Agilent HFCT-5611U
Gigabit Interface Converters (GBIC)
For Extended Link Lengths (up to 80 km)

Description

The HFCT-5611U interface converter meets the Gigabit Interface Converter specification Rev. 5.4, an industry standard. The converter provides a uniform form factor for a wide variety of standard connections to transmission media. The converter can be inserted or removed from a host chassis without removing power from the host system. The converter is suitable for Gigabit Ethernet Applications. The design of this converter is also practical for other high performance, point-to-point communication requiring gigabit interconnections. Since the converter is hot-pluggable, it allows system configuration changes simply by the plugging of a different type of converter.

The mechanical and electrical interfaces of the converter to the host system are identical for all implementations of the converter regardless of external media type. A 20-pin connector is used to connect the converter to the host system. The HFCT-5611U has been developed with 1550 nm long wavelength DFB Laser technology.

Serial Identification

The HFCT-5611U 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.

Features

- **IEEE 802.3Z Gigabit Ethernet with extended link lengths (up to 80 km)**
- **Compliant with Gigabit Interface Converter specification Rev. 5.4 (1)**
- **Hot-pluggable**
- **+5 V Power Supply**
- **Uncooled DFB Laser**
- **Eye safety certified:**
  - US 21 CFR(J)
  - IEC 60825-1 (+All)
- **PIN Receiver**
- **SC-Duplex Fiber Connector**
- **Fiber compatibility:**
  - Up to 80 km with 9 µm SM fiber

Applications

- **Gigabit Ethernet (1.25 GBd)**
- **Switch to switch interface**
- **High speed I/O for file servers**
- **Bus extension applications**

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Regulatory Compliance
See the Regulatory Compliance Table for the targeted typical and measured performance for these transceivers. The overall equipment design will determine the level it is able to be certified to. These transceiver performance targets are offered as a figure of merit to assist the designer in considering their use in equipment designs.

Electrostatic Discharge (ESD)
There are two design cases in which immunity to ESD damage is important. The first case is during handling of the transceiver prior to inserting it into the host system. It is important to use normal ESD handling precautions for ESD sensitive devices. These precautions include the use of grounded wrist straps, workbenches, and floor mats in ESD controlled areas. The second case to consider is static discharges during insertion of the GBIC into the host system.

There are two guide tabs integrated into the 20-pin connector 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.

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.

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

CAUTION:
There are no user serviceable parts nor any maintenance required for the HFCT-5611U. All adjustments are made at the factory before shipment to our customers. Tampering with or modifying the performance of any Agilent GBIC unit will result in voided product warranty. It may also result in improper operation of the circuitry, and possible overstress of the semiconductor components. Device degradation or product failure may result. Connection of the HFCT-5611U to a non-approved optical source, operating above the recommended absolute maximum conditions, or operating in a manner inconsistent with unit design and function, may result in hazardous radiation exposure and may be considered an act of modifying or manufacturing a laser product. The person(s) performing such an act is required by law to recertify the laser product under the provisions of US 21 CFR (Subchapter J).

Regulatory Compliance

This product is under testing with respect to American and European product safety and electromagnetic compatibility regulations.

Feature	Test Method	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883C Method 3015.4	Class 1 (> 1000 Volts)
Electrostatic Discharge (ESD) to the Duplex SC Receptacle	Variation of IEC 801-2	Typically, withstand at least 15kV without damage when a Human Body Model probe contacts port.
Electromagnetic Interference (EMI)	FCC Class B CENELEC EN55022 Class B (CISPR 22A) VCCI Class 1	System margins are dependent on customer board and chassis design.
Immunity	Variation of IEC 801-3	Typically show no measurable effect from a 10V/m field swept from 27 to 1000 MHz applied to the transceiver without a chassis enclosure.
Laser Eye Safety and Equipment Type Testing	US FDA CDRH AEL Class 1 US21 CFR, Subchapter J per Paragraphs 1002.10 and 1002.12. (IEC) EN60825-1: 1994 + A11+A2 (IEC) EN60825-2: 1994 + A1 (IEC) EN60950: 1992 + A1 + A2 + A3 + A4 + A11	CDRH certification #933/510236/01 TUV file #E9971083.07
Component Recognition	Underwriters Laboratories and Canadian Standards Association Joint Component Recognition for Information Technology Equipment Including Electrical Business Equipment	UL File # E173874

Eye Safety Design

The laser driver is designed to be Class 1 eye safe (CDRH21 CFR(J), IEC 60825-1) under a single fault condition.

There are three key elements to the safety circuitry: a monitor diode, a window detector circuit, and direct control of the laser bias.

