

XFP Optical Transceivers for 40km 10G Serial Applications

IGF series

IGF-32511J

The Bookham IGF-3000 Series optical transceiver modules are high-performance, cost-effective modules for serial optical data communication applications at 10Gb/s. The IGF-32511J is designed to provide SONET/SDH (with or without FEC) and 10Gb/s Ethernet for 40km compliant links.


The modules are designed for single mode fibre and operate at a nominal wavelength of 1550nm. They incorporate Bookham's exclusive optical packaging platform.

The modules aid system hardware engineers in implementing low-cost single mode PMD solutions, which are protocol transparent. The "hot pluggable" feature built into every module reduces manufacturing cost, inventory costs and allows optical port upgrades at the customer premises. Built-in remote monitoring via digital diagnostics allows user access to static and dynamic data as well as module condition.

The IGF-32511J uses an Electro-absorption Modulated Laser (EML) packaged in conjunction with an optical isolator. This design provides for maximum eye opening, minimized jitter generation, and excellent back reflection performance. The transmitter is fully IEC60825-1 and CDRH Class 1 laser eye safety compliant.



Features:

- Multi-Protocol Compliant
SONET OC-192 IR-2/SDH S-64.2b,
IEEE 802.3 10G Ethernet (10GBASE-ER/EW),
10G Fibre Channel
- Compliant with the XFP MSA
- Ultra small form factor
- 10Gb/s serial operation
- Hot Pluggable
- Supports 40km link distances
- Integrated PIN receiver technology
- Data rates up to 10.7Gb/s
- XFI electrical interface
- On board Enhanced Digital Diagnostics providing I²C remote monitoring capability
- Typically less than 3.0 W power dissipation
- Integral Signal Conditioning ICs enabling FR4 host board PCB traces up to 8 inches
- Duplex LC connector
- Low EMI
- Transmit disable and loss-of-signal functions
- RoHS compliant 

Applications:

- SONET/SDH Metro Networks
- 10G Ethernet Metro Links
- Metro Storage Networking
- Client side interconnection
- Inter-office connections

Absolute maximum ratings

Parameter	Symbol	Min	Max	Units	Notes
Storage Temp	T _{stg}	-40	85	°C	
Supply voltage ₅	VCC5	0	6	V	
Supply voltage ₃	VCC3	0	4.0	V	
Supply voltage ₂	VCC2	0	2.2	V	
Supply voltage _{E5}	VEE5	-6	0	V	[1]
Data AC volt. differential	Tx+, Tx-	-0.5	2	V _{pp}	
Data DC volt.	Tx+, Tx-	0	VCC2	V _{pp}	
Optical Damage Threshold	P _{damage}		+5	dBm	

[1] VEE5 supply is not used – if voltage is applied to these pins it must be within the limits specified

Operating conditions

Parameter	Symbol	Min	Typical	Max	Units	Notes
Baud Rate		9.95		10.75	GBd	STM-64/OC192; G.709; 10 GbE;
Supply Voltage ₅	VCC5	4.75	5.0	5.25	V	
Supply Current ₅	ICC5		350	550	mA	[1]
Supply voltage ₃	VCC3	3.13	3.3	3.47	V	
Supply Current ₃	ICC3		90	200	mA	[1]
Supply voltage ₂	VCC2	1.71	1.8	1.89	V	
Supply Current ₂	ICC2		50	750	mA	Supplies TEC, current draw depends on temp [1]
Supply voltage _{E5}	VEE5		-5.2		V	[2]
Power Dissipation	P _w		2.3	3.5	W	[3]
Temperature Case	T _{case}	-5		70	°C	

Please contact sales for special requirements.

[1] Typical figures for supply current and power dissipation represent start-of-life 40C.

Max figures for supply currents and power dissipation are worst case, end-of-life, over temperature.

Currents are quiescent values and exclude inrush.

[2] VEE5 supply is not used – if voltage is applied to these pins it must be within the limits specified.

[3] Maximum currents from each supply rail not all present simultaneously.

