

EOL2-1596-80

10Gbit/s X2 ZR 1550 nm Transceiver

Features

- ◆ Compatible with X2 MSA Rev.2.0b
- ◆ Support of IEEE 802.3ae, 10GBASE-ZR application
- ◆ Transmission distance up to 80km over SMF
- ◆ Low Power Consumption 2.0 W (typ.)
- ◆ Case Temperature Range:
Standard: -5°C - 70°C
- ◆ APD Photo-detector
- ◆ Laser Class 1 compliant
- ◆ Duplex SC connector
- ◆ Hot pluggable 70-pin connector with XAUI electrical interface
- ◆ Management and control via MDIO 2-wire interface
- ◆ Complaint with the EU RoHS 6 Environmental requirements



Applications

- ◆ 10G Ethernet

Ordering Information

| Part No. | Data Rate | Fiber | Distance ^{*(note2)} | Temperature | DDM |
|---------------------------------|-------------|-------|------------------------------|-------------|-----|
| EOL2-1596-80 ^(note1) | 10.3125Gbps | SMF | 80km | Standard | YES |

Note1: Standard version

Note2: Over 9/125um SMF.

Regulatory Compliance

| Feature | Standard | Performance |
|--|--|--|
| Electrostatic Discharge (ESD) to the Electrical Pins | MIL-STD-883G Method 3015.7 | Class 1C (>1000V) |
| Electrostatic Discharge to the Enclosure | EN 55024:1998+A1+A2 IEC-61000-4-2 GR-1089-CORE | Compliant with standards |
| Electromagnetic Interference (EMI) | FCC Part 15 Class B EN55022:2006 CISPR 22B :2006 VCCI Class B | Compliant with standards Noise frequency range: 30MHz to 6GHz. Good system EMI design practice required to achieve Class B margins. System margins are dependent on customer host board and chassis design. |
| Immunity | EN 55024:1998+A1+A2 IEC 61000-4-3 | Compliant with standards. 1KHz sine-wave, 80% AM, from 80MHz to 1GHz. No effect on transmitter/receiver performance is detectable between these limits. |
| Laser Eye Safety | FDA 21CFR 1040.10 and 1040.11 EN (IEC) 60825-1:2007 EN (IEC) 60825-2:2004+A1 | CDRH compliant and Class I laser product. TüV Certificate No. 50135086 |
| Component Recognition | UL and CUL EN60950-1:2006 | UL file E317337 TüV Certificate No. 50135086 (CB scheme) |
| RoHS6 | 2002/95/EC 4.1&4.2 2005/747/EC 5&7&13 | Compliant with standards ^{*note3} |

Note3: For update of the equipments and strict control of raw materials, EOPTOLINK has the ability to supply the customized products since Jan 1, 2007, which meet the requirements of RoHS6 (Restrictions on use of certain Hazardous Substances) of European Union.

In light of item 5 in RoHS exemption list of RoHS Directive 2002/95/EC, Item 5: Lead in glass of cathode ray tubes, electronic components and fluorescent tubes.

In light of item 13 in RoHS exemption list of RoHS Directive 2005/747/EC, Item13: Lead and cadmium in optical and filter glass. The three exemptions are being concerned for Eoptolink's transceivers, because Eoptolink's transceivers use glass, which may contain Pb, for components such as lenses, windows, isolators, and other electronic components.

Description

The EOL2-1596-80 is a highly integrated, serial optical transponder module for high-speed,

10Gbit/s data transmission applications. The module is fully compliant to IEEE 802.3ae standard for Ethernet, making it ideally suited for 10GbE datacom (rack to-rack, client interconnection) applications. Designed for distances of up to 80km, the transponder module comprises a transmitter with a directly modulated uncooled 1550nm EML laser, a receiver with a APD photodiode, a XAUI-Attachment Interface, an integrated Coder /Decoder and multiplexer / de-multiplexer (SERDES: Serializer/Deserializer).

The transponder operates within a wide case temperature range of -5°C to +70°C and offers optimum heat dissipation and excellent electromagnetic shielding which enables high port densities for 10GbE systems. A 70 pin electrical connector and a duplex SC connector optical interface assure that connectivity is compliant to the X2 and XENPAK MSA.

Digital diagnostic monitoring (DDM) is implemented and fully compliant with X2 DDM architecture. The unit monitors temperature, receive optical power, transmit optical power, and laser bias current.

