Model 10C

Single Sensor Control Module

Operator's Installation and Instruction Manual

Covers all Model 10C Control Modules

DETCON, Inc.
4055 Technology Forest, Suite 100,
The Woodlands, Texas 77387
Ph.281.367.4100 / Fax 281.298.2868
www.detcon.com

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Shipping Address: 4055 Technology Forest, Suite 100, The Woodlands Texas 77381
Mailing Address: P.O. Box 8067, The Woodlands Texas 77387-8067
Phone: 888.367.4286, 281.367.4100 • Fax: 281.292.2860 • www.detcon.com • sales@detcon.com

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1.0 Description

The Detcon Model 10C Single Sensor Control Module is designed to monitor and display gas concentration and the status of a remote gas sensor assembly. The 10C Control Module may be configured for a variety of toxic and combustible gases. The Control Module is designed to operate on a nominal input voltage range of 12 VDC to 24VDC and is compatible with a complete line of Detcon enclosures. The available enclosures include designs for stand-alone, rack, or panel mount indoor non-hazardous areas (NEMA 1 and 12), weatherproof indoor/outdoor locations in non-hazardous areas (NEMA 4 and 4X), and indoor/outdoor hazardous locations in areas classified as Class 1, Division 1, Groups B, C, and D (NEMA 7).

10C Control Modules accept 4-20mA current-loop analog inputs; they feature a four-character display, RS-485 Modbus™ serial communications, 4-20mA analog signal outputs, and three alarm relays (Alarm 1, Alarm 2, and Fault). Alarm status is displayed via light emitting diodes (LEDs) located on the front panel. Multiple Control Modules, configured individually and installed in a 10-Series Detcon Controller, can provide monitoring of a variety of gases from multiple field sensors in one system. Figure 1 illustrates how the 10C Control Module can be utilized and connected in a Model 10C System.

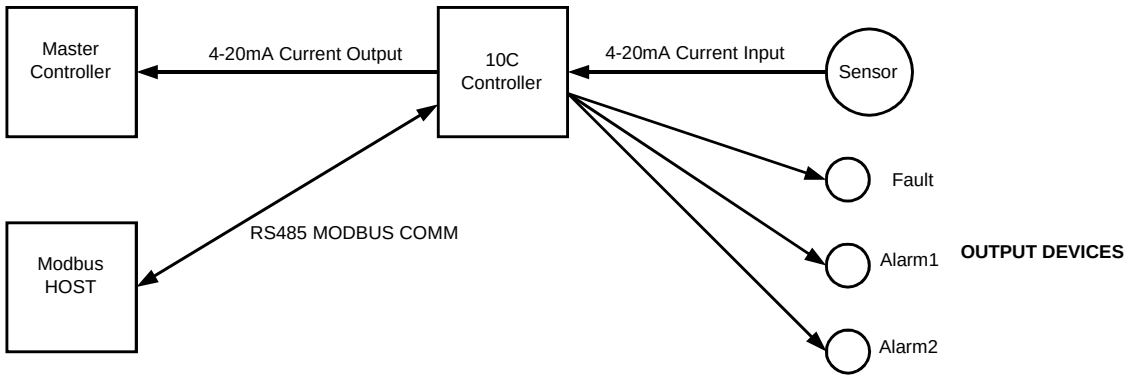

Figure 1 System Application Diagrams

The overall 10C system design may include Facilities Modules and Relay Modules. These additional modules are optional and are the same form-factor as the 10C Control Modules. The Facilities Module communicates with 10C Control Modules to gather data to associate the controllers in assigned zones, to optionally log data, to report multiple controllers as one Modbus™ ID, and to logically process and output conditions to the Relay Modules. Further description of the Facilities and Relay modules is beyond the scope of this document.

1.1 Front Panel/Operator Interface

The main purpose of the 10C Control Module's 4-character display is to show the current gas concentration reading of the sensor attached. The display is also used to The display on the front panel is also used to view and modify the configuration settings of the Control Module.

Three LED's on the front panel provide visual indication of alarm and fault conditions. These LED's are labeled "ALM 1", "ALM 2", and "FAULT".

Pushbuttons located on the Front Panel provide access to view and set parameters within the controller and to provide "Alarm Reset", "Alarm Acknowledge", and "Alarm Silence" functions. The pushbuttons allow navigation through an interactive menu to access programming of the 10C Control Module's configuration. The interactive menu allows the user to set parameters associated with the sensor attached: Gas type, Range, Units, Alarm settings, and Modbus ID. Navigation through the menu system is accomplished by use of the

Front Panel Pushbuttons: the Enter key “ENT”, the Escape key “ESC”, the Up key “⇧” (or “RESET”), and the Down key “⇩” (or “SLNC”).

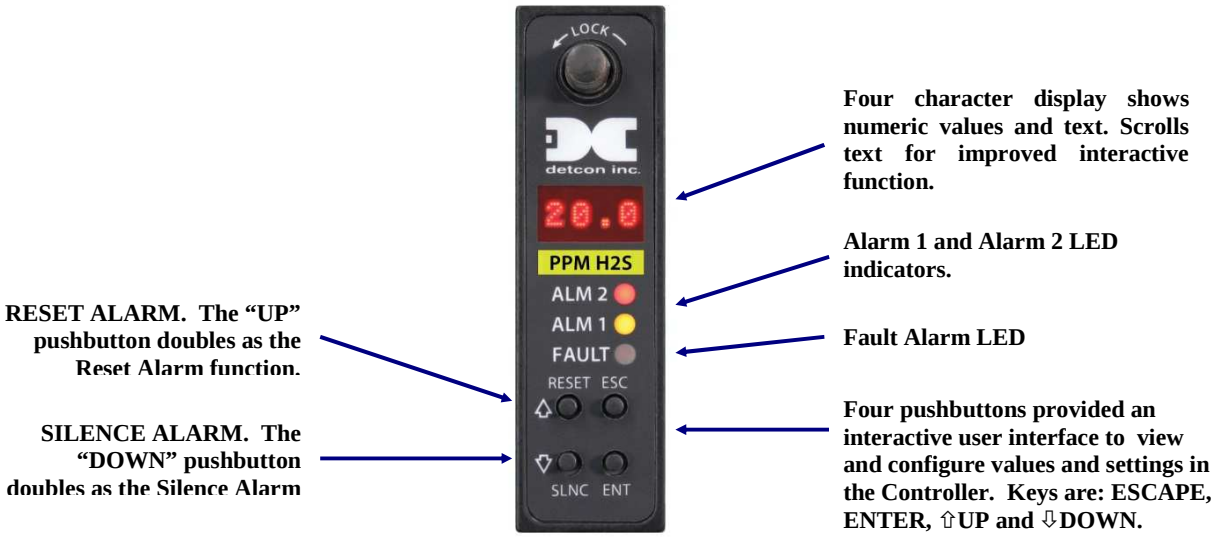

Figure 2 Front Panel Face Plate

1.2 Alarm Functions

The alarm configuration determines how the 10C Control Module responds to the attached sensors reading. Alarm set-points are programmed to flag alarms at predetermined levels. Alarm output relays and corresponding LEDs can be programmed for latching or non-latching, ascending or descending, energized or de-energized, and silenceable or non-silenceable operation. Any combination of these settings can be programmed to provide a setup for most any contingency. Prior planning is needed to determine the best configuration for the application.

