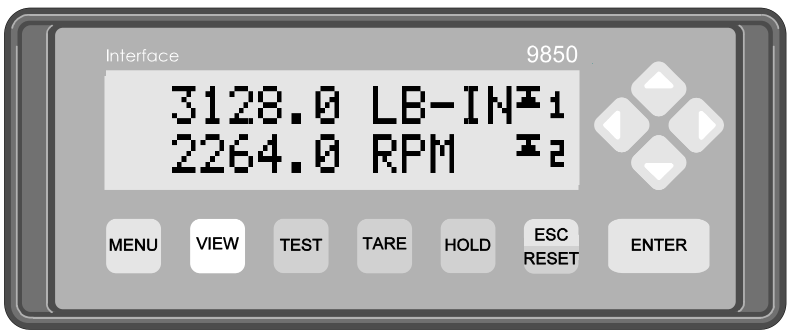
INTERFACE MODEL 9850

MULTI-CHANNEL SIGNAL CONDITIONER

DISPLAY AND CONTROLLER



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GETTING STARTED

General Features

The 9850 Series instrument is a full featured Data Acquisition system with Test Control capabilities. It handles up to two hardware channels and one calculated channel. Many advanced features are provided without sacrificing ease of use.

- The 16 character by 2 line alphanumeric display provides easy to read menu selections.
- All manual adjustments have been eliminated. Calibration is performed automatically. Resolution is **not** compromised because there are no ranges to select. Resolution is 0.01% for any Full Scale value.
- Simplified keypad allows access to all channels, data types, and status without stopping a Test. Data is displayed in engineering units.
- There is no battery to change. System settings are stored in EEPROM memory.
- There is no filter to change or fan to replace. Low power technology is used eliminating the need for a fan.
- Data for each analog hardware channel is sampled at 2000Hz using a 16-bit A/D converter.
- Hardware channels have a 4-pole Bessel response low pass digital filter. In addition, analog hardware channels have a low pass Bessel response hardware antialias filter.
- Cross channel calculation is computed at 50Hz rate.

*Option **12D1** allows 10 to 15VDC operation.*

- Standard instrument can be connected to 110 or 220VAC power without changes.
- Program 4 external logic inputs, 6 external logic outputs, and 6 internal Matrix signals to control your application.

Analog output options:
* **MA**: 4-20mA or 12±8mA*
* **MB**: 10±10mA*
* **MC**: 5±5V*

- There are two analog outputs. Each can be assigned to any channel. You can select ±5V or ±10V Full Scale.
- Connect instrument to a computer via RS232, RS422, or RS485. 32 instruments can be connected using RS485.

Installation

- Unpack the instrument and verify that you received the following items.

  One Series 9850 instrument.

  One power cord.

  One 10ft RS232 cable (for connection to computer).

  One M700 Windows Interface software.

  One 15 pin male mating connector (for I/O).

  One 9 pin male mating connector for each signal conditioning module purchased without a cable.

- For standard 9850 instruments, connect power cord to the back of the instrument and to a power source that delivers 90-250VAC, 47-63Hz.

  For 9850 instruments with option *12D1*, connect a power source that delivers 10 to 15VDC to banana jacks on the rear panel of the instrument.

- Connect transducers to CH1 and CH2, as applicable. Installed signal conditioning modules and corresponding transducers (if purchased) are listed on the Series 9850 Instrument Summary sheet in Section 2.0 (System Data) of the manual (blue binder). If cables were **not** purchased, see APPENDIX A for connectors pinouts and typical cables.

- Turn power ON. The power switch is located on the rear panel.

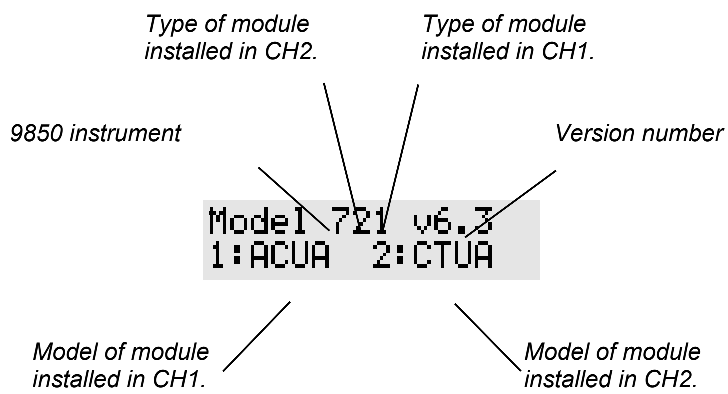
- If purchased with transducers, the 9850 instrument is ready to use. Calibration was performed at the factory. Also, the instrument was set up as defined on the Series 9850 Instrument Summary sheet in Section 2.0 (System Data) of the manual (blue binder).

  If the 9850 instrument was **not** purchased with transducers, see appropriate CHAN CALIBRATION chapter to calibrate instrument/transducer.

Power Up Display (Model Number Information)

When power is applied to the 9850 instrument, the following message is shown for about four seconds.

After the power up message is gone, you can view model and version numbers by pressing ENTER key three times in quick succession.




```
Bad CH Calib
Press ESC
```

*This message is displayed after the power up display if any of the channels have **not** been calibrated since the system was reset. See the appropriate CHAN CALIBRATION chapter(s).*

Signal Conditioning Modules

Type	Model	Description
0	NONE	**not** installed
1	ACUA	AC Strain Gage
2	CTUA	Frequency Input
3	DCVA	DC Voltage

Type	Model	Description
4	LVDA	LVDT
5	UDCA	Encoder/Totalizer
6	DCIA	DC Current
8	DCSA	DC Strain Gage

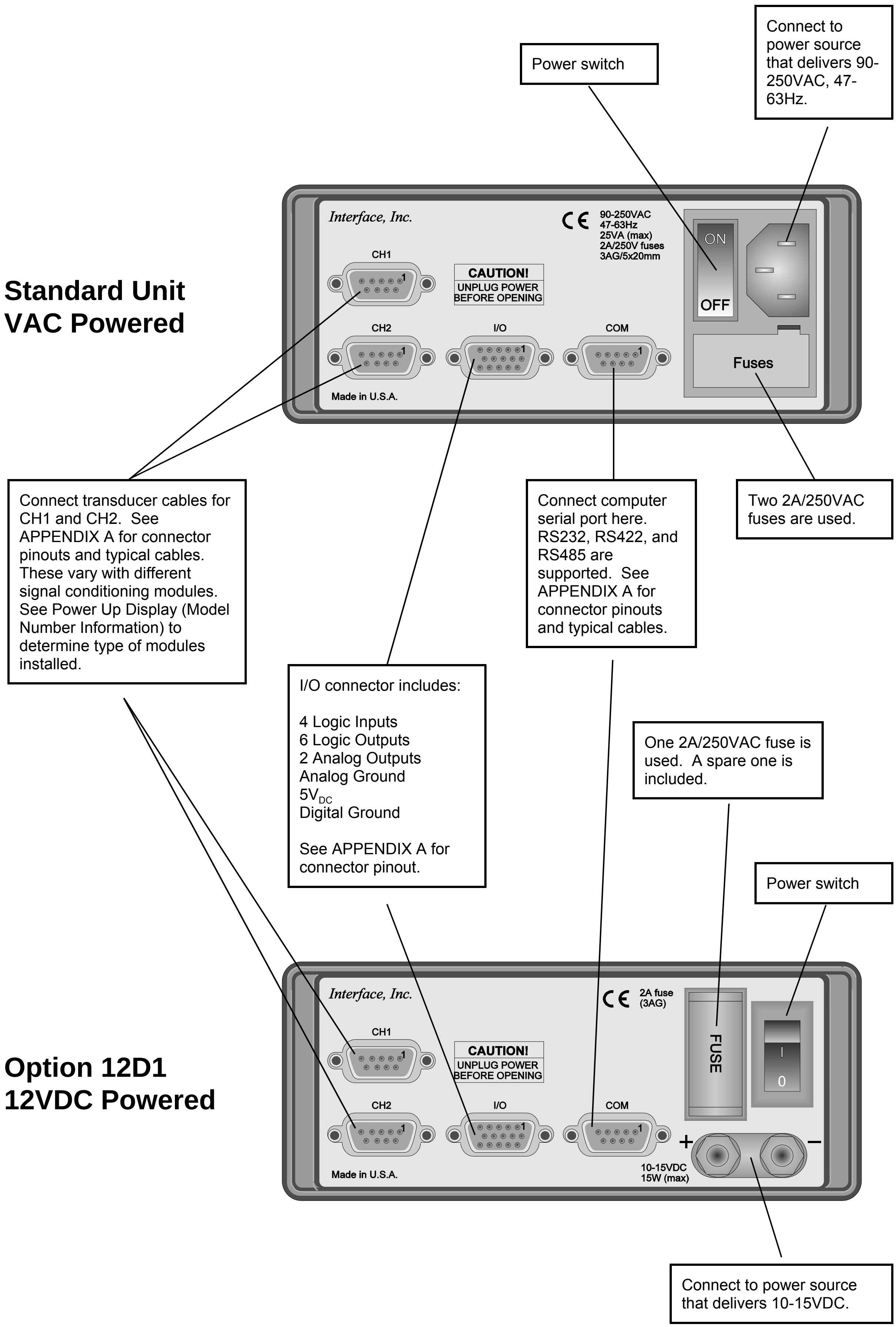
The **first line** of the power up display shows model and version numbers. The model number is based on the type of signal conditioning modules installed as described in diagram above. Up to two modules (channels) can be installed. The third channel is a calculation and is present on all models.

The **second line** of the power up display shows the model names of installed signal conditioning modules. Preceding each model name is the corresponding channel number.

9850 Model Number Examples

Model	CH1	CH2	CH3
9850-100-1 (701)	AC Strain Gage Amp	none	Calculation
9850-120-1 (721)	AC Strain Gage Amp	Frequency Input Module	
9850-820-1 (728)	DC Strain Gage Amp	Frequency Input Module	
9850-330-1 (733)	DC Voltage Amp	DC Voltage Amp	
9850-480-1 (784)	LVDT Amp	DC Strain Gage Amp	
9850-150-1 (751)	AC Strain Gage	Encoder/Totalizer Module	
9850-660-1 (766)	DC Current Amp	DC Current Amp	

Rear Panel


Power switch
Connect to power source that delivers 90-250VAC, 47-63Hz.
Standard Unit
VAC Powered
Interface, Inc.
90-250VAC
47-63Hz
25VA (max)
2A/250V fuses
3AG/5x20mm
CH1
CAUTION!
UNPLUG POWER BEFORE OPENING
ON
OFF
CH2
I/O
COM
Fuses
Made in U.S.A.
Connect transducer cables for CH1 and CH2. See APPENDIX A for connector pinouts and typical cables. These vary with different signal conditioning modules. See Power Up Display (Model Number Information) to determine type of modules installed.
Connect computer serial port here. RS232, RS422, and RS485 are supported. See APPENDIX A for connector pinouts and typical cables.
Two 2A/250VAC fuses are used.
I/O connector includes:
4 Logic Inputs
6 Logic Outputs
2 Analog Outputs
Analog Ground
$5V_{DC}$
Digital Ground
See APPENDIX A for connector pinout.
One 2A/250VAC fuse is used. A spare one is included.
Power switch
Option 12D1
12VDC Powered
Interface, Inc.
2A fuse
(3AG)
CH1
CAUTION!
UNPLUG POWER BEFORE OPENING
FUSE
I
0
CH2
I/O
COM
+
−
10-15VDC
15W (max)
Made in U.S.A.
Connect to power source that delivers 10-15VDC.

Front Panel

Use **MENU key** to set up instrument.

- Scroll through selections using Cursor keys.
- To edit entry, press ENTER key. Entry flashes.
- Use Cursor keys to select.
- Press ENTER key to accept or ESC key to cancel.
- Press MENU key to exit menu.

Use **LEFT/RIGHT keys** to view different data types. The following icons are displayed next to channel numbers.

- Current data
- Max data
- Min data
- Spread data
- Held data
- Tare value

Channel numbers are displayed on the right. Use **UP/DOWN keys** to view different channels.

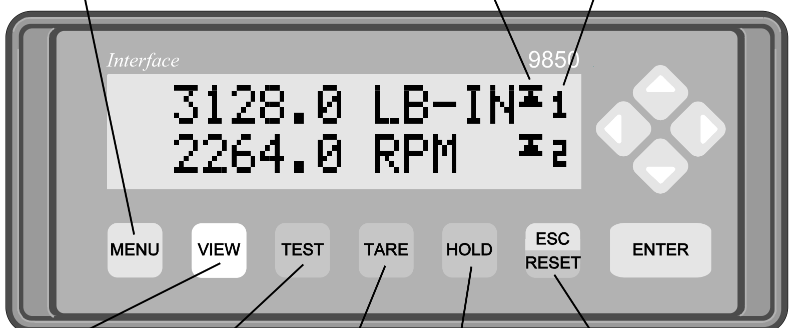
During a Test, channel numbers are displayed as reversed numbers.

- Test OFF
- Test ON

Other useful key combinations:

- Press **ENTER & UP keys** for positive test signal(s).
- Press **ENTER & DOWN keys** for negative test signal(s).
- Press **ENTER key** three times in quick succession to view model and version numbers.

See ENTER Key later in this chapter.



Press **VIEW key** for desired view.

- 2 Channel
- Limit Status
- I/O Status
- 1 Channel

RESET key

- Tare values of *enabled* channels are cleared.
- Held data and Latched Limits of *all* channels are cleared.
- Max and Min data of *all* channels are reset.
- Counters of *enabled* Model UDCA modules are reset.
- State Machine is reset to State1.

TEST key starts/stops a Test. During a Test,

- Limits are checked (if enabled).
- Max and Min data are updated (if enabled).
- Logic I/O is enabled.

To indicate a Test is running, channel numbers are displayed as reversed numbers.

TARE key tares *enabled* channels to 0.

HOLD key takes a snap shot of all channels. To display Held data, see data type icons above.

MENU Key

Use MENU key to enter and exit the menu. To learn how to navigate the menu and modify selections, see MENU BASICS.

You cannot enter the menu when a Test is running.

You can prevent unauthorized entry to the menu with a password. To enable or disable password protection, see Password Enable/Disable Jumper in APPENDIX B.

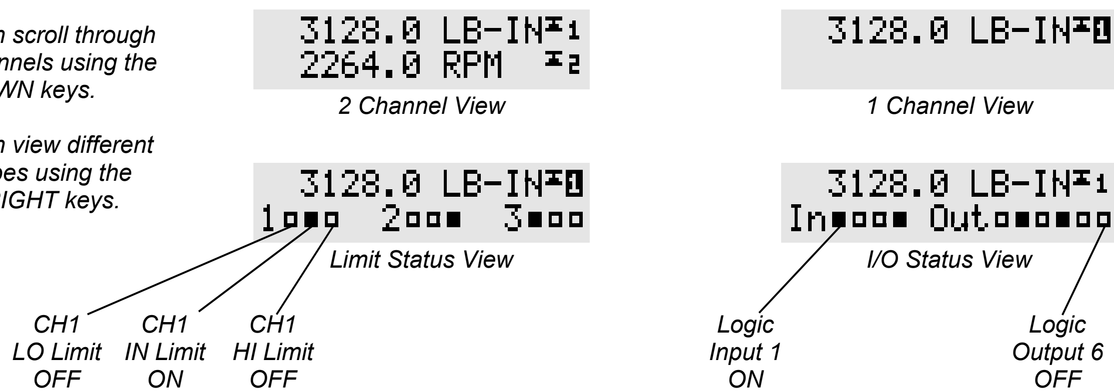
To view all menu items, see the menu flowchart in APPENDIX E.

VIEW Key

When the system is **not** in the menu, the data screen is displayed. Press VIEW key to change the data screen between *2 Channel*, *1 Channel*, *Limit Status*, and *I/O Status* views.

You can scroll through the channels using the UP/DOWN keys.

You can view different data types using the LEFT/RIGHT keys.



Status Indicators

True (ON)

False (OFF)

Inactive

The *2 Channel* view shows two channels - one on each of the two lines of the display.

The *1 Channel* view shows one channel on the first line of the display. The second line of the display is blank.

The *Limit Status* view shows one channel on the first line of the display, and limit status of all channels on the second line. When limit checking is **not** performed, the *inactive* status indicator is used instead of the *True* and *False* status indicators.

You can define the view, data type, and channels displayed on power up. See SYSTEM OPTIONS.

The *I/O Status* view shows one channel on the first line of the display, and status of the four logic inputs and six logic outputs on the second line. The status indicators for logic inputs and outputs always reflect the state of the external signals (True=ON=0V; False=OFF=5V). Logic outputs are always OFF when a Test is **not** running.

TEST Key

```
3045.0 LB-IN 1
2068.0 RPM   2
```

When Test is running, channel numbers are displayed as reversed numbers.

Use TEST key to start or stop a Test. Channel numbers are displayed as reversed numbers to indicate a Test is running. During a Test, limits are checked (if enabled), Max and Min data are updated (if enabled), and Logic I/O is enabled.

During a Test you can change the data screen view, channels displayed, and/or the data type without affecting the test.

Limit checking is only done during a Test. The instrument can be set up to check limits continuously for all channels during a Test. Or, limit checking of individual channels can be controlled by the Logic I/O. See Check Limits in SYSTEM OPTIONS. You can choose from Current data, Max data, Min data, Spread data, or Held data for each channel as the data to be limit checked. See Limit Type in CHAN SETTINGS. Normally, the backlight flashes when any limit is violated. To disabled this feature for a channel, see Limit Alarm in CHAN SETTINGS.

To automatically run a Test when power is applied, see Power Up in SYSTEM OPTIONS.

Similarly, Max/Min updating is only done during a Test. The instrument can be set up to update Max/Mins continuously for all channels during a Test. Or, Max/Min updating of individual channels can be controlled by the Logic I/O. See Do Max/Mins in SYSTEM OPTIONS. For each channel, Filtered or Raw data can be used for determining Max/Mins. See Max/Min Type in CHAN SETTINGS.

TARE Key

TARE key is active whether Test is running or not.

Press TARE key to tare enabled channels to 0. Channels can be disabled from responding to TARE key. See TARE Key in CHAN SETTINGS. During a Test, Logic I/O can also tare channels. The Tare value is the value (when Tare operation occurred) required to force the current data to 0. It is subtracted from new readings until another Tare or Clear Tare operation. To view Tare values, see Cursor Keys later in this chapter. Tare values are cleared on power up, when RESET key (if enabled) is pressed, via Logic I/O during a Test, and when a channel is calibrated.

HOLD Key

HOLD key is active whether Test is running or not.

Limit checking can be performed on Held data.

Press HOLD key to take a snap shot of all channels. Each snap shot overwrites the previous. During a Test, Logic I/O can also be used to take a snap shot. To view Held data, see Cursor Keys later in this chapter. Held data is cleared on power up, when RESET key is pressed, and via Logic I/O during a Test.

ESC/RESET Key

ESC/RESET key has two functions. In the menu it cancels a selection. See MENU BASICS. In the data screen it clears Tare values of enabled channels (see RESET Key - Clear Tare in CHAN SETTINGS), it clears Held data and Latched Limits of all channels, it resets Max/Min data of all channels, it resets State Machine to State1, and it resets counters of enabled Model UDCA modules (see RESET Key - Reset UDCA Counter in CHAN SETTINGS).

Cursor Keys

In the menu, Cursor keys are used to scroll through the menu. When editing an entry, Cursor keys are used to choose a setting. For more details see MENU BASICS.

In the data screen, UP/DOWN keys are used to scroll through the channels. LEFT/RIGHT keys are used to view different data types. To indicate the type of data currently displayed, an icon is displayed to the left of the channel number.

Spread = Max & Min

```
3045.0 LB-IN 1
2068.0 RPM   2
```

Current data displayed

```
162.0 LB-IN 1
392.0 RPM   2
```

Spread data displayed

```
3128.0 LB-IN 1
2264.0 RPM   2
```

Max data displayed

```
3105.0 LB-IN 1
2000.0 RPM   2
```

Held data displayed

```
2966.0 LB-IN 1
1872.0 RPM   2
```

Min data displayed

```
157.0 LB-IN 1
  0.0 RPM   2
```

Tare values displayed

ENTER Key

In the menu, ENTER key is used to initiate editing a selection, to accept an entry, and to carry out a command. For more details see MENU BASICS.

In data screen with Test ***not*** *running:*
ENTER & UP keys for % test signal(s).
ENTER & DOWN keys for & test signal(s).

In the data screen (with Test **not** running), ENTER key is used in combination with UP (or DOWN) key to activate test signal(s) for hardware channels. While pressing ENTER key, press UP key for positive test signal(s). Release keys to remove test signal(s). For negative test signal(s) use DOWN key instead of UP key. Test signals applied depend on the signal conditioning module. See Test Signals in appropriate CHAN CALIBRATION chapter.

Also, in the data screen, ENTER key is used to display model and version numbers of the 9850 instrument. Press ENTER key three times in quick succession.

MENU BASICS

The menu flowchart is shown in APPENDIX E.

This chapter discusses general editing procedures for selections in the menu. After reading this chapter you should know how to navigate the menu and modify selections. Subsequent chapters describe the definitions of the menu selections and special instructions, if any, unique for that selection.

When navigating the menu, if you press an invalid key or scroll to either end of the menu, the backlight flashes. If you scrolled too far right, then press the LEFT key, and visa versa.

You cannot enter the menu when a Test is running.

- Enter menu by pressing MENU key.

  If password is enabled, *Enter password* is displayed with first character of the three character password entry flashing.

The menu can be password protected. See Password Enable/Disable Jumper in APPENDIX B.

  Use UP/DOWN keys to change flashing character.
  Use LEFT/RIGHT keys to move the cursor.
  Press ENTER key when done.

- *CHAN Settings* is displayed.

- Use RIGHT/LEFT keys to choose from:

  CHAN Settings
  CHAN Calibration
  System Options
  Logic I/O
  Analog Outputs
  COM Options

- Then, press DOWN key. More info may be requested as applicable. See following.

```
CH1 Settings
```

CH1 flashes. Select a channel using LEFT/RIGHT keys.

  For *CHAN Settings* and *CHAN Calibration*, a channel number is requested. Select a channel using LEFT/RIGHT keys. Then, press DOWN key.

  For *Logic I/O,* a channel number or *SYS* (for system) is requested. Select a channel or *SYS* using the LEFT/RIGHT keys. Then, press DOWN key.

  For *System Options*, *Analog Outputs*, and *COM Options*, no further info is requested.

```
Filter         CH1
200Hz
Limits         CH1
```

You are at the bottom of the menu.

Second line is blank so you can go down further into the menu for more items.

- First selection of that menu is displayed. The first line of the display shows the name of the selection along with the channel number, if applicable, on the right. If the second line shows the current setting for that selection then you are at the bottom of the menu. If the second line is blank then you can go down to another menu level with more choices.

- To edit a selection, press ENTER key. Current setting flashes. There are two types of selections.

  For selections where the whole entry flashes, use UP/DOWN keys to choose from a list of choices.

  For selections where only one character flashes (cursor), enter a name or numeric value, as required.

  Use UP/DOWN keys to change flashing character.

  Use LEFT/RIGHT keys to move the cursor.

  Press VIEW key to change the character at the cursor from uppercase to lowercase, and visa versa.

  To move the decimal point in numeric values, first select it using LEFT/RIGHT keys, then move it using UP/DOWN keys.

To quickly jump to another channel at a menu selection, press VIEW key. This is much quicker than going back up the menu, changing channels and going back down to that selection. Not all menu selections allow channel jumping.

- When you are finished editing a selection press ENTER key to accept or ESC key to cancel. The flashing stops. If ENTER key was pressed the new setting is displayed. If ESC key was pressed the old setting is displayed. You are back on the original selection and can continue navigating the menu using Cursor keys.

The following actions will trigger adjustment of analog outputs when exiting menu.

- *Calibrating CH1 and/or CH2.*
- *Changing channel assigned to either analog output.*
- *Clearing memory (adjustment occurs next time you exit menu).*

- When you are finished making changes, press MENU key to exit the menu and return to the data screen.

  When exiting the menu, the system automatically adjusts analog outputs, if necessary. The messages, *Please wait... Adjusting ANA1*, followed by *Please wait... Adjusting ANA2*, are displayed. Typically, the adjustments take 5 to 15 seconds, but could take as long as 30 seconds.

CHAN SETTINGS

To learn how to navigate the menu and modify selections, see MENU BASICS.

The *CHAN Settings* menu contains general items that are selected on a per channel basis. Use RIGHT/LEFT keys to choose from the following selections. To go into the *Limits* menu, press DOWN key when *Limits* is displayed.

Filter *	
Limits	
LO Limit	
LO Hyster	(LO Hysteresis)
LO Latch	
HI Limit	
HI Hyster	(HI Hysteresis)
HI Latch	
Limit Mode	
Limit Type	
Limit Alarm	
Units	
Display Res.	(Display Resolution)
TARE Key	
RESET Key	(for Clear Tare action)
Max/Min Type *	
RESET Key **	(for Reset UDCA Counter action)

* Does **not** apply for CH3 calculation.
** Applies for Model UDCA modules only.

Filter

Default setting for Filter is 1Hz.

Select a cutoff frequency from *0.1* to *200Hz* (in 1-2-5 steps). For Model CTUA (Frequency Input Module) and Model UDCA (Encoder/Totalizer Module), the *200Hz* setting is replaced with *None* (no filter). Nominal attenuation of 3dB is provided at the cutoff frequency. Lower cutoff frequencies provide more stable data. Higher cutoff frequencies provide faster response. For filter step response, see APPENDIX G.

*Filter does **not** apply to CH3 calculation.*

The filter is a 4 pole Bessel response low pass digital filter. In addition, analog hardware channels have a 200Hz low pass Bessel response hardware antialias filter.

For each analog output, there is a 100Hz 5 pole Bessel response low pass hardware filter. The hardware channel's digital filter (described above) and the analog output filter both effect the analog output. But, the analog output filter does **not** effect the data read from the input channel. For example, if the digital filter of CH1 is 1Hz, the analog output response is 1Hz. The 100Hz analog output filter has little effect. If the digital filter of CH1 is 200Hz, the analog output response is 100Hz (the effect of the analog output filter).

Limits

Limits are checked during a Test only. They are checked at 1000Hz for each hardware channel and 50Hz for CH3 calculation.

There is one HI limit and one LO limit for each channel. When *Limits* is displayed there is no entry on the second line. So, press DOWN key to go into the *Limits* menu for more items. The first selection of the *Limits* menu is displayed. Use RIGHT/LEFT keys to choose from:

LO Limit
LO Hyster (LO Hysteresis)
LO Latch
HI Limit
HI Hyster (HI Hysteresis)
HI Latch
Limit Mode
Limit Type
Limit Alarm

LO Limit

Default value for LO Limit is &10000.

Enter value that when data drops below it, the LO limit is violated. The type of data (*Current Data, Max Data, Min Data, Spread Data, or Held Data*) used to compare to the LO Limit can be selected. See Limit Type later in this chapter.

Limit checking is only done during a Test. The instrument can be set up to check limits continuously for all channels during a Test. Or, limit checking of individual channels can be controlled by Logic I/O during a Test. See Check Limits in SYSTEM OPTIONS.

LO Hysteresis

*In addition to HI and LO limit violations, the 9850 has an **IN Limit** signal. When data is within the LO and HI limits, IN Limit is true, unless the data is within the hysteresis band of a limit that was violated, in which case, IN Limit is false. For latched limits, the hysteresis band is zero because hysteresis is disabled. IN Limit is never latched. So, if both HI and LO limits are latched and data exceeded both and then returned within limits, all three signals will be ON.*

Default value for LO Hysteresis is 0.

Enter offset value above LO Limit which the data must reach or go above to release the LO Limit violation. Let's assume the LO Limit is 5000 and the LO Hysteresis is 10. When data goes below 5000, the LO Limit is violated until the data returns to 5010 or higher. Hysteresis is used to prevent LO Limit signal from oscillating ON and OFF when data is near the LO Limit.

Only positive hysteresis numbers are allowed. By definition, latched mode disables hysteresis.

LO Hysteresis is also used to determine the status of the At Min output event. See At Min in LOGIC I/O.

LO Latch

IN Limit is viewed on the Limit Status view and is available for Logic I/O control.

Default setting for LO Latch is OFF.

Select *ON* to latch LO limit violations. A LO Limit violation remains true until it is cleared even if data returns above LO Limit. By definition, hysteresis is disabled. Latched limits are cleared on power up, when RESET key is pressed, when Test is started, and via Logic I/O during a Test.

Select *OFF* to unlatch LO limit violations. LO Limit violation is true when data goes below LO Limit and is false when data returns above LO Limit (including LO Hysteresis).

HI Limit

Enter value that when exceeded will generate a HI Limit violation. The type of data (*Current Data, Max Data, Min Data, Spread Data, or Held Data*) used to compare to the HI Limit can be selected. See Limit Type later in this chapter.

Limit checking is only done during a Test. The instrument can be set up to check limits continuously for all channels during a Test. Or, limit checking of individual channels can be controlled by Logic I/O during a Test. See Check Limits in SYSTEM OPTIONS.

HI Hysteresis

Default value for HI Limit is 10000.

Default value for HI Hysteresis is 0.

Enter offset value below HI Limit which the data must drop to or below to release the HI Limit violation. Let's assume the HI Limit is 10000 and the HI Hysteresis is 10. When data goes above 10000, the HI Limit is violated until the data drops to 9990 or lower. Hysteresis is used to prevent HI Limit signal from oscillating ON and OFF when data is near the HI Limit.

Only positive hysteresis numbers are allowed. By definition, latch mode disables hysteresis.

HI Hysteresis is also used to determine the status of the At Max output event. See At Max in LOGIC I/O.

HI Latch

Default setting for HI Latch is OFF.

Select *ON* to latch HI limit violations. A HI Limit violation remains true until it is cleared even if data returns below HI Limit. By definition, hysteresis is disabled. Latched limits are cleared on power up, when RESET key is pressed, when Test is started, and via Logic I/O during a Test.

Select *OFF* to unlatch HI limit violations. HI Limit violation is true when data goes above HI Limit and is false when data returns below HI Limit (including HI Hysteresis).

Limit Mode

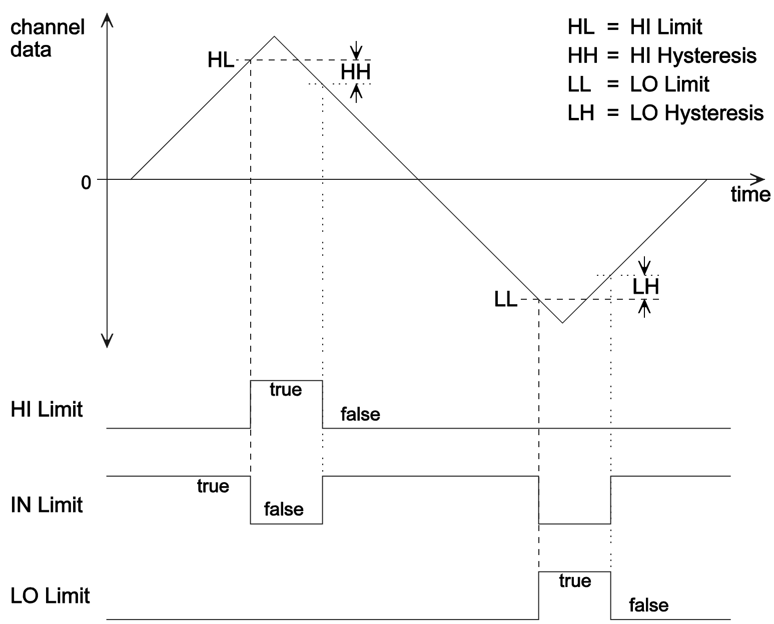
Select *Signed* or *Absolute*. The selected mode is common to both HI and LO limits.

Default setting for Limit Mode is Signed.

In *Signed* mode, the signs (positive, negative) of data, HI Limit, and LO Limit are used to determine limit violations. For example, a HI Limit violation does **not** occur if data equals &2000 and HI Limit equals %1000.

Signed Limits with Hysteresis Diagram

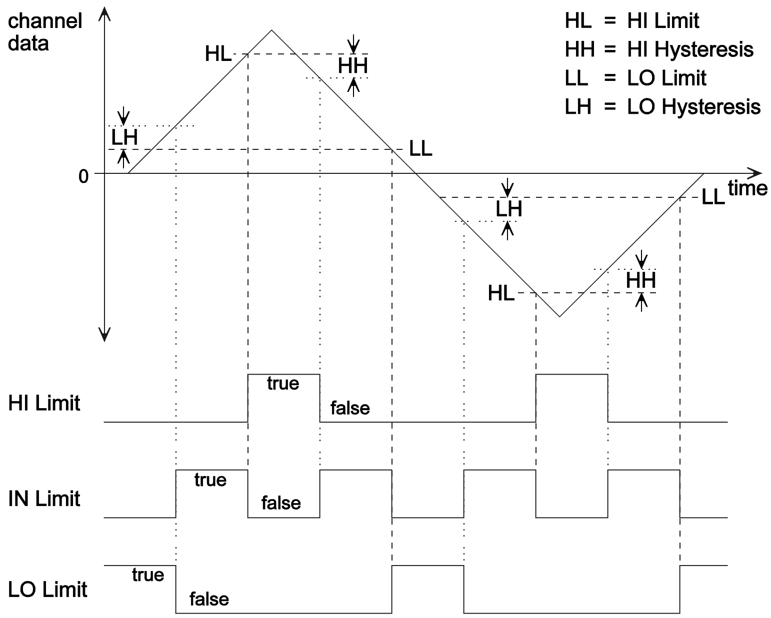
If HI Hysteresis is too small, HI Limit may oscillate true and false when data is near HI Limit value. Similarly, if LO Hysteresis is too small, LO Limit may oscillate true and false when data is near LO Limit value.



In *Absolute* mode, the absolute values of data, HI Limit, and LO Limit are used to determine limit violations. For example, a HI Limit violation occurs if data equals &2000 and HI Limit equals %1000.

Absolute Limits with Hysteresis Diagram

If HI Hysteresis is too small, HI Limit may oscillate true and false when data is near HI Limit value. Similarly, if LO Hysteresis is too small, LO Limit may oscillate true and false when data is near LO Limit value.



Limit Type

Default setting for Limit Type is Current Data.

Select the type of data used for limit checking. Choose from *Current Data*, *Max Data*, *Min Data*, *Spread Data*, or *Held Data*. Using *Current Data*, limit violations are determined on real-time data. But, if your test involves determining and classifying a peak or valley, then use *Max Data* or *Min Data*, respectively. Or, if your test grabs a data point at a precise moment and classifies it, use *Held Data*. Or, if your test determines a tolerance band for data whose absolute value is insignificant, and classifies it, use *Spread Data*.

Spread = Max & Min

Limit Alarm

Default setting for Limit Alarm is Flash Backlight.

Select *Flash Backlight* or *None*. If *Flash Backlight* is selected, then the backlight flashes for any limit violations (HI or LO) of the channel being set up. The backlight flashes even if *Backlight* (in *System Options* menu) is set to *OFF*.

You can see the limit status for all channels using the VIEW key. See VIEW Key in GETTING STARTED. Also, limit violation events can be assigned to logic outputs and internal Matrix signals. See LOGIC I/O.

Units

Default setting for Units is all blanks.

Enter up to 5 characters for channel units. The unit name is displayed on the data screen along with actual data, channel number, and data type icon. When selecting a character using UP key, the characters sequence in the order shown in the following table. Press VIEW key to change the character at the cursor from uppercase to lowercase, and visa versa.

space										
A through Z										
#	@	&	.	%	^	&	%	/	*	_
0 through 9										

Display Resolution

Internal computations (such as, scaling data, limit checking, Max/Min detection, etc) use internal resolution. Display resolution is used only when data (Current , Max, Min, Spread, Held, etc) is displayed.

Choose amongst four display resolutions. The Internal resolution of the 9850 is 0.01% of the user-entered Full Scale value. For easy viewing, displayed data is formatted with a fixed decimal point and a 1, 2, or 5 increment of the least significant digit (display resolution). The decimal point position and display resolution are determined from the Full Scale value. See following table for examples of display resolutions for Full Scale values from 1000 to 10000. For Full Scale values not listed, just shift the decimal point appropriately. For example, for a Full Scale value of 150, the four choices for display resolution are 0.020, 0.050, 0.100, and 0.200.

Default value for Display Resolution is best (smallest) value.

Full Scale (FS)	**Internal Resolution (FS÷10000)**	**Four Choices for Display Resolution**			
		Best			**Worst**
1000 to 1414	0.1000 to 0.1414	0.10	0.20	0.50	1.00
1415 to 3162	0.1415 to 0.3162	0.20	0.50	1.00	2.00
3163 to 7071	0.3163 to 0.7071	0.50	1.00	2.00	5.00
7072 to 10000	0.7072 to 1.0000	1.0	2.0	5.0	10.0

TARE Key

Default setting for TARE Key is Tare Enabled for CH1 and CH2, and Tare Disabled for CH3 calculation.

Select *Tare Enabled* or *Tare Disabled*. The TARE key tares enabled channels to 0. If you want a channel to be tared in response to the TARE key, select *Tare Enabled*. To prevent a channel from being tared in response to the TARE key, select *Tare Disabled*.

The Tare value is the value (when Tare operation occurred) required to force the current data to 0. It is subtracted from new readings until another Tare or Clear Tare operation. To view Tare values, see Cursor Keys in GETTING STARTED.

Logic I/O can also tare channels. See LOGIC I/O. This selection has no affect on the Logic I/O. Tare values are cleared on power up, when RESET key (if enabled) is pressed, via Logic I/O during a Test, and when a channel is calibrated.

RESET Key (Clear Tare)

Default setting for RESET Key is Clear Tare.

Select *Clear Tare* or *Don't Clear Tare*. If you want a channel's Tare value to be cleared in response to the RESET key, select *Clear Tare*. To leave it intact, select *Don't Clear Tare*. The RESET key clears Tare values of enabled channels, it clears Held data and Latched Limits of all channels, it resets Max/Min data of all channels, it resets State Machine to State1, and it resets counters of enabled Model UDCA modules.

Logic I/O can also clear a channel's Tare value. See LOGIC I/O. This selection has no affect on the Logic I/O.

Max/Min Type

*Max/Min Type does **not** apply to CH3 calculation.*

Select *Filtered Data* or *Raw Data*. When *Filtered Data* is selected, Max and Min data are updated with filtered real-time data. See Filter earlier in this chapter. The digital filter is bypassed for Max/Min data when *Raw Data* is selected. In this case, fastest response is obtained for Max/Min data. The 200Hz low pass Bessel response hardware anti-alias filter for analog hardware channels cannot be bypassed.

Default setting for Max/Min Type is Filtered Data.

Max and Min data are updated during a Test only. They are updated at 2000Hz for each hardware channel and 50Hz for CH3 calculation. They are reset on power up, when RESET key is pressed, and via Logic I/O during a Test.

RESET Key (Reset UDCA Counter)

Default setting for RESET Key is Don't Reset Cntr.

Reset Key (Reset UDCA Counter) applies only for Model UDCA modules.

Select *Don't Reset Cntr* or *Reset Counter*. If you want the RESET key to reset the counter on a Model UDCA module, select *Reset Counter*. To disable the RESET key from resetting the counter, select *Don't Reset Cntr*. The RESET key clears Tare values of enabled channels, it clears Held data and Latched Limits of all channels, it resets Max/Min data of all channels, it resets State Machine to State1, and it resets counters of enabled Model UDCA modules.

The counter on a Model UDCA module is reset on power up, when RESET key (if enabled, as described above) is pressed, via an external Reset signal at the transducer connector (if enabled, see Reset Signal in CHAN CALIBRATION for Model UDCA), and via Logic I/O (see Reset Count in LOGIC I/O). So, if you are resetting the counter externally, then most likely you'll want the RESET key to be disabled.

CHAN CALIBRATION (MODEL ACUA)

To learn how to navigate the menu and modify selections, see MENU BASICS.

The Model ACUA is an AC Strain Gage Amplifier that can handle any strain gage transducer that provides an output in the range, 0.5 to 5mV/V, directly wired or transformer coupled. The *CHAN Calibration* menu for Model ACUA allows you to define calibration mode and values, and actually perform a calibration based on these settings. No manual adjustments are necessary. Selections in the *CHAN Calibration* menu for Model ACUA depend on the *Type of CAL* setting (*Shunt* or *Load*) as shown below. There are two types of Shunt calibrations, *Shunt-Pos/Neg* and *Shunt-Positive*, and two types of Load calibrations, *Load-Pos/Neg* and *Load-Positive*. Use RIGHT/LEFT keys to choose from the following selections.

Xdcr ! Transducer

* *Omitted when Type of CAL is Shunt-Positive.*

** *Omitted when Type of CAL is Load-Positive.*

For Shunt Calibrations	**For Load Calibrations**
Type of CAL	*Type of CAL*
Full Scale	*Full Scale*
Zero Value	*Zero Value*
%CAL Value	*%Load Value*
*&CAL Value**	*&Load Value***
	To Zero Xdcr
To CAL Xdcr	*To do %CAL*
	*To do &CAL***

When you perform a calibration, internal adjustments are made automatically. If this is the first time a calibration is done on a given transducer, large adjustment changes may be required. So, for optimal accuracy, it is recommended that two calibrations are done.

To do a Shunt calibration,

Select *Type of CAL*.
Enter *Full Scale*, *Zero Value*, *%CAL Value*, *&CAL Value*.*
Perform *To CAL Xdcr*.

To do a Load calibration,

Select *Type of CAL*.
Enter *Full Scale*, *Zero Value*, *%Load Value*, *&Load Value*.**
Perform *To Zero Xdcr*.
Perform *To do %CAL*.
Perform *To do &CAL*.**

If any selections in the *CHAN Calibration* menu are changed, you must perform the calibration commands, *To CAL Xdcr* for Shunt calibrations, *To Zero Xdcr* and *To do %CAL* for Load Calibrations. Otherwise, when leaving the *CHAN Calibration* menu, the message, *Not Calibrated Undo Changes OK?*, appears. ENTER key will undo the changes. ESC key keeps you in the *CHAN Calibration* menu with changes intact. This allows you to perform the calibration commands and then leave menu. This feature assures that when you enter the *CHAN Calibration* menu, the channel was last adjusted using the current selections. The *To do &CAL* calibration command is **not** required. If it is **not** performed, negative data is scaled the same as positive data.

Type of CAL

Default setting for Type of CAL is Shunt-Pos/Neg.

Select *Shunt-Pos/Neg*, *Shunt-Positive*, *Load-Pos/Neg*, or *Load-Positive* based on the calibration you are doing.

Use one of the *Shunt* calibration selections when you cannot load the transducer to a known value. Instead, the CAL resistor on the Model ACUA, simulates a known load. A CAL value (in engineering units) associated with this CAL resistor is required. When a transducer is purchased with the system, the proper CAL resistor is installed. Otherwise, a 60kΩ CAL resistor is provided. Refer to the transducer calibration sheet for the CAL resistor value. ±0.02%, ±5ppm/EC resistors are recommended. To install or change the CAL resistor, see CAL Resistor Installation (Models ACUA and DCSA) in APPENDIX B.

*When doing a Shunt calibration, use Shunt-Positive when you are **not** interested in negative data.*

For *Shunt-Pos/Neg*, the CAL resistor simulates both a positive and negative load.

For *Shunt-Positive*, the CAL resistor simulates a positive load only, and negative data is scaled the same as positive data.

Use one of the *Load* calibration selections when you can physically load the transducer to known values for calibration. The magnitude of the applied loads, preferably, should be 75% to 100% of Full Scale. For *Load* calibrations, the CAL Resistor is **not** used for calibration.

*When doing a Load calibration, use Load-Positive for transducers with small symmetry error or if you are **not** interested in negative data.*

For *Load-Pos/Neg*, you must apply both a positive and negative load to the transducer during calibration. The amplifier is adjusted based on these loads. Using both loads allows the system to correct any symmetry error of the transducer.

For *Load-Positive*, only a positive load is required for calibration. The negative data is scaled the same as positive data.

Full Scale

Default value for Full Scale is 10000.

Enter the Full Scale (in engineering units) of the transducer connected to this channel. This can be obtained from the transducer calibration sheet.

The Full Scale of this channel is used to:

determine scaling of displayed data in engineering units,

fix the position of the decimal point in displayed data,

determine selections for display resolution,

and, set the scaling of any analog output assigned to this channel.

The overrange capability for the Model ACUA is 50% of Full Scale. So, data for this channel can be as large as 1.5 times Full Scale, otherwise *OVERLOAD* is displayed.

Zero Value

Default value for Zero Value is 0.

For *Shunt* calibrations, enter the value (in engineering units) representing an unloaded transducer.

For *Load* calibrations, enter the value (in engineering units) equivalent to the physical load (if any) present during zero calibration. This may be a known load that cannot easily be removed.

Typically, *Zero Value* is 0.

%CAL Value | %Load Value

Default value for %CAL Value and %Load Value is 7500.

For *Shunt* calibrations, *%CAL Value* is displayed. Enter the %Equivalent Calibration value (in engineering units) from the transducer calibration sheet. This is the value obtained when the CAL resistor is shunted across the bridge (on transducer) to simulate a known positive load.

For *Load* calibrations, *%Load Value* is displayed. Enter the value (in engineering units) of the physical load that will be applied during positive calibration. The closer this value is to Full Scale the better. Typical values are from 75% to 100% of Full Scale.

&CAL Value | &Load Value

Default value for &CAL Value and &Load Value is &7500.

This entry is omitted for Shunt-Positive and Load-Positive calibrations. Negative data is scaled the same as positive data.

For a *Shunt-Pos/Neg* calibration, *&CAL Value* is displayed. Enter the &Equivalent Calibration value (in engineering units) from the transducer calibration sheet. This is the value obtained when the CAL resistor is shunted across the bridge (on transducer) to simulate a known negative load.

For a *Load-Pos/Neg* calibration, *&Load Value* is displayed. Enter the value (in engineering units) of the physical load that will be applied during negative calibration. The closer this value is to negative Full Scale the better. Typical values are from 75% to 100% of negative Full Scale.

When the *%CAL Value* or *%Load Value* is entered, the *&CAL Value* or *&Load Value*, respectively, is automatically updated to the same value, except negative. This is only a shortcut, and the *&CAL Value* or *&Load Value* can be overwritten.

To CAL Transducer (Shunt Calibrations)

For Shunt calibrations a CAL resistor is used to simulate a load. The CAL resistor is automatically switched and both zero and gain are adjusted without user intervention. The transducer must be connected to the 9850 instrument and it must be unloaded during the calibration.

When *Type of CAL* is *Shunt-Pos/Neg* or *Shunt-Positive*, one of the selections in the *CHAN Calibration* menu is *To CAL Xdcr*. This command calibrates the transducer/amplifier using a CAL resistor to simulate a load. For *Shunt-Pos/Neg*, the CAL resistor simulates both a positive and negative load. See Type of CAL earlier in this chapter. For *Shunt-Positive*, the CAL resistor simulates a positive load only, and negative data is scaled the same as positive data. To calibrate, follow the steps below.

