

IDT Retools Midrange MIPS Devices

RC64474, '475 Revamp Midrange MIPS Lineup; Compete With NEC, QED

by Jim Turley

Lifting the veil on another stage of its MIPS makeover, IDT has revealed two new processors that go beyond simple cosmetic changes to the company's line of embedded processors. The new chips make up for time lost to MIPS competitors over the past two years.

IDT's new RC64474 and '475 displace the company's current midrange chips, offering more performance, better floating-point precision, and lower prices. A good set of features, but one that will face tough competition from the likes of NEC and QED, both of which have made a strong showing lately with their new MIPS processors.

Core Features Inherited From R4700

The 64474 and '475 are virtually identical; the only difference is the 64-bit external bus on the '475 versus the 32-bit bus on the '474. IDT has used this technique before with its R4640 and '50 chips; QED's RM5230 and '60 are similarly related.

Despite the new name, the 6447x processors are internally very similar to IDT's existing R4700 processor (see MPR 11/14/94, p. 18), a single-issue MIPS-III design intended for Silicon Graphics workstations. As the R4700 outlived its usefulness as a workstation processor, it descended into the embedded realms, taking up a position as IDT's top-of-the-line CPU with a double-precision FPU and a fast and wide bus interface.

Apart from its floating-point performance, most of the R4700's features were little valued by embedded designers,

who would generally prefer a simpler bus interface, lower power consumption, and a smaller, cheaper package.

Enter the 64474 and '475. Both chips are software-compatible with the R4700 but pin-compatible with the R4640 and R4650, respectively. That is, they have the same single-issue MIPS-III core as the R4700 but adopt the external bus interface—including the pinout—of the R4640 and '50 chips. Thus, the new '474 and '475 are hardware upgrades for existing R4640 or '50 sockets, or cost savers for existing R4700 designs.

External Interface Mirrors R4640

The 64474 and '475 supplant the R4640 and '50 in IDT's midrange. Rather than discontinue the two older parts, IDT has dropped their prices, making the newer chips about \$30 more expensive than the older components, or about twice their price. For the extra cash, the '474 and '475 offer twice the cache, double-precision floating-point, higher clock rates, JTAG, and support for Windows CE, as Table 1 shows. The data cache can be set for either write-back or write-through updates on a page-by-page basis. Either cache's contents can also be locked, one half at a time.

The bus interface stays the same, of course, between the old pair and the new pair, but the '474 and '475 add some new options. Although the new chips don't have a DRAM controller, they can "stutter" write cycles by a programmable amount to coincide with SDRAM timing requirements. The '475 has an option to "fold over" its bus and operate in 32-bit mode.

Both chips are made on IDT's 0.25-micron three-layer-metal CMOS process in Hillsboro (Oregon). Even at 0.25 microns, the 3.3-V chips handle 5-V I/O signals without resorting to a split power supply. IDT accomplished this feat by adding a 5-V reference pin for the pad ring. The chips draw a negligible amount of current from the reference pin, and it makes 5-V I/O much easier to implement. This is about as far as 5-V I/O can go; future revisions (or process generations) will likely forego 5-V signaling altogether. The 47-mm² chips have 2.5 million transistors, as Figure 1 shows.

	RC64474 IDT	RC64475 IDT	R4640 IDT	R4650 IDT	RM5231 QED	RM5261 QED	VR4310 NEC	VR5464 NEC
Clock Rate	250 MHz	250 MHz	200 MHz	200 MHz	250 MHz	250 MHz	167 MHz	250 MHz
I-Cache	16K	16K	8K	8K	32K	32K	16K	32K
D-Cache	16K	16K	8K	8K	32K	32K	8K	32K
FPU	SP, DP	SP, DP	SP	SP	SP, DP	SP, DP	SP, DP	SP, DP
WinCE	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Bus Width	32 bits	64 bits	32 bits	64 bits	32 bits	64 bits	32 bits	64 bits
MIPS	330 MIPS	330 MIPS	260 MIPS	260 MIPS	325 MIPS	325 MIPS	207 MIPS*	519 MIPS
Voltage	3.3 V	3.3 V	3.3 V	3.3 V	2.5/3.3 V	2.5/3.3 V	3.3 V	2.5/3.3 V
Power (typ)	3 W	4 W	2.5 W	3.0 W	3.3 W*	3.5 W*	1.8 W	4.4 W
MIPS/Watt	110	82	104	87	98	93	115	118
MIPS/Price	5.59	4.85	8.96	6.84	8.33	4.85	8.28	5.46
Transistors	2,500,000	2,500,000	1,050,000	1,050,000	n/a	n/a	1,700,000	5,800,000
IC Process	0.3μ 3M	0.3μ 3M	0.35μ 3M	0.35μ 3M	0.25μ 3M	0.25μ 3M	0.28μ 3M	0.25μ 3M
Die Size	47 mm ²	47 mm ²	56 mm ²	56 mm ²	45 mm ²	45 mm ²	29 mm ²	47 mm ²
Availability	4Q98	4Q98	Now	Now	4Q98	4Q98	Now	Now
Price (10K)	\$59	\$68	\$29	\$38	\$39	\$67	\$25	\$95

Table 1. IDT's new RC64474 and '475 compare favorably with NEC's VR4300 family and undercut QED's RM5271 on price. (Source: vendors, except *MDR estimates)

IDT Looks Good in Price/Performance

IDT's two new chips ride into town just as the local population is rising. New MIPS chips from fellow licensees QED and NEC appeared this year to stake their claim on the best price/performance territory. QED just freshened its line with the RM52x1 triplets (see MPR 8/3/98, p. 11). The low-end RM5231 undercuts the price of IDT's '474 by a good \$20 (33%), even though it has twice the cache. Paying IDT a \$20 premium for R4640 socket compatibility will be a poor investment for most embedded designers.

