

Hercules™ Safety Microcontrollers



Make the world safer with the new Hercules safety MCU platform



Hercules™ MCUs help developers make the world safer

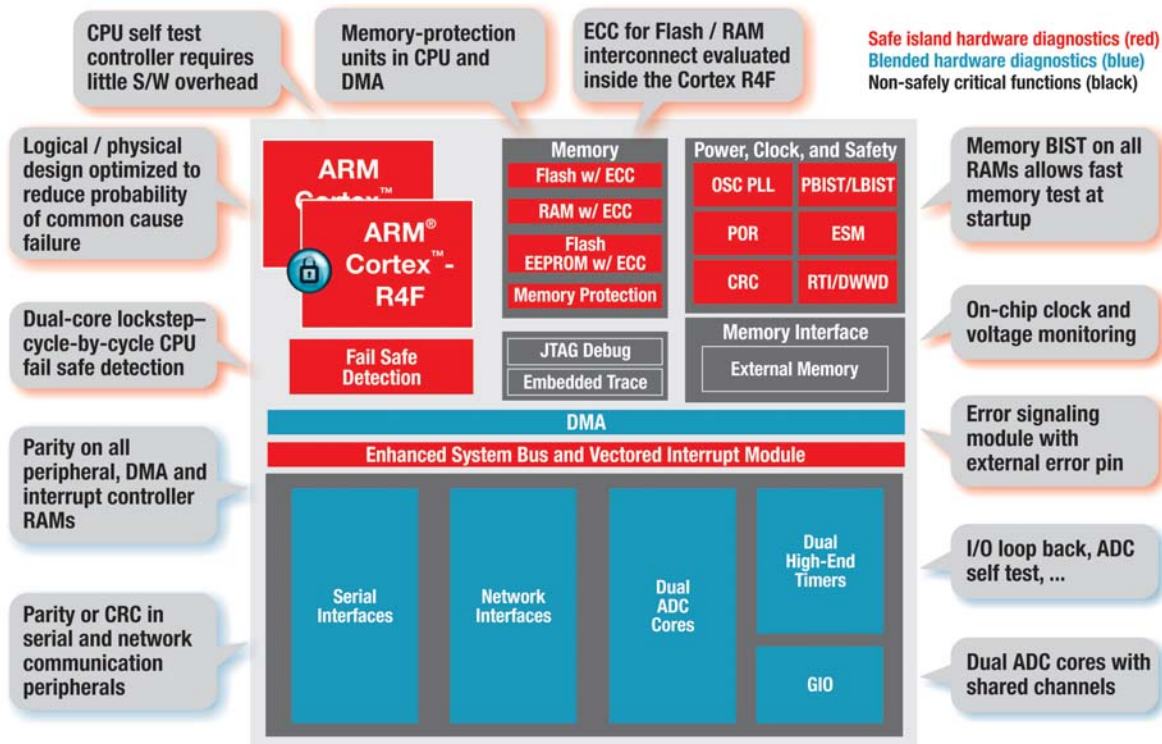
Hercules safety microcontrollers are based on TI's 20+ years of safety-critical system expertise, industry collaboration and proven hardware for the automotive market. The platform consists of three ARM® Cortex™-based microcontroller families (RM48x, TMS570 and TMS470M) that deliver scalable performance, connectivity, memory and safety features. Unlike many microcontrollers that rely heavily on software for safety capabilities, Hercules microcontrollers implement safety in hardware to maximize performance and reduce software overhead.



The Hercules RM4x family provides the highest level of performance for broad safety applications, including medical and industrial, and are developed to the IEC 61508 SIL-3 safety standard. The Hercules TMS570 family provides high performance for transportation applications and is very well suited for applications that need to meet IEC 61508 SIL-3 or ISO 26262 requirements. The Hercules TMS470M family cost efficiently meets the needs of applications that require less performance and lower safety levels.

The RM48x and TMS570 dual-CPU lockstep architectures simplify development while eliminating redundant system requirements to reduce cost. CPU hardware built-in self test (BIST) detects latent defects without complex safety software and code-size overhead. Hardware comparison of CPU outputs provides nearly instant safety response time without any additional performance impact. ECC logic is integrated in the CPU to protect both memories and busses. All RAM memories can be tested using HW BIST for high diagnostic coverage and an integrated Memory Protection Unit (MPU) helps protect against deterministic errors in application software.