Display	Description
`To CAL Xdcr   CH1` `Press ENTER`	To initiate calibration, press ENTER key.
`Unload Xdcr   CH1` `-    2.0  OK?`	Unload the transducer, then press ENTER key. Current data is shown.
`Please wait  CH1` `     0.0  Adj0`	Zero and gain are being adjusted.
`CAL Done     CH1` `     0.0  OK?`	Calibration is done. Press ENTER key to accept, or ESC key to cancel and return to previous adjustment.
`CHAN Calibration`	Return to top of *CHAN Calibration* menu.

*Character to right of **Adj** indicates operation being done.*
0 for zero adjustment
% for gain adjustment
& for minus correction

For zero/null range and input sensitivity, see APPENDIX H.

To Zero Transducer (Load Calibrations)

The transducer must be connected to the 9850 instrument during a calibration.

When *Type of CAL* is *Load-Pos/Neg* or *Load-Positive*, one of the selections in the *CHAN Calibration* menu is *To Zero Xdcr*. This command performs the zero adjustment for the transducer/amplifier. To adjust zero, follow the steps below.

To Zero Xdcr CH1 Press ENTER	To initiate adjustment, press ENTER key.
Unload Xdcr CH1 - 2.0 OK?	Unload the transducer, then press ENTER key. Current data is shown.
Please wait CH1 0.0 Adj0	Zero is being adjusted.
Zero Done CH1 0.0 OK?	Adjustment is done. Press ENTER key to accept, or ESC key to cancel and return to previous adjustment.
To do +CAL CH1 Press ENTER	Go to next menu selection.

For zero/null range, see APPENDIX H.

To do %CAL (Load Calibrations)

The transducer must be connected to the 9850 instrument during a calibration.

When *Type of CAL* is *Load-Pos/Neg* or *Load-Positive*, one of the selections in the *CHAN Calibration* menu is *To do %CAL*. This command performs the gain adjustment for the transducer/amplifier. To adjust gain, follow the steps below.

To do +CAL CH1 Press ENTER	To initiate adjustment, press ENTER key.
Load Xdcr + CH1 7286.0 OK?	Apply load corresponding to *%Load Value* to the transducer, then press ENTER key. Current data is shown.
Please wait CH1 7500.0 Adj+	Gain is being adjusted.
+CAL Done CH1 7500.0 OK?	Adjustment is done. Press ENTER key to accept, or ESC key to cancel and return to previous adjustment.
To do -CAL CH1 Press ENTER	Go to next menu selection.

For input sensitivity, see APPENDIX H.

To do &CAL (Load Calibrations)

For Load-Positive calibrations, this selection is omitted and the negative data is scaled the same as positive data.

The transducer must be connected to the 9850 instrument during a calibration.

When *Type of CAL* is *Load-Pos/Neg*, one of the selections in the *CHAN Calibration* menu is *To do &CAL*. This command corrects any symmetry error of the transducer by scaling negative data. Gain is **not** adjusted. To scale negative data, follow the steps below.

```
To do -CAL   CH1
Press ENTER
```

To initiate adjustment, press ENTER key.

```
Load Xdcr -  CH1
- 7243.0  OK?
```

Apply load corresponding to *&Load Value* to the transducer, then press ENTER key. Current data is shown.

```
Please wait  CH1
- 7500.0  Adj-
```

Negative data is being scaled.

```
-CAL Done    CH1
- 7500.0  OK?
```

&CAL is done. Press ENTER key to accept, or ESC key to cancel and return to previous setting.

```
CHAN Calibration
```

Return to top of *CHAN Calibration* menu.

Test Signals

*In data screen with Test **not** running:*
ENTER & UP keys for % test signal(s).
ENTER & DOWN keys for & test signal(s).

You can verify the calibration of the transducer/amplifier using internal test signals. In the data screen (with Test **not** running), ENTER key is used in combination with UP (or DOWN) key to activate test signal(s). While pressing ENTER key, press UP key for positive test signal(s). Release keys to remove test signal(s). For negative test signal(s) use DOWN key instead of UP key.

If you performed a Load calibration, you could invoke the test signals to determine the calibration values for future Shunt calibrations.

For the Model ACUA (AC Strain Gage Amplifier), the test signals are created by shunting the internal CAL resistor (on the Model ACUA) across the bridge (on transducer) simulating a known positive or negative load. Make sure the transducer is connected and unloaded. Otherwise, the load would add to the simulated load. If no physical load is present on the transducer and the channel has been calibrated, displayed data should be same as %Equivalent Calibration value or &Equivalent Calibration value from the transducer calibration sheet.

CHAN CALIBRATION (MODEL LVDA)

To learn how to navigate the menu and modify selections, see MENU BASICS.

The Model LVDA is an AC Amplifier that can handle an AC operated LVDT displacement transducer that provides an output in the range, 100 to 1000mV/V. The *CHAN Calibration* menu for Model LVDA allows you to define calibration mode and values, and actually perform a calibration based on these settings. No manual adjustments are necessary. There are two types of calibrations, *Load-Pos/Neg* and *Load-Positive*. Both, require zero and positive calibrations. In addition, *Load-Pos/Neg* includes a negative calibration. Use RIGHT/LEFT keys to choose from the following selections.

EXC Freq. (Excitation Frequency)
Type of CAL
Full Scale
Zero Point
%CAL Point
&CAL Point *
To Zero LVDT
To do %CAL
To do &CAL *

* *Omitted when Type of CAL is Load-Positive.*

To do a calibration,

Select *EXC Freq.*
Select *Type of CAL*.
Enter *Full Scale*, *Zero Point*, *%CAL Point*, *&CAL Point*. *
Perform *To Zero LVDT*.
Perform *To do %CAL*.
Perform *To do &CAL*. *

When you perform a calibration, internal adjustments are made automatically. If this is the first time a calibration is done on a given transducer, large adjustment changes may be required. So, for optimal accuracy, it is recommended that two calibrations are done.

If any selections in the *CHAN Calibration* menu are changed, you must perform the calibration commands, *To Zero LVDT* and *To do %CAL*. Otherwise, when leaving the *CHAN Calibration* menu, the message, *Not Calibrated Undo Changes OK?*, appears. ENTER key will undo the changes. ESC key keeps you in the *CHAN Calibration* menu with changes intact. This allows you to perform the calibration commands and then leave menu. This feature assures that when you enter the *CHAN Calibration* menu, the channel was last adjusted using the current selections. The *To do &CAL* calibration command is **not** required. If it is **not** performed, negative data is scaled the same as positive data.

Example:

Normally you would calibrate a ±5mm LVDT as follows. Data will go from &5 to 0 to %5mm.

The solution to the right provides best accuracy because zero calibration is done at LVDT electrical zero and Zero Point is 0mm. See note in Zero Point section, later.

Set *Type of CAL* to *Load-Pos/Neg*.
Enter the following.

Full Scale	=	5mm
Zero Point	=	0mm
%CAL Point	=	5mm
&CAL Point	=	&5mm

Execute *To Zero LVDT* with LVDT at electrical zero.
Execute *To do %CAL* with LVDT displaced 5mm from LVDT electrical zero.
Execute *To do &CAL* with LVDT displaced &5mm from LVDT electrical zero.

The solution to the right using CH3 calculation provides best accuracy because zero calibration is done at LVDT electrical zero and Zero Point is 0mm. See note in Zero Point section, later.

If you want the LVDT to provide positive data only while using the full range (positive and negative) of the LVDT, then use CH3 calculation to add 5mm to LVDT channel. As a result, CH3 data will go from 0 to 10mm. The resolution of the LVDT channel is preserved. For CH3 calculation, select *User Defined* and enter *1A%* as RPN string. This assumes channel 1 is LVDT channel. Change *1* to *2* if its channel 2. Also, enter 5 as *Constant A*. See CHAN CALIBRATION (CH3 CALCULATION).

To save the calculation at the cost of worst resolution and errors due to LVDT asymmetry (see note in Zero Point section, later), do the following. Data will go from 0 to 10mm.

*The solution to the right is **not** recommended because of LVDT symmetry error. Zero calibration is **not** done at LVDT electrical zero. See note in Zero Point section, later.*

Set *Type of CAL* to *Load-Positive*.
Enter the following.

Full Scale	=	10mm
Zero Point	=	0mm
%CAL Point	=	10mm

Execute *To Zero LVDT* with LVDT displaced &5mm from LVDT electrical zero.
Execute *To do %CAL* with LVDT displaced 5mm from LVDT electrical zero.

Excitation Frequency

EXC Freq ! Excitation Frequency

Default setting for EXC Freq is 5kHz.

For the entry, *EXC Freq.*, select *2.5kHz*, *3kHz*, *5kHz*, or *10kHz* as the excitation frequency. The Model LVDA excites an LVDT transducer with a 2Vrms sine wave with the frequency selected. An LVDT transducer is calibrated at a particular frequency. This frequency should be specified on the LVDT calibration sheet. For best performance, choose this frequency. If the calibration sheet does **not** specify the excitation frequency, check the specification sheet. It should indicate a range of frequencies supported by the LVDT transducer. Pick an excitation frequency within this range.

Type of CAL

Default setting for Type of CAL is Load-Pos/Neg.

Select *Load-Pos/Neg* or *Load-Positive* based on the calibration you are doing. You must be able to physically displace (load) the LVDT plunger to known values for calibration.

For both types of calibration you must set the LVDT plunger during the zero calibration. For best accuracy, set plunger to LVDT's electrical zero. The zero calibration process aids in determining the electrical zero.

For *Load-Pos/Neg*, you must physically displace the LVDT plunger on both sides (positive and negative) of its electrical zero during calibration. The amplifier is adjusted based on these displacements. Using both sides allows the system to correct any symmetry error of the LVDT.

For *Load-Positive*, a positive LVDT plunger displacement is required for calibration. The negative data is scaled the same as positive data. Use *Load-Positive* for LVDTs with small symmetry error or if you are **not** interested in negative data.

Full Scale

Default value for Full Scale is 10000.

Enter the Full Scale (in engineering units) of the LVDT connected to this channel. This can be obtained from the LVDT calibration sheet.

The Full Scale of this channel is used to:

determine scaling of displayed data in engineering units,

fix the position of the decimal point in displayed data,

determine selections for display resolution,

and, set the scaling of any analog output assigned to this channel.

The overrange capability for the Model LVDA is 50% of Full Scale. So, data for this channel can be as large as 1.5 times Full Scale, otherwise *OVERLOAD* is displayed.

Zero Point

Default value for Zero Point is 0.

Enter the value (in engineering units) equivalent to the LVDT plunger displacement during zero calibration. For best accuracy, *Zero Point* should be 0 and the LVDT plunger should be at its electrical zero during zero calibration.

NOTE:

> If *Zero Point* is non-zero and/or the LVDT plunger is **not** at its electrical zero during zero calibration, accuracy and non-linearity errors can result due to the symmetry error of the LVDT. Symmetry error is the difference of output for equal displacement on either side of the electrical zero. The output of the LVDT has different slopes on positive and negative sides of its electrical zero. The 9850 instrument compensates for asymmetrical transducers by using different positive and negative multipliers (Load-Pos/Neg calibration). For this to be effective, zero electrical signal (from LVDT) must be 0 in units of the selected channel. One way to accomplish this is to set *Zero Point* to 0 **and** make sure the LVDT plunger is at its electrical zero during zero calibration.

%CAL Point

Default value for %CAL Point is 7500.

Enter the value (in engineering units) equivalent to the LVDT plunger displacement during positive calibration. The closer this value is to Full Scale the better. Typical values are from 75% to 100% of Full Scale.

&CAL Point

Default value for &CAL Point is &7500.

This entry is omitted for Load-Positive calibrations. Negative data is scaled the same as positive data.

Enter the value (in engineering units) equivalent to the LVDT plunger displacement during negative calibration. The closer this value is to negative Full Scale the better. Typical values are from 75% to 100% of negative Full Scale.

When the *%CAL Point* is entered, the *&CAL Point* is automatically updated to the same value, except negative. This is only a shortcut, and the *&CAL Point* can be overwritten.

To Zero LVDT

The LVDT must be connected to the 9850 instrument during a calibration.

This command performs the zero adjustment for the LVDT/amplifier. For best accuracy, the LVDT plunger should be at its electrical zero during the zero adjustment. If it is **not**, accuracy and non-linearity errors can result due to the symmetry error of the LVDT. See note in Zero Point section, earlier. To adjust zero, follow the steps below.

Data displayed at Set LVDT @ 0 prompt:

*Data may vary a lot. Try to get it as close to 0 as possible. Data is **not** scaled to any particular units and gain is set high.*

Data may vary slightly. This is due to a significant change in Full Scale. Finish full calibration and then repeat it.

To Zero LVDT CH1 Press ENTER	To initiate adjustment, press ENTER key.
Set LVDT @ 0 CH1 - 2.0 OK?	Set LVDT at electrical zero by moving plunger until data is near 0. Then, press ENTER key.
Please wait CH1 0.0 Adj0	Zero is being adjusted.
Zero Done CH1 0.0 OK?	Adjustment is done. Press ENTER key to accept, or ESC key to cancel and return to previous adjustment.
To do +CAL CH1 Press ENTER	Go to next menu selection.

To do %CAL

The LVDT must be connected to the 9850 instrument during a calibration.

This command performs the gain adjustment for the LVDT/amplifier. To adjust gain, follow the steps below.

For input sensitivity, see APPENDIX H.

To do +CAL CH1 Press ENTER	To initiate adjustment, press ENTER key.
Set LVDT + CH1 7286.0 OK?	Displace LVDT plunger by amount equal to *%CAL Point*, then press ENTER key. Current data is shown.
Please wait CH1 7500.0 Adj+	Gain is being adjusted.
+CAL Done CH1 7500.0 OK?	Adjustment is done. Press ENTER key to accept, or ESC key to cancel and return to previous adjustment.
To do -CAL CH1 Press ENTER	Go to next menu selection.

To do &CAL

For Load-Positive calibrations, this selection is omitted and the negative data is scaled the same as positive data.

This command corrects any symmetry error of the transducer by scaling negative data. See note in Zero Point section, earlier. Gain is **not** adjusted. To scale negative data, follow the steps below.

The LVDT must be connected to the 9850 instrument during a calibration.

Display	Action
To do -CAL CH1 Press ENTER	To initiate adjustment, press ENTER key.
Set LVDT - CH1 - 7243.0 OK?	Displace LVDT plunger by amount equal to *&CAL Point*, then press ENTER key. Current data is shown.
Please wait CH1 - 7500.0 Adj-	Negative data is being scaled.
-CAL Done CH1 - 7500.0 OK?	&CAL is done. Press ENTER key to accept, or ESC key to cancel and return to previous setting.
CHAN Calibration	Return to top of *CHAN Calibration* menu.

Test Signals

*In data screen with Test **not** running:*
ENTER & UP keys for % test signal(s).
ENTER & DOWN keys for & test signal(s).

You can verify the calibration of the LVDT/amplifier using internal test signals. In the data screen (with Test **not** running), ENTER key is used in combination with UP (or DOWN) key to activate test signal(s). While pressing ENTER key, press UP key for positive test signal(s). Release keys to remove test signal(s). For negative test signal(s) use DOWN key instead of UP key.

For the Model LVDA (LVDT Amplifier), the test signals are created by injecting a portion of the signal from the Sense inputs (which originates from the regulated Excitation outputs) simulating a positive or negative displacement. After a calibration, invoke the positive and negative test signals making sure the LVDT is connected and at 0 in units of the selected channel. Otherwise, any displacement would add to the simulated displacement. Record the displayed data. Then, at any time, you can verify the calibration by using the test signals again, and comparing the displayed data to what you recorded.

CHAN CALIBRATION (MODEL DCSA)

To learn how to navigate the menu and modify selections, see MENU BASICS.

The Model DCSA is a DC Strain Gage Amplifier that can handle any directly wired strain gage transducer that provides an output in the range, 0.5 to 4.5mV/V. The *CHAN Calibration* menu for Model DCSA allows you to define calibration mode and values, and actually perform a calibration based on these settings. No manual adjustments are necessary. Selections in the *CHAN Calibration* menu for Model DCSA depend on the *Type of CAL* setting (*Shunt*, *Load*, or *mV/V*) as shown below. Each of these types are divided into two more types, *Pos/Neg* and *Positive*. For example, there are two Shunt calibrations, *Shunt-Pos/Neg* and *Shunt-Positive*. Use RIGHT/LEFT keys to choose from the following selections.

Xdcr ! Transducer

** Omitted when Type of CAL is Shunt-Positive.*

*** Omitted when Type of CAL is Load-Positive.*

**** Omitted when Type of CAL is mV/V-Positive.*

Shunt Calibrations	**Load Calibrations**	**mV/V Calibrations**
Type of CAL	*Type of CAL*	*Type of CAL*
Full Scale	*Full Scale*	*Full Scale*
Zero Value	*Zero Value*	
%CAL Value	*%Load Value*	*mV/V @ %FS*
*&CAL Value**	*&Load Value***	*mV/V @ &FS****
	To Zero Xdcr	
To CAL Xdcr	*To do %CAL*	*To CAL Xdcr*
	*To do &CAL***	

To do a Shunt calibration,

Select *Type of CAL*.
Enter *Full Scale*, *Zero Value*, *%CAL Value*, *&CAL Value*.*
Perform *To CAL Xdcr*.

*When you perform a calibration, internal adjustments are made automatically. If this is the first time a calibration is done on a given transducer, large adjustment changes may be required. So, for optimal accuracy, it is recommended that two calibrations are done. This applies to Shunt and Load calibrations, **not** mV/V calibrations.*

To do a Load calibration,

Select *Type of CAL*.
Enter *Full Scale*, *Zero Value*, *%Load Value*, *&Load Value*.**
Perform *To Zero Xdcr*.
Perform *To do %CAL*.
Perform *To do &CAL*.**

To do a mV/V calibration,

Select *Type of CAL*.
Enter *Full Scale*, *mV/V @ %FS*, *mV/V @ &FS*.***
Perform *To CAL Xdcr*.

If any selections in the *CHAN Calibration* menu are changed, you must perform the calibration commands, *To CAL Xdcr* for Shunt and mV/V calibrations, *To Zero Xdcr* and *To do %CAL* for Load calibrations. Otherwise, when leaving the *CHAN Calibration* menu, the message, *Not Calibrated Undo Changes OK?*, appears. ENTER key will undo the changes. ESC key keeps you in the *CHAN Calibration* menu with changes intact. This allows you to perform the calibration commands and then leave menu. This feature assures that when you enter the *CHAN Calibration* menu, the channel was last adjusted using the current selections. The *To do &CAL* calibration command is **not** required. If it is **not** performed, negative data is scaled the same as positive data.

Type of CAL

Default setting for Type of CAL is Shunt-Pos/Neg.

Select *Shunt-Pos/Neg*, *Shunt-Positive*, *Load-Pos/Neg*, *Load-Positive*, *mV/V-Pos/Neg*, or *mV/V-Positive* based on the calibration you are doing.

Use one of the *Shunt* (or *mV/V*, described later) calibration selections when you cannot load the transducer to a known value. Instead, the CAL resistor on the Model DCSA, simulates a known load. A CAL value (in engineering units) associated with this CAL resistor is required. When a transducer is purchased with the system, the proper CAL resistor is installed. Otherwise, a 60kΩ CAL resistor is provided. Refer to the transducer calibration sheet for the CAL resistor value. ±0.02%, ±5ppm/EC resistors are recommended. To install or change the CAL resistor, see CAL Resistor Installation (Models ACUA and DCSA) in APPENDIX B.

*When doing a Shunt calibration, use Shunt-Positive when you are **not** interested in negative data.*

For *Shunt-Pos/Neg*, the CAL resistor simulates both a positive and negative load.

For *Shunt-Positive*, the CAL resistor simulates a positive load only, and negative data is scaled the same as positive data.

Use one of the *Load* calibration selections when you can physically load the transducer to known values for calibration. The magnitude of the applied loads, preferably, should be 75% to 100% of Full Scale. For Load calibrations, the CAL Resistor is **not** used for calibration.

*When doing a Load calibration, use Load-Positive for transducers with small symmetry error or if you are **not** interested in negative data.*

For *Load-Pos/Neg*, you must apply both a positive and negative load to the transducer during calibration. The amplifier is adjusted based on these loads. Using both loads allows the system to correct any symmetry error of the transducer.

For *Load-Positive*, only a positive load is required for calibration. The negative data is scaled the same as positive data.

Use one of the *mV/V* calibration selections when you cannot load the transducer to a known value and you know the mV/V output value of the transducer at Full Scale. The *mV/V* calibration provides an absolute gain (span) adjustment (using an internal reference voltage) while compensating for any zero unbalance of the transducer. For *mV/V* calibrations, the CAL Resistor is **not** used for calibration.

For *mV/V-Pos/Neg*, you must have the mV/V output values for the transducer at both positive and negative Full Scale. The amplifier is adjusted based on these values. Using both values allows the system to correct any symmetry error of the transducer.

For *mV/V-Positive*, only the mV/V output value for the transducer at positive Full Scale is required for calibration. The negative data is scaled the same as positive data.

Full Scale

Default value for Full Scale is 10000.

Enter the Full Scale (in engineering units) of the transducer connected to this channel. This can be obtained from the transducer calibration sheet.

The Full Scale of this channel is used to:

determine scaling of displayed data in engineering units,

fix the position of the decimal point in displayed data,

determine selections for display resolution,

and, set the scaling of any analog output assigned to this channel.

The overrange capability for the Model DCSA is 50% of Full Scale. So, data for this channel can be as large as 1.5 times Full Scale, otherwise *OVERLOAD* is displayed.

Zero Value (Shunt and Load Calibrations)

Default value for Zero Value is 0.

For *Shunt* calibrations, enter the value (in engineering units) representing an unloaded transducer.

For *Load* calibrations, enter the value (in engineering units) equivalent to the physical load (if any) present during zero calibration. This may be a known load that cannot easily be removed.

For *mV/V* calibrations, this entry is omitted. The physical load (if any) present during calibration along with any transducer zero unbalance are calibrated to 0 (in engineering units).

Typically, *Zero Value* is 0.

%CAL Value | %Load Value | mV/V @ %FS

Default value for %CAL Value,%Load Value, and mV/V @ %FS is 7500.

For *Shunt* calibrations, *%CAL Value* is displayed. Enter the %Equivalent Calibration value (in engineering units) from the transducer calibration sheet. This is the value obtained when the CAL resistor is shunted across the bridge (on transducer) to simulate a known positive load.

For *Load* calibrations, *%Load Value* is displayed. Enter the value (in engineering units) of the physical load that will be applied during positive calibration. The closer this value is to Full Scale the better. Typical values are from 75% to 100% of Full Scale.

For *mV/V* calibrations, *mV/V @ %FS* is displayed. Enter the output (in mV/V's) of the transducer at positive Full Scale. This can be obtained from the transducer calibration sheet.

&CAL Value | &Load Value | mV/V @ &FS

Default value for &CAL Value, &Load Value, and mV/V @ &FS is &7500.

This entry is omitted for Shunt-Positive, Load-Positive, and mV/V-Positive calibrations. Negative data is scaled the same as positive data.

For a *Shunt-Pos/Neg* calibration, *&CAL Value* is displayed. Enter the &Equivalent Calibration value (in engineering units) from the transducer calibration sheet. This is the value obtained when the CAL resistor is shunted across the bridge (on transducer) to simulate a known negative load.

For a *Load-Pos/Neg* calibration, *&Load Value* is displayed. Enter the value (in engineering units) of the physical load that will be applied during negative calibration. The closer this value is to negative Full Scale the better. Typical values are from 75% to 100% of negative Full Scale.

For *mV/V* calibrations, *mV/V @ &FS* is displayed. Enter the output (in mV/V's) of the transducer at negative Full Scale. This can be obtained from the transducer calibration sheet.

When the *%CAL Value*, *%Load Value*, or *mV/V @%FS* is entered, the *&CAL Value*, *&Load Value*, or *mV/V @&FS*, respectively, is automatically updated to the same value, except negative. This is only a shortcut, and the *&CAL Value*, *&Load Value*, or *mV/V @&FS* can be overwritten.

To CAL Transducer (Shunt Calibrations)

For Shunt calibrations a CAL resistor is used to simulate a load. The CAL resistor is automatically switched and both zero and gain are adjusted without user intervention. The transducer must be connected to the 9850 instrument and it must be unloaded during the calibration.

When *Type of CAL* is *Shunt-Pos/Neg* or *Shunt-Positive*, one of the selections in the *CHAN Calibration* menu is *To CAL Xdcr*. This command calibrates the transducer/amplifier using a CAL resistor to simulate a load. For *Shunt-Pos/Neg*, the CAL resistor simulates both a positive and negative load. See Type of CAL earlier in this chapter. For *Shunt-Positive*, the CAL resistor simulates a positive load only, and negative data is scaled the same as positive data. To calibrate, follow the steps below.

```
To CAL Xdcr  CH1
Press ENTER
```

To initiate calibration, press ENTER key.

```
Unload Xdcr  CH1
-    2.0  OK?
```

Unload the transducer, then press ENTER key. Current data is shown.

*Character to right of **Adj** indicates operation being done.*
0 for zero adjustment
% for gain adjustment
& for minus correction

```
Please wait  CH1
     0.0  Adj0
```

Zero and gain are being adjusted.

```
CAL Done     CH1
     0.0  OK?
```

Calibration is done. Press ENTER key to accept, or ESC key to cancel and return to previous adjustment.

For zero range and input sensitivity, see APPENDIX H.

```
CHAN Calibration
```

Return to top of *CHAN Calibration* menu.

To Zero Transducer (Load Calibrations)

The transducer must be connected to the 9850 instrument during a calibration.

When *Type of CAL* is *Load-Pos/Neg* or *Load-Positive*, one of the selections in the *CHAN Calibration* menu is *To Zero Xdcr*. This command performs the zero adjustment for the transducer/amplifier. To adjust zero, follow the steps below.

To Zero Xdcr CH1 Press ENTER	To initiate adjustment, press ENTER key.
Unload Xdcr CH1 - 2.0 OK?	Unload the transducer, then press ENTER key. Current data is shown.
Please wait CH1 0.0 Adj0	Zero is being adjusted.
Zero Done CH1 0.0 OK?	Adjustment is done. Press ENTER key to accept, or ESC key to cancel and return to previous adjustment.
To do +CAL CH1 Press ENTER	Go to next menu selection.

For zero range, see APPENDIX H.

To do %CAL (Load Calibrations)

The transducer must be connected to the 9850 instrument during a calibration.

When *Type of CAL* is *Load-Pos/Neg* or *Load-Positive*, one of the selections in the *CHAN Calibration* menu is *To do %CAL*. This command performs the gain adjustment for the transducer/amplifier. To adjust gain, follow the steps below.

To do +CAL CH1 Press ENTER	To initiate adjustment, press ENTER key.
Load Xdcr + CH1 7286.0 OK?	Apply load corresponding to *%Load Value* to the transducer, then press ENTER key. Current data is shown.
Please wait CH1 7500.0 Adj+	Gain is being adjusted.
+CAL Done CH1 7500.0 OK?	Adjustment is done. Press ENTER key to accept, or ESC key to cancel and return to previous adjustment.
To do -CAL CH1 Press ENTER	Go to next menu selection.

For input sensitivity, see APPENDIX H.

To do &CAL (Load Calibrations)

For Load-Positive calibrations, this selection is omitted and the negative data is scaled the same as positive data.

The transducer must be connected to the 9850 instrument during a calibration.

When *Type of CAL* is *Load-Pos/Neg*, one of the selections in the *CHAN Calibration* menu is *To do &CAL*. This command corrects any symmetry error of the transducer by scaling negative data. Gain is **not** adjusted. To scale negative data, follow the steps below.

`To do -CAL   CH1` `Press ENTER`	To initiate adjustment, press ENTER key.
`Load Xdcr -  CH1` `- 7243.0  OK?`	Apply load corresponding to *&Load Value* to the transducer, then press ENTER key. Current data is shown.
`Please wait  CH1` `- 7500.0  Adj-`	Negative data is being scaled.
`-CAL Done    CH1` `- 7500.0  OK?`	&CAL is done. Press ENTER key to accept, or ESC key to cancel and return to previous setting.
`CHAN Calibration`	Return to top of *CHAN Calibration* menu.

To CAL Transducer (mV/V Calibrations)

The transducer must be connected to the 9850 instrument and unloaded during a calibration.

When *Type of CAL* is *mV/V-Pos/Neg* or *mV/V-Positive*, one of the selections in the *CHAN Calibration* menu is *To CAL Xdcr*. This command calibrates the transducer/amplifier using an internal reference voltage for an absolute gain (span) adjustment while compensating for any zero unbalance of the transducer. For *mV/V-Pos/Neg*, any symmetry error of the transducer is corrected by scaling negative data. See Type of CAL earlier in this chapter. For *mV/V-Positive*, negative data is scaled the same as positive data. To calibrate, follow the steps below.

```
To CAL Xdcr  CH1
Press ENTER
```

To initiate calibration, press ENTER key.

```
Unload Xdcr  CH1
-    2.0  OK?
```

Unload the transducer, then press ENTER key. Current data is shown.

*Character to right of **Adj** indicates operation being done.*
0 for zero adjustment
% for gain adjustment
& for minus correction

```
Please wait  CH1
          Adj0
```

Zero and gain are being adjusted. Current data is **not** shown.

```
CAL Done     CH1
     0.0  OK?
```

Calibration is done. Press ENTER key to accept, or ESC key to cancel and return to previous adjustment.

For zero range and input sensitivity, see APPENDIX H.

```
CHAN Calibration
```

Return to top of *CHAN Calibration* menu.

Test Signals

*In data screen with Test **not** running:*
ENTER & UP keys for % test signal(s).
ENTER & DOWN keys for & test signal(s).

You can verify the calibration of the transducer/amplifier using internal test signals. In the data screen (with Test **not** running), ENTER key is used in combination with UP (or DOWN) key to activate test signal(s). While pressing ENTER key, press UP key for positive test signal(s). Release keys to remove test signal(s). For negative test signal(s) use DOWN key instead of UP key.

If you performed a Load calibration, you could invoke the test signals to determine the calibration values for future Shunt calibrations.

For the Model DCSA (DC Strain Gage Amplifier), the test signals are created by shunting the internal CAL resistor (on the Model DCSA) across the bridge (on transducer) simulating a known positive or negative load. Make sure the transducer is connected and unloaded. Otherwise, the load would add to the simulated load. If no physical load is present on the transducer and the channel has been calibrated, displayed data should be same as %Equivalent Calibration value or &Equivalent Calibration value from the transducer calibration sheet.

CHAN CALIBRATION (MODEL DCVA)

To learn how to navigate the menu and modify selections, see MENU BASICS.

The Model DCVA is a DC Voltage Amplifier that can handle any transducer that provides an output in the range, ±1 to ±10VDC. The *CHAN Calibration* menu for Model DCVA allows you to define calibration mode and values, and actually perform a calibration based on these settings. No manual adjustments are necessary. Selections in the *CHAN Calibration* menu for Model DCVA depend on the *Type of CAL* setting (*Remote* or *Load*) as shown below. There are two types of Remote calibrations, *Remote-Pos/Neg* and *Remote-Positive*, and two types of Load calibrations, *Load-Pos/Neg* and *Load-Positive*. Use RIGHT/LEFT keys to choose from the following selections.

Xdcr ! Transducer

* *Omitted when Type of CAL is Remote-Positive.*

** *Omitted when Type of CAL is Load-Positive.*

For Remote Calibrations	**For Load Calibrations**
Type of CAL	*Type of CAL*
Full Scale	*Full Scale*
Zero Value	*Zero Value*
%CAL Value	*%Load Value*
*&CAL Value**	*&Load Value***
	To Zero Xdcr
To CAL Xdcr	*To do %CAL*
	*To do &CAL***

To do a Remote calibration,

Select *Type of CAL*.
Enter *Full Scale*, *Zero Value*, *%CAL Value*, *&CAL Value*.*
Perform *To CAL Xdcr*.

When you perform a calibration, internal adjustments are made automatically. If this is the first time a calibration is done on a given transducer, large adjustment changes may be required. So, for optimal accuracy, it is recommended that two calibrations are done.

To do a Load calibration,

Select *Type of CAL*.
Enter *Full Scale*, *Zero Value*, *%Load Value*, *&Load Value*.**
Perform *To Zero Xdcr*.
Perform *To do %CAL*.
Perform *To do &CAL*.**

If any selections in the *CHAN Calibration* menu are changed, you must perform the calibration commands, *To CAL Xdcr* for Remote calibrations, *To Zero Xdcr* and *To do %CAL* for Load Calibrations. Otherwise, when leaving the *CHAN Calibration* menu, the message, *Not Calibrated Undo Changes OK?*, appears. ENTER key will undo the changes. ESC key keeps you in the *CHAN Calibration* menu with changes intact. This allows you to perform the calibration commands and then leave menu. This feature assures that when you enter the *CHAN Calibration* menu, the channel was last adjusted using the current selections. The *To do &CAL* calibration command is **not** required. If it is **not** performed, negative data is scaled the same as positive data.

Type of CAL

Default setting for Type of CAL is Remote-Pos/Neg.

Select *Remote-Pos/Neg*, *Remote-Positive*, *Load-Pos/Neg*, or *Load-Positive* based on the calibration you are doing.

*When doing a Remote calibration, use Remote-Positive when you are **not** interested in negative data or the transducer supports a remote positive calibration signal only.*

Use one of the *Remote* calibration selections when you cannot load the transducer to a known value AND the transducer supports Remote calibration. A Remote calibration employs one or two relays (%CAL for positive operation, &CAL for negative operation, if applicable) on the Model DCVA to activate simulated calibration signal(s) at the transducer.

For *Remote-Pos/Neg*, both relays are used to simulate positive and negative loads.

For *Remote-Positive*, one relay output is used to simulate a positive load only, and negative data is scaled the same as positive data.

If the transducer has CAL button(s) to activate simulated calibration signal(s), use one of the Load calibrations.

Use one of the *Load* calibration selections when you can physically load the transducer to known values for calibration. The magnitude of the applied loads, preferably, should be 75% to 100% of Full Scale. For Load calibrations, the relays are **not** used for calibration.

*When doing a Load calibration, use Load-Positive for transducers with small symmetry error or if you are **not** interested in negative data.*

For *Load-Pos/Neg*, you must apply both a positive and negative load to the transducer during calibration. The amplifier is adjusted based on these loads. Using both loads allows the system to correct any symmetry error of the transducer.

For *Load-Positive*, only a positive load is required for calibration. The negative data is scaled the same as positive data.

Full Scale

Default value for Full Scale is 10000.

Enter the Full Scale (in engineering units) of the transducer connected to this channel. This can be obtained from the transducer calibration sheet.

The Full Scale of this channel is used to:

determine scaling of displayed data in engineering units,

fix the position of the decimal point in displayed data,

determine selections for display resolution,

and, set the scaling of any analog output assigned to this channel.

The overrange capability for the Model DCVA is 50% of Full Scale. So, data for this channel can be as large as 1.5 times Full Scale, otherwise *OVERLOAD* is displayed.

Zero Value

Default value for Zero Value is 0.

For *Remote* calibrations, enter the value (in engineering units) representing an unloaded transducer.

For *Load* calibrations, enter the value (in engineering units) equivalent to the physical load (if any) present during zero calibration. This may be a known load that cannot easily be removed.

Typically, *Zero Value* is 0.

%CAL Value | %Load Value

Default value for %CAL Value and %Load Value is 7500.

For *Remote* calibrations, *%CAL Value* is displayed. Enter the %Equivalent Calibration value (in engineering units) from the transducer calibration sheet. This is the value obtained when the transducer simulates a known positive load in response to the %CAL relay on the Model DCVA.

For *Load* calibrations, *%Load Value* is displayed. Enter the value (in engineering units) of the physical load that will be applied during positive calibration. The closer this value is to Full Scale the better. Typical values are from 75% to 100% of Full Scale.

&CAL Value | &Load Value

Default value for &CAL Value and &Load Value is &7500.

This entry is omitted for Remote-Positive and Load-Positive calibrations. Negative data is scaled the same as positive data.

For a *Remote-Pos/Neg* calibration, *&CAL Value* is displayed. Enter the &Equivalent Calibration value (in engineering units) from the transducer calibration sheet. This is the value obtained when the transducer simulates a known negative load in response to the &CAL relay on the Model DCVA.

For a *Load-Pos/Neg* calibration, *&Load Value* is displayed. Enter the value (in engineering units) of the physical load that will be applied during negative calibration. The closer this value is to negative Full Scale the better. Typical values are from 75% to 100% of negative Full Scale.

When the *%CAL Value* or *%Load Value* is entered, the *&CAL Value* or *&Load Value*, respectively, is automatically updated to the same value, except negative. This is only a shortcut, and the *&CAL Value* or *&Load Value* can be overwritten.

To CAL Transducer (Remote Calibrations)

For Remote calibrations, relay(s) are automatically activated and both zero and gain are adjusted without user intervention. The transducer must support Remote calibration, it must be connected to the 9850 instrument and it must be unloaded during the calibration.

When *Type of CAL* is *Remote-Pos/Neg* or *Remote-Positive*, one of the selections in the *CHAN Calibration* menu is *To CAL Xdcr*. This command calibrates the transducer/amplifier using relay(s) to activate simulated calibration signal(s) at the transducer. For *Remote-Pos/Neg*, two relays, %CAL and &CAL, are used to simulate positive and negative loads, respectively. For *Remote-Positive*, one relay, %CAL, is used to simulate a positive load, and negative data is scaled the same as positive data. To calibrate, follow the steps below.

*Character to right of **Adj** indicates operation being done.*
0 for zero adjustment
% for gain adjustment
& for minus correction

For zero range and input sensitivity, see APPENDIX H.

Display	Action
`To CAL Xdcr  CH1` `Press ENTER`	To initiate calibration, press ENTER key.
`Unload Xdcr  CH1` `-    2.0  OK?`	Unload the transducer, then press ENTER key. Current data is shown.
`Please wait  CH1` `     0.0  Adj0`	Zero and gain are being adjusted.
`CAL Done     CH1` `     0.0  OK?`	Calibration is done. Press ENTER key to accept, or ESC key to cancel and return to previous adjustment.
`CHAN Calibration`	Return to top of *CHAN Calibration* menu.

To Zero Transducer (Load Calibrations)

The transducer must be connected to the 9850 instrument during a calibration.

When *Type of CAL* is *Load-Pos/Neg* or *Load-Positive*, one of the selections in the *CHAN Calibration* menu is *To Zero Xdcr*. This command performs the zero adjustment for the transducer/amplifier. To adjust zero, follow the steps below.

To Zero Xdcr CH1 Press ENTER	To initiate adjustment, press ENTER key.
Unload Xdcr CH1 - 2.0 OK?	Unload the transducer, then press ENTER key. Current data is shown.
Please wait CH1 0.0 Adj0	Zero is being adjusted.
Zero Done CH1 0.0 OK?	Adjustment is done. Press ENTER key to accept, or ESC key to cancel and return to previous adjustment.
To do +CAL CH1 Press ENTER	Go to next menu selection.

For zero range, see APPENDIX H.

To do %CAL (Load Calibrations)

The transducer must be connected to the 9850 instrument during a calibration.

When *Type of CAL* is *Load-Pos/Neg* or *Load-Positive*, one of the selections in the *CHAN Calibration* menu is *To do %CAL*. This command performs the gain adjustment for the transducer/amplifier. To adjust gain, follow the steps below.

To do +CAL CH1 Press ENTER	To initiate adjustment, press ENTER key.
Load Xdcr + CH1 7286.0 OK?	Apply load corresponding to *%Load Value* to the transducer, then press ENTER key. Current data is shown.
Please wait CH1 7500.0 Adj+	Gain is being adjusted.
+CAL Done CH1 7500.0 OK?	Adjustment is done. Press ENTER key to accept, or ESC key to cancel and return to previous adjustment.
To do -CAL CH1 Press ENTER	Go to next menu selection.

For input sensitivity, see APPENDIX H.

To do &CAL (Load Calibrations)

For Load-Positive calibrations, this selection is omitted and the negative data is scaled the same as positive data.

The transducer must be connected to the 9850 instrument during a calibration.

When *Type of CAL* is *Load-Pos/Neg*, one of the selections in the *CHAN Calibration* menu is *To do &CAL*. This command corrects any symmetry error of the transducer by scaling negative data. Gain is **not** adjusted. To scale negative data, follow the steps below.

Display	Description
`To do -CAL   CH1` `Press ENTER`	To initiate adjustment, press ENTER key.
`Load Xdcr -  CH1` `- 7243.0  OK?`	Apply load corresponding to *&Load Value* to the transducer, then press ENTER key. Current data is shown.
`Please wait  CH1` `- 7500.0  Adj-`	Negative data is being scaled.
`-CAL Done    CH1` `- 7500.0  OK?`	&CAL is done. Press ENTER key to accept, or ESC key to cancel and return to previous setting.
`CHAN Calibration`	Return to top of *CHAN Calibration* menu.

Test Signals

*In data screen with Test **not** running:*
ENTER & UP keys for % test signal(s).
ENTER & DOWN keys for & test signal(s).

You can verify the calibration of the transducer/amplifier using internal test signals. In the data screen (with Test **not** running), ENTER key is used in combination with UP (or DOWN) key to activate test signal(s). While pressing ENTER key, press UP key for positive test signal(s). Release keys to remove test signal(s). For negative test signal(s) use DOWN key instead of UP key.

If you performed a Load calibration and the transducer supports Remote calibration, you could invoke the test signals to determine the calibration values for future Remote calibrations.

For the Model DCVA (DC Voltage Amplifier), the test signals are created by activating relays, %CAL or &CAL, on the Model DCVA simulating a known positive or negative load, respectively. Make sure the transducer is connected and unloaded. Otherwise, the load may add to the simulated load. This is transducer dependent. If no physical load is present on the transducer, and the channel has been calibrated, and the transducer supports Remote calibration, displayed data should be same as %Equivalent Calibration value or &Equivalent Calibration value from the transducer calibration sheet.

CHAN CALIBRATION (MODEL DCIA)

To learn how to navigate the menu and modify selections, see MENU BASICS.

The Model DCIA is a DC Current Amplifier that can handle a 4 to 20mA transmitter (2 or 4 wire) or a transducer that provides an output in the range, ±10 to ±20mA. The *CHAN Calibration* menu for Model DCIA allows you to define *Input Range* and *Full Scale* of the transducer, and actually adjust the Model DCIA based on these settings. The Model DCIA is an absolute measuring device, so the transducer (current source) does **not** need to be connected when making these selections. No manual adjustments are necessary. Use RIGHT/LEFT keys to choose from the following selections.

Input Range
Full Scale
Adjust DCIA

Input Range

Default setting for Input Range is ±10 mA.

Select ±*10 mA*, ±*20 mA*, *12±8 mA*, or *4-20 mA* based on the transducer output.

Use ±*10 mA* for transducers with an output on the order of 10mA with 0mA at zero. See following table.

Use ±*20 mA* for transducers with an output on the order of 20mA with 0mA at zero. See following table.

Use *12±8 mA* for transmitters in bi-directional mode (12mA zero with 8mA positive span and 8mA negative span). See following table.

Use *4-20 mA* for transmitters in uni-directional mode (4mA zero with 16mA positive span). See following table.

Transducer Output (mA)				Displayed Data	
Input Range					
±10 mA	**±20 mA**	**12±8 mA**	**4-20 mA**	**General Case**	**Example with FS*=1000**
15	30	24	28	1.5 x FS*	1500
10	20	20	20	FS*	1000
0	0	12	4	0	0
-10	-20	4	-12	&FS*	&1000
-15	-30	0	-20	&1.5 x FS*	&1500

* where FS is Full Scale in engineering units.

Full Scale

Default value for Full Scale is 10000.

Enter the value (in engineering units) of the transducer output that corresponds to the Full Scale current of the Input Range selected.

As you can see from the preceding table, Full Scale current is 20mA for all input ranges, except the *±10 mA* range in which case it is 10mA.

The Full Scale of this channel is used to:

determine scaling of displayed data in engineering units,

fix the position of the decimal point in displayed data,

determine selections for display resolution,

and, set the scaling of any analog output assigned to this channel.

The overrange capability for the Model DCIA is 50% of Full Scale. So, data for this channel can be as large as 1.5 times Full Scale, otherwise *OVERLOAD* is displayed.

Adjust DCIA

*During adjustment, it does **not** matter whether the transducer is connected or **not**.*

Press ENTER key to have system automatically adjust the zero and gain of the Model DCIA using *Input Range* and *Full Scale* settings. The message, *Please wait... Adjusting DCIA* is displayed. Typically, the adjustments take 5 to 10 seconds. When adjustments are finished, *CHAN Calibration* is displayed. You can continue navigating the menu using Cursor keys, or press MENU key to exit menu.

The Model DCIA is an absolute measuring device. During adjustment, it removes the transducer connection from the input, and injects a signal from an internal programmable calibrated reference. So during adjustment, it does **not** matter whether the transducer (current source) is connected or **not**.

Normally, you do **not** need to perform the *Adjust DCIA* operation because the system automatically performs it, if necessary, when you leave the *CHAN Calibration* menu for the Model DCIA. If you question the adjustment, you can perform this function.

Test Signals

In data screen with Test ***not*** *running:*
ENTER & UP keys for % test signal(s).
ENTER & DOWN keys for & test signal(s).

You can check operation of the transducer/amplifier using internal test signals. In the data screen (with Test **not** running), ENTER key is used in combination with UP (or DOWN) key to activate test signal(s). While pressing ENTER key, press UP key for positive test signal(s). Release keys to remove test signal(s). For negative test signal(s) use DOWN key instead of UP key.

For the Model DCIA (DC Current Amplifier), the test signals are created with an internal programmable calibrated reference. The transducer connection is removed from the input, so it does **not** matter whether the transducer (current source) is connected or **not**. For the positive test signal, the current injected is equivalent to %Full Scale, so, the displayed data should be %Full Scale. For the negative test signal, the current injected is equivalent to &Full Scale, so, the displayed data should be &Full Scale. See Full Scale earlier in this chapter. For actual test signal currents, refer to Input Range table earlier in this chapter. For example, if Input Range is 4-20mA, the positive test signal is 20mA and the negative test signal is &12mA.

CHAN CALIBRATION (MODEL CTUA)

To learn how to navigate the menu and modify selections, see MENU BASICS.

The Model CTUA is a Frequency Input Module that can handle transducers that provide a frequency output, such as speed pickups, flowmeters, encoders, etc. The *CHAN Calibration* menu for Model CTUA allows you to define the type of input signal you are measuring and scale it appropriately. The Model CTUA is an absolute measuring device, so the transducer (frequency source) does **not** need to be connected when making these selections. No manual adjustments are necessary. Use RIGHT/LEFT keys to choose from the following selections.

