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What is "Embedded - Microcontrollers"?

"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	e200z3
Core Size	32-Bit Single-Core
Speed	80MHz
Connectivity	CANbus, EBI/EMI, LINbus, SCI, SPI, UART/USART
Peripherals	DMA, POR, PWM, WDT
Number of I/O	80
Program Memory Size	1.5MB (1.5M x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	94K x 8
Voltage - Supply (Vcc/Vdd)	4.5V ~ 5.25V
Data Converters	A/D 32x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	144-LQFP
Supplier Device Package	144-LQFP (20x20)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/spc5634mf2mlq80

- Non-maskable interrupt (NMI) input for handling external events that must produce an immediate response, e.g., power down detection. On this device, the NMI input is connected to the Critical Interrupt Input. (May not be recoverable)
- Critical Interrupt input. For external interrupt sources that are higher priority than provided by the Interrupt Controller. (Always recoverable)
- New 'Wait for Interrupt' instruction, to be used with new low power modes
- Reservation instructions for implementing read-modify-write accesses
- Signal processing extension (SPE) APU
  - Operating on all 32 GPRs that are all extended to 64 bits wide
  - Provides a full compliment of vector and scalar integer and floating point arithmetic operations (including integer vector MAC and MUL operations) (SIMD)
  - Provides rich array of extended 64-bit loads and stores to/from extended GPRs
  - Fully code compatible with e200z6 core
- Floating point (FPU)
  - IEEE 754 compatible with software wrapper
  - Scalar single precision in hardware, double precision with software library
  - Conversion instructions between single precision floating point and fixed point
  - Fully code compatible with e200z6 core
- Long cycle time instructions, except for guarded loads, do not increase interrupt latency
- Extensive system development support through Nexus debug port

- Advanced microcontroller bus architecture (AMBA) crossbar switch (XBAR)
  - Three master ports, four slave ports
    - Masters: CPU Instruction bus; CPU Load/store bus (Nexus); eDMA
    - Slave: Flash; SRAM; Peripheral Bridge; calibration EBI
  - 32-bit internal address bus, 64-bit internal data bus
- Enhanced direct memory access (eDMA) controller
  - 32 channels support independent 8-bit, 16-bit, or 32-bit single value or block transfers
  - Supports variable sized queues and circular queues
  - Source and destination address registers are independently configured to post-increment or remain constant
  - Each transfer is initiated by a peripheral, CPU, or eDMA channel request
  - Each eDMA channel can optionally send an interrupt request to the CPU on completion of a single value or block transfer
- Interrupt controller (INTC)
  - 191 peripheral interrupt request sources
  - 8 software setable interrupt request sources
  - 9-bit vector
    - Unique vector for each interrupt request source
    - Provided by hardware connection to processor or read from register
  - Each interrupt source can be programmed to one of 16 priorities
  - Preemption
    - Preemptive prioritized interrupt requests to processor
    - ISR at a higher priority preempts ISRs or tasks at lower priorities
    - Automatic pushing or popping of preempted priority to or from a LIFO
    - Ability to modify the ISR or task priority. Modifying the priority can be used to implement the Priority Ceiling Protocol for accessing shared resources.
  - Low latency—three clocks from receipt of interrupt request from peripheral to interrupt request to processor

1 Introduction

1.1 Document overview

This document provides an overview and describes the features of the MPC5634M series of microcontroller units (MCUs). For functional characteristics, refer to the device reference manual. Electrical specifications and package mechanical drawings are included in this device data sheet. Pin assignments can be found in both the reference manual and data sheet.

