HEWLETT PACKARD

SNAP-IN FIBER OPTIC LINKS TRANSMITTERS, RECEIVERS, CABLE AND CONNECTORS

HFBR-0500 SERIES

T-41-91

Features

- GUARANTEED LINK PERFORMANCE OVER TEMPERATURE
  - High Speed Links: dc to 5 MBd
  - Extended Distance Links up to 82 m
  - Low Current Links: 6 mA Peak Supply Current for an 8 m Link
  - Photo Interrupters
- LOW COST PLASTIC DUAL-IN-LINE PACKAGE
- EASY FIELD CONNECTORING
- EASY TO USE RECEIVERS:
  - Logic Compatible Output Level
  - Single +5 V Receiver Power Supply
  - High Noise Immunity
- LOW LOSS PLASTIC CABLE:
  - Selected Super Low Loss Simplex Cable
  - Simplex and Zip Cord Style Duplex Cable

Applications

- HIGH VOLTAGE ISOLATION
- SECURE DATA COMMUNICATIONS
- REMOTE PHOTO INTERRUPTER
- LOW CURRENT LINKS
- INTER/INTRA-SYSTEM LINKS
- STATIC PROTECTION
- EMC REGULATED SYSTEMS (FCC, VDE)

Description

The HFBR-0500 series is a complete family of fiber optic link components for configuring low-cost control, data transmission, and photo interrupter links. These components are designed to mate with plastic snap-in connectors and low-cost plastic cable.* Link design is simplified by the logic compatible receivers and the ease of connectoring the plastic fiber cable. The key parameters of links configured with the HFBR-0500 family are fully guaranteed.

* Cable is available in standard low loss and selected super low loss varieties.

Link Selection Guide

GUARANTEED LINKS

	Data Rate	Guaranteed Link Length 0-70° C		Typical Link Lengths 25° C		Transmitter	Receiver	Page
		Standard Cable	Improved Cable	Standard Cable	Improved Cable			
5 MBd Link	5 MBd	12	17	35 m	40 m	HFBR-1510	HFBR-2501	5-74
1 MBd Link	1 MBd	24	34	50 m	65 m	HFBR-1502	HFBR-2502	5-76
Low Current Link	40 kBd	8	11	30 m	35 m	HFBR-1512	HFBR-2503	5-78
Extended Distance Link	40 kBd	60	82	100 m	125 m	HFBR-1512	HFBR-2503	5-78
Photo Interrupter Link	20 kHz 500 kHz	N/A N/A	N/A N/A	N/A N/A	N/A N/A	HFBR-1512 HFBR-1502	HFBR-2503 HFBR-2502	5-80 5-80

Component Selection Guide

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TRANSMITTERS

	Minimum Output Optical Power 0 to 70° C	Peak Emission Wavelength	Page
HFBR-1510	–16.5 dBm	665 nm	5-82
HFBR-1502	–13.6 dBm	665 nm	5-82
HFBR-1512	–13.6 dBm	665 nm	5-82

RECEIVERS

	Sensitivity 0 to 70° C	Data Rate	Page
HFBR-2501	–21.6 dBm	5 MBd	5-83
HFBR-2502	–24 dBm	1 MBd	5-83
HFBR-2503	–39 dBm	40 kBd	5-85

CABLES

Please refer to page 15 (of the Versatile Link Fiber Optics Data Sheet) for cable specifications.

CONNECTORS

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HFBR-4501 Gray Connector/Crimp Ring
HFBR-4511 Blue Connector/Crimp Ring
HFBR-4595 Polishing Kit
Polishing Fixture — Abrasive Paper
HFBR-4596 Polishing Fixture
Bulkhead Feedthrough/In-Line Splice
HFBR-4505 Gray
HFBR-4515 Blue

Mechanical Dimensions

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5 MBd Link

HFBR-1510 AND HFBR-2501

The dc to 5 MBd link is guaranteed over temperature to operate up to 17 m with a transmitter drive current of 60 mA. This link uses the 665 nm HFBR-1510 Transmitter, the HFBR-2501 Receiver, and Plastic Cable. The receiver compatible with LSTTL/TTL/CMOS logic levels offers a choice of internal pull-up or open collector output.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min.	Max.	Units	Ref.
Ambient Temperature	T_A	0	70	°C	
Transmitter Peak Forward Current	$I_{F\,PK}$	10	750	mA	Note 1
Avg. Forward Current	$I_{F\,AV}$		60	mA	
Receiver Supply Voltage	V_{CC}	4.75	5.25	V	Note 2
Fan-Out (TTL)	N		5		

SYSTEM PERFORMANCE Using Standard Cable under recommended operating conditions unless otherwise specified.

Parameter	Symbol	Min.	Typ.[5]	Max.	Units	Conditions	Ref.
Data Rate		dc		5	MBd	BER ≤ 10^{-9}	
Transmission Distance Standard Cable	ℓ	12			m	I_{FPK} = 60 mA, 0–70° C	
		17	35		m	I_{FPK} = 60 mA, 25° C	
Transmission Distance Improved Cable		17			m	I_{FPK} = 60 mA, 0–70° C	
		24	40		m	I_{FPK} = 60 mA, 25° C	
Propagation Delay	t_{PLH}		80	140	ns	R_L = 560 Ω, C_L = 30 pF	Fig. 4, 5
	t_{PHL}		50	140	ns	P_R = −21.6≤P_R≤−9.5dBm	Note 3
Pulse Width Distortion	t_D		30		ns	P_R = −15 dBm, R_L = 560 Ω, C_L = 30 pF	Fig. 4, 6 Note 4
EMI Immunity			8000		V/m	BER ≤ 10^{-9}	

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Notes: 1. For I_{FPK} > 80 mA, the duty factor must be such as to keep I_{FAV} ≤ 80 mA. In addition, for I_{FPK} > 80 mA, the following rules for pulse width apply: I_{FPK} ≤ 160 mA: Pulse width ≤ 1 ms I_{FPK} > 160 mA: Pulse width ≤ 1 μs

2. It is essential that a bypass capacitor (0.01 μF to 0.1 μF ceramic) be connected from pin 3 to pin 4 of the receiver. Total lead length between both ends of the capacitor and the pins should not exceed 20 mm.
3. The propagation delay of 1 m of cable (5 ns) is included.
4. $T_D = t_{PLH} - t_{PHL}$.
5. Typical data is at 25° C, V_{CC} = 5 V.

