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1. INTRODUCTION

1.A GENERAL DESCRIPTION AND SPECIFICATIONS

A prime member of Daytronic's family of pluggable SIGNAL CONDITIONER MODULES, the Model 5D30(V) is a high-reliability conditioner for measurement of displacement, force, pressure, and other parameters obtained with a linear variable differential transformer (LVDT) or other variable transformer transducer.

The **5D30** delivers filtered analog output of ± 5 VDC, while the **5D30V** produces ± 10 VDC. Based on the *synchronous carrier-demodulator principle*, both models can handle a remarkably wide range of signals (from 16 to 4000 mV/V, full scale)—with no special “long-stroke” cabling required for high-output sensors. Three selectable operating frequencies are provided to best match the user’s specific transducer. *Exceptional signal stability and accuracy over a remarkably wide range of sensor inputs are achieved through*

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

Each compact 5D30(V) module is a self-contained, easily configurable, physically hardened instrument. With pluggable screw-terminal connectors for easy installation and I/O field wiring, it can be used as an individual or “in-line” signal conditioner, or can reside in a host device to complete an effective, economical front-end solution. Connecting directly to its source LVDT or other displacement sensor via simple pinout, the module powers, conditions, isolates, filters, and scales its sensor’s analog signal to a standardized 5-V or 10-V level, making it usable as input to a PC, PLC, or other device for further processing, display, recording, etc. High output accuracy over a wide temperature range guarantees repeatable sensor signal integrity.

The 5D30(V)’s extruded-aluminum case has guides for insertion into a housing. It also provides an edge screw boss for securing the unit independently to a fixture or clipping it to a DIN rail. Or it can be plugged into a “motherboard” backplane for multiplexing into an analog input device, via the Analog Output / Power / Communications Connector described in Section 2.A.*

LVDT sensors that exhibit typical nonlinearity and/or asymmetry can be easily accommodated. By applying simple software commands, you can fit the output

* See the *Model 5DMB Instruction Manual* for a complete description of the Daytronic **Model 5DMB-8** and **Model 5DMB-16** cabinet-mountable motherboards.

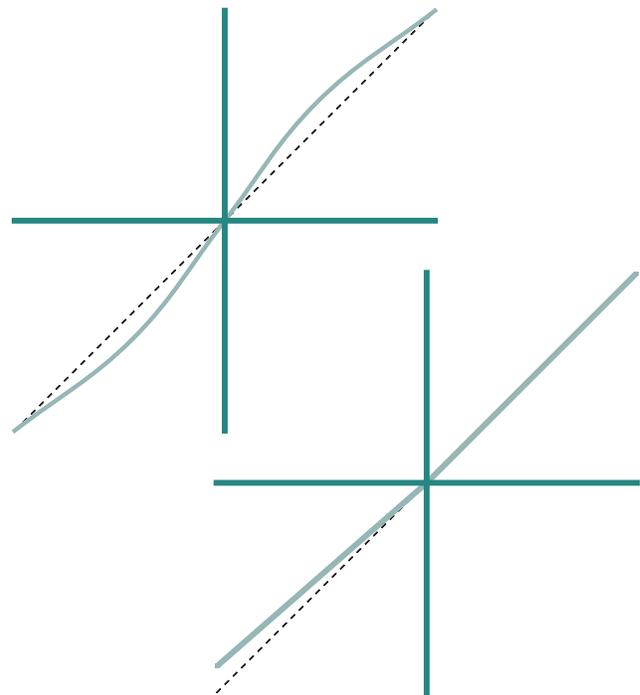


Fig. 1
Typical Nonlinearity and Asymmetry

curve to your linear, symmetric “ideal” (see Fig. 1 and Section 3.D).

Two high-level, noise-free analog outputs are provided. For the 5D30 (only), one output is continuously available, while the other may be switched on and off by setting the logic state of an “enable” line (thus eliminating the need for an external multiplexer in multiple-module applications). For the Model 5D30V, both outputs are continuously available. Powerful low-pass active filtering is independently selectable for each output, for removal of unwanted high-frequency measurement-signal components and the elimination of aliasing errors, if the module’s output is subsequently sampled.

For both the **Model 5D30V** and the **Model 5D30S** (the “S” Option version of the Model 5D30), a 10-pin header for a Phoenix Style screw-terminal connector replaces the Model 5D30’s standard DB25 connector for the module’s power, configuration, logic, and output wiring—see Fig. 3.b. Ensuring secure cable connections to individual 5D modules, these versions are intended primarily for single-point or single-mount module applications. Since the logic “enable” line is not provided in this case, both analog outputs are *continuously available* for both the 5D30V and the 5D30S.

Because of normal cable loading effects, it is a practical necessity to calibrate any LVDT/CABLE/INSTRUMENT

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system after installation, using a *known input standard*. The “ABSOLUTE” CALIBRATION method described in Section 3.D will normally yield a very good first approximation for an LVDT/cable/5D30(V) system (depending, of course, on actual cable length and capacitance).¹ However, absolute calibration of the 5D30(V) should always be followed by a conventional “in place” TWO-POINT (DEADWEIGHT) CALIBRATION, for optimum data integrity.

To perform initial ABSOLUTE CALIBRATION of the 5D30(V), you need only use the configuration software provided with the unit to specify the desired relationship between the module’s measured engineering units and its ± 5 -VDC or ± 10 -VDC output, given the full-scale input range for which it is currently set and the LVDT transducer’s known full-scale rating and sensitivity. A zero offset term may also be entered, expressed either in engineering units or millivolts.

TWO-POINT (DEADWEIGHT) CALIBRATION of the 5D30(V) requires the application of two independently and accurately known values of input loading (“ZERO” and “SPAN”), following the entry of a phase shift adjustment. Internal symmetry trimming is available for negative-domain slope adjustments of up to $\pm 2\%$ of full scale.

Employing the run-time version of Microsoft® Access 2000, the **5D CONFIGURATOR** software supplied with the Model 5D30(V) makes short work of module setup. Communicating via RS232 link, the Configurator lets you define, store, edit, download, upload, and manage any number of “configurations” for a connected array of one to 16 independent 5D modules. It also lets you perform selected run-time operations, including both “absolute” and two-point (deadweight) calibration, plus the sending of standard mnemonic commands to a specific module.

MODEL 5D30(V) SPECIFICATIONS

Housing: Extruded aluminum casing; mountable to panel, fixture, or DIN-rail

Dimensions: See Fig. 2, next page

Power Requirements: 24 VDC $\pm 10\%$; 100 mA nom.; 150 mA max.

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

ESD Protection: Up to 4 kV on all connections

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

Operating Temperature Range: -10°C to 70°C (14°F to 158°F)

Operating Relative Humidity: 5% to 95%, noncondensing

Transducer Types: Virtually any variable transformer transducer, including 4-, 5-, and 6-wire LVDT’s and 3- and 5-wire Variable Reluctance Transducers²

Input Ranges (Full-Scale): See Table 1, below; selectable when the 5D30(V) is configured (NOTE: the highest range selection accommodates actual inputs as high as 4000 mV/V^3)

Excitation Frequency: 3.27, 5.00, or 10.00 kHz; selectable when the 5D30(V) is configured

Excitation Voltage: Nominal 3 VAC rms

Accuracy: Dependent on range and excitation; see Table 1⁴

Amplifier:

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

Input Impedance (Differential): Greater than 350 k Ω

Offset: Initial: $\pm 0.05\%$ of full scale; vs. temperature: ± 25 ppm/ $^{\circ}\text{C}$; vs. time: ± 10 ppm/month

(cont’d)

Table 1
Model 5D30(V) Ranges (Nominal) and Accuracy per Excitation Setting^{3,4}

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

Range (mV/V)	Excitation Frequency (kHz)	
	3.27 or 5.00	10.00
16	0.03	0.04
25	0.03	0.04
40	0.02	0.03
64	0.02	0.02
100	0.02	0.02
160	0.02	0.02
250	0.02	0.02
400	0.02	0.02
640	0.02	0.02
1000	0.02	0.02
1600	0.03	0.03
2500	0.05	0.05

¹ Employing a low-capacitance cable will minimize the effects on overall offset and span. See note “4,” below.

² May require user-supplied half-bridge resistors.

³ See Table 2 in **Appendix B** for the “practical” ranges that apply to the 5D30(V) **RANGE (RNG)** setting.

⁴ The full-scale accuracies given in Table 1 refer to the 5D30(V)’s response to substantially *undistorted* waveform inputs. Any phase shift must be compensated for during calibration (by use of the **FAZ** command, as explained in Section 3.D). Some gain deviation from LVDT data-sheet specifications is normally to be expected as a result of loading the transducer’s finite output impedance with intrinsic cable capacitance. The degree of this error will vary with cable type and length. Nevertheless, when calibrated “in place,” the 5D30(V) offers *excellent stability and interchangeability of units*. As long as an initially calibrated 5D30(V)’s setup configuration is exactly transferred to the 5D30(V) that is replacing it, *no recalibration is usually required to maintain the stated accuracy*.

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

Gain Stability: vs. temperature: ± 25 ppm/ $^{\circ}\text{C}$; vs. time: ± 10 ppm/month

Analog Filters: 0.2, 2, 20, 200, or 2000 Hz, independently selectable for each output*

Analog Outputs: Filtered ± 0 to 5 VDC (for the Model 5D30) or ± 0 to 10 VDC (for the Model 5D30V), with linearity maintained for 20% overrange. For the Model 5D30, Output A is continuous and Output B is switchable via logic "Enable" line (see Section 2.F). The "Enable" line is not available for the Model 5D30V or the Model 5D30 with "S" Option; for these models, both outputs are continuously available.

Logic Input (Enable) for Model 5D30 (only): Nominal 0 - 5 V, where 5 V = Logic 1 ("true"); ± 25 V without damage; noise immunity 1 V; internal pull-up nom. 5 k Ω ; input assumes Logic 1 state in the absence of connection

Status Indicator Light: Green/Yellow/Red; indicates module input and communications status (see Section 5.A)

* **NOTE:** For the Model 5D30(V), the value of the highest allowed corner frequency is dependent on the currently selected **excitation frequency**: for an excitation of 10.00 kHz, it is 2000 Hz; for 5.00 kHz, it is 1400 Hz; and for 3.27 kHz, it is 1100 Hz.

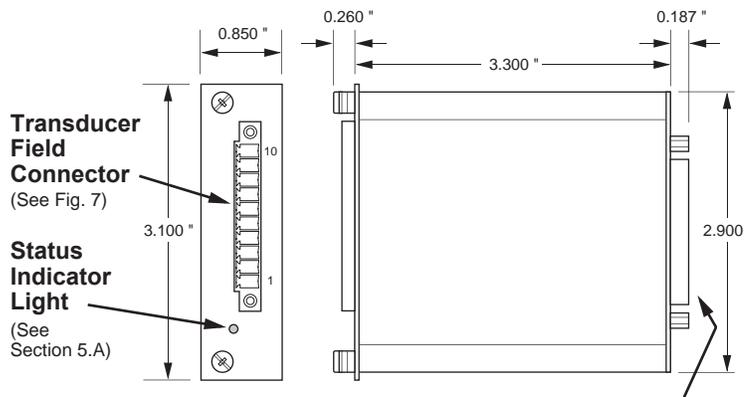


Fig. 2
5D Dimensions

Power, Configuration, Logic, and Analog Output Connector*
(see Figs. 5, 6, 8, and 9)

* Standard DB25 connector shown; "single-point" screw-terminal connection is provided with Model 5D30V or 5D30S (see Fig. 4.b).

