

MODULE 6 « OPTIQUE »**TP DE LA MISE EN ŒUVRE D'UNE  
TRANSMISSION PAR FIBRE OPTIQUE***(Version apprentissage)*Extrait du programme :

- Mettre en œuvre expérimentalement une photodiode ou un phototransistor.
- Présenter quelques composants utilisés comme émetteur et comme récepteur.

Objectifs :

- Mettre en œuvre le Kit d'évaluation HFBR0501 en votre possession.
- Effectuer un transfert de données binaires par fibre optique (de longueur 5m).

**1. Étape 1 :**

1. Prendre connaissance du Kit d'évaluation de la fibre optique d'Agilent Technologies et déterminer son domaine d'application (valeurs maxi et mini du débit du signal et de la longueur de transmission).
2. Repérage des différents éléments constituant ce kit.
3. Relever les principales caractéristiques de :
  - La fibre optique HFBR-3510 (son atténuation linéique, son ouverture numérique, ses dimensions...) (*cf Electrical/Optical Characteristics de la doc technique de la fibre optique*)
  - De l'émetteur HFBR-1524 (nature du composant, valeurs limites du débit et de la longueur de la fibre, longueur d'onde émise, son ouverture numérique, tension de seuil, valeur du courant  $i_F$  pour 5m...) (*cf Transmitter Electrical/Optical Characteristics de la doc technique de l'émetteur*)
  - Du récepteur HFBR-2524 (nature du composant, tension limite d'alimentation, son ouverture numérique...) (*cf Receiver Electrical/Optical Characteristics de la doc technique du récepteur*)

**2. Étape 2 :**

1. À partir du schéma de câblage de l'émetteur (*cf figure11 de la doc technique*), déterminer la valeur de  $R_1$  pour  $L=5m$ .

aide :

- Redessiner le schéma électrique alimentant la DEL (partir de  $V_{CC}$  en passant par  $R_1$ , la DEL et le transistor jusqu'à la masse)
- Appliquer la loi des mailles sur ce circuit alimentant la DEL.
- Déterminer le courant nominal  $I_{FD}$  pour une longueur de fibre de 5m (*cf figure12 de la doc technique*) ainsi que sa tension de seuil  $V_F$  (*cf Transmitter Electrical/Optical Characteristics de la doc technique de l'émetteur*).
- Déterminer la tension aux bornes du transistor lorsqu'il est passant, Low Level Output Voltage ( $V_{OL}$ ) (*doc technique du composant 75451*).
- En déduire la valeur de  $R_1$  pour  $V_{CC}=5V$ .

2. Le câbler et vérifier son fonctionnement en effectuant des mesures et les exploiter (états de la DEL et du transistor lors d l'émission ou nom de la lumière).

### **3. Étape 3 :**

1. À partir du schéma de câblage du récepteur (*cf figure11 de la doc technique*), le mettre en œuvre.
2. Vérifier son fonctionnement en effectuant des mesures au niveau des DATA et valider le fonctionnement de la transmission optique.

### **4. Étape 4 :**

1. Réaliser une transmission de donnée grâce à la carte codage fournie.



Agilent Technologies

# Versatile Link

## The Versatile Fiber Optic Connection

### Technical Data

#### HFBR-0501 Series

##### Features

- Low Cost Fiber Optic Components
- Enhanced Digital Links dc-5 MBd
- Extended Distance Links up to 120 m at 40 kBd
- Low Current Link: 6 mA Peak Supply Current
- Horizontal and Vertical Mounting
- Interlocking Feature
- High Noise Immunity
- Easy Connectoring Simplex, Duplex, and Latching Connectors
- Flame Retardant
- Transmitters Incorporate a 660 nm Red LED for Easy Visibility
- Compatible with Standard TTL Circuitry

