interface

ADVANCED FORCE MEASUREMENT

Model 9860

Digital Indicator

Issue: 13-76 Revision B

User Manual

www.interfaceforce.com

Description

The Model 9860 is a TEDS IEEE 1451.4 compliant, enhanced performance, microprocessor-based indicator capable of interfacing directly to a low level strain gage load cell transducer. The 9860 provides (3) user selectable calibration modes and (1) factory calibration mode. **Consult Interface before accessing the factory calibration mode.**

1. **CAL1**: Manual entry of zero and calibration values using a live or simulated transducer input.
2. **CAL2**: Allows calibration to a specific non-TEDS transducer, when the MAXIMUM FORCE and MAXIMUM ELECTRICAL values (mV/V), of that specific transducer are known.
3. **TEDS**: The 9860 automatically calibrates itself, when power is applied, if connected to a TEDS transducer. It must first sense a TEDS connection and then successfully read the TEDS template #33 data stored in a one-wire DS2344 or similar microchip on a configured transducer. This calibration mode overrides any previously stored calibration.

An internal, high gain, fully-differential amplifier and a 16-bit analog-to-digital converter combine to accurately digitize the input signal. This signal is filtered by a 1kHz analog filter. An additional, smart digital filter, with user selectable sample size and filter window (band), allows optimization for specific operating conditions, trading off depth of filtering and step change tracking. Unique, dual auto-calibrated ±10Vdc and 4-20mA real time analog outputs are standard. A RS232 interface provides facilities to continuously read data communicate command and query operating modes and parameters. A powerful 8-bit microprocessor utilizes a Real Time Operating System (RTOS) to provide seamless control of display, communications and mathematical computations.

A TEDS status indicator provides the information on the TEDS configuration of the input. See table for TEDS indicator description.

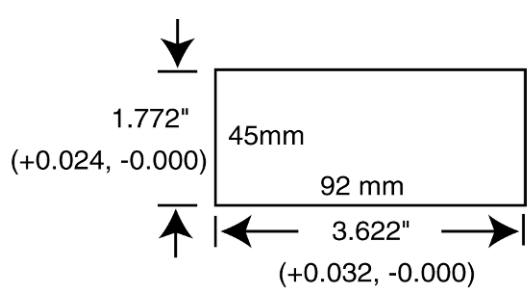
A precision 10Vdc @ 120mA, short circuit protected, transducer excitation supply is also provided.

A front panel RCAL switch provides a convenient feature for checking calibration. TARE and CALIBRATION are easily performed via front panel pushbuttons.

Installation and Wiring

INSTALLATION

The Model 9860 enclosure is designated for panel mounting in a 1/8 DIN cutout. The cutout dimensions are shown below.



To panel mount the 9860, perform the following steps.

1. Rotate the four pawl screws (outside screws in each corner) several turns counter-clockwise to retract the pawls. Make sure the pawls retract enough to clear the back of the mounting panel. The pawls may be retracted to accommodate panel thicknesses up to 0.25 inches (6.35mm).
2. Insert the instrument into the panel cutout.
3. Position the pawls so that their elongated dimension overlaps the panel cutout, and then tighten the screws. **Do not over-tighten!**
4. Installation complete.

WIRING

Reference Figures 3 and 4 for TRANSDUCER and I/O wiring information. Power is applied with a 3-prong AC power cord. The instrument is protected by a 250V, 315mA 5mm fuse. The fuse holder is an integral part of the input power connector. A spare fuse is provided in the fuse holder.

