

# DIN DC Strain Gage Conditioner

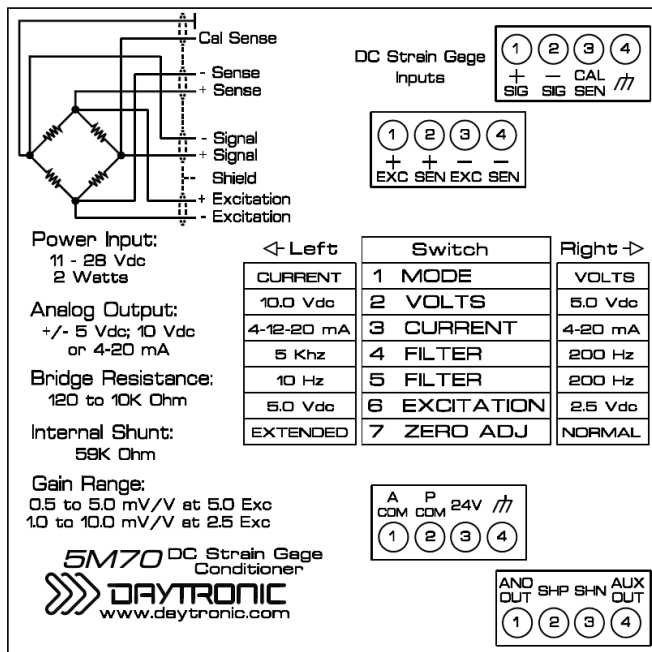
## MODEL 5M70

### DC Strain Gage CONDITIONER Module

#### 1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 5M70 is a single-channel DIN Mount instrument which is easily configured, rugged, analog based signal conditioner made to operate with traditional Wheatstone mv/V stain gage bridge sensors used to measure force, pressure, torque and other DC strain gage related measurements. The Model 5M70 has an extremely wide DC power input range with user selectable gain, zero and analog output making it adaptable to any users sensor application that requires stable, repeatable and noise free analog signals for control or data acquisition.

The Model 5M70 is best calibrated by means of a "two-point (dead-weight)" or shunt-calibration technique, which is outlined in section three. The supplied calibration resistor is 59 kilohms, 1% which is located internally to the 5M70 case.



#### Model 5M70 DC Strain Gage Module

Access switch settings via the front panel of the 5M70 by gently pulling the clear plastic cover (from the bottom side) so the cover rotates open from the top. Use a small tool or finger to place the switches to the left or right position as you face the front of the module. This process can be done with or without power to the unit. Once completed, return the cover to the original position.

#### DC Strain Gage Symmetry Operation

For applications requiring precision in both tension and compression (CW & CCW for torque cells), the 5M70 contains a symmetry adjustment which corrects for negative span or slope of the transducer.

View of Side Label of the Model 5M70 DC Strain Gage Module

## **WARNING**

Death, serious injury, or fire hazard could result from improper connection of this instrument. Read and understand this manual before connecting this instrument. Follow all installation and operating instructions while using this instrument.

Connection of this instrument must be performed in compliance with the National Electrical Code (ANSI/NFPA 70-2014) of USA and any additional safety requirements applicable to your installation.

Installation, operation, and maintenance of this instrument must be performed by qualified personnel only. The National Electrical Code defines a qualified person as "one who has demonstrated the skills and knowledge related to the construction and operation of the electrical equipment and installations, and who has received safety training on the hazards involved."

Qualified personnel who work on or near exposed energized electrical conductors must follow applicable safety related work practices and procedures including appropriate personal protective equipment in compliance with the Standard for Electrical Safety Requirements for Employee Workplaces (ANSI/NFPA 70E-2012) of USA and any additional workplace safety requirements applicable to your installation.

## **ADVERTENCIA**

Una conexión incorrecta de este instrumento puede producir la muerte, lesiones graves y riesgo de incendio. Lea y entienda este manual antes de conectar. Observe todas las instrucciones de instalación y operación durante el uso de este instrumento.

La conexión de este instrumento a un sistema eléctrico se debe realizar en conformidad con el Código Eléctrico Nacional (ANSI/NFPA 70-2014) de los E.E.U.U., además de cualquier otra norma de seguridad correspondiente a su establecimiento.

La instalación, operación y mantenimiento de este instrumento debe ser realizada por personal calificado solamente. El Código Eléctrico Nacional define a una persona calificada como "una que esté familiarizada con la construcción y operación del equipo y con los riesgos involucrados."

El personal cualificado que trabaja encendido o acerca a los conductores eléctricos energizados expuestos debe seguir prácticas y procedimientos relacionados seguridad aplicable del trabajo incluyendo el equipo protector personal apropiado en conformidad con el estándar para los requisitos de seguridad eléctricos para los lugares de trabajo del empleado (ANSI/NFPA 70E-2012) de los E.E.U.U. y cualquier requisito de seguridad adicional del lugar de trabajo aplicable a su instalación.

