

#### ADIN6310 Hardware and TSN Switch Evaluation User Guide

## **FEATURES**

- ▶ 6 port TSN switch with RGMII or SGMII interface
  - 6 RGMII ports to 10 Mbps/100 Mbps/1000 Mbps ADIN1300 PHYs
  - ► RJ45 with integrated magnetics
  - ▶ 4 SGMII ports connected to on board SFP cages
- ▶ Host interface hardware strapping with jumpers, choice of
  - ▶ S/D/Q SPI interface
  - Ethernet port through RJ45 (Port 0)
- ▶ FMC (LPC) connector
  - ► Host port access through S/D/Q SPI interface or Port 0
- ▶ PHY Strapping through surface-mount configuration resistors
  - ▶ Default state is software power down from Port 1 to Port 5
  - Switch firmware manages PHY operation over MDIO
- ► Operates from a single, external 9 V to 17 V supply
- ▶ LED indicators on GPIO pins
- ▶ IEEE 802.1AS Time Synchronization
- Scheduled traffic (IEEE 802.1Qbv)
- ▶ Frame preemption (IEEE 802.1Qbu)
- ▶ Frame replication and elimination for reliability (IEEE 802.1CB)
- Per stream filtering and policing (IEEE 802.1Qci)
- ▶ VLAN table control (remapping, reprioritization)
- ► IGMP snooping
- GPIO/Timer control

## **EVALUATION KIT CONTENTS**

- EVAL-ADIN6310EBZ evaluation board
- ▶ 9 V or 12 V, 18 W wall adapter with international adapters
- ▶ 1 Ethernet cable

#### **EQUIPMENT NEEDED**

- EVAL-ADIN6310EBZ evaluation kit
- Ethernet cables
- ▶ PC running Windows<sup>®</sup> 10

## **DOCUMENTS NEEDED**

ADIN6310 data sheet

#### SOFTWARE NEEDED

- TSN application suite (switch configuration GUI and web server)
- Npcap packet capture

## **GENERAL DESCRIPTION**

The EVAL-ADIN6310EBZ is a flexible platform, which enables an efficient evaluation of the ADIN6310 industrial Ethernet Switch with time sensitive networking (TSN) capability. This user guide describes the hardware kit and software evaluation package (**TSN Switch Evaluation** application). It discusses how to use the kit to interface to one or more Switches to configure the Switch, TSN, or redundancy features to meet the requirements of an industrial network.

The **TSN Switch Evaluation** application enables the initial evaluation of the Switch and its functionality, which further enables the users to familiarize themselves with the Switch capability in advance of migrating to the driver library. Simply connect a PC through Ethernet port to Port 0 on the evaluation board and run the application. The **TSN Switch Evaluation** application can identify and allow configuration of a chain of up to 10 ADIN6310 devices. The application launches a PC-based web server and NETCONF server for each Switch device it finds. A user can interact with the web server to configure the Switch functionality or load YANG configurations from a NETCONF client. Once configuration completes, the user applications can communicate with other devices over the TSN network.

Figure 1 shows an overview of the evaluation board. Full specifications on the ADIN6310 are available in the ADIN6310 data sheet available from Analog Devices, Inc., and must be consulted with this user guide and hardware reference manual when using the EVAL-ADIN6310EBZ evaluation board.



Figure 1. Hardware Overview

# **EVAL-ADIN6310**

## TABLE OF CONTENTS

Features	1
Evaluation Kit Contents	1
Equipment Needed	1
Documents Needed	1
Software Needed	1
General Description	1
Evaluation Board Hardware	4
Power Supplies	4
Power Sequencing	4
Evaluation Board Use Cases	4
Jumper And Switch Options	
GPIO and TIMER Headers	5
Clock Ontions	5
On-Board LEDs	5
Strapping And Configuration	5
	0 ۵
EMC Connector	0 6
Software Installation	0
Installing the TSN Switch Evolution	0
Application Cofficient	0
Application Software	ð
	.10
ISN Switch Evaluation Contents Overview	. 10
Initial Evaluation Board Setup	. 16
Software Execution	.17
TSN Switch Evaluation Web Page Overview	. 19
Candidate/Running/Startup Pages	.20
Setup Page	.21
Save and Load Candidate Datastore	. 21
Datastore Management	.21
Advanced	. 21
Performing a Reset	. 22
Port Statistics	23
Port Configuration	24
Candidate Page	24
Status Page	.25
MDIO Control	. 27
GPIO and Timer Configuration	. 28
TSN Output Timer	. 28
1PPS Periodic Output	. 28
Periodic Output	28
Capture Input	28
Other Modes	28
Switching Table	30
Candidate View	.30
Status View – Dynamic Entries	33
VI AN Control	. 34
VI AN Table	34
VI AN Remanning	37
VI AN Reprioritization	 
	. 09

Time Synchronization	41
Candidate Page	41
PTP Configuration	41
Port Configuration	41
Common Services	45
PTP Instances	47
Hardware Clock	48
External Port Config	48
Status Page	49
Time Svnc Messaging	52
Running Page	53
Startup Page	53
Timer Pins. 1PPS Signal	53
Frame Preemption	
Candidate Page	54
Status Page	55
Frame Preemption Example	56
Scheduled Traffic	57
Assigning Queues	
Scheduled Traffic – Set Queue Max SDU	60
Scheduled Traffic – Schedule	
Schedule Enabled	62
Guard Bands	02
Cycle Time	02 63
Base Time	00
Cycle Time Extension	03 63
Cycle Time Extension	05
Cut Through Allowed	04 64
Gate Control List Time Intervale	04 64
	04
Candidata Daga	00
	00
Running Page	07
Startup Page	00
Schedule on the Timer Pins	09
	/ 1
LINK Layer Discovery Protocol (LLDP)	
	/1
	13
	74
LLDP Example (Fast Tx)	75
Parallel Redundancy Protocol (PRP)	76
Enabling PRP Example	/ /
PRP Configuration Web Page Views	77
PRP Status Page	79
PRP – Supervision Frames	81
PRP – Capture of PRP Tagged Traffic	82
GPIO/Timer Configuration Tab When Using	
PRP Mode	83
VLAN Table Operation in PRP Mode	83

## TABLE OF CONTENTS

Switching Table in PRP Mode	. 83
High Availability Seamless Redundancy (HSR).	. 84
HSR Operating Modes	. 84
Enabling HSR Example	.84
HSR Candidate View	.85
HSR Status View	.87
HSR Running View	.89
HSR Startup View	89
HSR – Supervision Frames	.90
HSR – Capture of HSR Tagged Traffic	.91
Media Redundancy Protocol (MRP)	. 92
MRP Stack on the Switch	.92
Recovery Profiles	. 92
Configuring MRP	. 92
Candidate Page	.92
MRP Scenarios: MRM and MRC	.94
MRP Scenarios: MRA	96
Per-Stream Filtering And Policing, Qci	. 98
PSFP Candidate Page	. 99
PSFP Status Page	104
Frame Replication And Elimination for	
Reliability (FRER), 802.1CB	105
Redundancy Tag	106
Stream Identification	107
Sequence Recovery	108
Individual Recovery	108
Stream Table	108
FRER Configuration – Candidate View	109

# **REVISION HISTORY**

10/2024—Revision 0: Initial Version

FRER Status	. 111
Talker – Listener Configuration Example	112
Talker System	113
Listener System	114
Internet Group Management Protocol (IGMP)	
Snooping	115
Router Timeout	115
Group Member Timeout	116
IGMP Versions	117
IGMP Snooping Example	. 117
NETCONF/YANG	. 121
Sysrepo Datastore	121
YANG Models	121
Custom Leaf Nodes	121
Startup Configuration	. 121
Web Server Use and NETCONF	122
YANG Model Examples	. 122
Firmware Update	. 124
Automatic Firmware Update	124
Paired Firmware and Web Server	. 124
Firmware Downgrade	. 124
Troubleshooting	. 126
GUI Does Not Find ADIN6310 Devices	126
GUI Table Remains Blank	. 126
Web Page Fails to Load	. 126
Firmware Did Not Update	126
GUI Inconsistent at Finding Devices	. 127

#### **POWER SUPPLIES**

The EVAL-ADIN6310EBZ operates from a single, external, 5 V to 17 V supply rail. A 9 V or 12 V wall adapter is supplied as part of the kit.

Apply the wall adapter to P2 connector or alternatively 5 V to 17 V to the P1 plug. Switch BRD\_ON\_OFF to the ON position. The LED DS4 lights up to indicate a successful power up of the main power rails.

The EVAL-ADIN6310EBZ power requirements are generated from the input power rail by an on-board LTM4668A µModule regulator, which provides the four rails required for operation of the ADIN6310 Switch, the six ADIN1300 Ethernet PHYs and other support circuitry. The default nominal voltages are listed in Table 1.

By default, the VDDIO\_A and VDDIO\_B share the same voltage rail and default to 1.8 V with the installed components and jumper settings.

Table 1. Default Device Power Supply Configuration

LTM4668A Output	Nominal Voltage	ADIN6310 Switch	ADIN1300 PHY
V <sub>OUT1</sub>	3.3 V	VDD3P3	AVDD3P3
V <sub>OUT2</sub>	1.8 V	VDDIO_A/B	VDDIO
V <sub>OUT3</sub>	1.1 V	VDDCORE	N/A <sup>1</sup>
V <sub>OUT4</sub>	0.9 V	N/A <sup>1</sup>	VDD0P9

<sup>1</sup> N/A means not applicable.

The VDDIO\_A rail provides a separate voltage domain for the Switch interface pins that can connect to a Host interface. This includes SPI interface, TIMER, GPIO, and Port 0 MAC interface pins. The motivation for partitioning the VDDIO\_A/B voltage rails is to ensure flexible Host interface I/O voltage while helping to reduce overall power consumption for the Switch ports and PHY devices. For normal operation of the evaluation hardware, the default voltage rail should be sufficient. If user is connecting own Host interface over SPI or FMC connector, flexibility to change the VDDIO\_A rail may be beneficial.

If a different VDDIO\_A voltage is required, user can adjust by changing the placement of configuration jumpers. The VDDIO\_A rail can be changed from 1.8 V default to either 2.5 V or 3.3 V. To change the VDDIO\_A rail to 2.5 V, the LDO, U3 must be used. The jumpers to reconfigure this are P3, P4, P5, and P33.

For more details, see Table 2 and the evaluation board schematics.

Table 2. VDDIO\_A Configuration

VDDIO_A	Jumper Setting
1.8 V	P3 (1-2), P4 (1-2), P33 (OPEN)
2.5 V	P3 (OPEN), P4 (2-3), P33 (1-2)
3.3 V	P3 (1-2), P4 (2)-P5(1), P33 (OPEN)

Table 3 shows an overview of the EVAL-ADIN6310EBZ current for various operating modes.

#### Table 3. Board Quiescent Current (P2 = 9 V)

Board Status	Typical Quiescent Current
On Power-Up (S1 on)	104 mA initially
In Hardware Power-Down (RESET_N Held Low)	72 mA
1000BASE-T, 2 RGMII + HOST Port	250 mA
1000BASE-T, 5 RGMII + HOST Port	360 mA

## POWER SEQUENCING

The ADIN6310 device does not have any power supply sequencing requirements, however the preferred power up sequence is to bring up VDDCORE last and removed first on power down. There are no power sequence requirements for the ADIN1300 devices. The evaluation board is configured to bring up the power rails in the following order VDD3P3 and VDD0P9 -> VDDIO\_A/B -> VDDCORE.

## **EVALUATION BOARD USE CASES**

The EVAL-ADIN6310EBZ can be used in two general modes. The default and expected use case utilize Port 0 as the Host interface port through the RJ45 connector. Port 0 is connected to a PC running the TSN evaluation software package for network configuration and control. Port 0 can still be used for data traffic, but it is not a part of the time aware network as it is connected to the PC. In this use case, the other five RGMII ports and four SGMII ports on the EVAL-ADIN6310EBZ can be used to evaluate IEEE802.3 and TSN features of the ADIN6310, establish links with other link partners and evaluate the performance of the chip.

Alternatively, the user can connect their own Host directly to the EVAL-ADIN6310EBZ. If Host interface is SPI, then option to connect directly through the SPI header or the FMC LPC connector (FPGA mezzanine card low pin count). The FMC connector can be plugged into an FPGA development board. When the Switch hardware is used with an FPGA board, the media independent interfaces (MIIs) for Port 0, SPI interface, GPIO, and TIMER signals can be connected to the FPGA. In this use case, a MAC-MAC type Host interface can be used on Port 0 or the SPI (quad, dual, or single) interface can be used for control and configuration with the FGPA as the Host processor for evaluation of the ADIN6310 in a full system. With the SPI interface as the HOST interface, the system can have six TSN capable ports.

## JUMPER AND SWITCH OPTIONS

Several jumpers on the EVAL-ADIN6310EBZ must be set for the required operating setup before using the EVAL-ADIN6310EBZ for evaluation. The default settings and functions of these jumper options are described in Table 4.

Link	Position	Function
BRD_ON_OFF	OFF	Power ON/OFF Switch
S1	3	Reset options
P3	Inserted	

#### Table 4. Default Jumper, Switch Options and Descriptions (Continued)

Link	Position	Function
P4	1-2 Inserted	VDDIO_A = VDDIO_B = 1.8 V; runs off the Switching regulator
P33	Open	Enable for VDDIO_A LDO
TIMER2	Open	Host strapping (RGMII No Tx Rx Delay)
SPI_SS, TIMER0, TIMER1, TIMER3	1-2 Inserted	Host strapping (RGMII No Tx Rx Delay 1000 Mbps)
P28	1-2 Inserted	Power to TIMER/GPIO LEDs
P41	1-2 Inserted	Connect VCCIO supply of FTDI to VDDIO_A
P11, P13, P17, P18	1-2 inserted	PortX link from PHY
P36	Open	Connect power to U26

## **GPIO AND TIMER HEADERS**

The EVAL-ADIN6310EBZ provides a header (P10) for observation of all Timer and GPIO signals. In addition to the header, there are LEDs on these pins. When using the **TSN Switch Evaluation** application, TIMER2 is configured for a 1 pulse per second (1PPS) signal by default and the LED connected to TIMER2 pin can be observed to blink at a 1 second rate when the board is powered and has been successfully configured using the **TSN Switch Evaluation** application.

If the Switch Host strapping is changed to SPI interface (default is Ethernet Host - RGMII), the TIMER0 pin functionality changes to be an Interrupt signal to the Host and TIMER0 is no longer available for timer or TSN functionality.

## **CLOCK OPTIONS**

A crystal oscillator, Y8, is used to provide the ADIN6310 a clock signal. It is a 25 MHz crystal connected across the XTAL\_I pin and XTAL\_O pin of the ADIN6310 on the board. The clock for the ADIN1300 Ethernet PHYs can be provided from a buffered 25 MHz clock from the ADIN6310 or alternatively from a dedicated 25 MHz crystal local to each PHY (default). If the buffered clock option is selected, once the ADIN6310 has successfully powered up it generates a 25 MHz clock on CLK\_OUT\_1 pin. This clock is routed to a clock buffer chip, SI5330F-B00214-GMR (U31), which provides a buffered version of 25 MHz clock to each of the six ADIN1300 transceivers on the board.

## **ON-BOARD LEDS**

The EVAL-ADIN6310EBZ has one LED, DS4, that lights up to indicate a successful power up of the circuit. There are eight LEDs, that are controlled by GPIO (0-3) and the Timer (0-3) signals when link P28 is inserted.

For the ports that support SGMII interface, there are LEDs (DS1, DS2, DS3, DS5) close to the SFP modules. When an SFP module is inserted and the link is up, the LOS signal from the SFP module is used to indicate optical activity/link status.

# STRAPPING AND CONFIGURATION

# ADIN6310 Host Port Strapping

The ADIN6310 Switch supports stack Processor/Host control over SPI or any of the six Ethernet ports. There is no stack processor/microcontroller used on this board, instead use a Windows PC as the Host with the **TSN Switch Evaluation** package.

When using this hardware, the user can connect a Host in a few different ways, firstly, via Port 0 Ethernet Port, alternatively, connected to RMII/RGMII directly over the FMC connector or otherwise via SPI through the dedicated headers (P39, P40). The Host Hardware strapping jumpers must be set according to the Host interface required.

The default Host port strapping configuration for this hardware is using Ethernet interface with Port 0 as the Host interface. The Switch port is configured for RGMII with no TXC or RXC delays and port speed of 1000 Mbps. In a typical application, with an MII interface to the Host, the Switch MAC port is directly connected to the Host MAC interface without a PHY in the path. As a result, when the Switch is configured for MAC interface Host, the Switch does not expect a PHY and does not perform any PHY configurations for that port. The EVAL-ADIN6310EBZ hardware does include a PHY on Port 0 (default RGMII Host interface), but the TSN Switch **Evaluation** application does not configure this PHY directly. As a result, the link brought up by the PHY on the Host port must match the Switch port speed set by strapping jumpers, default 1000 Mbps. The PHY is hardware strapped to auto-negotiate all speeds, if it brings up a lower speed link, there is a link mismatch between the Switch port and the PHY, which blocks the communication between the Host and Switch.

The Host port and Host port interface selection are configured via jumpers labeled TIMER\_0/\_1/\_2/\_3 and SPI\_SS.

The Timer and SPI pins have internal pull-up/-down resistors, as shown in Table 5, the strapping jumpers provide user with ability to reconfigure the strapping to select alternative Host port types. For more details on all options available, refer to the Host Strapping section in the data sheet.

#### Table 5. Host Port Selection Jumpers

Host Port	SPI_SS	TIMER3	TIMER2	TIMER1	TIMER0
Internal Pull up (PU)/Pull down (PD)	PU	PD	PD	PU	PU
SPI (Single)	OPEN	OPEN	OPEN	OPEN	OPEN
SPI (dual)	OPEN	INSERT	OPEN	OPEN	OPEN
SPI (quad) (low drive strength)	INSERT	OPEN	INSERT	OPEN	OPEN
SPI (quad) (high drive strength)	INSERT	INSERT	INSERT	OPEN	OPEN

Host Port	SPI_SS	TIMER3	TIMER2	TIMER1	TIMER0
RGMII 1000M (default H/W config)	INSERT	INSERT	OPEN	INSERT	INSERT

#### Table 5. Host Port Selection Jumpers (Continued)

## ADIN1300 Strapping

There are six ADIN1300 devices on this evaluation board. The PHY on Port 0 is hardware strapped for auto-negotiation for all speeds (10 Mbps/100 Mbps/1000 Mbps), which allow it to bring a link up with a remote partner without any configuration from the Switch/Host. By default, the Switch Host strapping is configured for Port 0 as Host interface, the PHY needs to be able to bring up a link to enable communication path between the Host and the Switch so the **TSN Switch Evaluation** package can configure the Switch.

The other five PHYs (on Port 1 to Port 5) are configured for the same speeds (10 Mbps/100 Mbps/1000 Mbps), but power up in software power down mode with the Switch bringing them out of software power down and configuring them over the MDIO interface.

The PHY strapping upon power up is shown in Table 6.

Tahlo	6 ΔΠ	IN1300	PHY	Port	Confid	nuration
Ianic	0. AD	1111300	ЕШ	FUIL	Connig	juiauvii

Function	PHY Port 0	PHY Port (1-5)
MAC Interface	RGMII With Tx& Rx DLL Enabled	RGMII With Tx& Rx DLL Enabled
MDI Mode Speed	AutoMDI, Pref MDI 10/100 HD/FD, 1000 FD Target	AutoMDI, Pref MDI 10/100 HD/FD, 1000 FD Target, SftPd

#### **ADIN1300 Link Status Polarity**

The ADIN1300 LINK\_ST output pin is active high by default, whereas the P0\_LINK input of the ADIN6310 is active low by default, therefore the EVAL-ADIN6310EBZ hardware includes an inverter in the path between the Port 0 PHY LINK\_ST and the P0\_LINK of the Switch. The other five ports do not include this inverter, instead the PHY link polarity is changed to default low during the initial configuration.

As a result of this hardware difference on the Host Port 0, when the board first powers up, prior to configuration, the right LED of Port 1 to Port 5 lights. Once the configuration has been loaded from the **TSN Switch Evaluation** application, the PHY link signal as seen at the LEDs matches for all ports. The RJ45 right LEDs light to indicate link up, the left LEDs are on for link up and blink for traffic activity.

## ADIN1300 Link Status Voltage Domain

The ADIN1300 LINK\_ST is primarily intended to drive the Switch Px\_LINK input signal, therefore, resides on the VDDIO\_A/B voltage domain (default voltage rail is 1.8 V). If using the LINK\_ST pin to drive an LED to indicate link active, a level shifter must be used to

provide voltage and drive capability for the LED function. The LED anode is connected to 3.3 V through a 470  $\Omega$  resistors.

#### ADIN1300 PHY Addressing

The ADIN1300 PHY addresses are configured by sampling their RXD pins after power on, when they come out of reset. The ADIN6310 Switch has internal pull-up/-down resistors on its RXD pins to support assignment of unique PHY addresses to each PHY per port. As a result, external PHY address strapping resistors are not necessary, unless different PHY addressing is required. The default PHY addresses assigned to the ADIN1300 devices is shown in Table 7.

Table 7. Default PHY Addressing	(set by ADIN6310)
---------------------------------	-------------------

Port Number	PHY Address
0	0
1	1
2	2
3	4
4	8
5	9

## **MDIO INTERFACE**

The MDIO bus of the ADIN6310 connects to the MDIO bus of each of the six PHYs on the evaluation board. Configuration of the PHYs is done by the Switch firmware via this MDIO bus. The **TSN Switch Evaluation** application supports read and write access of the PHYs on all ports.

#### **FMC CONNECTOR**

This evaluation board is fitted with a low pin count FPGA mezzanine card (LPC FMC) connector on the back of the board. This allows it to interface directly with a compatible FPGA board. All port 0 signals, SPI, TIMER, and GPIO signals are brought directly to the connector. This allows users to directly interface with the ADIN6310 with any one of the three Host interface options SPI, RGMII, and RMII. To use the FMC connector to interface with an FPGA or a processor board, make the changes to the resistor set, as shown in Table 8.

#### Table 8. Resistor configuration for FMC Use

Signal	Remove	Install			
RGMII\RMII					
P0_TXC	R239	R227			
P0_TXCTL	R240	R228			
P0_TXD0	R238	R226			
P0_TXD1	R237	R225			
P0_TXD2	R236	R224			
P0_TXD3	R235	R217			
P0_RXC	R242	R219			
P0_RXCTL	R241	R218			
P0_RXD0	R243	R220			

## Table 8. Resistor configuration for FMC Use (Continued)

Signal	Remove	Install				
	RGMI\RMI					
P0_RXD1	R244	R221				
P0_RXD2	R245	R222				
P0_RXD3	R246	R223				
	SPI					
SPI_SS	R485	R372				
SPI_SCLK	R484	R329				
SPI_SIO0	R493	R358				
SPI_SIO1	R492	R365				
SPI_SIO2	R499	R373				
SPI_SIO3	R501	R379				
TIMER0	R494	R378				

# INSTALLING THE TSN SWITCH EVALUATION APPLICATION SOFTWARE

The evaluation package runs on Windows 10. To use the **TSN Switch Evaluation** software, first run the installer package to install the GUI and PC based web server. The installation steps are listed in the following section. The default location for the TSN Switch software install is **C:\Analog\ADINx310EVKSW-Relx.x.x folder**.

When the **TSN Switch Evaluation** software installation is complete, install Npcap if not already present on the machine. Download from Packet capture library for windows on the Npcap website. Npcap is recommended over WinPcap.

## **TSN Switch Evaluation Software Installation**

To install the **TSN Switch Evaluation** software package, do the following steps:

- 1. Launch the installer file to begin the **TSN Switch Evaluation** software installation.
- 2. If a window appears asking for permission to allow the program to make changes to the PC, click **Yes**.
- 3. The installation process starts, see Figure 2.

Analog Devices ADIN6310EVKSW Rel0.0.2 - InstallShield Wizard					
Analog Devices ADIN6310EVKSW Rel0.0.2 Setup is preparing the InstallShield Wizard, which will guide you through the program setup process. Please wait.					
Extract	Extracting: ADIN6310EVKSW.msi				
-		Cancel			

Figure 2. Installation Begins

4. The welcome window appears (see Figure 3), with prompts that user must separately install Npcap, click **Next**.



#### Figure 3. Welcome Message

 A license agreement appears. Read the agreement and click I accept the terms in the license agreement to allow the installation to proceed, as shown in Figure 4, click Next.

Analog Devices ADIN6310EVKSW Rel0.0.2 -	BETA		×	
License Agreement Please read the following license agreement ca	arefully.	ANALOG DEVICES	ADI Chronous BOUABLE ETHERNET THED TO PERFECTION	
EVALUATION LICEN 20201029-TSN	ISE AGR	EEMENT	^	
This Evaluation License Agreement (the "Agreement") is a legal agreement between Analog Devices, Inc., a Massachusetts corporation, with its principal office at One Technology Way, Norwood, Massachusetts, USA 02062 ("Analog Devices") and you (personally or on behalf of your employer, as applicable) ("Licensee") for the software and related documentation that accompanies this Agreement (the "Licensed Software"). YOU AGREE THAT YOU ARE BOUND BY THE TERMS AND CONDITIONS OF THIS AGREEMENT BY DOWNI OADING, INSTALLING, COPYING OR LISING THE SOFTWARE LE				
I accept the terms in the license agreement				
I do not accept the terms in the license agreem	nent			
InstallShield				
	< <u>B</u> ack	<u>N</u> ext >	Cancel	

Figure 4. License Agreement

Select the location to install the TSN Switch Evaluation software and click Next (see Figure 5).

滑 Analog l	Devices ADIN6310EVKSW Rel0.0.2 - BETA	×
Destinati Click Nex a differe	on Folder t to install to this folder, or dick Change to install to the folder.	ADI Chronous Scalare ethemet then to homeertem
	Install Analog Devices ADIN6310EVKSW Rel0.0.2 to:	
Þ	C:\Analog\ADIN6310EVKSW\	Change
InstallShield -		
	< <u>B</u> ack <u>Next</u> >	Cancel

Figure 5. Select Destination Folder

7. At the next step, click **Install** (see Figure 6).

🖶 Analog Devices ADIN6310EVKSW Rel0.0.2 - BET/	A	×
Ready to Install the Program The wizard is ready to begin installation.	ANALOG DEVICES AHEAD OF WHAT'S POSSIBLE*	ADI Chronous Schare enemet thes to reference
Click Install to begin the installation.		
If you want to review or change any of your install exit the wizard.	ation settings, click Ba	ck. Click Cancel to
nstallShield		
< Bac	k <u>I</u> nstall	Cancel

Figure 6. Installation Begins

**8.** A window appears, which shows the progress of the installation. When installation is complete, click **Finish**. (see Figure 7).

🕼 Analog Devices ADIN6310EVKSW Rel0.0.2 - BETA				
Caracteristic Activity of Caracteristic Acti	InstallShield Wizard Completed The InstallShield Wizard has successfully installed Analog Devices ADIN6310EVKSW Rel0.0.2. Click Finish to exit the wizard.			
	< Back Finish Cancel			

Figure 7. Installation Completes

#### **Repair/Remove Installation**

The installer also supports removing or repairing the installation. Launch the installer to remove or repair and do the following steps:

1. Select Repair or Remove and click Next (see Figure 8).

🖟 Analog Devic	es ADIN6310EVKSW Rel0.0.2 - BETA		×
Program Main Repair or remo	tenance ove the program	ANALOG DEVICES AHEAD OF WHAT'S POSSIBLE*	ADI Chronous" SCILABLE ETHERNET THER TO PROPERTION
O Repair	Repair installation errors in the progra corrupt files, shortcuts, and registry (	am. This option fixe: entries.	s missing or
Remove     Remove Analog Devices ADIN6310EVKSW Rel0.0.2 from your     computer.			
InstallShield	< Back	Next >	Cancel

Figure 8. Remove or Repair Installation

2. Follow the steps until complete, click Finish (see Figure 9).



Figure 9. Remove or Repair Completes

#### NPCAP INSTALLATION

Install Npcap if not already present on the machine. Npcap is recommended over WinPcap. Download from Packet capture library for Windows on the Npcap website.

When installing NPCAP, ensure that the **Install Npcap in WinPcap API-compatible Mode** check box is selected, as shown in Figure 10.



Figure 10. Npcap Installation Option (WinPcap API-Compatible Mode Selected)

# TSN SWITCH EVALUATION CONTENTS OVERVIEW

The software consists of GUI used to identify the Switch or chain of Switches and launch a PC based web server for each ADIN6310 device connected. The following section shows the different portions of the software. The default location for the **TSN Switch Evaluation** software install is **C:\Analog\ADINx310EVKSW-Relx.x.x** folder (see Figure 11).

OSDisk (C:)      Analog      ADIN6310EVKSW	_Rel3.0.0	
Name	Date modified	Ţ
bin	02/02/2024 14:39	F
doc	02/02/2024 14:42	F
exe	02/02/2024 14:40	F
lic 🛛	02/02/2024 14:40	F
GettingStarted.txt	09/06/2023 15:26	Т

Figure 11. Main Folder

This main folder contains the following sub-folders:

- The bin folder contains the firmware. New versions of the TSN Switch Evaluation package take care of automatically updating the latest firmware when initially run.
- The doc folder contains release note, schematics, and layout for the evaluation board in PDF format.
- The exe folder contains the executable (GUI), configuration files, and the web server file system (see Figure 12).
- ► The **lic** contains the license files (ELA license).

			open	-
•	exe	>		√ Č
	^	Name ^		Date n
		🗹 📙 FileSystemFolders		6/14/2
		modules		6/14/2
		ADIN6310-tsn-eva	luation-util.exe	6/13/2
		ses-configuration.	.txt	6/13/2
		🚳 ssh.dll		6/13/2
		📧 windows-tsn-io-a	pp.exe	6/13/2

Figure 12. Contents of the exe Sub-Folder

#### ADIN6310-tsn-evaluation-util

The **TSN Switch Evaluation** application GUI is named as **ADIN6310-tsn-evaluation-util.exe**. This application executes on a Windows PC platform and is used to query ADIN6310 boards that are present on a network. When an ADIN6310 board is found, the GUI configures the device primary MAC address, and allow the user to launch the **TSN Switch Evaluation** web page.

#### Process Application (windows-tsn-io-app)

The process tool runs automatically in the background for each instance of SES device found and does not need to be launched by the user.

#### **Modules Folder**

The **modules** folder contains yang models and start-up configuration.

#### FileSystemFolders

The **FileSystemFolders** folder (see Figure 13) contains the PCbased web server pages for each instance of the Switch that can be supported by the GUI (up to 10 max). Each device has its own file system, which is emulated on the PC by having a unique folder to act as the file system root.



Figure 13. Contents of the FileSystemFolders

When the application is first run, the process needs to create a repository inside the file system instance, this can take some time, on order of 30 seconds to complete. Creating the repository is done first, prior to communicating with the Switch. Once the repository is successfully created, only then the process starts to communicate with the Switch and load the default start up configuration.



Figure 14. Contents of an FS\_SES\_Instance\_0 Folder Prior to First Run of Application

Once the application runs successfully, additional folders can be observed in the **FileSystemFolders**, specifically the **eventLog**, **log**, and **repository** folders (see Figure 15).



Figure 15. Contents of an FS\_SES\_Instance\_0 Folder After Running Application and Successfully Configuring Device

#### ses-configuration File

The **ses-configuration.txt** file shown in Figure 16 contains configuration parameters for the PC based web server, such as IP address, Port, NETCONF server port, location of file system, and hardware configuration XML file:

- ▶ IP and Port address: Specifies the IP and Port address used by the process application instance web pages. For the ADIN6310 evaluation kit the IP address must be set to use the local Host, otherwise known as the loop back address, which is fixed to 127.0.0.1. Given the IP must remain the same for all process instances a port number must be used to identify which process instance the web pages belong to. This allows multiple instances of the process application to execute while controlling each board independently.
- ▶ FsName: Name of file system folder for each device.
- NetconfPortSsh: Port on which NETCONF server is listening (SSH), different port for each SES device.
- ImageType: Pass Production.

There are 10 instances included in the folder, one instance for each possible Switches in the network (up to 10 maximum supported by GUI). The **StartupFileName** points to the board specific configuration for the device, and for this example is using the EVAL-ADIN6310EBZ evaluation board. The software also supports operation with the EVAL-ADIN3310 and EVAL-ADIN6310T1L versions of hardware.

📄 ses-	configuration.txt 🗵
1	//Instance name
2	Instance 1
3	//IP address of the webserver
4	IP 127.0.0.1
5	//Port on which webserver is listening
6	Port 50000
7	//Port on which NETCONF server is listening (SSH)
8	NetconfPortSsh 830
9	//Instance folder name containing webserver contents
10	FsName FS_SES_Instance0
11	//Startup file name
12	StartupFileName eval-adin6310-10t11-rev-c.xml
13	//Image signature type to use with device: development, production
14	//Use development for B0
15	//Use production for Bl
16	ImageType production
17	

Figure 16. Contents of ses-configuration

The device/hardware specific configuration is contained in XML files within in each FS\_SES\_Instance folder inside the FileSystemFolders.

Pass the matching xml file name to the **ses-configuration.txt** instance for the version of hardware being used and the required mode of operation.

Example XML files are provided for various configurations and parameters can be modified within the XML files. The Switch configuration is volatile and power cycling the Switch requires reconfiguration:

- Default configuration is for TSN functionality (for example, file names eval-adin6310 and eval-adin6310-10t11.xml all support TSN capability).
- Redundancy configuration examples are provided for HSR, PRP, and MRP.

Syntax and case are important when modifying parameters in the XML file. Errors or passing incorrect parameters is not supported and affect the operation of application.

**Per-port configuration** parameters, including MII mode and PHY related specifics, see Figure 18.

- MII/Port MAC Interface Selection: All ports support RMII/ RGMII, additionally Port 1 to Port 4 support the following MAC interfaces, however hardware must be configured to match the required MAC interface:
  - ▶ SGMII
  - 1000base-SX/LX
  - ▶ 1000Base-KX
  - ▶ 100BASE-FX
- If-type: The default configuration for the EVAL-ADIN6310EBZ is RGMII interface to the ADIN1300 PHYs. The hardware does not support RMII interface to the PHYs. Port 0 (Ethernet Host) is always configured in unmanaged mode and the Switch does not configure that PHY directly. Hardware must be capable of the MII configured by software, for example, EVAL-ADIN6310 and EVAL-ADIN3310 hardware can support MII modes: rgmii, sgmii.100base-sxlx, or sgmii-100base-fx. EVAL-ADIN6310T1LEBZ supports RGMII interface for all

PHYs and can optionally support **sgmii**, **sgmii-1000base-kx**, or **sgmii-100base-fx** options on Port 2 and Port 3.

- Phy-rx-delay-supported/phy-tx-delay-supported: RxDelay/TxDelay: RXC and TXC delays configuration for the Port.
- Phy-type: Per port identification of what PHY is connected. Choice of ADIN1100, ADIN1200, ADIN1300, or Unmanaged for ports that either have no PHY or have a different PHY. Hardware must match/support. By default Unmanaged is passed to Port 0.
- clock-selection: For use with RMII mode only. A setting of 0 enables a 50 MHz clock to be output onto the Port TXC pin for use by the PHY. Only use RMII mode where hardware is configured appropriately, EVAL-ADIN6310EBZ evaluation board supports RGMII mode by default for all ports.
- PHY Address: PHY address as configured by internal/external strapping. EVAL-ADIN6310 evaluation board uses ADIN6310 internal strapping to provide unique PHY address to each PHY, see ADIN1300 PHY Addressing section.
- ▶ Link-polarity: ADIN6310 expects Port LINK pin to be driven low for link up, high for link down. The default polarity of the ADIN1200/ADIN1300/ADIN1100 PHYs is for the LINK ST pin to be active high with link up, however the polarity can be inverted via MDIO write if needed as part of the port initialization. In the **ses-configuration.txt** file, for this parameter, a setting of active-low indicates the default is active low (no inversion needed), while passing active-high instructs the ADIN6310 to perform a MDIO write to invert polarity of LINK signal in PHY as part of the initialization routine. For the EVAL-ADIN6310EBZ evaluation hardware, there are six ADIN1300 PHYs, the PHY on Port 0 includes an inverter in the path between the LINK ST and the Switch P0 LINK pin, therefore the inversion is already done for that port. For the remaining PHYs on Port 1 to Port 5, there is no inverter in the path, instead the ADIN6310 configuration needs to invert the polarity of the PHY LINK ST pin by writing over MDIO to configure the PHY.
- Phy-pull-up-control: Options of: internal, external, do-not-disable. Allows configuration of whether the PHY address strapping uses the internal pull resistors from the Switch RXD lines or uses external strapping resistors for PHY addressing. With EVAL-ADIN6310EBZ, the internal or do-not-disable options must be used. Do not use the external option as there are no external PHY address strapping resistors and this results in all PHYs defaulting to Address 0.
  - ▶ Internal: Internal pulls are enabled. Default setting for the EVAL-ADIN6310EBZ evaluation board, the Switch sets unique PHY addresses for each PHY. No external strapping resistors are required for PHY addressing as a result. The strapping resistors are enabled until the PHY is brought out of reset and then disabled.
  - External: Internal pulls are disabled. Use with EVAL-ADIN6310T1LEBZ evaluation board, external resistors are used to configure PHY addresses, therefore the internal pulls are disabled.

- ► **Do not disable**: Internal pulls are enabled and left enabled even after the PHYs are configured.
- **Speed**: Choice of 1, 0.1, 0.01 (Gbps).

**Device** configuration specifics such as device MAC Address, what redundancy capability is enabled and PHY latencies for PTP stack are passed next. See Figure 19.

 MAC address: Specifies the mac address the ADIN6310 hardware uses. The MAC address is unique to each device found and is also used by the process application to establish point-topoint communication with each device.

PhyIngressLatency/EgressLatency: Pass the ingress and egress latency if there is an Ethernet PHY connected to the Port. Must match the hardware, the values passed show the ADIN1300 PHY latency parameters.





🔚 eva	-adin63	310.xml 🔀	
1		<pre><!-- 6310 HARDWARE SETUP--></pre>	
2			
3	<b>-</b>	Syntax and case are important when modifying parameters in this file, errors or	
4	5	passing incorrect parameters is not supported and will affect operation of application.	
5			
6	LC	Only the parameters listed below are supported>	
7			
8	· · · · · ·	<pre><interfaces <="" pre="" xmlns="urn:ietf:params:xml:ns:yang:ietf-interfaces"></interfaces></pre>	
9	_	<pre>xmlns:sched="urn:ieee:std:802.1Q:yang:ieee802-dot1q-sched"</pre>	
10	보	xmlns:ses="urn:adi:ses">	
11	보	<interface></interface>	
12		<name>p0</name>	
13		<type xmlns:ianaift="urn:ietf:params:xml:ns:yang:iana-if-type">ianaift:ethernetCsmacd</type>	
14	닉	<pre><ethernet xmlns="urn:ieee:std:802.3:yang:ieee802-ethernet-interface"></ethernet></pre>	
15		<if-type xmlns="urn:adi:ses">rgmii</if-type>	MII supported values : rmii, rgmii, sgmii, sgmii-1000base-sxlx, sgmii-1000base-kx, sgmii-1000base-fx
17		<pre><pre><pre><pre><pre><pre><pre><pre></pre></pre></pre></pre></pre></pre></pre></pre>	<pre><!-- RxDelay supported values : false, true (false = disabled, true = enabled)--></pre>
18		<pre><pre><pre><pre><pre><pre><pre><pre></pre></pre></pre></pre></pre></pre></pre></pre>	TxDelay supported values : false, true (false = disabled, true = enabled)
19		<pre><pre><pre><pre><pre>smlns="urn:adi:ses"&gt;unmanaged</pre></pre></pre></pre></pre>	PhyType supported values : adin1100, adin1200, adin1300, unmanaged
20		<clock-selection xmlns="urn:adi:ses">internal</clock-selection>	ClockSelection supported values : internal, external
21		<pre><pre><pre><pre><pre><pre><pre><pre></pre></pre></pre></pre></pre></pre></pre></pre>	PhyAddress supported values : 0 to 255
22		<li>hk-polarity xmlns="urn:adi:ses"&gt;active-low</li>	LinkPolarity supported values : active-low, active-high
23		<pre><phy-pull-up-control xmlns="urn:adi:ses">internal</phy-pull-up-control></pre>	PhyPullupCtrl supported values : internal, external, do-not-disable
2.4		<speed>1</speed>	Speed supported values(in Gbps) : 1, 0.1, 0.01
25	-		
26	-		
27	白	<interface></interface>	
28		<name>P1</name>	
29		<type xmlns:ianaift="urn:ietf:params:xml:ns:yang:iana-if-type">ianaift:ethernetCsmacd</type>	
30	É	<pre><ethernet xmlns="urn:ieee:std:802.3:yang:ieee802~ethernet-interface"></ethernet></pre>	

Figure 18. EVAL-ADIN6310EBZ: Per-Port Specific Configuration

109		HOST MAC ADDRESS SETUP	
110		<pre>ses xmlns="urn:adi:ses"&gt;</pre>	
111	百	- <host-setup></host-setup>	
112	Т	<pre><smp-mac-address>7A-C6-BB-11-11-11</smp-mac-address></pre>	Host MAC Address of device supported values: Mac Address format
113	-	-	
114	L	L	
115			
116		PRP/HSR REDUNDANCY DISABLED	
117		<pre><iec62439 xmlns="urn:ietf:params:xml:ns:yang:iec62439"></iec62439></pre>	
118	Ġ	<pre><lreinterfaceconfigtable></lreinterfaceconfigtable></pre>	
119	白	<lreinterfaceconfigentry></lreinterfaceconfigentry>	
120		<pre><lreinterfaceconfigindex>0</lreinterfaceconfigindex></pre>	
121		<lrenodetype>none</lrenodetype>	LRE Node Type supported values: none, prpmodel, hsr
122	-	-	
123	-	<pre></pre>	
124	L	L	
125			
126	<	MRP REDUNDANCY DISABLED	
127	<b>-</b>	<pre>smrp xmlns="urn:ietf:params:xml:ns:yang:iec62439-2"&gt;</pre>	
128	Ę	<pre><mrpdomaintable></mrpdomaintable></pre>	
129	Ę	<pre><mrpdomainentry></mrpdomainentry></pre>	
130		<mrpdomainindex>0</mrpdomainindex>	
131		<pre><mrpdomainadminrole>disable</mrpdomainadminrole></pre>	MRP Admin role supported valued: disable , client, manager, managerAuto
132	F	<pre></pre>	
133	F	-	
134	L <	L	
135			
136		<pre><!-- PTP LATENCIES--></pre>	
137	님	□ <ptp:ptp xmins:ptp="urn:leee:std:l588;yang:leee1588-ptp"> </ptp:ptp>	
138	님	<pre>cytp:common-services&gt;</pre>	
139	님		
141	R		
142	9		
142	占	<pre></pre>	
144	Ϋ́	<pre></pre>	(In- DhyIngressLatency ADIN1200 datasheat value>
145		<pre></pre>	<pre></pre>
146		<pre></pre> //pup.egressine.comport=ds>	Inflyiospheric, Alicebo debasiet value>
147			
148	L L	<pre>shtp:port&gt;</pre>	
149	T	<pre>sptp:port-index&gt;1</pre>	
150	L L	<pre>cytp:timestamp-correction-port-ds&gt;</pre>	
151	Т	<pre><ptp:ingress-latency>226</ptp:ingress-latency></pre>	PhvIngressLatency ADIN1300 datasheet value



<pre>10</pre>	109	</th <th> HOST MAC ADDRESS SETUP&gt;</th> <th></th>	HOST MAC ADDRESS SETUP>	
<pre>111 c dood-setup 112 c dood-setup 113 c dood-setup 114 c dood-setup 115 c dood-setup 115 c dood-setup 115 c dood-setup 116 c dood-setup 117 c dood-setup 118 c dood-setup 119 c dood-setup 119 c dood-setup 110 c dood-setup 110 c dood-setup 110 c dood-setup 110 c dood-setup 110 c dood-setup 111 c d</pre>	110	-<	es xmlns="urn:adi:ses">	
<pre>111 (up-mail-address/Pa-C6-BB-11-11-11-/mg-mac-address/ (up- Kot Kat/set supported values: Mac Address format&gt; (up- Kot Mac Values: Mac Values: Ma</pre>	111	百	<host-setup></host-setup>	
<pre></pre>	112	T	<smp-mac-address>7A-C6-BB-11-11-11</smp-mac-address>	Host MAC Address of device supported values: Mac Address format
<pre>114 - Loges</pre>	113	-		
<pre>113</pre>	114	L </td <td>ses&gt;</td> <td></td>	ses>	
<pre>11 HSR EXCUMDANCY MODE&gt; 12</pre>	115			
<pre>11 classed243 malase**uniat:page:lec2439*&gt; 12 classed243 malase**uniat:page:lec2439*&gt; 13 classed243 malase**uniat:page:lec2439*&gt; 14 classed243 malase**uniat:page:lec2439*&gt; 15 classed243 malase**uniat:page:lec2439*&gt; 15 classed243 malase**uniat:page:lec2439*&gt; 16 classed243 malase**uniat:page:lec2439*&gt; 17 classed243 malase**uniat:page:lec2439*&gt; 18 classed243 malase**uniat:page:lec2439** 19 classed243 malase***********************************</pre>	116	</td <td> HSR REDUNDANCY MODE&gt;</td> <td></td>	HSR REDUNDANCY MODE>	
<pre>118 definition of the interface Config Tables 119 definition of the interface Config Tables 120 definition of the interface Config Tables 121 definition of the interface Config Tables 122 definition of the interface Config Tables 123 definition of the interface Config Tables 123 definition of the interface Config Tables 124 definition of the interface Config Tables 125 definition of the interface Config Tables 126 definition of the interface Config Tables 127 definition of the interface Config Tables 128 definition of the interface Config Tables 129 definition of the interface Config Tables 120 definition of the interface Config Tables 120 definition of</pre>	117	- <i< td=""><td>ec62439 xmlns="urn:ietf:params:xml:ns:yang:iec62439"&gt;</td><td></td></i<>	ec62439 xmlns="urn:ietf:params:xml:ns:yang:iec62439">	
<pre>119 clreinterfaceConfigIndex%/lreinterfaceConfigIndex%/lreinterfaceConfigIndex%/lreinterfaceConfigIndex%/lreinterfaceConfigIndex%/lreinterfaceConfigIndex%/lreinterfaceConfigIndex%/lreinterfaceConfigIndex%/lreinterfaceConfigIndex%/lreinterfaceConfigIndex%</pre> 123 clreinterfaceConfigIndex%%/lreinterfaceConfigIndex% 123 clreinterfaceConfigIndex%%/lreinterfaceConfigIndex% 123 clreinterfaceConfigIndex%%/lreinterfaceConfigIndex% 123 clreinterfaceConfigIndex%%/lreinterfaceConfigIndex% 123 clreinterfaceConfigIndex% 124 clreinterfaceConfigIndex% 125 clreinterfaceConfigIndex% 125 clreinterfaceConfigIndex% 126 clreinterfaceConfigIndex% 127 clreinterfaceConfigIndex% 128 clreinterfaceConfigIndex% 129 clreinterfaceConfigIndex% 129 clreinterfaceConfigIndex% 129 clreinterfaceConfigIndex% 120 clreinterfaceConfigIndex% 120 clreinterfaceConfigIndex% 121 clreinterfaceConfigIndex% 122 clreinterfaceConfigIndex% 123 clreinterfaceConfigIndex% 123 clreinterfaceConfigIndex% 124 clreinterfaceConfigIndex% 125 clreinterfaceConfigIndex% 126 clreinterfaceConfigIndex% 127 clreinterfaceConfigIndex% 128 clienterfaceConfigIndex% 129 clreinterfaceConfigIndex% 129 clreinterfaceConfigIndex% 129 clreinterfaceConfigIndex% 120 clreinterfaceConfigIndex% 120 clreinterfaceConfigIndex% 121 clreinterfaceConfigIndex% 122 clreinterfaceConfigIndex% 123 clreinterfaceConfigIndex% 123 clreinterfaceConfigIndex% 124 clreinterfaceConfigIndex% 125 clreinterfaceConfigIndex% 125 clreinterfaceConfigIndex% 126 clreinterfaceConfigIndex% 127 clreinterfaceConf	118	Ė	<pre><lreinterfaceconfigtable></lreinterfaceconfigtable></pre>	
101               (=:tinterfaceConfigIndex)=0/:lesinesfaceConfigIndex)             (=:LE Node Type supported values: none, prymodel, hsr>             (=:FieldVichingEndIdde*hermode/lesivichingEndIdde*)             (=:FieldVichingEndIdde*hermode/lesivichingEndIdde*)             (=:FieldVichingEndIdde*hermode/lesivichingEndIdde*)             (=:FieldVichingEndIdde*hermode/lesivichingEndIdde*)             (=:FieldVichingEndIdde*hermode/lesivichingEndIdde*)             (=:FieldVichingEndIdde*istation*)             (=:LE PublicALE SiztEstation*: 0 to 1521(corresponding to 15 Tes to 400 ms)>             (=:LE PublicALE************************************	119	Ė	<lr>InterfaceConfigEntry&gt;</lr>	
111	120		<lreinterfaceconfigindex>0</lreinterfaceconfigindex>	
112       cl==PDP/RSR_LRE SutchingEndlode* hermode*/lreSutchingEndlode*       cl==PDP/RSR_LRE SutchingEndlode* hermode, hermo	121		<lrenodetype>hsr</lrenodetype>	LRE Node Type supported values: none, prpmodel, hsr
133	122		<lreswitchingendnode>hsrnode</lreswitchingendnode>	PRP/HSR LRE Switching End Node Supported values: prpnode, hsrnode, hsrnedboxsan
1134	123		<pre><lreduplistresidemaxtime>625</lreduplistresidemaxtime></pre>	LRE Duplicate List Reside Max Time supported values : 0 to 26214 (corresponding to 15 Î%s to 400 ms)
<pre>125 - list - <td>124</td><td></td><td><pre><lremacaddress>78-C6-BB-00-00-11</lremacaddress></pre></td><td><!-- LRE MAC Address of device supported values: Mac Address format--></td></pre>	124		<pre><lremacaddress>78-C6-BB-00-00-11</lremacaddress></pre>	LRE MAC Address of device supported values: Mac Address format
<pre>112 - </pre> 113 -  114 -  115 -  115 -  115 -  115 -  115 -  115 -  115 -  115 -  116 -  117 -  118 -  119 -	125	L.		
127          -port-ssignment xmls="urn:di:ses">Pi         128          -(reforct #xmls="urn:di:ses">Pi       129          -(reforct #xmls="urn:di:ses">Pi          -(reforct #xmls="urn:di:ses")	126	-		
128	127	Ę.	<pre><port-assignment xmlns="urn:adi:ses"></port-assignment></pre>	
123 <l= b="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         134       <l= b="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         135       <l= d="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         136       <l= d="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         137       <l= d="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         138       <l= d="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         138       <l= d="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         138       <l= d="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         138       <l= d="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         138       <l= cedboxinterlinkportc3="" xulns="unriadi:ses">none         139       <l= d="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         136                139       <l= d="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         139       <l= d="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         139       <l= d="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         130       <l= d="" dort="" lbf="" none,="" p0,="" p1,="" p2,="" p3,="" p4,="" p5="" supported="" values:="">         1318</l=></l=></l=></l=></l=></l=></l=></l=></l=></l=></l=></l=></l=></l=></l=>	128		<pre><lreporta xmlns="urn:adi:ses">P1</lreporta></pre>	LRE Fort A supported values: none, P0, P1, P2, P3, P4, P5
<pre>130 </pre> <pre>131 </pre> <pre>132 </pre> <pre>133 </pre> <pre>133 </pre> <pre>134 </pre> <pre>135 </pre> <pre>135 </pre> <pre>136 </pre> <pre>137 </pre> <pre>138 </pre> <pre>139 </pre> <pre>139 </pre> <pre>139 </pre> <pre>139 </pre> <pre>130 <td>129</td><td></td><td><pre><lreportb xmlns="urn:adi:ses">P2</lreportb></pre></td><td><!-- LRE Port B supported values: none, P0, P1, P2, P3, P4, P5--></td></pre>	129		<pre><lreportb xmlns="urn:adi:ses">P2</lreportb></pre>	LRE Port B supported values: none, P0, P1, P2, P3, P4, P5
131 <predboxinterlinkpottcl :none<="" predboxinterlinkpottcl="" xmlns="urn:di:ses"> <!-- LRE RedBox Interlink Pott Cl supported values: none, PO, PI, P2, P3, P4, P5-->         133       <predboxinterlinkpottcl :none<="" predboxinterlinkpottcl="" xmlns="urn:di:ses"> <!-- LRE RedBox Interlink Pott Cl supported values: none, PO, PI, P2, P3, P4, P5-->         134       <predboxinterlinkpottcl :none<="" pre="" xmlns="urn:idi:ses">/redboxInterlinkPottCl&gt;       <!-- LRE RedBox Interlink Pott Cl supported values: none, PO, PI, P2, P3, P4, P5-->         134       <predboxinterlinkpottcl :none<="" pre="" xmlns="urn:idi:ses">/redboxInterlinkPottCl&gt;       <!-- LRE RedBox Interlink Pott Cl supported values: none, PO, PI, P2, P3, P4, P5-->         136       /pott-assignment&gt;       <!-- LRE RedBox Interlink Pott Cl supported values: none, P0, P1, P2, P3, P4, P5-->         136       /pott-assignment&gt;       <!-- LRE RedBox Interlink Pott Cl supported values: none, P0, P1, P2, P3, P4, P5-->         136       /pott-assignment&gt;       <!-- KDP RedBox Interlink Pott Cl supported values: none, P0, P1, P2, P3, P4, P5-->         137             138       <qup>cambin="urn:idi:parama:ml:ms:yang:lec62439-2"&gt;         139       <qup>cambin="urn:idi:parama:ml:ms:yang:lec62439-2"&gt;         140            141             142</qup></qup></predboxinterlinkpottcl></predboxinterlinkpottcl></predboxinterlinkpottcl></predboxinterlinkpottcl>	130		<lredanportc xmlns="urn:adi:ses">PO</lredanportc>	LRE Dan Port C supported values: none, P0, P1, P2, P3, P4, P5
<pre>132</pre>	131		<redboxinterlinkportcl xmlns="urn:adi:ses">none</redboxinterlinkportcl>	LRE RedBox Interlink Port Cl supported values: none. P0, P1, P2, P3, P4, P5
133	132		<redboxinterlinkportc2 xmlns="urn:adi:ses">none</redboxinterlinkportc2>	LRE RedBox Interlink Fort C2 supported values: none, F0, F1, F2, F3, F4, F5
<pre>134 &lt; credBoxInterlinkDox</pre>	133		<redboxinterlinkportc3 xmlns="urn:adi:ses">none</redboxinterlinkportc3>	LRE RedBox Interlink Port C3 supported values: none, P0, P1, P2, P3, P4, P5
<pre>135 -  136 -  137 137 138 - </pre> 139 139 139 139 139 139 139 140 -  141 -  142 -  143 -  144 -  145 -  145 -  145 -  146 -  147 -  147 -  148 -  149 -  149 -  140 -	134		<redboxinterlinkportc4< td=""><td><!-- LRE RedBox Interlink Fort C4 supported values: none, F0, F1, F2, F3, F4, F5--></td></redboxinterlinkportc4<>	LRE RedBox Interlink Fort C4 supported values: none, F0, F1, F2, F3, F4, F5
<pre>136 L</pre> 137 L	135	-		
137        138        139        130        131        132        141        141        142        143        143        144        145        145        146        147        148        149        140        141        142        143        145        146        147        148        148        149        140        141        142        143        144        145        146        147        148        148        149        140        141        142        143        143        144<	136	L </td <td>iec62439&gt;</td> <td></td>	iec62439>	
138 < MSP BECOMDARY DISABLED> 39 = second back for the second back fo	137			
<pre>133</pre>	138	</td <td> MRP REDUNDANCY DISABLED&gt;</td> <td></td>	MRP REDUNDANCY DISABLED>	
<pre>140</pre>	139	<b>-</b>	<pre>rp xmlns="urn:ietf:params:xml:ns:yang:iec62439-2"&gt;</pre>	
141 descriptionsinEntry> 142 descriptionsinEndex>C/mrpDomainEndex> 143 descriptionsinEndex>ExampDomainEnder>ExampDomainEnder>ExampDomainEnderNetriptionsinEnderNetriptionsinEnderNetriptionsinEnderNetriptionsinEnderNetriptionsinEnderNetriptionsinEnderNetriptionsinEnderNetriptionsinEnderNetriptionSinterNetriptionSin	140	Ę	<mrpdomaintable></mrpdomaintable>	
143 <mrpdomainindex>(/mrpDomainIndex)       143     <mrpdomainindex>( MRP Admin role supported valued: disable , client, manager, managerAuto&gt;</mrpdomainindex></mrpdomainindex>	141	Ę	<mrpdomainentry></mrpdomainentry>	
143 <pre>support of the support of t</pre>	142		<mrpdomainindex>0</mrpdomainindex>	
	143		<pre><mrpdomainadminrole>disable</mrpdomainadminrole></pre>	MRP Admin role supported valued: disable , client, manager, managerAuto
144 -	144	-		
145 -	145	-		
146 L	146	L </td <td>mrp&gt;</td> <td></td>	mrp>	



#### **HSR Specific Configuration**

Figure 20 shows an example of **eval-adin6310-hsr.xml** file where HSR is enabled. All TSN functionality is disabled when PRP/HSR is enabled, therefore the **TSN Switch Evaluation** web server only exposes HSR functionality and any TSN related functionality is hidden. The configuration specific parameters for HSR functionality are:

IreNodeType: LRE node type supported: none (redundancy disabled), prpmode1 for PRP operation or hsr to configure the device for HSR mode. Pass the relevant parameter to this field.

