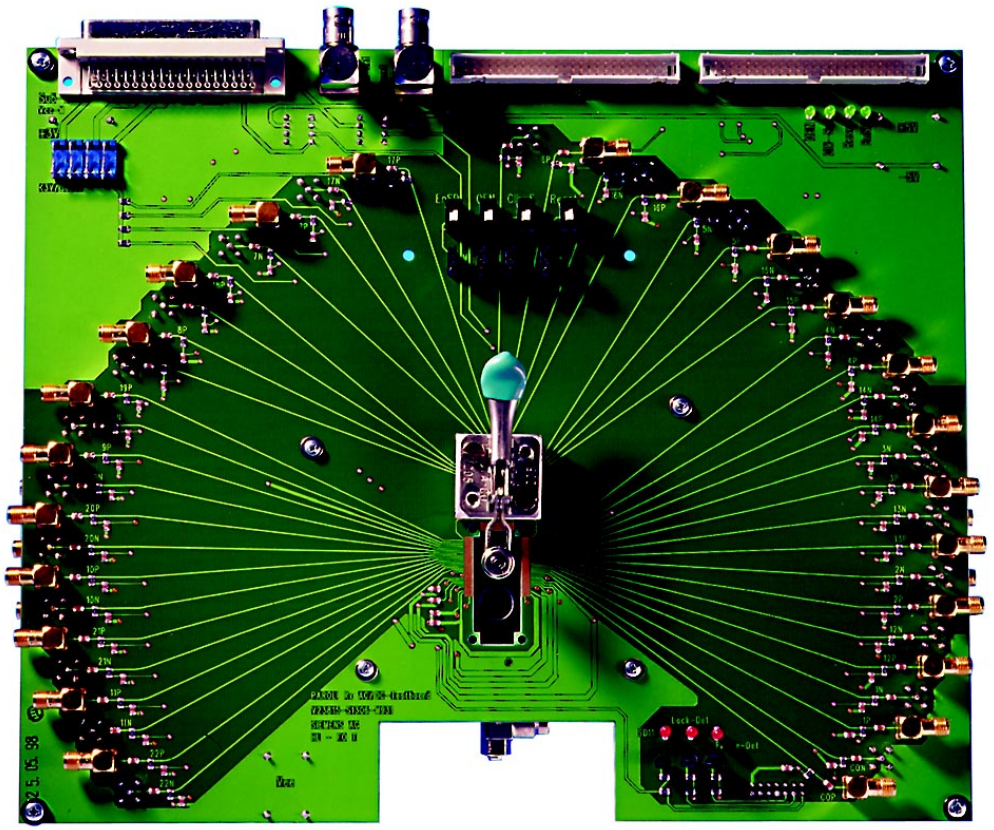
SIEMENS

V23814-S1306-M931

Test Board PAROLI™ Transmitter AC/DC

V23815-S1306-M931

Test Board PAROLI™ Receiver AC/DC



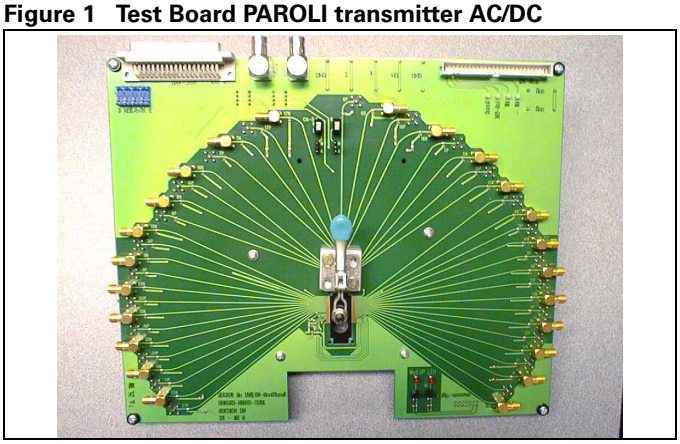
OVERVIEW

Siemens PAROLI Tx and Rx modules provide a 12-channel parallel optical link for high-speed data transmission applications. Two types of PAROLI modules are available - AC and DC versions. The AC version provides a 12-channel asynchronous optical link for 12 electrical data inputs, each with a maximum data rate of 1.25 Gb/s per channel. No data encoding is done in this version. The DC version provides a 12-channel synchronous optical link, but data is transmitted over 11 optical fibers using 22 electrical data inputs.

One optical fiber channel is used for clock transmission. Tx module provides 2:1 electrical multiplexing and encode data using 4B/5B encoding. The electrical input data rate per channel can range from 155 to 500 Mb/s with 155-500 MHz clock in STROBE mode and 75-250 MHz clock in SCI mode. This data sheet provides the general guidelines to set up and characterize PAROLI Tx and Rx modules. Although the measurements described here are done in manual mode, electrical interface connectors are provided on the PAROLI test boards for automated measurements. User can develop appropriate test program to automate testing as required.

TRANSMITTER TEST BOARD

Figure 1 Test Board PAROLI transmitter AC/DC



Electrical connectors

Layout of the Tx test board is shown in Figure 19. There are 3 multipin connectors provided on the Tx test board. These connectors are used if the test setup is to be automated and controlled via a computer. For manual testing, described in this data sheet, these connectors are not used.

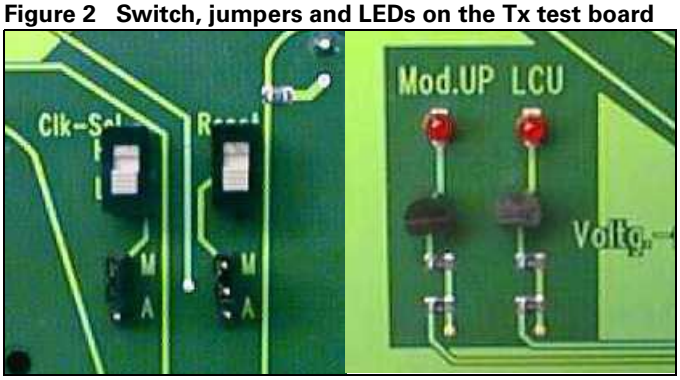
Connector 1	D-sub, 37-pin connector is used to provide V_{CC} power supply connections. For manual mode, banana plug sockets are provided for V_{CC} connections.
Connector 2	50-pin connector is used to set the status of slide switch settings
Connector 10	14-pin connector is used to read the Module/Laser active status

Two BNC connectors (ID #3) provided on the test board are used to measure the time delay between RESET until PLL locks. These BNC connectors have no function in AC module test.

