

## DESCRIPTION

The IF-D95T and IF-D95OC are high-sensitivity photologic detectors housed in “connector-less” style plastic fiber optic packages. The detector contains an IC with a photodiode, linear amplifier, and Schmitt trigger logic circuit. The IF-D95T features a TTL/CMOS compatible totem-pole output, while the IF-D95OC has an open-collector output. The devices can drive up to 5 TTL loads over supply voltages ranging from 4.5 to 16 Volts. Optical response extends from 400 to 1100 nm, making them compatible with a wide range of visible and near-infrared LED and laser diode sources. The detector package features an internal micro-lens and a precision-molded PBT housing to ensure efficient optical coupling with standard 1000  $\mu\text{m}$  core plastic fiber cable.

## APPLICATION HIGHLIGHTS

The IF-D95T and IF-D95OC are suitable for digital data links at rates up to 125 kbps. A Schmitt trigger improves noise immunity and TTL/CMOS logic compatibility greatly simplifies interfacing with existing digital circuits. The integrated design of the IF-D95 provides a total, cost-effective solution in a variety of digital applications.

## APPLICATIONS

- Digital Data Links
- PC-to-Peripheral Links
- Process Control
- Household Appliances
- Motor Controller Triggering
- Electronic Games
- Medical Instruments
- Automotive Electronics
- Robotics Communications
- EMC/EMI Signal Isolation

## FEATURES

- ◆ Integrated Photodetector, Amplifier and Schmitt Trigger
- ◆ Mates with Standard 1000  $\mu\text{m}$  Core, 2.2 mm Jacketed Plastic Fiber Optic Cable
- ◆ Mates with 2.2 mm Jacketed Multimode Glass Fiber, 200/230 or 400/430 using Active Device Adapter – 51 0537; 51 0538
- ◆ No Optical Design Required
- ◆ Inexpensive But Rugged Plastic Connector Housing
- ◆ Internal Micro-Lens for Efficient Optical Coupling
- ◆ Connector-Less Fiber Termination
- ◆ Light-Tight Housing Provides Interference-Free Transmission
- ◆ High Optical Sensitivity
- ◆ “Active Low” Output Options Available as Special Order – IF-D95TI and IF-D95OCI.
- ◆ RoHS Compliant

## MAXIMUM RATINGS

( $T_A = 25^\circ\text{C}$ )  
 Operating and Storage Temperature Range ( $T_{OP}, T_{STG}$ ).....-40° to 85°C  
 Soldering Temperature (2mm from case bottom) ( $T_S$ )  $t \leq 5$  s.....260°C  
 Supply Voltage, ( $V_{CC}$ ) .....16 V  
 Voltage at Output lead (IF-95OC only) .....30 V  
 Sinking Current, DC ( $I_C$ ) .....50 mA  
 Source Current ( $I_O$ ) (IF-95T only) .....10 mA  
 Power Dissipation ( $P_{TOT}$ )  $T_A=25^\circ\text{C}$  .....100 mW  
 De-rate Above 25°.....1.67 mW/°C

**CAUTION:** The IF D95 is ESD sensitive. To minimize risk of damage observe appropriate precautions during handling and processing.

## CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit
Peak Sensitivity	$\lambda_{PEAK}$	-	800	-	nm
Spectral Sensitivity (Response=10% of Maximum)	$\Delta\lambda$	400	-	1100	nm
Operating Voltage	$V_{CC}$	4.5	-	16	V
Supply Current	$I_{CC}$	-	-	6	mA
Light Required to Trigger $V_{CC}=5$ V, $R_L=1k$ , $\lambda=650$ nm	$E_r (+)$	-	1.0 (-30)	3.0 (-25.2)	$\mu\text{W}/(\text{dBm})$
Hysteresis Ratio	$E_r (+)/E_r (-)$	1.2	1.3	2.0	-
<b>IF-D95T</b>					
High Level Output Voltage ( $I_{OH} = -1.0 \mu\text{A}$ )	$V_{OH}$	$V_{CC}-2.1$	-	-	V
Low Level Output Voltage ( $I_{OL} = 16$ mA)	$V_{OL}$	-	-	0.4	V
Output Rise and Fall Times ( $f = 10.0$ kHz, $R_L = 10$ TTL Loads)	$t_r, t_f$	-	-	70	ns
Propagation Delay, Low-High, High-Low ( $f = 10.0$ kHz, $R_L = 10$ TTL Loads)	$t_{PLH}, t_{PHL}$	-	6	-	$\mu\text{s}$
<b>IF-D95OC</b>					
High Level Output Current ( $V_{OH}=30$ V)	$I_{OH}$	-	-	100	$\mu\text{A}$
Low Level Output Voltage ( $I_{OL}=16$ mA)	$I_{OL}$	-	-	0.4	V
Output Rise and Fall Times ( $f = 10.0$ kHz, $R_L=300\Omega$ )	$t_r, t_f$	-	-	100	ns
Propagation Delay, Low-High, High-Low ( $f = 10.0$ kHz, $R_L=300\Omega$ )	$t_{PLH}, t_{PHL}$	-	6	-	$\mu\text{s}$