RM48x	TMS570	TMS470M
High-Performance Industrial and Medical Safety MCUs <ul style="list-style-type: none"> Industrial applications Medical applications TMS qualification -40 to 105°C operation Ethernet, USB connectivity Developed to safety standards: <ul style="list-style-type: none"> IEC 61508 SIL-3 Cortex-R – over 350 DMIPS 	High-Performance Transportation and Safety MCUs <ul style="list-style-type: none"> Transportation applications Automotive Q100 qual -40 to 125°C operation FlexRay, CAN connectivity Developed to safety standards: <ul style="list-style-type: none"> IEC 61508 SIL-3 ISO 26262 ASIL-D Cortex-R – over 280 DMIPS 	Value Line Transportation and Safety MCUs <ul style="list-style-type: none"> Transportation applications Automotive Q100 qual -40 to 125°C operation LIN, CAN connectivity Supports safety for: <ul style="list-style-type: none"> IEC 61508 systems Cortex-M – up to 100 DMIPS



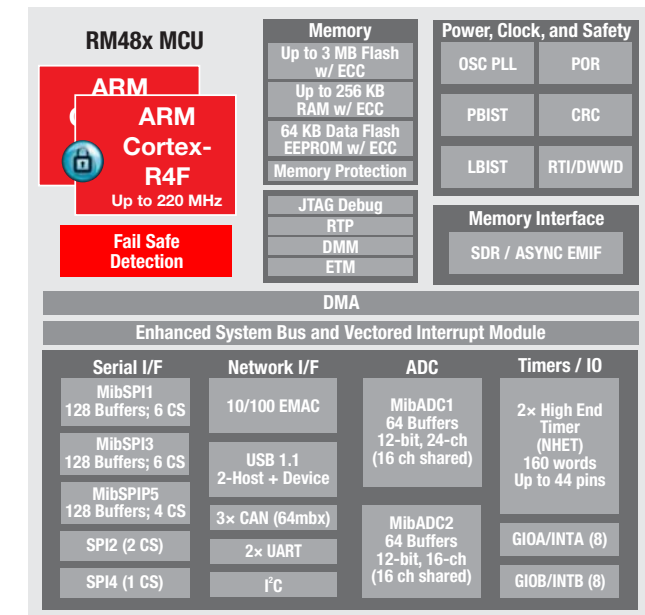
The RM48x is the highest performance Hercules Safety microcontroller family. Based on the ARM® Cortex™-R4F floating point core running at up to 220 MHz it includes several flash memory and connectivity options. Developed with the capability to meet the requirements of the IEC 61508 SIL-3 safety standard and supporting many functional safety features including a dual-CPU lockstep architecture, hardware built-in self test (BIST), memory protection unit (MPU), error correction code (ECC) and parity checking, the RM4x safety microcontrollers provide a high level of diagnostic coverage without costly safety software overhead. A wide choice of communication interfaces makes this family an ideal solution for safety critical industrial and medical applications.

Key features

- ARM Cortex-R4F core with floating-point support
- Up to 220 MHz
- Lockstep safety features built-in simplify SIL-3 applications
- Up to 3-MB Flash/256-KB RAM with ECC
- Memory protection units in CPU and DMA
- Multiple network peripherals:
 - Ethernet, USB, CAN
- Flexible timer module with up to 44 channels
- 12-bit analog/digital converter
- External memory interface

Targeted industrial/medical applications

- Industrial automation and control
- Safety Programmable Logic Controllers (PLCs)
- Power generation and distribution



Packages: LQFP: 144 pin - 20 x 20; nFBGA: 337 pin - 16 x 16, 0.8 mm; -40 to 105°C temperature range

- Turbines and windmills
- Ventilators and defibrillators
- Infusion and insulin pumps

