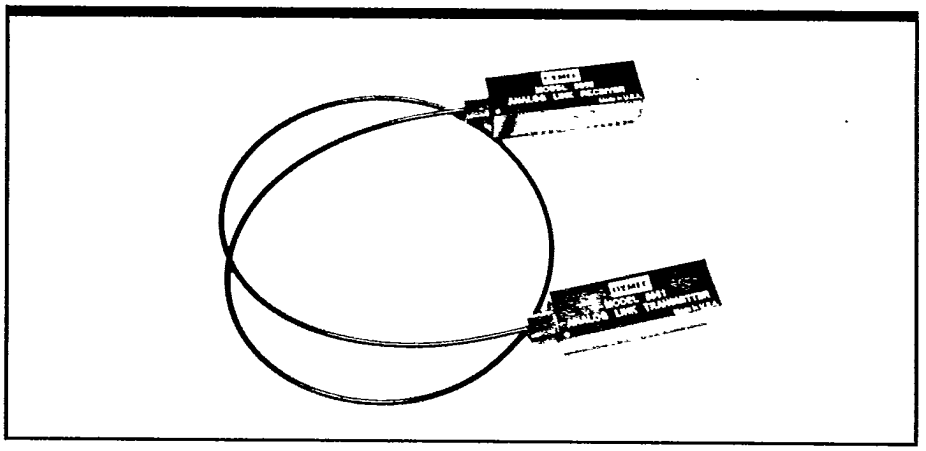
DYMEC

MODELS:

T-41-91

Transmitter: 5661
Receiver: 5662
Plastic Fiber Cable: 5663-xx
Evaluation Kit: 5660

10kHz Bandwidth Analog Fiber Optic Data Links



Description

The **5660 Series Link** components allow the designer, for the first time, to cost-effectively apply the advantages of fiber optics to the solution of isolation, ground loop and noise pickup/emission problems in system implementation. At approximately one-third to one-quarter of the cost of a glass fiber optic-based analog instrumentation link, the **5660 Series** utilizes advanced circuit and hybrid packaging techniques, and plastic fiber optic cable to implement an analog link with virtually identical performance to modular glass-based links. With this reduction in cost, fiber optics can be easily justified in most any system, where the real costs associated with an engineer to troubleshoot and resolve elusive ground loops and noise pickup problems can be significant.

The **5660 Series** consists of an analog transmitter and receiver, each housed in a 2.0"x0.67"x0.46" plastic DIL package. Pin-strappable transmitter input and receiver output full scale ranges of 0V to +1V, 0V to +2V, ±0.5V or ±1.0V may be independently selected. An uncommitted input buffer stage is provided in the transmitter, which can also be used to provide a modest system gain. To facilitate the calibration of the link, especially where the transmitter may be placed in relatively inaccessible locations, link calibration circuitry is located at the receiver only. With the exception of bypass capacitors, no external circuitry is required at the transmitter.

The transmitter and receiver are each powered from a single supply voltage in the range of +11.5V to +20.0V. Precision analog transmission is achieved by utilizing an FM carrier scheme. The receiver has an independently accessible 3-pole low-pass filter that can be used to reduce carrier ripple in the output signal by -50dB minimum relative to

FEATURES

- ❒ **Wide Analog Bandwidth**
  22kHz without filter
  10kHz with filter
- ❒ **Precision FM Transmission**
  ±0.035% typical end-to-end linearity
- ❒ **Exceptional Noise Immunity**
  Plastic fiber unaffected by EMI/RFI
- ❒ **Pin-strappable Full Scale Ranges**
  0V to +1V, 0V to +2V, ±1V, ±0.5V
- ❒ **User-configurable**
  Input Buffer/Gain Stage
  Output low-pass filter
- ❒ **Single Power Supply**
  +11.5V to +20.0V
- ❒ **Low-cost Fiber**
  Plastic fiber terminates with knife
- ❒ **Small Package**
  2.00"x0.67"x0.46"

APPLICATIONS

- ❒ Process Control
- ❒ 4-20mA Current Loops
- ❒ High Voltage Power Supply Monitoring & Control
- ❒ Data Acquisition
- ❒ Telemetry
- ❒ Robotics
- ❒ Remote Instrumentation/Control
- ❒ Medical Electronics

Specifications (continued)