##### Applications

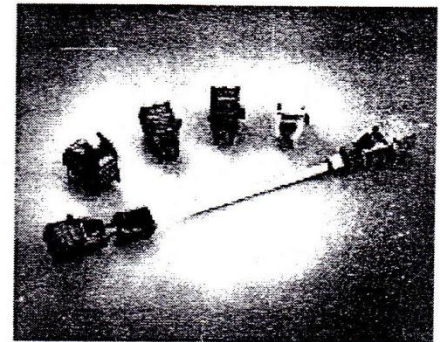
- Reduction of Lightning/Voltage Transient Susceptibility
- Motor Controller Triggering
- Data Communications and Local Area Networks
- Electromagnetic Compatibility (EMC) for Regulated Systems: FCC, VDE, CSA, etc.
- Tempest-Secure Data Processing Equipment

- Isolation in Test and Measurement Instruments
- Error Free Signalling for Industrial and Manufacturing Equipment
- Automotive Communications and Control Networks
- Noise Immune Communication in Audio and Video Equipment

##### Description

The Versatile Link series is a complete family of fiber optic link components for applications requiring a low cost solution. The HFBR-0501 series includes transmitters, receivers, connectors and cable specified for easy design. This series of components is ideal for solving problems with voltage isolation/insulation, EMI/RFI immunity or data security. The optical link design is simplified by the logic compatible receivers and complete specifications for each component. The key optical and electrical parameters of links configured with the HFBR-0501 family are fully guaranteed from 0° to 70°C.

A wide variety of package configurations and connectors provide the designer with numerous mechanical solutions to meet application requirements. The

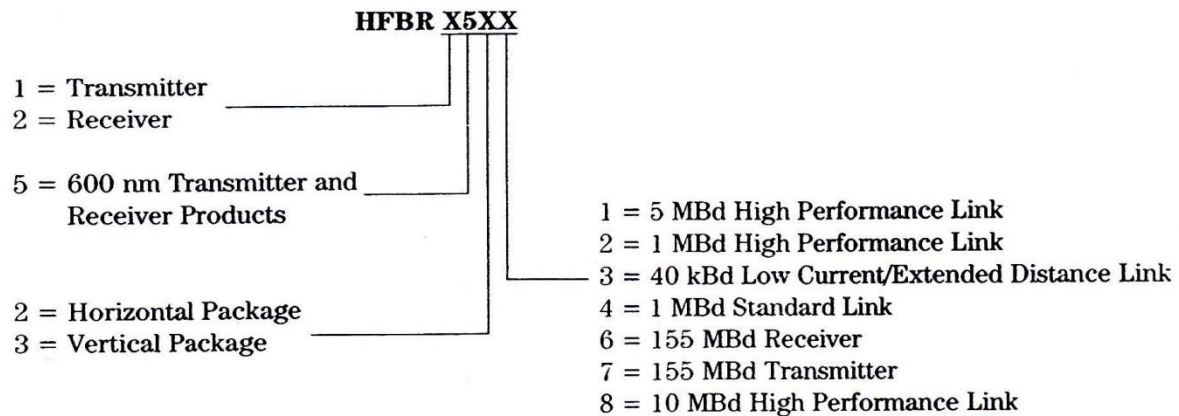


transmitter and receiver components have been designed for use in high volume/low cost assembly processes such as auto insertion and wave soldering.

Transmitters incorporate a 660 nm LED. Receivers include a monolithic dc coupled, digital IC receiver with open collector Schottky output transistor. An internal pullup resistor is available for use in the HFBR-25X1/2/4 receivers. A shield has been integrated into the receiver IC to provide additional, localized noise immunity.

Internal optics have been optimized for use with 1 mm diameter plastic optical fiber. Versatile Link specifications incorporate all connector interface losses. Therefore, optical calculations for common link applications are simplified.

## HFBR-0501 Series Part Number Guide



### Link Selection Guide

(Links specified from 0 to 70°C, for plastic optical fiber unless specified.)

