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Embedded microprocessors are utilized across a broad spectrum of applications, making them indispensable in

Details

Product Status	Obsolete
Core Processor	MIPS-I
Number of Cores/Bus Width	1 Core, 64-Bit
Speed	180MHz
Co-Processors/DSP	System Control; CP0
RAM Controllers	SDRAM
Graphics Acceleration	No
Display & Interface Controllers	-
Ethernet	-
SATA	-
USB	-
Voltage - I/O	3.3V
Operating Temperature	0°C ~ 85°C (TC)
Security Features	-
Package / Case	208-BFQFP Exposed Pad
Supplier Device Package	208-PQFP (28x28)
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/idt79rc64v475-180dp

Device Overview¹

Extending Integrated Device Technology's (IDT) RISCore4000 based choices (see Table 1), the RC64474 and RC64475 are high performance 64-bit microprocessors targeted towards applications that require high bandwidth, real-time response and rapid data processing and are ideal for products ranging from internetworking equipment (switches, routers) to multimedia systems such as web browsers, set-top boxes, video games, and Windows®CE based products. These processors are rated at 330 Dhrystone MIPS and 125 Million floating point operations per second, at 250 MHz. The internal cache bandwidth for these devices is over 3GB/second. The 64-bit external bus bandwidth is at more than 1000MB/s, and the 32-bit external bus bandwidth is at 500MB/s.

The RC64474 is packaged in a 128-pin QFP footprint package and uses a 32-bit external bus, offering the ideal combination of 64-bit processing power and 32-bit low-cost memory systems. The RC64475 is packaged in a 208-pin QFP footprint package and uses the full 64-bit external bus. The RC64475 is ideal for applications requiring 64-bit performance and 64-bit external bandwidth.

IDT's **RISCore4000** is a 250MHz 64-bit execution core that uses a 5-stage pipeline, eliminating the "issue restrictions" associated with other more complex pipelines. The RISCore4000 implements the MIPS-III Instruction Set Architecture (ISA) and is upwardly compatible with applications that run on earlier generation parts.

Implementation of the MIPS-III architecture results in 64-bit operations, improved performance for commonly used code sequences in

operating system kernels, and faster execution of floating-point intensive applications.

The **RISCore4000 integer unit** implements a load/store architecture with single cycle ALU operations (logical, shift, add, subtract) and an autonomous multiply/divide unit. The ALU consists of the integer adder and logic unit. The adder performs address calculations in addition to arithmetic operations, and the logic unit performs all of the processor's logical and shift operations. Each unit is highly optimized and can perform an operation in a single pipeline cycle. Both 32- and 64-bit data operations are performed by the RISCore4000, utilizing 32 general purpose 64-bit registers (GPR) that are used for integer operations and address calculation. A complete on-chip floating-point co-processor (CP1), which includes a floating-point register file and execution units, forms a "seamless" interface, decoding and executing instructions in parallel with the integer unit.

CP1's floating-point execution units support both single and double precision arithmetic—as specified in the IEEE Standard 754—and are separated into a multiply unit and a combined add/convert/divide/square root unit. Overlap of multiplies and add/subtract is supported, and the multiplier is partially pipelined, allowing the initiation of a new multiply instruction every fourth pipeline cycle.

The **floating-point register file** is made up of thirty-two 64-bit registers. The floating-point unit can take advantage of the 64-bit wide data cache and issue a co-processor load or store doubleword instruction in every cycle. The RISCore4000's **system control coprocessor (CP0) registers** are also incorporated on-chip and provide the path through which the virtual memory system's page mapping is examined and changed, exceptions are handled, and any operating mode selections are controlled.

¹. Detailed system operation information is provided in the RC64474/RC64475 user's manual.

RISCore4000/RISCore5000 Family of Socket Compatible Processors

	32-bit Processors			64-bit Processors		
	RC4640	RC64474	RC64574	RC4650	RC64475	RC64575
CPU	64-bit RISCore4000 w/ DSP extensions	64-bit RISCore4000	64-bit RISCore5000 w/ DSP extensions	64-bit RISCore4000 w/ DSP extensions	64-bit RISCore4000	64-bit RISCore5000 w/ DSP extensions
Performance	>350MIPS	>330MIPS	>440MIPS	>350MIPS	>330MIPS	>440MIPS
FPA	89 mflops, single precision only	125 mflops, single and double precision	666 mflops, single and double precision	89 mflops, single precision only	125 mflops, single and double precision	666 mflops, single and double precision
Caches	8kB/8kB, 2-way, lockable by set	16kB/16kB, 2-way, lockable by set	32kB/32kB, 2-way, lockable by line	8kB/8kB, 2-way, lockable by set	16kB/16kB, 2-way, lockable by set	32kB/32kB, 2-way, lockable by line
External Bus	32-bit	32-bit, Superset pin compatible w/RC4640	32-bit, Superset pin compatible w/RC4640, RC64474	32- or 64-bit	32- or 64-bit, Superset pin compatible w/ RC4650	32- or 64-bit, Superset pin compatible w/ RC4650, RC64475
Voltage	3.3V	3.3V	2.5V	3.3V	3.3V	2.5V
Frequencies	100-267 MHz	180-250 MHz	200-333 MHz	100-267 MHz	180-250 MHz	200-333 MHz
Packages	128 PQFP	128 QFP	128 QFP	208 QFP	208 QFP	208 QFP
MMU	Base-Bounds	96 page TLB	96 page TLB	Base-Bounds	96 page TLB	96 page TLB
Key Features	Cache locking, on-chip MAC, 32-bit external bus	Cache locking, JTAG, syncDRAM mode, 32-bit external bus	Cache locking, JTAG, syncDRAM mode, 32-bit external bus	Cache locking, on-chip MAC, 32-bit & 64-bit bus option	Cache locking, JTAG, syncDRAM mode, 32-64-bit bus option	Cache locking, JTAG, syncDRAM mode, 32-64-bit bus option

Table 1 RISCore4000/RISCore5000 Processor Family

A secure user processing environment is provided through the **user, supervisor, and kernel operating modes** of virtual addressing to system software. Bits in a status register determine which of these modes is used.

If configured for 64-bit **virtual addressing**, the virtual address space layout becomes an upwardly compatible extension of the 32-bit virtual address space layout. Figure 1 is an illustration of the address space layout for the 32-bit virtual address operation.

0xFFFFFFFF	Kernel virtual address space (kseg3)
0xE0000000	Mapped, 0.5GB
0xDFFFFFFF	Supervisor virtual address space (sseg)
0xC0000000	Mapped, 0.5GB
0xBFFFFFFF	Uncached kernel physical address space (kseg1)
0xA0000000	Unmapped, 0.5GB
0x9FFFFFFF	Cached kernel physical address space (kseg0)
0x80000000	Unmapped, 0.5GB
0x7FFFFFFF	User virtual address space (useg)
0x00000000	Mapped, 2.0GB

Figure 1 Kernel Mode Virtual Addressing (32-bit Mode)

The RC64474/RC64475's **Memory Management Unit (MMU)** controls the virtual memory system's page mapping and consists of a translation lookaside buffer (TLB) used for the virtual memory-mapping subsystem.

This large, **fully associative TLB** maps 96 virtual pages to their corresponding physical addresses. The TLB is organized as 48 pairs of even-odd entries and maps a virtual address and address space identifier into the large, 64GB physical address space. To assist in controlling the amount of mapped space and the replacement characteristics of various memory regions, two mechanisms are provided. First, the page size can be configured on a **per-entry basis**, to map a page size of 4KB to 16MB (in increments of 4x).

The second mechanism controls the replacement algorithm, when a TLB miss occurs. A random replacement algorithm is provided to select a TLB entry to be written with a new mapping; however, the processor provides a mechanism whereby a system specific number of mappings

can be locked into the TLB and avoid being randomly replaced, which facilitates the design of real-time systems, by allowing deterministic access to critical software.

