3000PLUS PANEL METER
WITH
MODEL 5D78
AC STRAIN GAGE CONDITIONER MODULE
INSTRUCTION MANUAL

VERSION SB.3
MANUAL PART NO. 92329

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PLEASE NOTE

This manual treats the setup and use of a 3000PLUS meter in which a Daytronic

Model 5D78 AC Strain Gage Conditioner Module

has been properly installed. If your 3000PLUS is equipped with a 5D Series conditioner model other than the 5D78, the corresponding instruction manual should be consulted.

ALWAYS TURN OFF THE 3000PLUS BEFORE REMOVING ITS INSTALLED 5D SERIES CONDITIONER MODULE, OR INSTALLING A DIFFERENT MODULE IN THE 3000PLUS CHASSIS. DO NOT REPLACE THE INSTALLED CONDITIONER MODULE WHILE THE 3000PLUS IS ON.

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(cont’d)

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1. INTRODUCTION

1.A GENERAL DESCRIPTION AND SPECIFICATIONS

THE 3000PLUS PANEL METER

Incorporating Daytronic's **5D Series Signal Conditioner Modules**, the 3000PLUS Panel Meter is a field-scalable indicator featuring operator-programmable signal processing and PC/PLC communications. With a durable front panel and secure screw terminals for all power and I/O connections, this mechanically and electrically rugged instrument is ideal for pump, motor, hydraulic, and other high-noise monitoring applications.

Accepting the fully conditioned output of any standard plug-in 5D module*, the 3000PLUS maintains signal integrity to deliver accurately scaled analog output, while sampling all data at 16-bit resolution. The data display provides selectable digital filtering for even greater readout stability.

The operator can easily select any of three separate output channels for display, as explained in Section 1.D:

- the meter's standard ±5-VDC scaled output (**Channel 1**), representing measured engineering units (after calibration)
- the "auxiliary" DAC output (**Channel 2**), which serves to monitor and process Channel 1, and to generate Channel 3
- the "scaled voltage" output (**Channel 3**), which is continuously proportional to the reading of the auxiliary output (Channel 2). Channel 3 may be set to a full scale of either ±5 or ±10 VDC, and is available from the rear of the 3000PLUS as both voltage and 4-20 mA output (see Section 2.D).**

The auxiliary analog output (Channel 2) is used for

- HI/OK/LO **limit monitoring** with selectable hysteresis windows, front-panel annunciation, and relay outputs for local process control (see Section 5.E for full details)
- high-speed positive or negative **peak capture** with TTL-level "have peak" output, selectable "backout" and "peak defeat" thresholds, and user-adjustable leak rate (Section 5.B)
- a **signal hold** to allow captured peaks and other values to be transferred to computer for processing (Section 5.C)
- automatic application of a desired **tare offset** (Section 5.D)

* "V" and "S" models may not be used with the 3000PLUS.

** The ±5-VDC output of the installed 5D78 conditioner (prior to A/D conversion) is also available from the rear of the meter.

Separate logic inputs provide external control of peak capture, signal hold, tare application, and the release of latched limit violations.

As explained in Sections 3 and 4 of this manual, you can quickly set up the 3000PLUS either via the simple front-panel button menu or via the configuration software supplied with the unit. Operator-entered ranges, filters, calibration points, and other setup parameters are always specific to the installed 5D Series conditioner.

A standard RS232 interface operating at a fixed rate of 19.2K baud allows connection of an external PC for instrument configuration and on-line monitoring. It may also be used for direct communication of simple ASCII mnemonic commands both for run-time reconfiguration and for interrogation of current data and setup values.

Employing the run-time version of Microsoft® Access 2000, the **3KP CONFIGURATOR** software supplied with the Model 3000PLUS makes short work of meter setup. Communicating via the RS232 link, the Configurator lets you define, store, edit, download, upload, and manage any number of "configurations" for your 3000PLUS. As explained in Section 4, "off-line" configurations can be easily created and downloaded, or you can use the "Live Output Window" to view and modify the present configuration of the connected 3000PLUS instrument on a purely run-time basis.

The Configurator also lets you perform selected run-time operations, including

- both "absolute" and two-point (deadweight) calibration
- viewing any of the meter's three "live" analog outputs and adjusting it as desired
- applying a signal hold command
- releasing any and all latched limits
- sending standard mnemonic commands to the meter
- activating the shunt resistor for verification of sensor calibration data.

THE MODEL 5D78 AC STRAIN GAGE CONDITIONER MODULE

Delivering a high-level filtered analog output of ±5 VDC, the Model 5D78 is a single-channel strain gage conditioner of *phase-sensitive carrier-amplifier design*.

While intended primarily for applications involving transformer-coupling to the transducer bridge (as with conventional **rotary-transformer torque sensors**), the Model 5D78 can also be used when high sensitivity is required or where the electrical environment is espe-

1. INTRODUCTION

cially noisy. Responding only to the modulated carrier frequency, the module rejects extraneous voltages that can cause errors in DC systems, particularly when there is a need to "blow up" a portion of the transducer range.

The conditioner's advanced analog design directly addresses the problem of measurement inaccuracy in industrial environments of high electromechanical noise. *Exceptional signal stability and accuracy over a remarkably wide range of sensor inputs are achieved through*

- regulated, remotely sensed AC excitation
- precise linearity / symmetry correction and signal phase adjustment via software commands
- high-stability amplification
- configurable low-pass active filtering
- "absolute" and "two-point" software-based calibration
- effective signal isolation & ESD protection

Plugging into the rear of the 3000PLUS meter, the 5D78 connects directly to its source strain gage sensor via simple screw-terminal pinout (see Fig. 3). High output accuracy over a wide temperature range guarantees repeatable sensor signal integrity. For steady indication and smooth, dependable control action, the conditioner provides a true average value of the measured variable, even in the face of substantial dynamic content.

The 5D78 features

- **Powerful user-selectable low-pass active filtering** for removal of unwanted high-frequency measurement-signal components and the elimination of aliasing errors
- **High noise rejection**, eliminating errors from common-mode pickup and ground-loop coupling, with 1500 VAC isolation between input and output terminals and between I/O and power supply / communications terminals
- **High ESD immunity and extensive EMI protection** further assure data integrity in harsh industrial environments

Because of normal cable loading effects, it is a practical necessity to calibrate any AC TORQUE SENSOR/CABLE/INSTRUMENT system after installation, using a *known input standard*. The "ABSOLUTE" CALIBRATION method described in Sections 3.B and 4.E will normally yield a very good first approximation for a sensor/cable/5D78 system (depending, of course, on actual cable length and capacitance).* However, absolute calibration of a 3000PLUS with installed Model 5D78 should always be followed by a conventional "in place" TWO-POINT (DEADWEIGHT) CALIBRATION, for optimum data integrity.

To perform initial ABSOLUTE CALIBRATION, you need only use the front-panel menu or configuration software to specify the desired relationship between the module's measured engineering units and its ±5-VDC output, given the full-scale input range for which it is currently set and the source transducer's known full-scale rating and sensitivity. A zero offset term may also be entered, expressed either in engineering units or millivolts.

TWO-POINT (DEADWEIGHT) CALIBRATION requires the application of two independently and accurately known values of input loading ("ZERO" and "SPAN"), following the entry of a phase shift adjustment. Activation of a user-supplied shunt calibration resistor is provided (for either a positive or negative upscale reading) for use in the two-point method, if desired. Internal symmetry trimming is available for negative-domain slope adjustments of up to ±2% of full scale, along with both positive and negative midscale linearity correction.

* Employing a low-capacitance cable will minimize the effects on overall offset and span. See note (**) on page 1.4.

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SPECIFICATIONS

MODEL 3000PLUS

Case: Extruded metal chassis, mountable to user's panel (see Section 1.C); secure rear connections via screw terminals

Dimensions: See Fig. 1, below

Power Requirements: 24 VDC ± 10%; 300 mA nom.; 350 mA max.; 8.4 W; optional AC adaptor (**Model 3KPS1**) available

Operating Temperature Range: 0° F to 130° F (-18° C to 55° C)

Operating Relative Humidity: 10% to 95%, noncondensing

Instrument Weight: 1 lb., 10 oz. with 5D module installed

A/D Conversion: 16-bit

Sample Rate: 10 kHz; delay of 20-25 msec for limit evaluation of DAC output

Data Display: 6-digit red LED; count by 1, 2, or 5 resolution to maximum count of 199990 (see Section 1.D); selectable digital filtering

Displayable Data Channels: (1) ±5 VDC Scaled Output; (2) Auxiliary DAC Output; (3) Scaled Voltage Output; selectable via front panel or software

Programmable Processing of Auxiliary DAC Output (Channel 2):

Limit Logic: Three limit zones (LOW/OK/HIGH) with front-panel annunciation and corresponding contact relay outputs (see below); latching or nonlatching limits; user-adjustable hysteresis windows; selectable relay polarity

Positive and Negative Peak Capture: Controlled by logic input (see below); selectable "peak defeat" and "backout" thresholds; user-adjustable leak rate

Tare Offset: User-adjustable offset applied and released via logic input (see below)

Hold Command: Applied and released via logic input (see below) or software command

Analog Output (Channel 3): Selectable ± 0 to 5 VDC, ± 0 to 10 VDC, or 4-20 mA, single-ended; 14-bit resolution; 47-Hz filter; update rate of 20 msec

TTL Logic Inputs (UNLATCH, TARE, PEAK, HOLD) and Output (HAVE PEAK): Nominal 0 - 5 V, where 5 V = Logic 1 ("true"); ±25 V without damage; noise immunity 1 V; internal pull-down nom. 4.7 kΩ; all inputs assume Logic 0 state in the absence of connection

Relay Logic Outputs (LIMIT HI, LIMIT OK, LIMIT LO): Two for each limit; selectable polarity; 8 A, 250 VAC at full resistive load; switch lifetime at 1 A exceeds 100,000 operations

Communications: Three-wire RS232 at fixed 19,200 Baud, 8 Data Bits, 1 Stop Bit, No Parity; for setup and data transfer

Front-Panel Instrument Indication: Limit status, displayed channel, setup stage, and overrange (flashing display)

MODEL 5D78

Input Overvoltage Protection: Up to 240 VAC rms on all Signal and Excitation lines

ESD Protection: Up to 4 kV on all connections

Isolation: 1500 VAC between input and output terminals; 1500 VAC between I/O terminals and power supply / communications terminals

Transducer Types: Conventional 4-arm strain gage bridges, typically transformer-coupled, 120 Ω to 10 kΩ; zero range is 20% of the stated full scale. A screw terminal is provided for user-supplied shunt calibration resistor (see Fig. 8).

Input Ranges (Full-Scale): See Table 1, below; selectable when the 3000PLUS meter is configured (NOTE: the highest range selection accommodates actual inputs as high as 4.8 mV/V*)

Excitation Frequency: 3.27, 5.00, or 10.00 kHz; selectable when the 3000PLUS meter is configured

Excitation Voltage: Nominal 3 VAC rms

Accuracy: Dependent on range and excitation; see Table 1

Amplifier:

Normal-Mode Range: 15 V rms operating; 240 V rms without damage

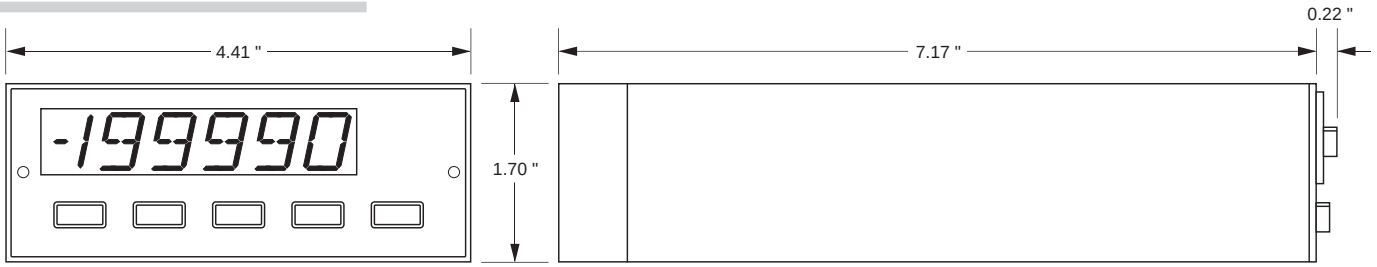
Input Impedance (Differential): Greater than 350 kΩ

Offset: Initial: ±0.05% of full scale; vs. temperature: ±25 ppm/°C; vs. time: ±10 ppm/month

(cont'd)

* See Table 2 in **Appendix B** for the "practical" ranges that apply to the 5D78 **RANGE (RNG)** setting.

Fig. 1
3000PLUS Dimensions



1. INTRODUCTION

SPECIFICATIONS (CONT'D)

Gain Accuracy: ±0.02% of full scale typical, following calibration; see Table 1

Gain Stability: vs. temperature: ±25 ppm/°C; vs. time: ±10 ppm/month

Analog Filter: 0.2, 2, 20, 200, or 2000 Hz, selectable when the 3000PLUS meter is configured*

Status Indicator Light: Green/Yellow/Red; indicates module input and communications status (see Section 1.D)

Table 1

Model 5D78 Full-Scale Ranges (Nominal) and Accuracy per Excitation Setting**

(Accuracy given as % of full scale overall expected maximum error, following calibration)

Range (mV/V)	Excitation Frequency (kHz)	
	3.27 or 5.00	10.00
0.5	0.04	0.06
0.75	0.03	0.04
1	0.02	0.03
1.5	0.02	0.02
2	0.02	0.02
3	0.02	0.02

* **NOTE:** For the Model 5D78, the value of the highest allowed corner frequency is dependent on the currently selected **excitation frequency**: for an excitation of 10.00 kHz, it is 2000 Hz; for 5.00 kHz, it is 1400 Hz; and for 3.27 kHz, it is 1100 Hz.

** See Table 2 in **Appendix B** for the "practical" ranges that apply to the 5D78 **RANGE (RNG)** setting. The full-scale accuracies given in Table 1 refer to the 5D78's response to substantially *undistorted* waveform inputs. Any phase shift must be compensated for during calibration (by use of the **FAZ** command, as explained in Sections 3.B and 4.E). Some gain deviation from transducer data-sheet specifications is normally to be expected as a result of loading the sensor's finite output impedance with intrinsic cable capacitance. The degree of this error will vary with cable type and length. Nevertheless, when calibrated "in place," a 3000PLUS meter with installed Model 5D78 offers *excellent stability and interchangeability of units*. As long as an initially calibrated 5D78's setup configuration is exactly transferred to the 5D78 that is replacing it, *no recalibration is usually required to maintain the stated accuracy*.

1.B PHYSICAL LAYOUT

Study the following diagrams to acquaint yourself with the most important 3000PLUS front and rear elements.

Fig. 2
3000PLUS Front Panel Elements

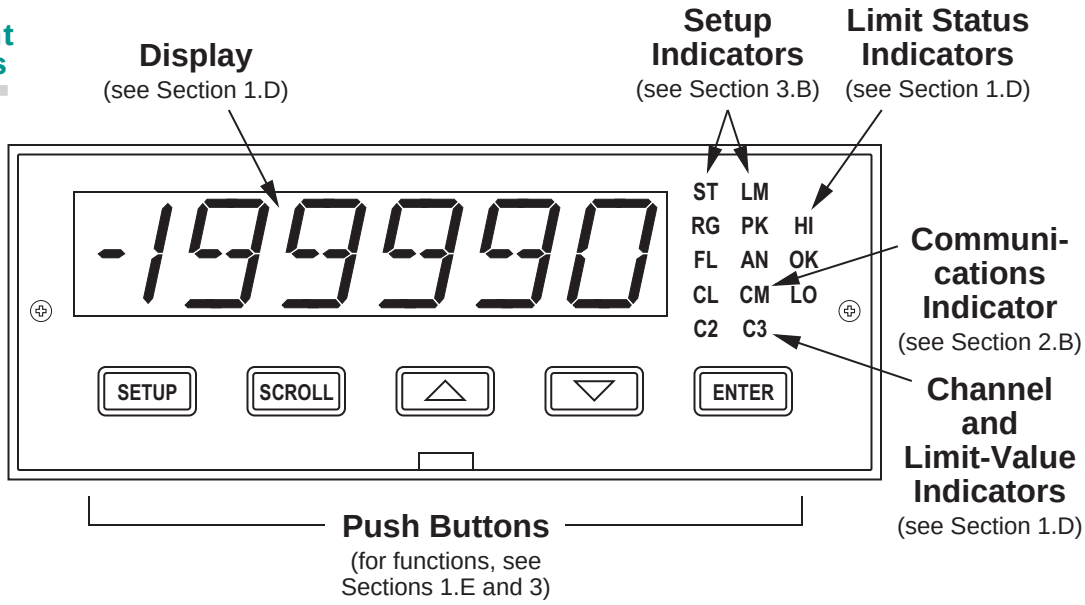
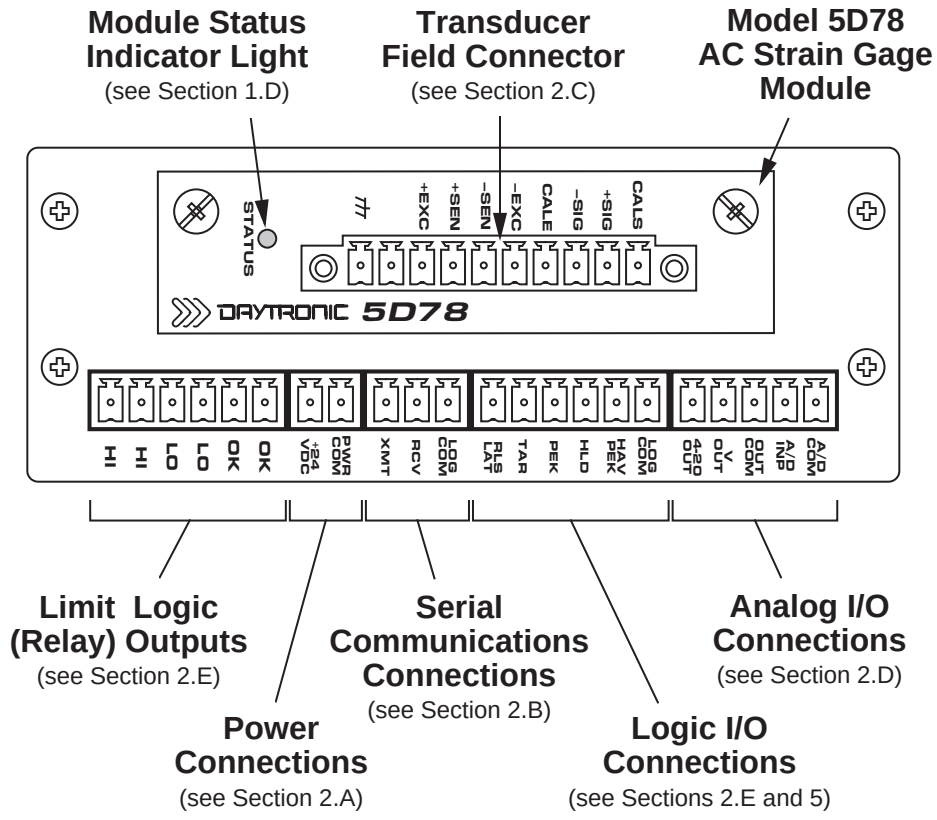


Fig. 3
3000PLUS / 5D78 Module Rear Panel Elements



1.C PANEL MOUNTING

You can easily mount the 3000PLUS instrument in your own precut panel. See Fig. 5, below, for appropriate cutout and hole dimensions. PANEL THICKNESS SHOULD NOT EXCEED 1/8 INCH. The mounting procedure is as follows:

1. Remove the two front-panel screws ("A" in Fig. 4).
2. Remove the front panel by inserting the tip of a flat screwdriver into the notch at the bottom of the panel and gently prying it out of the bezel case.
3. Remove the four screws ("B") holding the bezel to the instrument housing.

NOTE: YOU DO NOT NEED TO DISCONNECT THE INTERNAL DISPLAY CABLE.

4. Hold the instrument housing behind the panel and pass the bezel through the cutout (with cable attached).
5. Reattach the bezel to the housing, using the same four half-inch screws ("B"). The ribbon cable should fold into the space between the top of the instrument and the upper circuit board.
6. Snap the front panel back into the bezel case, and reinstall the two quarter-inch front-panel screws ("A").

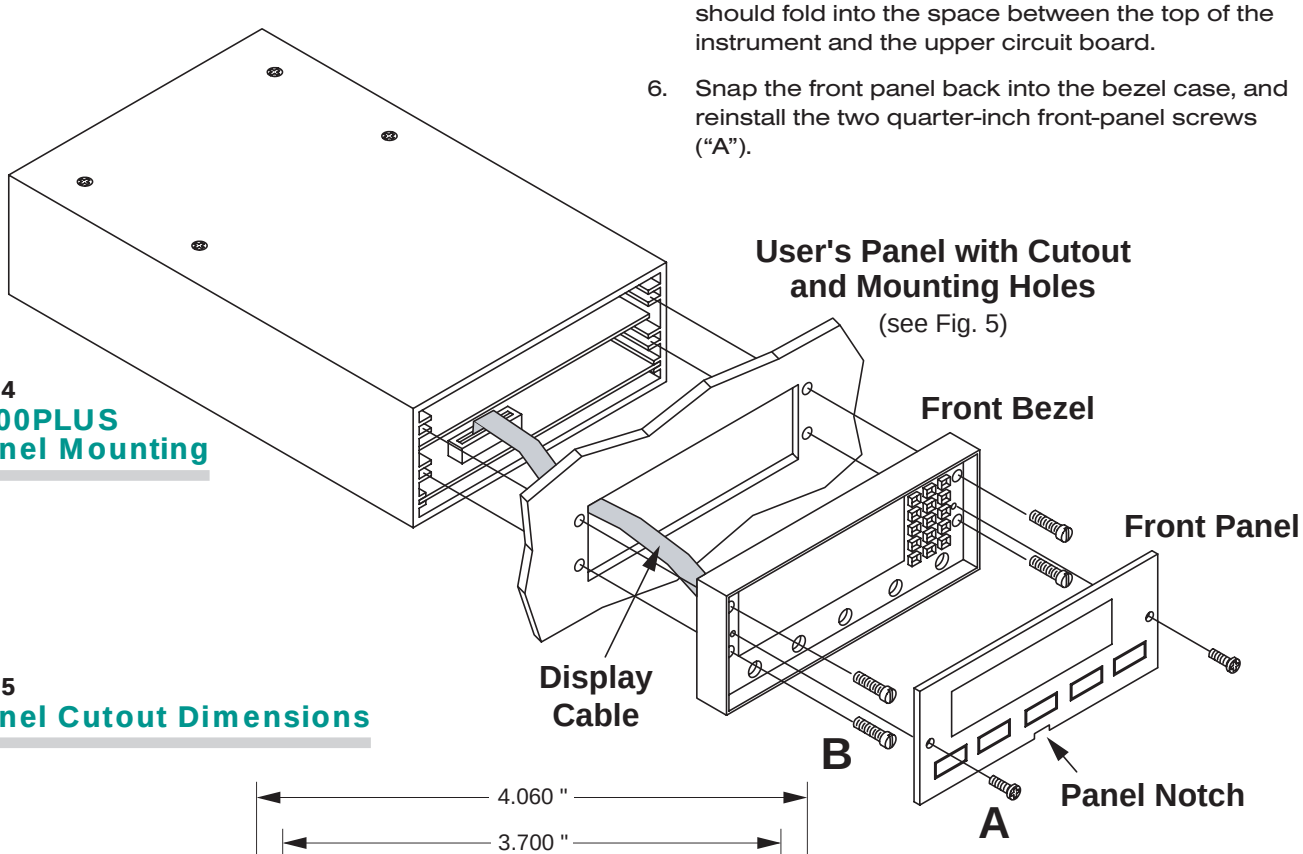
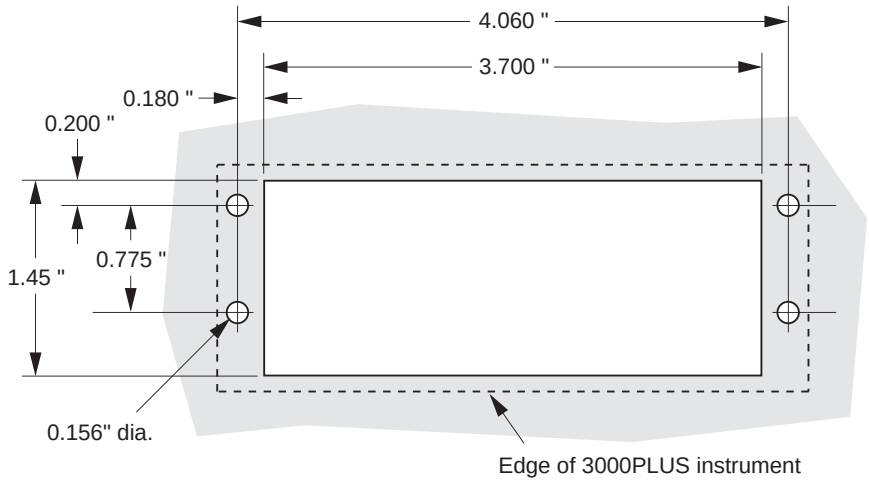


Fig. 4
3000PLUS
Panel Mounting

Fig. 5
Panel Cutout Dimensions



1.D DATA AND STATUS DISPLAYS

DATA DISPLAY

Updated four times a second, the 3000PLUS instrument's six-digit data LED data display is automatically scaled to count by a resolution of 1, 2, or 5 to a maximum reading of ±199990.[1] Regardless of the scaling currently in effect, a flashing display during normal run-time operation indicates that an *overrange condition* has occurred. *In this case, the displayed measurement reading may be invalid.*

During normal instrument setup, the operator will be called upon to indicate the **DESIRED FULL-SCALE READING IN ENGINEERING UNITS** (the "FULL SCALE UNITS" or "FSU" value), to correspond to a full-scale output of 5.000 volts. This can be done via the front-panel setup procedure (as explained in Section 3.B) or via the Configurator software, on a setup or run-time basis (as explained in Section 4). The **DECIMAL-POINT RESOLUTION** of the data display for Channels 1 and 2 will always match that of the last-entered FSU value.[2]

You can also specify a **DISPLAY OFFSET** value ("DSO"), if desired—again, either through the front panel or the Configurator software. The DSO is a value of numeric offset (positive or negative) to be continuously applied to the displayed reading of Channel 1 or 2 (see below). Note that the DSO is applied in addition to any zero offset resulting from instrument calibration (Sections 3 and 4) and to any specified tare offset (Section 5.D).[3]

In addition to the normal-mode analog filtering furnished by the installed 5D78 Conditioner, the 3000PLUS can apply selectable **DIGITAL FILTERING** ("DFL") to the data display to allow smooth, stable readout of dynamic variables. The DFL number ranges from 0 through 9 to indicate increasing amounts of digital smoothing. Like the FSU and DSO values, it may be entered through either the front panel or the Configurator software.

Use of the data display for manual setup of the 3000PLUS instrument is described in detail in Section 3 ("Front-Panel Configuration and Calibration").

CHANNEL INDICATION

At any time, you can select any one of the 3000PLUS instrument's three separate output channels for display:

- **Channel 1**—the meter's basic ±5-VDC scaled output, representing measured engineering units (after calibration). It is produced solely for display and interrogation via the **CHANNEL (CHN)** command (described in Appendix A).
- **Channel 2**—the "auxiliary" DAC output, which continuously operates on Channel 1 for purposes of limit evaluation, peak capture, tare offset, etc. It is produced for display, interrogation via the **CHN** command, and generation of the "raw volts" analog output (Channel 3).
- **Channel 3**—the instrument's "scaled voltage" output, which is continuously proportional to Channel 2. It may be set to a full scale of either ±5 or ±10 VDC, and is available at the rear of the 3000PLUS as both DC voltage and 4-20 mA output (see Section 2.D)

As explained in the following section, the front-panel **SCROLL** button may be used during normal run-time operation to cycle through the three channel displays.[4] When Channel 2 or 3 is being displayed, the corresponding front-panel indicator LED (**C2** or **C3**) will light—see Fig. 2. No indicator lights when Channel 1 is displayed.

The channel that is displayed whenever the 3000PLUS is powered up is always the channel that was on display when the meter was last turned off.

COMMUNICATIONS INDICATION

Fig. 2 also shows the 3000PLUS instrument's front-panel **CM** LED. This indicator lights when the RS232 serial communications port (Section 2.B) is in receipt of one or more transmitted ASCII characters (which may or may not constitute a valid MNEMONIC COMMAND—see Appendix A).

LIMIT STATUS INDICATION

Whenever *continuous limit monitoring* of the "auxiliary" output (Channel 2) is enabled, the appropriate front-panel limit status indicator (Fig. 2) will show the **LIMIT ZONE** in which Channel 2's existing data reading lies (regardless of whether Channel 2 is the one currently

[1] Under a reading of about 32000, the display's least significant digit will change by 1; from 32000 to 64000, it will change by 2; and over 64000, by 5.

[2] That is, the precision (decimal-point location) both of the basic ±5-volt scaled output (Channel No. 1) and of the "auxiliary" DAC output (Channel No. 2) will always reflect that of the currently stored FSU number—as will that of other setup values that directly relate to the 3000PLUS's scaled engineering-units reading, including display offset, high/low limit and hysteresis values, "peak defeat" threshold, tared output value, and all calibration numbers (both "absolute" and "two-point") that are expressed in units.

[3] Since the display offset is automatically set to zero during instrument calibration (either "absolute" or "two-point"), you should set a nonzero DSO value only *after calibration has been performed* (Sections 3 and 4).

[4] The Configurator software's "Live Output Window" (described in Section 4.D), lets you view any selected channel and modify applicable output characteristics on a run-time basis.