Electrical switches and jumpers

On the Tx test board, there are 2 slide switches and 2 electrical jumpers as shown in Figure 2. The CLK-SEL switch is used for DC modules to select between STROBE (H) and SCI (L) mode. The RESET switch is use to reset Tx module. The jumpers provide the option of AUTO (A) or MANUAL (M) mode. In AUTO mode, the switch settings are set remotely through a computer via connector (ID#2). The green LEDs (ID#8) located near this connector turn on if AUTO mode is selected.

Figure 2 Switch, jumpers and LEDs on the Tx test board



Two red LEDs, as shown in Figure 2, provide LASER ON (LCU) status, and for DC modules, the PLL (MOD-UP) status. MOD-UP LED ON indicates PLL is locked. When LCU LED is ON, the laser controller is ON, and laser is active and emitting. If MOD-UP LED is OFF, it indicates PLL is unlocked, and there may be PLL problem. MOD-UP and LCU status can be read remotely via computer through the 14-pin connector (ID #10).

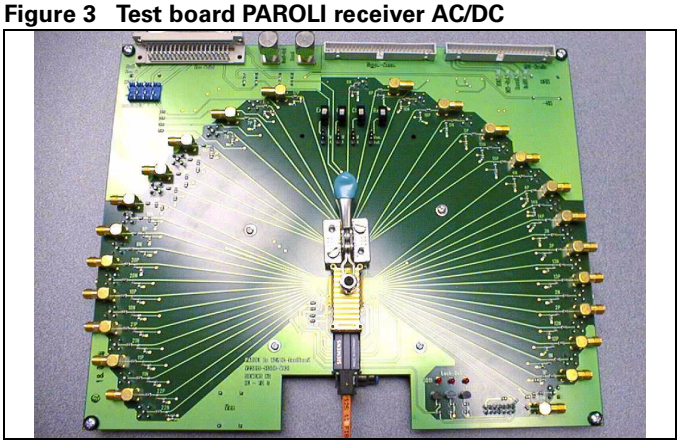
Table 1 Transmitter board switch and LED functions

Switch	**CLK-SEL (H, L)**		
		H	Strobe mode(1)
		L	SCI mode(1)
	Reset (H, L)		
		H	Normal operation
		L	Resets module
LED	**Mod-Up**		
		on	Module up, laser active, PLL locked(1)
		off	PLL unlocked(1)
	LCU		
		on	Laser control on, laser active
		off	Laser control off, laser not operating
Jumper	**(M, A)**		
		M	Manual mode
		A	Auto mode

Notes

1. Not used in AC Tx test

Figure 3 Test board PAROLI receiver AC/DC



RECEIVER TEST BOARD

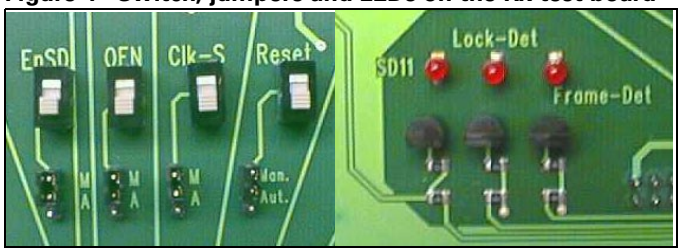
Electrical connectors

Layout of the Rx test board is shown in Figure 18. There are 4 multipin connectors provided on the Rx test board. All of these connectors are used if the test setup is to be automated and controlled via a computer. For manual testing, described in this data sheet, these connectors are not used.

Connector 1	D-sub, 37-pin connector is used to provide V_{CC} power supply connections. For manual mode, banana plug sockets are provided for V_{CC} connections.
Connector 2	50-pin connector is used to set the status of slide switch settings
Connector 10	14-pin connector is used to read the signal and lock detect status
Connector 16	50-pin connector to measure LVDS bias voltages

Two BNC connectors (ID #3) provided on the test board are used to measure the time delay between RESET until PLL is detected. These BNC connectors have no function in AC module test.

Figure 4 Switch, jumpers and LEDs on the Rx test board



Electrical switches and jumpers

On the Rx test board, there are 4 slide switches and 4 electrical jumpers as shown in Figure 4. These slide switches provide STROBE/SCI, OEN, CLOCK-SELECT and RESET functions. The jumpers provide the option of AUTO (A) or MANUAL (M) mode. In AUTO mode, the switch settings are set remotely through a computer via connector #2. The green LEDs located near this connector turn on if AUTO mode is selected. In AC module test, CLOCK-SELECT (Strobe/SCI) and RESET switch are not used and have no functionality.

Three red LEDs on the Rx test board provide status of SIGNAL DETECT, PLL LOCK DETECT and FRAME DETECT function. In AC module test, the center LED labeled LOCK-DET is not used and has no functionality. The other two LEDs indicate SIGNAL DETECT in fiber #1 and in fiber #12.