RM48x family overview

Device	Speed (MHz)	Flash (MB)	RAM (KB)	Data Flash/EEPROM (KB)	EMAC	USB OHC1+ Device	CAN	MibSPI	SPI	I2C	UART	HET (ch)	MibADC 12-b (ch)	EMIF	GIO (Int)	ETM/RTP/DMM	Package	Temperature Range
RM48L530	200	2	192	64	-	Yes	3	3	1	1	2	2 (40)	2 (24)	-	4 (4)	-	144 QFP	-40-105°C
	200	2	192	64	-	Yes	3	3	2	1	2	2 (44)	2 (24)	Yes	16 (16)	Yes	337 BGA	
RM48L540	200	2	192	64	10/100	-	3	3	1	1	2	2 (40)	2 (24)	-	10 (10)	-	144 QFP	-40-105°C
	200	2	192	64	10/100	-	3	3	2	1	2	2 (44)	2 (24)	Yes	16 (16)	Yes	337 BGA	
RM48L550	200	2	192	64	10/100	Yes	3	3	1	1	2	2 (40)	2 (24)	-	4 (4)	-	144 QFP	-40-105°C
	200	2	192	64	10/100	Yes	3	3	2	1	2	2 (44)	2 (24)	Yes	16 (16)	Yes	337 BGA	
RM48L730	200	2	256	64	-	Yes	3	3	1	1	2	2 (40)	2 (24)	-	4 (4)	-	144 QFP	-40-105°C
	200	2	256	64	-	Yes	3	3	2	1	2	2 (44)	2 (24)	Yes	16 (16)	Yes	337 BGA	
RM48L740	200	2	256	64	10/100	-	3	3	1	1	2	2 (40)	2 (24)	-	10 (10)	-	144 QFP	-40-105°C
	200	2	256	64	10/100	-	3	3	2	1	2	2 (44)	2 (24)	Yes	16 (16)	Yes	337 BGA	
RM48L750	200	2	256	64	10/100	Yes	3	3	1	1	2	2 (40)	2 (24)	-	4 (4)	-	144 QFP	-40-105°C
	200	2	256	64	10/100	Yes	3	3	2	1	2	2 (44)	2 (24)	Yes	16 (16)	Yes	337 BGA	
RM48L930	200	3	256	64	-	Yes	3	3	1	1	2	2 (40)	2 (24)	-	4 (4)	-	144 QFP	-40-105°C
	200	3	256	64	-	Yes	3	3	2	1	2	2 (44)	2 (24)	Yes	16 (16)	Yes	337 BGA	
RM48L940	200	3	256	64	10/100	-	3	3	1	1	2	2 (40)	2 (24)	-	10 (10)	-	144 QFP	-40-105°C
	200	3	256	64	10/100	-	3	3	2	1	2	2 (44)	2 (24)	Yes	16 (16)	Yes	337 BGA	
RM48L950	200	3	256	64	10/100	Yes	3	3	1	1	2	2 (40)	2 (24)	-	4 (4)	-	144 QFP	-40-105°C
	200	3	256	64	10/100	Yes	3	3	2	1	2	2 (44)	2 (24)	Yes	16 (16)	Yes	337 BGA	
RM48L952	220	3	256	64	10/100	Yes	3	3	1	1	2	2 (40)	2 (24)	-	4 (4)	-	144 QFP	-40-105°C
	220	3	256	64	10/100	Yes	3	3	2	1	2	2 (44)	2 (24)	Yes	16 (16)	Yes	337 BGA	

Note: Above reflects max configuration of each module – some functions are multiplexed.

Hercules™ TMS570LS Safety MCU

The Hercules TMS570LS safety microcontroller family enables customers to easily develop safety-critical products for transportation applications. Developed to the requirements of the ISO 26262 ASIL-D and IEC 61508 SIL-3 safety standards and qualified to the AEC-Q100 automotive specification this ARM® Cortex™-R4F-based family offers several options of performance, memory and connectivity. Dual-core lockstep CPU architecture, hardware BIST, MPU, ECC and on-chip clock and voltage monitoring are some of the key functional safety features available to meet the needs of automotive, railway and aerospace applications.

