# Freescale Semiconductor, Inc.

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Overview

During these tight times—when competition is more intense and sales dollars are fewer—our customers are focused on protecting software investments, lowering development costs and delivering higher value solutions. This at-a-glance guide to PowerPC® processors is designed to give you the information you need to make the right choices about processors. This guide includes key features, roadmaps, benchmarks, software/hardware tools support and URLs to help you find more information on our Web sites.

Motorola's G4 processors are ideal solutions for the networking infrastructure, telecom and embedded markets. In the first quarter of 2002, Motorola's G4 MPC7455 was recognized by In-Stat/MDR as the High-Performance Embedded Processor of 2001. This prestigious award was the result of Motorola's strong G4 family roadmap and consistent performance delivery over the past three years: 7400-400 MHz (Aug. 1999), 7410-533 MHz (March 2000), 7451-667 MHz (Jan. 2001), the 7455-1 GHz (Jan. 2002) and the 7457-1.3 GHz (Feb. 2003).

In spite of all of this acclaim, Motorola is not relaxing our commitment to this family; in fact, we will continue to deliver new G4 solutions—the MPC7457, for example, which delivers 1 GHz at less than 10 watts will be offered next year.

ANALYSTS' CHOICE
MICROPROCESSOR REPORT
Best High-Performance Embedded Processor Chip
MPC7455
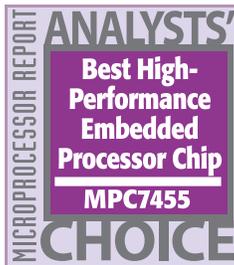
MOTOROLA'S HIGH-PERFORMANCE EMBEDDED MICROPROCESSOR PRODUCTS
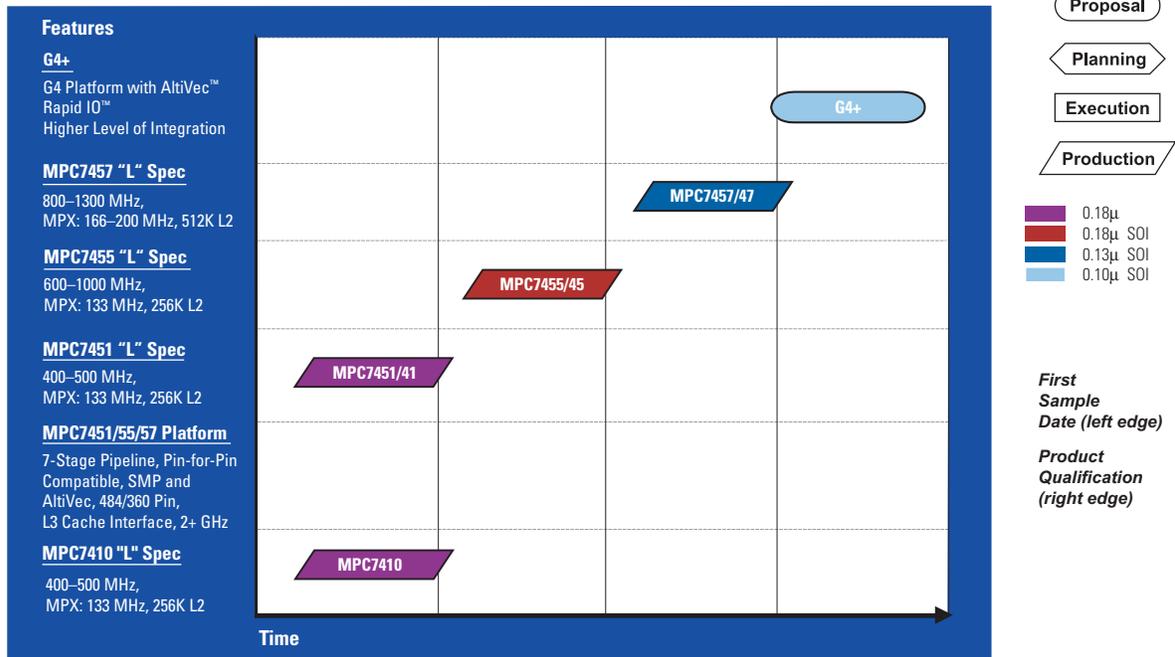
Features

