Agilent AFKG-xxxxP 1.25 Gb/s CWDM GBIC Transceiver Family

Data Sheet

Description

Agilent CWDM GBIC modules are high performance, cost effective transceivers for serial optical communications at a signal rate of 1.25 Gb/s. They are designed to provide Gigabit Ethernet IEEE 802.3z compatible links. These devices operate from 1470 - 1610 nm on the ITU-T G.694.2 CWDM wavelength grid. The optical power and receiver sensitivity allows for an optical power budget of at least 30 dB.

The transmitter section uses a Distributed Feedback (DFB) Laser packaged in conjunction with an optical isolator for excellent back reflection performance. The transmitter is a Class 1 device registered with CDRH (meeting requirements of CFR 21 Section 1010) and certified by TUV (showing compliance with IEC 60825-1,A2,-2 and EN60825). The receiver section uses an Avalanche Photodiode (APD) receiver for excellent sensitivity across the entire wavelength range. The Agilent CWDM GBIC family of interface converters meets the Gigabit Interface Converter specification Rev. 5.4, an industry standard. The family provides a uniform form factor for a wide variety of standard connections to transmission media. The converters can be inserted or removed from a host chassis without removing power from the host system.

Features

- **Compliant with Gigabit Interface Converter specification Rev. 5.4**
- **Compatible with IEEE 802.3z**
- **30 dB Link Budget with uncooled DFB emitter and APD receiver**
- **Operation from 1470-1610 nm on the ITU-T G.694.2 CWDM wavelength grid**
- **Data rate 1.25 Gb/s**
- **Hot pluggable**
- **Manufactured in ISO 9001 facility**
- **SC-Duplex fiber connector**

Applications

- **Capacity expansion on private SMF links**
- **Low cost WDM implementations**
- **Lighting of dark fiber**
- **Metro access rings and point to point**
- **SANs**

Agilent Technologies

Serial Identification

The Agilent CWDM GBIC family complies with Annex D (Module Definition 4) of the GBIC specification Revision 5.4, which defines the Serial Identification Protocol. Definition 4 specifies a serial definition protocol. For this definition, upon power up, MOD_DEF(1:2) (Pins 5 and 6 on the 20-pin connector) appear as NC. Pin 4 is TTL ground. When the host system detects this condition, it activates the public domain serial protocol. The protocol uses the 2-wire serial CMOS E2PROM protocol of the ATMEL AT24C01A or similar. The data transfer protocol and the details of the mandatory and vendor specific data structures are defined in Annex D of the GBIC specification Revision 5.4.

Hot Plug Capable

The converters are suitable for interconnections in the Gigabit Ethernet hubs and switches environment. The design of these converters is also practical for other high performance, point-to-point communication requiring gigabit interconnections. Since the converters are hot-pluggable, they allow system configuration changes simply by plugging in a different type of converter.

Electrical Connector

The mechanical and electrical interfaces of these converters to the host system are identical for all implementations of the converter regardless of wavelength. A 20-pin connector is used to connect the converter to the host system. Using pin sequencing at this connector and a slow start circuit eliminates surge currents. Two ground tabs at this connector also make contact before any other pins, discharging possible component damaging static electricity. In addition, the connector itself performs a two-stage contact sequence. Operational signals and power supply ground make contact in stage 1 while power makes contact in stage 2.

Regulatory Compliance

Electrostatic Discharge

There are two conditions in which immunity to ESD damage is important. The first condition is during the handling of the transceiver prior to insertion into the transceiver port. To protect the transceiver, it is important to use normal ESD handling precautions. The ESD sensitivity of the AFKG-xxxxP is compatible with typical industry production environments. The second condition is static discharges to the exterior of the host equipment chassis after installation. There are two guide tabs integrated into the 20-pinconnector on the GBIC. These guide tabs are connected to circuit ground. When the GBIC is inserted into the host system, these tabs will engage before any of the connector pins. The mating connector in the host system must have its tabs connected to circuit ground. This discharges any stray static charges and establishes a reference for the power supplies that are sequenced later.

