

CAUTION: The DE-2000 digital annunciator system is suitable for use in Class I, Group D, Division 2 hazardous locations when installed in accordance with these instructions.

The sensor 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 sensor leads and the ignition system or any AC or DC power source.

WARNING: READ THESE INSTRUCTIONS CAREFULLY BEFORE INSTALLING THE DE ANNUNCIATOR SYSTEM. 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 DE-2000 digital annunciator system is an electronic microprocessor-based system designed to monitor normally open or normally closed dry contact sensors used on industrial natural gas engines, compressors and equipment. It also can display analog information gathered by Altronic DSM/DSG type devices communicated through a RS-485 serial port. A backlit 4x20 LCD character display shows system status, programmed engine and compressor parameters and channel labels. A front-mounted keypad serves as the user interface. Remote communications to PC's, PLC's and modems is provided through a serial port. The annunciator system is field-programmable using a PC (personal computer) through a RS-232 port in conjunction with the DE-2000 terminal program and contains a non-volatile memory to store the setup.

1.2 The DE-2000 digital annunciator system consists of these components:

- 1. Display Module DE-2000
- 2. Power Supply Module 691122-1
- 3. Terminal Module 691123-1
- 4. Output Module 691124 (two required - one for fuel, one for ignition)
- 5. Cable 693115-1 (DB-25 male/female standard computer cable)

1.3 There are 32 discrete switch inputs that can be individually wired either for a normally open or a normally closed sensor switch. Any number of these may be connected to DSG serial port gauges with the analog values communicated to the DE-2000 annunciator. In addition, data from up to four Altronic DSM instruments (maximum of 36 analog points) can be communicated to the DE-2000 annunciator system via one of the RS-485 ports. Remote stop and remote reset functions are also available. Each digital input is continuously scanned at 15 times per second. When a sensor switch fault is detected, the output modules change state and shut the engine/compressor down in a user configured timed sequential manner. Additionally, the first fault, channel number, output status and user description are displayed on the LCD display and remain displayed until the shutdown is confirmed.

- 1.4 The DE-2000 series annunciator system is designed to be versatile and simple to use. Initial programming is performed via the RS-232 port on the back of the Display Module connected to a PC (personal computer) using the Altronic terminal program. Operating parameters can also be edited in the field via the Display Module keypad. The stop, reset and test features are functionally the same as the prior Altronic DA and DD annunciator series while additional features such as full user configuration, user labels on the LCD display, and view process screens with bargraphs are also incorporated.
- 1.5 The power requirement for the DE-2000 series annunciator system is 12 to 24 Vdc, 5 watts typical, 10 watts max.
- 1.6 For proper operation, these installation instructions must be adhered to strictly.

2.0 DISPLAY MODULE

- 2.1 The Display Module serves as the user interface for the DE-2000 system. It is in a 6.5 x 6.5 panel mounted enclosure and consists of an alphanumeric 20-character x 4-line backlit LCD display, a 16-key front-mounted keypad, DB-25 D-Sub and DB-9 D-Sub connectors and three pairs of serial port indicators.
- 2.2 The keypad is a sealed membrane unit that contains the familiar STOP, RESET and TEST keys as well as other keys used to navigate through channel status and description, view process screens, and to edit the configuration. The complete keypad description can be found in the operating instruction manual, form DE OI.
- 2.3 The LCD screens consist of a "home screen" that contains the engine speed, the suction pressure and the discharge pressure. A "view screen" is available by pressing the VIEW key and displays up to eight user configurable analog process labels and values and a bargraph of the analog values between the setpoints of the corresponding Altronic DSM or DSG devices. Channel number, its timer status, analog value (if configured) and the corresponding 20-character user entered label are displayed by pressing the VIEW CHANNEL key.
- 2.4 The back of the unit contains a DB-25 connector that is used to connect the Display Module to the Terminal Module and the Power Supply Module using the 693115 series Cable Assembly. The DB-9 connector is an RS-232 serial communications port used to connect the Display Module to a PC for configuring the annunciator system using the DE-2000 Terminal Program (see form DE PI). A standard male/female DB-9 computer cable assembly may be used for this connection; Altronic P/N 693116-1. There are also three pairs of serial port indicators on the back of the Display Module, one each for receiving data (RX) and the other for transmitting data (TX). The first pair is for the RS-232 port, the second pair is for the RS-485 port to the Altronic DSM/DSG instruments, and the third pair is for the RS-485 port to remote devices.

3.0 POWER SUPPLY MODULE

3.1 The Power Supply Module is made to be rail mounted and is the interface between the Terminal and Display Modules and to other systems. It typically plugs directly into the Terminal Module using the DB-25 connectors and is held together with screws and screwlocks.

3.2 The Power Supply Module is made to accept up to four industry standard commercially available 0.6 inch plug-in Output Modules. The Output Modules are optically isolated solid-state switches which are isolated from power supply minus and engine ground. The Output Modules will be in the open (de-energized) condition when the unit is unpowered. Each output can be software configured for either normally open (N/O) or normally closed (N/C) operation and has an LED indicator associated with it. If an Output Module is programmed for normally closed (energized for run), the LED will be ON in the normal run condition and OFF for a fault condition. For Normally open configured modules the LED will be OFF for normal run condition and turn ON for a fault condition.

The standard Output Modules' outputs use the top row of the dual 16-position terminal strip which is marked OUT 1 through OUT 4. Each of these outputs are fused with a replaceable 6.3 amp slow-blow fuse, Altronic P/N 601653. In addition to accepting industry standard Output Modules (see section 7.4), a custom Altronic Output Module P/N 691124 is available for tripping ignition powered CD fuel valves and shorting CD ignition shutdown leads upon a fault. When both functions are required, two of these modules are used as follows: OUT 1 slot must be used to trip the fuel valve, and OUT 2 slot must be used to short the ignition. If 12-24 Vdc is lost to the DE-2000 annunciator system, the custom Output Modules will trip the fuel valve and short the ignition shutdown lead. This mimics the "fail-safe" operation of a normally closed Output Module and therefore the LED will be ON in the normal run condition and OFF for a fault condition. In programming the system these modules are identified by using the IGN/FUEL selection. Terminals IGN+ and IGN- are used to connect the shutdown lead, and FV1 and FV2 are used for the CD fuel valve. A capacitor is included in the Power Supply Module to supply the energy to trip the fuel valve.

3.3 The 12-24 Vdc power for the DE-2000 annunciator system is applied to the power supply terminals marked (+) and (-) 12-24VDC INPUT POWER. A 6.3 amp replaceable slow-blow fuse protects the system from overcurrents, and a power LED lights when power is applied to the system.

