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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

FIGURE 1. BLOCK DIAGRAM OF THE XRT83VSH314

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) ٠
- Inverse Multiplexing for ATM (IMA) •
- Wireless Base Stations



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#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

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### 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



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## 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

## PIN OUT OF THE XRT83VSH314

	۲	Ш	U	۵	ш	ш	G	т	٦	¥	-	Σ	z	٩	R	T	D	>	3	۲	AA	AB	AC
~	TDI	тск	RGND_5	RRING_5	RTIP_5	RVDD_4	RTIP_4	RRING_4	RGND_4	RCLKOUT	PhDIN	RGND_3	RRING_3	RTIP_3	RVDD_3	RTIP_2	RRING_2	RGND_2	RRING_1	RTIP_1	NC	RLOS	NC
2	ICT	DGND_DRV	TRING_5	TVDD_5	RVDD_5	RCLK_5	RCLK_4	TRING_4	DVDD_3_4_5	CMPOUT	AGND_BIASDGND_3_4_5	TRING_3	TVDD_3	RCLK_3	RCLK_2	RVDD_2	TRING_2	DVDD_1_2	RGND_1	RVDD_1	RCLK_1	NPCLK	DVD_DRV
з	TCLK_5	INT	DVD_PRE	TDO	TTIP_5	RNEG_5	RNEG_4	TTIP_4	TVDD_4	ovdd_drv	AGND_BIAS	TTIP_3	RNEG_3	RNEG_2	TTIP_2	TVDD_2	DGND_DRV	TRING_1	TTIP_1	RNEG_1	RDY_TA	D[6]	D[5]
4	MCLKE1xN	TPOS_4	TPOS_5	TEST	TMS	TGND_5	RPOS_5	RPOS_4	TGND_4	AVDD_BIASDVDD_DRV	2 N	TGND_3	RPOS_3	RPOS_2	TGND_2	DGND_1_2	TVDD_1	TGND_1	RPOS_1	OMO	D[7]	D[2]	D[1]
5	MCLKIN MCLKOUT_E1	TCLK_4	TNEG_4	TNEG_5						<u> </u>										DVD_PRE	D[4]	[0]Q	TCLK_1
9	MCLKIN	TCLK_3	TNEG_3	TPOS_3																D[3]	TPOS_1	TPOS_2	TCLK_2
2	MCLKOUT_T1	TPOS_6	TNEG_6	TCLK_6																TNEG_1	TNEG_2	TNEG_0	TCLK_0
ω	RVDD_6	MCLKT1xN	GNDPLL_21	EIGHT_KHZ																TPOS_0	DGND_DRV	DGND_PRE	GNDPLL_11
6	RTIP_6	RCLK_6	GNDPLL_22	NC																RPOS_13 TGND_13 DGND_13_0 TGND_0 RPOS_0 GNDPLL_12	RCLK_0	RVDD_0	RTIP_0
10	RRING_6	TVDD_6	RNEG_6	TGND_6 RPOS_6																RPOS_0	RNEG_0	TVDD_0	RGND_0RRING_0
11	RGND_6	TRING_6	TTP_6									View								TGND_0	17TP_0	TRING_0	RGND_0
12	RGND_7	TRING_7	DGND_6_7	DVDD_6_7								Bottom View								DGND_13_(	DVDD_13_0	TRING_13	RGND_13
13	RRING_7	TVDD_7	T_P_7	TGND_7								ш								TGND_13	TTIP_13	TVDD_13	RTIP_13 RRING_13
14	RTIP_7	RCLK_7	RNEG_7	RPOS_7																RPOS_13	RNEG_13	RCLK_13	RTIP_13
15	RVDD_7	/DDPLL_21	/DDPLL_22	DGND_PRE																RXTSEL	DVDD_UP	DGND_UP	RVDD_13
16	DGND_DRV	TCLK_7	TNEG_7	TCLK_10 D																TCLK_13	0S_12TNEG_11DVDD_DRV	TPOS_11TPOS_13VDDPLL_12	.K_11 TNEG_13VDDPLL_11
17	TPOS_7 D	TNEG_10	TCLK_9	TPOS_9																TCLK_12	INEG_11	POS_13	NEG_13\
18	TPOS_10	TNEG_9	TNEG_8	RD_WE																L [7]A	TPOS_121	TPOS_11	
19	TCLK_8	TPOS_8	ALE_AS	CS2																A[1]	A[6]	RXON .	TNEG_12TCI
20	<u>wr</u> _rw	<u>CS5</u>	<u>cs</u> 3	DVD_PRE	A[9]	TGND_8	RPOS_8	RPOS_9	TGND_9	SENSE	DGND_PRE	TGND_10	RPOS_10	RPOS_11	TGND_11	TRING_11	DGND_11_12	TGND_12	RPOS_12	DVD_PRE	A[2]	A[5]	TxON
21	CS4	CS1	DVDD_DRV	ATP_TIP	TVDD_8	TTIP_8	RNEG_8	RNEG_9	TTIP_9	ATP_RING	NC	TTIP_10	RNEG_10	RNEG_11	ттР_11	TVDD_11	DVDD_DRVDVDD_11_12DGND_11_12	TVDD_12	TTIP_12	RNEG_12	UPTSO	A[3]	A[4]
22	cs	RESET	A[8]	TRING_8	RVDD_8	RCLK_8	RCLK_9	TVDD_9	TRING_9	NC	NC	TRING_10	TVDD_10	RCLK_10	RCLK_11	RVDD_11	DVDD_DRVC	TRING_12	RGND_12	RCLK_12	NC	UPTS1	A[0]
23	A[10]	NC	RGND_8	RRING_8	RTIP_8	RVDD_9	RTIP_9	RRING_9	RGND_9	DVDD_8_9_10	DGND_8_9_10	RGND_10	RRING_10	RTIP_10	RVDD_10	RTIP_11	RRING_11	RGND_11	RRING_12	RTIP_12	RVDD_12	DGND_DRV	UPTS2

## 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT



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**XRT83VSH314** 

#### **1.0 PIN DESCRIPTIONS**

#### MICROPROCESSOR

NAME	Pin	Түре	DESCRIPTION
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	Address Latch Enable Input (Transfer Start) See the Microprocessor section of this datasheet for a description. <b>Note:</b> Internally pulled "Low" with a 50k $\Omega$ resistor.
WR_R/W	A20	I	Write Strobe Input (Read/Write)See the Microprocessor section of this datasheet for a description.Note: Internally pulled "Low" with a 50k $\Omega$ resistor.
RD_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.
RDY_TA	AA3	0	Ready Output (Transfer Acknowledge) See the Microprocessor section of this datasheet for a description.
ĪNT	B3	0	<ul> <li>Interrupt Output</li> <li>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.</li> <li>Note: This pin is an open-drain output that requires an external 10KΩ pull-up resistor.</li> </ul>
μPCLK	AB2	I	Micro Processor Clock Input In a synchronous microprocessor interface, μPCLK is used as the internal tim- ing reference for programming the LIU. Note: Internally pulled "Low" with a 50k Ω resistor.

## 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### MICROPROCESSOR

NAME

ADDR10

ADDR9

ADDR8

ADDR7

ADDR6

ADDR5

ADDR4

ADDR3

ADDR2

ADDR1 ADDR0

DATA7

DATA6

DATA5

DATA4 DATA3

DATA2

/E1/J1 S	HORT-HAU	JL LINE INTERFACE UNIT REV. 1.0.1
OR		
PIN	Түре	DESCRIPTION
A23	I	Address Bus Input
E20		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.
C22 Y18		The LIU has the option to select itself (master device), up to 5 additional
AA19		devices, or all 6 devices simultaneously by setting the ADDR[10:8] pins speci-
AB20		fied below. ADDR[7:0] is a direct address bus for permitting access to the internal registers.
AC21		
AB21		ADDR[10:8]
AA20		000 = Master Device
Y19		001 = Chip Select Output 1 (Pin B21)
AC22		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.
AA4	I/O	Bi-directional Data Bus
AB3		DATA[7:0] is a bi-directional data bus used for read and write operations.
AC3		<b>NOTE:</b> Internally pulled "Low" with a 50k $\Omega$ resistor.
AA5 Y6		
AB4		
704		

DATA1 DATA0	AC4 AB5		
μPTS2 μPTS1 μPTS0	AC23 AB22 AA21	I	Microprocessor Type Select Input $\mu$ 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)Note: Internally pulled "Low" with a 50k $\Omega$ resistor.
Reset	B22	I	Hardware Reset Input Active low signal. When this pin is pulled "Low" for more than $10\mu$ S, the inter- nal registers are set to their default state. See the register description for the default values. Note: Internally pulled "High" with a 50K $\Omega$ resistor.
CS5           CS4           CS3           CS2           CS1	B20 A21 C20 D19 B21	0	<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	Түре	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 hard- ware 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.					
				RxTSEL (pin)	Rx Termination			
				0	External			
				1	Internal			
				Note: RxTCNTL (bit)	must be set to "1"			
RLOS	AB1	0	Receive Loss of Signal (Global Pin for All 14-Channels)         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.         NOTE: 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 RCLK1	AB14 Y22 R22 G22 F22 B14 B9 F2 G2 F2 G2 P2 R2 AA2 AA9	0	signal is abse an internal m RPOS/RNEG	ecovered clock from th nt or RxON is pulled "I aster clock as its refer data to be updated on	te incoming data stream. I Low", RCLK maintains its t rence. Software control (F either edge of RCLK. <i>t applies to all 14 channels</i> .	iming by using RCLKE) allows		



## 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### **RECEIVER SECTION**

NAME	ΡιΝ	Түре	DESCRIPTION					
RCLKOUT	K1	0	Recovered Clock Output: One of the 14 RCLKS is selected with the Recoved Clock Select [3:0] (register 0xEEh) bits and output through this pin. See table below.					
			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	0		I mode, this pin is the receive positive is the receive non-return to zero (NRZ)				



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## XRT83VSH314 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### **RECEIVER SECTION**

NAME	PIN	Түре	DESCRIPTION
RNEG13	AA14	0	RNEG/LCV_OF Output
RNEG12	Y21		In dual rail mode, this pin is the receive negative data output. In single rail
RNEG11	P21		mode, this pin can either be a Line Code Violation or Overflow indicator. If LCV
RNEG10	N21		is selected by software and if a line code violation, a bi-polar violation, or
RNEG9	H21		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
RNEG8	G21		OF is selected the LCV pin will pull "High" if the internal LCV counter is satu-
RNEG7	C14		rated. The LCV pin will remain "High" until the LCV counter is reset.
RNEG6	C10		
RNEG5	F3		
RNEG4	G3		
RNEG3	N3		
RNEG2	P3		
RNEG1	Y3		
RNEG0	AA10		
RTIP13	AC14	I	Receive Differential Tip Input
RTIP12	Y23		RTIP is the positive differential input from the line interface. Along with the
RTIP11	T23		RRING signal, these pins should be coupled to a 1:1 transformer for proper
RTIP10	P23		operation.
RTIP9	G23		
RTIP8	E23		
RTIP7	A14		
RTIP6	A9		
RTIP5	E1		
RTIP4	G1		
RTIP3	P1		
RTIP2	T1		
RTIP1	Y1		
RTIP0	AC9		
RRING13	AC13	I	Receive Differential Ring Input
RRING12	W23		RRING is the negative differential input from the line interface. Along with the
RRING11	U23		RTIP signal, these pins should be coupled to a 1:1 transformer for proper oper-
RRING10	N23		ation.
RRING9	H23		
RRING8	D23		
RRING7	A13		
RRING6	A10		
RRING5	D1		
RRING4	H1		
RRING3	N1		
RRING2	U1		
RRING1	W1		
RRING0	AC10		



### TRANSMITTER SECTION

NAME	PIN	Түре	DESCRIPTION
TxON	AC20	Ι	<ul> <li>Transmit On/Off Input</li> <li>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.</li> <li>Notes: <ol> <li>TxON is ideal for redundancy applications. See the Redundancy Applications Section of this datasheet for more details.</li> <li>Internally pulled "Low" with a 50KΩ resistor.</li> </ol> </li> </ul>
DMO	Y4	0	<ul> <li>Digital Monitor Output (Global Pin for All 14-Channels)</li> <li>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.</li> <li>Note: This pin is for redundancy applications to initiate an automatic switch to the backup card. For individual channel DMO, see the register map.</li> </ul>
TCLK13 TCLK12 TCLK11 TCLK10 TCLK9 TCLK8 TCLK7 TCLK6 TCLK5 TCLK4 TCLK3 TCLK2 TCLK1 TCLK1 TCLK0	Y16 Y17 AC18 D16 C17 A19 B16 D7 A3 B5 B6 AC6 AC5 AC7	Ι	<ul> <li>Transmit Clock Input</li> <li>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.</li> <li><i>Notes:</i> <ol> <li>TCLKE is a global setting that applies to all 14 channels.</li> <li>Internally pulled "Low" with a 50k Ω resistor.</li> </ol> </li> </ul>
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 AB6 AA6 Y8	Ι	<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. <i>Note: Internally pulled "Low" with a 50K</i> Ω <i>resistor.</i>



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## XRT83VSH314

## 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### TRANSMITTER SECTION

NAME	ΡιΝ	Түре	DESCRIPTION
TNEG13	AC17	I	Transmit Negative Data Input
TNEG12	AC19		In dual rail mode, this pin is the transmit negative data input. In single rail
TNEG11	AA17		mode, this pin can be left unconnected.
TNEG10	B17		<b>NOTE:</b> Internally pulled "Low" with a 50K $\Omega$ resistor.
TNEG9	B18		
TNEG8	C18		
TNEG7	C16		
TNEG6	C7		
TNEG5	D5		
TNEG4	C5		
TNEG3	C6		
TNEG2	AA7		
TNEG1	Y7		
TNEG0	AB7		
TTIP13	AA13	0	Transmit Differential Tip Output
TTIP12	W21		TTIP is the positive differential output to the line interface. Along with the
TTIP11	R21		TRING signal, these pins should be coupled to a 1:2 step up transformer for
TTIP10	M21		proper operation.
TTIP9	J21		
TTIP8	F21		
TTIP7	C13		
TTIP6	C11		
TTIP5	E3		
TTIP4	H3		
TTIP3	M3		
TTIP2	R3		
TTIP1	W3		
TTIP0	AA11		
TRING13	AB12	0	Transmit Differential Ring Output
TRING12	V22	J	TRING is the negative differential output to the line interface. Along with the
TRING12	T20		TTIP signal, these pins should be coupled to a 1:2 step up transformer for
TRING10	M22		proper operation.
TRING9	J22		
TRING8	D22		
TRING7	B12		
TRING6	B11		
TRING5	C2		
TRING4	H2		
TRING3	M2		
TRING2	U2		
TRING1	V3		
TRING0	AB11		
	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		



### CONTROL FUNCTION

NAME	ΡιΝ	Түре	DESCRIPTION
TEST	D4	I	<b>Factory Test Mode</b> For normal operation, the TEST pin should be tied to ground. <b>Note:</b> Internally pulled "Low" with a 50k $\Omega$ resistor.
ICT	A2	I	In Circuit Testing When this pin is tied "Low", all output pins are forced to "High" impedance for in circuit testing. <i>Note:</i> Internally pulled "High" with a 50KΩ resistor.
PhDIN	L1	I	<b>Test Pin</b> For testing purposes only. For normal operation leave this pin unconnected. <b>Note:</b> Internally pulled "Low" with a 50k $\Omega$ resistor.
CMPOUT	K2	0	<b>Test Pin</b> For testing purposes only. For normal operation leave this pin unconnected.

