



MODEL

4032

**TWO-CHANNEL
AC LVDT INSTRUMENT**

INSTRUCTION MANUAL



4000
Instrument Series

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Model 4032 Instruction Manual, v. SB.3

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AC LVDT INSTRUMENT

INSTRUCTION MANUAL

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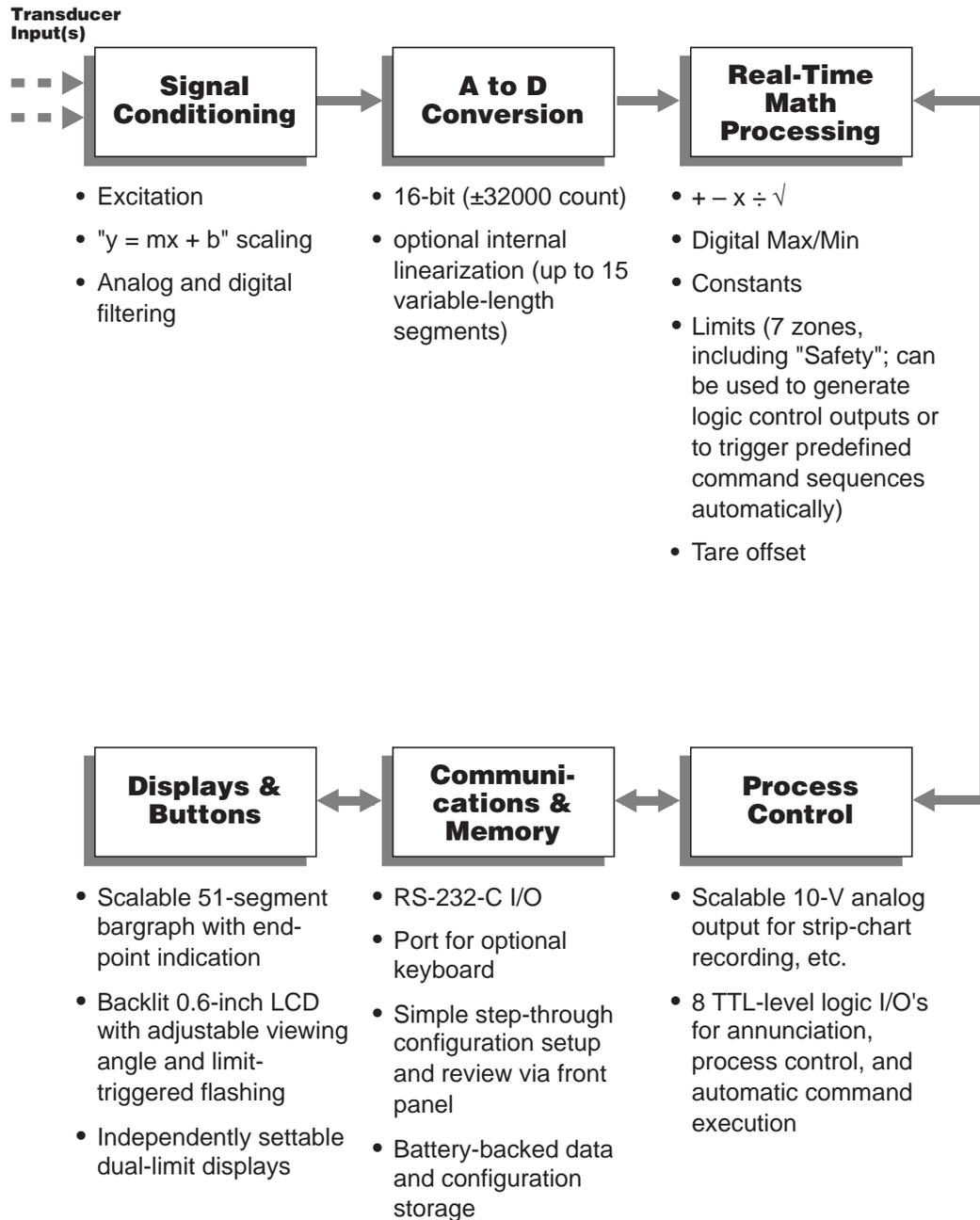
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1.a

Model 4032 Description and Specifications

General 4032 Features



The Model 4032 is a two-channel instrument for measurement of displacement, force, pressure, and other parameters obtained with **variable reluctance transducers** or **linear variable differential transformers (LVDT's)**—see "Transducer Types," below. A "tare" function is preprogrammed for each 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 4032 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 AND THE EIGHT REAR-PANEL LOGIC I/O. A full listing of your 4032's standard configuration is given in Appendix A.

Like all 4000 Series instruments, however, the 4032 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 4032 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 reprogram the 4032. These commands may also be issued directly to the 4032 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*

^{*} Alternatively, you can use any of a number of commercially available *terminal emulation programs* to issue commands directly to the 4032.

1.a

Model 4032 Description and Specifications

MANUAL BEFORE YOU ATTEMPT ANY RECONFIGURATION OF YOUR MODEL 4032 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 4032 and a computer or printer.

Each of the 4032's "live" inputs is initially configured for a full-scale transducer range of 120 mV/V . If you require a range setting of either 240 mV/V or 480 mV/V , see Appendix E. INPUT RANGES SHOULD BE SET *BEFORE TRANSDUCERS ARE CONNECTED*.

NOTE THAT EITHER OR BOTH INPUTS MAY BE RECONFIGURED FOR "LONG-STROKE" LVDTS (FULL-SCALE RANGE OF ± 1 INCH OR GREATER). CONTACT THE FACTORY FOR DETAILS.

NOTE TOO THAT UNDER THE "STANDARD CONFIGURATION," THE 4032'S SINGLE ANALOG OUTPUT IS NOT ASSIGNED TO ANY PARTICULAR CHANNEL. If you want to program your 4032 to generate an analog output corresponding to one of the two inputs—or to any other channel—see Appendix F for instructions.

Unless otherwise specified, every 4032 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 4032 to light any one or a combination of given legends and indicators. See Appendix C for "Legend and Indicator Annunciation."

Appendix D describes a special calibration procedure that may be applied to a *nonlinear* sensor input, instead of the normal "TWO-POINT (DEADWEIGHT)" technique (Section 2.e).

NOTE: WITH THE EXCEPTION OF APPENDICES C, E, AND F, THE PRESENT MANUAL WILL ONLY TREAT PROCEDURES AND CONSIDERATIONS WHICH ARE RELEVANT TO THE 4032 "STANDARD CONFIGURATION" AND WHICH DO **NOT** REQUIRE A CONNECTED COMPUTER OR KEYBOARD. FOR INFORMATION ON THE FULL FUNCTIONALITY OF YOUR MODEL 4032, SEE THE OPTIONAL *SYSTEM INSTRUCTION MANUAL*.

MODEL 4032 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 Types: 5- or 7-wire LVDT's capable of 4000-Hz operation and having primary impedance of 80 ohms or greater (all Daytronic LVDT transducers are suitable); 3- or 5-wire variable reluctance transducers.

Sensitivity Ranges (Full-Scale): 0-120 mV/V, 0-240 mV/V, and 0-480 mV/V—selectable via **RNG** command (see Appendix E).

Excitation: Nominal 3.0 V-AC (rms) at 4000 Hz; 40 mA (rms), maximum.

Amplifier (per channel):

Common-Mode Range:

±5 V operating; ±12 V without instrument damage.

Common-Mode Rejection Ratio: infinite at DC and 60 Hz; -60 dB at 3 kHz.

Input Impedance: Differential: 400 kilohms; Common-Mode: 100 kilohms.

Offset: Initial: ±3% of full scale; vs. temperature: ±20 ppm/°C; vs. time: ±0.01% of full scale / month.

Gain Accuracy:

±0.02% of full scale, *typical*, following calibration.*

Gain Stability:

vs. temperature: ±50 ppm/°C; vs. time: ±20 ppm/month.

Filter (per channel): 2-pole modified Butterworth; 3 dB down at 7.5 Hz; 60 dB down at 110 Hz.

Step Response Settling Time (Full-Scale Output):

To 1% of final value: 250 milliseconds.

To 0.1% of final value: 300 milliseconds.

To 0.02% of final value: 400 milliseconds.

Analog Output: ±10 V, microprocessor driven and scaled, ±1 mV

* Initial (uncalibrated) inaccuracy may be as great as ±3% of full scale. Maximum error that could occur upon replacement of a Model 4032 *not followed by calibration* is ±6% of full scale.

Maximum allowable count tolerance is 0 ± 601 (for ZERO) and 20000 ± 601 (for SPAN, where "m" = 20000).