3.4 The external connection for the two serial RS-485 communication ports is on the Power Supply Module terminal strips. Port 2 is for RS-485 serial communication to optional Altronic DSM and DSG instruments, and port 3 is for RS-485 serial communication to a PC (personal computer) or a PLC (programmable logic controller) to perform remote monitoring or control functions if desired.

3.5 Terminals marked IGN IN and PU IN are used by the annunciator system to detect either engine rotation or ignition system firings. This input monitors changing signals such as those seen on either the ignition shutdown lead or a magnetic pickup monitoring an engine mounted gear.

- The IGN IN terminal connects to the positive (+) C.D. ignition shutdown lead.
- The PU IN terminal connects to one magnetic pickup input; the other pickup wire connects to the minus (-) terminal on the Power Supply Module.

NOTE: An installation may use only one of the terminals IGN IN or PU IN.

4.0 TERMINAL MODULE

- 4.1 The Terminal Module is made to be rail mounted and is the interface between the power supply and Display Module. It typically plugs directly into the Power Supply Module using the male DB-25 connector and is held together with screws and screwlocks. The female DB-25 connector is used to connect it to the Display Module using the 693115 series cable assembly (a standard male-female DB-25 computer cable). A power LED indicator is on when 12-24 Vdc power is applied indicating the presence of power to the system.
- 4.2 A removable dual terminal strip is used for connection to normally open or normally closed sensor switches. These sensor inputs are numbered similar to previous Altronic DA and DD annunciator systems: 10-17, 20-27, 30-37, and 40-47. There are four other sets of terminals labeled A, B, C and D that are to be used to connect the output switch from the DSM monitors. The set of terminals labeled R and S are for remote Reset and Stop respectively. Stop overrides reset if both are initiated simultaneously.

5.0 DSM AND DSG INSTRUMENTS

- 5.1 The DE-2000 annunciator system works together with Altronic DSG and DSM instruments with serial communications (models DSG-1x01DUS and DSM-4xxxDUS) for home screen speed, suction and discharge analog values. They are also used for the view screen analog values and bargraph information. These devices communicate to the DE-2000 annunciator via the RS-485 serial ports. If these are not available, the home screen will display dashes in place of the analog values.
- 5.2 A DSG gauge output switch must be connected to sensor input numbers 10 through 47. If both switches of the DSG are used, the switches must be connected to consecutive inputs.
EXAMPLE: If DSG switch 1 is connected to sensor input 14, then switch 2 must be connected to sensor input 15. The node number for the DSG gauge must match the first switch sensor input number (14 in this example) to establish correct communications. The node number for the DSG is set in its menu. Sensor point 14 must also be configured for serial communications, this is done using the DE-2000 terminal program.
See the installation instructions for the DSG gauge (form DSG II) and programming instructions for the DE-2000 (form DE PI).
- 5.3 Up to four DSM monitors may be connected to the annunciator system via its output switch and serial communications port. The DSM output switch must be connected to annunciator sensor inputs A, B, C or D. The serial communications port must be connected as shown in the drawings section.

The node number of the DSM monitor must be:

- 50 for sensor switch input A
- 60 for sensor switch input B
- 70 for sensor switch input C
- 80 for sensor switch input D

See the DSM installation instructions to install and set the node number. See the DE-2000 programming instructions to configure the system for DSM monitors..

6.0 MOUNTING

- 6.1 **DISPLAY MODULE** - Mount the Display Module inside a control panel or to a suitable flat surface so that the display is at a convenient viewing height. A drilling template and mounting dimensions are provided. **NOTE:** Avoid mounting the unit with the LCD display facing direct sunlight. The display operating temperature range is -31°F to $+176^{\circ}\text{F}$ (-35°C to $+80^{\circ}\text{C}$).
- 6.2 **POWER SUPPLY MODULE** - Mount the Power Supply Module in the panel either on the bottom or the side of the main panel. The Power Supply Module is made to be rail mounted onto commercially available 32 or 35 mm DIN mounting rails. It is also made to plug directly into the Terminal Module using the DB-25 connectors and is held together with screws and screwlocks. Two end brackets P/N 610751 should be used to keep the modules from sliding off the ends of the mounting rail.

As an alternative, the Power Supply Module and the Terminal Module can be mounted separate from each other on the DIN mounting rails but in the same panel; in this case, a DB-25 male/female cable such as P/N 693115-1 is used to electrically connect these modules. The operating temperature range of the Power Supply Module is -31°F to $+176^{\circ}\text{F}$ (-35°C to $+80^{\circ}\text{C}$).

- 6.3 **TERMINAL MODULE** - Mount the Terminal Module in the panel either on the bottom or the side of the main panel. The Terminal Module and Power Supply Module are made to be rail mounted onto commercially available 32 or 35 mm DIN mounting rails. The Terminal Module is made to plug directly into the Power Supply Module using the DB-25 D-Sub connectors and held together with screws and screwlocks. Two end brackets P/N 610751 should be used to secure the modules from sliding off the ends of the mounting rail.

As an alternative, the Terminal Module and the Power Supply Module can be mounted separate from each other on the DIN mounting rails but in the same panel; in this case, a DB-25 male/female cable such as P/N 693115-1 or equivalent is used to electrically connect these modules.

A DB-25 male/female cable, 693115 series or equivalent, is used to connect the Terminal Module to the Display Module and secured with the cable lock screws. The operating temperature range of the Terminal Module is -31°F to $+176^{\circ}\text{F}$ (-35°C to $+80^{\circ}\text{C}$).

7.0 WIRING (SEE WIRING DIAGRAMS)

- 7.1 **SYSTEM COMPONENT WIRING** - A DB-25 male/female cable, 693115 series or equivalent, is used to connect the Terminal Module to the Display Module and secured with the cable lock screws. If mounted on the same mounting rail, plug the Terminal Module directly into the Power Supply Module using the DB-25 D-Sub connectors at the ends of the modules and secure them together with the screws and screwlocks captive to the connectors. If the Power Supply Module and the Terminal Module are mounted separate from each other (must be mounted in the same panel) a DB-25 male/female cable such as P/N 693115-1 or equivalent is used to connect these modules.
- 7.2 **POWER WIRING** - Connect the supply power wires to the 12-24 Vdc input power terminals on the annunciator power supply, plus to terminal (+) and minus to terminal (-); power requirement is 12 to 24 Vdc (10 watts max.). The DC- terminal must be connected to panel ground which should be the same as engine ground.

