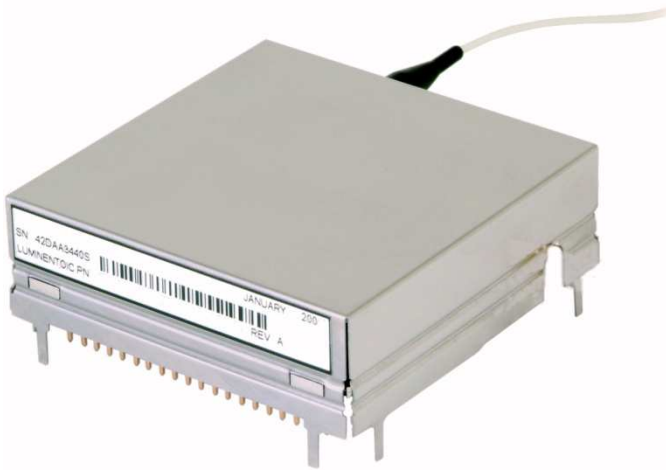


## 1310/1490/1555nm Integrated Triplexer Transceiver



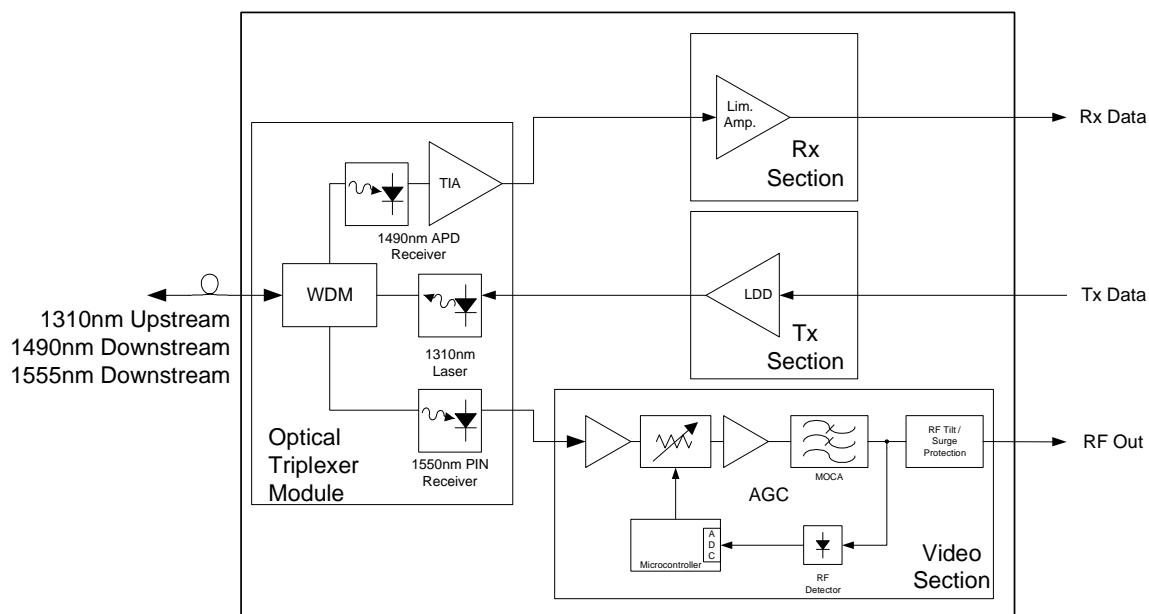
### Features

- Single fiber, integrated triplexer transceiver
- Compliant to FSAN G.984.5 specifications
- Voice/Data/Video FTTx ONT/ONU applications
- 1310nm Tx, 1490nm Rx, 1555nm video Rx
- 1244Mbps Tx / 2488Mbps Rx asymmetric data rate
- Burst mode upstream transmission
- 18dBmV minimum RF output power (with mixed GPON channel plan)
- 870MHz Video Bandwidth
- -40 to 85°C Case Operation
- Feedback Video AGC Operation
- 20km reach
- 28dB power budget

- **Digital Transmitter:** A DFB laser diode is employed for upstream transmission at OC-24 (1244Mbps). The optical transmitter includes a back facet photodetector to monitor laser power for APC control.

- **Digital Receiver:** An APD with TIA is employed for downstream data reception at OC-48 (2488Mbps). A post amplifier is also included for CML output compatibility.

- **Analog Receiver:** 870MHz forward path video (CATV) receiver with multiple gain stages, automatic gain control (AGC), and status indicators.



