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Micro ADM™

Micro Arc Data Monitor

Operation / Installation Manual

Manual Part Number: A8M5022
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1.0 SYSTEM OVERVIEW

1.1 General Overview

The Micro ADM™ Sensor (A3A0226) is a lightweight; compact, multi-sensor unit designed for monitoring, Parameter Testing and telemonitoring service purposes in a welding environment. The Micro ADM™ Transducer includes an embedded micro-controller to provide the necessary data acquisition, signal processing and communications firmware to allow remote logging/testing of the following basic welding parameters.

- Arc Current
- Arc Voltage
- Wire Feed Speed
- Shielding Gas Pressure

The light weight, easy to install design allows the user to install the Micro ADM™ at the wire drive motor inlet using industry standard quick disconnect conduit fittings or to a fixed surface with the optional mounting brackets (A2A0025). The LED indicators provide the operator or maintenance personnel with a quick visual indication of sensor activity.

The unit is powered by a user supplied external 24 VDC power source via the sensor interface cable (A3W0327). This cable also provides an RS-485 Full-Duplex serial communications port to an external system (data acquisition or PLC). A second Remote I/O cable (X3W5102) is provided to allow an external PLC/Robotic controller to control and monitor the sensors' embedded fault testing routines.

1.2 General Specifications

Listed below are the general system specifications:

Dimensions:	3.81" H x 5.38" W x 5.25" L (97mm x 137mm x 133mm)
Weight:	2.7 lbs (1.2 kg)
Power Input:	24 vdc @ 0.2 amp, ripple 200 mv
Operating Temp:	-12°C to +60°C
Remote Input:	5 – 24 vdc @10ma current limited
Remote Outputs:	Non isolated 24 vdc @ 75 ma Sourcing Open emitter Transistor output with current limit
Serial Communication	Modbus™ RTU slave mode protocol

1.3 Sensor Specifications

Current Sensor	
Current range	0-600 A (DC)
Relative precision on Range	± 1%
Max Linearity error	± 0.9 % of reading
Band Width at ±1db	2.5 Khz

Voltage Sensor	
Voltage range	0-100 V (DC)
Relative precision on Range	± 1%
Max Linearity error	± 0.5 % of reading
Band Width at ±1db	2.5 Khz

Pressure Sensor	**English Units**	**Metric Units**
Pressure range	2.5 – 14.5 PSI	15 – 100 Kpa
Relative precision on Range	± 3%	± 3%
Max Linearity error	± 1.8 % of reading	± 1.8 % of reading
Band Width at ± 1db	250 Hz	250 Hz

Wire Speed Sensor	**English Units**	**Metric Units**
Wire diameter (min/max)	.030 - .062 inch	0.8 mm / 1.6 mm
Speed range	10 – 1000 ipm	4 – 420 mm/s
Relative precision on Range	± 3%	± 3%

2.0 INSTALLATION

2.1 General Guidelines

The Micro ADM™ can be mounted two different ways. It can be installed at the wire feeder using the quick disconnect fittings or mounted to a fixed surface. Listed below are some things that should be taken into consideration when selecting a place and method for mounting of the Micro ADM™:

- Mount the Micro ADM™ in a location that is convenient for installation of the welding wire and will not cause any binding of the wire or the wire liner. It is recommended that the Micro ADM™ be mounted as close to the wire feeder as possible (**not to exceed 1 meter**).

- The Positive welding cable must pass through the Micro ADM™ sensor opening. Make sure that there is no stress on the sensor as a result of movement of the welding cable.

- The Shielding Gas line must be attached to the gas inlet of the sensor. Consideration must be given to the routing of the Shielding Gas hose to prevent any restriction of gas flow.

- The Sensor cable must be mounted in such a manner as to prevent stress on the sensor cable connector.

- The two 18 gage conductors supplied with the Micro ADM™ are used to provide the + and – of the Voltage Sense. These conductors must be routed so as not to produce stress on the Voltage Sense terminal strip.

- When mounting the Micro ADM™, position it so the operator or maintenance personnel can see the sensor LEDs if possible.

- If using the optional mounting brackets to mount the Micro ADM™, an insulating liner must be used for support of the wire from the sensor to the back of the wire feeder inlet guide.

2.2 Sensor Installation Guidelines

Installation of the Micro ADM™ is a simple 5-step process regardless of the selected mounting method.

1. Feed the Positive welding cable through the Micro ADM™ Current Sensor opening. The diameter of the opening will accommodate a 22 mm cable. If the crimp terminal is too large to fit through the opening then it must be removed and another terminal installed after the cable is passed through the opening.

2. Feed the wire through the Micro ADM™ Wire Feed Speed Sensor inlet. Push down on the pressure release lever located on the top of the sensor while feeding the wire through the guide rollers and out the other side of the sensor. Feed the wire into the wire drive motor as you would normally. If using the quick disconnect fittings to mount the sensor, connect one end to the wire drive motor quick disconnect fitting. Insert the wire liner quick disconnect fitting into the other end of the sensor. *If using the* ***optional mounting brackets****, install the sensor at the desired location. Install an insulated wire liner or conduit assembly (Maximum length of 1 meter) for support of the wire from the Micro ADM™ to the wire feeder inlet.*

3. Connect the Shielding Gas line to the Micro ADM™ Gas inlet. A barb T-fitting is provided to facilitate the installation of the Gas Line. Cut the Gas hose and install each end on to the 1/8" NPT 90° elbow. User to supply the necessary adaptor. Make sure to check for gas leaks after the hose clamps are installed.

4. Use the two Conductors (18 gage, 600V) provided with the Micro ADM™ Sensor to connect the Micro ADM™ Voltage Sensor to the welding system. Route the RED conductor (3' long) from the Positive (+) terminal of the Voltage Sense Terminal block to the Positive welding cable connection point (at the Torch or Wire Feeder). Route the BLACK conductor (25' long) from the Negative (-) terminal of the Voltage Sense Terminal block to the Negative welding cable connection point (at the Work piece ground point).

5. To connect the Sensor Cable (A3W0327) to the Micro ADM™, insert the connector into the Micro ADM™ Sensor Cable receptacle until it "Clicks" and locks into place. Connect the other end to the appropriate weld data acquisition system or PLC. To remove the Micro ADM™ Sensor Cable, pull back on the locking barrel of the connector plug while pulling the plug from the receptacle. A diagram of the connections for the cable can be found in Appendix B.

2.3 Configure ModBus™ Device ID

Two BCD switches are provided to allow external definition of 0 to 247 ModBus addresses. Prior to operation the user must set the desired Device ID number for the ModBus communications. Each address must be unique. To set the Device ID remove the Black hole plug from the bottom of the unit. Locate the LSB and MSB rotary switches. Set the binary address by rotating the switches to the desired address. The Switch is Binary encoded and has a range of “0 - F”. Reinstall the hole plug after setting the Device ID number. The maximum Device ID is restricted to 247 as specified by the ModBus Protocol standard. See Appendix D for Device ID MSB and LSB Decode Table.

3.0 OPERATION

3.1 Arc Detection

“Auto Arc On” is not available if firmware is Version 2.31 and later.

If the “Auto Arc On” mode is enabled the sensor will use the Arc Voltage and Current to determine when to log welding data. Both parameters must exceed the user defined threshold values to set an “Arc On” condition. When the Voltage or Current falls below the user specified value the sensor would set an “Arc Off” condition and stop data logging. The user must activate this input by setting the corresponding mode via the serial communication port.

If the “Auto Arc On” mode is disabled the user can force a arc on condition by asserting the “Remote Arc On” input. This signal is the “Black” wire provided in the sensor serial communication cable P/N A3W5042. Asserting a 5-24 VDC signal from the common (Grey) and the remote arc on input (Black) will force a sensor arc on condition.

3.2 Embedded Firmware

The embedded firmware has basic scaling and averaging capabilities as well as Slave mode ModBus RTU Communications protocol support. The sensor will provide user defined average and data collection mode to allow Run time and/or average data storage. The Run time data will be generated based on the averaging sample time specified by the user. The Raw analog data will be sampled at a 5 kHz rate. The Sensor will average 5 samples to produce a 1khz data rate for all analog sensors. The Wire feed conversion time will be based on the actual wire feed rate (16.6 Hz – 16.6 KHz).

Configuration of scaling and averaging parameters will be possible through the ModBus network port. The user may specify the number of samples (X) to be averaged before saving the data point in memory for later play back. The SENSOR will also generate a weld summary for each weld, which will be the average of all sampled data during the last weld cycle. The Data will be Date/Time stamped and stored in NV-RAM. Up to 1300 weld summaries may be stored before downloading. The sensor provides continuous averaging of the X most recent data values, and queries by the host system at lower frequencies of either last data value or last average value.

3.3 Host System Serial Interface

The sensor will provide a RS-485 compatible serial port and will support the ModBus RTU protocol. The Sensor default baud rate is 19.2K Baud.

The following is the general specification for the RS-485 port:

Serial Port Specification	Description
Physical support	Twisted Pair
Connector	Turck Eurofast 5 pin circular
Network	RS 485 – Full Duplex
Data exchange protocol	Modbus RTU

The RS-485 is a Turck Eurofast connector and will provide the RS-485 connections and the power to operate the sensor. The sensor provides a user configurable 120-ohm termination resistor for the RS-485 serial cable. The Host controller will provide the necessary power to operate the sensor. The power will be connected to the sensor through the RS-485 cable. The sensor requires an input voltage of 12 – 36 Vdc @ 3.6 watts. The sensor will provide polarity and over current protection. The sensor terminal connector Pin out is as follows:

Pin	Wire Color	Function
1	Brown	Sensor (12 – 24 vdc) Positive Input
2	White	Net_High RS-485 Signal High
3	Blue	Net_Low RS-485 Signal Low
4	Black	Remote Arc Active Input (5 – 24 vdc)
5	Grey	Sensor (12 – 24 vdc) Common
	Shield	Sensor Cable Shield – Not Connected at Sensor

4.0 Micro ADM™ MODBUS MEMORY MAP

4.1 General Description

This document provides the basic ModBus memory map and command structure for the Micro ADM™ RS-485 communications port. The Micro ADM™ supports the ModBus Protocol as specified in the Modicon Technical publications "ModBus Protocol" (intr7.html). The Micro ADM™ control does not support the Broadcast mode. The controller provides the slave side communications routines for the RTU mode. The user must define the Slave ID to a unique ID number from 1 – 247. Default Baud rate is 19.2 K baud.

4.2 Supported ModBus Commands

The following ModBus commands are supported:

CODE	DESCRIPTION	ADDRESS RANGE
01	Read Coil Status	0-15
03	Read Holding Registers	0-26
05	Force Single Coil	0-15
06	Preset Single Register	0-26
15	Force Multiple Coils	0-15
16	Preset Multiple Registers	0-26
17	Report Slave ID	5 bytes

4.3 Memory Map for Sensor

The following is the Coil definitions address 0-15:

COIL	ADDRESS	DESCRIPTION
1	0	Arc Active – Set when Weld Arc is detected
2	1	Save Average Data – When set Weld Summary Data is stored in NVRAM
3	2	Clear Summary Counter – When set the Average Data Counter is reset to 0 and Average Memory is cleared
4	3	Clear Part Fault Counter – When set the Fault Counter will be reset to 0
5	4	Enable Metric units of measure. When set the sensor use metric units of measure. (Wire = mm/sec; Gas = kpa)
6	5	Enable Auto Arc Detect – When set the Arc On condition is detected by sensing the arc voltage and arc current. When cleared the sensor can be forced into an arc on condition by asserting CR 1.
7	6	Read Memory – When set the Weld Summary data specified by Register 19 will be read into Register 2-12. Coil will be reset when summary has been loaded. Function is executed only

		when the arc is off.
8	7	Set Clock – When set the Date and Time values set in Register 7 – 12 will be loaded to the Real Time Clock. The Coil will be reset after the RTC is set. This function will only execute when the arc is off.
9	8	Learn Mode Enabled – When set the user defined Learn input is active.
10	9	New Part Enabled – When set the user New Part Input is active.
11	10	AAD Fault – When set the sensor has detected an Accumulated Arc Density Fault condition. This output will only be set when the weld is complete or when the part input is cleared.
12	11	TIME Fault – When set the sensor has determined an arc time fault has occurred. If set when the Part input is cleared the sensor indicates an accumulative arc time fault for the part.
13	12	VOLT Fault – When set the sensor has detected a volt parameter fault during the previous weld. If set when the Part input is cleared it indicates an arc density fault has occurred.
14	13	AMP Fault – When set the sensor has detected an amp parameter fault during the previous weld. If set when the Part input is cleared it indicates an arc density fault has occurred.
15	14	GAS Fault – When set the sensor has detected a gas pressure fault during the previous weld.
16	15	WIRE Fault - When set the sensor has detected a wire speed parameter fault during the previous weld. If set when the Part input is cleared it indicates a total volume applied fault has occurred.

The following is the Register definitions address 0-26:

REGISTER	ADDRESS	DESCRIPTION
1	0	Arc On Status – When the arc is active the value will be greater then 1. When the arc is off the value will be 0
2	1	Arc Time – Weld on timer in 0.1-second intervals. Value is incremented during a weld cycle and measures the Arc On time for each weld. When the weld cycle is complete the total time for the weld will be set. (Note 100 = 10.0 sec)
3	2	Volts – During the Arc on Time the value represents the actual arc voltage. The value is in 0.1-volt increments (100=10.0 volts). When the weld cycle is complete the value will be the statistical average for the last weld.
4	3	Amps- – During the Arc on Time the value represents the actual arc current. The value is in 1amp increments (100=100 amps). When the weld cycle is complete the value will be the statistical average for the last weld.
5	4	Gas Pressure - – During the Arc on Time the value represents the actual gas pressure. The value is in 0.1 PSI or 1KPa increments (100=100Kpa/10.0 PSI). When the weld cycle is complete the value will be the statistical average for the last weld.
6	5	Wire Speed - – During the Arc on Time the value represents the actual wire feed speed. The value is in 1-

		mm/sec increments (100=100 MM/Sec/100 IPM). When the weld cycle is complete the value will be the statistical average for the last weld.
7	6	RTC BCD SEC:MIN – The value is the arc start SEC:MIN based on the Real Time Clock. This value is set when an arc on condition is detected. (MSB = seconds; LSB = Minutes)
8	7	RTC BCD HR:DAY - The value is the arc start Hour and Day based on the Real Time Clock. This value is set when an arc on condition is detected. (MSB = Hour; LSB = Day)
9	8	RTC BCD MN:YR - The value is the arc start Month and Year based on the Real Time Clock. This value is set when an arc on condition is detected. (MSB = Month; LSB = Year)
10	9	Arc Time Mean – Arc Time mean value for in-process limits
11	10	Arc Voltage Mean – Voltage mean value used for in-process limits.
12	11	Arc Current Mean – Amperage mean value used for in-process limits.
13	12	Gas Pressure Mean – Gas pressure mean value used for in-process limits.
14	13	Wire Speed Mean – Wire speed mean value used for in-process limits.
15	14	Spare – Not Used
16	15	Weld Count – Total number of weld since last reset. If weld counter reaches the max count of 65535 the counter will reset to 0.
17	16	Weld Summary Count – Value indicates the number of weld summaries stored in memory (Max Count = 500).
18	17	Part Fault Counter – Total number of faulted parts since last fault count reset.
19	18	Read Weld Number – the value is used to select the stored Summary data to be read from memory to Register 2-12. Range of Value 1-500.
20	10	Arc On Amps – The value set in this Register is the welding current that must be exceeded to establish an arc on condition. Value is in 1-amp increments (10 = 10 amps).
21	20	Arc On Volts – The value set in this Register is the welding voltage that must be exceeded to establish an arc on condition. Value is in 0.1-volt increments (100 =10.0 volts).
22	21	SAMPLE COUNT: TIME Sigma – The MSB byte indicates the number of raw data samples to average to produce a single sample value as stored in Register 3-5. The LSB byte sets the Arc Time sigma value used by sensor for process limits Setting the Sigma value to 0 will disable the test function. (Arc Time Sigma = LSB/24; i.e. 55 =2.29)
23	22	VOLT: AMP Sigma – The MSB byte sets the Voltage sigma value used by the sensor for process limits. The LSB byte sets the Amp sigma value used by sensor for process limits Setting the Sigma value to 0 will disable the test function. (Sigma = MSB, LSB/24; i.e. 55 =2.29)
24	23	GAS: WIRE Sigma – The MSB byte sets the Gas Pressure sigma value used by the sensor for process limits. The LSB byte sets the Wire Speed sigma value used by sensor for process limits. Setting the Sigma value to 0 will disable

		the test function. (Sigma = MSB, LSB/24; i.e. 55 =2.29)
25	24	DENSITY: VOLUME Sigma – The MSB byte sets the Arc Density sigma value used by the sensor for process limits. The LSB byte sets the Weld Volume sigma value used by sensor for process limits. Setting the Sigma value to 0 will disable the test function. (Sigma = MSB, LSB/24; i.e. 55 =2.29)
26	25	DELAY: WELDS – The MSB byte sets the start/end Test delay time. The value is in 0.1 second increments and sets the delay time from arc start to begin testing and the end time, prior to arc off, to stop testing. The LSB indicates the number of welds per part. This value is set during the learn mode.

The following is a summary of the Report Slave ID and Status (Code 17) Response Data fields:

Byte	Contents
1	Sensor ID Number =10 Hex (Version 1, Rev0)
2	Run Indicator (0=OFF, FF=On)
3	Status Byte Bit 0 = Ram Full Bit 1 = Battery Ok Bit 2 = Self Test Ok Bit3-7 = 0
4	Firmware Version Number – BCD Format (MSB = Major: ISB = Minor)
5	Firmware Version Number – BCD Format (MSB+LSB = Release)

4.4 Coil Definitions and Operation

The Micro ADM™ has 16 simulated output coils. These coils are used as internal bit flags to perform specific functions. Only 1-8 of the simulated coils is used. Setting the coils 8-16 will not have any effect on the Micro ADM™ controller. However, they are reserved for future expansion. The Micro ADM™ supports both single and group force coil commands. Refer to Section 4.3 for summary of the Coil functions.

To clear the Micro ADM™ weld and average counters or reset the total arc timer, force the specific coil to the “ON” condition. The Micro ADM™ will clear the requested counter or timer and then reset the coil to the “OFF” condition signifying a successful operation.

To disable the auto arc on detection mode force coil 2 to the “ON” condition. When set the Micro ADM™ will only log data when the remote on input is active. To allow normal arc on detection Coil 2 must be in the “OFF” condition.

To set the Real time clock perform the following steps:

1. Set Coil 2 to the “ON” condition to disable automatic arc detection.

2. Load the BCD formatted Time and Date into the value Registers 6-12.

3. Set Coil 8 to the “ON” condition. The Micro ADM™ will clear the coil after completing the function.

4. Enable Coil 2 to resume automatic arc detection.

To read a stored weld data summary perform the following steps:

1. Set Coil 2 to the “ON” condition to disable automatic arc detection.

2. Load the desired weld summary number into Registers 19. This value must be equal to or less than the total number of saved welds as indicated by Register 17.

3. Set Coil 6 to the “ON” condition. The Micro ADM™ will load the stored data into Registers 2-12 and will clear the coil after completing the function. The data will remain in the register until the next arc on or stored weld request.

4. Enable Coil 2 to resume automatic arc detection.

4.5 Register Definitions

Register 1: Used to indicate when a welding arc has been detected. When this register is a 1 the Micro ADM™ controller is updating the welding parameters with new measured values.

Register 2–6: Contains the current value for each of the welding parameters: The following table shows the value and units of measure for each weld parameter register:

REGISTER	MEASURED PARAMETERS	UNITS OF MEASURE
2	Arc On time – Time in 0.1 seconds from arc detection	(Value /10) sec.
3	Arc Voltage – Voltage measured by Volt sensor	(Value/10) vdc
4	Arc Current – Welding amps measured by Hall Sensor	Value = Amps DC
5	Gas Pressure – Shielding Gas pressure from Torch	(Value * 0.1)=Kpa (psi)
6	Wire Speed – Linear wire speed measured by encoder	Value = mm/sec (ipm)

When the Arc is in the off condition the Registers will display the statistical average for the last weld.