Table 2 Receiver board switch and LED functions

Switch	**EnSD (H, L)**		
		H	Enables signal/frame detect and SD11
		L	Disables signal detect and SD11
	OEN (H, L)		
		H	Enables LVDS outputs
		L	Sets LVDS data outputs to static LOW(1)
	CLK_SEL (H, L)		
		H	Strobe mode(2)
		L	SCI mode(2)
	RESET (H, L)		
		H	Receiver active(2)
		L	Resets module, LVDS outputs set LOW(2)
LED	**SD11**		
			LED on, signal detect on data channel 11 (fiber #12)
	LOCK_DET		
			PLL locked on frame signal(2)
	FRAME_DET		
			LED on, signal present on fiber #1(3)
Jumper	**(M, A)**		
		M	Manual mode
		A	Auto mode

Notes

1. Output enable switch.
2. Not used in AC Rx test.
3. In DC, frame signal on fiber #1.

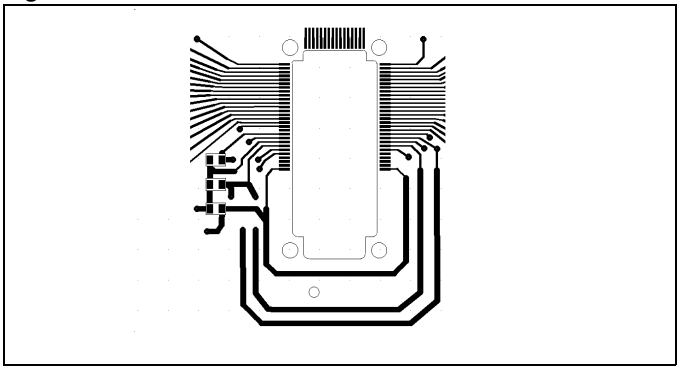
TEST BOARD CONFIGURATION

PAROLI Tx and Rx test boards must be configured correctly before the test is performed. PAROLI Tx test board and Rx test board are designed so that they can be used for both AC and DC versions with minor configuration changes on the test boards. Currently the following restrictions apply with respect to the compatibility of transmitter boards with AC and DC Tx modules.

Transmitter Test Board, Current DC Tx

Traces identical to those shown in Figure 5 are for the current version of the DC Transmitter modules.

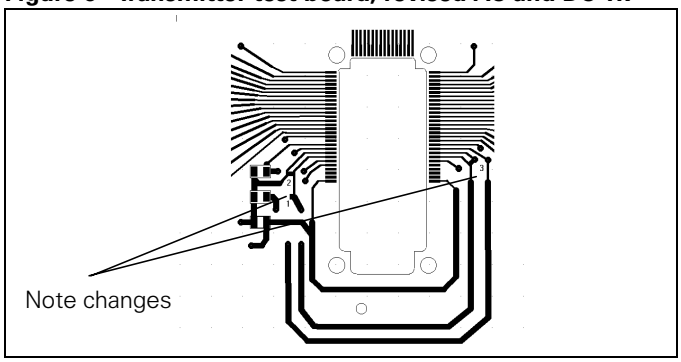
Figure 5 Transmitter test board, current DC Tx



Transmitter Test Board, revised AC and DC Tx

Traces identical to those shown in Figure 6 are for the revised version of the AC Tx and DC Tx modules.

Figure 6 Transmitter test board, revised AC and DC Tx



For AC PAROLI Tx and Rx tests, Table 3 lists the 12 applicable differential input and output ports on Tx and Rx test boards. Input and output cables must be connected to the applicable connectors only.

Table 3 Applicable channels in AC testing

AC Channel	Channel # on Board	AC Channel	Channel # on Board
1N	1N	7N	17N
1P	1P	7P	17P
2N	2N	8N	18N
2P	2P	8P	18P
3N	3N	9N	19N
3P	3P	9P	19P
4N	4N	10N	20N
4P	4P	10P	20P
5N	15N	11N	21N
5P	15P	11P	21P
6N	16N	12N	22N
6P	16P	12P	22P

POWER SUPPLY REQUIREMENTS

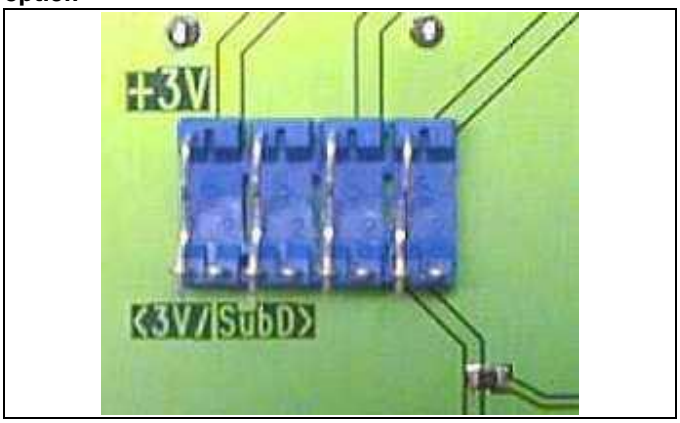
The Testing of PAROLI Tx and Rx test boards requires the following power supplies. All power supply connections must be made, and voltages adjusted, prior to the installation of the PAROLI module on the test board.

Table 4 Power supply requirement

Power supply	Applications
+3.3 V / 1.5 A	V_{CC} to operate the module, separate supplies for Tx and Rx recommended
+2.4 V / 100 mA	To supply LVDS High and Low to Tx
+5 V / 200 mA	To power display LEDs and buffer pre-amplifier
-5 V / 200 mA	To power buffer pre-amplifier and check PLL locking

Power supply connections to the test boards can be made either through banana plugs at sockets provided underside the test board, or via D-sub connectors for automated test setups. The blue DIP-switch on the upper left corner is used to select the D-sub or banana plug option. Two sockets on the test boards are provided for V_{EE} ground connections.

Figure 7 DIP-Switch S4 settings shown for 3V banana plug option



LASER SAFETY

The PAROLI Tx module is an IEC 825-1 Laser Class 3A product, and emits invisible laser radiation. To prevent eye injury, DO NOT STARE into the beam or view directly with optical instruments.

Handling

PAROLI modules are supplied with a 72-pin lead frame designed for hot bar soldering. Appropriate care should be taken during handling and installation of the modules on the test boards. Bending of the leads may result in lack of contact on the test board, which may cause the module to malfunction. PAROLI modules are sensitive to ESD damage. Appropriate precautions should be undertaken during handling and installation.

