Vx.xx; Gas**, access the submenu **Gas; HourlyTrend**.
2. Access the parameter **HourlyTr Period**.
3. Set this parameter to 1 hour.
4. In the submenu **H201Ti Vx.xx; Gas**, access the submenu **Gas;DailyTrend**.
5. Access the parameter **DailyTr Period**.
6. Set this parameter to 1 day.
7. In the submenu **H201Ti Vx.xx; Temperature**, access the submenu **Temperature; DynOil Sampl**.
8. Access the parameter **Period B**.
9. Set this parameter to 0 hour.
10. Wait five minutes and set these parameters to their default value:
    - **HourlyTr Period** to 24 hours
    - **DailyTr Period** to 30 days
    - **Period B** to 24 hours

For details on trend computations and reset, see Section 11.4.2.

7.4.5 Verifying and Setting the Temperature Parameters of the Hydran 201 Sensor

For details on the parameters and commands in the submenu **Temperature**, see Section 5.5.3.

1. Access the submenu **H201Ti Vx.xx; Temperature**.
2. Verify and set, as required, all parameters except **Period B**.

7.4.6 Verifying the Hydran 201 Sensor and its Parameters

For details on the parameters and commands in the submenu **Service**, see Section 5.5.4.

1. Access the submenu **H201Ti Vx.xx; Service**.
2. Access the submenu **Service; SensorCal Data**.
3. Ensure the displayed serial number, the ten parameters (**B**, **M**, **N**, **S** and **A1** to **A6**) and the checksum all correspond to the values on the Test Certificate and Data Sheet (for an example, see Figure 7-1).
4. Access the command **Force Sensor Test**.

5. Push **ENTER**. The message **Are You Sure?; Press Enter..** is now displayed.
6. Push **ENTER** again to confirm.
7. When asked to enter the password #1 (**1253**), use the **UP** and **ENTER** keys.
8. The message **Please wait...** appears, the test is executed (during a four-second countdown), and the Hydran 201T*i*'s display should indicate the message **Good**. If another message is displayed, see Section 13.1.3.

Note: The keypad cannot be used for two minutes following a sensor test. Wait before resuming the configuration.

7.4.7 Verifying and Setting the Battery Alarm Parameters

1. Access the submenu **H201Ti Vx.xx;Service**.
2. Access the submenu **Service;Battery**.
3. Verify the battery voltage (**Battery**). For details, see Section 7.1.4.
4. Verify and set, as required, the three alarm parameters.

7.4.8 Logging the Values of the Service Data

1. Access the submenu H201Ti Vx.xx;Service.
2. Access the submenu Service;ServiceData.
3. Write down the value of each parameter.

7.4.9 Verifying and Setting the Date and Time

For details on the parameters and commands in the submenu **Date&Time**, see Section 5.5.5.

1. Access the submenu **H201Ti Vx.xx;Date&Time**.
2. If required, set the parameters **Year**, **Month**, **Day**, **Hour** and **Minutes** to local values.

7.4.10 Verifying and Setting the Communications Parameters

For details on the parameters and commands in the submenu **Communication**, see Section 5.5.6.

1. Access the submenu **H201Ti Vx.xx; Communication**.
2. Verify and set, as required, the eight communication parameters (which can only be accessed from the Hydran 201T*i*'s keypad). Note the following considerations:
   - **Gas Monitor ID** (identification number of the H201T*i*): At least one H201T*i* in the local network must be set to an identification number from 1 to 5 inclusively. Each H201T*i* in the local network must have an exclusive number from 1 to 254.

- **PowerStat. ID** (identification number of the power station): All H201T*i*'s in the local network (power station) must be set to the same **PowerStat. ID** value. This number can vary from 1 to 9999.

3. To continue the installation using a host computer, run either the Hydran Host software (if 201T*i* is set to Hydran protocol) or Perception software (if Hydran *201Ti* is set to Modbus protocol) to define a local network using these identification numbers. See the *Hydran Host Software Manual or Perception User Manual*.

7.4.11 Verifying and Setting the Operation Mode of the Alarm Relays

For details on the parameters and commands in the submenu **Relays/Analog**, see Section 5.5.7. For details on relays, see Section 11.2.

1. Access the submenu **H201Ti Vx.xx; Relays/Analog**.
2. Verify and set, as required, the three **RelayMode** parameters.

7.4.12 Verifying and Setting the Fail Alarm Conditions

1. Access the submenu **SysOK Relay; FaultTrig**.
2. Verify and set, as required, the 16 trigger conditions of the Hydran 201T*i*'s fail alarm relay.

Note: An asterisk at the end of the display's bottom line indicates that the parameter is turned on (the fail alarm is triggered if this condition is detected). A space indicates that the parameter is off.

7.4.13 Verifying and Setting the Operation Mode of the Analog Output and TDM Signal

1. Access the submenu H201Ti Vx.xx; Relays/Analog.
2. Verify and set, as required, the parameters AnalogMode and TDM Mode.

7.4.14 Conclusion

If the configuration has been performed using a host computer connected to the USB connector located at the back of the CPU module, proceed as follows:

1. Access the submenu **Communication**.
2. Set the parameter **CommChannel** (communication channel) to **Supervisory Link** (for Hydran protocol) **or SuprvLink MODBUS** (for Modbus protocol).
3. Press **END** to return to the Main Display mode.

The Hydran 201T*i* configuration is now completed.

7.5 Fastening the Hydran 201Ti's Cover

Replace the H201T*i*'s aluminum cover as soon as the installation is completed.

1. Ensure the rubber washer is present on the central post.
2. Slide the cover over the H201T*i*.
3. Fasten the cover by tightening the knob. The breathing membrane must be facing down (at the "6 o'clock" position) if the H201T*i* is installed horizontally.

If connected to a Hydran 201C*i* Controller, the H201T*i* will later be used to test this Controller.

WARNING

When installing the cover, the knob must be tightened correctly. After the knob touches the cover, a minimum of two (2) more turns must be applied. Failure to do so may result in water ingress inside the enclosure.

7.6 Commissioning

1. Wait at least two hours for the Hydran 201T*i* to stabilize. The Hydran 201C*i* Controller(s) can be installed during this time.
2. Verify the H201T*i*'s accuracy by comparing its readings with a recent dissolved gas analysis (DGA).
3. If necessary and with the permission of the user, set the alarm set points again, this time according to the current level of dissolved gases in oil. See Section 11.4.1.

The installation of the H201T*i* is now completed. If properly installed and maintained, the H201T*i* provides many years of trouble-free service.

7.7 Other Installations

To install other components of the Hydran 201*i* System, please consult the following parts of this manual:

- Hydran 201C*i*-C: See Chapter 8.
- Hydran 201C*i*-1: See Chapter 9.
- Local network: See Section 10.5.
- Optional modem: See 10.6.

8 HYDRAN 201CI-C INSTALLATION

Please read the following Sections before proceeding with the installation:

- General warnings, in Section 6.1.
- Installation overview, in Section 6.2.

8.1 Incoming Inspection and Verification

It is strongly recommended that you verify the operation of the Hydran 201T*i*s and Hydran 201C*i* Controllers before their installation. This verification also confirms that no damage occurred during shipping and allows the user to become familiar with the Hydran 201*i* System. The Hydran 201C*i*-C installation procedure is described in Section 8.3.

8.1.1 Receiving and Unpacking

Upon receipt, the shipping box contains one pre-assembled Hydran 201C*i*-C.

1. Open the shipping box.
2. Remove the Test Certificate and Data Sheet (for an example, see Figure 7-1).
3. Carefully remove the H201C*i*-C from the box.

Note: Keep the packing material for storage or further shipment of the H201Ci-C.

8.1.2 Inspecting

Verify the Hydran 201C*i*-C completely as outlined below.

1. Inspect the enclosure for any visual damage (bump, scratch or others).
2. Open the enclosure door using a flat-blade screwdriver.
3. Verify the AC power supply voltage (indicated on the label inside the H201C*i*-C, near the power supply terminal block) corresponds to the power source voltage and the value on the Test Certificate and Data Sheet (for an example, see Figure 7-1). There are two possibilities:
   - 115 V, corresponding to 100–120 VAC 50/60 Hz
   - 230 V, corresponding to 200–240 VAC 50/60 Hz
4. Ensure the H201C*i*-C's serial number (indicated on the right internal side of the enclosure wall or on the back of the door) corresponds to those indicated on the Test Certificate and Data Sheet and on the shipping box.
5. Report any discrepancy to the company supervisor and the General Electric Customer Service (contact information can be found at the bottom of page 2).

Note: Never return equipment without first contacting the General Electric Customer Service.

8.1.3 Storage

If the Hydran 201C*i*-C is not installed immediately, it is strongly recommended to store it in its original shipping box in a safe place.

Storage should be at a temperature between 5 and 45°C (41 and 113°F) and a non-condensing, relative humidity between 5 and 95%; if these limits are to be exceeded, please contact the General Electric Customer Service (contact information can be found at the bottom of page 2). These restrictions do not apply to transportation.

8.2 Verification of Operation Prior to Installation

It is strongly recommended to verify the operation of the Hydran 201C*i*-C Controller(s) before installation in the field. The verification confirms that no damage occurred during shipping and allows the user to become familiar with the H201C*i*-C.

8.2.1 Preparation

To verify its operation, the Hydran 201C*i*-C must first be connected to at least one functional Hydran 201T*i* via a supervisory link cable. One end of this cable is already connected to the H201T*i*. For details on commissioning the H201T*i*(s), see Chapter 7.

Proceed as follows:

1. Connect a three-wire power cord to the AC Power 3-Terminal Block on the first H201T*i* (item 8 in Figure 3-4): The live side to **L1/L**, the other side to **L2/N**, and the ground to **E/G**. For additional wiring details, see Table D - 1.

WARNING

Disconnect power at disconnect switch or circuit breaker before making any electrical connections, and ensure a proper ground connection is made before connecting line voltage.

Failure to do so can result in property damage, personal injury and/or death.

2. Connect the second end of the two-pair supervisory link cable coming out of the H201T*i* to the main terminal block on the H201C*i*-C (item 5 in Figure 4-2).
3. Power On the H201T*i*.
4. Ensure the H201T*i* is operating normally and no gas or fail alarms are present, by looking at the small LED indicators on the right side of the I/O module (refer to Section 3.4.6.3).
5. Repeat the steps 1 to 4 above until all H201T*i*s are connected to the H201C*i*-C.
6. Connect a power cord to the AC Supply Connector on the H201C*i*-C (item 19 in Figure 4-3).
7. Power On the H201C*i*-C.
8. Repeat the steps 1 to 7 above until all H201C*i*-C's are fed.

8.2.2 Initial Observations

1. On each Hydran 201C*i*-C, verify the Supervisory Link Supply indicator (green, DS12; item 15 in Figure 4-3) is lit.
2. On each Hydran 201C*i*-C, look at the Heater indicator (yellow, DS8; item 13 in Figure 4-3):
   - The LED must initially be lit if the ambient temperature is below approximately 25°C (77°F).
   - After a while, the LED must flash as the enclosure temperature reaches the above set point.
   - The LED must remain off if the ambient temperature exceeds the set point.

8.2.3 Verification of RS-232 or USB and RS-485 Communications

If your installation includes only one Hydran 201*i* System and if it communicates with the host computer running the Hydran Host or Perception software, you must verify the RS-485 to USB converter or RS-232 link or USB link depending of which one is used. If your installation includes several Hydran 201*i* Systems forming a local RS-485 network, you must also verify the RS-485 local network link. Proceed as follows:

1. Put all Hydran C*i*-Cs in a common network by connecting the RS-485 LAN cable from one H201C*i*-C's RS-485 LAN connector (J11; item 11 in Figure 4-3) to the next in a daisy-chain fashion. Refer to Chapter 10
2. Ensure all Hydran 201T*i*'s and all H201C*i*-C's are connected together.
3. If Hydran Ci-C needs to be connected to the host computer: connect the DB-9 male RS-232 connector (item 2 in Figure 4-2 or J10; item 7 in Figure 4-3) or the female USB connector (item 3 in Figure 4-2 or J16; item 8 in Figure 4-3) of any H201C*i*-C on the network to your PC's RS-232 port or USB port. For wiring details, see Table D - 7.
4. In the **Communication** submenu of each H201T*i*, write down the current settings, in order to be able to restore them.
5. Set the parameters as follows:
   - **Comm Channel** = **Supervisory Link**
   - **DefaultChannel** = **Supervisory Link**
   - **Baud Rate** = **9600**
   - **Gas Monitor ID** = **1**

CAUTION

At least one H201Ti in a local network must be set with an identification number (Gas Monitor ID) from 1 to 5 inclusively. Each H201Ti in a local network must have an exclusive number from 1 to 254. The H201Tis are normally shipped with the Gas Monitor ID number set to 1.

6. Depending on the selected communication protocol, start the Hydran Host or Perception software on the PC. See the *Hydran Host Software Manual* or Perception User Manual for more information.
7. In the **Network Settings** menu of the Hydran Host software, set the network configuration to the **Gas Monitor ID** numbers that were assigned to each H201T*i* in the step 5 above.
8. In the **Setup** menu of the Hydran Host software, check the communication by accessing the H201T*i*(s). The Communications Status indicator (yellow, DS6; item 23 in Figure 4-3) flickers when the PC communicates with the H201T*i*(s).
9. In the **Network Survey** window of the Hydran Host software, verify the PC is communicating with each H201T*i* (there are no **Does not answer** warnings in the **Status** text boxes).
10. If the communication cannot be established:
    - Ensure the H201T*i* identification numbers entered in the Hydran Host software correspond to those entered in each H201T*i* (**Gas Monitor ID** parameters).
    - Verify the wiring of all supervisory link cables.
    - Verify the wiring of the RS-485 local network link.
    - Finally, disconnect the RS-485 link cable from all H201C*i*s and reinstall the local network, one H201C*i* at a time.
11. In the **Relays/Analog** window of the Hydran Host software, change the **Relay Mode** of each relay from **Force OFF** to **Force ON** and back; this should change the state of the alarm relays from **On** to **Off**, thus confirming good communications through the supervisory links. Following each step:
    - Verify the state of the **H**, **HH** and **OK** LED's on each H201T*i*.
    - Ensure the Communications Status indicator (yellow, DS6; item 23 in Figure 4-3) flickers inside each H201C*i*-C when the host computer communicates with any H201T*i* of the H201C*i*-C.
12. When the test is completed, in the **Relays/Analog** window of the Hydran Host software, restore the **Relay Mode** of each relay to **Normal**.
13. Disconnect all communication cables (supervisory links, RS-485 LAN and RS-232 or USB to the PC).
14. Restore the original communication settings in each H201T*i* as noted in the step 4 above.

8.2.4 Completing the Verification

This completes the incoming verification of the Hydran 201C*i*-C.

1. Disconnect all the H201T*i*s from the power outlets.
2. Disconnect all the H201C*i*-Cs from the power outlets.
3. Remove all supply cables.
4. Remove all communication cables.
5. Store the H201T*i*s and the H201C*i*-Cs in their respective boxes, ready for installation.
6. If the H201T*i*s are not installed immediately, refer to Section 7.1.4.
7. If the H201C*i*-Cs are not installed immediately, refer to Section 8.1.3.

8.3 Installation

This Section explains how to install the Hydran 201C*i*-C Controller.

CAUTION

Read all the warnings and recommendations in Section 6.1 (General Warnings) before proceeding with the installation.

Note: It is strongly recommended that the operation of all H201Ti's and H201Ci Controllers be verified before installation of the equipment in the field. Verification also allows the user to become familiar with the Hydran 201i System.

WARNING

All procedures in this manual must be strictly adhered to. Any deviation from these could cause irreversible damage to the transformer being monitored and/or the Hydran 201 i System, and could lead to property damage, personal injury and/or death.

Installation and maintenance of the Hydran 201i System must be carried out by qualified personnel only.

The H201C*i*-C is equipped with a Type NEMA 4X enclosure and internal heating; it can thus be installed outdoor.

8.3.1 Verifying the AC Power Supply Voltage and the Serial Numbers

Ensure steps 3 and 4 on page 122 have been performed.

8.3.2 Installing the Enclosure

Prepare the installation location of the Hydran 201C*i*-C. Read the recommend-dations in Section 6.2.3.

The H201C*i*-C must be mounted on a vibration-free structure. If vibrations are present, use vibration-absorbing rubber pads (Figure 2-5), which can be purchased from General Electric.

8.3.3 Installing the Cable Conduits

Note the following considerations prior to installing:

- All cables connected to the Hydran 201C*i*-C must be run through steel conduits. Otherwise, armored cables can be used.

- Flexible rather than rigid conduits should be used near the H201C*i*-C to ease installation and servicing.
- Conduits, or cable armors, should be made of steel to shield against magnetic fields.

The procedure is as follows:

1. Remove the rubber plugs from the required openings of the H201C*i*-C enclosure.
2. For each cable being used, install a standard, watertight conduit fitting (not supplied). Up to eight conduits may be installed (supervisory links, AC power supply).
3. Mount a conduit to each fitting.
4. Ground the conduits and/or cable shields at some point. Follow the company regulations meticulously.

8.3.4 Installing the Supervisory Link Cables

Note: The supervisory link cables have already been run into conduits up to the Hydran 201Ci-C if the installation of the Hydran 201Ti's is completed (see Section 7.3.9).

1. If required, trim the excess length from the end of the supervisory link cables to be wired into the H201Ci-C.

Note: The total maximum length of all supervisory link cables connected to one H201Ci-C is 1,200 m (4,000 ft).

2. Ensure the four wires of each cable have been labeled (for identification purposes) at both ends.
3. Connect the wires and shield of one cable to one of the four H201Ci-C's termination boards. For wiring details, see Table D - 8 in Appendix D.

Note: The shield is grounded through a capacitor at the H201Ti end to protect against radiofrequency interference. Shields must also be directly grounded at the H201Ci-C's termination board.

CAUTION

The H201Ci-Cs operation may be affected if wires are not connected correctly. Be careful when installing and inserting each wire. Be sure to insert all strands in the terminal; strands that touch two terminals cause problems. Strip each wire to a maximum of 8 mm before installing it. Do not leave trims of metallic strands inside the H201Ci-Cs enclosure

4. Repeat the step 3 above for each supervisory link cable (the installation order is not important).

8.3.5 Installing the AC Power Supply

1. The power supply cable of the Hydran 201Ci-C must be connected to an external circuit-breaker in accordance with local wiring regulations.

CAUTION

The circuit-breaker must be located in close proximity to the equipment and must be easily accessible.

The circuit-breaker must be clearly identified with a label and marked as the disconnecting device for the equipment.

2. Run the three-wire ac power supply cable through a conduit up to the Hydran 201C*i*-C.
3. Connect the cable to the H201C*i*-C's **L1/L** and **L2/N** terminals, and connect the **E/G** wire to the enclosure chassis. For wiring details, see Table D - 8 in Appendix D.
4. Connect the other end of the cable to the power source.

*Note: The earth/ground terminal (**E/G**) must be connected.*

CAUTION

Never perform high-voltage tests (mega-ohm measurements using a Megger* instrument) on cables connected to an H201Ti or a Hydran 201Ci Controller. Never apply high voltages to the components of a Hydran 201i System, as they are equipped with surge protection devices that could be damaged by Megger* tests.

8.3.6 Verifying the Operation

Proceed as described in Section 8.2.1 and Section 8.2.2.

8.3.7 Verifying the Supervisory Link Communications

Verify communications between the Hydran 201C*i*-C and the Hydran 201T*i*(s) using a host computer running the Hydran Host software. Proceed as described in Section 8.2.3 and Section 7.2.9.

8.3.8 Conclusion

The installation of the Hydran 201C*i*-C is now completed.

8.4 Other Installations

To install other components of the Hydran 201*i* System, please consult the following Sections:

- Local network: See Section 10.5.
- Optional modem: See Section 10.6.

9 HYDRAN 201CI-1 INSTALLATION

Please read the following Sections before proceeding with the installation:

- General warnings, in Section 6.1.
- Installation overview, in Section 6.2.

9.1 Incoming Inspection and Verification

It is strongly recommended that you verify the operation of the Hydran 201T*i*s and Hydran 201C*i* Controllers before their installation. This verification also confirms that no damage occurred during shipping and allows the user to become familiar with the Hydran 201R Model *i* System. The Hydran 201C*i*-1 installation procedure is described in Section 9.3.

9.1.1 Receiving and Unpacking

Upon receipt, the shipping box contains one pre-assembled Hydran 201C*i*-1.

1. Open the shipping box.
2. Remove the Test Certificate and Data Sheet (for an example, see Figure 7-1).
3. Carefully remove the H201C*i*-1 from the box.

Note: Keep the packing material for storage or further shipment of the H201Ci-1.

9.1.2 Inspecting

Verify the Hydran 201C*i*-1 completely as outlined below.

1. Inspect the enclosure for any visual damage (bump, scratch or others).
2. Open the enclosure door using a flat-blade screwdriver.
3. Verify the AC power supply voltage (indicated on the label inside the H201C*i*-1, near the power supply terminal block) corresponds to the power source voltage and the value on the Test Certificate and Data Sheet (for an example, see Figure 7-1). There are two possibilities:
   - 115 V, corresponding to 100–120 VAC 50/60 Hz
   - 230 V, corresponding to 200–240 VAC 50/60 Hz
4. Ensure the H201C*i*-1's serial number (indicated on the right internal side of the enclosure wall or on the back of the door) corresponds to those indicated on the Test Certificate and Data Sheet and on the shipping box.
5. Report any discrepancy to the company supervisor and the General Electric Customer Service (contact information can be found at the bottom of page 2).

Note: Never return equipment without first contacting the General Electric Customer Service.

9.1.3 Storage

If the Hydran 201C*i*-1 is not installed immediately, it is strongly recommended to store it in its original shipping box in a safe place. Ensure that the door-mounted push-buttons are covered with the protective caps.

Storage should be at a temperature between 5 and 45°C (41 and 113°F) and a non-condensing, relative humidity between 5 and 95%; if these limits are to be exceeded, please contact the General Electric Customer Service (contact information can be found at the bottom of page 2). These restrictions do not apply to transportation.

9.2 Verification of Operation Prior to Installation

It is strongly recommended that you verify the operation of the Hydran 201C*i*-1 Controller before installation in the field. The verification confirms that no damage occurred during shipping and allows the user to become familiar with the H201C*i*-1.

9.2.1 Preparation

To verify its operation, the Hydran 201C*i*-1 must first be connected to a functional Hydran 201T*i* via a supervisory link cable. One end of this cable is already connected to the H201T*i*. For details on commissioning the H201T*i*(s), see Chapter 7.

Proceed as follows:

1. Connect a three-wire power cord to the AC Power 3-Terminal Block on the first H201T*i* (item 8 in Figure 3-4): The live side to **L1/L**, the other side to **L2/N**, and the ground to **E/G**. For additional wiring details, see Table D - 1.
2. Connect the second end of the three-pair supervisory link cable coming out of the H201Ti to the main terminal block on the H201Ci-C (item 6 in Figure 4-6).
3. Power On the H201T*i*.
4. Ensure the H201T*i* is operating normally and no gas or fail alarms are present, by looking at the small LED indicators on the right side of the I/O module (refer to Section 3.4.6.3).
5. Connect a power cord to the terminals 1 and 2 on the main terminal block of the H201Ci-1 (item 6 in Figure 4-6) and connect the E/G wire to the enclosure chassis.
6. Power On the H201C*i*-1.

9.2.2 Initial Observations

1. Verify the Hydran 201C*i*-1's display is not blank. If it remains blank, the possible causes are as follows:
   - If the fail alarm is triggered, read the alarm message on the Hydran 201T*i*'s display to identify the cause of the alarm. Then see Chapter 13.
   - Verify the connections at both ends of the supervisory link cable.
   - Verify the fuse(s) and the ac power supply of the H201C*i*-1 and H201T*i*.
   - Verify the operation of the H201C*i*-1's display.
2. Verify the H201C*i*-1's display shows the same ppm value as the H201T*i*'s scrolling gas level display. A discrepancy of ± 2 ppm is acceptable.
3. Inside the H201C*i*-1, verify the Supervisory Link Supply indicator (green, DS12; item 17 in Figure 4-7) is lit.
4. Inside the H201C*i*-1, look at the Heater indicator (yellow, DS8; item 13 in Figure 4-7):
   - The LED must initially be lit if the ambient temperature is below approximately 25°C (77°F).
   - After a while, the LED must flash as the enclosure temperature reaches the above set point.
   - The LED must remain off if the ambient temperature exceeds the set point.

5. Since there are no alarm conditions present in the H201T*i*, verify the following points on the H201C*i*-1:
   - The Gas High alarm indicator of the door-mounted push-button **1** (item 2 in Figure 4-5) is off.
   - The Gas High-High alarm indicator of the door-mounted push-button **2** (item 2 in Figure 4-5) is off.
   - The Alarm 1 (Gas High) indicator (yellow, DS10; item 15 in Figure 4-7) is off.
   - The Alarm 2 (Gas High-High) indicator (yellow, DS9; item 14 in Figure 4-7) is off.
   - The System OK indicator (yellow, DS11; item 16 in Figure 4-7) is lit.

9.2.3 Verifying the Analog Output

The Hydran 201Ci-1 is equipped with an isolated, analog 4–20 mA output. Table 5-7 lists the electrical currents that should be generated and the values that should be displayed for each operation mode.

1. Proceed as follows: Connect a dc digital ammeter with 1% accuracy and a 0.01mA resolution to the main terminal block on the H201C*i*-1 (item 6 in Figure 4-6).
2. Connect the positive lead on the pin 17 of the main terminal block.
3. Connect the negative lead on the pin 18 of the main terminal block.
4. On the Hydran 201T*i*'s display, access the top of the extended menu by pushing **ENTER** twice (**History** appears).

Note: Once accessed, the extended menu times out after 30 minutes of keypad inactivity.

5. Push **DOWN** six times until **Relays/Analog** appears.
6. Access this menu by pushing **ENTER**.
7. Push **DOWN** until **TDM Pulse Out** appears.
8. Push **ENTER**.
9. Push **DOWN** until **TDM Out Mode** appears.
10. Push **ENTER**. The value should be **Normal**.
11. Modify the **TDM Out Mode** by pushing **CHANGE**.
12. When asked to enter the password #1 (**1253**), use the **UP**, **DOWN** and **ENTER** keys.
13. Use the **UP**, **DOWN** and **ENTER** keys to force the output to **0%**.
14. Allow about one minute for the output to stabilize.
15. Verify the H201C*i*-1's display reads 0 ± 2ppm.
16. Verify the ammeter reads 4.00 ± 0.10mA.
17. Use the **UP**, **DOWN** and **ENTER** keys to force the output to **50%**.
18. Allow about one minute for the output to stabilize.
19. Verify the H201C*i*-1's display reads 1000 ± 5ppm.
20. Verify the ammeter reads 12.00 ± 0.20mA.
21. Use the **UP**, **DOWN** and **ENTER** keys to force the output to **100%**.
22. Allow about one minute for the output to stabilize.
23. Verify the H201C*i*-1's display reads 1999 ppm.

Note: The maximum value of the Hydran 201Ci- 1's display scale is 1999ppm. If the signal is over scale, the display indicates ***1...*** *when the operation mode is set to* ***Force 100%****.*

24. Verify the ammeter reads 20.00 ± 0.40mA.
25. Use the **UP**, **DOWN** and **ENTER** keys to force the output to **Off**.
26. Verify that:
    - The H201C*i*-1's display is blank.
    - The analog output drops to 0.00 ± 0.10 mA.
    - The System OK indicator (yellow, DS11; item 16 in Figure 4-7) is off.
27. Use the **UP**, **DOWN** and **ENTER** keys to return the output to **Normal**.
28. Verify the signal of the analog output returns to its former value.
29. When all is done, push **END**.
30. Disconnect the ammeter.

9.2.4 Verifying the Alarm Indicators and Relays

The steps described in this Section may be used during the Hydran 201C*i*-1 verification, maintenance and troubleshooting procedures; certain steps may therefore not apply to your particular situation. Perform all procedures (from Section 9.2.4.1 to Section 9.2.4.6.

The alarm relays are verified by observing the LED's on the H201C *i*-1's circuit board and by connecting an ohmmeter to the main terminal block on the H201C*i*-1 (item 6 in Figure 4-6).

9.2.4.1 Gas High Alarm

1. In the Hydran 201T*i*, access the submenu **H201Ti Vx.xx;Relays/Analog**.
2. Access the submenu **Relays/Analog;GasH Relay**.
3. Set the parameter **RelayMode** of the Gas High relay to **On**.
4. On the H201C*i*-1, verify that:
   - The door-mounted **1** push-button indicator is lit.
   - The Alarm 1 (Gas High) indicator (yellow, DS10; item 15 in Figure 4-7) is lit.
   - The **Alarm 1** NO contact is closed.
   - The **Alarm 1** NC contact is open.
   - Other LED indicators and contacts have not changed from their previous state.
   - If connected, the supervisory control and data acquisition (SCADA) system has detected the alarm.

*Note: Pushing the **1** push-button to acknowledge the gas alarm condition should not turn off the indicator since the condition has not cleared.*

9.2.4.2 Gas High-High Alarm

1. Access the submenu **Relays/Analog;GasHH Relay**.
2. Set the parameter **RelayMode** of the Gas High-High relay to **On**.
3. On the H201C*i*-1, verify that:
   - The door-mounted 2 push-button indicator is lit.
   - The Alarm 2 (Gas High-High) indicator (yellow, DS9; item 14 in Figure 4-7) is lit.
   - The **Alarm 2** NO contact is closed.
   - The **Alarm 2** NC contact is open.
   - Other LED indicators and contacts have not changed from their previous state.
   - If connected, the SCADA system has detected the alarm.

Note: Pushing the 2 push-button to acknowledge the gas alarm condition should not turn off the indicator since the condition has not cleared.

9.2.4.3 System Fault Alarm

1. Access submenu **Relays/Analog;SysOK Relay**.
2. Set the parameter **RelayMode** of the System Fault relay to **Off**.
3. On the H201C*i*-1, verify that:
   - The display goes blank.
   - The two door-mounted push-button indicators (1 and 2) remain lit.
   - The System OK indicator (yellow, DS11; item 16 in Figure 4-7) turns off.
   - The **System OK** alarm NO contact is open.
   - The **System OK** alarm NC contact is closed.

- The gas alarm indicators (yellow DS9 and DS10) and contacts are restored to their normal state (no alarm condition).
- If connected, the SCADA system has detected the alarm.

Note: Pushing both push-buttons to acknowledge the gas alarm conditions should turn off the indicators since the conditions are cleared during a system fault.

9.2.4.4 System Fault Alarm Cleared

1. Set the same **RelayMode** parameter to **Normal**.
2. On the H201C*i*-1, verify that:
   - The H201C*i*-1's display is functional again.
   - The two door-mounted push-button indicators (**1** and **2**) are lit because the gas alarm conditions still exist.
   - The System OK indicator (yellow, DS11; item 16 in Figure 4-7) is lit.
   - The **System OK** alarm NO contact is closed.
   - The **System OK** alarm NC contact is open.
   - If connected, the SCADA system has detected the state change of the fail alarm relay.

Note: Pushing both push-buttons to acknowledge the gas alarm conditions should not turn off the indicators since the conditions are not cleared.

9.2.4.5 Gas Alarms Cleared

1. Access the submenu **Relays/Analog;GasH Relay**.
2. Set the parameter **RelayMode** of this relay to **Normal**.
3. Access the submenu **Relays/Analog;GasHH Relay**.
4. Set the parameter **RelayMode** of this relay to **Normal**.
5. On the H201C*i*-1, verify that:
   - The two door-mounted push-button indicators (**1** and **2**) remain lit.
   - The Alarm 1 (Gas High) indicator (yellow, DS10; item 15 in Figure 4-7) is off.
   - The Alarm 2 (Gas High-High) indicator (yellow, DS9; item 14 in Figure 4-7) is off.
   - The System OK indicator (yellow, DS11; item 16 in Figure 4-3) is lit.
   - The **Alarm 1** NO contact is open.
   - The **Alarm 1** NC contact is closed.
   - The **Alarm 2** NO contact is open.
   - The **Alarm 2** NC contact is closed.
   - The **System OK** alarm NO contact is closed.
   - The **System OK** alarm NC contact is open.
   - If connected, the SCADA system has detected the state change of both gas alarm relays.

Note: Pushing both buttons to acknowledge the gas alarm conditions should turn off the indicators since the conditions have been cleared.

9.2.4.6 Conclusion

If necessary, set the parameter **RelayMode** of each alarm relay to their initial mode.