1.a Model 4032 Description and Specifications

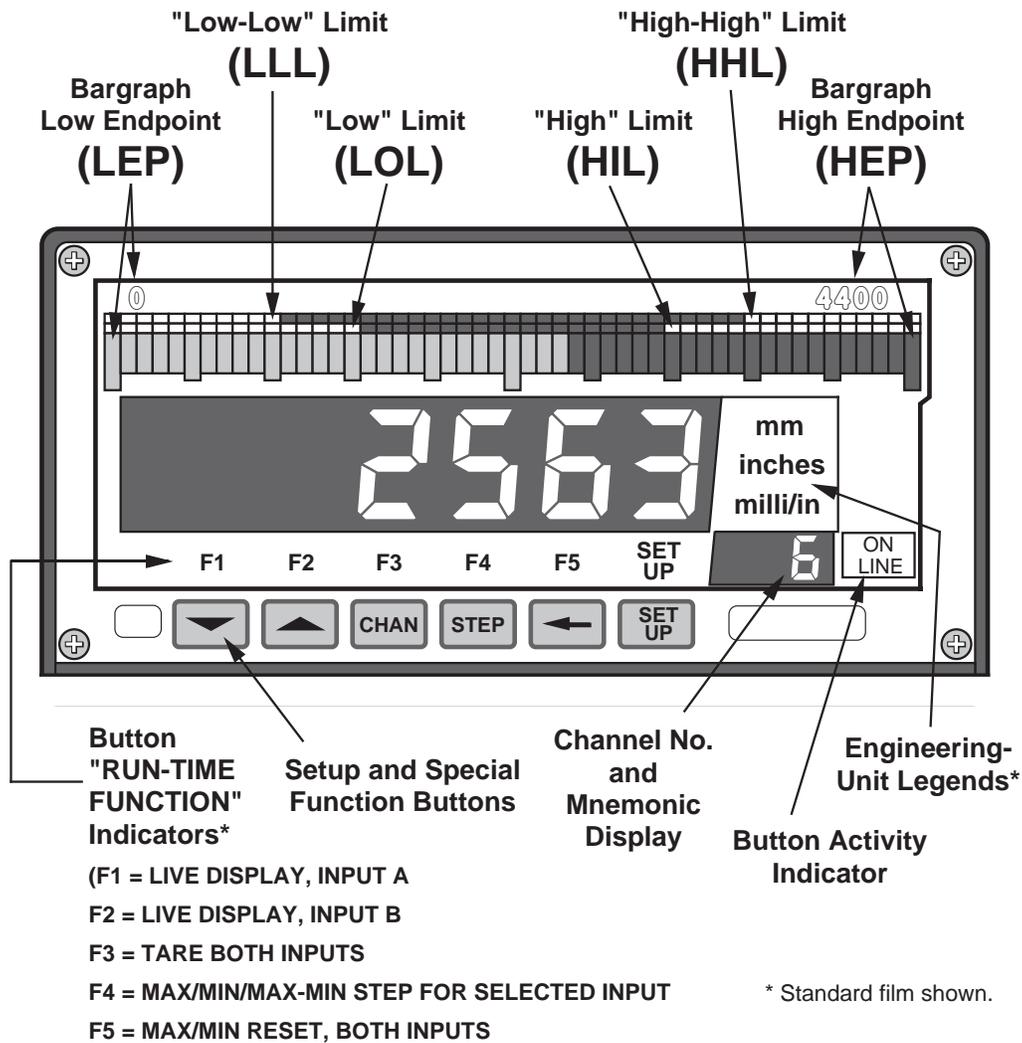
resolution (not assigned to any channel under the 4032 "Standard Configuration"—see Appendix F).

Accuracy: 0.05% of current voltage reading ± 2 mV.

Output Bandwidth: 40 Hz maximum.

1.b Physical Layout

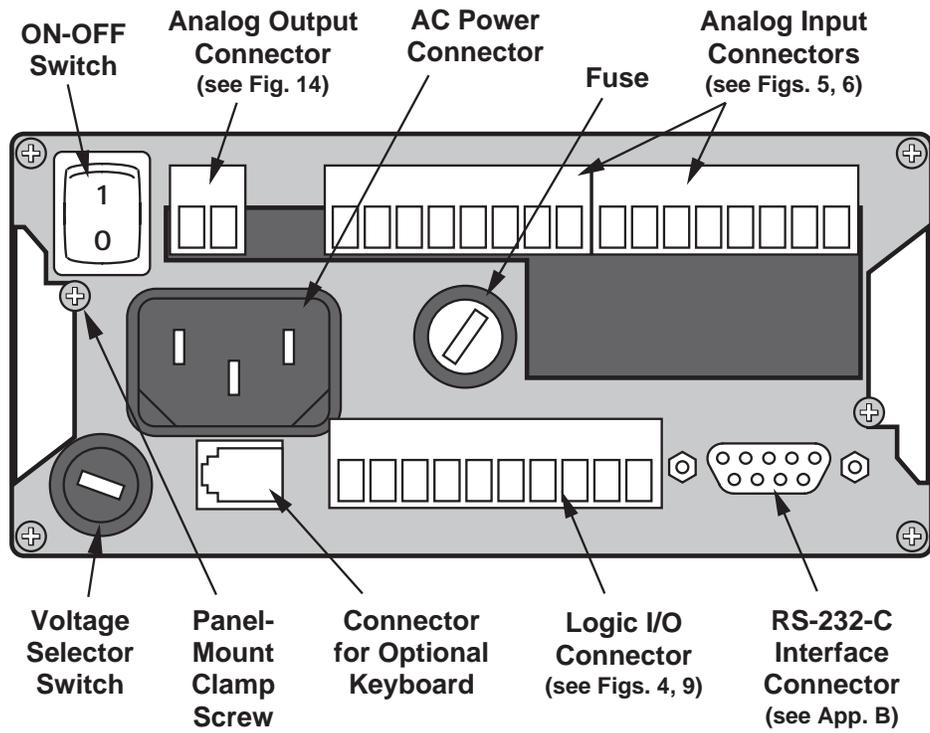
Study the following diagrams to acquaint yourself with your 4032's most important front and rear elements.



1.5 —see Section 3)

Fig. 1 4032 Front Panel

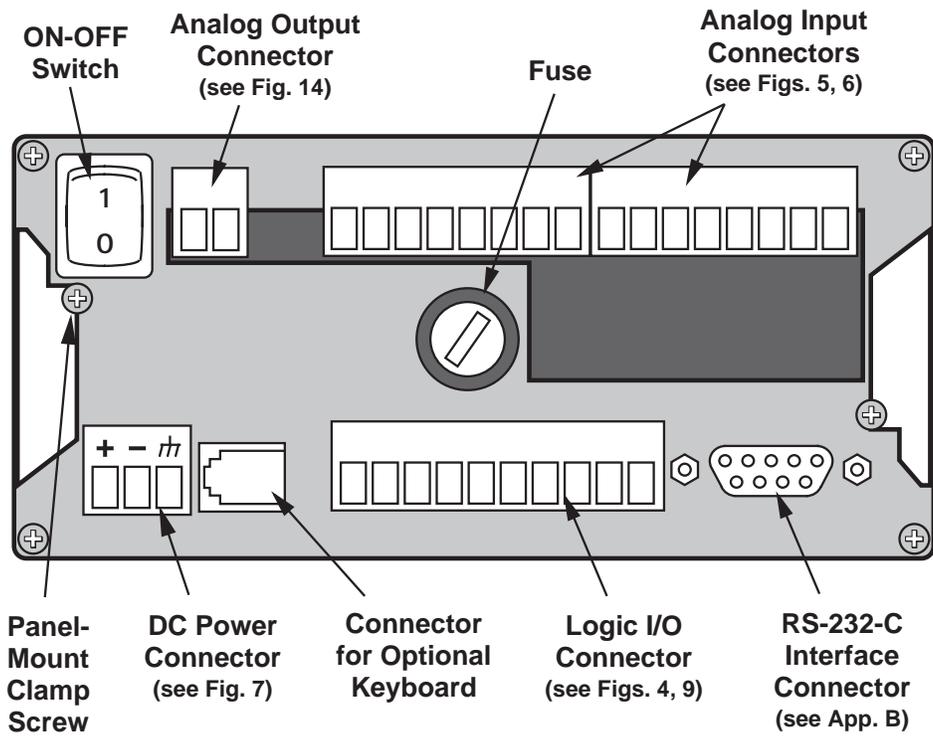
Fig. 2(a) 4032 Rear Panel (AC Power)