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being displayed). The three limit zones are defined by the 3000PLUS instrument's current **HIGH LIMIT** ("HIL") and **LOW LIMIT** ("LOL") settings:

- **HI** (or "GREATER THAN")—Channel 2's reading is greater than the current high limit value
- **OK** (or "BETWEEN")—Channel 2's reading is greater than or equal to the current low limit value and less than or equal to the current high limit value
- **LO** (or "LESS THAN")—Channel 2's reading is less than the current low limit value

When limit monitoring is disabled, none of the limit indicators will light.

For a complete discussion of limit monitoring, including definition of limit setpoints, limits **LATCH MODE** ("LAT"), relay contact **POLARITY** ("POL"), and both high-limit and low-limit **HYSTERESIS** deadbands ("LHY" and "HHY"), see Section 5.E.

RUN-TIME LIMITS DISPLAY

When the 3000PLUS instrument's **LIMITS SECURITY (LMS)** is OFF, the local operator is able to use the front-panel buttons (as explained in Sections 1.E and 5.E) to quickly view and adjust the operating limit values *during normal run-time operation, without having to enter Setup Mode*. This is the case even when limit monitoring is currently disabled (Section 5.E).

When limits security is ON, the operator can view and modify the limits values for monitoring the "auxiliary" DAC output only by following the standard front-panel setup procedure given in Section 3, which may require entry of a security code.

SETUP STAGE INDICATION

Each of the seven front-panel setup indicators shown in Fig. 2 will light when the 3000PLUS enters the corresponding stage of the **FRONT-PANEL SETUP PROCEDURE**, as listed below and described in detail in Section 3. Except for **ST** ("SETUP"), each indicator will remain on only as long as the meter is in that setup stage; **ST** will remain on until the operator exits setup mode.

1. **ST** ("SETUP")—security and module identification
2. **RG** ("RANGE")—input range and scaling information, including (for the 5D78 module) excitation frequency, full-scale mV/V range, desired full-scale reading in units, and desired decimal-point resolution
3. **FL** ("FILTER")—analog and digital filter settings
4. **CL** ("CALIBRATION")—including desired calibration method and all cal-point values applicable to that method
5. **LM** ("LIMIT")—parameters relating to the limit monitoring of the "auxiliary" output (Channel 2), including limit enable, latch mode, relay polarity, setpoint values, and hysteresis windows*
6. **PK** ("PEAK")—parameters relating to the further processing of the "auxiliary" output (Channel 2), including peak mode, "defeat" threshold, "backout" threshold, decay rate, and tare offset
7. **AN** ("ANALOG OUTPUT")—full-scale voltage output, followed by entry a new security code, if desired

MODULE STATUS INDICATION

Shown in Fig. 3, the status indicator light of the installed 5D78 Conditioner module serves to monitor the module's power, input, communications, and general health condition. The condition(s) represented by the light's three possible colors and color combinations are given below.

NOTE: As long as the module is properly communicating with the 3000PLUS meter (and the meter is powered up), the indicator light will be *flashing*.

- if the flashing light is constantly **GREEN**, the module's input signal is OK
- if the flashing light is constantly **YELLOW**, the module's input signal is over 20% out of range
- if the flashing light is constantly **RED**, a serious input condition has been detected (e.g., excessive current, overvoltage); it could indicate a transducer short or faulty cabling
- if the flashing light is alternating **YELLOW AND GREEN**, the module has received a mnemonic command from the 3000PLUS meter (the yellow light will continue for about a second after receipt of the command-terminating carriage return)
- if the flashing light is alternating **RED AND GREEN**, a significant internal software error detected; contact the Daytronic Service Department

* Also on when viewing limits in run-time (see above).

1.E FRONT-PANEL BUTTON FUNCTIONS

SETUP

RUN-TIME FUNCTION: Press to place the 3000PLUS in SETUP MODE, in order to change or view the instrument's present setup configuration via the front-panel buttons (see Section 3 for full setup instructions).

SETUP FUNCTION: Press repeatedly to step through the sequence of setup stages (as explained in Section 3.A). At any point during the setup procedure, pressing the **SETUP** button and keeping it depressed for about 2 seconds will return the 3000PLUS to normal run-time operation.

SCROLL

RUN-TIME FUNCTION: When **LIMITS SECURITY (LMS)** is ON, cycles through the display of the meter's three DATA CHANNELS (as described in Section 1.D):

When Channel 1 is on display, displays Channel 2 and lights **C2**
When Channel 2 is on display, displays Channel 3 and lights **C3**
When Channel 3 is on display, displays Channel 1 with no channel-indication light

When **LIMITS SECURITY (LMS)** is OFF, the current LOW-LIMIT and HIGH-LIMIT values are added to above cycle (when displayed, the limit values may be adjusted by the local operator as explained in Section 5.E):

When Channel 3 is on display, displays the current LOW LIMIT; lights **LM** and **C2**
When LOW LIMIT is on display, displays the current HIGH LIMIT; lights **LM** and **C3**
When HIGH LIMIT is on display, displays Channel 1 with no limits or channel-indication light

SETUP FUNCTION: When the operator is called on to select one of a set of discrete values for a given setup parameter, this button is used to cycle through the display of those values (for details, see "Entering a Setup Parameter" in Section 3.A).

UP

RUN-TIME FUNCTION: Press to close (turn "ON") the installed 5D78 module's calibration shunt for a POSITIVE upscale reading. The positive shunt will be closed only as long as the UP button is pressed. When the button is released, the 3000PLUS will resume normal measurement. For SHUNT CALIBRATION, see Section 4.E.*

SETUP FUNCTION: When the operator is called on to adjust the displayed numeric value of a given setup parameter, this button is used to *increase* that number—in the *positive* direction, regardless of sign—via the method explained in Section 3.A.

DOWN

RUN-TIME FUNCTION: Press to close (turn "ON") the installed 5D78 module's calibration shunt for a NEGATIVE upscale reading. The negative shunt will be closed only as long as the DOWN button is pressed. When the button is released, the 3000PLUS will resume normal measurement. For SHUNT CALIBRATION, see Section 4.E.*

SETUP FUNCTION: When the operator is called on to adjust the displayed numeric value of a given setup parameter, this button is used to *decrease* that number—in the *negative* direction, regardless of sign—via the method explained in Section 3.A. The **DOWN** button is also used during setup to answer "NO" to a displayed query such as "OK(?)," "RETRY(?)," or "RECAL(?)" (see Section 3.B for detailed instructions).

(cont'd)

* This button is also used to modify limit values during run-time operation (see Section 5.E).

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ENTER

RUN-TIME FUNCTIONS:

1. Releases any and all currently LATCHED LIMITS and their respective relay outputs (see also Section 5.E)
2. Resets PEAK CAPTURE function; clears any currently captured peak value by momentarily disabling and re-enabling peak capture (see Section 5.B).

SETUP FUNCTIONS: Used during setup to

1. "Acknowledge" each setup parameter when it appears on display
2. Accept the currently displayed value for the parameter being set and advance to the next parameter in the setup sequence
3. Answer "YES" to a displayed query such as "OK(?)," "RETRY(?)," or "RECAL(?)" (see Section 3.B for detailed instructions)

1.F INSTALLING AND RUNNING THE 3000PLUS CONFIGURATOR SOFTWARE

PLEASE NOTE: This software requires an operating system of Windows 95 or higher. It does NOT require that Microsoft Access be installed on your computer, but does require full installation of **Microsoft Access 2000 Runtime**, which is supplied with the Configurator and which takes approximately 32 MB of hard-drive space.

If **Microsoft Office 2000** or higher is already installed on your computer, Access 2000 Runtime will not be installed with the 3000PLUS ("3KP") Configurator, since the required runtime engine is already present.

For more information on "Using the 3KP Configurator," see **Section 4.A** of this manual.

To INSTALL the 3KP Configurator Software,

1. Make sure to close all applications before beginning the installation.
2. Insert the CD supplied with your 3000PLUS and open the **3KPCNFG** folder.
3. Double-click **SETUP.EXE** to begin the installation process.
4. Seven DLL files will first be copied to your hard drive. If **Access 2000 Runtime** or **Microsoft Office 2000** (or higher) is already installed on your computer, *go to Step 9, below.*
5. If you see a window that says "Setup cannot continue because some system files are out of date. . .", click the **OK** button. When you see the window that says "Do you want to restart Windows now?", click the **Yes** button. After Windows reboots and you can see the Windows Desktop, once again run **SETUP.EXE** from the CD's **3KPCNFG** folder (again, the seven DLL files will be loaded).
6. When you see the window that says "The application you are installing requires Microsoft Access 2000. . .", click the **OK** button. NOTE: If a window appears that says "Setup cannot install. . .", click the **Yes** button.
7. In the "Ready to Install" window, click the **Install Now** button to begin the installation of Access 2000 Runtime. NOTE: This will take several minutes. A window MAY appear that says "Setup has determined that the following applications are running. . ." If it does, just click the **Ignore** button.
8. When you see the window that says "The installer must restart your system before configuration. . .", click the **Yes** button. After the PC reboots, your Windows system will be updated, and the Access Runtime installation will be completed.
9. When you see the window that says "Welcome to the 3000PLUS Configurator installation program," click the **OK** button.
10. If you want to keep the default installation path of **C:\3KPCFG**, click the large button labelled "**Click this button. . .**"

    If you want to install to a folder other than **C:\3KPCFG**,

    a. Click **Change Directory**. Then enter or select the desired destination, and click **OK**. If the designated directory does not exist, you will be asked whether you want to create it. Click **Yes**.

    b. Click the large button labelled "**Click this button. . .**"
11. If you are prompted to add a new group, click **Continue**.

    NOTE: If the Configurator has been previously installed, you may get a message asking if you want to keep the existing MSCOMM32.OCX file. If your MSCOMM version is 6.0.81.69 or higher, click **Yes**. Similarly, you may get a message asking if you want to keep the existing COMDLG32.OCX file. If your COMDLG version is 6.0.84.18 or higher, click **Yes**.
12. Once the installation is complete, click the **OK** button.

    After the Configurator has been installed, your C:\3KPCFG folder (or other designated directory) should contain the following files:

3KPCONF.MDE	the main "300Plus Configurator" database/program file
3KPCONF1.ICO	the Configurator icon
3KPHELP.HLP	the on-line HELP file
3KPTOC.CNT	the HELP table of contents file
ODEUNST.LOG	a log file (for subsequent uninstalling of the software)
SAMPLE.MDB	a sample 5D module network configuration

(cont'd)

1. INTRODUCTION

13. To RUN the Configurator, go to your Windows popup **Start** menu, select **Programs**, and click **3000PLUS Configurator**.

PLEASE NOTE

IF **MICROSOFT OFFICE 2003** IS INSTALLED ON YOUR COMPUTER, you will have to modify the "target" specification for the Configurator shortcut in the **Programs** list, as follows (you only need to do this the first time you try to run the Configurator):

a. RIGHT-CLICK on **3000PLUS Configurator** in the **Programs** list.

b. Select **Properties**. The dialog box shown below will appear, with the cursor at the extreme right of the "Target" field.

c. Press the **LEFT ARROW** key (←) to move the cursor to just after "Microsoft Office\Office."

d. Type "11" so that the target reads
"C:\Program Files\Microsoft Office\Office11\ . . .

e. In the **Start in** field, type "11" after "Microsoft Office\Office" so that it reads
"C:\Program Files\Microsoft Office\Office11"

f. Click **OK**.

g. Now you can run the Configurator by clicking on **3000PLUS Configurator** in the **Programs** list.

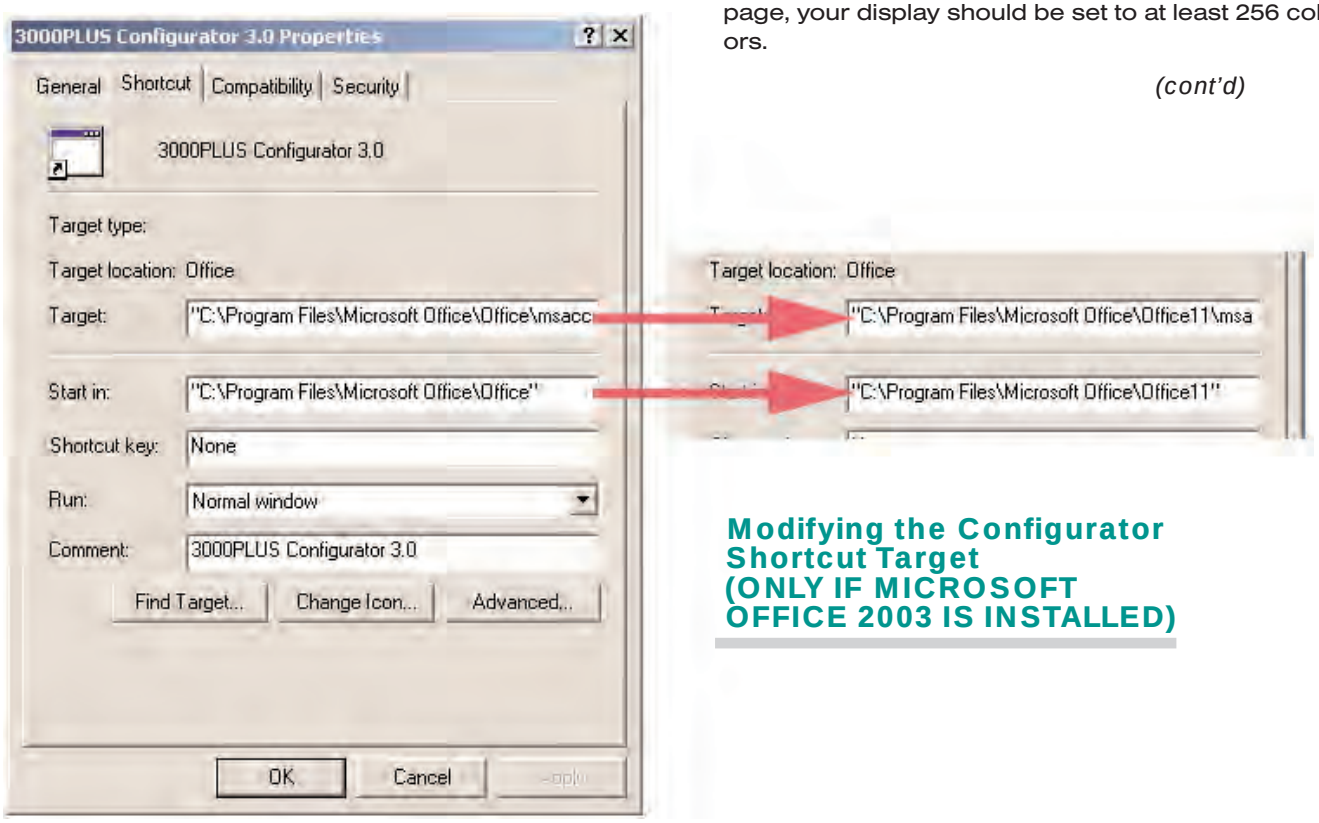
THE CONFIGURATOR IS A MICROSOFT ACCESS 2000 RUNTIME PROGRAM. DO NOT ATTEMPT TO OPEN THE "5DCONF.MDE" FILE OR ANY CONFIGURATION "*.MDB" FILE DIRECTLY THROUGH MICROSOFT ACCESS.

ALSO NOTE:

- If **Microsoft Access 97** (or an older version) is installed on your computer, the first time you attempt to open an Access 97 (or older) file after installing Access 2000 Runtime, you may have to do so through the Access 97 program itself. That is, start Microsoft Access via the Windows **Start / Programs** menu, and use **Open an Existing Database...** to open the file in question. Otherwise, the system may try to open it as an Access 2000 file and ask if you want to convert it, etc.
- After installing Access 2000 Runtime, you may have to rejoin any workgroup to which you were previously joined, using **WRKGADM.exe** in the Windows System folder.

For proper viewing of the Configurator startup page, your display should be set to at least 256 colors.

(cont'd)



Modifying the Configurator Shortcut Target (ONLY IF MICROSOFT OFFICE 2003 IS INSTALLED)

1. INTRODUCTION

A SAMPLE CONFIGURATION is installed with the software, to let you see typical 3000PLUS setup entries. Select **Open...** from the Configurator **File** menu and double-click on "SAMPLE."

14. To UNINSTALL the 3KP Configurator Software,

    a. Go to the Windows popup **Start** menu, select **Settings**, and then select **Control Panel**. Then double-click on the button called **Add/ Remove...** (or **Add or Remove Programs**).

    b. Select "3000PLUS Configurator" from the list of programs, and click the appropriate button to remove it.

    c. When asked whether you're sure you want to completely remove the 3KP Configurator and all its components, answer **Yes** to uninstall (or **No** to abort). You may be asked whether you're sure you want to remove **MSCOMM32.OCX** and **COMDLG32.OCX** (which are shared components). If in doubt, answer **No**.

    d. **NOTE:** This procedure will NOT delete any "*.mdb" 3KP CONFIGURATION FILES currently in your Configurator installation directory which were created through the Configurator software. In fact, if you have created any such files, you will be told that the directory itself cannot be removed (click **Ok** to exit this message). A hidden file named "TOC.GID" may remain in the installation directory after removal of the Configurator software. This file is harmless, and will not affect any later reinstallation of the Configurator.

2. CONNECTIONS

PLEASE NOTE: Some of the wiring diagrams in this section show only the male connector headers on the rear of the 3000PLUS instrument (also shown in Fig. 3). Each connected wire or jumper is to be firmly secured to the corresponding **SCREW TERMINAL** of the terminal block (supplied with the meter) that plugs into the appropriate header.

CABLE SHIELDING

Proper shielding of cable wires or twisted pairs—as shown in Figs. 7 through 10—is strongly recommended to minimize the production of unwanted electrical noise from capacitive and inductive effects.

In the I/O cabling diagrams below, only the "connector end" of each cable shield is shown, as represented by a gray circle surrounding either a single wire or a TWISTED PAIR of wires within the cable. Unless otherwise stated, every shield *should be grounded to the appropriate common or ground terminal only at the connector end*. The drain wire tying the connector end of the shield to common/ground should be as short as possible.

2.A POWER CONNECTIONS

The 3000PLUS requires a user-supplied external source of 24 VDC, regulated to ±10%. Nominal consumption is 300 mA; maximum is 350 mA.* The figure below shows how the positive and negative power leads are tied, respectively to the rear-panel **+24 VDC** and **POWER COMMON** terminals. Local grounding is not required.

* An optional 18-W in-line power supply for the 3000PLUS (the **Model 3KPS1**) is available from Daytronic. Contact the factory for more information.

NOTE: On every normal powerup, the 3000PLUS will display (for two or three seconds) its **firmware version number** ("V x.x") alternating with

COM SD

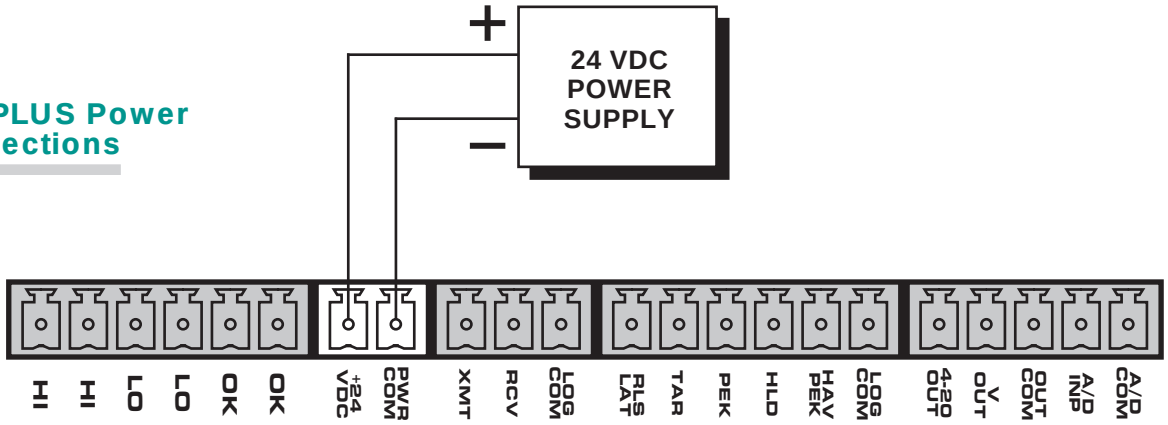


Fig. 6
3000PLUS Power Connections

2.B SERIAL COMMUNICATIONS CONNECTIONS

As shown in Fig. 7, simple two-wire RS232 cabling is employed for communications between the 3000PLUS and an external PC. While 3000PLUS / PC serial communications will usually take place through the 3KP Configurator software described in Section 4, a "terminal emulation" program (either conventional or customized) can also be used to issue standard mnemonic commands to the meter, and to receive meter responses.

The RS232 interface observes a fixed protocol of 19,200 baud, 8 data bits, 1 stop bit, and NO parity—with *no software or hardware "handshake."* The Configurator software will automatically set to this protocol the computer COM PORT selected for communications with the 3000PLUS (see "Setup and Testing of Serial Communications" in the Configurator's on-line HELP system).

Separate shielding of the RECEIVE and TRANSMIT lines is highly recommended, especially if the cable connecting the PC and the 3000PLUS is over three feet in length. This will prevent electrical noise from causing "break" signals and other communications errors.

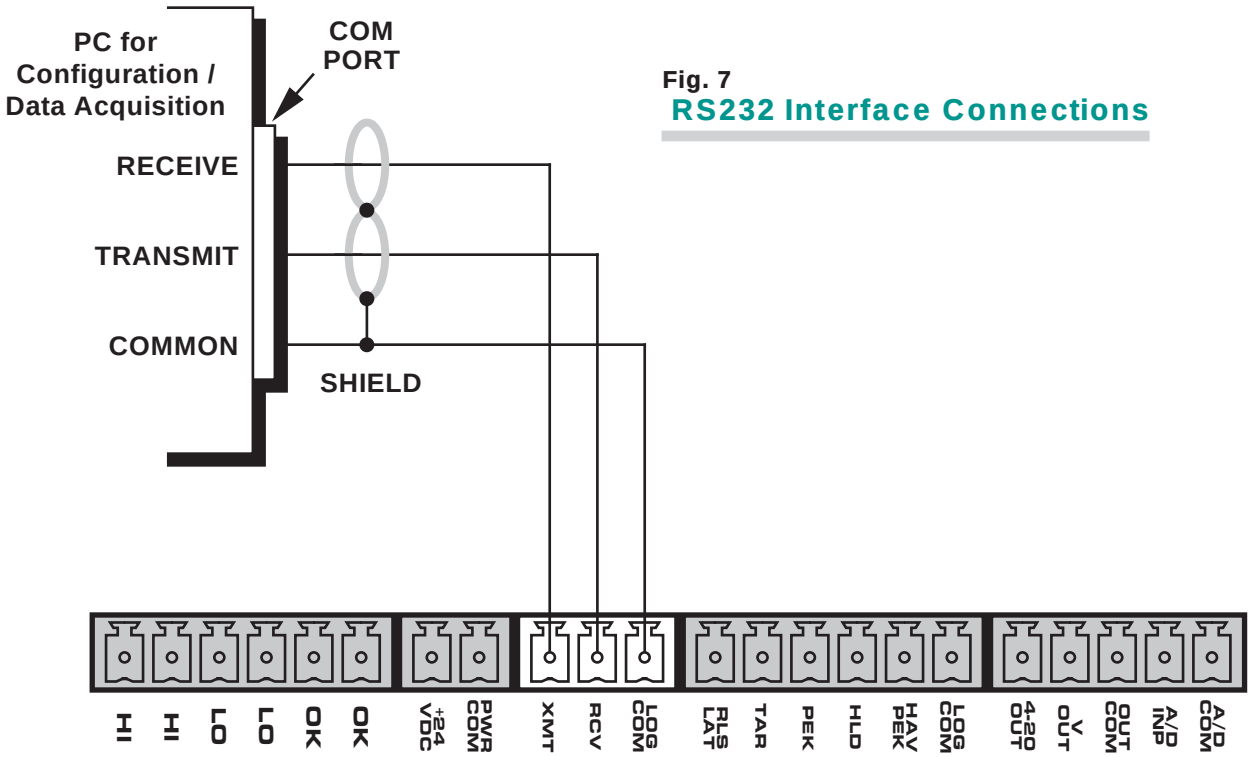


Fig. 7
RS232 Interface Connections

2.C TRANSDUCER CONNECTIONS

Each wire or jumper of the transducer cable is to be firmly secured to the appropriate screw terminal of the terminal block that plugs into the installed 5D78 module's 10-pin TRANSDUCER CONNECTOR (see Fig. 3).

4-wire connections to a full-bridge strain gage transducer are given in Fig. 8.a. This wiring is to be used with a cable of 18-gage conductors which is under 20 feet in length. In this case, the +SENSE and –SENSE lines are tied to the corresponding EXCITATION lines *at the 5D78 CONNECTOR*. It is recommended that the resistance of the conductors not exceed 0.0001 of the bridge resistance.

8-wire connections to a full-bridge strain gage transducer are given in Fig. 8.b. This wiring is to be used when the cable is 20 feet or longer, or when fine wire is used. In this case, the +SENSE and –SENSE lines are tied to the corresponding EXCITATION lines (and also the CAL SENSE line to the +SIGNAL line) *at the transducer.* Note also the extra wire connected to the –SIGNAL line at the transducer, but left *unconnected* at the 5D78. This wire is to be paired with the CAL SENSE line to establish proper shielding and to avoid asymmetrical dynamic loading.

When an optional SHUNT RESISTOR is being used in TWO-POINT (DEADWEIGHT) calibration of the 3000PLUS, it should be tied across Terminals 7 (CAL ENABLE) and 10 (CAL SENSE) of the Transducer Connector. For independent activation of the shunt for either a positive or negative upscale reading, see Section 5.F.

Fig. 8
Model 5D78 Transducer Connections

Fig. 8.a
4-Wire Strain Gage Cabling (under 20 ft. in length)

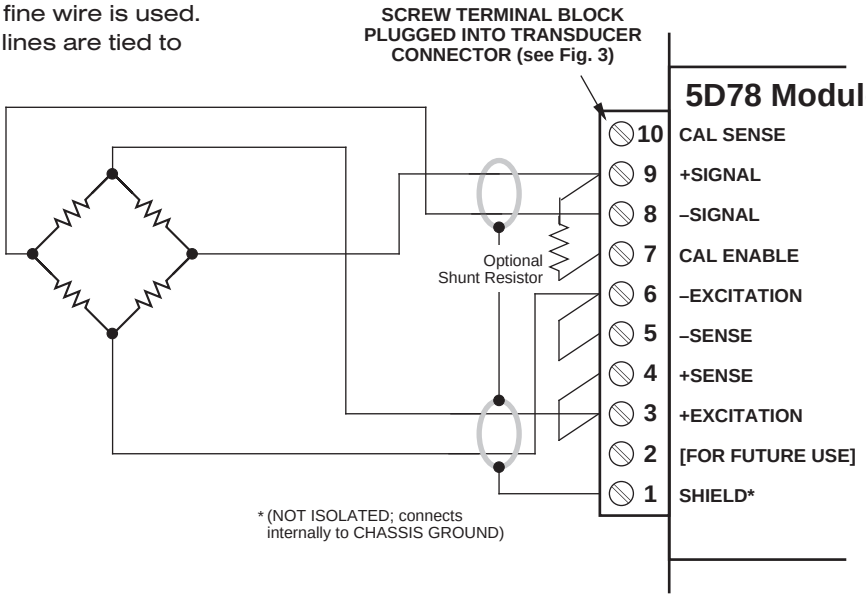
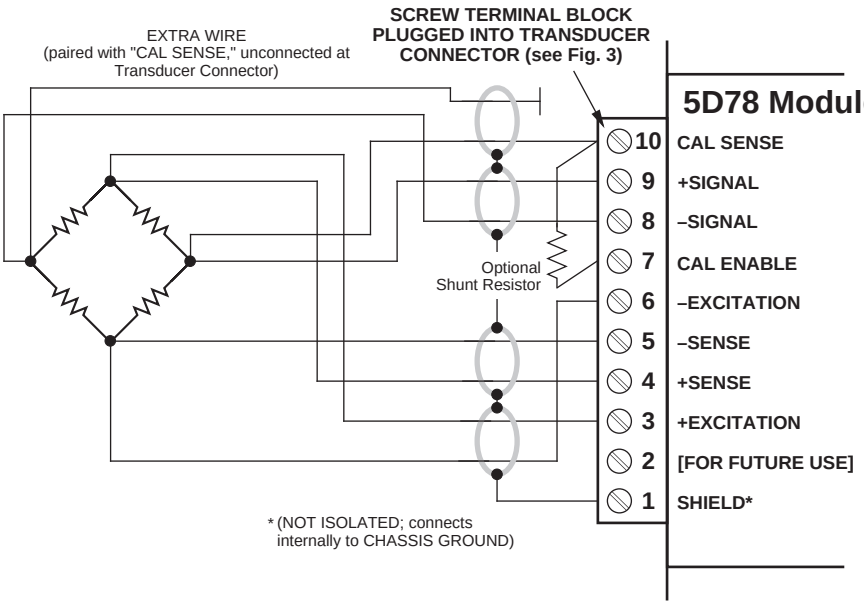


Fig. 8.b
8-Wire Strain Gage Cabling (20 ft. or longer)



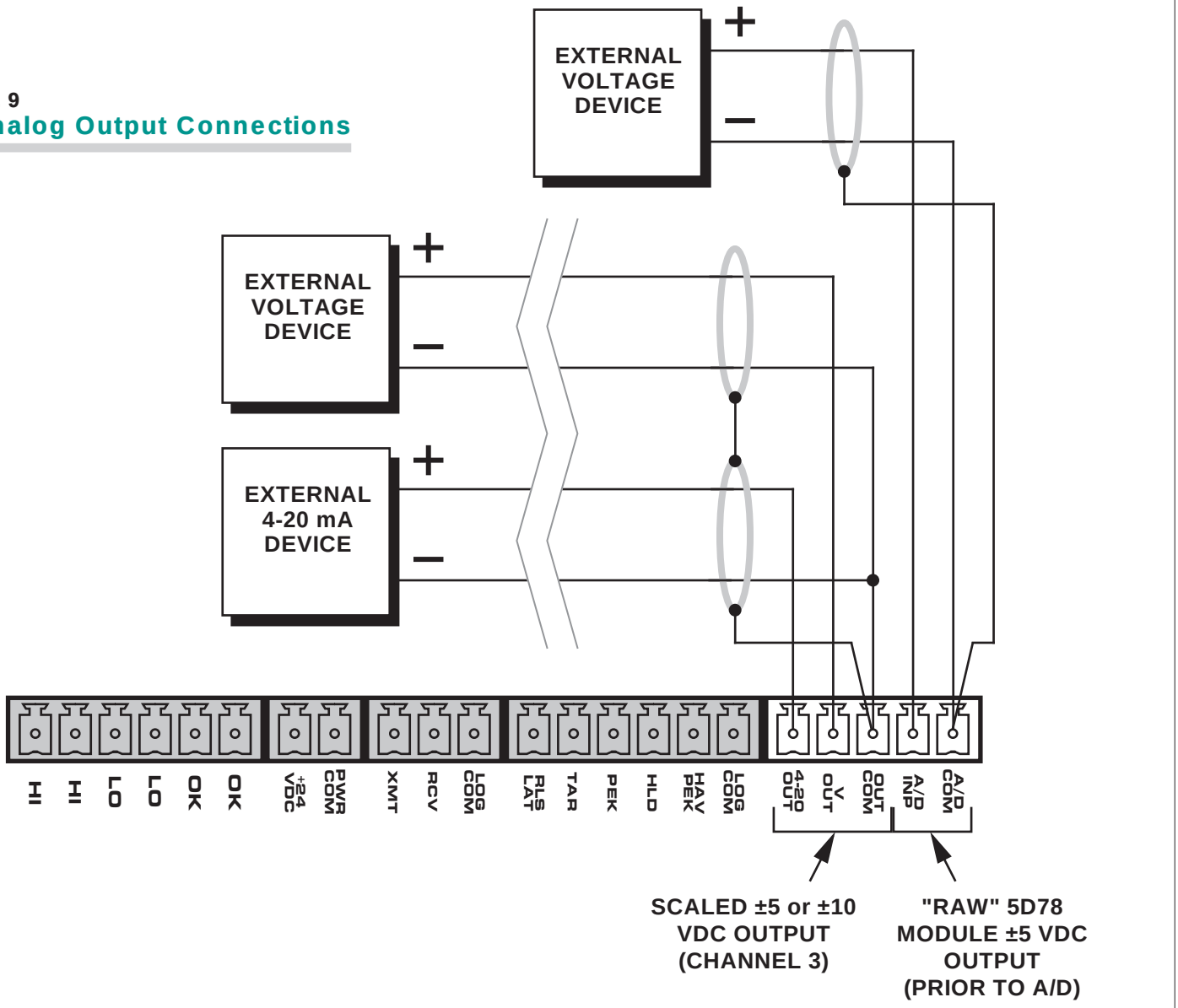
2.D ANALOG OUTPUT CONNECTIONS

The 3000PLUS produces three analog outputs:

- **Channel 3 (VOLTS)**—represents the instrument's "auxiliary" DAC output (Channel 2) as *scaled voltage.* As such, this output may be set to a full scale of either **±5 or ±10 VDC** (1) during meter configuration (Sections 3 and 4); (2) during run-time via the Configurator's "Live Output Window" (Section 4); or (3) by direct application of the **ANALOG VOLTAGE FULL SCALE (AVV)** command (Appendix A).
- **4-20 mA Output**—represents the instrument's "auxiliary" DAC output (Channel 2) as an industry standard *4-20 mA process signal*
- **5D78 Output**—represents the "raw" (unscaled) ±5-VDC output of the installed 5D78 conditioner module (prior to A/D conversion by the 3000PLUS).