## **CLOCK SECTION**

NAME	PIN	Түре	DESCRIPTION
MCLKin	A6	I	Master Clock Input
			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.
			<b>NOTE:</b> Internally pulled "Low" with a 50k $\Omega$ resistor.
8kHzOUT	D8	0	8kHz Output Clock
MCLKE1out	A5	0	2.048MHz Output Clock
MCLKE1Nout	A4	0	2.048MHz, 4.096MHz, 8.192MHz, or 16.384MHz Output Clock
			See the register map for programming details.
MCLKT1out	A7	0	1.544MHz Output Clock
MCLKT1Nout	B8	0	<b>1.544MHz, 3.088MHz, 6.176MHz, or 12.352MHz Output Clock</b> See the register map for programming details.



### JTAG SECTION

NAME	ΡιΝ	Түре	DESCRIPTION
ATP_TIP ATP_RING	D21 K21	I/O	Analog Test Pin_TIP Analog Test Pin_RING 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.
ТСК	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	0	<b>Test Data Out</b> This pin is used as the output data pin for the boundary scan chain.



## POWER AND GROUND

ΝΑΜΕ	ΡιΝ	Түре	DESCRIPTION
TVDD13	AB13	PWR	Transmit Analog Power Supply (3.3V ±5%)
TVDD12	V21		TVDD can be shared with DVDD. However, it is recommended that TVDD be
TVDD11	T21		isolated from the analog power supply RVDD. For best results, use an internal
TVDD10	N22		power plane for isolation. If an internal power plane is not available, a ferrite
TVDD9	H22		bead can be used. Each power supply pin should be bypassed to ground through an external $0.1\mu$ F capacitor.
TVDD8	E21		anough an external of the opposition.
TVDD7	B13		
TVDD6	B10		
TVDD5	D2		
TVDD4	J3		
TVDD3	N2		
TVDD2	Т3		
TVDD1	U4		
TVDD0	AB10		
RVDD13	AC15	PWR	Receive Analog Power Supply (3.3V ±5%)
RVDD12	AA23		RVDD should not be shared with other power supplies. It is recommended that
RVDD11	T22		RVDD be isolated from the digital power supply DVDD and the analog power
RVDD10	R23		supply TVDD. For best results, use an internal power plane for isolation. If an
RVDD9	F23		internal power plane is not available, a ferrite bead can be used. Each power
RVDD8	E22		supply pin should be bypassed to ground through an external $0.1 \mu F$ capacitor.
RVDD7	A15		
RVDD6	A8		
RVDD5	E2		
RVDD4	F1		
RVDD3	R1		
RVDD2	T2		
RVDD1	Y2		
RVDD0	AB9		
DVDD_DRV	AC2	PWR	Digital Power Supply (3.3V ±5%)
DVDD_DRV	K3	1 7 7 1 7	DVDD should be isolated from the analog power supplies. For best results,
DVDD_DRV	U22		use an internal power plane for isolation. If an internal power plane is not avail-
DVDD_DRV	C21		able, a ferrite bead can be used. Every two DVDD power supply pins should
DVDD_DRV	AA16		be bypassed to ground through at least one $0.1\mu F$ capacitor.
			Digital Dawar Supply (1.9)( .5%)
DVDD_PRE	Y5	PWR	Digital Power Supply (1.8V ±5%)
DVDD_PRE	C3		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 avail-
DVDD_PRE	D20		able, a ferrite bead can be used. Every two DVDD power supply pins should
DVDD_PRE	Y20		be bypassed to ground through at least one $0.1\mu$ F capacitor.
DVDD	J2		
DVDD	V2		
DVDD	D12		
DVDD	AA12		
DVDD	U21		
	K23		
DVDD_µP	AA15		



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## 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### POWER AND GROUND

AVDD_BIASK4PWRAnalog Power Supply (1.8V ±5%)AVDD_PLL22C15AVDD_PLL21B15AVDD_PLL21B15AB16AVDD_PLL12AVDD_PLL12AB16AB16a ferrite bead can be used. Each power supply pin should be bypassedAVDD_PLL11AC16Transmit Analog GroundTGND13Y13GNDTransmit Analog GroundTGND11R20ti's recommended that all ground pins of this device be tied together.TGND10M20TGND8TGND6D11TGND5F4TGND4J4TGND3M4TGND2R4TGND1V4	ilable,
AVDD_PLL11AC16ground through at least one 0.1µF capacitor.TGND13Y13GNDTransmit Analog GroundTGND12V20It's recommended that all ground pins of this device be tied together.TGND11R20It's recommended that all ground pins of this device be tied together.TGND10M20It's recommended that all ground pins of this device be tied together.TGND9J20It's recommended that all ground pins of this device be tied together.TGND8F20It's recommended that all ground pins of this device be tied together.TGND6D11It's recommended that all ground pins of this device be tied together.TGND5F4It's recommended that all ground pins of this device be tied together.TGND4J4It's recommended that all ground pins of this device be tied together.TGND3M4It's recommended that all ground pins of this device be tied together.	
TGND12V20It's recommended that all ground pins of this device be tied together.TGND11R20It's recommended that all ground pins of this device be tied together.TGND10M20It's recommended that all ground pins of this device be tied together.TGND9J20J20TGND8F20It's recommended that all ground pins of this device be tied together.TGND7D13TGND6D11TGND5F4TGND4J4TGND3M4TGND2R4	
TGND11       R20         TGND10       M20         TGND9       J20         TGND8       F20         TGND7       D13         TGND6       D11         TGND5       F4         TGND4       J4         TGND2       R4	
TGND10       M20         TGND9       J20         TGND8       F20         TGND7       D13         TGND6       D11         TGND5       F4         TGND4       J4         TGND3       M4         TGND2       R4	
TGND9       J20         TGND8       F20         TGND7       D13         TGND6       D11         TGND5       F4         TGND4       J4         TGND2       R4	
TGND8       F20         TGND7       D13         TGND6       D11         TGND5       F4         TGND4       J4         TGND3       M4         TGND2       R4	
TGND7       D13         TGND6       D11         TGND5       F4         TGND4       J4         TGND3       M4         TGND2       R4	
TGND6       D11         TGND5       F4         TGND4       J4         TGND3       M4         TGND2       R4	
TGND5F4TGND4J4TGND3M4TGND2R4	
TGND4J4TGND3M4TGND2R4	
TGND3M4TGND2R4	
TGND2 R4	
TGND1 V4	
TGND0 Y11	
RGND13 AC12 GND Receive Analog Ground	
RGND12W22It's recommended that all ground pins of this device be tied together.	
RGND11 V23	
RGND10 M23	
RGND9 J23	
RGND8 C23	
RGND7 A12	
RGND6 A11	
RGND5 C1	
RGND4 J1	
RGND3 M1	
RGND2 V1	
RGND1 W2	
RGND0 AC11	
DGND L2 GND Digital Ground	
DGND T4 It's recommended that all ground pins of this device be tied together.	
DGND C12	
DGND Y12	
DGND U20	
DGND L23	



## 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### POWER AND GROUND

NAME	ΡιΝ	Түре	DESCRIPTION
DGND_DRV	B2	GND	Digital Ground
DGND_DRV	U3		It's recommended that all ground pins of this device be tied together.
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	Analog Ground
AGND_PLL22	C9		It's recommended that all ground pins of this device be tied together.
AGND_PLL21	C8		
AGND_PLL12	Y9		
AGND_PLL11	AC8		

### NO CONNECTS

NAME	PIN	Түре	DESCRIPTION
NC	AA1	NC	No Connect
NC	AC1		These pins can be left floating or tied to ground.
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.

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.



#### 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.

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

TABLE 2: SELECTING THE INTERNAL IMPEDANCE

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







#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

RXTSEL	TERSEL1	TERSEL0	RXRES1	RXRES0	RXRES0 R <sub>ext</sub>		Mode
0	х	х	х	х	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

#### TABLE 3: RECEIVE TERMINATIONS

#### 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 multichannel 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. The timing specifications are shown in Table 4.

#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT



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	ΜιΝ	ΤΥΡ	ΜΑΧ	UNITS
RCLK Duty Cycle	R <sub>CDU</sub>	45	50	55	%
Receive Data Setup Time	R <sub>SU</sub>	150	-	-	ns
Receive Data Hold Time	R <sub>HO</sub>	150	-	-	ns
RCLK to Data Delay	R <sub>DY</sub>	-	-	40	ns
RCLK Rise Time (10% to 90%) with 25pF Loading	RCLK <sub>R</sub>	-	-	40	ns
RCLK Fall Time (90% to 10%) with 25pF Loading	RCLK <sub>F</sub>	-	-	40	ns

Note: VDD=3.3V ±5%, VDDc=1.8V ±5%, T<sub>A</sub>=25°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.





#### 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



#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### 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 (it 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 XRT83VSH314supports 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 predetermined range (over-flow or under-flow indication). The FLSD is set to "1" if the FIFO Read and Write Pointers are within ±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.

#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### 3.3 Jitter Attenuator



The jitter attenuator reduces phase and frequency jitter in the recovered clock if it is selected in the receive path. The jitter attenuator uses a data FIFO (First In First Out) with a programmable depth of 32-bit or 64-bit. If the LIU is used for line synchronization (loop timing systems), the JA should be enabled in the receive path. When the Read and Write pointers of the FIFO are within 2-Bits of over-flowing or under-flowing, the bandwidth of the jitter attenuator is widened to track the short term input jitter, thereby avoiding data corruption. When this condition occurs, the jitter attenuator will not attenuate input jitter until the Read/Write pointer's position is outside the 2-Bit window. In T1 mode, the bandwidth of the JA is always set to 3Hz. In E1 mode, the bandwidth is programmable to either 10Hz or 1.5Hz (1.5Hz automatically selects the 64-Bit FIFO depth). The JA has a clock delay equal to ½ of the FIFO bit depth.

**Note:** If the LIU is used in a multiplexer/mapper application where stuffing bits are typically removed, the jitter attenuator can be selected in the transmit path to smooth out the gapped clock. See the Transmit Section of this datasheet.

#### 3.4 HDB3/B8ZS Decoder

In single rail mode, RPOS can decode AMI or HDB3/B8ZS signals. For E1 mode, HDB3 is defined as any block of 4 successive zeros replaced with 000V or B00V, so that two successive V pulses are of opposite polarity to prevent a DC component. In T1 mode, 8 successive zeros are replaced with 000VB0VB. If the HDB3/B8ZS decoder is selected, the receive path removes the V and B pulses so that the original data is output to RPOS.

#### 3.4.0.1 RPOS/RNEG/RCLK

The digital output data can be programmed to either single rail or dual rail formats. Figure 10 is a timing diagram of a repeating "0011" pattern in single-rail mode. Figure 11 is a timing diagram of the same fixed pattern in dual rail mode.











#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### 3.5 RxMUTE (Receiver LOS with Data Muting)

The receive muting function can be selected by setting RxMUTE to "1" in the appropriate global register. If selected, any channel that experiences an RLOS condition will automatically pull RPOS and RNEG "Low" to prevent data chattering. If RLOS does not occur, the RxMUTE will remain inactive until an RLOS on a given channel occurs. The default setting for RxMUTE is "0" which is disabled. A simplified block diagram of the RxMUTE function is shown in Figure 12.





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#### 4.0 TRANSMIT PATH LINE INTERFACE

The transmit path of the XRT83VSH314 LIU consists of 14 independent T1/E1/J1 transmitters. The following section describes the complete transmit path from TCLK/TPOS/TNEG inputs to TTIP/TRING outputs. A simplified block diagram of the transmit path is shown in Figure 13.

#### FIGURE 13. SIMPLIFIED BLOCK DIAGRAM OF THE TRANSMIT PATH



#### 4.1 TCLK/TPOS/TNEG Digital Inputs

In dual rail mode, TPOS and TNEG are the digital inputs for the transmit path. In single rail mode, TNEG has no function and can be left unconnected. The XRT83VSH314 can be programmed to sample the inputs on either edge of TCLK. By default, data is sampled on the falling edge of TCLK. To sample data on the rising edge of TCLK, set TCLKE to "1" in the appropriate global register. Figure 14 is a timing diagram of the transmit input data sampled on the falling edge of TCLK. Figure 15 is a timing diagram of the transmit input data sampled on the rising edge of TCLK. The timing specifications are shown in Table 5.