1.b

Physical Layout

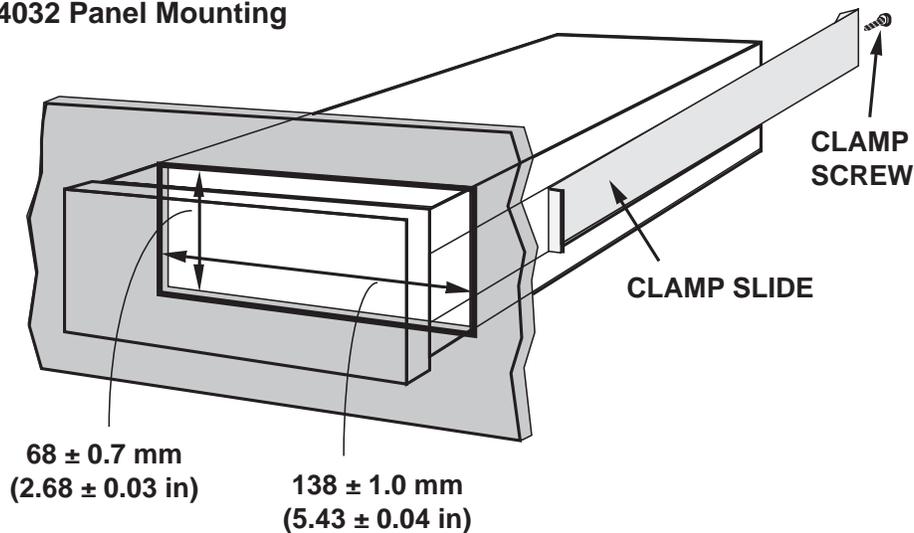
Fig. 2(b) 4032 Rear Panel (DC Power)



You can easily mount a Model 4032 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 4032, **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 4032 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
4032 Panel Mounting



Channel No.	Channel Function
1	"LIVE" INPUT CHANNEL "A" This channel represents the first of the 4032's two <i>conditioned analog inputs</i> (i.e., Input "A"). Sensor calibration is performed on this channel, as explained in Section 2.e.
2	"LIVE" INPUT CHANNEL "B" This channel represents the second of the 4032's two <i>conditioned analog inputs</i> (i.e., Input "B"). Sensor calibration is performed on this channel, as explained in Section 2.e.
5	"LIVE" INPUT "A" WITH TARE This channel represents the value of Channel 1 <i>minus the current "tare" offset for Input "A"</i> (that is, the value of Channel 1 that existed when the front-panel "TARE" button was last pressed). 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 <i>most positive</i> 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 <i>least positive</i> 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 <i>net difference</i> between Channel 6 and Channel 7.
10	"LIVE" INPUT "B" WITH TARE This channel represents the value of Channel 2 <i>minus the current "tare" offset for Input "B"</i> (that is, the value of Channel 2 that existed when the front-panel "TARE" button was last pressed). Active control limits will normally operate on the basis of this channel—see Section 1.e.

- 11 "MAXIMUM" VALUE OF CHN. 10**
This channel represents the *most positive* value of Channel 10 since "MAX" measurement was last reset via the front-panel "MAX/MIN RESET" button.
- 12 "MINIMUM" VALUE OF CHN. 10**
This channel represents the *least positive* value of Channel 10 since "MIN" measurement was last reset via the front-panel "MAX/MIN RESET" button.
- 13 "MAX minus "MIN" VALUE OF CHN. 10**
This channel represents the existing *net difference* between Channel 11 and Channel 12.

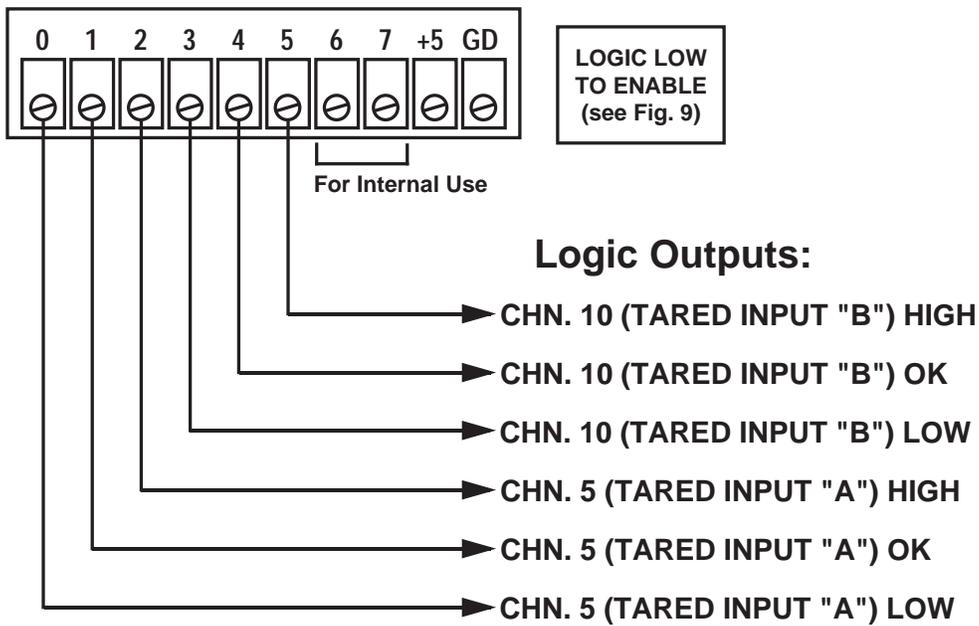
The 4032's Channel Nos. 4, 9, and 14-16 are used as intermediate result registers or reference channels, and will not normally be displayed. The remaining scanned channels (Nos. 3, 17-19) are not used in the standard 4032 configuration. Any otherwise unused channel can be assigned to the 4032's ANALOG OUTPUT, as explained in Appendix F.

1.e

Standard Logic Configuration

Your 4032 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 4032. For recommended logic interconnections, see Section 2.i.

Fig. 4 4032 Standard Logic Inputs and Outputs



You can use the six 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, 3	"LOW" VIOLATION OUTPUTS Terminal 0 or 3 will be at a <i>Logic 1</i> (0 V-DC) level whenever the reading of Channel 5 or 10, respectively, is less than the current "LOL" limit value for that channel.
1, 4	"OK" (NO VIOLATION) OUTPUTS Terminal 1 or 4 will be at a <i>Logic 1</i> (0 V-DC) level whenever the reading of Channel 5 or 10, respectively, 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.
2, 5	"HIGH" VIOLATION OUTPUTS Terminal 2 or 5 will be at a <i>Logic 1</i> (0 V-DC) level whenever the reading of Channel 5 or 10, respectively, is greater than the current "HIL" limit value for that channel.

Bits 6 and 7 are for internal use only.

1.f

Using the Front-Panel Setup Buttons

Study this manual section carefully to familiarize yourself with the general operation of your 4032'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 4032 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 4032 front panel (see Fig. 1). It will remain lit as long as the button is pressed.

The 4032'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  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 4032'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. 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

1.f

Using the Front-Panel Setup Buttons

—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)	(Appendix D)
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 4032 Channels 1 and 2. When **LNS** > 1, a series of calibration values will be displayed, from "**F1**" through "**Fn**," where "n" is the current **LNS** number (see Appendix D).

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

1.f

Using the Front-Panel Setup Buttons

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.

1.f

Using the Front-Panel Setup Buttons

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.

The 4032 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.

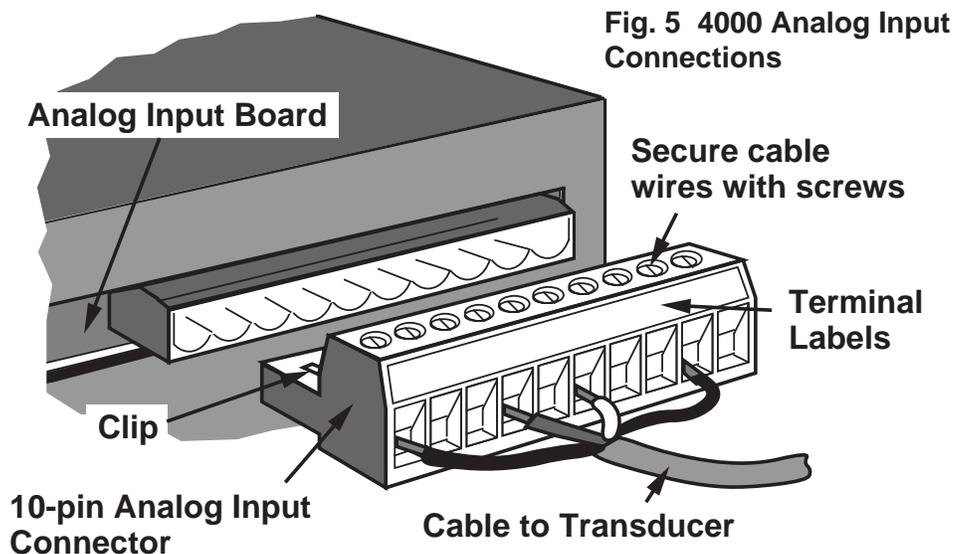
The 4032 will check its battery every time the unit is turned on. If on powerup, the battery is found to be below 3.0 V-DC, the front-panel LCD will display a warning of "**LO bat.**" Note that at this level the battery will still be good for weeks or even months. You are advised, however, to *change the battery* as soon as possible after the warning first appears. Detailed instructions for this procedure are given in Appendix G of this manual.

