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HIGHLAND TECHNOLOGY

J730 OPTICAL/ELECTRICAL CONVERTER



Technical Manual

January 10, 2023

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Table of Contents

1. Introduction 4
2. Specifications 5
3. Theory of Operation 6
4. Outlining and Mounting 11
5. Fiber Notes 13
6. Versions 14
7. Customization 14
8. Hardware Revision History 15
9. Accessories 15

1. Introduction

The J730 is a small single-channel DC-coupled optical-to-electrical converter.

The J730 allows fast timing and logic-level signals to be transported via fiberoptic levels to take advantage of the superior speed, attenuation, and EMI characteristics of optical fiber.

Features of the J730 include:

- Compact, rugged, logic-level optical-to-electrical converter allows the e/o transition to be located wherever most convenient
- Allows transport of logic levels and fast triggers over long distances in high EMI environments
- Below 12 picoseconds typical RMS link jitter
- Fast electrical rise times
- Provides fast, DC-coupled digital and analog electrical outputs
- Available with 62/125 micron multimode ST or FC connectorized fiber at 850 nanometers, or singlemode or multimode ST or FC connectorized fiber at 1310 or 1550 nanometers
- Accepts fiberoptic inputs from the Highland J720 Electrical/Optical Converter or compatible sources
- Ideal accessory for Highland Model P500 Digital Delay and Pulse Generator
- Compatible with Highland fiberoptic transmitter products:
    - J720 Standalone Electrical/Optical Converter
    - J724 Buffered Electrical/Optical Converter
    - V720 Electrical/Optical Converter VME Module

2. Specifications

FUNCTION	Single-channel optical-to-electrical converter
INPUT	DC coupled fiberoptic input, ST or FC connector 850, 1310, or 1550 nm wavelength 1 mW nominal optical fiber power, 2 mW absolute max Threshold adjustable 100 µW to 800 µW, factory set to 300 µW See manual section 6 for versions
PROPAGATION DELAY	Light in to electrical out < 10 ns
OUTPUTS	Digital: +5 volts typ, 2.25 V typ into 50 Ω load Analog: +1 volt per mW optical input into 50 Ω load Source impedance: 50 Ω
BANDWIDTH	DC to 180 MHz
RISETIME	Digital output: < 750 ps Analog output: < 2.5 ns
JITTER	< 12 ps RMS, J720 + J730
OPERATING TEMPERATURE	0 to 60ºC
CALIBRATION INTERVAL	One year
POWER	+12 volts at 60 mA, nominal plus load current J12 12 volt power supply adapter furnished
CONNECTORS	ST or FC optical input receptacles Gold plated SMB digital and analog output jacks Front panel test jacks for threshold measurement 2.1 mm X 5.5 mm barrel power connector
INDICATOR	LED: Green power
PACKAGING	3.3” (L) x 2.1” (W) x 0.9” (H) extruded anodized aluminum enclosure J732 mounting flange included

3. Theory of Operation

The J730 block diagram is presented in Figure 1. It incorporates a GaAs or InGaAs PIN diode detector, a fast analog amplifier, an adjustable comparator, and a digital output driver. The J730 design and bandwidth is optimized for minimum jitter when driven by a J720, J724, V720 or compatible e/o converter.

