Dex. 5, 2007

*Preliminary*

# SFF 1.25G/2.5G EPON ONU Transceiver

# FTM-9423P-F10DC(G)

**Members of Flexon™ Family**

## Features

- Single fiber bi-directional data links with asymmetric 1.25Gbit/s upstream and 2.5Gbit/s downstream
- Integrated with micro-optics WDM filter for dual wavelength Tx/Rx operation at 1310/1490nm
- Integrated with a 1550nm block filter to meet RF overlay application
- Burst mode operation transmitter with 1310nm FP laser
- Continuous mode operation receiver with 1490nm high sensitivity PIN-TIA with 1550nm optical signal rejection
- 0 to 70℃ operating ambient temperature
- 2×5 SFF package with SC/UPC pigtail
- Single 3.3V power supply
- LVPECL data input and CML data output interface
- LVTTL transmitter burst-mode control
- LVTTL receiver signal-detected indication
- Low EMI and excellent ESD protection
- Class I laser safety standard IEC-60825 compliant
- RoHS Compliance (for FTM-9423P-F10DCG)

## Applications

- 1.25G/2.5G Ethernet Passive Optical Networks (EPON) – ONU side

## Standard

- Compliant with SFF MSA
- Compliant with FCC 47 CFR Part 15, Class B
- Compliant with FDA 21 CFR 1040.10 and 1040.11, Class I

## Description

FTM-9423P-F10DC(G) is Optical Network Unit (ONU) transceiver for 1.25G/2.5G 10km Ethernet Passive Optical Networks (EPON) application.

The transceiver is the high performance modules for 1.25G/2.5G data link in single fiber by using 1310nm burst mode transmitter and 1490nm continuous mode receiver with 1550nm optical signal rejection.

The transmitter section uses a multiple quantum well 1310nm FP laser, which is Class Ⅰ laser compliant product according to international safety standard IEC-60825. The receiver section uses an integrated 1490nm PIN and preamplifier mounted in an optical header and limiting post-amplifier IC.

The optical burst output can be enabled by a LVTTL logic high-level input of TX_BRST. Signal Detected (SD) output is provided to indicate the detection of an input optical signal of receiver.

## Regulatory Compliance

The transceivers have been tested according to American and European product safety and electromagnetic compatibility regulations (See Table 1). For further information regarding regulatory certification, please refer to Flexon™ regulatory specification and safety guidelines, or contact with Fiberxon, Inc. America sales office listed at the end of documentation.

**Table 1 - Regulatory Compliance**

| Feature | Standard | Performance |
|---|---|---|
| Electrostatic Discharge (ESD) to the Electrical Pins | MIL-STD-883E Method 3015.7 | Class Ⅰ (>500 V) |
| Electromagnetic Interference (EMI) | FCC Part 15 Class B<br>EN55022 Class B (CISPR 22B)<br>VCCI Class B | Compliant with standards |
| Immunity | IEC 61000-4-3 | Compliant with standards |
| Laser Eye Safety | FDA 21CFR 1040.10 and 1040.11<br>EN60950, EN (IEC) 60825-1,2 | Compliant with Class I laser product |
| Component Recognition | UL and CSA | Compliant with standards |
| RoHS (for FTM-9423P-F10DCG) | 2002/95/EC 4.1&4.2 | Compliant with standards |

## Absolute Maximum Ratings

Absolute Maximum Ratings are those values, beyond which, some damages may occur to the devices. Exposure to conditions above the Absolute Maximum Ratings listed in Table 2 may negatively impact the reliability of the products.