Cooling

Cooling is not necessary for AC PAROLI modules. The DC Tx and Rx modules must be cooled appropriately to avoid damage by overheating. Cooling can be provided by installing a small device cooling fan a short distance away from the PAROLI module, or by connecting an air supply at the air inlet provided on the test board.

RECOMMENDED TEST EQUIPMENT

A variety of test equipment can be used to perform optical and electrical measurements on PAROLI optical modules. As general guidance, we recommend the use of the following test equipment. Table 5 provides only a selection of test equipment needed to characterize modules.

Table 5 Recommended test equipment

Description	Model	Application
Digital Communications Analyzer	HP 83840A	For signal waveforms analysis
Pattern Generator Module	HP 70841B	To generate electrical signal patterns
Error Detector Module	HP 70842B	For BER measurements
Clock Source	HP 70311A	For providing clock signal
2.5 GHz Optical Plug-in Module	HP 83487A	For optical measurements
Optical Power Meter	HP 8153A	For optical measurements
Power Supply	HP 6624A	Provides 4 power supply outputs

Besides the test equipment listed in Table 5, other accessories such as electrical jumper cables with SMA type connectors, optical fiber cable with appropriate connectors, and certain plug-in modules may also be required. Siemens supplies the following optical cable assemblies for PAROLI links that are useful in testing PAROLI modules.

SMC-SMC Jumper Cable, 10 meter jacketed
Siemens Part # V23867-B6474-A10

SMC-SC Fan-Out Cable, 2 meter, w/o jacket
Siemens Part # V23867-B6388-A2

The SMC to SC fan-out cable is especially useful for making certain optical measurements on individual channels and also for the testing and diagnostics of either Tx or Rx module.

TEST PROCEDURE FOR AC PAROLI MODULES

This section describes the step-by-step procedure to set up PAROLI test boards for performing tests on Tx and Rx modules.

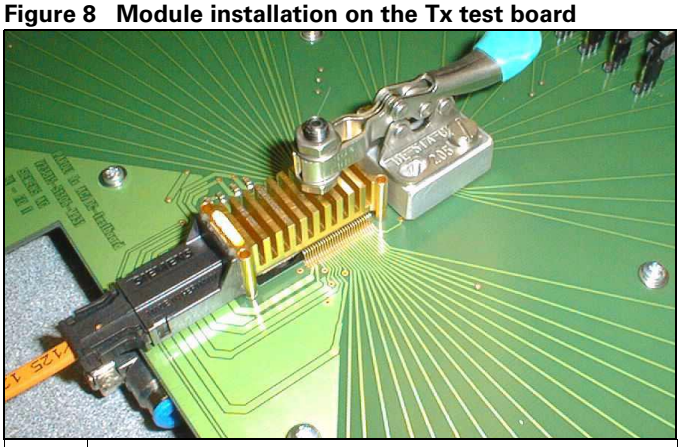
Testing of AC transmitter module

This section describes the step-by-step procedure to power up and test AC Tx module. Check the Tx test board configuration. Generally, test boards are factory set for AC or DC testing. However, changes can be made, if necessary, using instructions in the TEST BOARD CONFIGURATION section of this data sheet.

Test procedure

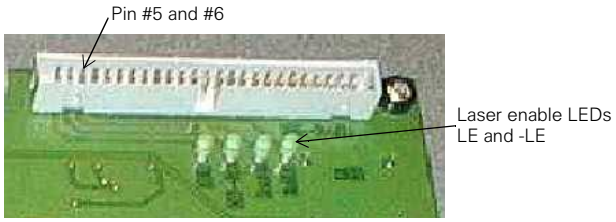
1	Make all required power supply connections, 3.3 V for V_{CC}, 2.4 V for LVDS, +5 V for LEDs and OpAmp. -5 V is used only for DC module. Set blue DIP-switch Figure 7 to 3 V setting and use banana plugs for power supply connections.
2	Apply 2.4 V so that static LOW is applied to LVDS inputs. This is important as static HIGH will turn the laser OFF due to built-in alert circuit for laser safety and you will not see a signal. To apply static LOW, connect +ve terminal to L, and -ve to H, and finally connect H to V_{EE}. The voltage is applied via a high impedance to the Tx input. If a data pattern is applied, it overrides the staic level due to its low impedance 50 Ω path.
3	Set RESET jumper to MANUAL mode. CLK-SEL switch has no functionality in AC Tx test.
4	Turn on all supply voltages and verify voltage levels using a digital voltmeter.
5	Switch off all power supplies to install PAROLI Tx module.
6	Install PAROLI Tx module. To install Tx module, drop the module in the alignment holes. The module will fit snugly and cannot be moved laterally. Now apply the mechanical clamp to hold Tx module in place (Figure 8). Cooling is not necessary for AC Tx module.

Figure 8 Module installation on the Tx test board



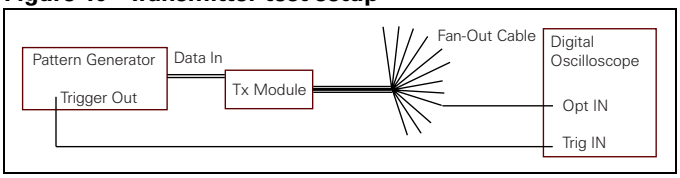
7	Laser enable function is supported only in AUTO mode. To use the test board in MANUAL mode, laser controller must be enabled. Use a jumper to short pin #5 and #6 (3rd row from the left) of the PCI connector #2, as shown in Figure 9 Laser enable green LED will turn ON when power is applied to the test board.

