J720 ELECTRICAL/OPTICAL CONVERTER

Technical Manual

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18 Otis Street San Francisco, CA 94103 www.highlandtechnology.com tel: 415 551-1700 fax: 415 551-5129

18 Otis Street, San Francisco, CA 94103
Phone 415-551-1700 • Fax 415-551-5129
www.highlandtechnology.com

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1. Introduction

Figure 1 shows the J720, a small single-channel electrical-to-optical converter. The J720 allows fast timing and logic-level signals to be converted to fiberoptic levels to take advantage of the superior speed, attenuation, and EMI characteristics of optical fiber.

Figure 1. Model J720-3 Electrical/Optical Converter

Features of the J720 include:

- DC-coupled fiberoptic logic link transmitter
- Accepts logic-level electrical inputs from the Highland P400 Digital Delay/Pulse Generator or compatible sources
- Compact, rugged aluminum package allows the e/o transition to be located wherever most convenient. No power supply is required
- Timing link jitter typically below 12 picoseconds RMS when used with companion J730 Optical/Electrical Converter
- Versions are available for 850 and 1310 nm wavelengths, with FC and ST fiber connectors. See section 7.
- Ideal accessory for Highland Models P400 and T560 Digital Delay/Pulse Generators
- Compatible with Highland optical receiver products:
    - J730 Standalone Optical/Electrical Converter
    - T735 O/E converter
    - T760 dual high-voltage O/E converter
    - V730 Optical-to-Electrical Converter VME Module

2. Specifications: J720 Electrical/Optical Converter

FUNCTION	Single-channel logic-level electrical-to-optical converter
INPUT	Nom 0 to +5 volts from 50 ohm source, +5.5 volts maximum Input impedance 50 Ω nominal
PROPAGATION DELAY	1 ns nominal, 50% electrical to 50% optical levels
OUTPUT	1.5 mW nominal optical power, driven from 5 volt, 50 Ω source 850 or 1310 nm wavelength versions available See manual section 7
BANDWIDTH	500 MHz min
OPTICAL RISETIME	< 300 ps driven by Highland P400 or equivalent
JITTER	< 12 ps RMS, J720 + J730 combination
OPERATING TEMPERATURE	0 to 60ºC
CALIBRATION INTERVAL	Two years
CONNECTORS	BNC electrical input jack ST or FC optical fiber output
PACKAGING	Aluminum enclosure 0.75” (19.1 mm) width x 0.62” (15.7 mm) height x 3.35” (85.1 mm) nom

CAUTION: The J720 uses an 850 nm or 1310nm infrared laser which can output up to 1.5 milliwatt of uncollimated invisible light. DO NOT look into the laser exit aperture when an electrical input is connected.

CAUTION: Keep the protective cap over the end of the laser when a fiber connector is not in place.

CAUTION: The J720 may be damaged by static electricity or by electrical overload.

3. Theory of Operation

The J720 incorporates an adjustable internal current limiting network and an 850 nm VCSEL or 1310 nm Fabry-Perot fiber-coupled laser. Fiber-coupled power is factory calibrated to 1.5 mW nominal when driven by a +5V, 50 Ω voltage source.

The J720 should be driven from a fast 50 Ω pulse generator or logic device capable of a 5 volt swing behind a 50 Ω source impedance. Do not apply voltages above +5.5 V or any negative potentials to the electrical input. Fiber-coupled optical output is typically 1.5 mW when driven from a 50 Ω pulse generator whose open-circuit voltage is +5 V.

The electrical drive level may be adjusted to trim optical power if a tightly controlled optical power level is needed. Exact coupled fiber power will vary with different fiber connectors and cables.

Fiber coupled lasers tend to interact with back reflections that are present in most fiber systems. The result may be non-flat optical pulses and, in extreme cases, mode jumps that manifest as fast, sometimes jittery steps in optical power level. In applications that require picosecond-level jitter performance, the electrical input level can be trimmed in-system for minimum jitter.

The Highland model J730 powered e/o converter is available for applications where available logic levels are not suitable to drive the J720.