## **AVERTISSEMENT**

Si l'instrument est mal connecté, la mort, des blessures graves, ou un danger d'incendie peuvent s'en suivre. Lisez attentivement ce manuel avant de connecter l'instrument. Lorsque vous utilisez l'instrument, suivez toutes les instructions d'installation et de service.

Cet instrument doit être connecté conformément au National Electrical Code (ANSI/NFPA 70-2014) des Etats-Unis et à toutes les exigences de sécurité applicables à votre installation.

Cet instrument doit être installé, utilisé et entretenu uniquement par un personnel qualifié. Selon le National Electrical Code, une personne est qualifiée si "elle connaît bien la construction et l'utilisation de l'équipement, ainsi que les dangers que cela implique".

Le personnel qualifié qui travaillent dessus ou s'approchent des conducteurs électriques activés exposés doit suivre des pratiques en matière et des procédures reliées par sûreté applicable de travail comprenant le matériel de protection personnel approprié conformément à la norme pour des conditions de sûreté électriques pour les lieux de travail des employés (ANSI/NFPA 70E-2012) des Etats-Unis et toutes les conditions de sûreté additionnelles de lieu de travail applicables à votre installation.

## WARNUNG

Der falsche Anschluß dieses Gerätes kann Tod, schwere Verletzungen oder Feuer verursachen. Bevor Sie dieses Instrument anschließen, müssen Sie die Anleitung lesen und verstanden haben. Bei der Verwendung dieses Instruments müssen alle Installation- und Betriebsanweisungen beachtet werden.

Der Anschluß dieses Instruments muß in Übereinstimmung mit den nationalen Bestimmungen für Elektrizität (ANSI/NFPA 70- 2014) der Vereinigten Staaten, sowie allen weiteren, in Ihrem Fall anwendbaren Sicherheitsbestimmungen, vorgenommen werden.

Installation, Betrieb und Wartung dieses Instruments dürfen nur von Fachpersonal durchgeführt werden. In dem nationalen Bestimmungen für Elektrizität wird ein Fachmann als eine Person bezeichnet, welche "mit der Bauweise und dem Betrieb des Gerätes sowie den dazugehörigen Gefahren vertraut ist."

Qualifiziertes Personal, das an bearbeiten oder herausgestellte angezogene elektrische Leiter sich nähern, muß anwendbare Sicherheit bezogener Arbeit Praxis und Verfahren einschließlich passende persönliche schützende Ausrüstung gemäß dem Standard für elektrische Sicherheitsauflagen für Angestellt-Arbeitsplätze (ANSI/NFPA 70E-2012) der Vereinigten Staaten und alle zusätzlichen Arbeitsplatzsicherheitsauflagen folgen, die auf Ihre Installation anwendbar sind.

## Safety Precautions

The following safety precautions must be followed whenever any type of voltage or current connection is being made to the instrument.

- Before connecting to electric circuits or pulse initiating equipment, open their related breakers or disconnects. It is recommended NOT TO install any connection of the instrument on live power lines. Only Qualified Service personnel that have demonstrated the abilities and received the proper safety training are capable of connecting to live circuits.
- Connections must be made to the instrument first, then connect to the circuit to be monitored.
- Wear proper personal protective equipment, including safety glasses and insulated gloves when making connections to power circuits.
- Hands, shoes and floor must be dry when making any connection to a power line.
- Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.
- If the equipment is used in a manner not specified in this user's guide, the protection provided by the equipment may be impaired.

## Medidas de seguridad

Las medidas de seguridad siguientes deberán observarse cuando se realice cualquier tipo de conexión al instrumento.

- o Cuando se haga conexiones a circuitos eléctricos o a equipo de activación por pulso, deberá abrirse sus respectivas cajas de seguridad. NO deberá hacerse ninguna conexión del instrumento en líneas eléctricas bajo tensión.
- o Las conexiones deberán hacerse primero al instrumento y, luego, al circuito a ser monitorizado.
- o Al hacer conexiones a circuitos eléctricos, deberá utilizar anteojos y guantes protectores.
- o Sus manos, zapatos y el piso deberán estar secos en todo momento en que se haga una conexión a un cable eléctrico.
- o Verifique que la unidad esté DESACTIVADA antes de conectar sondas en el panel posterior.
- o Previo a cada uso, deberá verificarse que los cables no estén rotos y que el material aislante no tenga rajaduras. Reemplace de inmediato cualquier parte defectuosa.

## Mesures de Sécurité

Les mesures de sécurité suivantes doivent être prises chaque fois qu'un type de connexion quelconque est effectué sur l'instrument.