**Table 2 - Absolute Maximum Ratings**

| Parameter | Symbol | Min. | Max. | Unit | Note |
|---|---|---|---|---|---|
| Storage Ambient Temperature | $T_{STG}$ | -40 | 85 | °C | |
| Operating Ambient Temperature | $T_{OPR}$ | 0 | 70 | °C | 1 |
| Operating Humidity | $H_{OPR}$ | 5 | 95 | % | |
| Power Supply Voltage | $V_{CC}$ | 0 | 4 | V | |
| Input Voltage | | GND | $V_{CC}$ | V | |
| Receiver Damaged Threshold | | +4 | | dBm | |
| Soldering Temperature | | | 400/10 | °C/s | 2 |
| | | | 260/10 | °C/s | 3 |
| Bending Radius | | 30 | | mm | |
| Pigtail Fiber Contact Temperature | | | 85 | °C | |

Note 1: With airflow 1m/sec when ambient temperature is above 60°C

Note 2: Only for soldering by iron on leads only (for FTM-9423P-F10DC).

Note 3: Soldering on lead only (for FTM-9423P-F10DCG).

## Recommended Operating Conditions

**Table 3 - Recommended Operating Conditions**

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Power Supply Voltage | $V_{CC}$ | 3.13 | | 3.47 | V | 3.3V±5% |
| Operating Ambient Temperature | $T_{OPR}$ | 0 | | 70 | °C | 1 |
| Operating Humidity | $H_{OPR}$ | 5 | | 95 | % | |
| Data Rate(Upstream/Downstream) | | | 1.25/2.5 | | Gbit/s | |

Note 1: With airflow 1m/sec when ambient temperature is above 60°C

## Optical and Electrical Characteristics

**Table 4 - Transmitter Optical and Electrical Characteristics (0°C <$T_{OPR}$<70°C and 3.13V<$V_{CC}$<3.47V)**

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Optical Center Wavelength | $\lambda_C$ | 1260 | | 1360 | nm | |
| Optical Spectrum Width (RMS) | $\Delta\lambda$ | | | 3 | nm | |
| Side Mode Suppression Ratio | SMSR | 30 | | | dB | |
| Average Launch Power | $P_{OUT}$ | -1 | | +4 | dBm | 1 |
| Average Launch Power-OFF Transmitter | $P_{OFF}$ | | | -45 | dBm | |
| Extinction Ratio | ER | 9 | | | dB | 2 |
| Rise/Fall Time (20%-80%) | $T_R/T_F$ | | | 260 | ps | 2.3 |
| Burst Turn On Time | $T_{BURST\_ON}$ | | | 30 | ns | 4 |
| Burst Turn Off Time | $T_{BURST\_OFF}$ | | | 30 | ns | |
| Burst Enable Duration | $T_{EN\_DUR}$ | 600 | | | ns | |
| Burst Disable Duration | $T_{DIS\_DUR}$ | 100 | | | ns | |
| $RIN_{15}OMA$ | | | | -115 | dB/Hz | |
| Optical Return Loss Tolerance | | | | 15 | dB | |
| Transmitter Reflectance | | | | -10 | dB | |
| Transmitter and Dispersion Penalty | TDP | | | 1.8 | dB | 5 |
| Optical Eye Diagram | Compliant With IEEE Std 802.3ah™-2004 | | | | | 2,6 |
| Data Input Differential Swing | $V_{IN}$ | 200 | | 1600 | mV | |
| Input Differential Impedance | $Z_{IN}$ | 90 | 100 | 110 | Ω | |
| Power Supply Current | $I_{CC\_TX}$ | | | 200 | mA | |
| Transmitter Burst Control Voltage - Low | $V_{BURST,\,L}$ | 0 | | 0.8 | V | 7 |
| Transmitter Burst Control Voltage - High | $V_{BURST,\,H}$ | 2.0 | | $V_{CC}$ | V | |

Note 1: Launched into 9/125um Single Mode Fiber.

Note 2: Measured with PRBS $2^7$-1 test pattern @1.25 Gbit/s.

Note 3: Measured with the fourth-order Bessel-Thomson filter OFF.

Note 4: Refer to Timing Parameter Definition in Burst Mode Sequence.

Note 5: Maximum sensitivity penalty due to transmitter and dispersion effect through 10km of SMF optical fiber.

Note 6: Transmitter eye mask definition is {0.22UI, 0.375UI, 0.20UI, 0.20UI, 0.30UI}.