9.2.5 Verifying the RS 232 or USB Communications

If your installation includes only one Hydran 201R Model *i* and if it communicates with the host computer running the Hydran Host or Perception software, you must verify the RS-232 link or USB link depending which one is used. Proceed as follows:

1. Connect the Hydran 201C*i*-1's RS-232 Computer Port connector (J10; item 7 in Figure 4-7) to your PC's RS-232 port. For wiring details, see Table D - 13. For USB users, connect the Hydran 201C*i*-1's USB Computer Port connector (J16; item 8 in Figure 4-7) to your PC's USB port.
2. In the **Communication** submenu of the Hydran 201T*i*, write down the current settings, in order to be able to restore them.
3. Set the parameters as follows:
   - **Comm Channel** = **Supervisory Link**
   - **Default Channel** = **Supervisory Link**
   - **Baud Rate** = **9600**
   - **Gas Monitor ID** = **1**
4. To establish the communication and depending on the protocol configured in the 201T*i* devices, start the Hydran Host or Perception software on the PC. See the *Hydran Host Software Manual or Perception User Manual* for more information.
5. If the communication cannot be established:
   - Ensure the H201T*i* identification number entered in the Hydran Host software corresponds to the one entered in the H201T*i* (**Gas Monitor ID** parameter).
   - Verify the wiring of the supervisory link cable.
   - Verify the configuration of the Hydran Host software. See the *Hydran Host Software Manual or Perception User Manual* for more information.
6. Disconnect all communication cables (supervisory link and RS-232 or USB to the PC).
7. When the test is completed, restore the original communication settings in the H201T*i* as noted in the step 2 above.

9.2.6 Conclusion

This completes the incoming verification of the Hydran 201C*i*-1.

1. Disconnect the H201T*i* from the power outlet.
2. Disconnect the H201C*i*-1 from the power outlet.

3. Remove all supply cables.
4. Remove all communication cables.
5. Store the H201T*i* and the H201C*i*-1 in their respective boxes, ready for installation.
6. If the H201T*i* is not installed immediately, refer to Section 7.1.4.
7. If the H201C*i*-1 is not installed immediately, refer to Section 9.1.3.

9.3 Installation

This Section explains how to install the Hydran 201C*i*-1 Controller.

CAUTION ***Read all the warnings and recommendations in Section 6.1 (General Warnings) before proceeding with the installation.***

Note: It is strongly recommended that the operation of all H201Ti's and H201Ci Controllers be verified before installation of the equipment in the field. Verification also allows the user to become familiar with the Hydran 201R Model i.

WARNING

All procedures in this manual must be strictly adhered to. Any deviation from these could cause irreversible damage to the transformer being monitored and/or the Hydran 201R Model i, and could lead to property damage, personal injury and/or death. Installation and maintenance of the Hydran 201R Model i must be carried out by qualified personnel only.

The H201C*i*-1 is equipped with a Type NEMA 4X enclosure and internal heating; it can thus be installed outdoor.

9.3.1 Verifying the AC Power Supply Voltage and the Serial Numbers

Ensure steps 3 (AC power supply) and 4 (serial number) in section7.1.3 have been performed.

9.3.2 Installing the Enclosure

Prepare the installation location of the Hydran 201C*i*-1. Read the recommenda-tions in Section 6.2.3.

The H201C*i*-1 must be mounted on a vibration-free structure. If vibrations are present, use vibration-absorbing rubber pads (Figure 2-5), which can be purchased from General Electric.

9.3.3 Installing the Cable Conduits

Note the following considerations prior to installing:

- All cables connected to the Hydran 201C*i*-1 must be run through steel conduits in accordance with local wiring regulations. Otherwise, armored cables can be used.

- Flexible rather than rigid conduits should be used near the H201C*i*-1 to ease installation and servicing.
- Conduits, or cable armors, should be made of steel to shield against magnetic fields.

The procedure is as follows:

1. Remove the rubber plugs from the required openings of the H201C*i*-1 enclosure.
2. For each cable being used, install a standard, watertight conduit fitting (not supplied). Up to six conduits may be installed (supervisory links, AC power supply and analog outputs).
3. Mount a conduit to each fitting.
4. Ground the conduits and/or cable shields at some point. Follow the company regulations meticulously.

9.3.4 Installing the Supervisory Link Cable

Note: The supervisory link cable has already been run into conduits up to the Hydran 201Ci-1 if the installation of the Hydran 201Ti is completed (see Section 7.3.9).

1. If required, trim the excess length from the end of the supervisory link cable from the H201T*i*.

Note: The total maximum length of the supervisory link cable connected to one H201Ci-1 is 1,200 m (4,000 ft).

2. Ensure the six have been labeled (for identification purposes) at both ends.
3. Connect the cable wires and shield to the H201Ci-1's termination board. For wiring details, see Table D - 11.

Note: The shield is grounded through a capacitor at the H201Ti end to protect against radiofrequency interference. Shields must also be directly grounded at the H201Ci-1's termination board.

CAUTION

The H201Ci-1's operation may be affected if wires are not connected correctly. Be careful when installing and inserting each wire. Be sure to insert all strands in the terminal; strands that touch two terminals cause problems. Strip each wire to a maximum of 8 mm before installing it. Do not leave trims of metallic strands inside the H201Ci-1's enclosure

9.3.5 Installing the Analog Output Cable (Optional)

Perform this procedure only if the Hydran 201C*i*-1's isolated, analog 4–20 mA output is used.

1. Run an instrumentation-grade cable (twisted pairs with individual and overall shields) through a conduit up to the H201C*i*-1, or use an armored cable.

Note: The shield must be grounded at one end only.

2. Connect the cable to the main terminal block. For wiring details, see Table D - 11.
3. Connect the cable to the SCADA system.

9.3.6 Installing the Alarms Cable (Optional)

Perform this procedure only if the Hydran 201C*i*-1's alarms are used.

1. Run the alarms cable through a conduit up to the SCADA system.
2. Connect the cable to the alarm contacts (terminals 7 to 15) of the main terminal block. For wiring details, see Table D - 11.

Note: Do not switch heavy loads. See the relay ratings in Table D - 11.

3. Connect the cable to the SCADA system.

9.3.7 Installing the AC Power Supply Cable

1. The power supply cable of the Hydran 201Ci-1 must be connected to an external circuit-breaker and the installation must comply with the regulations applicable for permanently connected equipment in accordance with local wiring regulations.

CAUTION

The circuit-breaker must be located in close proximity to the equipment and must be easily accessible.

The circuit-breaker must be clearly identified with a label and marked as the disconnecting device for the equipment.

2. Run the three-wire ac. power supply cable through a conduit up to the Hydran 201C*i*-1.
3. Connect the cable to terminals 1 and 2 of the main terminal block, and connect the **E/G** wire to the enclosure chassis. For wiring details, see Table D - 11.
4. Connect the other end of the cable to the power source.

WARNING

Turn off the electric power at the switch or circuit breaker provided for disconnection before making any electrical connections, and ensure a proper ground connection is made before connecting line voltage. Failure to do so can result in property damage, personal injury and/or death.

5. If desired, connect the H201T*i*'s ac power supply cable to terminals 4 to 6 of the main terminal block.

CAUTION

The earth/ground terminal (terminal 3) must be connected. Never perform high-voltage tests (mega-ohm measurements using a Megger* instrument) on cables connected to a Hydran 201Ti or a Hydran 201Ci Controller. Never apply high voltages to the components of a Hydran 201R Model i, as they are equipped with surge protection devices that could be damaged by Megger* tests.

9.3.8 Verifying the Operation

Proceed as described in Section 9.2.1 and Section 9.2.2.

9.3.9 Verifying the Analog Outputs

Perform this procedure only if the Hydran 201C*i*-1's analog outputs are used (connected to a SCADA system).

Proceed as described in Section 9.2.3.

9.3.10 Verifying the Alarm Indicators and Alarm Relays

Proceed as described in Section 9.2.4.

9.3.11 Verifying the Supervisory Link Communications

Verify communications between the Hydran 201C*i*-1 and the Hydran 201T*i* using a host computer running the Hydran Host software.

Proceed as described in Section 9.2.5.

9.3.12 Conclusion

The installation of the Hydran 201C*i*-1 is now completed

9.4 Other Installations

To install other components of the Hydran 201R Model *i*, please consult the following Sections:

- Local network: See Section 10.5.
- Optional modem: See Section 10.6.

10 COMMUNICATIONS & NETWORKING

There are many possible configurations of Hydran 201T*i* Intelligent Transmitters:

- It can be used alone.
- It can be combined with a Hydran 201C*i*-1 One-Channel Controller (see Section 4.2) to form a Hydran 201R Model *i*.
- From one to four H201T*i*'s can be combined with a Hydran 201C*i*-C Communications Controller (see Section 4.1) to form a Hydran 201*i* System.

The following Sections describe:

- Communications within a Hydran 201R Model *i* or a Hydran 201*i* System, using a supervisory link: See Section 10.1.
- Communications in a network, using an RS-485 local network link: See Section 10.2.
- Communications with a host computer, using an RS-232 or USB serial communication link: See Section 10.3.
- Communication protocol: See Section 10.4.
- Installation of a local network: See Section 10.5.
- Installation of an optional modem: See Section 10.5.

10.1 Communications for Hydran 201R Model i or Hydran 201i System, Using a Supervisory Link

In a Hydran 201R Model *i* or a Hydran 201*i* System, each Hydran 201T*i* is linked to its Hydran 201C*i* Controller using a cable referred to as *supervisory link*.

Note the following points:

- The total length of all supervisory link cables connected to a single H201C*i* must not exceed 1,200m (4,000ft).
- The supervisory link uses a four- or six-wire shielded cable:
  - One shielded pair for the supervisory link's 15-Vdc power supply (unregulated and impedance-protected).
  - One shielded pair to transmit serial communications.
  - *For the Hydran 201Ci-1 only*: One shielded pair for the TDM (time division multiplexing) signal transmitted by the H201T*i* (see Section 10.1.1).
- Each supervisory link is electrically isolated and protected (2,000V RMS optocouplers, gas arresters, capacitors and tranzorbs) to withstand at both ends (H201T*i* and H201C*i*) surges up to 2,000V RMS as well as the large noise transients and ground potential differences typically found in electrical substations.
- Bidirectional data communication is transparently passed by the H201C*i* between the supervisory link port, the RS-485 LAN connector and the RS-232 Computer Port or USB connector. The communication path is half-duplex (one direction at a time, from a single talker).

The supervisory link cable can be connected at the following locations:

- In the H201T*i*: To the Supervisory Link and Analog Output Termination Board (item 9 in Figure 3-4).
- In the H201C*i*-C: To the terminals 21 to 24 of the Main Terminal Block (item 5 in Figure 4-2).
- In the H201C*i*-1: To the terminals 21 to 24 of the Main Terminal Block (item 6 in Figure 4-6).

10.1.1 TDM Pulse

The TDM pulse is used *only* with the Hydran 201C*i*-1 Controller to transfer two pieces of information from the Hydran 201T*i* to the H201C*i*-1 itself:

- *Actual dissolved gas level*: This analog signal varies from 0 to 100% (0 to 2,000ppm) with a resolution of 1 part in 4,000.
- *Alarm relays status*: This digital information has four possible values, namely Normal, High, High-High and Fail.

The relationship between the alarm relay states and the status of the H201T*i*, of the TDM signal and of the H201C*i*-1 is shown in Table 10-1 below.

Alarm	Hydran 201T*i*[a]				Sup Link[a]	TDM[a] Signal	Hydran 201C*i*-1[a]				
	AC power	Relays					AC power	Relays			ppm Display
		Fail[b]	H	HH				Fail[b]	H	HH	
None	OK	On	Off	Off	OK	Normal	OK	On	Off	Off	On
H	OK	On	On	Off	OK	H	OK	On	On	Off	On
H-H	OK	On	-	On	OK	H-H	OK	On	On	On	On
Fail	OK	Off	-	-	OK	Fail	OK	OK	Off	Off	Off
-	-	-	-	-	Broken	Fail	OK	Off	Off	Off	Off
-	-	-	-	-	-	-	Out	Off	Off	Off	Off
-	Out	Off	Off	Off	-	-	-	Off	Off	Off	Off

a. - = without consequence; H = High Alarm; HH = High-High Alarm; Sup = Supervisory.
b. On = Normal (no alarm); Off = Alarm

Table 10-1: Alarm Relay States and Status of the H201Ti, TDM Signal and H201Ci-1

10.2 Communications in a Network, using an RS-485 Local Network Link and Hydran 201Ci controllers

Up to 128 Hydran 201T*i* Intelligent Transmitters can be connected in a single network to be monitored and controlled by computer. Once the H201T*i*s are connected to a Hydran 201C*i*-C or Hydran 201C*i*-1 Controller via an isolated supervisory link, each Hydran 201C*i* Controller is linked to the next H201C*i* in a daisy- chain configuration via an isolated RS-485 LAN. An example of local network is shown in Figure 10-1 below.

Any H201C*i* in the network can then be linked to the host computer (see Section 10.3). Each H201T*i* can communicate with the host computer because each H201T*i* is identified by a specific address (a number from 1 to 254) set by the user.

Note the following points:

- The total length of all RS-485 link cables in a single network must not exceed 1,200m (4,000ft). This corresponds to an average length of 40m (120ft) for a local network containing 32 H201C*i*s.
- The RS-485 LAN uses an isolated, three-wire, shielded cable which is protected to withstand the large noise transients typically found in electrical substations.
- The H201C*i*s manage all communications automatically (transmission and reception). Data transmission is half-duplex (one direction at a time, from a single talker).
- Ideally, the H201C*i*'s should be located in a limited zone of an electrical substation, for example the control room.

The RS-485 local network link cable can be connected at the following locations:

- In the H201C*i*-C: To the terminals 21 to 24 of the Main Terminal Block (item 5 in Figure 4-2).
- In the H201C*i*-1: To the terminals 21 to 24 of the Main Terminal Block (item 6 in Figure 4-6).

The installation of an RS-485 local network link cable is described in Section 10.5.1.

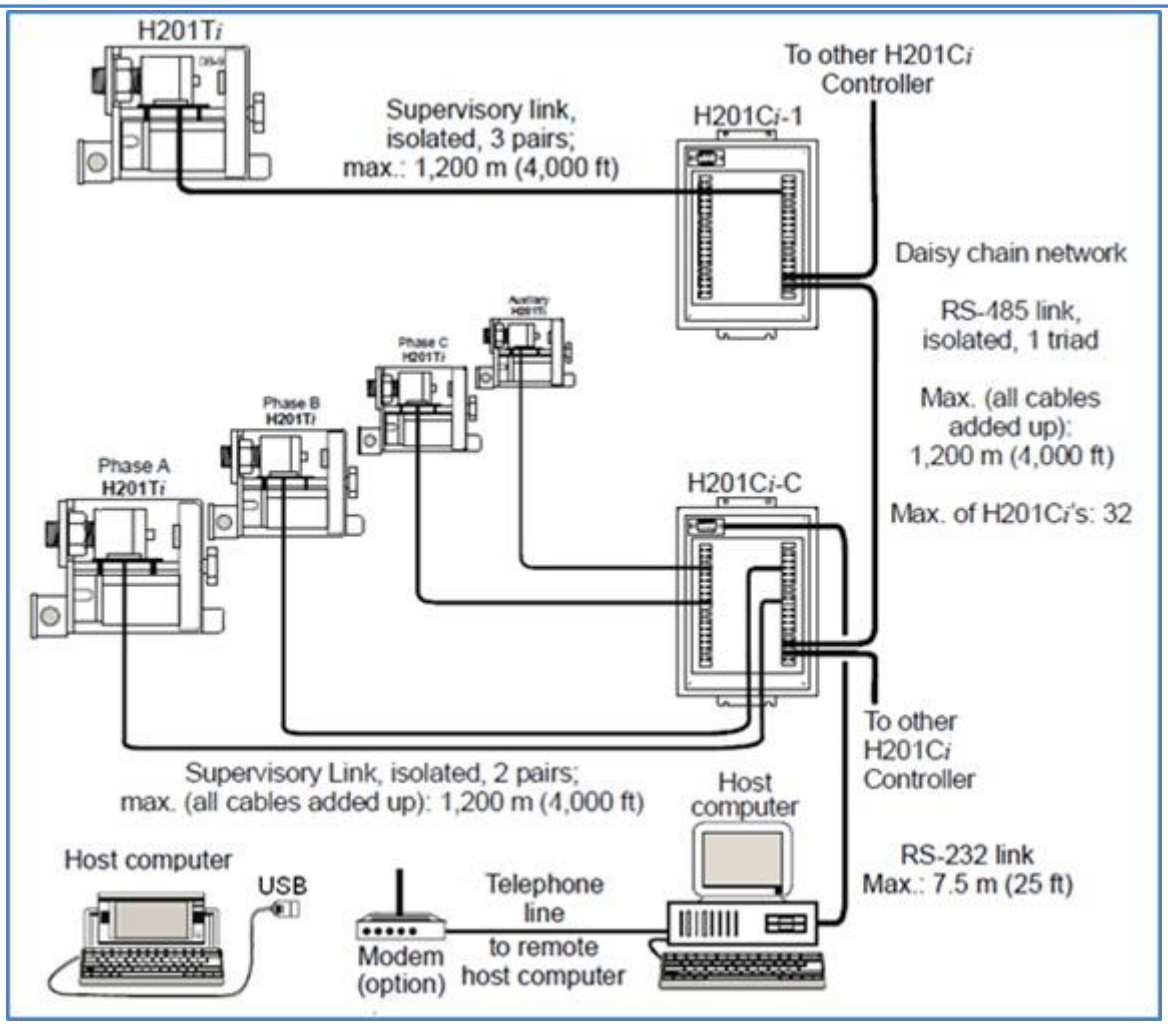


Figure 10-1: Example of a Local Network with 201 Ci's

10.3 Communications with a Host Computer

A Hydran 201T*i*, a Hydran 201R Model *i*, a Hydran 201*i* System or a local network can be connected, either locally or remotely (through a modem), to a host computer via an RS-485 serial link, RS-232 serial link or a USB communication link. Figure 10-2 illustrates the various ways to connect a host computer to a Hydran 201R Model *i*.

Figures 10-3 and 10-4 illustrate the various ways to connect a host computer to a Hydran 201 T*i*.

The computer (or modem) can be attached to *any* Hydran 201C*i* Controller on a local network. General Electric's Hydran Host and Perception software is the easiest way to communicate directly with the H201C*i*(s) or the network.

Note: A remote host computer can be used to supervise more than one local network of Hydran 201i Systems.

The RS-232 serial communication link cable can be connected at the following locations:

- In the H201C*i*-C: To the DB-9 Male RS-232 Computer Port Connector J10 (item 7 in Figure 4-3) on the circuit board.
- In the H201C*i*-1: To the DB-9 Male RS-232 Computer Port Connector J10 (item 7 in Figure 4-7).

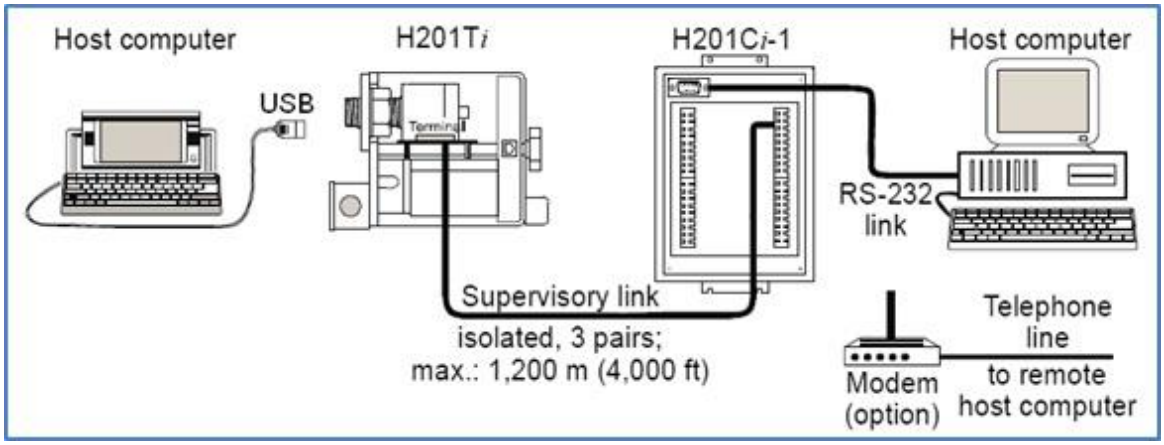


Figure 10-2: Host Computer Connection Modes in a Hydran 201R Model i

The installation of an RS-232 serial communication link cable is described in Section 10.5.2.

10.3.1 Local Communications using USB communication link

One or more Hydran 201R Model *i*s and/or Hydran 201*i* Systems are connected to a host computer using a USB communication link. This connection can be done as follows (see Figure 10-2) by connecting the host computer to the USB Type B connector of a Hydran 201T*i*. In this case, the communication can only be established with this particular H201T*i*.

- By connecting the host computer to the DB-9 or USB connector of a Hydran 201C*i* Controller. This connection gives access to all H201T*i*'s linked to this H201C*i* and also, if present, to all H201T*i*'s of all H201C*i*'s in this local network.

The maximum distance for an RS-232 link is 7.5m (25ft) and USB link is 5 m (16.4 ft).

10.3.2 Local Communications using RS-485 serial communication link

Starting with the CPU FW v4.0 that supports both proprietary Hydran protocol and standard Modbus RTU protocol, up to max 32 Hydran 201T*i* can be connected to a host computer to its USB port via a converter RS-485 to USB. An example is shown on Figure 10-3 below. The Hydran 201T*i*s are connected in daisy chain over the RS-485 link.

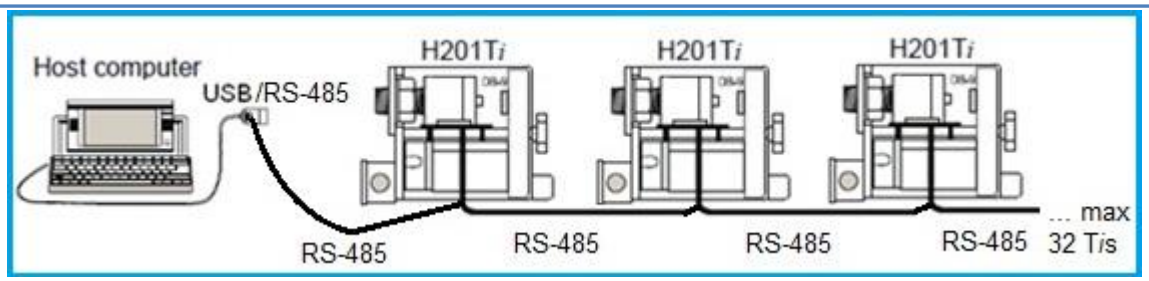


Figure 10-3: Local Network with H201 Ti's on RS-485 Link

Note the following points:

- The total length of all RS-485 cables must not exceed 1,200m (4,000ft). This corresponds to an average length of 40m (120ft) for a local network containing 32 H201T*i*s.
  - From the 201T*i* RS-485 link use the existing one shielded pair dedicated to transmit serial communications.
- Each supervisory link is electrically isolated and protected (2,000V RMS optocouplers, gas arresters, capacitors and tranzorbs) to withstand at both ends (H201T*i* and H201C*i*) surges up to 2,000V RMS as well as the large noise transients and ground potential differences typically found in electrical substations.
- Bidirectional data communication is transparently passed by the H201T*i* between the RS-485 port. The communication path is half-duplex (one direction at a time, from a single talker).
- The maximum distance for an USB link is 5 m (16.4 ft).

The RS-485 cable shall be connected at the following location in the H201T*i*: To the Supervisory Link and Analog Output Termination Board (item 9 in Figure 3-4).

10.3.3 Remote Communications (via Modem)

One or more Hydran 201R Model *i*s and/or Hydran 201*i* Systems are linked to a host computer by connecting a modem to a Hydran 201C*i* Controller's DB-9 connector and a telephone system (private or public); see Figure 10-2.

One or more Hydran 201 T*i* can be linked to a host computer by connecting a modem to a Hydran 201C*i* Controller's DB-9 connector and a telephone system (private or public); see Figure 10-4.

Note: this type of connectivity is only supported with the Hydran protocol. Modem connectivity shall be offered in the future Modbus ASCII implementation.

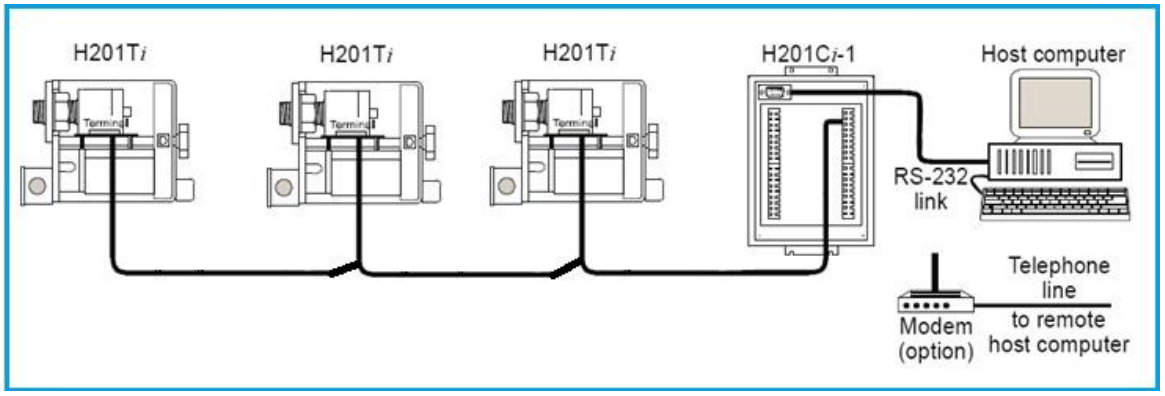


Figure 10-4: Host Computer Connection Modes in a Hydran 201 Ti RS-485 network

A Hayes-compatible modem can be pre-installed and pre-set at the factory in an H201C*i*. For details on settings, refer to the modem procedure located in the **English/Procedures** folder of the Hydran 201*i* System installation CD. A typical communication configuration with a modem is shown in Figure 10-5.

CAUTION

The modems supplied by General Electric should be connected to an analog line only. Using a non-analog line (for example, digital, PBX, Multi-line) will damage the modem.

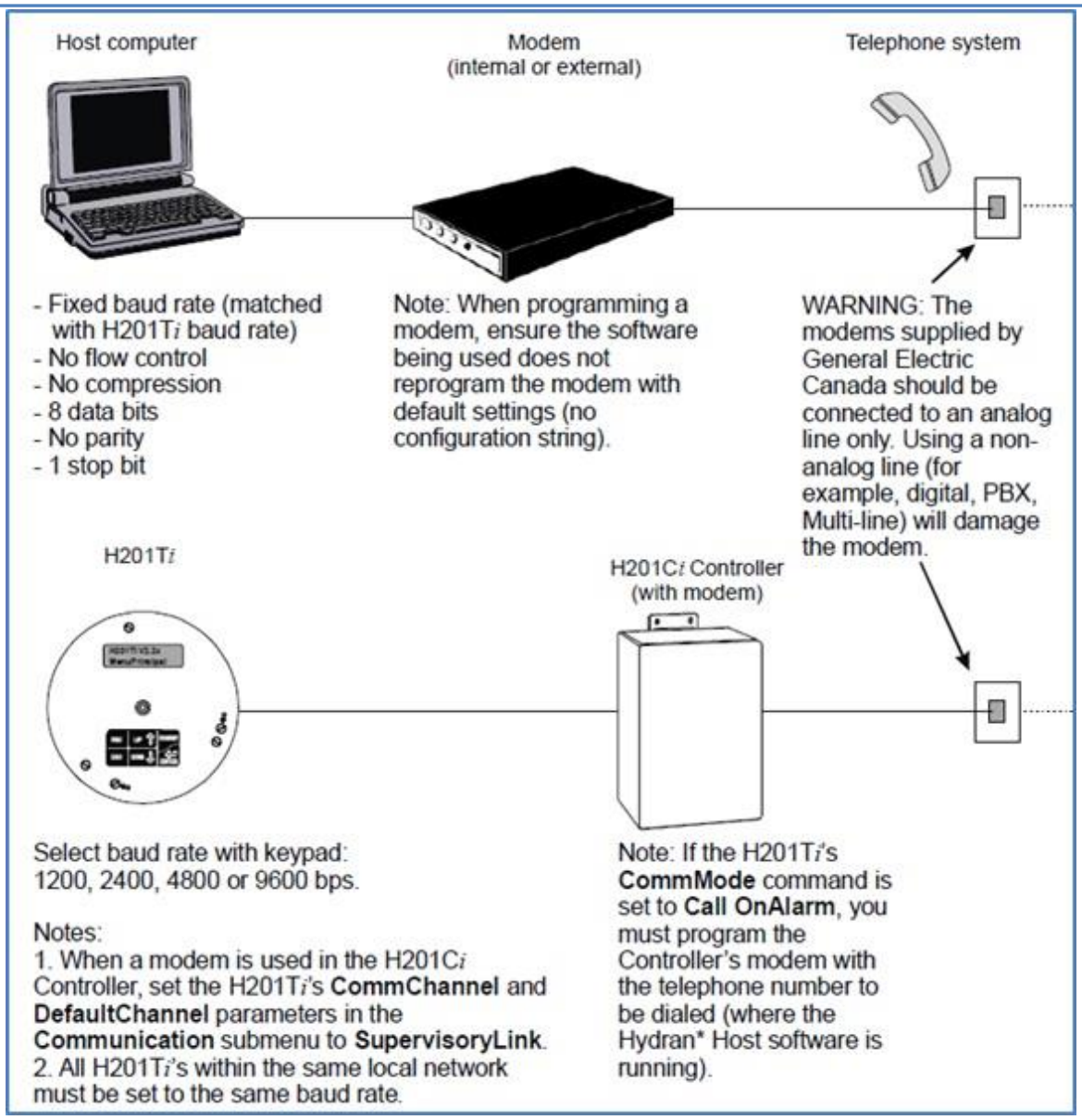


Figure 10-5: Typical Communication Configuration with a Modem

If desired, the user can install their own modem, although a few settings must be expected to make it functional.

When using a modem, each Hydran 201T*i* can be set to either one of the two following modes (in the **Communication** submenu; see Section 5.5.6):

- **Call OnAlarm**: In this mode, the H201T*i* communicates with the Hydran Host software through a telephone line each time a gas or fail alarm condition is detected (to select this mode, see Section 10.6.3).
- **AnswerOnly**: In this mode, the H201T*i* remains silent until a host computer running the Hydran Host software communicates with it.

In the **Call OnAlarm** mode, the following actions are performed when an alarm is triggered:

- The H201T*i* sends the *ATDS0* command through the selected communication channel (USB or supervisory link; see the **CommChannel** and **DefaultChannel** parameters in the **Communication** submenu).
- The Hayes-compatible modem receiving this command dials the telephone number previously stored in its register 0; this number is redialed until the connection with the host computer's modem is established. Then, no other message is sent; the host computer has the responsibility to communicate with the H201T*i* in alarm.
- The Hydran Host software answers and receives the alarm message.
- The Hydran Host software displays the alarm states and updates its data bank.
- The user must acknowledge the alarm in the Hydran Host software and take the appropriate measures.

Note:

1. This functionality is only supported in Hydran protocol and Hydran Host PC application. It is not supported by Perception software (when Hydran 201Ti is set to Modbus protocol)

2. It might take up to 15 min after the alarm is generated in the H201Ti for the Call OnAlarm to the Host software to occur.

2. Acknowledging the alarm in the Hydran Host software does not turn off the illuminated push-button of the Hydran 201Ci-1 Controller.

10.4 Communication Protocol

Hydran 201Ti only supports serial communications and for this type of connectivity, General Electric Canada uses its own protocol – Hydran protocol, and starting with the CPU FW v4.0, it also supports standard Modbus RTU protocol (see Appendix I). In the case of the Hydran protocol data is transmitted in ASCII codes; data clusters being transmitted are verified and, if necessary, transmitted again.

10.5 Local Network Installation

Read first the explanations in Section 6.2.4.

10.5.1 Installing an RS-485 Local Network Link between Hydran 201 Tis or between 201 Ci Controllers

A local network is a chain of Hydran 201T*i*, Hydran 201*i* Systems and/or Hydran 201R Model *i*'s in which the Hydran 201T*i* or the 201C*i* Controllers are connected together using an RS-485 link. If the installation includes only one Hydran 201T*i*, Hydran 201*i* System or Hydran 201R Model *i*, go to Section 10.5.2.

Proceed as follows:

1. Run an RS-485 cable from one H201T*i* or H201C*i* to the next in a conduit to form a chain. Use instrumentation-grade cables (twisted triad with overall shield); otherwise use armored cables.

Note: The total maximum length for all RS-485 link cables in a local network is 1,200 m (4,000 ft).

CAUTION ***The shield of each cable section must be grounded at one end only.***

2. Connect the RS-485 cables into the main terminal block. For wiring details, see Appendix D.

Note: In an RS-485 link pin 1 is always connected to pin 1, pin 2 to pin 2, pin 3 to pin 3. Except for the two H201Cis located at each end of a local network, two RS-485 link cables are attached to each H201Ci using the Main Terminal Block. Powering down one H201Ci does not affect the local network or the other H201Cis.

CAUTION ***The shield of each cable section must be grounded at one end only. Routing and shielding of the RS-485 cable is particularly important because all H201Cis belonging to a network share a common reference with this link.***

CAUTION ***The operation of the complete H201Ci network may be affected if wires are not connected correctly. Be careful when installing and inserting each wire. Be sure to insert all strands in the terminal; strands that touch two terminals cause problems. Do not leave trims of metallic strands inside the H201Ci's enclosure.***

10.5.2 Connecting a Host Computer to a Hydran 201Ci Controller in a Local Network, using an RS-485 Cable

The supplied USB cable can be connected to any H201C*i* in a local network to allow a host computer to communicate with all H201C*i*'s and Hydran 201T*i*'s in the network. A RS-232 cable can also be used to allow the host computer to communicate with all H201C*i*'s and Hydran 201T*i*'s in the network.