Full Scale	
Xdcr Freq.	(Transducer Frequency)
Xdcr Value	(Transducer Value)
Input Type	
Polarity	
Input Filter	
Lowest Freq.	(Lowest Frequency)

Full Scale

Default value for Full Scale is 10000.

Enter the Full Scale (in engineering units) of the transducer (frequency source) connected to this channel. If a speed pickup is used, enter the largest speed of interest, not exceeding the maximum speed rating of the transducer.

The Full Scale of this channel is used to:

determine scaling of displayed data in engineering units,

fix the position of the decimal point in displayed data,

determine selections for display resolution,

and, set the scaling of any analog output assigned to this channel.

The overrange capability for the Model CTUA is 50% of Full Scale. So, data for this channel can be as large as 1.5 times Full Scale, otherwise *OVERLOAD* is displayed.

Transducer Frequency | Transducer Value

Xdcr ! Transducer

Default value for Xdcr Freq is 10000.

Default value for Xdcr Value is 10000.

The two entries, *Xdcr Freq* and *Xdcr Value*, provide the necessary transducer (frequency source) calibration data required for engineering unit scaling. *Xdcr Value* is an arbitrary value (in engineering units), and *Xdcr Freq* is the corresponding frequency (in Hz) of the signal generated by the transducer at *Xdcr Value*. Following are three examples showing how to determine *Xdcr Value* and *Xdcr Freq* for various transducers.

Example 1:

A speed pickup with a 60 tooth gear is used and you want to display speed in RPM (rotations per minute). Determine *Xdcr Freq* and *Xdcr Value* as follows. Pick 60RPM and determine the frequency of the signal generated by speed pickup at 60RPM. You can arbitrarily pick any RPM, but when the desired engineering unit is 'per minute', an easy pick is 60 because it will cancel with 60 seconds (1 minute) as shown below.

$$
\begin{aligned}
60\ RPM &= \frac{60\ rotations}{minute} \times \frac{1\ minute}{60\ seconds} \times \frac{60\ pulses}{1\ rotation} \\
&= \frac{60\ pulses}{1\ second} \\
&= 60\ Hz
\end{aligned}
$$

Therefore, the speed pickup generates a 60Hz signal at 60RPM. Enter 60Hz as *Xdcr Freq* and 60RPM as *Xdcr Value*.

For the general case, to display speed in RPM using a 60 tooth gear, set *Xdcr Freq* equal to *Xdcr Value*.

Example 2:

A encoder with 512 pulses per revolution is used and you want to display speed in RPM (rotations per minute). Determine *Xdcr Freq* and *Xdcr Value* as follows. Pick 60RPM and determine the frequency of the signal generated by encoder at 60RPM. You can arbitrarily pick any RPM, but when the desired engineering unit is 'per minute', an easy pick is 60 because it will cancel with 60 seconds (1 minute) as shown below.

$$60\ RPM = \frac{60\ rotations}{minute} \times \frac{1\ minute}{60\ seconds} \times \frac{512\ pulses}{1\ rotation}$$

$$= \frac{512\ pulses}{1\ second}$$

$$= 512\ Hz$$

Therefore, the encoder generates a 512Hz signal at 60RPM. Enter 512Hz as *Xdcr Freq* and 60RPM as *Xdcr Value*.

Example 3:

A flowmeter with a calibration factor of 3000 cycles per gallon is used and you want to display flow in GPM (gallons per minute). Determine *Xdcr Freq* and *Xdcr Value* as follows. Pick 60GPM and determine the frequency of the signal generated by flowmeter at 60GPM. You can arbitrarily pick any RPM, but when the desired engineering unit is 'per minute', an easy pick is 60 because it will cancel with 60 seconds (1 minute) as shown below.

$$60\ GPM = \frac{60\ gallons}{minute} \times \frac{1\ minute}{60\ seconds} \times \frac{3000\ cycles}{1\ gallon}$$

$$= \frac{3000\ cycles}{1\ second}$$

$$= 3000\ Hz$$

Therefore, the flowmeter generates a 3000Hz signal at 60GPM. Enter 3000Hz as *Xdcr Freq* and 60RPM as *Xdcr Value*.

Input Type

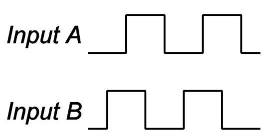
Select the voltage levels of the transducer signal (frequency source) you are using. Choose from the following settings.

Default setting for Input Type is TTL.

TTL

Use for signal that is compatible with TTL logic levels (V_{IL}=0.8V_{max}, V_{IH}=2.0V_{min}). A Schmitt Trigger buffer is used providing at least 0.4V hysteresis (1V, typical). Frequency is measured from Input A. A typical transducer is a zero velocity speed pickup.

Quadrature Signals



Input B leads Input A by 90°.

TTL (Quadrature)

Similar to *TTL* setting except two quadrature signals (90E phase difference) are used providing frequency measurement with directional sign. When Input B leads Input A, data is positive. Data is negative when Input A leads Input B. If the sign is opposite to what you want, see Polarity later in this chapter. Schmitt Trigger buffers are used providing at least 0.4V hysteresis (1V, typical). A typical transducer is an encoder with two quadrature signals.

For typical cable connections, see Model CTUA Connector in APPENDIX A.

10mVp-p
20mVp-p
50mVp-p
100mVp-p
200mVp-p

Use for differential signal at Input A and Input B. For the signal to be counted the peak to peak voltage of Input A with respect to Input B must exceed the setting selected. A typical transducer is a passive speed pickup. The output voltage of a passive speed pickup is proportional to speed. At low speeds try smaller thresholds. At moderate and high speeds try larger thresholds for better noise immunity.

Polarity

Default setting for Polarity is Not Inverted.

Select *Not Inverted* or *Inverted* to change positive/negative sign for data. This is primarily used for quadrature signals. When *Polarity* is *Not Inverted* and Input B leads Input A, data is positive. In this case, if you want negative data, change *Polarity* to *Inverted*.

Polarity still reverses sign for signals without directional content (i.e. *Input Type* is *TTL*, *10mVp-p*, *20mVp-p*, *50mVp-p*, *100mVp-p*, or *200mVp-p*). But, the sign will be fixed and never change.

Input Filter

Default setting for Input Filter is None.

Select *None* or *20kHz* to disable or enable, respectively, the low pass hardware input filter. This filter is **not** applied to TTL signals (i.e. *Input Type* is *TTL* or *TTL Quadrature*). When enabled, nominal attenuation of 3dB is provided at 20kHz. This noise suppression filter is applied to the input signal before digitizing (counting).

Select *None* if transducer generates frequencies above 20kHz. Otherwise, valid frequencies will be attenuated, and may **not** exceed the input voltage thresholds, and as a result, will **not** be counted.

Select *20kHz* if transducer generates frequencies less than 20kHz. This will attenuate any noise on the signal.

In addition to the hardware input filter, there is a low pass digital filter. The digital filter has selectable cutoff frequencies and is applied to digitized data. See Filter in CHAN SETTINGS.

Lowest Frequency

Default setting for Lowest Freq is 1% of FS.

For the entry, *Lowest Freq.*, select *1% of FS* or *0.01% of FS* to indicate the smallest data read before zero is displayed. This selection controls how fast data drops to zero when no signal is present. By definition, when determining frequency using period measurement, response time for very low frequencies is relatively long. So, the time to detect that no signal is present (0Hz) depends on the lowest frequency that the Model CTUA could measure.

To determine the frequency at Full Scale, use method described in Examples 1 though 3 earlier in this chapter.

For *0.01% of FS*, full resolution (1 part in 10000) is resolved all the way down to zero. When the frequency at Full Scale is small, the lowest frequency that can be measured may be so small that the time for it to be measured will be very long. For example, if the transducer generates a 200Hz signal at Full Scale, the lowest frequency that can be measured is 0.02Hz (0.01% of 200Hz). The period of 0.02Hz is 50s (1÷0.02Hz). So, it will take 50s for data to drop to zero. If this is undesirable and you are **not** interested in data less than 1% of Full Scale, then set *Lowest Freq* to *1% of FS* to decrease the drop to zero time by a factor of 100.

For *1% of FS*, full resolution (1 part in 10000) is resolved down to 1% of Full Scale. Data is zero for frequencies less than 1% of Full Scale. Using the same example as above (the transducer generates a 200Hz signal at Full Scale), the lowest frequency that could be measured is 2Hz (1% of 200Hz). The period of 2Hz is 0.5s. As a result, the drop to zero time is 0.5s instead of 50s.

Test Signals

*In data screen with Test **not** running:*
ENTER & UP keys for % test signal(s).
ENTER & DOWN keys for & test signal(s).

You can check operation of the Model CTUA (Frequency Input Module) using internal test signals. In the data screen (with Test **not** running), ENTER key is used in combination with UP (or DOWN) key to activate test signal(s). While pressing ENTER key, press UP key for positive test signal(s). Release keys to remove test signal(s). For negative test signal(s) use DOWN key instead of UP key.

For the Model CTUA, the test signals are created with an internal 16MHz signal scaled to display positive or negative Full Scale value. The transducer (frequency source) does **not** need to be connected.

CHAN CALIBRATION (MODEL UDCA)

To learn how to navigate the menu and modify selections, see MENU BASICS.

The Model UDCA is an Encoder/Totalizer Module counting TTL quadrature signals (up and down) from linear and rotary encoders or counting (up) external events (TTL signal). The *CHAN Calibration* menu for Model UDCA allows you to define the type of input signal you are counting and scale it appropriately. When making these selections, it does **not** matter whether the transducer (count source) is connected or **not**. No manual adjustments are necessary. Use RIGHT/LEFT keys to choose from the following selections.

Full Scale	
Xdcr Pulses	(Transducer Pulses)
Xdcr Value	(Transducer Value)
Count Mode	
% Direction	(when *Count Mode* is *1X*, *2X*, or *4X*)
Count Edge	(when *Count Mode* is *Event*)
ResetArm Sig	(Reset Arm Signal)
Reset Signal	
Reset Mode	

Full Scale

Default value for Full Scale is 10000.

Enter the largest value (in engineering units) you expect to count. For a rotary encoder, Full Scale would be 360 degrees if the counter is reset every revolution. Or, if you are counting number of revolutions (without resetting every revolution), then use the maximum number of revolutions expected. For linear encoders, Full Scale is maximum linear distance. For event counting, Full Scale is maximum number of events expected.

The Full Scale of this channel is used to:

determine scaling of displayed data in engineering units,

fix the position of the decimal point in displayed data,

determine selections for display resolution,

and, set the scaling of any analog output assigned to this channel.

The overrange capability for the Model UDCA is 50% of Full Scale. So, data for this channel can be as large as 1.5 times Full Scale, otherwise *OVERLOAD* is displayed.

Transducer Pulses | Transducer Value

Xdcr ! Transducer

Default value for Xdcr Pulses is 10000.

Default value for Xdcr Value is 10000.

The two entries, *Xdcr Pulses* and *Xdcr Value*, provide the necessary transducer (count source) calibration data required for engineering unit scaling. *Xdcr Value* is an arbitrary value (in engineering units), and *Xdcr Pulses* is the corresponding number of pulses generated by the transducer to get *Xdcr Value*. Following are six examples showing how to determine *Xdcr Value* and *Xdcr Pulses* for various transducers.

Example 1:

Do NOT change Xdcr Pulses or Xdcr Value as a result of changing Count Mode (1X, 2X, 4X). By increasing Count Mode from 1X to 4X, there are more count pulses, but the 9850 takes care of this increase automatically.

A rotary encoder with 512 pulses per revolution is used and you want to display number of revolutions. Pick 1 revolution as *Xdcr Value*, and use 512 for *Xdcr Pulses*.

Example 2:

A rotary encoder with 1000 pulses per revolution is used and you want to display data in degrees. Pick 360 degrees as *Xdcr Value*, and use 1000 for *Xdcr Pulses*.

Example 3:

A linear encoder with 100 pulses per inch is used and you want to display data in inches. Pick 1 inch as *Xdcr Value*, and use 100 for *Xdcr Pulses*

Example 4:

The Model UDCA is used as an event counter counting up to 10,000. The edge (rising or falling edge, user selectable) of an external TTL signal (Input A) is counted. Set *Full Scale* to 10,000. This provides a Display Resolution of 1 Event. See Display Resolution in CHAN SETTINGS. Pick 1 Event as *Xdcr Value*, and use 1 for *Xdcr Pulses*. With these settings, each event is counted and displayed up to at least 15,000 (overrange capability is 50% of Full Scale).

If you entered 20,000 as Full Scale, the Display Resolution would be 2. Each event is counted internally, but displayed data is rounded to the nearest 2.

Example 5:

The Model UDCA is used as an event counter counting up to 999,900. The edge (rising or falling edge, user selectable) of an external TTL signal (Input A) is counted. Set *Full Scale* to 999,900. This provides a Display Resolution of 100 Events. See Display Resolution in CHAN SETTINGS. Pick 1 Event as *Xdcr Value*, and use 1 for *Xdcr Pulses*. With these settings, each event is counted internally, but displayed data is rounded to the nearest 100. The maximum data displayed would be 999,900 since the display is limited to six digits.

Example 6:

The Model UDCA is used as an event counter counting up to 10,000,000. The edge (rising or falling edge, user selectable) of an external TTL signal (Input A) is counted. Since 10,000,000 cannot be displayed on the six digit display, you have to change the units to kEvents (1000's of events). Set *Full Scale* to 10,000. This provides a Display Resolution of 1 kEvent. See Display Resolution in CHAN SETTINGS. Pick 1 kEvent as *Xdcr Value*, and use 1000 for *Xdcr Pulses*. With these settings, each event is counted internally, but data is displayed in kEvents (1000's of events) up to at least 15,000 kEvents (overrange capability is 50% of Full Scale).

Count Mode

Default value for Count Mode is 1X (Quadrature).

For typical cable connections, see Model UDCA Connector in APPENDIX A.

Select the way you want the counter to count. Quadrature modes allow counting in both directions (up and down). Event mode counts up only. For Quadrature modes, both signals, Input A and Input B, are required. For Event mode, only Input A is used. Choose from the following settings.

1X (Quadrature) When *1X (Quadrature)* is selected, each full cycle shown in following Quadrature Count Mode diagram is counted. The edge that is counted depends on the actual signals and the *% Direction* and *Reset Mode* settings as shown in the following Quadrature Count Edge diagram.

2X mode counts twice as many pulses as 1X mode for the same input signals.

2X (Quadrature) When *2X (Quadrature)* is selected, each ½ cycle shown in following Quadrature Count Mode diagram is counted. The edge that is counted depends on the actual signals and the *% Direction* and *Reset Mode* settings as shown in the following Quadrature Count Edge diagram.

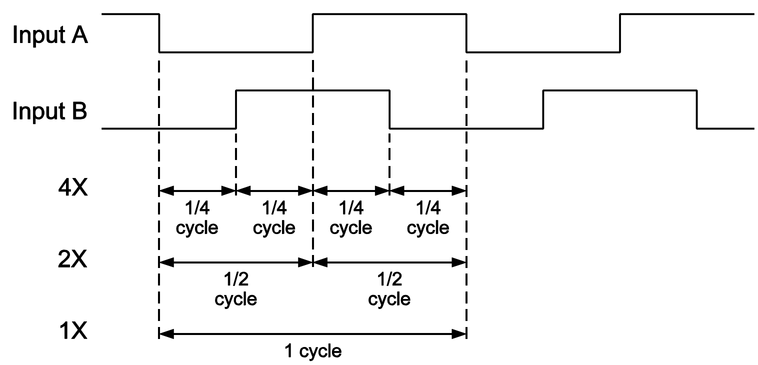
4X mode counts four times as many pulses as 1X mode for the same input signals.

4X (Quadrature) When *4X (Quadrature)* is selected, each ¼ cycle shown in following Quadrature Count Mode diagram is counted. The counter counts both edges of Input A **and** Input B as shown in the following Quadrature Count Edge diagram.

For Event mode, Input B is ignored.

Event (Input A) When *Event (Input A)* is selected, either the rising or falling edge (see Count Edge later in this chapter) of Input A is counted.

Quadrature Count Mode Diagram



2X and 4X count modes allow finer resolution for displayed data. But, for encoders with many pulses, the finer resolution is **not** viewable if it is smaller than the Display Resolution. For example, a rotary encoder has 3600 pulses/revolution. For a Full Scale of 360 degrees, the best Display Resolution is 0.050 degrees. The count resolution is determined as shown below.

See Display Resolution in CHAN SETTINGS.

$$1X: \quad \frac{360\ degrees}{3600\ counts} = 0.100\ \frac{degrees}{count}$$

$$2X: \quad \frac{360\ degrees}{7200\ counts} = 0.050\ \frac{degrees}{count}$$

$$4X: \quad \frac{360\ degrees}{14400\ counts} = 0.025\ \frac{degrees}{count}$$

For 1X and 2X modes, the count resolutions of 0.100 and 0.050 can be viewed with the Display Resolution of 0.050 degrees. But, for the 4X mode, the count resolution of 0.025 can only be resolved down to 0.050 degrees.

Even though in the example the 4X count resolution is not viewable, you can still use it.

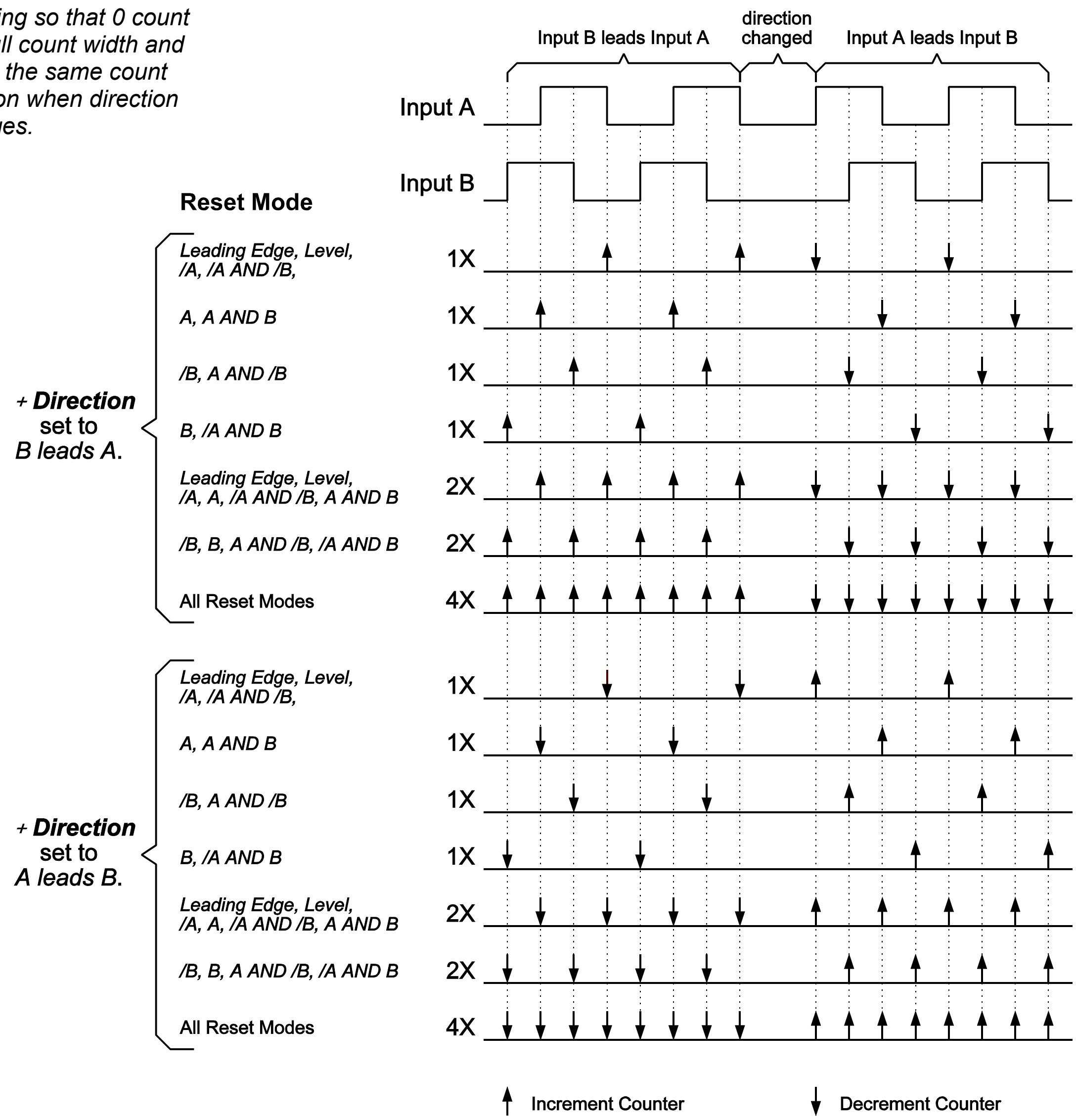
% Direction (1X, 2X, 4X Count Modes)

Default setting for % Direction is B leads A.

When *Count Mode* is *1X*, *2X*, or *4X*, one of the selections in the *CHAN Calibration* menu is *% Direction*. Select *B leads A* or *A leads B* to change the direction of the transducer that increments the counter. When *% Direction* is set to *B leads A*, the counter increments when Input B leads Input A and decrements when Input A leads Input B. Conversely, when *% Direction* is set to *A leads B*, the counter increments when Input A leads Input B and decrements when Input B leads Input A. The following Quadrature Count Edge diagram shows which edge increments and decrements the counter for the various *Count Mode*, *Reset Mode*, and *% Direction* settings.

The Count edge is dependent on Reset Mode in order to synchronize reset with counting so that 0 count is a full count width and it is in the same count position when direction changes.

Quadrature Count Edge Diagram



Count Edge (Event Count Mode)

Default setting for Count Edge is Rising Edge.

When *Count Mode* is *Event (Input A)*, one of the selections in the *CHAN Calibration* menu is *Count Edge*. Select *Rising Edge* or *Falling Edge* to specify the edge of Input A that is counted.

When *Rising Edge* is selected, the low (0V) to high (%5V) transition of Input A is counted. Whereas, when *Falling Edge* is selected, the high (%5V) to low (0V) transition of Input A is counted.

Reset Arm Signal

Default setting for Reset Arm Signal is Ignored.

For external connection of Reset Arm and Reset signals, see Model UDCA Connector in Appendix A.

Select *Ignored*, *TTL Low arms*, or *TTL High arms* to define how the Reset Arm signal is used. The Reset Arm signal is an external input to the Model UDCA. It can be ignored or it can be used to arm (enable) the external Reset signal. If it is used, the Reset Arm signal must be active to allow the Reset signal to reset the counter. When the Reset Arm signal is **not** active, the Reset signal cannot reset the counter.

Ignored	When *Ignored* is selected, the Reset Arm signal is disabled and the Reset signal works normally. See Reset Signal in next section.
TTL Low arms	When *TTL Low arms* is selected, the Reset Arm signal is active at 0V (or TTL low voltage). So, when the Reset Arm signal is 0V, an active Reset signal will reset the counter. When the Reset Arm signal is at 5V (or TTL high voltage), the Reset signal is disabled and cannot reset the counter.
TTL High arms	When *TTL High arms* is selected, the Reset Arm signal is active at 5V (or TTL high voltage). So, when the Reset Arm signal is 5V, an active Reset signal will reset the counter. When the Reset Arm signal is at 0V (or TTL low voltage), the Reset signal is disabled and cannot reset the counter.

If the Reset Arm signal is used (i.e. TTL Low arms or TTL High arms is selected), both Reset Arm and Reset signals must be active to reset the counter.

One use for the Reset Arm signal involves a rotary encoder. The Index signal from the encoder is connected to the Reset signal. It is used to reset the counter at the same position on each revolution. To count for multiple revolutions, deactivate the Reset Arm signal to prevent the Index signal from resetting the counter. Then, activate the Reset Arm signal, to reset the counter at the next Index pulse.

Reset Signal

Default setting for Reset Signal is TTL High resets.

If the Reset Arm signal is used (see Reset Arm Signal earlier in this chapter), both Reset Arm and Reset signals must be active to reset the counter.

Select *Ignored*, *TTL Low resets*, or *TTL High resets* to define whether the Reset signal is used, and if it is, what voltage level is active. The Reset signal is an external input to the Model UDCA. It can be ignored or it can be used to reset the counter.

Ignored	When *Ignored* is selected, the Reset signal is disabled. It will **not** reset the counter.
TTL Low resets	When *TTL Low resets* is selected, the Reset signal is active at 0V (or TTL low voltage).
TTL High resets	When *TTL High resets* is selected, the Reset signal is active at 5V (or TTL high voltage).

The counter on a Model UDCA module is reset on power up, when RESET key (if enabled, see RESET Key - Reset UDCA Counter in CHAN SETTINGS) is pressed, via an external Reset signal at the transducer connector (if enabled, as described above), and via Logic I/O (see Reset Count in LOGIC I/O).

Reset Mode

Default value for Reset Mode is Leading Edge.

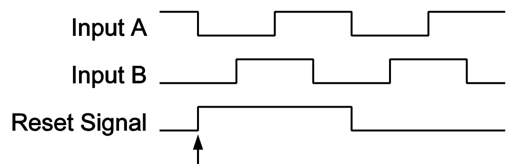
Select how the external Reset signal is used to reset the counter. Choose from the following settings.

If you are unsure which Reset Mode to use, pick Leading Edge.

Leading Edge — Counter is reset when Reset signal becomes active as defined by Reset Signal setting. See following diagrams.

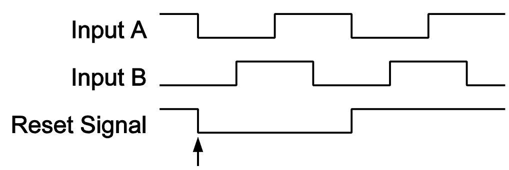
*The Reset signal from an encoder most likely is **not** synchronized with the quadrature count edge. As a result, with Leading Edge and Level Count Modes, the 0 count will **not** be a full count width and it will **not** be in the same position when direction changes. Longer reset pulse widths and smaller count widths (4X Count Mode) worsen this effect. Use one of the synchronizing Reset Modes on the next page.*

Reset Mode: **Leading Edge**
Reset Signal: **TTL High resets**



Counter is reset at this edge.

Reset Mode: **Leading Edge**
Reset Signal: **TTL Low resets**



Counter is reset at this edge.

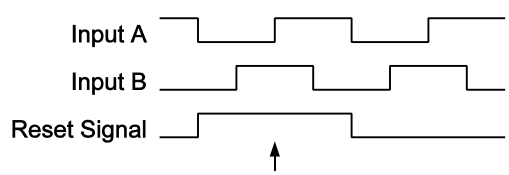
Level — Counter is continuously reset while the Reset signal is active as defined by Reset Signal setting. See following diagrams.

*If you use Level and 1X counting with a Reset signal longer than 1 cycle, then some count edges will **not** be counted because the counter is held in reset.*

For 2X counting, the Reset signal has to be longer than 1/2 cycle before counts are missed.

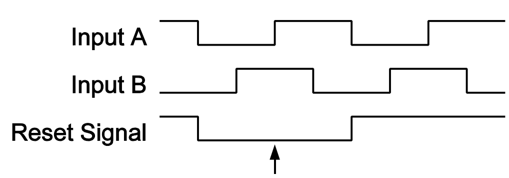
And, for 4X counting, the Reset signal has to be longer than 1/4 cycle before counts are missed.

Reset Mode: **Level**
Reset Signal: **TTL High resets**



Counter is reset repeatedly when Reset Signal is high.

Reset Mode: **Level**
Reset Signal: **TTL Low resets**



Counter is reset repeatedly when Reset Signal is low.

Generally, choose /B, B, /A, or A for 2X counting and /A AND /B, /A AND B, A AND /B, or A AND B for 4x counting.

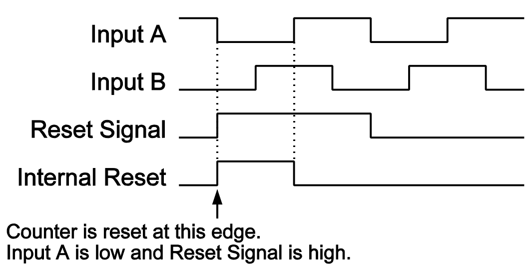
/B
B
/A
A
/A AND /B
/A AND B
A AND /B
A AND B

These settings allow you to synchronize reset with count edge so that 0 count is a full count width and it is in the same count position when direction changes. The external Reset signal is gated (ANDed) with Input A and/or Input B signals based on the selected setting. Before ANDing, the external Reset signal is inverted if the current setting for Reset Signal (described earlier in this chapter) is *TTL Low resets*. Otherwise, it is **not** inverted. The leading edge of the resultant signal is used to reset the counter. Following are two examples.

For the following example, Internal Reset is equal to the external Reset signal (non-inverted) ANDed with Input A (inverted). The counter is reset at the leading edge of Internal Reset.

*For the example to the right, when determining Internal Reset, the external Reset signal is **not** inverted because the Reset Signal setting is TTL High resets. Input A is inverted because the Reset Mode setting is /A.*

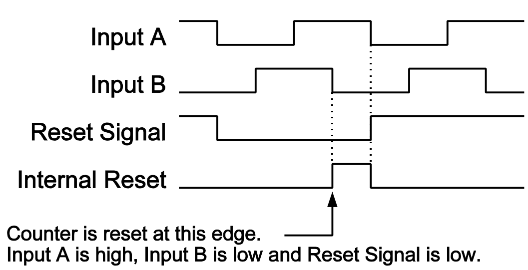
Reset Mode: **/A**
Reset Signal: **TTL High resets**



For the following example, Internal Reset is equal to the external Reset signal (inverted) ANDed with Input A (non-inverted) and Input B (inverted). The counter is reset at the leading edge of Internal Reset.

*For the example to the right, when determining Internal Reset, the external Reset signal is inverted because the Reset Signal setting is TTL Low resets. Input A is **not** inverted and Input B is inverted because the Reset Mode setting is A AND /B.*

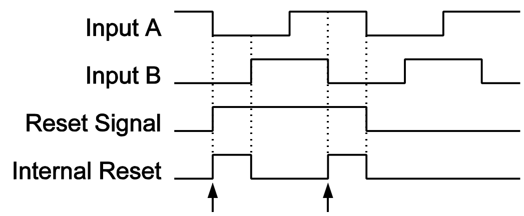
Reset Mode: **A AND /B**
Reset Signal: **TTL Low resets**



When using these synchronizing Reset Modes, there are some situations to avoid. These are described in the following diagrams.

For the example to the right, /B is a poor choice because Input B is low in two places when Reset signal is active. As a result, two reset pulses occur.

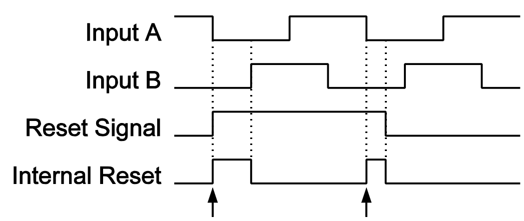
Reset Mode: **/B**
Reset Signal: **TTL High resets**



Counter is reset at both of these edges.
Input B is low and Reset Signal is high.

For the example to the right, /A AND /B is a poor choice because Input A and Input B are both low in two places when Reset signal is active. As a result, two reset pulses occur.

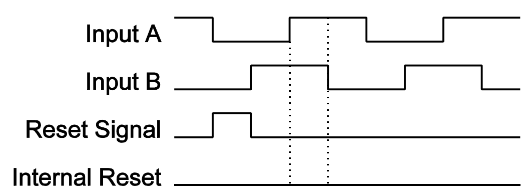
Reset Mode: **/A AND /B**
Reset Signal: **TTL High resets**



Counter is reset at both of these edges.
Input A is low, Input B is low and Reset Signal is high.

For the example to the right, A AND B is a poor choice because Input A and Input B are never both high when Reset signal is active. As a result, there is no reset pulse.

Reset Mode: **A AND B**
Reset Signal: **TTL High resets**



Counter is **not** reset at all because Input A and Input B are never high when Reset Signal is high.

Test Signals

*In data screen with Test **not** running:*
ENTER & UP keys for % test signal(s).
ENTER & DOWN keys for & test signal(s).

You can check operation of most modules using internal test signals. In the data screen (with Test **not** running), ENTER key is used in combination with UP (or DOWN) key to activate test signal(s). While pressing ENTER key, press UP key for positive test signal(s). Release keys to remove test signal(s). For negative test signal(s) use DOWN key instead of UP key.

For the Model UDCA, there are no test signals and instead positive or negative Full Scale is displayed.

CHAN CALIBRATION (CH3 CALCULATION)

To learn how to navigate the menu and modify selections, see MENU BASICS.

The *CHAN Calibration* menu for CH3 calculation allows you to define the calculation. Use RIGHT/LEFT keys to choose from the following selections.

Full Scale
Calculation
Constant A
Constant B
Constant C

Full Scale

Default value for Full Scale is 10000.

Enter the Full Scale (in engineering units) of the calculation. This value can be determined by computing the calculation using the Full Scale values of the transducer channels (CH1 and/or CH2) referenced, or by arbitrarily choosing a value you think would be the largest value obtained in your application.

In the example, you could use 1.5 x CH1 Full Scale and 1.5 x CH2 Full Scale because the overrange capability of the system is 50% of Full Scale.

For example,	CH3 = (CH1 (CH2)/A
	A = 63025
	CH1 Full Scale is 1000.
	CH2 Full Scale is 10000.
Then,	CH3 = (1000 x 10000) / 63025
	CH3 = 158.67

Use 158.67 as Full Scale for CH3 calculation, or if this value is **not** practical pick a smaller number.

The Full Scale of the CH3 calculation is used to:

fix the position of the decimal point in displayed data,

determine selections for display resolution,

and, set the scaling of any analog output assigned to CH3.

For a Full Scale value of 200, the decimal point is XXX.XXX, the best (smallest) resolution for displayed data is 0.020 (see Display Resolution in CHAN SETTINGS), and an analog output assigned to CH3 is 5V (or 10V if 10V Analog Output selection is set) when CH3 equals 200.

Calculation

Default setting for Calculation is (CH1(CH2)/A.

To check calculation, use test signals. See ENTER Key in GETTING STARTED.

CH2^2 is $(CH2)^2$.

CH1^2 is $(CH1)^2$.

*Square root ( ) operation is performed on one channel, **not** both.*

Choose a calculation from the following list. If CH1 or CH2 are empty, the calculations referencing them are omitted from the list. Notice, there are two similar sets of calculations, one with (A (multiply by Constant A) and one with /A (divide by Constant A). See Constant A later in this chapter for explanation. The calculation is computed at 50Hz using current data (filtered) of CH1 and CH2, as applicable.

*/CH2 *A*	*/CH2 /A*
*CH2^2 *A*	*CH2^2 /A*
*CH2 *A*	*CH2 /A*
*/CH1 *A*	*/CH1 /A*
*CH1^2 *A*	*CH1^2 /A*
*CH1 *A*	*CH1 /A*
*(CH1-CH2)*A*	*(CH1-CH2)/A*
*(CH1+CH2)*A*	*(CH1+CH2)/A*
*/CH2*CH1 *A*	*/CH2*CH1 /A*
*/CH1*CH2 *A*	*/CH1*CH2 /A*
*(CH2/CH1)*A*	*(CH2/CH1)/A*
*(CH1/CH2)*A*	*(CH1/CH2)/A*
*(CH1*CH2)*A*	*(CH1*CH2)/A*
	User Defined

The choice, *User Defined*, allows you to create a calculation that is not listed. When *User Defined* is flashing, press ENTER key. *RPN String* is displayed. Edit RPN String as desired. Press ENTER key when finished.

A User Defined calculation is entered in Reverse Polish Notation (RPN). The main difference between Reverse Polish Notation and Algebraic Notation is the order in which an expression is entered. For RPN, operands are entered first, then the operator follows. The result of the operation remains and can be used in the next operation. The following example shows the sequence you would use to add two values in both Algebraic Notation and Reverse Polish Notation.

Algebraic Notation:

1st value **þ** add operator **þ** 2nd value **þ** equal operator

Reverse Polish Notation (RPN):

1st value **þ** 2nd value **þ** add operator

The RPN String can contain up to 11 characters each representing an operand or operator. The following table lists all operands and operators supported.

IM4 ! Internal Matrix 4
IM5 ! Internal Matrix 5
IM6 ! Internal Matrix 6
See LOGIC I/O.

User Defined Calculation Operator/Operand List

Operators and Operands	Name	Description
1	Channel 1	Use data from channel selected. Type of data depends on which data type operator (*c*, *x*, *m*, *h*, or *t*) was last specified.
2	Channel 2	
3	Channel 3	
A	Constant A	Use value of user constant selected.
B	Constant B	
C	Constant C	
D	Duplicate	Copy last result.
E	Edge Counter of IM6	Result is the number of edges (false to true) on IM6 that occurred since last calculation. To accumulate the number of edges, add *E* to channel 3 (i.e. *E3%*).
I	Pulse Width of IM5	Measures time (in ms) that IM5 is true (ON). When IM5 goes true, time measurement begins starting at 0. When IM5 goes false (OFF), time measurement halts and is retained until IM5 goes true again.
L	Logic Level of IM4	Result is 1 if IM4 is true (ON). Result is 0 if IM4 is false (OFF).
a	Absolute Value	Compute absolute value of last result.
q	Square Root	Compute square root of last result.
n	Negation	Multiply last result by &1.
r	Reciprocal	Divide 1 by last result.
c	Current Data	Selects the type of data used for channel operands (*1*, *2*, or *3*). No data is entered. Once a type is selected, all following channel operands will be of that type, until a new type is specified.
x	Max Data	
m	Min Data	
h	Held Data	
t	Tare Value	
%	Addition	Perform the specified operation on the last two arguments. The result replaces the two arguments and can be used in further operations.
&	Subtraction	
(	Multiplication	
/	Division	

The following table lists examples of various calculations along with the RPN string equivalent.

A ! Constant A
B ! Constant B
See next section.

IM4 ! Internal Matrix 4
IM5 ! Internal Matrix 5
IM6 ! Internal Matrix 6
See LOGIC I/O.

Examples of User Defined Calculations

Calculation	**RPN String**
$\frac{\mathrm{CH1} \times \mathrm{CH2}}{\mathrm{A} \times \mathrm{B}}$	12(AB(/
$\mathrm{Max(CH1)} - \mathrm{Min(CH1)}$	x1m1&
$\mathrm{Max(CH1)} + \mathrm{Max(CH2)}$	x12%
$\mathrm{CH1} \times \sqrt{\mathrm{CH2}}$	12q(
$\mathrm{A} \times \mathrm{CH1} \times \sqrt{\frac{\mathrm{CH2}}{\mathrm{B}}}$	A1(2B/q(
$\sqrt{\mathrm{CH1}^2 + \mathrm{CH2}^2}$	1D(2D(%q
$(\mathrm{IM4} \times \mathrm{CH1}) + ((1 - \mathrm{IM4}) \times \mathrm{CH3})$ When IM4 is true (ON), result is CH1. When IM4 is false (OFF), result is CH3. This calculation tracks CH1 when IM4 is true and holds last value when IM4 is false.	L1(AL&3(% *Set Constant A to 1.*
$(2 \times \mathrm{IM4} - 1) \times \text{Edges of IM6} + \mathrm{CH3}$ When IM4 is true (ON), each false-true edge of IM6 increments result. When IM4 is false (OFF), each false-true edge of IM6 decrements result. Reset calculation by pressing RESET key.	AL(B&E(3% *Set Constant A to 2.* *Set Constant B to 1.*
$\frac{\text{pulse width of IM5}}{1000}$ Measures time (seconds) that IM5 is true (ON). When IM5 goes true, time measurement begins starting at 0. When IM5 goes false, time measurement halts and is retained until IM5 goes true again. To convert ms to seconds, time measurement is divided by 1000.	IA/ *Set Constant A to 1000.*

Constant A | Constant B | Constant C

Default values:
Constant A is 1.
Constant B is 0.
Constant C is 0.

There are three constants that can be used in the calculation. Only one, Constant A, is used in the preprogrammed calculations listed in the Calculation section earlier in this chapter. All three constants can be used in a User Defined calculation. For each constant, enter the appropriate value necessary for the calculation.

For the preprogrammed calculations listed in the Calculation section earlier in this chapter, there are two similar sets of calculations, one with (A (multiply by Constant A) and one with /A (divide by Constant A). If Constant A is a very small number, change Constant A to its reciprocal (1/X) and change the calculation from (A to /A, or visa versa.

The example to the right describes a Horsepower calculation where CH1 is torque (in LB-IN) and CH2 is speed (in RPM).

For example, CH3 = (CH1 (CH2) (A
A = $1.58667x10^{\&5}$
A = 0.0000158667

With the six digit display, Constant A would have to entered as 0.000015 (or 0.000016). Accuracy would be compromised. So, change Constant A to its reciprocal and change the calculation to:

CH3 = (CH1 (CH2)/A
A = $1/1.58667x10^{\&5}$
A = 63025

Sometimes, the desired constant for the calculation is so small its reciprocal ends up being too large. Or, it is so large that its reciprocal is too small. To handle these situations, a User Defined calculation must be created using more than one constant.

The example to the right describes a Horsepower calculation where CH1 is torque (in OZ-IN) and CH2 is speed (in RPM).

For example, CH3 = (CH1 (CH2)/A
A = 1008400
1/A = 0.000000991670

With the six digit display, both Constant A and its reciprocal cannot be entered. So, use two constants by creating the following User Defined calculation. User Defined calculations are described in Calculation section earlier in this chapter.

CH3 = (CH1 (CH2)/(A (B)
A = 1008.4
B = 1000
RPN String = 12 (AB (/

SYSTEM OPTIONS

To learn how to navigate the menu and modify selections, see MENU BASICS.

The *System Options* menu contains general items that pertain to the system as a whole. Use RIGHT/LEFT keys to choose from the following selections.

Adjust Contrast
Backlight
Menu Password
Check Limits
Do Max/Mins
Power Up
Power Up View
Power Up CHAN
Power Up Type
State Machine

Adjust Contrast

Default value for Adjust Contrast is 50

Select value from 1 to 100 that gives the best display contrast. Temperature and viewing angle effect the contrast of the display. Increasing the contrast darkens all display segments. Increase it too much and the segments that should be OFF start to darken. Decreasing the contrast lightens all display segments. Decrease it too much and the segments that should be ON start to lighten. If the display is unreadable, try tilting it until you could read it enough to correct the contrast.

Backlight

Select *ON* or *OFF*. For high ambient light the backlight may **not** be needed for viewing the display. In this case, select *OFF*. In most cases, select *ON*.

Default setting for Backlight is ON.

The backlight is also used to indicate the following error conditions by flashing. This flashing occurs even if *Backlight* is set to *OFF*.

> Normally, the backlight flashes when any limit is violated. This feature can be disabled for each channel. See Limit Alarm in CHAN SETTINGS.
>
> When navigating the menu, if you press an invalid key or scroll to either end of the menu, the backlight flashes.

Menu Password

Default setting for Password is SHC.

Default for Password Enable/Disable Jumper is Password Disabled.

Enter three character password of your choice. This password is used to prevent unauthorized entry to the menu if password protection is enabled. If you forget the password, then disable password protection, enter menu, and view *Menu Password*. To enable or disable password protection, see Password Enable/Disable Jumper in APPENDIX B.

Check Limits

Choose *Always in Test* or *Use I/O Control*. Limit checking is only done during a Test. See Limits in CHAN SETTINGS.

Default setting for Check Limits is Always in Test.

If *Always in Test* is selected, then limits are check continuously for all channels during a Test.

If *Use I/O Control* is selected, then limit checking is controlled by the Logic I/O. This allows limit checking to be performed only during critical portions of a Test. At certain points in a Test, data may legitimately exceed limits, and you do **not** want to signal an error. For more information see Check Limits in LOGIC I/O.

Do Max/Mins

Choose *Always in Test* or *Use I/O Control*. Max/Min updating is only done during a Test.

Default setting for Do Max/Mins is Always in Test.

If *Always in Test* is selected, then Max/Mins are updated continuously for all channels during a Test.

If *Use I/O Control* is selected, then Max/Min updating is controlled by the Logic I/O. This allows Max/Mins to be updated only during critical portions of a Test. At certain points in a Test, data peaks may be allowed, and you do **not** want to capture them. For more information see Do Max/Mins in LOGIC I/O.

Power Up

Default setting for Power Up is Test OFF.

Select *Test ON* or *Test OFF*. If *Test ON* is selected, the system automatically starts with Test running when power is applied. For an explanation of Test, see TEST Key in GETTING STARTED. If *Test OFF* is selected, then the system powers up normally with Test **not** running. In both cases, the data screen is displayed after the Model/Version message is displayed momentarily. The TEST key still functions (toggles between Test ON and OFF) no matter which Power Up selection was made.

Power Up View

Default setting for Power Up View is 2 Channel.

Choose *2 Channel*, *1 Channel*, *I/O Status*, or *Limit Status* as the data screen view displayed when power is applied (after Model/Version message is displayed momentarily). For a description of these views see VIEW Key in GETTING STARTED. Also, see Power Up CHAN and Power Up Type in this chapter for more on configuring the appearance of the data screen on power up.

Power Up CHAN

Default setting for Power Up CHAN is CH1.

Select channel that will be displayed on the first line of the data screen when power is applied (after Model/Version message is displayed momentarily). See VIEW Key in GETTING STARTED for a description of data screen views. For *1 Channel*, *Limit Status* and *I/O Status* views this would be the only channel displayed. For the *2 Channel* view, the next channel in numeric sequence is displayed on the second line. When the data screen is displayed, you can always change the channel(s) displayed using the UP/DOWN keys. Also, see Power Up View and Power Up Type in this chapter for more on configuring the appearance of the data screen on power up.

Power Up Type

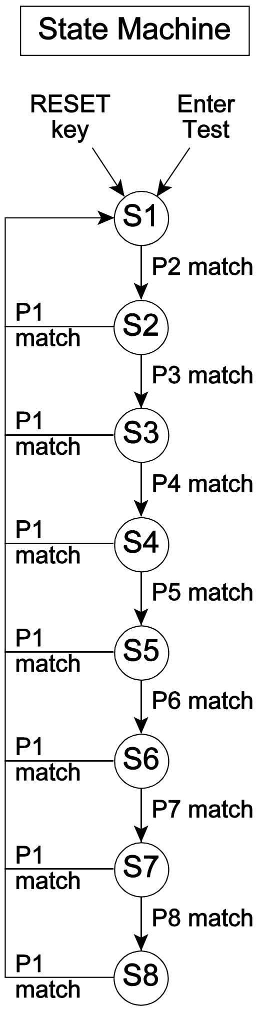
Default setting for Power Up Type is Current Data.

Select the type of data you want displayed when power is applied. Choose from *Current Data*, *Max Data*, *Min Data*, *Spread Data*, *Held Data*, and *Tare Value*. See VIEW Key in GETTING STARTED for a description of data screen views. When the data screen is displayed, you can always change the data type displayed using the LEFT/RIGHT keys. A data type icon (see Cursor Keys in GETTING STARTED) is displayed to indicate which type of data is currently viewed. Also, see Power Up View and Power Up CHAN in this chapter for more on configuring the appearance of the data screen on power up.

