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## GENERAL DESCRIPTION

The XRT83VSH314 is a fully integrated 14-channel short-haul line interface unit (LIU) that operates from a 1.8V Inner Core and 3.3V I/O power supplies. Using internal termination, the LIU provides one bill of materials to operate in T1, E1, or J1 mode independently on a per channel basis with minimum external components. The LIU features are programmed through a standard microprocessor interface. EXAR's LIU has patented high impedance circuits that allow the transmitter outputs and receiver inputs to be high impedance when experiencing a power failure or when the LIU is powered off. Key design features within the LIU optimize 1:1 or 1+1 redundancy and non-intrusive monitoring applications to ensure reliability without using relays.

The on-chip clock synthesizer generates T1/E1/J1 clock rates from a selectable external clock frequency and has five output clock references that can be used

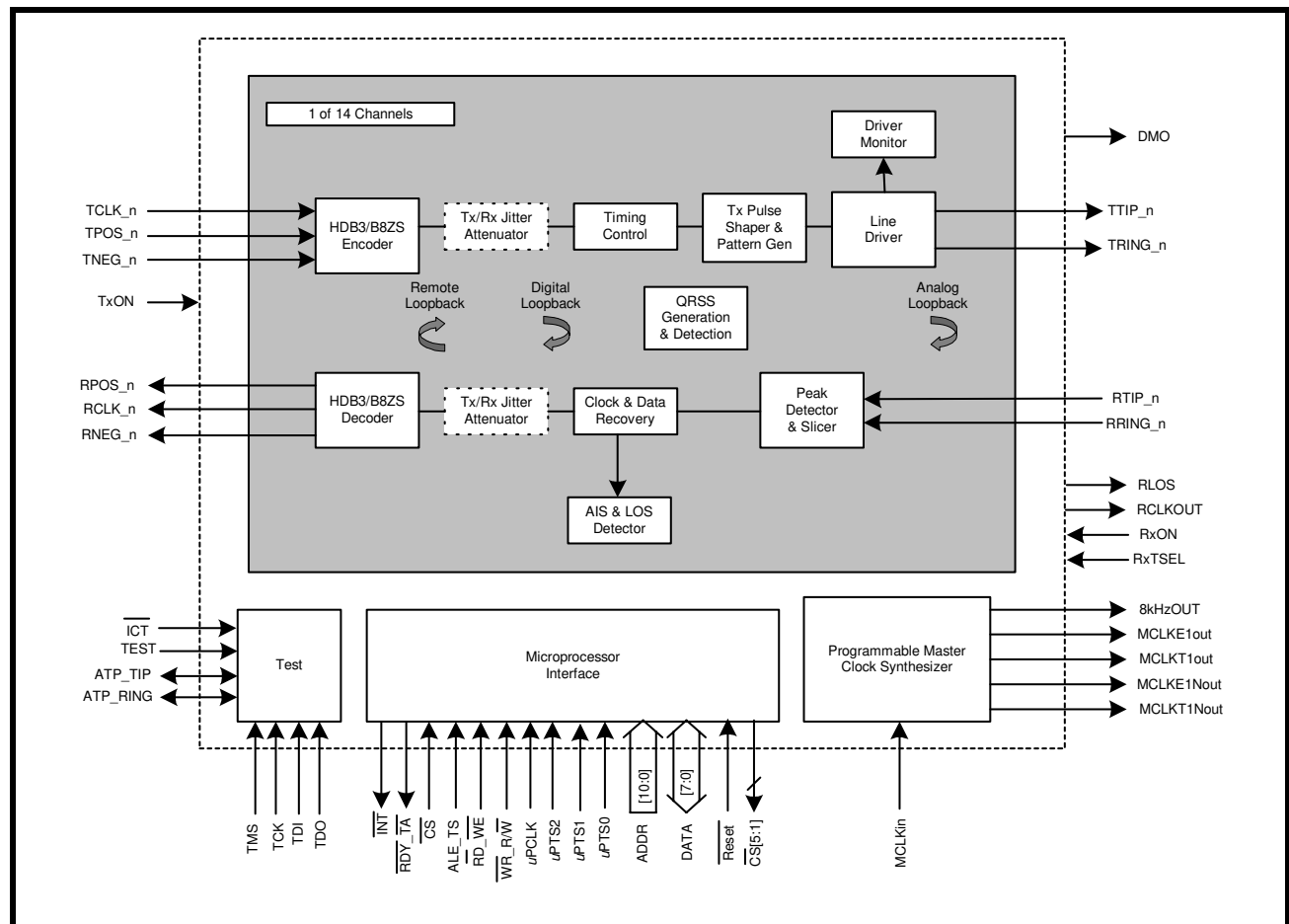
for external timing (8kHz, 1.544Mhz, 2.048Mhz, nxT1/J1, nxE1).

Additional features include RLOS, a 16-bit LCV counter for each channel, AIS, QRSS/PRBS generation/detection, TAOS, DMO, and diagnostic loopback modes.

## APPLICATIONS

- T1 Digital Cross Connects (DSX-1)
- ISDN Primary Rate Interface
- CSU/DSU E1/T1/J1 Interface
- T1/E1/J1 LAN/WAN Routers
- Public Switching Systems and PBX Interfaces
- T1/E1/J1 Multiplexer and Channel Banks
- Integrated Multi-Service Access Platforms (IMAPs)
- Integrated Access Devices (IADs)
- Inverse Multiplexing for ATM (IMA)
- Wireless Base Stations

**FIGURE 1. BLOCK DIAGRAM OF THE XRT83VSH314**



**FEATURES**

- Fully integrated 14-Channel short haul transceivers for T1/J1 (1.544MHz) and E1 (2.048MHz) applications
- T1/E1/J1 short haul and clock rate are per port selectable through software without changing components
- Internal Impedance matching on both receive and transmit for 75Ω (E1), 100Ω (T1), 110Ω (J1), and 120Ω (E1) applications are per port selectable through software without changing components
- Power down on a per channel basis with independent receive and transmit selection
- Five pre-programmed transmit pulse settings for T1 short haul applications per channel
- User programable Arbitrary Pulse mode
- On-Chip transmit short-circuit protection and limiting protects line drivers from damage on a per channel basis
- Selectable Crystal-Less digital jitter attenuators (JA) with 32-Bit or 64-Bit FIFO for the receive or transmit path
- Driver failure monitor output (DMO) alerts of possible system or external component problems
- Transmit outputs and receive inputs may be "High" impedance for protection or redundancy applications on a per channel basis
- Support for automatic protection switching
- 1:1 and 1+1 protection without relays
- Receive monitor mode handles 0 to 6dB resistive attenuation (flat loss) along with 0 to 6dB cable loss for both T1 and E1
- Loss of signal (RLOS) according to ITU-T G.775/ETS300233 (E1) and ANSI T1.403 (T1/J1)
- Programmable data stream muting upon RLOS detection
- On-Chip HDB3/B8ZS encoder/decoder with an internal 16-bit LCV counter for each channel
- On-Chip digital clock recovery circuit for high input jitter tolerance
- QRSS/PRBS pattern generator and detection for testing and monitoring
- Error and bipolar violation insertion and detection
- Transmit all ones (TAOS) Generators and Detectors
- Supports local analog, remote, digital, and dual loopback modes
- 1.8V Digital Core
- 3.3V I/O and Analog Core
- 304-Pin BGA package
- -40°C to +85°C Temperature Range
- Supports gapped clocks for mapper/multiplexer applications

