HIGHLAND TECHNOLOGY

J724

ELECTRICAL-TO-FIBEROPTIC CONVERTER

Technical Manual

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1. Introduction

The J724 is a small single-channel electrical-to-optical converter. It allows fast timing and logic-level signals to be transported while taking advantage of the superior speed, attenuation, and EMI characteristics of optical fiber.

Seven versions are available:

The J724-1 utilizes an 850 nm ST connectorized VCSEL laser, compatible with 62/125 µm multimode fiber. The J724-1 is suitable for driving the standalone J730-1 o/e converter and the V730-1 6-channel VME o/e converter.

The J724-3 utilizes a 1310 nm ST connectorized Fabry-Perot laser, compatible with 62/125 µm multimode fiber or 9/125 µm singlemode fiber. The J724-3 is suitable for driving the standalone J730-3 o/e converter and the V730-3 6-channel VME o/e converter.

The J724-5 utilizes a 1550 nm ST connectorized Fabry-Perot laser, compatible with 9/125 µm singlemode fiber or 62/125 µm multimode fiber. The J724-5 is suitable for driving the standalone J730-5 o/e converter and the V730-5 6-channel VME o/e converter.

The J724-11 utilizes an 850 nm FC connectorized VCSEL laser, compatible with 62/125 µm multimode fiber. The J724-11 is suitable for driving the standalone J730-11 o/e converter and V730-11 6-channel VME o/e converter.

The J724-13 utilizes a 1310 nm FC connectorized Fabry-Perot laser, compatible with 9/125 µm singlemode fiber or 62/125 µm multimode fiber. The J724-13 is suitable for driving the standalone J730-13 o/e converter and the V730-13 6-channel VME o/e converter.

The J724-15 utilizes a 1550 nm FC connectorized Fabry-Perot laser, compatible with 9/125 µm singlemode fiber or 62/125 µm multimode fiber. It is suitable for driving the standalone J730-15 o/e converter or the V730-15 6-channel VME o/e converter.

The J724-25 utilizes a 1550 nm FC-APC pigtail connectorized Fabry-Perot laser, compatible with 9/125 µm singlemode fiber or 62/125 µm multimode fiber.

Features of the J724 include:

- Compact DC-coupled logic-level to fiberoptic converter
- Small, rugged anodized extruded aluminum package allows the e/o transition to be located wherever most convenient
- Available with 850 nanometer laser for multimode fiber, and 1310 nanometer or 1550 nanometer laser for single or multimode fiber
- Uses commonly available ST or FC connectorized fiberoptic cables
- Adjustable logic-level inputs are compatible with TTL, LVTTL, ECL, NIM, and most other common logic levels
- High noise immunity ensures error-free logic transmission in severe EMI environments
- User-selectable input logic threshold and termination
- Timing link jitter typically below 12 picoseconds RMS when used with compatible J730 or V730 optical/electrical converters
- Ideal accessory for model P500 benchtop digital delay/pulse generator

2. Specifications

FUNCTION	Single-channel electrical-to-optical converter
INPUT	Electrical logic level on SMB connector Input threshold level adjustable -4 volts to +5 volts Switchable input termination: 50 Ω or HiZ
PROPAGATION DELAY	Electrical to light out: 1.2 ns, typical
OUTPUT	1 mW nominal optical fiber-coupled power 850 nm, 1310 nm or 1550 nm nominal wavelength versions FC, FC-APC Pigtail or ST connector
BANDWIDTH	DC to 180 MHz repetition rate
RISETIME	Optical out: < 250 ps, 20 to 80%
JITTER	< 12 ps RMS, typical
OPERATING TEMPERATURE	0 to 60ºC; extended MIL/COTS ranges available
CALIBRATION INTERVAL	One year
POWER	12 volts to 24 volts at 300 mA, nominal (28 volts max) Positive or negative polarity, power is isolated from chassis and connector signals J12 12 volt power supply adapter furnished
CONNECTORS	Gold plated SMB electrical logic input ST, FC or FC-APC Pigtail optical output receptacle Front panel test jack for threshold measurement 2.1 mm X 5.5 mm barrel power connector
INDICATORS	LED: Amber 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 J724 block diagram is presented in Figure 1. It incorporates an input comparator, a laser driver, and a temperature-compensated laser current source.