Note 7: TX_BRST (See Pin Function Definitions)

**Table 5 - Receiver Optical and Electrical Characteristics (0°C <$T_{OPR}$<70°C and 3.13V<$V_{CC}$<3.47V)**

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|---|
| Operating Wavelength | | 1480 | 1490 | 1500 | nm | |
| Sensitivity | $P_{SEN}$ | | | -21 | dBm | 1 |
| Overload | $P_{OV}$ | -1 | | | | |
| Signal-Detected Assert Level | $P_{SDA}$ | | | -22 | dBm | 2 |
| Signal-Detected Deassert Level | $P_{SDD}$ | -32 | | | dBm | 3 |
| Signal-Detected Hysteresis | $P_{SDA}$- $P_{SDD}$ | 0.5 | | 6 | dB | |
| Tolerance to Reflected Optical Power | | | | 10 | dB | |
| Receiver Reflectance | | | | -20 | dB | |
| Optical Crosstalk (1310nm/1490nm) | | | | -47 | dB | |
| Polarization Dependent Loss | PDL | | | 0.5 | dB | |
| Power Supply Current | $I_{CC\_RX}$ | | | 120 | mA | |
| Data Output Differential Swing | $V_{OUT}$ | 600 | | 1000 | mV | 4 |
| Signal-Detected Voltage - Low | $V_{SD,\ L}$ | 0 | | 0.4 | V | 5 |
| Signal-Detected Voltage - High | $V_{SD,\ H}$ | 2.4 | | $V_{CC}$ | V | |
| Signal-Detected Assert Time | $T_{ASS}$ | | | 100 | μs | |
| Signal-Detected Deassert Time | $T_{DAS}$ | | | 100 | μs | |

Note 1: Measured with a PRBS $2^7$-1 test pattern @2.5Gbit/s and ER=9dB, BER =$10^{-12}$.

Note 2: An increase in optical power above the specified level will cause the Signal Detect output to switch from a low state to a high state.

Note 3: A decrease in optical power below the specified level will cause the Signal Detect output to switch from a high state to a low state.

Note 4: CML output, AC coupled internally, guaranteed in the full range of input optical power(-1dBm to -22dBm) (See Recommended Interface Circuit)

Note 5: SD (See Pin Function Definitions)

**Table 6 - Electrical Input/Output Coupling Mode**

| P/N | Input (TD+/TD-) | Output (RD+/RD-) |
|---|---|---|
| FTM-9423P-F10DC(G) | Internal DC Coupling | Internal AC Coupling |