FIGURE 15. TRANSMIT DATA SAMPLED ON RISING EDGE OF TCLK



#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

TABLE 5: TIMING SPECIFICATIONS	FOR TCLK/TPOS/TNEG
--------------------------------	--------------------

PARAMETER	SYMBOL	Min	Түр	Мах	Units
TCLK Duty Cycle	T <sub>CDU</sub>	30	50	70	%
Transmit Data Setup Time	T <sub>SU</sub>	50	-	-	ns
Transmit Data Hold Time	Т <sub>НО</sub>	30	-	-	ns
TCLK Rise Time (10% to 90%)	TCLK <sub>R</sub>	-	-	40	ns
TCLK Fall Time (90% to 10%)	TCLK <sub>F</sub>	-	-	40	ns

NOTE: VDD=3.3V ±5%, VDDc=1.8V ±5%, T<sub>A</sub>=25°C, Unless Otherwise Specified

#### 4.2 HDB3/B8ZS Encoder

In single rail mode, the LIU can encode the TPOS input signal to AMI or HDB3/B8ZS data. In E1 mode and HDB3 encoding selected, any sequence with four or more consecutive zeros in the input will be replaced with 000V or B00V, where "B" indicates a pulse conforming to the bipolar rule and "V" representing a pulse violating the rule. An example of HDB3 encoding is shown in Table 6. In T1 mode and B8ZS encoding selected, an input data sequence with eight or more consecutive zeros will be replaced using the B8ZS encoding rule. An example with Bipolar with 8 Zero Substitution is shown in Table 7.

#### TABLE 6: EXAMPLES OF HDB3 ENCODING

	NUMBER OF PULSES BEFORE NEXT 4 ZEROS	
Input		0000
HDB3 (Case 1)	Odd	000V
HDB3 (Case 2)	Even	B00V

CASE	PRECEDING PULSE	NEXT 8 BITS
Case 1	+	0000000
B8ZS		000VB0VB
AMI Output	+	000+-0-+
Case 2		
Input	-	0000000
B8ZS		000VB0VB
AMI Output	-	000-+0+-

#### TABLE 7: EXAMPLES OF B8ZS ENCODING

#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### 4.3 Jitter Attenuator

The XRT83VSH314 LIU is ideal for multiplexer or mapper applications where the network data crosses multiple timing domains. As the higher data rates are de-multiplexed down to T1 or E1 data, stuffing bits are typically removed which can leave gaps in the incoming data stream. The jitter attenuator can be selected in the transmit path with a 32-Bit or 64-Bit FIFO that is used to smooth the gapped clock into a steady T1 or E1 output. The maximum gap width of the 14-Channel LIU is shown in Table 8.

FIFO DEPTH	MAXIMUM GAP WIDTH
32-Bit	9 UI
64-Bit	9 UI

#### TABLE 8: MAXIMUM GAP WIDTH FOR MULTIPLEXER/MAPPER APPLICATIONS

**Note:** If the LIU is used in a loop timing system, the jitter attenuator can be selected in the receive path. See the Receive Section of this datasheet.

#### 4.4 TAOS (Transmit All Ones)

The XRT83VSH314 has the ability to transmit all ones on a per channel basis by programming the appropriate channel register. This function takes priority over the digital data present on the TPOS/TNEG inputs. For example: If a fixed "0011" pattern is present on TPOS in single rail mode and TAOS is enabled, the transmitter will output all ones. In addition, if digital or dual loopback is selected, the data on the RPOS output will be equal to the data on the TPOS input. Figure 16 is a diagram showing the all ones signal at TTIP and TRING.

#### FIGURE 16. TAOS (TRANSMIT ALL ONES)



#### 4.5 Transmit Diagnostic Features

In addition to TAOS, the XRT83VSH314 offers multiple diagnostic features for analyzing network integrity such as ATAOS and QRSS on a per channel basis by programming the appropriate registers. These diagnostic features take priority over the digital data present on TPOS/TNEG inputs. The transmitters will send the diagnostic code to the line and will be maintained in the digital loopback if selected. When the LIU is responsible for sending diagnostic patterns, the LIU is automatically placed in the single rail mode.

**Note:** Dual and Remote Loopback have priority over TAOS.





## 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

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#### 4.5.1 ATAOS (Automatic Transmit All Ones)

If ATAOS is selected by programming the appropriate global register, an AMI all ones signal will be transmitted for each channel that experiences an RLOS condition. If RLOS does not occur, the ATAOS will remain inactive until an RLOS on a given channel occurs. A simplified block diagram of the ATAOS function is shown in Figure 17.





#### 4.5.2 QRSS/PRBS Generation

The XRT83VSH314 can transmit a QRSS/PRBS random sequence to a remote location from TTIP/TRING. To select QRSS or PRBS, see the register map for programming details. The polynomial is shown in Table 9.

TABLE 9: RANDOM BIT SEQUENCE POLYNOMIALS

RANDOM PATTERN	T1	E1
QRSS	2 <sup>20</sup> - 1	2 <sup>20</sup> - 1
PRBS	2 <sup>15</sup> - 1	2 <sup>15</sup> - 1

#### 4.6 Transmit Pulse Shaper and Filter

If TCLK is not present, pulled "Low", or pulled "High" the transmitter outputs at TTIP/TRING will automatically send an all ones or an all zero signal to the line by programming the appropriate global register. By default, the transmitters will send all zeros. To send all ones, the TCLKCNL bit must be set "High".

#### 4.6.1 T1 Short Haul Line Build Out (LBO)

The short haul transmitter output pulses are generated using a 7-Bit internal DAC (6-Bit plus the MSB sign bit). The line build out can be set to interface to five different ranges of cable attenuation by programming the appropriate channel register. The pulse shape is divided into eight discrete time segments which are set to fixed values to comply with the pulse template. The short haul LBO settings are shown in Table 10.

LBO SETTING EQC[4:0]	RANGE OF CABLE ATTENUATION
08h (01000)	0 - 133 Feet
09h (01001)	133 - 266 Feet
0Ah (01010)	266 - 399 Feet
0Bh (01011)	399 - 533 Feet
0Ch (01100)	533 - 655 Feet

TABLE 10: SHORT HAUL LINE BUILD OUT

#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### 4.6.2 Arbitrary Pulse Generator For T1 and E1

The arbitrary pulse generator divides the pulse into eight individual segments. Each segment is set by a 7-Bit binary word by programming the appropriate channel register. This allows the system designer to set the overshoot, amplitude, and undershoot for a unique line build out. The MSB (bit 7) is a sign-bit. If the sign-bit is set to "0", the segment will move in a positive direction relative to a flat line (zero) condition. If this sign-bit is set to "1", the segment will move in a negative direction relative to a flat line condition. The resolution of the DAC is typically 45mV per LSB. Thus, writing 7-bit = 111111 will clamp the output at either voltage rail corresponding to a maximum amplitude. A pulse with numbered segments is shown in Figure 18.

#### FIGURE 18. ARBITRARY PULSE SEGMENT ASSIGNMENT



**Note:** By default, the arbitrary segments are programmed to 0x00h. The transmitter outputs will result in an all zero pattern to the line interface.

#### 4.6.3 Setting Registers to select an Aribtrary Pulse

For T1: Address:0x0D hex

For E1: Address: 0xF4 hex, bit D0

To program the transmit output pulse, once the arbitrary pulse has been selected, write the appropriate values into the segment registers in Table 11.

The transmit output pulse is divided into eight individual segments. Segment 1 corresponds to the beginning of the pulse and segment 8 to end the pulse. The value for each segment can be programed individually through a corresponding 8-bit register. In normal operation, i.e., non-arbitrary mode, codes are stored in an internal ROM are used to generate the pulse shape, as shown in Table 11. Typical ROM values are given below in Hex.



#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

LINE DISTANCE	SEGMENT #							
FEET	1	2	3	4	5	6	7	8
0 - 133	24	21	20	20	4C	47	44	42
133 - 266	29	23	22	21	4E	4A	47	43
266 - 399	30	25	24	23	59	40	48	44
399 - 525	34	26	24	23	5F	50	48	44
525 - 655	39	28	25	23	59	50	48	44
E1	2C	2A	2A	00	00	00	00	00

#### TABLE 11: TYPICAL ROM VALUES

**Note:** The same register bank (eight registers in total) holds the values for any given line length. In other words, the user can not load all the desired values for all the line lengths into the device at one time. If the line length is changed, a new code must be loaded into the register bank.

#### 4.7 DMO (Digital Monitor Output)

The driver monitor circuit is used to detect transmit driver failures by monitoring the activities at TTIP/TRING outputs. Driver failure may be caused by a short circuit in the primary transformer or system problems at the transmit inputs. If the transmitter of a channel has no output for more than 128 clock cycles, DMO goes "High" until a valid transmit pulse is detected. If the DMO interrupt is enabled, the change in status of DMO will cause the interrupt pin to go "Low". Once the status register is read, the interrupt pin will return "High" and the status register will be reset (RUR).

#### 4.8 Line Termination (TTIP/TRING)

The output stage of the transmit path generates standard return-to-zero (RZ) signals to the line interface for T1/ E1/J1 twisted pair or E1 coaxial cable. 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 transmitter outputs only require one DC blocking capacitor of  $0.68\mu$ F. For redundancy applications (or simply to tri-state the transmitters), set TxTSEL to a "1" in the appropriate channel register. A typical transmit interface is shown in Figure 19.





#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### 5.0 T1/E1 APPLICATIONS

This applications section describes common T1/E1 system considerations along with references to application notes available for reference where applicable.

#### 5.1 Loopback Diagnostics

The XRT83VSH314 supports several loopback modes for diagnostic testing. The following section describes the local analog loopback, remote loopback, digital loopback, and dual loopback modes.

#### 5.1.1 Local Analog Loopback

With local analog loopback activated, the transmit output data at TTIP/TRING is internally looped back to the analog inputs at RTIP/RRING. External inputs at RTIP/RRING are ignored while valid transmit output data continues to be sent to the line. A simplified block diagram of local analog loopback is shown in Figure 20.





**Note:** The transmit diagnostic features such as TAOS and QRSS take priority over the transmit input data at TCLK/TPOS/ TNEG.

#### 5.1.2 Remote Loopback

With remote loopback activated, the receive input data at RTIP/RRING is internally looped back to the transmit output data at TTIP/TRING. The remote loopback includes the Receive JA (if enabled). The transmit input data at TCLK/TPOS/TNEG are ignored while valid receive output data continues to be sent to the system. A simplified block diagram of remote loopback is shown in Figure 21.

FIGURE 21. SIMPLIFIED BLOCK DIAGRAM OF REMOTE LOOPBACK





#### 5.1.3 Digital Loopback

With digital loopback activated, the transmit input data at TCLK/TPOS/TNEG is looped back to the receive output data at RCLK/RPOS/RNEG. The digital loopback mode includes the Transmit JA (if enabled). The receive input data at RTIP/RRING is ignored while valid transmit output data continues to be sent to the line. A simplified block diagram of digital loopback is shown in Figure 22.





#### 5.1.4 Dual Loopback

With dual loopback activated, the remote loopback is combined with the digital loopback. A simplified block diagram of dual loopback is shown in Figure 23.





5.2

#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

# 84-Channel T1/E1 Multiplexer/Mapper Applications

The XRT83VSH314 has the capability of providing the necessary chip selects for multiple 14-channel LIU devices. The LIU is responsible for selecting itself, up to 5 additional LIU devices, or all 6 devices simultaneously for permitting access to internal registers. The state of the chip select output pins is determined by a chip select decoder controlled by the 3 MSBs of the address bus ADDR[10:8]. Only one LIU (Master) requires the ADDR[10:8]. The other 5 LIU devices use the 8 LSBs for the direct address bus ADDR[7:0]. Figure 24 is a simplified block diagram of connecting six 14-channel LIU devices for 84-channel applications. Selection of the chip select outputs using ADDR[10:8] is shown in Table 12.

FIGURE 24. SIMPLIFIED BLOCK DIAGRAM OF AN 84-CHANNEL APPLICATION



#### TABLE 12: CHIP SELECT ASSIGNMENTS

ADDR[10:8]	ACTIVE CHIP SELECT
0h (000)	Current Device (Master)
1h (001)	Chip 1
2h (010)	Chip 2
3h (011)	Chip 3
4h (100)	Chip 4
5h (101)	Chip 5
6h (110)	Reserved
7h (111)	All Devices Active


#### 5.3 Line Card Redundancy

Telecommunication system design requires signal integrity and reliability. When a T1/E1 primary line card has a failure, it must be swapped with a backup line card while maintaining connectivity to a backplane without losing data. System designers can achieve this by implementing common redundancy schemes with the XRT83VSH314 LIU. EXAR offers features that are tailored to redundancy applications while reducing the number of components and providing system designers with solid reference designs.

#### **RLOS and DMO**

If an RLOS or DMO condition occurs, the XRT83VSH314 reports the alarm to the individual status registers on a per channel basis. However, for redundancy applications, an RLOS or DMO alarm can be used to initiate an automatic switch to the back up card. For this application, two global pins RLOS and DMO are used to indicate that one of the 14-channels has an RLOS or DMO condition.

#### **Typical Redundancy Schemes**

- 1:1 One backup card for every primary card (Facility Protection)
- 1+1 One backup card for every primary card (Line Protection)
- ·N+1 One backup card for N primary cards

#### 5.3.1 1:1 and 1+1 Redundancy Without Relays

The 1:1 facility protection and 1+1 line protection have one backup card for every primary card. When using 1:1 or 1+1 redundancy, the backup card has its transmitters tri-stated and its receivers in high impedance. This eliminates the need for external relays and provides one bill of materials for all interface modes of operation. For 1+1 line protection, the receiver inputs on the backup card have the ability to monitor the line for bit errors while in high impedance. The transmit and receive sections of the LIU device are described separately.

#### 5.3.2 Transmit Interface with 1:1 and 1+1 Redundancy

The transmitters on the backup card should be tri-stated. Select the appropriate impedance for the desired mode of operation, T1/E1/J1. A 0.68uF capacitor is used in series with TTIP for blocking DC bias. See Figure 25. for a simplified block diagram of the transmit section for a 1:1 and 1+1 redundancy.

#### FIGURE 25. SIMPLIFIED BLOCK DIAGRAM OF THE TRANSMIT INTERFACE FOR 1:1 AND 1+1 REDUNDANCY



#### 5.3.3 Receive Interface with 1:1 and 1+1 Redundancy

The receivers on the backup card should be programmed for "High" impedance. Since there is no external resistor in the circuit, the receivers on the backup card will not load down the line interface. This key design feature eliminates the need for relays and provides one bill of materials for all interface modes of operation.



### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

Select the impedance for the desired mode of operation, T1/E1/J1. To swap the primary card, set the backup card to internal impedance, then the primary card to "High" impedance. See Figure 26. for a simplified block diagram of the receive section for a 1:1 redundancy scheme.





#### 5.3.4 N+1 Redundancy Using External Relays

N+1 redundancy has one backup card for N primary cards. Due to impedance mismatch and signal contention, external relays are necessary when using this redundancy scheme. The relays create complete isolation between the primary cards and the backup card. This allows all transmitters and receivers on the primary cards to be configured in internal impedance, providing one bill of materials for all interface modes of operation. The transmit and receive sections of the LIU device are described separately.



#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### 5.3.5 Transmit Interface with N+1 Redundancy

For N+1 redundancy, the transmitters on all cards should be programmed for internal impedance. The transmitters on the backup card do not have to be tri-stated. To swap the primary card, close the desired relays, and tri-state the transmitters on the failed primary card. A 0.68uF capacitor is used in series with TTIP for blocking DC bias. See Figure 27 for a simplified block diagram of the transmit section for an N+1 redundancy scheme.





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#### 5.3.6 Receive Interface with N+1 Redundancy

For N+1 redundancy, the receivers on the primary cards should be programmed for internal impedance. The receivers on the backup card should be programmed for "High" impedance mode. To swap the primary card, set the backup card to internal impedance, then the primary card to "High" impedance. See Figure 28 for a simplified block diagram of the receive section for a N+1 redundancy scheme.



FIGURE 28. SIMPLIFIED BLOCK DIAGRAM OF THE RECEIVE INTERFACE FOR N+1 REDUNDANCY



#### 5.4 Power Failure Protection

For 1:1 or 1+1 line card redundancy in T1/E1 applications, power failure could cause a line card to change the characteristics of the line impedance, causing a degradation in system performance. The XRT83VSH314 was designed to ensure reliability during power failures. The LIU has patented high impedance circuits that allow the receiver inputs and the transmitter outputs to be in "High" impedance when the LIU experiences a power failure or when the LIU is powered off.

**Note:** For power failure protection, a transformer must be used to couple to the line interface. See the TAN-56 application note for more details.

#### 5.5 Overvoltage and Overcurrent Protection

Physical layer devices such as LIUs that interface to telecommunications lines are exposed to overvoltage transients posed by environmental threats. An Overvoltage transient is a pulse of energy concentrated over a small period of time, usually under a few milliseconds. These pulses are random and exceed the operating conditions of CMOS transceiver ICs. Electronic equipment connecting to data lines are susceptible to many forms of overvoltage transients such as lightning, AC power faults and electrostatic discharge (ESD). There are three important standards when designing a telecommunications system to withstand overvoltage transients.

- UL1950 and FCC Part 68
- Telcordia (Bellcore) GR-1089
- ITU-T K.20, K.21 and K.41

Note: For a reference design and performance, see the TAN-54 application note for more details.

#### 5.6 Non-Intrusive Monitoring

In non-intrusive monitoring applications, the transmitters are shut off by setting TxON "Low". The receivers must be actively receiving data without interfering with the line impedance. The XRT83VSH314's internal termination ensures that the line termination meets T1/E1 specifications for 75 $\Omega$ , 100 $\Omega$  or 120 $\Omega$  while monitoring the data stream. System integrity is maintained by placing the non-intrusive receiver in "High" impedance, equivalent to that of a 1+1 redundancy application. A simplified block diagram of non-intrusive monitoring is shown in Figure 29.

FIGURE 29.	SIMPLIFIED BLOCK DIAGRAM OF A	NON-INTRUSIVE MONITORING APPLICATION
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#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### 5.7 Analog Board Continuity Check

This test verifies the per-channel continuity from the Line Side of TIP and RING for both the transmitters and receivers, through the transformers on the assembly and LIU. Inside the LIU, a MUX and Control logic using TMS and TCK as reset and clock, successively connect each TIP and RING on the XRT83VSH314 side to two Analog Test Pins, (ATP\_TIP and ATP\_RING). Simplified block and timing diagrams are shown in Figure 30 and Figure 31.

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FIGURE 31. TIMING DIAGRAM FOR ATP TESTING



## 5.7.1 Transmitter TTIP and TRING Testing

Testing of each channel must be done in sequence. With a clock signal applied to TCK, Setting TMS to "0" will begin the test sequence. On the falling edge of the 1st clock pulse after TMS is set to "0", the sequence will reset as shown in Figure 31 above. On the 2nd falling clock edge the signal on ATP\_TIP and ATP\_RING will be TTIP\_0 and TRING\_0, respectively. On the falling edge of the 17th clock pulse the signal on ATP\_TIP and ATP\_RING will be connected to RTIP\_0 and RRING\_0, respectively. After the 30th clock pulse TMS can be returned to a "1" and all channels will return to their normal state.

Device side testing is implemented via the ATP\_TIP and ATP\_RING pins. The Line side Testing is done via the Line Side Receive and Transmit TIP and RING connections.

Each channel of the device can be tested from the line side by doing the following:

- 1. Apply a differental 2Vpp, 1MHz signal to the Tx Line Side channel TIP and RING pins.
- 2. Measure the signal at the device ATP\_TIP and ATP\_RING pins.
- 3. If the voltage measured ATP\_TTIP/TRING pins is 1Vpp±20%, your assembly is correct.



#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

**Note:** The Transmitter Line Side uses a 2:1 transformer.

4. If the measured signal is absent, there is either an open or short on the board.

5. A 1MHz signal applied to the Line Side TTIP pin should appear unattenuated on the Line Side TRING pin if there is no open. This could also be indicitive of a short.

6. A 1MHz signal applied to the ATP\_TIP pin should appear unattenuated on the ATP\_RING pin if the line side TTIP/TRING are appropriately terminated and there is no open. This could also be indicative of a short.

#### 5.7.2 Receiver RTIP and RRING

Each channel of the device can be tested from the line side by doing the following, using the TMS and TCK as describe above:

1. Apply a differential 2Vpp, 1MHz signal to the Rx Line Side channel TIP and RING pins.

2. Measure the signal at the device ATP\_TIP and ATP\_RING pins.

3. If the voltaged measured on the ATP\_TTIP ATP\_TRING pins is 2Vpp±20%, your assembly is correct.

Note: The Receiverr Line Side uses a 1:1 transformer.

4. If the measured signal is absent, there is either an open or short on the board.

5. A 1 MHZ or 1kHZ signal applied to the Line Side RTIP pin should appear attenuated on the Line Side RRING pin if there is no open. This could also be indicative of a short.

6. A 1kHZ signal applied to the ATP\_TIP pin should appear slightly attenuated on the ATP\_RING pin if the line side RTIP/RRING are appropriately terminated and there is no open. This could also be indicitive of a short.

The Receiver Device Side transformer is center tapped and capacitively connected to ground which would cause a 1MHz signal to be severely attenuated.

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#### 6.0 MICROPROCESSOR INTERFACE BLOCK

The Microprocessor Interface section supports communication between the local microprocessor ( $\mu$ P) and the LIU. The XRT83VSH314 supports an Intel asynchronous interface, Motorola 68K asynchronous, and a Motorola Power PC interface. The microprocessor interface is selected by the state of the  $\mu$ PTS[2:0] input pins. Selecting the microprocessor interface is shown in Table 13.

μ <b>ΡΤS[2:0]</b>	MICROPROCESSOR MODE
0h (000)	Intel 68HC11, 8051, 80C188 (Asynchronous)
1h (001)	Motorola 68K (Asynchronous)
7h (111)	Motorola MPC8260, MPC860 Power PC (Synchronous)

#### TABLE 13: SELECTING THE MICROPROCESSOR INTERFACE MODE

The XRT83VSH314 uses multipurpose pins to configure the device appropriately. The local  $\mu$ P configures the LIU by writing data into specific addressable, on-chip Read/Write registers. The microprocessor interface provides the signals which are required for a general purpose microprocessor to read or write data into these registers. The microprocessor interface also supports polled and interrupt driven environments. A simplified block diagram of the microprocessor is shown in Figure 32.

#### FIGURE 32. SIMPLIFIED BLOCK DIAGRAM OF THE MICROPROCESSOR INTERFACE BLOCK



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#### 6.1 The Microprocessor Interface Block Signals

The LIU may be configured into different operating modes and have its performance monitored by software through a standard microprocessor using data, address and control signals. These interface signals are described below in Table 14, Table 15, and Table 16. The microprocessor interface can be configured to operate in Intel mode or Motorola mode. When the microprocessor interface is operating in Intel mode, some of the control signals function in a manner required by the Intel 80xx family of microprocessors. Likewise, when the microprocessor interface is operating in Motorola mode, then these control signals function in a manner as required by the Motorola Power PC family of microprocessors. (For using a Motorola 68K asynchronous processor, see Figure 35 and Table 19) Table 14 lists and describes those microprocessor interface signals whose role is constant across the two modes. Table 15 describes the role of some of these signals when the microprocessor interface is operating in the Intel mode. Likewise, Table 16 describes the role of these signals when the microprocessor interface is operating in the Motorola Power PC mode.

## TABLE 14: XRT84SH314S MICROPROCESSOR INTERFACE SIGNALS COMMON TO BOTH INTEL AND MOTOROLA MODES

PIN NAME	Түре	DESCRIPTION
µPTS[2:0]	I	<b>Microprocessor Interface Mode Select Input pins</b> These three pins are used to specify the microprocessor interface mode. The relationship between the state of these three input pins, and the corresponding microprocessor mode is presented in Table 13.
DATA[7:0]	I/O	Bi-Directional Data Bus for register "Read" or "Write" Operations.
ADDR[10:8]	Ι	Three-Bit Address Bus InputsThe 3 MSBs of the address bits are used as a chip select decoder. The state of these 3 pins enable the Chip Selects for additional LIU devices.Note: See the 84-Channel Application Section of this datasheet.
ADDR[7:0]	I	<b>Eight-Bit Address Bus Inputs</b> The XRT83VSH314 LIU microprocessor interface uses a direct address bus. This address bus is provided to permit the user to select an on-chip register for Read/Write access.
CS	I	Chip Select Input This active low signal selects the microprocessor interface of the XRT83VSH314 LIU and enables Read/Write operations with the on-chip register locations.

#### TABLE 15: INTEL MODE: MICROPROCESSOR INTERFACE SIGNALS

XRT83VSH314 Pin Name	Intel Equivalent Pin	Түре	DESCRIPTION
ALE_TS	ALE	I	Address-Latch Enable: This active high signal is used to latch the contents on the address bus ADDR[7:0]. The contents of the address bus are latched into the ADDR[7:0] inputs on the falling edge of ALE.
RD_WE	RD	I	<b>Read Signal:</b> This active low input functions as the read signal from the local $\mu$ P. When this pin is pulled "Low" (if $\overline{CS}$ is "Low") the LIU is informed that a read operation has been requested and begins the process of the read cycle.
WR_R/W	WR	I	<b>Write Signal:</b> This active low input functions as the write signal from the local $\mu$ P. When this pin is pulled "Low" (if $\overline{CS}$ is "Low") the LIU is informed that a write operation has been requested and begins the process of the write cycle.
RDY_TA	RDY	0	<b>Ready Output:</b> This active low signal is provided by the LIU device. It indicates that the current read or write cycle is complete, and the LIU is waiting for the next command.

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XRT83VSH314 Pin Name	Motorola Equivalent Pin	Түре	DESCRIPTION
ALE_TS	TS	I	<b>Transfer Start:</b> This active high signal is used to latch the contents on the address bus ADDR[7:0]. The contents of the address bus are latched into the ADDR[7:0] inputs on the falling edge of TS.
WR_R/W	R/W	I	<b>Read/Write:</b> This input pin from the local $\mu P$ is used to inform the LIU whether a Read or Write operation has been requested. When this pin is pulled <u>"High</u> ", WE will initiate a read operation. When this pin is pulled "Low", WE will initiate a write operation.
RD_WE	WE	I	Write Enable: This active low input functions as the read or write signal from the local $\mu$ P dependent on the state of R/W. When WE is pulled "Low" (If CS is "Low") the LIU begins the read or write operation.
No Pin	ŌĒ	I	<b>Output Enable:</b> This signal is not necessary for the XRT83VSH314 to interface to the MPC8260 or MPC860 Power PCs.
μPCLK	CLKOUT	I	Synchronous Processor Clock: This signal is used as the timing reference for the Power PC synchronous mode.
RDY_TA	TA	0	<b>Transfer Acknowledge:</b> This active low signal is provided by the LIU device. It indicates that the current read or write cycle is complete, and the LIU is waiting for the next command.

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#### 6.2 Intel Mode Programmed I/O Access (Asynchronous)

If the LIU is interfaced to an Intel type  $\mu$ P, then it should be configured to operate in the Intel mode. Intel type Read and Write operations are described below.

#### Intel Mode Read Cycle

Whenever an Intel-type  $\mu P$  wishes to read the contents of a register, it should do the following.

- 1. Place the address of the target register on the address bus input pins ADDR[10:0].
- 2. While the μP is placing this address value on the address bus, the address decoding circuitry should assert the CS pin of the LIU, by toggling it "Low". This action enables further communication between the μP and the LIU microprocessor interface block.
- **3.** Toggle the ALE input pin "High". This step enables the address bus input drivers, within the microprocessor interface block of the LIU.
- **4.** The μP should then toggle the ALE pin "Low". This step causes the LIU to latch the contents of the address bus into its internal circuitry. At this point, the address of the register has now been selected.
- Next, the µP should indicate that this current bus cycle is a Read operation by toggling the RD input pin "Low". This action also enables the bi-directional data bus output drivers of the LIU.
- 6. After the μP toggles the Read signal "Low", the LIU will toggle the RDY output pin "Low". The LIU does this in order to inform the μP that the data is available to be read by the μP, and that it is ready for the next command.
- **7.** After the μP detects the RDY signal and has read the data, it can terminate the Read Cycle by toggling the RD input pin "High".

**Note:** ALE can be tied "High" if this signal is not available.

#### The Intel Mode Write Cycle

Whenever an Intel type  $\mu P$  wishes to write a byte or word of data into a register within the LIU, it should do the following.