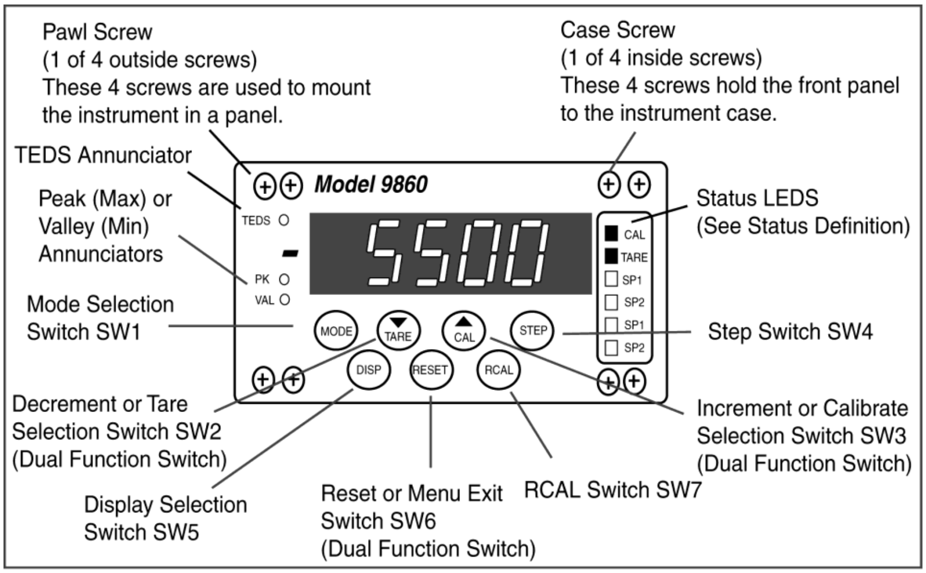


Figure 1- Model 9860 Front Panel View

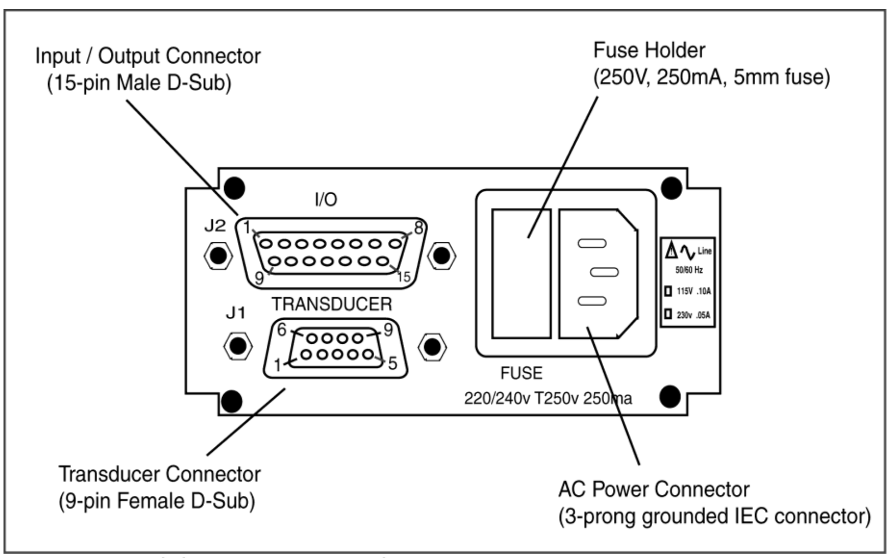


Figure 2. Model 9860 Rear Panel View

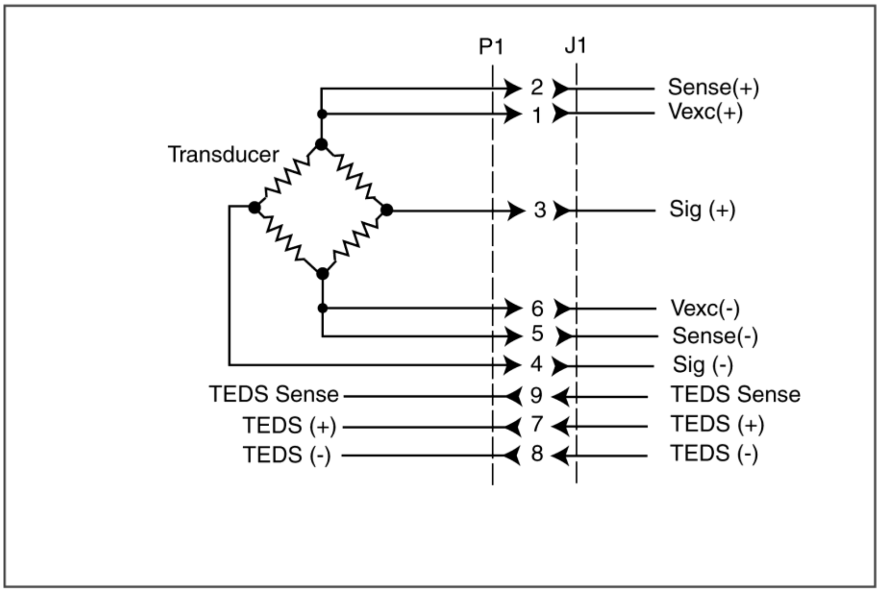


Figure3. Transducer Wiring – NOTE: for optimum performance cable shield should be connected to the instrument chassis.

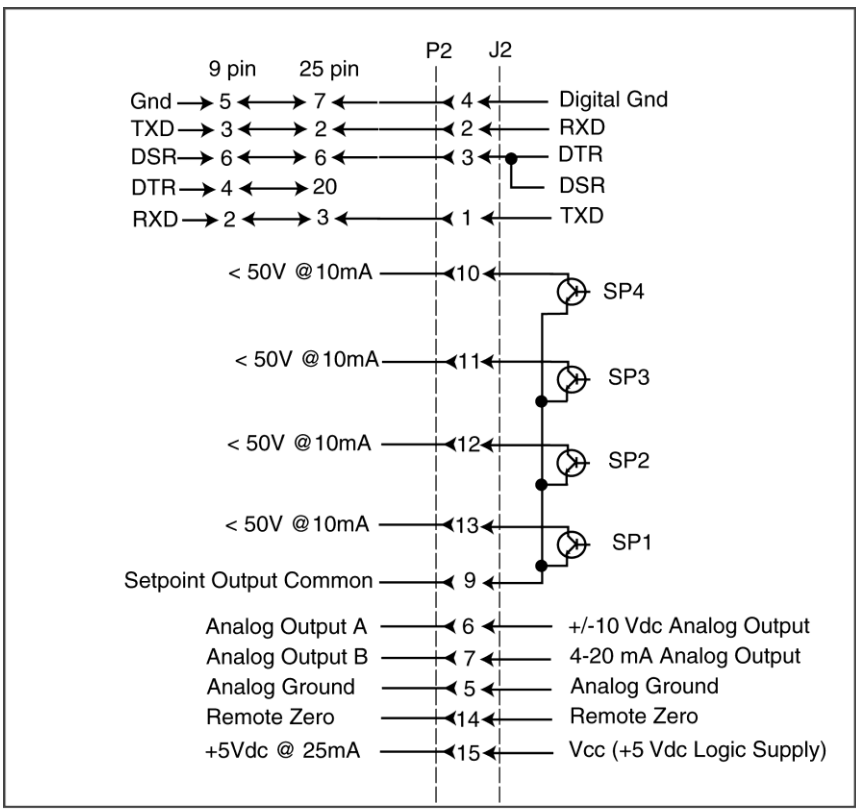


Figure 4. I/O Wiring

Open Collector Set point Outputs

The Interface model 9860 load cell indicator is equipped with open collector set point outputs. Open collector outputs work somewhat like dry relay contacts except that they only allow current to flow in one

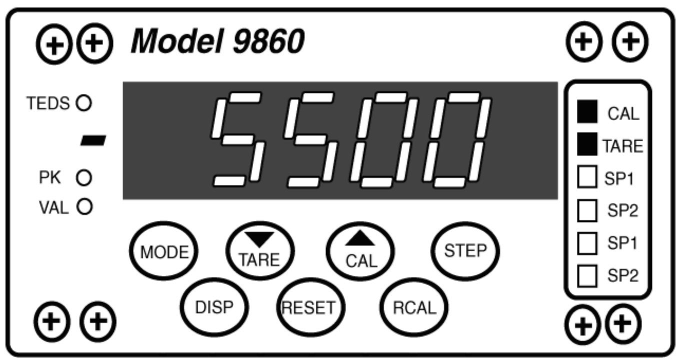
direction. The beauty of open collector outputs is, since these outputs are floating, they can be used with any voltage source up to 50 VDC. In this way you can match the output voltage level of the 9860 to any external equipment input be it 2.5 VDC or 48 VDC.
See Appendix H for further details.

Input range and analog output adjustment settings

The 9860 has selectable 2.5 and 5mV/V transducer inputs. See appendix F for further details.

Front Panel Switch and Function Definitions

SWITCH DEFINITIONS



Mode Selection Switch

Mode is used to cycle through the various programmable functions of the 9860. The sequence is as follows. The designators, in { }, identify text that will be displayed. The settable values are shown in ( )
Note: After a setting has been changed the mode switch must be pressed to save the changed value.

Factory Default Settings

Full Scale CAL Switch Disabled {CAL Off} or Enabled {CAL On}	CAL Off
Filter Value {FILtEr} (00 to 99)	99
Filter Window Value {bAnd} (001 to 999)	999
Decimal Point {dP} (x.xxxx, xx.xxx, xxx.xx, xxxx.x, xxxxx)	xxxxx
Calibration Number {CAL} (00001 to +/-99999)	10000
Full Scale Number {FS} (00001 to +/-99999)	10000
Setpoint 1 to Monitor {SP-} (Instantaneous, Peak, Valley, Peak-Valley)	Instantaneous
Setpoint 1 to be {SP1} high setpoint (HI) or low setpoint (LO)	High Setpoint
Set Setpoint 1 Value (Set SP) (00000 to +/-99999)	99999
Setpoint 2, 3 and 4 use the same format	
Hysteresis for Low Setpoints {HL} (000 to 200)	000
Hysteresis for High Setpoints {HH}	000

While in the Mode Selection sequence, the indicator is no longer monitoring the input signal. To exit Depress MODE once to save any changed settings, and then RESET to return to normal operation.