NOTE: This is the return path for normally open sensors and must be connected for proper operation. **DO NOT** ground this device directly to the ignition system common coil ground.

7.3 SENSOR WIRING - The sensor leads connect to the removable terminal strips on the Terminal Module. The terminal numbers correspond to the display numbers which also have a user assigned 20 character label associated with it. The sensor inputs are numbered similar to previous Altronic DA and DD annunciator systems: 10-17, 20-27, 30-37, and 40-47. There are four other sets of sensor input terminals labeled A, B, C and D that are used to connect to the output switch from DSM monitors. The set of terminals labeled R and S are for remote Reset and Stop respectively. Sensor inputs 10-47 can be user-configurable as class A, class B or class C logic. Any sensor point can be wired for normally open or normally closed operation.

- Normally Open (N/O) sensor switches are wired with one wire to the bottom terminal strip of the respective sensor number and the other to engine ground which should be the same as power minus (-). A short jumper from the bottom terminal to the top terminal must be connected for normally open sensors (see wiring diagrams).
- Normally closed (N/C) sensor switches are wired with one wire to the bottom terminal strip and the other to the top terminal strip of the respective sensor number. Note that the short jumper wire must be removed.
- Remote stop and remote reset are wired the same as the sensor switches and can be used with either normally open or normally closed contacts.

Use a wire size of between 16 AWG (max.) to 24 AWG (min.) to connect the sensor switches to the terminal strip connector. Strip the insulation back 3/8"; twist the exposed wires tightly together. Insert the exposed wire completely into the terminal strip and securely tighten the clamping screw. Wires running to sensor switches must be in good condition or replaced with new wires. In running wires take care not to damage the insulation and take precautions against later damage from vibration, abrasion, or liquids in conduits. An explosion conduit is not required. However, wires should be protected from damage by running them in a protective conduit or in sheaths where appropriate. In addition, it is essential that the following practices be adhered to:

- A. Never run sensor wires in the same conduit with ignition wiring or other high energy wiring such as the AC line power.
- B. Keep secondary wires to spark plugs and other high voltage wiring at least eight inches (200mm) away from sensor and sensor wiring.
- C. Sensor switches may be connected to any passive device using contacts such as standard switch gauges, pressure or level switches. DO NOT connect sensor leads to any voltage producing element.
- D. Sensor switches will be exposed to much lower voltages and current than with the standard Murphy or similar type system. In the case of a field conversion where sensors have previously been used with Murphy tattletales, it is recommended that the sensors be checked frequently (see Test procedures in the operating instruction manual) when the DE system is first put into use. Sensor contacts may be burned or pitted from past exposure to ignition system primary voltage. It is advisable to replace such sensors.
- E. If it becomes necessary to check sensor switch to panel wiring with an ohmmeter or other checker, first DISCONNECT the plug-in terminal strips from the Terminal Module. Applying voltage to the annunciator system through the sensor leads may damage the device. In addition, the area should be tested as non-hazardous before such testing commences.

7.4 OUTPUT SWITCH WIRING - The Power Supply Module is made to accept an industry standard 0.6 inch Output Module. The following modules are available from Altronic:

- 691124** This custom module has two uses: connection to a Murphy fuel valve and directly grounding a C.D. ignition system.
- Use in position OUT 1 to connect to a C.D. ignition type Murphy fuel valve. Connect terminals 3 and 8 of the fuel valve to the Power Supply Module terminals marked F1 (FV1) and F2 (FV2).
 - Use in position OUT 2 to directly ground-out (stop) a C.D. ignition system. Wire the C.D. ignition shutdown lead and ignition ground to the Power Supply Module terminals marked I+ (IGN+) and I- (IGN-) observing the proper polarity for the ignition system. DO NOT connect directly to the ignition system common coil ground.
- 691125** This module is rated for 5-48 Vdc, 5.0 A. and may be used in any of the four output slots OUT 1 through OUT 4.
NOTE: Use this module if it is desired to interrupt the DC supply to DC-powered ignition systems such as Altronic CD1, CPU-90, II-CPU or DISN.
- 691056** This module is rated for 5-60 Vdc, 2.0 A. and may be used in any of the four output slots OUT 1 through OUT 4.
- 691066** This module is rated for 5-200 Vdc, 0.67 A. and may be used in any of the four output slots OUT 1 through OUT 4.
- 691065** This module is rated for 24-280 Vac, 2.0 A. and may be used in any of the four output slots OUT 1 through OUT 4.

NOTE: Other industry standard 0.6 inch modules may be used as required.

7.5 RS-485 COMMUNICATIONS WIRING - There are two RS-485 communication ports available on the DE-2000 annunciator system.

- Port 2 is for communicating to the DSM and DSG series monitors with serial communications.
- Port 3 is for RS-485 serial communication to a PC (personal computer) or a PLC (programmable logic controller).

Use a two conductor shielded cable of fine gauge stranded wire and connect the wires for port 2 to the terminals marked "A2" and "B2" and the shield wire to terminal "S2". The wiring for port 3 connects to the terminals marked "A3", "B3" and "S3". Connect to the other communication devices "A" to "A"(-) and "B" to "B"(+). Connect the shield wire to the annunciator system ONLY.

7.6 SENSE ROTATION INPUT - Terminals marked IGN IN and PU IN on the Power Supply Module are used by the annunciator system to detect either engine rotation or ignition system firings. This input monitors changing signals such as those seen on either the ignition shutdown lead or a magnetic pickup monitoring an engine mounted gear.

- The IGN IN terminal connects to the positive (+) C.D. ignition shutdown lead.
- The PU IN terminal connects to one magnetic pickup input; the other pickup wire connects to the minus (-) terminal on the Power Supply Module.

NOTE: An installation may use only one of the terminals IGN IN or PU IN.

8.0 HAZARDOUS AREA OPERATION

8.1 The DE-2000 annunciator system is CSA certified for CLASS I, DIVISION 2, GROUP D areas when mounted in a suitable enclosure.

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

1. The low voltage sensor switch wires within the panel enclosure must be kept at least two (2) inches away from other wiring. Run the sensor switch 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.