- IreSwitchingEndNode: Defines the type of functionality, use hsrnode for a DANH or hsrredboxsan for HSR redbox.
- LreDuplisResideMaxTime: Duplicate list reside max time in second fraction units.
- LreMacAddress: MAC address of the LRE device, this must be the MAC address of the Host interface.
- ▶ LrePortX: Pass which ports are A, B ports.
- ► LreDanPortC: Pass which port is used as Port C. If using SPI Host interface, pass none to this parameter.

RedboxInterlinkPortCx: For redbox configurations, identify which ports are interlink ports.

## **PRP Specific Configuration**

Figure 21 shows an example of **eval-adin6310-prp.xml** file where PRP is enabled. All TSN functionality is disabled when PRP is enabled, therefore the PC-based web server only exposes the PRP related functionality and all TSN related functionality is hidden.

PRP REDUNDANCY MODE
<pre><iec62439 xmlns="urn:ietf:params:xml:ns:yang:iec62439"></iec62439></pre>
<li><lr><li><lr><li><lr><lr><lr><lr><lr><lr><lr><lr><lr><lr< td=""></lr<></lr></lr></lr></lr></lr></lr></lr></lr></lr></li></lr></li></lr></li>
<li><lr><li><lr><lr><lr><lr><lr><lr><lr><lr><lr><lr< td=""></lr<></lr></lr></lr></lr></lr></lr></lr></lr></lr></li></lr></li>
<pre><lreinterfaceconfigindex>0</lreinterfaceconfigindex></pre>
<lrenodetype>prpmode1</lrenodetype>
<pre><lreswitchingendnode>prpnode</lreswitchingendnode></pre>
<pre><lreduplistresidemaxtime>625</lreduplistresidemaxtime></pre>
<lremacaddress>78-C6-BB-00-00-11</lremacaddress>
<pre><lreredundancydevice xmlns="urn:adi:ses">danp</lreredundancydevice></pre>
-
-
<pre>ort-assignment xmlns="urn:adi:ses"&gt;</pre>
<pre><lreporta xmlns="urn:adi:ses">P1</lreporta></pre>
<pre><lreportb xmlns="urn:adi:ses">P2</lreportb></pre>
<pre><lredanportc xmlns="urn:adi:ses">P0</lredanportc></pre>
<pre><redboxinterlinkportc1 xmlns="urn:adi:ses">none</redboxinterlinkportc1></pre>
<pre><redboxinterlinkportc2 xmlns="urn:adi:ses">none</redboxinterlinkportc2></pre>
<pre><redboxinterlinkportc3 xmlns="urn:adi:ses">none</redboxinterlinkportc3></pre>
<pre><redboxinterlinkportc4 xmlns="urn:adi:ses">none</redboxinterlinkportc4></pre>
<pre>- </pre>
L

#### Figure 21. PRP Configuration

The configuration specific parameters for PRP functionality are:

- IreNodeType: LRE node type supported: none (redundancy disabled), prpmode1 for PRP operation.
- IreSwitchingEndNode: Defines the type of functionality, use prpnode.
- LreDuplisResideMaxTime: Duplicate list reside max time in second fraction units.
- ► LreMacAddress: MAC address of the LRE device, this must be the MAC address of the Host interface.
- ▶ LrePortX: Pass which ports are A, B ports.
- LreDanPortC: Pass which port is used as Port C. If using SPI Host interface, pass none to this parameter.
- RedboxInterlinkPortCx: For redbox configurations, identify which ports are interlink ports.

#### **MRP Specific Configuration**

MRP can be enabled up front or alternatively use the default **eval-adin6310.xml** configuration and enable the function through the MRP web server page.

Figure 22 shows an example of **eval-adin6310-mrp.xml** file where MRP is enabled. TSN functionality is supported with MRP, so the full web server configuration is exposed.

- **Domain ID**: Unique domain ID for the MRP ring.
- ▶ **MRP OUI**: MRP OUI, defaults to 0x080006 (Siemens OUI).
- Domain Name: Domain name for the ring.
- ▶ MRP Role: Choice of client (default), manager or auto-manager.

- Ring Ports 1, 2: Default Port 1 and Port 2, choice of any port.
- ▶ Domain VLANID: Defaults to untagged/4095.
- React on Link Change: For faster recovery, use react on link change enabled for which the manager does not wait for test frames to timeout, instead, reacts on the link change frames.
- Recovery rate: Recovery profile choice of 30 ms, 200 ms, and 500 ms.
- MRP Port Tx Priority: Default Queue 7 is highest priority. PTP traffic also egresses in Queue 7. If using lowest recovery profile, change default PTP queue from 7 to a lower priority in the Time Synchronization page.

MRP REDUNDANCY MODE	
<pre>[] <mrp xmlns="urn:ietf:params:xml:ns:yang:iec62439-2"></mrp></pre>	
<pre>mrpDomainTable&gt;</pre>	
A mpDomainEntry>	
<pre><mrdomainindex>0</mrdomainindex></pre> /mrDOmainIndex>	
<pre><mrpdomainid>FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFfffffff</mrpdomainid></pre>	
<mrpoui>080006</mrpoui>	
<pre><mrpdomainname>MRP</mrpdomainname></pre>	
<pre><mrpdomainadminrole>client</mrpdomainadminrole></pre>	MRP Admin role supported valued: disable , client, manager, managerAuto
<pre><mrpdomainringportl>1</mrpdomainringportl></pre>	MRP Ring Port 1 supported values: 1, 2, 3, 4, 5
<pre><mrpdomainringport2>2</mrpdomainringport2></pre>	MRP Ring Port 2 supported values: 1, 2, 3, 4, 5
<pre><mrpdomainvlanid>4095</mrpdomainvlanid></pre>	MRP Domain VlanId supported values : 0 to 4095
<pre><mrpdomainmanagerpriority>0</mrpdomainmanagerpriority></pre>	MRP Domain Manager Priority supported values : 0 to 65535 (equivalent in hex to 0 to FFFF)
<pre><mrpdomainmrmreactonlinkchange>disabled</mrpdomainmrmreactonlinkchange></pre>	MRP React on Link Change supported values: enabled, disabled
<recovery-rate xmlns="urn:adi:ses">recovery500</recovery-rate>	MRP Recovery Rate supported values: recovery500, recovery200, recovery30
<pre><mrprportltxpriority xmlns="urn:adi:ses">7</mrprportltxpriority></pre>	MRP Port 1 TxPriority supported values: 0 to 7
<pre><mrprport2txpriority xmlns="urn:adi:ses">7</mrprport2txpriority></pre>	MRP Port 2 TxPriority supported values: 0 to 7
-	
-	
L	

#### Figure 22. MRP Configuration Example

#### ADIN6310 and 10BASE-T1L Hardware

There are two versions of XML file for the 10-BASE-T1L version of hardware. Check which revision of hardware prior to configuring and only use the matching XML file. Use REV C XML for both REV C and D versions.

#### **INITIAL EVALUATION BOARD SETUP**

The **TSN Switch Evaluation** software can be used to test the Switch features. Connect the Switch evaluation board to another TSN capable device and do the following steps:

- 1. Do the steps shown in Installing the TSN Switch Evaluation Application Software to install the software.
- Pass the matching XML configuration file for the hardware/setup required (TSN, HSR, PRP, MRP).
- **3.** Apply power to the board with the wall adapter provided by connecting to P2.
- 4. Turn Switch S1 to ON position, LED DS4 lights up.
- 5. Connect PC through an Ethernet cable to Host Port 0 (Port 0 is the control plane for Switch configuration, it can also pass data traffic).
- Launch software by double-clicking the application ADIN6310tsn-evaluation-util.exe in the C:\Analog\ADINx310EVKSW-Relx.x.x\Files folder.
- 7. When the package is first run, it can take time to create the repository (less than 1 minute). The repository is created first, then the application starts communicating with the device for configuration purposes. The LED in the GUI blinks yellow until web server is ready to launch, when configuration is complete, the LEDs for any Switches found goes green.

- 8. If daisy-chaining a number of Switch boards, allow a couple of minutes for each board as a repository needs to be created for each instance of the web server.
- **9.** In the event it takes a lot longer than 2 minutes for the LED to go green, close the GUI and reopen, power cycle the board and start searching again.

## SOFTWARE EXECUTION

Start the application by double-clicking the **ADIN6310-tsn-evaluation-util.exe** executable. The GUI application window appears, as shown in Figure 24.

- The GUI automatically detects the available network adapters. Select the adapter that is connected to the ADIN6310 board Host (Port 0) by double-clicking the description line for that adapter. Once the adapter is selected, the device configuration information pulled from the ses-configuration.txt and XML files load and populate the lower window.
- 2. Click Find and Configure SES Devices button to start searching for connected Switch boards.
- 3. The GUI searches for and configures the MAC address for any ADIN6310 device it finds. Each Switch powers up with the same default MAC address (7a:c6:bb:ff:fe:00). The first thing the GUI application does during configuration is to assign a primary MAC address (based on XML configuration). If observing the traffic from Host to Switch using Wireshark, initially messages are sent from the PC to the default multicast address (79:c6:bb:ff:fe:00) and responses come from default MAC address 7a:c6:bb:ff:fe:00 until the primary MAC address gets assigned. An LED turns green for each board connected. Clicking on the LED for each connected ADIN6310 device launches a browser for each board as shown in Figure 24. Once the web server is launched, the LED color changes to orange. Keep the PC application open, it needs to stay running while interacting with the web server. The GUI application continues to search for more ADIN6310 devices, so if all connected devices have been identified, stop the application searching by clicking the Find and configure button again. The find LED then stops flashing.
- 4. If boards are power cycled or reset button is pressed, the device reverts to the default MAC address and if the GUI application is searching, it sees them as new devices (additional LED lights go green). To avoid this, close the older processes associated with those instances of boards on the keyboard, use Ctrl and Close All Running Processes, as shown in point 4 of Figure 24.

Note that the first time the application launches the web page, a user may receive a security warning regarding Windows firewall settings. Ensure that the firewall settings are configured to allow communications to pass through the firewall.



Figure 23. Firewall Security Pop-Up

## SOFTWARE EXECUTION

ADIN6310-tsn-evaluation-util	_ ×	ADIN6310-tsn-evaluation-util
Description Name RealExt us dobt Family Controller (222281-4574-4574-4574-74870506771) Exitement Derive (Personal Jeres Neberk) (284878-4424-4584-4594-4494-3406-36464494700) ALTX ANDETY USA Je to Subject themmet Adm (201740-474-4494-4494-3101725040) EXEMANDING AND REALEMENT ADMINISTRATION CONTROL DESCRIPTION	MAC Selected BC-04-8A-79-54-8A SE-84-23-CF-08-08 00-04-C0-21E-15-02 00-04-C0-21E-15-02	Description         Nume         PAC         Selected           testists 08 000 Femily Controller         (4272818-449-457-465050771)         67-46-46-79-64-64         Selected           Electorie Device (reruse) area betwert)         (980017-455-067-0504647100)         58-49-10-7-46-64         Selected           Auto and area betwerty         (980017-455-067-0504776)         68-49-10-7-46-64         Selected           Auto and area betweet (reruse)         (980017-455-067-0504776)         98-49-10-7-46-64         Selected           Auto and area betweet (reruse)         (980017-455-067-050476770)         98-49-10-7-46-64         Selected           Auto and area betweet (reruse)         (980017-455-067-050476770)         98-49-10-7-46-64         Selected           Auto and area betweet (reruse)         (980017-455-067-0504770)         98-49-10-7-46-64         Selected           Auto and area betweet (reruse)         (198017-467-067-067-067-067-067-067-067-067-067-0
Refresh Ethernet Network Adapters Close Selected Ethernet Network Adapter		Refresh Ethernet Network Adapters Close Selected Ethernet Network Adapter
Lts         Attive         Not         P         Pert         P3 same         National Same           1. PC Tool Launches & automatically detects available Network Adaptors, select which adaptor is connected to the SES Hardware and Double Click on it	Port PPP state LBE Port-A LAE Port-B	SE         Attive         NC         P         Pert         TS name         METCOM SER Pert         Pert to the total         METCOM SER Pert         Pert total         Name         Na
Find And Configure SES Devices	Chrome	Find And Configure SES Devices Chrome 🗸
953 952 954 955 956 957	SES 8 SES 9 SES 10	
Click to drag the dialog.	ANALOG DEVICES ADI Chronous	2. Click "Find and Configure SES Devices" ADIOmnos
ADIN6310-tsn-evaluation-util		ADIN6310-tsn-evaluation-util
	TAX	
Been 3. Searching for SES device, the LED tester lights/flashes yellow while configuring the data device and green when configuration is	D         D <thd< th=""> <thd< th=""> <thd< th=""> <thd< th=""></thd<></thd<></thd<></thd<>	NUMBER         Name         <
3. Searching for SES device, the LED lights/flashes yellow while configuring the device and green when configuration is complete and webserver is ready to	International and the second	Non-         Name         Name <th< th=""></th<>
Sterr All the second	PAC         Solution           Sec Solution         Solution           Solution         Like Perturb           Solution         Like Perturb           Solution         1           Solution         1           Solution         1           Solution         1           Solution         1           Solution         1	State         North         North         North         North         North           Healter ise de (Frank Article restrict)         (12)/21/21/21/21/21/21/21/21/21/21/21/21/21/
Bits         3. Searching for SES device, the LED           table         lights/flashes yellow while configuring the device and green when configuration is           table         complete and webserver is ready to launch. Click on each LED to launch webserver for each board (LED will turn Orange)           table         tackstated at 17.4.4.1 seet \$2,43,5tetnees           table         tackstated at 17.4.4.1 seet \$2,43,5tetnees	MAC         Solution           NAC         Solution           Schell, Al., 75, 54, 84         Solution           Schell, Al., 75, 64, 84         Solution           Solution, 20, 74, 76, 90         West           Work, Coll, 74, 76, 90         West           Work, Coll, 74, 76, 90         West           Work, Coll, 74, 76, 90         West           Vest         2           Status, 1         2	Exception         New         Net         Net         Net         Net           Healter is 60 64 Feally Controller         (4232835-447-443-543-5480-548-544)         Excent shows         Exlected         Exlected           Listents         (4232835-447-443-543-5480-548-544)         Scientification         Excent shows         Exlected
Second S	Mode         Solution           Mode         Solution           State         1           Sta	Image: State of the s
3. Searching for SES device, the LED lights/flashes yellow while configuring the device and green when configuration is complete and webserver is ready to a launch. Cl <sup>2</sup> ck on each LED to launch webserver for each board (LED will turn Orange) 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2	The state of the second s	Control         Control <t< th=""></t<>

Figure 24. Starting the GUI Application

## TSN SWITCH EVALUATION WEB PAGE OVERVIEW

The **TSN Switch Evaluation** software package contains a set of web pages to configure the Switch for use in a TSN network or with redundancy features (see Figure 25).

A separate instance of the web server is used for each evaluation board connected to the PC and identified by the GUI.

The **TSN Switch Evaluation – Home** page provides access to the following web pages:

- ► Setup: Which allows the user to perform global actions, such as loading, storing, and managing the overall TSN database.
- ▶ **Port Statistics**: Provides an overview of each port transmit and receive information and any errors observed.
- Port Configuration: Provides user ability to control the port configuration and change port speed, interface type (hardware must support). It is not supported to change MAC interface modes during run-time. MAC interface must be configured during initial configuration. User can also communicate directly with the Ethernet PHYs via an MDIO read/write from this page.
- GPIO and Timer Configuration: Configure the functionality of the GPIO and Timer pins.
- ► **IGMP Snooping Configuration**: Provides user ability to enable and configure timeouts for IGMP snooping in the Switch.
- Switching Table: Provides user ability to install static entries in the lookup table, install extended table entries and flush the dynamic table. Status view provides insight into the learned dynamic entries. Per stream filtering and policing filters can be linked with static and extended entries in the Switching table.
- VLAN Table: Provides user ability to configure the port behavior for VLAN IDs. Choice of standard VLAN configuration or configuring ports as Trunk or Access ports.
- VLAN Remapping: Provides the ability to remap VLAN IDs for each port.

- VLAN Reprioritization: Gives user ability to configure remapping of VLAN priority on a port basis.
- Time Synchronization: Provides ability to configure and observer status of time synchronization (IEEE802.1AS).
- ► Frame Preemption: Provides ability to configure frame preemption on each port and observe preemption statistics.
- Scheduled Traffic Assign Queue: Provides user the ability to configure the mapping of VLAN priorities to the available queues for each port.
- Scheduled Traffic Set Queue Max. SDU: Provides ability to configure the maximum SDU transmission size for each port and each queue.
- Scheduled Traffic Schedule: Provides ability to set up schedules per port and also configure a schedule for the hardware Timer pins.
- ▶ LLDP Configuration: Provides LLDP configuration.
- PSFP Configuration: Provides ability to configure Per-Stream filtering and policing, Qci.
- ▶ MRP Configuration: Provides ability to configure MRP function.
- Stream Table: Used with FRER specifically, provides ability to configure stream entries for FRER.
- FRER Configuration: Frame replication and elimination for Reliability, 802.1CB, configuration page.
- Firmware Update: Provides ability to update/check version of device firmware.

Click any of these links to go to the required page. Once in a page, use the menu on the left to navigate to any of the other pages at any time. Ensure the GUI is kept running while navigating the web pages.

## TSN SWITCH EVALUATION WEB PAGE OVERVIEW



Figure 25. TSN Switch Evaluation – Home Page

#### CANDIDATE/RUNNING/STARTUP PAGES

All configuration pages have **Candidate/Running/Startup** views and are linked to the sysrepo repository. To tune the way a function performs, users can change several parameters in the **Candidate** pages. Once the user has a new set of values for the candidate configuration, click **Save** followed by **Commit** to send the candidate configuration entries to the **Running** configuration. Click **Discard** to revert the candidate configuration back to current running configuration. The **Startup** page shows the current startup configuration. This may be the default startup configuration or user may have saved a previous configuration to **Startup**.

# SETUP PAGE

This page is used to perform global operations on the **Candidate**, **Running**, and Startup configurations. Figure 26 shows these three configurations and which commands act on each configuration from the **Setup** page. Click the following command labels to perform the following actions:

## SAVE AND LOAD CANDIDATE DATASTORE

- Save Candidate as: Save Candidate in JSON or XML format. The file gets saved to Downloads folder.
- ▶ Load Candidate from file: Select JSON or XML file to load.

#### DATASTORE MANAGEMENT

- Save current Running as Startup: To store the running configuration to the startup configuration.
- Commit All: To push saved configuration to the device.
- **Discard All**: To discard configuration and revert to startup.

#### ADVANCED

Save Status as JSON: The operational file gets saved in JSON format to Downloads folder.

- ▶ Restore default values: Revert to default.
- Hardware Reset: Provides ability to do a reset of the ADIN6310 over the Ethernet Port. This also resets all the ADIN1300 PHYs (except for the Host Port PHY on Port 0). When this reset is used, this requires that any previous application processes running on the PC (running the web server) need to be closed. To close the process instances, press the keyboard Ctrl key, click Close all running processes. Release the Ctrl key, click Find and Configure SES Devices to resume operation, as shown in Performing a Reset section.

**Port 0 to Port 5 Status**: The LEDs on the left of page visually show which ports have established a link, these LEDs do not update automatically and require a refresh of the page.

Setup Version 3.0.0 Copyright 2020 - 2024 Analog I	AND DEV ANE/AD OF WAST'S	LOG CES NGALLE LINEWET INED TO HAVE CITED	
	Use this page to configu	re device general setting	
Home			
Setup	Save and Load Candidate da	taetora using files	
Port Statistics	Save and Load Candidate da	lastore using mes	
Port Configuration	Save Candidate as JSON	Save Candidate as XML	Load Candidate from file
GPIO and Timer Configuration			
Switching Table			
VLAN Table	Datastores management		
VLAN Remapping			
VLAN Reprioritization	Save current Running as	Startup Commit All	Discard All
Time Synchronization			
Frame Preemption			
Scheduled Traffic - Assign Queue	Advanced		
Scheduled Traffic - Set Queue Max. SDU			
Scheduled Traffic - Schedule	Save Status as JSON	Restore default values	Hardware Reset
LLDP Configuration			
MRP Configuration			
Firmware Update			
O O O O O O Port 0 Port 1 Port 2 Port 3 Port 4 Port 5			

Figure 26. TSN Switch Evaluation – Setup Page

## SETUP PAGE

#### **PERFORMING A RESET**

After performing a reset, either using the RESET push button on the Evaluation kit or alternatively through the **Hardware Reset** button in the **Setup** page, the Switch reverts to it's power on reset configuration and the device MAC address reverts to default, therefore if the GUI is searching for devices, it likely finds it as a new device, not one of the previously found devices. Either reset the GUI or do the following steps (see Figure 27):

- 1. To reestablish communication with the device, return to the GUI. Using the keyboard **Ctrl** button, click **Close All Running Processes**. All LEDs should turn off on the GUI.
- 2. Click Find And Configure SES Devices to identify and connected boards (shown with green LEDs) the devices again.



Figure 27. After a Reset – Close Processes and Find Again

# PORT STATISTICS

As shown in Figure 28, click **Port Statistics** in the menu item on the **Home** page or in the menu on the left of the page to access the **Port Statistics** page. This page shows what data has been transmitted and received on each port and provides insight into any errors observed during transmission. The Clear buttons enable clearing of individual ports or all port statistics. This window is updating automatically on a refresh rate of 5 seconds. To update on demand, reload the page in the browser.

There is a **Download as CSV** option on the bottom right of this page, where the current snapshot of statistics can be saved to an excel file.

Port Statistics Version 2.1.0 Copyright 2020 - 2023 Analog Devices, Inc. ADI Chronous: Add a transmission of the biotectrome								
Home This is the port statistics page								
Port Statistics	Ethernet statistics	Port 0	Port 1	Port 2	Port 3	Port 4	Port 5	
Port Configuration	Bytes received	266355	400982	75721	160037	0	666743	
CPIO and Times Configuration	Unicast packets received	2842	0	0	0	0	858	
Suitables Table	Broadcast packets received	26	10	4	12	0	0	
Switching fable	Multicast packets received	296	4275	976	1994	0	8377	
VLAN Iable	Frames received with alignment error	0	0	0	0	0	0	
VLAN Remapping	Frames received with CRC/FCS error	0	0	0	0	0	0	
VLAN Reprioritization	Frames received with large frame error	0	0	0	0	0	0	
Time Synchronization	Frames with RX MAC error	0	0	0	0	0	0	
Frame Preemption	Bytes transmitted	1075619	458639	212309	459312	58276	4961759	
Scheduled Traffic - Assign Queue	Unicast packets transmitted	2879	56	0	54	0	933	
Scheduled Traffic - Set Queue Max. SDU	Broadcast packets transmitted	28	26	14	12	3	36	
Scheduled Traffic - Schedule	Multicast packets transmitted	9886	5850	2444	5322	677	61224	
LLDP Configuration	Frames transmitted after single collision	0	0	0	0	0	0	
Firmware Update	Frames transmitted after multiple collisions	0	0	0	0	0	0	
	0	0	0	0	0	0		
	0	0	0	0	0	0		
Part 0 Part 1 Part 2 Part 2 Part 4 Part 5	Frames delayed by traffic	0	0	0	0	0	0	
Porto Porti Portz Ports Port4 Port5	Frames with TX MAC errors	0	0	0	0	0	0	
Clear All Clear port 0 Clear port 1 Clear port 2 Clear port 3 Clear port 4 Clear port 5 Download as CSV								

Figure 28. Port Statistics Page

#### CANDIDATE PAGE

As shown in Figure 25 or Figure 26, in the menu item on the **Home** page or in the menu on the left of the page, click **Port Con-figuration**. Similar to other pages, there are **Status**, **Candidate**, **Running**, and **Startup** views for this page.

The **Candidate** page provides user ability to configure some parameters for the port operation. Note that the XML file in the package is the primary opportunity for port configuration, but some additional run-time configuration is possible within the **Candidate** page.

Each port can be configured independently and saved, or alternatively, there is a **Save** button at top of page. Click the **Commit** button to push any changes to the device.

As shown in Figure 29, the configuration provided here as follows:

- ▶ Enable Port: This check box allows user to enable or disable ports. By default, all ports are enabled.
- MAC Address: The default MAC addresses shown corresponds to the MAC addresses assigned to each port based on the primary MAC address set by the XML configuration file. Changes

to this field are supported within the web page, enter the required MAC address and click **Save** button.

- ▶ **PHY Type**: This shows what is provided in the XML configuration file.
- PHY Auto-Negotiation: This check box is enabled by default and if disabled, indicates that the PHY is in Forced Speed mode, therefore only speeds 10 Mbps/100 Mbps are available.
- Speed: For Auto-Negotiation enabled options of 10 Mbps/100 Mbps/1000 Mbps, 10 Mbps/100 Mbps or 10 Mbps. When Auto-Negotiation disabled, options of 10 Mbps or 100 Mbps only.
- PHY Duplex: Full duplex by default. PHY duplex can be configured for speeds of 10 Mbps or 100 Mbps.
- PHY Crossover Config: Enables user to decide the cable crossover configuration of the ADIN1300 PHY on each port. Defaults to Auto MDIX. The user can select the following options:
  - Auto
  - MDI
  - MDIX
- RGMII Strength: Configuration of the drive strength of the RGMII from the Switch side.

Port Configuration Version 3.0.0 Copyright 2020 - 2024 Analog Dev	rices, Inc.					OG CES SULALE ETHORIZET INER TO HOMESTON
Home	Status Candi	idate Running Startup	Commit Disc	ard		
Setup						
Port Statistics						
Port Configuration	Save					
GPIO and Timer Configuration						
Switching Table		Port 0		Port 1		Port 2
VLAN Table	Enable Port		Enable Port		Enable Port	
VLAN Remapping	MAC Address	7A-C6-BB-11-11-12	MAC Address	7A-C6-BB-11-11-13	MAC Address	7A-C6-BB-11-11-14
VLAN Reprioritization		рну		рну		рну
Time Synchronization	PHY Type	Unmanaged	PHY Type	ADIN1300	PHY Type	ADIN1300
Frame Preemption	Auto Negotiation		Auto Negotiation	<b>Z</b>	Auto Negotiation	<b>Z</b>
Scheduled Traffic - Assign Queue	Speed	1000 Mbps 🗸 🗸	Speed	1000/100/10 Mbps 🗸 🗸	Speed	1000/100/10 Mbps 🗸 🗸
Scheduled Traffic - Set Queue Max. SDU	Duplex	Full 🗸	Duplex	Full 🗸	Duplex	Full 🗸
Scheduled Traffic - Schedule	Crossover Config	Auto MDIX 🗸 🗸	Crossover Config	Auto MDIX 🗸	Crossover Config	Auto MDIX 🗸
LLDP Configuration	RGMII Strength	NORMAL V	RGMII Strength	NORMAL V	RGMII Strength	NORMAL 🗸
MRP Configuration		Save port 0		Save port 1		Save port 2
Firmware Update		Port 3		Port 4	۱ <b>.</b>	Port 5
	Enable Port	<u> </u>	Enable Port	<u> </u>	Enable Port	<u> </u>
000000	MAC Address	7A-C6-BB-11-11-15	MAC Address	7A-C6-BB-11-11-16	MAC Address	7A-C6-BB-11-11-17
Port 0 Port 1 Port 2 Port 3 Port 4 Port 5	DHV Turo	PHY ADIN1200	DHV Tures	PHY ADIN1200	DHV Tupo	PHY ADIN1200
	Auto Name Entire	ADIN1300	Auto Negotiation	ADIN1300		ADIN1300
	Speed	1000/100/10 Mbps	Speed	1000/100/10 Mbps	Speed	1000/100/10 Mbps
	Duplex	Full	Duplex	Full	Duplex	Full
	Crossover Config	Auto MDIX 🗸	Crossover Confid	Auto MDIX 🗸	Crossover Config	Auto MDIX 🗸
	RGMII Strength	NORMAL V	RGMII Strength	NORMAL V	RGMII Strength	NORMAL 🗸
		Save port 3		Save port 4		Save port 5
					n	
		MDIO Control				
	Port Reg-	Address Data				
	Port 0 ✔ 0x	0x				
		Read	Write			

Figure 29. Port Configuration Page Overview – Candidate View

## STATUS PAGE

The **Status** page provides user snapshot of the current port configuration status.

As shown in Figure 30, the configuration provided here as follows:

- Interface Type: Shows the MAC interface as configured by the XML file. When using EVAL-ADIN6310EBZ, this hardware supports RGMII on all ports and SGMII interfaces on Port 1 to Port 4. SGMII modes need to be configured during initial configuration by editing the XML configuration. This hardware does not have any PHYs connected via RMII, therefore no RMII connectivity is possible.
- ▶ MAC Address: Shows the assigned MAC address to the port.
- ▶ **PHY Type**: Shows what PHY is connected.
- ▶ Crossover: Shows the actual crossover configuration.
- ▶ Link: Shows whether the link is up or down.
- ▶ Speed (Mbps): Shows the speed of the established link.
- PHY Delay: Shows the PHY Tx delays (of ADIN1300 PHY), which depends on the speed of the link established.
- RGMII Strength: Shows the configured drive strength of RGMII from the Switch side.

Port Configuration Version 3.0.0 Copyright 2020 - 2024 Analog De	vices, Inc.					ADI Chronous Schare enemet their to heave
Home	Status Car	ididate Running Startup				
Setup						
Port Statistics						
Port Configuration						
GPIO and Timer Configuration						
Switching Table		Port 0		Port 1		Port 2
/LAN Table	Interface Type	RGMII	Interface Type	RGMII	Interface Type	RGMII
/LAN Remapping	MAC Address	7A-C6-BB-11-11-12	MAC Address	7A-C6-BB-11-11-13	MAC Address	7A-C6-BB-11-11-14
/LAN Reprioritization		PHY		РНҮ		РНҮ
ime Synchronization	PHY Type	Unmanaged	PHY Type	ADIN1300	PHY Type	ADIN1300
rame Preemption	Crossover	Unknown	Crossover	Auto MDIX	Crossover	Auto MDIX
cheduled Traffic - Assign Queue	Link	Up	Link	Up	Link	Up
cheduled Traffic - Set Queue Max, SDU	Speed (Mbps)	1000	Speed (Mbps)	1000	Speed (Mbps)	1000
cheduled Traffic - Schedule	Duplex	Full	Duplex	Full	Duplex	Full
DP Configuration	PHY Tx delay	Not Applicable	PHY Tx delay	68	PHY Tx delay	68
IRP Configuration	RGMII Strength	normal	RGMII Strength	normal	RGMII Strength	normal
imuare Lodate		Port 3		Port 4		Port 5
	Interface Type	RGMII	Interface Type	RGMII	Interface Type	RGMII
	MAC Address	7A-C6-BB-11-11-15	MAC Address	7A-C6-BB-11-11-16	MAC Address	7A-C6-BB-11-11-17
		DHV		DHV		DHY
rt0 Port1 Port2 Port3 Port4 Port5	PHY Type	ADIN1300	PHY Type	ADIN1300	PHY Type	ADIN1300
	Crossover	Auto MDIX	Crossover	Auto MDIX	Crossover	Auto MDIX
	Link	Up	Link	Down	Link	Up
	Speed (Mbps)	1000	Speed (Mbps)	1000	Speed (Mbps)	1000
	Duplex	Full	Duplex	Full	Duplex	Full
	PHY Tx delay	68	PHY Tx delay	68	PHY Tx delay	68
	RGMII Strength	normal	RGMII Strength	normal	RGMII Strength	normal
	rtoniii cuongui	inorma.		norma		norma
		1000				
	PortRec	MDIO Control	)ata			
	Port 0 🗸 🔿		)x			
		Read	Write			

Figure 30. Port Configuration Page Overview – Status View

Port Configuration							
Version 3.0.0 Copyright 2020 - 2024 Analog Devic	es, Inc.				AHEAD OF WH	AT'S POSSIBLE" SCALABLE ETHERNET THED TO PERFECT	NON
Home	Status Cand	idate Running Startun					
Setup	Claido Claid	in the second p					
Port Statistics							
Port Configuration							
GPIO and Timer Configuration							
Switching Table		Port 0	۱ <u>ـــــــ</u>	Port 1		Port 2	
VLAN Table	Enable Port	<u> </u>	Enable Port	<u> </u>	Enable Port		
VLAN Remapping	MAC Address	7A-C6-BB-11-11-12	MAC Address	7A-C6-BB-11-11-13	MAC Address	7A-C6-BB-11-11-14	
VLAN Reprioritization		РНҮ		РНҮ		РНҮ	
Time Synchronization	PHY Type	Unmanaged	PHY Type	ADIN1300	PHY Type	ADIN1300	
Frame Preemption	Auto Negotiation		Auto Negotiation		Auto Negotiation		
Scheduled Traffic - Assign Queue	Speed	1000 Mbps 🗸 🗸	Speed	1000/100/10 Mbps 🛛 🗸	Speed	1000/100/10 Mbps 🛛 🗸	
Scheduled Traffic - Set Queue Max. SDU	Duplex	Full 🗸	Duplex	Full 🗸	Duplex	Full 🗸	
Scheduled Traffic - Schedule	Crossover Config	Auto MDIX 🗸 🗸	Crossover Config	g Auto MDIX 🗸 🗸	Crossover Config	Auto MDIX 🗸 🗸	
LLDP Configuration	RGMII Strength	NORMAL 🗸	RGMII Strength	NORMAL 🗸	RGMII Strength	NORMAL 🗸	
MRP Configuration		Port 3	1 <u></u>	Port 4		Port 5	
Firmware Update	Enable Port		Enable Port		Enable Port		
	MAC Address	7A-C6-BB-11-11-15	MAC Address	7A-C6-BB-11-11-16	MAC Address	7A-C6-BB-11-11-17	
		РНҮ		РНҮ		РНҮ	
	PHY Type	ADIN1300	PHY Type	ADIN1300	РНҮ Туре	ADIN1300	
Port 0 Port 1 Port 2 Port 3 Port 4 Port 5	Auto Negotiation		Auto Negotiation	- 🗹	Auto Negotiation		
	Speed	1000/100/10 Mbps 🛛 🗸	Speed	1000/100/10 Mbps 🛛 🗸	Speed	1000/100/10 Mbps 🛛 🗸	
	Duplex	Full 🗸	Duplex	Full 🗸	Duplex	Full 🗸	
	Crossover Config	Auto MDIX 🗸 🗸	Crossover Config	g Auto MDIX 🗸 🗸	Crossover Config	Auto MDIX 🗸 🗸	
	RGMII Strength	NORMAL 🗸	RGMII Strength	NORMAL 🗸	RGMII Strength	NORMAL 🗸	
		MDIO Control					
	Port 0 v 0v	Address Data					
	1 0/1 0 V	Read	Write				
		rioud -	vante				

Figure 31. Port Configuration Page Overview – Running View

Port Configuration Version 2.1.0 Copyright 2020 - 2023 Analog De	vices, Inc.					NEAR DE MINUTE INDOGENET*	ADI Chronous
Home	Status Candi	date Running Startup					
Setup		date rearing orange					
Port Statistics							
Port Configuration							
GPIO and Timer Configuration							
Switching Table		Port 0		Port 1		Port 2	_
VLAN Table	Enable Port		Enable Port		Enable Port		
VLAN Remapping	MAC Address	7A-C6-BB-11-11-12	MAC Address	7A-C6-BB-11-11-13	MAC Address	7A-C6-BB-11-11-14	
VLAN Reprioritization		PHY		PHY		PHY	
Time Synchronization	PHY Type	Unmanaged	PHY Type	ADIN1300	PHY Type	ADIN1300	
Frame Preemption	Auto Negotiation		Auto Negotiation		Auto Negotiation		
Scheduled Traffic - Assign Queue	Speed	1000 Mbps 🗸	Speed	1000/100/10 Mbps 🗸 🗸	Speed	1000/100/10 Mbps 🗸 🗸	
Scheduled Traffic - Set Queue Max. SDU	Duplex	Full 🗸	Duplex	Full 🗸	Duplex	Full 🗸	
Scheduled Traffic - Schedule	Crossover Config	Auto MDIX 🗸 🗸	Crossover Config	Auto MDIX 🗸 🗸	Crossover Config	Auto MDIX 🗸 🗸	
LLDP Configuration	RGMII Strength	NORMAL 🗸	RGMII Strength	NORMAL V	RGMII Strength	NORMAL 🗸	
MRP Configuration		Port 3		Port 4	-)r	Port 5	-
Firmware Update	Enable Port	<u> </u>	Enable Port	<u> </u>	Enable Port	<u> </u>	
	MAC Address	7A-C6-BB-11-11-15	MAC Address	7A-C6-BB-11-11-16	MAC Address	7A-C6-BB-11-11-17	
		PHY		PHY		PHY	
	PHY Type	ADIN1300	PHY Type	ADIN1300	PHY Type	ADIN1300	
Port0 Port1 Port2 Port3 Port4 Port5	Auto Negotiation		Auto Negotiation	2	Auto Negotiation	2	
	Speed	1000/100/10 Mbps 🗸 🗸	Speed	1000/100/10 Mbps 🗸 🗸	Speed	1000/100/10 Mbps 🗸 🗸	
	Duplex	Full 🗸	Duplex	Full V	Duplex	Full 🗸	
	Crossover Config	Auto MDIX V	Crossover Config	Auto MDIX V	Crossover Config	Auto MDIX V	
	RGMII Strength	NORMAL V	RGMITStrength	NORMAL V	RGMITStrength	NORMAL V	
	Rod Rea	MDIO Control					
	Port 0 V 0x	Data Data	3				
	1 0/1 0 1	Read	Write				

Figure 32. Port Configuration Page Overview – Startup View

#### **MDIO CONTROL**

The **MDIO Control** field is shown at the bottom of the **Port Configuration** page and provides user ability to interrogate any of the six ADIN1300 PHYs on the evaluation board.

Clause 22 read/writes are supported to the standard IEEE802.3 registers and vendor specific registers up to 0x1F. As shown in Figure 33, to read a register, in the **Port** field, select the port, in the **Reg-Address** field, enter the register address, and then click the **Read** button. The Switch communicates over MDIO bus to the appropriate PHY and the data field appears with the register information returned.

Similarly to write a PHY register, in the **Port** field, select the port, in the **Reg-Address** field, enter the register address, and then click the **Write** button to load.

Port	Reg-Address	Data	
Port 1 💙	0x17	0x3048	
Read Write			
Read Write			

Figure 33. MDIO Control – Communication with the PHYs on the Evaluation Board

Access to Clause 45 or Extended registers is supported. Register address input format is 0xHEX.

MDIO Control							
Port	Reg-Address	Data					
Port 1 🗸	0x8e27	0x3d					
	Read	Write					

Figure 34. MDIO Control – Access of Extended Register Space

## **GPIO AND TIMER CONFIGURATION**

There are four GPIO pins and four Timer pins. This page provides user ability to control the function of these hardware pins. There are **Status**, **Candidate**, **Running**, and **Startup** pages for this functionality.

All pins are enabled by default. The GPIOs are enabled as Outputs. Timer0 is enabled as a GPIO by default, Timer1 is enabled for TSN timer function, Timer2 is enabled as a 1 pulse per second (1PPS) timer signal, and Timer3 is configured to be a Capture Input.

The available configurations and default configuration for these pins is shown in Table 9.

When changing GPIO or Timer operation, each change must be saved individually, otherwise, the user loses the change.

When SPI mode is selected as Host interface, Timer0 automatically configures as an Interrupt for the SPI interface to the Host and does not available to configure as a Timer/GPIO pin.

#### **TSN OUTPUT TIMER**

This is the default operation for Timer1. When TSN Output Timer function is selected in this page, then a user needs to navigate to the Scheduled Traffic – Schedule page. The TSN Output Timer functionality allows the user to control the Timer pins with specific cycle times and is configured through the Scheduled Traffic – Schedule page.

#### **1PPS PERIODIC OUTPUT**

Timer2 and Timer3 can support a 1 pulse per second (1PPS) output. As shown in Figure 35, in the **Mode** drop-down box, select the **1PPS\_PERIODIC\_OUT** option. The low/high pulse-width fields fix at 500 ms.

Table 9. GPTO and Timer Phi Functionality						
Hardware Pin	Available Mode					
GPIO0	GPIO					
GPI01	GPIO					
GPIO2	GPIO					
GPIO3	GPIO					
GPIO4/TIMER0	GPIO, TSN Output Timer (Default), Interrupt (SPI INT)					
GPIO5/TIMER1	GPIO, TSN Output Timer (Default)					
GPIO6/TIMER2	GPIO, TSN Output Timer, Periodic Output, 1PPS Output (Default)					
GPIO7/TIMER3	GPIO, TSN Output Timer, Periodic Output, 1PPS Output, Capture In (Default)					

## PERIODIC OUTPUT

Timer2 and Timer3 also support a user-configurable periodic output. As shown in Figure 35, in the **Mode** drop-down box, select the **PERIODIC\_OUT** option and enter the required high/low pulse-width for required pulse. The minimum value of high/low pulse-width is 16 ns and the time period must not exceed 1 second.

#### **CAPTURE INPUT**

Timer2 and Timer3 can also support configuration as a capture Input. By default, Timer3 is a capture input. A possible usage for the capture input is to trigger the Switch to capture a hardware timestamp in response to a transition on the Timer3 and send that timestamp information to the Host. Note the web server does not support this configuration, the driver APIs need to be used to enable this and send the message to the Host.

#### **OTHER MODES**

Any greyed out options are not available yet and intended for future releases.

## **GPIO AND TIMER CONFIGURATION**

GPIO and Timer Config Version 3.0.0 Copyright 2020 - 2024 Analog Devic	ANALOG DEVICES	ADI Chronous* Source etheret they to consection				
	Use this page to as	offering CDIO and Timoro				
Home	Use this page to co	onigure GPIO and Timers				
Setup						
Port Statistics	Status Candidat	e Running Startup Co	ommit Discard			
Port Configuration						
GPIO and Timer Configuration						
Switching Table	Save					
VLAN Table	Note: Minimum value of high	h/low pulse width is 16ns and tim	e period (Low pulse widt	th + High pulse width) shoul	d not exceed 1 sec	and (100000000ns)
VLAN Remapping	opios		opies	ceres		
VLAN Reprioritization	GPIO0	GPI01	GPIO2	GPI03	1	
Time Synchronization						
Frame Preemption	Value CLEAR	Value CLEAR V		Value CLEAR ¥		
Scheduled Traffic - Assign Queue	Save	Save	Save	Save		
Scheduled Traffic - Set Queue Max. SDU					J	
Scheduled Traffic - Schedule	т		ти	JER1 / GPI05		
LLDP Configuration	Mode	GPIO V	Mode	TSN OUT	$\overline{}$	
MRP Configuration	Enable		Enable	2		
Firmware Update	Direction	OUTPUT V	Direction	OUTPUT	~	
	Value	CLEAR 🗸	Value	CLEAR	×	
	Low Pulse Width (ns)	) 16	Low Pulse Width (ns)	16		
	High Pulse Width (ns	5) 16	High Pulse Width (ns)	) 16		
Portu Porti Portz Ports Port4 Port5	Phase Shift (ns)	0	Phase Shift (ns)	0		
	Output timer	TIMER 0	Output timer	TIMER 0	~	
		Save		Save		
	т	MER2 / GPIO6	TIN	MER3 / GPIO7		
	Mode	1 PPS PERIODIC OUT V	Mode	CAPTURE IN	~	
	Enable		Enable		_	
	Velue		Direction		×	
	Low Pulse Width (ps)	50000000	Low Pulse Width (os)	16		
	High Pulse Width (ns	50000000	High Pulse Width (ns)	16		
	Phase Shift (ns)	0	Phase Shift (ns)	0		
	Output timer		Output timer	TIMER 0	$\overline{}$	
		Save		Save		

Figure 35. GPIO and Timer – Candidate Page

## CANDIDATE VIEW

## **Dynamic Table**

Entries in the **Dynamic Table** are entries learned by the Switch based on traffic crossing the Switch. The Switch learns based on Source MAC address and if the VLAN configuration is enabled for learning, the Switch automatically installs an entry in the table with an age value based on when the entry is updated. The table ages out frames if they are no longer seen within the configured aging period. The default configuration is for learn and forwarding on untagged traffic. VLAN tagged traffic is not learned or forwarded unless user configures the VLAN table accordingly, see VLAN Table. The **Switching Table** page provides the user ability to configure the aging period of the **Dynamic Table** entries, simply enter the aging period in ms in the field and click the **Save** button to adjust the aging (range of 1000 ms to 10000000 ms). The default setting for aging is 300 seconds.

As shown in Figure 36, a user can flush the Dynamic table on-demand, by clicking the **Flush Dynamic Table** button.

