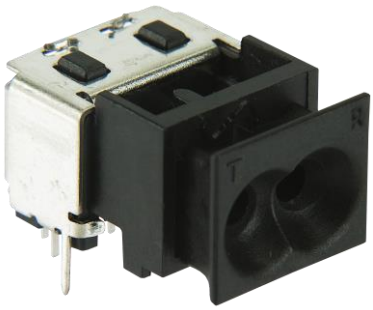
FB01GKAR

1 Gbps Fiber Optic OptoLock® Transceiver

Datasheet



DESCRIPTION

Firecomms' plugless OptoLock® transceiver in combination with the KDPOF KD1053 PHY IC enables Gigabit point-to-point links using multilevel encoding over standard Plastic Optical Fiber (POF). This combined solution supports both standard IEEE 802.3 Ethernet over POF at 100 Mbps and multi-level encoded Gigabit Ethernet at 1 Gbps over POF as outlined in IEEE 802.3-bv.

This OptoLock® offers a small form factor transceiver containing an integrated transmitter and receiver pair of opto-electronic components which are lensed for direct termination to POF. This port for bare fiber significantly simplifies the optical connection, (no plug required) thus reducing installation and maintenance time for consumer applications.

OptoLock® is protected by U.S. patents 7,597,485 and 7,905,665, Chinese patents 101501545 A and 102135650 B and other international patents.

FEATURES

- Simple low-cost termination solution for 2.2 mm jacketed POF cables without a plug
- Fully compatible with KD1053 PHY IC in both 1 Gbps and 100 Mbps modes
- Eye Safe and visible red light-based Resonant Cavity LED (RCLED) at 650 nm with small emission aperture and integrated POF driver IC for RCLED
- Receiver IC with integrated PIN diodes for robust EMI/EMC performance
- Integrated optics for efficient coupling to 0.5 NA POF
- -20 °C to +60 °C operating range
- RoHS compliant

AVAILABLE OPTIONS

Table 1
ORDERING INFORMATION / PART NUMBER

GigE OptoLock® Transceiver for 2.2 mm jacketed POF, Black	FB01GKAR

APPLICATIONS

Table 2
APPLICATIONS

Application	Home or Office data communications
Distance	40 meters over Step Index POF at 1 Gbps [1] 100 meters over Step Index POF at 100 Mbps [1]
Speed	100 Mbps Ethernet per IEEE 802.3 1 Gbps Gigabit Ethernet per IEEE 802.3-bv

***Note**: 1. Maximum link lengths will vary with installation conditions and operating data rate.*

SPECIFICATIONS

Table 3
TRANSCEIVER PIN DESCRIPTION

Pin	Name	Symbol
	TRANSMITTER	
1	EMI SHIELD [1]	GND
2	GROUND PIN	GND
3	GROUND PIN	GND
4	SIGNAL INPUT (POSITIVE)	TD+
5	SIGNAL INPUT (NEGATIVE)	TD-
6	DC POWER INPUT PIN 3.3 V	Vcc
	RECEIVER	
7	DC POWER INPUT PIN 3.3 V	Vcc
8	GROUND PIN	GND
9	RECEIVED SIGNAL STRENGTH INDICATOR	RSSI
10	DATA OUTPUT (POSITIVE)	RD+
11	DATA OUTPUT (NEGATIVE)	RD-
12	EMI SHIELD [1]	GND

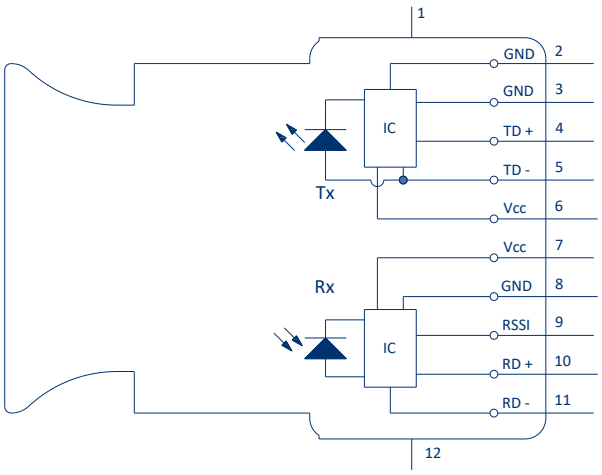


FIGURE 1
Transceiver pin-out, top view

*1. **N.B**. EMI Shield ground pins must be connected to the signal ground plane on the PCB. This is important to shield the FOT from external EMI and ESD*