Absolute Maximum Ratings*

| Rating | Symbol | Min | Max | Units |
|-----------------------------------|----------------------|------|------|-------|
| Storage Ambient Temperature | T _s | -40 | +85 | °C |
| Powered Case Temperature | T _c | -5 | +70 | °C |
| Supply Voltage 3.3V | V _{CC3} | -0.3 | 4.0 | V |
| Supply Voltage 5V | V _{CC5} | -0.5 | 7.0 | V |
| Input Voltage Low Speed Signals | V _I | -0.5 | 3.3 | V |
| Clamp Currents Low Speed Signals | I _{IK} | -50 | | mA |
| XAUI Input Level | V _{I,XAUI} | -0.4 | 2.3 | V |
| Differential XAUI Input Amplitude | V _{ID,XAUI} | | 1000 | mV |
| Static Discharge Voltage | | | 500 | V |

*Any stress beyond the maximum ratings can result in permanent damage. The device specifications are guaranteed only under the recommended operating conditions.

Recommended Operating Conditions

| Parameter | Symbol | Min | Typ | Max | Units |
|----------------------------------|------------------|-------|------|-------|-------|
| Operating Case Temperature Range | T _c | 0 | | +70 | °C |
| Operating Humidity | | 8 | | 80 | % |
| Power Supply Voltage @ 3.3V | V _{CC3} | 3.135 | 3.3 | 3.465 | V |
| Power Supply Voltage @ 5.0V | V _{CC5} | 4.75 | 5.00 | 5.25 | V |

Electrical Characteristics

| Parameter | Symbol | Min | Typ | Max | Units |
|---------------------|-------------------|-----|-----|-----|-------|
| 5V Supply Current | I _{VCC5} | - | - | 350 | mA |
| 3.3V Supply Current | I _{VCC3} | - | - | 300 | mA |

XAUI Input Characteristics ^{*Note4}

| Parameter | Conditions | Symbol | Min | Typ | Max | Units |
|-------------------------------------|-----------------------------|-------------------|------|---------|-------|-------------------|
| Data Rate | | | | 10.3125 | | GBD |
| Differential Input Voltage Swing | 8B/10B Coded Input Signal | V _{ID} | 175 | | 2,000 | mV _{P-P} |
| Differential Return Loss | 100MHz — 2.5GHz | SDD11 | 10 | | | dB |
| Common Mode Return Loss | 100MHz — 2.5GHz | SCC11 | 6 | | | dB |
| Total Peak-to-Peak Jitter Tolerance | Sinusoidal Jitter @ 0~20MHz | T _{JRDS} | 0.32 | | | UI |
| Differential Input Impedance | | R _{IND} | 80 | 100 | 120 | Ω |

Note4: XAUI-input-Lanes are ac-inputs.

XAUI Output Characteristics ^{*Note5}

| Parameter | Conditions | Symbol | Min | Typ | Max | Units |
|-----------------------------------|-----------------------------|------------------|-----|---------|-------|-------------------|
| XAUI Data Rate | | | | 10.3125 | | GBD |
| Differential Output Voltage Swing | R _{LOAD} =100 ± 5% | V _{out} | 800 | | 1,600 | mV _{P-P} |
| Differential Output Impedance | | Z _{out} | 80 | 100 | 120 | Ω |
| Differential Transition Time | 20% - 80% | tr/tf | 50 | | 130 | ps |
| Total Output Jitter | | | | | 0.17 | UI |
| Total Deterministic Output Jitter | | | | | 0.08 | UI |

Note5: XAUI-output-Lanes are ac-outputs.

Optical Interface

Recommended Operating Conditions

| Parameter | Remark | Symbol | Min | Typ | Max | Units |
|-----------------------|-------------------|------------------|-----|---------|-----|-------|
| Operating Range | Single Mode Fiber | | | 80 | | km |
| Input Data Rate | | | | 10.3125 | | GBD |
| Receiver Input Signal | Center Wavelength | λ _c | | 1550 | | nm |
| | Sensitivity | P _{min} | | | -24 | dBm |
| | Overload | P _{max} | | | -7 | dBm |

Transmitter Characteristics

(If not otherwise mentioned under recommended operating conditions and standard compliant single mode fiber.)