Fig. 9 shows how A/D Cards, dataloggers, recorders, oscilloscopes, and other external devices can connect to these outputs. Each output is single-ended, and returns to the appropriate COMMON pin, to which the respective cable shield should also be tied.

Fig. 9
Analog Output Connections



2.E LOGIC I/O CONNECTIONS

TTL-LEVEL LOGIC INPUTS

The 3000PLUS meter's rear connector has terminals for the four "positive-true" logic-level inputs shown in Fig. 10.a, below*:

- **HOLD ("HLD")** — when at the *Logic 1* (+ 5 V) level, will cause the reading of the "auxiliary" DAC output (Channel 2) to be *held* (see Section 5.C for details)
- **PEAK ("PEK")** — when at the *Logic 1* (+ 5 V) level, will enable *peak capture* for Channel 2 (Section 5.B)
- **TARE ("TAR)** — when at the *Logic 1* (+ 5 V) level, will apply a *tare offset* to Channel 2, initially forcing it to the existing *tared output* value (Section 5.D)
- **RELEASE LATCH ("RLS LAT")** — when at the *Logic 1* (+ 5 V) level, will release ("unlatch") any and all currently *latched limits* and their respective indicators and relays (Section 5.E)

NOTE: These inputs must be *continuously true* for their respective functions to be maintained. Thus, for example, if TAR is only *momentarily* set to *Logic 1*, the resulting tare offset will be immediately removed from the Channel 2 reading on return of the TAR input to *Logic 0*. This also means that, as long as it is held at *Logic 1*, the RELEASE LATCH input will continuously defeat the latching of any subsequent limit alarms.

Fig. 10.a shows how the "PEK" and "HLD" inputs can be independently applied to the 3000PLUS instrument by means of a normally open push button and contact switch (respectively), powered by an external supply of nominal 5-24 VDC. Similar connections can be made

* For all four inputs, the *Logic 1* state is represented by nominal 5 VDC, and is the "true" state (indicated by the *name* of the input); the *Logic 0* state is represented by nominal 0 VDC, and is the "false" state. Thus, for example, when the "PEK" input is at *Logic 1*, peak capture is *enabled*. Logic inputs may be generated directly from dry contacts (switches, relays, etc.), as in Fig. 10.a, or from solid-state logic systems, as in Fig. 10.b. All inputs assume the *Logic 0* state in the absence of any connection.

Fig. 10
3000PLUS Logic I/O Connections

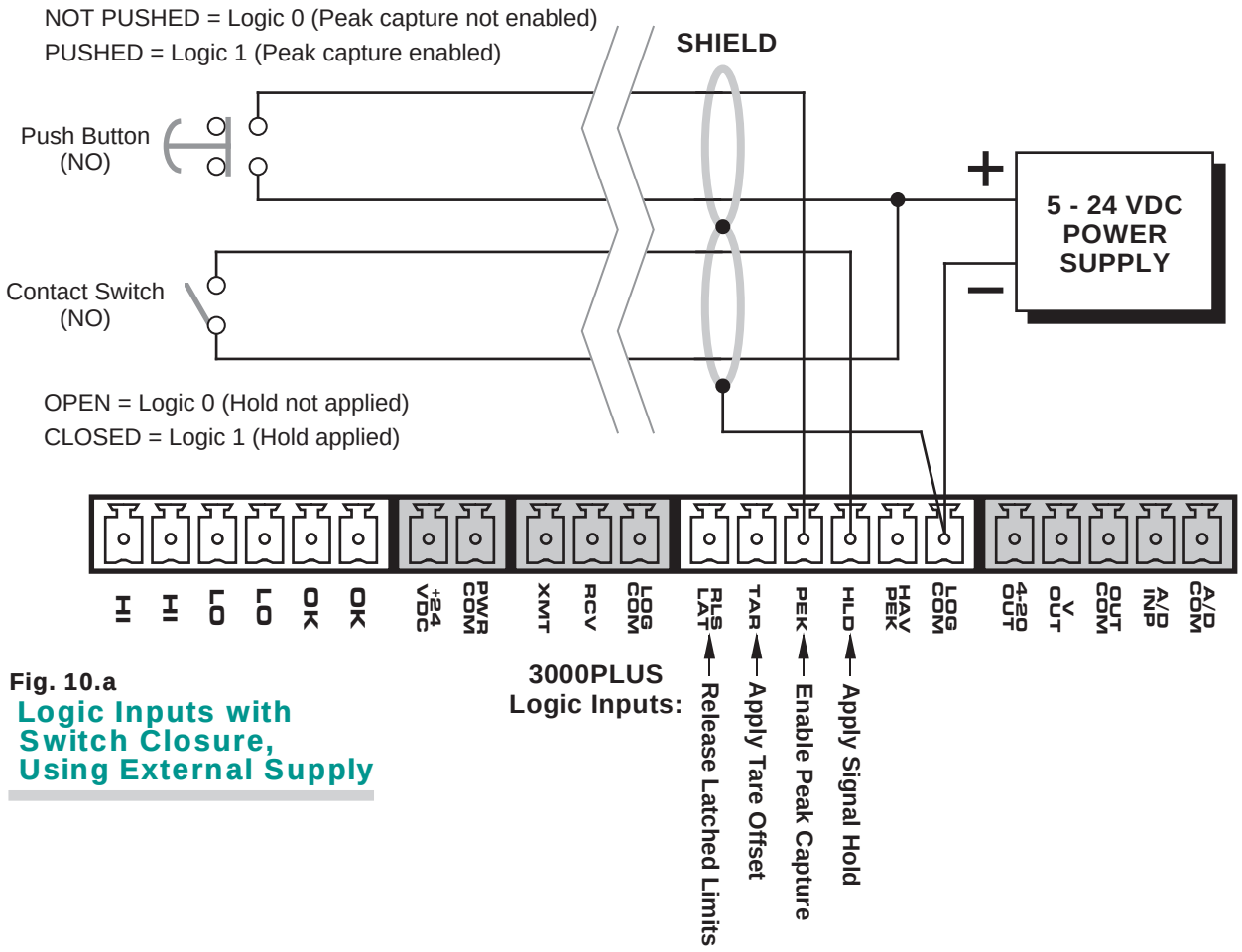


Fig. 10.a
Logic Inputs with Switch Closure, Using External Supply

2. CONNECTIONS

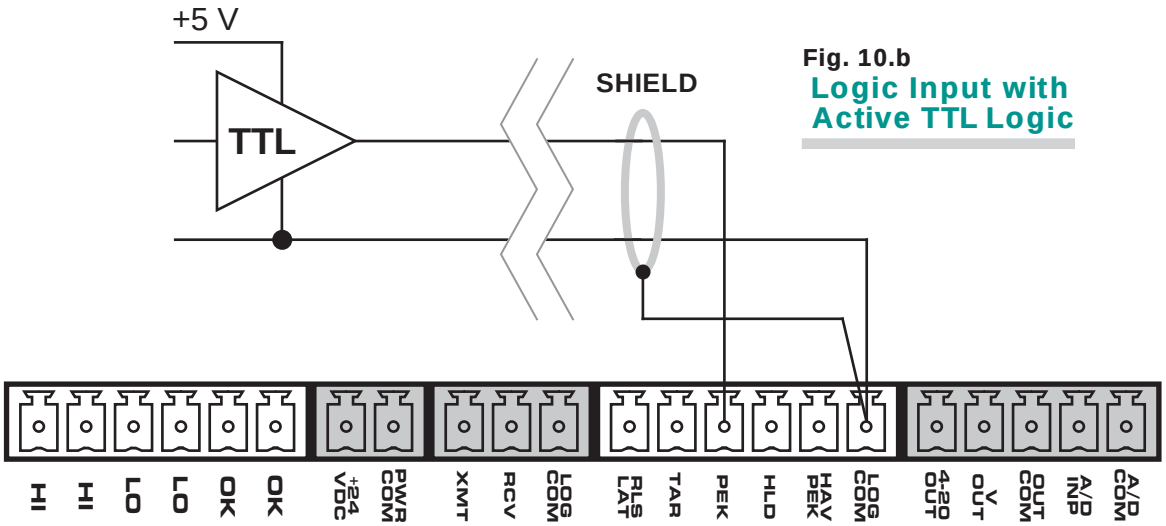


Fig. 10.b
Logic Input with Active TTL Logic

for the other two inputs. You may also use active TTL logic, as illustrated in Fig. 10.b, to produce the desired logic condition.

RELAY AND TTL-LEVEL LOGIC OUTPUTS

The six LIMIT RELAY outputs shown in Fig. 10.c are continuously controlled by the existing limit-zone status of the "auxiliary" DAC output (Channel 2), if limit monitoring is currently enabled for the meter (see Section 5.E). There are two independent relays for each limit condition ("HI," "OK", and "LO"), which may be used to switch power for control action in all types of open-loop or ON-OFF closed-loop operations—for example, to actuate alarms or sorting devices, or to start up or shut down external processes.

As explained in Section 5.E, the contact polarity of the limit relays may be set to either NORMALLY OPEN or NORMALLY CLOSED (1) during meter configuration (Sections 3.B and 4); (2) during run-time via the Configurator's "Live Output Window" (Section 4.D); or (3) by direct application of the **POLARITY (POL)** command (Appendix A). A normally *open* relay will *close* on occurrence of the triggering limit condition (and vice versa).

The TTL-level "HAVE PEAK" output is produced when a peak value of Channel 2 has been captured, if peak capture is currently enabled for the meter (see Section 5.B).

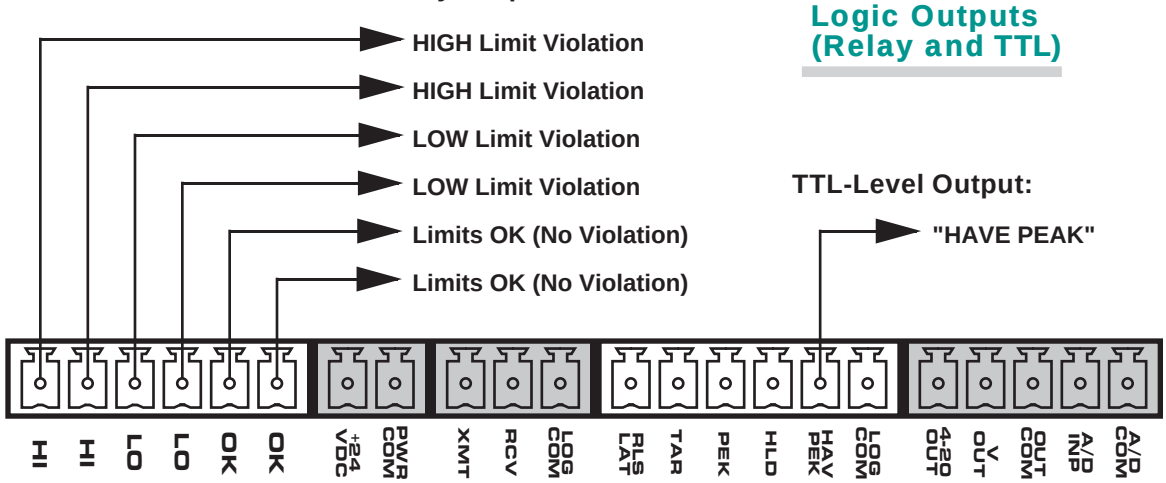


Fig. 10.c
Logic Outputs (Relay and TTL)

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

3.A INTRODUCTION

You can set up and calibrate your 3000PLUS completely via the instrument's front-panel push buttons and display (as detailed in the following section). For setup and calibration using the **3KP Configurator** software supplied with the meter, see Section 4.

ENTERING A SETUP PARAMETER

The general sequence for entry of any given setup parameter is as follows:

1. The two-to-six-character NAME of the parameter will first be displayed (e.g., **ID**, **RANGE**, **LO LIM**).
2. You will press

   to "acknowledge" the parameter.
3. The currently stored value of the parameter will be displayed (this will initially be its "factory default" value).
4. If you want to *keep* the currently displayed value for this parameter, you need only press **ENTER** once more to step to the next parameter in the setup sequence.
5. If you want to *change* the value of the parameter, what you do will depend on the type of parameter:
   a. If there are two or more *discrete selections* for the parameter, you will press

      repeatedly to cycle through the sequence of allowed values.

   b. If the parameter can take any *numeric value* within a given range, you will use the

      button to increment or decrement the currently displayed value (respectively) within that range (see below for details).

   When the desired parameter value is displayed, press

   once more to accept the value and step to the next parameter in the setup sequence.

NOTE: If you fail to press the **ENTER** button (or either the **UP** or **DOWN** button) within two minutes after you first press **ENTER** for a given parameter, the 3000PLUS display will alert you to this fact by alternating the parameter's current VALUE with its NAME.

USING THE UP/DOWN BUTTONS TO ADJUST A NUMERICAL PARAMETER

To *increase* a given parameter's displayed numerical value—in the *positive* direction, regardless of sign—you should press and hold down

using the method explained below, until the desired value is obtained.

To *decrease* a given parameter's displayed numerical value—in the *negative* direction, regardless of sign—you should press and hold down

until the desired value is obtained.

Changing an existing number to a new ("target") number requires that you create each digit of the target number separately, starting with the MOST SIGNIFICANT DIGIT (the leftmost digit of the number) and working back to the LEAST SIGNIFICANT DIGIT (the rightmost digit).

The best way to see how the **UP** and **DOWN** buttons work is to use an example: suppose that you want to change the instrument's **HI LIMIT** setpoint from its currently displayed value of "5.0" to a value of "1230.8."

1. Press and hold down the **UP** button until a "1" appears in the *thousands* place (fifth digit from the right).

   This is what you will see when you first press and hold the button:

   - The displayed number's LEAST SIGNIFICANT DIGIT (LSD)—initially the "0" of "5.0"—will begin to rapidly and continuously increment by the "count" value determined by its current scaling (see Section 1.D). It will do this until it cycles from its highest value back to "0," at which point...
   - The digit in the *ones* place (second from the right, initially "5") will immediately begin to increment by a count of "1." It will do this until it cycles from "9" back to "0," at which point...

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

- A "1" will appear in the *tens* place (third digit from the right), which will immediately begin to increment by a count of "1." It will do this until it cycles from "9" back to "0," at which point...
- A "1" will appear in the *hundreds* place (fourth digit from the right), which will immediately begin to increment by a count of "1." The first time it cycles from "9" back to "0,"...
- A "1" will appear in the *thousands* place (fifth digit from the right).

  The fifth digit from the right would behave similarly, if you needed to increase the displayed number to the order of *ten thousand*. Note, however, that the only nonzero value the *sixth* digit from the right can ever have is "1" (see Section 1.D).

Because the digits change rapidly, **it's easy to overshoot a target digit value**. Therefore, when you're getting near that value, it's best to release the button momentarily—*not longer than 2 seconds*—and then *repeat pressing the button rapidly without holding it down* until you get to the target digit value. If you hold the "re-pressed" button down longer than two seconds, the incrementing (or decrementing) process *will go back to the least significant digit (LSD)*.

Of course, you can correct an *upward* overshoot for a given digit by pressing the **DOWN** button, but you must do so within 2 seconds of releasing the **UP** button.

If you release the **UP** button and wait *more than 2 seconds* before pressing it again (or pressing the **DOWN** button), the incrementing (or decrementing) process *will go back to the least significant digit (LSD)*—as we want it to do in Steps 2-4.

In the above example of a target number of "1230.8," you could prevent upward overshoot by momentarily releasing the **UP** button as soon as "7" appears in the *hundreds* place. You would then immediately press it rapidly three more times to get the desired "1" in the *thousands* place.

2. When you have a "1" in the thousands place, release the **UP** button, *wait at least 2 seconds*, and press and hold it again. The LSD will again begin to increment by the present "count" value. This time you will press and hold down the **UP** button until a "2" appears in the *hundreds* place (fourth digit from the right).
3. Wait at least 2 seconds, and then press and hold down the **UP** button until a "3" appears in the *tens* place (third digit from the right).
4. Wait at least 2 seconds, and then press and hold down the **UP** button until the LSD reaches "8." The *ones* digit (second from the right) need not be changed from its present value of "0."

NOTE: As the number being increased or decreased *crosses zero*, its sign will immediately change. It doesn't matter which particular digit you are in the process of incrementing or decrementing; as soon as the value of the displayed number (as a whole) passes through zero, the sign change will occur. The digit that was active before the sign change will still be active (and will continue to increase or decrease) after the sign change. For example, you might see the following sequence of displays, as the fourth digit from the right is being decremented by holding down the **DOWN** button:

3000
2000
1000
0
-1000
-2000
-3000

VIEW ONLY MODE

In "VIEW ONLY" mode, the front-panel **SCROLL** and **UP/DOWN** buttons are disabled, so that the operator can sequentially *display* all values within the 3000PLUS's current setup configuration *without being able to change any of them* (the only exception is the instrument's **SECURITY CODE**, which will not be displayed in VIEW ONLY mode).

For entering VIEW ONLY mode, see Section 3.B, Steps 1.a through 1.d.

STEPPING THROUGH THE SETUP STAGES

By repeatedly pressing

you can quickly advance through the successive "stages" of the setup sequence (**SETUP**, **RANGE**, **FILTER**, etc., as announced by the front-panel indicator lights—see Fig. 2 and Section 1.D). Within each stage,

is used (as explained above) to step through the parameters of that stage. Remember that **ENTER** must

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

always be pressed *twice* for every parameter: once to acknowledge the parameter and once to accept its presently displayed value.

For example, after pressing **SETUP** five times, you should be at the **LIMITS** stage (as indicated by the **ST** and **LM** lights). Pressing **ENTER** will then display the current value of the first parameter within this stage: **LIMITS**, which can be either "ON" or "OFF" (as explained in the following section).

Note that

- You must be at the *first parameter* of a setup stage in order to use the **SETUP** button to step to the next stage.
- The **SETUP** stepping process works in both "CHANGE SETUP" and "VIEW ONLY" modes.

EXITING SETUP MODE

At any point within the setup procedure, pressing

and keeping it depressed for about 2 seconds will return the instrument to normal run-time operation.

3.B FRONT-PANEL SETUP PROCEDURE

To begin, press SETUP (for *exiting* the setup procedure at any time, see Section 3.A)

SETUP STAGE 1: SECURITY AND MODULE IDENTIFICATION

ST (only) is lit.

When the 3000PLUS displays this . . .	Do this . . .
ID	1.a. If you want to be able to *change* the value(s) of one or more setup parameters, press ENTER and proceed to Step 1.b. If you want only to *view* the instrument's current setup configuration, press **SETUP** once more. This will step you to a display of **Stage 2** of the setup sequence (see "Stepping Through the Setup Sequence" in Section 3.A).
0000	1.b. If you know the current instrument code (and it is not "0000"), use ▲ and ▼ to enter the required four-digit number.* Then press ENTER
	1.c. If the current instrument security code is "0000," you need only press **ENTER**.
	1.d. If the number you entered in Step 1.b is not the instrument's currently effective **SECURITY CODE**, it will display RETRY To enter another number by returning to Step 1.a, press ENTER To skip the code entry and simply view (but not change) the current setup configuration, answer "NO" to the "RETRY" query by pressing ▼

(cont'd)

* At the end of the front-panel setup procedure, the operator may change the present **SECURITY CODE**, if desired (see Step 7.d).

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 1: SECURITY AND MODULE IDENTIFICATION (*cont'd*)

ST (only) is lit.

When the 3000PLUS displays this . . .	Do this . . .
5G AC alternating with 5D78	1.e. Press ENTER to proceed to **Setup Stage 2** (next page). (The installed module has identified itself as a Model 5D78 AC Strain Gage instrument.)

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 2: INPUT RANGE INFORMATION

ST and **RG** are lit.

When the 3000PLUS displays this . . .	Do this . . .
EXC FR	2.a. Press **ENTER**
5D78 "EXCITATION" SELECTIONS (in kHz): **3.27** **5.00** **10.00**	2b. The current **EXCITATION FREQUENCY** of the installed 5D78 module (in *kHz*) will be displayed. Press **SCROLL** repeatedly to cycle through the list of allowed values (shown left).* When the desired AC excitation is displayed, press **ENTER**
RANGE	2.c. Press **ENTER**
5D78 "RANGE" SELECTIONS (in mV/V): **0.5** **0.75** **1** **1.5** **2** **3**	2.d. The current **FULL-SCALE RANGE** of the installed 5D78 module (in *millivolts per volt*) will be displayed, alternating with MV/V. Press **SCROLL** repeatedly to cycle through the list of allowed values (shown left). When the desired range is displayed, press **ENTER**

NOTE: The listed range values are strictly "nominal." In selecting the most suitable setting for your application, you should consult the table of "practical ranges," below, which takes into account the effective 4% overlap that has been built into the scaling structure of the 5D78 Signal Conditioner Module.

(cont'd)

* Note that the highest allowed corner frequency value for the 5D78's **analog filter** is dependent on the currently selected excitation frequency: for an excitation of 10.00 kHz, it is 2000 Hz; for 5.00 kHz, it is 1400 Hz; and for 3.27 kHz, it is 1100 Hz.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 2: INPUT RANGE INFORMATION (*cont'd*)

ST and **RG** are lit.

When the 3000PLUS displays this . . .	Do this . . .

Table 2
"Practical" 5D78 Range (RNG) Settings

"Practical" Range (mV/V)	Range To Select (mV/V)
0.5000 - 0.7799	0.5
0.7800 - 1.0399	0.75
1.0400 - 1.5599	1
1.5600 - 2.0799	1.5
2.0800 - 3.1199	2
3.1200 - 4.7997	3

Thus, if the actual full-scale range of the source transducer lies *close to a given nominal range value*, it is most "practical" to select the range just *below* that nominal value. For example, if your *actual* transducer full-scale range is 3.1 mV/V, it is most practical to select a *nominal* range of **2 mV/V** (and NOT 3 mV/V), since 3.1 lies with the "practical" range of "2.0800 - 3.1199." Note also that the *highest* "practical range" allows an actual transducer sensitivity as high as 4.7997 mV/V.

DEC PT

2.e. Press

ENTER

000.00

The BLINKING DECIMAL POINT (here shown to yield a number precise to *hundredths*) will appear in the position to which it was last set.

2.f. You should now indicate the desired **DECIMAL-POINT PRECISION** for the instrument's standard ±5-volt scaled output (Channel No. 1), for the "auxiliary" DAC output (Channel No. 2), and for all setup values directly relating to the instrument's scaled engineering-units reading (including full-scale reading, limit setpoint and hysteresis values, peak "defeat" threshold," tared output, and all calibration numbers expressed in units):

Pressing ▲ will cycle the decimal point to the *left*.

Pressing ▼ will cycle the decimal point to the *right*.

2.g. Then press

ENTER

OUT FS

2.h. Press

ENTER

(cont'd)

SETUP STAGE 2: INPUT RANGE INFORMATION (*cont'd*)

ST and **RG** are lit.

When the 3000PLUS displays this . . .	Do this . . .

2.i. The 3000PLUS instrument's currently effective **FULL-SCALE OUTPUT IN ENGINEERING UNITS** value will be displayed, alternating with

5.000

Use

as explained in Section 3.A to adjust the displayed number to equal the desired full-scale output in engineering units (to the decimal-point precision specified in Step 2.f, above). This is the instrument reading that is to correspond to a full-scale analog output of +5.000 volts. The initial (default) value is "5000."

NOTE: The **FULL-SCALE OUTPUT ("FSU")** parameter is critical for proper module CALIBRATION (Stage 4, below). It will also determine the "count" value for the 3000PLUS display's least significant digit (see Section 1.D).

2.j. Then press

to proceed to **Setup Stage 3** (next page).

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 3: FILTERS

ST and **FL** are lit.

When the 3000PLUS displays this . . .	Do this . . .
AN FIL	3.a. Press ENTER
5D78 ANALOG FILTER SELECTIONS: **0.2 Hz** **2 Hz** **20 Hz** **0.2 kHz** **2 kHz***	3.b. The installed 5D78 module's current **ANALOG FILTER** corner frequency will be displayed. Press SCROLL repeatedly to cycle through the list of allowed values (shown left). When the desired filter frequency is displayed, press ENTER
DG FIL	3.c. Press ENTER
	3.d. The 3000PLUS instrument's currently effective **DISPLAY (or "DIGITAL") FILTER** value will be displayed. This is an integer from 0 through 9, indicating increasing amounts of digital smoothing (with "9" being the maximum amount, and "0" indicating that no digital smoothing is being applied to the display reading). Press ▲ or ▼ repeatedly until the desired display filter value is displayed. You will not be able to display a number less than 0 or greater than 9. Then press ENTER to proceed to **Setup Stage 4** (next page).

* **NOTE:** The value of the highest allowed corner frequency is dependent on the 5D78's currently selected **excitation frequency**: for an excitation of 10.00 kHz, it is 2000 Hz; for 5.00 kHz, it is 1400 Hz; and for 3.27 kHz, it is 1100 Hz.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4: CALIBRATION

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .
CAL **5D78 CALIBRATION SELECTIONS:** **ABS (ABSOLUTE)** **2 PT (TWO-POINT)** **SHUNT**	4.a. Press **ENTER** 4.b. The currently specified **CALIBRATION METHOD** for the installed 5D78 module will be displayed. Press **SCROLL** repeatedly to cycle through the list of allowed values (shown left). When the desired method is displayed, press **ENTER** To continue with calibration, go to the subsection below for the calibration method you have selected: ABS For **ABSOLUTE CALIBRATION**, go to Section 4(A), p. 3.11. 2 PT For **TWO-POINT (DEADWEIGHT) CALIBRATION**, go to Section 4(T), p. 3.16. SHUNT For **SHUNT CALIBRATION**, go to Section 4(S), p. 3.24.

NOTE: For a general discussion of the three methods that may be employed for 5D78 CALIBRATION, see **Section 4.E** of this manual.