## Source Port Lookup Modes

The default behavior on all ports is to perform a destination MAC and VLAN lookup.

User can configure the lookup behavior on a port basis to instruct the Switch to perform other lookup options. Checking the bit 0 field for a port enables a Source lookup on all traffic to ingress that port. Setting bit 1 enables extended lookup on all frames for that port and setting bit 2 enables a Destination MAC address lookup (802.1D). Combinations of lookups are supported.

#### **Static Table Entries**

The **Static Table** allows user to install/remove entries in the lookup table. When the Switch is configured for TSN mode, the startup configuration installs an entry in the table for LLDP multicast addresses. This static entry can be seen as the first row of the table. Do not interfere or overwrite this entry.

To install a new entry, first add a row, then fill in the **Destination MAC Address**, **VLAN identifier**, and **Egress Ports**. For untagged traffic use **4095** as a **VLAN Identifier** to indicate no VLAN identified associated with entry. For tagged traffic, ensure to also configure the VLAN table to support the VLAN IDs of interest for specific ports. The format of the **Destination MAC Address** must be entered as xx-xx-xx-xx-xx and the **Egress Port** must be entered in hex. Figure 36 shows examples of adding various entries with different VLAN tags destined to egress on specific ports.

The **Static Table** also gives user the ability to add or remove VLAN tags from traffic. To insert a tag, add the table entry with the **Add Tag Option** and define the **VLAN ID** and **Priority** to add. To remove the tag as the frame egresses, select the **Remove** tag. The standards indicate a minimum sized frame for a VLAN tagged frame is 68 bytes (64 bytes + 4 byte VLAN tag). If user is ingressing frames of 64-bytes including VLAN tag and configuring the Switch to remove the VLAN tag directly or using VLAN access port, the Switch deliberately corrupts the frame on egress.

By default, only untagged or VID 0 frames crosses the Switch, the VLAN table must be configured to forward other VIDs.

## **Extended Table Entries**

Similarly, this page allows the user to install extended table entries and define how they are handled. A VLAN tag can be inserted or removed. Note that configuring the extended table to install a VLAN tag in traffic that has an existing VLAN tag results in two VLAN tags. This operation is a misconfiguration by user. Two VLAN tags are visible in the frame, upper layers need to handle accordingly.

The extended table input fields in the web server currently only support basic lookups up to 14-bytes. Installing lookups for EtherTypes such as IPv4, IPv6, and PTP are not yet supported and rejected by the web server. These type of entries are supported using the Driver APIs directly, for more details, refer to the ADIN6310 Hardware Reference Manual.

## **Cut Through Enable**

When installing a **Static Table** entry, user can install with cut through enabled/disabled by selecting the **Cut Through Enable** check box.

#### Stream Filter

When installing a **Static Table** entry or **Extended Table** entries, a **Stream Filter** can be associated with this entry. **Stream Filter** is a part of PSFP functionality. To use this feature, select the **Stream Filter Enable** check box and pass the ID of the **Stream Filter** to apply, then go to the PSFP web page to configure the **Stream Filter**, **Stream Gate**, or **Flow Meter** as required. Stream filters can only be applied to static entries that are configured for Store and forward mode, ensure that the **Cut Through Enable** check box is not selected when using PSFP.

Switching Table	
Version 4.0.0 Copyright 2020 - 2024 Analog De	nea n
Home	Use this page to configure switching table
Setup	
Port Statistics	Status Candidate Running Status Commit Discard
Port Configuration	
GPIO and Timer Configuration	
KIMP Snooping Configuration	
Bwitching Table	Dynamic Tuste :
VLAN Table	
VLAN Remapping	Ageing Period (s) 300 Vilid age-out period is 2 accords (4 hours)
VLAN Reprintization	
Time Synchronization	Flush Dynamic Table
Frame Preemption	Save & Save &
Scheduled Traffic - Assign Queue	Source Port Lookup Modes : Commit to
Scheduled Traffic - Set Queue Max, SOU	Bit 2: 802.1D
Scheduled Traffic - Schedule	Bit 1: Extended Lookup IOaC Bit 0: Source Lookup
LLDP Configuration	
PSFP Configuration	Port (xu)
MRP Configuration	Part I
Steam Table	Port2
PRER Configuration	Port3 🔳 🔳
Permeane Update	Part4
	Parts Analy Stroom filter with ID 0
$\circ$ $\circ$ $\circ$ $\circ$ $\circ$ $\circ$ $\circ$	Apply subtaining, with D o
Porto Ports Ports Ports Port6	(cut-unrough disabled)
	Static Table Entries :
	Nofa:
	1. Une VLAN 10 2405 E include no VLAN Montfer associated with entry. 2. Egress ENTer entry is a bit ang of the possible outputs. BIO 8 = Port 0 and BIS 5 = Port 5
	Errity Action Destination MAC Address VLAN Identifier Ecress Port Extended Lookup TAG Coversion VLAN ID Priority Drop Elobie Stream Filter Frable Stream Filter Cut Through Enable
Add Static Entries	
	Add Extended Table Entries with
	Data/Mask to match Apply Stream filter, with ID 1
	Extended Table Entries :
	Entry Action Etherhype Data Mask Egress Port TAG Operation VLAN ID Priority Drop Eligible Stream Ether Enable Stream Filter
	1 Delete 28-00 AA-AA-06-06-06-06-06-06-06-06-06-06-06-06-06-

Figure 36. Switching Table – Candidate View – Adding Static Entries and Extended Table Entries

tching Table	
4.0.0 Copyright 2020 - 2024 Analog	Devices, Inc.
	Use this page to configure switching table
les	Status Candidate Running Startup
auration	
Timer Configuration	
ping Configuration	Dynamic Table :
Table	
•	Ageing Period (a): 300 Valid age-out period is 2 seconds to 14400 seconds (4 hours)
apping	
ioritization	Flush Dynamic Table
ronization	
imption	Source Port Lookup Modes :
Traffic - Assign Queue	
Traffic - Set Queue Max. SOU	Bit 1: Ekinded Lookup
Traffic - Schedule	Bit 0: Source Lookup
guration	Port [2:0]
Iguration	Parto E
juration	Port
la la	
Iguration	
Ipdata	
11 Port2 Port3 Port4 Port6	Static Table Entries :
	Nota:
	1. Une VLAN ID 4069 to indicate no VLAN Identifier associated with entry. 2. Egress Port entry is a bit map of the possible output ports. Bit D = Port 0 and Bit 5 = Port 5
	Entry Action Destination MACAdress VLNN Identifier Egress Port Extended Lookup TAG Operation VLNN ID Priority Drop Eligible Stream Filter Cult Through Enable
	1 Delete 01-80-C2-00-00-0E 4095 0x00 🛛 No Operation 💙 1 0 0 0 0
	3 Dente 04-90-91-30-de-0/ 1 UXU2 No Operation ✓ 1 0 0 0 Ø Ø 0
	4 Dieste 64-96-91-86-98-1 4005 0x10 InsentTag 🛛 1 6 0 0 0 0
	Extended Table Entries :
	Entry Action Ethenhype Data Maak Egress Purt TAG Operation VLAN 10 Priority Drop Eligible Steam Filter Enable Str

Figure 37. Switching Table – Running View with Added Static Entries

Home Seture Spage to Configure Switching Laber Seture Spage to Configure Switching Laber Seture Spage Startup
Setup Port Statistics Status Gandidate Running Startup
Port Statistics Status Candidate Running Startup
Port Configuration
GPIO and Timer Configuration
Switching Table Dynamic Table :
VLAN Table
VLAN Remapping Ageing Period (s): 300 Valid age-out period is 2 seconds to 14400 seconds (4 hours)
VLAN Reprintization
Time Synchronization Flush Dynamic Table
Frame Preemption
Scheduled Traffic - Assign Queue
Scheduled Traffic - Set Cueue Max: SDU Source Port Lookup Modes :
Scheduled Traffic - Schedule Bit 2: 902-10
LDP Configuration Bit 0: Source Lookup
MRP Configuration Port (2:0)
Firmware Update Port 0
Port 1 Port
Pot2
Port 3
Port0 Port1 Port2 Port3 Port4 Port5 Port4 Port4
Port 5 🖉 🗖 🗖
Static Table Entries :
NOLE:
<ol> <li>Use VLAN ID 4009<sup>6</sup> to indicate no VLAN identifier associated with entry.</li> <li>Egress Port entry is a bit map of the possible output ports. Bit 0 = Port 0 and Bit 5 = Port 5</li> </ol>
Entry Action Destination MAC Address VLAN Identifier Egress Port Extended Lookup TAG Operation VLAN ID Priority Drop Eligible
1 Delete 01-80-C2-00-00-DE 4095 0x00 🛛 No Operation 🗸 1 0 0 0
Extended Table Entries :
Entry Action Ethertype Data Mask Egress Port TAG Operation VLAN ID Priority Drop Eligible

Figure 38. Switching Table – Startup View

#### **STATUS VIEW – DYNAMIC ENTRIES**

The **Status** view allows user to readback the MAC addresses learned by the Switch. Figure 39 shows the untagged traffic entries learned as the user is ingressed Port 0.

	Use this	page to configure	switching t	able	
Home					
Setup	Statu	s Candidate Run	ning Startun		
Port Statistics	otata		ang otartop		
Port Configuration					
GPIO and Timer Configuration					
Switching Table	Dynan	nic Table :			
VLAN Table					
VLAN Remapping	Read	Dynamic Table			
VLAN Reprioritization	Total n	mber of valid dynamic	entries from the	e last read reque	st 13
Time Synchronization	Start E	ntry 1			Last Entry 13
Frame Preemption	Entry	MAC Address	VLAN ID	Port Map	
Scheduled Traffic - Assign Queue	1 [	0-0A-CD-3E-15-D2	4095	0x01	
Scheduled Traffic - Set Queue Max. SDU	2 7	A-C6-BB-22-22-23	4095	0x20	
Scheduled Traffic - Schedule	3 🕻	00-11-11-11-77-77	4095	0x01	
LDP Configuration	4 [	0-11-11-11-77-78	4095	0x01	
MRP Configuration	5 (	0-11-11-11-77-79	4095	0x01	
Firmware Update	6 (	00-11-11-11-77-7A	4095	0x01	
	7 (	00-11-11-11-77-7B	4095	0x01	
	8 [	0-11-11-11-77-7C	4095	0x01	
	9 (	0-11-11-11-77-7D	4095	0x01	
ort0 Port1 Port2 Port3 Port4 Port5	10 (	0-11-11-11-77-7E	4095	0x01	
	11 0	0-11-11-11-77-7F	4095	0x01	
	12 (	0-11-11-11-77-80	4095	0x01	
	40	0 44 44 44 77 94	4095	0v01	

Figure 39. Switching Table – Status View with Learned Entries

# **VLAN CONTROL**

As shown in Figure 40, the VLAN Table has Candidate, Running, and Startup pages. There is no Status page for VLAN function. To see how the VLANs are configured based on changes in the Candidate view, see the Running page.

## VLAN TABLE

The **VLAN Table** page provides user ability to configure the port learning and forwarding operational mode for each VLAN IDs (1 through 4094).

The default behavior is **No Learn and No Forward** for all VLANs with exception of VLAN ID 0/untagged traffic.

There are two modes of operation within the VLAN Table, Candidate page: Trunk/Access Port configuration or VLAN Table Configuration. The default is VLAN Table, but this can be changed using the VLAN Table/Mode Table Switch check box.

## VLAN Table Configuration

To configure each individual port behavior, simply enter the VLAN ID, select the appropriate behavior for each port and click the Save button followed by Commit. The configuration is loaded and the web page moves automatically to show the Running view. To read the configuration for a specific VLAN ID, enter the ID of interest in the Running page.

The configuration mode choices for each port are: Learn and Forward, Learn and No Forward, No Learn and Forward, or No Learn and No Forward.

## **Trunk/Access Configuration**

The Switch ports can be configured as Trunk or Access ports. Trunk Ports can support multiple VLAN IDs or ranges of VLAN IDs, whereas access ports support only 1 VLAN ID. The Switch handles the insertion and removal of VLAN tags where required when traffic is crossing between ports. When removing a VLAN tag on an access port, the switch expects a minimum sized frame for a VLAN tagged frame to be 68 bytes (64 bytes + 4 byte VLAN tag). If user is ingressing frames of 64-bytes including VLAN tag and configuring the Switch to remove the VLAN tag directly or using VLAN access port, the Switch sees this frame as a runt frame and deliberately corrupts the frame on egress.

To use this feature, first enable the check box VLAN Table/Mode Table Switch.

Then configure the ports as Trunk or Access ports with the VLAN IDs or ranges of interest.

In the example shown in Figure 41, Port 0 is configured as a **Trunk** port for VLAN IDs 1 to 5, but VLAN ID 2 is not disabled.

Port 1 to Port 4 are configured as **Access** ports for individual VLANs and Port 5 is another **Trunk** port subscribing to VLAN IDs in range of 1 to 5 including VLAN ID 2. VLAN Priority can also be configured for the access port, so any traffic ingressing the access port have a VLAN tag inserted with the VID and the priority configured for the access port.

There is an upper limit on the number of different VLAN IDs that can be active with a max of 62 different VLAN IDs, therefore, when configuring Trunk ports, user must avoid enabling the full range of VLAN IDs. In practice, only a small number of VLAN IDs are in use.

The **Running** view in Figure 42 shows the configured VIDs across ports. Note that VID 2 is not shown for Port 0, but is for Port 5, which matches what is configured.

## **VLAN CONTROL**

VLAN Table					
Version 4.0.0 Copyright 2020 - 2024 Analog De	vices, Inc.				
Home	Use this page to	configure the	e port lear	n and forward operation	onal mode
Setup			_		
Port Statistics	Candidate R	lunning Startu	p Com	nit Discard	
Port Configuration					
GPIO and Timer Configuration		Trunk	A	Bort Configu	ration
IGMP Snooping Configuration	Save	munk//	Access	- Port Connigu	ration
Switching Table	Note:				
VLAN Table	Maximum 62 diffe	rent VLAN IDs ca	n be active.		
VLAN Remapping			<b>D</b> efaults		
VLAN Reprioritization	Port Mode Port 0 Accesses	VLAN ID	Phonty	Allowed VLAN IDS	Disabled VLANs
Time Synchronization	Port 1 Access A	· ·	0	1-10	
Frame Preemption	Port 2 Appess N	v 1	0	1-10	
Scheduled Traffic - Assign Queue	Port 3 Access 1	× 1	0	1-10	
Scheduled Traffic - Set Queue Max. SOU	Port 4 Access	v 1	0	1-10	
Scheduled Traffic - Schedule	Port 5 Access N	/ 1	0	1-10	
LLDP Configuration	Porto		•	1-10	
PSFP Configuration			_		
MRP Configuration	VLAN Table / Mo	de Table Switch			
Stream Table					
FRER Configuration	VLAN: 1				
Firmware Update	Port Mode			VLAN	Table
	0 No Learn	& No Forward	4	Config	uration
	No Learn	& No Porward N			
Parts Parts Parts Parts Parts	3 No Learn	& No Forward N			
Porto Porti Porta Porta Porta	4 No Learn	& No Forward			
	5 No Learn	& No Forward			

Figure 40. VLAN Table for Port Configuration

Home       Use this page to co         Setup       Candidate         Port Satistics       Ruma         Port Configuration       Save         Switching Table       Note:         VLAN Table       Maximum 82 different         VLAN Reproritization       Port Mode         Time Synchronization       Port Mode         Scheduled Traffic - Assign Queue       Port 3         Scheduled Traffic - Schedule       Port 4         LDP Configuration       Trunk <	Infigure the po ing Startup VLAN IDs can be VLAN ID P 0 0 0 0 3 3 5 5 5 5 5	e active. 1-10 1-10 1-10	operational mode
Home Setup Port Statistics Port Configuration GPIO and Time: Configuration Switching Table VLAN Table VLAN Table VLAN Table VLAN Remapping VLAN Reprioritization Time Synchronization Frame Preemption Scheduled Traffic - Set Queue Max: SDU Scheduled Traffic - Set Queue Max: SDU Extra prioritization Extra prioritization Extra prioritization Extra prioritization Port 1 Access V Port 3 Access V Port 4 Access V Port 5 Trunk V	Infigure the po ing Startup VLAN IDs can be VLAN ID P I 0 I 0 I 3 I 3 I 5 I 5	ort learn and forward of Commit Discard e active. hiority Allowed VLAN 1-5 1-10	operational mode
Home Setup Port Statistics Port Configuration GPIO and Timer Configuration Switching Table VLAN Table VLAN Table VLAN Remapping VLAN Reprioritization Time Synchronization Frame Preemption Scheduled Traffic - Set Queue Max: SDU Scheduled Traffic - Set Q	vLAN IDs can be VLAN IDs can be VLAN ID P 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ort learn and forward of Commit Discard e active. hiority Allowed VLAN 1-5 1-10	operational mode
Home     Use this page to co       Setup     Candidate       Port Statistics     Ruma       Port Statistics     Ruma       GPIO and Timer Configuration     Save       Switching Table     Note:       VLAN Table     Maximum 62 different       VLAN Reprioritization     Port Mode       Time Synchronization     Port Mode       Scheduled Traffic - Assign Queue     Port 2 Access V       Scheduled Traffic - Schedule     Port 3 Access V       LIDP Configuration     Port 5 Trunk V	nfigure the po ing Startup VLAN IDs can be VLAN ID P I 0 1 0 3 3 5 5 5 5 5	e active. 1-10 1-10 1-10 1-10	operational mode
Home     Setup       Setup     Candidate       Port Statistics     Candidate       Port Statistics     Rum       GPIO and Timer Configuration     Save       Switching Table     Note:       VLAN Table     Maximum 62 different       VLAN Remapping     Port Mode       Port Statistics     Port Mode       Port Onfiguration     Port 1 Access        Scheduled Traffic - Assign Queue     Port 2 Access        Scheduled Traffic - Schedule     Port 4 Access        ULDP Configuration     Port 5 Trunk	VLAN IDs can be VLAN IDs can be VLAN ID P 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Commit Discard e active. 1-5 1-10 1-10	IDs Disabled VLANs 2
Setup     Candidate     Rum       Port Statistics     Port Statistics     Rum       GPIO and Timer Configuration     Save     Save       Switching Table     Note:     Note:       VLAN Table     Maximum 62 different     Note:       VLAN Table     Mode     Port 0 furnik       Time Synchronization     Port 1 Access      Port 1 Access        Scheduled Traffic - Set Queue Max: SDU     Port 3 Access      Port 4 Access        Scheduled Traffic - Shedule     Port 5 Trunk      Port 5 Trunk	ing Startup VLAN IDs can be VLAN ID P. 0 0 3 5 5 5	Commit         Discard           e active.         Internet of the second s	IDs Disabled VLANs 2
Port Configuration     Save       Port Configuration     GMP Snooping Configuration       GMP Snooping Configuration     Note:       Switching Table     Note:       VLAN Table     Maximum 62 different       VLAN Remapping     Port       VLAN Reprioritization     Port Mode       Time Synchronization     Port 1       Frame Preemption     Port 2       Scheduled Traffic - Assign Queue     Port 3       Scheduled Traffic - Schedule     Port 4       LLPP Configuration     Port 5	VLAN IDs can be VLAN ID P 0 0 3 5 5	e active. Triority Allowed VLAN 1-5 1-10 1-10	IDs Disabled VLANs 2
Port Configuration     Save       GPI0 and Timer Configuration     Save       Switching Table     Note:       Switching Table     Maximum 62 different       VLAN Table     Maximum 62 different       VLAN Reprioritization     Port       Time Synchronization     Port 1       ACRESS     Port 1       Access     Scheduled Traffic - Assign Queue       Scheduled Traffic - Schedule     Port 4       LDP Configuration     Port 5	VLAN IDs can be VLAN ID P 0 0 3 5 5	e active. Yiority Allowed VLAN 1-5 1-10 1-10	IDs Disabled VLANs 2
GHO shift Timer Cohiguration     Save       IGMP Snooping Configuration     Save       VLAN Table     Note:       VLAN Remapping     Port Mode       VLAN Reprioritization     Port 0 Trunk <       Time Spothronization     Port 1 Access <       Scheduled Traffic - Assign Queue     Port 3 Access        Scheduled Traffic - Schedule     Port 5 Trunk <	VLAN IDs can be VLAN ID P 0 0 3 3 5	riority Allowed VLAN 1-5 1-10 1-10	IDs Disabled VLANs 2
Kowr shooping Conliguration     Note:       Switching Table     Maximum 62 different       VLAN Reimapping     Maximum 62 different       VLAN Repring transport     Port       MAR Repring transport     Port 0       Time Synchronization     Port 1       Frame Preemption     Port 2       Scheduled Traffic - Assign Queue     Port 3       Scheduled Traffic - Set Queue Max. SDU     Port 4       Scheduled Traffic - Schedule     Port 5       Trunk v     Port 4	VLAN IDs can be VLAN ID P 0 1 0 3 5 5	e active. Hiority Allowed VLAN 1-5 1-10 1-10	IDs Disabled VLANs 2
Santoning rable     Maximum 82 different       VLAN Remapping     Maximum 82 different       VLAN Reproduction     Port Mode       Time Syndhronization     Port 1 Access V       Frame Preemption     Port 2 Access V       Scheduled Traffic - Assign Queue     Port 4 Access V       Scheduled Traffic - Schedule     Port 5 Trunk V	VLAN IDs can be VLAN ID P 0 1 0 3 5 5	e active. hiority Allowed VLAN 1-5 1-10 1-10	IDs Disabled VLANs 2
VLAN Remapping     Nakonum 62 different       VLAN Remapping     Port Mode       VLAN Reprioritization     Port 0 Trunk ¥       Time Synchronization     Port 1 Access ¥       Frame Preemption     Port 2 Access ¥       Scheduled Traffic - Assign Queue     Port 3 Access ¥       Scheduled Traffic - Set Queue Max. SDU     Port 4 Access ¥       Port 5 Trunk ¥     Port 5 Trunk ¥	VLAN ID P 0 0 1 0 3 3 5	riority Allowed VLAN 1-5 1-10 1-10	IDs Disabled VLANs 2
VLAN Remapping     Port     Mode       VLAN Reprioritization     Port 0     Trunk     Intersection       Time Synchronization     Port 1     Access     Intersection       Scheduled Traffic - Set Queue Max. SDU     Port 2     Access     Intersection       Scheduled Traffic - Set Queue Max. SDU     Port 4     Access     Intersection       Scheduled Traffic - Set Queue Max. SDU     Port 4     Access     Intersection       Scheduled Traffic - Schedule     Port 5     Trunk     Intersection	VLAN ID P 0 0 3 3 5	Allowed VLAN           1-5           1-10           1-10	IDs Disabled VLANs 2
VCAN reproduzion     Port 0     Trunk        Time Synchronization     Port 0     Trunk        Prame Preemption     Port 1     Access        Scheduled Traffic - Set Queue Max. SDU     Port 3     Access        Scheduled Traffic - Schedule     Port 4     Access        LDP Configuration     Port 5     Trunk	0 0 3 3 5	1-5 1-10 1-10	2
Time Synchronization     Port 1     Access V       Frame Preemption     Port 2     Access V       Scheduled Traffic - Set Queue Max. SDU     Port 3     Access V       Scheduled Traffic - Schedule     Port 4     Access V       LDP Configuration     Port 5     Trunk	0 3 5	1-10 1-10	
Frame Preemption     Port 2     Access V     2       Scheduled Traffic - Set Queue Max. SDU     Port 3     Access V     2       Scheduled Traffic - Schedule     Port 4     Access V     2       Port 4     Access V     2       Port 5     Trunk V	3 3 5 5	1-10	
Scheduled Traffic - Set Queue Max. SDU Scheduled Traffic - Set Queue Max. SDU Scheduled Traffic - Schedule LDP Configuration LDP Configuration LDP Configuration	5		
Scheduled Traffic - Set Queue Max. SDU Port 4 Access V A Port 5 Trunk V Port 5 Trunk V		1-10	
Scheduled Traffic - Schedule Port 5 Trunk V	+ 1	1-10	
LLDP Configuration -	0	1-5	
PSFP Configuration V/I AN Table / Mode T:	able Switch 🔽		
MRP Configuration			
Stream Table			
FRER Configuration VLAN : 1			
Firmware Update Port Mode	-		
0 No Learn & No	5 Forward V		
	o Forward ➤		
Port 0 Port 1 Port 2 Port 3 Port 4 Port 5 3 No. Learn & No.	o Forward V		
4 No Learn & No	o Forward V		
5 No Learn & No	o Forward 🗸		

Figure 41. Using Trunk/Access Port Configuration – Candidate View

## **VLAN CONTROL**

VLAN Table							ANALOG		
Version 4.0.0 Copyright 2020 - 2024 Analog Devices, Inc. ADJ L/D/O									
11	Use this p	age to	configu	re the p	ort learn	and	forward operational	mode	
Home Satur	-								
Setup	Candida	e Rur	Running Startup						
		_							
GPIO and Timer Computation	Note								
	Hote.								
Switching Table	Maximum	62 differe	nt VLAN I	Ds can b	e active.				
VEAN Table	DODTO	1000							
VLAN Remapping	PORTS	VIDS				2			
VLAN Reproduzation		1	3	4	5	2			
	Port 0								
Frame Preemption	Port 1	PRI: 0							
Scheduled Traffic - Assign Queue		-							
Scheduled Traffic - Set Queue Max. SDU	Port 2		PRI: 3						
Scheduled Traffic - Schedule					PRI-5				
LLDP Configuration	Port 3		•						
		_	_	PRI: 1	_	_			
MRP Configuration	Port 4				-				
Stream Table	Port 5								
FRER Contiguration									

Figure 42. Using Trunk/Access Port Configuration – Running View
### **VLAN REMAPPING**

As shown in Figure 43, the VLAN Remapping page provides user ability on a per port basis to add entries to remap incoming VLAN IDs to a different VLAN ID. Remapping is achieved by replacing the source VID in an incoming VLAN tagged frame with a destination VID. Per port, a table with 16 entries (slots) is used to configure the remapping. To add an entry, select the port of interest, select the Enable remapping check box, add the Source VLAN ID and the **Target VLAN ID**, click the **Save** button followed by the **Commit** button. These remap entries are then saved and loaded to the device. Traffic ingressing a port with a corresponding VLAN ID can be observed to egress on the defined port with the remapped/target ID. To remove an entry, choose **Delete** button (see Figure 44). To view status of other ports, select the other port and any existing entries are displayed in the table.

VLAN Remapping Version 2.1.0 Copyright 2020 - 2023 Analog	Devices, Inc.
Home	Use this page to remap the VLAN IDs at each port
Setup	
Port Statistics	Candidate Running Startup Commit Discard
Port Configuration	
GPIO and Timer Configuration	_
Switching Table	Save
VLAN Table	Port: Port 0 🗸
VLAN Remapping	Enable remapping
VLAN Reprioritization	
Time Synchronization	Entry Source VLAN ID Target VLAN ID
Frame Preemption	Add
Scheduled Traffic - Assign Queue	
Scheduled Traffic - Set Queue Max. SDU	
Scheduled Traffic - Schedule	
LLDP Configuration	
Firmware Update	
Port 0 Port 1 Port 2 Port 3 Port 4 Port 5	

Figure 43. VLAN Remapping Page - Candidate View

VLAN Remapping		ANALOG ADI Chronous
Version 2.1.0 Copyright 2020 - 2023 Analog Dev	ioes, Inc.	AVEAD OF MANUTS POSSIBLE" SOM ARE ETHERNET THED TO POSTCOM
·		,
Home	Use this page to remap the VLAN	Ds at each port
Setup		
Port Statistics	Candidate Running Startup	Commit Discard
Port Configuration		
GPIO and Timer Configuration	(Comp)	
Switching Table	Save	
VLAN Table	Port: Port 2	<b>v</b>
VLAN Remapping	Enable remapping	
VLAN Reprioritization		
Time Synchronization	Entry Source VLAN ID Target VLAN ID	
Frame Preemption	0 100 200	Delete
Scheduled Traffic - Assign Queue	1 450 1	Delete
Scheduled Traffic - Set Queue Max. SDU	2 1000 2000	Delete
Scheduled Traffic - Schedule	Add	
LLDP Configuration		
Firmware Update		
Port0 Port1 Port2 Port3 Port4 Port5		

Figure 44. VLAN Remapping Page – Candidate View – Adding Entries for Port 2

VLAN Remapping	
	инова, ил
Home	Use this page to remap the VLAN IDs at each port
Setup	
Port Statistics	Candidate Running Startup
Port Configuration	
GPIO and Timer Configuration	
Switching Table	Port: Port 2 🗸
VLAN Table	Enable remapping
VLAN Remapping	
VLAN Reprioritization	Entry Source VLAN ID Target VLAN ID
Time Synchronization	0 100 200
Frame Preemption	1 450 1
Scheduled Traffic - Assign Queue	2 1000 2000
Scheduled Traffic - Set Queue Max. SDU	
Scheduled Traffic - Schedule	
LLDP Configuration	
Firmware Update	

Figure 45. VLAN Remapping Page – Running View – Displays Entries for Port 2

### VLAN REPRIORITIZATION

As shown in Figure 46, the VLAN Reprioritization page gives user ability to remap the priority of the VLAN traffic on a port basis. There is a **Candidate**, **Running**, and **Startup** view for these pages. There is no status page for VLAN Reprioritization.

All configuration happens in the **Candidate** page. To select a different priority for a VLAN ID, select the port of interest, enable prioritization on that port by enabling the **Enable Reprioritization** check box, then select the appropriate remapping IDs, use the

individual **Save** buttons or the main page **Save** button to save the changes to the web server and click the **Commit** button to load the changes to the device. When the **Commit** button is clicked, the changes are loaded and the web server automatically changes to show the **Running** view, where user can confirm programmed changes are applied.

The **Discard** button allows user to revert changes in the **Candidate** field, by copying the running configuration back to the **Candidate**.

VLAN Reprioritization Version 2.1.0 Copyright 2020 - 2023 Analog D	evices, Inc.						ADI Chronous"
11	Use this page to co	nfigure RX que	ues for specific VL	AN priorities			
Home							
Setup	Candidate Runn	ing Startup	Commit Discard				
Port Statistics							
Port Configuration							
GPIO and Timer Configuration	Save						
Switching Table	Jano						
VLAN Table	Por	t0	Por	rt 1	Por	t 2	
/LAN Remapping	Enable Reprioritizatio	n 🗖	Enable Reprioritization	on 🛄	Enable Reprioritizatio	n 🗌	
/LAN Reprioritization	VLAN Priority	Remap priority to	D: VLAN Priority	Remap priority to:	VLAN Priority	Remap priority	y to:
ime Synchronization		1		0 ¥	1	1	▼
Frame Preemption		2		2 ¥	2	2	<b>▼</b>
Scheduled Traffic - Assign Queue	3	3	3	3 ¥	3	3	· •
Scheduled Traffic - Set Queue Max. SDU	4	4 🗸	4	4 🗸	4	4	$\overline{\mathbf{v}}$
Scheduled Traffic - Schedule	5	5 🗸	5	5 🗸	5	5	<b>~</b>
		6 🗸	6	6 🗸	6	6	<b>~</b>
		7 🗸	7	7 🗸	7	7	<b>▼</b>
Firmware Opuate	Save port 0		Save port 1		Save port 2		
	Por	t3	Por	rt4	Por	t 5	
	Enable Reprioritizatio	n 🗌	Enable Reprioritization	on 🗹	Enable Reprioritizatio	n 🗹	
ort0 Port1 Port2 Port3 Port4 Port5	VLAN Priority	Remap priority to	o: VLAN Priority	Remap priority to	VLAN Priority	Remap priority	y to:
		0 🗸	0	0 🗸	0	0	<b>∽</b>
		1 🗸	1	1 🗸	1	2	<u>~</u>
		2 🗸	2	6 🗸	2	2	<u>~</u>
		3 🗸	3	5 🗸	3	5	<b>×</b>
	4	4 🗸	4	4 🗸	4	2	<b>×</b>
	5	5 🗸	5	5 🗸	5	1	× I
	8	• •	8	• <b>v</b>	6	0	Ť
		· •	· · · · · ·	/ <b>v</b>	· · · ·	/	×

Figure 46. VLAN Reprioritization Page – Candidate View

VLAN Reprioritization	1						ANALOG	ADI Chronous
Version 2.1.0 Copyright 2020 - 2023 Analog D	levices, Inc.						F MHATS POSSIBLEY	SCALABLE CTHERNET THED TO PEPED
	lles this nan	e to confi	aure DY que	ee for enecific VI	N priorities			
Home	use uns pag	e to com	guie na quei	ies for specific ver	an priorities			
Setup								
Port Statistics	Candidate	Running	Startup					
Port Configuration								
GPIO and Timer Configuration								
Switching Table		Port 0		Port	1	Port	2	
VLAN Table	Enable Repri	oritization		Enable Reprioritizatio	n 📃	Enable Reprioritization	•	
VLAN Remapping	VLAN Priority	/ R	emap priority to:	VLAN Priority	Remap priority to	: VLAN Priority	Remap prior	ty to:
VLAN Reprioritization	0		) 🗸	0	0 ~	0	0	<u>~</u>
Time Synchronization	1			1	1 🗸	1	1	
Frame Preemption	2			2	2 •	2	3	×
Scheduled Traffic - Assign Queue	4			Å	4 *	4	4	Č.
- Scheduled Traffic - Set Queue Max. SDU	5	Ē	5 <b>v</b>	5	5 🗸	5	5	~
Scheduled Traffic - Schedule			6 🗸	6	6 🗸	6	6	~
LDP Configuration		Ī	7 🗸	7	7 🗸	7	7	~
Firmware Undate		Port 3		Port	4	Port	5	
	Enable Repri	oritization		Enable Reprioritizatio	n 🗹	Enable Reprioritization		
	VLAN Priority	/ R	emap priority to:	VLAN Priority	Remap priority to	: VLAN Priority	Remap prior	ty to:
			) 🗸	0	0 ~	0	0	~
ort0 Port1 Port2 Port3 Port4 Port5	1			1	1 🗸	1	2	~
	2			2	6 V	2	2	Ň
	3			3	5 V 4 V	3	2	×
	4		· ·	5	5 *	5	1	
	6	6	i v	6	6 ×	6	6	×
		6	7 🖌	7	7 ~	7	7	~

Figure 47. VLAN Reprioritization Page – Running View

VLAN Reprioritization	n				Þ	ANALOG	ADI Chronous
Version 2.1.0 Copyright 2020 - 2023 Analog	Devices, Inc.				ALEAD (	F MINTS POSSIBLE*	MARE CHERNET THED TO POR
Home	Use this page to c	onfigure RX qu	eues for specific	VLAN priorities			
Setup							
Port Statistics	Candidate Run	ning Startup					
Port Configuration							
GPIO and Timer Configuration							
Switching Table	P	ort 0		Port 1	Port	2	
VLAN Table	Enable Reprioritiza	ion 🔲	Enable Reprioritiz	zation	Enable Reprioritization		
VLAN Remapping	VLAN Priority	Remap priority	to: VLAN Priority	Remap priority to:	VLAN Priority	Remap priority	to:
VLAN Reprioritization		0	0	0 🗸	0	0 1	<u> </u>
Time Synchronization	1	1 ,		1 🗸	1	1 1	4
Frame Preemption	2	2	2	2 🗸	2	2	
Scheduled Traffic - Assign Queue	3	3	3	<u> </u>	3		
Scheduled Traffic - Set Queue Max. SDU	5	5	5	5 ×	5	5	
Scheduled Traffic - Schedule	6	6 1	6	6 🗸	6	6	
LLDP Configuration		7	7	7 🗸	7	7	
Firmware Undate	P	ort 3		Port 4	Port	5	
	Enable Reprioritiza	ion 🔲	Enable Reprioritiz	zation	Enable Reprioritization		
	VLAN Priority	Remap priority	to: VLAN Priority	Remap priority to:	VLAN Priority	Remap priority	to:
	0	0 1	0	0 🗸	0	0	4
Port 0 Port 1 Port 2 Port 3 Port 4 Port 5	1	1 1	1		1	1	
	2	3	2	3	3	3	
	4	4	4	4 *	4	4	
	5	5 .	5	5 🗸	5	5	A     A
		6 •	6	6 🗸	6	6 •	4
		7	/ 7	7 🗸	7	7	<ul> <li>Image: A set of the set of the</li></ul>

Figure 48. VLAN Reprioritization Page – Startup View

The Switch supports IEEE 802.1AS 2020 Time Synchronization. As shown in Figure 25 or Figure 26, click **Time Synchronization** in the menu item on the **Home** page or in the menu on the left of the page to access the **Time Synchronization** pages.

By default, when the web server runs, the PTP stack running on the Switch is automatically enabled with one instance, Domain 0, and PTP is enabled for all ports using the instance-specific peer-to-peer delay mechanism. The instance-specific peer-to-peer delay mechanism supports backward compatibility with IEEE802.1AS 2011.

# CANDIDATE PAGE

The **Candidate** page provides user ability to modify the operation of the PTP instance or add additional instances. Any changes must be saved and then committed. When changes are successfully committed, the **Running** page appears and shows the updated configuration. If an update is unsuccessful, a pop-up appears that shows the user update failed, and the **Running** page displays the last successful configuration.



Figure 49. Time Synchronization Candidate Page – Update Unsuccessful

### **PTP CONFIGURATION**

The PTP stack supports up to 4 PTP instances. By default, one instance, Domain 0, is enabled for all 6 ports.

As shown in Figure 50, the page shows the mapping of PTP ports to Link Port Numbers. In the IEEE802.1AS standard, the Port assignment starts with Port 1. The web server Time Synchronization Port numbering aligns with this, but elsewhere in the web server, the port number starts at Port 0.

	. 10 Com									
Status Ca	indidate	Running	Startup	Commit	Discard					
Cauca										
Save										
PTP Coning	uration :									
PTP Instant	20	Instance	Туре		Clock Identity	Hardware Clo	ok Dom	ain number Numbe	of PTP Ports	Remo
0	DTD			_						
	PIP	Relay Inst	ance (AS)	▼ 7A-C6-	EE-11-11-11-00-0	TIMER A	▼ 0	6	~	Dele
Add Instan	ce	Relay Inst	ance (AS)	✓ 7A-C6-	EE-11-11-11-00-0	TIMER A	♥ 0	6	~	Dele
Add Instan nstance Co Clock Instan	ce onfigurati ce : Insta	Relay Inst	ance (AS)	✓ 7A-C6-	EE-11-11-11-00-0	TIMER A	▼ 0	6	~	Dele
Add Instan nstance Co Clock Instan Aapping PTP	onfigurati ce : Insta Ports :	nce 0 🗸	ance (AS)	▼ 7A-C6-	EE-11-11-11-00-0	TIMER A	•	6	~	Dele
Add Instan nstance Co Clock Instan Apping PTP PTP Port Nur	e : Insta Ports :	Relay Inst ion : nce 0 🗸	ance (AS)	▼ 7A-C6-	EE-11-11-11-00-0	TIMER A	•	6	v	Dele
Add Instan nstance Co Clock Instan Apping PTP PTP Port Num Port 1	e : Insta Ports : nber Link P Port	Relay Inst on : nce 0 🗸 ort Number 1 🖌	ance (AS)	✓ 7A-C6-	EE-11-11-11-00-0	TIMER A	•	6	~	Dele
Add Instan nstance Co Clock Instan Apping PTP PTP Port Num Port 1 Port 2	Ports : Ports : Ports : Port Port	Relay Inst on : nce 0 🗸 ort Number 1 🖌	ance (AS)	✓ 7A-C6-	EE-11-11-11-00-0	TIMER A	•	6	~	Dele
Add Instan nstance Co Clock Instan Apping PTP PTP Port Nur Port 1 Port 2 Port 3	ce : Insta ports : ports : port Port Port Port Port Port	Relay Inst on : nce 0 V fort Number 1 V 2 V 3 V	ance (AS)	✓ 7A-C6-	EE-11-11-01-00-00	TIMER A	~ 0	6	~	Dele
Add Instan nstance Co Clock Instan Mapping PTP PTP Port Num Port 1 Port 2 Port 2 Port 3 Port 4	e : Insta ce : Insta Ports : nber Link P Port Port Port Port Port Port	Relay Inst.	ance (AS)	✓ 7A-C6-	EE-11-11-00-00	IMER A	• 0	6	~	Dele
Add Instan nstance Co Clock Instan Apping PTP PTP Port Num Port 1 Port 2 Port 3 Port 4 Port 5	Ports : Ports : Ports Port Port Port Port Port Port Port	Relay Inst.	ance (AS)	✓ 7A-C6-	EE-11-11-11-00-0	TIMER A	• 0	6	~	Dele

Figure 50. Time Synchronization Candidate Page – PTP Configuration

**Traffic Priority**: By default, PTP messages go into the highest priority transmit queue which is queue 7. The queue that PTP messages use for each port can be changed via the corresponding **Transmit Priority** fields, see Figure 51. Using MRP with the fastest Recovery profiles may motivate the user to make changes to the priority of PTP messaging.

### Priorities

The default behavior for the enabled instance has Priority1 and Priority2 values set to 248. Priority values are among the parameters used as part of the best timeTransmitter clock algorithm (BTCA).

Lower values in the **Priority1** or **Priority2** fields, increase the chance that device becomes the Grandmaster. A service in a TSN network should not try to claim Grandmaster functionality unless it is by design. A typical Grandmaster is a node with a time normal receiver, a global positioning system (GPS) receiver, or an atomic clock. In industrial automation, an infrastructure Switch or a controller can cover Grandmaster functions. The priority value range is 0 to 255.

	aher value is hi	inter priority)		
Port 1	7	,		
Port 2	7			
Port 3	7			
Port 4	7			
Port 5	7			
Port 6	7			

Figure 51. Time Synchronization Candidate Page – Traffic Priority and Default Dataset

### PORT CONFIGURATION

The **Port Configuration**, shown in Figure 53. provides ability to configure various parameters associated with the PTP instance per port. The web server provides ability to change each individual port individually with the **PTP Port Number** drop-down menu, as shown in Figure 52. When changing port configuration, remember the port numbering for PTP is offset by one.

PTP Port Number :	Port 1 🗸	
	Port 1	1
Port Dataset :	Port 2	
	Port 3	
Port Enable Delay	Port 4	Anno
CMLD	Port 5	•
	Port 6	F
Mean Link In	itial Log	1-22-11
Mean Link In Delay Thresh Ar	itial Log mounce	Initia Sync I

Figure 52. Time Synchronization Candidate Page – Port Configuration per Port Selection



Figure 53. Time Synchronization Candidate Page – Port Configuration

Time Synchronization		ANALOG DEVICES	ADI Chronous
Version 3.0.0 Copyright 2020 - 2024 Analog De	moee, inc.	NEM OF MAINS POSSILE*	SOULARE CHARACT THEO TO POSTCORE
	Use this page to configure the Time Synchronization (802.1AS)		
Home			
Setup	Status Candidate Running Status Commit Discard		
Port Statistics			
Port Configuration			
GPIO and Timer Configuration	Sava		
Switching Table			
VLAN Table	PTP Configuration :		
VLAN Remapping	PTP Instance Instance Type Clock Identity Hardware Clock Domain number Number	er of PTP Ports Rem	
VLAN Reprioritization	0 PTP Relay Instance (AS) ▼ 7A-C6-EE-11-11-11-00-00 TIMER A ▼ 0 6	✓ Dele	te
Time Synchronization	Add Instance		
Frame Preemption			
Scheduled Traffic - Assign Queue	Instance Configuration :		
Scheduled Traffic - Set Queue Max. SDU	Clock Instance : Instance 0 V		
Scheduled Traffic - Schedule			
LLDP Configuration	Mapping PTP Ports :		
MRP Configuration	PTP Part Number Link Part Number		
Firmware Update	Port 1 Port 1 V		
	Port 2 Port 2 V		
	Port 3 Port 3 V		
	Port 4 Port 4 V		
Port0 Port1 Port2 Port3 Port4 Port5	Part 5 V		
	Port 6 V		
	Traffic Priority:		
	Link Port Transmit Priority		
	Port 1 7		
	Port 2 7		
	Port 3 7		
	Port 4 7		
	Port 5 7		
	Port 6 7		





Figure 55. Time Synchronization – Candidate Page (Bottom)

### **Delay Mechanism**

By default, the PTP instance is enabled on all ports with a peer-topeer delay mechanism, which supports backward compatibility to IEEE802.1AS 2011.

If only one time domain is enabled, user has choice of instancespecific peer-to-peer delay mechanism or common mean link delay service (CMLDS). CMLDS provides the mean propagation delay and neighbor rate ratio to all active domains.

For any PTP instance with a domain number that is not zero, CMLDS is enabled. Attempting to enable the instance-specific peer-to-peer delay mechanism on any one instance with a domain number that is not zero is not accepted. The update is rejected and the **Running** page shows the previous successful update.

To synchronize with devices running IEEE802.1AS 2020 and to add additional PTP instances, change the delay mechanism for the relevant ports to CMLDS.

### **Interval Times**

This section of web page gives user ability to adjust the interval messaging for Sync, Announce and Peer Delay request messages.

Changing interval settings can result in improved tuned application behavior of the synchronized clocks. For example, lowering the sync interval (to a smaller value) can improve the precision of the synchronization.

#### Table 10. Port Delay Message Options

Parameter	Description	Value Range	Default
Log Pdelay_Req Interval	The interval of peer delay requests sent from the timeReceiver to the timeTransmitter.	+5 to -5	0 (1 sec)
Log Sync Interval	The interval of sync messages sent out by the timeTransmitter.	+5 to −5	−3 (125 ms)
Log Announce Interval	The interval in which the timeTransmitter announces its leadership.	+5 to −5	0 (1 sec)

The interval time is given in log2 values, as the 802.1AS standard suggests:

$$t_{INTERVAL} = 1e9 \times 2^{\log 2INTERVAL} \tag{1}$$

#### Table 11. Interval Time Setting

Log2	tinterval
-5	31.25 ms
-4	62.5 ms
-3	125 ms
-2	250 ms
-1	500 ms
0	1 sec
+1	2 sec
+2	4 sec
+3	8 sec
+4	16 sec
+5	32 sec

Within the range specified, users can make changes to any of these values.

# Mean Link Threshold

The mean link threshold defaults to 800 ns. If using an Ethernet tap inline with the time aware link or attempting to synchronize over a

10BASE-T1L link, larger threshold values are required. In event the link delay is in excess of the programmed threshold, devices are not able to synchronize.

### **COMMON SERVICES**

Figure 56 shows the configuration for **Common Mean Link Delay Service**. This section only applies when using CMLDS as the **Delay Mechanism** (selected from the drop-down in the **Port Dataset** view).

Note that the clock identity for common services differs from the PTP instance Clock identity.

# Egress/Ingress Latency

The Egress/Ingress Latency values shown are specific to the Ethernet physical layer device (PHY). These are hardware dependent parameters based on the PHYs used. The default values shown in the web page are based on the ADIN1300 PHYs that are connected over RGMII interface to the Switch on the EVAL-ADIN6310EBZ hardware.

The RGMII latencies based on the ADIN1300 configuration are listed in Table 12. For Link Port 2 to Port 6, the ADIN1300 Rx/ Ingress latency defaults to the lowest latency mode when the cable length is estimated to be <100 m (CDIAG\_CBL\_LEN\_EST (0xBA25)) and the PHY MSE (mean squared error) is <14 on all four dimensions (MSE\_A (0x8402), MSE\_B (0x8403), MSE\_C (0x8404), and MSE\_D (0x8405)).

When Link Port 1 (Physical port 0) is used as the Host interface, the PHY is treated as unmanaged, therefore the ingress/egress latency for that port always shows the higher Ingress latency of 226 ns.

Table 12. ADIN1300 PHY RGMII Actual Rx/Tx Delay/Latency

Speed	Tx/Egress	Rx/Ingress	Comment
1000 Mbps	68 ns	178 ns	Low Latency mode when cable length <100 m or MSE values <14.
1000 Mbps	68 ns	226 ns	Standard latency mode when cable length >100 m or MSE values >14.
100 Mbps	92 ns	250 ns	Standard latency mode.
10 Mbps	124 ns	250 ns	Standard latency mode.

Common Services :										
Link Port Number : Port 1 Clock Identity : 7A-C6-BB	► -11-11-11-FF-FF									
Common Mean Link Delay Serv	rice :									
Delay Asymmetry 0										
Mean Link Initial Log M Delay Thresh Pdelay Req Pd (ns) Interval	Use Mgt Mgt Log Log Ielay Req Pdelay Interval Req Interval	Initial Use Mgt Compute Compute Rate Rate Ratio Ratio	Mgt I Compute Co Rate M Ratio C	Initial Use Mgt ompute Compute Mean Mean Link Link Delay	Mgt Compute Mean Link Delay	Allowed Lost Responses	Allowed Faults	Asymmetry Measurement Mode	Egress Latency (ns)	Ingress Latency (ns)
800 0 0		Image:			<b>V</b>	9	9		68	226

Figure 56. Time Synchronization Candidate Page – Common Services

### **PTP INSTANCES**

To add an additional instance, click the **Add Instance** button, as shown in Figure 57. Another row appears on the web page with different **Clock Identity**, **Hardware Clock**, and **Domain number**.



Figure 57. Time Synchronization Candidate Page – Adding a Second Instance

Select the number of ports with which this instance should be used. By default, only one is selected. Configure any specific other parameters associated with this instance. When more than one instance is configured, the delay mechanism CMLDS is automatically used. To remove an instance, in the **Remove** area, click the **Delete** button.



Figure 58. Time Synchronization with Two Instances

Status Can	didate Ru	nning Startı	p Commi	t Discard				
Save								
TP Configur	ation :							
DTD lastance		etana Turo		Cleak Identify	Lineburge Clea	k Domain m	mbor Number et	DTD Darks Domo
0	PTP Rel	av Instance (/	S) ¥ 74.0	6-FF-11-11-11-00-		<b>×</b> 0	6	Y Delet
	DTD Del	ay Instance (/	S) M 7A C	C EE 11 11 11 00		1	6	M Delet
Add Inchases	1 17 Rei	ay materice (a	(0) • TA-0	0-22-11-11-00-	THEE RONNING		5	<ul> <li>Delet</li> </ul>
Add Instance								
nstance Con	figuration	:						
Clock Instance	: Instance	1 🗸						
basing DTD D	and a s							
apping rirri	ль.							
PTP Port Numb	er Link Port I	Number						
Port 1	Port 1	~						
Port 2	Port 2	~						
Port 3	Port 3	~						
Port 4	Port 4	~						
Port 5	Port 5	~						

Figure 59. Time Synchronization Candidate Page – Adding a Second Instance for All 6-Ports

### HARDWARE CLOCK

The Switch supports two hardware clocks (TIMER A and TIMER B) and a free running clock. Currently only **TIMER A** and **FREE RUNNING** options are available. By default, the first instance is configured with **TIMER A**. When a second instance is added, it runs from the **FREE RUNNING** clock automatically.