| Characteristic | Conditions | Symbol | Min | Typ | Max | Units |
|------------------------------|------------------------|------------------|-------|---------|-------|-------|
| Data Rate | | | | 10.3125 | | GBD |
| Nominal Wavelength | | λ_c | 1,530 | 1,550 | 1,570 | nm |
| Spectral Width (-20 dB) | | $\Delta \lambda$ | | 0.6 | | nm |
| SMSR | | SMSR | 30 | | | dB |
| Optical Output Power | | P _{out} | -1 | | 4 | dBm |
| Extinction Ratio | | ER | 8.2 | | | dB |
| Optical Modulation Amplitude | | OMA | 500 | | | pW |
| Transmitter Penalty | Bessel-Thompson Filter | TP | | | 2 | dB |
| Overshoot | Bessel-Thompson Filter | O _s | | | 40 | % |

Receiver Characteristics ^{*Note6}

(If not otherwise mentioned under recommended operating conditions and standard compliant single mode fiber.)

| Parameter | Conditions | Symbol | Min | Typ | Max | Units |
|-------------------------|---|------------------|------|---------|------|-------|
| Data Rate | | | | 10.3125 | | GBD |
| Center Wavelength Range | | λ_c | 1260 | | 1600 | nm |
| Receiver Sensitivity | BER 10 ⁻¹² @2 ³¹ -1 | P _{min} | | | -24 | dBm |
| Receiver Overload | BER 10 ⁻¹² @2 ³¹ -1 | P _{max} | | | -7 | dBm |
| Saturation Input Power | | Sat | -5 | | | dBm |

Note6: The specified characteristics are met within the recommended range of operating conditions and under the default settings of output power and modulation amplitude. Changing the settings of the optical output power will affect the dynamic behavior of the output signal. Unless otherwise noted, typical data is quoted at nominal voltages and +25°C ambient temperature.

MDIO Interface

DC Characteristics

(If not otherwise mentioned under the recommended operating conditions.)

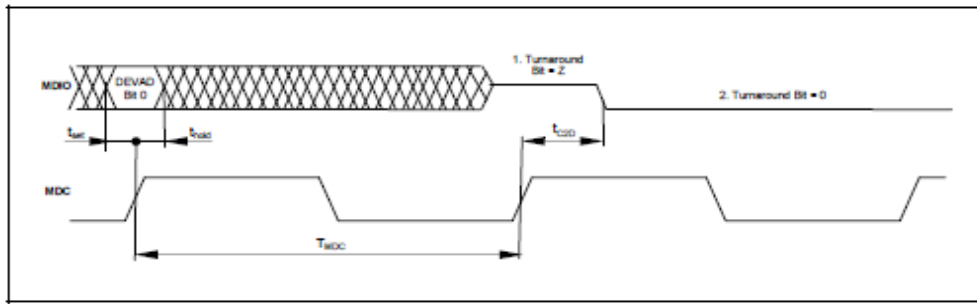
| Characteristic | Condition | Symbol | Minimum | Maximum | Unit |
|--------------------|-------------------------|-------------------|---------|---------|------|
| Input high voltage | | V _H | 0.84 | 1.5 | V |
| Input low voltage | | V _L | -0.3 | 0.36 | V |
| MDIO Input current | MMD Driver in tri-state | I _{MDIO} | -10 | 8 | pA |
| MDC Input current | | I _{MDC} | -5 | 5 | pA |
| Output low voltage | IOL= 100pA | VQL | -0.3 | | V |
| | IOL= 4mA | VQL | | 0.2 | V |

| | | | | | |
|------------------------|---|-----|-------|-----|----|
| Output high voltage | RPULL-Up = 357Ω ±1% VPULL-Up = 1.14~1.5V | VQH | 1.136 | 1.5 | V |
| Output low current | VI = 0.2V | IQL | 4 | | mA |
| MDIO Input capacitance | VI = 0~1.5V | Cin | | 10 | pF |

AC Characteristics

If not otherwise mentioned under the recommended operating conditions. Furthermore it's recommended that clock period time TMDC is not less than 310ns and the sum of input currents of loads on the bus does not exceed 256pA at high and at low not below -320pA.

| Characteristic | Condition | Symbol | Minimum | Maximum | Unit |
|--------------------|--|-------------------|---------|---------|------|
| Set Up Time | | tset | | 10 | ns |
| Hold Time | | t _{hold} | | 10 | ns |
| Clock to Data Time | R _{PULL-Up} = 357Ω ±1%, CBUS ≤ 470pF | t _{C2D} | 0 | 300 | ns |



