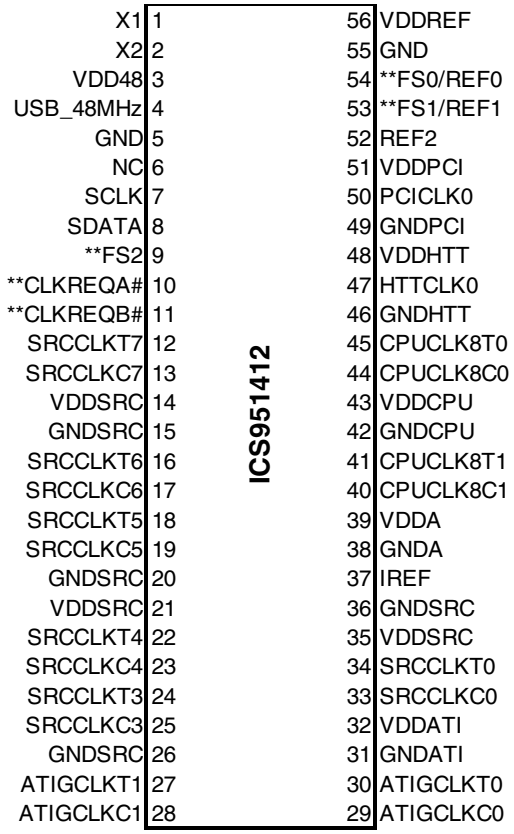
System Clock Chip for ATI RS480 K8-based Systems

Recommended Application:
ATI RS480 systems using AMD K8 processors

Output Features:
- 3 - 14.318 MHz REF clocks
- 1 - USB_48MHz USB clock
- 1 - HyperTransport 66 MHz clock seed
- 1 - PCI 33 MHz clock seed
- 2 - Pairs of AMD K8 clocks
- 6 - Pairs of SRC/PCI Express* clocks
- 2 - Pairs of ATIG (SRC/PCI Express) clocks

Features:
- 2 - Programmable Clock Request pins for SRC clocks
- Spread Spectrum for EMI reduction
- Outputs may be disabled via SMBus
- External crystal load capacitors for maximum frequency accuracy

Pin Configuration



Note: Pins preceeded by '**' have a 120 Kohm Internal Pull Down resistor

56 Pin SSOP/TSSOP

Power Groups

Pin Number		Description
VDD	GND	
56	55	Xtal, REF
51	49	PCICLK output
48	46	HTTCLK output
43	42	CPU Outputs
14, 21, 32,35	15, 20, 26,31,36	SRC outputs
39	38	Analog, CPU PLL
3	5	USB_48MHz output

Functionality

FS2	FS1	FS0	CPU	HTT	PCI
			MHz	MHz	MHz
0	0	0	Hi-Z	Hi-Z	Hi-Z
0	0	1	X	X/3	X/6
0	1	0	180.00	60.00	30.00
0	1	1	220.00	73.12	36.56
1	0	0	100.00	66.66	33.33
1	0	1	133.33	66.66	33.33
1	1	1	200.00	66.66	33.33

*Other names and brands may be claimed as the property of others.

Pin Descriptions

PIN #	PIN NAME	PIN TYPE	DESCRIPTION
1	X1	IN	Crystal input, Nominally 14.318MHz.
2	X2	OUT	Crystal output, Nominally 14.318MHz
3	VDD48	PWR	Power pin for the 48MHz output.3.3V
4	USB_48MHz	OUT	48.00MHz USB clock
5	GND	PWR	Ground pin.
6	NC	N/A	No Connection.
7	SCLK	IN	Clock pin of SMBus circuitry, 5V tolerant.
8	SDATA	I/O	Data pin for SMBus circuitry, 5V tolerant.
9	**FS2	IN	Frequency select pin.
10	**CLKREQA#	IN	Output enable for PCI Express (SRC) outputs. SMBus selects which outputs are controlled. 0 = enabled, 1 = tri-stated
11	**CLKREQB#	IN	Output enable for PCI Express (SRC) outputs. SMBus selects which outputs are controlled. 0 = enabled, 1 = tri-stated
12	SRCCLKT7	OUT	True clock of differential SRC clock pair.
13	SRCCLKC7	OUT	Complement clock of differential SRC clock pair.
14	VDDSRC	PWR	Supply for SRC clocks, 3.3V nominal
15	GNDSRC	PWR	Ground pin for the SRC outputs
16	SRCCLKT6	OUT	True clock of differential SRC clock pair.
17	SRCCLKC6	OUT	Complement clock of differential SRC clock pair.
18	SRCCLKT5	OUT	True clock of differential SRC clock pair.
19	SRCCLKC5	OUT	Complement clock of differential SRC clock pair.
20	GNDSRC	PWR	Ground pin for the SRC outputs
21	VDDSRC	PWR	Supply for SRC clocks, 3.3V nominal
22	SRCCLKT4	OUT	True clock of differential SRC clock pair.
23	SRCCLKC4	OUT	Complement clock of differential SRC clock pair.
24	SRCCLKT3	OUT	True clock of differential SRC clock pair.
25	SRCCLKC3	OUT	Complement clock of differential SRC clock pair.
26	GNDSRC	PWR	Ground pin for the SRC outputs
27	ATIGCLKT1	OUT	True clock of differential SRC clock pair.
28	ATIGCLKC1	OUT	Complementary clock of differential SRC clock pair.