Key features

- ARM Cortex-R4F core floating-point support
- Up to 180 MHz
- Lockstep safety features built-in simplify SIL-3/ASIL D applications
- Up to 3-MB Flash/256-KB RAM with ECC
- Memory protection units in CPU and DMA
- Multiple communication peripherals:
 - Ethernet, FlexRay, CAN, LIN, SPI
- Flexible timer module with up to 44 channels
- 12-bit analog/digital converter
- External memory interface

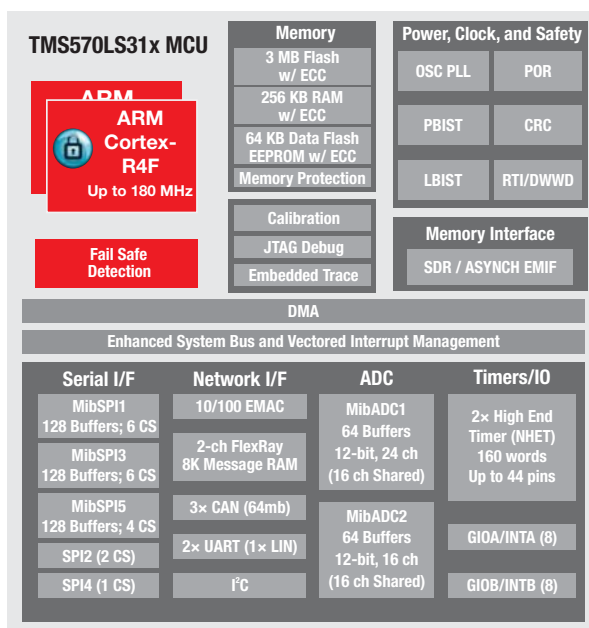
Targeted transportation applications

- Braking systems (ABS and ESC)
- Electric power steering (EPS)
- HEV/EV inverter systems
- Aerospace
- Railway control, communications and signaling
- Off-road vehicles

TMS570 family overview

Device	Speed (MHz)	Flash (MB)	RAM (kB)	FlexRay (ch)	CAN	MibSPI/SPI	UART (LIN)	HET (ch)	MibADC 12-b (ch)	EMIF	GIO (Intf)	Trace/Calibration			Package	Temperature Range
												ETM (Data)	RTP (Data)	DMM (Data)		
TMS570LS10106	140	1	128	–	2	3	2 (2)	(25)	2 (20)	–	8 (8)				144 QFP	–40 – +125°C
	160	1	128	–	3	3	2 (2)	(32)	2 (24)	Yes	16 (8)	(32)	(16)	(16)	337 BGA	
TMS570LS10116	140	1	128	2	2	3	2 (2)	(25)	2 (20)	–	8 (8)				144 QFP	–40 – +125°C
	160	1	128	2	3	3	2 (2)	(32)	2 (24)	Yes	16 (8)	(32)	(16)	(16)	337 BGA	
TMS570LS10206	140	1	160	–	2	3	2 (2)	(25)	2 (20)	–	8 (8)				144 QFP	–40 – +125°C
	160	1	160	–	3	3	2 (2)	(32)	2 (24)	Yes	16 (8)	(32)	(16)	(16)	337 BGA	
TMS570LS10216	140	1	160	2	2	3	2 (2)	(25)	2 (20)	–	8 (8)				144 QFP	–40 – +125°C
	160	1	160	2	3	3	2 (2)	(32)	2 (24)	Yes	16 (8)	(32)	(16)	(16)	337 BGA	
TMS570LS20206	140	2	160	–	2	3	2 (2)	(25)	2 (20)	–	8 (8)				144 QFP	–40 – +125°C
	160	2	160	–	3	3	2 (2)	(32)	2 (24)	Yes	16 (8)	(32)	(16)	(16)	337 BGA	
TMS570LS20216	140	2	160	2	2	3	2 (2)	(25)	2 (20)	–	8 (8)				144 QFP	–40 – +125°C
	160	2	160	2	3	3	2 (2)	(32)	2 (24)	Yes	16 (8)	(32)	(16)	(16)	337 BGA	
TMS570LS2124	160	2	192	–	3	3/1	2 (1)	2 (40)	2 (24)	–	10 (10)				144 QFP	–40 – +125°C
	180	2	192	–	3	3/2	2 (1)	2 (44)	2 (24)	Yes	16 (16)	(32)	(16)	(16)	337 BGA	
TMS570LS2125	160	2	192	2	3	3/1	2 (1)	2 (40)	2 (24)	–	4 (4)				144 QFP	–40 – +125°C
	180	2	192	2	3	3/2	2 (1)	2 (44)	2 (24)	Yes	16 (16)	(32)	(16)	(16)	337 BGA	
TMS570LS2134	160	2	256	–	3	3/1	2 (1)	2 (40)	2 (24)	–	10 (10)				144 QFP	–40 – +125°C
	180	2	256	–	3	3/2	2 (1)	2 (44)	2 (24)	Yes	16 (16)	(32)	(16)	(16)	337 BGA	
TMS570LS2135	160	2	256	2	3	3/1	2 (1)	2 (40)	2 (24)	–	4 (4)				144 QFP	–40 – +125°C
	180	2	256	2	3	3/2	2 (1)	2 (44)	2 (24)	Yes	16 (16)	(32)	(16)	(16)	337 BGA	
TMS570LS3134	160	3	256	–	3	3/1	2 (1)	2 (40)	2 (24)	–	10 (10)				144 QFP	–40 – +125°C
	180	3	256	–	3	3/2	2 (1)	2 (44)	2 (24)	Yes	16 (16)	(32)	(16)	(16)	337 BGA	
TMS570LS3135	160	3	256	2	3	3/1	2 (1)	2 (40)	2 (24)	–	4 (4)				144 QFP	–40 – +125°C
	180	3	256	2	3	3/2	2 (1)	2 (44)	2 (24)	Yes	16 (16)	(32)	(16)	(16)	337 BGA	
TMS570LS3137 (10/100 EMAC)	160	3	256	2	3	3/1	2 (1)	2 (40)	2 (24)	–	4 (4)				144 QFP	–40 – +125°C
	180	3	256	2	3	3/2	2 (1)	2 (44)	2 (24)	Yes	16 (16)	(32)	(16)	(16)	337 BGA	