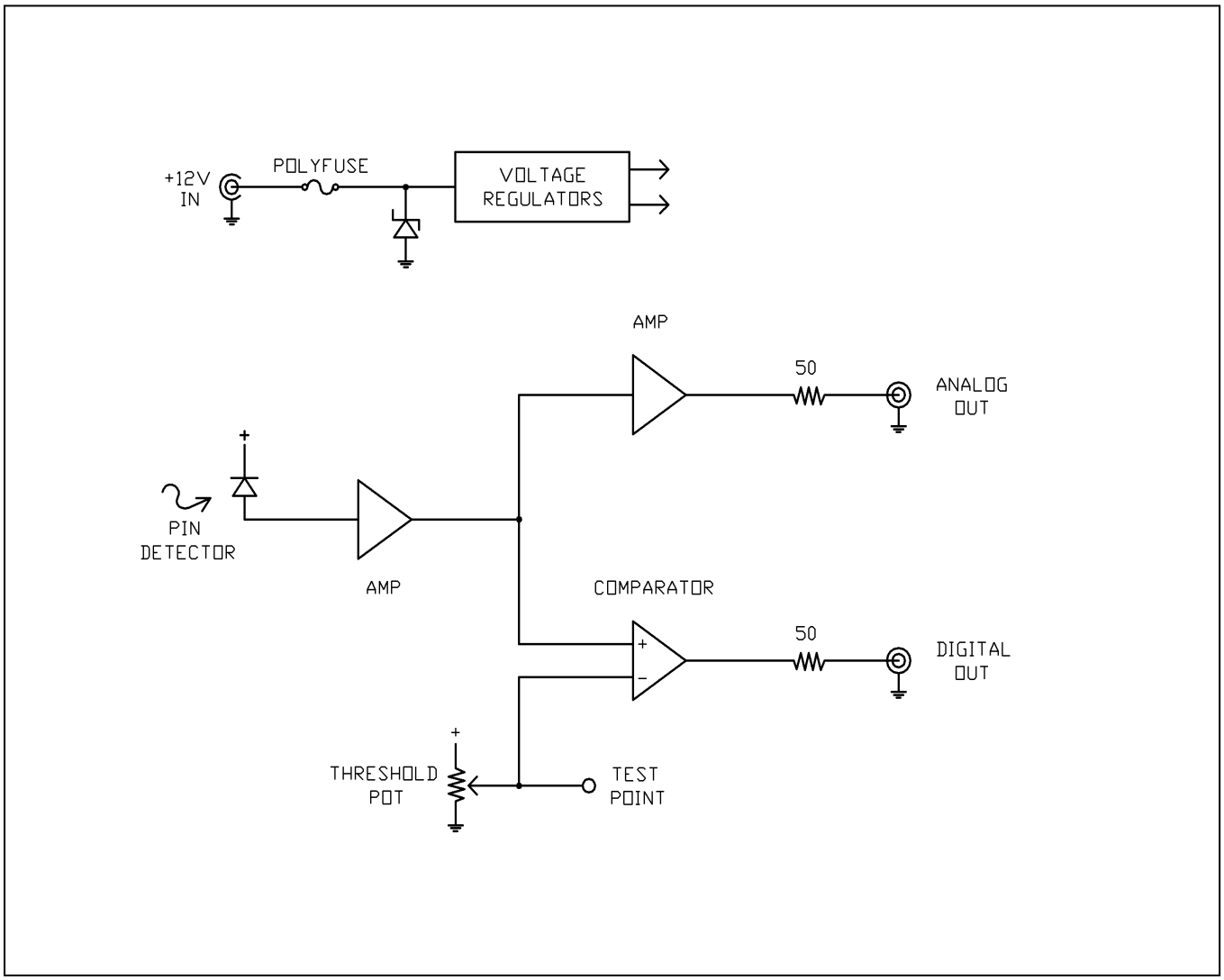


Figure 1. J730 Block Diagram

Figure 2 shows typical digital and analog output pulses generated by the J730 when driven by a Highland Model P400/P500 Digital Delay Pulse Generator and a J720 Electrical/Optical Converter delivering a 1-mW optical pulse. The digital voltage level is about +2.2 volts and the analog level is about +1.0 volts. Both signals were measured by a 50 Ω oscilloscope, and would be 2:1 greater if driven into high-impedance loads. The J730 analog output waveform is fairly representative of the actual optical pulse shape.