G4+
G4 Platform with AltiVec™
Rapid IO™
Higher Level of Integration

MPC7457 "L" Spec
800–1300 MHz,
MPX: 166–200 MHz, 512K L2

MPC7455 "L" Spec
600–1000 MHz,
MPX: 133 MHz, 256K L2

MPC7451 "L" Spec
400–500 MHz,
MPX: 133 MHz, 256K L2

MPC7451/55/57 Platform
7-Stage Pipeline, Pin-for-Pin Compatible, SMP and AltiVec, 484/360 Pin, L3 Cache Interface, 2+ GHz

MPC7410 "L" Spec
400–500 MHz,
MPX: 133 MHz, 256K L2

Time

- Proposal
- Planning
- Execution
- Production

- 0.18μ
- 0.18μ SOI
- 0.13μ SOI
- 0.10μ SOI

First Sample Date (left edge)

Product Qualification (right edge)

Chart labels: G4+, MPC7457/47, MPC7455/45, MPC7451/41, MPC7410

For More Information On This Product,
Go to: www.freescale.com

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Features and Benefits

The following information focuses on the benefits of Motorola's PowerPC G4 architecture, such as its support for system upgrades, its performance enhancement beyond 60x bus mode, and how it compares, feature by feature, to IBM's 750CXe and 750FX products.