Recommended Calibration

It is recommended **when calibrating the instrument for the first time** that you use the absolute (ABS) technique to establish the proper parameters for the meter in the area of full scale reading and the transducer's electrical sensitivity - which can be found on the trasnducer's calibration certificate. Once the unit is calibrated to its electrical specification, then you may recalibrate using the 2-Point method to adjust for any variations in the system's measurement due to any mechanical or electrical offsets.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(A): ABSOLUTE CALIBRATION

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .
xDR FS	4(A).a. Press **ENTER**.
	4(A).b. The last-entered **TRANSDUCER FULL-SCALE RANGE** will be displayed (having the decimal-point precision specified in Step 2.f). Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number to the desired value. This will normally be the *full-scale rating of the source transducer*, as stated by the transducer manufacturer, expressed in desired measurement units (e.g., for a torque sensor, 5000 (foot-pounds, full-scale)). Then press **ENTER**. **NOTE: TO AVOID POSSIBLE DAMAGE TO THE TRANSDUCER, YOU SHOULD NOT ENTER A TRANSDUCER FULL-SCALE RANGE THAT IS LESS THAN THE FULL-SCALE OUTPUT ("FSU") VALUE ENTERED IN STEP 2.i.**
xDR SN	4(A).c. Press **ENTER**.
DEC PT	4(A).d. Press **ENTER**.
000000	4(A).e. You should now indicate the desired **DECIMAL-POINT PRECISION** for the **TRANSDUCER SENSITIVITY** value you wish to enter*: Pressing ▲ will cycle the decimal point to the *left*. Pressing ▼ will cycle the decimal point to the *right*.
The BLINKING DECIMAL POINT (here shown to yield a number precise to *tenths*) will appear in the position to which it was last set.*	4(A).f. Then press **ENTER**.

* This decimal-point setting applies ONLY to the TRANSDUCER SENSITIVITY entry (Step 4(A).g); it does not affect the resolution established in Step 2.f for the instrument's FULL-SCALE OUTPUT ("FSU").

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(A): ABSOLUTE CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .
	4(A).g. The last-entered **TRANSDUCER SENSITIVITY** will be displayed, alternating with MV/V and with the decimal-point resolution specified in the previous step. Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number to the desired value. This will normally be the *rated output sensitivity of the source transducer, expressed in millivolts per volt (mV/V)*, as stated by the transducer manufacture (e.g., 3.5 mV/V, full-scale). The number you enter here should always be a *positive nonzero number*. Then press ENTER
OUT FS	4(A).h. Press ENTER
	4(A).i. The desired **FULL-SCALE OUTPUT IN ENGINEERING UNITS** value which you entered in Step 2.i will be displayed (having the decimal-point precision specified in Step 2.f). If you now need to change this number, you may use ▲ and ▼ as explained in Section 3.A to do so. Remember: this is the instrument reading that is to correspond to a full-scale analog output of +5.000 volts. Then press ENTER **TO AVOID POSSIBLE DAMAGE TO THE TRANSDUCER, YOU SHOULD NOT ENTER A FULL-SCALE OUTPUT THAT IS GREATER THAN THE TRANSDUCER FULL-SCALE RANGE VALUE ENTERED IN STEP 4(A).b.** The entered full-scale output should also be *greater than 20% of the value entered in Step 4(A).b*, to avoid possible nonlinearity and hysteresis effects.

SETUP STAGE 4(A): ABSOLUTE CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .

NOTE: The 3000PLUS will now calculate a **MODULE SCALING FACTOR (MSF)** from the three numbers you have just entered (as explained in Section 4.E and Appendix B, the **MSF** is used as a gain factor for the instrument's full-scale input range). If this calculation yields a gain that is too low (less than 1.0000, given the **FULL-SCALE RANGE** value established in Step 2.d), you will see a display of

ERROR alternating with RNG HI

If the calculated gain is too high (greater than 1.5999, given the current **RANGE** value), you will see a display of

ERROR alternating with RNG LO

Press

ENTER

to acknowledge the high or low range condition.

NOTE:

Units shipped after March 2008 had the automatic RANGE selection feature disabled for the user to enter the correct RANGE value manually.

If the 3000PLUS is able to reset the **RANGE** value so that a "legal" **MSF** may be calculated from the present calibration numbers, it will display

RESET alternating with RANGE

If you want the **RANGE** value to be reset, press

ENTER

to answer "YES" and proceed to Step 4(A).j, below.

If you do not want the **RANGE** value to be reset, press

▼

to answer "NO." You will be returned to Step 4(A).a.

If the 3000PLUS is not able to reset the **RANGE** value so that a "legal" **MSF** may be calculated from the present calibration numbers, you will be automatically returned to Step 4(A).a.

If you got a "RNG HI" (or "RNG LO") error, you may wish to exit and restart the setup procedure, this time selecting a lower (or higher} **FULL-SCALE RANGE** value in Step 2.d. Or you can continue with the calibration, but try to increase (or decrease) the effective sensitivity by increasing (or decreasing) either the TRANSDUCER SENSITIVITY entry or the FULL-SCALE OUTPUT entry, or by decreasing (or increasing) the TRANSDUCER FULL-SCALE RANGE entry.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(A): ABSOLUTE CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .
OUT ZR	4(A).j. Press **ENTER**.
	4(A).k. The last-entered **OUTPUT ZERO CORRECTION** will be displayed (having the decimal-point precision specified in Step 2.i). Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number to the desired value. This will normally be the *desired correction ("offset") to be continuously applied to the 3000PLUS instrument's scaled output channels (1 and 2), expressed in measurement units* (see Section 4.E for more information on the **MODULE INPUT OFFSET (MIO)** parameter). The number should be entered with the desired plus/minus polarity: a *positive* offset value will be algebraically *added* to the output signal; a *negative* offset value will be algebraically *subtracted*. The initial (default) setting is always zero. Then press **ENTER**. **NOTE:** The 3000PLUS will now calculate a **MODULE INPUT OFFSET (MIO)** (as explained in Section 4.E and Appendix B). If this calculation yields an offset that is *too high* (absolute value greater than 20%), you will see a display of ERROR alternating with ZRO HI Press **ENTER** to acknowledge the error message. You will be automatically returned to Step 4(A).a. Repeat the absolute calibration procedure, but enter a smaller **OUTPUT ZERO CORRECTION** (or a larger **FULL-SCALE OUTPUT**).
--SYM	4(A).l. The 3000PLUS lets you modify the slope of the output in the negative domain in order to make it symmetrical with the positive slope (see Section 4.E for more details regarding the **NEGATIVE SYMMETRY (SYM)** parameter). If you want to apply a **NEGATIVE SYMMETRY CORRECTION**, answer "YES" by pressing **ENTER**.

NOTE:

If you encounter this error, you should check to insure your sensor input is near its electrical zero position and the proper Range is selected.

SETUP STAGE 4(A): ABSOLUTE CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .
	If no symmetry correction is required, answer "NO" by pressing  and proceed to **Setup Stage 5** (p. 3.30).
4(A).m.	The display will now show the value you entered in Step 4(A).i, above (the desired **FULL-SCALE OUTPUT IN ENGINEERING UNITS**), *but with opposite sign*. Use  as explained in Section 3.A to to adjust the displayed number (if necessary) to equal the *desired full-scale output reading in the negative domain*, expressed in measurement units. The number you enter here determines the required symmetry correction factor. If no symmetry correction is desired, you need not change the initially displayed value. **NOTE:** You will not be allowed to enter a number with an absolute value greater than 2% of the **FULL-SCALE OUTPUT** entered in Step 4(A).i. Then press  to proceed to **Setup Stage 5** (p. 3.30).

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(T): TWO-POINT CALIBRATION

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .
FAZ	4(T).a. Press **ENTER**
+LOAD	4(T).b. Before you can adjust the 5D78 module's active **PHASE SHIFT**, you must apply an actual load to the source transducer in the positive direction. This load should be between 80% and 100% of the transducer's nominal full-scale rating.[1] Then press **ENTER**
FAZ alternating with the **"LIVE" SCALED OUTPUT READING (CHANNEL 1)**	4(T).c. You will now use ▲ and ▼ to produce a *maximum output reading.* Each time you press the **UP ARROW** button, the 5D78 module's **PHASE (FAZ)** setting will be increased by 1 degree; each time you press **DOWN ARROW**, it will be decreased by 1 degree.[2] When pressing either **UP** or **DOWN** causes the displayed reading to *decrease* in value, it indicates that you have reached the maximum. Then press **ENTER**
UNLOAD	4(T).d. Before you can enter your first calibration point (**ZERO POINT**), you must establish your transducer "zero" condition (less than 20% of full scale). Normally, you would either remove all load from the source transducer or apply a small but precisely known amount of load that is to be continuously "tared" from the final measurement. When the transducer is fully "unloaded," press **ENTER**
CAL 1 alternating with the **"LIVE" SCALED OUTPUT READING (CHANNEL 1)[3]**	4(T).e. Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number (if necessary) to the desired **ZERO POINT OUTPUT READING**, expressed in

1 You will be adjusting for the *transducer's phase shift with respect to the delivered excitation*, by means of an integral number between -39 and 39, representing DEGREES. See the description of the **PHASE (FAZ)** command in Appendix A.

2 You will not be allowed to enter a **FAZ** setting of less than -39 or greater than 39 (degrees).

3 The 3000PLUS instrument's **MODULE INPUT OFFSET (MIO)** will be automatically reset to "00.00" (zero) before the "live" output reading is invoked. The previously entered **CAL1** number may appear for a second or two while this occurs.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(T): TWO-POINT CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .

measurement units. The number you enter here should be less than 20% of the **FULL-SCALE OUTPUT IN ENGINEERING UNITS** which you entered in Step 2.i.

Then press

ENTER

If you have *not* changed the displayed number (alternating with **"CAL 1"**) via the **UP/DOWN** buttons, you should proceed directly to entry of the "CAL 2" point in Step 4(T).f, below.

If, however, you have changed the displayed zero-point (**"CAL 1"**) number, the 3000PLUS will calculate a new **MODULE INPUT OFFSET (MIO)**, based on the entered reading, the current full-scale output setting, and the **FULL-SCALE RANGE** entered in Step 2.d—see Section 4.E of this manual for more information on the **MIO** parameter.

If this calculation yields an allowable offset value, that value will be applied to the output, and you will see a display of

OK

alternating with the **"LIVE" SCALED OUTPUT READING**.

If the reading that is now displayed corresponds sufficiently to your desired **ZERO POINT OUTPUT READING**, press

ENTER

and proceed to Step 4(T).f.

If the displayed zero-point reading is not satisfactory, you may perform *additional "CAL 1" adjustment* by answering "NO" to the "OK?" query—that is, by pressing

▼

—which will return you to Step 4(T).d.*

If the offset calculation yields a value that is *too high* (an absolute value greater than 20%), you will see a display of

ERROR alternating with CAL IHI

(cont'd)

* In this case, the 3000PLUS instrument's **MODULE INPUT OFFSET (MIO)** is NOT automatically reset to "00.00" (zero)—see note on the previous page. When displayed once more, the zero-point reading will reflect the last change you made to this number, so that it can be further adjusted via the **UP/DOWN** buttons.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(T): TWO-POINT CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .

Press

ENTER

to acknowledge the error message. The instrument will now determine whether or not the **RANGE** setting (Step 2.d) can be adjusted to allow the amount of input offset specified by the calculated value.

If a **RANGE** readjustment is possible, the 3000PLUS will display

RESET alternating with RANGE

If you want the **RANGE** value to be appropriately reset, press

ENTER

to answer "YES." The new **MODULE INPUT OFFSET** will be applied to the instrument's output—along with the new **RANGE** setting—and you will see a display of

OK

alternating with the **"LIVE" SCALED OUTPUT READING**. As explained above, you can answer "YES" to the "OK?" query (If the reading that is now displayed corresponds sufficiently to your desired **ZERO POINT OUTPUT READING**) by pressing **ENTER**, or you can answer "NO" by pressing the **DOWN** button (thus returning to Step 4(T).d).*

If you do not want the **RANGE** value to be reset, press

▼

to answer "NO." You will be returned to Step 4(T).d.

If the 3000PLUS is not able to adjust the **RANGE** setting to accommodate the calculated offset, you will be automatically returned to Step 4(T).d. Repeat the procedure, but enter a smaller **ZERO POINT** value.

NOTE:

If you encounter this error, you should check to insure your sensor input is near its electrical zero position and the proper Range is selected.

* In this case, the 3000PLUS instrument's **MODULE INPUT OFFSET (MIO)** is NOT automatically reset to "00.00" (zero)—see note on the previous page. When displayed once more, the zero-point reading will reflect the last change you made to this number, so that it can be further adjusted via the **UP/DOWN** buttons.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(T): TWO-POINT CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .
LOAD	4(T).f. Before you can enter your second calibration point (**SPAN POINT**), you must establish your transducer "span" condition by applying a precisely known amount of positively directed load between 80% and 100% of full scale. When the transducer is positively "loaded," press **ENTER**
CAL 2 alternating with the **"LIVE" SCALED OUTPUT READING (CHANNEL 1)**	4(T).g. Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number (if necessary) to the desired **SPAN POINT OUTPUT READING**, expressed in measurement units. The number you enter here will ordinarily be less than or equal to the **FULL-SCALE OUTPUT IN ENGINEERING UNITS** which you entered in Step 2.i. Then press **ENTER** If you have *not* changed the displayed number (alternating with **"CAL 2"**) via the **UP/DOWN** buttons, you should proceed directly to the optional entry of the "–SYM" correction in Step 4(T).i, below. If, however, you have changed the displayed span-point (**"CAL 2"**) number, the 3000PLUS will calculate a new **MODULE SCALING FACTOR (MSF)**, based on the entered reading, the current full-scale output setting, and the **FULL-SCALE RANGE** entered in Step 2.d—see Section 4.E of this manual for more information on the **MSF** parameter. An appropriate adjustment of the effective **MODULE INPUT OFFSET (MIO)** initially determined in Step 4(T).e will also be calculated. If the gain calculation yields an allowable gain value—and if the recalculated offset value is also allowed—those values will be applied to the instrument's output, and you will see a display of OK alternating with the **"LIVE" SCALED OUTPUT READING**. If the reading that is now displayed corresponds sufficiently to your desired **SPAN POINT OUTPUT READING**, press **ENTER** and proceed to the "RECAL?" query in Step 4(T).h, below.

(cont'd)

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(T): TWO-POINT CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .

If the displayed span-point reading is not satisfactory, you may perform *additional "CAL 2" adjustment* by answering "NO" to the "OK?" query—that is, by pressing

—which will return you to Step 4(T).f.

If the gain calculation yields a value that is out of its legal limits for a 5D78 conditioner module (i.e., either less than 1.0000 or greater than 1.5999), you will see a display of

ERROR

alternating with, respectively,

RNG HI or RNG LO

NOTE:

Units shipped after March 2008 had the automatic RANGE selection feature disabled for the user to enter the correct RANGE value manually.

Press

to acknowledge the error message.* The instrument will now determine whether or not the **RANGE** setting (Step 2.d) can be adjusted to allow the amount of gain specified by the calculated value.

If a **RANGE** readjustment is possible, the 3000PLUS will display

RESET alternating with RANGE

If you want the **RANGE** value to be appropriately reset, press

to answer "YES." The new **MODULE SCALING FACTOR** will be applied to the instrument's output—along with the new **RANGE** setting and the readjusted **MODULE INPUT OFFSET**—and you will be returned to Step 4(T).d for re-entry of the **ZERO POINT ("CAL 1")**, after you have "unloaded" the transducer once more.**

If you do not want the **RANGE** value to be reset, press

to answer "NO." You will be returned to Step 4(T).f for re-entry of the **SPAN POINT ("CAL 2")**.

If the 3000PLUS is not able to adjust the **RANGE** setting to accommodate the calculated gain, you will be automatically returned to Step 4(T).f.

(cont'd)

* It is also possible that, while the calculated scaling factor is acceptable, the recalculated offset term (**MIO**) is not. In this case, the instrument will display "**ERROR**" alternating with "**ZRO HI**." Press **ENTER** to acknowledge the error message and return to Step 4(T).d for re-entry of the **ZERO POINT ("CAL 1")**, after you have "unloaded" the transducer once more. In this case, the offset will have been automatically set to the highest allowed value (20%).

** A complete recalibration is required because of the change in the **RANGE** setting.

SETUP STAGE 4(T): TWO-POINT CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .
	Repeat the procedure, but adjust your "span" input to produce a lower or higher reading.
RECAL	4(T).h. After you enter a new **SPAN POINT ("CAL 2")** value in Step 4(T).g and press **ENTER** to answer "YES" to the "OK?" query, you will be asked whether you want to RECALIBRATE. If you do NOT wish to repeat the two-point calibration procedure—starting with the **ZERO POINT** and **SPAN POINT** you have already "OKed"—answer "NO" by pressing  and proceed to Step 4(T).i. If you DO wish to recalibrate, answer "YES" by pressing  —which will return you to Step 4(T).d.*
--SYM	4(T).i The 3000PLUS lets you modify the slope of the output in the negative domain in order to make it symmetrical with the positive slope (see Section 4.E for more details regarding the **NEGATIVE SYMMETRY (SYM)** parameter). If you want to apply a **NEGATIVE SYMMETRY CORRECTION**, answer "YES" by pressing  and proceed to Step 4(T).j. If no symmetry correction is required, answer "NO" by pressing  and proceed to Step 4(T).m.
--LOAD	4(T).j. Before you can enter the symmetry correction, you must establish your transducer "negative span" condition by applying a precisely known amount of negatively directed load between 80% and 100% of full scale. When the transducer is negatively "loaded," press 

* In this case, the 3000PLUS instrument's **MODULE INPUT OFFSET (MIO)** is NOT automatically reset to "00.00" (zero)—see note on p. 3.17. When displayed once more, the zero-point reading will reflect the last change you made to this number.

(cont'd)

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(T): TWO-POINT CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .
-SYM alternating with the **"LIVE" SCALED OUTPUT READING (CHANNEL 1)**	4(T).k. Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number until the desired **NEGATIVE OUTPUT READING** is obtained (correctly representing the present amount of negative load, expressed in measurement units). **NOTE:** You will not be allowed to change the displayed number by more than 2% of its absolute value. Then press ENTER
+LIN	4(T).m The 3000PLUS lets you apply a midscale **POSITIVE LINEARITY CORRECTION**. Adjusting the 3000PLUS instrument's **POSITIVE LINEARITY (LPN)** factor—a percentage of midscale output not greater than ±2%—is useful in cases where the output linearity error increases and decreases smoothly (with no inflections) with increasing values of input, as is commonly the case with conventional LVDT sensors. If you want to apply the positive correction factor, answer "YES" by pressing ENTER and proceed to Step 4(T).n. If no positive linearity correction is required, answer "NO" by pressing ▼ and proceed to Step 4(T).p.
+MIDFS	4(T).n. Before you can enter the correction, you must apply input loading in the positive direction to approximately *half* of the transducer's nominal full-scale rating. When this has been done, press ENTER
+LIN alternating with the **"LIVE" SCALED OUTPUT READING (CHANNEL 1)**	4(T).o. Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number until the desired **POSITIVE MIDSCALE OUTPUT READING** is obtained (correctly representing the present amount of positive load, expressed in measurement units). **NOTE:** You will not be allowed to change the displayed number by more than 2% of its absolute value.

SETUP STAGE 4(T): TWO-POINT CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .		Do this . . .
		Then press ENTER
--LIN	4(T).p	The 3000PLUS lets you apply a midscale **NEGATIVE LINEARITY CORRECTION**. Like **LNP** (above), the 3000PLUS instrument's **NEGATIVE LINEARITY (LNN)** factor is a percentage of midscale output not greater than ±2%. If you want to apply the negative correction factor, answer "YES" by pressing ENTER and proceed to Step 4(T).q. If no negative linearity correction is required, answer "NO" by pressing ▼ and proceed to **Setup Stage 5** (p. 3.30).
--MIDFS	4(T).q.	Before you can enter the correction, you must apply input loading in the negative direction to approximately *half* of the transducer's nominal full-scale rating. When this has been done, press ENTER
--LIN alternating with the **"LIVE" SCALED OUTPUT READING (CHANNEL 1)**	4(T).r.	Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number until the desired **NEGATIVE MIDSCALE OUTPUT READING** is obtained (correctly representing the present amount of positive load, expressed in measurement units). **NOTE:** You will not be allowed to change the displayed number by more than 2% of its absolute value. Then press ENTER and proceed to **Setup Stage 5** (p. 3.30).

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(S): SHUNT CALIBRATION

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .
FAZ	4(S).a. Press **ENTER**
+LOAD	4(S).b. Before you can adjust the 5D78 module's active **PHASE SHIFT**, you must apply an actual load to the source transducer in the positive direction. This load should be between 80% and 100% of the transducer's nominal full-scale rating.[1] Then press **ENTER**
FAZ alternating with the **"LIVE" SCALED OUTPUT READING (CHANNEL 1)**	4(S).c. You will now use ▲ and ▼ to produce a *maximum output reading.* Each time you press the **UP ARROW** button, the 5D78 module's **PHASE (FAZ)** setting will be increased by 1 degree; each time you press **DOWN ARROW**, it will be decreased by 1 degree.[2] When pressing either **UP** or **DOWN** causes the displayed reading to *decrease* in value, it indicates that you have reached the maximum. Then press **ENTER**
UNLOAD	4(S).d. Before you can enter your first calibration point (**ZERO POINT**), you must establish your transducer "zero" condition (less than 20% of full scale). Normally, you would either remove all load from the source transducer or apply a small but precisely known amount of load that is to be continuously "tared" from the final measurement. When the transducer is fully "unloaded," press **ENTER**
CAL 1 alternating with the **"LIVE" SCALED OUTPUT READING (CHANNEL 1)[3]**	4(S).e. Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number (if necessary) to the desired **ZERO POINT OUTPUT READING**, expressed in

1 You will be adjusting for the *transducer's phase shift with respect to the delivered excitation*, by means of an integral number between -39 and 39, representing DEGREES. See the description of the **PHASE (FAZ)** command in Appendix A.

2 You will not be allowed to enter a **FAZ** setting of less than -39 or greater than 39 (degrees).

3 The 3000PLUS instrument's **MODULE INPUT OFFSET (MIO)** will be automatically reset to "00.00" (zero) before the "live" output reading is invoked. The previously entered **CAL1** number may appear for a second or two while this occurs.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(S): SHUNT CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .

measurement units. The number you enter here should be less than 20% of the **FULL-SCALE OUTPUT IN ENGINEERING UNITS** which you entered in Step 2.i.

Then press

ENTER

If you have *not* changed the displayed number (alternating with **"CAL 1"**) via the **UP/DOWN** buttons, you should proceed directly to entry of the "CAL 2" point in Step 4(S).f, below.

If, however, you have changed the displayed zero-point (**"CAL 1"**) number, the 3000PLUS will calculate a new **MODULE INPUT OFFSET (MIO)**, based on the entered reading, the current full-scale output setting, and the **FULL-SCALE RANGE** entered in Step 2.d—see Section 4.E of this manual for more information on the **MIO** parameter.

If this calculation yields an allowable offset value, that value will be applied to the output, and you will see a display of

OK

alternating with the **"LIVE" SCALED OUTPUT READING**.

If the reading that is now displayed corresponds sufficiently to your desired **ZERO POINT OUTPUT READING**, press

ENTER

and proceed to Step 4(S).f.

If the displayed zero-point reading is not satisfactory, you may perform *additional "CAL 1" adjustment* by answering "NO" to the "OK?" query—that is, by pressing

▼

—which will return you to Step 4(S).d.*

If the offset calculation yields a value that is *too high* (an absolute value greater than 20%), you will see a display of

ERROR alternating with CAL IHI

(cont'd)

* In this case, the 3000PLUS instrument's **MODULE INPUT OFFSET (MIO)** is NOT automatically reset to "00.00" (zero)—see note on the previous page. When displayed once more, the zero-point reading will reflect the last change you made to this number, so that it can be further adjusted via the **UP/DOWN** buttons.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(S): SHUNT CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .

Press

ENTER

to acknowledge the error message. The instrument will now determine whether or not the **RANGE** setting (Step 2.d) can be adjusted to allow the amount of input offset specified by the calculated value.

If a **RANGE** readjustment is possible, the 3000PLUS will display

RESET alternating with RANGE

If you want the **RANGE** value to be appropriately reset, press

ENTER

to answer "YES." The new **MODULE INPUT OFFSET** will be applied to the instrument's output—along with the new **RANGE** setting—and you will see a display of

OK

alternating with the **"LIVE" SCALED OUTPUT READING**. As explained above, you can answer "YES" to the "OK?" query (If the reading that is now displayed corresponds sufficiently to your desired **ZERO POINT OUTPUT READING**) by pressing **ENTER**, or you can answer "NO" by pressing the **DOWN** button (thus returning to Step 4(S).d).*

If you do not want the **RANGE** value to be reset, press

▼

to answer "NO." You will be returned to Step 4(S).d.

If the 3000PLUS is not able to adjust the **RANGE** setting to accommodate the calculated offset, you will be automatically returned to Step 4(S).d. Repeat the procedure, but enter a smaller **ZERO POINT** value.

NOTE:

If you encounter this error, you should check to insure your sensor input is near its electrical zero position and the proper Range is selected.

* In this case, the 3000PLUS instrument's **MODULE INPUT OFFSET (MIO)** is NOT automatically reset to "00.00" (zero)—see note on the previous page. When displayed once more, the zero-point reading will reflect the last change you made to this number, so that it can be further adjusted via the **UP/DOWN** buttons.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(S): SHUNT CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .
+SHUNT	4(S).f. Press **ENTER**. The 5D78 module's *positive calibration shunt* will now be automatically closed (i.e., turned "ON") in order to simulate a known up-scale value of mechanical input in the positive direction. This **"EQUIVALENT INPUT"** value is often supplied by the transducer manufacturer for a specific value or values of shunt resistance. See Section 4.E for more information on shunt calibration, including calculation of an approximate equivalent input. For connection of the external shunt resistor, see Section 2.C.
+CAL 2 alternating with the **"LIVE" SCALED OUTPUT READING (CHANNEL 1)**	4(S).g. Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number (if necessary) to equal the shunt-supplied EQUIVALENT INPUT, expressed in measurement units. Then press **ENTER**. If you have *not* changed the displayed number (alternating with **"+CAL 2"**) via the **UP/DOWN** buttons, you should proceed directly to the entry of the "–SHUNT" input value in Step 4(S).i, below. If, however, you have changed the displayed +shunt-point (**"+CAL 2"**) number, the 3000PLUS will calculate a new **MODULE SCALING FACTOR (MSF)**, based on the entered reading, the current full-scale output setting, and the **FULL-SCALE RANGE** entered in Step 2.d—see Section 4.E of this manual for more information on the **MSF** parameter. An appropriate adjustment of the effective **MODULE INPUT OFFSET (MIO)** initially determined in Step 4(S).e will also be calculated. If the gain calculation yields an allowable gain value—and if the recalculated offset value is also allowed—those values will be applied to the instrument's output, and you will see a display of OK alternating with the **"LIVE" SCALED OUTPUT READING**. If the reading that is now displayed corresponds sufficiently to your desired **SPAN POINT OUTPUT READING**, press **ENTER**. and proceed to the "RECAL?" query in Step 4(S).e, below.

(cont'd)

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(S): SHUNT CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .

If the displayed +shunt-point reading is not satisfactory, you may perform *additional "+CAL 2" adjustment* by answering "NO" to the "OK?" query—that is, by pressing

—which will return you to Step 4(S).f.

If the gain calculation yields a value that is out of its legal limits for a 5D78 conditioner module (i.e., either less than 1.0000 or greater than 1.5999), you will see a display of

ERROR

alternating with, respectively,

RNG HI or RNG LO

NOTE:

Units shipped after March 2008 had the automatic RANGE selection feature disabled for the user to enter the correct RANGE value manually.

Press

to acknowledge the error message.* The instrument will now determine whether or not the **RANGE** setting (Step 2.d) can be adjusted to allow the amount of gain specified by the calculated value.

If a **RANGE** readjustment is possible, the 3000PLUS will display

RESET alternating with RANGE

If you want the **RANGE** value to be appropriately reset, press

to answer "YES." The new **MODULE SCALING FACTOR** will be applied to the instrument's output—along with the new **RANGE** setting and the readjusted **MODULE INPUT OFFSET**—and you will be returned to Step 4(S).a for re-entry of the **ZERO POINT ("CAL 1")**, after you have "unloaded" the transducer once more.**

If you do not want the **RANGE** value to be reset, press

to answer "NO." You will be returned to Step 4(S).f for re-entry of the **+SHUNT POINT ("+CAL 2")**.

If the 3000PLUS is not able to adjust the **RANGE** setting to accommodate the calculated gain, you will be automatically returned to Step 4(S).f.

* It is also possible that, while the calculated scaling factor is acceptable, the recalculated offset term (**MIO**) is not. In this case, the instrument will display "**ERROR**" alternating with "**ZRO HI**." Press **ENTER** to acknowledge the error message and return to Step 4(T).d for re-entry of the **ZERO POINT ("CAL 1")**, after you have "unloaded" the transducer once more. In this case, the offset will have been automatically set to the highest allowed value (20%).

** A complete recalibration is required because of the change in the **RANGE** setting.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 4(S): SHUNT CALIBRATION (*cont'd*)

ST and **CL** are lit.

When the 3000PLUS displays this . . .	Do this . . .
	Repeat the procedure, but adjust your shunt-supplied "equivalent input" to produce a lower or higher reading.
RECAL	4(S).h. After you enter a new **+SHUNT POINT ("+CAL 2")** value in Step 4(S).g and press **ENTER** to answer "YES" to the "OK?" query, you will be asked whether you want to RECALIBRATE. If you do NOT wish to repeat the shunt calibration procedure—starting with the **ZERO POINT** and **+SHUNT POINT** you have already "OKed"—answer "NO" by pressing  and proceed to Step 4(S).i. If you DO wish to recalibrate, answer "YES" by pressing  —which will return you to Step 4(S).d.*
--SHUNT	4(S).i. Press  The 5D78's positive shunt will now be opened (i.e., turned "OFF") and its *negative calibration shunt* closed (turned "ON") in order to simulate a known up-scale value of mechanical input in the negative direction. This part of the procedure lets you modify the slope of the output in the negative domain in order to make it symmetrical with the positive slope (see Section 4.E for more details regarding the **NEGATIVE SYMMETRY (SYM)** parameter).
--CAL 2 alternating with the **"LIVE" SCALED OUTPUT READING (CHANNEL 1)**	4(S).j. Use  as explained in Section 3.A to adjust the displayed number (if necessary) to equal the *negative* value of the EQUIVALENT INPUT entered in Step 4(S).g, above, expressed in measurement units. **NOTE:** You will not be allowed to change the displayed number by more than 2% of its absolute value. Then press  This will open the negative shunt to resume normal 3000PLUS measurement operations. You should proceed to **Setup Stage 5** (next page).