The window detection circuit monitors the average optical power using the photo diode in the laser OSA. If a fault occurs such that the dc bias circuit cannot maintain the preset conditions within ±20%, TX_FAULT (Pin 10) will be asserted (high).

Note: Under any single fault, the laser optical output power will remain within Class 1 eye safe limits.

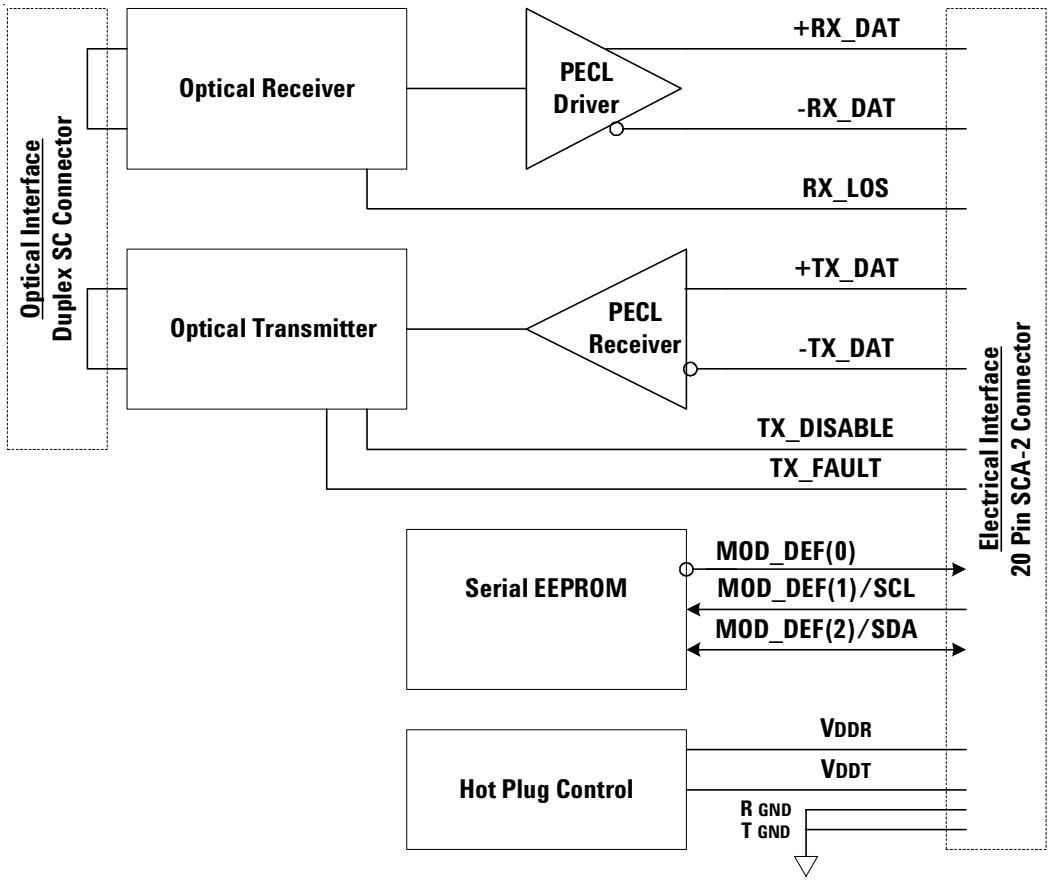

Figure 1. Block Diagram

Absolute Maximum Ratings

Absolute maximum ratings are those values beyond which functional performance is not intended, device reliability is not implied, and damage to the device may occur.

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
Storage Temperature	T_c	-40		+85	°C	
Relative Humidity (non-condensing)	RH	5		95	%	
Module Supply Voltage	$V_{CC}T$, R	-0.5		6.0	V	1
Data/Control Input Voltage	V_{IN}	-0.5		$V_{DD}T$	V	
Receiver Optical Input	PINabsmax			6	dBm	

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 amage to the device may occur for such operation over an extended time period.

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
Case Operating Temperature	T_C	0		+70	°C	
Supply Voltage	V_{CC}	4.75	5	5.25	V	
Supply Current	$I_{DD}T + I_{DD}R$			300	mA	1
Surge Current	I_{SURGE}		+30	mA	2	2
Data Rate	BR	1250		1250	Mb/s	3
Fiber Length	L	-		80	km	4, 5
Rx Input Operating Wavelength	λ	1450		1620	nm	
Control Inputs:						
TX_DISABLE,	V_{IH}	2.0		$V_{DD}T + 0.3$	V	6
MOD-DEF1,2	V_{IL}	0		0.8	V	
Sense Outputs:						6
TX_FAULT,	V_{OH}	V_{CC} - 0.5		V_{CC} + 0.3	V	
LOS, MOD-DEF0, 2	V_{OL}			0.5	V	
Data Output:						
Receiver Differential Output Voltage	±RX_DAT	400		1100	mV pk-pk	
Receiver Output Rise Time	tr	85		400	ps	
Receiver Output Fall Time	tf	85		400	ps	
Receiver Differential Output Skew				50	ps	
Data Input:						
Transmitter Differential Input Voltage	± TX_DAT	650		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. Over temperature, over life.
2. Hot plug, above steady state.
3. For data patterns with restricted lengths, e.g. 8B10B encoded data.
4. Assumes 9/125 µm fiber.
5. For short link lengths, attenuation may be necessary.
6. External 4.7-10 kΩ pull up resistor required on host board.

