CAUTION: The DSM-4388DUS pyrometer is suitable for use in Class I, Group D, Division 1 and 2 hazardous locations when installed in accordance with these instructions.

The thermocouple leads connected to this device operate at a very low voltage and power levels and MUST NOT CONTACT any external voltage source. Damage to the system will result from connection between the thermocouple and the ignition system or any AC or DC power source.

WARNING: DEVIATION FROM THESE INSTALLATION INSTRUCTIONS MAY LEAD TO IMPROPER OPERATION OF THE MONITORED MACHINE WHICH COULD CAUSE PERSONAL INJURY TO OPERATORS OR OTHER NEARBY PERSONNEL.

1.0 DESCRIPTION

1.1 The Altronic DSM-4388DUS pyrometer is an electronic instrument designed to monitor temperatures using industry standard type J or K thermocouples. The DSM-4388DUS can monitor and alarm up to eight temperature inputs. The pyrometer uses a microcontroller to process the input signal and a nonvolatile memory to store the setup and setpoint values. An LCD displays the channel number and the numeric temperature value in °F or °C. A front mounted keypad serves as the user interface. The instrument can read type J thermocouples between −76°F and 1382°F (−60°C and 750°C) and type K thermocouples between −76°F and +1472°F (−60°C and 800°C).

1.2 Each temperature point is continuously compared against its individual user-settable high and low setpoint. When the temperature on a point has reached either its high or low setpoint value, a solid state Form C output switch turns on/off to the switch common, and the "ALARM" LCD indicator turns on. Additionally, the "HI" or "LO" indicator will display whenever any faulted point is displayed. All setpoint changes are performed through the keypad or through RS-485 communications.

1.3 The DSM-4388DUS pyrometer is designed to be versatile and simple to use. Type J or K thermocouples and °F or °C units can be selected via the keypad. Either automatic or manual scan functions can be selected. RS-485 serial communications allows data and alarm status to be communicated to other devices. An escape key is provided to permit the user to exit any setup function and return to the normal display. A programmable software filter is also provided which can be used to stabilize readings where the thermocouple signal is fluctuating. Calibration can be performed using the keypad. Factory default configurations, including factory calibration settings, can be recalled for easy setup.

1.4 The power requirement for the DSM-4388DUS pyrometer is 12 to 30 Vdc, 50 mA max.

1.5 For proper operation, these installation instructions must be adhered to strictly.

2.0 THERMOCOUPLES

2.1 The DSM-4388DUS pyrometer is designed to operate with industry standard, grounded or ungrounded, type J or K thermocouples. Ungrounded thermocouples are recommended where possible.

3.0 MOUNTING

3.1 Mount the pyrometer inside a control panel or to a suitable flat surface so that the display is at a convenient viewing height. A drilling template is provided. NOTE: Avoid mounting pyrometer with the LCD display facing direct sunlight. The display temperature range is −40°F to +175°F (−40°C to +80°C).

4.0 WIRING (SEE WIRING DIAGRAMS)

4.1 POWER WIRING - Connect the power input wires, plus to terminal DC+ and minus to DC−; power requirement is 12 to 30 Vdc (10 watts max.). The DC− terminal is connected to panel ground which should be the same as engine ground. DO NOT ground this device directly to the ignition system common coil ground.

4.2 THERMOCOUPLES AND THERMOCOUPLE EXTENSION WIRE - Grounded or ungrounded type J or K thermocouples may be used. Use thermocouple extension wire of the same type as the thermocouple probe to connect the thermocouple to the pyrometer. Use stranded thermocouple wire having a good moisture-resistant insulation such as PVC; for higher ambient temperatures, Teflon or B-fibre insulated thermocouple wire is recommended. To insure an accurate signal is transmitted to the instrument, avoid any added junctions, splices and contact with other metals. Take care not to damage the insulation when installing and take precautions against later damage from vibration, abrasion, or liquids in conduits. In addition, it is essential that the following practices be adhered to:

A. Never run thermocouple wires in the same conduit with ignition wiring or other high energy wiring such as AC line power.
B. Keep secondary wires to spark plugs and other high voltage wiring at least eight inches (200mm) away from thermocouples and extension wiring.

4.3 OUTPUT SWITCH WIRING - An alarm or fault condition occurs when the temperature of a point reaches or violates either the high or low setpoint value of that point. This will cause the single Form C (N/O and N/C) solid state output switch to turn ON/OFF to the switch common terminal. The output switch is isolated from the DC− terminal and is rated 200V, 0.2 amp. The N/O switch has a unique internal overload current protection circuit. If an overload occurs, the internal circuitry limits current to safe levels. When the overload is removed, the relay resumes its normal ON characteristics. These switches can be wired to an Altronic annunciator system or to pilot duty relays as shown in the wiring diagrams.

4.4 RS-485 COMMUNICATIONS WIRING - The DSM-4388 pyrometer can communicate to other instruments, PC's or PLC's via the two serial RS-485 communication wires. Use a two conductor shielded cable of fine gauge stranded wire and connect the wires to the terminals marked RS-485 "A" and RS-485 "B". Connect to the other communication device "A" to "A"(−) and "B" to "B"(+). Connect the shield wire to the master device only.

4.5 HAZARDOUS AREA OPERATION - The DSM-4388DUS pyrometer is CSA certified for CLASS I, DIVISION 2, GROUP D areas when mounted in a suitable enclosure. The device may be operated as CLASS I, DIVISION 1, GROUP D intrinsically safe, if the following conditions are met:

A. The pyrometer must be powered through a CSA-certified zener barrier rated 30 volts max., 120 ohms min. A suitable barrier is a Stahl part no. 9001/01-280-165-10; follow the installation instructions supplied with the barrier.

B. The switch outputs, if used, must be connected to the sensor inputs of an Altronic DA or DD annunciator system with the 690 series power supply.

C. The RS-485 communications, if used, must be connected through a CSA-certified zener barrier rated 30 volts max., 120 ohms min. A suitable barrier is a Stahl part no. 9001/01-280-165-10; follow the installation instructions supplied with the barrier.

In addition, the following requirements must be met (see NFPA standard no. 493):

1. The intrinsically safe instrument wires within the panel enclosure must be kept at least two (2) inches away from other wiring. Run the thermocouple extension wires leaving the panel in a separate conduit from all other wiring and keep them separate throughout the installation.
2. Wiring to the sensors must have a grade of insulation capable of withstanding an AC voltage of 500 volts RMS.
3. Sensor wires must be run in separate conduits and junction boxes from high voltage wires such as ignition, fuel valve, and other high voltage wiring.

WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY AND/OR SUITABILITY FOR CLASS I, DIV. 2, GROUP D.

DO NOT DISCONNECT EQUIPMENT IN DIV. 2 ENVIRONMENT UNLESS POWER IS SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

4.6 TESTING THERMOCOUPLE LEADS - If it becomes necessary to check thermocouple to terminal strip wiring with an ohmmeter or other checker, first unplug the thermocouple connectors from the pyrometer. This will prevent possible damage to the device's sensitive low voltage detection circuitry.

5.0 NORMAL OPERATION

5.1 When the DSM-4388DUS pyrometer is in the "normal" mode, it displays the channel number, numeric temperature value and either °F or °C. The digit to the left of the colon indicates the displayed channel. The number to the right of the colon indicates the temperature associated with that particular channel.

5.2 If a monitored thermocouple temperature falls below the minimum range of the instrument (−76°F or −60°C), the display will read "X: LO" to identify this condition. If the thermocouple temperature exceeds the maximum range of the instrument (1382°F or 750°C for type J, 1472°F or 800°C for type K) the display will read "X: HI". "X" represents the associated channel number.

NOTE: If a thermocouple or its wiring becomes open or disconnected from the pyrometer, the display will read "X: HI" and its output switch will turn on. All unused thermocouple inputs must be shunted to prevent this condition in normal operation.