Triplexer Block Diagram

## Absolute Maximum Ratings

Usage of this transceiver shall adhere to the following absolute maximum ratings. Stresses beyond those in Table 1 may cause permanent damage to the unit. These are stress ratings only, and functional operation of the unit at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect unit reliability.

**Table 1 - Absolute Maximum Ratings**

| Parameter                          | Minimum | Maximum    | Unit/Conditions |
|------------------------------------|---------|------------|-----------------|
| Ambient Storage Temperature        | -40     | 85         | °C              |
| Operating Case Temperature         | -40     | 85         | °C              |
| Operating Case Humidity Range      | 10%     | 90%        | non-condensing  |
| ESD Sensitivity (Human Body Model) | -       | 1000       | V               |
| Lead Soldering Temperature         | -       | 260°C      | 10 sec          |
| Vdd_+12V                           | -       | 15         | V               |
| Vcc_Rx                             | -0.4    | +4.2       | V               |
| Vcc_Tx                             | -0.4    | Vcc_Rx + 1 | V               |
| Vcc_μC                             | -0.4    | +4.2       | V               |

## Module Characteristics

**Table 2 - Module Characteristics**

| Parameter                                 | Minimum | Typical | Maximum | Unit/Conditions        |
|---|---------|---------|---------|------------------------|
| 1555nm external to 1490 nm Rx Isolation   | 32      | -       | -       | dB                     |
| 1490nm external to 1555nm Rx Isolation    | 32      | -       | -       | dB                     |
| 1310nm external to 1555nm Video Isolation | 40      | -       | -       | dB                     |
| 1310nm external to 1490nm data Isolation  | 30      | -       | -       | dB                     |
| 1310nm Tx to 1490nm Rx Optical Crosstalk  | -       | -       | -47     | dB                     |
| 1310nm Tx to 1555nm Rx Optical Crosstalk  | -       | -       | -47     | dB                     |
| G.984.5 Wavelength Blocking Filter (WBF)  | 7       | -       | -       | dB, 1441 nm to 1450 nm |
|   | 7       | -       | -       | dB, 1530 nm to 1539 nm |
|   | 22      | -       | -       | dB, 1400 nm to 1441 nm |
|   | 22      | -       | -       | dB, 1539 nm to 1625 nm |
| Back Reflection @ 1310nm                  | -       | -       | -6      | dB                     |
| Back Reflection @ 1555nm                  | -       | -       | -32     | dB                     |
| Back Reflection @ 1490nm                  | -       | -       | -20     | dB                     |
| Total 3.3V Supply Current                 | -       | -       | 350     | mA                     |
| Total 12V Supply Current                  | -       | -       | 225     | mA                     |
| PSRR (Power Supply Rejection)             | -       | -       | 100     | mVp-p                  |

## Functional Characteristics

The following tables list the performance specifications for the various functional blocks of the integrated optical transceiver module.

**Table 3 – Digital Transmitter Specifications**

| Parameter                                    | Minimum          | Typical | Maximum   | Unit  | Notes  |
|--|------------------|---------|---|-------|--|
| Operating Voltage                            | 3.14             | 3.30    | 3.46  | V     | V <sub>CC</sub> referenced to GND_Tx         |
| Data Rate                                    | -                | 1244.16 | -   | Mbps  |  |
| Average Optical Output Power, P <sub>O</sub> | 0.5              | -       | 5   | dBm   |  |
| Output Power at Transmit Off                 | -                | -       | -40   | dBm   |  |
| Extinction Ratio                             | 10               | -       | -   | dB    | PRBS 2 <sup>23</sup> -1, NRZ, 50% duty cycle |
| Transmitter Output Eye                       | G.984.2 Figure 3 |         |   |       |  |
| Center Wavelength                            | 1290             |         | 1330  | nm    |  |
| Optical Rise and Fall Time                   | -                | 250     | -   | ps    | 20% to 80%                                   |
| Side Mode Suppression Ration (SMSR)          |                  | -       | -   |       | Per IEEE PX20 (tables 60-8, 60-9)            |
| Differential Input Voltage, V <sub>in</sub>  | 300              | -       | 1800  | mVp-p | TXD+/- DC-coupled                            |
| Input Impedance, differential                | -                | 100     | -   | Ω     | TXD+/-                                       |
| Common-Mode Input Voltage                    | GND_Tx +<br>1.4  | -       | V <sub>CC</sub> - (V <sub>in</sub> /2) -<br>0.1 | V     | DC coupled                                   |
| Tx Burst Enable Time                         | -                | -       | 12.86   | ns    | 16 bits data @ 1244Mbps                      |
| Tx Burst Disable Time                        | -                | -       | 12.86   | ns    | 16 bits data @ 1244Mbps                      |
| Jitter Generation                            | -                | -       | 0.2   | UI    | 4 kHz to 10 MHz                              |