Signal Rate	Distance (m) 25°C	Distance (m)	Transmitter	Receiver
40 kBd	120	110	HFBR-1523	HFBR-2523
1 MBd	20	10	HFBR-1524	HFBR-2524
1 MBd	55	45	HFBR-1522	HFBR-2522
5 Mbd	30	20	HFBR-1521	HFBR-2521

### Evaluation Kit

#### HFBR-0501 1 MBd Versatile Link:

This kit contains: HFBR-1524 Tx, HFBR-2524 Rx, polishing kit, 3 styles of plastic connectors, Bulkhead feedthrough, 5 meters of 1 mm diameter plastic cable, lapping film and grit paper, and HFBR-0501 data sheet.

### Application Literature

Application Note 1035 (Versatile Link)

### Package and Handling Information

The compact Versatile Link package is made of a flame retardant VALOX® UL V-0 material (UL file # E121562) material and uses the same pad layout as a standard, eight pin dual-in-line package. Vertical and horizontal mountable parts are available. These low profile Versatile Link packages are

stackable and are enclosed to provide a dust resistant seal. Snap action simplex, simplex latching, duplex, and duplex latching connectors are offered with simplex or duplex cables.

#### Package Orientation

Performance and pinouts for the vertical and horizontal packages are identical. To provide additional attachment support for the

vertical Versatile Link housing, the designer has the option of using a self-tapping screw through a printed circuit board into a mounting hole at the bottom of the package. For most applications this is not necessary.

#### Package Housing Color

Versatile Link components and simplex connectors are color coded to eliminate confusion

VALOX® is a registered trademark of the General Electric Corporation.



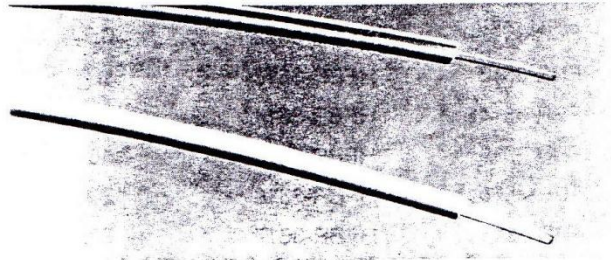
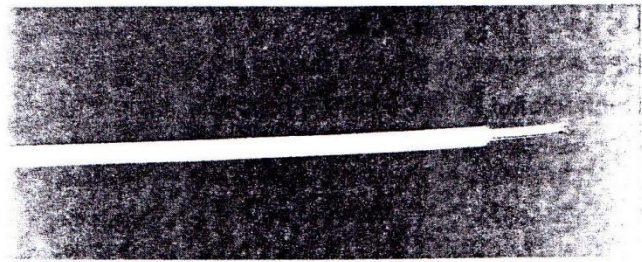
## Plastic Fiber Optic Cable

### HFBR-3510/HFBR-3610

The HFBR-3510 Simplex Fiber Optic Cable is constructed of a single step index plastic fiber sheathed in a PVC jacket. The HFBR-3610 Duplex Fiber Optic Cable has two plastic fibers, each in a cable of construction similar to the Simplex Cable, joined with a web. The individual channels are identified by a marking on one channel of the cable.

These cables are UL recognized components and pass UL VW-1 flame retardancy specification. The cable's safety in flammable environments, and non-conductive electrical properties may make the use of conduit unnecessary.

The HFBR-3510/3610 Fiber Optic Cables may be ordered with or without factory installed connectors. Connected cables are available in fixed lengths ranging from 0.1 m to 60 m. Connected cables may also be ordered to user specified lengths in one metre increments.