DRAWINGS SECTION:

SYSTEM OVERVIEW - DE-2000 ANNUNCIATOR SYSTEM

MOUNTING DIMENSIONS AND SPECIFICATIONS - DISPLAY MODULE

**MOUNTING DIMENSIONS AND SPECIFICATIONS - TERMINAL MODULE
AND POWER SUPPLY MODULE**

WIRING DIAGRAM - GENERAL HOOK-UP

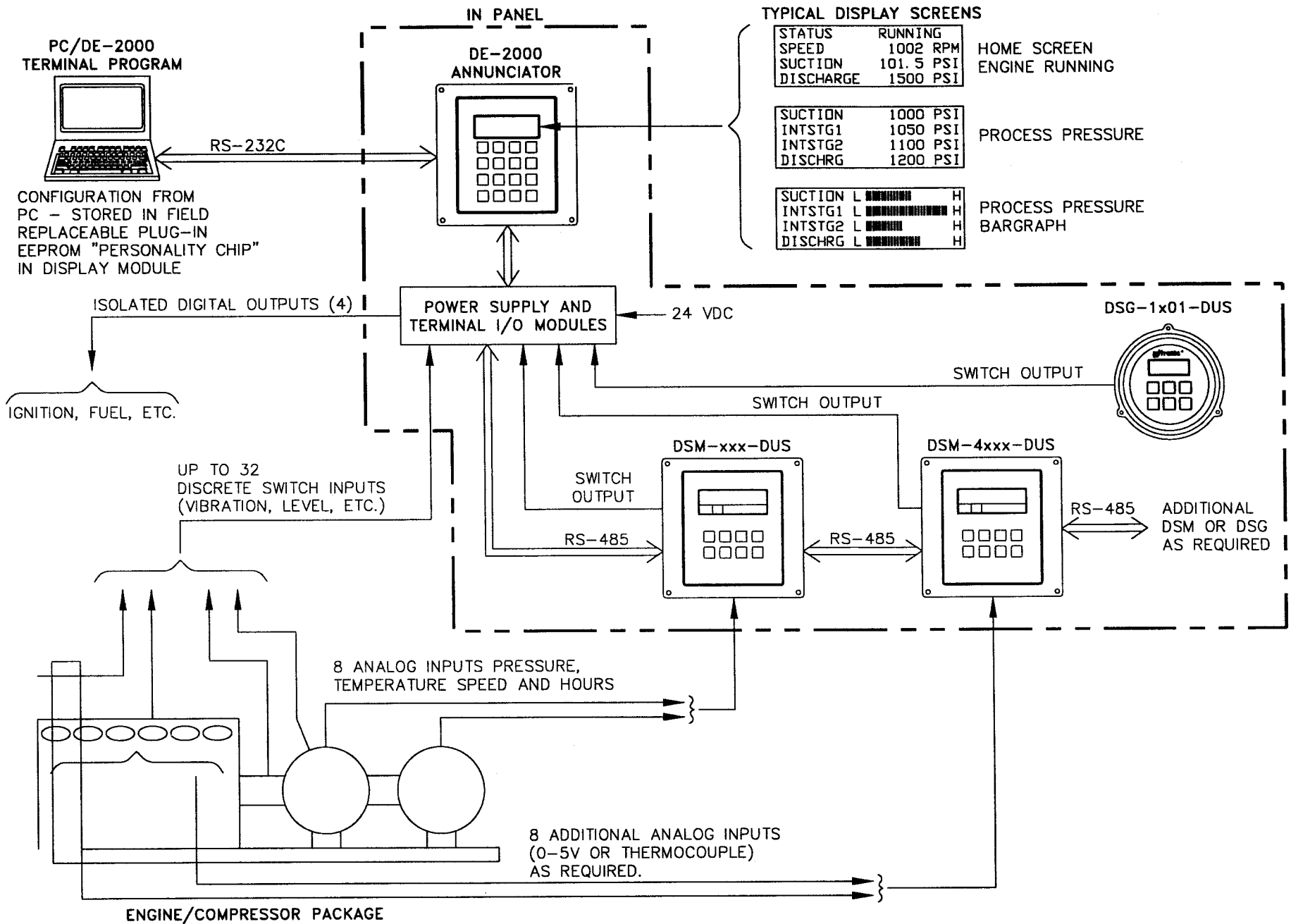
WIRING DIAGRAM - POWER SUPPLY MODULE

WIRING DIAGRAM - TERMINAL MODULE

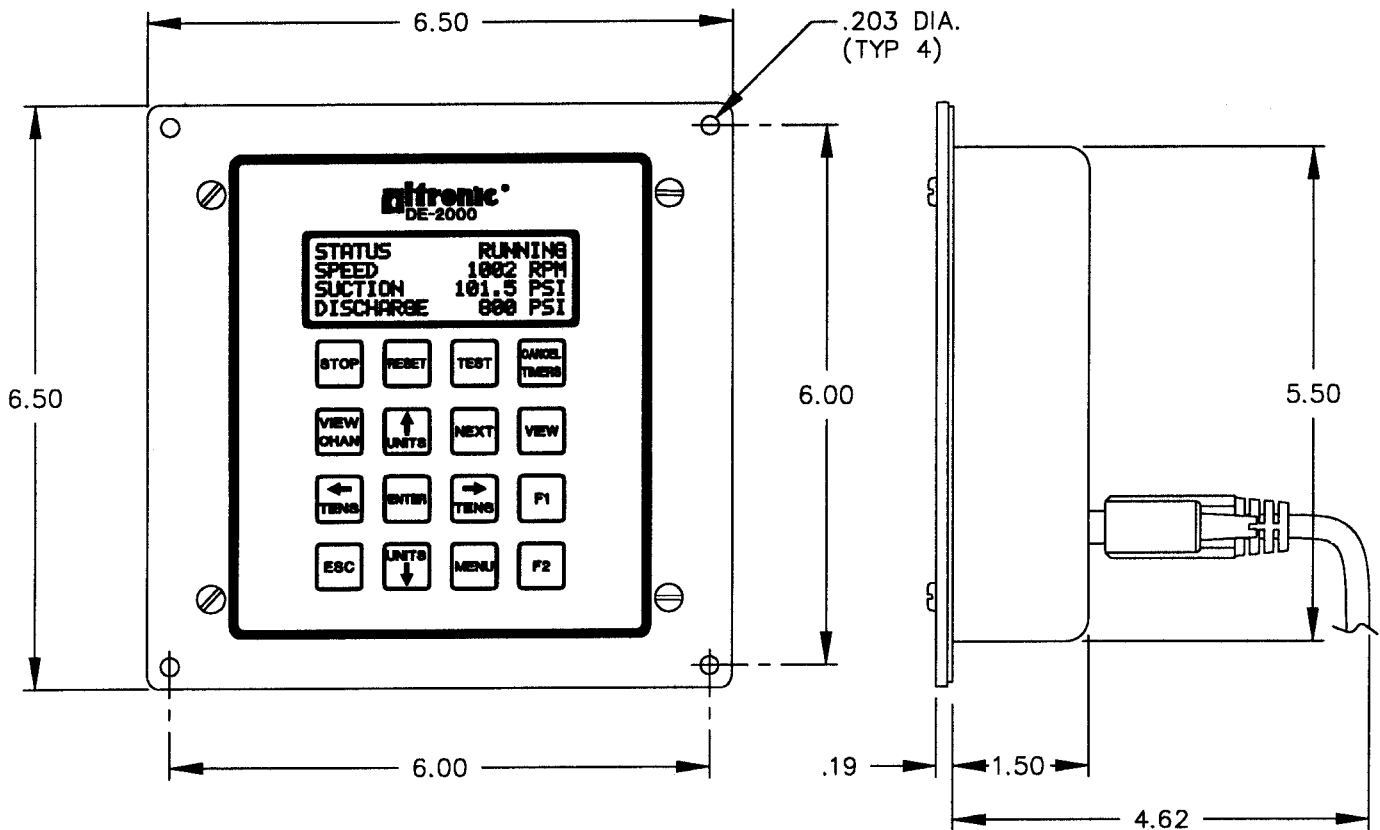
WIRING DIAGRAM - RS-485 COMMUNICATIONS

WIRING DIAGRAM - PERSONAL COMPUTER

SYSTEM OVERVIEW - DE-2000 ANNUNCIATOR SYSTEM



MOUNTING DIMENSIONS AND SPECIFICATIONS



SPECIFICATIONS:

POWER REQUIRED: DC POWERED 12-24 VDC, 5 WATTS TYPICAL
10 WATTS MAXIMUM.

INPUTS: 32 + 4 DISCRETE SWITCH INPUTS EITHER NORMALLY