1.2.1 Latching or Non-latching Relays

Alarm 1, Alarm 2, and Fault, can be programmed as Latching or Non-latching. If an alarm is programmed as Latching, its corresponding relay and LED Indicator, once activated, will stay activate until reset, even if the alarm or fault condition has passed. If an alarm is programmed as Non-latching, the alarm will return to the inactive state once the alarm condition has passed.

A “RESET” pushbutton on the front of the 10C Control Module allows the alarms to be reset if the alarms are set as Latched. In response to the front panel reset switch, the display will scroll the text: “**Reset Alarms?**” If the “ENT” pushbutton is pressed the alarms will be cleared, and the display will scroll the text: “**Reset DONE**”.

An external momentary reset switch may be wired to the backplane of the control unit. The external reset does not have an acknowledge feature, and when the Control Module senses that the external reset, the 10C Control Module will reset the alarms and the display will scroll the text: “**Ext Alm Rst**”.

1.2.2 Energized or De-energized Relay Coils

All alarm relays (Alarm 1, Alarm 2, and Fault) can be programmed as normally Energized or De-Energized. The standard setting for alarms is De-energized; however, a relay can be programmed as Energized to provide application specific features. For De-Energized relays, the coil will energize in an alarm state so that a N.O. (Normally Open) contact on the relay will close upon an alarm. For Normally Energized relays, the coil will de-energize in an alarm state.

The advantage of a Normally Energized relay coil is that if power is lost, the normally closed contact having been held open by the energized coil, will close. Therefore, loss of power or an unplugged card is distinguishable from lack of alarm. A typical application of an Energized relay could be the use of the Fault Relay in a Fail-Safe Fault Circuit. The loss of functionality or other fault of the Controller would cause the coil to De-Energize, thus creating a Fault output to annunciators or other equipment. For instance: if power is lost to the 10C Control Module, or if the 10C module is unplugged from the live controller.

1.2.3 Ascending or Descending

Alarm 1 and Alarm 2 can be programmed to trigger by an increasing gas concentration (Ascending) or a decreasing gas concentration (Descending) through a predetermined set-point. The descending feature, although mainly used for oxygen deficiency, can be useful for setting the trigger of alarms when there is lack of gas concentration. When set for ascending, the associated alarms will trigger when the gas concentration goes above the preset set-point. When set for descending, the associated alarms will trigger when the gas concentration falls below the preset set-point. The set-point of an alarm is programmable, and is covered in section 2.4 Alarm 1, 2, and Fault Set.

1.2.4 Silenceable or Non-silenceable (Alarm Acknowledge)

The terminology "to acknowledge alarms" is synonymous with the terminology "to silence an alarm". All Alarms (Alarm 1, Alarm 2, and Fault) can be programmed as Silenceable or Non-silenceable. When an alarm is programmed as Silenceable, the setting allows the alarm(s) to be silenced even during an alarm condition. To silence an alarm the 10C Control Module's alarm must be programmed as Silenceable.

When an alarm occurs, the alarm can be silenced by pressing the "SLNC" pushbutton. When the "SLNC" pushbutton is pressed during an alarm the display will scroll the text: "**Silence Alarms?**" Pressing the "ENT" pushbutton will silence the alarms, and the display will scroll the text: "**Silence DONE**".

An example where this feature might be used is a Strobe connected to Alarm 1 and a Horn connected to Alarm 2. If Alarm 1 is set as Non-silencable, and Alarm 2 is set as Silencable, in the event of an alarm where both the Strobe and Horn were activated, the Horn could be silenced while the Strobe would remain activated. The silenced state is reset if and when the alarm condition clears and then exceeds alarm set-point again. The Horn would be reactivated upon the return of the alarm condition.

The "Remote Reset" signal that resets latched alarms also functions as a signal to silence active Silenceable Alarms.

> **NOTE:** There is a minimum alarm time before acknowledge. When a silenceable alarm triggers, a minimum-time timer starts. A silenceable alarm cannot be silenced until this timer has run out. This guarantees that the alarm has a minimum activity time.

1.2.5 Alarm Reset

An alarm "RESET" pushbutton is located on the front panel of the 10C Control Module. This switch is used to reset alarms that have been programmed as latching. Once alarm conditions clear, alarms that have been set as latching can be reset by use of this switch. If an alarm is set as latching, and the alarm condition has passed, pressing the "RESET" pushbutton will cause the display to scroll the text: "**Reset Alarms?**" Pressing the "ENT" pushbutton will reset the alarms and the display will scroll the text: "**Reset DONE**".

An externally mounted Normally-Open Momentary Switch may be wired to the backplane of the control unit as a 'Remote Reset' Switch. The external reset switch performs the same function as the "RESET"

pushbutton, but does not have an acknowledge feature. When the 10C Control Module senses that the external reset signal is activated, the Control Module will reset the alarms and the display will scroll the text: "**Ext Alm Rst**".

1.3 Fault Circuit Functions

How the 10C Control Module responds to a fault condition is determined by the configuration programmed into the controller. 'Fault' may be programmed as latching or non-latching, energized or de-energized, and silenceable or non-silenceable operation. Any combination of these settings can be programmed to provide a setup for most any application. Planning is needed to determine the best configuration for the application.

10C Control Modules can be set up in a Fail-Safe Fault supervisory circuit. A Fail-Safe Fault can be created by setting the Fault Relay as Energized, and connecting the fault circuits of several 10C Control Modules in series. If a fault occurs anywhere in the series circuit, the de-energized fault relay will 'break' the circuit, causing a system fault. With this set-up, a loss of power to any unit will break the circuit because of the normally-energized relays becoming de-energized, thus creating a "Fault Condition" due to the loss of power.

The 10C Control Module is designed to detect a sensor as being "In Calibration Mode" when the 4-20mA input is nominally 2mA. The Display will show "**CAL**" to signify sensor Calibration Mode. When the 4-20mA signal falls below 2mA, the display will change to "**SENS**" to signify that there is a sensor related problem. The Fault Set-Point can be set to any point below 4mA (in steps of .05mA) so that the input of the sensor can trigger a fault at any point below 4mA.

For 3-wire sensors, the Set-Point can be adjusted to 1.8mA so that when the sensor is in Calibration, a Fault is not generated. If the input current falls below 1.8mA, a fault will be generated. Since most sensors reduce their output current for internally detected faults, this set-point is a good setting.

For 2-wire sensors, the sensor uses the loop current for power, so the set-point ordinarily must be higher. The fault Set-Point for 2-wire sensors is recommended to be 3.5mA.