Registers 7-9: Contains the BCD coded Time and Date at the start of the last weld. These registers will only update when a new weld is detected or a weld summary is loaded from memory. The Time and Date parameters are in BCD format. The low nibble is the 1's units and the upper nibble is the 10's units.

> **Note:** When setting the Real time Date and Time the values loaded into the Registers 7-9 must be in a BCD format.

Register 10–14: Used to indicate the statistical mean values as calculated during the Learn Mode for each weld within the learned part. The value is an integer value and represents mean value that is used with the sigma value to set the upper and lower control limits for parameter testing. These values have the same scaling as Register 2-6 (see above table).

Register 15: Spare Register - Not used at this time.

Register 16: The current weld count since the last weld count reset. This counter is incremented when the total arc time for a weld is greater then 0.5 seconds. This prevents false arc starts from being counted as a valid weld.

Register 17: Indicates the number of weld summaries stored in the weld memory. The maximum number of welds stored is 1024. Writing a new value to this register will cause the next collected weld to be written to that weld number location. The Welds will only be saved if the Save Weld summary coil (2) has been set and the minimum weld time is greater than 0.5 seconds.

Register 18: This register sets the number of raw data points to be averaged to generate a single sampled value. The minimum value is 1 and the maximum value is 255. Setting this value to 0 will disable the Analog Data collection routines.

Register 19: This register is used to read a previously stored weld summary from memory. Set the desired weld summary number in this register then set the Read Weld Memory Coil 7. The value will be written to Register 2 – 12. Maximum value is 1024.

Register 20-21: These registers are used to specify the conditions required to establish an arc on signal. To set the auto arc on signal the Voltage and current sensor values must exceed both values stored in the these registers. If any single sensor input drops below this level the arc on signal will be reset.

Register 22-26: These registers are used to specify the process control limits used for in process monitoring. The MSB and LSB bytes are used as independent byte size variables and have a Byte size decimal range of 0-255.

5.0 Micro ADM™ ASCII TERMINAL MODE PROTOCOL

5.1 General Description

If the Device ID is set to zero when the power is applied then the Micro ADM™ Terminal mode is active and can be used to off-line program the user configurable parameters and operating modes. The protocol is a simple ASCII command string that allows the user to upload or download the various data. The user can use any terminal program to perform the programming function. All program command functions are case sensitive. The serial port is configured for the following data format:

- Baud Rate: 19.2K, Full Duplex
- Word Length: 8 Data Bits, One Stop and no parity
- Hand Shaking: None

5.2 TERMINAL PROTOCOL

The protocol consists of a command string and optional data bytes. The command string is an alpha character and an option number followed by a "=" or "?", followed by optional data and terminated with an ASCII "cr" (0dh). The "=" will indicate that data is being sent to the selected parameter by the host controller. The "?" will indicate a request for data from the Micro ADM™ to the host controller. If the host is sending data to the Micro ADM™ the data will be placed after the "=" character and will be an ASCII string terminated with an ASCII "cr" (0dh). The following is an example of reading a parameter value from the Micro ADM™:

From Host type: **V1? (cr)**
Response from Micro ADM™: **##**

Where: ## is the current value for the parameter and
(cr) is the enter key

The following is an example of how to modify a value in the Micro ADM™ using the terminal commands:

From Host type: **V1=#### (cr)**

Where: ## is the new value for the parameter and
(cr) is the enter key

The following is a summary of the two special command functions. They are used to set and read the Micro ADM™ Real Time Clock (RTC). To read the current Time type the following command:

From Host type: **T? (cr)**
Response from Micro ADM™: **hh:mm:ss**

Where: hh is the current hour, mm is the current minute and ss is the current second. (cr) is the enter key

To set the time (hour/minute/second) type: **T=10:17:35** (cr) Entire field must be completed as explained below:

Type 6:45 am as **T=06:45:00 (cr)**
Type 7:25 PM as **T=19:25:00 (cr)**

Note: *"cr" denotes carriage return (Enter)*

To read the current Date type the following command:

From Host type: **D? (cr)**
Response from Micro ADM™: **mn:dd:yy**

Where: mn is the current month, dd is the current day and yy is the current year, (cr) is the enter key

To set the date (year/month/day) type: **D=99/06/01** (cr). The Entire field must be completed as explained below:

Type February 4, 1999 as **D=99/02/04(cr)**
Type November 23, 2000 as **D=00/11/23(cr)**

Note: *"cr" denotes carriage return (Enter)*

5.3 TERMINAL COMMANDS

The following is a summary of the Terminal Commands supported by the Micro ADM™:

Command	DESCRITION	RANGE
C0	Voltage zero offset calibration value. (128 = 0 offset) Negative offset < 128 > Positive offset	0-255
C1	Current zero offset calibration value (128 = 0 offset) Negative offset < 128 > Positive offset	0-255
C2	Gas Pressure zero offset calibration value (128 = 0 offset) Negative offset < 128 > Positive offset	0-255
C3	Gas pressure Gain value (Gain = Value/32)	0-255
D	Sets or reads the Real Time Clock date parameters Format = YY/MM/DD	8 Bytes
T	Sets or Reads the Real Time Clock Time parameters Format = HH:MM:SS	8 Bytes
M0	ModBus Coils 1-8 Set/Read. Binary Bit's are set by decimal value. CR1=1, CR2=2, CR3=4, CR4=8, CR5=16, CR6=32, CR7=64, CR8=128	0-255
M1	ModBus Coils 9-16 Set/Read. Binary Bit's are set by decimal value. CR1=1, CR2=2, CR3=4, CR4=8, CR5=16, CR6=32, CR7=64, CR8=128	0-255
M2	Baud Rate – Sets the serial communications Baud Rate 0=38.4Kb, 1=19.2Kb, 2=9600buad, 3=4800 baud	0-3
M3	Sample Count – Number of raw samples to averaged for a single parameter sample	0-255
M4	Voltage Sigma value. When set to zero parameter testing is disabled. (Note: Sigma = Value/24)	0-255
M5	Amp Sigma value. When set to zero parameter testing is disabled. (Note: Sigma = Value/24)	0-255
M6	Gas Sigma value. When set to zero parameter testing is disabled. (Note: Sigma = Value/24)	0-255
M7	Wire Speed Sigma value. When set to zero parameter testing is disabled. (Note: Sigma = Value/24)	0-255
M8	Arc Density Sigma value. When set to zero parameter testing is disabled. (Note: Sigma = Value/24)	0-255
M9	Weld Volume Sigma value. When set to zero parameter testing is disabled. (Note: Sigma = Value/24)	0-255
M10	Start/End Test time value. The value specifies the delay time from Arc On to begin parameter testing and the time prior to arc off to stop all parameter testing.	0 – 25.5
M11	Number of welds per Part. This value indicates the number of welds per part as determined by the Learn mode.	
V1	Arc On Status – When the arc is active the value will be greater 1. When the New Part input is active, the value will be the calculated End Test time for the current weld. When the arc is off the value will be 0	0-65535
V2	Arc Time – Weld on timer in 0.1-second intervals. Value is incremented during a weld cycle. And	0-65535

	measures the Arc On time for each weld. When the weld cycle is complete the total time for the weld will be set. (Note 100 = 10.0 sec)	
V3	Volts – During the Arc on Time the value represents the actual arc voltage. The value is in 0.1 volt increments (100=10.0 volts). When the weld cycle is complete the value will be the statistical average for the last weld.	0-102.3
V4	Amps- – During the Arc on Time the value represents the actual arc current. The value is in 1amp increments (100=100 amps). When the weld cycle is complete the value will be the statistical average for the last weld.	0-1023
V5	Gas Pressure - – During the Arc on Time the value represents the actual gas pressure. The value is in 1KPa increments (100=100KPa). When the weld cycle is complete the value will be the statistical average for the last weld.	0-2032
V6	Wire Speed - – During the Arc on Time the value represents the actual wire feed speed. The value is in 1-mm/sec increments (100=100 MM/Sec). When the weld cycle is complete the value will be the statistical average for the last weld.	0-1000
V7	SEC:MIN – The value is the arc start Second:Minute based on the Real Time Clock. This value is set when an arc on condition is detected.	0-65535
V8	HR:DAY - The value is the arc start Hour and Day based on the Real Time Clock. This value is set when an arc on condition is detected.	0-65535
V9	MN:YR - The value is the arc start Month and Year based on the Real Time Clock. This value is set when an arc on condition is detected.	0-65535
V10	Arc Time Mean - This value is set during the learn mode for each weld on a part.	0-6553.5
V11	Volt Mean - This value is set during the learn mode for each weld on a part.	0-102.3
V12	Amp Mean - This value is set during the learn mode for each weld on a part.	0-600
V13	Gas Pressure Mean - This value is set during the learn mode for each weld on a part.	0-16.0
V14	Wire Speed Mean - This value is set during the learn mode for each weld on a part.	0-1000
V15	Spare Register – Not Defined	0-65535
V16	Weld Count – Total number of weld since last reset. If weld counter reaches the max count of 65535 the counter will reset to 0.	0-65535
V17	Weld Summary Count – Value indicates the number of weld summaries stored in memory (Max Count = 500).	0-1365
V18	Sample Count – Value indicates the number of raw data samples to average to produce a single sample value as stored in Register 3-5.	0-255
V19	Read Weld Number – the value is used to select the stored Summary data to be read from memory to Register 2-12. Range of Value 1-500.	0-1024
V20	Arc On Amps – The value set in this Register is the	0-1023

	welding current that must be exceeded to establish an arc on condition. Value is in 1-amp increments (10 = 10 amps).	
V21	Arc On Volts - The value set in this Register is the welding voltage that must be exceeded to establish an arc on condition. Value is in 0.1-volt increments (100 =10.0 volts).	0-102.3

6.0 Micro ADM™ Remote I/O User Interface

6.1 GENERAL DESCRIPTION

The Micro ADM™ AAD interface is comprised of three 24 VDC inputs and three 24 VDC sourcing outputs. INP1 *"Learn"* input is used to invoke a learn mode for the Micro ADM™. This input will allow the Micro ADM™ to monitor multiple parts and to establish the necessary control limits that will be used to verify production parts. The Micro ADM™ uses Accumulated Arc Density (AAD) to validate the welds and assure conformance to the base-line sampled group of parts.

The INP2 *"Part"* input is configured to allow the user to indicate when a part is being welded. This input must be asserted during the complete part cycle. The Micro ADM™ uses this input to establish when a new part is being welded. When the input is cleared the Micro ADM™ will perform a final analysis of all the welds made and set the pass/fail Part output signals. The pass-fail outputs will be set based on weld volume, weld counts and work-applied calculations.

The optional INP3 *"Group B"* input can be used to separate two weld groups within a single Part. When invoked the Group input signals the completion of the "Group A" welds and the start of the "Group B" welds. This input must be asserted during the complete *"Group B"* weld cycle. The Micro ADM™ uses this input to establish when the first "Group A" welds have been completed and the beginning of the "Group B" welds. When the input is asserted the Micro ADM™ will perform a final analysis of the entire first *"Group A"* welds and will assert the pass/fail Part output signals. The *"Group A"* pass-fail outputs will be set based on total weld volume, weld counts and total work applied for all of the Group A welds. When the "*New Part*" and the *"Group B"* input are cleared, at the end of the "*Group B*" welds, then pass-fail output will be asserted for the second "*Group B*" welds. The *"Group B"* pass-fail outputs will be set based on total weld volume; weld counts and total work applied for only the Group B welds. When using the *"Group B"* input the Micro ADM™ will generate automatic process control limits for all welds made for the first Group A welds and the second Group B welds. This input is used during the learn mode to build the control limits and weld counts for each weld group.

The three output signals are used to indicate the operational and pass-fail status for each weld and part. CR1 is the *"Part Complete"* output and is asserted when the user INP2 has been cleared and the Micro ADM™ has completed its Part evaluation routines. When INP2 is asserted the *"Part Complete"* (CR1) output is cleared. This output can be used to validate operation of the Micro ADM™ and to determine Part or Weld faults. When the *"Part Complete"* (CR1) output is cleared then any faults indicated will be based on individual welds. When the *"Part Complete"* (CR1) is asserted then the Fault indication will be the result of a Part totalize error. The second output CR2 provides a *"No Fault"* output. This output will be asserted when the each weld has terminated and no faults were

detected during the weld cycle. When the Cycle On input (INP2) is cleared the *"No Fault"* (CR2) output will be asserted if the AAD testing passed the established limits. The *"No Fault"* (CR2) output will always be cleared when a weld is detected. The Third output CR3 provides a *"Fault"* output. This out will be asserted when a fault has occurred during the active weld cycle. When the Cycle On input (INP2) is cleared the *"Fault"* (CR3) output will be asserted if the AAD testing failed the established limits. The *"Fault"* (CR3) output will always be cleared when a weld is detected. At the end of every weld and/or Part the *"No Fault"* CR2 or *"Fault"* CR3 output will be asserted.

6.2 OPERATIONAL DESCRIPTION

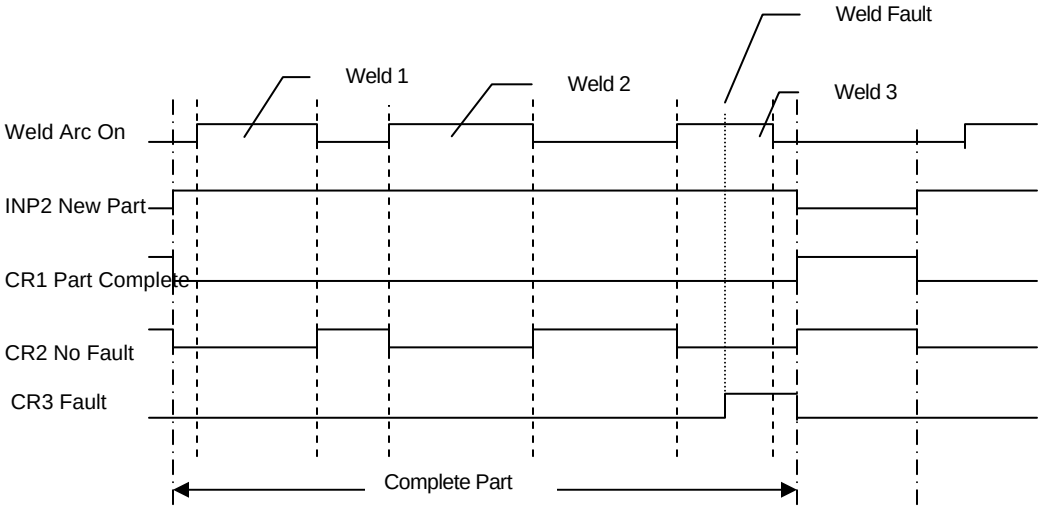
The normal operation of the Micro ADM™ requires a user provide *"INP2-New Part"* signal that must be asserted at the beginning of the part weld sequence. This input must be held during the complete part weld cycle. The Micro ADM™ will count and test each weld as the part is welded. Each weld will then be verified based on AAD process algorithms. If the optional *"Part B"* input is used the input must be reset prior to asserting the *"INP 2 - New Part"* signal and must be asserted at the end of the Part A weld cycle.

At the end of each weld the previous test status will be asserted by the *"CR2-NO Fault"* or *"CR3-Fault"* outputs. One of the two outputs will be set at the end of the weld. If a fault occurs during the weld cycle then the *"CR3-Fault"* output will be set at the first occurrence of the fault. The Status outputs CR2 and CR3 will be cleared when the next weld is detected.

The Micro ADM™ will count each valid weld and will internally load new Process limits for each weld event. The *"INP2-New Part"* signal is used to synchronize the weld counts. A min arc time for a valid weld is used to verify valid completion of a specific weld event. At the end of each weld event the Micro ADM™ will summarize and store the results of the previous weld to include average Volt, Amp, Wire Speed, Arc Time and Weld Number.

When the *"Part B"* is asserted or the *"INP2–New Part"* input is cleared the Micro ADM™ will calculate the total wire volume, work applied, spot heat and total number of welds on part. The result of the previous part data will be verified to the part control limits and the Part Status will be asserted on the Status outputs *"CR2–No Fault"* or *"CR3–Fault"*. The status condition will remain until the next *"INP2–New Part"* input is asserted.

The following is the Micro ADM™ I/O timing diagram:



6.3 SETTING PROCESS CONTROL LIMITS

The Micro ADM™ has a learn mode that is used to establish the Part and weld process control limits. This mode is used to calculate the required AAD limits and to establish the base-line weld data limits. The user must first validate the process parameters and be assured that the parts are conforming to applicable codes and design specification.

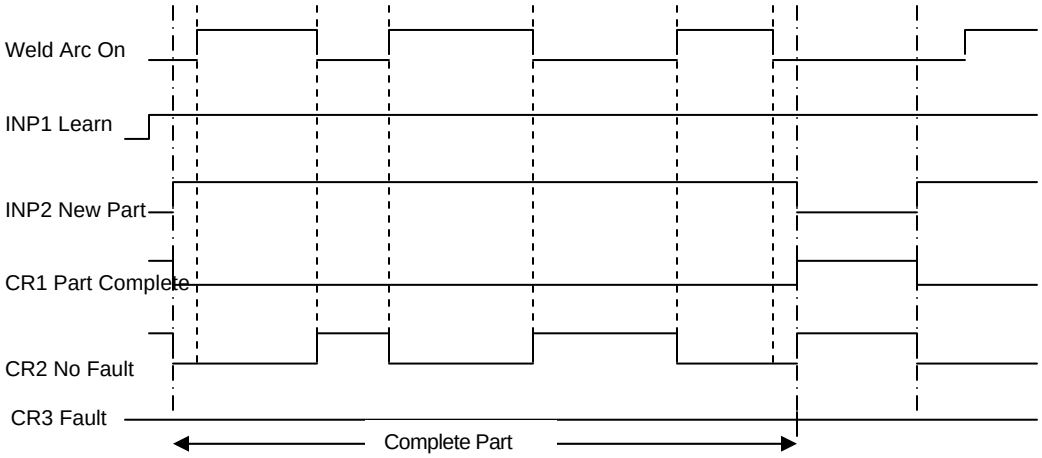
To activate the learn mode assert the INP 1 input. This input is a 24 VDC input and is an active high input. To activate the learn mode assert and maintain the INP1 input during the complete learn cycle. Weld 10 parts using the normal interface sequence. If the optional *"INP3 - Part B"* input is used, it should be asserted at the end of Part A welds and cleared when the *"INP2-New Part"* input is cleared, after completing the Part B welds.

The Micro ADM™ will assert the *"CR2-No Fault"* and *"CR3-Fault"* output will be cleared to indicate the learn mode. The *"CR2-No Fault"* output will be cleared during the arc on period then asserted when the arc is off. After processing 10 parts the Micro ADM™ will assert and hold the *"CR2-No Fault"* which will indicate completion of the Learn cycle. The user should than clear the *"INP1-Learn"* input. To terminate a learn cycle before completing the 10 parts the user will clear the *"INP1-Learn"* Input. The *"CR3-Fault"* output will be asserted indicating a learn mode fail.

Warning: *Clearing the learn mode prior to completing the 10 welds will result in all process limits being reset and inhibiting further testing until the part is re-learned.*

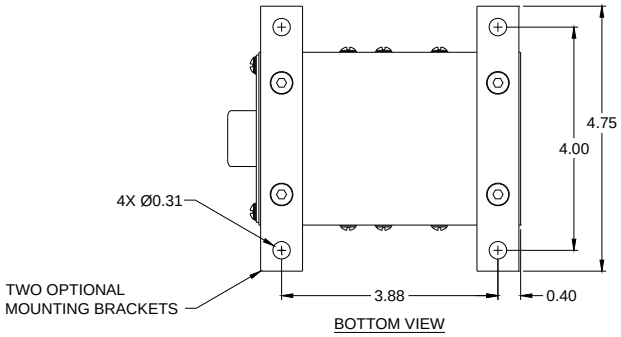
The *“CR3-Fault”* is reset when a new weld is detected or the “INP1-Learn” input is asserted. After completing the *“Learn”* the Micro ADM™ will not begin testing until the *“INP2- New Part”* has been cleared then asserted indicating a new part.