The TLB also contains information to control the cache coherency protocol, and cache management algorithm for each page. However, hardware-based cache coherency is not supported.

The RC64474 and RC64475 enhance IDT's entire RISCORE4000 series through the implementation of features such as boundary scan, to facilitate board level testing; enhanced support for SyncDRAM, to simplify system implementation and improve performance.

The RC64474/475 processors offer a **direct migration path** for designs based on IDT's RC4640/RC4650 processors², through full pin and socket compatibility. Also, full 64-bit-family software and bus-protocol compatibility ensures the RC64474/475 access to a robust development tools infrastructure, allowing quicker time to market.

Development Tools

An array of hardware and software tools is available to assist system designers in the rapid development of RC64474/475 based systems. This accessibility allows a wide variety of customers to take full advantage of the device's high-performance features while addressing today's aggressive time-to-market demands.

Cache Memory

To keep the RC64474 and RC64475's high-performance pipeline full and operating efficiently, on-chip instruction and data caches have been incorporated. Each cache has its own data path and can be accessed in the same single pipeline clock cycle.

The 16KB two-way set associative **instruction cache (I-cache)** is virtually indexed, physically tagged, and word parity protected. Because this cache is virtually indexed, the virtual-to-physical address translation occurs in parallel with the cache access, further increasing performance by allowing both operations to occur simultaneously. The instruction cache provides a peak instruction bandwidth of 1000MB/sec at 250MHz.

The 16KB two-way set associative **data cache (D-cache)** is byte parity protected and has a fixed 32-byte (eight words) line size. Its tag is protected with a single parity bit. To allow simultaneous address translation and data cache access, the D-cache is virtually indexed and physically tagged. The data cache can provide 8 bytes each clock cycle, for a peak bandwidth of 2GB/sec.

To lock critical sections of code and/or data into the caches for quick access, a **"cache locking"** feature has been implemented. Once enabled, a cache is said to be locked when a particular piece of code or data is loaded into the cache and that cache location will not be selected later for refill by other data. This feature locks a set (8KB) of Instructions and/or Data.

Table 2 lists the RC64474/475 Instruction and data cache attributes.

² To ensure socket compatibility, refer to Table 8 and Table 9 at back of data sheet.

Characteristics	Instruction	Data
Size	16KB	16KB
Organization	2-way set associative	2-way set associative
Line size	32B	32B
read unit	32-bits	64-bits
write policy	na	write-back, write-through with or without write-allocate
Line transfer order	sub-block order, for refill	sub-block order, for load sequential order, for store
Miss restart after transfer of:	entire line	miss word
Parity	per-word	per-byte
Cache locking	per set	per set

Table 2 RC64474/RC64475 Instruction/Data Cache Attributes

System Interfaces

The RC64475 supports a 64-bit system interface that is bus compatible with the RC4650 and RC64575 system interface. The system interface consists of a 64-bit Address/Data bus with 8 check bits and a 9-bit command bus that is parity protected.

During 64-bit operation, RC64475 system address/data (SysAD) transfers are protected with an 8-bit parity check bus, SysADC. When initialized for 32-bit operation, the RC64475's SysAD can be viewed as a 32-bit multiplexed bus that is protected by 4 parity check bits.

The RC64474 supports a 32-bit system interface that is bus compatible with the RC4640. During 32-bit operation, SysAD transfers are performed on a 32-bit multiplexed bus (SysAD 31:0) that is protected by 4 parity check bits (SysADC 6:0).

Writes to external memory—whether they are cache miss write-backs, stores to uncached or write-through addresses—use the on-chip **write buffer**. The write buffer holds a maximum of four 64-bit addresses and 64-bit data pairs. The entire buffer is used for a data cache write-back and allows the processor to proceed in parallel with memory updates.

Included in the system interface are **six handshake signals**: RdRdy*, WrRdy*, ExtRqst*, Release*, ValidOut*, and ValidIn*; **six interrupt inputs**, and a **simple timing** specification that is capable of transferring data between the processor and memory at a peak rate of 1000MB/sec. A boot-time selectable option to run the system interface as 32-bits wide—using basically the same protocols as the 64-bit system—is also supported.

A **boot-time mode control interface** initializes fundamental processor modes. The boot-time mode control interface is a serial interface that operates at a very low frequency (MasterClock divided by 256). This low-frequency operation allows the initialization information to be kept in a low-cost EPROM; alternatively, the twenty-or-so bits could be generated by the system interface ASIC or a simple PAL. The boot-time serial stream and configuration options are listed in Table 3.

The **clocking interface** allows the CPU to be easily mated with external reference clocks. The CPU input clock is the bus reference clock and can be between 25 and 125MHz. An on-chip **phase-locked-loop (PLL)** generates the pipeline clock (PClock) through multiplication of the system interface clock by values of 2,3,4,5,6,7 or 8, as defined at system reset. This allows the pipeline clock to be implemented at a significantly higher frequency than the system interface clock. The RC64474/475 support single data (one to eight bytes) and 8-word block transfers on the SysAD bus.

The RC64474/475 implement additional **write protocols** that **double the effective write bandwidth**. The write re-issue has a repeat rate of 2 cycles per write. Pipelined writes have the same 2-cycle per write repeat rate, but can issue an additional write after WrRdy* de-asserts.

Choosing a 32- or 64-bit wide system interface dictates whether a cache line block transaction requires 4 double word data cycles or 8 single word cycles as well as whether a single data transfer—larger than 4 bytes—must be divided into two smaller transfers.

Board-level testing during Run-Time mode is facilitated through the full JTAG boundary scan facility. Six pins—TDI, TDO, TMS, TCK, TRST* and JTAG32*—have been incorporated to support the standard JTAG interface.

System Enhancement

To facilitate discrete **interface to SDRAM**, the RC64474/475 bus interface is enhanced during write cycles with a programmable delay that is inserted between the write address and the write data (for both block and non-block writes).

The bus delay can be defined as 0 to 7 MasterClock cycles and is activated and controlled through mode bit (17:15) settings selected during the reset initialization sequence. The '000' setting provides the same write operations timing protocol as the RC4640, RC4650, and RC5000 processors.

Serial Bit	Description	Value & Mode Setting	
255:18	Reserved	Must be 0	
17:15	WAdrWDData_Del Write address to write data delay in Master-Clock cycles.®	000 → 0 cycles 001 → 1 cycle 010 → 2 cycles 011 → 3 cycles 100 → 4 cycles 101 → 5 cycles 110 → 6 cycles 111 → 7 cycles	
14:13	Drv_Out output driver slew rate control. Bit 14 is MSB. Affects only non-clock outputs.	Output driver strength: 10 → 100% strength (fastest) 11 → 83% strength 00 → 67% strength 01 → 50% strength (slowest)	
12	System interface bus width	0 → 64-bit system interface 1 → 32-bit system interface	
11	TmrIntEn Disables the timer interrupt on Int*[5]	0 → Enabled Timer Interrupt 1 → Disabled Timer Interrupt	
10:9	Non-block write Selects non-block write type. Bit 10 is MSB.	00 → RC4x00 compatible 01 → Reserved 10 → Pipelined writes 11 → Write re-issue	
7:5	Clock Multiplier MasterClock is multiplied internally to generate PClock	Clock multiplier: 0 Multiply by 2 1 Multiply by 3 2 Multiply by 4 3 Multiply by 5 4 Multiply by 6 5 Multiply by 7 6 Multiply by 8 7 Reserved	
8	EndBit Specifies byte ordering	0 → Little endian 1 → Big endian	
4:1	Writeback data rate System interface data rate for block writes only: bit 4 is MSB	64-bit: 9:15 Reserved 8 → dxxdxxxddxxx 7 → ddxxxxddxxxx 6 → dxddxxdx 5 → ddxddxxx 4 → dxxddxxx 3 → dxddxx 2 → dxdxx 1 → dxx 0 → dddd	32-bit: 9:15 Reserved 8 → wxxxwxxxwxxxwxxxwxxxwxxxwxxx 7 → wwxxxxwwxxxxwwxxxxwwxxxx 6 → wxwxwxwxwxwxwxwxwxwxwx 5 → wwwxxxwwwxxxwwwxxxwwwxxx 4 → wwxxwxxwxxwxxwxxwxxwxx 3 → wxwxwxwxwxwxwxwxwxwx 2 → wwwxwwwxwwwxwwwx 1 → wwxxwwwxwwwx 0 → /E wwwwwwwww
0	Reserved	Must be zero	

Table 3 Boot-time Mode Stream

Pin Description Table

The following is a list of system interface pins available on the RC64474/475. Pin names ending with an asterisk (*) are active when low.