Figure 9 Laser controller enable by shorting pin #5 and #6



8	Switch on the power supplies and activate Tx reset by toggling RESET switch to LOW and then to HIGH. This will reset the Tx module. LCU LED will be ON. Laser array will be active and emitting. MOD-UP LED has no functionality in AC Tx test.
9	At this point, you can proceed to characterize Tx module only, or proceed to setup for testing parallel link. To perform link testing, proceed to power up the Rx test board described in the next section and then set up the parallel optical link using a ribbon cable.
10	To characterize Tx module only, use a PAROLI fan-out optical cable. This cable has at one end a 12-fiber SMC connector, and at the other end 12 individual SC fiber connectors. This fan-out cable provides a convenient way of separating and testing individual optical channels. Connect SMC connector end into the PAROLI optical port and SC connector at the other end to a digital sampling scope as shown in Figure 10.

Figure 10 Transmitter test setup



Test procedure - continued

11	Apply LVDS signal to one of the 12 inputs via SMA connectors. Use configuration Table 4 in for applicable input ports. Make sure that the LVDS voltage is adjusted to account for impedance matching as described in LVDS LEVEL SETTINGS.
12	Use corresponding optical fiber of the fan-out cable to monitor signal using sampling oscilloscope. Pattern should be easily recognizable.

Testing of AC receiver module

This section describes the step-by-step procedure to power up and test AC Rx module. Check Rx test board configuration for AC module testing. Generally, test boards are factory set for AC or DC testing. However, changes can be made, if necessary, using instructions in the TEST BOARD CONFIGURATION section of this data sheet.

Test procedure

1	Make all required power supply connections, 3.3 V for V_{CC}, +5 V LEDs and OpAmp. Set blue DIP-switch (Figure 7) to 3 V setting to apply 3.3 V via banana plugs.
2	Set jumpers to MANUAL mode. CLK-SEL switch has no functionality in AC Rx test.
3	Set all other slide switches, ENSD, OEN and RESET, to level HIGH.
4	Verify all supply voltages using a digital voltmeter.
5	Switch off all power supplies to install PAROLI Rx module.
6	Install PAROLI Rx module and apply mechanical clamp to hold Rx module in place (Figure 8). External cooling is not necessary for AC Rx module.
7	At this point, SD11 LED will be ON, indicating no light on fiber #12. Note: If you are using an earlier version of test board, this functionality is reversed and LED will be OFF.
8	LOCK-DET LED has no functionality in AC Rx test and will be OFF.
9	FRAME-DET is fiber #1 in this case, and this LED will come ON when an optical signal through fiber #1 is applied.
10	Connect optical cable to Rx optical port. Optical signal can be applied either by using a PAROLI fan-out cable and using a modulated optical source as shown in Figure 11, or by using a PAROLI Tx module and PAROLI jumper cable as shown in Figure 12.

Figure 11 Rx test setup using fan-out cable

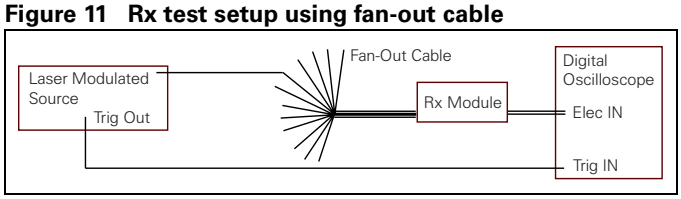


Figure 12 Rx test setup in parallel link

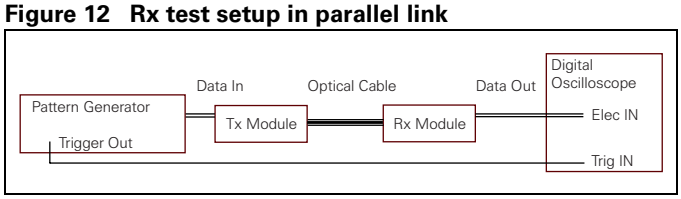
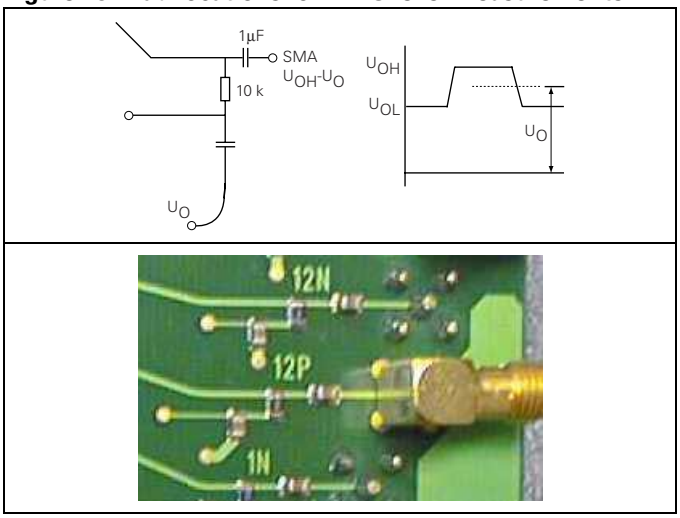


Figure 13 Pad locations for LVDS level measurements



TEST PROCEDURE FOR DC PAROLI MODULES

This section describes the step-by-step procedure to set up PAROLI test boards for performing tests on Tx and Rx modules.

Testing of DC transmitter module

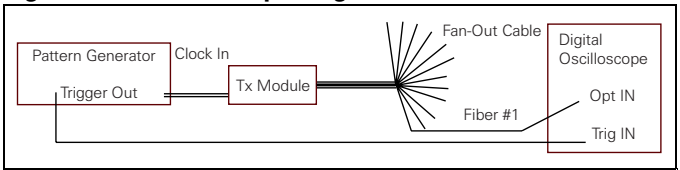
This section describes the step-by-step procedure to set up and test DC Tx module. Check the Tx test board configuration for DC module testing. Generally, test boards are factory set for AC or DC testing. However, changes can be made if necessary using instructions in TEST BOARD CONFIGURATION section of this data sheet.