All Specifications Guaranteed at 25°C Unless Otherwise Noted

T-41-91

5661 TRANSMITTER

ANALOG INPUT
Input Range
0V to +1V, 0V to +2V, ±1V, ±0.5V,
pin strappable
Overrange
5%
Configuration/Impedance
Single-ended;
Uncommitted Buffer Amplifier ($10^{12}\Omega$)
Overvoltage Protection
+Vs without damage

REFERENCE VOLTAGE OUTPUT
Output Voltage
+10.0V
Output Current
50µA maximum

TRANSFER CHARACTERISTICS
Analog Bandwidth (-3dB)
dc to 22kHz
Temperature Coefficient
±100ppm FS/°C typical
Power Supply Sensitivity
±100ppm FS/1% change in supply voltage, maximum
Warm-up Time
5 minutes to rated performance
Carrier Frequency
150kHz ±50kHz

OPTICAL OUTPUT
Optical Port Core Diameter
1000µm
Peak Wavelength (λ)
660nm

POWER REQUIREMENTS
+11.5V to +20.0V
30mA maximum at +12V
35mA maximum at +15V

ENVIRONMENTAL AND MECHANICAL
Operating Temperature
0°C to +70°C
Storage Temperature
-30°C to +100°C
Dimensions
2.00"x0.67"x0.46"
Optical Connector
Motorola FLCS-type

5662 RECEIVER

ANALOG OUTPUT
Output Voltage Ranges
0V to +1V, 0V to +2V, ±1V, ±0.5V,
pin strappable
Analog Bandwidth (-3dB)
dc to 22kHz
Output Current
10mA maximum
Offset Adjustment Range
±2.5% FS minimum
Offset Adjustment Potentiometer
5kΩ

TRANSFER CHARACTERISTICS
(WITHOUT INTERNAL LOW-PASS FILTER)
Analog Bandwidth (-3dB)
dc to 22kHz
Temperature Coefficient
±100ppm FS/°C typical
Power Supply Sensitivity
±100ppm FS/1% change in supply voltage, maximum
Warm-up Time
5 minutes to rated performance
Carrier Frequency
150KHz ±50kHz

TRANSFER CHARACTERISTICS
(WITH INTERNAL LOW-PASS FILTER)
Analog Bandwidth (-3dB)
dc to 10kHz
Gain
0dB
Rolloff
18dB/octave, 60dB/decade
Phase Response
Refer to Figure 4.
Output Ripple Voltage
$3mV_{p-p}$ typical at 1V full scale
$4.5mV_{p-p}$ typical at 2V full scale
Signal to Noise
80dB typical, relative to 1V
Signal to Carrier
50dB minimum, relative to full scale

OPTICAL INPUT
Optical Port Core Diameter
1000µm

POWER REQUIREMENTS
+11.5V to +20.0V
30mA maximum at +12V
35mA maximum at +15V

Specifications (continued)

T-41-91

ENVIRONMENTAL AND MECHANICAL
Operating Temperature
0°C to +70°C
Storage Temperature
-30°C to +100°C
Dimensions
2.00"x0.67"x0.46"
Optical Connector
Motorola FLCS-type

LINK
Non-Linearity
±0.05% FS maximum
Optical Budget
120dB typical

5663-XX CABLE
Core Diameter
1000µm
Core Material
Plastic
Attenuation
~2dB/meter
Length
50 meters maximum

Description (continued)

full scale, while reducing the overall link bandwidth to 10kHz. An external filter may be used in its place if different link bandwidth or response is required.

The link uses a visible red optical carrier at 660nm and inexpensive plastic fiber cable to interconnect the transmitter and receiver. The cable can be cut to length and the outer jacket stripped using a pocket knife or razorblade, with no polishing or other preparation required, making field termination as simple as possible. Compression-type bushing nuts (provided) are placed over the prepared ends of the cable and screwed onto the transmitter and receiver.

Link performance is guaranteed over a 50 meter maximum cable length.

Using the 5660 Series of 10kHz Analog Fiber Optic Data Links

LINK INTERCONNECTION

Figure 2 depicts the interconnection of the transmitter and receiver and the associated circuitry for offset and gain calibration and normal operation. In all pin strapping configurations shown, the input buffer is factory set at unity gain. To provide additional gain using the internal buffer in the transmitter, refer to the following section of *Transmitter Gain*.