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

2.a

Transducer Cabling

Located on the rear of the 4032, each of the two 8-pin ANALOG INPUT CONNECTORS is similar to the 10-pin connector shown in Fig. 5. Referring to the appropriate *cabling diagram* below, connect the wires of each TRANSDUCER CABLE to the appropriate screw terminals of the corresponding 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 4032'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).



With regard to 4032 transducer cabling, please note the following:

1. In the following diagrams, standard cabling is shown for CHANNEL NO. 1 (INPUT "A") only.
2. 5-wire LVDT cabling (Fig. 6(a)) or 3-wire variable reluctance transducer cabling (Fig. 6(c)) 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 *at the CONDITIONER CONNECTOR*.

7-wire LVDT cabling (Fig. 6(b)) or 5-wire variable reluctance transducer cabling (Fig. 6(d)) 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 *at the transducer*.

3. When wiring an LVDT transducer to the 4032, you should connect both series-opposed secondary coils to the terminal labelled "CENTER WIRE," as shown in Figs. 6(a) and 6(b).
4. When wiring a variable reluctance transducer to the 4032, you must install a 10-kilohm "half-bridge completion" resistor between the –SIGNAL line and *each* of the two EXCITATION lines, as shown in Figs. 6(c) and 6(d).
5. IMPORTANT: If you are using only one of the 4032's two input channels, the +SIG and –SIG lines of the *unused channel* should be tied. This is to prevent high-frequency oscillation, which can in turn produce significant interchannel crosstalk, and possibly inaccurate data readings.

----- 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.

2.a

Transducer Cabling

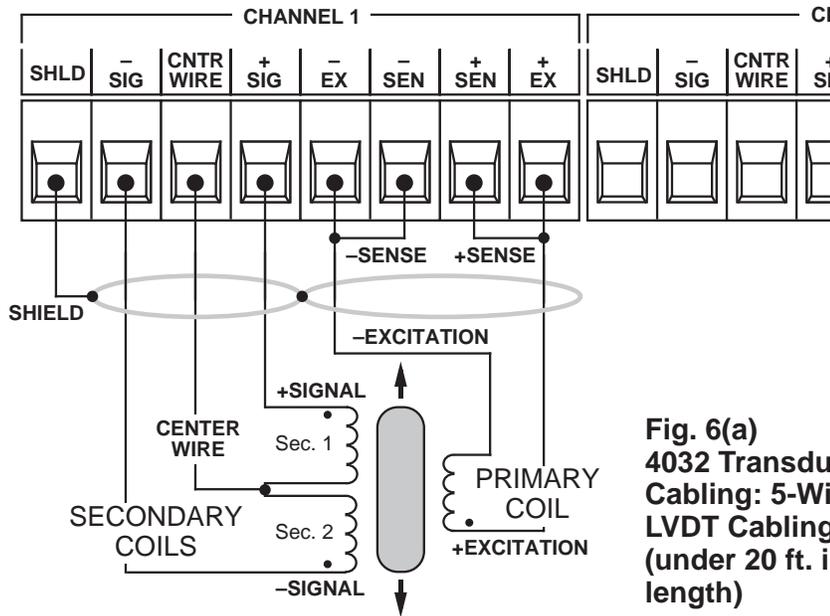


Fig. 6(a)
4032 Transducer
Cabling: 5-Wire
LVDT Cabling
(under 20 ft. in
length)

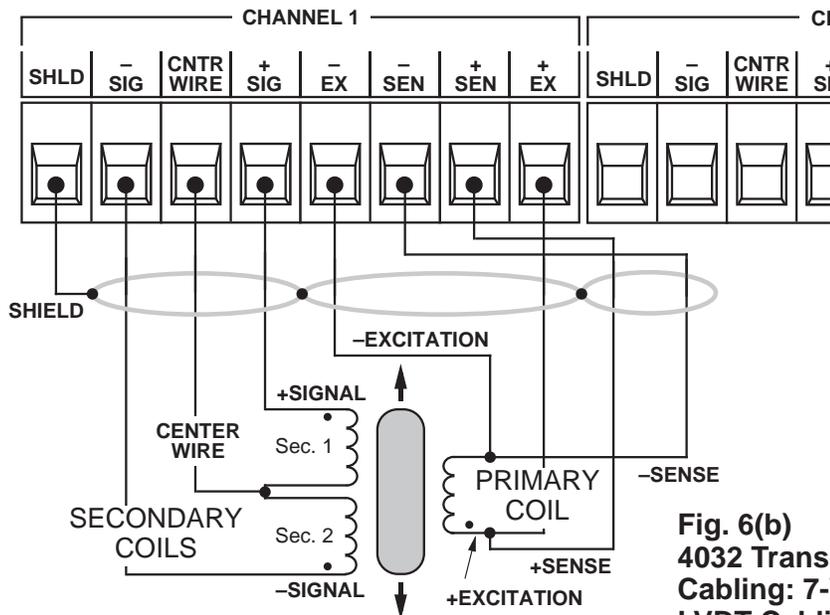


Fig. 6(b)
4032 Transducer
Cabling: 7-Wire
LVDT Cabling (20
ft. or longer)

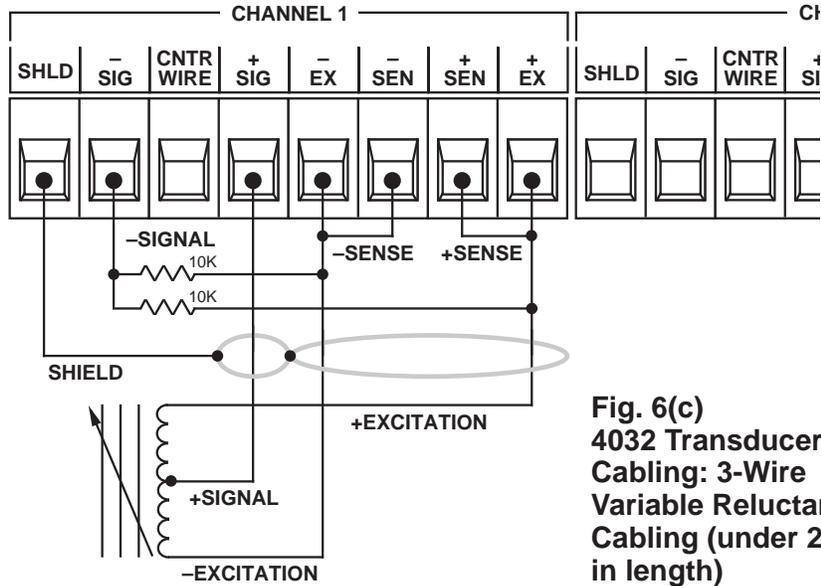


Fig. 6(c)
4032 Transducer
Cabling: 3-Wire
Variable Reluctance
Cabling (under 20 ft.
in length)

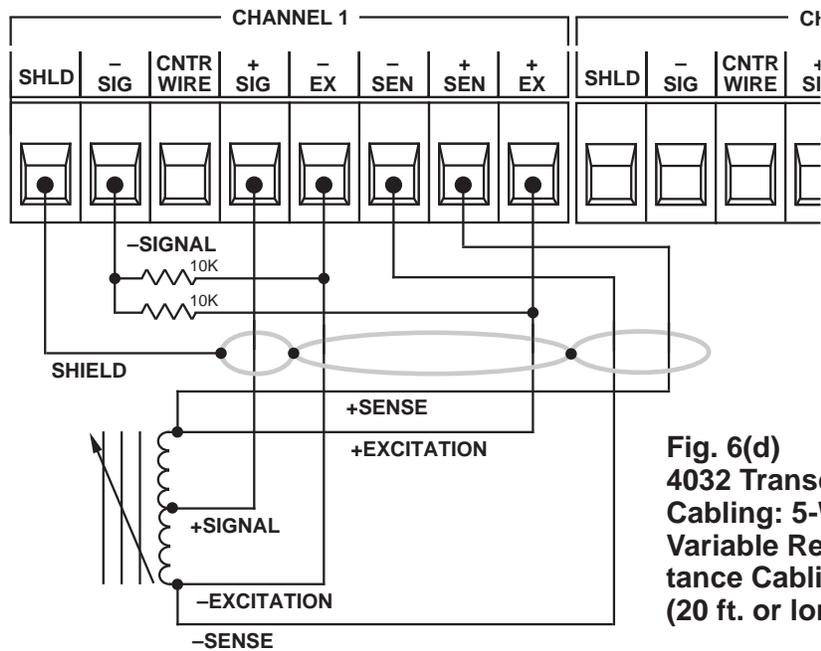


Fig. 6(d)
4032 Transducer
Cabling: 5-Wire
Variable Reluctance
Cabling (20 ft. or longer)

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

EVERY TIME YOU POWERUP YOUR MODEL 4032, 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 4032 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 4032.

