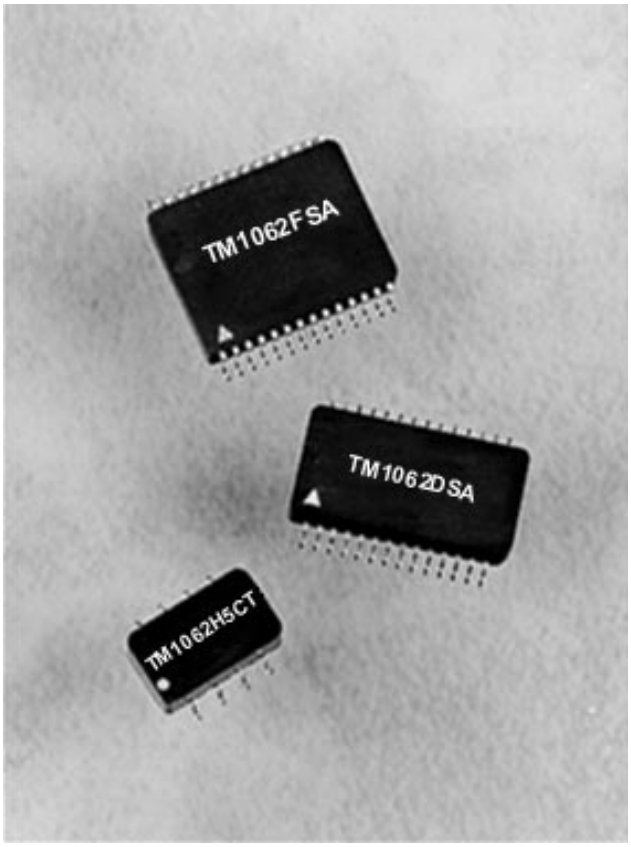
Pulse
A TECHNITROL COMPANY

SPECIALTY COMPONENTS

Copperhead™ Series Fibre Channel transceiver line interface module

Fiber speed data and communications over 100+ meters of copper



Designed to be inter-operable with existing ECL fiber-transceiver drivers, Copperhead™ fibre channel copper transceiver line interface modules drive high frequency (fiber speed) signals over copper media. Models TM133 thru TM1062 are designed to deliver fibre channel capabilities to the workstation over shielded twisted pair (STP), twinax, mini coax, and video coaxial cable. Model TM1250 provides communications for short haul Gigabit Ethernet applications, typically over twinax or coaxial cable. All Copperhead™ fibre channel copper transceiver line interface modules are supplied as surface mount gull wing packages.

Features

- High performance, low cost alternative to completely fiber systems
- Enhanced distance and signal clarity with complete inter-operability per ANSI X3T11, FC-PH (FC-0 Rev 9.1)
- Small, discrete passive design incorporates equalizer, transformers, and filters for "short haul" applications; industrial temp -40°C to +85°C (-55°C to +125°C available)
- Compact active models for "long haul" applications; -40°C to +85°C and -55° to +125°
- Low EMI emissions; designed for FCC Class B compliance and use over shielded twisted pair cable with high radiated electromagnetic susceptibility - 10 V/m
- Low transmit/receive jitter
- Small footprint for surface mounting
- Low power dissipation; 450 mW typical
- ECL logic interface - directly compatible with proposed standards

Applications

- Fibre Channel
- Gigabit Ethernet
- SONET

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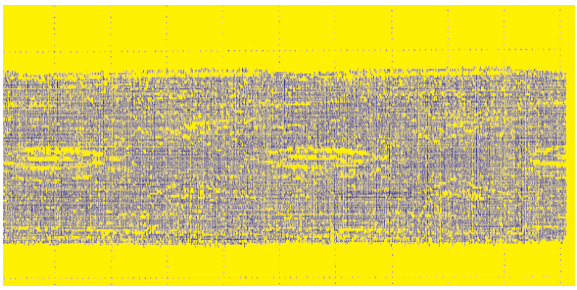
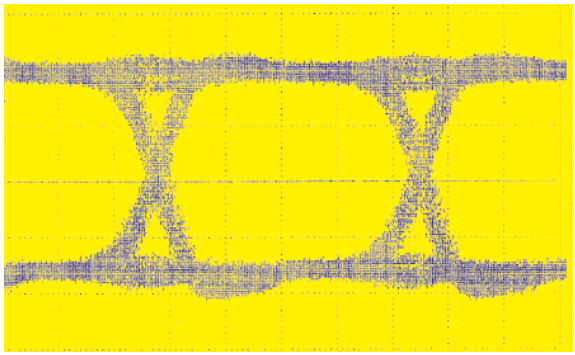
BEFORE
(unequalized)



(Figure 1) Actual oscilloscope tracing of 1.0265 Gb/s unequalized input to receiver pins 13 and 14 after transmission over 30 meters of twinax cable.