6.0 KEYPAD DESCRIPTION

6.1 The DSM-4388DUS pyrometer contains an eight-key front keypad which is used to view or change the setpoint values and to configure and calibrate the pyrometer. The eight front panel keys are VIEW ALARMS, RESET, CHANNEL, ENTER, SETPTS, ESC, and ▲, ▼ (up and down arrow keys).

6.2 VIEW ALARMS - The VIEW ALARMS key allows the user to display channels which in the past have exceeded their setpoints, in the order they occurred after a reset has been performed. This is helpful in determining which thermocouple is responsible for causing an alarm. Pressing VIEW ALARMS scrolls through the channels in the order in which the measured temperature has violated the setpoint values. The first channel that was violated will be displayed first along with the "ALARM" and either "HI" or "LO" LCD indicators. The LCD will display "ALARM, HI, X:1st" indicating high setpoint on channel X was first to cause an alarm. Any other channels that have had an alarm condition after the first one will be displayed in the order they occurred. Examples would be "ALARM, LO, 6:2nd", "ALARM, HI, 1:3rd" and so on. Any channel that has not violated its setpoint value will not be displayed. After displaying all channels that have violated their setpoints, the display will show "donE" and revert back to the normal display. Reset will clear all faults. If no faults are logged, "CLEAr" will display. NOTE: The "ALARM" and "HI" or "LO" indicators will stay on in this menu and do not necessarily indicate a fault condition is occurring.

6.3 RESET - The RESET key is used to clear any faults in the view alarms mode; it restarts the low setpoint timer delay times and clears the output switch if set to latching mode. See section 9.3 for more information on reset.

6.4 CHANNEL - This key allows the user to increment the channel and corresponding temperature value on the LCD display in either auto or manual scan mode. After the maximum selected channel is displayed, the display will return to channel 1. The CHANNEL key also advances the display menu in the configuration mode.

6.5 ENTER - The ENTER key is used in conjunction with the CHANNEL key to enter the setup mode and to save new data or a new configuration in nonvolatile memory. The setup will remain even through power-down.

6.6 SETPTS - The SETPTS (setpoints) key is used to view or change each setpoint value. When pressed, the message "StP" is displayed followed by the setpoint temperature for channel 1. Refer to section 9.0 for more information. NOTE: The setpoints cannot be changed if the protection is set to "On".

6.7 ESC - The ESC (escape) key can be used at any time during the setup or setpoint mode to return to the normal mode. When the ESC key is pressed in any configuration mode, any changed values are ignored (not stored in memory), the configuration returns to the previous values, and the display returns to the normal reading.

6.8 ▲ ▼ - The up and down arrow keys are used to scroll through the selections in the setup mode and to increase or decrease values for setpoints, calibration, number of points, node numbers, trip delay times and the filter value.

7.0 DEFAULT FACTORY SETTINGS

7.1 The DSM-4388DUS pyrometer contains two default settings that are available to the user anytime during the life of the instrument. Upon receipt, the pyrometer is set to one of these settings. These default settings will provide factory calibration for both type J and K thermocouples.

7.2 SELECTING A DEFAULT SETTING - From the normal mode, press the ENTER and then also press the CHANNEL key. Press the CHANNEL key until the display reads either "J:tc" or "K:tc". Use the ▲ and ▼ keys to select either a type J or K thermocouple and press ENTER. All of the configuration parameters as well as the calibration values will automatically be reset to the factory settings for that thermocouple type.

7.3 DEFAULT SETTINGS - Listed below are the factory default settings stored in permanent memory.

UNITS:	Degrees F (°F) or Degrees C (°C)
DISPLAY SCAN:	Manual
NUMBER OF POINTS:	8 channels
PROTECTION STATUS:	Protection is OFF (Allows setpoints to be changed.)
NODE:	01
OUTPUT SWITCH:	Shelf state, non-latching
LOW SETPOINT DELAY TIME:	5 Seconds
DISPLAY FILTER:	230 out of 255
SETPOINT VALUES:	1000 °F all High setpoints, −76 °F all Low setpoints
CHECKSUM:	Checksum disabled

WARNING: UNIT MUST BE PROPERLY CONFIGURED FOR EACH APPLICATION PRIOR TO USE.

8.0 INITIAL OPERATION

8.1 This section allows for quick setup and installation of the DSM-4388DUS pyrometer. Mount and wire the device as described in sections 3.0 and 4.0. Upon initial power up, press and hold the ENTER key and press the CHANNEL key; the unit will be in the configuration mode. Press the CHANNEL key until the display reads either "J-tc" or "K-tc". Press the ▲ or ▼ (up or down arrow key) to view the thermocouple options. Press ENTER when the appropriate thermocouple type is displayed to load the default data for that type. This procedure loads the factory default calibration parameters and no additional calibration should be required. Next, enter the configuration mode again and when the display reads either "dEG °F" or "dEG °C", press the ▲ or ▼ (up or down arrow key) to scroll and press ENTER to accept the desired units choice. The device is now ready to accurately read temperatures.

9.0 SETPOINTS

9.1 There are eight individually adjustable high and low setpoints for the DSM-4388DUS pyrometer. These can be set to any value within the range of the device. To view or change the setpoint values, press the SETPTS key one time to view the first setpoint; press it again to view the second setpoint, and so on; the high setpoints are listed first followed by the low. The number to the left of the colon represents the setpoint channel being viewed. The number to the right of the colon is the numeric setpoint value for that point and the HI or LO display indicator indicates if the setpoint is high or low. To adjust the displayed value, press the ▲ or ▼ (up/down arrow key) to increase or decrease the value until the desired trip-point for that switch is reached. Press ENTER to accept and save the new value. The new setpoint value will change only if the ENTER key is pressed. Press the ESC key to return to the normal display mode with no setpoint value change.

NOTE: When in the setpoints mode, the previous setpoint values are monitored, and the new value is monitored only after the ENTER key is pressed. If no key is pressed for 15 seconds, the display will return to the normal mode and the configuration will revert back to the previous parameters.

9.2 OUTPUT SWITCH - The output switch is a Form C (normally open and normally closed break before make) solid state switch rated 200 V, 0.2 amp max. The output switch will make an electrical connection to switch common within one second (see note below) if any channel's input temperature violates its setpoint value. For a low setpoint to cause a fault, it must remain continuously faulted longer than the timer delay time set for that point. A hysteresis of 10°F or 5°C is used on both high and low setpoints to prevent the output from rapidly turning on and off near a setpoint. The output switch, if set to non-latching, will clear when the temperature values of all channels are 10°F / 5°C less than any high setpoint, or 10°F / 5°C greater than any low setpoint. For example, if a high setpoint on channel 3 is set to 900°F, the output switch will trip when the monitored temperature on channel 3 reaches 900°F or greater and will not clear until the input temperature is less than or equal to 890°F. If the output switch is set to LATCHING, the output switch will remain tripped until reset is initiated.

NOTE: The output switch reaction time is tied to the filter value with one second being the minimum. For other reaction times see section 10.11 below.

9.3 RESET OPERATION - Reset can be initiated in one of four ways: by pressing the RESET key, by grounding the reset terminal on the back of the unit, by removing and reapplying power from the pyrometer or by sending a reset command via the RS-485 communications. A reset operation clears the low setpoint timers, clears view alarms and places the output switch in the non-tripped condition. Reset can be held active by either grounding the reset terminal on the back of the unit or by depressing and holding the reset button in on the front keypad. When reset is kept active, the output switch will stay in the non-faulted condition and the display will flash "RESET" to remind the operator.

10.0 CONFIGURATION

10.1 The following are the configuration headings of the pyrometer. From the normal display mode, press and hold the ENTER key and then press the CHANNEL key to enter the configuration mode. Once in the setup mode press the CHANNEL key to reach any of these configuration headings. After a selection has been made, press the ENTER key; the display will read "SAVE/donE". It is at this time the new data is saved. The ESC (escape) key can be used at any time to abort the configuration mode and return to the normal reading. During configuration, the unit allows 15 seconds for first level and 60 seconds for other levels between keystrokes to change or save a new configuration. If the time lapses without a keystroke, the device will automatically return to the normal mode without making any changes. The new information is saved only if the ENTER key is pressed and the display reads "SAVE/donE". A flowchart is provided that shows step-by-step progression through the configuration procedure.