- o Ouvrir les disjoncteurs correspondants lors d'une connexion à des circuits électriques ou à des équipement de génération d'impulsions. NE PAS effectuer de connexion d'instrument sur des lignes électriques sous tension.
- o Une fois toutes les connexions de l'instrument effectuées, connecter au circuit à contrôler.
- o Porter des lunettes de protection et des gants isolants pour effectuer des connexions aux circuits électriques.
- o S'assurer que les mains, les chaussures et le sol soient secs lors de connexions à une ligne électrique.
- o S'assurer que l'unité est ÉTEINTE avant de connecter les sondes au panneau arrière.
- o Inspecter tous les câbles, avant chaque utilisation, pour s'assurer que les isolants ne sont pas coupés ou fendus. Remplacer immédiatement tous les équipements défectueux.

## Sicherheitsvorkehrungen

Die folgenden Sicherheitsvorkehrungen sind immer dann zu befolgen, wenn eine Verbindung zum Instrument hergestellt wird.

- o Öffnen Sie beim Anschluß an elektrische Stromkreise oder Impulsauslösungseinrichtungen die entsprechenden Unterbrecher. Es dürfen KEINE Anschlüsse an das Instrument unter stromführenden Spannungsleitungen montiert werden.
- o Die Verbindungen müssen zuerst am Instrument und danach an der zu überwachenden Schaltung hergestellt werden.
- o Tragen Sie Schutzbrillen und Isolierhandschuhe, wenn Sie Anschlüsse an den Stromkreisen vornehmen.
- o Hände, Schuhe und Fußboden müssen trocken sein, wenn Sie Anschlüsse an den Stromkreisen durchführen.
- o Stellen Sie sicher, daß das Gerät AUSgeschaltet ist, bevor Sie an der rückwärtigen Konsole Meßfühler anschließen.
- o Prüfen Sie vor jedem Gebrauch alle Kabel auf Bruchstellen und Risse in der Isolierung. Wechseln Sie schadhafte Kabel sofort aus.

## Standard Accessories

### Standard accessories

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The following table lists the 5M standard accessories.

Description	Part Number
Manual & Operating instruction	Resource CD

# 5M70 DC Strain Gage Module

## 5M70 SPECIFICATIONS

**Measurement Range:** Adjustable 0.5 mV/V to 10.0 mV/V; nominal full-scale

**Transducer Types:** Conventional 4-arm strain gage bridges, 120 to 10 k ohm

**Excitation:** 2.5 or 5.0, selectable - up to 70mA

**Power Supply :** 11 - 28 Vdc regulated; 2 watts max.

**Analog Output:** selectable;  $\pm 0$  to 5,  $\pm 0$  to 10 Vdc, 4-12-20 or 4-20mA (20% over-range, voltage only)

**Operating Temperature :** -10 to +70 Degrees C, 5 to 95% relative humidity, non-condensing

**Accuracy:** Limited only by calibration accuracy.

### Amplifier

**Common - Mode Range:**  $\pm 3$  V operating;  $\pm 30$  V without instrument damage

**Common - Mode Rejection Ratio:** - 60 dB @ 1/2 excitation

**Input Impedance:** Differential and Common-Mode > 10,000 M $\Omega$

**Offset :** user adjustable; vs. Temperature:  $\pm 30$  ppm / $^{\circ}$ C; vs. Time:  $\pm 10$  ppm/month

**Gain Accuracy:** Limited only by calibration accuracy

**Gain Stability:** vs. Temperature:  $\pm 30$  ppm/ $^{\circ}$ C; vs. Time:  $\pm 10$  ppm/month

**Linearity:** better than  $\pm 0.03\%$  of full scale

**Filter:** 3-pole modified Butterworth; 3 dB down at 10 Hz, 200 Hz or 5kHz; selectable

### Step-Response Settling Time (Full-Scale Output @ 10 Hz)

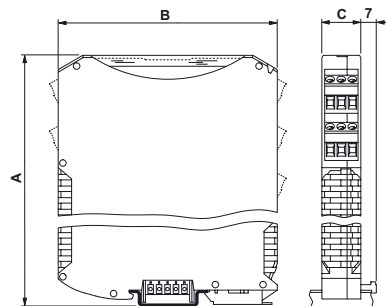
To 1% of final value: 0.068 sec; (0.0034 sec @ 200 Hz) (0.00015 sec @ 5 kHz)

To 0.1% of final value: 0.090 sec; (0.0046 sec @ 200 Hz) (0.00018 sec @ 5 kHz)

To 0.02% of final value: 0.100 sec; (0.0054 sec @ 200 Hz) (0.0002 sec @ 5 kHz)