* In this case, the 3000PLUS instrument's **MODULE INPUT OFFSET (MIO)** is NOT automatically reset to "00.00" (zero)—see note on p. 3.17. When displayed once more, the zero-point reading will reflect the last change you made to this number.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 5: LIMITS

ST and **LM** are lit.

When the 3000PLUS displays this . . .	Do this . . .
LIMITS	5.a. Press **ENTER**
"LIMITS ENABLE" SELECTIONS: **ON** **OFF**	5.b. The instrument's current **LIMITS ENABLE** status will be displayed: "ON" or "OFF." In the limits "ON" state, the 3000PLUS will continuously monitor the "auxiliary" DAC output (Channel 2) for conformance to the currently specified high/low limit values—and will activate appropriate relays on detection of limit violation (for LOGIC I/O connections, see Section 2.E). Press **SCROLL** to toggle between the two allowed states. When the desired limits state is displayed, press **ENTER** **NOTE:** If you choose to *disable* limit monitoring (by selecting **"OFF"**), you will go directly to **Setup Stage 6** (p. 3.35), since the following limit-related parameters are now immaterial.
LIMSEC	5.c. Press **ENTER**
"LIMITS SECURITY" SELECTIONS: **ON** **OFF**	5.d. The instrument's current **LIMITS SECURITY** status will be displayed: "ON" or "OFF." When limits security is "ON," the 3000PLUS local operator will not be allowed to display and adjust limit values during normal run-time operation (see Sections 1.E and 5.E for details). Press **SCROLL** to toggle between the two allowed states. When the desired limits security setting is displayed, press **ENTER**

(cont'd)

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 5: LIMITS (*cont'd*)

ST and **LM** are lit.

When the 3000PLUS displays this . . .	Do this . . .
LATCH **"LIMITS LATCH MODE" SELECTIONS:** **ON** **OFF**	5.e. Press **ENTER** 5.f. The instrument's current **LIMITS LATCH MODE** status will be displayed: "ON" or "OFF." In LATCHING mode (the "ON" state), when a high-limit or low-limit violation is detected, that violation condition will remain in effect—regardless of the subsequent behavior of the auxiliary output reading—until limits are "released" (see Section 5.E for the different ways you can accomplish this). When limits are NONLATCHING (the "OFF" state), any detected limit violation condition will cease to occur as soon as the auxiliary output reading leaves the corresponding limit zone (or associated hysteresis deadband).* Press **SCROLL** to toggle between the two allowed states. When the desired latch mode state is displayed, press **ENTER**
POL **"LIMITS POLARITY" SELECTIONS:** **NC** **NO**	5.g. Press **ENTER** 5.h. The instrument's current **LIMITS POLARITY** status will be displayed: NORMALLY CLOSED ("NC") or NORMALLY OPEN ("NO"). This selection sets the contact polarity of the 3000PLUS instrument's limit output relays (for LOGIC I/O connections, see Section 2.E). Press **SCROLL** to toggle between the two allowed states. When the desired polarity state is displayed, press **ENTER**

* Latching also applies to the "BETWEEN" ("OK") limit zone. See Section 5.E for a complete discussion of 3000PLUS limit monitoring.

(cont'd)

SETUP STAGE 5: LIMITS (*cont'd*)

ST and **LM** are lit.

When the 3000PLUS displays this . . .	Do this . . .
LO LIM	5.i. Press ENTER 5.j. The instrument's currently effective **LOW LIMIT** setpoint value will be displayed (having the decimal-point precision specified in Step 2.f). The LOW LIMIT setting and HIGH LIMIT setting (see below) define the 3000PLUS's three distinct LIMIT ZONES, as diagramed in Fig. 21 (Section 5.E)*: • "**LESS THAN**" ZONE ("LO"): the reading for Channel 2 is less than the current Low Limit • "**BETWEEN**" ZONE ("OK"): the reading for Channel 2 is greater than or equal to the current Low Limit and less than or equal to the current High Limit • "**GREATER THAN**" ZONE ("HI"): the reading for Channel 2 is greater than the current High Limit The "LESS THAN" or "GREATER THAN" zones may be effectively extended for *nonlatching* limits by means of a user-specified HYSTERESIS DEADBAND (see below). Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number until the desired limit value is obtained (expressed in measurement units). **NOTE:** You will not be allowed to enter a LOW LIMIT that is greater than the current HIGH LIMIT (see below).** Then press ENTER
LO HYS	5.k. Press ENTER 5.l. The instrument's currently effective **LOW LIMIT HYSTERESIS** value will be displayed (having the decimal-point precision specified in Step 2.f). This parameter lets you define a HYSTERESIS window (or "deadband") immediately above the "LESS THAN" LIMIT ZONE defined by the current LOW LIMIT setpoint value (see Fig. 21, Section 5.E). The hysteresis deadband is to prevent low-level signal noise from toggling the low-limit relays on and off while the reading of Channel 2 remains in the neighborhood of the setpoint. *(cont'd)*

* For a complete discussion of limit monitoring, see Section 5.E. For front-panel limit status indication, see Section 1.D.

** Also, the absolute value of the LOW LIMIT value should not be greater than that of the **FULL-SCALE OUTPUT IN ENGINEERING UNITS** entered in Step 2.i.

SETUP STAGE 5: LIMITS (*cont'd*)

ST and **LM** are lit.

When the 3000PLUS displays this . . .	Do this . . .
	Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number until the desired low limit hysteresis value is obtained (expressed in measurement units). Enter a value of zero ("0," "0.0," etc.) to indicate no deadband. **NOTE:** You will not be allowed to enter a negative number, or a number that is greater than the *difference between the existing HIGH LIMIT and LOW LIMIT values.* Then press ENTER
HI LIM	5.m. Press ENTER
	5.n. The instrument's currently effective **HIGH LIMIT** setpoint value will be displayed (having the decimal-point precision specified in Step 2.f). See Step 5.h, above, for an explanation of limit zones. Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number until the desired limit value is obtained (expressed in measurement units). **NOTE:** You should not enter a HIGH LIMIT that is less than the current LOW LIMIT.*
HI HYS	5.o. Press ENTER
	5.p. The instrument's currently effective **HIGH LIMIT HYSTERESIS** value will be displayed (having the decimal-point precision specified in Step 2.f). This parameter lets you define a HYSTERESIS window (or "deadband") immediately below the "GREATER THAN" LIMIT ZONE defined by the current HIGH LIMIT setpoint value (see Fig. 21, Section 5.E). The hysteresis deadband is to prevent low-level signal noise from toggling the high-limit relays on and off while the reading of Channel 2 remains in the neighborhood of the setpoint. *(cont'd)*

* Also, the absolute value of the HIGH LIMIT value should not be greater than that of the **FULL-SCALE OUTPUT IN ENGINEERING UNITS** entered in Step 2.i.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 5: LIMITS (*cont'd*)

ST and **LM** are lit.

When the 3000PLUS displays this . . .	Do this . . .
	Use  as explained in Section 3.A to adjust the displayed number until the desired high limit hysteresis value is obtained (expressed in measurement units). Enter a value of zero ("0," "0.0," etc.) to indicate no deadband. **NOTE:** You will not be allowed to enter a negative number, or a number that is greater than the *difference between the existing HIGH LIMIT and LOW LIMIT values.* Then press  to proceed to **Setup Stage 6** (next page).

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 6: "AUXILIARY" OUTPUT

ST and **PK** are lit.

When the 3000PLUS displays this . . .	Do this . . .
CHAN 2	6.a. Press **ENTER**
"PEAK MODE" SELECTIONS: **P PEAK** **N PEAK**	6.b. The meter's current **PEAK CAPTURE MODE** will be displayed: POSITIVE PEAK ("P PEAK") or NEGATIVE PEAK ("N PEAK"). Here, "positive" peak operation refers to the analog capture and hold of the *maximum* (most positive) excursion of the "auxiliary" DAC output (Channel 2), while "negative" peak operation refers to the capture of Channel 2's *minimum* (most negative) excursion. The 3000PLUS will be placed in the selected mode *whenever peak capture is enabled* by means of a logic input at the rear **PEAK** terminal (for a complete discussion of peak capture operation, with diagrams, see Section 5.B; for LOGIC I/O connections, see Section 2.E). Press **SCROLL** to toggle between the two allowed modes. When the desired peak capture mode is displayed, press **ENTER**
PK DEF	6.c. Press **ENTER**
	6.d. The instrument's current **PEAK "DEFEAT" THRESHOLD** will be displayed (having the decimal-point precision specified in Step 2.f). By means of this parameter, you can set up a "peak-defeat" input threshold in order to prevent induced low-level signal noise from triggering a "HAVE PEAK" condition, when analog peak capture is enabled (see Fig. 18, Section 5.B). Within the low-level deadband defined by this threshold, the output will simply track the input, regardless of signal behavior. Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number until the desired peak "defeat" threshold value is obtained (expressed in measurement units). **NOTE:** You will not be allowed to enter a negative number.* Then press **ENTER**

* Also, the threshold value should not be greater than 20% of the **FULL-SCALE OUTPUT IN ENGINEERING UNITS** entered in Step 2.i.

(cont'd)

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 6: "AUXILIARY" OUTPUT (*cont'd*)

ST and **PK** are lit.

When the 3000PLUS displays this . . .	Do this . . .
BCKOUT	6.e. Press **ENTER** 6.f. The instrument's current **PEAK "BACKOUT" THRESHOLD** will be displayed. When analog peak capture is enabled, a positive or negative "capture"—and the consequent "HAVE PEAK" logic output—will occur when the "auxiliary" output signal *differs* from the input by more than a preset threshold amount (called the *peak "backout"*). The presence of the backout threshold prevents low-amplitude signal noise from toggling the "HAVE PEAK" output on and off (see Fig. 16, Section 5.B). The backout threshold is expressed in *A/D counts* (an integral number from 1 through 999). The initial (default) setting is "256" (counts), which corresponds to a signal change of approximately 0.8% of full scale. For best results, the backout setting should not be less than "40" (counts), corresponding to a signal change of approximately 0.1% of full scale. Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number until the desired peak "backout" threshold value is obtained (expressed in A/D counts). Then press **ENTER**
DECAY	6.g. Press **ENTER** 6.h. The instrument's current **LEAK RATE** will be displayed.* This is the rate at which every signal value held by the "auxiliary" DAC output (Channel 2) will decay, in *percent of full scale per second*. The ability to adjust the leak rate is useful in the measurement of *peak trends* in very fast cyclic processes, and permits capture of rapidly successive peaks of similar amplitude without having to provide a "reset" for each peak (see Fig. 19, Section 5.B).

* The leak rate will always be displayed with a resolution of hundredths (of a percent).

(cont'd)

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 6: "AUXILIARY" OUTPUT (*cont'd*)

ST and **PK** are lit.

When the 3000PLUS displays this . . .	Do this . . .
	Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number until the desired leak rate value is obtained (expressed in percent of full scale per second). **NOTE:** You will not be allowed to enter a negative number, or a number greater than 3.50 (%). Then press ENTER
TARE	6.i. Press ENTER
	6.j. The instrument's current **"TARED" OUTPUT** value will be displayed (having the decimal-point precision specified in Step 2.f). This parameter determines the value of a nonzero *tare offset* for the "auxiliary" DAC output (Channel 2)—if, for example, you wanted to subtract out the container weight in batch-weighing operations or establish an arbitrary zero reference in comparator gaging operations (among many other applications). Use ▲ and ▼ as explained in Section 3.A to adjust the displayed number until the you obtain *the engineering-units reading you wish the auxiliary output to display—regardless of the existing transducer input—the next time the 3000PLUS is placed in the TARE = ON mode.** To actually apply the specified tare offset to the output reading (that is, to actually turn "ON" the tare function), you must apply a logic-level input at the instrument's rear **TARE** terminal (for a complete discussion of tare operation, with diagram, see Section 5.D; for LOGIC I/O connections, see Section 2.E). Then press ENTER to proceed to **Setup Stage 7** (next page).

* The absolute value of the desired "TARED" OUTPUT reading should not be greater than that of the **FULL-SCALE OUTPUT IN ENGINEERING UNITS** entered in Step 2.i.

3. FRONT-PANEL CONFIGURATION AND CALIBRATION

SETUP STAGE 7: VOLTAGE OUTPUT

ST and **AN** are lit.

When the 3000PLUS displays this . . .	Do this . . .
CHAN 3	7.a. Press **ENTER**
FULL-SCALE VOLTAGE OUTPUT SELECTIONS: **5 V** **10 V**	7.b. The instrument's current **FULL-SCALE VOLTAGE OUTPUT**—that is, the full-scale range of the scaled analog output (Channel 3)—will be displayed: "5 V" or "10 V." For rear-terminal connections involving the voltage output (including 4-20 mA conversion), see Section 2.D. Press **SCROLL** to toggle between the two allowed ranges. When the desired full-scale output range is displayed, press **ENTER**
ID	7.c. Press **ENTER**
	7.d. The instrument's current four-digit **SECURITY CODE** will be displayed.* This is the number (initially "0000") that must be entered in Step 1.b in order to make changes to the instrument configuration via the front-panel buttons. If you do not want to change the displayed code, press **ENTER** to exit the front-panel setup procedure. If you want to change the code number, use ▲ and ▼ as explained in Section 3.A to adjust the displayed number until the desired security code is obtained (any number from "0000" through "9999"). Then press **ENTER** to exit the front-panel setup procedure.

* The **SECURITY CODE** will *not* be displayed, however, when you are in "VIEW ONLY" mode (see Steps 1.a through 1.d). In this mode, pressing **ENTER** after display of the **FULL-SCALE VOLTAGE OUTPUT** parameter will cause you to exit the setup display.

4. SOFTWARE CONFIGURATION AND CALIBRATION

4.A USING THE 3000PLUS CONFIGURATOR SOFTWARE

WHAT IS THE 3KP CONFIGURATOR?

Employing the run-time version of Microsoft® Access 2000, **3000PLUS ("3KP") Configurator** software lets you define, store, edit, download, upload, and manage any number of "configurations" for the Daytronic 3000PLUS Panel Meter.

Every real-world 3000PLUS application requires its own unique configuration. A "configuration" is a set of operating parameters that instruct the instrument precisely how it is to collect, display, process, and output sensor-based measurement data. The information contained in a 3000PLUS configuration includes general information, *instrument* setup parameters, *Signal Conditioner Module (SCM)* setup parameters, and calibration data.

The Configurator lets you set up and test serial communications between the PC running the Configurator software and a connected 3000PLUS instrument. Once valid communications have been established, you can configure the instrument using either the "OFF-LINE" or the "ON-LINE" method:

OFF-LINE CONFIGURATION

You may either create a new "default" configuration file or *upload* the existing setup parameters of the connected 3000PLUS instrument to form a new configuration file. You will then enter and validate all required setup values (see below), and finally *download* these values to the 3000PLUS instrument. This is the method outlined in Section 4.C. It requires you to perform at least an initial "ABSOLUTE" calibration of the instrument (see Step 5 of the overview).

ON-LINE CONFIGURATION

You may use the Configurator's **"Live" Output** window to view and modify the present configuration of the connected 3000PLUS instrument *on a run-time basis*. You may then (if desired) save the modified configuration to the currently open configuration file. In this case, no calibration or overall download is required.* You need not open or create a configuration file in order to configure your instrument "on-line," *unless you want to save the resulting configuration or perform a subsequent calibration*. See Section 4.D for a brief overview of "ON-LINE" configuration.

In general terms, the Configurator lets you

- define instrument setup values, including the model number of the installed **Signal Conditioner Module (SCM)** and parameters relating to real-time measurement and display, limit logic, and output processing
- define SCM-specific setup values, including the module's input range, analog filter cutoff frequency, plus (when the SCM is a **Model 5D78**) the AC excitation frequency (3.27, 5, or 10 kHz)
- define or view general parameters relating to the configuration itself or to the configured instrument, including configuration file path, size, and version; instrument description; configuration creator code; user comments; instrument security code; etc.
- validate the configuration at any time
- download the validated configuration to the connected 3000PLUS instrument

The Configurator also lets you perform selected run-time operations, including

- "absolute" and/or "two-point" (or "shunt") calibration of the 3000PLUS instrument's "live" measurement channel, including on-line adjustment of negative symmetry and positive or negative mid-scale linearity
- viewing any of the connected 3000PLUS instrument's three "live" analog outputs and adjusting it as desired (as part of **"ON-LINE" configuration**)
- viewing the entire "live" setup configuration of the connected 3000PLUS instrument, adjusting any displayed setup parameter on a run-time basis (as part of **"ON-LINE" configuration**), and saving all "live" parameters to the currently open configuration file, if desired
- sending one or more standard mnemonic commands to the instrument and viewing the response(s)
- applying a "HOLD" command to the instrument's "Auxiliary" and Voltage Outputs
- applying a positive or negative shunt to the instrument
- releasing any and all latched limits

(cont'd)

* In this case, calibration must be performed separately; the setup parameters that may be viewed and adjusted via the "Live" Output window do NOT include the basic calibration constants (see Section 4.E).

4. SOFTWARE CONFIGURATION AND CALIBRATION

You may also

- upload the current configuration of the connected 3000PLUS instrument to a new configuration file for storage and/or editing
- view/print a configuration report or save it as a ".txt" file

STARTING THE 3KP CONFIGURATOR

Instructions for *installing and running* the Configurator software were given in Section 1.F.

After the Configurator starts up, you can do one of several things:

- OPEN AN EXISTING 3000PLUS CONFIGURATION by selecting **Open...** from the **File** menu (a SAMPLE CONFIGURATION is installed with the Configurator software, to let you see typical setup entries)
- CREATE A NEW 3000PLUS CONFIGURATION by selecting **New...** from the **File** menu
- CREATE A NEW 3000PLUS CONFIGURATION by uploading the setup data contained in the connected 3000PLUS instrument, by selecting **Upload Configuration from 3000PLUS...** from the **Configuration** menu
- VIEW AND/OR MODIFY THE "LIVE" OUTPUT AND PRESENT CONFIGURATION of the connected 3000PLUS instrument by going to the **Calibrate / Configure** page and pressing the **View / Set . . .** button
- SEND ONE OR MORE COMMANDS to the connected 3000PLUS instrument by selecting **Send Command...** from the **Communications** menu

An overview of the procedure for creating a new instrument configuration "off-line" via the **New...** command is given in Section 4.C, below. For on-line modification of the connected 3000PLUS instrument's configuration, see Section 4.D.

GETTING CONFIGURATOR HELP

The Configurator provides a complete ON-LINE HELP system. To open HELP—and for instructions on how to use the **F1** key to get *context-sensitive help* for a Configurator page, field, or button—select **Configurator HELP...** from the Configurator's **Help** menu. Click the **OPEN CONFIGURATOR HELP** button (or press **[Alt] h**). The introductory topic entitled "What is the 3000PLUS Configurator?" will appear. For the complete HELP **Contents** or **Index**, click the respective tab.

Be sure to study the following "Getting Started" HELP topics—along with Sections 4.B through 4.E of this manual—before proceeding:

- **Setup and Testing of Serial Communications**
- **Read Me (Version x.x)**

4. SOFTWARE CONFIGURATION AND CALIBRATION

4.B SUMMARY OF CONFIGURATOR MENUS

FILE MENU[1]

New... (= [Control]N)
Select to create a new configuration

Open... (= [Control]O)
Select to open an existing configuration

Close[2]
Select to close the open configuration

Save As...[2] (= [Control]S)
Select to save the open configuration using a new file name

Exit
Select to exit the Configurator program

COMMUNICATIONS MENU[1]

Comm's Setup and Test...
Select to set up and test serial communications with the connected 3000PLUS

Send Command... (= [Control]T)
Select to send one or more mnemonic commands to the connected 3000PLUS

CONFIGURATION MENU[1]

Validate Configuration[2]
Select to validate the open configuration

Download Configuration to 3000PLUS...[2]
Select to download the open configuration to the connected 3000PLUS

Upload Configuration from 3000PLUS...
Select to upload the current setup values of the connected 3000PLUS to a new configuration

REPORTS MENU[2]

Full Configuration Report[1]
Select to view/print the full configuration

Configuration Commands List[1]
Select to view/print the set of mnemonic commands representing the open configuration

Close Report Preview[3] (= [Control]W)
Select to close the presently displayed report preview

Zoom[3]
Select to switch between the selected **Zoom Magnification Percentage** and the best window "fit" of the displayed report preview

[Zoom Magnification Percentage][3]
Select the magnification percentage to be applied to the displayed report preview

Output to Notepad[3]
Select to output the displayed report to a ".txt" file

Page Setup...[3]
Select to open the standard Windows PAGE SETUP window

Print...[3] (= [Control]P)
Select to open the standard Windows PRINT window

HELP MENU

Configurator HELP...
Select to open the Configurator's HELP system and for an explanation of how to use the **F1** key to get context-sensitive help for a Configurator page, field, or button

About...
Select to display Configurator version, copyright, and protection information

[1] Not active when a REPORT preview is being displayed.
[2] Not active when a configuration has not yet been opened.
[3] Only active when a REPORT preview is being displayed.

4. SOFTWARE CONFIGURATION AND CALIBRATION

4.C OVERVIEW OF "OFF-LINE" CONFIGURATION

In general, you will take the steps listed below for "off-line" development of a new 3000PLUS setup configuration (although the exact sequence of steps may vary, depending on your own preference). Alternatively, you may initially wish to upload the existing setup parameters of the connected instrument to form a new 3000PLUS configuration, which you may then proceed to modify as desired. In this case, you need not perform Steps 1 and 2, below; the instrument's **SCM model number** will be automatically and accurately entered.

If in the course of defining a complete configuration, you should neglect to enter a value for any critical configuration parameter, you will be so informed when you attempt to download that configuration to the 3000PLUS instrument. The software will not let you download a critically incomplete configuration. You can run the validation routine at any time during the configuration process (without first having to command a download), to see if there are currently any errors that need to be corrected (see **"Validating the Open Configuration"** in the Configurator ON-LINE HELP).

As each configuration value is entered, it is automatically saved. There is no need to apply a "Save" to the configuration as a whole. This also means, however, that you cannot easily "restore" a changed configuration to its original state. For this reason, if you're editing an existing configuration, and think that you might later need that same configuration in its original (unedited) form, it's best to use the **Save As...** menu command and work on a copy of the original configuration (you can always delete the original later, if desired).

On any Configurator page, a *turquoise-colored data field* indicates a configuration value that is automatically determined by the software, usually on the basis of one or more user-entered values. You cannot directly type in the contents of such fields.

At any time you can view and print out a full Configuration report or a full list of the 3000PLUS mnemonic commands that represent the currently open configuration (see Appendix A of this manual).

1. Using the **New...** menu command, open and give a name to a new (default) configuration. In the new configuration, all *instrument* setup parameters will be assigned specific default values, while all *Signal Conditioner Module (SCM)* setup parameters will be initially blank (until the **SCM model number** is entered).
2. Enter the **model number** of the currently installed Signal Conditioner Module (SCM). You may either select "5D78" from the popup list, or interrogate the installed module directly via the **Get/Check SCM Model Number** button (assuming that serial communications have been established). When you ask the installed module for its model number, its **serial number** will also be communicated to the Configurator.
3. In the **Instrument Setup** page, enter or select appropriate values for
   - measurement and display setup
   - limit logic setup
   - setup of output processing, including analog peak capture, tare offset, and voltage output full scale
4. In the **SC Module Setup** page, select appropriate values for
   - 5D78 excitation frequency (3.27, 5, or 10 kHz)
   - 5D78 nominal full-scale input range (in mV/V)
   - 5D78 analog filter (0.2, 2, 20, 200, or 2000 Hz)
5. Go to the **Calibrate / Configure** page, press the button labeled **Calibrate This Instrument**, and enter all requested calibration settings (see Section 4.E). If the Configurator is unable for any reason to communicate with the connected 3000PLUS instrument, the **Instrument Calibration** window cannot be opened. As explained in Section 4.E, both ABSOLUTE and TWO-POINT/SHUNT calibration methods are available for the Model 5D78 conditioner.
6. In the **General** page, enter optional instrument/configuration description, configuration creator code, transducer model/serial number, and comments (if desired). You may also (1) specify a four-digit **security code** other than the default "0000" (if desired) to prevent unauthorized alteration of the 3000PLUS instrument's operating configuration via the front-panel keypad; and (2) indicate whether the operator will or will not be permitted to view and edit limit setpoint values while the instrument is in normal run mode by turning "limits security" off or on, respectively.
7. Assuming that it passes the automatic **validation** test, your configuration is now ready to be downloaded (see **"Downloading a Configuration to the 3000PLUS Instrument"** in the Configurator ON-LINE HELP).

4.D OVERVIEW OF "ON-LINE" CONFIGURATION

As mentioned in Section 4.A, you may at any time use the Configurator's **3000PLUS "Live" Output** window (Fig. 11) to view and modify the present configuration of the connected 3000PLUS instrument *on a strictly run-time basis*. If a configuration file is currently open, you may, if you wish, save to that file all the configuration modifications you make via the **"Live" Output** window. However, you need not open or create a configuration file in order to configure your instrument "on-line," *unless you want to save the resulting configuration or perform a subsequent calibration.*

To open the **"Live" Output** window, go to the **Calibrate / Configure** page and press the button labeled **View/Set "Live" Instrument Output and Configuration**. This button will be active even if you have not yet opened an existing configuration or created a new one.

Assuming that valid serial communications have been established between the Configurator and the 3000PLUS, the Configurator will now query the instrument for each of its current setup parameters (excluding calibration data). This includes

- the current **DISPLAY (DIS)** setting, which determines which of the meter's three outputs will be initially displayed.
- the current **HOLD (HLD)** status for Channels 2 and 3 and the current **SHUNT (SHS)** status for all three channels—either of which operations can be subsequently controlled via corresponding buttons in the **"Live" Output** window)

All queried values will be loaded into the various data fields of the **"Live" Output** window that now appears.

SELECTING AND MODIFYING THE "LIVE" OUTPUT

At any time, you can select any of the 3000PLUS instrument's three separate output channels for "live" display just by clicking the corresponding button (see Section 1.D for a description of the channels). When a channel is selected, the fields and/or buttons for modifying any setup parameter(s) specific to that channel will be enabled.[1] When Channel 2 or 3 is selected, the **HOLD ON/OFF** button will also be enabled.

The **"Live" Output** window lets you change the currently effective value of each of the following output-specific parameters on a strictly run-time basis. As soon as you edit an existing parameter and exit that parameter's field or button set, the newly entered value will be immediately sent to the connected 3000PLUS instrument.[2]

- Peak Mode (Channel 2)
- Peak "Defeat" Threshold (Channel 2)
- Peak "Backout" Threshold (Channel 2)
- Leak Rate (Channel 2)
- Desired "Tared" Output (Channel 2)
- Limits Enable, Limits Latch Mode, and Limits Polarity (Channel 2)[3]
- High and Low Limits (Channel 2)
- High and Low Limit Hysteresis (Channel 2)
- Voltage Output Full Scale (Channel 3)

MODIFYING THE "LIVE" CONFIGURATION

The **"Live" Output** window also lets you change the currently effective value of each of the following instrument / module setup parameters on a strictly run-time basis, regardless of the output channel being displayed. Again, as soon as you edit an existing parameter and exit that parameter's field or button set, the newly entered value will be immediately sent to the connected 3000PLUS instrument.[2]

- Security Code
- Limits Security
- Configuration Description
- Transducer Model/Serial Number
- Full-Scale Reading in Engineering Units
- Units Legend
- Display Offset
- Display Filter
- 5D78 Excitation Frequency, Input Range, and Analog filter

SAVING "LIVE" PARAMETERS TO THE CURRENT CONFIGURATION

You can easily transfer to the currently open 3000PLUS configuration all of the setup values presently displayed in the **"Live" Output** window by pressing the button labeled **"Save All Current Settings to This Configuration."**[4]

[1] Selecting a given output channel for display in the **"Live" Output** window will not affect the front-panel display of the connected 3000PLUS instrument.

[2] The corresponding parameter of the presently open configuration will not be affected. Also, you will be informed if any of the modified configuration values are, for some reason, not accepted by the instrument.

[3] By pressing the **Release Latched Limits** button in the **"Live" Output** window, you can release any and all currently latched limits (when limit monitoring has been enabled and the meter is set to latching limits mode).

[4] This will reset the existing "CAL" numbers that are used to determine both absolute and two-point calibration (except for the Transducer Full-Scale Output ("CAL3")). The currently stored calibration values themselves will NOT be changed.

