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.
- 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.
- 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.

### Signal Conditioning Modules

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Description</th>
<th>Type</th>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NONE</td>
<td>not installed</td>
<td>4</td>
<td>LVDA</td>
<td>LVDT</td>
</tr>
<tr>
<td>1</td>
<td>ACUA</td>
<td>AC Strain Gage</td>
<td>5</td>
<td>UDCA</td>
<td>Encoder/Totalizer</td>
</tr>
<tr>
<td>2</td>
<td>CTUA</td>
<td>Frequency Input</td>
<td>6</td>
<td>DCIA</td>
<td>DC Current</td>
</tr>
<tr>
<td>3</td>
<td>DCVA</td>
<td>DC Voltage</td>
<td>8</td>
<td>DCSA</td>
<td>DC Strain Gage</td>
</tr>
</tbody>
</table>

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

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

### Rear Panel

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).
GETTING STARTED

**Power switch**
Connect to power source that delivers 90-250VAC, 47-63Hz.

**Standard Unit VAC Powered**
- Two 2A/250VAC fuses are used.
- Connect computer serial port here. RS232, RS422, and RS485 are supported. See APPENDIX A for connector pinouts and typical cables.
- 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.
- I/O connector includes:
  - 4 Logic Inputs
  - 6 Logic Outputs
  - 2 Analog Outputs
  - Analog Ground
  - 5Vdc
  - Digital Ground
  - See APPENDIX A for connector pinout.

**Option 12D1 12VDC Powered**
- Connect to power source that delivers 10-15VDC.
- One 2A/250VAC fuse is used. A spare one is included.
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.

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

**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.

**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 State 1.

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
**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 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.

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.

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.

You cannot enter the menu when a Test is running.

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

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.

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.

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

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

- Current data displayed
- Spread data displayed
- Max data displayed
- Held data displayed
- Min data displayed
- 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 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.

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

- Enter menu by pressing MENU key.
  
  If password is enabled, Enter password is displayed with first character of the three character password entry flashing.
  
  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.

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.

- 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.

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.

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.
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

LO Limit
LO Hyst
LO Latch
HI Limit
HI Hyst
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

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.

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).

Filter does not apply to CH3 calculation.
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

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.

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 exceeded and data returned within limits, all three signals will be ON.

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

### LO Hysteresis

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

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**

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

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.

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

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*.

### Limit Alarm

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.

Default setting for Limit Type is *Current Data*.

Spread = Max − Min

Default setting for Limit Alarm is *Flash Backlight*. 
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.

<table>
<thead>
<tr>
<th>space</th>
<th>A through Z</th>
<th># @ &amp; . % ^ _</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 through 9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Display Resolution

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.

<table>
<thead>
<tr>
<th>Full Scale (FS)</th>
<th>Internal Resolution (FS÷10000)</th>
<th>Four Choices for Display Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 to 1414</td>
<td>0.1000 to 0.1414</td>
<td>Best: 0.10 0.20 0.50 1.00</td>
</tr>
<tr>
<td>1415 to 3162</td>
<td>0.1415 to 0.3162</td>
<td>Worst: 1.00 2.00 5.00</td>
</tr>
<tr>
<td>3163 to 7071</td>
<td>0.3163 to 0.7071</td>
<td></td>
</tr>
<tr>
<td>7072 to 10000</td>
<td>0.7072 to 1.0000</td>
<td></td>
</tr>
</tbody>
</table>
TARE Key

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)

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

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.

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)**

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.
CHANG CALIBRATION (MODEL ACUA)

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.

**For Shunt Calibrations**
- **Type of CAL**
- **Full Scale**
- **Zero Value**
  - +CAL Value
  - -CAL Value
- **To CAL Xdcr**

**For Load Calibrations**
- **Type of CAL**
- **Full Scale**
- **Zero Value**
  - +Load Value
  - -Load Value
- **To Zero Xdcr**
- **To do +CAL**
- **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**.

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 60k\(\Omega\) CAL resistor is provided. Refer to the transducer calibration sheet for the CAL resistor value. \(\pm 0.02\%, \pm 5\text{ppm}/^\circ\text{C}\) resistors are recommended. To install or change the CAL resistor, see CAL Resistor Installation (Models ACUA and DCSA) in APPENDIX B.

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.

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

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.

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

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

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

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.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To CAL Xdcr CH1 Press ENTER</td>
<td>To initiate calibration, press ENTER key.</td>
</tr>
<tr>
<td>2. Unload Xdcr CH1 - 2.0 OK?</td>
<td>Unload the transducer, then press ENTER key. Current data is shown.</td>
</tr>
<tr>
<td>3. Please wait CH1 0.0 Adj0</td>
<td>Zero and gain are being adjusted.</td>
</tr>
<tr>
<td>4. CAL Done CH1 0.0 OK?</td>
<td>Calibration is done. Press ENTER key to accept, or ESC key to cancel and return to previous adjustment.</td>
</tr>
<tr>
<td>5. CHAN Calibration</td>
<td>Return to top of CHAN Calibration menu.</td>
</tr>
</tbody>
</table>

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.

For zero/null range, see APPENDIX H.

- **Please wait CH1**
  - 0.0 Adj
  - 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.

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.

For input sensitivity, see APPENDIX H.

- **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 (Load Calibrations)

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

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.

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)

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.

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.

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.

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.

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

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.

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.

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 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.

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.

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

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.

To initiate adjustment, press ENTER key.

Set LVDT at electrical zero by moving plunger until data is near 0. Then, press ENTER key.

Zero is being adjusted.

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

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.

To initiate adjustment, press ENTER key.

Displace LVDT plunger by amount equal to +CAL Point, then press ENTER key. Current data is shown.

Gain is being adjusted.

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

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.

### Test Signals

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.
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.

### Shunt Calibrations
- **Type of CAL**: Full Scale, Zero Value, +CAL Value, -CAL Value
- **To CAL Xdcr**: To do +CAL, To do -CAL

### Load Calibrations
- **Type of CAL**: Full Scale, Zero Value, Load Value, To Zero Xdcr
- **To do**: +CAL, -CAL

### mV/V Calibrations
- **Type of CAL**: Full Scale, mV/V @ +FS, mV/V @ -FS
- **To CAL Xdcr**: To do +CAL, 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**.

To do a Load calibration,

- Select **Type of CAL**.
- Enter **Full Scale**, **Zero Value**, Load Value, 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/°C resistors are recommended. To install or change the CAL resistor, see CAL Resistor Installation (Models ACUA and DCSA) in APPENDIX B.

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.

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.

\[ +\text{CAL Value} \mid +\text{Load Value} \mid mV/V \@ +\text{FS} \]

Default value for \(-\text{CAL Value}, -\text{Load Value}, \) and \(mV/V \@ -\text{FS}\) is 7500.

For Shunt calibrations, \( -\text{CAL Value} \) 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, \(-\text{Load Value}\) 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, \( mV/V \@ -\text{FS}\) 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.

\[ -\text{CAL Value} \mid -\text{Load Value} \mid mV/V \@ -\text{FS} \]

Default value for \(-\text{CAL Value}, -\text{Load Value}, \) and \(mV/V \@ -\text{FS}\) 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, \(-\text{CAL Value}\) 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, \(-\text{Load Value}\) 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, \( mV/V \@ -\text{FS}\) 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 initiate calibration, press ENTER key.

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

Zero and gain are being adjusted.

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

Return to top of CHAN Calibration menu.

For zero 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

Unload Xdcr CH1
- 2.0 OK?

For zero range, see APPENDIX H.

Please wait CH1
0.0 Adj:

Zero Done CH1
0.0 OK?

To do +CAL CH1
Press ENTER

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

Load Xdcr + CH1
7286.0 OK?

For input sensitivity, see APPENDIX H.

Please wait CH1
7500.0 Adj:

+CAL Done CH1
7500.0 OK?

To do -CAL CH1
Press ENTER

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

Gain is being adjusted.

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

Go to next menu selection.
To do –CAL (Load Calibrations)

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 initiate adjustment, press ENTER key.

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

Negative data is being scaled.

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

Return to top of CHAN Calibration menu.

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.
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 initiate calibration, press ENTER key.

Unload Xdcr CH1

- 2.0 OK?

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.

Return to top of CHAN Calibration menu.

Test Signals

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.

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)
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.