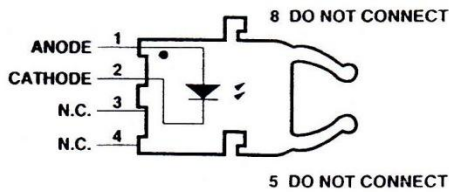
## Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units	Ref.
Storage Temperature	T <sub>S</sub>	-40	+75	°C	
Installation Temperature	T <sub>I</sub>	-20	+70	°C	
Short Term Tensile Force	(Single Channel) F <sub>T</sub>		50	N	Note 1
	(Dual Channel) F <sub>T</sub>		100	N	
Short Term Bend Radius	r	10		mm	Note 2
Long Term Bend Radius	r	35		mm	
Long Term Tensile Load	F <sub>T</sub>		1	N	
Flexing			1000	Cycles	Note 3
Impact	m		0.5	Kg	Note 4
	h		150	mm	

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

Parameter	Symbol	Min.	Typ. <sup>[5]</sup>	Max.	Units	Conditions	Ref.
Cable Attenuation	$\alpha_0$	0.3	0.45	0.63	dB/m	at 665 nm Source NA = 0.5	
Numerical Aperture	N.A.		0.5			$\ell > 2m$	
Diameter, Core	D <sub>C</sub>		1.0		mm		
Diameter, Jacket	D <sub>J</sub>		2.3		mm	Simplex Cable	
Travel Time Constant	I/V		5.0		nsec/m		
Mass per Unit Length/Cable	m/ $\ell$		4.6		g/m	Without Connectors	
Cable Leakage Current	I <sub>L</sub>		1		nA	50 kV, $\ell = 0.3m$	



**HFBR-15X2/15X4 Transmitters**

Pin #	Function
1	Anode
2	Cathode
3	Open
4	Open
5	Do not connect
8	Do not connect

Note: Pins 5 and 8 are for mounting and retaining purposes only. Do not electrically connect these pins.

**Absolute Maximum Ratings**

Parameter	Symbol	Min.	Max.	Units	Reference
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	
Forward Input Current	$I_{FPK}$		1000	mA	Note 2, 3
	$I_{Fdc}$		80		
Reverse Input Voltage	$V_{BR}$		5	V	

**Notes:**

- 1.6 mm below seating plane.
- Recommended operating range between 10 and 750 mA
- 1  $\mu$ s pulse, 20  $\mu$ s period.

**All HFBR-15XX LED transmitters are classified as IEC 825-1 Accessible Emission Limit (AEL) Class 1 based upon the current proposed draft scheduled to go into effect on January 1, 1997. AEL Class 1 LED devices are considered eye safe. Contact your Agilent sales representative for more information.**

**Transmitter Electrical/Optical Characteristics 0°C to 70°C unless otherwise specified.**

For forward voltage and output power vs. drive current graphs.

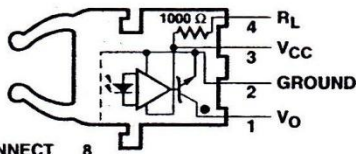
Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions	Ref.
Transmitter Output Optical Power	$P_T$	-13.6		-4.5	dBm	$I_{Fdc} = 60$ mA	
		-11.2		-5.1		$I_{Fdc} = 60$ mA, 25°C	
Optical Power	$P_T$	-17.8		-4.5	dBm	$I_{Fdc} = 60$ mA	
		-15.5		-5.1		$I_{Fdc} = 60$ mA, 25°C	
Output Optical Power Temperature Coefficient	$\Delta P_T / \Delta T$		-0.85		%/°C		
Peak Emission Wavelength	$\lambda_{PK}$		660		nm		
Forward Voltage	$V_F$	1.45	1.67	2.02	V	$I_{Fdc} = 60$ mA	
Forward Voltage Temperature Coefficient	$\Delta V_F / \Delta T$		-1.37		mV/°C		Fig. 11
Effective Diameter	$D_T$		1		mm		
Numerical Aperture	NA		0.5				
Reverse Input Breakdown Voltage	$V_{BR}$	5.0	11.0		V	$I_{Fdc} = 10$ $\mu$ A, $T_A = 25^\circ\text{C}$	
Diode Capacitance	$C_O$		86		pF	$V_F = 0$ , $f = 1$ MHz	
Rise Time	$t_r$		80		ns	10% to 90%, $I_F = 60$ mA	Note 1
Fall Time	$t_f$		40		ns		

**Note:**

- Rise and fall times are measured with a voltage pulse driving the transmitter and a series connected 50  $\Omega$  load. A wide bandwidth optical to electrical waveform analyzer, terminated to a 50  $\Omega$  input of a wide bandwidth oscilloscope, is used for this response time measurement.