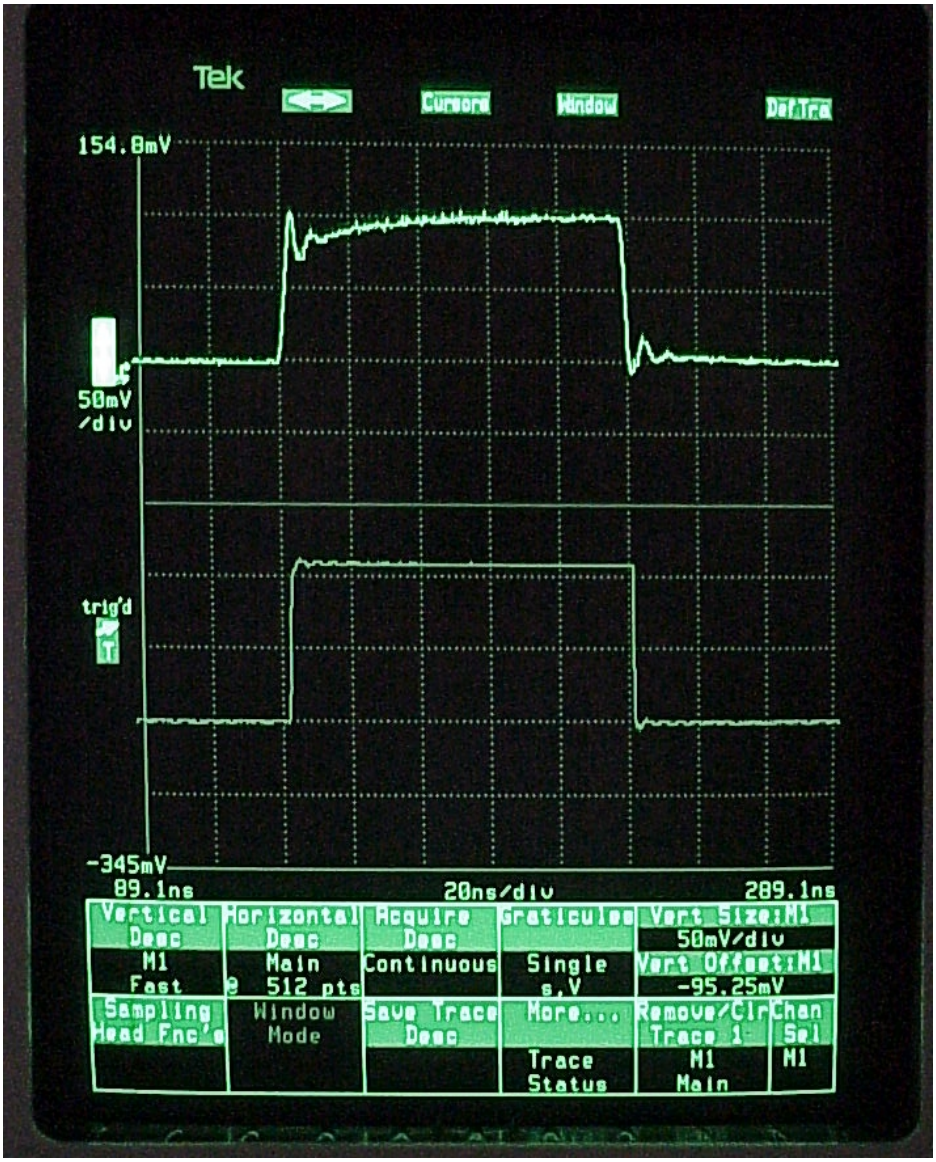
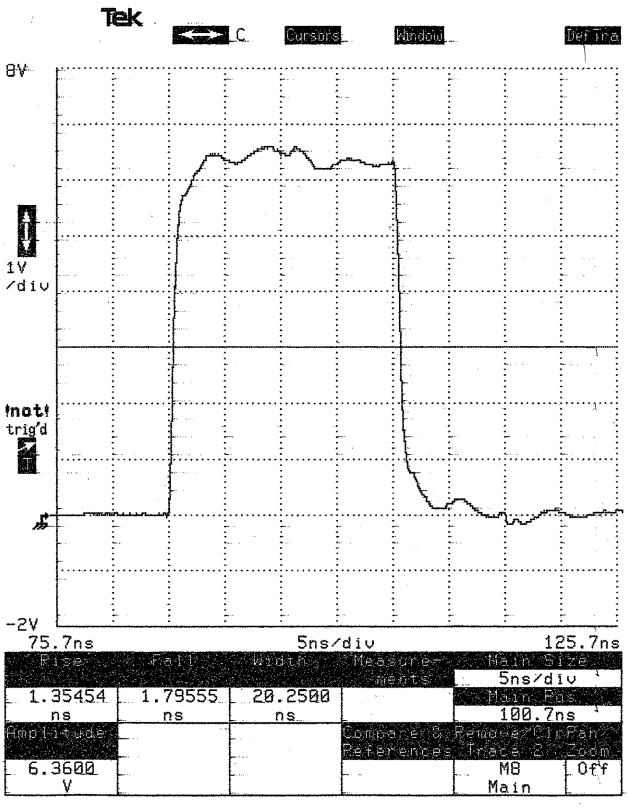


