

# SFP-1GBT-10

## SFP Copper Transceiver, 10/100/1000Base-T to SGMII with SyncE

The Bel SFP-1GBT-10 transceiver is a 10/100/1000Base-T SFP module with Synchronous Ethernet capability for SGMII host interface. The host interface transmits and receives serial data differentially at 1.25Gbps. The copper interface is advertised as full duplex and will auto-negotiate to 10/100/1000 Base-T.

### Key Features & Benefits

- Designed with Broadcom's BCM54616S chipset
- Complies with IEEE 802.3, 802.3u, and 802.3ab specifications
- Configured for operation with a SGMII compliant host
- Supports SyncE functionality (1000Base-T connection only)
- Conforms to Multi-Source Agreement (MSA) specifications for SFP transceivers (Exceptions for SyncE features)
- Supports IEEE 802.3u and IEEE 802.3ab auto-negotiation features to allow networking equipment to automatically determine and adjust the required settings
- Supports jumbo frames up to 10 KB
- Operates in extended temperature range of -40° to +85° C
- Automatically compensates for baseline wander by removing DC offset from the input signal
- Automatic dependent interface (DI) crossover, eliminating the need for crossover cables or cross-wire (MDIX) ports
- Bail latch provides ease of extraction
- Compact RJ45 connector assembly
- The BCM54616S physical layer IC (PHY) can be accessed via I<sup>2</sup>C interface:  
PHY address = "ACh"  
EEPROM address = "A0h"
- The SyncE feature can be controlled by register, accessed via I<sup>2</sup>C Interface:  
Address = "A2h"
- 128 Byte EEPROM

### Applications

- 10/100/1000 Mbps data rate in excess of 100 meters of Category 5/5e cable
- Industrial temperature environments -40° to +85° C
- Networking equipment
- Switch-to-switch interface
- Routers



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**Bel Modules**  
28 Turkey Court, Turkey Mill, Ashford Road  
Maidstone Bel ME 14 5PP UK

+44 1622 757 395  
techhelp@belf.com  
[belfuse.com](http://belfuse.com)

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### SFP-1GBT-10 Module Specifications

| Parameter      | Symbol           | Min  | Type | Max  | Units | Notes       |
|----------------|------------------|------|------|------|-------|-------------|
| Supply Voltage | V <sub>DD3</sub> | 3.13 | 3.3  | 3.46 | V     | VDC         |
| Supply Current | I <sub>s</sub>   |      | 185  |      | mA    | 1000 Base-T |

| SFP Host Serial Interface (TX/RX) | Symbol                         | Min | Type | Max | Units  | Notes  |
|-----------------------------------|--------------------------------|-----|------|-----|--------|--|
| Line Frequency                    | F <sub>LINE</sub>              |     | 125  |     | MHz    |  |
| TX Output Impedance               | Z <sub>TX_OUT</sub>            |     | 100  |     | Ω      | Differential                                       |
| RX Output Impedance               | Z <sub>RX_IN</sub>             |     | 100  |     | Ω      | Differential                                       |
| Clock Frequency                   |                                |     | 25   |     | MHz    |  |
| Rise/Fall Time                    | T <sub>R</sub> /T <sub>F</sub> |     | 4    |     | ns     | 20% - 80%  |
| RMS Phase Jitter                  | F <sub>J</sub>                 |     |      | 1.5 | ps-rms | F <sub>J</sub> = 12 kHz to 20 MHz offset frequency |

| SyncE                   | Symbol | Min | Type   | Max | Units | Notes                                |
|-------------------------|--------|-----|--------|-----|-------|--------------------------------------|
| Recovered Clock Jitter  |        |     | ±25ppm |     |       |                                      |
| Recovered Clock         | RCO    |     | 25     |     | MHz   | (125MHz for locally generated clock) |
| Primary Reference Clock | PRC    |     | 25     |     | MHz   | ±25ppm                               |

| Environmental Specifications | Symbol           | Min | Type | Max | Units | Notes               |
|------------------------------|------------------|-----|------|-----|-------|---------------------|
| Operating Temp               | T <sub>OP</sub>  | -40 |      | +85 | °C    | Case temperature    |
| Storage Temp                 | T <sub>STG</sub> | -40 |      | +85 | °C    | Ambient temperature |