**HFBR-25X2/25X4 Receivers**

DO NOT CONNECT 5



DO NOT CONNECT 8

Pin #	Function
1	V <sub>O</sub>
2	Ground
3	V <sub>CC</sub>
4	R <sub>L</sub>
5	Do not connect
8	Do not connect

**Note:** Pins 5 and 8 are for mounting and retaining purposes only. Do not electrically connect these pins.

**Absolute Maximum Ratings**

Parameter	Symbol	Min.	Max.	Units	Reference
Storage Temperature	T <sub>S</sub>	-40	+75	°C	
Operating Temperature	T <sub>A</sub>	0	+70	°C	
Lead Soldering Cycle	Temp.		260	°C	Note 1
	Time		10	sec	
Supply Voltage	V <sub>CC</sub>	-0.5	7	V	Note 2
Output Collector Current	I <sub>OAV</sub>		25	mA	
Output Collector Power Dissipation	P <sub>OD</sub>		40	mW	
Output Voltage	V <sub>O</sub>	-0.5	18	V	
Pull-up Voltage	V <sub>P</sub>	-5	V <sub>CC</sub>	V	
Fan Out (TTL)	N		5		

**Notes:**

1. 1.6 mm below seating plane.
2. It is essential that a bypass capacitor 0.01 μF be connected from pin 2 to pin 3 of the receiver. Total lead length between both ends of the capacitor and the pins should not exceed 20 mm.

**Receiver Electrical/Optical Characteristics** 0°C to 70°C, 4.75 V ≤ V<sub>CC</sub> ≤ 5.25 V unless otherwise specified.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions	Ref.
Receiver Optical Input Power Level Logic 0	P <sub>R(L)</sub>	-24			dBm	V <sub>OL</sub> = 0 V I <sub>OL</sub> = 8 mA	Notes 1, 2, 3  Note 4
		-20					
Optical Input Power Level Logic 1	P <sub>R(H)</sub>			-43	dBm	V <sub>OH</sub> = 5.25 V I <sub>OH</sub> = ≤ 250 μA	
High Level Output Current	I <sub>OH</sub>		5	250	μA	V <sub>O</sub> = 18 V, P <sub>R</sub> = 0	Note 5
Low Level Output Voltage	V <sub>OL</sub>		0.4	0.5	V	I <sub>OL</sub> = 8 mA P <sub>R</sub> = P <sub>R(L)MIN</sub>	Note 5
High Level Supply Current	I <sub>CCH</sub>		3.5	6.3	mA	V <sub>CC</sub> = 5.25 V, P <sub>R</sub> = 0	Note 5
Low Level Supply Current	I <sub>CCL</sub>		6.2	10	mA	V <sub>CC</sub> = 5.25 V, P <sub>R</sub> = -12.5 dBm	Note 5
Effective Diameter	D		1		mm		
Numerical Aperture	NA		0.5				
Internal Pull-up Resistor	R <sub>L</sub>	680	1000	1700	Ω		

**Notes:**

1. Measured at the end of the fiber optic cable with large area detector.
2. Pulsed LED operation at I<sub>F</sub> > 80 mA will cause increased link t<sub>PLH</sub> propagation delay time. This extended t<sub>PLH</sub> time contributes to increased pulse width distortion of the receiver output signal.
3. The LED drive circuit of Figure 11 is required for 1 MBd operation of the HFBR-25X2/25X4.
4. Optical flux, P (dBm) = 10 Log [P(μW)/1000 μW].
5. R<sub>L</sub> is open.



