

3.3 volt OC-12/STM-4 Single Mode Transceiver with Clock Recovery



Features

- ☑ Single +3.3 V supply & LV-PECL interface
- ☑ Full Compliance with OC-12/STM-4 SONET/SDH Specifications
- ☑ Long Reach 1310 nm & 1550 nm or Intermediate Reach
- ☑ Eye Safe (Class I Laser Safety)
- ☑ Multi-sourced 2x9 package style
- ☑ Duplex SC or ST or FC connector
- ☑ - 40°C to +85°C Operating Temperature ("A" option)
- ☑ Wave Solder Process Compatible

Description

The DTC-12-3.3 is a 3.3 volt supply fiber optic transceiver with clock recovery designed to interface ATM/SONET/SDH OC-12/STM-4 PCBs to single mode fiber optic cables. A 1300 nm Fabry Perot Laser is used for Short and Intermediate Reach applications, while for Long Reach applications, a 1300 nm or 1550 nm DFB Laser is used. All modules satisfy Class I Laser Safety requirements in accordance with the US FDA/CDRH and international IEC-825 standards.

The transmit and receive functions are contained in a two-row, 18-pin (2x9) package with a Duplex SC or ST or FC connector interface. The transmitter includes the laser driving circuitry as well as an Average Power Control (APC) loop to stabilize the transmitter average optical

output power. A Transmitter Disable input, a Laser Back Facet Monitor and differential Laser Bias Monitor outputs are provided. The receiver features a high performance InGaAs PIN photodiode and a transimpedance amplifier IC with internal AGC for wide dynamic range. A PLL clock recovery IC is used to generate LV-PECL data and clock. A Signal Detect status output (LV-PECL) and an analog Receiver Power Monitor output are also included.

The transceiver operates from a single +3.3V power supply over an operating temperature range of 0°C to +70°C ("B" option) or - 40°C to +85°C ("A" option). The transceiver package is made of either *conductive* plastic with blue color (Duplex-SC version) or metal (FC and ST version) for excellent EMI shielding.

Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Storage Temperature	T_{st}	- 40	+ 85	°C
Operating Temperature	T_{op}	"A" option	+ 85	°C
		"B" option	0	
Supply Voltage	V_{cc}	0	+ 5.0	V
Input Voltage	V_{in}	0	V_{cc}	V
Output Current	I_o	-	50	mA
Lead Soldering Temperature & Time	-	-	260°C, 10 sec	

DTC-12-3.3

Transmitter Performance Characteristics (over Operating Case Temperature Range)

Parameter		Symbol	Minimum	Typical	Maximum	Units
Data Rate		B	622.08 - 50 ppm	622.08	622.08 + 50 ppm	Mb/s
Average Optical Output Power (coupled into single mode fiber, 50% duty cycle)	HP	P_o	- 3.0	0	+2.0	dBm
	L0		- 5.0	- 3.0	0	
	L1		- 8.0	- 5.0	- 2.0	
	L2		- 12.0	- 8.0	- 5.0	
	L3		- 15.0	- 11.0	- 8.0	
Extinction Ratio	SR & IR	P_{hi} / P_{lo}	8.2	-	-	dB
	LR1 & LR2		10	-	-	
Center Wavelength ¹	SR (Short Reach)	λ_c	1261	1310	1360	nm
	IR (Intermediate Reach)		1274	1310	1356	
	LR1 (Long Reach 1310 nm)		1293	1310	1334	
	LR2 (Long Reach 1550 nm)		1280	1310	1335	
			1480	1550	1580	
Spectral Width (RMS) ¹	SR (Short Reach)	$\Delta\lambda_{RMS}$	-	-	4.0	nm
	IR (Intermediate Reach)		-	-	2.5	
			-	-	4.0	
Spectral Width (-20 dB)	LR1 & LR2	$\Delta\lambda_{20}$	-	-	1.0	
Optical Output Eye	compliant with Bellcore TR-NWT-000253 and ITU-T Recommendation G.957					
¹ For Intermediate Reach version, the Center Wavelength is either $1274 \text{ nm} \leq \lambda_c \leq 1356 \text{ nm}$ for $\Delta\lambda_{RMS} \leq 2.5 \text{ nm}$ or $1293 \text{ nm} \leq \lambda_c \leq 1334 \text{ nm}$ for $\Delta\lambda_{RMS} \leq 4.0 \text{ nm}$.						