State Machine

Default setting for State Machine is OFF.

Select *ON* or *OFF* to enable or disable the State Machine. If *ON* is selected, then the State Machine executes when a Test is running (see TEST key in GETTING STARTED). If *OFF* is selected, the State Machine does not execute.



The State Machine extends the powerful Logic I/O capability of the 9850 instruments to include event driven applications. Patterns (any possible combination of logic inputs, outputs, and internal Matrix signals) trigger the State Machine from state to state. To enter patterns, see Define Patterns in LOGIC I/O. Up to eight states are available. State outputs are available to drive logic outputs and internal Matrix signals. To define State outputs, see Pattern/State Outputs in LOGIC I/O.

During a Test, patterns are used to control the flow of the State Machine. When you first enter a Test, the State Machine starts in State1. Pattern2 is compared to actual signals, and when there is a match, the State Machine goes to State2. Then, Pattern3 is checked, and when it matches, the State Machine goes to State3. This continues to a maximum of eight states. During any state, a Pattern1 match forces the State Machine to go to State1. Pattern1 works differently than the other patterns. Pattern1 is checked in all states, whereas, the other patterns are only checked in the state previous the pattern number. Pattern2 is checked in State1, Pattern3 is checked in State2, and so forth. Pattern1 acts as a reset to the State Machine because it is checked in all states. RESET key also resets State Machine to State1.

When *State Machine* is *ON*, there are no pattern outputs. Instead, there are state outputs (see Pattern/State Outputs in LOGIC I/O). When the State Machine is in a specific state, the corresponding state output is true. That is, State5 output is true when the State Machine is in State5. Each state output can drive any of the logic outputs and internal Matrix signals.

LOGIC I/O

To learn how to navigate the menu and modify selections, see MENU BASICS.

The *Logic I/O* menu contains items used to define the four external logic inputs, six external logic outputs, and six internal Matrix signals for control of your application. The Logic I/O capabilities described in this chapter are enabled only during a Test (see TEST Key in GETTING STARTED). The I/O Control diagram on the next page summarizes how logic inputs, outputs, and internal Matrix signals can be routed between output events (such as, HI Limit violation), input actions (such as, Tare), patterns (any logical representation of logic inputs, outputs, and internal Matrix signals), and Pattern/State outputs.

***Logic inputs** are external signals that can be assigned to perform input actions on one or more channels. Also, they can be used in pattern matching.*

Selections in the *Logic I/O* menu depend on whether a channel or *SYS* (system) was chosen as shown below. If a channel was selected, use RIGHT/LEFT keys to choose *Input Action* or *Output Event*, described later in this chapter. If *SYS* was selected, use RIGHT/LEFT keys to choose *Define Patterns* or *Pattern/State Outputs*, described later in this chapter. *Pattern/State Outputs* has a dual meaning based on *State Machine* setting in the *System Options* menu. *Pattern Outputs* apply if *State Machine* is *OFF*. *State Outputs* apply if *State Machine* is *ON*.

***Logic outputs** are external signals that can be driven by output events from one or more channels and by pattern/state outputs. Also, they can be assigned to perform input actions on one or more channels. In addition, they can be used in pattern matching.*

Clr Ltch Lim ! Clear Latched Limits

***Internal Matrix signals** allow you to route output events and pattern/state outputs to input actions without wasting a logic output. They offer same capability as logic outputs, but are **not** available externally.*

If a channel is selected

- *Input Action*
  - *Tare*
  - *Clear Tare*
  - *Hold*
  - *Clear Hold*
  - *Reset MaxMin*
  - *Clr Ltch Lim*
  - *Check Limits*
  - *Do Max/Mins*
  - *Apply %CAL**
  - *Apply &CAL**
  - *Reset Count***
- *Output Event*
  - *HI Limit*
  - *NOT HI Limit*
  - *IN Limit*
  - *NOT IN Limit*
  - *LO Limit*
  - *NOT LO Limit*
  - *At Max*
  - *NOT At Max*
  - *At Min*
  - *NOT At Min*

If *SYS* (system) is selected

- *Define Patterns*
  - *Pattern1*
  - *to*
  - *Pattern8*
- *Pattern/State Outputs****
  - *Pattern1 OUT*
    - *(or State1 OUT)*
  - *NOT Pattern1 OUT*
    - *(or NOT State1 OUT)*
  - *to*
  - *Pattern8 OUT*
    - *(or State8 OUT)*
  - *NOT Pattern8 OUT*
    - *(or NOT State8 OUT)*

* Does **not** apply for CH3 calculation.
** Applies for Model UDCA only.
*** Pattern Outputs (for *State Machine OFF*) or State Outputs (for *State Machine ON*).

I/O Control Diagram

Input actions and output events are shown for one channel only.

Logic inputs and outputs are available at the rear panel I/O connector. They are low-true.

When a logic input is true (0V), all assigned input actions are performed.

A logic output is true (0V) when any of its assigned output events or pattern/state outputs are true.

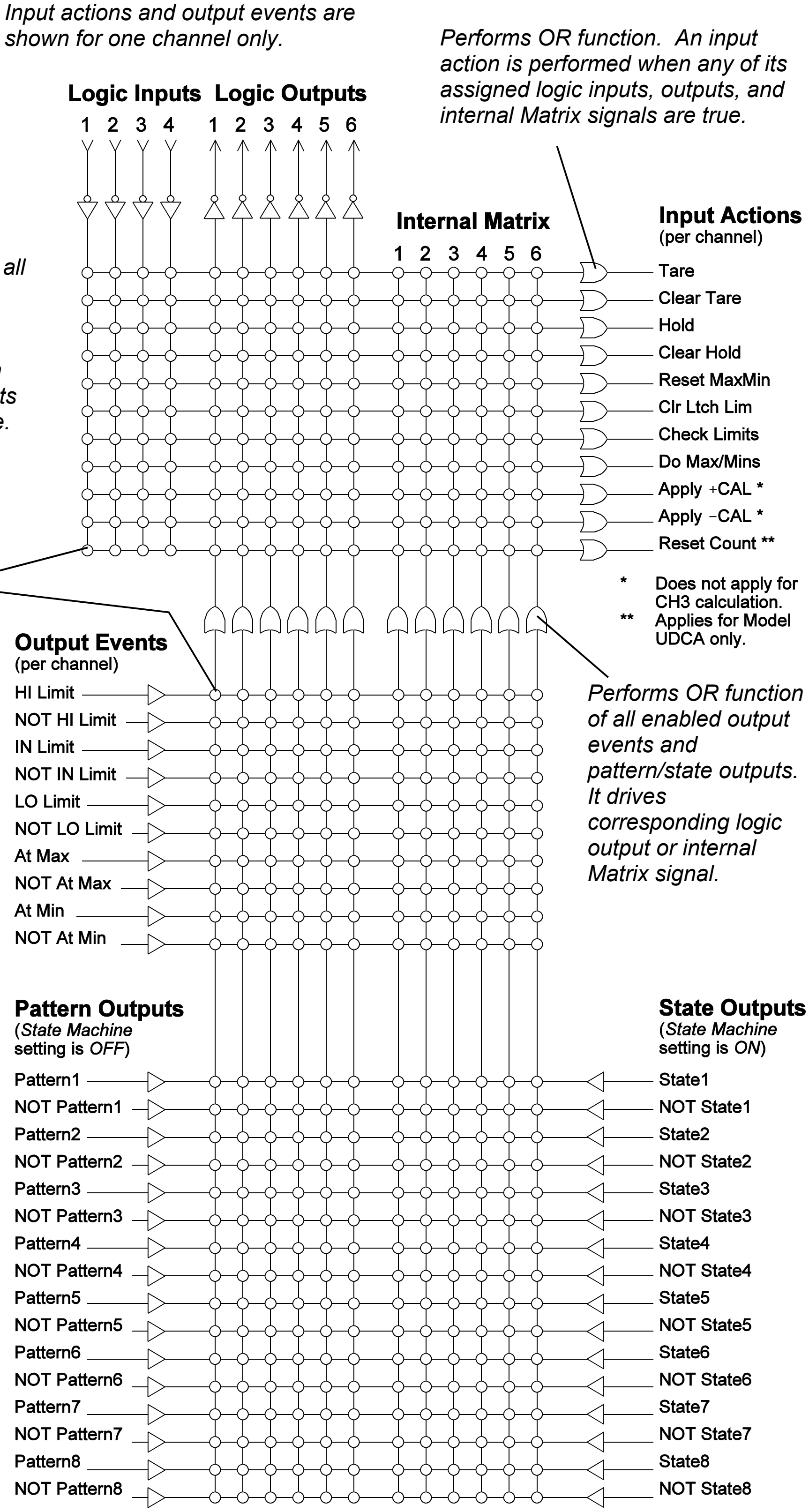
Enable or disable signal routing.

Output events can be assigned to drive logic outputs and internal Matrix signals.

For State Machine setting OFF:
When a pattern is recognized the corresponding pattern output is true and the corresponding NOT pattern output is false.

For State Machine setting ON:
When the State Machine is in a specific state the corresponding state output is true and the corresponding NOT state output is false.

The pattern/state outputs can be assigned to drive logic outputs and internal Matrix signals.



*Patterns (**not** shown here) are defined as any logical representation of logic inputs, outputs, and internal Matrix signals.*
Use “0", “1", or “-“ for each signal. “-“ means ignore signal.

Input Actions

During a Test, an input action is performed whenever any of its assigned signals are true. The maximum delay of the input action from the time these signals go true is 1ms (for hardware channels) or 20ms (for CH3 calculation).

Inputs actions (such as, Tare) perform a given function on a channel. Each input action can be assigned to one or more logic inputs, outputs, and internal Matrix signals. During a Test, the assigned signals of an input action are OR'ed to determine whether the action is performed. In other words, whenever any of its assigned signals are true, the action is performed. On the other hand, many input actions can be assigned to the same signal. For example, input actions, *Clear Tare* and *Reset MaxMin*, for each channel can be assigned to logic input 1 providing a general reset.

When *Input Action* is displayed there is no entry on the second line. So, press DOWN key to go into the *Input Action* menu for more items. The first selection of the *Input Action* menu is displayed. Use RIGHT/LEFT keys to choose from:

Default settings for all Input Actions are:

	1234
Logic Ins	*&&&&*
LogicOuts	*&&&&&&*
IntMatrix	*&&&&&&*
	123456

Tare
Clear Tare
Hold
Clear Hold
Reset MaxMin
Clr Ltch Lim (Clear Latched Limits)
Check Limits
Do Max/Mins
*Apply %CAL**
*Apply &CAL**
*Reset Count***

* Does **not** apply for CH3 calculation.
** Applies for Model UDCA only.

When the desired input action is displayed, press DOWN key. *Logic Ins* along with the current setting are displayed on second line. Use RIGHT/LEFT keys to choose from:

Logic Ins	Logic Inputs
LogicOuts	Logic Outputs
IntMatrix	Internal Matrix Signals

Each input action has these three selections. Shown below is an example of the Tare input action for CH1.

```
Tare          CH1
Logic Ins   1-1-
            1234
```

```
Tare          CH1
LogicOuts -11---
          123456
```

```
Tare          CH1
IntMatrix 1---11
          123456
```

1 ! *assigned*
– ! *not assigned*

Whenever LI1, LI3, LO2, LO3, IM1, IM5, or IM6 are true, CH1 is tared.

LI is logic input *LO is logic output* *IM is internal Matrix*

Tare

Select *assigned* (1) or *not assigned* (–) for each logic input, output, and internal Matrix signal. During a Test, whenever any of the assigned signals are true, the channel being set up is tared to 0.

The Tare value is the value (when Tare operation occurred) required to force the current data to 0. It is subtracted from new readings until another Tare or Clear Tare operation. To view Tare values, see Cursor Keys in GETTING STARTED.

The TARE key also tares channels to 0. Channels can be disabled from responding to the TARE key. See TARE Key in CHAN SETTINGS.

Tare values are cleared on power up, when RESET key (if enabled) is pressed, via Clear Tare input action, and when a channel is calibrated.

Clear Tare

Select *assigned* (1) or *not assigned* (–) for each logic input, output, and internal Matrix signal. During a Test, whenever any of the assigned signals are true, the Tare value of the channel being set up is cleared.

The Tare value is the value (when Tare operation occurred) required to force the current data to 0. It is subtracted from new readings until another Tare or Clear Tare operation. To view Tare values, see Cursor Keys in GETTING STARTED.

Tare values are also cleared on power up, when RESET key (if enabled) is pressed, and when a channel is calibrated. The Clear Tare operation of the RESET key could be disabled for any channel. See RESET Key - Clear Tare in CHAN SETTINGS.

Hold

Limit checking can be performed on Held data.

Select *assigned* (1) or *not assigned* (–) for each logic input, output, and internal Matrix signal. During a Test, as soon as one of the assigned signals goes true, the current data of the channel being set up is stored as Held data. All assigned signals must go false before another Hold operation can occur.

The Hold input action is different from the other input actions in the fact that it is edge sensitive as opposed to level sensitive. The Hold operation occurs on the leading edge (false to true) of the signal created by OR'ing all assigned signals.

Each Hold operation overwrites the previous. To view Held data, see Cursor Keys in GETTING STARTED. Held data is cleared on power up, when RESET key is pressed, and via Clear Hold input action.

Clear Hold

Select *assigned* (1) or *not assigned* (–) for each logic input, output, and internal Matrix signal. During a Test, whenever any of the assigned signals are true, the Held data of the channel being set up is cleared.

To view Held data, see Cursor Keys in GETTING STARTED. Held data is also cleared on power up and when RESET key is pressed.

Reset Max/Mins

Select *assigned* (1) or *not assigned* (–) for each logic input, output, and internal Matrix signal. During a Test, whenever any of the assigned signals are true, Max and Min data of the channel being set up are both set to current data. As a result, Spread data (Max&Min) becomes 0.

The current data assigned to Max and Min data during a reset depends on the *Max/Min Type* setting (*Filtered Data* or *Raw Data*). See Max/Min Type in CHAN SETTINGS.

To view Max or Min data, see Cursor Keys in GETTING STARTED. Max/Mins are also reset on power up and when RESET key is pressed.

Clear Latched Limits

Clr Ltch Lim ! Clear Latched Limits

Select *assigned* (1) or *not assigned* (–) for each logic input, output, and internal Matrix signal. During a Test, whenever any of the assigned signals are true, any latched limit (LO and/or HI) of the channel being set up is cleared. See LO Latch and HI Latch in CHAN SETTINGS.

To view limit status for all channels, see VIEW key in GETTING STARTED. Latched limits are also cleared on power up, when RESET key is pressed, and when a Test is started.

To use the Check Limits input action, make sure the Check Limits setting in System Options menu is User I/O Control.

Check Limits

Select *assigned* (1) or *not assigned* (–) for each logic input, output, and internal Matrix signal. During a Test, whenever any of the assigned signals are true, limits are checked for the channel being set. When **all** assigned signals are false, limits are **not** checked. This allows limit checking to be performed only during critical portions of a Test. At certain points in a Test, data may legitimately exceed limits, and you do **not** want to signal an error.

Limit checking rate is 1000Hz for each hardware channel and 50Hz for CH3 calculation.

Limit checking is only done during a Test. The instrument can be set up to check limits continuously for all channels during a Test (*Check Limits* setting in *System Options* menu is *Always in Test*). Or, limit checking of individual channels can be controlled by the Check Limits input action described here (*Check Limits* setting in *System Options* menu is *Use I/O Control*). See Check Limits in SYSTEM OPTIONS.

You can choose from Current data, Max data, Min data, Spread data, or Held data for each channel as the data to be limit checked. See Limit Type in CHAN SETTINGS.

Normally, the backlight flashes when any limit is violated. To disabled this feature for a channel, see Limit Alarm in CHAN SETTINGS.

To view limit status for all channels, see VIEW key in GETTING STARTED.

Do Max/Mins

To use the Do Max/Mins input action, make sure the Do Max/Mins setting in System Options menu is User I/O Control.

Select *assigned* (1) or *not assigned* (–) for each logic input, output, and internal Matrix signal. During a Test, whenever any of the assigned signals are true, Max/Mins are updated for the channel being set. When **all** assigned signals are false, updating is suspended. This allows Max/Mins to be updated only during critical portions of a Test. At certain points in a Test, data peaks may be allowed, and you do **not** want to capture them.

Max/Min update rate is 2000Hz for each hardware channel and 50Hz for CH3 calculation.

Max/Min updating is only done during a Test. The instrument can be set up to update Max/Mins continuously for all channels during a Test (*Do Max/Mins* setting in *System Options* menu is *Always in Test*). Or, Max/Min updating of individual channels can be controlled by the Do Max/Mins input action described here (*Do Max/Mins* setting in *System Options* menu is *Use I/O Control*). See Do Max/Mins in SYSTEM OPTIONS.

For each channel, Filtered or Raw data can be used for determining Max/Mins. See Max/Min Type in CHAN SETTINGS.

To view Max or Min data, see Cursor Keys in GETTING STARTED.

Apply %CAL

Apply %CAL is omitted for CH3 calculation.

When both Apply %CAL and Apply &CAL are true, the positive test signal is applied.

Select *assigned* (1) or *not assigned* (–) for each logic input, output, and internal Matrix signal. During a Test, whenever any of the assigned signals are true, a positive test signal is applied to the channel being set up. The test signal depends on the signal conditioning module used. See Test Signals in appropriate CHAN CALIBRATION chapter.

Apply &CAL

Apply &CAL is omitted for CH3 calculation.

Select *assigned* (1) or *not assigned* (–) for each logic input, output, and internal Matrix signal. During a Test, whenever any of the assigned signals are true, a negative test signal is applied to the channel being set up. The test signal depends on the signal conditioning module used. See Test Signals in appropriate CHAN CALIBRATION chapter.

Reset Count

Reset Count applies only for Model UDCA modules.

Select *assigned* (1) or *not assigned* (–) for each logic input, output, and internal Matrix signal. During a Test, whenever any of the assigned signals are true, the counter of the UDCA channel being set up is reset.

The counter on a Model UDCA module is reset on power up, when RESET key (if enabled, see RESET Key - Reset UDCA Counter in CHAN SETTINGS) is pressed, via an external Reset signal at the transducer connector (if enabled, see Reset Signal in CHAN CALIBRATION for Model UDCA), and via Reset Count input action described here.

Output Events

During a Test, if an output event is true, its assigned signals are true. The maximum delay for these signals to go true from the time of the output event is 1ms (for hardware channels) or 20ms (for CH3 calculation).

Output events are status signals (such as, HI Limit violation) unique to each channel. Each output event can drive any of the logic outputs and internal Matrix signals. During a Test, if an output event is true, its assigned signals are true. On the other hand, many output events and pattern/state outputs (described later in this chapter) can be assigned to the same signal (logic output or internal Matrix signal). The assigned output events and pattern/state outputs are OR’ed to create the signal. In other words, a logic output or internal Matrix signal is true whenever any of its assigned output events and pattern/state outputs are true. For example, output events, HI Limit and LO Limit, for each channel, can be assigned to logic output 1 creating an overall error signal.

Output events can perform input actions via logic outputs and internal Matrix signals. See Input Actions.

When *Output Event* is displayed there is no entry on the second line. So, press DOWN key to go into the *Output Event* menu for more items. The first selection of the *Output Event* menu is displayed. Use RIGHT/LEFT keys to choose from:

Default settings for all Output Events are:

	123456
LogicOuts	*&&&&&&*
IntMatrix	*&&&&&&*

HI Limit
NOT HI Limit
IN Limit
NOT IN Limit
LO Limit
NOT LO Limit
At Max
NOT At Max
At Min
NOT At Min

When the desired output event is displayed, press DOWN key. *LogicOuts* along with the current setting are displayed on second line. Use RIGHT/LEFT keys to choose from:

LogicOuts	Logic Outputs
IntMatrix	Internal Matrix signals

Each output event has these two selections. Shown below is an example of the HI Limit output event for CH1.

1 ! *assigned*
– ! *not assigned*

```
HI Limit     CH1
LogicOuts --1-1-
          123456
```

```
HI Limit     CH1
IntMatrix 11---1
          123456
```

LO is logic output.
IM is internal Matrix.

When CH1 HI Limit is violated, LO3, LO5, IM1, IM2, and IM6 are true.
Other output events and pattern/state outputs might drive these logic outputs and internal Matrix signals also.

HI Limit

If Check Limits selection in System Options menu is Use I/O Control and Check Limits input action is false, then HI Limit and NOT HI Limit are both false.

Select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever the HI Limit of the channel being set up is violated (including HI Hysteresis, HI Latch, and Limit Mode effects as described in CHAN SETTINGS). When the HI Limit is **not** violated, an assigned signal is false, only if no other output events or pattern/state outputs are assigned to the same signal.

NOT HI Limit

*NOT HI Limit is an inverted version of HI Limit. When one is true, the other is false, unless Limits are **not** being checked, in which case, both signals are false.*

Select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever the HI Limit of the channel being set up is **not** violated (including HI Hysteresis, HI Latch, and Limit Mode effects as described in CHAN SETTINGS). When the HI Limit is violated, an assigned signal is false, only if no other output events or pattern/state outputs are assigned to the same signal.

IN Limit

If Check Limits selection in System Options menu is Use I/O Control and Check Limits input action is false, then IN Limit and NOT IN Limit are both false.

Select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever the IN Limit signal of the channel being set up is true. IN Limit is described in left margin note by HI Limit in CHAN SETTINGS. When the IN Limit signal is false, an assigned signal is false, only if no other output events or pattern/state outputs are assigned to the same signal.

NOT IN Limit

*NOT IN Limit is an inverted version of IN Limit. When one is true, the other is false, unless Limits are **not** being checked, in which case, both signals are false.*

Select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever the IN Limit signal of the channel being set up is false. IN Limit is described in note in left margin by HI Limit in CHAN SETTINGS. When the IN Limit signal is true, an assigned signal is false, only if no other output events or pattern/state outputs are assigned to the same signal.

LO Limit

If Check Limits selection in System Options menu is Use I/O Control and Check Limits input action is false, then LO Limit and NOT LO Limit are both false.

Select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever the LO Limit of the channel being set up is violated (including LO Hysteresis, LO Latch, and Limit Mode effects as described in CHAN SETTINGS). When the LO Limit is **not** violated, an assigned signal is false, only if no other output events or pattern/state outputs are assigned to the same signal.

NOT LO Limit

*NOT LO Limit is an inverted version of LO Limit. When one is true, the other is false, unless Limits are **not** being checked, in which case, both signals are false.*

Select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever the LO Limit of the channel being set up is **not** violated (including LO Hysteresis, LO Latch, and Limit Mode effects as described in CHAN SETTINGS). When the LO Limit is violated, an assigned signal is false, only if no other output events or pattern/state outputs are assigned to the same signal.

At Max

Max/Min update rate is 2000Hz for each hardware channel and 50Hz for CH3 calculation.

Select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever *At Max* for the channel being set up is true. When *At Max* is false, an assigned signal is false, only if no other output events or pattern/state outputs are assigned to the same signal.

At Max is used to sense when a channel is at a peak. It is defined by the following statements.

At Max is set when Current data $ *Max data*
and is reset when Current data < *Max data & HI Hysteresis*

If Do Max/Mins selection in System Options menu is Use I/O Control and Do Max/Mins input action is false, then At Max and NOT At Max are both false.

For a graphical representation, see At Max Diagram. Hysteresis is used to prevent *At Max* signal from oscillating ON and OFF. *HI Hysteresis* is also used similarly for HI Limit violations. See HI Hysteresis in CHAN SETTINGS.

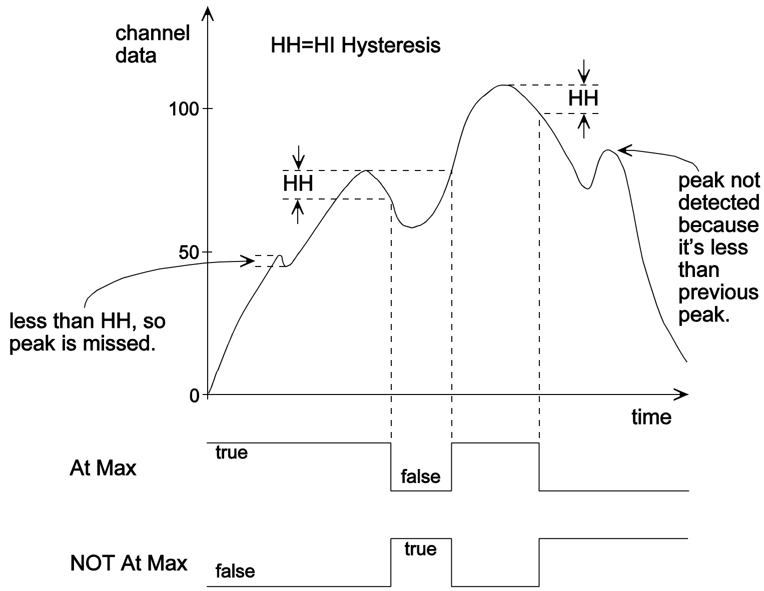
When Max/Mins are reset (on power up, when RESET key is pressed, and via Logic I/O during a Test), *At Max* goes true and *NOT At Max* goes false.

When *Max/Min Type* is set to *Filtered Data*, then the digital filter is used for both channel data and Max data when determining *At Max*. When *Max/Min Type* is set to *Raw Data*, then the digital filter is bypassed for both channel data and Max data when determining *At Max*. In this case, fastest response is obtained for peak detection but noise may trigger false peaks unless *HI Hysteresis* is larger than noise. The 200Hz low pass Bessel response hardware anti-alias filter for analog hardware channels cannot be bypassed. See Filter in CHAN SETTINGS.

At Max Diagram

If HI Hysteresis is too small, At Max may oscillate true and false when data is near Max data. If HI Hysteresis is too large, the peak may be missed or detected too late.

Because At Max goes false right after the peak, NOT At Max is more useful, since it goes true right after the peak.



NOT At Max

*NOT At Max is an inverted version of At Max. When one is true, the other is false, unless Max/Mins are **not** being updated, in which case, both signals are false.*

Select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever *NOT At Max* for the channel being set up is true. When *NOT At Max* is false, an assigned signal is false, only if no other output events or pattern/state outputs are assigned to the same signal. See At Max earlier in this chapter.

At Min

Max/Min update rate is 2000Hz for each hardware channel and 50Hz for CH3 calculation.

Select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever *At Min* for the channel being set up is true. When *At Min* is false, an assigned signal is false, only if no other output events or pattern/state outputs are assigned to the same signal.

At Min is used to sense when a channel is at a valley. It is defined by the following statements.

At Min is set when Current data # Min data
and is reset when Current data > Min data % LO Hysteresis

If Do Max/Mins selection in System Options menu is Use I/O Control and Do Max/Mins input action is false, then At Min and NOT At Min are both false.

For a graphical representation, see At Min Diagram. Hysteresis is used to prevent *At Min* signal from oscillating ON and OFF. *LO Hysteresis* is also used similarly for LO Limit violations. See LO Hysteresis in CHAN SETTINGS.

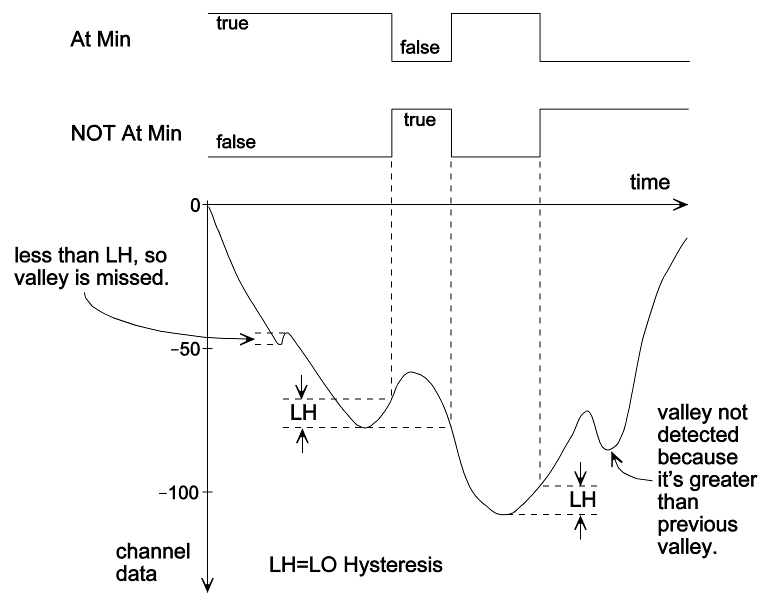
When Max/Mins are reset (on power up, when RESET key is pressed, and via Logic I/O during a Test), *At Min* goes true and *NOT At Min* goes false.

When *Max/Min Type* is set to *Filtered Data*, then the digital filter is used for both channel data and Max data when determining *At Min*. When *Max/Min Type* is set to *Raw Data*, then the digital filter is bypassed for both channel data and Min data when determining *At Min*. In this case, fastest response is obtained for valley detection but noise may trigger false valleys unless *LO Hysteresis* is larger than noise. The 200Hz low pass Bessel response hardware anti-alias filter for analog hardware channels cannot be bypassed. See Filter in CHAN SETTINGS.

At Min Diagram

Because At Min goes false right after the valley, NOT At Min is more useful, since it goes true right after the valley.

If LO Hysteresis is too small, At Min may oscillate true and false when data is near Min data. If LO Hysteresis is too large, the valley may be missed or detected too late.



NOT At Min

*NOT At Min is an inverted version of At Min. When one is true, the other is false, unless Max/Mins are **not** being updated, in which case, both signals are false.*

Select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever *NOT At Min* for the channel being set up is true. When *NOT At Min* is false, an assigned signal is false, only if no other output events or pattern/state outputs are assigned to the same signal. See At Min earlier in this chapter.

Define Patterns

Patterns are checked during a Test only.

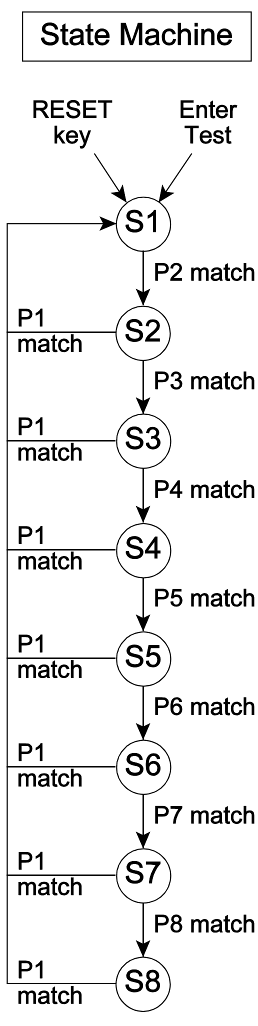
During a Test, defined patterns are compared to the actual signals, and when there is a match, the pattern is true. All signals (logic inputs, outputs, and internal Matrix signals) must match (unless ignore is assigned) for a pattern to be true. Patterns are checked every 1ms.

There are eight patterns. For each pattern you define the logic state (or *ignore*) of each logic input, output, and internal Matrix signal. Then, during a Test, patterns are compared to actual signals. Patterns are used in two ways depending on the *State Machine* setting in the *System Options* menu.

If *State Machine* is *OFF*,

Then, during a Test, patterns are compared to actual signals, and when there is a match, the pattern is true, and therefore, its corresponding pattern output (described later in this chapter) is true. Each pattern output can drive any of the logic outputs and internal Matrix signals.

Input actions (described earlier in this chapter) include a logical OR function. The assigned signals of an input action are OR'ed to determine whether the action is performed. That is, whenever any of its assigned signals are true, the action is performed. Output events (described earlier in this chapter) also include a logical OR function. Logic outputs and internal Matrix signals are created by OR'ing all assigned output events and pattern outputs. That is, a logic output or internal Matrix signal is true whenever any of its assigned output events and pattern outputs are true. To provide a logical AND function, you must use the patterns. All signals (logic inputs, outputs, and internal Matrix signals) must match (unless *ignore* is assigned) for a pattern to be true.



If *State Machine* is *ON*,

Then, during a Test, patterns are used to control the flow of the State Machine. When you first enter a Test, the State Machine starts in State1. Pattern2 is compared to actual signals, and when there is a match, the State Machine goes to State2. Then, Pattern3 is checked, and when it matches, the State Machine goes to State3. This continues to a maximum of eight states. During any state, a Pattern1 match forces the State Machine to go to State1. Pattern1 works differently than the other patterns. Pattern1 is checked in all states, whereas, the other patterns are only checked in the state previous the pattern number. Pattern2 is checked in State1, Pattern3 is checked in State2, and so forth. Pattern1 acts as a reset to the State Machine because it is checked in all states. RESET key also resets State Machine to State1.

When *State Machine* is *ON*, there are no pattern outputs. Instead, there are state outputs (described later in this chapter). When the State Machine is in a specific state, the corresponding state output is true. That is, State5 output is true when the State Machine is in State5. Each state output can drive any of the logic outputs and internal Matrix signals.

When *Define Patterns* is displayed there is no entry on the second line. So, press DOWN key to go into the *Define Patterns* menu for more items. The first selection of the *Define Patterns* menu is displayed. Use RIGHT/LEFT keys to choose from:

Default settings for all Patterns are:

	1234
Logic Ins	*&&&&*
LogicOuts	*&&&&&&*
IntMatrix	*&&&&&&*
	123456

Pattern1
to
Pattern8

When the desired pattern is displayed, press DOWN key. *Logic Ins* along with the current setting are displayed on second line. Use RIGHT/LEFT keys to choose from:

Logic Ins	(Logic Inputs)
LogicOuts	(Logic Outputs)
IntMatrix	(Internal Matrix signals)

Each pattern has these three selections. Shown below is an example for Pattern1.

```
Pattern1
Logic Ins   00-1
            1234
```

```
Pattern1
LogicOuts 00--1-
          123456
```

```
Pattern1
IntMatrix -011--
          123456
```

0 ! *false*
1 ! *true*
– ! *ignore*

LI is logic input.
LO is logic output.
IM is internal Matrix.

Pattern1 is true when,
(LI1 is false) AND (LI2 is false) AND (LI4 is true)
AND
(LO1 is false) AND (LO2 is false) AND (LO5 is true)
AND
(IM2 is false) AND (IM3 is true) AND (IM4 is true)
Otherwise, Pattern1 is false.

Pattern1 to Pattern8

For each of the eight patterns, select *false* (0), *true* (1), or *ignore* (–) for each logic input, output, and internal Matrix signal. During a Test, these patterns are compared to the actual signals to determine whether they match. These could then be used to drive logic outputs and internal Matrix signals via pattern outputs or to control the flow of the State Machine.

Pattern/State Outputs

This selection will be either *Pattern Outputs* or *State Outputs* depending on the *State Machine* setting in *System Options* menu. *Pattern Outputs* apply if *State Machine* is *OFF*. *State Outputs* apply if *State Machine* is *ON*.

During a Test, if a pattern/state output is true, its assigned signals are true. The delay for these signals to go true from the time the signals (of the pattern definition) match is 1ms.

Pattern outputs are signals based on eight user-defined patterns (described earlier in this chapter). When a Test is running and a pattern matches the actual signals, the corresponding pattern output is true.

State outputs are signals based on the current state of the State Machine. When the State Machine is in a specific state, the corresponding state output is true.

Pattern/state outputs can perform input actions via logic outputs and internal Matrix signals. See Input Actions.

Each pattern/state output can drive any of the logic outputs and internal Matrix signals. If the pattern/state output is true, its assigned logic outputs and internal Matrix signals are true. On the other hand, many pattern/state outputs and output events (described earlier in this chapter) can be assigned to the same signal (logic output or internal Matrix signal). The assigned pattern/state outputs and output events are OR'ed to create the signal. In other words, a logic output or internal Matrix signal is true whenever any of its assigned pattern/state outputs and output events are true.

When *Pattern Outputs* (or *State Outputs*) is displayed there is no entry on the second line. So, press DOWN key to go into the *Pattern Outputs* (or *State Outputs*) menu for more items. The first selection of the *Pattern Outputs* (or *State Outputs*) menu is displayed. Use RIGHT/LEFT keys to choose from:

Default settings for all Pattern/State Outputs are:

	123456
LogicOuts	*&&&&&&*
IntMatrix	*&&&&&&*

Pattern1 OUT		*State1 OUT*
NOT Pattern1 OUT		*NOT State1 OUT*
to	**OR**	*to*
Pattern8 OUT		*State8 OUT*
NOT Pattern8 OUT		*NOT State8 OUT*

When the desired pattern/state output is displayed, press DOWN key. *LogicOuts* along with the current setting are displayed on second line. Use RIGHT/LEFT keys to choose from:

LogicOuts	(Logic Outputs)
IntMatrix	(Internal Matrix signals)

Each pattern/state output has these two selections. Shown below are examples for *Pattern1 OUT* and *State1 OUT*.

1 ! assigned
– ! not assigned

```
Pattern1 OUT
LogicOuts 1---1-
          123456
```

```
Pattern1 OUT
IntMatrix -111--
          123456
```

LO is logic output.
IM is internal Matrix.

When Pattern1 matches, LO1, LO5, IM2, IM3, and IM4 are true.
Other output events and pattern outputs might drive these logic outputs and internal Matrix signals also.

1 ! assigned
– ! not assigned

```
State1 OUT
LogicOuts -1-1--
          123456
```

```
State1 OUT
IntMatrix 1--11-
          123456
```

LO is logic output.
IM is internal Matrix.

When State Machine is in State1, LO2, LO4, IM1, IM4, and IM5 are true.
Other output events and state outputs might drive these logic outputs and internal Matrix signals also.

Pattern1 OUT to Pattern8 OUT

*When State Machine setting is OFF, pattern outputs apply. There are **no** state outputs.*

For each of the eight pattern outputs, select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever the corresponding pattern matches actual signals. If *Pattern1* matches, then the assigned signals of *Pattern1 OUT* are true. When there is no match, an assigned signal is false, only if no other output events or pattern outputs are assigned to the same signal.

State1 OUT to State8 OUT

*When State Machine setting is ON, state outputs apply. There are **no** pattern outputs.*

For each of the eight state outputs, select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever the State Machine is in the corresponding state. If the State Machine is in State1, then the assigned signals of *State1 OUT* are true. When the State Machine is **not** in State1, an assigned signal is false, only if no other output events or state outputs are assigned to the same signal.

NOT Pattern1 OUT to NOT Pattern8 OUT

NOT pattern outputs are inverted versions of pattern outputs. When Pattern1 OUT is true, NOT Pattern1 OUT is false, and visa versa.

For each of the eight *NOT* pattern outputs, select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever the corresponding pattern does **not** match actual signals. If *Pattern1* does **not** match, then the assigned signals of *NOT Pattern1 OUT*, are true. When there is a match, an assigned signal is false, only if no other output events or pattern outputs are assigned to the same signal.

NOT State1 OUT to NOT State8 OUT

NOT state outputs are inverted versions of state outputs. When State1 OUT is true, NOT State1 OUT is false, and visa versa.

For each of the eight *NOT* state outputs, select *assigned* (1) or *not assigned* (–) for each logic output and internal Matrix signal. During a Test, the assigned signals are true whenever the State Machine is **not** in the corresponding state. If the State Machine is **not** in State1, then the assigned signals of *NOT State1 OUT* are true. When the State Machine is in State1, an assigned signal is false, only if no other output events or state outputs are assigned to the same signal.

ANALOG OUTPUTS

To learn how to navigate the menu and modify selections, see MENU BASICS.

The *Analog Outputs* menu allows you to define the two analog outputs and adjust them, if necessary. Use RIGHT/LEFT keys to choose from the following selections.

CH used for ANA1	(Channel used for Analog Output 1)
CH used for ANA2	(Channel used for Analog Output 2)
Adjust ANAOUTS	(Adjust Analog Outputs)

See I/O Connector in APPENDIX A for external connection of the analog outputs.

Each of the analog outputs can be assigned to any one of the three channels (CH1 to CH3). The analog outputs provided on the standard 9850 instrument are voltage outputs. You can set up each one as 5V or 10V outputs. See Analog Outputs 5V/10V Selection Jumpers in APPENDIX B for 5V/10V selection. Options MA and MB convert an analog output voltage to a current. Option MC shifts an analog output voltage by 5V.

Option MA is an add-on board that converts an analog output voltage to a 4 to 20mA current. Two modes, 12±8mA and 4-20mA, are supported. For 12±8mA mode, 4mA is negative Full Scale, 12mA is zero, and 20mA is positive Full Scale. For 4-20mA mode, 4mA is zero and 20mA is positive Full Scale. See following Analog Output Reference table. See Option MA in APPENDIX B for add-on board location and for 12±8mA and 4-20mA jumper selection.

*For all Analog Output Option boards, the standard analog output must be set up as a 5V output (**not** 10V). See Analog Outputs 5V/10V Selection Jumpers in APPENDIX B for 5V/10V selection.*

Option MB is an add-on board that converts an analog output voltage to a 0 to 20mA current. Only one mode, 10±10mA, is supported. 0mA is negative Full Scale, 10mA is zero, and 20mA is positive Full Scale. See following Analog Output Reference table. See Option MB in APPENDIX B for add-on board location.

Analog Output Option boards each handle one analog output. Up to two can be installed, one per analog output.

Option MC is an add-on board that shifts an analog output voltage by 5V. Only one mode, 5±5V, is supported. 0V is negative Full Scale, 5V is zero, and 10V is positive Full Scale. See following Analog Output Reference table. See Option MC in APPENDIX B for add-on board location.

See APPENDIX H for specifications of the analog outputs.

The following table describes analog output scaling for all modes. Analog outputs are internally updated at 1000Hz and filtered with a 100Hz Bessel response low pass hardware filter.

Analog Output Reference Table

FS is Full Scale of channel (CH1, CH2, or CH3) assigned to analog output. See appropriate CHAN CALIBRATION chapter.

Shaded boxes in table indicate voltage or current limits reached.

See APPENDIX H for analog output resolution.

Data of Channel Driving Output	Analog Outputs, ANA1 and ANA2					
	Standard Modes		Option MC	Option MA Modes		Option MB
	±5V	±10V	5±5V	12±8mA	4&20mA	10±10mA
1.50 x FS	7.5					
1.40 x FS	7		12	23.2		
1.35 x FS	6.75	13.5	11.75	22.8		
1.32 x FS	6.6	13.2	11.6	22.56		23.2
1.20 x FS	6	12	11	21.6	23.2	22
FS	**5**	**10**	**10**	**20**	**20**	**20**
0.90 x FS	4.5	9	9.5	19.2	18.4	19
0.80 x FS	4	8	9	18.4	16.8	18
0.70 x FS	3.5	7	8.5	17.6	15.2	17
0.60 x FS	3	6	8	16.8	13.6	16
0.50 x FS	2.5	5	7.5	16	12	15
0.40 x FS	2	4	7	15.2	10.4	14
0.30 x FS	1.5	3	6.5	14.4	8.8	13
0.20 x FS	1	2	6	13.6	7.2	12
0.10 x FS	0.5	1	5.5	12.8	5.6	11
0	**0**	**0**	**5**	**12**	**4**	**10**
-0.10 x FS	-0.5	-1	4.5	11.2	2.4	9
-0.20 x FS	-1	-2	4	10.4	0.8	8
-0.30 x FS	-1.5	-3	3.5	9.6		7
-0.40 x FS	-2	-4	3	8.8		6
-0.50 x FS	-2.5	-5	2.5	8		5
-0.60 x FS	-3	-6	2	7.2		4
-0.70 x FS	-3.5	-7	1.5	6.4		3
-0.80 x FS	-4	-8	1	5.6		2
-0.90 x FS	-4.5	-9	0.5	4.8		1
-FS	**-5**	**-10**	**0**	**4**		**0**
-1.35 x FS	-6.75	-13.5		1.2		
-1.40 x FS	-7			0.8		
-1.50 x FS	-7.5					
	Volts			mA		

Symbol, d, is data of channel (CH1, CH2, or CH3) assigned to analog output.

FS is Full Scale of channel (CH1, CH2, or CH3) assigned to analog output.

Results are volts or mA.

Mode	Analog Output Formula
±5V	$\frac{d}{FS} \times 5V$
±10V	$\frac{d}{FS} \times 10V$
5±5V Option MC	$\left(\frac{d}{FS} \times 5V\right) + 5V$

Mode	Analog Output Formula
12±8mA Option MA	$\left(\frac{d}{FS} \times 8mA\right) + 12mA$
4-20mA Option MA	$\left(\frac{d}{FS} \times 16mA\right) + 4mA$
10±10mA Option MB	$\left(\frac{d}{FS} \times 10mA\right) + 10mA$

Channel used for Analog Output 1

Default setting for CH used for ANA1 is CH1 if it exists, otherwise it's CH2.

For the entry, *CH used for ANA1*, select the transducer channel (CH1 or CH2) or calculation (CH3) that you want to drive ANA1 (Analog Output 1).

Channel used for Analog Output 2

Default setting for CH used for ANA2 is CH2 if it exists, otherwise it's CH3.

For the entry, *CH used for ANA2*, select the transducer channel (CH1 or CH2) or calculation (CH3) that you want to drive ANA2 (Analog Output 2).

Adjust Analog Outputs

ANAOUTS ! Analog Outputs

At the selection, *Adjust ANAOUTs*, press ENTER key to have system automatically adjust both analog outputs. The messages, *Please wait... Adjusting ANA1*, followed by *Please wait... Adjusting ANA2*, are displayed. Typically, the adjustments take 5 to 15 seconds, but could take as long as 30 seconds. When adjustments are finished, the systems returns to the top of the *Analog Outputs* menu. *Analog Outputs* is displayed. You can continue navigating the menu using Cursor keys.

Normally, you do **not** need to adjust analog outputs because the system automatically performs this operation when necessary. If you question the analog outputs, or want them adjusted under certain conditions (like at a certain temperature) you can perform this function.

The following actions will trigger adjustment of analog outputs when exiting menu.

Calibrating CH1 and/or CH2.

Changing channel assigned to either analog output.

Clearing memory (adjustment occurs next time you exit menu).

COM OPTIONS

To learn how to navigate the menu and modify selections, see MENU BASICS.

The *COM Options* menu allows you to set up the serial communications port (RS232/422/485). Use RIGHT/LEFT keys to choose from the following selections.

BAUD Rate
Data Bits/Parity
Unit ID

BAUD Rate

Select the BAUD Rate used for serial communications. Make sure the BAUD Rate selected is the same as that for the computer. Choices are:

Default value for BAUD Rate is 38400.

38400
19200
9600
4800
2400
1200
600
300

Data Bits/Parity

Select the number of data bits and parity for serial communications. Make sure these are set the same as those for the computer. Choices are:

Default setting for Data Bits/Parity is 8/None.

7/Odd	(7 data bits, odd parity)
7/Even	(7 data bits, even parity)
8/Odd	(8 data bits, odd parity)
8/Even	(8 data bits, even parity)
8/None	(8 data bits, no parity)

Notice, with 7 data bits you must have a parity bit. Number of Stop bits is one and cannot be changed. Also, on the computer, disable all handshaking (such as, XON/XOFF, RTS, etc).