Operating specifications – electrical

T_{case} = -5°C to +70°C

Parameter	Symbol	Value			Units	Notes
		min	typical	max		
CML Input (differential)	V _{TxDiff}	150	n/a	900	mVpp	100 ohm differential
CML Output (differential)	V _{RxDiff}	360	600	770	mVpp	100 ohm differential
Rise/Fall Time	T _r /T _f	24			ps	20% - 80%
Loss of Signal Output Voltage High	V _{OH}	2		VCC3+0.3	V	
Loss of Signal Output Voltage Low	V _{OL}	0		0.8	V	
Loss of Signal Timing Assert [Off to On]	T _A			100	µs	
Loss of Signal Timing Deassert [On to Off]	T _D			100	µs	
Tx_Disable High	V _{DH}	2		VCC3+0.3	V	
Tx_Disable Low	V _{DL}	0		0.8	V	

The IGF-32511J requires a baud/64 external reference clock. Reference clock requirements are defined by the XFP MSA.

Transmitter operating specifications – optical

T_{case} = -5°C to +70°C

Parameter	Symbol	Value			Units	Notes
		min	typical	max		
Optical Transmit Power	P _o	-1.0		+2.0	dBm	EOL
Side mode suppression	SMSR	30			dB	
Extinction Ratio	ER	8.2	9.8		dB	
Jitter Generation	T _{J rms}	Compliant to GR-253 Issue 4			UI	RMS
Jitter Generation	T _{J p-p}	and ITU-T G.825/G.8251			UI	Peak-to-Peak
Optical Path Penalty	OPP			2	dB	800ps/nm disp.
Output Optical Eye	Compliant with Telcordia GR-253, ITU-T G.691/G.959.1 and IEEE802.3ae					

Receiver operating specifications – optical

T_{case} = -5°C to +70°C

Parameter	Symbol	Value			Units	Notes
		min	typical	max		
Receiver Sensitivity	PIN-MIN			-15.8	dBm	Ave. power at ER=8.2dB _[1]
Stressed Receiver Sensitivity (OMA)			-13.5	-11.4	dBm	_[1]
Receiver Overload	PIN-MAX	+2			dBm	Ave. power _[1]
Reflectance				-27	dB	
Loss of Signal						
Loss of Signal Assert (Off to On)	PA	-32		-19	dBm	
Loss of Signal Deassert (On to Off)	Pd			-17	dBm	
Hysteresis	PA - Pd	0.5		6	dB	

[1] BER 1E-12 used for Rx sensitivity measurements

Electrical pin out

The electrical connection interface of the module and host board is shown below in Figure 1 and Figure 2, respectively.

Bottom of Board as viewed through top of board		Top of Board	
1	GND	GND	30
2	VEE5	TD+	29
3	Mod_Desel	TD-	28
4	Interrupt_BAR	GND	27
5	TX_DIS	GND	26
6	VCC5	RefCLK-	25
7	GND	RefCLK+	24
8	VCC3	GND	23
9	VCC3	VCC2	22
10	SCL	P_down/RST	21
11	SDA	VCC2	20
12	Mod_Abs	GND	19
13	Mod_Nr	RD+	18
14	Rx_LOS	RD-	17
15	GND	GND	16

Figure 1. XFP Module Board Pinout & Names

1	GND	GND	30
2	VEE5	TD+	29
3	Mod_Desel	TD-	28
4	Interrupt_BAR	GND	27
5	TX_DIS	GND	26
6	VCC5	RefCLK-	25
7	GND	RefCLK+	24
8	VCC3	GND	23
9	VCC3	VCC2	22
10	SCL	P_down/RST	21
11	SDA	VCC2	20
12	Mod_Abs	GND	19
13	Mod_NR	RD+	18
14	Rx_LOS	RD-	17
15	GND	GND	16