Link Design Considerations

The HFBR-1510/2501 Transmitter/Receiver pair is guaranteed for operation at data rates up to 5 MBd over link distances from 0 to 12 metres with standard cable and from 0 to 17 metres with improved cable. The value of transmitter drive current, I_F, depends on the link distance as shown in Figures 2 and 3. Note that there is an upper as well as a lower limit on the value of I_F for any given distance. The dotted lines in Figures 2 and 3 represent pulsed operation. When operating in the pulsed mode, the conditions in Note 1 must be met. After selecting a value of the transmitter drive current I_F, the value of R_1 in Figure 1 can be calculated as follows:

$$R_1 = \frac{V_{CC} - V_F}{I_F}$$

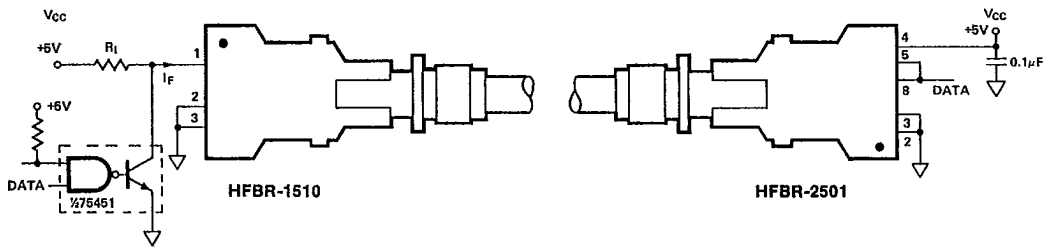


Figure 1. Typical Circuit Operation (5 MBd ≤ 12 m)

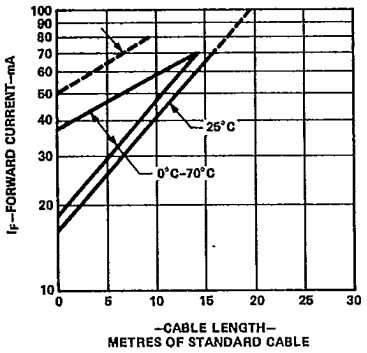


Figure 2. Guaranteed System Performance with HFBR-1510 and HFBR-2501, Standard Cable

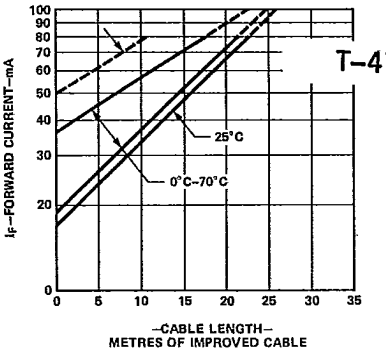
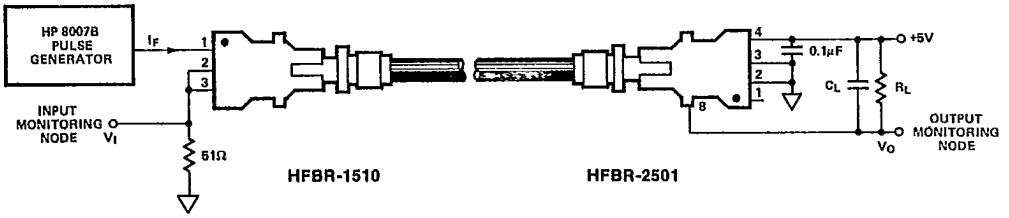


Figure 3. Guaranteed System Performance with HFBR-1510 and HFBR-2501, Improved Cable



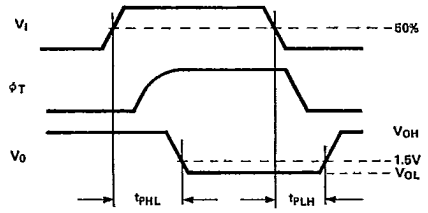


Figure 4. A.C. Test Circuit

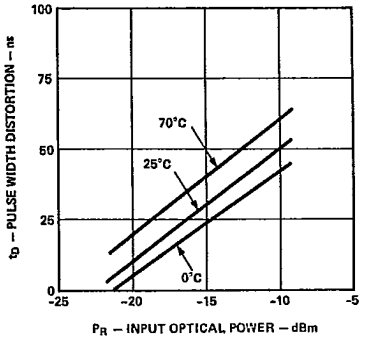


Figure 5. HFBR-1510/2501 Link Pulse Width Distortion vs. Optical Power

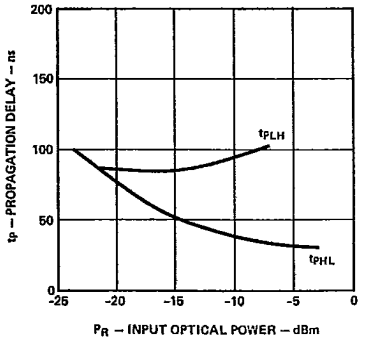


Figure 6. HFBR-1510/2501 Link Propagation Delay vs. Optical Power

1 MBd Link HFBR-1502 AND HFBR-2502

The dc to 1 MBd link is guaranteed over temperature to operate from 0 to 34 m with a transmitter drive current of 60 mA. This link uses the 665 nm HFBR-1502 Transmitter, the HFBR-2502 Receiver, and Improved Cable. The receiver is compatible with LSTTL/TTL/CMOS logic levels and offers a choice of an internal pull-up or open collector output.