10.2 "dEG °F / dEG °C" UNITS - The available temperature units are °F and °C. The indicators appear on the right side of the display. When changing temperature units, the displayed temperature is automatically converted to the new unit value. To change the unit indicator, enter the configuration mode and press the CHANNEL key until the display reads either "dEG °F" or "dEG °C". The previously programmed unit indicator will appear. Use the ▲ or ▼ arrow key to select one of the available units, and press ENTER to accept and save the change. The display will read "SAVE/donE" and return to the normal mode displaying the new units selected and the numeric value converted to the selected units.

10.3 "A:SCAn" AUTO SCAN - Allows the user to display automatically or manually the selected number of points. The scan starts with channel 1 and progresses in numerical order to the last channel selected in configuration and then repeats the sequence. In manual scan the device continually displays the temperature value of one channel at a time. The next channel and corresponding temperature value is displayed with each press of the CHANNEL button. In auto scan the device will display each channel number and temperature value for approximately two seconds before automatically switching to the next channel.

10.4 "J:tc / K:tc" THERMOCOUPLE TYPE - The instrument can read either type J or K thermocouples. Use the ▲ or ▼ arrow keys to select a thermocouple type and press ENTER to accept and save the new thermocouple type.

NOTE: Pressing ENTER will return all of the adjustable parameters, including the setpoint switch values, to factory default values. When verifying the type, press ESC to exit without reloading default values. All thermocouple inputs must be either type J or K; the inputs cannot be mixed.

10.5 "CAL" CALIBRATION - For calibration procedures, see Section 11.0.

10.6 "X:PtS" NUMBER OF POINTS - This allows the user to select the number of channels to be monitored, from 1 to 8 channels. Channels not selected will not display and will have no effect on the output switch. NOTE: Channel 1 is always used and the rest of the channels used follow in numeric order from channel 1.

10.7 "P:On / P:OFF" PROTECTION STATUS - This feature allows the user an added layer of protection by preventing the setpoints from inadvertently being changed. When protection is ON, the user is able to view the setpoint values but is not able to change any of them. If the ▲ or ▼ keys are pressed when protection is on with the display in the setpoints mode, the display will read "no" and return to the normal display mode.

10.8 "nodE" RS-485 COMMUNICATIONS NODE NUMBER - For RS-485 serial communications each unit must be assigned a node or identification number so that a DSM device can be identified by the device communicating with it. Any unique number from 01 to 99 may be used.

10.9 "StAtE" OUTPUT SWITCH STATE - The options for the output switch are fail safe or shelf state, and latching or non-latching. Shelf-state is when the outputs are in the same condition with no faults as when unpowered; Fail-safe is when they are opposite. In non-latching mode, the output switch changes state when the setpoints come out of violation; in latching mode, a reset condition is required to clear.

10.10 "t.dLy" LOW SETPOINT TIME DELAY - This configuration allows the user to set a timeout value in seconds from 0 to 999 seconds before the low setpoint values are active. Each low setpoint can have its own unique timeout value.

10.11 "FILt" DISPLAY FILTER - The display filter can be used to stabilize the display reading of a changing input. Filtering is done in both hardware and software. The software filter is an adjustable filter; the rate of change is less for large values. The filter value is read-out in a number from 1 to 255, 1 being no filter value and 255 being maximum filter value. Below are some typical filter values and their effect on the display reading. Settling values are approximate times in seconds to reach 90% of new reading. Use the ▲ or ▼ arrow key to increase or decrease the filter value and press ENTER to save the new filter value.

FILTER VALUE	1	128	200	210	220	230	240	250	253	255
SETTLING, SEC.	1.0	1.5	2.5	3.0	3.5	4.0	5.5	14	28	81

11.0 CALIBRATION

11.1 The instrument is calibrated at the factory and should not require additional calibration. However, calibration can be performed in the field many times over the life of the device. The calibration mode is used to calibrate the zero and span values. Calibration can be performed from the front keypad without disassembling the unit. A thermocouple calibrator or simulator is required to provide a calibration reference.

NOTE: During calibration, the unit allows 60 seconds between keystrokes to change or save a new calibration. If 60 seconds lapse without a keystroke, the device will automatically return to the normal mode with the previous values. The new calibration information is saved only if the ENTER key is pressed and the display reads "SAVE/donE".

11.2 CALIBRATION PROCEDURE - Connect the proper thermocouple simulator, either type J or K using proper thermocouple extension wire, to pyrometer thermocouple input channel 1. The DSM-4388DUS pyrometer MUST be calibrated on channel 1 only. The calibration performed on channel 1 applies to all channels. To calibrate the pyrometer, press and hold the ENTER key and press the CHANNEL key, then press the CHANNEL key alone until the display reads "CAL" and press ENTER. The display will read "1:CAL". Adjust the simulator for a very low reading (0°F) and press ENTER. Use the ▲ or ▼ arrow key to increase or decrease the display reading to match the setting of the simulator and press ENTER. The display will now read "2:CAL". Adjust the simulator for a very high reading (1000°F) and press ENTER. Again use the ▲ or ▼ arrow key to increase or decrease the display reading to match the simulator and press ENTER. The display will read "SAVE/donE" and will return to the normal reading with the new calibration values stored in permanent memory. NOTE: Be sure that the units (°F or °C) of the calibrator match the units of the instrument before performing a calibration.

11.3 The DSM-4388DUS pyrometer has a feature that allows a slight adjustment of either the zero or span values individually. This type of calibration can be used to "tweak" the readout to match that of a known value without actually performing a formal calibration procedure. This adjustment must be performed only on channel 1. NOTE: This type of adjustment will invalidate calibration settings from the procedures in section 11.2.

A. ZERO ADJUSTMENT ONLY - To make a small adjustment on the zero calibration value of the pyrometer, enter the calibration mode by pressing and holding ENTER and press the CHANNEL key, then press the CHANNEL key alone until the display reads "CAL" and press ENTER; the display will read "1:CAL". With the standard at or near zero, press ENTER and use the ▲ or ▼ arrow key to increase or decrease the display reading to match the standard and press ENTER. The display will read "2:CAL"; press the SETUP key and the display will read "SAVE/donE" and will return to the normal reading with the new zero calibration value stored in permanent memory.

B. SPAN ADJUSTMENT ONLY - To make a small adjustment on the span point of the pyrometer, enter the calibration mode by pressing and holding ENTER and press the CHANNEL key, then press the CHANNEL key alone until the display reads "CAL" and press ENTER; the display will read "1:CAL". Press the CHANNEL key and the display will read "2:CAL". With the standard at or near the desired span value, press ENTER and use the ▲ or ▼ arrow key to increase or decrease the display reading to match the standard and press ENTER. The display will read "SAVE/donE" and will return to the normal reading with the new span calibration value stored in permanent memory.

12.0 RS-485 COMMUNICATIONS

12.1 The DSM-4388DUS pyrometer is part of a system that has been carefully designed to easily interface to popular computers, terminals, programmable controllers and future Altronic instruments. The data and status on any channel as well as the high and low setpoint values can be read remotely. The setpoints can also be adjusted remotely. The first alarm fault can be displayed and then cleared. A remote reset can also be performed.

12.2 MASTER / SLAVE OPERATION - The DSM device RS-485 communication system is designed as a master/slave system; that is, each unit responds to its own unique address (node number) only after it is interrogated by the master (computer). One master and up to 32 slaves can communicate in the system. The units communicate with the master via a polling system. The master sends a command and only the polled slave responds. The slave modules can never initiate a communications sequence. A simple command/response protocol must be strictly observed.