Immunity

Equipment utilizing these modules will be subject to radio-frequency electro-magnetic fields in some environments. These transceivers have good immunity to such fields due to their shielded design.

Eye Safety

These CWDM DFB based transceivers provide Class 1 eye safety by design. Agilent has tested the transceiver design for compliance with the requirements under normal operating conditions and under a single fault condition.

Electromagnetic Interference (EMI)

Most equipment designs utilizing these high-speed transceivers from Agilent will be required to meet the requirements of FCC in the United States, CENELEC EN55022 (CISPR 22) in Europe and VCCI in Japan.

Table 1. Regulatory Compliance

Feature	Test Method	Required Performance
Electrostatic Discharge (ESD) to the electrical pins	Mil Std 883CMethod 3015.4	Must meet class 1 (2000V)
Electrostatic Discharge (ESD) to Duplex SC Receptacle	Variation of IEC-61000-4-2 -Direct ESD (i.e. front panel connector receptacle). Bellcore 1089	15 kV (air discharge) and 8 kV (contact). Transceiver shall perform properly during test (no data loss)
	Variation of IEC 61000-4-2 - Indirect ESD (Contact discharge to coupling plane)	15 kV (contact discharge applied to coupling plane). Transceiver shall perform properly during test (no data loss)
Electromagnetic Interference (EMI)	FCC class BCENLEC EN55022 Class B (CISCP 22A)VCCI Class 1	Margins are dependent on customer board and chassis design
Immunity	Variation of IEC 61000-4-3	Typically show no measurable effect from a 10V/m field swept from 80MHz to 1000 MHz applied to the transceiver without a chassis enclosure
Laser Eye Safety and Equipment Type Testing	IEC 60825-1 Amendment 2CFR 21 Section 1040	IEC AEL & USDA CDRH Class 1 CDRH Accession Number: 0220412-03 TUV Certificate: 933/21201365/01
Component Recognition	Underwriter's Laboratories and Canadian Standards Association Joint Component Recognition for Information Technology Equipment Including Electrical Business Equipment	UL file # NWGQ2.E173874