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RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min.	Max.	Units	Ref.
Ambient Temperature	T_A	0	70	°C	
Transmitter Peak Forward Current	$I_{F\,PK}$	10	750	mA	Note 1
Avg. Forward Current	$I_{F\,AV}$		60	mA	
Receiver Supply Voltage	V_{CC}	4.75	5.25	V	Note 2
Fan-Out (TTL)	N		5		

SYSTEM PERFORMANCE Using Standard Cable under recommended operating conditions unless otherwise specified.

Parameter	Symbol	Min.	Typ.[5]	Max.	Units	Conditions	Ref.
Data Rate		dc		1	MBd	BER ≤ 10^{-9}	
Transmission Distance Standard Cable	ℓ	24			m	I_{FPK} = 60 mA, 0–70° C	
		30	50		m	I_{FPK} = 60 mA, 25° C	
Transmission Distance Improved Cable	ℓ	34			m	I_{FPK} = 60 mA, 0–70° C	
		41	65		m	I_{FPK} = 60 mA, 25° C	
Transmission Distance Standard Cable	ℓ	30				I_{FPK} = 120 mA, 0–70° C	
		36	60			I_{FPK} = 120 mA, 25° C	
Transmission Distance Improved Cable	ℓ	41				I_{FPK} = 120 mA, 0–70° C	
		50	75			I_{FPK} = 120 mA, 25° C	
Propagation Delay	t_{PLH}		180	250	ns	R_L = 560 Ω, C_L = 30 pF	Fig. 4, 5
	t_{PHL}		100	140	ns	P_R = −24 dBm	Note 3
Pulse Width Distortion	t_D		80		ns	P_R = −24 dBm R_L = 560 Ω, C_L = 30 pF	Fig. 4, 6 Note 4
EMI Immunity			8000		V/m	BER ≤ 10^{-9}	

Notes: 1. For I_{FPK} > 80 mA, the duty factor must be such as to keep I_{FAV} ≤ 80 mA. In addition, for I_{FPK} > 80 mA, the following rules for pulse width apply: I_{FPK} ≤ 160 mA: Pulse width ≤ 1 ms I_{FPK} > 160 mA: Pulse width ≤ 1 μs
2. It is essential that a bypass capacitor (0.01 μF to 0.1 μF ceramic) be connected from pin 3 to pin 4 of the receiver. Total lead length between both ends of the capacitor and the pins should not exceed 20 mm.
3. The propagation delay of 1 m of cable (5 ns) is included. 4. $T_D = t_{PLH} - t_{PHL}$. 5. Typical data is at 25° C, V_{CC} = 5 V.

Link Design Considerations

The HFBR-1502/2502 Transmitter/Receiver pair is guaranteed for operation at data rates up to 1 MBd over link distances from 0 to 24 metres with standard cable and from 0 to 34 metres with improved cable. The value of transmitter drive current, I_F, depends on the link distance as shown in Figures 2 and 3. Note that there is a lower limit on the value of I_F for any given distance. The dotted lines in Figures 2 and 3 represent pulsed operation. When operating in the pulsed mode, the conditions in Note 1 must be met. After selecting a value of the transmitter drive current I_F, the value of R_1 in Figure 1 can be calculated as follows:

$$R_1 = \frac{V_{CC} - V_F - V_{OL\,(75451)}}{I_F}$$

For the HFBR-1502/2502 pair, the value of the capacitor, C_1 (Figure 1) must be chosen such that $R_1 C_1 \geq 75$ ns.

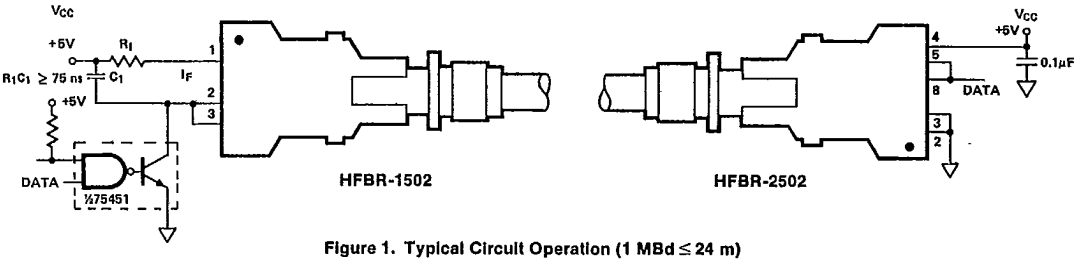

Figure 1. Typical Circuit Operation (1 MBd ≤ 24 m)

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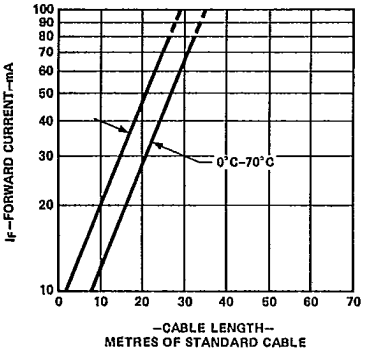

Figure 2. Guaranteed System Performance with HFBR-1502 and HFBR-2502, Standard Cable

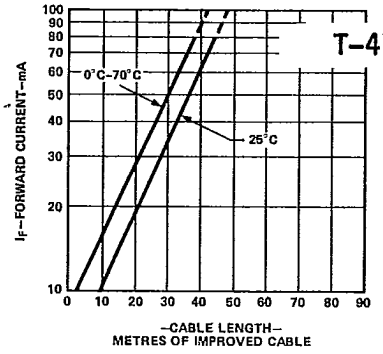

Figure 3. Guaranteed System Performance with HFBR-1502 and HFBR-2502, Improved Cable