- 1. Place the address of the target register on the address bus input pins ADDR[10:0].
- 2. While the μP is placing this address value on the address bus, the address decoding circuitry should assert the CS pin of the LIU, by toggling it "Low". This action enables further communication between the μP and the LIU microprocessor interface block.
- **3.** Toggle the ALE input pin "High". This step enables the address bus input drivers, within the microprocessor interface block of the LIU.
- **4.** The μP should then toggle the ALE pin "Low". This step causes the LIU to latch the contents of the address bus into its internal circuitry. At this point, the address of the register has now been selected.
- **5.** The μP should then place the byte or word that it intends to write into the target register, on the bi-directional data bus DATA[7:0].
- **6.** Next, the μP should indicate that this current bus cycle is a Write operation by toggling the WR input pin "Low". This action also enables the bi-directional data bus input drivers of the LIU.
- **7.** After the μP toggles the Write signal "Low", the LIU will toggle the RDY output pin "Low". The LIU does this in order to inform the μP that the data has been written into the internal register location, and that it is ready for the next command.

#### **Note:** ALE can be tied "High" if this signal is not available.

The Intel Read and Write timing diagram is shown in Figure 33. The timing specifications are shown in Table 17.



#### FIGURE 33. INTEL $\mu P$ INTERFACE SIGNALS DURING PROGRAMMED I/O READ AND WRITE OPERATIONS

TABLE 17: INTEL MICROPROCESSOR INTERFACE TIMING SPECIFICATIONS

SYMBOL	PARAMETER	Μιν	ΜΑΧ	Units
t <sub>0</sub>	Valid Address to $\overline{CS}$ Falling Edge	0	-	ns
t <sub>1</sub>	CS Falling Edge to RD Assert	65	-	ns
t <sub>2</sub>	RD Assert to RDY Assert	-	90	ns
NA	RD Pulse Width (t <sub>2</sub> )	90	-	ns
t <sub>3</sub>	CS Falling Edge to WR Assert	65	-	ns
t <sub>4</sub>	WR Assert to RDY Assert	-	90	ns
NA	$\overline{\text{WR}}$ Pulse Width (t <sub>4</sub> )	90	-	ns

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#### 6.3 MPC86X Mode Programmed I/O Access (Synchronous)

If the LIU is interfaced to a MPC86X type  $\mu$ P, it should be configured to operate in the MPC86X mode. MPC86X Read and Write operations are described below.

#### MPC86X Mode Read Cycle

- 1. Place the address of the target register on the address bus input pins ADDR[10:0].
- 2. While the μP is placing this address value on the address bus, the address decoding circuitry should assert the CS pin of the LIU, by toggling it "Low". This action enables further communication between the μP and the LIU microprocessor interface block.
- Next, the μP should indicate that this current bus cycle is a Read operation by pulling the R/W input pin "High".
- 4. The LIU will toggle the TA output pin "Low". The LIU does this in order to inform the μP that the data is available to be read by the μP.
- **5.** After the μP detects the TA signal and has read the data, it can terminate the Read Cycle by toggling the CS input pin "High".

#### MPC86X Mode Write Cycle

- 1. Place the address of the target register on the address bus input pins ADDR[10:0].
- 2. While the μP is placing this address value on the address bus, the address decoding circuitry should assert the CS pin of the LIU, by toggling it "Low". This action enables further communication between the μP and the LIU microprocessor interface block.
- Next, the μP should indicate that this current bus cycle is a Write operation by pulling the R/W input pin "Low".
- **4.** Toggle the  $\overline{WE}$  input pin "Low".
- 5. After the  $\mu$ P toggles the WE signal "Low", the LIU will toggle the TA output pin "Low". The LIU does this in order to inform the  $\mu$ P that the data has been written into the internal register location.
- **6.** After the μP detects the TA signal, the Write operation is completed by toggling both WE and CS pins "High".

The Motorola Read and Write timing diagram is shown in Figure 34. The timing specifications are shown in Table 18.

## FIGURE 34. MOTOROLA MPC86X $\mu P$ Interface Signals During Programmed I/O Read and Write Operations



#### TABLE 18: MOTOROLA MPC86X MICROPROCESSOR INTERFACE TIMING SPECIFICATIONS

SYMBOL	PARAMETER	Min	ΜΑΧ	Units
t <sub>0</sub>	Valid Address to $\overline{CS}$ Falling Edge	0	-	ns
t <sub>1</sub>	CS Falling Edge to WE Assert	0	-	ns
t <sub>2</sub>	WE Assert to TA Assert	-	90	ns
t <sub>dc</sub>	μPCLK Duty Cycle	40	60	%
t <sub>cp</sub>	µPCLK Clock Period	20		ns

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#### FIGURE 35. MOTOROLA 68K µP INTERFACE SIGNALS DURING PROGRAMMED I/O READ AND WRITE OPERATIONS

#### TABLE 19: MOTOROLA 68K MICROPROCESSOR INTERFACE TIMING SPECIFICATIONS

SYMBOL	PARAMETER	Μιν	ΜΑΧ	Units
t <sub>0</sub>	Valid Address to $\overline{CS}$ Falling Edge	0	-	ns
t <sub>1</sub>	$\overline{CS}$ Falling Edge to $\overline{DS}$ (Pin $\overline{RD}_{\overline{WE}}$ ) Assert	65	-	ns
t <sub>2</sub>	DS Assert to DTACK Assert	-	90	ns
NA	DS Pulse Width (t <sub>2</sub> )	90	-	ns
t <sub>3</sub>	$\overline{\text{CS}}$ Falling Edge to $\overline{\text{AS}}$ (Pin ALE_TS) Falling Edge	0	-	ns

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#### 7.0 REGISTER DESCRIPTIONS

## TABLE 20: MICROPROCESSOR REGISTER ADDRESS (ADDR[7:0])

Register Number	Address (Hex)	FUNCTION
0 - 15	0x00 - 0x0F	Channel 0 Control Registers
16 - 31	0x10 - 0x1F	Channel 1 Control Registers
32 - 47	0x20 - 0x2F	Channel 2 Control Registers
48 - 63	0x30 - 0x3F	Channel 3 Control Registers
64 - 79	0x40 - 0x4F	Channel 4 Control Registers
80 - 95	0x50 - 0x5F	Channel 5 Control Registers
96 - 111	0x60 - 0x6F	Channel 6 Control Registers
112 - 127	0x70 - 0x7F	Channel 7 Control Registers
128 - 143	0x80 - 0x8F	Channel 8 Control Registers
144 - 159	0x90 - 0x9F	Channel 9 Control Registers
160 - 175	0xA0 - 0xAF	Channel 10 Control Registers
176 - 191	0xB0 - 0xBF	Channel 11 Control Registers
192 - 207	0xC0 - 0xCF	Channel 12 Control Registers
208 - 223	0xD0 - 0xDF	Channel 13 Control Registers
224 - 235	0xE0 - 0xEB	Global Control Registers Applied to All 14 Channels
236 - 237	0xEC - 0xED	Registers Reserved
238	0xEE	RCLKOUTPUT Control
239 - 242	0xEF - 0xF3	Registers Reserved
244	0xF4	Global Control Register
245 - 253	0XF5 - OxFD	Registers Reserved for Testing
254	0xFE	Device "ID"
255	0xFF	Device "Revision ID"

Reg	ADDR	Түре	D7	D6	D5	D4	D3	D2	D1	D0	
Chan	Channel 0 Control Registers (0x00 - 0x0F)										
0	0x00	R/W	QRSS/ PRBS	PRBS_Rx/ Tx	RxON	EQC4	EQC3	EQC2	EQC1	EQC0	
1	0x01	R/W	RxTSEL	TxTSEL	TERSEL1	TERSEL0	JASEL1	JASEL0	JABW	FIFOS	
2	0x02	R/W	INVQRSS	TxTEST2	TxTEST1	TxTEST0	TxON	LOOP2	LOOP1	LOOP0	
3	0x03	R/W	Reserved	Reserved	CODES	RxRES1	RxRES0	INSBPV	INSBER	Reserved	



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Reg	ADDR	Түре	D7	D6	D5	D4	D3	D2	D1	D0
4	0x04	R/W	Reserved	DMOIE	FLSIE	LCV_OFIE	Reserved	AISDIE	RLOSIE	QRPDIE
5	0x05	RO	Reserved	DMO	FLS	LCV_OF	Reserved	AISD	RLOS	QRPD
6	0x06	RUR	Reserved	DMOIS	FLSIS	LCV_OFIS	Reserved	AISDIS	RLOSIS	QRPDIS
7	0x07	RO	Reserved							
8	0x08	R/W	Reserved	1SEG6	1SEG5	1SEG4	1SEG3	1SEG2	1SEG1	1SEG0
9	0x09	R/W	Reserved	2SEG6	2SEG5	2SEG4	2SEG3	2SEG2	2SEG1	2SEG0
10	0x0A	R/W	Reserved	3SEG6	3SEG5	3SEG4	3SEG3	3SEG2	3SEG1	3SEG0
11	0x0B	R/W	Reserved	4SEG6	4SEG5	4SEG4	4SEG3	4SEG2	4SEG1	4SEG0
12	0x0C	R/W	Reserved	5SEG6	5SEG5	5SEG4	5SEG3	5SEG2	5SEG1	5SEG0
13	0x0D	R/W	Reserved	6SEG6	6SEG5	6SEG4	6SEG3	6SEG2	6SEG1	6SEG0
14	0x0E	R/W	Reserved	7SEG6	7SEG5	7SEG4	7SEG3	7SEG2	7SEG1	7SEG0
15	0x0F	R/W	Reserved	8SEG6	8SEG5	8SEG4	8SEG3	8SEG2	8SEG1	8SEG0

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#### TABLE 22: MICROPROCESSOR REGISTER GLOBAL DESCRIPTION

Reg	ADDR	Түре	D7	D6	D5	D4	D3	D2	D1	D0
Globa	al Contro	l Reg	isters for Al	I 14 Channe	ls					
224	0xE0	R/W	SR/DR	ATAOS	RCLKE	TCLKE	DATAP	Reserved	GIE	SRESET
225	0xE1	R/W	Reserved	Reserved	Reserved	Reserved	Reserved	RxMUTE	EXLOS	ICT
226	0xE2	R/W	Reserved	RxTCNTL	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
227	0xE3	R/W	Reserved	Reserved	Reserved	Reserved	SL<1>	SL<0>	Reserved	Reserved
228	0xE4	R/W	MCLKT1out1	MCLKT1out0	MCLKE1out1	MCLKE1out0	Reserved	Reserved	Reserved	Reserved
229	0xE5	R/W	LCV_OFLW	CNTRDEN	Reserved	Reserved	LCVCH3	LCVCH2	LCVCH1	LCVCH0
230	0xE6	R/W	Reserved	Reserved	Reserved	allRST	allUPDATE	BYTEsel	chUPDATE	chRST
231	0xE7	R/W	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
232	0xE8	RO	LCVCNT7	LCVCNT6	LCVCNT5	LCVCNT4	LCVCNT3	LCVCNT2	LCVCNT1	LCVCNT0
233	0xE9	R/W	Reserved	Reserved	Reserved	TCLKCNL	CLKSEL3	CLKSEL2	CLKSEL1	CLKSEL0
234	0xEA	RUR	GCHIS7	GCHIS6	GCHIS5	GCHIS4	GCHIS3	GCHIS2	GCHIS1	GCHIS0
235	0xEB	RUR	Reserved	Reserved	GCHIS13	GCHIS12	GCHIS11	GCHIS10	GCHIS9	GCHIS8
236- 237	0xEC 0xED	RO	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
238	0xEE	R/W	Reserved	Reserved	Reserved	Reserved	Recovered Clock Selects [3:0]			

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TABLE 22: MICROPROCESSOR REGISTER GLOBAL DESCRIPTION

Reg	ADDR	Түре	D7	D6	D5	D4	D3	D2	D1	D0
239- 242	0xEF 0xF2	R/W	Reserved							
244 245	0xF4 0xF5	R/W	Reserved	E1Arben						
246- 253	0xF6 0xFD	R/W	Reserved for Testing							
R/W I	Register	s Rese	erved for Te	sting (0xEC	- 0xFD), Exc	luding 0xF4	h			
254	0xFE	RO	Device "ID"	levice "ID"						
255	0xFF	RO	Device "Revisi	on ID"						

#### TABLE 23: MICROPROCESSOR REGISTER 0x00H BIT DESCRIPTION

		CHANNEL 0-13 (0x00H-0xD0H)		
Віт	Nаме	FUNCTION	Register Type	Default Value (HW reset)
D7	QRSS/PRBS	<b>QRSS/PRBS Select Bits</b> These bits are used to select between QRSS and PRBS. 0 = PRBS 1 = QRSS	R/W	0
D6	PRBS_Rx/Tx	PRBS Receive/Transmit Select: This bit is used to select where the output of the PRBS Generator is directed if PRBS generation is enabled. 0 = Normal Operation - PRBS generator is output on TTIP and TRING if PRBS generator is output on RPOS; RNEG is internally grounded, if PRBS generation is enabled. Bit $6 = "0"$ Tx TTIP PBRS Generator TTIP Tx TRING Bit $6 = "1"$ RNEG Note: If PRBS generation is disabled, user should set this bit to '0' for normal operation.	R/W	0



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#### TABLE 23: MICROPROCESSOR REGISTER 0x00H BIT DESCRIPTION

	CHANNEL 0-13 (0x00H-0xD0H)									
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)						
D5	RxON	Receiver ON/OFF Upon power up, the receiver is powered OFF. RxON is used to turn the receiver ON or OFF if the hardware pin RxON is pulled "High". If the hardware pin is pulled "Low", all receivers are turned off. 0 = Receiver is Powered Off 1 = Receiver is Powered On	R/W	0						
D4 D3 D2 D1 D0	EQC4 EQC3 EQC2 EQC1 EQC0	Cable Length Settings The Cable Length Settting bits are shown in Table 24 below.	R/W	0 0 0 0 0						