1.2 Description

These 32-bit automotive microcontrollers are a family of system-on-chip (SoC) devices that contain all the features of the MPC5500 family and many new features coupled with high performance 90 nm CMOS technology to provide substantial reduction of cost per feature and significant performance improvement. The advanced and cost-efficient host processor core of this automotive controller family is built on Power Architecture® technology. This family contains enhancements that improve the architecture's fit in embedded applications, includes additional instruction support for digital signal processing (DSP), integrates technologies—such as an enhanced time processor unit, enhanced queued analog-to-digital converter, Controller Area Network, and an enhanced modular input-output system—that are important for today's lower-end powertrain applications. This device family is a completely compatible extension to Freescale's MPC5500 family. The device has a single level of memory hierarchy consisting of up to 94 KB on-chip SRAM and up to 1.5 MB of internal flash memory. The device also has an external bus interface (EBI) for 'calibration'. This external bus interface has been designed to support most of the standard memories used with the MPC5xx and MPC55xx families.

2 Overview

This document provides electrical specifications, pin assignments, and package diagrams for the MPC5634M series of microcontroller units (MCUs). For functional characteristics, refer to the MPC5634M *Microcontroller Reference Manual.*

The MPC5634M series microcontrollers are system-on-chip devices that are built on Power Architecture® technology and:

- Are 100% user-mode compatible with the Power Architecture instruction set
- Contain enhancements that improve the architecture's fit in embedded applications
- Include additional instruction support for digital signal processing (DSP)
- Integrate technologies such as an enhanced time processor unit, enhanced queued analog-to-digital converter, Controller Area Network, and an enhanced modular input-output system

2.1 Device comparison

2.2 MPC5634M feature details

2.2.1 e200z335 core

The e200z335 processor utilizes a four stage pipeline for instruction execution. The Instruction Fetch (stage 1), Instruction Decode/Register file Read/Effective Address Calculation (stage 2), Execute/Memory Access (stage 3), and Register Writeback (stage 4) stages operate in an overlapped fashion, allowing single clock instruction execution for most instructions.

The integer execution unit consists of a 32-bit Arithmetic Unit (AU), a Logic Unit (LU), a 32-bit Barrel shifter (Shifter), a Mask-Insertion Unit (MIU), a Condition Register manipulation Unit (CRU), a Count-Leading-Zeros unit (CLZ), a 32×32 Hardware Multiplier array, result feed-forward hardware, and support hardware for division.

Most arithmetic and logical operations are executed in a single cycle with the exception of the divide instructions. A Count-Leading-Zeros unit operates in a single clock cycle. The Instruction Unit contains a PC incrementer and a dedicated

- Sets up the MMU to allow user boot code to execute as either Power Architecture code (default) or as Freescale VLE code
- Detection of user boot code
- Automatic switch to serial boot mode if internal flash is blank or invalid
- Supports user programmable 64-bit password protection for serial boot mode
- Supports serial bootloading via FlexCAN bus and eSCI using Freescale protocol
- Supports serial bootloading via FlexCAN bus and eSCI with auto baud rate sensing
- Supports serial bootloading of either Power Architecture code (default) or Freescale VLE code
- Supports booting from calibration bus interface
- Supports censorship protection for internal flash memory
- Provides an option to enable the core watchdog timer
- Provides an option to disable the software watchdog timer

2.2.12 eMIOS

The eMIOS (Enhanced Modular Input Output System) module provides the functionality to generate or measure time events. The channels on this module provide a range of operating modes including the capability to perform dual input capture or dual output compare as well as PWM output.

The eMIOS provides the following features:

- 16 channels (24-bit timer resolution)
- For compatibility with other family members selected channels and timebases are implemented:
  - Channels 0 to 6, 8 to 15, and 23
  - Timebases A, B and C
- Channels 1, 3, 5 and 6 support modes:
  - General Purpose Input/Output (GPIO)
  - Single Action Input Capture (SAIC)
  - Single Action Output Compare (SAOC)
- Channels 2, 4, 11 and 13 support all the modes above plus:
  - Output Pulse Width Modulation Buffered (OPWMB)
- Channels 0, 8, 9, 10, 12, 14, 15, 23 support all the modes above plus:
  - Input Period Measurement (IPM)
  - Input Pulse Width Measurement (IPWM)
  - Double Action Output Compare (set flag on both matches) (DAOC)
  - Modulus Counter Buffered (MCB)
  - Output Pulse Width and Frequency Modulation Buffered (OPWFMB)
- Three 24-bit wide counter buses
  - Counter bus A can be driven by channel 23 or by the eTPU2 and all channels can use it as a reference
  - Counter bus B is driven by channel 0 and channels 0 to 6 can use it as a reference
  - Counter bus C is driven by channel 8 and channels 8 to 15 can use it as a reference
- Shared time bases with the eTPU2 through the counter buses
- Synchronization among internal and external time bases

2.2.13 eTPU2

The eTPU2 is an enhanced co-processor designed for timing control. Operating in parallel with the host CPU, eTPU2 processes instructions and real-time input events, performs output waveform generation, and accesses shared data without host

results to the result FIFOs. This allows the ADCs to sample the sensor at a rate high enough to avoid aliasing of out-of-band noise; while providing a reduced sample rate output to minimize the amount DSP processing bandwidth required to fully process the digitized waveform.

The eQADC provides the following features:

- Dual on-chip ADCs
  - 2 × 12-bit ADC resolution
  - Programmable resolution for increased conversion speed (12 bit, 10 bit, 8 bit)
    - 12-bit conversion time – 1 µs (1M sample/sec)
    - 10-bit conversion time – 867 ns (1.2M sample/second)
    - 8-bit conversion time – 733 ns (1.4M sample/second)
  - Up to 10-bit accuracy at 500 KSample/s and 9-bit accuracy at 1 MSample/s
  - Differential conversions
  - Single-ended signal range from 0 to 5 V
  - Variable gain amplifiers on differential inputs (×1, ×2, ×4)
  - Sample times of 2 (default), 8, 64 or 128 ADC clock cycles
  - Provides time stamp information when requested
  - Parallel interface to eQADC CFIFOs and RFIFOs
  - Supports both right-justified unsigned and signed formats for conversion results
- Up to 34[1] input channels (accessible by both ADCs)
- 23 additional internal channels for measuring control and monitoring voltages inside the device
  - Including Core voltage, I/O voltage, LVI voltages, etc.
- An internal bandgap reference to allow absolute voltage measurements
- 4 pairs of differential analog input channels
  - Programmable pull-up/pull-down resistors on each differential input for biasing and sensor diagnostic (200 kΩ, 100 kΩ, 5 kΩ)
- Silicon die temperature sensor
  - provides temperature of silicon as an analog value
  - read using an internal ADC analog channel
  - may be read with either ADC
- Decimation Filter
  - Programmable decimation factor (2 to 16)
  - Selectable IIR or FIR filter
  - Up to 4th order IIR or 8th order FIR
  - Programmable coefficients
  - Saturated or non-saturated modes
  - Programmable Rounding (Convergent; Two’s Complement; Truncated)
  - Pre-fill mode to pre-condition the filter before the sample window opens
- Full duplex synchronous serial interface to an external device
  - Free-running clock for use by an external device
  - Supports a 26-bit message length
- Priority based Queues
  - Supports six Queues with fixed priority. When commands of distinct Queues are bound for the same ADC, the higher priority Queue is always served first

1. 176-pin and 208-pin packages have 34 input channels; 144-pin package has 32.