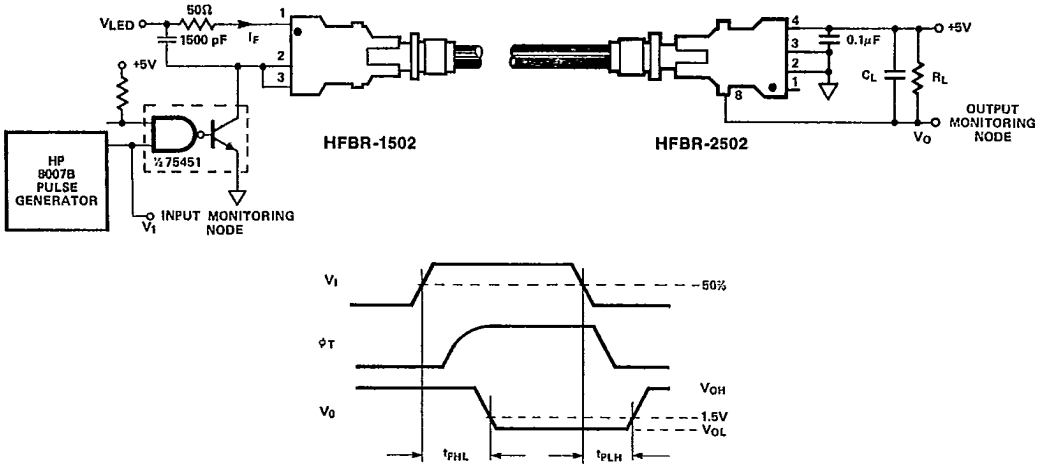

Figure 4. A.C. Test Circuit

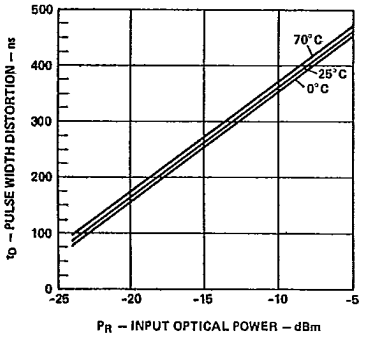

Figure 5. HFBR-1502/2502 Link Pulse Width Distortion vs. Optical Power

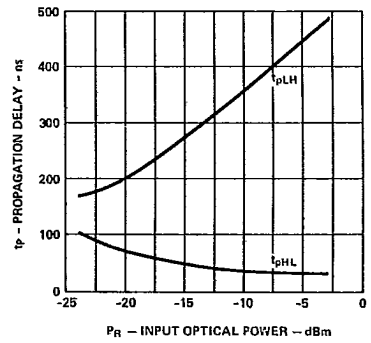

Figure 6. HFBR-1502/2502 Link Propagation Delay vs. Optical Power

Low Current/Extended Distance Link

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HFBR-1512 AND HFBR-2503

The low current link requires only 6 mA peak supply current for the transmitter and receiver combined to achieve an 11 m link. Extended distances up to 82 m can be achieved at a maximum transmitter drive current of 60 mA peak. This link can be driven with TTL/LSTTL and most CMOS logic gates.

The black plastic housing of the HFBR-1512 Transmitter is designed to prevent the penetration of ambient light into the cable through the transmitter. This prevents the sensitive receiver from being triggered by ambient light pulses.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min.	Max.	Units	Ref.
Ambient Temperature	T_A	0	70	°C	
Transmitter Peak Forward Current	$I_{F\,PK}$	2	120	mA	Note 1
Avg. Forward Current	$I_{F\,AV}$		60	mA	
Receiver Supply Voltage	V_{CC}	4.5	5.5	V	Note 2
Output Voltage	V_O		V_{CC}	V	
Fan-Out (TTL)	N		1		

SYSTEM PERFORMANCE Using Standard Cable under recommended operating conditions unless otherwise specified.

Parameter	Symbol	Min.	Typ.[5]	Max.	Units	Conditions	Ref.
Data Rate		dc		40	kBd	$t_D \le 7.0\ \mu s$	
Transmission Distance Standard Cable	ℓ	8	30		m	$I_{FPK} = 2$ mA, 0–70° C	
		60	100		m	$I_{FPK} = 60$ mA, 0–70° C	
Transmission Distance Improved Cable	ℓ	11	35		m	$I_{FPK} = 2$ mA, 0–70° C	
		82	125		m	$I_{FPK} = 60$ mA, 0–70° C	
Propagation Delay	t_{PLH}		4		μs	$R_L = 3.3K\ \Omega$, $C_L = 30$ pF	Fig. 4, 5
	t_{PHL}		2.5		μs	$P_R = -25$ dBm	Note 3
Pulse Width Distortion	t_D			7.0	μs	$-39 \le P_R \le -14$ dBm $R_L = 3.3\ K\Omega$, $C_L = 30$ pF	Fig. 4, 6 Note 4
Bit Error Rate	BER		10^{-9}			$P_R = -30$ dBm	
EMI Immunity			5000		V/m	$P_R = 0$ mW	

Notes:
1. For $I_{FPK} > 80$ mA, the duty factor must be such as to keep $I_{FAV} \le 80$ mA. In addition, if $I_{FAV} > 80$ mA, then the pulse width must be equal to or less than 1 ms.
2. It is recommended that a bypass capacitor (0.01 μF to 0.1 μF ceramic) be connected from pin 3 to pin 4 of the receiver.
3. The propagation delay of 1 m of cable (5 ns) is included.
4. $t_D = t_{PLH} - t_{PHL}$.
5. Typical data is at 25° C, $V_{CC} = 5$ V.