Pin Name	Type	Description
System Interface		
ExtRqst*	I	External request An external agent asserts ExtRqst* to request use of the System interface. The processor grants the request by asserting Release*.
Release*	O	Release interface In response to the assertion of ExtRqst* or a CPU read request, the processor asserts Release* and signals to the requesting device that the system interface is available.
RdRdy*	I	Read Ready The external agent asserts RdRdy* to indicate that it can accept a processor read request.
WrRdy*	I	Write Ready An external agent asserts WrRdy* when it can now accept a processor write request.
ValidIn*	I	Valid Input Signals that an external agent is now driving a valid address or data on the SysAD bus and a valid command or data identifier on the SysCmd bus.
ValidOut*	O	Valid output Signals that the processor is now driving a valid address or data on the SysAD bus and a valid command or data identifier on the SysCmd bus.
SysAD(63:0)	I/O	System address/data bus A 64-bit address and data bus for communication between the processor and an external agent. During address phases only, SysAd(35:0) contains valid address information. The remaining SysAD(63:36) pins are not used. The whole 64-bit SysAD(63:0) may be used during the data transfer phase. In 32-bit mode and in the RC64474, SysAD(63:32) is not used, regardless of Endianness. A 32-bit address and data communication between processor and external agent is performed via SysAD(31:0).
SysADC(7:0)	I/O	System address/data check bus An 8-bit bus containing parity check bits for the SysAD bus during data bus cycles. In 32-bit mode and in the RC64474, SysADC(7:4) is not used. The SysADC(3:0) contains check bits for SysAD(31:0).
SysCmd(8:0)	I/O	System command/data identifier bus A 9-bit bus for command and data identifier transmission between the processor and an external agent.
SysCmdP	I/O	System Command Parity A single, even-parity bit for the Syscmd bus. This signal is always driven low.
Clock/Control Interface		
MasterClock	I	Master Clock Master clock input establishes the processor and bus operating frequency. It is multiplied internally by 2,3,4,5,6,7,8 to generate the pipeline clock (PClock). This clock must be driven by 3.3V (Vcc) clock signals, regardless of the 5V tolerant pin setting.
VccP	I	Quiet VCC for PLL Quiet Vcc for the internal phase locked loop.
VssP	I	Quiet Vss for PLL Quiet Vss for the internal phase locked loop.
Interrupt Interface		
Int*(5:0)	I	Interrupt Six general processor interrupts, bit-wise ORed with bits 5:0 of the interrupt register.

Table 5 Pin Descriptions (Page 1 of 2)

Logic Diagram — RC64474/RC64475

Figure 2 illustrates the direction and functional groupings for the processor signals.

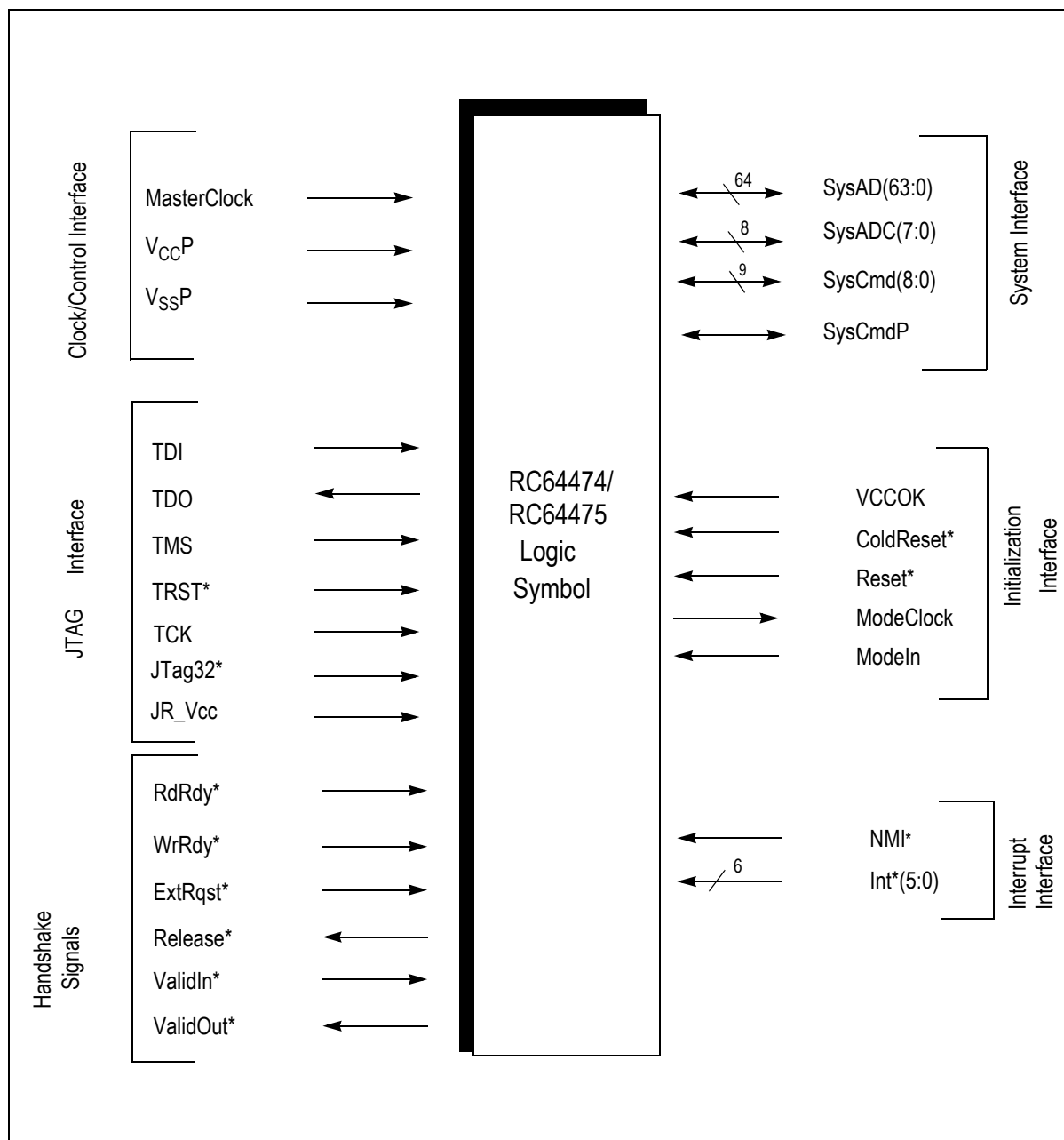


Figure 2 Logic Diagram for RC64474/RC64475

RC64475 208-pin QFP Package Pin-out

Pin names followed by an asterisk (*) are active when low. For maximum flexibility and compatibility with future designs, N.C. pins should be left floating.