The use of 10µF tantalum capacitors as shown in Figure 2 is critical to the performance of the link. The 0.1µF capacitors at the power supply pins are also critical, and should be placed as close as possible to the pins, both physically and electrically.

TRANSMITTER GAIN
(Optional)

The internal input buffer is factory adjusted for unity gain. To use this buffer to provide gain for the input signal, a resistor with less than 50ppm temperature coefficient is connected between the GAIN pin (12) and ground as shown in Figure 3. The tempco of this resistor directly affects the gain and offset tempco of the link. The value of this resistor is calculated from the formula:

$$R_G = 10k\Omega/(A-1)$$

where R_G is the gain setting resistor, and A is the required gain. The gain must be chosen such that the output voltage of the buffer amplifier does not exceed the pin-strapped full scale voltage range, i.e. either 1V or 2V, unless the configuration discussed below is utilized. If the gain is set too high, link offset will not adjust properly.

Input voltages from 0V to 10V such as those produced by many industrial sensors and transducers can be accommodated by the transmitter as shown in Figure 4a-c.

0 TO10 VOLT BUFFERED INPUT/≥15V SUPPLY VOLTAGE

Figure 4a depicts the input configuration to accommodate a 0-10V input signal while using the buffer amplifier to maintain a high input impedance. This scheme will function properly only if the transmitter has a +15V or greater supply. The 8kΩ resistor must

Using the 5660 Series of 10kHz Analog Fiber Optic Data Links (continued)

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have a low temperature coefficient, typically less than 50ppm.

0 TO 10VOLT BUFFERED INPUT/ ≤15V SUPPLY VOLTAGE

Figure 4b adds a precision voltage divider to the input of the buffer amplifier in order to accommodate a 0-10V input signal using the buffer amplifier,with a power supply voltage of +12V or greater. The 900KΩ and 100KΩ resistors should be tight tolerance, low temperature coefficient units to minimize their effect on overall link performance over temperature.

0 TO 10VOLT UNBUFFERED INPUT/ ANY RATED SUPPLY VOLTAGE

Figure 4c shows the 0V to 10V input signal tied directly to the 2V input of the transmitter through an 8kΩ low temperature coefficient resistor. This resistor is in series with a 2kΩ input resistor internal to the transmitter.

RECEIVER GAIN (Optional)

Normal link operation is shown in Figure 2. An output full scale range of 0V to +1V, 0V to +2V, ±1V or ±0.5V may be pin strapped, independently of the transmitter full scale range, allowing either gain or attenuation through the link. Link offset and gain potentiometers allow for calibrating the link under operating conditions (Refer to the section titled ***Link Calibration*** for the calibration procedure).

