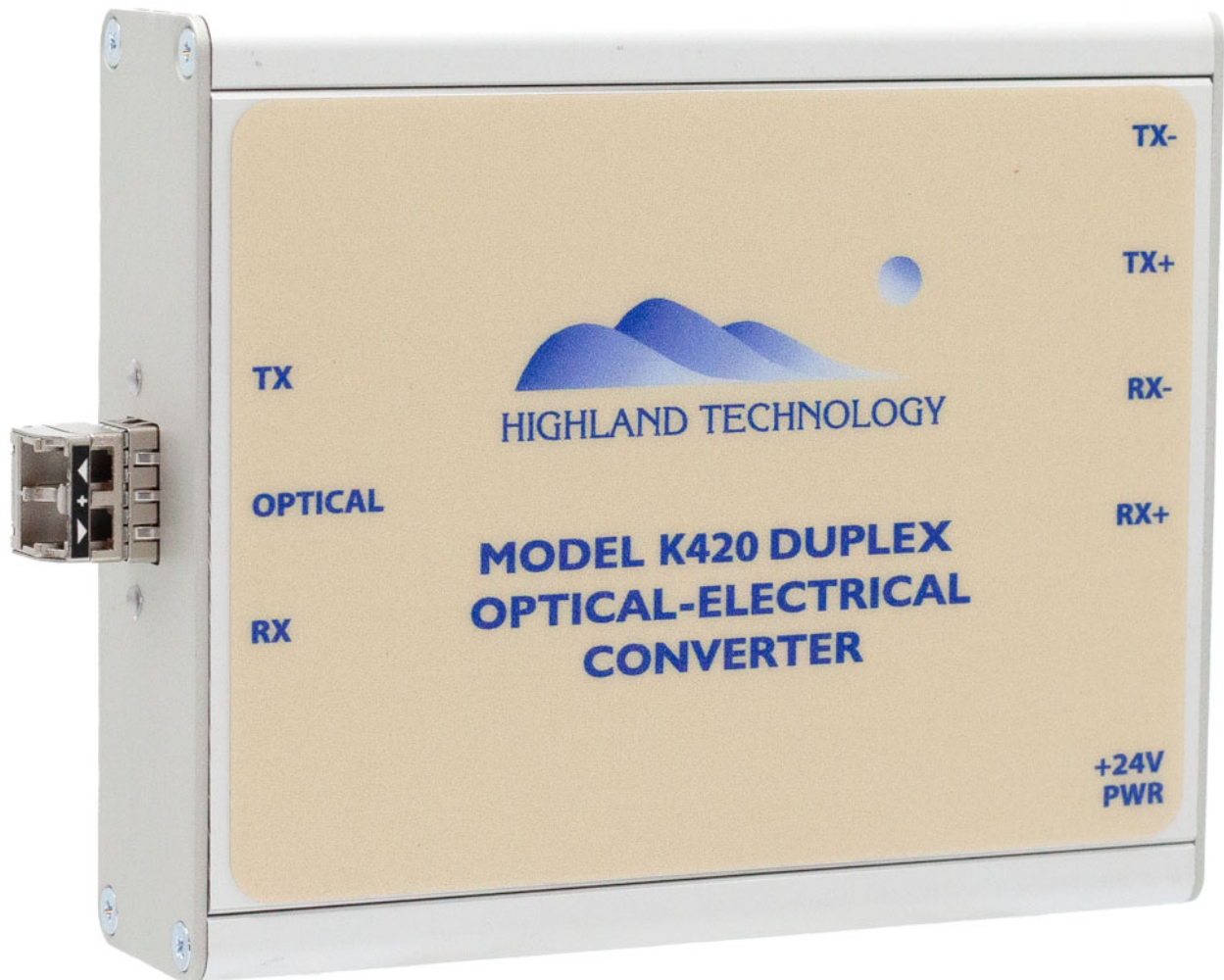


Model K420 Duplex Optical-Electrical Converter



Technical Manual

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1 Introduction

This is the manual for Model K420 duplex logic to fiberoptic converter.