1. INTRODUCTION

1.B MOUNTING THE MODEL 5D30(V)

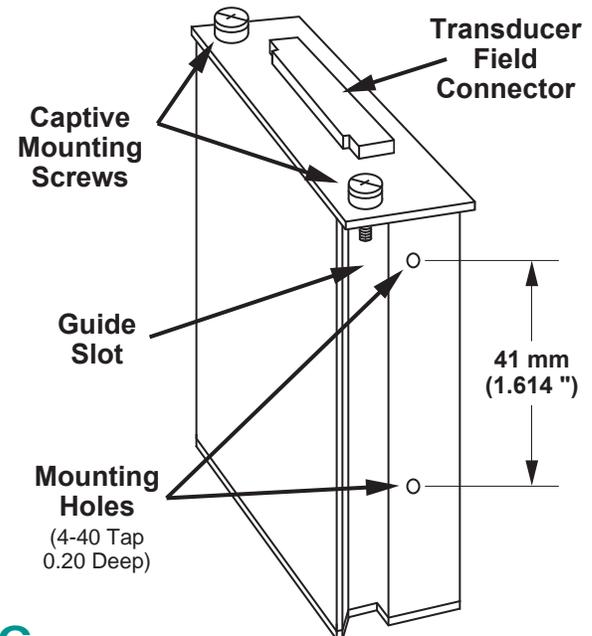
In most applications, a Model 5D30(V) unit will be either individually mounted to a fixture, clipped to a European DIN standard 35-mm rail, or plugged into a “mother-board” backplane assembly (such as a Daytronic “5DMB”) to be part of an interconnected array of up to 16 “5D” modules. See the *Model 5DMB Instruction Manual* for installing 5D modules on a Daytronic **Model 5DMB-8** or **5DMB-16** cabinet-mountable motherboard.

As shown in Fig. 3, mounting holes are provided on the side of the unit for securing it to the user’s fixture or for attaching a conventional DIN clip.*

The 5D30(V)’s captive mounting screws are normally used only when its DB25 connector is plugged into a Daytronic “5DMB” or other host backplane / instrument that provides suitable guide rails (see the *Model 5DMB Instruction Manual*).

* The holes are spaced to accommodate the standard JIT Component “JSDA” clip (available from Daytronic).

Fig. 3
5D Mounting Features



1.C INSTALLING AND RUNNING THE 5D CONFIGURATOR SOFTWARE

PLEASE NOTE: This software requires an operating system of Windows 95 or higher which takes approximately 3.5 MB of hard-drive space.

For more information on “Using the 5D Configurator,” see Section 3.A of this manual.

To INSTALL the 5D Configurator Software,

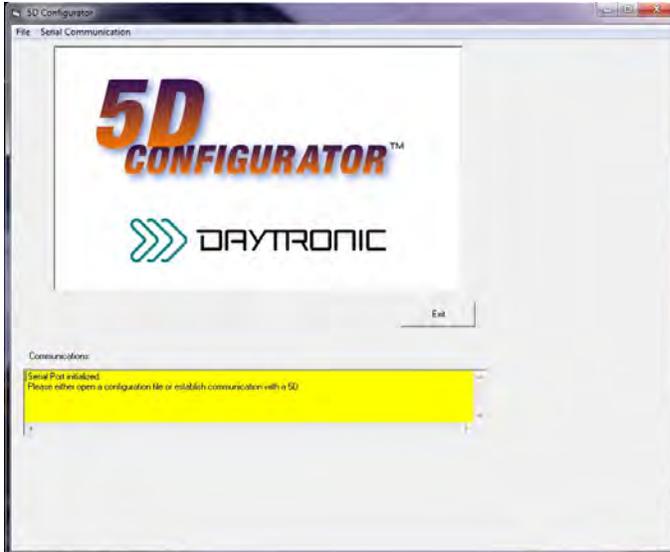
1. Make sure to close all applications before starting the installation. Use Windows Explorer to access programs.
2. Insert the CD supplied with your 5D30(V) or you can download the zip file by registering a the www.daytronic.com web site, under Software Downloads -5D Windows Configurator - 5DCONFIG-W.
3. With the software copied over to your designated folder, Unzip the contents - there will be three files extrated - CONFIG5D, SETUP and SETUP.LST. Double-click on the application file SETUP to begin the installation process.
4. Acknowledge to begin installation or Exit back to main screen.
5. Begin the installation process by Double-clicking on the computer icon box as shown below. If desired, you can designate a different file location for the 5D Configuration program or exit the process
6. Once enabled, the program will install in the designated file directly. When completed, a popup will appear indicating completion. Acknowledge by clicking OK. This will return the computer display to your original Windows Explorer screen.
7. Verify the program loaded by selecting the Main Start Menu of the computer and locating the "5D Configurator" icon.



(cont'd)

1. INTRODUCTION

8. To **RUN** the Configurator, go to your Windows popup Start menu, select Programs, and click 5D Configurator. The follow screen will appear



File Menu

- New** - Starts blank configuration
- Open....** - Retrieves stored configuration
- Close** - Clears existing configuration
- Save** - Stores ".fiv" configuration file
- Save as..** - Stores renamed ".fiv" file
- Exit** - Exit configuration program

Serial Communications Menu

- Initialize Port** - Selects COM port to use
- Terminal** - Used for direct command and response setup and queries to the 5D(s)

Upload 5D Module(s)

- Retrieves all connected module's configuration information to begin setup changes and calibration

9. To **UNINSTALL** the 5D Configurator Software,
- a. Go to the Windows popup **Start** menu, select **Settings**, and then select **Control Panel**. Then double-click on the button called **Add/Remove...** (or **Add or Remove Programs**).
 - b. Select "5D Configurator" from the list of programs, and click the appropriate button to remove it.
 - c. When asked whether you're sure you want to completely remove the 5D Configurator and all its components, answer **Yes** to uninstall (or **No** to abort).
 - d. NOTE: This procedure will NOT delete any "*.fiv" 5D CONFIGURATION FILES currently in your Configurator installation directory which were created through the Configurator software. In fact, if you have created any such files, you will be told that the directory itself cannot be removed (click Ok to exit this message).

2. CONNECTIONS

2.A INTRODUCTION

Pin assignments for the 5D30's standard DB25 **POWER, CONFIGURATION, LOGIC, AND ANALOG OUTPUT CONNECTOR** are shown in Fig. 4.a, below.

Fig. 4.b gives pinout for these same functions for the screw-terminal connection provided by the **Models 5D30V** (± 10 -volt output) **and 5D30S** ("S" Option). The only difference is that the ENABLE logic lines are not available with these modules.

Fig. 5 is a generalized diagram of a "network" of one to sixteen individual Daytronic 5D modules, including the

PC being used for module configuration and the network power supply. The proper connections required for Power and Ground, RS232 Communications, Transducer I/O, Analog Outputs, and Logic Inputs are treated separately in the sections and figures that follow.

NOTE: When a network of 5D modules is installed in a Daytronic "5DMB" backplane unit, all module interconnections are automatically established (see the *Model 5DMB Instruction Manual* for full details).

Fig. 4
5D Power, Configuration, Logic, and Analog Output Connections

Fig. 4.a
Standard DB25 Connector (Model 5D30)

ALL PINS NOT LISTED ARE CURRENTLY UNUSED.

Pin Number(s)	Line Function
1	± 5 -V ANALOG OUTPUT A (CONTINUOUS)
2	± 5 -V ANALOG OUTPUT B (SWITCHABLE)
3, 14	ANALOG COMMON
10	TRANSMIT (RS232 OUTPUT)
11	RECEIVE (RS232 INPUT)
12	24 VDC POWER INPUT
13	POWER COMMON
16	ENABLE (LOGIC INPUT; REFERENCED TO ANALOG COMMON)
22	ENABLE (LOGIC INPUT; REFERENCED TO POWER COMMON)
25	CHASSIS GROUND

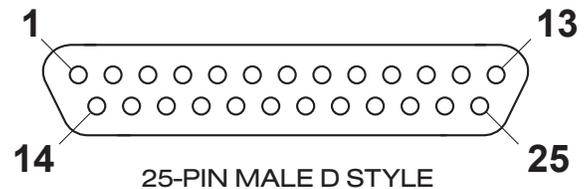
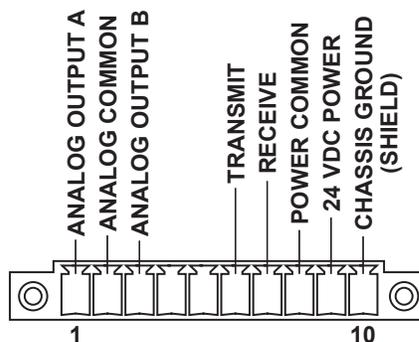


Fig. 4.b
Alternative Screw-Terminal Connection (Models 5D30V and 5D30S)



2. CONNECTIONS

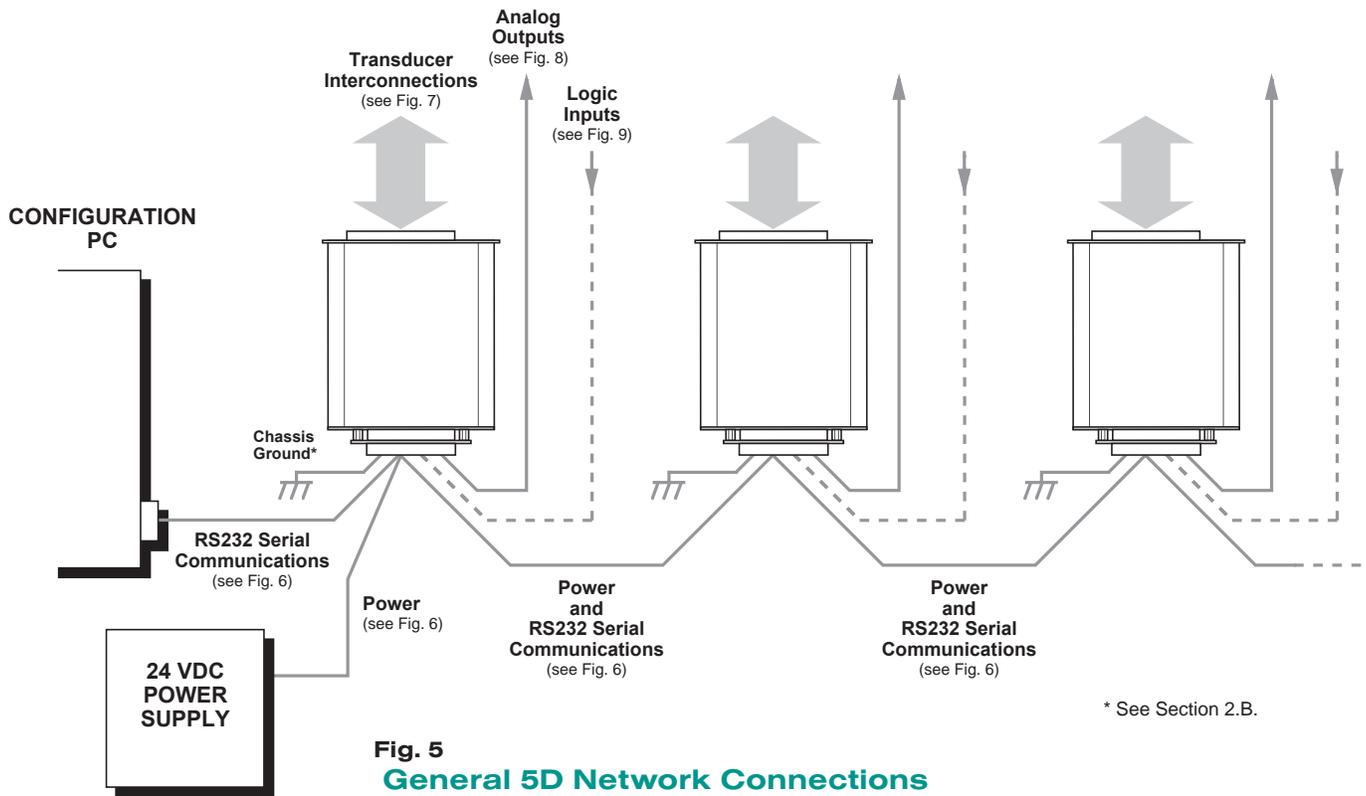


Fig. 5
General 5D Network Connections

2.B POWER AND GROUND CONNECTIONS

The 5D30(V) requires a user-supplied external source of 24 VDC, regulated to $\pm 10\%$. Nominal consumption is 100 mA; maximum is 150 mA. Fig. 6 on the next page shows how the positive and negative power leads are tied, respectively, to the **+24 VDC** and **POWER COMMON** terminals of the 5D30's standard DB25 connector (the Models 5D30V and 5D30S use the corresponding screw-terminal connections—see Fig. 4.b).