OPEN OR NORMALLY CLOSED.
REMOTE RESET AND REMOTE STOP.
ACCEPTS DSG SERIES GAUGES ON POINTS 10-47 AND
DSM SERIES INSTRUMENTS ON POINTS A-D.

OUTPUTS: UP TO FOUR STANDARD DIGITAL OUTPUT MODULES
OR AN ALTRONIC IGNITION SHUTDOWN AND
FUEL VALVE TRIP OUTPUT MODULE (691124)
AND TWO STANDARD DIGITAL MODULES.

DISPLAY: 4 X 20 LCD CHARACTER DISPLAY WITH LED BACKLIGHT.

TIME KEEPING: REAL TIME CLOCK AND CALENDAR WITH
BATTERY BACKUP.



SCAN RATE: SCANS ALL 36 DISCRETE SWITCHES PLUS
REMOTE RESET AND STOP 15 TIMES/SECOND.

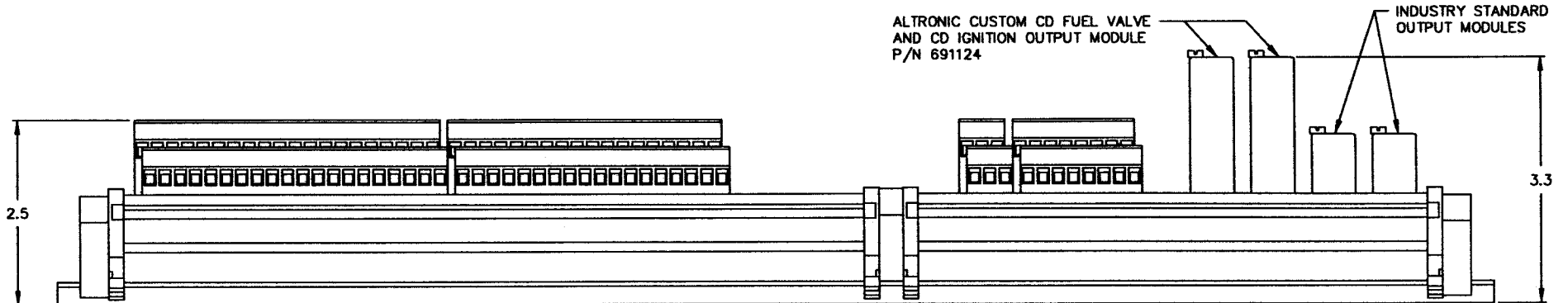
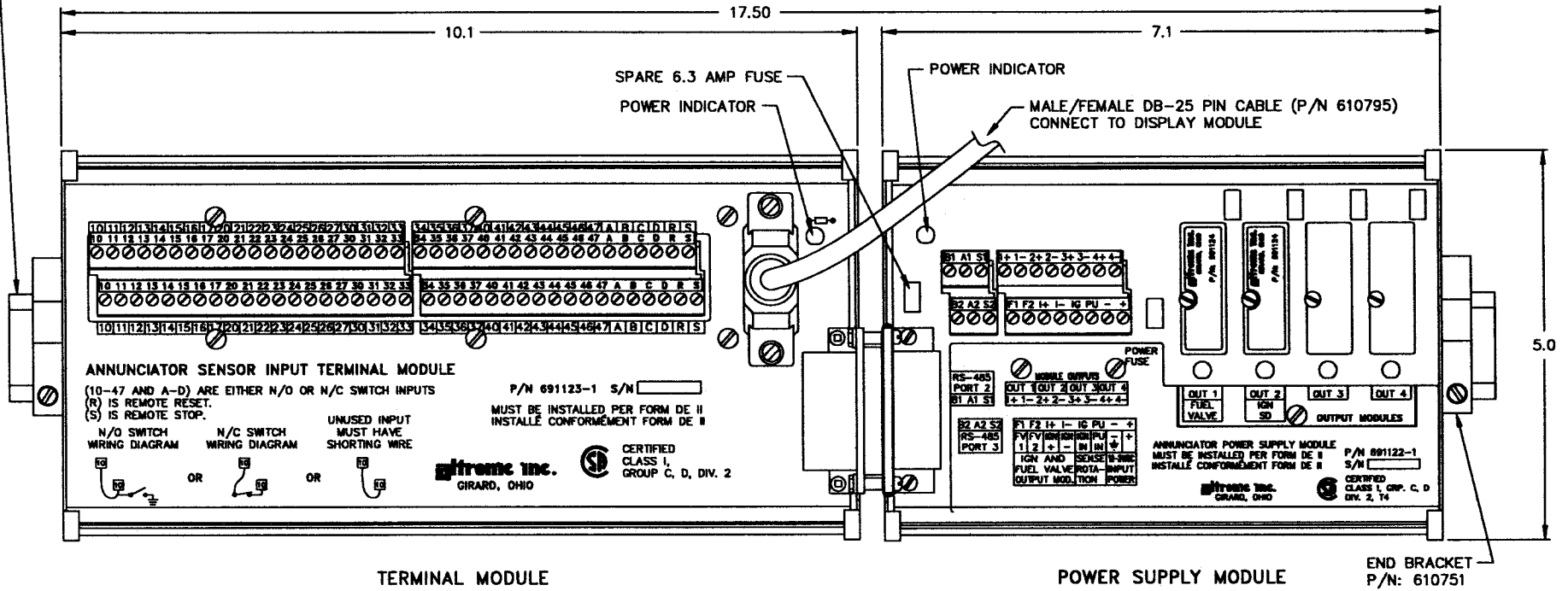
OPERATING TEMPERATURE RANGE: -35°C TO +80°C (-31°F TO 176°F).