Figure 2. Typical J730 Analog and Digital Outputs

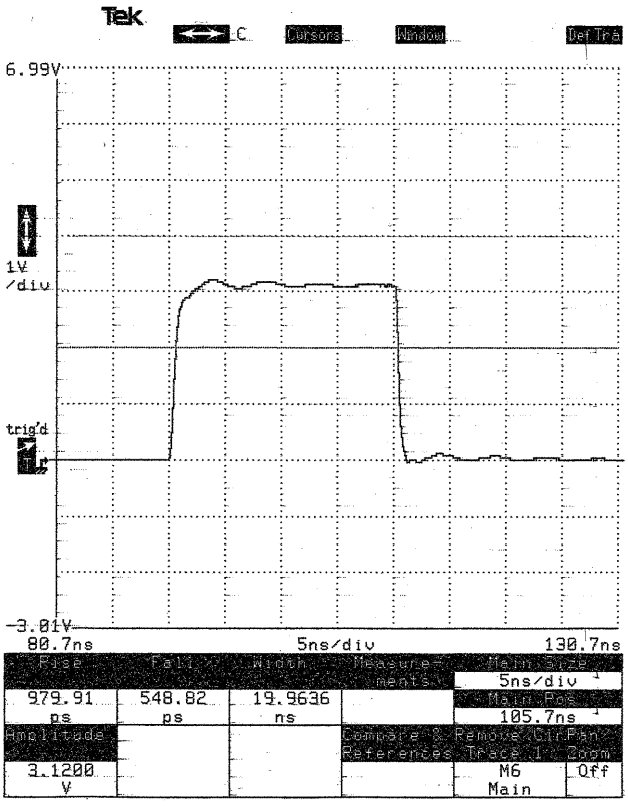
The digital output goes high when incoming optical power exceeds the threshold setting. The threshold is adjustable using the trimpot located adjacent to the fiber input connector. The nearby test point voltage may be measured with a DVM to facilitate setting the threshold; it is scaled 1 volt per milliwatt; measure this voltage against any of the cover securing screws or the fiberoptic connector shell, all of which are grounded and circuit common.

The comparator threshold is factory-set to 300 μW (300 mV at the test point) and is adjustable from below 100 μW to at least 800 μW. A setting of about 30 percent of expected optical pulse power is recommended. Too high or two low a setting can result in excess jitter or unreliable operation. If the analog output is monitored with a 50 Ω oscilloscope, the threshold voltage at the test point is scaled identically to the analog output voltage, so the threshold pot might be set so the test point voltage is 30 percent of the peak observed analog pulse level. If a high-impedance scope is used to check the analog output, set the test point voltage to about 15 percent of the observed peak analog pulse level.

Custom high digital drive versions of the J730 are available in volume.



Custom J730 Driving Hi-Z Load



Custom J730 Driving 50Ω Load

Figure 3 shows the rising edge of the digital output. Digital output risetime is typically about 650 picoseconds, and analog edge risetime is about 2 nanoseconds. The midpoint of the digital edge rises about 700 picoseconds after the midpoint of the analog output.

