DAYTRONIC

MODEL 4077

SINGLE-CHANNEL DC STRAIN GAGE INSTRUMENT

INSTRUCTION MANUAL

4000
Instrument Series

Model 4077 Instruction Manual, v. SB.7
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SINGLE-CHANNEL
DC STRAIN GAGE INSTRUMENT

INSTRUCTION MANUAL

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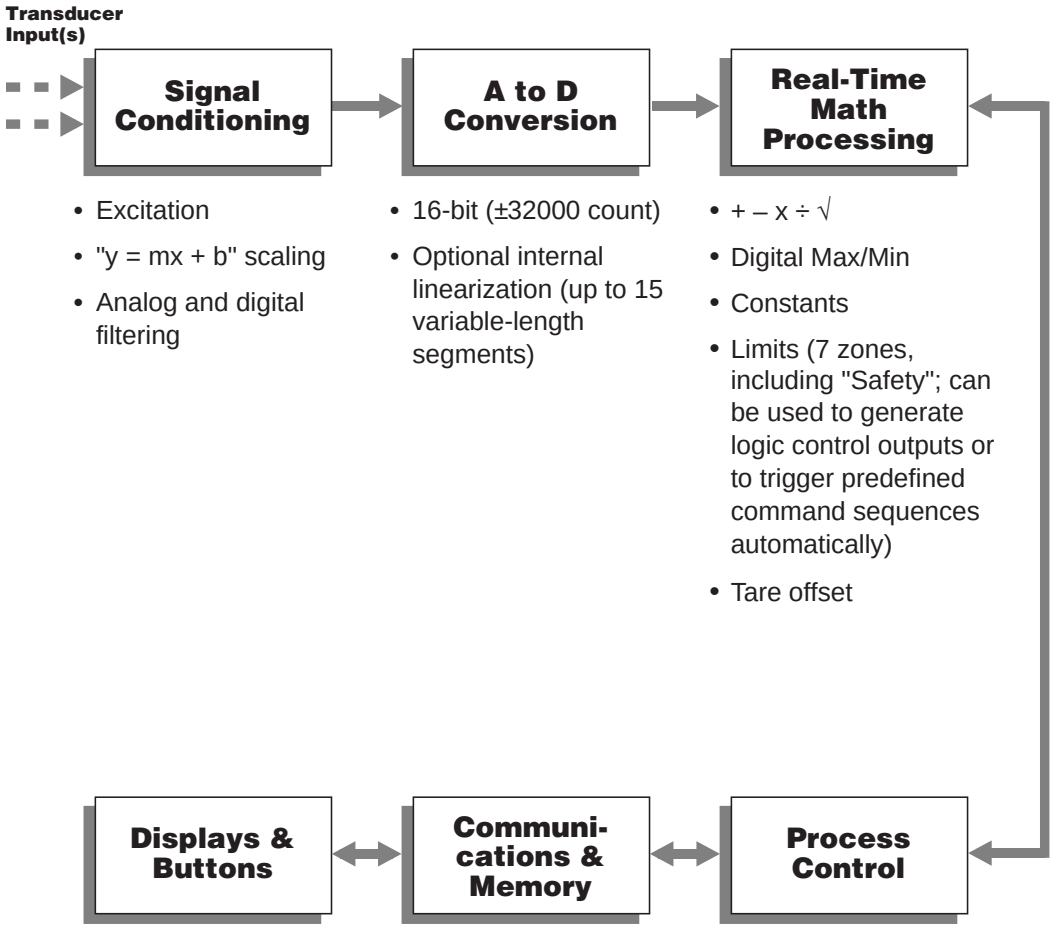
General 4077 Features



- Excitation
- "y = mx + b" scaling
- Analog and digital filtering

- 16-bit (±32000 count)
- Optional internal linearization (up to 15 variable-length segments)

- + – x ÷ √
- Digital Max/Min
- Constants
- Limits (7 zones, including "Safety"; can be used to generate logic control outputs or to trigger predefined command sequences automatically)
- Tare offset

- Scalable 51-segment bargraph with end-point indication
- Backlit 0.6-inch LCD with adjustable viewing angle and limit-triggered flashing
- Independently settable dual-limit displays

- RS-232-C I/O
- Port for optional keyboard
- Simple step-through configuration setup and review via front panel
- Battery-backed data and configuration storage

- Scalable 10-V analog output for strip-chart recording, etc.
- 8 TTL-level logic I/O's for annunciation, process control, and automatic command execution

The Model 4077 is a general-purpose instrument for input of *pressure, force, torque, weight*, and other variables measured by conventional **strain gage transducers.** It accepts a single input from *any conventional 4-arm strain gage bridge, nominal 120 ohms or higher, with a full-scale range of 1.5 or 3.00 mV/V*. Other bridge configurations are possible with the optional **Model 10CJB-2 Bridge Completion Card**, as explained in Appendix F.

A "tare" function is preprogrammed for the strain gage input, and may be activated by a front-panel push button. Via front-panel buttons, you can also display and reset MAXIMUM, MINIMUM, and "MAX minus MIN" values for each "tared" analog input.

Unless otherwise specified at the time of order, your Model 4077 has been set, prior to shipment, to a *standard configuration*. THIS CONFIGURATION IS FULLY ADEQUATE FOR MOST APPLICATIONS, AND LETS YOU CONTROL BASIC INSTRUMENT SETUP AND OPERATION SOLELY BY MEANS OF THE SIX FRONT-PANEL PUSH BUTTONS. A full listing of your 4077's standard configuration is given in Appendix A.

Like all 4000 Series instruments, however, the 4077 can be rapidly and easily reprogrammed in the field, to provide a variety of unique application solutions. For such reprogramming you can use either

- an optional **Model 10P80D Extended Keyboard** that plugs directly into the rear of the 4077 unit, or
- the optional **StartPAC 100 Software (Model GS-SP100)**.* This software applies to ALL Daytronic RS-485 networkable instruments, and offers a number of valuable utilities for terminal emulation, node configuration, network monitoring, data display and logging, etc. IT IS SUPPLIED FREE OF CHARGE WITH ALL 4000 SERIES MODELS. For details on the installation and operation of **StartPAC 100**, see the *StartPAC 100 Instruction Manual*.

StartPAC 100 lets a connected computer serve as a "dumb" terminal for entry of the specific MNEMONIC COMMANDS required to repro-

* Alternatively, you can use any of a number of commercially available *terminal emulation programs* to issue commands directly to the 4077.

gram the 4077. These commands may also be issued directly to the 4077 via the optional Extended Keyboard. Commands which are common to all 4000 Series models are described in detail in the optional 4000 Series ***System Instruction Manual***. IT IS RECOMMENDED THAT YOU STUDY THE *SYSTEM INSTRUCTION MANUAL* BEFORE YOU ATTEMPT ANY RECONFIGURATION OF YOUR MODEL 4077 BEYOND THAT DISCUSSED IN THE APPENDICES OF THE PRESENT MANUAL.

See Appendix B of the present manual for direct **RS-232-C** connections between the 4077 and a computer or printer.

Unless otherwise specified, every 4077 comes with the standard *engineering-unit legends* and *button-function indicators* shown in Fig. 1. Different legend/indicator films may be optionally obtained. Via optional keyboard or computer, you can instruct the 4077 to light any one or a combination of given legends and indicators. See Appendix C for "Legend and Indicator Annunciation."

Your 4077 is initially configured for a full-scale transducer range of *3.00 mV/V* and for a nominal excitation level of *+10 V-DC*. If you require a range setting of 1.5 mV/V and/or an excitation of +5 V-DC, see Appendix D. Appendix E explains alternative methods of calibration that involve the entry of special mnemonic commands (via computer or keyboard). Appendix G deals with the setup and use of the 4077's internal *analog peak-capture* channels, again using computer- or keyboard-entered commands. Note that the dedicated +PEAK and -PEAK channels (Nos. 2 and 3, respectively) are not used in the 4077 "standard configuration," but are available for use in custom configurations.

NOTE: WITH THE EXCEPTION OF APPENDICES C, D, E, AND G, THE PRESENT MANUAL WILL ONLY TREAT PROCEDURES AND CONSIDERATIONS WHICH ARE RELEVANT TO THE 4077 "STANDARD CONFIGURATION" AND WHICH DO **NOT** REQUIRE A CONNECTED COMPUTER OR KEYBOARD. FOR INFORMATION ON THE FULL FUNCTIONALITY OF YOUR MODEL 4077, SEE THE OPTIONAL *SYSTEM INSTRUCTION MANUAL*.

MODEL 4077 SPECIFICATIONS (for general 4000 Series Physical, Electrical, and Environmental specifications—including Logic I/O—see Appendix A of the 4000 Series *System Instruction Manual)***:**

Transducer Type and Range: Conventional 4-arm strain gage bridge, nominal 120 ohms or higher, with a full-scale range of 1.5 or 3.00 mV/V (the standard range setting is 3.00 mV/V; see Appendix D if you require a 1.5 mV/V setting). Since channel zeroing is by digital techniques, no input balance control is provided. The allowable input range, therefore, must include any initial unbalance (which, in commercially produced strain gage transducers, is usually negligible). Other transducers may have to be externally trimmed to be used with the 4077, if zero unbalance exceeds 20% of full scale.

The optional **Model 10CJB-2 Bridge Completion Card** is an external accessory that lets you connect your 4077's analog input to a *2-wire 1/4-bridge, 3-wire 1/4-bridge, 1/2-bridge*, or *full-bridge* strain gage transducer. Each 1/4-bridge configuration may use either 120 or 350 ohms nominal gage resistance (see Appendix F for details).

Excitation: Selectable 5 or 10 V-DC (i.e., ± 2.5 or ± 5 V-DC, respectively), nominal; ± 80 mA, maximum, for each voltage. NOTE: The 10-V setting is "standard"; if 5-V excitation is required, see Appendix D.

Amplifier: Differential input, programmable gain.

Normal-Mode Range:
± 50 mV peak, operating; ± 8 V without instrument damage.

Common-Mode Range:
± 0.25 V peak, operating; ± 8 V without instrument damage.

Common-Mode Rejection Ratio: –90 dB at DC; –120 dB at 60 Hz, 1 kHz, and 3 kHz.

Input Impedance (Differential and Common-Mode): Greater than 100 MΩ.

Offset:

Initial: ± 0.02% of full scale.

vs. Temperature: ± 20 ppm / °C.

vs. Time: ± 10 ppm / month.

Gain Accuracy: ± 0.02% of full scale, *typical*, following calibration*
Gain Stability:
vs. Temperature : ± 50 ppm / °C.
vs. Time: ± 20 ppm / month.

Filter: 3-pole modified Butterworth; 3 dB down at 20 Hz; 60 dB down at 220 Hz.
Step Response Settling Time (Full-Scale Output):
To 1% of final value: 60 milliseconds.
To 0.1% of final value: 80 milliseconds.
To 0.02% of final value: 125 milliseconds.

Analog Peak Memory Decay Rate: Does not exceed 0.4% of full scale/second (e.g., with full scale of 20000 counts, decay rate will not exceed 8 counts/100 msec).

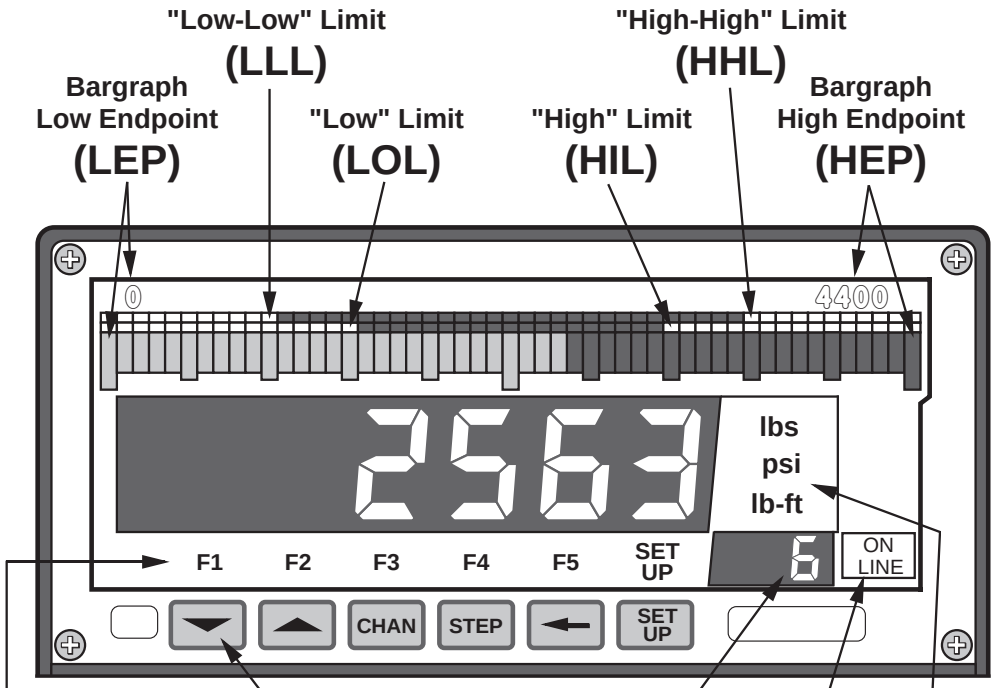
Analog Output: ±10 V, microprocessor driven and scaled, ±1 mV resolution.
Accuracy: 0.05% of current voltage reading ± 2 mV.
Output Bandwidth: 40 Hz max.

* Initial (uncalibrated) inaccuracy may be as great as ±0.05% of full scale. Maximum error that could occur upon replacement of a Model 4077 *not followed by calibration* is ±0.1% of full scale.

Maximum allowable count tolerance is 0 ± 5 (for ZERO) and 20000 ± 11 (for SPAN, where "m" = 20000).

Study the following diagrams to acquaint yourself with your 4077's most important front and rear elements.

Fig. 1 4077 Front Panel



Button "RUN-TIME FUNCTION" Indicators*

(F1 = LIVE DISPLAY

F2 = [NOT USED]

F3 = TARE

F4 = MAX/MIN/MAX-MIN STEP

F5 = MAX/MIN RESET

—see Section 3)

Setup and Special Function Buttons

Channel No. and Mnemonic Display

Button Activity Indicator

Engineering-Unit Legends*

* Standard film shown.