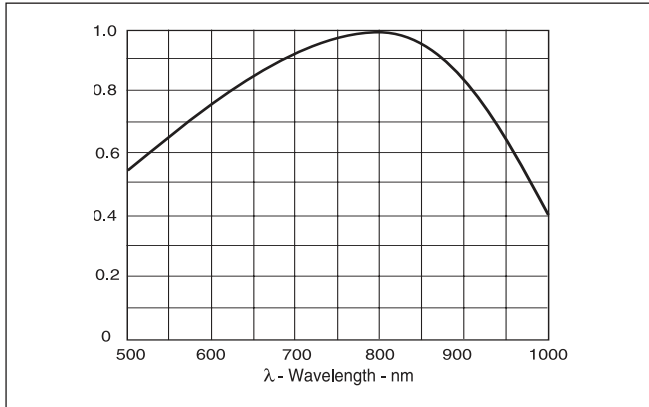


FIGURE 1. Normalized detector response versus wavelength.

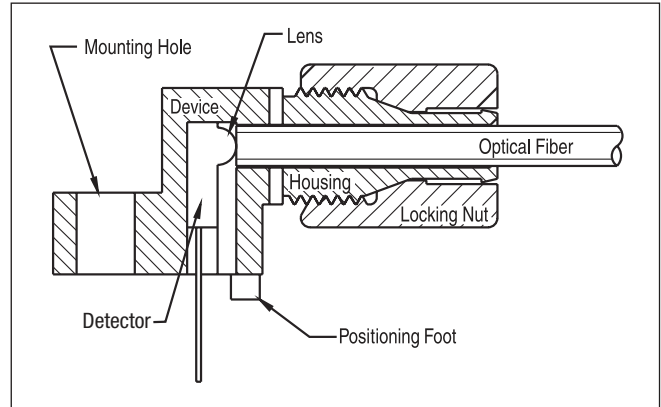


FIGURE 4. Cross-section of fiber optic device.

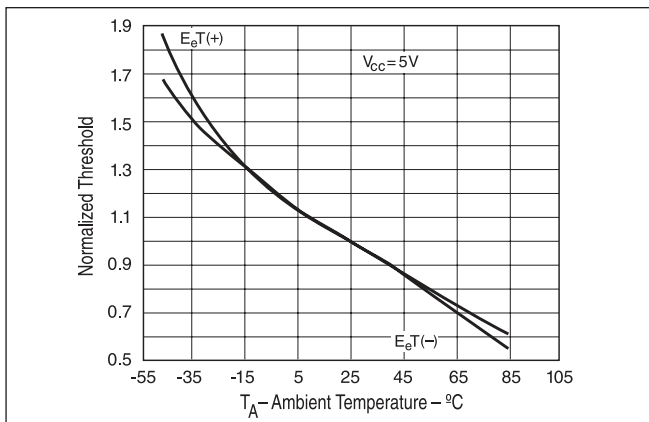


FIGURE 2. Normalized threshold irradiance vs. amb. temp.

### FIBER TERMINATION INSTRUCTIONS – PLASTIC OPTICAL FIBER

1. Cut off the ends of the optical fiber with a single-edge razor blade or sharp knife. Try to obtain a precise 90-degree angle (square).
2. Insert the fiber through the locking nut and into the connector until the core tip seats against the internal micro-lens.
3. Screw the connector locking nut down to a snug fit, locking the fiber in place. Do not exceed a torque of 0.4 N·m.