The USB cable can be used or an RS-232 cable can be used as well; in the case of a permanent installation with the RS-232 cable, you can also use a commercial null-modem cable (Rx and Tx wires are crossed) with female DB-9 connectors at both ends. Cut and splice the cable in order to be able to run it into the conduit fitting. These cables are available in lengths up to 7.7m (25ft).

CAUTION

The length of an RS-232 communication cable must not exceed 7.7m (25ft). For the length of a USB communication cable, it cannot exceed 5m (16.4ft).

You can also make your own null-modem cable by using the same type of cable as for the RS-485 link. Wire the female DB-9 connector as shown in Table 10-2 below.

From the Hydran 201Ci Controller	To the Host Computer
Female DB 9 Connector pin 2	Female DB 9 Connector pin 3
Female DB 9 Connector pin 3	Female DB 9 Connector pin 2
Female DB 9 Connector pin 5	Female DB 9 Connector pin 5

Table 10-2: Wiring for Serial Cable

CAUTION

The shield of each cable section must be grounded at one end only. Ensure the H201Ci and the host computer share a common earth ground. Otherwise, use short-haul (private line) modem to provide electrical isolation between them.

10.5.3 Verifying RS-232 or USB and RS-485 Communications

Proceed as described in Section 8.2.3.

10.6 Optional Modem Installation

Remote communications with a Hydran 201*i* System or a Hydran 201R Model *i* can be established using a telephone system (private or public). This Section pertains to Hydran 201C*i* Controllers equipped with an internal modem (optional, available from General Electric).

CAUTION

The modems supplied by General Electric should be connected to an analog line only. Using a non-analog line (for example, digital, PBX, Multi-line) will damage the modem.

10.6.1 Connecting a Telephone Line

1. Run a telephone line cable through a conduit up to the Hydran 201C*i* Controller equipped with a modem.
2. Connect the telephone line cable.

CAUTION

When using a modem, a solid-state station protector (model Circa 1360B or equivalent) must be installed on the modem telephone line within 20 meters of the Hydran 201Ci Controller to ensure proper operation of the modem during network disturbances.

10.6.2 Verifying Communications between the Two Modems

Once the modems are set up, proceed as follows to verify modem communications:

1. Power up the host computer.
2. Start the Hydran Host software.
3. If not already done, use this software to prepare the communication with the Hydran 201T*i*'s by entering the definition of all H201T*i*'s in the network according to the identification numbers previously assigned. For details, see the *Hydran Host Software Manual*.
4. Enter the model name and configuration string of the modem in the **Host Config** window of the Hydran Host software (see the *Hydran Host Software Manual*).
5. In the Hydran Host software, enter the telephone number and the communication speed of the H201C*i*'s modem in the **Power Stations Set-Up** window (see the *Hydran Host Software Manual*).

Note: The communication speed assigned to the power station in the Hydran Host software must be the same as the one set in all H201Ti's in the local network.

6. If the H201T*i*'s **Call OnAlarm** command is used, program the H201C*i*'s modem with the telephone number of the host computer's modem.
7. If not already done, set the communication speed of the H201T*i*'s. To do so, access the submenu **Communication** of each H201T*i* and set the parameter

BaudRate to the same speed as the one indicated in the **Power Stations Set-Up** window for this power station.

8. If the H201T*i* communication speed is set for the first time, you must initialize the H201C*i*'s modem with this communication speed. To do so, access the submenu **Communication** of one of the H201T*i*'s connected to this H201C*i*, select the **Force HostCall** command and press **ENTER**.

*Note: This task can be performed even if the H201C*i*'s modem is not connected to a telephone line and even if this modem is not yet programmed with a telephone number.*

9. If the H201T*i*'s **Call OnAlarm** command is not used (the H201C*i*'s modem is not programmed with the telephone number of the host computer's modem), you must use the Hydran Host software to trigger the communications between the two modems. In the Hydran Host software, start the **Hydran Host** module; click **Remote** and then **Call Now** (see the *Hydran Host Software Manual*).
10. Verify the status of communications with the H201T*i*'s in the **Network Survey** window of the Hydran Host software (see the *Hydran Host Software Manual*).

Note: The Hydran Host software, the communication software and the modem must use the same communication port (COM1 or COM2).

10.6.3 Configuring the Call OnAlarm Mode

Prior to use the **Call OnAlarm** mode, make sure of the following:

- The installation of the Hydran 201*i* System is completed.
- Hydran protocol is used
- The network configuration is defined in the Hydran Host software (see the *Hydran Host Software Manual*).
- The Hydran 201C*i* Controller's modem is programmed with the telephone number of the host computer's modem.

To use the **Call OnAlarm** mode, proceed as follows:

1. In the Hydran Host software, start the **Hydran Host** module.
2. Click **Remote**.
3. In the **Remote Access** window, select the desired power station.
4. Click **Put on Watch**.

The following actions are then performed:

1. The Hydran Host software initializes the host computer's modem.
2. This modem telephones to the H201C*i*'s modem.
3. The Hydran Host software sets to **Call OnAlarm** the **CommMode** parameter of all Hydran 201T*i*'s in the Hydran 201*i* System or in the local network.
4. The Hydran Host software hangs up.

11 ALARMS

This Chapter explains in detail the sophisticated alarm features of the Hydran 201*i* System from an operator's point of view.

Note: The complete list of alarm messages and each corresponding troubleshooting procedure are given in Section 13.1.

CAUTION

Wiring the alarm contacts (see Section 11.2.1 to safety tripping devices of the equipment monitored by the Hydran 201i System is not recommended because this system is an early warning device of incipient faults. Information obtained using the Hydran 201i System should always be used in conjunction with other available information to decide if the monitored equipment should be removed from service.

CAUTION

This Chapter contains examples of how to set the gas alarm parameters of the Hydran 201i System. The values used are fictitious and do not correspond to any standard. General Electric does not suggest nor recommend specific alarm set points. It is solely the responsibility of the user to determine the appropriate settings.

There are three methods to set the value of the alarm parameters:

- Using the Hydran Host software for Hydran protocol only (see the *Hydran Host Software Manual*).
- Using Perception software (for Modbus protocol only)
- Directly, using the Hydran 201T*i*'s keypad and display (they are explained in detail in Chapter 5).

For more information on the interpretation of gases in oil, refer to the following guides:

- IEEE Standard C57.104-1991, "IEEE Guide for the Interpretation of Gases Generated in Oil-Immersed Transformers".
- IEC 60599-1999, "Mineral Oil-Impregnated Electrical Equipment in Service – Guide to the Interpretation of Dissolved and Free Gases Analysis".

11.1 Alarm Levels

The Hydran 201*i* System is a microprocessor-based family of instruments with sophisticated alarm features. It is equipped with three alarm levels:

- *Gas High alarm* (Hydran 201T*i*'s Alarm 1): This alarm is set at a lower gas level than the High-High alarm. It is a caution sign and should initiate closer monitoring of the equipment.
- *Gas High-High alarm* (H201T*i*'s Alarm 2): This alarm is set at a higher level than the High alarm. It is a warning sign and should trigger immediate operator action according to standard utility procedures.
- *Fail alarm of the Hydran 201i System*: This alarm includes all alarms other than the High and High-High alarms. The fail alarm warns the operator that the Hydran 201*i* System is not functioning properly. A fail alarm must therefore be verified and solved rapidly because it indicates that the *monitoring* system (the Hydran 201*i* System) of the transformer is faulty.

Note: A fail alarm does not concern the transformer.

The High and High-High alarms provide an *early warning of incipient faults* in transformers or any other oil-filled electrical equipment.

11.1.1 Alarm Conditions

An alarm is triggered when an *alarm condition* is detected. Each alarm has its own set of alarm conditions.

Gas High and High-High alarms are triggered by one or several of the following conditions:

- The *level of gases in oil* exceeds the user-defined alarm set point (250ppm, for example). The gas level is a composite value of the following gases: Hydrogen (H_2), carbon monoxide (CO), acetylene (C_2H_2) and ethylene (C_2H_4).
- The *hourly trend* (short term) of the gas level exceeds the user-defined alarm set point (10ppm per 24 hours, for example). The hourly trend represents the level variation of gases in the oil during a period of time measured in hours. The hourly trend is updated every five seconds.
- The *daily trend* (long term) of the gas level exceeds the user-defined alarm set point (25ppm per 30 days, for example). The daily trend represents the level variation of gases in the oil during a period of time measured in days. The daily trend is updated every five minutes.

The complete list of fail alarm conditions is shown in Section 11.5.1. Table 11-1 below lists the alarm conditions monitored by the Hydran 201T*i*.

Source	Possible States			
Gas Level	Low-Low	Low	High	High-High
Hourly trend				
Daily trend				
Sensor temperature				
Battery voltage			--	--
Sensor and connections	Cable[a] short	-	Replace sensor now	Cable[a] open

Table 11-1: Alarm Conditions Monitored by the Hydran 201T*i*

a. Either one of the following cables (or connectors in the connection link): Sensor, sensor thermistor, or heating plate thermistor.

11.1.2 Purpose of Hourly and Daily Trends

Detection of hourly and daily trend alarm conditions is a unique feature of the Hydran 201*i* System that provides early warning of slowly increasing gas level. For example, let us consider a transformer with a 50-ppm gas level and a typical gas High alarm set point of 150 ppm.

- If no trend alarm is used and if the gas level reading starts increasing at the rate of 50 ppm per month, it takes two months before the gas High alarm condition is detected and the investigation of the possible causes of the increase begins (unless the gas reading was already closely monitored).
- If the *daily trend* High alarm is used and its alarm set point is adjusted to 25ppm, its period to 30 days and its alarm delay to 33% of the period (10 days), the alarm would occur approximately 23 days after the beginning of the gas level increase. Investigation of the possible causes could thus start five weeks earlier. For details on trend computations, see Section 11.4.3.

11.2 Alarm Relays

The Hydran 201T*i* and the Hydran 201C*i*-1 both have three alarm relays, in other words one relay per alarm level:

- One gas High alarm relay.
- One gas High-High alarm relay.
- One fail alarm relay, referred to as *System* in the H201T*i*'s menus.

Note: The Hydran 201Ci -C does not have alarm relays. The H201Ci-1 alarm relays are more accessible than the H201Ti's relays. Generally, the H201Ci-1 alarm relays are the ones connected to an alarm panel or SCADA system.

11.2.1 Alarm Contacts

Each relay has:

- A normally open (NO) contact.
- A normally closed (NC) contact.
- A common contact (Type C).

The physical form of these contacts is as follows:

- Hydran 201T*i*: See the Alarm Contacts 9-Terminal Block (item 12 in Figure 3-5).
- Hydran 201Ci -1: See the terminals 7 to 15 of the Main Terminal Block (item 6 in Figure 4-6).
- Hydran 201C*i*-C: Does not have alarm relays and thus no alarm contacts.

11.2.2 Status of Alarm Relays

The gas High and High-High alarm relays can only be in two states:

- On (coil energized, alarm state LED's turned on).
- Off (coil de-energized, alarm state LED's off).

Note: The relays of the Hydran 201Ci Controller always adopt the state of the Hydran 201Ti's corresponding relay (except if the supervisory link is broken, in which case the H201Ci triggers a fail alarm, regardless of the H201Ti's fail alarm relay). As far as the fail alarm relay, the coil is energized in normal operation (no alarm).

Table 10-1 lists the possible states of all relays. The state of each relay can be determined as follows:

- H201T*i*:
  - By displaying **RelayH State**, **RelayHH State** and **SysOk State** in the **Relays/Analog** submenu.
  - By looking at the LED's on the right side of the I/O module (see Figure 3-7)
  - By verifying the state of the alarm contacts on the Alarm Contacts 9-Terminal Block (item 12 in Figure 3-5).

- H201Ci-1:
  - By looking at the LEDs on the circuit board (see items 13 to 18 in Figure 4-7)

- By verifying the status of the alarm contacts on the terminals 7 to 15 of the Main Terminal Block (item 6 in Figure 4-6).
- By looking at the illuminated **1** (High alarm) and **2** (High-High alarm) push-buttons on the enclosure door.

- H201Ci-C: No alarms.

Table 11-2 below lists the possible states of the alarm contacts.

	Off	On
NO contact	Contact open	Contact closed
NC contact	Contact closed	Contact open

Table 11-2: Possible States of the Alarm Contacts

11.2.3 Operation Modes of Alarm Relays

The mode of each alarm relay is set using the corresponding **RelayMode** parameter in the Hydran 201T*i*'s **Relays/Analog** submenu (or using the Hydran Host software). There are four operation modes:

- **Normal**: See Section 1.1.1.1 below.
- **Latch**: See Section 1.1.1.2 below.
- **Force OFF**: See Section 1.1.1.3 below.
- **Force ON**: See Section 1.1.1.4 below.

The H201T*i*'s three relays are independent. A relay can therefore be set to any operation mode regardless of the mode of the two other relays.

1.1.1.1 Normal Mode

In this mode, the relay status changes if an alarm condition is detected during a period of time exceeding the corresponding alarm delay; the relay returns to its former status when the alarm condition disappears during a period of time exceeding the same alarm delay. The **Normal** mode is the default setting.

In the **Normal** and **Latch** modes:

- The High and High-High alarm relays are *energized* when an alarm condition is detected.
- The fail alarm relay, however, is *de-energized* when an alarm condition is detected, to permit to detect a power failure (the relay's power being immediately off). This feature of the Hydran 201*i* System strengthens the security of the alarm system. The fail alarm relay is thus *energized* (NO contacts closed and NC contacts open) if no alarm condition is detected.

1.1.1.2 Latch Mode

In this mode, the relay status changes if an alarm condition is detected during a period of time exceeding the corresponding alarm delay; the relay returns to its former status when the alarm condition disappears during a period of time exceeding the same alarm delay *and* when the alarm is acknowledged by the user (using the Hydran 201T*i*'s keypad or the Hydran Host software).

Note: Only pushing the Hydran 201Ci-1's push-buttons is not enough to acknowledge an alarm.

Read also the points in the **Normal** mode (Section 1.1.1.1 above).

1.1.1.3 Force OFF

In this mode, the relay does not respond to changes in alarm conditions; the relay's power always remains off. This mode is used mainly to test the alarm relays or disable an alarm circuit.

1.1.1.4 Force ON

In this mode, the relay does not respond to changes in alarm conditions; the relay's power always remains on. This mode is used mainly to test the alarm relays or disable an alarm circuit.

11.3 Alarm Interface

The alarm interface between the Hydran 201*i* System and the user can take different forms. When an alarm is triggered, the following actions are generated:

1. An alarm message flashes on the Hydran 201T*i*'s display. For example: **Gas H;250ppm** (the gas level exceeds the gas High alarm set point, which is currently set to 250ppm). For the complete list of alarm messages, see Section 13.1; for details on the display of alarm messages, see Section 5.2.1.
2. The status of the corresponding alarm relay changes. The classic interface method consists in linking the relays' alarm contacts of the Hydran 201C*i* Controller (or H201T*i*) to an alarm panel (or any other SCADA system) located in such a way that an alarm being triggered would immediately warn the operator. For details, see Section 12.1.2.
3. An alarm signal is transmitted (through the supervisory link) to the H201C*i* and from the latter to the host computer. The Hydran Host software (if running) displays an alarm window. This way, the state of the alarms can be continuously monitored (locally or remotely) or verified periodically.
4. A call can be made to a host computer via modem (see the **CommMode** parameter in the H201T*i*'s **Communication** submenu; Section 5.5.6.2).
5. The two illuminated push-buttons (alarm indicators) mounted on the door of the Hydran 201C*i*-1 (the Hydran 201C*i*-C is not equipped with push-buttons) indicate the status of the gas alarms. Each push-button turns on when the corresponding

alarm is triggered. The push-button's alarm indicator is latched; in other words, it remains on even if the alarm condition has disappeared and even if the alarm is acknowledged (using the H201T*i*'s keypad or the Hydran Host software). To turn it off, you must press the corresponding push-button; an alarm indicator can only be turned off if the alarm condition has disappeared during a period of time exceeding the corresponding alarm delay (one of the alarm parameters).

6. Table 11-3 below lists the possible states of the Hydran 201C*i*-1's display and alarm indicators.

State	Display	High Indicator	High-High Indicator
Normal	Normal	Off	Off
High Alarm		On (Latch)	
High-High Alarm		On	On (Latch)
Fail Alarm	Off	Unchanged	Unchanged
Power Failure		Off	Off

Table 11-3: Possible States of the Hydran 201C*i*-1's Display and Alarm Indicators

7. During a fail alarm, the Hydran 201C*i*-1's display is blank (see Table 11-3 above), and the analog outputs of the H201T*i* and the H201C*i*-1 drop to 4.00 ± 0.10 mA.
8. A message is recorded in the H201T*i*'s **History;Events** file. Alarm messages are thus stored in memory. The Events file can contain up to 500 messages. Each message comes with a set of relevant parameters (gas level, trends, etc.) and is identified with the recording date and time. For details, see Section 5.5.1.

11.4 Gas High and High-High Alarms

Parameters pertaining to gas High and High-High alarms are set in the Hydran 201T*i*'s **Gas** submenu. For explanations on each parameter, see Section 5.5.2.

Set points for High alarms should be adjusted at values that indicate that the transformer (or other equipment) requires *closer monitoring*. Set points for High-High alarms should be adjusted at values considered as critical by the user, meaning that the transformer requires *immediate action*; in general, this alarm implies an evaluation of the equipment and its possible removal from service.

11.4.1 Alarm Parameters Setting

1.1.1.5 Gas Level

The gas level alarm uses the following parameters:

- **GasAlr H** and **GasAlr HH**: Gas High and High-High alarm set points.
- **GasAlr Delay**: The gas alarms delay determines the period of time during which the gas level must exceed the gas High and High-High alarm set points in order to trigger the alarm. Accordingly, the gas level must get below the alarm set point for the same amount of time in order to cancel the alarm.

Before setting these alarm set points, the readings of the Hydran 201*i* System should be monitored over a minimum period of two weeks. A simple method to monitor this value is to consult the Hydran 201T*i*'s historic data files using its keypad (see Section 5.5.1) or a host computer running the Hydran Host software.

Follow these rules:

- Adjust the High set point above the highest reading that was obtained.
- Adjust it low enough to detect the earliest sign of an abnormal increase of gas.
- But set it at a value high enough to minimize unnecessary alarms.

Table 11-4 contains *suggested* guidelines for setting the *gas level High alarm condition*, according to the maximum reading obtained during the monitoring period.

CAUTION

This Chapter contains examples of how to set the gas alarm parameters of the Hydran 201i System. The values used are fictitious and do not correspond to any standard. General Electric does not suggest nor recommend specific alarm set points. It is solely the responsibility of the user to determine the appropriate settings

Hydran 201T*i* Maximum Reading	Minimum Suggested Alarm Set Point
(Obtained during the monitoring period)	(to reduce the likelihood of false alarms)
Below 70ppm	100ppm
From 70 to 400ppm	1.5 times the highest H201T*i* reading
Above 400ppm	200ppm above the highest H201T*i* reading

Table 11-4: Suggested Guidelines for Setting the Gas Level High Alarm Conditions

1.1.1.6 Hourly Trend

The hourly trend alarm uses the following parameters:

- **HourTrAlr H** and **HourTrAlr HH**: Hourly trend High and High-High alarm set points.
- **HourTrAlr Delay**: The hourly trend alarm delay determines the period of time during which the hourly trend must exceed the corresponding High and High-High alarm set points in order to trigger the alarm. Accordingly, the hourly trend must get below the alarm set point for the same amount of time in order to cancel the alarm. This delay is set in percentage of the *period* of the hourly trend computation.
- **HourlyTr Period**: The period of time (in hours) during which the hourly trend is calculated. Increasing the period decreases the normal fluctuations of the readings, but increases the response time.

The readings of the Hydran 201*i* System should be monitored over a minimum period of two weeks before setting these parameters; follow the same rules as for the gas High alarm (see Section 1.1.1.5).

1.1.1.7 Daily Trend

The daily trend alarm uses the following parameters:

- **DayTrAlr H** and **DayTrAlr HH**: Daily trend High and High-High alarm set points.
- **DayTrAlr Delay**: The daily trend alarm delay determines the period of time during which the daily trend must exceed the corresponding High and High-High alarm set points in order to trigger the alarm. Accordingly, the daily trend must get below the alarm set point for the same amount of time in order to cancel the alarm. This delay is set in percentage of the *period* of the daily trend computation.
- **DailyTr Period**: The period of time (in days) during which the daily trend is calculated. Increasing the period decreases the normal fluctuations of the readings, but increases the response time.

The readings of the Hydran 201*i* System should be monitored over a minimum period of two months before setting these parameters; follow the same rules as for the gas High alarm (see Section 1.1.1.5).

11.4.2 Guidelines for Setting Trend Alarms

The hourly and daily trend High and High-High alarm settings cannot be described in terms of absolute criteria. They are related to the user's field experience and the utility's standard practice.

This Section provides a few guidelines to optimize both the hourly and daily trend alarms.

1. If a fast response to a sudden gas level increase is needed, it is best to rely on the gas level alarm rather than on trend alarms. Trend alarms are ideal when it comes to detect slow and steady changes from fluctuating readings, but are not as good to detect abrupt changes.
2. The transformer's (or other equipment) past history and the user's field experience are the most important criteria for alarm settings. If existing, records of previous dissolved gas analysis (DGA) for the equipment monitored should be used to help determine alarm settings in general and especially daily trend settings.
3. Trend alarm delays should be set according to each trend period. For example:
   - If the hourly trend period is set to four hours, the hourly trend reading may show quite large, but short, positive and negative peaks during a day. In this case, an hourly trend alarm delay of 50 to 75% of the period could avoid unnecessary alarms.
   - However, if the hourly trend period is set to 48 hours, daily fluctuations would not affect the trend reading significantly. In this case, the alarm delay could be set to 10 to 20% of the period.
4. The hourly trend period should be long enough to filter out reading fluctuations caused by short-term changes in ambient conditions and transformer operation. The factory default of 24 hours is a good starting value.
5. The longer the trend period, the higher the trend value in ppm is for a given steady increase in gas level reading. For example, a constant gas level increase of 10ppm/24 hours results in a 10ppm/period reading if the period is set to 24 hours, but in a 20ppm/period reading if the period is set to 48 hours.
6. The longer the period, the smoother the trend readings are. However, it takes longer for the trend to stabilize ("taper off") to its final value. In the preceding example, it would take two days to obtain the final value of 10ppm/24 hours; in the second case, it would take four days to reach the final value of 20ppm/48 hours (for details on computations, see Section 11.4.3).

11.4.3 Hourly and Daily Trend Computations

A unique computation method is used for both the hourly and daily trends. In these computations, the gas level reading is processed through a first- order, digital, low -pass filter; the trend reading (slope) is then extracted using a first-order, digital, high-pass filter. The time constants for both filters are set to 33% of the trend period for optimum results.

Table 11-5 and Table 11-6 show two examples of trend computations.

Example 1: The gas level starts to increase at a rate of 10 ppm/24 hours. The hourly trend period is set to 24 hours.

Initial	After 8 hours	After 24 hours	After 48 hours
0ppm/24 hr	+4ppm/24 hr	+9ppm/24 hr	+10ppm/24 hr

Table 11-5: Evolution of the Hourly Trend

Example 2: The gas level starts to increase at a rate of 50 ppm/30 days. The daily trend period is set to 30 days.

Initial	After 10 days	After 30 days	After 60 days
0ppm/30 d	+20ppm/30 d	+45ppm/30 d	+50ppm/30 d

Table 11-6: Evolution of the Daily Trend

Note the following points:

- If the Hydran 201T*i* undergoes a power failure that lasts less than 1/6 of the trend period, the corresponding trend reading remains constant until the H201T*i* is powered up again.
- If the power failure lasts more than 1/6 of the trend period, the corresponding trend reading is reset to zero.
- If the user changes the hourly or daily trend period, the corresponding trend reading is reset to 0.0 ppm/period.

11.4.4 High and High-High Alarms Triggering

If the High alarm relay is set to the **Normal** or **Latch** mode, the High alarm is triggered (the High alarm relay is energized) when one of the alarm conditions *exceeds* the corresponding High alarm set point during a period of time exceeding its alarm delay.

The same way, if the High-High alarm relay is set to the **Normal** or **Latch** mode, the High-High alarm is triggered (the High-High alarm relay is energized) when one of the alarm conditions *exceeds* the corresponding High-High alarm set-point during a period of time exceeding its alarm delay.

Each alarm (High and High-High) can be triggered by one or several of the following conditions (for details, see Section 11.1.1):

- Gas level (**GasLevel** submenu).
- Hourly trend (**HourlyTrend** submenu).
- Daily trend (**DailyTrend** submenu)

Each alarm condition has an adjustable alarm delay that is common to all levels (High, High-High, Low and Low-Low) of this condition.

11.4.5 High and High-High Alarms Cancellation

Note: To be cancelled, an alarm condition must disappear during a period of time exceeding the corresponding alarm delay.

To cancel a High or High-High alarm, proceed as follows:

1. Find and solve the problem. Generally, the Hydran 201T*i*'s reading must be verified by sampling the transformer's oil and performing a dissolved gas analysis (DGA).
2. Acknowledge the alarm using the H201T*i*'s keypad or the Hydran Host software. For the procedure, see Section 5.2.1, and the *Hydran Host Software Manual*. If the problem has been corrected since a period of time exceeding the corresponding alarm delay, the alarm message then disappears from the H201T*i*'s display; otherwise, it simply stops flashing and remains on the display.
3. Press the Hydran 201C*i*-1's corresponding push-button.

11.5 Fail Alarm

The fail alarm generally indicates to the user that there is a problem with the Hydran 201*i* System, not with the transformer. A fail alarm must therefore be verified and solved rapidly because it indicates that the *protection* system of the transformer is not functioning properly.

11.5.1 Fail Alarm Triggering

If the fail alarm relay is set to the **Normal** or **Latch** mode, the fail alarm is triggered (the fail alarm relay is de-energized) when one of the following alarm conditions occurs:

- Supervisory link broken between the Hydran 201T*i* and the Hydran 201C*i* Controller. This condition is the only one that affects *only* the fail alarm relay of the Hydran 201C*i*-1. All other conditions affect the fail alarm relays of both the H201T*i* and the H201C*i*-1.
- AC power failure or partial failure (power voltage too low for the H201T*i* to function properly).
- Unable to restart the microprocessor.
- H201T*i* not initialized (no alarm message appears on the H201T*i*'s display for this condition). To cancel this alarm, enter the information requested on the H201T*i*'s display (for details, see Section 5.2.5).
- More than 20 "watchdogs" occurred in 15 minutes (no alarm message appears on the H201T*i*'s display for this condition).
- Detection of a hardware malfunction during the auto-verification phase of the initialization (no alarm message appears on the H201T*i*'s display for this condition).
- **Setup Lost** (for details, see Section 13.1.23).

- One of the fault triggers conditions, listed in Table 11-1 (for details, see Section 11.5.2 below).

11.5.2 Fault Triggers

Fault triggers are fail alarm conditions that can produce two actions:

1. Display of a message on the screen. The alarm message is displayed only if the corresponding alarm set point is adjusted to a value; if not, it is set to **OFF**. This setting is performed in the corresponding submenu.
2. Trigger of the fail alarm relay. Whether the relay is triggered when an alarm condition is detected is determined in the **SysOK Relay; FaultTrig.** submenu.

*Note: The alarm set point adjustment has priority over the relay triggering. In other words, the relay is not triggered if the alarm set point is adjusted to **OFF**.*

Almost all these alarm conditions have an alarm set point and an alarm delay (both can be adjusted). The fail alarm, for these conditions, is therefore triggered the same way than the *gas* High and High-High alarms:

- Low and Low-Low alarms: The fail alarm is triggered when one of the alarm conditions is *below* the corresponding alarm set point during a period of time exceeding its alarm delay.
- High and High-High alarms: The fail alarm is triggered when one of the alarm conditions *exceeds* the corresponding alarm set point during a period of time exceeding its alarm delay.

1.1.1.8 Gas Fault Triggers

The conditions shown in Table 11-7 although being Low and Low-Low gas alarms, are classified as fail alarms because they indicate a problem of gas detection rather than one of gas production in the transformer. A gas Low alarm, for example, is triggered if the valve on which is mounted the Hydran 201T*i* is closed.

The parameters pertaining to these alarm conditions are set in the H201T*i*'s **Gas** and **SysOK Relay; FaultTrig.** submenus (for explanations, see Chapter 5).

Description	Priority	Alarm Set Point	Fault Trigger	Alarm Message
Low-Low gas level	Average	**GasAlr LL**	**Gas LL**	
Low gas level		**GasAlr L**	**Gas L**	
Low-Low hourly trend		**HourTrAlr LL**	**Hour Trend LL**	
Low hourly trend		**HourTrAlr L**	**Hour Trend L**	
Low-Low daily trend		**DayTrAlr LL**	**Day Trend LL**	
Low daily trend		**DayTrAlr L**	**Day Trend L**	

Table 11-7: Gas Fault Triggers

1.1.1.9 Sensor Temperature Fault Triggers

The parameters pertaining to these alarm conditions are presented in Table 11-8 below set in the Hydran 201T*i*'s **Temperature** and **SysOK Relay;FaultTrig.** submenus (for explanations, see Chapter 5).

Description	Priority	Alarm Set Point	Fault Trigger	Alarm Message
Low-Low sensor temperature	Average	**STempAlr LL**	**SensTemp LL**	
Low sensor temperature	Low	**STempAlr L**	**SensTemp L**	
High sensor temperature	Low	**STempAlr H**	**SensTemp H**	
High-High sensor temperature	Average	**STempAlr HH**	**SensTemp HH**	

Table 11-8: Sensor Temperature Fault Triggers

For explanations on the heating system, see Section 3.6.

1.1.1.10 Battery Voltage Fault Triggers

The parameters pertaining to these alarm conditions are presented in Table 11-9 below and set in the H201T*i*'s **Service; Battery** and **SysOK Relay; FaultTrig.** Sub-menus (for explanations, see Chapter 5).

Description	Priority	Alarm Set Point	Fault Trigger	Alarm Message
Low-Low battery voltage	Average	**Batt.Alr LL**	**Batt. LL**	
Low battery voltage	Very Low	**Batt.Alr L**	**Batt. L**	

Table 11-9: Battery Voltage Fault Triggers

For explanations on the battery, see Section 3.7.

1.1.1.11 Sensor Operation and Connections Fault Triggers

A sensor test is automatically performed on the first and fifteenth days of each month at midnight, and relevant parameters are recorded in the **History; Service** file. The test can also be forced manually (**Service; ForceSensor Test** command), but the result is not recorded. In both cases, one of the alarm messages shown in Table 11-10 is displayed if the sensor fails the test.

Description	Priority	Alarm Set Point	Fault Trigger	Alarm Message
Replace sensor now	Very High	**SensRep Now**	**Replace Sensor NOW**	
Cable[a] short		**CableShort**		
Cable[a] open		**CableOpen**		

a: Either one of the following cables (or connectors in the connection link): Sensor, sensor thermistor or heating plate thermistor.

Table 11-10: Sensor Operation and Connections Fault Triggers

11.5.3 Fail Alarm Cancellation

Note: To be cancelled, an alarm condition must disappear during a period of time exceeding the corresponding alarm delay (if existing for this condition).

To cancel a fail alarm, proceed as follows:

1. Find and solve the problem (for help, see Section 11.5.2).
2. Acknowledge the alarm using the Hydran 201Ti's keypad or the Hydran Host software. For the procedure, see Section 5.2.1, and the Hydran Host Software Manual. If the problem has been corrected during a period of time exceeding the corresponding alarm delay, the alarm message then disappears from the H201Ti's display; otherwise, it simply stops flashing and remains on the display.

12 OPERATING THE HYDRAN 201I SYSTEM

CAUTION ***Read all of the warnings and recommendations in Section 6.1 before proceeding with the operation.***

12.1 Operating Methods

The Hydran 201 *i* System can be operated using several methods. Each of these methods is explained in the following pages, from the simplest to the most powerful one:

- Periodic, visual monitoring: See Section 12.1.1below.
- Alarm monitoring: See Section 12.1.2.
- Analog output monitoring: See Section 12.1.3.
- Combined alarm and analog output monitoring: See Section 12.1.4.
- Local monitoring with host computer: See Section 12.1.5.
- Remote monitoring with host computer: See Section 12.1.6.

12.1.1 Periodic, Visual Monitoring

Among the Hydran 201*i* System's operating methods, the *periodic, visual monitoring* is the simplest. If used, the following routine must be an integral part of the on-site, station inspection:

- Periodic, visual reading (once or twice a day) of the gas level reading on the display of the Hydran 201T*i*'s or the Hydran 201C*i*-1. For details on the various methods of data reading, see Section 12.2.
- On-site verification of alarms. For details on the alarms and relays operation, see Chapter 11.
- Manual logging of the above results.

Only basic training to the station's personnel is required to implant this operating method. When an alarm is detected, the operator must report the alarm and take the appropriate actions for this type of alarm (follow the regulations and practices of the company).

Note: With this method, the analog outputs and the alarm contacts are not connected to a SCADA system.