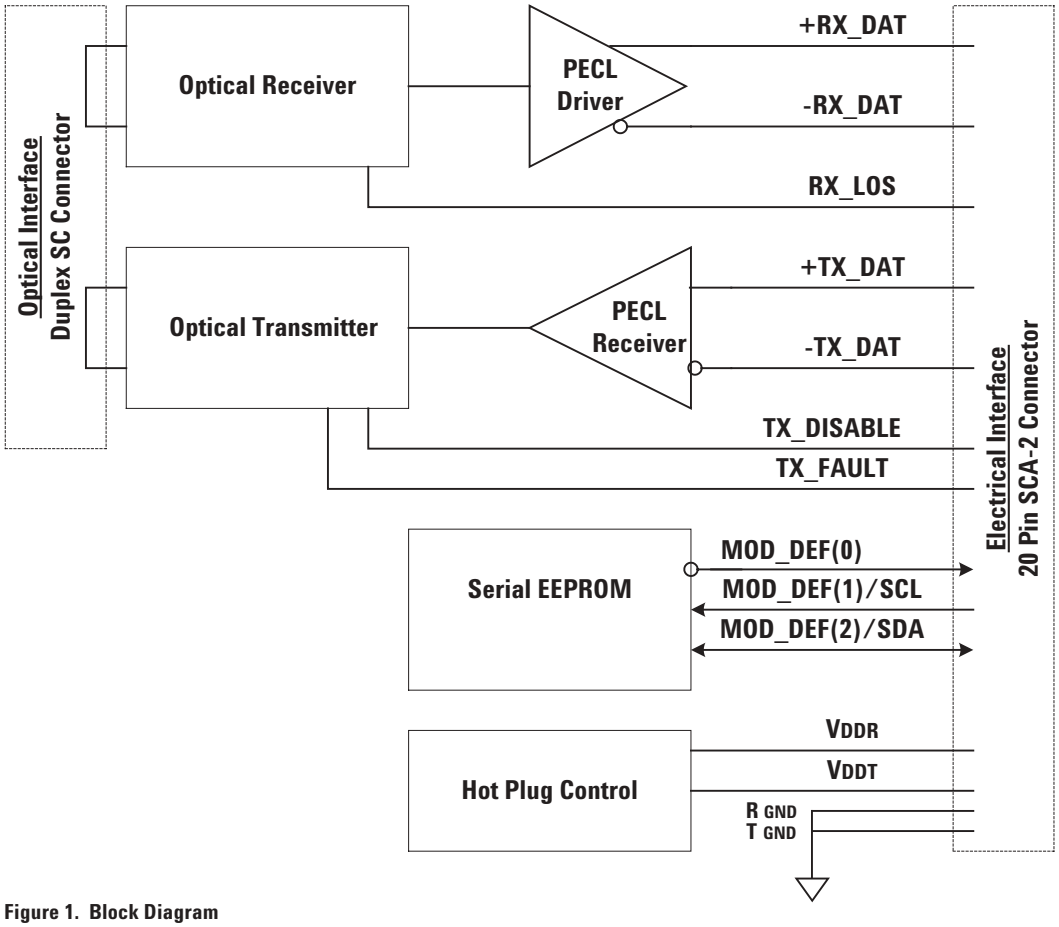

Figure 1. Block Diagram

Absolute Maximum Ratings

Absolute maximum ratings specify conditions for which operation beyond any one of the limits may damage the device.

Parameter	Symbol	Minimum	Maximum	Unit	Notes
Storage Temperature	T_S	-40	+85	°C	
Supply Voltage	$V_{CC}R$, $V_{CC}T$	-0.5	+6.0	V	
Data Input Voltage	TX_DAT	-.05	$V_{CC}T$	V	
Data Differential Input Voltage	ΔTX_DAT		2.0	V	1
Receiver Optical Input	P_{IN} AbsMax		6	dBm	
Relative Humidity (non-condensing)	RH	5	95	%	

Recommended Operating Conditions

Recommended Operating Conditions specify conditions for which the optical and electrical characteristics hold. Optical and electrical characteristics are not specified for operation beyond the Recommended Operating Conditions, reliability is not implied and damage to the device may occur for such operation over an extended time period.

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
Case Temperature	T_C	-5		+70	°C	2
Supply Voltage	V_{CC}	4.75	5	5.25	V	
Data Rate			1250		Mb/s	3
Rx Input Operating Wavelength	λ	1460		1620	nm	
Control Inputs						
TX_DISABLE	V_{IH}	2.0		$V_{CC}T$+0.3	V	4
MOD-DEF 1,2	V_{IL}	0		0.8	V	
Data Input						
Transmitter Differential Input Voltage	Δ TX_DAT	600		2000	mV pk-pk	
Transmitter Input Rise Time	tr	85		350	ps	
Transmitter Input Fall Time	tf	85		350	ps	
Data Input Differential Skew				25	ps	

Notes:

1. This is the maximum voltage that can be applied across the input differential pair without damaging the input circuit.
2. Case Temperature is measured as indicated in Figure 2.
3. For data patterns with restricted run lengths, e.g. 8B10B encoded data
4. LVTTL output, External 4.7-10 kΩ pull up resistor required on host board

Transceiver Electrical Characteristics

Recommended Operating Conditions except where noted. Typicals at T_C = +40 °C and nominal supplies except where noted.