Decrement or Tare Switch 

This switch serves two functions, depending on the present status of MODE. If the meter is in the Mode Selection sequence, this switch decrements the flashing digit.
If the meter is in its normal operating mode, it becomes the TARE switch. Depressing TARE will automatically zero the readout, illuminate the TARE LED and zero the analog output. Depressing and holding TARE depressed for approximately 3 seconds will UNTARE the readout and extinguish the TARE

LED. TARING is accomplished by storing the reading prior to TARING and subtracting this value from all subsequent readings.

Increment or Cal Switch

This switch also serves two functions, depending on the present status of MODE. If the instrument is in the Mode Selection sequence, this switch functions in the following manner.

1. In the CAL selection mode, it selects the calibration mode: CAL OFF, CAL1 or CAL2.
2. In the parameter update mode, it will increment the flashing digit or toggle status.

If the instrument is in its operating mode and waiting for a CAL1 calibration to be performed this switch will input zero and calibration values. ***Be sure to read Appendix B & C before using this switch.***

Step Switch

When the instrument is in the Mode Selection sequence, this switch allows the user to cycle through the digits. Used In conjunction with and it allows rapid updating of numerical values.

Display Switch

In operating mode this switch cycles the readout to display:

	Annunciator(s) Illuminated
Peak-Valley	PK and VAL
Peak	PK
Valley	VAL
Instantaneous readings	None

While in the Peal-Valley, Peak or Valley readout mode, the RESET switch resets the readout to the instantaneous value. In the Peak-Valley readout mode, resets both Peak and Valley readouts to the instantaneous value.

Reset or Exit Switch

This switch also serves two functions, depending on the present status of MODE. If the instrument is in the Mode selection sequence, this switch is used to Exit this sequence and return to the normal display mode. Any selections made during the Mode Selection sequence, prior to that selected just before exiting, will be saved and remembered in non-volatile memory.

If the instrument is in the normal (instantaneous) display mode the reset switch will reset the stored Peak, Valley and Peak-Valley readings to the current Instantaneous value.

RCAL Switch

This switch activates a reed relay, which places a fixed resistor across -Sig and -Vexc for a positive RCAL reading, or across -Sig and +Vexc for a negative RCAL reading. Removing the back panel of the instrument case will allow access to the RCAL resistor and settings jumper. The jumper on P2 determines the polarity of the RCAL output with position 1 for negative and position 2 for positive. The RCAL resistor can be changed if desired; a 10ppm tempco resistor is recommended.

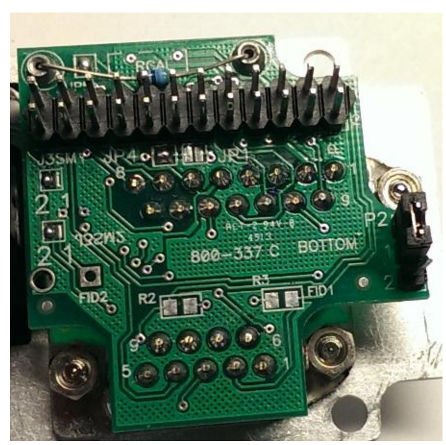


Figure 8 – Location of Rcal direction Jumpers and Rcal resistor.

Menu Function Definitions

Filter Value (FILtEr) (00 to 99)

The 9860 uses a filter based on a digital averaging technique where N samples are arithmetically averaged.
Subsequent averages subtract the oldest reading and add the newest reading. The number of readings is equal to the value of (FILtEr). The default filter setting is 99.
Higher (FILtEr) values produce stronger filtering with a slower response. Maximum Filtering=99.

Filter Band (bAnd) (001 to 999)

To permit a heavy filter and still have fast response to a step input change, the filter operates only inside a stable Band. If two consecutive conversions have a difference greater than the **bAnd value**, the instrument temporarily shuts off the filter, permitting maximum response. When the difference is again within the **bAnd value**, the filter returns to the selected (FILtEr) value. The **bAnd** number corresponds roughly to the raw ADC counts. The factory default is **bAnd** = 999. ***See appendix A for filter details***.

Decimal Point (dP) (x.xxxx, xx.xxx, xxx.xx, xxxx.x, xxxxx)

dP allows selection of decimal point locations for display. The locations selectable are shown in ( ) above. The Increment and Decrement switches are used to shift decimal places.

Calibration Number (CAL) (00001 to 99,999)

In the **ON1** mode, the (CAL) is equal to the desired reading corresponding to the calibration load, whether the load is Actual, simulated or from RCAL. This value is in user units (lbf or N for example). The number is entered prior to performing the calibration. A Full Scale Number must also be entered to scale the ANALOG output. See ANALOG OUPUTS for a detailed description.

In the **ON2** mode, (CAL) is equal to the FULL SCALE value of the transducer. The full scale value will be Automatically set to the Calibration Number.

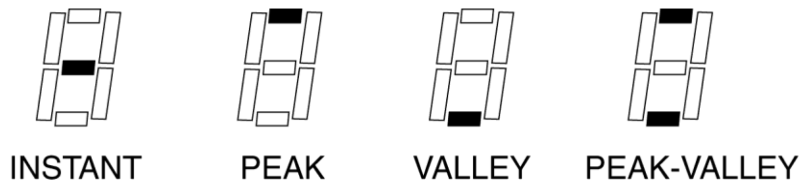
In the **TEDS** mode, the (CAL) value is automatically set, by the instrument, to the (FS) value read from the Transducer. See CALIBRATION INSTRUCTIONS for more details.

Scale
In the calibration **ON2** mode, the SCALE value is equal to the transducer MAXIMUM OUTPUT value in mV/V as found on a calibration certificate. In this mode values are entered manually similar to what would be automatically uploaded from a TEDS transducer. SCALE is only changeable in the ON2 mode.

Full Scale Number (FS) (00001- to +/-99999)
The (FS) represents the value at which the ANALOG output is at full value (10v or 20mA). In the ON1 calibration mode this value can be altered to fit the needs of the user. For example if using a 10000lbf load cell but the user is only interested in the output up to 5000lbf the FS can be set for 5000 for a 10V output at 5000lbf. The display would still read values up to and over 10000lbf. This allows for a higher analog output resolution (lower noise) over a smaller input range of interest.
In the **ON2** mode, the (FS) value is equal to the user entered CAL value. (FS) is automatically updated when the CAL value is updated. It cannot be altered by the user.
In the **TEDS** mode, (FS) is used to indicate the full scale value of a TEDS transducer. (FS) cannot be changed in this mode.