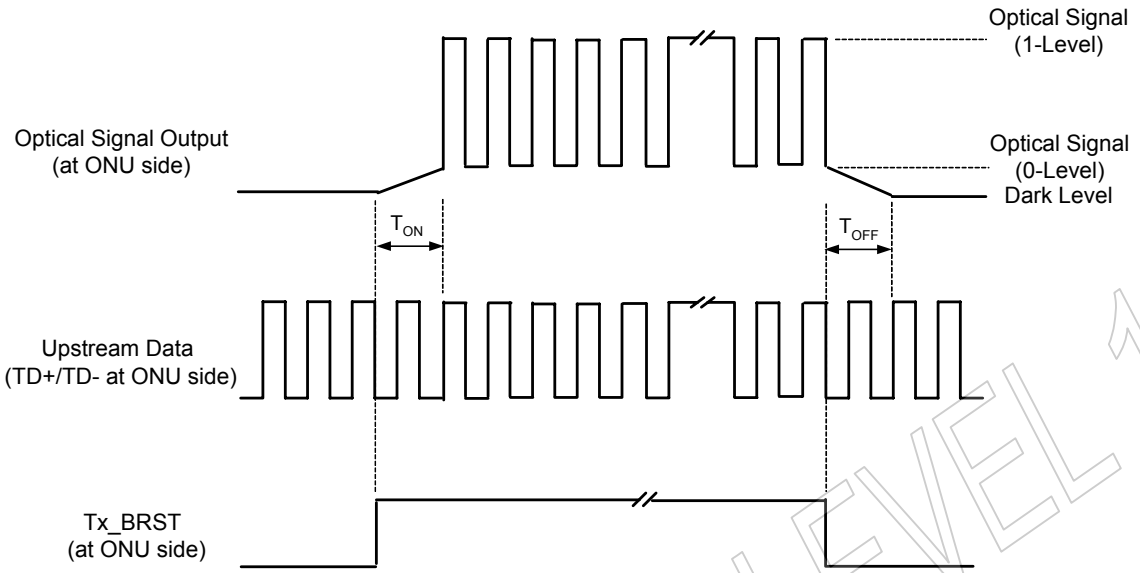


**Figure 1 Timing Parameter Definition in Burst Mode Sequence**

## Recommended Interface Circuit

Figure 2 shows the recommended interface scheme

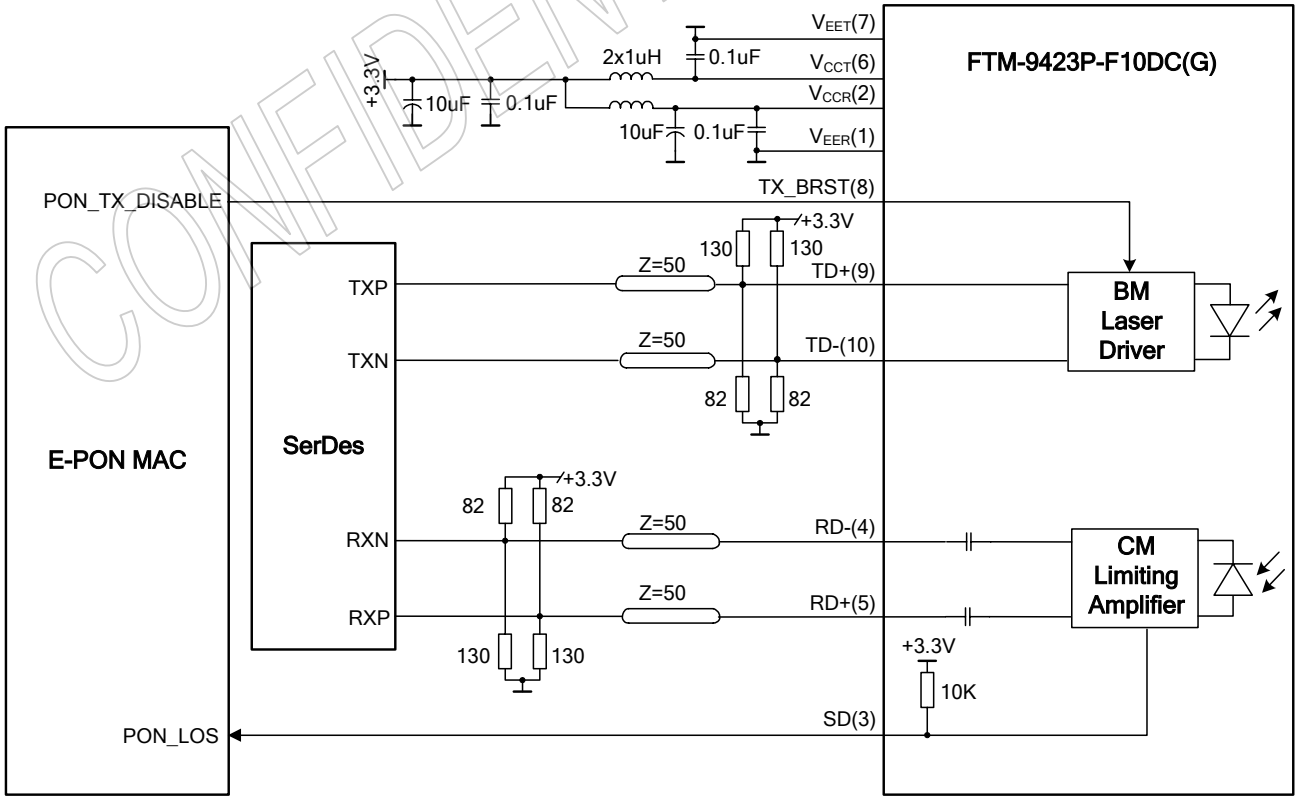


**Figure 2 Recommended Interface Circuit**

## Pin Definitions

2×5 SFF planform in Figure 3 below shows the pin information of electrical interface and mounting studs. Functions are described in Table 7 with some accompanying notes.