In a network of more than one 5D module, you can power the entire chain by connecting the supply to any given module—although it is recommended that it be connected to the first one, as shown. The +24 VDC terminals of adjacent modules are then tied pin-to-pin, as shown in Fig. 6. The +24 VDC line between adjacent modules may be paired with the RECEIVE line in the cable shield (as shown), or it may be shielded separately. The cable shield is tied to POWER COMMON.

When the 5D30(V) is properly powered, the module's indicator light will be GREEN—*unless* there is presently an input overrange of 20% or more, an incoming CARRIAGE RETURN, or a serious hardware/software malfunction (see Section 5.A).

CABLE SHIELDING

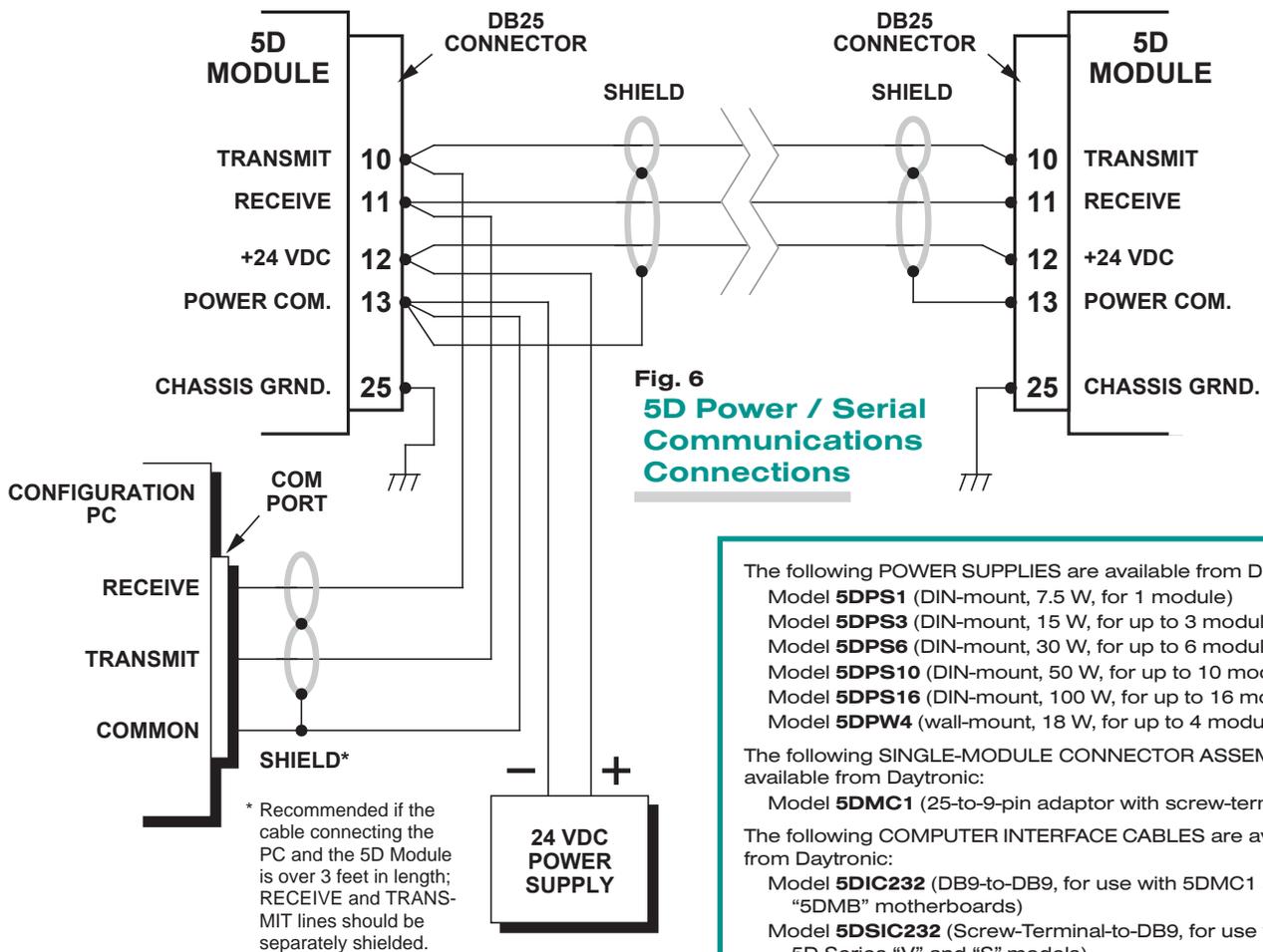
Proper shielding of cable wires or twisted pairs—as shown in Figs. 6 through 9—is strongly recommended to minimize the production of unwanted electrical noise from capacitive and inductive effects.

In the I/O cabling diagrams (Figs. 7 through 9), only the “connector end” of each cable shield is shown, as represented by a gray circle surrounding either a single wire or a TWISTED PAIR of wires within the cable. Unless otherwise stated, every shield *should be grounded to the appropriate common or ground terminal only at the connector end*. The drain wire tying the connector end of the shield to common/ground should be as short as possible.

MODULE GROUNDING

For optimum ESD/EMI immunity, every 5D module should be **LOCALLY GROUNDED**. Use a single drain wire to connect the module's **CHASSIS GROUND** terminal (No. 25) to local earth ground (see Fig. 6). The drain wire should be as short as possible.

2. CONNECTIONS



The following POWER SUPPLIES are available from Daytronic:

- Model **5DPS1** (DIN-mount, 7.5 W, for 1 module)
- Model **5DPS3** (DIN-mount, 15 W, for up to 3 modules)
- Model **5DPS6** (DIN-mount, 30 W, for up to 6 modules)
- Model **5DPS10** (DIN-mount, 50 W, for up to 10 modules)
- Model **5DPS16** (DIN-mount, 100 W, for up to 16 modules)
- Model **5DPW4** (wall-mount, 18 W, for up to 4 modules)

The following SINGLE-MODULE CONNECTOR ASSEMBLY is available from Daytronic:

Model **5DMC1** (25-to-9-pin adaptor with screw-terminal I/O)

The following COMPUTER INTERFACE CABLES are available from Daytronic:

Model **5DIC232** (DB9-to-DB9, for use with 5DMC1 and "5DMB" motherboards)

Model **5DSIC232** (Screw-Terminal-to-DB9, for use with 5D Series "V" and "S" models)

2.C SERIAL COMMUNICATIONS CONNECTIONS

As shown in Fig. 6, simple two-wire RS232 cabling is employed for communications between the 5D30(V) module and an external PC.* The RS232 interface observes a fixed protocol of 19,200 baud, 8 data bits, 1 stop bit, and NO parity—with *no software or hardware "handshake."* The Configurator software will automatically set to this protocol the computer COM PORT selected for communications with the 5D network.

Separate shielding of the RECEIVE and TRANSMIT lines is highly recommended, to prevent electrical noise from causing "break" signals and other communications errors. If desired, the RECEIVE line may be paired with the +24 VDC line in the cable shield (as shown). The cable shield is tied to POWER COMMON. Separate RECEIVE and TRANSMIT shielding is also recommend-

ed for the cable connecting the 5D module to the PC COM PORT, if that cable is over 3 feet in length.

As with power connections (above), you can establish communications with all members of a network of more than one 5D module by connecting the PC COM PORT to any given module—although it is recommended that it be connected to the first one, as shown.** The RECEIVE and TRANSMIT terminals of adjacent modules are then tied pin-to-pin, as shown in Fig. 6.

* For corresponding **screw-terminals** of the Models 5D30V and 5D30S, see Fig. 4.b.

While 5D / PC serial communications will usually take place through the 5D CONFIGURATOR software described in Section 3, a "terminal emulation" program (either conventional or customized) can also be used to issue standard mnemonic commands to one or more 5D modules, and to receive module responses.

** Unless you are using the 5D Configurator software, it is first necessary to issue an **OPEN (OPN)** command in order to initiate single-point communications between the computer issuing the command and a specific 5D module (see Section 4.A).

2. CONNECTIONS

2.D TRANSDUCER CONNECTIONS

Each wire or jumper of the transducer cable is to be firmly secured to the appropriate screw terminal of the terminal block that plugs into the 5D30(V)'s 10-pin TRANSDUCER CONNECTOR.

Figs. 7.a and 7.b show cabling for conventional LVDT's that use *series-opposed secondary coils*. The 5-wire connections given in Fig. 7.a are to be used with a cable of 18-gage conductors which is under 20 feet in length. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the 5D30(V) CONNECTOR*. The 7-wire connections given in Fig. 7.b. are to be used when the cable is 20 feet or longer, or when fine wire is used. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the transducer*. In either case, you should connect both coils to the CENTER TAP terminal, as shown.

Figs. 7.c and 7.d show cabling for less common LVDT's that use *series-aiding secondary coils*. Again, the 5-

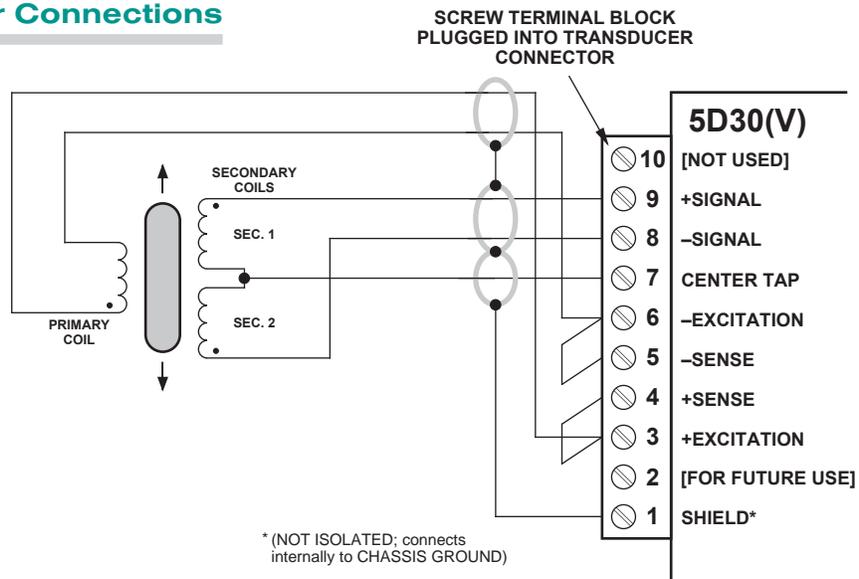
wire connections (Fig. 7.c) are to be used with a cable of 18-gage conductors which is under 20 feet in length, while the 7-wire connections (Fig. 7.d) are to be used when the cable is 20 feet or longer, or when fine wire is used. In each case, however, the -SIGNAL line ties to CENTER TAP, and the user must install a 10-kilohm "half-bridge" resistor on each of the two branches of the +SIGNAL line, as shown.