1.1.1.12 Method Drawbacks

The *periodic, visual monitoring* method has a deficient response time following the detection of an alarm; this response time cannot be inferior to the period of time between two inspections. The Hydran 201*i* System, however, has a response time measured in minutes.

12.1.2 Alarm Monitoring

The *alarm monitoring* method solves the disadvantages of the *periodic, visual monitoring* method as follows:

- Connecting the alarm contacts to an alarm panel (or any other SCADA system) located in the station's control room.
- Continuous alarm monitoring.
- Periodic, visual reading (weekly) of the gas level on the display of the Hydran 201T*i*'s or the Hydran 201C*i*-1. For details on the various methods of data reading, see Section 12.2.
- Manual logging of the gas level readings.

For details on the alarms and relays operation, see Chapter 11.

1.1.1.13 Method Drawbacks

The *alarm monitoring* method solves the response time inadequacy of the *periodic, visual monitoring* method (Section 12.1.1above), but does not provide any information to anticipate and prevent alarms.

Moreover, no information is available to immediately evaluate the severity of this alarm. For example, a rapid gas level increase and a daily trend increase trigger the same alarm. These two alarm conditions, however, do not have the same importance.

12.1.3 Analog Output Monitoring

The *analog output monitoring* (gas level monitoring via the analog output) solves the disadvantages of the *alarm monitoring* method (Section 12.1.2) as follows:

- Connecting the analog output to a SCADA system. The Hydran 201T *i* and the Hydran 201C*i*-1 both have analog outputs that allow to monitor the gas level evolution.
- Using a SCADA system to generate alarms based on the collected data.
- Periodic, visual reading (weekly) of the gas level on the display of the H201T*i*'s or the H201C*i*-1. For details on the various methods of data reading, see Section 12.2.

It is recommended to use a SCADA system that offers the following advantages:

- Gas level reading from the control room.
- Regular processing data analysis.
- Detection of gas and fail alarms when the specified alarm conditions are present. The system's response time must be short enough for the application's needs.
- Safe storage of historic data in a format that allows easy analysis from a host computer.

1.1.1.14 Method Drawbacks

Analog outputs have the following disadvantages:

- Analog outputs are generally sensitive to electric noise. Special software must be used to compute the gas hourly and daily trends using "noisy" data.
- It is not possible to detect analog outputs that are out of calibration.
- An industrial-grade analog input and cables are necessary for each Hydran 201*i* System.
- Analog outputs carry only one type of information in only one direction: The level of dissolved gases in oil.
- In the following cases, the trend computations are interrupted and cannot be restarted before enough data are available again. For a 30-day trend, this represents a long time.
  - The analog output cable is broken.
  - The host computer loses contact with the analog output signal.
  - The host computer becomes "unavailable."

Because of the above considerations, it is difficult to implement a reliable gas-trend alarm system based on the analog output signal.

1.1.1.15 Conclusion

Because of the above limitations and because it is not possible to change the Hydran 201*i* System's parameters from the control room, we can conclude that the *analog output monitoring* method (gas level monitoring via the analog output) still requires that a host computer be connected to the Hydran 201C*i* Controller to retrieve the Hydran 201T*i*'s historic data and modify parameters.

12.1.4 Combined Alarm and Analog Output Monitoring

As the name implies, this method combines the two previous monitoring methods. The major advantage of this method is its familiarity. Its limits become apparent when one reads the text on the two previous methods:

- Although the gas level, the gas alarms (gas level, hourly trend and daily trend) and fail alarm are now available at the same time, important information is still confined to the Hydran 201T*i*.
- Accessing the H201T*i* is still required to modify operation parameters.
- The amount of cabling becomes an important issue. For each H201T*i*, a minimum of four pairs of wires is required to connect the analog output, the two gas alarms and the fail alarm. To *receive* this information, three digital inputs and one analog input must be available in the SCADA system.

12.1.5 Local Monitoring With Host Computer

The *local monitoring with host computer* method consists of connecting a host computer running the **Hydran Host** software or **Perception** software to a Hydran 201*i* System or a network using computer's local RS-232 serial port or a USB port, depending on the communication protocol set in the network of Hydrans; for Hydran protocol use Hydran Host, or ModBus protocol use Perception. In case the 201Ti network is set to ModBus, then the connection from the host computer to the network can be established either using an USB to RS-485 converter and connect to the first H201T*i* in the network, directly on the Supervisory Link port, or using the network solution with Hydran 201Ci Controller.

Note: An RS-232 or USB communication port is available on each Hydran 201Ci Controller.

Both the Hydran Host software and Perception software allow various tasks, among which:

- Data reading (gas level, hourly and daily trends, etc.)
- Immediate detection of all alarms and their acknowledgment by the user.
- Modification of alarm settings and other parameters.
- Historic data upload from one or several Hydran 201T*i*'s.

For details, see the Hydran Host or Perception Software Manuals.

Note: Other software can be run on the host computer at the same time as the Hydran Host software, respectively Perception software. Hydran Host cannot be used in conjunction with a network of H201Ti set to ModBus protocol, and Perception software cannot be used in conjunction with a network of H201Ti set to Hydran protocol.

1.1.1.16 Method Benefits

The advantages of this method are as numerous as important:

- Gas level monitoring can be fully integrated to the transformer or station monitoring.
- Cabling is minimized.
- Reliability and performances are greater than those of methods based only on alarms and analog outputs monitoring.
- The use of networked electronic intelligent devices (such as the Hydran 201T*i* and the Hydran 201C*i*) is a mature technology with an extensive future.

12.1.6 Remote Monitoring With Host Computer

The *remote monitoring with host computer* method consists of connecting a host computer running the Hydran Host software to a Hydran 201*i* System or to one or several network(s) of Hydran 201*i* Systems located at different locations, through a telephone system and a modem link.

Remote monitoring offers the same features and benefits as local monitoring, plus:

- A modem can be connected to any Hydran 201*i* System in a local network. The modem is typically installed in any of the local network's Hydran 201C*i* Controllers.
- The modem of the local network is connected to a telephone line.
- The host computer equipped with a modem and the Hydran Host software communicates with the Hydran 201*i* System network(s), thus simplifying the monitoring process.
- Each power station can have its own, independent network.
- The station can be entirely automated (unmanned).

12.2 Data Reading

Data (gas level, hourly and daily trends, alarm messages, etc.) can be read as follows:

- Direct reading using a Hydran 201T*i*, a Hydran 201C*i* controller, the Hydran Host software or Perception software: See Section 12.2.1.
- Reading of the Hydran 201*i* System's historic data (using the H201T*i*, the Hydran Host software or Perception software): See Section 12.2.2.

12.2.1 Direct Data Reading

Data can be read directly as follows:

- *With the Hydran 201Ti*: Its local user-interface includes a six-key keypad and a 2-line per 16-character display. For details, see Chapter 5.
- *With the Hydran 201Ci-1*: Its local user-interface includes two illuminated push-buttons and a display, all mounted on the enclosure's door. Note that the H201C*i*-1 does not provide the cause of the alarm.
- *With the Hydran Host software*: A host computer running General Electric's Hydran Host software remains the easiest way to read data when the H201T*i* is set to Hydran protocol. The host computer screen provides an interaction far superior to the one of the H201T*i*'s local user-interface. For details, see the *Hydran Host Software Manual*. The windows **Network Survey** and **Real Time Log Set-Up** can be used to monitor the data of up to 128 H201T*i*'s.
- *With the Perception software*: A host computer running General Electric's Perception software remains the easiest way to read data when the H201T*i* is set to ModBus protocol. Perception screens provide an interaction far superior to the one of the H201T*i*'s local user-interface.

12.2.2 Historic Data Reading

The historic data simply consists of information (self-explanatory message, date and time of occurrence, etc.) recorded by and within the Hydran 201T*i* when an event happens (alarm triggering, parameter modification by the user, etc.) or at fixed, adjustable logging rates.

Historic data can be read as follows:

- *With the H201Ti local user interface*: Simply access the **History** submenu with the H201T*i*'s keypad. For details, see Section 5.5.1.
- *With the Hydran Host software or Perception software*: The H201T*i*'s historic data can be accessed easily using General Electric's Hydran Host (for Hydran protocol communication only) or Perception (for ModBus communication only) software. Simply transfer the historic data from the H201T*i*'s toward the Hydran Host or Perception software with the **Express Download** button in the **Network Survey** window. The procedure is described in the *Hydran Host Software Manual*.
- *With the Perception software*

12.3 Data Analysis

The Hydran 201*i* System generates numerous data to assist in the early detection of incipient faults in transformers or other oil-filled equipment.

Other parameters (transformer load, oil temperature, dissolved gas analysis [DGA]) can also be useful in interpreting the gas level and trend evolutions. This information can even be used to comment the historic data (see the *Hydran Host Software Manual*).

An excellent source of information on the interpretation of gases in oil is the IEEE Standard C57.104-1991 "Guide for the Interpretation of Gases in Oil-Immersed Transformers."

When interpreting the data of the Hydran 201*i* System, take the following points in consideration:

- An alarm can be triggered because of a misadjusted alarm set point. The historic data file Events indicates the modifications to the parameter settings (see Section 12.2.2 on above).
- An alarm (example: Low gas level) can be triggered following some maintenance procedure on the transformer, such as vacuum degassing of the oil.
- Daily load cycles and intermittent transformer operations both affect the Hydran 201T*i*'s gas level and hourly trend readings.

13 TROUBLESHOOTING

CAUTION

Read all of the warnings and recommendations in Section 6.1 before attempting one of the troubleshooting procedures listed in this Chapter.

The following useful references help to understand the instructions given in this Chapter:

- Alarms operation: See Chapter 11.
- Display of Hydran 201T*i*'s alarm messages: See Section 5.2.1.

13.1 Alarm Messages on the Hydran 201Ti's Display

This Section contains, in alphabetical order, all alarm messages that can be displayed by the H201T*i*:

- Battery L: See Section 13.1.1.
- Battery LL: See Section 13.1.2.
- CableOpen: See Section 13.1.3.
- CableShort: See Section 13.1.4.
- DayTrend H: See Section 13.1.5.
- DayTrend HH: See Section 13.1.6.
- DayTrend L: See Section 13.1.7.
- DayTrend LL: See Section 13.1.8.
- Gas H: See Section 13.1.9.
- Gas HH: See Section 13.1.10.
- Gas L: See Section 13.1.11.
- Gas LL: See Section 13.1.12.
- HourTrend H: See Section 13.1.13.
- HourTrend HH: See Section 13.1.14.
- HourTrend L: See Section 13.1.15.
- HourTrend LL: See Section 13.1.16.
- Replace SensNOW: See Section 13.1.17.
- Sensor Not Inst!: See Section 13.1.18.
- SensTemp H: See Section 13.1.19.
- SensTemp HH: See Section 13.1.20.
- SensTemp L: See Section 13.1.21.
- SensTemp LL: See Section 13.1.22.
- Setup Lost: See Section 13.1.23.

13.1.1 Battery L

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Battery voltage Low
- *Priority*: Very low
- *Parameter(s) involved*:
  - **Batt. L**; **SysOK Relay; FaultTrig.** submenu; Section 5.5.7.
  - **Batt.Alr L** (alarm set point); **Service; VoltPile** submenu; Section 5.5.4.3.
  - **BattAlr Delay**; **Service; VoltPile** submenu; Section 5.5.4.3.
- *Alarm cause(s)*: Battery voltage below the **Batt.Alr L** alarm set point

Replace the battery within the next nine months. For details, see Section 3.7.3.

13.1.2 Battery LL

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Battery voltage Low-*Low*
- *Priority*: Low
- *Parameter(s) involved*:
  - **Batt. LL**; **SysOK Relay; FaultTrig.** submenu; Section 5.5.7.
  - **Batt.Alr LL** (alarm set point); **Service; VoltPile** submenu; Section 5.5.4.3.
  - **BattAlr Delay**; **Service; VoltPile** submenu; Section 5.5.4.3.
- *Alarm cause(s)*: Battery voltage below the **Batt.Alr LL** alarm set point

Replace the battery within the next three months. For details, see Section 3.7.3.

13.1.3 CableOpen

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Cable open (not connected)
- *Priority*: Very high (repair cable immediately)
- *Parameter(s) involved*:
  - **CableOpen**; **SysOK Relay; FaultTrig.** submenu; Section 5.5.7.
  - No set point nor delay
- *Alarm cause(s)*: Faulty connection with one of the following cables:
  - Hydran 201 sensor cable
  - Sensor thermistor cable (reading of -75°C [-103°F] during one minute)
  - Heating plate thermistor cable (reading of -75°C [-103°F] during one minute)

Proceed as follows:

1. Identify the cable that triggers the alarm.
   - Verify whether the **SensorTemp** value in the **Temperature** submenu displays -75°C (-103°F). If so, the sensor thermistor cable (or a connector in the chain of connections) is the one causing the alarm.

- Verify whether the **HeaterTemp** value in the extended **Temperature** submenu displays -75°C (-103°F). If so, the heating plate thermistor cable (or a connector in the chain of connections) is the one causing the alarm.
- If the two above temperature readings are correct, execute the **ForceSensor Test** command in the **Service** submenu. If the result is different than **Good**, the sensor cable is probably the one causing the alarm.

2. Locate the corresponding cable and connectors in the Hydran 201T*i* (see Section 3.4.6.2).
3. Verify thoroughly the chain of connections for this cable, including the connectors.
4. Once the problem is fixed, execute the **ForceSensor Test** command in the **Service** submenu to reset the H201T*i* and cancel the alarm.
5. Wait at least two minutes.
6. Verify that the alarm has disappeared.
7. If applicable, verify that the corresponding temperature has returned to a normal value.

13.1.4 CableShort

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Short-circuited cable
- *Priority*: Very high (repair cable immediately)
- *Parameter(s) involved*:
  - **CableShort**; **SysOK Relay;FaultTrig.** submenu; Section 5.5.7.
  - No set point nor delay
- *Alarm cause(s)*: Faulty connection with one of the following cables:
  - Hydran 201 sensor cable
  - Sensor thermistor cable (reading of 200°C [392°F] during one minute)
  - Heating plate thermistor cable (reading of 200°C [392°F] during one minute)

Proceed as described for the **CableOpen** alarm (Section 13.1.3 above), but replace the temperature values indicated in the text by the following one: 200°C (392°F).

13.1.5 DayTrend H

- *Alarm type*: Gas alarm
- *Non-abbreviated description*: Daily trend High
- *Priority*: Medium
- *Parameter(s) involved*:
  - **DayTrAlr H** (alarm set point); **Gas; DailyTrend** submenu; Section 5.5.2.3.
  - **DayTrAlr Delay**; **Gas; DailyTrend** submenu; Section 5.5.2.3.

- *Alarm cause(s)*: Daily trend above the **DayTrAlr H** alarm set point

Proceed as follows:

1. Verify the daily trend calculated by the Hydran 201T*i*. This value is displayed in the Main Display mode (see Section 5.5.2) and also in the **DailyTrend** screen in the **Gas;DailyTrend** submenu (see Section 5.5.2.3). If this value seems normal, verify whether the value of the alarm set point is adequate. This parameter was probably set to a value that is too low.
2. Verify the gas level measured by the H201T*i*. This value is displayed in the Main Display mode (see Section 5.5.2) and also in the **GasLevel** screen in the **Gas;GasLevel** submenu (see Section 5.5.2.1). If this value seems normal, verify whether the value of the alarm set point is adequate. This parameter was probably set to a value that is too low.
3. If the gas level value is abnormally too high and the alarm set point is set to an adequate value, verify the reading accuracy of the Hydran 201*i* System. Perform a dissolved gas analysis (DGA; see Section 14.6).
4. If the gas level measured by the DGA corresponds to the H201T*i*'s reading, verify the equipment monitored by the H201T*i*; follow the company regulations.
5. If the gas level readings are different (taking into account the accuracy of the apparatus and the method), execute the **ForceSensor Test** command in the **Service** submenu to test the operation of the Hydran 201 sensor. A problem may have occurred since the last automatic sensor test (which is performed the first and fifteenth days of each month at midnight).

13.1.6 DayTrend HH

- *Alarm type*: Gas alarm
- *Non-abbreviated description*: Daily trend High-High
- *Priority*: High
- *Parameter(s) involved*:
  - **DayTrAlr HH** (alarm set point); **Gas;DailyTrend** submenu; Section 5.5.2.3.
  - **DayTrAlr Delay**; **Gas;DailyTrend** submenu; Section 5.5.2.3.

- *Alarm cause(s)*: Daily trend above the **DayTrAlr HH** alarm set point

Proceed as described for the **DayTrend H** alarm (Section 13.1.5).

13.1.7 DayTrend L

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Daily trend Low
- *Priority*: Medium
- *Parameter(s) involved*:
  - **DayTrend L**; **SysOK Relay;FaultTrig.** submenu; Section 5.5.7.
  - **DayTrAlr L** (alarm set point); **Gas;DailyTrend** submenu; Section 5.5.2.3.
  - **DayTrAlr Delay**; **Gas;DailyTrend** submenu; Section 5.5.2.3.

- *Alarm cause(s)*: Daily trend below the **DayTrAlr L** alarm set point. Probably indicates a gas level reading problem.

Proceed as follows:

1. Verify the daily trend calculated by the Hydran 201T*i*. This value is displayed in the Main Display mode (see Section 5.2.2) and also in the **DailyTrend** screen in the **Gas;DailyTrend** submenu (see Section 5.5.2.3). If this value seems normal, verify whether the value of the alarm set point is adequate. This parameter was probably set to a value that is too high.
2. Verify the gas level measured by the H201T*i*. This value is displayed in the Main Display mode (see Section 5.2.2) and also in the **GasLevel** screen in the **Gas; GasLevel** submenu (see Section 5.5.2.1). If this value seems normal, verify whether the value of the alarm set point is adequate. This parameter was probably set to a value that is too high.
3. Verify whether the breathing membrane of the H201Ti's enclosure (item 4 in Figure 3-1) and/or the one of the Hydran 201 sensor (see Figure 3-3) are obstructed by paint, grease or other products.
4. Verify whether the valve on which the H201T*i* is installed is open.
5. Execute the **ForceSensor Test** command in the **Service** submenu to test the operation of the H201 sensor. A problem may have occurred since the last automatic sensor test (which is performed the first and fifteenth days of each month at midnight).

13.1.8 DayTrend LL

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Daily trend Low-Low
- *Priority*: Medium
- *Parameter(s) involved*:
  - **DayTrend LL**; **SysOK Relay;FaultTrig.** submenu; Section 5.5.7.
  - **DayTrAlr LL** (alarm set point); **Gas;DailyTrend** submenu; Section 5.5.2.3.
  - **DayTrAlr Delay**; **Gas;DailyTrend** submenu; Section 5.5.2.3.

- *Alarm cause(s)*: Daily trend below the **DayTrAlr LL** alarm set point. Probably indicates a gas level reading problem.

Proceed as described for the **DayTrend L** alarm (Section 13.1.7 above).

13.1.9 Gas H

- *Alarm type*: Gas alarm
- *Non-abbreviated description*: Gas level High
- *Priority*: Medium
- *Parameter(s) involved*:
  - **GasAlr H** (alarm set point); **Gas;GasLevel** submenu; Section 5.5.2.1.
  - **GasAlr Delay**; **Gas;GasLevel** submenu; Section 5.5.2.1.

- *Alarm cause(s)*: Gas level above the **GasAlr H** alarm set point.

Perform steps 2 to 5 in Section 13.1.5.

13.1.10 Gas HH

- *Alarm type*: Gas alarm
- *Non-abbreviated description*: Gas level High-High
- *Priority*: High
- *Parameter(s) involved*:
  - **GasAlr HH** (alarm set point); **Gas;GasLevel** submenu; Section 5.5.2.1
  - **GasAlr Delay**; **Gas;GasLevel** submenu; Section 5.5.2.1
- *Alarm cause(s)*: Gas level above the **GasAlr HH** alarm set point.

Perform steps 2 to 5 in Section 13.1.5.

13.1.11 Gas L

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Gas level Low
- *Priority*: Medium
- *Parameter(s) involved*:
  - **Gas L**; **SysOK Relay;FaultTrig.** submenu; Section 5.5.7
  - **GasAlr L** (alarm set point); **Gas;GasLevel** submenu; Section 5.5.2.1
  - **GasAlr Delay**; **Gas;GasLevel** submenu; Section 5.5.2.1
- *Alarm cause(s)*: Gas level below the **GasAlr L** alarm set point. Probably indicates a gas level reading problem.

Perform steps 2 to 5 in Section 13.1.7.

13.1.12 Gas LL

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Gas level Low-Low
- *Priority*: Medium
- *Parameter(s) involved*:
  - **Gas LL**; **SysOK Relay;FaultTrig.** submenu; Section 5.5.7
  - **GasAlr LL** (alarm set point); **Gas;GasLevel** submenu; Section 5.5.2.1
  - **GasAlr Delay**; **Gas;GasLevel** submenu; Section 5.5.2.1

- *Alarm cause(s)*: Gas level below the **GasAlr LL** alarm set point. Probably indicates a gas level reading problem.

Perform steps 2 to 5 in Section 13.1.7.

13.1.13 HourTrend H

- *Alarm type*: Gas alarm
- *Non-abbreviated description*: Hourly trend High
- *Priority*: Medium
- *Parameter(s) involved*:
  - **HourTrAlr H** (alarm set point); **Gas;HourlyTrend** submenu; Section 5.5.2.2
  - **HourTrAlr Delay**; **Gas;HourlyTrend** submenu; Section 5.5.2.2

- *Alarm cause(s)*: Hourly trend above the **HourTrAlr H** alarm set point

Proceed as follows:

1. Verify the hourly trend calculated by the Hydran 201T*i*. This value is displayed in the Main Display mode (see SectionUser Interface) and also in the **HourlyTrend** screen in the **Gas; HourlyTrend** submenu (see Section 5.5.2.2). If this value seems normal, verify whether the value of the alarm set point is adequate. This parameter is probably set to a value that is too low.

Perform steps 2 to 5 in Section 13.1.5.

13.1.14 HourTrend HH

- *Alarm type*: Gas alarm
- *Non-abbreviated description*: Hourly trend High-High
- *Priority*: High
- *Parameter(s) involved*:
  - **HourTrAlr HH** (alarm set point); **Gas;HourlyTrend** submenu; Section 5.5.2.2
  - **HourTrAlr Delay**; **Gas;HourlyTrend** submenu; Section 5.5.2.2
- *Alarm cause(s)*: Hourly trend above the **HourTrAlr HH** alarm set point

Perform step 1 in Section 13.1.13 above, and then steps 2 to 5 in Section 13.1.5.

13.1.15 HourTrend L

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Hourly trend Low
- *Priority*: Medium
- *Parameter(s) involved*:
  - **HourTrend L**; **SysOK Relay;FaultTrig.** submenu; Section 5.5.7
  - **HourTrAlr L** (alarm set point); **Gas;HourlyTrend** submenu; Section 5.5.2.2
  - **HourTrAlr Delay**; **Gas;HourlyTrend** submenu; Section 5.5.2.2
- *Alarm cause(s)*: Hourly trend below the **HourTrAlr L** alarm set point. Probably indicates a gas level reading problem.

Proceed as follows:

1. Verify the hourly trend calculated by the Hydran 201T*i*. This value is displayed in the Main Display mode (see Section 5.2.2) and also in the **HourlyTrend** screen in the **Gas;HourlyTrend** submenu (see Section 5.5.2.2). If this value seems normal, verify whether the value of the alarm set point is adequate. This parameter was probably set to a value that is too high.
2. Perform steps 2 to 5 in Section 13.1.7.

13.1.16 HourTrend LL

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Hourly trend Low-Low
- *Priority*: High
- *Parameter(s) involved*:
  - **HourTrend LL**; **SysOK Relay;FaultTrig.** submenu; Section 5.5.7
  - **HourTrAlr LL** (alarm set point); **Gas;HourlyTrend** submenu; Section 5.5.2.2
  - **HourTrAlr Delay**; **Gas;HourlyTrend** submenu; Section 5.5.2.2
- *Alarm cause(s)*: Hourly trend below the **HourTrAlr LL** alarm set point. Probably indicates a gas level reading problem.

Perform step 1 in Section 13.1.15, and then steps 2 to 5 in Section 13.1.7.

13.1.17 Replace SensNOW

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Replace Hydran 201 sensor immediately
- *Priority*: Very high
- *Parameter(s) involved*:
  - **SensRep Now**; **SysOK Relay; FaultTrig.** submenu; Section 5.5.7

  - No set point nor delay
- *Alarm cause(s)*: The sensor sensitivity has dropped significantly or the sensor is not functioning.

Replace sensor as soon as possible.

Note: The Hydran 201Ti's H201 sensor is verified twice a month (the first and fifteenth days of the month at midnight); the relevant parameters are recorded in the historic data file Service. This test can also be performed manually using the ***ForceSensor Test*** *command (in the* ***Service*** *submenu), but no results are recorded. In both cases, the following message is displayed if the test fails:* ***Replace SensNOW****.*

13.1.18 Sensor Not Inst

- *Alarm type*: Not applicable
- *Non-abbreviated description*: Hydran 201 sensor not installed
- *Priority*: Very high
- *Parameter(s) involved*: None
- *Alarm cause(s)*: Problem with the H201 sensor

This message can only be displayed following the execution of a **ForceSensor Test** command (see Section 5.5.4.2).

Proceed as follows:

1. Ensure the serial numbers of the Hydran 201T*i* (located at the back of the heating plate) and the H201 sensor (located under the sensor connector) correspond to those indicated on the shipping box and on the H201T*i*'s Test Certificate and Data Sheet. For an example of certificate, see Figure 7-1.
2. Verify whether the **NewSensor** submenu (Section 5.5.8) contains the value belonging to the corresponding H201 sensor.
3. Press **CHANGE** to "force" the installation of a new sensor.

Note: Each H201Ti is configured for a specific H201 sensor. If you receive more than one H201Ti, take the necessary precautions to not interchange the H201 sensors and the H201Tis.

13.1.19 SensTemp H

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Sensor temperature High
- *Priority*: Low
- *Parameter(s) involved*:
  - **SensTemp H**; **SysOK Relay;FaultTrig.** submenu; Section 5.5.7
  - **STempAlr H** (alarm set point); **Temperature** submenu; Section 5.5.3
  - **TempoAlr Delay**; **Temperature** submenu; Section 5.5.3
- *Alarm cause(s)*: Temperature of the Hydran 201 sensor above the **STempAlr H** alarm set point

Although the H201 sensor is not affected by the temperature, monitor its temperature regularly.

13.1.20 SensTemp HH

- *Alarm type*: Fail alarm
- *Non-abbreviated description* : Sensor temperature High-High
- *Priority*: Medium
- *Parameter(s) involved*:
  - **SensTemp HH**; **SysOK Relay; FaultTrig.** submenu; Section 5.5.7
  - **STempAlr HH** (alarm set point); **Temperature** submenu; Section 5.5.3
  - **TempoAlr Delay**; **Temperature** submenu; S Section 5.5.3
- *Alarm cause(s)*: Temperature of the Hydran 201 sensor above the **STempAlr HH** alarm set point

CAUTION ***Exposing the H201 sensor to temperatures above the STempAlr HH alarm set point can damage the sensor.***

Proceed as follows:

1. The oil is probably too hot at the location where the H201 sensor is installed; install the Hydran 201T*i* at another location on the transformer tank, preferably at the bottom. For details on typical installations, see Section 6.2.2.3.
2. If not already done, install the finned high temperature adaptor shown in Figure B - 6; it can be purchased from General Electric.

13.1.21 SensTemp L

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Sensor temperature Low
- *Priority*: Low
- *Parameter(s) involved*:
  - **SensTemp L**; **SysOK Relay;FaultTrig.** submenu; Section 5.5.7
  - **STempAlr L** (alarm set point); **Temperature** submenu; Section 5.5.3
  - **TempoAlr Delay**; **Temperature** submenu; Section 5.5.3
- *Alarm cause(s)*: Temperature of the Hydran 201 sensor below the **STempAlr L** alarm set point

Although the H201 sensor is not affected by the temperature, monitor its temperature regularly.

13.1.22 SensTemp LL

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Sensor temperature Low-Low
- *Priority*: Medium
- *Parameter(s) involved*:
  - **SensTemp LL**; **SysOK Relay;FaultTrig.** submenu; Section 5.5.7
  - **STempAlr LL** (alarm set point); **Temperature** submenu; Section 5.5.3
  - **TempoAlr Delay**; **Temperature** submenu; Section 5.5.3
- *Alarm cause(s)*: Temperature of the Hydran 201 sensor below the **STempAlr LL** alarm set point

The sensor sensitivity is very low; repair the Hydran 201T*i*'s heating system.

13.1.23 Setup Lost

- *Alarm type*: Fail alarm
- *Non-abbreviated description*: Lost setup (configuration)
- *Priority*: Very high
- *Parameter(s) involved*: None
- *Alarm cause(s)*: See below

The **Setup Lost** alarm can be triggered by three causes. Each one is identified by a number displayed at the right of the message:

- **(1)** The value of at least one Hydran 201T*i*'s parameters is incorrect in the memory; in other words, the parameter has been changed, but not by a user.
  - Especially, verify the value of the **CheckSum** parameter in the **Service** submenu. For details, see Section 5.5.4.1.
  - Because of this error, the default values are now the ones being used; verify carefully if the value of each parameter corresponds to your needs.
- (**2**) Sensor not installed.
- (**4**) Date before 1996.

If two or all above causes trigger the alarm, the numbers are added up. For example, if, at the same time, a value is incorrect (**1**) and the date is before 1996 (**4**), the number **5** (**1** + **4**) is displayed.

*Note: Each time the **Setup Lost** alarm is triggered, the **BattAlr Delay** parameter in the **Service** submenu (see Section 5.5.4.3) is reset. This parameter must be set to the desired value after the alarm has disappeared.*

13.2 RS-232, USB and/or RS-485 Communications

13.2.1 No Communication when the Host Computer is connected directly or by Modem to the Hydran 201Ti's USB Connector

1. Ensure the H201T*i*'s **CommChannel** parameter (communication channel; **Communication** submenu; Section 5.5.6.1) is set to **Local USB** (for Hydran protocol only) **or LocalUSB MODBUS** (for ModBus protocol only).
2. Ensure the H201T*i*'s **BaudRate** parameter (data transmission speed; **Communication** submenu) is identical to the one indicated in the Hydran Host software, respectively Perception software.
3. Ensure the H201T*i*'s **H201Ti ID** and **PowerStat. ID** parameters (identification numbers of the H201T*i* and the power station; **Communication** submenu) are identical to the ones indicated in the Hydran Host software, respectively Perception software.
4. In the Hydran Host software, respectively Perception software, ensure the specified communication port is valid (COM1, COM2).
5. Verify the USB link cable.
6. Ensure the modem's configuration string is correct.

13.2.2 No Communication when the Host Computer is connected directly or by Modem to the Hydran 201Ci Controller's DB-9 or USB Connector

1. Ensure the **CommChannel** parameter (communication channel; **Communication** submenu; Section 5.5.6.1) of all Hydran 201T*i*'s connected to the H201C*i* Controller is set to **Supervisory Link** (for Hydran protocol only) **or SupervLink MODBUS** (for ModBus protocol only).
2. Ensure the **BaudRate** parameter (data transmission speed; **Communication** submenu) of all H201T*i*'s connected to the H201C*i* Controller is identical to the one indicated in the Hydran Host, respectively Perception software.
3. Ensure the **H201Ti ID** and **PowerStat. ID** parameters (identification numbers of the H201T*i*'s and the power station; **Communication** submenu) of all H201T*i*'s connected to the H201C*i* Controller are identical to the ones indicated in the Hydran Host, respectively Perception software.
4. In the Hydran Host software, respectively Perception, ensure the specified communication port is valid (COM1, COM2, etc.).
5. If the USB port is used ensure the specified communication port is identical to the one associated by your computer to your USB link.
6. Verify the USB to RS-485 converter
7. Verify the supervisory link cable.
8. Verify the RS-232 or USB link cable to the H201Ci Controller.
9. Verify the power supply and the operation of the H201C*i* Controller.
10. Ensure the modem's configuration string is correct.

13.2.3 No Communication between the Host Computer and the Network of Hydran 201i Systems

1. Connect the host computer to each Hydran 201C*i* Controller and perform the tests listed in Section 13.2.2 above.
2. Verify all RS-485 local network link cables.
3. Disconnect all RS-485 link cables and "rebuild" the network, one H201C*i* Controller at a time. See Section 8.2.3.

13.3 Hydran 201Ci Controller's Display is Blank

1. If the fail alarm is triggered (and the analog outputs have dropped to 4.00 ± 0.10 mA), read the alarm message on the Hydran 201T*i*'s display to identify the cause of the alarm. Then see Section 13.1.
2. Verify the fuse(s) and power supply of the H201C*i* Controller and H201T*i*.
3. Verify the connections of the TDM signal at both ends of the supervisory link cable.
4. Verify the operation of the H201C*i* Controller's display.