ELECTRICAL INTERFACE

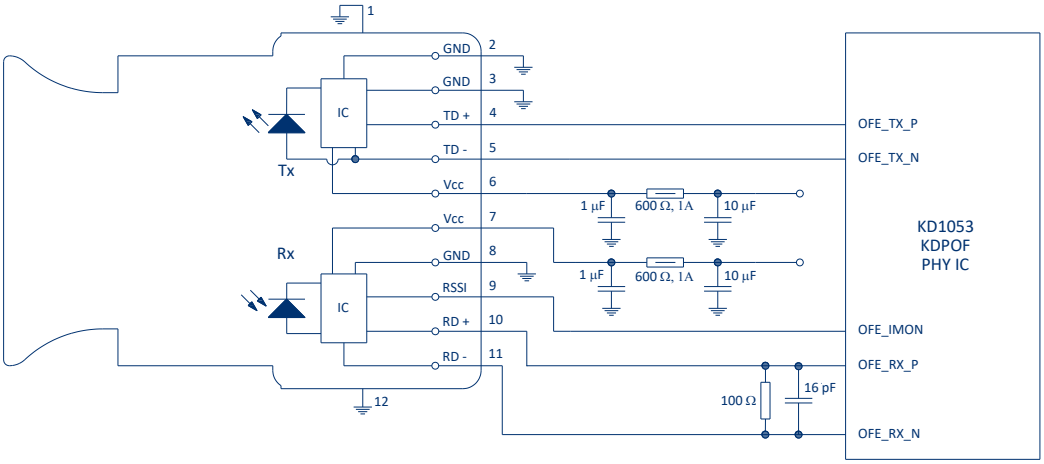


FIGURE 2
General application circuit schematic to connect Firecomms transceiver to KD1053 PHY IC.
Notes:

1. *The transmitter and receiver are shielded from each other to prevent crosstalk. To be effective, the shield must be grounded.*
2. *GND pins 2 and 3 of the Tx FOT must be connected to a full ground plane for heat sinking from the transceiver for best possible operating life duration.*
3. *Power line capacitors should be located as close as possible to the FOT's DC power PINs. The power supply Vcc must be isolated by means of a ferrite bead (600 Ω @ 100 MHz, DCR < 200 mΩ), in order to avoid spurious noise degrading the signal.*
4. *The data lines are impedance-matched differential pairs. The printed circuit board (PCB) layout for these tracks must comply with IEEE standards for high-speed data and impedance matching.*

RECEIVED SIGNAL STRENGTH INDICATOR

The FB01GKAR OptoLock® transceiver provides an optical power monitoring pin as the Received Signal Strength Indicator (RSSI) output from the receiver. The RSSI output indicates the Average Optical Power (AOP) falling on the receiver. This RSSI signal therefore provides a health status indication that can be communicated to the user and wider network. The RSSI pin should be connected to KD1053 when using this PHY, as shown in Figure 2.

GIGABIT OPERATION

For operation at 1 Gbps, the FB01GKAR transceiver must be used with the KD1053 PHY IC that supports the prescribed multilevel encoded signal needed to achieve the Gigabit data rate. For further details on KD1053 PHY IC can be found at www.KDPOF.com.

