MODULE 6 « OPTIQUE »

TP DE LA MISE EN ŒUVRE D'UNE TRANSMISSION PAR FIBRE OPTIQUE

(Version expert)

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).

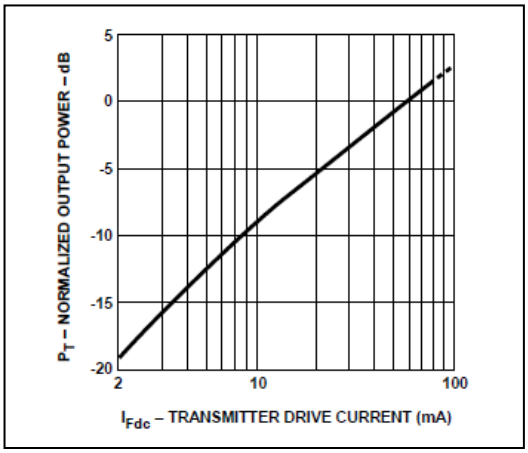
1. Prendre connaissance du Kit d'évaluation de la fibre optique *d'Agilent Technologies* et déterminer :
   - Son domaine d'application (valeurs maxi et mini du débit du signal et de la longueur de transmission).
   - Les principales caractéristiques de la fibre optique HFBR-3510 (son atténuation linéique, son ouverture numérique, ses dimensions…), 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…), du récepteur HFBR -2524 (nature du composant, tension limite d'alimentation, son ouverture numérique…).
2. Mettre en œuvre (la valeur de la résistance devra être justifiée) et valider le fonctionnement de la transmission optique (un schéma de câblage et des mesures à exploiter, sont attendus dans votre compte rendu).
3. Réaliser une transmission de données grâce à la carte codage fournie.

Bonus expert :

1. Proposer une mesure permettant de déterminer l'atténuation linéique de la fibre.
2. Effectuer sa mesure et conclure.

Piste de travail : A partir de la caractéristique (ci-dessous), on pourra déterminer la puissance minimum à fournir en entrée de la fibre afin d'être détecter en sortie de celle-ci par le récepteur ; Cette mesure pourra être effectuée pour 5m et 15m de fibre (l'atténuation typique due à un connecteur est de 1.5dB).

Caractéristique correspondant à la puissance lumineuse fournie par l'émetteur en fonction de courant de polarisation



Extrait de la documentation technique du kit d'évaluation fibre optique HFBR-0501

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**

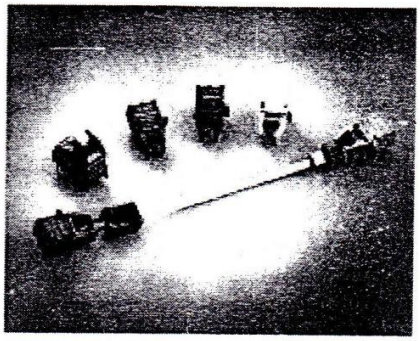
Applications

- **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

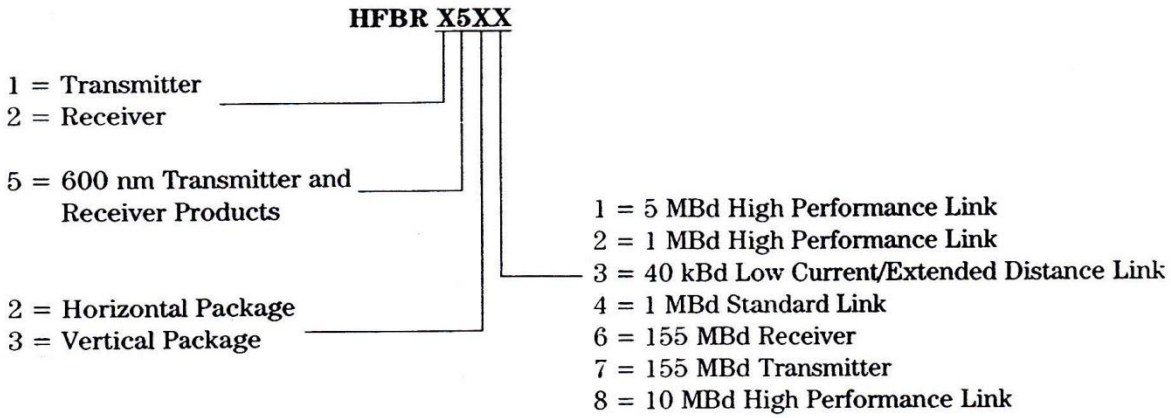


transmitter and receiver components have been designed for use in high volume/low cost assembly processes such as auto insertion and wave soldering.