Unit ID

Default setting for Unit ID is A.

Select a character from *A* to *Z* or *a* to *z*. The Unit ID is case sensitive. Press VIEW key to change the character from uppercase to lower case, and visa versa. The Unit ID is used to identify which 9850 instrument is being talked to when using the serial communication port. Every serial communication command sent must include the Unit ID. For RS485, up to 32 instruments can be connected to a computer. For RS232/422, only one 9850 instrument can be connected. Even though only one instrument can be connected, the Unit ID is required for serial communication commands. See COM Connector in APPENDIX A for cable information and APPENDIX F for serial communication commands.

APPENDIX A, REAR PANEL CONNECTORS

I/O Connector

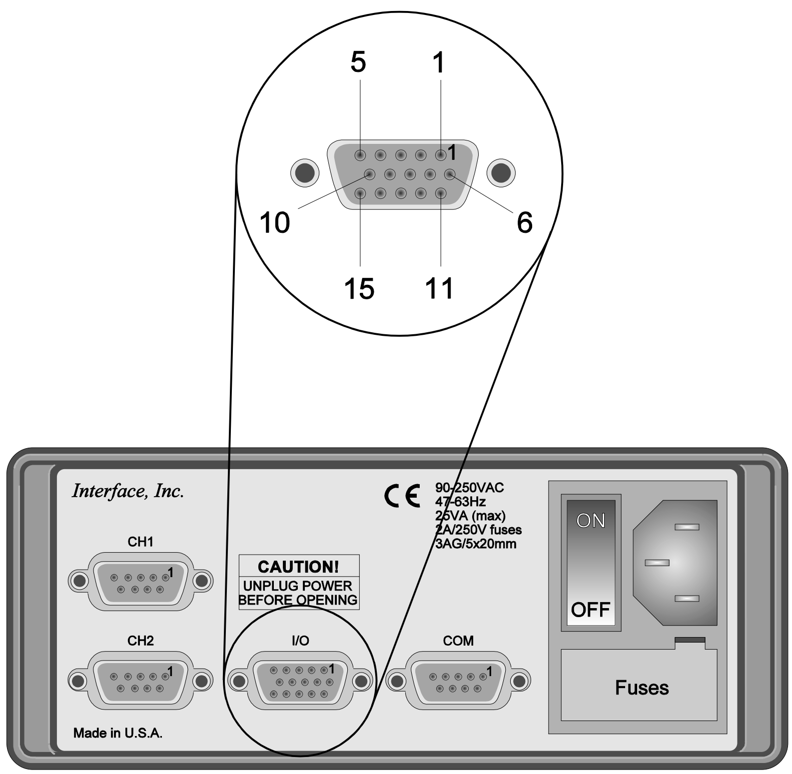
The I/O connector on the rear panel is the 15 pin female D connector labeled I/O. It contains the Logic I/O, Analog outputs, and %5V supply voltage. The table below shows the pinout. Typical input and output connections follow. See APPENDIX H for specifications of the signals.

5	4	3	2	1
Logic Out 5	Logic Out 4	Logic Out 3	Logic Out 2	Logic Out 1

10	9	8	7	6
Logic In 4	Logic In 3	Logic In 2	Logic In 1	Logic Out 6

15	14	13	12	11
ANA Out 2	ANA Out 1	ANA GND	Logic GND	5VDC

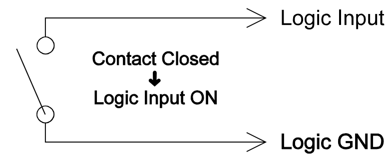
A 15 pin male mating connector with hood is provided with unit. It includes various size grommets for different cable thickness.



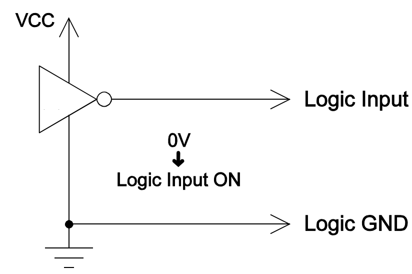
Examples of Typical Logic Input Sources

Logic Inputs
TTL compatible
Low-true
Schmitt trigger
Pull-up Resistor:
47kΩ (internal)

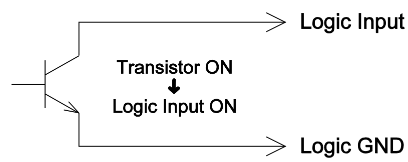
Contact Closure



TTL Compatible Driver



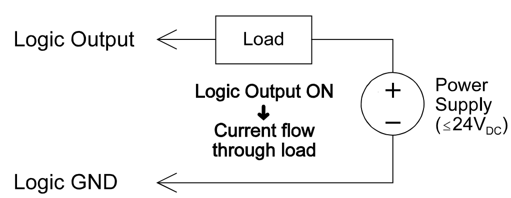
Open Collector
(typical of solid state
input modules)



Examples of Typical Logic Output Loads

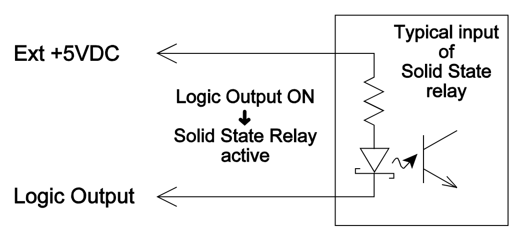
Logic Outputs
Open collector
Low-true
Operating Voltage:
24V max
Sink Current:
300mA max

Load using external
power supply



Ext %5VDC
Load Current:
250mA max

Solid State Relay



Model ACUA Connector

CAUTION:
The COM connector is also a 9 pin female D connector.

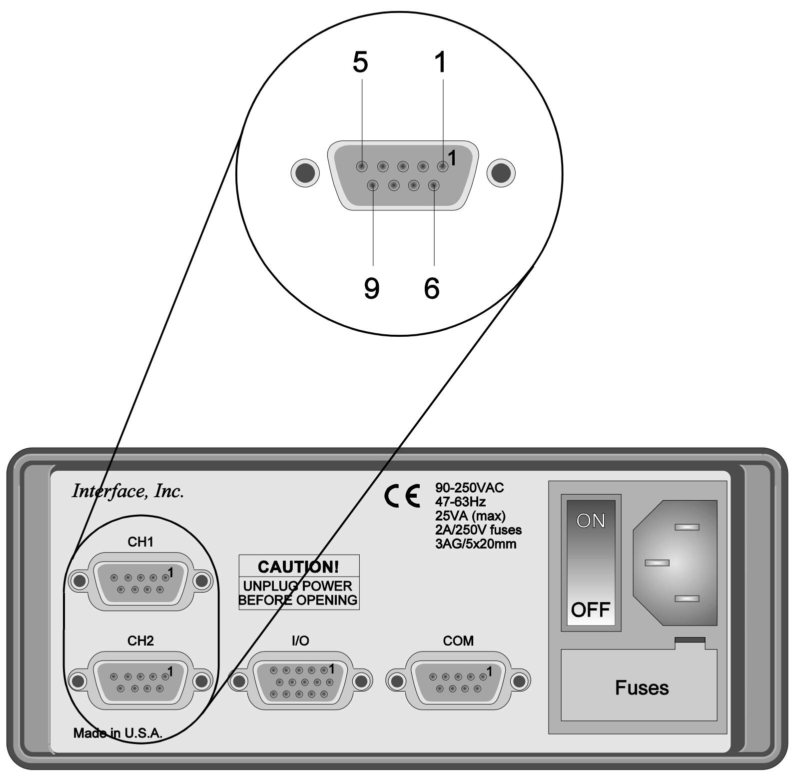
Transducer connectors on the rear panel are the two 9 pin female D connectors labeled CH1 and CH2. The pinout is dependent on the type of modules installed. The table below shows the pinout for the Model ACUA (AC Strain Gage Amplifier). A drawing of a typical cable follows. See APPENDIX H for specifications.

CAL FB is CAL Feedback

5	4	3	2	1
CAL FB	%Input	&Input	ANA GND	Shield

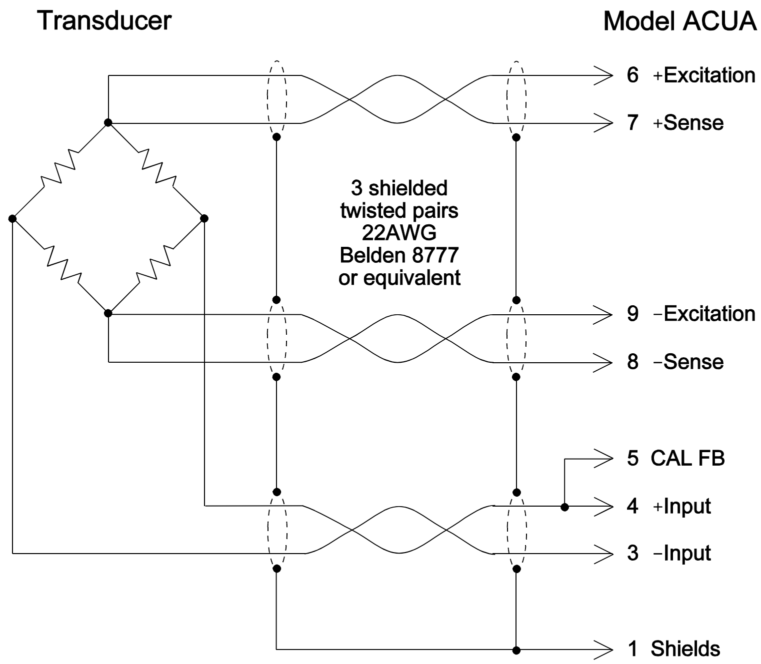
9	8	7	6
&Excitation	&Sense	%Sense	%Excitation

For systems purchased without cables, a 9 pin male mating connector with hood is provided with unit. It includes various size grommets for different cable thickness.



Typical AC Strain Gage Transducer Cable

6 Wire Cable
(recommended for most high accuracy applications)



Model ACUA
Excitation:
3Vrms, 3030Hz
Excitation Load:
80 to 2000Ω
Input Sensitivity:
0.5 to 5mV/V
Max Cable Length:
500ft (load$100Ω)
200ft (load<100Ω)

Other than connections shown, isolate shields from other conductors including connector housing.

Model LVDA Connector

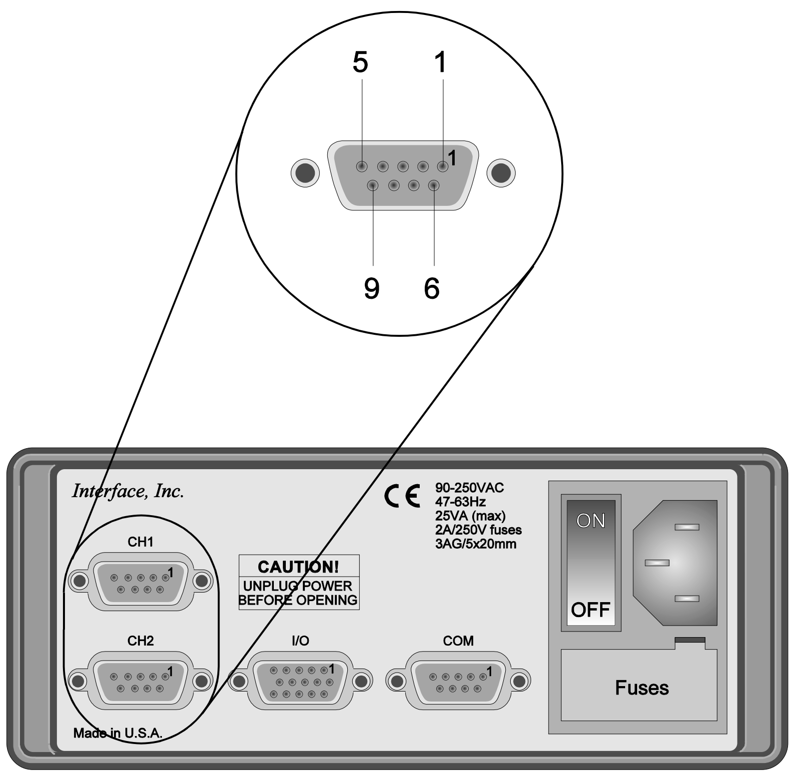
CAUTION:
The COM connector is also a 9 pin female D connector.

Transducer connectors on the rear panel are the two 9 pin female D connectors labeled CH1 and CH2. The pinout is dependent on the type of modules installed. The table below shows the pinout for the Model LVDA (LVDT Amplifier). A drawing of a typical cable follows. See APPENDIX H for specifications.

5	4	3	2	1
Reserved	%Input	&Input	ANA GND	Shield

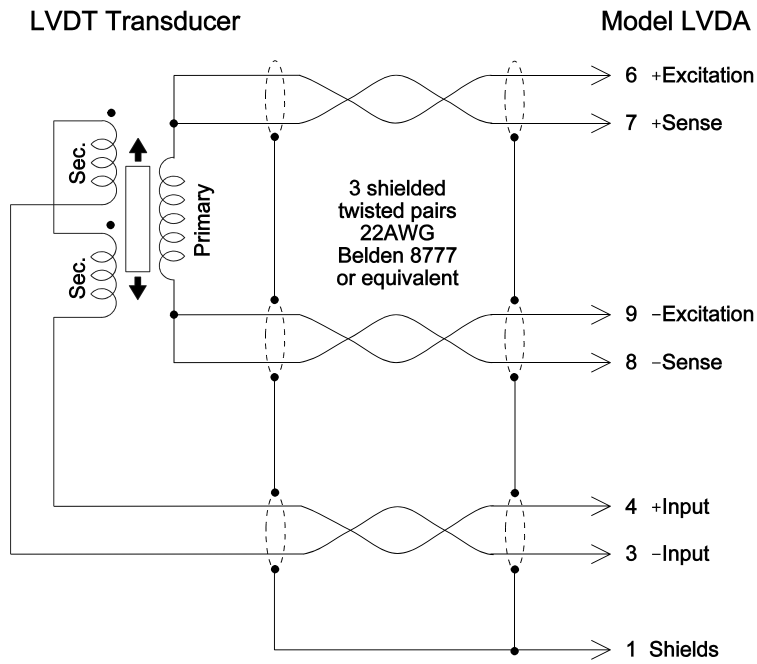
9	8	7	6
&Excitation	&Sense	%Sense	%Excitation

For systems purchased without cables, a 9 pin male mating connector with hood is provided with unit. It includes various size grommets for different cable thickness.



Typical LVDT Transducer Cable

Model LVDA
Excitation:
2Vrms
2.5, 3, 5, or 10kHz
Excitation Load:
\$80Ω
Input Sensitivity:
100 to 1000mV/V
Max Cable Length:
50ft



Other than connections shown, isolate shields from other conductors including connector housing.

Model DCSA Connector

CAUTION:
The COM connector is also a 9 pin female D connector.

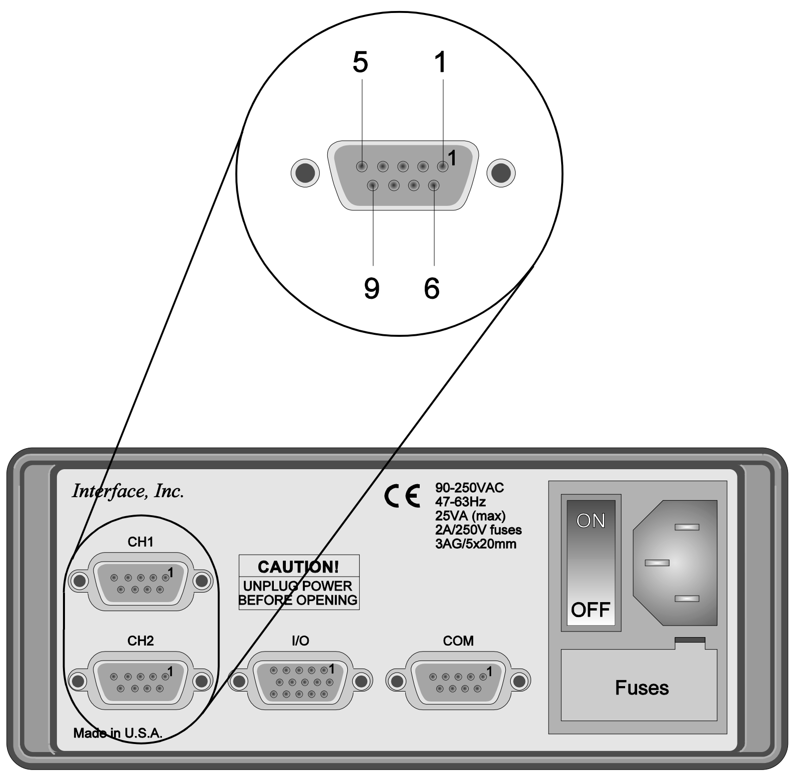
Transducer connectors on the rear panel are the two 9 pin female D connectors labeled CH1 and CH2. The pinout is dependent on the type of modules installed. The table below shows the pinout for the Model DCSA (DC Strain Gage Amplifier). A drawing of a typical cable follows. See APPENDIX H for specifications.

CAL FB is CAL Feedback

5	4	3	2	1
CAL FB	%Input	&Input	ANA GND	Shield

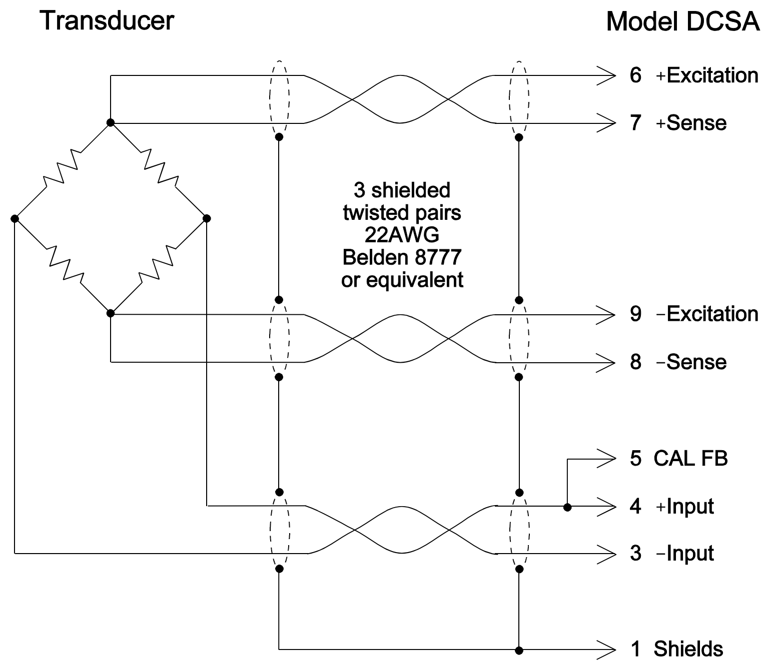
9	8	7	6
&Excitation	&Sense	%Sense	%Excitation

For systems purchased without cables, a 9 pin male mating connector with hood is provided with unit. It includes various size grommets for different cable thickness.



Typical DC Strain Gage Transducer Cable

6 Wire Cable
(recommended for most high accuracy applications)



Model DCSA
Excitation:
5 or 10VDC
Excitation Load:
80 to 2000Ω (5V)
170 to 2000Ω (10V)
Input Sensitivity:
1 to 4.5mV/V
Max Cable Length:
500ft

Model DCVA Connector

CAUTION:
The COM connector is also a 9 pin female D connector.

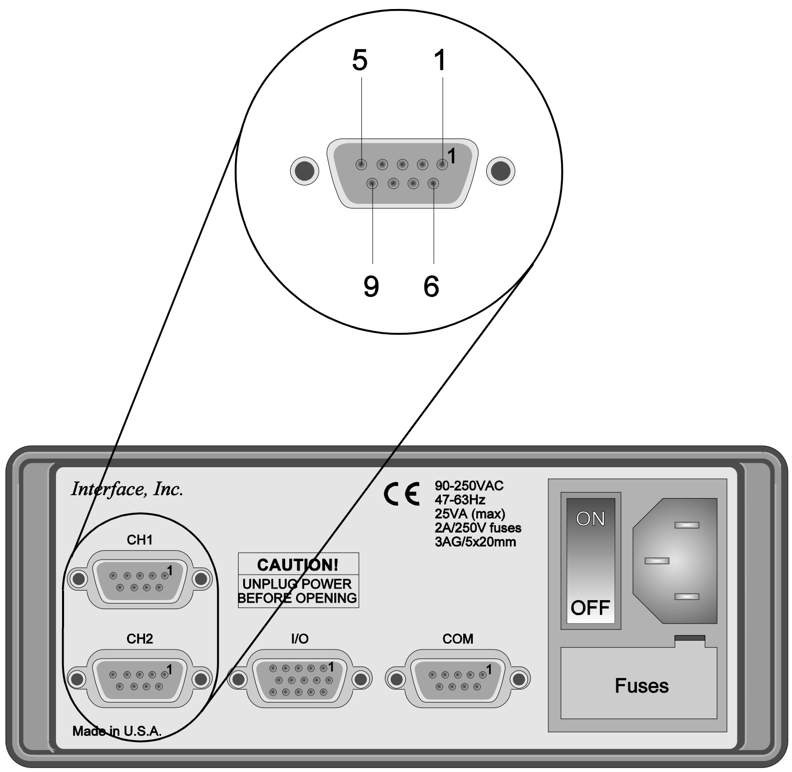
Transducer connectors on the rear panel are the two 9 pin female D connectors labeled CH1 and CH2. The pinout is dependent on the type of modules installed. The table below shows the pinout for the Model DCVA (DC Voltage Amplifier). A drawing of a typical cable follows. See APPENDIX H for specifications.

%CAL (NO) and &CAL (NO) are normally open contacts that short to CAL COM during Remote (%) and (&) CAL operations, respectively.

5	4	3	2	1
&CAL (NO)	%CAL (NO)	GND	&Input	%Input

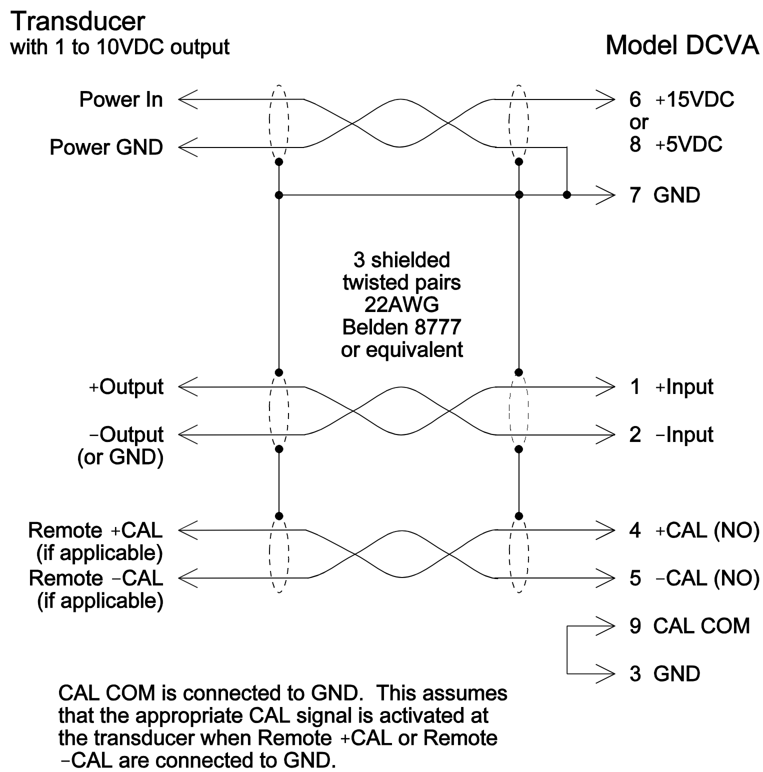
9	8	7	6
CAL COM	%5VDC	GND	%15VDC

For systems purchased without cables, a 9 pin male mating connector with hood is provided with unit. It includes various size grommets for different cable thickness.



Typical DC Voltage Transducer Cable

Model DCVA
Excitation Supplies:
5V@250mA or*
*15V@100mA**
Input Sensitivity:
±1 to ±10V
Max Cable Length:
2000ft



* Both excitation voltages can be used simultaneously with the following restrictions.
(5V current) % 6 x (15V current) # 700mA, 5V current # 250mA, 15V current # 100mA

Model DCIA Connector

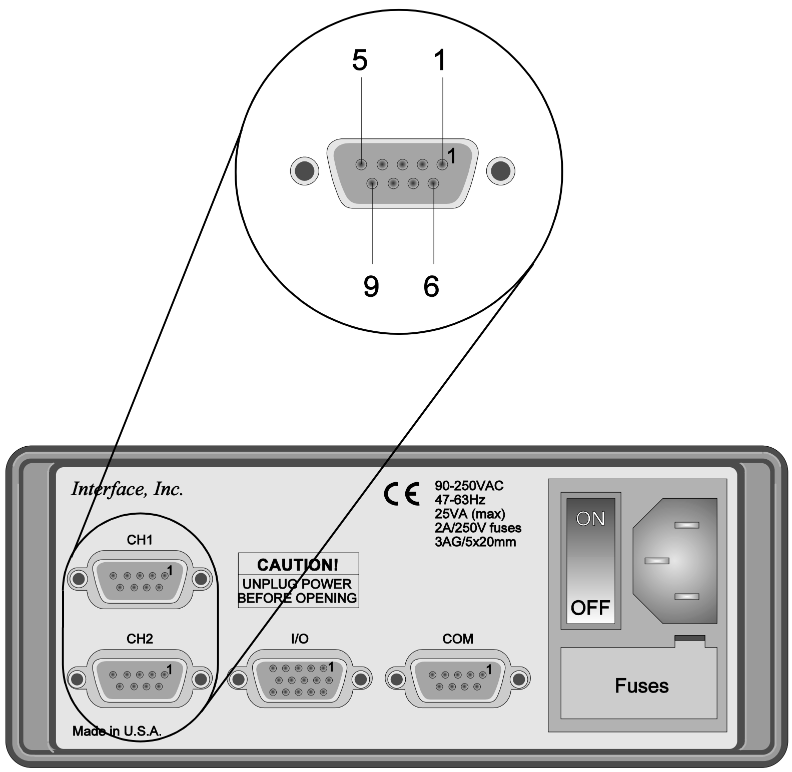
CAUTION:
The COM connector is also a 9 pin female D connector.

Transducer connectors on the rear panel are the two 9 pin female D connectors labeled CH1 and CH2. The pinout is dependent on the type of modules installed. The table below shows the pinout for the Model DCIA (DC Current Amplifier). Drawings of typical cables follow. See APPENDIX H for specifications.

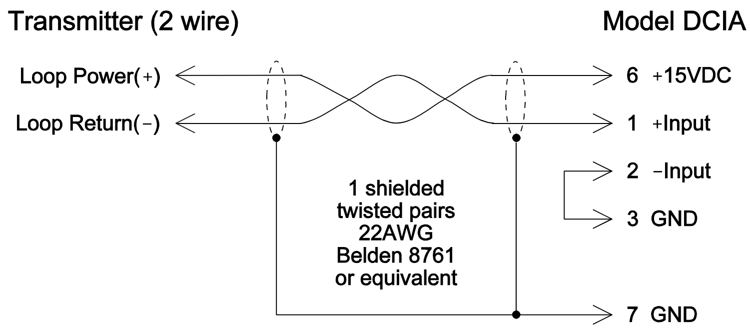
5	4	3	2	1
Reserved	Reserved	GND	&Input	%Input

9	8	7	6
Reserved	Reserved	GND	%15VDC

For systems purchased without cables, a 9 pin male mating connector with hood is provided with unit. It includes various size grommets for different cable thickness.

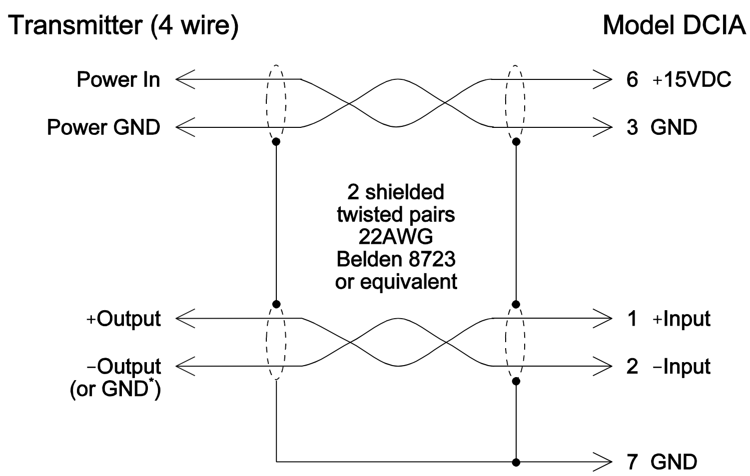


Typical Transmitter (2 wire) Cable



Typical Transmitter (4 wire) Cable

Model DCIA
Excitation Supply:
15V@30mA
Input Ranges:
4-20mA, 12±8mA,
0±10mA, 0±20mA
Max Cable Length:
2000ft



* If transmitter has single-ended output then connect −Input (pin 2) to GND at transmitter. Do not make this connection at DCIA connector. Instead, run separate wires for Power GND and Output GND as shown in diagram.

Model CTUA Connector

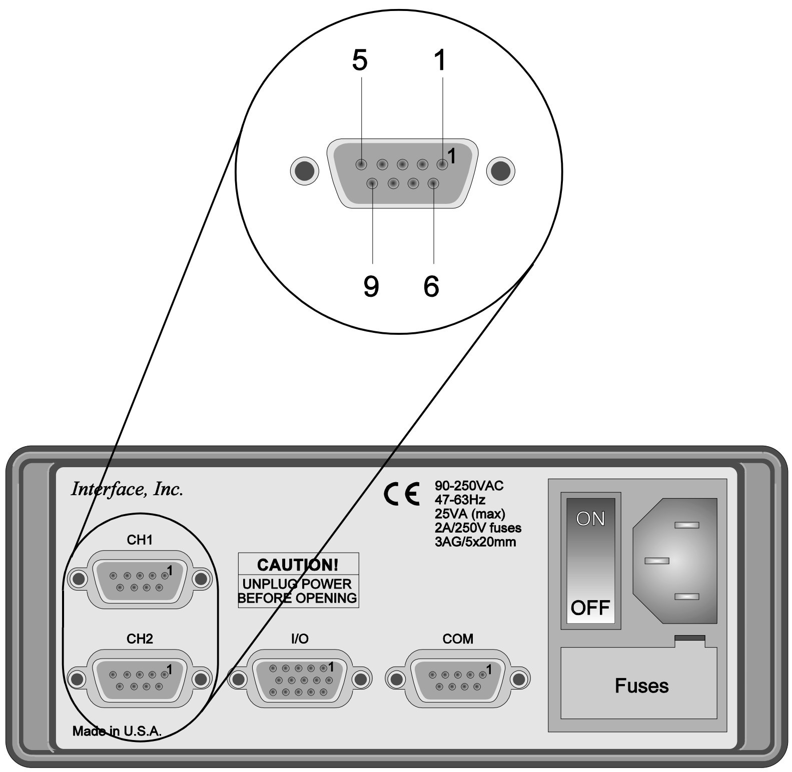
CAUTION:
The COM connector is also a 9 pin female D connector.

Transducer connectors on the rear panel are the two 9 pin female D connectors labeled CH1 and CH2. The pinout is dependent on the type of modules installed. The table below shows the pinout for the Model CTUA (Frequency Input Module). Drawings of typical cables follow. See APPENDIX H for specifications.

5	4	3	2	1
Reserved	GND	Input B(&)	Input B(&)	Input A(%)

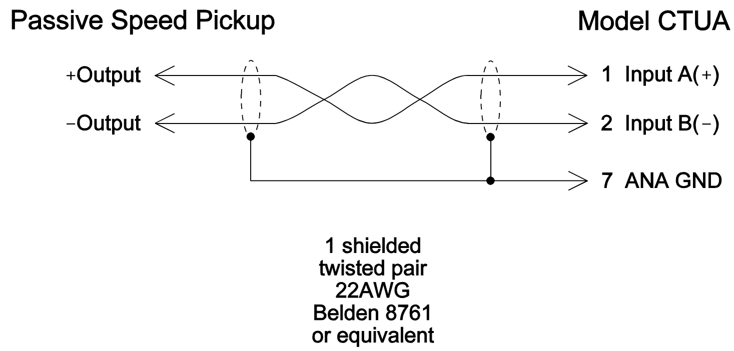
9	8	7	6
Reserved	%5VDC	ANA GND	%12VDC

For systems purchased without cables, a 9 pin male mating connector with hood is provided with unit. It includes various size grommets for different cable thickness.



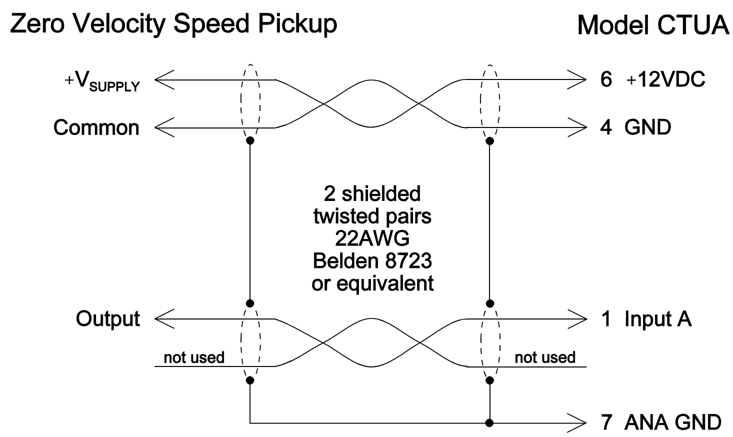
Typical Passive Speed Pickup Cable

Model CTUA
Excitation Supplies:
5V@250mA or*
*12V@125mA**
Input Types:
Differential or
Single-ended
Input Thresholds:
10,20,50,100mVp-p
or TTL
Max Cable Length:
500ft

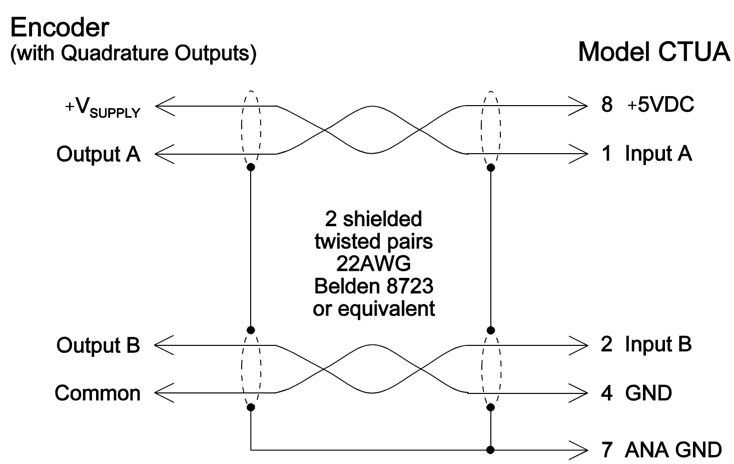


Typical Zero Velocity Speed Pickup Cable

To be compatible with other systems, some Zero Velocity Speed Pickup cables have Common going to Input B (pin 2) and a jumper going from Input B (pin 3) to GND (pin 4). These cables are compatible with the Model CTUA, also.



Typical Encoder (with Quadrature Signals) Cable



* Both excitation voltages can be used simultaneously with the following restrictions.
(5V current) % 4.8 x (12V current) # 700mA, 5V current # 250mA, 12V current # 125mA

Model UDCA Connector

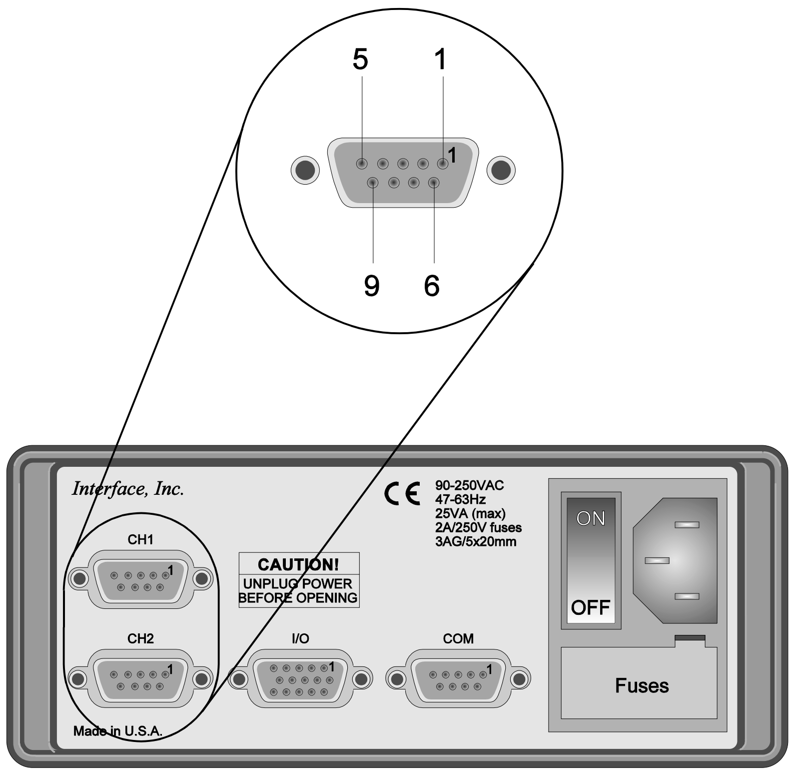
CAUTION:
The COM connector is also a 9 pin female D connector.

Transducer connectors on the rear panel are the two 9 pin female D connectors labeled CH1 and CH2. The pinout is dependent on the type of modules installed. The table below shows the pinout for the Model UDCA (Encoder/Totalizer Module). Drawings of typical cables follow. See APPENDIX H for specifications.

5	4	3	2	1
Reset	GND	Input B	Input B	Input A

9	8	7	6
Reset Arm	%5VDC	ANA GND	%12VDC

For systems purchased without cables, a 9 pin male mating connector with hood is provided with unit. It includes various size grommets for different cable thickness.

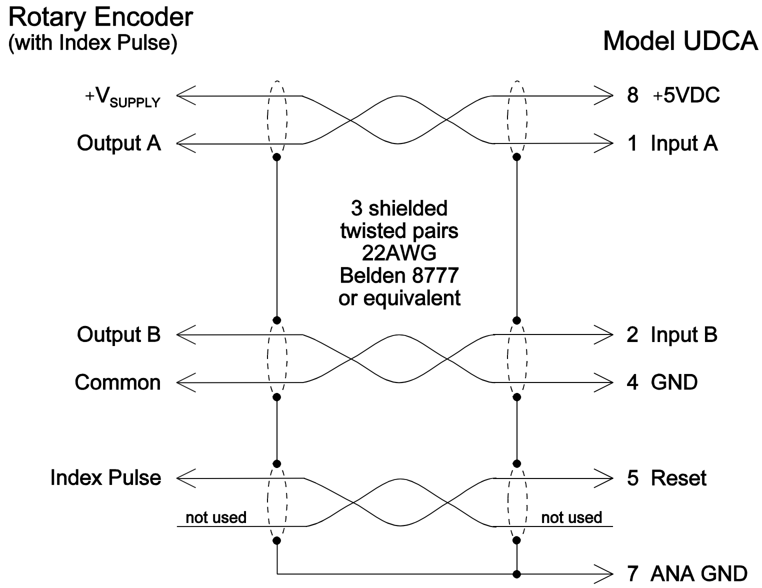


Typical Rotary Encoder (with Index Pulse) Cable

To have Index Pulse reset the Model UDCA counter once per revolution, make sure the Reset Signal setting is TTL Low resets or TTL High resets depending on the polarity of the Index Pulse.

*If Reset Signal setting is ignore, then the Reset signal (pin 5) does **not** reset the counter. Index Pulse can still be connected.*

The counter can also be reset via RESET key (see RESET Key - Reset UDCA Counter in CHAN SETTINGS) and/or Logic I/O (see Reset Count in LOGIC I/O).

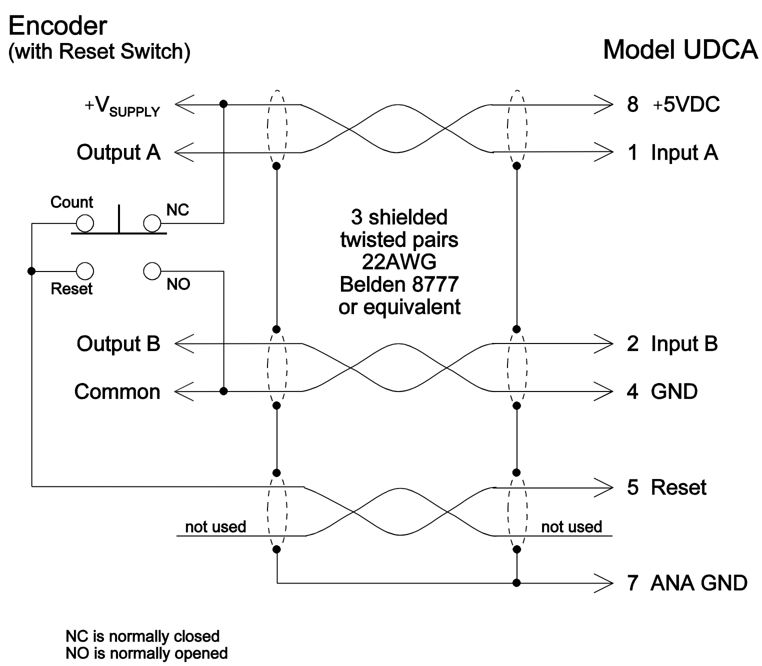


Typical Encoder (with Reset Switch) Cable

Model UDCA
Excitation Supplies:
5V@250mA or*
*12V@125mA**
Input Types:
Single-ended
Count Modes:
1X, 2X, 4X, Events
Max Cable Length:
500ft

The momentary switch resets the Model UDCA counter. Make sure the Reset Signal setting is TTL Low resets.

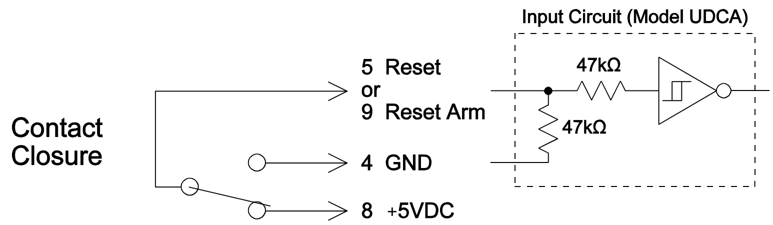
The counter can also be reset via RESET key (see RESET Key - Reset UDCA Counter in CHAN SETTINGS) and/or Logic I/O (see Reset Count in LOGIC I/O).

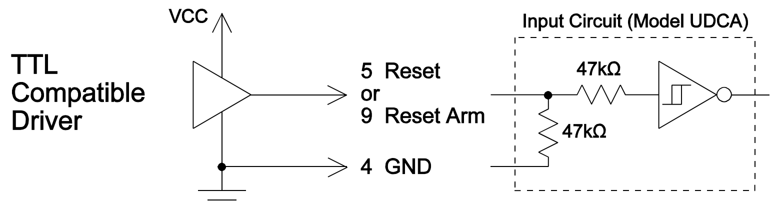


* Both excitation voltages can be used simultaneously with the following restrictions.
(5V current) % 4.8 x (12V current) # 700mA, 5V current # 250mA, 12V current # 125mA

Examples of Typical Reset and Reset Arm Sources

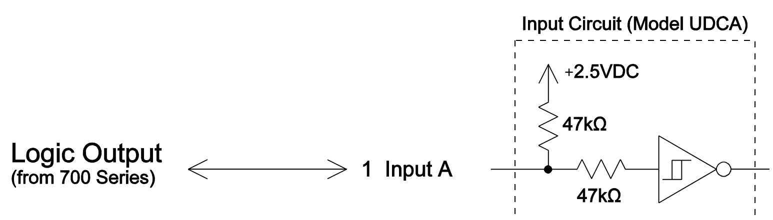
Make sure Reset Signal and/or ResetArm Sig settings are each set to the proper polarity.

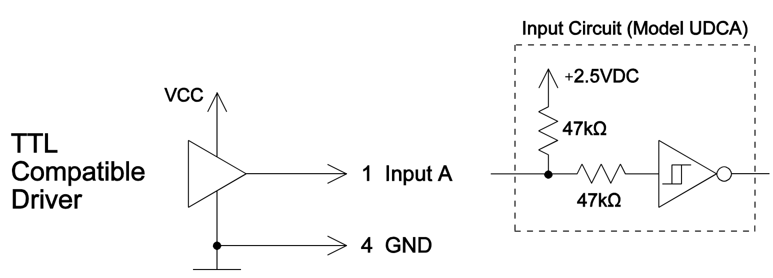




Examples of Typical Input A (Event) Sources

Make sure Count Mode setting is Event (Input A) and Count Edge setting is set to the proper edge.





COM Connector

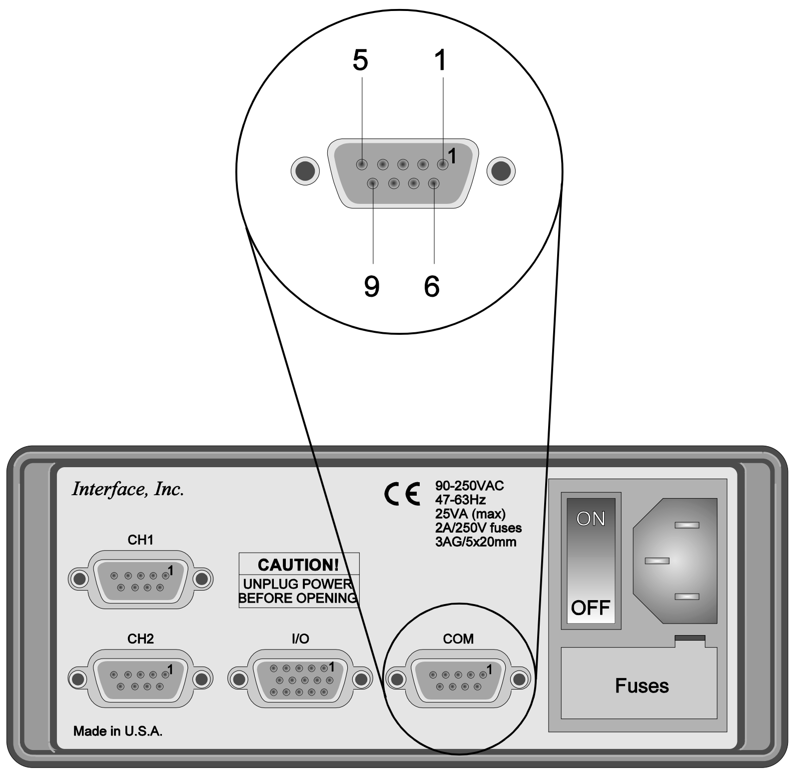
CAUTION:
CH1 and CH2 connectors are also 9 pin female D connectors.

