

# AFBR-1012/AFBR-2012

## Fiber Optic Transmitter and Receiver for 50 MBaud MOST®



## Data Sheet



### Description

AFBR-1012 Transmitter and AFBR-2012 Receiver are designed to transmit/ receive up to 25MBit/s optical data which are biphase coded (up to 50Mbaud). Both are packaged in 4-pin transfer molded, low-cost packages ready for assembly into MOST® plastic fiber optic connector receptacles.

The transmitter utilizes a 650 nm LED source with integrated optics for efficient coupling into 1mm Polymer Optical Fiber (POF), and the receiver contains a high speed PIN diode to receive this light.

Input/output data has TTL switching levels, compatible with MOST® Network Interface Controller ICs.

These optical components are specified for operation over a -40°C to +95°C temperature range, and meet the reliability requirements of automotive applications. In the absence of data activity, the receiver switches to very low power mode. While in this mode, the PIN diode can sense new data activity and switch the receiver back to full operation.

### Applications

- Optical Transmitter and Receiver for MOST® 50 Mbaud systems (a full description of the MOST® 50 Mbaud system is available at [www.mostcooperation.com](http://www.mostcooperation.com))

### Features

- Operating @ 3.3V or 5V (+/-5% each) Power supply
- Operating temperature range -40°C to +95°C
- TTL Data Input/ Output (Logic to Light Function)
- Power down mode
- During the low power mode a receiver STATUS-pin indicates if modulated light is received (Light on -> STATUS = low). The power supply of the whole MOST device can be switched on with this Status-pin.
- Duty Cycle Adjust (DCA), yields to enhanced SP1 input range
- 650nm for working in a low attenuation range of PMMA Fiber
- -25dBm guaranteed sensitivity @ 650nm
- Fully compliant to "MOST® Specification of Physical Layer Rev 1.1"
- RoHS compliant (Lead free and halogen free)
- Lead is flash gold
- Low power consumption
- Photo current sensing, network activity detection and Low Power Mode ( $I_{CC} < 10\mu A$ )
- Additional Low Power Mode ( $I_{CC} < 15\mu A$ ) for the transmitter when SP1 input is low
- Signal detect and Status Output
- Pulse width control

### Absolute maximum ratings

Parameter	Symbol	Min.	Max.	Units
Supply Voltage <sup>[1]</sup>	V <sub>CCMax</sub>	-0.5	6.0	V
Storage Temperature	T <sub>STG</sub>	-40	110	°C
Soldering Temperature (distance to package >3mm; t≤10s) <sup>[2]</sup>	T <sub>S</sub>		260	°C
Voltage at any PIN		-0.5	VCC+0.5	V
Electrostatic Voltage Capability <sup>[3]</sup>	ESD		2.0	kV

Notes:

1. Maximum supply voltage without causing damage
2. For more information regarding the solder process see Application Note 5420 (Handling, Storage, Operating and Processing)
3. ESD Capability for all Pins HBM (human body model) according JESD22-A114B

### Recommended operating conditions

Parameter	Symbol	Min.	Max.	Units
Supply Voltage low	V <sub>CC_L</sub>	3.135	3.465	V
Supply Voltage high	V <sub>CC_Hl</sub>	4.75	5.25	V
Operating temperature (ambient) <sup>[1]</sup>	T <sub>A</sub>	-40	95	°C

Notes:

1. For more information see Application Note 5420 (Handling, Storage, Operating and Processing)

**All the data in this specification refers to the operating conditions above and over lifetime unless otherwise stated.**

### Part Number Options

Part Number	Part Description	Solder Heat Resistance
AFBR-1012S/AFBR-2012S	Transmitter/Receiver – Short Leads	Lead dip in liquid solder of 260°C for 10 Sec. acc. JEDEC standard JESD22-B106-C
AFBR-1012L/AFBR-2012L	Transmitter/Receiver – Long Leads	(for more information see Application Note 5420)

## AFBR-1012 (Transmitter)

### DC Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Low Level Input voltage	$V_{IL}$	-0.3		0.8	V
High Level Input Voltage	$V_{IH}$	2.0		$V_{CC}+0.3$	V
Input Leakage Current ( $V_{CC} = 5.0V$ ; $V_I = 0V$ or $V_I = 5.0V$ )	$I_L$			+/-20	$\mu A$
Input Capacitance	$C_I$			7	pF
Input Resistance	$R_I$	2			$k\Omega$
Supply Current Full Power Mode [1]	$I_{CC}$			25	mA
Supply Current Low Power Mode [2]	$I_{LP2}$			15	$\mu A$