AFTER
(equalized for Fibre Channel)



(Figure 2) Tracing of the same signal after equalization. Receiver output measured at pins 2 and 3.

Technical description

Copperhead™ fibre channel transceiver line interface modules (LIM) take differential ECL level NRZ data signal from the available fibre channel (or Gigabit Ethernet) silicon. The signal is then converted to drive level, pre-conditioned with an output filter, and transmitted over the cable through an interfacing wideband pulse transformer.

The transformer converts the signal to current and voltage levels, with exceptionally low transmit jitter, suitable for transmission on STP, twinax or coaxial cable. The transceiver matches the impedance of both the ECL circuit and the cable plant, providing a resultant output signal with minimum jitter and return loss.

The receiver portion of the transceiver LIM takes the signal from the media cable and equalizes it by using a unique wideband pulse transformer and circuitry. This initiates the conversion process of reducing the composite signal to ECL level NRZ for the next level fibre channel silicon.

Benefits of transformer coupling

The pulse transformers used in Copperhead™ transceiver LIMs provide high isolation and optimum damping of transients. They also eliminate DC components in the signal and provide common mode signal rejection. The transformer is also used to match the load to the source and provide maximum power transfer, and also to prevent reflections from transmission line effects.

Product Qualification Test Outline

I. Subgroup I (all devices - 40 pieces)
Electrical tests at 25°
- Receiver (R_X) tests
  - Jitter (total peak-to-peak)
- Transmit (T_X) tests
  - CMI Mask Test (rise time, fall time, and amplitude)
  - Jitter (total peak-to-peak)
- Total power supply current

II. Subgroup II (4 pieces)
External visual inspection
- Resistance to solvents per MIL-STD-202, Method 215H
  - 1 part isopropyl alcohol, 3 parts mineral spirits
  - Trichloroethane
  - Terpene defluxer with a minimum of 90% d-limonene and 10% surfactant
  - 42 parts water, 1 part propylene glycol monomethyl ether, 1 part monoethanolamine
- Terminal strength per MIL-STD-883, Method 2004.5
  - Lead tension

III. Subgroup III (4 pieces)
Solderability
- Per MIL-STD-202, Method 208, with a 4-hour steam age

IV. Subgroup IV (6 pieces)
Resistance to soldering heat
- Hand solder (2 pieces), solder dip temperature of 430 ±5° C for 3 seconds maximum
- Vapor phase reflow (4 pieces) for a period of 60 seconds at a temperature of 215 +5/-0° C

V. Subgroup V (6 pieces)
Thermal shock
- Per MIL-STD-202, Method 107, Condition A-1, except temperature range shall be -20° C to +125° C, 25 cycles

Vibration
- Per MIL-STD-202, Method 204D, Condition D, 20G peak acceleration, 10 Hz to 2 KHz and return to 10 Hz traversed in 6 minutes

Shock
- Per MIL-STD-202, Method 213B, Condition J, 30G, 11msec shock, 3 shocks in each direction along mutually perpendicular axes

VI. Subgroup VI (6 pieces)
Life Test
- Per MIL-STD-202, Method 108, 1000 hours at a temperature of 75° C

VII. Subgroup VII (8 pieces)
Humidity Test
- Humidity test @ 40° C, and 90% humidity (4 pieces)

VIII. Subgroup VIII (6 pieces)
Electrostatic Discharge, ESD Classification
- The ESD classification to be derived from ESD testing per IEC801-2, EN50082-1, Criteria B

NOTE: There shall be 0 (zero) rejects allowable for each of the subgroups.