Setpoint *x* to Monitor

This function allows Setpoints 1-4 to monitor the instantaneous, peak, valley, or peak minus valley displays. The Increment or Decrement switches are used to cycle through the various displays. To signify which display is being monitored, the least Significant 7-segment display will be illuminated as shown below.



Setpoint *x* to be (SP*x* HI) {SP*x* HI, SP*x* LO}

This allows Setpoints 1-4 to be a High or Low Setpoint. The Increment or Decrement switches are used to cycle through the HI or LO selection.
A High Setpoint is disabled when the compared value is less than the Setpoint value. The High Setpoint is enabled when the compared value is equal to or greater than the Setpoint value.
A Low Setpoint is disabled when the compared value is greater than the Setpoint value. The Low Setpoint turns on when the compared value is equal to or less than the Setpoint value.

Set Setpoint *x* Value (Set SP) {00000 to +/-99,999}

Setpoints 1-4 can be set for any value from 00000 to +/-99,999. This value along with the previous selection of SP HI or SP LO determines when the optically isolated open-collector output transistors are activated and the relevant SP enunciator is illuminated.

Hysteresis Low (HL) {000 to 200}

HL is the hysteresis value for all Setpoints set to SP LO. HL determines the value the displayed reading must exceed the Setpoint value by before deactivating their respective open-collector output(s).

Hysteresis High (hh) {000 to 200}

HH is the hysteresis value for all Setpoints set to SP HI. HH determines the value the displayed reading must get below the Setpoint value by before deactivating their respective open-collector output(s).
See appendix D for programming instructions.

Operating Instructions

Turn-On Instructions

Reference Figures 3 and 4 for proper input and output signal wiring.

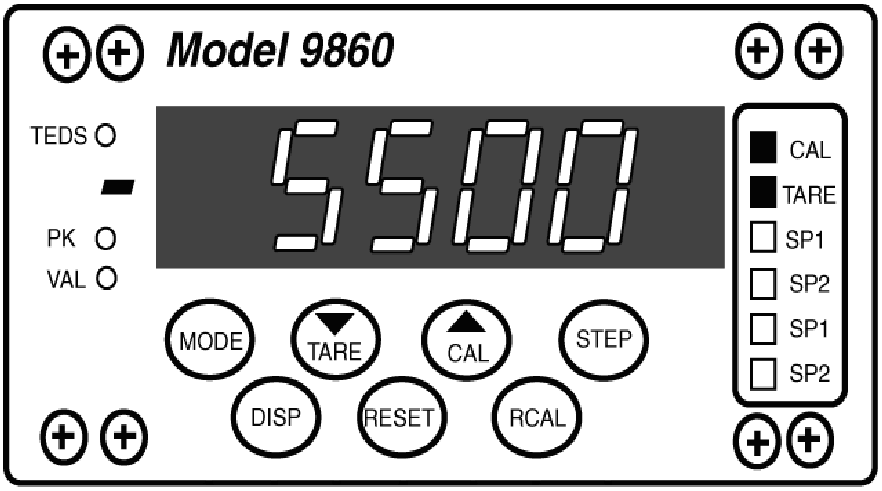
1. Apply power to the instrument.
2. Verify the instruments readout momentarily displays a **relx.xr** firmware version number.

Program Instructions

(4) front panel switches allow the user to program Cal Mode, LSD, Decimal Point (dP), Filter

Value, Filter Window (bAnd), Calibration Number (CAL), Scale, Full Scale Number (FS), Setpoint to Monitor (SP-), Setpoint to be (SP HI), Setpoint value (Set SP), Hysteresis Low (HL), Hysteresis High (HH) and Baud rate values.

To exit the MODE sequence without enabling a change, depress the RESET switch. All entries prior to RESET, not including the function active at RESET, will be updated.



Calibration Instructions

The Model 9860 provides three (3) calibration modes. In the **OFF** state, the **CAL1** and **CAL2** manual entry modes are disabled.

1. **CAL1**
2. **CAL2**
3. **TEDS**
   Auto calibration when connecting to a TEDS, Template #33 configured transducer, with TEDS sensing pin. In the TEDS AUTO MODE, the unit self calibrates to the **MAXIMUM FORCE** and MAXIMUM OUTPUT values found in the TEDS transducer. The 9860 updates the CAL value to the MAXIMUM FORCE value read from the TEDS template.

   Calibration is automatic if the 9860 senses a TEDS connection and is able to read the TEDS microchip imbedded in the transducer. Simply connect the TEDS transducer to the 9860 and apply power. The displayed reading and analog outputs are automatically calibrated.
   The TEDS parameters are stored in non-volatile memory. When the TEDS transducer is disconnected and reconnected or a different TEDS transducer, with sensing pin, is connected, the unit automatically self calibrates, without the need for power recycling. The TEDS LED indicates the state of the TEDS connection. See **TEDS INDICATOR AND BLINK CONFIGURATIONS** for detail description. ***See appendix B & C for programming instructions.***

TEDS Indicator LED behavior

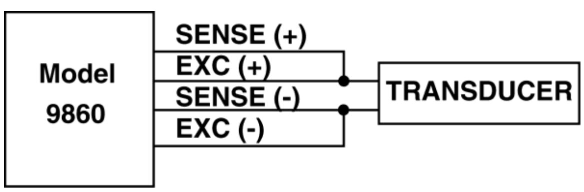
The following TABLE describes the functionality of the red TEDS led. The led is ON when a combination of TEDS SENSE switch or TEDS ROM is detected. The particular combination is indicated by the led activity. If the TEDS SENSE switch and valid TEDS ROM data are detected, the led is ON steady. If TEDS SENSE switch is detected and valid TEDS ROM is not detected, the led blinks FAST. If TEDS SENSE switch is not detected and valid TEDS ROM is detected, the led blinks SLOW. A blink condition indicates a problematic situation.

If both TEDS SENSE SWITCH and valid TEDS ROM are not detected, the TEDS led is OFF. The instrument is in one of the other calibration modes: Either OFF, ON1 or ON2.

TEDS SWITCH	ROM DETECTED	TEDS LED	CAL MODE	BLINK STATE
NO	NO	OFF	OFF	NONE
NO	NO	OFF	CAL1	NONE
NO	NO	OFF	CAL2	NONE
NO	YES	ON	TEDS	SLOW
YES	NO	ON	TEDS	FAST
YES	YES	ON	TEDS	NONE

Excitation Supply

A switchable 5 or 10Vdc @ 120mA, short circuit protected, transducer excitation supply is provided. ***See appendix E for excitation voltage selection*.**
The connection to the transducer is shown below. The SENSE(+) and SENSE(-) leads can also be connected at the D-Sub connector on the 9860, rather than at the transducer. Connecting it at the TRANSDUCER provides a more accurate excitation voltage at the TRANSDUCER. If the instrument is only to be used with 4-wire sensors, JP2 and JP3 on the connector PCB can be solder bridged to terminate the sense leads at the connector.