12.3 NODE NUMBER - The node number is used in the system to identify the desired slave unit being polled. The node number can be any numeric value from 01 to 99 although only 32 devices can be served on a single communications port. This number range (01 to 99) is allowed so that if device grouping by function or application is desired it can be implemented using the first digit as the group or engine number and the second as the unit number. For example, 53 could be used to identify the number 3 slave unit mounted on engine number 5.

12.4 ASCII COMMUNICATION - All communication to and from the pyrometer is performed using ASCII characters. This allows the information to be processed with the "string" functions common to high level computer languages such as BASIC and C. For computers that support standard serial port interfaces, no special machine language software drivers are required. The use of the ASCII format also allows for the connection of these devices to an auto answer modem for long distance operation without the need for a local supervisory computer. The ASCII characters also make system debugging easy using standard terminal emulation software.

12.5 HALF DUPLEX OPERATION - The RS-485 system employed uses two wires for communication and cannot send and receive data at the same time over the same two wires making it a half duplex system. When the master is in the transmit mode, the slave is in the receive mode and visa-versa.

12.6 ELECTRICAL OPERATING RANGE - RS-485 is a communications standard to satisfy the need for multi-dropped systems that can operate at high speeds over long distances. RS-485 uses a balanced differential pair of wires switching from 0 to 5 volts to communicate data. RS-485 drivers can handle common mode voltages from −7 to +12 volts without loss of data, making them an excellent choice for industrial environments.

12.7 COMMUNICATIONS PARAMETERS - The following must be set by the master to communicate with the slaves:

Baud Rate:	9600
Data Bits:	8
Stop Bits:	1
Parity:	None

12.8 COMMUNICATIONS WIRING - The RS-485 wiring diagram illustrates the wiring required for multiple slave unit hookup. Note that every slave unit has a direct connection to the master. This allows any one slave unit to be removed from service without affecting the operation of the other units. Every unit must be programmed with a unique address or node number, but the addition of new units or nodes can be in any order. To minimize unwanted reflections on the transmission line, the bus should be arranged as a trunk line going from one module to the next. Random structures of the transmission line should be avoided. Special care must be taken with long busses (500 feet or more) to ensure error free operation. Long busses must be terminated with a 120 ohm resistor between the terminals marked RS-485 "A" and RS-485 "B" at the master only. The use of twisted pair shielded cable will enhance signal fidelity and is recommended. To prevent ground loops the shield should be connected to the shield terminal at the master only.

12.9 RX, TX INDICATORS - An RX and TX (receive and transmit) LED is visible on the back of the DSM-4388DUS unit to indicate when the unit is either receiving or transmitting data.

12.10 CONNECTING TO A PC - When connecting the DSM-4388DUS pyrometer to the RS-232 port on a PC, an RS-232 to RS-485 converter must be used for the communication interface. See wiring diagram for details.

12.11 LOADING - RS-485 uses a balanced differential pair of wires switching from 0 to 5 volts to communicate data. In situations where many units (32 max.) are connected together on a long run, voltage drop on the communications leads becomes a major problem. Voltage drops on the RS-485 minus lead appear as a common mode voltage to the receivers. While the receivers are rated to a maximum voltage difference of +/−7 volts, −7V to +12V, a practical system should not have a voltage difference exceeding +/−3 volts under normal conditions. The wire gauge used for the connections therefore limits the maximum number of units or the maximum length of wire between units in each application. The following formula can be used as a guideline to select the appropriate wire gauge.

For 18 AWG wire	No. of DSM units = (4000) / (ft of wire used)
For 20 AWG wire	No. of DSM units = (3600) / (ft of wire used)
For 22 AWG wire	No. of DSM units = (2400) / (ft of wire used)

NOTE: The maximum number of units connected together in a system is 32.

12.12 COMMAND STRUCTURE - The DSM units operate with a simple command/response protocol to control all functions. A command must be transmitted to the unit by the master (computer or PLC) before the slave can respond with useful data. A slave unit can never initiate a communications sequence. A variety of commands exist to fully exploit the functionality of the individual units.

Communication of functions to the DSM is performed with two character ASCII command codes. The general format used for the commands is illustrated below using the READ DATA command from channel 3 of a DSM as an example. The hexadecimal values for the characters are shown only as a reference for those using low level (assembly language) decoding and will not appear on the communications terminal screen. All of the characters used in the communications protocol are standard ASCII characters and appear on the computer keyboard as shown with the exception of the "not acknowledge" (NAK) which is the industry standard "control U".

	header	**start**	**node**	**space**	**command**	**space**	**data**	**end**
ASCII	>	(	0 1		R D		0 3	)
HEX	3Eh	28h	30h 31h	20h	52h 44h	20h	30h 33h	29h

COMMAND HEADER ">" (3Eh) - Each command must begin with the command header sometimes referred to as a prompt character. The ASCII character used is the ">" which means that a command message will be sent from the master to the slave.

START OF TEXT "(" (28h) - The command header must be followed by the start of text indicator.

NODE NUMBER 01 - 99 - The node number or address of the device being contacted is next. A two digit number from 01 to 99 can be used.

SPACE (20h) - Following the node number is an ASCII space character (not printable, value 20h) to act as a delimiter between the node number and the two character command word. For the balance of this document the space character will be shown normally without a specific description of each occurrence.

COMMAND WORD "RD" (52h, 44h) - The command words are standard two letter (upper case) commands sent by the master for gathering specific information about the status of a slave. The commands are listed under STANDARD COMMANDS below.

SPACE (20h) - Following the command word is another ASCII space character to act as a delimiter between the command word and the channel number.

CHANNEL NUMBER "03" - This is the channel number in the slave unit that the information is requested from.

END OF TEXT ")" (29h) - The end of text indicator says this is the end of the command.

STANDARD COMMANDS - The standard commands available are:

RD	for **R**ead **D**ata	>(01 RD 03)	Read the value of ch3 for the unit at node 01.
RL	for **R**ead **L**ow alarm value	>(02 RL 04)	Read the low setpoint of ch4 for the unit at node 02.
RH	for **R**ead **H**igh alarm value	>(15 RH 02)	Read the high setpoint of ch2 for the unit at node 15.
LS	for **L**o **S**etpoint adjustment	>(02 LS 04 sxxxx.)	Send new value for ch4 low setpoint for unit at node 02.
HS	for **H**i **S**etpoint adjustment	>(15 HS 02 sxxxx.)	Send new value for ch2 high setpoint for unit at node 15.
CA	for **C**lear **A**larms	>(11 CA)	Clear alarms of the device at node 11, timer not reset.
RR	for **R**emote **R**eset	>(01 RR)	Reset the unit and its timers at node 01.
FA	for **F**irst **A**larm value	>(01 FA)	Read the first alarm to fault for the unit at node 01.

NOTES: In the LS and HS setpoint adjustment commands, the variable data is of the form: sign (+/−) followed by the four most significant digits and a decimal point. Digits to the left of the most significant non-zero number must be filled with zero's for place holders (Ex: +0325.0). A plus sign must be used for a setpoint value of zero (Ex: +0000.0).

STANDARD RESPONSES - The standard responses to the commands above are:

<(01 4388 CH03 sxxxx. DegF OK OK)	Unit type 4388, node 01 channel 3, x value, DegF units, low setpoint status indicator, high setpoint status indicator.
<(02 CH04 sxxxx. DegF)	The low alarm value at node 02 of ch4 is x value, DegF units.
<(15 CH02 sxxxx. DegF)	The high alarm value at node 15 of ch2 is x value DegF units.
<(02 LS 04)	Made the low setpoint adjustment to ch4 at node 02.
<(15 HS 02)	Made the high setpoint adjustment to ch2 at node 15.
<(11 CA)	Cleared alarms at node 11.
<(01 RR)	Performed a remote reset at node 01.
<(01 CH07 HI)	Ch7's high setpoint was first to fault at node 01.