Pin	Function	Pin	Function	Pin	Function	Pin	Function
1	N.C.	53	JTAG32*	105	N.C.	157	N.C.
2	N.C.	54	N.C.	106	N.C.	158	N.C.
3	N.C.	55	N.C.	107	N.C.	159	SysAD59
4	N.C.	56	N.C.	108	N.C.	160	ColdReset*
5	N.C.	57	SysCmd2	109	N.C.	161	SysAD28
6	N.C.	58	SysAD36	110	N.C.	162	VCC
7	N.C.	59	SysAD4	111	N.C.	163	V _{SS}
8	N.C.	60	SysCmd1	112	N.C.	164	SysAD60
9	N.C.	61	V _{SS}	113	N.C.	165	Reset*
10	SysAD11	62	V _{cc}	114	SysAD52	166	SysAD29
11	V _{SS}	63	SysAD35	115	ExtRqst*	167	SysAD61
12	V _{cc}	64	SysAD3	116	V _{cc}	168	SysAD30
13	SysCmd8	65	SysCmd0	117	V _{SS}	169	V _{cc}
14	SysAD42	66	SysAD34	118	SysAD21	170	V _{SS}
15	SysAD10	67	V _{SS}	119	SysAD53	171	SysAD62
16	SysCmd7	68	V _{cc}	120	RdRdy*	172	SysAD31
17	V _{SS}	69	SysAD2	121	Modein	173	SysAD63
18	V _{cc}	70	Int5*	122	SysAD22	174	V _{cc}
19	SysAD41	71	SysAD33	123	SysAD54	175	V _{SS}
20	SysAD9	72	SysAD1	124	V _{cc}	176	V _{cc} OK
21	SysCmd6	73	V _{SS}	125	V _{SS}	177	SysADC3
22	SysAD40	74	V _{cc}	126	Release*	178	SysADC7
23	V _{SS}	75	Int4*	127	SysAD23	179	N.C.
24	V _{cc}	76	SysAD32	128	SysAD55	180	TDI
25	SysAD8	77	SysAD0	129	NMI*	181	TRst*
26	SysCmd5	78	Int3*	130	V _{cc}	182	TCK
27	SysADC4	79	V _{SS}	131	V _{SS}	183	TMS
28	SysADC0	80	V _{cc}	132	SysADC2	184	TDO
29	V _{SS}	81	Int2*	133	SysADC6	185	V _{cc} P
30	V _{cc}	82	SysAD16	134	SysAD24	186	V _{SS} P
31	SysCmd4	83	SysAD48	135	V _{cc}	187	MasterClock
32	SysAD39	84	Int1*	136	V _{SS}	188	V _{cc}
33	SysAD7	85	V _{SS}	137	SysAD56	189	V _{SS}

Table 6 RC64475 208-pin QFP Package Pin-Out (Page 1 of 2)

Pin	Function	Pin	Function	Pin	Function	Pin	Function
34	SysCmd3	86	V _{cc}	138	SysAD25	190	SysADC5
35	V _{ss}	87	SysAD17	139	SysAD57	191	SysADC1
36	V _{cc}	88	SysAD49	140	N.C.	192	V _{cc}
37	SysAD38	89	Int0*	141	V _{ss}	193	V _{ss}
38	SysAD6	90	SysAD18	142	N.C	194	SysAD47
39	ModeClock	91	V _{ss}	143	SysAD26	195	SysAD15
40	WrRdy*	92	V _{cc}	144	SysAD58	196	SysAD46
41	SysAD37	93	SysAD50	145	N.C.	197	V _{cc}
42	SysAD5	94	ValidIn*	146	V _{cc}	198	V _{ss}
43	V _{ss}	95	SysAD19	147	V _{ss}	199	SysAD14
44	V _{cc}	96	SysAD51	148	SysAD27	200	SysAD45
45	N.C.	97	V _{ss}	149	N.C.	201	SysAD13
46	N.C.	98	V _{cc}	150	JR_V _{cc}	202	SysAD44
47	N.C.	99	ValidOut*	151	N.C.	203	V _{ss}
48	N.C.	100	SysAD20	152	N.C.	204	V _{cc}
49	N.C.	101	N.C.	153	N.C.	205	SysAD12
50	N.C.	102	N.C.	154	N.C.	206	SysCmdP
51	N.C.	103	N.C.	155	N.C.	207	SysAD43
52	N.C.	104	N.C.	156	N.C.	208	N.C.

Table 6 RC64475 208-pin QFP Package Pin-Out (Page 2 of 2)

RC64474 128-pin QFP Package Pin-out

Pin	Function	Pin	Function	Pin	Function	Pin	Function
1	JTAG32*	33	V _{cc}	65	V _{cc}	97	V _{cc}
2	SysCmd2	34	V _{ss}	66	SysAD28	98	V _{ss}
3	V _{cc}	35	SysAD13	67	ColdReset*	99	SysAD19
4	V _{ss}	36	SysAD14	68	SysAD27	100	ValidIn*
5	SysAD5	37	V _{ss}	69	V _{ss}	101	V _{cc}
6	WrRdy*	38	V _{cc}	70	V _{cc}	102	V _{ss}
7	ModeClock	39	SysAD15	71	JR_V _{cc}	103	SysAD18
8	SysAD6	40	V _{ss}	72	SysAD26	104	Int0*
9	V _{cc}	41	V _{cc}	73	N.C.	105	SysAD17
10	V _{ss}	42	SysADC1	74	V _{ss}	106	V _{cc}
11	SysCmd3	43	V _{ss}	75	N.C.	107	V _{ss}
12	SysAd7	44	V _{cc}	76	SysAD25	108	Int1*
13	SysCmd4	45	MasterClock	77	V _{ss}	109	SysAD16

Table 7 RC64474 128-pin QFP Package Pin-out (Page 1 of 2)

Pin	Function	Pin	Function	Pin	Function	Pin	Function
14	Vcc	46	VssP	78	Vcc	110	Int2*
15	Vss	47	VccP	79	SysAD24	111	Vcc
16	SysAdC0	48	TDO	80	SysADC2	112	Vss
17	SysCmd5	49	TMS	81	Vss	113	Int3*
18	SysAD8	50	TCK	82	Vcc	114	SysAD0
19	Vcc	51	TRst*	83	NMI*	115	Int4*
20	Vss	52	TDI	84	SysAD23	116	Vcc
21	SysCmd6	53	Vss	85	Release*	117	Vss
22	SysAD9	54	SysADC3	86	Vss	118	SysAD1
23	Vcc	55	VccOK	87	Vcc	119	Int5*
24	Vss	56	Vss	88	SysAD22	120	SysAD2
25	SysCCmd7	57	Vcc	89	Modein	121	Vcc
26	SysAD10	58	SysAD31	90	RdRdy*	122	Vss
27	SysCmd8	59	Vss	91	SysAD21	123	SysCmd0
28	Vcc	60	Vcc	92	Vss	124	SysAd3
29	Vss	61	SysAD30	93	Vcc	125	Vcc
30	SysAD11	62	SysAD29	94	ExtRqst*	126	Vss
31	SysCmdP	63	Reset*	95	SysAD20	127	SysCmd1
32	SysAD12	64	Vss	96	ValidOut*	128	SysAD4

Table 7 RC64474 128-pin QFP Package Pin-out (Page 2 of 2)

Socket Compatibility—RC64474 & RC4640

To ensure socket compatibility between the RC4640 and the RC64474 devices, several pin changes are required, as shown below.

Pin	RC4640	RC64574/ RC64474	Compatible to RV4640?	Comments
1	N.C	JTAG32*	Yes.	Pin has an internal pull-down, to enable 32-bit scan. Can also be left a N.C.
48	V _{ss}	TDO	Yes.	Can be driven with V _{ss} , if JTAG is not needed. Is tristated when TRst* is low.
49	V _{ss}	TMS	Yes.	Can be driven with V _{ss} if JTAG is not needed.
50	V _{ss}	TCK	Yes.	Can be driven with V _{ss} if JTAG is not needed.
51	V _{ss}	TRst*	Yes.	Can be driven with V _{ss} if JTAG is not needed.
52	V _{ss}	TDI	Yes.	Can be driven with V _{ss} if JTAG is not needed.
71	N.C.	JR_V _{cc}	Yes.	Can be left N.C. in RC64474, if JTAG is not need. If JTAG is needed, it must be driven to V _{cc} .