**Table 4 – Digital Receiver Specifications**

| Parameter                                     | Minimum | Typical | Maximum           | Unit | Notes  |
|---|---------|---------|-------------------|------|--|
| Operating Voltage                             | 3.14    | 3.30    | 3.46              | V    | V <sub>CC</sub> referenced to GND_RX   |
| Data Rate                                     | -       | 2488.32 | -                 | Mbps |  |
| Operational Wavelength Range                  | 1480    | -       | 1500              | nm   |  |
| Received Optical Power                        | -28     | -       | -8                | dBm  | PRBS 2 <sup>23</sup> -1, 50% duty cycle  |
| Bit Error Rate (BER)                          |         | -       | 10 <sup>-10</sup> |      |  |
| CID   | 72      |         |                   | bits |  |
| Data Output Rise and Fall Time                | -       | 160     | -                 | ps   | 20% to 80%   |
| Signal Detect Assertion Level                 | -       |         | -28               | dBm  | Transition during increasing light   |
| Signal Detect De-Assertion Level <sup>a</sup> | -38     | -       | -                 | dBm  | Transition during decreasing light   |
| Signal Detect Hysteresis                      | 0.5     | -       | -                 | dB   |  |
| Differential Output Voltage                   | 600     | -       | 900               | mV   | CML output, ac coupled (0.1μF)   |
| Signal Detect Output HIGH Voltage             | 2.4     | -       | -                 | V    | LVTTL with internal pull up resistor. Asserts HIGH when input data amplitude is above threshold. |
| Signal Detect Output LOW Voltage              | -       | -       | 0.4               | V    | LVTTL. De-asserts LOW when input data amplitude is below threshold .                             |
| RSSI Range <sup>b</sup>                       | -28     | -       | -8                | dBm  |  |
| RSSI Accuracy                                 | -3      | -       | +3                | dB   |  |

<sup>a</sup> Rx outputs are squelched upon Signal Detect de-assert

<sup>b</sup> Externally calibrated.

**Table 5 – Video Receiver Specifications**

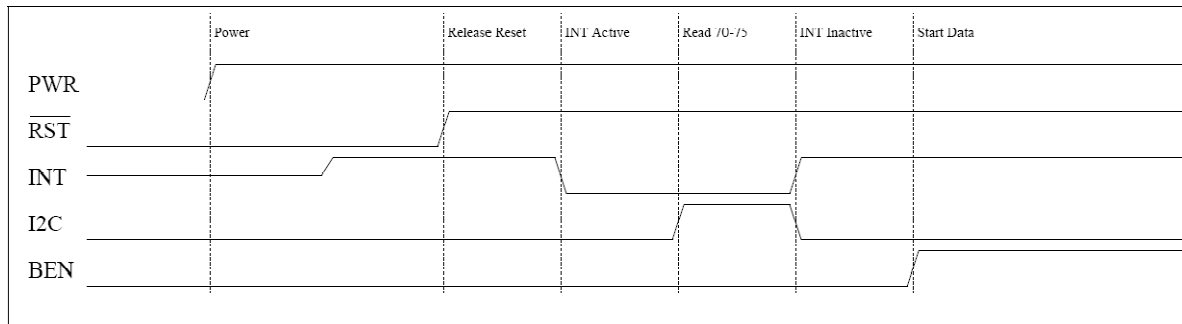
| Parameter                                      | Minimum | Typical | Maximum | Unit | Notes   |
|--|---------|---------|---------|------|---|
| 12V Operating Voltage Range                    | 11.7    | -       | 13.2    | V    |   |
| Frequency Range                                | 50      | -       | 870     | MHz  |   |
| Receiver Wavelength (Bandwidth)                | 1550    | 1555    | 1560    | nm   |   |
| Responsivity                                   | 0.8     | -       | -       | A/W  |   |
| Analog Channels                                | 40      | -       | -       |      | OMI = 4.3%/channel  |
| Digital Channels                               | 63      | -       | -       |      | OMI = 2.15%/channel   |
| Channel Bandwidth                              | -       | 4       | -       | MHz  |   |
| Channel Spacing                                | -       | 6       | -       | MHz  |   |
| Video PD Monitor Accuracy                      | -       | -       | 10      | %    |   |
| AGC Time Constant                              | 0.5     | -       | -       | s    |   |
| Received Average Optical Power                 | -8      | -       | 2       | dBm  |   |
| RF Channel Output Power 50 MHz <sup>a</sup>    | 18      | -       | -       | dBmV |   |
| RF Channel Output Power 450 MHz <sup>a</sup>   | 19.5    | -       | -       | dBmV |   |
| RF Channel Output Power 870 MHz <sup>a,b</sup> | 21      | -       | -       | dBmV |   |
| S22 Output Return Loss                         | 14      | 20      | -       | dB   | 75Ω   |
| Distortions CSO                                | -       | -65     | -55     | dBc  | For digital channels, CSO max an<br>CTB max will be 7 dB higher |
| CTB  | -       | -62     | -55     |      |   |
| Carrier to Noise Ratio (CNR)                   | 46      | -       | -       | dB   |   |