The EXC output is short circuit protected from shorts to ground. When a short to ground is detected, the output current is reduced to prevent damage. In most cases, removing the short will cause the output to recover. If removing the short fails to cause recovery, recycle the AC line power.

Analog Outputs

The 9860 provides auto-calibrating ±10Vdc and 4-20mA analog output signals. The maximum output of 10 volts or 20mA corresponds to the FULL SCALE value. Both the 10V output and the 4-20mA outputs are automatically scaled by (FS). (FS) = the display value that corresponds to the full scale spans of the outputs, either 10V or 20mA. The ANALOG output is a digitally-scaled, real time, analog filtered and buffered output directly proportional to the input.

Examples:

1. A 9860 reads TEDS capable transducer with a maximum capacity of 10,000 lb. FS will indicate 10000. The actual load is 4000 lb. The voltage output is +(4000/10000)X10=+4 V and +(4000/10000)x16+4=10.4 mA.

2. A 9860 is in the ON1/OFF mode. The CAL and FS values are 10000 lb and 20000 lb, respectively. The actual load is 50000 lb. The voltage output is +(5000/20000)X10=+2.5 V and +(5000/20000)x16+4=8.0 mA.

3. A 9860 is in the ON2 mode. The CAL and FS values are 15000 lb. The actual load is 9000 lb. The voltage
Output is +(9000/15000)X10=+6.0 V and +(9000/15000)x16+4=13.6 mA.

The TARE function operates on the analog output the same as it does on the digital display. The polarity of the analog output is always the same as the input signal. However, the 4-20 mA output is unipolar and is linear only with positive input signals. Signals less than zero are clamped and will typically generate only 2mA on the 4-20mA output.

Serial RS232 Communications

General Information

See Figure 4 on page 4 for RS232 connections and wiring information.
See Appendix F for serial commands.

The RS232 port is always active. The data is transmitted in the following format:
One Start Bit;
Eight Data Bits;
No Parity Bit;
One Stop Bit;
Baud rate is set manually through the MODE sequence or via the RS232 port. Available baud rates are: 9600, 19.2k, 38.4k, 57.6k and 115.2k baud. The **default baud rate is 115200**.

Transmissions to and from the Model 9860 is defined in the following Tables:
<CR> denotes ENTER
XON and XOFF are used to control transmission of a continuous data stream
INPUT, MAX, MIN or MAX-MIN as being displayed, will be transmitted
The data being transmitted can be changed from the front panel SEL switch or by RS232 command
During data transmission, most COMMANDS and QUERYS are functional.
RESET, will function as the front panel switch
The FILTER VALUE and FILTER BAND can be updated and will immediately be implemented
TARE and UNTARE are active
DECIMAL POINT can be altered. **CAUTION: changing the DECIMAL POINT will cause the MAX-MIN Value to be in error. The MAX-MIN value must be RESET after the DECIMAL POINT change.**
The LSD can be turned ON and Off.
The HYSTERESIS values can be changed.
SETPOINT parameters can be modified

Appendix A
Understanding the 9860 Digital Filter Settings

The 9860 digital filter is implemented as a cumulative moving average filter. It is used to filter the output of a 16-bit successive approximation analog-to-digital converter running at a rate of 250 conversions per second. The filter has (2) user selectable inputs that determine the digital filter settling time and noise rejection capabilities. The user selectable inputs are Filter (01-99) and Band (000-999).

Filter (01-99) Sets the cumulative moving average filter subset size, where i=subset size. CAi = Xi/i + CAi-1(i-1/i). Xi is the unfiltered raw analog-to-digital converter data. The number of readings averaged is 4x the filter subset size.

Band (000-999) Sets the unfiltered, raw analog-to-digital converter data variation limits. It is used to determine when the cumulative moving average filter is enabled and when it is disabled. If the magnitude of the difference between 2 successive unfiltered, raw analog-to-digital converter data is less than the Band, the filter is enabled. If it is equal to or greater than the Band, the filter is disabled.

When the Band is exceeded, and the filter is disabled, the Instantaneous display of the 9860 is the unfiltered, calibrated data from the analog-to-digital converter and is read in approximately 4 milliseconds. This allows the display to follow large changes in display values, peaks or valleys, virtually instantaneously.

If the readings are within the Band and the Filter is set to 90, the digital filter is basically averaging 360 readings using a weighted moving average. This is done in 4 milliseconds. If the Band is then exceeded, it would take approximately 360 readings x (4ms/reading) or approximately 1.44 seconds to fully implement the Filter subset size.

NOTE 1: The digital filter uses the ***unfiltered***, raw analog-to-digital converter data. The Instantaneous, Peak (PK) and Valley (VAL) readings are normally ***filtered, calibrated*** analog-to-digital converter data, and with the exception explained above, when 2 successive readings initially exceed the Band.

NOTE 2: The analog output is implemented using the signal input to the 9860. The input signal is amplified, buffered and auto-scaled to the calibrated reading. It is a real time display, not the step output of a digital-to-analog converter. It is filtered by a 2-pole, 1kHz, Butterworth analog active filter.

Appendix B
Calibrating the 9860 using the CAL ON1 calibration method

The CAL ON1 calibration requires one of the following to perform.

1. A load cell and calibrated loads.
2. A precision load cell simulator or calibrator.
3. A known readout value for an applied RCAL resistor.

The 9860 has (2) input full scale ranges, 25mV and 50mV. Unless otherwise specified, the factory default is 50mV. To change the full scale range to 25mV, reference the instructions shown in Appendix F.

Example: Calibrate the 9860 to read 00000 to 10.000 with an input of ZERO and XXmV/V full scale using a precision load cell simulator or known force (weight).

Connect the 9860 to the load cell simulator. Set the simulator to ZERO and apply power to the 9860. Depress the KEY switch, followed by the ENTRY as shown below.

KEY PRESS	ENTRY	9860 DISPLAY	COMMENTS
MODE		C0dE	A prompt to enter code
	▲▼▲	CAL … OFF	Entry code accepted
	▲or▼	0n 1	CAL1 active
MODE		LSd … 0n	Least significant digit active
MODE		dP … blank display	Default setting (no DP)
	▼	x.xxxxx	Decimal point shifts l digit to the right
	▼	xx.xxxx	DP shifts to the right again
	▼	xxx.xxx	And again
MODE		FILtEr … 90	Filter value factory default setting
MODE		bAnd … 500	Filter band factory default
MODE		CAL … xxx.xxx	Last CAL number entry displayed, left most digit will be flashing
	▲▼and STEP	010.000	Use entry keys to set CAL number
MODE		SCALE … x.xxxxx	Ignore this reading
MODE		FS … xxx.xxx	Last FS entry displayed
	▲▼and STEP	010.000	Use entry keys to set FS number
MODE		SP1 -	Ignore this reading
RESET		xxx.xxx	
▲		000.000	TARE and CAL LEDs illuminate
	Set the simulator to desired full scale or apply full scale force		Verify the calibration
▲		10.000	Calibration complete

Appendix C
Calibrating the 9860 using the CAL ON2 calibration method

CAL2: Auto calibration when connecting to a non-TEDS transducer, with known MAXIMUM FORCE and corresponding MAXIMUM OUTPUT in mV/V. The mV/V values should be found on the transducer calibration sheet.