Table 8 RC64574 Socket Compatibility to RC64474 and R4640

Socket Compatibility—RC64475 & RC4650

Pin	RV4650 32-bit	RC64575 32-bit RC64475 32-bit	RV4650 64-bit	RC64575 64-bit RC64475 64-bit	Compatible to RV4650?	Comments
53	N.C.	JTAG32*	No Connect	JTAG32*	Yes	In 32-bit, this pin can be left unconnected because of internal pull-down. In 64-bit, this assumes that JTAG will not be used. If using JTAG, this pin must be at V_{CC} .
150	N.C.	JR_ V_{CC}	No Connect	JR_ V_{CC}	Yes	In RC64475, can be left a N.C. if JTAG is not need. If JTAG is needed, it must be driven to V_{CC} .
180	N.C.	TDI	No Connect	TDO	Yes	If JTAG is not needed, can be left a N.C.
181	N.C.	TRsT*	No Connect	TRsT*	Yes	If JTAG is not needed, can be left a N.C.
182	N.C.	TCK	No Connect	TCK	Yes	If JTAG is not needed, can be left a N.C.
183	N.C.	TMS	No Connect	TMS	Yes	If JTAG is not needed, can be left a N.C.
184	N.C.	TDO	No Connect	TDIO	Yes	If JTAG is not needed, can be left a N.C.

Table 9 RC64575 Socket Compatibility to RC64475 & RC4650

Absolute Maximum Ratings

Note: Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Symbol	Rating	RC64474/475 3.3V±5%	RC64474/475 3.3V±5%	Unit
		Commercial	Industrial	
V_{TERM}	Terminal Voltage with respect to GND	−0.5 ¹ to +4.6	−0.5 ¹ to +4.6	V
T_C	Operating Temperature(case)	0 to +85	−40 to +85	°C
T_{BIAS}	Case Temperature Under Bias	−55 to +125	−55 to +125	°C
T_{STG}	Storage Temperature	−55 to +125	−55 to +125	°C
I_{IN}	DC Input Current	20 ²	20 ²	mA
I_{OUT}	DC Output Current	50 ³	50 ³	mA

¹ V_{IN} minimum = −2.0V for pulse width less than 15ns. V_{IN} should not exceed V_{CC} +0.5 Volts.

² When $V_{IN} < 0V$ or $V_{IN} > V_{CC}$

³ Not more than one output should be shorted at a time. Duration of the short should not exceed 30 seconds.

Recommended Operation Temperature and Supply Voltage

Grade	Temperature	Gnd	RC64474/475
			V_{CC}
Commercial	0°C to +85°C (Case)	0V	3.3V±5%
Industrial	−40 + 85°C (Case)	0V	3.3V±5%

DC Electrical Characteristics

Commercial Temperature Range—RC64474/64475

($V_{CC} = 3.3 \pm 5\%$, $T_{CASE} = 0^{\circ}\text{C}$ to $+85^{\circ}\text{C}$)

Parameter	RC64474/RC64475 180MHz		RC64474/RC64475 200MHz		RC64474/RC64475 250MHz		Conditions
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	
V_{OL}	—	0.1V	—	0.1V	—	0.1V	$ I_{OUT} = 20\mu\text{A}$
V_{OH}	$V_{CC} - 0.1\text{V}$	—	$V_{CC} - 0.1\text{V}$	—	$V_{CC} - 0.1\text{V}$	—	
V_{OL}	—	0.4V	—	0.4V	—	0.4V	$ I_{OUT} = 4\text{mA}$
V_{OH}	2.4V	—	2.4V	—	2.4V	—	
V_{IL}	-0.5V	$0.2V_{CC}$	-0.5V	$0.2V_{CC}$	-0.5V	$0.2V_{CC}$	—
V_{IH}	2.0V	$V_{CC} + 0.5\text{V}$	$0.7V_{CC}$	$V_{CC} + 0.5\text{V}$	2.0V	$V_{CC} + 0.5\text{V}$	—
I_{IN}	—	$\pm 10\mu\text{A}$	—	$\pm 10\mu\text{A}$	—	$\pm 10\mu\text{A}$	$0 \leq V_{IN} \leq V_{CC}$
C_{IN}	—	10pF	—	10pF	—	10pF	—
C_{OUT}	—	10pF	—	10pF	—	10pF	—
I/O_{LEAK}	—	20 μA	—	20 μA	—	20 μA	Input/Output Leakage

Power Consumption—RC64474

Parameter		RC64474 180MHz		RC64474 200MHz		RC64474 250MHz		Conditions
		Typical ¹	Max	Typical ¹	Max	Typical ¹	Max	
System Condition:		180/90MHz		200/100MHz		250/125MHz		—
I_{CC}	standby	—	60 mA^2	—	60 mA^2	—	100 mA^2	$C_L = 0\text{pF}^3$
		—	110 mA^2	—	110 mA^2	—	110 mA^2	$C_L = 50\text{pF}$
	active	530 mA^2	630 mA^2	600 mA^2	700 mA^2	700 mA^2	850 mA^2	$C_L = 0\text{pF}$ No SysAd activity ³
		630 mA^2	750 mA^2	700 mA^2	850 mA^2	850 mA^2	1000 mA^2	$C_L = 50\text{pF}$ R4x00 compatible writes, $T_C = 25^{\circ}\text{C}$
		750 mA^2	1050 mA^4	850 mA^2	1200 mA^4	1000 mA^2	1400 mA^2	$C_L = 50\text{pF}$ Pipelined writes or write re-issue, $T_C = 25^{\circ}\text{C}^3$

¹. Typical integer instruction mix and cache miss rates

². These are not tested. They are the results of engineering analysis and are provided for reference only

³. Guaranteed by design.

⁴. These are the specifications IDT tests to insure compliance.

Power Consumption—RC64475

Parameter		RC64475 180MHz		RC64475 200MHz		RC64475 250MHz		Conditions
		Typical ¹	Max	Typical ¹	Max	Typical ¹	Max	
System Condition:		180/90MHz		200/100MHz		250/125MHz		—
I _{CC}	standby	—	60 mA ²	—	60 mA ²	—	100 mA ²	C _L = 0pF ³
		—	110 mA ²	—	110 mA ²	—	110 mA ²	C _L = 50pF
	active, 64-bit bus option ⁴	720 mA ²	850 mA ²	850 mA ²	1000 mA ²	935 mA ²	1100 mA ²	C _L = 0pF No SysAd activity ³
		850 mA ²	1000 mA ²	1000 mA ²	1200 mA ²	1100mA ²	1360mA ²	C _L = 50pF R4x00 compatible writes, T _C = 25°C
		1000 mA ²	1200 mA ⁵	1200 mA ²	1400 mA ⁵	1360 mA ²	1600 mA ²	C _L = 50pF Pipelined writes or write re-issue, T _C = 25°C ³