SUPPORT FOR SYSTEM UPGRADE
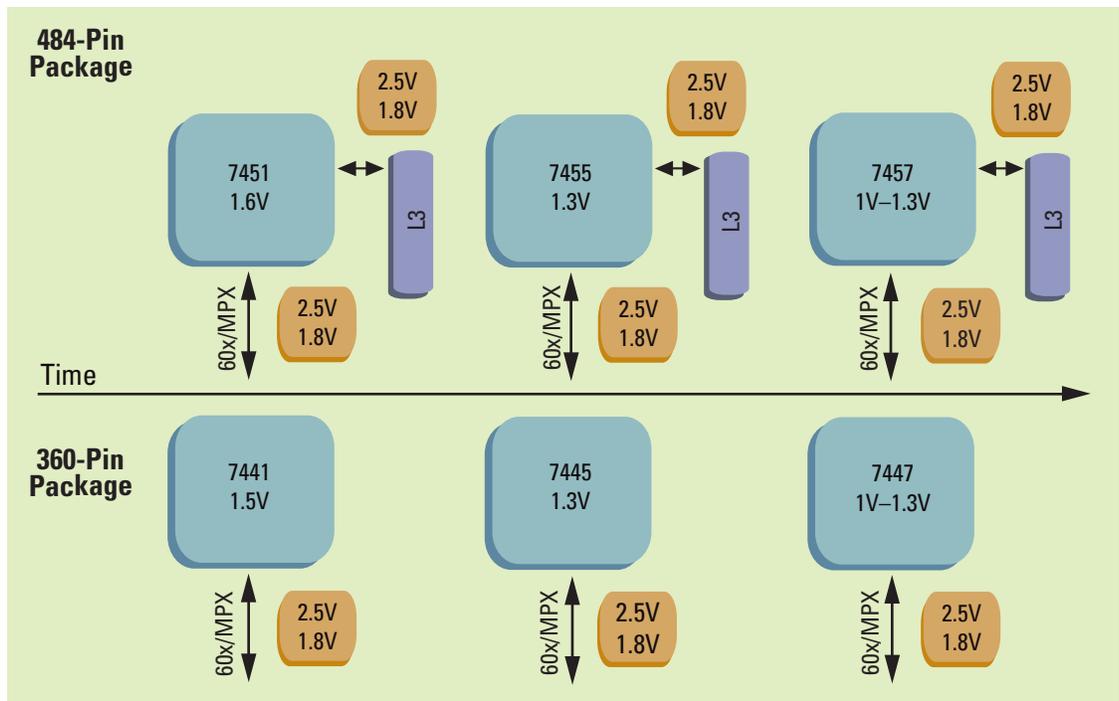
BENEFITS

1. Pin-Compatible
2. Software-Compatible
3. Power Savings
4. Performance Improvement

MOTOROLA: THE LEADER IN COMMUNICATIONS PROCESSORS

- Proven platform in networking and embedded applications with more than 100 million processors shipped
  - >300 customers; >4000 design wins
  - 70% market share (Source: Cahners In-Stat)
- Long-term support for our Smart Networks Platform solutions
  - 10 years of support for 6xx/7xx product families
  - 10+ years of support for communications processors

- Best-in-class tools support
  - With Smart Networks partners, largest variety of development tools
  - Reference design support with Sandpoint, MVP and Excimer systems
- Dedicated resources that have developed and improved the architecture for many years
- Pin-for-pin compatible products for three generations of process technologies providing ever improving performance and power

POWERPC G4 ARCHITECTURE: DELIVERING PERFORMANCE ENHANCEMENT BEYOND 60X BUS MODE

- Address and data bus streaming for reduced cycle latency
  - 60x bus requires a dead cycle between back-to-back address tenures or data tenures.
  - MPX bus supports both "address streaming" and "data streaming": A master may drive consecutive address tenures or consecutive burst data tenures without a dead cycle in between.
- Data intervention for fewer memory accesses
  - Snoop Hit Scenario: Processor "A" performs a read operation; The target data is modified in Processor "B's" cache.
    - 60x bus—Write to main memory and read from main memory: "B" responds with a retry and pushes the data to memory; "A" repeats the read request and loads the data from memory.
    - MPX bus—Single fast write on the bus: "B" asserts the data ready signal and uses a data-only transaction to supply the data directly to "A."
- Out-of-order transactions
  - 60x bus: Data tenures must occur in the same order as the associated address tenures.
  - MPX bus: When a processor receives data out-of-order, the processor uses an index value (driven with the data) to associate the data on the bus with a previous address tenure.
  - Out-of-order transactions may hide the latency of a slow memory or peripheral access.

PowerPC® Processors

	MOTOROLA						
	7410	7441	7445*	7447*	7451	7455*	7457*
CPU Speed (MHz)	400–550	600–700	733–1000	733–1300	533–667	733–1000	733–1300
Bus Speed (MHz)	133	133	150/166	166/200	133	150/166	166/200
MPX Bus Support	Yes	Yes	Yes	Yes	Yes	Yes	Yes
L2 Cache (KB)		256	256	512	256	256	512
Backside Cache Support (MB)	1 or 2	N/A	N/A	N/A	1 or 2	1 or 2	1, 2 or 4
Process	0.18µ 6LM	0.18µ 6LM	0.18µ 6LM SOI	0.13µ 9LM SOI	0.18µ 6LM	0.18µ 6LM SOI	0.13µ 8LM SOII
Pipeline	4 stage	7 stage	7 stage	7 stage	7 stage	7 stage	7 stage
SPECint95 (est.)	22.8 @ 500 MHz	32.1 @ 733 MHz	32.1 @ 733 MHz	32.1 @ 733 MHz	32.1 @ 733 MHz	32.1 @ 733 MHz	32.1 @ 733 MHz
SPECfp95 (est.)	17 @ 500 MHz	23.9 @ 733 MHz	23.9 @ 733 MHz	23.9 @ 733 MHz	23.9 @ 733 MHz	23.9 @ 733 MHz	23.9 @ 733 MHz
Other Performance	1210 MIPS @ 500 MHz	1617 MIPS @ 700 MHz	1848 MIPS @ 800 MHz	1848 MIPS @ 800 MHz	1617 MIPS @ 700 MHz	2310 MIPS @ 1 GHz	2310 MIPS @ 1 GHz
Dhrystone MIPS/MHz	2.42	2.31	2.31	2.31	2.31	2.31	2.31
Address and Data Bus Streaming	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Data Intervention Support	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Out-of-Order Transaction	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AltiVec™ Support	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SMP Support	MESI	MESI	MESI	MESI	MESI	MESI	MESI
Instructions/Clock	3 (2+branch)	4 (3+branch)	4 (3+branch)	4 (3+branch)	4 (3+branch)	4 (3+branch)	4 (3+branch)
Typical Power Consumption	5.3W @ 500 MHz	11.5W @ 600 MHz	11.2W @ 800 MHz	6.5W @ 900 MHz	11.7W @ 600 MHz	11.2W @ 800 MHz	7.5W @ 1 GHz (est.)