The following is the Micro ADM™ Learn Mode I/O timing diagram:

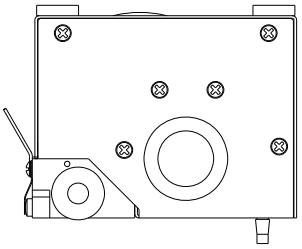


Appendix A Micro ADM™ Installation Specifications

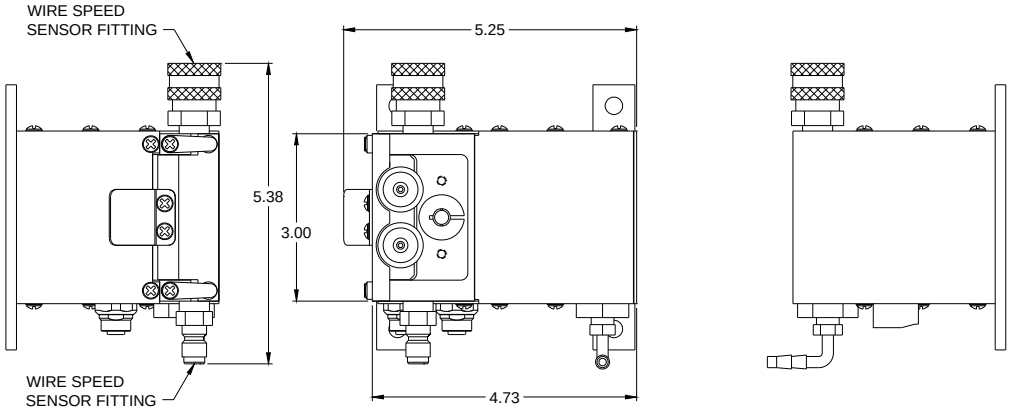
A.1 Micro ADM™ Sensor Mounting Dimensions



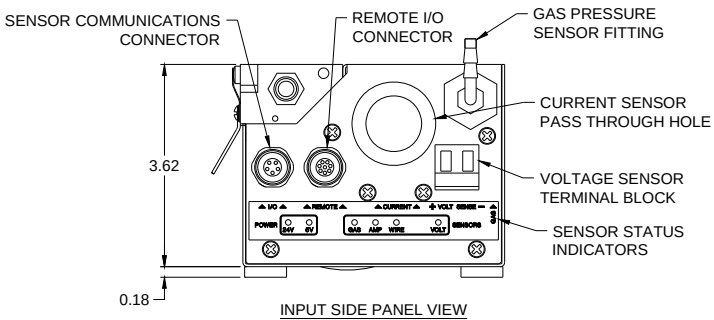
BOTTOM VIEW



OUTPUT SIDE PANEL VIEW

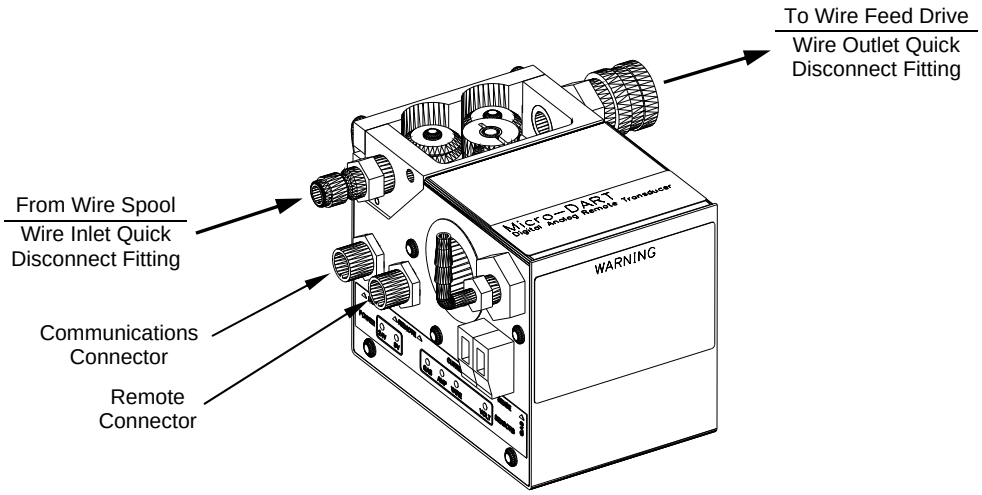


LEFT END VIEW TOP VIEW RIGHT END VIEW

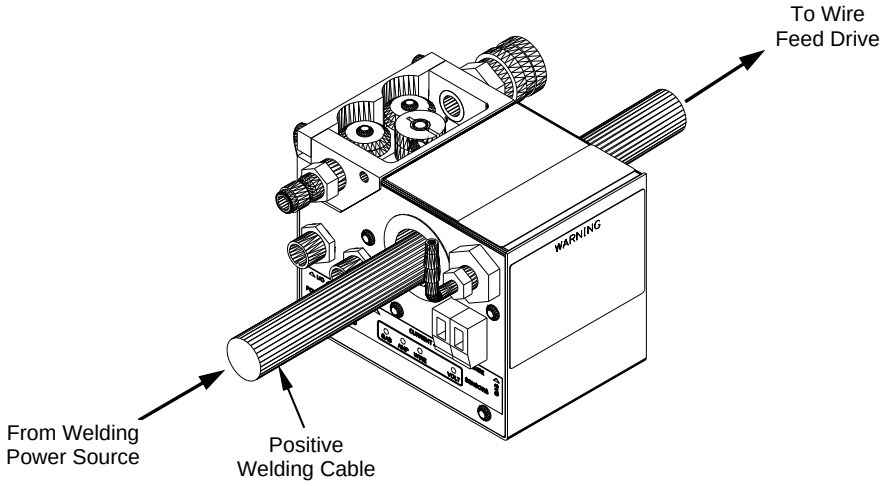


INPUT SIDE PANEL VIEW

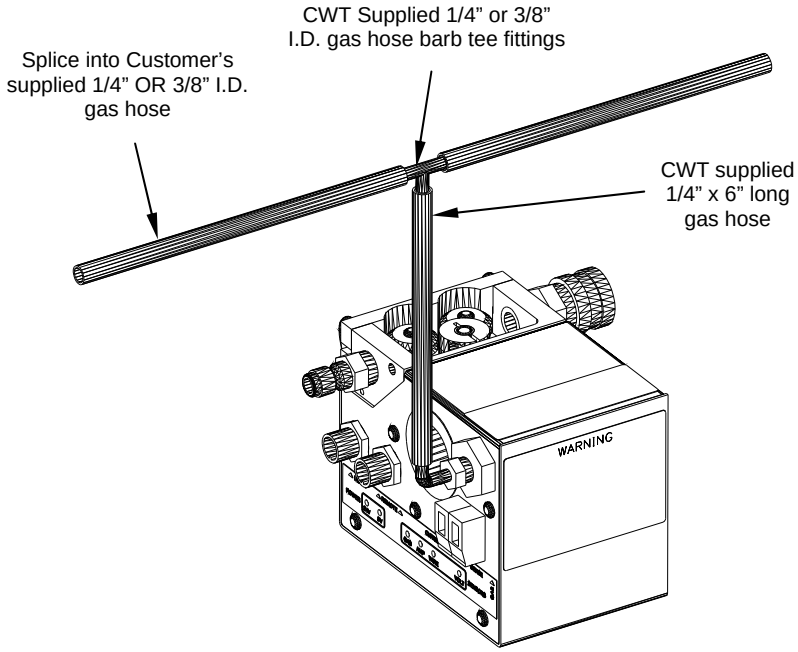
A.2 Sensor Cables and Wire Speed Sensor Installation



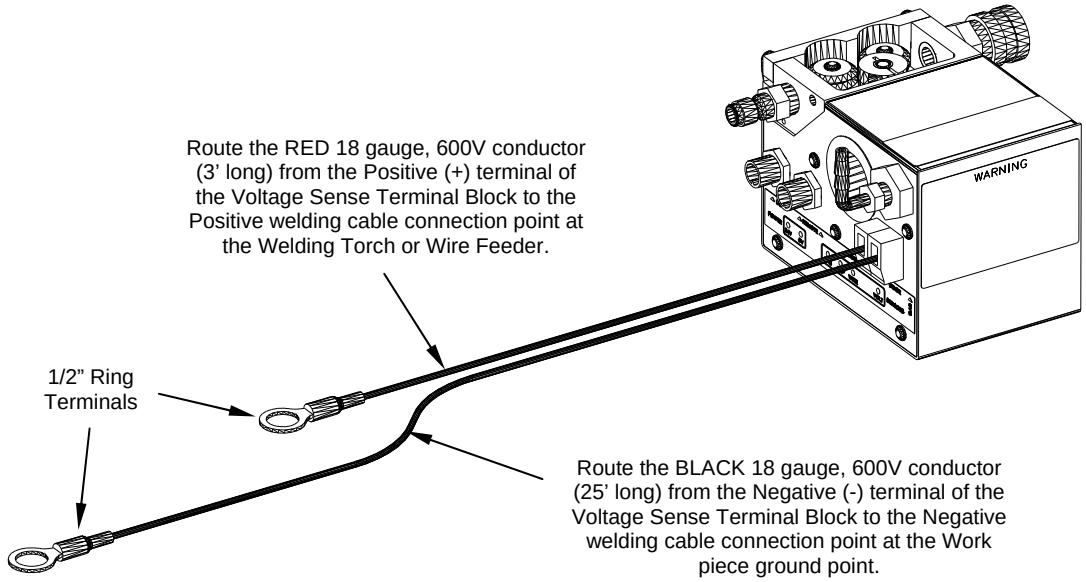
A.3 Positive Welding Cable Installation



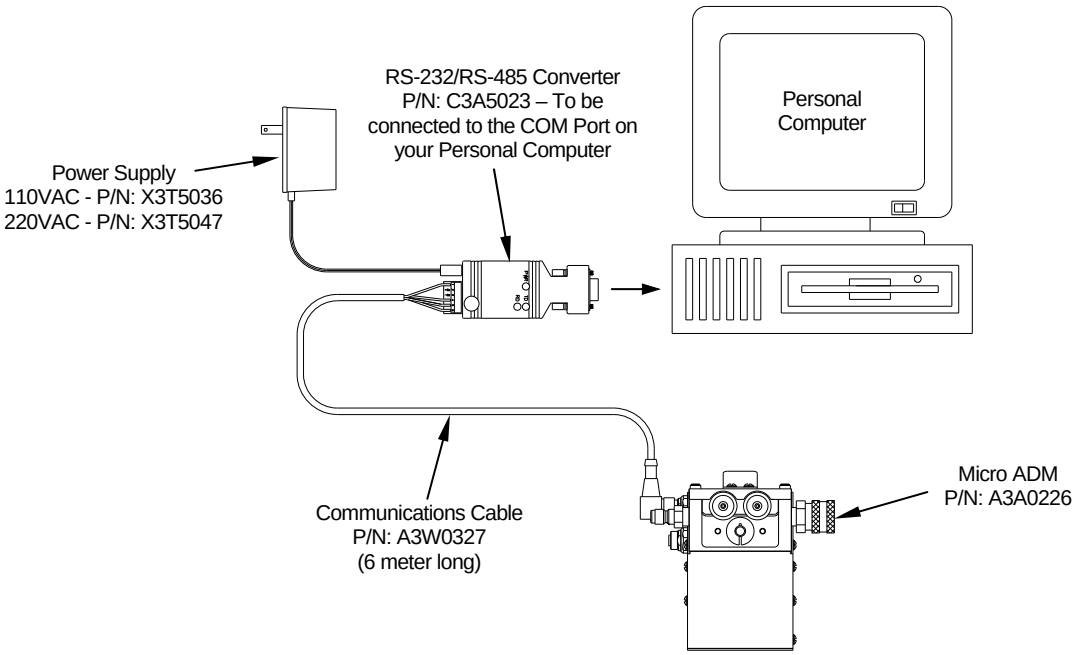
A.4 Gas Pressure Hose Installation



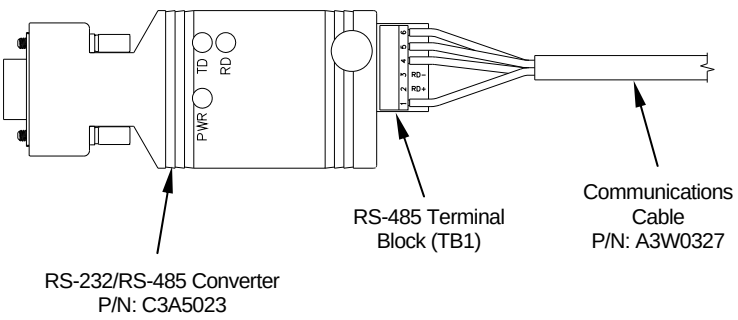
A.5 Voltage Sensor Installation



A.6 Single Unit Installation



SYSTEM INSTALLATION DIAGRAM

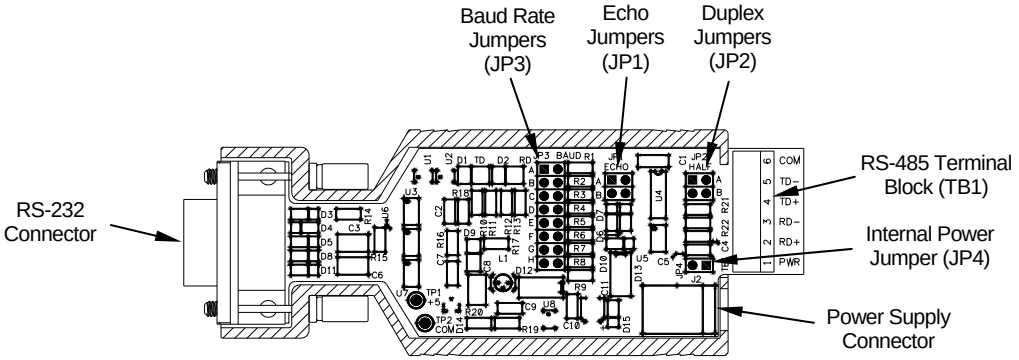


RS-485 CABLE HOOKUP

TERMINAL	LABEL	WIRE COLOR
1	PWR	Brown
2	RD+	N/C
3	RD-	N/C
4	TD+	White
5	TD-	Blue
6	COM	Gray

Note: Cable shield to be clipped off.

COMMUNICATIONS CABLE INSTALLATION DIAGRAM



ECHO JUMPERS (JP1)

ECHO	JUMPER
On	A
Off**	B

** Denotes the default jumper

DUPLEX JUMPERS (JP2)

DUPLEX	JUMPER
Full	None
Half**	A and B

** Denotes the default jumper

BAUD RATE JUMPERS (JP3)

BAUD	JUMPER
1200	A
2400	B
4800	C
9600	D
19200**	E
38400	F
57600	G
115200	H

** Denotes the default jumper

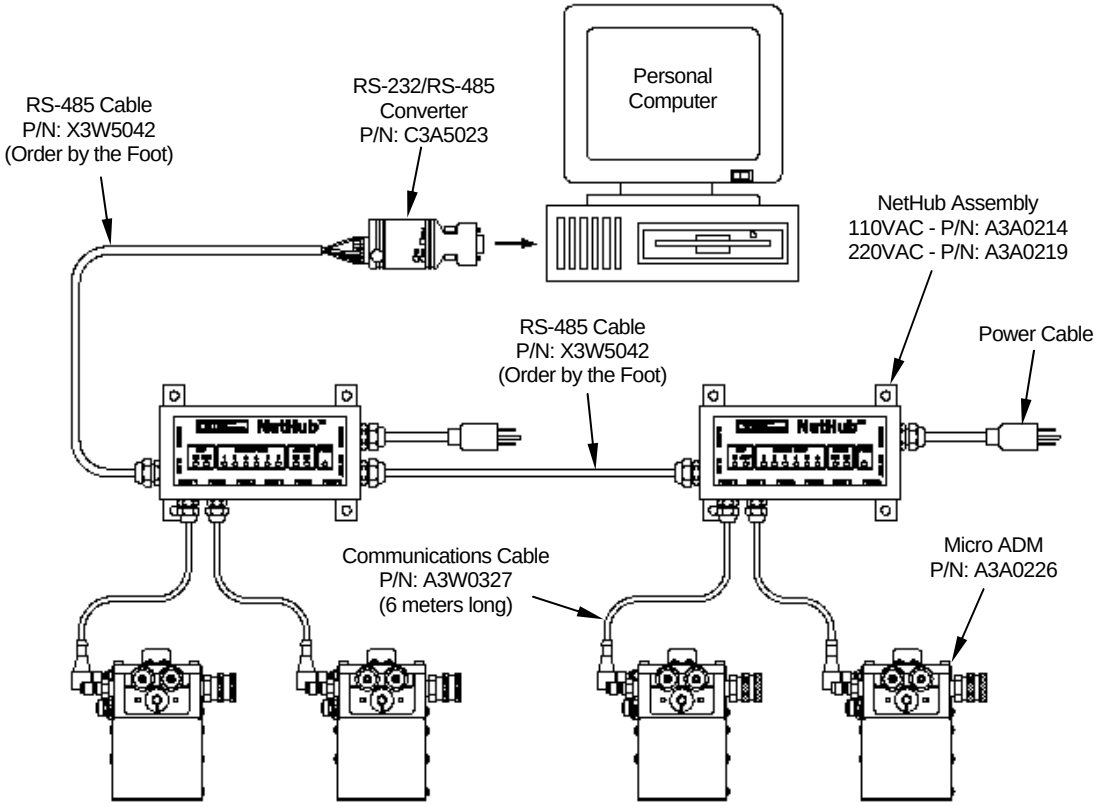
POWER JUMPERS (JP4)

POWER	JUMPER
External**	Yes
Internal	No

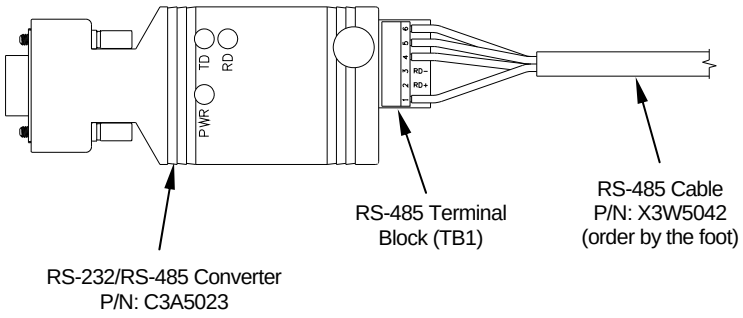
** Denotes the default jumper

RS-485/RS-232 CONVERTER JUMPER LOCATION DIAGRAM

A.7 Multiple Unit Network Installation



SYSTEM INSTALLATION DIAGRAM

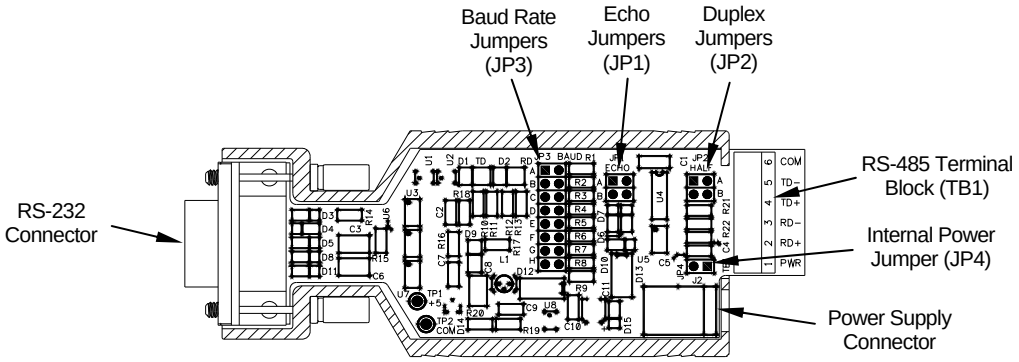


RS-485 CABLE HOOKUP

TERMINAL	LABEL	WIRE COLOR
1	PWR	Orange
2	RD+	N/C
3	RD-	N/C
4	TD+	Blue
5	TD-	White/Blue
6	COM	White/Orange

Note: Cable shield to be clipped off.