4. Setup and Application

Figure 2 is a typical test setup for a J720/J730 digital signal link. The J720 is driven by the 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 oscilloscope added up to 9.2 picoseconds RMS.

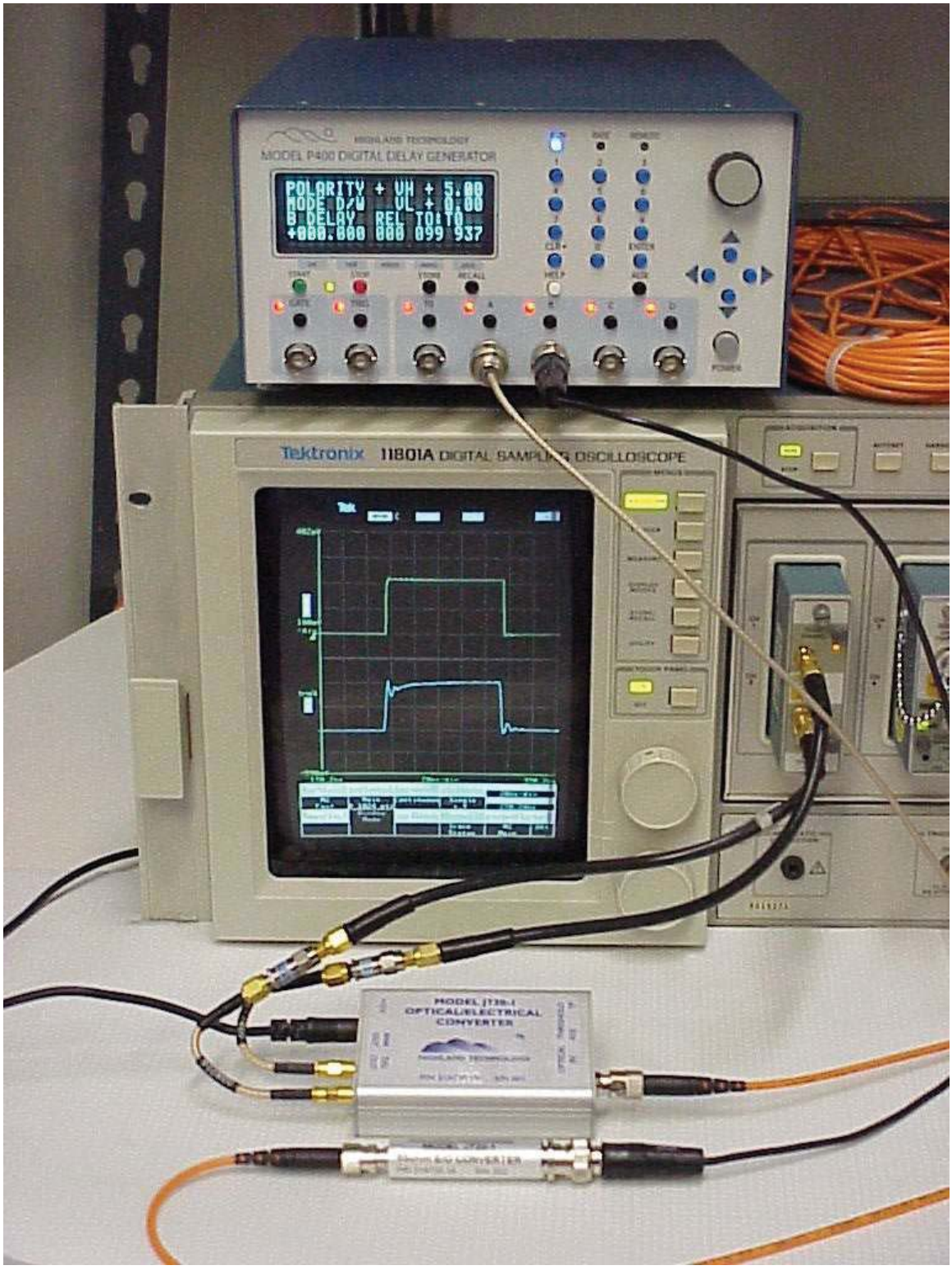


Figure 2. Typical J720/J730 Optical Link Test

Figure 3 shows a typical optical pulse generated by the J720-1 or -11 when driven by a Highland Model P400 Digital Delay/Pulse Generator; Figure 4 shows a typical J720-3 or -13 optical pulse. Pulse amplitude and flatness depend on the attenuation and reflection characteristics of all optical components in the system, and will vary from setup to setup.