Pin Descriptions (Continued)

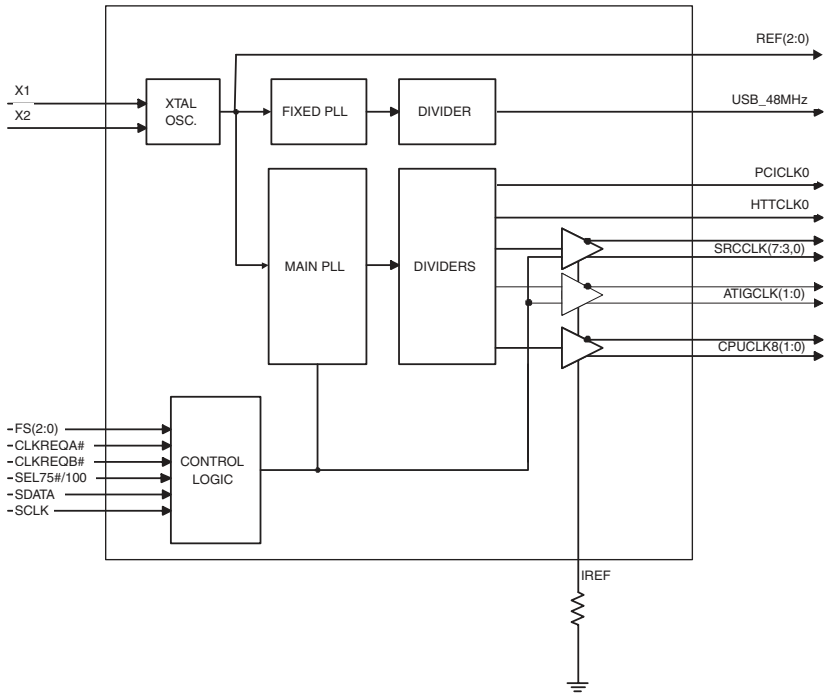
PIN #	PIN NAME	Type	Pin Description
29	ATIGCLKC0	OUT	Complementary clock of differential SRC clock pair.
30	ATIGCLKT0	OUT	True clock of differential SRC clock pair.
31	GNDATI	PWR	Ground for ATI Gclocks, nominal 3.3V
32	VDDATI	PWR	Power supply ATI Gclocks, nominal 3.3V
33	SRCCLKC0	OUT	Complement clock of differential SRC clock pair.
34	SRCCLKT0	OUT	True clock of differential SRC clock pair.
35	VDDSRC	PWR	Supply for SRC clocks, 3.3V nominal
36	GNDSRC	PWR	Ground pin for the SRC outputs
37	IREF	OUT	This pin establishes the reference current for the differential current-mode output pairs. This pin requires a fixed precision resistor tied to ground in order to establish the appropriate current. 475 ohms is the standard value.
38	GNDA	PWR	Ground pin for the PLL core.
39	VDDA	PWR	3.3V power for the PLL core.
40	CPUCLK8C1	OUT	Complementary clock of differential 3.3V push-pull K8 pair.
41	CPUCLK8T1	OUT	True clock of differential 3.3V push-pull K8 pair.
42	GNDCPU	PWR	Ground pin for the CPU outputs
43	VDDCPU	PWR	Supply for CPU clocks, 3.3V nominal
44	CPUCLK8C0	OUT	Complementary clock of differential 3.3V push-pull K8 pair.
45	CPUCLK8T0	OUT	True clock of differential 3.3V push-pull K8 pair.
46	GNDHTT	PWR	Ground pin for the HTT outputs
47	HTTCLK0	OUT	3.3V Hyper Transport output
48	VDDHTT	PWR	Supply for HTT clocks, nominal 3.3V.
49	GNDPCI	PWR	Ground pin for the PCI outputs
50	PCICLK0	OUT	PCI clock output.
51	VDDPCI	PWR	Power supply for PCI clocks, nominal 3.3V
52	REF2	OUT	14.318 MHz reference clock.
53	**FS1/REF1	I/O	Frequency select latch input pin / 14.318 MHz reference clock.
54	**FS0/REF0	I/O	Frequency select latch input pin / 14.318 MHz reference clock.
55	GND	PWR	Ground pin.
56	VDDREF	PWR	Ref, XTAL power supply, nominal 3.3V

General Description

The **ICS951412B** is a main clock synthesizer chip that provides all clocks required for ATI RS480-based systems.

An SMBus interface allows full control of the device.

Block Diagram



Skew Characteristics

Parameter	Description	Test Conditons	Skew Window	Unit
$T_{sk\_CPU\_CPU}$	time independent skew not dependent on V, T changes	measured at x-ing of CPU,	250	ps
$T_{sk\_CPU\_PCI}$		measured at x-ing of CPU, 1.5V of PCI clock	2000	ps
$T_{sk\_PCI\_PCI}$		measured between rising edge at 1.5V	500	ps
$T_{sk\_PCI33-HT66}$		measured between rising edge at 1.5V	500	ps
$T_{sk\_CPU\_HT66}$		measured between rising edge at 1.5V	2000	ps
$T_{sk\_CPU\_HT66}$		measured at x-ing of CPU, 1.5V of PCI clock	500	ps
$T_{sk\_CPU\_CPU}$	time variant skew varies over V, T changes	measured at x-ing of CPU,	200	ps
$T_{sk\_CPU\_PCI}$		measured at x-ing of CPU, 1.5V of PCI clock	200	ps
$T_{sk\_PCI\_PCI}$		measured between rising edge at 1.5V	200	ps
$T_{sk\_PCI33-HT66}$		measured between rising edge at 1.5V	200	ps
$T_{sk\_CPU\_HT66}$		measured between rising edge at 1.5V	200	ps
$T_{sk\_CPU\_HT66}$		measured at x-ing of CPU, 1.5V of PCI clock	200	ps

1232A—06/12/06

General SMBus serial interface information

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 begining 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***
  (see Note 2)
- 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 begining 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
- Controllor (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 D2$_{(H)}$			
WR	WRite		
			ACK
Beginning Byte = N			
			ACK
Data Byte Count = X			
			ACK
Beginning Byte N		X Byte	
			ACK
	○		
	○		○
	○		○
			○
Byte N + X - 1			
			ACK
P	stoP bit		