### EXTERNAL PORT CONFIG

The External Port configuration enable is used where user does not want to use BTCA to decide who is Grandmaster in the network. Instead, user configures each device and port accordingly. The External Port Config Enable is used in conjunction with the External Port Config Desired state drop-down.

	iet :							
Instance En	ble External Port Co	nfig Enable Prio 248	rity1 Priority 248	12				
Port Config	mbe Port 1 v	1						
Port Dataset		-•						
Port Enable	Delay Mechanism	Announce Receip	t Timeout Delay	Asymmetry Log	Sync Interval Log	Announce Inter	al External Port Config Des	sired state
Mean Link D Thresh (n:	CMLDS Option V elay Initial Log Announce Interval	Announce Receip 3 Initial Log Sync Interval	sync Receipt	Asymmetry Log nitial Log Pdelay Req Interval	Sync Interval Log 3 Mgt Log Pdelay Reg Interval	Announce Inter 0 Initial Log Gpt Cap Interval	al External Port Config Des Disabled Disabled Master Passive	sired state

Figure 60. Time Synchronization Candidate Page – External Port Config Enable

Figure 61 shows an example where the first Switch is configured to be Grandmaster by configuring all its ports with timeTransmitter as the desired state. The following applies to Switch 2 and Switch 3. The **External Port Config Desired state** for the ports connected to Switch 1 is configured as **timeReceiver** and all other ports as **timeTransmitter**.



Figure 61. Time Synchronization Example for External Port Config

# STATUS PAGE

As shown in Figure 62, the **Status** page provides insight into the current status of PTP instances and indicates whether the device is synchronized.

The status information is available per configured instance, showing information such as who is Grandmaster.

The remaining parameters displayed are those defined by IEE 802.1AS and provide information regarding the operation of the time synchronization.

The following parameters are displayed for each port in the **Port Configuration > Port Dataset**:

- Port State: which is either timeTransmitter, timeReceiver, or Disabled.
- Mean Link Delay (ns): Measured the link delay across the cable.
- ► AS Capable: Which is either Enable or Disable.

The **Status** page also shows the detailed Port Statistics for the PTP instance, such as counts for PTP messaging, see Figure 64 and Figure 65 for CMLDS dataset (only shows valid information if CMLDS is active).



Figure 62. Time Synchronization Status Page – PTP Instance Configuration

Port Con	figuration :																	
Port Datas	et :																	
Port Numi	er Clock Identity	Port	State	Mean Link (	Delay (ns)	) Is Measurir	ng Delay	As Cap	able	One Step Tx	Oper	One Step Recei	ive	One Step Transm	nit	Sync Locked		
1	7A-C6-BB-11-11-11-00-00	Disabled	~	0		Disable	~	Disable	~	Disable	~	Disable	~	Disable	~	Disable	-	
2	7A-C6-BB-11-11-11-00-00	Slave	~	45		Enable	~	Enable	~	Disable	~	Disable	~	Disable	~	Enable	~	
3	7A-C6-BB-11-11-11-00-00	Master	~	61		Enable	~	Enable	~	Disable	~	Disable	~	Disable	~	Enable	~	
4	7A-C6-BB-11-11-11-00-00	Master	~	42		Enable	~	Enable	~	Disable	~	Disable	~	Disable	~	Enable	~	
5	7A-C6-BB-11-11-11-00-00	Disabled	~	0		Disable	~	Disable	~	Disable	~	Disable	~	Disable	~	Disable	~	
6	7A-C6-BB-11-11-11-00-00	Disabled	~	0		Disable	~	Disable	~	Disable	~	Disable	~	Disable	~	Disable	~	
Port lumber	Sync Receipt Timeout Interval	(ns)	Neighbor Ra (PPN	ate Ratio I)	Current	Log Announce nterval	Current I	Log Sync Interv	al Currer	t Log Pdelay Rec Interval	l Cuu	rent Log Gptp Cap Interval	Cu	rrent Compute Rate Ratio	C	urrent Compute Mean Link Delay	Curr	ľ
	0		0		0		-3		0		0		1		1		0	i
	374996992		-1		0		-3		0		0		1		1		0	l
	0		-1		0		-3		0		0		1		1		0	
	0		-1		0		-3		0		0		1		1		0	i
5	0		0		0		-3		0		0		1		1		0	l
ð	0		0		0		-3		0		0		1		1		0	l
ort Numi	er Pdelay Truncated Timestamps	T1 Pde	elay Truncated	Timestamp	s T2	Pdelay Truncat	ted Timesta	amps T3 Pd	lelay Trunc	ated Timestamps	T4							
1	0	0			0			0										
2	95127147380736	1683	38039804313	36	1	68385301577	728	951	32056420	)352								
3	102991182692352	1762	24442870169	96	1	76249270960	128	102	9960324	37424								
4	78742978035712	1519	99624383692	28	1	52000940146	688	787	4768050	5856								
5	0	0			0			0										
6	0	0			0			0										

Figure 63. Time Synchronization Status Page – Port Configuration Dataset

Port Stati	istic	s Dataset :										
Port Num	nber	Sync Receipt Timeout Cou	nt	Announce Receipt Tim	eout Count	Pdelay Allowed Lo	st Exceeded Count					
1		0		0		0						
2		0		0		0						
3		0		0		0						
4		0		0		0						
5		0		0		0						
6		0		0		0						
Port Numbe	r	Rx Sync Count	Rx (	One Step Sync Count	Rx Foll	ow Up Count	Rx Pdelay Rec	q Count	Rx Pdelay Resp Count	Rx Pdelay Resp Follow Up Count	Rx Announce Count	Rx Packet Discard Count
1		0	0		0		0		0	0	0	1379
2	1	162	0		162		21		20	20	21	1315
3	Т	0	0		0		21		20	20	0	1315
4	Π	0	0		0		20		21	21	0	1345
5	T	0	0		0		0		0	0	0	0
6	Π	0	0		0		0		0	0	0	0
Port Num	nber	Tx Sync Count	Tx	One Step Sync Count	Tx Fo	llow Up Count	Tx Pdelay Re	eq Count	Tx Pdelay Resp Count	Tx Pdelay Resp Follow Up Cou	unt Tx Announce Count	
1		0	0		0		1380		0	0	0	
2		5	0		5		1337		21	21	1	
3		150	0		150		1337		21	21	20	
4		153	0		153		1369		20	20	20	
5		0	0		0		0		0	0	0	
6		0	0		0		0	-/	0	0	0	

Figure 64. Time Synchronization Status Page – Port Statistics Dataset

Commo	n Services Port Dataset :								
Cmids	Link Port Port Number								
1									
2									
3									
4									
5									
6									
Comm	on Mean Link Delay Servic	e :							
Default	Dataset :								
	Clock Identity Number	Link Ports							
7A-CE	-BB-11-11-11-FF-FF 6								
Link Po	rt Dataset :								
									Asymmetry
Numbe	r Clock Identity	Number Mean Link	Delay (ns) Scaled Neighbor Rate Ratio	Cmlds Link Port Enabled	Is Measuring Delay	As Capable Across Domains	Use Mgt Log Polelay Req Interval	Use Mgt Compute Rate Use Ratio	Link Delay Measurement
1	7A-C6-BB-11-11-11-FF-FF	0 0	0	•	•	•	•	•	• •
2	7A-C6-BB-11-11-11-FF-FF	0 0	0	•	•	•	•	•	
3	7A-C6-BB-11-11-11-FF-FF	0 0	0	•	•	•	•	•	•
4	7A-C6-BB-11-11-11-FF-FF	0 0	0	•	•	•	•	•	• •
5	7A-C6-BB-11-11-11-FF-FF	0 0	0		-	•			
6	7A-C6-BB-11-11-11-FF-FF	0 0	0		<b>_</b>				
Port Numb	Mean Link Delay Initial Log er Thresh (ns) Interval	g Current Log Mg eq Pdelay Req R	t Log Pdelay Initial Compute Con Req Interval Rate Ratio	Current Mgt Compute I npute Rate Rate Ratio M Ratio	nitial Compute Current lean Link Delay Mean Li	Compute ink Delay Delay	Allowed Lost Allow Responses Faul	red Egress Latency (ns) ts	Ingress Latency (ns)
1	800 0	0	0 1 1	1	1 1	1	9 9	68	226
2	800 0	0	0 1 1	1	1 1	1	9 9	68	178
3	800 0	0	0 1 1	1	1 1	1	9 9	68	178
4	800 0	0	0 1 1	1	1 1	1	9 9	68	178
5	800 0	0	0 1 1	1	1 1	1	9 9	68	226
6	800 0	0	0 1 1	1	1 1	1	9 9	68	226
Port Nu	mber Pdelay Truncated Timesta	amps T1 Pdelay Trunc	cated Timestamps T2 Pdelay 1	Truncated Timestamps T3	Pdelay Truncated Time	stamps T4			
1	0	0	0		0				
2	0	0	0		0				
3	0	0	0		0				
4	0	0	0		0				
6	0	0	0		0				
0	0	0	U		0				
Port Sta	tistics Dataset :								
Port Numb	ar Rx Pdelay Req Count	Rx Pdelay Resp Co	unt Rx Pdelay Resp Follow Count	Up Rx Packet Discard	Count Pdelay Allow	ed Lost Exceeded - Count	Tx Pdelay Req Count	Tx Pdelay Resp Count	Tx Pdelay Resp Follow Up Count
1	0	0	0	0	0	0		0	0
2	0	0	0	0	0	0		0	0
3	0	0	0	0	0	0		0	0
4	0	0	0	0	0	0		0	0
		0	0						

Figure 65. Time Synchronization Status Page – Common Mean Link Delay Service Dataset and Statistics (Returns Information if CMLDS is Enabled)

### TIME SYNC MESSAGING

Using an Ethernet Tap between two Time Aware devices with just one instances enabled, user can view the gPTP messaging.

Figure 66 shows an example of the messaging between two devices with the default Time Sync parameters. The messaging intervals can be modified through the **Candidate** web page.

	15 *DEE*	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	10 Appounce Message
Ť	16 0 000125840	70100100111111117	LIDP MUTT		86 Signalling Message
<b>+</b>	17 0.000281936	7a:c6:bb:11:11:17	LLDP Multicast	Switch 1 💈	80 Peer Delay Reg Message
	18 0.000470950	7a:c6:bb:22:22:23	1.1.1.1.	Curitals 2 2	80 Peer Delay Resp Message
	19 0.000601606	7a:c6:bb:22:22:23	LLDP Multicast	Switch Z	80 Reen Delay Resp Follow Up Message
	20 0.018074222	7a:c6:bb:22:22:23	LLDP Multicast	PTPv2	8 Signalling Message
<b>▲</b>	21 0.018225094	7a:c6:bb:22:22:23	LLDP Multicast	PTPv2	80 Peer Delay Reg Message
	22 0.018423352	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	80 Peer Delay Resp Message
	23 0.018552824	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	8 The Bring Follow Up Message
	24 0.120146160	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	71 Sync Message
	25 0.120482816	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	102 Follow Up Message
	26 0.245146224	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	72 Sync Message
	27 0.245482912	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	102 Follow Up Message
econd intervals	28 0.370146296	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	72 Sync Message
nnounce	29.0.370482952	7a:c6:bb:11:11:17	LLDP_Multicast	PTPv2	102 Follow Up Message
Palau Part	30 0.495146360	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	72 Sync Message
er_Delay_Req)	31 0.495483032	7a:c6:bb:11:11:17	LLDP_Multicast	PTPv2	102 Follow Un Message
	32 0 620146424	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	72 Sync Message
	33 0 620483096	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	102 Follow Un Message
	34 0 745146472	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	72 Sync Message
	35 0.745483152	7a+c6+bb+11+11+17	LLDP_Multicast	PTPv2	102 Follow Up Message
	36 0.870146568	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	72 Sync Message
	37 0.870483224	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	102 Follow Un Message
	38 0 995146720	7a:c6:bb:11:11:17	LLDP_Multicast	PTPv2	72 Sync Message
	30 0.005483384	7a:c6:bb:11:11:17	LLDP_Multicast	PTPv2	102 Follow Un Message
+	40 0.99999984	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	102 Appounce Message
+	41 1 000125312	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	86 Signalling Message
	42 1.000280936	7a:c6:bb:11:11:17	LLDP_Multicast	PTPv2	8 Peer Delay Ren Message
	43 1.000473702	7a:c6:bb:22:22:23	LLDP_Multicast	PTPv2	Ri Peer Delay Resp Message
	44 1.000603445	7a+c6+bb+22+22+23	LLDP_Multicast	PTPv2	8 Peer Delay Resp Follow Un Message
	45 1.018069654	7a:c6:bb:22:22:23	LLDP_Multicast	PTPv2	86 Signalling Message
*	46 1.018220414	7a:c6:bb:22:22:23	LLDP_Multicast	PTPv2	80 Peer Delay Reg Message
	47 1.018415744	7a:c6:bb:11:11:17	LLDP_Multicast	PTPv2	80 Peer Delay Resp Message
	48 1.018545888	7a:c6:bb:11:11:17	LLDP_Multicast	PTPv2	80 Peer Delay Resp Follow Un Message
SVNC Message	49 1 120147192	7a:c6:bb:11:11:17	LLDP_Multicast	PTPv2	72 Sync Message
on to Message	50 1.120484248	7a:c6:bb:11:11:17	LLDP_Multicast	PTPv2	102 Follow Un Message
125ms intervals 🕴	51 1,245147249	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	72 Sync Message
	52 1.245484328	7a:c6:bb:11:11:17	LLDP_Multicast	PTPv2	102 Follow Un Message
	53 1.370147376	7a:c6:bb:11:11:17	LLDP_Multicast	PTPv2	72 Sync Message
	54 1.370484448	7a:c6:bb:11:11:17	LLDP_Multicast	PTPv2	102 Follow Un Message
	55 1.495147376	7a:c6:bb:11:11:17	LLDP Multicast	PTPv2	72 Sync Message
	56 1 495484448	7a:c6:bb:11:11:17	LLDP_Multicast	DTDv2	182 Follow Un Message
	20 7:433404440	10.00.00.00.00.00	FFOL UNITIEDER	FIFV2	TAY LATON OD LESSENC

Figure 66. Time Synchronization View of Messaging through Wireshark Using an Ethernet Tap between Two Devices

### **RUNNING PAGE**

The Running page shows the running configuration on the device.

The fields on this page cannot be edited. Return to the **Candidate** configuration to change configuration.

# STARTUP PAGE

The **Startup** page shows the startup configuration. These parameters are displayed to verify the values of the **Startup** configuration only.

# **TIMER PINS, 1PPS SIGNAL**

The TIMER2 pin is used to provide a 1PPS (one pulse per second) signal. Probing the TIMER2 pin with a logic analyzer shows the 1PPS Time Synchronization pulse, as shown in Figure 67. It is also visible on the evaluation board via the blinking of LED TIMER2.



Figure 67. 1PPS Signal on TIMER2 Pin for Two Switch Boards

# FRAME PREEMPTION

Click Frame Preemption in the menu item on the TSN Switch Evaluation – Home page (see Figure 25) or in the menu on the left of the page to access the Frame Preemption page, as shown in Figure 69. Similar to Time Synchronization, the Frame Preemption page has Status, Candidate, Running, and Startup views.

### CANDIDATE PAGE

To configure the way **Frame Preemption** operates, users can configure each port through the **Candidate** page, see Figure 68.

The following control parameters are provided for each port:

- Preemption Support: Check box to enable or disable the function, default is disabled.
- Ignore Peer Preemption Status: Check box to allow port ignore the peer preemption capabilities. This bypasses the checks for peer preemption. This must be used in conjunction with the Disable Verify Message Transmit.
- Minimum Non-Final Fragment Size (bytes): Provides control of the fragment size, drop-down with choice of 64, 28, 192, or 256 bytes.
- Disable Verify Message Transmit: By default, this check box is cleared, which is the expected operation. Preemption requires that a port sending a verification frame must get a response to

allow frame preemption be enabled. This check box provides ability to disable the verify message if required to force preemption on.

- Verify Message Period (ms): Sets the verify frame transmit retry timer with a range of 1 ms to 128 ms, default 10 ms.
- Express Queues: Defaults to all queued marked as express. Select the required check boxes to enable preemption on that queue. Queues map directly to VLAN priorities.

Once the user has a new candidate configuration, click **Save** button followed by **Commit** button to send the **Candidate** configuration entries to the **Running** configuration. Click **Discard** button to revert the **Candidate** configuration back to current **Running** configuration.

When committing the **Candidate** configuration to the **Running** configuration, the current **Running** configuration saves to a running backup configuration before the **Candidate** configuration saves to the **Running** configuration. The purpose of this save to the running backup configuration is to allow the user to undo the **Commit** action in the event that the committed **Candidate** configuration results in a catastrophic effect on the TSN operation.

The example configuration shown in Figure 68 has Port 5 with preemption enabled and all queues except queue 5 are configured as preemptable.



Figure 68. Frame Preemption – Candidate Page View

# FRAME PREEMPTION

### STATUS PAGE

The Preemption **Status** page is shown in Figure 69. The following status information is provided per port:

- Preemption Active: Reports status check box. Selected indicates active, cleared indicates inactive.
- ▶ Verify Status: Shows state (Initial, Active).
- Peer Supported: Shows whether the peer is capable of Preemption.
- ▶ Peer Enabled: Shows whether the peer has preemption enabled
- ▶ Peer Active: Shows whether the peer has preemption active.
- Hold Advance (nsec): Shows the maximum number of nanoseconds that can elapse between issuing a Hold to the MAC and the MAC ceasing to transmit any preemptable frame that is in the process of transmission or any preemptable frames that are queued for transmission, including any MAC specific delay before transmission of an express frame can start once preemptable frame transmission has ceased.

- Release Advance (nsec): Shows the maximum number of nanoseconds that can elapse between issuing a Release to the MAC and the MAC being ready to resume transmission of preemptable frames, in the absence of there being any express frames available for transmission.
- Preemption Statistics: Provides overview of the various statistics associated with Transmit and Receive processing:
  - Frame Assembly Error Count
  - Frame SMD Error Count
  - Frame Assembly OK Count
  - Fragment Count Rx
  - Fragment Count Tx
- Hold Count: Associated with use of Hold\_EN with Scheduled Traffic, returns a count of the number of times the HOLD enable transitions from FALSE to TRUE.

Frame Preemption							G AD OF
/ersion 2.1.0 Copyright 2020 - 2023 Analog	Devices, Inc.						ES ADI COFONOL SELEY SON ARE ETHERNET THED TO
	- Use this page to configu	re Frame	preemptior	1			
ome							
etup	Status Candidate R	unning St	artun				
ort Statistics		ining Or	anop				
ort Configuration							
PIO and Timer Configuration							
witching Table		Port 0:	Port 1:	Port 2:	Port 3:	Port 4:	Port 5:
LAN Table	Preemption Active:	_					
LAN Remapping	Verify Status:	initial	initial	initial	initial	initial	initial
LAN Reprioritization	Peer Supported:	-	•		•	•	•
ime Synchronization	Peer Enabled:	-	•	•	•	•	•
rame Preemption	Peer Active:	-					
cheduled Traffic - Assign Queue	Hold Advance (nsec):	1128	10560	1128	1128	1128	1128
cheduled Traffic - Set Queue Max. SDU	Release Advance (nsec):	80	160	80	80	80	80
cheduled Traffic - Schedule	Frame Assembly Error Count	0	0	0	0	0	0
LDP Configuration	Frame SMD Error Count	0	0	0	0	0	0
irmware Undate	Frame Assembly OK Count:	0	0	0	0	0	0
	Fragment Count Rx:	0	0	0	0	0	0
	Fragment Count Tx:	0	0	0	0	0	0
	Hold Count	0	0	0	0	0	0

Figure 69. Frame Preemption Status Page

# FRAME PREEMPTION

# FRAME PREEMPTION EXAMPLE

The following example works through enabling preemption in a configuration with two EVAL-ADIN6310EBZ evaluation boards. Port 3 of Switch 1 is connected to Port 0 of Switch 2.

- The Preemption settings for each device are configured through the individual web pages.
- In Switch 1, Preemption is enabled on Port 3, express and preemptable queues configured accordingly Queue 5 is assigned as the only express queue and all other queues are cleared and therefore preemption can be applied to these queues. Once the

changes are made, then click the **Save** button followed by the **Commit** button to load the settings.

- ▶ In Switch 2, enable Preemption support on Port 0. A transmitting port only sends frames with an SMD-S/C (frames to which preemption has been applied) only after it has been established that the link partner supports preemption and the transmitting port has been instructed to enable preemption on the Tx Queues for this link. LLDP frames are used to exchange capabilities.
- Enabling Preemption in Switch 2 allows preemption to become active as shown in Figure 71.

Frame Preemption															
Frame Freempuon					► ANALO							ECO			
Version 2.1.0 Copyright 2020 - 2023 Analog D	evices, Inc.				AVEAD OF MINTS POSS	RE- SOMME	bES1 <mark>™</mark>					DESZ			
Home	Use this page to configure Fram	ne preen	nption			Enabl	ed	ire Fr	ame preem	otion					
Setup							cu		<b>O</b> 11	Course 1	Discout				
Port Statistics	Status Candidate Running	Startup	Commit	Discard		/		unning	Startup	Commit	Discard				
Port Configuration					/	(									
GPIO and Timer Configuration	Sava									/ E	nabled				
Switching Table	Save				*				¥						
VLAN Table		Port 0:	Port 1:	Port 2:	Port 3:	Port 4:	Port 5:		Port 0	: Port 1:	Port 2:	Port 3:	Port 4:	Port 5:	
VLAN Remapping	Preemption Support:								<u> </u>						
VLAN Reprioritization	Ignore Peer Preemption State:							te:	0.4.0						
Time Synchronization	Minimum Non-Final Fragment Size (bytes)	64	✔ 64	✔ 64	✔ 64	♥ 64	✓ 64	nt Size	(oytes) 04	♥ 04	♥ 04	♥ 04	♥ 04	• 04	×
Frame Preemption	Disable Verify Message Transmit:							BITHL	10	10	10	10	10	10	-
Scheduled Traffic - Assign Queue	Verify Message Period (ms):	10	10	10	10	10	10		10	10	10	10	10	10	
Scheduled Traffic - Set Queue Max. SDU	Express Queues:								Q0: 🗹						
Scheduled Traffic - Schedule	(	20: 🗹							Q1: 🗹						
LLDP Configuration	(	21: 🗹							Q2: 🗹						
Firmware Update	(	22: 🗹							Q3: 🗹						
		23: 🗹							Q4: 🗹						
		24: 🗹							Q5; 🗸						
		25: 🗹							Q6: 🗸	~				<b>V</b>	
Port0 Port1 Port2 Port3 Port4 Port5		26: 🗹							Q7: 🗹						
		27: 🗹	2	2		<b>Z</b>	<b>Z</b>								

Figure 70. Candidate Page View to Enable and Configure Preemption

Frame Preemption						NALOG						
Version 2.1.0 Copyright 2020 - 2023 Analog	Devices, Inc.				AVEAD OF 1	EVICES	SCALABLE ETHERNET THED TO PO	S". Sfecten				
					S	ES1			SE	:52		
	Use this page to configur	e Frame	preemptior	ı —					ire Frame p	reemptio	n	
Home					Active							
Setup	Status Candidate Ru	nnina S	lartuo						unning Sta	rtup		
Port Statistics											Active	
Port Configuration											/ 1001/0	
GPIO and Timer Configuration					+							
Switching Table		Port 0:	Port 1:	Port 2:	Port 3:	Port 4:	Port 5:		Port 0:	Port 1:	Port 2:	P
VLAN Table	Preemption Active:	-										
VLAN Remapping	Verify Status:	initial	initial	initial	success	initial	initial		success	initial	initial	_ ii
VLAN Reprioritization	Peer Supported:	•										
Time Synchronization	Peer Enabled:						•					
Frame Preemption	Peer Active:											
Scheduled Traffic - Assian Queue	Hold Advance (nsec):	1128	1128	1128	1128	1128	1128		1128	1128	1128	1
Scheduled Traffic - Set Queue Max. SDU	Release Advance (nsec):	80	80	80	80	80	80		80	80	80	8
Scheduled Traffic - Schedule	Frame Assembly Error Count	0	0	0	0	0	0		ıt 0	0	0	0
	Frame SMD Error Count:	0	0	0	0	0	0		0	0	0	0
Econ consignation	Frame Assembly OK Count:	0	0	0	0	0	0 Stat	istics	5685867	0	0	0
Parimare Opdate	Fragment Count Rx:	0	0	0	0	0	0		2577	0	0	0
	Fragment Count Tx:	0	0	0	2577	0	0		0	0	0	0
	Hold Count:	0	0	0	0	0	0		0	0	0	0
Port 0 Port 1 Port 2 Port 3 Port 4 Port 5												

Figure 71. Status View with Preemption Enabled and visibility into Statistics

Configuration of Scheduled Traffic is done on three main pages: Scheduled Traffic – Assign Queue, Scheduled Traffic – Set Queue Max SDU, and Scheduled Traffic – Schedule (see Figure 72).

Click **Scheduled Traffic – Assign Queue** menu item on the Home page or in the menu on the left of the page to start configuration, this opens the **Candidate** view, as shown in Figure 73.

	Frame Freempuon	
,t	Scheduled Traffic - Assign Queue	
re	Scheduled Traffic - Set Queue Max. SDU	
t	Scheduled Traffic - Schedule	

Figure 72. Scheduled Traffic Pages

# **ASSIGNING QUEUES**

Traffic is scheduled on a TSN network using VLAN Priority. By assigning **VLAN Priority** to an Ethernet message, that message can be assigned to a queue in the Switch hardware. There are 8 queues in this hardware and any of the 8 VLAN Priorities can be assigned to any of the queues.

By default, PTP and LLDP traffic has been designated to go into **Q7**, therefore **Q7** must be enabled for at least 10  $\mu$ s to provide bandwidth for time synchronization messages.

**Q0** is designated **best effort**, untagged traffic is forced to this queue.

The **Candidate** page is used to map **VLAN Priority** to a queue. Click the white dot under a queue corresponding to the required **VLAN Priority**. The default mapping is, for example, **Q0** to **VLAN Priority** 0, **Q1** to **VLAN Priority** 1.

In Figure 73, the configuration for Port 1 has been remapped to the following, by clicking Q0 for VLAN Priority 0 and 1, Q1 for VLAN Priority 2 and 3, Q2 for VLAN Priority 4 and 5, Q3 for VLAN Priority 6 and 7. Click the Save button followed by Commit button to send assignments to the Running configuration. Click the Discard button to revert to current Running configuration. Click the **Running** button to display the current **Running** configuration. This is shown in Figure 74 for the Queue Assignment Running page.

Click the **Startup** button to display the configuration of the **Startup** configuration. This is shown in Figure 75 for the Queue Assignment Startup page.

Scheduled Traffic - As	ssign Que	ue										ANALO	g /	DI Chronous
Version 2.1.0 Copyright 2020 - 2023 Analog D	levices, Inc.											AHEAD OF MENTS POS	100 F	ALLE CTHERNET THED TO PEPEE
me	Use this pag	je to con	figure the r	napping	of VLAN	priorities	s to the	e avai	ilable qu	eues for al	l ports			
atup				_	_	_								
rt Statistics	Candidate	Running	g Startup	Com	nit Disca	ard								
rt Configuration														
- PIO and Timer Configuration														
vitching Table	Save													
AN Table														
AN Remapping		Por	t0	09.07		P(	ort 1	04.0	E 08 07		Por	t2	E 09 0	7
AN Reprioritization	ULAN Phon 0				0		0 0			0				
ne Synchronization		001			1	00		Č.		1	00			
me Preemption			0 0 0 0		2	••	0.0	•		2	••	0000		
heduled Traffic - Assign Queue		•••	• • • •	••	3	••	• •	•	•••	3	•••	• • • •		
aduled Traffic - Set Overe May SDU	4		••••		4	•••	00	2		4	•••	000		
	5				5		<u> </u>	23		5				
	7				7			2		0 7				
DP Configuration			42		· ·			0.		· ·				<u>'</u>
mware Update	VI AN Priorit	v 00 01 0	13 02 03 04 05	5 06 07	VI AN Priori	ity 00 01	02.03	04.0	5 06 07	VI AN Priori	ty 00 01 0	1 0 2 03 04 0	5 06 0	7]
		001			0	0.0				0	0.0			
		001			1	00				1	00			
			0 0 0 0		2		0.0	0.0		2		0 0 0 0		
Port1 Port2 Port3 Port4 Port5			• • • •	•••	3	••	00	•		3	•••	•••		
		•••	• • • •	••	4	••	• •	0 (		4	• •	•••		
			• • • •	••	5	••	••	•	••	5	••	•••		
		•••		00	6	••	••	•		6	•••			
	7			00	7	•••	••	0.0		7	• •			

Figure 73. Scheduled Traffic – Queue Assignment Candidate Page

Scheduled Traffic - As	ssign Que	ue									ANALO	G ADI Chro	
Version 2.1.0 Copyright 2020 - 2023 Analog D	Devices, Inc.											ILEY SOMALE CHERKET IN	TIOUS
	llee this nam	e to config	ure the m	annin		oriorities (	o the s	wailahl	e au	euee for all i	norte		
Home	ose uns pag	c to comi	jure are ma	abbini	JOITEAN	prioritica	o une e	avanabi	c qu		porta		
Setup													
Port Statistics	Candidate	Running	Startup										
Port Configuration													
GPIO and Timer Configuration													
Switching Table													
VLAN Table		Port (	,			Por	1				Port 2		
VLAN Remapping	VLAN Priority	00 01 02	Q3 Q4 Q5 (	26 Q7	VLAN Prior	ity Q0 Q1 Q	2 03 0	4 0.5 0.6	Q7	VLAN Priority	Q0 Q1 Q2 Q3 Q4 Q	Q6 Q7	
VLAN Reprioritization		•••	$\bullet \bullet \bullet$	••	0	• • •			•	0	$\circ \bullet \bullet \bullet \bullet \bullet$		
Time Synchronization		• • •	•••	••	1	• •			•	1	• • • • •		
Frame Preemption					2					2	0		
Scheduled Traffic - Assign Queue	4				4					4			
Scheduled Traffic - Set Queue Max. SDU				••	5		ŏ			5			
Scheduled Traffic - Schedule				•	6				•	6		0.0	
LLDP Configuration	7	$\bullet \bullet \bullet$	$\bullet \bullet \bullet$	• •	7				۲	7	$\bullet \bullet \bullet \bullet \bullet \bullet$	$\bullet \bullet \bullet$	
Firmware Update		Port 3	;		1	Por	4				Port 5		
	VLAN Priority	00 01 02	Q3 Q4 Q5 (	26 Q7	VLAN Prior	ity Q0 Q1 Q	2 03 0	4 0.5 0.6	07	VLAN Priority	Q0 Q1 Q2 Q3 Q4 Q	Q3 Q7	
	1				1					1			
	2				2					2			
Port0 Port1 Port2 Port3 Port4 Port5			0	••	3				•	3		••	
			• • •	••	4				٠	4			
		•••	• • •	• •	5	• • •		00	٠	5			
			•••	•	6	• • •			٠	6		0 0	
	7			• •	7				0	7			

Figure 74. Scheduled Traffic – Queue Assignment Running Page

Scheduled Traffic - As	ssign Queue		
Version 2.1.0 Copyright 2020 - 2023 Analog D	evices, Inc.		AREAD OF MARES POSSIBLE* SOLVALE CTHEMET THED TO POPERTIEN
	Use this page to configure the mappin	n of VI AN priorities to the available or	eues for all ports
Home			
Setup	Constitute Dispring Starting		
Port Statistics	Gandidate Running Startup		
Port Configuration			
GPIO and Timer Configuration			
Switching Table			
VLAN Table	Port 0	Port 1	Port 2
VLAN Remapping	VLAN Priority Q0 Q1 Q2 Q3 Q4 Q5 Q6 Q7	VLAN Priority Q0 Q1 Q2 Q3 Q4 Q5 Q6 Q7	VLAN Priority Q0 Q1 Q2 Q3 Q4 Q5 Q8 Q7
VLAN Reprioritization	0 0 0 0 0 0 0 0 0		
Time Synchronization	1 0000000	1 0000000	1 0000000
Frame Preemption	2	2 0 0 0 0 0 0	2 0 0 0 0 0 0
Scheduled Traffic - Assign Queue		3 0 0 0 0 0 0	
Scheduled Traffic - Set Oueue May, SDU	5		
Scheduled Traffic - Schedule	6	6	
	7	7	7
	Port 3	Port 4	Port 5
Pirmware Opdate	VLAN Priority Q0 Q1 Q2 Q3 Q4 Q5 Q6 Q7	VLAN Priority Q0 Q1 Q2 Q3 Q4 Q5 Q6 Q7	VLAN Priority Q0 Q1 Q2 Q3 Q4 Q5 Q6 Q7
	0 0 0 0 0 0 0 0 0	• • • • • • • • •	
	1 000000		
Part 0 Part 1 Part 2 Part 2 Part 4 Part 5	2 0 0 0 0 0 0	2 0 0 0 0 0 0	2 0 0 0 0 0 0
FOILD FOILT FOIL2 FOILS FOIL4 FOIL3	3 0 0 0 0 0 0	3 0 0 0 0 0 0 0	3 0 0 0 0 0 0
	4 0 0 0 0 0	4 0 0 0 0 0 0	
		5 0 0 0 0	
		7	

Figure 75. Scheduled Traffic – Queue Assignment Startup Page

### SCHEDULED TRAFFIC – SET QUEUE MAX. SDU

This page provides ability to adjust the service data unit (SDU) size of the frames allowed to egress per queue per port. The web server startup default setting is 1536 bytes, while the hardware defaults to 10,000 bytes. Adjusting the SDU size allows the user to fine tune the timing of the scheduled traffic. These values only need to be adjusted if the user knows precisely how they want to configure the timing. QueueMaxSDU does not include MAC addresses or FCS (QueueMaxSDU = Frame Size – 16 bytes).

The Queue Max. SDU **Candidate** page (see Figure 76) has a **Max. SDU [bytes]** field that can be defined for each of the 8 queues per port. Use this page to edit to the SDU byte sizes, by changing the values. Click the **Save** button and then click the **Commit** button to load the new values. To return to the previously used parameters, click the **Discard** button.

When using Scheduled traffic with guard bands enabled, the guard band calculation uses the Max. SDU value to determine the duration of guard band to implement.

Note that Queue Max. SDU limits only apply to traffic forwarding in Store and Forward mode. When the Switch is cutting frames through, the frame has already started to egress before the frame size is known.

Similar to the other pages, there are **Candidate**, **Running**, and **Startup** views.

Scheudieu Hanne - Serv	Queue Max	(. SDU						ANALOG	
/ersion 2.1.0 Copyright 2020 - 2023 Analog Device	es, Inc.							ALEAD OF MENTS POSSILE*	SOLVELE ETHERNET THE
ome	Use this page to o	onfigure the	maximum	SDU transmis	sion size for t	the ports			
tup									
ort Statistics	Status Candida	ate Running	Startup	Commit D	scard				
ort Configuration									
PIO and Timer Configuration									
vitching Table	Save	Dort 0	Dout 4	Devi 2	Devi 2	Dort 4	Deed 5		
AN Table	Max. SDU [bytes]	Port U	Port 1	Port 2	Port 3	Port 4	Porto		
AN Remapping	Queue o	1530	1530	1536	1530	1530	1530	-	
AN Reprioritization	Queue 1	1530	1530	1536	1530	1530	1536	-	
me Synchronization	Queue 2	1530	1530	1536	1550	1530	1530	-	
ame Preemption	Queue 5	1530	1530	1536	1530	1530	1530	-	
heduled Traffic - Assign Queue	Queue 4	1530	1530	1530	1530	1530	1530	-	
heduled Traffic - Set Queue Max. SDU	Queue 6	1536	1536	1536	1536	1536	1536		
heduled Traffic - Schedule	Queue 7	1536	1536	1536	1536	1536	1536	-	
DP Configuration	queuer	1550	1330	1000	1550	1550	1550		

Figure 76. Scheduled Traffic – Queue Max. SDU Candidate Page

Scheduled Traffic - Se	et Queue Max	. SDU						ANALOG	
Version 2.1.0 Copyright 2020 - 2023 Analog D	evices, Inc.							AHEAD OF MAKES POSSIBLE*	SCN AGLE CTHERNET THED TO PERFECTION
Liama	Use this page to c	onfigure the	maximum S	DU transmiss	sion size for t	he ports			
Satura									
Port Statistics	Status Candida	e Running	Startup						
Port Configuration									
GPIO and Timer Configuration									
Switching Table	Max. SDU [bytes]	Port 0	Port 1	Port 2	Port 3	Port 4	Port 5		
VLAN Table	Queue 0	1536	1536	1536	1536	1536	1536		
VLAN Remapping	Queue 1	1536	1536	1536	1536	1536	1536		
VLAN Reprioritization	Queue 2	1536	1536	1536	1536	1536	1536	]	
Time Synchronization	Queue 3	1536	1536	1536	1536	1536	1536		
Frame Preemption	Queue 4	1536	1536	1536	1536	1536	1536		
Scheduled Traffic - Assign Queue	Queue 5	1536	1536	1536	1536	1536	1536		
Scheduled Traffic - Set Queue Max, SDU	Queue 6	1536	1536	1536	1536	1536	1536		
Scheduled Traffic - Schedule	Queue 7	1536	1536	1536	1536	1536	1536	1	
LLDP Configuration									
Firmware Undate									
Port0 Port1 Port2 Port3 Port4 Port5									



Scheduled Traffic - Set	t Queue Ma	x. SDU							
Version 2.1.0 Coovright 2020 - 2023 Analog Dev	vices. Inc.							DEVICES	ADI Chron
······································									
	Use this name to	configure the	maximum 9	SDII transmis	sion size for t	the norts			
Home	oac una puge to	comguic die				ine porta			
Setup		-t- Duration	Charles 1						
Port Statistics	Status Candid	ate Running	startup						
Port Configuration									
GPIO and Timer Configuration									
Switching Table	Max. SDU [bytes]	Port 0	Port 1	Port 2	Port 3	Port 4	Port 5		
/LAN Table	Queue 0	1536	1536	1536	1536	1536	1536		
/LAN Remapping	Queue 1	1536	1536	1536	1536	1536	1536		
AAN Reprioritization	Queue 2	1536	1536	1536	1536	1536	1536		
Time Synchronization	Queue 3	1536	1536	1536	1536	1536	1536		
Frame Preemption	Queue 4	1536	1536	1536	1536	1536	1536		
Scheduled Traffic - Assign Queue	Queue 5	1536	1536	1536	1536	1536	1536		
Scheduled Traffic - Set Queue Max, SDU	Queue 6	1536	1536	1536	1536	1536	1536		
cheduled Traffic - Schedule	Queue 7	1536	1536	1536	1536	1536	1536		
rimware update									



As shown in Figure 25 or Figure 26, click the Scheduled Traffic – Schedule menu item on the Home page or in the menu on the left of the page to access the Scheduled Traffic – Schedule pages. The first page that is navigated to is the Scheduled Traffic Candidate page. The Scheduled Traffic Candidate page provides a means to set the gate open events for each of the queues to support 802.1Qbv Scheduled Traffic.

Schedules can be configured on a per port basis. Figure 79 shows the controls for **Port 0** only.

### SCHEDULE ENABLED

To enable a Schedule, select the **Schedule Enabled** check box. Clear to disable scheduled traffic on this port. Note that any schedule must be saved and committed to load it to the device.



Figure 79. Scheduled Traffic Page (Showing Port 0 Only)

### **GUARD BANDS**

As shown in Figure 79, two check boxes (**Guard Band Gate Event** and **Guard Band Hold Event**) are associated with Guard band capability. The Switch supports automatic insertion of guard bands when these check boxes are enabled.

Guard bands are used with scheduled traffic to protect transmission of the schedule gate open times. Consider the scenario shown in Figure 80 where no guard bands are used. An Ethernet port that has started transmission of a frame must complete transmitting that frame before another transmission can start. Consider a scenario where a new frame transmission starts just before the end of the first cycle, with a frame size too large to complete before the second cycle is due to begin, this results in a delayed start of the second cycle. The impact of this is that potentially lower priority traffic can be infringing on the start of time critical time slice, meaning real-time frames delays, which impact the application requirements.

Scheduled traffic can use guard bands in front of every time slice that carries time critical traffic. During the guard band duration, no new Ethernet transmissions can be started, only ongoing transmissions can complete. The duration of the guard band is sized for as long as it takes the maximum frame size to safely transmit.

When the **Guard Band Gate Event** check box is enabled, the Switch automatically inserts a guard band between the step that has the gate open for a traffic class and the step that has the gate closed. The length of the guard band is the product of the QueueMaxSDU value of the queue associated with the gate and the current link speed. The guard band time value is subtracted from the gate close time. This ensures that the start of the time slots do not get delayed.

As the different queues can have different QueueMaxSDU values, the guard bands for the different queues are calculated accordingly, as shown in Figure 82.

Different QueueMaxSDU values do consume entries in the internal Gate control list. In the event the automatic guard band insertion fails, the driver package reports a return error. Exotic schedules with many different time slots and different QueueMaxSDU values can result in failure of guard bands to be inserted, but the GUI prompts in this event and user can review their schedule and revise accordingly.



Figure 80. Scheduled Traffic Affect of No Guard Band



Figure 81. Scheduled Traffic with Guard Band



Figure 82. Scheduled Traffic with Different Max. SDUs per Queue

When using the evaluation package and PC based web server, the QueueMaxSDU values are set to 1536 bytes per queue per port. With a 1 Gbps link speed, this corresponds to 12.29 µs guard band.

The Switch hardware defaults to QueueMaxSDU setting of 10,000 bytes, therefore, when interfacing directly to the driver from own stack processor, configure the QueueMaxSDU values as required to avoid having excessive guard bands.

The second Guard band check box, **Guard Band Hold Event** is only relevant where Scheduled traffic and Frame preemption co-exist and the **Hold En** check box in the gate control list is enabled. When **Guard Band Hold Event** is enabled, a guard band of hold advance length is inserted between the step that has the Hold\_En signal asserted and the previous step and the release advance length is inserted between the steps where the Hold\_En signal transitions from asserted to deasserted. The value of hold advance can be seen in the **Frame Preemption Status** page and vary depending on the speed of the link established.



Figure 83. Guard Band Hold Event – Hold Advance and Release Advance

Table 13. Hold Advance,	Release	Advance	(1	Gbps	;)
-------------------------	---------	---------	----	------	----

Fragment Size	Hold Advance (ns)	Release Advance
64	1128	80
128	1640	80
192	2152	80
256	2664	80

Tuble 14: Hold Ad	Table 14. Hold Havanoe, Release Havanoe (100 mbpo)									
Fragment Size	Hold Advance (ns)	Release Advance								
64	10560	160								
128	15680	160								
192	20800	160								
256	25920	160								

Table 14 Hold Advance Release Advance (100 Mbns)

In all cases, for guard bands to be successfully inserted, the Port link must be up, as the speed of the established link is part of the calculation to determine the guard band duration required.

Note that the guard bands do rely on the Switch operating in Store and Forward mode. When the Switch cuts through traffic, frames egress an empty port before the frame size is known, therefore a frame larger than the Max. SDU setting can egress and the start of a time slot can be delayed in this scenario.

When a schedule has been saved and committed, confirm that the schedule is accepted by viewing the **Running** page. If the **Running** page does not show what is loaded, then there is an issue with the loaded schedule.

#### CYCLE TIME

The next controls available in Figure 79 are related to the **Cycle Time** for scheduled traffic. The first check box is the **Cycle Time Numerator**, the second is the **Cycle Time Denominator** expressed in seconds. The ratio of the cycle time numerator and denominator must be an integer multiple of 1 ns. Values that do not result in integer multiples of 1 ns are not loaded to the device, with the schedule being rejected. If an invalid cycle time is entered, when a user clicks the **Save** button, followed by the **Commit** button, if the schedule is not accepted, the **Running** page is not updated. The default values in the web page of 1/1000 results in a cycle time of 1 ms.

#### BASE TIME

The **Base Time** value is the absolute time at which a new schedule is required to take effect. A new schedule takes effect at the programmed base time. If the base time is in the past, then the Switch takes the base time for the new schedule and projects forward based on the new schedule cycle times to get past the current time and apply the new schedule at the next new cycle boundary.

#### **CYCLE TIME EXTENSION**

The **Cycle Time Extension** value defines the maximum amount of time by which the old cycle for the port is permitted to be extended when Switching to a new schedule. When changing from an old schedule to a new schedule, without cycle time extension, the new cycle can result in a partial or runt cycle of the old schedule directly before the transition to the new cycle, as shown in Figure 84.

Using the **Cycle Time Extension** ensures a more seamless transition between schedules. Now instead of a partial old schedule, the last valid cycle is extended with the old schedule gate states being

retained until the new schedule is implemented at the programmed base time, thereby, bridging the Switchover between the two schedules, as shown in Figure 85.

BASE TIME (OLD SCHEDULE)	BASE (NEW SCI	TIME HEDULE)		
NETWORK CYCLE (OI (OLD SCHEDULE) (OI CURRENT TIME	TWORK CYCLE NLD SCHEDULE) CYCLETIME	NETWORK CYCLE (NEW SCHEDULE)	NETWORK CYCLE (NEW SCHEDULE)	

Figure 84. Schedule Switchover with no Cycle Time Extension Setting

BASE (OLD SCH	TIME (EDULE)		BASE (NEW SC	TIME HEDULE)		
ļ						
{	NETWORK CYCLE (OLD SCHEDULE)	NETWORK CY (OLD SCHEDU	CLE	NETWORK CYCLE (NEW SCHEDULE)	NETWORK CYCLE (NEW SCHEDULE)	)
	CYCLE TIME	CURRENT TIME	CYCLE TIME EXTENSION			8

Figure 85. Schedule Switchover with Cycle Time Extension Setting

### GATE STATES WHEN DISABLED

These check boxes only apply to the gates after a schedule has been disabled.

# **CUT-THROUGH ALLOWED**

The Switch operates in cut-through mode by default. To configure queues per port to Store and Forward mode, clear the corresponding check box, click **Save** button followed by **Commit** button. This functionality does not require a valid schedule to be running. Note that guard bands do rely on the Switch operating in Store and Forward mode. When the Switch cuts-through traffic, frames egress an empty port before the frame size is known, therefore, a frame larger than the Max. SDU setting can egress and the start of a time slot can be delayed in this scenario.

# GATE CONTROL LIST, TIME INTERVALS

The Switch supports a gate control list of 32 entries per port through the driver. By default, the web page displays 8 entries, but it is possible to extend this to 32 entries per port. When the last time interval has a value entered into the **Interval [ns]** field, the web page automatically increases the number of entries displayed. The last entry always needs to be 0 ns.



Figure 86. Adding Additional GCL Entries

Next to the time interval entries are **Gate State** check boxes for each of the 8 queues. The gate state corresponds to Queue number, with lowest priority on the right. When a box is selected, the gate for that queue is open from the completion of the last time slot for the duration specified in the entry field. If a check box is not selected the gate, for that queue is closed for that duration. Up to 8 entries (Entry 0 to 7) can be entered for the queues by default, the web server allows additional fields to be added. These entries make up a queue's **Gate Control List**. The entries are relative, meaning they are additive from the previous entry. Entry 0 is from Time = 0, so entering a value of 100000 ns means the gate control value for the first entry is from 0  $\mu$ s to 100  $\mu$ s. Entering 100000 ns in Entry 1 means that gate control value starts at 100000 ns with 100000 ns duration, so finish at 200000 ns or 200  $\mu$ s.

For queues that are checked for Entry 0, their gate opens at the start of the cycle. For queues that are checked for Entry 1, their gate opens at 100  $\mu$ s. For any entry where a queue is not checked, those queues have their gates closed at that entry duration. For example, if Q0, Q1, Q2, and Q3 are all checked and 100000 ns is entered at Entry 0, all 4 queues open at 0  $\mu$ s. The Entry 1 Gate States become active at 100  $\mu$ s. Then, if Q0 and Q1 are checked, Q2 and Q3 are unchecked, and 100000 ns is entered at Entry 1, Q0 and Q1 continue to have their gates open for another 100  $\mu$ s and Q2 and Q3 have their gates closed. And at Entry 2 closes the

gates for Q0 and Q1 if their queues are not checked. This is shown in Figure 87.

Note that gPTP and LLDP messages use Queue7 by default, therefore Gate 7 must always be open for some duration of the cycle.



Figure 87. Simplified Schedule

Schedules with time entry intervals in excess of the programmed cycle time are accepted, but the duration and gate states in excess of the cycle time are ignored.

### HOLD EN

There is an additional check box shown adjacent to the **Gate State**. This check box provides the ability to enable **Hold EN** for each entry. This feature can be enabled when Scheduled traffic and frame preemption are used in combination. When **Hold EN** is enabled for a time slot, no preemptable traffic is allowed to start egressing the port in that window.



Figure 88. Hold EN Control

#### **CANDIDATE PAGE**

The default page is the **Candidate** tab, see Figure 89, where user can configure the schedule for each port individually. It is also possible to configure a schedule for the hardware Timer pins. Once the user has a new set of values for the **Candidate** configuration, click the **Save** button, followed by **Commit** button to send the **Candidate** configuration entries to the **Running** configuration. Click **Discard** button to revert the **Candidate** configuration back to current **Running** configuration.

When committing the **Candidate** configuration to the **Running** configuration, the current **Running** configuration saves to a running backup configuration before the **Candidate** configuration saves to the **Running** configuration. The purpose of this save to the running backup configuration is to allow the user to undo the **Commit** action in the event that the committed **Candidate** configuration results in a catastrophic effect on the TSN operation.