*Glass fiber – Refer to instructions listed on manufacturer's data sheet for each active device adapter.*

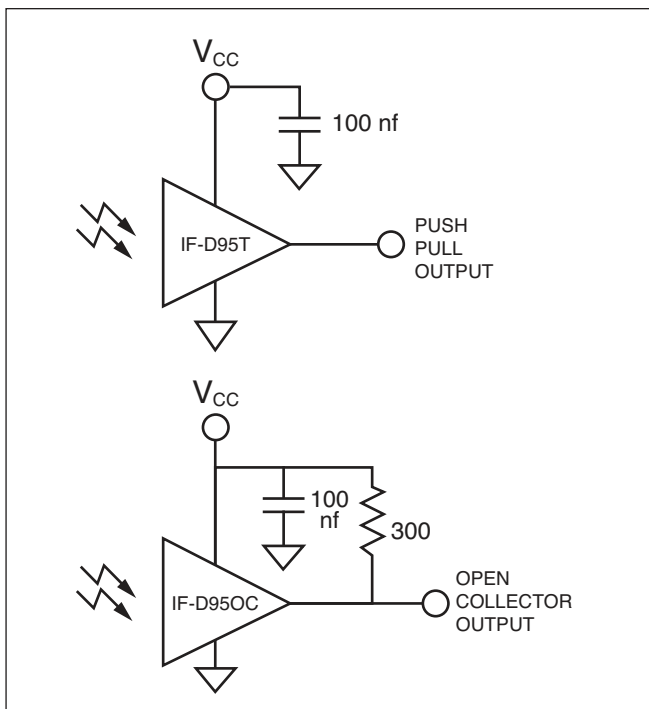


FIGURE 3. Application/test circuits

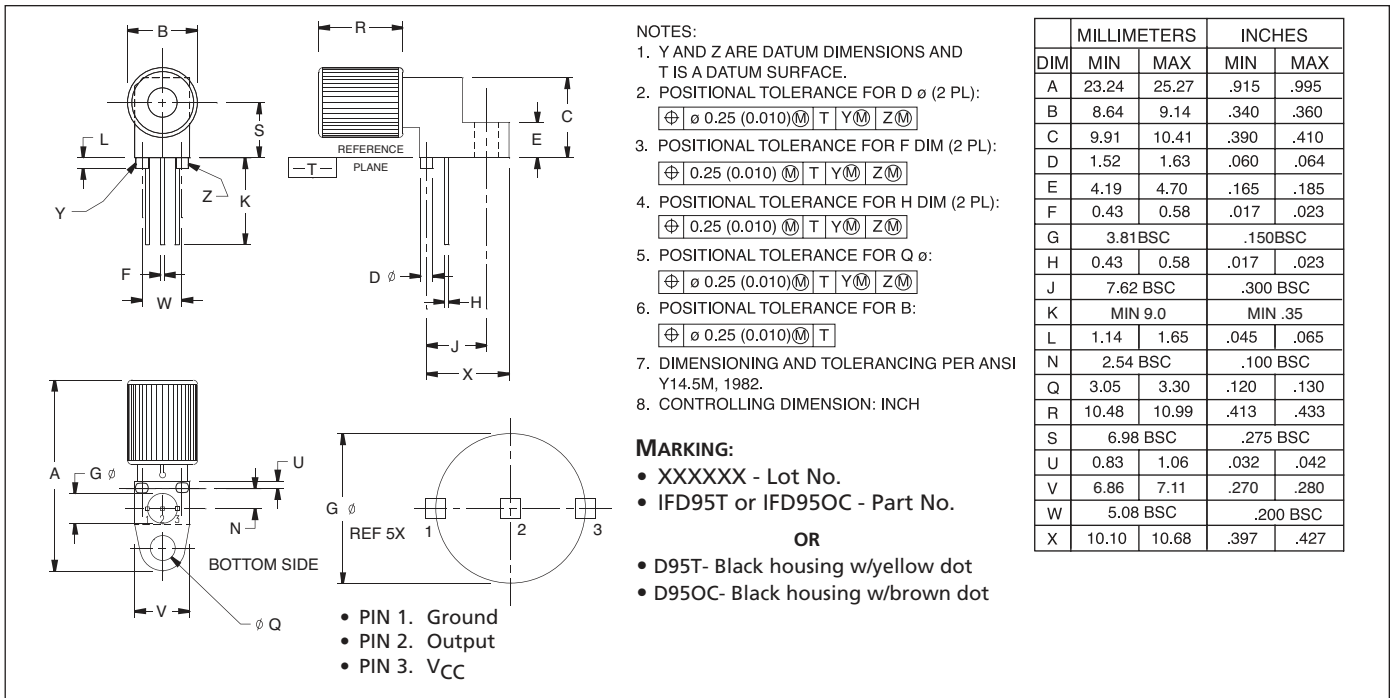


FIGURE 4. Case outline. Specifications are believed to be accurate but are subject to change. Industrial Fiber Optics assumes no responsibility for the consequences of using the information provided beyond replacement warranty for products not meeting stated specifications. Industrial Fiber Optics products are not authorized for use in life support applications without written approval from the President of Industrial Fiber Optics Corporation.

CAUTION: • To avoid degraded device life due to package stress, do not bend or form leads outside the orientation shown on drawing.  
 • Ensure that solder flux does not migrate into the device and block the optical path, degrading the performance.  
 • If washing the device, liquid may become trapped in the part cavity. Ensure that all potentially corrosive materials are flushed out of the device.

### APPLICATION NOTES

To create a fiber optic link between an emitter and a digital detector an optical budget should be calculated. This is a determination of how much margin a system (emitter, fiber, junctions and detector) will have. Certain parameters may be set by the system, such as power available, cost, temperature etc. Other parameters may be adjusted to increase or decrease the margin.

#### Example of an optical budget:

As an example we will set the following conditions. The link length is ten meters. The fiber will be GH4001 and the ends will be razor cut. The signal is 5 V digital data and the rate is no higher than 100 K bits per second.

For this data rate any of the emitters could be used, so we will use the IF-E96E with the IF-D95T.

Since the IF-D95T is a digital detector it has a fixed threshold that must be reached to trigger the part. We will start the calculations at the detector and work backwards through the system to the emitter.