Fig. 2(a) 4077 Rear Panel (AC Power)

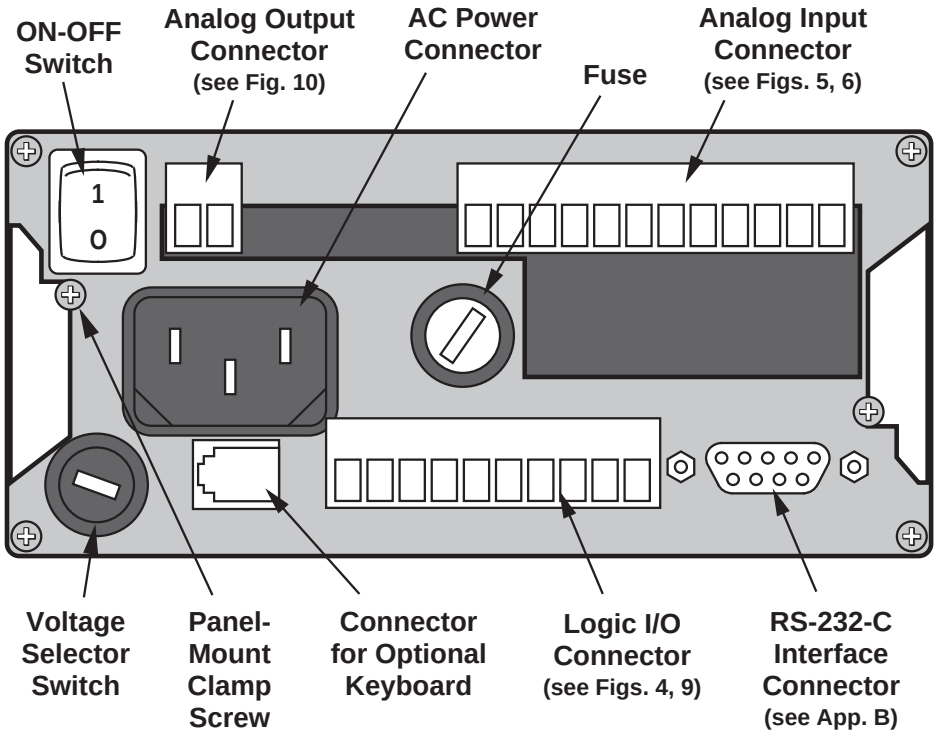
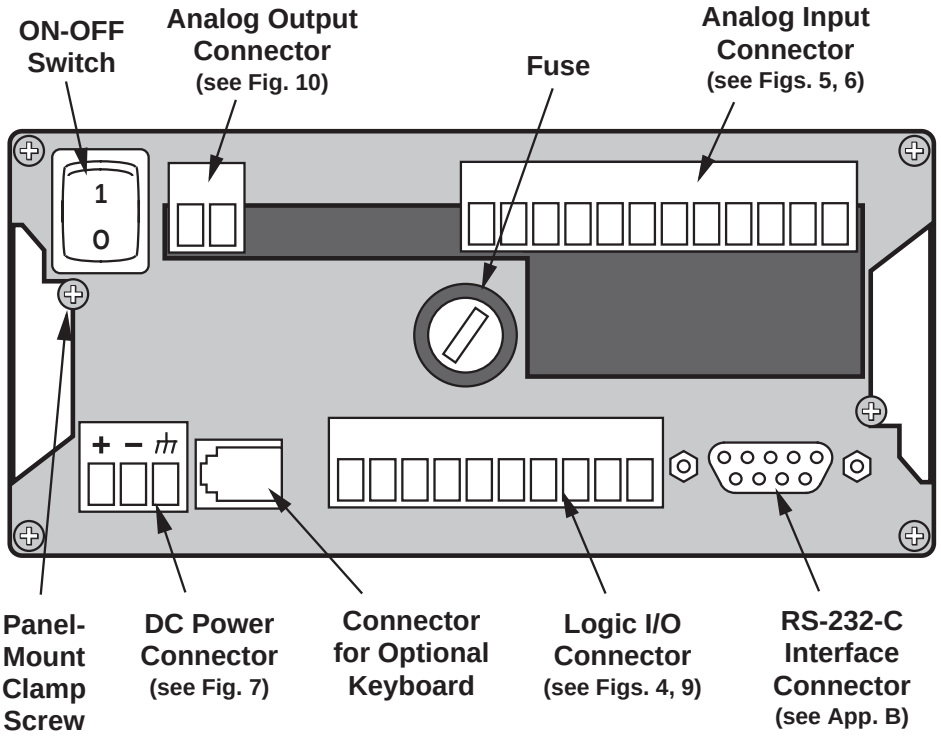


Fig. 2(b) 4077 Rear Panel (DC Power)

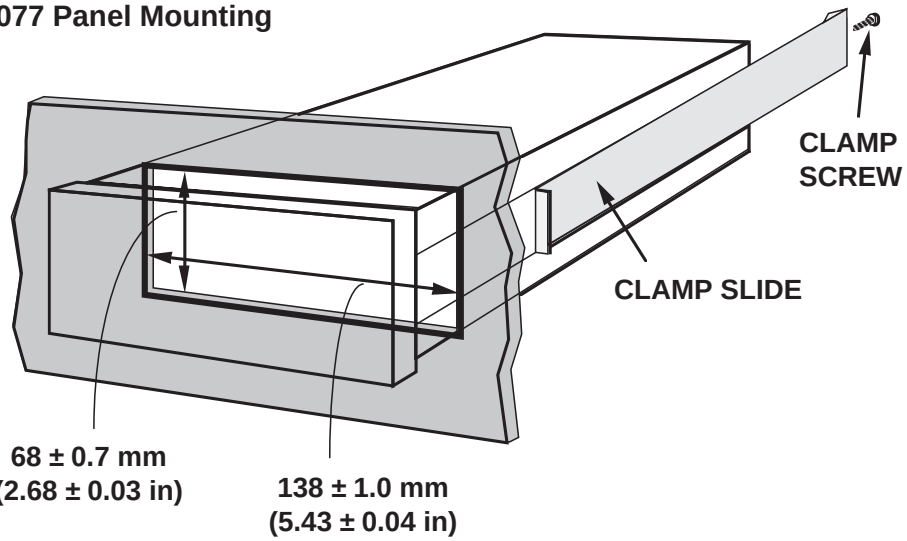


1.c Panel Mounting

You can easily mount a Model 4077 in your own precut panel. Cutout dimensions for a *panel-mounted* unit are standard **DIN** (see Fig. 3); panel thickness should not exceed 6 mm (0.24 in).

When mounting a 4077, *DO NOT REMOVE THE FRONT BEZEL.* Simply unscrew the two rear-panel CLAMP SCREWS and slide the CLAMP SLIDES rearwards out of their grooves. Insert the 4077 unit through the panel cutout, *from the front of the panel* (if the unit has rubber feet, these will have to be removed). Then reinstall the CLAMP SLIDES, and tighten the CLAMP SCREWS until the instrument is securely mounted.

Fig. 3
4077 Panel Mounting



Channel No. **Channel Function**

1 **"LIVE" INPUT CHANNEL**
This channel represents the 4077's *conditioned analog input.* Sensor calibration is performed on this channel, as explained in Section 2.e.

2 **ANALOG "+PEAK" OF CHN. 1** (see Appendix G)

3 **ANALOG "–PEAK" OF CHN. 1** (see Appendix G)

5 **"LIVE" INPUT WITH TARE**
This channel represents the value of Channel 1 *minus the current "tare" offset* (that is, the value of Channel 1 that existed when the front-panel "TARE" button was last pressed. The 4077's active control limits will normally operate on the basis of this channel—see Section 1.e.

6 **"MAXIMUM" VALUE OF CHN. 5***
This channel represents the *most positive* value of Channel 5 since "MAX" measurement was last reset via the front-panel "MAX/MIN RESET" button.

7 **"MINIMUM" VALUE OF CHN. 5***
This channel represents the *least positive* value of Channel 5 since "MIN" measurement was last reset via the front-panel "MAX/MIN RESET" button.

8 **"MAX minus MIN" VALUE OF CHN. 5**
This channel represents the existing *net difference* between Channel 6 and Channel 7.

19 **ANALOG OUTPUT**
This channel represents Channel 5 ("tared" analog input), scaled to a full range of ± 10 V-DC. It may be used for strip-chart recording, input to other systems, or general-purpose signal monitoring. For rescaling and connection of the analog output, see Section 2.j.

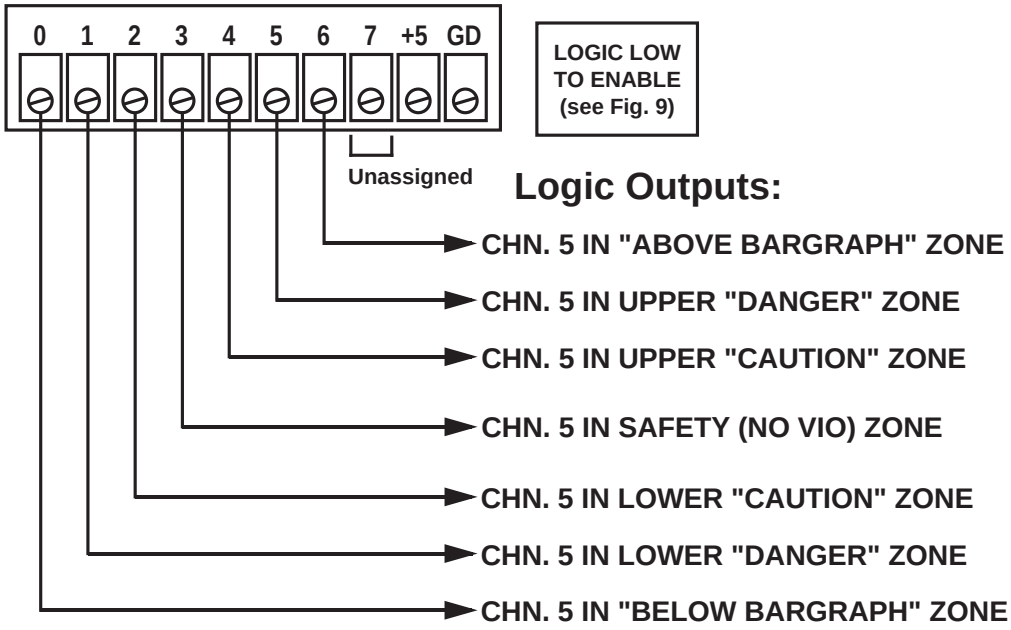
The 4077's Channel Nos. 4 and 14-16 are used as intermediate result registers or reference channels, and will not normally be displayed. The remaining scanned channels (Nos. 9-13, 17, and 18) are not used in the standard 4077 configuration.

* Note that the digital "MAX" and "MIN" functions of Channels 6 and 7 operate with a *20-millisecond sampling response.* For applications requiring a faster response, you can use Channels 2 and 3, as explained in Appendix G.

1.e Standard Logic Configuration

Your 4077 provides eight logic input/output bits in *open-collector, negative-true* form, where the "Logic 1" state is defined as nominal *0 V-DC* and "Logic 0" as nominal *+5 V-DC.* The standard logic I/O configuration is shown in Fig. 4, below, with reference to the 10-terminal Logic I/O Connector on the rear of the 4077. For recommended logic interconnections, see Section 2.i.

Fig. 4 4077 Standard Logic Outputs



You can use the seven logic control outputs to actuate solenoid valves, illuminate panel displays, sound alarms, start and stop motors or pumps, initiate and control safety shut-down sequences, and perform many other automation tasks that require "intelligent" switching, even of substantial amounts of power. These are *nonlatching* outputs; each terminal will return to *Logic 0* as soon as the corresponding limit violation ceases to occur. For "Defining Limit Zones," see Section 2.h.

Bit No.	Logic Function
0	**"BELOW BARGRAPH" VIOLATION OUTPUT** Terminal 0 will be at a *Logic 1* (0 V-DC) level whenever the reading of Channel 5 is less than the current **"LEP"** value for that channel.
1	**"LOW LOW" VIOLATION OUTPUT** Terminal 1 will be at a *Logic 1* (0 V-DC) level whenever the reading of Channel 5 is less than the current **"LLL"** value for that channel and greater than or equal to the current **"LEP"** value.
2	**"LOW" VIOLATION OUTPUT** Terminal 2 will be at a *Logic 1* (0 V-DC) level whenever the reading of Channel 5 is less than the current **"LOL"** value for that channel and greater than or equal to the current **"LLL"** value.
3	**"OK" (NO VIOLATION) OUTPUT** Terminal 3 will be at a *Logic 1* (0 V-DC) level whenever the reading of Channel 5 is greater than or equal to the current **"LOL"** limit value and less than or equal to the current **"HIL"** limit value for that channel.
4	**"HIGH" VIOLATION OUTPUT** Terminal 4 will be at a *Logic 1* (0 V-DC) level whenever the reading of Channel 5 is greater than the current **"HIL"** value for that channel and less than or equal to the current **"HHH"** value.
5	**"HIGH HIGH" VIOLATION OUTPUT** Terminal 5 will be at a *Logic 1* (0 V-DC) level whenever the reading of Channel 5 is greater than the current **"HHH"** value for that channel and less than or equal to the current **"HEP"** value.
6	**"ABOVE BARGRAPH" VIOLATION OUTPUT** Terminal 6 will be at a *Logic 1* (0 V-DC) level whenever the reading of Channel 5 is greater than the current **"HEP"** value for that channel.

1.f Using the Front-Panel Setup Buttons

Study this manual section carefully to familiarize yourself with the general operation of your 4077's front-panel buttons when they are in "SETUP" mode. Specific setup parameters—such as "HIGH END-POINT (HEP)", "FILTER (FIL)," "LCD," etc.—are explained in detail in Section 2.

The 4077 provides *instant visual feedback* for its front-panel buttons. Thus, pressing any button will light the green **ON LINE** indicator. This indicator is located in the lower right-hand corner of the 4077 front panel (see Fig. 1). It will remain lit as long as the button is pressed.

The 4077's six front-panel buttons greatly simplify the basic setup procedure. With them you can quickly review in sequence the existing *numeric "configuration parameters"* of any selected channel. At the same time you can easily reset any displayed parameter to any allowable value. The **LEFT ARROW** button lets you select a displayed *digit* or *decimal-point location.* The **UP ARROW** and **DOWN ARROW** buttons let you change as desired the numeric value of the parameter, its polarity, and/or (if it is a calibration value) its decimal-point location. The new number goes into effect as soon as you exit "SETUP," and is automatically stored in battery-backed memory.

WARNING!

DO NOT USE A SHARP OR POINTED OBJECT TO DEPRESS THE FRONT-PANEL BUTTONS. SERIOUS INSTRUMENT DAMAGE COULD RESULT.

ALSO, DO NOT SPLASH LIQUID ON THE FRONT OF THE UNIT. THIS CAN CAUSE THE BUTTON SWITCHES TO SHORT OUT.

1. Entering "Setup" Mode

To enter "SETUP" mode,

PRESS THE [SET UP] **BUTTON**

Each of the six buttons will now assume its "SETUP" function, as designated by the actual button label (for each button's "RUN-TIME" function, see Section 3.) The small mnemonic display under the 4077's unit legends will alternately read **"DIS"** and the number of the channel that was on display when you pushed the **SETUP** button. The main LCD display will read the number of the currently selected channel (this is initially Channel 6). The rightmost digit of the main LCD display will now flash, indicating that it is the "active" digit. NOTE: the smaller display will continue to read the number of the *initially selected* channel—even though you may call one or more other channels to the main display during the setup procedure—and will alternate this number with the *mnemonic* of the parameter presently under consideration. On exiting "SETUP," the smaller display will show the number of the channel currently displayed by the main LCD.

2. Selecting a Channel for Setup and/or Review

If, after pressing **SETUP**, you wish to review and/or reconfigure the channel whose number is now being displayed,

PRESS THE 

BUTTON

This will invoke the channel's actual "parameter list," beginning with **"LCT."**

If this is *not* the channel you wish to review and/or reconfigure,

PRESS THE  **BUTTON OR THE**  **BUTTON**

one or more times until you arrive at the desired channel. Then press the **STEP** button to invoke its parameter list. When you exit "SETUP" mode, the last channel to have been thus selected will continue to be displayed.

At any time during the setup procedure, you can move back up to the **"DIS"** parameter of the channel currently on display. Simply

PRESS THE 

BUTTON

—at which point you can, if desired, move to any other channel via the **UP/DOWN ARROW** buttons, as above.

3. Stepping Through a Channel's Parameter List

A given channel's configuration sequence includes the parameters listed on the next page. These will appear as mnemonics under the unit-legend display. Their respective *numeric values* will appear on the main LCD digital display. ONLY THE PARAMETERS PRINTED IN **BOLDFACE** ARE TREATED IN THIS MANUAL. For the remaining parameters, see the optional *System Instruction Manual.*

Channel Configuration Parameters

DIS	**(DISPLAY)**	(Section 2.d)
LCT	(LOCATE)	
LNS	(LINEARIZATION SEGMENTS)	
F0	**(FIRST CALIBRATION POINT)**	(Section 2.e)
F1*	**(SECOND CALIBRATION POINT)**	(Section 2.e)
LEP	**(LOW ENDPOINT)**	(Section 2.g)
LLL	**(LOW LOW LIMIT)**	(Section 2.h)
LOL	**(LOW LIMIT)**	(Section 2.h)
HIL	**(HIGH LIMIT)**	(Section 2.h)
HHL	**(HIGH HIGH LIMIT)**	(Section 2.h)
HEP	**(HIGH ENDPOINT)**	(Section 2.g)
ASN	(ASSIGN SATELLITE NUMBER)	
FIL	**(FILTER)**	(Section 2.f)
BAU	(BAUD RATE)	
DBS	(DATA BITS)	
SBS	(STOP BITS)	
PAR	(PARITY)	
LCD	**(LCD VIEWING ANGLE)**	(Section 2.c)
REL	(4000 SOFTWARE RELEASE DATE)	

* Applicable only to 4077 Channels 1, 2, and 3.

To move to the next parameter in sequence,

PRESS THE 

BUTTON

As each parameter appears, you have the option of leaving it as it is and stepping to the next one by again pressing **STEP**, or of modifying its value by means of the "ARROW" buttons. You cannot backstep through the parameter sequence; you can only start it over again, via the **CHAN** button, or continue stepping forward until you come back around to the desired parameter.