SPECIFICATIONS

Table 4
REGULATORY COMPLIANCE

Parameter	Symbol	Standard	Level
Storage Compliance	MSL	J-STD-020	2a (4-week floor life)
Restriction of Hazardous Substances Directive	RoHS	Directive 2011/65/EU Incl. Amendment 2015/863	
Eye Safety		IEC 60825-1	LED Class 1

Table 5
ABSOLUTE MAXIMUM RATINGS

These are the absolute maximum ratings at or beyond which the component can be expected to be damaged
Notes:
1. Ambient air temperature in which the transceiver is operating
2. In any case the EMI shield of the Transceiver should not exceed 85°C (See PCB Layout & Enclosure Design section)
3. 260 °C for 10 seconds, one time only, at least 2.2 mm away from lead root

Parameter	Symbol	Minimum	Maximum	Unit
Storage Temperature	T_{stg}	-40	+85	°C
Operating Air Temperature [1,2]	T_{op}	-20	+60	°C
Soldering Temperature [3]	T_{sld}		+260[3]	°C
Supply Voltage	V_R	-0.5	4.5	V
Vin (Tx+/-)		-0.3	Vcc + 0.3	V

SPECIFICATIONS

Table 6
TRANSMITTER ELECTRICAL AND OPTICAL CHARACTERISTICS

Test Conditions:

1. *Test data was validated over the full temperature range of -20 °C to +60 °C, and over the supply range of 3.3 V +/- 5%*
2. *Test data operation using a multi-level encoded signal*
3. *Optical power is measured when coupled into 0.5 m of a 1 mm diameter 0.5 NA POF where POF has been terminated with a professional termination tool*

Parameter	Symbol	Min	Typical	Max	Unit	Test Condition
DC Supply Voltage	Vcc	3.13	3.3	3.47	V	
Operating Current Consumption	Icc	61	71	75.5	mA	
Data Rate (1 Gbps Operation Mode)				1	Gbps	See encoding [2]
Data Rate (100 Mbps Operation Mode)				100	Mbps	See encoding [2]
Peak Wavelength	λ_{peak}		660		nm	
Spectral Bandwidth (FWHM)	$\Delta\lambda$		23	30	nm	
Average Optical Power	P	-5	-2.5	-1.5	dBm	[3]
Optical Rise Time (20 % - 80 %)	t_R		1.76		ns	
Optical Fall Time (80 % - 20 %)	t_F		1.83		ns	
Single ended Input Impedance to GND	$Z_{IN, SE}$	46	50	54	Ω	
Single ended input capacitance	$C_{IN,TX+/-}$	1.90	2.33		pF	

SPECIFICATIONS

Table 7
RECEIVER ELECTRICAL AND OPTICAL CHARACTERISTICS

Test Conditions:

1. *Test data was validated over the full temperature range of -20 °C to +60 °C, and over the supply range of 3.3 V +/- 5%*
2. *Optical power was coupled from a minimum 1 m length of 1 mm diameter core and 0.5 NA step index POF where POF has been terminated with a professional termination tool*
3. *Measured by an oscilloscope with AC Coupled 50 Ohm termination for each data input line or using a 100 Ohm terminated differential probe*
4. *Test data operation using a multi-level encoded signal*
5. *Measured using a large area photodetector*

Parameter	Symbol	Min	Typical	Max	Unit	Test Condition
DC Supply Voltage	Vcc	3.13	3.3	3.47	V	
Data Rate (1 Gbps Operation Mode)				1	Gbps	See encoding [4]
Data Rate (100 Mbps Operation Mode)				100	Mbps	
Operating Current Consumption	Icc	25.5	39	46	mA	
Sleep State Current Consumption	I_s	3.75	7	12.2	µA	
Input AOP for reliable link establishment		-16		0	dBm	[4,5]
Average Optical Power to enter Sleep	P_{SL}	-36			dBm	
Average Optical Power to wake from Sleep	P_{WU}			-30	dBm	
Differential Output Voltage Swing	$V_{OUT,DIFF}$	190		323	mV	(peak to peak)
Differential Output Impedance	$Z_{Diff-Out}$		100		Ω	
Common Mode Output Voltage	$V_{OUT,CM}$	0.6	0.96	1.12	V	
RSSI Output Responsivity	I_{RSSI}/P_{IN}		0.52		A/W	
RSSI Output Current	I_{RSSI}			300	µA	
RSSI Voltage Compliance	V_{RSSI}	0.3		2.7	V	
Wake up time	$t_{on-wake}$		24		µs	Time to switch on output once AOP > P_{WU}