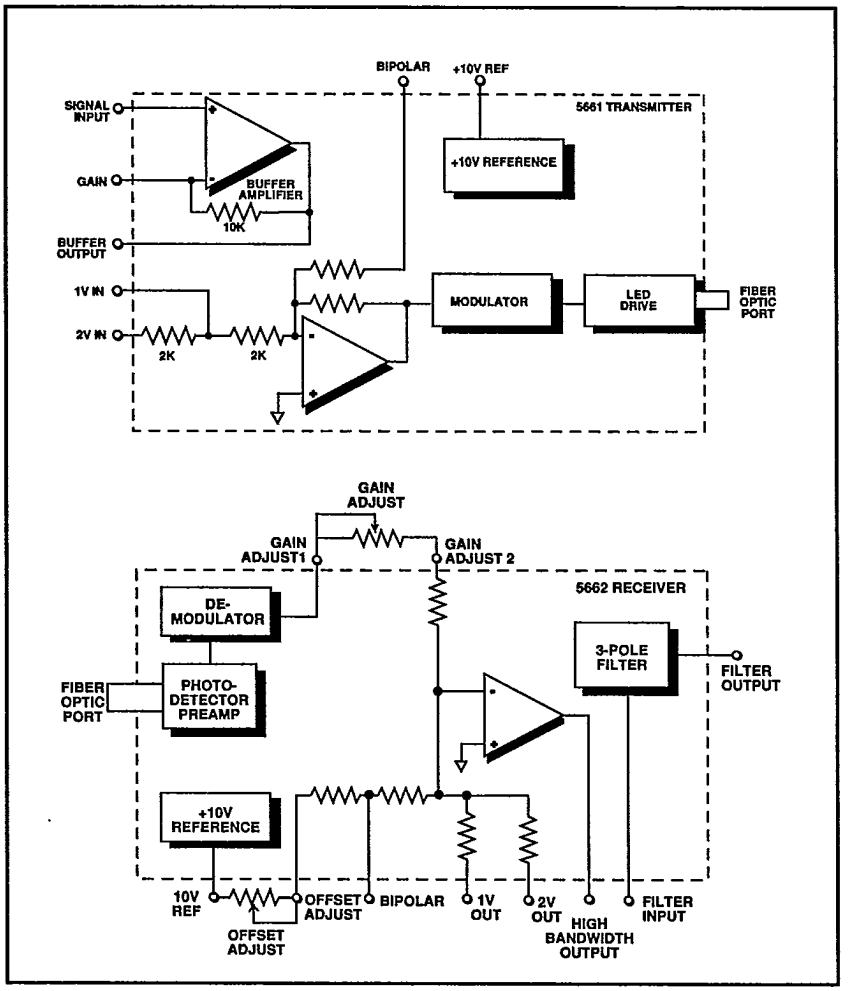

Figure 1. Block Diagram — Transmitter (TOP) — Receiver (BOTTOM)

For systems that require a 0V to 10V output from the link receiver without using an outboard gain stage, the output amplifier in the receiver can be

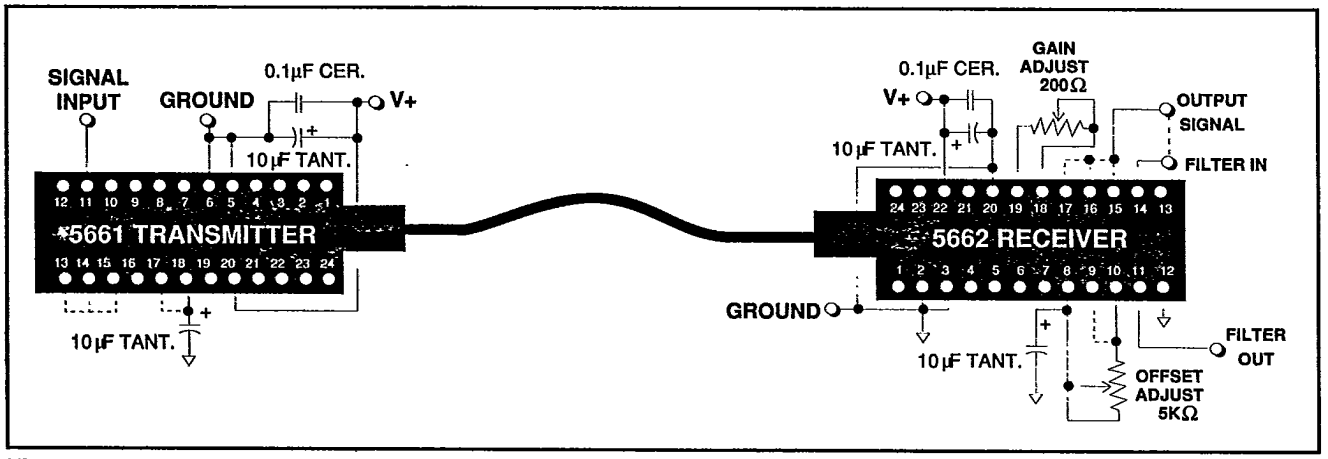

Figure 2. Interconnection Diagram

Using the 5660 Series of 10kHz Analog Fiber Optic Data Links (continued)