a) Valid with CW carriers with Register 32 = 00

b) Equivalent value of digital channel frequencies is 6 dB lower.

**Table 6 – Suggested Start-up Sequence**

| Step | Action  |
|------|---|
| 1    | Power up the host system, with the RESET pin pulled to ground via a $\leq 4.7k\Omega$ resistor.   |
| 2    | Drive the RESET pin LOW.  |
| 3    | Set the BEN control lines to disable the transmitter (BEN lines must be driven with differential logic).  |
| 4    | Ensure power to the unit is on.   |
| 5    | Drive the RESET pin HIGH to release the unit to become operational.   |
| 6    | Wait approximately 250ms until the INTERRUPT pin goes LOW.  |
| 7    | Read bytes A2.70/71/74/75 to clear the interrupt condition. Verify that byte A2.75 bit 7 was set. Use multi-byte read of bytes 70/71 and bytes 74/75. |
| 8    | Wait 50ms. Verify that the INTERRUPT pin has changed to HIGH.   |
| 9    | The unit is now ready for normal operation.   |



**Figure 1 - Recommended transceiver module start-up sequence**

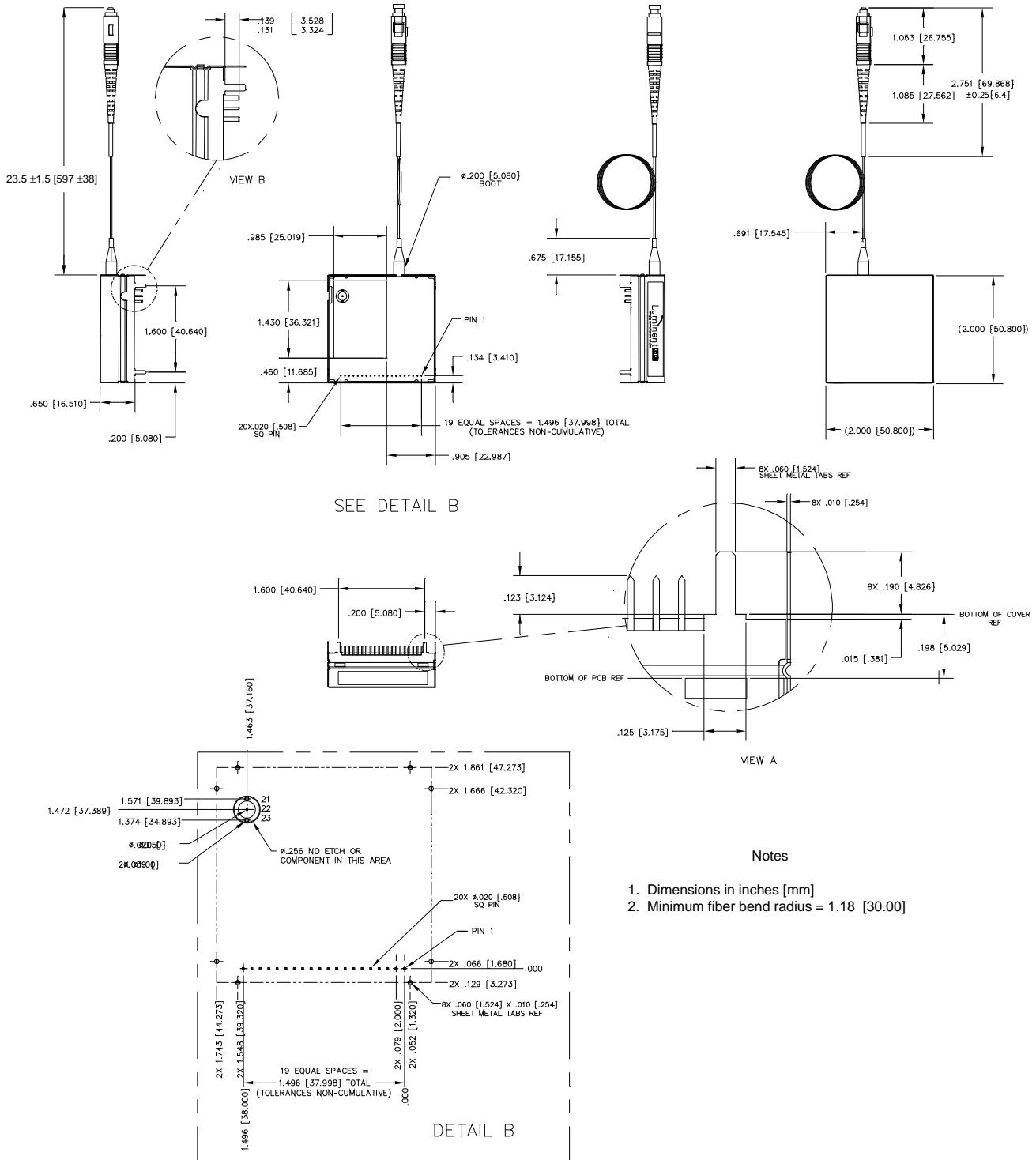
## Pin Definitions

Refer to Table 7 for a description of the function of each I/O pin.

**Table 7 - Module Pin Definitions**

| Pin Number | Label     | Definition   |
|------------|-----------|--|
| 1          | GND_A     | Common ground  |
| 2          | GND_Rx    | Digital Rx ground  |
| 3          | Vcc_Rx    | Digital Rx Vcc   |
| 4          | SD        | Signal Detect output. LVTTTL with internal 3.3kΩ pull-up. Asserts HIGH when input optical signal level is above threshold. |
| 5          | RXD+      | RX data output, CML. 50Ω terminated to Vcc and AC coupled to module output (0.1μF)   |
| 6          | RXD-      | RX data bar output, CML. 50Ω terminated to Vcc and AC coupled to module output (0.1μF)                                     |
| 7          | NC        | Decoupled with 0.01uF to Ground  |
| 8          | BEN-      | Burst Enable bar input, internally DC coupled. Active Low  |
| 9          | GND_Tx    | Digital Tx ground  |
| 10         | TXD+      | Tx data input, CML. Internally DC coupled. 100Ω differential termination.  |
| 11         | GND_Tx    | Digital Tx ground  |
| 12         | TXD-      | Tx data bar input, CML. Internally DC coupled. 100Ω differential termination.  |