A 4032 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 4032, 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 4032'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 4032 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 4032 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 4032 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 4032 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 4032 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

2.b

Powerup

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 4032 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)

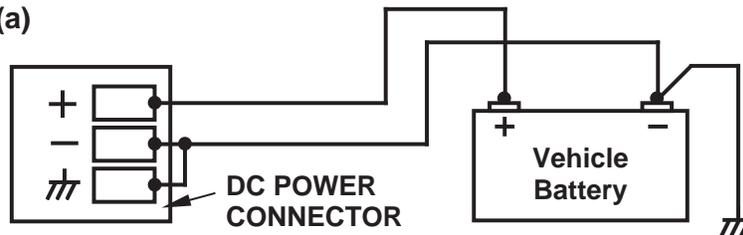
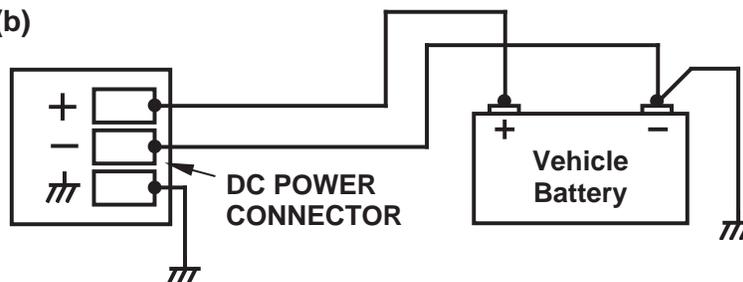


Fig. 7(b)



Adjusting LCD Viewing Angle

2.c

You can easily optimize your 4032'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 4032 should subsequently powerup with the LCD angle to which you have just set it.

2.d

Selecting a Channel for Display

Your 4032'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** buttons—when not in "SETUP MODE"—to call to display either of the 4032's "tared" data channels (5 or 10). You can also use the **MAX/MIN/MAX-MIN STEP** button to cycle sequentially through Channels 6 through 8 or 11 through 13, depending on the currently selected input (A or B).

IMPORTANT: FOR THE MOST ACCURATE CALIBRATION, YOU SHOULD ALLOW THE 4032 TO WARM UP FOR AT LEAST 30 MINUTES BEFORE CALIBRATING.

Under "standard" 4032 operating conditions, the only channels you need to calibrate are Channel 1 ("LIVE" ANALOG INPUT "A") and Channel 2 ("LIVE" ANALOG INPUT "B"). All other channels derive their readings from Channels 1 and 2.

In general terms, you will normally calibrate each input channel by commanding the 4032 microprocessor to compute and store two constant values for that channel: a ZERO OFFSET (based on setup entry "**F0**") and a SCALING FACTOR (based on entry "**F1**").

Note, however, that if an input channel's source transducer is *nonlinear*, you can calibrate that channel by means of the 4032's internal 15-segment linearization, as explained in Appendix D.

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. Set the load for Channel 1's transducer equal to the *minimum* value of its rated operating range. For a given displacement sensor, this load value will be obtained when the sensor is in its "NULL" position.
4. Using the "ARROW" buttons, enter for "**F0**" the exact minimum load value established in Step 3, expressed in appropriate engineering units. Then press the **STEP** button to display Channel 1's "**F1**" parameter. (NOTE: For this "two-point" calibration procedure to work, the **LNS** setting must be "1." For linearization using more than one segment, see Appendix D.)
5. Using a gage block or other convenient standard, 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.

2.e

Channel Calibration

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 "millimeters," and enter an "F1" of "100," then all subsequent readings will be rounded to the nearest millimeter. If "F1" is "100.0," then all readings will be rounded to the nearest *tenth* of a millimeter. This same precision will be automatically reflected in Channel 1's "limit-zone" parameters: "LEP," "LLL," "LOL," "HIL", "HHL," and "HEP" (Section 2.h).

7. Repeat the above procedure for Channel 2. Then exit "SETUP" mode by pressing the **SETUP** button.

2.f

Setting Channel Filters

In addition to the normal-mode analog filtering applied to the Model 4032's "live" input channels (Nos. 1 and 2), per-channel *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 either input channel,

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. Channels 1 and 2 are normally preset to a filter setting of "3."
4. Exit "SETUP" mode by pressing the **SETUP** button.

After calibrating your 4032's "live" input channels (Nos. 1 and 2), you should set the high and low endpoints for the individual BARGRAPH display of Channel 5 ("LIVE" INPUT "A" WITH TARE) and Channel 10 ("LIVE" INPUT "B" WITH TARE), using the procedure given below. This same procedure may be used to scale the bargraph display of any of the other 4032 data channels listed in Section 1.d. For the relation of BARGRAPH 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 "-1.000." 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 "-1.0." 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 "1.000."
5. Repeat the above procedure for Channel 10.

2.g

Scaling the Bargraph Display

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.*

NOTE, however, that the 4032'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."**

2.h

Defining Limit Zones

Once you have set the endpoints of the respective bargraph display for Channel 5 and Channel 10, you can define seven discrete *limit zones* for each 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.

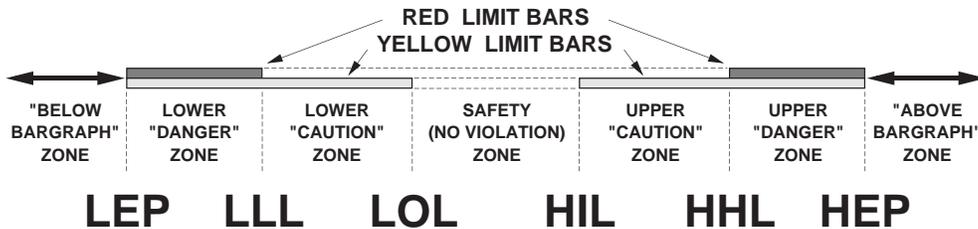


Fig. 8 Per-Channel Limit Zones

* At least 51 units (absolute count) must separate the **HEP** and **LEP** values.

** 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

Using the same "SETUP" button techniques as before, enter desired values for these parameters for Channels 5 and 10:

- "LLL" ("LOW LOW LIMIT")—initially set to "-0.750"
- "LOL" ("LOW LIMIT")—initially set to "-0.500"
- "HIL" ("HIGH LIMIT")—initially set to "0.500"
- "HHL" ("HIGH HIGH LIMIT")—initially set to "0.750"

As with the "LEP" and "HEP" entries (Section 2.g), each value should be expressed in the engineering units selected for the channel, 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 or 3 of the 4032's rear Logic I/O Connector whenever the "live" reading of Channel 5 or 10, respectively, lies BELOW the current "LOL" value for that channel (i.e., within the "BELOW BARGRAPH," "LOWER DANGER," or "LOWER CAUTION" ZONE). A logic output will be issued from Terminal 2 or 5 whenever the reading of Channel 5 or 10, respectively, lies ABOVE the channel's current "HIL" value (i.e., within the "UPPER CAUTION," "UPPER DANGER," or "ABOVE BARGRAPH" ZONE)—and from Terminal 1 or 4 whenever it lies BETWEEN the current "LOL" and "HIL" values (or is equal to one of them).

Logic I/O Connections

2.i

As shown in Fig. 4, the 4032'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" 4032 configuration calls for logic OUTPUTS only (from Terminals 0 through 5; Terminals 6 and 7 are not to be used). Fig. 9 shows how to wire

1. negative-true logic INPUT to a given terminal ("N") from an active TTL logic system (not applicable to the "standard" 4032);
2. negative-true logic INPUT to Terminal "N" from external switch contacts (not applicable to the "standard" 4032);
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**).

2.i

Logic I/O Connections

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

Fig. 9 (a) Input from External TTL Logic

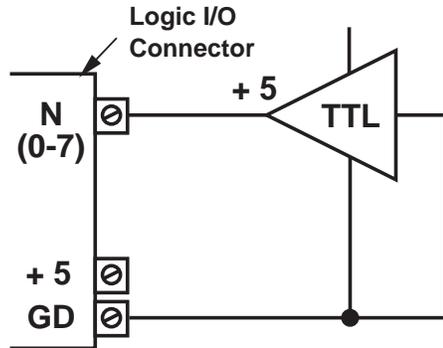


Fig. 9(b) Input from External Switch

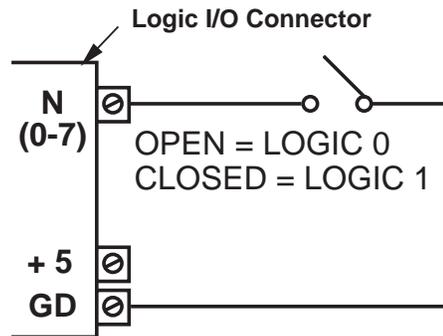
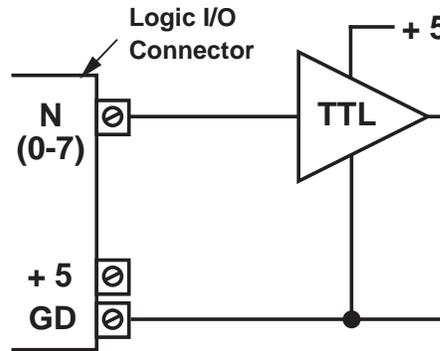