COMMUNICATIONS CABLE INSTALLATION DIAGRAM



ECHO JUMPERS (JP1)

ECHO	JUMPER
On**	A
Off	B

** Denotes the default jumper

DUPLEX JUMPERS (JP2)

DUPLEX	JUMPER
Full**	None
Half	A and B

** Denotes the default jumper

BAUD RATE JUMPERS (JP3)

BAUD	JUMPER
1200	A
2400	B
4800	C
9600	D
19200**	E
38400	F
57600	G
115200	H

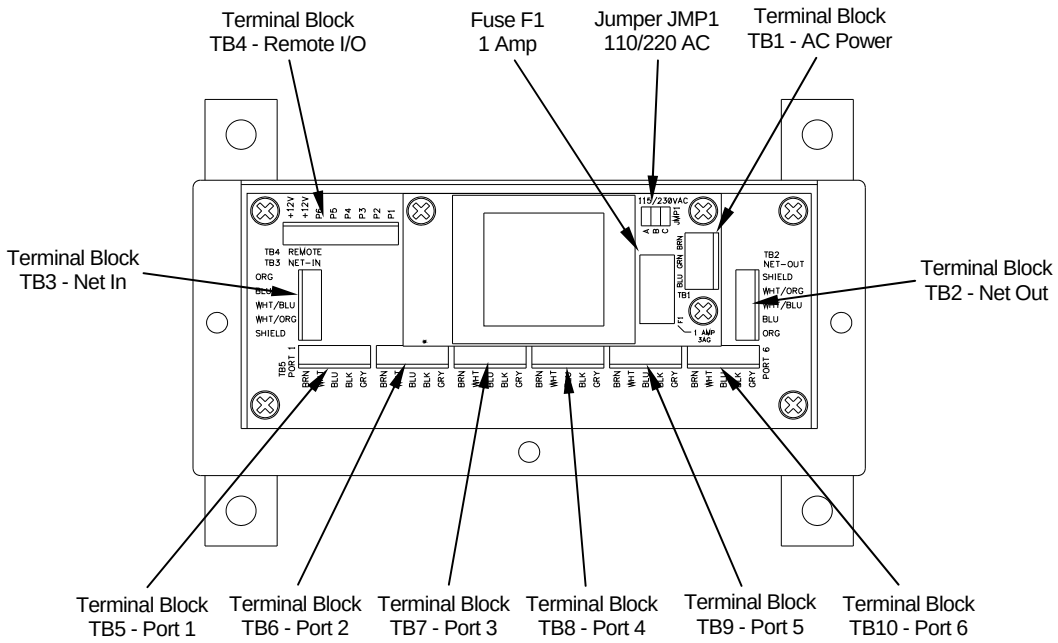
** Denotes the default jumper

POWER JUMPERS (JP4)

POWER	JUMPER
External**	Yes
Internal	No

** Denotes the default jumper

RS-485/RS-232 CONVERTER JUMPER LOCATION DIAGRAM



JUMPER JMP1 - 110/220VAC

VOLTAGE	JUMPERS
110VAC	A and B
220VAC	C

The next two jumpers (JP1 and JP2) are for whether the RS-485 Converter is powered from an external power source or uses the power supplied by the NetHub.

JUMPER JP1 - NPWR

POWER	JUMPERS
External Powered	A
NetHub Powered	A and B

JUMPER JP2 - NCOM

POWER	JUMPERS
External Powered	A
NetHub Powered	A and B

TERMINAL BLOCK TB1 – AC POWER

PIN	REFERENCE	WIRE COLOR
1	HOT	BLU
2	EARTH	GRN/YEL
3	NEU	BRN

TERMINAL BLOCK TB2 – NET OUT
TERMINAL BLOCK TB3 – NET IN

PIN	REFERENCE	WIRE COLOR
1	NET PWR	ORG
2	NET+	BLU
3	NET-	WHT/BLU
4	NET COM	WHT/ORG
5	EARTH GND	SHIELD

Note: Cable shield to be clipped off.

TERMINAL BLOCK TB4 – REMOTE

PIN	REFERENCE	WIRE COLOR
1	RMT P1	WHT
2	RMT P2	BRN
3	RMT P3	GRN
4	RMT P4	YEL
5	RMT P5	GRY
6	RMT P6	PNK
7	+12 VDC	BLU
8	+12VDC	RED

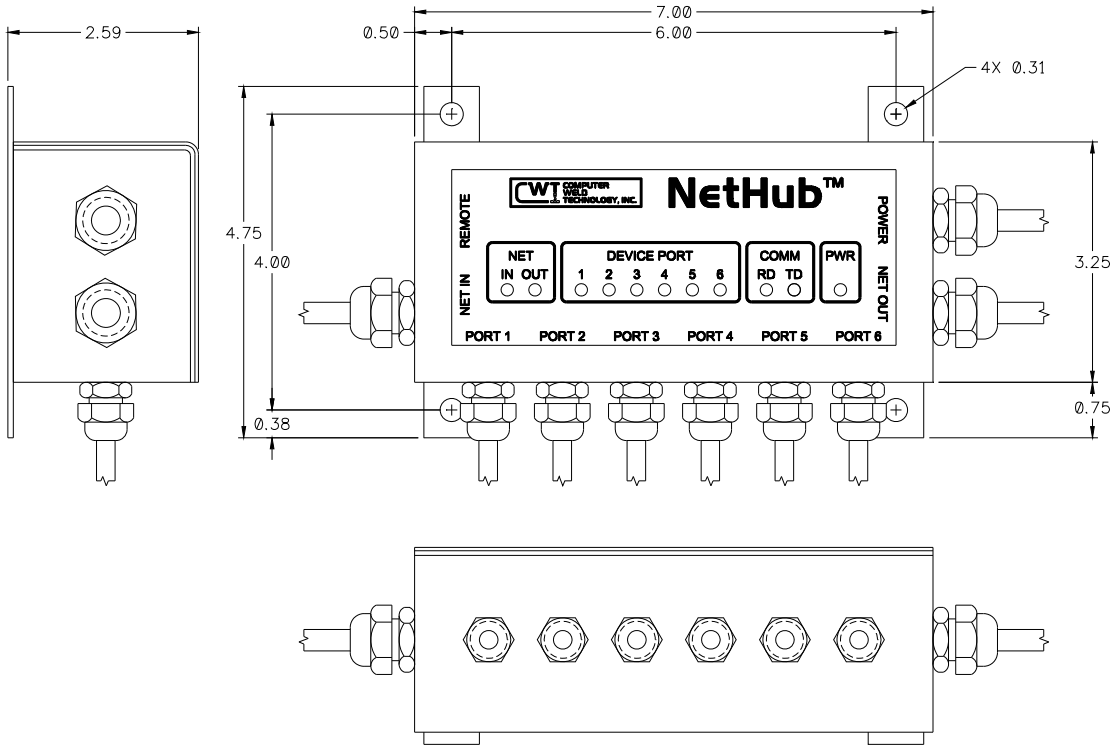
TERMINAL BLOCK TB5 – PORT 1
TERMINAL BLOCK TB6 – PORT 2
TERMINAL BLOCK TB7 – PORT 3
TERMINAL BLOCK TB8 – PORT 4
TERMINAL BLOCK TB9 – PORT 5
TERMINAL BLOCK TB10 – PORT 6

PIN	REFERENCE	WIRE COLOR
1	+12V	BRN
2	NET+	WHT
3	NET-	BLU
4	REMOTE ON	BLK
5	GND	GRY

Note: Cable shield to be clipped off.

NetHub JUMPER and TERMINAL BLOCK LOCATION DIAGRAM

A.8 NetHub™ Mounting Dimensions



A.9 Communications Cable P/N: A3W0327

This part includes both a cable and a strain relief.
The strain relief is to be used for a NetHub installation.

6-Meter Long Cable

WIRE LIST

WIRE COLOR	FROM	REFERENCE
BROWN	ITEM 1 PIN 1	+24 VDC
WHITE	ITEM 1 PIN 2	NET+
BLUE	ITEM 1 PIN 3	NET-
BLACK	ITEM 1 PIN 4	PSEL
GRAY	ITEM 1 PIN 5	24VDC GROUND
SHIELD		CABLE SHIELD

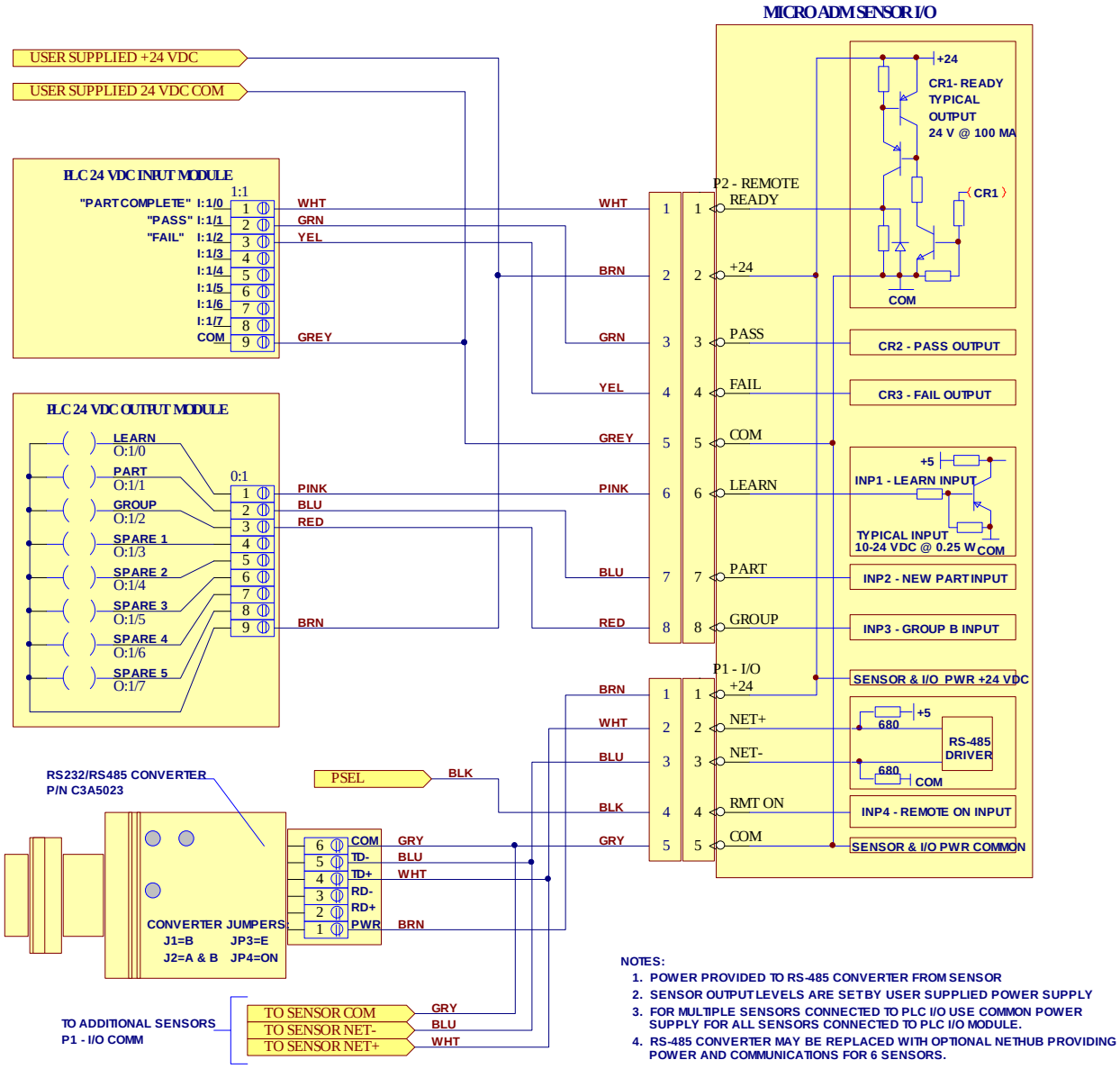
A.10 Remote I/O Cable P/N: X3W5102

6-Meter Long Cable

WIRE LIST

WIRE COLOR	FROM	REFERENCE
WHITE	ITEM 1 PIN 1	Part Complete (CR1)
BROWN	ITEM 1 PIN 2	+24 VDC
GREEN	ITEM 1 PIN 3	No Fault (CR2)
YELLOW	ITEM 1 PIN 4	Fault (CR3)
GRAY	ITEM 1 PIN 5	COM
PINK	ITEM 1 PIN 6	Learn (INP1)
BLUE	ITEM 1 PIN 7	Part (INP2)
RED	ITEM 1 PIN 8	Part B (NP3)

A.11 Typical External Powered PLC I/O System Integration

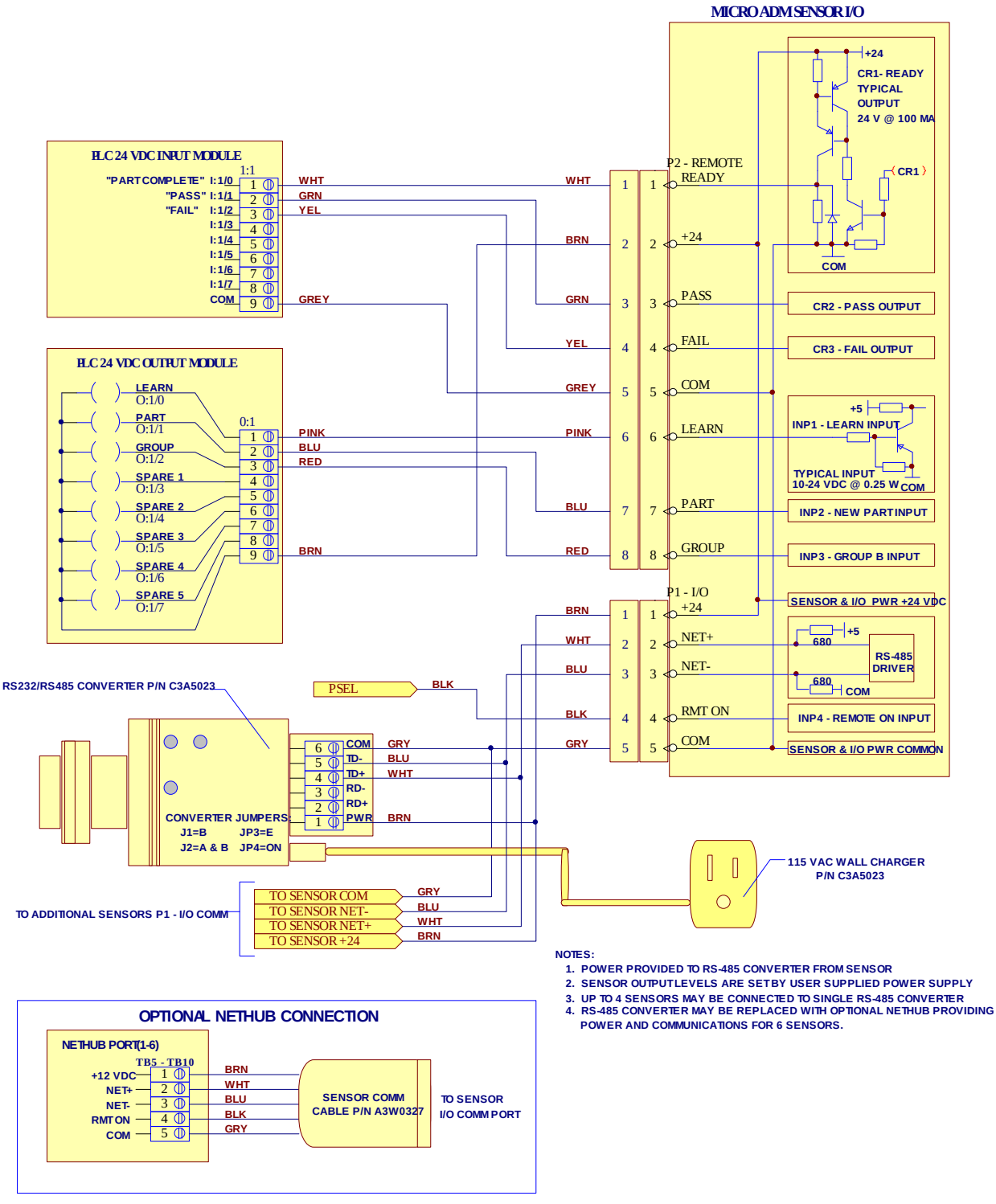


NOTES:

1. POWER PROVIDED TO RS-485 CONVERTER FROM SENSOR
2. SENSOR OUTPUT LEVELS ARE SET BY USER SUPPLIED POWER SUPPLY
3. FOR MULTIPLE SENSORS CONNECTED TO PLC I/O USE COMMON POWER SUPPLY FOR ALL SENSORS CONNECTED TO PLC I/O MODULE.
4. RS-485 CONVERTER MAY BE REPLACED WITH OPTIONAL NETHUB PROVIDING POWER AND COMMUNICATIONS FOR 6 SENSORS.

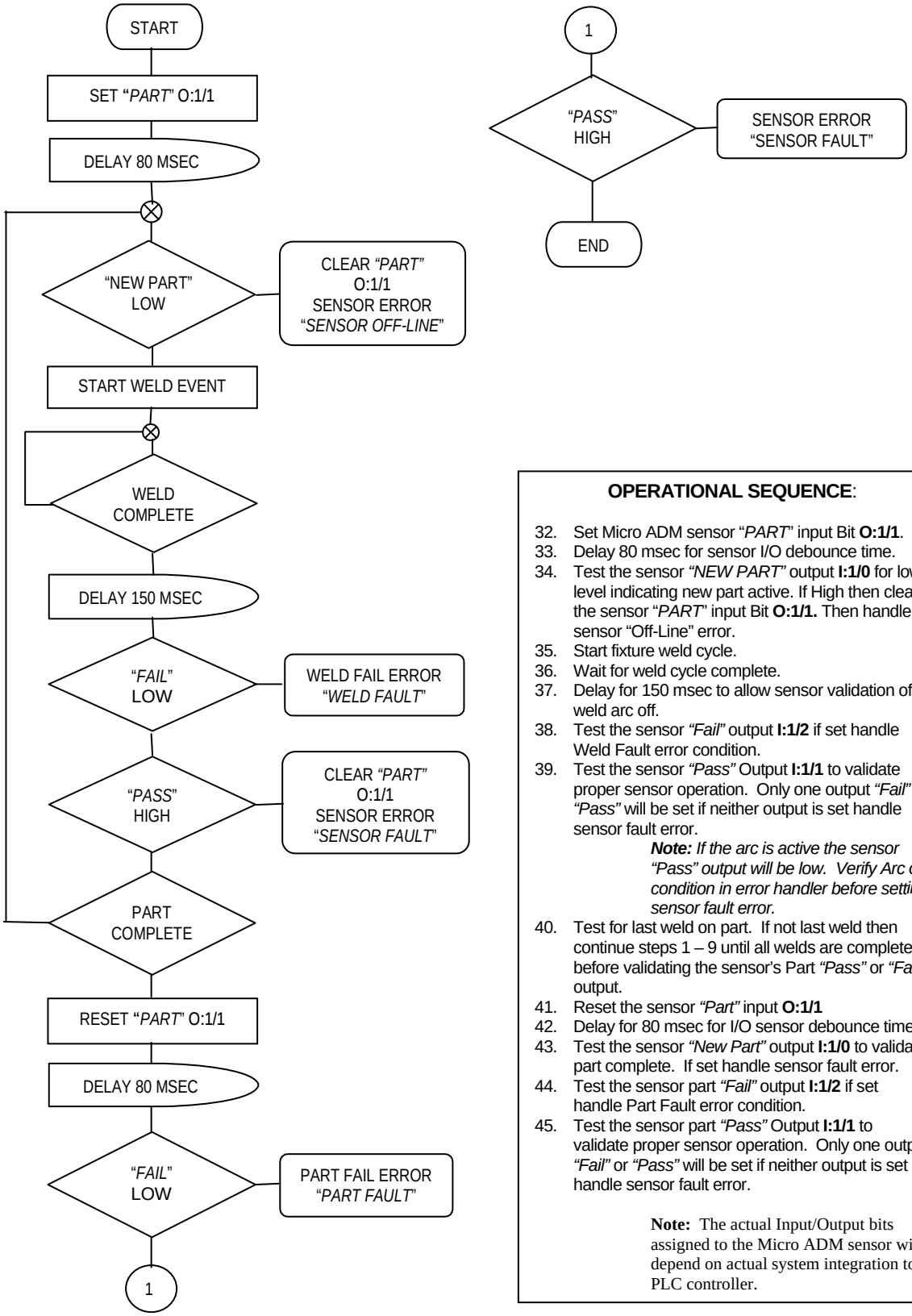
TYPICAL SENSOR POWERED PLC TO MICRO ADM INTERFACE