## SFP Host Connector Electrical Interface Descriptions

| Pin | Name                         | Descriptions  |
|-----|------------------------------|---|
| 1   | VeeT                         | Transmitter ground (common with receiver ground)  |
| 2   | Normal Operation<br>TX Fault | <ul style="list-style-type: none"> <li>Not used. Internal pull down <sup>[1]</sup> (default)</li> </ul>   |
|     | SyncE Operation<br>RCO       | <ul style="list-style-type: none"> <li>125MHz clock locally generated <sup>[2]</sup></li> <li>Recovered Clock <sup>[3]</sup>: <ul style="list-style-type: none"> <li>Link-down – 25 MHz clock locally generated</li> <li>1000BASE-T – 25 MHz clock recovered from line-side data</li> <li>100BASE-TX – 25 MHz clock recovered from line-side data</li> <li>10BASE-T – 2.5 MHz clock recovered from line-side data</li> </ul> </li> </ul> <p>(note: PHY configuration also required)</p> |
| 3   | TX Disable                   | Disable PHY (low power mode) when logic '1'. Internal 4.7kΩ pull up   |
| 4   | MOD-DEF2                     | Signal SDA (data) of the two-wire serial interface. Internal 4.7kΩ pull up  |
| 5   | MOD-DEF1                     | Signal SCL (clock) of the two-wire serial interface. Internal 4.7kΩ pull up   |
| 6   | MOD-DEF0                     | Module Absent, pin is internally connected to transmit ground   |
| 7   | Normal Operation<br>RS0      | <ul style="list-style-type: none"> <li>Not implemented (default)</li> </ul>   |
|     | SyncE Operation<br>PRC       | <ul style="list-style-type: none"> <li>Primary reference clock (25MHz input)</li> </ul> <p>(note: PHY configuration also required)</p>  |
| 8   | LOS                          | <ul style="list-style-type: none"> <li>Logic '0' indicate Ethernet link, '1' when no signal (default)</li> </ul>  |
|     | PHY Interrupt                | <ul style="list-style-type: none"> <li>Logic '0' when PHY interrupt occurred, '1' otherwise</li> </ul> <p>(note: PHY configuration also required)</p>   |
| 9   | RS1                          | Not implemented (pin not connected)   |
| 10  | VeeR                         | Receiver ground (common with transmitter ground)  |
| 11  | VeeR                         | Receiver ground (common with transmitter ground)  |
| 12  | RD-                          | Differential Transmitter Output. User to terminate 100Ω differential at host. AC Coupled within SFP   |
| 13  | RD+                          | Differential Transmitter Output. User to terminate 100Ω differential at host. AC Coupled within SFP   |
| 14  | VeeR                         | Receiver ground (common with transmitter ground)  |
| 15  | VccR                         | 3.3V power (common with VccT)   |
| 16  | VccT                         | 3.3V power (common with VccR)   |
| 17  | VeeT                         | Transmitter ground (common with receiver ground)  |
| 18  | TD+                          | Differential Receiver Input. 100Ω differential termination & AC Coupling within SFP   |
| 19  | TD-                          | Differential Receiver Input. 100Ω differential termination & AC Coupling within SFP   |
| 20  | VeeT                         | Transmitter ground (common with receiver ground)  |

[1] Clock Output is disabled (by clear RCO Control flag in "SyncE Control")

[2] Clock Output is enabled (by set RCO Control flag in "SyncE Control") and Recovered Clock is disable (by "Recovered Clock Control")

[3] Clock Output is enabled (by set RCO Control flag in "SyncE Control") and Recovered Clock is enable (by "Recovered Clock Control")

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### Default Configuration

| Part Number | Link Indicator on Rx LOS Pin | Auto-Negotiation | SyncE    | Host Interface |
|-------------|------------------------------|------------------|----------|----------------|
| SFP-1GBT-10 | Yes                          | Enabled          | Disabled | SGMII          |

The SFP-1GBT-10 will default to SGMII without SyncE support. In this mode pins 2 and 7 have no function.

### Change Configuration

Users may select various configuration options for the module by writing to a range of I2C addresses within the device.

### SyncE Control Register\*

| Bit | Name                | Description   |
|-----|---------------------|---|
| 7   | Reserved            | Write 1 only  |
| 6   | Host Interface      | 1 = GBIC<br>0 = SGMII (default)   |
| 5   | Low Power Mode      | 1 = Low power mode released (default)<br>0 = Low power mode active                            |
| 4   | PHY Reset Line      | 1 = PHY Reset line released (default)<br>0 = PHY Reset line active                            |
| 3   | RCO Mode            | 1 = Normal RCO (2.5/25/125MHz) (default)<br>0 = Restrict clock to 25MHz                       |
| 2   | RCO Control         | 1 = disable Clock Output (pin 2) (default)<br>0 = enable Clock Output (pin 2)                 |
| 1   | LOS / PHY Interrupt | 1 = LOS functionality (pin 8) (default)<br>0 = PHY Interrupt indication (pin 8)               |
| 0   | Clock Source Select | 1 = internal 25MHz Oscillator (default)<br>0 = external Primary Reference Clock (pin 7) Input |

\* Direct access by write/read configuration byte to/from I2C device under A2h address.

### Recovered Clock Control

| I2C Device Address | Control Register | Byte 1 | Byte 2 | Description                       |
|--------------------|------------------|--------|--------|-----------------------------------|
| ACh                | 17h              | 0Fh    | 44h    | Disable Recovered Clock (default) |
| ACh                | 15h              | 00h    | 00h    |                                   |
| ACh                | 17h              | 0Fh    | 44h    | Enable Recovered Clock            |
| ACh                | 15h              | 00h    | 10h    |                                   |

### Advertise 1000BASE-T full duplex capability and Master / Slave Configuration

| I2C Device Address | Control Register | Byte 1 | Byte 2 | Description                                    |
|--------------------|------------------|--------|--------|--|
| ACh                | 09h              | 02h    | 00h    | Automatic Master/Slave configuration (default) |
| ACh                | 09h              | 1Ah    | 00h    | Configure SFP as Master                        |
| ACh                | 09h              | 12h    | 00h    | Configure SFP as Slave                         |