Example Timing Diagram: Turnover Timing at Read Cycle

Electro Static Discharge (ESD)

The maximum electrostatic charge based on a human body model and the conditions as outlined below is:

| Parameter | Conditions | Symbol | Min | Typ | Max | Units |
|--------------------------|--------------------|--------|-----|-----|-----|-------|
| Static Discharge Voltage | MIL STD 883 Method | | | | 500 | V |

Thermal Management

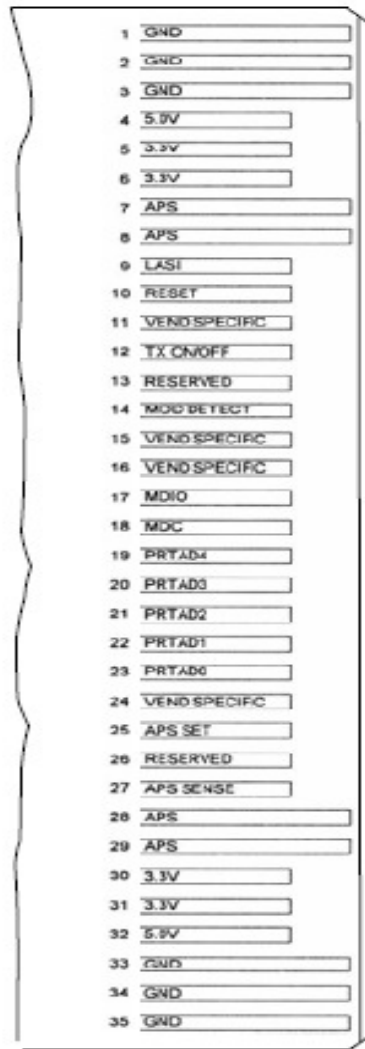
The transponder is designed for an operation within a case temperature range between 0 to +70°C at an altitude of < 3km. The built in heatsink provides an optimized thermal performance. The user needs to guarantee per system design not to exceed this temperature range. It has to be considered that in case of usage of multiple modules on a single hostboard that there is a temperature rise among the modules hosted side by side. Airflow direction and air speed needs to be chosen accordingly. For further information it is referred to the MSA document.

DDM Monitoring Specification

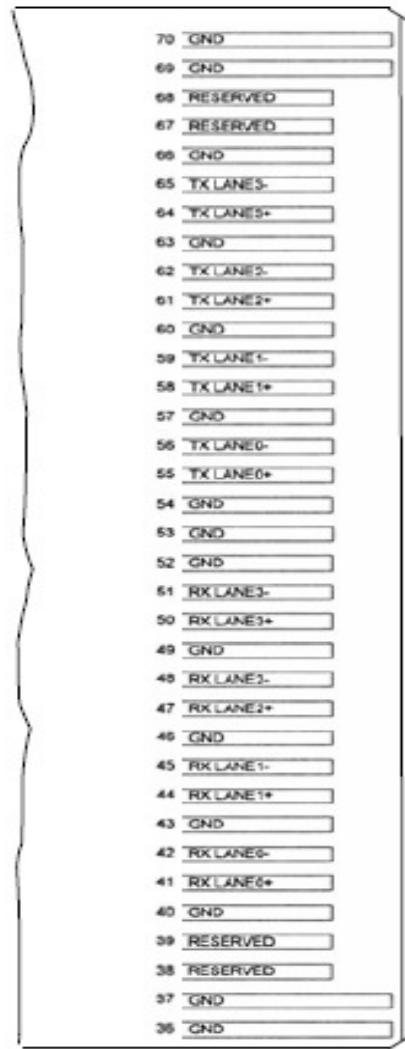
| Parameter | Range | Accuracy | Calibration |
|-----------|-------|----------|-------------|
|-----------|-------|----------|-------------|

| | | | |
|--------------|--------------|-------|----------|
| Temperature | -10 to +80°C | ± 3°C | Internal |
| Bias Current | 0 to 100mA | ±10% | Internal |
| TX Power | 0 to +5dBm | ± 3dB | Internal |
| RX Power | -25 to -4dBm | ± 3dB | Internal |

