
SERCOS Fiber Optic Transmitters and Receiver

Technical Data

HFBR-0600 Series

Features

- **Fully Compliant to SERCOS Optical Specifications**
- **Optimized for 1 mm Plastic Optical Fiber**
- **Compatible with SMA Connectors**
- **Auto-Insertable and Wave Solderable**
- **Data Transmission at Symbol Rates from DC to over 2 MBd for Distances from 0 to over 20 Metres**

Applications

- **Industrial Control Data Links**
- **Reduction of Lightning and Voltage Transient Susceptibility**
- **Tempest-Secure Data Processing Equipment**
- **Isolation in Test and Measurement Instruments**
- **Robotics Communication**

SERCOS

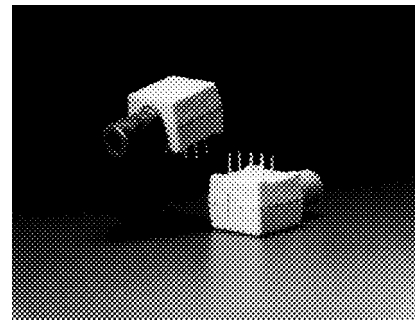
SERCOS is a SErial Realtime Communication System, a standard digital interface for communication between controls and drives for numerically

controlled machines. The SERCOS interface specification was written by a joint working group of the VDW (German Machine Tool Builders Association) and ZVEI (German Electrical and Electronic Manufacturer's Association) to allow data exchange between NC controls and drives via fiber optic rings, with isolation and noise immunity. The HFBR-0600 family of fiber optic transmitters and receivers comply to the SERCOS specifications for transmitter and receiver optical characteristics and connector style (SMA).

Description

The HFBR-0600 components are capable of operation at symbol rates from DC to over 2 MBd and distances from 0 to over 20 metres. The HFBR-1602 and HFBR-1604 transmitters contain a 655-nm AlGaAs emitter capable of efficiently launching optical power into 1000 μ m plastic optical fiber. The optical output is specified at the end of 0.5 m of plastic optical fiber.

The HFBR-1604 is a selected version of the HFBR-1602, with power specified to meet the

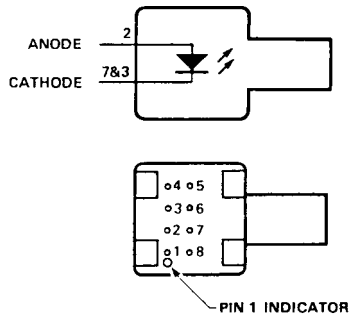


SERCOS high attenuation specifications.

The HFBR-2602 receiver incorporates an integrated photo IC containing a photodetector and dc amplifier driving an open-collector Schottky output transistor. The HFBR-2602 is designed for direct interfacing to popular logic families. The absence of an internal pull-up resistor allows the open-collector output to be used with logic families such as CMOS requiring voltage excursions higher than V_{CC} . The HFBR-2602 has a dynamic range of 15 dB.

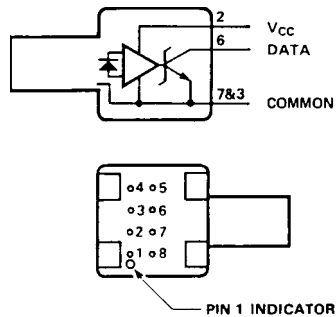
CAUTION: The small junction sizes inherent to the design of this component increase the component's susceptibility to damage from electrostatic discharge (ESD). It is advised that normal static precautions be taken in handling and assembly of this component to prevent damage and/or degradation which may be induced by ESD.

HFBR-160X Transmitters



Pin	Function
1*	N.C.
2	ANODE
3	CATHODE
4*	N.C.
5*	N.C.
6	N.C.
7**	CATHODE
8*	N.C.

HFBR-2602 Receiver



Pin	Function
1*	N.C.
2	V _{CC} (5 V)
3	COMMON
4*	N.C.
5*	N.C.
6	DATA
7	COMMON
8*	N.C.

