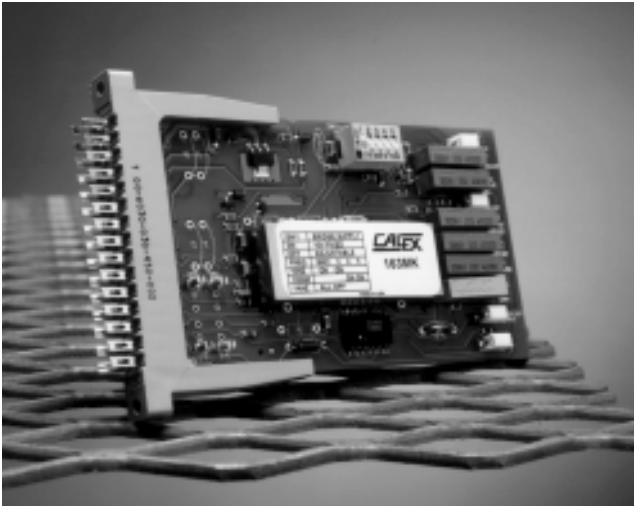


Model 163MK Bridgesensor



Features

- Pin for Pin Replacement for Model 161MK
- Compact, complete and convenient to use
- Easy access to all trim adjustments
- Simplifies Single and Half Bridge Applications
- On card Bridge Balance Trimpot eliminates additional wiring for Three Wire applications
- Changing Bridge supply voltage is easy using on board trimpot with adjustment range from +4 to +10 VDC
- Bridge supply lead resistance effects can be ignored with built-in remote sensing
- Filter frequency can be changed with the flick of a DIP switch

Description

The CALEX 163MK Bridgesensor is a complete signal conditioning system on a card designed expressly for single half, or full bridge transducers. The 163MK consists of a high performance instrumentation amplifier, a user adjustable active filter, high stability bridge supply and all of the required circuitry, trimpots, etc., so that only point to point wiring need be made to the inputs, outputs and power to have a complete signal conditioning system up and running.

The mounting kit provides coarse and fine gain adjustment trimpots along with input and output offset adjustments, DIP switches for setting the bridge supply output and active low pass filter cutoff frequency. Provisions are also provided to mount a quarter bridge completion resistor and a calibration resistor which can be wired to an external CAL switch. Two close tracking 1/2 bridge completion resistors are also included.

Application of the 163MK is easy by following the detailed applications information that is included with this data sheet and full engineering specifications allow easy and complete worst case analysis.

163MK vs 161MK

The Model 163MK is a pin compatible replacement for the Model 161MK which is no longer available. The one major difference is that the 163MK does not have a reference voltage on pin J. Pin J is connected to COM, pins B and 2. The 163MK also has a high frequency input filter to reduce EMI. This filter has a high frequency cutoff above 200KHz which is well above the requirements of weighing systems. See figure 3 163MK INPUT AMP RESPONSE. The output of the instrumentation amplifier, pin P, is not inverted with respect to the Filter Output as it was in the 161MK. The OUTPUT OFFSET pot, RP1, is disabled by a jumper, J5, which must be removed to use RP1. The external OUTPUT OFFSET input, pin K, is always active.

Applications using the 161MK can use the 163MK simply by inserting the board and making the typical zero and span adjustments. No wiring changes should be required.