Features of the K420 include:

- Bi-directional, electrical-optical / optical-electrical data link
- Differential logic input and output
- Uses standard SFP optical module
- 2.05 GHz (4.1 Gbps) bandwidth
- Input accepts single-ended or differential PECL, ECL, CML, LVDS
- Output is AC coupled LVDS, CML compatible
- LED power and data activity indicators
- Compact extruded enclosure

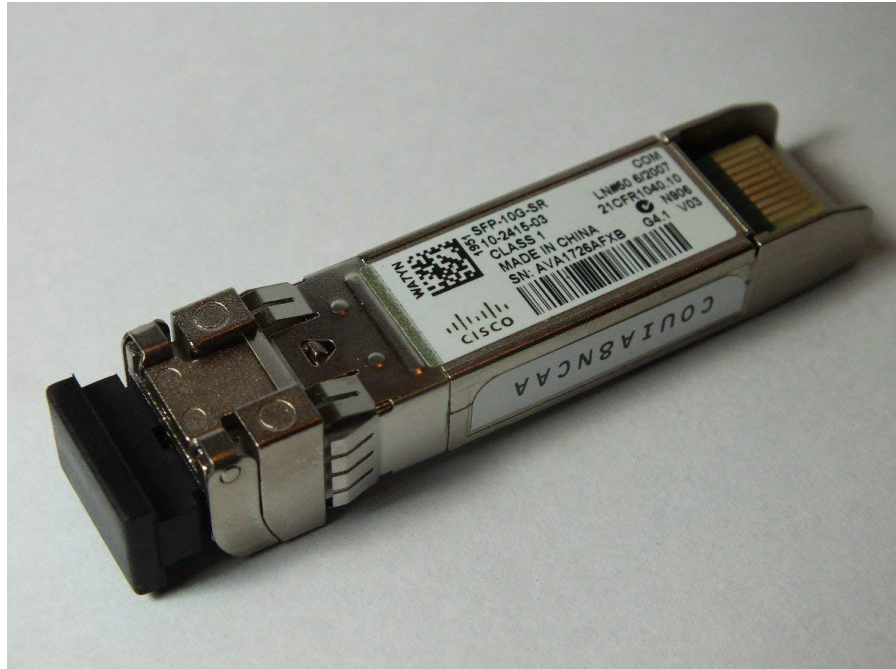


Figure 1: Typical SFP module

2 Specifications

Specifications are typical unless otherwise noted.

FUNCTION	AC-coupled bidirectional digital optical-electrical converter
ELECTRICAL INPUT	Dual SMA connectors Single-ended or differential logic input, AC coupled square wave PECL, ECL, LVDS or CML levels
ELECTRICAL OUTPUT	Dual SMA connectors Single-ended or differential, AC coupled square wave LVDS, or CML compatible
OPTICAL	SFP plugin module, duplex LC compatible Standard Cisco SFP-10G-SR included 850 nm compatible with 50 or 62.5 micron multimode fiber
BANDWIDTH	5 MHz to 2 GHz, 4 Gbps equivalent
OPERATING TEMPERATURE	0 to 60°C, non-condensing
STORAGE TEMPERATURE	-20 to 80°C
POWER IN	+24 VDC at 80 mA, negative ground 2.1mm x 5.5mm locking barrel connector, pigtail power cable furnished J24 24 volt wall-plug universal-input power supply furnished
CONNECTORS	TX+ TX- RX+ RX- SMA jacks TX RX Duplex LC fiberoptic receptacles Fiber receptacles are integral to removable SFP module
CALIBRATION INTERVAL	One year
LED INDICATORS	green Power, blue TX Data, orange RX optical input
PACKAGING	4.75 (L) x 4.0 (W) x 1.25 (H) inches extruded aluminum enclosure
CONFORMANCE	OEM product has no UL/FCC/CE compliance requirements Designed to meet UL/FCC/CE requirements