#### TABLE 24: CABLE LENGTH SETTINGS

EQC[4:0]	T1/E1 MODE/RECEIVE SENSITIVITY	TRANSMIT LBO	CABLE	CODING
0x08h	T1 Short Haul	0 to 133 feet (0.6dB)	100Ω TP	B8ZS
0x09h	T1 Short Haul	133 to 266 feet (1.2dB)	100Ω TP	B8ZS
0x0Ah	T1 Short Haul	266 to 399 feet (1.8dB)	100Ω TP	B8ZS
0x0Bh	T1 Short Haul	399 to 533 feet (2.4dB)	100Ω TP	B8ZS
0x0Ch	T1 Short Haul	533 to 655 feet (3.0dB)	100Ω TP	B8ZS
0x0Dh	T1 Short Haul	Arbitrary Pulse	100Ω TP	B8ZS
0x1Ch	E1 Short Haul	ITU G.703	75Ω Coax	HDB3
0x1Dh	E1 Short Haul	ITU G.703	120Ω TP	HDB3

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			Сн	ANNEL 0-13 (	0х01н-0хD1н)			
Віт	NAME	FUNCTION					Register Type	Default Value (HW reset)
D7	RxTSEL		Termination				R/W	0
		used to s ance. 0 = Exter	ver up, the re witch betwee nal Terminational Termination					
D6	TxTSEL	Transmit	Terminatio	n Select			R/W	0
		used to s ance. 0 = "High	ver up, the tra witch betwee " Impedance nal Terminatio					
D5	TERSEL1		Line Impeda				R/W	0
D3 D4	TERSEL0		-		e line impedance for <sup>-</sup>	Г1/J1/Е1.	R/ VV	0
								_
		ſ	TERSEL1	TERSEL0				
		-	0	0	100Ω			
			0	1	110Ω			
		-	1	0	75Ω			
			1	1	120Ω			
D3	JASEL1	Jitter Att	enuator Sel	ect			R/W	0
D2	JASEL0				jitter attenuator in the attenuator is disabled			
			JASEL1	JASEL0	JA PATH			
			0	0	Disabled			
			0	1	Transmit Path			
			1	0	Receive Path			
			1	1	Receive Path			

## TABLE 25: MICROPROCESSOR REGISTER 0x01H BIT DESCRIPTION



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#### TABLE 25: MICROPROCESSOR REGISTER 0x01H BIT DESCRIPTION

		CHANNEL 0-13 (0x01H-0xD1H)		
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)
D1	JABW	Jitter Bandwidth (E1 Mode Only, T1 is permanently set to 3Hz) The jitter bandwidth is a global setting that is applied to both the receiver and transmitter jitter attenuator. 0 = 10Hz 1 = 1.5Hz	R/W	0
DO	FIFOS	<b>FIFO Depth Select</b> The FIFO depth select is used to configure the part for a 32-bit or 64-bit FIFO (within the jitter attenuator blocks). The delay of the FIFO is equal to $\frac{1}{2}$ the FIFO depth. This is a global setting that is applied to both the receiver and transmitter FIFO. 0 = 32-Bit 1 = 64-Bit	R/W	0

#### TABLE 26: MICROPROCESSOR REGISTER 0x02H BIT DESCRIPTION

		CHANNEL 0-13 (0x02H-0xD2H)		
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)
D7	INVQRSS	QRSS inversion INVQRSS is used to invert the transmit QRSS or PRBS pattern set by the TxTEST[2:0] bits. By default (bit D7=0), INVQRSS is dis- abled for PRBS and enabled for QRSS. 0 = Disabled for PRBS 0 = Enabled for QRSS 1 = Disabled for QRSS 1 = Enabled for PRBS	R/W	0
D6 D5	TxTEST2 TxTEST1	<b>Test Code Pattern</b> TxTEST[2:0] are used to select a diagnostic test pattern to the line	R/W	0 0
D4	TxTESTO	(transmit outputs). 0XX = No Pattern 100 = Tx QRSS 101 = Tx TAOS 110 = Reserved 111 = Reserved		0

## 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### TABLE 26: MICROPROCESSOR REGISTER 0x02H BIT DESCRIPTION

		CHANNEL 0-13 (0x02H-0xD2H)		
Віт	Nаме	FUNCTION	Register Type	Default Value (HW reset)
D3	TxOn	Transmit ON/OFFUpon power up, the transmitters are powered off. This bit is used to turn the transmitter for this channel On or Off if the TxON pin is pulled "High". If the TxON pin is pulled "Low", all 14 transmitters are powered off.0 = Transmitter is Powered OFF 1 = Transmitter is Powered ON	R/W	0
D2	LOOP2	Loopback Diagnostic Select	R/W	0
D1	LOOP1	LOOP[2:0] are used to select the loopback mode.		0
DO	LOOP0	0XX = No Loopback 100 = Dual Loopback 101 = Analog Loopback 110 = Remote Loopback 111 = Digital Loopback		0

#### TABLE 27: MICROPROCESSOR REGISTER 0x03H BIT DESCRIPTION

		CHANNEL 0-13 (0x03H-0xD3H)		
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)
D7 D6	Reserved	These Bits are Reserved.	R/W	0 0
D5	CODES	Encoding/Decoding Select (Single Rail Mode Only) 0 = HDB3 (E1), B8ZS (T1) 1 = AMI Coding	R/W	0
D4 D3	RxRES1 RxRES0	Receive External Fixed Resistor RxRES[1:0] are used to select the value for a high precision exter- nal resistor to improve return loss. 00 = None $01 = 240\Omega$ $10 = 210\Omega$ $11 = 150\Omega$	R/W	0 0
D2	INSBPV	<b>Insert Bipolar Violation</b> When this bit transitions from a "0" to a "1", a bipolar violation will be inserted in the transmitted data from TPOS, QRSS/PRBS pattern. The state of this bit will be sampled on the rising edge of TCLK. To ensure proper operation, it is recommended to write a "0" to this bit before writing a "1".	R/W	0



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#### TABLE 27: MICROPROCESSOR REGISTER 0x03H BIT DESCRIPTION

	CHANNEL 0-13 (0x03H-0xD3H)									
Віт	Nаме	FUNCTION	Register Type	Default Value (HW reset)						
D1	INSBER	<b>Insert Bit Error</b> When this bit transitions from a "0" to a "1", a bit error will be inserted in the transmitted QRSS/PRBS pattern. The state of this bit will be sampled on the rising edge of TCLK. To ensure proper operation, it is recommended to write a "0" to this bit before writing a "1".	R/W	0						
D0	Reserved	This Bit is Reserved	R/W	0						

#### TABLE 28: MICROPROCESSOR REGISTER 0x04H BIT DESCRIPTION

		CHANNEL 0-13 (0x04H-0xD4H)		
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)
D7	Reserved	This Bit is Reserved	R/W	0
D6	DMOIE	Digital Monitor Output Interrupt Enable 0 = Masks the DMO function 1 = Enables Interrupt Generation	R/W	0
D5	FLSIE	FIFO Limit Status Interrupt Enable 0 = Masks the FLS function 1 = Enables Interrupt Generation	R/W	0
D4	LCV_OFIE	Line Code Violation / Counter Overflow Interrupt Enable 0 = Masks the LCV/OF function 1 = Enables Interrupt Generation	R/W	0
D3	Reserved	This Bit is Reserved	R/W	0
D2	AISDIE	Alarm Indication Signal Detection Interrupt Enable 0 = Masks the AIS function 1 = Enables Interrupt Generation	R/W	0
D1	RLOSIE	Receiver Loss of Signal Interrupt Enable 0 = Masks the RLOS function 1 = Enables Interrupt Generation	R/W	0
D0	QRPDIE	Quasi Random Pattern Detect Interrupt Enable 0 = Masks the QRPD function 1 = Enables Interrupt Generation	R/W	0

## 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

**Note:** The GIE bit in the global register 0xE0h must be set to "1" in addition to the individual register bits to enable the interrupt pin.

#### TABLE 29: MICROPROCESSOR REGISTER 0x05H BIT DESCRIPTION

	CHANNEL 0-13 (0x05h-0xD5h)					
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)		
D7	Reserved	This Bit is Reserved	RO	0		
D6	DMO	Digital Monitor OutputThe digital monitor output is always active regardless if the inter- rupt generation is disabled. This bit indicates the DMO activity. An interrupt will not occur unless the DMOIE is set to "1" in the chan- nel register 0x04h and GIE is set to "1" in the global register 0xE0h.0 = No Alarm 1 = Transmit output driver has failures	RO	0		
D5	FLS	<ul> <li>FIFO Limit Status</li> <li>The FIFO limit status is always active regardless if the interrupt generation is disabled. This bit indicates whether the RD/WR pointers are within 3-Bits. An interrupt will not occur unless the FLSIE is set to "1" in the channel register 0x04h and GIE is set to "1" in the global register 0xE0h.</li> <li>0 = No Alarm</li> <li>1 = RD/WR FIFO pointers are within ±3-Bits</li> </ul>	RO	0		
D4	LCV_OF	Line Code Violation / Counter Overflow This bit serves a dual purpose. By default, this bit monitors the line code violation activity. However, if bit 7 in register 0xE5h is set to a "1", this bit monitors the overflow status of the internal LCV counter. An interrupt will not occur unless the LCV_OFIE is set to "1" in the channel register 0x04h and GIE is set to "1" in the global register 0xE0h. 0 = No Alarm 1 = A line code violation, bipolar violation, or excessive zeros has occurred	RO	0		
D3	Reserved	This Bit is Reserved	RO	0		
D2	AISD	Alarm Indication Signal Detection The alarm indication signal detection is always active regardless if the interrupt generation is disabled. This bit indicates the AIS activity. An interrupt will not occur unless the AISIE is set to "1" in the channel register 0x04h and GIE is set to "1" in the global regis- ter 0xE0h. 0 = No Alarm 1 = An all ones signal is detected	RO	0		





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**Note:** The GIE bit in the global register 0xE0h must be set to "1" in addition to the individual register bits to enable the interrupt pin.

	CHANNEL 0-13 (0x05H-0xD5H)						
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)			
D1	RLOS	Receiver Loss of SignalThe receiver loss of signal detection is always active regardless if the interrupt generation is disabled. This bit indicates the RLOS activity. An interrupt will not occur unless the RLOSIE is set to "1" in the channel register 0x04h and GIE is set to "1" in the global register 0xE0h.0 = No Alarm 1 = An RLOS condition is present	RO	0			
D0	QRPD	Quasi Random Pattern Detection The quasi random pattern detection is always active regardless if the interrupt generation is disabled. This bit indicates that a QRPD has been detected. An interrupt will not occur unless the QRPDIE is set to "1" in the channel register 0x04h and GIE is set to "1" in the global register 0xE0h. 0 = No Alarm 1 = A QRP is detected	RO	0			

#### TABLE 29: MICROPROCESSOR REGISTER 0x05H BIT DESCRIPTION

#### TABLE 30: MICROPROCESSOR REGISTER 0x06H BIT DESCRIPTION

	CHANNEL 0-13 (0x06H-0xD6H)						
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)			
D7	Reserved	This Bit is Reserved	RUR	0			
D6	DMOIS	Digital Monitor Output Interrupt Status 0 = No change 1 = Change in status occurred	RUR	0			
D5	FLSIS	FIFO Limit Interrupt Status 0 = No change 1 = Change in status occurred	RUR	0			
D4	LCV_OFIS	Line Code Violation / Overflow Interrupt Status 0 = No change 1 = Change in status occurred	RUR	0			
D3	Reserved	This Bit is Reserved	RUR	0			
D2	AISDIS	Alarm Indication Signal Detection Interrupt Status 0 = No change 1 = Change in status occurred	RUR	0			

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#### TABLE 30: MICROPROCESSOR REGISTER 0x06h BIT DESCRIPTION

	CHANNEL 0-13 (0x06H-0xD6H)					
Віт	Nаме	FUNCTION	Register Type	Default Value (HW reset)		
D1	RLOSIS	Receiver Loss of Signal Interrupt Status 0 = No change 1 = Change in status occurred	RUR	0		
D0	QRPDIS	Quasi Random Pattern Detection Interrupt Status 0 = No change 1 = Change in status occurred	RUR	0		

**Note:** Any change in status will generate an interrupt (if enabled in channel register 0x04h and GIE is set to "1" in the global register 0xE0h). The status registers are reset upon read (RUR).

#### TABLE 31: MICROPROCESSOR REGISTER 0x07H BIT DESCRIPTION

	CHANNEL 0-13 (0x07H-0xD7H)				
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)	
D[7:0]	Reserved	These Bits are Reserved	RO	0	

#### TABLE 32: MICROPROCESSOR REGISTER 0x08H BIT DESCRIPTION

	CHANNEL 0-13 (0x08H-0xD8H)					
Віт	Nаме	FUNCTION	Register Type	Default Value (HW reset)		
D7	Reserved	This Register Bit is Not Used	Х	0		
D6	1SEG6	Arbitrary Pulse Generation	R/W	0		
D5	1SEG5	The transmit output pulse is divided into 8 individual segments.		0		
D4	1SEG4	This register is used to program the first segment which corre-		0		
D3	1SEG3	sponds to the overshoot of the pulse amplitude. There are four		0		
D2	1SEG2	segments for the top portion of the pulse and four segments for the bottom portion of the pulse. Segment number 5 corresponds to		0		
D1	1SEG1	the undershoot of the pulse. The MSB of each segment is the sign		0		
D0	1SEG0	bit.		0		
		Bit 6 = 0 = Negative Direction				
		Bit 6 = 1 = Positive Direction				



#### TABLE 33: MICROPROCESSOR REGISTER 0x09H BIT DESCRIPTION

	CHANNEL 0-13 (0x09H-0xD9H)				
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)	
D7	Reserved	This Register Bit is Not Used	Х	0	
D[6:0]	2SEG[6:0]	Segment Number Two, Same Description as Register 0x08h	R/W		

#### TABLE 34: MICROPROCESSOR REGISTER 0x0AH BIT DESCRIPTION

	CHANNEL 0-13 (0x0AH-0xDAH)					
Віт	Name	FUNCTION	Register Type	Default Value (HW reset)		
D7	Reserved	This Register Bit is Not Used	Х	0		
D[6:0]	3SEG[6:0]	Segment Number Three, Same Description as Register 0x08h	R/W			

#### TABLE 35: MICROPROCESSOR REGISTER 0x0BH BIT DESCRIPTION

	CHANNEL 0-13 (0x0BH-0xDBH)					
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)		
D7	Reserved	This Register Bit is Not Used	Х	0		
D[6:0]	4SEG[6:0]	Segment Number Four, Same Description as Register 0x08h	R/W			