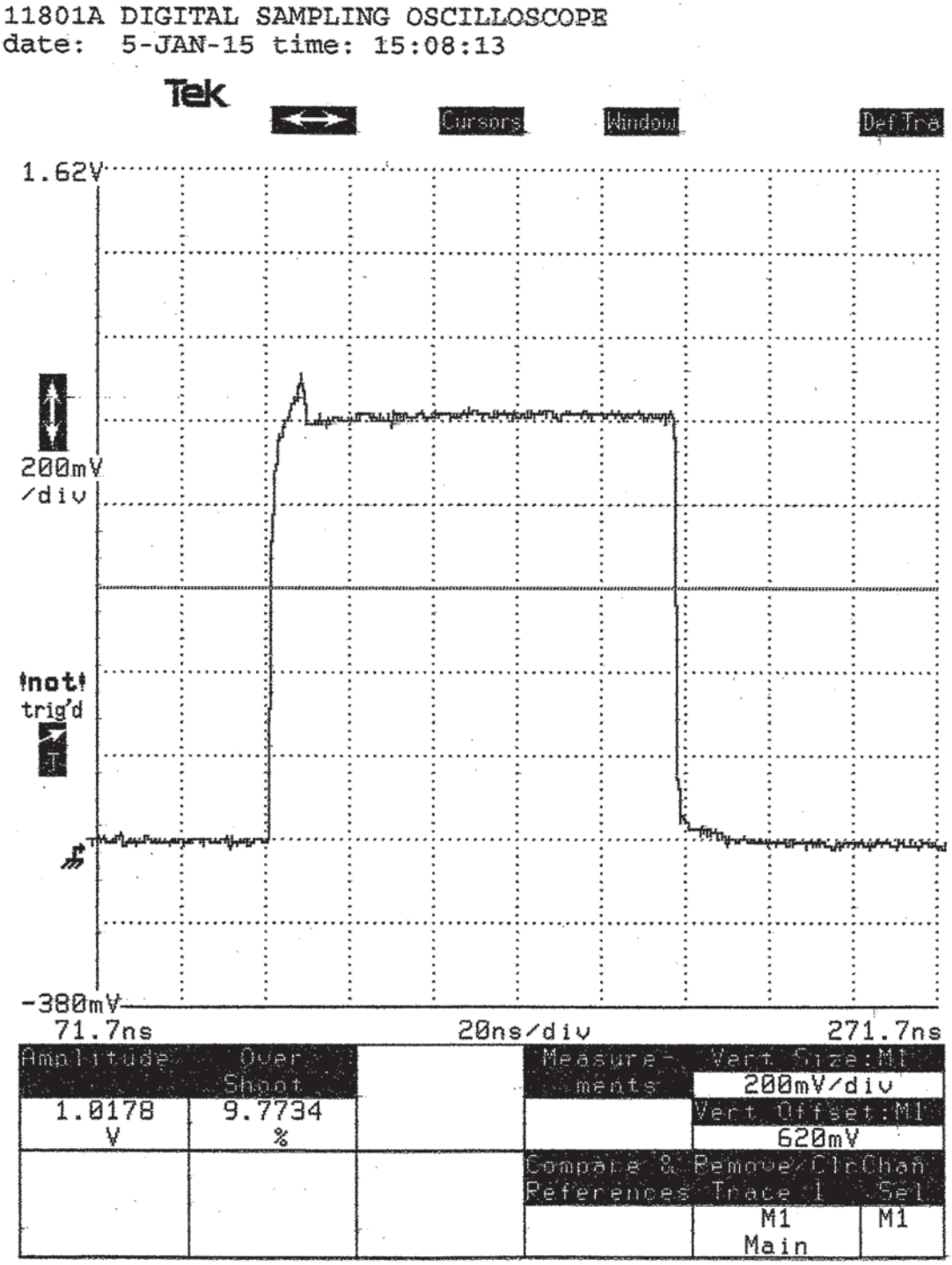


Figure 3. Typical J720-1, -11 Optical Pulse, 200 µW/cm