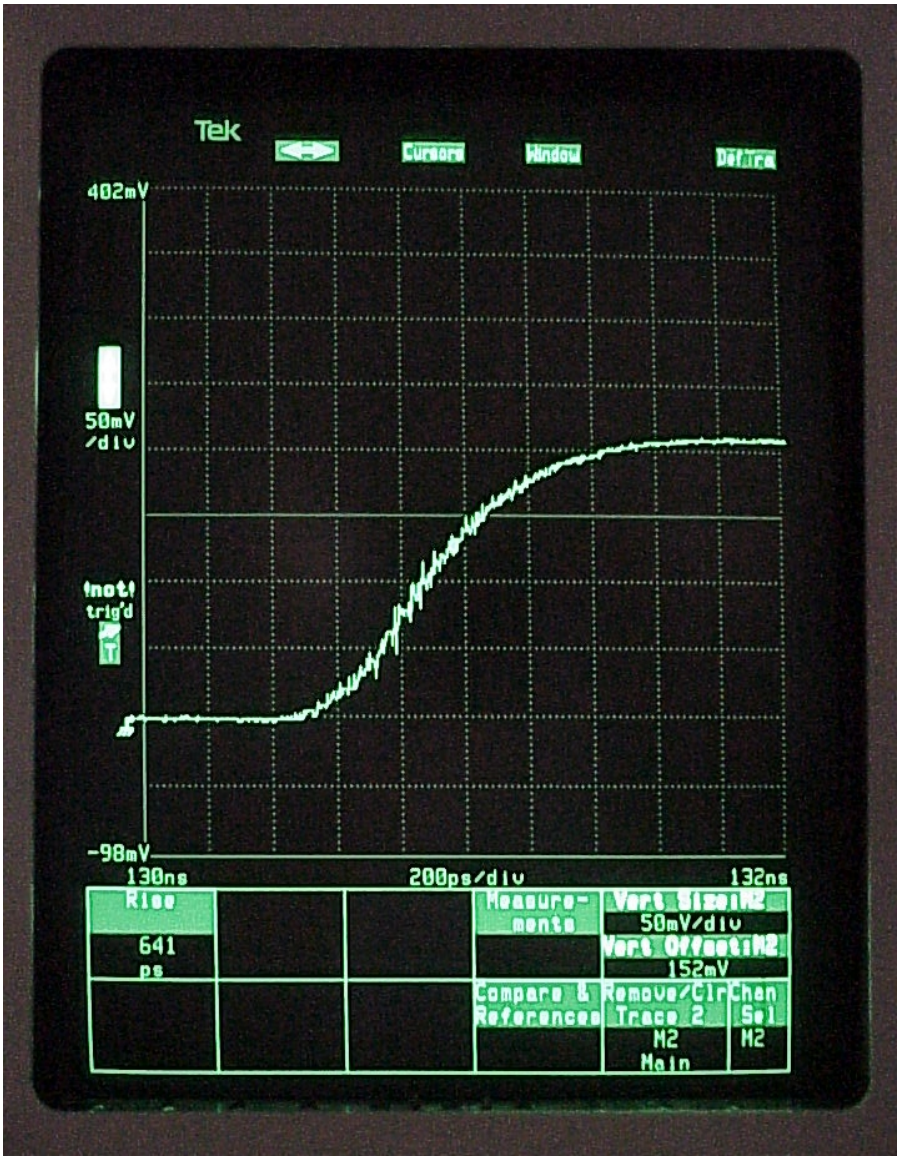


Figure 3. Digital Output Risetime

Figure 4 is a typical test setup for a J720/J730 digital signal link. The J720 is driven by a Highland P400 Digital Delay/Pulse Generator which also triggers the Tektronix 11801A sampling scope. A 25 meter fiber cable connects the J720 transmitter to the J730 receiver, and the scope displays the J730 analog and logic-level outputs.

In this test, the total timing jitter of the P400, the J720, the J730, and the scope was 9.2 picoseconds RMS.