### TABLE 36: MICROPROCESSOR REGISTER 0x0CH BIT DESCRIPTION

	CHANNEL 0-13 (0x0CH-0xDCH)				
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)	
D7	Reserved	This Register Bit is Not Used	Х	0	
D[6:0]	5SEG[6:0]	Segment Number Five, Same Description as Register 0x08h	R/W		



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#### TABLE 37: MICROPROCESSOR REGISTER 0x0DH BIT DESCRIPTION

	CHANNEL 0-13 (0x0DH-0xDDH)					
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)		
D7	Reserved	This Register Bit is Not Used	Х	0		
D[6:0]	6SEG[6:0]	Segment Number Six, Same Description as Register 0x08h	R/W			

#### TABLE 38: MICROPROCESSOR REGISTER 0x0EH BIT DESCRIPTION

		CHANNEL 0-13 (0x0EH-0xDEH)		
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)
D7	Reserved	This Register Bit is Not Used	Х	0
D[6:0]	7SEG[6:0]	Segment Number Seven, Same Description as Register 0x08h	R/W	

#### TABLE 39: MICROPROCESSOR REGISTER 0x0FH BIT DESCRIPTION

		CHANNEL 0-13 (0x0FH-0xDFH)		
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)
D7	Reserved	This Register Bit is Not Used	Х	0
D[6:0]	8SEG[6:0]	Segment Number Eight, Same Description as Register 0x08h	R/W	

#### TABLE 40: MICROPROCESSOR REGISTER 0xE0H BIT DESCRIPTION

		GLOBAL REGISTER (0XE0H)		
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)
D7	SR/DR	Single Rail/Dual Rail Mode This bit sets the LIU to receive and transmit digital data in a single rail or a dual rail format. 0 = Dual Rail Mode 1 = Single Rail Mode	R/W	0
D6	ATAOS	Automatic Transmit All Ones If ATAOS is selected, an all ones pattern will be transmitted on any channel that experiences an RLOS condition. If an RLOS condi- tion does not occur, TAOS will remain inactive. 0 = Disabled 1 = Enabled	R/W	0



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### TABLE 40: MICROPROCESSOR REGISTER 0XE0H BIT DESCRIPTION

		GLOBAL REGISTER (0xE0H)		
Віт	Nаме	FUNCTION	Register Type	Default Value (HW reset)
D5	RCLKE	Receive Clock Data 0 = RPOS/RNEG data is updated on the rising edge of RCLK 1 = RPOS/RNEG data is updated on the falling edge of RCLK	R/W	0
D4	TCLKE	Transmit Clock Data 0 = TPOS/TNEG data is sampled on the falling edge of TCLK 1 = TPOS/TNEG data is sampled on the rising edge of TCLK	R/W	0
D3	DATAP	Data Polarity 0 = Transmit input and receive output data is active "High" 1 = Transmit input and receive output data is active "Low"	R/W	0
D2	Reserved	This Register Bit is Not Used	R/W	0
D1	GIE	<ul> <li>Global Interrupt Enable</li> <li>The global interrupt enable is used to enable/disable all interrupt activity for all 14 channels. This bit must be set "High" for the interrupt pin to operate.</li> <li>0 = Disable all interrupt generation</li> <li>1 = Enable interrupt generation to the individual channel registers</li> </ul>	R/W	0
D0	SRESET	<b>Software Reset</b> Writing a "1" to this bit for more than $10\mu$ S initiates a device reset for all internal circuits except the microprocessor register bits. To reset the registers to their default setting, use the Hardware Reset pin (See the pin description for more details).	R/W	0

#### TABLE 41: MICROPROCESSOR REGISTER 0xE1H BIT DESCRIPTION

GLOBAL REGISTER (0xE1H)				
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)
D7 - D3	Reserved	These Register Bits are Not Used	R/W	0
D2	RxMUTE	<b>Receiver Output Mute Enable</b> If RxMUTE is selected, RPOS/RNEG will be pulled "Low" for any channel that experiences an RLOS condition. If an RLOS condi- tion does not occur, RxMUTE will remain inactive. 0 = Disabled 1 = Enabled	R/W	0

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TABLE 41: MICROPROCESSOR REGISTER 0XE1H BIT DESCRIPTION
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		GLOBAL REGISTER (0xE1h)		
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)
D1	EXLOS	Extended Loss of Zeros The number of zeros required to declare a Digital Loss of Signal is extended to 4,096. 0 = Normal Operation 1 = Enables the EXLOS function	R/W	0
D0	ICT	In Circuit Testing 0 = Normal Operation 1 = Sets all output pins to "High" impedance for in circuit testing	R/W	0

#### TABLE 42: MICROPROCESSOR REGISTER 0xE2H BIT DESCRIPTION

		GLOBAL REGISTER (0xE2H)		
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)
D7	Reserved	This Register Bit is Not Used	R/W	0
D6	RxTCNTL	<b>Receive Termination Select Control</b> This bit sets the LIU to control the RxTSEL function with either the individual channel register bit or the global hardware pin. 0 = Control of the receive termination is set to the register bits 1 = Control of the receive termination is set to the hardware pin	R/W	0
D[5:0]	Reserved	These Bits are Reserved	R/W	0

#### TABLE 43: MICROPROCESSOR REGISTER 0xE3H BIT DESCRIPTION

		GLOBAL REGISTER (0xE3H)		
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)
D[7:4]	Reserved	These Register Bits are Not Used	R/W	0
D3	SL<1>	Slicer Level Select	R/W	0
D2	SL<0>	00 = 60%		0
		01 = 65%		
		10 = 70%		
		11 = 55%		
D[7:0]	Reserved	These Register Bits are Not Used	R/W	0





## TABLE 44: MICROPROCESSOR REGISTER 0xE4H BIT DESCRIPTION

	GLOBAL REGISTER (0xE4H)					
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)		
D7 D6		MCLKT1Nout Select MclkT1out[1:0] is used to program the MCLKT1out pin. By default, the output clock is 1.544MHz. 00 = 1.544MHz 01 = 3.088MHz 10 = 6.176MHz 11 = 12.352MHz	R/W	0 0		
D5 D4		MCLKE1Nout Select MclkE1out[1:0] is used to program the MCLKE1Nout pin. By default, the output clock is 2.048MHz. 00 = 2.048MHz 01 = 4.096MHz 10 = 8.192MHz 11 = 16.384MHz	R/W	0 0		
D[3:0]	Reserved	These Register Bits are Not Used	R/W	0		

#### TABLE 45: MICROPROCESSOR REGISTER 0xE5H BIT DESCRIPTION

		GLOBAL REGISTER (0xE5h)		
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)
D7	LCV_OFLW	Line Code Violation / Counter Overflow Monitor Select This bit is used to select the monitoring activity between the LCV and the counter overflow status. When the 16-bit LCV counter sat- urates, the counter overflow condition is activated. By default, the LCV activity is monitored by bit D4 in register 0x05h. 0 = Monitoring LCV 1 = Monitoring the counter overflow status	R/W	0
D6	Reserved		R/W	0
D5	Reserved	This Register Bit is Not Used	R/W	0

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#### TABLE 45: MICROPROCESSOR REGISTER 0xE5H BIT DESCRIPTION

	GLOBAL REGISTER (0xE5H)							
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)				
D4	Reserved	This Register Bit is Not Used	R/W	0				
D3 D2 D1 D0	LCVCH3 LCVCH2 LCVCH1 LCVCH0	Line Code Violation Counter Select These bits are used to select which channel is to be addressed for reading the contents in register 0xE8h. It is also used to address the counter for a given channel when performing an update or reset on a per channel basis. By default, Channel 0 is selected. 0000, 1111 = None 0001 = Channel 0 0010 = Channel 1 0010 = Channel 2 0100 = Channel 3 0101 = Channel 3 0101 = Channel 4 0110 = Channel 5 0111 = Channel 6 1000 = Channel 7 1001 = Channel 8 1010 = Channel 9 1011 = Channel 10 1100 = Channel 11 1101 = Channel 12 1110 = Channel 13	R/W	0 0 0				

#### TABLE 46: MICROPROCESSOR REGISTER 0xE6H BIT DESCRIPTION

	GLOBAL REGISTER (0XE6H)						
Віт	BIT NAME FUNCTION		Register Type	Default Value (HW reset)			
D[7:5]	Reserved	These Register Bits are Not Used	R/W	0			
D4	alIRST	LCV Counter Reset for All Channels This bit is used to reset all internal LCV counters to their default state 0000h. This bit must be set to "1" for 1μS. 0 = Normal Operation 1 = Resets all Counters	R/W	0			
D3	allUPDATE	LCV Counter Update for All Channels This bit is used to latch the contents of all 14 counters into holding registers so that the value of each counter can be read. The chan- nel is addressed by using bits D[3:0] in register 0xE5h. 0 = Normal Operation 1 = Updates all Counters	R/W	0			



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#### TABLE 46: MICROPROCESSOR REGISTER 0xE6H BIT DESCRIPTION

	GLOBAL REGISTER (0xE6H)							
Віт	BIT NAME FUNCTION		Register Type	Default Value (HW reset)				
D2	BYTEsel	LCV Counter Byte Select This bit is used to select the MSB or LSB for Reading the contents of the LCV counter for a given channel. The channel is addressed by using bits D[3:0] in register 0xE5h. By default, the LSB byte is selected. 0 = Low Byte 1 = High Byte	R/W	0				
D1	chUPDATE	LCV Counter Update Per Channel This bit is used to latch the contents of the counter for a given channel into a holding register so that the value of the counter can be read. The channel is addressed by using bits D[3:0] in register 0xE5h. 0 = Normal Operation 1 = Updates the Selected Channel	R/W	0				
D0	ChRST	<b>LCV Counter Reset Per Channel</b> This bit is used to reset the LCV counter of a given channel to its default state 0000h. The channel is addressed by using bits D[3:0] in register 0xE5h. This bit must be set to "1" for $1\mu$ S. 0 = Normal Operation 1 = Resets the Selected Channel	R/W	0				

#### TABLE 47: MICROPROCESSOR REGISTER 0xE7H BIT DESCRIPTIO

	GLOBAL REGISTER (0xE7h)						
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)			
D[7:0]	Reserved	These Register Bits are Not Used	R/W	0			

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	GLOBAL REGISTER (0XE8H)						
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)			
D7	LCVCNT7	Line Code Violation Byte Contents	R/W	0			
D6	LCVCNT6	These bits contain the LCV counter contents of the Byte selected		0			
D5	LCVCNT5	by bit D2 in register 0xE6h for a given channel. The channel is		0			
D4	LCVCNT4	addressed by using bits D[3:0] in register 0xE5h. By default, the contents contain the LSB, however no channel is selected		0			
D3	LCVCNT3			0			
D2	LCVCNT2			0			
D1	LCVCNT1			0			
D0	LCVCNT0			0			

#### TABLE 48: MICROPROCESSOR REGISTER 0XE8H BIT DESCRIPTION

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#### CLOCK SELECT REGISTER

The input clock source is used to generate all the necessary clock references internally to the LIU. The microprocessor timing is derived from a PLL output which is chosen by programming the Clock Select Bits in register 0xE9h. Therefore, if the clock selection bits are being programmed, the frequency of the PLL output will be adjusted accordingly. During this adjustment, it is important to "Not" write to any other bit location within the same register while selecting the input/output clock frequency. For best results, register 0xE9h can be broken down into two sub-registers with the MSB being bit D4 and the LSB being bits D[3:0] as shown in Figure 36.

Note: Bits D[7:5] are reserved.





Programming Examples:

**Example 1**: Changing bits D[7:4]

If bit D4 is the only values within the register that will change in a WRITE process, the microprocessor only needs to initiate ONE write operation.

#### Example 2: Changing bits D[3:0]

If bits D[3:0] are the only values within the register that will change in a WRITE process, the microprocessor only needs to initiate ONE write operation.

#### Example 3: Changing bits within the MSB and LSB

In this scenario, one must initiate TWO write operations such that the MSB and LSB do not change within ONE write cycle. It is recommended that the MSB and LSB be treated as two independent sub-registers. One can either change the clock selection bits D[3:0] (LSB) and then change bit D4 (MSB) on the SECOND write, or vice-versa. No order or sequence is necessary.