COMMUNICATIONS: 2 EACH RS-485, CONNECTION ON POWER SUPPLY.
1 EACH RS-232, CONNECTION ON DISPLAY MODULE.

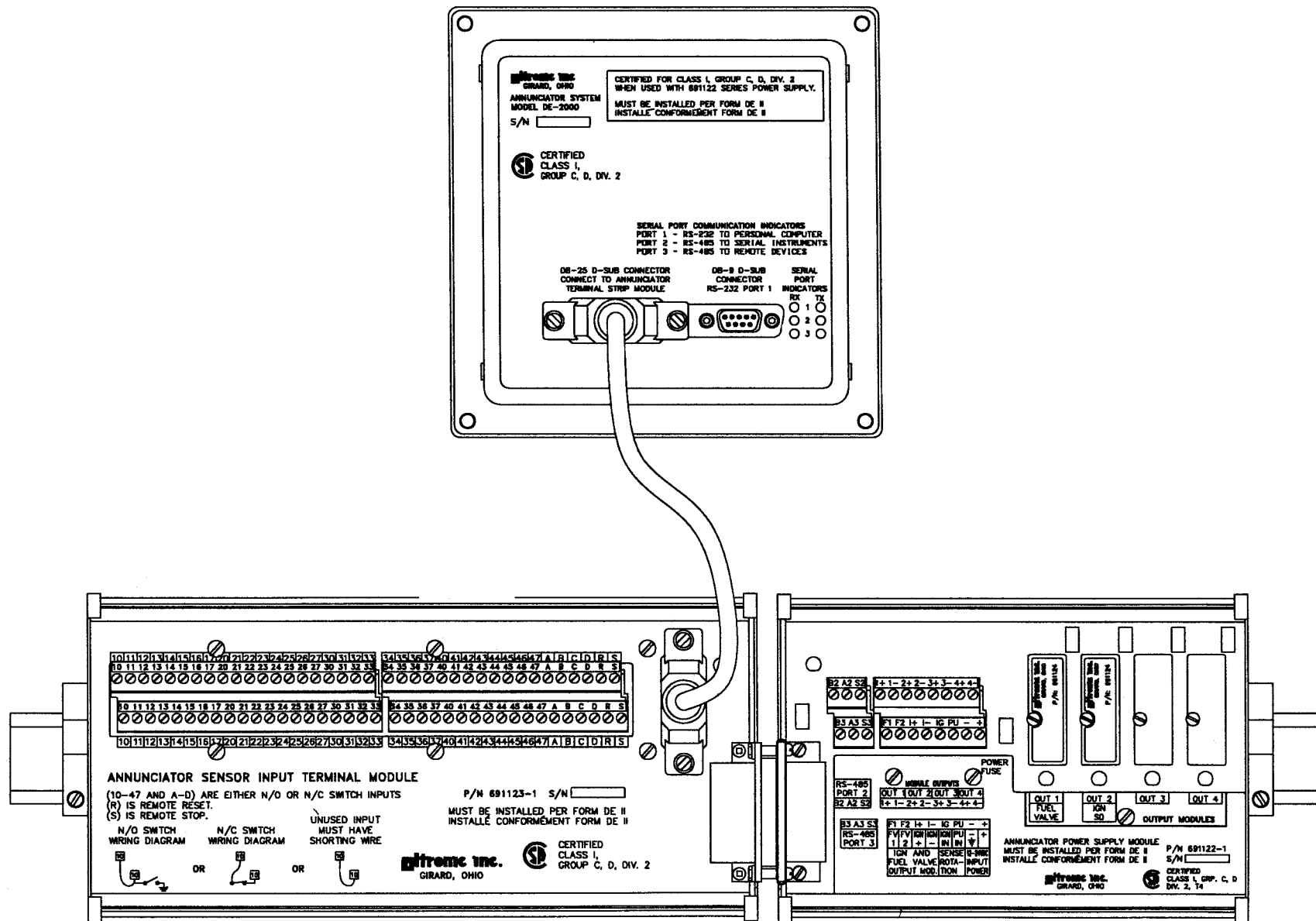
HAZARDOUS AREA CLASSIFICATION: CLASS 1, GROUP C, D, DIV. 2, T4.