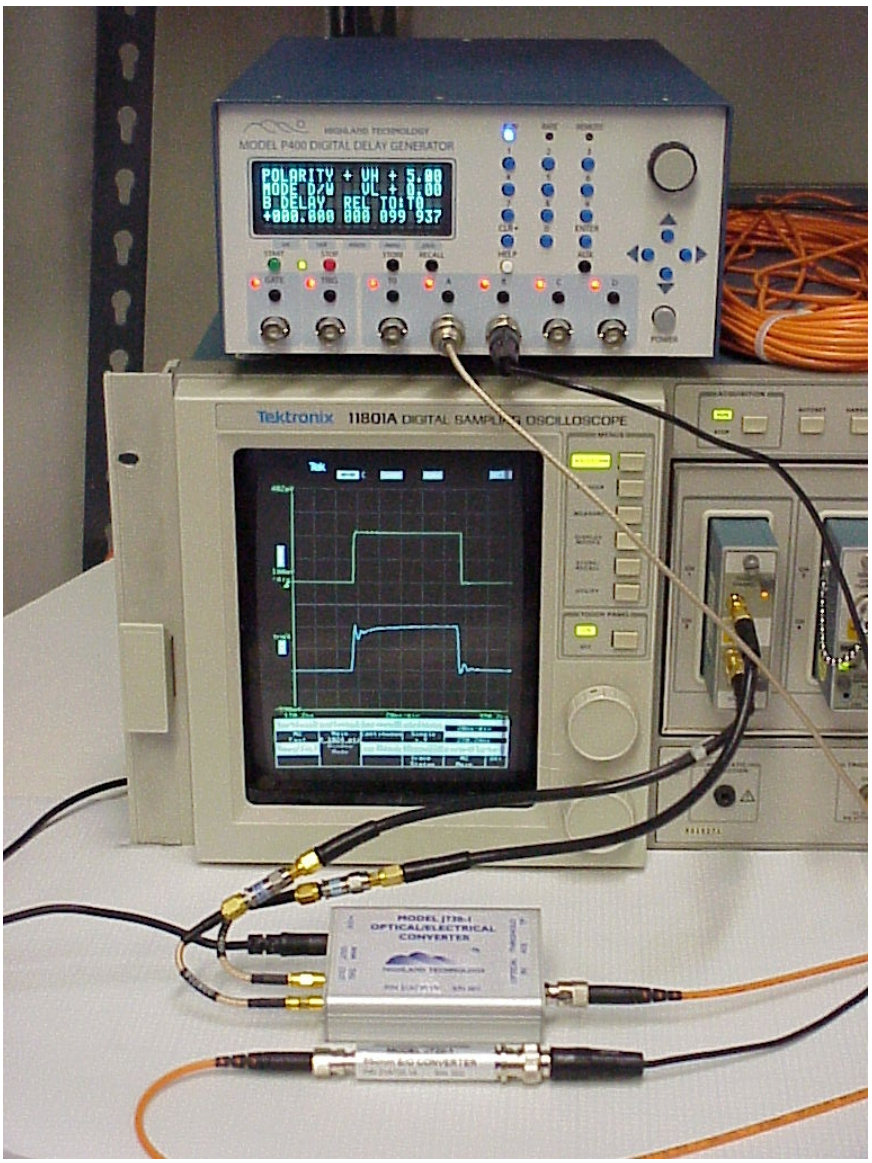


Figure 4. Typical P400/P500 + J720 + J730 Test Setup

4. Outlining and Mounting

Figure 5 shows the J730 outline and mounting dimensions, and Figure 6 is the standard J732 mounting flange.

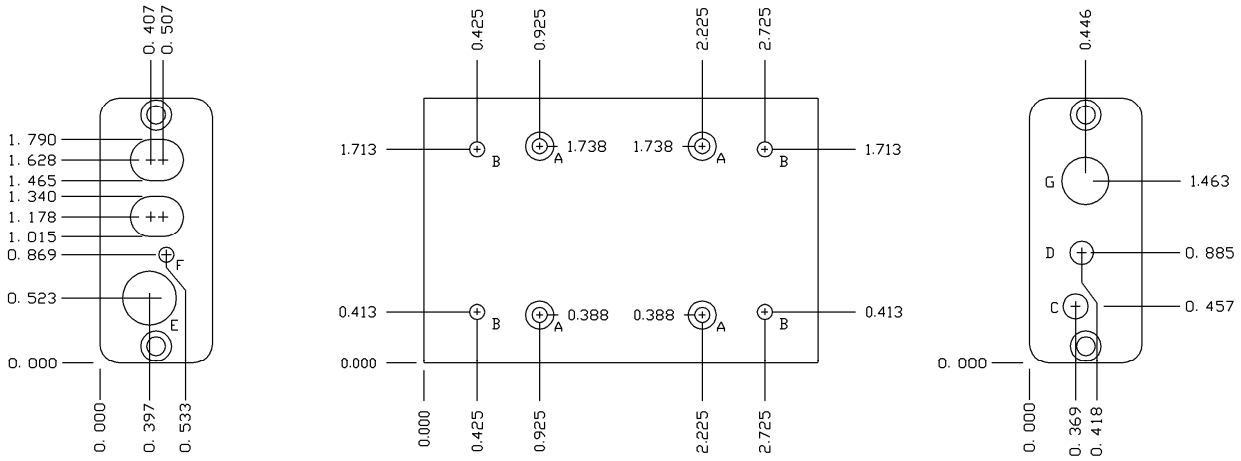


Figure 5. J730 Mounting Dimensions

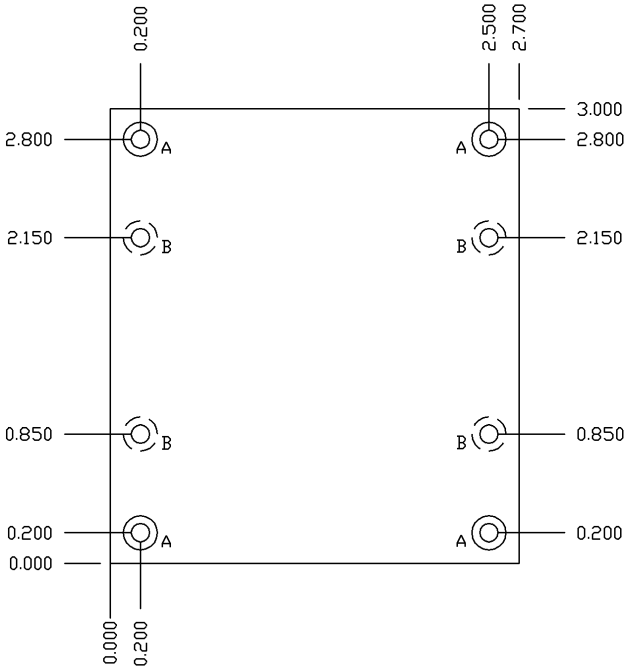


Figure 6. J732 Flange Dimensions

It is recommended that the J730 be securely bolted to a grounded metal surface.