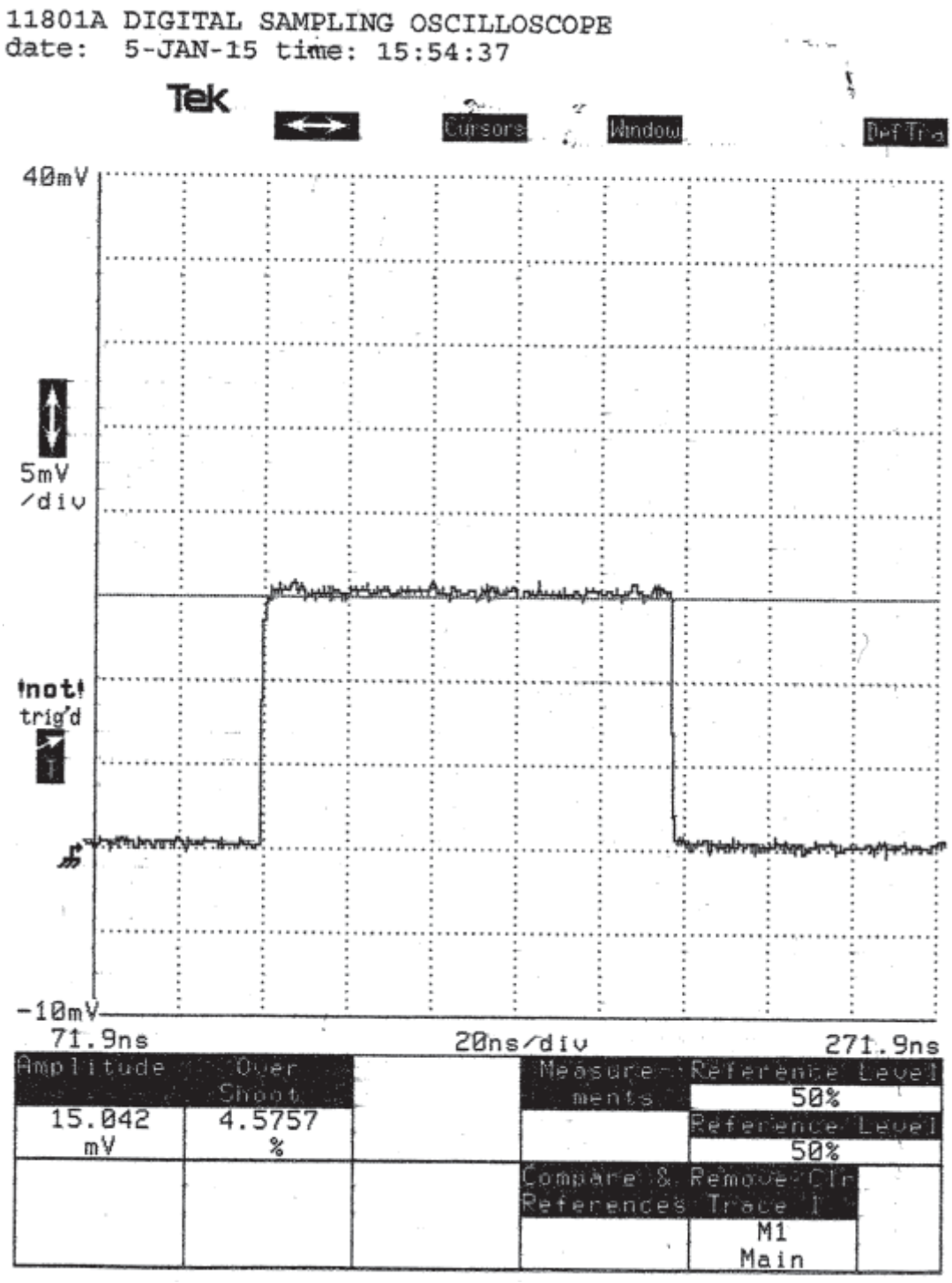
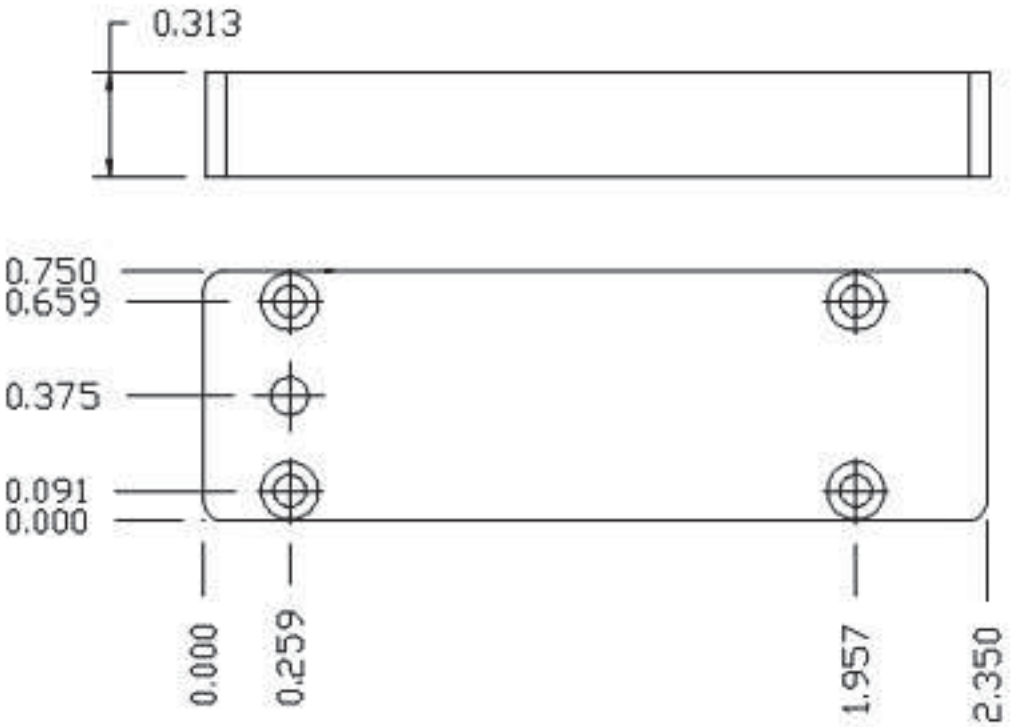