EMC Immunity and Radiated Emissions Tests

- Radiated Emissions, FCC Class B, 6 dB margin
- IEC 1000-4-2 ESD Test Method
  Performance Criteria B, Level 2
- IEC 1000-4-3 Radiated Immunity
  Performance Criteria A, Level 3 (10V/m)
- IEC 10004-4 EFT Test Method
  Performance Criteria B, Level 3 (at I/O port)

Criteria A: The system shall continue to operate normally. The EUT shall be deemed to have passed the immunity tests if no bit errors occur when receiving data over the cable. Changes of state, reset condition, unrecoverable jab condition, blocked network, or loss of packets is unacceptable.

Criteria B: The system shall operate normally with no data errors through the loop after the test. During the test, data errors, aborted frames and collisions are acceptable. No change of operating state such as system reset or unrecoverable condition is permitted during or after the test.

Table 1 Absolute Maximum Ratings

PARAMETER		SYM	MIN	MAX	UNIT
Storage temperature		T_S	-55	+150	°C
Operating temperature ambient	Active[1]	T_A	-40	+85	°C
	Passive	T_A	-55	+125	°C
Power supply voltage (MECL or PECL)		V_{CC}	-6.0	6.0	V
Power supply current[2]		I_C	-	95	mA
Power dissipation (total)		P_D	-	500	mW
Output current		I_O	-	100	mA
Data input voltage		V_I	0	V_{CC}+0.5	V
Differential input voltage		V_D	-	2.40	V
Component body temperature/time		-	-	220/60	°C/s

Note 1: Exception: for TM1062DSA1, -55° to +125°C
Note 2: Excluding external pull-down resistors

Important: This is a hybrid device and is rated for 220ºC max for 60 seconds. Contact factory for recommended solder reflow profile.

Table 2 System Jitter Budget

Copperhead™ fibre channel copper transceivers require less than 50% (worst case) of system jitter budget

JITTER PARAMETER	TOTAL JITTER				
Data rate	133 Mb	266 Mb	531 Mb	1.062 Gb	UNIT
Transmit in (PHY)	1.204	0.602	0.377	0.188	ns
Transmit out (PHY + Transmitter)	1.356	0.678	0.414	0.207	ns
Receive out (PHY + Transmitter + Cable + Receiver)	6.0	2.64	1.32	0.658	ns

Note: These numbers are currently under evaluation by a special Jitter Study Group in ANSI X3T11 and IEEE 802.3z.

Table 3 Transmitter Electrical Characteristics V_{CC} = 4.75V to 5.25V

PARAMETER		SYM	MIN	TYPICAL	MAX	UNIT
Input data voltage	Low High	V_{IL} V_{IH}	V_{CC} -2.000 V_{CC} -1.110	V_{CC} -1.750 V_{CC} -0.880	V_{CC} -1.500 V_{CC} -0.670	V V
Input current	Low[1] High[2]	I_{IL} I_{IH}	0.4 -	- -	- 0.4	mA mA
Data rate (NRZ Encoding)		DR	133	-	1250	Mb/s
Differential signal level[3] (peak-peak)		V_{OT}	1100[4]	-	2000[4]	mV
Output rise and fall time[3] for TM1062 (20-80%)		T_R/T_F	-	-	300	ps
Return loss (0.1 to 0.5 of baud rate)		S_{11}	-12	-	-	dB
Total peak-peak transmit jitter (D_J+R_J) 12-TP-EL-S 25-TP-EL-S 50-TP-EL-S 100-TP-EL-S	 133 Mb 266 Mb 531 Mb 1062 Mb	T_{PK-PK}	 - - - -	 500 250 125 62	 750 376 188 94	 ps ps ps ps

Note 1: Measured with V_{IL} Min.

Note 2: Measured with V_{IH} Min.

Note 3: Differential signal level (V_{OT}), rise time (T_R) and overshoot (O_S) shall be measured at the transmitter output with 150 ohm differential termination as load. The data pattern for this test shall be a square wave of 0.1 bit rate.

Note 4: For TM1062DSA1; 600 mV min and 1600 mV max for all other devices.