Figure 2 shows a typical optical pulse generated by the J724-1 (850 nm version) when driven by a Highland model P500 pulse/delay generator. The detector system was a Tektronix P6701 O/E converter and an SD-22/11801 sampling scope, with net bandwidth of 700 MHz.

Figure 3 shows a typical optical pulse generated by the J724-3 (1310 nm version) when driven by a Highland model P500 pulse/delay generator. The detector system was a Tektronix SD-48 O/E converter and an SD-22/11801 sampling scope, with net bandwidth of >12 GHz. The laser noise is typical of Fabry-Perot lasers, and is effectively filtered by the bandwidth and threshold behavior of the J730-3 receiver.

Figure 4 is a typical test setup for a J724/J730 digital signal link. The J724 is driven by a Highland P500 Digital Delay/Pulse generator which also triggers the Tektronix 11801A sampling scope. A one-meter fiber cable connects the J724 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 P500, the J724, the J730, and the scope was 7 picoseconds RMS.

4. Setup And Application

The J724 requires an external source of DC power, in the range of 10.8 to 26.4 volts (28 volts, absolute max). Power is applied to the unit through a female, coaxial-type 2.1 mm x 5.5 mm connector and is compatible with either center pin positive or center pin negative supplies. J724 connectors, testpoints, enclosure and mounting plate are fully isolated from the power supply. A model J12 power supply is furnished with purchase.

Two user adjustments are provided: termination and logic threshold.

The TERM adjustment is actually a trimpot which sets the logic termination to 50 Ω when set fully clockwise, and 1 kΩ when fully CCW. Termination is to ground. This is normally used as a "switch" but can be set to intermediate resistance levels, with an ohmmeter, if useful.

The THRESHOLD pot sets the input comparator decision level, with a test point provided to assist in accurately setting the level. The threshold adjustment range is -4.0 to +5.0 volts respectively. The J724 may be driven with standard TTL, ECL, CMOS, or NIM logic levels, or, with a zero-centered (or AC-coupled) sine or square wave in the range of -4.0 to +5.0 volts peak-to-peak. Some common settings are:

INPUT TYPE	THRESHOLD	TEST POINT SETTING
TTL	+1.25 volts	+1.25 volts
ECL	-1.35 volts	-1.35 volts
NIM	-0.40 volts	-0.40 volts
Sine	0.0 volts	0.0 volts

Input slew rate should be at least 10 volts/µs to ensure reliable operation, and at least 100 v/µs for low-jitter applications. To avoid damage, do not apply inputs beyond -6 volts and +8 volts, and ensure that the input is not exposed to static discharge.

5. Outline And Mounting

Figure 5 shows the J724 outline and mounting dimensions, and Fig 6 is the J732 mounting flange, furnished with all units.

It is recommended that the J724 be securely bolted to a grounded metal surface.

The J724 may be bolted directly to a mounting surface with four 4-40 machine screws from below. In Fig 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 J724, and the flange mounted from above.

CAUTION: mounting screws must not penetrate more than 0.125 inches into the J724 enclosure.

The model J12 external +12 volt power supply is furnished with purchase. If users prefer to supply power, apply 10.8 to 26.4 volts DC at the 2.1 x 5.5 mm coaxial power connector, either polarity. The J724 enclosure is ground/circuit common and fully isolated from the power supply. The J724 is protected against reasonable power supply over voltage with poly fuse and TVS (transient voltage suppressor) circuitry. Exceeding 29 volts can activate the TVS and result in a tripped poly fuse. Over voltage protection is self-resetting, with normal operation typically resuming once overload is removed.