## Dimensions

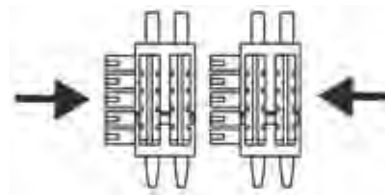
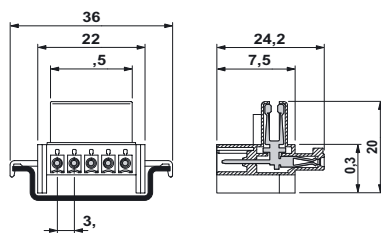
Dimensional drawing



Housing height [A] : 114.5 mm

Housing depth [B] : 99 mm

Housing width [C] : 22.5 mm



DIN Power Connection (top)

5	N/C
4	N/C
3	N/C
2	POWER COMMON
1	DC POWER

Optional DIN Power Rail Connector Model 5M-PCON

## 2 TRANSDUCER CONNECTIONS

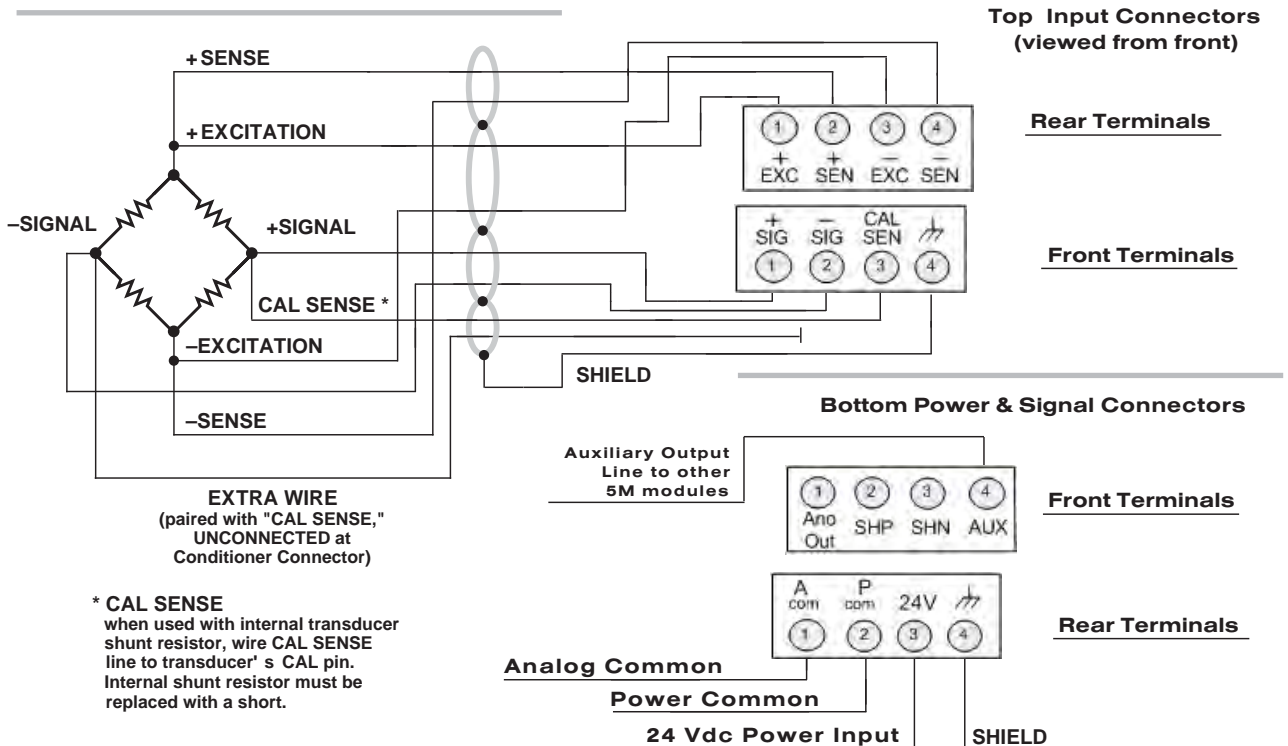
The Model 5M70 I/O CONNECTIONS are via non-removable screw terminals which will accept wire sizes from AWG 12 to 26. **NOTE:** The recommended transducer cabling would be eight wire, individually shielded, twisted pair - wired as indicated (Fig. 1) Sense lines must be connected at the transducer (as recommended) or at the 5M70 screw terminals - as a minimum. Table 2 denotes screw terminal assignments