The RS232/485/422 communications connector on the rear panel is the 9 female D connector labeled COM. The table below shows the pinout. Drawings of typical cables follow. See APPENDIX H for specifications and APPENDIX F for serial communication commands.

5	**4**	**3**	**2**	**1**
GND	Reserved	RXD	TXD	%TXD

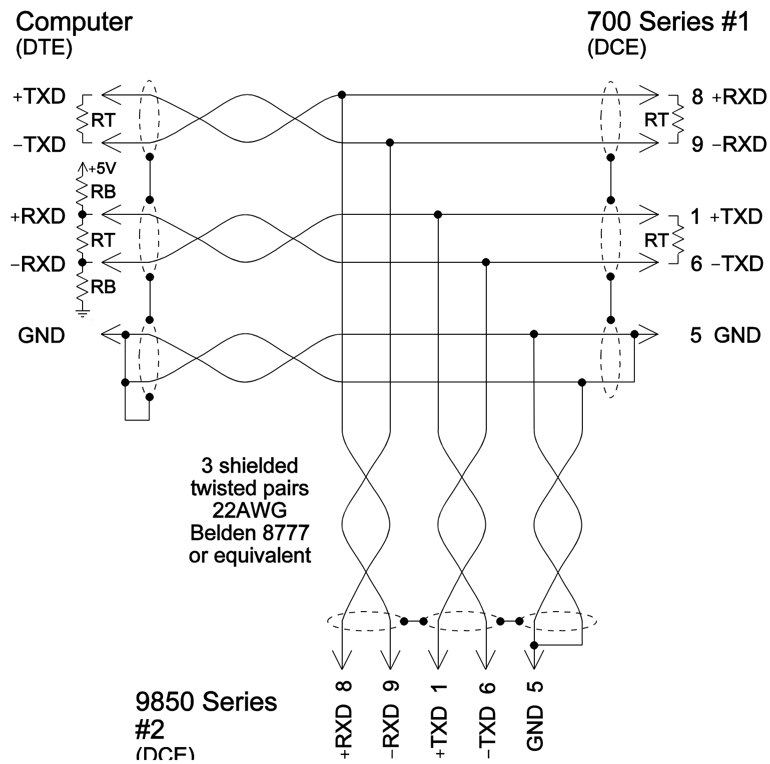
9	**8**	**7**	**6**
&RXD	%RXD	Reserved	&TXD

A 9 pin male mating connector with hood is provided with unit. It includes various size grommets for different cable thickness.



Typical RS485 Cable

***GND connection** is used to keep common mode voltage to a safe range at receivers. If GND is **not** connected, reliability and noise immunity are sacrificed.*



9850 COM port
- *Set BAUD Rate, # of Data Bits, and Parity to desired values.*
- *Make sure each 9850 instrument has a unique Unit ID. See Unit ID in COM OPTIONS.*

Computer COM port
- *Make sure BAUD Rate, # of Data Bits, and Parity are set the same as those for the 9850 instrument(s).*
- *Set # Stop Bits to 1.*
- *Disable handshaking (such as, RTS, XON/XOFF, etc).*
- *Enable RS485 driver always. See manual for RS485 adapter. Some adapters use RTS to enable drivers. In these cases, set up port to always turn on RTS.*

***Termination resistors (RT)** should only be used with high data rates **and** long cable runs. A good rule of thumb is 2000ft at 38400 BAUD. Terminate with 120Ω at no more than two places; the computer and the 9850 at the furthest end. To use the termination resistors installed in the 9850, see RS485/422 Termination Jumpers in APPENDIX B.*

***Bias resistors (RB)** are used to maintain a proper idle voltage state when all drivers are inactive. Otherwise, the state of the signal is unknown.*

As long as the computer communication port is set up to enable drivers (TXD) always when port is open, there is no need for bias resistors on the Receive Data lines (RXD) at the 9850 instrument(s).

But, since the drivers (TXD) on the 9850 instrument are only active when they are addressed, bias resistors are required on the Receive Data lines (RXD) at the computer. Typically, these are provided on the RS485 adapter.

There are two requirements for determining the value of RB. There must be at least 200mV from %RXD to &RXD, and the load of the RS485 drivers must be greater than 54Ω. The impedance of an RS485 receiver is 12kΩ. If the bias resistors are too large, noise immunity decreases with possible data loss. If the bias resistors are too small, the load on the driver increases. The value for the bias resistors depends on whether termination resistors (RT) are used.

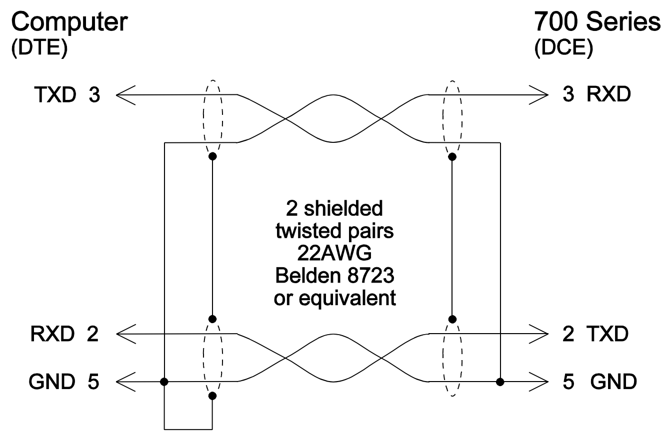
*If termination resistors (RT) are **not** used, RB must be between 28Ω and 144kΩ. A typical value for RB is 4.7kΩ.*

If termination resistors (RT) are used, RB must be between 283Ω and 716Ω. A typical value for RB is 470Ω.

Typical RS232 Cable

9850 COM port

- *Set BAUD Rate, # of Data Bits, and Parity to desired values.*
- *Even though only one instrument can be connected, the Unit ID is required for serial communication commands. See Unit ID in COM OPTIONS.*



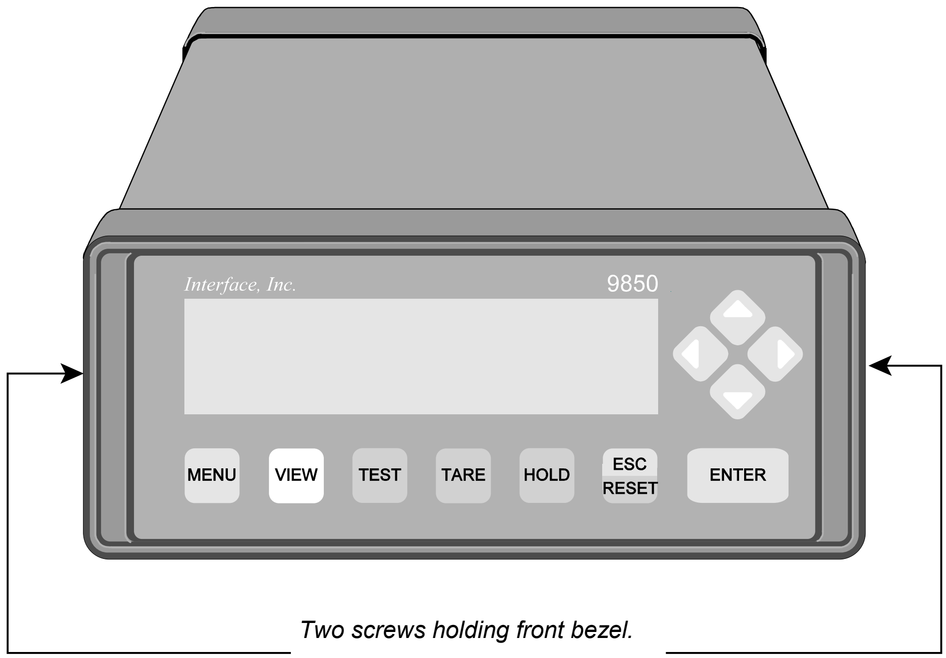
Computer COM port

- *Make sure BAUD Rate, # of Data Bits, and Parity are set the same as those for the 9850 instrument.*
- *Set # Stop Bits to1.*
- *Disable handshaking (such as, RTS, XON/XOFF, etc).*

APPENDIX B, INSIDE THE CABINET

Opening the Cabinet

CAUTION:
To avoid electric shock, remove power cord before opening cabinet.

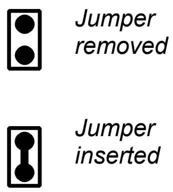


- Turn power OFF and unplug unit from power source.
- Take off front bezel by removing two screws shown above.
- Lift up top cover from front and pull it outwards toward front.

Jumpers and Fuses

CAUTION:
To avoid electric shock, remove power cord before opening cabinet.

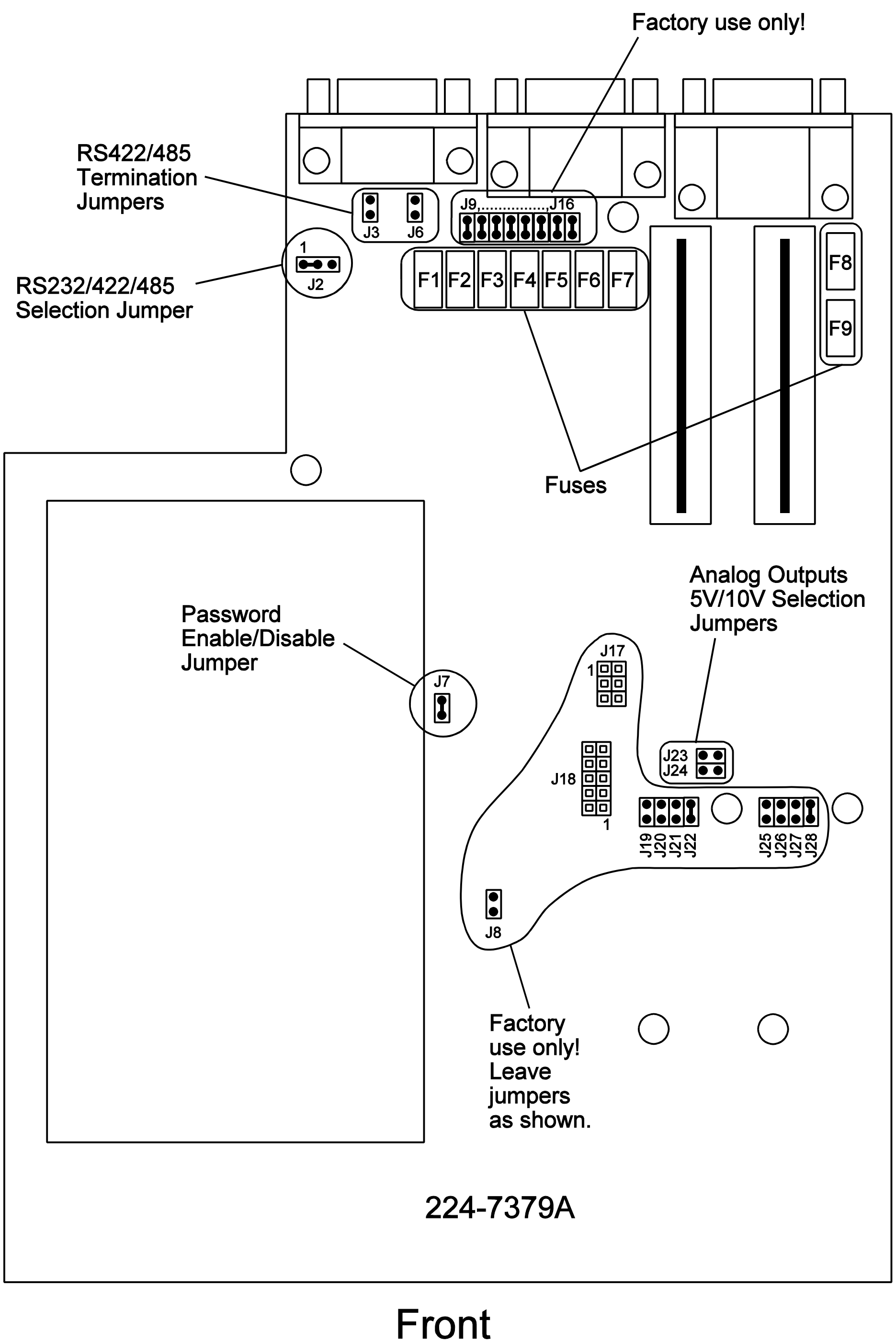
- Turn power OFF and unplug unit from power source.
- Open cabinet (see Opening the Cabinet in APPENDIX B).
- Jumpers and fuses are shown below and are described on the following pages.



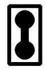
Jumpers are shown in default positions.

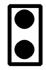
Default settings are:
- *No password*
- *RS232 selected*
- *No termination resistors for RS422/485*
- *5V Full Scale for analog outputs*

*For options that require a jumper to be removed, just slip it on **one** of the pins to keep it for possible use in the future.*



Password Enable/Disable Jumper

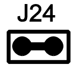
J7  No password required to enter menu.

J7  Password required to enter menu. Default password is SHC. You can change it in the menu. See Menu Password in SYSTEM OPTIONS.

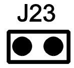
Analog Outputs 5V/10V Selection Jumpers

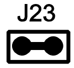
ANA1 is Analog Output 1

J24  Full Scale voltage of ANA1 is 5V. This corresponds to the Full Scale (in engineering units) of the channel (CH1, CH2, or CH3) assigned to ANA1.

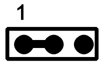
J24  Full Scale voltage of ANA1 is 10V. This corresponds to the Full Scale (in engineering units) of the channel (CH1, CH2, or CH3) assigned to ANA1.

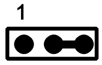
ANA2 is Analog Output 2

J23  Full Scale voltage of ANA2 is 5V. This corresponds to the Full Scale (in engineering units) of the channel (CH1, CH2, or CH3) assigned to ANA2.

J23  Full Scale voltage of ANA2 is 10V. This corresponds to the Full Scale (in engineering units) of the channel (CH1, CH2, or CH3) assigned to ANA2.

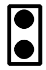
RS232/422/485 Selection Jumper

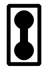
1  J2 — RS232 is selected.

1  J2 — RS422/485 is selected.

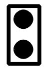
RS485/422 Termination Jumpers

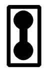
RXD% and RXD& are differential signals for Receive Data.

J3  No termination resistor for RXD% and RXD&.

J3  120Ω termination resistor between RXD% and RXD&.

TXD% and TXD& are differential signals for Transmit Data.

J6  No termination resistor for TXD% and TXD&.

J6  120Ω termination resistor between TXD% and TXD&.

Logic Output Fuses

Fuse	***Signal***
F1	*External %5VDC*
F2	*Logic Output 6*
F3	*Logic Output 1*
F4	*Logic Output 2*
F5	*Logic Output 3*
F6	*Logic Output 4*
F7	*Logic Output 5*
F8	*Analog Output 2*
F9	*Analog Output 1*

500mA Fast-Acting fuses are used for overvoltage protection on the logic outputs. In addition, the logic outputs are short circuit protected using current and thermal limits providing a maximum sink current of 300mA. See APPENDIX H for specifications.

Replace with SHC P/N 1380-0007 (Littlefuse R451.500).

Analog Output Fuses

250mA Fast-Acting fuses are used for overvoltage protection on the analog outputs. In addition, the analog outputs are short circuit protected using a current limit providing a maximum load current of about 1mA (10kΩ load). See APPENDIX H for specifications.

Replace with P/N 1380-0006 (Littlefuse R451.250).

External %5V Fuse

Fuse labeled F1 is used for External %5V. A 1A Slo-Blo fuse is used for overvoltage protection. In addition, External %5V is short circuit protected using a current limit providing a maximum load current of 250mA. See APPENDIX H for specifications.

Replace with P/N 1380-0008 (Littlefuse R452.001).

Module Removal

CAUTION:
To avoid electric shock, remove power cord before opening cabinet.

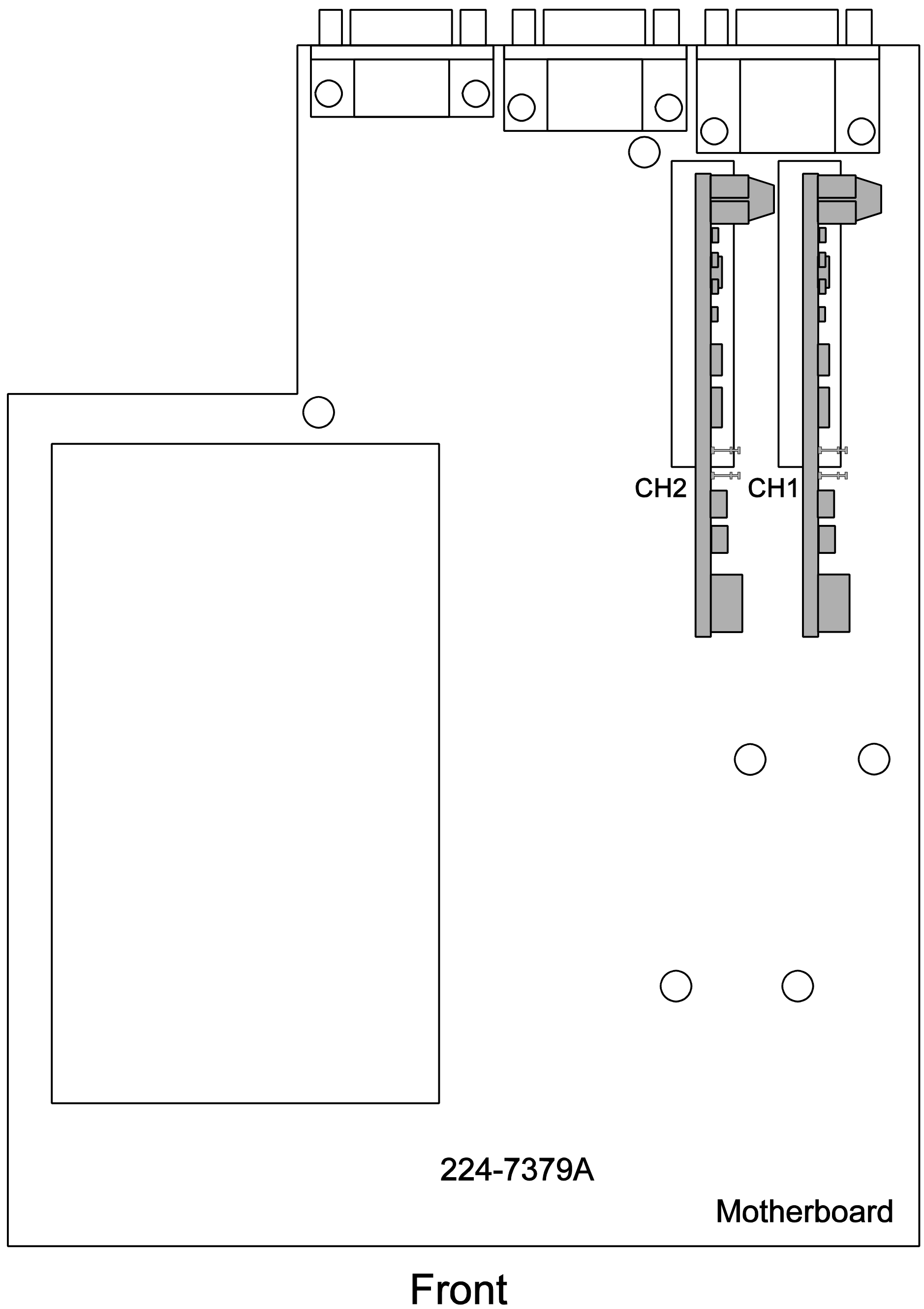
- Turn power OFF and unplug unit from power source.
- Open cabinet (see Opening the Cabinet in APPENDIX B).
- The 9850 instrument handles one or two signal conditioning modules (CH1 and CH2). These are shown in drawing below. Pull up on module to remove.

Anti-Static precautions must be observed when removing and handling modules.

To retain the most accurate calibration make sure removed modules are returned to original slots. Color coded stickers on the modules and motherboard serve this purpose.

Even if a module is removed, its settings are retained until a module of another type (model) is installed in that location or memory is reset.

*When the unit is powered with both modules removed, memory is reset. **ALL** user selections are initialized to default settings.*



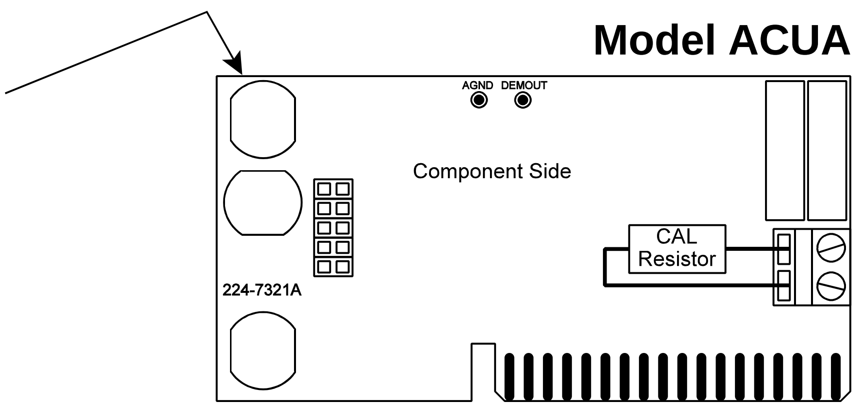
CAL Resistor Installation (Models ACUA and DCSA)

CAUTION:
To avoid electric shock, remove power cord before opening cabinet.

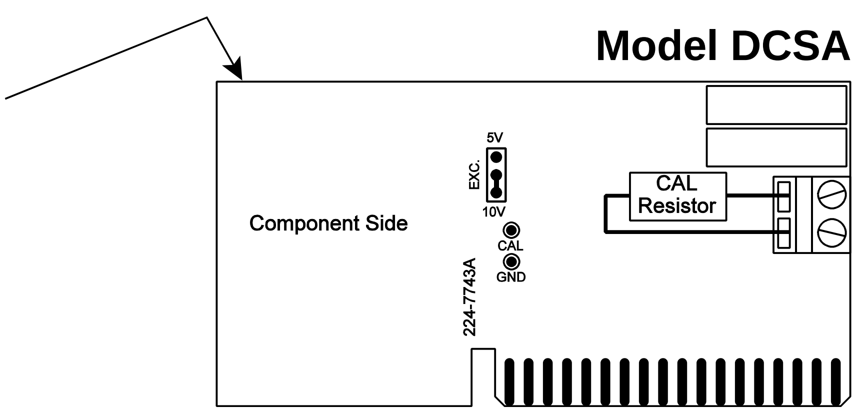
- Turn power OFF and unplug unit from power source.
- Open cabinet (see Opening the Cabinet in APPENDIX B).
- Locate the module (Model ACUA or DCSA) requiring CAL resistor installation (see Module Removal in APPENDIX B).
- Connect CAL resistor to terminal strips as shown below. When a transducer is purchased with the system, the proper CAL resistor is installed. Otherwise, a 60kΩ CAL resistor is provided. Refer to the transducer calibration sheet for the CAL resistor value. ±0.02%, ±5ppm/EC resistors are recommended.

Model name, ACUA, etched on back side.

*Make sure CAL resistor leads do **not** touch components below them.*



Model name, DCSA, etched on back side.

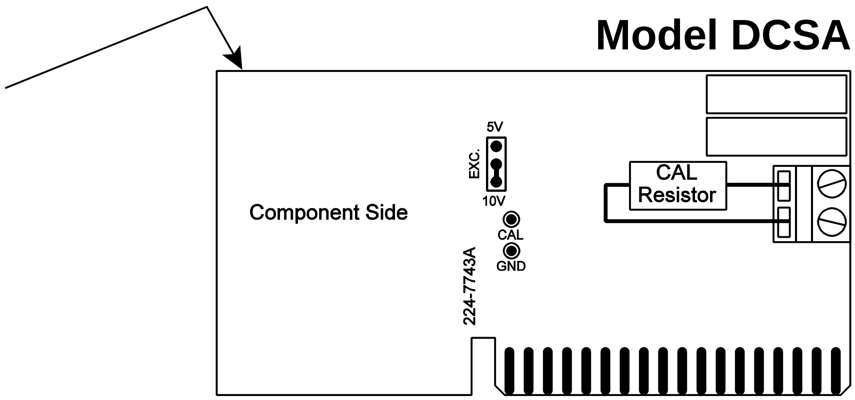


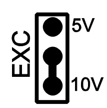
Excitation 5V/10V Selection Jumper (Model DCSA)

CAUTION:
To avoid electric shock, remove power cord before opening cabinet.

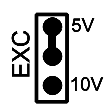
- Turn power OFF and unplug unit from power source.
- Open cabinet (see Opening the Cabinet in APPENDIX B).
- Locate Model DCSA (see Module Removal in APPENDIX B).
- Set Excitation Selection jumper to 5V or 10V position as shown below.

Model name, DCSA, etched on back side.





Jumper shown in 10V (default) position.

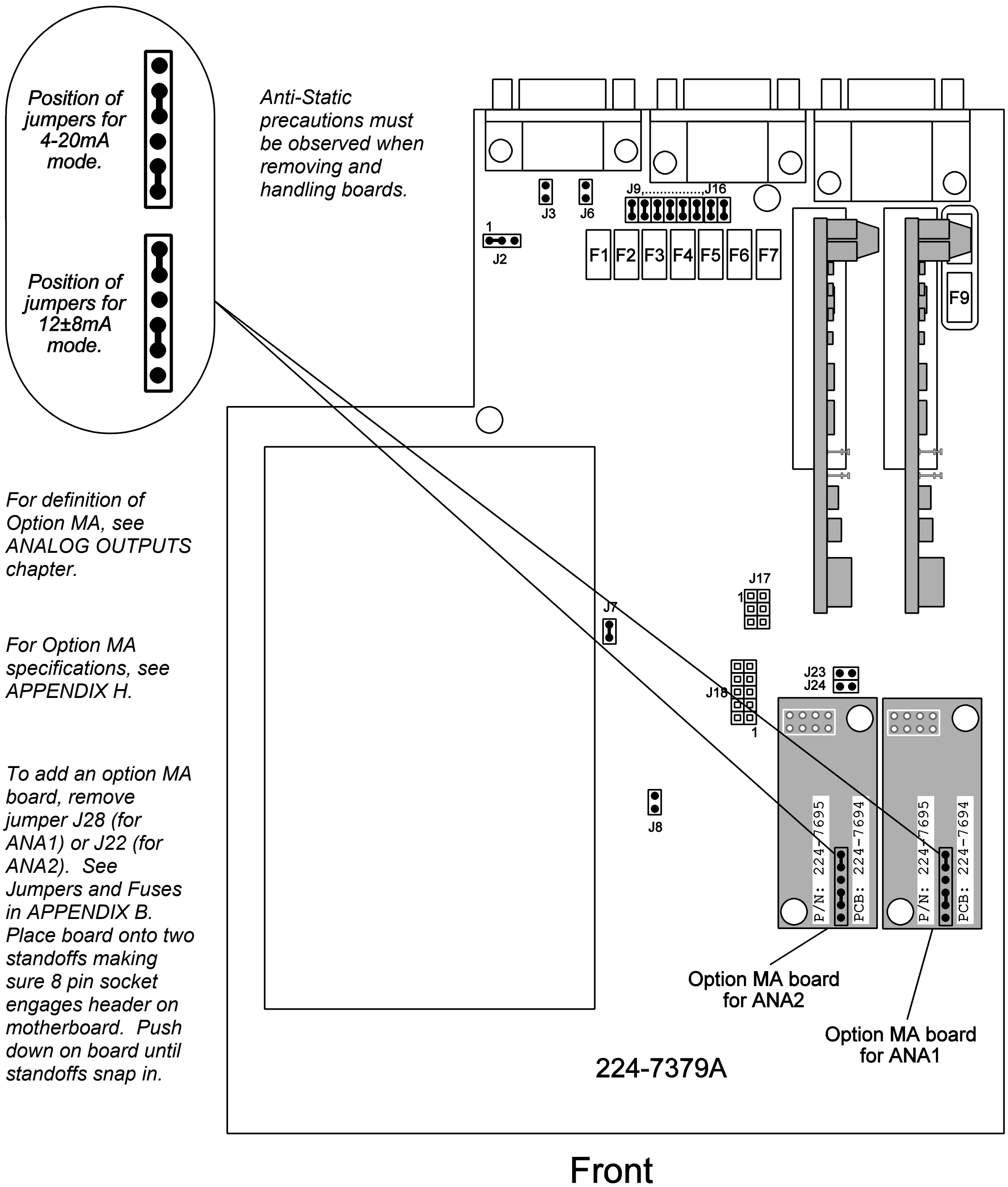


Jumper shown in 5V position.

Option MA Current Output

CAUTION:
To avoid electric shock, remove power cord before opening cabinet.

- Turn power OFF and unplug unit from power source.
- Open cabinet (see Opening the Cabinet in APPENDIX B).
- One or two Analog Output Option boards can be installed, one for ANA1 and one for ANA2. Two Option MA boards are shown in drawing below. Select 4-20mA or 12±8mA modes by changing jumpers as shown.



For definition of Option MA, see ANALOG OUTPUTS chapter.

For Option MA specifications, see APPENDIX H.

To add an option MA board, remove jumper J28 (for ANA1) or J22 (for ANA2). See Jumpers and Fuses in APPENDIX B. Place board onto two standoffs making sure 8 pin socket engages header on motherboard. Push down on board until standoffs snap in.

Option MB Current Output

CAUTION:
To avoid electric shock, remove power cord before opening cabinet.

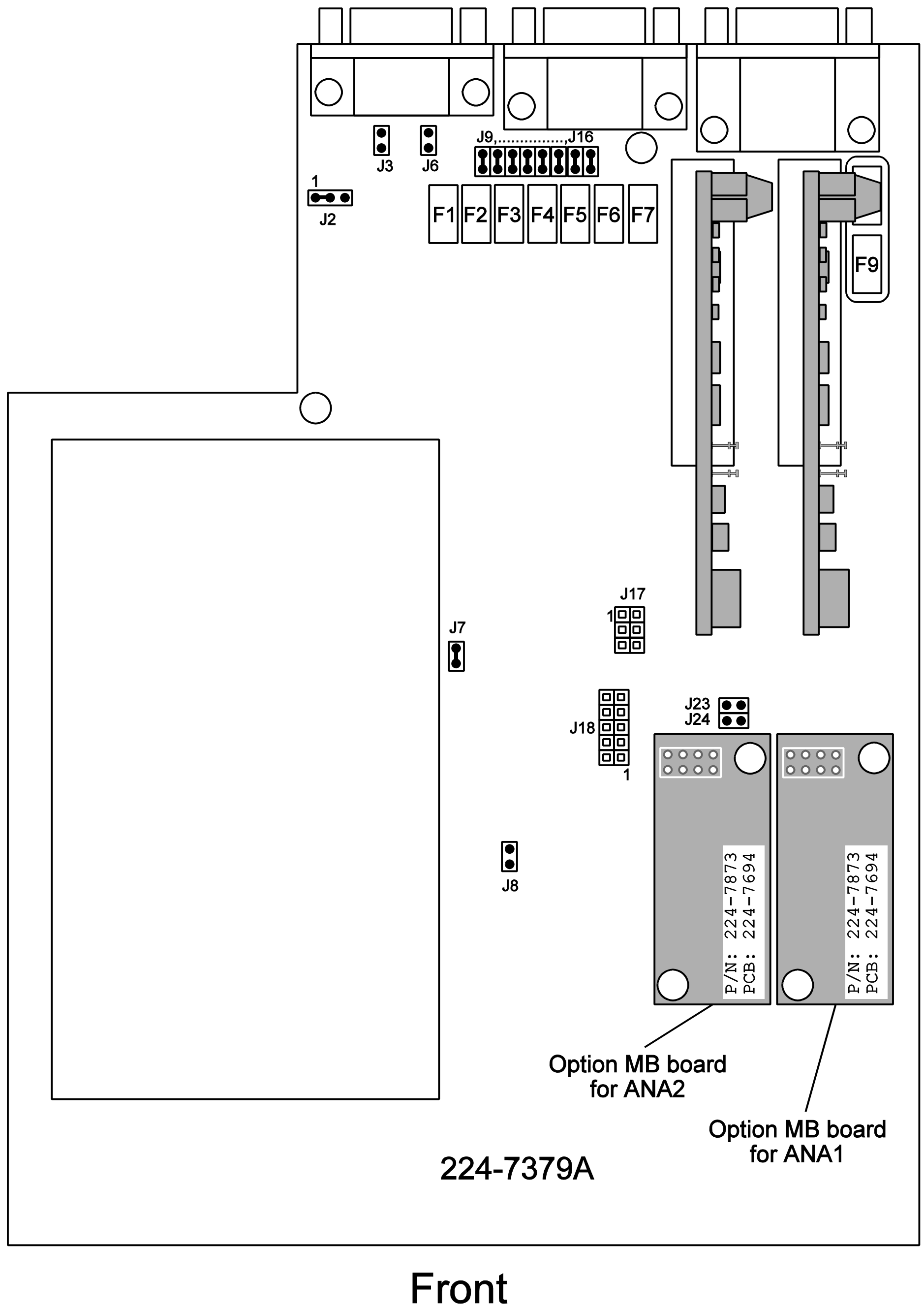
- Turn power OFF and unplug unit from power source.
- Open cabinet (see Opening the Cabinet in APPENDIX B).
- One or two Analog Output Option boards can be installed, one for ANA1 and one for ANA2. Two Option MB boards are shown in drawing below. There are no jumpers. Only one mode, 10±10mA, is supported.

Anti-Static precautions must be observed when removing and handling boards.

For definition of Option MB, see ANALOG OUTPUTS chapter.

For Option MB specifications, see APPENDIX H.

To add an option MB board, remove jumper J28 (for ANA1) or J22 (for ANA2). See Jumpers and Fuses in APPENDIX B. Place board onto two standoffs making sure 8 pin socket engages header on motherboard. Push down on board until standoffs snap in.



Option MC Voltage Output

CAUTION:
To avoid electric shock, remove power cord before opening cabinet.

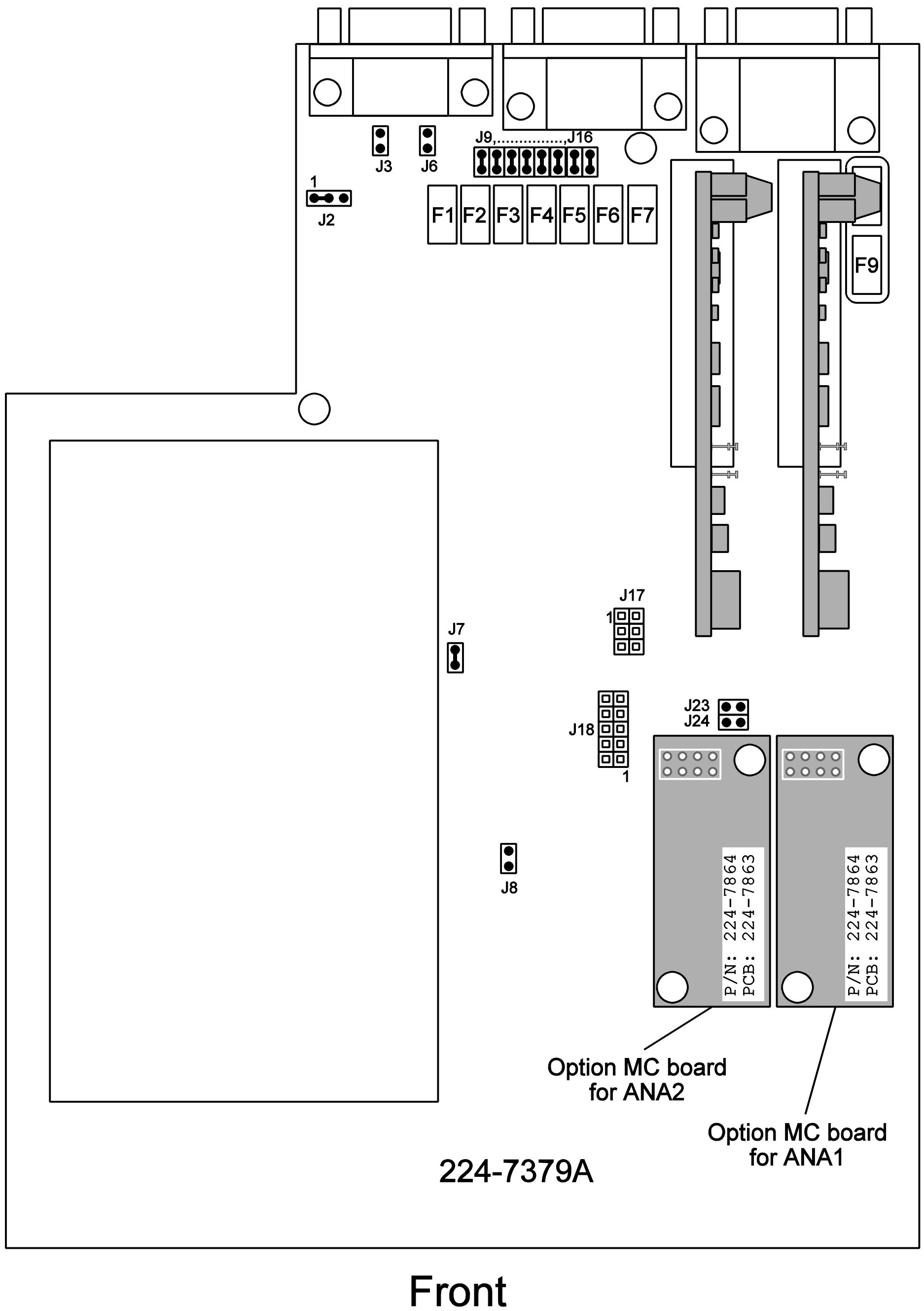
- Turn power OFF and unplug unit from power source.
- Open cabinet (see Opening the Cabinet in APPENDIX B).
- One or two Analog Output Option boards can be installed, one for ANA1 and one for ANA2. Two Option MC boards are shown in drawing below. There are no jumpers. Only one mode, 5±5V, is supported.

Anti-Static precautions must be observed when removing and handling boards.

For definition of Option MC, see ANALOG OUTPUTS chapter.

For Option MC specifications, see APPENDIX H.

To add an option MC board, remove jumper J28 (for ANA1) or J22 (for ANA2). See Jumpers and Fuses in APPENDIX B. Place board onto two standoffs making sure 8 pin socket engages header on motherboard. Push down on board until standoffs snap in.



APPENDIX C, RESETTING MEMORY TO DEFAULTS

CAUTION:
Resetting memory initializes ***ALL*** *user selections including calibration adjustments to default settings. All channels must be re-calibrated.*

User settings are stored in EEPROM. They are retained when the instrument is turned OFF. Many settings (limits, units, calibration, logic I/O, etc) are unique for each channel. Even if a hardware channel (signal conditioning module) is removed, its settings are retained until a module of another type (model) is installed in that location (channel) or memory is reset (see following discussion).

To reset memory (i.e. initialize all user selections to default settings), follow the steps below. Default settings are shown in the left margin throughout this book and are also listed in APPENDIX D.

CAUTION:
To avoid electric shock, remove power cord before opening cabinet.

- Turn power OFF and unplug unit from power source.
- Open cabinet (see Opening the Cabinet in APPENDIX B).
- Make sure both module slots are empty. See Module Removal in APPENDIX B.
- Place cover on cabinet to avoid electric shock. Bezel can remain off. Connect power source and turn unit ON.
- The power up message is shown for about four seconds followed by the MEMORY RESET message shown below. This message remains until power is removed.

```
MEMORY RESET
1:NONE  2:NONE
```

To retain the most accurate calibration make sure removed modules are returned to original slots. Color coded stickers on the modules and motherboard serve this purpose.

- After the MEMORY RESET message appears turn the power OFF.
- Remove cover and re-insert module(s) in original slots.
- Replace cover and bezel.
- Turn power ON. All user selections are initialized to default settings.

APPENDIX D, MENU LIST WITH DEFAULT SETTINGS

CHAN Settings Menu Selections

Selection	Choices	Default	CH1	CH2	CH3 Calc
Filter	0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200Hz[1]	1Hz			
LO Limit	enter numeric value	&10000			
LO Hysteresis	enter numeric value	0			
LO Latch	OFF or ON	OFF			
HI Limit	enter numeric value	10000			
HI Hysteresis	enter numeric value	0			
HI Latch	OFF or ON	OFF			
Limit Mode	Signed or Absolute	Signed			
Limit Type	Current, Held, Spread, Min, or Max Data	Current Data			
Limit Alarm	Flash Backlight or None	Flash Backlight			
Units	enter up to 5 characters (upper or lower case)	*blank*			
Display Resolution	choose from 4 choices	*best (smallest)*			
TARE Key	Tare Enabled or Tare Disabled	CH1/2: Enabled CH3: Disabled			
RESET Key	Clear Tare or Don't Clear Tare	Clear Tare			
Max/Min Type	Filtered Data or Raw Data	Filtered Data			
RESET Key[2]	Don't Reset Cntr or Reset Counter	Don't Reset Cntr			

System Options Menu Selections

Selection	Choices	Default	System
Adjust Contrast	1 to 100	50	
Backlight	ON or OFF	ON	
Menu Password	enter 3 characters	SHC	
Check Limits	Always in Test or Use I/O Control	Always in Test	
Do Max/Mins	Always in Test or Use I/O Control	Always in Test	
Power Up	Test OFF or Test ON	Test OFF	
Power Up View	2 Channel, 1Channel, I/O Status, or Limit Status	2 Channel	
Power Up CHAN	CH1, CH2, or CH3	CH1	
Power Up Type	Current, Tare Value, Held, Spread, Min, or Max Data	Current Data	
State Machine	OFF or ON	OFF	

Analog Outputs Menu Selections

Selection	Choices	Default	System
CH used for ANA1	CH1, CH2, or CH3	CH1, if present, otherwise CH2	
CH used for ANA2	CH1, CH2, or CH3	CH2, if present, otherwise CH3	
Adjust ANAOUTs	press ENTER to adjust		

COM Options Menu Selections

Selection	Choices	Default	System
BAUD Rate	300, 600, 1200, 2400, 4800, 9600, 19200, 38400	38400	
Data Bits/Parity	8/None, 8/Even, 8/Odd, 7/Even, 7/Odd	8/None	
Unit ID	enter single upper or lower case alpha character	A	

1. For Model CTUA (Frequency Input Module) and Model UDCA (Encoder/Totalizer Module), the *200Hz* setting is replaced with *None* (no filter).
2. For Model UDCA (Encoder/Totalizer Module) only.

Logic I/O Menu Selections

Enter ”&” or “1".
Default is ”&” (not assigned) for all.

			Logic Inputs				Logic Outputs						Internal Matrix					
			1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6
Output Events	CH1	HI Limit																
		NOT HI Limit																
		IN Limit																
		NOT IN Limit																
		LO Limit																
		NOT LO Limit																
		At Max																
		NOT At Max																
		At Min																
		NOT At Min																
	CH2	HI Limit																
		NOT HI Limit																
		IN Limit																
		NOT IN Limit																
		LO Limit																
		NOT LO Limit																
		At Max																
		NOT At Max																
		At Min																
		NOT At Min																
	CH3	HI Limit																
		NOT HI Limit																
		IN Limit																
		NOT IN Limit																
		LO Limit																
		NOT LO Limit																
		At Max																
		NOT At Max																
		At Min																
		NOT At Min																
Input Actions	CH1	Tare																
		Clear Tare																
		Hold																
		Clear Hold																
		Reset Max/Mins																
		Clear Latched Limits																
		Check Limits																
		Do Max/Mins																
		Apply %CAL																
		Apply &CAL																
		Reset Count (Model UDCA only)																
	CH2	Tare																
		Clear Tare																
		Hold																
		Clear Hold																
		Reset Max/Mins																
		Clear Latched Limits																
		Check Limits																
		Do Max/Mins																
		Apply %CAL																
		Apply &CAL																
		Reset Count (Model UDCA only)																
	CH3	Tare																
		Clear Tare																
		Hold																
		Clear Hold																
		Reset Max/Mins																
		Clear Latched Limits																
		Check Limits																
		Do Max/Mins																
Pattern Outputs or State Outputs		Pattern1 OUT (or State1 OUT)																
		NOT Pattern1 OUT (or NOT State1 OUT)																
		Pattern2 OUT (or State2 OUT)																
		NOT Pattern2 OUT (or NOT State2 OUT)																
		Pattern3 OUT (or State3 OUT)																
		NOT Pattern3 OUT (or NOT State3 OUT)																
		Pattern4 OUT (or State4 OUT)																
		NOT Pattern4 OUT (or NOT State4 OUT)																
		Pattern5 OUT (or State5 OUT)																
		NOT Pattern5 OUT (or NOT State5 OUT)																
		Pattern6 OUT (or State6 OUT)																
		NOT Pattern6 OUT (or NOT State6 OUT)																
		Pattern7 OUT (or State7 OUT)																
		NOT Pattern7 OUT (or NOT State7 OUT)																
		Pattern8 OUT (or State8 OUT)																
		NOT Pattern8 OUT (or NOT State8 OUT)																

Enter ”&”, “0", or “1".
Default is ”&” (ignore) for all.