<table>
<thead>
<tr>
<th>For Remote Calibrations</th>
<th>For Load Calibrations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of CAL</td>
<td>Type of CAL</td>
</tr>
<tr>
<td>Full Scale</td>
<td>Full Scale</td>
</tr>
<tr>
<td>Zero Value</td>
<td>Zero Value</td>
</tr>
<tr>
<td>+CAL Value</td>
<td>-Load Value</td>
</tr>
<tr>
<td>-CAL Value</td>
<td>-Load Value</td>
</tr>
<tr>
<td></td>
<td>To Zero Xdcr</td>
</tr>
<tr>
<td>To CAL Xdcr</td>
<td>To do +CAL</td>
</tr>
<tr>
<td></td>
<td>To do -CAL</td>
</tr>
</tbody>
</table>

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

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.

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.

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

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

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

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.

To initiate calibration, press ENTER key.

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

Zero and gain are being adjusted.

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

Return to top of CHAN Calibration menu.

For zero 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 Adj
  - 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.

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)

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 initiate adjustment, press ENTER key.

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

Negative data is being scaled.

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

Return to top of CHAN Calibration menu.

Test Signals

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.

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.
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**

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.

<table>
<thead>
<tr>
<th>Transducer Output (mA)</th>
<th>Displayed Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Range</strong></td>
<td>General Case</td>
</tr>
<tr>
<td>±10 mA</td>
<td>±20 mA</td>
</tr>
<tr>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-10</td>
<td>-20</td>
</tr>
<tr>
<td>-15</td>
<td>-30</td>
</tr>
</tbody>
</table>

* 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**

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

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.
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

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

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

\[
60 \text{ RPM} = \frac{60 \text{ rotations}}{\text{minute}} \times \frac{1 \text{ minute}}{60 \text{ seconds}} \times \frac{60 \text{ pulses}}{1 \text{ rotation}}
\]

\[
= \frac{60 \text{ pulses}}{1 \text{ second}}
\]

\[
= 60 \text{ Hz}
\]

Therefore, the speed pickup generates a 60Hz signal at 60RPM. Enter 60Hz as \textit{Xdcr Freq} and 60RPM as \textit{Xdcr Value}.

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

\textit{Xdcr • Transducer}

Default value for \textit{Xdcr Freq} is 10000.

Default value for \textit{Xdcr Value} is 10000.
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.

\[
60 \text{ RPM} = \frac{60 \text{ rotations}}{\text{minute}} \times \frac{1 \text{ minute}}{60 \text{ seconds}} \times \frac{512 \text{ pulses}}{1 \text{ rotation}}
\]

\[
= \frac{512 \text{ pulses}}{1 \text{ second}}
\]

\[
= 512 \text{ Hz}
\]

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.

\[
60 \text{ GPM} = \frac{60 \text{ gallons}}{\text{minute}} \times \frac{1 \text{ minute}}{60 \text{ seconds}} \times \frac{3000 \text{ cycles}}{1 \text{ gallon}}
\]

\[
= \frac{3000 \text{ cycles}}{1 \text{ second}}
\]

\[
= 3000 \text{ Hz}
\]

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.

**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.

**TTL (Quadrature)**

Similar to TTL setting except two quadrature signals (90° 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.

<table>
<thead>
<tr>
<th>Quadrature Signals</th>
<th>10mVp-p</th>
<th>20mVp-p</th>
<th>50mVp-p</th>
<th>100mVp-p</th>
<th>200mVp-p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

Default setting for Input Type is TTL.
Polarity

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

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

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.

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**

You can check operation of the Model CTUA (Frequency Input 
Module) using internal test signals. In the data screen (with Test *not* 
runtime), 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)

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

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.

Default value for Full Scale is 10000.
The two entries, \textit{Xdcr Pulses} and \textit{Xdcr Value}, provide the necessary transducer (count source) calibration data required for engineering unit scaling. \textit{Xdcr Value} is an arbitrary value (in engineering units), and \textit{Xdcr Pulses} is the corresponding number of pulses generated by the transducer to get \textit{Xdcr Value}. Following are six examples showing how to determine \textit{Xdcr Value} and \textit{Xdcr Pulses} for various transducers.

**Example 1:**

A rotary encoder with 512 pulses per revolution is used and you want to display number of revolutions. Pick 1 revolution as \textit{Xdcr Value}, and use 512 for \textit{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 \textit{Xdcr Value}, and use 1000 for \textit{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 \textit{Xdcr Value}, and use 100 for \textit{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 \textit{Full Scale} to 10,000. This provides a Display Resolution of 1 Event. See Display Resolution in CHAN SETTINGS. Pick 1 Event as \textit{Xdcr Value}, and use 1 for \textit{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.

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

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 (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 (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.

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

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

For Event mode, Input B is ignored.

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.

1X: \[
\frac{360 \text{ degrees}}{3600 \text{ counts}} = 0.100 \frac{\text{degrees}}{\text{count}}
\]

2X: \[
\frac{360 \text{ degrees}}{7200 \text{ counts}} = 0.050 \frac{\text{degrees}}{\text{count}}
\]

4X: \[
\frac{360 \text{ degrees}}{14400 \text{ counts}} = 0.025 \frac{\text{degrees}}{\text{count}}
\]

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.
+ Direction (1X, 2X, 4X Count Modes)

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.

Quadrature Count Edge Diagram

Count Edge (Event Count Mode)
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

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.

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
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.

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.

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.

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.

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.
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.

![Diagram](https://via.placeholder.com/150)

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.

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.

![Diagram](https://via.placeholder.com/150)

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

**Test Signals**

You can check operation of most modules using internal test signals.

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

For the Model UDCA, there are no test signals and instead positive or negative Full Scale is displayed.
CHAN CALIBRATION (CH3 CALCULATION)

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

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.

For example, \[ CH3 = \frac{CH1 \times CH2}{A} \]

- \( A = 63025 \)
- CH1 Full Scale is 1000.
- CH2 Full Scale is 10000.

Then, \[ CH3 = \frac{1000 \times 10000}{63025} \]

\[ CH3 = 158.67 \]

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

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 \( \times A \) (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.

- \( \times CH2 \times A \)
- \( CH2 \times A \)
- \( CH2 \times A \)
- \( \times CH1 \times A \)
- \( CH1 \times A \)
- \( CH1 \times A \)
- \( (CH1-CH2) \times A \)
- \( (CH1+CH2) \times A \)
- \( \times CH2 \times CH1 \times A \)
- \( CH2 \times CH1 \times A \)
- \( \times CH1 \times CH2 \times A \)
- \( CH1 \times CH2 \times A \)
- \( (CH1-CH2) \times A \)
- \( (CH1+CH2) \times A \)
- \( \times CH2 \times CH1 \times A \)
- \( CH2 \times CH1 \times A \)

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 \( \times \) add operator \( \times \) 2nd value \( \times \) equal operator

**Reverse Polish Notation (RPN):**

1st value \( \times \) 2nd value \( \times \) 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.

### User Defined Calculation Operator/Operand List

<table>
<thead>
<tr>
<th>Operators and Operands</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Channel 1</td>
<td>Use data from channel selected. Type of data depends on which data type operator (c, x, m, h, or t) was last specified.</td>
</tr>
<tr>
<td>2</td>
<td>Channel 2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Channel 3</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Constant A</td>
<td>Use value of user constant selected.</td>
</tr>
<tr>
<td>B</td>
<td>Constant B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Constant C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Duplicate</td>
<td>Copy last result.</td>
</tr>
<tr>
<td>E</td>
<td>Edge Counter of IM6</td>
<td>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).</td>
</tr>
<tr>
<td>I</td>
<td>Pulse Width of IM5</td>
<td>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.</td>
</tr>
<tr>
<td>L</td>
<td>Logic Level of IM4</td>
<td>Result is 1 if IM4 is true (ON). Result is 0 if IM4 is false (OFF).</td>
</tr>
<tr>
<td>a</td>
<td>Absolute Value</td>
<td>Compute absolute value of last result.</td>
</tr>
<tr>
<td>q</td>
<td>Square Root</td>
<td>Compute square root of last result.</td>
</tr>
<tr>
<td>n</td>
<td>Negation</td>
<td>Multiply last result by −1.</td>
</tr>
<tr>
<td>r</td>
<td>Reciprocal</td>
<td>Divide 1 by last result.</td>
</tr>
<tr>
<td>c</td>
<td>Current Data</td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>Max Data</td>
<td>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.</td>
</tr>
<tr>
<td>m</td>
<td>Min Data</td>
<td></td>
</tr>
<tr>
<td>h</td>
<td>Held Data</td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>Tare Value</td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>Addition</td>
<td>Perform the specified operation on the last two arguments. The result replaces the two arguments and can be used in further operations.</td>
</tr>
<tr>
<td>−</td>
<td>Subtraction</td>
<td></td>
</tr>
<tr>
<td>×</td>
<td>Multiplication</td>
<td></td>
</tr>
<tr>
<td>/</td>
<td>Division</td>
<td></td>
</tr>
</tbody>
</table>

*IM4 • Internal Matrix 4*

*IM5 • Internal Matrix 5*

*IM6 • Internal Matrix 6*

See LOGIC I/O.
The following table lists examples of various calculations along with the RPN string equivalent.