4. SOFTWARE CONFIGURATION AND CALIBRATION

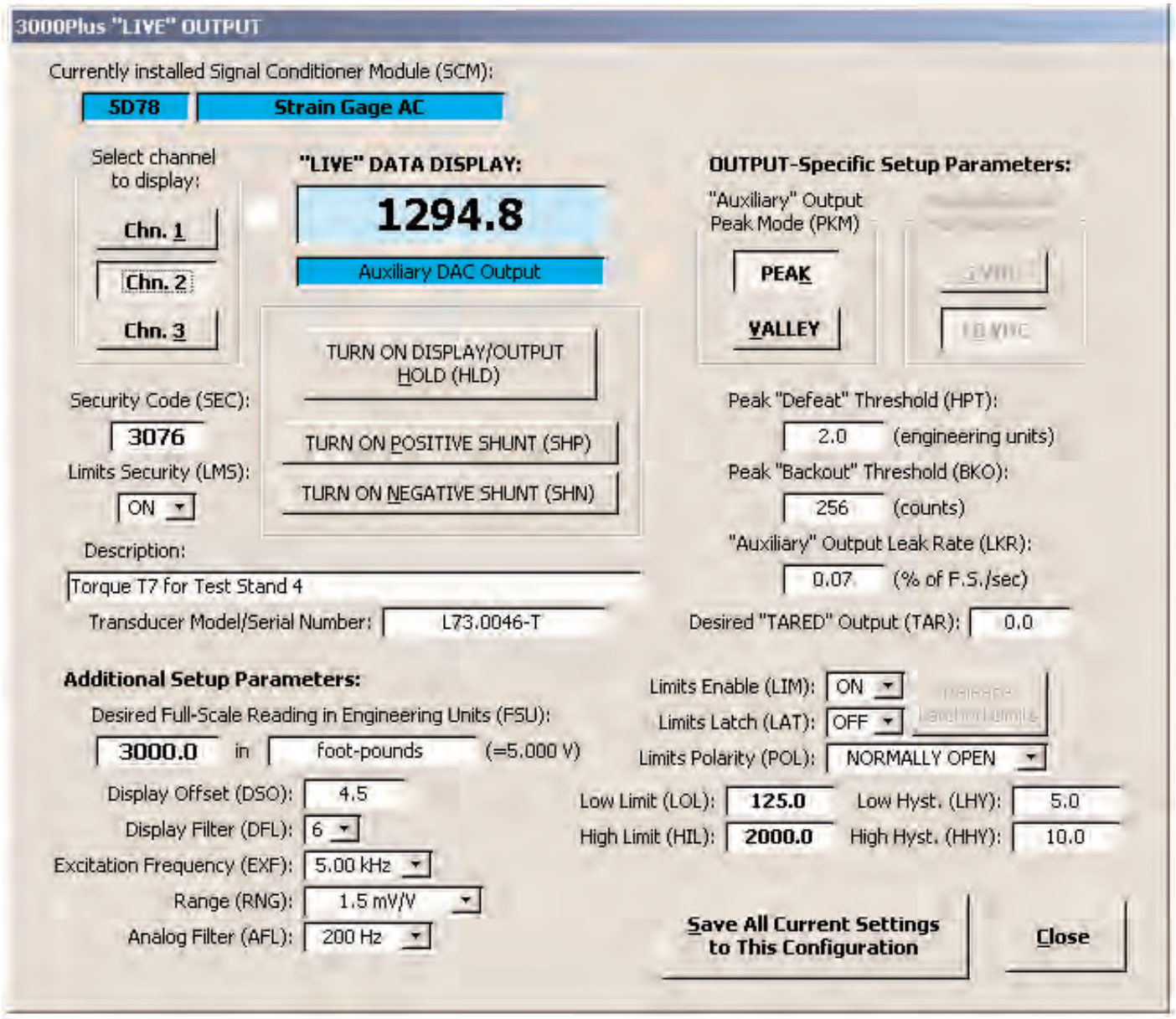


Fig. 11
3000PLUS Configurator "Live" Output Window

4. SOFTWARE CONFIGURATION AND CALIBRATION

PLEASE NOTE: The following is only a general overview of Configurator-based calibration of the 3000PLUS with installed Model 5D78 AC Strain Gage Conditioner Module. *Complete and detailed instructions* for the entry of calibration values and for loading these values into the meter itself (when required) are given in the Configurator ON-LINE HELP sections titled **"Absolute Calibration with an Installed Model 5D78 AC Strain Gage Conditioner"** and **"Two-Point ('Deadweight') Calibration with an Installed Model 5D78 AC Strain Gage Conditioner."**

4.E SOFTWARE CALIBRATION OF THE 3000PLUS WITH 5D78

CALIBRATION OVERVIEW

The two methods described below are provided by the **3KP Configurator** software for calibration of a 3000PLUS instrument with installed Model 5D78.

To calibrate your 3000PLUS by either or both methods, you must first go to the **Calibrate / Configure** page and click the button labeled **Calibrate This Instrument**. This will open the **Instrument Calibration** window to display the **ABSOLUTE Calibration** page (Fig. 13). To switch between the two calibration methods, click on the tab for the desired method.

NOTE: If the Configurator is unable for any reason to communicate with the 3000PLUS, the **Instrument Calibration** window cannot be opened (see the ON-LINE HELP section titled **"Setup and Testing of Serial Communications"**).

When it is opened, the **Instrument Calibration** window will display (in the center of its upper section) a "live," continuously refreshed readout of the connected meter's basic *scaled output channel* (Channel 1).*

The **Instrument Calibration** window will also display the following sets of "CALIBRATION VALUES":

- **ACTUAL ("Live") Calibration values** (in the upper right corner). These represent the calibration that is *currently in effect for the connected 3000PLUS instrument.* Also displayed here is the current *shunt state* of the installed 5D78 module, and the date/time of the *last 3000PLUS calibration* performed via the 3KP Configurator.

* If the decimal-point precision of the configuration's currently entered **Full-Scale Reading in Engineering Units (FSU)** is different from that of the current "live" scaled output reading of the connected 3000PLUS, you will be alerted to this fact. During the course of either ABSOLUTE or TWO-POINT CALIBRATION, the instrument's display resolution will be automatically changed to accord with the *configuration's* "FSU" precision.

** The user-selectable **AC EXCITATION** frequency is also included in the calibration information sent to 3000PLUS.

- **CALCULATED Calibration Values** (on the **ABSOLUTE Calibration** page only). This set of numbers is determined by the current entries of the page's **"CAL"** fields (described below). Some of the numbers may be missing, if one or more "CAL" fields are blank. When you press the button labeled **"Save and Send Calculated Calibration Values,"** these numbers will be sent to the connected 3000PLUS instrument, and will be permanently transferred to the present configuration.
- **CONFIGURATION Calibration Values** (on the **ABSOLUTE Calibration** page only). These represent the calibration data *currently stored in this configuration*. They do not depend directly on the present "CAL"-field entries, as do the "calculated" values, and are changed only when absolute or two-point calibration is actually performed.

Also displayed in the top left section of the window—for the user's reference only—is the **Excitation Frequency (EXF)** setting contained *in the present configuration*

In very general terms, the scaled analog output of a 3000PLUS with a 5D78 conditioner is calibrated by means of three variables**:

1. the 5D78 module's nominal full-scale input **RANGE (RNG)**, expressed in *millivolts per volt (mV/V)*
2. a **MODULE SCALING FACTOR (MSF)** to be used as a gain multiplier for the module's nominal full-scale input range
3. a **MODULE INPUT OFFSET (MIO)**—i.e., a percentage of full-scale input range applied to the module's *pre-amplified (input)* signal, in order to remove signal bias inherent to the source transducer

PLEASE NOTE: For a 3000PLUS with 5D78 conditioner, cable loading and other extraneous factors usually make it a practical necessity to use the conventional **TWO-POINT (DEADWEIGHT)** calibration technique with an accurately known input standard to calibrate the entire sensor/cable/instrument system after installation. In this case, the **ABSOLUTE** calibration technique

4. SOFTWARE CONFIGURATION AND CALIBRATION

should always be performed first, since it normally yields a good first approximation (depending on actual cable length and capacitance). For optimum 5D78 data integrity, however, *ABSOLUTE calibration must be followed by fully "in-place" TWO-POINT calibration.*

As explained below, TWO-POINT calibration of the 5D78 includes any necessary PHASE SHIFT adjustment and optional ± midscale LINEARITY corrections. Both calibration techniques allow NEGATIVE SYMMETRY adjustment of the 5D78's output (up to ±2% of full scale).

Also note that both calibration methods provide a means to *restore the 3000PLUS to the calibration state that existed before the last calibration was performed.*

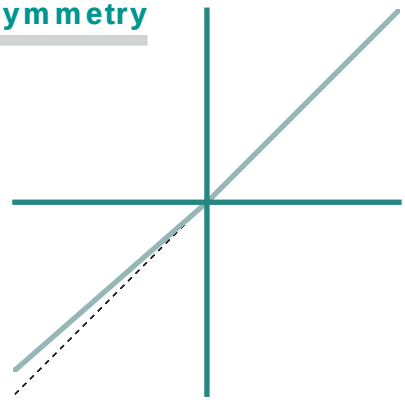
ABSOLUTE CALIBRATION

In absolute calibration, the required calibration values are calculated "off-line" by the Configurator software, based on the numbers you enter in the **ABSOLUTE Calibration** page (shown in Fig. 13). Calibration information will not be issued to the 3000PLUS or saved to the present configuration until you press the button labeled **"Save and Send Calculated Calibration Values."**

The **CAL3** field will always contain the 3000PLUS instrument's current **Full-Scale Reading in Engineering Units (FSU)** value (which cannot be changed in the **Instrument Calibration** window). **CAL3** therefore specifies the desired relationship between the 5D78 module's *measured engineering units* and its high-level ±5.000 VDC output, given the full-scale **input range (RNG)** for which the 5D78 is currently set.

The **CAL4** field lets you enter an optional *zero correction term ("offset")* to be continuously applied to the 5D78 module's measurement signal, expressed either in *engineering units* or in *millivolts*. In either mode, **CAL4** should be entered with the desired plus/minus polarity: a *positive* offset value will be algebraically *added* to the module's output signal; a *negative* offset value will be algebraically *subtracted*. The initial (default) **CAL4** setting for every 3000PLUS configuration is zero ("0").

Fig. 12
Typical Asymmetry



Since the 5D78's voltage output normally represents an *analog of some (force-related) parameter other than voltage itself,* the internal absolute calibration calculations also require entry of the *source transducer's full-scale rating* (**CAL1**) and the fixed *"sensitivity"* relationship between an electrical stimulus and the output response of the source transducer. Entered in the **CAL2** field in units of **mV/V**, the sensitivity data is normally supplied by the transducer manufacturer.

To summarize, the first four absolute calibration values for a 3000PLUS with 5D78 are as follows:

Transducer Information:

CAL1: Transducer full-scale range in engineering units
CAL2: Transducer sensitivity (in mV/V)

Output Information:

CAL3: Desired full-scale output reading in engineering units (= 5.000 V)
CAL4: Desired zero correction in either engineering units or mV

The **CAL5** field may be used to determine an appropriate *symmetry correction factor* (**SYM**), based on the deviation that exists between the magnitude of the 5D78's *actual* negative full-scale output and that of the currently entered **CAL3** (= **Full-Scale Output**) value—see Fig. 12.* The symmetry adjustment cannot exceed 2% of full scale.

As the Configurator calculates appropriate **RNG**, **MSF**, **MIO**, and **SYM** values, these numbers will be displayed in the respective **CALCULATED Calibration Values** fields. For the actual algorithms involved in these calculations, see **Appendix B**.

Once all required absolute calibration information has been entered—and has been evaluated as "valid" by the Configurator—you can actually calibrate the 3000PLUS either by issuing the relevant commands (only) via the button labeled **"Save and Send Calculated Calibration Values."** This action will also save these calculated values to the current configuration, so that they will be part of any future download to the instrument. With

* A *negative* **SYM** value is needed when you want the full-scale measurement reading in the negative domain to be *more negative* (i.e., when you want a higher slope for the output), while a *positive* **SYM** value causes the reading to be *more positive* (lower output slope). In Fig. 12, the actual negative full-scale reading needs to be brought *downwards* (i.e., to be made more negative), until it corresponds to the dotted line.

4. SOFTWARE CONFIGURATION AND CALIBRATION

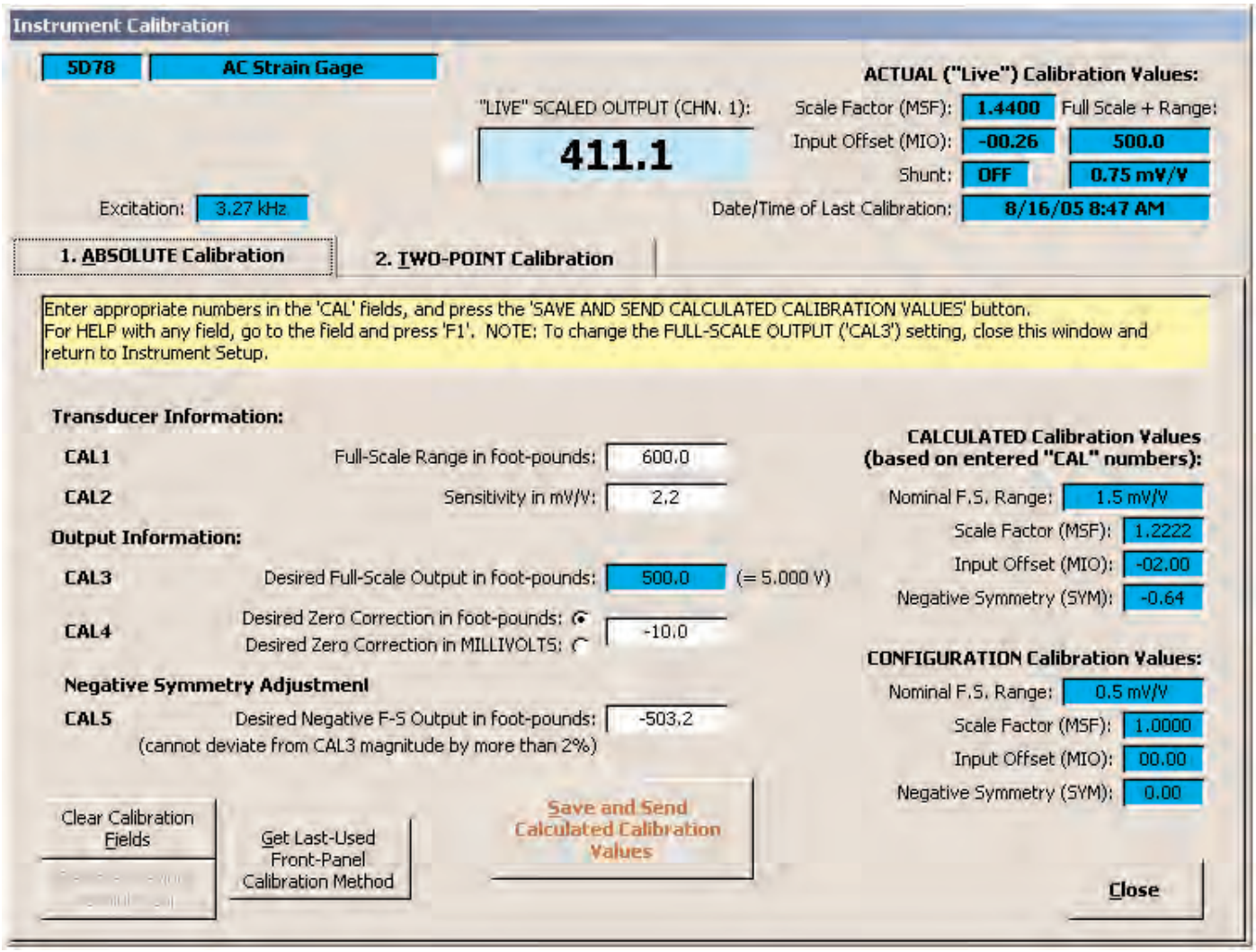


Fig. 13
Absolute Calibration Page for Installed Model 5D78

every complete calibration download, the present date and time will be entered in the **Date/Time of Last Calibration** field on the module's **Calibrate / Configure** page.

If, after you have calibrated the 3000PLUS by pressing the **Save and Send...** button, you wish to restore the meter to the calibration that existed before you pressed the button, you may do so by pressing the **Restore Previous Absolute Calibration** button, as explained in the Configurator ON-LINE HELP.*

* While this operation will return the *connected 3000PLUS instrument* to its previous calibration state by issuing appropriate **RNG**, **EXF**, **MSF**, **MIO**, and **SYM** commands, it will NOT change the corresponding values currently stored *in the present configuration.*

TWO-POINT (DEADWEIGHT) CALIBRATION

Unlike absolute calibration, two-point calibration is fully "on-line." In its computation of the required calibration constants, the Configurator will use the **Instrument Calibration** window's "live" scaled output reading (see Fig. 14 for the **TWO-POINT Calibration** page).

The Configurator will step you through the entire calibration procedure, enabling appropriate data fields and displaying appropriate prompting instructions at each step. *Each required calibration value will be automatically sent to the 3000PLUS as soon as it is calculated and verified.*

4. SOFTWARE CONFIGURATION AND CALIBRATION

If the installed 5D78 module is equipped with a SHUNT CALIBRATION RESISTOR (see Section 2.D), you can instruct the Configurator to switch the positive and negative shunts on and off at appropriate times within the calibration procedure.[1] For calculation of the approximate "equivalent input" provided by your shunt resistor, see the following subsection. For independent activation of the shunt for either a positive or negative upscale reading, see Section 5.F.

It is strongly recommended that you perform an ABSOLUTE calibration prior to every two-point calibration. This will not only yield a "nominally" calibrated instrument, but will also automatically ensure a good "first-approximation" **Range (RNG)** setting (which cannot be directly entered via the **Instrument Calibration** window). If you go to the **TWO-POINT Calibration** page *without having first performed absolute calibration* (since you last opened the **Instrument Calibration** window), the Configurator will bring this to your attention.

In very brief outline, the sequential steps of the two-point calibration procedure are as follows (in most cases, you will use the **Continue** button to advance from one step to the next and the **Back** button to return to a prior step, if it is to be repeated; for complete details concerning each step, see the Configurator ON-LINE HELP):

1. Make sure that the desired FULL-SCALE READING IN ENGINEERING UNITS (**FSU**) has been entered on the **Instrument Setup** page.
2. Make sure that the appropriate EXCITATION FREQUENCY (**EXF)** and INPUT RANGE (**RNG**) values have been selected on the **SC Module Setup** page.[2]
3. Enable SHUNT CALIBRATION, if desired.
4. Click the **Begin Calibration** button.
5. "Load" the transducer in the positive direction between 80% and 100% of full scale.
6. Enter PHASE SHIFT (**FAZ**) adjustment.[3]
7. "Unload" the transducer—i.e., establish transducer "zero" input condition (less than 20% of full scale).
8. Enter DESIRED ZERO-POINT READING in engineering units.
9. Repeat the zero-point procedure, if necessary.
10. "Load" the transducer—i.e., establish transducer "span" input condition (between 80% and 100% of full scale).[4]
11. Enter DESIRED SPAN-POINT READING (in engineering units).
12. Repeat the span-point procedure, if necessary.
13. If NEGATIVE SYMMETRY adjustment is desired, establish transducer "negative span" input condition.[5]
14. If NEGATIVE SYMMETRY adjustment is desired, adjust the displayed **SYM** value to obtain the desired output reading (see Fig. 12).
15. If POSITIVE LINEARITY adjustment is desired (see Fig. 15), apply input loading in the positive direction to approximately half of the transducer's nominal full-scale rating.
16. If POSITIVE LINEARITY adjustment is desired, adjust the displayed **LNP** value to obtain the desired output reading (see "Midscale Linearity Corrections," below, for details).
17. If NEGATIVE LINEARITY adjustment is desired (see Fig. 15), apply input loading in the negative direction to approximately half of the transducer's nominal full-scale rating.
18. If NEGATIVE LINEARITY adjustment is desired, adjust the displayed **LNN** value to obtain the desired output reading (see "Midscale Linearity Corrections," below, for details).
19. End or repeat calibration.

Every time a new **RNG**, **MSF**, or **MIO** value is automatically computed and sent to the 3000PLUS during the two-point procedure, the present date and time will be entered in the **Date/Time of Last Calibration** field on the module's **Calibrate / Configure** page.

[1] Shunt calibration is an easier though generally less accurate technique than "direct load" two-point calibration. It is useful, however, when overall "deadweighting" is impossible or inconvenient, and is good for an accuracy of about 0.2% of full scale (depending, of course, on the accuracy of the specified equivalent input, and on the resistor/bridge tolerance and temperature).

[2] The listed values for the **RANGE (RNG)** field are strictly "nominal." In selecting the most appropriate **RNG** setting, you should consult the table of "practical ranges" given in the Configurator ON-LINE HELP (and also in **Appendix B** of this manual), which takes into account the effective 4% overlap that has been built into the 5D78 scaling structure.

[3] The transducer manufacturer will normally specify the value of the effective *transducer phase shift* (with respect to the delivered excitation). The Configurator lets you enter this as an integral number between -39 and 39 (representing degrees). Of you may determine the required value by adjusting the displayed **FAZ** number until a maximum output reading is obtained.

[4] If you have enabled shunt calibration, the 5D78's *positive* shunt will now be automatically closed.

[5] If you have enabled shunt calibration, the 5D78's *negative* shunt will now be automatically closed.

4. SOFTWARE CONFIGURATION AND CALIBRATION

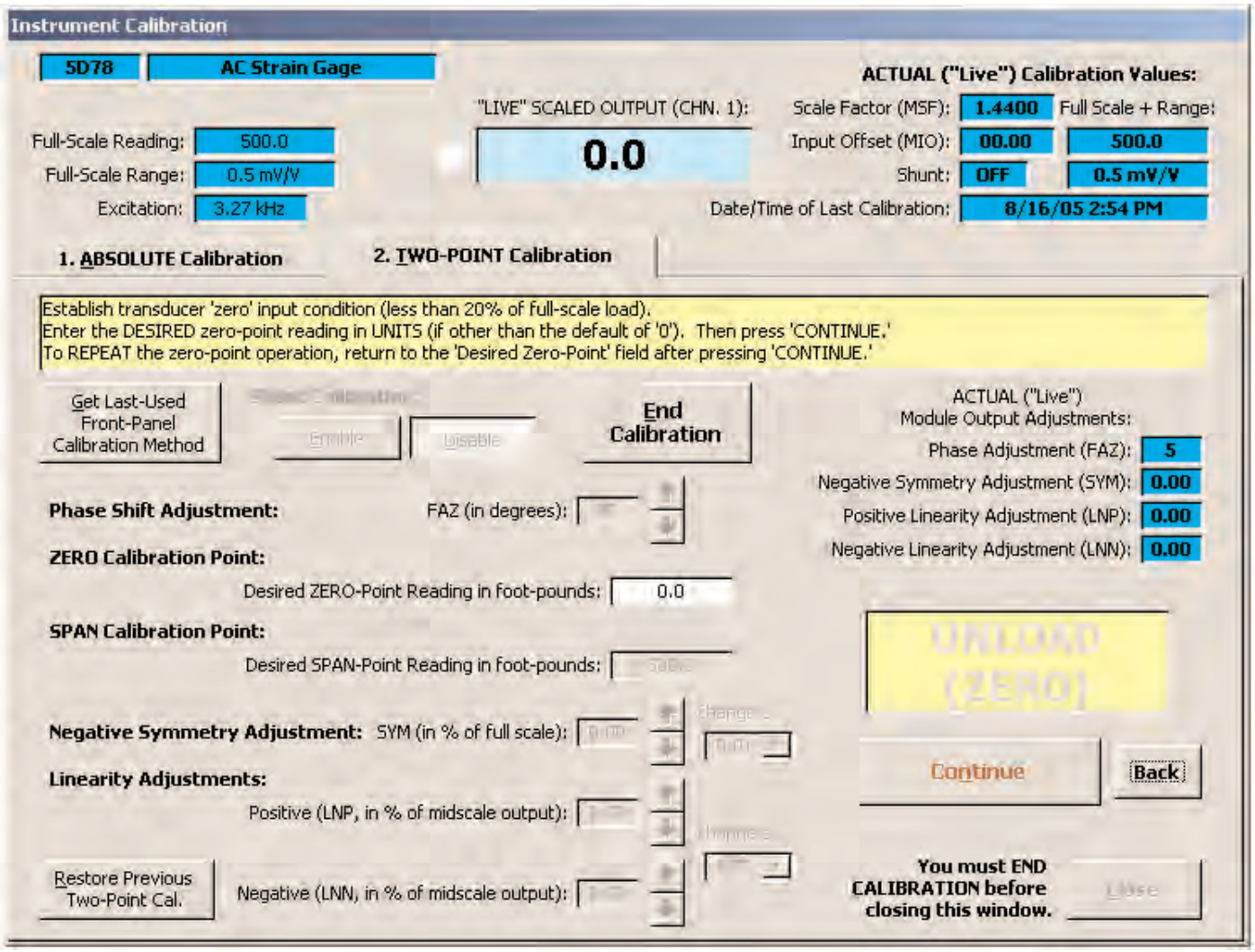


Fig. 14
Two-Point Calibration Page for Installed Model 5D78

If, after you have calibrated the 3000PLUS via the two-point procedure, you wish to restore the meter to the calibration that existed before you last pressed the **Begin Calibration** button, you may do so by pressing the **Restore Previous Two-Point Calibration** button, as explained in the Configurator ON-LINE HELP.*

CALCULATING "EQUIVALENT INPUT" FOR SHUNT CALIBRATION

In shunt calibration of a 3000PLUS with installed 5D78 conditioner, the second of the two calibration points ("SPAN") is not produced by directly loading the source transducer, but by shunting a resistor of known magnitude across one arm of the transducer's strain gage bridge in order to simulate a particular up-scale value of mechanical input in either the positive or negative direction. This known EQUIVALENT INPUT can then be entered as the DESIRED SPAN-POINT READING in the two-point calibration procedure, in order determine a suitable **MODULE SCALING FACTOR (MSF)**.

The transducer manufacturer will often supply the exact value of the transducer's equivalent input for a specific shunt resistor. If this is not the case, this value can be approximated from a knowledge of the *Shunt Calibra-*

* While this operation will return the *connected 3000PLUS instrument* to its previous calibration state by issuing appropriate **RNG**, **EXF**, **MSF**, **MIO**, **FAZ**, and **SYM** commands, it will NOT change the corresponding values currently stored *in the present configuration.*

4. SOFTWARE CONFIGURATION AND CALIBRATION

tion Resistance (R), the transducer's *Bridge Resistance (B)*, and the transducer's *Full-Scale Sensitivity (K, in mV/V full scale)*.

To determine the equivalent input (X) as an approximate percentage of full-scale output, you may use the following equation:

X = 25000B / K(R + 0.5B) %

Since the equivalent input is here expressed as a percentage of full-scale output, you must multiply it by the rated full-scale capacity of the transducer, in order to obtain the *actual input simulated by the shunt*.

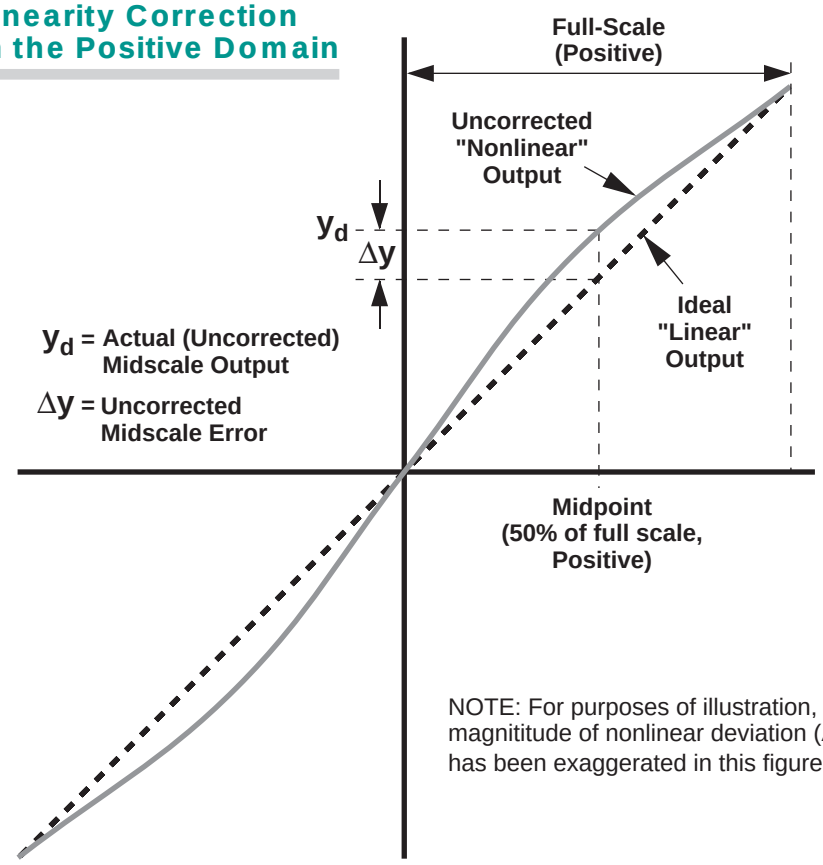
MIDSCALE LINEARITY CORRECTIONS

The Configurator's **LINEARITY POSITIVE (LNP)** and **LINEARITY NEGATIVE (LNN)** fields are for entry of a midscale linearity correction in the positive and negative domains, respectively (see Fig. 15). The linearity improvement furnished here is useful in cases where the output linearity error increases and decreases smoothly (with no inflections) with increasing values of input.

You may wish to determine through standard error-plot analysis the approximate correction that needs to be applied to the output midway between zero and positive (or negative) full scale, as a *plus or minus percent of the actual output reading at that point* (it cannot exceed ±2.00 % of midscale output). You would then enter this number directly in the **LNP** (or **LNN**) field, after which you should observe the actual midscale output reading to see if further adjustment is necessary (if so, you may use the corresponding **UP / DOWN ARROW** buttons). Fig. 15 illustrates a typical nonlinearity in need of both positive and negative midscale correction.

NOTE: A *positive* **LNP** value moves the positive-domain midpoint *upwards* (yielding a larger positive reading at that point), while a *negative* **LNP** value moves it *downwards* (yielding a smaller positive reading). Similarly, a *positive* **LNN** value moves the negative-domain midpoint *upwards* (yielding a smaller negative reading at that point), while a *negative* **LNN** value moves it *downwards* (yielding a larger negative reading).

Fig. 15
Linearity Correction in the Positive Domain



NOTE: For purposes of illustration, the magnitude of nonlinear deviation (Δy) has been exaggerated in this figure.

To correct for *positive-directed* nonlinearity in the positive domain, enter a **POSITIVE LINEARITY (LNP)** command of

$$LNP = -(\Delta y / y_d * 100)$$

A *negative* **LNP** value is entered because the midpoint of the actual output curve needs to be pushed *downward* (in the negative direction).