Figure 4. Typical J720-3, -13 Optical Pulse, 333 µW/cm

5. Dimensions

Figure 7 below shows the J720 rev B outline dimensions



6. Fiber Notes

J720 versions are listed in section 7. The 850 nm versions use a VCSEL laser and should be used with 62/125 µm graded-index multimode glass fiber cables.

The 1310 nm versions incorporate a Fabry-Perot Laser and are preferentially used with or 9/125 µm singlemode, glass fiber cables, but may be used with multimode fiber.

Cable-end fiber connectors must 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".

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, typically about 0.5 dB/km at 1310 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 1500 µW range, and saturates at about 2000 µW.

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.

7. Versions

Standard versions of the J720 include:

Model	Part Number	Wavelength	F/O connector	fiber compatibility
J720-1	21A720-1B	850 nm	ST	multimode
J720-3	21A720-3B	1310 nm	ST	single or multimode
J720-11	21A720-11B	850 nm	FC	multimode
J720-13	21A720-13B	1310 nm	FC	single or multimode

8. Hardware Revision History

Revision B Jan 2015
Form-factor change, functionally equivalent to Revision A

Revision B

Revision A Feb 2005 Initial Release

Revision A

9. Customization

Consult Highland for information about custom versions and OEM electro-optical and timing products.

10. Accessories

J43	3' BNC to BNC cable
J53	3' SMB to BNC cable
J53-2	6" SMB to BNC cable
J59	3' ST to ST multimode fiberoptic cable
J730	single-channel compact fiberoptic-to-electrical converter
P730	dual 1:4 benchtop optical-to-electrical fanout buffer