### Examples of User Defined Calculations

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

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 \( \times A \) (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 \( \times A \) to \( /A \), or visa versa.

For example, \( CH3 = (CH1 \times CH2) \times A \)

\[
A = 1.58667 \times 10^{-5}
\]

\[
A = 0.0000158667
\]

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:

\[
CH3 = (CH1 \times CH2)/A
\]

\[
A = 1/1.58667 \times 10^{-5}
\]

\[
A = 63025
\]

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.

For example, \( CH3 = (CH1 \times CH2)/A \)

\[
A = 1008400
\]

\[
1/A = 0.000000991670
\]

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.

\[
CH3 = (CH1 \times CH2)/(A \times B)
\]

\[
A = 1008.4
\]

\[
B = 1000
\]

RPN String = 12 \( \times AB \times / \)
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
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.

**Default value for Adjust Contrast is 50**

### 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.

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

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

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.

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**

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

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.

Default setting for Power Up View is 2 Channel.

Power Up CHAN

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.

Default setting for Power Up CHAN is CH1.

Power Up Type

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.

Default setting for Power Up Type is Current Data.
State Machine

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.

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.

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.

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.

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.

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.

If a channel is selected
- Input Action
  - Tare
  - Hold
  - Clear Hold
  - Reset MaxMin
  - Clear Latch Lim
  - Check Limits
  - Do Max/Min
  - 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
  - Pattern8
  - Pattern/State Outputs
  - Pattern1 OUT
  - Pattern8 OUT
  - Pattern1 OUT (or State1 OUT)
  - Pattern8 OUT (or 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.

Performs OR function. An input action is performed when any of its assigned logic inputs, outputs, and internal Matrix signals are true.

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:

Tare
Clear Tare
Hold
Clear Hold
Reset MaxMin
Clr Ltlh Lim (Clear Latched Limits)
Check Limits
Do Max/Minš
Apply ‘CAL’
Apply ‘CAL’*  * Does not apply for CH3 calculation.
Reset Count**  ** 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.

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 (0) 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 (0) 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

Select assigned (1) or not assigned (0) 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.

Limit checking can be performed on Held data.
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 \((\text{Max} - \text{Min})\) 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**

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.

**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 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

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 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
Select assigned (1) or not assigned (0) 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

Select assigned (1) or not assigned (0) 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

Select assigned (1) or not assigned (0) 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

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.

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:

- 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

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

Select assigned (1) or not assigned (0) 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.

IN Limit

Select assigned (1) or not assigned (0) 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.

LO Limit

Select assigned (1) or not assigned (0) 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**

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**

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.

\[
\text{At Max is set when Current data} \leq \text{Max data} \quad \text{and is reset when Current data} < \text{Max data} - \text{HI Hysteresis}
\]

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**
**NOT At Max**

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**

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.

\[
\text{At Min is set when Current data } < \text{ Min data} \\
\text{and is reset when Current data } > \text{ Min data } + \text{ LO Hysteresis}
\]
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**

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

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:

- 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
LogicOuts 00--1-
IntMatrix 011--

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 (Ø), 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.

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.

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:

Pattern1 OUT OR State1 OUT
NOT Pattern1 OUT to NOT State1 OUT
Pattern8 OUT to 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.

Pattern1 OUT

<table>
<thead>
<tr>
<th>LogicOuts 1---1-</th>
<th>IntMatrix -111--</th>
</tr>
</thead>
<tbody>
<tr>
<td>123456</td>
<td>123456</td>
</tr>
</tbody>
</table>

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.

State1 OUT

<table>
<thead>
<tr>
<th>LogicOuts -1-1--</th>
<th>IntMatrix 1--11--</th>
</tr>
</thead>
<tbody>
<tr>
<td>123456</td>
<td>123456</td>
</tr>
</tbody>
</table>

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**

For each of the eight pattern outputs, select assigned (I) 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**

For each of the eight state outputs, select assigned (I) 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**

For each of the eight *NOT* pattern outputs, select assigned (1) or not assigned (0) 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**

For each of the eight *NOT* state outputs, select assigned (1) or not assigned (0) 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

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
- CH used for ANA2
- Adjust ANAOUTS

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.

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.

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.

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

<table>
<thead>
<tr>
<th>Data of Channel Driving Output</th>
<th>Analog Outputs, ANA1 and ANA2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard Modes</td>
</tr>
<tr>
<td></td>
<td>±5V</td>
</tr>
<tr>
<td>1.50 x FS</td>
<td>7.5</td>
</tr>
<tr>
<td>1.40 x FS</td>
<td>7</td>
</tr>
<tr>
<td>1.35 x FS</td>
<td>6.75</td>
</tr>
<tr>
<td>1.32 x FS</td>
<td>6.6</td>
</tr>
<tr>
<td>1.20 x FS</td>
<td>6</td>
</tr>
</tbody>
</table>

### Shaded boxes in table
- Indicate voltage or current limits reached.

### See APPENDIX H for analog output resolution.

### 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.

### Channel used for Analog Output 1

#### 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 | \( \left( \frac{d}{FS} \times 10mA \right) + 10mA \)
For the entry, \textit{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**

For the entry, \textit{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**

At the selection, \textit{Adjust ANAOUTs}, press ENTER key to have system automatically adjust both analog outputs. The messages, \textit{Please wait... Adjusting ANA1}, followed by \textit{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 \textit{Analog Outputs} menu. \textit{Analog Outputs} is displayed. You can continue navigating the menu using Cursor keys.

Normally, you do \textbf{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).

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

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

\textbf{Default setting for CH used for ANA1 is CH1 if it exists, otherwise it’s CH2.}

\textbf{Default setting for CH used for ANA2 is CH2 if it exists, otherwise it’s CH3.}
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**

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

- 38400
- 19200
- 9600
- 4800
- 2400
- 1200
- 600
- 300

*Default value for BAUD Rate is 38400.*

**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:

- 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)

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

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

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.
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.

<table>
<thead>
<tr>
<th></th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic Out</td>
<td>5</td>
<td>Logic Out</td>
<td>4</td>
<td>Logic Out</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Logic In</td>
<td>4</td>
<td>Logic In</td>
<td>3</td>
<td>Logic In</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>ANA Out</td>
<td>2</td>
<td>ANA Out</td>
<td>1</td>
<td>ANA GND</td>
<td>Logic GND</td>
</tr>
</tbody>
</table>
Examples of Typical Logic Input Sources

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

**Examples of Typical Logic Output Loads**

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

**Ext +5VDC**
- Load Current: 250mA max

**Solid State Relay**
- Typical Input of Solid State Relay
Model ACUA 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.

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

CAL FB is CAL Feedback

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.

<table>
<thead>
<tr>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAL FB</td>
<td>-Input</td>
<td>-Input</td>
<td>ANA GND</td>
<td>Shield</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Excitation</td>
<td>-Sense</td>
<td>+Sense</td>
<td>-Excitation</td>
</tr>
</tbody>
</table>
**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

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.

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

<table>
<thead>
<tr>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserved</td>
<td>Input</td>
<td>Input</td>
<td>ANA GND</td>
<td>Shield</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Excitation</td>
<td>-Sense</td>
<td>+Sense</td>
<td>-Excitation</td>
</tr>
</tbody>
</table>

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

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.