Notes:

- The current through the LED and therefore the optical output power and overall power consumption depends on the settings of  $R_{EXT}$ . The nominal value for  $R_{EXT}$  is 15k $\Omega$ . With  $R_{EXT} = 30k\Omega$  the optical output power is about -3dB of the nominal value.  
**Important: The external resistor of  $R_{EXT}$  must be within the range of 13.5k $\Omega$  to 33k $\Omega$ . For values out of this range functionality may not be given over the whole temperature range and the device lifetime.**
- If the transmitter is in full power mode it is switched OFF 1ms (max) after Tx DATA is low. If the transmitter is in low power mode it is switched ON 6ms (max) after Tx Data transmission starts.

### AC Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Power Up Time	$T_{PU}$		0.016	6	ms
Data Power Down Time	$T_{PD}$		0.01	1.0	ms

### Optical Signal Characteristics 45.158Mbaud (44.1kHz)

(22.5 MBit/s MOST Data,  $V_{CC} = 3.135 \dots 3.465V$  or  $4.75 \dots 5.25V$ ,  $R_{EXT} = 15k\Omega$ )

Parameter	Symbol	Min.	Typ.	Max.	Units
Peak wavelength	$\lambda_{Peak}$	630	650	685	nm
Temperature coefficient $\lambda_{PEAK}$	$TC_{\lambda}$		0.16		nm/K
Spectral Bandwidth (FWHM)	$\Delta\lambda$		20	30	nm
Average Output Power coupled into plastic fiber [1]	$P_{opt}$	-8.0	-5.2	-2.0	dBm
Average Output Power coupled into plastic fiber (if $R_{EXT} = 13.5k$ is used instead of $R_{EXT} = 15k$ ) [1]	$P_{opt}$	-7.5	-4.7	-1.5	dBm
Optical Output Power "Light off" [2]	$P_{OFF}$			-50	dBm
Optical Rise Time (20% - 80%) [4]	$t_r$		2.5	5.98	ns
Optical Fall Time (80% - 20%) [4]	$t_f$		3.5	5.98	ns
Extinction Ratio [4,6]	$r_e$	10	15		dB
Pulse Width Variation [3,4,5]	$t_{PWV}$	20.0		24.29	ns
Average Pulse Width Distortion [3,4]	$t_{APWD}$	-1.4		1.4	ns
Data Dependent Link Jitter [3,4]	$t_{DDJ}$		0.2	0.77	ns
Uncorrelated Link Jitter [3,4]	$t_{UJ}$		0.05	0.33	ns
Positive Overshoot within 0UI ... 2/3UI [4,6]		-20		40	%
Negative Overshoot within -1UI ... -1/4UI [4,6]		-10		20	%
High Level Signal Ripple between 2/3UI and 3/4UI		-10		10	%

Notes:

- Average value when transmitting modulated light @signal timing parameters. The output power coupled into plastic fiber  $P_{opt}$  is measured with a large area detector at the end of 30cm POF fiber with a NA = 0.5 which is ideally coupled to the transmitter
- Average value when signal on Tx\_Data is low
- The electrical input signal has to fulfill the following requirements:  $t_{pwv(min)} = 20.1ns$ ,  $t_{pwv(max)} = 24.1ns$ ,  $t_{tAPWD(min)} = -1.5ns$  and  $t_{tAPWD(max)} = 1.5ns$ ,  $t_{DDJ(max)} = 0.22ns$ ,  $t_{UJ(max)} = 0.10ns$
- Characterized with Avago Characterization Boards
- Limits for 2UI are 42.2 ... 46.4ns and for 3UI they are 64.3 ... 68.5ns.
- Top and Base level measured at least over 10UIs.

## Optical Signal Characteristics 49.152Mbaud (48kHz)

(24.576 MBit/s MOST Data,  $V_{CC} = 3.135 \dots 3.465V$  or  $4.75 \dots 5.25V$ ,  $R_{EXT} = 15k\Omega$ )