163MK Block Diagram

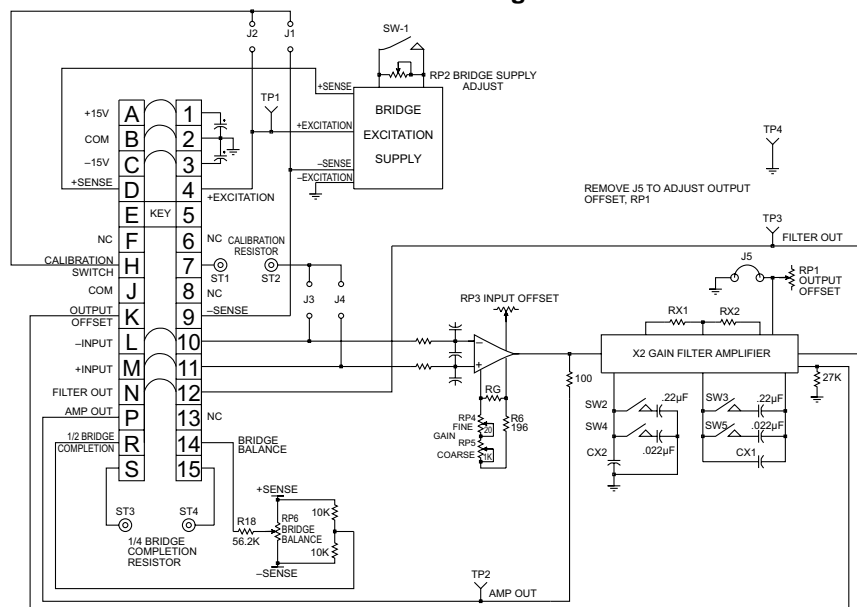


FIGURE 1. Complete block diagram of the 163MK Bridgesensor

Model 163MK BridgeSensor

Specifications

Conditions (Unless Noted): Ta = 25°C, Vs = ±15 VDC, G = 500 V/V

Parameter		Minimum	Typical	Maximum	Units
Amplifier (1)					
Gain Range	Adjustable (2) w/External Set Resistor	100 2		500 5000	V/V
Gain Equation		Rg = 100,000/(G-2)			ohms
Gain Equation Accuracy	2 < G < 1000 V/V		3		%
Gain Temperature Coefficient	w/Trim pots Amplifier alone		75 25	150 100	ppm/°C
Nonlinearity, ±10V Output Swing			0.002	0.005	%
Offset Voltage, Input and Output		Adjustable to Zero			
Warmup Drift (3)			±1	±5	µV
Input Offset					
Vs. Temperature:	G = 2V/V G = 1000V/V At Other Gains, Max.		±2 ±0.2	±10 ±1	µV/°C
Vs. Power Supply			±0.2 ±(20/G) ±1	±5	µV/V
Output Offset Adjust Range		±10			V
Input Bias Current (4)			1	5	nA
Vs. Temperature			40		pA/°C
Input Offset Current			1	5	nA
Vs. Temperature			40		pA/°C
Input Impedance (5)			4G ohms .0047 µF		
Common Mode Input Voltage:	Range, Linear Response Maximum		±9 ±15		VDC
CMR (6):	1 kHz bw, DC-60 Hz (7) 10 Hz bw, DC-60 Hz (7)		100 120		dB
Input Noise Voltage:	0.1 Hz - 10 Hz 10 Hz - 100 Hz		0.3 1		µV P-P
Current:	0.1 Hz - 10 Hz		80		pA P-P
Rated Output:	Voltage, 2 kohm Load Current Load Capacitance Short Circuit	±10 ±5		1000	VDC mA pF
			1 minute		
Dynamic Response (8):	Small Signal Bandwidth Amp Response (see figure 3)		Adjustable		kHz
Low Pass Filter (9):	Number of Poles DC Gain (Pin P to N) Roll Off		2 +2 40		V/V dB/Dec
Bridge Excitation Supply (10)					
Output Adjustment Range:	w/Trim pot	4		10	VDC
Output Current		0		120	mA
Load Regulation	I _L = 0 - 120 mA		0.02	0.05	%
Line Regulation	Vin = 14.5 - 16 VDC		0.005	0.01	%/V
Stability (11):	Short Term Long Term Vs. Temperature Warm-up Drift		0.05 0.2 40 0.01	80	%/24 Hrs %/kHrs ppm/°C %
Short Circuit Protection		Short Term - 10 minutes			
Output Noise, 10 Hz - 1 kHz			200		µV P-P
Half Bridge Completion					
Nominal Resistance Value			10		kohms
Initial Accuracy				0.1%	%
Temperature Tracking				5	ppm/°C
Balance Adjustment Range, 350 ohm Bridge			±15		mV
Power Requirements					
Voltage:	Rated Performance Operating	±13	±15	±16	VDC
Current (12)			±12		mA
Environmental					
Ambient:	Operating Storage	-25 -40		55 80	°C

Model 163MK Bridgesensor

Notes:

- (1) Specifications referred to the filter output (Pin N).
- (2) Using on board coarse and fine gain adjust trimpots.
- (3) Warm-up drift is specified as the input offset drift for the first 5 minutes after the application of power with $G = 1000 \text{ V/V}$, Bridge supply = 10V driving a 350 ohm bridge.
- (4) Measured at 25°C Ambient with unit fully warmed up.
- (5) Measured from -Input to +Input or input with respect to ground.
- (6) Specified with 350 ohm bridge as source impedance.
- (7) Filter frequency set with DIP switches.
- (8) Small signal response, switch or resistor/capacitor selectable, see applications section.
- (9) The low pass filter cutoff frequency is adjustable to 10, 100 and 1000 Hz using the onboard DIP switches and from 1 Hz to 10 KHz using external resistors and capacitors.
- (10) Bridge supply must be operated with +Sense connected to the Bridge Supply Pin and with -Sense connected to Common.
- (11) Stability is defined after a 5 minute warm-up period and with constant line, load and ambient temperature unless otherwise specified.
- (12) Quiescent current for amplifiers only, the current drawn from the bridge supply must be added to the +15 VDC current drain for total current draw.

Functional Description

The CALEX Model 163MK is a completely self contained single channel signal conditioning system on a card. This device offers the high performance and reliability of surface mount circuitry with the completeness of a mounting kit containing all trimpots and components needed for operation. All that needs to be added is power and transducer inputs to get a conditioned output suitable for driving A/D converters, panel meters, indicators, or PC based controllers.

Instrumentation Amplifier

The heart of the 163MK is the high performance instrumentation amplifier. This amplifier features low noise, low drift and high accuracy along with trimpot adjustments for coarse/fine gain and input offset voltage. The direct instrumentation amplifier output is brought out to Pin P on the 163MK, through a 100 ohm isolation resistor. This output is also brought out to the test point AMP OUT at the trimpot edge of the mounting kit. The trimpots allow a gain adjustment range of 100 to 500 V/V with a coarse and fine gain adjuster (clockwise rotation increases gain). A user supplied resistor can be used in place of the trimpots (see equations below) to get any gain from 2 to 5000V/V (referred to filtered output). To use an external resistor remove R6 from the mounting kit to disable the trimpots, then calculate the required value for RG and solder it on the mounting kit in the spot provided.

The gain equation accuracy is ± 3 percent for gains from 2 to 1000 V/V.

$$RG = \frac{100,000}{G - 2} \text{ ohms}$$

Equation 1: User supplied resistor value required to set gain with respect to Pin N, filtered output.

$$RG = \frac{50,000}{G - 1} \text{ ohms}$$

Equation 2: User supplied resistor value required to set gain with respect to Pin P, amplifier direct output. NOTE: If a fixed resistor is used for RG, then resistor R6 should be removed from the 163MK to disable the gain trimpots. If a slightly higher RG is used, the pots and R6 can be used to provide a small adjustment range.

Example Resistor Values for Common Gains (to Filtered Output):

Required Gain, Filtered Output	RG Value
10	12,400 ohms
100	10,200 ohms
333.33	301 ohms (Use for 3mV/V Transducers)
500	205 ohms (Use for 2mV/V Transducers)
1000	100 ohms

Note: A high stability, 5 ppm/°C metal film resistor should be selected for RG for maximum performance.

The instrumentation amplifier also has a trimpot adjustment for input offset voltage, this trimpot should be used to null the instrumentation amplifier offset only. System offsets should be adjusted out using the Bridge Balance or the Output Offset feature (see applications section for more information) to retain minimum offset drift of the instrumentation amplifier. The 163MK inputs should be placed as close to the transducer as possible. This will minimize any possible pickup of electrostatic or electromagnetic noise into the very high impedance inputs. See the applications section for more information on shielding methods.

Active Filter

The output of the instrumentation amplifier is connected to the input of a 2 pole, active filter with a gain of 2. This filter has an adjustable filter cutoff frequency of 10, 100 and 1kHz by the use of on board DIP switches and can be set to any frequency from 10 Hz to 10 kHz by the use of user supplied resistors and capacitors. The filtered output is brought out to Pin N and to test point FILTER OUT at the trimpot end of the board on the 163MK. Pin N is the standard output for most strain gage and instrumentation applications. By using the filtered output extraneous noise above the useful signal frequency is removed at a rate of 40dB/decade above the filter cutoff frequency allowing very precise and low noise measurements to be made. Figure 2 details the DIP switch settings and the equations required to set the filter cutoff to any other frequency.