DE-2000 TERMINAL MODULE AND POWER SUPPLY MODULE

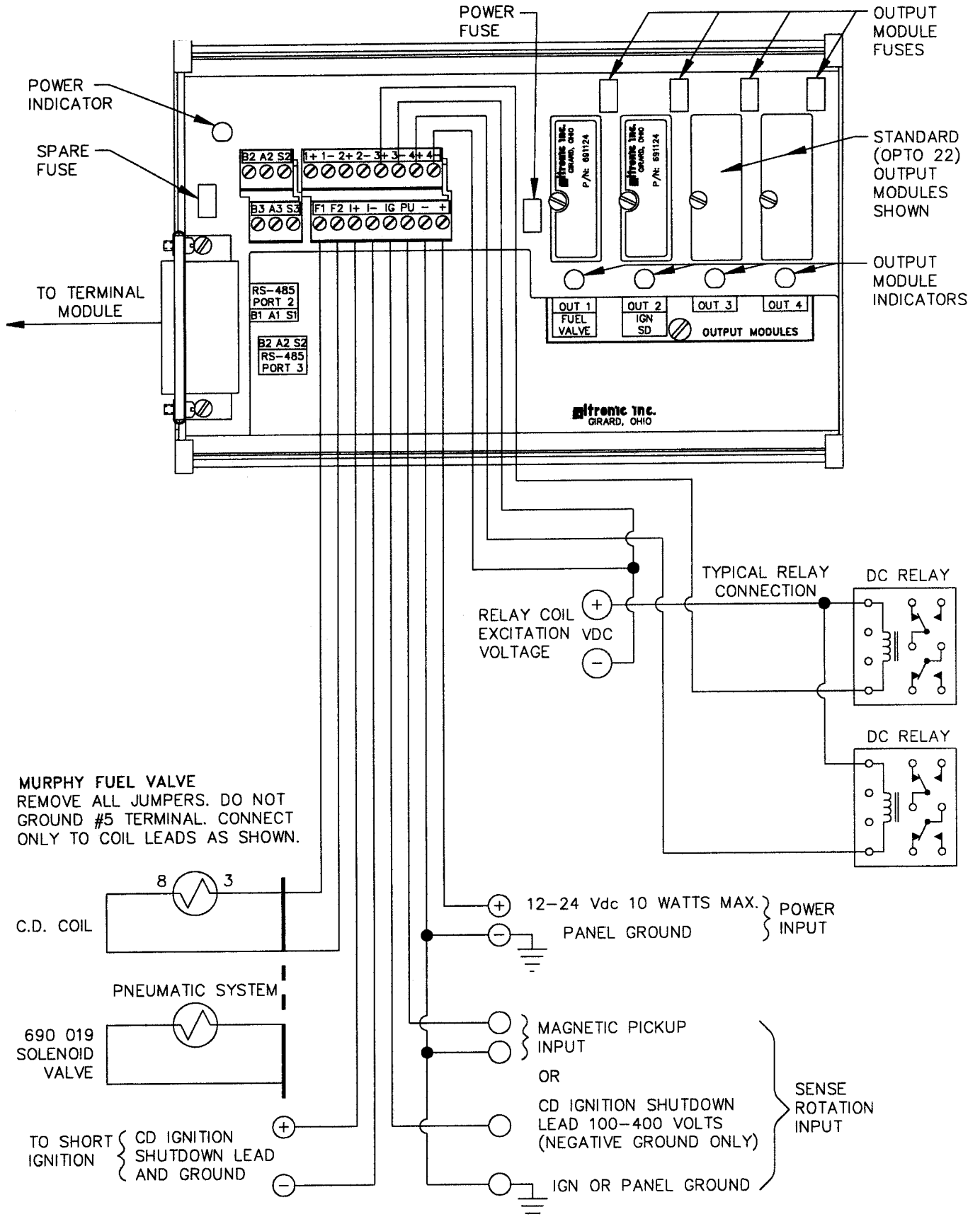
MOUNTING RAIL: TERMINAL AND POWER SUPPLY MODULES CAN BE SNAPPED ONTO THE COMMERCIALY AVAILABLE 32 OR 35 mm DIN MOUNTING RAILS  OR  (SIDE PROFILES).