1	Make all required power supply connections, 3.3 V for V_{CC}, 2.4 V for LVDS, +5 V and -5 V for LEDs and OpAmp. Set blue DIP-switch (Figure 5) to 3 V setting and use banana plugs for power supply connections.
2	Apply 2.4 V so that static HIGH or LOW is applied to LVDS inputs. To apply static HIGH, connect +ve terminal to H, and -ve to L, and finally connect L to V_{EE}. To apply static LOW, connect +ve terminal to L, and -ve to H, and finally connect H to V_{EE}.
3	Set CLK-SEL switch to HIGH or LOW as required by the application. Setting CLK-SEL to HIGH will select STROBE mode. Setting CLK-SEL to LOW will select SCI mode.
4	Set both electrical jumpers to MANUAL mode.
5	Turn on all supply voltages, and verify voltage levels using a digital voltmeter. See page 10 for LVDS voltage settings.
6	Switch off all power supplies to install PAROLI Tx module.
7	Install PAROLI Tx module. To install Tx module, drop the module in the alignment holes. The module will fit snugly and cannot be moved laterally. Now apply the mechanical clamp to hold Tx module in place.
8	Laser enable function is supported only in AUTO mode. To use the test board in MANUAL mode, laser controller must be enabled. Use a jumper to short pin #5 and #6 (3rd row from the left) of the PCI connector #2, as shown in Figure 9. Laser enable green LED will turn ON when power is applied to the test board.

Figure 14 Air inlet for cooling module

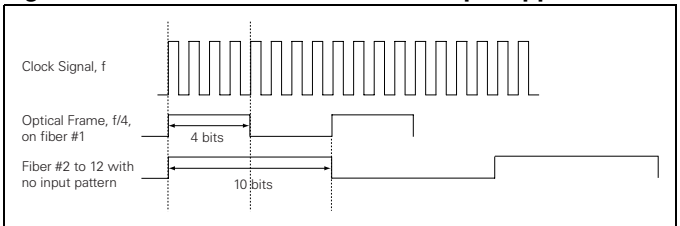
9	Cooling is recommended during testing of DC Tx module. Therefore, either use an external fan or connect air supply to the port provided as shown in Figure 14.
10	Switch on the power supplies, and apply differential clock input at SMA connectors marked CIN and CIP.
11	Activate Tx by toggling RESET switch to LOW, and then to HIGH. This will reset the Tx module, and MOD-UP and LCU LED will be ON. LCU LED ON indicates that the Laser control is ON and laser array is emitting. MOD-UP LED ON indicates that laser is active and PLL is working. MOD-UP LED OFF indicates PLL problem and possible defect of the module.
12	At this point you can proceed to characterize Tx module only or proceed to setup for testing parallel link. To perform link testing, proceed to power up the Rx test board described in the next section and then setup the parallel optical link using a ribbon cable.
13	To characterize Tx module only, use a PAROLI fan-out optical cable. This cable has at one end a 12-fiber SMC connector, and at the other end, 12 individual SC fiber connectors. This fan out cable provides a convenient way of separating and testing individual optical channels. Connect SMC connector into the PAROLI optical port, and SC connector at fiber #1 to a digital sampling scope as shown in Figure 15.

Figure 15 Tx test setup using fan-out cable



14	At this point, optical frame signal can be seen on fiber #1. If STROBE mode is selected, the frame frequency will be a quarter of the clock frequency as shown. For example, for a 200 MHz clock input, the optical frame frequency will be 50 MHz. With no AC input signal applied, you can see 4B/5B encoded signal of f/8 frequency on fiber #2 to #12. This signal is the result of 2:1 electrical multiplexing incorporated in the Tx. The start of the encoded signal may be HIGH or LOW due to the functionality of the encoding scheme and should not be of concern.

Figure 16 Frame structure with clock input applied



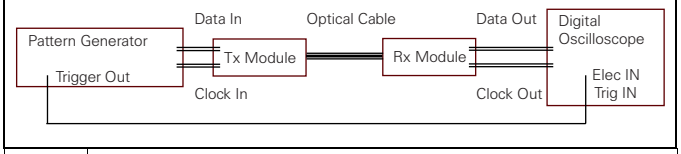
15	At this point, Tx is ready to make measurements. Input patterns can be applied and Tx performance can be evaluated.

Testing of DC receiver module

This section describes the step-by-step procedure to set up and test DC Rx module. Check Rx test board configuration for DC module testing. Generally, test boards are factory set for AC or DC testing. However, changes can be made if necessary using instructions in the TEST BOARD CONFIGURATION section of this data sheet.

