

# Programmable System Clock Chip for ATI RS790 - K8™ based Systems

## 9LPRS471C

### Recommended Application:

ATI RS790 systems using AMD K8 processors

### Output Features:

- 2 - Greyhound compatible K8 CPU pair
- 6 - low-power differential SRC pairs
- 2 - low-power differential SouthBridge SRC pairs
- 4 - low-power differential ATIG pairs
- 1 - Selectable low-power differential 100MHz non-spread SATA/ SRC output
- 1 - Selectable 100MHz low-power differential/ 66 MHz single-ended HTT clock
- 2 - 48MHz USB clock
- 3 - 14.318MHz Reference clock

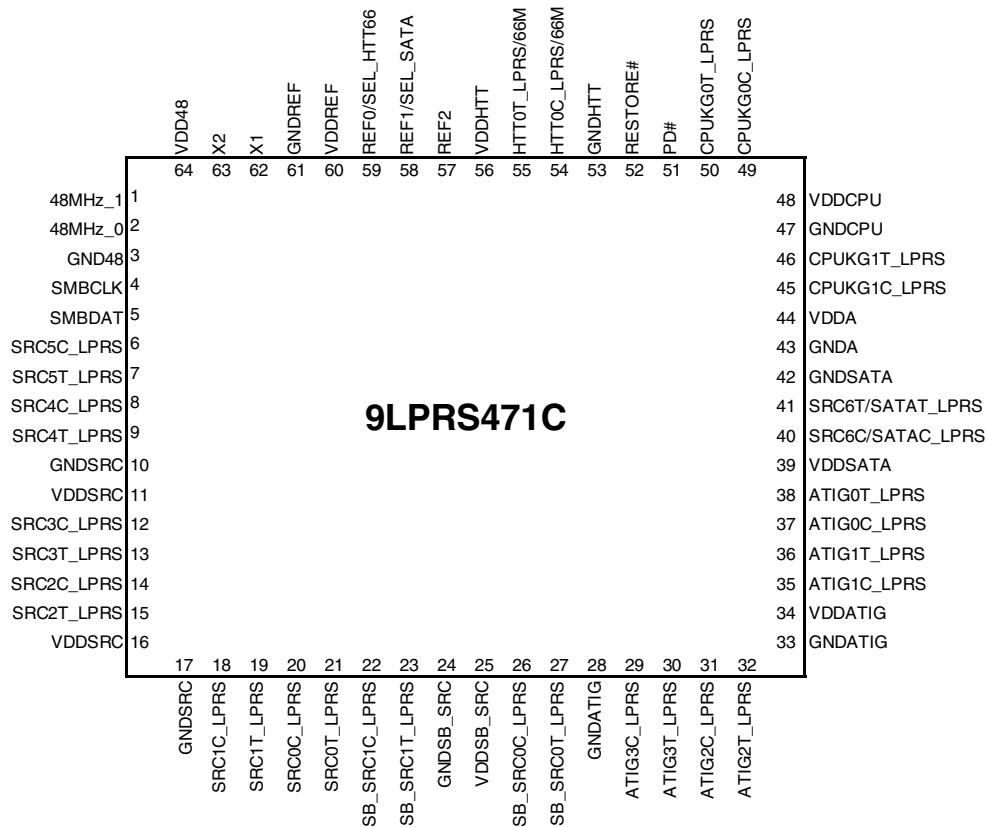
### Key Specifications:

- CPU outputs cycle-to-cycle jitter < 85ps
- SRC outputs cycle-to-cycle jitter < 125ps
- ATIG outputs cycle-to-cycle jitter < 125ps
- +/- 300ppm frequency accuracy on CPU, SRC & ATIG clocks

### Features/Benefits:

- CPU, ATIG, SB\_SRC and SRC outputs are independently programmable for frequency
- Spread Spectrum for EMI reduction
- Outputs may be disabled via SMBus
- External crystal load capacitors for maximum frequency accuracy
- Meets PCIeX Gen2 specifications

### Pin Configuration



### 64-Pin MLF

- \* Internal Pull-Up Resistor
- \*\* Internal Pull-Down Resistor

## Pin Description

PIN #	PIN NAME	TYPE	DESCRIPTION
1	48MHz_1	OUT	48MHz clock output.
2	48MHz_0	OUT	48MHz clock output.
3	GND48	GND	Ground pin for the 48MHz outputs
4	SMBCLK	IN	Clock pin of SMBus circuitry, 5V tolerant.
5	SMBDAT	I/O	Data pin for SMBus circuitry, 5V tolerant.
6	SRC5C_LPRS	OUT	Complement clock of low power differential SouthBridge SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
7	SRC5T_LPRS	OUT	True clock of low power differential SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
8	SRC4C_LPRS	OUT	Complement clock of low power differential SouthBridge SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
9	SRC4T_LPRS	OUT	True clock of low power differential SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
10	GNDSRC	GND	Ground pin for the SRC outputs
11	VDDSRC	PWR	Supply for SRC core, 3.3V nominal
12	SRC3C_LPRS	OUT	Complement clock of low power differential SouthBridge SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
13	SRC3T_LPRS	OUT	True clock of low power differential SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
14	SRC2C_LPRS	OUT	Complement clock of low power differential SouthBridge SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
15	SRC2T_LPRS	OUT	True clock of low power differential SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
16	VDDSRC	PWR	Supply for SRC core, 3.3V nominal
17	GNDSRC	GND	Ground pin for the SRC outputs
18	SRC1C_LPRS	OUT	Complement clock of low power differential SouthBridge SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
19	SRC1T_LPRS	OUT	True clock of low power differential SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
20	SRC0C_LPRS	OUT	Complement clock of low power differential SouthBridge SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
21	SRC0T_LPRS	OUT	True clock of low power differential SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
22	SB_SRC1C_LPRS	OUT	Complement clock of low power differential SouthBridge SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
23	SB_SRC1T_LPRS	OUT	True clock of low power differential SouthBridge SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
24	GNDSB_SRC	GND	Ground pin for the SB_SRC outputs
25	VDDSB_SRC	PWR	Supply for SRC core, 3.3V nominal
26	SB_SRC0C_LPRS	OUT	Complement clock of low power differential SouthBridge SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
27	SB_SRC0T_LPRS	OUT	True clock of low power differential SouthBridge SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
28	GNDATIG	GND	Ground pin for the ATIG outputs
29	ATIG3C_LPRS	OUT	Complementary clock of low-power differential push-pull PCI-Express pair with integrated series resistor. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
30	ATIG3T_LPRS	OUT	True clock of low-power differential push-pull PCI-Express pair with integrated series resistor. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
31	ATIG2C_LPRS	OUT	Complementary clock of low-power differential push-pull PCI-Express pair with integrated series resistor. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
32	ATIG2T_LPRS	OUT	True clock of low-power differential push-pull PCI-Express pair with integrated series resistor. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
33	GNDATIG	GND	Ground pin for the ATIG outputs
34	VDDATIG	PWR	Power supply for ATIG core, nominal 3.3V
35	ATIG1C_LPRS	OUT	Complementary clock of low-power differential push-pull PCI-Express pair with integrated series resistor. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
36	ATIG1T_LPRS	OUT	True clock of low-power differential push-pull PCI-Express pair with integrated series resistor. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)

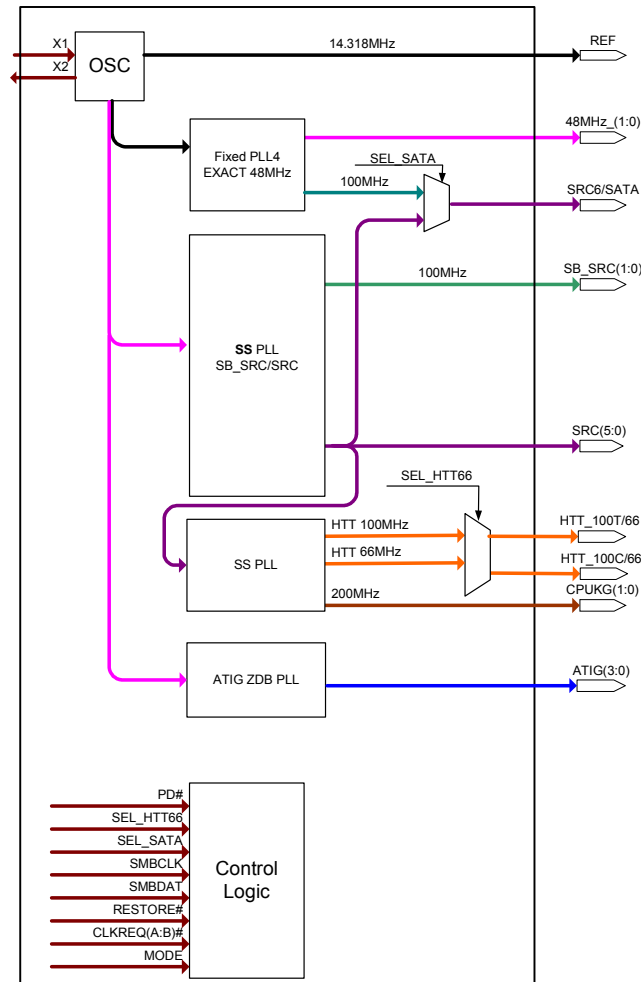
Pin Description (Continued)

