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User's Guide

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OM2-165
Strain Gage Bridge Signal Conditioner

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OM2-165
Stain Gage Bridge Signal Conditioner

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OM2-165 Signal Conditioner (1)

Operator's Manual (1)

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NOTE

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Figure 7-1 shows the dimensions of the OM2-165 BRIDGESENSOR.

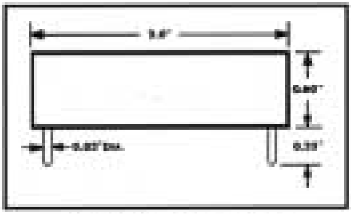

Figure 7-1. Dimensions

Figure 7-2 shows the bottom view and dimensions.

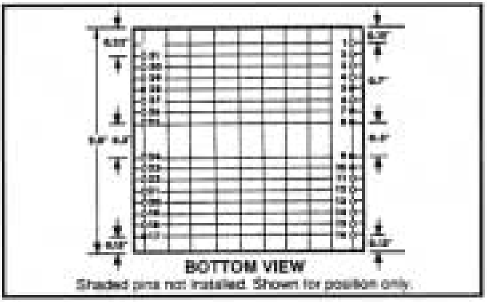

Figure 7-2. Bottom View

Output - Pin 16	
High state, max Source Voltage:	16V
Low State, 100mA max. Current:	0.7V max.
Leakage Currentat 16V:	10µsec max.
Response Time, 100mV Overdrive:	70µsec max.
Rise and Fall Time, 2k to 15V:	2µsec max.

Power requirements

Single Supply Operation:	14 to 16V
Dual Supply Operation:	±14 to ±16V
Current with max. Bridge Load	
Positive Supply:	130 mA max.
Negative Supply:	2mA max.

Note: Add any comparator output current to positive power supply requirement.

Environment

Temperature:	0°C to 70°C
Size:	2″ x 2″ x 0.6″

OM2-165
Strain Gage Bridge Signal Conditioner

TABLE OF CONTENTS

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Bridge Excitation Supply

Adjustment Range:	4 to 10V
Temperature Coefficient:	±0.01%/°C max.
Output Current, at 4V:	47mA max.
at 10V (See Figure 2-1):	100mA max.
Noise Voltage, dc to 10k Hz:	1 mV_{rms}, max.
Load Regulation, 0 to max. load:	0.01%, max.
Power Supply Sensitivity:	1mV/V max.
Output Impedance, at dc:	0.05 ohm typ.
at 100k Hz:	5Ω typ.

Comparator

Trip Point Range	
Dual Supply:	-10 to 10V
Single Supply:	50mV to 10V
Temperature Coefficient:	±10μV/°C max.
Hysteresis	
Dual Supply:	8 mV max. at dc
Single Supply:	4 mV max. at dc

Output	
Single Supply Operation	
(2kΩ min. load to common):	0.05V to 10V
Dual Supply Operation:	-10V to 10V.
Minimum Load Resistance:	2kΩ
Frequency Response, Gain = 100	10k Hz
Full power Bandwidth, Gain = 100,	
with 2k or greater load:	2k Hz

Reference Supply

+VR:	10.3V, ±0.03V
Temperature Coefficient:	±0.01%/°C max.
Output Impedance, at dc:	0.05Ω
at 100k Hz:	10Ω
Load Current:	5mA max.
+5V Reference:	5V at ± 1%
Output Impedance, to 100k Hz:	1.3kΩ
±0.05V Reference:	0.05V ±2%
Output Impedance, to 100k Hz:	25Ω

1 Description

The OM2-165 BRIDGESENSOR is a complete signal conditioning system designed for use with RTD's, transducer bridge circuits, thermocouples, and other signal sources. It provides power to excite a strain gage or other type of bridge signal. In addition, a sensitive comparator is included that can be connected to monitor the amplifier output. The comparator drives an output switch that can be used to operate a relay, light or audible alarm.