**PRODUCT ORDERING INFORMATION**

PRODUCT NUMBER	PACKAGE TYPE	OPERATING TEMPERATURE RANGE
XRT83VSH314IB	304 Lead PBGA	-40°C to +85°C

## PIN OUT OF THE XRT83VSH314

23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1		
A[10]	CS	CS4	WR_RW	TCLK_8	TPOS_10	TPOS_7	DGND_DRV	RVDD_7	RTIP_7	RRING_7	RGND_7	RGND_6	RRING_6	RTIP_6	RVDD_6	MCLKOUT_T1	MCLKIN	MCLKOUT_E1	MCLKE1xN	TCLK_5	ICT	TDI	A	
NC	RESET	CS1	CS5	TPOS_8	TNEG_9	TNEG_10	TCLK_7	VDDPLL_21	RCLK_7	TVDD_7	TRING_7	TRING_6	TVDD_6	RCLK_6	MCLKT1xN	TPOS_6	TCLK_3	TCLK_4	TPOS_4	INT	DGND_DRV	TCK	B	
RGND_8	A[8]	DVDD_DRV	CS3	ALE_AS	TNEG_8	TCLK_9	TNEG_7	VDDPLL_22	RNEG_7	TTIP_7	DGND_6_7	TTIP_6	RNEG_6	GNDPLL_22	GNDPLL_21	TNEG_6	TNEG_3	TNEG_4	TPOS_5	DVD_PRE	TRING_5	RGND_5	C	
RRING_8	TRING_8	ATP_TIP	DVD_PRE	CS2	RD_WE	TPOS_9	TCLK_10	DGND_PRE	RPOS_7	TGND_7	DVDD_6_7	TGND_6	RPOS_6	NC	EIGHT_KHZ	TCLK_6	TPOS_3	TNEG_5	TEST	TDO	TVDD_5	RRING_5	D	
RTIP_8	RVDD_8	TVDD_8	A[9]	Bottom View																TMS	TTIP_5	RVDD_5	RTIP_5	E
RVDD_9	RCLK_8	TTIP_8	TGND_8																	TGND_5	RNEG_5	RCLK_5	RVDD_4	F
RTIP_9	RCLK_9	RNEG_8	RPOS_8																	RPOS_5	RNEG_4	RCLK_4	RTIP_4	G
RRING_9	TVDD_9	RNEG_9	RPOS_9																	RPOS_4	TTIP_4	TRING_4	RRING_4	H
RGND_9	TRING_9	TTIP_9	TGND_9																	TGND_4	TVDD_4	DVDD_3_4_5	RGND_4	J
DVDD_8_9_10	NC	ATP_RING	SENSE																	AVDD_BIAS	DVDD_DRV	CMPOUT	RCLKOUT	K
DGND_8_9_10	NC	NC	DGND_PRE																	NC	AGND_BIAS	DGND_3_4_5	PhDIN	L
RGND_10	TRING_10	TTIP_10	TGND_10																	TGND_3	TTIP_3	TRING_3	RGND_3	M
RRING_10	TVDD_10	RNEG_10	RPOS_10																	RPOS_3	RNEG_3	TVDD_3	RRING_3	N
RTIP_10	RCLK_10	RNEG_11	RPOS_11																	RPOS_2	RNEG_2	RCLK_3	RTIP_3	P
RVDD_10	RCLK_11	TTIP_11	TGND_11																	TGND_2	TTIP_2	RCLK_2	RVDD_3	R
RTIP_11	RVDD_11	TVDD_11	TRING_11																	DGND_1_2	TVDD_2	RVDD_2	RTIP_2	T
RRING_11	DVDD_DRV	DVDD_11_12	DGND_11_12																	TVDD_1	DGND_DRV	TRING_2	RRING_2	U
RGND_11	TRING_12	TVDD_12	TGND_12																	TGND_1	TRING_1	DVDD_1_2	RGND_2	V
RRING_12	RGND_12	TTIP_12	RPOS_12																	RPOS_1	TTIP_1	RGND_1	RRING_1	W
RTIP_12	RCLK_12	RNEG_12	DVD_PRE	A[1]	A[7]	TCLK_12	TCLK_13	RXTSEL	RPOS_13	TGND_13	DGND_13_0	TGND_0	RPOS_0	GNDPLL_12	TPOS_0	TNEG_1	D[3]	DVD_PRE	DMO	RNEG_1	RVDD_1	RTIP_1	Y	
RVDD_12	NC	UPTS0	A[2]	A[6]	TPOS_12	TNEG_11	DVDD_DRV	DVDD_UP	RNEG_13	TTIP_13	DVDD_13_0	TTIP_0	RNEG_0	RCLK_0	DGND_DRV	TNEG_2	TPOS_1	D[4]	D[7]	RDY_TA	RCLK_1	NC	AA	
DGND_DRV	UPTS1	A[3]	A[5]	RXON	TPOS_11	TPOS_13	VDDPLL_12	DGND_UP	RCLK_13	TVDD_13	TRING_13	TRING_0	TVDD_0	RVDD_0	DGND_PRE	TNEG_0	TPOS_2	D[0]	D[2]	D[6]	UPCLK	RLOS	AB	
UPTS2	A[0]	A[4]	TxON	TNEG_12	TCLK_11	TNEG_13	VDDPLL_11	RVDD_13	RTIP_13	RRING_13	RGND_13	RGND_0	RRING_0	RTIP_0	GNDPLL_11	TCLK_0	TCLK_2	TCLK_1	D[1]	D[5]	DVD_DRV	NC	AC	

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## 1.0 PIN DESCRIPTIONS

### MICROPROCESSOR

NAME	PIN	TYPE	DESCRIPTION
$\overline{\text{CS}}$	A22	I	<b>Chip Select Input</b> Active low signal. This signal enables the microprocessor interface by pulling chip select "Low". The microprocessor interface is disabled when the chip select signal returns "High". <b>NOTE:</b> Internally pulled "High" with a 50k $\Omega$ resistor.
ALE_TS	C19	I	<b>Address Latch Enable Input (Transfer Start)</b> See the Microprocessor section of this datasheet for a description. <b>NOTE:</b> Internally pulled "Low" with a 50k $\Omega$ resistor.
$\overline{\text{WR}}_{\text{R}/\text{W}}$	A20	I	<b>Write Strobe Input (Read/Write)</b> See the Microprocessor section of this datasheet for a description. <b>NOTE:</b> Internally pulled "Low" with a 50k $\Omega$ resistor.
$\overline{\text{RD}}_{\text{WE}}$	D18	I	<b>Read Strobe Input (Write Enable)</b> See the Microprocessor section of this datasheet for a description. <b>NOTE:</b> Internally pulled "Low" with a 50k $\Omega$ resistor.
$\overline{\text{RDY}}_{\text{TA}}$	AA3	O	<b>Ready Output (Transfer Acknowledge)</b> See the Microprocessor section of this datasheet for a description.
$\overline{\text{INT}}$	B3	O	<b>Interrupt Output</b> Active low signal. This signal is asserted "Low" when a change in alarm status occurs. Once the status registers have been read, the interrupt pin will return "High". GIE (Global Interrupt Enable) must be set "High" in the appropriate global register to enable interrupt generation. <b>NOTE:</b> This pin is an open-drain output that requires an external 10K $\Omega$ pull-up resistor.
$\mu\text{PCLK}$	AB2	I	<b>Micro Processor Clock Input</b> In a synchronous microprocessor interface, $\mu\text{PCLK}$ is used as the internal timing reference for programming the LIU. <b>NOTE:</b> Internally pulled "Low" with a 50k $\Omega$ resistor.