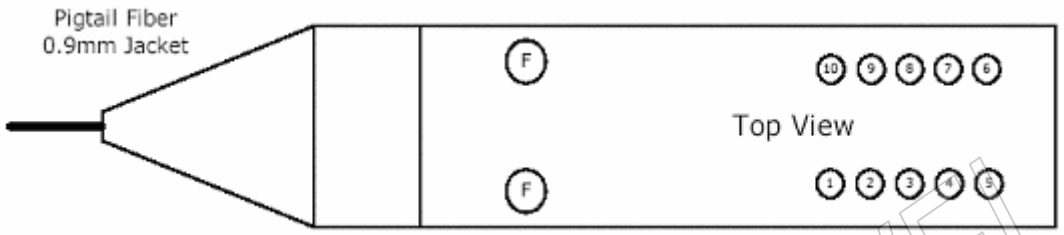


**Figure 3 2×5 SFF Planform**



**Table 7 - Pin Function Definitions**

| Pin No. | Name | Description | Notes |
|---|---|---|---|
| 1 | $V_{EER}$ | Receiver Signal Ground | |
| 2 | $V_{CCR}$ | Receiver Power Supply | |
| 3 | SD | Receiver Signal-Detected Indication | 1 |
| 4 | RD- | Inverted Receiver Data Output | 2 |
| 5 | RD+ | Non-inverted Receiver Data Output | |
| 6 | $V_{CCT}$ | Transmitter Power Supply | |
| 7 | $V_{EET}$ | Transmitter Signal Ground | |
| 8 | TX_BRST | Transmitter Burst Control (LVTTL) | 3 |
| 9 | TD+ | Transmitter Non-inverted Data Input | 4 |
| 10 | TD- | Transmitter Inverted Data Input | |
| F | MS | Mounting Studs | 5 |

Note 1: LVTTL logic output, with internal 10KΩ pull-up resistor.
Optical Signal-Detected: High; Optical Signal Loss: Low

Note 2: CML logic output, AC coupled internally. (See Recommended Interface Circuit)

Note 3: A positive level enable optical signal output under burst mode.
(See Timing Parameter Definition in Burst Mode Sequence)

Note 4: Compatible with LVPECL input, DC coupled internally
(See Recommended Interface Circuit and Table 6 - Electrical Input/Output Coupling Mode)

Note 5: The mounting studs are provided for transceiver mechanical attachment to circuit board. They may also provide an optional connection of the transceiver to the equipment chassis ground. The holes in the circuit board must be tied to chassis ground. It is not recommended that the mounting studs be connected to signal ground.

## Mechanical Design Diagram

The form factor is 2×5 SFF with pigtail fiber. The pigtail fiber has a length 605 - 625mm and 30mm minimum bending radius. The fiber connector type is SC/UPC. The mechanical design diagram is shown in Figure 4. (Dimension in mm)