The OM2-165 also includes a stable voltage reference source which is then available as a comparator trip point reference or for use as an output offset voltage for the amplifier. When used in an instrumentation system, external adjustment pots are frequently required. For this reason, a complete printed circuit mounting kit is available which furnishes all the necessary pots as well as test points and jumpers to alter the operational mode. The mounting kit plugs into a 15 pin card edge connector that comes with the mounting kit.

A complete instrumentation or control system can be built using the OM2-165, a power source, and a transducer. The power source can be either single or dual polarity.

Figure 1-1 shows the Block Diagram for the OM2-165 BRIDGESENSOR.

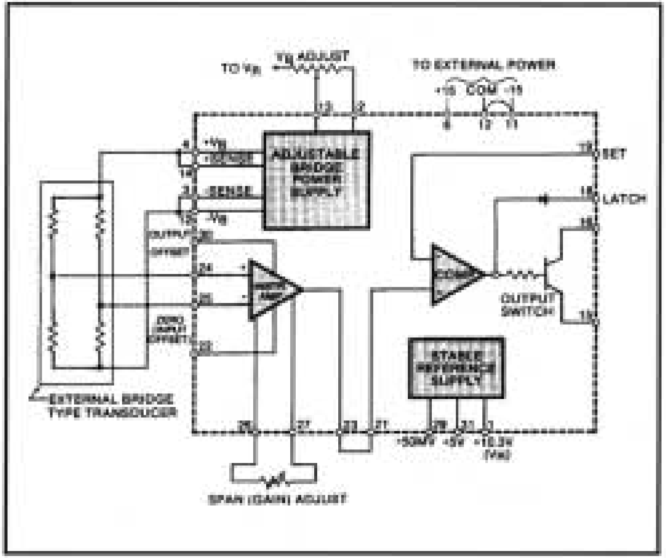

Figure 1-1. Block Diagram

Specifications

Instrumentation Amplifier

Gain Range, adjustable:	10 to 1000
Gain Non-linearity:	±0.01%
Gain Temperature Coefficient:	±50pp/°C
Input Resistance	
Differential:	10MΩ
Common Mode:	500MΩ
Common Mode Voltage	
Single Supply Operation:	2V to 7V
Dual Supply Operation:	-7V to 7V
CMRR, dc to 100 Hz, G = 100:	100db, min.
1 kHz	80db, typ.
Input Offset Voltage (adjustable):	±2mV max.
Temperature Coefficient:	5μV/°C max.
Power Supply Sensitivity:	50μV/V max.
Input Bias Current:	70nA max.
Temperature Coefficient:	1nA/°C max.
Differential:	±10nA max.

A good example would be a load cell used in a weighing system. It is also necessary to use a single polarity power supply. In this case the bridge power supply and input offset are adjusted as before. The output however is offset to +5.0 Vdc by using the reference supply and the output offset pin. Negative loads cause the output voltage to drop below 5.0 volts and positive load is greater than 5.0 volts. In the example shown in Figure 6-2, the comparator is not used but could easily be connected to provide a switch closure at any load in the range.

Figure 1-2 shows the schematic for the MK-165 mounting kit with an OM2-165 module installed.