The J730 may be bolted directly to a mounting surface with four 4-40 machine screws from below. In Figure 5, the four holes denoted "B" are the tapped mounting holes. If access to the rear of the mounting surface is inconvenient, the J732 flange may be bolted to the J730, and the flange mounted from above.

CAUTION: Mounting screws must not penetrate more than 0.125 inches into the J730 enclosure.

The Model J12 external +12 volt power supply is furnished with purchase. If users prefer to supply power, apply +8.5 to +15.5 volts DC at the center conductor of the 2.1 x 5.5 mm coaxial power connector. The J730 enclosure is ground and circuit common. The J730 is protected against polarity reversal and reasonable overloads.

5. Fiber Notes

The 850 nm versions of the J730 use a GaAs PIN diode detector in an ST or FC connector housing. It should be used with standard 62/125 μm ST or FC connectorized, graded-index, multimode, glass-fiber cables. Longwave versions use an ST or FC mounted InGaAs photodiode, and are usable with singlemode or multimode fiber. Fiber-coupled power is typically 3dB higher when multimode fiber is used with InGaAs photodiode equipped versions.

Fiber connectors should be kept clean and covered with protective caps when not in use, and should be cleaned with an approved fiber wipe before each use. Dust and other contaminants may not only result in immediate coupling problems, but may lodge within the laser/detector housings and produce long-term degradation.

Do not bend the fibers to a radius below 1 inch.

Multimode fiber propagation delay is typically about 0.66 C, or about 5 nanoseconds/meter (1.5 nanoseconds per foot). Propagation delay varies with temperature and is roughly +15 PPM/ºC but may vary considerably depending on the fiber and jacketing.

Communications grade multimode fiber will have losses in the vicinity of 3 dB/km at 850 nm. A connector pair may add 1 dB loss. The receiver threshold can be reduced to accommodate fiber loss or splitters, at the cost of additional jitter. A receive threshold of perhaps 300 μW will generally result in good system performance when the J730 receives inputs in the 800 to 1000 μW range.

Dispersion results in a degradation of optical pulse risetime with distance; expect risetime loss of up to several nanoseconds per kilometer for graded-index multimode fiber.

Singlemode fiber will typically have losses and dispersion that are a small fraction of those of multimode fiber.



6. Versions

Standard versions of the J730 include:

J730-1: 850 nm single-channel compact fiberoptic-to-electrical converter with ST connectorization

J730-3: 1310 nm single-channel compact fiberoptic-to-electrical converter with ST connectorization

J730-5: 1550 nm single-channel compact fiberoptic-to-electrical converter with ST connectorization

J730-11: 850 nm single-channel compact fiberoptic-to-electrical converter with FC connectorization

J730-13: 1310 nm single-channel compact fiberoptic-to-electrical converter with FC connectorization

J730-15: 1550 nm single-channel compact fiberoptic-to-electrical converter with FC connectorization

7. Customization

Consult factory regarding additional custom versions. Highland also offers standard and custom laser drivers, delay generators, and timing controllers.

8. Hardware Revision History

Revision C	May 2012 Overall bandwidth increase Improved digital output source impedance match and drive capability
Revision B	May 2005 Bandwidth improvements
Revision A	Apr 2005 Initial PCB release

9. Accessories

J12-1	12 volt power supply (furnished with purchase)
J41-1	3’ SMB to SMB cable
J41-2	6” SMB to SMB cable
J42-1	3’ SMB to SMA cable
J53-1	3’ SMB to BNC cable
J53-2	6” SMB to BNC cable
J59-1	3’ ST to ST fiberoptic cable (multi mode simplex)
J60-1	3’ FC to FC fiberoptic cable (single mode simplex)
J61-1	3’ ST to ST fiberoptic cable (single mode simplex)
J732-1	mounting flange (furnished with purchase)

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