4. Moving the "Active" Digit

As each parameter value appears on the LCD display, its least significant digit will be *flashing*, to signify that this is the currently "active" (changeable) digit. You have the option of changing the value of the "active" digit, as explained in Step 5, or of "activating" the next digit to the left. To move the "active" digit one digit to the left,

PRESS THE  **BUTTON**

For "activation" of *decimal points*, see Step 7, below.

NOTE: You cannot move the active digit to the right. If you want to return to a digit you have already passed, you must continue moving leftward until you come back around to the desired digit.

5. Modifying the "Active" Digit

To increase the value of the active digit by "1"—that is, to add "+1" to that number, regardless of its algebraic sign—

PRESS THE  **BUTTON**

To decrease the value of the active digit by "1"—that is, to add "-1" to that number, regardless of its sign—

PRESS THE  **BUTTON**

In the negative realm, these buttons seem at first glance to function backwards. Thus, if the displayed parameter is preceded by a minus sign, then "increasing" the active digit by "1"—as a result of pressing the **UP ARROW** button—means *decreasing* that digit's *absolute value* by "1." Similarly, by pressing the **DOWN ARROW** button you will cause the absolute value of a negative active digit to *increase* by "1." When dealing with negative parameters, just remember that the **UP ARROW** button brings you UP the number scale towards zero, through progressively "lower" (more positive) negative numbers, while the **DOWN ARROW** takes you DOWN the scale through progressively "higher" negative numbers.

You can cycle a given active digit—positive or negative—in either direction. With the completion of every "upward" cycle (either a *positive* active digit going from"9" back to "0" or a *negative* one going from "0" back to "9"), "+1" will be added to that digit, with appropriate adjustment of higher-placed digits. For example, if the originally displayed number is "990" (the active digit being the second from the right), and the **UP ARROW** button is pressed once, the resulting number will be "1000." Note that the original active digit will continue to flash until you press the **LEFT ARROW** button.

Similarly, after every "downward" cycle (either a *positive* active digit going from"0" back to "9" or a *negative* one going from "9" back to "0"), "-1" will be added to that digit, with appropriate adjustment of higher-placed digits (e.g., "-1920" becomes "-2020" when the active digit is the third from the right and the **DOWN ARROW** is pressed once).

6. Modifying the Polarity of the Displayed Value

To change the polarity of the presently displayed number, press the **LEFT ARROW** button repeatedly until the *leftmost* digit (the "most significant digit") is active. Cycle this digit once *through zero* and back to its original numeric value. If you're changing the number from *positive to negative*, you will cycle "downwards" through zero via the **DOWN ARROW** button; if you're changing from *negative to positive*, you will cycle "upwards" through zero via the **UP ARROW** button. The number's sign will change as the most significant digit passes through zero.

NOTE: The above procedure *will change the original values of one or more digits to the right of the most significant digit*, except in the case where they are all originally zero. Therefore, you will most likely have to go back and *reset* these digits, using the **LEFT ARROW** and **UP/DOWN ARROW** buttons as explained in Step 5.

7. Adding a Decimal Point or Modifying the Decimal-Point Location

NOTE: You can only add or modify a decimal point for an **"F0"** or **"F1"** entry (see Section 2.e). Decimal points may appear in the limit-zone parameters (**"LEP," "LLL," "LOL,"** etc.) following calibration, but *these cannot then be modified*.

To add a decimal point to an existing integral **"F0"** or **"F1"** value, press the **LEFT ARROW** button repeatedly until five flashing decimal points appear. Then press the **UP ARROW** button repeatedly until a single flashing decimal point appears in the desired position (the **DOWN ARROW** button can here be used to move the decimal point to the right, if necessary).

To change the position of an existing decimal point, press the **LEFT ARROW** button repeatedly until the present decimal point is "active." To move it to the left, press the **UP ARROW** button; to move it to the right, press the **DOWN ARROW** button.

NOTE: Decimal-point modification of the **"F0"** setting will not be effective until the **"F1"** setting has been similarly modified. If the **"F1"** decimal point is initially in the desired location, it is still necessary to "relocate" it. Move the **"F1"** decimal point first to some other location, and then back to its original location.

8. Exiting "Setup" Mode

To exit "SETUP" mode at any time during the above procedure,

PRESS THE 

BUTTON

All configuration changes will be saved, and all front-panel buttons will resume the normal "RUN-TIME" functions described in Section 3.

1.g Low Battery Warning

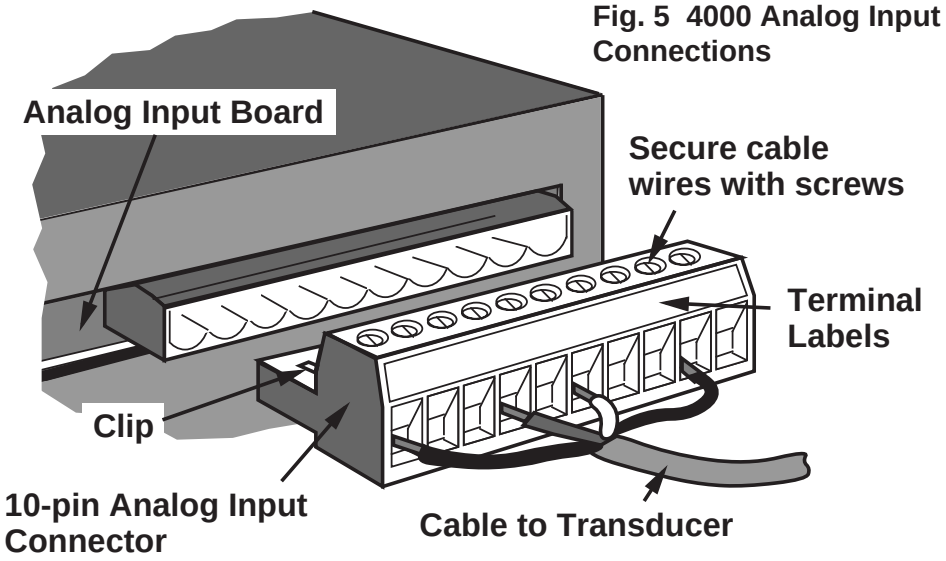
The 4077 is equipped with an internal 3-V lithium battery. This battery is necessary to maintain the instrument's DATA RAM and to retain factory-entered analog alignment values required for accurate calibration. Data retention is guaranteed down to a battery level of 2.2 V-DC. Under normal usage, the battery should last about five years.

The 4077 will check its battery every time the unit is turned on. If on powerup, the battery is found to be below 3.0 V-DC, the front-panel LCD will display a warning of "**LO bat**." Note that at this level the battery will still be good for weeks or even months. You are advised, however, to *change the battery* as soon as possible after the warning first appears. Detailed instructions for this procedure are given in Appendix H of this manual.

To acknowledge the "**LO bat**" warning and resume the normal display, simply press any one of the front-panel buttons.

Located on the rear of the 4077, the *12*-pin ANALOG INPUT CONNECTOR is similar to the 10-pin connector shown in Fig. 5. Referring to the appropriate *cabling diagram* below, connect the wires of your TRANSDUCER CABLE to the corresponding screw terminals of the INPUT CONNECTOR. To facilitate cable connection, the front (screw-terminal) portion of the connector may be removed from the rear (pin) portion, which is mounted on the 4077's internal ANALOG INPUT BOARD. Press hard when reinserting the front portion, to make sure it is fully engaged (the small clips should snap into place on the rear portion).

Fig. 5 4000 Analog Input Connections



4-wire strain gage cabling (Fig. 6(a)) is to be used when the cable is under 20 feet in length. In this case, the +SENSE and –SENSE lines are tied to the corresponding EXCITATION lines, and also the CALIBRATION SENSE line to the +SIGNAL line, *at the CONDITIONER CONNECTOR.*

8-wire strain gage cabling (Fig. 6(b)) is to be used when the cable is 20 feet or longer. In this case, the +SENSE and –SENSE lines are tied to the corresponding EXCITATION lines, and the CALIBRATION SENSE line to the +SIGNAL line, *at the transducer.* Note also the wire connected to the –SIGNAL line, at the transducer, but left *unconnected* at the 4077. This wire is to be paired with the CAL SENSE, as shown, for shielding purposes.

2.a Transducer Cabling

For transducer cabling to an optional **Model 10CJB-2 Bridge Completion Card**, see Appendix F.

---------- NOTE ----------

CABLE SIGNAL WIRES OR TWISTED WIRE PAIRS SHOULD ALWAYS BE PROPERLY *SHIELDED*, AS INDICATED IN THE CABLING DIAGRAMS. THIS WILL MINIMIZE THE PRODUCTION OF UNWANTED ELECTRICAL NOISE FROM CAPACITIVE AND INDUCTIVE EFFECTS.

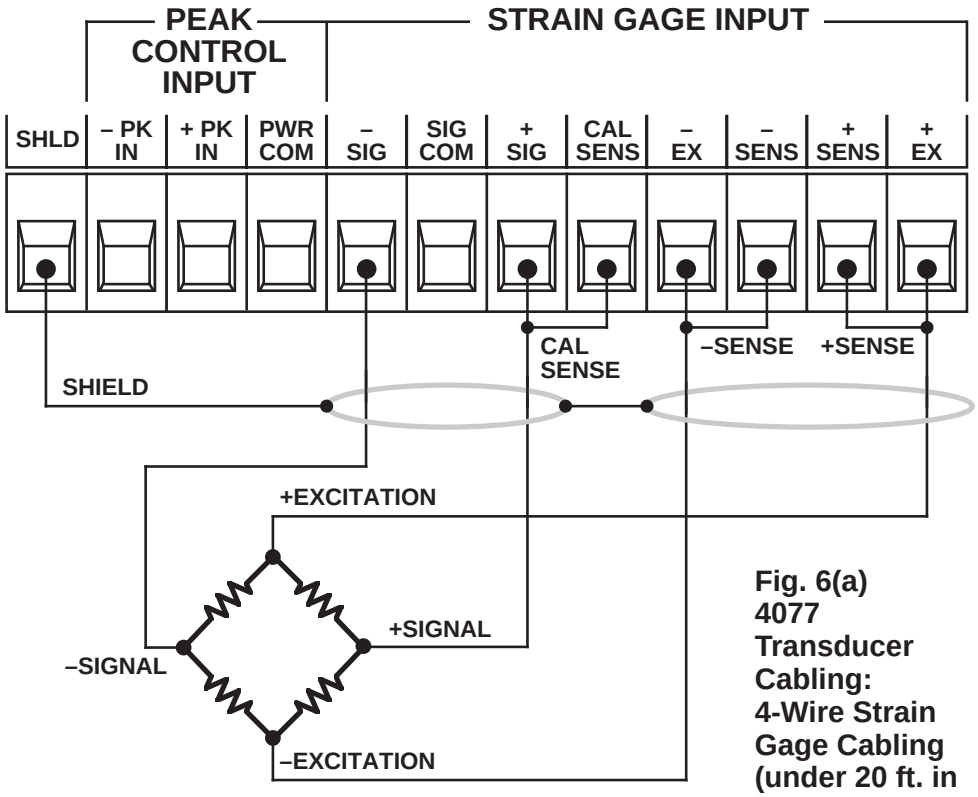


Fig. 6(a) 4077 Transducer Cabling: 4-Wire Strain Gage Cabling (under 20 ft. in length)

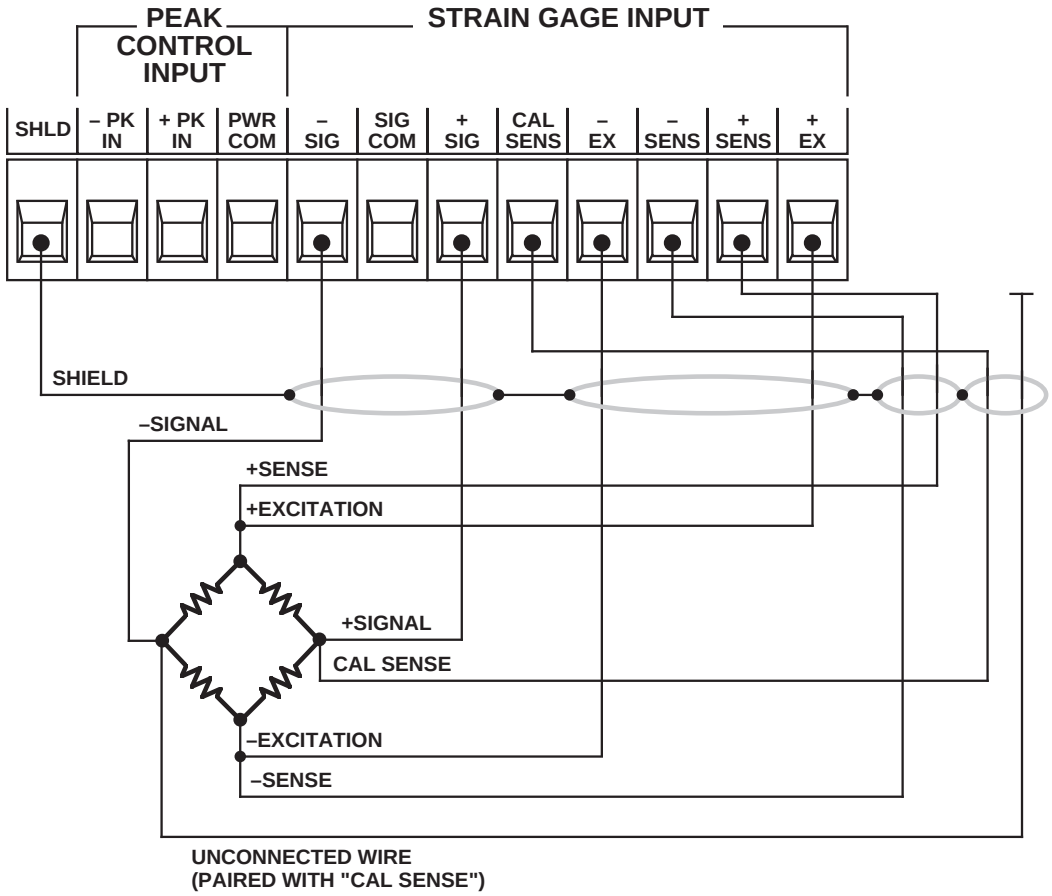


Fig. 6(b) 4077 Transducer Cabling: 8-Wire Strain Gage Cabling (20 ft. or longer)

---------- PLEASE NOTE ----------

EVERY TIME YOU POWERUP YOUR MODEL 4077, ALLOW A NOMINAL 15 SECONDS FOR VALID DATA AND SETUP VALUES TO BE ESTABLISHED.

ALSO NOTE: Since setup entries are automatically saved to nonvolatile memory, your 4077 will always powerup to the same setup and display configuration that existed when it was last powered down.

1. AC Operation

This is "normal" operation for the Model 4077.

A 4077 can operate from a line voltage of either 90-135 or 180-270 V-AC (47-63 Hz; 35 W maximum). The VOLTAGE SELECTOR SWITCH is located on the rear panel (see Fig. 2(a)).

---------- IMPORTANT ----------

Before powering up your 4077, make sure that the VOLTAGE SELECTOR SWITCH is set to the proper nominal AC line voltage (110 or 220).

If you change the voltage-level setting, YOU MUST ALSO CHANGE THE 4077'S BUSS FUSE (again, see Fig. 2.(a)): nominal 110 V-AC takes a 0.5-amp fuse; nominal 220 V-AC takes a 0.25-amp fuse.

To change the fuse after changing the voltage setting—or after the existing fuse has "blown" for some reason—use a screwdriver to turn the fuse slot counterclockwise, and the fuse will spring out.

IN THE EVENT OF AN APPARENT POWER-SUPPLY FAILURE, FIRST CHECK THE FUSE. WHEN REPLACING A "BLOWN" FUSE, ALWAYS INVESTIGATE THE CAUSE OF OVERLOAD BEFORE REACTIVATING THE INSTRUMENT.

The 7.5-foot, three-conductor power cord supplied with the 4077 plugs into the rear AC POWER CONNECTOR. The offset pin on the power connector is ground. **THE INSTRUMENT MUST BE PROPERLY GROUNDED.** To safely operate from a *two-contact* outlet, use a 3-prong-to-2-prong adaptor and connect the green pigtail on the adaptor to earth ground.