Index Block Read Operation

Controller (Host)			ICS (Slave/Receiver)
T	starT bit		
Slave Address D2$_{(H)}$			
WR	WRite		
			ACK
Beginning Byte = N			
			ACK
RT	Repeat starT		
Slave Address D3$_{(H)}$			
RD	ReaD		
			ACK
			Data Byte Count = X
ACK			
		X Byte	Beginning Byte N
ACK			
			○
	○		○
	○		○
	○		
			Byte N + X - 1
N	Not acknowledge		
P	stoP bit		

1232A—06/12/06

Table1: CPU Frequency Selection Table

CPU SS_EN (B0:b4)	CPU FS3 (B0:b3)	CPU FS2	CPU FS1	CPU FS0	CPU (MHz)	HTT66 (MHz)	PCI33 (MHz)	Spread %
0	0	0	0	0	Hi-Z	Hi-Z	Hi-Z	None
0	0	0	0	1	X/6	X/12	X/24	None
0	0	0	1	0	180.00	60.00	30.00	None
0	0	0	1	1	220.00	73.33	36.67	None
0	0	1	0	0	100.00	66.67	33.33	None
0	0	1	0	1	133.33	66.67	33.33	None
0	0	1	1	0	166.67	66.67	33.33	None
0	0	1	1	1	200.00	66.67	33.33	None
0	1	0	0	0	186.00	62.00	31.00	None
0	1	0	0	1	214.00	71.33	35.67	None
0	1	0	1	0	190.00	63.33	31.67	None
0	1	0	1	1	210.00	70.00	35.00	None
0	1	1	0	0	102.00	68.00	34.00	None
0	1	1	0	1	136.00	68.00	34.00	None
0	1	1	1	0	170.00	68.00	34.00	None
0	1	1	1	1	204.00	68.00	34.00	None
1	0	0	0	0	169.58	56.53	28.26	-0.5%
1	0	0	0	1	229.43	76.48	38.24	-0.5%
1	0	0	1	0	179.55	59.85	29.93	-0.5%
1	0	0	1	1	219.45	73.15	36.58	-0.5%
1	0	1	0	0	99.75	66.50	33.25	-0.5%
1	0	1	0	1	133.00	66.50	33.25	-0.5%
1	0	1	1	0	166.25	66.50	33.25	-0.5%
1	0	1	1	1	199.50	66.50	33.25	-0.5%
1	1	0	0	0	185.54	61.85	30.92	-0.5%
1	1	0	0	1	106.73	71.16	35.58	-0.5%
1	1	0	1	0	189.53	63.18	31.59	-0.5%
1	1	0	1	1	209.48	69.83	34.91	-0.5%
1	1	1	0	0	101.75	67.83	33.92	-0.5%
1	1	1	0	1	135.66	67.83	33.91	-0.5%
1	1	1	1	0	169.58	67.83	33.92	-0.5%
1	1	1	1	1	203.49	67.83	33.92	-0.5%

Table2: SRC & ATIG Frequency Selection Table

Byte 5					SRC(7:3,0), ATIG(1:0) (MHz)	Spread %
Bit4	Bit3	Bit2	Bit1	Bit0		
SRC Spread Enable	SRC FS3	SRC FS2	SRC FS1	SRC FS0		
0	0	0	0	0	100.00	0
0	0	0	0	1	100.00	0
0	0	0	1	0	100.00	0
0	0	0	1	1	100.00	0
0	0	1	0	0	101.00	0
0	0	1	0	1	101.00	0
0	0	1	1	0	101.00	0
0	0	1	1	1	101.00	0
0	1	0	0	0	102.00	0
0	1	0	0	1	102.00	0
0	1	0	1	0	102.00	0
0	1	0	1	1	102.00	0
0	1	1	0	0	104.00	0
0	1	1	0	1	104.00	0
0	1	1	1	0	104.00	0
0	1	1	1	1	104.00	0
1	0	0	0	0	99.75	-0.5%
1	0	0	0	1	99.75	-0.5%
1	0	0	1	0	99.75	-0.5%
1	0	0	1	1	99.75	-0.5%
1	0	1	0	0	100.74	-0.5%
1	0	1	0	1	100.74	-0.5%
1	0	1	1	0	100.74	-0.5%
1	0	1	1	1	100.74	-0.5%
1	1	0	0	0	101.74	-0.5%
1	1	0	0	1	101.74	-0.5%
1	1	0	1	0	101.74	-0.5%
1	1	0	1	1	101.74	-0.5%
1	1	1	0	0	103.74	-0.5%
1	1	1	0	1	103.74	-0.5%
1	1	1	1	0	103.74	-0.5%
1	1	1	1	1	103.74	-0.5%

SMBus Table: Frequency Select Register

Byte 0	Pin #	Name	Control Function	Type	0	1	PWD
Bit 7	-	FS Source	Latched Input or SMBus Frequency Select	RW	Latched Inputs	SMBus	0
Bit 6	-	CPU SS_EN	CPU Spread Enable	RW	OFF	ON	0
Bit 5	-	Reserved	Reserved	RW	Reserved	Reserved	X
Bit 4	-	CPU FS4	Freq Select Bit 4	RW	See Table 1: CPU Frequency Selection		0
Bit 3	-	CPU FS3	Freq Select Bit 3	RW			0
Bit 2	-	CPU FS2	Freq Select Bit 2	RW			Latched
Bit 1	-	CPU FS1	Freq Select Bit 1	RW			Latched
Bit 0	-	CPU FS0	Freq Select Bit 0	RW			Latched

Note: Byte 0 Bit 6, Byte 0 Bit 4 and Byte 5 Bit 4 must be set to '1' to fully enable spread.