Towards Bezel
Towards ASIC

Figure 2. Host Board Connector Pinout & Names

Pin definitions

Pin #	Logic	Symbol	Function	Plug Seq	Notes
1		GND	Module Ground; Signal Ground	1	1
2		VEE5	Optional -5.2V Power Supply	2	
3	LVTTTL-I	Mod_Desel	Module De-select; When held low by host allows the module to respond to 2-wire serial interface commands	3	
4	LVTTTL-O	Interrupt_BAR	Interrupt_BAR; Indicates the presence of an important condition that can be read over the two wire interface	3	2
5	LVTTTL-I	TX_DIS	Transmitter Disable; Turns Off Transmitter Laser Source	3	
6		VCC5	+5V Power Supply	2	
7		GND	Module Ground; Signal Ground	1	1
8		VCC3	+3.3V Power Supply	2	
9		VCC3	+3.3V Power Supply	2	
10	LVTTTL-I	SCA	Two Wire Interface Clock	3	2
11	LVTTTL-I/O	SDA	Two Wire Interface Data Line	3	2
12	LVTTTL-O	Mod_Abs	Indicates Module Not Present; Grounded in Module	3	2
13	LVTTTL-O	Mod_NR	Module Not Ready or Indicating Module Operational Fault	3	2
14	LVTTTL-O	RX_LOS	Receiver Loss of Signal Indicator	3	2
15		GND	Module Ground; Signal Ground	1	1
16		GND	Module Ground; Signal Ground	1	1
17	CML-O	RD-	Receiver Inverted Data Output	3	
18	CML-O	RD+	Receiver Non-Inverted Data Output	3	
19		GND	Module Ground; Signal Ground	1	1
20		VCC2	+1.8V Power Supply	2	
21	LVTTTL-I	P_down/RST	Power down; When high, places the module in the low power standby mode of less than 1.5W with 2-wire interface still operational. Reset; The falling edge of P_Down/RST initiates a complete module reset including the 2-wire interface.	3	
22		VCC2	+1.8V Power Supply	2	
23		GND	Module Ground; Signal Ground	1	1
24	PECL-I	RefCLK+	Reference Clock Non-Inverted Input, AC coupled on Host Board	3	3
25	PECL-I	RefCLK-	Reference Clock Inverted Input, AC coupled on Host Board	3	3
26		GND	Module Ground; Signal Ground	1	1
27		GND	Module Ground; Signal Ground	1	1
28	CML-I	TD-	Transmitter Inverted Data Input	3	
29	CML-I	TD+	Transmitter Non-Inverted Data Input	3	
30		GND	Module Ground; Signal Ground	1	1

[1] Module ground pins are isolated from the module case and chassis ground within the module.

[2] Open Collector should be pulled up with 4.7K-10Kohms to a voltage between 3.15V and 3.6V on the host board.

[3] Required for the IGF-32511J.

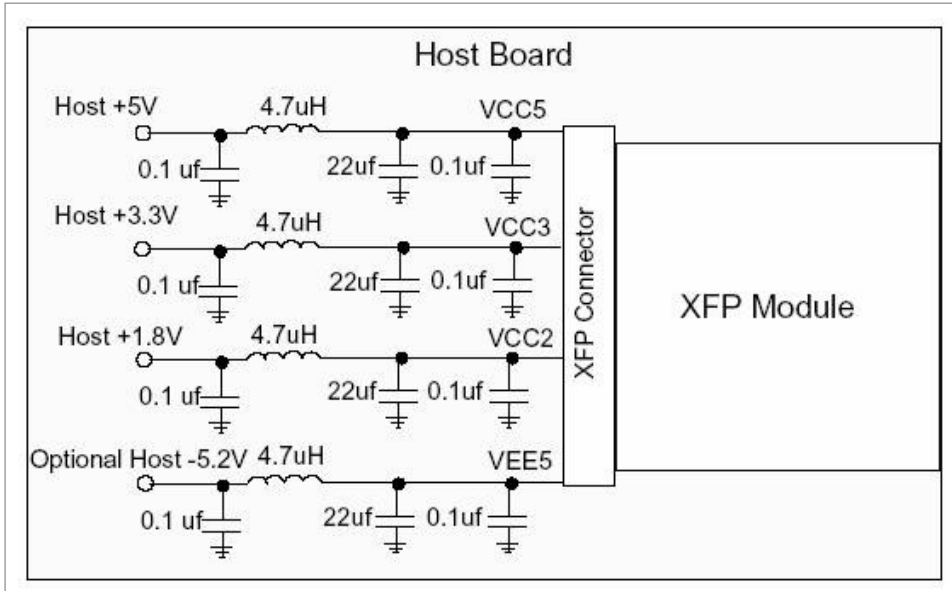


Figure 3. Host Board supply filtering.