Figs. 7.e and 7.f show cabling for Variable Reluctance Transducers. The 3-wire cabling in Fig. 7.e is for a cable under 20 feet in length, and the 5-wire cabling in Fig. 7.f is for a cable of 20 feet or longer. In each case, the user must install a 10-kilohm "half-bridge" resistor between the -SIGNAL terminal and each of the two EXCITATION LINES, as shown.

For general information on **CABLE SHIELDING**, see Section 2.B.

Fig. 7
Model 5D30(V) Transducer Connections

Fig. 7.a
5-Wire LVDT Cabling
(series-opposed,
under 20 ft. in length)



(cont'd)

2. CONNECTIONS

Fig. 7.b
7-Wire LVDT Cabling
(series-opposed,
20 ft. or longer)

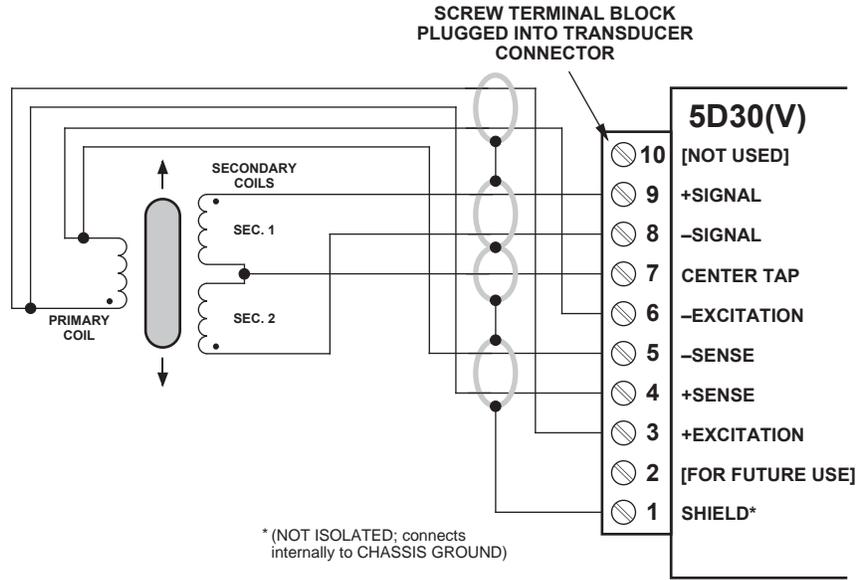


Fig. 7.c
5-Wire LVDT Cabling
(series-aiding,
under 20 ft. in length)

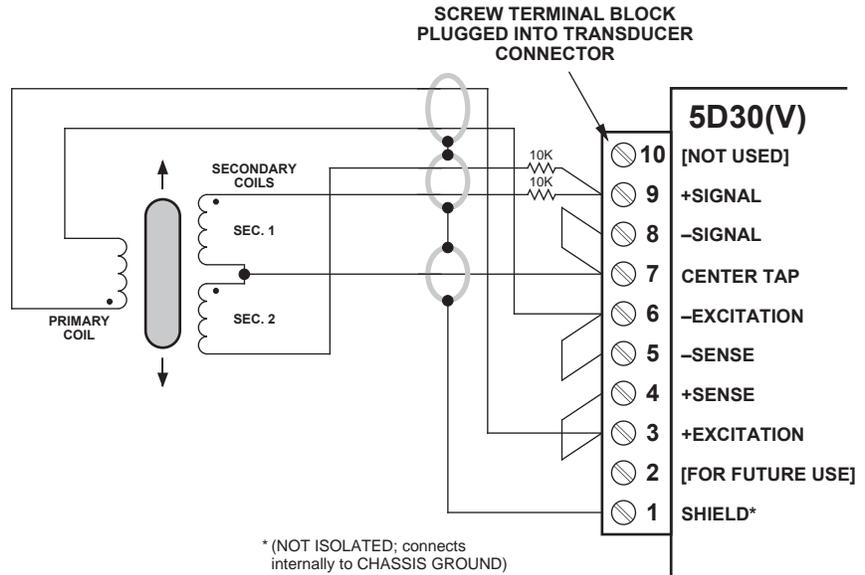
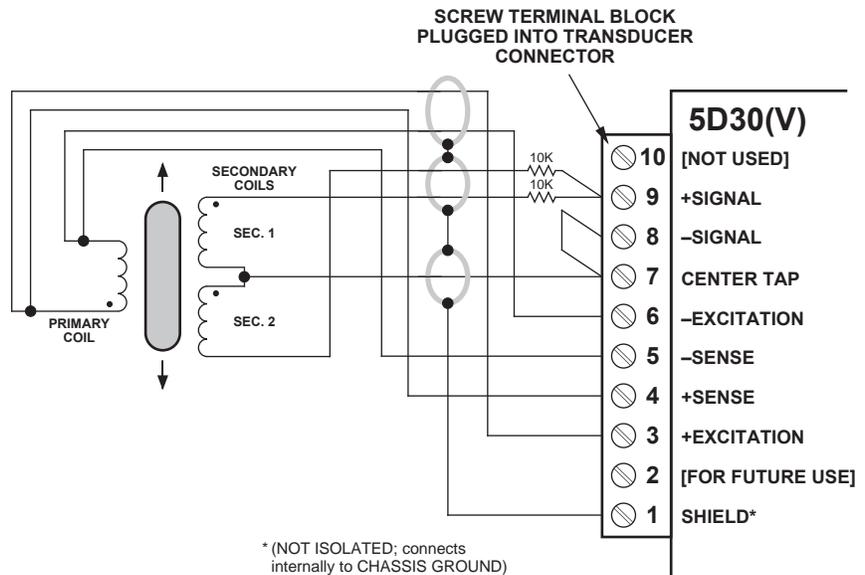


Fig. 7.d
7-Wire LVDT Cabling
(series-aiding,
20 ft. or longer)



2. CONNECTIONS

Fig. 7.e
3-Wire Variable Reluctance Transducer Cabling
(under 20 ft. in length)

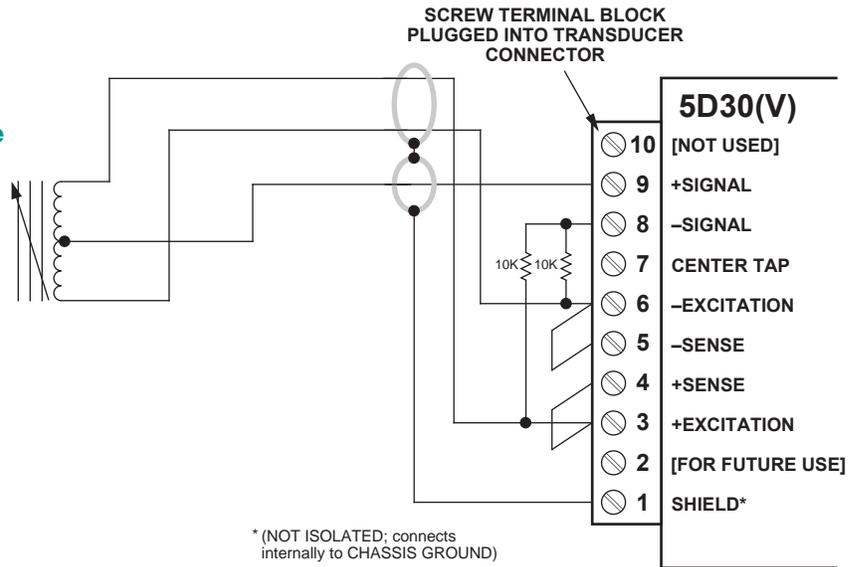
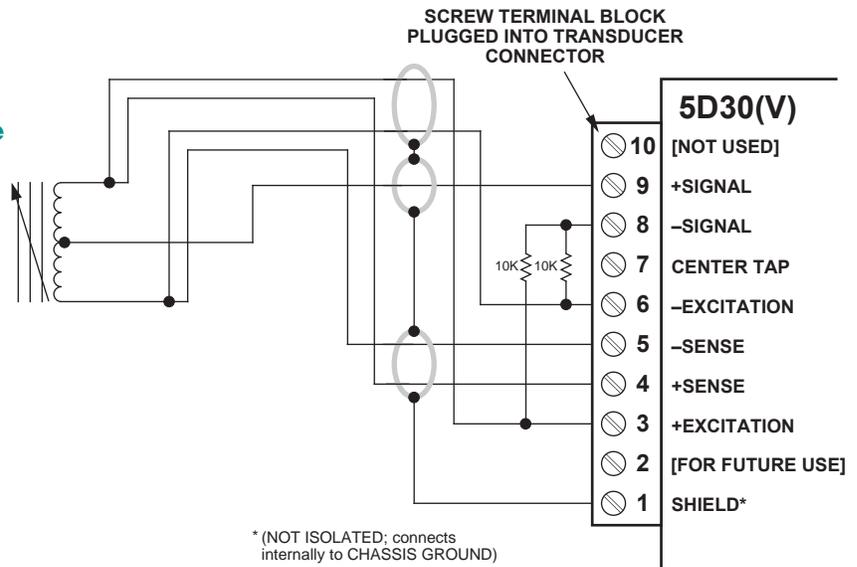


Fig. 7.f
5-Wire Variable Reluctance Transducer Cabling
(20 ft. or longer)



2. CONNECTIONS

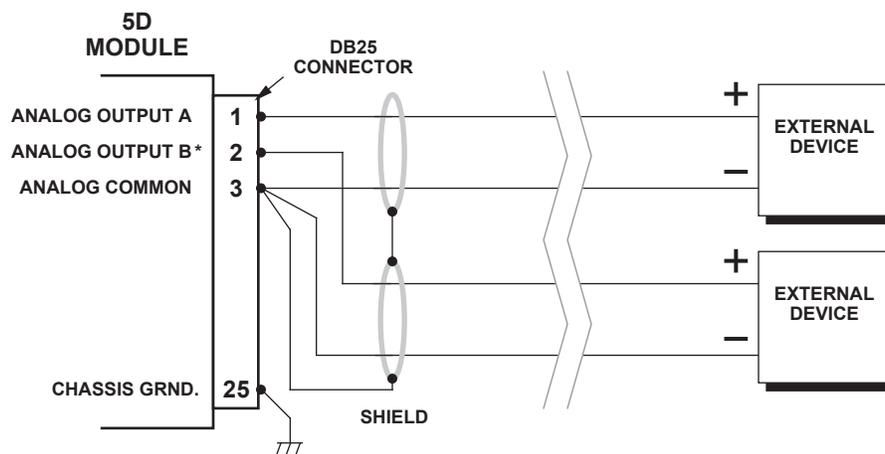
2.E ANALOG OUTPUT CONNECTIONS

Fig. 8 shows how an A/D Card, datalogger, recorder, or other external device connects to one of the Model 5D30's two ± 5 -V ANALOG OUTPUTS, using the standard DB25 connector shown in Fig. 4.a.* The 5D30V's two ± 10 -V outputs and the 5D30S's two ± 5 -V outputs are similarly connected, using the corresponding screw terminals shown in Fig. 4.b. Each output is single-ended, and returns to ANALOG COMMON. The cable shield should also be tied to ANALOG COMMON.

NOTE: When a network of 5D modules is installed in a Daytronic "5DMB" backplane unit, each module's Analog Output A is accessible from a terminal block on the board (Output B is also available when the eight-module **Model 5DMB-8** is used; see the the *Model 5DMB Instruction Manual* for full details).

* Outputs A and B are independently filtered. For the standard Model 5D30, Output A is continuously available, while Output B may be switched on and off via the logic "ENABLE" line (see Section 2.F, below). For the Models 5D30V and 5D30S ("S" Option), the "ENABLE" function is not provided, and both analog outputs are continuously available.