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### Interface Selection

At power up, the SFP-1GBT-10 is configured in SGMII mode. The user may select a different host interface using one of the following methods:

#### Changing the interface mode - method 1.

The user may select GBIC mode by writing the following two bytes to register 1Ch. (*PHY reset restore the default setting.*)

| I2C Device Address | Control Register | Byte 1 | Byte 2 | Description                 |
|--------------------|------------------|--------|--------|-----------------------------|
| ACh                | 1Ch              | FCh    | FEh    | Set mode to GBIC*           |
| ACh                | 1Ch              | FCh    | FCh    | Set mode to SGMII (default) |

\* please also clear related Auto-Negotiation Advertisement bits in PHY Register 04h.

#### Changing the interface mode - method 2.

Alternatively, the user may select GBIC mode via [SyncE Control Register](#) by following the procedure below. (*PHY reset not change the selected interface. The power cycle of SFP module, resets the settings to the default values.*)

| I2C Device Address | Config. Byte | Description                                    |
|--------------------|--------------|--|
| A2h                | EFh          | Set mode to GBIC mode<br>PHY Reset line active |
| —                  | —            | Wait, at least 10 ms                           |
| A2h                | FFh          | Release PHY Reset line                         |
| —                  | —            | Wait, at least 20 µs                           |

### List of Supported IEEE Defined PHY Registers – I2C Device Address ACh

| Register | Name                                  |
|----------|---------------------------------------|
| 00h      | Control                               |
| 01h      | Status                                |
| 02h-03h  | PHY Identifier                        |
| 04h      | Auto-Negotiation Advertisement        |
| 05h      | Auto-Negotiation Link Partner Ability |
| 06h      | Auto-Negotiation Expansion            |
| 07h      | Next Page Transmit                    |
| 08h      | Link Partner Received Next Page       |
| 09h      | 1000Base-T Control                    |
| 0Ah      | 1000Base-T Status                     |
| 0Fh      | Extended Status                       |
| 19h      | Auxiliary Status Register             |

### PHY Register 00h: Control

| Bit | Name     | Description   | R/W                   | Default |
|-----|----------|---|-----------------------|---------|
| 15  | Reset    | Software Reset<br>1 = PHY reset<br>0 = normal operation | R/W<br>*Self-Clearing | 0       |
| 14  | Loopback | Internal loopback mode<br>1 = enable loopback mode      | R/W                   | 0       |

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| Bit | Name                     | Description   | R/W                   | Default |
|-----|--------------------------|---|-----------------------|---------|
|     |                          | 0 = disable loopback mode   |                       |         |
| 13  | Speed Selection (LSB)    | When auto-negotiation is disabled, bits 6 and 13 can be used to manually select the speed of operation<br>Bits [6, 13]<br>11 = Reserved<br>10 = 1000Mbps<br>01 = 100Mbps<br>00 = 10Mbps | R/W                   | 0       |
| 12  | Auto-Negotiation Enable  | If enabled, Auto-Negotiation result overrides Speed Selection, Duplex Mode settings.<br>1 = enable Auto-Negotiation process<br>0 = disable Auto-Negotiation process                     | R/W                   | 1       |
| 11  | Power Down               | Placed SFP in a low-power mode.<br>1 = power down<br>0 = normal operation   | R/W                   | 0       |
| 10  | Isolate                  | 1 = isolate<br>0 = normal operation   | R/W                   | 0       |
| 9   | Restart Auto-Negotiation | When auto-negotiation is enabled, setting this bit restarts the Auto-Negotiation process.<br>1 = restart Auto-Negotiation process<br>0 = normal operation                               | R/W<br>*Self-Clearing | 0       |
| 8   | Duplex Mode              | 1 = full duplex<br>0 = half duplex  | R/W                   | 1       |
| 7   | Reserved                 | Write as 0, ignore on read  | R/W                   | 0       |
| 6   | Speed Selection (MSB)    | Use in conjunction with bit 13  | R/W                   | 1       |
| 5:0 | Reserved                 | Write as zero, ignore on read   | R/W                   | 000000  |