**Table 2 Model 5M70 Pin Assignments**

I/O Connector Pin Number	Screw Terminal	Terminal Label	Conditioner Line Function
Top Rear 1	1	+ EXC	+ EXCITATION
Top Rear 2	2	+ SEN	+ SENSE
Top Rear 3	3	- EXC	- EXCITATION
Top Rear 4	4	- SEN	- SENSE
Top Front 1	1	+ SIG	+ SIGNAL Input
Top Front 2	2	- SIG	- SIGNAL Input
Top Front 3	3	CAL SEN	CALIBRATION SENSE
Top Front 4	4	//	SHIELD
Bottom Front 1	1	Ano Out	ANALOG Output
Bottom Front 2	2	SHP	Shunt Positive
Bottom Front 3	3	SHN	Shunt Negative
Bottom Front 4	4	AUX	AUXILIARY Output *
Bottom Rear 1	1	Acom	Analog Common
Bottom Rear 2	2	Pcom	Power Common
Bottom Rear 3	3	24 V	24 Vdc Power
Bottom Rear 4	4	//	SHIELD

\* AUXILIARY Output is used for future 5M module interfacing only

**Fig. 1 Model 5M70 Transducer Cabling**



### 3. CALIBRATION

**Calibration of the 5M70** is accomplished by the conventional shunt technique, using an internally installed calibration resistor, or via the "dead-weight" method.

**Calibration Resistor.** If a fixed resistor is shunted across one arm of a strain gage bridge, it produces an unbalance equivalent to that of a particular value of mechanical input. If this Equivalent Input value is accurately known, it can be used as a reference point for shunt calibration of the system. Upon completion of installation of the transducer and its associated cabling, the user can:

- (1) Perform an overall dead weight calibration using a precisely known value of mechanical input. The calibration can then be transferred to the installed calibration resistor for convenience in subsequent checking.
- (2) Replace the installed calibration resistor with one (or an equivalent resistance value) supplied by the transducer manufacturer to achieve a precisely known Equivalent Input allowing the instrument sensitivity to be adjusted correctly.
- (3) Determine the Equivalent Input value for the installed calibration resistor, knowing the transducer sensitivity, and adjust the instrument sensitivity accordingly.

A one percent, 59-kilohm calibration resistor is installed in the 5M70 at the factory. The installed resistor can usually be used even though the transducer calibration data mentions some other resistance value. In Section 4 of this manual, the techniques described above are demonstrated. If, however, the installed value of calibration resistor is not appropriate for the transducer and measurement range to be used, the 59-kilohm resistor should be replaced at this time. The calibration resistor is mounted on terminals located internally to the 5M70 conditioner's printed-circuit board. It can be accessed by removing the instrument case (Fig. 5).

**Note:** A variety of DC Load Cells and Slip Ring Torque Transducers are supplied with the appropriate calibration resistor integral to the transducer. When this type of transducer is used it will be necessary to place a short across the 59-kilohm resistor internal to the instrument. The transducer calibration resistor can be appropriately connected to the 5M70 calibration circuit via the transducer cabling. Refer to cabling diagram section of this manual in the area of CAL SENSE.

This section contains the instructions for calibrating the 5M70. Included is a functional description of the instrument front-panel (see Figure 2). To perform calibration, proceed as follows with the sensor or calibration standard connected.

- (a) Turn power ON to the 5M70 DC Power input terminal (11 to 28 Vdc input) The front-panel indicator should light green to indicate the application of dc power. Allow 10 minutes of warmup for stabilization of transducer characteristics. Set the Coarse Zero and Span controls label marked position.



### 3. CALIBRATION

- (b) Set the Coarse Zero and Span controls to the marked label position (<, Min>).
- (c) Position the front panel switches to the desired settings for the application. Refer to Fig. 2 for details. Connect readout device (i.e. voltmeter) to ANO & A Common.
- (d) With the transducer unloaded, adjust the Coarse Zero and the Fine Zero control until the desired analog output is achieved. If greater zero authority is desired, place the front panel Switch 7 - "Zero Adj" to the extended range. This will allow the user to obtain 100% zero offset control. The Normal position of switch 7 allows for approx. 25% Zero authority.
- (e) Apply a known dead weight value which is greater than one half of full scale in the positive direction or activate the "SHP" terminal (shunt positive) by connecting "SHP" to "Power Common" as described in Fig. 3. Adjust Coarse Span to obtain your nominal full scale analog output. Use Fine Span control to adjust the signal to the precise value required (or for an analog value that corresponds with the appropriate Shunt Calibration value). Unload the transducer and check "Zero" and adjust as necessary. Repeat Span load and verify values. If the transducer is to be also used in the negative realm, load the transducer in the negative direction with the the same dead weight value or activate the "SHN" (shunt negative) and adjust the Symmetry control until you obtain the proper negative output reading.
- (f) Repeat step (e) as needed to obtain analog output precision. Note that any Span (gain) adjustments will effect the Zero (balance) value.

Note: When applying the SHUNT resistor value for calibration, the sensor should be in an "unloaded" condition.

When completed, replace the plastic front cover to its original position and ensure connections and proper shielding to the module, and to the DIN rail to which the 5M70 is attached, are correct.