Parameter	Symbol	Min.	Typ.	Max.	Units
Peak wavelength	$\lambda_{Peak}$	630	650	685	nm
Temperature coefficient $\lambda_{PEAK}$	$TC_{\lambda}$		0.16		nm/K
Spectral Bandwidth (FWHM)	$\Delta\lambda$		20	30	nm
Average Output Power coupled into plastic fiber [1]	$P_{opt}$	-8.0	-5.2	-2.0	dBm
Average Output Power coupled into plastic fiber (if $R_{EXT} = 13.5k$ is used instead of $R_{EXT} = 15k$ ) [1]	$P_{opt}$	-7.5	-4.7	-1.5	dBm
Optical Output Power "Light off" [2]	$P_{OFF}$			-50	dBm
Optical Rise Time (20% - 80%) [4]	$t_r$		2.5	5.49	ns
Optical Fall Time (80% - 20%) [4]	$t_f$		3.5	5.49	ns
Extinction Ratio [4,6]	$r_e$	10	15		dB
Pulse Width Variation [3,4,5]	$t_{PWV}$	18.4		22.3	ns
Average Pulse Width Distortion [3,4]	$t_{APWD}$	-1.28		1.28	ns
Data Dependent Link Jitter [3,4]	$t_{DDJ}$		0.2	0.71	ns
Uncorrelated Link Jitter [3,4]	$t_{UJ}$		0.05	0.31	ns
Positive Overshoot within 0UI ... 2/3UI [4,6]		-20		40	%
Negative Overshoot within -1UI ... -1/4UI [4,6]		-10		20	%
High Level Signal Ripple between 2/3UI and 3/4UI		-10		10	%

### Notes:

1. Average value when transmitting modulated light @signal timing parameters. The output power coupled into plastic fiber  $P_{opt}$  is measured with a large area detector at the end of 30cm POF fiber with a  $NA = 0.5$  which is ideally coupled to the transmitter
2. Average value when signal on Tx\_Data is low
3. The electrical input signal has to fulfill the following requirements:  $t_{pwv(min)} = 20.1ns$ ,  $t_{pwv(max)} = 24.1ns$ ,  $t_{tAPWD(min)} = -1.5ns$  and  $t_{tAPWD(max)} = 1.5ns$ ,  $t_{DDJ(max)} = 0.22ns$ ,  $t_{UJ(max)} = 0.10ns$
4. Characterized with Avago Characterization Boards
5. Limits for 2UI are 38.72 ... 42.66ns and for 3UI they are 59.06 ... 63.01ns.
6. Top and Base level measured at least over 10UIs.



## AFBR-2012 (Receiver)

### Optical Input Signal Characteristics

(22.5 MBit MOST Data,  $V_{CC} = 3.135 \dots 3.465V$  or  $4.75 \dots 5.25V$ )

Parameter	Symbol	Min.	Typ.	Max.	Units
Peak wavelength of input signal	$\lambda_{Peak}$	630	650	685	nm
FWHM of input signal	$\Delta\lambda$			30	nm
Receiveable optical power range for data recovery <sup>[1,2]</sup>	$P_{Opt}$	-25		-2	dBm
Receiveable optical power for switching to low power mode <sup>[1]</sup>	$P_{OFF}$	-40		-25	dBm

Notes:

1. Optical power data are average values when using any MOST25 optical transmitter, measured at the end of a plastic optical fiber with metal insert (diameter 2.90 +/- 0.02mm). The transmitter data is biphase coded.
2. Measured with worst case pattern a BER  $\leq 10^{-9}$  can be reached

### DC Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Supply Voltage low	$V_{CC\_l}$	3.135	3.3	3.465	V
Supply Voltage high	$V_{CC\_hl}$	4.75	5	5.25	V
Low Level Output Voltage Data and Status Pin <sup>[1]</sup>	$V_{OL}$			0.4	V
High Level Output Voltage Data Pin <sup>[1]</sup>	$V_{OH}$	2.5	3.3	$V_{CC}+0.3$	V
High Level Output Voltage Status Pin <sup>[1]</sup>	$V_{OH}$	2.5		VCC	V
Supply Current Full Power Mode	$I_{CC, FPM}$			15	mA
Supply Current Low Power Mode	$I_{CC, LPM}$			10	$\mu A$

Notes:

1. Resistor load must not be smaller than 50k $\Omega$

## AC Electrical Characteristics 45.158Mbaud (44.1kHz)

Parameter	Symbol	Min.	Typ.	Max.	Units
Output Rise Time @V <sub>CC_l</sub> [1,4,6]	t <sub>r_l</sub>		6	9	ns
Output Rise Time @V <sub>CC_h</sub> [1,4,6]	t <sub>r_h</sub>		5	9	ns
Output Fall Time @V <sub>CC_l</sub> [1,4,6]	t <sub>f_l</sub>		6	9	ns
Output Fall Time @V <sub>CC_h</sub> [1,4,6]	t <sub>f_h</sub>		5	9	ns
Output Pulse Width Variation 1UI [1,2,3,4,5]	t <sub>PWV</sub>	16.5		31	ns
Output Average Pulse Width Distortion [1,2,3,4]	t <sub>APWD</sub>	-3.3		7	ns
Data Dependent Link Jitter [2,3,4]	t <sub>DDJ</sub>			3.3	ns
Uncorrelated Link Jitter [2,3,4]	t <sub>UJ</sub>			1.0	ns
Power-up time at detection of rising V <sub>CC</sub>	t <sub>PUO</sub>		0.1	6	ms
Power-up time from low power mode	t <sub>PU</sub>		0.5	6	ms
Low Power mode timer delay	t <sub>LPM</sub>		0.005	2	ms