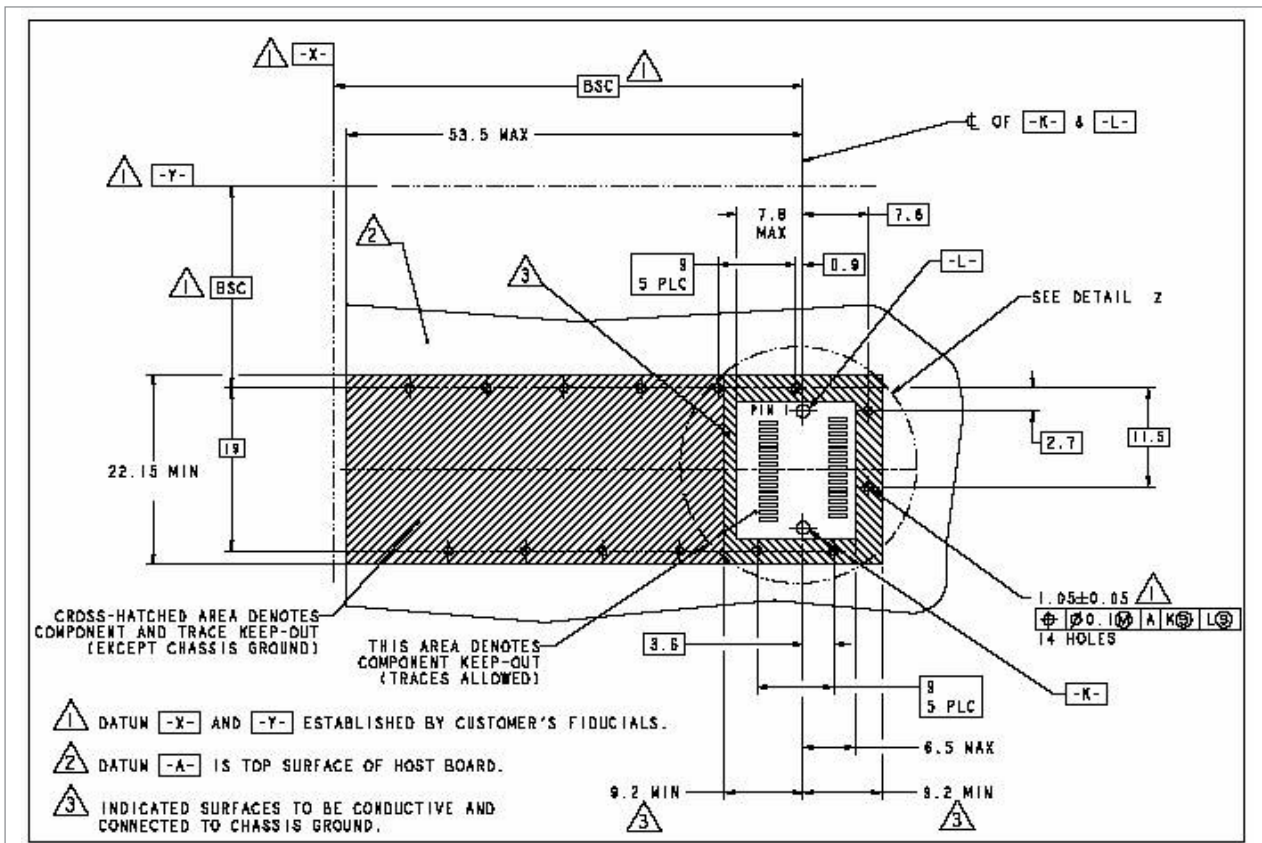


Figure 4. Host Board mechanical layout (mm)

Mechanical interface:

The XFP module is a pluggable module with its foundation based on the successful SFP package configuration. It consists of a rectangular package that is approximately 18mm wide and 78mm long. The module interface is a 30 lead connector. The module is inserted into a metal cage assembly.