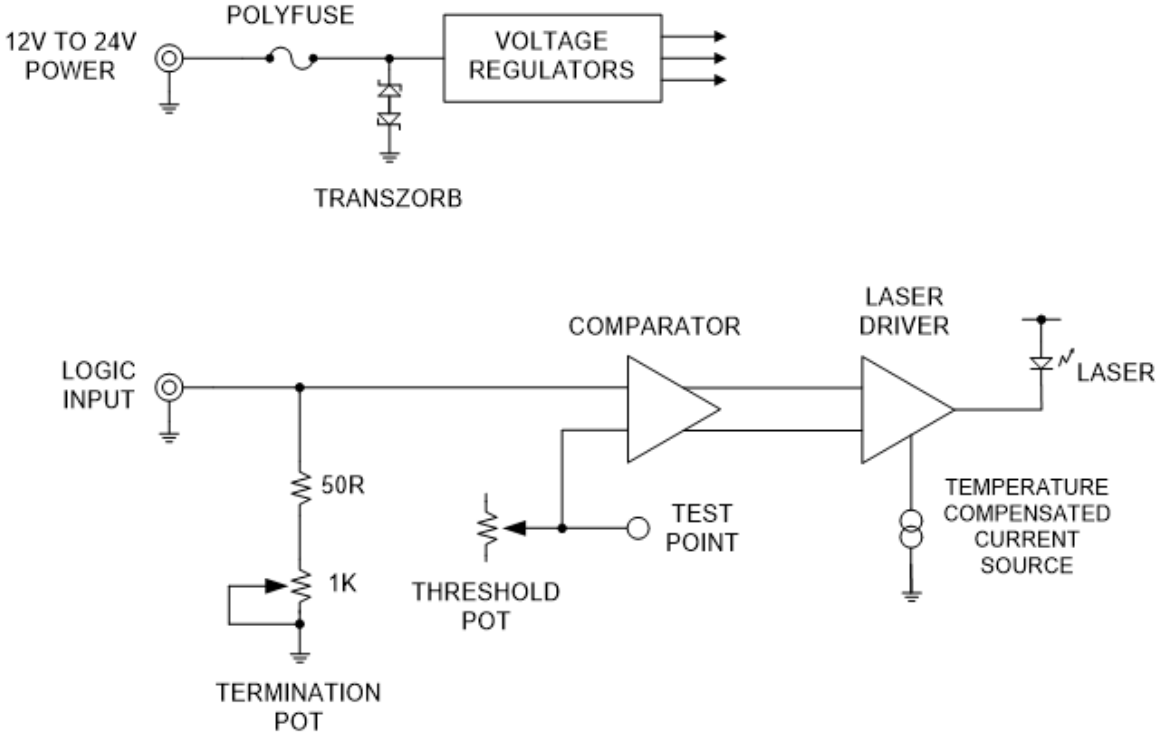

Fig. 1 J724 Block Diagram