Link Design Considerations

The HFBR-1512/2503 Transmitter/Receiver pair is guaranteed for operation at data rates up to 40 kBd for transmitter drives as low as 2 mA. The value of transmitter drive current, I_F, depends on the link distance as shown in Figures 2 and 3. Note that there is an upper as well as a lower limit on the value of I_F for any given distance. After selecting a value of the transmitter drive current I_F, the value of R_1 in Figure 1 can be calculated as follows:

$$R_1 = \frac{V_{CC} - V_F}{I_F}$$

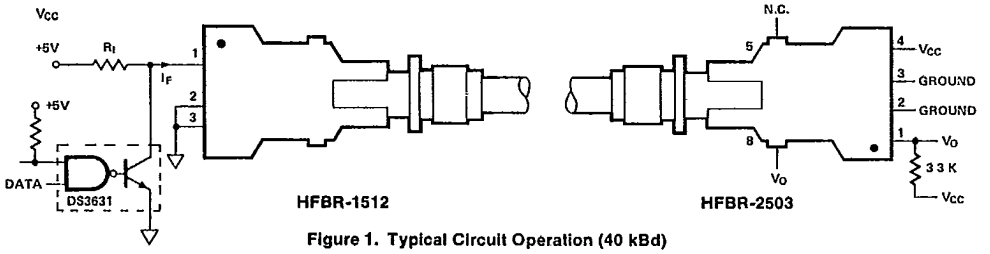

Figure 1. Typical Circuit Operation (40 kBd)

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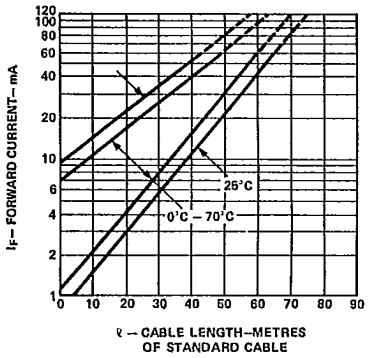


Figure 2. Guaranteed System Performance with HFBR-1512 and HFBR-2503, Standard Cable

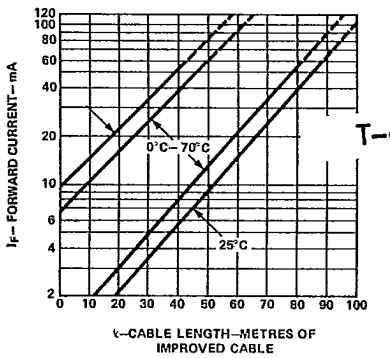
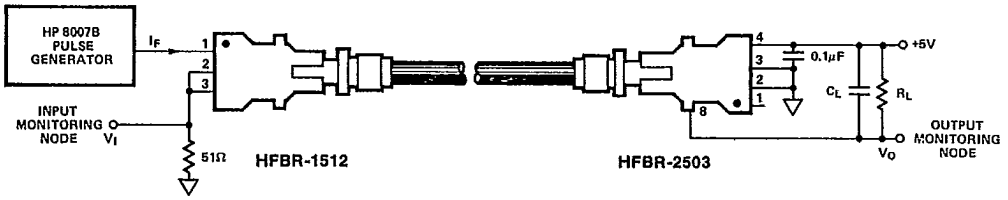


Figure 3. Guaranteed System Performance with HFBR-1512 and HFBR-2503, Improved Cable



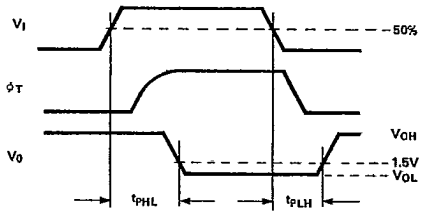


Figure 4. A.C. Test Circuit

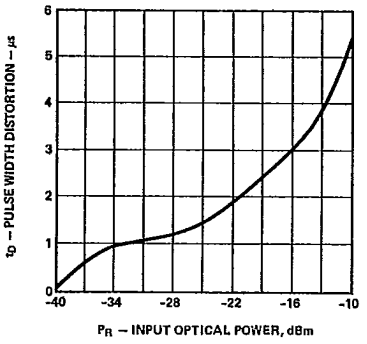


Figure 5. HFBR-1512/2503 Link Pulse Width Distortion vs. Optical Power

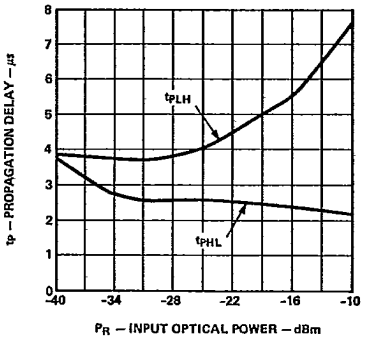


Figure 6. HFBR-1512/2503 Link Propagation Delay vs. Optical Power

Photo Interrupter Links

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HFBR-1502/2502
HFBR-1512/2503

These links may be used in optical switches, shaft position sensors, and velocity sensors. They are particularly useful where high voltage, electrical noise, or explosive environments prohibit the use of electromechanical or optoelectronic sensors.

The HFBR-1512/2503 link (20 kHz) has an optical power budget of 24 dB, and the HFBR-1502/2502 link (500 kHz) budget is 10 dB. Total system losses (cable attenuation, air-gap loss, etc) must not exceed the link optical power budget.

RECOMMENDED OPERATING CONDITIONS

Parameter		Symbol	Min.	Max.	Units	Ref.
Ambient Temperature		T_A	0	70	°C	
Transmitter Peak Forward Current		$I_{F\,PK}$	10	750	mA	Note 1
Avg. Forward Current		$I_{F\,AV}$		60	mA	
Receiver Supply Voltage	HFBR-2503	V_{CC}	4.50	5.50	V	Note 2
	HFBR-2502		4.75	5.25		
Output Voltage	HFBR-2503	V_O		V_{CC}	V	
	HFBR-2502			18		
Fanout (TTL)	HFBR-2503			1		
	HFBR-2502			5		

SYSTEM PERFORMANCE

See HFBR-1502/2502 link data sheet (page 5) and HFBR-1512/2503 link data sheet (page 7) for more design information.