The IF-D95T nominally requires -30 dBm (1 uW) of power at 650 nm to trigger. The IF-E96E wavelength is 645 nm, so the response will be essentially the same. If an emitter with a significantly different wavelength is used then the threshold of the IF-D95T should be calculated using the graph in Figure 1. Referring to the Fiber Total Loss chart on the IF-E96E data sheet we see that at 10 meters there is 2.3 dB of loss relative to 1 meter. The sensitivity of the detector and output of the emitter are specified with polished fibers. Razor cut ends will have about 2 dB more loss per end. This gives the required power from the emitter as -30 dBm + 2.3 dB + 2 dB + 2 dB = -23.7 dBm.

# IF D95 Plastic Fiber Optic Photologic Detectors

The IF-E96E typically outputs -4.0 dBm (400 uW) with 20 mA of drive current. This is more than enough for this application. If fact, we can lower the drive level of the emitter which will allow it to run cooler and will improve its lifetime. If we lower the drive level to 5 mA, the chart on the IF-E96E datasheet indicates that the output will be about 0.23 times the output at 20 mA. This will be 92 uW or -10.4 dBm. This still gives us 13.3 dB of margin over the nominal requirement.

The about calculations were done using the typical characteristics for the emitter and detector. A more rigorous calculation could be done by considering the worst case values. i.e. the minimum emitter power and the maximum detector trigger level. Some margin must be in the system to account for changes over time and changes that may happen to the system. The emitter power will slowly decrease over time. Even changing the position of the fiber cable will slightly change the signal attenuation.

## Circuit Applications:

The circuits shown in Figure 3 are all that is needed to use the IF-D95T or IF-D95OC. They need a power supply de-coupling capacitor to remain stable and the IF-D95OC needs a pull-up resistor that can be connected to any voltage within the maximum ratings.

## PART DATA COMPARISON

Input/Output Table

Part Number	Light	Output
IF D95T	ON	HIGH
	OFF	LOW
IF D95TI	ON	LOW
	OFF	HIGH
IF D95OC	ON	HIGH
	OFF	LOW
IF D95OCi	ON	LOW
	OFF	HIGH

FIGURE 5. Optical input to electrical output