Motorola and Third-Party Tools Support for G4 Family

Along with our Smart Networks Alliance members, Motorola provides extensive, best-in-class tools to assist customers in their system design process. The chart below displays the extensive support available for the G4 family from both third-party vendors and Motorola. Tool support includes embedded OSes, compilers, debuggers, coverification tools, emulators, chipsets and more. For more information about tools, visit www.motorola.com/semiconductors/webapp/sps/libary/tools_lib.jsp

G4 THIRD-PARTY SUPPORT

Third-Party Vendor	Embedded Operating Systems	Compilers and Code Generation Tools	Software Debuggers	Coverification Tools and Simulation Models	Emulators and Diagnostic Tools	Logic Analyzers	Reference and Evaluation Boards	Support Chips	Chipsets
Abatron					•				
Agilent Technologies					•	•			
Applied Microsystems		•			•				
Apogee Software		•							
Artis Microsystems							•		
Corelis			•		•				
Green Hills Software	•	•	•		•				
Innoveda				•					
Kadak	•		•						
Lineo	•		•						
LynuxWorks	•	•	•						
Macraigor Systems			•		•				
Marvell Technology							•	•	•
Mentor Graphics				•					
MetaWare		•	•						
Metrowerks		•	•						
MicroAPL		•							
MontaVista Software	•		•						
Motorola				•			•	•	•
Motorola Computer Group						•			
MPI Software Technology		•	•						
OSE Systems	•		•						
Pacific-Sierra Research		•							
PLX Technology							•	•	•
Precise Software Technologies	•		•						
QNX Software Systems	•	•	•						
Red Hat	•	•	•						
RedSwitch									•
Simpod				•					
Sun Microsystems	•	•	•						
Synopsys				•					
Tektronix						•			
Tundra Semiconductor								•	•
Wasabi Systems	•	•	•						
Wind River System	•	•	•		•		•		

G4 Family Parametrics

Use the following charts to find facts, features and parametric data about the members of the MPC74xx (G4) family.

CHECK APPROPRIATE

- H/W Specifications
- Part Number Specifications

	Freq	Vcore	Tj
P	Fastest	Highest	65°C
L	Faster	High	105°C
N	Fast	Low	105°C

MPC7410
- 360 BGA
- 4-stage execution pipe
- Backside bus
- 2M L2/private memory
- 133 MHz MPX/60x bus

MPC7441
- 360 BGA
- No backside bus

THE MPC7445 ADDS:
- Address parity on L2
- 150/166 MHz 60x/MPX*
- 8 I-BAT and 8 D-BAT

THE MPC7447 ADDS:
- 512 KB on-chip L2
- 166/200 MHz 60x/MPX

MPC7451
- 484 BGA
- 7-stage execution pipe
- 256K L2
- Backside bus
- 36-bit address mode
- 2M L3/private memory
- 133 MHz MPX/60x bus
- AltiVec™
- Software tablewalk
- Cache locking

THE MPC7455 ADDS:
- Address parity on L2
- 150/166 MHz 60x/MPX*
- 8 I-BAT and 8 D-BAT

THE MPC7457 ADDS:
- 512 KB on-chip L2
- Address parity on L3
- 166/200 MHz 60x/MPX bus