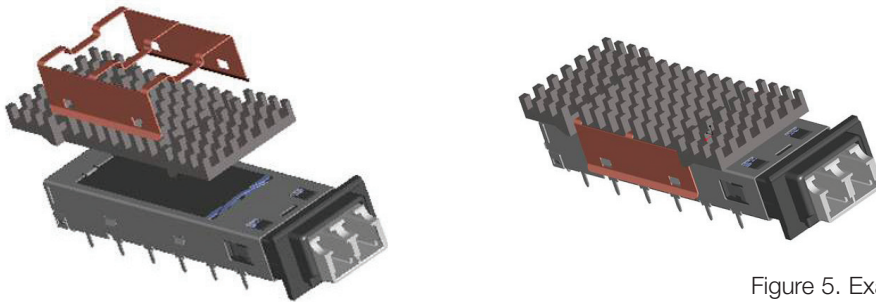
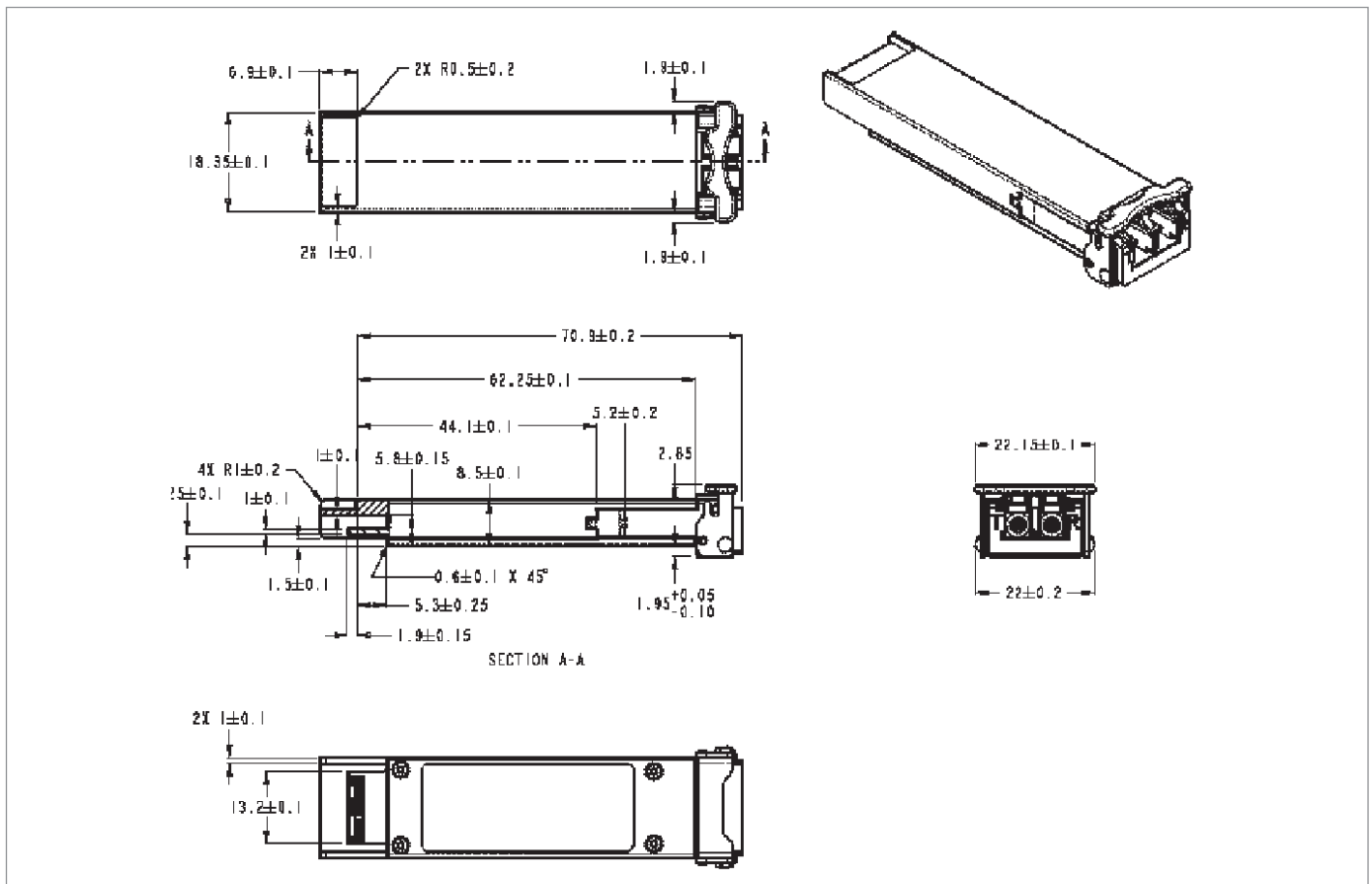