Table 4 Receiver Electrical Characteristics V_{CC} = 4.75V to 5.25V

PARAMETER		SYM	MIN	TYPICAL	MAX	UNIT
Output data voltage	Low High	V_{OL} V_{OH}	V_{CC} -2.000 V_{CC} -1.110	V_{CC} -1.750 V_{CC} -0.880	V_{CC} -1.500 V_{CC} -0.670	V V
Data rate (NRZ Encoding)		DR	133	-	1250	Mb/s
Input sensitivity (D21.5 idle pattern)		-	100	-	-	mV
Input differential voltage		V_{DIFF}	-	-	2.40	V
Return loss (0.1 to 0.5 bit rate) STP		S_{11}	-15	-17	-	dB
Total peak-peak receive jitter	133 Mb 266 Mb 531 Mb 1062 Mb	T_{PK-PK}	- - - -	0.350 0.350 0.240 0.120	1.500 0.900 0.650 0.400	ns ns ns ns

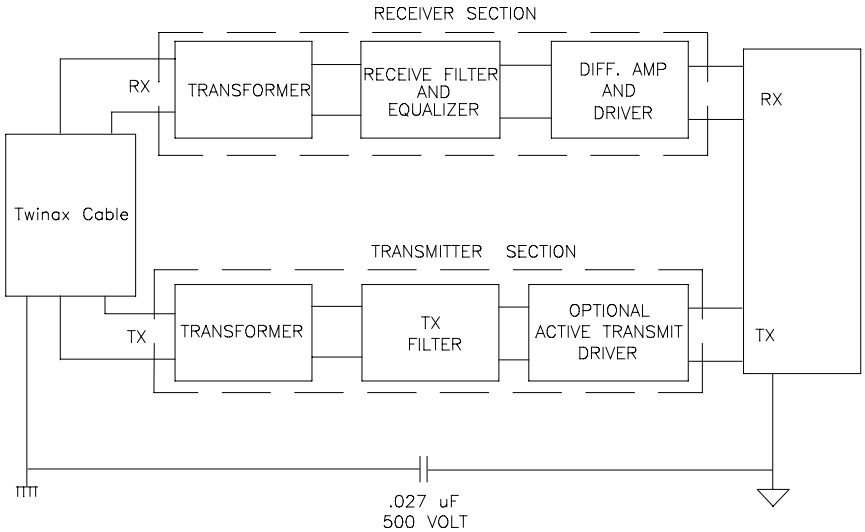
Application Guide

The transceiver type (passive/short haul or active/long haul) is based on the cable insertion loss (attenuation) for the length of cable in question. Pulse Components Division recommends the product type/cable length combinations listed below. Specific models recommended as examples are based on installation/use within 1 Gbaud /150 ohm systems.

CABLE LENGTH	PART TYPE	EXAMPLE MODEL	DESCRIPTION
10 meters	Equalization rarely required.		For use in applications < 10 meters requiring isolation and common mode signal rejection, see T-1062 data sheet for dual (T_X & R_X) pulse transformer products.
Short haul: 10-30 meters	Copperhead™ passive transceiver module	TM1062HSCT without active logic chip and buffering	For use in applications presenting an input voltage of no less than 400 mV (from cable) to transceiver R_X. An insertion loss (S21) calculation with respect to cable length should be made in order to determine compliance. ***If the voltage is less than 400 mV, use "long haul" device (below).***
Long haul: > 30 meters	Copperhead™ transceiver module with active logic chip and buffering for receive side only	TM1062DSA with active receive amplifier	For use in long haul applications where losses accumulate and diminish (receive) signal strength. This device requires a minimum input signal of only 100 mV (from cable) to transceiver R_X.
Long haul: > 30 meters, enhanced transmit	Copperhead™ transceiver module with active logic chip and buffering for both receive and transmit sides	TM1062DSA1 with active transmit driver and receive amplifier	For use in long haul applications requiring buffered transmit signal. The active transmitter acts as a buffer. It reconditions the signal to the appropriate drive level. Transmitter output signal level is 1100 mV minimum.

Block diagram for "long haul" application

Shown is an application of the Model TM1062DSA with "active receive" amplifier for a "long haul" application presenting an input voltage of less than 400 mV (from cable) to transceiver R_X.



Module Pinouts

Pin number(s)

1, 28 . . . . . The positive supply for the line interface module. Connect to +5.0V for PECL applications, and to Gnd for ECL applications.

2, 3 . . . . . $\overline{D_O}$, D_O: Differential ECL data outputs. These outputs can drive 50 ohm loads connected to V_{CC} –2.0V. Recommend 330 ohms to Gnd.

7, 8 . . . . . Gnd (V_{EE}): The negative supply for the line interface module. Connect to Gnd for raised ECL (PECL) applications, and to –5.2V for standard ECL applications.