Use this page to configure IEEE 802.1Qbv (Scheduled	l Traffic)		
Onter Conditate Durates Onter Course	Discuss		
Status Candidate Running Stanup Commit	Discard		
Saw			
<ol> <li>Note:</li> <li>The ratio of the cycle time numerator and denominator must be</li> </ol>	an integer multiple of 1ns.		
<ol> <li>Entry 0 sets the gate states at the start of the cycle and its inte 3. An entry interval must be zero, if there are no following entries.</li> </ol>	val gives the delay until the Entry 1 gate states take effect, and so on. or at least 8 ns.		
4. The Timers[3:0] in the 'External timers' table are enabled/disab	led based on the mode configured in the 'GPIO and Timers Configuration	n' page.	
Port 0	Port 1	Port 2	
Schedule Enabled	Schedule Enabled	Schedule Enabled	
Guard Band Gate Event	Guard Band Gate Event	Guard Band Gate Event	
Guard Band Hold Event	Guard Band Hold Event	Guard Band Hold Event	
Cycle Time Numerator 1	s Cycle Time Numerator 1 s	Cycle Time Numerator 1 s	
Cycle Time Denominator 1000	Cycle Time Denominator 1000	Cycle Time Dehominator 1000	
Base Time Seconds	Resea Time Seconde	Cycle Time Extension U ns	
Base Time Nanoeaconde	pr Base Time Nanoseconde 0 s	Base Time Veccrids U S	
Gate States When Disabled 17:01 V V V V V V V V	Gate States When Disabled [7:0] VVVVV	Gate States When Disabled [7:0]	
Cut-Through Allowed [7:0]	Cut-Through Allowed [7:0]	Cut-Through Allowed [7:0]	
Entry Interval [ns] Hold En Gate State [7:0]	Entry Interval [ns] Hold En Gate State [7:0]	Entry Interval [ns] Hold En Gate State [7:0]	
	0 250000		
1 0	1 250000	1 0	
2 0	2 250000	2 0	
3 0	3 0 • • • • • • • • • • • • • • • • • •	3 0	
4 0	4 0	4 0	
5 0	5 0 • • • • • • • • • • • •	5 0	
6 0		6 0	
7 0	7 0	7 0	
Clear Time intervals	Clear Time intervals	Clear Time intervals	
Port 3	Port 4	Port 5	External Timere
Schedule Enabled	Schedule Enabled	Schedule Enabled	Schedule Enabled
Guard Band Gate Event	Guard Band Gate Event	Guard Band Gate Event	Cycle Time Numerator 1 s
Cycle Time Numerator		Guard Barld Hold Event	Cycle Time Denominator 1000
Cycle Time Numerator	e II Curde Time Numerator 1	Cucle Time Numerator	Outle Time Extension 0
Cycle Time Denominator 1000	s Cycle Time Numerator 1 s	Cycle Time Numerator 1 s	Cycle Time Extension 0 ns
Cycle Time Denominator 1000 Cycle Time Extension 0	s Cycle Time Numerator 1 s Cycle Time Denominator 1000 rs Cycle Time Extension 0 rs	Cycle Time Numerator 1 s Cycle Time Denominator 1000 Cycle Time Extension 0 ns	Cycle Time Extension         0         ns           Base Time Seconds         0         s           Base Time Nanoseconds         0         ns
Cycle Time Denominator         1000           Cycle Time Extension         0           Base Time Seconds         0	s Cycle Time Numerator 1 s Cycle Time Denominator 1000 ns Cycle Time Extension 0 ns Base Time Scoords 0 s	Cycle Time Numerator 1 s Cycle Time Denominator 1000 Cycle Time Extension 0 ns Base Time Seconds 0 s	Cycle Time Extension 0 ns Base Time Seconds 0 s Base Time Nanoseconds ns Timers States When Disabled (5:0) 2 2 2 2
Cycle Time Denominator 1000 Cycle Time Extension 0 Base Time Seconds 0 Base Time Nanoseconds 0	Cycle Time Numerator         1         s           Cycle Time Denominator         10000         ns           ns         Cycle Time Extension         0         ns           Base Time Seconds         0         ns         s	Cycle Time Numerator         1         s           Cycle Time Denominator         1000            Cycle Time Extension         0         ns           Base Time Seconds         0         s           Base Time Nanoseconds         0         ns	Cycle Time Extension 0 ns Base Time Seconds 0 s Base Time Nanoseconds 0 ns Timers States When Disabled (3:0) ♥ ♥ ♥ Entry Interval Ind Timers State (3:0)
Cycle Time Denominator         1000           Cycle Time Extension         0           Base Time Seconds         0           Cate States When Disabled [7:0]         2	Cycle Time Numerator         1         s           Cycle Time Denominator         1000         nrs           Cycle Time Extension         0         nrs           Base Time Nanoseconds         0         nrs           Cate States When Disabled [7:0]         2 <td>Cycle Time Numerator         1         s           Cycle Time Denominator         1000         ns           Cycle Time Extension         0         ns           Base Time Seconds         0         s           Gate States When Disabled [7:0]         V</td> <td>Cycle Time Extension 0 ns Base Time Seconds 0 s Base Time Nanoseconds 0 ns Timers States When Disabled [3:0] ✓ ✓ ✓ Entry Interval [ns] Timers State [3:0] 0 0 ✓ ✓ ✓ ✓</td>	Cycle Time Numerator         1         s           Cycle Time Denominator         1000         ns           Cycle Time Extension         0         ns           Base Time Seconds         0         s           Gate States When Disabled [7:0]         V	Cycle Time Extension 0 ns Base Time Seconds 0 s Base Time Nanoseconds 0 ns Timers States When Disabled [3:0] ✓ ✓ ✓ Entry Interval [ns] Timers State [3:0] 0 0 ✓ ✓ ✓ ✓
Cycle Time Denominator         1000           Cycle Time Extension         0           Base Time Seconds         0           Cate States When Desabled [7:0]         2		Cycle Time Numerator         1         s           Cycle Time Denominator         1000         ns           Cycle Time Extension         0         ns           Base Time Nanoseconds         0         s           Gate States When Disabled [7:0]         V	Cycle Time Extension 0 ns Base Time Seconds 0 s Base Time Neaconds 0 ns Timers States When Disabled [3:0] 2 2 2 2 Entry Interval [ns] Timers State [3:0] 0 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
Cycle Time Denominator 1000 Cycle Time Extension 0 Base Time Seconds 0 Gate State When Disabled [7:0] 2 2 2 2 2 2 2 2 2 Cut-Through Allowed [7:0] 2 2 2 2 2 2 2 2 2 2 2 Entry Interval [ns] Hold En Gate State [7:0]	s Cycle Time Numerator 1 s Cycle Time Denominator 1000 ns S Cycle Time Seconds 0 ns Base Time Seconds 0 ns Gate States When Disabiled [7:0] 0 0 0 0 0 0 0 0 Cat Through Newed [7:0] 0 0 0 0 0 0 0 0 0 Entry Interval [ns] Hold En Gate State [7:0]	Cycle Time Numerator 1 s Cycle Time Denominator 1000 Cycle Time Extension 0 ns Base Time Seconds 0 s Base Time Nanoseconds 0 ns Gate States When Disabled (7:0) V V V V V V V Cut Through Allowed (7:0) V V V V V V V V Entry Interval (ns) Hold En Gate State (7:0)	Cycle Time Extension 0 ns Base Time Seconds 0 ss Base Time Mexaconds 0 ns Timers States When Disabled [3:0] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Cycle Time Denominator 1000 Cycle Time Extension 0 Base Time Seconds 0 Base Time Nanoteconds 0 Cut-Through Aloved (7:0) 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	s Cycle Time Numerator 1 s Cycle Time Denominator 1000 nn S Base Time Seconds 0 nn Gate States When Disabled [7:0] V V V V V V Cut-Through Allowed [7:0] V V V V V V V Cut-Through Allowed [7:0] V V V V V V V V 0 0 0 V V V V V V V V V	Cycle Time Numerator 1 s Cycle Time Denominator 1000 Cycle Time Extension 0 ms Base Time Seconds 0 s Base Time Nanoseconds 0 ms Gate States When Disability 7:0 v v v v v v v Cut-Through Allowed (7:0) v v v v v v v v v Cut-Through Allowed (7:0) v v v v v v v v v v v v v v v v v v v	Cycle Time Extension 0 ns Base Time Seconds 0 s Base Time Nanoseconds 0 ns Timers States When Disabled [3:0] V V V Entry Interval (ns) Timers State [3:0] 0 0 V V V 1 0 0 V V V V 2 0 0 V V V V 3 0 V V V V V V V V V V V V V V V V V V
Cycle Time Denominator 1000 Cycle Time Extension 0 Base Time Seconds 0 Gate States When Disabled [7:0] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Cycle Time Numerator         1         s           Cycle Time Denominator         1000           rs         Cycle Time Denominator         0           s         Base Time Saconds         0         s           rs         Base Time Nanoseconds         0         rs           Gale States When Disabled [7:0]         2	Cycle Time Numerator 1 s Cycle Time Denominator 1000 Cycle Time Extension 0 ms Base Time Seconds 0 ns Base Time Seconds 0 ns Gate States When Disabled [7:0] V V V V V V V Cub Through Allowed [7:0] V V V V V V V Entry Interval [ns] Hold En Gate State [7:0] 0 0 V V V V V V V V V V V V 1 0	Cycle Time Extension         0         ns           Base Time Seconds         0         s           Base Time Seconds         0         ns           Timers State When Disabled [3:0]         Image: State [3:0]         Image: State [3:0]           0         0         Image: State [3:0]         Image: State [3:0]           1         0         Image: State [3:0]         Image: State [3:0]           2         0         Image: State [3:0]         Image: State [3:0]           3         Image: State [3:0]         Image: State [3:0]           4         0         Image: State [3:0]         Image: State [3:0]
Cycle Time Denominator 1000 Cycle Time Extension 0 Base Time Seconds 0 Cate States When Disabled [7:0] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	s Cycle Time Denominator 1 standard Cycle Time Denominator 1000 standard Cycle Time Denominator 1000 standard Cycle Time Standard Cycle Time Standard Cycle Time Standard Cycle Time Cycle Time Standard Cycle Time Cycle Ti	Cycle Time Numerator 1 s Cycle Time Denominator 1000 Cycle Time Extension 0 ns Base Time Seconds 0 ns Gate States When Disabled [7:0] V V V V V V Cut-Through Allowed [7:0] V V V V V V V Entry Interval [ns] Hold En Gate State [7:0] 0 0 V V V V V V V V V V 1 0 V V V V V V V V V V V V V V V V V V	Cycle Time Extension 0 rs Base Time Seconds 0 rs Base Time Associated (3:0) 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Cycle Time Extension Cycle Time Extension Base Time Seconds Cate States When Disabled (7:0) C-diffraugh Allowed (7:0) C-diff	s Cycle Time Numerator 1 s Cycle Time Denominator 1000 n Cycle Time Stansion 0 nn s Base Time Saconds 0 nn Cale States When Disabled [7:0] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Cycle Time Numerator 1 s Cycle Time Denominator 1000 Cycle Time Extension 0 ns Base Time Seconds 0 s Base Time Nanoseconds 0 ns Gate States When Disabled (7:0) V V V V V V V Cut Through Allowed (7:0) V V V V V V V V Entry Interval (ns) Hold En Gate State (7:0) 0 0 0 V V V V V V V V V V V 1 0 0 0 V V V V V V V V V V V V V V V V	Cycle Trime Extension Cycle Trime Seconds Base Time Nenconds Base Time Nenconds Timers States When Disabled [3:0] Cycle Trimers States [3:0] Cycle Trimers [3:
Cycle Time Denominator         1000           Cycle Time Extension         0           Base Time Nancesconds         0           Gate States When Desched [7:0]         0         0         0           Cut-Through Allowed [7:0]         0         0         0         0           Entry         Interval [res]         Hold En         Gate State [7:0]         0         0           10         0	Cycle Time Numerator         1         s           Cycle Time Denominator         1000           S         Cycle Time Stemation         0           s         Base Time Seconds         0         ns           s         Base Time Nancesconds         0         ns           Gate States When Disabled [7:0]         2         2         2         2           1         0         2         2         2         2         2           3         0         2	Cycle Time Numerator         1         s           Cycle Time Demoninator         1000         rs           Cycle Time Demoninator         0         ns           Base Time Seconds         0         ns           Base Time Nanotaconds         0         ns           Gate States When Disabled (7:0)         V         V         V         V         V           Cut-Through Allowed [7:0]         V </th <th>Cycle Time Extension Cycle Time Extension Base Time Seconds Base Time Seconds Timers States When Disabled [3:0] Cycle Timers States [3:0] Cycle Timers Timers States [3:0] Cycle Timers States [3:0] Cycle Timers States [3:0] Cycle Timers States [3:0] Cycle Timers Timers States [3:0] Cycle Timers Timers Timers Timers [3:0] Cycle Timers Timers Timers Timers [3:0] Cycle Timers Time</th>	Cycle Time Extension Cycle Time Extension Base Time Seconds Base Time Seconds Timers States When Disabled [3:0] Cycle Timers States [3:0] Cycle Timers Timers States [3:0] Cycle Timers States [3:0] Cycle Timers States [3:0] Cycle Timers States [3:0] Cycle Timers Timers States [3:0] Cycle Timers Timers Timers Timers [3:0] Cycle Timers Timers Timers Timers [3:0] Cycle Timers Time
Cycle Time Denominator         1000           Cycle Time Extension         0           Base Time Seconds         0           Gate States When Disabled [7:0]         2         2         2         2           Cut-Through Allowed [7:0]         2         2         2         2         2         2           Entry         Interval [na]         Hold En         Cate States (7:0)         2         2         2         2         3	Cycle Time Numerator         1         s           Cycle Time Denominator         1000         nrs           Gycle Time Denominator         0         nrs           Base Time Seconds         0         s           ns Base Time Nanoseconds         0         nrs           Gale States When Disabled [7:0]         2         2         2         2           Cult Through Allowed [7:0]         2         2         2         2         2           I         0         0         0         2         <	Cycle Time Numerator 1 s Cycle Time Denominator 1000 Cycle Time Extension 0 ms Base Time Seconds 0 ms Base Time Nanoseconds 0 ms Cathe States When Disabled [7:0] V V V V V V V V Cut-Through Allowed [7:0] V V V V V V V V Cut-Through Allowed [7:0] V V V V V V V V V 1 0 0 V V V V V V V V V V V V V 1 0 0 0 V V V V V V V V V V V V V V V V	Cycle Time Extension Cycle Time Extension Base Time Seconds Content States Content States Content States Content State Content S
Cycle Time Denominator 1000 Cycle Time Statemicin Base Time Statemicin Base Time States When Disabled [7:0]  Cate States When Dis	s Cycle Time Numerator 1 s Cycle Time Denominator 1000 nr Cycle Time Extension 0 nr Base Time Stansion 0 nr Base Time Nancesconds 0 nr Cate States (7:0) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Cycle Time Numerator         1         s           Cycle Time Denominator         1000           Cycle Time Extension         0         ms           Base Time Seconds         0         ms           Base Time Seconds         0         ms           Catls States When Disabled [7:0]         V	Cycle Time Extension Cycle Time Seconds Comment Clear Time Seconds Comment Clear Time intervals Comment Clear Time intervals
Cycle Time Extension         0           Cycle Time Extension         0           Base Time Seconds         0           Cate States When Desabled (7:0)         2         2         2         2           Cultimer Time Time Time Time Time Seconds         0         2 <td< th=""><td>Cycle Time Numerator         1         s           Cycle Time Stansion         1000           Cycle Time Stansion         0         nn           s         Base Time Sconds         0         nn           s         Base Time Nancesconds         0         nn           Cath State When Disable(7:0)         2</td><td>Cycle Time Numerator         1         s           Cycle Time Extension         0         ns           Base Time Seconds         0         ns           Base Time Nanosaconds         0         ns           Gate States When Disabled (7:0)         V         &lt;</td><td>Cycle Time Extension Cycle Time Seconds Base Time Nenconds Base Time Nenconds Base Time Nenconds Comparison Co</td></td<>	Cycle Time Numerator         1         s           Cycle Time Stansion         1000           Cycle Time Stansion         0         nn           s         Base Time Sconds         0         nn           s         Base Time Nancesconds         0         nn           Cath State When Disable(7:0)         2	Cycle Time Numerator         1         s           Cycle Time Extension         0         ns           Base Time Seconds         0         ns           Base Time Nanosaconds         0         ns           Gate States When Disabled (7:0)         V         <	Cycle Time Extension Cycle Time Seconds Base Time Nenconds Base Time Nenconds Base Time Nenconds Comparison Co

Figure 89. Scheduled Traffic – Candidate Page

### **RUNNING PAGE**

Click **Running** to display the **Running** configuration, as shown in Figure 90. The fields on this page cannot be edited. Return to the **Candidate** configuration to change configuration.



Figure 90. Scheduled Traffic – Running Page

### STARTUP PAGE

The **Startup** page displays the **Startup** configuration, see Figure 91. These parameters are displayed to verify the values of the **Startup** configuration only.

Use this page to configure IEEE 802.1Qbv (Scheduled T	raffic)				
Status Candidate Running Startup					
Port 0	Port 1	Port 2			
Schedule Enabled	Schedule Enabled	Schedule Enabled			
Guard Band Gate Event	Guard Band Gate Event	Guard Band Gate Event			
Guard Band Hold Event	Guard Band Hold Event	Guard Band Hold Event			
Cycle Time Numerator 1000	Cycle Time Numerator 1000	Cycle Time Numerator 1000			
Cycle Time Extension 0 no	Cycle Time Denominator 1000	Cycle Time Denominator			
Base Time Seconde 0	Base Time Seconde	Basa Time Seconde			
Base Time Nencesconde	Base Time Nanoseconde 0	Base Time Mencesconde			
Gate States When Disabled [7:0]	Gate States When Disabled [7:0]	Gate States When Disabled [7:0]			
Cut-Through Allowed [7:0]	Cut-Through Allowed [7:0]	Cut-Through Allowed (7:0)			
Entry Interval [ns] Hold En Gate State [7:0]	Entry Interval [ns] Hold En Gate State [7:0]	Entry Interval [ns] Hold En Gate State [7:0]			
2 0	2 0	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			
3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3 0	3 0			
4 0	4 0				
5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			
6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0					
7 0	7 0	7 0			
7 0 Clear Time intervals	7 0 Clear Time intervals	7 0 Clear Time intervals			
7 0 Clear Time Intervals Port 3	7 0 Clear Time Intervals Port 4	7 0 ClearTime Intervals Port 5	External Timers		
7 0 Class Time Intervals Port 3 Schedule Enabled	7 0 Clear Time Intervals Port 4 Schedule Enabled	7 Diser Time Intervals Port 5 Schedule Enabled	External Timers Schedule Enabled		
7 0 ClearTime intervals Port 3 Schedule Enabled Guard Band Cale Event	7 0 Class Time Intervals Fort 4 Schedule Enabled Guard Band Gale Event	7 0 Clean Time Intervals Port 5 Scherdule Enabled Cuard Band Gale Event	External Timere Schwidule Enabled Cycle Time Numerator		
7 Clear Time Intervals  Schedule Enables  Clear Band Gale Cuard Band Idde Event  Cuard Band Idde Event	7 Contract Terret Contract Terret Contract Terret Contract Terret Contract Terret Contract Terret Contract Band Hold Event	7 0 Ports Ports Schedule Event Cuard Band Hold Event Cuard Band Ho	External Timere Schedule Enabled Cycle Time Numerator 1000 s Cycle Time Denominator 1000		
7 Caracteria Intervals Ford 3 Schedule Enabled Guard Band Gale Event Cavard Band Hold Event Cycle Time Numerator	7 Clashing Intervals Pert 4 Scheduls Enabled Gasel Bankled Gasel Bankled Event Gasel Bankled Event Cycle Time Numerator Cycle Time Numerator	7 December and an and a second	External Times Schedule Enabled Cycle Time Numerator Cycle Time Dennisator 1000 Cycle Time Extension		
7 C Clash Time Intervals Fort 3 Schedule Enabled Gaurd Band Gale Event Cuced Band Gale Event Cycle Time Numerator Cycle Time Scheduler (1000 Cycle Time Sche	7 Clash Time Intervals  Port 4 Schedule Enabled Gave Bland Gale Event Cauce Bland Hold Event Cycle Time Numerator 1 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	7 Decision interviewed Parts Schedule Enabled Guard Band Guile Event Cuard Band Hod Event Cuard Band Hod Event Cysto Time Demonshator 1000 Cysto Time Demonshator 1000 Cysto Time Demonshator 1000 Cysto Time Demonshator 100 Cysto Time Dem	External Timers Schedule Enabled Opda Time Numerator Opda Time Seconds Base Time Seconds		
7 Contract C	7 Contract Terretoria	7 0 Cash Time Intervals  Schedule Enabled Cash Band Gale Event Cash Band Hold Event Cash Hold Event Cycle Time Intervals  Cycle Time Extension Cycle Time Ex	External Times Schedule Enabled Oyde Time Denominator Oyde Time Extension Oyde Time Extension Base Time Records O as a Time Re		
7 Carrier Internation	7 Contract International Contract Internation	Contribution and and a set of the Second	External Times Schedule Enabled Cycle Time Numerator Cycle Time Demonstrator Cycle Time Extension Base Time Sconds Base Time Nuncesconds Timers States When Disabled (3:0)		
7 Carl Carl Intervals Port 3 Schedule Enabled Gaurd Band Gate Event Cycle Time Numerator Cycle Time Numerator Cycle Time Scheminin On nin Base Time Scheminin O Base Time Scheminin O Base Time Nunoseconds O Base Time Nunos	7 Contract Time Intervation  Part 4  Schedule Enabled  Cause Band Hold Sevet  Cycle Time Numerator  Cycle Time Rumenator  Cycle Time Rumenator  Cycle Time Rumenator  Base Time Soconds  Contract  C	Cost Time Intervent      Port 5  Schedule Enabled      Cuard Band Solis Event      Cuard Band Hold Event      Cycle Time Rumentor      Cycle Time Rumentor      Cycle Time Rumentor      Cycle Time Rumentor      Base Time Seconds      G      Base Time Rancescords      G      Seader State When      Substrib Mind      Subst	External Times Schedule Enabled Cycle Time Numerator Oycle Time Doministor Oycle Time Extension Oycle Time Extension Cycle Time Scends Base Time Noncends Timers States When Disabled (3.0) Entry Interval (ne) Timers States (3.0) Entry Interval (ne) Timers States (3.0)		
7 Cardina Carabled Cardina Carabled Cardina Carabled Cardina Carabled Cardina Carabled Cardina Carabled Cycle Time Denominator Cycle Time Seconds Base Time Seconds Carable States When Deabled (7:0)	7 Contract Terms Televisor Pert 4 Schedule Enabled Caard Band Hold Event Caard Band Hold Event Cycle Time Numerator Cycle Time Schemator Cycle Time Schemator Cycle Time Schemator Caard Band Cycle Televisor Base Trens Sciences Caard Band Televisor Caard Band Sciences Caard Band Sciences Caard Band Hold Sciences Contract Sciences Caard Band Televisor Caard Band Sciences Caard Band Sciences	7 Contract Interview Pert 3 Schedule Evable Cuard Band Hold Event Cuard Band Hold Event Cuard Band Hold Event Cycle The Devenhabr Cycle The Devenhabr Cycle The Eventemator Cycle These Eventemator Context Ev	External Times Schedule Enabled Cycle Time Numerator Cycle Time Scherolis Cycle Time Extension Base Time Records Base Time Records Base Time Numeraconds Base Times Numeraconds Base Times Numeraconds Base Times Numeraconds Base Times Scherolis Base Times Scherol		
7 Carl Class Trends Internation Class Trends Internation Caurol Band Hold Event Cycle Time Numerator Cycle Time Numerator Cycle Time Selension Cycle	7 Contract Interval Port 4 Count Gate Event Count Time Numerator Cycle Time Sciences Count Time S	Contribution and and a set of the set o	External Times Schedule Enabled Cycle Time Numerator Cycle Time Numerator Cycle Time Denominator 1000 Cycle Time Seconds Comment Base Time Noneseconds Comment States When Disable (3:0) Comment Timers States (3:0) Comment C		
ClassPirmeLintervals      Port 3      Schedulde Enabled     Guard Band Kole Event     Guard Band Kole Event     Cycle Time Denominator     Cycle Time Schemisin     Schedulde Event     Cycle Time Schemisin	7 Concentrations intervals	7 Description of terms of term	External Times Schedule Enubled Cycle Time Numerator Oycle Time Romeniator Oycle Time Extension Cycle Time Extension Cycle Time Extension Cycle Time Extension Cycle Time Scorods Base Time Numerator Base Tim		
7         Clear Time Interval           Ford 3           Schedule Trabled           Caurel Band Hold Event           Cuerd Band Hold Event           Cuerd Band Hold Event           Cycle Time Nonenstate           Cycle Time Nonenstate           Cycle Time Nonenstate           Cycle Time Sciencido           Operative Sciencido           Colspan="2">Colspan="2"           Colspan="2">Colspan="2"           Colspan="2"	2 Contract Intervalor Pert 4 Schedule Enabled Cause Band Cale Event Cause Band Hold Event Cause Cause Cause State Cause Cau	7 Concentrational intervalues Pert 3 Schedule Enabled Caure Band Cale Event Caure Band Kole Event Caure Band Kole Event Caure Band Kole Event Caure Band Kole Event Cale Time Rummarkar Cycle Time Eventation Cycle Time Rummarkar Concentation Con	External Times Cycle Time Numerator (Cycle Time Numerator (Cycle Time Extension Cycle Time Extension Base Time Roomsconds Base Time Roomsconds Comment Base Time Roomsconds Comment Base Time Roomsconds Comment Base		
7 Carl Class Trends Internation Port 3 Scheduke Enabled Caurol Band Cole Event Guard Band Hold Event Guard Band Hold Event Cycle Time Eventematic Cycle Time Eventematic Cycle Time Eventematic Base Time Neurointaitor Cycle Time Eventematic Base Time Neurointaitor Caurol State (7:0) Caurol State (7	7 Contract Interval	Clear Time Intervation      Clear Time Intervation      Clear Band Calls Event      Caurd Band Calls Event      Caurd Band Mod Event      Cycle Time Rummator      Cycle Time Rummator      Cycle Time Standard      Community	External Times Schedule Enabled Cycle Time Numerator Cycle Time Numerator Cycle Time Seconds Code Time Seconds Code Times States When Disable (1-0) Code Timers States (0) Code Timers (0)		
7     Class Times Intervals       Ford 3       Schedulae Enabled       Guard Band Gate Event       Cuard Band Hold Event       Cycle Time Schemanne       Colsspan="2">Colsspan="2"       Colsspan="2"       Colsspan="2" <td colsspan<="" td=""><td>7     Clash Time Interval       Dert 4       Scheduk Enabled       Cavel Bard Med Cavel     Clash Cavel Med Vevel       Cycle Time Numerator     1000       Cycle Time Scheduk     0       Cycle Time Scheduk     0       Base Time Scheduk     0       Cavel Mard Med Cavel     0       Cavel Mard Med Vevel     0       Cavel Mard Med Vevel     0       Cavel Time Numerator     1000       Cavel Mardaeconds     0       Cavel Mardaeconds     0</td><td>7         Case Time character           Port 5         Schedule Enabled           Guard Band Noti Sevent         Guard Band Noti Sevent           Cycle Time Envolvements         1000           Cycle Time Envolvements         1000           Cycle Time Envolvements         0           Base Time Seconds         0           Gains Base Mere Namosconds         0           Cub Risker Med Env         8           Cub Risker Med Envolve         8           2         0           1         0           2         0</td><td>External Times Schedule Enabled Opda Time Numerator Opda Time Dominiator Opda Time Scands Basa Time Nuncesched Bas</td></td>	<td>7     Clash Time Interval       Dert 4       Scheduk Enabled       Cavel Bard Med Cavel     Clash Cavel Med Vevel       Cycle Time Numerator     1000       Cycle Time Scheduk     0       Cycle Time Scheduk     0       Base Time Scheduk     0       Cavel Mard Med Cavel     0       Cavel Mard Med Vevel     0       Cavel Mard Med Vevel     0       Cavel Time Numerator     1000       Cavel Mardaeconds     0       Cavel Mardaeconds     0</td> <td>7         Case Time character           Port 5         Schedule Enabled           Guard Band Noti Sevent         Guard Band Noti Sevent           Cycle Time Envolvements         1000           Cycle Time Envolvements         1000           Cycle Time Envolvements         0           Base Time Seconds         0           Gains Base Mere Namosconds         0           Cub Risker Med Env         8           Cub Risker Med Envolve         8           2         0           1         0           2         0</td> <td>External Times Schedule Enabled Opda Time Numerator Opda Time Dominiator Opda Time Scands Basa Time Nuncesched Bas</td>	7     Clash Time Interval       Dert 4       Scheduk Enabled       Cavel Bard Med Cavel     Clash Cavel Med Vevel       Cycle Time Numerator     1000       Cycle Time Scheduk     0       Cycle Time Scheduk     0       Base Time Scheduk     0       Cavel Mard Med Cavel     0       Cavel Mard Med Vevel     0       Cavel Mard Med Vevel     0       Cavel Time Numerator     1000       Cavel Mardaeconds     0	7         Case Time character           Port 5         Schedule Enabled           Guard Band Noti Sevent         Guard Band Noti Sevent           Cycle Time Envolvements         1000           Cycle Time Envolvements         1000           Cycle Time Envolvements         0           Base Time Seconds         0           Gains Base Mere Namosconds         0           Cub Risker Med Env         8           Cub Risker Med Envolve         8           2         0           1         0           2         0	External Times Schedule Enabled Opda Time Numerator Opda Time Dominiator Opda Time Scands Basa Time Nuncesched Bas	
7     Clear Time Interval       Interval       Clear Time Interval       Courd Band Hold Event     Clear Band Hold Event       Cycle Time Nonematic     1       Cycle Time Seconds     0       Base Time Seconds     0       Cult-Timegh Moned (7:0)     0    C	Constructions instances     Pert 4     Schedule Enabled     Caurd Band Cale Event     Caurd Band Hold Event     Caurd Band Hold Event     Cycle Time Remaining     Cycle Time Remaining     Cycle Time Remaining     Cycle Time Stancescore     Constructions     C	Contract Interview      C	Cycle Trine Numerator  Cycle Trine Numerator  Cycle Trine Numerator  Cycle Trine Extension  Base Trine States When Disables  Base Trine States View Disables  Cycle Trine States View Disables  Cycle Trine States View Disables  Cycle Trine States  Cycle Trine		
7     Class Transmission       Port 3       Scheduke Enabled       Caused Band Hold Event       Guard Band Hold Event       Guard Band Hold Event       Cycle Time Numerator       Opto Time Doministor       Opto Time Dotestord (7:0)       Base Time Numocondo       Base Time Numocondo       Caulo States When Dotabled (7:0)       Opto Time Dotabled (7:0) <td <="" colspan="2" td=""><td>7     Construction interval       Peri 4       Scheduke Enabled       Count diate Enabled       Count diate Enabled       Count diate Enabled       Cycle Time Numerator       Cycle Time Numerator       Cycle Time Sciencian       Cycle Time Enablescond       Base Time Necesconds       Count Truck Necesconds</td><td>Clear Time Intervation      Clear Time Intervation      Clear Band Calls Event      Caurd Band Calls Event      Cuard Band Mod Event      Cycle Time Rumentator      Cycle Time Rumentator      Cycle Time Standard      Common 0      mase Time Kennescords      Canter States      When Distabular      (7:0)      Cuard Band (7:0)      Cuard (</td><td>External Times Schedule Enabled Cycle Time Numerator Cycle Time Numerator Cycle Time Scherakish Cycle Time Scherakish Cycle Time Scherakish Cycle Times Intervalish Cycle Times Inte</td></td>	<td>7     Construction interval       Peri 4       Scheduke Enabled       Count diate Enabled       Count diate Enabled       Count diate Enabled       Cycle Time Numerator       Cycle Time Numerator       Cycle Time Sciencian       Cycle Time Enablescond       Base Time Necesconds       Count Truck Necesconds</td> <td>Clear Time Intervation      Clear Time Intervation      Clear Band Calls Event      Caurd Band Calls Event      Cuard Band Mod Event      Cycle Time Rumentator      Cycle Time Rumentator      Cycle Time Standard      Common 0      mase Time Kennescords      Canter States      When Distabular      (7:0)      Cuard Band (7:0)      Cuard (</td> <td>External Times Schedule Enabled Cycle Time Numerator Cycle Time Numerator Cycle Time Scherakish Cycle Time Scherakish Cycle Time Scherakish Cycle Times Intervalish Cycle Times Inte</td>		7     Construction interval       Peri 4       Scheduke Enabled       Count diate Enabled       Count diate Enabled       Count diate Enabled       Cycle Time Numerator       Cycle Time Numerator       Cycle Time Sciencian       Cycle Time Enablescond       Base Time Necesconds       Count Truck Necesconds	Clear Time Intervation      Clear Time Intervation      Clear Band Calls Event      Caurd Band Calls Event      Cuard Band Mod Event      Cycle Time Rumentator      Cycle Time Rumentator      Cycle Time Standard      Common 0      mase Time Kennescords      Canter States      When Distabular      (7:0)      Cuard Band (7:0)      Cuard (	External Times Schedule Enabled Cycle Time Numerator Cycle Time Numerator Cycle Time Scherakish Cycle Time Scherakish Cycle Time Scherakish Cycle Times Intervalish Cycle Times Inte
7     Clean Time Intervals       Port 3       Schedule Enable Event       Cuard Band Kold Event       Cyclo Time Nomeniator       Cyclo Time Stemation       Cyclo Time Stemator       Colspan="2">Colspan="2">Colspan="2">Cyclo Time Stemator       Colspan="2">Colspan="2">Colspan="2">Cyclo Time Stemator       Colspan="2">Colspan="2">Colspan="2">Cyclo Time Stemator       Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Cyclo Time Stemator       Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2"       Cyclo Time Stemator       Colspan="2"	7     Construction and analysis       Pert 4       Exheck Event       Caurd Bard Kell Sevet     Colspan="2">Colspan="2"       Colspan="2"       Colspan="2" <td <="" colspan="2" td=""><td>7     Contrast of the status       Ports       Bothedue Enabled       Guard Band Able Event     Count Band Able Text       Cycle Time Derrominator     1000       Cycle Time Derrominator     1000       Cycle Time Derrominator     0       Base Time Seconds     0       Base Time Nancesconds     0       Cult State Wench Dabled (7:0)     0       Cult Time Lange (1)     0       Cult Time Seconds     0       Call State Wench Dabled (7:0)     0       0     0       1     0       2     0       3     0       4     0       6     0</td><td>External Times Schedule Enabled Cycle Time Numerator Cycle Time Schedule Cycle Time Sc</td></td>	<td>7     Contrast of the status       Ports       Bothedue Enabled       Guard Band Able Event     Count Band Able Text       Cycle Time Derrominator     1000       Cycle Time Derrominator     1000       Cycle Time Derrominator     0       Base Time Seconds     0       Base Time Nancesconds     0       Cult State Wench Dabled (7:0)     0       Cult Time Lange (1)     0       Cult Time Seconds     0       Call State Wench Dabled (7:0)     0       0     0       1     0       2     0       3     0       4     0       6     0</td> <td>External Times Schedule Enabled Cycle Time Numerator Cycle Time Schedule Cycle Time Sc</td>		7     Contrast of the status       Ports       Bothedue Enabled       Guard Band Able Event     Count Band Able Text       Cycle Time Derrominator     1000       Cycle Time Derrominator     1000       Cycle Time Derrominator     0       Base Time Seconds     0       Base Time Nancesconds     0       Cult State Wench Dabled (7:0)     0       Cult Time Lange (1)     0       Cult Time Seconds     0       Call State Wench Dabled (7:0)     0       0     0       1     0       2     0       3     0       4     0       6     0	External Times Schedule Enabled Cycle Time Numerator Cycle Time Schedule Cycle Time Sc
7     Clear Trans Interval       Interval       Clear Trans Clear Cl	Constructions instances      Pert 4  Schedule Enabled Counce fand Cale Event Counce fand Cale Event Counce fand Hold Event Counce fand Counc	7     Constructions intervalue       Pert 3       Schedulic Enabled       Council Band Add Calle Event       Called Band Mold Scient       Called Band Mold Scient       Cycle Trime Rumerador       Cycle Trime Rumerador       Cycle Trime Extension       Cycle Trime Extension       Colspan="2">Colspan="2"       Colspan="2"       Colspan="2" <td colsp<="" td=""><td>Schedule Enabled       Cycle Time Numerator       Cycle Time Numerator       Opto Time Scherator       Base Time Scherator       Base Time Scherator       Opto Time Vianoscondo       Opto Time Nanoscondo       Opto Time Nanoscondo       Opto Time Nanoscondo       Opto Time Scherator       Opto Time</td></td>	<td>Schedule Enabled       Cycle Time Numerator       Cycle Time Numerator       Opto Time Scherator       Base Time Scherator       Base Time Scherator       Opto Time Vianoscondo       Opto Time Nanoscondo       Opto Time Nanoscondo       Opto Time Nanoscondo       Opto Time Scherator       Opto Time</td>	Schedule Enabled       Cycle Time Numerator       Cycle Time Numerator       Opto Time Scherator       Base Time Scherator       Base Time Scherator       Opto Time Vianoscondo       Opto Time Nanoscondo       Opto Time Nanoscondo       Opto Time Nanoscondo       Opto Time Scherator       Opto Time	

Figure 91. Scheduled Traffic – Startup Page

### SCHEDULE ON THE TIMER PINS

The Switch has four hardware Timer pins. A schedule can be created on all four pins. The functionality of the timer pins can be configured in the GPIO and Timer Configuration page. By default, Timer0 and Timer1 are configured to allow a schedule be created, while Timer2 is configured to provide a 1PPS signal and is shown greyed out in this page, Timer3 defaults as a Capture input. To apply a TSN schedule on Timer2 or Timer3, first change the configuration in the GPIO and Timer Configuration page. In the examples below, two different schedules have been applied to the two devices for the Timer0, Timer1, and Timer3 pins.

Figure 92 and Figure 93 show the two different scheduled for two sets of ADIN6310 Timers pins.

For Switch 1 timers, the Cycle time is 1 ms and there are four time slots. Each Timer is enabled for a window of 200  $\mu$ s, starting with Timer0, followed by Timer1, then Timer3. The remaining time of the 1 ms cycle time, all timers are in the Off state. Figure 94 and Table 15 show visually how the schedule looks in terms of time.

For the second devices, Switch 2, the Cycle time is still 1 ms and there are eight time slots with a binary pattern enabled for a slot duration of 100  $\mu$ s, using 700  $\mu$ s of the cycle time. The remaining time of the 1 ms cycle time, all timers are in the Off state. Table 16 shows visually how the schedule looks in terms of time and Figure 95 shows a capture of the scheduled activity on the Timer pins for both devices using a logic analyzer.



Figure 92. Configured Schedule for Switch 1 Timers



Figure 93. Configured Schedule for Switch 2 Timers



Figure 94. Schedule for Switch 1 Timer Pins

#### Table 15. Switch 1 Schedule (1 ms Cycle Time)

	Start time				
Entry	(µs)	End Time (µs)	Timer3	Timer1	Timer0
0	0	200	0	0	1
1	200	400	0	1	0
2	400	600	1	0	0
3	600	Remainder	0	0	0

#### Table 16. Switch 2 Schedule (1 ms Cycle Time)

Entry	Start time (μs)	End Time (µs)	Timer3	Timer1	Timer0
0	0	100	0	0	1
1	100	200	0	1	0
2	200	300	0	1	1
3	30	400	1	0	0
4	400	500	1	0	1
5	50	600	1	1	0
6	600	700	1	1	1
7	700	Remainder	0	0	0



Figure 95. Logical Analyzer View of a Schedule on the Hardware Timer Pins

# **LLDP CONFIGURATION**

### LINK LAYER DISCOVERY PROTOCOL (LLDP)

LLDP is a protocol devices use to advertise information about their capabilities between peers. The configuration exposed in the web server is limited to basic configuration and visibility into statistics. Additional capability is exposed in the TSN driver library APIs, for more details, refer to the ADIN6310 Hardware Reference Manual.

### LLDP CANDIDATE VIEW

The LLDP stack runs on the Packet Assist engine of the Switch and is enabled during initial configuration of the device from the GUI application when using TSN functionality or HSR functionality (not currently enabled with PRP operation). The default configuration is shown in the **Candidate** page in Figure 96. Configure the required changes, click the **Save** button followed by **Commit** button to load changes to the Switch. The admin configuration included in the web server are as follows:

- Admin status: Choice of Tx and Rx, Tx only, Rx only, or disabled.
- Message Fast Tx: Time intervals (in ticks) between transmissions during fast transmission periods. Default is 1, range of 1 to 3600. Fast transmission periods are initiated when a new neighbor is detected and results in LLDP packets to be transmitted on a shorter time interval than the normal message Tx interval.
- Message Tx Hold Multiplier: Used as a multiplier of msgTxInterval to determine the value of txTTL (Time to Live), txTTL =

((Message Tx Interval X Message Tx Hold) + 1). Default is 4, intended range is 1 to 100, but web page currently limits field to 2 to 10, this needs to be addressed in future release.

- Message Tx Interval: Time interval in ticks between transmission during normal transmission periods. Default is 30, range of 1 to 3600.
- Reinit Delay: Amount of delay from when Admin Status becomes disabled until reinitialization is attempted. Default value is 2 seconds.
- Tx Credit Max: TxCredit is the number of consecutive LLDPDUs that can be transmitted at any time. The parameter is the maximum value of txCredit. Default is 5, range of 1 to 10.
- Tx Fast Init: Used as the initial value for txFast. Default is 4, range of 1 to 8.
- Number of peer supported: Per port number of peers supported.
- Enable end of LLDPDU TLV: Enable or disable end of LLDPDU TLV in Tx LLDP frames, which marks the end of the LLDPDU frame.
- Override MAC address: The default MAC address for the LLDP stack is derived from the Port MAC address. Overriding the MAC address changes the source MAC address, PortID and/or ChassisID in the LLDP frames egressing from the given port.

LLDP Configuration						ANALOG	
Version 2.1.0 Copyright 2020 - 2023 Analog D	evices, Inc.					MEAD OF MEATS POSSIBLE® S	
	This is the LLDP configuration	Dade					
Home							
Setup	Challen Constitute Discrime	Charles Commit	Needer				
Port Statistics	Status Candidate Running	Startup Commit	Jiscard				
Port Configuration							
GPIO and Timer Configuration	50000						
Switching Table	Save						
/LAN Table			Admin Con	figuration			
LAN Remapping	Admin status Message Fast Tx	Message Mess Tx Hold Multiplier Tx Int	age Reinit Delay erval	y Tx Credit Max Tx Fas	Init Number o	f Enable end of Override MAC. ted LLDPDU TLV	Address
LAN Reprioritization	Port 0 Tx and Rx 🗸 1	4 30	2	5 4	4	Z 7A-C6-BB-11-	11-12
Time Synchronization	Port 1 Tx and Rx 🗸 1	4 30	2	5 4	4	Z 7A-C6-BB-11-	11-13
Frame Preemption	Port 2 Tx and Rx 🗸 1	4 30	2	5 4	4	7A-C6-BB-11-	11-14
Scheduled Traffic - Assign Queue	Port 3 Tx and Rx 🗸 1	4 30	2	5 4	4	Z 7A-C6-BB-11	11-15
Scheduled Traffic - Set Queue Max. SDU	Port 4 Tx and Rx 🗸 1	4 30	2	5 4	4	Z 7A-C6-BB-11	11-16
Scheduled Traffic - Schedule	Port 5 Tx and Rx 🗸 1	4 30	2	5 4	4	Z 7A-C6-BB-11-	11-17
LLDP Configuration							
and the second sec							
Firmware Update	LLDP Primary						

Figure 96. LLDP Candidate Page

# **LLDP CONFIGURATION**

	nuinna lan									ANALOG DEVICES A	DI Ch
version 2. 1.0 Copyright 2020 - 2023 Analog D	evides, ind.										
	This is the LLDD cos	Fouration									
Home	This is the LLDP con	ngurauon	page								
Setup		Duration	<b>Charter</b>								
Port Statistics	Status Candidate	Running	Startup								
Port Configuration											
GPIO and Timer Configuration											
Switching Table					Admin Co	onfiguration					
/LAN Table	Admin status	Message Fast Tx	Message Tx Hold Multiplier	Message Tx Interval	Reinit Del	ay Tx Credit Ma	x Tx Fast Ini	Number of peer supporte	Enable end o d LLDPDU TLV	f Override MAC Ad	Idress
AN Remapping	Port 0 Tx and Rx 🗸	1	4	30	2	5	4	4		7A-C6-BB-11-1	1-12
AN Reprioritization	Port 1 Tx and Rx 🗸	1	4	30	2	5	4	4		7A-C6-BB-11-1	1-13
ime Synchronization	Port 2 Tx and Rx 🗸	1	4	30	2	5	4	4		7A-C6-BB-11-1	1-14
ame Preemption	Port 3 Tx and Rx 🗸	1	4	30	2	5	4	4		7A-C6-BB-11-1	1-15
cheduled Traffic - Assign Queue	Port 4 Tx and Rx 🗸	1	4	30	2	5	4	4		7A-C6-BB-11-1	1-16
cheduled Traffic - Set Queue Max. SDU	Port 5 Tx and Rx 🗸	1	4	30	2	5	4	4		7A-C6-BB-11-1	1-17
cheduled Traffic - Schedule											
LLDP Configuration	LLDP	Primarv									

Figure 97. LLDP Running Page

LLDP Configuration Version 2.1.0 Copyright 2020 - 2023 Analog Devices, Inc.										ANALOG DEVICES	ADI Chronou	
Home	This is the LLDP con	figuration p	age									
Setup												
Port Statistics	Status Candidate	Running	Startup									
Port Configuration												
GPIO and Timer Configuration												
witching Table					Admin Conf	figuration						
LAN Table	Admin status	Message Fact Tx	Message	Message Tx Interval	Reinit Delay	Tx Credit Max	x Tx Fast Init	Number of	Enable end of	Override MAC	Address	
LAN Remapping	Port 0 Tx and Rx 🛩	1		30	2	5	4	4		7A-C6-BB-11	-11-12	
LAN Reprioritization	Port 1 Tx and Rx V	1	4	30	2	5	4	4		7A-C6-BB-11	-11-13	
ime Synchronization	Port 2 Tx and Rx 🗸	1	4	30	2	5	4	4		7A-C6-BB-11	-11-14	
rame Preemption	Port 3 Tx and Rx 🗸	1	4	30	2	5	4	4		7A-C6-BB-11	-11-15	
cheduled Traffic - Assign Queue	Port 4 Tx and Rx 🗸	1	4	30	2	5	4	4		7A-C6-BB-11	-11-16	
cheduled Traffic - Set Queue Max. SDU	Port 5 Tx and Rx 🗸	1	4	30	2	5	4	4		7A-C6-BB-11	-11-17	
cheduled Traffic - Schedule												
LDP Configuration		Primary										

Figure 98. LLDP Startup Page
## **LLDP CONFIGURATION**

## LLDP STATUS

The **Status** view shows an overview of the Remote, Local, and Port based statistics for the LLDP feature. This includes a capture of the

LLDP frames transmitted and received and additional information related to error scenarios, ageouts, inserts, and deletes.

LLDP Configuration					► ANA	
Version 2.1.0 Copyright 2020 - 2023 Analog De	vices, Inc.				NEAD OF MARTS	POSSINE" SCALARE CTHEINET THEO TO POSSICE
	This is the LLDD seed					
Home	This is the LLDP cont	iguration page				
Setup	Status Constitute	Duration Director				
Port Statistics	Status Candioate	Running Startup				
Port Configuration						
GPIO and Timer Configuration						
Switching Table	Remote	Statistics	Local Syst	em Data		
VLAN Table	Last change time 9524	8 Cha	ssis ID Subtype mac	-address		
VLAN Remapping	Remote inserts 8	Cha	issis ID 11			
VLAN Reprioritization	Remote deletes 0	Sys	tem Name			
Time Synchronization	Remote drops 0	Sys	tem description			
Frame Preemption	Remote ageouts 0	Сар	abilities Supported			
Scheduled Traffic - Assign Queue		Сар	abilities Enabled			
Scheduled Traffic - Set Queue Max. SDU		Root 0		Doct 4		Part 2
Scheduled Traffic - Schedule		Transmit		Transmit		Fort 2
LLDP Configuration	Total Frames	349	Total Frames	345	Total Frames	344
Firmware Update	Total Length Errors	0	Total Length Errors	0	Total Length Errors	0
		Receive		Receive		Receive
	Total Ageouts	0	Total Ageouts	0	Total Ageouts	0
Port0 Port1 Port2 Port3 Port4 Port5	Discarded Frames	0	Discarded Frames	0	Discarded Frames	0
	Error Frames	0	Error Frames	0	Error Frames	0
	Total Frames	10	Total Frames	18	Total Frames	18
	Total Discarded TLVs	0	Total Discarded TLVs	0	Total Discarded TLVs	0
	Total Unrecognized TLV	5 0	Total Unrecognized T	LVs 0	Total Unrecognized TLVs	5 ()
		Port 3		Port 4		Port 5
	Total Frames	1359	Total Frames	nansmit	Total Frames	nansmit
	Total Longth Errors	0	Total Longth Error	0	Total Length Errorr	0
	Total Length Errors	U	Total Lengur Errors		Total Lengur Errors	
		Receive		Receive		Receive
	Total Ageouts	0	Total Ageouts	0	Total Ageouts	0
	Discarded Frames	0	Discarded Frames	0	Discarded Frames	0
	Error Frames	0	Error Frames	0	Error Frames	0
	Total Frames	350	Total Frames	0	Total Frames	0
	Total Discarded TLVs	0	Total Discarded TLVs	0	Total Discarded TLVs	0
	Total Unrecognized TLV	5 0	Total Unrecognized T		Total Unrecognized TLVs	0

Figure 99. LLDP Status Page

#### **LLDP CONFIGURATION**

#### LLDP EXAMPLE

Figure 100 shows a Wireshark capture of the LLDP messages exchanged between two ADIN6310 devices (Switch 1 - Port 3 to Switch 2 - Port 0). The messages are targeted at the LLDP multicast address 01:80:c2:00:00:0e, and originate with a source MAC of the Switch Port MAC address. The LLDP protocol message contents can be observed in the capture, with information describing the Chassis Subtype, Port Subtype, Time to live ((message Tx Hold x message Tx Interval) +  $1 = (4 \times 30) + 1 = 121$ ), and additional Ethernet capabilities. The Switch uses LLDP to exchange capability for Frame Preemption with its peer.

The LLDP messages can be observed every 30 seconds (Message Tx Interval).

lldp						
ю.	Time	Source	Destination	Protocol	Length T	ime delta from previous displayed frame
49	2.033664936	7a:c6:bb:22:22:23	LLDP_Multicast	LLDP	72	2.03366
	2.664010672	7a:c6:bb:11:11:15	LLDP_Multicast		72	0.63034
753	32.033606864	7a:c6:bb:22:22:23	LLDP_Multicast	LLDP	72	29.36959
768	32.663781984	7a:c6:bb:11:11:15	LLDP_Multicast	LLDP	72	0.63017
1451	62.033548864	7a:c6:bb:22:22:23	LLDP_Multicast	LLDP	72	29.36976
1466	62.663553352	7a:c6:bb:11:11:15	LLDP_Multicast	LLDP	72	0.63000
Enomo	64, 72 butos or	wine (E76 bits) 7	2 butos contuned	(576 hits) o	n intenface	oSob1b2920pp R id 2
Frame	04: 72 Dytes of	I WITE (STO DICS), 7.	z bytes captureu	(370 DICS) 0	n incernace	eoeb10303988_D, 10 2
TEEE	602.50r Frame Pr	Peembrion Protocol				
<ul><li>Y Tin</li><li>Y Ten</li></ul>	rt Subtype = MAC me To Live = 121 0000 011 00000 Seconds: 121 ee 802.3 - IEEE 1111 111	<pre>address, 10: 7a:co l sec  = TLV Type: Tim 0010 = TLV Length: 2 802.3br Additional f  = TLV Type: Org</pre>	ne to Live (3) 2 Ethernet capabili ganization Specif	ities Fic (127)		
	Organization Un	dave Cadas 00.12.0f	/T 000 0\			
	TEEE 802.3 Subt	vpe: TEEE 802.3bc Ac	(leee 802.3) ditional Etherne	et canabilitie	es (0x07)	
>	IEEE 802.3 Subt Additional Ethe	ype: IEEE 802.3br Ac rnet Capabilities: 0	(leee 802.3) dditional Etherne 0x0000	et capabilitie	es (0x07)	

Figure 100. Wireshark Capture of LLDP Frames between Two ADIN6310 Devices (Default Configuration)

## **LLDP CONFIGURATION**

## LLDP EXAMPLE (FAST TX)

Fast transmission periods are initiated when a new neighbor is detected and results in LLDP packets to be transmitted on a shorter time interval than the normal message Tx interval. The default setting for Message Fast Tx is 1 second. As shown in Figure 101, LLDP is disabled on Port 3 after time 12 seconds and then

reenabled after approx 73 seconds. At that time, both SES 1 and SES 2 start transmitting fast Tx messages at a 1 second interval before returning to the normal Tx interval of 30 seconds. They each send 5 LLDP messages as the default value of the Maximum Tx Credit parameter is set to 5.