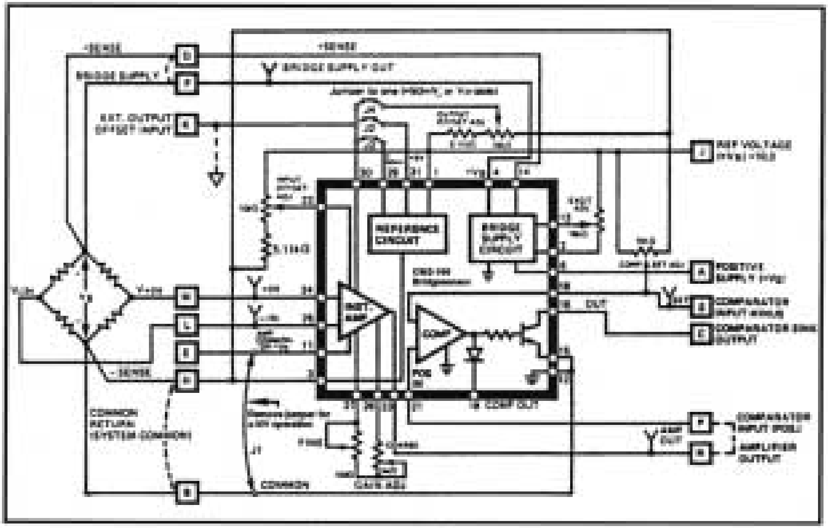

Figure 1-2. Schematic

Table 1-1 shows the pin assignment for the OM2-165 BRIDGESENOR

Table 1-1. Pin Assignment

PIN ASSIGNMENTS			
1	REFERENCE +10.3V	17	–
2	EX. ADJ. CCW	18	COMPARATOR OUT
3	- SENSE	19	COMPARATOR SET INPUT
4	BRIDGE SUPPLY OUT	20	LATCH INPUT
5	–	21	COMPARATOR IN
6	+Vs	22	INPUT OFFSET ADJ.
7	–	23	AMP OUT
8	–	24	+ IN
9	–	25	- IN
10	–	26	GAIN PROGRAMMING
11	AMP CMN	27	GAIN PROGRAMMING
12	COMMON	28	–
13	EXC. ADJ. WIPER	29	50 mV REFERENCE
14	+ SENSE BRIDGE SUPPLY	30	OUTPUT OFFSETTING
15	SOURCE OUT	31	5V REFERENCE
16	SINK OUT		

As can be seen, the need for using the separate sense lines depends entirely on the amount of lead resistance between the bridge power supply and the itself.

6.2 Load Cell Weighing

Figure 6-2 shows a similar application except here it is required to observe plus and minus changes about an equilibrium balance point for the bridge.

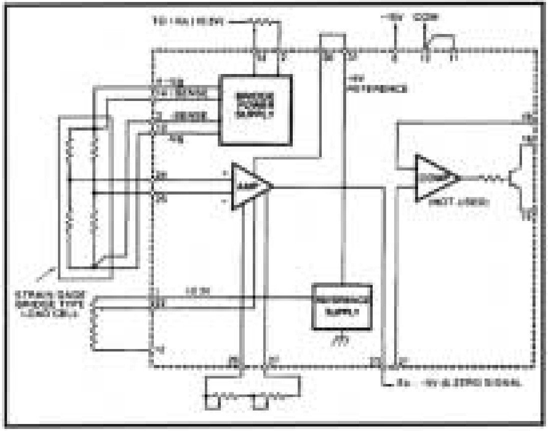

Figure 6-2. Load Cell Example

The bridge voltage has been adjusted for 10 Volts giving a full scale pressure output of 30 mV from the bridge for 3000 PSI. The gain of the amplifier has been set at 333.33 so that a 0 to 3000 PSI pressure change is represented as a 10 Volt output change. The power supply is a single +15Vdc so the -15V pin has been jumped to common. The common mode voltage for the amplifier input is +5 Volts and is thus within the range specified. The circuit is to trip at 2000 PSI and sound an alarm. The output of the amplifier has been offset to 50mV so that zero PSI corresponds to 50mV and 30000 PSI is +10.050 volts. Therefore, 2000 PSI is (333.333) x (0.020) +50mV = 6.7166 V. The comparator setpoint is adjusted for this value. Latching has been incorporated through a push button switch which allows for reset after the pressure drops below 2000 PSI.

This example also serves to illustrate the use of the bridge power supply sensing wires. The transducer is located a significant distance away from the OM2-165 so there is a noticeable resistance in the lead wires of 10 ohms. If the sense wires were connected to Vb right at the module, the actual voltage across the bridge would be 28.38mV full scale instead of 30mV. Connecting the sense wires directly across the bridge eliminates the problem entirely.

Table 1-3 shows the pin assignment for the OM2-165 BRIDGESENOR and potentiometer designations.