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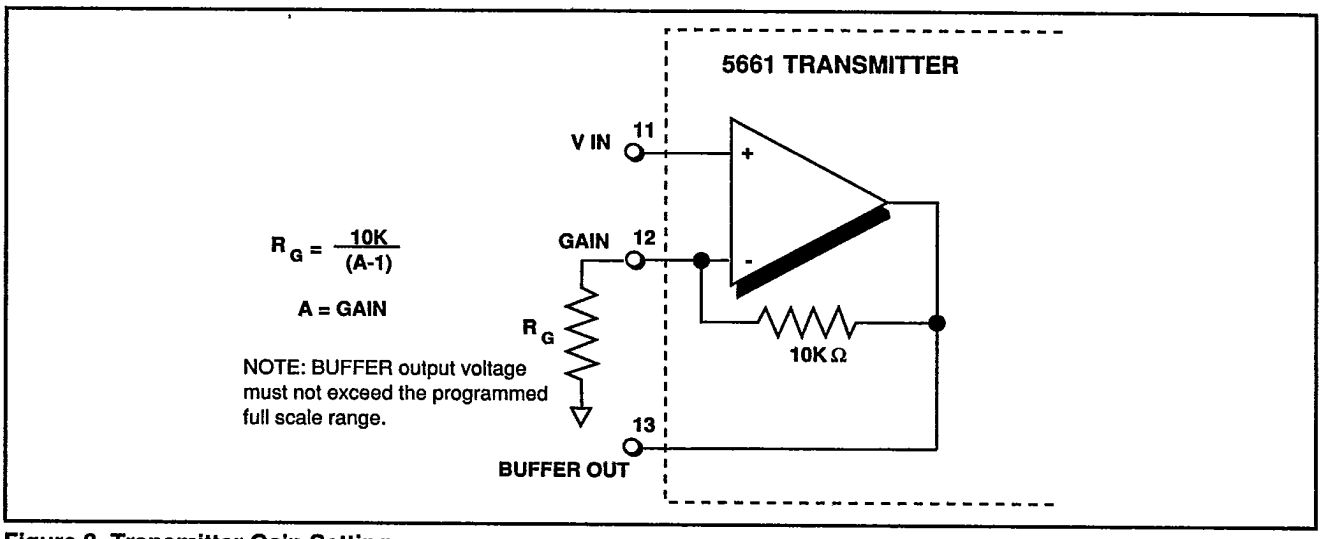

Figure 3. Transmitter Gain Setting

configured to provide a 10V full scale output as shown in Figure 4d. The receiver must be powered from +15V for this scheme to work properly. The GAIN ADJUST potentiometer value in this configuration is 500Ω rather than the 200Ω for normal operation. The 45kΩ fixed resistor should be a ≤50ppm tempco unit. Ripple will be increased by a factor of ten (10).

GROUNDING

Good analog grounding practices should be utilized in designing with the 5660 Series analog link, as with any precision analog circuit. Of particular importance with the 5662 receiver is the internal low-pass filter ground must be connected to the power ground for the receiver to operate properly.

CABLE TERMINATION

The plastic fiber optic cable provided as part of the link allows very simple field termination and connection to the transmitter and receiver, without the use of expensive connectors or complex epoxy or polishing techniques. The cable is cut to length using a pocket knife or razorblade, and the fiber jacket is stripped off to expose about 1/2" of bare fiber core. Care should be exercised to minimize nicking of the fiber core during the stripping process. Scribe the bare fiber core completely around its circumference with a razorblade or similar tool to leave 1/8" of core protruding beyond the jacket. Break off the core using your fingers. Loosen the connector locking nut on the transmitter or receiver. Insert the prepared fiber end into the connector until the core tip seats against the molded lens inside. Screw the connector nut down to a snug fit. This will lock the fiber in place. Repeat this procedure on the other end of the cable.

5661 TRANSMITTER

FULL SCALE INPUT	BUFFER OUT (13) TO PIN:	10V REF (18) TO BIPOLAR (17)
0V TO +1V	1V IN (14)	NO
0V TO +2V	2V IN (15)	NO
±0.5V	1V IN (14)	YES
±1.0V	2V IN (15)	YES

5662 RECEIVER

FULL SCALE INPUT	RCVR OUT (15) TO PIN(S):	OFFSET ADJ.(10) TO BIPOLAR (9)
0V TO +1V	1V OUT (16) & 14	NO
0V TO +2V	2V OUT (17) & 14	NO
±0.5V	1V OUT (16) & 14	YES
±1.0V	2V OUT (17) & 14	YES

Table 1. Input and Output Full Scale Programming

Using the 5660 Series of 10kHz Analog Fiber Optic Data Links (continued)