3 Block Diagram

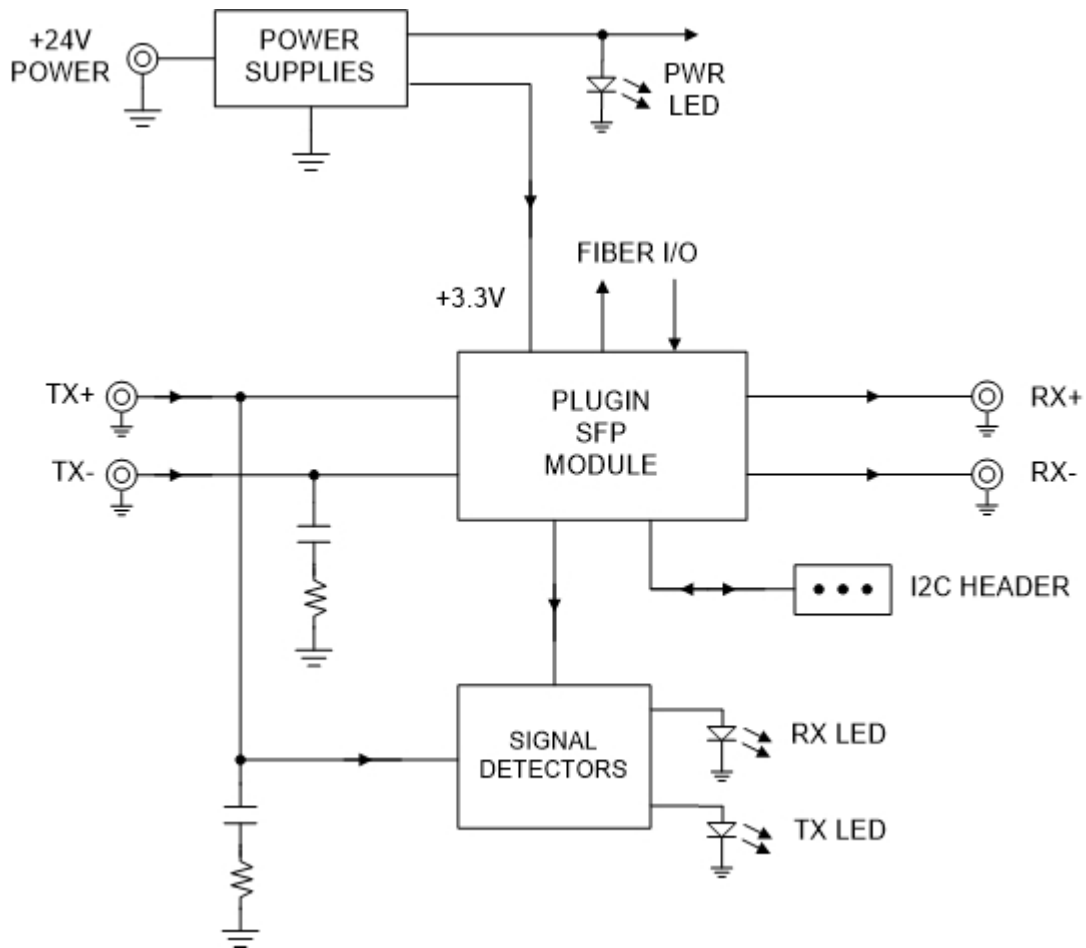


Figure 2: K420 revision B block diagram

The K420 is a duplex E/O – O/E, intended to transport single or bi-directional digital data at speeds up to 2 GHz (4 GBS).