SMBus Table: Output Control Register

Byte 1	Pin #	Name	Control Function	Type	0	1	PWD
Bit 7	50	PCICLK0	Output Enable	RW	Disable	Enable	1
Bit 6	47	HTTCLK0	Output Enable	RW	Disable	Enable	1
Bit 5	4	USB_48MHz	Output Enable	RW	Disable	Enable	1
Bit 4	54	REF0	Output Enable	RW	Disable	Enable	1
Bit 3	53	REF1	Output Enable	RW	Disable	Enable	1
Bit 2	52	REF2	Output Enable	RW	Disable	Enable	1
Bit 1	45,44	CPUCLK8(0)	Output Enable	RW	Disable	Enable	1
Bit 0	41,40	CPUCLK8(1)	Output Enable	RW	Disable	Enable	1

SMBus Table: CLKREQB# Output Control Register

Byte 2	Pin #	Name	Control Function	Type	0	1	PWD
Bit 7	12,13	REQBSRC7	CLKREQB# Controls SRC7	RW	Does not control	Controls	0
Bit 6	16,17	REQBSRC6	CLKREQB# Controls SRC6	RW	Does not control	Controls	0
Bit 5	18,19	REQBSRC5	CLKREQB# Controls SRC5	RW	Does not control	Controls	0
Bit 4	22,23	REQBSRC4	CLKREQB# Controls SRC4	RW	Does not control	Controls	0
Bit 3	24,25	REQBSRC3	CLKREQB# Controls SRC3	RW	Does not control	Controls	0
Bit 2	-	Reserved	Reserved	RW	Reserved	Reserved	X
Bit 1	-	Reserved	Reserved	RW	Reserved	Reserved	X
Bit 0	34,33	REQBSRC0	CLKREQB# Controls SRC0	RW	Does not control	Controls	0

SMBus Table: SRCCLK(7:3,0), CLKREQA# Output Control Register

Byte 3	Pin #	Name	Control Function	Type	0	1	PWD
Bit 7	12,13	SRCCLK7	Master Output control. Enables or disables output, regardless of CLKREQ# inputs.	RW	Disable	Enable	1
Bit 6	16,17	SRCCLK6		RW	Disable	Enable	1
Bit 5	18,19	SRCCLK5		RW	Disable	Enable	1
Bit 4	22,23	SRCCLK4		RW	Disable	Enable	1
Bit 3	24,25	SRCCLK3		RW	Disable	Enable	1
Bit 2	34,33	SRCCLK0		RW	Disable	Enable	1
Bit 1	24,25	REQASRC3	CLKREQA# Controls SRC3	RW	Does not control	Controls	0
Bit 0	34,33	REQASRC0	CLKREQA# Controls SRC0	RW	Does not control	Controls	0

SMBus Table: SRCCLK(3,0), ATIGCLK Output Control Register

Byte 4	Pin #	Name	Control Function	Type	0	1	PWD
Bit 7	12,13	REQASRC7	CLKREQA# Controls SRC7	RW	Does not control	Controls	0
Bit 6	16,17	REQASRC6	CLKREQA# Controls SRC6	RW	Does not control	Controls	0
Bit 5	18,19	REQASRC5	CLKREQA# Controls SRC5	RW	Does not control	Controls	0
Bit 4	22,23	REQASRC4	CLKREQA# Controls SRC4	RW	Does not control	Controls	0
Bit 3	27,28	ATIGCLK1	Output Enable These outputs cannot be controlled by CLKREQ# pins.	RW	Disabled	Enabled	1
Bit 2	30,29	ATIGCLK0		RW	Disabled	Enabled	1
Bit 1	-	Reserved	Reserved	RW	Reserved	Reserved	0
Bit 0	4	USB_48Str	48MHz Strength Control	RW	1X	2X	0

Note: Do NOT simultaneously select CLKREQA# and CLKREQB# to control an SRC output. Behavior of the device is undefined under these conditions.

SMBus Table: Output Drive and ATIG Frequency Control Register

Byte 5	Pin #	Name	Control Function	Type	0	1	PWD
Bit 7	52	REF2Str	REF2 Strength Control	RW	1X	2X	0
Bit 6	-	Reserved	Reserved	RW	Reserved	Reserved	0
Bit 5	-	Reserved	Reserved	RW	Reserved	Reserved	0
Bit 4	-	SRC SSEN	SRC Spread Enable	RW	See Table 2: SRC Frequency Selection		0
Bit 3	-	SRCFS3	Freq Select Bit 3	RW			0
Bit 2	-	SRCFS2	Freq Select Bit 2	RW			0
Bit 1	-	SRCFS1	Freq Select Bit 1	RW			0
Bit 0	-	SRCFS0	Freq Select Bit 0	RW			0

SMBus Table: Device ID Register

Byte 6	Pin #	Name	Control Function	Type	0	1	PWD
Bit 7	-	DevID 7	Device ID MSB	R	-	-	0
Bit 6	-	DevID 6	Device ID 6	R	-	-	0
Bit 5	-	DevID 5	Device ID 5	R	-	-	0
Bit 4	-	DevID 4	Device ID4	R	-	-	1
Bit 3	-	DevID 3	Device ID3	R	-	-	0
Bit 2	-	DevID 2	Device ID2	R	-	-	0
Bit 1	-	DevID 1	Device ID1	R	-	-	1
Bit 0	-	DevID 0	Device ID LSB	R	-	-	0

SMBus Table: Vendor ID Register

Byte 7	Pin #	Name	Control Function	Type	0	1	PWD
Bit 7	-	RID3	Revision ID	R	-	-	X
Bit 6	-	RID2		R	-	-	X
Bit 5	-	RID1		R	-	-	X
Bit 4	-	RID0		R	-	-	X
Bit 3	-	VID3	VENDOR ID (0001 = ICS)	R	-	-	0
Bit 2	-	VID2		R	-	-	0
Bit 1	-	VID1		R	-	-	0
Bit 0	-	VID0		R	-	-	1

SMBus Table: Byte Count Register

Byte 8	Pin #	Name	Control Function	Type	0	1	PWD
Bit 7	-	BC7	Byte Count Programming b(7:0)	RW	Writing to this register will configure how many bytes will be read back, default is 9 bytes.		0
Bit 6	-	BC6		RW			0
Bit 5	-	BC5		RW			0
Bit 4	-	BC4		RW			0
Bit 3	-	BC3		RW			1
Bit 2	-	BC2		RW			0
Bit 1	-	BC1		RW			0
Bit 0	-	BC0		RW			1