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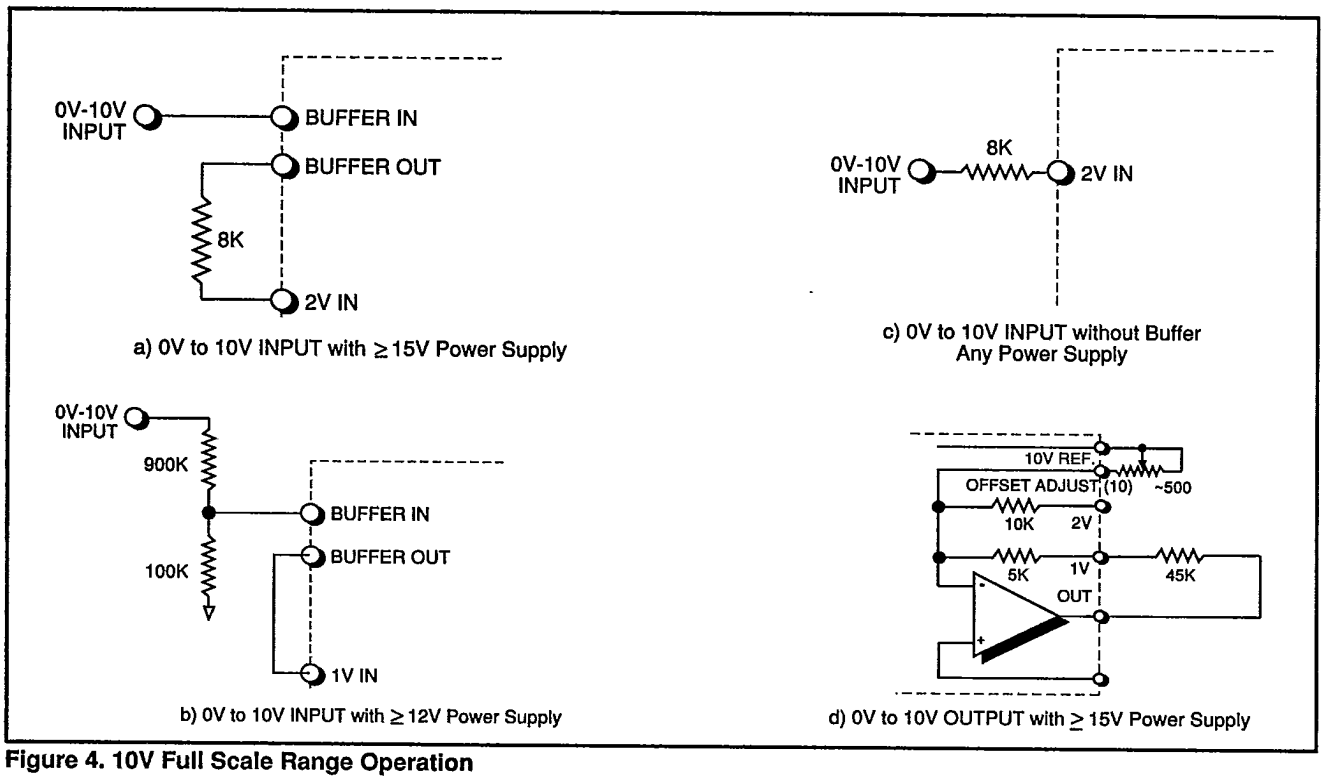

Figure 4. 10V Full Scale Range Operation

SETTING THE LINK BANDWIDTH/FILTERING THE RECEIVER OUTPUT

The low-pass filter internal to the **5662 Receiver** is a 3-pole active filter with phase characteristics as shown in Figure 5. This filter may be utilized to reduce the carrier frequency by 50dB minimum, and the bandwidth to 10kHz, or may be bypassed and the **Receiver** output signal fed to an external filter with differing bandwidth and/or response. The unfiltered output voltage has an analog bandwidth of 22kHz, but has a ripple component approaching 30% of full scale.

OPERATING TEMPERATURE LIMITS

The link transmitter and receiver will provide rated performance over a 0°C to +70°C temperature range. The plastic fiber optic cable is rated for continuous service over a -25°C to +80°C temperature range, with short term exposure to +100°C.

VERIFYING OPERATION

There are several techniques for verifying the proper operation of the link components if there is a problem in getting the link running.

First and foremost, if the link is tested outside of a system, typically at a lab bench, ***verify that the transmitter and receiver are powered by separate lab power supplies.*** This is critical. Under normal operating conditions in a system, the transmitter and receiver are operated from separate power supplies. On the bench, there is a natural tendency to use one supply to power both the transmitter and receiver since they are not separated by any great distance physically. This practice results in ground noise through the power supply return which can cause a 0.5V offset to occur which can not be adjusted out.

At the receiver, disconnect the optical cable and look at the end. You should see the red light output from the transmitter.

With a 1Megohm oscilloscope probe, check for a 100-200kHz signal at pin 24 of the transmitter, and a similar signal at pin 1 of the receiver.