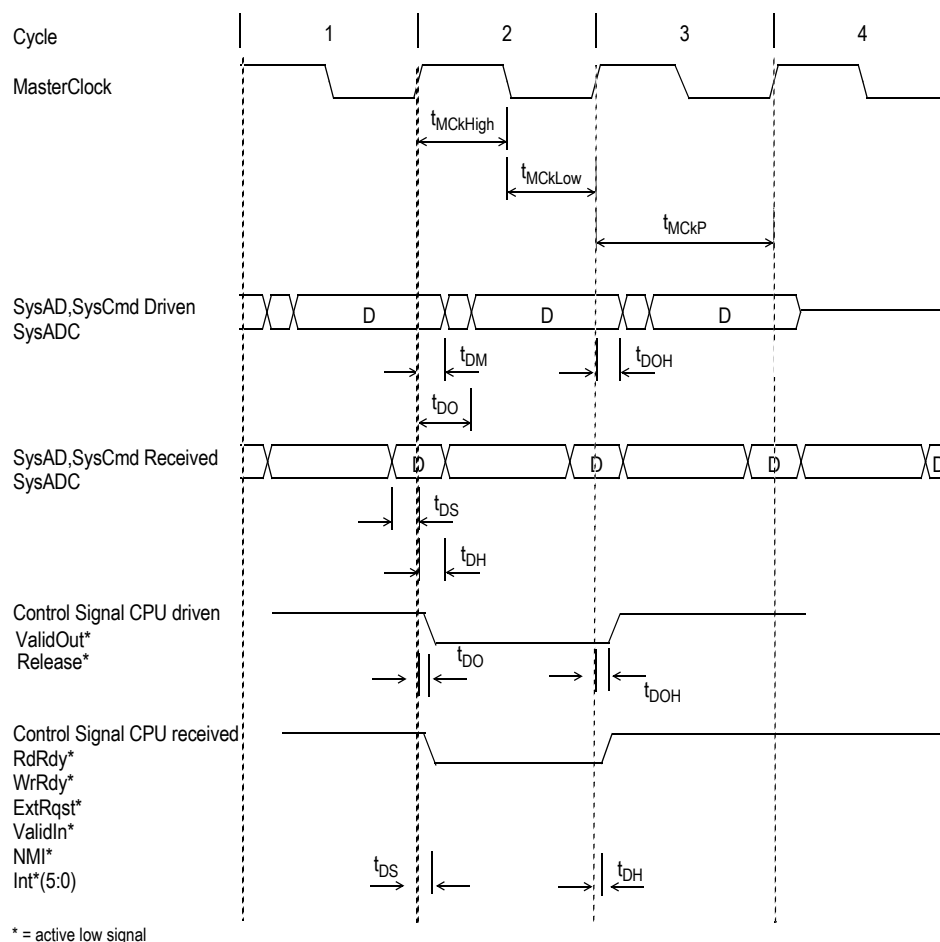
¹ Typical integer instruction mix and cache miss rates² These are not tested. They are the results of engineering analysis and are provided for reference only.³ Guaranteed by design.⁴ In 32-bit bus option, use RC64474 power consumption values.⁵ These are the specifications IDT tests to insure compliance.**Timing Characteristics—RC64474/RC64475**

Figure 3 System Clocks Data Setup, Output, and Hold Timing

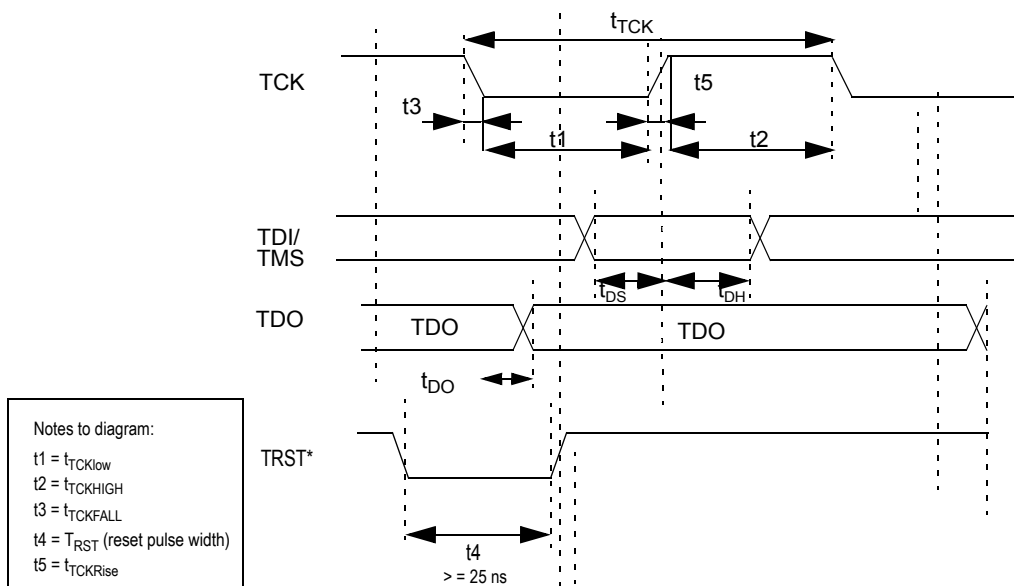


Figure 4 Standard JTAG timing

AC Electrical Characteristics

Commercial Temperature Range RC64474/RC64475

($V_{CC} = 3.3V \pm 5\%$; $T_{CASE} = 0^\circ\text{C}$ to $+85^\circ\text{C}$)

Clock Parameters

Parameter ¹	Symbol	Test Conditions	RC64474/ RC64475 180MHz		RC64474/ RC64475 200MHz		RC64474/ RC64475 250MHz		Units
			Min	Max	Min	Max	Min	Max	
Pipeline clock Frequency	PClk		80	180	80	200	80	250	MHz
MasterClock HIGH	t_{MCHIGH}	Transition $\leq 3\text{ns}$	3	—	3	—	2.5	—	ns
MasterClock LOW	t_{MCLow}	Transition $\leq 3\text{ns}$	3	—	3	—	2.5	—	ns
MasterClock Frequency	—	—	10	90	10	100	10	125	MHz
MasterClock Period	t_{MCP}	—	11.1	100	10	100	8	100	ns
Clock Jitter for MasterClock	$t_{JitterIn}$	—	—	± 250	—	± 250	—	± 250	ps
MasterClock Rise Time	t_{MCRise}	—	—	2.5	—	2	—	2	ns
MasterClock Fall Time	t_{MCFall}	—	—	2.5	—	2	—	2	ns
ModeClock Period	$t_{ModeCKP}$	—	—	256* t_{MCP}	—	256* t_{MCP}	—	256* t_{MCP}	ns
JTAG Clock Input	t_{TCK}	—	100	—	100	—	100	—	ns
JTAG Clock HIGH	$t_{TCKHIGH}$	—	40	—	40	—	40	—	ns
JTAG Clock Low	t_{TCKLOW}	—	40	—	40	—	40	—	ns
JTAG Clock Rise Time	$t_{TCKRise}$	—	—	5	—	5	—	5	ns
JTAG Clock Fall Time	$t_{TCKFall}$	—	—	5	—	5	—	5	ns

¹ Timings are measured from 1.5V of the clock to 1.5V of the signal.

Capacitive Load Deration—RC64474/RC64475

Parameter	Symbol	Test Conditions	180MHz		200MHz†		250MHz†		Units
			Min	Max	Min	Max	Min	Max	
Load Derate	C _{LD}	—	—	2	—	2	—	2	ns/25pF

System Interface Parameters

Note: Operation of the RC64474/RC64475 is only guaranteed with the Phase Lock Loop enabled.

Parameter ¹	Symbol	Test Conditions	RC64474/ RC64475 180MHz		RC64474/ RC64475 200MHz		RC64474/ RC64475 250MHz		Units
			Min	Max	Min	Max	Min	Max	
Data Output ²	t _{DM} = Min t _{DO} = Max	mode _{14..13} = 10	0 ³	6	0 ³	5	0 ³	4.7	ns
		mode _{14..13} = 11	0 ³	6	0 ³	5	0 ³	4.7	ns
		mode _{14..13} = 00	—	9	—	9	—	7	ns
		mode _{14..13} = 01	—	9	—	9	—	7	ns
Data Output Hold	t _{DOH} ⁴	mode _{14..13} = 10	0 ³	—	0 ³	—	0 ³	—	ns
		mode _{14..13} = 11	0 ³	—	0 ³	—	0 ³	—	ns
		mode _{14..13} = 00	0 ³	—	0 ³	—	0 ³	—	ns
		mode _{14..13} = 01	0 ³	—	0 ³	—	0 ³	—	ns
Input Data Setup	t _{DS}	t _{rise} = 5ns	2	—	2	—	2	—	ns
Input Data Hold	t _{DH}	t _{fall} = 5ns	1.0	—	1.0	—	1.0	—	ns

¹. Timings are measured from 1.5V of the clock to 1.5V of the signal.

². Capacitive load for all output timings is 50pF.

³. Guaranteed by design.