Since the presence of *electrical noise* can affect the ultimate integrity of your data, the noise level should be suppressed as much as possible. In particular, care should be taken to avoid utility-line problems that can interfere with or possibly even damage sensitive microprocessor-based equipment. Such noise can also be generated by electrical motors, relays, and motor control devices.

While your 4077 has internal circuitry to protect it from overvoltage transients and mild EMI, a clean line is still very desirable. No protection is provided against dropout longer than 8 milliseconds or brownout below 90 volts. Depending on your line conditions, a number of protective devices are available (isolators, regulators, uninterruptible power supplies, etc.).

2. DC Operation

When ordered with the "V" (*Vehicle*) option, a 4077 may be operated from nominal 12 V-DC (30 W maximum). The actual tolerance range is 11-18 V-DC.

As shown in Fig. 2(b), every "V"-version 4077 is equipped with a screw-terminal DC POWER CONNECTOR on the rear of the unit. Be sure to connect the *positive, negative,* and *ground* lines from your external DC source to the proper terminals of this connector. Although all "V" units are protected against accidental polarity reversal, they naturally will not work under that condition.

Each DC-powered 4077 unit has a 4-amp buss FUSE. To change the fuse, use a screwdriver to turn the fuse slot counterclockwise, and the fuse will spring out. IN THE EVENT OF AN APPARENT POWER-SUPPLY FAILURE, FIRST CHECK THE FUSE. WHEN REPLACING A "BLOWN" FUSE, ALWAYS INVESTIGATE THE CAUSE OF OVERLOAD BEFORE REACTIVATING THE INSTRUMENT.

----------IMPORTANT----------

In all cases, the "ground" terminal of the 4077 DC CONNECTOR should be connected either to the negative terminal of the vehicle battery or directly to the vehicle chassis. IT SHOULD NEVER BE LEFT UNCONNECTED. ALSO, TO MINIMIZE NOISE PICKUP, THE GROUND LEAD SHOULD BE AS SHORT AS POSSIBLE.

The configuration shown in Fig. 7(a) is normally recommended. Under conditions of HIGH ELECTRICAL NOISE, however, you should make the connections shown in Fig. 7(b).

Fig. 7(a)

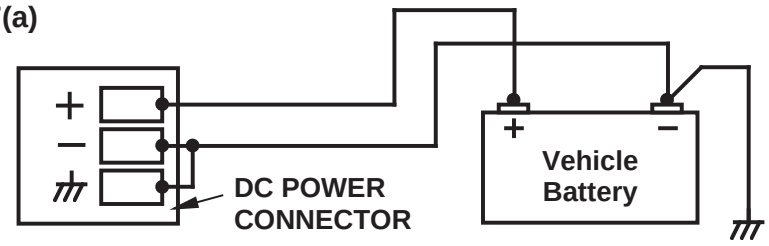
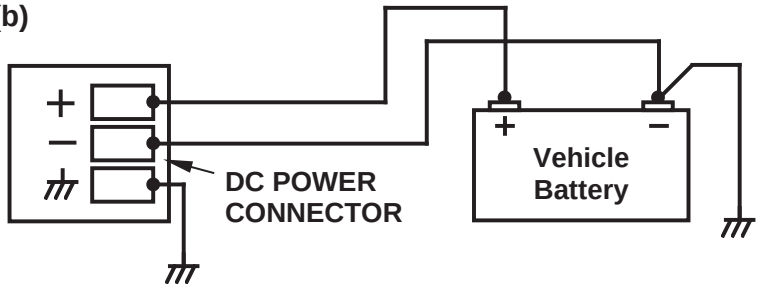


Fig. 7(b)



Adjusting LCD Viewing Angle 2.c

You can easily optimize your 4077's LCD DIGITAL DISPLAY for your particular *viewing angle*.

1. Following the procedure given in Section 1.f, above, press the instrument's front-panel **SETUP** key, and then "step" to the **"LCD"** parameter (the letters "LCd" should appear in the digital display, to indicate that the instrument is in "LCD adjustment" mode).

2. If you wish to *raise* the viewing angle—that is, to make the display more readable from *above* the instrument—press the **"UP ARROW"** key until the desired display of the word "LCd" is produced (note that the extreme setting in this direction will cause the display to disappear, and you will then have to lower the angle somewhat (Step 3)). Also note that it usually takes about three seconds before you see any real change in the display.

3. If you wish to *lower* the viewing angle—that is, to make the display more readable from *below* the instrument—press the **"DOWN ARROW"** key until the desired display of the word "LCd" is produced (note that the extreme setting in this direction will cause all segments of the display to be clearly visible when the instrument is viewed from any angle except approximately 30% below the level of the display).

4. To return the display to "normal" mode, press the **SETUP** key once again. The 4077 should subsequently powerup with the LCD angle to which you have just set it.

2.d Selecting a Channel for Display

Your 4077's "Standard Channel Configuration" was given in Section 1.d, above. To cause the current "live" reading of any channel—either "scanned" or "unscanned"—to be displayed on both the DIGITAL and BARGRAPH displays, you need only

1. **PRESS THE** 

BUTTON

2. **PRESS THE**  **BUTTON OR THE**  **BUTTON**

   repeatedly until the number of the desired channel appears in the *main* LCD display (the original channel number will continue to flash in the small mnemonic display under the engineering legends).

3. Again **PRESS THE** 

BUTTON

   The number of the displayed channel should now appear in the mnemonic display, with the "live" reading of this channel in the main LCD display.

NOTE: As explained in Section 3, you can always use the **LIVE DISPLAY** button—when not in "SETUP MODE"—to call to display your 4077's Channel 5 ("tared" analog input). You can also use the **MAX/MIN/MAX-MIN STEP** button to cycle sequentially through Channels 5 through 8.

IMPORTANT: FOR THE MOST ACCURATE CALIBRATION, YOU SHOULD ALLOW THE 4077 TO WARM UP FOR AT LEAST 30 MINUTES BEFORE CALIBRATING.

Under "standard" 4077 operating conditions, the only channel you need to calibrate is Channel 1 ("LIVE" ANALOG INPUT).* All other channels derive their readings from Channel 1.

Of the three calibration methods possible with the 4077, only the "TWO-POINT (DEADWEIGHT)" method described in this section can be accomplished solely via the front-panel buttons. For "COMPUTED" and "SIMULATED (SHUNT)" calibration, see Appendix E. For use of the 4077's internal LINEARIZATION TABLES, and for a discussion of "y = mx + b" calibration theory, see the optional 4000 Series *System Instruction Manual*.

Note too that when an optional **Model 10CJB-2 Bridge Completion Card** is used with the 4077, special calibration procedures are required. See Appendix F for details.

In general terms, you will calibrate your 4077's Channel 1 by commanding its microprocessor to compute and store two constant values: a ZERO OFFSET (based on setup entry **"F0"**) and a SCALING FACTOR (based on entry **"F1"**).

1. Display Channel 1 (see Section 2.d).

2. Following the general procedure explained in Section 1.f, enter "SETUP" mode and step to Channel 1's **"F0"** parameter.

3. Apply an *accurately known* value of input loading to the source transducer—a value (positive or negative) less than 50% of the nominal full-scale rating. If it is possible to remove all load from the transducer, thus establishing a true *zero input* for Channel 1, you should do so.

4. Using the "ARROW" buttons, enter the numerical value of the known input, with appropriate polarity (in the "zero input" case, of

* In *analog peak capture* operations, however, Channels 2 and/or 3 must also be calibrated—see Appendix G.

course, you will enter "0"). Then press the **STEP** button to display Channel 1's **"F1"** parameter.

5. Apply a second *accurately known* value of input loading—a value (positive or negative) from 80% to 100% of the transducer's nominal full-scale rating.

6. Now enter the numerical value of the second known input, with appropriate polarity. This "forces" the channel's data reading to equal this value, thereby determining the SCALING FACTOR to be applied to all subsequent channel readings.

   NOTE: This entry also sets the desired *precision* for Channel 1. If, for example, you're measuring "pounds," and enter an **"F1"** of "100," then all subsequent readings will be rounded to the nearest pound. If **"F1"** is "100.0," then all readings will be rounded to the nearest *tenth* of a pound. This same precision will be automatically reflected in Channel 1's "limit-zone" parameters: **"LEP," "LLL," "LOL," "HIL", "HHL,"** and **"HEP"** (see Section 2.h).

7. Exit "SETUP" mode by pressing the **SETUP** button.

Setting Channel Filters 2.f

In addition to the normal-mode analog filtering applied to the 4077's "LIVE" INPUT CHANNEL (No. 1), *digital filtering* is also provided, with smoothing constants selectable via the front panel.* The effect of the digital filter is to remove small unwanted dynamic signal components, while allowing large-scale fluctuations to pass unaffected.

To set the digital filter for Channel 1, 2, or 3,

1. Display the channel (see Section 2.d).

2. Following the general procedure explained in Section 1.f, enter "SETUP" mode and step to the **"FIL"** parameter.

3. Enter a number from 0 through 10. These "filter constants" signify increasing amounts of automatic digital filtering. Channel 1 is normally preset to a filter setting of "4."

4. Exit "SETUP" mode by pressing the **SETUP** button.

* Digital filtering may also be selected for Channels 2 and 3.

2.g Scaling the Bargraph Display

After calibrating your 4077's "LIVE" INPUT channel (No. 1), you should set the high and low endpoints for the BARGRAPH display of Channel 5 ("LIVE" INPUT WITH TARE), using the procedure given below. This same procedure may be used to scale the bargraph display of any of the other 4077 data channels listed in Section 1.d. For the relation of the endpoint values to the other four limit-zone-defining parameters, see Fig. 8 in the next section.

1. Display Channel 5 (see Section 2.d).

2. Following the general procedure explained in Section 1.f, enter "SETUP" mode and step to the **"LEP" (LOW ENDPOINT)** parameter.

   The initial **"LEP"** setting for Channel 5 is normally "-20000." THIS WILL HAVE BEEN AUTOMATICALLY SCALED, HOWEVER, SO THAT ITS DECIMAL-POINT LOCATION MATCHES THAT OF THE SCALING FACTOR (**"F1"**) YOU ENTERED WHEN YOU CALIBRATED CHANNEL 1 IN SECTION 2.e. If, for example, your **"F1"** value for Channel 1 was "XXX.X" (where "X" is any number), the displayed **"LEP"** value for Channel 5 will be "-200.0." The decimal-point position will always be the same for all six limit-zone parameters (**"LEP," "LLL," "LOL," "HIL," "HHL,"** and **"HEP"**). As mentioned in Section 1.f, *this position cannot be changed*, since it depends directly on the precision of the last **"F1"** entry.

3. Using the "ARROW" buttons as explained in Section 1.f, enter the desired LOW ENDPOINT value for the bargraph display of Channel 5, as expressed in the engineering units selected for that channel.

4. Press the **STEP** button five times. The **"HEP"** parameter should now be displayed. Enter the desired HIGH ENDPOINT value for the bargraph display of Channel 5 (again, as expressed in the engineering units selected for that channel). The initial **"HEP"** setting for Channel 5 is normally "20000."

The **"LEP"** and **"HEP"** values for a given channel may be any numeric constants from -32768 through 32767, provided that the **"LEP"** value is less than the **"HEP"** value. At least 51 units (absolute count) must separate the **HEP** and **LEP** values.

Scaling the Bargraph Display 2.g

NOTE, however, that the 4077's front panel furnishes a "truncated" numeric display of the two endpoint values of the currently displayed bargraph (see Fig. 1). That is, the endpoint numbers will appear with *all but the first two significant digits converted to "0."* THE RESULTING PRECISION OF THE DISPLAYED **"LEP"** AND **"HEP"** VALUES DOES NOT REFLECT THE PRECISION OF THE ACTUAL BARGRAPH ENDPOINTS CURRENTLY IN EFFECT. If, for example, a **"HEP"** of "3495.0" is entered, this value is still in effect, *to that precision*, even though it is displayed as "3400." In order to update the decimal-point position in the numeric **HEP** and **LEP** displays after rescaling the bargraph, it is necessary to "recall" the channel—i.e., to display another channel and then return to the original one.

Defining Limit Zones 2.h

Once you have set the endpoints of Channel 5's bargraph display, you can define seven discrete *limit zones* with respect to that bargraph, as shown in Fig. 8: "BELOW BARGRAPH" ZONE (less than **LEP**); LOWER "DANGER" ZONE (**LEP** to **LLL**); LOWER "CAUTION" ZONE (**LLL** to **LOL**); SAFETY (NO VIOLATION) ZONE (**LOL** to **HIL**); UPPER "CAUTION" ZONE (**HIL** to **HHL**); UPPER "DANGER" ZONE (**HHL** to **HEP**); and "ABOVE BARGRAPH" ZONE (greater than **HEP**). These limit zones are represented by pairs of smaller bars that light up above the main bargraph. The upper and lower "CAUTION" ZONES are indicated by the YELLOW bars; and the upper and lower "DANGER" ZONES by the RED ones.

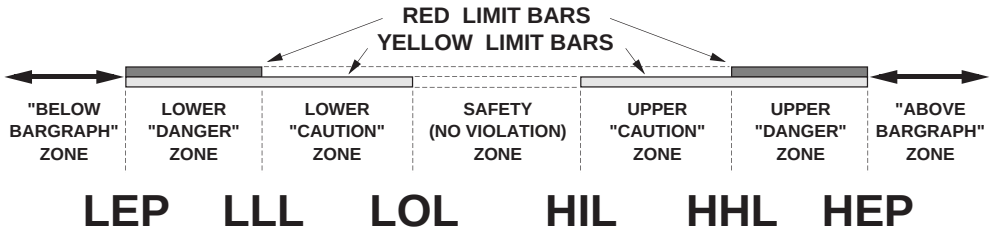


Fig. 8 Per-Channel Limit Zones

Using the same "SETUP" button techniques as before, enter desired values for these Channel 5 parameters:

2.h Defining Limit Zones

"LLL" ("LOW LOW LIMIT")—initially set to "-10000"
"LOL" ("LOW LIMIT")—initially set to "-5000"
"HIL" ("HIGH LIMIT")—initially set to "5000"
"HHL" ("HIGH HIGH LIMIT")—initially set to "10000"

As with the **"LEP"** and **"HEP"** entries (Section 2.g), each value should be expressed in the engineering units selected for Channel 5, and each can be any constant from -32768 through 32767, provided that **"LLL"** is less than **"HHL"** and that **"LOL"** is less than **"HIL."**

As mentioned in Section 1.e, a separate TTL-level *control output* will be automatically issued from Terminal 0 of the 4077's rear Logic I/O Connector whenever the "live" reading of Channel 5 lies *below* the current **"LEP"** value for that channel (i.e., within the "BELOW BAR-GRAPH" ZONE). Similarly, a logic output will be issued from Terminal 1 when Channel 5 is in the current LOWER "DANGER" ZONE; from Terminal 2 when it is in the current LOWER "CAUTION" ZONE; from Terminal 3 when it is in the current SAFETY (NO VIOLATION) ZONE; from Terminal 4 when it is in the current UPPER "CAUTION" ZONE; from Terminal 5 when it is in the current UPPER "DANGER" ZONE; and from Terminal 6 when it is in the current "ABOVE BARGRAPH" ZONE.

2.i Logic I/O Connections

As shown in Fig. 4, the 4077's rear Logic I/O Connector has eight numbered LOGIC I/O terminals, plus a +5-V (LOGIC REFERENCE) terminal and a "GD" (GROUND) terminal. The "standard" 4077 configuration calls for logic OUTPUTS from Terminals 0 through 6. It does not call for any logic INPUTS, but the initially unassigned Terminal 7 can be used for this purpose, if the application requires. Fig. 9 shows how to wire

1. negative-true logic INPUT to a given terminal ("N") from an active TTL logic system;
2. negative-true logic INPUT to Terminal "N" from external switch contacts;
3. open-collector logic OUTPUT from Terminal "N" to an active TTL logic system; and
4. open-collector logic OUTPUT from Terminal "N" to drive an external relay or TRIAC controller (including the **Model 9398 and 9399 Solid State Relays**).