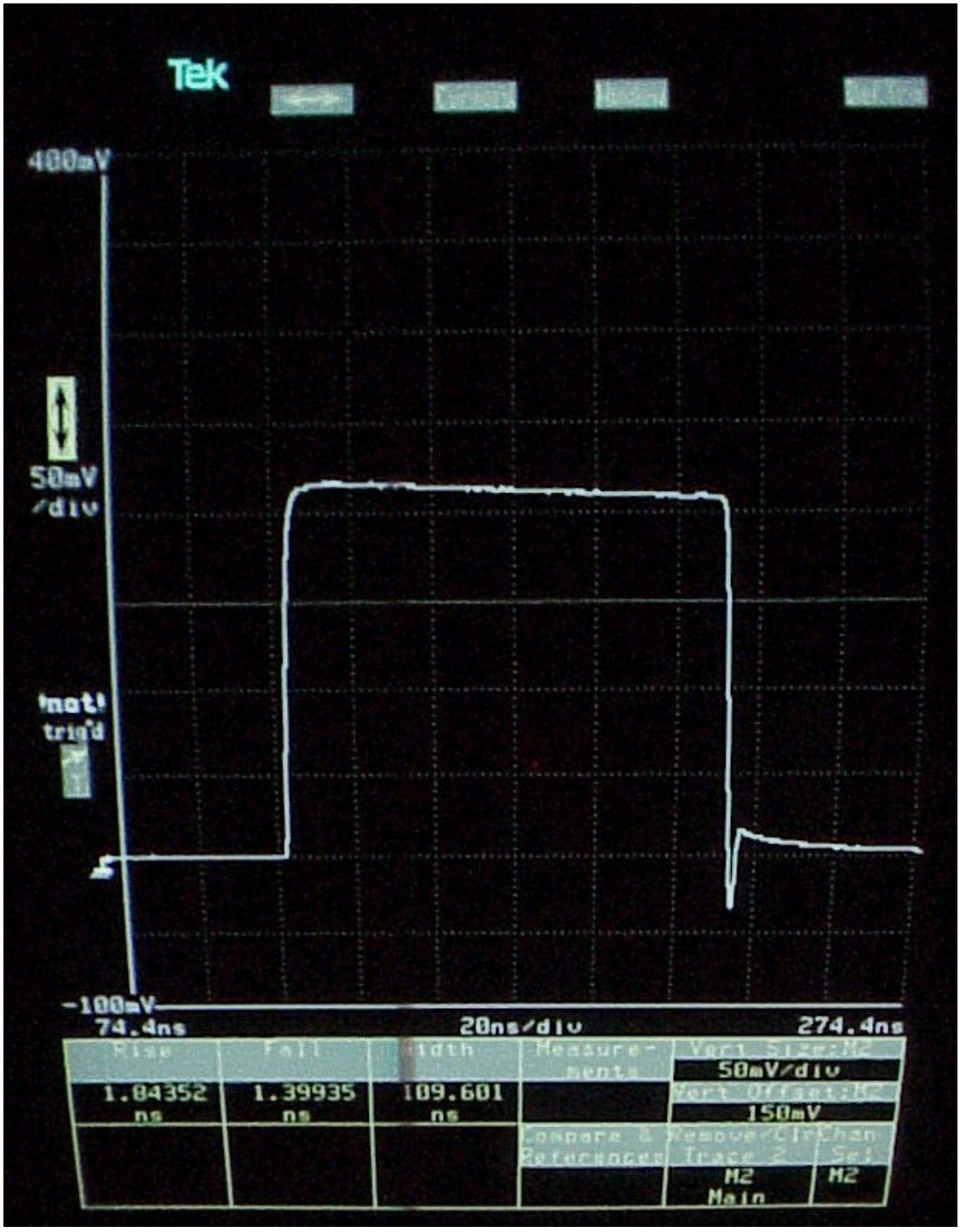

Fig. 2 Typical J724-1 Output Waveform (850 nm)