#### GLOBAL REGISTER (0xE9H) Register Default Туре Value **FUNCTION** Віт NAME (HW reset) D7 - D5 Reserved These Register Bits are Not Used R/W 0 R/W D4 TCLKCNL Transmit Clock Control 0 When this bit is pulled "High" and there is no TCLK signal present on the transmit input path, TTIP/TRING will Transmit All "Ones" (TAOS). By default, TTIP/TRING will Transmit All Zeros. 0 = All Zeros 1 = All Ones R/W D3 CLKSEL3 **Clock Input Select** 0 CLKSEL2 CLKSEL[3:0] is used to select the input clock source used as the D2 0 internal timing reference. CLKSEL1 D1 0 0000 = 2.048 MHz D0 CLKSEL0 0 0001 = 1.544 MHz 1000 = 4.096 Mhz 1001 = 3.088 Mhz 1010 = 8.192 Mhz 1011 = 6.176 Mhz 1100 = 16.384 Mhz 1101 = 12.352 Mhz 1110 = 2.048 Mhz 1111 = 1.544 Mhz

#### TABLE 49: MICROPROCESSOR REGISTER 0XE9H BIT DESCRIPTION

#### TABLE 50: MICROPROCESSOR REGISTER 0XEAH BIT DESCRIPTION

	GLOBAL REGISTER (0XEAH)						
Віт	NAME	ME FUNCTION Regi		Default Value (HW reset)			
D7	GCHIS7	Global Channel Interrupt Status for Channel 7 0 = No interrupt activity from channel 7 1 = Interrupt was generated from channel 7	RUR	0			
D6	GCHIS6	Global Channel Interrupt Status for Channel 6 0 = No interrupt activity from channel 6 1 = Interrupt was generated from channel 6	RUR	0			
D5	GCHIS5	Global Channel Interrupt Status for Channel 5 0 = No interrupt activity from channel 5 1 = Interrupt was generated from channel 5	RUR	0			
D4	GCHIS4	<b>Global Channel Interrupt Status for Channel 4</b> 0 = No interrupt activity from channel 4 1 = Interrupt was generated from channel 4	RUR	0			

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#### TABLE 50: MICROPROCESSOR REGISTER 0XEAH BIT DESCRIPTION

GLOBAL REGISTER (0XEAH)						
Віт			Register Type	Default Value (HW reset)		
D3	GCHIS3	Global Channel Interrupt Status for Channel 3 0 = No interrupt activity from channel 3 1 = Interrupt was generated from channel 3	RUR	0		
D2	GCHIS2	Global Channel Interrupt Status for Channel 2 0 = No interrupt activity from channel 2 1 = Interrupt was generated from channel 2	RUR	0		
D1	GCHIS1	Global Channel Interrupt Status for Channel 1 0 = No interrupt activity from channel 1 1 = Interrupt was generated from channel 1	RUR	0		
D0	GCHIS0	Global Channel Interrupt Status for Channel 0 0 = No interrupt activity from channel 0 1 = Interrupt was generated from channel 0	RUR	0		

#### TABLE 51: MICROPROCESSOR REGISTER 0XEBH BIT DESCRIPTION

GLOBAL REGISTER (0XEBH)						
Віт	Nаме	FUNCTION	Register Type	Default Value (HW reset)		
D7	Reserved	This Register Bit is Not Used	RUR	0		
D6	Reserved	This Register Bit is Not Used	RUR	0		
D5	GCHIS13	Global Channel Interrupt Status for Channel 13 0 = No interrupt activity from channel 13 1 = Interrupt was generated from channel 13	RUR	0		
D4	GCHIS12	Global Channel Interrupt Status for Channel 12 0 = No interrupt activity from channel 12 1 = Interrupt was generated from channel 12	RUR	0		
D3	GCHIS11	Global Channel Interrupt Status for Channel 11 0 = No interrupt activity from channel 11 1 = Interrupt was generated from channel 11	RUR	0		
D2	GCHIS10	Global Channel Interrupt Status for Channel 10 0 = No interrupt activity from channel 10 1 = Interrupt was generated from channel 10	RUR	0		
D1	GCHIS9	Global Channel Interrupt Status for Channel 9 0 = No interrupt activity from channel 9 1 = Interrupt was generated from channel 9	RUR	0		
D0	GCHIS8	Global Channel Interrupt Status for Channel 8 0 = No interrupt activity from channel 8 1 = Interrupt was generated from channel 8	RUR	0		



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#### TABLE 52: RECOVERED CLOCK SELECT

		I	RECOVERED CLOCK SE	LECT REGISTER (0xEEH	)		
Віт	NAME		FUNCTION				Default Value (HW reset)
D[7:4]	Reserved						
D[3:0]	RCLKOUT         Recovered Clock Select           These register bits are used to select the recovered clock from one of the RCLK[13:0] lines and output it on the RCLKOUT pin.		R/W	0			
			Recovered Clock Select[3:0]	Selected RCLK			
			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			
			1110	RULK 13	J		

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#### TABLE 53: E1 ARBITRARY SELECT

	E1 ARBITRARY SELECT REGISTER (0xF4H)						
Віт	BIT NAME FUNCTION		Register Type	Default Value (HW reset)			
D[7:1]	Reserved						
DO	E1Arben	<b>E1 Arbitrary Pulse Enable</b> This bit is used to enable the Arbitrary Pulse Generators for shap- ing the transmit pulse shape when E1 mode is selected. If this bit is set to "1", all 14 channels will be configured for the Arbitrary Mode. However, each channel is individually controlled by pro- gramming the channel registers 0xn8 through 0xnF, where n is the number of the channel. "0" = Disabled (Normal E1 Pulse Shape ITU G.703) "1" = Arbitrary Pulse Enabled	R/W	0			

#### TABLE 54: MICROPROCESSOR REGISTER 0xFEH BIT DESCRIPTION

	DEVICE "ID" REGISTER (0xFEH)							
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)				
D7	Device "ID"	The device "ID" of the XRT83VSH314 short haul LIU is 0xF2h.	RO	1				
D6		Along with the revision "ID", the device "ID" is used to enable soft-		1				
D5		ware to identify the silicon adding flexibility for system control and		1				
D4		debug.		1				
D3				0				
D2				0				
D1				1				
D0				0				

#### TABLE 55: MICROPROCESSOR REGISTER 0xFFH BIT DESCRIPTION

	REVISION "ID" REGISTER (0xFFH)						
Віт	NAME	FUNCTION	Register Type	Default Value (HW reset)			
D7 D6 D5 D4 D3 D2 D1 D0	Revision "ID"	<ul> <li>The revision "ID" of the XRT83VSH314 LIU is used to enable software to identify which revision of silicon is currently being tested.</li> <li>The revision "ID" for the first revision of silicon will be 0x01h.</li> <li><b>Note:</b> The value contained in this register is subject to change when a newer revision of the silicon has been issued.</li> </ul>	RO	0 0 0 0 0 0 0 1			



#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### 8.0 ELECTRICAL CHARACTERISTICS

#### TABLE 56: ABSOLUTE MAXIMUM RATINGS

Storage Temperature	-65°C to +150°C
Operating Temperature	-40°C to +85°C
Supply Voltage	-0.5V to +3.8V
Vin	-0.5V to +5.5V

VDD=3.3V ±5%, T <sub>A</sub> =25°C, UNLESS OTHERWISE SPECIFIED							
PARAMETER	SYMBOL	Min	Түр	ΜΑΧ	UNITS		
Power Supply Voltage	VDD	3.13	3.3	3.46	V		
Input High Voltage	V <sub>IH</sub>	2.0	-	5.0	V		
Input Low Voltage	V <sub>IL</sub>	-0.5	-	0.8	V		
Output High Voltage IOH=-2.0mA	V <sub>OH</sub>	2.4	-		V		
Output Low Voltage IOL=2.0mA	V <sub>OL</sub>	-	-	0.4	V		
Input Leakage Current	ΙL	-	-	±10	μΑ		
Input Capacitance	Cl	-	5.0		pF		
Output Lead Capacitance	CL	-	-	25	pF		

NOTE: Input leakage current excludes pins that are internally pulled "Low" or "High"

#### TABLE 58: AC ELECTRICAL CHARACTERISTICS

VDD=3.3V ±5%, T <sub>A</sub> =25°C, UNLESS OTHERWISE SPECIFIED					
PARAMETER	SYMBOL	Min	Түр	ΜΑΧ	Units
MCLKin Clock Duty Cycle		40	-	60	%
MCLKin Clock Tolerance		-	±50	-	ppm

## XRT83VSH314 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT



	VDD=3.3V $\pm$ 5%, T <sub>A</sub> =25°C, INTERNAL IMPEDANCE, UNLESS OTHERWISE SPECIFIED							
Mode	SUPPLY Voltage	IMPEDANCE	Receiver	TRANSMITTER	Түр	Мах	Unit	TEST CONDITION
E1	3.3V	75Ω	1:1	1:2	2.145 1.551		W	100% ones 50% ones
E1	3.3V	120Ω	1:1	1:2	1.881 1.419		W	100% ones 50% ones
T1	3.3V	100Ω	1:1	1:2	2.937 1.881		W	100% ones 50% ones
Note: The t	ypical power o	consumption o	f the 1.8V sup	ply represents ~ 7	72mW of the	above listed	Ι.	

#### TABLE 59: POWER CONSUMPTION

#### TABLE 60: E1 RECEIVER ELECTRICAL CHARACTERISTICS

	(VDD=3.3V±5%, TA=25°C UNLESS OTHERWISE SPECIFIED)						
PARAMETER	Min	Typ.	Мах	Unit	TEST CONDITIONS		
Receiver loss of signal:							
Number of consecutive zeros before LOS is set	-	32	-	bit	Cable attenuation @1024KHz ITU-G.775, ETS1 300 233		
Input signal level at LOS	13	16	-	dB			
RLOS Clear	12.5	-	-	% ones			
Receiver Sensitivity Cable + Flat Loss	6+6	-	-	dB	With nominal pulse amplitude of 3.0V for 120 $\Omega$ and 2.37V for 75 $\Omega$ application.		
Interference Margin	-18	-14	-	dB	With 6dB cable loss		
Input Impedance	15		-	KΩ			
Jitter Tolerance: 1 Hz 10KHz100KHz	37 0.3	-	-	Ulpp Ulpp	ITU G.823		
Recovered Clock Jitter Transfer Corner Frequency Peaking Amplitude	-	20	36 0.5	KHz dB	ITU G.736		
Jitter Attenuator Corner Frequency(-3dB curve) JABW=0 JSBW=1	-	10 1.5	-	Hz Hz	ITU G.736		
Return Loss: 51KHz 102KHz 102KHz 2048KHz 2048KHz 3072KHz	12 8 8	- -	- - -	dB dB dB	ITU G.703		



## 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

PARAMETER	MIN.	TYP.	MAX.	Unit	TEST CONDITIONS
Receiver loss of signal:					
Number of consecutive zeros before RLOS is set		175			
Input signal level at RLOS	13	16	-	dB	Cable attenuation @772kHz
RLOS Clear	12.5	-	-	% ones	ITU-G.775, ETSI 300 233
Receiver Sensitivity Cable + Flat Loss	6+6	-	-	dB	With nominal pulse amplitude of 3.0V for $100\Omega$ termination
Interference Margin	-18	-14	-	dB	With 6db of cable loss
Input Impedance	15	-	-	kW	
Jitter Tolerance: 1Hz 10kHz - 100kHz	138 0.4	-	-	Ulpp	AT&T Pub 62411
Recovered Clock Jitter Transfer Corner Frequency Peaking Amplitude	-	10	- 0.1	KHz dB	TR-TSY-000499
Jitter Attenuator Corner Frequency (-3dB curve)	-	3		Hz	AT&T Pub 62411
Return Loss: 51kHz - 102kHz	14	-	-	dB dB	
102kHz - 2048kHz 2048kHz - 3072kHz	20 16	-	-	dB dB	

#### TABLE 61: T1 RECEIVER ELECTRICAL CHARACTERISTICS

#### TABLE 62: E1 TRANSMITTER ELECTRICAL CHARACTERISTICS

VDD=3.3V ±5%, T <sub>A</sub> =25°C, UNLESS OTHERWISE SPECIFIED					
PARAMETER	Min	Түр	Мах	Unit	TEST CONDITION
AMI Output Pulse Amplitude					
75Ω	2.13	2.37	2.60	V	1:2 Transformer
120Ω	2.70	3.00	3.30	V	
Output Pulse Width	224	244	264	ns	
Output Pulse Width Ratio	0.95	-	1.05		ITU-G.703
Output Pulse Amplitude Ratio	0.95	-	1.05		ITU-G.703

## 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### TABLE 62: E1 TRANSMITTER ELECTRICAL CHARACTERISTICS

VDD=3.3V ±5%, T <sub>A</sub> =25°C, UNLESS OTHERWISE SPECIFIED					
PARAMETER	Min	Түр	Мах	Unit	TEST CONDITION
Jitter Added by the Transmitter Output	-	0.025	0.05	UI <sub>p-p</sub>	Broad Band with jitter free TCLK applied to the input.
<b>Output Return Loss</b> 51kHz - 102kHz 102kHz - 2048kHz 2048kHz - 3072kHz	15 9 8	- - -	- - -	dB dB dB	ETSI 300 166

#### TABLE 63: T1 TRANSMITTER ELECTRICAL CHARACTERISTICS

VDD=3.3V ±5%, T <sub>A</sub> =25°C, UNLESS OTHERWISE SPECIFIED					
PARAMETER	ΜιΝ	Түр	ΜΑΧ	Unit	TEST CONDITION
AMI Output Pulse Amplitude	2.4	3.0	3.6	V	1:2 Transformer measured at DSX-1
Output Pulse Width	338	350	362	ns	ANSI T1.102
Output Pulse Width Imbalance	-	-	20		ANSI T1.102
Output Pulse Amplitude Imbal- ance	-	-	±200	mV	ANSI T1.102
Jitter Added by the Transmitter Output	-	0.025	0.05	UI <sub>p-p</sub>	Broad Band with jitter free TCLK applied to the input.
Output Return Loss					
51kHz - 102kHz	17	-	-	dB	
102kHz - 2048kHz	12	-	-	dB	
2048kHz - 3072kHz	10	-	-	dB	



## ORDERING INFORMATION

PRODUCT NUMBER	Package	OPERATING TEMPERATURE RANGE
XRT83VSH314IB	304 LEAD PBGA	-40 <sup>0</sup> C to +85 <sup>0</sup> C

## PACKAGE DIMENSIONS (BOTTOM VIEW)



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#### 14-CHANNEL T1/E1/J1 SHORT-HAUL LINE INTERFACE UNIT

#### **REVISION HISTORY**

<b>REVISION #</b>	DATE	DESCRIPTION
P1.0.0	06/22/04	First release of the 14-Channel LIU Preliminary Datasheet
P1.0.1	10/25/04	Made changes to the pin-out, pin descriptions (RCLKOUT, CMPOUT, PhDIN, power pins swapped DVDD_PRE and DVDD_DRV, NC pins L4 and L21) and register tables. Modfied table 3.
P1.0.2	12/08/04	Made corrections to pinout diagram.
P1.0.3	1/26/05	Various text edits. Corrected register information. Added pull-up/pull-down infor- mation for some pins.
P1.0.4	3/4/05	Various text edits in Register Descriptions.
P1.0.5	07/20/05	Changed definition of pins D21 and K21.Added description for ATP_TIP and ATP_RING., section 3.6.3. Updated table 3, (receive terminations).
P1.0.6	07/27/05	Corrected Device ID; Corrected Register 0x00, bit 6 description.
P1.0.7	08/15/05	Corrected Motorola Synchronous Microprocessor Mode PCLK timing.
P1.0.8	01/19/06	Corrected electrical tables. Removed 83sh314s references. Various edits and corrections.
1.0.0	07/11/06	Corrected power consumption numbers. Removed reference to on chip frequency multiplier. Release to production.
1.0.1	09/27/06	Edited QRSS/PRBS and INVQRSS definition in the register descriptions.

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