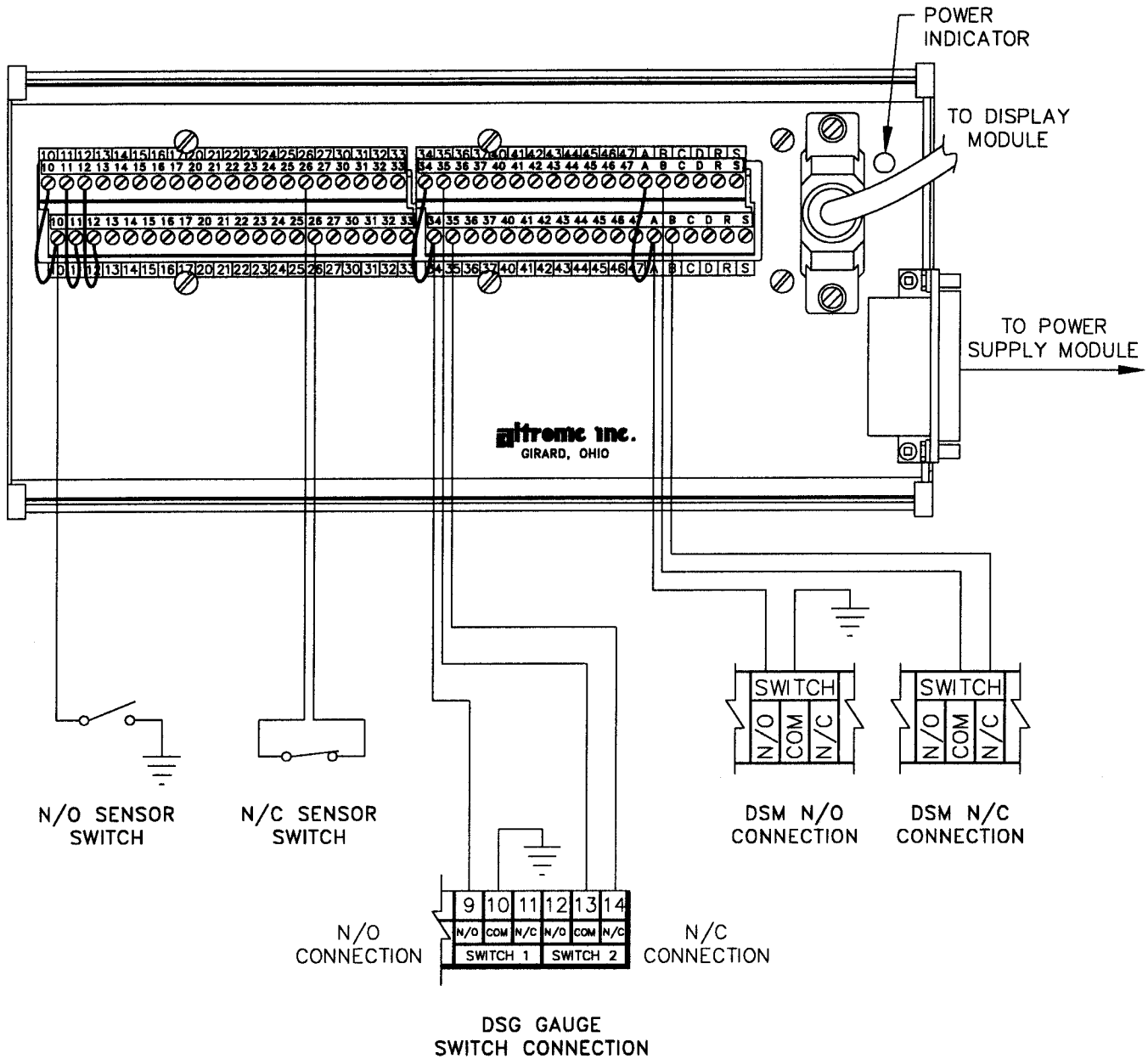
WIRING DIAGRAM - GENERAL HOOK-UP



WIRING DIAGRAM - POWER SUPPLY MODULE



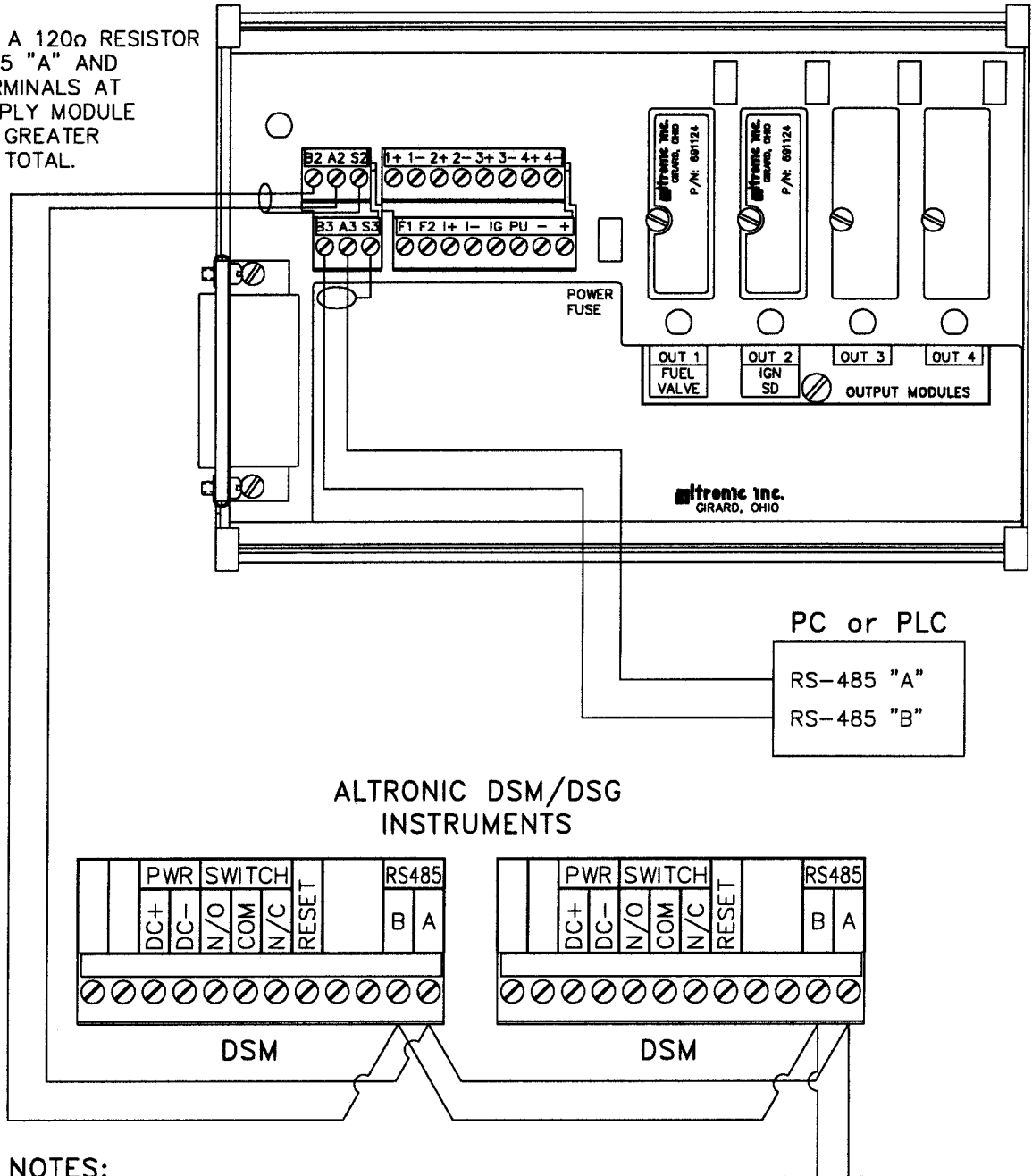
WIRING DIAGRAM – TERMINAL MODULE



- NOTE: 1. N/O SENSOR SWITCH MUST HAVE JUMPER IN PLACE BETWEEN TOP ROW AND BOTTOM ROW OF TERMINAL BLOCK. POWER SUPPLY MINUS AND SENSOR GROUND MUST BE AT GROUND.
2. N/C SENSOR SWITCH, REMOVE JUMPER AND PLACE SWITCH WIRES, ONE IN TOP ROW OTHER IN BOTTOM ROW.
3. ALL UNUSED INPUTS MUST HAVE JUMPER WIRE IN PLACE.
4. SENSOR INPUTS A-D ARE FOR ALTRONIC DSM MONITORS, CONNECT THE OUTPUT SWITCH, EITHER N/O OR N/C, IN THE SAME MANNER AS SWITCHES 10-47.
5. REMOTE RESET (R) AND REMOTE STOP (S) ARE WIRED SAME AS OTHER SWITCHES. STOP OVERRIDES RESET.

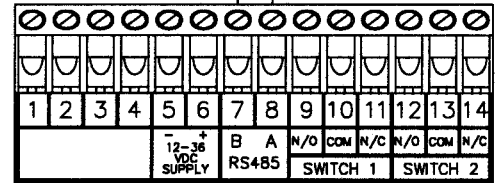
WIRING DIAGRAM - RS-485 COMMUNICATION

NOTE: CONNECT A 120Ω RESISTOR BETWEEN RS-485 "A" AND RS-485 "B" TERMINALS AT THE POWER SUPPLY MODULE FOR WIRE RUNS GREATER THAN 500 FEET TOTAL.



NOTES:

1. USE SHIELDED CABLE FOR RS-485 CONNECTIONS. CONNECT SHIELD AT POWER SUPPLY MODULE ONLY.
2. EACH DSM/DSG INSTRUMENT MUST HAVE A UNIQUE NODE NUMBER. MAXIMUM 32 NODES.
3. TO MINIMIZE UNWANTED REFLECTIONS ON THE RS-485 LINE, THE WIRES SHOULD BE HOOKED-UP FROM ONE INSTRUMENT TO THE NEXT IN A DAISYCHAIN FORMAT.



DSG

WIRING DIAGRAM – PERSONAL COMPUTER