Fig. 8
5D Analog Output Connections



* Active when "Enable" is at LOGIC 1, which is the default state (i.e., in the absence of any connection to the ENABLE input terminal). See Fig. 9.

2. CONNECTIONS

2.F LOGIC INPUT CONNECTION

The standard DB25 connector of the **Model 5D30** (shown in Fig. 4.a) has a terminal for a single “positive-true” logic-level input (not available on the screw-terminal connector of the **Model 5D30V** or **Model 5D30S** (Fig. 4.b))*:

- **ENABLE** — used to switch the module’s ANALOG OUTPUT B**

Fig. 9.a shows how this command input can be applied to a 5D30’s DB25 connector, without the need of an external logic reference supply. You may also use active TTL logic, as illustrated in Fig. 9.b, to produce the “ENABLE ANALOG OUTPUT B” condition for the 5D30.

* For this input, the *Logic 1* state is represented by nominal 5 VDC, and is the “true” state (indicated by the *name* of the input); the *Logic 0* state is represented by nominal 0 VDC, and is the “false” state. Thus, when the “Enable” input is at *Logic 1*, Analog Output B is enabled. The logic input may be generated directly from dry contacts (switches, relays, etc.), as in Fig. 9.a, or from solid-state logic systems, as in Fig. 9.b. It will assume the *Logic 1* state in the absence of any connection.

** If the logic signal for control of a Model 5D30’s Analog Output B is referred to the same common as the analog outputs (i.e., ANALOG COMMON), Terminal No. 16 is available for connection of that signal. Note too that a logic input connected to Terminal No. 22 (only) may also be used in the initialization routine of certain Daytronic “5DMB” backplane units (see the *Model 5DMB Instruction Manual* and the description of the **MODULE IDENTIFICATION (MID)** command in Appendix A).

Since “ENABLE” is not provided for the Models 5D30V and 5D30S, both analog outputs are continuously available for these modules.

Fig. 9
Model 5D30 Logic Input Connection

Fig. 9.a
**Switch Closure,
No External Supply**

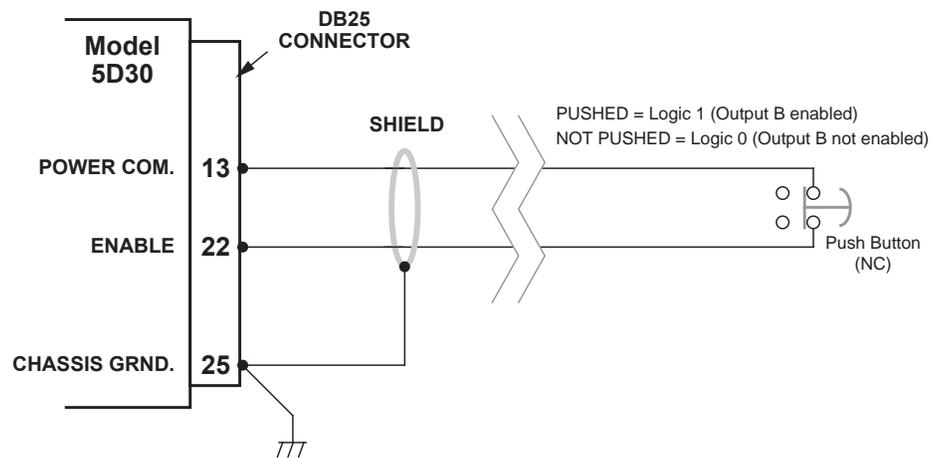
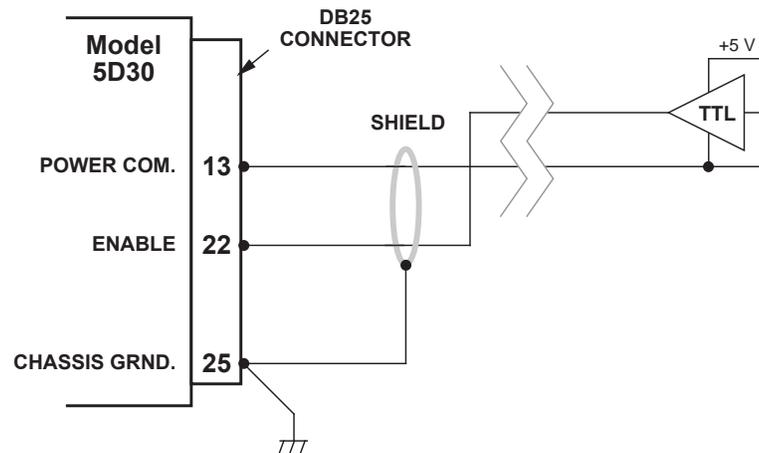


Fig. 9.b
Active TTL Logic



3. CONFIGURATION AND CALIBRATION

3.A USING THE 5D CONFIGURATOR

WHAT IS THE 5D CONFIGURATOR?

Employing the 5D Configurator software lets you define, store, edit, download, upload, and manage any number of “configurations” for a connected array of one to sixteen independent Daytronic “5D” Signal Conditioner Modules.

Every “5D configuration” actually consists of a numbered set of individual module configurations (or “setups”), one for each module in the connected network, along with general information pertaining to the complete collection of individual module setups.

Every real-world application of a particular 5D module requires its own unique configuration. A module “configuration” is a set of operating parameters that instruct the signal conditioner precisely how it is to process sensor-based measurement data. The information contained in a 5D module configuration includes module-specific setup parameters and calibration data.

Specifically, the 5D Configurator lets you

- set up and test serial communications between the PC running the Configurator software and each and every connected 5D module
- enter identifying and descriptive information for each connected 5D module, tag name, engineering units, optional description strings, and optional transducer model/serial number
- define module-specific setup values, including the module’s analog filter cutoff frequencies, plus (for the Model 5D30(V)) the AC excitation frequency level (3.28, 5, or 10 KHz)
- define or view general parameters relating to the entire set of individual module configurations, including file path and size, configuration description, calibration info., comments, etc.
- perform selected run-time operations, including
 - both “absolute” and two-point (deadweight) calibration of a specific module
 - sending one or more standard mnemonic commands to a specific module
 - applying a positive or negative mid-range calibration along with the two point calibration points
- download an individual module configuration to a specific module
- download an entire 5D configuration to a network of modules

- upload the current configuration(s) of all connected modules to a new configuration file, for storage and/or editing
- upload an individual module configuration (to be appended to the presently open configuration file)
- “update” an existing module configuration based on the active setup values of the corresponding connected module

STARTING THE 5D CONFIGURATOR

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

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

- OPEN AN EXISTING 5D CONFIGURATION by selecting Open... from the File menu
- CREATE A NEW 5D CONFIGURATION by selecting New... from the File menu
- UPLOAD A 5D CONFIGURATION by polling the connected module array to a New Configuration using the Serial Communications entry tab.

An overview of the procedure for creating a new module configuration via the New... command is given in Section 3.C, below.

FILE MENU

New...

Select to create a new configuration

Open...

Select to open an existing configuration

Close

Select to close the open configuration

Save

Select to close the open configuration

Save As...

Select to save the open configuration using a new file name

Exit

Select to exit the Configurator program

3. CONFIGURATION AND CALIBRATION

3.B SUMMARY OF CONFIGURATOR MENUS

SERIAL COMMUNICATION MENU

Initialize Port

Selects the computer's communication port to be utilized
- Com Port Definition

Terminal

Sends direct command and response syntax statements to the 5D modules. See section A.2

Upload 5D Module(s)

When selected, will upload all connected 5D modules.... up to 16 modules can be uploaded using the 5D configurator software.

In general, you will take the steps listed below to develop a *new configuration* for an array of one to sixteen connected 5D Signal Conditioner Modules (although the exact sequence of steps may vary, depending on your own preference). Alternatively, you may initially wish to upload the existing configuration of each connected 5D module to form a new 5D configuration, which you may then proceed to modify as desired. In this case, you need not perform the "To Create a New 5D configuration" as listed in section 3.C

The *numbering of individual modules* within a total 5D configuration is initially determined by the order in which they have been sequentially added to that configuration, or by the order of the list of serial numbers used by the Configurator to upload one or more individual configurations from the connected module array. Thus, any given Module Number within a total configuration *need not necessarily reflect the physical placement of that module on the external 5D network*. You can always rearrange the sequence of module setups so that they do in fact correspond to the external module arrangement. Modules can also be added or removed from the open configuration, as desired.

The Module Setup Parameters page displays in tabular form the most important setup parameters for all currently defined modules.

Once a given 5D module's setup configuration (Fig 5) has been completely entered (including all required calibration information), it may then be individually downloaded to that module. Or the entire "5D configuration" may be downloaded to the connected network, in which case each individual module setup within the collective configuration will be downloaded to its respective module.

HOME PAGE - SERIAL COMMUNICATIONS TAB

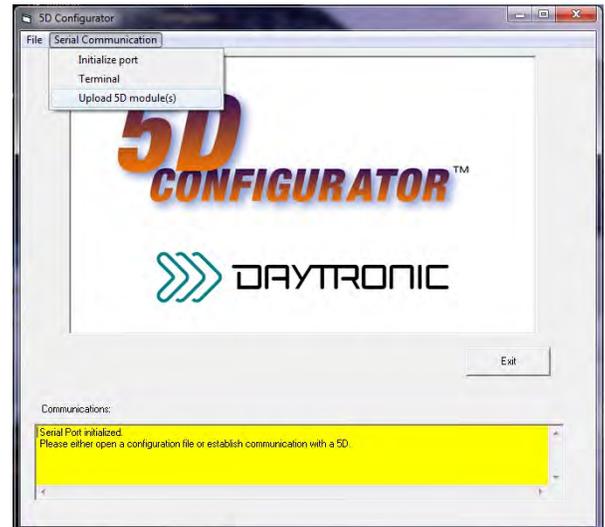


Fig. 1

NEW CONFIGURATION PAGE w/ default modules

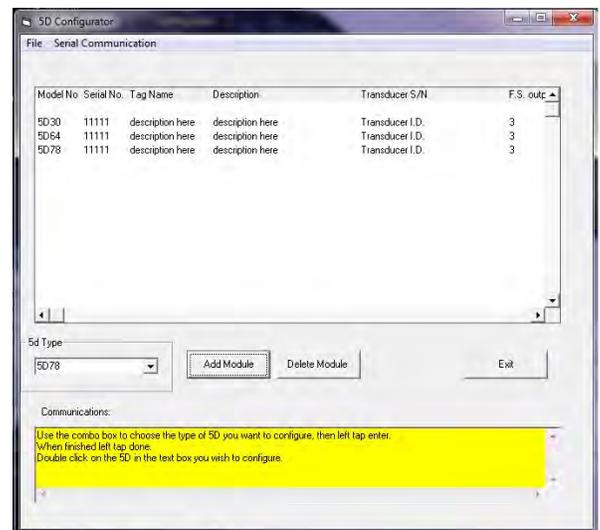


Fig. 2

3. CONFIGURATION AND CALIBRATION

3.C OVERVIEW OF THE CONFIGURATION PROCESS

To Create a New 5D configuration - OFF LINE

1. **Using the New... menu command**, open to a new (blank) configuration. A list of all available 5D Series Conditioner Modules appear in the pull down selection box on the left side of the menu. Select the Module type that you wish to add to the configuration. Click the Add Module button on the Module Setup page (Fig 2) to add the first module to the configuration. Continue to add module types as needed. Once completed, double click on the first Module Model No. in the worksheet area to begin configuration.
2. With the first Module selected, the Module Type Absolute Menu page (Fig 3) will be displayed allowing the user to configure the specific module's parameters as needed. Once the specific module parameters are entered, Click on the "Next 5D" to sequence to the next module in your configuration. Enter the specific parameters and continue through the complete configuration. When completed "Exit" the Absolute Configuration Page and save to file.
3. When the "New" configuration is downloaded to a connected 5D array, the program will query the modules and allow for proper serial number assignment and configuration. Each module configuration will be assigned it unique serial number, replacing the "11111" default ID. Save the configuration as needed on "Exit" of the Summary Configuration Page (Fig 4) or proceed to the "two point" calibration process for each module as describe in 3.D.