Bytes 9 to 21 are reserved

Absolute Maximum Ratings

Supply Voltage 3.8V
Logic Inputs . . . . . GND –0.5 V to V_{DD} +3.8 V
Ambient Operating Temperature . . . . . 0°C to +70°C
Storage Temperature . . . . . –65°C to +150°C
ESD Protection . . . . . Input ESD protection usung human body model > 1KV

Stresses above those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These ratings are stress specifications only and functional operation of the device at these or any other conditions above those listed in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

Electrical Characteristics - Input/Supply/Common Output Parameters

T_A = 0 - 70°C; Supply Voltage V_{DD} = 3.3 V +/-5%

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Input High Voltage	V_{IH}	3.3 V +/-5%	2		V_{DD} + 0.3	V	1
Input Low Voltage	V_{IL}	3.3 V +/-5%	V_{SS} - 0.3		0.8	V	1
Input High Current	I_{IH}	V_{IN} = V_{DD}	-5		5	uA	1
Input Low Current	I_{IL1}	V_{IN} = 0 V; Inputs with no pull-up resistors	-5			uA	1
	I_{IL2}	V_{IN} = 0 V; Inputs with pull-up resistors	-200			uA	1
Operating Current	$I_{DD3.3OP}$	all outputs driven			300	mA	
Input Frequency[3]	F_i	V_{DD} = 3.3 V		14.31818		MHz	3
Pin Inductance[1]	L_{pin}				7	nH	1
Input Capacitance[1]	C_{IN}	Logic Inputs			5	pF	1
	C_{OUT}	Output pin capacitance			6	pF	1
	C_{INX}	X1 & X2 pins			5	pF	1
Clk Stabilization[1,2]	T_{STAB}	From V_{DD} Power-Up or de-assertion of PD# to 1st clock			3	ms	1,2
Modulation Frequency		Triangular Modulation	30		33	kHz	1
SMBus Voltage	V_{DD}		2.7		5.5	V	1
Low-level Output Voltage	V_{OL}	@ I_{PULLUP}			0.4	V	1
Current sinking at V_{OL} = 0.4 V	I_{PULLUP}		4			mA	1
SCLK/SDATA Clock/Data Rise Time[3]	T_{RI2C}	(Max VIL - 0.15) to (Min VIH + 0.15)			1000	ns	1
SCLK/SDATA Clock/Data Fall Time[3]	T_{FI2C}	(Min VIH + 0.15) to (Max VIL - 0.15)			300	ns	1

[1]Guaranteed by design and characterization, not 100% tested in production.

[2]See timing diagrams for timing requirements.

[3] Input frequency should be measured at the REFOUT pin and tuned to ideal 14.31818MHz to meet ppm frequency accuracy on PLL outputs.

Electrical Characteristics - K8 Push Pull Differential Pair

T_A = 0 - 70°C; V_{DD} = 3.3 V +/-5%; C_L =AMD64 Processor Test Load

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Rising Edge Rate	$\delta V/\delta t$	Measured at the AMD64 processor's test load. 0 V +/- 400 mV (differential measurement)	2		10	V/ns	1
Falling Edge Rate	$\delta V/\delta t$		2		10	V/ns	1
Differential Voltage	V_{DIFF}	Measured at the AMD64 processor's test load. (single-ended measurement)	0.4	1.25	2.3	V	1
Change in V_{DIFF_DC} Magnitude	ΔV_{DIFF}		-150		150	mV	1
Common Mode Voltage	V_{CM}		1.05	1.25	1.45	V	1
Change in Common Mode Voltage	ΔV_{CM}		-200		200	mV	1
Jitter, Cycle to cycle	$t_{jcyc-cyc}$	Measurement from differential wavefrom. Maximum difference of cycle time between 2 adjacent cycles.	0	100	200	ps	1
Jitter, Accumulated	t_{ja}	Measured using the JIT2 software package with a Tek 7404 scope. TIE (Time Interval Error) measurement technique: Sample resolution = 50 ps, Sample Duration = 10 us	-1000		1000		1,2,3
Duty Cycle	d_{t3}	Measurement from differential wavefrom	45		53	%	1
Output Impedance	R_{ON}	Average value during switching transition. Used for determining series termination value.	15	35	55	Ω	1
Group Skew	$t_{src-skew}$	Measurement from differential wavefrom			250	ps	1

[1]Guaranteed by design and characterization, not 100% tested in production.

[2] All accumulated jitter specifications are guaranteed assuming that REF is at 14.31818MHz

[3] Spread Spectrum is off

Electrical Characteristics - SRC 0.7V Current Mode Differential Pair

T_A = 0 - 70°C; V_{DD} = 3.3 V +/-5%; C_L =2pF, R_S=33.2Ω, R_P=49.9Ω, I_{REF} = 475Ω

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Current Source Output Impedance	Zo	$V_O = V_x$	3000			Ω	1
Voltage High	VHigh	Statistical measurement on single ended signal using oscilloscope math function.	660		850	mV	1,3
Voltage Low	VLow		-150		150		1,3
Max Voltage	Vovs	Measurement on single ended signal using absolute value.			1150	mV	1
Min Voltage	Vuds		-300				1
Crossing Voltage (abs)	Vcross(abs)		250	350	550	mV	1
Crossing Voltage (var)	d-Vcross	Variation of crossing over all edges		12	140	mV	1
Long Accuracy	ppm	see Tperiod min-max values	-300		300	ppm	1,2
Average period	Tperiod	75.00 MHz nominal	8.5684	8.5714	8.5744	ns	2
		75.00 MHz spread	8.5684		8.6244	ns	2
		100.00 MHz nominal	9.9970	10.0000	10.0030	ns	2
		100.00 MHz spread	9.9970		10.0530	ns	2
		116.67 MHz nominal	13.3303	13.3333	13.3363	ns	2
		116.67 MHz spread	13.3303		13.3863	ns	2
		133.33 MHz nominal	7.4972	7.5002	7.5032	ns	2
		133.33 MHz spread	7.4972		7.5532	ns	2
Absolute min period	Tabsmin	@100.00MHz nominal/spread	9.8720			ns	1,2
Rise Time	t_r	V_{OL} = 0.175V, V_{OH} = 0.525V	175		700	ps	1
Fall Time	t_f	V_{OH} = 0.525V V_{OL} = 0.175V	175		700	ps	1
Rise Time Variation	d-t_r			30	125	ps	1
Fall Time Variation	d-t_f			30	125	ps	1
Duty Cycle	d_{t3}	Measurement from differential wavefrom	45		55	%	1
Group Skew	$t_{src-skew}$	Measurement from differential wavefrom			250	ps	
Jitter, Cycle to cycle	$t_{jcyc-cyc}$	Measurement from differential wavefrom			100	ps	1