<table>
<thead>
<tr>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAL FB</td>
<td>+Input</td>
<td>-Input</td>
<td>ANA GND</td>
<td>Shield</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Excitation</td>
<td>-Sense</td>
<td>+Sense</td>
<td>-Excitation</td>
</tr>
</tbody>
</table>

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

CAL FB is CAL Feedback

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

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.

<table>
<thead>
<tr>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>-CAL (NO)</td>
<td>+CAL (NO)</td>
<td>GND</td>
<td>-Input</td>
<td>-Input</td>
</tr>
<tr>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>CAL COM</td>
<td>+5VDC</td>
<td>GND</td>
<td>+15VDC</td>
<td></td>
</tr>
</tbody>
</table>

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

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

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

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.

<table>
<thead>
<tr>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserved</td>
<td>Reserved</td>
<td>GND</td>
<td>Input</td>
<td>Input</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserved</td>
<td>Reserved</td>
<td>GND</td>
<td>+15VDC</td>
</tr>
</tbody>
</table>

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

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.
APPENDIX A, REAR PANEL CONNECTORS

**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.*
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.

<table>
<thead>
<tr>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserved</td>
<td>GND</td>
<td>Input B(−)</td>
<td>Input B(−)</td>
<td>Input A(+)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserved</td>
<td>+5VDC</td>
<td>ANA GND</td>
<td>+12VDC</td>
</tr>
</tbody>
</table>

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.
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

* 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.

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Reset</td>
<td>GND</td>
<td>Input B</td>
<td>Input B</td>
<td>Input A</td>
</tr>
</tbody>
</table>

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Reset Arm</td>
<td>+5VDC</td>
<td>ANA GND</td>
<td>+12VDC</td>
</tr>
</tbody>
</table>

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.
APPENDIX A, REAR PANEL CONNECTORS

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).

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).

Typical Encoder (with Reset Switch) 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
Examples of Typical Reset and Reset Arm Sources

Make sure Reset Signal and/or Reset Arm 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.

<table>
<thead>
<tr>
<th></th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GND Reserved</td>
<td>RXD</td>
<td>TXD</td>
<td>+TXD</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-RXD</td>
<td>+RXD</td>
<td>Reserved</td>
<td>-TXD</td>
</tr>
</tbody>
</table>

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 2000 ft 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 28Ω and 716Ω. A typical value for RB is 47Ω.
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 to 1.
- 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

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.

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 — RS232 is selected.

1 — RS422/485 is selected.
RS485/422 Termination Jumpers

J3
No termination resistor for RXD+ and RXD−.

J3
120Ω termination resistor between RXD+ and RXD−.

J6
No termination resistor for TXD+ and TXD−.

J6
120Ω termination resistor between TXD+ and TXD−.

Logic Output Fuses

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.

224-7379A

Front
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 60k\(\Omega\) CAL resistor is provided. Refer to the transducer calibration sheet for the CAL resistor value. ±0.02%, ±5ppm/°C resistors are recommended.

Make sure CAL resistor leads do **not** touch components below them.

---

Model name, ACUA, etched on back side.

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 DCSA**

Component Side

- Jumper shown in 10V (default) position.
- Jumper shown in 5V position.

---

Model name, DCSA, etched on back side.
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.

Anti-Static precautions must be observed when removing and handling boards.
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.

For Option MB board for ANA1

Option MB board for ANA2

224-7379A

Front
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

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.