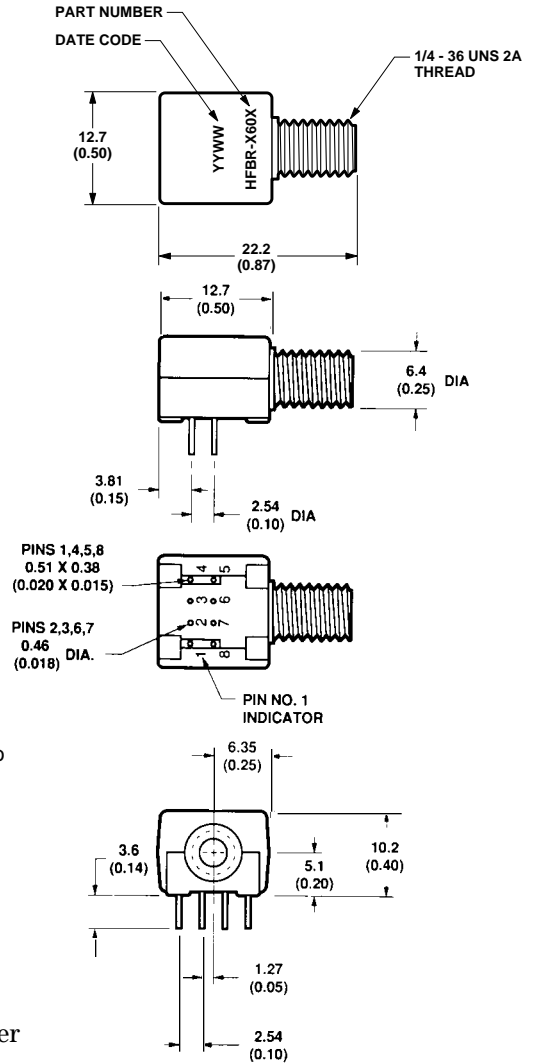
*Pins 1, 4, 5, and 8 are isolated from the internal circuitry, but electrically connected to one another.

**Transmitter Pin 7 may be left unconnected if necessary.

In the receiver, both the open-collector "Data" output Pin 6 and V_{CC} Pin 2 are referenced to "Common" Pin 3 and 7. It is essential that a bypass capacitor (0.1 μ F ceramic) be connected from Pin 2 (V_{CC}) to Pin 3 (circuit common) of the receiver.

SMA is an industry standard fiber optic connector, available from many fiber optic connector suppliers. HFBR-4401 is a kit consisting of 100 nuts and 100 washers for panel mounting the HFBR-0600 components.

HFBR-0600 SMA Series Mechanical Dimensions



HFBR-1602/1604 Transmitters

Absolute Maximum Ratings

Parameter		Symbol	Min.	Max.	Unit	Reference
Storage Temperature		T_S	-55	85	°C	
Operating Temperature		T_A	-40	85	°C	
Lead Soldering Cycle	Temp.			260	°C	Note 1
	Time			10	s	Note 1
Forward Input Current Peak		I_{FPK}		120	mA	
Forward Input Current Average		I_{Favg}		60	mA	
Reverse Input Voltage		V_{BR}		-5	V	

Electrical/Optical Characteristics 0 to 55°C, unless otherwise stated.

Parameter	Symbol	Min.	Typ. ^[2]	Max.	Unit	Condition	Reference
Forward Voltage	V_F	1.5	1.9	2.2	V	$I_F = 35 \text{ mA}$	
Forward Voltage Temp. Coefficient	$\Delta V_F / \Delta T$		-1.2		mV/°C	$I_F = 35 \text{ mA}$	
Reverse Input Voltage	V_{BR}	-5.0	-18		V	$I_R = 100 \mu\text{A}$	
Peak Emission Wavelength	λ_P	640	655	675	nm		
Full Width Half Maximum	FWHM		20	30	nm	25°C	
Diode Capacitance	C_T		30		pF	$V_F = 0$ $f = 1 \text{ MHz}$	
Optical Power Temp. Coefficient	$\Delta P_T / \Delta T$		-0.01		dBm/°C	$I_F = 35 \text{ mA}$	
Thermal Resistance	θ_{JA}		330		°C/W		Notes 3, 4
Peak Optical Output Power of HFBR-1602	P_{T1602}	-10.5		-5.5	dBm	$I_F = 35 \text{ mA}$	Notes 5, 6, 11
Peak Optical Output Power of HFBR-1604	P_{T1604}	-7.5 -10.5		-3.5 -5.5	dBm dBm	$I_F = 60 \text{ mA}$ $I_F = 35 \text{ mA}$	Notes 5, 6, 11
Rise Time (10% to 90%)	t_r		57 50		ns ns	$I_F = 60 \text{ mA}$ $I_F = 35 \text{ mA}$	
Fall Time (90% to 10%)	t_f		40 27		ns ns	$I_F = 60 \text{ mA}$ $I_F = 35 \text{ mA}$	