These specifications apply when using Standard Cable and, unless otherwise specified, under recommended operating conditions.

Parameter	Symbol	Min.	Typ.[5]	Max.	Units	Conditions	Ref.
HFBR-1512/HFBR-2503							
Max. Count Frequency		dc		20	kHz		
Optical Power Budget		25.4			dB	I_{FPK} = 60 mA, 0–70° C	
		27.8	34		dB	I_{FPK} = 60 mA, 25° C	Note 3, 4
HFBR-1502, HFBR-2502							
Max. Count Frequency		dc		500	kHz		
Optical Power Budget		10.4			dB	I_{FPK} = 60 mA, 0–70° C	
		12.8	15.6		dB	I_{FPK} = 60 mA, 25° C	Note 3

Notes:

1. For I_{FPK} > 80 mA, the duty factor must be such as to keep $I_{FAV} \leq 80$ mA. In addition, for I_{FPK} > 80 mA, the following rules for pulse width apply:
   $I_{FPK} \leq 160$ mA: Pulse width ≤ 1 ms
   I_{FPK} > 160 mA: Pulse width ≤ 1 μs
2. A bypass capacitor (0.01 μF to 0.1 μF ceramic) connected from pin 3 to pin 4 of the receiver is recommended for the HFBR-2503 and essential for the HFBR-2502. For the HFBR-2502, the total lead length between both ends of the capacitor and the pins should not exceed 20 mm.
3. Optical Power Budget = P_T Min. − $P_{R(L)}$ Min. Refer to HFBR-1502/1512 data sheet, page 11; HFBR-2502 data sheet, page 12; and HFBR-2503 data sheet, page 14 for additional design information.
4. In addition to a minimum power budget, care should be taken to avoid overdriving the HFBR-2503 receiver with too much optical power. For this reason power levels into the receiver should be kept less than −13.7 dBm to eliminate any overdrive with the recommended operating conditions.
5. Typical data is at 25° C, V_{CC} = 5 V.

Link Design Considerations

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The HFBR-1512/2503 and HFBR-1502/2502 Transmitter/Receiver pairs are intended for applications where the photo interrupter must be physically separate from the optoelectronic emitter and detector. This separation would be useful where high voltage, electrical noise or explosive environments prohibit the use of electronic devices. To ensure reliable long term operation, links designed for this application should operate with an ample optical power margin $\alpha_M \geq 3$ dB, since the exposed fiber ends are subject to environmental contamination that will increase the optical attenuation of the slot with time. A graph of air gap separation versus attenuation for clean fiber ends with minimum radial error ≤ 0.005 inches (0.127 mm) and angular error (≤ 3.0°) is provided in Figure 2. The following equations can now be used to determine the transmitter output power, P_T, for both the overdrive and minimum drive cases. Overdrive is defined as a condition where excessive optical power is delivered to the receiver. The first equation enables the maximum P_T that will not result in receiver overdrive to be calculated for a predetermined link length and slot attenuation. The second equation defines the minimum P_T allowed for link operation.

$$P_T\,(MAX) - P_R\,(MAX) \leq \alpha_{O\,MIN}\ell + \alpha_{SLOT} \qquad \text{Eq. 1}$$

$$P_T\,(MIN) - P_{RL}\,(MIN) \geq \alpha_{O\,MAX}\ell + \alpha_{SLOT} + \alpha_M \qquad \text{Eq. 2}$$

Once P_T (MIN) has been determined in the second equation for a specific link length (ℓ), slot attenuation (α_{SLOT}) and margin (α_M), Figure 3 can then be used to find I_F.

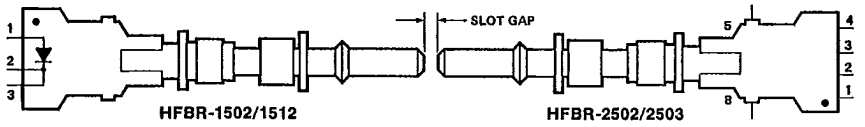

Figure 1. Typical Slot Interrupter Configuration. Refer to 1 MBd or Low Current Links for Schematic Diagrams

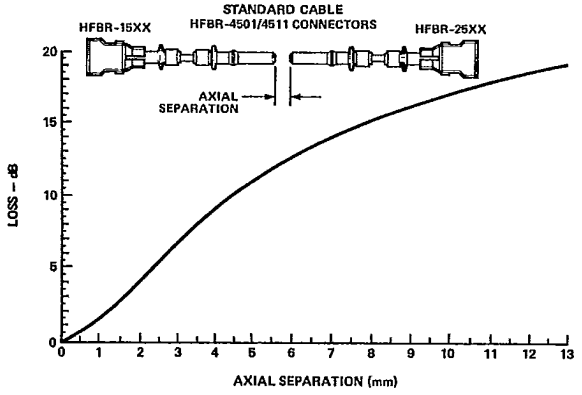

Figure 2. Typical Loss vs. Axial Separation

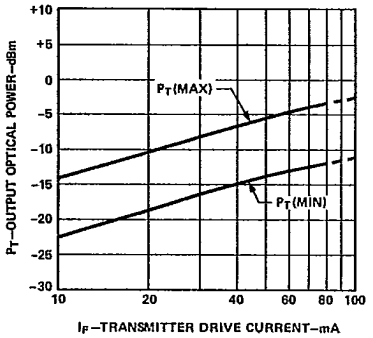

Figure 3. Typical HFBR-1502/1512 Optical Output Power vs. Transmitter I_F (0—70° C)

665 nm Transmitters

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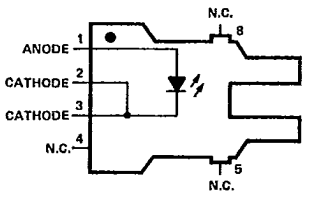
HFBR-1502/HFBR-1510 and HFBR-1512

The HFBR-1510/1502/1512 Transmitter modules incorporate a 665 nm LED emitting at a low attenuation wavelength for the HFBR-3510/3610 plastic fiber optic cable. The transmitters can be easily interfaced to standard TTL logic. The optical power output of the HFBR-1510/1512/1502 is specified at the end of 0.5 m of cable. The HFBR-1512 output optical power is tested and guaranteed at low drive currents.