13.4 Hydran 201Ti and Hydran 201Ci Controller's Analog Outputs at Zero

1. If the fail alarm is triggered (the H201C*i* Controller's display is blank and the analog outputs have dropped to zero), read the alarm message on the H201T*i*'s display to identify the cause of the alarm. Then see Section 13.1.
2. Verify the fuses and power supply of the H201C*i* Controller and H201T*i*.
3. Verify the connections of the TDM signal at both ends of the supervisory link cable.
4. Verify the H201T*i*'s analog output circuit by setting the H201T*i*'s **AnalogMode** parameter (**Relays/Analog;Analog Out** submenu; see Section 5.5.7.4) to **Force 50%** or **Force 100%**. Verify the result via the Hydran Host software or the SCADA system.
5. Verify the H201C*i* Controller's analog output circuit by setting the H201T*i*'s **TDM Mode** parameter (**Relays/Analog;TDM Out** submenu; see Section 5.5.7.5) to **Force 50%** or **Force 100%**. Verify the result via the Hydran Host software or the SCADA system.

13.5 Alarms

13.5.1 Fail Alarm is Triggered

1. Read the alarm message on the Hydran 201T*i*'s display to identify the cause of the alarm. Then see Section 13.1.
2. Verify the fuses and power supply of the Hydran 201C*i* Controller and H201T*i*.
3. Verify the connections of the TDM signal at both ends of the supervisory link cable.

13.5.2 Fail Alarm Message Displayed in the Hydran Host Software

1. Display the on-line help of the alarm message window to identify the cause of the alarm.
2. For the procedure, see Section 13.1.

13.5.3 Intermittent Gas Alarms are Occurring

1. Alarm set points are too low. Consult the Hydran 201T*i*'s historic data files Short Term and Long Term.
2. Compare the set points with the variations of gas level, hourly trend and daily trend.
3. Verify the H201T*i*'s gas alarm delays.

13.5.4 An Alarm Relay does not Reset, even if the Alarm Condition has Disappeared

1. The corresponding alarm delay has not yet expired.
2. The **RelayMode** parameter (**Relays/Analog** submenu; Section 5.5.7) of the Hydran 201T*i*'s corresponding relay is set to **Force ON** or **Force OFF**.
3. The **RelayMode** parameter of the H201T*i*'s corresponding relay is set to **Latch**. The alarm must be acknowledged using the H201T*i*'s keypad (and the alarm condition must have disappeared) to cancel the alarm.
4. Verify the relay's contacts and the circuit by setting the corresponding **RelayMode** parameter to **Force ON** and **Force OFF** in the H201T*i*'s **Relays/Analog** submenu.

13.5.5 Irregular Gas Readings

1. Ensure the valve (on which the Hydran 201T*i* is installed) is fully open.
2. Confirm that the valve type is acceptable (full bore, gate or ball, no restriction between valve and tank). See the recommendations in Section 6.1.

3. Verify the Hydran 201 sensor's serial number and parameters in the H201T*i*'s **Service; SensorCal Data** submenu (Section 5.5.4.1).
4. Execute the H201T*i*'s **ForceSensor Test** command (**Relays/Analog** submenu) to test sensor operation.
5. Verify the value of the **HourlyTr Period** parameter (period of the hourly trend; **Gas; HourlyTrend** submenu).
6. Verify the value of the **DailyTr Period** parameter (period of the daily trend; **Gas;DailyTrend** submenu).
7. Verify the value of the **Period B** parameter (**Temperature; DynOil Sampl** submenu).
8. Verify the parameters pertaining to the sensor temperature (**Temperature** submenu).
9. Consult General Electric to optimize the value of the parameters and the location of the H201 sensor.

13.5.6 Inaccurate Gas Readings

1. Verify the transformer's level of fault gases-in-oil by performing a dissolved gas analysis (DGA; see Section 14.6).
2. Ensure the valve (on which the Hydran 201T*i* is installed) is fully open.
3. Confirm that the valve type is acceptable (full bore, gate or ball, no restriction between valve and tank). See the recommendations in Section 6.1.
4. Verify the Hydran 201 sensor's serial number and parameters in the H201T*i*'s **Service; SensorCal Data** submenu (Section 5.5.4.1).
5. Execute the H201T*i*'s **ForceSensor Test** command (**Relays/Analog** submenu) to test the sensor operation.
6. Verify the parameters pertaining to the sensor temperature (**Temperature** submenu).
7. Consult General Electric to optimize the value of the parameters and the location of the H201 sensor.

13.5.7 Gas Level Reading is Abnormally High

See Section 13.1.9.

13.5.8 Gas Level is Slowly Decreasing towards Zero

See Section 13.1.15.

14 MAINTENANCE

The maintenance schedule suggested in this Chapter provides optimum performance and reliability from the Hydran 201*i* System. The maintenance routines should be performed in fair weather.

WARNING

All procedures in this manual must be strictly adhered to. Any deviation from these could cause irreversible damages to the transformer being monitored and/or the Hydran 201i System, and could lead to property damage, personal injury and/or death. Installation and maintenance of the Hydran 201i System must be carried out by qualified personnel only.

Note: Some steps in the maintenance procedures described in this Chapter may not apply, depending on the option(s) installed.

CAUTION

Before proceeding with any maintenance operation, review the local safety regulations. Read all the warnings and recommendations in Section 6.1.

14.1 Cleaning the Enclosure Exterior

WARNING

Do not remove the cover, to prevent electric shock.

There are no inside parts that you can service; maintenance or cleaning of internal parts is not necessary.

To clean the exterior of the enclosure, use a clean cloth that is dry or slightly damp.

CAUTION

Do not use cleaning agents or chemicals, as they may damage the plastic parts or lettering.

14.2 Replacing the Fuse

In case the fuse of the Hydran 201T*i* has blown off, remove the fuse holder and replace the fuse.

WARNING

The replacement of the fuse must be executed by trained service personnel only.

- Fuse specifications:
  - GE part number: 17225
  - Fuse size: 5 x 20 mm
  - Fuse type: Time delay
  - Fuse rating: 5A, 250V
  - Recommended models: 0218005.MXP (Littelfuse)

14.3 Replacing the Battery

Refer to section 3.7.4.

14.4 Periodic Maintenance

The person in charge of maintenance must already be familiar enough with the Hydran 201*i* System to:

- Use and set the Hydran 201T*i*'s parameters with its keypad.
- Use the Hydran 201C*i* Controller and communicate with it.
- Use General Electric Canada's Hydran Host software.

If not, reviewing the previous chapters helps in performing maintenance routines. Also, consult the *Hydran Host Software Manual*.

Table 14-1 below summarizes the maintenance routines and their frequency. Each routine is explained in detail in the Section indicated in the table.

Routine	Frequency
Historic data verification (Section 14.5)	Annually or on alarm
Dissolved gas analysis (DGA; Section 14.6)	
Hydran 201T*i* verification (Section 14.7): • Visual inspection • LED's, heater, display and keypad verification (Section 7.2.2) • Parameter verification (alarm set points, etc.) • Alarm relays verification (Section 7.2.4) • Verification of sensor tests[a] (Section 7.2.6) • Analog output verification (if connected; Section 7.2.8)	Annually or on fail alarm
Hydran 201C*i* Controller verification (Section 14.8): • Visual inspection • LED's, heater and display verification (Section 9.2.2) • Hydran 201Ci-1's analog output verification (if connected; Section 9.2.3) • H201Ci-1's alarm relays verification (if connected; Section 9.2.4) • RS-232 or USB and RS-485 communications verification (Section 8.2.3)	Annually or on fail alarm

a. *The H201Ti's sensor is tested automatically twice a month, and the results are stored in the historic data file Service.*

Table 14-1: Maintenance Routines and their Frequency

14.5 Historic Data Verification

Frequency: Annually or on alarm

In addition to the annual or on-alarm verification, the Hydran 201T*i*'s historic data must also be read regularly by the user.

If the data is read from the H201T*i*, follow the instructions in Section 5.5.1. The data can be collected using a host computer running the Hydran Host software (see the *Hydran Host Software Manual*).

The historic data are verified as follows:

1. Consult the historic data file Events to investigate suspicious alarms and other events.
2. Consult the historic data files Short Term and Long Term to study the evolution of the gas level and the hourly and daily trends.
3. Ensure the hourly and daily trends periods are optimized. Change the values if necessary.
4. Examine every alarm setting. Change the values if necessary.

Note: Alarm settings should be modified by authorized personnel only.

14.6 Dissolved Gas Analysis (DGA)

Frequency: Annually (minimum) or on alarm

The dissolved gas analysis (DGA) is the reference method used to determine the exact level of dissolved gases in oil. A DGA should be performed at least once a year.

To verify the readings of the Hydran 201*i* System using a DGA, proceed as follows:

1. Note the Hydran 201T*i*'s gas level reading.
2. Take an oil sample from the Hydran 201 sensor's sampling port (see Appendix I).
3. Send the sample to a qualified laboratory.

The DGA results include the concentrations, in parts per million (ppm), of the following gases:

- Hydrogen (H_2)
- Carbon monoxide (CO)
- Acetylene (C_2H_2)
- Ethylene (C_2H_4)
- Methane (CH_4)
- Ethane (C_2H_6)
- Carbon dioxide (CO_2)
- Nitrogen (N_2)
- Oxygen (O_2)

The Hydran 201*i* System gives a composite reading of the first four gases in the above list, in other words the gases generated by transformer incipient faults. This reading can be compared to the DGA results using the following formula:

H201T*i* reading = 100 % [H_2] + 18 % [CO] + 8 % [C_2H_2] + 1.5 % [C_2H_4]

A few examples are given in Table 14-2. The difference between the actual and the calculated readings should fall within the technical specifications of the Hydran 201*i* System.

Dissolved Gas Analysis (DGA) (ppm)				H201T*i* Reading (ppm)
Hydrogen (H_2)	Carbon Monoxide (CO)	Acetylene (C_2H_2)	Ethylene (C_2H_4)	
100	0	0	0	100
100	1000	0	0	280
100	100	0	0	118
100	100	50	0	122
100	100	50	200	125

Table 14-2: Examples of Gas Reading Comparisons between a DGA and a Hydran 201T*i*

14.7 Hydran 201Ti Verification

Frequency: Annually or on fail alarm

Note: Alarms are triggered during this verification procedure. Please warn the appropriate personnel.

CAUTION ***Read the precautions listed in Section 6.1 before handling the Hydran 201 sensor.***

The H201T*i* is verified as follows:

1. Check for oil leaks.
2. If necessary, clean and retighten the brass adaptor and the H201 sensor.
3. Check for loose connections on the terminal blocks and connectors. Retighten if necessary.

WARNING

AC power supply voltage is present on most terminals.

4. Verify the LED's, the heater, the display and the keypad by performing the procedure in Section7.2.2.
5. Using the H201T*i*'s keypad or a host computer running the Hydran Host software (see the *Hydran Host Software Manual*), verify the date and time in the **Date&Time** submenu (Section 5.5.5) by performing the procedure in Section 7.4.9. If they must be adjusted, see Section 7.2.3.
6. Verify the four parameters in the **History;HistoSetup** submenu (Section 5.5.1). If they must be adjusted, see Section 7.4.2.
7. Verify the parameters in the **Gas** submenu (Section 5.5.2). If they must be adjusted, see Section 7.4.3.
8. Verify the parameters in the **Temperature** submenu (Section 5.5.3). If they must be adjusted, see Section 7.4.5.
9. Verify the **Period A** and **Period B** parameters in the **Temperature;DynOil Sampl** submenu.
10. Verify the **SerialNumber**, the ten H201 sensor parameters and the **CheckSum** (all in the **Service;SensorCal Data** submenu, Section 5.5.4.1) correspond to those written on the Test Certificate and Data Sheet (see an example in Figure 7-1). If those parameters must be adjusted, see Section 7.4.6.
11. Verify the parameters (only accessed using the H201T*i*'s keypad) in the **Communication** submenu (Section 5.5.6) by performing the procedure in Section 7.4.10. If they must be adjusted, see Section 7.4.1.
12. Verify the operation mode of the TDM signal in the **Relays/Analog;TDM Out** submenu (Section 5.5.7.5).
13. If the H201T*i*'s alarm contacts are used (connected to a SCADA system), verify the alarm relays by performing the procedure in Section 7.2.4.

Note: Generally, the SCADA system is connected to the alarm contacts of the Hydran 201Ci Controller.

14. Verify the battery voltage and the other parameters in the **Service;Battery** submenu. (Section 5.5.4.3) by performing the procedure in Section 7.2.5. If they must be adjusted, see Section 7.4.7.
15. Verify the sensor serial number and perform a sensor test, as described in Section 7.2.6.
16. If the analog output is used (connected to a SCADA system), verify it by performing the procedure in Section 7.2.8.

Note: Generally, the SCADA system is connected to the analog outputs of the H201Ci Controller.

17. If a USB link is used, verify it by performing the procedure in Section 7.2.9.

14.8 Hydran 201Ci Controller Verification

Frequency: Annually or on fail alarm

Note: Alarms are triggered during this verification procedure. Please warn the appropriate personnel.

The H201C*i* is verified as follows:

1. Check for water or dust infiltration inside the enclosure.
2. If necessary, clean and fix the enclosure.
3. Check for loose connections on the terminal blocks and connectors. Retighten if necessary.

WARNING ***AC power supply voltage is present on most terminals.***

4. Verify the LED's, the heater and the display by performing the procedure in Section 9.2.2.
5. Verify the Hydran 201C*i*-1's analog output by performing the procedure in Section 9.2.3.
6. If the H201C*i*-1 is not currently in operation and if its alarm contacts are used (connected to a SCADA system), verify the alarm indicators and relays by performing the procedure in Section 9.2.4.
7. Verify the RS-232 or USB and RS-485 communications by performing the procedure in Section 8.2.3.

14.9 Fuse

The Hydran 201T*i*, the Hydran 201C*i*-C and the Hydran 201C*i*-1 require the following type of fuse:

- 5 A
- 250 VAC
- 5 x 20mm
- Slow blow / Time delay

15 DECOMMISSIONING THE HYDRAN 201TI

The Hydran 201*i* system is designed to be permanently installed for autonomous operation on a transformer. If however, the Hydran 201*i* must be decommissioned, the procedure to be followed is described in this chapter.

15.1 Powering Off

WARNING

The following procedure must be carried out thoroughly. Failure to do so may result in property damage, personal injury and/or death.

The decommissioning of the Hydran 201Ti must be executed by trained service personnel only.

1. Switch OFF the circuit breaker to which the power cable of the Hydran 201*i* system is connected.
2. Verify, with a voltmeter, there is no AC or DC voltage on the power cable.
3. Disconnect the power cable from the circuit breaker.
4. Remove the cover of the Hydran 201*i* system to be decommissioned.
5. Verify there is no AC or DC voltage on the mains supply terminals of the unit.
6. Verify there is no AC or DC voltage on the cables connected to the analog inputs, analog outputs or/and digital inputs if present.
7. Verify there is no AC or DC voltage on the cables connected to the alarm relays.
8. Verify there is no AC or DC voltage on the cable connected to the RS-485 terminals.
9. If any of the cables is still fed by an external source, identify and isolate the source.

15.2 Cable Disconnection

After verification that there is no AC or DC voltage on all cables connected to the Hydran 201T*i* unit, proceed as following:

1. Disconnect the power supply cable and remove this cable.
2. Disconnect the cables from the analog inputs, analog outputs or/and digital inputs if installed and remove these cables.
3. Disconnect the cable from the alarm relays terminals and remove this cable.
4. Disconnect the cable from the RS-485 terminals and remove this cable.

15.3 Removing the Hydran 201Ti

1. Refer to section 6.2.1 for the tools required

CAUTION ***Perform this step according to company regulations. Proceed carefully to avoid introducing air into the transformer. Use a bucket to collect oil.***

2. Close the valve to which the Hydran 201Ti is mounted.
3. Slightly loosen the bleed screw on the sensor about 1/8 of a turn, using the supplied 5/32-in Allen key. Refer to Figure 7-7
4. Remove carefully the CPU module. Refer to section 7.3.2.1
5. Disconnect the sensor cable from Hydran 201 sensor connector.
6. Remove the six 1/4-28 cap screws from the adaptor using the supplied 3/16-in Allen key.
7. Separate the adaptor with sensor from the Hydran 201T*i* electronic enclosure.
8. Unscrew the sensor adaptor from the valve using an adjustable wrench. It is recommended not to use a wrench with jagged jaws as these may damage the sensor.
9. Use disposable paper to absorb the oil from the sensor. Allow the sensor to drip overnight on disposable absorbent paper.
10. Dispose of the collected oil and paper according to the power utility regulations.
11. Reassemble the sensor adaptor with the electronic enclosure, as well as the CPU module.
12. Store the H201T*i* unit.

Appendix A : Technical Specifications for the Hydran 201i System

A.1 Hydran 201Ti Intelligent Transmitter

GENERAL

Description	Continuous, on-line, intelligent gas-in-oil transmitter
Components	Sensor and electronic modules housed in cylindrical enclosure
Gas Response	Hydrogen (H_2), carbon monoxide (CO), acetylene (C_2H_2), ethylene (C_2H_4)
Medium	Mineral, insulating oil for transformers
Application	Transformer monitoring; specifically, detection of incipient faults in oil-filled electrical equipment

ANALYTICAL PERFORMANCE

Principle	Gas-permeable membrane and combustible gas detector
Sampling Method	Flooded port with 1 in NPT male threads
Measurement	Gas: 0-2,000 ppm (volume/volume, H2 equivalent) other ranges available
Accuracy	For 0–2,000 ppm range: ± 10% of reading ±25 ppm (H_2 equivalent)
Relative Sensitivity	H_2: 100 % of concentration CO: Typical 15 ± 4 % of concentration C_2H_2: Typical 8 ± 2 % of concentration C_2H_4: Typical 1.5 ± 0.5 % of concentration
Response Time	10 minutes sensor response (90 % of step change)
External Sampling Port	Designed for glass syringe with Luer stop cock; closed with 5/32-in (approximately 4 mm) Allen screw

ELECTRONIC UNIT

Hardware	Microprocessor; watchdog; clock
Software	Real-time operating system; menu-driven interface
Functions	- Gas level, hourly trend and daily trend readings - Gas level and gas trends an fail alarms - History data logging (Short Term, Long Term, Events and Service) - Periodic sensor test - Calibration, configuration and self-test - Networking - Remote embedded software upgrading - Remote control via Hydran 201Ci Controller (optional modem) - Hydran protocol or ModBus protocol over Supervisory link (RS-485)
Communications	User selection (one port at a time): USB Type B female connector for host computer Supervisory link to connect to PC or H201Ci Controller
Display	Backlit liquid crystal display (LCD); 2 lines x 16 characters
Keypad	Keypad 6 keys: **Enter, Up, Down, Change, Esc** and **End**
Alarm Contacts	Gas High, Gas High-High and System Fail One NO and one NC contact (type C) per alarm Resistive load: 3A @ 250 VAC; 3A @ 30 VDC
Analog Output	Isolated 4–20 mA; 0–2,000 ppm range; isolation 2,000 Vac RMS; 10 V load maximum; 500-ohm @ 20 mA

MISCELLANEOUS

Enclosure	Type NEMA 4X; white, cylindrical aluminum housing; 186mm (7.3in) diameter x 180 mm (7-1/8 in)
Electronic Modules	Totally enclosed CPU and I/O electronics
Enclosure Heating/Cooling	300-W heating plate; convection cooling; maintain unit between 15 and 65°C (59 and 149°F)
Brass Adaptor	With 1.5-in male NPT threads (standard); mounting on

transformer valve; other dimensions are available

Oil Temperatures

Oil at the valve: -40 to +90°C (-40 to +194°F)

With finned, high-temperature adaptor: Oil up to 105 °C (221 °F)

Possible short-duration exposure: Oil up to 120 °C (248 °F)

Oil Pressure

Vacuum-resistant sensor; 0–700 kPa (0–100 psi)

Power Supply

Rated voltage: 100–120 VAC or 200–240 VAC, 50/60 Hz

Rated power: 475 VA maximum

Standards Met

- CISPR 11: Measurement of radiated and conducted emissions
- IEC 60068-2-1: Environmental testing at cold temperature
- IEC 60068-2-2: Environmental testing at dry heat temperature
- IEC 60255-5: Insulation coordination for measuring relays and protection equipment
- EN 61000-4-2: ESD immunity
- EN 61000-4-3: Radiated electromagnetic field immunity – radio frequencies
- EN 61000-4-4: Electrical fast transient/burst immunity
- EN 61000-4-5: Surge immunity
- EN 61000-4-6: Immunity to conducted disturbance induced by radio-frequency fields
- EN 61000-4-8: Power frequency magnetic field immunity
- EN 61000-4-11: Voltage dips, short interruptions and voltage variations immunity (applicable for ac power supply only)
- EN 61010-1: Product safety

Weight

Installed: 5.6kg (12lb)

Shipping: 6.9kg (15lb)

Hydran Host Software

Supports all H201Ti functions plus networking and embedded software upgrading; available in Microsoft Windows version

ENVIRONMENTAL CONDITIONS

Operation

Ambient temperature*: -40 to +55˚C (-40 to +131˚F)

Relative humidity: 95% RH, non-condensing

Altitude: up to 2,000m (6,500ft)

Storage

Ambient temperature: +5 to +45˚C (41 to +113˚F)

Storage period should not exceed six months.

★ *Note 1: At low temperatures, the LCD display might not be legible, but all other functionalities are fully operational.*
★ *Note 2: For operation ambient temperature lower than -40°C, consult General Electric Customer Service.*

General Electric has made every reasonable attempt to ensure the completeness and accuracy of these technical specifications. However, the information contained in these technical specifications is subject to change without notice, and does not represent a commitment on the part of General Electric.

A.2 Hydran 201Ci-C Communications Controller

GENERAL

Description Remote controller for one to four Hydran 201Ti's; manages communications, including networking

Components Electronic unit housed in a IP55/NEMA 4X enclosure, suitable for outdoor installation

Application Supervision of one to four H201Ti's and/or a network of up to 128 H201Ti's via a single RS-232 or USB port, either locally or remotely through an optional modem

ELECTRONIC UNIT

Functions Management of communications transmitted from:

H201Ti's (supervisory link)

H201Ci Controllers (H201Ci-C's and/or H201Ci-1's) in the network (RS-485 link)

A host computer (RS-232 or USB link)

Display None

Analog Outputs None

Alarm Contacts None

COMMUNICATIONS/NETWORK

Supervisory Link Connects with one H201Ti

2,000-V RMS isolated

A 2-twisted-pairs (16 or 18 AWG) cable with overall shield is required per H201Ti

Maximal length (all cables added up): 1,200 m (4,000 ft)

	Power supply: Separate, isolated, impedance-protected, +15 Vdc
RS485 Local Network Link (Isolated)	Standard RS-485 communication port allows daisy-chaining of up to 32 H201Ci Controllers (H201Ci-C's and/or H201Ci-1's) via the Main Terminal Block
	One twisted triad (16 or 18 AWG) with overall shield required
	Maximal total daisy-chain length: 1,200 m (4,000 ft)
RS-232 or USB Link	Standard RS-232 port (DB-9 connector), or standard USB link (type-B connector)
	Allows serial communications with a local host computer (or remotely with optional modem)
	Any H201Ti can be accessed through any H201Ci Controller in the local network
Recommendation	Run all communication cables in flexible or rigid, metallic conduits for maximum mechanical and electrical protection

MISCELLANEOUS

Enclosure	Type NEMA 4X steel enclosure; baked enamel; textured white finish
Dimensions	244.5 x 349.3 x 157.7 mm (9 5/8 x 13 3/4 x 3 3/16 in)
Power Supply	Rated voltage: 100–120 VAC or 200–240 VAC, 50/60 Hz
	Rated power: 145 VA maximum
Standards Met	• CISPR 11: Measurement of radiated and conducted emissions • IEC 60068-2-1: Environmental testing at cold temperature • IEC 60068-2-2: Environmental testing at dry heat temperature • IEC 60255-5: Insulation coordination for measuring relays and protection equipment • EN 61000-4-2: ESD immunity • EN 61000-4-3: Radiated electromagnetic field immunity – radio frequencies • EN 61000-4-4: Electrical fast transient/burst immunity • EN 61000-4-5: Surge immunity • EN 61000-4-6: Immunity to conducted disturbance induced by radio-frequency fields • EN 61000-4-8: Power frequency magnetic field immunity • EN 61000-4-11: Voltage dips, short interruptions and voltage variations immunity (applicable for ac power supply only) • EN 61010-1: Product safety

Weight	• Installed: 6.6kg (15lb) • Shipping: 7.5kg (17lb)
Hydran Host Software	Supports all H201Ti functions plus networking and embedded software upgrading; available in Microsoft Windows version

ENVIRONMENTAL CONDITIONS

Operation	Ambient temperature*: -40 to +55˚C (-40 to +131˚F) Relative humidity: 95% RH, non-condensing Altitude: up to 2,000m (6,500ft)
Storage	Ambient temperature: +5 to +45˚C (41 to +113˚F)

★ *Note: For operation ambient temperature lower than -40°C, consult General Electric Customer Service.*

General Electric has made every reasonable attempt to ensure the completeness and accuracy of these technical specifications. However, the information contained in these technical specifications is subject to change without notice, and does not represent a commitment on the part of General Electric.

A.3 Hydran 201Ci-1 One-Channel Controller

GENERAL

Description	Remote controller for one Hydran 201Ti; provides network communications capabilities, a gas level digital display, alarm contacts, alarm indicators and an isolated, analog output
Components	Electronic unit housed in a IP55/NEMA 4X enclosure, suitable for outdoor installation
Application	Supervision of one to H201Ti and/or a network of up to 128 H201Ti's via a single RS-232 or USB port, either locally or remotely through an optional modem

ELECTRONIC UNIT

Display	Digital, light-emitting diodes (LED's); 0–1999 ppm scale

Isolated Analog Outputs	4–20 mA, 0–2000 ppm range
Gas Alarms	High and High-High alarms duplicate alarms in H201Ti: Gas level, hourly and daily trends
Fail Alarm	Duplicates alarm in H201Ti: Power failure, loss of communications, sensor and other system malfunctions; upon system fault, analog outputs are set to zero and display is blanked
Alarm Contacts	Gas High, Gas High-High and System Fail One NO and one NC contacts (type C) per alarm Resistive load: 3A @ 250 VAC; 3A @ 30 VDC
Illuminated Push Buttons (alarm Indicators)	2 illuminated door-mounted push-buttons (gas High and High-High alarms) Latched on when corresponding alarm condition is detected Turned off by pushing button when alarm condition is cleared

COMMUNICATIONS/NETWORK

Supervisory Link	Connects with one H201Ti 2,000 Vac RMS isolated 3-twisted-pairs (16 or 18 AWG) cable with overall shield is required Maximal length (all cables added up): 1,200 m (4,000 ft) Power supply: Separate, isolated, impedance-protected, +15 Vdc
RS-485 Local Network Link (Isolated)	Standard RS-485 communication port allows daisy-chaining of up to 32 H201Ci Controllers (H201Ci-C's and/or H201Ci-1's) via the Main Terminal Block One twisted triad (16 or 18 AWG) with overall shield required Maximal total daisy-chain length: 1,200 m (4,000 ft)
RS-232 or USB Link	Standard RS-232 port (DB-9 connector), or standard USB link (type-B connector) Allows serial communications with a local host computer (or remotely with optional modem) Any H201Ti can be accessed through any H201Ci Controller in the local network

Recommendation Run all communication cables in flexible or rigid, metallic conduits for maximum mechanical and electrical protection

MISCELLANEOUS

Enclosure Type NEMA 4X steel enclosure; baked enamel; textured white finish

Dimensions 244.5 x 349.3 x 157.7 mm (9-5/8 x 13-3/4 x 3-3/16 in)

Power Supply Rated voltage: 100–120 VAC or 200–240 VAC, 50/60 Hz

Rated power: 160 VA maximum

Standards Met

- CISPR 11: Measurement of radiated and conducted emissions
- IEC 60068-2-1: Environmental testing at cold temperature
- IEC 60068-2-2: Environmental testing at dry heat temperature
- IEC 60255-5: Insulation coordination for measuring relays and protection equipment
- EN 61000-4-2: ESD immunity
- EN 61000-4-3: Radiated electromagnetic field immunity – radio frequencies
- EN 61000-4-4: Electrical fast transient/burst immunity
- EN 61000-4-5: Surge immunity
- EN 61000-4-6: Immunity to conducted disturbance induced by radio-frequency fields
- EN 61000-4-8: Power frequency magnetic field immunity
- EN 61000-4-11: Voltage dips, short interruptions and voltage variations immunity (applicable for ac power supply only)
- EN 61010-1: Product safety

Weight

- Installed: 6.6kg (15lb)
- Shipping: 7.5kg (17lb)

Hydran Host Software Supports all H201Ti functions plus networking and embedded software upgrading; available in Microsoft Windows version

ENVIRONMENTAL CONDITIONS

Operation Ambient temperature*: -40 to +55˚C (-40 to +131˚F)

Relative humidity: 95% RH, non-condensing

Altitude: up to 2,000m (6,500ft)

Storage Ambient temperature: +5 to +45˚C (41 to +113˚F)

★ *Note: For operation ambient temperature lower than -40°C, consult General Electric Customer Service.*

General Electric has made every reasonable attempt to ensure the completeness and accuracy of these technical specifications. However, the information contained in these technical specifications is subject to change without notice, and does not represent a commitment on the part of General Electric.