A comparable *positive* **NEGATIVE LINEARITY (LNN)** value would be entered to move the output curve upward (in the positive direction) in the negative domain.

5. OPERATING CONSIDERATIONS

5.A SENDING A COMMAND TO THE 3000PLUS

The **3000PLUS ("3KP") Configurator** software lets you send standard mnemonic commands to the connected 3000PLUS during normal run-time operation, one command at a time, while viewing the instrument's exact response to each command as it is sent. This feature can be used not only to perform run-time adjustments to the meter setup, but also to review the meter's current channel readings and configuration status—and to issue run-time "imperative" commands as desired.

For use of the Configurator's **Send Command...** window, see **"Sending a Command to the 3000PLUS Instrument"** in the Configurator ON-LINE HELP.

A "terminal emulation" program (either conventional or customized) can also be used to issue standard mnemonic commands to the 3000PLUS, and to receive the meter's responses.*

When the 3000PLUS is in receipt of a command issued to its serial communications port, the front-panel **CM** indicator will light (see Fig. 2 and Section 1.D).

For a discussion of 3000PLUS *command and response syntax*, plus a description of all setup, interrogation, and imperative commands, see **Appendix A**.

* When using a terminal program (such as Windows HyperTerminal), remember that the 3000PLUS instrument's RS232 communications interface employs a fixed protocol of 19,200 baud, 8 data bits, 1 stop bit, and No parity—with no software or hardware "handshake."

5.B CAPTURING A SIGNAL PEAK

SETTING PEAK MODE

Whenever peak capture is enabled, the 3000PLUS will be automatically placed in one of two possible PEAK MODES, as determined by the last-entered **PEAK MODE (PKM)** setting:

- **PEAK**—indicates that the reading of the "auxiliary" DAC output (Channel 2) will continuously equal the *highest* (i.e., *most positive*) value experienced by Channel 2 since peak capture was last enabled*
- **VALLEY**—indicates that the reading of Channel 2 will continuously equal the *lowest* (i.e., *most negative*) value experienced by Channel 2 since peak capture was last enabled*

The active peak mode can be specified as part of the normal 3000PLUS setup procedure—either by means of the front-panel button menu (as explained in Section 3.B) or the Configurator software (Section 4). It can be changed on a strictly *run-time* basis by using the "PKM" toggle button in the Configurator's **"Live Output"** window when Channel 2 is being displayed (see Fig. 11). It may also be specified at any time by issuing one of the following **PEAK MODE (PKM)** commands to the 3000PLUS, either via the Configurator's **Send Command...** window or via a conventional or customized "terminal emulation" program (see Section 5.A, above):

PKM = 1 [sets to "PEAK" mode]

PKM = 2 [sets to "VALLEY" mode]

* Since the 3000PLUS instrument's "scaled voltage" output (Channel 3) is continuously proportional to Channel 2, it will report "peak" and "valley" readings along with Channel 2, as long as peak capture is enabled.

ENABLING AND DISABLING PEAK CAPTURE

The 3000PLUS instrument's peak-capture operation is turned on and off solely by means of a logic input at the rear **PEAK ("PEK")** screw terminal shown in Fig. 2. See Section 2.E for an explanation of how the "PEK" logic input can be connected for the enabling/disabling of peak capture, either by switch closure (no external supply required) or by active TTL logic.

The capture and hold of a typical input maximum is illustrated in Fig. 16 below. Here, a peak mode of "PEAK" (= positive peak capture) was established for the 3000PLUS during initial setup. Until peak capture is actually enabled at time t_1, the "auxiliary" output (Channel 2) simply tracks the basic scaled output (Channel 1). After time t_1, Channel 2 continuously reports the highest signal value experienced since peak capture last began. As long as Channel 1's value is continuously rising—as it does after t_1 up to the first small (uncaptured) peak—the reading of Channel 2 still appears to track it.

(cont'd)

5. OPERATING CONSIDERATIONS

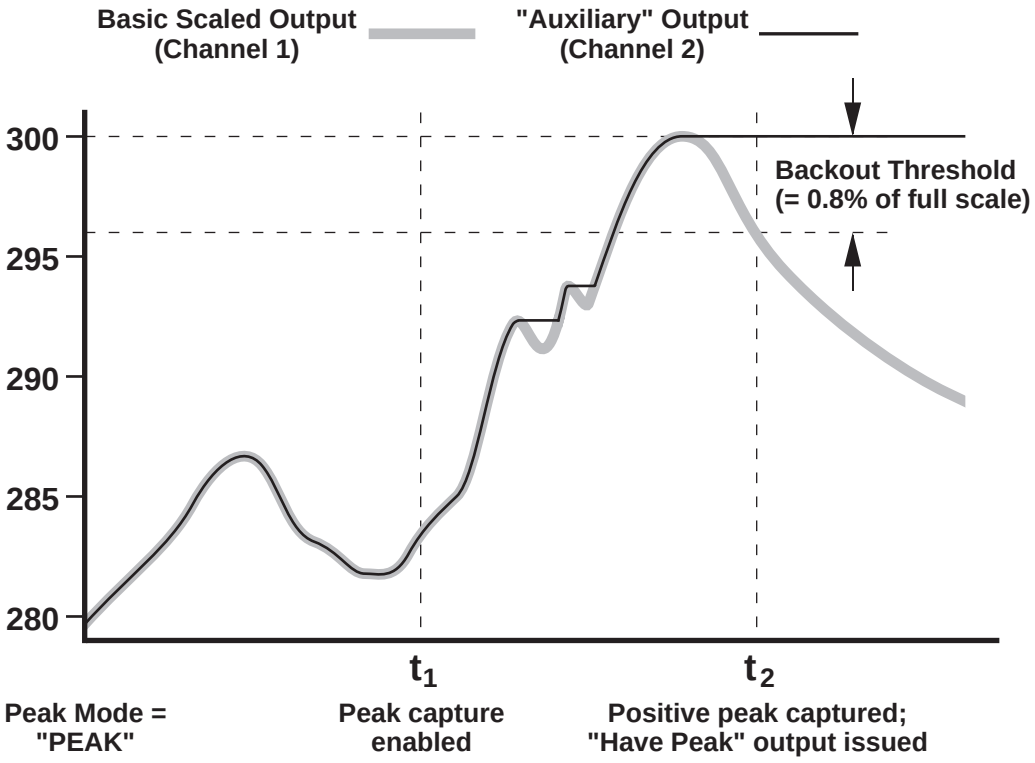


Fig. 16
Typical Positive Peak Capture

CAPTURING A PEAK: "BACKOUT" THRESHOLD AND "HAVE PEAK" OUTPUT

After peak capture has been enabled, an actual peak/valley "capture"—and the resulting transmission of a TTL-level **"HAVE PEAK" logic output** from the rear of the 3000PLUS (see Section 2.E)—will occur when Channel 2's reading *differs* from that of the basic scaled output (Channel 1) by more than a preset threshold amount, called the peak "backout." The presence of the backout threshold prevents low-amplitude signal noise from toggling the "HAVE PEAK" output on and off, as illustrated in Fig. 16.

Suppose, for example, that the full-scale input range is 500 (engineering units) and that the input signal (represented by Channel 1) "peaks" at 300, as in Fig. 16. If the backout threshold is currently set to indicate 0.8% of full scale (see below), then the "HAVE PEAK" condition will be registered only at time t_2, when Channel 1 falls below 296 (engineering units)—the "auxiliary" output (Channel 2) remaining all the while at the "captured" maximum of 300.

The first two ("noise") peaks that occur between times t_1 and t_2 are held only until a higher input value is detected; they do not have sufficient backout to be actually "captured."

Like peak mode (above), the active backout threshold can be specified as part of the normal 3000PLUS setup procedure. It can be changed on a strictly *run-time* basis by entering the desired counts value in the "BKO" field in the **"Live Output"** window when Channel 2 is being displayed (see Fig. 11). It may also be specified at any time by issuing the "write" form of the **PEAK BACKOUT THRESHOLD (BKO)** command to the 3000PLUS.

The initial (default) backout setting for a new configuration is "256" (counts), which corresponds to a signal change of approximately 0.8% of full scale. For best results, the backout should not be less than "40" (counts), corresponding to a signal change of about 0.1% of full scale.

By issuing a **HOLD (HLD)** command as explained in Section 5.C, you can indefinitely "freeze" a captured peak or valley (within the limits imposed by the presently effective *decay rate* of the "auxiliary" output—see below).

RESETTING PEAK CAPTURE

You can clear any currently captured peak value—thus resetting the meter's "Have Peak" output to *Logic 0*—by momentarily pressing the front-panel **Enter** button *during RUN-TIME 3000PLUS operation (only)*,

5. OPERATING CONSIDERATIONS

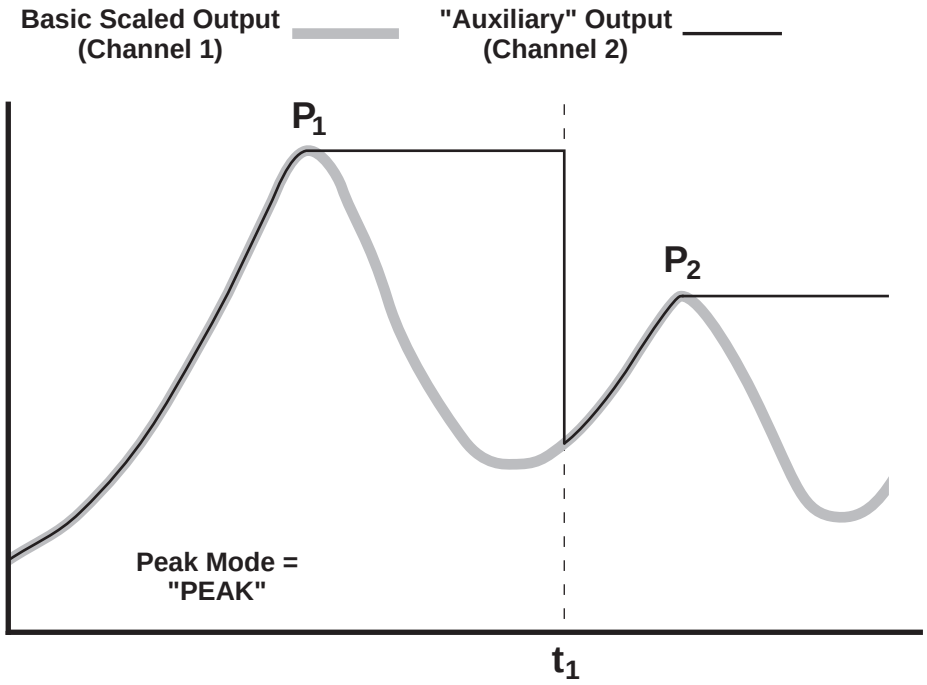


Fig. 17
Typical Positive Peak Reset

Resetting a peak may also be accomplished by momentarily bringing the meter's rear-panel **PEAK ("PEK")** terminal to the *Logic 0* level, and then immediately back to *Logic 1* (see Fig. 10.a, Section 2.E). As a result, Channel 2 will be returned (at least momentarily) to the existing value of the basic scaled output (Channel 1).

Fig. 17 shows how a peak reset at time t_1 allows the capture of successively lower-valued signal maxima.

SETTING THE "PEAK DEFEAT" THRESHOLD

A "PEAK DEFEAT" input threshold expressing in engineering units can be set up in order to prevent induced low-level signal noise from triggering a "HAVE PEAK" condition, when analog peak capture is enabled (as shown in Fig. 18). As long as the value of the "auxiliary" output remains below the specified threshold, no peak capture will occur. Within the low-level deadband thus

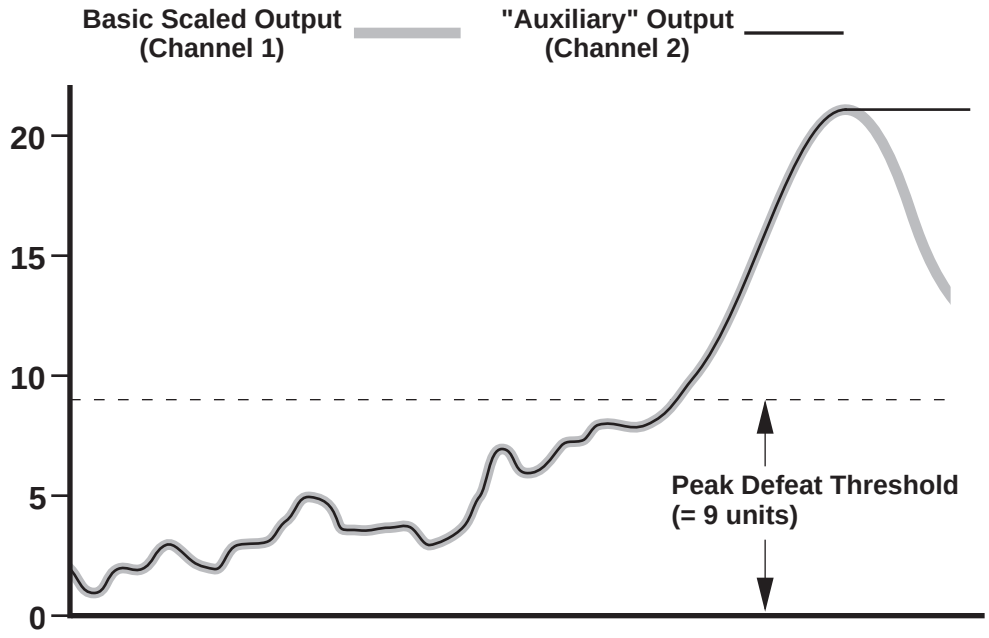


Fig. 18
Peak Defeat Input Threshold

5. OPERATING CONSIDERATIONS

defined, Channel 2 will simply track the basic scaled output, regardless of actual signal behavior.

Like the backout threshold (above), the active peak defeat threshold can be specified as part of the normal 3000PLUS setup procedure. It can be changed on a strictly *run-time* basis by entering the desired units value in the "HPT" field in the **"Live Output"** window when Channel 2 is being displayed (see Fig. 11). It may also be specified at any time by issuing the "write" form of the **PEAK DEFEAT THRESHOLD (HPT)** command to the 3000PLUS.

Expressed in the active engineering units, the peak defeat threshold value should not be greater than 20% of the 3000PLUS instrument's currently effective **Full Scale Units (FSU)** value (discussed in Section 1.D).

SETTING THE "LEAK RATE"

The 3000PLUS user can specify the rate at which every signal value held by the "auxiliary" DAC output will decay, in *percent of full scale per second*. This is useful in the measurement of peak trends in very fast cyclic processes, and permits capture of rapidly successive peaks of similar amplitude—as shown in Fig. 19—without having to provide a "reset" for each peak. Typical applications involve high-speed displacement sensors in the monitoring of tool or material wear (wear and metal fatigue of dies, presses, bearings, bushings, etc.) or of eccentric phenomena like shaft runout or flywheel wobble.

Like the backout and peak defeat thresholds (above), the active peak "leak rate" can be specified as part of the normal 3000PLUS setup procedure. It can be changed on a strictly *run-time* basis by entering the desired rate value in the "LKR" field in the **"Live Output"** window when Channel 2 is being displayed (see Fig. 11). It may also be specified at any time by issuing the "write" form of the **LEAK RATE (LKR)** command to the 3000PLUS.

The desired leak rate should be entered as a positive number (or zero) representing percent of full scale per second. You cannot enter a value greater than 3.50 (%).

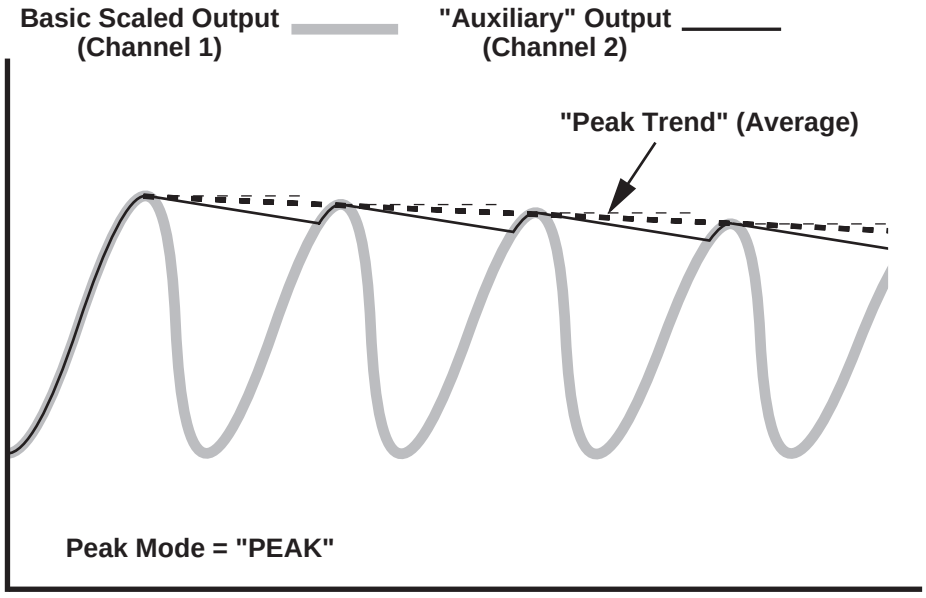


Fig. 19
Peak Trend Monitoring Using Adjustable Leak Rate

5.C APPLYING A SIGNAL HOLD

There are three ways to instruct the 3000PLUS instrument to instantly "freeze" its "auxiliary" DAC and "raw volts" outputs (Channels 2 and 3) at their existing readings—and to subsequently "unfreeze" these outputs to resume normal measurement reporting*:

VIA LOGIC INPUT

See Section 2.E for an explanation of how the 3000PLUS instrument's rear-panel **HOLD ("HLD")** logic input can be connected for application of the signal hold, either by switch closure (no external supply required) or by active TTL logic.

VIA CONFIGURATOR SOFTWARE

You can use the **HOLD ON/OFF** button of the **"Live" Output** window (when Channel 2 or 3 is on display) to apply and remove the signal hold. See Fig. 11 and **"Applying a Hold Command to the 'Auxiliary' and Voltage Outputs"** in the Configurator ON-LINE HELP.

VIA OTHER SOFTWARE COMMAND SOURCE

When communicating with the 3000PLUS through a conventional or customized "terminal emulation" program (see Section 5.A, above), you can apply the signal hold by issuing a **HOLD (HLD)** command of the form

HLD = ON

To discontinue the signal hold, command

HLD = OFF

On receipt of either of the above **HLD** commands, the 3000PLUS will respond with "ACK." These are strictly run-time "imperative" commands; the 3000PLUS will always power up in the **HLD = OFF** state.

INTERROGATING FOR HOLD STATUS

Every time the **"Live" Output** window is opened, the Configurator will automatically interrogate for the 3000PLUS meter's current hold status, which will then be reflected in the state of the **HOLD ON/OFF** button (see above).

When communicating with the 3000PLUS through a conventional or customized "terminal emulation" program, you can request the hold status by sending the "read" form of the **HOLD (HLD)** command:

HLD

The meter will answer with "ON" (if Channels 2 and 3 are currently frozen) or "OFF" (if they are not).

* Like captured peaks and valleys, signal values frozen in response to a **HOLD (HLD)** command are subject to the currently effective *decay rate* of the "auxiliary" DAC output (for user adjustment of the "leak rate," see Section 5.B, above). Note also that the positive or negative shunt of the installed 5D78 module can be switched on or off while a hold is in effect, although the signal will not respond until the hold is released.

5.D APPLYING A TARE OFFSET

By specifying a TARE OFFSET for the 3000PLUS instrument's "auxiliary" DAC output (Channel 2), you can automatically subtract out the container weight in batch-weighing operations or establish an arbitrary zero reference in comparator gaging operations (among many other applications).*

The actual application of a tare offset value to Channel 2 is initiated solely by means of a logic input at the rear **TARE ("TAR")** screw terminal shown in Fig. 2. See Section 2.E for an explanation of how the "TAR" logic input can be connected for the tare enable/disable, either by switch closure (no external supply required) or by active TTL logic.

The *amount of offset* to be algebraically subtracted from Channel 2 is determined by the last-entered **DESIRED TARED OUTPUT ("TAR")** value, a number stored in EEPROM by the 3000PLUS instrument. Expressed in the active engineering units, the currently effective TAR value indicates *the reading to which Channel 2 is to be forced when tare is next enabled*.**

Fig. 20, below, shows how this works. Here, tare is initiated at time t_1—and maintained until time t_2—by a continuously "true" logic **TARE** input. At t_1, the "auxiliary" output is brought down to the last-entered TAR value. From this point, it continues to track Channel 1, but now with the continuous application of the constant tare offset determined by the difference between the value of Channel 1 at time t_1 and the stored TAR value. At time t_2, tare is disabled by resetting the TARE input to *Logic*

* The tare offset should not be confused with the **DISPLAY OFFSET (DSO)**, discussed in Section 1.D, which is a user-specified amount of ± offset applied to the instrument's scaled measurement display in addition to any zero offset resulting from instrument calibration and to any currently enabled tare offset. See Sections 3.B and 4 for entering the desired DSO.

** In many cases, it is desirable to keep the default TAR setting of "0," so that tare can be enabled *while only the container itself is being weighed*, thereby resulting in an initial "empty" reading of exactly zero.

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0, and Channel 2 is returned to the "untared" tracking of Channel 1.

The TAR value can be specified as part of the normal 3000PLUS setup procedure—either by means of the front-panel button menu (as explained in Section 3.B) or the Configurator software (Section 4). It can be changed on a strictly *run-time* basis by entering the desired tared output in the "TAR" field in the **"Live Output"** window when Channel 2 is being displayed (see Fig. 11). It may also be specified at any time by issuing the "write" form of the **TARE (TAR)** command to the 3000PLUS, either via the Configurator's **Send Command...** window or via a conventional or customized "terminal emulation" program (see Section 5.A, above).

Expressed in the active engineering units, the tared output value may be either positive or negative—where a negative tare offset is actually *added* to the basic output—but should not have an absolute value greater than the 3000PLUS instrument's currently effective **Full Scale Units (FSU)** value (discussed in Section 1.D).

Note that issuing a new TAR value to the meter *while the tare function is already on* will not affect the current reading of Channel 2. In order for the new TAR value to take effect, *the tare function must first be turned OFF and then ON again* (via logic input to the rear-panel **TARE** terminal).

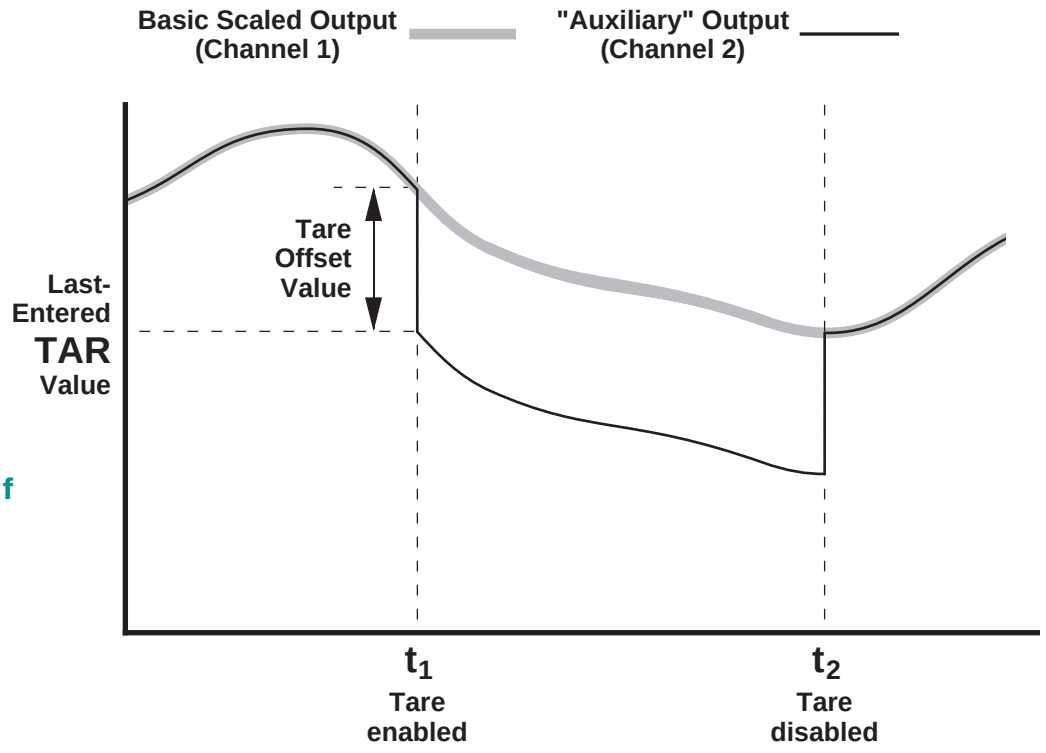

Fig. 20
Application of Tare Offset

5.E LIMIT MONITORING

ENABLING / DISABLING LIMITS

When limit monitoring is enabled, the 3000PLUS will continuously evaluate its "auxiliary" DAC output (Channel 2) for conformance to the currently specified high/low setpoint values, activating appropriate relays and front-panel indication on detection of limit violation (for LOGIC I/O connections, see Section 2.E).

The active limits status can be specified as part of the normal 3000PLUS setup procedure—either by means of the front-panel button menu (as explained in Section 3.B) or the Configurator software (Section 4). It can be changed on a strictly *run-time* basis by selecting "ON" or "OFF" in the "LIM" field in the Configurator's **"Live Output"** window when Channel 2 is being displayed (see Fig. 11). It may also be specified at any time by issuing the "write" form of the **LIMITS (LIM)** command to the 3000PLUS, either via the Configurator's **Send Command...** window or via a conventional or customized "terminal emulation" program (see Section 5.A, above).

When limits are disabled, the meter's three front-panel limit indicator lights will be inactive.

SETTING HIGH / LOW LIMITS

By specifying two independent limit setpoints, you can define the three distinct limit zones shown in Fig. 21:

- "**LESS THAN**" ZONE ("LO"): the reading for Channel 2 is less than the current Low Limit
- "**BETWEEN**" ZONE ("OK"): the reading for Channel 2 is greater than or equal to the current Low Limit and less than or equal to the current High Limit
- "**GREATER THAN**" ZONE ("HI"): the reading for Channel 2 is greater than the current High Limit

The "LESS THAN" or "GREATER THAN" zones may be effectively extended for *nonlatching* limits by means of a user-specified hysteresis deadband (see below).

Normally entered during 3000PLUS setup, the high/low limits can be changed on a strictly *run-time* basis by entering desired values in the "HIL" and "LOL" fields, respectively, in the Configurator's **"Live Output"** window when Channel 2 is being displayed (see Fig. 11). They may also be specified at any time by issuing the "write" forms of the **HIGH LIMIT (HIL)** and **LOW LIMIT (LOL)** commands to the 3000PLUS.

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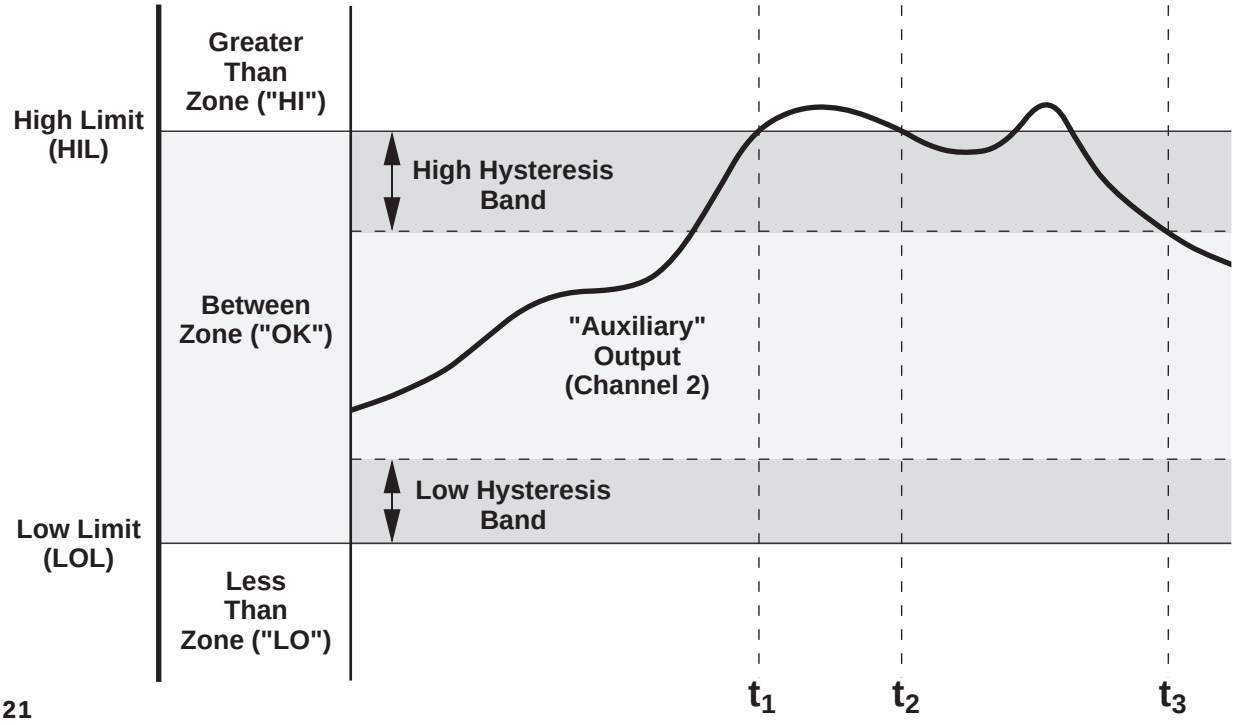

Fig. 21
3000PLUS Limit Zones

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Expressed in the active engineering units, the absolute value of either limit value should not be greater than the 3000PLUS instrument's currently effective **Full Scale Units (FSU)** value (discussed in Section 1.D).