### PHY Register 01h: Status

| Bit | Name                      | Description  | R/W | Default |
|-----|---------------------------|--|-----|---------|
| 15  | 100BASE-T4                | 100BASE-T4 protocol is not supported.<br>0 = not capable to perform 100BASE-T4   | RO  | 0       |
| 14  | 100BASE-TX Full Duplex    | 1 = capable to perform full duplex 100BASE-TX<br>0 = not capable to perform full duplex 100BASE-TX                                   | RO  | 1       |
| 13  | 100BASE-TX Half Duplex    | 1 = capable to perform half duplex 100BASE-TX<br>0 = not capable to perform half duplex 100BASE-TX                                   | RO  | 1       |
| 12  | 10Base-T Full Duplex      | 1 = capable to operate at 10Base-T in full duplex mode<br>0 = not capable to operate at 10Base-T in full duplex mode                 | RO  | 1       |
| 11  | 10Base-T Half Duplex      | 1 = capable to operate at 10Base-T in half duplex mode<br>0 = not capable to operate at 10Base-T in half duplex mode                 | RO  | 1       |
| 10  | 100BASE-T2 Full Duplex    | 100BASE-T2 protocol is not supported.<br>0 = not capable to perform full duplex 100BASE-T2   | RO  | 0       |
| 9   | 100BASE-T2 Half Duplex    | 100BASE-T2 protocol is not supported.<br>0 = not capable to perform half duplex 100BASE-T2   | RO  | 0       |
| 8   | Extended Status           | 1 = extended status information in register 0Fh  | RO  | 1       |
| 7   | Reserved                  | Ignore on read   | RO  | 1       |
| 6   | MF Preamble Suppression   | 1 = PHY will accept management frames with preamble suppressed<br>0 = PHY will not accept management frames with preamble suppressed | RO  | 1       |
| 5   | Auto-Negotiation Complete | 1 = Auto-Negotiation process completed<br>0 = Auto-Negotiation process not completed   | RO  | 0       |
| 4   | Remote Fault              | 1 = remote fault condition detected  | RO  | 0       |

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| Bit | Name                     | Description  | R/W | Default |
|-----|--------------------------|--|-----|---------|
|     |                          | 0 = no remote fault condition detected   |     |         |
| 3   | Auto-Negotiation Ability | 1 = capable to perform Auto-Negotiation  | RO  | 1       |
| 2   | Link Status              | 1 = link is up<br>0 = link is down   | RO  | 0       |
| 1   | Jabber Detect            | 1 = jabber condition detected<br>0 = no jabber condition detected              | RO  | 0       |
| 0   | Extended Capability      | 1 = extended register capabilities<br>0 = basic register set capabilities only | RO  | 1       |

### PHY Register 02h-03h: PHY Identifier

| Bit  | Name                      | Description                                   | R/W | Default |
|------|---------------------------|---|-----|---------|
| 15:0 | Address 02h: PHY ID (MSB) | MSB of PHY Identifier                         | RO  | 0362h   |
| 15:0 | Address 03h: PHY ID (LSB) | LSB of PHY Identifier<br>(* - PHY Rev Number) | RO  | 5D1*h   |

### PHY Register 04h: Auto-Negotiation Advertisement

| Bit | Name                           | Description  | R/W | Default |
|-----|--------------------------------|--|-----|---------|
| 15  | Next Page                      | 1 = Next Page capable<br>0 = no Next Page capability   | R/W | 0       |
| 14  | Reserved                       | Write as zero, ignore on read  | R/W | 0       |
| 13  | Remote Fault                   | 1 = remote fault supported<br>0 = no remote fault  | R/W | 0       |
| 12  | Reserved                       | Write as zero, ignore on read  | R/W | 0       |
| 11  | Asymmetric Pause               | 1 = advertise asymmetric pause<br>0 = advertise no asymmetric pause                            | R/W | 0       |
| 10  | Pause Capable                  | 1 = capable of full duplex pause operation<br>0 = not capable of pause operation               | R/W | 0       |
| 9   | 100BASE-T4 Capable             | 100BASE-T4 protocol is not supported. Do not write 1.<br>0 = not capable to perform 100BASE-T4 | R/W | 0       |
| 8   | 100BASE-TX Full Duplex Capable | 1 = 100BASE-TX full duplex capable<br>0 = Not 100BASE-TX full duplex capable                   | R/W | 1       |
| 7   | 100BASE-TX Half Duplex Capable | 1 = 100BASE-TX half duplex capable<br>0 = Not 100BASE-TX half duplex capable                   | R/W | 1       |
| 6   | 10BASE-T Full Duplex Capable   | 1 = 10BASE-T full duplex capable<br>0 = Not 10BASE-T full duplex capable                       | R/W | 1       |
| 5   | 10BASE-T Half Duplex Capable   | 1 = 10BASE-T half duplex capable<br>0 = Not 10BASE-T half duplex capable                       | R/W | 1       |
| 4:0 | Selector Field                 | Selector Field mode: 00001 = IEEE 802.3  | R/W | 00001   |

### PHY Register 05h: Auto-Negotiation Link Partner Ability

| Bit | Name         | Description  | R/W | Default |
|-----|--------------|--|-----|---------|
| 15  | Next Page    | 1 = link partner capable of Next Page<br>0 = link partner not capable of Next Page               | RO  | 0       |
| 14  | Acknowledge  | 1 = link partner has received link code word<br>0 = link partner has not received link code word | RO  | 0       |
| 13  | Remote Fault | 1 = link partner has detected remote fault<br>0 = link partner has not detected remote fault     | RO  | 0       |