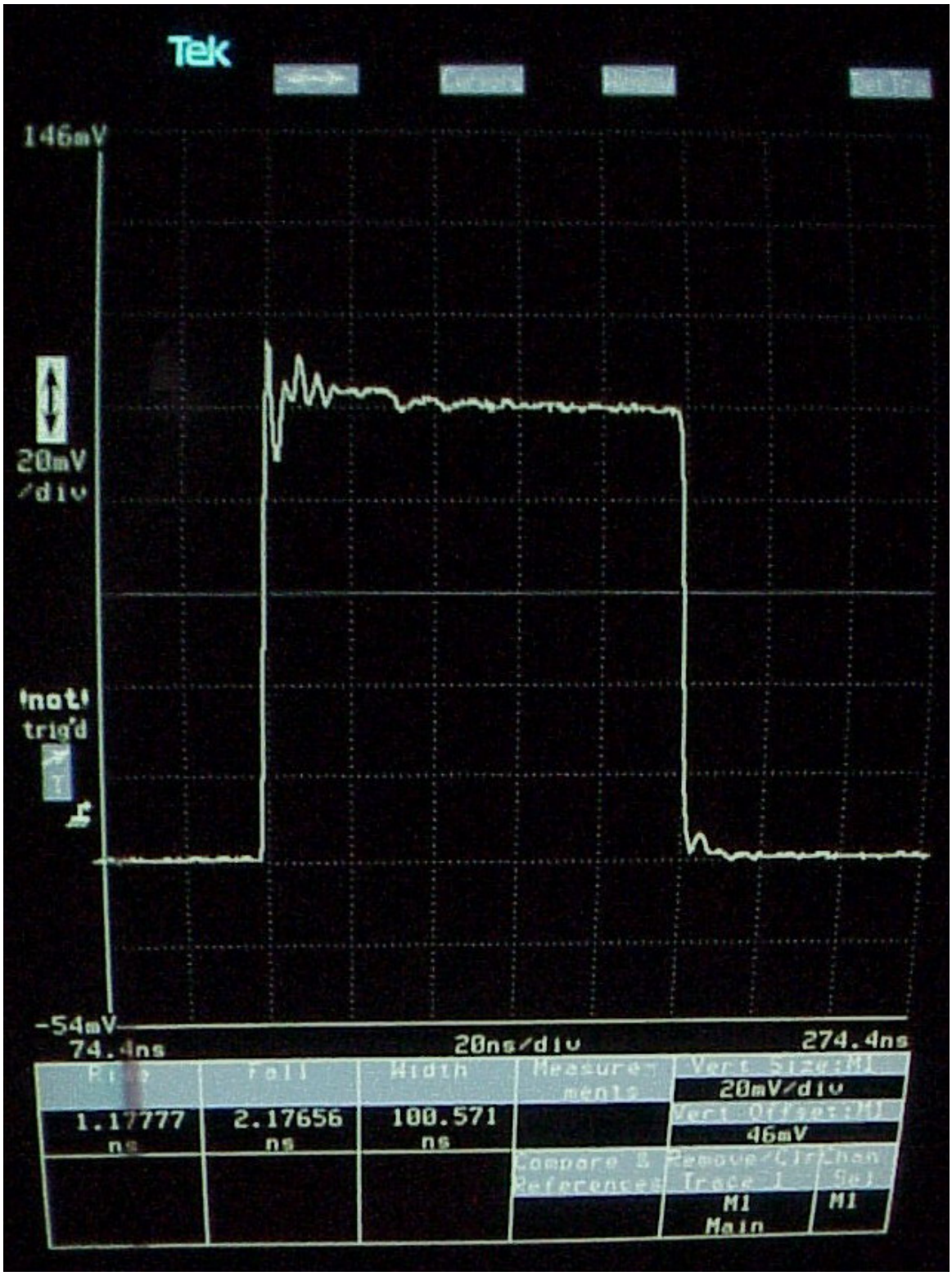

Fig. 3 Typical J724-3 Output Waveform (1310 nm)