		Logic Inputs				Logic Outputs						Internal Matrix					
		1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6
Pattern Definitions	Pattern1																
	Pattern2																
	Pattern3																
	Pattern4																
	Pattern5																
	Pattern6																
	Pattern7																
	Pattern8																

Model ACUA (AC Strain Gage Amp) Calibration Menu Selections

Selection		Choices	Default	CH1	CH2
Type of CAL		Shunt-Pos/Neg, Shunt-Positive, Load-Pos/Neg, or Load-Positive	Shunt-Pos/Neg		
Full Scale		enter numeric value	10000		
Zero Value		enter numeric value	0		
%CAL or %Load Value		enter numeric value	7500		
&CAL or &Load Value[1]		enter numeric value	&7500		
To CAL Xdcr	Shunt	press ENTER to Cal (adjust zero and gain)			
To Zero Xdcr	Load	press ENTER to adjust zero			
To do %CAL	Load	press ENTER to adjust gain			
To do &CAL[2]	Load	press ENTER to scale negative data			

1. For Shunt-Pos/Neg and Load-Pos/Neg only.
2. For Load-Pos/Neg only.

applies if channel is a Model ACUA (AC Strain Gage Amp)

Model LVDA (LVDT Amplifier) Calibration Menu Selections

Selection	Choices	Default	CH1	CH2
EXC Freq.	2.5kHz, 3kHz, 5kHz, or 10kHz	5kHz		
Type of CAL	Load-Pos/Neg or Load-Positive	Load-Pos/Neg		
Full Scale	enter numeric value	10000		
Zero Point	enter numeric value	0		
%CAL Point	enter numeric value	7500		
&CAL Point[3]	enter numeric value	&7500		
To Zero LVDT	press ENTER to adjust zero			
To do %CAL	press ENTER to adjust gain			
To do &CAL[3]	press ENTER to scale negative data			

3. For Load-Pos/Neg only.

applies if channel is a Model LVDA (LVDT Amplifier)

Model DCSA (DC Strain Gage Amp) Calibration Menu Selections

Selection		Choices	Default	CH1	CH2
Type of CAL		Shunt-Pos/Neg, Shunt-Positive, Load-Pos/Neg, Load-Positive, mV/V-Positive, or mV/V-Pos/Neg	Shunt-Pos/Neg		
Full Scale		enter numeric value	10000		
Zero Value[4]		enter numeric value	0		
%CAL Value, %Load Value, or mV/V @ %FS		enter numeric value	7500		
&CAL Value, &Load Value, or mV/V @ &FS[5]		enter numeric value	&7500		
To CAL Xdcr	Shunt & mV/V	press ENTER to Cal (adjust zero and gain)			
To Zero Xdcr	Load	press ENTER to adjust zero			
To do %CAL	Load	press ENTER to adjust gain			
To do &CAL[6]	Load	press ENTER to scale negative data			

4. For Shunt and Load calibrations only.
5. For Shunt-Pos/Neg, Load-Pos/Neg, and mV/V-Pos/Neg only.
6. For Load-Pos/Neg only.

applies if channel is a Model DCSA (DC Strain Gage Amp)

Model DCVA (DC Voltage Amplifier) Calibration Menu Selections

Selection		Choices	Default	CH1	CH2
Type of CAL		Remote-Pos/Neg, Remote-Positive, Load-Pos/Neg, or Load-Positive	Remote-Pos/Neg		
Full Scale		enter numeric value	10000		
Zero Value		enter numeric value	0		
%CAL or %Load Value		enter numeric value	7500		
&CAL or &Load Value[1]		enter numeric value	&7500		
To CAL Xdcr	Remote	press ENTER to Cal (adjust zero and gain)			
To Zero Xdcr	Load	press ENTER to adjust zero			
To do %CAL	Load	press ENTER to adjust gain			
To do &CAL[2]	Load	press ENTER to scale negative data			

1. For Remote-Pos/Neg and Load-Pos/Neg only.
2. For Load-Pos/Neg only.

applies if channel is a Model DCVA (DC Voltage Amplifier)

Model DCIA (DC Current Amplifier) Calibration Menu Selections

Selection	Choices	Default	CH1	CH2
Input Range	±10 mA, ±20mA, 4-20 mA, or 12±8mA	±10 mA		
Full Scale	enter numeric value	10000		
Adjust DCIA	press ENTER to Cal (adjust zero and gain)			

applies if channel is a Model DCIA (DC Current Amplifier)

Model CTUA (Frequency Input Module) Calibration Menu Selections

Selection	Choices	Default	CH1	CH2
Full Scale	enter numeric value	10000		
Xdcr Freq.	enter numeric value	10000		
Xdcr Value	enter numeric value	10000		
Input Type	TTL, TTL (Quadrature), 10, 20, 50, 100, or 200mVp-p	TTL		
Polarity	Not Inverted or Inverted	Not Inverted		
Input Filter	None or 20kHz	None		
Lowest Freq.	1% of FS or 0.01% of FS	1% of FS		

applies if channel is a Model CTUA (Frequency Input Module)

Model UDCA (Encoder/Totalizer Module) Calibration Menu Selections

Selection		Choices	Default	CH1	CH2
Full Scale		enter numeric value	10000		
Xdcr Pulses		enter numeric value	10000		
Xdcr Value		enter numeric value	10000		
Count Mode		1X, 2X, 4X (Quadrature), or Event (Signal A)	1X (Quadrature)		
% Direction	1X,2X,4X	B leads A or A leads B	B leads A		
Count Edge	Event	Rising Edge or Falling Edge	Rising Edge		
ResetArm Sig		Ignored, TTL High arms, or TTL Low arms	Ignored		
Reset Signal		TTL High resets, TTL Low resets, or Ignored	TTL High resets		
Reset Mode		Leading Edge, Level, A AND B, A AND /B, /A AND B, or /A AND /B	Leading Edge		

applies if channel is a Model UDCA (Encoder/Totalizer Module)

CH3 (Calculation) Calibration Menu Selections

Selection	Choices	Default	CH3
Full Scale	enter numeric value	10000	
Calculation	choose from list below	(CH1*CH2)/A	
Constant A	enter numeric value	1	
Constant B	enter numeric value	0	
Constant C	enter numeric value	0	

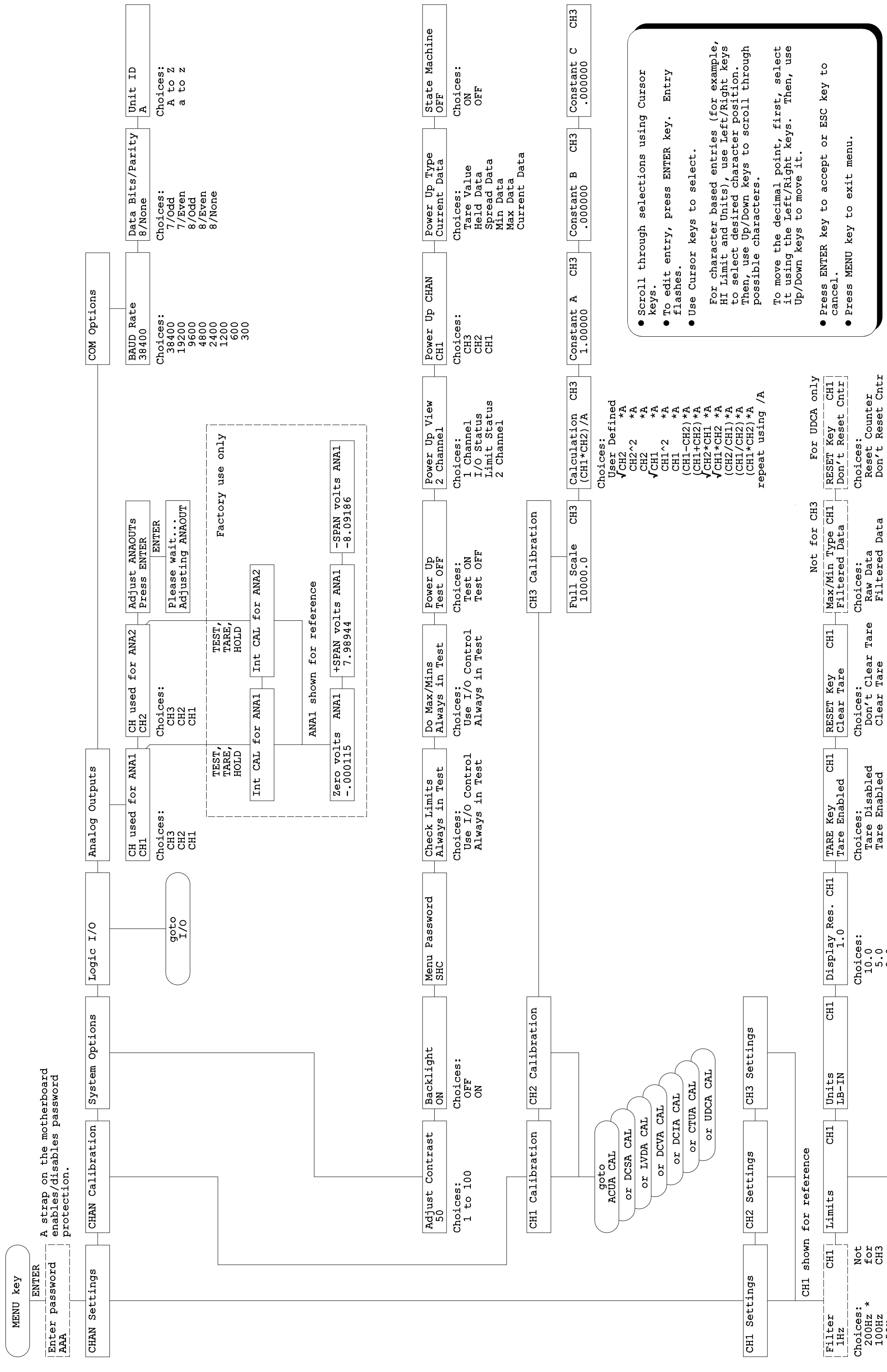
Calculation List

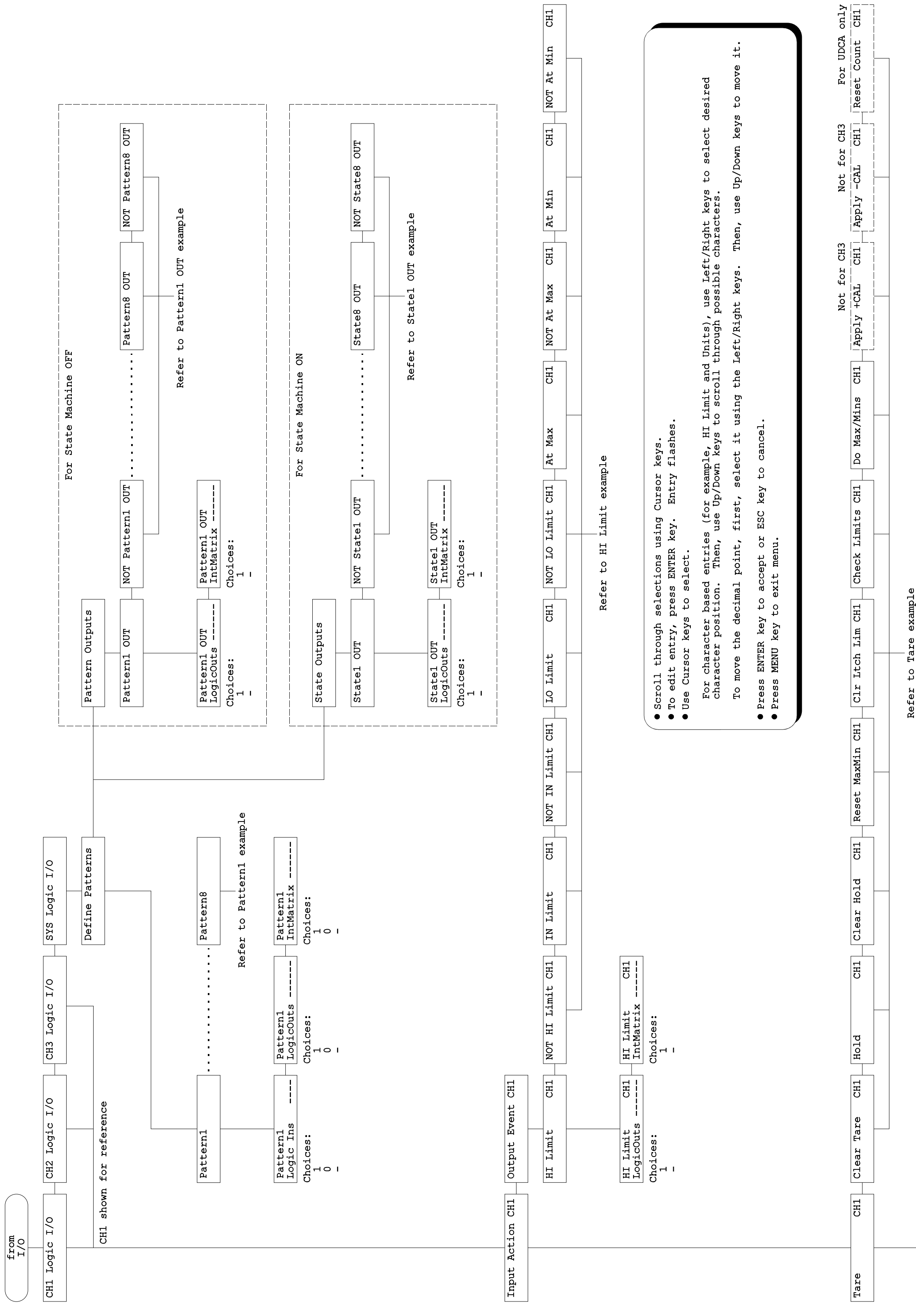
```
(CH1*CH2)/A        (CH1*CH2)*A
(CH1/CH2)/A        (CH1/CH2)*A
(CH2/CH1)/A        (CH2/CH1)*A
 CH1*CH2 /A         CH1*CH2 *A
 CH2*CH1 /A         CH2*CH1 *A
(CH1+CH2)/A        (CH1+CH2)*A
(CH1-CH2)/A        (CH1-CH2)*A
 CH1     /A         CH1     *A
 CH1^2   /A         CH1^2   *A
 CH1     /A         CH1     *A
 CH2     /A         CH2     *A
 CH2^2   /A         CH2^2   *A
 CH2     /A         CH2     *A
                    User Defined
```

User Defined Calc Operator/Operand List (RPN String - 11 Characters max)

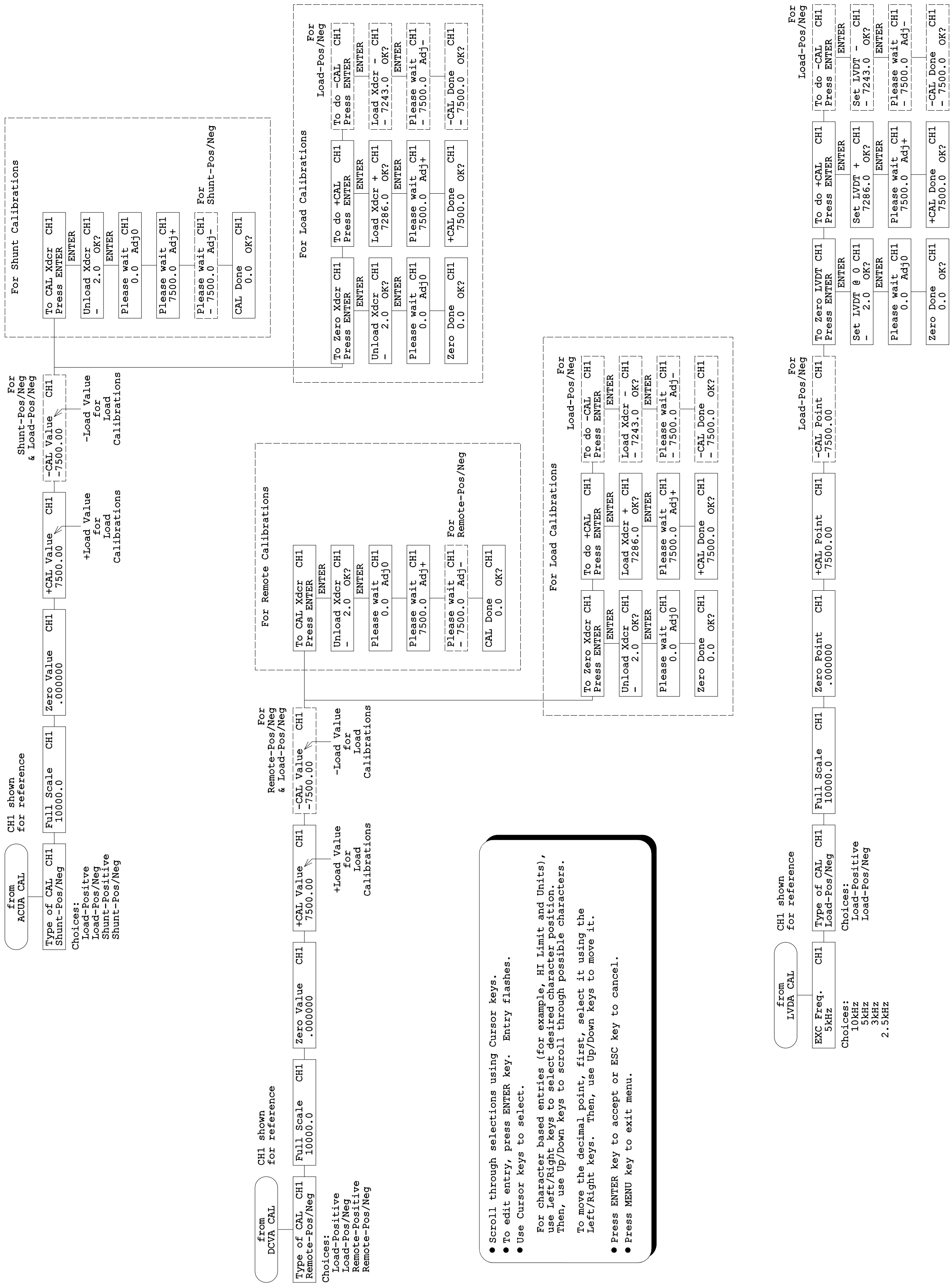
1	CH1
2	CH2
3	CH3
A	Constant A
B	Constant B
C	Constant C
D	Duplicate Top
E	IM6 Edge Counter
I	IM5 Pulse Width(ms)
L	IM4
a	Absolute Value
q	Square Root
n	Negation
r	Reciprocal
c	Current Data
x	Max Data
m	Min Data
h	Held Data
t	Tare Value
%	Addition
&	Subtraction
*	Multiplication
/	Division

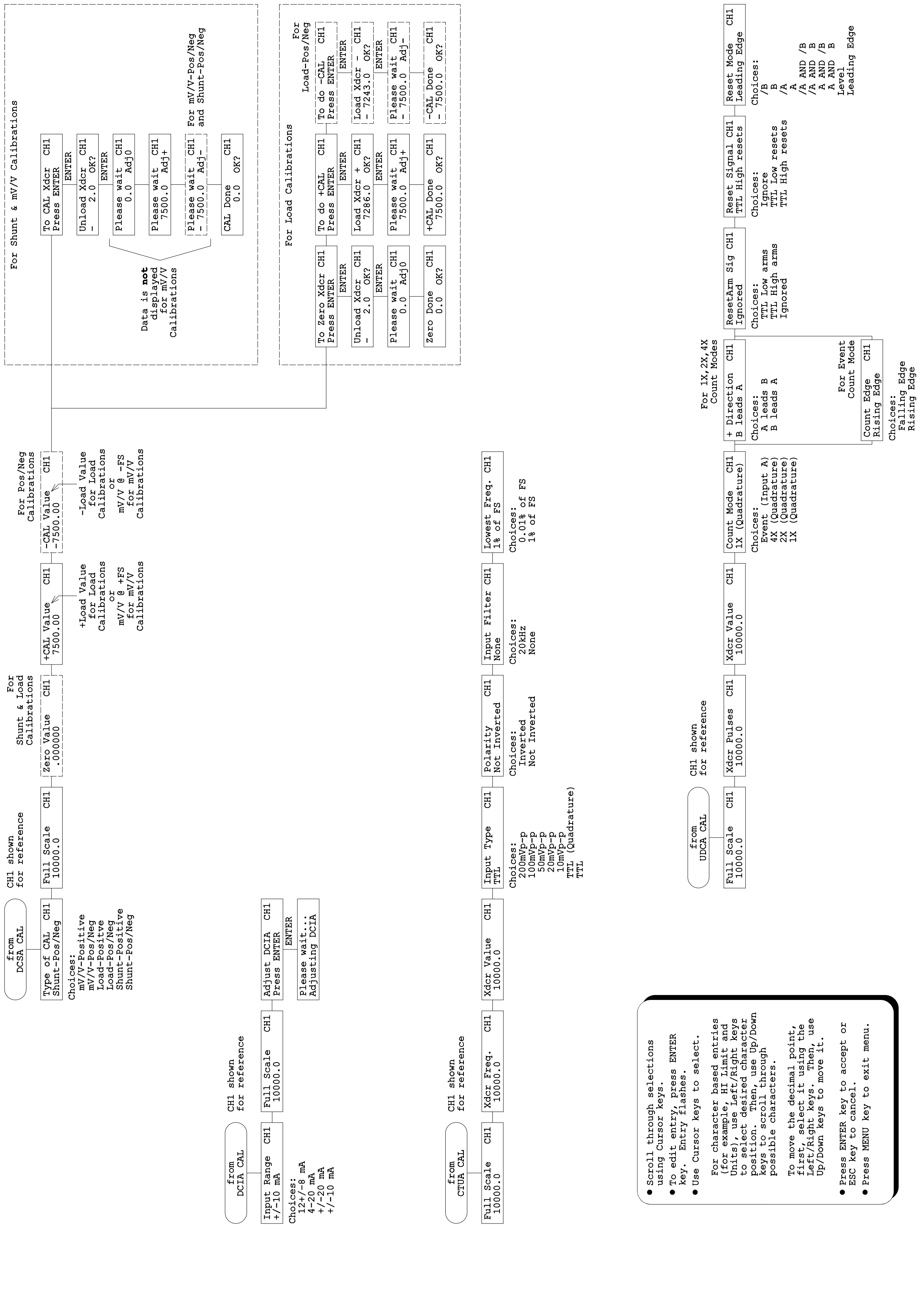
APPENDIX E, MENU FLOWCHART





from I/O
CH1 Logic I/O
CH2 Logic I/O
CH3 Logic I/O
SYS Logic I/O
CH1 shown for reference
Define Patterns
Pattern1
Pattern8
Refer to Pattern1 example
Pattern1 Logic Ins ----
Choices: 1 0 -
Pattern1 LogicOuts ------
Choices: 1 0 -
Pattern1 IntMatrix ------
Choices: 1 0 -
For State Machine OFF
Pattern Outputs
Pattern1 OUT
NOT Pattern1 OUT
Pattern8 OUT
NOT Pattern8 OUT
Refer to Pattern1 OUT example
Pattern1 OUT LogicOuts ------
Choices: 1 -
Pattern1 OUT IntMatrix ------
Choices: 1 -
For State Machine ON
State Outputs
State1 OUT
NOT State1 OUT
State8 OUT
NOT State8 OUT
Refer to State1 OUT example
State1 OUT LogicOuts ------
Choices: 1 -
State1 OUT IntMatrix ------
Choices: 1 -
Input Action CH1
Output Event CH1
HI Limit CH1
NOT HI Limit CH1
IN Limit CH1
NOT IN Limit CH1
LO Limit CH1
NOT LO Limit CH1
At Max CH1
NOT At Max CH1
At Min CH1
NOT At Min CH1
Refer to HI Limit example
HI Limit CH1 LogicOuts ------
Choices: 1 -
HI Limit CH1 IntMatrix ------
Choices: 1 -
● Scroll through selections using Cursor keys.
● To edit entry, press ENTER key. Entry flashes.
● Use Cursor keys to select.
For character based entries (for example, HI Limit and Units), use Left/Right keys to select desired character position. Then, use Up/Down keys to scroll through possible characters.
To move the decimal point, first, select it using the Left/Right keys. Then, use Up/Down keys to move it.
● Press ENTER key to accept or ESC key to cancel.
● Press MENU key to exit menu.
Tare CH1
Clear Tare CH1
Hold CH1
Clear Hold CH1
Reset MaxMin CH1
Clr Ltch Lim CH1
Check Limits CH1
Do Max/Mins CH1
Not for CH3
Apply +CAL CH1
Not for CH3
Apply -CAL CH1
For UDCA only
Reset Count CH1
Refer to Tare example
Tare CH1 Logic Ins ----
Choices: 1 -
Tare CH1 LogicOuts ------
Choices: 1 -
Tare CH1 IntMatrix ------
Choices: 1 -


from ACUA CAL
CH1 shown for reference
Type of CAL CH1 Shunt-Pos/Neg
Choices: Load-Positve Load-Pos/Neg Shunt-Positive Shunt-Pos/Neg
Full Scale CH1 10000.0
Zero Value CH1 .000000
+CAL Value CH1 7500.00
+Load Value for Load Calibrations
-CAL Value CH1 -7500.00
For Shunt-Pos/Neg & Load-Pos/Neg
-Load Value for Load Calibrations
For Shunt Calibrations
To CAL Xdcr CH1 Press ENTER
ENTER
Unload Xdcr CH1 - 2.0 OK?
ENTER
Please wait CH1 0.0 Adj0
Please wait CH1 7500.0 Adj+
Please wait CH1 - 7500.0 Adj-
For Shunt-Pos/Neg
CAL Done CH1 0.0 OK?
For Load Calibrations
To Zero Xdcr CH1 Press ENTER
ENTER
Unload Xdcr CH1 - 2.0 OK?
ENTER
Please wait CH1 0.0 Adj0
Zero Done CH1 0.0 OK?
To do +CAL CH1 Press ENTER
ENTER
Load Xdcr + CH1 7286.0 OK?
ENTER
Please wait CH1 7500.0 Adj+
+CAL Done CH1 7500.0 OK?
To do -CAL CH1 Press ENTER
ENTER
Load Xdcr - CH1 - 7243.0 OK?
ENTER
Please wait CH1 - 7500.0 Adj-
-CAL Done CH1 - 7500.0 OK?
For Load-Pos/Neg
from DCVA CAL
CH1 shown for reference
Type of CAL CH1 Remote-Pos/Neg
Choices: Load-Positive Load-Pos/Neg Remote-Positive Remote-Pos/Neg
Full Scale CH1 10000.0
Zero Value CH1 .000000
+CAL Value CH1 7500.00
+Load Value for Load Calibrations
-CAL Value CH1 -7500.00
For Remote-Pos/Neg & Load-Pos/Neg
-Load Value for Load Calibrations
For Remote Calibrations
To CAL Xdcr CH1 Press ENTER
ENTER
Unload Xdcr CH1 - 2.0 OK?
ENTER
Please wait CH1 0.0 Adj0
Please wait CH1 7500.0 Adj+
Please wait CH1 - 7500.0 Adj-
For Remote-Pos/Neg
CAL Done CH1 0.0 OK?
For Load Calibrations
To Zero Xdcr CH1 Press ENTER
ENTER
Unload Xdcr CH1 - 2.0 OK?
ENTER
Please wait CH1 0.0 Adj0
Zero Done CH1 0.0 OK?
To do +CAL CH1 Press ENTER
ENTER
Load Xdcr + CH1 7286.0 OK?
ENTER
Please wait CH1 7500.0 Adj+
+CAL Done CH1 7500.0 OK?
To do -CAL CH1 Press ENTER
ENTER
Load Xdcr - CH1 - 7243.0 OK?
ENTER
Please wait CH1 - 7500.0 Adj-
-CAL Done CH1 - 7500.0 OK?
For Load-Pos/Neg
● Scroll through selections using Cursor keys.
● To edit entry, press ENTER key. Entry flashes.
● Use Cursor keys to select.
For character based entries (for example, HI Limit and Units), use Left/Right keys to select desired character position. Then, use Up/Down keys to scroll through possible characters.
To move the decimal point, first, select it using the Left/Right keys. Then, use Up/Down keys to move it.
● Press ENTER key to accept or ESC key to cancel.
● Press MENU key to exit menu.
from LVDA CAL
EXC Freq. CH1 5kHz
Choices: 10kHz 5kHz 3kHz 2.5kHz
CH1 shown for reference
Type of CAL CH1 Load-Pos/Neg
Choices: Load-Positive Load-Pos/Neg
Full Scale CH1 10000.0
Zero Point CH1 .000000
+CAL Point CH1 7500.00
-CAL Point CH1 -7500.00
For Load-Pos/Neg
To Zero LVDT CH1 Press ENTER
ENTER
Set LVDT @ 0 CH1 - 2.0 OK?
ENTER
Please wait CH1 0.0 Adj0
Zero Done CH1 0.0 OK?
To do +CAL CH1 Press ENTER
ENTER
Set LVDT + CH1 7286.0 OK?
ENTER
Please wait CH1 7500.0 Adj+
+CAL Done CH1 7500.0 OK?
To do -CAL CH1 Press ENTER
ENTER
Set LVDT - CH1 - 7243.0 OK?
ENTER
Please wait CH1 - 7500.0 Adj-
-CAL Done CH1 - 7500.0 OK?
For Load-Pos/Neg


from DCSA CAL
CH1 shown for reference
Type of CAL CH1 Shunt-Pos/Neg
Choices: mV/V-Positive mV/V-Pos/Neg Load-Positve Load-Pos/Neg Shunt-Positive Shunt-Pos/Neg
Full Scale CH1 10000.0
For Shunt & Load Calibrations
Zero Value CH1 .000000
+CAL Value CH1 7500.00
+Load Value for Load Calibrations or mV/V @ +FS for mV/V Calibrations
For Pos/Neg Calibrations
-CAL Value CH1 -7500.00
-Load Value for Load Calibrations or mV/V @ -FS for mV/V Calibrations
For Shunt & mV/V Calibrations
To CAL Xdcr CH1 Press ENTER
ENTER
Unload Xdcr CH1 - 2.0 OK?
ENTER
Please wait CH1 0.0 Adj0
Please wait CH1 7500.0 Adj+
Please wait CH1 - 7500.0 Adj-
For mV/V-Pos/Neg and Shunt-Pos/Neg
CAL Done CH1 0.0 OK?
Data is not displayed for mV/V Calibrations
For Load Calibrations
To Zero Xdcr CH1 Press ENTER
Unload Xdcr CH1 - 2.0 OK?
Please wait CH1 0.0 Adj0
Zero Done CH1 0.0 OK?
To do +CAL CH1 Press ENTER
Load Xdcr + CH1 7286.0 OK?
Please wait CH1 7500.0 Adj+
+CAL Done CH1 7500.0 OK?
For Load-Pos/Neg
To do -CAL CH1 Press ENTER
Load Xdcr - CH1 - 7243.0 OK?
Please wait CH1 - 7500.0 Adj-
-CAL Done CH1 - 7500.0 OK?
from DCIA CAL
CH1 shown for reference
Input Range CH1 +/-10 mA
Choices: 12+/-8 mA 4-20 mA +/-20 mA +/-10 mA
Full Scale CH1 10000.0
Adjust DCIA CH1 Press ENTER
ENTER
Please wait... Adjusting DCIA
from CTUA CAL
CH1 shown for reference
Full Scale CH1 10000.0
Xdcr Freq. CH1 10000.0
Xdcr Value CH1 10000.0
Input Type CH1 TTL
Choices: 200mVp-p 100mVp-p 50mVp-p 20mVp-p 10mVp-p TTL (Quadrature) TTL
Polarity CH1 Not Inverted
Choices: Inverted Not Inverted
Input Filter CH1 None
Choices: 20kHz None
Lowest Freq. CH1 1% of FS
Choices: 0.01% of FS 1% of FS
from UDCA CAL
CH1 shown for reference
Full Scale CH1 10000.0
Xdcr Pulses CH1 10000.0
Xdcr Value CH1 10000.0
Count Mode CH1 1X (Quadrature)
Choices: Event (Input A) 4X (Quadrature) 2X (Quadrature) 1X (Quadrature)
For 1X,2X,4X Count Modes
+ Direction CH1 B leads A
Choices: A leads B B leads A
For Event Count Mode
Count Edge CH1 Rising Edge
Choices: Falling Edge Rising Edge
ResetArm Sig CH1 Ignored
Choices: TTL Low arms TTL High arms Ignored
Reset Signal CH1 TTL High resets
Choices: Ignore TTL Low resets TTL High resets
Reset Mode CH1 Leading Edge
Choices: /B B /A A /A AND /B /A AND B A AND /B A AND B Level Leading Edge
• Scroll through selections using Cursor keys.
• To edit entry, press ENTER key. Entry flashes.
• Use Cursor keys to select.
For character based entries (for example, HI Limit and Units), use Left/Right keys to select desired character position. Then, use Up/Down keys to scroll through possible characters.
To move the decimal point, first, select it using the Left/Right keys. Then, use Up/Down keys to move it.
• Press ENTER key to accept or ESC key to cancel.
• Press MENU key to exit menu.

APPENDIX F, SERIAL COMMUNICATION COMMANDS

The following information is available in comm.html file which is included in the M700 software package. This file has the latest information and is in a more readable format.

```
----------------------Serial Communications for the 9850-----------------------
This specification of the serial communications for the model 9850 is subject
   to change at any time without notice.

    Lines that end in "=a.b" apply only to version a.b
    Lines that end in ">c.d" apply only to versions >c.d
    Lines that end in "<e.f" apply only to versions <e.f

General conventions used in this document

    <OK> stands for the string "OK"
    <ID> stands for the 9850's ID (a single character)
    <IX> is an alphanumeric character (A-Z or 0-9)
    <CH> is a channel number (1,2,3)
    <CR> is a carriage return (^M / 13 decimal / 0D hexadecimal / 15 octal)
    <LF> is a line feed (^J / 10 decimal / 0A hexadecimal / 12 octal)
    <FP> is a floating point number string (e.g. "1234.57")
    <HNUM> is a hexadecimal string that is NUM characters long (e.g. <H4> could be
       "8FC4")
    <ST> is a string (e.g. "LB-IN")

General information

    All messages to and from the 9850 are terminated with a <CR> or <LF>.
        The default termination character is <CR>.
        This can be changed via the "SS" command.                          >6.1
    All messages to the 9850 start with the 9850's ID, followed by a 2 character
       message code.
    To set a value on the 9850, find the message the retrieves the data you want to
       change.  Then append to that message the desired value of the parameter.  The
       9850 should respond with "OK".
    All hexadecimal/binary data from the 9850 is in big-endian (MSB first) format.

In response to any command, the 9850 returns one of the following:

    "string" where string is the data requested.
    "OK" operation was successful
    "!Command"  command is not recognized                                  <2.1
    "!Command:xx"  command "xx" is not recognized                          >2.0
    "!Channel"  command is inappropriate for the given channel.
    "!Arg" parameter is malformed.
    "!Index"  an index <IX> is bad (see "IA" for example)
    "!InTest" attempted to set a value while in test mode.
    "!InMenu" attempted to set a value while in menu mode.
    "!Invalid"  there is some other error.
    "!Unknown Error" an unknown error occurred.                            >1.1
    "!Signal Too Small" calibration signal is too small.                   >1.1
    "!Signal Too Large" calibration signal is too large.                   >1.1
    "!Signal Negative"  calibration signal is negative when it should be   >1.1
       positive.                                                           >1.1
    "!Signal Positive"  calibration signal is positive when it should be   >1.1
       negative.                                                           >1.1
    "!Null-C Too Large" the null-c signal of an ACUA/ACUL is too large to  >1.1
       compensate for.                                                     >1.1
```

```
--------------------------------------Examples---------------------------------------
In the following examples, assume that the ID for the 9850 is "A". Remember *ALL*
   messages to and from the 9850 end with a CR or a LF.

    Retrieve data for channel 1:
       Send "ADC1" to the 9850. The "A" is the 9850's ID, the "DC" is the data current
          command, and the "1" is for channel 1. The return message should look
          something like "1234.56".
    Retrieve data for channel all channels:
       Send "ADC0" to the 9850. The "A" is the 9850's ID, the "DC" is the data current
          command, and the "0" designates all channels. The return message should
          look something like "1234.56,987.654,11.2233".
    Retrieve the filter on channel 2:
       Send "AFL2" to the 9850. The return message should be something like "07"
          which implies (referring to the appropriate list under the "FL" message)
          that channel 2 has a filter of 20 Hz.
    Set the Full Scale of channel 3 to 879.0:
       Send "AFS3879.0" to the 9850. The 9850 should respond with "OK" if the
          operation was successful.
    Set the filter of channel 2 to 100 Hz:
       Refer to the list under the "FL" (filter) command to find that a 100 Hz
          filter corresponds to the value 09. Therefore, send "AFL209" to the 9850.
          The 9850 should respond with "OK" if the operation was successful.
    Change the unit name of channel 1 to "LB-IN":
       Send "AUN1LB-IN" to the 9850. The 9850 should respond with "OK" if the
          operation was successful.
    Calibrate channel 1:
       (assume channel 1 is an ACUA/ACUL and the calibration type is load) Unload
          the transducer and send "ACL1A" to the 9850 to perform the zero
          calibration. Wait for an "OK" reply. Then put the + load on the transducer
          and send "ACL1B". Wait for an "OK" reply. Then put the - load on the
          transducer and send "ACL1C". Wait for an "OK" reply.
    Retrieve the version number of the 9850:
       Send "AVR" to the 9850. The return message should be something like "Model 9850
          v1.2".
```

```
----------------------------Informational Only Messages------------------------------

    These messages can only retrieve information from the 9850 -- they can not change
       any data on the 9850.
    The time returned is the number of 2kHz clock ticks since the 9850 was power on.
    If <CH> is a "0", then the data is returned for all appropriate channels in a
       comma separated list.


   DC<CH>       <FP>       Data Current for the given channel
   DX<CH>       <FP>       Data maXimum for the given channel
   DN<CH>       <FP>       Data miNimum for the given channel
   DH<CH>       <FP>       Data Held for the given channel
   DT<CH>       <H8>,<FP>  Data Tare for the given channel
   EC<CH>       <H8>,<FP>  Time, Data Current for the given channel
   EX<CH>       <H8>,<FP>  Time, Data maXimum for the given channel
   EN<CH>       <H8>,<FP>  Time, Data miNimum for the given channel
   EH<CH>       <H8>,<FP>  Time, Data Held for the given channel
   ET<CH>       <H8>,<FP>  Time, Data Tare for the given channel
   XC<CH>       <H4>       Hexadecimal Data Current for the given channel
   XX<CH>       <H4>       Hexadecimal Data maXimum for the given channel
   XN<CH>       <H4>       Hexadecimal Data miNimum for the given channel
   XH<CH>       <H4>       Hexadecimal Data Held for the given channel
   XT<CH>       <H8>,<H4>  Hexadecimal Data Tare for the given channel
   YC<CH>       <H8>,<H4>  Time, Hexadecimal Data Current for the given channel
   YX<CH>       <H8>,<H4>  Time, Hexadecimal Data maXimum for the given channel
   YN<CH>       <H8>,<H4>  Time, Hexadecimal Data miNimum for the given channel
   YH<CH>       <H8>,<H4>  Time, Hexadecimal Data Held for the given channel
   YT<CH>       <H8>,<H4>  Time, Hexadecimal Data Tare for the given channel
   L1           <ST>       Line 1 of LCD
   L2           <ST>       Line 2 of LCD
   VR           <ST>       Version number of the 9850
                              The format of the string is "Model 9850 v#.#"
   VC           <ST>       Version number of the 9850 Channels                   >6.1
                              <ST> has the form "1:xxxx  2:yyyy".               >6.1
                              If the channel is a CTUA/UDCA then the version    >6.1
                                 number is returned                             >6.1
                              Otherwise the type of the channel is returned.    >6.1
   ST<CH>       <H2>       Status of the given channel
                              0x80: Channel is (0x00=not) over-ranged
                              0x40: (0x00=Not) currently < low limit            >1.1
                              0x20: (0x00=Not) at a maximum
                              0x10: (0x00=Not) at a minimum
                              0x08: (0x00=Not) currently > high limit           >1.1
                              0x04: High Limit (0x00=not) violated
                              0x02: In Limit (0x00=not) violated
                              0x01: Low Limit (0x00=not) violated
   SC<CH>       <FP>,<FP>  Scaling Constants plus, minus
   TY<CH>       <ST>       TYpe of channel.
                              "ACUA": Universal strain gage amplifier
                              "ACUL": Universal strain gage amplifier (Lebow)
                              "CALC": Calculation
                              "CTUA": Counter/Timer
                              "DCIA": DC current amplifier
                              "DCSA": DC strain gage amplifier
                              "DCVA": Direct current/voltage amplifier
                              "LVDA": Linear voltage displacement amplifier
                              "NONE": No channel
                              "UDCA": Up/down counter
```

```
---------------------------------System Messages-----------------------------------

   SS           <H4>       System Settings (16 bits)
                              0x4000: Terminate serial communications with       >6.1
                                 0x0000: <CR> (carriage return)                  >6.1
                                 0x4000: <LF> (linefeed)                         >6.1
                              0x2000: State machine (0x0000=not) active          >4.9
                              0x1000: Do (0x0000=not) always show sign of numbers
                              0x0800: Do (0x0800=not) Display power up message
                              0x0400: Back light (0x0000=off/0x0400=on)
                              0x0200: Do max/mins
                                 0x0000: always when in test
                                 0x0200: using I/O control
                              0x0100: Check Limits
                                 0x0000: always when in test
                                 0x0100: using I/O control
                              0x00E0: Power-up data
                                 0x0000: Display current data
                                 0x0020: Display max data
                                 0x0040: Display min data
                                 0x0060: Display spread data
                                 0x0080: Display held data
                                 0x00A0: Display tare data
                              0x0018: Power-up 1st channel
                                 0x0000: channel 1
                                 0x0008: channel 2
                                 0x0010: channel 3
                              0x0006: Power-up view
                                 0x0000: 2 channel
                                 0x0002: Limit status
                                 0x0004: I/O Status
                                 0x0006: 1 Channel                               >2.4
                              0x0001: Power up (0x0000=not) in test mode
   CT           <H2>       ConTrast (0-100) (7 bits)
                              0x7F: LCD Contrast setting
   A1           <H2>       Analog output 1 driver (2 bits)
                              Changing this necessitates a "RS" command
                              0x03: Which channel drives analog output 1
   A2           <H2>       Analog output 2 driver (2 bits)
                              Changing this necessitates a "RS" command
                              0x03: Which channel drives analog output 2
   SP<IX>       <H4>       System Patterns (16 bits)
                              0xF000: Logic inputs
                              0x0FC0: Internal matrix
                              0x003F: Logic outputs
                              <IX>:
                                 A: Pattern1
                                 B: Pattern1 care bits
                                 C: Pattern1 OUT (only 12 bits used)
                                 D: NOT Pattern1 OUT (only 12 bits used)
                                 E: Pattern2
                                 F: Pattern2 care bits
                                 G: Pattern2 OUT (only 12 bits used)
                                 H: NOT Pattern2 OUT (only 12 bits used)
                                 I: Pattern3
                                 J: Pattern3 care bits
                                 K: Pattern3 OUT (only 12 bits used)
                                 L: NOT Pattern3 OUT (only 12 bits used)
                                 M: Pattern4                                     >4.9
                                 N: Pattern4 care bits                           >4.9
                                 O: Pattern4 OUT (only 12 bits used)             >4.9
                                 P: NOT Pattern5 OUT (only 12 bits used)         >4.9
                                 Q: Pattern5                                     >4.9
                                 R: Pattern5 care bits                           >4.9
                                 S: Pattern5 OUT (only 12 bits used)             >4.9
                                 T: NOT Pattern5 OUT (only 12 bits used)         >4.9
                                 U: Pattern6                                     >4.9
                                 V: Pattern6 care bits                           >4.9
                                 W: Pattern6 OUT (only 12 bits used)             >4.9
                                 X: NOT Pattern6 OUT (only 12 bits used)         >4.9
                                 Y: Pattern7                                     >4.9
                                 Z: Pattern7 care bits                           >4.9
                                 [: Pattern7 OUT (only 12 bits used)             >4.9
                                 \: NOT Pattern7 OUT (only 12 bits used)         >4.9
```

```
                     ]: Pattern8                                      >4.9
                     ^: Pattern8 care bits                            >4.9
                     _: Pattern8 OUT (only 12 bits used)              >4.9
                     `: NOT Pattern8 OUT (only 12 bits used)          >4.9
@1           <H8>      Calibration data for analog output 1 (32 bits)
                          The "RS" command over-writes this data
                             0xFFFF0000: cal-zero offset
                             0x0000FF00: plus gain
                             0x000000FF: minus gain
@2           <H8>      Calibration data for analog output 2 (32 bits)
                          The "RS" command over-writes this data
                             0xFFFF0000: cal-zero offset
                             0x0000FF00: plus gain
                             0x000000FF: minus gain
TM           <H8>      TiMe on 9850                                      >1.1
                          The base unit of time is 0.0005 seconds (2kHz).   >1.1
IO           <H4>      I/O lines                                         >1.1
                          Get the logic IO lines                         >1.1
                          0xF000: Logic inputs                           >1.1
                          0x0FC0: Internal matrix                        >1.1
                          0x003F: Logic outputs                          >1.1
cm           <H8>      CoMm port settings
                          This command is fairly useless, since you have to know
                             these settings to get these setting.
                          DO NOT CHANGE THESE UNLESS YOU KNOW WHAT YOU ARE DOING
                          0xFF000000: communication ID
                             0x41000000-0x5A000000: "A" - "Z"
                             0x61000000-0x7A000000: "a" - "z"
                          0x00FF00FF: should be 0
                          0x00007000: % of bits/Parity
                             0x00000000: 8/None
                             0x00001000: 8/Even
                             0x00002000: 8/Odd
                             0x00003000: 7/Even
                             0x00004000: 7/Odd
                          0x00000F00: Baud Rate
                             0x00000000: 300 baud
                             0x00000100: 600 baud
                             0x00000200: 1200 baud
                             0x00000300: 2400 baud
                             0x00000400: 4800 baud
                             0x00000500: 9600 baud
                             0x00000600: 19200 baud
                             0x00000700: 38400 baud
```

```
---------------------------------Special Messages----------------------------------

   ZZ<ST>       <OK>       Repeat command                                     >3.9
                              When Internal Matrix 3 is on, repeatedly send the  >3.9
                                 response to the command <ST> back to the user.  >3.9
                                 E.G. Assuming that the ID of the 9850 is "A",    >3.9
                                 the command "AZZDC1" sets things up so that     >3.9
                                 when Internal Matrix 3 is on, the 9850 will      >3.9
                                 return the current data for channel 1 back to   >3.9
                                 the user (see the "DC" command).  Send the      >3.9
                                 command "AZZ" to cancel this behavior.          >3.9

----------------------------------Other Messages-----------------------------------

   T0           <OK>       Exit Test mode
   T1           <OK>       Start a Test
                              This fails if the 9850 is in the menu.
   RS           <OK>       Restart System
                              This command might take takes up to 20 seconds to
                                 finish.
   RSA          <OK>       Restart system
                              Does not necessarily do a calibration of the analog
                                 output channels.
                              This command might take takes up to 20 seconds to
                                 finish.
   KY<IX>       <OK>       KeY press (and release)
                              <IX>:
                                 A: Menu key
                                 B: View key
                                 C: Test key
                                 D: Tare key
                                 E: Hold key
                                 F: ESC/Reset key
                                 G: Enter key
                                 H: Up key
                                 I: Right key
                                 J: Down key
                                 K: Left key
                                 N: Lock key (lock/unlock the keyboard)
                                 O: Plus Cal (use the "AS" command to apply the  >1.3
                                    plus cal signal)                             >1.3
                                 P: Minus Cal (use the "AS" command to apply     >1.3
                                    the minus cal signal)                        >1.3
                                 1: Lock keyboard                                >1.1
                                 0: UnLock keyboard                              >1.1
                                 2: Toggle lock state of keyboard                >1.1
                                 other: Ignored                                  >1.1
   AS<IX>       <OK>       Apply Shunt (to BOTH channels)
                              <IX>:
                                 A: no-shunt applied
                                 B: Apply Plus Cal
                                 C: Apply Minus Cal
```

```
----------------------------Channel Specific Messages-------------------------------

   FS<CH>       <FP>       Full Scale
                              Changing this requires a re-calibration of the channel
                                 ("CL" command) followed by an "RS" command
   HL<CH>       <FP>       High Limit
   LL<CH>       <FP>       Low Limit
   HH<CH>       <FP>       High Hysteresis (unsigned)
   LH<CH>       <FP>       Low Hysteresis (unsigned)
   CC<CH><IX>   <FP>       Calibration Constants
                              Changing this requires a re-calibration of the channel
                                 ("CL" command) followed by an "RS" command
                              If the type of <CH> is an CTUA:
                                 <IX>:
                                    A: FS Frequency                             <3.9
                                    A: Xdcr Frequency                           >3.9
                                    B: Xdcr Value
                              If the type of <CH> is an UDCA:
                                 <IX>:
                                    A: Xdcr Pulses
                                    B: Xdcr Value
                              If the type of <CH> is an ACUA/ACUL/LVDA/DCVA:
                                 <IX>:
                                    A: Plus Value
                                    B: Zero Value
                                    C: Minus Value
                              If the type of <CH> is a DCSA:
                                 If the calibration type is mV/V:
                                    <IX>:
                                       A: mV/V at Full Scale
                                       B: not used
                                       C: mV/V at -Full Scale
                                 else (calibration type is NOT mV/V):
                                    <IX>:
                                       A: Plus Value
                                       B: Zero Value
                                       C: Minus Value
                              If the type of <CH> is a CALC:
                                 <IX>:
                                    A: Calculation constant A
                                    B: Calculation constant B                   >2.3
                                    C: Calculation constant C                   >2.3
   UN<CH>       <ST>       Unit Name
   FL<CH>       <H2>       FiLter (0-10) (4 bits)
                              If the type of <CH> is NOT a CALC:
                                 0x00: 0.1Hz
                                 0x01: 0.2Hz
                                 0x02: 0.5Hz
                                 0x03: 1Hz
                                 0x04: 2Hz
                                 0x05: 5Hz
                                 0x06: 10Hz
                                 0x07: 20Hz
                                 0x08: 50Hz
                                 0x09: 100Hz
                                 0x0A: 200Hz
                              If the type of <CH> is a CALC:
                                 ignored > 2.9
   LC<CH>       <H2>       Limit Control  (6 bits)
                              0x30: Data to use for limit checking
                                 0x00: Current data
                                 0x10: Max data
                                 0x20: Min data
                                 0x30: Held data
                              0x08: (0x08=No) Flash backlight on limit violation
                              0x04: Low limit (0x00=not) latched
                              0x02: High limit (0x00=not) latched
                              0x01: Limit mode is (0x00=signed/0x01=absolute)
   CK<CH>       <H2>       Channel Key  (8 bits)
                              0x70: Display Resolution
                                 0x00: 0.01% of full scale
                                 0x10: approx. 0.02% of full scale
                                 0x20: approx. 0.05% of full scale
                                 0x30: 0.1% of full scale)
```

```
                           0x40: approx. 0.2% of full scale
                           0x50: approx. 0.5% of full scale
                           0x60: 1% of full scale
                           0x70: unlimited resolution (no rounding)
                        0x08: (0x00=Don't/0x08=Do) reset counter (UDCA only)
                        0x04: Do max/mins on (0x00=filtered/0x04=raw) data
                        0x02: Reset key does (0x02=not) clear tare
                        0x01: Tare key does (0x01=not) tare channel
CF<CH>       <H8>    Calibration Flags
                        Changing this requires a calibration of the channel
                           ("CL" command) followed by an "RS" command
                        If the type of <CH> is an ACUA/ACUL:
                           0x03000000: Type of calibration
                              0x00000000: Do a shunt-pos/neg cal
                              0x01000000: Do a load-pos/neg cal            <5.9
                              0x01000000: Do a shunt-positive cal          >5.9
                              0x02000000: Do a shunt-positive cal          <5.9
                              0x02000000: Do a load-pos/neg cal            >5.9
                              0x03000000: Do a load-positive cal
                        If the type of <CH> is an DCVA:
                           0x03000000: Type of calibration
                              0x00000000: Do a remote-pos/neg cal
                              0x01000000: Do a load-pos/neg cal            <5.9
                              0x01000000: Do a remote-positive cal         >5.9
                              0x02000000: Do a remote-positive cal         <5.9
                              0x02000000: Do a load-pos/neg cal            >5.9
                              0x03000000: Do a load-positive cal
                        If the type of <CH> is an DCSA:
                           0x07000000: Type of calibration
                              0x00000000: Do a shunt pos/neg calibration
                              0x01000000: Do a shunt positive-only calibration
                              0x02000000: Do a load pos/neg calibration
                              0x03000000: Do a load positive-only calibration
                              0x04000000: Do a mV/V pos/neg calibration
                              0x05000000: Do a mV/V positive-only calibration
                        If the type of <CH> is an DCIA:
                           0x07000000: Input Range
                              0x00000000: +/-10 mA
                              0x01000000: +/-20 mA
                              0x02000000: 4-20 mA
                              0x03000000: 12+/-8 mA
                        If the type of <CH> is an LVDA:
                           0x01000000: MUST BE 1                           <5.9
                           0x0C000000: Excitation Frequency                <5.9
                              0x00000000: 2.5KHz                           <5.9
                              0x04000000: 3KHz                             <5.9
                              0x08000000: 5KHz                             <5.9
                              0x0C000000: 10KHz                            <5.9
                           0x01000000: Do a positive-only calibration      >5.9
                           0x02000000: MUST BE 1                           >5.9
                           0x18000000: Excitation Frequency                >5.9
                              0x00000000: 2.5KHz                           >5.9
                              0x08000000: 3KHz                             >5.9
                              0x10000000: 5KHz                             >5.9
                              0x18000000: 10KHz                            >5.9
                        If the type of <CH> is an CTUA:
                           0x01000000: Zero return is (0=fast/1=slow)
                           0x02000000: (0=regular/1=inverted) Polarity
                           0x04000000: (1=non-) filtered input
                           0x00000700: Input Type
                              0x00000000: TTL input
                              0x00000100: TTL quadrature input
                              0x00000200: 10 mVp-p
                              0x00000300: 20 mVp-p
                              0x00000400: 50 mVp-p
                              0x00000500: 100 mVp-p
                              0x00000600: 200 mVp-p
                        If the type of <CH> is an UDCA:
                           0x0F000000: Reset Mode
                              0x00000000: Leading Edge
                              0x01000000: Level
                              0x02000000:  A and  B
                              0x03000000:  A and /B
                              0x04000000: /A and  B
                              0x05000000: /A and /B
```

```
                                 0x06000000:  A                                >5.0
                                 0x07000000: /A                                >5.0
                                 0x08000000:        B                          >5.0
                                 0x09000000:       /B                          >5.0
                              0x00C00000: Reset Arm Signal
                                 0x00000000: Ignored
                                 0x00400000: TTL High arms
                                 0x00800000: TTL Low arms
                              0x00300000: Reset Signal
                                 0x00000000: TTL High resets
                                 0x00100000: TTL Low resets
                                 0x00200000: Ignored
                              0x00080000: + Direction
                                 0x00000000: B leads A
                                 0x00080000: A leads B
                              0x00040000: Count Edge
                                 0x00000000: Rising Edge
                                 0x00040000: Falling Edge
                              0x00030000: Count Mode
                                 0x00000000: 1x Quadrature
                                 0x00010000: 2x Quadrature
                                 0x00020000: 4x Quadrature
                                 0x00030000: Event Signal A
                           If the type of <CH> is a CALC:
                              0x00000000:     (CH1 * CH2) / CONST_A
                              0x01000000:     (CH1 / CH2) / CONST_A
                              0x02000000:     (CH2 / CH1) / CONST_A
                              0x03000000: sqrt(CH1)* CH2  / CONST_A
                              0x04000000: sqrt(CH2)* CH1  / CONST_A
                              0x05000000:     (CH1 + CH2) / CONST_A
                              0x06000000:     (CH1 - CH2) / CONST_A
                              0x07000000:      CH1        / CONST_A
                              0x08000000:      CH1^2      / CONST_A
                              0x09000000: sqrt(CH1)       / CONST_A
                              0x0A000000:      CH2        / CONST_A
                              0x0B000000:      CH2^2      / CONST_A
                              0x0C000000: sqrt(CH2)       / CONST_A
                              0x0D000000:     (CH1 * CH2) * CONST_A
                              0x0E000000:     (CH1 / CH2) * CONST_A
                              0x0F000000:     (CH2 / CH1) * CONST_A
                              0x10000000: sqrt(CH1)* CH2  * CONST_A
                              0x11000000: sqrt(CH2)* CH1  * CONST_A
                              0x12000000:     (CH1 + CH2) * CONST_A
                              0x13000000:     (CH1 - CH2) * CONST_A
                              0x14000000:      CH1        * CONST_A
                              0x15000000:      CH1^2      * CONST_A
                              0x16000000: sqrt(CH1)       * CONST_A
                              0x17000000:      CH2        * CONST_A
                              0x18000000:      CH2^2      * CONST_A
                              0x19000000: sqrt(CH2)       * CONST_A
                              0x1A000000: User Defined (see "@B" command)
IA<CH><IX>   <H4>       Input Action    (16 bits)
                           0xF000: Logic inputs
                           0x0FC0: Internal matrix
                           0x003F: Logic outputs
                              <IX>:
                                 A: Tare
                                 B: Clear Tare
                                 C: Hold
                                 D: Clear Hold
                                 E: Reset Max/Min
                                 F: Clear Latched Limits
                                 G: Check Limits
                                 H: Do Max/Mins
                                 I: Apply + remote cal. (Channels 1 and 2 only)
                                 J: Apply - remote cal. (Channels 1 and 2 only)
                                 K: Reset UDCA Counter (UDCA only)
OE<CH><IX>   <H4>       Output Event    (12 bits)
                           0x0FC0: Internal matrix
                           0x003F: Logic outputs
                              <IX>:
                                 A: High Limit
                                 B: NOT High Limit
                                 C: In limit
                                 D: NOT In limit
```