[1]Guaranteed by design and characterization, not 100% tested in production.

[2] All Long Term Accuracy and Clock Period specifications are guaranteed assuming that REF is at 14.31818MHz

[3]$I_{REF} = V_{DD}/(3xR_R)$. For R_R = 475Ω (1%), I_{REF} = 2.32mA. I_{OH} = 6 x I_{REF} and V_{OH} = 0.7V @ Z_O=50Ω.

Electrical Characteristics - PCI33, HTT66 Clocks

T_A = 0 - 70°C; VDD=3.3V +/-5%; C_L = 30 pF (unless otherwise specified)

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		-46	mA	1
		V_{OH}@ MAX = 3.135 V	-50		-80	mA	1
Output Low Current	I_{OL}	V_{OL} @ MIN = 1.95 V	47		64	mA	1
		V_{OL} @ MAX = 0.4 V	58		91	mA	1
Edge Rate	δV/δt	Rising edge rate	1		4	V/ns	1
Edge Rate	δV/δt	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
Skew	t_{sk1}	V_T = 1.5 V			500	ps	1
Jitter, Cycle to cycle	$t_{jcyc-cyc}$	V_T = 1.5 V			180	ps	1

[1]Guaranteed by design and characterization, not 100% tested in production.

[2] All Long Term Accuracy and Clock Period specifications are guaranteed with the assumption that REF is at 14.31818MHz

Electrical Characteristics - 48MHz, USB

T_A = 0 - 70°C; V_{DD} = 3.3 V +/-5%; C_L = 10-20 pF (unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	Notes
Long Accuracy	ppm	see Tperiod min-max values	-200		200	ppm	1,2
Clock period	T_{period}	48.00MHz output nominal	20.8257		20.8340	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		-46	mA	1
		V_{OH}@ MAX = 3.135 V	-50		-80	mA	1
Output Low Current	I_{OL}	V_{OL} @MIN = 1.95 V	47		64	mA	1
		V_{OL} @ MAX = 0.4 V	58		91	mA	1
Edge Rate	δV/ δt	Rising edge rate	1		2	V/ns	1
Edge Rate	δV/ δt	Falling edge rate	1		2	V/ns	1
Rise Time	t_{r1}	V_{OL} = 0.4 V, V_{OH} = 2.4 V	1	1.43	2	ns	1
Fall Time	t_{f1}	V_{OH} = 2.4 V, V_{OL} = 0.4 V	1	1.33	2	ns	1
Duty Cycle	d_{t1}	V_T = 1.5 V	45	50	55	%	1
Jitter, Cycle to cycle	$t_{jcyc-cyc}$	V_T = 1.5 V			150	ps	1

[1]Guaranteed by design and characterization, not 100% tested in production.

[2] All Long Term Accuracy and Clock Period specifications are guaranteed with the assumption that REF is at 14.31818MHz

Electrical Characteristics - REF-14.318MHz

T_A = 0 - 70°C; V_{DD} = 3.3 V +/-5%; C_L = 10-20 pF (unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Long Accuracy	ppm	see Tperiod min-max values	-300		300	ppm	1
Clock period	T_{period}	14.318MHz output nominal	69.8270		69.8550	ns	2
Output High Voltage	V_{OH}	I_{OH} = -1 mA	2.4			V	1
Output Low Voltage	V_{OL}	I_{OL} = 1 mA			0.4	V	1
Output High Current	I_{OH}	V_{OH} @MIN = 1.0 V	-29		-41	mA	1
		V_{OH}@MAX = 3.135 V	-45		-71	mA	1
Output Low Current	I_{OL}	V_{OL} @MIN = 1.95 V	39		54	mA	1
		V_{OL} @MAX = 0.4 V	49		77	mA	1
Edge Rate	δV/ δt	Rising edge rate	1		4	V/ns	1
Edge Rate	δV/ δt	Falling edge rate	1		4	V/ns	1
Rise Time	t_{r1}	V_{OL} = 0.4 V, V_{OH} = 2.4 V	1		2	ns	1
Fall Time	t_{f1}	V_{OH} = 2.4 V, V_{OL} = 0.4 V	1		2	ns	1
Skew	t_{sk1}	V_T = 1.5 V			500	ps	1
Duty Cycle	d_{t1}	V_T = 1.5 V	45	50	55	%	1
Jitter, Cycle to cycle	$t_{jcyc-cyc}$	V_T = 1.5 V			300	ps	1

[1]Guaranteed by design and characterization, not 100% tested in production.