Note: Above reflects max configuration of each module – some functions are multiplexed.



Packages: LQFP: 144 pin - 20 × 20; nBGA: 337 pin - 16 × 16, 0.8 mm; –40 to 125°C temperature range

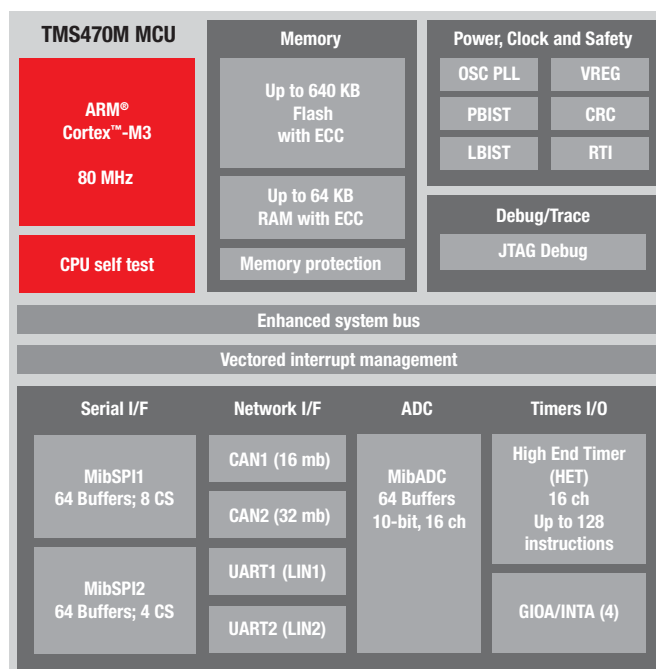
The TMS470M safety microcontroller family is based on the widely adopted ARM® Cortex™-M3 CPU running at 80 MHz. The family offers several flash memory and RAM options and a wide range of connectivity and control peripherals. Built-in safety features like CPU and RAM self-test (BIST) engines, ECC and parity-checking enable the TMS470M to support applications that meet the IEC 61508 safety standard. The TMS470M safety microcontrollers are AEC-Q100 qualified and are the right fit for safety and transportation applications with lower performance needs.

Key features

- 80-MHz Cortex-M3 CPU
- Up to 640-KB Flash / 64-KB RAM with ECC protection and EEPROM emulation
- Single 3.3-V supply (Vreg on-chip)
- Multiple communication interfaces
 - 2 CAN, 2 MibSPIs, 2 LIN/UART
- Flexible timer module (16 ch)
- 10-bit analog/digital converter (16 ch)
- Safety features (ECC, BISTs, CRC)
- Pin and software compatible family
- Embedded debug module

Targeted transportation applications

- Electric Power Steering (EPS)
- Braking systems (ABS, ESC)
- Safety-related automotive
- Automotive infrastructure
- Commercial vehicles
- Off-road vehicles
- Airbags, electric park brake, safe communication, parking assist