PIN #	PIN NAME	TYPE	DESCRIPTION
38	ATIG0T_LPRS	OUT	True clock of low-power differential push-pull PCI-Express pair with integrated series resistor. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
39	VDDSATA	PWR	Power supply for SATA core logic, nominal 3.3V
40	SRC6C/SATAC_LPRS	OUT	Complement clock of low power differential SRC/SATA clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
41	SRC6T/SATAT_LPRS	OUT	True clock of low power differential SRC clock pair. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed)
42	GND SATA	GND	Ground pin for the SRC outputs
43	GND A	GND	Ground for the Analog Core
44	VDDA	PWR	3.3V Power for the Analog Core
45	CPUKG1C_LPRS	OUT	Complementary signal of low-power differential push-pull AMD K8 "Greyhound" clock with integrated series resistor.(no 33 ohm series resistor needed)
46	CPUKG1T_LPRS	OUT	True signal of low-power differential push-pull AMD K8 "Greyhound" clock with integrated series resistor. (no 33 ohm series resistor needed)
47	GND CPU	GND	Ground pin for the CPU outputs
48	VDD CPU	PWR	Supply for CPU core, 3.3V nominal
49	CPUKG0C_LPRS	OUT	Complementary signal of low-power differential push-pull AMD K8 "Greyhound" clock with integrated series resistor. (no 33 ohm series resistor needed)
50	CPUKG0T_LPRS	OUT	True signal of low-power differential push-pull AMD K8 "Greyhound" clock with integrated series resistor.(no 33 ohm series resistor needed)
51	PD#	IN	Enter /Exit Power Down. 0 = Power Down, 1 = normal operation.
52	RESTORE#	I/O	Open Drain I/O. As an input it restores the PLL's to power up default state. As an output, this signal is driven low when the internal watchdog hardware timer expires. It is cleared when the internal watchdog hardware timer is reset or disabled. The input is falling edge triggered. 0 = Restore Settings, 1 = normal operation.
53	GND HTT	PWR	Ground pin for the HTT outputs
54	HTT0C_LPRS/66M	OUT	Complementary signal of low-power differential push-pull hypertransport clock with integrated series resistor. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed) / 3.3V single ended 66MHz hyper transport clock
55	HTT0T_LPRS/66M	OUT	True signal of low-power differential push-pull hypertransport clock with integrated series resistor. (no 50ohm shunt resistor to GND and no 33 ohm series resistor needed) / 3.3V single ended 66MHz hyper transport clock
56	VDD HTT	PWR	Supply for HTT clocks, nominal 3.3V.
57	REF2	OUT	14.318 MHz reference clock, 3.3V
58	REF1/SEL_SATA	I/O	14.318 MHz 3.3V reference clock./ 3.3V tolerant latched input to select function of SRC6/SATA output 0 = 100MHz differential spreading SRC clock, 1 = 100MHz non-spreading differential SATA clock
59	REF0/SEL_HTT66	I/O	14.318 MHz 3.3V reference clock./ 3.3V tolerant latched input to select Hyper Transport Clock Frequency. 0 = 100MHz differential HTT clock, 1 = 66MHz 3.3V single ended HTT clock
60	VDD REF	PWR	Ref, XTAL power supply, nominal 3.3V
61	GND REF	GND	Ground pin for the REF outputs.
62	X1	IN	Crystal input, nominally 14.318MHz
63	X2	OUT	Crystal output, nominally 14.318MHz
64	VDD48	PWR	Power pin for the 48MHz outputs and core. 3.3V

## General Description

The **9LPRS471C** is a main clock synthesizer chip that provides all clocks required for ATI RS7xx-based systems using AMD processors. An SMBus interface allows full control of the device.

## Block Diagram



9LPR471C Power Group Table

Pin Number		Description
VDD	GND	
64	3	48M I/O & Core
11, 16	10, 17	SRC & SRCI/O I/O & Core; SRC PLL Analog
25	24	SB_SRCI/O I/O & Core; SB_SRC PLL Analog / Digital
34	28, 33	ATIG I/O & Core; ATIG PLL Analog
39	42	SATA I/O & Core; FIX PLL Analog / Digital
44	43	ATIG PLL & SRC PLL Digital
48	47	CPU I/O & Core; CPU PLL Analog / Digital
56	53	HTT I/O & Core
60	61	Crystal, REF I/O & Core

Table1: CPU and HTT Frequency Selection Table

Byte 3					CPU (MHz)	HTT	HTT	Spread % (B6b6=1 and B3b5=1)	CPU OverClock %
Bit4	Bit3	Bit2	Bit1	Bit0		Single-ended	Differential		
CPU FS4	CPU FS3	CPU FS2	CPU FS1	CPU FS0		SEL_HTT66 = 1	SEL_HTT66 = 0		
0	0	0	0	0	200.00	66.67	100.00		0%
0	0	0	0	1	205.00	68.33	102.50		2%
0	0	0	1	0	210.00	70.00	105.00		5%
0	0	0	1	1	215.00	71.67	107.50		8%
0	0	1	0	0	220.00	73.33	110.00		10%
0	0	1	0	1	225.00	75.00	112.50		13%
0	0	1	1	0	230.00	76.67	115.00		15%
0	0	1	1	1	235.00	78.33	117.50		18%
0	1	0	0	0	240.00	80.00	120.00		20%
0	1	0	0	1	245.00	81.67	122.50		23%
0	1	0	1	0	250.00	83.33	125.00		25%
0	1	0	1	1	255.00	85.00	127.50		28%
0	1	1	0	0	260.00	86.67	130.00		30%
0	1	1	0	1	265.00	88.33	132.50		33%
0	1	1	1	0	270.00	90.00	135.00		35%
<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>200.00</b>	<b>66.67</b>	<b>100.00</b>		<b>0%</b>
1	0	0	0	0	280.00	93.33	140.00		40%
1	0	0	0	1	285.00	95.00	142.50		43%
1	0	0	1	0	290.00	96.67	145.00		45%
1	0	0	1	1	295.00	98.33	147.50		48%
1	0	1	0	0	300.00	100.00	150.00		50%
1	0	1	0	1	305.00	101.67	152.50		53%
1	0	1	1	0	310.00	103.33	155.00		55%
1	0	1	1	1	315.00	105.00	157.50		58%
1	1	0	0	0	320.00	106.67	160.00		60%
1	1	0	0	1	325.00	108.33	162.50		63%
1	1	0	1	0	330.00	110.00	165.00		65%
1	1	0	1	1	335.00	111.67	167.50		68%
1	1	1	0	0	340.00	113.33	170.00		70%
1	1	1	0	1	345.00	115.00	172.50		73%
1	1	1	1	0	350.00	116.67	175.00		75%
1	1	1	1	1	355.00	118.33	177.50		78%

Depends on SB\_SRC\_PLL. See Table 4.

Table 2: SRC Frequency Selection Table

Byte 4				SRC (MHz)	Spread % (B6b5=1)	SRC OverClock %
Bit3 SB FS3	Bit2 SB FS2	Bit1 SB FS1	Bit0 SB FS0			
0	0	0	0	100.00	-0.50%	0%
0	0	0	1	101.00		1%
0	0	1	0	102.00		2%
0	0	1	1	103.00		3%
0	1	0	0	104.00		4%
0	1	0	1	105.00		5%
0	1	1	0	106.00		6%
0	1	1	1	107.00		7%
1	0	0	0	108.00		8%
1	0	0	1	109.00		9%
1	0	1	0	110.00		10%
1	0	1	1	111.00		11%
1	1	0	0	112.00		12%
1	1	0	1	113.00		13%
1	1	1	0	114.00	14%	
1	1	1	1	100.00	OFF	0%

Table3: ATIG Frequency Selection Table

Byte 5				ATIG(3:0) (MHz)	Spread % (B6b7=1)	ATIG OverClock %
Bit3 ATIG FS3	Bit2 ATIG FS2	Bit1 ATIG FS1	Bit0 ATIG FS0			
0	0	0	0	100.00	-0.50%	0%
0	0	0	1	101.00		1%
0	0	1	0	102.00		2%
0	0	1	1	103.00		3%
0	1	0	0	104.00		4%
0	1	0	1	105.00		5%
0	1	1	0	106.00		6%
0	1	1	1	107.00		7%
1	0	0	0	108.00		8%
1	0	0	1	109.00		9%
1	0	1	0	110.00		10%
1	0	1	1	111.00		11%
1	1	0	0	112.00		12%
1	1	0	1	113.00		13%
1	1	1	0	114.00	14%	
1	1	1	1	100.00	OFF	0%