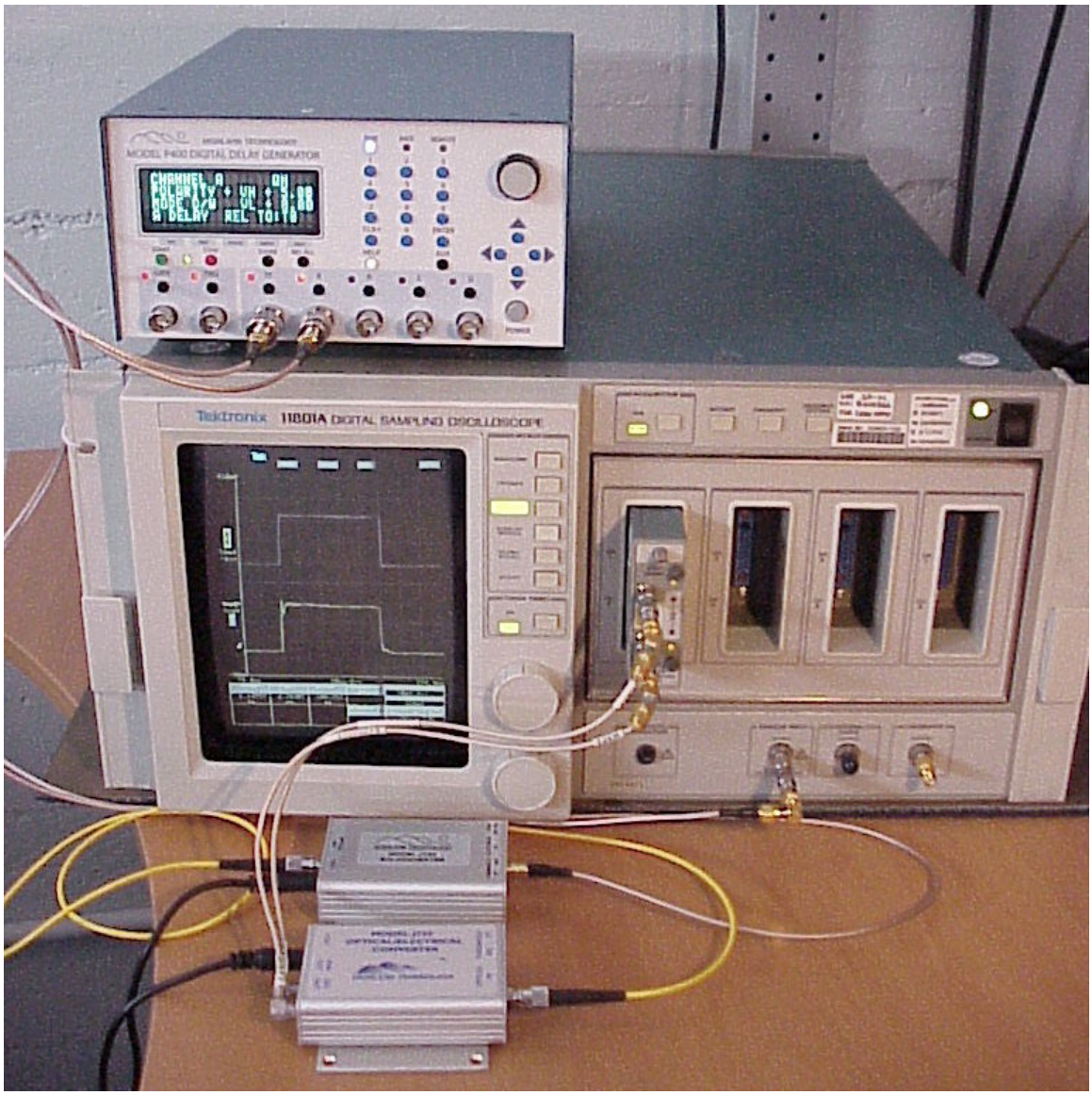

Fig. 4 Typical P400 + J724-3 + J730-3 Test Setup

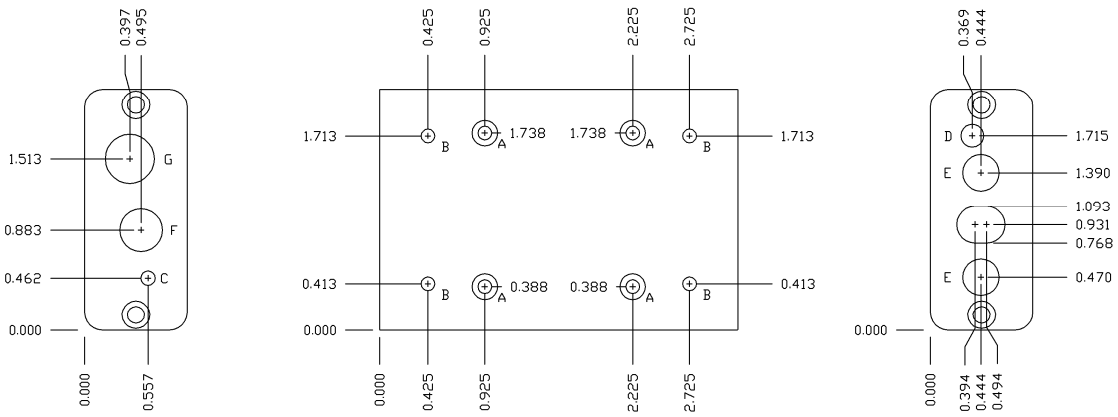

Fig. 5 J724 Mounting Dimensions

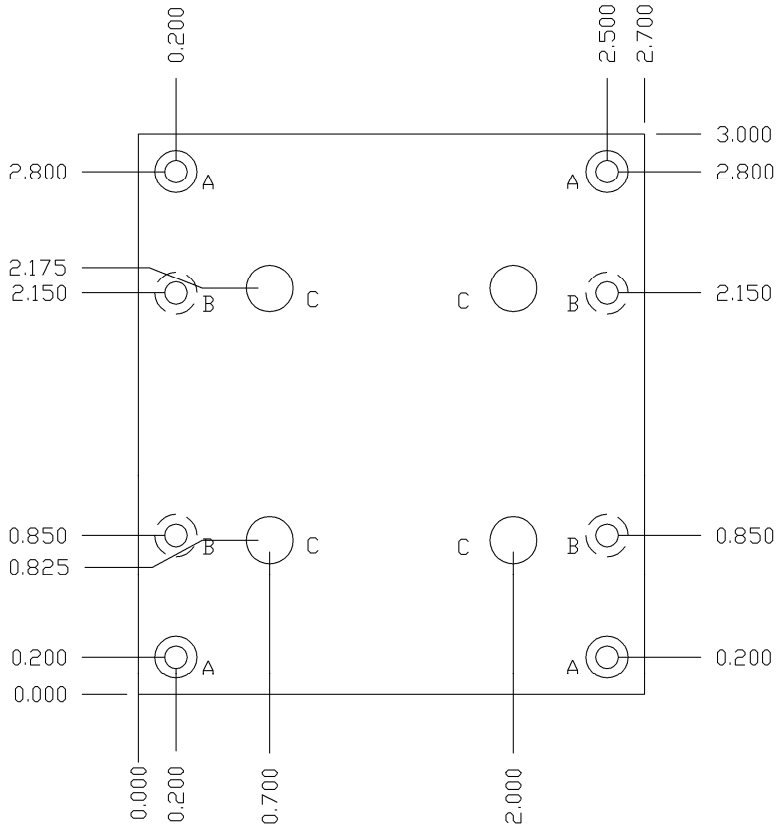

Fig. 6 J732 Flange Dimensions

6. Fiber Notes

The J724-1 uses an 850 nm VCSEL diode in an ST connector housing and should be used with standard 62/125 µm ST connectorized graded-index multimode glass fiber cables. J724-3 and J724-5 versions utilize 1310 nm and 1550 nm Fabry-Perot Lasers and may be used with standard 62/125 µm ST connectorized graded-index multimode or 9/125 µm singlemode glass fiber cables. J724-11 versions utilize a 850 nm VCSEL and should be used with standard 62/125 µm FC connectorized graded-index multimode glass fiber cable. J724-13 and J724-15 versions utilize 1310 nm and 1550 nm Fabry-Perot Lasers and may be used with standard 62/125 µm FC connectorized graded-index multimode or 9/125 µm singlemode glass fiber cables. J724-25 versions utilize a FC-APC pigtail connectorized 1550 nm Fabry-Perot laser and may be used with FC-APC connectorized graded-index multimode or 9/125 µm singlemode glass fiber cables.

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".

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. Singlemode fiber losses are less, about 0.5 dB/km at 1310 nm and 0.25 dB/km at 1550-nm. A connector pair may add 1 dB loss. The J730 receive 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.

The following reference discusses fiber losses and dispersion:

http://www.corning.com/docs/opticalfiber/wp4119_10-01.pdf


INVISIBLE LASER RADIATION
DO NOT VIEW DIRECTLY WITH
OPTICAL INSTRUMENTS
(MAGNIFIERS)
CLASS 1M LASER PRODUCT
PER IEC/EN 60825-1/A2:2001
Class 1M

7. Versions

J724-1: 850 nm single-channel compact buffered electrical-to-fiberoptic converter with ST connectorization

J724-3: 1310 nm single-channel compact buffered electrical-to-fiberoptic converter with ST connectorization

J724-5: 1550 nm single-channel compact buffered electrical-to-fiberoptic converter with ST connectorization

J724-11: 850 nm single-channel compact buffered electrical-to-fiberoptic converter with FC connectorization

J724-13: 1310 nm single-channel compact buffered electrical-to-fiberoptic converter with FC connectorization

J724-15: 1550 nm single-channel compact buffered electrical-to-fiberoptic converter with FC connectorization

J724-25: 1550 nm single-channel compact buffered electrical-to-fiberoptic converter with Pigtail FC-APC connectorization

8. Customization

Consult factory for information about additional custom versions.

9. Hardware Revision History

Revision E	October 2023 Isolate power supply, expand power supply voltage range, accommodate positive or negative polarity power supply
Revision D	April 2009
Revision C	March 2008
Revision B	September 2007
Revision A	June 2006 Initial PCB release

10. Accessories

J12-1: 12 volt power supply (furnished with purchase)

J24-1: 24 volt power supply

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)