

IEEE 1588v2 Precision Timing Protocol (PTP) Verification Measurements in an ITU-T G.8275.1 PTP Telecom Profile Architecture

This quick card outlines how to run IEEE 1588 measurements for Time Distribution in an ITU-T G.8275.1 PTP Telecom Profile Architecture with full timing support. The quick card documents a procedure to set up a TEM V2 Timing Expansion Module and T-BERD/MTS on a 1GigE Optical Interface, but the same workflow may be applied to other Ethernet data rates, or when using the GNSS option and connector on the TB/MTS 5882 or TB/MTS 5800-100 platform.

EQUIPMENT REQUIREMENTS

► T-BERD/MTS 5800 with

- Transport Software V31.1.1 or greater
- Ethernet Option C510M1GE
- PTP Option C5LS1588
- Timing Expansion Module V2 (TEM V2)
- GNSS Antenna (Taoglas A.171, Taoglas AA.162, Tallysman TW7882, or Maxtena M9706CWT recommended)



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Figure 1: Equipment Requirements

CONNECT GNSS ANTENNA AND ACTIVATE TEM V2

- 1. Press the Power button 🕑 to turn on the test set.
- Connect the male SMA connector on the end of the antenna cable to the female SMA connector on the TEM V2 (labeled Antenna).
- 3. Tighten the connector until the antenna is securely attached.
- 4. Place the antenna in a location with minimum interference or blocking.
- 5. Tap the **Test** icon at the top of the screen.
- 6. Tap the **Timing Source** tab to activate the TEM V2 Timing Module.



Figure 2: TEM V2

System 🔛 T	'est 😽 Fiber	Optics	🚾 📣 🜒 🔒	3:12 PM 02/06/2021
Select ~ No Run	ning Test 🗙	Timing Source	What's This?	
DS1/DS3	· _	Timing Medule		
E1/E3/E4	C	Timing Module		
SONET		1PPS Analysis		
Ethernet	: 🛞	10/100/1000 Eth Layer 2 PTP/1588 Term		
CPRI		1GigE Layer 2 PTP/1588 Term		





QUICK CARD

SETUP GNSS RECEIVER AND START SURVEY

- 1. Tap the **Setup** soft key on the upper right-hand corner of the screen.
- 2. Configure GNSS settings as follows:
 - GNSS System: Select GPS for use in North America. Other constellations or combination of constellations can also be used:
 - · Galileo and SBAS: European systems
 - GLONASS: Russian System
 - · BeiDou: Chinese system
 - QZSS: Japanese system
 - > Too few Satellites Alarm: 3
 - > Time Reference: GPS
 - > Time Format: 12-hour
 - Elevation Limit: 5 to 15 deg recommended, Using satellites near the horizon may degrade performance but may be needed in "urban canyons".
 - Minimum C/No: 9 dB-Hz recommended, 30 dB-Hz maximum. Using satellites with a weak carrier to noise ratio may degrade performance but may be needed in "urban canyons".
 - Antenna Power: 5 volts for VIAVI supplied magnetic mount antennas. If you are using a different antenna, enter the antenna power, or select 0V if the site powers the GPS antenna.
 - Antenna Time Bias: Select Antenna Type for VIAVI supplied antennas; otherwise, Select "User Defined" and enter the cumulative delay introduced by the antenna, cables, and any inline splitters or amplifiers. In absence of more specific information, use 1.2ns/foot or 4.5ns/meter of cable.
 - > Jamming Detection Mode: Off
- 3. Tap the **Location** settings tab and configure location settings as follows:
 - Survey mode: Typical (3 hours) is recommended, Fast (15 minutes) may be used with reduced position accuracy, Quick should not be used.
- 4. Tap the **Start Survey** button to start a survey.
- 5. Tap the **Results** soft key on the upper right-hand corner of the screen.



Figure 4: Timing Module Results

Timing Module • No I	Running Test			What's This?	10
GNSS R Location NTRIP Client Oscillator/Timing	GNSS System ✓ GPS □ GA Too Few Satellites Ala	ALILEO 🗆 BEIDOU arm Threshold 3	GLONASS	SBAS	QZSS
IPPS Analysis	Time				
RJ45	Time Reference	GPS ÷	Time Format	12-hour	\$
Timed Test	UTC Standard	USNO(GPS) +			
	Filter Elevation Limit (deg)	15	Minimum C/No (d	B-Hz) 9	
	Antenna Antenna Power 5 Vol	lts 🔹 🍘 Antenna 1	lime Bias Taoglas A	A.162.301111 (45	ns) 🗘
	Jamming Detection Mode	Off ÷)		