A.12 Typical Sensor Powered PLC I/O System Integration



TYPICAL SENSOR POWERED PLC TO MICRO ADM INTERFACE

A.13 Normal Weld Cycle Process Control Flow Chart



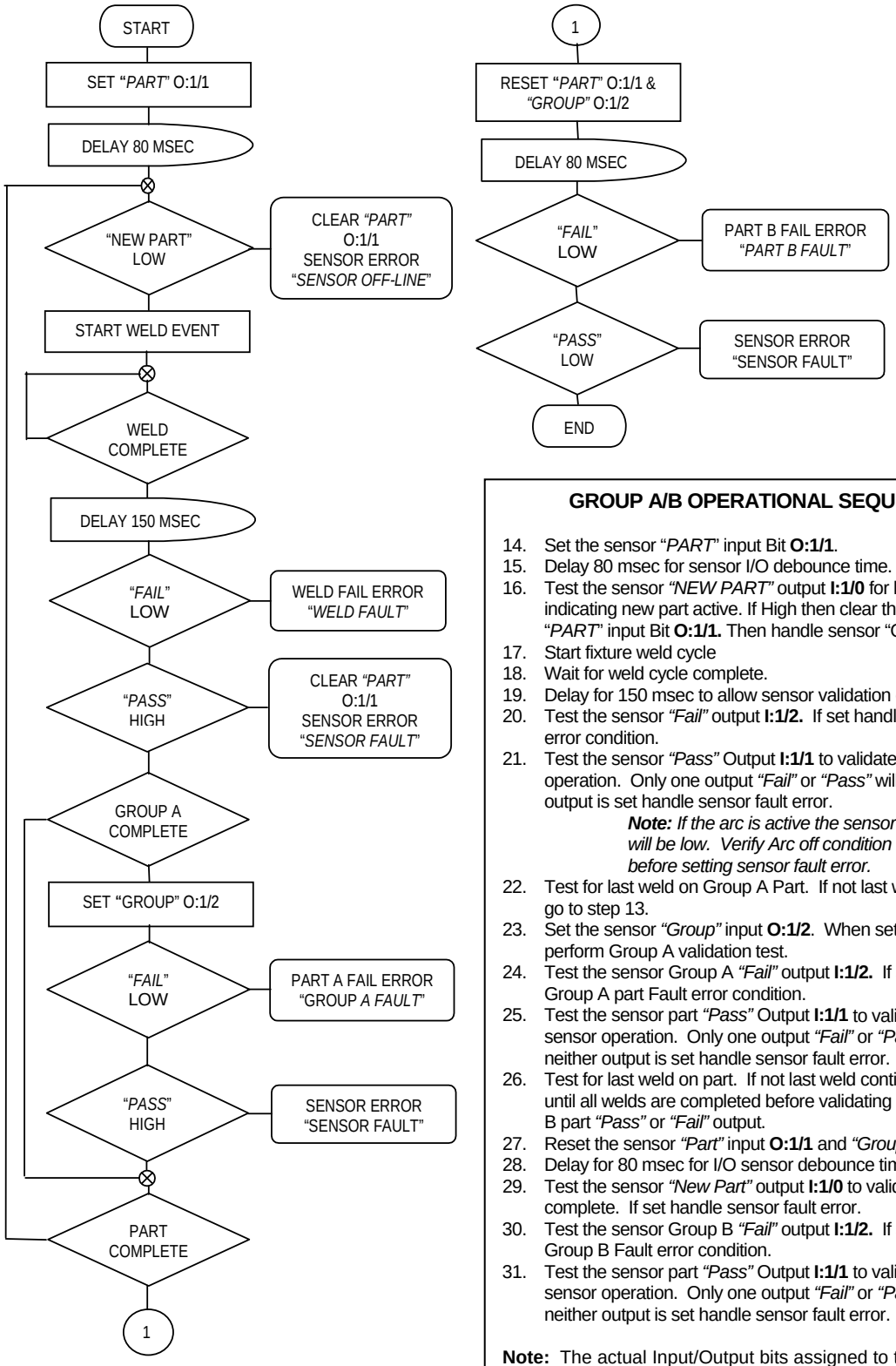
OPERATIONAL SEQUENCE:

32. Set Micro ADM sensor "*PART*" input Bit **O:1/1**.
33. Delay 80 msec for sensor I/O debounce time.
34. Test the sensor *"NEW PART"* output **I:1/0** for low level indicating new part active. If High then clear the sensor "*PART*" input Bit **O:1/1.** Then handle sensor "Off-Line" error.
35. Start fixture weld cycle.
36. Wait for weld cycle complete.
37. Delay for 150 msec to allow sensor validation of weld arc off.
38. Test the sensor *"Fail"* output **I:1/2** if set handle Weld Fault error condition.
39. Test the sensor *"Pass"* Output **I:1/1** to validate proper sensor operation. Only one output *"Fail"* or *"Pass"* will be set if neither output is set handle sensor fault error.

    Note: *If the arc is active the sensor "Pass" output will be low. Verify Arc off condition in error handler before setting sensor fault error.*
40. Test for last weld on part. If not last weld then continue steps 1 – 9 until all welds are completed before validating the sensor's Part *"Pass"* or *"Fail"* output.
41. Reset the sensor *"Part"* input **O:1/1**
42. Delay for 80 msec for I/O sensor debounce time.
43. Test the sensor *"New Part"* output **I:1/0** to validate part complete. If set handle sensor fault error.
44. Test the sensor part *"Fail"* output **I:1/2** if set handle Part Fault error condition.
45. Test the sensor part *"Pass"* Output **I:1/1** to validate proper sensor operation. Only one output *"Fail"* or *"Pass"* will be set if neither output is set handle sensor fault error.

Note: The actual Input/Output bits assigned to the Micro ADM sensor will depend on actual system integration to PLC controller.

A.14 Group Weld Cycle Process Control Flow Chart

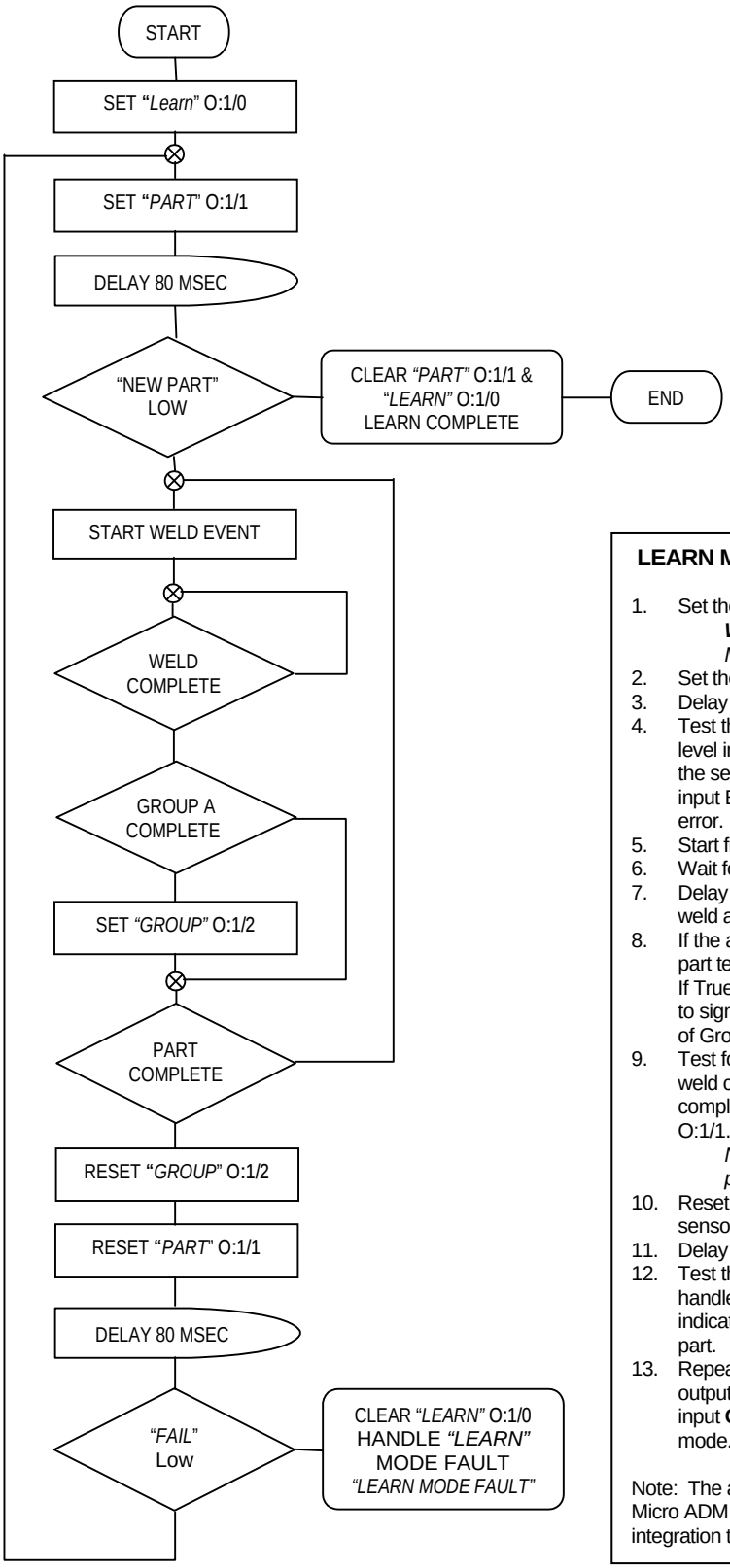


GROUP A/B OPERATIONAL SEQUENCE:

14. Set the sensor "*PART*" input Bit **O:1/1**.
15. Delay 80 msec for sensor I/O debounce time.
16. Test the sensor *"NEW PART"* output **I:1/0** for low level indicating new part active. If High then clear the sensor "*PART*" input Bit **O:1/1.** Then handle sensor "Off-Line" error.
17. Start fixture weld cycle
18. Wait for weld cycle complete.
19. Delay for 150 msec to allow sensor validation of weld arc off.
20. Test the sensor *"Fail"* output **I:1/2.** If set handle Weld Fault error condition.
21. Test the sensor *"Pass"* Output **I:1/1** to validate proper sensor operation. Only one output *"Fail"* or *"Pass"* will be set if neither output is set handle sensor fault error.
    Note: *If the arc is active the sensor "Pass" output will be low. Verify Arc off condition in error handler before setting sensor fault error.*
22. Test for last weld on Group A Part. If not last weld on Group A go to step 13.
23. Set the sensor *"Group"* input **O:1/2**. When set the sensor will perform Group A validation test.
24. Test the sensor Group A *"Fail"* output **I:1/2.** If set handle the Group A part Fault error condition.
25. Test the sensor part *"Pass"* Output **I:1/1** to validate proper sensor operation. Only one output *"Fail"* or *"Pass"* will be set if neither output is set handle sensor fault error.
26. Test for last weld on part. If not last weld continue steps 1 – 9 until all welds are completed before validating sensor's Group B part *"Pass"* or *"Fail"* output.
27. Reset the sensor *"Part"* input **O:1/1** and *"Group"* input **O:1/2**.
28. Delay for 80 msec for I/O sensor debounce time.
29. Test the sensor *"New Part"* output **I:1/0** to validate part complete. If set handle sensor fault error.
30. Test the sensor Group B *"Fail"* output **I:1/2.** If set handle Group B Fault error condition.
31. Test the sensor part *"Pass"* Output **I:1/1** to validate proper sensor operation. Only one output *"Fail"* or *"Pass"* will be set if neither output is set handle sensor fault error.

Note: The actual Input/Output bits assigned to the Micro ADM sensor will depend on actual system integration to PLC controller.

A.15 Learn Weld Cycle Process Control Flow Chart



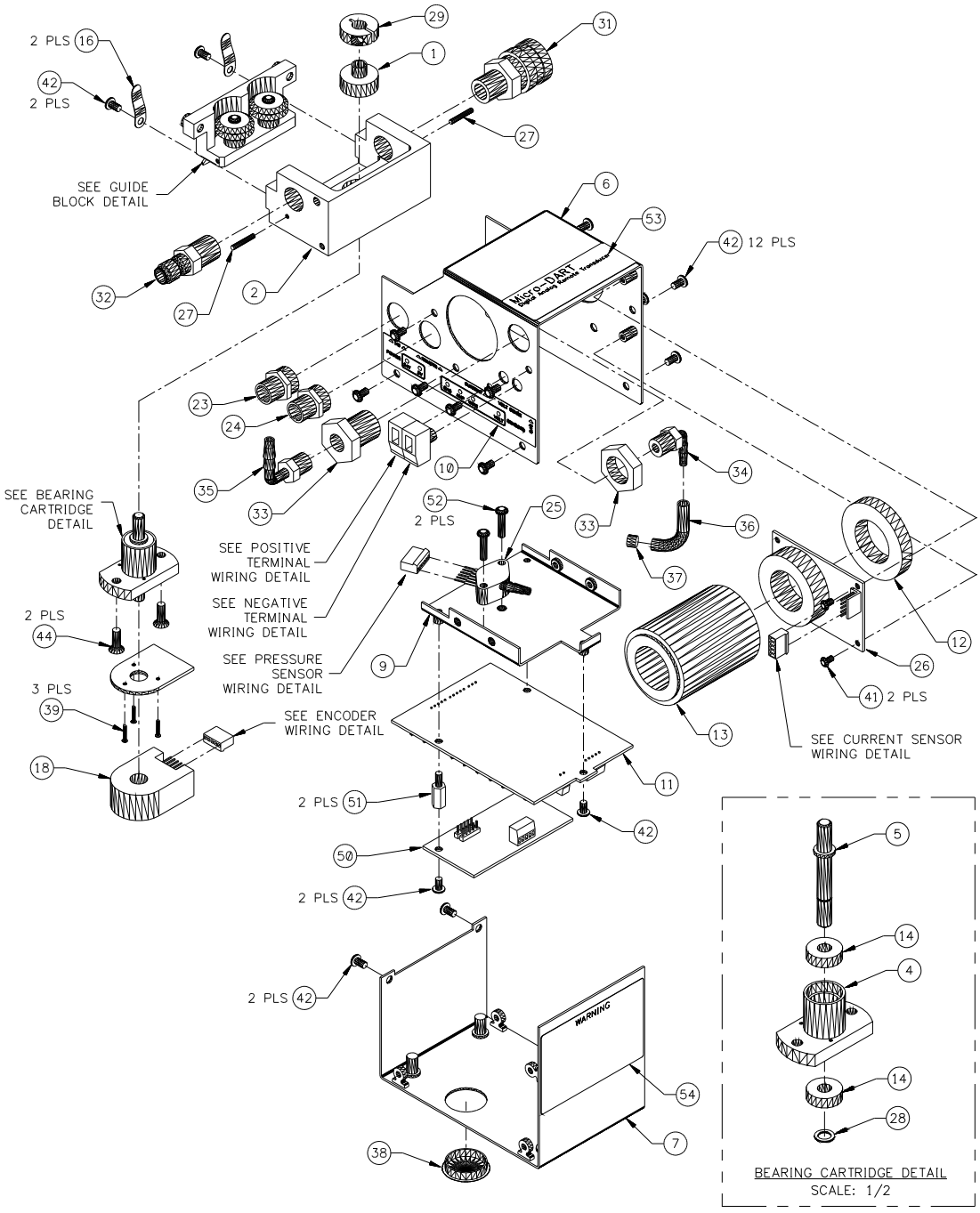
LEARN MODE OPERATIONAL SEQUENCE:

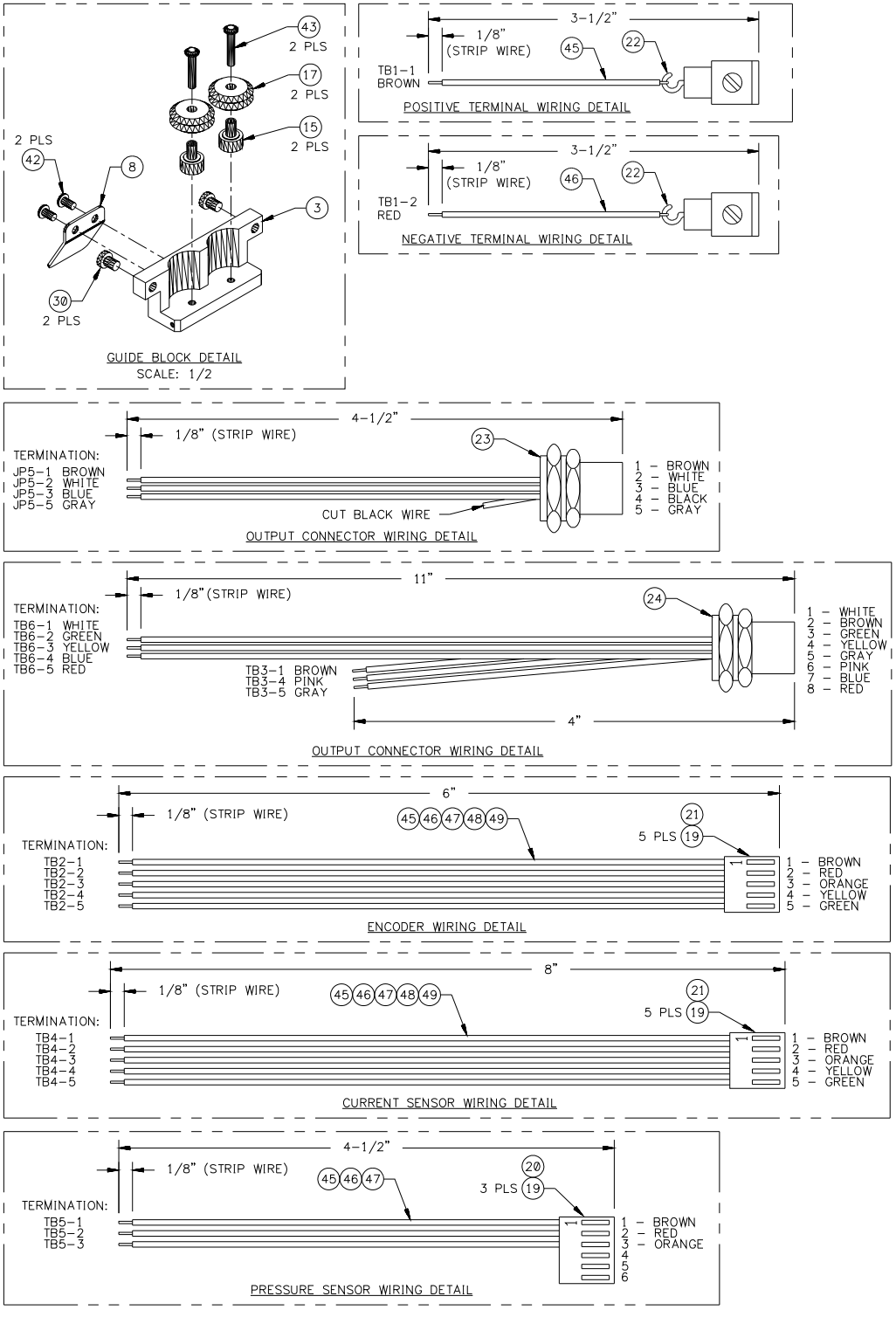
1. Set the "Learn" input O:1/0.
   Warning: *When "Learn input is set the Micro ADM will clear all previous limits.*
2. Set the sensor "*PART*" input Bit **O:1/1**.
3. Delay 80 msec for sensor I/O debounce time.
4. Test the sensor *"NEW PART"* output **I:1/0** for low level indicating new part active. If High then clear the sensor "*PART*" input Bit **O:1/1** and *"Learn"* input Bit **O:1/0.** Then handle sensor "Off-Line" error.
5. Start fixture weld cycle.
6. Wait for weld cycle complete.
7. Delay for 150 msec to allow sensor validation of weld arc off.
8. If the application requires Group A and Group B part testing. Then test for end of Group A welds. If True then set the sensor *"Group"* input **O:1/2** to signify the end of Group A welds and the start of Group B welds.
9. Test for last weld on part. If this is not the last weld continue steps 1 – 9 until all welds are completed before clearing the sensor Part input O:1/1.
   Note: The learn mode requires ten (10) parts to establish the process limits.
10. Reset the sensor *"Part"* input **O:1/1** and the sensor *"Group"* input **O:1/2**.
11. Delay for 80 msec for sensor I/O debounce time.
12. Test the sensor Part *"Fail"* output **I:1/2.** If set handle Learn Fault error condition. This fault indicates an invalid weld count during the last part.
13. Repeat Steps 2-13 until the sensor *"New Part"* output **I:1/0** is not cleared when the sensor *"Part"* input **O:1/1** is set. This indicates end of learn mode.