Check for 10V reference voltage at pin 8 of the receiver.

If all of the above prove out, and the link is still not functioning properly, please consult the factory.

LINK CALIBRATION

The link is designed such that calibration is performed at the receiver only, thereby allowing the transmitter to be located without regard to access for calibration purposes. The link may be calibrated in either of

Using the 5660 Series of 10kHz Analog Fiber Optic Data Links (continued)

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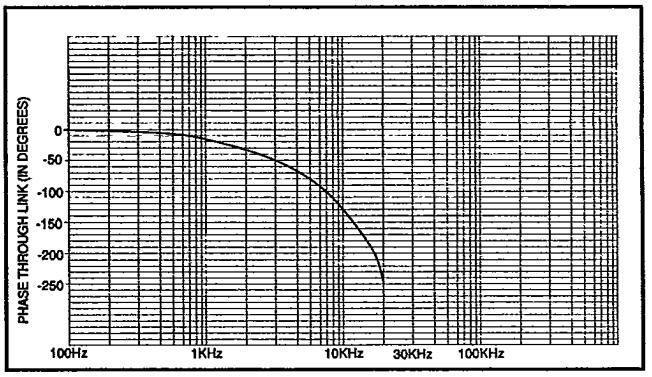


Figure 5. Link Phase Characteristics (w/ Internal Filter)

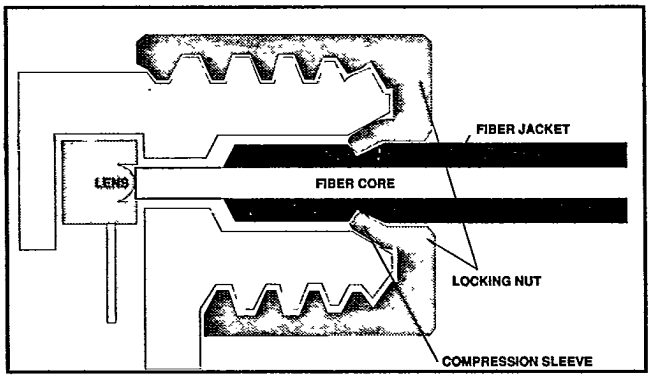


Figure 6. Cable/Connector Cutaway

two ways as described below, or the offset and gain of the link may be fixed. It is important to note that the GAIN and OFFSET adjustments are somewhat interactive. Calibration will be achieved more easily if the GAIN is adjusted first, then the OFFSET.

METHOD 1

A sinewave below 400Hz of known amplitide is applied to the transmitter input. The GAIN and OFFSET potentiometers at the receiver are adjusted until the sinewave is reproduced at the receiver output

METHOD 2

A step change of 0V to +1V is applied to the transmitter input. The GAIN potentiometer is adjusted for a 1 volt step at the receiver output. With 0V applied to the transmitter input, the OFFSET potentiometer is adjusted until 0V is produced at the receiver output.

If there is difficulty in adjusting the offset of the link, check to see if the gain of the input buffer, if used as a gain stage, is higher than it should be, causing a voltage in excess of the full scale range selected to appear at the input of the transmitter (pins 14 and 15).