HFBR-2602 Receiver

Absolute Maximum Ratings

Parameter		Symbol	Min.	Max.	Unit	Reference
Storage Temperature		T_S	-55	85	°C	
Operating Temperature		T_A	-40	85	°C	
Lead Soldering Cycle	Temp.			260	°C	Note 1
	Time			10	s	Note 1
Supply Voltage		V_{CC}	-0.5	7.0	V	
Output Current		I_O		25	mA	
Output Voltage		V_O	-0.5	18.0	V	
Output Collector Power Dissipation		$P_{O\text{ AVG}}$		40	mW	
Fan Out (TTL)		N		5		Note 8

Electrical/Optical Characteristics 0 to 55°C;

Fiber core diameter ≤ 1.0 mm, fiber N.A. ≤ 0.5 , $4.75\text{ V} \leq V_{CC} \leq 5.25\text{ V}$

Parameter	Symbol	Min.	Typ. ^[2]	Max.	Unit	Condition	Reference
High Level Output Current	I_{OH}		5	250	μA	$V_{OH} = 18\text{ V}$ $P_R < -31.2\text{ dBm}$	
Low Level Output Voltage	V_{OL}		0.4	0.5	V	$I_{OL} = 8\text{ mA}$ $P_R > -20.0\text{ dBm}$	
High Level Supply Current	I_{CCH}		3.5	6.3	mA	$V_{CC} = 5.25\text{ V}$ $P_R < -31.2\text{ dBm}$	
Low Level Supply Current	I_{CCL}		6.2	10	mA	$V_{CC} = 5.25\text{ V}$ $P_R > -20.0\text{ dBm}$	

Dynamic Characteristics 0 to 55°C unless otherwise specified; $4.75\text{ V} \leq V_{CC} \leq 5.25\text{ V}$; BER $\leq 10^{-9}$

Parameter	Symbol	Min.	Typ. ^[2]	Max.	Unit	Condition	Reference
Peak Input Power Level Logic HIGH	P_{RH}			-31.2	dBm	$\lambda_P = 655\text{ nm}$	Note 7
Peak Input Power Level Logic LOW	P_{RL}	-20.0		-5.0	dBm	$I_{OL} = 8\text{ mA}$	Note 7
Propagation Delay LOW to HIGH	t_{PLH}		60		ns	$P_R = -20\text{ dBm}$ 2 MBd	Note 8, 9
Propagation Delay HIGH to LOW	t_{PHL}		110		ns	$P_R = -20\text{ dBm}$ 2 MBd	Note 8, 9
Pulse Width Distortion, $t_{PLH} - t_{PHL}$	PWD		50 -50		ns ns	$P_R = -5\text{ dBm}$ $P_R = -20\text{ dBm}$	Note 10 Figure 6

Notes:

1. 2.0 mm from where leads enter case.
2. Typical data at $T_A = +25^\circ\text{C}$.
3. Thermal resistance is measured with the transmitter coupled to a connector assembly and fiber, and mounted on a printed circuit board.
4. Pins 2, 6, and 7 are welded to the cathode header connection to minimize the thermal resistance from junction to ambient. To further reduce the thermal resistance, the cathode trace should be made as large as is consistent with good RF circuit design.
5. P_T is measured with a large area detector at the end of 0.5 metre of plastic optical fiber with 1 mm diameter and numerical aperture of 0.5.
6. When changing μW to dBm , the optical power is referenced to 1 mW (1000 μW). Optical Power $P(\text{dBm}) = 10 \log [P (\mu\text{W})/1000 \mu\text{W}]$.
7. Measured at the end of 1mm plastic fiber optic cable with a large area detector.
8. 8 mA load ($5 \times 1.6 \text{ mA}$), $R_L = 560 \Omega$.
9. Propagation delay through the system is the result of several sequentially occurring phenomena. Consequently it is a combination of data-rate-limiting effects and of transmission-time effects. Because of this, the data-rate limit of the system must be described

in terms of time differentials between delays imposed on falling and rising edges. As the cable length is increased, the propagation delays increase. Data-rate, as limited by pulse width distortion, is not affected by increasing cable length if the optical power level at the receiver is maintained.