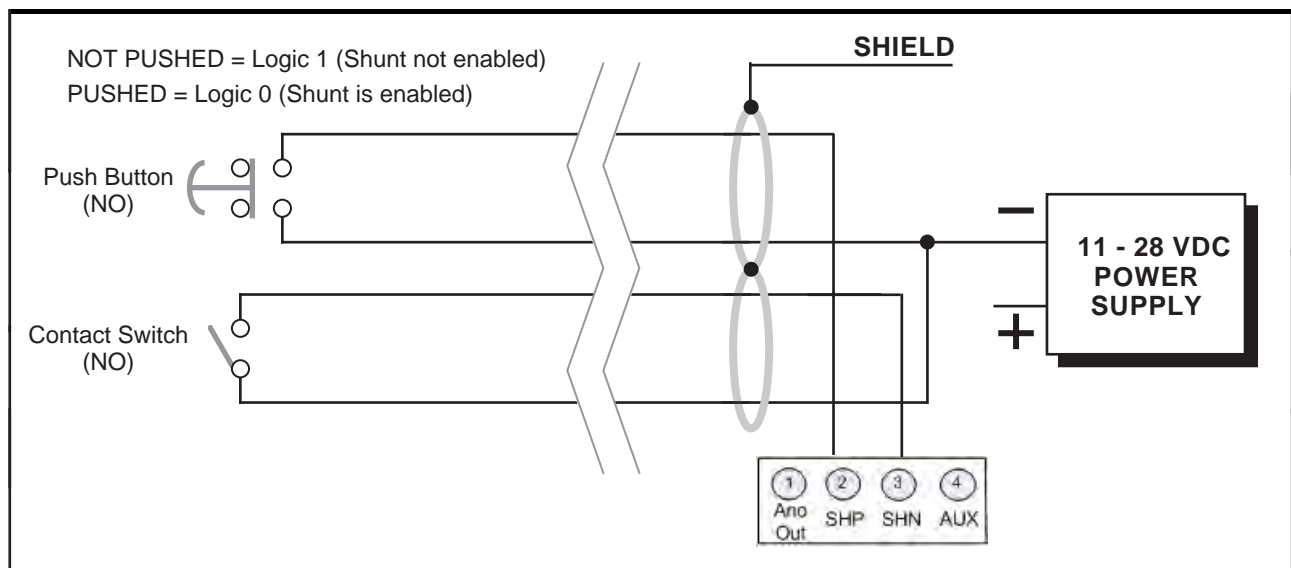


Fig. 3 Shunt Connections

### 3. CALIBRATION (cont.)

If the transducer calibration is unknown, the following calculation is useful to calculate an *Equivalent Input* value for the factory installed, 59K Ohm shunt resistor. This will approximate the value assuming that the mv/V sensitivity and bridge resistance of the sensor are known.

$$X = \frac{25000 R_b}{K R_c}$$

where  $X$  = Equivalent Input, % of full scale

$R_b$  = bridge resistance, ohms

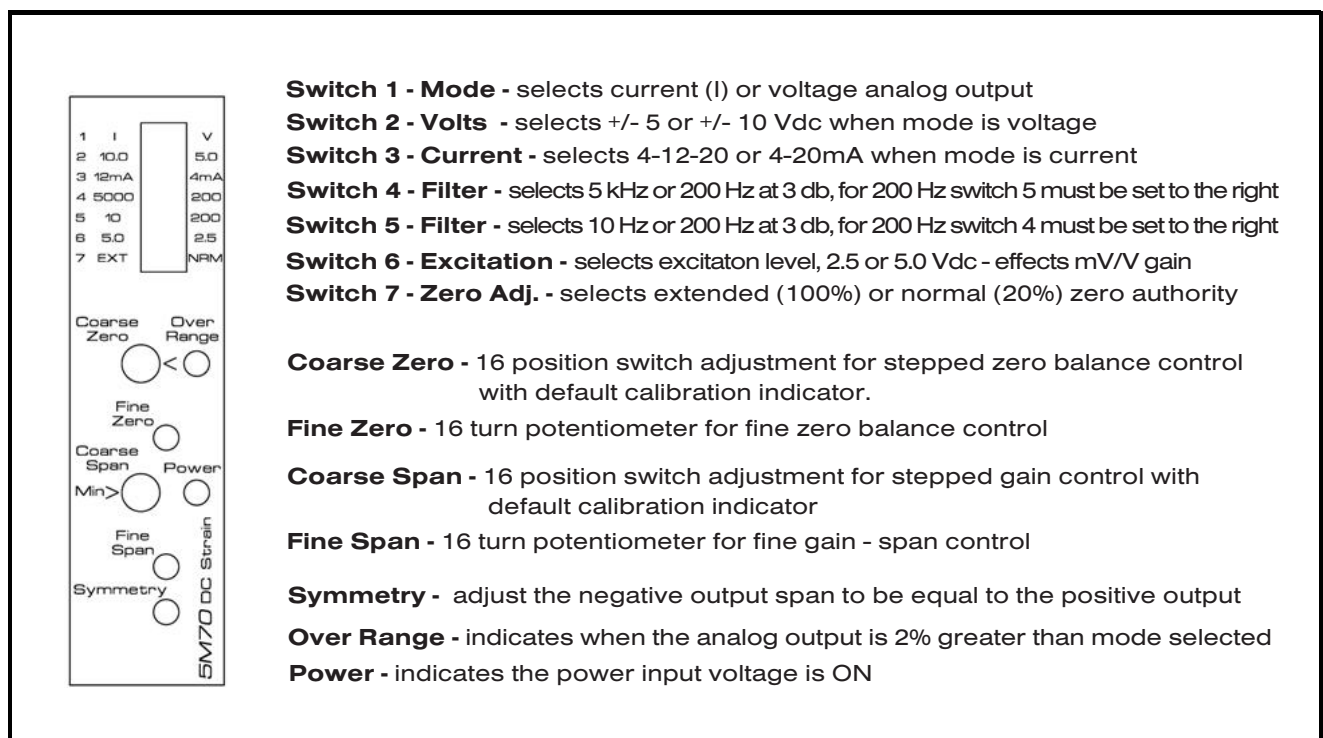
$K$  = transducer sensitivity, mV/V full scale