## MICROPROCESSOR

NAME	PIN	TYPE	DESCRIPTION
ADDR10 ADDR9 ADDR8 ADDR7 ADDR6 ADDR5 ADDR4 ADDR3 ADDR2 ADDR1 ADDR0	A23 E20 C22 Y18 AA19 AB20 AC21 AB21 AA20 Y19 AC22	I	<b>Address Bus Input</b> ADDR[10:8] is used as a chip select decoder. The LIU has 5 chip select output pins for enabling up to 5 additional devices for accessing internal registers. The LIU has the option to select itself (master device), up to 5 additional devices, or all 6 devices simultaneously by setting the ADDR[10:8] pins specified below. ADDR[7:0] is a direct address bus for permitting access to the internal registers.  <b>ADDR[10:8]</b> 000 = Master Device 001 = Chip Select Output 1 (Pin B21) 010 = Chip Select Output 2 (Pin D19) 011 = Chip Select Output 3 (Pin C20) 100 = Chip Select Output 4 (Pin A21) 101 = Chip Select Output 5 (Pin B20) 110 = Reserved 111 = All Chip Selects Active Including the Master Device <b>NOTE:</b> Internally pulled "Low" with a 50k $\Omega$ resistor.
DATA7 DATA6 DATA5 DATA4 DATA3 DATA2 DATA1 DATA0	AA4 AB3 AC3 AA5 Y6 AB4 AC4 AB5	I/O	<b>Bi-directional Data Bus</b> DATA[7:0] is a bi-directional data bus used for read and write operations. <b>NOTE:</b> Internally pulled "Low" with a 50k $\Omega$ resistor.
$\mu$ PTS2 $\mu$ PTS1 $\mu$ PTS0	AC23 AB22 AA21	I	<b>Microprocessor Type Select Input</b> $\mu$ PTS[2:0] are used to select the microprocessor type interface. 000 = Intel 68HC11, 8051, 80C188 (Asynchronous) 001 = Motorola 68K (Asynchronous) 111 = Motorola MPC8260, MPC860 Power PC (Synchronous) <b>NOTE:</b> Internally pulled "Low" with a 50k $\Omega$ resistor.
Reset	B22	I	<b>Hardware Reset Input</b> Active low signal. When this pin is pulled "Low" for more than 10 $\mu$ S, the internal registers are set to their default state. See the register description for the default values. <b>NOTE:</b> Internally pulled "High" with a 50K $\Omega$ resistor.
$\overline{\text{CS}}_5$ $\overline{\text{CS}}_4$ $\overline{\text{CS}}_3$ $\overline{\text{CS}}_2$ $\overline{\text{CS}}_1$	B20 A21 C20 D19 B21	O	<b>Chip Select Output</b> The XRT83VSH314 can be used to provide the necessary chip selects for up to 5 additional devices by using the 3 MSBs ADDR[10:8] from the 11-Bit address bus. The LIU allows up to 84-channel applications with only using one chip select. See the ADDR[10:0] definition in the pin description.

**RECEIVER SECTION**

NAME	PIN	TYPE	DESCRIPTION								
RxON	AB19	I	<b>Receive On/Off Input</b> Upon power up, the receivers are powered off. Turning the receivers On or Off can be selected through the microprocessor interface by programming the appropriate channel register if the hardware pin is pulled "High". If the hardware pin is pulled "Low", all channels are automatically turned off. <b>NOTE:</b> Internally pulled "Low" with a 50K $\Omega$ resistor.								
RxTSEL	Y15	I	<b>Receive Termination Control</b> Upon power up, the receivers are in "High" impedance. Switching to internal termination can be selected through the microprocessor interface by programming the appropriate channel register. However, to switch control to the hardware pin, RxTCNTL must be programmed to "1" in the appropriate global register. Once control has been granted to the hardware pin, it must be pulled "High" to switch to internal termination. <b>NOTE:</b> Internally pulled "Low" with a 50k $\Omega$ resistor. <table><tr><th>RxTSEL (pin)</th><th>Rx Termination</th></tr><tr><td>0</td><td>External</td></tr><tr><td>1</td><td>Internal</td></tr><tr><td colspan="2">Note: RxTCNTL (bit) must be set to "1"</td></tr></table>	RxTSEL (pin)	Rx Termination	0	External	1	Internal	Note: RxTCNTL (bit) must be set to "1"	
RxTSEL (pin)	Rx Termination										
0	External										
1	Internal										
Note: RxTCNTL (bit) must be set to "1"											
RLOS	AB1	O	<b>Receive Loss of Signal (Global Pin for All 14-Channels)</b> When a receive loss of signal occurs for any one of the 14-channels according to ITU-T G.775, the RLOS pin will go "High" for a minimum of one RCLK cycle. RLOS will remain "High" until the loss of signal condition clears. See the Receive Loss of Signal section of this datasheet for more details. <b>NOTE:</b> This pin is for redundancy applications to initiate an automatic switch to the backup card. For individual channel RLOS, see the register map.								
RCLK13 RCLK12 RCLK11 RCLK10 RCLK9 RCLK8 RCLK7 RCLK6 RCLK5 RCLK4 RCLK3 RCLK2 RCLK1 RCLK0	AB14 Y22 R22 P22 G22 F22 B14 B9 F2 G2 P2 R2 AA2 AA9	O	<b>Receive Clock Output</b> RCLK is the recovered clock from the incoming data stream. If the incoming signal is absent or RxON is pulled "Low", RCLK maintains its timing by using an internal master clock as its reference. Software control (RCLKE) allows RPOS/RNEG data to be updated on either edge of RCLK. <b>NOTE:</b> RCLKE is a global setting that applies to all 14 channels.								

**RECEIVER SECTION**

NAME	PIN	TYPE	DESCRIPTION																																
RCLKOUT	K1	O	<p><b>Recovered Clock Output:</b></p> <p>One of the 14 RCLKS is selected with the Recovered Clock Select [3:0] (register 0xEEh) bits and output through this pin.</p> <p>See table below.</p> <table><tr><th>Recovered Clock Select[3:0]</th><th>Selected RCLK[13:0]</th></tr><tr><td>0000, 1111</td><td>No RCLK Selected</td></tr><tr><td>0001</td><td>RCLK 0</td></tr><tr><td>0010</td><td>RCLK 1</td></tr><tr><td>0011</td><td>RCLK 2</td></tr><tr><td>0100</td><td>RCLK 3</td></tr><tr><td>0101</td><td>RCLK 4</td></tr><tr><td>0110</td><td>RCLK 5</td></tr><tr><td>0111</td><td>RCLK 6</td></tr><tr><td>1000</td><td>RCLK 7</td></tr><tr><td>1001</td><td>RCLK 8</td></tr><tr><td>1010</td><td>RCLK 9</td></tr><tr><td>1011</td><td>RCLK 10</td></tr><tr><td>1100</td><td>RCLK 11</td></tr><tr><td>1101</td><td>RCLK 12</td></tr><tr><td>1110</td><td>RCLK 13</td></tr></table>	Recovered Clock Select[3:0]	Selected RCLK[13:0]	0000, 1111	No RCLK Selected	0001	RCLK 0	0010	RCLK 1	0011	RCLK 2	0100	RCLK 3	0101	RCLK 4	0110	RCLK 5	0111	RCLK 6	1000	RCLK 7	1001	RCLK 8	1010	RCLK 9	1011	RCLK 10	1100	RCLK 11	1101	RCLK 12	1110	RCLK 13
Recovered Clock Select[3:0]	Selected RCLK[13:0]																																		
0000, 1111	No RCLK Selected																																		
0001	RCLK 0																																		
0010	RCLK 1																																		
0011	RCLK 2																																		
0100	RCLK 3																																		
0101	RCLK 4																																		
0110	RCLK 5																																		
0111	RCLK 6																																		
1000	RCLK 7																																		
1001	RCLK 8																																		
1010	RCLK 9																																		
1011	RCLK 10																																		
1100	RCLK 11																																		
1101	RCLK 12																																		
1110	RCLK 13																																		
RPOS13 RPOS12 RPOS11 RPOS10 RPOS9 RPOS8 RPOS7 RPOS6 RPOS5 RPOS4 RPOS3 RPOS2 RPOS1 RPOS0	Y14 W20 P20 N20 H20 G20 D14 D10 G4 H4 N4 P4 W4 Y10	O	<p><b>RPOS/RDATA Output</b></p> <p>Receive digital output pin. In dual rail mode, this pin is the receive positive data output. In single rail mode, this pin is the receive non-return to zero (NRZ) data output.</p>																																

**RECEIVER SECTION**

NAME	PIN	TYPE	DESCRIPTION
RNEG13 RNEG12 RNEG11 RNEG10 RNEG9 RNEG8 RNEG7 RNEG6 RNEG5 RNEG4 RNEG3 RNEG2 RNEG1 RNEG0	AA14 Y21 P21 N21 H21 G21 C14 C10 F3 G3 N3 P3 Y3 AA10	O	<b>RNEG/LCV_OF Output</b>  In dual rail mode, this pin is the receive negative data output. In single rail mode, this pin can either be a Line Code Violation or Overflow indicator. If LCV is selected by software and if a line code violation, a bi-polar violation, or excessive zeros occur, the LCV pin will pull "High" for a minimum of one RCLK cycle. LCV will remain "High" until there are no more violations. However, if OF is selected the LCV pin will pull "High" if the internal LCV counter is saturated. The LCV pin will remain "High" until the LCV counter is reset.
RTIP13 RTIP12 RTIP11 RTIP10 RTIP9 RTIP8 RTIP7 RTIP6 RTIP5 RTIP4 RTIP3 RTIP2 RTIP1 RTIP0	AC14 Y23 T23 P23 G23 E23 A14 A9 E1 G1 P1 T1 Y1 AC9	I	<b>Receive Differential Tip Input</b>  RTIP is the positive differential input from the line interface. Along with the RRING signal, these pins should be coupled to a 1:1 transformer for proper operation.
RRING13 RRING12 RRING11 RRING10 RRING9 RRING8 RRING7 RRING6 RRING5 RRING4 RRING3 RRING2 RRING1 RRING0	AC13 W23 U23 N23 H23 D23 A13 A10 D1 H1 N1 U1 W1 AC10	I	<b>Receive Differential Ring Input</b>  RRING is the negative differential input from the line interface. Along with the RTIP signal, these pins should be coupled to a 1:1 transformer for proper operation.