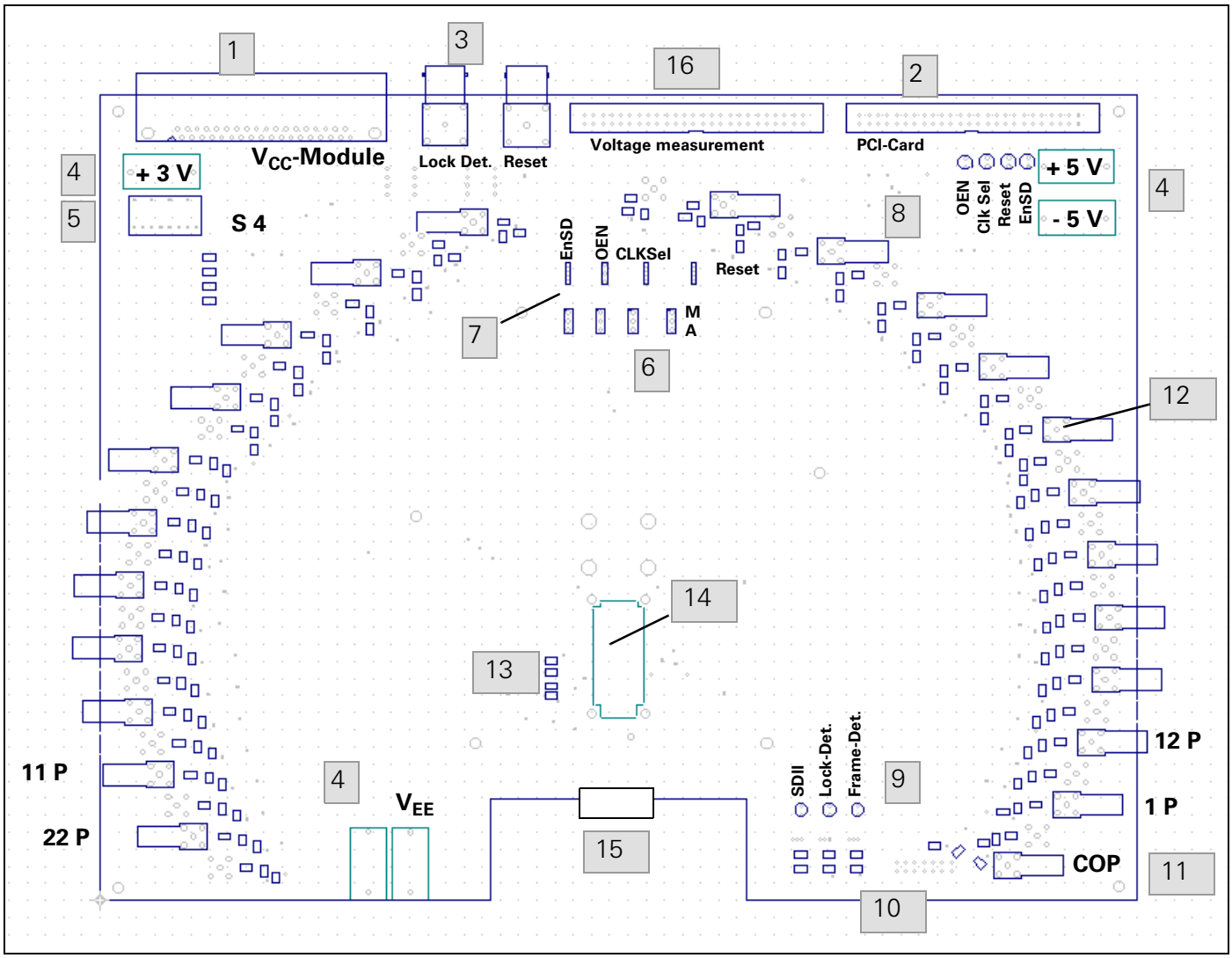
1	Make all required power supply connections, 3.3 V for V_{CC}, +5 V and -5 V for LEDs and OpAmp. Set blue DIP-switch (Figure 7) to 3 V setting and use banana plugs for power supply connections.
2	Set jumpers to MANUAL mode. Set CLK-SEL switch to STROBE or SCI. It should be identical to Tx board setting.
3	Toggle slide switches, EnSD, OEN and RESET to HIGH.
4	Turn on all supply voltages, and verify voltage levels using a digital voltmeter.
5	Switch off all power supplies to install PAROLI Rx module.
6	Install PAROLI Rx module. To install Rx module, drop the module in the alignment holes. The module will fit snugly and cannot be moved laterally. Now apply the mechanical clamp to hold Rx module in place.
7	Cooling is recommended during testing of DC Rx module. Therefore, either use an external fan or connect air supply to the port provided shown in Figure 14.
8	Set up the parallel link as shown and turn on the power supplies.

Figure 17 Test setup for testing DC parallel link



9	At this time, FRAME DET and LOCK DET LEDs should be ON. SD11 (signal detect on data channel #11, fiber #12) will be OFF, implying presence of optical signal. Note: If you are using an earlier version of the test board, this functionality is reversed and LED will be ON when signal is present.
10	At this point, link is ready to make measurements. Input patterns can be applied and link performance can be evaluated.

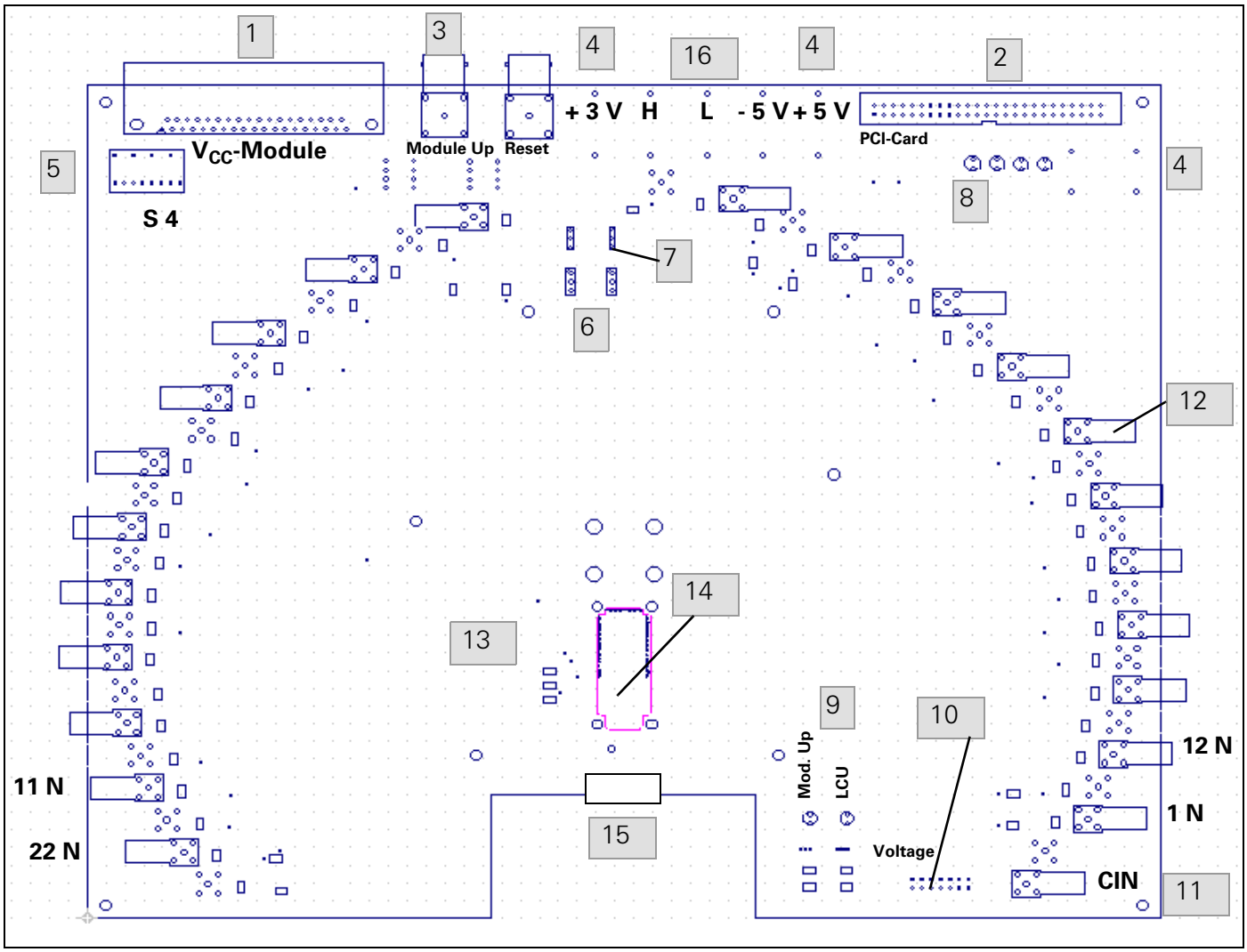
Figure 18 PAROLI receiver test board layout