SETPOINT STATUS INDICATORS FOR THE READ RESPONSE - Setpoint status indicators consist of two ASCII characters. The first is the low setpoint indicator, the second is the high setpoint indicator. The valid status indicators are:

OK	No faults detected on the requested channel
HI	Channel temperature value is above its setpoint value
LO	Channel temperature value is below its setpoint value
NA	Channel has been disabled by X:PtS in the configuration menu
TD	Channel low setpoint has not timed out and the channel is not yet armed

VALID RESPONSE - A command/response sequence is not complete until a valid response is received. When a slave unit receives a valid command, it interprets the command, performs the desired function and then communicates the response to the master within the specified time. The master may not initiate a new command until the response from a previous command is completed.

A valid response can occur in three ways:
1) a normal response indicated by a "< " header and "( )" beginning and end of text
2) an error response indicated by a "§" NAK (not acknowledged)
3) a communications time-out error

Each command has an associated delay time before a response can be made from the slave unit. If the response does not occur within the time specified for the commands as given, a communications time-out error occurs. This error is usually caused by an improper command header or possibly an improper or non-existent node sent by the master. The commands and their associated maximum response delay times are listed below.

RD, RL, RH, FA, CD, CE commands	20 msec. max.
LS, HS, CA, RR commands	100 msec. max.

An NAK error response will be sent by the DSM-4388DUS unit when it has received a command with an error in the message. All commands must be of the format above. The header, start-and-end of text characters, a valid node number and spaces must be sent and correct to receive an NAK; if not, no response will be sent.

NO ALARMS RESPONSE - If view alarms memory in the unit polled is clear, the response will be: <(01 CH ~ ~CL)

12.13 CHECKSUMS - Two additional commands are provided so that the user may enable or disable the communication checksum routines. When enabled, the messages include an error-checking checksum that is based upon an Exclusive-Or, Modulo 100 conversion sum of the characters in the message string between and including the start of text "(" character and the end of text ")" character. The checksum number is a decimal number that is appended to the message. The slave unit calculates the checksum of the message and compares the calculated value to the actual value it received from the master in the checksum field. If the two values are not equal, an error results and no response is sent.

CE for **C**hecksum **E**nabled >(01 CE) checksum enabled for node 01
CD for **C**hecksum **D**isabled >(01 CD) checksum disabled for node 01

To calculate the Exclusive-Or, Modulo 100 checksum, take the binary value of the 8 bit ASCII character "(" and XOR it with the next binary value of the ASCII character in the string. Take the result and XOR it with the next. Continue these calculations until the end of text ")" character and that is the checksum value. If the decimal number of any of the calculations are greater than 99, use Modulo 100 math. For example, for decimal 154, use 54.

The Exclusive-Or is a binary Boolean operator. The XOR truth table is as follows:

A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

XOR EXAMPLE FOR "(" XORed WITH "0":

```
  00101000
  00110000
  00011000  =  24 (DECIMAL)
```

An example of the calculation of the checksum is below:
Command: >(01 RD 01)

ASCII CHAR	BINARY EQUIV	CHECKSUM (DECIMAL)
>	Not used	---
(	00101000	---
0	00110000	24
1	00110001	41
SPACE	00100000	9
R	01010010	91
D	01000100	31
SPACE	00100000	63
0	00110000	15
1	00110001	62
)	00101001	23

The checksum value will be sent at the end of the command, so the command will look like: >(01 RD 01)23

FIGURES SECTION:

MOUNTING DIMENSIONS AND SPECIFICATIONS

DSM-4388DUS CONFIGURATION WORKSHEET

DSM-4388DUS FLOWCHART

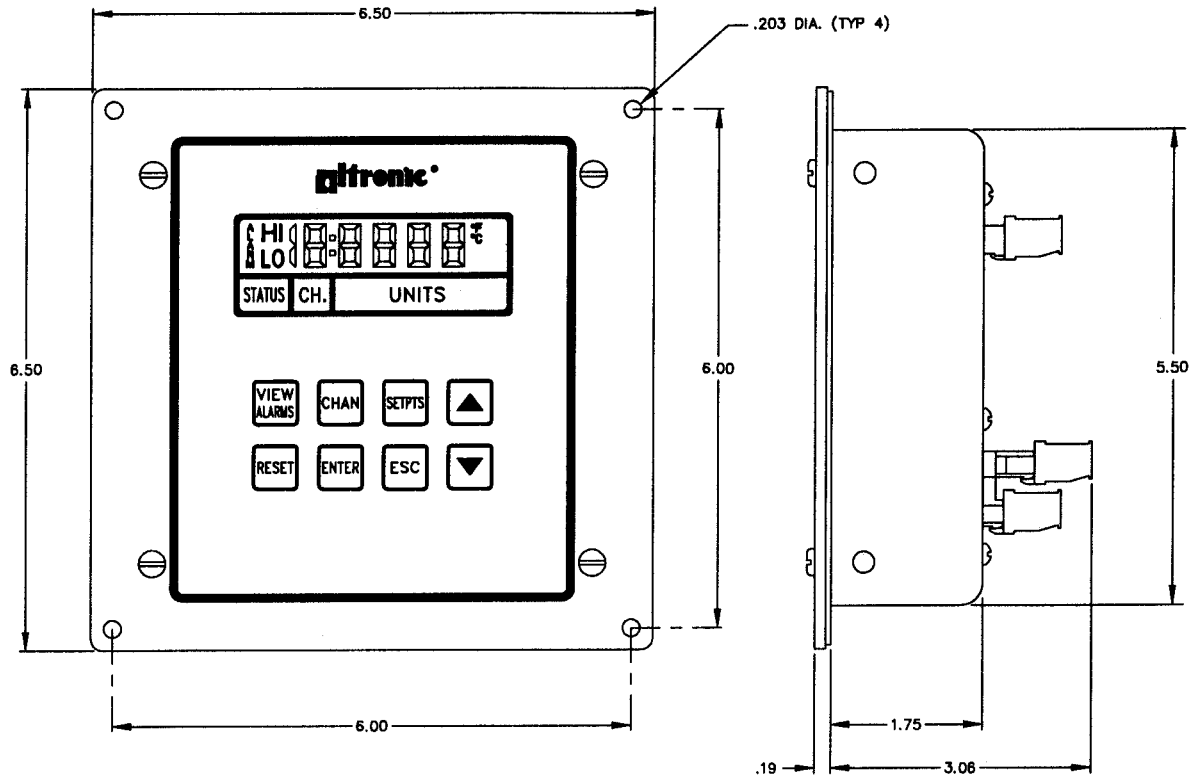
GENERAL ELECTRICAL CONNECTIONS

WIRING DIAGRAM - ALTRONIC ANNUNCIATOR SYSTEMS

WIRING DIAGRAM - DC RELAYS

WIRING DIAGRAM - RS-485 COMMUNICATIONS

MOUNTING DIMENSIONS AND SPECIFICATIONS



SPECIFICATIONS:

POWER REQUIRED: DC POWERED 12–30 VDC, 10 WATTS MAX.

THERMOCOUPLE TYPE: "J" (IRON–CONSTANTAN) OR "K" (CHROMEL–ALUMEL).

TEMPERATURE SCALE: PROGRAMMABLE °C OR °F.

DISPLAY: 0.5" 5–1/2 DIGIT LCD WITH DISPLAY INDICATORS.

DISPLAY UPDATE RATE: 1 SECOND NOMINAL.

DISPLAY SCAN RATE: 2.25 SECONDS PER CHANNEL (18 SECONDS FOR 8 CHANNELS NOMINAL).

RANGE: TYPE "J" THERMOCOUPLE –60° TO 750°C OR –76° TO 1382°F.
TYPE "K" THERMOCOUPLE –60° TO 800°C OR –76° TO 1472°F.

OUTPUT SWITCH: ONE FORM C (N/O, N/C) SOLID STATE SWITCH
RATED 200 VDC, 0.2 AMP CONTINUOUS, OPTICALLY ISOLATED
FROM POWER SUPPLY. HYSTERESIS FIXED AT 10°F.