Package: LQFP: 100-pin - 14 × 14 mm; -40 to 125°C temperature range

TMS470M family overview

Device	Speed (MHz)	Flash (KB)	EEPROM or Flash* (KB)	RAM (KB)	CAN	MibSPI (CS)	UART (LIN)	HET (ch)	MbADC 10-b (ch)	GIO	Voltage (V)	Package	Temperature Range	Q100
TMS470MF03107	80	256	64	16	2	2 (12)	2 (2)	16	16	4	3.3	100QFP	-40 – +125°C	Yes
TMS470MF04207	80	384	64	24	2	2 (12)	2 (2)	16	16	4	3.3	100QFP	-40 – +125°C	Yes
TMS470MF06607	80	512	128	64	2	2 (12)	2 (2)	16	16	4	3.3	100QFP	-40 – +125°C	Yes

Note: * Memory area can be used for code Flash or EEPROM emulation.

Please see the datasheet online at www.ti.com/tms470m for orderable part numbers.

Evaluation

Low-cost USB stick evaluation/development kits

TMDXRM48USB – RM48 USB Stick Kit
 TMDX570LS31USB – TMS570 USB Stick Kit
 TMDX470MF066USB – TMS470M USB Stick Kit

USB Stick Kit features:

- USB powered
- On-board USB XDS100v2 JTAG debug
- On-board SCI-to-PC serial communication
- Access to select signal pin test points
- LEDs, temp sensor and light sensor
- CAN transceiver



Development

Full-featured development kits

TMDXRM48HDK – RM48 Development Kit
 TMDX570LS31HDK – TMS570 Development Kit
 TMDX470MF066HDK – TMS470M Development Kit

Hercules Development Kit features:

- On-board USB XDS100v2 JTAG debug
- On-board SCI-to-PC serial communication
- External high-speed emulation via JTAG
- Access to signal pin test points
- LEDs, temp sensor and light sensor
- 2 CAN transceivers
- MIPI connector for 32-bit ETM trace (RM48 and TMS570)
- RJ-45 10/100 Ethernet interface (RM48 and TMS570)
- USB-A host interface (RM48)
- USB-B device interface (RM48)



Software

Software included in each kit

- CCStudio v4.x IDE: C/C++ compiler/linker/debugger
- HALCoGen peripheral driver generation tool
- CCStudio and nowFlash flash programming tools
- HET IDE/simulator/assembler
- GUI demo with project/code examples



Integrated development environment (IDE)



Program/compile/debug code using these IDEs:

- Code Composer Studio™ (CCStudio) IDE
- IAR Workbench
- KEIL μVision



Real-Time Operating Systems



WITTENSTEIN

- SAFERTOS: High-integrity systems
- μC/OS: Micrium
- ThreadX: Express Logic
- AUTOSAR: Vector Microsar and EB tresos

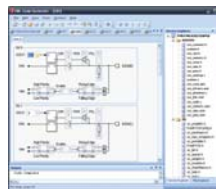
Micrium **expresslogic** **AUTOSAR**

GUI-based code-generation tools and other software tools



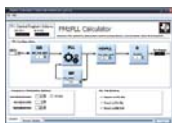
Safety MCU demos

- Safety feature highlight
- Ambient light demo
- Temperature demo
- LED light show
- Maze game (RM48 and TMS570)
- Source Code viewable via CCStudio



HALCoGen

- User input on high-abstraction level
- Graphical-based code generation
- Easy configuration
- Quick start for new projects
- Supports CCStudio, IAR and KEIL IDEs



PLL calculators

- Easily configure the FMzPLL and FPLLs in the Hercules platform Phase Lock Loop modules.



nowECC Generation Tool

- Command line program for generating error correction code for Hercules devices. Can be used in conjunction with CCStudio.



HET IDE

- Graphical programming environment
- Includes WaveFormer Pro SynaptiCAD
- Generates CCStudio-ready software
- Includes functional examples



nowFlash Programming Tool

- GUI and command line programmer for loading code into Hercules devices without an IDE.

Third-party Hercules software/tools partners



IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Mobile Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Transportation and Automotive	www.ti.com/automotive
Video and Imaging	www.ti.com/video

TI E2E Community Home Page

e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2011, Texas Instruments Incorporated