In the CAL2 mode, the MAXIMUM FORCE or CAL value and the MAXIMUM OUTPUT in mV/V or SCALE values are entered. The 9860 uses these values to auto-calibrate the readout and analog outputs. ZERO or TARE may be initiated after the CAL2 calibration is completed.
The CAL2 calibration mode does not require a transducer or simulator connection to the 9860.

KEY PRESS	ENTRY	9860 DISPLAY	COMMENTS
MODE		C0dE	A prompt to enter code
	▲▼▲	CAL … OFF	Entry code accepted
	▲or▼	0n 1	Now select CAL2
	▲or▼	0n 2	CAL2 active
MODE		LSd … 0n	Least significant digit active
MODE		dP … blank display	Default setting (no DP)
	▼	x.xxxxx	Decimal point shifts I digit to the right
	▼	xx.xxxx	DP shifts to the right again
	▼	xxx.xxx	And again
MODE		FILtEr … 90	Filter value factory default setting
MODE		bAnd … 500	Filter band factory default
MODE		CAL … xxx.xxx	Last CAL number entry displayed, left most digit will be flashing
	▲▼and STEP	010.000	Use entry keys to set CAL number
MODE		SCALE … x.xxxxx	Enter the mV/V value that corresponds to the CAL value in the last step
MODE		FS … xxx.xxx	Last FS entry displayed
	▲▼and STEP	010.000	Use entry keys to set FS number
MODE		SP1 -	Ignore this reading
RESET		xxx.xxx	
▲		000.000	TARE and LED illuminates but not CAL
	Set the simulator to desired full scale or apply full scale force		Verify the calibration
▲		10.000	Calibration complete

Appendix D
Programming set points

KEY PRESS	ENTRY	9860 DISPLAY	COMMENTS
MODE		C0dE	A prompt to enter code
	▲▼▲	CAL … OFF	Entry code accepted
MODE		SP1 -	Press MODE until setpoint menu
	▲▼	-	Monitor Normal, PK, VAL or PK-VAL
MODE		SP1 HI or L0	High or Low setpoint?
	▲▼		Select high or low
MODE		Set SP then xxx.xxx	Will display last SP value
	▲▼and STEP	xxx.xxx	Set the desired value
MODE		SP2 -	Repeat steps to program SP2 – SP4

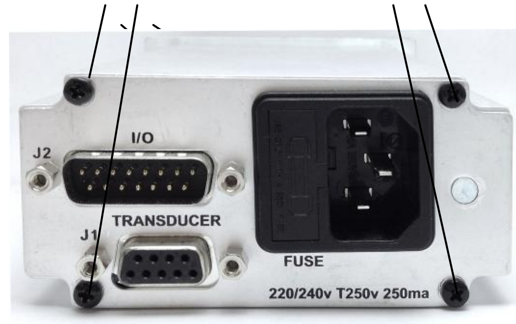
After the settings for SP4 have been entered there is an opportunity to set the hysteresis for Low and High setpoints. These values are entered the same as any other numerical value: step selected the digit and the up and down buttons selected the value of that digit.

Appendix E
Accessing Internal Switches and Potentiometers

To access the internal DIP switch and analog output potentiometer adjustments perform the following.

Remove these 4 screws

Remove these 4 screws

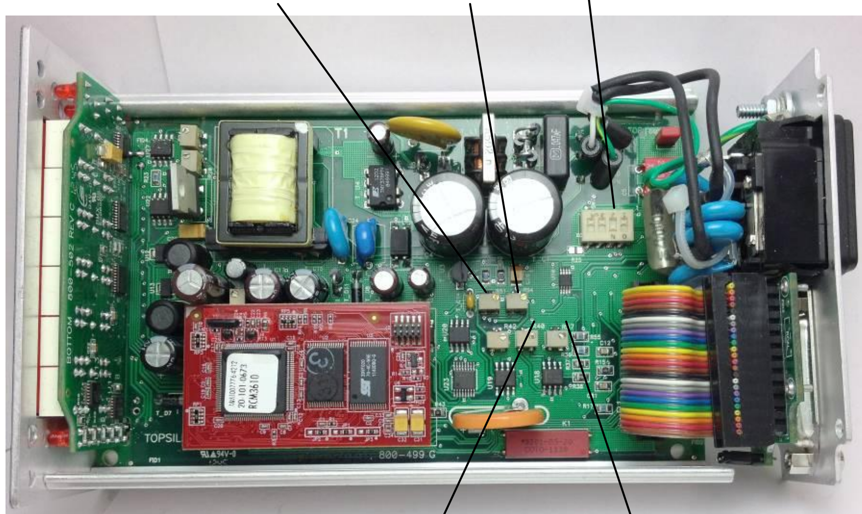


Then gently remove the top cover, to expose the DIP switch and analog output gain adjustment pots

DIP SW2 position

Excitation	4	3	2	1	INPUT RANGE
10V	ON	OFF	ON	OFF	50mV
5V	OFF	OFF	OFF	ON	25mV

20mA Adj (R51)   4mA Adj (R54)



Zero Adj (R40)   +10V Adj (R57)

Appendix F
Serial RS232 Queries and Commands

Query/Command	Response	Notes:
[<CTRL>Q]<CR>	XON serial mode	Streams current display values
[<CTRL>S]<CR>	XOFF	Meter to command mode
RS<CR>	Reset Display	Function of front panel RESET button
ZA<CR>	TARE status	Returns 0=UNTARE, 1=TARE
ZA<n><CR>	Functions as TARE button	Sets 0=UNTARE, 1=TARE

Queries and commands that derive from the set up menu

BR<n><CR>	Baud Rate Selection	n=9600, 19200, 38400, 57600 or 115200*
CV<CR> CV<nnnnnn><CR>	Cal Value	Will return 6 digit cal value
CS<CR> CS<nn.nnnn><CR>	Cal mV/V for pseudo TEDS	0.00nnnnn or n.nnnnE-03 format
DP<CR> DP<n><CR>	Decimal Point Value	0 to 5 With 0 being no decimal point
FB<CR> FB<nnn><CR>	Filter Band Value	000 to 999
FV<CR> FV<nn><CR>	Filter Value	00 to 99
FS<CR> FS<nnnnnn><CR>	Fullscale Value	999999
SF<CR> SF<nn.nnnn><CR>	Scale factor value	Returns SF in E format Use 0.00nnnnn or n.nnnnE-03 format
HH<CR> HH<nn><CR>	Hysteresis High Value	00 to 99
HL<CR> HL<nn><CR>	Hysteresis Low Value	00 to 99
IF<CR>	Instrument FS Value	Adc output with no TEDS scaling
IS<CR>	Instrument Scale Value	Scaling analog input voltage
IZ<CR>	Instrument Zero Value	Adc output with no TEDS at zero
LD<CR> LD<n><CR>	Least Display Digit On or Off	1=Off, 0=On