SWITCH RESPONSE TIME: TIED TO FILTER VALUE AND DISPLAY READING (WITH FILTER AT 1
MAX RESPONSE TIME IS APPROXIMATELY ONE SECOND).

AMBIENT TEMPERATURE RANGE: –40° TO 80°C (–40° TO 175°F).

INSTRUMENT ACCURACY: ±1%, ±1 DEGREE EXCLUSIVE OF THERMOCOUPLE ERROR.

HAZARDOUS AREA CLASSIFICATION: CLASS I, GROUP D, DIV. 2
CLASS I, GROUP D, DIV. 1 WHEN
POWERED FROM A CSA CERTIFIED ZENER
BARRIER RATED 30 VOLTS MAX., 120Ω MIN.

DSM-4388DUS - CONFIGURATION WORKSHEET

SERIAL#_____ **SITE:**_____

UNIT __ °F __ °C

AUTO SCAN __ YES __ NO

TYPE __ "J" THERMOCOUPLE (iron-constantan)
__ "K" THERMOCOUPLE (chromel-alumel)

X:PTS _____ POINTS MONITORED

SETPOINT PROTECTION __ ON __ OFF

RS-485 COMMUNICATIONS NODE NUMBER _____

OUTPUT SWITCH STATE __SHELF __FAIL SAFE
__LATCHING __NON-LATCHING

LOW SETPOINT TIMER DELAY TIMES (SECONDS)

#1 ____ #2____ #3____ #4____

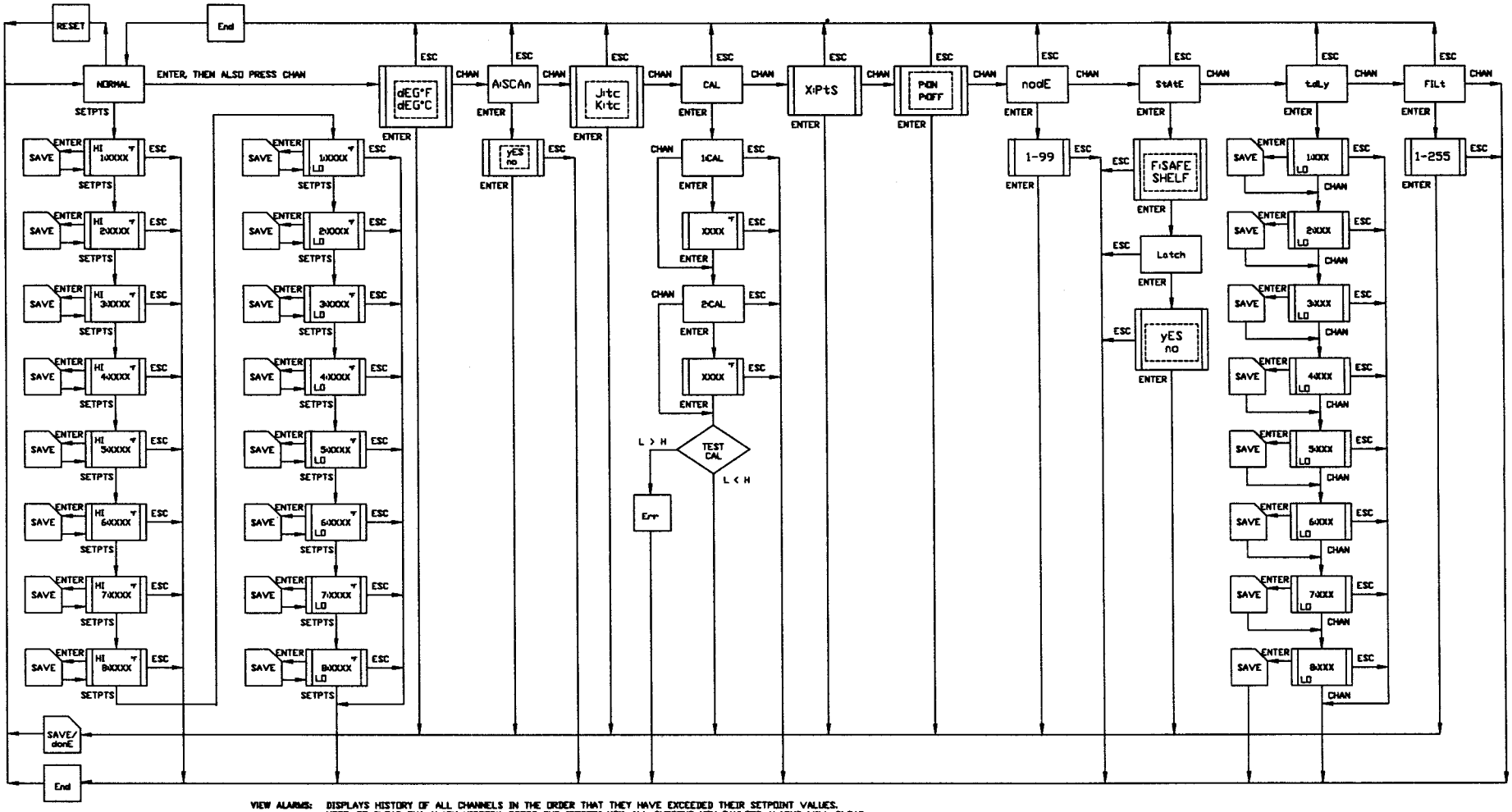
#5____ #6____ #7____ #8____

FILTER _____ (1=min filtering, 255=max filtering, default = 230)

SETPOINTS

#1 HI _____ (in °F or °C)	#1 LO _____ (in °F or °C)
#2 HI _____ (in °F or °C)	#2 LO _____ (in °F or °C)
#3 HI _____ (in °F or °C)	#3 LO _____ (in °F or °C)
#4 HI _____ (in °F or °C)	#4 LO _____ (in °F or °C)
#5 HI _____ (in °F or °C)	#5 LO _____ (in °F or °C)
#6 HI _____ (in °F or °C)	#6 LO _____ (in °F or °C)
#7 HI _____ (in °F or °C)	#7 LO _____ (in °F or °C)
#8 HI _____ (in °F or °C)	#8 LO _____ (in °F or °C)

DSM-4388DU – FLOWCHART



VIEW ALARMS: DISPLAYS HISTORY OF ALL CHANNELS IN THE ORDER THAT THEY HAVE EXCEEDED THEIR SETPOINT VALUES.
NOTE: TO CLEAR THA ALARM HISTORY, PRESS THE "RESET" KEY, ALL CURRENT NON-FAULTED ALARMS WILL CLEAR.
IF THERE IS NO ALARM HISTORY TO VIEW, THE DISPLAY WILL READ "CLEAR" AND RETURN TO THE NORMAL READING.

RESET: RESETS ALL CURRENT NON-FAULTED ALARMS AND RETURNS THE OUTPUT SWITCH TO THE NON-FAULTED MODE WHEN IT IS SET TO LATCHING.

CHAN: THE CHANNEL BUTTON, WHEN PRESSED, DISPLAYS THE NEXT CHANNEL NUMBER AND TEMPERATURE VALUE.

SETPTS: WHEN THE SETPTS KEY IS PRESSED THE SETPOINT WILL BE DISPLAYED FOR 16 SECONDS AND WILL AUTOMATICALLY REVERT BACK TO THE NORMAL DISPLAY MODE IF NO KEY IS PRESSED. IF THE UP OR DOWN ARROW KEY IS PRESSED THE SETPOINT VALUE WILL INCREMENT OR DECREMENT AND REFRESH THE TIMER. PRESSING THE ENTER KEY SAVES THE NEW VALUE AND DISPLAYS THE SAME SETPOINT. PRESSING THE SETPOINTS KEY DOES NOT SAVE AND TAKES YOU TO NEXT SETPOINT. IF THE ESC KEY IS PRESSED THE DISPLAY WILL REVERT BACK TO THE NORMAL DISPLAY MODE AND RETAIN THE PREVIOUS SETPOINT VALUE.