**TRANSMITTER SECTION**

NAME	PIN	TYPE	DESCRIPTION
TxON	AC20	I	<b>Transmit On/Off Input</b> Upon power up, the transmitters are powered off. Turning the transmitters On or Off is selected through the microprocessor interface by programming the appropriate channel register if this pin is pulled "High". If the TxON pin is pulled "Low", all 14 transmitters are powered off. <b>NOTES:</b> <ol style="list-style-type: none"> <li>1. TxON is ideal for redundancy applications. See the Redundancy Applications Section of this datasheet for more details.</li> <li>2. Internally pulled "Low" with a 50K<math>\Omega</math> resistor.</li> </ol>
DMO	Y4	O	<b>Digital Monitor Output (Global Pin for All 14-Channels)</b> When no transmit output pulse is detected for more than 128 TCLK cycles on one of the 14-channels, the DMO pin will go "High" for a minimum of one TCLK cycle. DMO will remain "High" until the transmitter sends a valid pulse. <b>NOTE:</b> This pin is for redundancy applications to initiate an automatic switch to the backup card. For individual channel DMO, see the register map.
TCLK13 TCLK12 TCLK11 TCLK10 TCLK9 TCLK8 TCLK7 TCLK6 TCLK5 TCLK4 TCLK3 TCLK2 TCLK1 TCLK0	Y16 Y17 AC18 D16 C17 A19 B16 D7 A3 B5 B6 AC6 AC5 AC7	I	<b>Transmit Clock Input</b> TCLK is the input facility clock used to sample the incoming TPOS/TNEG data. If TCLK is absent, pulled "Low", or pulled "High", the transmitter outputs at TTIP/TRING can be selected to send an all ones or an all zero signal by programming TCLKCNL. In addition, software control (TCLKE) allows TPOS/TNEG data to be sampled on either edge of TCLK. <b>NOTES:</b> <ol style="list-style-type: none"> <li>1. TCLKE is a global setting that applies to all 14 channels.</li> <li>2. Internally pulled "Low" with a 50k <math>\Omega</math> resistor.</li> </ol>
TPOS13 TPOS12 TPOS11 TPOS10 TPOS9 TPOS8 TPOS7 TPOS6 TPOS5 TPOS4 TPOS3 TPOS2 TPOS1 TPOS0	AB17 AA18 AB18 A18 D17 B19 A17 B7 C4 B4 D6 AB6 AA6 Y8	I	<b>TPOS/TDATA Input</b> Transmit digital input pin. In dual rail mode, this pin is the transmit positive data input. In single rail mode, this pin is the transmit non-return to zero (NRZ) data input. <b>NOTE:</b> Internally pulled "Low" with a 50K $\Omega$ resistor.

**TRANSMITTER SECTION**

NAME	PIN	TYPE	DESCRIPTION
TNEG13	AC17	I	<b>Transmit Negative Data Input</b> In dual rail mode, this pin is the transmit negative data input. In single rail mode, this pin can be left unconnected. <i><b>NOTE:</b> Internally pulled "Low" with a 50K<math>\Omega</math> resistor.</i>
TNEG12	AC19		
TNEG11	AA17		
TNEG10	B17		
TNEG9	B18		
TNEG8	C18		
TNEG7	C16		
TNEG6	C7		
TNEG5	D5		
TNEG4	C5		
TNEG3	C6		
TNEG2	AA7		
TNEG1	Y7		
TNEG0	AB7		
TTIP13	AA13	O	<b>Transmit Differential Tip Output</b> TTIP is the positive differential output to the line interface. Along with the TRING signal, these pins should be coupled to a 1:2 step up transformer for proper operation.
TTIP12	W21		
TTIP11	R21		
TTIP10	M21		
TTIP9	J21		
TTIP8	F21		
TTIP7	C13		
TTIP6	C11		
TTIP5	E3		
TTIP4	H3		
TTIP3	M3		
TTIP2	R3		
TTIP1	W3		
TTIP0	AA11		
TRING13	AB12	O	<b>Transmit Differential Ring Output</b> TRING is the negative differential output to the line interface. Along with the TTIP signal, these pins should be coupled to a 1:2 step up transformer for proper operation.
TRING12	V22		
TRING11	T20		
TRING10	M22		
TRING9	J22		
TRING8	D22		
TRING7	B12		
TRING6	B11		
TRING5	C2		
TRING4	H2		
TRING3	M2		
TRING2	U2		
TRING1	V3		
TRING0	AB11		

**CONTROL FUNCTION**

NAME	PIN	TYPE	DESCRIPTION
TEST	D4	I	<b>Factory Test Mode</b> For normal operation, the TEST pin should be tied to ground. <i>NOTE: Internally pulled "Low" with a 50kΩ resistor.</i>
$\overline{\text{ICT}}$	A2	I	<b>In Circuit Testing</b> When this pin is tied "Low", all output pins are forced to "High" impedance for in circuit testing. <i>NOTE: Internally pulled "High" with a 50KΩ resistor.</i>
PhDIN	L1	I	<b>Test Pin</b> For testing purposes only. For normal operation leave this pin unconnected. <i>NOTE: Internally pulled "Low" with a 50kΩ resistor.</i>
CMPOUT	K2	O	<b>Test Pin</b> For testing purposes only. For normal operation leave this pin unconnected.

**CLOCK SECTION**

NAME	PIN	TYPE	DESCRIPTION
MCLKin	A6	I	<b>Master Clock Input</b> The master clock input can accept a wide range of inputs that can be used to generate T1 or E1 clock rates on a per channel basis. See the register map for details. <i>NOTE: Internally pulled "Low" with a 50kΩ resistor.</i>
8kHzOUT	D8	O	<b>8kHz Output Clock</b>
MCLKE1out	A5	O	<b>2.048MHz Output Clock</b>
MCLKE1Nout	A4	O	<b>2.048MHz, 4.096MHz, 8.192MHz, or 16.384MHz Output Clock</b> See the register map for programming details.
MCLKT1out	A7	O	<b>1.544MHz Output Clock</b>
MCLKT1Nout	B8	O	<b>1.544MHz, 3.088MHz, 6.176MHz, or 12.352MHz Output Clock</b> See the register map for programming details.



**JTAG SECTION**

NAME	PIN	TYPE	DESCRIPTION
ATP_TIP ATP_RING	D21 K21	I/O	<b>Analog Test Pin_TIP</b> <b>Analog Test Pin_RING</b> These pins are used to check continuity of the Transmit and Receive TIP and RING connections on the assembled board. <b>NOTE:</b> See "Section 5.7, Analog Board Continuity Check" on page 39 for more detailed description.
TMS	E4	I	<b>Test Mode Select</b> This pin is used as the input mode select for the boundary scan chain. <b>NOTE:</b> Internally pulled "High" with a 50K $\Omega$ resistor.
TCK	B1	I	<b>Test Clock Input</b> This pin is used as the input clock source for the boundary scan chain. <b>NOTE:</b> Internally pulled "High" with a 50K $\Omega$ resistor.
TDI	A1	I	<b>Test Data In</b> This pin is used as the input data pin for the boundary scan chain. <b>NOTE:</b> Internally pulled "High" with a 50K $\Omega$ resistor.
TDO	D3	O	<b>Test Data Out</b> This pin is used as the output data pin for the boundary scan chain.