Table4: SB\_SRC Frequency Selection Table

Byte 6					SB_SRC (1:0) (MHz)	Spread % (B6b6=1)	SB_SRC OverClock %
Bit4 SRC FS4	Bit3 SRC FS3	Bit2 SRC FS2	Bit1 SRC FS1	Bit0 SRC FS0			
0	0	0	0	0	85.00	-0.50%	-15%
0	0	0	0	1	86.00		-14%
0	0	0	1	0	87.00		-13%
0	0	0	1	1	88.00		-12%
0	0	1	0	0	89.00		-11%
0	0	1	0	1	90.00		-10%
0	0	1	1	0	91.00		-9%
0	0	1	1	1	92.00		-8%
0	1	0	0	0	93.00		-7%
0	1	0	0	1	94.00		-6%
0	1	0	1	0	95.00		-5%
0	1	0	1	1	96.00		-4%
0	1	1	0	0	97.00		-3%
0	1	1	0	1	98.00		-2%
0	1	1	1	0	99.00		-1%
<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>100.00</b>	<b>OFF</b>	<b>0%</b>
1	0	0	0	0	100.00	-0.50%	0%
1	0	0	0	1	101.00		1%
1	0	0	1	0	102.00		2%
1	0	0	1	1	103.00		3%
1	0	1	0	0	104.00		4%
1	0	1	0	1	105.00		5%
1	0	1	1	0	106.00		6%
1	0	1	1	1	107.00		7%
1	1	0	0	0	108.00		8%
1	1	0	0	1	109.00		9%
1	1	0	1	0	110.00		10%
1	1	0	1	1	111.00		11%
1	1	1	0	0	112.00		12%
1	1	1	0	1	113.00		13%
1	1	1	1	0	114.00		14%
1	1	1	1	1	115.00	15%	

NOTE: All frequencies assume that the SB\_SRC are at 0% Overclocking.

Table 5: IO\_Vout select table

B12b2	B12b1	B12b0	IO_Vout
0	0	0	0.3V
0	0	1	0.4V
0	1	0	0.5V
0	1	1	0.6V
1	0	0	0.7V
<b>1</b>	<b>0</b>	<b>1</b>	<b>0.8V</b>
1	1	0	0.9V
1	1	1	1.0V

**Bold Entry is Power up Default**

## General SMBus serial interface information for the 9LPRS471C

### How to Write:

- Controller (host) sends a start bit.
- Controller (host) sends the write address  $D2_{(H)}$
- ICS clock will **acknowledge**
- Controller (host) sends the beginning byte location = N
- ICS clock will **acknowledge**
- Controller (host) sends the data byte count = X
- ICS clock will **acknowledge**
- Controller (host) starts sending **Byte N through Byte N + X - 1**
- ICS clock will **acknowledge** each byte **one at a time**
- Controller (host) sends a Stop bit

### How to Read:

- Controller (host) will send start bit.
- Controller (host) sends the write address  $D2_{(H)}$
- ICS clock will **acknowledge**
- Controller (host) sends the beginning byte location = N
- ICS clock will **acknowledge**
- Controller (host) will send a separate start bit.
- Controller (host) sends the read address  $D3_{(H)}$
- ICS clock will **acknowledge**
- ICS clock will send the data byte count = X
- ICS clock sends **Byte N + X - 1**
- ICS clock sends **Byte 0 through byte X (if  $X_{(H)}$  was written to byte 8).**
- Controller (host) will need to acknowledge each byte
- Controller (host) will send a not acknowledge bit
- Controller (host) will send a stop bit

Index Block Write Operation		
Controller (Host)		ICS (Slave/Receiver)
T	starT bit	
Slave Address *D0 <sub>(H)</sub>		
WR	WRite	
		ACK
Beginning Byte = N		
		ACK
Data Byte Count = X		
		ACK
Beginning Byte N		X Byte
	◇	
	◇	
	◇	
	◇	
Byte N + X - 1		
		ACK
P	stoP bit	

Index Block Read Operation		
Controller (Host)		ICS (Slave/Receiver)
T	starT bit	
Slave Address *D0 <sub>(H)</sub>		
WR	WRite	
		ACK
Beginning Byte = N		
		ACK
RT	Repeat starT	
Slave Address *D1 <sub>(H)</sub>		
RD	ReaD	
		ACK
		Data Byte Count = X
ACK		X Byte
ACK		
◇		
◇		
		Beginning Byte N
		◇
		◇
		◇
		Byte N + X - 1
N	Not acknowledge	
P	stoP bit	



SMBus Table: Latched Input Readback Output Enable Control Register

Byte	0	Name	Description	Type	0	1	Default
Bit 7	SEL_HTT66 readback		Hypertransport Select	R	100MHz Differential HTT clock	66 MHz 3.3V Single-ended HTT clock	Latch
Bit 6	SEL_SATA readback		SATA Select	R	SRC6/SATA pair is SRC SS capable output	SRC6/SATA pair is SATA non-spread output	Latch
Bit 5	REF0_OE		Output Enable	RW	Hi-Z	Enabled	1
Bit 4	REF1_OE		Output Enable	RW	Hi-Z	Enabled	1
Bit 3	REF2_OE		Output Enable	RW	Hi-Z	Enabled	1
Bit 2	48MHz_1_OE		Output Enable	RW	Low	Enabled	1
Bit 1	48MHz_0_OE		Output Enable	RW	Low	Enabled	1
Bit 0	Reserved						0

SMBus Table:Output Enable Control Register

Byte	1	Name	Control Function	Type	0	1	Default
Bit 7	Reserved						0
Bit 6	SRC6/SATA_OE Enable		Output Enable	RW	Low/Low	Enabled	1
Bit 5	SRC5_OE		Output Enable	RW	Low/Low	Enabled	1
Bit 4	SRC4_OE		Output Enable	RW	Low/Low	Enabled	1
Bit 3	SRC3_OE		Output Enable	RW	Low/Low	Enabled	1
Bit 2	SRC2_OE		Output Enable	RW	Low/Low	Enabled	1
Bit 1	SRC1_OE		Output Enable	RW	Low/Low	Enabled	1
Bit 0	SRC0_OE		Output Enable	RW	Low/Low	Enabled	1

SMBus Table: Output Enable and 48MHz Strength Control Register

Byte	2	Name	Control Function	Type	0	1	Default
Bit 7	SB_SRC1_OE		Output Enable	RW	Low/Low	Enabled	1
Bit 6	SB_SRC0_OE		Output Enable	RW	Low/Low	Enabled	1
Bit 5	ATIG3_OE		Output Enable	RW	Low/Low	Enabled	1
Bit 4	ATIG2_OE		Output Enable	RW	Low/Low	Enabled	1
Bit 3	ATIG1_OE		Output Enable	RW	Low/Low	Enabled	1
Bit 2	ATIG0_OE		Output Enable	RW	Low/Low	Enabled	1
Bit 1	48MHz_1_Strength		48MHz_1 Drive Strength Sel.	RW	1 Load	2 Load	1
Bit 0	48MHz_0_Strength		48MHz_0 Drive Strength Sel.	RW	1 Load	2 Load	1

SMBus Table: CPU/HTT Frequency Control Register

Byte	3	Name	Control Function	Type	0	1	Default
Bit 7	CPU1_OE		Output enable	RW	Low/Low	Enable	1
Bit 6	CPU0_OE		Output enable	RW	Low/Low	Enable	1
Bit 5	CPU_Source		CPU Spread Source	RW	Fix PLL	SB_SRC_PLL	1
Bit 4	CPU_FS4		CPU Frequency Select MSB	RW	See CPU Frequency Select Table Default value corresponds to 200MHz. Note that Selected HTT frequency tracks the CPU frequency.		0
Bit 3	CPU_FS3		CPU Frequency Select	RW			1
Bit 2	CPU_FS2		CPU Frequency Select	RW			1
Bit 1	CPU_FS1		CPU Frequency Select	RW			1
Bit 0	CPU_FS0		CPU Frequency Select LSB	RW			1

SMBus Table: SRC Frequency Control Register

Byte	4	Name	Control Function	Type	0	1	Default
Bit 7	REF0_Strength		REF0_Drive Strength Sel	RW	1 Load	2 Load	1
Bit 6	REF1_Strength		REF1_Drive Strength Sel	RW	1 Load	2 Load	1
Bit 5	REF2_Strength		REF2_Drive Strength Sel	RW	1 Load	2 Load	1
Bit 4	Reserved						0
Bit 3	SRC_FS3		SRC Frequency Select	RW	See SRC Frequency Select Table		1
Bit 2	SRC_FS2		SRC Frequency Select	RW			1
Bit 1	SRC_FS1		SRC Frequency Select	RW			1
Bit 0	SRC_FS0		SRC Frequency Select LSB	RW			1