Ildp						X
No. Time	Source	Destination	Protocol	Length	Time delta from prev	ious dis
269 11.623047768	7a:c6:bb:11:11:15	LLDP_Multicast	LLDP	72	)	
349 14.870846576	7a:c6:bb:22:22:23	LLDP_Multicast	LLDP	72	<u>)</u>	
1041 44.870787576	7a:c6:bb:22:22:23	LLDP_Multicast	LLDP	72	)	
1737 74.870728536	7a:c6:bb:22:22:23	LLDP_Multicast	LLDP	7:		
1745 75.200541896	7a:c6:bb:11:11:15	LLDP_Multicast		7.		
1763 75.870885368	7a:c6:bb:22:22:23	LLDP_Multicast	LLDP	7.		
1771 76.200679984	7a:c6:bb:11:11:15	LLDP_Multicast	LLDP	7.		
1788 76.870983616	7a:c6:bb:22:22:23	LLDP_Multicast	LLDP	7:		
1796 77.200436608	7a:c6:bb:11:11:15	LLDP_Multicast	LLDP	73		
1813 77.870792424	7a:c6:bb:22:22:23	LLDP_Multicast	LLDP	7:		
1821 78.200428928	7a:c6:bb:11:11:15	LLDP_Multicast	LLDP	7:		
1838 78.870790448	7a:c6:bb:22:22:23	LLDP_Multicast	LLDP	7		
1847 79.200421200	7a:c6:bb:11:11:15	LLDP_Multicast	LLDP	7:		
1864 79.870788560	7a:c6:bb:22:22:23	LLDP_Multicast	LLDP	7:		
2563 109.200118896	7a:c6:bb:11:11:15	LLDP_Multicast	LLDP	72		
2580 109.870729504	7a:c6:bb:22:22:23	LLDP_Multicast	LLDP	72	2	
3255 139.199888160	7a:c6:bb:11:11:15	LLDP_Multicast	LLDP	72	2	
3272 139.870670400	7a:c6:bb:22:22:23	LLDP_Multicast	LLDP	72	)	
3947 169 199657544	7a+c6+bb+11+11+15	LINP Multicast	IINP	73	)	
<						
<pre>&gt; Frame 1745: 72 bytes on wire (576 b &gt; IEEE 802.3br Frame Preemption Proto &gt; Ethernet II, Src: 7a:c6:bb:11:11:15 &gt; Link Layer Discovery Protocol &gt; Chassis Subtype = MAC address, I &gt; Port Subtype = MAC address, Id: &gt; Time To Live = 121 sec &gt; Ieee 802.3 - IEEE 802.3br Additi &gt; Guide Guidean State Stat</pre>	<pre>its), 72 bytes captured (576 col (7a:c6:bb:11:11:15), Dst: LL d: 7a:c6:bb:11:11:11 7a:c6:bb:11:11:15 onal Ethernet capabilities</pre>	bits) on interfac	e e8e 0000 0010 80:c2 0020 0030 0040	55 55 55 bb 11 11 07 03 7a 0f 07 00 00 00 00	55 55 55 55 d5 15 88 cc 02 07 c6 bb 11 11 15 00 00 00 00 00 00 50 4d e8 7c	01 8 04 7 06 0 00 0

Figure 101. Wireshark Capture of LLDP Frames between Two ADIN6310 Devices when LLDP is Reenabled on Switch 1

The Switch hardware supports PRP per IEC62439-3 (2021 ed4) standard. The capability exposed in the Switch is ability to support one instance of a doubly attached node obeying PRP (DANP) or Redundancy Box (Redbox) function configured over either an SPI or Ethernet connected Host (web server only supports configuration over Ethernet Host). The Host configures the Switch for the PRP function, defining which ports are PRP network ports, sets the link redundancy entity (LRE) MAC address and enables the PRP function.

The Switch hardware takes care of duplicating the outgoing traffic onto LAN A/B and inserting the RCT tag to the end of the frame. On reception of PRP traffic, the Switch consumes the first frame, removes the tag, and discards duplicates. The Switch generates supervision frames, which are sent out on the LAN A/B ports and maintain a nodes table of other PRP DANP, Redbox, and SAN entities in the network. PRP supervisory frames are generated periodically with or without VLAN tag every 2 seconds. The device maintains a nodes table, recording the last time a frame is received from a node. Node entries are removed from the table if no frames are received for over 60 seconds. The node table can support 1024 entries max. The Switch supports operation of one instance of PRP on the 6-port ADIN6310 Switch, multiple instances of PRP running on the 6-port device is not supported. The Switch PRP functionality can be configured to support:

- PRP operation as a DANP or PRP Redbox.
- PRP configured over Ethernet or SPI Host.

Enabling PTP or LLDP functionality with PRP is not currently supported, future software updates include this capability. Using TSN features such as Scheduled Traffic, Frame Preemption, Per Stream Filtering, and Policing or Frame Replication and Elimination for Reliability with PRP is not supported.

Figure 102 shows a simple configuration of the Switch with Ethernet Host (Port C) configured as a DANP and connected over a PRP network (LAN A/B) to another PRP capable Switch. The duplicate network, LAN A/B, provides the redundant path ensuring seamless redundancy. Three Ethernet ports are used in a PRP DANP device, Port A, Port B are network facing ports, while Port C is connected to the Host/End node over Ethernet interface and is used for control plane configuration of the Switch and PRP data plane traffic to that node. PRP Port C can also be connected over SPI interface.



Figure 102. Example of Switch Configuration as PRP-DANP (Host Connected over Ethernet)

#### ENABLING PRP EXAMPLE

To enable PRP, pass an XML file that includes PRP configuration to the ses-configuration.txt file as PRP needs to be enabled as part of the initial configuration. The XML file must include all relevant PRP configuration, how PRP is configured, which ports are PRP Port A, Port B, and Port C for DANP configuration and interlink ports if configuring the device for PRPRedbox. The LRE MAC address must be the Host MAC address (or if connected over Ethernet to a PC Network adapter, it must be the MAC of the NIC). In the configuration shown in Figure 103, Port 0, Port 1, and Port 2 are the LRE Port C, Port A, Port B, and Port 3 to Port 5 are configured as Interlink ports. For details on the XML configuration for PRP, see the PRP Specific Configuration section.



Figure 103. PRP Configuration as a Redbox

After the configuration file has been edited for the relevant PRP configuration, launch the GUI, click the **Find and Configure** to search for a connected Switch. Once the Switch has been configured and the GUI LED turns green, the web server can be opened. When using PRP functionality, the web server shows the features supported with PRP, which is a reduced feature vs. when operating in TSN mode, see Figure 104.



Figure 104. Web Page when PRP Function is Enabled

#### PRP CONFIGURATION WEB PAGE VIEWS

#### **PRP Candidate View**

The default PRP configuration is based on the XML configuration as discussed in the ses-configuration File section. There are additionally some run-time configurable parameters for PRP, as shown in the **Candidate** view, see Figure 105. To change the PRP configuration during operation, make the required changes, click the **Save** button followed by **Commit** button to load them to the device. The configuration included are as follows:

- Redundancy Device: Shows the type of redundancy device configured as per the XML file. Choice of PRP DANP or PRP Redbox.
- ▶ Duplicate mode: The Switch receiving hardware can detect duplicates based on information in the RCT tag in the frame. When Duplicate Discard mode is enabled, it only forwards the first frame of a pair to the upper layers. Duplicate Accept is typically only used for testing purposes and allows the Switch to forward both duplicate frames to upper layers. The default mode is for Duplicate Discard. In the event a frame is received with the wrong LANID (ID 0xA on Port B or ID 0xB on port A), the Switch performs a Duplicate Discard and strip off the PRP RCT trailer, this applies to DANP and PRP Redbox use cases.
- Port-A Admin State: Shows if the port is active or not, choice of On or Off, default is On.
- LRE MAC Address: Shows the LRE MAC address as configured through the XML file.
- ► Max Reside Time: Sets the maximum time an entry may reside in the duplicate list. The default is 10 ms (15 µs × 625). The range of possible values is 15 µs to 400 ms (corresponding to 0 to 26214).
- Evaluate Supervision: By default, the Switch evaluates supervision frames in the network and add nodes to its nodes table. This can be disabled by clearing the check box.
- ► Transparent Reception: By default, the Switch removes the RCT tag from the frame before it passes it to upper layers. Select **Pass** to leave the PRP RCT tag in the frame.
- Supervision VLAN ID (0-4095): By default the supervision frames are sent untagged (VLAN 4095). To send supervision frames with a VLAN tag, enter a valid VLAN ID in this field.

PRP Configuration					ADI Chronous
Version 3.0.0 Copyright 2020 - 2024 Analog Dev	ioes, Inc.			NEND OF MINTS POSSELEY	SOM ARE CTHERNET THED TO POSTOCTEM
	This is the PRP configuration	Dage			
Home		, pogo			
Setup					
Port Statistics	Status Candidate Running	g Startup Commit	Discard		
Port Configuration					
GPIO and Timer Configuration	Cana				
Switching Table	Save				
PRP Configuration	PRP		Supervis	ion	_
Firmware Update	Redundancy Device	REDBOX 🗸	Evaluate Supervision		
	Duplicate mode	Accept 🔵 Discard 🔿	Transparent Reception	Pass 🔘 Remove 🔘	
	Port-A Admin State	On 💿 Off 📀	Supervision VLAN ID (0-4095)	4095	
	Port-B Admin State	On Off O			
Port 0 Port 1 Port 2 Port 3 Port 4 Port 5	LRE MAC Address	00-0A-CD-3F-71-C5			
	Max Reside Time(second fraction	) 625			

Figure 105. PRP Candidate Page

# **PRP Running View**

PRP **Running** page shows the configuration loaded to the device. No changes can be made in the **Running** page. See Figure 106.

PRP Configuration Version 3.0.0 Copyright 2020 - 2024 Analog De	vices, Inc.			ANALOG DEVICES NEAD OF MONTS POSSEET	ADI Chronous
	This is the PDD configurati	on nage			
Home	This is the FKF configurat	on page			
Setup		Charles .			
Port Statistics	Status Candidate Runn	ing Startup			
Port Configuration					
GPIO and Timer Configuration					
Switching Table	PRI	3	Supervis	ion	_
PRP Configuration	Redundancy Device	REDBOX 🗸	Evaluate Supervision		
Firmware Update	Duplicate mode	Accept 🔵 Discard 🔘	Transparent Reception	Pass 🔵 Remove 🔘	
	Port-A Admin State	On Off O	Supervision VLAN ID (0-4095)	4095	
Portů Port1 Port2 Port3 Port4 Port5	Port-B Admin State LRE MAC Address Max Reside Time(second fracti	On Off 00-0A-CD-3F-71-C5 on) 625			

Figure 106. PRP Running Page

#### **PRP Startup View**

PRP Startup page shows the Startup configuration. See Figure 107.

PRP Configuration Version 3.0.0 Copyright 2020 - 2024 Analog De	vices, Inc.	ANALOG DEVICES NEW OF MISSINGER: SOLALE CHERKY THE TO REPORT
Home	This is the PRP configuration page	
Setup		
Port Statistics	Status Candidate Running Startup	
Port Configuration		
GPIO and Timer Configuration		
Switching Table	PRP	Supervision
PRP Configuration	Redundancy Device REDBOX V	Evaluate Supervision
Firmware Update	Duplicate mode Accept   Discard	Transparent Reception Pass  Remove
	Port-A Admin State On O Off	Supervision VLAN ID (0-4095) 4095
	Port-B Admin State On Off	
	LRE MAC Address 00-0A-CD-3F-71-C5	
Port0 Port1 Port2 Port3 Port4 Port5	Max Reside Time(second fraction) 625	

Figure 107. PRP Startup Page

#### **PRP STATUS PAGE**

The Status page shows the LRE Statistics and the Node Table Statistics. See Figure 108.

The **LRE Statistics** section shows the traffic statistics and error counters associated with each PRP LAN that have been observed by the Switch in addition to showing how many nodes are in the network. The configuration included are as follows:

- Rx Count: Shows the number of frames received by Port A or Port B that have PRP RCT trailers added.
- ► **Tx Count**: Shows the number of frames transmitted by Port A or Port B that have PRP RCT trailers added.
- Error Count: Shows the number of frames with errors received on the LRE Port A or Port B.

- Wrong LAN error count: Shows the number of frames with the wrong LAN identifier received on LRE Port A or Port B.
- Duplicate Count: Shows the number of entries in the duplicate detection mechanism on Port A or Port B for which one single duplicate is received.
- Multi Count: Shows the number of entries in the duplicate detection mechanism on Port A or Port B for which more than one duplicate is received.
- Unique Count: Shows the number of entries in the duplicate detection mechanism on Port A or Port B for which no duplicate is received.
- Node Count: Returns the number of nodes detected in the system.

PRP Configuration	rices, Inc.									LOG ICES	ADI Chronous" Sonale ethernet theo to possection
Home Setup Port Statistics	This is the PRP conf	iguration page Running Startu	p								
GPIO and Timer Configuration											
Switching Table		LRE S	tatistics				Node Table Statis	stics			Proxy Node Table
PRP Configuration		Port-A(LAN-A)	Port-B(LAN-B)	Port-C(Host)	Inde	x Mac Address	Time Last Seen A	Time Last Seen B	Type	Index	Mac Address
Firmware Update	Rx Count	3093	3098	34582		B4 96 91 8C DE 55	(TimeTicks 1/100s) 1038815	(Time Licks 1/100s) 1038815	vdann	1	B4-96-91-8C-DE-66
	Tx Count	35207	35222	2145		B4 96 91 8C DE 56	1938715	1938715	vdanp	2	B4-96-91-8C-DE-67
	Error Count	0	0	0		B4-96-91-8C-DE-57	1938615	1938615	vdann	3	B4-96-91-8C-DE-68
	Wrong LAN error count	0	0		4	B4-96-91-8C-DE-58	1938515	1938515	vdann	4	B4-96-91-8C-DE-69
Port0 Port1 Port2 Port3 Port4 Port5	Duplicate Count	2158	0		5	B4-96-91-8C-DE-59	1938415	1938415	vdanp	5	B4-96-91-8C-DE-6A
	Multi Count	0	0		6	B4-96-91-8C-DE-5A	1938315	1938315	vdanp	6	B4-96-91-8C-DE-6B
	Unique Count	0	0		7	B4-96-91-8C-DE-5B	1938215	1938215	vdann	7	B4-96-91-8C-DE-6C
	Nodo count	17			8	B4-96-91-8C-DE-5C	1938115	1938115	vdanp	8	B4-96-91-8C-DE-6D
	Prove Node count	8			9	B4-96-91-8C-DE-5D	1938015	1938015	vdanp		Clear Provy Table
	r rong rroue ocon	Clear I	RE Table		10	B4-96-91-8C-DE-5E	1939515	1939515	vdanp		
		Oldar E			11	B4-96-91-8C-DE-5F	1939415	1939415	vdanp		
					12	B4-96-91-8C-DE-60	1939315	1939315	vdanp		
					13	B4-96-91-8C-DE-61	1939215	1939215	vdanp		
					14	B4-96-91-8C-DE-62	1939115	1939115	vdanp		
					15	B4-96-91-8C-DE-63	1939015	1939015	vdanp		
					16	B4-96-91-8C-DE-64	1938915	1938915	vdanp		
					17	00-90-E8-B2-CC-20	1933801	1933801	redboxp		
							Clear Node Ta	ble			

Figure 108. PRP Status Page

#### **Node Table Statistics**

The **Node Table Statistics** shows the MAC addresses of other PRP devices in the network. The nodes table is built up of entries based on Supervision frames received by the Switch from other PRP devices. The nodes table can hold 1024 entries. The Switch also reports the time (in TimeTicks 1/100 seconds) a node is last seen on either Port A or Port B and what type of device it is. The Host can access this information to understand what is happening and whether there are any issues in the network. The nodes table refreshes every 60 seconds, therefore, node entries remove from the table if traffic from that address is no longer seen.

#### **Proxy Node Table**

The **Proxy Node Table** captures information when the Switch is configured as a PRP Redbox. A Switch **Proxy Node Table** shows the LRE MAC addresses of the detected SAN devices connected to its Interlink ports. The **Proxy Node Table** can support up to 8 entries. The entries are learned based on the traffic coming into the interlink port. The table refreshes every 60 seconds, therefore, node entries remove from the table if traffic from that address is no longer seen.

#### **PRP - SUPERVISION FRAMES**

The Wireshark capture shown in Figure 109 is a supervision frame generated by the Switch and transmitted on Port B (LAN B). By default, supervisory frames are transmitted at a 2 second interval and without VLAN tags. The Switch sends a supervisory frame for

its LRE MAC address and on behalf of any proxy nodes connected to its interlink ports if configured as a Redbox. Supervisory frames are sent out to the PRP network, therefore, only visible on Port A and Port B. The PRP RCT tag has a suffix 0x88fb and the tag can be seen at the end of the frame.

	hsr_prp_supervision															×ŀ		·] +	
No.	Time	Source	Destination		Protocol				Leng	t Info	)								^
	107 0.941914456	SunrichT_3f:71:c5	Iec_00:01:00		HSR/PR	P			78	B PRF	Sup	pervi	sion						
	108 0.942084504	SunrichT_3f:71:c5	Iec_00:01:00		HSR/PR	P			78	B PRF	Sup	pervi	sion						v
<																	>		
>	Frame 106: 78 byt	es on wire (624 bits),	78 bytes captured (624 bits	) on int	0000	55	55 5	5 55	5 55	55 5	55 ds	5 01	15	4e	00 0	91 0	0 00	0a	_
>	IEEE 802.3br Fram	e Preemption Protocol			0010	cd 🛛	3f 7	1 c5	5 88	fb (	00 01	1 07	b1	14	06 0	0 0	a cd	3f	
>	Ethernet II, Src:	SunrichT_3f:71:c5 (00:	0a:cd:3f:71:c5), Dst: Iec_0	0:01:00	0020	71	c5 1	.e 06	5 00	0a (	:d 31	f 71	c5	00	00 e	0 0	0 00	00	
~	HSR/PRP Supervisi	ion (IEC62439 Part 3)	_		0030	00	00 0	0 00	00	00 0	00 00	00 00	00	00	00 0	0 0	0 00	00	
	0000	= Path: 0			0040	00	00 0	10 00	0 07	DI a	40 D4	+ 00	TD	as	ez d	0 0	/		
	0000 0000	0001 = Version: 1																	
	Sequence numbe	r: 1969																	
	TLV type: PRP	Node (Duplicate Discard	) (20)																
	TLV length: 6																		
	Source MAC Add	lress: SunrichT_3f:71:c5	(00:0a:cd:3f:71:c5)																
	TLV type: Redu	indancy Box MAC Address	(30)																
	TLV length: 6																		
	RedBox MAC Add	lress: SunrichT_3f:71:c5	(00:0a:cd:3f:71:c5)																
	TLV type: End	of TLVs (0)																	
	TLV length: 0																		
				1															

Figure 109. Wireshark Capture of Supervision Frames in LAN B

#### **PRP – CAPTURE OF PRP TAGGED TRAFFIC**

The Wireshark capture shown in Figure 110 is traffic sent into Port C of the Switch and observed on Port B of the PRP network. The

PRP RCT tag can be seen at the end of the frame, with LAN information, SDU size, and Sequence number.

No.	Time	Source	Destination	Protocol	Length	Time delta from previous	displayed frame
	6987 168.936901	SunrichT_3e:15:d3	Schaffne_22:22:22	0x1233	152		0.19996
	6988 168.943886	SunrichT_3e:15:d3	Iec_00:01:00	HSR/PRP	70		0.00698
	6989 168.999394	7a:c6:bb:22:22:23	LLDP_Multicast	PTPv2	68		0.05550
	6990 169.136953	SunrichT_3e:15:d3	Schaffne_22:22:22	0x1233	152		0.13755
	6991 169.336943	SunrichT_3e:15:d3	Schaffne_22:22:22	0x1233	152		0.19999
	6992 169.536945	SunrichT_3e:15:d3	Schaffne_22:22:22	0x1233	152		0.20000
	6993 169.736968	SunrichT_3e:15:d3	Schaffne_22:22:22	0x1233	152		0.20002
	6994 169.936952	SunrichT_3e:15:d3	Schaffne_22:22:22	0x1233	152		0.19998
	6995 169.999446	7a:c6:bb:22:22:23	LLDP_Multicast	PTPv2	68		0.06249
	6996 170.136951	SunrichT_3e:15:d3	Schaffne_22:22:22	0x1233	152		0.13750
	6997 170.337000	SunrichT_3e:15:d3	Schaffne_22:22:22	0x1233	152		0.20004
	6998 170.536943	SunrichT_3e:15:d3	Schaffne_22:22:22	0x1233	152		0.19994
	6999 170.736970	SunrichT_3e:15:d3	Schaffne_22:22:22	0x1233	152		0.20002
	7000 170.936929	SunrichT_3e:15:d3	Schaffne_22:22:22	0x1233	152		0.19995
	7001 170.943860	SunrichT_3e:15:d3	Iec_00:01:00	HSR/PRP	70		0.00693
<							>
>	Frame 6996: 152 bytes on wire (1216 bits)	), 152 bytes captured (1	1216 bits) on i 000	0 00 22 22	22 22 22	00 0a cd 3e 15 d	3 81 00 20 64
~	Ethernet II, Src: SunrichT 3e:15:d3 (00:0	Ja:cd:3e:15:d3), Dst: Sc	haffne 22:22:2 001	0 12 33 00	00 00 00	04 05 06 07 08 0	9 0a 0b 0c 0d
	> Destination: Schaffne 22:22:22 (00:22:	22:22:22:22)	002	0 0e 0f 10	11 12 13	14 15 16 17 18 1	9 1a 1b 1c 1d
	> Source: SunrichT 3e:15:d3 (00:0a:cd:3e	2:15:d3)	003	0 1e 1f 20	21 22 23	24 25 26 27 28 2	9 2a 2b 2c 2d
		,	004	0 2e 2t 30	31 32 33	34 35 36 37 38 3	9 3a 3b 3c 3d
	Type: 802.10 Virtual LAN (0x8100)		0.00	<b>- - - - - - - - -</b>		44 45 46 4/ 48 4	9 4a 4b 4c 4d
>	Type: 802.10 Virtual LAN (0x8100) 802.10 Virtual LAN, PRI: 1, DEI: 0, ID: 1	100	005	0 3e 3f 40	41 42 45 51 52 53	54 55 56 57 58 5	0 5a 5h 5c 5d
>	Type: 802.1Q Virtual LAN (0x8100) 802.1Q Virtual LAN, PRI: 1, DEI: 0, ID: 1 Data (134 bytes)	100	005	0 3e 3f 40 0 4e 4f 50 0 5e 5f 60	41 42 45 51 52 53 61 62 63	54 55 56 57 58 5 64 65 66 67 68 6	9 5a 5b 5c 5d 9 6a 6b 6c 6d
> > <b>&gt;</b>	Type: 802.1Q Virtual LAN (0x8100) 802.1Q Virtual LAN, PRI: 1, DEI: 0, ID: 1 Data (134 bytes) Parallel Redundancy Protocol (IEC62439 Pa	100 irt 3)	005 006 007 008	0 3e 3f 40 0 4e 4f 50 0 5e 5f 60 0 6e 6f 70	41 42 43 51 52 53 61 62 63 71 72 73	54 55 56 57 58 5 64 65 66 67 68 6 74 75 76 77 78 7	9 5a 5b 5c 5d 9 6a 6b 6c 6d 9 7a 7b 7c 7d
> > ~	Type: 802.10 Virtual LAN (0x8100) 802.10 Virtual LAN, PRI: 1, DEI: 0, ID: 1 Data (134 bytes) Parallel Redundancy Protocol (IEC62439 Pa [PRP Version: PRP-1]	100 art 3)	005 006 007 008 009	0 3e 3f 40 0 4e 4f 50 0 5e 5f 60 0 6e 6f 70 0 7e 7f 00	41 42 43 51 52 53 61 62 63 71 72 73 a2 b0 86	54 55 56 57 58 5 64 65 66 67 68 6 74 75 76 77 78 7 88 fb	9 5a 5b 5c 5d 9 6a 6b 6c 6d 9 7a 7b 7c 7d
> >	Type: 802.10 Virtual LAN (0x8100) 802.10 Virtual LAN, PRI: 1, DEI: 0, ID: 1 Data (134 bytes) Parallel Redundancy Protocol (IEC62439 Pa [PRP Version: PRP-1] Sequence number: 162	100 art 3)	005 006 007 008 009	0 3e 3f 40 0 4e 4f 50 0 5e 5f 60 0 6e 6f 70 0 7e 7f 00	41 42 45 51 52 53 61 62 63 71 72 73 a2 b0 86	54 55 56 57 58 5 64 65 66 67 68 6 74 75 76 77 78 7 88 fb	9 5a 5b 5c 5d 9 6a 6b 6c 6d 9 7a 7b 7c 7d
> >	Type: 802.10 Virtual LAN (0x8100) 802.10 Virtual LAN, PRI: 1, DEI: 0, ID: 1 Data (134 bytes) Parallel Redundancy Protocol (IEC62439 Pa [PRP Version: PRP-1] Sequence number: 162 1011 = LAN: LAN B (11)	100 art 3)	005 006 007 008 008	0 3e 3f 40 0 4e 4f 50 0 5e 5f 60 0 6e 6f 70 0 7e 7f 00	41 42 45 51 52 53 61 62 63 71 72 73 a2 b0 86	54 55 56 57 58 5 64 65 66 67 68 6 74 75 76 77 78 7 88 fb	9 5a 5b 5c 5d 9 6a 6b 6c 6d 9 7a 7b 7c 7d
> > <b>&gt;</b>	Type: 802.1Q Virtual LAN (0x8100) 802.1Q Virtual LAN, PRI: 1, DEI: 0, ID: 1 Data (134 bytes) Parallel Redundancy Protocol (IEC62439 Pa [PRP Version: PRP-1] Sequence number: 162 1011 = LAN: LAN B (11) LSDU size: 134 [correct]	100 art 3)	005 006 007 008 008	0 3e 3f 40 4e 4f 50 5e 5f 60 6e 6f 70 0 7e 7f 00	41 42 45 51 52 53 61 62 63 71 72 73 a2 b0 86	54 55 56 57 58 5 64 65 66 67 68 6 74 75 76 77 78 7 88 fb	9 5a 5b 5c 5d 9 6a 6b 6c 6d 9 7a 7b 7c 7d

Figure 110. Wireshark Capture of PRP Tagged Frames in LAN B

# GPIO/TIMER CONFIGURATION TAB WHEN USING PRP MODE

In the **GPIO/Timer** page, the options to configure the Timers as TSN/periodic output are shown as available, but not intended for use when the device is configured for PRP mode.

# VLAN TABLE OPERATION IN PRP MODE

The web server does not expose the VLAN configuration pages that are included with the TSN functionality (VLAN table operation, prioritization, and remapping). The default VLAN table behavior is for forwarding on VLAN ID 0x0 and 0xFFF. VLAN configuration can be performed when using the TSN Driver Library, for more details, refer to the ADIN6310 Hardware Reference Manual.

## SWITCHING TABLE IN PRP MODE

# Dynamic Table, Learning Operation

Normal learning is disabled when in PRP mode.

# **Static Table Entries**

Entries can be placed into the static table in the usual way and used to direct traffic from the DANP/End Node Host to a SAN on one of the LANs. For the ADIN6310, static entries can be used to route traffic from the Host to ports not involved in PRP network or from the other ports to SANs on the network, as shown in Figure 111 and Figure 112. This traffic is not duplicated, and do not have PRP RCT tags added and only egress on the port(s) defined by the installed table entry.

By default, broadcast entries do not forward in the PRP device, therefore, user needs to install a broadcast entry in the Switching table to support broadcast frames crossing from Port C to Port A/Port B. This is required to ping across a PRP device.



Figure 111. Host Routing to SAN on One of the LANs



Figure 112. Host Routing to SAN Device on One of the LANs or to Another Port

# **Extended Table Entries**

In PRP mode, extended table is available and entries can be installed similar to the static table.

HSR is a ring protocol that provides seamless fail-over in event of a single failure in the network. The Switch supports being configured as a doubly attached node obeying HSR (DANH) or HSR Redundancy box (Redbox). Following initial device configuration, the Host configures the Switch for the required HSR function. In the case of a DANH, Port A/Port B/Port C are defined. In the case of a RedBox, Port A/Port B/Port C are defined as well as any other Interlink ports used to bridge singly attached node (SAN) devices to the HSR ring. The Host sets the link redundancy entity (LRE) MAC address (same as Host MAC address) and enables the HSR function.

Once configured for the HSR mode, the Switch hardware takes care of HSR functionality, duplicating the outgoing traffic onto each of its ring ports with the HSR tag inserted into the frame. On receipt of HSR frames from the ring, the receiving device consumes the first frame, removes the tag on reception and discards duplicates. The Switch generates supervisory frames and maintains a nodes table that lists other HSR entities in the network based on the supervision frames it received from the ring ports. The HSR supervisory frames are generated periodically with or without VLAN tag every 2 seconds. The hardware records the last time a frame is received from a node, refreshing the nodes table. Each device in the HSR ring maintains its own nodes table. Node entries are removed from the table based on the NodeForgetTime default of 1 minute. The node table is currently capable of supporting up to 1024 entries. The nodes table records entries for DANH, RedBox, and VDAN devices connected to the ring, based on the supervision frames circulating the ring.

When operating as a RedBox, the Switch maintains a **Proxy Node Table** in addition to the Nodes table. The **Proxy Node Table** is a list of the detected SANs that are connected to the RedBox and the last time they are seen. The **Proxy Node Table** learns the SAN/VDAN MAC based on ingressing traffic on ports configured as Interlink ports. Like the nodes table, the **Proxy Node Table** keeps its table refreshed based on incoming frames and ages out entries after 60 seconds. The maximum size of the **Proxy Node Table** for HSR Redbox is 8. The Switch supports operation of one instance of HSR on the 6-port ADIN6310 Switch, multiple instances of HSR running on the 6-port device is not supported.

The Switch HSR functionality can be configured to support:

- ▶ HSR as DANH
- HSR as RedBoxSAN
- ▶ HSR with LLDP and VLAN Table

Enabling PTP functionality with HSR is not currently supported, future software updates include this capability. Using TSN features such as Scheduled Traffic, Frame Preemption, Per Stream Filtering, and Policing or Frame Replication and Elimination for Reliability with HSR is not supported.

#### HSR OPERATING MODES

The Switch supports the various HSR Modes. Mode H is the default operating mode.

- ▶ MIB\_PRP\_HSR\_modeH: Default mode, the DANH inserts the HSR tag on behalf of its Host and forwards the ring traffic, except for frames sent by the node itself, duplicate frames, and frames for which the node is the unique destination.
- MIB\_PRP\_HSR\_modeN: No forwarding, node behaves as Mode H with the exception that it does not forward ring traffic from Port to Port.
- MIB\_PRP\_HSR\_modeT: Transparent forwarding, removes the HSR tag before forwarding the frame to the other Port and sends a frame from the Host to both Ports, untagged, and without discarding duplicates.
- MIB\_PRP\_HSR\_modeU: Unicast forwarding, the node behaves as in Mode H, except that it also forwards traffic for which it is the unique destination.
- MIB\_PRP\_HSR\_modeM: Mixed forwarding, the DANH inserts the HSR tag depending on local criteria when injecting frames into the ring.
- MIB\_PRP\_HSR\_modeX: No sending on counter-duplicate, node behaves as in Mode H, except that a Port does not send a frame that is a duplicate of a frame that it received completely and correctly from the opposite direction.

#### ENABLING HSR EXAMPLE

HSR needs to be enabled as part of the initial configuration. To enable HSR, pass an XML file that includes HSR configuration to the ses-configuration.txt file. The XML file must include all relevant HSR configuration. This entails the HSR mode (DANH/RedBox), the identification of which ports are Port A/Port B/Port C and the identification of any interlink ports connected if a RedBox. The LRE MAC address must be the Host MAC address. In case of connection over Ethernet to a PC Network adapter, the LRE MAC address must be the MAC of the network interface controller (NIC). In this example, the LRE MAC is shown as 00:11:11:11:11 and matches the Host MAC, as shown in the RedBox in Figure 113. For more details, see the HSR Specific Configuration section.

After the configuration file has been edited for the relevant HSR configuration, launch the GUI and configure the Switch by clicking **Find and Configure**. Once the device has been configured and the GUI LED turns green, the web server can be opened and shows a reduced feature set, as shown in Figure 114.



Figure 113. HSR Configuration with Two HSR Redbox Devices and One DANH

ADIN6310 TSN Sv	vitch Evaluation Home		
			ADI Chronous
Se Use 1	tup his page to configure device general settings		
Pc Use	IT Statistics his page to show and reset the ADIN6310 port statistics		
Po Use	nt Configuration his page to configure ADIN6310 ports		
G Use	PIO and Timer Configuration his page to configure ADIN6310 GPIOs and Timers	n	
Sv Use	vitching Table his page to configure switching table		
<b>VL</b> Use	AN Table his page to configure the VLAN port forwarding table		
<b>VL</b> Use	AN Remapping his page to configure VID replacement		
<b>VL</b> Use	AN Reprioritization		
L.L. Use t	DP Configuration		
HS Use 1	SR Configuration this page to configure the HSR		
Fil Use	TRIVIATE Update his page to update the ADIN6310 firmware		

Figure 114. Web Page when HSR Function is Enabled

#### **HSR CANDIDATE VIEW**

The default HSR configuration originates from the initial configuration passed from the XML file. In addition, there are some run-time configurable parameters, as shown in the **Candidate** view, see Figure 115. Make the required changes, click the **Save** button followed by **Commit** button to load them to the device. In the **Mode Transition** field, **Mode H** is the default mode.

#### **HSR Configuration**

The HSR Configuration included as follows:

Cut-Through: By default, the Switch is configured for Store and Forward mode. Note that when cut-through operation is enabled for HSR, the device applies it to all Ports. However, Interlink Ports must always operate Store and Forward as the HSR device needs to understand frame size to correctly calculate the LSDU size. Cut-through operation must not be applied to Interlink Ports and result in frames sent from Interlink Ports to Ring Ports with the wrong LSDU size. For now, the Switch must only be used in Store and Forward mode when HSR is enabled. This is addressed in future software updates.

- Port-A Admin State: Shows if the Port is active or not, choice of On or Off, default is On.
- LRE MAC Address: Shows the MAC address as set in the XML configuration file.
- Max Reside Time: Sets the maximum duration for which an entry may reside in the duplicate list. The default is 625 expressed in second fraction, which corresponds to 15µs × 625. The range of possible values is 0 to 26214 (corresponding to 15 µs to 400 ms).
- Evaluate Supervision: By default, the Switch evaluates supervision frames in the network and add nodes to its nodes table. This can be disabled by clearing the check box.

- Supervision VLAN ID (0-4095): By default, the supervision frames are sent untagged (VLAN 4095). To send supervision frames with a VLAN tag, enter a valid VLAN ID in this field.
- Supervision Address: The supervision frames have a multicast destination MAC address 01:15:4E:00:01:xx. The last byte is programmable. The default is 0x00, but can be configured to use any value between 0x00 and 0xFF.

HSR Configuration			ADI Chronous
Version 3.1.0 Copyright 2020 - 2024 Analog D	evices, Inc.	AHEAD OF MHAT'S POSSIBLE*	SCALABLE ETHERNET THED TO POSTDETEN
Home	This is the HSR configuration page		
Setup	Data Cardida Durin Data Carda Durin		
Port Statistics	Status Candidate Running Statup Commit Discaro		
Port Configuration			
GPIO and Timer Configuration	Save		
Switching Table			
LLDP Configuration	Mode Transition		
HSR Configuration	Mode H 🔘 Mode N 🌑 Mode U 💿 Mode X 🌑 Mode T 💿 Mode M 💿		
Firmware Update	HSR Supervision		
	Redundancy Device HSR-SAN REDBOX V Evaluate Supervision	<b>Z</b>	
	Cut-Through Enable O Disable O Supervision VLAN ID (0-4095) 4	4095	
	Port-A Admin State On O Off O Supervision Address 01-15-4E-00-01-	00	
Port 0 Port 1 Port 2 Port 3 Port 4 Port 5	Port-B Admin State On O Off O		
	LRE MAC Address 00-0A-CD-3E-15-D2		
	Max Reside Time(second fraction) 625		
	VLAN ID (0-4095) 4094		

Figure 115. HSR Candidate View

#### **HSR STATUS VIEW**

The Status page shows the LRE Statistics and the Node Table Statistics. See Figure 116.

The **Status** page shows the **LRE Statistics**, which shows the traffic statistics and error counters associated with each HSR port. The **Node Table Statistics** provides a list of the other HSR entities in the network, in addition to how many nodes in the network. When the device is configured as a Redbox, the **Proxy Node Table** provides a list of SANs connected to the device Interlink Ports.

The LRE Statistics fields are as follows:

- Rx Count: Shows the number of frames received by Port A or Port B that have a HSR tag.
- ► **Tx Count**: Shows the number of frames transmitted by Port A or Port B that have a HSR tag inserted.

- Error Count: Shows the number of frames with errors received on the LRE Port A or Port B.
- Duplicate Count: Shows the number of entries in the duplicate detection mechanism on Port A or Port B for which one single duplicate is received.
- Multi Count: Shows the number of entries in the duplicate detection mechanism on Port A or Port B for which more than one duplicate is received.
- Unique Count: Shows the number of entries in the duplicate detection mechanism on Port A or Port B for which no duplicate is received.
- Node Count: Returns the number of nodes detected in the system.

2.0.0 Converselt 2020 2024 Apples Devices	a kao					ADI Chronou
n 3.0.0 Copyngnt 2020 - 2024 Analog Devices	s, inc.				ANEXAL OF BRIAL SPRUSSERS	SEX ALL COMMENT OF CITY.
T	his is the HSI	R configurati	ion page			
	Status Car	ndidate Runr	ning Startup			
tistics						
nfiguration						
nd Timer Configuration						
ig Table		Port A	LRE Statistics	Patica	Jost)	
onfiguration	Bx Count	6837	6847		1051)	
re Update	Tx Count	38	38	7837		
	Error Count	18	0	0		
	Duplicate Coun	t 6809	0			
Port 1 Port 2 Port 3 Port 4 Port 5	Multi Count	0	0			
	Unique Count	10	0			
	Own Count	0	0			
	Node count	17				
	Node count	17	Clear LRE Table	•		
	Node count	17	Clear LRE Table Node Table Stati	stics		
	Node count	17 ress	Clear LRE Table Node Table Stati Time Last Seen A (Time Ticks 1/100s)	stics Time Last Seen B (TimeTicks 1/100s		1
	Node count Index Mac Addr 1 B4-96-9	17 ress 91-8C-DE-55	Clear LRE Table Node Table Stati Time Last Seen A (TimeTicks 1/100s) 1394231	stics Time Last Seen B (TimeTicks 1/100s 1394231	) Type danh	]
	Node count Index Mac Addr 1 84-96-9 2 84-96-9	17 ress 91-8C-DE-55 91-8C-DE-56	Clear LRE Table Node Table Stati Time Last Seen A (TimeTicks 1/100s) 1394231 1394230	stics Time Last Seen B (TimeTicks 1/100s 1394231 1394230	Type danh danh	
	Node count Index Mac Addr 1 84-96-9 2 84-96-9 3 84-96-9	17 ress 91-8C-DE-55 91-8C-DE-56 91-8C-DE-57	Clear LRE Table Node Table Stati Time Last Seen A (TimeTicks 1/100s) 1394231 1394230 1394229	stics Time Last Seen B (TimeTicks 1/100s 1394231 1394230 1394229	Type danh danh danh	
	Node count Index Mac Addr 1 84-96-9 2 84-96-9 3 84-96-9 4 84-96-9	17 ress 91-8C-DE-55 91-8C-DE-56 91-8C-DE-57 91-8C-DE-57 91-8C-DE-58	Clear LRE Table Node Table Stati Time Last Seen A (TimeTicks 1/100s) 1394231 1394230 1394229 1394228	stics Time Last Seen B (TimeTicks 1/100s 1394231 1394230 1394229 1394228	Type danh danh danh danh	
	Node count Index Mac Addr 1 B4-96-9 2 B4-96-9 3 B4-96-9 4 B4-96-9 5 B4-96-9	17 ress 91-8C-DE-55 91-8C-DE-55 91-8C-DE-56 91-8C-DE-57 91-8C-DE-58 91-8C-DE-59	Clear LRE Table Node Table Stati Time Last Seen A (TimeTicks 1/100s) 1394231 1394229 1394229 1394228 1394227	stics Time Last Seen B (Time Ticks 1/100s 1394231 1394230 1394229 1394228 1394227	Type danh danh danh danh danh	
	Node count Index Mac Addi 1 84-96-9 2 84-96-9 3 84-96-9 4 84-96-9 5 84-96-9 6 84-96-9	17 ress 91-8C-DE-55 91-8C-DE-55 91-8C-DE-56 91-8C-DE-57 91-8C-DE-58 91-8C-DE-59 91-8C-DE-54	Clear LRE Table Node Table Stati Time Last Seen A (TimeTicks 1/100s) 1394230 1394220 1394228 1394227 1394226	stics Time Last Seen B (TimeTicks 1/100s 1394231 1394220 1394229 1394228 1394227 1394226	Type danh danh danh danh danh danh danh	
	Node count Index Mac Addi 1 84-96-9 2 84-96-9 3 84-96-9 4 84-96-9 5 84-96-9 6 84-96-9 7 84-96-9	17 ress 91-8C-DE-55 91-8C-DE-56 91-8C-DE-57 91-8C-DE-58 91-8C-DE-59 91-8C-DE-54 91-8C-DE-58	Clear LRE Table Node Table Stati Time Lasi Seen A (Time Tids 1/106) 1394231 1394229 1394228 1394227 1394226 1394225	stics Time Last Seen B (Time Last Seen B (Time Ticks 1/100) 1394231 1394220 1394222 1394227 1394222 1394225	Type danh danh danh danh danh danh danh danh	
	Node count Index Mac Adde 1 B4-96-9 2 B4-96-9 3 B4-96-9 5 B4-96-9 6 B4-96-9 8 B4-96-9 8 B4-96-9 8 B4-96-9	17 ress 91-8C-DE-55 91-8C-DE-56 91-8C-DE-57 91-8C-DE-58 91-8C-DE-59 91-8C-DE-58 91-8C-DE-58 91-8C-DE-58 91-8C-DE-56	Clear LRE Table Node Table Staffi Time Last Seen A (TimeTicks 1/100e) 13942231 13942230 1394223 1394227 1394226 1394225 1394225 1394225	stics Time Last Seen B (TimeTicks 1/100s 1394221 1394229 1394227 1394227 1394225 1394225 1394225	Type danh danh danh danh danh danh danh danh	
	Node count Index Mac Add 1 84-96-9 2 84-96-9 3 84-96-9 5 84-96-9 5 84-96-9 7 84-96-9 8 84-96-9 9 84-96-9 9 84-96-9	17 ress 91-8C-DE-55 91-8C-DE-56 91-8C-DE-57 91-8C-DE-58 91-8C-DE-59 91-8C-DE-56 91-8C-DE-56 91-8C-DE-50 91-8C-DE-50	Clear LRE Table Node Table Statis Time Last Seen A (TimeTicks 1/100s) 1394221 1394229 1394228 1394227 1394225 1394225 1394224	Stics           Time Last Seen B (TimeTicks 1/100s)           1394231           1394220           1394228           1394228           1394226           1394226           1394225           1394224           1394223	Type danh danh danh danh danh danh danh danh	
	Node count Index Mac Add 1 84-96-9 2 84-96-9 3 84-96-9 4 84-96-9 5 84-96-9 6 84-96-9 8 84-96-9 8 84-96-9 9 84-96-9 10 84-96-9	17 11-8C-DE-55 11-8C-DE-55 11-8C-DE-55 11-8C-DE-57 11-8C-DE-58 11-8C-DE-58 11-8C-DE-58 11-8C-DE-50 11-8C-DE-55 11-8C-DE-55 11-8C-DE-55 11-8C-DE-55	Clear LRE Table Node Table Statin Time Lat's Seen A (TimeTicks 1/100s) 1394231 1394223 1394228 1394228 1394226 1394225 1394225 1394225 1394223 1394223	Stics           Time Last Seen B (TimeTicks 1/1005)           1394231           1394230           1394229           1394228           1394228           1394226           1394227           1394228           1394229           1394229           1394229           1394229           1394221           1394225           1394223           1394223           1394223	Type danh danh danh danh danh danh danh danh	
	Node count Index Mac Add 1 84-96-9 2 84-96-9 3 84-96-9 4 84-96-9 5 84-96-9 7 84-96-9 8 84-96-9 9 84-96-9 10 84-96-9 11 84-96-9	17 11-8C-DE-55 11-8C-DE-55 11-8C-DE-56 11-8C-DE-57 11-8C-DE-58 11-8C-DE-58 11-8C-DE-58 11-8C-DE-50 11-8C-DE-50 11-8C-DE-5E 11-8C-DE-5E 11-8C-DE-5E 11-8C-DE-5E	Clear LRE Table Node Table Static Time Lat's een A (TimeTicks 1/100s) 1394231 1394220 1394225 1394226 1394225 1394225 1394225 1394223 1394223 1394223	Stics           Time List Seen B           TimeTicks 1/100s           1394231           1394230           1394220           1394228           1394226           1394226           1394227           1394226           1394227           1394228           1394228           1394228           1394228           1394228           1394228           1394228           1394223           1394223           1394223           1394223           1394223	Type danh danh danh danh danh danh danh danh	
	Node count Index Mac Add 1 84-96-9 2 84-96-9 3 84-96-9 4 84-96-9 6 84-96-9 7 84-96-9 8 84-96-9 8 84-96-9 10 84-96-9 11 84-96-9 12 84-96-9	17 11.8C-DE-55 11.8C-DE-56 11.8C-DE-56 11.8C-DE-58 11.8C-DE-58 11.8C-DE-58 11.8C-DE-58 11.8C-DE-56 1	Clear LRE Table Node Table Static Time Last Seen A (TimeTicks 1/100s) 1394231 1394229 1394229 1394228 1394227 1394226 1394225 1394224 1394223 1394223 1394223 1394223 1394223	Stics           Time Last Seen B           Time Virtual Sector           1394231           1394230           1394223           1394228           1394228           1394226           1394227           1394226           1394227           1394228           1394228           1394229           1394228           1394228           1394228           1394224           1394223           1394223           1394223           1394223           1394223           1394223           1394223           1394223           1394223           1394236	Type danh danh danh danh danh danh danh danh	
	Node count           Index Mac Add           1         84-96-9           2         84-96-9           3         84-96-9           5         84-96-9           6         84-96-9           7         84-96-9           8         84-96-9           10         84-96-9           11         84-96-9           12         84-96-9           13         84-96-9	17 14:55 14:6C-DE-55 14:6C-DE-56 14:6C-DE-57 14:6C-DE-58 14:6C-DE-59 14:6C-DE-58 14:6C-DE-58 14:6C-DE-58 14:6C-DE-56 14:6C-D	Clear LRE Table Node Table Staff Time Last Seen A (TimeTicks 1/100e) 1394223 1394229 1394226 1394226 1394225 1394225 1394223 1394223 1394233 1394233 1394233	States           Time Last Seen B (TimeTicks 1/100s)           1394231           1394220           1394220           1394227           1394226           1394225           1394224           1394225           1394224           1394225           1394224           1394225           1394223           1394233           1394234           1394235	Type danh danh danh danh danh danh danh danh	
	Node count Index Mac Add 1 84-96-9 2 84-96-9 3 84-96-9 4 84-96-9 5 84-96-9 6 84-96-9 7 84-96-9 9 84-96-9 10 84-96-9 11 84-96-9 13 84-96-9 14 84-96-9	17 18-0-DE-55 11-80-DE-55 11-80-DE-56 11-80-DE-56 11-80-DE-58 11-80-DE-58 11-80-DE-58 11-80-DE-58 11-80-DE-59 11-80-DE-56 11-80-DE-56 11-80-DE-60 11-80-DE-62	Clear LRE Table Node Table Statis Time Last Seen A (TimeTicks 1/100s) 1394231 1394223 1394227 1394225 1394225 1394225 1394223 1394233 1394233 1394235 1394235	Sitis           Time Last Seen B (TimeTicks 1/100s)           1394231           1394220           1394220           1394220           1394225           1394226           1394225           1394226           1394226           1394226           1394227           1394228           1394226           1394223           1394223           1394231           1394232           1394235           1394234	Type danh danh danh danh danh danh danh danh	
	Node count Index Mac Add 1 84-96-9 2 84-96-9 3 84-96-9 5 84-96-9 6 84-96-9 7 84-96-9 8 84-96-9 9 84-96-9 10 84-96-9 11 84-96-9 13 84-96-9 14 84-96-9 15 84-96-9	17 11-8C-DE-55 11-8C-DE-55 11-8C-DE-56 11-8C-DE-59 11-8C-DE-59 11-8C-DE-59 11-8C-DE-59 11-8C-DE-59 11-8C-DE-59 11-8C-DE-59 11-8C-DE-61 11-8C-DE-61 11-8C-DE-63	Clear LRE Table Node Table Statis Time Last Seen A (TimeTicks 1/100e) 1394220 1394220 1394226 1394226 1394226 1394225 1394225 1394223 1394233 1394233	Stics           Time Last Seen B (TimeTicks 1/100c)           1394231           1394220           1394228           1394226           1394226           1394226           1394226           1394226           1394226           1394226           1394226           1394225           1394223           1394234           1394236           1394236           1394234           1394234           1394234	Type danh danh danh danh danh danh danh danh	
	Node count           Index Mac Add           1         84-96-9           2         84-96-9           3         84-96-9           4         84-96-9           5         84-96-9           6         84-96-9           7         84-96-9           8         84-96-9           9         84-96-9           10         84-96-9           11         84-96-9           12         84-96-9           13         84-96-9           14         84-96-9           15         84-96-3           16         84-96-3	17 11-8C-DE-55 11-8C-DE-55 11-8C-DE-56 11-8C-DE-56 11-8C-DE-58 11-8C-DE-58 11-8C-DE-58 11-8C-DE-58 11-8C-DE-58 11-8C-DE-58 11-8C-DE-58 11-8C-DE-58 11-8C-DE-58 11-8C-DE-61 11-8C-DE-61 11-8C-DE-62 11-8C-DE-62 11-8C-DE-64 11-8C-DE-64	Clear LRE Table Node Table Statin Time Last Seen A (TimeTicks 1/100s) 1394231 1394223 1394228 1394228 1394226 1394226 1394225 1394225 1394223 1394233 1394235 1394235 1394233 1394233	Stics           Time Last Seen B           1394231           1394231           1394230           1394220           1394228           1394228           1394227           1394228           1394228           1394229           1394223           1394223           1394223           1394223           1394233           1394234           1394235           1394233           1394233           1394233	Type danh danh danh danh danh danh danh danh	
	Node count Index Mac Add 1 84-96-9 2 84-96-9 3 84-96-9 5 84-96-9 6 84-96-9 7 84-96-9 8 84-96-9 9 84-96-9 10 84-96-9 10 84-96-9 11 84-96-9 12 84-96-9 13 84-96-9 14 84-96-9 15 84-96-9 15 84-96-9 17 00-90-E	17 11-8C-DE-55 11-8C-DE-55 11-8C-DE-56 11-8C-DE-56 11-8C-DE-56 11-8C-DE-58 11-8C-DE-58 11-8C-DE-56 11-8C-DE-56 11-8C-DE-61 11-8C-DE-61 11-8C-DE-61 11-8C-DE-61 11-8C-DE-63 11-8C-DE-64 11-8C-DE-63 1	Clear LRE Table Node Table Statin Time Last Seen A TimeTicks 1/1002) 1394231 1394220 1394228 1394228 1394226 1394226 1394225 1394225 1394223 1394238 1394238 1394237 1394236 1394235 1394235 1394234 1394234 1394234 1394232 1396066	Stics           Time Last Seen B TimeTicks 1/1005           1394231           1394230           1394220           1394223           1394226           1394226           1394227           1394228           1394228           1394228           1394228           1394228           1394226           1394228           1394228           1394228           1394228           1394236           1394236           1394236           1394238           1394234           1394232           1394232           1394232           1394232           1394232	Type danh danh danh danh danh danh danh danh	

Figure 116. HSR Status Page

#### **Nodes Table Statistics**

The **Nodes Table Statistics** shows the MAC addresses of other HSR devices in the network. The nodes table is built up of entries based on Supervision frames received by the Switch from other HSR devices. The nodes table can hold maximum of 1024 entries. By analyzing the incoming the supervision frames, the Switch reports the time (in TimeTicks 1/100 seconds) at which other devices were last seen on either Port A or Port B and reports the type of each device. The Host can access this information to gain insight into the workings of the network/network functionality and to identify any issues. The nodes table continuously refreshes its content. Node entries are automatically removed from the table if traffic from that address has not been seen by the Switch within a duration of 60 seconds.