For full LOGIC I/O SPECIFICATIONS, see the optional 4000 Series *System Instruction Manual*.

Fig. 9 (a) Input from External TTL Logic

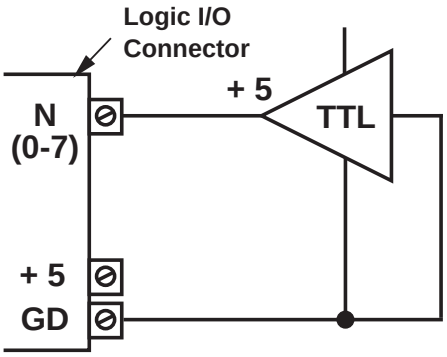
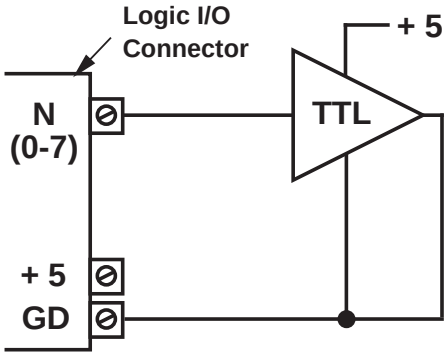


Fig. 9(b) Input from External Switch



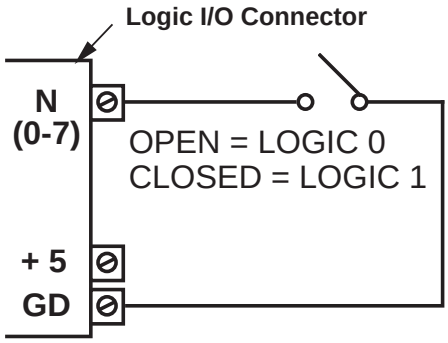
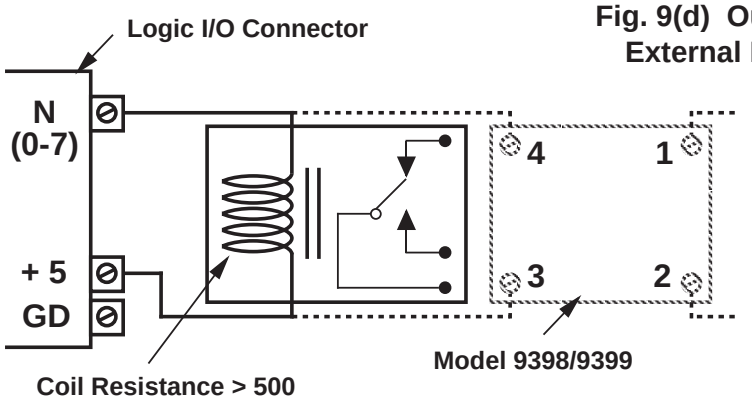


Fig. 9(c) Output to External TTL Logic

Fig. 9(d) Output to External Relay



2.j Analog Output Connections

Under the "standard" configuration, the 4077's Channel 19 is an analog output that corresponds to the "LIVE" INPUT WITH TARE (Channel 5) with a full range of ±10 V-DC and a maximum resolution of ±1 mV. This output is initially scaled for *1 mV of output per count for the current reading of Channel 5*.

It can be rescaled by entering a new value for the scaling factor "m" of the **ANALOG OUTPUT (ANO)** expression that defines Channel 19:

ANO 19 = m(CHN5) + 0 [CR]

An appropriate "m" can be determined by dividing the desired full-scale analog output range in *millivolts* (up to the allowable maximum of 10000 mV) by the actual force reading (in lbs, kg, ft-lbs, etc.) which you want the full-scale output to represent. The "m" value should reflect the precision that currently applies to Channel 5 (this is initially the nearest *integral unit*).

For example, if you want a reading of 500 lbs to output the full +10000 mV, you need only enter a command of

ANO19 = 20(CHN5) + 0 [CR]

since (10000/500) = 20. If, however, you want 500 lbs to produce an output of +5000 mV, you would enter

ANO19 = 10(CHN5) + 0 [CR]

since (5000/500) = 10.

Fig. 10 shows how an external device connects to the two-terminal Analog Output Connector on the rear of the 4077. The output is single-ended, and returns to "SIGNAL COMMON" (this is the negative Analog Output terminal).

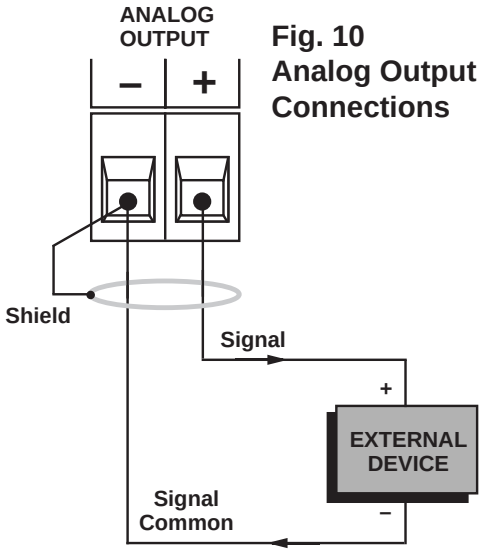


Fig. 10
Analog Output Connections

Use of Front-Panel Buttons 3

The "SETUP" functions of the 4077's six front panel buttons have been described in Section 1.f. These are the functions labelled on the buttons themselves. The "RUN-TIME" button functions are as follows:

BUTTON No. 1 ("LIVE DISPLAY"):

Each Push: Calls Channel 5 ("LIVE" INPUT WITH TARE) to digital and bargraph display. Under the "standard configuration," the **"F2"** indicator will *always* be on when the 4077 is in "RUN-TIME" mode.

BUTTON No. 2 [NOT ASSIGNED]:

This button has no assigned "run-time" function in the "standard" 4077 configuration.

BUTTON No. 3 ("TARE"):

Each Push: Zeroes Channel 5 ("LIVE" INPUT WITH TARE) so that subsequent readings of Channel 5 will represent the value of Channel 1 ("LIVE" INPUT) *minus the existing value of Channel 1* (now stored as a constant "tare" offset).

BUTTON No. 4 ("MAX/MIN/MAX-MIN STEP"):

Each Push:

If Channel 5 is currently on display, displays Channel 6 ("MAXIMUM" VALUE OF CHANNEL 5) and lights the **"F3"** indicator.

If Channel 6 is currently on display, displays Channel 7 ("MINIMUM" VALUE OF CHANNEL 5) and lights the **"F4"** indicator.

If Channel 7 is currently on display, displays Channel 8 ("MAX minus MIN" VALUE OF CHANNEL 5) and lights the **"F5"** indicator.

If Channel 8 is currently on display, displays Channel 5 ("LIVE" INPUT WITH TARE) and lights the **"F2"** indicator.

BUTTON No. 5 ("MAX/MIN RESET"):

Each Push: Resets the "MAX"- and "MIN-" measuring functions of Channels 6 and 7, respectively, momentarily setting each of these channels equal to the current "live" reading of Channel 5.

BUTTON No. 6 ("SETUP")

First Push: Enables "SETUP MODE" for the selected channel (see Section 1.f). Causes the **"SETUP"** indicator to light.

Second Push: Disables "SETUP MODE" for the selected channel (see Section 1.f). Turns off the **"SETUP"** indicator.

For a full explanation of the parameters listed in this section, see the optional **4000 Series *System Instruction Manual***.

CHANNEL CONFIGURATION

Channel No.	TYP	LCT	EMM	BEE	FIL	RNG	LNS
1	00	1	20000	0	4	3M [mV/V]	1
2	00	2	20000	0	4	3M [mV/V]	1
3	00	3	20000	0	4	3M [mV/V]	1
4	F6	1	1	0	N/A	N/A	N/A
5	F1	1	1	0	N/A	N/A	N/A
6	FA	1	1	0	N/A	N/A	N/A
7	FB	1	1	0	N/A	N/A	N/A
8	F1	1	1	0	N/A	N/A	N/A
9	00	1	20000	0	N/A	N/A	N/A
10	00	1	20000	0	N/A	N/A	N/A
11	00	1	20000	0	N/A	N/A	N/A
12	00	1	20000	0	N/A	N/A	N/A
13	00	1	20000	0	N/A	N/A	N/A
14	F6	1	1	0	N/A	N/A	N/A
15	F6	1	1	0	N/A	N/A	N/A
16	F6	1	1	0	N/A	N/A	N/A
17	00	1	1	0	N/A	N/A	N/A
18	00	1	1	0	N/A	N/A	N/A
19	E0	1	1	0	N/A	N/A	N/A

CHANNEL LIMIT VALUES

Channel No.	LEP	LLL	LOL	HIL	HHL	HEP
1 - 13	-20000	-10000	-5000	5000	10000	20000
14	0	0	1	1	2	2
15	0	0	2	2	3	3
16	0	0	3	3	4	4
17	-20000	-10000	-5000	5000	10000	20000
18 - 19	-10000	-7500	-5000	5000	7500	10000

CHANNEL LIMIT LOGIC

Channel No.	BLE	BLL	LLT	LBT	LGT	BHH	BHE
1 - 4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	0	1	2	3	4	5	6
6 - 13	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	N/A	N/A	N/A	13	N/A	N/A	N/A
15	N/A	N/A	N/A	14	N/A	N/A	N/A
16	N/A	N/A	N/A	N/A	15	N/A	N/A
17 - 19	N/A	N/A	N/A	N/A	N/A	N/A	N/A

CALCULATION CHANNELS

Channel No.	CLC
4	1(CHN4)+0
5	1(CHN1-CHN4)+0
6	1(MAX CHN5)+0
7	1(MIN CHN5)+0
8	1(CHN6–CHN7)+0
14	1(CHN14)+0
15	1(CHN14)+0
16	1(CHN14)+0

ANALOG OUTPUT

Channel No.	ANO
19	1(CHN5)+0

EXECUTES

Bit Number	EXU	EXU/
0 - 12	N/A	N/A
13	ANN3=1	ANN3=0:ANN4=1
14	N/A	ANN4=0:ANN5=1
15	CHN14=0:ANN1TO5=0: ANN1=1:DIS=5	ANN1TO5=0: ANN1=1:DIS=5

BUTTON EXECUTES

Button Number	EXB and EXB/
1	CHN14=0:ANN1TO5=0:ANN1=1:DIS=5
2	N/A
3	CHN4=CHN12
4	INC14:SDI
5	CHN6TO7=CHN5

ANNUNCIATION

Annunciator Number	ANN
1	1
2 - 6	0
7	1
8	0

LOGIC I/O

Bit Number	LIO
0 - 7	OUT

LOGIC SOURCES

Bit Number	SRC
0 - 6	LIM,NON
7 - 10	EXT,NON
11	LIM,NON
12	EXT,NON
13 - 15	LIM,NON
16 - 31	EXT,NON

COMMUNICATIONS PROTOCOL

BAU = 5,7,2,0
DBS = 7
SBS = 2
PAR = 0
DLY = 0
CMT = [0D]
OPT = [00,0D]
EOT = [00,0D]

OTHER GENERAL SETUP PARAMETERS

SCN = 1,19
TER = 19
EXC = 10
SBC = 1
ASN = 0
LGO = 4077 STANDARD
EDT = Y
DIS = 5
BAR = DIS
BEP = LEP
FLA = 1000
CPC = 9
CLM = 1
PKN = HLD
PKP = HLD
XBG1 = 1
XBG2 = 2
SHP = OFF
SHN = OFF

If you did not order a specific *RS-232-C Interface Cable* with your 4077, you will have to provide your own connection. Fig. 11 shows suggested cabling between a 4077 and a computer, terminal, buffered printer, etc., that uses a *25-Pin RS-232-C Connector*. FOR MAXIMUM DATA-TRANSFER SPEED AND ACCURACY, A "FULL HANDSHAKE" INTERCONNECTION IS GENERALLY RECOMMENDED (Fig. 11(a)). However, cabling is also given for "INCOMING HANDSHAKE ONLY" and "NO HANDSHAKE" situations (Figs. 11(b) and 11(c), respectively). Following RS-232-C conventions, the device at each end of the interface is seen as "DATA TERMINAL EQUIPMENT (DTE)."

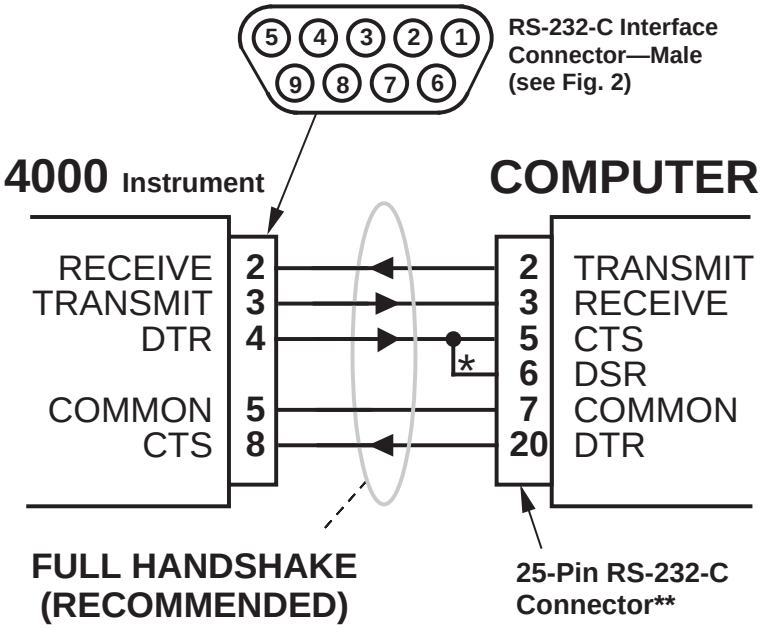
Fig. 12 shows suggested cabling between a 4077 and a computer, terminal, printer, etc., that uses a *9-Pin D-Subminiature Connector* for its RS-232-C interface (such as an IBM PC/AT).

Please note that the cabling in Figs. 11 and 12 is by no means definitive. In all cases, you should carefully study the literature accompanying the specific RS-232-C device you wish to connect to your 4077, to determine the cable arrangement that will create the "handshake" you need (if any). On some devices, for example, the **DATA TERMINAL READY (DTR)** signal may have a different name (such as **NOT BUSY**) and may even appear on a pin other than No. 20 or No. 4.

NOTE: OPTIONAL **IEEE-488** INTERFACING REQUIRES AN EXTERNAL **MODEL 10CIF488A IEEE Interface Adaptor**. Complete instructions will be supplied with this equipment.

Fig. 11 Suggested RS-232-C Interface Connections (to 25-Pin RS-232-C Connector)

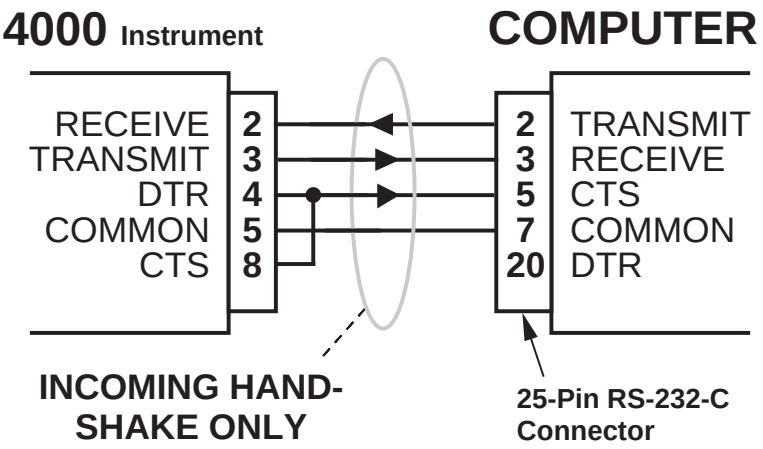
11(a)



* Required for connection of the 4000 instrument to an IBM or IBM-compatible computer, but not to a Daytronic Model PC-HSICA.