The following commands either return values or change the meter display mode. The 3 character

commands perform functions similar to the meter front panel DISP button

PD<CR>	Peak - Valley Value	Returns the Max-Min value
PDD<CR>	PK – VAL display	Meter displays PK-VAL value
PI<CR>	Instantaneous reading	Returns scaled reading
PID<CR>	Display readings	Meter displays scaled readings
PP<CR>	Peak Value	Returns the Max value
PPD<CR>	PK display	Meter displays the Peak value
PV<CR>	Valley Value	Returns the Min value
PVD<CR>	VAL display	Meter displays the Valley value

The following commands set the setpoint parameters

Setpoint 1		
SP1L<CR>	Setpoint HI or LOW	0 = LOW, 1 = HIGH
SP1L<n><CR>		Changes setpoint LOW or HIGH
SP1P<CR>	Setpoint parameter	0=reading, 1=PK, 2=VAL. 3=PK-VAL
SP1P<n><CR>		Sets setpoint mode
SP1V<CR>	Setpoint value	Returns nnnnnn
SP1V<nnnnnn><CR>		Sets setpoint value nnnnnn
Setpoint 2		
SP2L<CR>	Setpoint HI or LOW	0 = LOW, 1 = HIGH
SP2L<n><CR>		Changes setpoint LOW or HIGH
SP2P<CR>	Setpoint parameter	0=reading, 1=PK, 2=VAL. 3=PK-VAL
SP2P<n><CR>		Sets setpoint mode
SP2V<CR>	Setpoint value	Returns nnnnnn
SP2V<nnnnnn><CR>		Sets setpoint value nnnnnn
Setpoint 3		
SP3L<CR>	Setpoint HI or LOW	0 = LOW, 1 = HIGH
SP3L<n><CR>		Changes setpoint LOW or HIGH
SP3P<CR>	Setpoint parameter	0=reading, 1=PK, 2=VAL. 3=PK-VAL
SP3P<n><CR>		Sets setpoint mode
SP3V<CR>	Setpoint value	Returns nnnnnn
SP3V<nnnnnn><CR>		Sets setpoint value nnnnnn
Setpoint 4		
SP4L<CR>	Setpoint HI or LOW	0 = LOW, 1 = HIGH
SP4L<n><CR>		Changes setpoint LOW or HIGH
SP4P<CR>	Setpoint parameter	0=reading, 1=PK, 2=VAL. 3=PK-VAL
SP4P<n><CR>		Sets setpoint mode
SP4V<CR>	Setpoint value	Returns nnnnnn
SP4V<nnnnnn><CR>		Sets setpoint value nnnnnn

Appendix G
Factory Calibration

The instrument has been calibrated at the factory using a mV/V standard. This calibration covers the selected input range (either 2.5 or 5 mV/V) and provides a correlation of the mV/V input to the actual ADC range. If necessary a mV/V calibration can be performed in the field. NOTE this may invalidate a system calibration that had been performed by Interface.

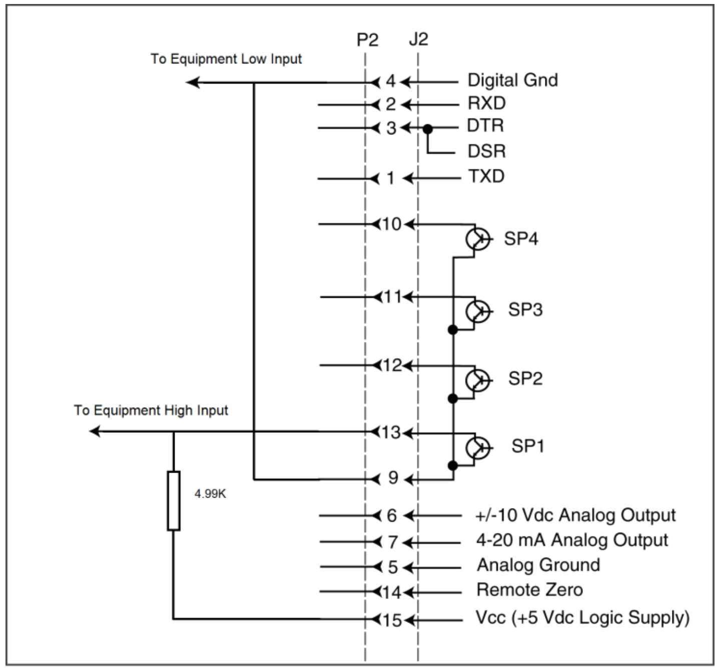
NOTES:
Always use a precision mV/V simulator for the transducer input when performing a factory calibration.
A factory calibration must be performed if the excitation voltage selection or input range was changed.
Do not perform a factory calibration with a TEDS transducer attached.

KEY PRESS	ENTRY	9860 DISPLAY	COMMENTS
MODE		C0dE	A prompt to enter code
	STEP DISP STEP	AdC ZEr0	Entry code accepted
Apply a precision 0.000mV/V to the transducer input			
	▲ or ▼	0000000	Calibrated ADC zero value
Apply a full scale mV/V input, the default max is 5mV/V but any value larger than the transducer full scale output is fine. For example if the transducer FS output is 4.19mV/V a calibration value of 4.5mV/V could be used. Do not exceed the instrument maximum input values; 2.5 or 5mV/V as configured by the switch settings in Appendix F.			
	▲ or ▼	32768	Calibrated ADC full scale
		SCALE … x.xxxxx	Last ADC full scale mV/V
	▲▼ and STEP	4.50000	Use entry keys to set full scale mV/V
MODE		run	Instrument returns to normal operation

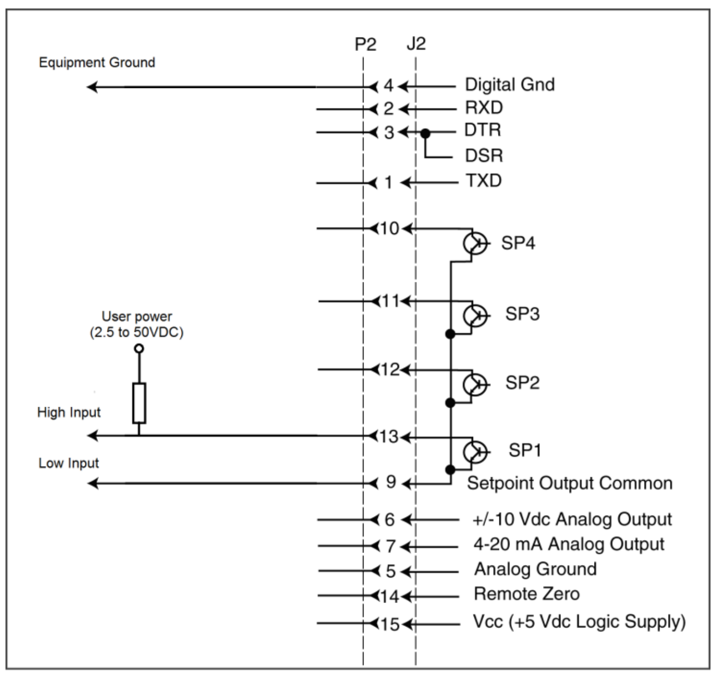
Appendix H
Open collector output configuration