SMBus Table: ATIG Frequency Select Register

Byte	5	Name	Control Function	Type	0	1	Default
Bit 7				RW	Reserved		0
Bit 6				RW	Reserved		0
Bit 5				RW	Reserved		0
Bit 4		DISABLE_OR_T	Disable <b>Q</b> overshoot <b>R</b> eduction <b>T</b> echnology during CPU PLL M/N Programming	RW	ENABLE OR_T	DISABLE OR_T	0
Bit 3		ATIG_FS3	ATIG Frequency Select	RW	See ATIG Frequency Select Table		1
Bit 2		ATIG_FS2	ATIG Frequency Select	RW			
Bit 1		ATIG_FS1	ATIG Frequency Select	RW			
Bit 0		ATIG_FS0	ATIG Frequency Select LSB	RW			

SMBus Table: SB\_SRC Frequency Select Register

Byte	6	Name	Control Function	Type	0	1	Default
Bit 7		ATIG_SSEN	ATIG Spread Enable	RW	Disable	Enable	0
Bit 6		SB_SRC/CPU_SSEN	SB_SRC/CPU Spread Enable	RW	Disable	Enable	0
Bit 5		SRC_SSEN	SRC Spread Enable	RW	Disable	Enable	0
Bit 4		SB_SRC_FS4	SB_SRC Frequency Select MSB	RW	See SB_SRC Frequency Select Table Note: SB_SRC and CPU Clocks are synchronous. Changing this frequency will alter the SB_SRC and CPU frequency by the same percentage.		0
Bit 3		SB_SRC_FS3	SB_SRC Frequency Select	RW			
Bit 2		SB_SRC_FS2	SB_SRC Frequency Select	RW			
Bit 1		SB_SRC_FS1	SB_SRC Frequency Select	RW			
Bit 0		SB_SRC_FS0	SB_SRC Frequency Select LSB	RW			

SMBus Table: Device ID register

Byte	7	Name	Control Function	Type	0	1	Default
Bit 7		Device ID7	Device ID	R	78 hex for 9LP478, 71 hex for 9LP471		x
Bit 6		Device ID6		R			x
Bit 5		Device ID5		R			x
Bit 4		Device ID4		R			x
Bit 3		Device ID3		R			x
Bit 2		Device ID2		R			x
Bit 1		Device ID1		R			x
Bit 0		Device ID0		R			x

SMBus Table: Vendor & Revision ID Register

Byte	8	Name	Control Function	Type	0	1	Default
Bit 7		RID3	REVISION ID	R	-	-	0
Bit 6		RID2		R	-	-	0
Bit 5		RID1		R	-	-	1
Bit 4		RID0		R	-	-	0
Bit 3		VID3	VENDOR ID	R	-	-	0
Bit 2		VID2		R	-	-	0
Bit 1		VID1		R	-	-	0
Bit 0		VID0		R	-	-	1

SMBus Table: WatchDog Timer Control Register

Byte	9	Name	Control Function	Type	0	1	Default
Bit 7		HWD_EN	Watchdog Hard Alarm Enable	RW	Disable and Reload Hard Alarm Timer, Clear WD Hard status bit.	Enable Timer	0
Bit 6		SWD_EN	Watchdog Soft Alarm Enable	RW	Disable	Enable	0
Bit 5		WD Hard Status	WD Hard Alarm Status	R	Normal	Alarm	X
Bit 4		WD Soft Status	WD Soft Alarm Status	R	Normal	Alarm	X
Bit 3		WDTCtrl	Watch Dog Alarm Time base Control	RW	290ms Base	1160ms Base	0
Bit 2		HWD2	WD Hard Alarm Timer Bit 2	RW	These bits represent the number of Watch Dog Time Base Units that pass before the Watch Alarm expires. Default is 7 X 290ms = 2s.		1
Bit 1		HWD1	WD Hard Alarm Timer Bit 1	RW			
Bit 0		HWD0	WD Hard Alarm Timer Bit 0	RW			

**SMBus Table: WD Timer Safe Frequency Control Register**

Byte	10	Name	Control Function	Type	0	1	Default
Bit 7		SWD2	WD Soft Alarm Timer Bit 2	RW	These bits represent the number of Watch Dog Time Base Units that pass before the Watch Alarm expires. Default is 7 X 290ms = 2s.		1
Bit 6		SWD1	WD Soft Alarm Timer Bit 1	RW			1
Bit 5		SWD0	WD Soft Alarm Timer Bit 0	RW			1
Bit 4		WD SF4	Watch Dog Safe Freq Programming bits	RW	These bits configure the safe frequency that the device returns to if the Watchdog Timer expires. The value show here corresponds to the power up default of the device. See the various Frequency Select Tables for the exact frequencies.		0
Bit 3		WD SF3		RW			1
Bit 2		WD SF2		RW			1
Bit 1		WD SF1		RW			1
Bit 0		WD SF0		RW			1

**SMBus Table: Byte Count Register**

Byte	11	Name	Control Function	Type	0	1	Default
Bit 7				Reserved			0
Bit 6				Reserved			0
Bit 5		BC5	Byte Count bit 5 (MSB)	RW	Determines the number of bytes that are read back from the device. Default is 0F hex.		0
Bit 4		BC4	Byte Count bit 4	RW			0
Bit 3		BC3	Byte Count bit 3	RW			1
Bit 2		BC2	Byte Count bit 2	RW			1
Bit 1		BC1	Byte Count bit 1	RW			1
Bit 0		BC0	Byte Count bit 0 (LSB)	RW			1

**SMBus Table: M/N Programming Enable and I/O Vout Control Register**

Byte	12	Name	Control Function	Type	0	1	Default
Bit 7		CPU M/N En	CPU PLL M/N Prog. Enable	RW	M/N Prog. Disabled	M/N Prog. Enabled	0
Bit 6		SRC M/N En	SRC M/N Prog.Enable	RW	M/N Prog. Disabled	M/N Prog. Enabled	0
Bit 5		ATIG M/N En	ATIG M/N Prog. Enable	RW	M/N Prog. Disabled	M/N Prog. Enabled	0
Bit 4		SB_SRC M/N En	SB_SRC M/N Prog. Enable	RW	M/N Prog. Disabled	M/N Prog. Enabled	0
Bit 3				Reserved			0
Bit 2		IO_VOUT2	IO Output Voltage Select (Most Significant Bit)	RW	See Table 5: V_IO Selection (Default is 0.8V)		1
Bit 1		IO_VOUT1	IO Output Voltage Select	RW			0
Bit 0		IO_VOUT0	IO Output Voltage Select (Least Significant Bit)	RW			1

**SMBus Table: CLKREQA# Configuration Register (9LPRS478 only)**

Byte	13	Name	Control Function	Type	0	1	Default
Bit 7				Reserved			0
Bit 6		CLKREQA#_SRC6/SATA	CLKREQA# controls SRC6/SATA	RW	Not Controlled	Controlled	0
Bit 5		CLKREQA#_SRC5	CLKREQA# controls SRC5	RW	Not Controlled	Controlled	0
Bit 4		CLKREQA#_SRC4	CLKREQA# controls SRC4	RW	Not Controlled	Controlled	0
Bit 3		CLKREQA#_SRC3	CLKREQA# controls SRC3	RW	Not Controlled	Controlled	0
Bit 2		CLKREQA#_SRC2	CLKREQA# controls SRC2	RW	Not Controlled	Controlled	0
Bit 1		CLKREQA#_SRC1	CLKREQA# controls SRC1	RW	Not Controlled	Controlled	0
Bit 0		CLKREQA#_SRC0	CLKREQA# controls SRC0	RW	Not Controlled	Controlled	0

**SMBus Table: CLKREQB# Configuration Register (9LPRS478 only)**

Byte	14	Name	Control Function	Type	0	1	Default
Bit 7				Reserved			0
Bit 6		CLKREQB#_SRC6/SATA	CLKREQB# controls SRC6/SATA	RW	Not Controlled	Controlled	0
Bit 5		CLKREQB#_SRC5	CLKREQB# controls SRC5	RW	Not Controlled	Controlled	0
Bit 4		CLKREQB#_SRC4	CLKREQB# controls SRC4	RW	Not Controlled	Controlled	0
Bit 3		CLKREQB#_SRC3	CLKREQB# controls SRC3	RW	Not Controlled	Controlled	0
Bit 2		CLKREQB#_SRC2	CLKREQB# controls SRC2	RW	Not Controlled	Controlled	0
Bit 1		CLKREQB#_SRC1	CLKREQB# controls SRC1	RW	Not Controlled	Controlled	0
Bit 0		CLKREQB#_SRC0	CLKREQB# controls SRC0	RW	Not Controlled	Controlled	0

Note: If CLKREQA and CLKREQB are both selected to control an output, the control condition is an OR function. CLKREQA# = 0 OR CLKREQB = 0 results in the controlled output running.