Figure 5: GNSS Settings



Figure 6: Location Settings



QUICK CARD

VERIFY GNSS RECEPTION

- Tuning Status will be displayed at the bottom of the screen. The Oscillator will cycle through these stages: Warming Up, Initializing, Wait for 1PPD, Course Tune, Intermediate Tune, Fine Tune. At least Course Tune is required.
- 2. Using the results group and category drop-down menus, change the right results display to the following:
 - Satellites/Sky Plot: Displays the satellites detected by the GNSS receiver. Ensure at least 4 satellites are "Used". Otherwise, relocate antenna to a less obstructed location.
 - Satellites/Signal Strength: Uses a bar graph to display the signal strength for each identified satellite. Ensure signal strength of used satellites exceeds Minimum C/No setting (bar will be green). Otherwise, reduce Minimum C/No setting.
 - GNSS/Status: Displays general information concerning the GNSS Satellites. Ensure that Status progresses from "No Lock" to "Locked" to "Fixed Position" during the survey. Ensure that Timing Mode Status progresses from "Survey" to "Survey Done".
 - GNSS/Location: Displays general information concerning the location and position accuracy. A Mean Position Dilution of Precision (PDOP) value below 4.0 is desired.
- A "Typical" survey will run for 3 hours and stop if it has reached a 1-meter position accuracy.
 If, after 3 hours, the survey still shows "Survey Active", the Timing Module was not able to attain a 1-meter or better position accuracy. Tap the Setup soft key, set Survey Mode to Fast, and tap the Results soft key. Repeat steps 1 and 2 above to conduct a 15minute survey with 45-meter position accuracy.



Figure 7: Satellites/Sky Plot Results



Figure 8: Satellites/Signal Strength Results

🔯 System 🔛 Test	Fiber Optics			4	🎗 🕩 🔽	1:55 PM 01/12/2024
Timing Module • No Rur	ning Test		What's This?			
Running 27m:19s	Summary 🗢 State	us ;	GNSS	Location	•	Setup
Summary Oscillator/Timing	Intermediate Tune	(N	Latitude (deg) Longitude (deg) Altitude (m)	k	28.1224119 -80.6254869 -41.4810000	C Restart
Sync Source: TEM GNSS Present Frequency Valid GNSS			Mean C/No (dB-Hz) Survey ⊟		27.33	Clear Log
Status Fixed Position			Mean 3D Accuracy (r	nm)	27,355 Unavailable	-
Satellites Used: 6			Mean PDOP		4.12	Wander
Antenna System History Location Latitude: 28.1224 Longitude: -80.6255 Altitude (m): -41			Mean C/No (dB-Hz)		29.61	Analysis Save TIE Data Export
						ming Data
Reports Tools View Help	Rubidium Tuning Osc. On Status:	Intermediate Tune	Force St Holdover Su	tart rvey		Dual Test View

Figure 9: GNSS/Status Results



QUICK CARD

LAUNCH PTP/1588 TEST

- Tap the Select Test drop-down Select v and select the following Layer 2 PTP/1588 test:
 - Ethernet> 1GigE Optical> Layer 2 PTP/1588> P1 Terminate
- 3. Connect T-BERD SFP+ Port 1 to the network port to be tested using an LC patch cable.
 - ► Enable the Laser: Off Con
 - ► Press **Restart**:
 - Look for 5 or 6 green LEDs: This will indicate that the link is up, and GPS sourced timing is available.

😻 System 🔀 Microsco	ope 🏼 Test	😽 Fiber Optics]		Va	📣 🜒 👔	9:53 AM
Timing Module + Port 1:	1GigE Layer 2 Tr	affic Term	+		What's This?	10	-
Running 2h:22m:08s	Summary	\$ Status	•	GNSS	Location	•	Setup
No messages	Intermediate Tur	ne	ON	Latitude (deg)		28,1224363	

Figure 10: Port 1 or Port 2 Tab



Figure 11: Select Test

Laser	Actions	C	apture			
Laser		•	-1	+1	-10	+10
Off	Clock Source	e 15-		Freq Off	set (ppm)	

Figure 12: Enable the Laser

System 🔡 Te	st Select	Fiber Optics	<mark>gE Lay</mark>	er 2 P	TP/15	88 Teri	m 🔀 👘	+	What	ve 's This?	4 🔹	8:58 PM
Running B 3 messages	385	Frames/Packets Frame Detect VLAN SVLAN		2	3	4						Setup
Ever (dom) -2.1 Freq Dev (ppm) 22.5 Status Signal Present Sync Acquired Link Actor		Summary PTP Port State SyncE MTIE Mas SyncE TDEV Mas	k Failur ik Failur	e			0 Statu	5		,	o Vot started ON ON	Restart Stop Test
Frame Detect ToD 3ync IPPS Sync History												
		ŀ	-igi	ıre	13	: C	heck	LEL)s			