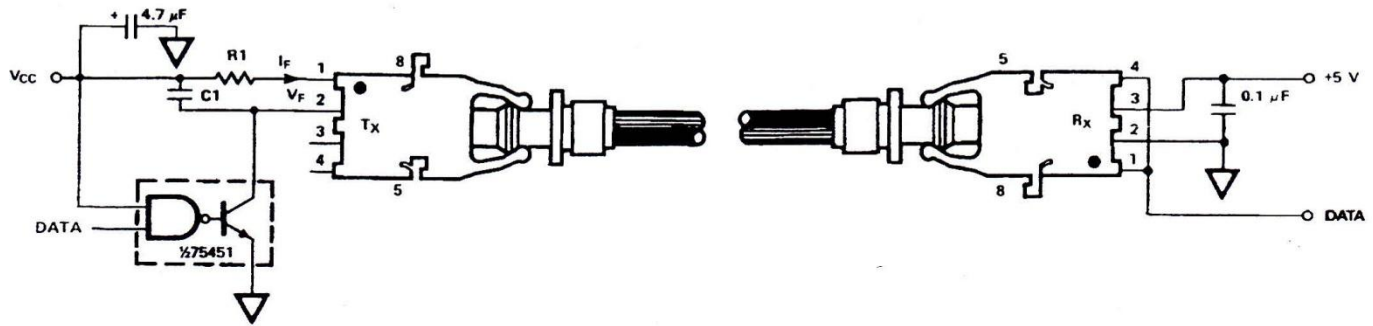


Figure 11. Required 1 MBd Interface Circuit.

The HFBR-25X2 receiver can not be overdriven when using the required interface circuit shown in Figure 11.

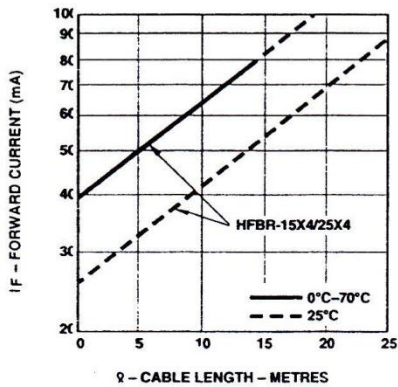


Figure 12. Guaranteed System Performance for the HFBR-15X4/25X4 Link with Standard Cable.

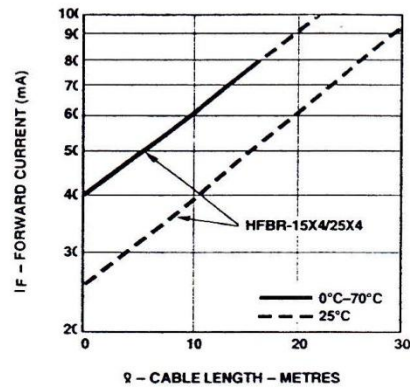


Figure 13. Guaranteed System Performance for the HFBR-15X4/25X4 Link with Improved Cable.

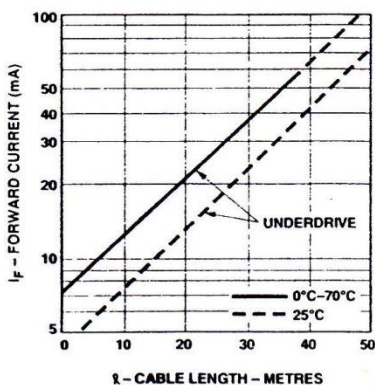


Figure 14. Guaranteed System Performance for the HFBR-15X2/25X2 Link with Standard Cable.

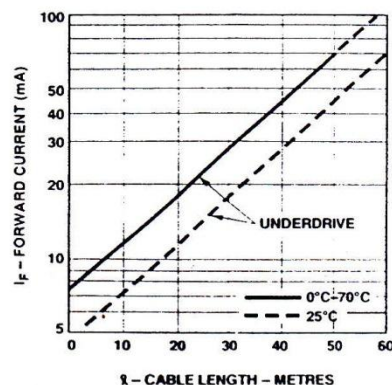


Figure 15. Guaranteed System Performance for the HFBR-15X2/25X2 Link with Improved Cable.