1.4 Analog 4-20mA Sensor Input

If the current-loop input reads below the Fault Set-Point, the sensor is 'In Fault'. The 10C Control Module will activate the Fault Alarm relay and the Fault LED to indicate the Fault condition. Table 1 Input current below 4mA shows what should be displayed for input current less than 4mA. If the current-loop input measures nominally 2.0mA, the Sensor is in Calibration Mode and the 10C Control Module will display the text '**CAL**'. Very low input current will cause a display of '**SENS**' to indicate Sensor Fault. In either case, the Fault Relay is set according to the current configuration to convey a fault status. Note that if the Fault Relay is configured as normally energized, the relay coil will de-energize to convey a fault status. If the Fault Relay is configured as normally de-energized, the relay coil will energized to convey a fault status.

Table 1 Input current below 4mA

Input Current (mA)	Display
0-1.8	SENS
1.8-2.4	CAL
2.40-2.56	-9
2.56-2.72	-8
2.72-2.88	-7
2.88-3.04	-6
3.04-3.20	-5
3.20-3.36	-4
3.36-4.00	00

In normal operation, the 4-20mA current output corresponds directly with the Sensor 4-20mA input. The RS-485 Modbus™ serial communications provides the current gas reading and complete fault status when polled by the Master Controller.

1.5 RS-485 Modbus™

The 10C Control Modules feature Modbus™ compatible communications protocol and are addressable via the programming menu for multi-point communications. Communication is two wire, half-duplex, with the 10C Control Module set as a slave device. A master controller can address a maximum of 255 different 10C Control Modules. The actual limit of how many 10C Control Modules can be connected to one RS485 Multi-drop line depends upon desired maximum response time, noise conditions, cable quality, and distance. If a multi-point system is utilized, each 10C Control Module must be set to a unique Modbus™ address. Address settings are given in hexadecimal, such as: 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B, 0C, 0D, 0E, 0F, 10, 11, etc. (See Section 2.5 to set the Modbus™ address.)

The following register list describes the parameters available from 10C Control Module:

Register #	High Byte	Low Byte
40000		Range
40001		Reading
40002		Alarm 1 Set Point
40003		Alarm 2 Set Point
40004		Not Used
40005		Status Bits

40005 Status Bits High Byte:
Bit 15 – Reserved
Bit 14 – Reserved
Bit 13 – Reserved
Bit 12 – Test mode status
Bit 11 – Reserved
Bit 10 – Reserved
Bit 9 – Reserved
Bit 8 – Reserved

40005 Status Bits Low Byte:
Bit 7 – Alarm 2 / 0 – Ascending, 1 – Descending
Bit 6 – Alarm 2 / 0 – Non-latching, 1 – Latching
Bit 5 – Alarm 2 alarm status / 0 – no alarm, 1 – alarm
Bit 4 – Alarm 1 / 0 – Ascending, 1 – Descending
Bit 3 – Alarm 1 / 0 – Non-latching, 1 – Latching
Bit 2 – Alarm 1 alarm status / 0 – no alarm, 1 – alarm
Bit 1 – Fault / 0 – Non-latching, 1 – Latching
Bit 0 – Fault status / 0 – no fault, 1 - fault

1.6 Controller Models

Table 2 10C Control Module Models provides a list of the available 10C Control Modules, the target gas, the standard range and units for that gas, and the gas formula. Most 10C Control Modules can be programmed for a range other than the standard range if needed. (For more information on setting Range, see Section 2.2 Range Set.)

The label on the 10C Control Module faceplate follows a standard color scheme for identifying the gas type: Yellow = Solid State H2S, Orange = Combustible Gas, Green = Oxygen and Blue = Electrochemical Toxic (various). The gas identifier label on the face plate also shows the gas formula and Units: ppm, ppb, or %.

Table 2 10C Control Module Models

Model #	Target Gas	Standard Range	Formula
AsH_3-10	Arsine	0-1 PPM	AsH_3
Br_2-10	Bromine	0-5 PPM	Br2
B_2H_6-10	Diborane	0-5 PPM	B_2H_6
CG–10	Combustible Gases	0-100 % LEL	various
CH_20-10	Formaldehyde	0-100 PPM	CH_20
CH_30H-10	Methanol	0-100 PPM	CH_30H
CH_3SH-10	Methyl Mercaptan	0-100 PPM	CH_3SH
ClO_2-10	Chlorine Dioxide	0-1 PPM	ClO_2
Cl2-10	Chlorine	0-10 PPM	Cl_2
CO-10	Carbon Monoxide	0-100 PPM	CO
$COCl_2$-10	Phosgene	0-1 PPM	$COCl_2$
CO_2-10	Carbon Dioxide	0-1 %	CO_2
CS-10	Carbonyl Sulfide	0-100 PPM	CS
CS_2-10	Carbon Disulfide	0-100 PPM	CS_2
C_2H_2-10	Acetylene	0-100 PPM	C_2H_2
C_2H_3Cl-10	Vinyl Chloride	0-100 PPM	C_2H_3Cl
C_2H_30-10	Acetyldehyde	0-100 PPM	C_2H_30
C_2H_4-10	Ethylene	0-100 PPM	C_2H_4
C_2H_4O-10	Ethylene Oxide	0-100 PPM	C_2H_4O
C_2H_5OH-10	Ethanol	0-100 PPM	C_2H_5OH
C_2H_6S-10	Dimethyl Sulfide	0-100 PPM	C_2H_6S
C_3H_3N-10	Acrylonitrile	0-100 PPM	C_3H_3N
C_3H_5OCl-10	Epichlorohydrin	0-10 PPM	C_3H_5OCl
C_4H_4S-10	Thiophane	0-100 PPM	C_4H_4S
C_4H_6-10	Butadiene	0-100 PPM	C_4H_6
C_4H_8S-10	Tetrahydrothiophene	0-100 PPM	C_4H_8S
$C_4H_6O_2$-10	Vinyl Acetate	0-100 PPM	$C_4H_6O_2$
F_2-10	Fluorine	0-1 PPM	F_2
GeH_4-10	Germane	0-2 PPM	GeH_4
HBr-10	Hydrogen Bromide	0-30 PPM	HBr
HCl-10	Hydrogen Chloride	0-30 PPM	HCl
HCN-10	Hydrogen Cyanide	0-30 PPM	HCN
HF-10	Hydrogen Fluoride	0-10 PPM	HF
H_2S-100	Hydrogen Sulfide	0-100PPM	H_2S
H_2-10	Hydrogen	0-100 PPM	H_2
H_2-10	LEL Hydrogen	0-100 %	H_2
NH_3-10	Ammonia	0-100 PPM	NH_3
NO-10	Nitric Oxide	0-100 PPM	NO
NO_2-10	Nitrogen Dioxide	0-5 PPM	NO_2
N_2H4-10	Hydrazine	0-1 PPM	N_2H_4
O_2-10	Oxygen	0-25 %	O_2
O_3-10	Ozone	0-1 PPM	O_3
PH_3-10	Phosphine	0-5 PPM	PH_3
SiH_4-10	Silane	0-50 PPM	SiH_4
SO_2-10	Sulfur Dioxide	0-20 PPM	SO_2

1.7 Normal Operation

Upon power-up initialization of the 10C Control Module the text "**WARM UP**" is displayed for about sixty seconds, the controller will then begin Normal Operation. The 10C displays the current Gas Concentration Reading of the sensor when in Normal Operation, the "ESC" button can be pressed to momentarily display the Gas Type and the Units; for instance: H_2S and ppm.