### Notes:

1. Maximum Capacitive Load is 10pF
2. MOST Data 44.1kHz FS corresponds to a 45Mbaud data stream
3. The optical input signal has to fulfill following requirements: t<sub>PWV(min)</sub> = 20.0ns, t<sub>PWV(max)</sub> = 24.3ns; t<sub>APWD(min)</sub> = -1.4ns and t<sub>APWD(max)</sub> = 1.4ns, t<sub>DDJ(max)</sub> = 0.77ns, t<sub>UJ(max)</sub> = 0.33ns, Positive Overshoot within 0UI...2/3UI = -20...40%, Extinction Ratio min = 10dB. Variations within those limits do not change t<sub>PWV</sub> significantly.
4. Characterized with Avago Characterization Boards
5. Limits for 2UI are 38.6 ... 53.1 and for 3UI they are 60.8 ... 75.2ns.
6. Output Rise Time from 10% - 90%, Output Fall Time from 90% - 10%

## AC Electrical Characteristics 49.152Mbaud (48kHz)

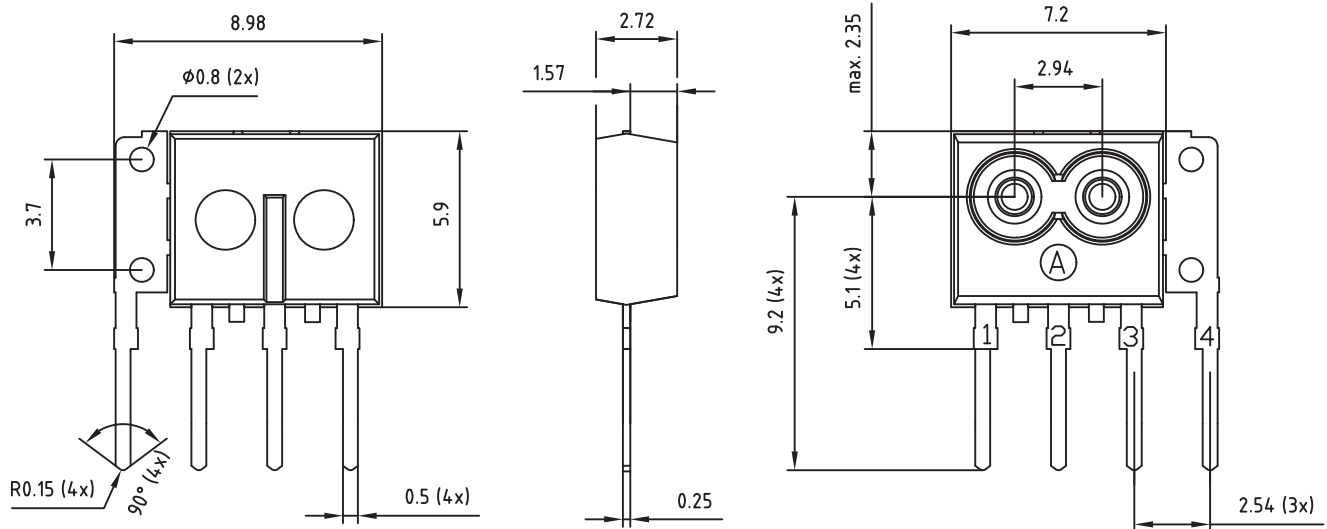
Parameter	Symbol	Min.	Typ.	Max.	Units
Output Rise Time @V <sub>CC_l</sub> [1,4,6]	t <sub>r_l</sub>		6	9	ns
Output Rise Time @V <sub>CC_h</sub> [1,4,6]	t <sub>r_h</sub>		5	9	ns
Output Fall Time @V <sub>CC_l</sub> [1,4,6]	t <sub>f_l</sub>		6	9	ns
Output Fall Time @V <sub>CC_h</sub> [1,4,6]	t <sub>f_h</sub>		5	9	ns
Output Pulse Width Variation 1UI [1,2,3,4,5]	t <sub>PWV</sub>	15.12		28.48	ns
Output Average Pulse Width Distortion [1,2,3,4]	t <sub>APWD</sub>	-3		6.4	ns
Data Dependent Link Jitter [2,3,4]	t <sub>DDJ</sub>			3.0	ns
Uncorrelated Link Jitter [2,3,4]	t <sub>UJ</sub>			0.9	ns
Power-up time at detection of rising V <sub>CC</sub>	t <sub>PUO</sub>		0.1	6	ms
Power-up time from low power mode	t <sub>PU</sub>		0.5	6	ms
Low Power mode timer delay	t <sub>LPM</sub>		0.005	2	ms