Transmitter Optical Characteristics

(T_C = 0 °C to +70 °C, V_{CC} = 5 V ± 5%)

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
Average Optical Output Power	Pout	0		+5	dBm	
Optical Extinction Ratio	ER	9			dB	
Center Wavelength	λC	1480	1550	1580	nm	
-20dB Spectral Width	$\Delta\lambda_{20}$			1	nm	
Side Mode Suppression Ratio		30			dB	
Optical Rise/Fall Time1.25 Gb/s	t_R, t_F			260	ps	1
Optical Rise/Fall Time1.0625 Gb/s	t_R, t_F			260	ps	1
RIN_{12} (OMA)	RIN			-120	dB/Hz	
Contributed TJ (1.25 Gb/s)	TJ			0.332	UI	2
Contributed TJ (1.063 Gb/s)	TJ			0.267	UI	2
Contributed DJ (1.063 Gb/s)	DJ			0.09	UI	
Pout TX_DISABLE Asserted	P_{OFF}			-40	dBm	

Receiver Optical Characteristics

(T_C = 0 °C to +70 °C, V_{CC} = 5 V ± 5%)

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
Receiver Sensitivity	P_{IN} MIN			-24	dBm	
Receiver Saturation	P_{IN} MAX	-3			dBm	
Wavelength	λ	1270		1620	nm	
Contributed TJ (1.25 Gb/s)	TJ			.284	UI	2
Contributed TJ (1.063 Gb/s)	TJ			.218	UI	2
Contributed DJ (1.063 Gb/s)	TJ			.12	UI	
Return Loss		12			dB	
Loss of Signal - Assert	P_A	-35			dBm	
Loss of Signal - De-Assert	P_D			-24	dBm	
Loss of Signal Hysterisis	P_D - P_A	0.5			dB	

Note:

1. Unfiltered 20-80% values.
2. Contributed total jitter is calculated from DJ and RJ measurements using TJ = RJ + DJ. Contributed RJ is calculated for $1x10^{-12}$ BER by multiplying the RMS jitter (measured on a single rise or fall edge) from the oscilloscope by 14.

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 start reset	t_reset	10				5
RX_LOS Assert Time	t_los_on			100	µs	6
RX_LOS De-Assert Time	t_los_off			100	µs	7

Notes:
1. Rising edge of TX_DISABLE to fall of output signal 10% of nominal.
2. Falling edge of TX_DISABLE to rise of output sign at above 90% of nominal.
3. From power on or hot plug after $V_{CC}T > 4.75$ volts or from negaion of TX_DISABLE during reset of TX_FAULT.
4. From occurence of fault (output safety violation or $V_{CC} < 4.5$ 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.

20-Pin SCA-2 Host Connector Characteristics

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	VDDR	2
6	MOD_DEF(2)	2	16	VDDT	2
7	TX_DISABLE*	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

Notes:
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.

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

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	Transmitter 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

EEPROM Serial ID Memory Contents

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	48	"H" - 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	43	"C" - Vendor Part Number ASCII character
6	02	Code for electronic/optical compatibility	43	54	"T" - 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	35	"5" - Vendor Part Number ASCII character
9	00	Code for electronic/optical compatibility	46	36	"6" - Vendor Part Number ASCII character
10	00	Code for electronic/optical compatibility	47	31	"1" - Vendor Part Number ASCII character
11	01	Encoding	48	31	"1" - Vendor Part Number ASCII character
12	0D	BR, Nominal	49	55	"U" - Vendor Part Number ASCII character
13	00	Reserved	50	20	" " - Vendor Part Number ASCII character
14	50	Length (9µ)	51	20	" " - Vendor Part Number ASCII character
15	00	Length (9µ)	52	20	" " - Vendor Part Number ASCII character
16	00	Length (50µ)	53	20	" " - Vendor Part Number ASCII character
17	00	Length (62.5µ)	54	20	" " - Vendor Part Number ASCII character
18	00	Length (Copper)	55	20	" " - Vendor Part Number ASCII character
19	00	Reserved	56	00	Vendor Rev
20	41	"A" - Vendor Name ASCII character	57	00	Vendor Rev
21	47	"G" - Vendor Name ASCII character	58	00	Vendor Rev
22	49	"I" - Vendor Name ASCII character	59	00	Vendor Rev
23	4C	"L" - Vendor Name ASCII character	60	00	Reserved
24	45	"E" - Vendor Name ASCII character	61	00	Reserved
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	Hardware 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