B.1 Hydran 201Ti Intelligent Transmitter

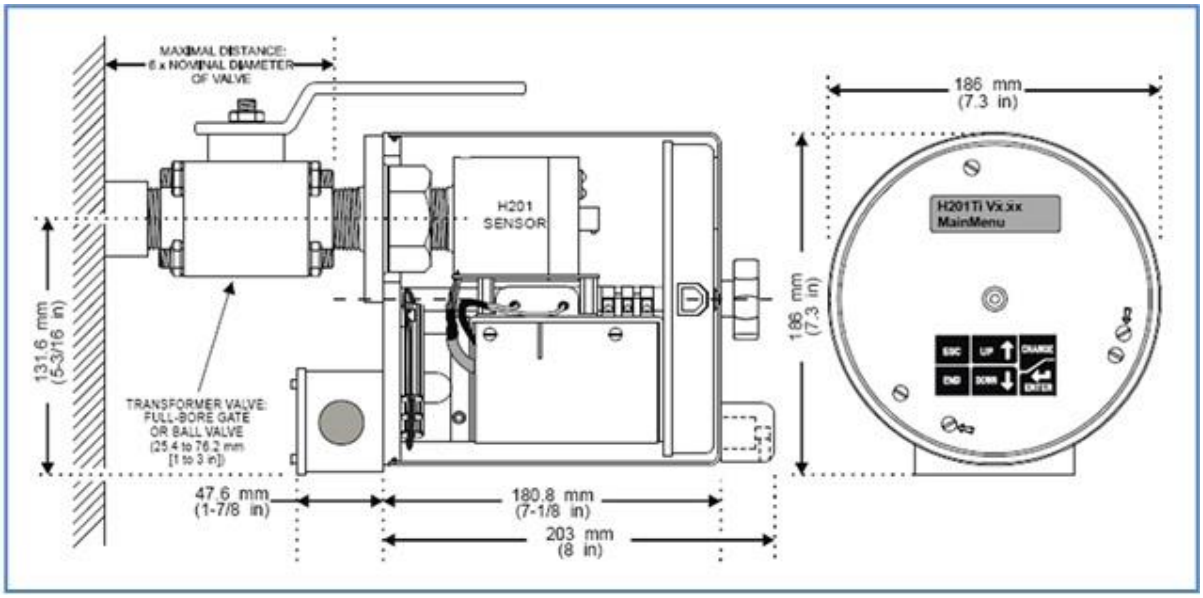


Figure B - 1: Hydran 201T*i* Dimensions

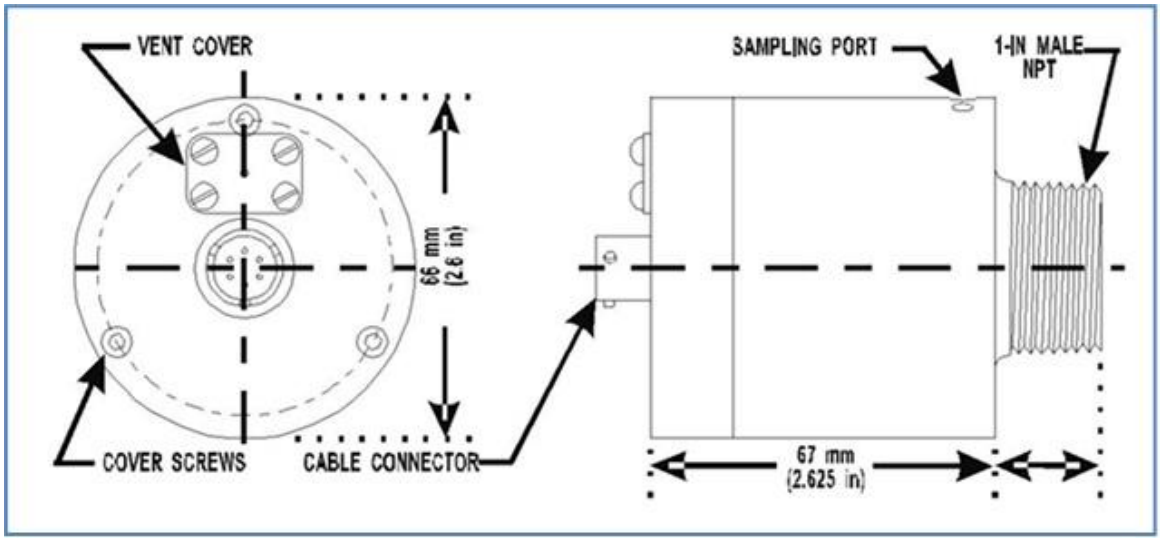


Figure B - 2: Hydran 201 Sensor

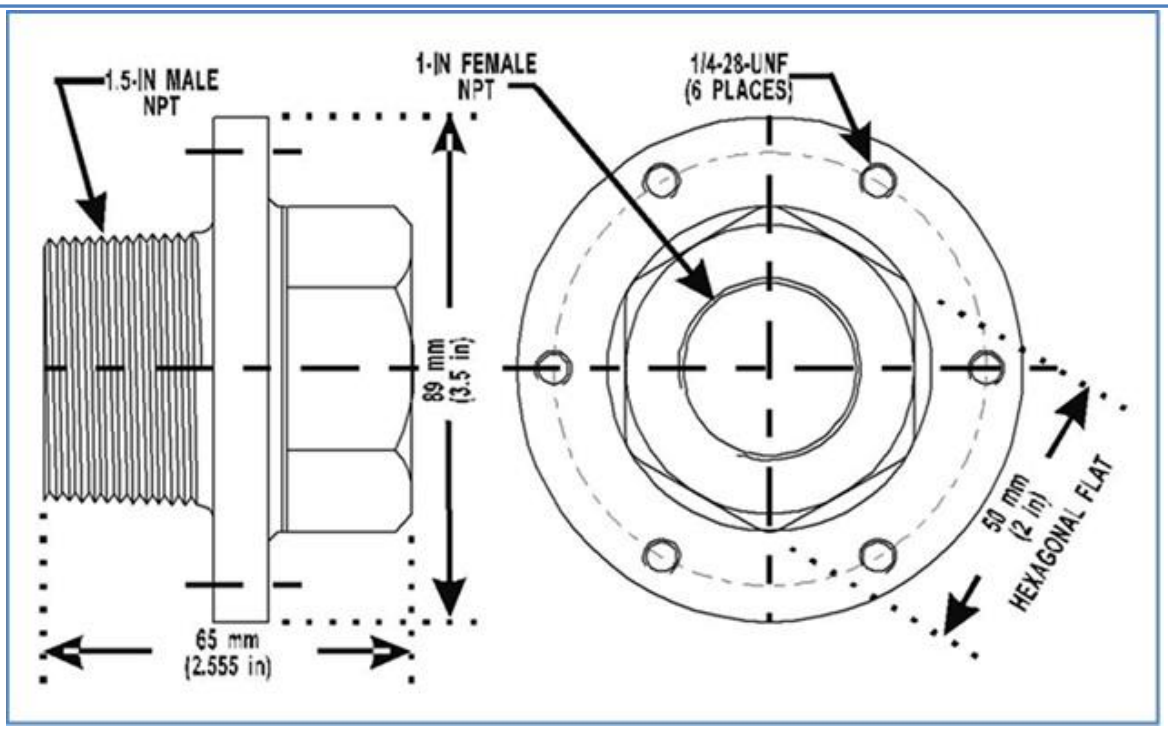


Figure B - 3: 1.5 in Adapter

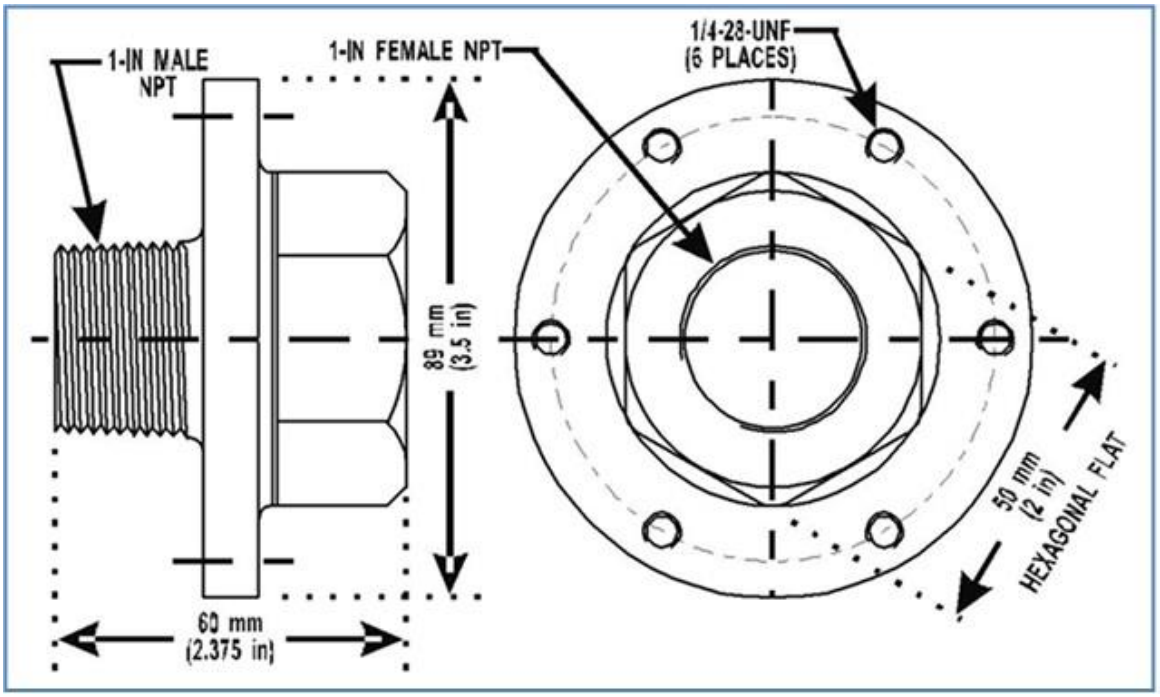


Figure B - 4: 1 in Adapter

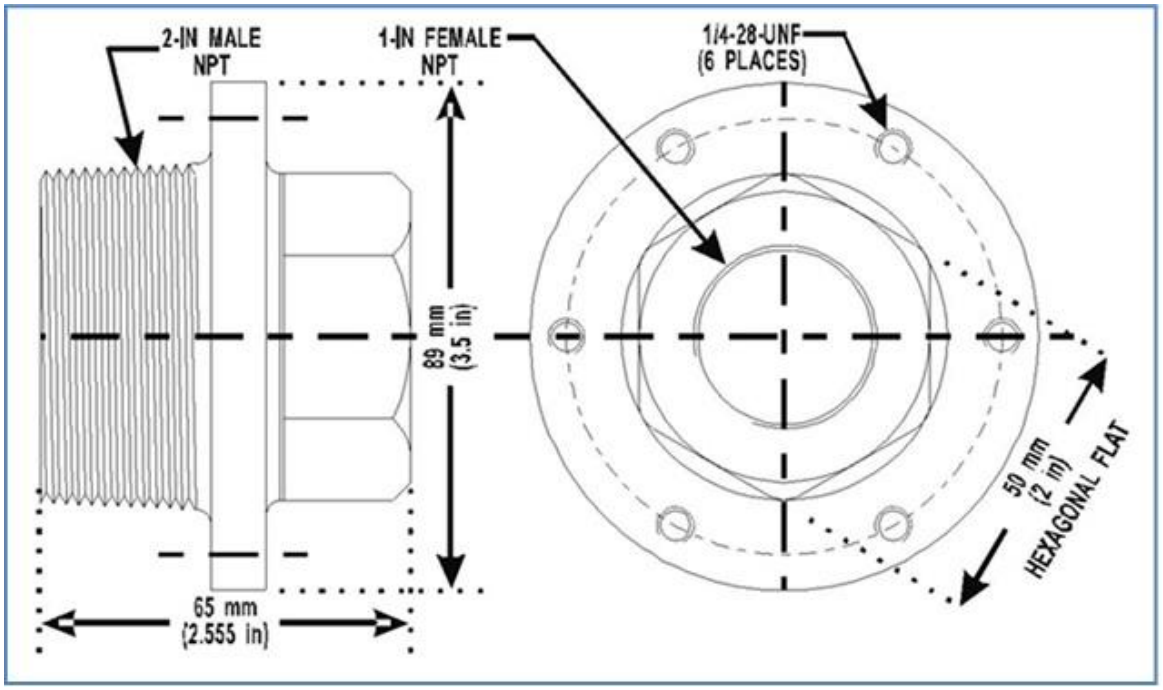


Figure B - 5: 2 in Adapter

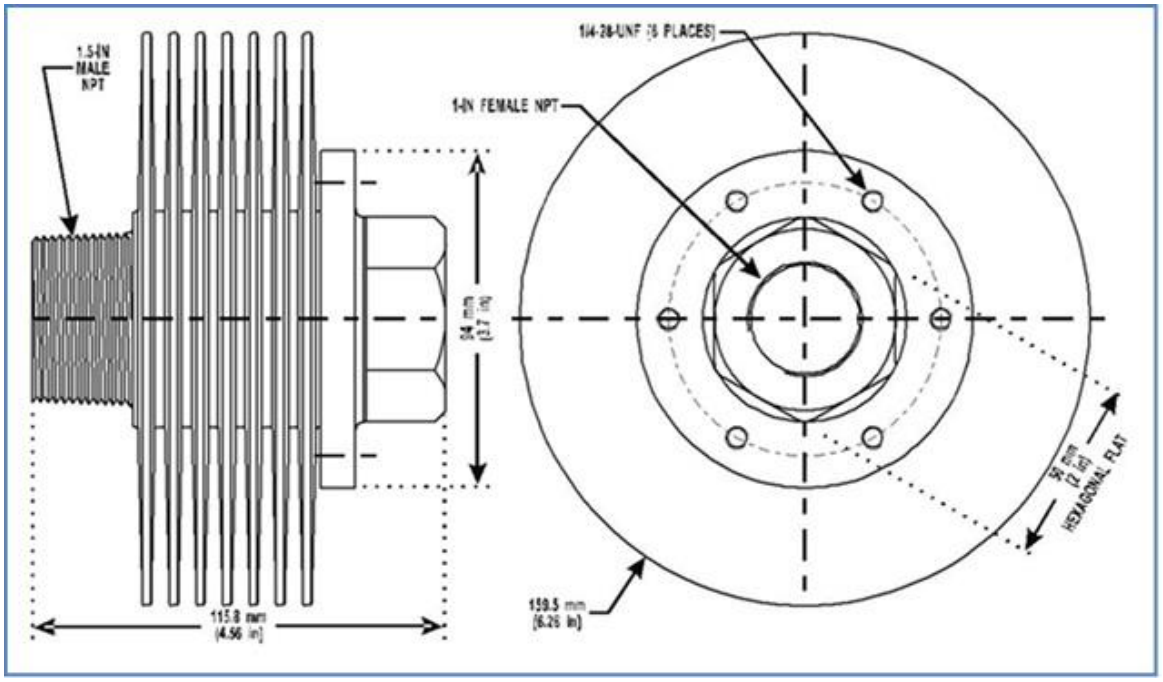


Figure B - 6: Finned High Temperature Adaptor

B.2 Hydran 201Ci-C Communications Controller

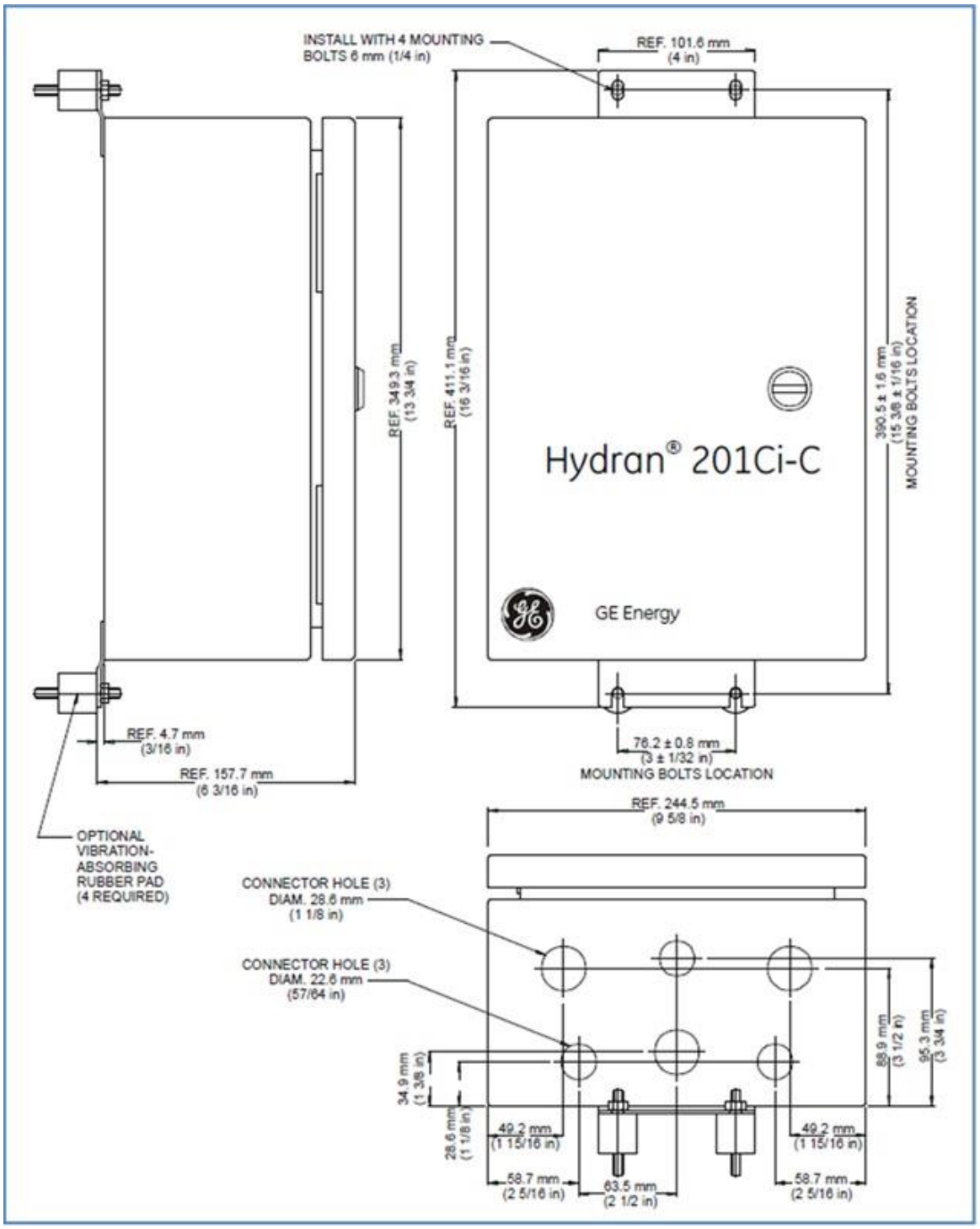


Figure B - 7: Hydran 201C*i*-C Dimensions

B.3 Hydran 201Ci-1 One-Channel Controller

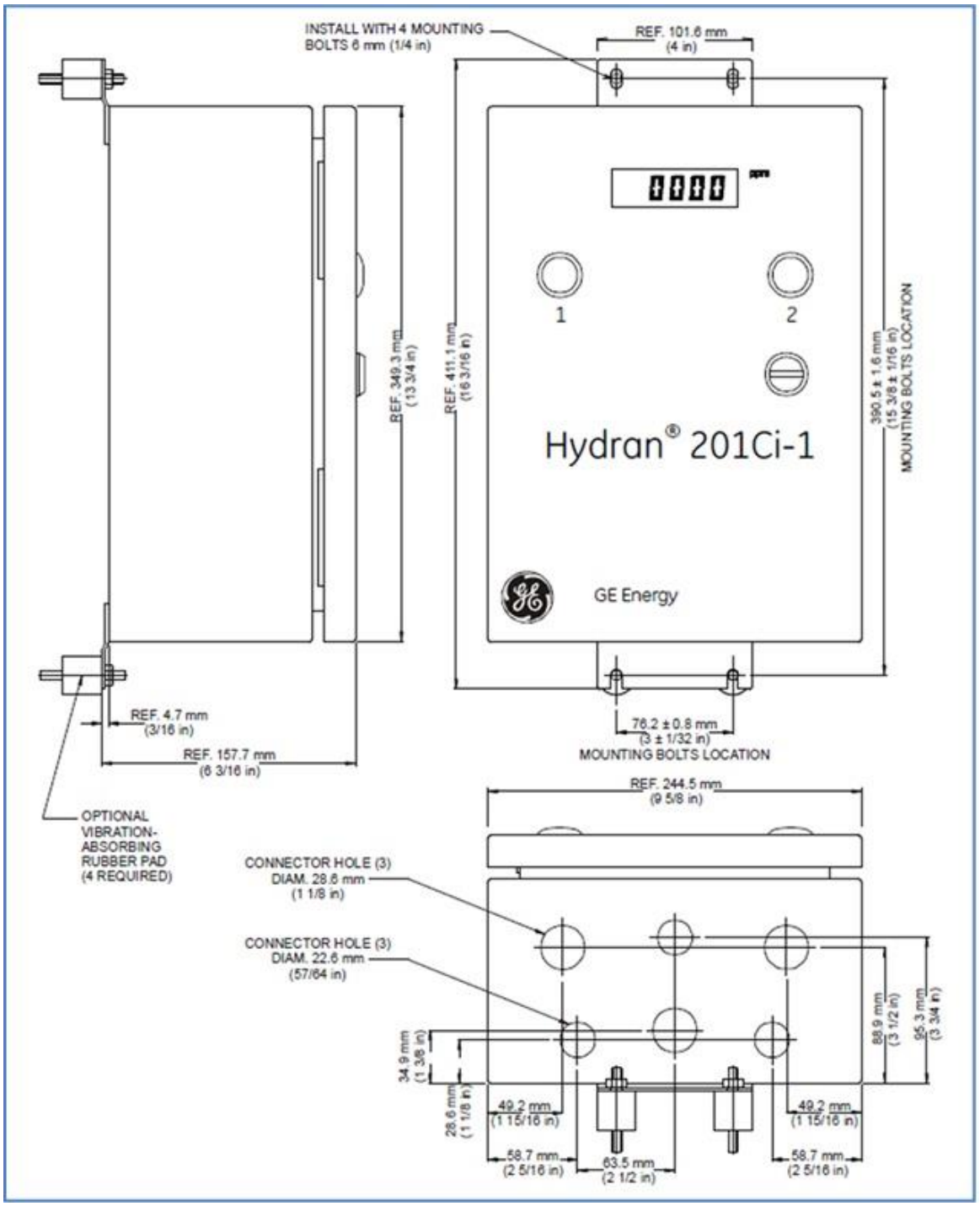


Figure B - 8: Hydran 201C*i*-1 Dimensions

Appendix C : Functional Block Diagrams

C.1 Hydran 201Ti Intelligent Transmitter

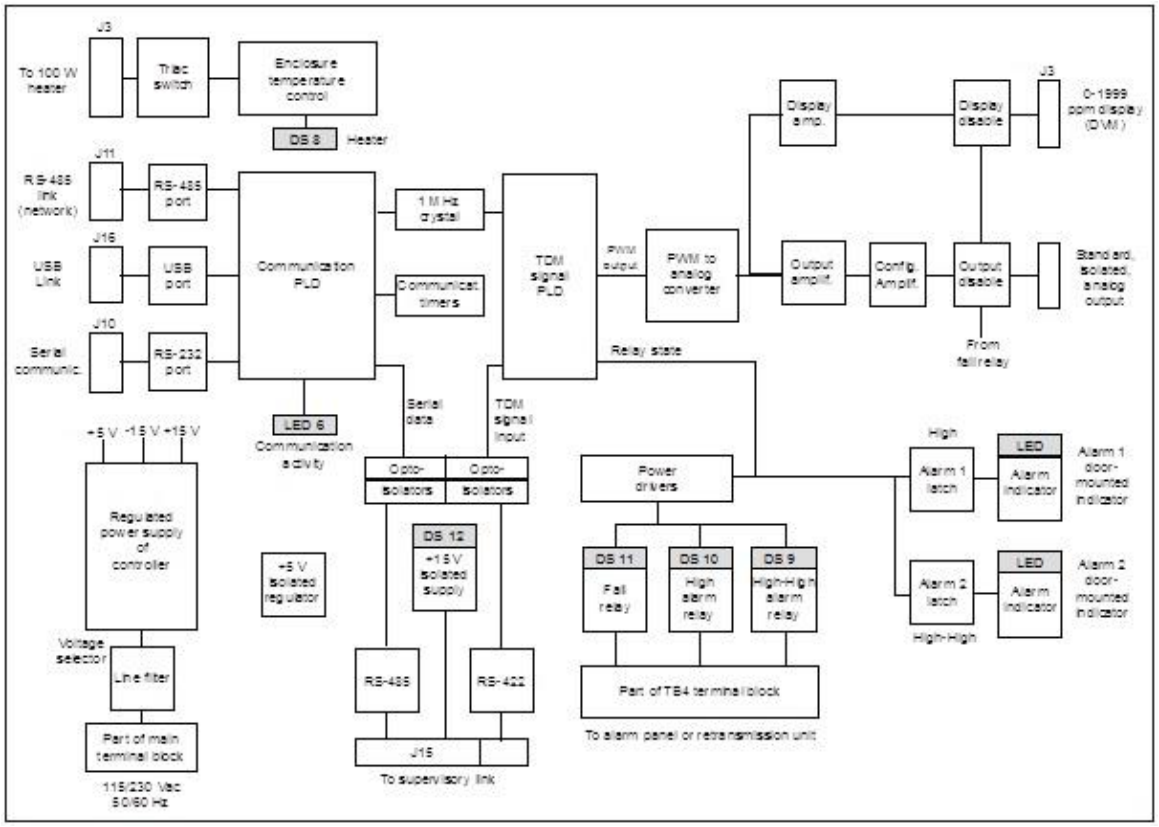


Figure C-1 - Functional Block Diagram for the Hydran 201T*i*

C.2 Hydran 201Ci-C Communications Controller

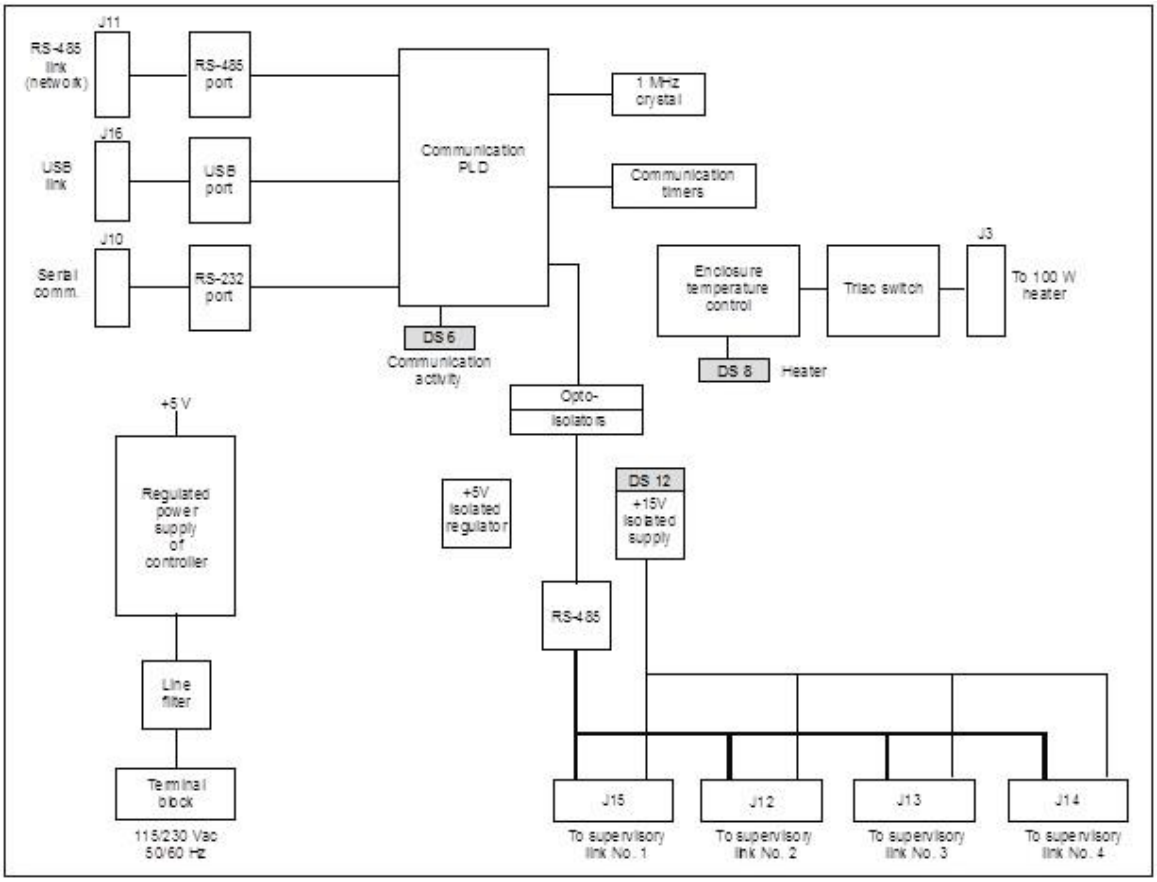


Figure C-2 - Functional Block Diagram for the Hydran 201C*i*-C

C.3 Hydran 201Ci-1 One-Channel Controller

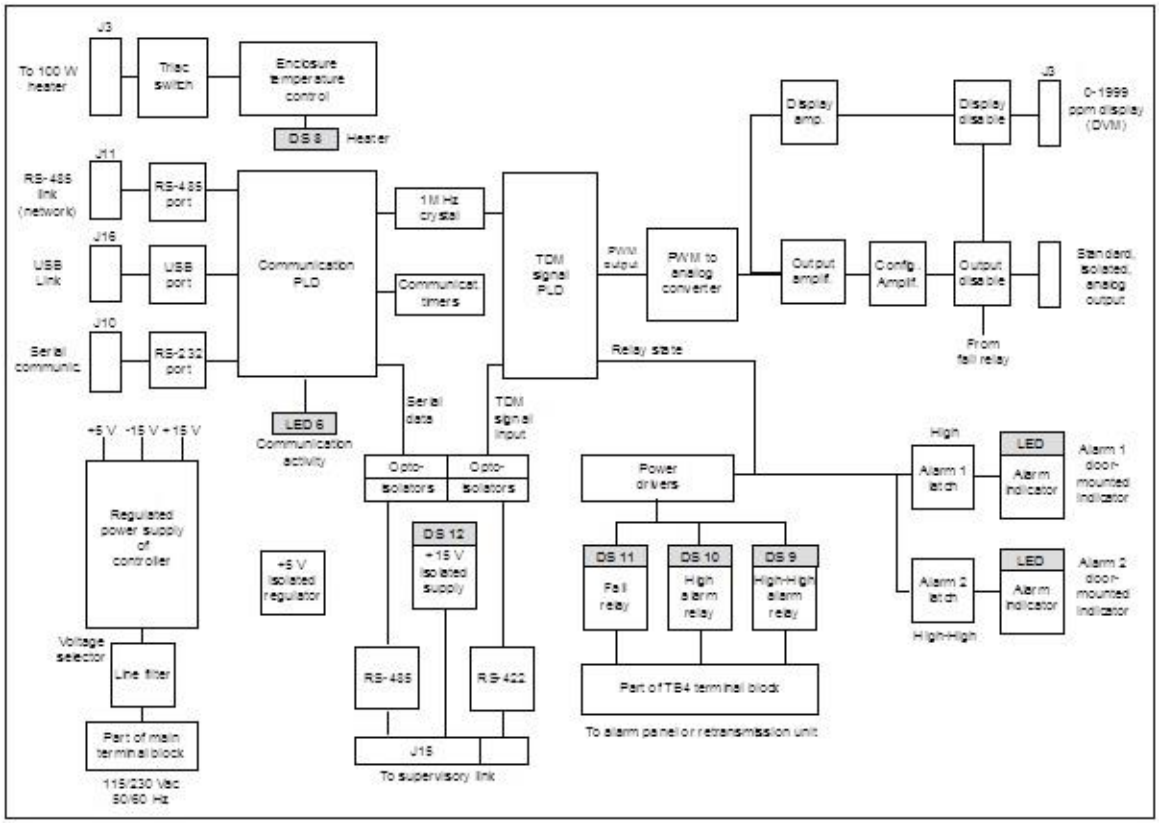


Figure C-3 - Functional Block Diagram for the Hydran 201C*i*-1

D.1 Hydran 201Ti Intelligent Transmitter

Terminal	Description[a]	To (Internal)	From (External)	Comments
L1/L	Line or Line 1	JP0-1 through line filter	Live side of AC supply	F1 fuse[b] 5A, 250V
L2/N	Neutral or Line 2	JP0-2 through line filter	Other side of AC supply	
E/G	Chassis ground	Module chassis and JP0-3	Ground wire of AC supply	Protective ground

a: Wires have a maximum section of 2.5 mm2.
b: An isolating, double-pole breaker must be installed in accordance with IEC 947-1 and 947-3 standards.