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
Supply Current	I_{DDT}, I_{DDR}			300	mA	1
Power Dissipation	P_{DISS}		1.0	1.58	W	1
Surge Current	I_{SURGE}			+30	mA	2
Sense Outputs						
TX_FAULT,	V_{OH}	V_{CC} - 0.5		V_{CC} + 0.3	V	3
LOS, MOD-DEF 0,2	V_{OL}			0.5	V	
Data Output						
Receiver Differential Output Voltage	±RX_DAT	400		1100	mV pk-pk	4
Data Output Rise Time	tr	85		400	ps	5
Data Output Fall Time	tf	85		400	ps	
Receiver Differential Output Skew				50	ps	

Notes:

1. Over temperature, over life.
2. Hot plug, above steady state.
3. LVTTL output, External 4.7-10 kΩ pull up resistor required on host board.
4. Internally AC coupled and terminated (150 Ω differential).
5. Unfiltered 20-80% values.

Transmitter Optical Characteristics

Recommended Operating Conditions except where noted. Typicals at T_C = +40 °C and nominal supplies except where noted.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Reference
Output Power (avg.)	P_{OUT}	1	3	5	dBm	1
Output Power, Tx Disabled	P_{OFF}			-40	dBm	
Output Center Wavelength	λC	x - 4	x + 1	x + 7	nm	2
Spectral Width (-20 dB)	σ			1.0	nm	3
Extinction Ratio	ER	9			dB	4
Optical Rise Time	T_r			260	ps	5
Optical Fall Time	T_f			260	ps	
SMSR		30			dB	
Relative Intensity Noise (OMA)	RIN_{12}			-120	dB/Hz	6
Total Dispersion Penalty				2.0	dB	7
Determinstc Jitter (TP1 to TP2)	DJ			0.100	UI	
				80	ps	
Total Jitter (TP1 to TP2)	TJ			0.28	UI	
				227	ps	

Receiver Optical Characteristics

Recommended Operating Conditions except where noted. Typicals at T_C = +40 °C and nominal supplies except where noted.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Reference
Receiver Sensitivity	P_{IN} MIN		-31	-29	dBm	8
Receiver Saturation	P_{IN} MAX	-6			dBm	9
Return Loss	ORL	14			dB	
Total Jitter (TP3 to TP4)	TJ			0.332	UI	
				266	ps	
LOS - Deasserted	P_D	-42	-39	-31	dBm	
LOS - Asserted	P_A	-40	-37	-32	dBm	
LOS - Hysteresis	P_D-P_A	0.5			dB	

Notes:

1. Minimum output optical level includes end of life.
2. x indicates center wavelength and conforms to the ITU-t G.694.2 CWDM grid.
3. Full Width, -20 dB from peak
4. ER is measured with a recurring 1010 pattern at 125 MHz, as the ratio of light output at the middle of a "1" bit to the light output at the middle of a "0" bit.
5. These are unfiltered 20-80% values
6. Includes 12 dB return loss
7. Measured over standard single mode fiber for link distances up to 100 km.
8. Sensitivity is defined as the minimum average input optical power necessary to produce a BER 10^{-12} at the center of the Bit interval. The input is a 1250 MBd Pseudo Random Bit Sequence of length (2^7)-1 (PRBS-7) or equivalent Test pattern from a fast rise/fall time source with RIN of –120 dB/Hz or better. Sensitivity is specified at the worst case extinction ratio.
9. Saturation is defined as the minimum average Input Optical Power that produces at the center of the output swing a receiver output eye width less than 201 ps where BER 10^{-12} using a 1.25 GBd PRBS-7 or equivalent test pattern.

Timing Characteristics

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
TX_DISABLE Assert Time	t_off		3	10	µs	1
TX_DISABLE Negate Time	t_on		0.5	1	ms	2
TX Initialization Time, includes reset of TX_FAULT	t_init		30	300	ms	3
TX_FAULT Assert Time	t_fault		20	100	µs	4
TX_DISABLE time to start reset	t_reset	10				5
RX_LOS Assert Time	t_los_on			100	µs	6
RX_LOS Deassert Time	t_los_off			100	µs	7

Notes:

1. Rising edge of TX_DISABLE to fall of output signal below 10% of nominal.
2. Falling edge of TX_DISABLE to rise of output signal above 90% of nominal.
3. From power on or hot plug after $V_{CC}T$>4.75 volts or from negation of TX_DISABLE during reset of TX_FAULT.
4. From occurrence of fault (output safety violation or $V_{CC}T$<4.5 volts).
5. Time TX_DISABLE is High before TX_DISABLE is set Low.
6. From detection of loss of signal to assertion of RX_LOS.
7. From detection of presence of signal to negation of RX_LOS.