[2] All Long Term Accuracy and Clock Period specifications are guaranteed with the assumption that REF is at 14.31818MHz

SRC Reference Clock			
Common Recommendations for Differential Routing	Dimension or Value	Unit	Figure
L1 length, Route as non -coupled 50 ohm trace.	0.5 max	inch	2, 3
L2 length, Route as non -coupled 50 ohm trace.	0.2 max	inch	2, 3
L3 length, Route as non -coupled 50 ohm trace.	0.2 max	inch	2, 3
Rs	33	ohm	2, 3
Rt	49.9	ohm	2, 3

Down Device Differential Routing	Dimension or Value	Unit	Figure
L4 length, Route as coupled **microstrip** 100 ohm differential trace.	2 min to 16 max	inch	2
L4 length, Route as coup led **stripline** 100 ohm differential trace.	1.8 min to 14.4 max	inch	2

Differential Routing to PCI Express Connector	Dimension or Value	Unit	Figure
L4 length, Route as coupled **microstrip** 100 ohm differential trace.	0.25 to 14 max	inch	3
L4 length, Rout e as coupled **stripline** 100 ohm differential trace.	0.225 min to 12.6 max	inch	3

Fig.1

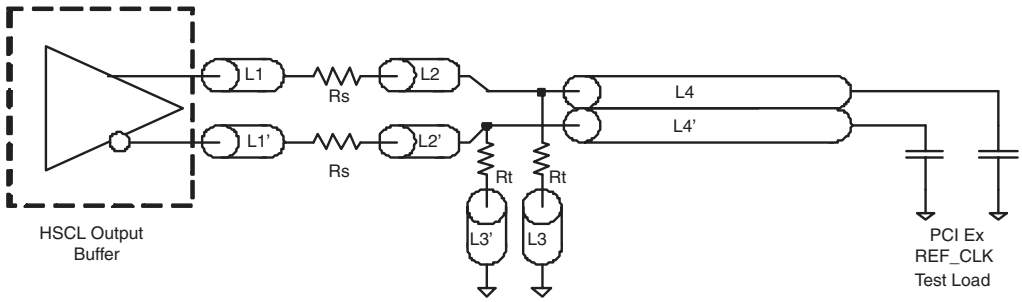


Fig.2

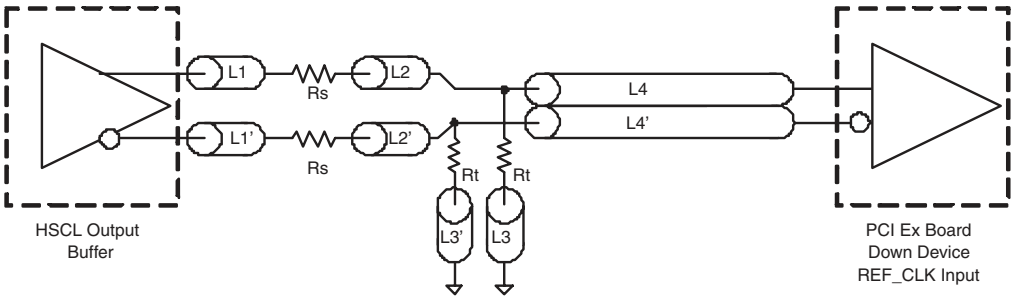
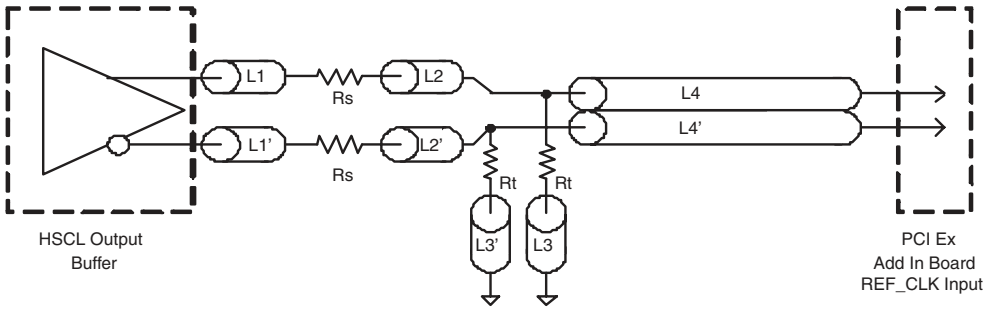


Fig.3



1232A—06/12/06

Shared Pin Operation - Input/Output Pins

The I/O pins designated by (input/output) on the **ICS951412B** serve as dual signal functions to the device. During initial power-up, they act as input pins. The logic level (voltage) that is present on these pins at this time is read and stored into a 5-bit internal data latch. At the end of Power-On reset, (see AC characteristics for timing values), the device changes the mode of operations for these pins to an output function. In this mode the pins produce the specified buffered clocks to external loads.

To program (load) the internal configuration register for these pins, a resistor is connected to either the VDD (logic 1) power supply or the GND (logic 0) voltage potential. A 10 Kilohm (10K) resistor is used to provide both the solid CMOS programming voltage needed during the power-up programming period and to provide an insignificant load on the output clock during the subsequent operating period.

Figure 1 shows a means of implementing this function when a switch or 2 pin header is used. With no jumper is installed the pin will be pulled high. With the jumper in place the pin will be pulled low. If programmability is not necessary, than only a single resistor is necessary. The programming resistors should be located close to the series termination resistor to minimize the current loop area. It is more important to locate the series termination resistor close to the driver than the programming resistor.