Fig. 9(c) Output to External TTL Logic

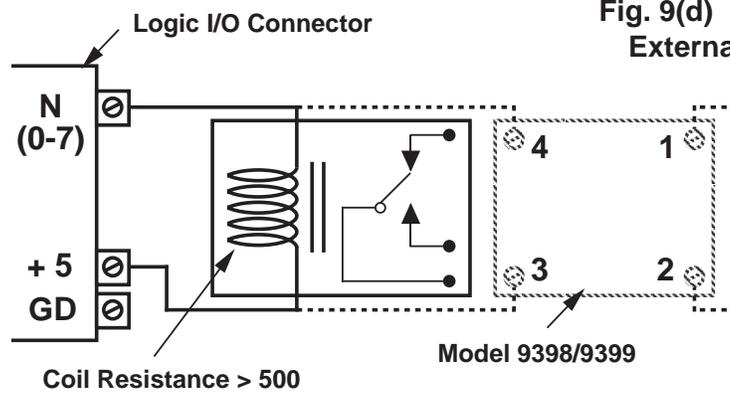


Fig. 9(d) Output to External Relay

The "SETUP" functions of the 4032'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, INPUT A"):

Each Push: Calls Channel 5 ("LIVE" INPUT "A" WITH TARE) to digital and bargraph display. Causes the "F1" indicator to light. This light will remain on continuously until Button No. 2 is pressed, indicating that "A" is the input currently selected for display.

BUTTON No. 2 ("LIVE DISPLAY, INPUT B"):

Each Push: Calls Channel 10 ("LIVE" INPUT "B" WITH TARE) to digital and bargraph display. Causes the "F2" indicator to light. This light will remain on continuously until Button No. 1 is pressed, indicating that "B" is the input currently selected for display.

BUTTON No. 3 ("TARE BOTH INPUTS"):

Each Push: Zeroes both Channel 5 and Channel 10 so that subsequent readings of each channel will represent the value of the channel *minus the existing value of the channel* (now stored as a constant "tare" offset). The results of this operation will be immediately *displayed*, of course, only for the currently selected input.

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

Each Push, INPUT "A" BEING THE SELECTED INPUT:

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 "A" WITH TARE).

(cont'd)

3

Use of Front-Panel Buttons

Each Push, INPUT "B" BEING THE SELECTED INPUT:

If Channel 10 is currently on display, displays Channel 11 ("MAXIMUM" VALUE OF CHANNEL 10) and lights the "F3" indicator.

If Channel 11 is currently on display, displays Channel 12 ("MINIMUM" VALUE OF CHANNEL 10) and lights the "F4" indicator.

If Channel 12 is currently on display, displays Channel 13 ("MAX minus MIN" VALUE OF CHANNEL 10) and lights the "F5" indicator.

If Channel 13 is currently on display, displays Channel 10 ("LIVE" INPUT "B" WITH TARE).

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

Each Push: Resets the "MAX-" and "MIN-" measuring functions of Channels 6,7,11, and 12, momentarily setting Channels 6 and 7 equal to the current "live" reading of Channel 5, and setting Channels 11 and 12 equal to the current "live" reading of Channel 10. The results of this operation will be immediately *displayed*, of course, only for the currently selected input.

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	1.000	0	3	5	1
2	00	2	1.000	0	3	5	1
3	00	1	1.000	0	1	10	1
4	F6	1	1	0	N/A	N/A	N/A
5	F1	1	1	0.000	N/A	N/A	N/A
6	FA	1	1	0.000	N/A	N/A	N/A
7	FB	1	1	0.000	N/A	N/A	N/A
8	F1	1	1	0.000	N/A	N/A	N/A
9	F6	1	1	0	N/A	N/A	N/A
10	F1	1	1	0.000	N/A	N/A	N/A
11	FA	1	1	0.000	N/A	N/A	N/A
12	FB	1	1	0.000	N/A	N/A	N/A
13	F1	1	1	0.000	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	5.000	0	N/A	N/A	N/A
18	00	1	5.000	0	N/A	N/A	N/A
19	00	1	5.000	0	N/A	N/A	N/A

CHANNEL LIMIT VALUES

Channel						
No.	LEP	LLL	LOL	HIL	HHL	HEP
1 - 13	-1.000	-0.750	-0.500	0.500	0.750	1.000
14	0	0	1	1	2	2
15	0	0	2	2	3	3
16	0	0	3	3	4	4
17 - 19	-1.000	-0.750	-0.500	0.500	0.750	1.000

App. A

Complete Standard Configuration

CHANNEL LIMIT LOGIC

Channel No.	BLE	BLL	LLT	LBT	LGT	BHH	BHE
1 - 4	N/A						
5	0	0	0	1	2	2	2
6 - 9	N/A						
10	3	3	3	4	5	5	5
11 - 13	N/A						
14	N/A	N/A	N/A	6	N/A	N/A	N/A
15	N/A	N/A	N/A	7	N/A	N/A	N/A
16	N/A	N/A	N/A	N/A	11	N/A	N/A
17 - 19	N/A						

CALCULATION CHANNELS

Channel No.	CLC
4	1(CHN4)+0
5	1(CHN1-CHN4)+0.000
6	1(MAX CHN5)+0.000
7	1(MIN CHN5)+0.000
8	1(CHN6-CHN7)+0.000
9	1(CHN9)+0
10	1(CHN2-CHN9)+0.000
11	1(MAX CHN10)+0.000
12	1(MIN CHN10)+0.000
13	1(CHN11-CHN12)+0.000
14	1(CHN14)+0
15	1(CHN14)+0
16	1(CHN14)+0

EXECUTES

Bit Number	EXU	EXU/
0 - 5	N/A	N/A
6	ANN3=1	ANN3=0:ANN4=1
7	N/A	ANN4=0:ANN5=1

(cont'd)

8	CHN14=0:SRC10TO12=EXT: BIT8=0	ANN1TO5=0:ANN1=1: LGT16=11
9	CHN14=0:SRC13TO15=EXT: BIT9=0	ANN1TO5=0:ANN2=1: LGT16=14
10	CHN4=CHN1:BIT10=0	N/A
11	ANN1TO5=0:ANN1=1:DIS=5: CHN14=0	N/A
12	CHN6TO7=CHN5:BIT12=0	N/A
13	CHN9=CHN2:BIT13=0	N/A
14	ANN1TO5=0:ANN2=1:DIS=10: CHN14=0	N/A
15	CHN11TO12=CHN10:BIT15=0	N/A

BUTTON EXECUTES

Button Number	EXB and EXB/
1	DIS=5:SRC13TO15=LIM:BIT8=1
2	DIS=10:SRC10TO12=LIM:BIT9=1
3	BIT10=1:BIT13=1
4	INC14:SDI
5	BIT12=1:BIT15=1

ANNUNCIATION

Annunciator Number	ANN
1 - 7	0
8	1

LOGIC I/O

Bit Number	LIO
0 - 7	OUT

LOGIC SOURCES

Bit Number	SRC
0 - 7	LIM,NON
8 - 10	EXT,NON
11	LIM,NON
12	EXT,NON
13 - 31	LIM,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 = 5

SBC = 1

ASN = 0

LGO = 4032 STANDARD

EDT = Y

DIS = 2

BAR = DIS

BEP = LEP

FLA = 1000

CPC = 9

CLM = 1

PKN = TRK

PKP = TRK

XBG1 = 1

XBG2 = 2

SHP = OFF

SHN = OFF

If you did not order a specific *RS-232-C Interface Cable* with your 4032, you will have to provide your own connection. Fig. 10 shows suggested cabling between a 4032 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. 10(a)). However, cabling is also given for "INCOMING HANDSHAKE ONLY" and "NO HANDSHAKE" situations (Figs. 10(b) and 10(c), respectively). Following RS-232-C conventions, the device at each end of the interface is seen as "DATA TERMINAL EQUIPMENT (DTE)."

Fig. 11 shows suggested cabling between a 4032 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).