**POWER AND GROUND**

NAME	PIN	TYPE	DESCRIPTION
TVDD13	AB13	PWR	<b>Transmit Analog Power Supply (3.3V ±5%)</b> TVDD can be shared with DVDD. However, it is recommended that TVDD be isolated from the analog power supply RVDD. For best results, use an internal power plane for isolation. If an internal power plane is not available, a ferrite bead can be used. Each power supply pin should be bypassed to ground through an external 0.1µF capacitor.
TVDD12	V21		
TVDD11	T21		
TVDD10	N22		
TVDD9	H22		
TVDD8	E21		
TVDD7	B13		
TVDD6	B10		
TVDD5	D2		
TVDD4	J3		
TVDD3	N2		
TVDD2	T3		
TVDD1	U4		
TVDD0	AB10		
RVDD13	AC15	PWR	<b>Receive Analog Power Supply (3.3V ±5%)</b> RVDD should not be shared with other power supplies. It is recommended that RVDD be isolated from the digital power supply DVDD and the analog power supply TVDD. For best results, use an internal power plane for isolation. If an internal power plane is not available, a ferrite bead can be used. Each power supply pin should be bypassed to ground through an external 0.1µF capacitor.
RVDD12	AA23		
RVDD11	T22		
RVDD10	R23		
RVDD9	F23		
RVDD8	E22		
RVDD7	A15		
RVDD6	A8		
RVDD5	E2		
RVDD4	F1		
RVDD3	R1		
RVDD2	T2		
RVDD1	Y2		
RVDD0	AB9		
DVDD_DRV	AC2	PWR	<b>Digital Power Supply (3.3V ±5%)</b> DVDD should be isolated from the analog power supplies. For best results, use an internal power plane for isolation. If an internal power plane is not available, a ferrite bead can be used. Every two DVDD power supply pins should be bypassed to ground through at least one 0.1µF capacitor.
DVDD_DRV	K3		
DVDD_DRV	U22		
DVDD_DRV	C21		
DVDD_DRV	AA16		
DVDD_PRE	Y5	PWR	<b>Digital Power Supply (1.8V ±5%)</b> DVDD should be isolated from the analog power supplies. For best results, use an internal power plane for isolation. If an internal power plane is not available, a ferrite bead can be used. Every two DVDD power supply pins should be bypassed to ground through at least one 0.1µF capacitor.
DVDD_PRE	C3		
DVDD_PRE	D20		
DVDD_PRE	Y20		
DVDD	J2		
DVDD	V2		
DVDD	D12		
DVDD	AA12		
DVDD	U21		
DVDD	K23		
DVDD_µP	AA15		

**POWER AND GROUND**

NAME	PIN	TYPE	DESCRIPTION
AVDD_BIAS AVDD_PLL22 AVDD_PLL21 AVDD_PLL12 AVDD_PLL11	K4 C15 B15 AB16 AC16	PWR	<b>Analog Power Supply (1.8V <math>\pm</math>5%)</b> AVDD should be isolated from the digital power supplies. For best results, use an internal power plane for isolation. If an internal power plane is not available, a ferrite bead can be used. Each power supply pin should be bypassed to ground through at least one 0.1 $\mu$ F capacitor.
TGND13 TGND12 TGND11 TGND10 TGND9 TGND8 TGND7 TGND6 TGND5 TGND4 TGND3 TGND2 TGND1 TGND0	Y13 V20 R20 M20 J20 F20 D13 D11 F4 J4 M4 R4 V4 Y11	GND	<b>Transmit Analog Ground</b> It's recommended that all ground pins of this device be tied together.
RGND13 RGND12 RGND11 RGND10 RGND9 RGND8 RGND7 RGND6 RGND5 RGND4 RGND3 RGND2 RGND1 RGND0	AC12 W22 V23 M23 J23 C23 A12 A11 C1 J1 M1 V1 W2 AC11	GND	<b>Receive Analog Ground</b> It's recommended that all ground pins of this device be tied together.
DGND DGND DGND DGND DGND DGND	L2 T4 C12 Y12 U20 L23	GND	<b>Digital Ground</b> It's recommended that all ground pins of this device be tied together.

**POWER AND GROUND**

NAME	PIN	TYPE	DESCRIPTION
DGND_DRV	B2	GND	<b>Digital Ground</b> It's recommended that all ground pins of this device be tied together.
DGND_DRV	U3		
DGND_DRV	A16		
DGND_DRV	AA8		
DGND_DRV	AB23		
DGND_PRE	D15		
DGND_PRE	AB8		
DGND_PRE	L20		
DGND_UP	AB15		
AGND_BIAS	L3	GND	<b>Analog Ground</b> It's recommended that all ground pins of this device be tied together.
AGND_PLL22	C9		
AGND_PLL21	C8		
AGND_PLL12	Y9		
AGND_PLL11	AC8		

**NO CONNECTS**

NAME	PIN	TYPE	DESCRIPTION
NC	AA1	NC	<b>No Connect</b> These pins can be left floating or tied to ground.
NC	AC1		
NC	K20		
NC	K22		
NC	L22		
NC	AA22		
NC	B23		
NC	L4		
NC	L21		
NC	D9		

## 2.0 CLOCK SYNTHESIZER

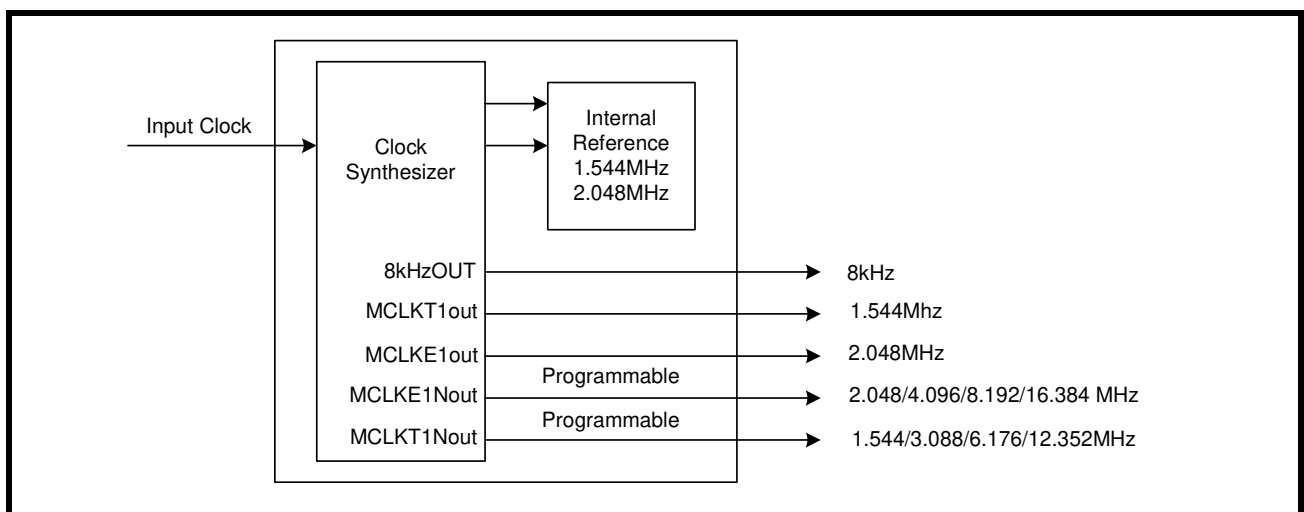
In system design, fewer clocks on the network card could reduce noise and interference. Network cards that support both T1 and E1 modes must be able to produce 1.544MHz and 2.048MHz transmission data. The XRT83VSH314 has a built in clock synthesizer that requires only one input clock reference by programming CLKSEL[3:0] in the appropriate global register. A list of the input clock options is shown in Table 1.