SMBus Table:Test Mode Register

Byte	15	Name	Control Function	Type	0	1	Default
Bit 7		Test_Sel	Selects Test Mode	RW	Normal mode	All outputs are REF/N	0
Bit 6		SB_SRC Source	SB_SRC Source Selection	RW	SB_SRC PLL	SRC PLL	1
Bit 5					Reserved		0
Bit 4					Reserved		0
Bit 3					Reserved		0
Bit 2					Reserved		0
Bit 1					Reserved		0
Bit 0					Reserved		0

SMBus Table: CPU PLL Frequency Control Register

Byte	16	Name	Control Function	Type	0	1	Default
Bit 7		N Div2	N Divider Prog bit 2	RW	The decimal representation of M and N Divider in Byte 16 and 17 will configure the VCO frequency. Default at power up = Byte 3 Rom table. See M/N Calculation Tables for VCO frequency formulas.		X
Bit 6		N Div1	N Divider Prog bit 1	RW			X
Bit 5		M Div5	M Divider Programming bits	RW			X
Bit 4		M Div4		RW			X
Bit 3		M Div3		RW			X
Bit 2		M Div2		RW			X
Bit 1		M Div1		RW			X
Bit 0		M Div0		RW			X

SMBus Table: CPU PLL Frequency Control Register

Byte	17	Name	Control Function	Type	0	1	Default
Bit 7		N Div10	N Divider Programming b(10:3)	RW	The decimal representation of M and N Divider in Byte 16 and 17 will configure the VCO frequency. Default at power up = Byte 3 Rom table. See M/N Calculation Tables for VCO frequency formulas.		X
Bit 6		N Div9		RW			X
Bit 5		N Div8		RW			X
Bit 4		N Div7		RW			X
Bit 3		N Div6		RW			X
Bit 2		N Div5		RW			X
Bit 1		N Div4		RW			X
Bit 0		N Div3		RW			X

SMBus Table: SB\_SRC PLL Spread Spectrum Control Register

Byte	18	Name	Control Function	Type	0	1	Default
Bit 7		SSP7	Spread Spectrum Programming b(7:0)	RW	These bits set the SB_SRC spread percentage.Please contact IDT for the appropriate values.		X
Bit 6		SSP6		RW			X
Bit 5		SSP5		RW			X
Bit 4		SSP4		RW			X
Bit 3		SSP3		RW			X
Bit 2		SSP2		RW			X
Bit 1		SSP1		RW			X
Bit 0		SSP0		RW			X

SMBus Table: SB\_SRC PLL Spread Spectrum Control Register

Byte	19	Name	Control Function	Type	0	1	Default
Bit 7		SSP15	Spread Spectrum Programming b(15:8)	RW	These bits set the SB_SRC spread percentage.Please contact IDT for the appropriate values.		X
Bit 6		SSP14		RW			X
Bit 5		SSP13		RW			X
Bit 4		SSP12		RW			X
Bit 3		SSP11		RW			X
Bit 2		SSP10		RW			X
Bit 1		SSP9		RW			X
Bit 0		SSP8		RW			X

SMBUS Table: CPU Output Divider Register

Byte	20	Name	Control Function	Type	0	1	Default
Bit 7		CPU NDiv0	LSB N Divider Programming	RW	Byte 28 has the N Divider LSB (bit 0) for CPU M/N		X
Bit 6					Reserved		X
Bit 5					Reserved		X
Bit 4					Reserved		X
Bit 3		CPUDiv3	CPU Divider Ratio Programming Bits	RW	0000:/2 ; 0100:/4	1000:/8 ; 1100:/16	X
Bit 2		CPUDiv2		RW	0001:/3 ; 0101:/6	1001:/12 ; 1101:/24	X
Bit 1		CPUDiv1		RW	0010:/5 ; 0110:/10	1010:/20 ; 1110:/40	X
Bit 0		CPUDiv0		RW	0011:/9 ; 0111:/18	1011:/36 ; 1111:/72	X

SMBUS Table: SRC Frequency Control Register

Byte	21	Name	Control Function	Type	0	1	Default
Bit 7		N Div2	N Divider Prog bit 2	RW	The decimal representation of M and N Divider in Byte 21 and 22 configure the SRC VCO frequency. See M/N Calculation Tables for VCO frequency formulas.		X
Bit 6		N Div1	N Divider Prog bit 1	RW			X
Bit 5		M Div5	M Divider Programming bit (5:0)	RW			X
Bit 4		M Div4		RW			X
Bit 3		M Div3		RW			X
Bit 2		M Div2		RW			X
Bit 1		M Div1		RW			X
Bit 0		M Div0	RW	X			

SMBUS Table: SRC Frequency Control Register

Byte	22	Name	Control Function	Type	0	1	Default
Bit 7		N Div10	N Divider Programming Byte16 bit(7:0) and Byte15 bit(7:6)	RW	The decimal representation of M and N Divider in Byte 21 and 22 configure the SRC VCO frequency. See M/N Calculation Tables for VCO frequency formulas.		X
Bit 6		N Div9		RW			X
Bit 5		N Div8		RW			X
Bit 4		N Div7		RW			X
Bit 3		N Div6		RW			X
Bit 2		N Div5		RW			X
Bit 1		N Div4		RW			X
Bit 0		N Div3		RW			X

SMBUS Table: SRC Spread Spectrum Control Register

Byte	23	Name	Control Function	Type	0	1	Default
Bit 7		SSP7	Spread Spectrum Programming bit(7:0)	RW	These bits set the SRC spread percentages. Please contact IDT for the appropriate values.		X
Bit 6		SSP6		RW			X
Bit 5		SSP5		RW			X
Bit 4		SSP4		RW			X
Bit 3		SSP3		RW			X
Bit 2		SSP2		RW			X
Bit 1		SSP1		RW			X
Bit 0		SSP0		RW			X

SMBUS Table: SRC Spread Spectrum Control Register

Byte	24	Name	Control Function	Type	0	1	Default
Bit 7		SSP15	Spread Spectrum Programming bit(15:8)	RW	These bits set the SRC spread percentages. Please contact IDT for the appropriate values.		X
Bit 6		SSP14		RW			X
Bit 5		SSP13		RW			X
Bit 4		SSP12		RW			X
Bit 3		SSP11		RW			X
Bit 2		SSP10		RW			X
Bit 1		SSP9		RW			X
Bit 0		SSP8		RW			X

**SMBUS Table: SRC Output Divider Control Register**

Byte	25	Name	Control Function	Type	0	1	Default
Bit 7		SB_SRC NDiv0	LSB N Divider Programming	RW	N Divider LSB (bit 0) for SRC M/N programming.		X
Bit 6					Reserved		X
Bit 5					Reserved		X
Bit 4					Reserved		X
Bit 3		SRCDiv3	SRC Divider Ratio Programming Bits	RW	0000:/2 ; 0100:/4	1000:/8 ; 1100:/16	X
Bit 2		SRCDiv2		RW	0001:/3 ; 0101:/6	1001:/12 ; 1101:/24	X
Bit 1		SRCDiv1		RW	0010:/5 ; 0110:/10	1010:/20 ; 1110:/40	X
Bit 0		SRCDiv0		RW	0011:/9 ; 0111:/18	1011:/36 ; 1111:/72	X

**SMBUS Table: ATIG Frequency Control Register**

Byte	26	Name	Control Function	Type	0	1	Default
Bit 7		N Div2	N Divider Prog bit 2	RW	The decimal representation of M and N Divider in Byte 26 and 27 will configure the VCO frequency. Default at power up = Byte 5 Rom table. See M/N Calculation Tables for VCO frequency formulas.		X
Bit 6		N Div1	N Divider Prog bit 1	RW			X
Bit 5		M Div5	M Divider Programming bit (5:0)	RW			X
Bit 4		M Div4		RW			X
Bit 3		M Div3		RW			X
Bit 2		M Div2		RW			X
Bit 1		M Div1		RW			X
Bit 0		M Div0	RW	X			

**SMBUS Table: ATIG Frequency Control Register**

Byte	27	Name	Control Function	Type	0	1	Default
Bit 7		N Div10	N Divider Programming Byte20 bit(7:0) and Byte19 bit(7:6)	RW	The decimal representation of M and N Divider in Byte 26 and 27 will configure the VCO frequency. Default at power up = Byte 5 Rom table. See M/N Calculation Tables for VCO frequency formulas.		X
Bit 6		N Div9		RW			X
Bit 5		N Div8		RW			X
Bit 4		N Div7		RW			X
Bit 3		N Div6		RW			X
Bit 2		N Div5		RW			X
Bit 1		N Div4		RW			X
Bit 0		N Div3		RW			X