Note: The actual Input/Output bits assigned to the Micro ADM sensor will depend on actual system integration to PLC controller.

Appendix B Micro ADM™ Assembly Parts List

B.1 Micro ADM™ Sensor Assembly P/N: A3A0226 Rev: 0

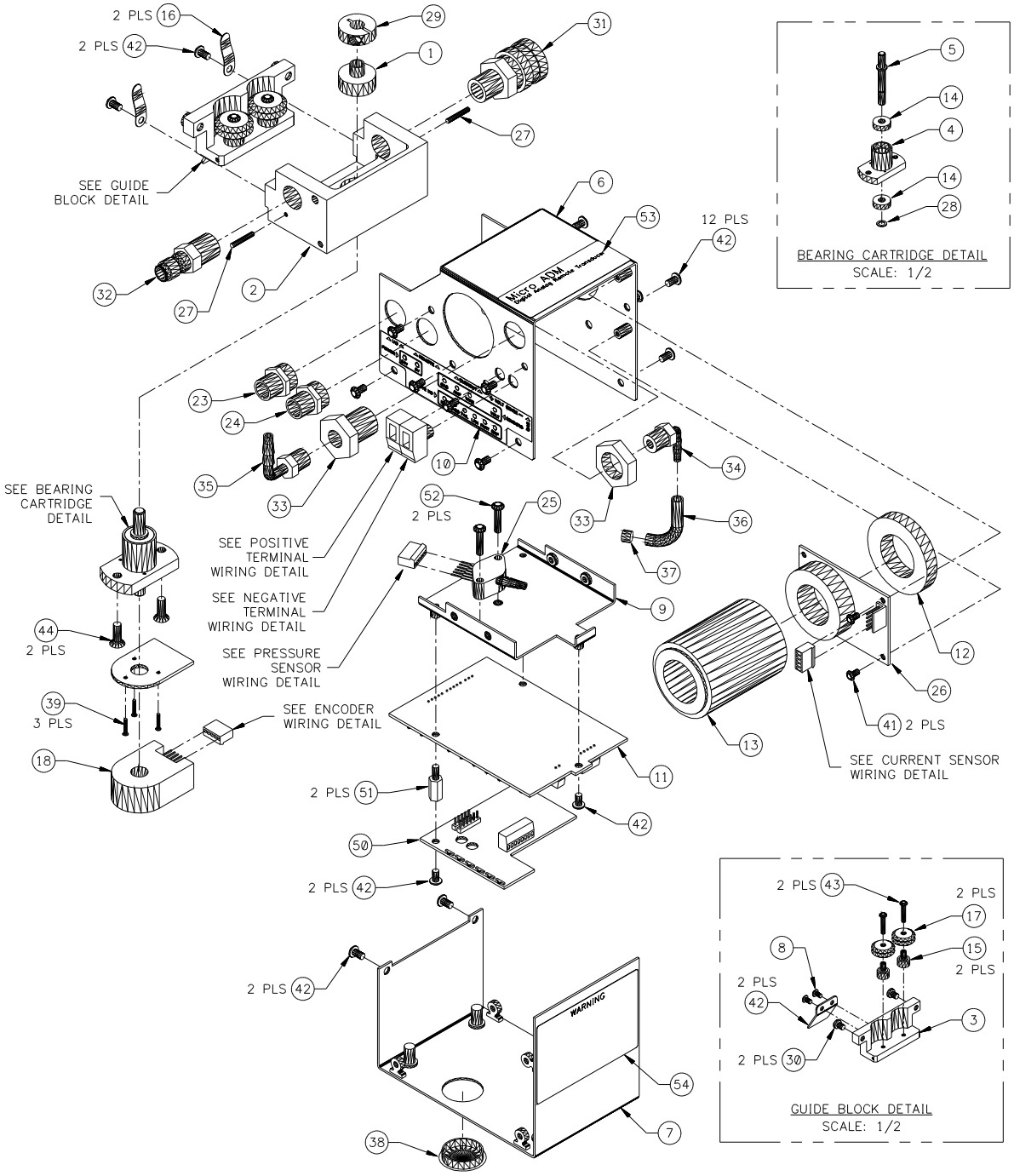


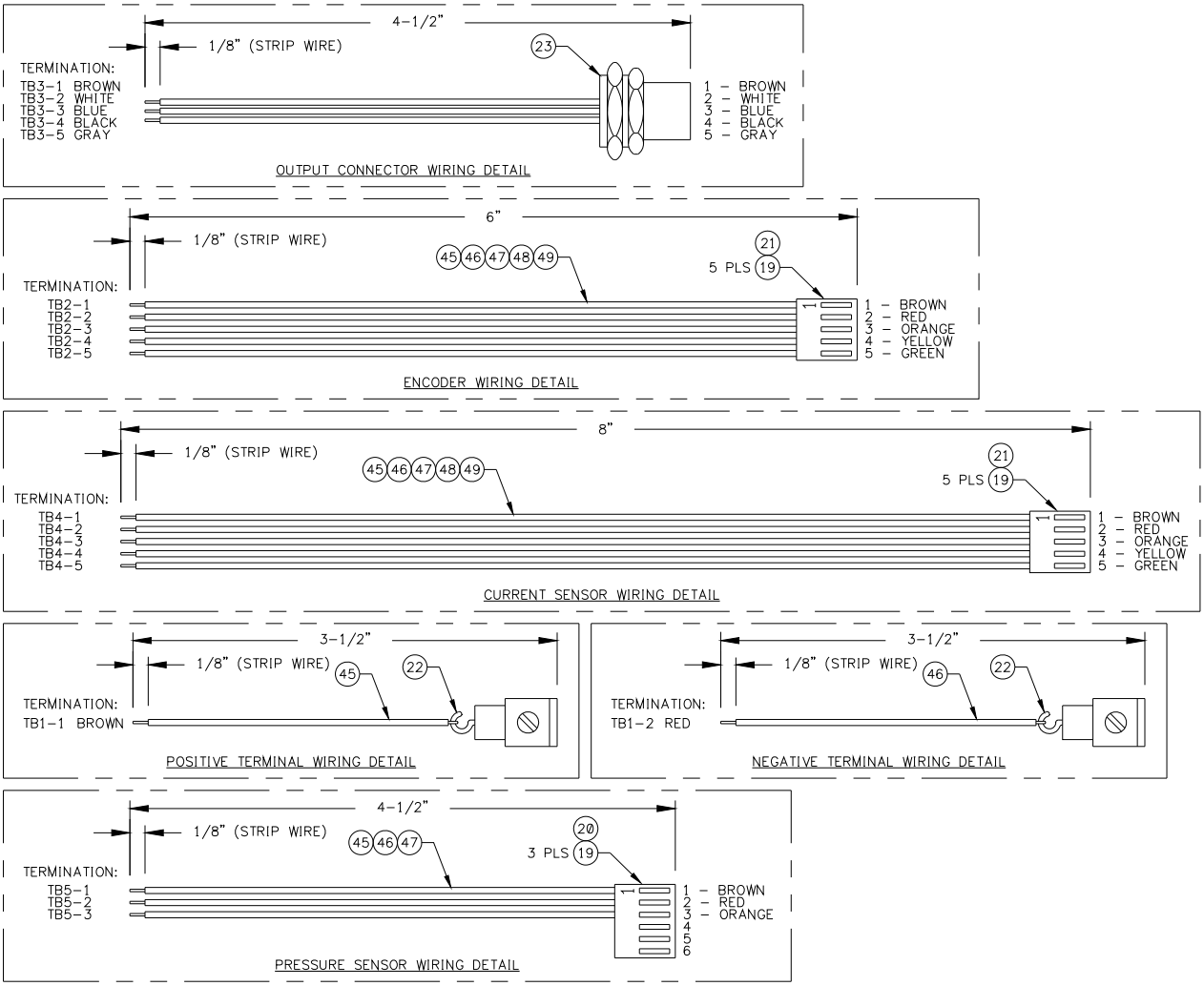

43
2 PLS
17
2 PLS
15
2 PLS
2 PLS
42
8
3
30
2 PLS
GUIDE BLOCK DETAIL
SCALE: 1/2
3-1/2"
1/8"
(STRIP WIRE)
45
22
TB1-1
BROWN
POSITIVE TERMINAL WIRING DETAIL
3-1/2"
1/8"
(STRIP WIRE)
46
22
TB1-2
RED
NEGATIVE TERMINAL WIRING DETAIL
4-1/2"
1/8" (STRIP WIRE)
23
TERMINATION:
JP5-1 BROWN
JP5-2 WHITE
JP5-3 BLUE
JP5-5 GRAY
1 - BROWN
2 - WHITE
3 - BLUE
4 - BLACK
5 - GRAY
CUT BLACK WIRE
OUTPUT CONNECTOR WIRING DETAIL
11"
1/8"(STRIP WIRE)
24
TERMINATION:
TB6-1 WHITE
TB6-2 GREEN
TB6-3 YELLOW
TB6-4 BLUE
TB6-5 RED
1 - WHITE
2 - BROWN
3 - GREEN
4 - YELLOW
5 - GRAY
6 - PINK
7 - BLUE
8 - RED
TB3-1 BROWN
TB3-4 PINK
TB3-5 GRAY
4"
OUTPUT CONNECTOR WIRING DETAIL
6"
1/8" (STRIP WIRE)
45 46 47 48 49
21
5 PLS 19
TERMINATION:
TB2-1
TB2-2
TB2-3
TB2-4
TB2-5
1 - BROWN
2 - RED
3 - ORANGE
4 - YELLOW
5 - GREEN
ENCODER WIRING DETAIL
8"
1/8" (STRIP WIRE)
45 46 47 48 49
21
5 PLS 19
TERMINATION:
TB4-1
TB4-2
TB4-3
TB4-4
TB4-5
1 - BROWN
2 - RED
3 - ORANGE
4 - YELLOW
5 - GREEN
CURRENT SENSOR WIRING DETAIL
4-1/2"
1/8" (STRIP WIRE)
45 46 47
20
3 PLS 19
TERMINATION:
TB5-1
TB5-2
TB5-3
1 - BROWN
2 - RED
3 - ORANGE
4
5
6
PRESSURE SENSOR WIRING DETAIL

PARTS LIST

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	A2A0014	Driven Wheel
2	1	A2M0206	Transducer Block
3	1	A2M0203	Guide Block
4	1	A2M0204	Bearing Cartridge
5	1	A2M0205	WFS Shaft
6	1	A3E0159	Top Cover
7	1	A3E0160	Bottom Cover
8	1	A3E0141	Guide Handle
9	1	A3E0161	PCB Mounting Bracket
10	1	A3E0162	DART Status Overlay
11	1	A5A0109-MA	Micro ADM PCB Assembly
12	1	A2M0207	Small Current Sensor Tube
13	1	A2M0208	Large Current Sensor Tube
14	2	X2B0373	Bearing #R4ZZ MRC
15	2	X2B5002	Stationary Bushing #B-1 Dua-L-Vee
16	2	X2N5023	Flat Spring #U-FS-2 Small Parts
17	2	X2P5004	Wheel #W1-X Dua-L-Vee
18	1	X3M5044	Encoder, Optical 256 cpr #HEDS-5500F06 Agilent
19	13	X3P5138	Crimp, Terminal #08-56-0110 Molex
20	1	X3P5224	Connector, Housing 6 circuit #22-01-2067 Molex
21	2	X3P5443	Connector, Housing 5 circuit #22-01-2057 Molex
22	2	X3P5767	Block, Terminal Series VDFK #0708250 Phoenix
23	1	X3P5805	Connector, RCPT 5 circuit #FS4.5-0.5 Turck
24	1	X3P5807	Connector, RCPT 8 circuit #FS8-0.5 Turck
25	1	X3Q5017	Pressure Sensor #MPX5100DP Motorola
26	1	X3Q5013	Hall Effect Current Sensor #BB-600 FW Bell
27	2	X6P5007	Dowel Pin, 0.093” diameter ¾” long #D2-6 Berg
28	1	X6B5025	Retaining Ring, ¼” External #5100-25 Thruarc
29	1	X6B5054	Shaft Collar #DSCA-5 Small Parts
30	2	X6B5055	Locator Button #CL-1-SLB Carr Lane
31	1	X6F5090	Fitting, Quick Disconnect #BST-2M Parker
32	1	X6F5102	Fitting, Nipple #BST-N2M Parker
33	1	X6F5119	Fitting, Coupling Anchor 1/8” NPT #207ACBHS-2 Parker
34	1	X6F5118	Fitting, Elbow 3/16” Hose 1/8” NPT #5013008 New Age
35	1	X6F5115	Fitting, Elbow 1/4” Hose 1/8” NPT #5013043 New Age
36	2.5”	X6H5019	Tubing, Black 0.17” ID 0.25” OD #2121483 New Age
37	1		Clamp, Hose 1/4”
38	1	X6Z5092	Plug, Hole Short 7/8” Black #1699 Heyco
39	3		#0-80 x 3/8” long Philips Pan Head Screw
40	2		#4-40 x 1/2“ long Binder Head Screw
41	1		#4-40 x 5/16” long Pan Head Screw w/ Internal Lock Washer
42	21		#6-32 x 5/16” long Pan Head Screw w/ Internal Lock Washer
43	2		Fitting, Elbow 1/4” Hose 1/8” NPT #5013043 New Age
44	2		#8-32 x 1/2” long Socket Flat Head Screw
45	22”		Wire, 24 AWG CSA Type Tr-64 Brown
46	22”		Wire, 24 AWG CSA Type Tr-64 Red
47	18”		Wire, 24 AWG CSA Type Tr-64 Orange
48	14”		Wire, 24 AWG CSA Type Tr-64 Yellow
49	14”		Wire, 24 AWG CSA Type Tr-64 Green
50	1	A5A0117	I-Dart I/O PCB Assembly
51	2	X6S5023	Spacer, M-F #6-32 x 1/2” long #8250 HH Smith
52	2		#6-32 x 5/8” long Pan Head Screw
53	1		Micro ADM Sensor Serial Number Label
54	1		Warning #1 Label