Receiver Performance Characteristics (over Operating Case Temperature Range)

Parameter		Symbol	Minimum	Typical	Maximum	Units
Data Rate		B	622.08 - 50 ppm	622.08	622.08 + 50 ppm	Mb/s
Receiver Sensitivity (10^{-10} BER) ¹		P_{min}	- 28.0	- 30.0	-	dBm
Maximum Input Optical Power (10^{-10} BER) ¹		P_{max}	- 7.0	0	-	dBm
Signal Detect Thresholds	Increasing Light Input	P_{sd+}	-	-	- 28.0	dBm
	Decreasing Light Input	P_{sd-}	- 40.0	-	-	dBm
Signal Detect Hysteresis			-	0.5	-	dB
Wavelength of Operation		λ	1100	-	1600	nm
Output Clock Jitter		CLK_j	-	-	0.01	UIrms
Jitter Tolerance & Transfer Function		compliant with ITU Recommendation G.958				
¹ Specified in Average Optical Input Power and measured at 1300 nm wavelength with 2 ²³ -1 PRBS.						

Transmitter Electrical Interface (over Operating Case Temperature Range)

Parameter		Symbol	Minimum	Typical	Maximum	Units
Input HIGH Voltage		V_{IH}	$V_{CC} - 1.165$	-	$V_{CC} - 0.880$	V
Input LOW Voltage		V_{IL}	$V_{CC} - 1.810$	-	$V_{CC} - 1.475$	V
Data Input Current - HIGH		I_H	-	-	150	μA
Data Input Current - LOW		I_L	0.5	-	-	μA
Transmitter Disable Voltage		V_{DIS}	2.0	-	V_{CC}	V
Transmitter Enable Voltage		V_{EN}	0	-	0.8	V
Differential Bias Monitor Voltage ($T_a = 25^\circ\text{C}$)		$V_{BM+} - V_{BM-}$	0.02	-	0.12	V
Back Facet Monitor Voltage	HIGH Light Limit	V_{FM}	1.7	2.0	-	V
	Normal Operation		-	1.2	-	V
	LOW Light limit		-	0.6	0.7	V

DTC-12-3.3

Receiver Electrical Interface (over Operating Case Temperature Range)

Parameter		Symbol	Minimum	Typical	Maximum	Units
Output HIGH Voltage ¹		V_{OH}	$V_{CC} - 1.165$	-	$V_{CC} - 0.70$	V
Output LOW Voltage ¹		V_{OL}	$V_{CC} - 1.95$	-	$V_{CC} - 1.50$	V
Output Current		I_O	-	-	25	mA
RPM (Receiver Power Monitor) Voltage	@ -15 dBm	V_{RPM}	2	2.5	3	V
	@ -28 dBm		75	125	200	mV

¹ With 50 ohm termination to $V_{CC} - 2$ V.

Electrical Power Supply Characteristics (over Operating Case Temperature Range)

Parameter		Symbol	Minimum	Typical	Maximum	Units
Supply Voltage		V_{CC}	3.13	3.3	3.47	V
Supply Current	TX	Fabry Perot lasers	-	80	115	mA
		DFB lasers	-	85	130	
	RX	$I_{CC,RX}$	-	195	225	mA

Application Notes

Transmitter: When the DATA+ input is at logic HIGH and DATA- input is at logic LOW, the LD is ON; and vice versa. In single-ended applications, the unused input pin should be biased to $V_{CC} - 1.29$ V. The transmitter is normally enabled (i.e. when the TX DISABLE control input is not connected). When the TX DISABLE input voltage is higher than 2 V, the laser is turned off independent of the input data.

The transmitter incorporates an Average Power Control (APC) loop to stabilize the transmitter average optical output power against temperature variation. The APC loop always acts to keep the transmitter average optical output power at a constant value (assuming that the transmitter is enabled). Therefore, when the input data is all continuous “zeroes” or all continuous “ones”, the transmitter optical output power is a constant level equal to the nominal average optical output power (not at the “OFF” level or at the “ON” level).

Receiver: Both differential outputs (DATA+ and DATA-, CLOCK+ and CLOCK-) are LV-PECL levels requiring termination (either 50 ohms to $V_{CC} - 2$ volts or 160 ohms to GND is recommended). For optimum performance, both

outputs should be terminated in the same manner, even if only one is used.