**TABLE 1: INPUT CLOCK SOURCE SELECT**

CLKSEL[3:0]	INPUT CLOCK REFERENCE
0h (0000)	2.048 MHz
1h (0001)	1.544MHz
8h (1000)	4.096 MHz
9h (1001)	3.088 MHz
Ah (1010)	8.192 MHz
Bh (1011)	6.176 MHz
Ch (1100)	16.384 MHz
Dh (1101)	12.352 MHz
Eh (1110)	2.048 MHz
Fh (1111)	1.544 MHz

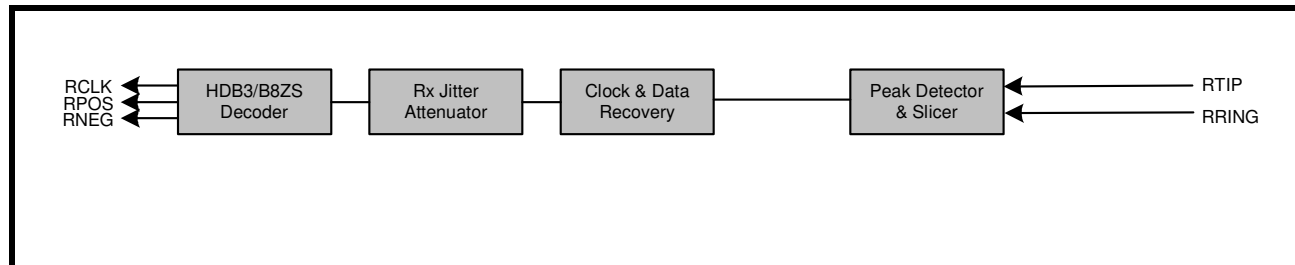
The single input clock reference is used to generate multiple timing references. The first objective of the clock synthesizer is to generate 1.544MHz and 2.048MHz for each of the 14 channels. This allows each channel to operate in either T1 or E1 mode independent from the other channels. The state of the equalizer control bits in the appropriate channel registers determine whether the LIU operates in T1 or E1 mode. The second objective is to generate additional output clock references for system use. The available output clock references are shown in Figure 2.

**FIGURE 2. SIMPLIFIED BLOCK DIAGRAM OF THE CLOCK SYNTHESIZER**



**14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT**
**3.0 RECEIVE PATH LINE INTERFACE**

The receive path of the XRT83VSH314 LIU consists of 14 independent T1/E1/J1 receivers. The following section describes the complete receive path from RTIP/RRING inputs to RCLK/RPOS/RNEG outputs. A simplified block diagram of the receive path is shown in Figure 3.

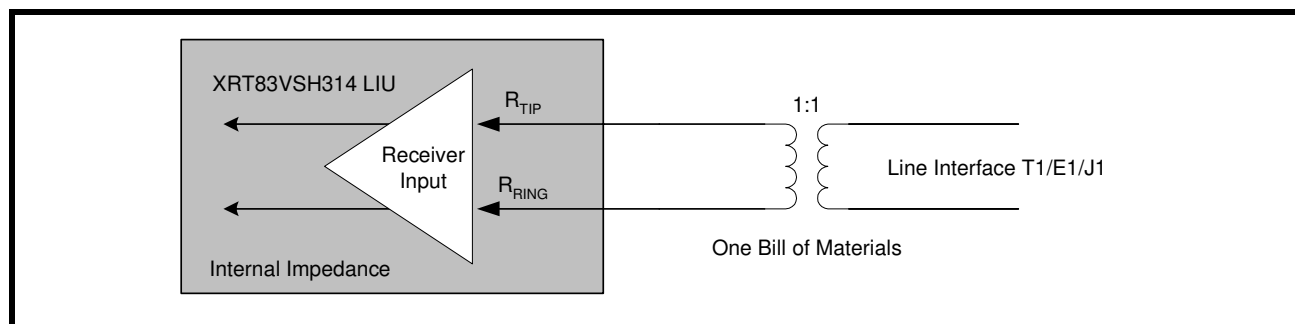
**FIGURE 3. SIMPLIFIED BLOCK DIAGRAM OF THE RECEIVE PATH**

**3.1 Line Termination (RTIP/RRING)**
**3.1.1 Internal Termination**

The input stage of the receive path accepts standard T1/E1/J1 twisted pair or E1 coaxial cable inputs through RTIP and RRING. The physical interface is optimized by placing the terminating impedance inside the LIU. This allows one bill of materials for all modes of operation reducing the number of external components necessary in system design. The receive termination impedance (along with the transmit impedance) is selected by programming TERSEL[1:0] to match the line impedance. Selecting the internal impedance is shown in Table 2.

**TABLE 2: SELECTING THE INTERNAL IMPEDANCE**

TERSEL[1:0]	RECEIVE TERMINATION
0h (00)	100Ω
1h (01)	110Ω
2h (10)	75Ω
3h (11)	120Ω

The XRT83VSH314 has the ability to switch the internal termination to "High" impedance by programming RxTSEL in the appropriate channel register. For internal termination, set RxTSEL to "1". By default, RxTSEL is set to "0" ("High" impedance). For redundancy applications, a dedicated hardware pin (RxTSEL) is also available to control the receive termination for all channels simultaneously. This hardware pin takes priority over the register setting if RxTCNTL is set to "1" in the appropriate global register. If RxTCNTL is set to "0", the state of this pin is ignored. See Figure 4 for a typical connection diagram using the internal termination.

**FIGURE 4. TYPICAL CONNECTION DIAGRAM USING INTERNAL TERMINATION**


**TABLE 3: RECEIVE TERMINATIONS**

RXTSEL	TERSEL1	TERSEL0	RXRES1	RXRES0	R <sub>ext</sub>	R <sub>int</sub>	MODE
0	x	x	x	x	R <sub>ext</sub>	∞	T1/E1/J1
1	0	0	0	0	∞	100Ω	T1
1	0	1	0	0	∞	110Ω	J1
1	1	0	0	0	∞	75Ω	E1
1	1	1	0	0	∞	120Ω	E1
1	0	0	0	1	240Ω	172Ω	T1
1	0	1	0	1	240Ω	204Ω	J1
1	1	0	0	1	240Ω	108Ω	E1
1	1	1	0	1	240Ω	240Ω	E1
1	0	0	1	0	210Ω	192Ω	T1
1	0	1	1	0	210Ω	232Ω	J1
1	1	0	1	0	210Ω	116Ω	E1
1	1	1	1	0	210Ω	280Ω	E1
1	0	0	1	1	150Ω	300Ω	T1
1	0	1	1	1	150Ω	412Ω	J1
1	1	0	1	1	150Ω	150Ω	E1
1	1	1	1	1	150Ω	600Ω	E1

### 3.2 Clock and Data Recovery

The receive clock (RCLK) is recovered by the clock and data recovery circuitry. An internal PLL locks on the incoming data stream and outputs a clock that's in phase with the incoming signal. This allows for multi-channel T1/E1/J1 signals to arrive from different timing sources and remain independent. In the absence of an incoming signal, RCLK maintains its timing by using the internal master clock as its reference. The recovered data can be updated on either edge of RCLK. By default, data is updated on the rising edge of RCLK. To update data on the falling edge of RCLK, set RCLKE to "1" in the appropriate global register. Figure 5 is a timing diagram of the receive data updated on the rising edge of RCLK. Figure 6 is a timing diagram of the receive data updated on the falling edge of RCLK. The timing specifications are shown in Table 4.