The filter stage is also the input for the output offset voltage adjustment. The output offset may be adjusted with the on board trimpot or by driving the output offset input (Pin K) with a low impedance source or the wiper of a trimpot. NOTE: to use the on-board offset pot, J1 must first be removed. The gain from the External Output Offset pin (Pin K) to the filtered output (Pin N) is approximately 1 V/V (i.e. if Pin K is changed by 1 Volt in a positive direction then Pin N will also change by 1 Volt in a positive direction).

Model 163MK Bridge sensor

If pin K is used as the Output Offset control, than J1 should be installed to prevent interaction of RP1.

Filter Cutoff Frequency Adjustment

Cutoff Frequency	SW2	SW3	SW4	SW5
10 Hz	ON	ON		
100 Hz			ON	ON
1000 Hz or User Select	ALL OFF			

$$CX1 = CX2 = 0.0024 \mu F \left[\frac{1000}{F_c} - 1 \right]$$

CUTOFF FREQUENCY > 1000 Hz

$$RX1 = 35,000 / \left[\frac{F_c}{1000} - 1 \right]$$

$$RX2 = 105,000 / \left[\frac{F_c}{1000} - 1 \right]$$

BUILT IN LOW PASS FILTER FREQUENCY RESPONSE

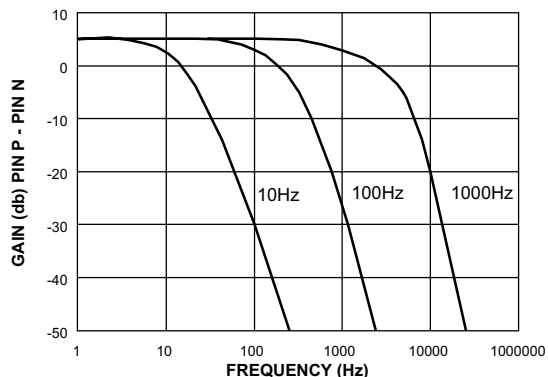


FIGURE 2. Dip switch settings and equations required to set the filter cutoff frequency.

163MK INPUT AMP RESPONSE

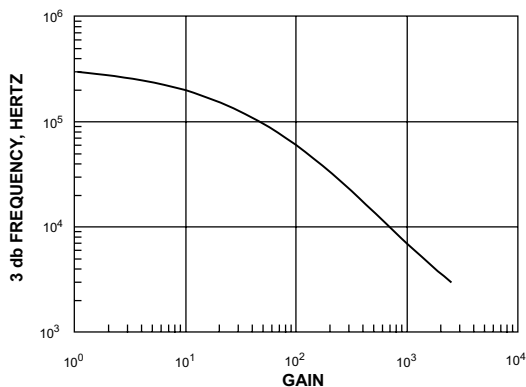


FIGURE 3.

Bridge Supply

The bridge excitation supply is a very well regulated low noise output designed to drive either full or half bridge transducers from 0 to 120mA output current. The output can be set to a fixed +10V by setting DIP switch SW1 ON. By setting SW1 OFF the output can be adjusted from +4 to +10Volts by adjusting the bridge supply adjust trimpot.

The bridge supply uses + and - sense connections to compensate for any line drops that might be present when using remote transducers. See the applications examples for more information on properly using the + and - sense pins. If remote sensing is not required connect +Sense (Pin D) to Bridge Supply (Pin 4) and -Sense (Pin 9) to Common (Pin B) directly at the mounting kit socket. The maximum voltage difference between the Bridge Supply, Pin 4 and the +Sense, Pin D, is 0.4V.

Half Bridge Completion/Bridge Balance

Two 10K ohm thin film resistors are connected to the excitation supply sense lines and their center connection is brought out to pin R. These resistors have a low temperature coefficient and track to 5 PPM/°C. This circuit can be used as the other half of a Half Bridge transducer to provide a common mode voltage to the instrumentation amplifier. Pin R can be connected to either the + or - input pin, depending on the polarity of the transducer output signal.