HFBR-1510/1512/1502 Transmitter



Absolute Maximum Ratings

Parameter		Symbol	Min.	Max.	Units	Ref.
Storage Temperature		T_S	−40	+75	°C	
Operating Temperature		T_A	0	+70	°C	
Lead Soldering Cycle	Temp.			260	°C	Note 1
	Time			10	sec.	
Peak Forward Input Current		$I_{F\,PK}$		1000	mA	Note 2
Average Forward Input Current		$I_{F\,AV}$		80	mA	
Reverse Input Voltage		V_R		5	V	

Electrical/Optical Characteristics 0°C to +70°C Unless Otherwise Specified

Parameter		Symbol	Min.	Typ.[5]	Max.	Units	Conditions	Ref.
Transmitter Output Optical Power	HFBR-1510	P_T	−16.5		−7.6	dBm	I_F = 60 mA, 0–70°C	
			−14.3		−8.0	dBm	I_F = 60 mA, 25°C	
	HFBR-1502 and HFBR-1512	P_T	−13.6		−4.5	dBm	I_F = 60 mA, 0–70°C	Fig. 2
			−11.2		−5.1	dBm	I_F = 60 mA, 25°C	Note 4
	HFBR-1512	P_T	−35.5			dBm	I_F = 2 mA, 0–70°C	Note 3
Output Optical Power Temperature Coefficient		$\frac{\Delta P_T}{\Delta T}$		−0.026		dB/°C		
Peak Emission Wavelength		λ_{PK}		665		nm		
Forward Voltage		V_F	1.45	1.67	2.02	V	I_F = 60 mA	
Forward Voltage Temperature Coefficient		$\frac{\Delta V_F}{\Delta T}$		−1.37		mV/°C		Fig. 1
Effective Diameter		D_T		1		mm		
Numerical Aperture		N.A.		0.5				
Reverse Input Breakdown Voltage		V_{BR}	5.0	12.4		V	I_F = −10 μA, T_A = 25°C	
Diode Capacitance		C_O		86		pF	V_F = 0, f = 1 MHz	
Rise and Fall Time		t_R, t_F		50		ns	10% to 90%	

Notes:
1. 1.6 mm below seating plane.
2. 1 μs pulse, 20 μs period.
3. Measured at the end of 0.5 m standard Fiber Optic Cable with large area detector.
4. Optical power, P (dBm) = 10 Log P (μW)/1000 μW.
5. Typical data is at 25°C.

WARNING. When viewed under some conditions, the optical port of the Transmitter may expose the eye beyond the Maximum Permissible Exposure recommended in ANSI Z-136-1, 1981. Under most viewing conditions there is no eye hazard.

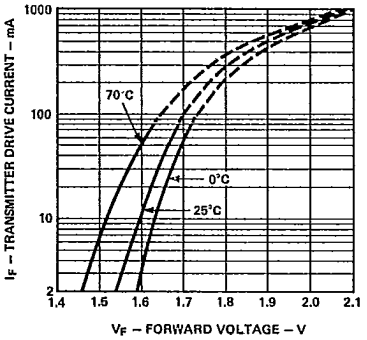


Figure 1. Typical Forward Voltage vs. Drive Current for HFBR-1510/1502/1512

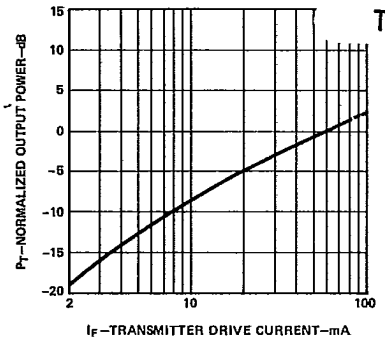


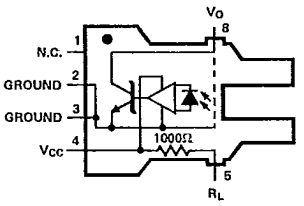
Figure 2. Normalized HFBR-1510/1502/1512 Typical Output Optical Power vs, Drive Current

Receivers

HFBR-2501 (5 MBd) and HFBR-2502 (1 MBd)

The HFBR-2501/2502 Receiver modules feature a shielded integrated photodetector and wide bandwidth DC amplifier for high EMI immunity. A Schottky clamped open-collector output transistor allows interfacing to common logic families and enables "wired-OR" circuit designs. The open collector output is specified up to 18V. An integrated 1000 ohm resistor internally connected to Vcc may be externally jumpered to provide a pull-up for ease-of-use with +5V logic. The combination of high optical power levels and fast transitions falling edge could result in distortion of the output signal (HFBR-2502 only), that could lead to multiple triggering of following circuitry.