**SMBUS Table: ATIG Output Divider Control Register**

Byte	28	Name	Control Function	Type	0	1	Default
Bit 7		ATIG NDiv0	LSB N Divider Programming	RW	N Divider LSB (bit 0) for ATIG M/N programming.		X
Bit 6					Reserved		X
Bit 5					Reserved		X
Bit 4					Reserved		X
Bit 3		ATIGDiv3	ATIG Divider Ratio Programming Bits	RW	0000:/2 ; 0100:/4	1000:/8 ; 1100:/16	X
Bit 2		ATIGDiv2		RW	0001:/3 ; 0101:/6	1001:/12 ; 1101:/24	X
Bit 1		ATIGDiv1		RW	0010:/5 ; 0110:/10	1010:/20 ; 1110:/40	X
Bit 0		ATIGDiv0		RW	0011:/9 ; 0111:/18	1011:/36 ; 1111:/72	X

**SMBUS Table: SB\_SRC Frequency Control Register**

Byte	29	Name	Control Function	Type	0	1	Default
Bit 7		N Div2	N Divider Prog bit 2	RW	The decimal representation of M and N Divider in Byte 29 and 30 will configure the VCO frequency. Default at power up = Byte 6 Rom table. See M/N Calculation Tables for VCO frequency formulas.		X
Bit 6		N Div1	N Divider Prog bit 1	RW			X
Bit 5		M Div5	M Divider Programming bit (5:0)	RW			X
Bit 4		M Div4		RW			X
Bit 3		M Div3		RW			X
Bit 2		M Div2		RW			X
Bit 1		M Div1		RW			X
Bit 0		M Div0	RW	X			

SMBUS Table: SB\_SRC Frequency Control Register

Byte	30	Name	Control Function	Type	0	1	Default
Bit 7		N Div10	N Divider Programming Byte20 bit(7:0) and Byte19 bit(7:6)	RW	The decimal representation of M and N Divider in Byte 29 and 30 will configure the VCO frequency. Default at power up = Byte 6 Rom table. See M/N Caculation Tables for VCO frequency formulas.		X
Bit 6		N Div9		RW			X
Bit 5		N Div8		RW			X
Bit 4		N Div7		RW			X
Bit 3		N Div6		RW			X
Bit 2		N Div5		RW			X
Bit 1		N Div4		RW			X
Bit 0		N Div3		RW			X

SMBUS Table: SB\_SRC Output Divider Control Register

Byte	31	Name	Control Function	Type	0	1	Default
Bit 7		SB_SRC NDiv0	LSB N Divider Programming	RW	N Divider LSB (bit 0) for SRC M/N programming.		X
Bit 6					Reserved		X
Bit 5					Reserved		X
Bit 4					Reserved		X
Bit 3		SB_SRCDiv3	SB_SRC Divider Ratio Programming Bits	RW	0000:/2 ; 0100:/4	1000:/8 ; 1100:/16	X
Bit 2		SB_SRCDiv2		RW	0001:/3 ; 0101:/6	1001:/12 ; 1101:/24	X
Bit 1		SB_SRCDiv1		RW	0010:/5 ; 0110:/10	1010:/20 ; 1110:/40	X
Bit 0		SB_SRCDiv0		RW	0011:/9 ; 0111:/18	1011:/36 ; 1111:/72	X

Bytes 32-40 are reserved

SMBus Table: ATIG PLL Spread Spectrum Control Register

Byte	41	Name	Control Function	Type	0	1	Default
Bit 7		SSP7	Spread Spectrum Programming b(7:0)	RW	These bits set the ATIG spread percentage.Please contact IDT for the appropriate values.		X
Bit 6		SSP6		RW			X
Bit 5		SSP5		RW			X
Bit 4		SSP4		RW			X
Bit 3		SSP3		RW			X
Bit 2		SSP2		RW			X
Bit 1		SSP1		RW			X
Bit 0		SSP0		RW			X

SMBus Table: ATIG PLL Spread Spectrum Control Register

Byte	42	Name	Control Function	Type	0	1	Default
Bit 7		SSP15	Spread Spectrum Programming b(15:8)	RW	These bits set the ATIG spread percentage.Please contact IDT for the appropriate values.		X
Bit 6		SSP14		RW			X
Bit 5		SSP13		RW			X
Bit 4		SSP12		RW			X
Bit 3		SSP11		RW			X
Bit 2		SSP10		RW			X
Bit 1		SSP9		RW			X
Bit 0		SSP8		RW			X

### Absolute Maximum Rating

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	Notes
3.3V Core Supply Voltage	VDDxxx	-		3.3	GND + 3.9V	V	1
Storage Temperature	Ts	-	-65		150	°C	1
Ambient Operating Temp	Tambient	-	0		70	°C	1
Case Temperature	Tcase	-			115	°C	1
Input ESD protection HBM	ESD prot	-	2000			V	1

<sup>1</sup>Guaranteed by design and characterization, not 100% tested in production.

### Electrical Characteristics - Input/Supply/Common Output Parameters

PARAMETER	SYMBOL	CONDITIONS*	MIN	TYP	MAX	UNITS	Notes
3.3V Core Supply Voltage	VDDxxx	-	3.135	3.3	3.465	V	1
Input High Voltage	V <sub>IH</sub>	VDD = 3.3 V +/-5%	2		V <sub>DD</sub> + 0.3	V	1
Input Low Voltage	V <sub>IL</sub>	VDD = 3.3 V +/-5%	V <sub>SS</sub> - 0.3		0.8	V	1
Input High Current	I <sub>IH</sub>	V <sub>IN</sub> = V <sub>DD</sub>	-5		5	uA	1
Input Low Current	I <sub>IL1</sub>	V <sub>IN</sub> = 0 V; Inputs with no pull-up resistors	-5			uA	1
	I <sub>IL2</sub>	V <sub>IN</sub> = 0 V; Inputs with pull-up resistors	-200			uA	1
Low Threshold Input-High Voltage	V <sub>IH_FS</sub>	VDD = 3.3 V +/-5%	0.7		V <sub>DD</sub> + 0.3	V	1
Low Threshold Input-Low Voltage	V <sub>IL_FS</sub>	VDD = 3.3 V +/-5%	V <sub>SS</sub> - 0.3		0.35	V	1
Operating Current	I <sub>DD3.3OP</sub>	all outputs driven			225	mA	1
Powerdown Current	I <sub>DD3.3PD</sub>	all diff pairs low/low			12	mA	1
Input Frequency	F <sub>i</sub>	VDD = 3.3 V +/-5%		14.31818		MHz	2
Pin Inductance	L <sub>pin</sub>				7	nH	1
Input Capacitance	C <sub>IN</sub>	Logic Inputs			5	pF	1
	C <sub>OUT</sub>	Output pin capacitance			6	pF	1
	C <sub>INX</sub>	X1 & X2 pins			5	pF	1
Clk Stabilization	T <sub>STAB</sub>	From VDD Power-Up or deassertion of PD to 1st clock			1.8	ms	1
Modulation Frequency		Triangular Modulation	30		33	kHz	1
Tdrive_PD		CPU output enable after PD de-assertion			300	us	1
Tfall_PD		PD fall time of			5	ns	1
Trise_PD		PD rise time of			5	ns	1
SMBus Voltage	V <sub>DDSMB</sub>		2.7		5.5	V	1
Low-level Output Voltage	V <sub>OLSMB</sub>	@ I <sub>PULLUP</sub>			0.4	V	1
Current sinking at V <sub>OL</sub> = 0.4 V	I <sub>PULLUPSMB</sub>		4	6		mA	1
SMBCLK/SMBDAT Clock/Data Rise Time	T <sub>RSMB</sub>	(Max VIL - 0.15) to (Min VIH + 0.15)			1000	ns	1
SMBCLK/SMBDAT Clock/Data Fall Time	T <sub>FSMB</sub>	(Min VIH + 0.15) to (Max VIL - 0.15)			300	ns	1

\*TA = 0 - 70°C; Supply Voltage VDD = 3.3 V +/-5%

<sup>1</sup>Guaranteed by design and characterization, not 100% tested in production.

<sup>2</sup>Input frequency should be measured at the REF pin and tuned to ideal 14.31818MHz to meet ppm frequency accuracy on PLL outputs.