- 13-bit baud rate selection
- Programmable 8-bit or 9-bit, data format
- Programmable 12-bit or 13-bit data format for Timed Serial Bus (TSB) configuration to support the Microsecond Channel upstream
- Automatic parity generation
- LIN support
  - Autonomous transmission of entire frames
  - Configurable to support all revisions of the LIN standard
  - Automatic parity bit generation
  - Double stop bit after bit error
  - 10- or 13-bit break support
- Separately enabled transmitter and receiver
- Programmable transmitter output parity
- 2 receiver wake up methods:
  - Idle line wake-up
  - Address mark wake-up
- Interrupt-driven operation with flags
- Receiver framing error detection
- Hardware parity checking
- 1/16 bit-time noise detection
- DMA support for both transmit and receive data
  - Global error bit stored with receive data in system RAM to allow post processing of errors

2.2.17 FlexCAN

The MPC5634M MCU contains two controller area network (FlexCAN) blocks. The FlexCAN module is a communication controller implementing the CAN protocol according to Bosch Specification version 2.0B. The CAN protocol was designed to be used primarily as a vehicle serial data bus, meeting the specific requirements of this field: real-time processing, reliable operation in the EMI environment of a vehicle, cost-effectiveness and required bandwidth. FlexCAN module ‘A’ contains 64 message buffers (MB); FlexCAN module ‘C’ contains 32 message buffers.

The FlexCAN module provides the following features:

- Based on and including all existing features of the Freescale TouCAN module
- Full Implementation of the CAN protocol specification, Version 2.0B
  - Standard data and remote frames
  - Extended data and remote frames
  - Zero to eight bytes data length
  - Programmable bit rate up to 1 Mbit/s
- Content-related addressing
- 64 / 32 message buffers of zero to eight bytes data length
- Individual Rx Mask Register per message buffer
- Each message buffer configurable as Rx or Tx, all supporting standard and extended messages
- Includes 1056 / 544 bytes of embedded memory for message buffer storage
- Includes a 256-byte and a 128-byte memories for storing individual Rx mask registers
- Full featured Rx FIFO with storage capacity for six frames and internal pointer handling
- Powerful Rx FIFO ID filtering, capable of matching incoming IDs against 8 extended, 16 standard or 32 partial (8 bits) IDs, with individual masking capability

Table 1. MPC5634M series block summary (continued)

Block	Function
DMA (direct memory access)	Performs complex data movements with minimal intervention from the core
DSPI (deserial serial peripheral interface)	Provides a synchronous serial interface for communication with external devices
eMIOS (enhanced modular input-output system)	Provides the functionality to generate or measure events
eQADC (enhanced queued analog-to-digital converter)	Provides accurate and fast conversions for a wide range of applications
eSCI (serial communication interface)	Allows asynchronous serial communications with peripheral devices and other microcontroller units
eTPU (enhanced time processor unit)	Processes real-time input events, performs output waveform generation, and accesses shared data without host intervention
FlexCAN (controller area network)	Supports the standard CAN communications protocol
FMPLL (frequency-modulated phase-locked loop)	Generates high-speed system clocks and supports the programmable frequency modulation of these clocks
INTC (interrupt controller)	Provides priority-based preemptive scheduling of interrupt requests
JTAG controller	Provides the means to test chip functionality and connectivity while remaining transparent to system logic when not in test mode
NPC (Nexus Port Controller)	Provides real-time development support capabilities in compliance with the IEEE-ISTO 5001-2003 standard
PIT (peripheral interrupt timer)	Produces periodic interrupts and triggers
Temperature sensor	Provides the temperature of the device as an analog value
SWT (Software Watchdog Timer)	Provides protection from runaway code
STM (System Timer Module)	Timer providing a set of output compare events to support AutoSAR and operating system tasks

3.4 208 MAPBGA ballmap (MPC5634M)