MECHANICAL DATA

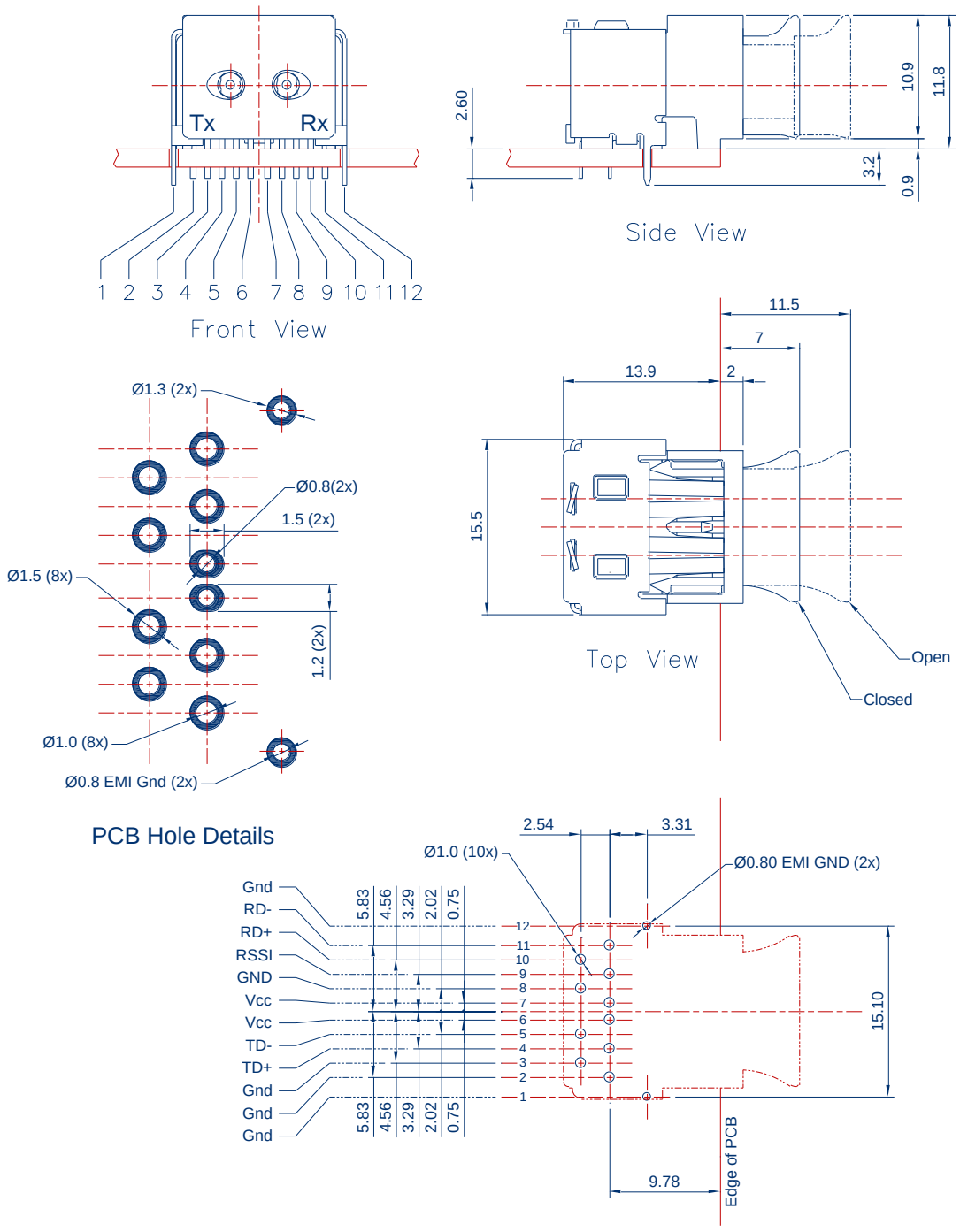


FIGURE 3
Mechanical dimensions of the product, and PCB footprint, which is a top view
General dimensional tolerance is ± 0.2 mm.