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 Versatilie 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

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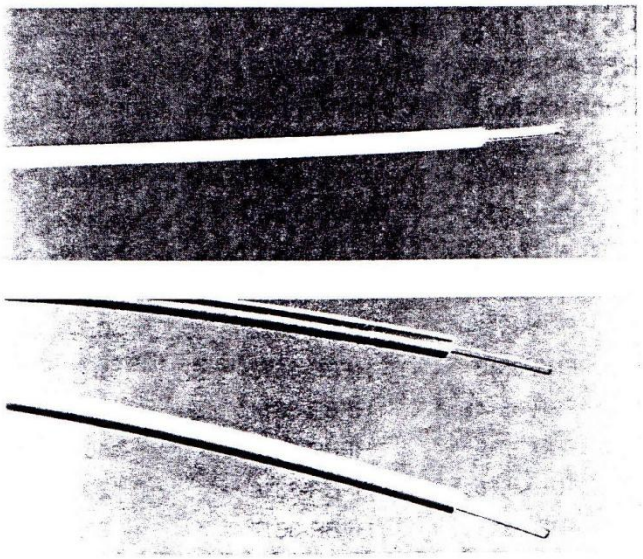
Plastic Fiber Optic Cable

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. Connectored cables are available in fixed lengths ranging from 0.1 m to 60 m. Connectored cables may also be ordered to user specified lengths in one metre increments.



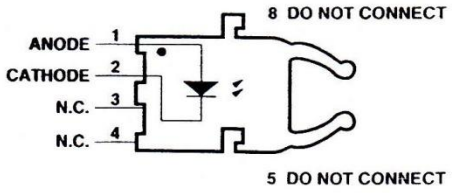
Absolute Maximum Ratings

Parameter		Symbol	Min.	Max.	Units	Ref.
Storage Temperature		T_S	−40	+75	°C	
Installation Temperature		T_I	−20	+70	°C	
Short Term Tensile Force	(Single Channel)	F_T		50	N	Note 1
	(Dual Channel)	F_T		100	N	
Short Term Bend Radius		r	10		mm	Note 2
Long Term Bend Radius		r	35		mm	
Long Term Tensile Load		F_T		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.[5]	Max.	Units	Conditions	Ref.
Cable Attenuation	α_o	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_C		1.0		mm		
Diameter, Jacket	D_J		2.3		mm	Simplex Cable	
Travel Time Constant	I/V		5.0		nsec/m		
Mass per Unit Length/Cable	m/ℓ		4.6		g/m	Without Connectors	
Cable Leakage Current	I_L		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. 1.6 mm below seating plane.
2. Recommended operating range between 10 and 750 mA
3. 1 µs pulse, 20 µs 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.

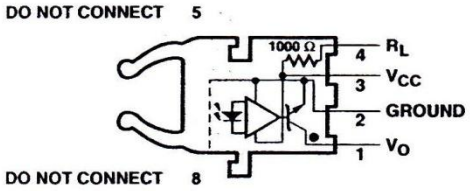
Transmitter Electrical/Optical Characteristics 0°C to 70°C unless otherwise specified.

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

Parameter		Symbol	Min.	Typ.	Max.	Units	Conditions	Ref.
Transmitter Output Optical Power	HFBR-15X2	P_T	-13.6 -11.2		-4.5 -5.1	dBm	I_{Fdc} = 60 mA I_{Fdc} = 60 mA, 25°C	
	HFBR-15X4	P_T	-17.8 -15.5		-4.5 -5.1	dBm	I_{Fdc} = 60 mA I_{Fdc} = 60 mA, 25°C	
Output Optical Power Temperature Coefficient		$\Delta P_T/\Delta T$		-0.85		%/°C		
Peak Emission Wavelength		λ_{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 µA, T_A = 25°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:
1. Rise and fall times are measured with a voltage pulse driving the transmitter and a series connected 50 Ω load. A wide bandwidth optical to electrical waveform analyzer, terminated to a 50 Ω input of a wide bandwidth oscilloscope, is used for this response time measurement.

HFBR-25X2/25X4 Receivers



Pin #	Function
1	V_O
2	Ground
3	V_{CC}
4	R_L
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	
Supply Voltage		V_{CC}	-0.5	7	V	Note 2
Output Collector Current		I_{OAV}		25	mA	
Output Collector Power Dissipation		P_{OD}		40	mW	
Output Voltage		V_O	-0.5	18	V	
Pull-up Voltage		V_P	-5	V_{CC}	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_{CC} ≤ 5.25 V unless otherwise specified.