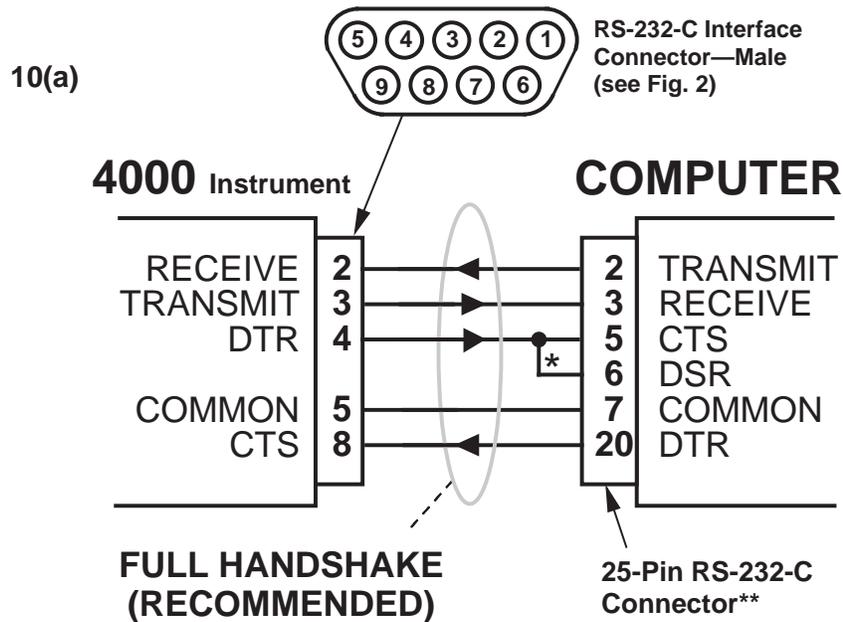
Please note that the cabling in Figs. 10 and 11 is by no means definitive. In all cases, you should carefully study the literature accompanying the specific RS-232-C device you wish to connect to your 4032, to determine the cable arrangement that will create the "handshake" you need (if any). On some 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.

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

App. B

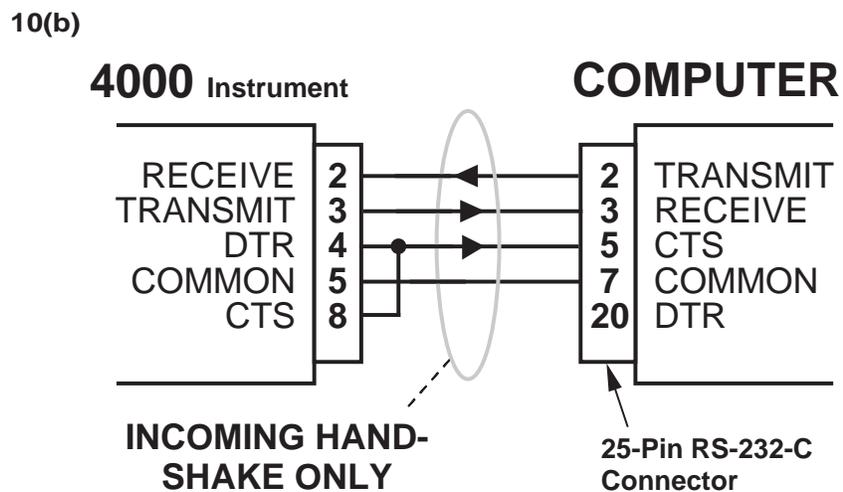
4032/Computer RS-232-C Connections

Fig. 10 Suggested RS-232-C Interface Connections
(to 25-Pin RS-232-C Connector)



* 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.



10(c)

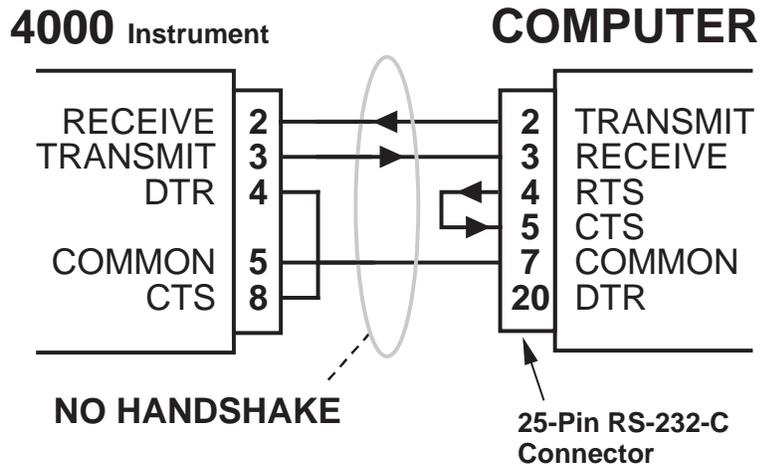
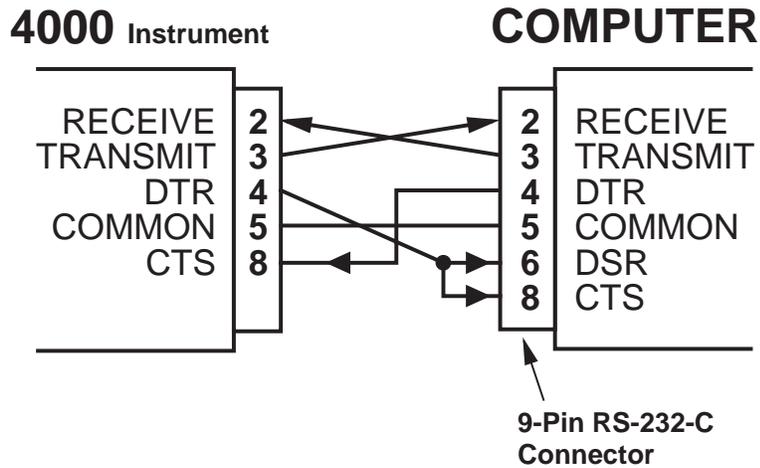


Fig. 11 Suggested RS-232-C Interface Connections (to 9-Pin RS-232-C Connector)



App. C

Legend and Indicator Annunciation

Every Model 4032 will normally come with the UNIT LEGENDS and BUTTON FUNCTION INDICATORS shown in Fig. 1, the legend/indicator negative being already fitted in the 4032's front-panel "FRAME" LABEL. Customized negatives are available as an option. Contact the factory for precise installation instructions; IMPROPER INSTALLATION CAN DAMAGE THE 4032 DISPLAY PANEL.

Unless other specified, the 4032 comes with only the front-panel "mm" indicator lit. To cause one or more legends and/or indicators to light up at any time (when instrument power is on), you can 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. 12 for the precise numbering), you need only command

ANN n = 1 [CR]

To turn OFF Annunciator No. n , command

ANN n = 0 [CR]

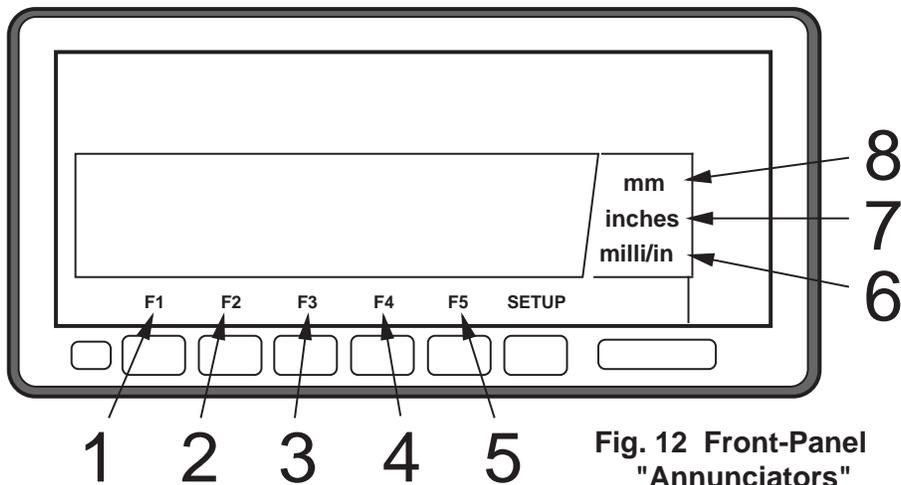


Fig. 12 Front-Panel "Annunciators"

* The **SETUP** indicator cannot be affected by the **ANNUNCIATOR (ANN)** command. It will only be on when the 4032 is in "SETUP" mode.

When a "live" input channel (No. 1 or 2) is derived from a *nonlinear* transducer, you may calibrate it by means of one of the 4032's eight internal "look-up" tables. The purpose of such a table is to *linearize* the signal in question, to "bend" its characteristic curves to achieve at least approximately "straight-line" performance.

You will set up a linearization table for an input channel by entering a ZERO ("MINIMUM") POINT and up to 15 subsequent LINEARIZATION POINTS. These points will define up to 15 SEGMENTS of the ideal linear output for that channel (see Fig. 13). The more segments you specify, the greater the overall linearity. In the following procedure, you will have to be able to continuously vary the magnitude of physical input, or "load," on the channel's source transducer, and to measure the resulting output accurately in the desired engineering units.