HFBR-2501/2502 Receiver



Absolute Maximum Ratings

Parameter		Symbol	Min.	Max.	Units	Ref.
Storage Temperature		T_S	-40	+75	°C	
Operating Temperature		T_A	0	+70	°C	
Lead Soldering Cycle	Temp			260	°C	Note 1
	Time			10	sec	
Supply Voltage		V_{CC}	-0.5	7	V	Note 6
Output Collector Current		I_O		25	mA	
Output Collector Power Dissipation		P_{OD}		40	mW	
Output Voltage		V_O	-0.5	18	V	
Pullup Voltage		V_{RL}	-0.5	V_{CC}	V	

Electrical/Optical Characteristics $0°C$ to $+70°C$, $4.75 \le V_{CC} \le 5.25$ Unless Otherwise Specified

Parameter		Symbol	Min.	Typ.[5]	Max.	Units	Conditions	Ref.
Receiver Input Optical Power Level for Logic "0"	HFBR-2501	$P_{R(L)}$	−21.6		−9.5	dBm	0-70°C, V_{OL} = 0.5 V I_{OL} = 8 mA	Note 2, 3
			−21.6		−8.7	dBm	25°C, V_{OL} = 0.5 V I_{OL} = 8 mA	
	HFBR-2502	$P_{R(L)}$	−24			dBm	0-70°C, V_{OL} = 0.5 V I_{OL} = 8 mA	
			−24			dBm	25°C, V_{OL} = 0.5 V I_{OL} = 8 mA	
Input Optical Power Level for Logic "1"		$P_{R(H)}$			−43	dBm	V_{OH} = 5.25 V, $I_{OH} \le 250\ \mu A$	Note 2
High Level Output Current		I_{OH}		5	250	μA	V_O = 18 V, P_R = 0	Note 4
Low Level Output Voltage		V_{OL}		0.4	0.5	V	I_{OL} = 8 mA, $P_R = P_{RL\ MIN}$	Note 4
High Level Supply Current		I_{CCH}		3.5	6.3	mA	V_{CC} = 5.25 V, P_R = 0 μW	Note 4
Low Level Supply Current		I_{CCL}		6.2	10	mA	V_{CC} = 5.25 V, P_R = −12.5 dBm	Note 4
Effective Diameter		D_R		1		mm		
Numerical Aperture		$N.A._R$		0.5				
Internal Pull-Up Resistor		R_L	680	1000	1700	Ohms		

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Notes:
1. 1.6 mm below seating plane.
2. Optical flux, P (dBm) = 10 Log P (μW)/1000 μW.
3. Measured at the end of standard Fiber Optic Cable with large area detector.
4. R_L is open.
5. Typical data is at 25°C, V_{CC} = 5 V.
6. It is essential that a bypass capacitor 0.01 μF to 0.1 μF be connected from pin 3 to pin 4 of the receiver. Total lead length between both ends of the capacitor and the pins should not exceed 20 mm.

High Sensitivity Receiver

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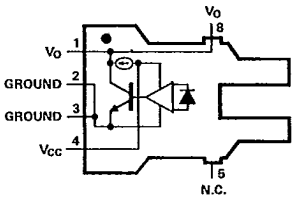
HFBR-2503

The blue plastic HFBR-2503 Receiver module has a sensitivity of −39 dBm. It features an integrated photodetector and DC amplifier for high EMI immunity. The output is an open collector with a 150 μA internal current source pull-up and is compatible with TTL/LSTTL and most CMOS logic families. For minimum rise time add an external pull-up resistor of at least 3.3K ohms. V_{CC} must be greater than or equal to the supply voltage for the pull-up resistor.

HFBR-2503 Receiver



Absolute Maximum Ratings

Parameter		Symbol	Min.	Max.	Units	Ref.
Storage Temperature		T_S	−40	+75	°C	
Operating Temperature		T_A	0	+70	°C	
Lead Soldering Cycle	Temp			260	°C	Note 1
	Time			10	sec	
Supply Voltage		V_{CC}	−0.5	7	V	Note 7
Output Collector Current (Average)		I_O	−1	5	mA	
Output Collector Power Dissipation		P_{OD}		25	mW	
Output Voltage		V_O	−0.5	V_{CC}	V	

Electrical/Optical Characteristics 0° C to +70° C, 4.5 ≤ V_{CC} ≤ 5.5 Unless Otherwise Specified

Parameter		Symbol	Min.	Typ. (5)	Max.	Units	Conditions	Ref.
Receiver Input Optical Power Level for Logic "0"	HFBR-2503	$P_{R(L)}$	−39		−13.7	dBm	0-70° C, $V_O = V_{OL}$ I_{OL} = 3.2 mA	Note 2, 3, 4
			−39		−13.3	dBm	25° C, $V_O = V_{OL}$ I_{OL} = 3.2 mA	
Input Optical Power Level for Logic "1"		$P_{R(H)}$			−53	dBm	V_{OH} = 5.5V, $I_{OH} \leq 40$ μA	Note 2
High Level Output Voltage		V_{OH}	2.4			V	I_{OH} = −40 μA, P_R = 0 μW	
Low Level Output Voltage		V_{OL}			0.4	V	I_{OL} = 3.2 mA, $P_R = P_{RL\ MIN}$	Note 6
High Level Supply Current		I_{CCH}		1.2	1.9	mA	V_{CC} = 5.5V, P_R = 0 μW	
Low Level Supply Current		I_{CCL}		2.9	3.7	mA	V_{CC} = 5.5V, $P_R \geq P_{RL}$ (MIN)	Note 6
Effective Diameter		D_R		1		mm		
Numerical Aperture		N.A.$_R$		0.5				

Notes:
1. 1.6 mm below seating plane.
2. Optical flux, P (dBm) = 10 Log P (μW)/1000 μW.
3. Measured at the end of the standard Fiber Optic Cable with large area detector.
4. Because of the very high sensitivity of the HFBR-2503, the digital output may switch in response to ambient light levels when a cable is not occupying the receiver optical port. The designer should take care to filter out signals from this source if they pose a hazard to the system.
5. Typical data is at 25° C, V_{CC} = 5 V.
6. Including current in 3.3K pull-up resistor.
7. It is recommended that a bypass capacitor 0.01 μF to 0.1 μF ceramic be connected from pin 3 to pin 4 of the receiver.