In Normal Operation, the Pushbuttons on the left have the meaning "Alarm Reset" and "Alarm Silence" and are used to reset and acknowledge alarms. The "RESET" pushbutton will reset the alarm(s) if the 10C Control Module has been configured properly, and all conditions for Alarm Reset have been satisfied. The "SLNC" Button will silence the alarm(s) if the 10C Control Module has been configured properly, and the alarm silence conditions have been satisfied.

When an alarm is triggered the corresponding alarm LED will illuminate to indicate the alarm (Alarm 1 and/or Alarm 2). The corresponding relays will also be set to convey the appropriate status. If the associated alarm relay is configured as normally energized, the relay coil will de-energize to convey an alarm status. If the alarm relay is configured as normally de-energized, the relay coil will energize to convey an alarm status.

1.8 Program Status

While in Normal Operation, and while the Gas Concentration is being displayed, the ability to view the configuration or "Program Status" is available to the operator. To view the Program Status, momentarily press the "ENT" pushbutton, the display will scroll "**PR STATUS**". To view the Program Status press the "ENT" pushbutton again. Upon entering the Program Status the Lamp Test function will light up all display light elements, the 10C Control Module will then display the current settings of each of the configuration parameters starting with the Gas Type, Range, and Units:

Program Status:
- (Lamp Test)
- Gas Type
- Range
- Units
- Alarm 1 Set-Point
- Alarm 1 Direction
- Alarm 1 Latching
- Alarm 1 Energized
- Alarm 1 Silenceable
- Alarm 2 Set-Point
- Alarm 2 Direction
- Alarm 2 Latching
- Alarm 2 Energized
- Alarm 2 Silenceable
- Fault Set-Point
- Fault Direction
- Fault Latching
- Fault Energized
- Fault Silenceable
- Modbus™ Address
- Firmware Version
- Firmware Checksum
- Firmware last programmed address (Top of code address in memory)

The "**PR STATUS**" first item is Gas Type (I.E.: "**LEL**" or "**H2S**" or "**CO2**".) and then the Range (for instance: "**100**") and will continue through the list. The user needs to be familiar with the order in which these items are displayed. When all of the items have been displayed, or through use of the "ESC" pushbutton, the 10C Control Module will return to normal operation and will display the current sensor reading.

2.0 Program Mode

Program Mode is only accessible with the “ACCESS/NORM” Switch (SW1) in the “ACCESS” position. With the switch in the “NORM” position, only the Program Status Function is available, and only the reading of configuration values is possible. The “ACCESS/NORM” switch is located in the lower left-hand corner on the PCA just behind the faceplate (refer to Figure 3), and can be accessed by removing the PCA from the card rack.

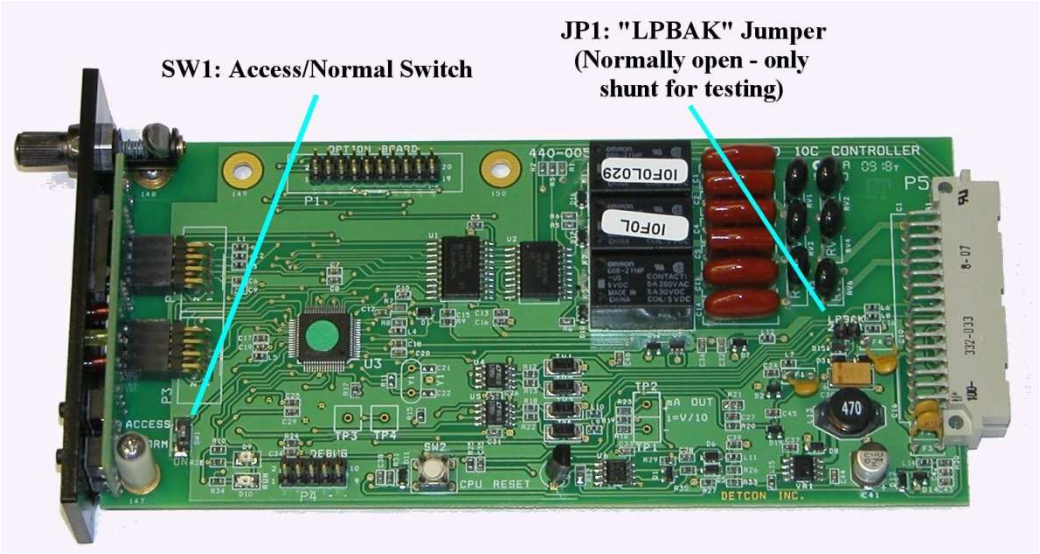

Figure 3 10C Control Board

From Normal Operation, with the “ACCESS/NORM” Switch (SW1) in the “ACCESS” position, pressing the “ENT” pushbutton and holding it for about three seconds will enter Program Mode. The display will scroll the first item in the list of programmable items: “**Set Gas Type**”. Navigation through the Program Mode is achieved through use of the ENT pushbutton, the ESC pushbutton, and the “⇧” (UP) and “⇩” (DOWN) pushbuttons. When the selected menu item is reached, the “ENT” pushbutton is used to enter the selected menu item. The Programming Mode allows the setting of multiple parameters within the Module:

- Set Gas Type
- Set Range
- Set Units
- Set Alarm 1:
  - Set-Point
  - Direction
  - Latching
  - Energized
  - Silenceable
- Set Alarm 2:
  - Set-Point
  - Direction
  - Latching
  - Energized
  - Silenceable
- Set Fault:
  - Set-Point Threshold in milliamps and always descending
  - Latching
  - Energized

Silenceable
Set Modbus™ Address
Set Sensor-Cal Mode
Test

Three additional menu selections are available only with "Technician Access" enabled:

Trim Input
Trim Output
Restore Default Settings

Refer to 3.0 Special Configuration (Technician Access)

NOTE: If an alarm triggers while in the Program Mode, the 10C Control Module will automatically exit the Program Mode and return to Normal Operation, whereupon the up and down pushbuttons become the alarm Reset/Silence pushbuttons.

NOTE: Pushbutton inactivity for about 15 seconds will cause the displayed function to time out and return the controller to Normal Operation with the exception of Technician tests.

2.1 Set Gas Type

Set Gas Type is used to set the "Gas Type" parameter of the 10C Control Module. This parameter should be set to match the sensor being attached. The Gas Type choices are listed in Table 3 Gas Types.

The menu item appears as: "**GAS TYPE**".

From the "**GAS TYPE**" display, the "ENT" pushbutton can be used to select a particular gas type. In response the "ENT" key, the display will scroll the current gas type. The gas type will flash while being displayed to show that the gas type is selectable. The "⇧" and "⇩" pushbuttons allow movement through the list of choices of gas types.