$R_c$  = calibration resistance, ohms (59 k installed)

Sample Calculation: Assume that  $K = 3.000$  mV/V for a 5000-pound loadcell (fullscale) with a bridge resistance of 350 ohms.

$$X = \frac{25000 \times 350}{59000 \times 3} = 49.4\% \text{ of full scale} = 2472 \text{ pounds}$$

**Remote Calibration Check** The instrument can be placed in the calibration mode (positive or negative) by shorting pin Power Common and SHP for positive or SHN for negative on the lower I/O connector. Figure 4 indicates two methods of remotely entering the calibration mode (external switch, or push button control). The Remote Cal function provides a convenient method of periodically monitoring calibration of the instrument in the positive or negative realm.



**Fig. 2 Front Panel Settings and Indicators**

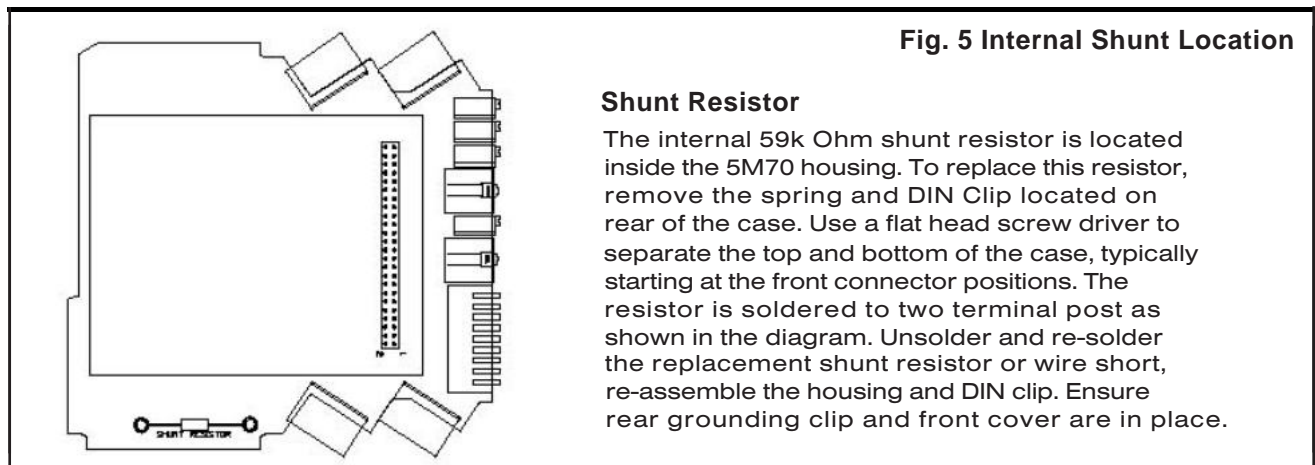
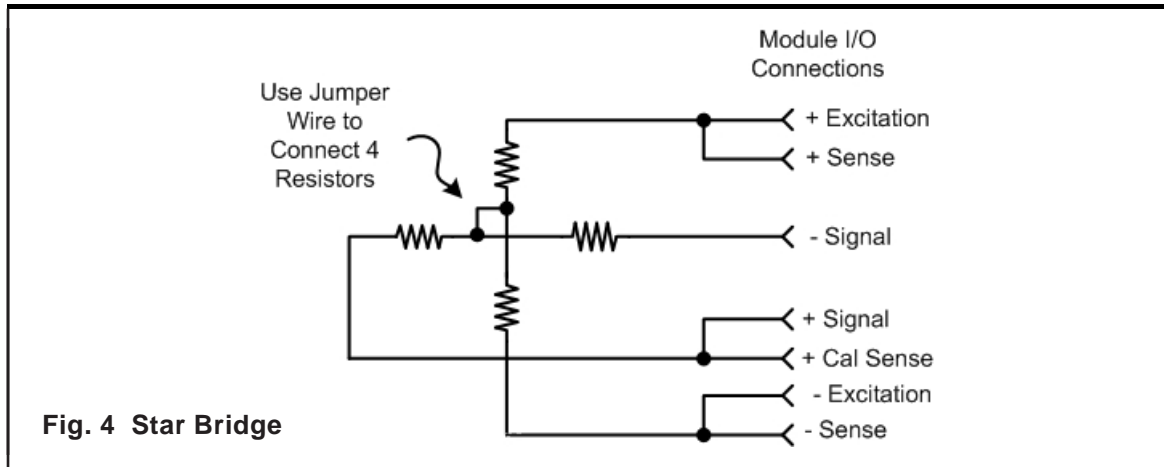
## 4. VERIFICATION OF NORMAL OPERATION