#### **Proxy Node Table**

As shown in Figure 117, the **Proxy Node Table** shows the MAC addresses of the detected SAN devices connected to the Interlink Ports when the device is configured as a Redbox. The **Proxy Node Table** can support up to 8 entries. The entries are learned based on the traffic sent into the Interlink Port. The table refreshes each entry every 60 seconds, with entries getting removed from the table if traffic from that address is not seen again within this duration.



Figure 117. HSR Status Page for HSR Redbox with Proxy Node Table Entries

#### **HSR RUNNING VIEW**

HSR **Running** page shows the configuration loaded to the device. See Figure 118.



Figure 118. HSR Running Page

#### **HSR STARTUP VIEW**

HSR **Startup** page shows the **Startup** configuration. See Figure 119.

HSR Configuration			ANALOG	DI Chronous
Version 3.0.0 Copyright 2020 - 2024 Analog De	evices, Inc.		NEND OF MINUTS POSSERT* 22	A ALL CHARMET THEE TO PERFECTION
	This is the HSR configuration	nage		
Home	the is no not comiguration	. pago		
Setup				
Port Statistics	Status Candidate Running	Startup		
Port Configuration				
GPIO and Timer Configuration				
Switching Table	Mo	de Transition		
HSR Configuration	Mode H 🔘 Mode N 🔵 Mode U	J 🌒 Mode X 🌒 Mode	Г 🔵 Mode M 🔵	
Firmware Update	USD.		Supervicio	
	Cut-Through	Enable 🔘 Disable 🔿	Evaluate Supervision	
	Port-A Admin State	On Off o	Supervision VLAN ID (0-4095)	4095
	Port-B Admin State	On Off 🍥	Supervision Address 01-15-4E-0	0.01- 00
Port 0 Port 1 Port 2 Port 3 Port 4 Port 5	LRE MAC Address	00-0A-CD-3F-71-C5	Supervision Address 01-10-42-0	00
	Max Reside Time(second fraction	) 625		
	VLAN ID (0-4095)	4094		

Figure 119. HSR Startup Page

#### **HSR – SUPERVISION FRAMES**

The Wireshark capture shown in Figure 120 is a supervision frame sent out from the Switch on Port B. By default, supervision frames are sent out on both ring ports at a 2 second interval and without

VLAN tags. The Switch sends a supervision frame for LRE MAC address for the DANH. Supervision frames are sent out to the HSR ring, so only visible on Port A and Port B. The HSR tag can be seen in the frame with the suffix 0x892f.

No.	Time	Source	Destination	Protocol	Lengt	Info						$^{\sim}$
	1 0.000000000	SunrichT_3f:71:c5										
	2 0.000006488	SunrichT_3f:71:c5	Iec_00:01:00	HSR/PRP	78	HSR	Supervi	sion				
	3 0.000179686	SunrichT_3f:71:c5	Iec_00:01:00	HSR/PRP	78	HSR	Supervi	sion				$\sim$
<										3	•	
>>> > > > > > > > > > > > > > > > > >	<pre>Frame 1: 78 bytes IEEE 802.3br Frame Ethernet II, Src: &gt; Destination: Ie &gt; Source: Sunrich Type: High-avai High-availability 0000 0000 0011 Sequence number Type: Parallel HSR/PRP Supervisio 0000 0000 0000 Sequence number TLV type: HSR N TLV length: 6</pre>	on wire (624 bits), 78 byt : Preemption Protocol SunrichT_3f:71:c5 (00:0a:c :c_00:01:00 (01:15:4e:00:01 IT_3f:71:c5 (00:0a:cd:3f:71 lability Seamless Redundancy Seamless Redundancy (IEC62 = Path: 0 = Lane id: Lane A (0) 0100 = LSDU size: 52 [corrol : 723 Redundancy Protocol (PRP) i = Path: 0 0001 = Version: 1 : 723 Hode (23)	es captured (624 bits) on interf d:3f:71:c5), Dst: Iec_00:01:00 ( :00) :c5) cy (IEC62439 Part 3) (0x892f) 439 Part 3 Chapter 5) ect] and HSR Supervision (IEC62439 Pa	aci 00000 0010 0020 0030 0040	55 55 55 55 cd 3f 71 c5 17 06 00 00 00 00 00 00 00 00 00 00	55 5 89 2 cd 3 00 0 00 0	5 55 d5 1 00 34 7 71 c5 0 00 00 0 00 00 0 00 00	01 15 02 d3 00 00 00 00 00 00	6 4e ( 88 1 9 00 ( 9 00 ( 9 3d 1	900 01 Fb 00 900 00 900 00 900 00 FØ ec	00 0 01 0 00 0 00 0 87	9 0; 2 d: 9 0; 9 0;
	Source MAC Addr TLV type: End o TLV length: 0	ess: SunrichT_3f:71:c5 (00 f TLVs (0)	:0a:cd:3f:71:c5)									

Figure 120. HSR Supervision Frame

#### **HSR – CAPTURE OF HSR TAGGED TRAFFIC**

The Wireshark capture shown in Figure 121 is traffic sent into Port C of the DANH and observed on Port A. The HSR tag can be seen

in the frame with type 0x892f in addition to the LAN information, SDU size and sequence number.

			•															
No	o. Time	Source	Destination	Prot	tocol		L	engt	Info								^	1
	1 0.000000000	IntelCor_8c:de:5e	SunrichT_3f:71:c5	HSR	t			164	HSR-	Data	Fra	me						I.
	2 0.001000328	IntelCor_8c:de:5d	SunrichT_3f:71:c5	HSR	t			164	HSR-	Data	Fra	me						ł
	3 0.002000072	IntelCor_8c:de:5c	SunrichT_3f:71:c5	HSR	ł			164	HSR-	Data	Fra	me						l
	4 0.002999616	IntelCor 8c:de:5b	SunrichT 3f:71:c5	HSR	t in the second s			163	HSR-	Data	Fra	me						I.
<																>		4
>	Frame 2: 164 byte	s on wire (1312 bits),	164 bytes captured (1312 bits)	on inter	0000	55 5	5 55	55	55 5	5 55	d5	00 (	Da d	cd 31	F 71	c5	b4 9	1
>	IEEE 802.3br Fram	e Preemption Protocol			0010	91 8	c de	5d	89 2	f 00	8a	0a 9	94 1	12 0	ð 00	00	00 0	r
>	Ethernet II, Src:	IntelCor 8c:de:5d (b4	:96:91:8c:de:5d), Dst: SunrichT	3f:71:c	0020	04 0	5 06	07	08 0	9 Øa	Øb	0c (	0d (	0e 0	f 10	11	12 1	Ц
~	High-availability	Seamless Redundancy (	IEC62439 Part 3 Chapter 5)	_	0030	14 1	5 16	17	18 1	9 1a	1b	1c :	ld 1	le 1	ŕ 20	21	22 2	4
	0000	= Path: 0			0040	24 2	5 26	27	28 2	9 2a	20	20 2	20 2	2e 2	: 30 F 40	31 41	32 3	1
	000	<pre> = Network id: 0</pre>			0050	44 4	5 46	47	48 4	9 4a	4h	4 4	4d 4	1e 4	F 50	51	52 5	1
	0	= Lane id: Lane	A (0)		0070	54 5	5 56	57	58 5	9 5a	5b	5c !	5d 5	5e 5	F 60	61	62 6	
	0000 1000	1010 = LSDU size: 138	[correct]		0080	64 6	5 66	67	68 6	9 6a	6b	6c (	5d 6	5e 61	F 70	71	72 7	r.
	Sequence numbe	r: 2708			0090	74 7	5 76	77	78 7	9 7a	7b	7c 🕻	7d 7	7e 7	F 80	81	82 8	3
	Type: Unknown	(0x1200)			00a0	54 0	e 94	<b>a</b> 3										1
	> Data (132 byte	s)																

Figure 121. Wireshark Capture of HSR Tagged Frames in the HSR Ring Seen at Port A

MRP is a redundancy protocol used to avoid single points of failure in industrial communications networks. The MRP protocol is based on a ring topology and in accordance with IEC 62439-2 2021 standard. For full details on MRP protocol review the detailed standard. The following descriptions provide an overview of MRP to help describe the functionality provided by the Switch and does not intend to be a full overview of MRP function.

## MRP STACK ON THE SWITCH

MRP can be configured on startup of the Switch or during run-time. The MRP stack is running on the Packet Assist Engine, thereby, offloading MRP overhead from the Host. The Switch supports operation as a media redundancy client (MRC), a media redundancy manager (MRM), or a media redundancy automanager (MRA).

The Switch does not support interconnected rings.

One instance of MRA/MRC/MRM is supported on a 6-port device. All TSN functionality is supported with MRP.

## **RECOVERY PROFILES**

When the Switch is configured for MRP operation, it supports recovery profiles of 500 ms, 200 ms, or 30 ms. In practice, all MRP devices in the ring may be configured with the same recovery profile, but it is also possible to have different recovery profiles. For example, the MRM can be configured with a 30 ms recovery profile and the clients with 200 ms profile.

#### **CONFIGURING MRP**

MRP can be configured up front using parameters in the xml file, alternatively, it can be enabled during run-time via the MRP web page. To enable it up front, see MRP Specific Configuration section.

By default (web page or XML), the Switch is configured as an MRC with a recovery profile of 500 ms and with Port 1 and Port 2 used as ring ports. If configuring more than one device with MRP from one PC, always configure MRP up front before connecting the ring.

#### CANDIDATE PAGE

The **Candidate** page (see Figure 122) provides user ability to configure how the MRP capability of the device should operate. The configuration included are as follows:

- MRP Role: Choice of Client (default), Manager, or Auto-Manager.
- **Domain ID**: Unique Domain ID for the MRP ring.
- **Domain Name**: Domain name for the ring.
- ▶ OUI: MRP OUI, defaults to 0x080006 (Siemens OUI).
- ▶ Domain VLANID: Defaults to untagged/4095.
- Recovery Profile: Choice of 30 ms, 200 ms, or 500 ms (default).
- Ring Port 1/Ring Port 2: Default Port 1 and Port 2, choice of any pair of ports.
- Ring 1 Priority/Ring 2 Priority: Default Queue 7 is highest priority. PTP traffic also egresses in Queue 7. If using lowest recovery profile, change default PTP queue from 7 to a lower priority in the Time Synchronization page.
- React on Link Change: For faster recovery, enable React on Link Change. This allows the manager to react on the link change frames instead of waiting for test frames to timeout.

Status	Candidate	Running	Startup	Commit	Discard
Save	J				
		Confi	guration		
MRP Rol	e	Client			~
Domain I	D (hex)	FFFFFF	FFFFFFF	FFFFFFFF	FFFFFFF
Domain I	Name	MRP			
OUI		080006			
Domain \	/lanID (0-4095	4095			
Recovery	/ Profile	500ms			~
Ring Por		Port 1			~
Ring Por	12	Port 2			~
Ring 1 Pr	riority:	7			
Ring 2 Pr	riority:	7			
Manager	Priority	0			
React on	Link Change				

Figure 122. MRP Candidate Page – Default Configuration

The MRP **Status** Page (see Figure 123) provides insight into the MRP configuration, the state of the ring, the forwarding/blocked position of the ports (for MRM), and statistics related to the MRP operation.

ome		configuration page		
tup				
rt Statistics	Status Candi	idate Running Startup		
rt Configuration				
PIO and Timer Configuration				
vitching Table	MRP disabled curr	rently. Once enabled from web page, note that cor	figuration needs to be active befo	re a ring is connected in the network
AN Table		Domain Information		Domain Statistics
AN Remapping	Domain ID:	(FEFFEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF	Ring Open Count	0
LAN Reprioritization	Domain Name	MRP	Last open timestamp	0
me Synchronization	OUI:	080006	Round Trip Delays Max (msec)	0
ame Preemption	Domain VLAN ID:	4095	Round Trip Delays Min (msec)	0
heduled Traffic - Assign Queue	Recovery Profile:	500ms 🗸	Domain Errors:	noError
heduled Traffic - Set Queue Max. SDU	Ring State:	disabled		
heduled Traffic - Schedule	Ring Port 1:	Port 1 🗸		
DP Configuration	Ring 1 State:	disabled		
RP Configuration	Ring 1 Priority:	7		
mware Update	Ring Port 2:	Port 2 🗸		
	Ring 2 State:	disabled		
	Ring 2 Priority:	7		

Figure 123. MRP Status Page – Default Configuration – MRP Disabled

#### **MRP SCENARIOS: MRM AND MRC**

The following example shows a simple MRP configuration with two Switch devices in a ring topology. Switch 1 is configured as MRM and Switch 2 configured as MRC through the web server.



Figure 124. MRP Configuration with Two Switches, One MRM, One MRC

Status	Candidate	Rupping	Starbus	Commit	Discar
Status	Ganuldate	Running	Startup	Commit	Discar
Save					
Cave					
		Confi	guration		
MRP Role	2	Manager			
Domain II	D (hex)	FFFFFF	FFFFFFFF	FFFFFFFF	FFFFFF
Domain N	lame	MRP			
OUI		080006			
Domain V	lanID (0-4095)	4095			
Recovery	Profile	500ms			
Ring Port		Port 1			
Ring Port		Port 2			
Ring 1 Pr	iority:	7			
Rina 2 Pr	iority:	7			

Figure 125. MRP Candidate Page: Switch 1, MRP Enabled as MRM (Manager)

his is the	e MRP confi	guration (	oage					
Status	Candidate	Running	Startup	Commit	Discard			
Save								
		Confi	guration					
MRP Role	e	Client			~			
Domain II	D (hex)	FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF						
Domain N	lame	MRP						
oui		080006						
Domain V	/lanID (0-4095	4095						
Recovery	Profile	500ms			~			
Ring Port		Port 1			~			
Ring Port		Port 2			~			
Ring 1 Pr	iority:	7						
Ring 2 Pr	iority:	7						
Manager	Priority	0						
React on	Link Change							

Figure 126. MRP Candidate Page: Switch 2, MRP Enabled as MRC (Client)

After configuration, the ring cables are connected and from the **Status** page shown in Figure 127, Switch 1 configured as MRM reports the ring is closed, it is forwarding on Ring Port 1 with Ring Port 2 blocked. Figure 128 shows that Switch 2 as MRC is forwarding on both ports. Per the IEC standard, the MRC does not report the ring state, instead shows it as undefined.

Status Candi	daté Runni	ng Startup		
	Domain	Information		
MRP Role:	Manager		~	
Domain ID:	FFFFFFF	FFFFFFFFFFFFFFF	FFFFFFFF	
Domain Name	MRP			
OUI:	080006			
Domain VLAN ID:	4095			
Recovery Profile:	500ms		$\sim$	
Ring State:	ringClosed			
Ring Port 1:	Port 1		~	
Ring 1 State:	forwarding			
Ring 1 Priority:	7			
Ring Port 2:	Port 2		~	
Ring 2 State:	blocked			
Ring 2 Priority:	7			
Manager Priority:	32768			
		Domain Statistics		
Ring Open Count		1		
Last open timesta	mp	1008474		
Round Trip Delay	s Max (msec):	1		
Round Trip Delay	s Min (msec)	0		
Domain Errors:		noError		

Figure 127. MRP Status Page: Switch 1, MRM (Manager) – Ring Closed

Status Cand	idate Running Startup	
	Domain Information	
MRP Role:	Client	
Domain ID:	FFFFFFFFFFFFFFFFFFFFFFFFFFFFF	
Domain Name	MRP	
OUI:	080006	
Domain VLAN ID	4095	
Recovery Profile:	500ms 🗸	
Ring State:	undefined	
Ring Port 1:	Port 1	
Ring 1 State:	forwarding	
Ring 1 Priority:	7	
Ring Port 2:	Port 2	
Ring 2 State:	forwarding	
Ring 2 Priority:	7	
	Domain Statistics	
Ring Open Count	0	
Last open timesta	imp 0	
Round Trip Delay	s Max (msec): 0	
Round Trip Delay	s Min (msec) 4294967295	
Domain Errors:	noError	

Figure 128. MRP Status Page: Switch 2 MRC (Client) – Ring Closed

Figure 129 shows the MRP test frames sent out each MRM ring port. When the recovery profile is 500 ms, these frames are sent every 50 ms on both ports.

In event of a fault in the ring, the MRM device no longer sees the test frames on the other ring port and opens the blocked port to forward traffic around the ring. MRP devices send other MRP frames with information related to what is happening in the ring

such as MRP\_LinkChange and MRP\_TopologyChange, see Figure 130 and Figure 131.

		7a:c6:bb:11:11:14	Iec_00:00:01				
	267 0.000151	7a:c6:bb:11:11:13	Iec_00:00:01	PN-MRP	60	0.000151000 MRP_Test, MRP_Common, MRP_End	
	268 0.050024	7a:c6:bb:11:11:14	Iec_00:00:01	PN-MRP	60	0.049873000 MRP_Test, MRP_Common, MRP_End	
	269 0.050133	7a:c6:bb:11:11:13	Iec_00:00:01	PN-MRP	60	0.000109000 MRP_Test, MRP_Common, MRP_End	
	270 0.100017	7a:c6:bb:11:11:14	Iec_00:00:01	PN-MRP	60	0.049884000 MRP_Test, MRP_Common, MRP_End	
	271 0.100137	7a:c6:bb:11:11:13	Iec_00:00:01	PN-MRP	60	0.000120000 MRP_Test, MRP_Common, MRP_End	
	272 0.150005	7a:c6:bb:11:11:14	Iec_00:00:01	PN-MRP	60	0.049868000 MRP_Test, MRP_Common, MRP_End	-
<				211 1122			>
> Fra	me 266: 60 bytes (	on wire (480 hits) 60 hv	tes cantured (480 hits)	on interface \Device\NPE (673)	0000	01 15 4e 00 00 01 7a c6 bb 11 11 14 88 e3 00 01	
> Fth	ernet II. Src: 7a:	c6:bb:11:11:14 (7a:c6:bb	:11:11:14). Dst: Tec 00	:00:01 (01:15:4e:00:00:01)	0010	02 12 80 00 7a c6 bb 11 11 11 00 00 00 01 00 06z	
Y PRO	ETNET MRP MRP Test	. MRP Common, MRP End		(01115) (01115) (0100) (01)	0020	00 2b fa 2d 01 12 67 f2 ff ff ff ff ff ff ff ff ffg	
	MRP Version: 1				0030	ff ff ff ff ff ff ff ff 00 00 00 00	
~	MRP_TLVHeader.Type	e: MRP_Test (0x02)					
	MRP TLVHeader.T	ype: MRP Test (0x02)					
	MRP_TLVHeader.L	ength: 18					
	MRP_Prio: 0x800	0 Default priority for r	edundancy manager				
	MRP_SA: 7a:c6:b	b:11:11:11 (7a:c6:bb:11:	11:11)				
	MRP_PortRole: P	rimary ring port (0x0000	)				
	MRP_RingState:	Ring closed (0x0001)					
	MRP_Transition:	0x0006					
	MRP_TimeStamp [	ms]: 0x002bfa2d					
~	MRP_TLVHeader.Type	: MRP_Common (0x01)					
	MRP_TLVHeader.T	ype: MRP_Common (0x01)					
	MRP_TLVHeader.L	ength: 18					
	MRP_SequenceID:	0x67f2					
	MRP_DomainUUID:	ffffffff-ffff-ffff-ffff	-fffffffffff				
~	MRP_TLVHeader.Type	: MRP_End (0x00)					
	MRP_TLVHeader.T	ype: MRP_End (0x00)					
	MRP_TLVHeader.L	ength: 0					

#### Figure 129. MRP Test Frames from Both Ports of MRM Every 50 ms

Jo. Time 456 9.531488 458 9.550986	Source 7a:c6:bb:11:11:13	Destination Iec_00:00:02	Protocol PN-MRP	Length	Time de	elta from previous disp	Info	
456 9.531488 458 9.550986	7a:c6:bb:11:11:13	Iec_00:00:02	PN-MRP					
458 9.550986	7					0.00000000	MRP_TopologyChange, MRP_Com	mon, MRP_End
	/d:C0:DD:II:II:I5	Iec_00:00:02	PN-MRP		60	0.019498000	MRP_TopologyChange, MRP_Com	mon, MRP_End
459 9.571026	7a:c6:bb:11:11:13	Iec_00:00:02	PN-MRP		60	0.020040000	MRP_TopologyChange, MRP_Com	mon, MRP_End
463 9.590976	7a:c6:bb:11:11:13	Iec_00:00:02	PN-MRP		60	0.019950000	MRP_TopologyChange, MRP_Com	mon, MRP_End
<ul> <li>Frame 456: 60 bytes on</li> <li>Ethernet II, Src: 7a:ct</li> <li>PROFINET MRP_MRP_Topol( MRP_Version: 1</li> <li>MRP_TLVHeader.Type:</li> </ul>	wire (480 bits), 60 by 5:bb:11:11:13 (7a:c6:bb ogyChange, MRP_Common, MRP_TopologyChange (0x	tes captured (480 bits) :11:11:13), Dst: Iec_00: MRP_End 03)	on interface \Device\N 00:02 (01:15:4e:00:00:	IPF_{673B( 00 00 00 00 00	00 01 15 10 03 0a 20 ff ff 30 00 00	5 4e 00 00 02 7a 0 1 80 00 7a c6 bb 1 5 ff ff ff ff ff ff 0 00 00 00 00 00 00 0	c6         bb         11         11         13         88         e3         00         01           11         11         11         00         3c         01         12         a5         05           ff         ff <th>N z</th>	N z
MRP_TLVHeader.tyr MRP_TLVHeader.ter MRP_Prio: 0x8000 MRP_SA: 7a:c6:bb MRP_Interval: 60 ✓ MRP_TLVHeader.Type: MRP_TLVHeader.ter MRP_SequenceID: ( MRP_SequenceID: ( MRP_DomainUUID: 1	<pre>pe: NRP_TopologyChange gth: 10 Default priority for r: 11:11:11 (7a:c6:bb:11:: Interval for next topo: MRP_Common (0x01) we: NRP_Common (0x01) ugth: 18 bxa505 fffffffffffffffffffffffffffffffffff</pre>	(0x03) sdundancy manager [1:11] Logy change event (in ms	) Mandatory					

#### Figure 130. MRP Topology Change Frame – Link Opened Somewhere in the Ring Port 1 Side of MRM

397 6.080072270	7a:c6:bb:22:22:13	Iec_00:00:02	PN-MRP	64 MRP_LinkDown, MRP_Comm				
398 6.080216040	7a:c6:bb:11:11:14	Iec_00:00:01	PN-MRP	64 MRP_Test, MRP_Common, I	MRP_End			
399 6.099721878	7a:c6:bb:22:22:13	Iec 00:00:02	PN-MRP	64 MRP LinkDown, MRP Comm	ion, MRP End			
400 6.110109288	7a:c6:bb:11:11:14	Iec_00:00:01	PN-MRP	64 MRP_Test, MRP_Common, M	MRP_End			
401 6.119723662	7a:c6:bb:22:22:13	<pre>Iec_00:00:02</pre>	PN-MRP	64 MRP_LinkDown, MRP_Comm	ion, MRP_End			
402 6.119866616	7a:c6:bb:11:11:14	<pre>Iec_00:00:01</pre>	PN-MRP	64 MRP_Test, MRP_Common, I	MRP_End			
<								
<ul> <li>&gt; Frame 337: 64 bytes on</li> <li>&gt; Ethernet LI, Scr. 7a: c</li> <li>&gt; PROFINET MRP MRP_LinkD</li> <li>MRP_Version: 1</li> <li>&gt; MRP_TUVHeader.Type:</li> <li>NRP_TUVHeader.Type:</li> <li>NRP_TUVHeader.Type:</li> <li>NRP_SA: 7a:c6:bb</li> <li>MRP_PortRole: Pr</li> <li>NRP_Blocked: 0x0</li> <li>PR0FME_SIC</li> <li>PR0F_SICHEAGE: 0x0</li> <li>PR0F_SICHEAGE: 0x0</li> </ul>	wire (512 bits), 60 (51b):22:22:13 (7a:c6 own, MRP_Common, MRP_ MRP_LinkDown (0x04) pe: NRP_LinkDown (0x04) mgth: 14 :22:22:11 (7a:c6:bb): Interval for next to 801 The NRC is able t MRP_Common (0x08)	bytes captured (48 :bb:22:22:13), Dst: End 04) 12:222:11) 000) co receive and forw	00 bits) on interfa Iec_00:00:02 (01: t (in ms) Mandatory ard frames to port	ce 801f125f7652_B, id 2 15:4e:00:00:02) / in state blocked	0000 0010 0020 0030	01 15 4e 00 00 02 7a c6 04 0e 7a c6 0b 22 22 11 01 12 00 13 ff ff ff ff ff ff ff ff 00 00 00 00	bb 22 22 13 88 e3 00 01 00 00 00 50 00 01 00 00 ff ff ff ff ff ff ff ff ff 00 00 00 00	
MRP_TLVHeader.Le MRP_SequenceID: MRP_DomainUUID:	ngth: 18 0x0013 fffffffff-ffff-ffff-ff	ff-ffffffffffff						
MRP TLVHeader.Type:	MRP End (0x00)							



Status Candi	date Runni	ng Startup	
MPP Palar	Domain	Information	
Domain ID:	manager		
Domain Name	MDD		
OUI	020006		
Domain VI ANUD:	4005		
Recovery Profile:	500ms		~
Ring State:	ringOpen		
Ring Port 1:	Port 1		$\mathbf{v}$
Ring 1 State:	forwarding		
Ring 1 Priority:	7		
Ring Port 2:	Port 2		$\mathbf{v}$
Ring 2 State:	forwarding		
Ring 2 Priority:	7		
Manager Priority:	32768		
		Domain Statistics	
Ring Open Count		4	
Last open timesta	mp	2630702	
Round Trip Delay	s Max (msec):	1	
Round Trip Delay:	s Min (msec)	0	
Domain Errors:		noError	

Figure 132. MRP Status Page: Switch 1 MRM (Manager) - Ring Port 1 Open

Status Candi	date Running Startup
	Domain Information
MRP Role:	Client 🗸
Domain ID:	(FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
Domain Name	MRP
OUI:	080006
Domain VLAN ID:	4095
Recovery Profile:	500ms 🗸
Ring State:	undefined
Ring Port 1:	Port 1
Ring 1 State:	forwarding
Ring 1 Priority:	7
Ring Port 2:	Port 2 V
Ring 2 State:	not-connected
Ring 2 Priority:	7
	Domain Statistics
Ring Open Count	0
Last open timesta	mp 0
Round Trip Delays	s Max (msec): U
Round Trip Delay:	s Min (msec) 4294967295
Domain Errors:	noError

Figure 133. MRP Status Page: Switch 2 MRC (Client) - Ring Port 1 Open

#### **MRP SCENARIOS: MRA**

A ring can only have one MRM. In a configuration where there is more than one MRA, the MRA devices use the MRP Voting process to decide who is the rings MRM.

When configuring a ring with multiple MRAs, other devices must be configured with MRA or MRC roles. Per the IEC62439-2 standard, it is not supported to have MRA and MRM combinations in one ring.

The **Status** page shows additional information for the MRA configuration, for example, reporting the best Manager MAC. Voting is based on priority and MAC address. The MRP priority is 0xA000 (40960) for MRA devices. Since both devices have the same priority, voting is based on MAC address.



his is the MRP configuration page								
Status Candidate	Running Startup Commit Discard							
Save								
a the second second	Configuration							
MRP Role	Auto_Manager 🗸							
Domain ID (hex)	FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF							
Domain Name	MRP							
oui	080006							
Domain VlanID (0-4095)	4095							
Recovery Profile	500ms 🗸							
Ring Port 1	Port 1 🗸							
Ring Port 2	Port 2 🗸							
Ring 1 Priority:	7							
Ring 2 Priority:	7							
Manager Priority	0xa000							
React on Link Change								

Figure 135. MRP Configuration with Two Switches, Both Configured as MRA Using Web Server

Figure 134. MRP Configuration with Two Switches, Both Configured as MRA

his is the MRP configuration page								
Status Candi	date Runni	ing Startup						
	Domain	Information						
MRP Role:	Manager	V						
Domain ID:	FFFFFFF	FFFFFFFFFFFFFFFFFFF						
Domain Name	MRP							
OUI:	080006							
Domain VLAN ID:	4095							
Recovery Profile:	500ms	~						
Ring State:	ringClosed							
Ring Port 1:	Port 1	~						
Ring 1 State:	forwarding							
Ring 1 Priority:	7							
Ring Port 2:	Port 2	✓						
Ring 2 State:	blocked							
Ring 2 Priority:	7							
Manager Priority:	0							
		Domain Statistics						
Ring Open Count		1						
Last open timesta	mp	93089						
Round Trip Delay	s Max (msec):	1						
Round Trip Delay	s Min (msec)	0						
Domain Errors:		multipleMRM singleSideReceive						
Best Manag Informatio	jer n							
Best Manager MA	C: 7A-	-C6-BB-11-11-11						
Best Manager Pri	ority: 409	960						
Clear Don	nain Errors	Clear Round trip delays						

Figure 136. MRP Configuration with Two Switches, Switch 1 Becomes MRM

his is the MRP (	configuration page
Status Candi	date Running Startup
	Domain Information
MRP Role:	Client
Domain ID:	(FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
Domain Name	MRP
OUI:	080006
Domain VLAN ID:	4095
Recovery Profile:	500ms 🗸
Ring State:	undefined
Ring Port 1:	Port 1
Ring 1 State:	forwarding
Ring 1 Priority:	7
Ring Port 2:	Port 2
Ring 2 State:	forwarding
Ring 2 Priority:	7
	Domain Statistics
Ring Open Count	0
Last open timesta	mp 0
Round Trip Delays	Max (msec): 0
Round Trip Delays	Min (msec) 4294967295
Domain Errors:	multipleMRM
Best Manager Information	
Best Manager MAC:	7A-C6-BB-11-11-11
Best Manager Priority:	40960

Figure 137. MRP Configuration with Two Switches, Switch 2 Becomes MRC

Per-stream filtering and policing (PSFP), as defined by IEEE 802.1Qci standard provides filtering policing for a stream.

The purpose of this feature is to prevent traffic overload conditions from affecting the receiving node. This is done by filtering traffic on a per-stream basis.

PSFP applies to Store and Forward Switching as frame size must be known to apply a filter. A cut-through frame starts forwarding before the full frame size is known.

The filtering and policing capabilities apply on a stream basis to the receive path:

- ▶ Size based filters 32 per port
- ▶ Time based filters 16 gates per port
- ▶ Rate based filters 8 per port

Any stream can be assigned to any combination of filters and the device can support up to 32 combinations of filters.

PSFP relies on Switching table entries (static entries and extended table entries) mapped to a stream filter. Stream table entries with PSFP are not yet supported.

Version 4.0.0 Copyright 2020 - 2024 Analog	Devices, Inc.
Home	This is the PSFP configuration page
Partura .	
Det Statistics	Status Candidate Running Startup Commit Discard
Port Configuration	
IGMP Second Configuration	Save
Switching Table	Stream Filter Table :
VLAN Table	
VLAN Remapping	Fritz, PortMan Stream Priority SOU Block Blocker Uses Frame Flow Flow
VLAN Reprioritization	Handle Spec Stze Crusbled Stream Gate Ref Meter Ref Enable
Time Synchronization	Add
Frame Preemption	Row and a second se
Scheduled Traffic - Assign Queue	
Scheduled Traffic - Set Queue Max. SDU	Stream Gate Table :
Scheduled Traffic - Schedule	Gate Admin Gate Admin Cycle Admin Cycle Race Time Race Time Gate Consed Gate Closed Gate Closed Gate Closed Gate Closed Gate Closed
LLDP Configuration	Entry PortMap Enable States Admini II-V Inne (s)
PSFP Configuration	Add Row
MRP Configuration	
Stream Table	Flow Meter Table :
FRER Configuration	Committed Committed Excess
Firmware Update	Entry PontMap Information Burst Size Information Excess Burst Coupling Celor Drop On Frames Red Mark All Brief (1701/brief) (orderla) (orderla) Size (0018/b) Flag Mode Vellow Enable Frames Red
	Add Row

Figure 138. PSFP Candidate View

#### **PSFP CANDIDATE PAGE**

#### **Stream Filter**

Filtering of frames is based on VLAN Priority (PCP), stream ID and frame size. Frames matching the filter in excess of the programmed frame size are discarded. The stream filter can be blocked or unblocked. The stream filter can optionally be associated with a stream gate and flow meter. Frames that fail the filter are discarded. The configuration included are as follows:

- PortMap: Ingress port map to apply the filter to. Can be an individual port or group of ports.
- Stream Handle: Stream ID, map stream ID to Static table entry. Uniquely identifies the stream filter to be used.
- Priority Spec: VLAN Priority/PCP, 0 to 7, 0xFF indicates Wildcard/any priority.

- Max SDU Size (bytes): Frames in excess of MaxSDU value are discarded. MaxSDU definition includes the MAC addresses and FCS.
- Stream Block Enabled: Provides ability to completely block stream if the stream violates the programmed MaxSDU. If disabled (default), any frames that exceed MaxSDU for the filter are discarded, smaller frames are allowed to be received. If enabled, any frame that exceeds the MaxSDU for the filter are discarded and all subsequent matching frames are dropped unconditionally.
- Clear Blocked Stream: Allows user to clear a blocked stream (blocked/unblocked status is visible in the Status page).
- ► Use Stream Gate and Stream Gate Ref: To associate a stream gate, enable the check box and pass the stream gate ID.
- Use Flow Meter, Flow Meter Ref, Flow Meter Enable: To associate a flow meter with the stream filter, select the use check box, provide the flow meter ID and enable the flow meter.



Figure 139. Stream Filter Configuration

Stream Filter Table :												
Entry	PortMap	Stream Handle	Pi	riority Spec	Max SDU Size (bytes)	Stream Block Enabled	Clear Blocked Stream	Use Stream Gate	Stream Gate Ref	Use Flow Meter	Flow Meter Ref	Flow Meter Enable
0	0x04	0	4	~	1500				255		255	
1	0x04	1	3	~	1000				255	<b>X</b>	0	<b>2</b>
2	0x04	2	6	~	850	<b>Z</b>			255	<b>X</b>	1	<b>Z</b>
Add Row												

Figure 140. Stream Filter with Multiple Entries and Flow Meters Associated

#### **Stream Gate**

The Stream Gate is either open or closed. The Stream Gate monitors the arrival time of frames on that stream and uses the port Timer control unit to control the gate, similar to that of Scheduled traffic on the Transmit side. If a stream arrives when the gate is open, accept the frame and perform the required lookups and handle as required. Alternatively, if the stream arrives when the gate is closed, discard the frame.

Internal Priority Vector (IPV) – The Stream Gate can change the IPV of a frame.

The Stream Gate can allow ports support a defined amount of traffic in a certain amount of time, Octets per unit time based on the port Timer control unit (TCU).

Note that the cycle time for the Stream Gate must match that of Scheduled Traffic for the port.

The stream gate configuration parameters are as follows:

- Gate ID/Ref: Entry value corresponds to the Gate reference. This uniquely identifies the Stream Gate instance to be used and linked to the stream filter.
- PortMap: Ingress port map to apply the filter to. Can be an individual port or group of ports.
- ▶ Gate Enable: Enable the stream gate function.
- Admin Gate States: If open, frames are permitted to pass through the gate. If closed, frames are not permitted to pass.
- Admin IPV: Gives Stream Gate opportunity to change a frames traffic class. If null value is passed, the priority value associated with the frame is used to determine the frames traffic class. If an IPV value is passed, the IPV value is used in place of the priority value associated with the frame, the priority value is not changed within the frame itself.
- Admin Cycle Time (Numerator, Denominator): Sets cycle time for the Stream Gate. Default 1 ms. Cycle time must be same as the Cycle time configured in Scheduled traffic for that port.

- Admin Cycle Time Extension: The Cycle Time Extension value defines the maximum amount of time by which the old cycle is permitted to be extended when Switching to a new schedule for the Stream Gate.
- Base Time (s, ns): Absolute time at which a new Stream Gate schedule is required to take effect.
- ► Gate Control: Provides additional configuration of the Stream Gate schedule parameters.
- **Config Change**: Enable to update parameters.
- Gate Closed Invalid RX Enable: When enabled, if any frame is discarded because the gate is in the closed state, then the gate remains in the closed state and all subsequent frames are discarded. If disabled, has no effect.
- Gate Closed Octet Exceeded Enable: When enabled, if any frame is discarded because there is insufficient value of Interva-IOctetsleft, then the gate closes and remains in the closed state and all subsequent frames are discarded. During an interval, each frame size is compared to IntervalOctetsleft, if the frame size is smaller than IntervalOctetsleft, the frame passes the gate and the frame size is subtracted from IntervalOctetsleft.

Gate Control fields provide four entries as follows:

- Time Interval Value (ns): Time interval.
- Gate-State-Value: Open or closed.
- ▶ IPV Spec: Use Ignore IPV to leave stream route based on admin IPV. Alternatively, if reprioritization is required, pass the IPV value with the traffic class the stream should egress.
- Interval Octet Max: Maximum number of octets allowed to pass during a time interval, if exceeded, subsequent frames are discarded.
- Interval Octet Enable: When set, indicates the Interval Octet value must be used.

Stream F	ilter Table	:															
Entry	PortMap	Stream Handle	Priority Spec	Max SDI (byte	USize Strea rs) En	n Block Strea	am Block Oversize Frame	d Use Stream Gate	n Stream Gate Ref	Use Flow Meter	Flow Meter Ref	Flow Mete Enable	r				
	0x08	0	4 <b>v</b>	850			•		0		255						
Add									*								
Row										En	able St	ream G	ate 0				
Stream G	ate Table																
																o	
Entry	PortMa	p Gate Enable	Admin Gate States	Admin IPV	Admin Cycle Tim (Numerator)	(s) Admin Cycl (Denom	le Time (s) Admi ninator) Ext	n Cycle Time ension (ns)	Base Time (s)	Base	e Time (ns)	Gate control	Config Change	Gate Closed Inv RX Enable	Gate Closed Inv RX	Oct Exd	Gate Closed Oct Exd
0	0x04	<b>v</b>	open 🗸	four 👻	1	1000	0		0	0						Enable	
Add Rov	1								-	-							
Gate contro	i entry																
Inde		peration name	Time inte	rval value	Gate-state-	Spec Interval (	Octet Interval Octet Enabl	<b>b</b>									
	set	-gate-and-ipv	<ul><li>100000</li></ul>		open 👻 Igno	re 🕶 0											
	set	gate-and-ipv	900000		ciosec 🗸 🛛 zero	✓ 0											
	set	-gate-and-ipy	<b>X</b> 0		open 🗸 Zero				0								
	set	gate-and ipv	✓ 0		open 👻 two				Option to	cnan	ge						
					Close three			IP'	V/repriori	tize w	hich						
0	pen 1	00us, cl	osed		four				eoress	gate							
900	us of 1	lms Cva	le time		six					Bare							
500	15 01 3	unis cyc			Sev	n In Invi Comb		Market M	lark All								
Entry	PortMap	<ul> <li>Informatio</li> <li>Rate (100kb</li> </ul>	n Burst Si (octets	ize Inform s) Rate (1	mation Size (u	re IPV Coupling acco) Flag	g Color L Mode	Yellow Fran	mes Red Frames	Red							
Add Rov	1	find (room	ter (orang	,													

Figure 141. Stream Filter and Stream Gate

#### **Flow Meter**

Stream data per unit time allows a certain amount of traffic through the port. This feature uses a token bucket or a bandwidth profile where it compares a frame size to how many tokens in a one or two buckets (commit, excess).

The flow meter configuration parameters are as follows:

- Flow Meter ID/Ref: Entry value corresponds to the Flow meter reference. This uniquely identifies the flow meter instance to be used and linked to the stream filter.
- PortMap: Ingress port map to apply this filter to. Can be an individual port or group of ports.
- Committed Information Rate: CIR expressed in units of 100 kbps. Rate at which tokens are added to commit bucket.
- Committed Burst Size: CBS, expressed in octets, maximum capacity of the commit bucket.
- Excess Information Rate: EIR, expressed in units of 100 kbps. Rate at which tokens are added to excess bucket.
- Excess Burst Size: EBS, expressed in octets, maximum capacity of the excess bucket.
- Coupling Flag: Shows whether any overflow in the commit bucket tokens must be added to excess bucket. Select the check box to enable coupling the overflow to the excess bucket.

- Color Mode: Option of Color Aware or Color Blind. If Color Aware is selected, the VLAN tag drop eligible indicator (DEI) bit of incoming frames is used in metering decisions. Incoming frames, with DEI bit set to one, are dropped if drop on yellow is enabled. If Color Blind, then incoming frame color is ignored.
- Drop on Yellow: If enabled, discard yellow frames. If disabled, forward yellow frames if bandwidth allows. Yellow frames have their DEI bit set to 1 before transmitting. Drop on Yellow control is only available when color mode is Color Aware. Disabled by default.
- Mark All Frames Red Enable: If enabled, mark all incoming frames red, discard all frames. When disabled (default) flow meter works as normal.
- ▶ Mark All Frames Red: Enables the Mark All frames Red.

In the example shown in Figure 142, three separate flow meters are configured for use with ingressing traffic on Port 2. The first entry at Flow meter reference 0, configures a CIR rate of 10, corresponding to 1 Mbps ( $10 \times 100$  kbps). The second entry configures a 100 kbps rate. The third entry configures 200 kbps from the commit bucket and uses the excess bucket with an additional 100 kbps. Thus if bandwidth allows, the flow meter potentially grants this stream up to 300 kbps bandwidth.

	Flow Mete	r Table :									
1Mbps	Entry	PortMap	Committed Information Rate (100kbps)	Committed Burst Size (octets)	Excess Information Rate (100kbps)	Excess Burst Size (octets)	Coupling Flag	Color Mode	Drop On Yellow	Mark All Frames Red Enable	Mark All Frames Red
		0x07	10	1500	0	0	zero 🗸	color-aware 🗸			•
100kbps	1	0x07	1	1500	0	0	zero 🗸	color-aware 🗸			
	2	0x07	2	1000	1	100	zero 🗸	color-aware 🗸			•
200kbps	Add Row										

Figure 142. Flow Meter with Different CIR Rates per Stream

Save														
	-													
Stream	Hilter Tab	le :												
					St	ream								
Entry	PortMap	Stream	n Priorit	y Max SDU	Stream B	lock Stream S	tream Gate El	se Flow Mete	r Meter					
		Handle	e Spec	Size (byte	Enabled Ove	ame Gate	Ref Me	ter Ref	Enable					
0	0×07	0	4	✓ 1500			255	0						
Add														
Row														
Stroam	Cato Tabl	la •												
Jucan		G.												
		Gate	Admin Ga	te	Admin Cycle	Admin Cycle	Admin Cycle	Base Time	Base Time	Gate Con	fig Gate Closed	Gate Closed	Gate Closed	Gate Closed
Entry	PortMap	Enable	States	Admin IPV	(Numerator)	(Denominator)	Extension (ns)	(s)	(ns)	control Char	ige Inv RX Enable	Inv RX	Oct Exd Enable	Oct Exd
Add														
Row														
Flow N	leter Table													
<b>F</b> -4-		C	ommitted	Committed	Excess	Excess Burst	Coupling	0-111-1-	Drop On	Mark All	Mark All			
Entr	у Ропи	nap ini Rate	e (100kbps)	octets)	Rate (100kbps	) Size (octets)	Flag	Color Mode	Yellow	Enable	Frames Red			
0	0x04	1		1500	1	1500	zero 🗸	color-aware	× 🗆					
Add R	ow													

Figure 143. Stream Filter + Flow Meter

#### **PSFP STATUS PAGE**

The **Status** page shows statistics for the PSFP functionality. For the stream filter, there are a number of statistics captured and available to read for a number of parameters. PSFP statistics have an associated errata as shown in the **Silicon Anomaly** topic included in the ADIN6310 data sheet.

#### The statistics available are as follows:

- A count of frames matching both the stream\_handle and priority specifications.
- ▶ A count of frames that **passed** the Stream Gate.
- ▶ A count of frames that **did not pass** the Stream Gate.

- ▶ A count of frames that **passed the Maximum SDU** size filter.
- ► A count of frames that **did not pass the Maximum SDU** size filter.
- Whether the stream is blocked due to oversized frame.
- A count of frames that were discarded as a result of the operation of the flow meter.

Statistics are available on a per port basis, select the port of interest to view the statistics. The statistics counts do not accumulate and refreshes of the page resets the values shown.

Statistics for the Stream Gate functionality are not completed yet and added in future updates.



#### Figure 144. Stream Filter Statistics

PSFP Configuration													F	ANALO	g ar		
Version 4.0.0 Copyright 2020 - 2024 Analog D	Devices, Inc.												AHE	DEVIC ID OF WHAT'S POS	ES AL SELE" SCALA	BLE ETHERNET TIMED TO	IS <sup>-</sup> PERFECTION
Home	This is the PSF	P configurati	on page														
Setup																	
Port Statistics	Status Cano	lidate Runnir	ig Startup														
Port Configuration																	
GPIO and Timer Configuration																	
IGMP Spooning Configuration	PSFI	P Stream Paran	neter Status														
Switching Table	Max Stream Filte	r Instances	32														
V/ AN Table	Max Stream Gate		8	-													
V/ AN Remansing	Supported List M	ax	4														
Frame Presention	DSED Stream	Eiltor Statieti	<b>C</b> 8														
	i Si i Sueann	i inter statisti	<b>U</b> 5														
Scheduled Traffic - Assign Queue	Stream Filter Por	t Number :	Port 0 🗸														
Scheduled Traffic Set Queue Max. SDO	SFI ID	Matching Fr Count	ame Passing Fram Count	e Not Passi Frame Co	ng Pas unt	sing SDU Count	Not Passir Cou	ig SDU it	RED	Frames							
UDR Configuration																	
PSEP Configuration																	
MPR Configuration																	
Stream Table	PSFP SGI Stat	tus															
ERER Configuration	Stream Gate Por	t Number :	Port 0 🗸														
Firmware   Indate			Cate Control Entry	Sata Control En	try 0 se	Oper Cu	da Timo		Oper	Pano Timo	Config	Change		Curro	at Timo		
	SGLID Gate	Oper IPV	Time	Cate	uy o 🗸	Oper Cy	Op	er Cycle			ī	ime	Tick	Culle		Config	Config
	State	C	oper Interval	State IPV Spe	C Interval	Num	Den Ex	tension	Sec	NSecs	Sec	NSecs	Granularity	Sec	NSecs	Pending	Error
			Value	Value													
Port 0 Port 1 Port 2 Port 3 Port 4 Port 5																	

Figure 145. PSFP Status View

FRER aims to improve network reliability by reducing packet loss due to equipment failures as defined by the IEEE 802.1CB standard.

The Switch supports the replication of frames in the talker (source) and elimination of frames in the listener (destination). The talker sends replicated streams along two or more redundant paths with a redundancy tag added to the frame. The point of having these redundant paths is to minimize packet loss due to link failure, device failure, or stream congestion. The listener is then responsible for eliminating the duplicate packets. The network ensures that no matter which of the paths the stream takes, it arrives where and when it is supposed to. The Switch includes the sequence generation and recovery algorithms for FRER support.

Note that the FRER needs loop protection to prevent non-FRER/unknown traffic from creating a storm when connecting multiple ports of an FRER system. The default behavior of the Switch is to flood unknown traffic on all ports when the lookup returns a miss. The miss behavior is configurable for Unicast and Multicast/Broadcast traffic. When using FRER function, multiple ports can be connected together between Switches, thereby, creating potential for a loop. A temporary approach to prevent traffic from circulating, is to configure the Unicast and Multicast Miss Return to exclude the duplicate paths. When evaluating FRER, only connect two FRER systems together after the Miss Return has been configured. In the following example, the Miss Return has been configured for the talker system which breaks traffic from circulating in a loop. In the next software release, the Switch includes support for multiple spanning tree protocol (MSTP) functionality, which acts to break any such loop. To support evaluation of FRER functionality without MSTP, configuration of the default miss behavior must be used to prevent a loop.

Recommended sequence to configure FRER functionality to avoid creating a loop as follows:

- 1. Connect only one duplicate path between devices initially.
- 2. Configure first device, with Unicast/Multicast miss returns to exclude other duplicate paths.
- **3.** Configure second device, with Unicast/Multicast miss returns to exclude other duplicate paths.
- 4. Connect second duplicate path.



Figure 146. Frame Replication and Elimination Overview

#### **REDUNDANCY TAG**

The Redundancy Tag (R-Tag) includes an Ether type (F1-C1) and a two-byte sequence number, which gets incremented for each frame

received by the generator. The sequence number is used in the listener recovery function to identify and eliminate duplicates of a frame. Figure 148 shows an R-Tag inserted into a frame.



Figure 148. FRER R-Tag in Frame Observed through Wireshark

#### STREAM IDENTIFICATION

The stream identification function is used to determine the port routing for the streams. There are two types of stream identification: active or passive. Passive identification only examines the packets of the stream, while active identification modifies data parameters

#### Table 17. Stream Identification Types

of the packet to be transmitted. The Switch can be configured to handle all the different stream identifications described in IEEE 802.1CB. Table 17 shows the different types of stream identification, the parameters they examine in a packet, and where applicable, the parameters they overwrite.