### Notes:

1. Maximum Capacitive Load is 10pF
2. MOST Data 48kHz FS corresponds to a 49.152Mbaud data stream
3. The optical input signal has to fulfill following requirements: t<sub>PWV(min)</sub> = 18.37ns, t<sub>PWV(max)</sub> = 22.32ns; t<sub>APWD(min)</sub> = -1.28ns and t<sub>APWD(max)</sub> = 1.28ns, t<sub>DDJ(max)</sub> = 0.71ns, t<sub>UJ(max)</sub> = 0.3ns, Positive Overshoot within 0UI...2/3UI = -20...40%, Extinction Ratio min = 10dB. Variations within those limits do not change t<sub>PWV</sub> significantly.
4. Characterized with Avago Characterization Boards
5. Limits for 2UI are 35.47 ... 48.825 and for 3UI they are 55.81 ... 69.17ns.
6. Output Rise Time from 10% - 90%, Output Fall Time from 90% - 10%

## Package Dimensions Receiver

### Receiver Short Lead Option (AFBR-2012S)



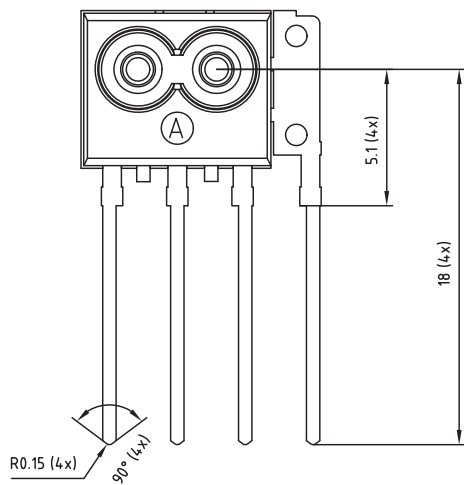
Unit: mm

For more information see package outline drawing

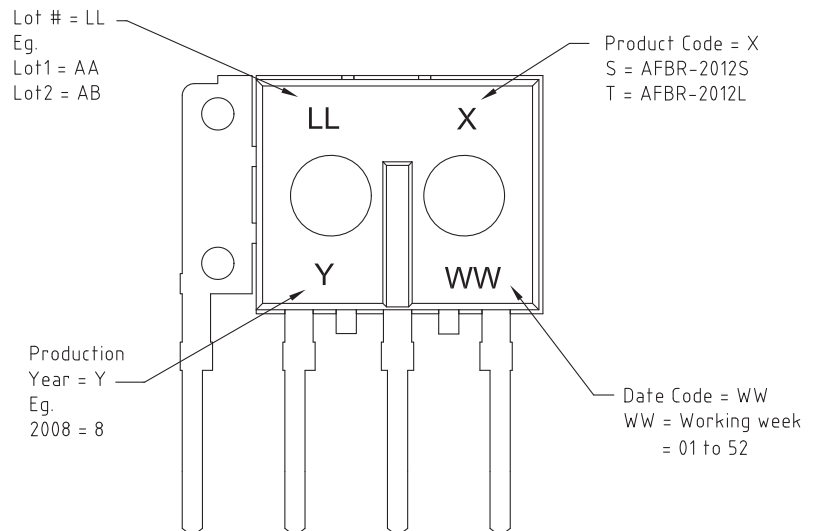
### Pin Description Receiver

Pin	Name Function/Description
1	$V_{CC}$ = Power 3.3V or 5V (+/-5% each)
2	GND = Ground
3	MODE <sub>OUT</sub> = Mode Output
4	$V_{OUT}$ = Data Output

### Receiver Long Lead Option (AFBR-2012L)



### Device Marking Receiver





For product information and a complete list of distributors, please go to our web site: [www.avagotech.com](http://www.avagotech.com)

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