FIGURE 5. RECEIVE DATA UPDATED ON THE RISING EDGE OF RCLK

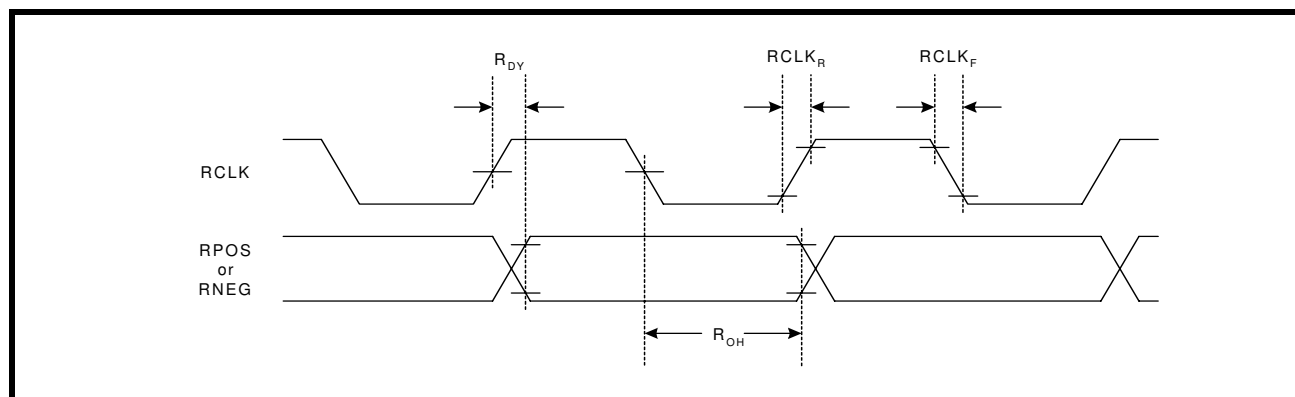


FIGURE 6. RECEIVE DATA UPDATED ON THE FALLING EDGE OF RCLK

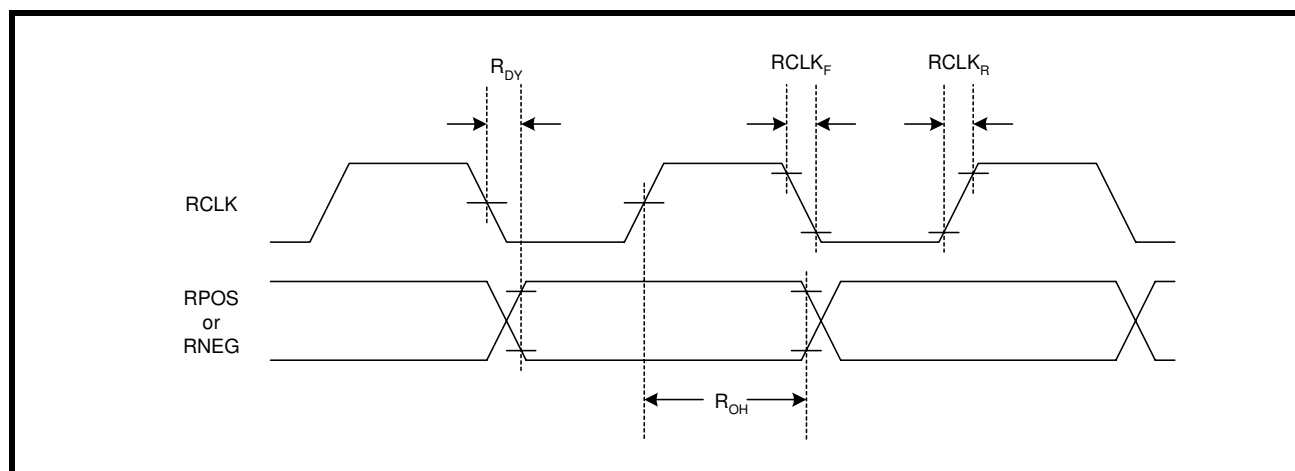


TABLE 4: TIMING SPECIFICATIONS FOR RCLK/RPOS/RNEG

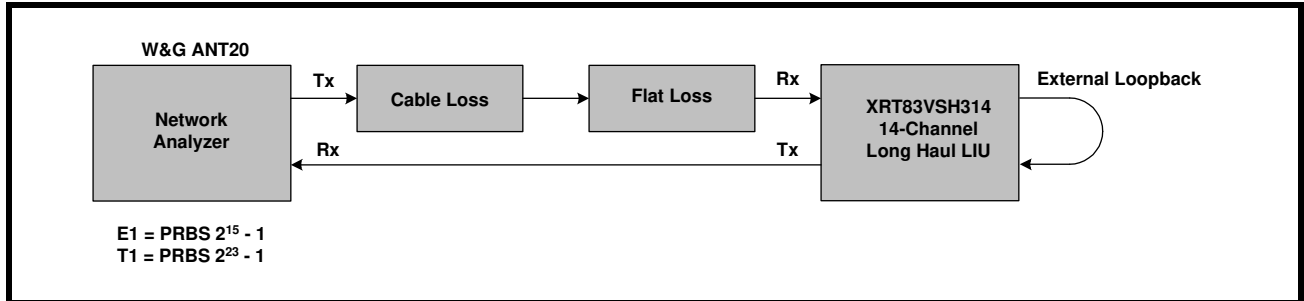
PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
RCLK Duty Cycle	$R_{CDU}$	45	50	55	%
Receive Data Setup Time	$R_{SU}$	150	-	-	ns
Receive Data Hold Time	$R_{HO}$	150	-	-	ns
RCLK to Data Delay	$R_{DY}$	-	-	40	ns
RCLK Rise Time (10% to 90%) with 25pF Loading	$RCLK_R$	-	-	40	ns
RCLK Fall Time (90% to 10%) with 25pF Loading	$RCLK_F$	-	-	40	ns

**NOTE:**  $VDD=3.3V \pm 5\%$ ,  $VDDc=1.8V \pm 5\%$ ,  $T_A=25^\circ C$ , Unless Otherwise Specified

### 3.2.1 Receive Sensitivity

To meet short haul requirements, the XRT83VSH314 can accept T1/E1/J1 signals that have been attenuated by 6dB of cable loss plus 6db of flat loss . Although data integrity is maintained, the RLOS function (if enabled) will report an RLOS condition according to the receiver loss of signal section in this datasheet. The test configuration for measuring the receive sensitivity is shown in Figure 7.

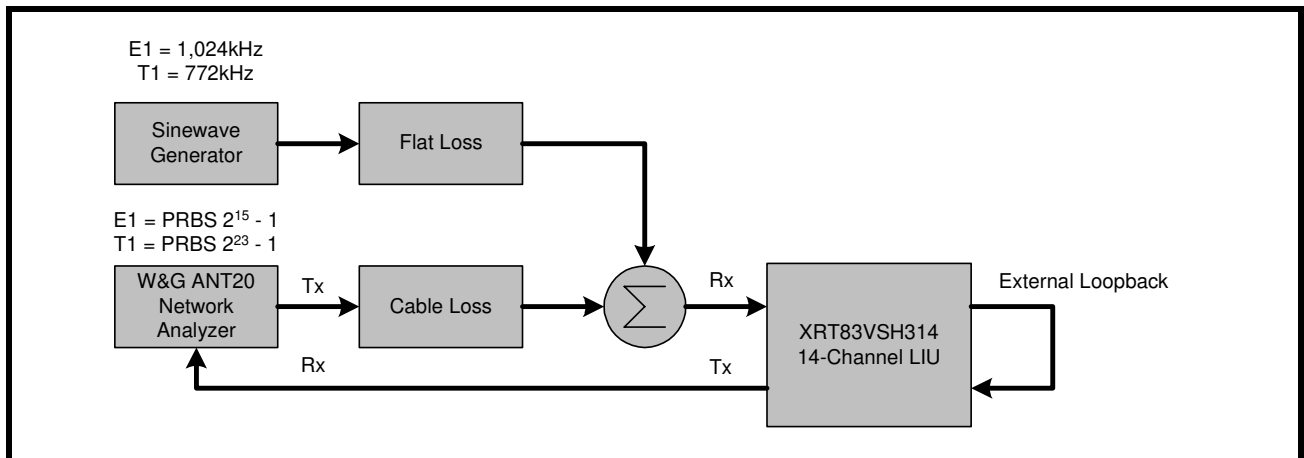
**FIGURE 7. TEST CONFIGURATION FOR MEASURING RECEIVE SENSITIVITY**



### 3.2.2 Interference Margin

The test configuration for measuring the interference margin is shown in Figure 8.