DEFAULT SETTINGS

FOR FACTORY DEFAULT SETTINGS SELECT "J" OR "K" THERMOCOUPLE TYPE

J OR K THERMOCOUPLE
°F OR °C UNITS
FILTER 230

SETPOINTS HIGH 1000°F
SETPOINTS LOW -76°F

MANUAL SCAN
8 POINTS
SETPOINT PROTECTION OFF
NODE = 01

OUTPUT SWITCH IN SHELF STATE
NON-LATCHING
LOW SETPOINT TIMER DELAY 5 SECONDS
CHECKSUM DISABLED

FLOWCHART KEY

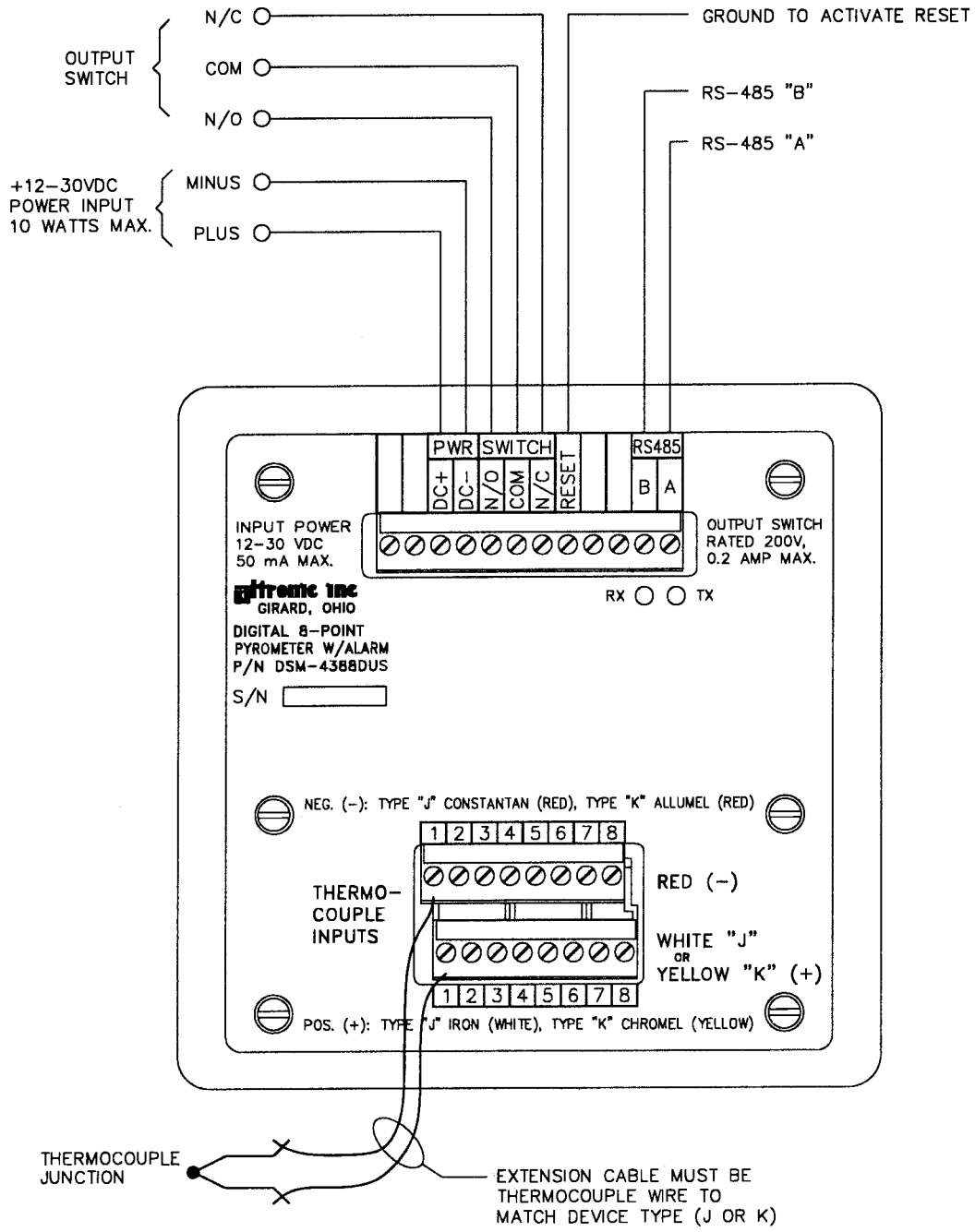
XXXX — △ ▽ DOUBLE BARS- USE UP AND DOWN ARROW KEYS TO SCROLL

dEG°F / dEG°C — DASHED LINES- MAKE SELECTION

XPtS = MAXIMUM NUMBER OF POINTS DISPLAYED IN SCAN CYCLE.

GENERAL ELECTRICAL CONNECTIONS

NOTE: THE OUTPUT SWITCH IS FORM "C" RATED 200VDC, 0.2 AMP CONTINUOUS. SWITCH TURNS ON TO COMMON WHICH IS ISOLATED FROM MINUS (DC−).



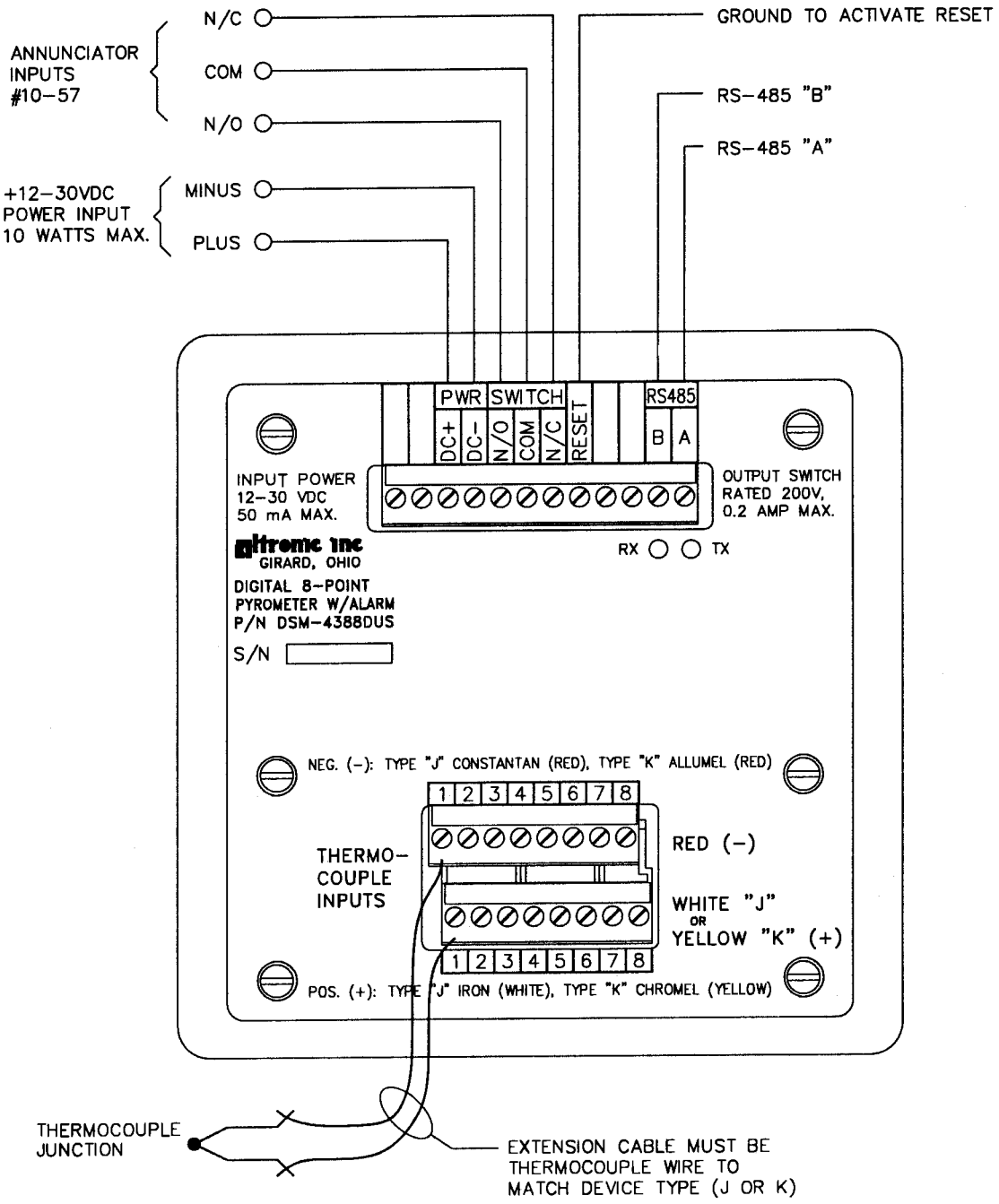
NOTES:

1. ALWAYS USE POINT 1 AND PROCEED IN SUCCESSION TO THE HIGHEST POINT REQUIRED.
2. ALL THERMOCOUPLES AND EXTENSION WIRE MUST BE OF THE SAME TYPE. ALL CONNECTIONS TO BE CLEANED, TIGHTLY TWISTED AND INSULATED WITH CERAMIC WIRE NUTS.
3. ALL UNUSED THERMOCOUPLE INPUTS MUST BE SHUNTED FOR PROPER OPERATION.
4. THERMOCOUPLES SHOULD BE EITHER ALL UNGROUNDED OR ALL GROUNDED.

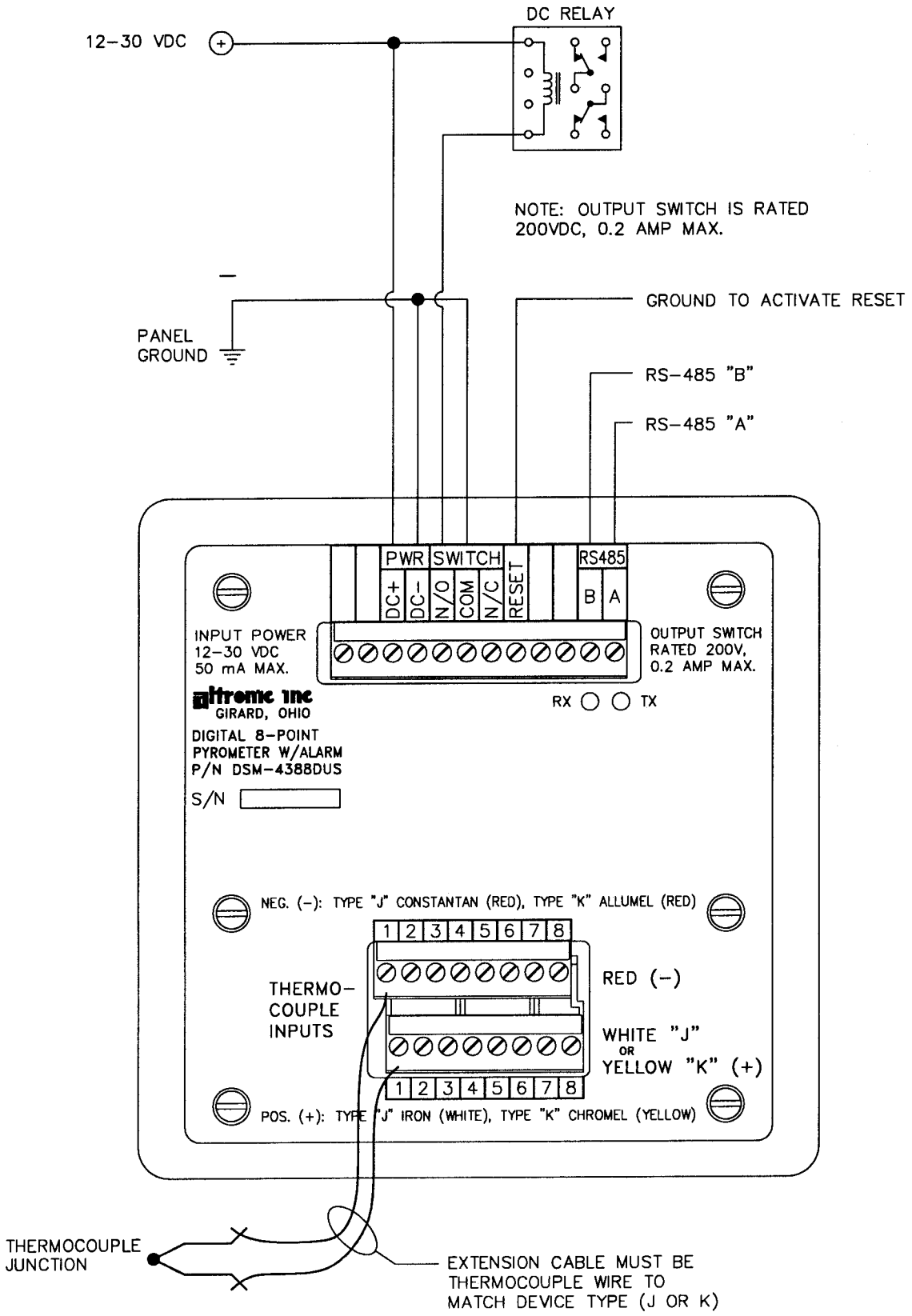
WIRING DIAGRAM
ALTRONIC ANNUNCIATOR SYSTEMS

NOTE: FOR INTRINSICALLY SAFE OPERATION THE FOLLOWING CONDITIONS MUST BE MET:

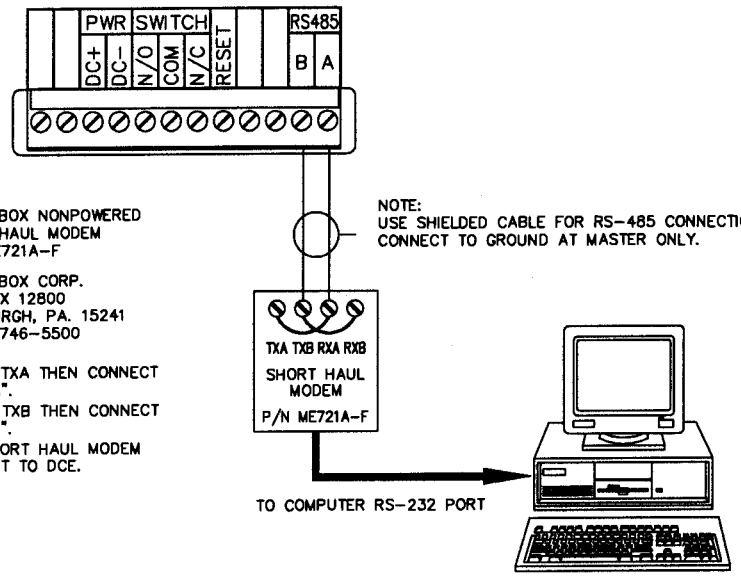
1. DC POWER MUST BE FROM A CSA CERTIFIED ZENER BARRIER RATED 30 VOLTS MAX., 120 OHMS MIN. FOLLOW THE INSTALLATION INSTRUCTIONS SUPPLIED WITH THE BARRIER.
2. THE SWITCH OUTPUTS, IF USED, MUST BE CONNECTED TO THE SENSOR INPUTS OF AN ALTRONIC DA OR DD ANNUNCIATOR SYSTEM WITH 690 SERIES POWER SUPPLY.
3. THE RS-485 COMMUNICATIONS, IF USED, MUST BE CONNECTED THROUGH A CSA-CERTIFIED BARRIER OR TO A CSA APPROVED COMMUNICATION DEVICE.



WIRING DIAGRAM – DC RELAY



RS-485 COMMUNICATIONS (PC HOOK-UP)



RS-485 COMMUNICATIONS (MULTIPLE SLAVE UNITS)