Table D - 1: AC Power Supply: 3 Terminal Block, J3 Connector and Fuse

Terminal	Description	From (Internal)	To (External)	Comments
1	Fail NC[a] (no alarm=open)	J5-1	Wired by the user to a SCADA or RTU	Relay rating (resistive): 5A, 1,250 VA, 240 VAC FCC surge voltage between open contacts: 1,000V RMS
2	Fail common	J5-2		
3	Fail NO[b] (no alarm=closed)	J5-3		
4	Gas High NC	J5-4		
5	Gas High common	J5-5		
6	Gas High NO	J5-6		
7	Gas High-High NC	J5-7		
8	Gas High-High common	J5-8		
9	Gas High-High NO	J5-9		

a: NC = Normally Closed (contact is closed when the relay is NOT energized)
b: NO = Normally Open (contact is open when the relay is NOT energized)

Table D - 2: Alarm Contacts 9 Terminal Block and J5 Connector

Voltage Selector[a]	Voltage Range	Comment
115V	100–120 VAC, 50/60 Hz	430 W maximum heating @ 264 VAC
230V	200–240 VAC, 50/60 Hz	

a: The voltage selector is factory-selected and configured as per user requirements

Table D - 3: SW1 Voltage Selector

Terminal	Description	To (Internal)	From (External)	Comments
J2-1 and J2-5	Heater A	Power board	Heating plate	Heater resistance: 81 Ω (each)
J2-4 and J2-6	Heater B			
J2-2 and J2-3	Thermostat		Thermostat	

Table D - 4: J2 Heater 6 pin Connector

Terminal	Description	To (Internal)	From (External)
J1-4	Sensor cell (+)	Cell amplifier	Sensor cable (black)
J1-3	Sensor cell (-)		Sensor cable (brown)
J1-2	Sensor thermistor	Sensor thermistor amplifier	Sensor cable (white)
J1-1			
	Cable shield	I/O module chassis	Not connected
J2-1	Heater thermistor	Heater thermistor amplifier	Heating plate thermistor
J2-2			
	Cable shield	I/O module chassis	Not connected

Table D - 5: J1 Sensor 4 Pin Connector and J2 Thermistor 2 Pin Connector-

Terminal	Description	From (Internal)	To (External)	Comments
1	TDM pulse, output (-)	Isolated RS-422 driver, J4-1 and J4-2	Isolated RS-422 receiver	Must be connected to H201C*i*-1; not used with H201C*i*-C
2	TDM pulse, output (+)			
3	Serial data, I/O (-)	Isolated RS-485 transceiver, J4-3 and J4-4	Isolated RS-485 receiver	Must be connected to any H201C*i* Controller
4	Serial data, I/O (+)			
5	Loop supply, input (-)	Isolated +5VDC regulator input, J4-5 and J4-6	Isolated 15V link supply output	Isolated power supply built into H201C*i*-Controller
6	Loop supply, input (+)			
7	4-20 mA analog current, OUT(+)	Current loop, J3-2	Wired by the user to a SCADA or RTU	4-20mA= 0-2,000ppm (500Ω maximum)
8	4-20 mA analog current, OUT(-)	Current loop, J3-3		
Sh 1	Supervisory link cable shield	H201T*i* chassis	Supervisory link cable shield	High frequency
CFG	Analog output configuration	Current loop, J3-4	Active output not connected. Passive output to the 4-20 mA OUT(-) terminal 8	See Figure D-1 and Figure D-2 below

Table D - 6: J3 Local Analog Output Connector, J4 Isolated Supervisory Link Connector, and Termination Board

Terminal	Name	Description
1	VBUS	+5V
2	D-	Data -
3	D+	Data +
4	GND	Ground

Table D - 7: USB Type B Connector (Side of CPU Module)

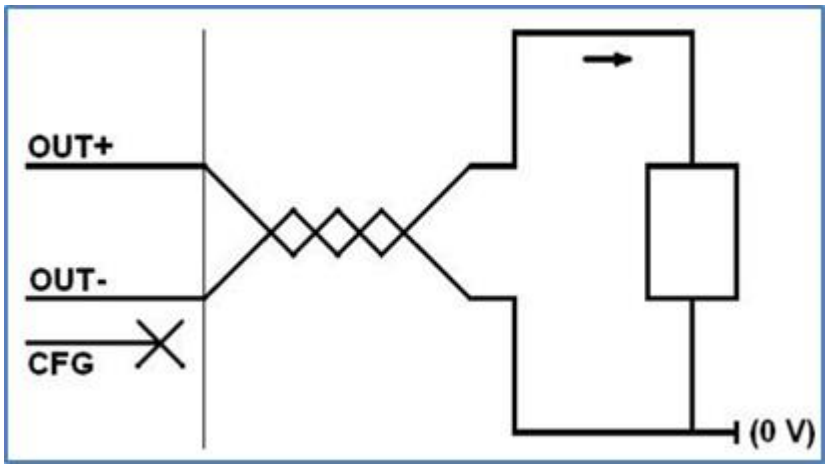


Figure D - 1: Wiring Diagram for Active Current Output

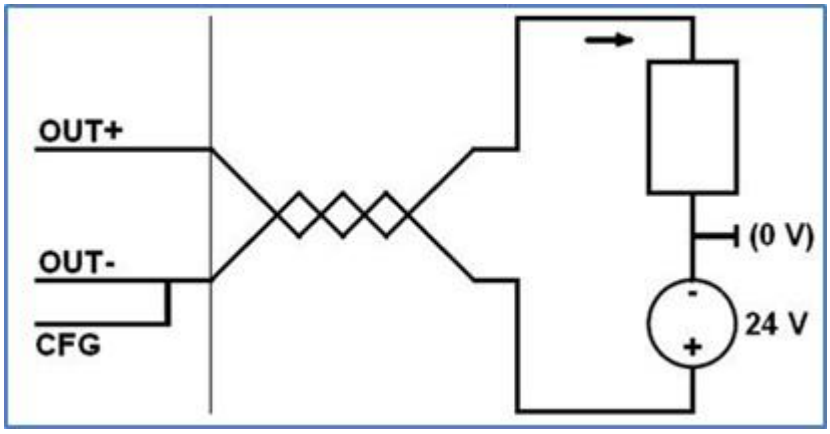


Figure D - 2: Wiring Diagram for Passive Current Output

D.2 Hydran 201Ci-C Communications Controller

Terminal	Description	From (Internal)	To (External)	Comments
1	Line or Line1[a]	J2-1, ac supply connector	Live side of ac supply	F11 fuse: 5 A, 250 V[b]
2	Neutral or Line2[a]	J2-2, ac supply connector	Other side of ac supply	
3	Chassis ground (earth)[a]			Connect the P/E to the chassis, not to the Main Terminal Block
4	Auxiliary Line or Line1[a]	J2-1, ac supply connector	Live side of auxiliary ac supply	
5	Auxiliary Line or Line2[a]	J2-2, ac supply connector	Other side of auxiliary ac supply	No fuse installed[b]
6	Auxiliary Chassis ground (earth)[a]	J2-3, ac supply connector	Ground wire of auxiliary ac supply	
7	Not used			
8				
9	Serial data (-), I/O unit No.4	J14-3, supervisory link connector No. 4	Isolated RS485 transceiver	Must be connected to H201T*i*
10	Serial data (+), I/O unit No.4	J14-4, supervisory link connector No. 4		
11	Loop supply (-) input	J14-2, supervisory link connector No. 4	Isolated +5Vdc regulator input	Isolated supply built into H201C*i*
12	Loop supply (+) input	J14-1, supervisory link connector No. 4		
13	Cable shield	Chassis	Supervisory link cable shield of unit No. 4	Direct ground connection
14	Not used			

Terminal	Description	From (Internal)	To (External)	Comments
15				
16	Serial data(-), I/O unit No. 3	J13-3, supervisory link connector No. 3	Isolated RS-485 transceiver	Must be connected to H201Ti
17	Serial data(+), I/O unit No. 3	J13-4, supervisory link connector No. 3		
18	Loop supply(-), input	J13-2, supervisory link connector No. 3	Isolated +5Vdc regulator input	Isolated supply built into H201C*i*
19	Loop supply(+), input	J13-1, supervisory link connector No. 3		
20	Cable shield	Chassis	Supervisory link cable shield of unit No. 3	Direct ground connection
21	Serial data(-), I/O RS-485 LAN	J11-3, RS-485 LAN connector	Isolated RS-485 transceiver	Must be connected to other H201Ci-C or H201Ci-1
22	Serial data(+), I/O RS-485 LAN	J11-4, RS-485 LAN connector		
23	RS-485 LAN ground	J11-2, RS-485 LAN connector	Isolated +5Vdc regulator input	Direct ground connection
24	Cable shield	J11-1, RS-485 LAN connector		
25	Not used			
26				
27				
28				
29	Serial data(-), I/O unit No. 2	J12-3, supervisory link connector No. 2	Isolated RS485 transceiver	Must be connected to H201Ti
30	Serial data(+), I/O unit No. 2	J12-4, supervisory link connector No. 2		
31	Loop supply(-), input	J12-2, supervisory link connector No. 2	Isolated +5Vdc	Isolated supply built

Terminal	Description	From (Internal)	To (External)	Comments
32	Loop supply(+), input	J12-1, supervisory link connector No. 2	regulator input	into H201C*i*
33	Cable shield	Chassis	Supervisory link cable shield of unit No 2	Direct ground connection
34	Not used			
35				
36	Serial data(-), I/O unit No. 1	J15-3, supervisory link connector No. 1	Isolated RS485 transceiver	Must be connected to H201Ti
37	Serial data(+), I/O unit No. 1	J15-4, supervisory link connector No. 1		
38	Loop supply(-), input	J15-2, supervisory link connector No. 1	Isolated +5Vdc regulator input	Isolated supply built into H201C*i*
39	Loop supply(+), input	J15-1, supervisory link connector No. 1		
40	Cable shield	Chassis	Supervisory link cable shield of unit No 1	Direct ground connection

a: Wires have a maximum section of 2.5 mm2.
b: An isolating, double-pole breaker must be installed in accordance with IEC 947-1 and 947-3 standards.

Table D - 8: Main Terminal Block for the Hydran 201C*i*-C

Voltage Selector[a]	Voltage Range	Comment
115V	100–120 VAC, 50/60 Hz	130W maximum heating @ 264 VAC
230V	200–240 VAC, 50/60 Hz	

a: The voltage selector is factory-selected and configured as per user requirements

Table D - 9: SW1 Voltage Selector for the Hydran 201C*i*-C

Terminal	Name	Direction	Comments
2	RxD (receives data)	To H201C*i*	The DB-9 connector is wired as in a PC: Cross wires 2 and 3 when connecting to a PC; do not cross wires 2 & 3 when attaching a modem. Only wires 2, 3 and 5 are needed to communicate.
3	TxD (transmits data)	From H201C*i*	
5	GND (signal ground)t		
1,4,6,9	DCD, DTR, DSR & RI wired together		
7,8	RTS & CTS wired together		

Table D - 10: J10 DB-9 Male RS-232 Connector for the Hydran 201Ci-C

D.3 Hydran 201Ci-1 One-Channel Controller

Terminal	Description	From (Internal)	To (External)	Comments
1	Line or Line1[a]	J2-1, ac supply connector	Live side of ac supply	F11 fuse: 5 A, 250 V[c]
2	Neutral or Line2[a]	J2-2, ac supply connector	Other side of ac supply	
3	Chassis ground (earth)[a]			Connect the P/E to the chassis, not to the Main Terminal Block
4	Auxiliary Line or Line1[a]	J2-1, ac supply connector	Live side of auxiliary ac supply	
5	Auxiliary Line or Line2[a]	J2-2, ac supply connector	Other side of auxiliary ac supply	No fuse installed[b]
6	Auxiliary Chassis ground (earth)[a]	J2-3, ac supply connector	Ground wire of auxiliary ac supply	
7	Gas High (Alarm 1) NO[b]	J18-6, alarm contacts connector	Wired by the user to a SCADA or RTU	Current rating: 5A Voltage rating: 300Vdc 1,250 VA @ 240Vac
8	Gas High (Alarm 1) Common	J18-5, alarm contacts connector		
9	Gas High (Alarm 1) NC	J18-4, alarm contacts connector		
10	Gas High-High (Alarm 1) NO	J18-9, alarm contacts connector		
11	Gas High-High (Alarm 1) Common	J18-8, alarm contacts connector	Wired by the user to a SCADA or RTU	Current rating: 5A Voltage rating:
12	Gas High-High	J18-7, alarm		

Terminal	Description	From (Internal)	To (External)	Comments
	(Alarm 1) NC	contacts connector		300Vdc 1,250 VA @ 240Vac
13	System Fail NO (closed when no alarm)	J18-3, alarm contacts connector		
14	System Fail Common	J18-2, alarm contacts connector		
15	System Fail NC (open when no alarm)	J18-1, alarm contacts connector		
16	Not used			
17	4–20 mA analog current, OUT(+)	J22-2, analog outputs connector	Wired by the user to a recorder, display or RTU	See Figure D-1 and Figure D-2 above
18	4–20 mA analog current, OUT(-)	J22-3, analog outputs connector		
19	Configuration	J22-4, analog outputs connector		
20	Analog output shield	J22-1, analog outputs connector		
21	Serial data(-), I/O RS-485 LAN	J11-3, RS-485 LAN connector	Isolated RS485 transceiver	Must be connected to other H201Ci-C or H201Ci-1
22	Serial data(+), I/O RS-485 LAN	J11-4, RS-485 LAN connector		
23	RS-485 LAN ground	J11-2, RS-485 LAN connector	LAN ground	Direct ground connection
24	Cable shield	J11-1, RS-485 LAN connector	RS-485 LAN cable shield	

Terminal	Description	From (Internal)	To (External)	Comments
25	Not used			
26				
27				
28				
29				
30				
31				
32				
33				
34	TDM pulse(-), input	J15-1, supervisory link connector	Isolated RS-422 driver	Must be connected to H201Ti
35	TDM pulse(+), input	J15-2, supervisory link connector		
36	Serial data(-), I/O unit No. 1	J15-3, supervisory link connector	Isolated RS-485 transceiver	
37	Serial data(+), I/O unit No. 1	J15-4, supervisory link connector		
38	Loop supply(-), input	J15-5, supervisory link connector	Isolated +5Vdc regulator input	Isolated supply built into H201C*i*
39	Loop supply(+), input	J15-6, supervisory link connector		
40	Cable shield	Chassis	Supervisory link cable shield	Direct ground connection

Table D - 11: Main Terminal Block for the Hydran 201Ci-1

a: Wires have a maximum section of 2.5 mm^2.
b: NO = Normally Open; NC = Normally Closed.
c: An isolating, double-pole breaker must be installed in accordance with IEC 947-1 and 947-3 standards.

Voltage Selector[a]	Voltage Range	Comment
115V	100–120 VAC 50/60 Hz	130W maximum heating @ 264 VAC
230V	200–240 VAC 50/60 Hz	

a: The voltage selector is factory-selected and configured as per user requirements

Table D - 12: SW1 Voltage Selector for the Hydran 201C*i*-1

Terminal	Name	Direction	Comments
2	RxD (receives data)	To H201C*i*	The DB-9 connector is wired as in a PC: Cross wires 2 and 3 when connecting to a PC; do not cross wires 2 & 3 when attaching a modem. Only wires 2, 3 and 5 are needed to communicate.
3	TxD (transmits data)	From H201C*i*	
5	GND (signal ground)		
1,4,6,9	DCD, DTR, DSR & RI wired together		
7,8	RTS & CTS wired together		

Table D - 13: DB-9 Male RS-232 Connector for the Hydran 201Ci-1

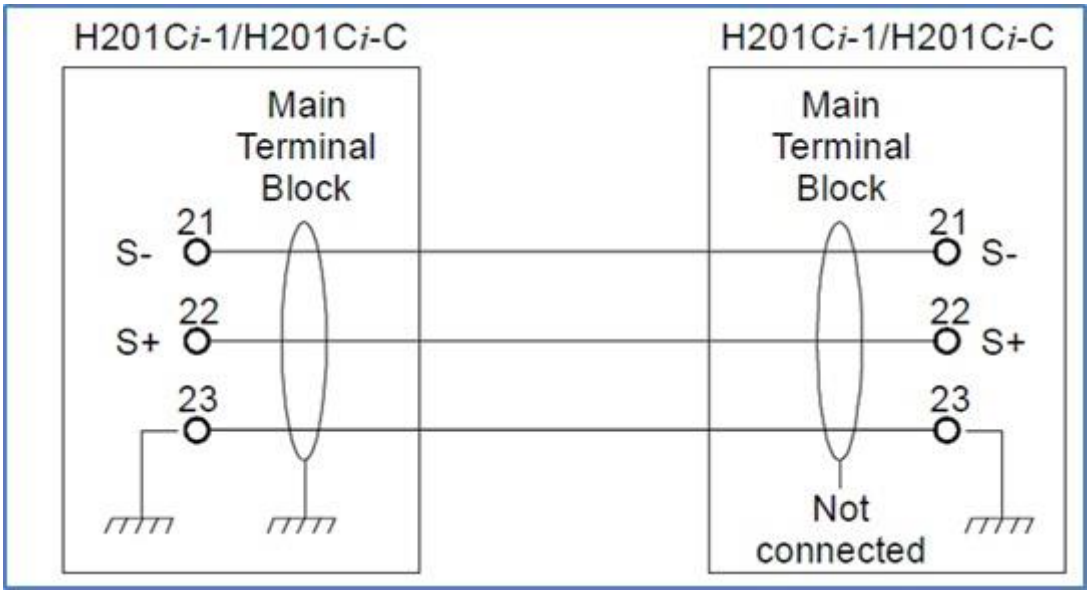


Figure D - 3: Wiring of RS-485 Link Cable Between Two or More H201Ci-C's and H201Ci-1's

*Note: The cable shield must be connected to the enclosure ground at only **one** end.*

Appendix E : Hydran 201Ti's History File Messages

This Appendix complements Section 5.5.1. The messages below are sorted in alphabetical order:

Event	Message Description
AnalogMode chg	Modification of the analog output's operation mode
Batt.Alr Ack	Battery voltage alarm has been acknowledged
BattAlr L chg	Modification of the Low battery voltage alarm's set point
BattAlr L OFF	Low battery voltage alarm turned off
BattAlr L ON	Low battery voltage alarm turned on
BattAlr LL chg	Modification of the Low-Low battery voltage alarm's set point
BattAlr LL OFF	Low-Low battery voltage alarm turned off
BattAlr LL ON	Low-Low battery voltage alarm turned on
BattDelay chg	Modification of the battery voltage alarm's delay
BaudRate c.	Modification of the transmission rate (bits per second)
CableOpen OFF	Open cable alarm turned off
CableOpen ON	Open cable alarm turned on
CableShort OFF	Short circuit cable alarm turned off
CableShort ON	Short circuit cable alarm turned on
CommMode chg	Modification of the communication mode
Date&Time chg	Modification of the date and/or time
DayAcqRate chg	Modification of the daily trend period
DayAlr Ack	Daily trend alarm has been acknowledged
DayAlr H chg	Modification of the High daily trend alarm's set point
DayAlr H OFF	High daily trend alarm turned off
DayAlr H ON	High daily trend alarm turned on
DayAlr HH chg	Modification of the High-High daily trend alarm's set point
DayAlr HH OFF	High-High daily trend alarm turned off
DayAlr HH ON	High-High daily trend alarm turned on
DayAlr L chg	Modification of the Low daily trend alarm's set point
DayAlr L OFF	Low daily trend alarm turned off
DayAlr L ON	Low daily trend alarm turned on

DayAlr LL chg	Modification of the Low-Low daily trend alarm's set point
DayAlr LL OFF	Low-Low daily trend alarm turned off
DayAlr LL ON	Low-Low daily trend alarm turned on
DayDelay chg	Modification of the daily trend alarm's delay
DefaultChan chg	Modification of the default communication channel
GasAlr Ack	Gas level alarm has been acknowledged
GasAlr H chg	Modification of the gas level High alarm's set point
GasAlr H OFF	Gas level High alarm turned off
GasAlr H ON	Gas level High alarm turned on
GasAlr HH OFF	Gas level High-High alarm turned off
GasAlr HH ON	Gas level High-High alarm turned on
GasAlr HH chg	Modification of the gas level High-High alarm's set point
GasAlr L chg	Modification of the gas level Low alarm's set point
GasAlr L OFF	Gas level Low alarm turned off
GasAlr L ON	Gas level Low alarm turned on
GasAlr LL chg	Modification of the gas level Low-Low alarm's set point
GasAlr LL OFF	Gas level Low-Low alarm turned off
GasAlr LL ON	Gas level Low-Low alarm turned on
GasDelay chg	Modification of a gas level alarms' delay
H201 ID chg	Modification of the Hydran 201Ti identification number
HistoEvent Clr	Events history file has been cleared (erased)
HistoLogRate c	Modification of the logging rate of the Short Term history recordings
Hist LogTime chg	Modification of one of the four logging times of the Long Term history recordings
HistoLong Clr	Long Term history file has been cleared (erased)
HistoRam Bad	RAM memory test of history files has failed
HistoService Clr	Service history file has been cleared (erased)
HistoShort Clr	Short Term history file has been cleared (erased)
HourAlr Ack	Hourly trend alarm has been acknowledged
HourAlr H chg	Modification of the hourly trend High alarm's set point
HourAlr H OFF	Hourly trend High alarm turned off
HourAlr H ON	Hourly trend High alarm turned on
HourAlr HH chg	Modification of the hourly trend High-High alarm's set point

HourAlr HH OFF	Hourly trend High-High alarm turned off
HourAlr HH ON	Hourly trend High-High alarm turned on
HourAlr L chg	Modification of the hourly trend Low alarm's set point
HourAlr L OFF	Hourly trend Low alarm turned off
HourAlr L ON	Hourly trend Low alarm turned on
HourAlr LL chg	Modification of the hourly trend Low-Low alarm's set point
HourAlr LL OFF	Hourly trend Low-Low alarm turned off
HourAlr LL ON	Hourly trend Low-Low alarm turned on
HourDelay chg	Modification of the hourly trend alarm's delay
HourAcqRate chg	Modification of the hourly trend period
InternalErr 0	Internal error No. 0
InternalErr 1	Internal error No. 1
InternalErr 2	Internal error No. 2
InternalErr 3	Internal error No. 3
InternalErr 4	Internal error No. 4
InternalErr 5	Internal error No. 5
NewSensor	Installation of a new sensor
Period A chg	Modification of the Period A parameter
Period B chg	Modification of the Period B parameter
PowerDown	Power-down of Hydran 201Ti
PowerUp	Power-up of Hydran 201Ti
PowStat ID chg	Modification of the power station's identification number
ProgRam Bad	RAM memory test of program data has failed
ProgUpgraded	Hydran 201Ti's embedded software has been upgraded
RelayMode chg	Modification of a relay's operating mode
ReplaceNow OFF	Replace-sensor-now alarm turned off
ReplaceNow ON	Replace-sensor-now alarm turned on
RTC Bad	Real-time clock has failed
SensTstAlr Ack	Sensor fail alarm has been acknowledged
SetupLost Ack	Setup lost alarm has been acknowledged
SetupLost OFF	Setup lost alarm turned off

Set-up Lost ON	Setup lost alarm turned on
Soft WatchDog	Reset of Hydran 201Ti induced by the software watchdog
Sp Span chg	Modification of the sensor temperature set point's range
STempAlr Ack	Sensor temperature fail alarm has been acknowledged
STempAlr H chg	Modification of the sensor temperature High alarm's set point
STempAlr H ON	Sensor temperature High alarm turned on
STempAlr HH chg	Modification of the sensor temperature High-High alarm's set point
STempAlr HH ON	Sensor temperature High-High alarm turned on
STempAlr L chg	Modification of the sensor temperature Low alarm's set point
STempAlr L ON	Sensor temperature Low alarm turned on
STempAlr LL chg	Modification of the sensor temperature Low-Low alarm's set point
STempAlr LL ON	Sensor temperature Low-Low alarm turned on
STempDelay chg	Modification of the sensor temperature alarm's delay
STemp H OFF	Sensor temperature High alarm turned off
STemp HH OFF	Sensor temperature High-High alarm turned off
STemp L OFF	Sensor temperature Low alarm turned off
STemp LL OFF	Sensor temperature Low-Low alarm turned off
STempSetP chg	Modification of the sensor temperature set point
SystemCalib	Calibration of Hydran 201Ti
TDM Mode chg	Modification of the TDM signal's operating mode
Unit in Service	Hydran 201Ti back in service after the battery was disconnected
Watchdog	Reset of Hydran 201Ti induced by the hardware watchdog

Appendix F : Default Values of Parameters

Table F-1 below presents the default values of the adjustable parameters after the battery has been disconnected or after the Hydran 201T*i*'s embedded software has been upgraded.

Category	Parameter	Unit	Value	Status
Gas level	Period B	Hours	24	
	Low-Low alarm	ppm	5	Disabled
	Low alarm	ppm	15	Disabled
	High Alarm	ppm	250	Enabled
	High-High Alarm	ppm	500	Enabled
	Alarms delay	Minutes	10	
Hourly Trend	Trend Period	Hours	24	
	Low-Low alarm	ppm	-20	Disabled
	Low alarm	ppm	-10	Disabled
	High Alarm	ppm	10	Enabled
	High-High Alarm	ppm	20	Enabled
	Alarms delay	% of period	33	
Daily Trend	Trend Period	Days	30	
	Low-Low alarm	ppm	-50	Disabled
	Low alarm	ppm	-25	Disabled
	High Alarm	ppm	25	Enabled
	High-High Alarm	ppm	50	Enabled
	Alarms delay	% of period	33	

Category	Parameter	Unit	Value	Status
Temperature	Desired temperature	˚C	35	
	Modulation amplitude	˚C	10.0	
	Period A	Minutes	120	
	Low-Low alarm	˚C	5	Enabled
	Low alarm	˚C	15	Enabled
	High Alarm	˚C	65	Enabled
	High-High Alarm	˚C	75	Enabled
	Alarms delay	Minutes	30	
Battery	Low-Low alarm	Volt	2.45	Enabled
	Low alarm	Volt	2.75	Enabled
	Alarms delay	Hours	50	
Historical data acquisition	Short term log rate	Minutes	15	
	Long term log time #1		00:00	
	Long term log time #2		06:00	Enabled
	Long term log time #3		12:00	Enabled
	Long term log time #4		18:00	Enabled
Communications	CommChannel		Supervisory Link	
	DefaultChannel		Supervisory Link	
	CommMode		Call on Alarm	
	BaudRate		9600	
	H201Ti ID			
	PowerStat. ID			

Category	Parameter	Unit	Value	Status
Relays/Analog	Gas High		Normal	
	Gas High-High		Normal	
	SysOK		Normal	
	Analog output		Normal	
	TDM pulse output		Normal	
Fault triggers	Low-Low gas level			Disabled
	Low gas level			Disabled
	Low-Low Hourly trend			Disabled
	Low Hourly trend			Disabled
	Low-Low Daily trend			Disabled
	Low Daily trend			Disabled
	Low-Low sensor temperature			Enabled
	Low sensor temperature			Enabled
	High sensor temperature			Enabled
	High-High sensor temperature			Enabled
	Low-Low battery			Enabled
	Low battery			Enabled
	CableShort			Enabled
	Replace SensNOW			Enabled
	CableOpen			Enabled

Table F - 1: Default Values of the Parameters

Appendix G : Unit Conversions

In a current loop, any length of cable and number of devices can be connected in series provided that the following conditions are met:

- All devices have floating differential inputs (*both* leads of signal input are ungrounded).
- The total loop resistance does not exceed 500 Ω.

G.1 Converting Current to Voltage

Recording devices with voltage inputs can be converted to current inputs by shunting their input terminals with an appropriate resistor. The resistor value is calculated as follows:

Resistor (Ω) = 50 x input voltage range (in volts) of recording device

Example: A chart recorder with an input range of 1V uses a 50 Ω (1%, 1W) resistor across the recorder input.

G.2 Analog Outputs – Converting ppm to mA (or Vice Versa)

To convert mA (milliampere) into ppm (or vice versa), use the following formula:

ppm = 125 x (mA - 4); or mA = 4 + (ppm÷125)

Example: For a 4.8-mA current, the level of gases in oil is 100 ppm. Likewise, if the display reads 250 ppm, then the current value is 6.0 mA.

Appendix H : USB Port Driver Installation

In order to enable the Hydran Host software to work with Hydran 201Ti when connecting to it via the USB Communication port, the appropriate driver must be properly installed on the computer where Hydran Host is installed. It is also important to identify on which COM port of the computer the USB driver is installed.

Proceed as follows:

1. To install the driver, open the manufacturer's Web site at:
   http://www.silabs.com/products/mcu/Pages/USBtoUARTBridgeVCPDrivers.aspx

2. In the Keyword Search tool at the top, type CP2102 driver.

3. Install the driver using the instructions on the Web site.

4. To identify the COM port, right-click My Computer on the computer desktop.

5. In the drop-down menu, click Properties.

Appendix I : Extracting an Oil Sample

Proceed as follows to sample the oil from the transformer (see below):

1. Remove the Hydran 201T*i*'s aluminum cover.
2. Open the Luer stopcock valve of the glass syringe and ensure the syringe is free of air.
3. Insert and adjust the tip of the syringe valve into the sensor's sampling port.
4. Using the 5/32-in Allen key, slowly open the sensor's bleed screw.
5. Generally, the oil pressure by itself should fill the syringe. If not, slowly pull the syringe's plunger.
6. When the syringe contains enough oil (35 ml for a DGA), shut the bleed screw.
7. Close the stopcock valve of the syringe.
8. Withdraw the syringe.
9. Empty the syringe; make sure to purge all air bubbles from the syringe. This first extraction wets the inner walls of the syringe with liquid to assure better accuracy of sampling.
10. Repeat steps 3 to 8 to extract the oil sample.
11. Purge all air bubbles from the syringe.
12. Put back the aluminum cover.

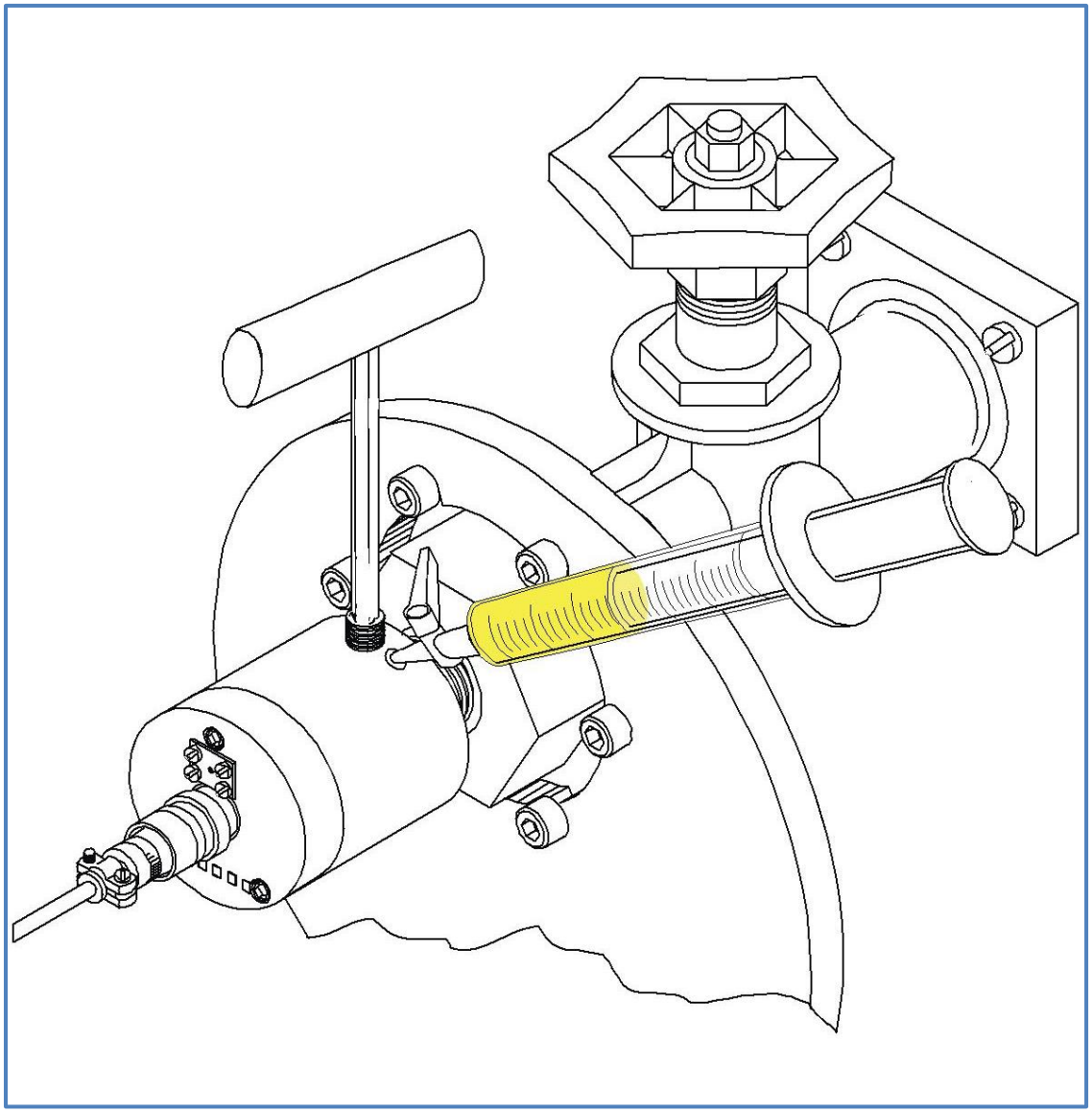


Figure H-1: Extracting an Oil Sample from the Sensor's Sampling Port
Using a Glass Syringe and a 5/32 in Allen Key

Appendix J : Modbus Protocol Documentation

J.1 Introduction to the Modbus for the Hydran 201Ti

Starting with the firmware version 4.0, Hydran 201T*i* supports Modbus communication protocol to allow connection to equipment such as SCADA masters, and other Modbus master interface, GE's Perception software or other user software PC interface. The Modicon Modbus RTU protocol is the most basic protocol supported. In H201Ti Modbus is available via USB and RS-485 serial links. The selection of the Modbus protocol and its configuration are possible through the H201Ti local user interface (display) .

The following description is intended primarily for users who wish to develop their own master communication drivers. Please note that:

- The Hydran 201T*i* always acts as a slave device, and therefore does not initiate communication requests; it only listens and responds to requests issued by a master device.
- The Hydran 201T*i* complies with a subset of the Modbus protocol and provides extensive monitoring capabilities through selected read-and-write register commands (functions 01, 02, 03, 04, 05, 06, 15, 16 in decimal).
- Refer to the dedicated datasheets for an overview of the Hydran 201Ti proprietary data mapping models.

Note: The Hydran 201Ti Modbus implementation is not compliant with the Modicon standard. For a detailed address mapping of the registers and their description, please refer to section J.5 below.

CAUTION

Even if most of the Modbus registers are write-protected, be careful when writing to a device's Modbus address. In order to prevent errors and possible loss of data, please refer to Section J.4 for detailed operation.

J.2 Modbus RTU Protocol

J.2.1 Physical Layer

The Modbus RTU protocol is hardware-independent and accommodates the physical layers of a variety of hardware configurations, including USB and RS-485.

Each data byte is transmitted in an asynchronous 10- or 11-bit data format, consisting in 1 start bit, 8 data bits, 1 stop bit, and possibly 1 parity bit. This can be noticeable for modem transmissions at high baud rates (many modems do not achieve communications at baud rates higher than 300 bps with 11-bit data frames).

The baud rate and parity are independently programmable for each communications port. For Hydran 201T*i* the baud rates options are 1,200, 2,400, 4,800 and 9,600 bps. Even, odd, and no parity are available.

In a Modbus network architecture every slave unit is identified by its unique address. The master device relies on these specific addresses in order to identify the slave station it communicates with. The slave does not respond to requests issued by a master unless the address embedded in the Modbus telegram matches its own address (broadcast telegrams are discarded).

J.2.2 Data Link Layer

Communications take place in packets which are groups of asynchronously-framed byte data. The master transmits a packet to the slave and the slave responds with a packet. The end of a packet is marked by a dead time on the communications line.

Section J.2.3 below details the general format for both transmit and receive packets. For more details on packet formatting, refer to subsequent Sections describing each function code.

J.2.3 Modbus RTU Packet Format

Table J-1 below presents the size of the Modbus RTU packets.

- *Slave Address*: Identifies the slave device intended to receive and process the packet. Each slave unit has a unique address in order to prevent bus contention. A slave device only responds to communication packets including its own address.

Description	Size
Slave Address	1 byte
Function Code	1 byte
Data	n bytes
CRC	2 bytes
Dead Time	(3.5-byte transmission time)

Table J - 1: Size of the Modbus RTU Packets

- *Function Code*: Indicates one of the implemented function codes; see Section J-3.a for complete details. An exception response from the slave is indicated by setting the high-order bit of the function code in the response packet; see Section J-3.b for further details.
- *Data*: Contains a variable number of bytes depending on the function code and the nature of the data to be transmitted. This may include actual values, settings, or addresses sent by the master to the slave or by the slave to the master.
- *CRC*: This is a 2-byte error checking code. The RTU version of Modbus includes a 16-bit Cyclic Redundancy Check (CRC-16) with every packet, which

is an industry-standard method used for error detection. If a Modbus slave device receives a packet in which an error is indicated by the CRC, the slave device discards the packet, thus preventing any erroneous operations. See Section J.2.4 below for details on CRC calculation.