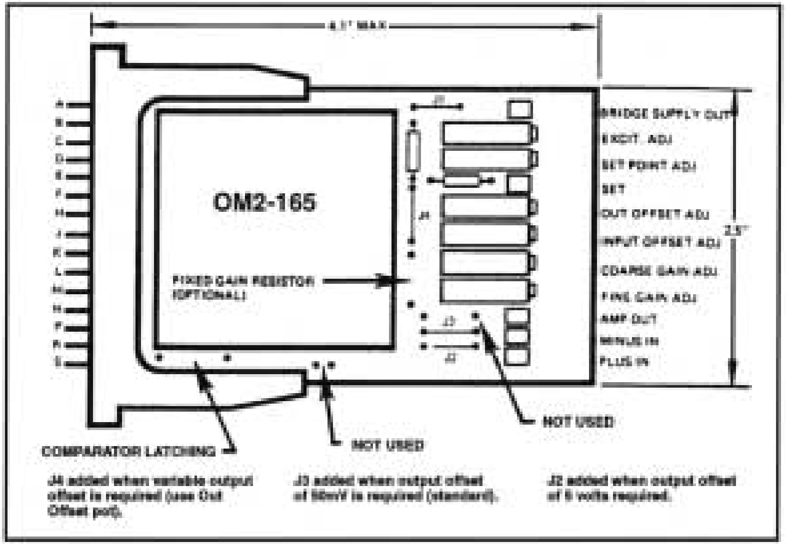

Figure 1-3. Potentiometers and Pin Assignments

NOTES

6.1 Pressure Transducer

Figure 6-1 shows a typical application using a standard 350 Ω pressure transducer bridge circuit.

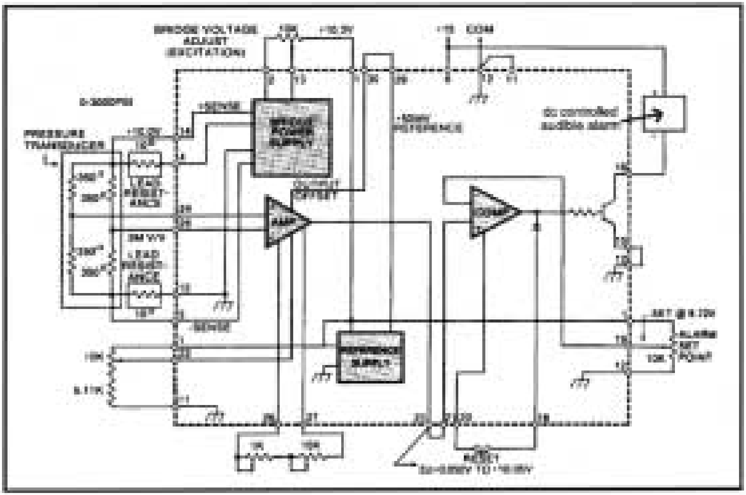

Figure 6-1. Pressure Transducer Applications

NOTES

Transducer Excitation - Bridge Supply

The Bridge Supply is variable from +4 to +10 volts and is short circuit protected for momentary shorts to common. It has two limits. A maximum current of 100 mA and maximum dissipation of the output transistor. The Bridge Supply Maximum Load curves, shown in Figure 2-1, show the maximum load current and the smallest load resistance as a function of the bridge supply output voltage.

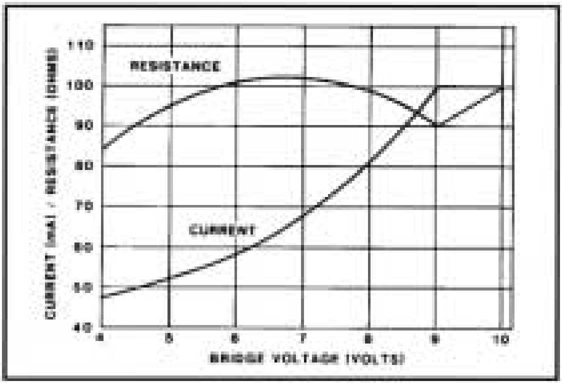

Figure 2-1. Bridge Supply Maximum Load

If a Sensor has a lower residence than allowed by the resistance curve, a series resistor can be added to the bridge supply output, pin 4. The bridge supply + sense, pin 14 is connected directly to the sensor since that is the voltage to regulate. See Figure 2-2. The resistor, RS can be determined from the following equation:

$$RS = RB\ (10 - VB)/VB$$

where RB is the sensor resistance and VB is desired sensor excitation voltage.