Figure 5. Example of clip-on heat sink

Thermal interface:

One of the unique features of the XFP module is that the module cage is designed with the ability to accommodate a clip-on thermal heat sink, as shown in Figure 5, to enhance the cooling of the module. Thus the equipment manufacturer that designs with the XFP can select a heat sink that is optimized for the particular environmental conditions of vertical space above module, air flow, air flow direction and desired pressure drop.



8 Figure 6. Mechanical Dimensions (mm) of XFP module.

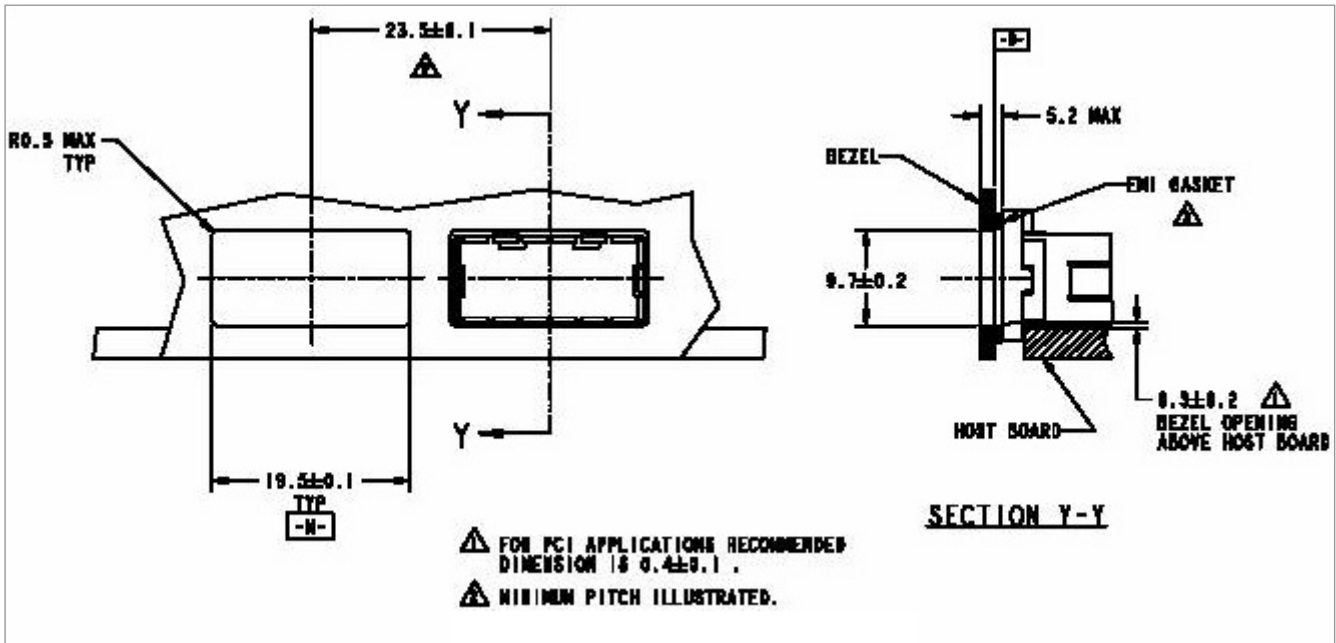


Figure 7. Interface Design with Bezel (mm)

Management Interface

Digital diagnostics is available on all Bookham XFP transceivers. A 2-wire Serial ID interface provides user access to vendor/module identification, customer specific data, link type, static and dynamic monitor hooks, and a check code mechanism for verifying accuracy in the data registers. These “static” and “dynamic” diagnostics allow users to remotely and accurately identify modules and their vendors, make determinations about its compatibility with the system, verify which “Enhanced” diagnostics are supported, and monitor module parameters to determine the module and link condition.