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| Bit | Name                           | Description  | R/W | Default |
|-----|--------------------------------|--|-----|---------|
| 12  | Reserved                       | Write as zero, ignore on read  | RO  | 0       |
| 11  | Asymmetric Pause               | 1 = link partner wants asymmetric pause<br>0 = link partner does not want asymmetric pause                   | RO  | 0       |
| 10  | Pause Capable                  | 1 = link partner is capable of pause operation<br>0 = link partner is not capable of pause operation         | RO  | 0       |
| 9   | 100BASE-T4 Capable             | 1 = link partner is 100BASE-T4 capable<br>0 = link partner is not 100BASE-T4 capable                         | RO  | 0       |
| 8   | 100BASE-TX Full Duplex Capable | 1 = link partner is 100BASE-TX full duplex capable<br>0 = link partner is not 100BASE-TX full duplex capable | RO  | 0       |
| 7   | 100BASE-TX Half Duplex Capable | 1 = link partner is 100BASE-TX half duplex capable<br>0 = link partner is not 100BASE-TX half duplex capable | RO  | 0       |
| 6   | 10BASE-T Full Duplex Capable   | 1 = Link partner is 10BASE-T full duplex capable<br>0 = Link partner is not 10BASE-T full duplex capable     | RO  | 0       |
| 5   | 10BASE-T Half Duplex Capable   | 1 = link partner is 10BASE-T half duplex capable<br>0 = link partner is not 10BASE-T half duplex capable     | RO  | 0       |
| 4:0 | Protocol Selector Field        | Link partner protocol selector field   | RO  | 00000   |

### PHY Register 06h: Auto-Negotiation Expansion

| Bit  | Name                                | Description  | R/W | Default  |
|------|-------------------------------------|--|-----|----------|
| 15:7 | Reserved                            | Write as zero, ignore on read  | RO  | 00000000 |
| 6    | Receive Next Page Location Able     | 1 = bit 5 determines Next Page receive location.<br>0 = bit 5 does not determine Next Page receive location.                               | RO  | 1        |
| 5    | Received Next Page Storage Location | 1 = link partner Next Pages are stored in Register 8<br>0 = link partner Next Pages are stored in Register 5                               | RO  | 1        |
| 4    | Parallel Detection Fault            | 1 = a fault has been detected via the Parallel Detection function<br>0 = a fault has not been detected via the Parallel Detection function | RO  | 0        |
| 3    | Link Partner Next Page Able         | 1 = link Partner is Next Page able<br>0 = link Partner is not Next Page able   | RO  | 0        |
| 2    | Next Page Able                      | 1 = local Device is Next Page able<br>0 = local Device is not Next Page able   | RO  | 1        |
| 1    | Page Received                       | 1 = a New Page has been received<br>0 = a New Page has not been received   | RO  | 0        |
| 0    | Link Partner Auto-Negotiation Able  | 1 = link Partner is Auto-Negotiation able<br>0 = link Partner is not Auto-Negotiation able   | RO  | 0        |

### PHY Register 07h: Next Page Transmit

| Bit  | Name                           | Description   | R/W | Default    |
|------|--------------------------------|---|-----|------------|
| 15   | Next Page                      | 1 = additional Next Pages to follow<br>0 = last Next Page   | R/W | 0          |
| 14   | Reserved                       | Write as zero, ignore on read                               | RO  | 0          |
| 13   | Message Page                   | 1 = message page<br>0 = unformatted page                    | R/W | 1          |
| 12   | Acknowledge 2                  | 1 = complies with message<br>0 = cannot comply with message | R/W | 0          |
| 11   | Toggle                         | Toggles between exchanges of different Next Pages           | RO  | 0          |
| 10:0 | Message/Unformatted Code field | Next Page message code or unformatted data                  | R/W | 0000000001 |



### PHY Register 08h: Link Partner Received Next Page

| Bit  | Name               | Description   | R/W | Default    |
|------|--------------------|---|-----|------------|
| 15   | Next Page          | 1 = additional Next Pages to follow<br>0 = last Next Page   | RO  | 0          |
| 14   | Acknowledge        | 1 = acknowledge<br>0 = no acknowledge                       | RO  | 0          |
| 13   | Message Page       | 1 = message page<br>0 = unformatted page                    | RO  | 0          |
| 12   | Acknowledge 2      | 1 = complies with message<br>0 = cannot comply with message | RO  | 0          |
| 11   | Toggle             | Toggles between exchanges of different Next Pages           | RO  | 0          |
| 10:0 | Message Code field | Next Page message code or unformatted data                  | RO  | 0000000000 |

### PHY Register 09h: 1000Base-T Control

| Bit   | Name                              | Description  | R/W | Default  |
|-------|-----------------------------------|--|-----|----------|
| 15:13 | Test mode bits                    | 000 = normal operation<br>001 = test mode 1—Transmit waveform test<br>010 = test mode 2—Master transmit jitter test<br>011 = test mode 3—Slave transmit jitter test<br>100 = test mode 4—Transmitter distortion test<br>101, 110, 111 = reserved | R/W | 000      |
| 12    | Master/Slave Manual Config Enable | 1 = manual Master/Slave configuration<br>0 = automatic Master/Slave configuration  | R/W | 0        |
| 11    | Master/Slave Config Value         | 1 = configure PHY as Master<br>0 = configure PHY as Slave<br>This bit is ignored if bit 12 = 0.  | R/W | 0        |
| 10    | Port type                         | 1 = indicate the preference to operate as multiport device<br>0 = indicate the preference to operate as single-port device   | R/W | 0        |
| 9     | 1000BASE-T Full Duplex            | 1 = advertise 1000BASE-T full duplex capability<br>0 = advertise no 1000BASE-T full duplex capability  | R/W | 1        |
| 8     | 1000BASE-T Half Duplex            | 1 = advertise 1000BASE-T half duplex capability<br>0 = advertise no 1000BASE-T half duplex capability  | R/W | 1        |
| 7:0   | Reserved                          | Write as 0, ignore on read.  | R/W | 00000000 |