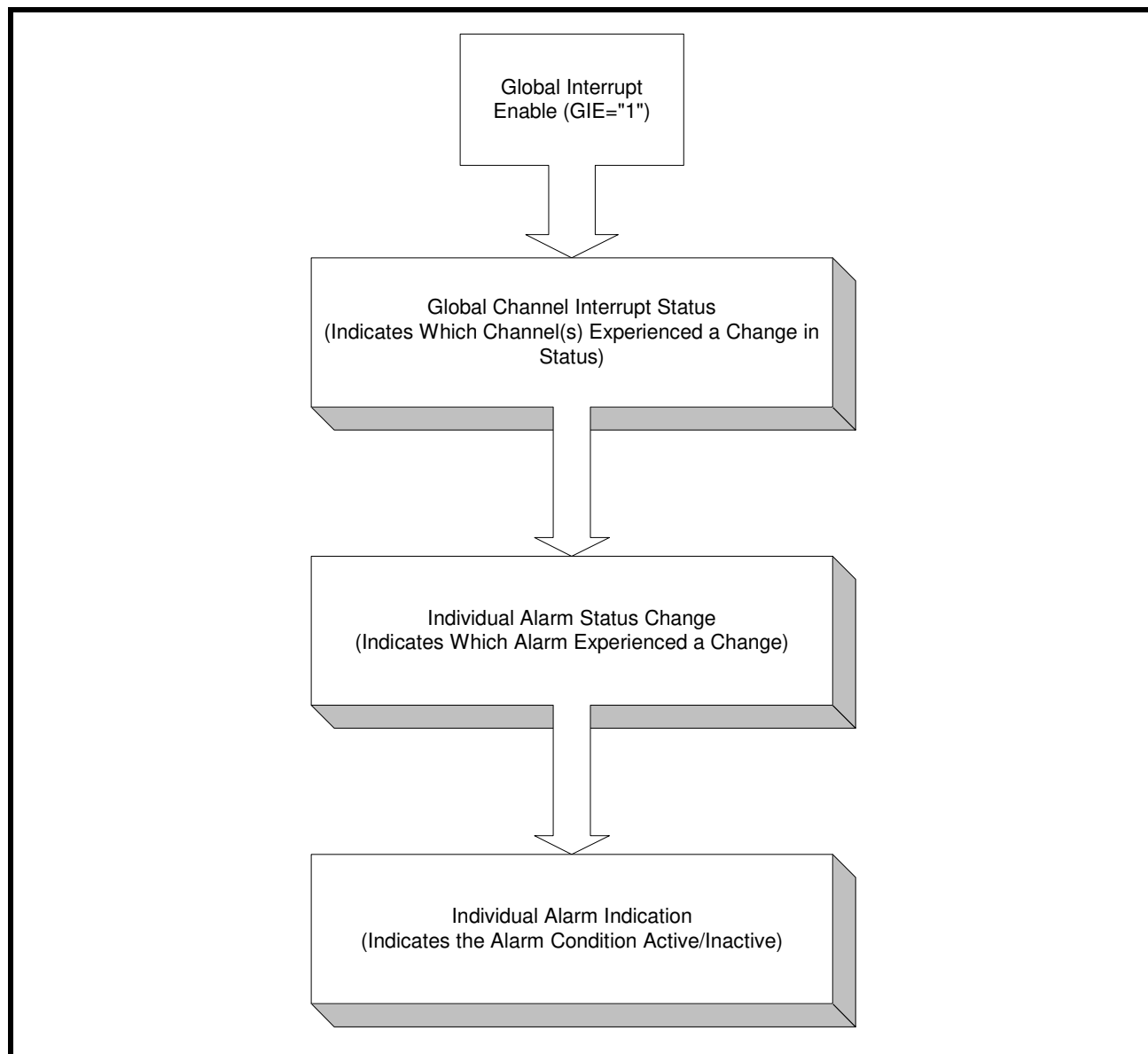
**FIGURE 8. TEST CONFIGURATION FOR MEASURING INTERFERENCE MARGIN**



### 3.2.3 General Alarm Detection and Interrupt Generation

The receive path detects RLOS, AIS, QRPD and FLS. These alarms can be individually masked to prevent the alarm from triggering an interrupt. To enable interrupt generation, the Global Interrupt Enable (GIE) bit must be set "High" in the appropriate global register. Any time a change in status occurs (if the alarms are enabled), the interrupt pin will pull "Low" to indicate an alarm has occurred. Once the status registers have been read, the INT pin will return "High". The status registers are Reset Upon Read (RUR). The interrupts are categorized in a hierarchical process block. Figure 9 is a simplified block diagram of the interrupt generation process.

**FIGURE 9. INTERRUPT GENERATION PROCESS BLOCK**



**NOTE:** The interrupt pin is an open-drain output that requires a 10k $\Omega$  external pull-up resistor.

### **3.2.3.1 RLOS (Receiver Loss of Signal)**

The XRT83VSH314 supports both G.775 or ETSI-300-233 RLOS detection scheme.

In G.775 mode, RLOS is declared when the received signal is less than 375mV for 32 consecutive pulse periods (typical). The device clears RLOS when the receive signal achieves 12.5% ones density with no more than 15 consecutive zeros in a 32 bit sliding window and the signal level exceeds 425mV (typical).

In ETSI-300-233 mode the device declares RLOS when the input level drops below 375mV (typical) for more than 2048 pulse periods (1msec).

The device exits RLOS when the input signal exceeds 425mV (typical) and has transitions for more than 32 pulse periods with 12.5% ones density with no more than 15 consecutive zero's in a 32 bit sliding window. ETSI-300-233 RLOS detection method is only available in Host mode.

In T1 mode RLOS is declared when the received signal is less than 320mV for 175 consecutive pulse period (typical). The device clears RLOS when the receive signal achieves 12.5% ones density with no more than 100 consecutive zeros in a 128 bit sliding window and the signal level exceeds 425mV (typical).

### **3.2.3.2 EXLOS (Extended Loss of Signal)**

By enabling the extended loss of signal by programming the appropriate channel register, the digital RLOS is extended to count 4,096 consecutive zeros before declaring RLOS in T1 and E1 mode. By default, EXLOS is disabled and RLOS operates in normal mode.

### **3.2.3.3 AIS (Alarm Indication Signal)**

The XRT83VSH314 adheres to the ITU-T G.775 specification for an all ones pattern. The alarm indication signal is set to "1" if an all ones pattern (at least 99.9% ones density) is present for T, where T is 3ms to 75ms in T1 mode. AIS will clear when the ones density is not met within the same time period T. In E1 mode, the AIS is set to "1" if the incoming signal has 2 or less zeros in a 512-bit window. AIS will clear when the incoming signal has 3 or more zeros in the 512-bit window.

### **3.2.4 FLSD (FIFO Limit Status Detection)**

The purpose of the FIFO limit status is to indicate when the Read and Write FIFO pointers are within a pre-determined range (over-flow or under-flow indication). The FLSD is set to "1" if the FIFO Read and Write Pointers are within  $\pm 3$ -Bits.

### **3.2.4.1 LCVD (Line Code Violation Detection)**

The LIU contains 14 independent, 16-bit LCV counters. When the counters reach full-scale, they remain saturated at FFFFh until they are reset globally or on a per channel basis. For performance monitoring, the counters can be updated globally or on a per channel basis to place the contents of the counters into holding registers. The LIU uses an indirect address bus to access a counter for a given channel. Once the contents of the counters have been placed in holding registers, they can be individually read out from register 0xE8h 8-bits at a time according to the BYTEsel bit in the appropriate global register. By default, the LSB byte is in register 0xE8h until the BYTEsel is pulled "High" where upon the MSB byte will be placed in the register for read back. Once both bytes have been read, the next channel may be selected for read back.

By default, the LCV\_OFD will be set to a "1" if the receiver is currently detecting line code violations or excessive zeros for HDB3 (E1 mode) or B8ZS (T1 mode). In AMI mode, the LCVD will be set to a "1" if the receiver is currently detecting bipolar violations or excessive zeros. However, if the LIU is configured to monitor the 16-bit LCV counter by programming the appropriate global register, the LCV\_OFD will be set to a "1" if the counter saturates.