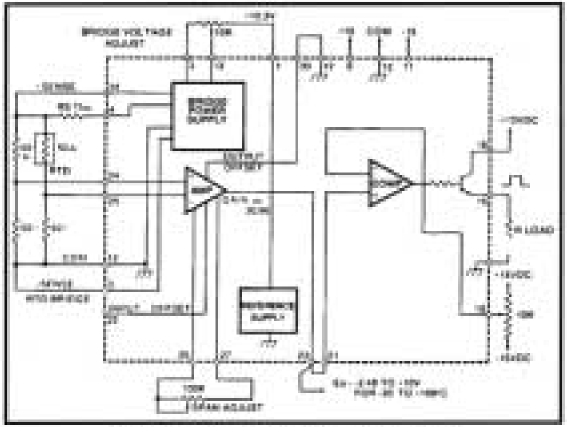

Figure 2-2. RTD Bridge Application

5

Reference Supply

The reference power supply uses a very stable zener reference diode as the primary reference voltage. This voltage is then converted to three values for use as excitation power supply voltage adjust, comparator setpoint adjust and amplifier output offset. The three voltages are +10.3V, +.05V, and +50mV. When the OM2-165 is used with a single polarity power supply the amplifier output will not swing to ground potential but it can go to a little below 50mV. By applying 50mV to the output offset input, a zero signal to the amplifier becomes equal to 50mV at output. The amplifier may then swing to a positive value to represent an increasing input signal. If it is desired to observe both increasing and decreasing signal changes with a single polarity power supply it then becomes necessary to make the zero signal level in between 50mV and 10 volts such as 5.0 volts. The 5.0 volt reference voltage is therefore connected to the output offset. This offsets the amplifier output to +5.0 volts for zero input signal.

An internal diode latch circuit is also included in the comparator. By connecting pin 18 to 20, the comparator will latch in the switch ON state when the input becomes more positive than the setpoint. It will not unlatch after the input signal decreases unless the connection from pin 18 to 20 is opened momentarily or module power is removed momentarily.

An example is illustrated in Figure 2-2, RTD Application. A standard Platinum RTD with a 0° resistance of 50 ohms and an alpha of 0.00385 is used. It desired to have an output of +10 volts for +100° and to measure temperatures between -20 and +100°C, with zero volts out at 0°. The OM2-165 is operated with dual 15 volt supplies. The comparator is connected to monitor the amplifier output and the setpoint, pin 19, is connected to a potentiometer that is connected between the + and -15 Volts supplies. This allows setting the comparator to any temperature in the measurement range. The comparator output is connected as an emitter follower, driving the load positive when the amplifier output exceeds the setpoint. The comparator output could be used to drive a dc controlled solid state relay, for example.

The series resistor, RSA is determined as follows:

Sensor Resistance =50 ohms

Sensor Voltage = 4 volts at 80 mA

The Bridge Supply Maximum Load curves show a maximum current of 47 mA and a minimum resistance of 85 ohms at 4 Volts.

RS = 50 (10-4)/4 = 75 ohms

The power in RS = I x I x RS = 0.08 x 0.08 x 75 = 0.48 Watt Use a 1 Watt resistor.

Pin 14 will be at 10 volts when the voltage across the 50 ohm bridge is set to 4 volts. Do not bypass the sensor with a capacitor.

At 0° the bridge will be balanced and the amplifier output will be zero. Atr + 100° the resistance of the RTD will be 69.25 ohms producing a voltage of +1.677 volts at the amplifier negative input. The gain required for 10 Volts output is then 10/(2.0 -1.677) = 30.96, which is set by the potentiometer between pins 26 and 27. At -20°, the RTD resistance will be 46.15 ohms, giving a voltage of +2.080 at the amplifier negative input. The output voltage will be

$$30.96\ (-0.08) = -2.48\ \text{volts.}$$

The error due to the OM2-165 typical 0.5mV input offset is 30.96 x $.5^{-3}$ = 15.4mV, or about 0.15°, and the input offset, pin 22, can be left open. Do not connect pin 22 to any voltage when it is desired not to adjust the input offset.