**AC Electrical Characteristics - Low-Power DIF Outputs: CPUKG and HTT**

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Crossing Point Variation	$\Delta V_{\text{CROSS}}$	Single-ended Measurement			140	mV	1,2,5
Frequency	f	Spread Specturm On	198.8		200	MHz	1,3
Long Term Accuracy	ppm	Spread Specturm Off	-300		+300	ppm	1,11
Rising Edge Slew Rate	$S_{\text{RISE}}$	Differential Measurement	0.5		10	V/ns	1,4
Falling Edge Slew Rate	$S_{\text{FALL}}$	Differential Measurement	0.5		10	V/ns	1,4
Slew Rate Variation	$t_{\text{SLVAR}}$	Single-ended Measurement			20	%	1
CPU, DIF HTT Jitter - Cycle to Cycle	$\text{CPUJ}_{\text{C2C}}$	Differential Measurement			150	ps	1,6
Accumulated Jitter	$t_{\text{JACC}}$	See Notes			1	ns	1,7
Peak to Peak Differential Voltage	$V_{\text{D(PK-PK)}}$	Differential Measurement	400		2400	mV	1,8
Differential Voltage	$V_{\text{D}}$	Differential Measurement	200		1200	mV	1,9
Duty Cycle	$D_{\text{CYC}}$	Differential Measurement	45		55	%	1
Amplitude Variation	$\Delta V_{\text{D}}$	Change in $V_{\text{D}}$ DC cycle to cycle	-75		75	mV	1,10
CPU[1:0] Skew	$\text{CPU}_{\text{SKEW10}}$	Differential Measurement			100	ps	1

\*TA = 0 - 70°C; Supply Voltage VDD = 3.3 V +/-5%, CL = 2pF with Rs = 0Ω (unless otherwise specified)

<sup>1</sup>Guaranteed by design and characterization, not 100% tested in production.

<sup>2</sup>Single-ended measurement at crossing point. Value is maximum – minimum over all time. DC value of common mode is not important due to the blocking cap.

<sup>3</sup>Minimum Frequency is a result of 0.5% down spread spectrum

<sup>4</sup>Differential measurement through the range of ±100 mV, differential signal must remain monotonic and within slew rate spec when crossing through this region.

<sup>5</sup> Defined as the total variation of all crossing voltages of CLK rising and CLK# falling. Matching applies to rising edge rate of CLK and falling edge of CLK#. It is measured using a +/-75mV window centered on the average cross point where CLK meets CLK#.

<sup>6</sup> Max difference of  $t_{\text{CYCLE}}$  between any two adjacent cycles.

<sup>7</sup> Accumulated  $t_{\text{jc}}$  over a 10μs time period, measured with JIT2 TIE at 50ps interval.

<sup>8</sup> VD(PK-PK) is the overall magnitude of the differential signal.

<sup>9</sup> VD(min) is the amplitude of the ring-back differential measurement, guaranteed by design, that ring-back will not cross 0V VD. VD(max) is the largest amplitude allowed.

<sup>10</sup> The difference in magnitude of two adjacent VD\_DC measurements. VD\_DC is the stable post overshoot and ring-back part of the signal.

<sup>11</sup> All Long Term Accuracy and Clock Period specifications are guaranteed assuming that REFOUT is at 14.31818MHz

**AC Electrical Characteristics - Low-Power DIF Outputs: SRC, SB\_SRC, ATIG**

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Rising Edge Slew Rate	$t_{SLR}$	Differential Measurement	0.6		4	V/ns	1,2
Falling Edge Slew Rate	$t_{FLR}$	Differential Measurement	0.6		4	V/ns	1,2
Slew Rate Variation	$t_{SLVAR}$	Single-ended Measurement			20	%	1
Maximum Output Voltage	$V_{HIGH}$	Includes overshoot			1150	mV	1
Minimum Output Voltage	$V_{LOW}$	Includes undershoot	-300			mV	1
Differential Voltage Swing	$V_{SWING}$	Differential Measurement	300			mV	1
Crossing Point Voltage	$V_{XABS}$	Single-ended Measurement	300		550	mV	1,3,4
Crossing Point Variation	$V_{XABSVAR}$	Single-ended Measurement			140	mV	1,3,5
Duty Cycle	$D_{CYC}$	Differential Measurement	45		55	%	1
SRC, SB_SRC, ATIG, Jitter - Cycle to Cycle	$SRCJ_{C2C}$	Differential Measurement			125	ps	1
SRC[5:0] Skew	$SRC_{SKEW}$	Differential Measurement			250	ps	1
SB_SRC[1:0] Skew	$SRC_{SKEW}$	Differential Measurement			100	ps	1
ATIG[3:0] Skew	$SRC_{SKEW}$	Differential Measurement			100	ps	1

\*TA = 0 - 70°C; Supply Voltage VDD = 3.3 V +/-5%, CL = 2pF with Rs = 0Ω (unless otherwise specified)

<sup>1</sup>Guaranteed by design and characterization, not 100% tested in production.

<sup>2</sup>Slew rate measured through Vswing centered around differential zero

<sup>3</sup>Vxabs is defined as the voltage where CLK = CLK#

<sup>4</sup>Only applies to the differential rising edge (CLK rising and CLK# falling)

<sup>5</sup>Defined as the total variation of all crossing voltages of CLK rising and CLK# falling. Matching applies to rising edge rate of CLK and falling edge of CLK#. It is measured using a +/-75mV window centered on the average cross point where CLK meets CLK#.

<sup>6</sup>All Long Term Accuracy and Clock Period specifications are guaranteed assuming that REFOUT is at 14.31818MHz

**Electrical Characteristics - Single-Ended HTT 66MHz Clock**

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	Notes
Long Accuracy	ppm	see Tperiod min-max values	-300		300	ppm	1,2
PCI33 Clock period	$T_{period}$	33.33MHz output nominal	29.9910		30.0090	ns	2
		33.33MHz output spread	29.9910		30.1598	ns	2
HTT66 Clock period	$T_{period}$	66.67MHz output nominal	14.9955		15.0045	ns	2
		66.67MHz output spread	14.9955		15.0799	ns	2
Output High Voltage	$V_{OH}$	$I_{OH} = -1$ mA	2.4			V	1
Output Low Voltage	$V_{OL}$	$I_{OL} = 1$ mA			0.55	V	1
Output High Current	$I_{OH}$	$V_{OH} @ MIN = 1.0$ V	-33			mA	1
		$V_{OH} @ MAX = 3.135$ V			-33	mA	1
Output Low Current	$I_{OL}$	$V_{OL} @ MIN = 1.95$ V	30			mA	1
		$V_{OL} @ MAX = 0.4$ V			38	mA	1
Edge Rate	. V. t	Rising edge rate	1		4	V/ns	1
Edge Rate	. V. t	Falling edge rate	1		4	V/ns	1
Rise Time	$t_{r1}$	$V_{OL} = 0.4$ V, $V_{OH} = 2.4$ V	0.5		2	ns	1
Fall Time	$t_{f1}$	$V_{OH} = 2.4$ V, $V_{OL} = 0.4$ V	0.5		2	ns	1
Duty Cycle	$d_{t1}$	$V_T = 1.5$ V	45		55	%	1
Jitter, Cycle to cycle	$t_{jvc-cyc}$	$V_T = 1.5$ V			180	ps	1

\*TA = 0 - 70°C; Supply Voltage VDD = 3.3 V +/-5%, CL = 5pF with Rs = 33Ω (unless otherwise specified)

<sup>1</sup>Guaranteed by design and characterization, not 100% tested in production.

<sup>2</sup>All Long Term Accuracy and Clock Period specifications are guaranteed with the assumption that REF is at 14.31818MHz

**Electrical Characteristics - USB - 48MHz**

PARAMETER	SYMBOL	CONDITIONS*	MIN	TYP	MAX	UNITS	NOTES
Long Accuracy	ppm	see Tperiod min-max values	-100		100	ppm	1,2
Clock period	T <sub>period</sub>	48.00MHz output nominal	20.8229		20.8344	ns	2
Clock Low Time	T <sub>low</sub>	Measure from < 0.6V	9.3750		11.4580	ns	2
Clock High Time	T <sub>high</sub>	Measure from > 2.0V	9.3750		11.4580	ns	2
Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -1 mA	2.4			V	1
Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 1 mA			0.55	V	1
Output High Current	I <sub>OH</sub>	V <sub>OH</sub> @ MIN = 1.0 V	-33			mA	1
		V <sub>OH</sub> @ MAX = 3.135 V			-33	mA	1
Output Low Current	I <sub>OL</sub>	V <sub>OL</sub> @ MIN = 1.95 V	30			mA	1
		V <sub>OL</sub> @ MAX = 0.4 V			38	mA	1
Rise Time	t <sub>r_USB</sub>	V <sub>OL</sub> = 0.4 V, V <sub>OH</sub> = 2.4 V	0.5		1.5	ns	1
Fall Time	t <sub>f_USB</sub>	V <sub>OH</sub> = 2.4 V, V <sub>OL</sub> = 0.4 V	0.5		1.5	ns	1
Duty Cycle	d <sub>Tt</sub>	V <sub>T</sub> = 1.5 V	45		55	%	1
Group Skew	t <sub>skew</sub>	V <sub>T</sub> = 1.5 V			250	ps	1
Jitter, Cycle to cycle	t <sub>jcy-cyc</sub>	V <sub>T</sub> = 1.5 V			130	ps	1,2

\*TA = 0 - 70°C; Supply Voltage VDD = 3.3 V +/-5%, CL = 5pF with Rs = 33Ω (unless otherwise specified)

<sup>1</sup>Guaranteed by design and characterization, not 100% tested in production.