Table 3 Gas Types

Gas Type	Target Gas	Standard Range	Formula
H_2S	Hydrogen Sulfide	0-100PPM	H2S
LEL	LEL Combustible Gases	0-100 % LEL	various
O_2	Oxygen	0-25 %	O_2
CO	Carbon Monoxide	0-100 PPM	CO
CO_2	Carbon Dioxide	0-1 %	CO_2
Cl_2	Chlorine	0-10 PPM	CL_2
NH_3	Ammonia	0-100 PPM	NH_3
H_2	Hydrogen	0-100 PPM	H_2
NO	Nitric Oxide	0-100 PPM	NO
NO_2	Nitrogen Dioxide	0-5 PPM	NO_2
SO_2	Sulfur Dioxide	0-20 PPM	SO_2
VOC	Volatile Organic Com	0-1000PPM	Various
AsH_3	Arsine	0-1 PPM	AsH_3
B_2H_6	Diborane	0-5 PPM	B_2H_6
C_2H_2	Acetylene	0-100 PPM	C_2H_2
C_2H_3O	Acetaldehyde	0-100 PPM	C_2H_3O
C_2H_3Cl	Vinyl Chloride	0-100 PPM	C_2H_3Cl

Gas Type	Target Gas	Standard Range	Formula
C_2H_4	Ethylene	0-100 PPM	C_2H_4
C_2H_4O	Ethylene Oxide	0-100 PPM	C_2H_4O
C_2H_5OH	Ethanol	0-100 PPM	C_2H_5OH
C_2H_6S	Dimethyl Sulfide	0-100 PPM	C_2H_6S
C_3H_3N	Acrylonitrile	0-100 PPM	C_3H_3N
C_3H_5OCl	Epichlorohydrin	0-10 PPM	C_3H_5OCl
C_4H_4S	Thiophane	0-100 PPM	C_4H_4S
C_4H_6	Butadiene	0-100 PPM	C_4H_6
$C_4H_6O_2$	Vinyl Acetate	0-100 PPM	$C_4H_6O_2$
C_4H_8S	Tetrahydrothiophene	0-100 PPM	C_4H_8S
CH_2O	Formaldehyde	0-100 PPM	CH_2O
CH_3OH	Methanol	0-100 PPM	CH_3OH
CH_3SH	Methyl Mercaptan	0-100 PPM	CH_3SH
$COCl_2$	Phosgene	0-1 PPM	$COCl_2$
CS_2	Carbon Disulfide	0-100 PPM	CS_2
F_2	Fluorine	0-1 PPM	F_2
GeH_4	Germane	0-2 PPM	GeH_4
HBr	Hydrogen Bromide	0-30 PPM	HBr
HCl	Hydrogen Chloride	0-30 PPM	HCl
HCN	Hydrogen Cyanide	0-30 PPM	HCN
HF	Hydrogen Fluoride	0-10 PPM	HF
N_2H_4	Hydrazine	0-1 PPM	N_2H_4
PH_3	Phosphine	0-5 PPM	PH_3
SiH_4	Silane	0-50 PPM	SiH_4
Br_2	Bromine	0-5 PPM	Br_2
ClO_2	Chlorine Dioxide	0-1 PPM	ClO_2
O_3	Ozone	0-1 PPM	O_3

NOTE: While the term "LEL" is used as a Gas Type, it must be explained that the term stands for 'Lower Explosive Limit' and implies a Range for combustible gas without being specific about the gas. If the gas is Methane (CH4), the LEL is about 5% by volume of Methane in Air. Therefore, 100% LEL is equivalent to about 5% equivalent methane in air by volume.

When the chosen Gas Type is found, use the "ENT" pushbutton to select it. The display will stop flashing and the selected gas type will remain solidly displayed. The "ENT" pushbutton or the "ESC" pushbutton can be used to leave the Gas Type selection function and return to the "**GAS TYPE"** menu item.

Move to another menu item by using the "⇧" and "⇩" pushbuttons, or use the "ESC" pushbutton to leave Program Mode and return to Normal Operation of the display.

NOTE: Pushbutton inactivity of 15 seconds during any part of the above procedure will cause the displayed function to time out and return the controller to Normal Operation.

2.2 Range Set

Range Set is used to set the full-scale range of gas concentration, with respect to the attached sensor type. This setting **must** match the attached sensor's range. Setting the range to something other than the range of the sensor attached to the controller will cause erroneous readings, and is not advised.

The menu item appears as: "**RANGE SET**".

From the "**RANGE SET**" display the "ENT" pushbutton is used to enter the range set function. The display will flash the range that is currently set to show that the range is selectable. Use of the "⇧" and "⇩" pushbuttons allows movement through the available ranges. When the chosen range value is found, the "ENT" pushbutton sets the range to the displayed value. The display will stop flashing to signify the range selection was set. The "ENT" pushbutton or the "ESC" pushbutton can be used to leave the range selection function and return and return to the "**RANGE SET**" menu item.
The list of Range selection choices are:

1.00, 2.00, 3.00, 4.00, 5.00, 6.00, 7.00, 8.00, 9.00,
10.0, 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0, 20.0, 21.0, 22.0, 23.0, 24.0, 25.0,
30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95,
100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950,
1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500,
5000, 5500, 6000, 6500, 7000, 7600, 8000, 8500, 9000, 9500, 9999

NOTE: % (percent) can only be found in the Units selection if the range is set to 100 or less. Likewise, the range cannot be set above 100 if the Units are set to "%".

The "⇧" and "⇩" pushbuttons can be used to move to another menu item, or the "ESC" pushbutton can be used to leave Program Mode.

NOTE: Pushbutton inactivity of 15 seconds during any part of the above procedure will cause the displayed function to time out and return the controller to Normal Operation.

2.3 Set Units

Set Units provides a means to adjust the units of measure for the Range selected. The Units should match the units of measure of the associated sensor.

The menu item appears as: "**UNITS SET**".

From the "**UNITS SET**" display use the "ENT" pushbutton to enter the function. The display will flash the units of measure currently set. Use the "⇧" and "⇩" pushbuttons to move through the different units of measure available. When the correct unit is found, use the "ENT" pushbutton to select that unit of measure. The display will stop flashing and the units selected will be displayed continuously. Press the "ENT" pushbutton again, or the "ESC" pushbutton, to leave the function and return to the "**UNITS SET**" menu item. Choice for Units is given as:

"**ppm**" parts per million concentration
"**ppb**" parts per billion concentration
"**%**" percent concentration
"**mA**" milliamps of loop current

NOTE: % (percent) can only be found in the Units selection if the range is set to 100 or less. Likewise, the range cannot be set above 100 if the Units are set to "%".

Move to another menu item by using the "⇧" and "⇩" pushbuttons, or use the "ESC" pushbutton to leave Program Mode.

NOTE: Pushbutton inactivity of 15 seconds during any part of the above procedure will cause the displayed function to time out and return the controller to Normal Operation.

2.4 Alarm 1, 2, and Fault Set

Alarm 1 Set, Alarm 2 Set, and Fault Set are used to set the configuration parameters that will dictate the behavior of Alarm 1, Alarm 2, and Fault, respectively. Setting the configuration of Alarm 1, and Alarm 2 is the same, setting the Fault parameters differ somewhat from the alarm parameters. The difference is that "**FAULT SET**" does not provide an option for "direction" because Fault is always triggered on descending input current, the "direction" step is skipped when setting up the Fault parameters. The first variable in the list for each function is the Set-Point.