A Bridge Balance circuit is also provided. RP6, BAL ADJ, is also connected across the excitation sense leads and it's swinger is brought out to Pin 14 through R18. With pin 14 connected to the same amplifier input as a 350 ohm Half Bridge transducer, a bridge balance range of ±50% is available. Alternately, pin 14 can be connected to the Bridge Completion resistors. However, in this case R18 should be increased to 1 megohm to reduce the sensitivity of the adjustment. The Bridge Balance pin can be connected to either input when a Full Bridge transducer is used.

General Calibration Procedures

The 163MK comes from the factory adjusted to the following specifications:

- GAIN 333 V/V
- INPUT OFFSET Adjusted to 0, ±2mV
- OUTPUT OFFSET J1 Installed
- BRIDGE SUPPLY SW1 CLOSED, Bridge Output at +10 Volts
- FILTER SW2 - SW5 OFF, Filter at 1 kHz
- BRIDGE BALANCE Pin 14 at 0 Volts

When adjusting the 163MK to other values the following methodology should be used,

- 1) Ground the inputs, set the input offset trimpot to get 0 Volts on the output you will be using (Pins N or P). Input offset is for amplifier nulling only. Do not use the input offset for zeroing systems offsets, use the bridge balance or the output offset adjustments for system offset correction.

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- 2) Using a millivolt calibrator or the transducer output itself, set the gain so that the proper full scale output voltage is realized (the mV calibrator or transducer should be set to simulate full scale output).
- 3) If system offsets must be accounted for repeat step 1 again with the inputs disconnected from the source and connected to ground, or short them together with the bridge connected, then reconnect the inputs and re-zero the output with the bridge balance (if used).
- 4) Steps 1 - 3 above may need to be repeated several times to achieve the desired accuracy of gain and offset.