Table 2. SCA-2 Host connector pin assignment

Pin	Name	Sequence	Pin	Name	Sequence
1	RX_LOS	2	11	RGND	1
2	RGND	2	12	-RX_DAT	1
3	RGND	2	13	+RX_DAT	1
4	MOD_DEF(0)	2	14	RGND	1
5	MOD_DEF(1)	2	15	VCCR	2
6	MOD_DEF(2)	2	16	VCCT	2
7	TX_DISABLE[1]	2	17	TGND	1
8	TGND	2	18	+TX_DAT	1
9	TGND	2	19	-TX_DAT	1
10	TX_FAULT	2	20	TGND	1

Note:
A sequence value of 1 indicates that the signal is in the first group to engage during plugging of a module. A sequence value of 2 indicates that the signal is the second and last group. The two guide pins integrated on the connector are connected to TGND. These two guide pins make contact with circuit ground prior to Sequence 1 signals.

1. This pin is tied high via 10 K pull-up resistor.

Table 3. Signal Definition

Pin	Signal Name	Input/Output	Description
1	RX_LOS	Output	Receiver Loss of Signal, TTL High, open collector
2	RGND		Receiver Ground
3	RGND		Receiver Ground
4	MOD_DEF(0)	Output	TTL Low
5	MOD_DEF(1)	Input	SCL Serial Clock Signal
6	MOD_DEF(2)	Input/Output	SDA Serial Data Signal
7	TX_DISABLE	Input	Transmit Disable
8	TGND		Transmitter Ground
9	TGND		Transmitter Ground
10	TX_FAULT	Output	Transmit Fault
11	RGND		Receiver Ground
12	-RX_DAT	Output	Received Data, Differential PECL, ac coupled
13	+RX_DAT	Output	Received Data, Differential PECL, ac coupled
14	RGND		Receiver Ground
15	VDDR	Input	Receiver +5 V supply
16	VDDT	Input	Transmitter +5 V supply
17	TGND		Transmitter Ground
18	+TX_DAT	Input	Transmit Data, Differential PECL, ac coupled
19	-TX_DAT	Input	Transmit Data, Differential PECL, ac coupled
20	TGND		Transmitter Ground