Since open collector outputs do not produce any voltage output on their own, a pull-up resistor to a voltage source is required to provide a voltage.
You will notice that since open collector outputs sink current to the common pin, they seem to work in reverse. The output transistor turns on when the set point LED on the front panel is lit.
Using the standard configuration shown in figure 5, the set point output will be +5 VDC when the set point LED is off and 0 VDC when the LED is on.

The figure to the right shows a typical installation using the instruments internal +5v supply with a pull-up resistor installed between pin 15 (+5VDC) and the setpoint output. The pull-up resistor must be chosen to limit the current through to < 10 mA (a value between 2.5 KΩ and 5 KΩ should be fine). **If the internal +5 VDC supply is used, the current draw of all 4 set point outputs together must be lower than 25 mA.**
Note that in this configuration the setpoint common (pin 9) must be jumpered to the digital ground (pin 4).



This figure shows that when using an external power to provide power to the set point outputs, the value of the pull-up resistor in ohms should be between SUPPLY VOLTAGE / .01 as the lowest value and SUPPLY VOLTAGE / .001 as the highest. The setpoint common (pin 9) is typically tied to the external supply common pin.



9860 Specifications

Parameter	***Value***	***Notes***
Measurement Section		
Channels	1	
Sensor Connection	4 Wire	
Connector	Screw terminals	
Input range	±5 or ±50 mV	Switch gain selection
Input Impedance	>1000MΩ	
CMRR	120dB @ 50-60 Hz	
Excitation	5 or 10 VDC	Switch selection
Accuracy	0.1%	
Current	30 mA MAX	Short circuit protected
Performance		
Zero Adjustment Range	±50% FS	Using both coarse and fine adjustment
Nonlinearity	±0.01% reading	
Zero temperature stability	±1 µV/°C	
Gain temperature stability	±20 ppm/°C	
Input filter (analog)	1 kHz, 2 pole	3dB point
Outputs		
Analog voltage	±10 VDC	
Analog current	4-20 mA	
Analog output step response	1 mS (typ)	
Serial	RS-232	Bi-directional
Serial data latency	25 mS	Without digital filter
Display	6 digit LED	With separate - sign
Display update	10 times/sec	
Digital IO	4 discrete outputs	Open collector
Digital IO latency	4 mS	For change outside of filter band. For changes inside the filter band the reaction time will depend upon the filter setting.
General functions		
Display scaling	±99999	Display counts
Digital filter	1-99 (i)	CAi = Xi/i + CAi-1(i-1/i). CAi = cumulative average, i=subset size, Xi is the unfiltered raw ADC data. The number of readings averaged is 4x the filter subset size.

Parameter	***Value***	***Notes***
Band	0-999 (ADC counts)	Sets the unfiltered, raw ADC data variation limits. It is used to determine when the digital filter is enabled and when it is disabled.
Rcal function	Socketed resistor	
Installed	59K 1% 50ppm	Accepts custom values
Actuation	Front panel button	
Settings	Selectable pos or neg	Jumper selection
Display Reset	Resets PK, VAL	
Actuation	Front panel button/remote	Rear connector remote pin
TEDS	IEEE 1451.4 Template 33	
Environmental		
Operating temperature range	-32 to 122°F (0 to 70°C)	Non-condensing
Input power	100-250VAC, 50/60Hz	Universal
Environmental protection	IP50	IP54 (front panel only)
Mechanical		
Dimensions L x W x H (mm)	5.13 x 3.78 x 1.89 (130 x 96 x 48)	
Panel cutout		
Marking	DMA2	Model number on Interface branded label
Fuse	T315mA 250V	Littlefuse P/N 0213.315MXP

Warranty and Repair Policy

1. Interface warrants that its instruments shall be free from defects in material and workmanship for one year under normal and proper use when correctly installed.

2. Any Interface product which proves defective in material or in workmanship within one year from date of shipment by Interface, will be repaired or replaced free of charge provided that (1) buyer provides Interface with satisfactory proof of the defect and that the product was properly installed, maintained, and operated within the limits of rated and normal usage: (2) buyer obtains from Interface authorization to return the product; and (3) products claimed to be defective must be returned with transportation charges prepaid. Product will be returned to Buyer with transportation charges collect unless the item is found to be defective, in which case Interface will pay the return transportation charges.

3. The remedy set forth herein does not apply to damage to or defects in any product caused by the Buyer's misuse or neglect, nor does it apply to any product which has been repaired or disassembled, which in the sole judgment of Interface affects the performance of the product.

4. Interface makes no warranty concerning components not manufactured by it. However, in the event of the failure of any component or accessory not manufactured by Interface reasonable assistance will be given to Buyer in obtaining from the respective manufacturer whatever adjustment is reasonable based on the manufacturer's own warranty. Interface expressly disclaims any liability to its customers, dealers, and representatives, and to users of its products, and to any other person for special or consequential damages of any kind and from any cause whatsoever arising out of or in any way connected with the manufacture, sale, handling, repair, maintenance, or replacement arising out or in anyway connected with the use of said products.

5. Representations and warranties made by any person, including dealers and representatives of Interface which are inconsistent or in conflict with the terms of this warranty (including but not limited to the limitations of the liability of Interface as set forth above), shall not be binding upon Interface unless reduced to writing and approved by an officer of Interface, Inc.

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OBTAINING SERVICE UNDER WARRANTY
Advance Authorization is required before any product is returned to Interface. Prior to the return of any product, write or call the Repair Department at Interface advising the of: (1) a part number; (2) a serial number of the defective product; (3) a technical description of the defect including specific test data, written observations on the failure and specific correction required; (4) a no-charge purchase order number (so the product can be returned to sender correctly); and (5) ship and bill addresses. Non-verified problems or defects may be subject to an evaluation charge. Please return the original calibration data with the unit.

REPAIR WARRANTY
All repairs of Interface products are warranted for a period of 90 days from the date of shipment. This Warranty applies only to those items which were found defective and repaired. It does not apply to products in which no defect was found and returned as is or merely recalibrated. Out of warranty products may not be capable of being repaired.