RUN-TIME MODIFICATION OF LIMIT VALUES

As mentioned in Section 1.D, when the 3000PLUS instrument's **LIMITS SECURITY (LMS)** is OFF, the local operator is able to use the front-panel buttons to quickly view and adjust the operating limit values *during normal run-time operation, without having to enter Setup Mode*. This is the case even when limit monitoring is currently disabled (see above).

As long as LMS = OFF, the 3000PLUS meter's currently effective LOW-LIMIT and HIGH-LIMIT setpoint values will be added to the run-time display cycle controlled by the

button (as explained in Section 1.E).

When either limit is displayed, its numerical value may be changed by means of the

buttons, as explained in Sections 3.A and 3.B ("Setup Stage 5: Limits"). To finalize the limit alteration, you must press

once more (NOT **Enter**). This will step the display to the HIGH LIMIT value (if LOW LIMIT is currently displayed) or to Channel 1 (if HIGH LIMIT is currently displayed).

SETTING LIMIT LATCH MODE

Limit monitoring may be in either LATCHING or NON-LATCHING mode. In latching mode, when a high-limit or low-limit violation is detected, that violation condition will remain in effect—regardless of the subsequent behavior of Channel 2—until the limits have been "released," as explained below. When limits are non-latching, any detected limit violation condition will cease to occur as soon as the Channel 2 reading leaves the corresponding limit zone (or associated hysteresis deadband).*

Like the limits enable status (above), the active latch mode can be specified as part of the normal 3000PLUS setup procedure. It can be changed on a strictly *run-time* basis by selecting "ON" or "OFF" in the "LAT" field in the Configurator's **"Live Output"** window when Channel 2 is being displayed (see Fig. 11). It may also be specified at any time by issuing the "write" form of the **LIMIT LATCH (LAT)** command to the 3000PLUS.

* Latching also applies to the "BETWEEN" ("OK") limit zone. That is, when a limit violation occurs and latching is enabled, the "OK" indicator will remain on and the "OK" relays will remain activated until limits are released.

SETTING LIMIT HYSTERESIS

The high and low limit hysteresis values let you define the hysteresis windows (or "deadbands") shown in Fig. 21, in order to prevent low-level signal noise from toggling the limit relays on and off while the reading of Channel 2 remains in the neighborhood of the corresponding setpoint.

Expressed in the active engineering units, the *high* hysteresis value is *subtracted* from the present high limit value to determine the *lower threshold* of the high deadband. Similarly, the *low* hysteresis value is *added* to the present low limit to determine the *upper threshold* of the low deadband.

In the example shown in Fig. 21, a "high violation" is triggered when the Channel 2 reading enters the "Greater Than" zone by exceeding the high limit value at time t_1. At time t_2, Channel 2 falls back to the "OK" zone. If there were no hysteresis band—and assuming that limits are NONLATCHING—the high violation would cease to occur at t_2. In this case, however, the limit status continues to be evaluated as "high violation" until such time as the reading becomes less than the lower threshold of the high hysteresis band, which happens at time t_3. At this point, the limit status returns to "OK."

Normally entered during 3000PLUS setup, the high/low hysteresis values can be changed on a strictly *run-time* basis by entering desired values in the "HHY" and "LHY" fields, respectively, in the Configurator's **"Live Output"** window when Channel 2 is being displayed (see Fig. 11). They may also be specified at any time by issuing the "write" forms of the **HIGH HYSTERESIS (HHY)** and **LOW HYSTERESIS (LHY)** commands to the 3000PLUS.

Note that you cannot enter a negative hysteresis value, or a number that is greater than the *difference* between the existing high and low limit values.

SETTING LIMIT RELAY POLARITY

The 3000PLUS meter lets you set the contact polarity of the six limit relays to NORMALLY OPEN ("NO") or NORMALLY CLOSED ("NC").

Like the limits enable status and latch mode (above), the active relay polarity can be specified as part of the normal 3000PLUS setup procedure. It can be changed on a strictly *run-time* basis by selecting the desired state in the "POL" field in the Configurator's **"Live Output"** window when Channel 2 is being displayed (see Fig. 11). It may also be specified at any time by issuing the "write" form of the **POLARITY (POL)** command to the 3000PLUS.

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RELEASING LATCHED LIMITS

When limit monitoring has been enabled and the instrument is set to the LATCHING mode, there are four ways to release any and all currently latched limits, thereby turning off the corresponding front-panel indicator and deactivating the corresponding limit relays:

VIA FRONT-PANEL "ENTER" BUTTON

To "unlatch" all latched limits *during RUN-TIME 3000PLUS operation (only)*, momentarily press the **Enter** button:

VIA LOGIC INPUT

See Section 2.E for an explanation of how the 3000PLUS instrument's rear-panel **RELEASE LATCH ("RLS LAT")** logic input can be connected for release of latched limits, either by switch closure (no external supply required) or by active TTL logic.

VIA CONFIGURATOR SOFTWARE

You can use the **Release Latched Limits** button of the **"Live" Output** window (when Channel 2 is on display) to "unlatch" all latched limits. See Fig. 11 and **"Releasing Latched Limits"** in the Configurator ON-LINE HELP.

VIA OTHER SOFTWARE COMMAND SOURCE

When communicating with the 3000PLUS through a conventional or customized "terminal emulation" program (see Section 5.A, above), you can issue the **RELEASE (RLS)** command in order to release all latched limits. On receipt of **RLS**, the 3000PLUS will respond with "ACK."

5.F APPLYING A POSITIVE OR NEGATIVE CALIBRATION SHUNT

As explained in Section 2.D, the installed 5D78 module's Transducer Connector provides terminals for installation of a shunt resistor supplied by the user. If desired, the resulting shunt may then be used when calibrating the 3000PLUS meter via the front-panel "SHUNT" procedure (described in Section 3.B) or via the Configurator software's "TWO-POINT" procedure (Section 4.E). In either case, the calibration shunt is automatically switched on when required to simulate a particular upscale value of mechanical input loading.

The shunt can also be independently controlled during run-time operation by the front-panel "Arrow" buttons, or—at any time—by the **3KP Configurator** software or some other software command source. For instance, you may wish to apply the shunt (independent of the normal calibration procedure) in the course of evaluating the performance of the strain gage transducer or configuration attached to the 5D78 conditioner module.*

VIA FRONT-PANEL "ARROW" BUTTONS

To switch in the 5D78's optional calibration shunt for a POSITIVE "equivalent input" *during RUN-TIME 3000PLUS operation (only)*, press and hold down the **UP ARROW** button:

To switch in the calibration shunt for a NEGATIVE "equivalent input," *during RUN-TIME 3000PLUS operation (only)*, press and hold down the **DOWN ARROW** button:

NOTE: In either case, the shunt will be closed only as long as the respective button is pressed. when the button is released, the 3000PLUS will resume normal measurement.

VIA CONFIGURATOR SOFTWARE

You can use the **SHUNT ON/OFF** buttons of the **"Live" Output** window to switch in the installed 5D78 module's optional shunt resistor for positive or negative "equivalent input." See Fig. 11 and **"Applying a Positive or Negative Shunt to a Strain Gage Module"** in the Configurator ON-LINE HELP.

VIA OTHER SOFTWARE COMMAND SOURCE

When communicating with the 3000PLUS through a conventional or customized "terminal emulation" program (see Section 5.A, above), you can issue the **SHUNT POSITIVE (SHP)** or **SHUNT NEGATIVE (SHN)** command in order to close the calibration shunt of the meter's installed 5D78 module for a *positive* or *negative* upscale reading, respectively. The **RESUME (RSM)**

* Either shunt can be switched on or off while a signal HOLD is in effect (see Section 5.C), although the signal will not respond until the hold is released.

5. OPERATING CONSIDERATIONS

command may then be applied to open the calibration shunt, thus resuming the normal measurement mode. On receipt of **SHP**, **SHN**, or **RSM**, the 3000PLUS will respond with "ACK."

INTERROGATING FOR SHUNT STATUS

Every time the **"Live" Output** window is opened for a 3000PLUS with 5D78 conditioner module, the Configurator will automatically interrogate for the current shunt status that module, which will then be reflected in the states of the two shunt buttons (see above).

When communicating with the 3000PLUS through a conventional or customized "terminal emulation" program, you can request the shunt status by sending a **SHUNT STATUS (SHS)** command. The meter will answer with "P" (if the shunt is closed for *positive* calibration), "N" (if the shunt is closed for *negative* calibration), or "O" (if the shunt is open—i.e., shunt calibration of either polarity is OFF, as will be the case on module powerup and following a **RESUME (RSM)** command).

SUMMARY OF MNEMONIC COMMANDS

A.1 COMMAND AND RESPONSE SYNTAX

When issuing one or more commands to a 3000PLUS meter by some means *other than the 3KP CONFIGURATOR software*, please note the following:

- *SPACE CHARACTERS* SHOULD NOT BE INCLUDED IN ANY COMMAND EXPRESSION.*
- ALL *COMMANDS* ARE TO BE TERMINATED BY A SINGLE **CARRIAGE RETURN ([CR])**.** ALL *RESPONSES* BY THE 3000PLUS ARE ALSO TERMINATED BY A **CARRIAGE RETURN ([CR])**. This standard termination is not shown in the specific commands and responses listed below.
- After a command has been issued, no further characters should be sent *until receipt of a response to that command* (**ACK**, **NAK**, or ANSWER).

A *setup* (or "write") command instructs the meter to store a particular setup value in EEPROM memory, and has the general form

[MNEMONIC]=[value][CR]

Upon receipt of a setup command, the 3000PLUS will issue a response of either "ACKNOWLEDGED" or "NOT ACKNOWLEDGED"—i.e., of either

ACK[CR] or **NAK[CR]**

NOTE: The **ACK[CR]** message will be issued only after the received setup value has been successfully stored in the meter's EEPROM memory.

A response of **NAK[CR]** means that the meter did not recognize the received ASCII string as a valid mnemonic command. If, for example, you were to issue a command of **RNG= 6[CR]**, you would receive a response of **NAK[CR]** because there is a space following the equals sign (for space inclusion, see above); if you issued a command of **SYN=0.05[CR]**, you would receive **NAK[CR]** because there is no "SYN" command.

An *interrogation* (or "read") command normally asks the 3000PLUS for the current value of a stored setup parameter, and has the general form

[MNEMONIC][CR]

Upon receipt of a valid interrogation command, the meter will issue a response of

[value][CR]

If the interrogation command is invalid, the only response will be **NAK[CR]**.

An *imperative* command does not store or request information, but rather tells the 3000PLUS to do something (for example, **DIS=2[CR]** calls the meter's "Auxiliary" output (Channel 2) to the front-panel display; **SHN[CR]** closes the installed Model 5D78 module's calibration shunt for a negative upscale reading). The general form of an imperative command will usually resemble that of an interrogation command, being usually a single three-character mnemonic, although—as in the case of **DIS**—it can sometimes resemble a setup command. Upon receipt of an imperative command, the meter will issue a response of either **ACK[CR]** or **NAK[CR]**, depending on whether or not the command has been recognized as valid—or, if a valid command has requested a given run-time status such as the current **DIS** or **HLD** status, it will issue that value (e.g., **2** or **OFF**).

NOTE: The **ACK[CR]** message will be issued only after the action specified by the imperative command has been successfully performed.

* The only exception to this rule are the following **MODULE PARAMETER ("MP")** commands: **MP1**, **MP2**, **MP3**, **MP4**, **MP5**, **MP8**, and **MP9**. Spaces may be included in the character string being entered via the "write" form of any of these commands. See below for the allowed syntax of each **"MP"** command.

** Commands are *never* to be terminated by **CARRIAGE RETURN, LINE FEED ([CR][LF]).**

A.2 MODEL 5D78 SETUP AND INTERROGATION COMMANDS

PLEASE NOTE: All of the 3000PLUS commands listed in this and the following section are applicable when the installed 5D module is a **Model 5D78 AC Strain Gage Conditioner**. Valid commands that only apply to other 5D models (and NOT to the 5D78) are not listed here, and will evoke a response of **NAK** when issued to a 3000PLUS instrument with an installed 5D78 module.

AFL ANALOG FILTER

AFL= f — Sets *both* analog output filters of the installed 5D78 module to f (1 through 5). Actual cutoff frequencies corresponding to filter constants are module-specific; for the Model 5D78, they are as follows:

- **f = 1 :** 0.2 Hz
- **f = 2 :** 2 Hz
- **f = 3 :** 20 Hz
- **f = 4 :** 200 Hz
- **f = 5 :** 2000 Hz, 1400 Hz, or 1100 Hz*

AFL — Reads current filter-constant values—which, for a 5D module installed in a 3000PLUS, are always the same; returns f,f.

EXF EXCITATION FREQUENCY

EXF=f — Sets the installed 5D78's excitation frequency to f, where v = 1 (for 3.27 kHz), 2 (for 5.00 kHz), or 3 (for 10.00 kHz).

EXF — Reads current excitation frequency setting; returns 1, 2, or 3.

FAZ PHASE

FAZ=n — Sets the installed 5D78's phase adjustment value to n degrees (where $-39 \leq n \leq 39$).

FAZ — Reads current phase adjustment value; returns n.

* Depending on the 5D78's currently selected **EXCITATION FREQUENCY (EXF)** value: for an excitation of 10.00 kHz, **AFL = 5** corresponds to 2000 Hz; for 5.00 kHz, to 1400 Hz; and for 3.27 kHz, to 1100 Hz.

** For interpretation of the error code, see any *5D Module Instruction Manual.*

LNN NEGATIVE LINEARITY

LNN=m — Sets the installed 5D78's negative linearity adjustment to the value m (% of actual midscale output reading), where $-2 \leq m \leq 2$. A *positive* LNN value moves the negative-domain midpoint upwards (yielding a smaller negative reading at that point), while a *negative* LNN value moves it downwards (yielding a larger negative reading).

LNN — Reads current negative linearity adjustment value; returns m in the format X.XX.

LNP POSITIVE LINEARITY

LNP=m — Sets the installed 5D78's positive linearity adjustment to the value m (% of actual midscale output reading), where $-2 \leq m \leq 2$. A *positive* LNP value moves the positive-domain midpoint upwards (yielding a larger positive reading at that point), while a *negative* LNP value moves it downwards (yielding a smaller positive reading).

LNP — Reads current positive linearity adjustment value; returns m in the format X.XX.

MID MODULE IDENTIFICATION

MID — Reads the installed 5D78's current ID and diagnostic information string. Returns **5D78,xxxx,hhhh** (where "xxxx" is the module's 4-character alphanumeric **Serial Number**, and "hhhh" is the 4-character hexadecimal-ASCII error code).**

NOTE: There is no "write" form of the MID command.

APPENDIX A: MNEMONIC COMMANDS

MIO MODULE INPUT OFFSET

MIO=m	Sets the installed 5D78's *pre-amplified* (analog input) offset to the value m (% of selected full-scale input range—see **RNG**, below), where $-20 \le m \le 20$.
MIO	Reads current module input offset value; returns m in the format XX.XX.

MP0 through MPD MODULE PARAMETER

Used by the 3000PLUS CONFIGURATOR software to write and read miscellaneous module configuration information, as follows (each **MPn** string $ can have up to 16 ASCII characters; *spaces* may be included as desired or required. **NOTE: THE FOLLOWING LIST INCLUDES ONLY THOSE "MP" COMMANDS THAT ARE USED WHEN A 5D MODULE IS INSTALLED INA 3000PLUS METER.**

MP1=$	$ = Configuration Description (first 16 characters) NOTE: The MP1, MP2, and/or MP3 string may be NULL (no characters), if desired.
MP2=$	$ = Configuration Description (next 16 characters)
MP3=$	$ = Configuration Description (final 16 characters)
MP4=$	$ = Last Download Date/Time NOTE: The 3KP Configurator software requires an MP4 format of "(M)M/(D)D/YY (H)H:MM A" or "(M)M/(D)D/YY (H)H:MM P," depending on whether the time is "AM" or "PM," respectively; digits in parentheses are optional
MP5=$	$ = Engineering Units NOTE: The MP5 string may be NULL (no characters), if desired.
MP8=$	$ = Last Calibration Date/Time NOTE: The 3KP Configurator software requires an MP8 format of "(M)M/(D)D/YY (H)H:MM A" or "(M)M/(D)D/YY (H)H:MM P," depending on whether the time is "AM" or "PM," respectively; digits in parentheses are optional
MP9=$	$ = Transducer Model/Serial Number NOTE: The MP9 string may be NULL (no characters), if desired.
MP1	Reads the current MP1 string; returns $
MP2	Reads the current MP2 string; returns $
Etc.	

MSF MODULE SCALE FACTOR

MSF=m	Sets the installed 5D78's gain (scale factor) to the value m, where $1.0000 \le m \le 1.5999$ (for the Model 5D78); m is used as a multiplier for the full-scale input range (see **RNG**, below).
MSF	Reads the current module scale factor value; returns m in the format 1.XXXX.

RNG RANGE

RNG=r	Sets the installed 5D78's range code to the alphanumeric character r. Allowed full-scale input ranges are module-specific; for the Model 5D78, they are as follows (see Table 2, Appendix B, for the associated "practical" ranges): **r = 0 :** 0.50 mV/V **r = 1 :** 0.75 mV/V **r = 2 :** 1.00 mV/V **r = 3 :** 1.50 mV/V **r = 4 :** 2.00 mV/V **r = 5 :** 3.00 mV/V
RNG	Reads current module range code; returns r.

SYM NEGATIVE SYMMETRY

SYM=m	Sets the installed 5D78's negative symmetry adjustment to the value m (% of full scale), where $-2 \le m \le 2$.
SYM	Reads current negative symmetry adjustment value; returns m in the format X.XX.

A.3 MODEL 5D78 IMPERATIVE COMMANDS

RSM RESUME

RSM — Resumes normal measurement mode by opening the installed 5D78's calibration shunt (see the **SHN**, **SHP**, below).

SHN SHUNT NEGATIVE

SHN — Closes the installed 5D78's calibration shunt for a negative upscale reading; shunt is opened by a subsequent **RESUME (RSM)** command.

SHP SHUNT POSITIVE

SHP — Closes the installed 5D78's calibration shunt for a positive upscale reading; shunt is opened by a subsequent **RESUME (RSM)** command.

SHS SHUNT STATUS

SHS — Queries the current status of the installed 5D78's calibration shunt and returns "P" (if the shunt is closed for positive calibration), "N" (if the shunt is closed for negative calibration), or "O" (if the shunt is open—i.e., shunt calibration of either polarity is OFF, as will be the case on module powerup and following a **RESUME (RMS)** command).

A.4 3000PLUS SETUP AND INTERROGATION COMMANDS

AVV ANALOG VOLTAGE VALUE

AVV=n — Sets to n the full-scale value for the meter's Channel 3 ("scaled voltage" output); n = 1 (for 0-5 VDC) or 2 (for 0-10 VDC).

AVV — Reads current full-scale setting for Channel 3; returns 1 or 2.

BKO PEAK BACKOUT THRESHOLD

BKO=c — Sets the width of the peak "backout" threshold for the meter's "auxiliary" DAC output (Channel 2) to c, which is expressed in A/D counts (an integral number from 1 through 999, typically greater than 40).

BKO — Reads current peak "backout" threshold value; returns c.

CAL CALIBRATION

CAL=n — Sets the meter's calibration method number to n. For a 3000PLUS with installed Model 5D78, n = 1 (for ABSOLUTE), 2 (for TWO-POINT), or 3 (for SHUNT). This parameter is primarily for front-panel menuing, and is not included in a 3000PLUS configuration file.

CAL — Reads current calibration method; returns n.

DFL DISPLAY FILTER

DFL=f — Sets the smoothing filter constant of the meter's displayed value to f (an integer from 0 through 9, indicating increasing amounts of digital filtering).

DFL — Reads current display filter constant; returns f.

DSO DISPLAY OFFSET

DSO=b — Sets the display offset for the meter's Channel 1 (basic 5-VDC scaled output) and Channel 2 ("auxiliary" DAC output) to the value b, which is expressed in engineering units and to the decimal-point precision of the current **FSU** value; $-199990 \leq b \leq 199990$; b should not be greater than 30% of the current full-scale reading.

DSO — Reads current display offset value; returns b.

APPENDIX A: MNEMONIC COMMANDS

FSU FULL SCALE UNITS

FSU=m	Sets to m the desired full-scale reading of the meter (to correspond to a full-scale output of +5.000 V). The value m is expressed in *desired engineering units*; -199990 ≤ m ≤ 199990. NOTE: The *decimal-point precision* of the entered FSU value determines the precision of other scaled values, including display offset (DSO), tare offset (TAR), high and low limits (HIL and LOL), limit hysteresis values (HHY and LHY), and peak "defeat" threshold (HPT).
FSU	Reads current full-scale setting; returns m.

HHY HIGH LIMIT HYSTERESIS

HHY=h	Sets the width of the high-limit hysteresis deadband for the meter's "auxiliary" DAC output (Channel 2) to the value h, which is expressed in engineering units and to the decimal-point precision of the current **FSU** value; 0 ≤ h ≤ 199990; h cannot be greater than the difference between the existing **HIL** and **LOL** values.
HHY	Reads current high-limit hysteresis value; returns h.

HIL HIGH LIMIT

HIL=h	Sets the high-limit setpoint for the meter's "auxiliary" DAC output (Channel 2) to the value h, which is expressed in engineering units and to the decimal-point precision of the current **FSU** value; -199990 ≤ h ≤ 199990; h cannot be less than the existing **LOL** value.
HIL	Reads current high-limit setpoint value; returns h.

HPT PEAK "DEFEAT" THRESHOLD*

HPT=t	Sets the width of the "peak defeat" input threshold for the meter's "auxiliary" DAC output (Channel 2) to t, which is expressed in engineering units and to the decimal-point precision of the current **FSU** value; -199990 ≤ h ≤ 199990; t should not be greater than 20% of the current full-scale reading.
HPT	Reads current peak defeat threshold; returns t.

IP0 through IP2 INSTRUMENT PARAMETER

Used to write and read miscellaneous instrument configuration information, as follows (each **IPn** string $ can have up to 16 ASCII characters). Analogous to the set of **MODULE PARAMETER ("MP")** commands, above. NOTE: THESE COMMANDS ARE NOT PRESENTLY USED BY THE 3KP CONFIGURATOR.

LAT LIMIT LATCH

LAT=ON	Enables latching of both limits for the meter's "auxiliary" DAC output (Channel 2) by setting the latch mode to ON.
LAT=OFF	Disables latching of both limits for the meter's "auxiliary" DAC output (Channel 2) by setting the latch mode to ON.
LAT	Reads current latch mode setting; returns ON or OFF.

LIM LIMITS

LIM=ON	Enables continuous monitoring of both limits for the meter's "auxiliary" DAC output (Channel 2) by setting the limit mode to ON.
LIM=OFF	Disables continuous monitoring of both limits for the meter's "auxiliary" DAC output (Channel 2) by setting the limit mode to OFF.
LIM	Reads current limit mode setting; returns ON or OFF.

LHY LOW LIMIT HYSTERESIS

LHY=h	Sets the width of the low-limit hysteresis deadband for the meter's "auxiliary" DAC output (Channel 2) to the value h, which is expressed in engineering units and to the decimal-point precision of the current **FSU** value; 0 ≤ h ≤ 199990; h cannot be greater than the difference between the existing **HIL** and **LOL** values.
LHY	Reads current low-limit hysteresis value; returns h.

LKR LEAK RATE

LKR=m	Sets the decay rate for the meter's "auxiliary" DAC output (Channel 2) to m (% of full scale per second), where -3.50 ≤ m ≤ 3.50.
LKR	Reads current leak rate value; returns m.

* Formerly called "HAVE PEAK THRESHOLD."

APPENDIX A: MNEMONIC COMMANDS

LMS LIMITS SECURITY

LMS=ON	Turns on the instrument's limits security, so that the local operator can view and modify limit values only through the standard front-panel setup procedure.
LMS=OFF	Turns off the instrument's limits security, so that the local operator can use the front-panel buttons to view and modify limit values during normal runtime operation (without entering setup mode).
LMS	Reads current limits security setting; returns ON or OFF.

LOL LOW LIMIT

LOL=h	Sets the low-limit setpoint for the meter's "auxiliary" DAC output (Channel 2) to the value h, which is expressed in engineering units and to the decimal-point precision of the current **FSU** value; -199990 ≤ h ≤ 199990; h cannot be greater than the existing **HIL** value. Applies only to the meter's "auxiliary" DAC output (Channel 2).
LOL	Reads current low-limit setpoint value; returns h.

PKM PEAK MODE

PKM=n	Sets to n the peak mode to be in effect for the meter's "auxiliary" DAC output (Channel 2) when peak capture operation is enabled via logic-signal input; n = 1 (for PEAK mode) or 2 (for VALLEY mode).
PKM	Reads current peak mode setting; returns n.

POL POLARITY

POL=NO	Sets the polarity of the meter's limit-zone relays to NORMALLY OPEN.
POL=NC	Sets the polarity of the meter's limit-zone relays to NORMALLY CLOSED.
POL	Reads current polarity setting; returns NO or NC.

SEC SECURITY

SEC=n	Sets the security code that must be entered via the meter's front panel before any front-panel configuration changes can be made (n is any four-digit number between 0000 and 9999).
SEC	Reads current security code number; returns n.

TAR TARE

TAR=m	Sets the tare offset for the meter's "auxiliary" DAC output (Channel 2) to yield a reading of m when application of the tare offset is enabled via logic-signal input. The value m is expressed in engineering units and to the decimal-point precision of the current **FSU** value; -199990 ≤ m ≤ 199990; stores in EEPROM memory the actual tare offset required to yield a reading of m.
TAR	Reads last-entered "tared" reading; returns m.

A.5 3000PLUS IMPERATIVE COMMANDS

CHN CHANNEL

CHNx	Returns the current reading of the meter's Channel No. x, where x = 1 (for the basic 5-VDC output, scaled to engineering units), 2 (for the "auxiliary" DAC output), or 3 (for the "scaled voltage" output).

DIS DISPLAY

DIS=x	Calls the meter's Channel No. x to display (for channel numbers, see the **CHN** command, above). Note that on powerup, Channel 1 will be automatically displayed.
DIS	Returns the number of the currently displayed channel (x).

HLD HOLD

HLD=ON	"Freezes" the current values of Channel 2 ("auxiliary" DAC output) and Channel 3 ("raw volts" output) until receipt of a subsequent **HLD = OFF** command or recycling of power.
HLD=OFF	"Unfreezes" Channels 2 and 3, allowing them to resume normal operation. The meter will always power up in the HLD = OFF state.
HLD	Returns the current "hold status" of Channels 2 and 3 (ON or OFF).

RLS RELEASE

RLS	"Unlatches" any and all latched limits for the meter's "auxiliary" DAC output (Channel 2), when limits mode and latch mode are both ON (see the **LIM** and **LAT** commands, respectively).

5D78 ABSOLUTE CALIBRATION CALCULATIONS

A range value with respect to transducer electrical units (R_e) is first calculated according to the equation

$$R_e = (CAL3/CAL1) \cdot CAL2$$

where the allowed limits of R_e (for the Model 5D78) are 0.1 (or 0.5) to 25.5984 (mV/V).* For an explanation of the "CAL1," "CAL2," "CAL3," "CAL4," and "CAL5" values, see Section 4.E.

Using the calculated R_e as a "practical range" value, an appropriate *nominal* full-scale input **RANGE (RNG)** setting is determined by means of the following table**:

Table 2
"Practical" 5D78 Range (RNG) Settings

"Practical" Range (mV/V)	Range To Select (mV/V)	Corresponding "RNG" Setting
0.5000 - 0.7799	0.5	0
0.7800 - 1.0399	0.75	1
1.0400 - 1.5599	1	2
1.5600 - 2.0799	1.5	3
2.0800 - 3.1199	2	4
3.1200 - 4.7997	3	5

The **MSF** gain factor is then calculated by

$$MSF = R_e/RNG$$

where RNG is the mV/V value corresponding to the module's current **RANGE (RNG)** setting (as given in Table 2). To be accepted by the 5D78 module, the **MSF** value must be expressed in the format of **1.XXXX**; it cannot be less than 1.0000 or greater than 1.5999.

If the **CAL4** value has been entered in *engineering units*, the **MIO** offset term (as a percentage of the selected full-scale input range) is calculated by

$$MIO = (CAL4/CAL3)MSF \cdot 100$$

If **CAL4** has been entered in *millivolts*, **MIO** is

$$MIO = (CAL4/5000)MSF \cdot 100$$

The **MIO** value must be expressed in the format of **XX.XX** (%), with or without minus sign; its absolute value cannot be greater than 20 (since the offset cannot be greater than 20% of the selected full-scale input range).

The **SYM** adjustment factor is calculated by

$$SYM = ((CAL5/NCAL3) - 1) \cdot (-1) \cdot 100$$

where "NCAL3" = CAL3 • (-1). The **SYM** value must be expressed in the format of **X.XX** (%), with or without minus sign; its absolute value cannot be greater than 2.

The 5D78 is then calibrated "absolutely" upon receipt of the appropriate **RANGE (RNG)**, **EXCITATION FREQUENCY (EXF)**, **MODULE SCALE FACTOR (MSF)**, **MODULE INPUT OFFSET (MIO)**, and **NEGATIVE SYMMETRY (SYM)** setup commands (for command syntax, see Appendix A).

* These limits are defined for the product (**MSF•RNG**), which must lie between the low limit of "0.5" (= 1.0000 x 0.5, for the lowest **RNG** of 0.5 mV/V) and the high limit of "4.7997" (= 1.5999 x 3, for the highest **RNG** of 3 mV/V).

** This table takes into account the effective 4% overlap that has been built into the 5D78 scaling structure. As can be seen from the table, if the actual full-scale range lies *close to a given nominal range value*, it is most "practical" to select the range just *below* that nominal value. For example, if your *actual* transducer full-scale range is 3.1 mV/V, it is most practical to select a nominal range of **2 mV/V** (and NOT 3 mV/V), since 3.1 lies within the "practical" range of "2.0800 - 3.1199."

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