13, 14 . . . . . R_X-, R_X+ : Transformer coupled differential inputs to receiver section. For coax applications, R_X-should be connected to shield of cable/earth Gnd; R_X+ should be connected to the center conductor. Earth Gnd should be AC coupled to DC signal Gnd using a 0.027 µF capacitor, ~500V.

15, 16 . . . . . T_X+ , T_X- : Transformer coupled differential outputs to cable. For coax applications, T_X- should be connected to shield of cable/earth Gnd; T_X+ should be connected to the center conductor. Earth Gnd should be AC coupled to DC signal Gnd using a 0.027 µF capacitor, 500V.

21, 22 . . . . . Gnd (V_{EE}): The negative supply for the line interface module. Connect to Gnd for raised ECL (PECL) applications, and to –5.2V for standard ECL applications.

23 . . . . . V_{BB} : Is an output pin, which is used for biasing up a threshold reference level, i.e. PECL (3.67V). This pin can only source 1 mA maximum.

24, 25 . . . . . $\overline{D_I}$, D_I : Differential ECL compatible data inputs to the transmitter side of the module.

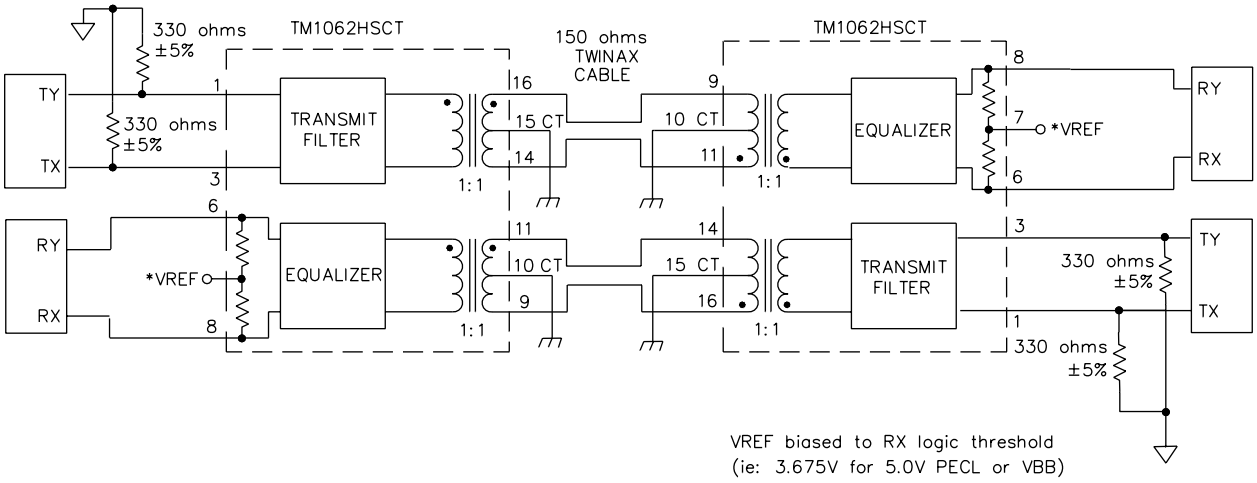
4, 5, 6, 9, 10, 11, 12, 17, 18, 19, 20, 26, 27 . .These pins are "no connect;" do not apply Gnd, VCC, or signal lines to these pins.

Board Layout Considerations

- 0.1 µF capacitors should be ceramic and placed as close to the V_{CC} pins (1 & 28) of the transceiver as possible.
- Differential lines should be of equal length.
- Data out and signal detect output lines should be as short as possible and isolated from noisy sources.
- Controlled impedance traces from pins 14 (R_X+) and 15 (T_X+) of the transceiver to the BNCs or DB9 connector must be used in order to control return loss.
- A DC signal ground plane should occupy the complete area directly beneath the transceiver LIM from pins 1-2 and 17-28.
- The earth ground plane should occupy the complete area directly beneath pins 13-14 and 15-16.
- There should be a separation of 0.050" between earth and DC ground.
- The earth ground should be AC coupled to DC ground with a 0.027 µF capacitor on both sides of the transceiver (T_X side and R_X side).