B.2 Micro ADM™ Sensor Assembly P/N: A3A0226 Rev: A

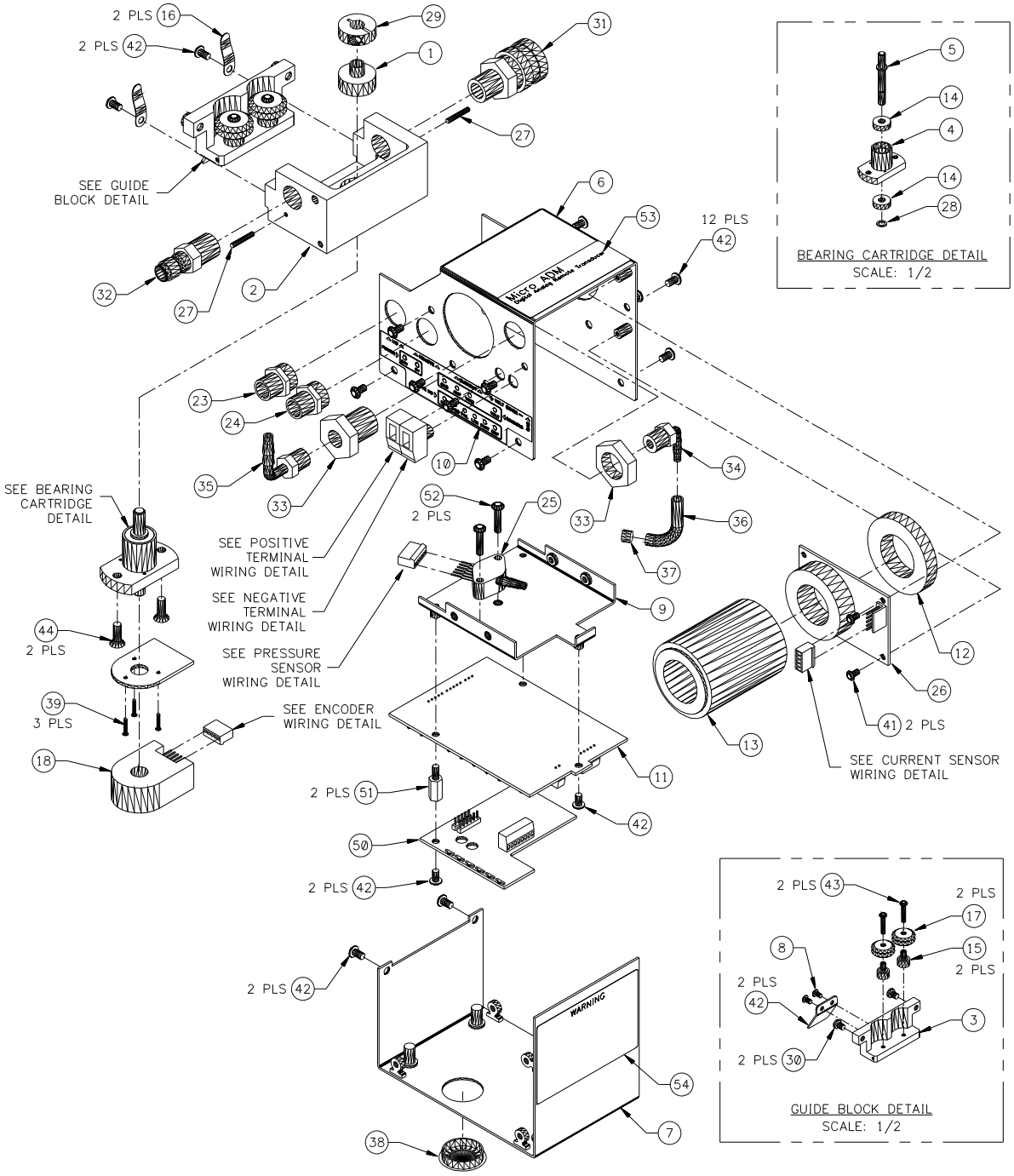


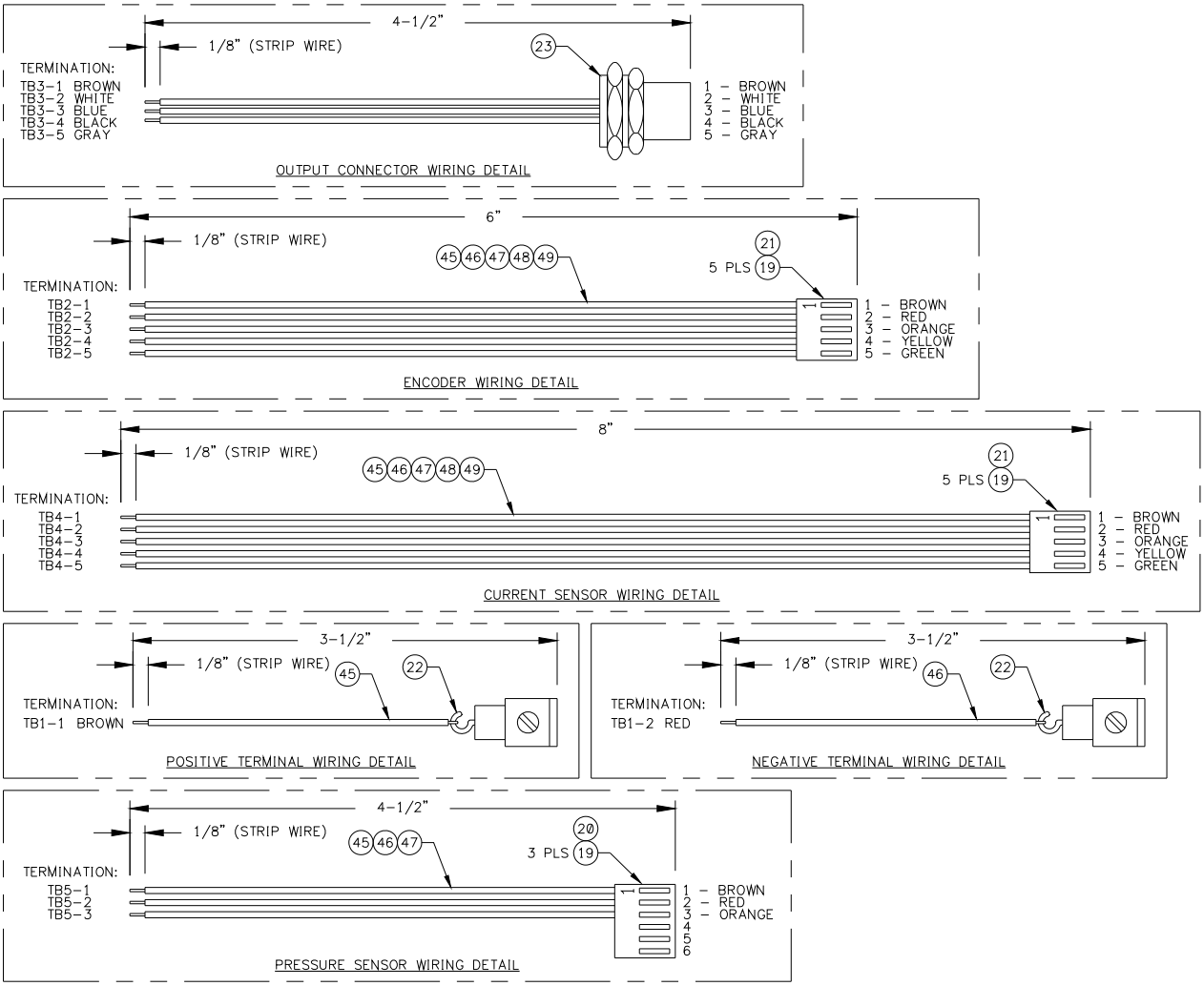

4-1/2"
1/8" (STRIP WIRE)
23
TERMINATION:
TB3-1 BROWN
TB3-2 WHITE
TB3-3 BLUE
TB3-4 BLACK
TB3-5 GRAY
1 - BROWN
2 - WHITE
3 - BLUE
4 - BLACK
5 - GRAY
OUTPUT CONNECTOR WIRING DETAIL
6"
1/8" (STRIP WIRE)
45 46 47 48 49
21
5 PLS 19
TERMINATION:
TB2-1
TB2-2
TB2-3
TB2-4
TB2-5
1 - BROWN
2 - RED
3 - ORANGE
4 - YELLOW
5 - GREEN
ENCODER WIRING DETAIL
8"
1/8" (STRIP WIRE)
45 46 47 48 49
21
5 PLS 19
TERMINATION:
TB4-1
TB4-2
TB4-3
TB4-4
TB4-5
1 - BROWN
2 - RED
3 - ORANGE
4 - YELLOW
5 - GREEN
CURRENT SENSOR WIRING DETAIL
3-1/2"
1/8" (STRIP WIRE)
45
22
TERMINATION:
TB1-1 BROWN
POSITIVE TERMINAL WIRING DETAIL
3-1/2"
1/8" (STRIP WIRE)
46
22
TERMINATION:
TB1-2 RED
NEGATIVE TERMINAL WIRING DETAIL
4-1/2"
1/8" (STRIP WIRE)
45 46 47
20
3 PLS 19
TERMINATION:
TB5-1
TB5-2
TB5-3
1 - BROWN
2 - RED
3 - ORANGE
4
5
6
PRESSURE SENSOR WIRING DETAIL

PARTS LIST

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	A2A0014	Driven Wheel
2	1	A2M0206	Transducer Block
3	1	A2M0203	Guide Block
4	1	A2M0204	Bearing Cartridge
5	1	A2M0205	WFS Shaft
6	1	A3E0159	Top Cover
7	1	A3E0160	Bottom Cover
8	1	A3E0141	Guide Handle
9	1	A3E0161	PCB Mounting Bracket
10	1	A3E0165	Micro ADM Status Overlay
11	1	A5A0109-MA	Micro ADM PCB Assembly
12	1	A2M0207	Small Current Sensor Tube
13	1	A2M0208	Large Current Sensor Tube
14	2	X2B0373	Bearing #R4ZZ MRC
15	2	X2B5002	Stationary Bushing #B-1 Dua-L-Vee
16	2	X2N5023	Flat Spring #U-FS-2 Small Parts
17	2	X2P5004	Wheel #W1-X Dua-L-Vee
18	1	X3M5044	Encoder, Optical 256 cpr #HEDS-5500F06 Agilent
19	13	X3P5138	Crimp, Terminal #08-56-0110 Molex
20	1	X3P5224	Connector, Housing 6 circuit #22-01-2067 Molex
21	2	X3P5443	Connector, Housing 5 circuit #22-01-2057 Molex
22	2	X3P5767	Block, Terminal Series VDFK #0708250 Phoenix
23	1	X3P5805	Connector, RCPT 5 circuit #FS4.5-0.5 Turck
24	1	X3P5807	Connector, RCPT 8 circuit #FS8-0.5 Turck
25	1	X3Q5017	Pressure Sensor #MPX5100DP Motorola
26	1	X3Q5013	Hall Effect Current Sensor #BB-600 FW Bell
27	2	X6P5007	Dowel Pin, 0.093” diameter ¾” long #D2-6 Berg
28	1	X6B5025	Retaining Ring, ¼” External #5100-25 Thruarc
29	1	X6B5054	Shaft Collar #DSCA-5 Small Parts
30	2	X6B5055	Locator Button #CL-1-SLB Carr Lane
31	1	X6F5090	Fitting, Quick Disconnect #BST-2M Parker
32	1	X6F5102	Fitting, Nipple #BST-N2M Parker
33	1	X6F5119	Fitting, Coupling Anchor 1/8” NPT #207ACBHS-2 Parker
34	1	X6F5118	Fitting, Elbow 3/16” Hose 1/8” NPT #5013008 New Age
35	1	X6F5115	Fitting, Elbow 1/4” Hose 1/8” NPT #5013043 New Age
36	2.5”	X6H5019	Tubing, Black 0.17” ID 0.25” OD #2121483 New Age
37	1		Clamp, Hose 1/4”
38	1	X6Z5092	Plug, Hole Short 7/8” Black #1699 Heyco
39	3		#0-80 x 3/8” long Philips Pan Head Screw
40	2		#4-40 x 1/2“ long Binder Head Screw
41	1		#4-40 x 5/16” long Pan Head Screw w/ Internal Lock Washer
42	21		#6-32 x 5/16” long Pan Head Screw w/ Internal Lock Washer
43	2		Fitting, Elbow 1/4” Hose 1/8” NPT #5013043 New Age
44	2		#8-32 x 1/2” long Socket Flat Head Screw
45	22”		Wire, 24 AWG CSA Type Tr-64 Brown
46	22”		Wire, 24 AWG CSA Type Tr-64 Red
47	18”		Wire, 24 AWG CSA Type Tr-64 Orange
48	14”		Wire, 24 AWG CSA Type Tr-64 Yellow
49	14”		Wire, 24 AWG CSA Type Tr-64 Green
50	1	A5A0117	I-Dart I/O PCB Assembly
51	2	X6S5023	Spacer, M-F #6-32 x 1/2” long #8250 HH Smith
52	2		#6-32 x 5/8” long Pan Head Screw
53	1		Micro ADM Sensor Serial Number Label
54	1		Warning #1 Label

B.3 Micro ADM™ Sensor Assembly P/N: A3A0226 Rev: B

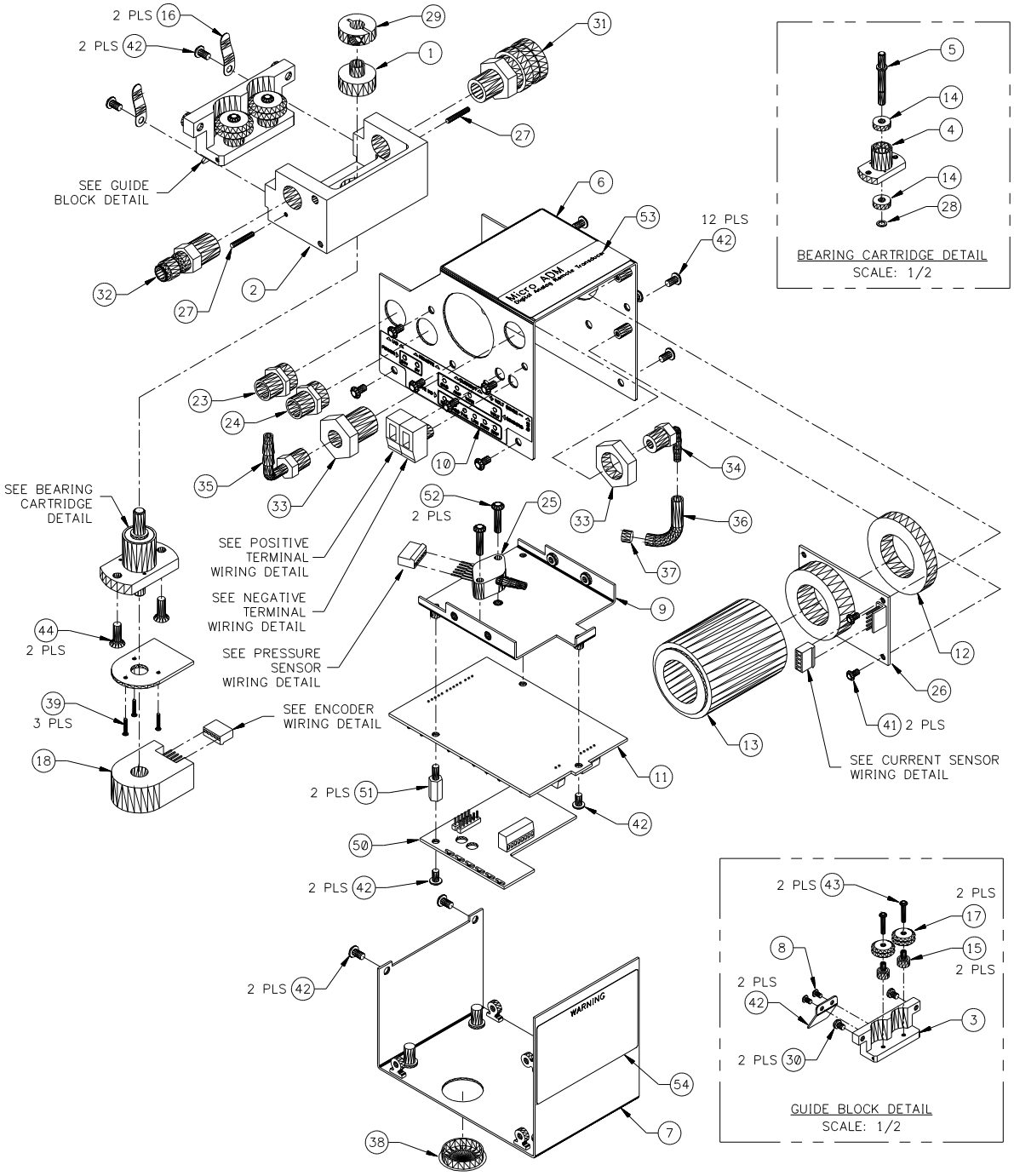


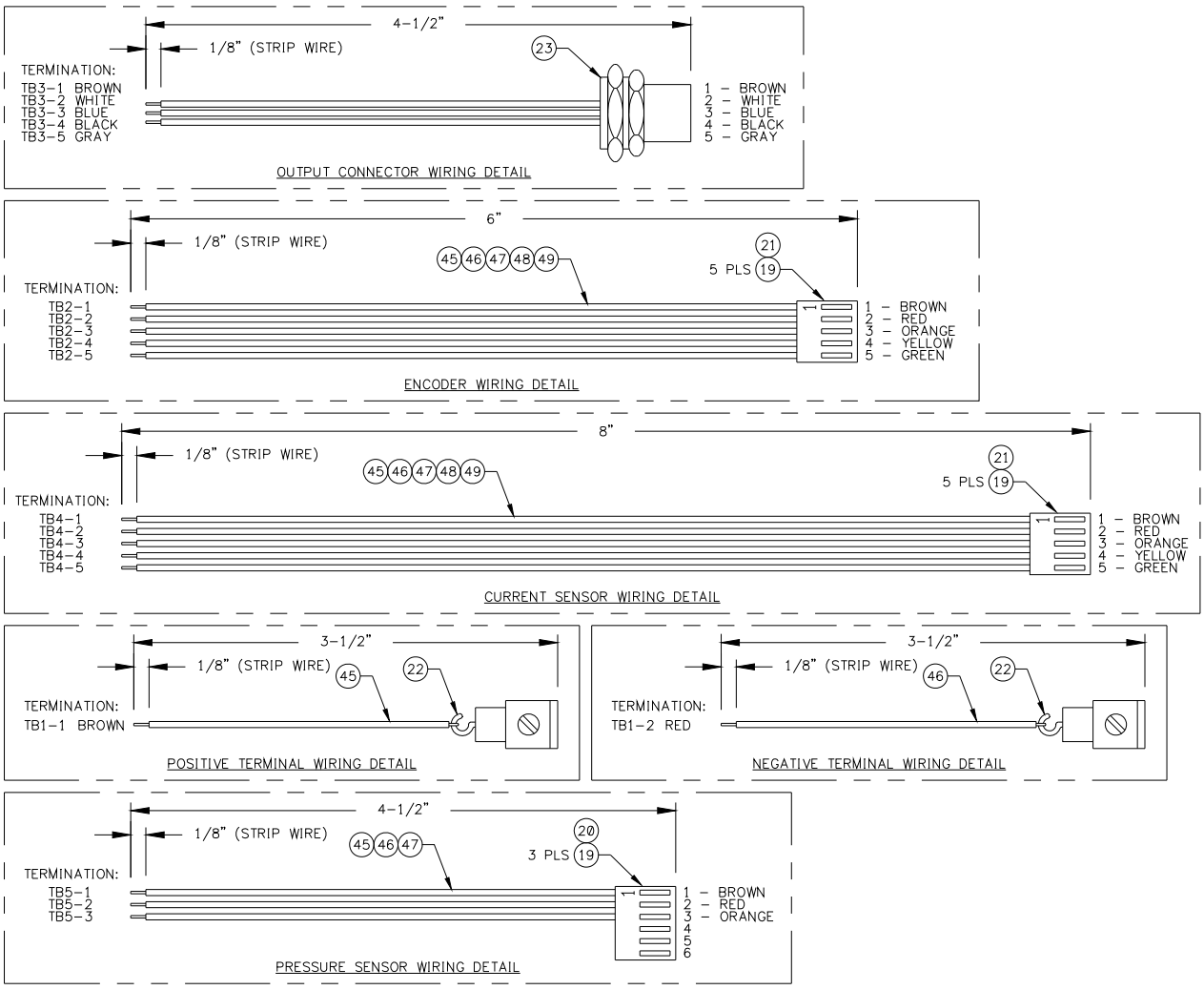

4-1/2"
1/8" (STRIP WIRE)
23
TERMINATION:
TB3-1 BROWN
TB3-2 WHITE
TB3-3 BLUE
TB3-4 BLACK
TB3-5 GRAY
1 - BROWN
2 - WHITE
3 - BLUE
4 - BLACK
5 - GRAY
OUTPUT CONNECTOR WIRING DETAIL
6"
1/8" (STRIP WIRE)
45 46 47 48 49
21
5 PLS 19
TERMINATION:
TB2-1
TB2-2
TB2-3
TB2-4
TB2-5
1 - BROWN
2 - RED
3 - ORANGE
4 - YELLOW
5 - GREEN
ENCODER WIRING DETAIL
8"
1/8" (STRIP WIRE)
45 46 47 48 49
21
5 PLS 19
TERMINATION:
TB4-1
TB4-2
TB4-3
TB4-4
TB4-5
1 - BROWN
2 - RED
3 - ORANGE
4 - YELLOW
5 - GREEN
CURRENT SENSOR WIRING DETAIL
3-1/2"
1/8" (STRIP WIRE)
45
22
TERMINATION:
TB1-1 BROWN
POSITIVE TERMINAL WIRING DETAIL
3-1/2"
1/8" (STRIP WIRE)
46
22
TERMINATION:
TB1-2 RED
NEGATIVE TERMINAL WIRING DETAIL
4-1/2"
1/8" (STRIP WIRE)
45 46 47
20
3 PLS 19
TERMINATION:
TB5-1
TB5-2
TB5-3
1 - BROWN
2 - RED
3 - ORANGE
4
5
6
PRESSURE SENSOR WIRING DETAIL

PARTS LIST

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	A2A0014	Driven Wheel
2	1	A2M0206	Transducer Block
3	1	A2M0203	Guide Block
4	1	A2M0204	Bearing Cartridge
5	1	A2M0205	WFS Shaft
6	1	A3E0159	Top Cover
7	1	A3E0160	Bottom Cover
8	1	A3E0141	Guide Handle
9	1	A3E0161	PCB Mounting Bracket
10	1	A3E0165	Micro ADM Status Overlay
11	1	A5A0109-MA	Micro ADM PCB Assembly
12	1	A2M0207	Small Current Sensor Tube
13	1	A2M0208	Large Current Sensor Tube
14	2	X2B5070	Bearing #R4FF MRC
15	2	X2B5002	Stationary Bushing #B-1 Dua-L-Vee
16	2	X2N5023	Flat Spring #U-FS-2 Small Parts
17	2	X2P5004	Wheel #W1-X Dua-L-Vee
18	1	X3M5044	Encoder, Optical 256 cpr #HEDS-5500F06 Agilent
19	13	X3P5138	Crimp, Terminal #08-56-0110 Molex
20	1	X3P5224	Connector, Housing 6 circuit #22-01-2067 Molex
21	2	X3P5443	Connector, Housing 5 circuit #22-01-2057 Molex
22	2	X3P5767	Block, Terminal Series VDFK #0708250 Phoenix
23	1	X3P5805	Connector, RCPT 5 circuit #FS4.5-0.5 Turck
24	1	X3P5807	Connector, RCPT 8 circuit #FS8-0.5 Turck
25	1	X3Q5017	Pressure Sensor #MPX5100DP Motorola
26	1	X3Q5013	Hall Effect Current Sensor #BB-600 FW Bell
27	2	X6P5007	Dowel Pin, 0.093" diameter ¾" long #D2-6 Berg
28	1	X6B5025	Retaining Ring, ¼" External #5100-25 Thruarc
29	1	X6B5054	Shaft Collar #DSCA-5 Small Parts
30	2	X6B5055	Locator Button #CL-1-SLB Carr Lane
31	1	X6F5090	Fitting, Quick Disconnect #BST-2M Parker
32	1	X6F5102	Fitting, Nipple #BST-N2M Parker
33	1	X6F5119	Fitting, Coupling Anchor 1/8" NPT #207ACBHS-2 Parker
34	1	X6F5118	Fitting, Elbow 3/16" Hose 1/8" NPT #5013008 New Age
35	1	X6F5115	Fitting, Elbow 1/4" Hose 1/8" NPT #5013043 New Age
36	2.5"	X6H5019	Tubing, Black 0.17" ID 0.25" OD #2121483 New Age
37	1		Clamp, Hose 1/4"
38	1	X6Z5092	Plug, Hole Short 7/8" Black #1699 Heyco
39	3		#0-80 x 3/8" long Philips Pan Head Screw
40	2		#4-40 x 1/2" long Binder Head Screw
41	1		#4-40 x 5/16" long Pan Head Screw w/ Internal Lock Washer
42	21		#6-32 x 5/16" long Pan Head Screw w/ Internal Lock Washer
43	2		Fitting, Elbow 1/4" Hose 1/8" NPT #5013043 New Age
44	2		#8-32 x 1/2" long Socket Flat Head Screw
45	22"		Wire, 24 AWG CSA Type Tr-64 Brown
46	22"		Wire, 24 AWG CSA Type Tr-64 Red
47	18"		Wire, 24 AWG CSA Type Tr-64 Orange
48	14"		Wire, 24 AWG CSA Type Tr-64 Yellow
49	14"		Wire, 24 AWG CSA Type Tr-64 Green
50	1	A5A0117	I-Dart I/O PCB Assembly
51	2	X6S5023	Spacer, M-F #6-32 x 1/2" long #8250 HH Smith
52	2		#6-32 x 5/8" long Pan Head Screw
53	1		Micro ADM Sensor Serial Number Label
54	1		Warning #1 Label