NOTE: For Gas Type "**LEL**", the 10C Control Module will not allow Alarm 2 settings to be greater than 60%. Alarm 2 set-point cannot be set less than the Alarm 1 set-point, And Alarm 2 is forced to latching.

The menu item appears as: "**ALARM 1 SET**", "**ALARM 2 SET**", or "**FAULT SET**", depending upon which function is chosen.

From the "**ALARM 1 SET",** "**ALARM 2 SET**" or "**FAULT SET**" display, use the "ENT" pushbutton to enter the function.

2.4.1 Set-Point

The display will show the current Set-Point. Use the "⇧" and "⇩" pushbuttons to move through the choice of values for the Set-Point. When the chosen value is found, the "ENT" pushbutton is used to select the value. The display will stop flashing and the selected Set-Point value will be solidly displayed. Pressing the "ENT" pushbutton again will move to the next parameter in the list.

Note that when setting the Set-Point of an Alarm, that the reading is directly proportional to the Range. Therefore, if the range is set to 500ppm the Set-Point display will step by the increment of 5ppm. That is, for every press of the "⇧" or the "⇩" pushbutton, the display will increase or decrease by 5ppm.

When setting the Fault Set-Point, that the reading corresponds directly to milliamps (mA) units. Input current that descends through the Fault Set-Point triggers a Fault alarm. I.E. if the desired level for Fault alarm is when the mA input from a sensor drops below 2.5mA, then this parameter should be set for 2.50. Latching / Non-latching, Energized / Non-Energized, and Silenceable / Non-silenceable can be set to the customer's preference.

2.4.2 Direction: Ascending / Descending

The flashing display will show the currently set value of the Ascending / Descending parameter as "**UP**" for ascending and "DN for descending. The "⇧" and "⇩" pushbuttons can be used to select either "**UP**" or "**DN**". The "ENT" pushbutton can then be used to accept the value. The display will stop flashing to signify that the value was set. Pressing the "ENT" pushbutton again will move to the next parameter in the list. For Fault, the direction is always set to Descending and cannot be changed.

2.4.3 Latching / Non-latching

The flashing display shows the currently set value of the Latching / Non-latching parameter. I.E. as "**LT=0**" for Non-Latching, and "**LT=1**" for Latching. Use the "⇧" and "⇩" pushbuttons to change the parameter,

followed by the "ENT" pushbutton to accept the value. The display will stop flashing to signify the excepted value. Pressing the "ENT" pushbutton again will move to the next parameter in the list.

2.4.4 Energized / Non-energized

The alarm relay coil can be set as energized or non-energized in a no alarm condition. The flashing display will show the currently set value of the Energized / Non-energized parameter. I.E. "**EN=0**" for Non-energized, and "**EN=1**" for Energized. Use the "⇧" and "⇩" pushbuttons to change the parameter, followed by the "ENT" pushbutton to accept the value. The display will stop flashing to signify the excepted value. Pressing the "ENT" pushbutton again will move to the next parameter in the list.

2.4.5 Silenceable / Non-silenceable

The flashing display will show the currently set value of the Silenceable / Non-silenceable Alarm parameter. I.E. "**SL=0**" for Non-silenceable, and "**SL=1**" for Silenceable. Use the "⇧" and "⇩" pushbuttons to change the parameter, followed by the "ENT" pushbutton to accept the value. The display will stop flashing to signify the excepted value. Pressing the "ENT" pushbutton again will return to the appropriate "**ALARM 1 SET**", "**ALARM 2 SET**", or "**FAULT SET**" scrolling display.

After setting the alarm/Fault configuration parameters, another Program Mode Menu item can be selected by use of the "⇧" and "⇩" pushbuttons, or use of the "ESC" pushbutton to leave Program Mode.

NOTE: Pushbutton inactivity of 15 seconds during any part of the above procedure will cause the displayed function to time out and return the controller to Normal Operation.

2.5 Modbus™ Set

Set Modbus™ provides a means to set the unique identifying Modbus™ Address. The Address is also known as the "ID" or "Modbus RTU ID".

The menu item appears as: "**MODBUS SET**".

From the "**MODBUS SET**" display press the "ENT" pushbutton to enter the function.

To enter "**ID Set**" function, press the "ENT" pushbutton while the "**ID Set**" display is scrolling. The display will flash the current Modbus™ ID Address in Hexadecimal format. Use the "⇧" and "⇩" pushbuttons to set the appropriate address and press the "ENT" pushbutton to accept this value. The display will stop flashing and the ID address will be displayed continuously. Press the "ENT" pushbutton again to leave the menu item. The display will return to "**MODBUS SET**".

The "⇧" and "⇩" pushbuttons can be used to move to another menu item, or the "ESC" pushbutton can be used to leave Program Mode.

NOTE: Pushbutton inactivity of 15 seconds during any part of the above procedure will cause the displayed function to time out and return the controller to Normal Operation.

2.6 Sensor-Cal Mode

Sensor Cal Mode is used to set the 10C Control Module's output current to 2mA and to inhibit alarm processing during calibration of the sensor.

The menu item appears as: "**SENSOR-CAL MODE"**.

From the "**SENSOR-CAL MODE**" display, the "ENT" pushbutton is used to enter the function. The display will flash and show "**Cal-Mode OFF**". The "ENT" pushbutton is used to change the state to **"Cal-Mode ON**" or the "ESC" pushbutton can be used to escape to the menu.

When the 10C Control Module is set to "**Cal-Mode ON**", the Current Output will change to and remain at 2mA and input current will not be processed for alarm triggering. The purpose of this is to allow the sensor's output current signal to be ignored while calibrating the sensor.

Until the controller is returned to normal operation by pressing the "ESC" pushbutton or when the 10C Control Module reaches a time limit. To help remind the user that the 10C Control Module is in Sensor Calibration Mode, the Fault LED will flash on/off rapidly and continuously while the display scrolls the text "**Cal-Mode ON**".

To escape this function, the "ESC" pushbutton can be pressed and the Sensor-Cal Mode will be turned off and the 10C Control Module will leave the Program Mode and return to Normal Mode.

NOTE: The Sensor-Cal Mode will eventually time-out and return the controller to Normal Operation if escape of the function is not manually executed. The timeout period is nominally about one hour.

2.7 Test

The 10C Control Module "**TEST**" provides a means of checking the external alarm system by artificially setting Relay Outputs without having to force them on/off through the external sensor input to the Controller. The "**TEST**" consists of an internal test variable that starts at zero and increases to full-scale range and then decreases back to zero. The internal variable is fed into the internal processor as if it were an external sensor signal. During this test the 10C Output Current stays at a nominal zero reading, or 4mA. As the internal test variable sweeps through alarm set point values, the appropriate triggering of alarms should occur. This allows the verification of proper operation of the relays, the connection through to the backplane, the wiring, the power source, and the actual Horns, Strobes or other actuated devices. The alarm configuration with regard to set-point thresholds, direction, latching, coil energize setting, and silenceable setting, can all be tested for desired performance. Performance results deviating from expected desired results should be evaluated for cause, whether equipment malfunctions, incorrect settings, or bad configuration.