Table 4. Memory Table
GBIC Serial ID Memory Contents for CWDM GBIC Family

Byte Decimal #	Data Hex	Notes	Byte Decimal #	Data Hex	Notes
0	01	Identifier	37	00	Hex Byte of Vendor OUI
1	04	Ext. Identifier	38	30	Hex Byte of Vendor OUI
2	01	Connector	39	D3	Hex Byte of Vendor OUI
3	00	Code for electronic/optical compatibility	40	41	"A" - Vendor Part Number ASCII Character
4	00	Code for electronic/optical compatibility	41	46	"F" - Vendor Part Number ASCII Character
5	00	Code for electronic/optical compatibility	42	4B	"K" - Vendor Part Number ASCII Character
6		Code for electronic/optical compatibility	43	47	"G" - Vendor Part Number ASCII Character
7	00	Code for electronic/optical compatibility	44	2D	"-" - Vendor Part Number ASCII Character
8	00	Code for electronic/optical compatibility	45	31	"1" - Vendor Part Number ASCII Character
9	00	Code for electronic/optical compatibility	46	See Table 5	" " Vendor Part Number ASCII Character
10	00	Code for electronic/optical compatibility	47	See Table 5	" " Vendor Part Number ASCII Character
11	01	Encoding	48	30	"0" - Vendor Part Number ASCII Character
12	0D	BR, Nominal	49	50	"P" - Vendor Part Number ASCII Character
13	00	Reserved	50	20	" " - Vendor Part Number ASCII Character
14	64	Length (9 m)	51	20	" " - Vendor Part Number ASCII Character
15	FF	Length (9 m)	52	20	" " - Vendor Part Number ASCII Character
16	00	Length (50 m)	53	20	" " - Vendor Part Number ASCII Character
17	00	Length (62.5 m)	54	20	" " - Vendor Part Number ASCII Character
18	00	Length (Copper)	55	20	" " - Vendor Part Number ASCII Character
19	00	Reserved	56	30	0
20	41	"A" - Vendor Name ASCII character	57	30	0
21	47	"G" - Vendor Name ASCII character	58	30	0
22	49	"I" - Vendor Name ASCII character	59	30	0
23	4C	"L" - Vendor Name ASCII character	60	00	
24	45	"E" - Vendor Name ASCII character	61	00	
25	4E	"N" - Vendor Name ASCII character	62	00	
26	54	"T" - Vendor Name ASCII character	63	Checksum	Checksum for Bytes 0-62
27	20	" " - Vendor Name ASCII character	64	00	
28	20	" " - Vendor Name ASCII character	65	1A	Hardward TX_DISABLE, TX_FAULT & RX_LOS
29	20	" " - Vendor Name ASCII character	66	00	
30	20	" " - Vendor Name ASCII character	67	00	
31	20	" " - Vendor Name ASCII character	68-83		Vendor Serial Number ASCII characters
32	20	" " - Vendor Name ASCII character	84-91		Vendor Date Code ASCII characters
33	20	" " - Vendor Name ASCII character	92	00	
34	20	" " - Vendor Name ASCII character	93	00	
35	20	" " - Vendor Name ASCII character	94	00	
36	00		95	Checksum	Checksum for Bytes 64-94
			96	See Table 5	Reserved
			97-127	00	Reserved

Note:
Blanks in ASCII column are numeric values not ASCII characters.

Table 5. Laser Wavelength

		Data Address		
Part Number	**Wavelength**	**46**	**47**	**96**
AFKG-1470P	1470	34	37	01
AFKG-1490P	1490	34	39	02
AFKG-1510P	1510	35	31	03
AFKG-1530P	1530	35	33	04
AFKG-1550P	1550	35	35	05
AFKG-1570P	1570	35	37	06
AFKG-1590P	1590	35	39	07
AFKG-1610P	1610	36	31	08