Signal flow is non-inverting, a positive transition on TX+ results in light out of the left LC optical connector adjacent the blue TX signal indicator. Received light is applied to the right LC connector adjacent the orange RX link indicator, resulting in a positive transition output signal on the RX+ SMA connector. Corresponding TX- and RX- signal compliments are present when the K420 is operated with differential signals. It is assumed that the customer device is transformer coupled in both directions.

The standard K420-1B unit is shipped with an 850 nm SFP module intended to be used with multimode fiber having a 50 or 62.5 micron core diameter.

The blue TX LED indicates the presence of data transitions on the incoming TX electrical inputs. The orange RX LED reflects the state of the LOS signal from the SFP module, which indicates the presence of an incoming optical input, modulated or not.

A 3-pin, 2-wire serial interface header is located on the PCB for accessing extended SFP module digital diagnosis functions.

4 Connection and Operating Notes

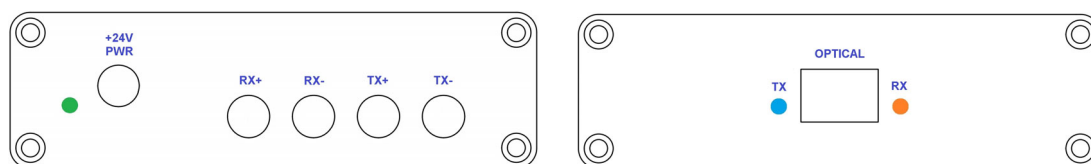


Figure 3: electrical and optical endplates

A bi-directional duplex E/O – O/E link would utilize two K420 converters, one at each station. Differential signals are typically preferred for reduced susceptibility to external noise sources. Single-ended low-voltage signals are also compatible with the K420, provided that the amplitude is 200 to 800 millivolts, and the signal is a 50% duty square wave. A 50-ohm SMA terminator, such as the Highland J48, should be attached to the unused complimentary connector when single-ended signals are used.

The K420 input and output is AC coupled. If the TX driver or RX receiver is CML or ECL, it must have appropriate pull-up or pull-down resistors. LVDS drivers and receivers are usually self-biased and can be directly connected to the K420.

The TX signal indicator LED typically requires nominally 200 mV peak-to-peak signal amplitude at TX+ to illuminate, especially at high data rates. Applying a single-ended signal to only TX- will not illuminate the indicator. The K420 will operate with lower amplitude signals under 200 mV pk-pk, but the blue signal indicator may not illuminate.

Other SFP modules may be compatible with the K420, please refer to the SFP connector pin map in Table 1.

SFP PIN	NAME	FUNCTION	K420 CONNECTION
1	VEET	Vee, transmitter	GND
2	TX_FAULT+	Optical transmitter fault (active high)	4.99k pullup to +3.3V PCB test point TP8
3	TX_EN-	Optical TX enable (active low)	49.9 ohm to GND PCB test point TP7
4	SDA	Serial Data	J2 pin 2
5	SCL	Serial Clock	J2 pin 1
6	MOD ABS	Module absent	GND
7	RS0	Rate select 0	4.99K pullup to +3.3V PCB test point TP3
8	RX LOS+	Optical RX Loss of Signal (active high)	4.99K pullup to +3.3V Drives orange RX LED PCB test point TP6
9	RS1	Rate select 1	GND
10	VEER	Vee, receiver	GND
11	VEER	Vee, receiver	GND
12	RD-	Received optical data, inverted electrical output	RX- SMA

13	RD+	Received optical data, non-inverted electrical output	RX+ SMA
14	VEER	Vee, receiver	GND
15	VCCT	Vcc, transmitter	+3.3V (filtered)
16	VCCT	Vcc, transmitter	+3.3V (filtered)
17	VEET	Vee, transmitter	GND
18	TD+	Transmitted optical data, non-inverted electrical input	TX+ SMA
19	TD-	Transmitted optical data, inverted electrical input	TX- SMA
20	VEET	Vee, transmitter	GND