The module’s “Enhanced Digital Diagnostics” features provide real-time monitoring of receiver input power, transmitter power, internal module temperature, laser bias current, and supply voltage parameters.

The 2-wire serial ID interface was originally defined by the GBIC (GigaBit Interface Converter) and SFF-8472 specifications. The XFP MSA (Multi-Source Agreement) document further defined the diagnostics features and introduced a new memory map of the diagnostic information. This interface is a 2-wire interface that allows read-only access to separate memory locations.

The memory location starting at A0h [data address 0 ~ 127] contains the Digital Diagnostic Functions.

The normal 256 Byte I2C address space is divided into lower and upper blocks of 128 Bytes. The lower block of 128 Bytes is always directly available and is used for the diagnostics and control functions that must be accessed repeatedly. One exception to this is that the standard module identifier Byte defined in the GBIC and SFP is located in Byte 0 of the memory map [in the diagnostics space] to allow software developed for multiple module types to have a common branching decision point. This Byte is repeated in the Serial ID section so that it also appears in the expected relationship to other serial ID bits.

Multiple blocks of memories are available in the upper 128 Bytes of the address space. These are individually addressed through a table select Byte which the user enters into a location in the lower address space. Thus, there is a total available address space of $128 * 256 = 32\text{Kbytes}$ in this upper memory space. The upper address space tables are used for less frequently accessed functions such as serial ID, user writable EEPROM, reserved EEPROM and diagnostics and control spaces for future standards definition, as well as ample space for vendor specific functions. These are allocated as follows:

- Table 01h: Serial ID EEPROM
- Table 02h: User writable EEPROM

The details of each memory space are found in the XFP MSA specification Chapter 5.

Reference Documents:

1. XFP MSA revision 4.0, INF-8077i, "10 Gigabit Small Form Factor Pluggable Module" found at www.xfpmsa.org; April 13, 2004

Regulatory compliance

Bookham IGF-3000 Series 1550 nm XFP transceivers are designed to be Class 1 Laser compliant. They are certified per the following standards:

Feature	Agency	Standard	Certificate/Comments
Laser Safety	FDA/CDRH	CDRH 21(J) CFR 1040.10 Laser Safety	0520196-02
	TÜV	IEC/EN 60950-1:2001 IEC/EN 60825-1/A2:2001	US-TUVR-3130
		CAN/CSA-60825-1-03	CU72060154
Component Safety	UL/CSA	CAN/CSA-C22.2 No. 60950-1-03 UL 60950-1:2003 UL 94 V-0	CU72060154
ESD	IEC	MIL-STD-883 Method 3015 IEC61000-4-2	Pass
EMI	FCC/89/336/EE	Part 15 Class B	FCC Class B margin = 46.0 dBuV/m
	[EU Directive]	EN55022, EN55024 Class B	EN55022 Class B margin = 15.9 dBuV/m
CE	EU Directives	73/23/EEC (Low voltage) 89/336/EEC (EMC)	Pass

This product meets the requirements of the relevant EMC standards (EN 55022, EN 55024, FCC Part 15). However the EMC performance of the product within the host system may depend on characteristics of the host system over which Bookham has no control. It may therefore be necessary to ensure that the host system provides adequate grounding & shielding of the product.

RoHS Compliance



Bookham is fully committed to environment protection and sustainable development and has set in place a comprehensive program for removing polluting and hazardous substances from all of its products. The relevant evidence of RoHS compliance is held as part of our controlled documentation for each of our compliant products. RoHS compliance parts are available to order, please refer to the ordering information section for further details.

Ordering Information:

IGF-32511J

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ROHS 5/6

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