CONFIGURE PTP SLAVE SESSION

- 1. Press Setup:
- Select the PTP Folder. Make all PTP settings as necessary for a PTP Slave on the network under test:
 - Mode: Slave
 - Address Mode: Multicast
 - Domain: default value should be set to 24, otherwise use the value recommended by your network timing administrators, in the range 24 to 43
 - Encapsulation: None
 - Announce Rx Timeout: 3
 - Announce: 8 per second

System 🔛 Test 🗧	😽 Fiber Optics						<u>N2</u>	* •)	9:04 P
Timing Module Selec	t 👻 Port 1: 1Gi	gE Lay	er 2 P	TP/15	88 Term 🔣	+	What's This?	10	-
 Running 6m:37s 3 messages 	Frames/Packets Frame Detect VLAN	1	2	3	4				setup
Level (dBm) -2.1 Freg Dev (ppm) 22.5	SUDM			40		States			Ŭ

Figure 14: Setup

😻 System 😽 Fiber Op	otics Text			🛛 🔺 🕺	ا 🏠 🕩	8:00 PM
Timing Module Selec Test	t 🗸 Port 1: 1GigE Laye	r 2 PTP/1588Term 🔀	+	What's This?	ø	\leftarrow
Interface	Mode					Results
Capture	Mode	Slave 🗘	Address Mode	Multicast	+	
Filters	Domain	24	✓ Ignore Flags			
All Streams	Use 01-80-C2-00-0	0-0E non-forwardable	Destination MAC			
2	Encapsulation Encapsulation	None 🗘				Streams Pipe
	Message Interval					
РТР	Announce Rx Timeou	it 3				
THI CSHOIGS	Announce	8 per second 🗘				
Timed Test	cTE Sampling period (s) 1000	🥜 Cable Delay (ns)	0		
Defaults						Dual Test View

Figure 15: PTP Setup



QUICK CARD

CONFIGURE PTP SLAVE SESSION (Continued)

- 3. Select the Thresholds folder. Enable and set the desired settings thresholds including Time Error Max.
 - Swipe screen or use scroll bar to view and configure additional Measurement settings and pass/fail limits.
- 4. Press Results: to return to the results view.

• Timing Module	elect v Port 1: "	IGigE Layer 2 PTP/1588 Term 🔣	+	What's This?	- E -
Interface Capture Filters All Streams 1 2 3 4 4 900	PTP Thres Enable Enable Enable Enable Enable Enable Enable	olds Sync PDV Max. (ns) Delay Request PDV Max. (ns) Floor Packet Measurement Packet Select 2-Way TE Measurent Slave to Master Delay Min. (ns) Master to Slave Delay Min. (ns)	ment		Results Streams Pipe
Thresholds	🗌 🗆 Enable	Master to Slave Delay Max. (ns)			
Timed Test		Time Error Max. (ns)	100		-
	🗆 Enable	Two Way cTE Over Time Abs Max	c. (ns)		
		۲			

Figure 16: Thresholds Setup

REVIEW PTP SLAVE SESSION RESULTS

1. The default Results view is single screen with Summary and Status. The view can be changed to dual results (Split Left/Right) through the View button on the lower left.



Figure 17: Split Left/Right View



Figure 18: PTP/Link Stats

Select the Actions tab at the bottom of the 3. screen, press Start Slave PTP Session.

2. Select PTP / Link Stats for the left result

Laser	Actions	Captur	e			
Start raffic	Loop Up	Loop Down	LLB	Pause Frame Insert	Start Slave PTP Session	
	Figu	re 19.	Start	Slave Ses	ssion	

windows.



QUICK CARD

- Port State should progress from "Not Started" to "Listening" to "Slave"
- Detecting the Rx Domain Number (24 to 43) and seeing a Max TE value indicates that the PTP Slave Session is active. The T-BERD is receiving timing from the PTP master.
- Additional PTP/Link Stats results can be viewed by scrolling through the window.
- If Pass/fail thresholds are met, the Summary/Status window and Status LED will remain green.
- If any thresholds are triggered, Summary/Status window and the Status LED and the value for that result will turn red.
- 4. Select **Graphs / Max TE** for the left results window to view a graph of a key performance indicator.
- 5. Note: There are many more categories and sub-categories of results both tabular and graphed.



Figure 20: PTP Link Stats



Figure 21: Max TE Graph



Figure 22: Create Report

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CREATE REPORT

- Tap Keports to open the **Reports** Panel and select Create Report...
- 2. Optionally, tap Choose Contents to select and unselect report groups
- 3. Tap Create
- 4. A report will be saved to the T-BERD 5800's /user/bert/reports folder.

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