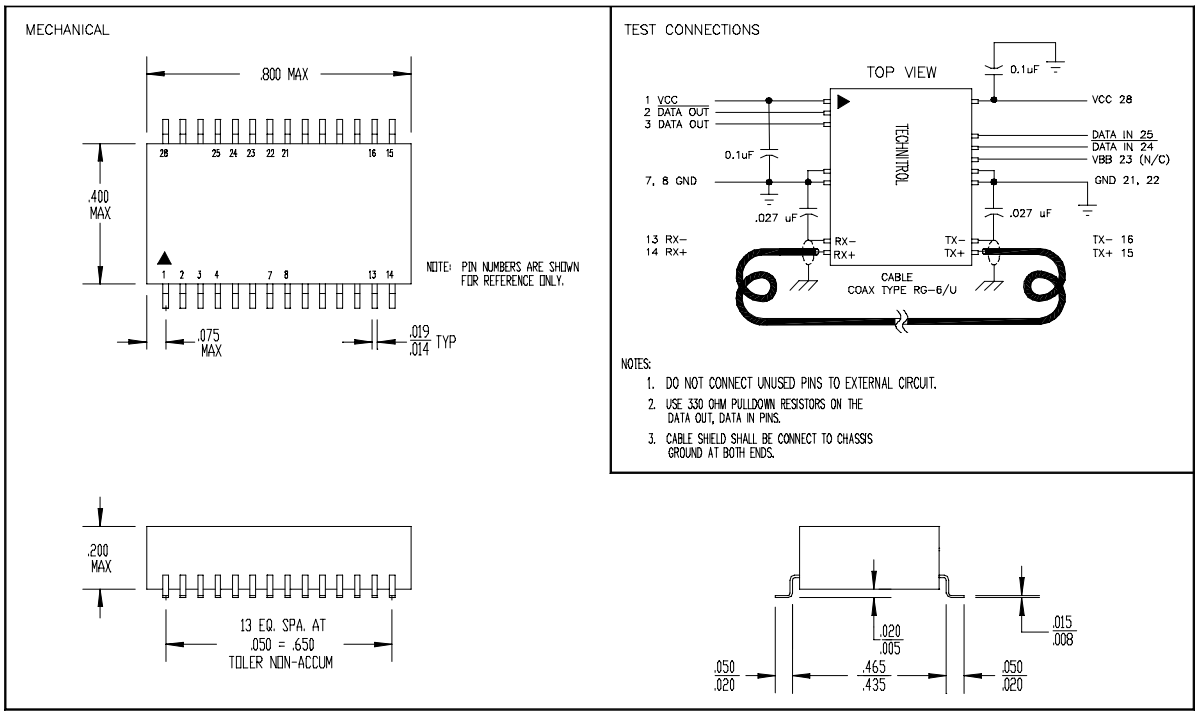
Block diagram for "short haul" application

Shown is an application of the Model TM1062HSCT passive transceiver LIM, used in a "short haul" application presenting an input voltage of no less than 400 mV (from cable) to transceiver RX.