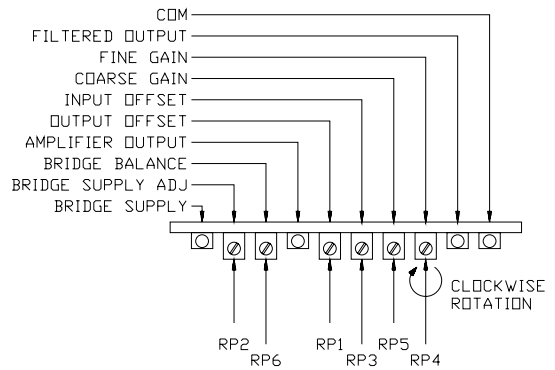


FIGURE 4. 163MK Trimpot Adjustment Detail

163MK Application Examples

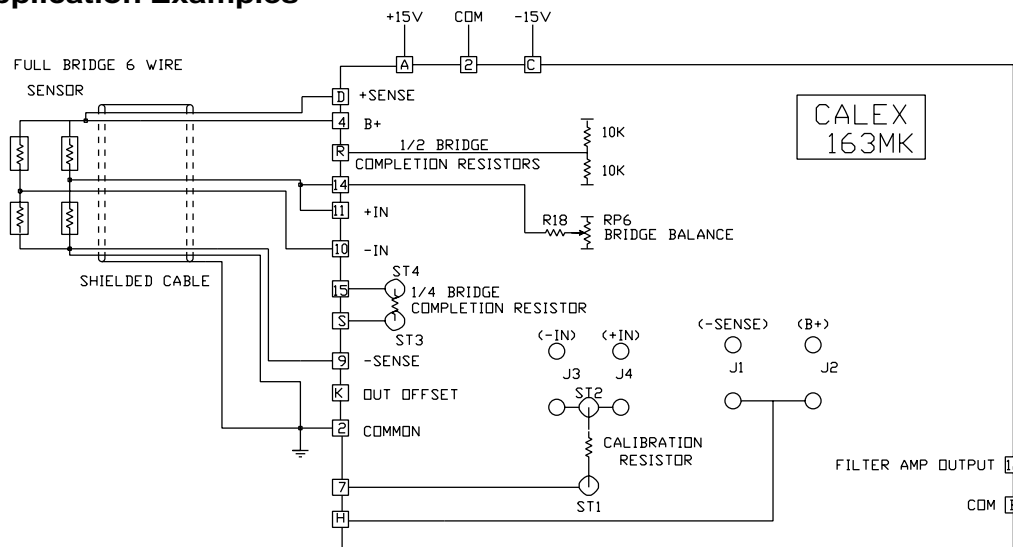


FIGURE 5. Full Bridge with Remote Excitation Sense

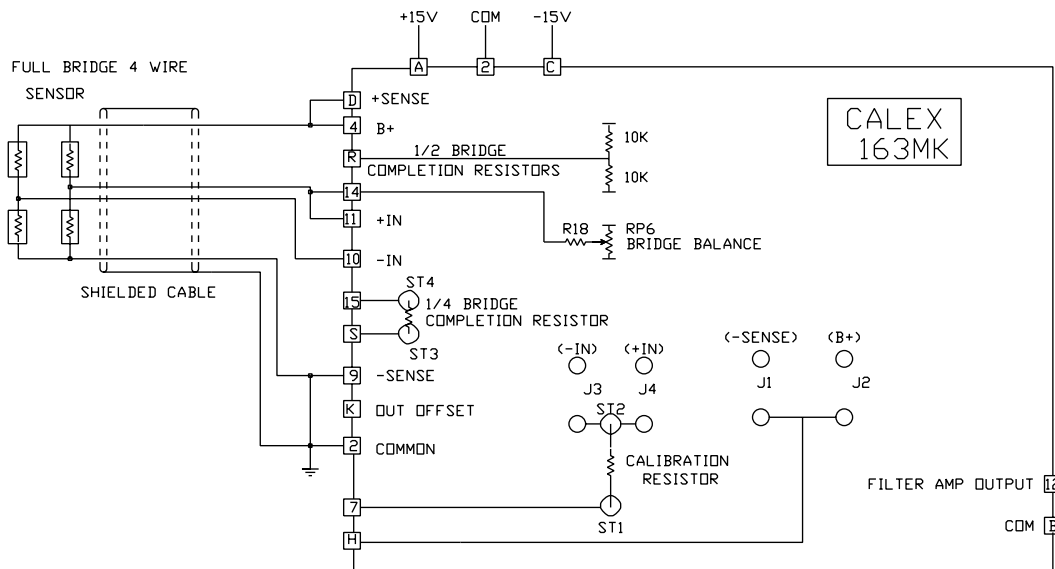


FIGURE 6. Full Bridge with No Remote Sense

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163MK Application Examples