* Initial product offered at 133 MHz

MPC7410YXP500LE

- Process (if required)
- Package
- Frequency
- Operating Specifications
- Revision
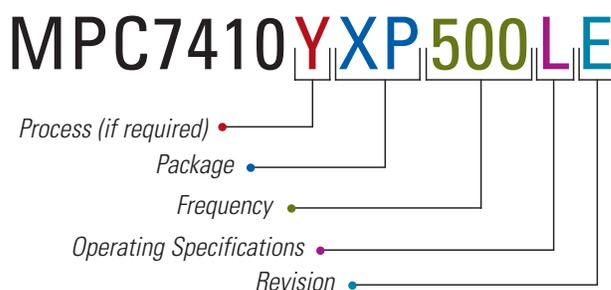
G4+ FAMILY: XC PRODUCTION, SPEED, POWER

DEVICE	DATE	OPER. SPEC	VOLTAGE			FREQ MHz	BUS MHz	POWER W	DOCUMENT
			Core	Bus	BSB				
XPC7451	Now	L	1.6	2.5/1.8	2.5/1.8/1.5	667	133	13.0	MPC7451EC/D
	Now					600	133	11.7	Rev. 0.1, 11/01
XPC7441	Now	N	1.5	2.5/1.8	N/A	700	133	13.4	MPC7441EC/D
	Now					600	133	11.5	Rev. 0, 10/01
XPC7445/55	Now	L	1.6	2.5/1.8	2.5/1.8/1.5	933	150/166*	19.9	MPC7455EC/D
	Now					867	150/166*	18.5	Feb 02
						800	150/166*	9.4	
XPC7445/55	Now	N	1.3	2.5/1.8	2.5/1.8/1.5	733	150/166*	9.7	
XPC7445/55	Now		1.3	2.5/1.8	2.5/1.8/1.5	600	150/166*	8.0	
XC7445/55 (Node 5) (Rev 3.3)	Oct (S) Dec (P)	L	1.3	2.5/1.8	2.5/1.8/1.5	1067	150/166*	15.0	Review hardware specifications for final numbers.
						933	150/166*	13.0	
						867	150/166*	12.2	
						800	150/166*	11.2	
						733	150/166*	10.3	
						600	150/166*	8.4	
XPC7447/57	2Q–03	L	1.3	2.5/1.8	2.5/1.8/1.5	1300	166/200	16.6	TBD
	2Q–03					1200	166/200	15.4	
XPC7447/57	2Q–03	N	1.0	2.5/1.8	2.5/1.8/1.5	1067	166/200	7.5	TBD
	2Q–03					933	166/200	6.5	
	2Q–03					867	166/200	6.1	

* Initial product offered at 133 MHz

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Benchmarking Data

EEMBC® RESULTS: NETWORKING—PRODUCTION SILICON

Bar chart — EEMBC Netmark™ scores:
- MPC7455-1G_diab44: ~31
- MPC7400-500_ghs30: ~14.5
- MPC755-400_diab44: ~11.2
- MPC8245-400_diab44: ~6.8
- MPC603e-300_ghs30: ~4.6
- AMD K6-IIIE 550_VC++: ~11.2
- NEC VR5500-400_64_gcc31: ~6.4
- IDT79RC64757-250_algo: ~3.8

X-axis: EEMBC Netmark™ (0, 5, 10, 15, 20, 25, 30, 35)

*MPC7455 at 1 GHz/133 is 3.4x published
NEC VR5500 score at 400/100 MHz.*

www.eembc.org

www.ebenchmarks.com

The EEMBC Certification Laboratories, LLC (ECL) has certified these scores according
to the rules established by the EEMBC Board of Directors and ECL. These scores are
repeatable and the disclosure information on the EEMBC Web site has all been verified.
EEMBC is a registered trademark of the Embedded Microprocessor Benchmark Consortium.

For More Information

Customer URL: www.motorola.com/powerpc
Additional Tech Questions: www.motorola.com/semiconductors/support