Output Comparator

The comparator is designed to monitor the output of the instrumentation amplifier and provide a solid state switch closure when the amplifier voltage reaches a pre-set level. The pre-set level is determined by a potentiometer adjusted voltage which is fed into the set input of the comparator. For a precise and stable setpoint, the OM2-165 provides a very stable 10.3 volt reference voltage that can be used as a source for the setpoint.

If the set input is more positive than the comparator input, the output switch will be OFF, and of course the reverse is also true. The output switch is an open collector NPN transistor and will source or sink up to 100 mA. The switch is current limited so that it cannot be damaged by trying to drive too small a load resistance. However, if the collector of the transistor is connected directly to a positive supply such as +15 Vdc and the emitter is grounded, the transistor would have to dissipate over 2 watts if turned on and would fail after a short time. Use caution when connecting load circuits.

NOTES

The built-in amplifier is true differential input, low drift, instrumentation amplifier. It is factory trimmed for a high common mode rejection ratio (CMRR) and external adjustments for input and output offsets. See Figure 3-1.

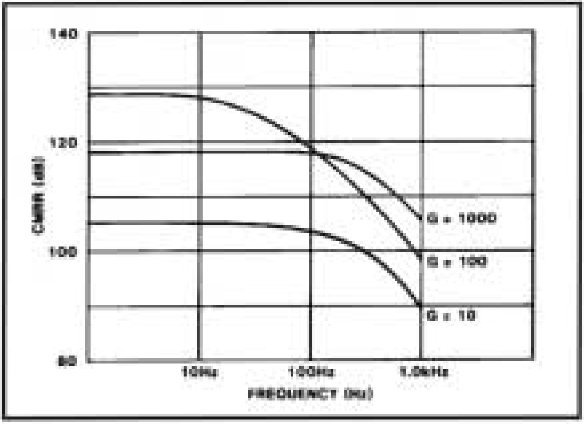

Figure 3-1. Common Mode Rejection Ratio Graph

The minimum gain is 10 and maximum gain is 1000. Gain is set be one resistor, Rg, connected across pin 26 and 27. RG can be determined to within 2% from the following formula, for gain A:

$$Rg = [2.02^5/A) - 200]/[1 - 10/A]$$

In most applications it is best to split the gain resistor into two potentiometers to provide a course and a fine adjustment. Gain resistors should have low temperature coefficient.

The input offset is the output voltage divided by the amplifier gain. For example, if the gain is 500 and the output voltage is 0.5 Volt, the input offset is 1 mV. The input offset is measured and adjusted by shorting the two inputs together and connecting them to common. The output offset, pin 30, must be connected to pin 3 for no output offset. The input offset is then adjusted for zero output.

If a single +15 Volt supply is used, the input must have a common mode voltage between +2 and +7 volts. The output offset must be set to +50 mV or greater. The output offset is applied to pin 30 and is not amplified by the gain of the amplifier. The output of the amplifier should be loaded by connecting a 2000 ohm resistor from pin 23 to pin 12, amp common. Connect the 50 mV reference, pin 29, to pin 31, for this adjustment. Measure the voltage between pin 30 and the amplifier output, pin 23, and adjust the input offset for zero volts.

The output offset appears at the amplifier output unaltered by the amplifier gain. This useful feature allows the output to be purposely offset when using a single power supply or to add corrective voltages such as thermocouple cold junction compensation or tare weight. The output offset is buffered by a high input impedance amplifier with a typical input current of 15 nanoamps.

The amplifier output swings from +50 mV to at least +10.05 volts when operated from a single +15 volts supply and loaded with a 2k resistor. When operated from dual 15 volt supplies, the output will swing a minimum of ±10 Volts into a 2 k Load. The output is protected against shorts to the power supply common.