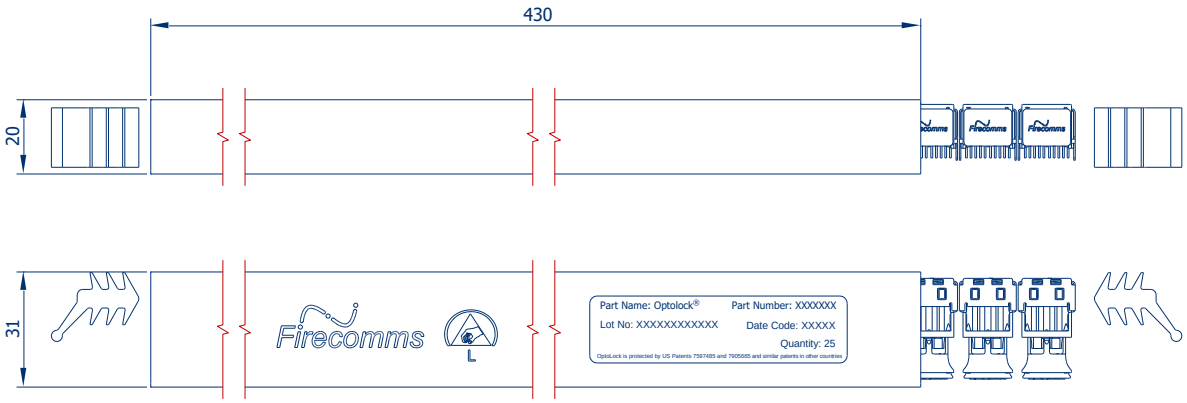


FIGURE 4
Packing tube for Firecomms OptoLock® Transceivers

PART HANDLING

Firecomms OptoLock® transceivers are tested for handling in static-controlled assembly processes (Human Body Model - HBM). Cleaning, degreasing and post solder washing should be carried out using standard solutions compatible with both plastics and the environment. For example, recommended solutions for degreasing are alcohols (methyl, isopropyl and isobutyl). Acetone, ethyl acetate, phenol or similar solution based products are not permitted.

In the soldering process, non-halogenated water soluble fluxes are recommended. OptoLock® transceivers are not suitable for use in reflow solder processes (infrared/vapor-phase reflow). The dust plug should remain in place during soldering, washing and drying processes to avoid contamination of the active optical area of each connector.

The Moisture Sensitivity Level (MSL) classification of this device is 2a according to JEDEC J-STD-020.
The shelf life of an unopened MBB (Moisture Barrier Bag) is 24 months at < 40 °C and < 90 % R.H.
Once the Moisture Barrier Bag is opened the devices can be either

a) Stored in normal factory conditions < 30 °C and < 60 % R.H. for a maximum of 672 hours (4 Weeks) prior to soldering.
b) Stored at < 10 % R.H. (Dry Cabinet).

PCB LAYOUT & ENCLOSURE DESIGN

For optimal optical, electrical and lifetime performance, implementing best practice heat management is essential for both PCB layout and PCB enclosure design. The PCB should use a large ground-plane which can provide a path for maximum thermal dissipation. Additional care must also be taken to avoid the transceiver being in proximity to other heat producing components. In designing an enclosure, it is recommended to ensure the enclosure provides good ventilation and air flow through the assembly and the use of heat sinks where appropriate e.g. placement of component heat sinks onto IC, connection of PCB ground plane to external metal frame.

PACKING INFORMATION

Components are packed in PVC and anti-static tubes in moisture barrier bags. Bags should be opened only in static-controlled locations, and standard procedures should be followed for handling moisture sensitive components.

Components per Tube		25
	Tube Length	430 mm
	Tube Width	31 mm
	Tube Height	20 mm
Tubes per Bag		10
Bags per Inner Carton		1
	Inner Carton Length	588 mm
	Inner Carton Width	147 mm
	Inner Carton Height	84 mm
Weight per Inner Carton, Complete		1.80 kg
Components per Inner Carton		250
Inner Cartons per Outer Carton		4
	Outer Carton Length	600 mm
	Outer Carton Width	310 mm
	Outer Carton Height	195 mm
Weight per Outer Carton, Complete		7.53 kg
Components per Outer Carton		1000