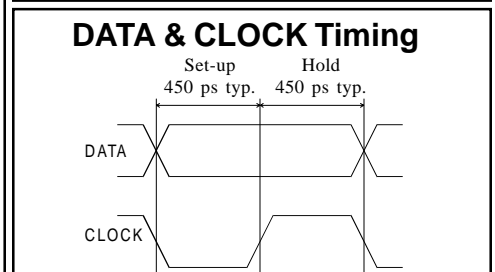
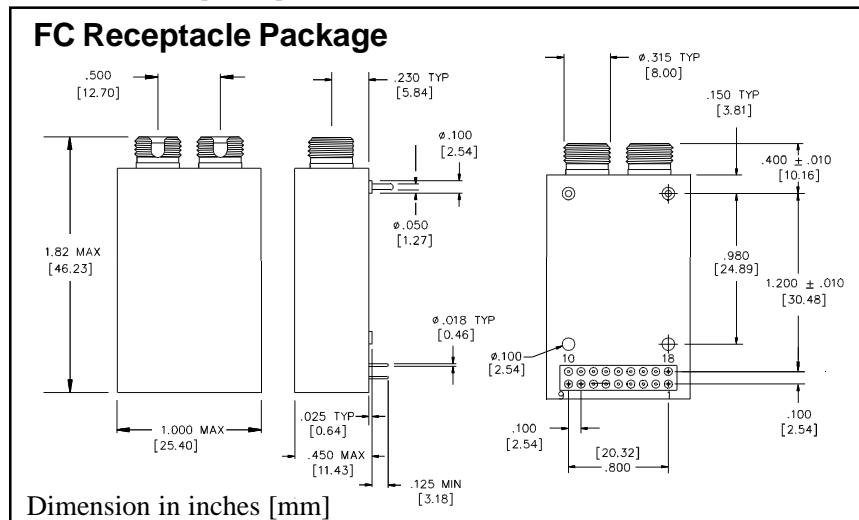
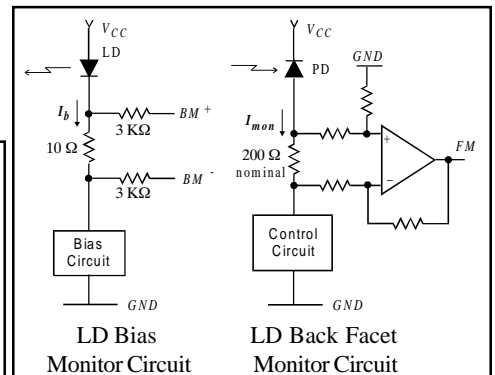
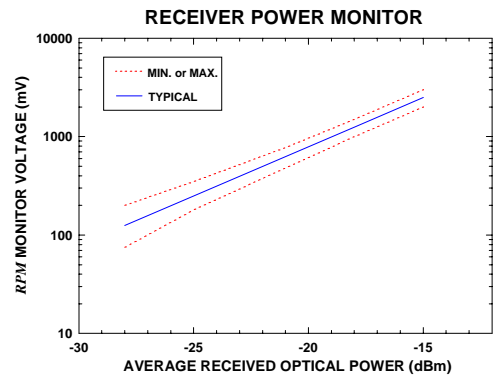
The Signal Detect circuit monitors the level of the incoming optical signal and generates a logic LOW signal when insufficient photocurrent is produced. The SIGNAL DETECT output is LV-PECL level requiring termination (270 ohms to GND is recommended).

The LOCK REF- input is used to set the receiver operational mode when there is loss of synchronization (e.g. when there is no optical input). If the LOCK REF- is tied to V_{CC} or logic HIGH, the CLOCK will be at its free running frequency and the DATA+ and DATA- outputs are random noise (i.e. not squelched to static logic LOW and HIGH level).

If the LOCK REF- is left unconnected or tied to logic LOW, the clock is locked to an internal reference frequency and provides an output CLOCK frequency of 622.08 ± 0.2 MHz. In addition, the DATA+ output is held at static logic LOW and the DATA- output is held at static logic

HIGH. If this squelch feature is used, one convenient way to implement it is to externally connect the LOCK REF- (pin 2) to SIGNAL DETECT (pin 15), with pull down resistor for SIGNAL DETECT as described previously.

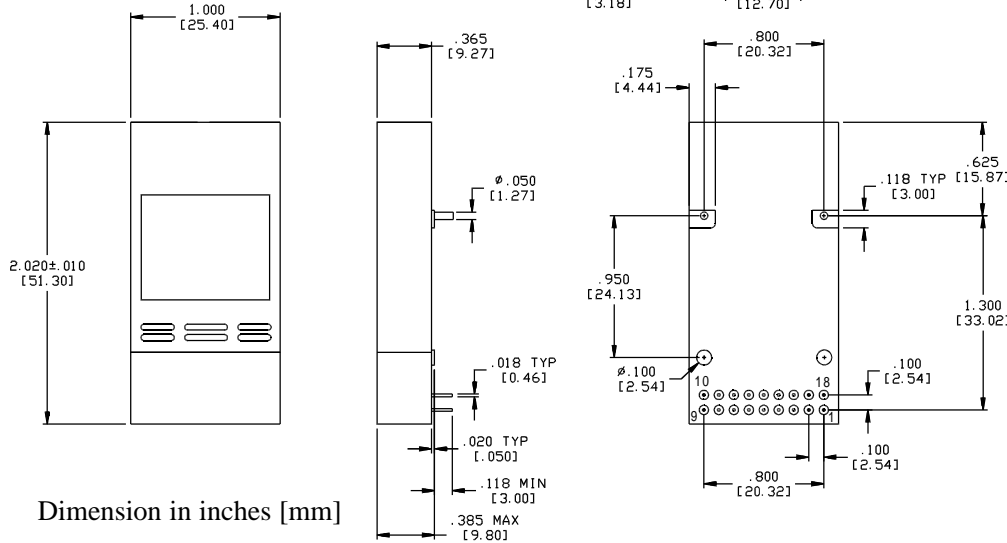
The RPM monitor is an analog voltage output which is proportional to the received optical power.