B.4 Micro ADM™ Sensor Assembly P/N: A3A0226 Rev: C



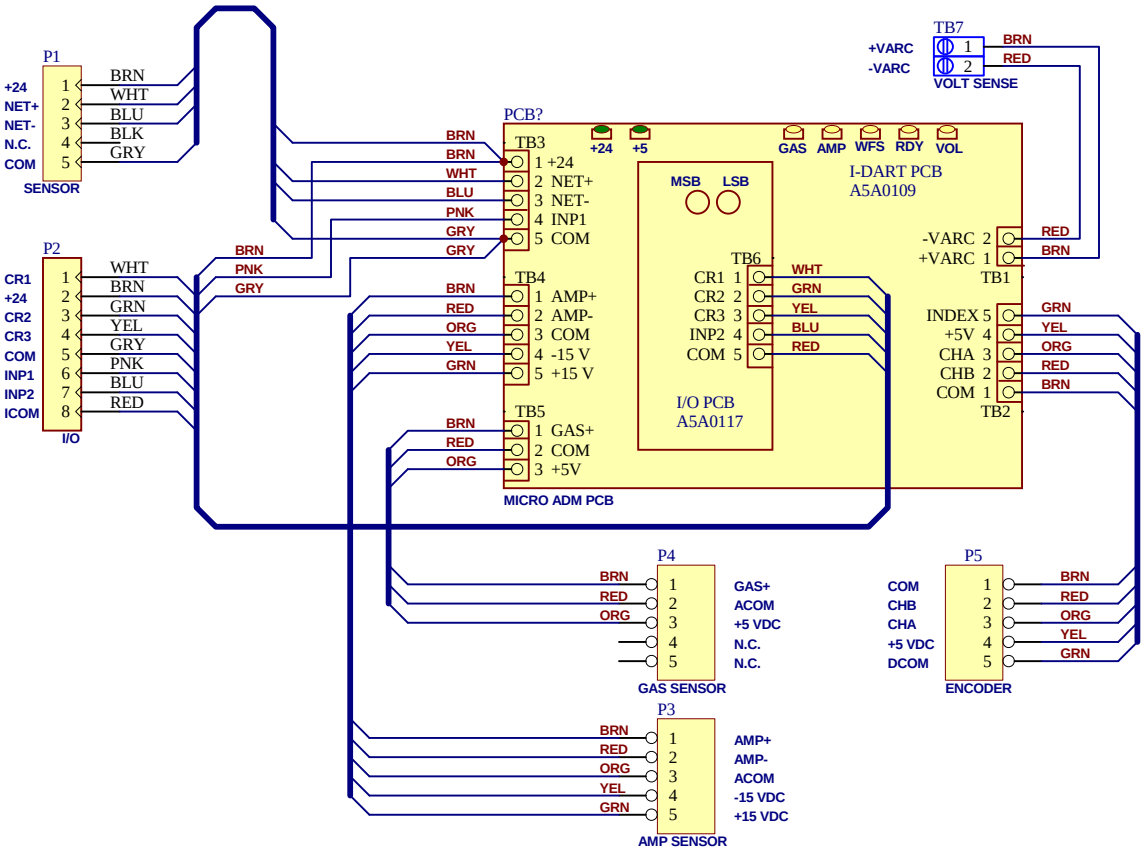

4-1/2"
1/8" (STRIP WIRE)
23
TERMINATION:
TB3-1 BROWN
TB3-2 WHITE
TB3-3 BLUE
TB3-4 BLACK
TB3-5 GRAY
1 - BROWN
2 - WHITE
3 - BLUE
4 - BLACK
5 - GRAY
OUTPUT CONNECTOR WIRING DETAIL
6"
1/8" (STRIP WIRE)
45 46 47 48 49
21
5 PLS 19
TERMINATION:
TB2-1
TB2-2
TB2-3
TB2-4
TB2-5
1 - BROWN
2 - RED
3 - ORANGE
4 - YELLOW
5 - GREEN
ENCODER WIRING DETAIL
8"
1/8" (STRIP WIRE)
45 46 47 48 49
21
5 PLS 19
TERMINATION:
TB4-1
TB4-2
TB4-3
TB4-4
TB4-5
1 - BROWN
2 - RED
3 - ORANGE
4 - YELLOW
5 - GREEN
CURRENT SENSOR WIRING DETAIL
3-1/2"
1/8" (STRIP WIRE)
45
22
TERMINATION:
TB1-1 BROWN
POSITIVE TERMINAL WIRING DETAIL
3-1/2"
1/8" (STRIP WIRE)
46
22
TERMINATION:
TB1-2 RED
NEGATIVE TERMINAL WIRING DETAIL
4-1/2"
1/8" (STRIP WIRE)
45 46 47
20
3 PLS 19
TERMINATION:
TB5-1
TB5-2
TB5-3
1 - BROWN
2 - RED
3 - ORANGE
4
5
6
PRESSURE SENSOR WIRING DETAIL

PARTS LIST

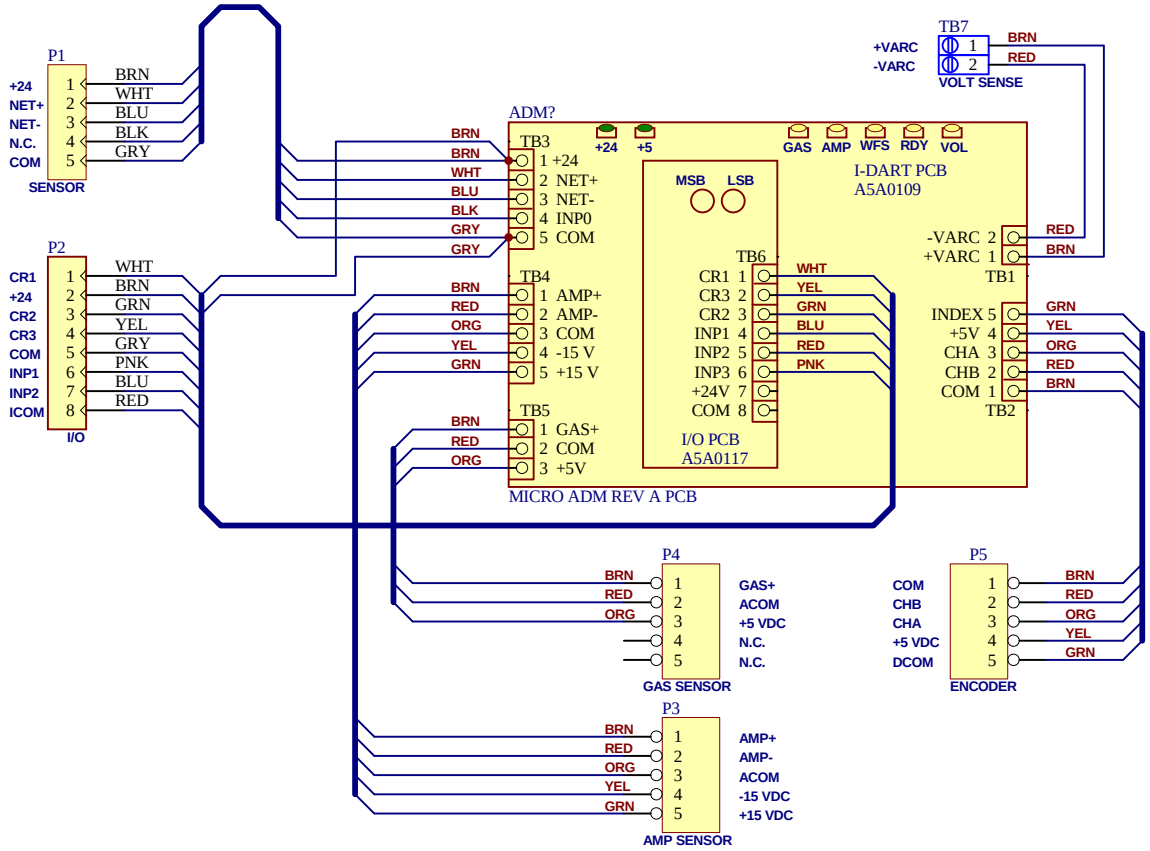
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	A2A0014	Driven Wheel
2	1	A2M0206	Transducer Block
3	1	A2M0203	Guide Block
4	1	A2M0204	Bearing Cartridge
5	1	A2M0205	WFS Shaft
6	1	A3E0159	Top Cover
7	1	A3E0160	Bottom Cover
8	1	A3E0141	Guide Handle
9	1	A3E0161	PCB Mounting Bracket
10	1	A3E0165	Micro ADM Status Overlay
11	1	A5A0109-MA	Micro ADM PCB Assembly
12	1	A2M0207	Small Current Sensor Tube
13	1	A2M0208	Large Current Sensor Tube
14	2	X2B5070	Bearing #R4FF MRC
15	2	X2B5002	Stationary Bushing #B-1 Dua-L-Vee
16	2	X2N5023	Flat Spring #U-FS-2 Small Parts
17	2	X2P5004	Wheel #W1-X Dua-L-Vee
18	1	X3M5044	Encoder, Optical 256 cpr #HEDS-5500F06 Agilent
19	13	X3P5138	Crimp, Terminal #08-56-0110 Molex
20	1	X3P5224	Connector, Housing 6 circuit #22-01-2067 Molex
21	2	X3P5443	Connector, Housing 5 circuit #22-01-2057 Molex
22	2	X3P5767	Block, Terminal Series VDFK #0708250 Phoenix
23	1	X3P5805	Connector, RCPT 5 circuit #FS4.5-0.5 Turck
24	1	X3P5807	Connector, RCPT 8 circuit #FS8-0.5 Turck
25	1	X3Q5017	Pressure Sensor #MPX5100DP Motorola
26	1	X3Q5013	Hall Effect Current Sensor #BB-600 FW Bell
27	2	X6P5007	Dowel Pin, 0.093” diameter ¾” long #D2-6 Berg
28	1	X6B5025	Retaining Ring, ¼” External #5100-25 Thruarc
29	1	X6B5054	Shaft Collar #DSCA-5 Small Parts
30	2	X6B5055	Locator Button #CL-1-SLB Carr Lane
31	1	X6F5090	Fitting, Quick Disconnect #BST-2M Parker
32	1	X6F5102	Fitting, Nipple #BST-N2M Parker
33	1	X6F5119	Fitting, Coupling Anchor 1/8” NPT #207ACBHS-2 Parker
34	1	X6F5118	Fitting, Elbow 3/16” Hose 1/8” NPT #5013008 New Age
35	1	X6F5115	Fitting, Elbow 1/4” Hose 1/8” NPT #5013043 New Age
36	2.5”	X6H5019	Tubing, Black 0.17” ID 0.25” OD #2121483 New Age
37	1		Clamp, Hose 1/4”
38	1	X6Z5092	Plug, Hole Short 7/8” Black #1699 Heyco
39	3		#0-80 x 3/8” long Philips Pan Head Screw
40	2		#4-40 x 1/2“ long Binder Head Screw
41	1		#4-40 x 5/16” long Pan Head Screw w/ Internal Lock Washer
42	21		#6-32 x 5/16” long Pan Head Screw w/ Internal Lock Washer
43	2		Fitting, Elbow 1/4” Hose 1/8” NPT #5013043 New Age
44	2		#8-32 x 1/2” long Socket Flat Head Screw
45	22”		Wire, 24 AWG CSA Type Tr-64 Brown
46	22”		Wire, 24 AWG CSA Type Tr-64 Red
47	18”		Wire, 24 AWG CSA Type Tr-64 Orange
48	14”		Wire, 24 AWG CSA Type Tr-64 Yellow
49	14”		Wire, 24 AWG CSA Type Tr-64 Green
50	1	A5A0117	I-Dart I/O PCB Assembly
51	2	X6S5023	Spacer, M-F #6-32 x 1/2” long #8250 HH Smith
52	2		#6-32 x 5/8” long Pan Head Screw
53	1		Micro ADM Sensor Serial Number Label
54	1		Warning #1 Label

Appendix C Schematic Diagrams

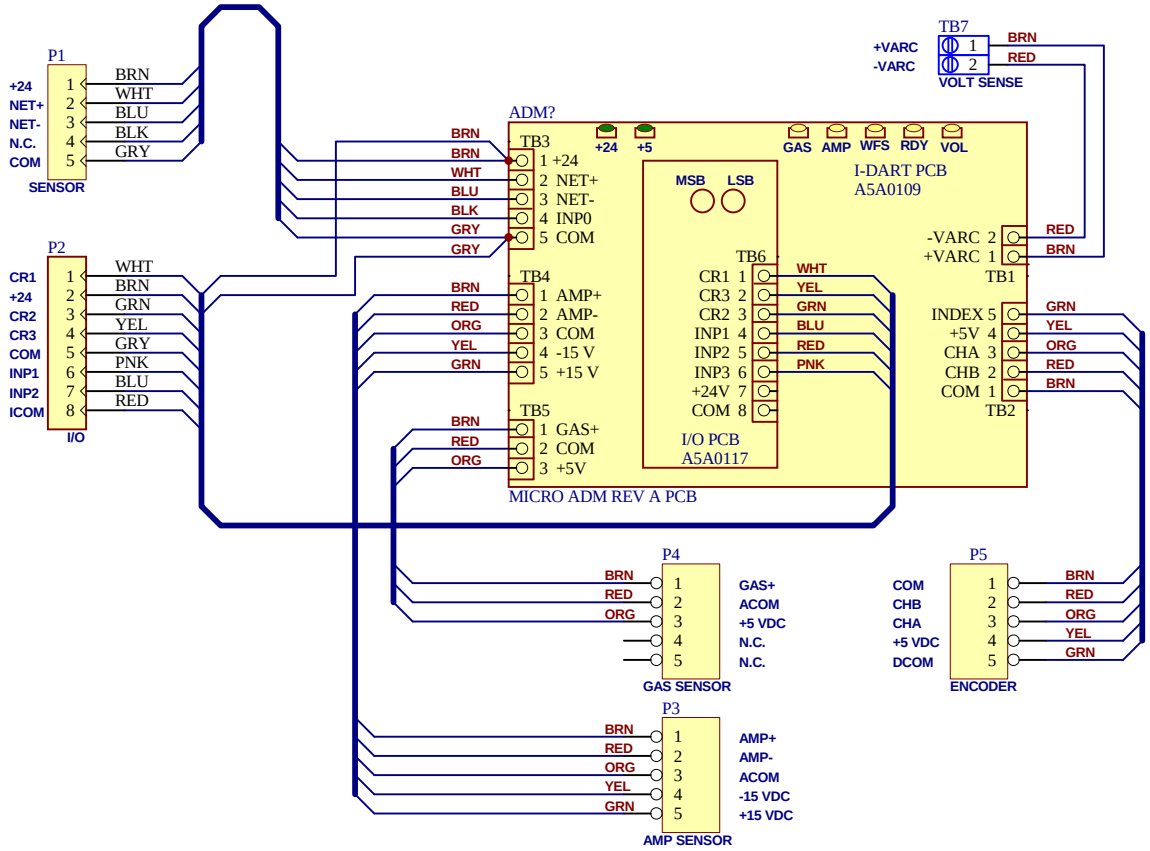
C.1 Micro ADM™ Sensor Assembly P/N: A3A0226 Rev: 0



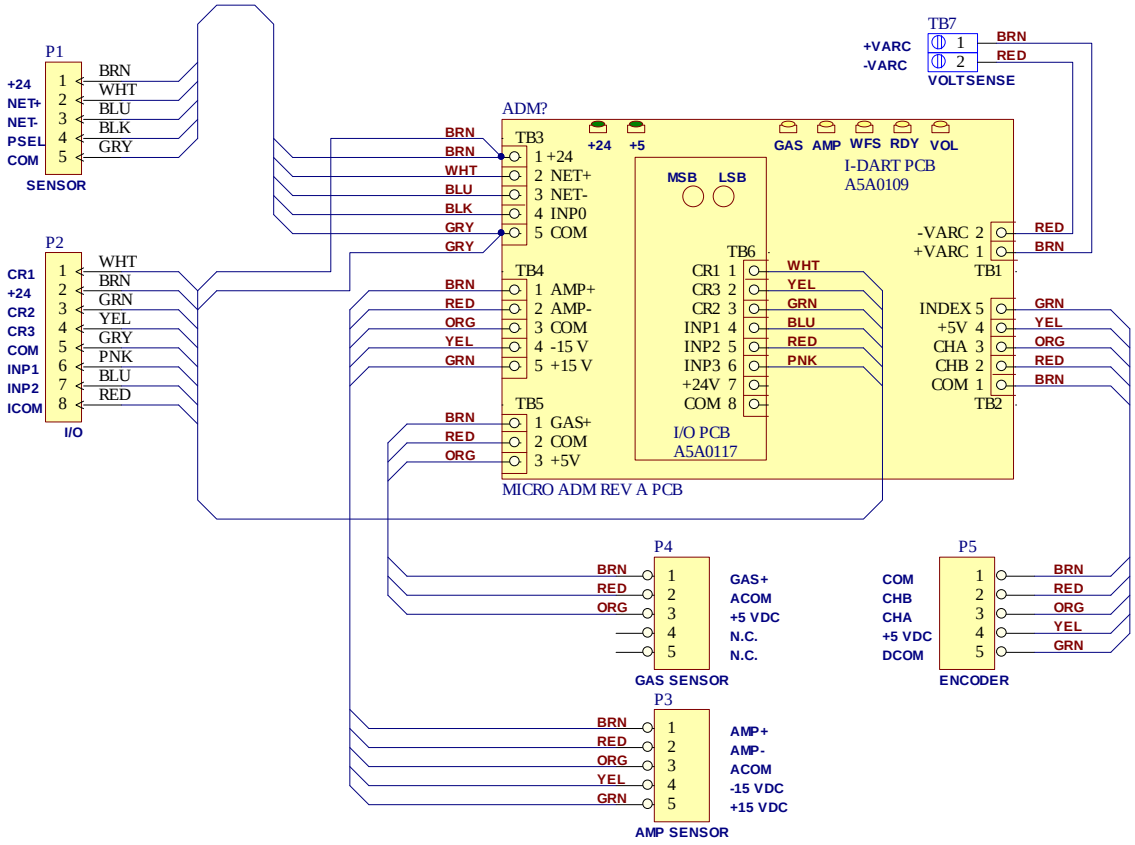
C.2 Micro ADM™ Sensor Assembly P/N: A3A0226 Rev: A



C.3 Micro ADM™ Sensor Assembly P/N: A3A0226 Rev: B



C.4 Micro ADM™ Sensor Assembly P/N: A3A0226 Rev: C



Appendix D Device ID MSB and LSB Decode Table

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