** Male connector required for Model PC-HSICA.

11(b)



11(c)

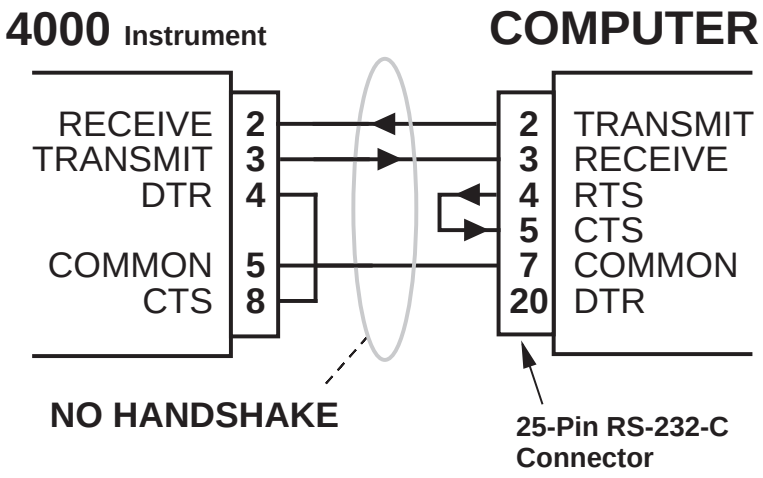
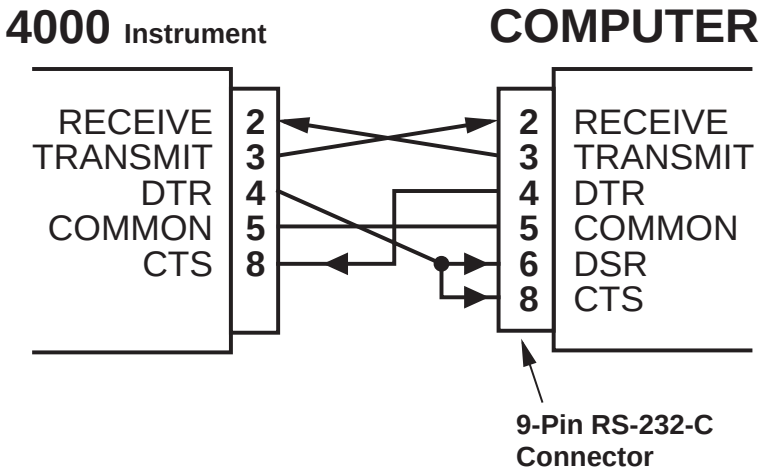


Fig. 12 Suggested RS-232-C Interface Connections (to 9-Pin RS-232-C Connector)



App. C Legend and Indicator Annunciation

Every Model 4077 will normally come with the UNIT LEGENDS and BUTTON FUNCTION INDICATORS shown in Fig. 1, with the legend/ indicator negative already fitted in the 4077's front-panel "FRAME" LABEL. Customized negatives are available as an option. Contact the factory for precise installation instructions; IMPROPER INSTALLATION CAN DAMAGE THE 4077 DISPLAY PANEL.

Unless other specified, the 4077 comes with only the **"F1"** and **"psi"** indicators lit. To cause one or more legends and/or indicators to light up whenever instrument power is on, you must use the **ANNUNCIATOR (ANN)** command. The front-panel "annunciators" consist of the indicators that correspond to the *first five* buttons, plus the three engineering-unit legends.* Thus, to turn ON Annunciator Number n, where $1 \leq n \leq 8$ (see Fig. 13 for the precise numbering), you need only command

ANN n = 1 [CR]

To turn OFF Annunciator No. n, command

ANN n = 0 [CR]

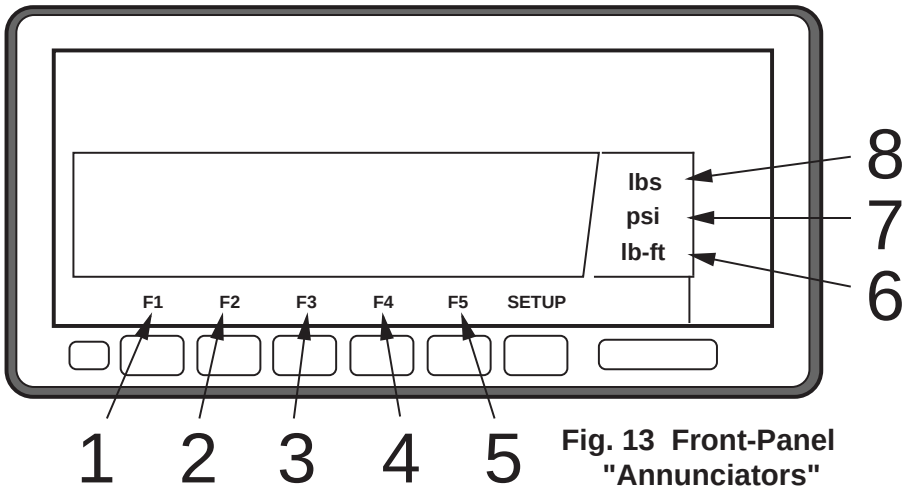


Fig. 13 Front-Panel "Annunciators"

* The **SETUP** indicator cannot be affected by the **ANNUNCIATOR (ANN)** command. It will only be on when the 4077 is in "SETUP" mode.

Modifying Input Range & Excitation Level App. D

IF YOU NEED TO RESET THE 4077's INPUT RANGE AND/OR EXCITATION LEVEL, IT SHOULD BE DONE BEFORE THE TRANSDUCER IS CONNECTED.

Under the "standard configuration," your 4077 is initially set for a full-scale transducer range of 3.00 mV/V. If your transducer's full scale is 1.5 mV/V, you need only enter the following **RANGE (RNG)** command to set the 4077 accordingly:

RNG 1 = 1.5M [CR]

To reset the 4077 to the 3 mV/V range, command

RNG 1 = 3M [CR]

Note that entry of either of the above commands automatically sets all three 4077 analog channels (Nos. 1, 2, and 3) to the same specified input range.

Under the "standard configuration," your 4077 is initially set for a nominal excitation level of 10 V-DC (i.e., ± 5 V-DC). You can select a level of 5 V-DC (i.e., ± 2.5 V-DC) by entering an **EXCITATION (EXC)** command of

EXC = 5 [CR]

To reset the 4077 to the 10-V level, command

EXC = 10 [CR]

Using low excitation helps reduce gage heating effects in *stress analysis* of materials with low thermal conductivity.

App. E "Computed" and "Simulated" Calibration

NOTE: When an optional **Model 10CJB-2 Bridge Completion Card** is used with the 4077, see Appendix F, below, for special calibration considerations.

1. "Computed" Calibration: MVV

This is generally a faster, more convenient, and inherently more accurate alternative to either "TWO-POINT (DEADWEIGHT)" or "SIMULATED (SHUNT)" CALIBRATION—though final accuracy of calibration will depend, of course, on the accuracy of the transducer manufacturer's specifications.

To calibrate the 4077's ANALOG INPUT CHANNEL (No.1),

a. Command

MVV 1 = i, u [CR]

For "i," enter the manufacturer-supplied *transducer sensitivity rating* in "mV/V, full scale." For "u," enter the transducer's *nominal full-scale rating* in whatever engineering units are desired. (**PLEASE NOTE:** In the answer returned in response to an **MVV x [CR]** interrogation, the displayed "i" and "u" values will have been automatically *rescaled* to reflect the current "mV/V range" setting (see Appendix D, above). Thus, for example, if the "3 mV/V" range is in effect and the command **MVV 1 = 2.500, 5000 [CR]** has been entered, an answer of **"3.000, 6000"** will be given to a subsequent query of **MVV 1 [CR]** (since 3.000/2.500 = 6000/ 5000)).

b. Then "zero" the channel by commanding

ZRO 1 = 0 [CR]

A channel calibrated by the **MVV** and **ZRO** commands will report measurement data to a precision matching that of the entered "u" value. If, for example, you're measuring "psi," and enter a "u" of "500," then all subsequent channel readings will be rounded to the nearest psi. If the entry is "500.0," then all readings will be rounded to the nearest *tenth* of a psi.

2. "Simulated (Shunt)" Calibration: SHP and SHN

This is an easier though generally less accurate technique than "TWO-POINT (DEADWEIGHT)" CALIBRATION. It is useful, however, when overall "deadweighting" is impossible or inconvenient, and is good for an accuracy of about 0.2% (depending, of course, on the accuracy of the specified EQUIVALENT INPUT, and on the resistor/bridge tolerance and temperature). The known calibration input is not produced by loading the transducer, as in the "deadweight" method, but by shunting a resistor of known magnitude across one arm of the strain-gage bridge, thereby "simulating" a particular up-scale value of mechanical input. This known EQUIVALENT INPUT then serves to determine the SCALING FACTOR for the channel.

The 4077 is equipped with a 100-kΩ, 0.1% *calibration resistor* which you may, if you wish, replace with a resistor of some other value (strain-gage transducer manufacturers often supply such resistors with their instruments, along with the exact values of EQUIVALENT INPUT thereby produced—contact the factory for installation instructions).

EQUIVALENT INPUT can be approximated from a knowledge of the *Shunt Calibration 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:

$$X = \frac{25000(mV/V)B}{KR} \%$$

a. Apply an *accurately known* value of input loading to the source transducer—a value (positive or negative) less than 50% of the nominal full-scale rating. If it is possible to remove all load from the transducer, thus establishing a true *zero input* for the 4077's Channel 1, you should do so.

b. Enter a command of

ZRO 1 = z [CR]

where "z" is the numerical value of the known input, with appropriate polarity (in the "zero input" case, z = 0). This command establishes the channel's ZERO OFFSET (i.e., the "b" term of its "y = mx + b" equation).

c. To switch in the shunt resistor for a *positive* up-scale reading, enter a **SHUNT CALIBRATE—POSITIVE (SHP)** command of

SHP = ON [CR]

To switch in the resistor for a *negative* reading, enter a **SHUNT CALIBRATE—NEGATIVE (SHN)** command of

SHN = ON [CR]

d. Now command

FRC 1 = X [CR]

where "X" is the known EQUIVALENT INPUT produced by the shunt, with appropriate polarity.

e. Before Channel 1 can resume normal measurement, its shunt-calibration switch must be opened. If it has been closed for a positive up-scale reading, command

SHP = OFF [CR]

—and if for a negative reading, command

SHN = OFF [CR]

---------- NOTE ----------

Like all 4000 Series instruments, the 4077 permits calibration of a relatively *nonlinear* input by setting up an internal LINEARIZATION TABLE of up to 15 "segments." The procedure is given in the optional *System Instruction Manual.*

Cabling & Calibration of a 4077 That Uses an Optional Model 10CJB-2 Bridge Completion Card

F

You may use the Model 10CJB-2 Bridge Completion Card to connect the 4077's input to its "real-world" gage configuration. The function of the 10CJB-2 is to "complete" the connected bridge—that is, to allow it to be "seen" by the 4077 as a full (4-arm) Wheatstone bridge. Note that you may provide your own bridge-completion circuitry (equivalent to the 10CJB-2), if desired, in which case you should contact the factory for instructions on connections.

1. 10CJB-2 Cabling

Remove the top plate of the Model 10CJB-2 box (4 screws in corners). Inside the box are two sets of labelled screw terminals: "A" and "B" (only *one* of the terminal sets will be used, since the 4077 is a single-input instrument). The terminals are labelled **–SIG, 1/2 BR, –EX, 120, 350, +SIG**, and **+EX**. As shown in the following figures, you will connect your gage wires directly to these terminals, and, if necessary, interconnect certain terminal pairs by means of jumper wires. Gage leads should enter the 10CJB-2 through the cutout on the right-hand side of the box.

NOTE: The user must furnish his own *pin-to-pin shielded cable* for connecting the 10CJB-2 box to the 4077's rear I/O CONNECTOR. Daytronic will supply terminal connectors for this cable.

Fig. 14(a) shows the connections you must make to a **2-wire 1/4-bridge gage configuration** (represented by the resistor "RG"). Here, you must install a jumper wire between the **–SIG** and **1/2 BR** terminals, and between the **+SIG** terminal and *either* the **120** terminal *or* the **350** terminal, depending on the nominal resistance of RG.

Fig. 14(b) shows connections to a **3-wire 1/4-bridge gage configuration** (again represented by "RG"). Here again, the **–SIG** and **1/2 BR** terminals are tied. The gage's third (self-compensating) lead is connected *either* to the **120** terminal *or* to the **350** terminal, depending on the nominal resistance of RG.

Fig. 14(c) shows connections to a **1/2-bridge gage configuration** (represented by the resistors "RG1" and "RG2"). Here again, the **–SIG** and **1/2 BR** terminals are tied.

Cabling & Calibration of a 4077 That Uses an Optional Model 10CJB-2 Bridge Completion Card

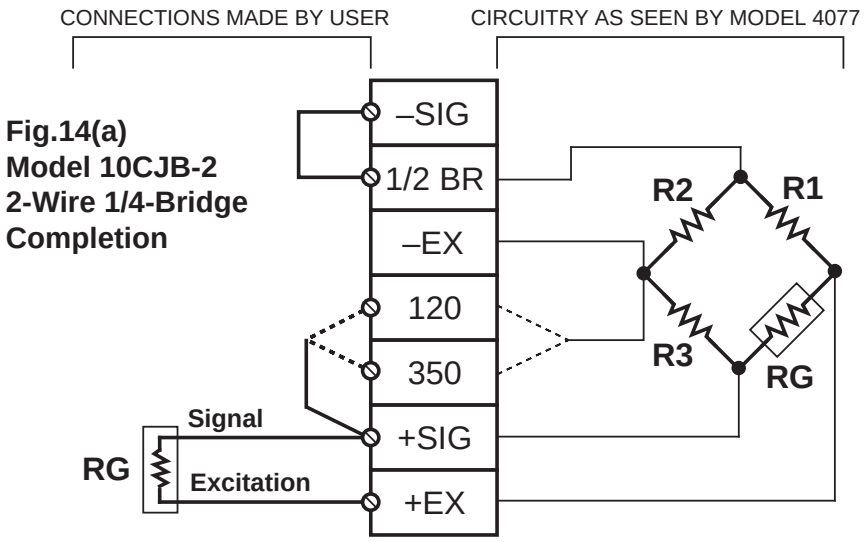


Fig.14(a)
Model 10CJB-2
2-Wire 1/4-Bridge
Completion

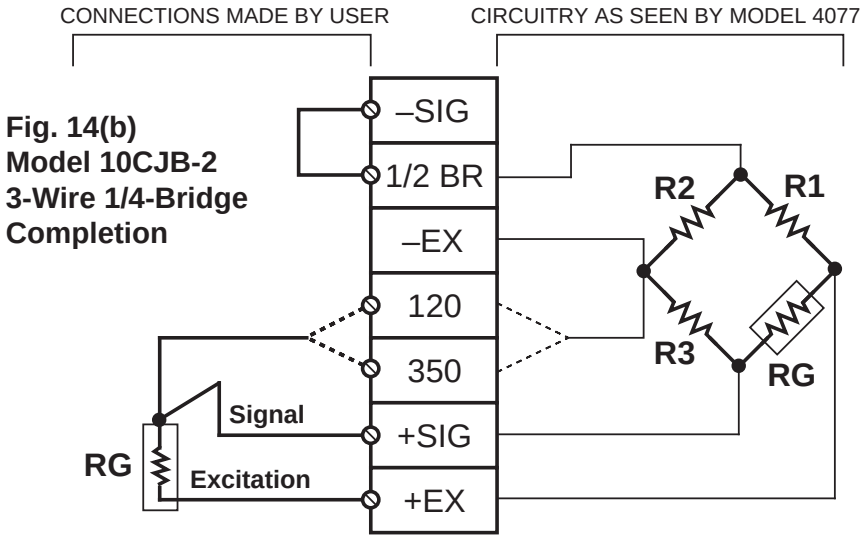


Fig. 14(b)
Model 10CJB-2
3-Wire 1/4-Bridge
Completion

Fig. 14(d) shows connections to a **full-bridge gage configuration** (represented by the resistors "RG1," "RG2," "RG3," and "RG4").