1. Turn power OFF and unplug unit from power source.
2. Open cabinet (see Opening the Cabinet in APPENDIX B).
3. Make sure both module slots are empty. See Module Removal in APPENDIX B.
4. Place cover on cabinet to avoid electric shock. Bezel can remain off. Connect power source and turn unit ON.
5. 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
```

- 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.

CAUTION:
Resetting memory initializes ALL user selections including calibration adjustments to default settings. All channels must be recalibrated.

CAUTION:
To avoid electric shock, remove power cord before opening cabinet.

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.
### APPENDIX D, MENU LIST WITH DEFAULT SETTINGS

#### CHAN Settings Menu Selections

<table>
<thead>
<tr>
<th>Selection</th>
<th>Choices</th>
<th>Default</th>
<th>CH1</th>
<th>CH2</th>
<th>CH3 Calc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter</td>
<td>0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200Hz</td>
<td>1Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LO Limit</td>
<td>enter numeric value</td>
<td>-10000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LO Hysteresis</td>
<td>enter numeric value</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LO Latch</td>
<td>OFF or ON</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HI Limit</td>
<td>enter numeric value</td>
<td>10000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HI Hysteresis</td>
<td>enter numeric value</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HI Latch</td>
<td>OFF or ON</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit Mode</td>
<td>Signed or Absolute</td>
<td>Signed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit Type</td>
<td>Current, Held, Spread, Min, or Max Data</td>
<td>Current Data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit Alarm</td>
<td>Flash Backlight or None</td>
<td>Flash Backlight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units</td>
<td>enter up to 5 characters (upper or lower case)</td>
<td>blank</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display Resolution</td>
<td>choose from 4 choices</td>
<td>best (smallest)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TARE Key</td>
<td>Tare Enabled or Tare Disabled</td>
<td>CH1/2: Enabled, CH3: Disabled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESET Key</td>
<td>Clear Tare or Don’t Clear Tare</td>
<td>Clear Tare</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max/Min Type</td>
<td>Filtered Data or Raw Data</td>
<td>Filtered Data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESET Key²</td>
<td>Don’t Reset Cntr or Reset Counter</td>
<td>Don’t Reset Cntr</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### System Options Menu Selections

<table>
<thead>
<tr>
<th>Selection</th>
<th>Choices</th>
<th>Default</th>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjust Contrast</td>
<td>1 to 100</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Backlight</td>
<td>ON or OFF</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>Menu Password</td>
<td>enter 3 characters</td>
<td>SHC</td>
<td></td>
</tr>
<tr>
<td>Check Limits</td>
<td>Always in Test or Use I/O Control</td>
<td>Always in Test</td>
<td></td>
</tr>
<tr>
<td>Do Max/Mins</td>
<td>Always in Test or Use I/O Control</td>
<td>Always in Test</td>
<td></td>
</tr>
<tr>
<td>Power Up</td>
<td>Test OFF or Test ON</td>
<td>Test OFF</td>
<td></td>
</tr>
<tr>
<td>Power Up View</td>
<td>2 Channel, 1Channel, I/O Status, or Limit Status</td>
<td>2 Channel</td>
<td></td>
</tr>
<tr>
<td>Power Up CHAN</td>
<td>CH1, CH2, or CH3</td>
<td>CH1</td>
<td></td>
</tr>
<tr>
<td>Power Up Type</td>
<td>Current, Tare Value, Held, Spread, Min, or Max Data</td>
<td>Current Data</td>
<td></td>
</tr>
<tr>
<td>State Machine</td>
<td>OFF or ON</td>
<td>OFF</td>
<td></td>
</tr>
</tbody>
</table>

#### Analog Outputs Menu Selections

<table>
<thead>
<tr>
<th>Selection</th>
<th>Choices</th>
<th>Default</th>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH used for ANA1</td>
<td>CH1, CH2, or CH3</td>
<td>CH1, if present, otherwise CH2</td>
<td></td>
</tr>
<tr>
<td>CH used for ANA2</td>
<td>CH1, CH2, or CH3</td>
<td>CH2, if present, otherwise CH3</td>
<td></td>
</tr>
<tr>
<td>Adjust ANAOUTs</td>
<td>press ENTER to adjust</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### COM Options Menu Selections

<table>
<thead>
<tr>
<th>Selection</th>
<th>Choices</th>
<th>Default</th>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAUD Rate</td>
<td>300, 600, 1200, 2400, 4800, 9600, 19200, 38400</td>
<td>38400</td>
<td></td>
</tr>
<tr>
<td>Data Bits/Parity</td>
<td>8/None, 8/Even, 8/Odd, 7/Even, 7/Odd</td>
<td>8/None</td>
<td></td>
</tr>
<tr>
<td>Unit ID</td>
<td>enter single upper or lower case alpha character</td>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>CH1</th>
<th>Logic Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hi Limit</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>NOT Hi Limit</td>
<td>5 6</td>
</tr>
<tr>
<td>In Limit</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>NOT In Limit</td>
<td>5 6</td>
</tr>
<tr>
<td>Lo Limit</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>NOT Lo Limit</td>
<td>5 6</td>
</tr>
<tr>
<td>At Max</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>NOT At Max</td>
<td>5 6</td>
</tr>
<tr>
<td>At Min</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>NOT At Min</td>
<td>5 6</td>
</tr>
</tbody>
</table>

### Logic Outputs

<table>
<thead>
<tr>
<th>CH2</th>
<th>Logic Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hi Limit</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>NOT Hi Limit</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>In Limit</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>NOT In Limit</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Lo Limit</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>NOT Lo Limit</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>At Max</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>NOT At Max</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>At Min</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>NOT At Min</td>
<td>1 2 3 4 5 6</td>
</tr>
</tbody>
</table>

### Internal Matrix

<table>
<thead>
<tr>
<th>CH3</th>
<th>Logic Inputs</th>
<th>Logic Outputs</th>
<th>Internal Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hi Limit</td>
<td>1 2 3 4 5 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOT Hi Limit</td>
<td>1 2 3 4 5 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Limit</td>
<td>1 2 3 4 5 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOT In Limit</td>
<td>1 2 3 4 5 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lo Limit</td>
<td>1 2 3 4 5 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOT Lo Limit</td>
<td>1 2 3 4 5 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Max</td>
<td>1 2 3 4 5 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOT At Max</td>
<td>1 2 3 4 5 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Min</td>
<td>1 2 3 4 5 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOT At Min</td>
<td>1 2 3 4 5 6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Input Actions

<table>
<thead>
<tr>
<th>CH1</th>
<th>Input Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tare</td>
<td></td>
</tr>
<tr>
<td>Clear Tare</td>
<td></td>
</tr>
<tr>
<td>Hold</td>
<td></td>
</tr>
<tr>
<td>Clear Hold</td>
<td></td>
</tr>
<tr>
<td>Reset Max/Mins</td>
<td></td>
</tr>
<tr>
<td>Clear Latched Limits</td>
<td></td>
</tr>
<tr>
<td>Check Limits</td>
<td></td>
</tr>
<tr>
<td>Do Max/Mins</td>
<td></td>
</tr>
<tr>
<td>Apply - CAL</td>
<td></td>
</tr>
<tr>
<td>Apply - CAL</td>
<td></td>
</tr>
<tr>
<td>Reset Count (Model UDCA only)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CH2</th>
<th>Input Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tare</td>
<td></td>
</tr>
<tr>
<td>Clear Tare</td>
<td></td>
</tr>
<tr>
<td>Hold</td>
<td></td>
</tr>
<tr>
<td>Clear Hold</td>
<td></td>
</tr>
<tr>
<td>Reset Max/Mins</td>
<td></td>
</tr>
<tr>
<td>Clear Latched Limits</td>
<td></td>
</tr>
<tr>
<td>Check Limits</td>
<td></td>
</tr>
<tr>
<td>Do Max/Mins</td>
<td></td>
</tr>
<tr>
<td>Apply - CAL</td>
<td></td>
</tr>
<tr>
<td>Apply - CAL</td>
<td></td>
</tr>
<tr>
<td>Reset Count (Model UDCA only)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CH3</th>
<th>Input Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tare</td>
<td></td>
</tr>
<tr>
<td>Clear Tare</td>
<td></td>
</tr>
<tr>
<td>Hold</td>
<td></td>
</tr>
<tr>
<td>Clear Hold</td>
<td></td>
</tr>
<tr>
<td>Reset Max/Mins</td>
<td></td>
</tr>
<tr>
<td>Clear Latched Limits</td>
<td></td>
</tr>
<tr>
<td>Check Limits</td>
<td></td>
</tr>
<tr>
<td>Do Max/Mins</td>
<td></td>
</tr>
</tbody>
</table>

### Pattern Outputs or State Outputs

<table>
<thead>
<tr>
<th>Pattern Outputs or State Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pattern1 OUT (or State1 OUT)</td>
</tr>
<tr>
<td>NOT Pattern1 OUT (or NOT State1 OUT)</td>
</tr>
<tr>
<td>Pattern2 OUT (or State2 OUT)</td>
</tr>
<tr>
<td>NOT Pattern2 OUT (or NOT State2 OUT)</td>
</tr>
<tr>
<td>Pattern3 OUT (or State3 OUT)</td>
</tr>
<tr>
<td>NOT Pattern3 OUT (or NOT State3 OUT)</td>
</tr>
<tr>
<td>Pattern4 OUT (or State4 OUT)</td>
</tr>
<tr>
<td>NOT Pattern4 OUT (or NOT State4 OUT)</td>
</tr>
<tr>
<td>Pattern5 OUT (or State5 OUT)</td>
</tr>
<tr>
<td>NOT Pattern5 OUT (or NOT State5 OUT)</td>
</tr>
<tr>
<td>Pattern6 OUT (or State6 OUT)</td>
</tr>
<tr>
<td>NOT Pattern6 OUT (or NOT State6 OUT)</td>
</tr>
<tr>
<td>Pattern7 OUT (or State7 OUT)</td>
</tr>
<tr>
<td>NOT Pattern7 OUT (or NOT State7 OUT)</td>
</tr>
<tr>
<td>Pattern8 OUT (or State8 OUT)</td>
</tr>
<tr>
<td>NOT Pattern8 OUT (or NOT State8 OUT)</td>
</tr>
</tbody>
</table>

### Pattern Definitions

<table>
<thead>
<tr>
<th>Pattern Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pattern1</td>