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 channel's "**LINEARIZATION SEGMENTS (LNS)**" parameter (the initial **LNS** setting is "1").
3. For the **LNS** value, enter an integral number from 1 through 15, equal to the number of linearization segments you wish to create for this channel. This entry has the effect of initializing Linearization Table 1 or 2, canceling any previous linearization points in that table, and thereby letting you enter a new set of points. (NOTE: When an **LNS** value of "1" is in effect for a given channel, its *single* linearization segment is governed by the " $y = mx + b$ " equation, the constants of which expression may be modified by the **EMM** and **BEE** commands, respectively; see the *System Instruction Manual* for details)
4. Press the **STEP** button to display the channel's "**F0**" (ZERO POINT) parameter.
5. Set the load for the channel's source transducer equal to the *minimum* value of its rated operating range. For a given displacement sensor, this load value will be obtained when the sensor is in its "NULL" position.

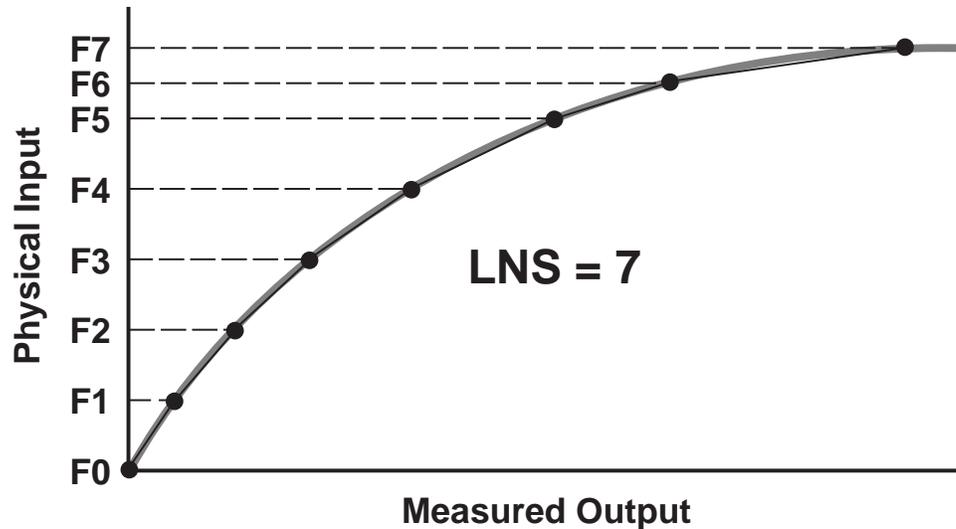


Fig. 13 Typical Linearization Curve, with Seven Segments

6. Using the "ARROW" buttons, enter for "F0" the exact minimum load value established in Step 5, expressed in appropriate engineering units.
7. Press the **STEP** button again to display the channel's "F1" parameter (this is the value of the endpoint of the first linearization segment).
8. Now use a gage block or other convenient standard to set the transducer load equal to a *known value* within the rated operating range (you should first divide this range into approximately equal segments*, the number of segments being the number entered for **LNS** in Step 3, above).
9. To define the linear segment from "F0" to "F1," use the "ARROW" buttons to enter for "F1" the exact load value established in Step 8, expressed in the same engineering units as before.

* The more *nonlinear* curve portions, however, may require shorter and more numerous linearization segments, as with segments F5 to F6 and F6 to F7 in Fig. 13.

10. Step to the next LINEARIZATION POINT ("**F2**"), adjust the transducer load to equal a second known value, and enter this value as "**F2**," expressed to the *same precision* (i.e., the decimal-point location) as the first point (F1).

Note that the *precision* of the measurements reported by the channel will always match the precision of the LINEARIZATION POINTS entered for that channel. IT IS THEREFORE IMPORTANT THAT ALL "**F_n**" ENTRIES BE EXPRESSED TO THE SAME PRECISION. If, for example, you wish to measure to the nearest *hundredth of an inch*, you should enter all LINEARIZATION POINTS expressed to the nearest hundredth of an inch (e.g., "1.00"). The 4032's display of any channel based on this input channel will then reflect this precision.

11. Continue to enter as many LINEARIZATION POINTS as you specified in the original **LNS** entry (Step 3, above). The linearization table you have set up will be automatically reloaded for the channel on every subsequent powerup.
12. Exit "SETUP" mode by pressing the **SETUP** button.
13. If at any time you wish to *cancel* the channel's present linearization table and to re-establish it with new LINEARIZATION POINTS, simply enter a new **LNS** value and proceed again from Step 4, above. Note too if you later wish to change a particular linearization segment, *you must repeat the entire table setup procedure*.

THE MODEL 4032'S INPUT RANGES SHOULD BE SET BEFORE TRANSDUCERS ARE CONNECTED.

You can use the **RANGE (RNG)** command to select an input range that matches that of the analog signal source for each of the 4032's two analog input channels (Nos. 1 and 2).

Thus, for LVDT's not exceeding 120 mV/V full scale, enter a command of

RNG x = 5 [CR]

where "x" is the number of the channel in question. Both input channels are initially set to an **RNG** value of "5."

For LVDT's not exceeding 240 mV/V full scale, command

RNG x = 10 [CR]

and for LVDT's not exceeding 480 mV/V full scale, command

RNG x = 20 [CR]

An LVDT's full-scale "mV/V" rating can be easily calculated by multiplying its rated sensitivity (expressed in "mV/V/0.001 inch" or in "mV/V/mm") by the full linear range of the LVDT (in thousandths of an inch or in millimeters).

Under the "standard" configuration, no specific channel is assigned to the 4032's single analog output. You can easily arrange, however, to designate any unused *scanned* channel as an analog output that corresponds to any other channel's data reading, with a full range of ± 10 V-DC and a maximum resolution of ± 1 mV. This output may be scaled as desired.

To assign a Channel Number of "x" to the 4032's analog output and to establish any scanned channel as the "data source" for Channel No. x, enter an **ANALOG OUTPUT (ANO)** command of

$$\mathbf{ANO\ x = m(CHN\ y) + b\ [CR]}$$

where "x" is any Channel Number within the current SCAN RANGE, and where "m" and "b" are constants necessary to convert the engineering units of Channel No. y to *millivolts*, for output by Channel No. x (again, the allowable full-scale range is ± 10 V).

You can always specify a new "data source" channel for the analog output by re-entering the above **ANO** command with a different "CHN y." If at some point, however, you wish to assign a different channel number to the analog output itself, you will first have to apply the following **TYPE (TYP)** command to the currently assigned channel (No. x):

$$\mathbf{TYP\ x = 00\ [CR]}$$

You may now proceed to apply an **ANO** command to establish the new analog output channel.

For more details on setting up and cancelling an analog output channel, see the optional *System Instruction Manual*.

Fig. 14 on the next page shows how an external device connects to the two-terminal Analog Output Connector on the rear of the 4032. The output is single-ended, and returns to "SIGNAL COMMON" (this is the negative Analog Output terminal).

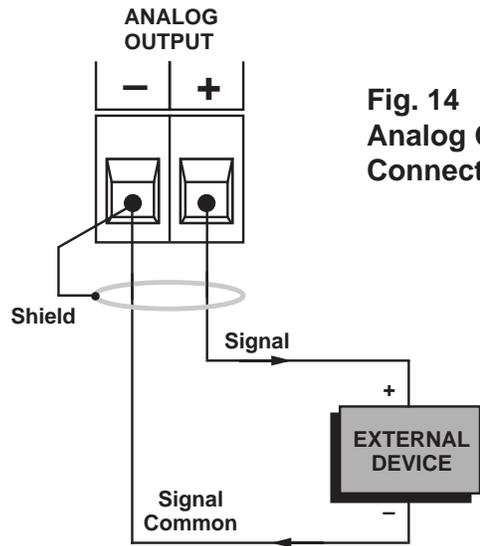


Fig. 14
Analog Output
Connections

If, on powerup, your 4032 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 4032'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 4032 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 4032'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.

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 4032 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.

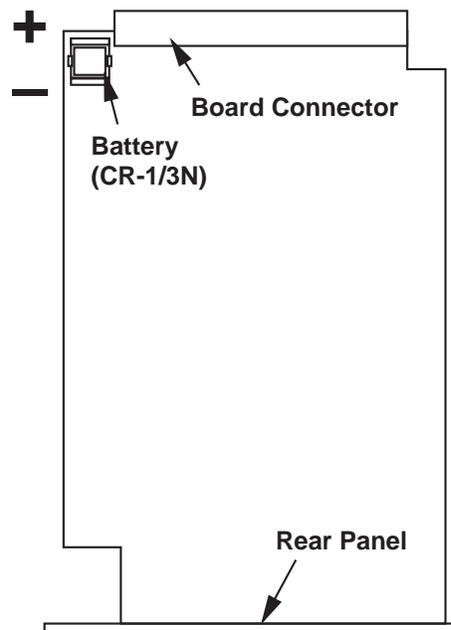


Fig. 15 Location of Battery

6. Locate the battery in the corner of the top board (see Fig. 15). 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 4032. 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 4032, 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 4032 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 4032, 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 4032 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 4032. YOU WILL HAVE TO CYCLE POWER TWICE. The first time you turn on the 4032, the "**LO bat**" warning will reappear. Simply turn the unit off and on once again.



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