### PHY Register 0Ah: 1000Base-T Status

| Bit | Name                                  | Description  | R/W                  | Default  |
|-----|---------------------------------------|--|----------------------|----------|
| 15  | Master/Slave configuration fault      | 1 = Master/Slave configuration fault detected<br>0 = no Master/Slave configuration fault detected                  | RO                   | 0        |
| 14  | Master/Slave configuration resolution | 1 = local transmitter is Master<br>0 = local transmitter is Slave  | RO                   | 0        |
| 13  | Local Receiver Status                 | 1 = local receiver OK<br>0 = local receiver not OK   | RO                   | 0        |
| 12  | Remote Receiver Status                | 1 = remote Receiver OK<br>0 = remote Receiver not OK   | RO                   | 0        |
| 11  | LP 1000T FD                           | 1 = link partner is capable of 1000BASE-T full duplex<br>0 = link partner is not capable of 1000BASE-T full duplex | RO                   | 0        |
| 10  | LP 1000T HD                           | 1 = link partner is capable of 1000BASE-T half duplex<br>0 = link partner is not capable of 1000BASE-T half duplex | RO                   | 0        |
| 9:8 | Reserved                              | Write as zero, ignore on read  | RO                   | 00       |
| 7:0 | Idle Error Count                      | Indicate the idle Error count, since last read   | RO<br>*Self-Clearing | 00000000 |

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### PHY Register 0Fh: Extended Status

| Bit  | Name                   | Description  | R/W | Default      |
|------|------------------------|--|-----|--------------|
| 15   | 1000BASE-X Full Duplex | 1 = 1000BASE-X full duplex capable<br>0 = Not 1000BASE-X full duplex capable | RO  | 0            |
| 14   | 1000BASE-X Half Duplex | 1 = 1000BASE-X half duplex capable<br>0 = Not 1000BASE-X half duplex capable | RO  | 0            |
| 13   | 1000BASE-T Full Duplex | 1 = 1000BASE-T full duplex capable<br>0 = Not 1000BASE-T full duplex capable | RO  | 1            |
| 12   | 1000BASE-T Half Duplex | 1 = 1000BASE-T half duplex capable<br>0 = Not 1000BASE-T half duplex capable | RO  | 1            |
| 11:0 | Reserved               | Write as zero, ignore on read  | RO  | 000000000000 |

### PHY Register 19h: Auxiliary Status Register

| Bit   | Name                                    | Description   | R/W | Default |
|-------|---|---|-----|---------|
| 15    | Auto-Negotiation Complete               | 1 = Auto-Negotiation process completed<br>0 = Auto-Negotiation process not completed  | RO  | 0       |
| 14:13 | Reserved                                | Ignore on read  | RO  | 00      |
| 12    | Auto-Negotiation Ability Detect State   | 1 = Auto-Negotiation acknowledge detect state<br>0 = State not entered  | RO  | 0       |
| 11    | Reserved                                | Ignore on read  | RO  | 0       |
| 10:8  | Current Operating Speed and Duplex mode | 000 = link has not been established<br>001 = 10BASE-T half-duplex<br>010 = 10BASE-T full-duplex<br>011 = 100BASE-TX half-duplex<br>100 = 100BASE-T4<br>101 = 100BASE-TX full-duplex<br>110 = 1000BASE-T half-duplex<br>111 = 1000BASE-T full-duplex | RO  | 000     |
| 7     | Parallel Detection Fault                | 1 = parallel link fault detected<br>0 = parallel link fault not detected  | RO  | 0       |
| 6     | Remote Fault                            | 1 = link partner has detected remote fault<br>0 = link partner has not detected remote fault  | RO  | 0       |
| 5     | Reserved                                | Ignore on read  | RO  | 0       |
| 4     | Link Partner Auto-Negotiation Ability   | 1 = link partner has Auto-Negotiation capability<br>0 = link partner does not perform Auto-Negotiation  | RO  | 0       |
| 3     | Reserved                                | Ignore on read  | RO  | 0       |
| 2     | Link Status                             | 1 = link status is OK<br>0 = link status is not OK  | RO  | 0       |
| 1:0   | Reserved                                | Ignore on read  | RO  | 00      |

### EEPROM Data Fields; I2C Device Address A0h

| Address | Name of Field   | Data Value | Note |
|---------|-----------------|------------|------|
| 00h     | Identifier      | 03h        |      |
| 01h     | Ext. Identifier | 04h        |      |
| 02h     | Connector       | 00h        |      |
| 03h     | Reserved        | 00h        |      |
| 04h     | Sonet Codes     | 00h        |      |