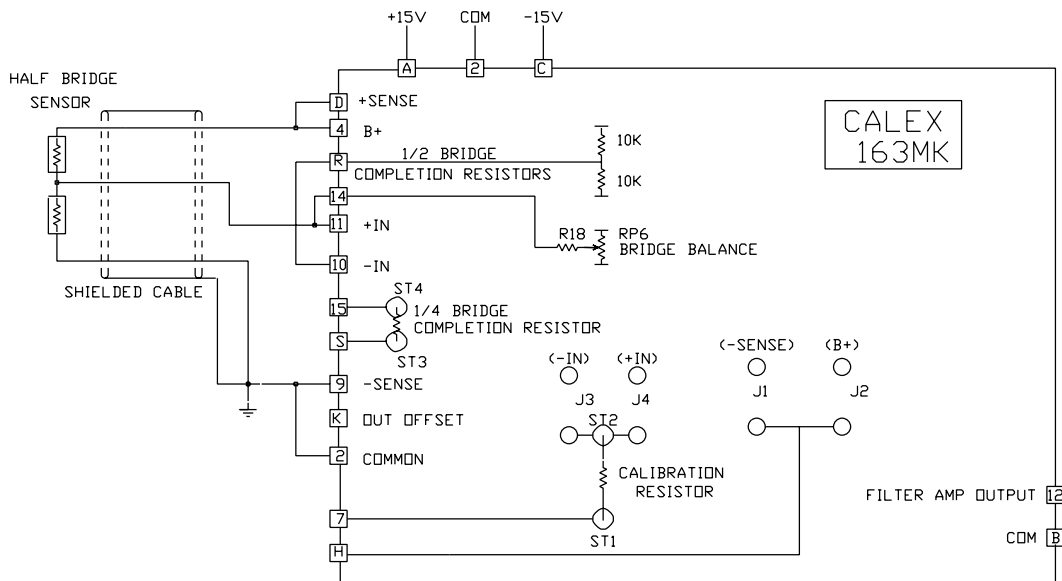


FIGURE 7. Half Bridge - 3 Wire

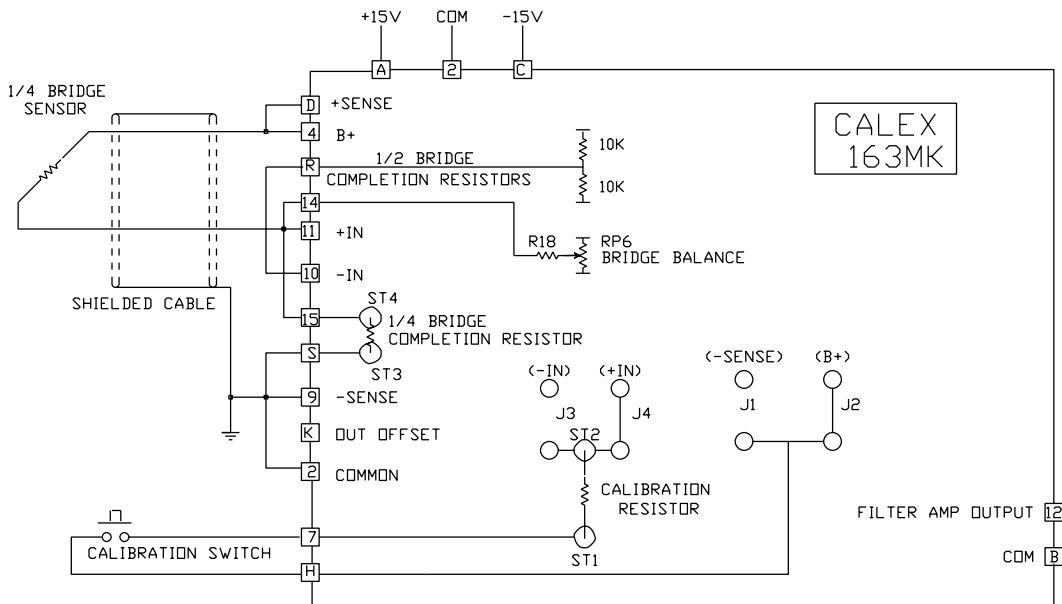


FIGURE 8. 1/4 Bridge - 2 Wire

Model 163MK Bridgesensor

163MK Application Examples

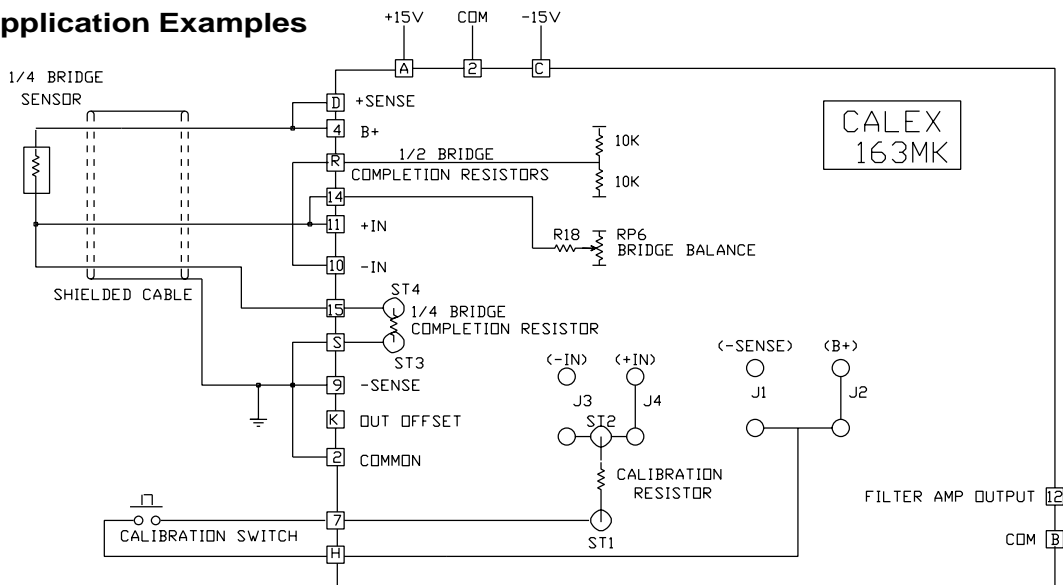


FIGURE 9. 1/4 Bridge - 3 Wire

163MK Mechanical Specifications