It is the purpose of this section to aid the user in determining, in the event of a malfunction of which the Model 5M70 is suspected of contributing, whether the instrument is functioning normally or whether it is the source of the observed trouble. In the event the unit requires repair, the user may also contact the factory Service Department or the local Daytronic Representative for assistance. Daytronic service information is located on the last page of this document.

If the instrument is suspected of faulty operation, perform the following steps.

- (a) If the unit is totally inoperational (front-panel power indicator does not light), check the primary power input terminals for proper connection. Input power can be from 11 to 28 Vdc and will draw less than 2 watts. If properly connected, the front panel Green LED will be illuminated. Before reapplying power, visually inspect the power supply and the input power connections for any discrepancy which could have caused the overload.
- (b) If the transducer has some preloading, the BALANCE controls may not allow successful zeroing of the instrument output. This condition can be remedied by connecting a resistor (50 k- 200 k range, metal-film type) from the +Signal terminal of the transducer to the + or -Excitation Sense terminals. The Excitation terminal to which the connection is made is determined by the direction of the loading or off-zero reading.
- (c) The inability to balance correctly, where the instrument output reads totally off scale and the BALANCE controls have no authority, can very likely be the result of a damaged or defective transducer or cable. This possibility can be confirmed (or eliminated) by substituting a transducer and cable known to be in good condition or by simulating a balanced transducer, using either a commercially available transducer simulator or the simple star bridge arrangement shown in Figure 7. The star bridge simulates a conventional four-arm bridge in an exact condition of balance. To construct a star bridge, connect four 10% carbon resistors as shown in Figure 5. Use 180-ohm resistors to simulate a 350-ohm bridge and use 56-ohm resistors to simulate a 120-ohm bridge. Neither the resistor values nor temperature characteristics are critical since the balance condition of a star bridge is not determined by the resistance values. Solder two resistors together, then solder the remaining two resistors together. Next, connect the two junctions together using a separate wire as shown. There is a good reason for this method of construction, and it should be followed. Connect the substitute or simulated transducer to the instrument I/O connector using a short 4-wire cable configuration as shown in Figure 4. Attempt to balance the substitute simulated transducer. If conditions now appear to be normal, the transducer or cable is at fault. If the previous difficulties persist, the 5M70 may be faulty.

# 5M70 DC Strain Gage Conditioner Module



## Product Warranty and Repair

Daytronic Corporation warrants its products to be free from defects in material and workmanship, under normal and proper use in accordance with our instructions, for the period of time specified below. Our liability under such warranty or in connection with any other claim relating to the products shall be limited to, at our option, the repair or replacement of any products or parts or components thereof which are returned to us freight prepaid and which are defective in material or workmanship or the refund of the purchase price to the Buyer.

ANY PRODUCT FOUND TO BE DAMAGED THROUGH CUSTOMER NEGLIGENCE OR MIS-USE MAY BE EXCLUDED FROM ANY AND ALL POLICIES CONTAINED IN THIS DOCUMENT.

**ALL EQUIPMENT TO BE REPAIRED OR REPLACED UNDER WARRANTY MUST BE RETURNED TO THE FACTORY.** Before returning a product or products for any reason, the customer must call **Daytronic Customer Support Services** at **(937) 866-3300** to request a **RETURN MATERIAL AUTHORIZATION (RMA)**. Once the customer has provided the necessary information and has been assigned a specific RMA, the product(s) in question may be returned to Daytronic by shipping it

**Daytronic Corp. , 1000 New Durham Road, Edison, New Jersey 08818**

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