Card-Edge-Connector-Pinning and Layout



Top view -Top side of PCB



Top view -Bottom side of PCB

Electrical Pin Definition

| Symbol | Logic | PIN | Name/Description | Note |
|--------|-------|--------------|---|------|
| 3.3V | | 5, 6, 30, 31 | Power Supply of Optical Receiver and Transmitter and Control Circuits | 2 |
| 5.0V | | 4, 32 | Power Supply of Optical Receiver | 2 |

| Frontend | | | | |
|------------|-----------------------------|--|--|---|
| APS | | 7, 8, 28, 29 | Adaptive Power Supply, Supply of PHY XS and PCS Layer Devices | 2 |
| APS SENSE | | 27 | APS Sense Output for APS Control Circuit | |
| APS SET | | 25 | Feedback Input for APS, Input of APS Setting Resistor | |
| GND | | 1, 2, 3, 33,34, 35, 36,37, 40, 43,46, 49, 52, 53, 54, 57, 60, 63, 66, 69, 70 | Common Electrical Ground | 1 |
| LASI | 1.2V CMOS Open Drain Output | 9 | Link Alarm Status Interrupt, low active, Open Drain Output Supposed to operate with 10K Ω - 22K Ω pull upon host. Logic High: Normal Operation Logic Low: Link Alarm is indicated | |
| MDC | | 18 | Management Clock Input | 3 |
| MDIO | | 17 | Management Data IO | 3 |
| MOD DETECT | | 14 | 1k Ω to Ground for APS Circuit Environment | |
| PRTADO | 1.2V CMOS Input | 23 | Port Address Bit 0 (Low = 0), internally pulled up by 18k Ω | |
| PRTAD1 | 1.2V CMOS Input | 22 | Port Address Bit 1 (Low = 0), internally pulled up by 18k Ω | |
| PRTAD2 | 1.2V CMOS Input | 21 | Port Address Bit 2 (Low = 0), internally pulled up by 18k Ω | |
| PRTAD3 | 1.2V CMOS Input | 20 | Port Address Bit 3 (Low = 0), internally pulled up by 18k Ω | |
| PRTAD4 | 1.2V CMOS Input | 19 | Port Address Bit 4 (Low = 0), internally pulled up by 18k Ω | |
| RESERVED | | 13, 38, 39, 67, 68 | Reserved by MSA, internally not connected | |
| RESERVED | | 26 | Reserved for Avalanche Photodiode use, internally not connected | 5 |
| RESET | 1.2V CMOS | 10 | Low active Reset Input 10K Ω pull-up on Transceiver | |

| | | | | |
|--------------|-----------------------|----------------|---|---|
| | Input | | Logic high = Normal Operation Logic Low = Reset asserted | |
| TX ON/OFF | 1.2V CMOS Input | 12 | High active Transmitter Enable Input 10K Ω pull-up on Transceiver Logic high = Transmitter active (normal Operation) And Register Bit 1.9.0 set to low as well Logic Low = shut down of Transmitter | |
| VENDSPECIFIC | | 11, 15, 16, 24 | Vendor Specific Pin,. for proper operation leave unconnected | 5 |
| RX LANE0+ | | 41 | Module XAUI Output Lane 0+ | 4 |
| RX LANE0- | | 42 | Module XAUI Output Lane 0- | 4 |
| RXLANE1+ | | 44 | Module XAUI Output Lane 1+ | 4 |
| RXLANE1- | | 45 | Module XAUI Output Lane 1- | 4 |
| RX LANE2+ | | 47 | Module XAUI Output Lane 2+ | 4 |
| RX LANE2- | | 48 | Module XAUI Output Lane 2- | 4 |
| RX LANE3+ | | 50 | Module XAUI Output Lane 3+ | 4 |
| RX LANE3- | | 51 | Module XAUI Output Lane 3- | 4 |
| TX LANE0+ | | 55 | Module XAUI Input Lane 0+ | 4 |
| TX LANE0- | | 56 | Module XAUI Input Lane 0- | 4 |
| TXLANE1+ | | 58 | Module XAUI Input Lane 1+ | 4 |
| TXLANE1- | | 59 | Module XAUI Input Lane 1- | 4 |
| TX LANE2+ | | 61 | Module XAUI Input Lane 2+ | 4 |
| TX LANE2- | | 62 | Module XAUI Input Lane 2- | 4 |
| TX LANE3+ | | 64 | Module XAUI Input Lane 3+ | 4 |
| TX LANE3- | | 65 | Module XAUI Input Lane 3- | 4 |

- 1) Ground connections are common for TX and RX.
- 2) Each connector contact is rated at 0.5A.
- 3) MDIO and MDC timing must comply with IEEE 802.3ae clause 45.3.
- 4) XAUI output characteristics comply with IEEE 802.3ae clause 47.
- 5) Transceivers will be MSA compliant when no signals are present on the vendor specific pins.