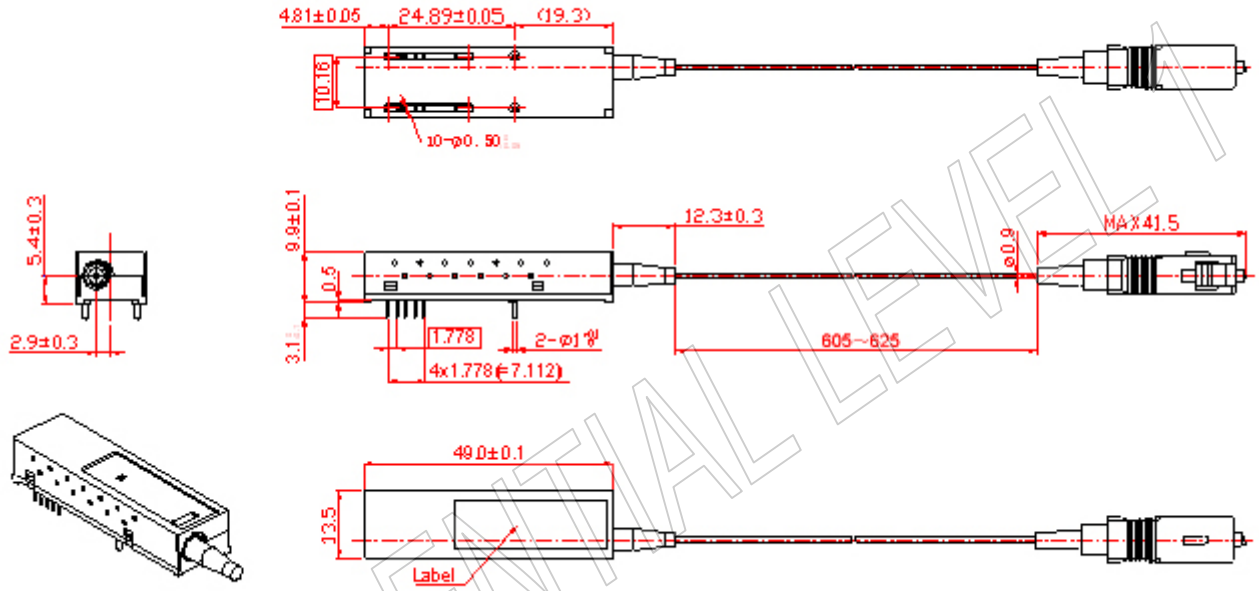


**Figure 4 Mechanical Design Diagram**

**Table 8 - Pigtail Fibre Characteristics**

| Parameter | Min. | Typical | Max. | Unit |
|---|---|---|---|---|
| Mode Field Diameter | | 9 | | μm |
| Cladding Diameter | | 125 | | μm |
| Jacket Diameter | | 0.9 | | mm |
| Bending Radius of Pigtail Fiber | 30 | | | mm |
| Tension Force on Pigtail Fiber | | | 1 | Kg |
| Pigtail Fiber Length | 605 | | 625 | mm |
| Optical Return Loss (UPC type) -1310nm | 50 | | | dB |

## Ordering Information

| Part No. | Product Description |
|---|---|
| FTM-9423P-F10DC | 1310nm(TX)/1490nm(RX), SC/UPC Pigtailed 2×5 SFF for EPON ONU 1.25G/2.5G 10km application, 0°C ~ 70°C, Tx DC Coupling, Rx AC Coupling |
| FTM-9423P-F10DCG | 1310nm(TX)/1490nm(RX), SC/UPC Pigtailed 2×5 SFF for EPON ONU 1.25G/2.5G 10km application, 0°C ~ 70°C, Tx DC Coupling, Rx AC Coupling, RoHS compliance |

## Related Documents

For further information, please refer to the following document:

- IEEE Std 802.3ah™-2004

## Obtaining Document

You can visit our website:
http://www.fiberxon.com/
Or contact with Fiberxon, Inc. America Sales Office listed at the end of documentation to get the latest documents.

## Revision History

| Reversion | Initiate | Review | Approve | Subject | Release Date |
|---|---|---|---|---|---|
| 1a | Jacob Cai | Johnny Yang | Peter Tang | Initial datasheet<br>(Doc No. DS0000190-1a) | Mar. 30, 2007 |
| 1b | Jacob Cai | Zachary Lu | Peter Tang | Revised datasheet<br>1. Update document template;<br>2. Correct a typo in ordering information.<br>(Doc No. DS0000190-1b) | Dec. 5, 2007 |

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