Parameter		Symbol	Min.	Typ.	Max.	Units	Conditions	Ref.
Receiver Optical Input Power Level Logic 0	HFBR-2522	$P_{R(L)}$	-24			dBm	V_{OL} = 0 V I_{OL} = 8 mA	Notes 1, 2, 3
	HFBR-2524		-20					Note 4
Optical Input Power Level Logic 1		$P_{R(H)}$			-43	dBm	V_{OH} = 5.25 V I_{OH} = ≤ 250 µA	
High Level Output Current		I_{OH}		5	250	µA	V_O = 18 V, P_R = 0	Note 5
Low Level Output Voltage		V_{OL}		0.4	0.5	V	I_{OL} = 8 mA P_R = $P_{R(L)MIN}$	Note 5
High Level Supply Current		I_{CCH}		3.5	6.3	mA	V_{CC} = 5.25 V, P_R = 0	Note 5
Low Level Supply Current		I_{CCL}		6.2	10	mA	V_{CC} = 5.25 V, P_R = -12.5 dBm	Note 5
Effective Diameter		D		1		mm		
Numerical Aperture		NA		0.5				
Internal Pull-up Resistor		R_L	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_F > 80 mA will cause increased link t_{PLH} propagation delay time. This extended t_{PLH} 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_L is open.

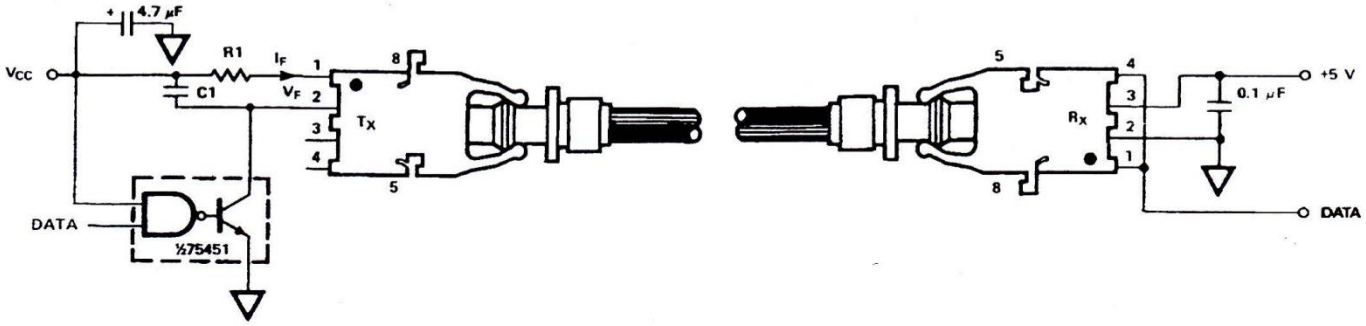


Figure 11. Required 1 MBd Interface Circuit.

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

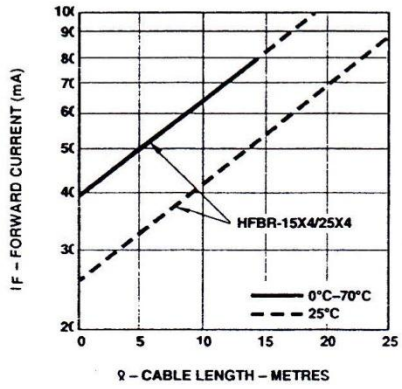


Figure 12. Guaranteed System Performance for the HFBR-15X4/25X4 Link with Standard Cable.

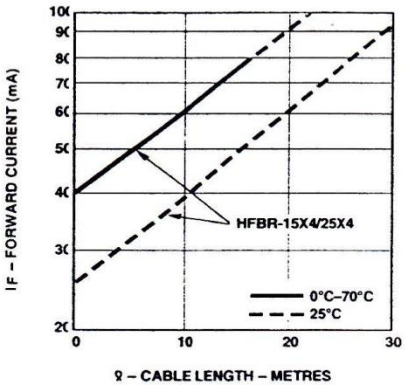


Figure 13. Guaranteed System Performance for the HFBR-15X4/25X4 Link with Improved Cable.

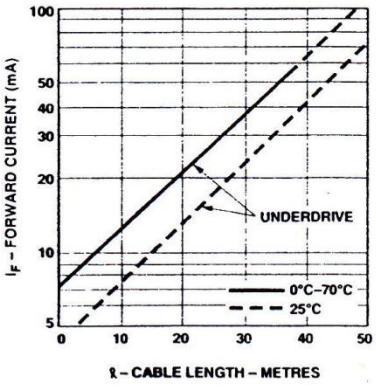


Figure 14. Guaranteed System Performance for the HFBR-15X2/25X2 Link with Standard Cable.

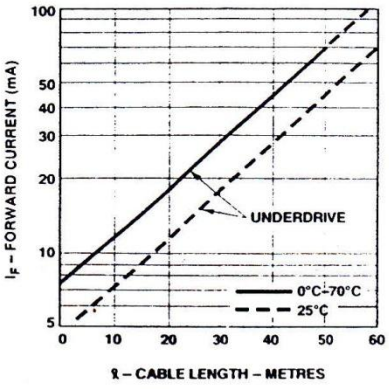


Figure 15. Guaranteed System Performance for the HFBR-15X2/25X2 Link with Improved Cable.