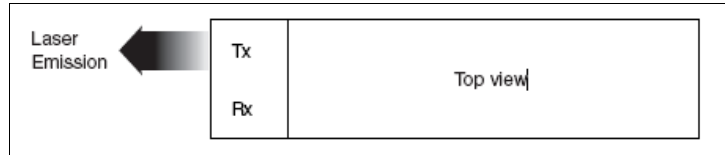
Eye Safety

This laser based multimode transceiver is a Class **1** product. It complies with IEC 60825-1: 2007 and FDA performance standards for laser products (21 CFR 1040.10 and 1040.11) except for deviations pursuant to Laser Notice 50, dated June 24, 2007.

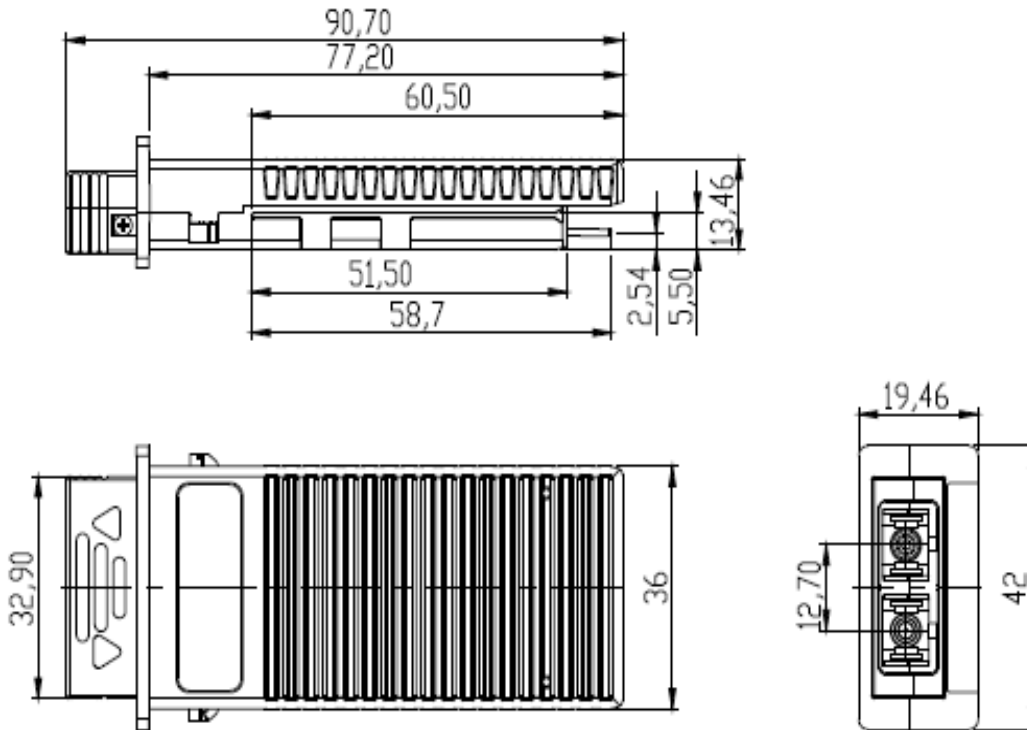
Class 1 Labels

| | |
|-----|--|
| FDA | Complies with 21 CFR 1040.10 and 1040.11 |
| IEC | Class 1 Laser Product |

Laser Emission



Mechanical Drawing



Obtaining Document

You can visit our website:

<http://www.eoptolink.com>

Or contact Eoptolink Technology Inc., Ltd. listed at the end of the documentation to get the latest documents.

Revision History

| Revision | Initiated | Reviewed | Approved | Revision History | Release Date |
|----------|-----------|----------|----------|--------------------------------------|--------------|
| V1.a | Phlio | Kelly | | Released. | 2009-7-10 |
| V1.b | Kelly | | | Correct the input power description. | 2009-12-3 |
| V1.c | Kelly | | | Updating the PN. | 2010-4-22 |

Notice:

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