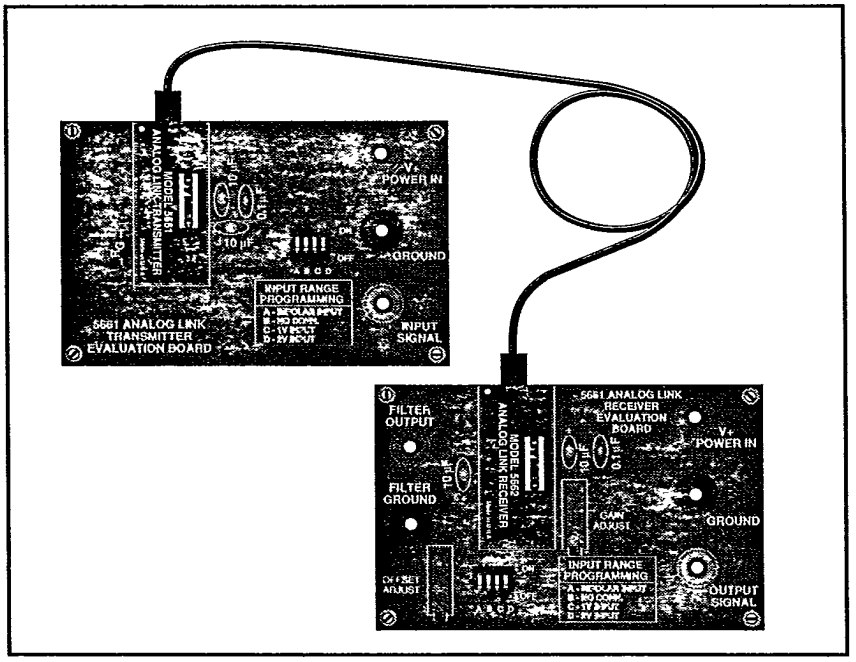


Figure 7. Evaluation Kit

EVALUATION KIT

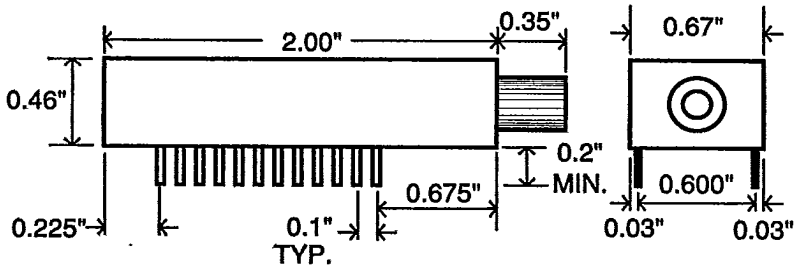
An evaluation kit is available for the **5660 Series** link that consists of two pc boards with standoffs and binding posts for power and signal leads. OFFSET and GAIN adjust potentiometers are provided on the receiver board to calibrate the link. Sockets for the transmitter and receiver are also provided.

Figure 7 shows a sketch of the two pc boards. Full scale range programming with the DIP switches consists of turning ON only the switch for the full scale range (1V or 2V)desired. The BIPOLAR switch is turned ON for bipolar operation and OFF for unipolar operation.

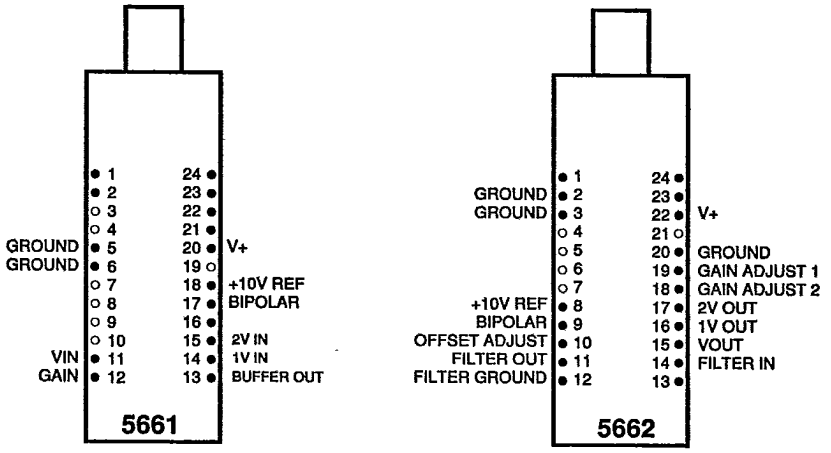
Input power of +11.5V to +20V is applied to the V+ and GROUND binding posts. The analog signal is applied to the INPUT SIGNAL binding post on the transmitter board. This signal is routed through the input buffer. The analog output signal can be taken from the receiver board either at the OUTPUT SIGNAL, which is the signal prior to the filter, or FILTER OUTPUT posts.

Mechanical Dimensions & Pinout

T-41-91



5661 TRANSMITTER/5662 RECEIVER



VIEWED FROM TOP OF UNIT
- o Denotes no pin present
- • Denotes pin present (Do NOT make connections to unlabelled pins)

ORDERING INFORMATION	
10kHz Hybrid Analog Fiber Optic Link	**Order Model:**
Transmitter	**5661**
Receiver	**5662**
Plastic, 1000 micron cable (xx = length in meters; 50 meters max.)	**5663-XX**
Evaluation Kit - consists of one each of the 5661, 5662, a 5663-03 3 meter cable, and a pair of pc boards with binding posts for power and signals	**5660**

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Bulletin No. 12-88045660 REV.0