The "ENT" pushbutton is used to enter the "TEST" function, "**TEST OFF**" will be displayed. The "ENT" pushbutton should be pressed again to start the test. The displayed text: "**TEST ON**" will scroll across the display, then the display will start displaying the internal test variable value, starting at zero and increasing. When the display returns to zero, the test in complete. The "ESC" pushbutton can be used to return the display to the menu selection or back to display Normal Operation. The "ESC" pushbutton can be used during the test to exit the test.

NOTE: Alarm Outputs that are latched during the test remain latched after the test is finished and are not automatically reset.

3.0 Special Configuration (Technician Access)

Technician access allows trimming the analog-to-digital conversion and digital-to-analog conversion, and for restoring the default configuration.

The 10C Control Module's conversion of input current to a displayed value can be trimmed up or down. Likewise, the 10C Control Module's output current can be trimmed so that a Modbus™ Master Controller can register what is on the 10C Control Module's display. The 4-20mA analog current input and the 4-20mA analog current output of the 10C Control Module may be trimmed independently. Both are calibrated at the factory and should require no further adjustments.

NOTE: Calibration of the sensor to standard gas is performed on the sensor itself, not the 10C Control Module. There is no "calibration" of the Controller, only "trim".

Technician Access can only be accessed from Programming Mode. To gain Technician Access press and hold both the "⇧" and "⇩" pushbuttons for more than ten seconds, the technician mode will be enabled but is not indicated on the display although the new menu items will be displayed in the programming menu.

The Technician Access menu items only remain active for a short time. If the user does not access these menu items, the access will time out. After the Technician Access menus have timed out, the above procedure must be repeated to regain access.

3.1 Trim Input

Trim Input Mode allows a technician to adjust the analog-to-digital-conversion inside the 10C Control Module. A two-point-trim is accomplished by setting the zero-current input point and the full-scale current input point at 20.0mA. During the input trimming procedure the adjustment at the zero-current input point is called "**SET 0 mA**" and the adjustment at the 20.0mA current input point is called "**SET 20mA**".

NOTE: The Trim Input function is only accessible in Technician Access Mode. The 10C Control Module analog input is trimmed at the factory and under normal circumstances should not need to be trimmed again.

NOTE: If the Default Settings function (see section 3.3) is executed the input trim values are restored to un-trimmed values and the 10C Control Module's input will not be as accurate as if it were trimmed.

In order for the technician to do this procedure, there needs to be available an accurate 20.0mA current source. The convenient way to accomplish the input trim is to use the Detcon Mod 10/12 Controller Test Fixture. Another way is to ascertain that the 10C Control Module's output is sufficiently accurate to use as a source of 20.0mA, and temporarily connect a jumper to JP1 "LPBAK" to loop-back the output current to the input current. An accurate Digital Volt Meter (DVM) can be placed in a current mode and clipped across the JP1 jumper pins to monitor the current. (See section 3.2 Trim Output for the procedure to trim the output current.)

The menu item appears as: "**TRIM INPUT"**.

From the "**TRIM INPUT**" display the technician can use the "ENT" pushbutton to enter the function. The display will scroll "**SET 0mA**". Apply 0mA to the 10C Control Module's 4-20mA current input. Removal of the input current wire to the sensor is the same as applying 0mA. Once 0mA is applied, press the "ENT" pushbutton to accept the value, the display will scroll "**0mA Done**". Press the "ENT" pushbutton again, and

the display will scroll "**SET 20mA**". Apply 20.0mA to the current input and press the "ENT" pushbutton. The display will scroll "**20mA Done**" if the controller accepts the input. If the controller does not accept the input, the display will scroll "**20mA Failed**". The cause of the failure is that the 10C Control Module did not see a reasonable input current level for 20mA. If this happens the "**TRIM INPUT**" function did not make an adjustment to the gain factor for input current. The "ESC" pushbutton must be pushed to leave the function, and the controller will return to "**TRIM INPUT**".

Move to another menu item by using the "⇧" and "⇩" pushbuttons, or use the "ESC" pushbutton to leave the "**TRIM INPUT**" function.

NOTE: This mode does not automatically time-out and must be exited or power-cycled to return to normal operation.

3.2 Trim Output

Trim Output Mode allows a technician to adjust the 4mA point and the 20mA point of the 10C Control Module's current output.

NOTE: The Trim Output function is only accessible in Technician Access Mode. The 10C Control Module analog output is trimmed at the factory and under normal circumstances should not need to be trimmed again.

NOTE: If the Default Settings function (see section 3.3) is executed the output trim values are restored to un-trimmed values and the 10C Control Module's output will not be as accurate as if it were trimmed.

The menu item appears as: "**TRIM OUTPUT"**.

From the "TRIM OUTPUT" display, the technician can use the "ENT" pushbutton to enter the function. The display will scroll "D**AC Trim Out**". Pressing the "ENT" pushbutton will cause the display to change to "**FORCE 4mA**". The mA output of the controller will change to 4mA. The "⇧" and "⇩" pushbuttons can be used to make the output current go up or down in small incremental steps. By monitoring the output current, the technician can adjust the current to exactly 4.00mA. When the output is trimmed to 4.00mA, the technician can accept the internal trimmed value by pressing "ENT". When "ENT" pushbutton is pressed, the zero is trimmed and the display will change to "F**ORCE 20mA**". The mA output of the controller will change to 20mA. The "⇧" and "⇩" pushbuttons can be used to make the output current go up or down in small incremental steps. When the output is trimmed to 20.0mA, the technician can accept the internal trimmed value by pressing "ENT", and if he has pressed "⇧" or "⇩" at least once, the internal trimmed value will be accepted. In response to the "ENT" pushbutton, the 10C Control Module will return to the display "**FORCE 4mA**" allowing multiple passes through this procedure to attain the best trimming. Usually two passes is sufficient.

The "ESC" pushbutton may be pressed at any time to leave the function, and the controller will return to "**TRIM OUTPUT**".

Move to another menu item by using the "⇧" and "⇩" pushbuttons, or use the "ESC" pushbutton to leave the "**TRIM OUTPUT**" function.

NOTE: This mode does not automatically time-out and must be exited or power-cycled to return to normal operation.

3.3 Default Settings

NOTE: The Default Settings function is only accessible in Technician Access Mode.

Each and any setting within the 10C Control Module should be manually changeable to valid values. This feature sets all configuration values to default state at once, including the trim coefficients. This feature should only be used as a last resort if it is suspected that 10C Control Module function is not correctly functioning due to a bad configuration.

To utilize this function the "ENT" pushbutton is pressed, in response to which the Display should say "Restore Defaults?" Another "ENT" pushbutton entry should cause the 10C Control Module to load default constants into the configuration variables and acknowledge with the Displayed text: "Defaults Restored".