10. Pulse width distortion is the difference between the delay of the rising and falling edges.
11. Both HFBR-1602 and HFBR-1604 meet the SERCOS "low attenuation" specifications when operated at 35 mA; only HFBR-1604 meets the SERCOS "high attenuation" limits when operated at 60 mA.

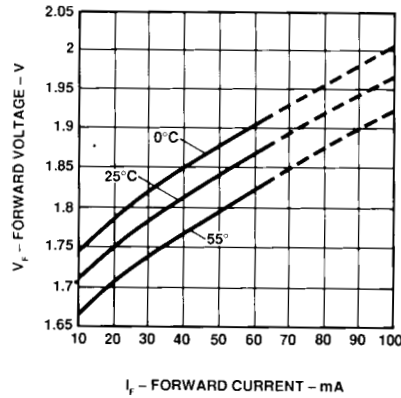


Figure 1. Forward Voltage and Current Characteristics.

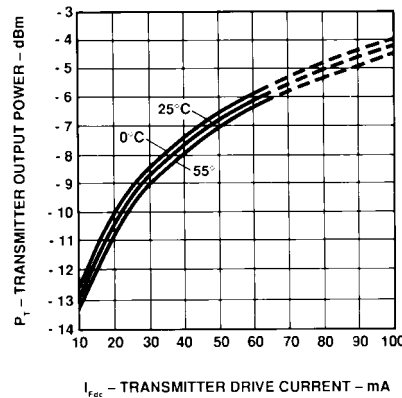


Figure 2. Typical Transmitter Output vs. Forward Current.

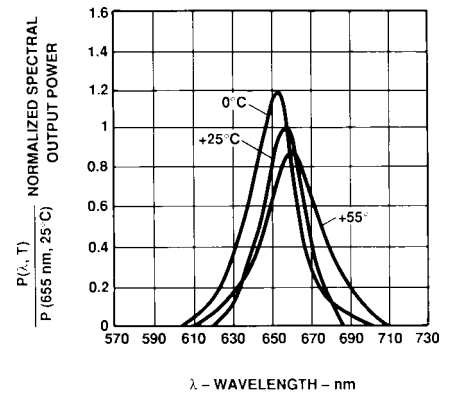


Figure 3. Transmitter Spectrum Normalized to the Peak at 25°C.

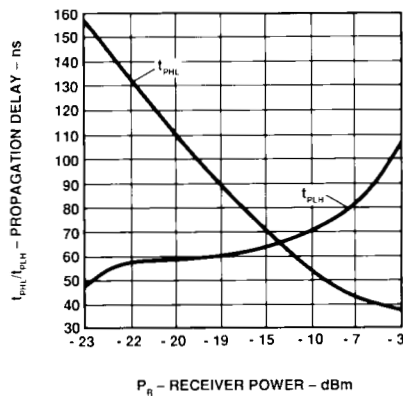


Figure 4. Typical Propagation Delay through System with 0.5 Metre of Cable.

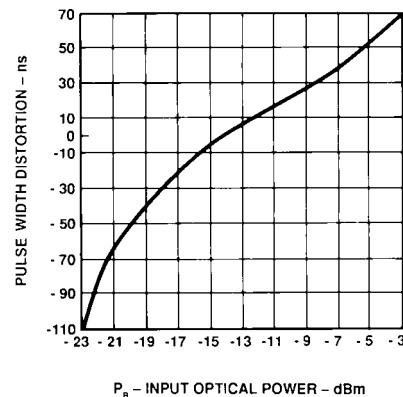


Figure 5. Typical HFBR-160X/2602 Link Pulsethickness Distortion vs. Optical Power.

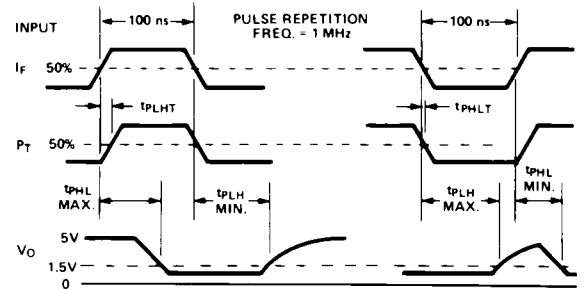


Figure 6. System Propagation Delay Test Circuit and Waveform Timing Definitions.

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