<sup>2</sup>ICS recommended and/or chipset vendor layout guidelines must be followed to meet this specification

**Electrical Characteristics - REF-14.318MHz**

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	Notes
Long Accuracy	ppm	see Tperiod min-max values	-300		300	ppm	1,2
Clock period	T <sub>period</sub>	14.318MHz output nominal	69.8270		69.8550	ns	2
Clock Low Time	T <sub>low</sub>	Measure from < 0.6V	30.9290		37.9130	ns	2
Clock High Time	T <sub>high</sub>	Measure from > 2.0V	30.9290		37.9130	ns	2
Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -1 mA	2.4			V	1
Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 1 mA			0.4	V	1
Output High Current	I <sub>OH</sub>	V <sub>OH</sub> @ MIN = 1.0 V,	-29			mA	1
		V <sub>OH</sub> @ MAX = 3.135 V			-23	mA	1
Output Low Current	I <sub>OL</sub>	V <sub>OL</sub> @ MIN = 1.95 V,	29			mA	1
		V <sub>OL</sub> @ MAX = 0.4 V			27	mA	1
Rise Time	t <sub>r1</sub>	V <sub>OL</sub> = 0.4 V, V <sub>OH</sub> = 2.4 V	1		1.5	ns	1
Fall Time	t <sub>f1</sub>	V <sub>OH</sub> = 2.4 V, V <sub>OL</sub> = 0.4 V	1		1.5	ns	1
Skew	t <sub>sk1</sub>	V <sub>T</sub> = 1.5 V			250	ps	1
Duty Cycle	d <sub>Tt</sub>	V <sub>T</sub> = 1.5 V	45		55	%	1
Jitter	t <sub>jcy-cyc</sub>	V <sub>T</sub> = 1.5 V			200	ps	1

\*TA = 0 - 70°C; Supply Voltage VDD = 3.3 V +/-5%, CL = 5pF with Rs = 33Ω (unless otherwise specified)

<sup>1</sup>Guaranteed by design and characterization, not 100% tested in production.

<sup>2</sup>All Long Term Accuracy and Clock Period specifications are guaranteed assuming that REFOUT is at 14.31818MHz

### Clock Jitter Specifications - Low Power Differential Outputs

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
SRC/SB_SRC/ATIG Phase Jitter	$t_{\text{phasePLL}}$	PCIe Gen 1			86	ps (p-p)	1,2
	$t_{\text{phaseLo}}$	PCIe Gen 2 10kHz < f < 1.5MHz			3	ps (RMS)	1,4
	$t_{\text{phaseHigh}}$	PCIe Gen 2 1.5MHz < f < Nyquist (50MHz)			3.1	ps (RMS)	1,4

\*TA = 0 - 70°C; Supply Voltage VDD = 3.3V +/-5%, Rs = 0ohms, CL = 2pF

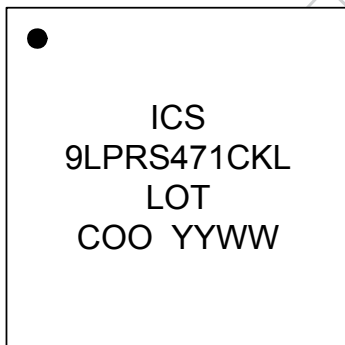
<sup>1</sup> Unless otherwise noted, guaranteed by design and characterization, not 100% tested in production.

<sup>2</sup> Jitter specs are specified as measured on a clock characterization board. System designers need to take special care not to use these numbers, as the in-system performance will be somewhat degraded. The receiver EMTS (chispet or CPU) will have the rece

<sup>3</sup> Phase jitter requirement: The deisgnated Gen2 outputs will meet the reference clock jitter requiremernts from the PCI Express Gen2 Base Spec. The test is performed on a componnet test board under quiet conditions with all outputs on.

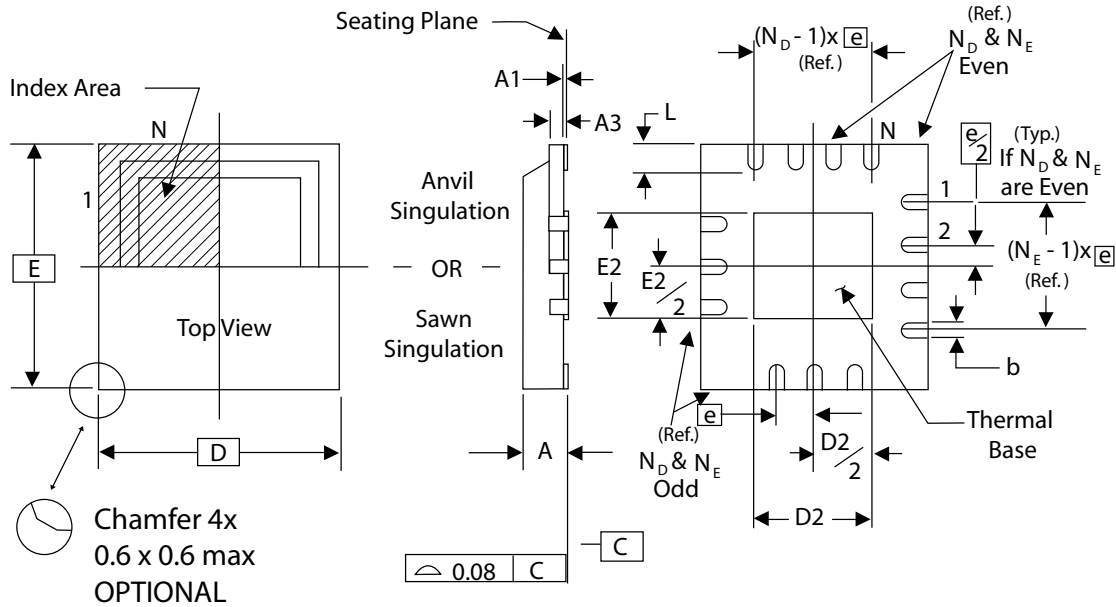
<sup>4</sup> See <http://www.pcisig.com> for complete specs

### Marking Diagram



#### Notes:

1. 'L' denotes RoHS compliance.
2. 'LOT' denotes the lot number.
3. 'COO' denotes country of origin.
4. 'YYWW' denotes the assembly date code.



THERMALLY ENHANCED, VERY THIN, FINE PITCH  
QUAD FLAT / NO LEAD PLASTIC PACKAGE

DIMENSIONS

SYMBOL	64L
N	64
N <sub>D</sub>	16
N <sub>E</sub>	16

OPTION 1 DIMENSIONS (mm)

SYMBOL	MIN.	MAX.
A	0.8	1.0
A1	0	0.05
A3	0.25 Reference	
b	0.18	0.3
e	0.50 BASIC	
D x E BASIC	9.00 x 9.00	
D2 MIN. / MAX.	7.00	7.25
E2 MIN. / MAX.	7.00	7.25
L MIN. / MAX.	0.30	0.50

OPTION 2 DIMENSIONS (mm)

SYMBOL	MIN.	MAX.
A	0.8	1.0
A1	0	0.05
A3	0.25 Reference	
b	0.18	0.3
e	0.50 BASIC	
D x E BASIC	9.00 x 9.00	
D2 MIN. / MAX.	6.00	6.25
E2 MIN. / MAX.	6.00	6.25
L MIN. / MAX.	0.30	0.50

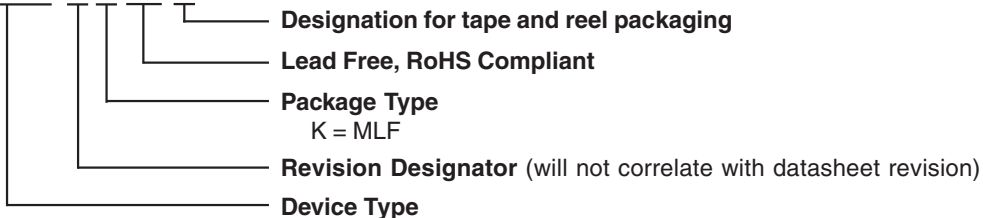
## Ordering Information

### 9LPRS471CKLFT

\*Due to package size constraints actual top side marking may differ from the full orderable part number.

Example:

**XXXX C K LFT**



**Revision History**

Rev.	Issue Date	Description	Page #
0.1	10/2/2007	Initial Release	-
0.2	3/20/2008	Added IO_Vout select table	7
0.3	4/8/2008	1. Updated MLF Ordering Information. 2. Reformatted Dimensions Tables	20
0.4		Fixed typo in Electrical Specifications	
0.5	9/16/2009	Updated Power Group Table.	4
0.6	2/5/2010	Updated electrical tables; updated document template	Various
0.7	2/19/2010	Corrected RESTORE# pin description	3
0.8	5/23/2012	Added marking diagram/notes.	20

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### Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,  
Koto-ku, Tokyo 135-0061, Japan  
[www.renesas.com](http://www.renesas.com)

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