This is a list of configuration values and the default condition restored with this function:

Analog Input Offset (zero)	= 0
Analog Input Gain	= 1.000
Alarm 1	= Ascending, not latched, not energized, not silenceable
Alarm 2	= Ascending, not latched, not energized, not silenceable
Fault	= Descending, not latched, energized, not silenceable
Alarm 1 set point	= 10% of range
Alarm 2 set point	= 20% of range
Fault set point	= 1.80 mA
Gas Type	= H2S
Range	= 100
Units	= ppm
Modbus ID	= 01
Analog Output Offset (zero)	= 0
Analog Output Gain	= 1.000
Baud Rate	= 9600
Parity	= none

4.0 Specifications

Input Power

9 VDC to 28VDC (For use in nominal 12VDC or 24VDC typical systems)
300mA Maximum (Including Sensor)
3W Maximum (Including Sensor)

Operating Temperature

–40°C to +70°C
Humidity: 10 to 95% Non-condensing

Range

Configurable: From 1 to 25 in increments of 1
From 25 to 100 in increments of 5
From 100 to 1000 in increments of 50
From 1000 to 9999 in increments of 500

Accuracy/Repeatability

Sensor input current conversion to 10C Displayed reading: ±1%F.S. after trim procedure
Output current converted from 10C Displayed reading: ±1%F.S. after trim procedure

Inputs/Outputs

Communications: Serial RS-485 Modbus™

Input: Analog 4-20mA DC, current sinking through 100 ohms.

Output: Analog 4-20mA DC, current sourcing.

Open-Collector outputs follow relay coils.

Relays

Relay Contact terminations: Common, Normally Open, and Normally Closed (x 3 Relays)
Relay Contact Manufacturer's Specification:
Resistive load: 5A, 250VAC; 5A, 30 VDC
Inductive load: 2A, 250VAC; 2A, 30 VDC
Max. Operating current: 5A

Alarm/Fault Alarm Timing and Triggering

Alarms are inhibited during the power-up initialization period indicated by the display "Warm Up".
Alarm signal delay: nominally 2 seconds
Alarm set-point hysteresis: nominally 1 unit
Alarm minimum activity before acknowledge silences it: 10 seconds.

Warranty

One year
Five year fixed fee service policy

5.0 Warranty and Service Policy

Detcon, Inc., as manufacturer, warrants each new Model 10 series digital electronic control module to be free from defects in material and workmanship under intended normal use for a period of one year from date of shipment to the original purchaser. Detcon, Inc., additionally provides for a fixed fee repair/replace service policy which covers Model 10 series digital control modules for a period of five years. The fixed fee service policy shall affect any necessary factory repair for the period following the one-year warranty period and shall end five years after expiration of the warranty. The fixed policy rate is $75.00 per control module, per transaction, during the period of the policy. The policy is FOB Detcon, Inc., The Woodlands, Texas.

6.0 Appendix

6.1 Hexadecimal Table

Table 4 Hexadecimal Conversion Table

ID#	MSD	LSD	ID#	MSD	LSD	ID#	MSD	LSD	ID#	MSD	LSD	ID#	MSD	LSD	ID#	MSD	LSD
0	0	0	43	2	B	86	5	6	129	8	1	172	A	C	215	D	7
1	0	1	44	2	C	87	5	7	130	8	2	173	A	D	216	D	8
2	0	2	45	2	D	88	5	8	131	8	3	174	A	E	217	D	9
3	0	3	46	2	E	89	5	9	132	8	4	175	A	F	218	D	A
4	0	4	47	2	F	90	5	A	133	8	5	176	B	0	219	D	B
5	0	5	48	3	0	91	5	B	134	8	6	177	B	1	220	D	C
6	0	6	49	3	1	92	5	C	135	8	7	178	B	2	221	D	D
7	0	7	50	3	2	93	5	D	136	8	8	179	B	3	222	D	E
8	0	8	51	3	3	94	5	E	137	8	9	180	B	4	223	E	F
9	0	9	52	3	4	95	5	F	138	8	A	181	B	5	224	E	0
10	0	A	53	3	5	96	6	0	139	8	B	182	B	6	225	E	1
11	0	B	54	3	6	97	6	1	140	8	C	183	B	7	226	E	2
12	0	C	55	3	7	98	6	2	141	8	D	184	B	8	227	E	3
13	0	D	56	3	8	99	6	3	142	8	E	185	B	9	228	E	4
14	0	E	57	3	9	100	6	4	143	8	F	186	B	A	229	E	5
15	0	F	58	3	A	101	6	5	144	9	0	187	B	B	230	E	6
16	1	0	59	3	B	102	6	6	145	9	1	188	B	C	231	E	7
17	1	1	60	3	C	103	6	7	146	9	2	189	B	D	232	E	8
18	1	2	61	3	D	104	6	8	147	9	3	190	B	E	233	E	9
19	1	3	62	3	E	105	6	9	148	9	4	191	B	F	234	E	A
20	1	4	63	3	F	106	6	A	149	9	5	192	C	0	235	E	B
21	1	5	64	4	0	107	6	B	150	9	6	193	C	1	236	E	C
22	1	6	65	4	1	108	6	C	151	9	7	194	C	2	237	E	D
23	1	7	66	4	2	109	6	D	152	9	8	195	C	3	238	E	E
24	1	8	67	4	3	110	6	E	153	9	9	196	C	4	239	F	F
25	1	9	68	4	4	111	6	F	154	9	A	197	C	5	240	F	0
26	1	A	69	4	5	112	7	0	155	9	B	198	C	6	241	F	1
27	1	B	70	4	6	113	7	1	156	9	C	199	C	7	242	F	2
28	1	C	71	4	7	114	7	2	157	9	D	200	C	8	243	F	3
29	1	D	72	4	8	115	7	3	158	9	E	201	C	9	244	F	4
30	1	E	73	4	9	116	7	4	159	9	F	202	C	A	245	F	5
31	1	F	74	4	A	117	7	5	160	A	0	203	C	B	246	F	6
32	2	0	75	4	B	118	7	6	161	A	1	204	C	C	247	F	7
33	2	1	76	4	C	119	7	7	162	A	2	205	C	D	248	F	8
34	2	2	77	4	D	120	7	8	163	A	3	206	C	E	249	F	9
35	2	3	78	4	E	121	7	9	164	A	4	207	C	F	250	F	A
36	2	4	79	4	F	122	7	A	165	A	5	208	D	0	251	F	B
37	2	5	80	5	0	123	7	B	166	A	6	209	D	1	252	F	C
38	2	6	81	5	1	124	7	C	167	A	7	210	D	2	253	F	D
39	2	7	82	5	2	125	7	D	168	A	8	211	D	3	254	F	E
40	2	8	83	5	3	126	7	E	169	A	9	212	D	4	255	F	F
41	2	9	84	5	4	127	7	F	170	A	A	213	D	5			
42	2	A	85	5	5	128	8	0	171	A	B	214	D	6			

6.2 Revision History

Revision	Date	Changes made	Approval
0.0	01/13/09	Initial release	LU
1.0	07/04/15	Corrections and updates	LU