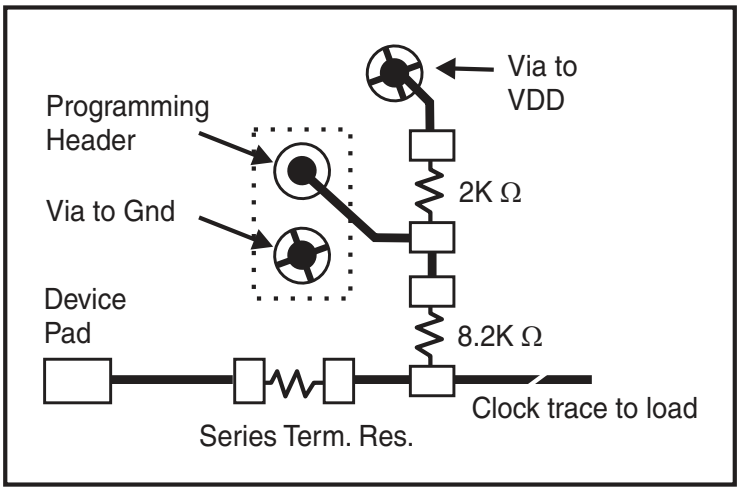
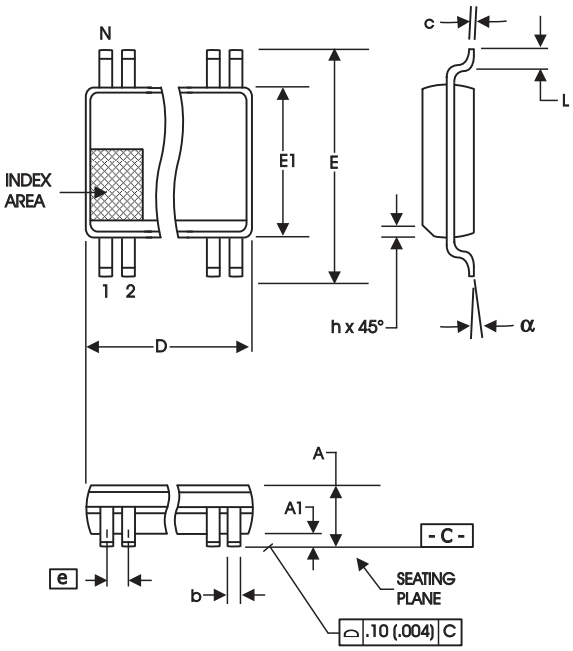


Fig. 1



56-Lead, 300 mil Body, 25 mil, SSOP

SYMBOL	In Millimeters COMMON DIMENSIONS		In Inches COMMON DIMENSIONS	
	MIN	MAX	MIN	MAX
A	2.41	2.80	.095	.110
A1	0.20	0.40	.008	.016
b	0.20	0.34	.008	.0135
c	0.13	0.25	.005	.010
D	SEE VARIATIONS		SEE VARIATIONS	
E	10.03	10.68	.395	.420
E1	7.40	7.60	.291	.299
e	0.635 BASIC		0.025 BASIC	
h	0.38	0.64	.015	.025
L	0.50	1.02	.020	.040
N	SEE VARIATIONS		SEE VARIATIONS	
a	0°	8°	0°	8°

VARIATIONS

N	D mm.		D (inch)	
	MIN	MAX	MIN	MAX
56	18.31	18.55	.720	.730

Reference Doc.: JEDEC Publication 95, MO-118

10-0034

Ordering Information

ICS951412BFLFT

Example:

ICS XXXX B F - LF T

Designation for tape and reel packaging
Lead Free, RoHS Compliant

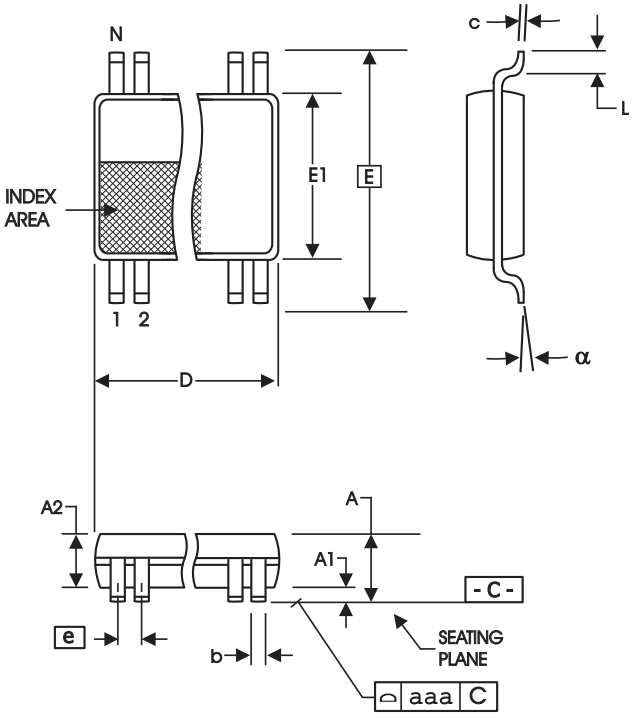
Package Type
F = SSOP

Revision Designator

Device Type (consists of 3 or 4 digit numbers)

Prefix
ICS, AV = Standard Device

1232A—06/12/06



56-Lead 6.10 mm. Body, 0.50 mm. Pitch TSSOP
(240 mil) (20 mil)

SYMBOL	In Millimeters COMMON DIMENSIONS		In Inches COMMON DIMENSIONS	
	MIN	MAX	MIN	MAX
A	--	1.20	--	.047
A1	0.05	0.15	.002	.006
A2	0.80	1.05	.032	.041
b	0.17	0.27	.007	.011
c	0.09	0.20	.0035	.008
D	SEE VARIATIONS		SEE VARIATIONS	
E	8.10 BASIC		0.319 BASIC	
E1	6.00	6.20	.236	.244
e	0.50 BASIC		0.020 BASIC	
L	0.45	0.75	.018	.030
N	SEE VARIATIONS		SEE VARIATIONS	
a	0°	8°	0°	8°
aaa	--	0.10	--	.004

VARIATIONS

N	D mm.		D (inch)	
	MIN	MAX	MIN	MAX
56	13.90	14.10	.547	.555

Reference Doc.: JEDEC Publication 95, MO-153

10-0039

Ordering Information

ICS951412BGLFT

Example:

ICS XXXX B G - LF T

- **Designation for tape and reel packaging**
- **Lead Free, RoHS Compliant**
- **Package Type**
  G = TSSOP
- **Revision Designator**
- **Device Type (consists of 3 or 4 digit numbers)**
- **Prefix**
  ICS, AV = Standard Device

1232A—06/12/06

Revision History

Rev.	Issue Date	Description	Page #
A	6/12/2006	Initial Release	-

IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES (“RENESAS”) PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers skilled in the art designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only for development of an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising out of your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use o any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Disclaimer Rev.1.0 Mar 2020)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan

www.renesas.com

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:

www.renesas.com/contact/

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.