Table 1: SFP cage connector pin mapping

The Cisco SFP-10G-SR module included with the K420 can operate at distances up to 400 meters with 50 micron OM4 or better fiber. Other fiber types may be used for shorter link distances according to the table below:

FIBER TYPE	FIBER CORE (MICRONS)	MODAL BW (MHz * km)	MAX LINK DISTANCE (meters)
FDDI	62.5	160	26
OM1	62.5	200	33
OM1	50	400	66
OM2	50	500	82
OM3	50	2000	300
OM4	50	4700	400
OM5	50	4700	400

Table 2: optical fiber link distances

5 Waveforms

Measurements were taken with a Tektronix 11801/SD-24 sampling system having approximate 17ps rise time, so actual K420 timings are slightly faster than indicated.

Note that rise/fall measurements below are taken at the 10/90 per-cent points. Picosecond-range measurements are sometimes quoted at the 20/80 points, which would result in faster reported rise and fall times.

Picosecond measurements require connections to be short, high-quality hardline coax, and the SMA connectors must be properly torqued to ensure waveform fidelity.

A 1-meter 62.5/125 multimode duplex fiber was used to obtain E/O-O/E loopback response for the following figures. Figure 4 shows RX+, RX- output with a 5 MHz single-ended clock applied to TX+ at the minimum specified clock rate. Figure 5 shows RX response at 500 MHz, and Figure 6 at 2.05 GHz. Figure 7 shows RX with 1.55 GBS PRBS LVDS data stream applied at TX+, TX-. Figure 8 shows typical jitter performance at TX+ with a 2.05 GHz, 200 mV pk-pk single-ended clock signal applied at RX+. Note that the reported jitter is from a 13-second capture and is mostly attributed to the 3 ps RMS jitter specification of the 11801 oscilloscope.