## SFP Copper Transceiver, 10/100/1000Base-T to SGMII with SyncE

| Address | Name of Field | Data Value | Note         |
|---------|---------------|------------|--------------|
| 05h     | Sonet Codes   | 00h        |              |
| 06h     | GbE Code      | 08h        |              |
| 07h     | Fibre Code    | 00h        |              |
| 08h     | Fibre Code    | 00h        |              |
| 09h     | Fibre Code    | 00h        |              |
| 0Ah     | Fibre Code    | 00h        |              |
| 0Bh     | Encoding      | 01h        |              |
| 0Ch     | BR. Normal    | 0Dh        |              |
| 0Dh     | Reserved      | 00h        |              |
| 0Eh     | Length 9m-Km  | 00h        |              |
| 0Fh     | Length 9m     | 00h        |              |
| 10h     | Length 50m    | 00h        |              |
| 11h     | Length 62.5m  | 00h        |              |
| 12h     | Length Copper | 64h        |              |
| 13h     | Reserved      | 00h        |              |
| 14h     | Vendor Name   | 42h        | ASCII: "B"   |
| 15h     | Vendor Name   | 45h        | ASCII: "E"   |
| 16h     | Vendor Name   | 4Ch        | ASCII: "L"   |
| 17h     | Vendor Name   | 2Dh        | ASCII: "-"   |
| 18h     | Vendor Name   | 46h        | ASCII: "F"   |
| 19h     | Vendor Name   | 55h        | ASCII: "U"   |
| 1Ah     | Vendor Name   | 53h        | ASCII: "S"   |
| 1Bh     | Vendor Name   | 45h        | ASCII: "E"   |
| 1Ch     | Vendor Name   | 20h        | ASCII: Space |
| 1Dh     | Vendor Name   | 20h        | ASCII: Space |
| 1Eh     | Vendor Name   | 20h        | ASCII: Space |
| 1Fh     | Vendor Name   | 20h        | ASCII: Space |
| 20h     | Vendor Name   | 20h        | ASCII: Space |
| 21h     | Vendor Name   | 20h        | ASCII: Space |
| 22h     | Vendor Name   | 20h        | ASCII: Space |
| 23h     | Vendor Name   | 20h        | ASCII: Space |
| 24h     | Reserved      | 00h        |              |
| 25h     | Vendor OUI    | 00h        |              |
| 26h     | Vendor OUI    | 00h        |              |
| 27h     | Vendor OUI    | 00h        |              |
| 28h     | Vendor PN     | 31h        | ASCII: "1"   |
| 29h     | Vendor PN     | 47h        | ASCII: "G"   |
| 2Ah     | Vendor PN     | 42h        | ASCII: "B"   |
| 2Bh     | Vendor PN     | 54h        | ASCII: "T"   |
| 2Ch     | Vendor PN     | 2Dh        | ASCII: "-"   |
| 2Dh     | Vendor PN     | 53h        | ASCII: "S"   |
| 2Eh     | Vendor PN     | 46h        | ASCII: "F"   |
| 2Fh     | Vendor PN     | 50h        | ASCII: "P"   |
| 30h     | Vendor PN     | 31h        | ASCII: "1"   |
| 31h     | Vendor PN     | 30h        | ASCII: "0"   |
| 32h     | Vendor PN     | 20h        | ASCII: Space |
| 33h     | Vendor PN     | 20h        | ASCII: Space |
| 34h     | Vendor PN     | 20h        | ASCII: Space |

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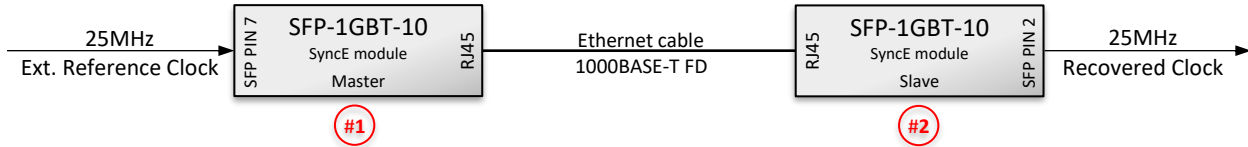
## SFP Copper Transceiver, 10/100/1000Base-T to SGMII with SyncE