</tr>
<tr>
<td>Pattern2</td>
</tr>
<tr>
<td>Pattern3</td>
</tr>
<tr>
<td>Pattern4</td>
</tr>
<tr>
<td>Pattern5</td>
</tr>
<tr>
<td>Pattern6</td>
</tr>
<tr>
<td>Pattern7</td>
</tr>
<tr>
<td>Pattern8</td>
</tr>
</tbody>
</table>

---

134  APPENDIX D, MENU LIST WITH DEFAULT SETTINGS
### Model ACUA (AC Strain Gage Amp) Calibration Menu Selections

<table>
<thead>
<tr>
<th>Selection</th>
<th>Choices</th>
<th>Default</th>
<th>CH1</th>
<th>CH2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of CAL</td>
<td>Shunt-Pos/Neg, Shunt-Positive, Load-Pos/Neg, Load-Positive</td>
<td>Shunt-Pos/Neg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Scale</td>
<td>enter numeric value</td>
<td>10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zero Value</td>
<td>enter numeric value</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-CAL or -Load Value</td>
<td>enter numeric value</td>
<td>7500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-CAL or -Load Value¹</td>
<td>enter numeric value</td>
<td>-7500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To CAL Xdcr Shunt</td>
<td>press ENTER to Cal (adjust zero and gain)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To Zero Xdcr Load</td>
<td>press ENTER to adjust zero</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To do -CAL</td>
<td>press ENTER to adjust gain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To do -CAL²</td>
<td>press ENTER to scale negative data</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. For Shunt-Pos/Neg and Load-Pos/Neg only.
2. For Load-Pos/Neg only.

### Model LVDA (LVDT Amplifier) Calibration Menu Selections

<table>
<thead>
<tr>
<th>Selection</th>
<th>Choices</th>
<th>Default</th>
<th>CH1</th>
<th>CH2</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXC Freq.</td>
<td>2.5kHz, 3kHz, 5kHz, or 10kHz</td>
<td>5kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of CAL</td>
<td>Load-Pos/Neg or Load-Positive</td>
<td>Load-Pos/Neg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Scale</td>
<td>enter numeric value</td>
<td>10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zero Point</td>
<td>enter numeric value</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-CAL Point</td>
<td>enter numeric value</td>
<td>7500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-CAL Point¹</td>
<td>enter numeric value</td>
<td>-7500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To Zero LVDT</td>
<td>press ENTER to adjust zero</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To do -CAL</td>
<td>press ENTER to adjust gain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To do -CAL²</td>
<td>press ENTER to scale negative data</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. For Load-Pos/Neg only.

### Model DCSA (DC Strain Gage Amp) Calibration Menu Selections

<table>
<thead>
<tr>
<th>Selection</th>
<th>Choices</th>
<th>Default</th>
<th>CH1</th>
<th>CH2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of CAL</td>
<td>Shunt-Pos/Neg, Shunt-Positive, Load-Pos/Neg, Load-Positive, mV/V-Positive, or mV/V-Pos/Neg</td>
<td>Shunt-Pos/Neg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Scale</td>
<td>enter numeric value</td>
<td>10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zero Value</td>
<td>enter numeric value</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-CAL Value, -Load Value, or mV/V @ -FS</td>
<td>enter numeric value</td>
<td>7500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-CAL Value, -Load Value, or mV/V @ -FS²</td>
<td>enter numeric value</td>
<td>-7500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To CAL Xdcr Shunt &amp; mV/V</td>
<td>press ENTER to Cal (adjust zero and gain)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To Zero Xdcr Load</td>
<td>press ENTER to adjust zero</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To do -CAL</td>
<td>press ENTER to adjust gain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To do -CAL²</td>
<td>press ENTER to scale negative data</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
### Model DCVA (DC Voltage Amplifier) Calibration Menu Selections

<table>
<thead>
<tr>
<th>Selection</th>
<th>Choices</th>
<th>Default</th>
<th>CH1</th>
<th>CH2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of CAL</td>
<td>Remote-Pos/Neg, Remote-Positive, Load-Pos/Neg, or Load-Positive</td>
<td>Remote-Pos/Neg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Scale</td>
<td>enter numeric value</td>
<td>10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zero Value</td>
<td>enter numeric value</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+CAL or -Load Value</td>
<td>enter numeric value</td>
<td>7500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-CAL or -Load Value</td>
<td>enter numeric value</td>
<td>-7500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To CAL Xdcr</td>
<td>Remote</td>
<td>press ENTER to Cal (adjust zero and gain)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To Zero Xdcr</td>
<td>Load</td>
<td>press ENTER to adjust zero</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To do +CAL</td>
<td></td>
<td>press ENTER to adjust gain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To do -CAL</td>
<td></td>
<td>press ENTER to scale negative data</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. For Remote-Pos/Neg and Load-Pos/Neg only.
2. For Load-Pos/Neg only.

### Model DCIA (DC Current Amplifier) Calibration Menu Selections

<table>
<thead>
<tr>
<th>Selection</th>
<th>Choices</th>
<th>Default</th>
<th>CH1</th>
<th>CH2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Range</td>
<td>±10 mA, ±20mA, 4-20 mA, or 12±8mA</td>
<td>±10 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Scale</td>
<td>enter numeric value</td>
<td>10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjust DCIA</td>
<td>pressed ENTER to Cal (adjust zero and gain)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Model CTUA (Frequency Input Module) Calibration Menu Selections

<table>
<thead>
<tr>
<th>Selection</th>
<th>Choices</th>
<th>Default</th>
<th>CH1</th>
<th>CH2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Scale</td>
<td>enter numeric value</td>
<td>10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xdcr Freq</td>
<td>enter numeric value</td>
<td>10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xdcr Value</td>
<td>enter numeric value</td>
<td>10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Type</td>
<td>TTL, TTL (Quadrature), 10, 20, 50, 100, or 200mVp-p</td>
<td>TTL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polarity</td>
<td>Not Inverted or Inverted</td>
<td>Not Inverted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Filter</td>
<td>None or 20kHz</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lowest Freq.</td>
<td>1% of FS or 0.01% of FS</td>
<td>1% of FS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Model UDCA (Encoder/Totalizer Module) Calibration Menu Selections

<table>
<thead>
<tr>
<th>Selection</th>
<th>Choices</th>
<th>Default</th>
<th>CH1</th>
<th>CH2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Scale</td>
<td>enter numeric value</td>
<td>10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xdcr Pulses</td>
<td>enter numeric value</td>
<td>10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xdcr Value</td>
<td>enter numeric value</td>
<td>10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count Mode</td>
<td>1X, 2X, 4X (Quadrature), or Event (Signal A)</td>
<td>1X (Quadrature)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Direction</td>
<td>B leads A or A leads B</td>
<td>B leads A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count Edge</td>
<td>Event</td>
<td>Rising Edge or Falling Edge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reset Arm Sig</td>
<td>Ignored, TTL High arms, or TTL Low arms</td>
<td>Ignored</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reset Signal</td>
<td>TTL High resets, TTL Low resets, or Ignored</td>
<td>TTL High resets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reset Mode</td>
<td>Leading Edge, Level, A AND B, A AND /B, /A AND B, or /A AND /B</td>
<td>Leading Edge</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Applies if channel is a Model DCVA (DC Voltage Amplifier), DCIA (DC Current Amplifier), CTUA (Frequency Input Module), or UDCA (Encoder/Totalizer Module).
### CH3 (Calculation) Calibration Menu Selections

<table>
<thead>
<tr>
<th>Selection</th>
<th>Choices</th>
<th>Default</th>
<th>CH3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Scale</td>
<td>enter numeric value</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Calculation</td>
<td>choose from list below</td>
<td></td>
<td>(CH1*CH2)/A</td>
</tr>
<tr>
<td>Constant A</td>
<td>enter numeric value</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Constant B</td>
<td>enter numeric value</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Constant C</td>
<td>enter numeric value</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

### Calculation List

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

### User Defined Calc

- 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
- m Min Data
- h Held Data
- t Tare Value
- + Addition
- - Subtraction
- * Multiplication
- / Division
APPENDIX E, MENU FLOWCHART

- For State Machine OFF
  - Pattern Outputs
    - Pattern OUT
    - Pattern OUT
    - Pattern OUT
    - Pattern OUT
    - Pattern OUT
    - Pattern OUT
    - Pattern OUT
    - Pattern OUT
  - Refer to Pattern OUT example

- For State Machine ON
  - State Outputs
    - State OUT
    - State OUT
    - State OUT
    - State OUT
    - State OUT
    - State OUT
    - State OUT
    - State OUT
  - Refer to State OUT example

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

- HI Limit CH1 | NOT HI Limit CH1

- Choices: 1

- Choices: 1

- Choices: 0

- Choices: 0