⁴. 50pf loading on external output signals, fastest settings. Also applies to JTAG signals (TRST*, TDO, TDI, TMS)

Boot-Time Interface Parameters

Parameter	Symbol	RC64474/ RC64475 180 MHz		RC64474/ RC64475 200 MHz		RC64474/ RC64475 250MHz		Units
		Min	Max	Min	Max	Min	Max	
Mode Data Setup	t _{DS}	3	—	3	—	3	—	Master Clock Cycle
Mode Data Hold	t _{DH}	0	—	0	—	0	—	Master Clock Cycle

Mode Configuration Interface Reset Sequence

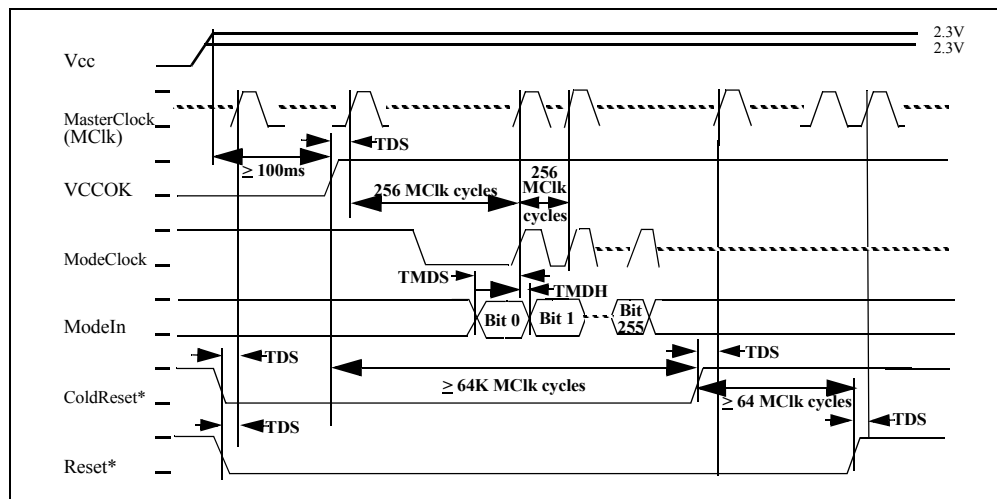


Figure 5 Power-on Reset

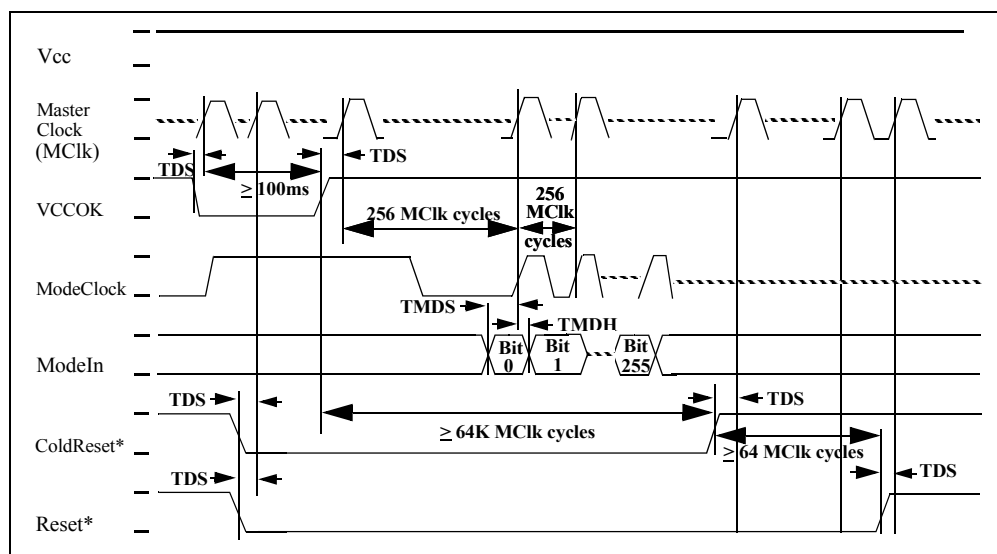


Figure 6 Cold Reset

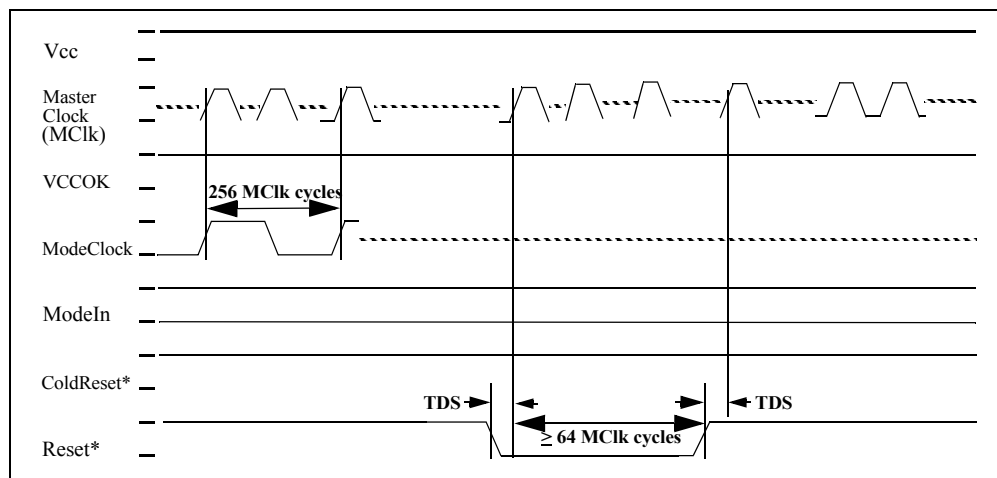
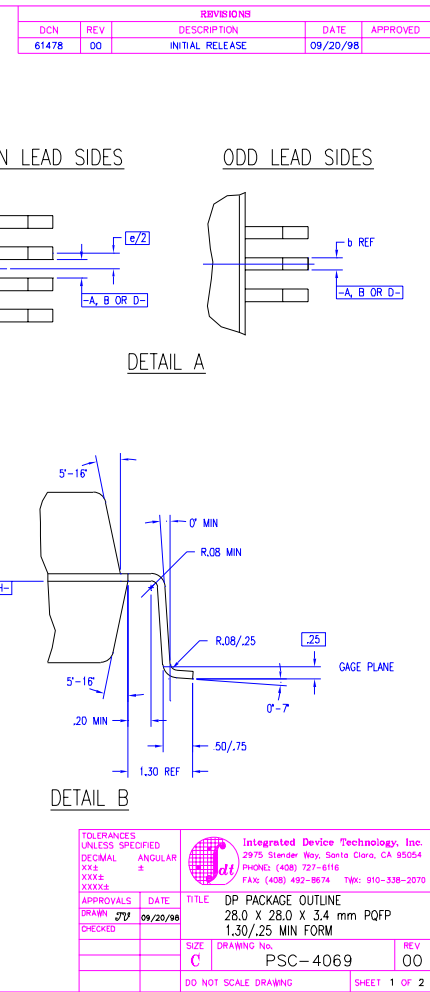