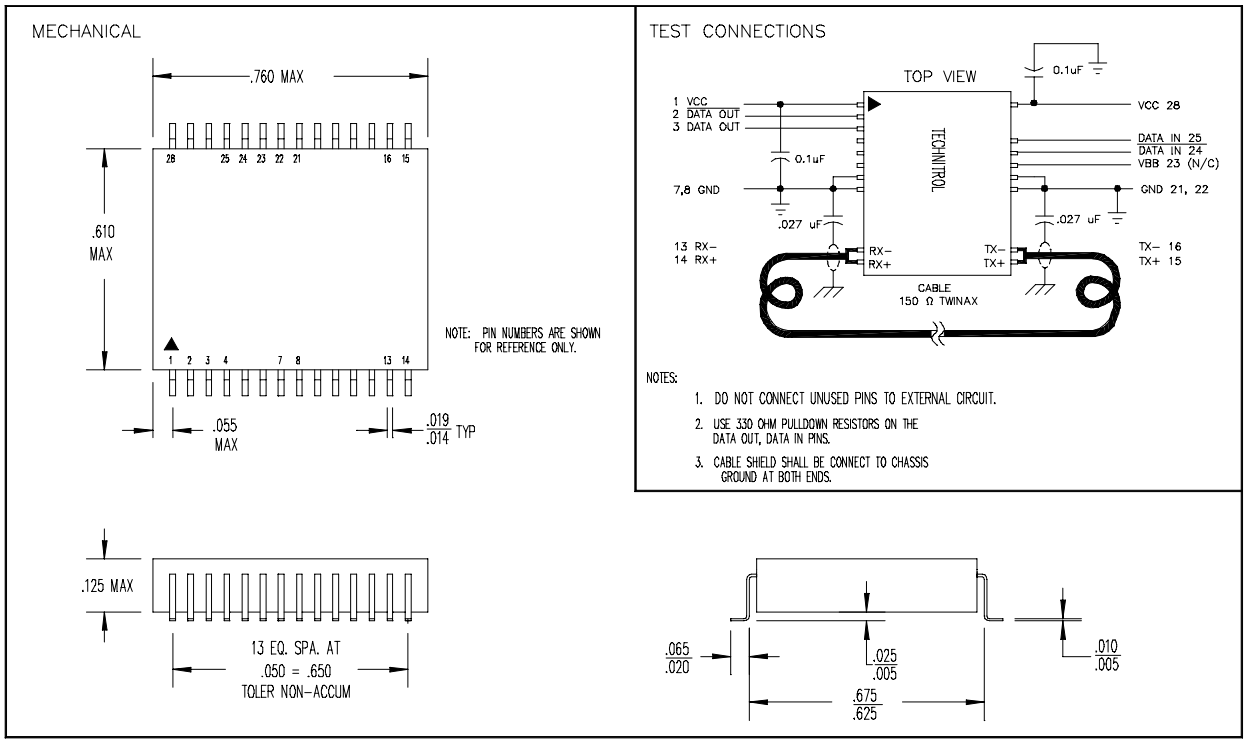


Request dimensions and pin assignment for Model TM1062HSCT completely passive transceiver for "short haul" applications

Dimensions and test circuit "D" package (DIP)
Test circuit shown is for coax single-ended application



Dimensions and test circuit "F" package (flat pack)
Test circuit shown is for twinax/STP differential application



Note: Test circuits for both package types are interchangeable.

Ordering Information

TM 531 D S A 1

1	-	1100 mV output on TX and military temperature range
A	-	All 28 pins provided for mounting
S	-	Impedance matched for STP and twinax (150 ohm)
U	-	Impedance matched for unshielded twisted pair (100 ohm)
V	-	Impedance matched for video and mini-coax (75 ohm)
C	-	Impedance matched for coax (50 ohm)
D	-	Gull wing DIP package: 0.800"L x 0.400"W x 0.200"H
F	-	Gull wing flat pack package: 0.760"L x 0.610"W x 0.125"H
H	-	Gull wing half DIP package: 0.300"L x 0.500"W x 0.250"H (This package is only available on passive units)
133	-	132.8125 Mbaud version 1/8 speed Fibre Channel/ATM
266	-	265.625 Mbaud version 1/4 Speed Fibre Channel
531	-	531.25 Mbaud version ½ Speed Fibre Channel
1062	-	1.0625 Gbaud version Full Speed Fibre Channel
1250	-	1.250 Gbaud version, Gigabit Ethernet (both short haul and long haul)
TM	-	Transceiver line interface module; compact surface mount package

Note 1: Part number TM1062LDSA has been superseded by TM1062DSA (see photo on cover).
Note 2: Part number TM1062LFSA has been superseded by TM1062FSA (see photo on cover).

Related Products

Series	Features
TM311DVA	311.04 Mb version SONET STM1 (also SONET E4 278.528 Mb) CMI
TM311TRFVA	311.04 Mb version SONET STM1 (also SONET E4 278.528 Mb) CMI with G.775 LOS
TM622 Series	622.08 Mbaud version SONET OC-12, STM-4
T-330SCT	330 Mbaud "HOT LINK" / 265.625 Mbaud version 1/4 speed Fibre Channel Transformer
T-1062SCT	1.0625 Gbaud version full speed Fibre Channel Transformer

WARRANTY

Pulse Specialty Components warrants for a period of 90 days from the date of shipment, that under normal use and service, its products will be free from defects in workmanship and material. Pulse Specialty Components' sole responsibility under this warranty is, at its option, to repair or replace, without charge, any defective product or part, or to credit buyer for the purchase price of such defective product, provided:

1) Buyer promptly notifies Pulse Specialty Components in writing within the warranty period, and

2) The defective product or part is returned to Pulse Specialty Components with transportation charges prepaid by Buyer, and

3) Pulse Specialty Components examination of such product shall disclose to its satisfaction that said defect exists and has not been caused by misuse, neglect, improper installation, repair or alteration, or accident.

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