To Upload a connected 5D configuration - ON LINE

1. **Using the Upload 5D Module(s)... command**. Under the "Serial Communications" tab on the Home page. Click on the "serial communications" tab and click on the "Upload 5D modules" tab. Selecting this tab will initiate an uploading of the connected 5D modules configuration setups. Once completed the specific parameters are displayed on the Summary workspace screen. Double click on the specific module to review or change. Through the Model Type Absolute Menu page the user can access the "two point" or "dead-weight" calibration of the specific module.
2. The **Module Type Absolute Menu Page** is used to review, alter or process through the Module's parameters for a specific 5D that was uploaded, or created as "new". It is called "absolute" due to the module's calibration parameters being entered with known documented values such as sensitivity, full scale value, zero offset, expected load, etc. - which are downloaded to the module prior to a "two point" calibration verification. Menu through the parameters to configure the module for the application. Once a field value has been changed, the "Download" button will be enabled to allow the configuration to be sent the the specific 5D module. Note when completed the "Calculated Parameters" (which is the result of the entered menu values) will be the same as the "Current Parameters" (which are the values stored into the 5D module).

ABSOLUTE CONFIGURATION PAGE w/ default module

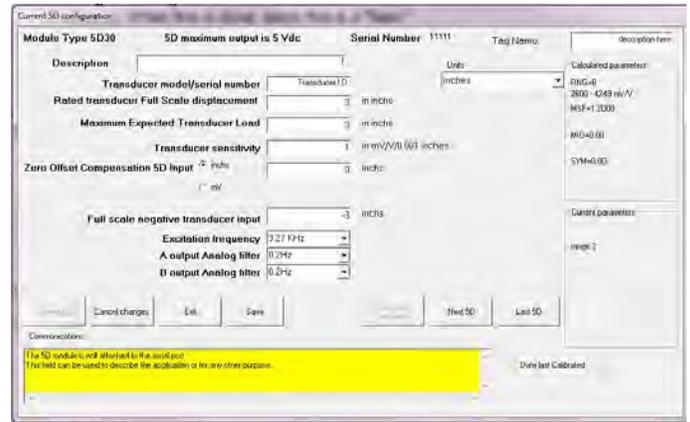


Fig. 3

SUMMARY CONFIGURATION PAGE w/ uploaded modules

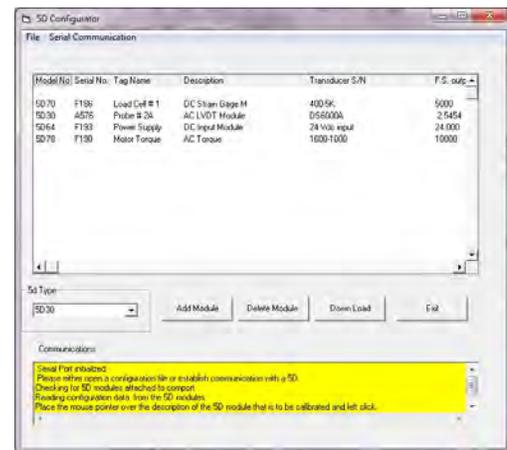


Fig. 4

ABSOLUTE CONFIGURATION PAGE w/ uploaded module

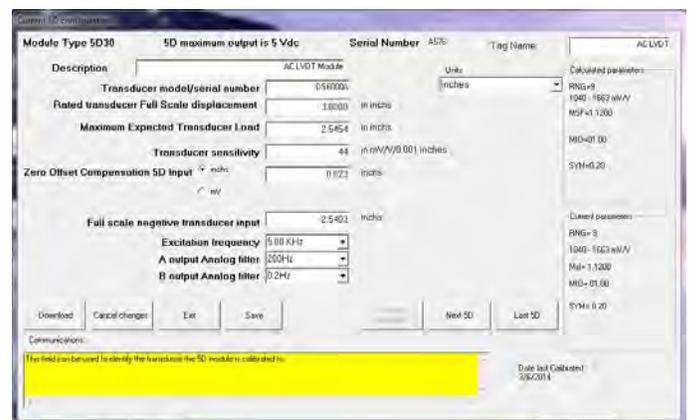


Fig. 5

3. CONFIGURATION AND CALIBRATION

ABSOLUTE CONFIGURATION PAGE parameter information

Changable user parameters -

Description - User entered description (up to 32 characters) scratch pad field for general module information

Tag Name - Short name field (16 characters) for ID information.

Transducer Model / Serial Number - User information for traceable connection of module to the sensor

Engineering Units - User information field for transducer measurement value

Transducer Rated Full Scale Load - Specification information of the transducer's rated capacity. Affects gain calculation.

Maximum Expected Transducer Load - Application information of the transducer's working capacity. Optimizes gain level.

Transducer sensitivity - Entry of the transducer's electrical characteristic, typically obtain from calibration document of the sensor

Zero Offset Compensation 5D Input - Select Offset value in Engineering Units or is Electrical Units

Offset value - Zero offset of the sensor (range is +/- 20% of full scale value)

Full Scale Negative Transducer Input - Used to calculate the symmetry compensation value level.

Excitation Frequency or Level - Module specific parameter for power to the sensor connected to the module.

"A" Output Analog Filter - Selects 3 db corner response on the analog output signal

"B" Output Analog Filter - Selects 3 db corner response on the analog output signal

Information parameters -

Module Type - 5D Module Model Identification

5D Maximum Output - Identifies the module's full scale output level.... 5V or 10V unit.

Serial Number - ID number of the Module used to address the unit for upload-download parameters

Download - Will initiate downloading of configuration parameters to the identified module

Cancel Changes - Clears changes to the module's calculated parameters

Exit - Returns user to Summary page or queries for a "save configuration" if needed.

Save - Queries user for file information to save the configuration.

Two Point Calibration - When enable via changes, will enter into the "Two-Point" menu page for on-line calibration process

Next 5D - Sequences to the next active 5D module in the current configuration

Last 5D - Sequences to the last active 5D module in the current configuration

Calculated Parameters - Absolute calibration calculated command parameters to be sent to the module for update **Current**

Parameters - Actual command parameters that are present in the module which affect calibration.

Date Last Calibrated - Recorded date of last calibration of the module.

3. CONFIGURATION AND CALIBRATION

3.D 5D30(V) CALIBRATION

CALIBRATION OVERVIEW

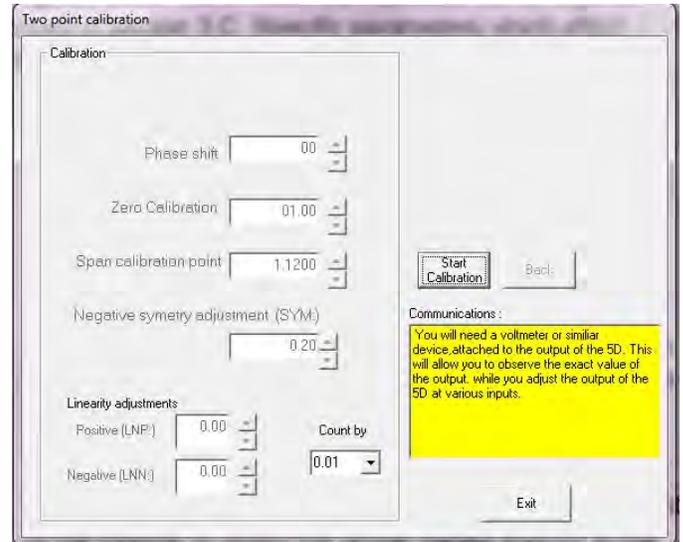
To calibrate a 5D30(V), the first step is to enter the User Configured parameters within the Absolute Menu Page as described in section 3.C. Specific parameters which affect calibration are:

- Transducer Rated Full Scale Load
- Maximum Expected Transducer Load
- Transducer sensitivity
- Offset value (Zero)
- Full Scale Negative Transducer Input, Symmetry
- Excitation level

1. Once the Absolute Calibration information has been downloaded to the specific module. The "Two Point" button will be enabled. Once the download is complete, Click on the "Two Point" button. When this action has been acknowledged, the "Two Point" page will be displayed.
2. Two Point calibration is used to "fine" tune the analog output of the module to reflect the actual values specific to the sensor's input to the module. Sometimes referred to as "dead weight calibration"; where the input is stimulated via a known value and those point are defined as calibration points.
3. With the analog output for the specific module under calibration - being measured (recommend a 5 digit voltmeter or similar device), begin the two point process by first doing a quick check of the "Zero" point and the "Full Scale" point to make sure the analog parameters are near the expected values for the sensor. Apply approximately 75% of the positive displacement to the sensor. With this value fixed, "click" on the "Start Calibration" button in the two point menu page.
4. Phase Shift will be hi-lighted. Increment and decrement this value so the "most" positive analog output value is obtained. (Note - if the analog signal is saturated (> 5 or 10 Vdc) then the gain setting on the Absolute Page will require adjustment.) Phase Shift aligns the AC excitation signal with the LVDT's output signal to compensate for cable and transducer phase shift errors for proper linearity.
5. Once completed, click "Continue", this will hi-light the "Zero Calibration" area. Select the "Count by" value needed for the adjustment. With a known Zero load (Null), increment or decrement the Zero Calibration field to achieve the expected Zero analog output result. Range adjustment for Zero is +/- 20.00% of full scale. Note when changing this value, it is done on-line with the module and a short delay will occur between the program action and the response of the analog output result.

* Note: Due to analog adjustment of the module, step 5 & 6 should be re-checked. Gain adjustment will affect the "zero" setting. Utilize the "Back" button for this purpose.

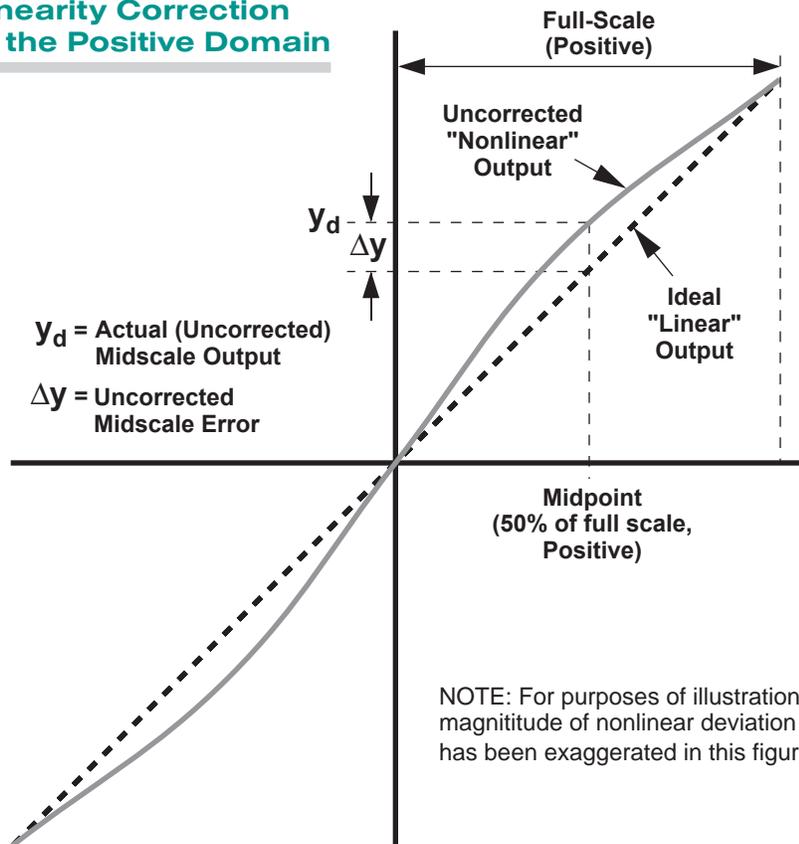
TWO POINT CALIBRATION PAGE



6. Once the "Zero" parameter has been established, Click "Continue" to proceed to the "Span Calibration Point". This field is used to adjust for any Gain or Span changes needed. While the sensor is loaded, increment or decrement the Span Calibration value for the appropriate analog output value. Typically this is done at the nominal working level of the sensor, which may or may not be full scale.
7. The 5D30(V) module has a "Negative symmetry adjustment" which is used to adjust the negative full scale gain or span position. This control has an adjustment range of +/- 2.00 % of full scale. To use this feature - Load the displacement sensor in the Negative direction and increment or decrement the controls for the proper negative analog value as referenced by the full scale displacement of the sensor.
8. Click "Continue" to proceed to the Linearity adjustment. The 5D30(V) module has mid-scale analog correction to compensate for any linearity errors at the mid-range area of the sensor. If needed, Load the sensor's to its positive mid-point value and increment or decrement the value (+/- 2.00 %) to provide correction to the positive analog output value, click "Continue" and apply the same procedure for the negative analog output level.
9. When completed, Click on the "Continue" button until it is no longer hi-lighted. Click on "Exit" to save the changes to the module. When downloading is complete, a menu to save the new configuration file will appear. On completion, the Absolute Calibration Page will be displayed over-viewing the calibrated module with the two point calibration values.