The '475 is more evenly matched with QED's RM5261. At 250 MHz, the two sell for the same price (within \$1), with similar FPUs, bus interfaces, power budgets, production schedules, and performance ratings, but once again QED offers twice the cache capacity.

For big, high-bandwidth applications, QED goes beyond the '475 with its RM5271. The chip is \$26 more expensive than the '475, but it includes an on-chip interface to L2 cache and pinout compatibility with the RM7000 (see MPR 8/3/98, p. 12). This time it is QED that offers the socket compatibility at a premium price.

For cost-conscious designers, there's the ever-popular VR4300 from NEC (also sold under the VR4305 and VR4310 names). The VR4310 is cheap (\$25 at 167 MHz) but pays for it with fairly lackadaisical floating-point performance. IDT charges just \$27 for its 180-MHz 64474, so a first-rate double-precision FPU need not be a casualty of a budget design.

In a somewhat higher class of device stands NEC's VR5464 (see MPR 3/9/98, p. 1). This chip sells for nearly \$100, but it offers a lot for the extra \$27 over the 64475. Its integer unit is two-way superscalar, and its caches are twice as big, so performance should benefit, even though they both run at the same 250-MHz clock rate (NEC claims a Dhrystone rating that's 50% higher). Just as important, the VR5464 has Sandcraft's media-processing extensions, which are a subset of the MDMX specification. With them, the VR5464 excels in media applications.

The VR5432 has all the internal features of its big brother except its 64-bit bus. At 167 MHz, the narrow-bus part sells for just \$45—still a big premium over IDT's chips but worth considering if the media extensions are valuable. Finally, there's the PowerPC EC603e, which has no FPU but is still a bargain at just \$25 and up.

New Chips Retool IDT's Place

In summary, the new 64474 and '475 are good parts in a field suddenly awash in good parts. That's good news for buyers. Armed with basically the same microarchitecture and process technology as its competitors, IDT has run straight into QED and NEC. Each has its own unique charms: the IDT chips are pin compatible with two of their predecessors, a philosophy that IDT has maintained admirably for many years. Apart from that,

Price & Availability

IDT's RC64474 and '475 are sampling now; production is scheduled for the end of 1998. Both chips are offered at 180 MHz, 200 MHz, and 250 MHz. In 10,000-unit quantities, the '474 sells for \$27, \$38, and \$59; the '475 is priced at \$38, \$50, and \$68.

For more information, contact IDT (Santa Clara) at 408.492.8632 or visit www.idt.com/products/risc/Welcome.html.

their strongest points are probably their floating-point performance and single supply voltage.

NEC is well-versed in making and selling embedded processors for this market segment, garnering a huge number of design wins all across the embedded market. IDT chips are not unpopular either, appearing in WebTV, arcade games, and satellite receivers. The pin compatibility of the two new chips makes them a shoo-in for upgrades of all three classes of systems.

The debut of the 64474 and '475 probably marks the end of this existence for the R4700. The older chip has been reincarnated in a smaller package with a simpler bus interface and a lower price. All the same operating systems (Nucleus, VxWorks, Windows CE) that run on the R4700 also run on the 6447x chips. IDT now has the undying R30xx chips (R3041, R3051, et al) at the low end, the 32xxx and 6447x chips in the middle, and the R5000 at the top. That midrange is where IDT has focused most of its development effort, and where the company is likely to be the most successful. ☐

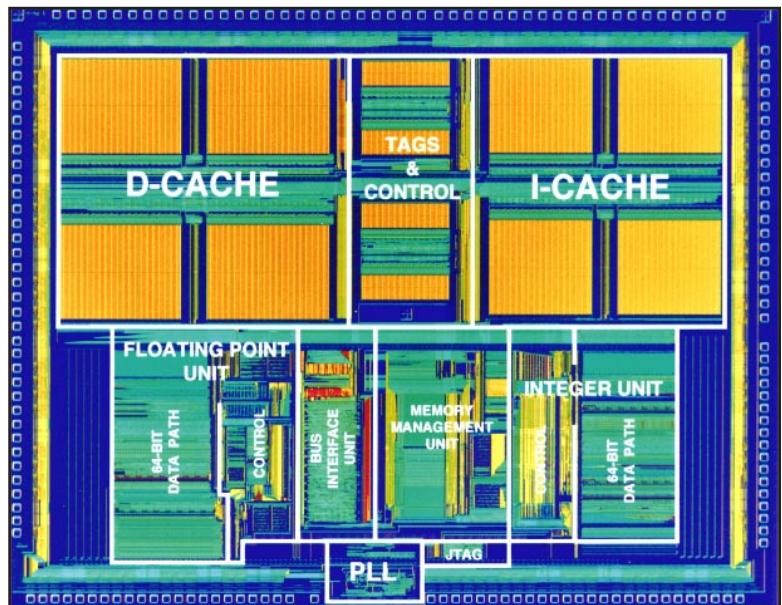


Figure 1. The IDT RC64465 measures 47 mm² in 0.25-micron, three-layer-metal CMOS.