- Refer to HI Limit example

* Scroll through selections using Cursor keys.
* To edit entry, press Enter key. Entry flashes.
* Use Cursor keys to select.
* For character based entries (e.g., 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 Max/Min CH1 | Clear Limit CH1 | Check Limits CH1 | No Max/Min CH1

- Tare CH1 | Tare OUT CH1

- Choices: 1

- Choices: 1

- Refer to Tare example

Not for CH3 | Not for CH3 | For UXCR only

- Not for CH3

- Not for CH3

- For UXCR only

- Tare Logic OUT CH1 | Tare Logic OUT CH1 | Tare Logic OUT CH1

- Choices: 1

- Choices: 1

- 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, ST Units 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 positive. >1.1
"!Signal Positive" calibration signal is positive when it should be negative. >1.1
"!Null-C Too Large" the null-c signal of an ACUA/ACUL is too large to compensate for. >1.1
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".
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
<ST> has the form "1:xxxx 2:yyyy".
If the channel is a CTUA/UDCA then the version number is returned.
Otherwise the type of the channel is returned.

ST<CH> <H2> Status of the given channel
0x80: Channel is (0x00=not) over-ranged
0x40: (0x00=Not) currently < low limit
0x20: (0x00=Not) at a maximum
0x10: (0x00=Not) at a minimum
0x08: (0x00=Not) currently > high limit
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**<br>System Settings (16 bits)<br>0x4000: Terminate serial communications with<br>0x0000: \(<CR>\) (carriage return)<br>0x4000: \(<LF>\) (linefeed)<br>0x2000: State machine (0x0000=not) active<br>0x1000: Do (0x0000=not) always show sign of numbers<br>0x0800: Do (0x0800=not) Display power up message<br>0x0400: Back light (0x0000=off/0x0400=on)<br>0x0200: Do max/mins<br>  0x0000: always when in test<br>  0x0200: using I/O control<br>0x0100: Check Limits<br>  0x0000: always when in test<br>  0x0100: using I/O control<br>0x00E0: Power-up data<br>  0x0000: Display current data<br>  0x0020: Display max data<br>  0x0040: Display min data<br>  0x0060: Display spread data<br>  0x0080: Display held data<br>  0x00A0: Display tare data<br>0x0018: Power-up 1st channel<br>  0x0000: channel 1<br>  0x0008: channel 2<br>  0x0010: channel 3<br>0x0006: Power-up view<br>  0x0000: 2 channel<br>  0x0002: Limit status<br>  0x0004: I/O Status<br>  0x0006: 1 Channel<br>  0x0001: Power up (0x0000=not) in test mode

**CT**<br>ConTrast (0-100) (7 bits)<br>0x7F: LCD Contrast setting

**A1**<br>Analog output 1 driver (2 bits)<br>Changing this necessitates a "RS" command<br>0x03: Which channel drives analog output 1

**A2**<br>Analog output 2 driver (2 bits)<br>Changing this necessitates a "RS" command<br>0x03: Which channel drives analog output 2

**SP<IX>**<br>System Patterns (16 bits)<br>0xF000: Logic inputs<br>0x0FC0: Internal matrix<br>0x003F: Logic outputs<br><IX>:<br>  A: Pattern1<br>  B: Pattern1 care bits<br>  C: Pattern1 OUT (only 12 bits used)<br>  D: NOT Pattern1 OUT (only 12 bits used)<br>  E: Pattern2<br>  F: Pattern2 care bits<br>  G: Pattern2 OUT (only 12 bits used)<br>  H: NOT Pattern2 OUT (only 12 bits used)<br>  I: Pattern3<br>  J: Pattern3 care bits<br>  K: Pattern3 OUT (only 12 bits used)<br>  L: NOT Pattern3 OUT (only 12 bits used)<br>  M: Pattern4<br>  N: Pattern4 care bits<br>  O: Pattern4 OUT (only 12 bits used)<br>  P: NOT Pattern4 OUT (only 12 bits used)<br>  Q: Pattern5<br>  R: Pattern5 care bits<br>  S: Pattern5 OUT (only 12 bits used)<br>  T: NOT Pattern5 OUT (only 12 bits used)<br>  U: Pattern6<br>  V: Pattern6 care bits<br>  W: Pattern6 OUT (only 12 bits used)<br>  X: NOT Pattern6 OUT (only 12 bits used)<br>  Y: Pattern7<br>  Z: Pattern7 care bits<br>  \: Pattern7 OUT (only 12 bits used)<br>  \: NOT Pattern7 OUT (only 12 bits used)
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>@1</code></td>
<td>Calibration data for analog output 1 (32 bits)</td>
</tr>
<tr>
<td><code>@2</code></td>
<td>Calibration data for analog output 2 (32 bits)</td>
</tr>
<tr>
<td><code>TM</code></td>
<td>TiMe on 9850</td>
</tr>
<tr>
<td><code>IO</code></td>
<td>I/O lines</td>
</tr>
<tr>
<td><code>cm</code></td>
<td>CoMm port settings</td>
</tr>
</tbody>
</table>

**User's Guide**

- Pattern8
- Pattern8 care bits
- Pattern8 OUT (only 12 bits used)
- NOT Pattern8 OUT (only 12 bits used)

**Pattern8**

- Pattern8 OUT (only 12 bits used)

**Pattern8 care bits**

- Pattern8 OUT (only 12 bits used)

**Pattern8 OUT (only 12 bits used)**

- NOT Pattern8 OUT (only 12 bits used)

- Cal-zero offset
- Plus gain
- Minus gain

- Communication ID
- “A” - “Z”
- “a” - “z”

- Bits/Parity
- 8/None
- 8/Even
- 8/Odd
- 7/Even
- 7/Odd

- Baud Rate
- 300 baud
- 600 baud
- 1200 baud
- 2400 baud
- 4800 baud
- 9600 baud
- 19200 baud
- 38400 baud

**User's Guide**

- Cal-zero offset
- Plus gain
- Minus gain

**User's Guide**

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- “A” - “Z”
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- 7/Odd

- Baud Rate
- 300 baud
- 600 baud
- 1200 baud
- 2400 baud
- 4800 baud
- 9600 baud
- 19200 baud
- 38400 baud
--- Special Messages ---

ZZ<ST>  <OK>  Repeat command
When Internal Matrix 3 is on, repeatedly send the
response to the command <ST> back to the user.
E.G. Assuming that the ID of the 9850 is "A",
the command "AZZDC1" sets things up so that
when Internal Matrix 3 is on, the 9850 will
return the current data for channel 1 back to
the user (see the "DC" command). Send the
command "AZZ" to cancel this behavior.

--- Other Messages ---

T0  <OK>  Exit Test mode
T1  <OK>  Start a Test
RS  <OK>  Restart System
This command might take up to 20 seconds to
finish.
RSA <OK>  Restart system
This command might take 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
  plus cal signal)
P: Minus Cal (use the "AS" command to apply
  the minus cal signal)
1: Lock keyboard
0: UnLock keyboard
2: Toggle lock state of keyboard
other: Ignored

AS<IX> <OK>  Apply Shunt (to BOTH channels)
<IX>:
A: no-shunt applied
B: Apply Plus Cal
C: Apply Minus Cal
APPENDIX F, SERIAL COMMUNICATION COMMANDS

--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)

LL<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
B: 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)
0x00: 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
0x01000000: 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 load-positive cal >5.9
0x03000000: Do a load-positive cal
If the type of <CH> is an DCVA:
0x03000000: Type of calibration
0x01000000: 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
0x01000000: Do a shunt pos/neg calibration
0x01000000: Do a load-positive-only calibration
0x02000000: Do a load 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
0x01000000: +/-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
0x00000000: Excitation Frequency
0x00000000: 2.5KHz <5.9
0x00400000: 3KHz <5.9
0x00800000: 5KHz <5.9
0x00C00000: 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
0x00800000: 3KHz >5.9
0x01000000: 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
0x00000000: 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
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
0xFFFFFFFF0000000000000000: plus-scaling constant (IEEE float)
0x0000000000000000FFFFFFFF0000: minus-scaling constant (IEEE float)
0x000000000000000000000000FFFF: 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)
0x0000000000000000000000000000FFFF: previous cal-zero offset
0x00000000000000000000000000000000: gain
0x00000000000000000000000000000000: null-c
If the type of channel is an DCVA/DCSA:
0xFFFFFFFF0000000000000000: zero-factor (IEEE float)
0x00000000000000000000000000000000: previous cal-zero offset
0x00000000000000000000000000000000: gain
0x00000000000000000000000000000000: previous gain
0x00000000000000000000000000000000: gain
0x00000000000000000000000000000000: copy of cal-flags
If the type of channel is an DCIA:
0xFFFFFFFFFFFFFFFFFFFF: not used
0x000000000000000000000000: gain
If the type of channel is an LVDA:
0xFFFFFFFF0000000000000000: zero-factor (IEEE float)
0x00000000000000000000000000000000: previous cal-zero offset
0x00000000000000000000000000000000: gain
0x00000000000000000000000000000000: previous gain
0x00000000000000000000000000000000: gain
0x00000000000000000000000000000000: 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.
0xFFFFFFFFFFFFFFFFFFFFFFFFFFFF: 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 Internal Matrix 6 onto the stack.
  This counter is reset every time this is accessed.
0x49 I: push(logic inputs) =1.2
0x49 I: push(IM5 counter) >1.2
  Push the number of 2kHz clock ticks that Internal Matrix 5 has been on since the last time it turned on. This 'timer' gets reset every time Internal Matrix 5 turns on
0x48 L: push(IM4) >1.2
  If Internal Matrix 4 is on then push 1 onto the stack; else push 0 onto the stack.
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
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@B331322B00000000000000000" (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
|\n| = 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 up to 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 second.

The "MEASURED SPEED" is the number of messages per second that the Visual Basic program "savedata.exe" executes.

"THEORETICAL SPEED" takes into account the latency of the 9850, and assumes NO latency for the PC.

#### ALL CHANNELS:

<table>
<thead>
<tr>
<th>TYPE OF DATA</th>
<th>MESSAGE</th>
<th>MEASURED SPEED</th>
<th>THEORETICAL SPEED</th>
<th>CHARACTERS PER REPLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time+Float</td>
<td>AEC0</td>
<td>47-55</td>
<td>80</td>
<td>18-36</td>
</tr>
<tr>
<td>Time+Hex</td>
<td>AYC0</td>
<td>80-90</td>
<td>140</td>
<td>19</td>
</tr>
<tr>
<td>Float</td>
<td>ADC0</td>
<td>60-72</td>
<td>100</td>
<td>9-27</td>
</tr>
<tr>
<td>Hex</td>
<td>AXC0</td>
<td>128-135</td>
<td>235</td>
<td>10</td>
</tr>
</tbody>
</table>