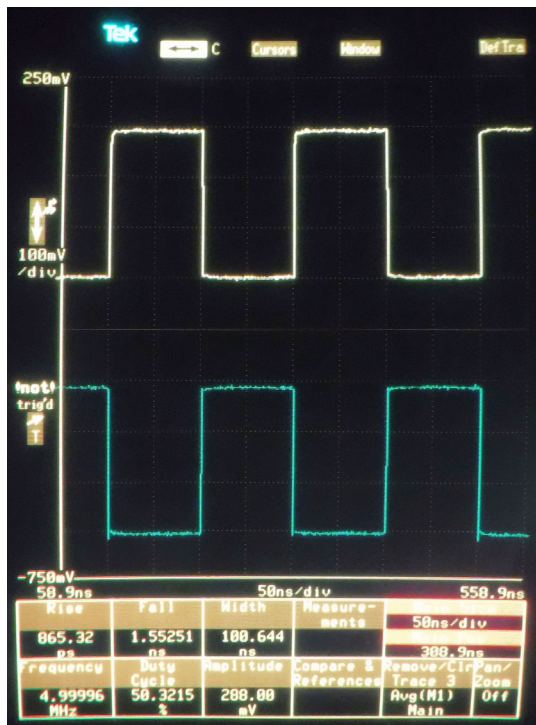


Figure 4: 5 MHz loopback

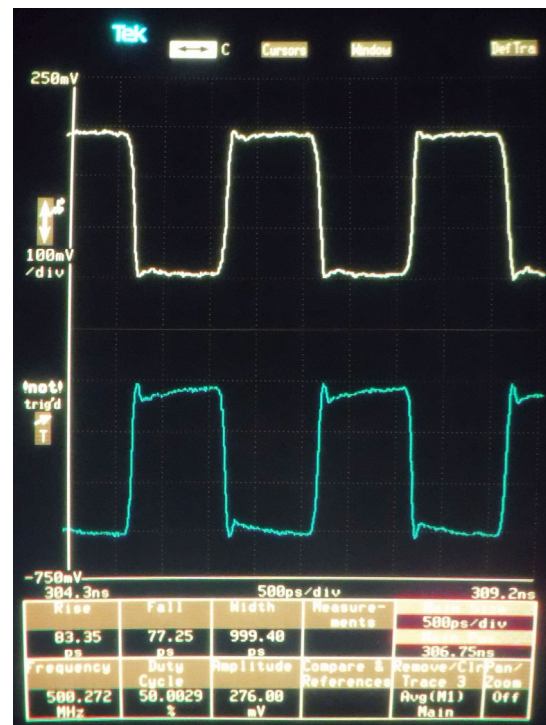


Figure 5: 500 MHz loopback

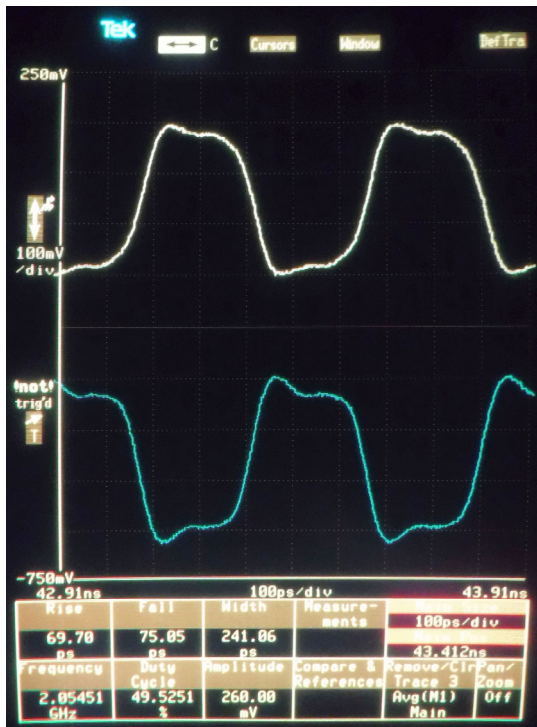


Figure 6: 2.05 GHz loopback

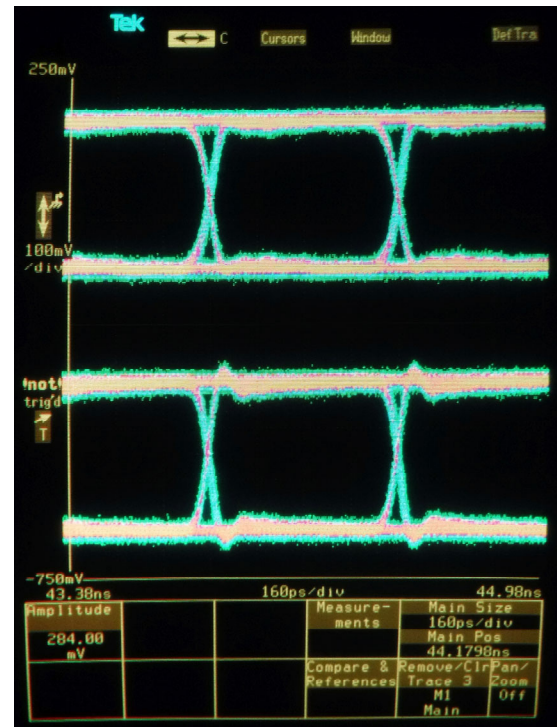


Figure 7: 1.55 GBS PRBS

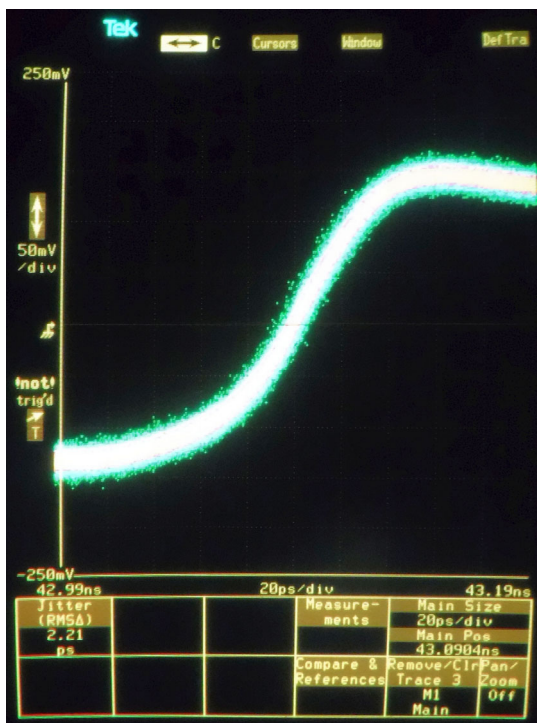


Figure 8: Typical Jitter

6 Dimensions

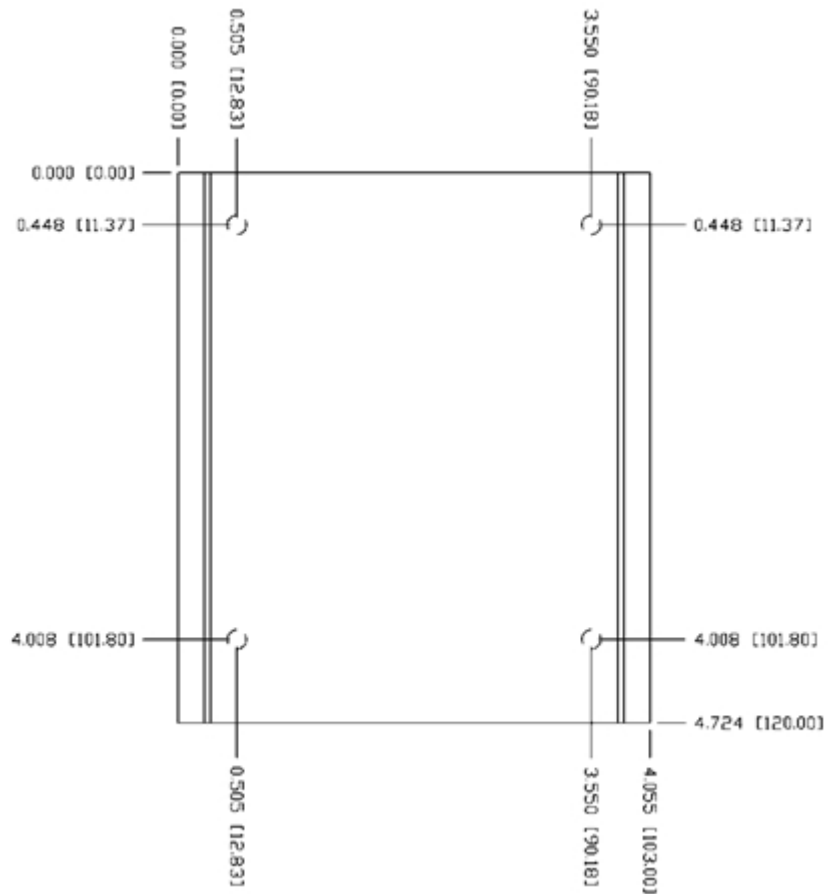


Figure 9: K420 enclosure outline and mounting hole positions

7 Versions

K420-1: duplex optical to electrical converter

8 Customization

Consult factory for information about additional custom versions.

9 Revision History

24A420 Revision A	September 2020 Initial K420 release
24A420 Revision B	September 2021 Improved bandwidth

10 Accessories

J24-1: 24 volt 1.2 amp power supply (included with purchase)

J27-1: 2.1 x 5.5 mm barrel to pigtail power cable (included with purchase)

J44-1: 3' SMA to SMA cable

J48-1: 50 ohm SMA terminator

P10-1: 19" rack mount shelf (four k-boxes per rack)

T566-1: mounting flange