EEPROM Serial ID Memory Contents (continued)

Byte # Decimal	Data Hex	Notes	Byte # Decimal	Data Hex	Notes
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 - 127	00	Reserved

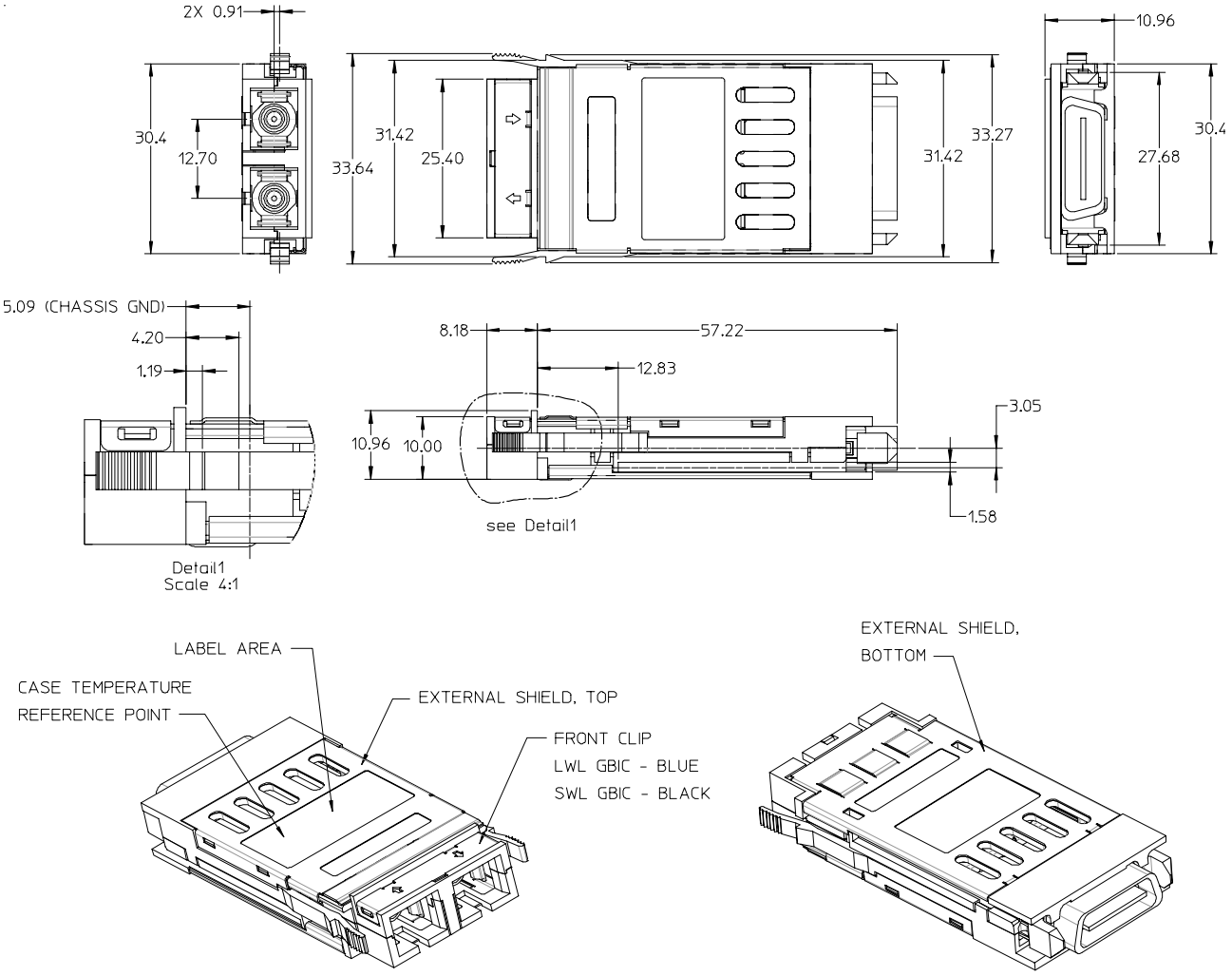

Figure 2. Package Dimensions

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Data subject to change.

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