#### SINGLE CHANNEL:

<table>
<thead>
<tr>
<th>TYPE OF DATA</th>
<th>MESSAGE</th>
<th>MEASURED SPEED</th>
<th>THEORETICAL SPEED</th>
<th>CHARACTERS PER REPLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time+Float</td>
<td>AEC1</td>
<td>82-90</td>
<td>140</td>
<td>12-18</td>
</tr>
<tr>
<td>Time+Hex</td>
<td>AYC1</td>
<td>103-110</td>
<td>180</td>
<td>14</td>
</tr>
<tr>
<td>Float</td>
<td>ADC1</td>
<td>128-137</td>
<td>220</td>
<td>3-9</td>
</tr>
<tr>
<td>Hex</td>
<td>AXC1</td>
<td>180-190</td>
<td>350</td>
<td>5</td>
</tr>
</tbody>
</table>

#### ALL CHANNELS -- ZZ Command -- THEORETICAL SPEED assumes the latency of 9850 to be 0:

<table>
<thead>
<tr>
<th>TYPE OF DATA</th>
<th>MESSAGE</th>
<th>MEASURED SPEED</th>
<th>THEORETICAL SPEED</th>
<th>CHARACTERS PER REPLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time+Float</td>
<td>AZZEC0</td>
<td>-</td>
<td>213-106</td>
<td>18-36</td>
</tr>
<tr>
<td>Time+Hex</td>
<td>AZZYC0</td>
<td>184</td>
<td>202</td>
<td>19</td>
</tr>
<tr>
<td>Float</td>
<td>AZZDC0</td>
<td>-</td>
<td>426-142</td>
<td>9-27</td>
</tr>
<tr>
<td>Hex</td>
<td>AZZXC0</td>
<td>333</td>
<td>384</td>
<td>10</td>
</tr>
</tbody>
</table>

#### SINGLE CHANNEL -- ZZ Command -- THEORETICAL SPEED assumes the latency of 9850 to be 0:

<table>
<thead>
<tr>
<th>TYPE OF DATA</th>
<th>MESSAGE</th>
<th>MEASURED SPEED</th>
<th>THEORETICAL SPEED</th>
<th>CHARACTERS PER REPLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time+Float</td>
<td>AZZEC1</td>
<td>-</td>
<td>320-213</td>
<td>12-18</td>
</tr>
<tr>
<td>Time+Hex</td>
<td>AZZYC1</td>
<td>250</td>
<td>274</td>
<td>14</td>
</tr>
<tr>
<td>Float</td>
<td>AZZDC1</td>
<td>-</td>
<td>1280-426</td>
<td>3-9</td>
</tr>
<tr>
<td>Hex</td>
<td>AZZXC1</td>
<td>666</td>
<td>768</td>
<td>5</td>
</tr>
</tbody>
</table>
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 anti-alias filter.

For all five models, the DC signal from the low pass hardware anti-alias 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/fc) 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.

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).

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/fc) 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.

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.
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 (2.5\* s) can be counted internally. Data is read from the counter at 2000Hz (0.5ms).

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 \(\frac{1}{2}\) 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.

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.

*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.*

*MaxMin update and limit checking are performed only while running a Test.*
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.

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

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
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
Type ........................................... TTL compatible, Schmitt Trigger, low-true.
Internal Pull-up Resistor ........................................ 47kΩ.
Input Current ........................................... -100mA @ 0V.
Protection ........................................ To ±130VDC or 130VAC.

Six Logic Outputs
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 ........................................ Logic inputs, outputs, and internal Matrix signals control following actions.
(per channel)
Tare, Clear Tare, Hold, Clear Hold, Reset Max/Min,
Clear Latched Limits, Check Limits, Do Max/Mins,
Apply +CAL, Apply -CAL, Reset Count (Model UDC only).

Output Events ........................................ The following events drive logic outputs and internal Matrix signals.
(per channel)
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).
- **Option 12D1**: 10 to 15VDC @ 15W (max).

**Operating Temperature**
- -41°F to 122°F (-5°C to 50°C).

**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).
- Quadrature Signals: ±60% of Full Scale (with 0% overrange capability).

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:
- 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 77°F/25°C): 0.02% of Full Scale.

Zero Temperature Effects: ±0.001% of Full Scale per °F (max).

Span Temperature Effects: ±0.001% of Full Scale per °F (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
- 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 77°F/25°C)
- 0.02% of Full Scale.

Zero Temperature Effects
- ±0.001% of Full Scale per •F (max).

Span Temperature Effects
- 2.5kHz, 3kHz, 5kHz excitation: ±0.001% of Full Scale per •F (max).
- 10kHz excitation: ±0.002% of Full Scale per •F (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 2000 Ω (with 5VDC excitation).
  170 to 2000 Ω (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**
- **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 77°F/25°C)
- 0.01% of Full Scale (typical).
- 0.02% of Full Scale (worst case).

**Zero Temperature Effects**: ±0.001% of Full Scale per °F (max).

**Span Temperature Effects**: ±0.001% of Full Scale per °F (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<sup>3</sup>
- 5V and 15V.
- Maximum Load Currents: 250mA<sup>3</sup> (for 5V) or 100mA<sup>3</sup> (for 15V).
- Protection: Short circuit (current limit), Overvoltage (fuses: 1A for 5V, 375mA for 15V) to ±130VDC or 130VAC.

Overrange Capability
- ±10% of Full Scale (with 50% overrange capability).
- ±60% of Full Scale (with 0% overrange capability).

Zero Control Range
- ±10% of Full Scale.
- ±60% of Full Scale.

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<sup>2</sup>
- 86/76/70/62dB with 1/10/100/200Hz filters.

Resolution
- 0.01% of Full Scale.

Overall Accuracy (at 77°F/25°C)
- 0.02% of Full Scale.

Zero Temperature Effects
- ±0.001% of Full Scale per •F (max).

Span Temperature Effects
- ±0.001% of Full Scale per •F (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
- 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
- 86/80/70/63dB with 1/10/100/200Hz filters.

## Resolution
- 0.01% of Full Scale.

## Overall Accuracy
- 0.02% of Full Scale (typical).
- 0.03% of Full Scale (worst case).

## Zero Temperature Effects
- ±0.001% of Full Scale per •F (max).

## Span Temperature Effects
- ±0.001% of Full Scale per •F (max).

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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 Supplies² .......................... 5V and 12V. Maximum Load Currents .................. 250mA² (for 5V) or 125mA² (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 Filter³ (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 @ ±77°F (-25°C).
0.015% of Full Scale @ ±41°F to ±122°F (-5°C to -50°C).

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 ................................................................. 500 ft.

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 ................................................................. 50\(\Omega\).
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, /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 \(- 4.8 \times (12V\) 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 ............................................................ 6.4mA.
- Bi-directional Mode ............................................................. 3.2mA.

Overrange Capability
- Unidirectional Mode ............................................................ 0.8 to 23.2mA.
- Bi-directional Mode ............................................................. 12±11.2mA.

Non-linearity
- Unidirectional Mode ............................................................. ±8mA.
- Bi-directional Mode ............................................................ ±4mA.

Overall Error (including temperature effects)
- Unidirectional Mode ............................................................. ±20mA.
- Bi-directional Mode ............................................................. ±10mA.

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.

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Option MB (Current Output) Specifications

Output ................................................................. 10±10mA.

Resolution ................................................................. 4mA.

Overrange Capability ............................................................. 0 to 23.2mA.

Non-linearity ................................................................. ±5mA.

Overall Error (including temperature effects) ............................................................. ±12mA.

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.

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Option MC (Voltage Output) Specifications

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<th>Specification</th>
<th>Detail</th>
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</thead>
<tbody>
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<td>5±5V</td>
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<tr>
<td>Resolution</td>
<td>2mV</td>
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<tr>
<td>Overrange Capability</td>
<td>0 to 12V</td>
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<tr>
<td>Non-linearity</td>
<td>±2.5mV</td>
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<tr>
<td>Overall Error (including temperature effects)</td>
<td>±6mV</td>
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<tr>
<td>Output Filter</td>
<td>100Hz, 5 pole Bessel response low pass filter.</td>
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<td>Output Impedance</td>
<td>&lt;1Ω</td>
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<td>Minimum Load Resistance</td>
<td>10kΩ</td>
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<td>Protection</td>
<td>Short circuit (current limit), Overvoltage (0.25A fuse) to ±130VDC or 130VAC.</td>
</tr>
</tbody>
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