| Address | Name of Field     | Data Value | Note                 |
|---------|-------------------|------------|----------------------|
| 35h     | Vendor PN         | 20h        | ASCII: Space         |
| 36h     | Vendor PN         | 20h        | ASCII: Space         |
| 37h     | Vendor PN         | 20h        | ASCII: Space         |
| 38h     | Vendor Rev        | 41h-5Ah    |                      |
| 39h     | Vendor Rev        | 20h        | ASCII: Space         |
| 3Ah     | Vendor Rev        | 20h        | ASCII: Space         |
| 3Bh     | Vendor Rev        | 20h        | ASCII: space         |
| 3Ch     | Laser Wavelength  | 00h        |                      |
| 3Dh     | Laser Wavelength  | 00h        |                      |
| 3Eh     | Reserved          | 00h        |                      |
| 3Fh     | CC_Base           |            | Checksum (00h - 3Eh) |
| 40h     | Reserved          | 00h        |                      |
| 41h     | Options           | 12h        |                      |
| 42h     | BR. Max           | 00h        |                      |
| 43h     | BR. Min           | 00h        |                      |
| 44h     | Vendor SN         | 30h-39h    |                      |
| 45h     | Vendor SN         | 30h-39h    |                      |
| 46h     | Vendor SN         | 30h-39h    |                      |
| 47h     | Vendor SN         | 30h-39h    |                      |
| 48h     | Vendor SN         | 30h-39h    |                      |
| 49h     | Vendor SN         | 30h-39h    |                      |
| 4Ah     | Vendor SN         | 30h-39h    |                      |
| 4Bh     | Vendor SN         | 30h-39h    |                      |
| 4Ch     | Vendor SN         | 30h-39h    |                      |
| 4Dh     | Vendor SN         | 30h-39h    |                      |
| 4Eh     | Vendor SN         | 30h-39h    |                      |
| 4Fh     | Vendor SN         | 30h-39h    |                      |
| 50h     | Vendor SN         | 30h-39h    |                      |
| 51h     | Vendor SN         | 30h-39h    |                      |
| 52h     | Vendor SN         | 30h-39h    |                      |
| 53h     | Vendor SN         | 30h-39h    |                      |
| 54h     | Year              | 31h-32h    |                      |
| 55h     | Year              | 30h-39h    |                      |
| 56h     | Week              | 30h-35h    |                      |
| 57h     | Week              | 30h-39h    |                      |
| 58h     | Date Code         | 20h        | space                |
| 59h     | Date Code         | 20h        | space                |
| 5Ah     | Date Code         | 20h        | space                |
| 5Bh     | Date Code         | 20h        | space                |
| 5Ch     | No Diag           | 00h        |                      |
| 5Dh     | Enhanced Features | 00h        |                      |
| 5Eh     | No Diag           | 00h        |                      |
| 5Fh     | CC_EXT            |            | Checksum (40h - 5Eh) |
| 60h-7Fh | Not Used          | 00h        |                      |

# SFP-1GBT-10

## SFP Copper Transceiver, 10/100/1000Base-T to SGMII with SyncE

### SyncE Configuration Example



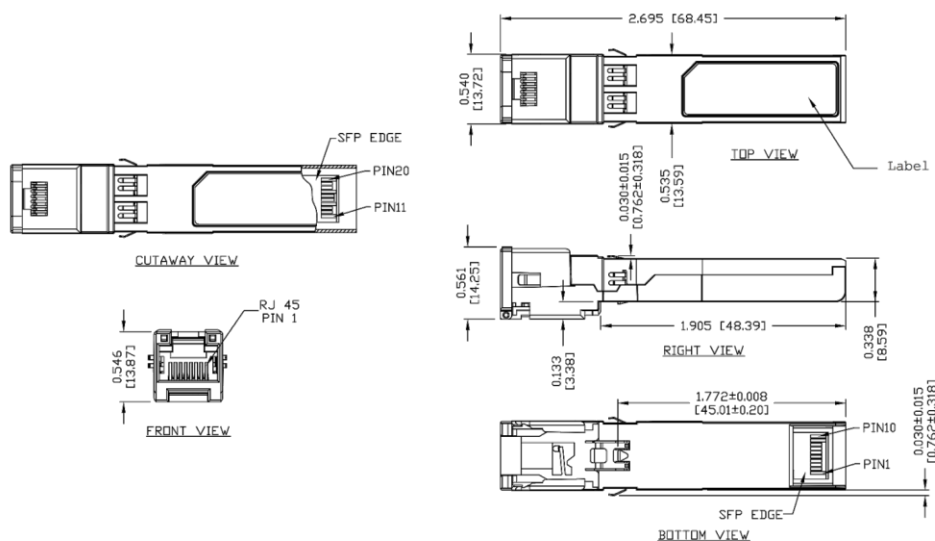
### #1 Enable Primary Reference 25MHz Clock input on pin 7 for the SFP in Master mode - SyncE Configuration Sequence

| Device Address | Control Register / Config. Byte | Byte 1 | Byte 2 | Description  |
|----------------|---------------------------------|--------|--------|--|
| A2h            | FEh                             | -      | -      | Enable external Primary Reference Clock Input (pin 7)        |
| ACH            | 09h                             | 1Ah    | 00h    | Configure SFP as manual Master mode (1000BASE-T full duplex) |
| ACH            | 00h                             | 13h    | 40h    | Restart Auto-Negotiation                                     |

### #2 Enable Recovery Clock Output on pin 2 for the SFP in Slave mode - SyncE Configuration Sequence

| Device Address | Control Register / Config. Byte | Byte 1 | Byte 2 | Description   |
|----------------|---------------------------------|--------|--------|---|
| ACH            | 17h                             | 0Fh    | 44h    | Enable Clock Data Recovery Process                          |
| ACH            | 15h                             | 00h    | 10h    | Enable Clock Data Recovery Process                          |
| A2h            | BBh                             | -      | -      | Enable Clock Output (pin 2)                                 |
| ACH            | 09h                             | 12h    | 00h    | Configure SFP as manual Slave mode (1000BASE-T full duplex) |
| ACH            | 00h                             | 13h    | 40h    | Restart Auto-Negotiation                                    |

### Mechanical



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