| 13         | Vcc_Tx    | Digital Tx Vcc   |
| 14         | SDA       | I <sup>2</sup> C Data input/output. LVTTTL   |
| 15         | SCL       | I <sup>2</sup> C Clock input. LVTTTL   |
| 16         | INT       | Interrupt output. LVTTTL with internal 100kΩ pull-up. Active LOW.  |
| 17         | Vdd_+12V  | Video Rx 12V Vdd   |
| 18         | Vcc_3.3V  | Microcontroller Vcc  |
| 19         | Reset     | Reset input. LVTTTL. Internal pull up. Active low.   |
| 20         | GND_A     | Common ground  |
| 21         | RF_GND    | RF ground  |
| 22         | RF_SIGNAL | RF signal  |
| 23         | RF_GND    | RF ground  |

# Package Diagram





## Ordering Information

| Part No.      | Application | Data Rate                 | Laser Source | Temp. Range |
|---------------|-------------|---------------------------|--------------|-------------|
| ITR-D3T-SD6-4 | GPON ONT    | 1244.16Mb/s / 2488.32Mb/s | 1310nm DFB   | -40 to 85°C |

**Table 9 - Device Handling/ESD Protection**

The devices are static sensitive and may easily be damaged if care is not taken during handling. The following handling practices are recommended.

|   |  |
|---|--|
| 1 | Devices should be handled on benches with conductive and grounding surfaces.   |
| 2 | All personnel, test equipment and tools shall be grounded.   |
| 3 | Do not handle the devices by their leads.  |
| 4 | Store devices in protective foam or carriers.  |
| 5 | Avoid the use of non-conductive plastics, rubber, or silk in the area where the devices are handled  |
| 6 | All modules shall be packaged in materials that are anti-static to protect against adverse electrical environments.  |
| 7 | Avoid applications of any voltage higher than maximum rated voltages to this part. For proper operation, any VIN or VOUT should be constrained to the range $GND \leq (VIN \text{ or } VOUT) \leq VCC$ . Unused inputs must always be tied to an appropriate logic voltage (e.g. either GND or VCC). Unused outputs must be left open. |

## Warnings

**Handling Precautions:** This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.

**Laser Safety:** Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.

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