Fig. 14(c) Model 10CJB-2 1/2-Bridge Completion

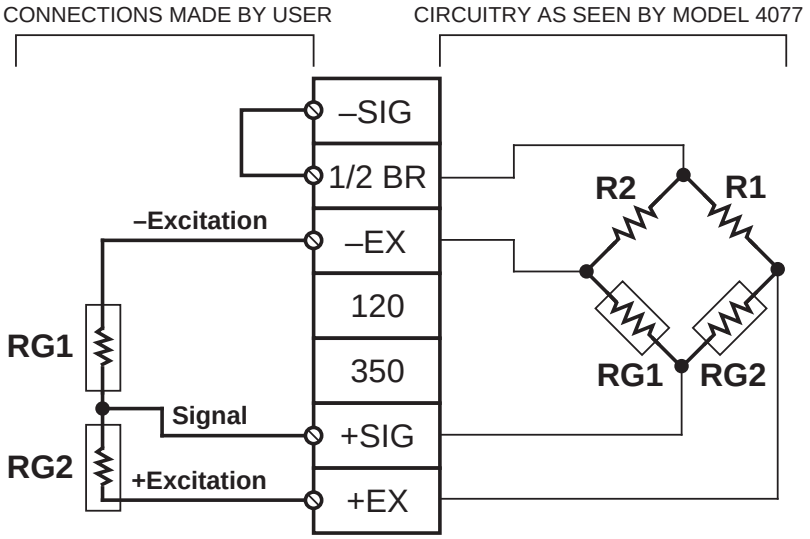
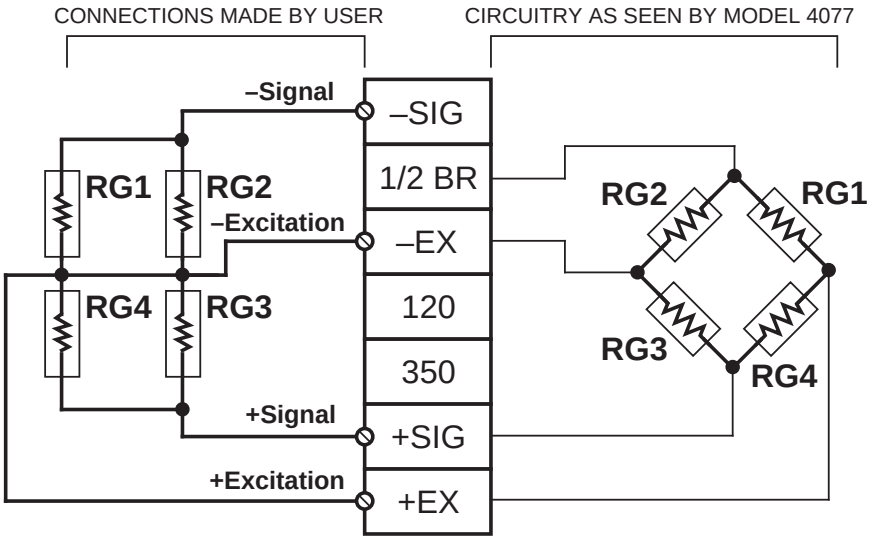


Fig. 14(d) Model 10CJB-2 Full-Bridge Completion



2. 10CJB-2 Calibration

When the 4077's Channel 1 receives its input from the 10CJB-2, it can be calibrated in any of the ways discussed in Section 2.e and Appendix E. NOTE, HOWEVER, THE FOLLOWING:

a. "Two-Point (Deadweight)" Calibration

Your first calibration point (**"F0"**) should be *zero*. Your second point, entered as **"F1,"** should be expressed in *microstrain (microinches/inch).*

b. "Computed" Calibration

To determine the appropriate "u" value to be entered in the

MVV 1 = i, u [CR]

command, you should use one of the following equations, depending on the value of "i" (the full-scale "mV/V" sensitivity) being entered:

If "i" = 1.5 (mV/V), "u" = 6000 / (N x G).
If "i" = 3.00 (mV/V), "u" = 12000 / (N x G).

Here, "N" is the *number of active strain-gage arms* in the gage configuration. Thus, for a "1/4-bridge" configuration, N = 1; for a "1/2-bridge" configuration, N = 2; and for a "full-bridge" configuration, N = 4. "G" is the *gage factor* of the gage(s), and is normally provided by the gage manufacturer.

c. "Simulated (Shunt)" Calibration

Your EQUIVALENT INPUT value, which is entered via the **FORCE (FRC)** command (following zeroing of the channel and switching in of the shunt resistor via **SHP** or **SHN**), should be expressed in *microstrain (microinches/inch).*

d. Coarse Zero Offset

In the event that, during "TWO-POINT" or SHUNT CALIBRATION of the 10CJB-2 channel, you are unable to set the desired span via the **"F1"** entry or the **FORCE (FRC)** command, you can apply an *approximate positive or negative zero offset*, as follows:

1. Remove the top plate of the Model 10CJB-2 and locate the three programming jumper pads corresponding to the 10CJB-2 channel you have connected to the 4077 ("A" or "B"). The pads are near the left edge of the 10CJB-2 circuit board.

2. Place a solder drop between the center pad and either the "+" or "–" pad, depending on the desired offset polarity.

3. Re-enter your **"F0"** and **"F1"** values (or **ZRO** and **FRC** commands)—**"F1"** or **FRC** being entered with or without calibration "shunt."

---------- NOTE ----------

The analog peak-capture operations discussed in this section should not be confused with the digital peak-capture made possible by the "MAX" and "MIN" forms of the CALCULATE (CLC) command. The CLC procedure is described in the optional 4000 Series *System Instruction Manual.*

1. Setup of Peak-Capture Channels: EMM and BEE

In addition to Channel 1's "live" data reading of the analog input signal, two special "CONDITIONED SIGNALS" are provided by the 4077 for **real-time capture of input "± PEAK" values.** Unless otherwise specified, these signals are initially dedicated to Channels 2 and 3.

Channel 2 is the "+PEAK" channel. It detects and stores in analog (capacitor) memory the *most positive* value experienced by the analog input since it was last reset by an appropriate "+PEAK TRACK" command. Similarly, Channel No. 3 (the "–PEAK" channel) detects and stores the *most negative* value experienced since the last "–PEAK TRACK" command. Each peak value will remain in memory—though subject to analog decay*—until reapplication of the respective "TRACK" command, or until occurrence of a subsequent more positive or more negative signal excursion (thus permitting the capture of successively higher maxima or successively lower minima).

The 4077's peak-capture channels must be calibrated before they may be used. You may do so by applying to these channels the *same calibration method that has been used to calibrate the 4077's ANALOG INPUT CHANNEL (No. 1).* See Section 2.e and Appendix E.

* The 4077's capacitor memory is volatile, and entails inevitable decay of "captured" signal values. The actual decay rate (less than 1 mV/sec) is small enough, however, to allow essentially perfect capture of signal peaks using the "MAX" or "MIN" form of the **CALCULATE (CLC)** command, as explained in Section G.5, below.

You may wish to use the "range" form of the commands involved, in order to apply these commands to all three channels simultaneously :

MVV 1 TO 3 = . . . [CR]
ZRO 1 TO 3 = . . . [CR]
FRC 1 TO 3 = . . . [CR]
SHP 1 TO 3 = . . . [CR]
SHN 1 TO 3 = . . . [CR]

Before entering any of these calibration commands, however, MAKE SURE THAT CHANNEL NOS. 2 AND 3 ARE NOT IN "PEAK HOLD" MODE—THAT IS, MAKE SURE THAT THE FOLLOWING COMMANDS ARE IN EFFECT:

PKP = TRK [CR]
PKN = TRK [CR]

Another way to achieve the same effect is simply to load Channels 2 and 3 with the "m" and "b" values presently in effect for the previously calibrated Channel 1, as follows:

a. After calibrating Channel 1, ask for its existing calibration constants "m" and "b," via the "READ" forms of the **SCALING FACTOR (EMM)** and **ZERO OFFSET (BEE)** commands:
EMM 1 [CR] and **BEE 1 [CR]**

b. Now use the "WRITE" forms of the **EMM** and **BEE** commands to enter the same "m" and "b" values for the 4077's peak-capture channels:
EMM 2 TO 3 = m [CR]
BEE 2 TO 3 = b [CR]

2. "+PEAK" Capture: PKP

You can control the operation of your 4077's "+PEAK" channel in one of two ways: 1) through the **PEAK POSITIVE (PKP)** command, entered via keyboard or RS-232-C INTERFACE PORT; or 2) through a **LOGIC COMMAND INPUT** from some external logic source, received at the 4077's rear "+PK IN" terminal (*connection* of this logic input is discussed in Section G.4, below).

Thus, the "+PEAK" channel (No. 2) can be made to "track" the ANALOG INPUT CHANNEL (No. 1)—that is, to report a data value continuously equal to that of Channel 1—either by commanding

PKP = TRK [CR]

or by applying a *Logic 1* level to the "+PK IN" input, WHILE THE ABOVE **PKP** COMMAND IS IN EFFECT (see Fig. 19, below, for logic connections).

To place Channel 2 in "+PEAK HOLD" mode—i.e., to cause it to continuously represent the *most positive* value experienced by the Channel 1 since "+PEAK HOLD" mode was begun—you can either command

PKP = HLD [CR]

or apply a *Logic 0* level to the "+PK IN" input WHILE THE **PKP = TRK [CR]** COMMAND IS IN EFFECT (again, see Fig. 19 for logic connections).

NOTE THAT THE **PEAK POSITIVE (PKP)** AND **PEAK NEGATIVE (PKN)** COMMANDS WILL ALWAYS OVERRIDE THE CORRESPONDING LOGIC COMMAND INPUTS ("+PK IN" AND "–PK IN"). THE "+PEAK" LOGIC INPUT WILL BE EFFECTIVE ONLY WHEN THE

PKP = TRK [CR]

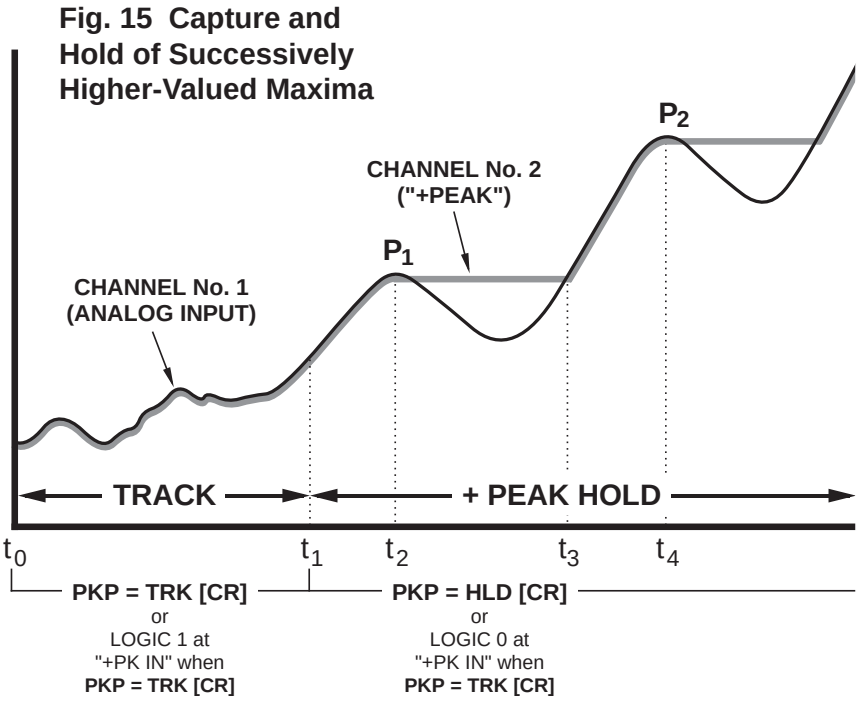
COMMAND IS IN EFFECT; THE "–PEAK" LOGIC INPUT WILL BE EFFECTIVE ONLY WHEN THE

PKN = TRK [CR]

COMMAND IS IN EFFECT.

TO ARRANGE FOR THE *AUTOMATIC EXECUTION* OF A GIVEN **PKP** OR **PKN** COMMAND UPON DETECTION OF A LIMIT VIOLATION OR OTHER PRESPECIFIED INTERNAL LOGIC CONDITION—OR UPON THE PRESSING OF A SELECTED 4077 FRONT-PANEL BUTTON—SEE THE *SYSTEM INSTRUCTION MANUAL.*

Fig. 15 shows the capture and hold of successively higher-valued signal maxima by the "+PEAK" channel (No. 2), after entering the "+PEAK HOLD" mode at time t_1. Until time t_1, this channel had been continuously "tracking" the analog input (Channel 1). After time t_1, it continuously reports the highest input-signal value perceived since "+PEAK HOLD" last began. From time t_1 to time t_2, the input is continuously rising, and so the "+PEAK" channel appears to be continuing to track it. At time t_2, however, the input signal reaches its first true maximum since time t_1. Channel 2 "captures" this "positive" peak (P_1), holding it as a constant until



time t_3, when a yet higher input value is detected, and the channel begins once more to track the input upwards to a yet higher peak (P_2).

Fig. 16 shows the capture of successively lower-valued signal maxima. Here, it is necessary to *reset* the "+PEAK" channel—to get it "back on track," so to speak—somewhere along the rise of the input toward the second, lower-valued peak (P_2). This is done by returning the "+PEAK" channel *momentarily* to "TRACK" mode at time t_2.

3. "–PEAK" Capture: PKN

Control of your 4077's "–PEAK" channel (No. 3) is strictly analogous to that of the "+PEAK" channel, explained above. Thus, Channel 3 can be made to "track" the ANALOG INPUT CHANNEL 1 either by entering a **PEAK NEGATIVE (PKN)** command of

PKN = TRK [CR]

or by applying a *Logic 1* level to the "–PK IN" input, WHILE THE ABOVE **PKN** COMMAND IS IN EFFECT.

To place Channel 3 in "–PEAK HOLD" mode—i.e., to cause it to continuously represent the *least positive* value experienced by the Channel 1 since "–PEAK HOLD" mode was begun—you can either command

PKN = HLD [CR]

or apply a *Logic 0* level to the "–PK IN" input WHILE THE **PKN = TRK [CR]** COMMAND IS IN EFFECT.

Fig. 17 shows the capture and hold of successively lower-valued signal minima by the "–PEAK" channel (No. 3), after entering the "–PEAK HOLD" mode at or prior to time t_0. The *initial* signal minimum (time t_0) is held only until the input reaches a yet lower value at time t_1, at which time Channel 3 appears to begin to "track" the input down to the first true negative peak (P_1). This peak value will be "captured" at time t_2 and held until a still lower input value is

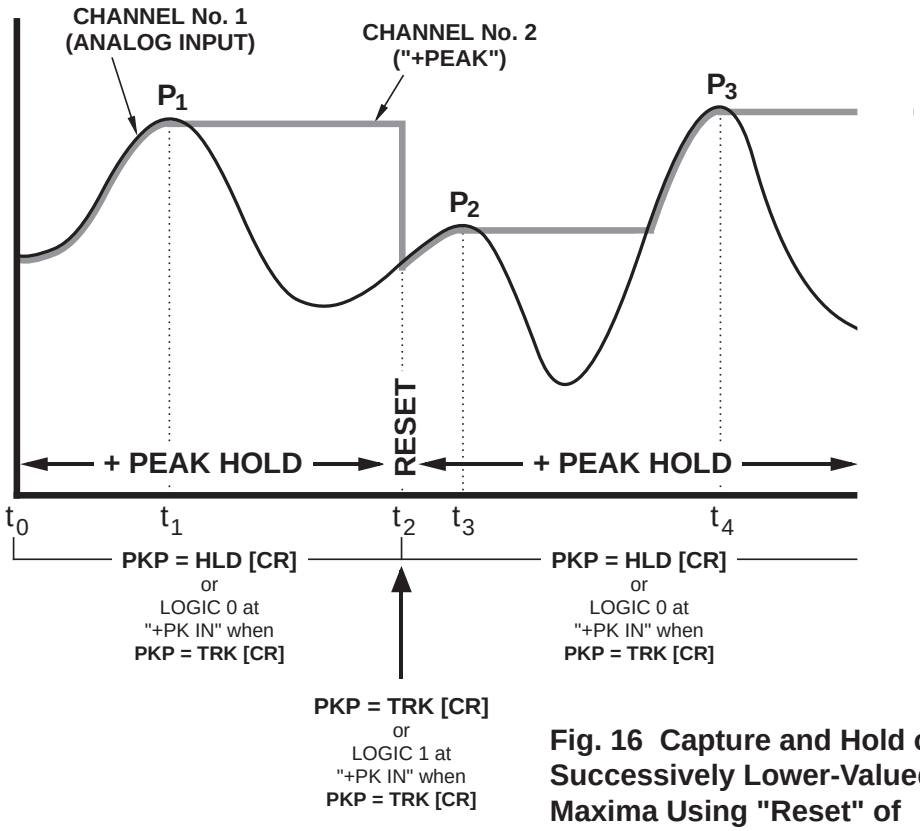


Fig. 16 Capture and Hold of Successively Lower-Valued Maxima Using "Reset" of "+PEAK" Channel

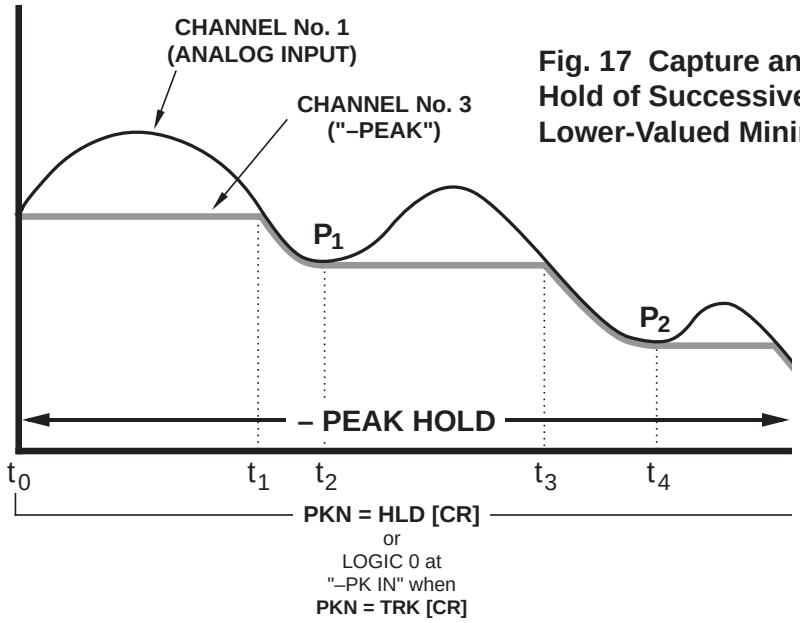


Fig. 17 Capture and Hold of Successively Lower-Valued Minima

detected at time t_3, whereupon the "–PEAK" channel will track down to the second, lower peak (P_2), etc.