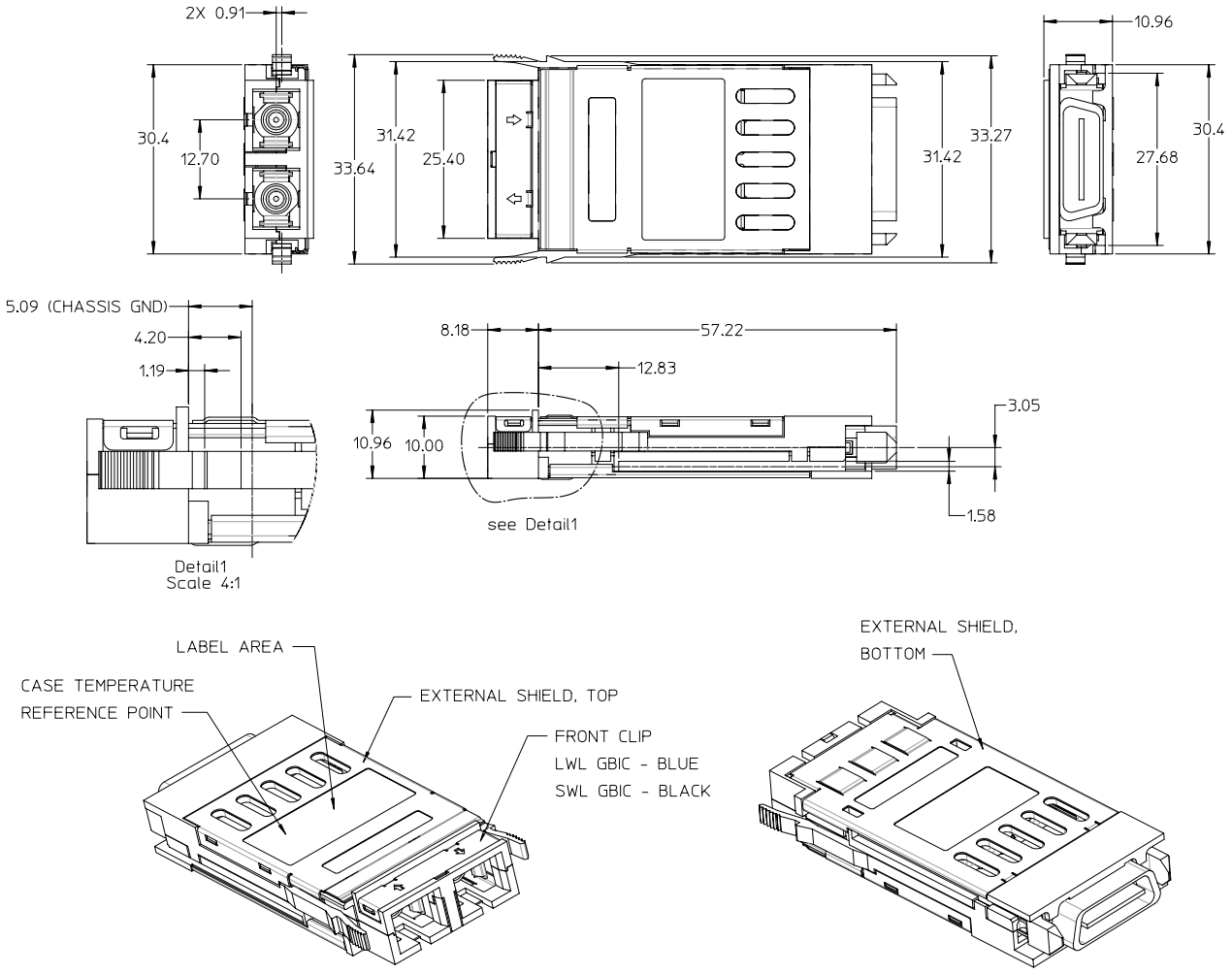

Figure 2. Package Dimensions

Ordering Information

Part Number	Center Channel Wavelength (nm)	Dot Color Code
AFKG-1470P	1470	Gray
AFKG-1490P	1490	Violet
AFKG-1510P	1510	Blue
AFKG-1530P	1530	Green
AFKG-1550P	1550	Yellow
AFKG-1570P	1570	Orange
AFKG-1590P	1590	Red
AFKG-1610P	1610	Brown

Customer Manufacturing Processes

This module is pluggable and is not designed for aqueous wash, IR reflow or wave soldering processes.

www.agilent.com/ semiconductors

For product information and a complete list of distributors, please go to our web site.

For technical assistance call:
Americas/Canada: +1 (800) 235-0312 or (408) 654-8675

Europe: +49 (0) 6441 92460

China: 10800 650 0017

Hong Kong: (+65) 6756 2394

India, Australia, New Zealand: (+65) 6755 1939

Japan: (+81 3) 3335-8152(Domestic/International), or 0120-61-1280(Domestic Only)

Korea: (+65) 6755 1989

Singapore, Malaysia, Vietnam, Thailand, Philippines, Indonesia: (+65) 6755 2044

Taiwan: (+65) 6755 1843

Data subject to change.

September 23, 2004
5988-8373EN

Agilent Technologies