Description of components and location

Label #	Description of component
1	37 pin D-sub connector for power supply in Auto mode
2	50 pin connector to read slide switch status in Auto mode
3	BNC connectors for Reset and PLL delay
4	Banana plug socket for 3.3 V and +/-5 V supply
5	DIP switch for selecting D-sub banana plug option for 3.3 V supply
6	Jumpers for selecting Manual/Auto mode
7	Slide switches
8	LEDs indicators for Auto mode
9	LEDs indicators for module functions
10	14-pin connector for reading LEDs status in Auto mode
11	SMA connector for clock output
12	SMA connectors for signal outputs
13	Location for checking AC or DC configuration changes
14	Rx module location
15	Connector for air supply for cooling
16	50 pin connector to read LVDS voltages in Auto mode

Figure 19 PAROLI transmitter test board layout



Description of components and location

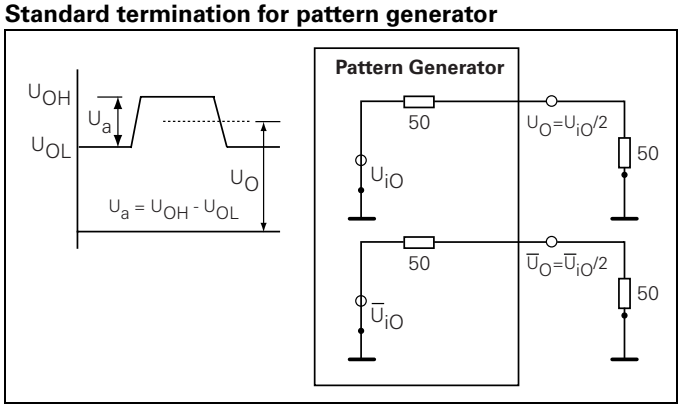
Label #	Description of component
1	37 pin D-sub connector for power supply in Auto mode
2	50 pin connector to read slide switch status in Auto mode
3	BNC connectors for Reset and PLL delay
4	Banana plug socket for 3.3 V and +/-5 V supply
5	DIP switch for selecting D-sub banana plug option for 3.3 V supply
6	Jumpers for selecting Manual/Auto mode
7	Slide switches
8	LEDs indicators for Auto mode
9	LEDs indicators for module functions
10	14-pin connector for reading LEDs status in Auto mode
11	SMA connector for clock input
12	SMA connectors for signal inputs
13	Location for checking AC or DC configuration changes
14	Tx module location
15	Connector for air supply for cooling
16	2.4 V Supply for LVDS HIGH / LOW

LVDS LEVEL SETTINGS

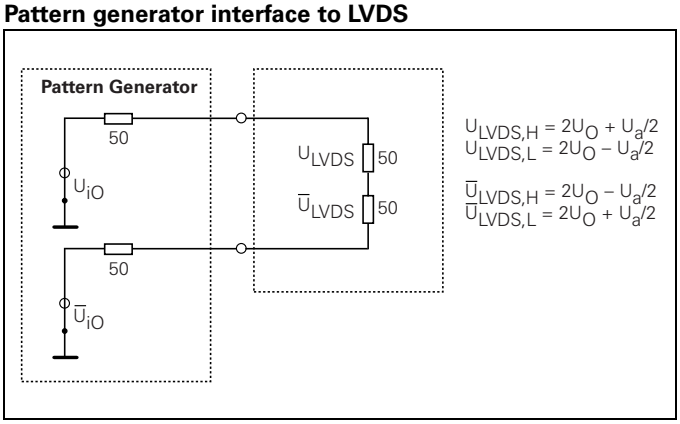
This section describes how to adjust the LVDS levels of the test equipment to interface with PAROLI modules. Most of the test equipment, including pattern generators, provides output levels for 50 Ohm terminations. PAROLI module inputs require LVDS signals with the input resistance of 100 Ohm. It is, therefore, necessary to adjust the offset and amplitude accordingly at the test equipment.

Terminology		
	U_{OH}	High voltage level
	U_{OL}	Low voltage level
	U_a	Signal amplitude
	U_O	Signal offset

Standard termination for pattern generator



Pattern generator interface to LVDS



LVDS level settings

U LVDS, H	U LVDS, L	Amplitude Ua, mV	Offset Uo, mV	High Level U_{OH},mV	Low Level U_{OL},mV
1600	1000	600	650	950	350
1400	1000	400	600	800	400
1600	1200	400	700	900	500
1400	800	600	550	850	250

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