Figure 7 Warm Reset

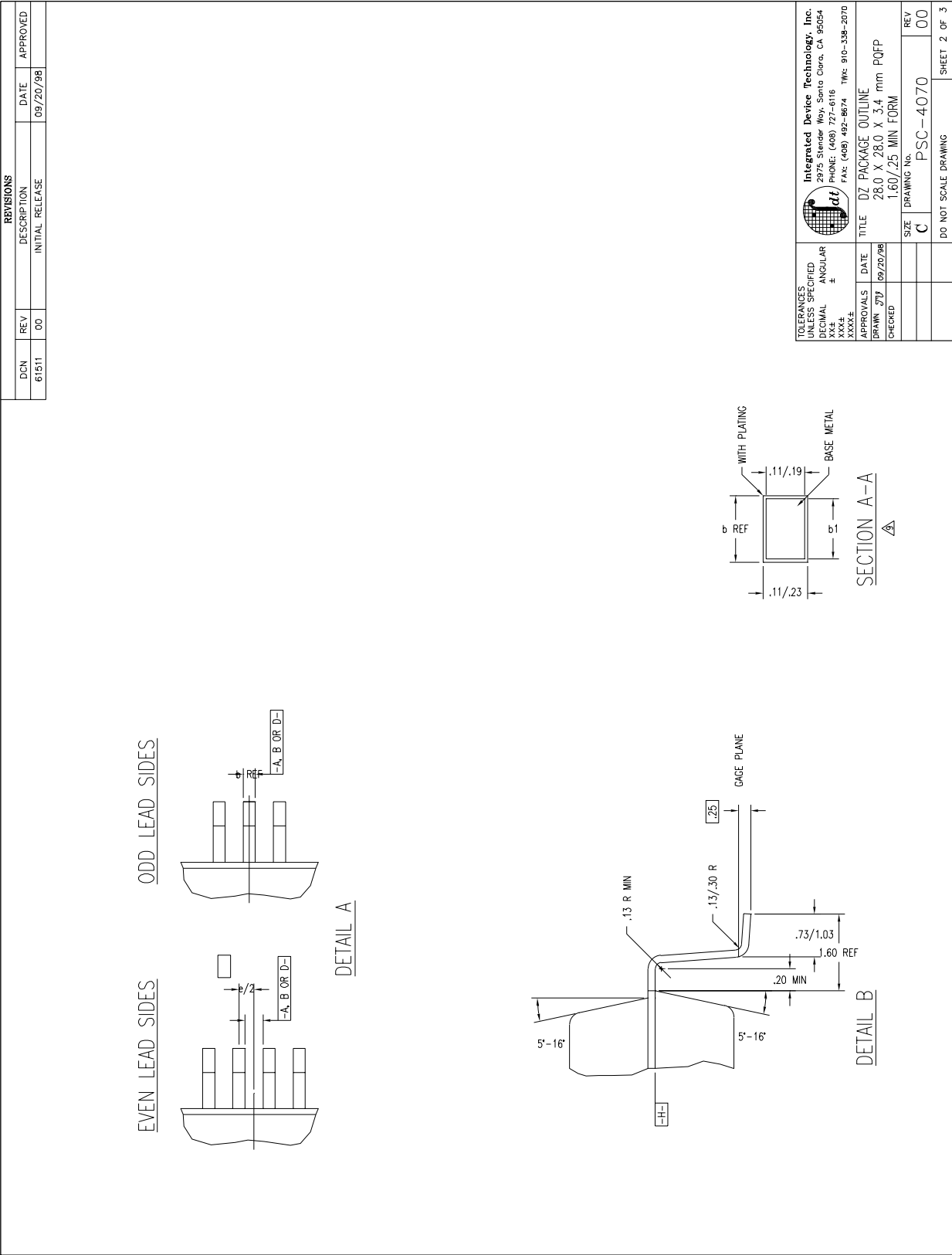
RC64475 Physical Specifications

The RC64475 is available in a 208-pin power quad (PQUAD) package.

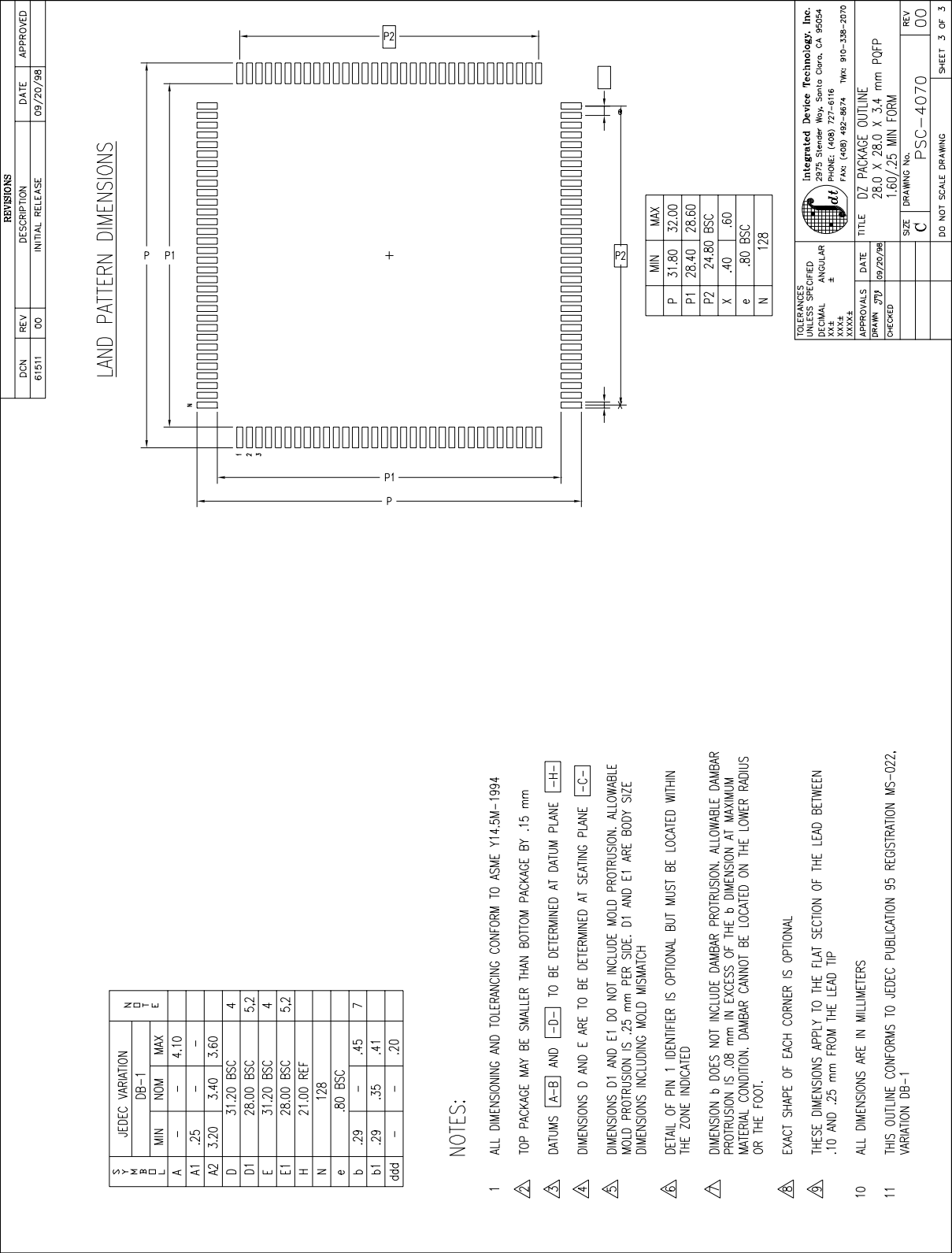




RC64474 128-pin Package (page 2 of 3)



RC64474 128-pin Package (Page 3 of 3)



Ordering Information

79RCXX	YY	XXXX	999	A	A	
Product Type	Operating Voltage	Device Type	Speed	Package	Temp range/ Process	
					Blank	Commercial Temperature (0°C to +85°C Case)
					I	Industrial Temperature (-40°C to +85°C Case)
					DZ	128-pin QFP
					DP	208-pin QFP
					180	180 MHz PCIk
					200	200 MHz PCIk
					250	250 MHz PCIk
					474	Embedded Processor
					475	
					V	3.3V +/-5%
					79RC64	64-bit Embedded Microprocessor

Valid Combinations

79RC64V474 - 180, 200, 250 DZ	128-pin QFP package, Commercial Temperature
79RC64V475 - 180, 200, 250 DP	208-pin QFP package, Commercial Temperature
79RC64V474 - 180, 200, 250 DZI	128-pin QFP package, Industrial Temperature
79RC64V475 - 180, 200, 250 DPI	208-pin QFP package, Industrial Temperature



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