DTC-12-3.3

Laser Safety: All transmitters are Class I Laser products per FDA/CDRH and IEC-825 standards. They must be operated under specified operating conditions.

Duplex SC Receptacle Package



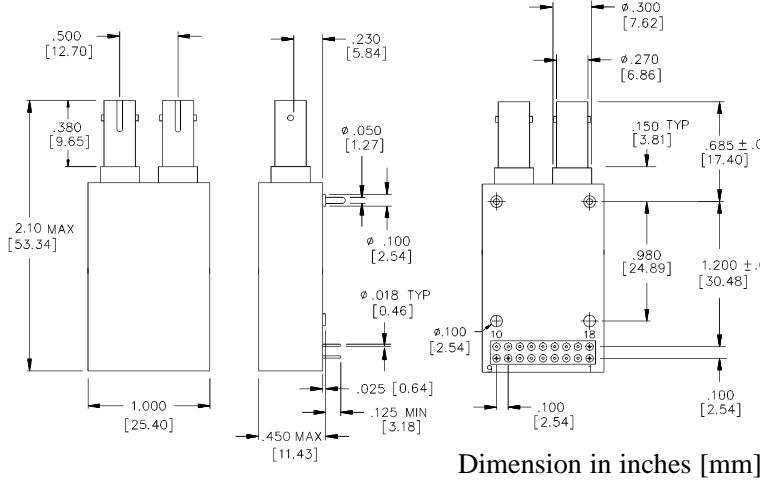
Optical Communication Products, Inc.
DATE OF MANUFACTURE:

MANUFACTURED IN THE USA

This product complies with
21 CFR 1040.10 and 1040.11

Meets Class I Laser Safety Requirements

ST Receptacle Package



PIN	FUNCTION	PIN	FUNCTION
1	N/C	10	TX GND
2	LOCK REF -	11	TD+ (TX DATA IN +)
3	CLOCK -	12	TD- (TX DATA IN -)
4	CLOCK +	13	V _{cc} TX
5	BM- (BIAS MONITOR -)	14	V _{cc} RX
6	BM+ (BIAS MONITOR+)	15	SD (RX SIGNAL DETECT)
7	TX DISABLE	16	RD- (RX DATA OUT -)
8	RPM (RECEIVE POWER MONITOR)	17	RD+ (RX DATA OUT +)
9	FM (FACET MONITOR)	18	RX GND

Ordering Information

DTC - 12 - 3.3 - XX - T - Ln - DR

<p>Receptacle</p> <p>Blank : SC Receptacle</p> <p>ST : ST Receptacle</p> <p>FC : FC Receptacle</p>	<p>Temperature Range</p> <p>A: - 40°C to 85°C</p> <p>B: 0°C to 70°C</p>	<p>Light Output Option</p> <p>HP: 0 dBm (typ.)</p> <p>L0: - 3 dBm (typ.)</p> <p>L1: - 5 dBm (typ.)</p> <p>L2: - 8 dBm (typ.)</p> <p>L3: - 11 dBm (typ.)</p>	<p>Distance Option</p> <p>specifies the range for Center Wavelength & Spectral Width to be compliant with SONET/SDH standard</p> <p>Blank: Short Reach / I-4</p> <p>IR : Intermediate Reach / S-4.1</p> <p>LR1 : Long Reach 1310 nm / L-4.1</p> <p>LR2 : Long Reach 1550 nm / L-4.2</p>
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NOTES

- For full compliance with OC-12/STM-4 Intermediate Reach / S-4.1 standard, the DTC-12-3.3-xx-T-L3-IR modules are recommended.
- For full compliance with OC-12/STM-4 Long Reach / L-4.1 & L-4.2 standard, the DTC-12-3.3-xx-T-HP-LR1 & LR2 are recommended. They all use DFB lasers. However, the DTC-12-3.3-xx-A-HP-LR2 operating temperature is limited to only -25°C to +70°C.
- The LR1 & LR2 options are available only with DFB lasers and HP optical output power level.

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Contents

Description	1
Absolute Maximum Ratings	1
Features	1
Transmitter Performance Characteristics	2
Receiver Performance Characteristics	2
Transmitter Electrical Interface	2
Receiver Electrical Interface.....	3
Electrical Power Supply Characteristics	3
Application Notes	3
FC Receptacle Package	3
DATA & CLOCK Timing	3
Duplex SC Receptacle Package	4
ST Receptacle Package	4
Ordering Information	4