Fig. 18 shows how to *reset* the "–PEAK" channel to capture successively higher-valued signal minima. Until time t_1 (when the "–PEAK HOLD" mode begins), Channel 3 has been continuously "tracking" the analog input, as shown. From time t_1 to time t_2, the input is continuously falling, and so Channel 3 appears to be continuing to track it. At time t_2, however, the input signal reaches its first true minimum since time t_1. This "negative" peak (P_1) is "captured" and held until Channel 3 is *momentarily* returned to "TRACK" mode at time t_2. The second, higher-valued minimum (P_2) can now be captured at time t_4, etc.

4. Connection of Logic Inputs

A logic input to the 4077's rear-panel "+PK IN" or "–PK IN" terminal may be applied by means of an external switch or an active TTL source, using the connections shown in Fig. 19. The switch-closure method does not require an external logic reference supply.

When the switch in Fig. 19(a) is in "open" position, the "+PK IN" and "–PK IN" terminals will both be at a *Logic 1* level, and the corresponding peak-capture channels will be in the "TRACK" mode, provided that the **PKP = TRK [CR]** and **PKN = TRK [CR]** commands are in effect (see above). Closing Switch "A" will produce a Logic 0 level at "+PK IN," thus activating the "+PEAK HOLD" mode when the **PKP = TRK [CR]** command is in effect; closing Switch "B" will activate the "–PEAK HOLD" mode when the **PKN = TRK [CR]** command is in effect.

5. Holding Analog Peaks without Decay: CLC

As mentioned above, the 4077's capacitor memory is volatile, and entails inevitable decay of "captured" analog signal values. If you need to display a "+PEAK" or "–PEAK" value for any length of time, you may wish to apply to the peak-capture channel in question a

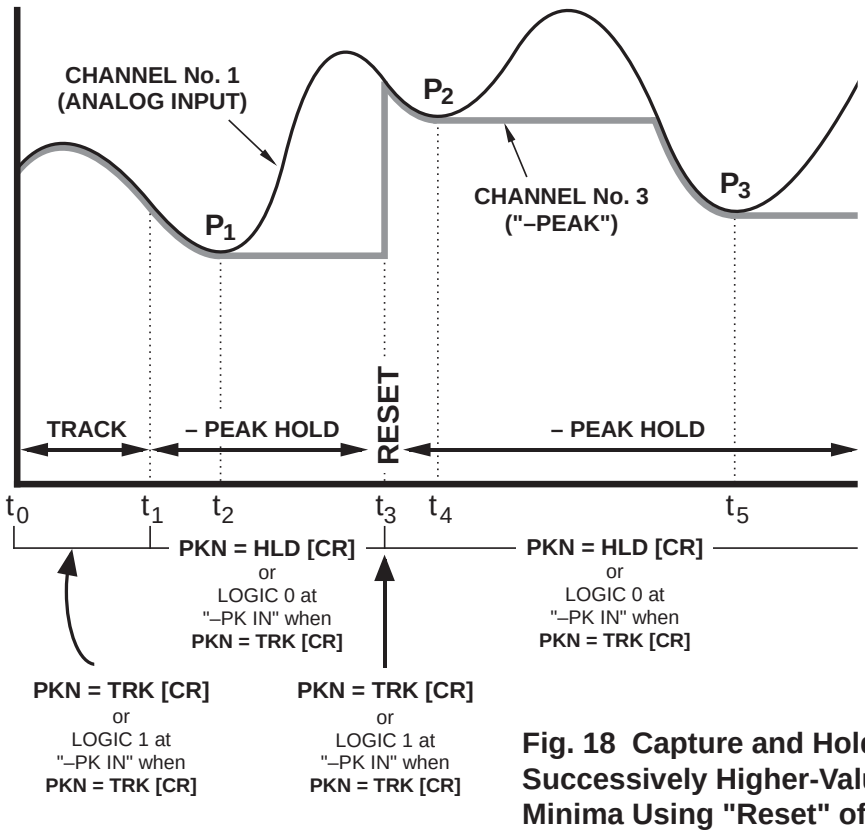


Fig. 18 Capture and Hold of Successively Higher-Valued Minima Using "Reset" of "–PEAK" Channel

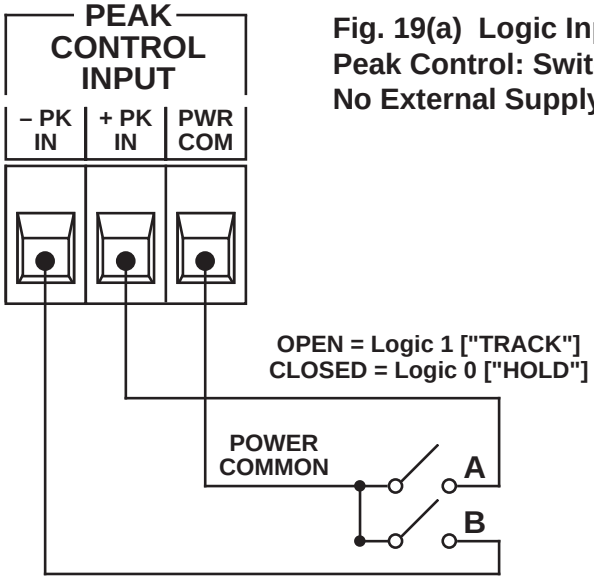


Fig. 19(a) Logic Inputs for Peak Control: Switch Closure, No External Supply

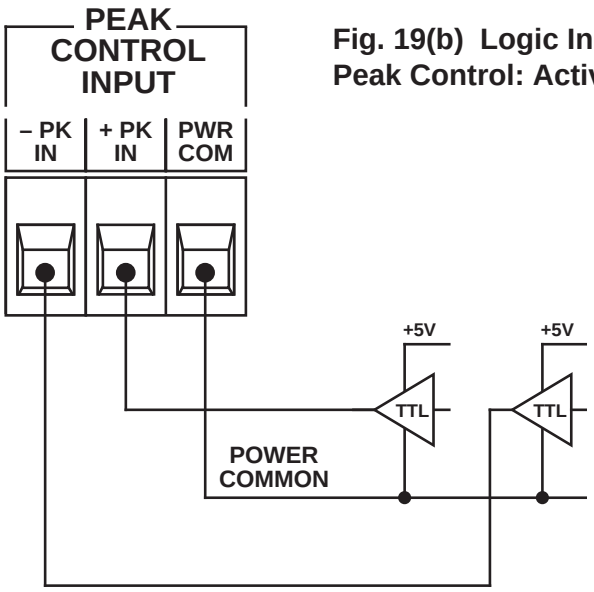


Fig. 19(b) Logic Inputs for Peak Control: Active TTL Logic

special **CALCULATE (CLC)** command that allows the captured peak to be indefinitely (digitally) held.

If, for example, you need to observe for a relatively long time the latest "+PEAK" reported by Channel 2, you may set up a "CALCULATE" PSEUDOCHANNEL No. x to report this maximum *without decay* by entering a command of

CLC x = (MAX CHN 2) [CR]

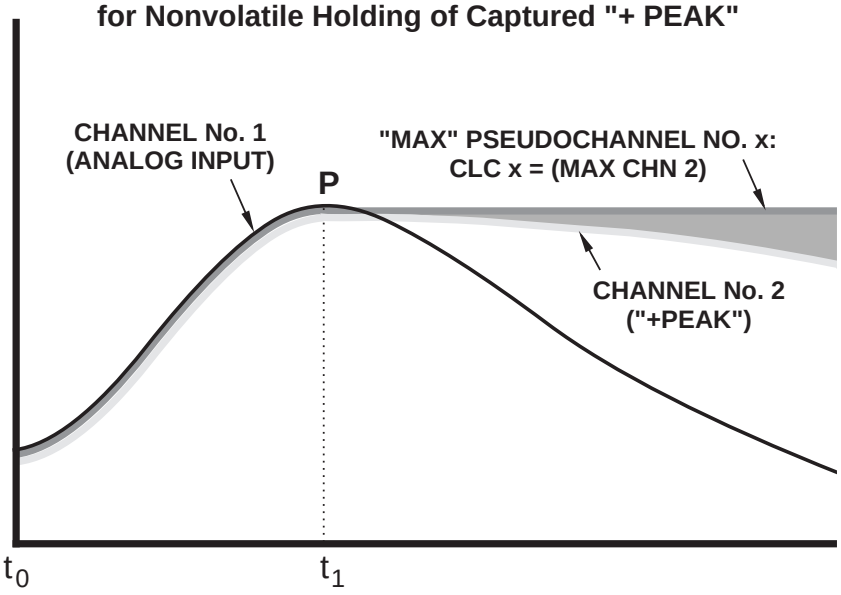
Referring to Fig. 20, below, this command may be applied at any time between t_0 and t_1. The reading of "MAX" PSEUDOCHANNEL No. x will at first equal that of the "+PEAK" channel (No. 2), but only until the analog peak value held by Channel 2 begins to decay. Of course, if an input value *higher* than that of the captured peak "P" subsequently occurs, PSEUDOCHANNEL x will, like Channel 2, reflect this input behavior.

Similarly, to set up a CALCULATE PSEUDOCHANNEL No. y to report without decay a minimum reported by the 4077's "–PEAK" channel (No. 3), command

CLC y = (MIN CHN 3) [CR]

For general setup and use of CALCULATE PSEUDOCHANNELS, including the *resetting* of "MAX" and "MIN" channels, see the *System Instruction Manual.*

Fig. 20 Use of "MAX" CALCULATE PSEUDOCHANNEL for Nonvolatile Holding of Captured "+ PEAK"



Changing the Battery

If, on powerup, your 4077 displays the "**LO bat**" warning, you should take the following steps to replace the battery (**READ ALL OF THESE DIRECTIONS COMPLETELY BEFORE YOU BEGIN**):

1. If possible, offload your 4077's present configuration data to disk by means of the **Upload Node Configuration** routine in the **StartPAC 100 Software** (you can use **Download Node Configuration** to reload the configuration at a later time, if necessary).

2. Turn off the 4077 and **disconnect the power cord** and any other cables attached to the rear panel.

IMPORTANT: YOU SHOULD TAKE PRECAUTIONS TO AVOID ELECTROSTATIC DISCHARGE THAT MIGHT HARM THE 4077'S MICROPROCESSOR. IF POSSIBLE, WORK ON AN ANTI-STATIC SURFACE AND WEAR A GROUNDING STRAP AROUND YOUR WRIST. THE STRAP SHOULD BE CONNECTED TO EARTH GROUND.

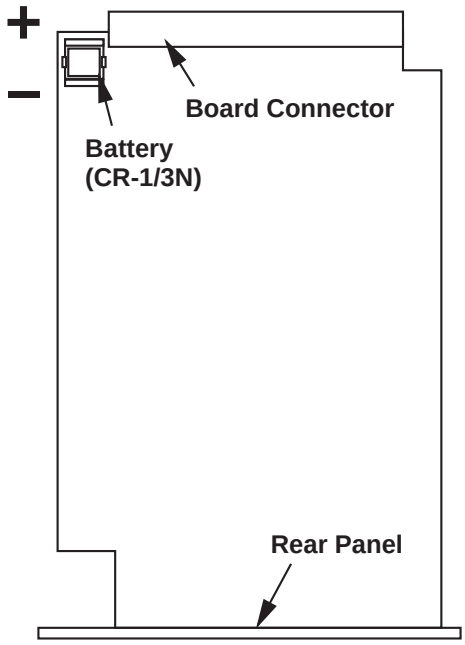


Fig. 21 Location of Battery

3. Unscrew the two rear-panel CLAMP SCREWS and slide the CLAMP SLIDES rearwards out of their grooves (see Fig. 3, Section 1.c).

4. Now remove the four screws in the corners of the rear panel (see Fig. 2).

5. Holding the 4077 with the rear panel upward, use a flat-tipped screwdriver to gently pry up the rear panel from the instrument case until you feel it loosen. The internal board connectors are now disengaged from the front display assembly, and you can easily pull the entire dual-board assembly out of the case.

6. Locate the battery in the corner of the top board (see Fig. 21). It is held in by two plastic clips. NOTE THE POLARITY OF THE BATTERY TERMINALS, AS SHOWN IN THE FIGURE.

VERY IMPORTANT: YOU MUST USE A **CR-1/3N 3-V LITHIUM BATTERY** IN THE 4077. YOU SHOULD HAVE THE REPLACEMENT BATTERY READY TO INSTALL AS SOON AS YOU REMOVE THE EXISTING (LOW) BATTERY. ONCE THE EXISTING BATTERY HAS BEEN REMOVED FROM THE 4077, YOU WILL HAVE ONLY *ONE MINUTE* TO REPLACE IT BEFORE CALIBRATION AND RUN-TIME DATA ARE IRRETRIEVABLY LOST.

IF THIS DATA SHOULD BE LOST, YOU WILL NOT BE ABLE TO RECALIBRATE THE 4077 IN THE FIELD, BUT MUST SEND IT BACK TO THE FACTORY FOR RELOADING OF THE APPROPRIATE ANALOG ALIGNMENT VALUES.

7. Using a small flat-tipped screwdriver, pry the existing battery out of its clip socket. IMMEDIATELY INSERT THE NEW BATTERY INTO THE SOCKET, BEING CAREFUL TO OBSERVE THE CORRECT POLARITY OF THE TERMINALS. A backwards battery won't damage the 4077, but it won't work either. Remember: you have *one minute* to replace the battery before calibration and run-time data are lost.

8. Align the dual-board assembly with the guide slots on the inside of the 4077 case and reinsert the assembly all the way (if it is wrong-side-up, you won't be able to insert it).

9. Replace the four rear-panel corner screws. As you screw down the rear panel, the internal board connectors will automatically engage with the front display assembly.

10. Reinstall the CLAMP SLIDES.

11. Reattach the rear-panel cables and power connector. Then reactivate the 4077. YOU WILL HAVE TO CYCLE POWER TWICE. The first time you turn on the 4077, the "**LO bat**" warning will reappear. Simply turn the unit off and on once again.

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