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                                 E: Low limit
                                 F: NOT Low limit
                                 G: At Max
                                 H: NOT At Max
                                 I: At Min
                                 J: NOT At Min
@A<CH>       <H20>      Calibration data (80 bits)
                           DO NOT ATTEMPT TO CHANGE THIS DATA
                           This data might change during calibration
                           0xFFFFFFFF000000000000: plus-scaling constant (IEEE
                              float)
                           0x00000000FFFFFFFF0000: minus-scaling constant (IEEE
                              float)
                           0x0000000000000000FFFF: cal-zero offset
@B<CH>       <H24>      Calibration data (96 bits)
                           This data may change during calibration
                           If the type of channel is an ACUA/ACUL:
                              0xFFFFFFFF0000000000000000: zero-factor (IEEE float)
                              0x00000000FFFF000000000000: previous cal-zero offset
                              0x000000000000FFFF00000000: previous gain
                              0x0000000000000000FFFF0000: gain
                              0x00000000000000000000FFFF: null-c
                           If the type of channel is an DCVA/DCSA:
                              0xFFFFFFFF0000000000000000: zero-factor (IEEE float)
                              0x00000000FFFF000000000000: previous cal-zero offset
                              0x000000000000FFFF00000000: previous gain
                              0x0000000000000000FFFF0000: gain
                              0x00000000000000000000FFFF: not used
                           If the type of channel is an DCIA:
                              0xFFFFFFFFFFFFFFFF0000FFFF: not used
                              0x0000000000000000FFFF0000: gain
                           If the type of channel is an LVDA:
                              0xFFFFFFFF0000000000000000: zero-factor (IEEE float)
                              0x00000000FFFF000000000000: previous cal-zero offset
                              0x000000000000FFFF00000000: previous gain
                              0x0000000000000000FFFF0000: gain
                              0x00000000000000000000FFFF: copy of cal-flags
                           If the type of channel is a CALC:
                              This data is overwritten by the "CL<CH>A" command
                                 if the "CF<CH>" command is NOT 0x1A000000.
                              Notice that this data is hexadecimal string, NOT an
                                 ASCII string.  See Examples below.
                              0xFFFFFFFFFFFFFFFFFFFFFFFF: RPN String (NUL
                                 terminated)
                                 0x31 1: push(CH1 data)
                                 0x32 2: push(CH2 data)
                                 0x33 3: push(CH3 data)
                                 0x41 A: push(calculation constant A)
                                 0x42 B: push(calculation constant B)        >2.0
                                 0x43 C: push(calculation constant C)        >2.0
                                 0x64 d: push(top())                         =1.1
                                 0x44 D: push(top())                         >1.1
                                 0x45 E: push(edge counter IM6)              >1.2
                                    Push the number of rising edges of       >1.2
                                       Internal Matrix 6 onto the stack.     >1.2
                                       This counter is reset every time this >1.2
                                       is accessed.                          >1.2
                                 0x49 I: push(logic inputs)                  =1.2
                                 0x49 I: push(IM5 counter)                   >1.2
                                    Push the number of 2kHz clock ticks that >1.2
                                       Internal Matrix 5 has been on since   >1.2
                                       the last time it turned on.  This     >1.2
                                       'timer' gets reset every time         >1.2
                                       Internal Matrix 5 turns on            >1.2
                                 0x4B L: push(IM4)                           >1.2
                                    If Internal Matrix 4 is on then push 1   >1.2
                                       onto the stack; else push 0 onto the  >1.2
                                       stack.                                >1.2
                                 0x4F O: push(logic outputs)                 =1.2
                                 0x61 a: push(pop() absolute_value)          >6.3
                                 0x6E n: push(pop() negate)
                                 0x71 q: push(pop() sqrt)
                                 0x72 r: push(pop() reciprocal)
                                 0x63 c: set data selector = current         >3.9
                                 0x78 x: set data selector = max             >3.9
```

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                                 0x6D m: set data selector = min              >3.9
                                 0x68 h: set data selector = held             >3.9
                                 0x74 t: set data selector = tare             >3.9
                                 0x2A *: push(pop() pop() *)
                                 0x2F /: push(pop() pop() /)
                                 0x2B +: push(pop() pop() +)
                                 0x2D -: push(pop() pop() -)
                                 other:    finish w/result=top of stack
                              Example 1: You want the RPN string to be "12+" (the
                                 sum of channel 1 and channel 2).  The ASCII code
                                 for "1" is 0x31, the ASCII code for "2" is 0x32,
                                 and the ASCII code for "+" is 0x2B.  Therefore
                                 the appropriate command to send is
                                 "A@B331322B000000000000000000" (the "A" is the
                                 9850's ID, and the first "3" is the channel
                                 number of the calculation).
                              Example 2: You want the calculation to be the ratio
                                 of the spreads of channel 1 and channel 2.  The
                                 RPN string is "x1m1-x2m2-/".  The ASCII codes
                                 are:
                                    "x" = 0x78   "1" = 0x31   "m" = 0x6D
                                    "1" = 0x31   "-" = 0x2D   "x" = 0x78
                                    "2" = 0x32   "m" = 0x6D   "2" = 0x32
                                    "-" = 0x2D   "/" = 0x2F
                                 Therefore the appropriate command to send is
                                    "A@B378316D312D78326D322D2F00".
                              Example 3: You want the calculation to track
                                 channel 1 while Internal Matrix 4 is on.  First
                                 set Calculation Constant "A" equal to 1.000 by
                                 using the command "ACC3A1.0000". Then an RPN
                                 string that does the job is "1L*AL-3*+".
                                 Therefore send "A@B3314B2A414B2D332A2B000000".
CL<CH><IX>   OK         CaLibrate channel
                           These commands may take upto 20 seconds to finish
                           If the type of channel is an ACUA/ACUL/LVDA/DCVA/DCSA:
                              <IX>:
                                 A: Perform zero calibration
                                 B: Perform plus calibration
                                 C: Perform minus calibration
                           If the type of channel is a CALC:
                              <IX>:
                                 A: Initialize RPN string from "CF" flags and
                                    other initializations
                           If the type of channel is a CTUA/UDCA/DCIA:
                              <IX>:
                                 A: Calibrate channel
```

------------------------Speed of Communication at 38400 baud-------------------------

The data for the "MEASURED SPEED" and "THEORETICAL SPEED" is in messages per seconds
The "MEASURED SPEED" is the number of messages per second that the Visual Basic program "savedata.exe" executes.
"THEORETICAL SPEED" takes in account the latency of the 9850, and assumes NO latency for the PC

ALL CHANNELS:

TYPE OF DATA	MESSAGE	MEASURED SPEED	THEORETICAL SPEED	CHARACTERS PER REPLY
Time+Float	AEC0	47-55	80	18-36
Time+Hex	AYC0	80-90	140	19
Float	ADC0	60-72	100	9-27
Hex	AXC0	128-135	235	10

SINGLE CHANNEL:

TYPE OF DATA	MESSAGE	MEASURED SPEED	THEORETICAL SPEED	CHARACTERS PER REPLY
Time+Float	AEC1	82-90	140	12-18
Time+Hex	AYC1	103-110	180	14
Float	ADC1	128-137	220	3-9
Hex	AXC1	180-190	350	5

ALL CHANNELS -- ZZ Command -- THEORETICAL SPEED assumes the latency of 9850 to be 0:

TYPE OF DATA	MESSAGE	MEASURED SPEED	THEORETICAL SPEED	CHARACTERS PER REPLY
Time+Float	AZZEC0	-	213-106	18-36
Time+Hex	AZZYC0	184	202	19
Float	AZZDC0	-	426-142	9-27
Hex	AZZXC0	333	384	10

SINGLE CHANNEL -- ZZ Command -- THEORETICAL SPEED assumes the latency of 9850 to be 0:

TYPE OF DATA	MESSAGE	MEASURED SPEED	THEORETICAL SPEED	CHARACTERS PER REPLY
Time+Float	AZZEC1	-	320-213	12-18
Time+Hex	AZZYC1	250	274	14
Float	AZZDC1	-	1280-426	3-9
Hex	AZZXC1	666	768	5

APPENDIX G, SYSTEM RESPONSE RATES

Model ACUA (AC Strain Gage Amplifier) Rates

Model LVDA (LVDT Amplifier) Rates

Model DCSA (DC Strain Gage Amplifier) Rates

Model DCVA (DC Voltage Amplifier) Rates

Model DCIA (DC Current Amplifier) Rates

These models vary in the excitation voltage(s) provided and how the signal is conditioned. Once the signal is digitized all five models perform the same.

The **Model ACUA** excites a strain gage transducer with a 3Vrms, 3030Hz sine wave. The AC output signal (0.5 to 5mV/V) of the transducer is amplified, conditioned, and demodulated providing a DC voltage. This DC signal is filtered with a 200Hz 7 pole low pass Bessel response hardware antialias filter.

The **Model LVDA** excites an LVDT transducer with a 2Vrms sine wave. You can select amongst 2.5kHz, 3kHz, 5kHz, and 10kHz frequencies. The AC output signal (100 to 1000mV/V) of the LVDT is amplified, conditioned, and demodulated providing a DC voltage. This DC signal is filtered with a 200Hz 7 pole low pass Bessel response hardware antialias filter.

The **Model DCSA** excites a directly wired strain gage transducer with a 5 or 10VDC regulated supply. The DC output signal (0.5 to 4.5mV/V) of the transducer is amplified and conditioned. This DC signal is filtered with a 200Hz 5 pole low pass Bessel response hardware antialias filter.

The **Model DCVA** provides 5VDC and 15VDC excitation supplies to power a transducer. The DC output signal (±1 to ±10VDC) of the transducer is conditioned and filtered with a 200Hz 5 pole low pass Bessel response hardware antialias filter.

The **Model DCIA** can be connected to a 4 to 20mA transmitter (2 or 4 wire) or a transducer with a 10 to 20mA output. This DC current signal is converted to voltage, conditioned, and filtered with a 200Hz 5 pole low pass

Bessel response hardware antialias filter.

For all five models, the DC signal from the low pass hardware antialias filter is sampled (Analog to Digital Conversion) at 2000Hz (0.5ms). The digitized data is digitally filtered at a selectable cutoff frequency from 0.1 to 200Hz (see Filter in CHAN SETTINGS). As with any filter, the digital filter delays the signal, more so at low cutoff frequencies. The step response of the digital filter is between ½ and 1 period ($1/f_C$) of the cutoff frequency for data to get to 99.9% of actual value. If the filter is set to 200Hz, expect 2.5 to 5ms for data to reach 99.9% of actual value. Expect 0.5 to 1s when the filter is set to 1Hz.

Max/Mins are updated at 2000Hz (0.5ms) using data before or after the digital filter. This is user selectable. See Max/Min Type in CHAN SETTINGS.

MaxMin update and limit checking are performed only while running a Test.

Limit checking is performed at 1000Hz (1ms) using the type of data (*Current Data, Max Data, Min Data, Spread Data, or Held Data*) you choose. See Limit Type in CHAN SETTINGS.

Model CTUA (Frequency Input Module) Rates

The Model CTUA measures one or more periods of the input signal and converts this to frequency. At low frequencies (<1000Hz), one period is measured to get the specified resolution (0.01% of Full Scale). So, the sampling time at low frequencies is equal to the period of the input signal. At high frequencies (>1000Hz), multiple periods are measured to get the specified resolution. The number of periods measured depends on the frequency of the input signal. A minimum of 1ms is required to obtain the specified resolution. Since the input signal is **not** synchronized to the internal 32MHz clock, an extra period may be measured beyond the 1ms minimum time. So, the sampling time at high frequencies ranges from 1ms to 1ms plus the period of the input signal. For example, if the input frequency is 1000Hz, then the sampling time ranges from 1 to 2ms (1ms+1/1000Hz). For 20000Hz the sampling time ranges from 1 to 1.05ms (1ms+1/20000Hz).

*This is **not** a hardware filter. So, noise spikes above selected thresholds will be measured even with digital filter invoked. For hardware filter, see Input Filter in CHAN CALIBRATION (MODEL CTUA).*

The digitized data can be digitally filtered at a selectable cutoff frequency from 0.1 to 100Hz, or the digital filter can be bypassed (*None*). See Filter in CHAN SETTINGS. As with any filter, the digital filter delays the signal, more so at low cutoff frequencies. The step response of the digital filter is between ½ and 1 period ($1/f_C$) of the cutoff frequency for data to get to 99.9% of actual value. If the filter is set to 100Hz, expect 5 to 10ms for data to reach 99.9% of actual value. Expect 0.5 to 1s when the filter is set to 1Hz.

MaxMin update and limit checking are performed only while running a Test.

Max/Mins are updated at 2000Hz (0.5ms) using data before or after the digital filter. This is user selectable. See Max/Min Type in CHAN SETTINGS. Data is **not** sampled this fast, so data used for Max/Min update is repeated.

Limit checking is performed at 1000Hz (1ms) using the type of data (*Current Data, Max Data, Min Data, Spread Data, or Held Data*) you choose. See Limit Type in CHAN SETTINGS. For low sampling rates (low input frequencies), data used for limit checking is repeated.

Model UDCA (Encoder/Totalizer Module) Rates

The Model UDCA counts edges of a pair of TTL quadrature signals (up and down) or counts edges of a single TTL signal (up). Signals as fast as 400kHz (2.5Fs) can be counted internally. Data is read from the counter at 2000Hz (0.5ms).

*Generally, the digital filter for the Model UDCA is **not** desirable. One use is when an encoder jitters between positions. This is **not** a hardware filter. So, noise spikes above TTL thresholds will be counted even with digital filter invoked.*

This data can be digitally filtered at a selectable cutoff frequency from 0.1 to 100Hz, or the digital filter can be bypassed (*None*). See Filter in CHAN SETTINGS. As with any filter, the digital filter delays the signal, more so at low cutoff frequencies. The step response of the digital filter is between ½ and 1 period ($1/f_C$) of the cutoff frequency for data to get to 99.9% of actual value. If the filter is set to 100Hz, expect 5 to 10ms for data to reach 99.9% of actual value. Expect 0.5 to 1s when the filter is set to 1Hz.

MaxMin update and limit checking are performed only while running a Test.

Max/Mins are updated at 2000Hz (0.5ms) using data before or after the digital filter. This is user selectable. See Max/Min Type in CHAN SETTINGS.

Limit checking is performed at 1000Hz (1ms) using the type of data (*Current Data, Max Data, Min Data, Spread Data, or Held Data*) you choose. See Limit Type in CHAN SETTINGS.

CH3 Calculation Rates

The calculation is computed at 50Hz (20ms). It is **not** digitally filtered. But, data from CH1 and CH2 used in the calculation are filtered. All filters introduce a delay. For CH1 and CH2 to be delayed similarly, use the same filter for both channels.

MaxMin update and limit checking are performed only while running a Test.

Max/Mins of the calculation are updated at 50Hz. And, limit checking is performed at 50Hz using the type of data (*Current Data, Max Data, Min Data, Spread Data, or Held Data*) you choose. See Limit Type in CHAN SETTINGS.

Logic I/O Response Time

Logic I/O capabilities are enabled only while running a Test.

The Logic I/O response time is 1ms (1000Hz) for hardware channels (CH1 and CH2) and 20ms (50Hz) for CH3 calculation. In other words, Logic I/O signals are activated at most 1ms (for hardware channels) or 20ms (for CH3 calculation) after an output event goes true, while input actions are executed at most 1ms (for hardware channels) or 20ms (for CH3 calculation) after the activation of the Logic I/O signal(s). These times do **not** include filter delay or sampling rate. See previous sections.

Analog Output Rates

The analog outputs are updated with channel data at 1000Hz. If channel data is sampled at a lower rate (for example, CH3 calculation is computed at 50Hz), then data is repeated. To select the channel assigned to an analog output, see ANALOG OUTPUTS chapter.

Digitally filtered data (for hardware channels) or computed data (for CH3 calculation) is used. Furthermore, each analog output has a 100Hz 5 pole Bessel response low pass hardware filter. The step response of this filter is approximately 10ms for data to get to 99.9% of actual value.

The hardware channels digital filter and the analog output filter both effect the response of the analog output. For example, if the digital filter of CH1 is 1Hz, the analog output response is 1Hz. The 100Hz analog output filter has little effect. If the digital filter of CH1 is 200Hz, the analog output response is 100Hz (the effect of the analog output filter).

APPENDIX H, SPECIFICATIONS

System Specifications

Display

Type	2 line by 16 characters, backlit, LCD with adjustable contrast.
Character Size	0.2" wide, 0.3" high.
Views	Select from 1 Channel, 2 Channel, Limit Status, and I/O Status.
Data Displayed	Select from Current, Max, Min, Spread, Held data and Tare value.
Numeric Format	Data displayed in engineering units with 6 digits (1-2-5 format).
Units	5 character user-entered unit name is displayed.

Channels

Hardware	Supports one or two signal conditioning modules (CH1 and CH2).
Calculated	One (CH3). Choose from list of formulas or enter a user defined formula.

Response	Per channel.
Data Sampling Rate	2000Hz (analog hardware channels), 50Hz (CH3 calculation).
Max/Min Update Rate	2000Hz (analog hardware channels), 50Hz (CH3 calculation).
Limit Checking Rate	1000Hz (hardware channels), 50Hz (CH3 calculation).
Logic I/O Response Time	1ms (hardware channels), 20ms (CH3 calculation).
Update Rate for each Analog Output	1000Hz.
Display Update Rate	4Hz.

Four Logic Inputs	Programmable.
Type	TTL compatible, Schmitt Trigger, low-true.
Internal Pull-up Resistor	47kΩ.
Input Current	&100FA @ 0V.
Protection	To ±130VDC or 130VAC.

Six Logic Outputs	Programmable.
Type	Open collector, low-true.
Maximum Operating Voltage	24V.
Maximum Sink Current	300mA.
Protection	Short circuit (current and thermal limits), Overvoltage (0.5A fuse) to ±130VDC or 130VAC.

Control	All I/O functions can be OR'ed. Patterns add AND'ing capability.
Input Actions (per channel)	Logic inputs, outputs, and internal Matrix signals control following actions. Tare, Clear Tare, Hold, Clear Hold, Reset Max/Min, Clear Latched Limits, Check Limits, Do Max/Mins, Apply %CAL, Apply &CAL, Reset Count (Model UDCA only).
Output Events (per channel)	The following events drive logic outputs and internal Matrix signals. HI Limit, NOT HI Limit, IN Limit, NOT IN Limit, LO Limit, NOT LO Limit, At Max, NOT At Max, At Min, NOT At Min.
Eight User-defined Patterns	Based on logic inputs, outputs, and internal Matrix signals. Pattern outputs drive logic outputs and internal Matrix signals.
State Machine (eight states)	Patterns are used to control State Machine flow. State outputs drive logic outputs and internal Matrix signals.

Limit Checking	
Limits	Each channel has a HI and LO limit with hysteresis.
Modes	Latched/unlatched, absolute/signed.
Data Type	Select either Current, Max, Min, Spread, or Held data for limit checking.
Alarm	Enable/disable backlight flashing for each channel.
External %5VDC	On I/O connector.
Maximum Load Current	250mA.
Protection	Short circuit (current limit), Overvoltage (1A fuse) to ±130VDC or 130VAC.
Two Analog Outputs	Each assignable to any of the three channels.
Output Impedance	<1Ω.
Minimum Load Resistance	10kΩ.
Full Scale	±5V or ±10V (user selectable).
Resolution	2mV (±5V FS) or 4mV (±10V FS).
Overrange	±8.2V (±5V FS) or ±13.5V (±10V FS).
Non-linearity	±2mV (±5V FS) or ±4mV (±10V FS).
Overall Error (including temperature effects)	±5mV (±5V FS) or ±10mV (±10V FS).
Filter	100Hz, 5 pole Bessel response low pass filter.
Protection	Short circuit (current limit), Overvoltage (0.25A fuse) to ±130VDC or 130VAC.
Serial Communication Port	User selectable as RS232, RS422, or RS485.
BAUD Rate	300 to 38400.
Maximum Number of Devices	32 (RS485),1 (RS232/422).
Maximum Cable Length	4000ft (RS422/RS485), 50ft (RS232).
120Ω Termination Resistors (RS485)	User selectable for RXD and TXD.
RS422/485 Transceivers	Slew-rate limited, short circuit protected (current & thermal limits).
RS232 Drivers	Short circuit protected (current limit).
All Serial Inputs and Outputs	±15kV ESD protected, floating (100kΩ to Earth Ground).
Connector on Rear Panel	9 pin D (female).
Commands	Control of all modes, settings, and measurements.
Non-Volatile Memory Storage for System Settings	EEPROM, no battery required.
Input Voltage	**Standard**: 90 to 250VAC, 50/60Hz @ 25VA (max). with two 2A/250V fuses, line filter, and rear power switch. **Option 12D1**: 10 to 15VDC @ 15W (max). with 2A/250V fuse (spare one is provided), filter, and rear power switch.
Operating Temperature	%41EF to %122EF (%5EC to %50EC).
Weight (includes two signal conditioning modules)	3.0lbs.
Dimensions	6.5" wide, 2.9" high, 8.7" deep.

1. Specifications are subject to change without notice.

Model ACUA (AC Strain Gage Amplifier) Specifications

Transducer

Type	Any strain gage transducer, directly wired or transformer coupled.
Impedance	80 to 2000Ω.
Connections	Provision for 4, 6, or 7 wire circuits.

Maximum Cable Length	500ft (for transducer impedance $100Ω). 200ft (for transducer impedance <100Ω).

Excitation

Amplitude	3Vrms sine wave, regulated, and short circuit protected.
Frequency	3030Hz ± 0.01%.
Synchronization	Automatically synchronized with other carrier amplifier, if present.

Signal Input

Sensitivity	0.5 to 5mV/V.
Impedance	100MΩ in parallel with 33pF.

Overrange Capability	50% of Full Scale.

Null Range

In-Phase Signals	±10% of Full Scale (with 50% overrange capability). ±60% of Full Scale (with 0% overrange capability).
Quadrature Signals	±1mV/V.

Calibration	Dual polarity shunt calibration with provision for CAL resistor feedback.
Common/Normal Mode Rejection	120/100dB at 60Hz.
Quadrature Rejection	60dB.
Antialias Filtering	200Hz, 7 pole Bessel response filter.
Low Pass Filtering	4 pole Bessel response digital filter with 10X oversampling. 11 cutoff frequencies from 0.1 to 200Hz (in 1-2-5 steps).
Signal-to-Noise Ratio[2]	0.5mV/V Full Scale: 80/72/62/58dB with 1/10/100/200Hz filters. 1mV/V Full Scale: 86/76/66/62dB with 1/10/100/200Hz filters. 5mV/V Full Scale: 86/80/72/66dB with 1/10/100/200Hz filters.
Resolution	0.01% of Full Scale.
Overall Accuracy (at 77EF/25EC)	0.02% of Full Scale.
Zero Temperature Effects	±0.001% of Full Scale per EF (max).
Span Temperature Effects	±0.001% of Full Scale per EF (max).

1. Specifications are subject to change without notice.
2. Ratio expressed in decibels (dB), of Full Scale to noise spread. Measurements made for a 1 minute interval using a 350Ω bridge.

Model LVDA (LVDT Amplifier) Specifications

Transducer	
Type	Any 4, 5, or 6 wire LVDT.
Impedance	$80Ω at the selected frequency.
Connections	Includes provision for excitation sense.
Excitation	
Amplitude	2Vrms sine wave, regulated, and short circuit protected.
Frequency	2.5kHz, 3kHz, 5kHz or 10kHz ± 1% (keyboard selectable).
Frequency Stability	±0.01% over full operating temperature range.
Signal Input	
Sensitivity	100 to 1000mV/V.
Impedance	100kΩ.
Overrange Capability	50% of Full Scale.
Automatic Zero Range	±10% of Full Scale (with 50% overrange capability). ±60% of Full Scale (with 0% overrange capability).
Auto Calibration	Dual polarity calibration with CAL-CHECK function.
Common/Normal Mode Rejection	120/70dB at 60Hz.
Quadrature Rejection	60dB.
Antialias Filtering	200Hz, 7 pole Bessel response filter.
Low Pass Filtering	4 pole Bessel response digital filter with 10X oversampling. 11 cutoff frequencies from 0.1 to 200Hz (in 1-2-5 steps).
Signal-to-Noise Ratio[2]	100mV/V Full Scale: 86/80/72/64dB with 1/10/100/200Hz filters. 1000mV/V Full Scale: 86/82/74/66dB with 1/10/100/200Hz filters.
Resolution	0.01% of Full Scale.
Overall Accuracy (at 77EF/25EC)	0.02% of Full Scale.
Zero Temperature Effects	±0.001% of Full Scale per EF (max).
Span Temperature Effects	2.5kHz, 3kHz, 5kHz excitation: ±0.001% of Full Scale per EF (max). 10kHz excitaion: ±0.002% of Full Scale per EF (max).

1. Specifications are subject to change without notice.
2. Ratio expressed in decibels (dB), of Full Scale to noise spread. Measurements made for a 1 minute interval using a 100Ω source impedance.

Model DCSA (DC Strain Gage Amplifier) Specifications

Transducer

Type . . . . DC strain gage transducer, directly wired, not transformer coupled.
Resistance . . . . 80 to 2000Ω (with 5VDC excitation).
170 to 2000Ω (with 10VDC excitation).
Connections . . . . Provision for 4, 6, or 7 wire circuits.

Maximum Cable Length . . . . 500ft.

Excitation . . . . 5 or 10VDC, user selectable via jumper.
Regulated and short circuit protected.

Input

Sensitivity . . . . 1 to 4.5mV/V.
Differential Impedance . . . . 100MΩ.

Overrange Capability . . . . 50% of Full Scale.

Automatic Zero Range . . . . ±10% of Full Scale (with 50% overrange capability).
±60% of Full Scale (with 0% overrange capability).

Tare Range . . . . ±100% of Full Scale.
Tare may be actuated from keypad or remotely via logic I/O or serial communication port.

Auto Calibration

Shunt and Load Types . . . . Dual polarity calibration with provision for CAL resistor feedback.
mV/V Type . . . . Absolute span calibration.

Spurious Signal Rejection . . . . 130dB for 60Hz common mode signal.

Antialias Filtering . . . . 200Hz, 5 pole Bessel response filter.

Low Pass Filtering . . . . 4 pole Bessel response digital filter with 10X oversampling.
11 cutoff frequencies from 0.1 to 200Hz (in 1-2-5 steps).

Signal-to-Noise Ratio[2] . . . . 1mV/V FS & 5V Exc: 80/70/59/55dB with 1/10/100/200Hz filters.
1mV/V FS & 10V Exc: 80/74/64/60dB with 1/10/100/200Hz filters.
4.5mV/V FS & 5V Exc: 86/74/68/64dB with 1/10/100/200Hz filters.
4.5mV/V FS & 10V Exc: 86/86/74/68dB with 1/10/100/200Hz filters.

Resolution . . . . 0.01% of Full Scale.

Overall Accuracy (at 77EF/25EC) . . . . 0.01% of Full Scale (typical).
0.02% of Full Scale (worst case).

Zero Temperature Effects . . . . ±0.001% of Full Scale per EF (max).

Span Temperature Effects . . . . ±0.001% of Full Scale per EF (max).

1. Specifications are subject to change without notice.
2. Ratio expressed in decibels (dB), of Full Scale to noise spread. Measurements made for a 1 minute interval using a 100Ω source impedance.

Model DCVA (DC Voltage Amplifier) Specifications

Voltage Input

Type	Differential or single ended.
Sensitivity	±1V to ±10V.
Impedance	2MΩ (differential), 1MΩ (single ended).
Protection	To ±130VDC or 130VAC.

Maximum Cable Length . . . . . 2000ft.

Excitation Supplies[3] . . . . . 5V and 15V.

Maximum Load Currents	250mA[3] (for 5V) or 100mA[3] (for 15V).
Protection	Short circuit (current limit), Overvoltage (fuses: 1A for 5V, 375mA for 15V) to ±130VDC or 130VAC.

Overrange Capability . . . . . 50% of Full Scale.

Zero Control Range . . . . . ±10% of Full Scale (with 50% overrange capability).
±60% of Full Scale (with 0% overrange capability).

Calibration . . . . . Dual polarity calibration.
Two contact closures provided to activate ±CAL signals remotely.

Common Mode Rejection Ratio . . . . . >80dB (DC to 10MHz).

Antialias Filtering . . . . . 200Hz, 5 pole Bessel response filter.

Low Pass Filtering . . . . . 4 pole Bessel response digital filter with 10X oversampling.
11 cutoff frequencies from 0.1 to 200Hz (in 1-2-5 steps).

Signal-to-Noise Ratio[2] . . . . . 86/76/70/62dB with 1/10/100/200Hz filters.

Resolution . . . . . 0.01% of Full Scale.

Overall Accuracy (at 77EF/25EC) . . . . . 0.02% of Full Scale.

Zero Temperature Effects . . . . . ±0.001% of Full Scale per EF (max).

Span Temperature Effects . . . . . ±0.001% of Full Scale per EF (max).

1. Specifications are subject to change without notice.
2. Ratio expressed in decibels (dB), of Full Scale to noise spread. Measurements made for a 1 minute interval using a 100Ω source impedance.
3. Both excitation voltages can be used simultaneously with the following restrictions.
   (5V current) % 6 x (15V current) # 700mA
   5V current # 250mA
   15V current # 100mA
   example, 5V@100mA and 15V@100mA
   example, 5V@250mA and 15V@ 75mA

Model DCIA (DC Current Amplifier) Specifications

Current Input
Type ... May be used either differentially or single ended.
Ranges ... 4-20mA, 12±8mA, 0±10mA, or 0±20mA (selectable from keypad or remotely).
Impedance ... 100Ω (differential), 200kΩ (negative input to ground).
Protection ... ±130VDC or 130VAC at each input to ground.
Differential inputs protected by 62mA fuse.

Maximum Cable Length ... 2000ft.

Excitation Supply ... 15V.
Maximum Load Current ... 30mA.
Protection ... Short circuit (current limit),
Overvoltage (62.5mA fuse) to ±130VDC or 130VAC.

Overrange Capability ... 50% of Full Scale.

Calibration ... Absolute calibration is automatic when current range is selected.

Common Mode Rejection Ratio ... >80dB (DC to 10MHz).

Antialias Filtering ... 200Hz, 5 pole Bessel response filter.

Low Pass Filtering ... 4 pole Bessel response digital filter with 10X oversampling.
11 cutoff frequencies from 0.1 to 200Hz (in 1-2-5 steps).

Signal-to-Noise Ratio[2] ... 86/80/70/63dB with 1/10/100/200Hz filters.

Resolution ... 0.01% of Full Scale.

Overall Accuracy (at 77EF/25EC) ... 0.02% of Full Scale (typical).
0.03% of Full Scale (worst case).

Zero Temperature Effects ... ±0.001% of Full Scale per EF (max).

Span Temperature Effects ... ±0.001% of Full Scale per EF (max).

1. Specifications are subject to change without notice.
2. Ratio expressed in decibels (dB), of Full Scale to noise spread. Measurements made for a 1 minute interval using a 100Ω source impedance.

Model CTUA (Frequency Input Module) Specifications

Transducer . . . . Any uni-directional or bi-directional (quadrature) frequency source, including passive and zero velocity speed pickups, optical encoders, flowmeters, etc. When used with bi-directional sensors, the system outputs both direction and magnitude.

Maximum Cable Length . . . . 500ft.

Excitation Supplies[2] . . . . 5V and 12V.
- Maximum Load Currents . . . . 250mA[2] (for 5V) or 125mA[2] (for 12V).
- Protection . . . . Short circuit (current limit), Overvoltage (fuses: 1A for 5V, 375mA for 12V) to ±130VDC or 130VAC.

Input
- Type . . . . Differential or single ended.
- Threshold (keypad selectable) . . . . 10, 20, 50, 100, or 200mVp-p (between inputs) or TTL.
- Impedance . . . . 100kΩ differential, 50kΩ single ended.
- Maximum Voltage . . . . 130VDC or 130VAC.
- Bandwidth . . . . 0.001 to 200kHz (10 to 200mVp-p threshold) or 400kHz (TTL threshold).
- Low Pass Filter[3] (keypad selectable) . . . . 20kHz (-3dB) or none.
- Common Mode Rejection . . . . 80dB (60Hz), 55dB (0 to 10kHz).

Ranges . . . . Rangeless (use any Full Scale value) with 50% overrange.

Resolution . . . . 0.01% of Full Scale.

Response Time . . . . Greater of: 1ms typical (2ms worst case) or the input period.

Low Pass Filtering of Input Data . . . . Unfiltered or 4 pole Bessel response digital filter. 10 cutoff frequencies from 0.1 to 100Hz (in 1-2-5 steps).

Time Base Stability . . . . 50ppm (max) over operating temperature range.

Overall Accuracy . . . . 0.01% of Full Scale @ %77EF (%25EC). 0.015% of Full Scale @ %41EF to %122EF (%5EC to %50EC).

1. Specifications are subject to change without notice.
2. Both excitation voltages can be used simultaneously with the following restrictions.
   (5V current) % 4.8 x (12V current) # 700mA
   5V current # 250mA
   12V current # 125mA
   example, 5V@100mA and 12V@125mA
   example, 5V@250mA and 12V@ 90mA
3. Low pass hardware filter is **not** available for TTL signals.

Model UDCA (Encoder/Totalizer Module) Specifications

Signal Source . . . . Rotary and linear quadrature encoders or TTL events.

Maximum Cable Length . . . . 500ft.

Excitation Supplies[2] . . . . 5V and 12V.
Maximum Load Currents . . . . 250mA[2] (for 5V) or 125mA[2] (for 12V).
Protection . . . . Short circuit (current limit),
Overvoltage (fuses: 1A for 5V, 375mA for 12V) to ±130VDC or 130VAC.

Inputs . . . . Signal A, Signal B, Reset, Reset Arm.
Type . . . . Single ended, TTL.
Impedance . . . . 50kΩ.
Maximum Voltage . . . . 130VDC or 130VAC.
Bandwidth . . . . 400kHz.

Operating Modes
Quadrature Encoder Mode . . . . Counts input cycles once (1X), or doubles (2X),
or quadruples (4X) the number of input pulses.
Choose *A leads B* or *B leads A* for incrementing direction of counter.
Totalizer Mode . . . . Counts edges of Signal A.
Choose *Rising Edge* or *Falling Edge*.

Counter Reset . . . . Via the RESET key, the Logic I/O, or the transducer connector.

Reset Via the Transducer Connector . . . . Choose *TTL Low*, *TTL High*, or *Ignore*.
Reset Mode . . . . Choose *Leading Edge*, *Level*, */B*, *B*, */A*, *A*,
/A AND /B, */A AND B*, *A AND /B*, or *A AND B*.
Reset Arm Signal . . . . Enables Reset signal (choose *TTL Low*, *TTL High*, or *Ignore)*.

Internal Counter . . . . 48 bits.

Resolution . . . . 0.01% of Full Scale.

Response Time . . . . 0.5ms.

Low Pass Filtering of Input Data . . . . Unfiltered or 4 pole Bessel response digital filter.
10 cutoff frequencies from 0.1 to 100Hz (in 1-2-5 steps).

1. Specifications are subject to change without notice.
2. Both excitation voltages can be used simultaneously with the following restrictions.
   (5V current) % 4.8 x (12V current) # 700mA
   5V current # 250mA
   12V current # 125mA
   example, 5V@100mA and 12V@125mA
   example, 5V@250mA and 12V@ 90mA

Option MA (Current Output) Specifications

Output (two jumper selected modes, as follows)
Unidirectional Mode . . . . . 4-20mA.
Bi-directional Mode . . . . . 12±8mA.

Resolution
Unidirectional Mode . . . . . 6.4FA.
Bi-directional Mode . . . . . 3.2FA.

Overrange Capability
Unidirectional Mode . . . . . 0.8 to 23.2mA.
Bi-directional Mode . . . . . 12±11.2mA.

Non-linearity
Unidirectional Mode . . . . . ±8FA.
Bi-directional Mode . . . . . ±4FA.

Overall Error (including temperature effects)
Unidirectional Mode . . . . . ±20FA.
Bi-directional Mode . . . . . ±10FA.

Output Filter . . . . . 100Hz, 5 pole Bessel response low pass filter.

Load Resistance . . . . . 0 to 200Ω, maximum.

Protection . . . . . Overvoltage (0.25A fuse) to ±130VDC or 130VAC.

1. Specifications are subject to change without notice.

Option MB (Current Output) Specifications

Output . . . . . 10±10mA.

Resolution . . . . . 4FA.

Overrange Capability . . . . . 0 to 23.2mA.

Non-linearity . . . . . ±5FA.

Overall Error (including temperature effects) . . . . . ±12FA.

Output Filter . . . . . 100Hz, 5 pole Bessel response low pass filter.

Load Resistance . . . . . 0 to 500Ω, maximum.

Protection . . . . . Overvoltage (0.25A fuse) to ±130VDC or 130VAC.

1. Specifications are subject to change without notice.

Option MC (Voltage Output) Specifications

Output . . . . 5±5V.

Resolution . . . . 2mV.

Overrange Capability . . . . 0 to 12V.

Non-linearity . . . . ±2.5mV.

Overall Error (including temperature effects) . . . . ±6mV.

Output Filter . . . . 100Hz, 5 pole Bessel response low pass filter.

Output Impedance . . . . <1Ω.

Minimum Load Resistance . . . . 10kΩ.

Protection . . . . Short circuit (current limit),
Overvoltage (0.25A fuse) to ±130VDC or 130VAC.

1. Specifications are subject to change without notice.