Stream Identification	Active/Passive	Examines	Overwrites
Null Stream	Passive	DA, VLAN ID	None
Source MAC and VLAN Stream	Passive	SA, VLAN ID	None
Active Destination MAC and VLAN Stream	Active	DA, VLAN ID	DA, VLAN ID, PCP
IP Stream	Passive	DA, VLAN ID, IP Source, Destination, DSCP, IP next protocol, source port, destination port	None
Mask-and-match Stream	Passive	DA, SA, MAC SDU	None

#### SEQUENCE RECOVERY

There are two sequence recovery algorithms defined by IEEE802.1CB, Match algorithm or Vector algorithm. The Switch supports both recovery algorithms.

When using the Match algorithm, the Switch accepts the first packet received as valid. The sequence number in subsequent packets are evaluated based on their match status with the sequence number of the last accepted packet. If the sequence number matches the last accepted one, it is considered a duplicate and is discarded. If the sequence number does not match, the frame is accepted and forwarded, subsequent frames are compared against this new sequence number. Each accepted sequence number resets a timer. Expiration of the timer resets the algorithm and the next sequence number is accepted. The Match algorithm is ideal for intermittent streams where no more than one packet is in flight on any given path compared to other paths.

The Vector algorithm provides a more robust duplicate elimination. Upon packet arrival, the Switch checks whether the sequence number falls within the range of the sequence number of the previously accepted packet. The acceptable range is defined as plus or minus the history length parameter. Any packets outside of this range are discarded and duplicated packets within the history length are also discarded. Each time a packet is accepted, the timer restarts. When the timer expires, the algorithm resets, which allows acceptance of any sequence number in the next arriving packet. Increasing the history length of the Vector algorithm makes it suitable for scenarios of bulk streams, where there can be more than one packet in flight on any given path.

The Switch allows tracking of the various packet type for the Vector algorithm such as Passed Packets, Discarded Packets, Out-of-Order Packets, Rogue Packets, and Lost Packets.

#### INDIVIDUAL RECOVERY

The individual recovery addresses specific errors, such as a stuck transmitter, which repeatedly sends the same packet. When a transmitter gets stuck, it may send duplicate packets with the same sequence number. The duplicates can disrupt the reliability of the network. The individual recovery identifies repeating sequence number within a single member stream and removes them early on. This allows early detection of errors. The individual recovery can be applied to each port of the Switch.

#### STREAM TABLE

Using **FRER** requires configuration of two web server pages, namely the **Stream Table** and the **FRER** page. The **Stream Table** is currently only used with **FRER** function and installed entries are only active when associated with an **FRER** configuration. The **Stream Table** cannot be used independent of the **FRER** feature.

#### **Stream Table Configuration**

Figure 149 shows an over of the **Candidate** view of the **Stream Table**. This table is used to configure streams used by the **FRER** function:

- ▶ Handle: Number to differentiate between different streams.
- Handle Alias: Alias to nickname the Stream and easily map the handle to the FRER configuration page.
- Port Map: Determines where stream egress.
- Identification Type: Drop-down selection for the different stream identification type.

When configuring a Stream entry, the second row of the stream identification changes based on the identification type. Figure 149 shows the different fields for different identification types based on Table 17. The parameters to be examined need to be configured here. For example, in Figure 149, the first entry is a Null Stream, where the VLAN ID and the destination MAC of interest are configured.

When installing stream entries, where **Stream Table** is false, the entry is installed in the regular static table entry space. Setting stream table to true, installs the entry into the **Stream Table** space. The **Stream Table** can support 16,000 entries, (16 blocks of 1024 entries). Enabling the stream table groups streams together in a single block based on the base MAC address, which is defined by the first 38 bits of the MAC address. The **Stream Table** is ideal for groups of devices in the same MAC address range.
Stream Tab	le									
Entry		Handle	Handle Alias		Identification Type					
1	Delete	100. 0	nul_stream	PS- P4- P3- P2- P1- P0	Null Stream identification 💙					
		VLAN Identifier	useStreamtable	Destination MAC Address						
		100 0	False v	11-11-11-11-11						
Entry	Action	Handle	Handle Alias	Port Map	Identification Type					
2	Delete	101 0	smac_stream	P5- P4- P3- P2- P1- P0	Source MAC and VLAN Strea -					
		VLAN Identifier	Source MAC Address							
-		100 0	11-22-22-22-22-22							
Entry	Action	Handle	Handle Allas	Port Map	Identification Type					
з	Delete	102 0	dmac_stream	PS- P4- P3- P2- P1- P0	Active Destination MAC and 1 v					
		Down VLAN Identifier	Up VLAN Identifier	Up Priority	Down Destination MAC Address	Up Destination MAC Address	useStreamtable			
		100 0	200 0	1 0	11-33-33-33-33	11-44-44-44-44-44	False ~			
Entry		Handle	Handle Alias	Port Map	Identification Type					
4	Delete	103 0	ip_stream	P5- P4- P3- P2- P1- P0	IP Stream identification 🗸					
		VLAN Identifier	Destination MAC Address	P Source Address	P Destination Address		Next Protocol		Destination Port	
		100 0	11-11-11-11-11-11	192.168.1.3	192.168.1.15	0	RFC 768 V	0	0	0 🗸
Entry	Action	Handle	Handle Alias	Port Map	Identification Type					
5	Delete	104 0	mask_match_stream	P5- P4- P3- P2- P1- P0	Mask and Match identificatior $\sim$					
		Mask Length	Mask		Destination MAC Mask Address	Destination MAC Match Address	Source MAC Mask Address	Source MAC Match Address		
		4 0	FF-FF-00-00	12-34-00-00	FF-FF-FF-FF-FF-FF	11-11-11-11-11-11	FF-FF-FF-FF-FF-FF	11-22-22-22-22-22		

Figure 149. Overview of the Stream Table Candidate Page

## FRER CONFIGURATION – CANDIDATE VIEW

The Switch can be simultaneously configured as a **Talker**, Listener, or **Relay** system (see Figure 150). The **FRER** configuration can be configured in the **FRER Configuration Candidate** page. The configuration parameters for the **FRER** function are broken into three distinct sections, as follows:

#### Talker:

- Stream Handle: Drop-down option of existing stream entries. This is mapped to the Handle Alias set in the Stream Table entry. Stream Table changes must be saved and committed to appear as an option in the Stream Handle.
- Port: Stream to apply FRER to, stream ingressing this port is replicated and R-Tag inserted.
- Reset: Set to enable (True) or disable (False) sequence generation reset.

#### Listener:

- Stream Handle: Drop-down option of existing stream entries. This is mapped to the Handle Alias set in the Stream Table entry. Stream Table changes must be committed to appear as an option in the Stream Handle.
- Port List: Ports where R-Tagged stream ingress. This defines which port to apply individual recovery.
- Reset: Set to enable (True) or disable (False) sequence recovery reset.
- **Recovery Algorithm**: Set to **Match** or **Vector** algorithm.
- History Length: Applies to Vector Algorithm, defines the History Length range.
- Reset Timeout: Set duration of reset before timeout.
- ► Take No Sequence: Determines whether frames without a sequence number are to be accepted (True) or not (False).

- Individual Recovery: Determines whether to enable (True) or disable (False) individual recovery.
- Latent Error Detection: Currently set to False, this is not yet available.

#### Relay:

- Stream Handle: This is mapped to the Handle Alias set in the Stream Table. Stream Table changes must be committed to appear as an option in the Stream Handle.
- Sequence Generation Port: Stream entering this port is replicated and R-Tag added. Set to NULL (-) if Tag Operation is set to No Operation.
- Tag Operation: Set whether to Insert R-Tag, Remove R-Tag, or No Operation.
- Sequence Generation Reset: Set to enable (True) or disable (False) sequence generation reset.
- Sequence Recovery Port: Port where R-Tagged stream ingress. This defines which port to apply individual recovery.
- Sequence Recovery Reset: Set to enable (True) or disable (False) sequence recovery reset.
- ▶ Recovery Algorithm: Set to Match or Vector algorithm.
- History Length: Applies to Vector Algorithm, defines the History Length range.
- ▶ **Reset Timeout**: Set duration of reset before timeout.
- Take No Sequence: Determines whether frames without a sequence number are to be accepted (True) or not (False).
- Individual Recovery: Determines whether to enable (True) or disable (False) individual recovery.
- Latent Error Detection: Currently set to False, this is not yet available.

#### Unicast and Multicast Miss:

The default behavior of the Switch is to flood unknown traffic on all ports. The miss behavior is configurable for Unicast and Multicast/Broadcast traffic. When using **FRER** function, multiple ports may be connected together between Switches, thereby, creating potential for a loop. In future software release, the Switch supports MSTP functionality, which acts to break any such loop. To support evaluation of **FRER** functionality without MSTP, configuration of the default miss behavior can be used to prevent a loop. The following examples include configuration for the Miss return:

- ▶ Enable Port: Check box to enable Miss Return on specific port.
- PortMap: Set bit to 1 to route miss values to certain ports.
- ▶ Port Check Box: Check box to route miss values to this port.

Use this page to configure FRER
Status Candidate Running Startup Commit Discard
Save
Unicast and Multicast Miss:
Ports Enable Port PortMap. P5-P4-P3-P2-P1-P0
port0 v Dx3F v v v v v v
port v Dual v v v v v v
parti s Ukar V S V S V S V
Talker:
Entry Action Stream Handle Port Reset
1 Delete null_stream v P0 v Felse v
Add Kow
Listener:
Entry Action Stream Handle Port List Reset Recovery Algorithm History Length Reset Timeout Take No Sequence Individual Recovery Latent Error Detection Difference Period Paths Reset Period
1 Delete smac_stream v 55.94.73.72.91.70 False v Vector v 2 0 10000 0 False v False v False v
Add Row
Relay:
Entry Action Stream Sequence Tag Sequence Sequence Recovery Sequence Recovery History Length Reset Timeout Take No Individual Latent Error Difference Period Paths Reset Algorithm History Length Reset Timeout Sequence Recovery Detection Difference Period Paths Peniod
1 Delete dmac_1 v • v No Oper v False v P5-P4-P3-P2-P1-P1 False v Vector v 2 0 10000 0 False v False v False v
Add Row

Figure 150. FRER Configuration Page

## FRER STATUS

**FRER** statistics are shown in the **Status** view of the **FRER Configuration** page (see Figure 151). The **Status** page currently clears the count on read and does not accumulate, therefore, refreshing the page or navigating to another page and back to **Status** page clears any previous statistics captured. The **Status** page shows the following parameters on a per-stream per port basis:

- ▶ **Passed-pkts**: Count of packets successfully accepted.
- Discarded-pkts: Count of packets discarded.
- Out-of-order-pkts: Count for received packet with a sequence number older than a previous packet and not previously accepted.

- Rogue-pkts: Count of packets with sequence number beyond the history window length.
- Tagless-pkts: Count of packets received without a sequence number.
- Resets: Count of the number of times the sequence recovery reset function is called.
- Encoded-errored-pkts: Count of packets that are unable to be decoded successfully.

age to configur	e FRER							
Candidate Rur	nning Startup							
	Deres die late	Discondent alter	Out of order alth	Denve alte		Todaya alka	Deaste	Fronds arrest alter
lieams	Passeu-pkis	Discarded-pkts	Out-or-order-pkts	Rogue-pkis	LOSI-PKIS	Tagless-pkts	Resels	Encode-enfored-pkts
dmac_stream	0	0	0	0	0	0	0	0
smac_stream	0	0	0	0	0	0	0	0
dmac_stream	0	0	0	0	0	0	0	0
smac_stream	0	0	0	0	0	0	0	0
1	Candidate Rur reams mac_stream mac_stream mac_stream	Candidate Running Startup reams Passed-pkts mac_stream 0 mac_stream 0 mac_stream 0	Candidate     Running     Startup       reams     Passed-pkts     Discarded-pkts       mac_stream     0     0       mac_stream     0     0       mac_stream     0     0       mac_stream     0     0	Candidate     Ruming     Startup       reams     Passed-pkts     Discarded-pkts     Out-of-order-pkts       mac_stream     0     0     0       mac_stream     0     0     0       mac_stream     0     0     0       mac_stream     0     0     0	Candidate Rumming Startup         reams       Passed-pkts       Discarded-pkts       Out-of-order-pkts       Rogue-pkts         mac_stream       0       0       0       0       0         mac_stream       0       0       0       0       0         mac_stream       0       0       0       0       0         mac_stream       0       0       0       0       0	Candidate       Rumming       Startup         reams       Passed-pkts       Discarded-pkts       Out-of-order-pkts       Rogue-pkts       Lost-pkts         mac_stream       0       0       0       0       0       0         mac_stream       0       0       0       0       0       0       0         mac_stream       0	Candidate Ruming Startup         reams       Passed-pkts       Discarded-pkts       Out-of-order-pkts       Rogue-pkts       Lost-pkts       Tagless-pkts         mac_stream       0	Candidate       Ruming       Startup         reams       Passed-pkts       Discarded-pkts       Out-of-order-pkts       Rogue-pkts       Lost-pkts       Tagless-pkts       Resets         mac_stream       0       0       0       0       0       0       0       0         mac_stream       0

Figure 151. FRER Statistics

# TALKER – LISTENER CONFIGURATION EXAMPLE

The following example shows a configuration for a **Talker** and a **Listener** system, which shows the configuration steps needed in the **Stream Table** and **FRER** pages. In this example, each Switch is configured independently from a separate PC/web server.

Recommended sequence to configure **FRER** functionality to avoid creating a loop as follows:

- 1. Connect only one duplicate path between devices initially.
- 2. Configure first device, **FRER/Stream Table** with unicast/multicast miss returns to exclude other duplicate paths.
- 3. Configure second device, with unicast/multicast miss returns to exclude other duplicate paths.
- 4. Connect second duplicate path.



Figure 152. Talker – Listener Configuration Example

#### TALKER SYSTEM

Install a Stream Identification entry in the **Stream Table** for the type of stream, in this case a Null stream. **Port Map** is configured for Port P1 and Port P2 as egress ports for this stream.

**Configure Miss Return** and **Talker System** in the **FRER Configuration** Page. Sequence Generation port is set to Port P0. Unicast and Multicast Miss returns are configured so that unknown traffic ingressing Port P1 do not egress Port P2. Similarly, Port P1 is removed from the Port P2 **Port Map**. This ensures the loop is broken for unknown traffic. Any streams related to the **FRER** configuration have installed table entries based on the **Stream Table** configuration, therefore are not affected by changing the Miss Return configuration.

The VLAN mode is set at the VLAN Table page. Port 0, Port 1, and Port 2 are set to learn and forward mode for the VID of interest.

Use this	page to con	figure FF	RER		
Status	Candidate	Running	Startup	Commit	Discard
Save					
Unicast	and Multica	ast Miss:			
Ports En	able Port Porti	lap P5-P	4- P3- P2- P1	- P0	
port 0 🗸	0x3	F 🗸 🗸	< < < <	✓	
port 1 🗸	0x3	b 🗸 🗸	<ul> <li></li> <li><th><b>~</b></th><th></th></li></ul>	<b>~</b>	
port 2 🗸	0x3	d 🗸 🗸	· • • =	~	
port 3 🗸	0x3	F 🗸 🗸		~	
port 4 🗸	0x3	F 🗸 🗸		~	
nort 5	0x2	F V V			
ponto 🗸	0,51				
Talker:					
Entry	Action	Stroom Hon	dia Port	Pacat	
21	Delete	ull stroam		Falco y	
	Delete	iun_scream		ruise 🔹	
Add Rov	~				

Figure 153. Talker FRER Configuration Example

Note:		
Maxir	num 62 different VLAN IDs c	an be active.
VLAN	N : 100	$\Diamond$
Port	Mode	
0	Learn & Forward	<b>v</b>
1	Learn & Forward	<b>~</b>
2	Learn & Forward	<b>v</b>
3	No Learn & No Forward	<b>~</b>
4	No Learn & No Forward	<b>v</b>
5	No Learn & No Forward	<b>~</b>

Figure 154. VLAN Table Configuration

Stream Ta	able							
Entry	Action	Handle		Handle Alia	15	Port Map	Identification Type	
1	Delete	100 🗘		null_stream		P5- P4- P3- P2- P1- P0	Null Stream identification	~
		VLAN Identifier		useStreamt	able	Destination MAC Address		
		100	0	False	~	11-11-11-11-11		

Figure 155. Talker Stream Configuration Example

The VLAN mode is set at the **VLAN Table** page. Port 0, Port 1, and Port 2 are set to learn and forward mode for the VID of interest.

#### FRAME REPLICATION AND ELIMINATION FOR RELIABILITY (FRER), 802.1CB

#### LISTENER SYSTEM

Install the Stream Identification entry in the **Stream Table**. **Port Map** is set to Port 0 to egress streams at this port.

**Configure Listener System** in the **FRER Configuration** page. The recovery algorithm is set as **Vector** with a **History Length** of 2.

> Note: Maximum 62 different VLAN IDs can be active. VLAN : 100 Port Mode 0 Learn & Forward 1 Learn & Forward 2 Learn & Forward 3 No Learn & No Forward 4 No Learn & No Forward 5 No Learn & No Forward 4

Figure 156. VLAN Table

Stream Tab	le				
Entry	Action	Handle	Handle Alias	Port Map	Identification Type
	Delete	100 0	null_stream	P5- P4- P3- P2- P1- P0	Null Stream identification 💙
		VLAN Identifier	useStreamtable	Destination MAC Address	
		100	C False ✓	11-11-11-11-11	

Figure 157. Listener Stream Configuration Example

	Listener:														
	Entry	Ac	tion	Str	ean	n Hano	dle		Port	List		Reset	R	ecovery	Algorithm
	1	De	lete	null_	str	eam	~	P5- P	4- P3-	P2- P1	- P0	False	~ \	/ector	~
	Add Row														
	History Length		Res	et Timeou		Take No S	Sequence	Individua	Recovery	Latent Erro	or Detectio	n Difference	e Perio	d Paths	Reset Period
2		~ ×	10000		^ V	False	v	False	v	False	v	•			

Figure 158. Listener Configuration Example

IGMP snooping is a method network Switches use to identify multicast groups and forward packets accordingly. Multicast is a one-to-many communication method where data is sent from one source to multiple specific destinations. In a multicast setup, data packets are addressed to a specific group of devices that have expressed interest in receiving the data, which makes it more efficient than broadcast for targeted communication. As such, multicasting is highly efficient as it reduces unnecessary data transmission and processing with only the Hosts that need the data receiving it, thus conserving bandwidth and reducing processing load on uninterested Hosts.

IGMP snooping works by the Switch observing IGMP network traffic and using this information to map the ports of interest in a particular multicast group in order to control traffic flow. The Switch can support IGMP snooping (versions 1, 2, and 3).

IGMP messages are sent by devices informing their intention to join or leave a multicast group. The Switch snoops on these messages and maintains an internal map of which ports are members of which IP multicast transmission, which ensures that the multicast traffic is only sent to the Hosts that have requested it. The example shown in Figure 159 is a scenario where the multicast source out on Port 2 sends IGMP queries, and devices on Port 0 and Port 5 send IGMP reports indicating interest in this multicast group. Subsequently, the Switch controls the flow of traffic to ensure only these two ports receive this particular multicast traffic.

There is no status information provided as part of this feature and no visibility into the internal mapping of ports to IP multicast.



Figure 159. Example of IGMP

IGMP snooping is disabled by default. To use IGMP snooping, enable the function in the **IGMP Snooping Configuration** page. By default, both the **Router Timeout** and the **Group Member Timeout** are programmed to 260 seconds. Click the **Save** button followed by **Commit** button for any changes. The page automatically shows the **Running** view and the Switch starts monitoring the IGMP traffic crossing the Switch and handle any multicast traffic accordingly.

## ROUTER TIMEOUT

The **Router Timeout** is the duration for which a Switch considers a multicast router to be present on a particular port. When a Switch receives IGMP queries from a router on a port, it marks that port as having an active multicast router.

The purpose of the **Router Timeout** is to ensure that the Switch does not keep forwarding multicast traffic to a port where the multicast router is no longer active. This helps prevent unnecessary flooding of multicast traffic. The default timeout is 260 seconds.

#### **GROUP MEMBER TIMEOUT**

The **Group Member Timeout** is the duration for which a Switch considers a Host to be a member of a particular multicast group. When a Switch receives IGMP membership reports from Hosts on specific ports, it marks those ports as having active members for the corresponding multicast groups.

The purpose of the **Group Member Timeout** is to ensure that the Switch does not keep forwarding multicast traffic to ports where there are no longer interested receivers for a particular multicast group. The default timeout value is 260 seconds.



Figure 160. IGMP Snooping Web Page - Candidate View

## **IGMP VERSIONS**

#### IGMPv1:

- Basic Operation: Hosts send IGMP Reports to join groups. The router periodically sends IGMP Queries to verify group memberships.
- Leave Group: Hosts do not explicitly send Leave messages. The Switch relies on the absence of Reports to determine if a Host has left the group.

#### IGMPv2:

- Enhanced Operation: Similar to IGMPv1 but includes the ability for Hosts to send Leave Group messages, which allows a quicker leave detection.
- Leave Group: Hosts can send IGMP Leave messages, prompting the router to send a Group-Specific Query to verify if any other Hosts are still interested in the group.

#### IGMPv3:

- Advanced Features: Supports source-specific multicast (SSM), which allows Hosts to specify which sources they want to receive traffic from within a multicast group.
- Leave Group: Enhanced leave mechanisms and ability to manage memberships based on specific sources.

#### IGMP SNOOPING EXAMPLE

With IGMP snooping disabled, multicast traffic is visible on all ports. IGMP report messages sent from any port to join a multicast group are ignored and all ports continue to receive the multicast traffic.

When IGMP snooping is enabled, consider the following scenario (see Figure 161) where an IGMP report is sent from the device connected to Port P3 (Ethernet\_5) to join a multicast group. At this point, a multicast channel is established between Port P0 (Ethernet\_6) and Port P3 (Ethernet\_5). All multicast traffic entering Port P0 are forwarded only to Port P3 and not to the other ports.



Figure 161. IGMP Snooping Example

This configuration remains active until the **Group Member Timeout** is reached, which is 40 seconds in this case, per configuration in Figure 162. If no new IGMP report is received within this period, the Switch deletes the multicast group, and any multicast traffic of this group sent into Port P0 is treated as broadcast and is forwarded on all ports.

This is th	e IGMP Sno	oping con	figuratior	ı page	
Status	Candidate	Running	Startup	Commit	Discard
Save IGMP Sta	) Itus Ena	abled 🗸			
Router Til (1-300 Se Group Me (30-600 S	meout: econds) ember Timeout: Seconds)	40 40			
Router Ti (1-300 Se Group Me (30-600 S	meout: econds) ember Timeout: Seconds)	40 40			

Figure 162. IGMP Snooping Configuration in Web Server

The Wireshark shown in Figure 163 is the behavior of the network traffic. The group of messages highlighted in orange occurs within the 40 second timeout period. During this time, multicast traffic sent into Port P0 is seen only by Port P3 (Ethernet\_5). After the 40 second period, since no further IGMP report is received, the Switch deletes the multicast group. The subsequent multicast traffic sent into Port P0 is treated as broadcast and forwarded on all ports, as highlighted in red.

With IGMPv1, a device that is part of the multicast group continue receives multicast traffic until the **Group Member Timeout** elapses. It is not possible for a device to stop receiving before the timeout with IGMPv1. This limitation is addressed in IGMPv2, which introduces Leave Group messages allowing ports to explicitly signal when they no longer wish to receive multicast traffic.

Capt	uring from Ethernet 6	<b>P0</b>				🙍 Captur	ing from Ethernet 5	P3			
e <u>E</u> d	lit <u>V</u> iew <u>G</u> o <u>C</u> a	pture Analyze	Statistics Telephony	<u>Wireless</u> <u>To</u>	ols <u>H</u> elp	File Edit	View Go Cap	ture Analyze	Statistics Telephony	Wireless Too	ls <u>H</u> elp
	201138	6 9 + +	8 T 1 🗔 📑		1	<u>/</u>		و ج ۽ ک	🕾 🛪 🗶 🗔 📃		
(_ws.c	col.protocol == "UDP"	)    (igmp)				(_ws.co	I.protocol == "UDP")	(igmp)			
	Time	Source	Destination	Protocol	Length Info	No.	Time	Source	Destination	Protocol L	ength Info
	2075 198.732236	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28	E	2034 195.887159	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
	2131 209.147841	10.90.90.95	232.1.1.3	IGMPv1	70 Membership Report		2093 206.302050	10.90.90.95	232.1.1.3	IGMPv1	70 Membership Repor
	2140 212.428971	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28		2102 209.584069	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
-	3495 343.756912	10.90.90.95	232.1.1.3	IGMPv1	70 Membership Report		3450 340.910998	10.90.90.95	232.1.1.3	IGMPv1	70 Membership Repor
	3542 346.574211	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28		3497 343.729183	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
	3551 350.653931	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28		3506 347.808906	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
	3657 355.818071	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28		3612 352.973118	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
0	3729 364.634582	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28		3685 361.789604	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
U	5676 368.280413	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28		3734 365.435403	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
	3887 375.354182	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28		3844 372.509065	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
	3898 379.688354	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28		3853 376.843270	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
_	3939 383.716189	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28	1	3894 380.871164	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
	3949 387.239777	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28		3906 384.394830	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
Captu Edi	uring from Ethernet 4 it View Go Captu	P1 re Analyze Stati   ९ ⇔ ⊜ ≌	istics Telephony Wire	eless Tools Help	i	- Captu File Edit	ring from Ethernet 2 : View Go Cap 2 💿 📄 🛅 🕅	P2 iture Analyze ⓒ � ⊕ ⊜	Statistics Telephony	Wireless Tool	is Help
_ws.co	ol.protocol == "UDP")    (	ïgmp)				(_ws.co	I.protocol == "UDP")	(igmp)			
	Time	Source De	estination F	rotocol Length In	nfo	No.	Time	Source	Destination	Protocol L	ength Info
	1959 189.817252	10.90.90.91 232	2.1.1.3 U	OP 78 8	+ 0 Len=28	F	1987 193.447566	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
	2018 200.232579	10.90.90.95 232	2.1.1.3 I	GMPv1 70 M	embership Report		2045 203.862892	10.90.90.95	232.1.1.3	IGMPV1	70 Membership Repor
-	2027 203.514054	18.98.98.91 232	L.1.1.3 U	OP 78 8	→ 8 Len=28		2054 207.144373	10.90.90.91	252.1.1.3	UDP	70 0 → 0 Len=28
-	3375 334.841789	10.98.90.95 232	1.1.1.5 1	0PPV1 78 M	emperanip Report		5485 558.472817	10.90.90.95	252.1.1.3	IGMPVI	70 Membership Repor
	3847 381,927555	18,98,98,91 232	2.1.1.3	DP 78.8	+ 8 Len=28		2022 201.955125	10.90.90.91	202.1.1.0	009	70 0 4 0 Len=28
				10 0			660122.202.227668	ALC: MIC. MIC. M.L.		LUL P	

Figure 163. IGMPv1 Multicast Group Created and Group Member Timeout

#### IGMPv2

The use of IGMP version 2 is demonstrated to show that it is possible for a Host to leave a multicast group before the **Group Member Timeout**. The scenario is shown in Figure 164. The first multicast UDP packet (length 70) is sent into Port P0 (Ethernet\_6) and gets forwarded on all other ports. A membership report is then sent into Port P3 (Ethernet\_5), followed by two more UDP packets of length 70 are sent into Port P0. The result is that these multicast UDP packets are seen only on Port P3 (Ethernet\_5) since it joined the multicast group with an IGMPv2 report. At this point, an IGMPv2 leave message is sent into Port P3, and another two UDP packets (this time with a length of 80, to distinguish them in Wireshark) are sent again into Port P0 (Ethernet\_6). These packets are visible on all ports because Port P3 has left the group, and if the Switch does not see any members, it treats the packets as broadcast.

This behavior shows that IGMPv2 allows a Host to dynamically manage its membership in multicast groups, which provides greater flexibility and efficiency in network traffic management. By leaving the group, the Host ensures it no longer receives unnecessary multicast traffic, thereby, optimizing network resources and performance.

Ca	pturing from Ethernet 6		- 0	C	apturing from Ethernet 5	P3					
File	Edit View Go Cap	ture Analyze	Statistics Telephony	Wireless Tools	Help	File	Edit View Go Cap	pture Analyze	Statistics Telephony	Wireless Tools	Help
<u>/</u>	2 0 I T X	ତି । ବ୍ 🍝 🏓	1 T 1 🗔 🗖			<u>/</u>	d 💿 💷 🛅 🗙	⊜ ⇔ ۹ ا	271		
Lw.	s.col.protocol == "UDP")	(igmp)			× =		vs.col.protocol == "UDP")	)    (igmp)			
No.	Time	Source	Destination	Protocol Le	ngth Info	No.	Time	Source	Destination	Protocol Ler	ngth Info
F	17 6.569567	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28	Г	25 10.449841	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
	34 12.616509	10.90.90.95	232.1.1.3	IGMPv2	70 Membership Report group 232.1.1.3		42 16.495709	10.90.98.95	232.1.1.3	IGMPV2	70 Membership Report group 232.1.1.3
	41 15.626167	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28		49 19.506422	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
100	49 18.839450	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28		57 22.719684	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
	114 41.195048	10.90.90.91	232.1.1.3	UDP	80 0 → 0 Len=38		87 31.095800	10.90.90.95	232.1.1.3	IGMPV2	70 Leave Group 232.1.1.3
	115 44.290049	10.90.90.91	232.1.1.3	UDP	80 0 → 0 Len=38		123 45.075186	10.90.90.91	252.1.1.5	UDP	80 0 + 0 Len=38
						-	124 40.1/0315	10.30.30.31	232.1.1.3	UUP	60 8 4 8 Len=36
C C	apturing from Ethernet 2	P2				🗖 Ca	apturing from Ethernet 4	P1			- 0
File	Edit View Go Cap	oture Analyze	Statistics Telephony	Wireless Tools	Help	File	Edit View Go Ca	pture Analyze	Statistics Telephony	Wireless Too	ols Help
1	0 🛛 🗅 🗙	🛱 🗣 🖨	🖻 🗿 🕹 📃 🔳	<b>Q Q Q I</b>		1	i 🖉 💿 💷 🖺 🕅	ି ବ୍ 🖛 🔿	2 Ŧ 生 📃 📃	@ @ @ <u> </u>	
<b>I</b> (w	vs.col.protocol == "UDP")	(igmp)				L Cv	vs.col.protocol == "UDP"	')    (igmp)			
No.	Time	Source	Destination	Protocol Ler	igth Info	No.	Time	Source	Destination	Protocol I	ength Info
r.	28 12.969814	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28	E.	12 4.154807	10.90.90.91	232.1.1.3	UDP	70 0 → 0 Len=28
	48 19.016510	10.90.90.95	232.1.1.3	IGMPv2	70 Membership Report group 232.1.1.3		30 10.201506	10.90.90.95	232.1.1.3	IGMPv2	70 Membership Report group 232.1.1.3
	124 47.595212	10.90.90.91	232.1.1.3	UDP	80 0 → 0 Len=38		106 38.780178	10.90.90.91	232.1.1.3	UDP	80 0 → 0 Len=38
L	125 50.690274	10.90.90.91	232.1.1.3	UDP	80 0 → 0 Len=38	L	107 41.875255	10.90.90.91	232.1.1.3	UDP	80 0 → 0 Len=38

Figure 164. IGMPv2 – Leaving Message Scenario on Port P3

#### IGMPv3

IGMPv3 provides the same functionality as IGMPv2 but also supports SSM, which allows a device to join a multicast group and specify from which server it wants to receive traffic. For example, if two servers (10.90.90.1 and 10.90.90.2) are sending multicast traffic to group 239.1.1.1, a device on Port P3 of the Switch can request traffic only from server 10.90.90.1 when it sends the membership report. The Switch is fully compatible with IGMPv3 queries, report, and leave messages. However, SSM selection is not supported.

## **NETCONF/YANG**

The **TSN Switch Evaluation** application runs a NETCONF server (netopeer2) on the Windows platform in parallel to the web server application. The server is not running on the Switch itself, instead on the PC acting as a Host. The server supports SSH.

The user can run a NETCONF client to configure the Switch functionality, the user name can be anything, the password must be blank.

The datastore repository is based on Sysrepo. The repository supports four datastores: **Startup**, **Candidate**, **Running**, and **Opera-tional**. All YANG models used by the Switch follow the models as required in IEC/IEEE 60802 with Switch specific features included in the YANG models as custom leaf nodes.

To use a NETCONF client to configure the device, first launch the GUI and **Find and Configure** the Switch or chain of Switch devices in the usual way described in the ses-configuration File section. This launches a windows-tsn-io process and NETCONF server for each device. Each server instance listens on the SSH port defined in the ses-configuration.txt file. There is a different SSH port for each Switch if there is a chain of Switches. By default, the first device is accessed through SSH port 830, the second via 50831.

🔡 s	configuration.txt 🗵
]	//Instance name
2	Instance 1
3	//IP address of the webserver
4	IP 127.0.0.1
5	//Port on which webserver is listening
6	Port 50000
- 7	//Port on which NETCONF server is listening (SSH)
8	NetconfPortSsh 830
9	//Instance folder name containing webserver contents
10	FsName FS_SES_Instance0
11	//Startup file name
12	StartupFileName eval-adin6310-10tll-rev-c.xml
13	<pre>//Image signature type to use with device: development, production</pre>
14	//Use development for B0
15	//Use production for Bl
16	ImageType production
17	

Figure 165. ses-configuration.txt File Showing Netconf SSH Port

## SYSREPO DATASTORE

The datastore model implemented by Sysrepo is defined in RFC 8342 Section 5 and includes four datastores defined as follows:

- Startup: The startup configuration datastore (<startup>) is a configuration datastore holding the configuration loaded by the device when it boots.
- Candidate: The candidate configuration datastore (<candidate>) is a configuration datastore that can be manipulated without impacting the device's current configuration and that can be committed to <running>.
- Running: The running configuration datastore (<running>) is a configuration datastore that holds the current configuration of the device.
- Operational: The operational state datastore (<operational>) is a read-only datastore that consists of all config true (ct) and config false (cf) nodes defined in the datastore's schema.

This means the <operational> datastore is a superset of <running> that augments configuration data (ct) with state data (cf).

As a result, retrieving data from <operational> is different from retrieving data from any of the other three datastores, because it uses device-specific code to provide the data whereas reading from <startup>/<candidate>/<running> return the values stored in the datastore itself.

Note that the RFC 8342 includes the <intended> datastore, which is a read-only version of <running>, created after transformations are applied to the configuration stored in <running> prior to applying configuration to the device. But also note that for simple implementations, <running> and <intended> are identical, which is what Sysrepo implements.

## YANG MODELS

The **modules** folder in the evaluation package contains the YANG modules relevant for the switch. This includes IEEE and IETF models in addition to Switch custom leaf nodes. User can save the candidate file in XML format in the Setup Page to view and edit the YANG parameters and use as a template for models including custom leafs. To see all parameters associated with a feature, ensure to configure the relevant feature within in the web server and then save the candidate file.

## **CUSTOM LEAF NODES**

Custom leaf nodes are used for Switch specific functionality or functionality that is not currently included in the standard YANG modules. The file ses.yang has all the custom leaf nodes. A summary are as follows:

- ▶ Port Configuration: MII modes, PHY types
- VLAN operation: Learning/Forwarding
- Switching mode: Cut-through or Store and forward
- Crossover type (PHY) Auto/Man-MDIX/MDI
- Port Statistics
- Lookup-Types: Combinations of lookups (destination, source, and extended)
- Timer/GPIO function
- Time Synchronization: PHY delays
- Scheduled Traffic Guard-Bands
- Frame Preemption: Peer-supported/enabled/active. Preemption enabled, ignore-peer, fragment size, and statistics
- ▶ Frame replication and elimination for reliability
- Stream identification

## STARTUP CONFIGURATION

The **ses-default-startup.xml** in the **modules** folder contains all the **Startup** configuration details for the device. In the startup file, custom leafs can be seen with a prefix of adi:ses. This startup file is only used during the initial configuration for SES and from then on, the startup datastore contents are used to initialize the device. The

## **NETCONF/YANG**

datastore is contained in the **Repository** folder in the file system for each device.

**Netconf-setup.xml** file in the **modules** folder contains configuration data for the NETCONF server, it is not intended the user edits this file when using the evaluation package.

## WEB SERVER USE AND NETCONF

The web server and NETCONF server both share the same connection to Sysrepo. Sysrepo manages the access to the datastores, therefore the web server is still available to use and any changes made in the web server are reflected in the datastore and vice versa.

## YANG MODEL EXAMPLES

The **Setup** page allows user to save the candidate YANG file in XML format. Go to the **Setup** page and click **Save Candidate as XML**. The candidate file is saved to the **Downloads** location and captures the YANG model parameters based on the current repository candidate.



Figure 166. Save Candidate in Setup Page

## Cut-Through vs. Store and Forward

The following snippet of code shows an example YANG model that a NETCONF client sends to the server to enable store and forward operation on Port 0 (P0) for queues 2, 3, and 4. Switching mode is a custom leaf, therefore has the prefix adi:ses.

```
<interfaces xmlns="urn:ietf:par>
ams:xml:ns:yang:ietf-interfaces"
xmlns:sched="urn:ieee:std:802.1Q:yang:ieee802-
dot1q-sched"
    xmlns:ses="urn:adi:ses">
    <interface>
        <name>P0</name>
        <bridge-
port xmlns="urn:ieee:std:802.1Q:yang:ieee802-
dot1q-bridge">
        <switching-mode xmlns="urn:adi:ses">
        <queue0>cut-through</queue0>
        <queue1>cut-through</queue1>
        <queue2>store-and-forward
```

```
<queue3>store-and-forward</queue3>
<queue4>store-and-forward</queue4>
<queue5>cut-through</queue5>
<queue6>cut-through</queue6>
<queue7>cut-through</queue7>
</switching-mode>
</bridge-port>
</interface>
</interfaces>
```

## Scheduled Traffic Example

The following snippet of code shows an example YANG model the NETCONF client sends to the server to enable Scheduled traffic on Port 0 (P0), with a Gate Control List of 3, first entry for 250  $\mu$ s with gate 0 open, second entry another 250  $\mu$ s with gate 1 open and remainder of the cycle time (1 ms) with all gates open. Guard bands are disabled in this example.

```
<interfaces xmlns="urn:ietf:par>
ams:xml:ns:yang:ietf-interfaces"
xmlns:sched="urn:ieee:std:802.1Q:yang:ieee802-
dot1g-sched"
      xmlns:ses="urn:adi:ses">
  <interface>
    <name>PO</name>
    <bridge-
port xmlns="urn:ieee:std:802.1Q:yang:ieee802-
dot1q-bridge">
    <gate-parameter-ta
ble xmlns="urn:ieee:std:802.10:yang:ieee802-
dot1q-sched-bridge">
        <gate-enabled>true</gate-enabled>
        <admin-gate-states>255</admin-gate-
states>
        <admin-cycle-time>
          <numerator>1</numerator>
          <denominator>1000</denominator>
        </admin-cycle-time>
        <admin-base-time>
          <seconds>0</seconds>
          <nanoseconds>0</nanoseconds>
        </admin-base-time>
        <admin-control-list>
          <gate-control-entry>
            <index>0</index>
            <operation-name>sched:set-and-re>
lease-mac</operation-name>
            <gate-states-value>1</gate-states-
value>
            <time-interval-value>250000</time-
interval-value>
          </gate-control-entry>
```

# EVAL-ADIN6310

## **NETCONF/YANG**

```
<gate-control-entry>
            <index>1</index>
            <operation-name>sched:set-and-re>
lease-mac</operation-name>
            <gate-states-value>2</gate-states-
value>
            <time-interval-value>250000</time-
interval-value>
          </gate-control-entry>
          <gate-control-entry>
            <index>2</index>
            <operation-name>sched:set-and-re>
lease-mac</operation-name>
            <gate-states-value>255</gate-
states-value>
            <time-interval-value>500000</time-
interval-value>
          </gate-control-entry>
        </admin-control-list>
        <admin-cycle-time-extension>0</admin-
cycle-time-extension>
        <config-change>true</config-change>
        <ses:guard-band-gate-event>false</
ses:guard-band-gate-event>
        <ses:guard-band-hold-event>false
ses:guard-band-hold-event>
      </gate-parameter-table>
    </bridge-port>
  </interface>
  </interfaces>
```

## Frame Preemption Example

The following snippet of code shows the example YANG configuration the NETCONF client sends to the server to enable Frame Preemption on Port 3 with Queue 5/Priority 5 configured as express and all other queues preemptable.

```
<interfaces xmlns="urn:ietf:par>
ams:xml:ns:yang:ietf-interfaces">
  <interface>
    <name>P3</name>
    <type
xmlns:ianaift="urn:ietf:params:xml:ns:yang:ia>
na-if-type">ianaift:ethernetCsmacd</type>
    <enabled>true</enabled>
    <br/>bridge-
port xmlns="urn:ieee:std:802.10;yang:ieee802-
dot1q-bridge">
       <frame-preemption-parame
ters xmlns="urn:ieee:std:802.1Q:yang:ieee802-
dot1q-preemption-bridge">
        <frame-preemption-status-table>
          <priority0>preemptable</priority0>
```

```
<priority1>express</priority1>
          <priority2>express</priority2>
          <priority3>preemptable</priority3>
          <priority4>preemptable</priority4>
          <priority5>express</priority5>
          <priority6>preemptable</priority6>
          <priority7>preemptable</priority7>
        </frame-preemption-status-table>
        cpreemption-enabled
xmlns="urn:adi:ses">true</preemption-enabled>
        <ignore-peer
xmlns="urn:adi:ses">false</ignore-peer>
        <verify-disable
xmlns="urn:adi:ses">false</verify-disable>
        <fragment-size xmlns="urn:adi:ses">0</
fragment-size>
        <verify-period xmlns="urn:adi:ses">10
verify-period>
      </frame-preemption-parameters>
    </bridge-port>
  </interface>
  </interfaces>
```

## FIRMWARE UPDATE

The device supports firmware updates over the Host interface (SPI or Ethernet). With the **TSN Switch Evaluation** application, firmware updates are supported over the Ethernet port.

Firmware is developed by Analog Devices only and updates are provided through the product web page to add features and implement bug fixes as software development progresses.

### AUTOMATIC FIRMWARE UPDATE

The software package supports automatic firmware update. Simply power on the hardware, connect to the Host port, launch the new software package, and the GUI application coordinates loading the new firmware.

## PAIRED FIRMWARE AND WEB SERVER

Firmware (binary file) and web server files are paired and only function together in corresponding package pair. When new packages come available, migrate to the newer package and continue to use that new version.

### FIRMWARE DOWNGRADE

Firmware running on a device updates automatically when a new package is first run. The **Firmware Update** page is available if user wanted to roll back to a previous version of firmware or check what version is currently present. If rolling back to a previous version of firmware, then once the firmware update is complete to the older version, user must revert to use the matching GUI application that came with that firmware version. Alternatively, revert to an older version by using the previous GUI application, it downgrades the firmware on the device to match the firmware supported by that GUI version.

Firmware Update		
Version 3.0.0 Copyright 2020 - 2024 Analog De	vices, Inc.	ALE SCALABLE CTHERMET TIMED TO PERFECTION
Home	Stene hafare firmware undate:	
Setup		
Port Statistics	1. The ADIN6310-tsn-evaluation-util tool must be stopped (stop searching for SES devices) prior to performing a firmwa	re update.
Port Configuration	<ol> <li>The LED next to "Find and Configure SES Devices" blinks when the tool is searching for devices.</li> <li>To stop searching, click the "Find and Configure SES Devices" button, the LED shows OFF.</li> </ol>	
GPIO and Timer Configuration	4. Now proceed to update the firmware.	
Switching Table		
VLAN Table	Following a successful firmware update:	
VLAN Remapping	1. Close all SES related webpages	
M AN Reprioritization	<ol> <li>Close all processes in the PC tool. This is done by holding down "Ctrl" key + clicking "Find and Configure SES Device "Ctrls 4.1 processes".</li> </ol>	s" button (button changes to
	"Close All running processes") 3. Restart searching for SES devices	
Frame Presemption		
Sebeduled Traffic - Assign Output	Choose firmware hinany	
Scheduled Traffic Set Oursus Max SDI I		
Coloridad Tallic - Set Guede Max. SUO	Choose File No file chosen	
Scheduled Traffic - Schedule	Upload	
MRP Configuration	Upload status : Not started	
Firmware Update		
	SES Firmware Information	
Port 0 Port 1 Port 2 Port 3 Port 4 Port 5	Name: 15N Agent SES Application, Development Signature	
	Version info: SC0000519-003.167	
	SES Bootloader Information	
	Name: SES Bootloader Application, Development Signature	
	Version info: SC0000520-003.123	
	Finance 407 Finances Marticle Device	

Figure 167. Firmware Update Page

## FIRMWARE UPDATE

Do the following steps:

1. Browse and upload the firmware image binary and click the **Submit** button.



Figure 168. Firmware Update – Navigate and Select the Binary File

2. Figure 169 shows the progress of the file upload into the web server.



Figure 169. Firmware Update – Upload to Web Server

**3.** The web page refreshes to show progress as the upload progresses. Wait until the Progress bar reaches 100%, now the firmware upload has completed. The device automatically gets software reset once upload is complete, so the connection with the Switch is lost (MAC address gets reset to default).



Figure 170. Firmware Update – Firmware Upload Complete

 To reestablish communication with the device, return to the GUI. Using the keyboard Ctrl button, click Close All Running Processes. All LEDs must turn off on the GUI.



Figure 171. Firmware Update – Close Processes and Search for Devices Again

- 5. Click Find And Configure SES devices to identify and connected boards (shown with green LEDs) the devices again.
- 6. Firmware version and Bootloader versions appears on the **Firmware Update** page.



Figure 172. Firmware Update Version

## TROUBLESHOOTING

## **GUI DOES NOT FIND ADIN6310 DEVICES**

If the GUI does not find the ADIN6310 devices, do the following steps:

- 1. Check the board is powered on (blue power LED lights up near P2 connector).
- 2. Check that the correct Network Adapter is selected and the speed of the link established is 1 Gbps.
- Check the Ethernet Cable on this Network Adapter is connected to the Host Port 0 Ethernet Port. When a device is found, the SES LED turns green.

Description Realtek LISB Gb	Name (422E288			
Bluetooth Device (Personal Area Network)			(F80ASE)	
VirtualBox Host	Only Ethernet Adapt	er	(FSE4511	
ASIX AX88179 U	JSB 3.0 to Gigabit Eth	ernet Adapter	(F95C78)	
Find Ethernet	Network Adapters			
SES Number	Active	MAC		
1	No	7A:C6:88	:11:11:11	
2	No	7A:C6:88	:22:22:22	
3	No	7A:C6:88	:33:33:33	
4	No	7A:C6:88	:44:44:44	
5	No	7A:C6:88	:55:55:55	
6	No	7A:C6:88	:66:66:66	
7	No	7A:C6:88:77:77:77		
8	No	7A:C6:88:88:88:88		
9	No	7A:C6:88:99:99:99		
10	No	7A:C6:BE	:AA:AA:AA	
Find And Con	fgure SES Devices			
ES 1	SES 2 SE	5 3	SES 4	
_		-	_	

Figure 173. No ADIN6310 Devices Found

4. Check the speed of the link established by the Network Adapter. The ADIN1300 PHY on the Host port (Port 0) autonegotiate with the Network Adapter to bring up a link of the highest common speed. The Switch port strapping (Table 18) must match the speed of the link established. If for example, the established link is 100 Mbps and the Switch strapping configures the Switch Host port for 1 Gbps, then there is a mismatch in the Switch Host Port speed and the PHY speed. Default hardware strapping for the Switch Host port is for RGMII 1 Gbps speed.

Table 18.	Host Port	Strapping	Link	Configuration
-----------	-----------	-----------	------	---------------

RGMII	Timer3	Timer2	Timer1	Timer0	SPI_SS
RGMII 1 Gbps	INSERT	OPEN	INSERT	INSERT	INSERT
RGMII 100 Mbps	OPEN	OPEN	INSERT	INSERT	INSERT

## **GUI TABLE REMAINS BLANK**

If the GUI table remains blank, even after double-clicking the selected NIC connected to the board, this may be due to the Npcap installation. Older versions of Npcap had an option for legacy loopback, if using an older version, check if it is installed with **Legacy loopback support** enabled. Try reinstalling Npcap with this disabled and then launch the GUI again. Double-clicking the Network Adapter connected to the Switch Port 0 should fill the GUI table.

Also verify that Npcap is installed with WinPCAP API-compatible mode enabled as discussed in Npcap Installation section.



Figure 174. GUI Table Does Not Fill, Find And Configure SES Devices Button Stays Greyed Out

## WEB PAGE FAILS TO LOAD

The Browser page returns to the **This page isn't working**. Do the following steps:

- Check if the GUI application is still running. Aborting the application while using the web pages stops the web page from communicating with the ADIN6310 devices. Keep the GUI running while using the web pages.
- 2. Power cycle the board, restart the GUI and search for the Switch again.
- 3. Try changing the URL to 127.0.0.5.50000 or 127.0.5.1.50000.

$\leftarrow \rightarrow$	CΔ	③ 127.0.0.	1:50000/tsna	· ☆	<b>1</b>
Apps	succes	sfactors Lear	G Google	SES	📙 Link
ΓP4					
This	page is	sn't work	king		
127.0.0	<b>).1</b> didn't se	end any data.			
ERR_EM	PTY_RESPONS	ε			
Relo	ad				

Figure 175. No Response from Web Page

4. Navigate to FileSystemFolders/FS\_SES\_InstanceX, delete the repository folder and its contents, power cycle the device, restart the GUI and start searching again.

## FIRMWARE DID NOT UPDATE

If the Firmware did not update, do the following steps:

- 1. Confirm correct .bin file is loaded.
- Check installation path for software. Default path is C:\Analog\ADIN6310EVKSW-Relx.x.x. If installing to another location, ensure there are no spaces in the folder names. Use one-word folder name, for example, AnalogDevices instead of Analog Devices.

## TROUBLESHOOTING

### **GUI INCONSISTENT AT FINDING DEVICES**

If GUI is inconsistent at finding devices, do the following step:

 Using a USB-Ethernet Network Adapter can result in some inconsistent/unstable connection between the PC Host and the Switch. Where possible, use an integrated Network Adapter for configuration of the Switch.



#### ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

#### Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board that you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement and agreed to the Agreement. This Agreement is make by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, benon-exclusive, non-sublemesable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, subilcense, or distribute the Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board of the subject on the subjection of ADI. Customer may not disaclese or reverse engineer chips on the Evaluation Board. Customer may not disclose or transfer any portion of the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disaclesemble, decompile or reverse engineer chips on the Evaluation Board ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board at that time. LIMITATION of LIABILITY. THE EVALUATION BOARD PROVIDED HEQUIDENE ALVESTRICTIONS. Customer may not disassemble,



©2024 Analog Devices, Inc. All rights reserved. Trademarks and registered trademarks are the property of their respective owners. One Analog Way, Wilmington, MA 01887-2356, U.S.A.

## **Mouser Electronics**

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Analog Devices Inc.:

EVAL-ADIN6310EBZ