- *Dead Time*: The packet synchronization is achieved with minimum dead time insertion between packets. In a standard Modbus RTU implementation, a packet is terminated when no data is received for a period of 3.5-byte transmission time (about 15 milliseconds at 2,400 bps, 2 milliseconds at 19,200 bps, and 300 microseconds at 115,200 bps). Consequently, the transmitting device does not allow gaps longer than this interval between bytes in a given message. Once the dead time has expired without a new byte transmission, all slaves start listening for a new packet from the master except for the addressed slave.

CAUTION

Perception software cannot meet the standard 3.5-byte dead time delay requirement in reception at high speed. For the Hydran 201Ti firmware, the end-of-frame detection delay is replaced by a fixed 20-millisecond delay. This implement-ation limitation may cause a problem on the RS-485 bus when addressing different slaves in two consecutive requests. The master must respect the 20-milli- second dead time delay following the slave's response before sending a new request to another slave. Failure to do so might result in an exception response or no response from the newly-addressed slave. This limitation causes no problem when requests are sent to the same slave.

J.2.4 CRC-16 Algorithm

The CRC-16 algorithm (16-bit Cyclic Redundancy Check) essentially processes the entire data stream (data bits only; start, stop and parity are ignored) as one continuous binary number. This number is first shifted left 16 bits and then divided by a characteristic polynomial term (11000000000000101B). The 16-bit remainder of the division is appended to the end of the packet, MSB first. The resulting packet including the CRC, when divided by the same polynomial term at the receiver, gives a zero remainder if no transmission errors have occurred. This algorithm requires the characteristic polynomial to be reverse-bit-ordered. The most significant bit of the characteristic polynomial is dropped, since it does not affect the value of the remainder.

The C programming language implementation of the CRC algorithm can be provided upon request.

Table J-2 below presents the CRC-16 algorithm. The symbols used are described in Table J-3 below.

1.	FFFF (hex) --> A
2.	0 --> i

3.	0 --> j	
4.	Di (+) Alow --> Alow	
5.	j + 1 --> j	
6.	shr (A)	
7.	Is there a carry?	No: go to 8; Yes: G (+) A --> A and continue
8.	Is j = 8?	No: go to 5; Yes: continue
9.	i + 1 --> i	
10.	Is i = N?	No: go to 3; Yes: continue
11.	A --> CRC	

Table J - 2 CRC-16 Algorithm

Symbol	Description
-->	Data transfer
A	16-bit working register
Alow	Low-order byte of A
Ahigh	High-order byte of A
CRC	16-bit CRC-16 result
i,j	Loop counters
(+)	(+) logical Exclusive Or operator
N	Total number of data bytes
Di	i-th data byte (i = 0 to N-1)
G	16-bit characteristic polynomial = 1010000000000001 (binary) with MSbit dropped and bit order reversed
shr (x)	Right shift operator (the LSbit of x is shifted into a carry flag, a "0"

Symbol	Description
	is shifted into the MSbit of x, all other bits are shifted right one location)

Table J - 3: Description of the Symbols Used in the CRC-16 Algorithm

J.3 Modbus PDU Description

The Modbus protocol defines a simple Protocol Data Unit (PDU) independent of the underlying communication layer. When the Modbus PDU is parsed, the function code is first controlled. In case of invalid data, a Modbus exception response is built. If the function code is accepted, the request will be processed. Depending on the result of the processing, two types of response can be built:

- A positive Modbus response: The response function code matches the request function code.
- An Exception response:
  - The objective is to provide to the client relevant information concerning the error detected during the processing.
  - The response function code is the request function code + 80h.
  - The exception code is provided to indicate the reason of the error.

J.3.1 Supported Modbus Function Codes

This Section explains how to access Modbus data and how to use and understand the Modbus subset implemented on the Hydran 201T*i*. The guidelines provided below first give an idea on the sequence required to master the communication interface.

Modbus officially defines function codes from 1 to 127, though only a small subset is generally needed to gain access to all system data. The Hydran 201T*i*'s Modbus protocol implementation only includes the function codes shown in Table J-4 below.

Modbus Date Type	Referred as	Function Code (hex)
Read coil status	Read Binary	01
Read discrete input status		02
Read holding registers	Read Analog	03
Read input register		04
Force single coil	Write Binary	05
Force multiple coils		0F
Preset single holding register	Write Analog	06
Preset multiple holding registers		10

Table J - 4: Function codes

In order to promote the interoperability of systems, the coils and discrete inputs are accessed as the same digital data objects. For the same reason, the input and holding registers are also accessed through the same 16-bit data objects. An unsupported function code addressed to the Hydran 201T*i* slave returns an Illegal Function Code exception response code of 01; see Section J.3.2 on page 252 for more details.

J.3.1.1 Read Coils (01h) / Read Discrete Inputs (02h)

This function is used to read a binary value. Up to 2,000 (07D0h) consecutive binary can be read per request. Table J-5 shows the format of the master and slave packets.

Note: This Section demonstrates how to build and understand a 01h or 02h Modbus request/response exchange. To read or write Hydran 201Ti's digital data values, please refer to the subsequent Sections.

Request	Function Code	1 byte	**01h**
	Starting Address	2 bytes	0000h to FFFFh
	Quantity of Coils	2 bytes	1 to 2,000 (07D0h)
Response	Function Code	1 byte	**01h**
	Byte Count	2 bytes	N *
	Coils Status	n bytes	n = N or N + 1
Error	Error Code	1 byte	**81h**
	Exception Code	1 byte	01 or 02 or 03 or 04 or 06

Table J - 5: Format for the Read Coils (01h) / Read Discrete Inputs (02h)

*** N** = Quantity of Output / 8, if the remainder is different of 0 --> N =N + 1

Table J-6 below presents, as an example, the reading of discrete outputs with the address range 20–38. The starting address must be specified, followed by the quantity to read. The return, in LSB format, can be seen in Table J-7 that follows.

Request		**Response**	
Field Name	(hex)	Field Name	(hex)
Function	01	Function	01
Starting Address Hi	00	Byte Count	03
Starting Address Lo	13	Output Status 27–20	CD
Quantity of Outputs Hi	00	Output Status 35–28	6B
Quantity of Outputs Lo	13	Output Status 38–36	05

Table J - 6: Reading of Discrete Outputs with the Address Range 20-38

1st word								**2nd word**	
X+15	X+14	X+13	...	X+3	X+2	X+1	X *	X+31	...

Table J - 7: Return in LSB Format

*** X** = Starting address

J.3.1.2 Write (SET or FORCE) Single Coil (05h)

This function is used to set a binary value. Only one binary can be set at a time. The address to set and the value must be specified. The value will be FF00h to set a binary, and 0000h to clear it. The return will confirm the address and the value set. Table J - 8 below shows the format of the master and slave packets.

Note: This Section shows how to build and understand a 05h Modbus request/response exchange. To read or write Hydran 201Ti digital data values, please refer to the subsequent Sections.

Table J-9 below presents, as an example, the writing (SET) of coil 173 value to "ON".

Request	Function Code	1 byte	**05h**
	Output Address	2 bytes	0000h to FFFFh
	Output Value	2 bytes	0000h or FF00h
Response	Function Code	1 byte	**05h**
	Output Address	2 bytes	0000h to FFFFh
	Output Value	2 bytes	0000h or FF00h
Error	Error Code	1 byte	**85h**
	Exception Code	1 byte	01 or 02 or 03 or 04 or 06

Table J - 8: Format for Write (SET or FORCE) Single Coil (05h)

Request		**Response**	
Field Name	**(hex)**	**Field Name**	**(hex)**
Function	05	Function	05
Output Address Hi	00	Output Address Hi	00
Output Address Lo	AC	Output Address Lo	AC
Output Value Hi	FF	Output Value Hi	FF
Output Value Lo	00	Output Value Lo	00

Table J - 9: Writing (SET) of Coil 173 Value to "ON"

J.3.1.3 Read Holding Registers (03h) / Read Input Registers (04h)

This function code is used by the master to read one or more consecutive data registers (actual values or settings). Data registers are always 16-bit (two-byte) values transmitted with the high-order byte first. The maximum number of registers that can be read in a single packet is 125. Since some PLC implementations of Modbus only support one of function codes 03h and 04h, in this case, either function code can be used to read one or more consecutive data registers. The data starting address determines the type of data being read. Table J - 10 below shows the format of the master and slave packets.

Note: This Section demonstrates how to build and understand a 03h or 04h Modbus request/response exchange. To read or write Hydran 201Ti analog data values, please refer to the subsequent Sections.

Request	Function Code	1 byte	**03h**
	Starting Address	2 bytes	0000h to FFFFh
	Quantity of Registers	2 bytes	1 to 125 (7Dh)
Response	Function Code	1 byte	**03h**
	Byte count	1 byte	2 x N *
	Register Value	N x 2 bytes	
Error	Error Code	1 byte	**83h**
	Exception Code	1 byte	01 or 02 or 03 or 04 or 06

Table J - 10: Format for Read Holding Registers (03h) / Read Input Registers (04h)

*** N** = Quantity of Registers

Table J-12 presents, as an example, the reading of multiple data registers with the address range 108–110.

J.3.1.4 Write Multiple Registers (10h)

This function is used to write one or more registers. Up to 125 (7Dh) registers can be written per request. The starting address must be specified, followed by the quantity to write, the byte count of data to write, and the data.

This function code is used by the master to modify the contents of a one or more consecutive setting registers. Setting registers are 16-bit (two -byte) values transmitted with the high-order byte first. Table J-11 shows the format of the master and slave packets.

Note: This Section shows how to build and understand a 10h Modbus request/response exchange. To read or write Hydran 201Ti's analog data values, please refer to the subsequent Sections.

Request		Response	
Field Name	**(hex)**	**Field Name**	**(hex)**
Function	03	Function	03
Starting Address Hi	00	Byte Count	06
Starting Address Lo	6B	Registers Value Hi (108)	02
Number of Registers Hi	00	Registers Value Lo (108)	2B
Number of Registers Lo	03	Registers Value Hi (109)	00
		Registers Value Lo (109)	00
		Registers Value Hi (110)	00
		Registers Value Lo (110)	64

Table J - 11: Format for the Write multiple registers (10h)

Request	Function Code	1 byte	**10h**
	Starting Address	2 bytes	0000h to FFFFh
	Quantity of Registers	2 bytes	0001h to 007Bh
	Byte Count	1 byte	2 x N *
	Registers Value	N x 2	Value
Response	Function Code	1 byte	**10h**
	Starting Address	2 bytes	0000h to FFFFh
	Quantity of Register	2 bytes	1 to 123 (7Bh)
Error	Error Code	1 byte	**90h**
	Exception Code	1 byte	01 or 02 or 03 or 04 or 06

Table J - 12: Reading of Multiple Data Registers With the Address Range 108-110

*** N** = Quantity of Registers

Note: With the Hydran 201Ti, the master can only write one logical value per request. The number of registers accessed in that request depends on the type of logical value the master is trying to change

Table J - 13 below presents, as an example, the writing of data registers with the addresses 1 and 2.

Request		Response	
Field Name	**(hex)**	**Field Name**	**(hex)**
Function	10	Function	10

Starting Address Hi	00	Starting Address Hi	00
Starting Address Lo	01	Starting Address Lo	01
Quantity of Registers Hi	00	Quantity of Registers Hi	00
Quantity of Registers Lo	02	Quantity of Registers Lo	02
Byte Count	04		
Register Value Hi	00		
Register Value Lo	0A		
Register Value Hi	01		
Register Value Lo	02		

Table J - 13: Writing of Data Registers with the Address 1 & 2

J.3.2 Exception Response

Programming or operation errors usually occur due to illegal data detection in a packet. These errors result in an exception response from the slave. The slave detecting one of these errors sends a response packet to the master with the high- order bit of the function code set to 1. The exception codes are described in Table J - 14 below.

Exception Code	Modbus Name	Comment
01	Illegal Function Code	The function code is unknown by the server.
02	Illegal Data Address	Depends on the request.
03	Illegal Data Value	Depends on the request.
04	Server Failure	The server failed during the execution. The server was unable to accept the MB Request
06	Server Busy	PDU. The client application has the responsibility of deciding if and when to re-send the request.

Table J - 14: Description of Exception Codes

J.4 Hydran 201Ti Data Model

The Modbus protocol only supports very basic data types. Manufacturers combine registers to be able to represent more complex types of data such as floating point, time-stamped, event files, logs, etc. The Modbus standards do not define how this is done and that becomes an obstacle for interoperability between systems. Modbus bases its data model on a set of four tables that reflect simple data types (see Table J-15 below).

Modbus Data Type	Object Type	Access Type	Comment
Discrete Inputs	Single bit	Read only	Referenced as binary data objects
Coils		Read-write	
Input Registers	16-bit word	Read only	Referenced as analog data objects
Holding Registers		Read-write	

Table J - 15: Modbus Data Types

Basically, the Modbus register mapping can be summarized as this:

- "Binary In" are mapped to "Modbus coils status" and to "Modbus input status".
- "Binary Out" are mapped to "Modbus coils".
- "Analog In" and "Analog Out" are mapped to "Modbus Holding Registers" and "Modbus Input Registers".

Refer to J.5 for mapping details.

J.4.1 Data Access – read from H201Ti via Modbus

J.4.1.1 Holding Registers (Analog Inputs)

For improved flexibility and better compatibility with different SCADA, the Hydran 201T*i* provides three different mappings for most Analog Input data objects: 16-bit signed integer, 32-bit signed integer, and 32-bit floating point. All three mappings are equivalent (subject to their respective range and precision).

- 16-bit signed integer mapping provides access to Analog Input values that fit in 16 bits, in order to minimize the amount of the data to exchange on the communication link. It provides compatibility with widest range of Modbus Masters.
- 32-bit signed integer mapping provides access to Analog Inputs with sufficient precision and allows for interoperation with Modbus Masters that don't support floating-point data.
- 32-bit floating-point mapping provides access to Analog Inputs with full precision available to the Hydran 201T*i*.

To represent Analog Inputs with necessary precision, values accessed via integer mappings are pre-multiplied with a scale factor specific to each Analog Input. These scale factors can be found in the Section J-5.b.

16-Bit Integer Analog Input Read

In the 16-bit mapping, an object value exceeding 32767 or below -32768 is clamped. A Hydran 201T*i* Analog Input object corresponds to a Modbus 16-bit data object.

32-Bit Integer Analog Input Read

Modbus has no support for 32-bit variables. In order to access the Hydran 201T*i*'s 32-bit variables, an access must be implemented to 32-bit values. All Hydran 201T*i* variables with a value exceeding 16 bits are accessible through the Int32 registers type in the Modbus Holding Registers map. In this region, all analog values are mapped using two 16-bit registers.

In the 32-bit mapping, a Hydran 201T*i* "Analog Input" object is stored in two consecutive Modbus 16-bit data objects: the first one is the 16 MSB bits and the second one is the 16 LSB bits (Big-endian).

In order to ensure data consistency, both parts of a mapped Analog Input object must be accessed within one Modbus command (function codes 03, 04 or 10). Using function 06 *Preset single holding register* with a 32-bit mapping is not possible. If only part of a 32-bit object mapping is accessed by a Modbus command, the Hydran 201T*i* will respond with an exception code 02 *Illegal data address*.

32-Bit Floating-Point Analog Input Read

Modbus has no support for 32-bit floating-point variables. In order to access the Hydran 201T*i*'s 32-bit floating-point variables, an access must be implemented to 32-bit values. Floating-point values are mapped using two 16-bit Modbus registers.

In the 32-bit floating-point mapping, a Hydran 201T*i* Analog Input object is represented in **binary32** form according to ISO/IEC/IEEE 60559:2011 (IEEE 754) International Standard. This representation is split in two 16-bit parts which are stored in two consecutive 16-bit Modbus registers. The first register contains sign, exponent, and 9 most-significant bits of the mantissa. The second register contains 16 least-significant bits of the mantissa.

In order to ensure data consistency, both parts of a mapped Analog Input object must be accessed within one Modbus command (function codes 03, 04 or 10). Using function 06 *Preset single holding register* with a 32-bit mapping is not possible. If only part of a 32-bit object mapping is accessed by a Modbus command, the Hydran 201T*i* will respond with an exception code 02 *Illegal data address*.

J.4.1.2 Strings

Modbus has no native support for Strings; all access string variables must be wrapped through standard 16-bit registers. The string values are accessible in a specific region of the Modbus Holding Registers. Each string variable uses 128 X 16-bit registers, giving a possible string size of 255 bytes. The most-significant byte of the first 16-bit register specifies the size of the octet string. If the string is shorter than 255 bytes, it is padded at the end with 00 bytes, which are not counted in the string length.

String Read

To read a specific string object on Modbus, proceed as follows:

1. First you need to know the point index of the first Modbus Holding Register where the string can be accessed; refer to J.5 for mapping details.
2. Issue a Read Holding Registers command with this point index as start register. Since you can't read the complete 128 registers in a single Modbus query, the embedded device always buffers the last string object accessed.
3. Issue another Read command for the rest of the string, and the string integrity is preserved.

J.4.2 Data access - write to H201Ti via Modbus

Hydran 201Ti supports following actions that can be performed via Modbus:

- Acknowledge pending alarms;
- Set Hydran 201T*i* system date and time.

These actions can be performed by issuing Modbus commands with function codes 05 (*Force single coil*), 15 (*Force multiple coils*), 06 (*Preset single holding register*) or 16 (*Preset multiple holding registers*) to corresponding registers or coils.

To prevent accidental modification of Hydran 201T*i* settings or behavior, all Modbus registers that allow modification are write-protected. To unlock the write protection mechanism, Level 1 password has to be written to the *SCADA Password* holding register. See chapter 5.4 *Passwords* for the password value. After it is done, write protection mechanism stays unlocked until a time-out of **10 minutes** expires or an invalid password value is written to the *SCADA Password* register.

J.4.2.1 Acknowledging Pending Alarms

If a particular alarm needs acknowledge, corresponding binary value (Modbus coil) *Alarm_XXXXX_Pending* will be in active state. The alarm can be acknowledged by issuing Modbus command 05 (*Force single coil*) to the corresponding binary register. Multiple alarms can be acknowledged by issuing command 15 (*Force multiple coils*) with a range of Alarm Pending status binary registers.

The steps to acknowledge pending alarms are as follows:

1. Write Level 1 Password to the *SCADA Password* holding register.
2. Issue one or more Binary Write commands to acknowledge pending alarms.
3. Write **0** to the *SCADA Password* holding register.

The last step is optional; it ensures that write protection mechanism engages as soon as write access is completed, without waiting for the timeout to expire.

See chapter 5.4 *Passwords* for the password value.

See chapter J-5 below for addresses of the Modbus registers.

J.4.2.2 Setting Hydran 201Ti System Date and Time

The Hydran 201T*i* supports changing its system date and time via Modbus. This can be accomplished by writing a 32-bit integer Unix time value to the *System Date* holding register.

The steps to change system date and time are as follows:

4. Write Level 1 Password to the *SCADA Password* holding register.
5. Write new system date and time value to the System Date register using command 16 *Preset multiple holding registers*. See chapter I-4.a.i above for the explanation of the register format.
6. Write **0** to the *SCADA Password* holding register.

The last step is optional; it ensures that write protection mechanism engages as soon as write access is completed, without waiting for the timeout to expire.

See chapter 5.4 *Passwords* for the password value.

See chapter J-5 below for addresses of the Modbus registers.

J.5 Addresses Mapping

This Appendix contains tables that present the Hydran 201T*i* addresses mapping for the following:

- Coils: See Section J-5.a.
- Holding registers: See Section J-5.b.
- Strings: See Section J-5.c.

J.5.1 Address Mapping for the Coils

Table J-16 below presents the addresses mapping for the Binary Inputs. The columns contain the following information:

- *Modbus Address*: Modbus register address of the variable.
- *Register Description*: Name of the variable.
- *Format*: Type of format used by the data. See Section D.7 for details.
- *Default Value*: Default value of the variable.

Modbus Address	Register Description	Format	Default
32823	Gas PPM High Relay state	F1001	0 (Off)
32824	Gas PPM High High Relay state	F1001	0 (Off)
32825	System OK Relay state	F1001	0 (Off)
32826	Alarm_Gas_LL_Active	F1002	0 (Off)
32827	Alarm_Gas_L_Active	F1002	0 (Off)
32828	Alarm_Gas_H_Active	F1002	0 (Off)
32829	Alarm_Gas_HH_Active	F1002	0 (Off)
32830	Alarm_Hourly_LL_Active	F1002	0 (Off)

Modbus Address	Register Description	Format	Default
32831	Alarm_Hourly_L_Active	F1002	0 (Off)
32832	Alarm_Hourly_H_Active	F1002	0 (Off)
32833	Alarm_Hourly_HH_Active	F1002	0 (Off)
32834	Alarm_Daily_LL_Active	F1002	0 (Off)
32835	Alarm_Daily_L_Active	F1002	0 (Off)
32836	Alarm_Daily_H_Active	F1002	0 (Off)
32837	Alarm_Daily_HH_Active	F1002	0 (Off)
32838	Alarm_SensTemp_LL_Active	F1002	0 (Off)
32839	Alarm_SensTemp_L_Active	F1002	0 (Off)
32840	Alarm_SensTemp_H_Active	F1002	0 (Off)
32841	Alarm_SensTemp_HH_Active	F1002	0 (Off)
32842	Alarm_Battery_LL_Active	F1002	0 (Off)
32843	Alarm_Battery_L_Active	F1002	0 (Off)
32844	Alarm_SetupLost_Active	F1002	0 (Off)
32845	Alarm_SensTest_CableShort_Active	F1002	0 (Off)
32847	Alarm_SensTest_ReplaceNow_Active	F1002	0 (Off)
32848	Alarm_SensTest_CableOpen_Active	F1002	0 (Off)
32849	Alarm_Gas_LL_Pending	F1003	0 (Acknowledged)
32850	Alarm_Gas_L_Pending	F1003	0 (Acknowledged)
32851	Alarm_Gas_H_Pending	F1003	0 (Acknowledged)
32852	Alarm_Gas_HH_Pending	F1003	0 (Acknowledged)
32853	Alarm_Hourly_LL_Pending	F1003	0 (Acknowledged)
32854	Alarm_Hourly_L_Pending	F1003	0 (Acknowledged)
32855	Alarm_Hourly_H_Pending	F1003	0 (Acknowledged)
32856	Alarm_Hourly_HH_Pending	F1003	0 (Acknowledged)
32857	Alarm_Daily_LL_Pending	F1003	0 (Acknowledged)
32858	Alarm_Daily_L_Pending	F1003	0 (Acknowledged)
32859	Alarm_Daily_H_Pending	F1003	0 (Acknowledged)
32860	Alarm_Daily_HH_Pending	F1003	0 (Acknowledged)
32861	Alarm_SensTemp_LL_Pending	F1003	0 (Acknowledged)
32862	Alarm_SensTemp_L_Pending	F1003	0 (Acknowledged)

Modbus Address	Register Description	Format	Default
32863	Alarm_SensTemp_H_Pending	F1003	0 (Acknowledged)
32864	Alarm_SensTemp_HH_Pending	F1003	0 (Acknowledged)
32865	Alarm_Battery_LL_Pending	F1003	0 (Acknowledged)
32866	Alarm_Battery_L_Pending	F1003	0 (Acknowledged)
32867	Alarm_Battery_H_Pending	F1003	0 (Acknowledged)
32868	Alarm_SetupLost_Pending	F1003	0 (Acknowledged)
32869	Alarm_SensTest_CableShort_Pending	F1003	0 (Acknowledged)
32871	Alarm_SensTest_ReplaceNow_Pending	F1003	0 (Acknowledged)
32872	Alarm_SensTest_CableOpen_Pending	F1003	0 (Acknowledged)

Table J - 16: Hydran 201 T*i* Coil registries map

J.5.2 Address Mapping for the Holding registers

Modbus Register			Description	Range	Units	Precision	Multiplication factor[1]	Format
Int16	Int32	Float32						
-	16897	-	System Date	0 - 4294967295	seconds	1	1	Unix Time
-	16899	-	Firmware source code revision Id	0 - 4294967295	-	1	1	-
-	16901	-	Firmware source code sequential Id	0 - 4294967295	-	1	1	-
-	16903	-	Modbus error counter	0 - 4294967295	-	1	1	-
32769	33025	33537	Gas ppm value	0 to 2000	ppm	1	1	-
32770	33027	33539	Hourly trend	-2000 to 2000	ppm/hr	0.1	10	-
32771	33029	33541	Daily trend	-2000 to 2000	ppm/day	0.1	10	-
32772	33031	33543	Sensor temperature	-75 to 200	°C	0.1	10	-
32863	33213	33725	Sensor serial number	0 to 1000000	-	1	1	-
32864	33215	33727	Program revision	0 to 1000	-	0.01	100	-
32882	33251	33763	SCADA Password	-32768 to 32767	-	1	1	-

Table J - 17: Hydran 201 T*i* Holding registries map

[1] Not applicable to **Float32** mapping.

J.5.3 Address Mapping for the String registers

Modbus Register	Register Description	Range	Default	Format
20481	Device type and identifier	-	" "	StringWithLen
21889	H201T*i* Serial Number	-	" "	StringWithLen

Table J - 18: Hydran 201 T*i* String registries map

The *Device type and identifier* string (first string in the Table J-18 above) consists of the following semicolon-separated fields:

- Firmware product code and revision;
- PowerStation ID (decimal) – see chapter 5.5.6.6;
- Hydran 201T*i* ID (decimal) – see chapter 5.5.6.6;
- One or more reserved fields.

The *H201Ti Serial Number* string (second in the Table J-18 above) contains the Hydran 201Ti serial number that is defined during factory configuration.

J.5.4 Used formats

Format	Description	Value	State
Unix Time	Time in seconds since January 1st, 1970	--	--
F1001	Relay Status (binary)	0	Off
		1	Energized
F1002	Alarm_Active (binary)	0	Off
		1	Alarm
F1003	Alarm_Pending (binary)	0	Aknowledged
		1	Pending
StringWithLen	String with explicit length field	--	Byte 0: string length (N)
		--	Bytes 1..N: string characters
		--	Bytes N+1 and above: optional NUL (0) bytes

Table I - 19: Hydran 201 T*i* – used Formats

Appendix K : Glossary

A	Ampere
ac	Alternating Current
ACK	ACKnowledge
A/D or **ADC**	Analog-to-Digital Converter
Alarm	Condition when a data point value exceeds a set point
Alarm Contact	Contact of an alarm relay
Analog Output	Analog signal proportional to gas or moisture level
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
B.P.	Base Plate with heating resistors
bps	Bit Per Second
CD-ROM	Compact Disc - Read-Only Memory
CE	Conformité Européenne (European Conformity)
CH_4	Methane (gas)
C_2H_2	Acetylene (gas)
C_2H_4	Ethylene (gas)
C_2H_6	Ethane (gas)
CO	Carbon monoxide (gas)
CO_2	Carbon dioxide (gas)
COM	COMmunication port on a PC
Combustible Gas	Fault gas in the dielectric oil of a transformer
CPU	Central Processing Unit
CSA	Canadian Standards Association
CT	Current Transformer
D/A or **DAC**	Digital-to-Analog Converter
Daily Trend	Variation during a time period (days)
Daisy Chain	Daisy connection of devices using RS-485 link cable
dc	Direct Current
DGA	Dissolved Gas Analysis
Digital Output	Output in form of a digital signal (e.g. relay contact)
DIN	Deutsches Institut für Normung (German Standards Institute)
Download	Transferring data from a device

EC	Electronic Controller
EEC	European Economic Community
E/G	Earth/Ground
Embedded Software	Software to control micro-controller based machines or devices with fixed hardware, such as Hydran 201Ti. Application is specific to the operation of the device.
EMI	Electro-Magnetic Interference
Error	Deviation of a measurement from its expected value
Esc	ESCape (key)
ESD	Electro-Static Discharge
Extended Menu	Menu that gives access to all operation parameters and commands (including those of the Main Menu) of the Hydran 201Ti
Fault	Abnormal condition
FCC	Federal Communications Commission
FIFO	First In, First Out (type of memory)
Gas Level	Gas concentration measured by device
GE	General Electric
GND	GrouND (Earth)
GUI	Graphical User Interface
H or **Hi**	High alarm
H_2	Hydrogen (gas)
HH or **Hi-Hi**	High-High alarm
History File	This include Short Term, Long Term, Events and Service data that are stored in the Hydran 201Ti's memory
HMI	Human/Machine Interface
H_2O	Water
Host Computer	Computer connected remotely to a Hydran 201Ti or a network of Hydran 201Ti's
Hourly Trend	Variation during a time period (hours)
Hydran 201Ci	Refer to one of the Hydran 201 family of controllers: Hydran 201Ci-C, 201Ci-1 or 201Ci-4.
Hydran 201Ci-1	One-channel controller and display designed to supervise one Hydran 201Ti unit
Hydran 201Ci-4	Four-channel controller and display designed to supervise up to four Hydran 201Ti units.
Hydran 201Ci-C	Communications controller designed to supervise up to four Hydran 201Ti units
Hydran 201i System	System comprising of a Hydran 201Ti unit together with a Hydran 201Ci Controller

Hydran 201Ti	Intelligent combustible gas monitor and transmitter device for dissolved gas in oil
Hydran M2	Intelligent combustible gas and moisture monitor and transmitter device for dissolved gas in oil
Hydran 201Ti Host	Application software (Microsoft Windows) used to interface with one or several Hydran 201Ti units using a laptop or desktop computer.
Hz	Hertz (unit for frequency)
ID	IDentification
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
IEEE	Institute of Electrical and Electronics Engineers
in	INch
I/O	Input/Output
IP	Internet Protocol
kVA	Kilo Volt-Ampere
L or **Lo**	Low alarm level
Lab Data	Data obtained from laboratory analysis of gas samples
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
LL or **Lo-Lo**	Low-Low alarm
Local Network	Local network of Hydran 201Ti units or Hydran 201i systems using RS-485 link
Local Site	User location where the data of the remote site is being analyzed
mA	milli-Ampere
mAdc	milli-Ampere Direct Current
Main Menu	Menu that gives access to the most frequently used operation parameters and commands of the Hydran 201Ti
Menu	Group of parameters and values accessed through a hierarchical, treelike structure
MHz	Mega-Hertz
Modbus	Standard serial communications protocol originally published by Modicon (now Schneider Electric) in 1979 for use with its programmable logic controllers (PLCs). Currently is managed by Modbus Organization (www.modbus.org). It is a commonly available means of connecting industrial electronic devices.
Modem	MOdulator/DEModulator (a communication device)
MOV	Metal Oxide Varistor

MVA	Mega Volt-Ampere
mV/A	milli Volt per Ampere
N_2	Nitrogen (gas)
NC	Normally Closed (contact)
NEMA	National Electrical Manufacturers Association
Network	See Local Network
NO	Normally Open (contact)
NPT	National Pipe Thread
O_2	Oxygen (gas)
PC	Personal Computer
PCB	Printed Circuit Board
PCBA	Printed Circuit Board Assembly
PDF	Portable Document Format
PLC	Programmable Logic Controller
P/N	Part Number
POT	POTentiometer
ppm	Part Per Million (unit used for gas concentration)
PT	Potential Transformer
PVC	PolyVinyl Chloride (type of plastic)
RAM	Random Access Memory
Range	The limit of measurement values that an instrument is capable of reading
RDBMS	Relational Data-Base Management System
Real-Time	Pertaining to a system or operating mode under which computation is performed during the actual time when an external process occurs.
Remote	A connection with Hydran 201Ti unit(s) using a modem or Ethernet connection through a remote host computer
Repeatability	Ability of an instrument to measure the same input to the same value over a short period of time
Response Time	Time a system (Hydran 201Ti) unit takes to react to a given input (gas concentration change)
RFI	Radio-Frequency Interference
%RH	Relative Humidity in %
RMS	Root Mean Square
RS-232	Serial communications based on TIA-232-F standard
RS-485 Network Link	Network using RS-485 serial connection
RTC	Real-Time Clock
RTD	Resistance Temperature Detector

RTDB	Real-Time Data Base
RTU	Remote Terminal Unit
RTV	Room Temperature Vulcanization
SCADA	Supervisory Control And Data Acquisition
SH	SHield
S/N	Serial Number
SP	Set Point
SPDT	Single Pole Double Throw
SQL	Structured Query Language
SSR	Solid-State Relay
Submenu	A branch of the treelike structure of a menu
TB	Terminal Block
TCP/IP	Transmission Control Protocol/Internet Protocol
TDM	Time Division Multiplexing
Teflon	polyTEtraFLuOrethyleNe
TM	TradeMark
TUV	Technischer Überwachungs-Verein (Technical Inspection Association)
USB	Universal Serial Bus
User	Person operating the device (Hydran 201Ti)
User-Friendly	An interface application easy to use
User Interface	Means provided to interface with a device (display, keypad, push button, etc.)
µV	Microvolt
V	Volt
VA	Volt-Ampere
Vac	Volt Alternating Current
Vdc	Volt Direct Current
VDE	Verein Deutscher Elektrotechniker (Association for Electrical, Electronic and Information Technologies)
V RMS	Volt Root Mean Square
W	Watt
WAN	Wide Area Network,
Watchdog	Process used periodically to test condition of a micro-controller based system
% w/w	Percentage Weight by Weight

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