3. CONFIGURATION AND CALIBRATION

Fig. 11
Linearity Correction
in the Positive Domain



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

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

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

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

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

4. OPERATING CONSIDERATIONS

4.A SENDING A COMMAND TO THE 5D30(V)

The **5D Configurator** software lets you send standard mnemonic commands to a specific connected 5D module, one command at a time, while viewing the module's exact response to each command as it is sent. This feature can be used not only to perform run-time adjustments to the module setup, but also to review the module's current configuration status and to issue run-time "imperative" commands as desired.

For use of the Configurator's **Terminal...** window, see page 3.2 in the 5D Configurator Home Page

* When using a terminal program (such as Windows HyperTerminal), remember that every 5D module's RS232 communications interface employs a fixed protocol of 19,200 baud, 8 data bits, 1 stop bit, and No parity—with no software or hardware "handshake."

** The **QUERY MODULE ID (QID)** command may be used to obtain the serial number of each 5D module in a connected array, without having to "open" any specific module(s). See the description of **QID** in **Appendix A**.

A "terminal emulation" program (either conventional or customized) can also be used to issue standard mnemonic commands to one or more 5D modules, and to receive module responses.*

When using a terminal program, it is first necessary to issue an **OPEN (OPN)** command of the form

OPN=xxxx [CR]

* Note: OPN command is Case sensitive

in order to initiate single-point communications between the computer issuing the command and the single 5D module bearing SERIAL NUMBER "xxxx." The addressed module (only) will respond to a valid **OPN** command with "ACK."**

When a given 5D module is "open" for RS232 communications, its indicator light will *flash* (see Section 5.A).

For a discussion of 5D Series *command and response syntax*, plus a description of all 5D setup, interrogation, and imperative commands, see **Appendix A**.

5. TROUBLESHOOTING

5.A INTERPRETING THE STATUS INDICATOR LIGHT

Shown in Fig. 2, the 5D30(V)'s status indicator light serves to monitor the module's power, input, communications, and general health condition. The condition(s) represented by the light's three possible colors and color combinations are given below.

If the indicator light is *flashing* a single color, or is alternating between YELLOW and GREEN, it means that the module is currently "open" for RS232 communications (see Section 4.A, above). If the indicator is alternating between RED and GREEN, the module may or may not be "open." Obviously, if the indicator is lit with any color or color combination, it indicates that *power is ON*.

GREEN

Input signal is OK

YELLOW

Input signal is over 20% out of range

* This need not be a syntactically valid command (see Appendix A); it could, in fact, be any ASCII string terminated by a carriage return.

RED

Serious input condition detected (e.g., excessive current, overvoltage); could indicate transducer short or faulty cabling

YELLOW / GREEN

The module has received a mnemonic command* through its RS232 port (the yellow light will continue for about a second after receipt of the command-terminating carriage return)

RED / GREEN

Significant internal software error detected; contact the Daytronic Service Department

5.B INTERPRETING THE MODULE DIAGNOSTIC CODE

The last four characters of a 5D module's response to a **MODULE IDENTIFICATION (MID)** interrogation will always represent the module's current ERROR (or DIAGNOSTIC) CODE. Intended primarily as a programming tool, this code will help identify the nature of syntax and communications errors when they occur (when, for example, the computer receives a response of "NAK" instead of an expected "ACK").*

The first of the four code characters is an alphanumeric character (0 through 9, A through J, or Z). The next three characters are hexadecimal digits (0 through 9, A through F). Note that syntax and communication errors will combine additively to generate the respective digit. For example, a combination of *serial communication* errors "4" and "8" will yield a fourth character of "c" (= decimal 12).

* After a mnemonic command has been sent to a given 5D module via the Configurator's **Send Command...** window (see Section 4.A), the module will be immediately and automatically queried for its current diagnostic code. The response will be displayed in the lower right-hand corner of the window. If an erroneous command has been sent, the code will help identify the precise nature of the error.

The diagnostic code characters (X_1, X_2, X_3, X_4) are as follows:

FIRST CHARACTER (X_1)

Indicates the *three-letter MNEMONIC CODE* of the *previously received command*:

X_1	MNEMONIC	X_1	MNEMONIC
0	[NONE]	C	RNG
1	AFL	D	RSM
2	EXC	E	SEN
3	EXF	F	SHN
4	FAZ	G	SHP
5	MID	H	SHS
6	MIO	J	SYM
7	MOO	P	LNP
8	MP_	N	LNN
9	MSF	R	TWW
A	OPN	Z	UNKNOWN
B	QID		

(cont'd)

5. TROUBLESHOOTING

SECOND CHARACTER (X₂)

Indicates *SYNTAX OR VALUE* error:

X ₂	Error
0	NONE
1	Syntax Error
2	Numeric Range Error
4	[NOT USED]
8	[NOT USED]

THIRD CHARACTER (X₃)

Indicates *OTHER COMMUNICATION* error:

X ₃	Error
0	NONE
1	Unknown Mnemonic
2	Illegal Character in Mnemonic Field
4	[NOT USED]
8	[NOT USED]

FOURTH CHARACTER (X₄)

Indicates *SERIAL COMMUNICATION* error:

X ₄	Error
0	NONE
1	Break, UART Framing or Overrun Error
2	Receive Buffer Overrun
4	Insufficient Characters for Command
8	Received Before ACK/NAK (i.e., before a previous command had been answered)

APPENDIX A: 5D30(V) COMMANDS

SUMMARY OF 5D30(V) MNEMONIC COMMANDS

PLEASE NOTE: This appendix treats only those 5D Series mnemonic commands that are applicable to the **Model 5D30 or 5D30V DC Strain Gage Conditioner**. Valid commands that only apply to other 5D models (and NOT to the 5D30(V)) will evoke a response of **NAK** when issued to a 5D30(V) module.

A.1 COMMAND AND RESPONSE SYNTAX

When issuing one or more commands to a 5D module by some means *other than the 5D CONFIGURATOR software*, please note the following:

- You must apply the **OPEN (OPN)** command to establish RS-232 communications with that module, as explained in Section 4.A (“Sending a Command to the 5D30(V)”). The **QUERY MODULE ID (QID)** command may be used to obtain the serial number of every connected module, prior to application of the **OPN** command to any specific module.
- *SPACE CHARACTERS SHOULD NOT BE INCLUDED IN ANY COMMAND EXPRESSION.**
- ALL *COMMANDS* ISSUED TO A 5D MODULE ARE TO BE TERMINATED BY A SINGLE **CARRIAGE RETURN ([CR])****. ALL *RESPONSES* BY THE 5D MODULE ARE ALSO TERMINATED BY A **CARRIAGE RETURN ([CR])**. This standard termination is not shown in the specific commands and responses listed below.
- After a command has been issued, no further characters should be sent *until receipt of a response to that command (ACK, NAK, or ANSWER)*, or until at least *0.25 second* has elapsed without response (indicating that no module is currently “open”).

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

[MNEMONIC]=[value][CR]

* The only exception to this rule are the following **MODULE PARAMETER (“MP”)** commands: **MP0, MP1, MP2, MP3, MP4, MP5, MP8, and MP9**. Spaces may be included in the character string being entered via the “write” form of any of these commands (the **MP6, MP7, MPA, MPB, MPC, and MPD** commands should never include spaces). See below for the allowed syntax of each “MP” command.

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

Upon receipt of a setup command, the module will issue a response of either “ACKNOWLEDGED” or “NOT ACKNOWLEDGED”—i.e., of either

ACK[CR] or NAK[CR]

NOTE: The **ACK[CR]** message will be issued only after the received setup value has been successfully stored in the 5D module’s EEPROM memory.

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

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

[MNEMONIC][CR]

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

[value][CR]

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

An *imperative* command does not store or request information, but rather tells the module to do something (for example, **OPN=xxxx[CR]** opens single-point communications with the module of serial number “xxxx”). The general form of an imperative command will usually resemble that of an interrogation command, being usually a single three-character mnemonic, although—as in the case of **OPN**—it can sometimes resemble a setup command. Upon receipt of an imperative command, the module will issue a response of either

APPENDIX A: 5D30(V) COMMANDS

ACK[CR] or **NAK[CR]**, depending on whether or not the command has been recognized as valid.

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

A.2 5D30(V) SETUP AND INTERROGATION COMMANDS

AFL ANALOG FILTER

AFL=f_A,f_B Sets the analog output filter constant for the module's Output A (continuous output) to the number f_A (1 through 5) and for Output B (switched output) to the number f_B (1 through 5). Actual cutoff frequencies corresponding to filter constants are module-specific; for the Model 5D30(V), they are as follows:

$$f_A/f_B = 1 : 0.2 \text{ Hz}$$

$$f_A/f_B = 2 : 2 \text{ Hz}$$

$$f_A/f_B = 3 : 20 \text{ Hz}$$

$$f_A/f_B = 4 : 200 \text{ Hz}$$

$$f_A/f_B = 5 : 2000 \text{ Hz, } 1400 \text{ Hz, or } 1100 \text{ Hz}^*$$

Note that if a low filter setting (0.2, 2, or 20 Hz) is selected for BOTH f_A and f_B, the settings must be the same.

AFL Reads current filter-constant values; returns f_A,f_B.

EXF EXCITATION FREQUENCY

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

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

FAZ PHASE

FAZ=n Sets the module's phase adjustment value to n degrees (where -39 ≤ n ≤ 39). NOTE: the **FAZ** value must be expressed in the format of XX, with or without minus sign (e.g., **FAZ=01** and **FAZ=-22** are acceptable; **FAZ=1** and **FAZ=+22** are not).

FAZ=U Increments the module's current phase adjustment by 1 degree, unless the existing value is 39.

FAZ=D Decrements the module's current phase adjustment by 1 degree, unless the existing value is -39.

FAZ Reads current phase adjustment value; returns n.

LNN NEGATIVE LINEARITY

LNN=m Sets the module's negative linearity adjustment to the value m (% of actual midscale output reading), where -2 ≤ m ≤ 2. A *positive* LNN value moves the negative-domain midpoint upwards (yielding a smaller negative reading at that point), while a *negative* LNN value moves it downwards (yielding a larger negative reading). NOTE: The LNN value must be expressed in the format of X.XX (%), with or without minus sign (e.g., **LNN=0.00**, **LNN=1.40**, and **LNN=-0.60** are acceptable; **LNN=0** and **LNN=+0.60** are not).

LNN Reads current negative linearity adjustment value; returns m.

LNP POSITIVE LINEARITY

LNP=m Sets the module's positive linearity adjustment to the value m (% of actual midscale output reading), where -2 ≤ m ≤ 2. A *positive* LNP value moves the positive-domain midpoint upwards (yielding a larger positive reading at that point), while a *negative* LNP value moves it downwards (yielding a smaller positive reading). NOTE: The LNP value must be expressed in the format of X.XX (%), with or without minus sign (e.g., **LNP=0.00**, **LNP=1.40**, and **LNP=-0.60** are acceptable; **LNP=0** and **LNP=+0.60** are not).

LNP Reads current positive linearity adjustment value; returns m.

MID MODULE IDENTIFICATION

MID Reads the module's current ID and diagnostic information string. Returns 5Dnn,xxxx,hhhh (where "5Dnn" is the **Model Number**, "xxxx" is the 4-charac-

* Depending on the 5D30(V)'s currently selected **EXCITATION FREQUENCY (EXF)** value: for an excitation of 10.00 kHz, **AFL = 5** corresponds to 2000 Hz; for 5.00 kHz, to 1400 Hz; and for 3.27 kHz, to 1100 Hz.

APPENDIX A: 5D30(V) COMMANDS

ter alphanumeric **Serial Number**, and “hhhh” is the 4-character hexadecimal-ASCII **ERROR CODE**—see Section 5.B).

(cont'd)

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

ALSO NOTE: When the MID command is issued within 5 seconds of powerup to a module with the “ENABLE” line at the *Logic 1* state, a MID response will be returned even though that module has not been specifically “opened” by means of the **OPEN (OPN)** command (see below). This feature is used in the initialization routine of certain Daytronic “5DMB” motherboard backplane units, where the installed modules are sequentially enabled in order to determine their respective connector “locations” (as well as their respective model and serial numbers)—see the *Model 5DMB Instruction Manual*. Unless you are sure that *no more than one 5D module of the connected network is presently “enabled,”* do not issue a MID command within 5 seconds of network powerup.

MIO MODULE INPUT OFFSET

MIO=m Sets the *pre-amplified* (analog input) offset to the value m (% of selected full-scale input range—see **RNG**, below), where $-20 \leq m \leq 20$. NOTE: The MIO value must be expressed in the format of XX.XX (% of full-scale range), with or without minus sign (e.g., **MIO=01.33** and **MIO=-14.50** are acceptable; **MIO=1.33**, **MIO=-14.5**, and **MIO=+14.50** are not).

MIO Reads current module input offset value; returns m.

MP1 through MPD MODULE PARAMETER

Used by the 5D CONFIGURATOR software to write and read miscellaneous module configuration information, as follows (each **MPn** string \$ can have up to 16 ASCII characters; *spaces* may be included as desired or required in all but the **MP6**, **MP7**, **MPA**, **MPB**, **MPC**, and **MPD** strings):

MP0=\$ \$ = Module Tag Name

NOTE: Do not enter more than eight (8) characters for the tag name; no more

than eight characters will be uploaded by the 5D Configurator software.

MP1=\$ \$ = Module Description (first 16 characters)

NOTE: The MP1, MP2, and/or MP3 string may be NULL (no characters), if desired.

MP2=\$ \$ = Module Description (next 16 characters)

MP3=\$ \$ = Module Description (final 16 characters)

MP4=\$ \$ = Last Download Date/Time

NOTE: The 5D Configurator software requires an MP4 format of “(M)M/(D)D/YY (H)H:MM A” or “(M)M/(D)D/YY (H)H:MM P,” depending on whether the time is “AM” or “PM,” respectively; digits in parentheses are optional

MP5=\$ \$ = Engineering Units

NOTE: The MP5 string may be NULL (no characters), if desired.

MP6=\$ \$ = CAL1,CAL2

NOTE: The 5D Configurator software requires an MP6 format of “[number],[number].”

MP7=\$ \$ = CAL3,CAL4

NOTE: The 5D Configurator software requires an MP7 format of “[number],[number].”

MP8=\$ \$ = Last Calibration Date/Time

NOTE: The 5D Configurator software requires an MP8 format of “(M)M/(D)D/YY (H)H:MM A” or “(M)M/(D)D/YY (H)H:MM P,” depending on whether the time is “AM” or “PM,” respectively; digits in parentheses are optional

MP9=\$ \$ = Transducer Model/Serial Number

NOTE: The MP9 string may be NULL (no characters), if desired.

MPA=\$ \$ = Calibration Mode,Sensitivity Mode, CAL4 (Zero Offset) Mode

NOTE: The Calibration Mode is applicable where two or more forms of absolute calibration are possible for a given 5D module; the Sensitivity Mode is applicable for modules that offer a “TRANSDUCER” absolute calibration mode; the CAL4 Mode selects between a calibration zero offset

APPENDIX A: 5D30(V) COMMANDS

expressed in engineering UNITS or in raw MILLIVOLTS (see Section 3.D). Allowed Calibration and Sensitivity Mode strings are model-specific; if not applicable to a model, the Calibration and Sensitivity Modes should be NULL (no characters). The CAL4 Mode string—immediately following the second comma in the MPA expression—is always a single character: either **U** (for UNITS) or **V** (for MILLIVOLTS).

MPB=\$	\$ = ZERO,SPAN NOTE: The 5D Configurator software requires an MPB format of “[number],[number].”
MPC=\$	\$ = Two-Point Calibration Mode NOTE: This string is always a single character: either U (for UNITS) or V (for VOLTS).
MPD=\$	\$ = CAL5 NOTE: The 5D Configurator software requires an MPD format of “[number].”
MP0	Reads the current MP0 string; returns \$
MP1	Reads the current MP1 string; returns \$
Etc.	

MSF MODULE SCALE FACTOR

MSF=m	Sets the module gain (scale factor) to the value m, where $1.0000 \leq m \leq 1.6999$ (for the Model 5D30(V)); m is used as a multiplier for the full-scale input range (see RNG , below), and must be expressed in the format of 1.XXXX.
MSF	Reads the current module scale factor value; returns m.

RNG RANGE

RNG=r	Sets the module’s range code to the alphanumeric character r. Allowed full-scale input ranges are module-specific; for the Model 5D30(V), they are as follows (see Table 2, Appendix B, for the associated “practical” ranges): r = 0 : 16 mV/V r = 1 : 25 mV/V r = 2 : 40 mV/V r = 3 : 64 mV/V r = 4 : 100 mV/V r = 5 : 160 mV/V r = 6 : 250 mV/V r = 7 : 400 mV/V r = 8 : 640 mV/V r = 9 : 1000 mV/V r = A : 1600 mV/V r = B : 2500 mV/V
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RNG	Reads current module range code; returns r.
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SYM NEGATIVE SYMMETRY

SYM=m	Sets the module’s negative symmetry adjustment to the value m (% of full scale), where $-2 \leq m \leq 2$. NOTE: The SYM value must be expressed in the format of X.XX (% of full scale), with or without minus sign (e.g., SYM=0.00 and SYM=-1.60 are acceptable; SYM=0 and SYM=+1.60 are not).
SYM	Reads current negative symmetry adjustment value; returns m.

A.3 5D30(V) IMPERATIVE COMMANDS

OPN OPEN

OPN=xxxx Opens single-point communications between the computer or other device issuing the command and the single 5D module bearing **Serial Number** “xxxx” (see the **MID** command, above). The addressed module (only) will respond to a valid OPN command with “ACK.” NOTE: Issuing any OPN command—valid or invalid—will automatically cancel any previous OPN command.

NOTE: This command cannot be sent via the Configurator’s **Send Command...** window.

QID QUERY MODULE ID

QID Reiteration of this command allows the creation of a list of the Serial Numbers of all modules in a connected array. Upon each issuance of QID, one and only one module in the array will respond with its 4-character alphanumeric serial number (see the **MID** command, above), after which that module is placed in a “mute” mode, so that it will not respond to subsequent QID interrogations. After all modules in the array have delivered their respective serial numbers and have been “muted,” the issuance of QID will yield *no response*, which signals that the interrogation session is complete. Each module may then be specifically “opened” (via the **OPN** command) and queried for complete ID information (via the **MID** command). NOTE: The first issuance of QID places all modules in the “QID MODE,” in which state they will remain until an OPN command (valid or invalid) is issued.

NOTE: This command cannot be sent via the Configurator’s **Send Command...** window.

APPENDIX B: MSF & MIO CALCULATION

5D30(V) ABSOLUTE CALIBRATION CALCULATIONS

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

$$R_e = \text{CAL2} \cdot \text{CAL3}$$

where the allowed limits of R_e (for the Model 5D30(V)) are 16 to 4249.75 (mV/V).^{*} For an explanation of the “CAL1,” “CAL2,” “CAL3,” “CAL4,” and “CAL5” values, see Section 3.D.

Using the calculated R_e as a “practical range” value, an appropriate module full-scale input **RANGE (RNG)** setting is determined by means of the following table^{**}:

Table 2
“Practical” 5D30(V)
Range (RNG) Settings

If the Actual Full-Scale Range (in mV/V) Lies Between...	“Practical” Nominal Range to Select (in mV/V)	“RNG” Setting
16.0000 and 25.9999	16	0
26.0000 and 41.5999	25	1
41.6000 and 66.5599	40	2
66.5600 and 103.9999	64	3
104.0000 and 166.3999	100	4
166.4000 and 259.9999	160	5
260.0000 and 415.9999	250	6
416.0000 and 665.5999	400	7
665.6000 and 1039.9999	640	8
1040.0000 and 1663.9999	1000	9
1664.0000 and 2599.9999	1600	A
2600.0000 and 4249.7500	2500	B

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

$$\text{MSF} = R_e / \text{RNG}$$

where RNG is the mV/V value corresponding to the module’s current **RANGE (RNG)** setting (as given in

Table 2). To be accepted by the 5D30(V) module, the **MSF** value must be expressed in the format of **1.XXXX**; it cannot be less than 1.0000 or greater than 1.6999.

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

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

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

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

or

$$\text{MIO} = (\text{CAL4}/10000)\text{MSF} \cdot 100$$

depending on whether it is a Model 5D30 or 5D30V, respectively.

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

The **SYM** adjustment factor is calculated by

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

where “NCAL3” = $\text{CAL3} \cdot (-1)$. The **SYM** value must be expressed in the format of **X.XX** (%), with or without minus sign; its absolute value cannot be greater than 2.

The 5D30(V) is then calibrated “absolutely” upon receipt of the appropriate **RANGE (RNG)**, **EXCITATION FREQUENCY (EXF)**, **MODULE SCALE FACTOR (MSF)**, **MODULE INPUT OFFSET (MIO)**, and **NEGATIVE SYMMETRY (SYM)** setup commands (for command syntax, see Appendix A).

^{*} These limits are defined for the product (**MSF · RNG**), which must lie between the low limit of “16” (= 1.0000 x 16, for the lowest **RNG** of 16 mV/V) and the high limit of “4249.75” (= 1.6999 x 2500, for the highest **RNG** of 2500 mV/V).

^{**} This table takes into account the effective 4% overlap that has been built into the 5D30(V) scaling structure. As can be seen from the table, if the actual full-scale range lies *close to a given nominal range value*, it is most “practical” to select the range just *below* that nominal value. For example, if your *actual* transducer full-scale range is 164 mV/V, it is most practical to select a *nominal* range of **100 mV/V** (and NOT 160 mV/V), since 164 lies between 104.0000 and 166.3999.



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