Figure 5 shows the 208-pin MAPBGA ballmap for the MPC5634M (1536 KB flash memory) as viewed from above.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A	VSS	AN9	AN11	VDDA1	VSSA1	AN1	AN5	VRH	VRL	AN27	VSSA0	AN12- SDS	ALT_ MDO2	ALT_ MDO0	VRC33	VSS
B	VDD	VSS	AN38	AN21	AN0	AN4	REFBYPC	AN22	AN25	AN28	VDDA0	AN13-SDO	ALT_ MDO3	ALT_ MDO1	VSS	VDD
C	VSTBY	VDD	VSS	AN17	AN34	AN16	AN3	AN7	AN23	AN32	AN33	AN14-SDI	AN15 FCK	VSS	ALT_ MSEO0	TCK
D	VRC33	AN39	VDD	VSS	AN18	AN2	AN6	AN24	AN30	AN31	AN35	VDDEH7	VSS	TMS	ALT_EVTO	NIC[1]
E	ETPUA30	ETPUA31	AN37	VDD									VDDE7	TDI	ALT_EVTI	ALT_ MSEO1
F	ETPUA28	ETPUA29	ETPUA26	AN36									VDDEH6	TDO	ALT_MCKO	JCOMP
G	ETPUA24	ETPUA27	ETPUA25	ETPUA21			VSS	VSS	VSS	VSS			DSPI_B_ SOUT	DSPI_B_ PCS3	DSPI_B_ SIN	DSPI_B_ PCS0
H	ETPUA23	ETPUA22	ETPUA17	ETPUA18			VSS	VSS	VSS	VSS			GPIO99	DSPI_B_ PCS4	DSPI_B_ PCS2	DSPI_B_ PCS1
J	ETPUA20	ETPUA19	ETPUA14	ETPUA13			VSS	VSS	VSS	VSS			DSPI_B_ PCS5	SCI_A_TX	GPIO98	DSPI_B_ SCK
K	ETPUA16	ETPUA15	ETPUA7	VDDEH1			VSS	VSS	VSS	VSS			CAN_C_ TX	SCI_A_RX	RSTOUT	VDDREG
L	ETPUA12	ETPUA11	ETPUA6	ETPUA0									SCI_B_TX	CAN_C_ RX	WKPCFG	RESET
M	ETPUA10	ETPUA9	ETPUA1	ETPUA5									SCI_B_RX	PLLREF	BOOTCFG1	VSSPLL
N	ETPUA8	ETPUA4	ETPUA0	VSS	VDD	VRC33	EMIOS2	EMIOS10	VDDEH1/6[2]	EMIOS12	eTPU_A19[3]	VRC33	VSS	VRCCTL	NIC[1]	EXTAL
P	ETPUA3	ETPUA2	VSS	VDD	GPIO207	VDDE7	NIC[1]	EMIOS8	eTPU_A29[3]	eTPU_A2[3]	eTPU_A21[3]	CAN_A_ TX	VDD	VSS	NIC[1]	XTAL
R	NIC[1]	VSS	VDD	GPIO206	EMIOS4	NIC[1]	EMIOS9	EMIOS11	EMIOS14	eTPU_A27[3]	EMIOS23	CAN_A_ RX	NIC[1]	VDD	VSS	VDDPLL
T	VSS	VDD	NIC[1]	EMIOS0	EMIOS1	GPIO219	eTPU_A25[3]	EMIOS13	EMIOS15	eTPU_A4[3]	eTPU_A13[3]	NIC[1]	VDDE5	CLKOUT	VDD	VSS

1 Pins marked “NIC” have no internal connection.
2 This ball may be changed to “NC” (no connection) in a future revision.
3 eTPU output only channel.

Figure 5. 208-pin MAPBGA ballmap (MPC5634M; top view)

3.5 208 MAPBGA ballmap (MPC5633M only)

Figure 6 shows the 208-pin MAPBGA ballmap for the MPC5633M (1024 KB flash memory) as viewed from above.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A	VSS	AN9	AN11	VDDA1	VSSA1	AN1	AN5	VRH	VRL	AN27	VSSA0	AN12-SDS	ALT_ MDO2	ALT_ MDO0	VRC33	VSS
B	VDD	VSS	AN38	AN21	AN0	AN4	REFBYPC	AN22	AN25	AN28	VDDA0	AN13-SDO	ALT_ MDO3	ALT_ MDO1	VSS	VDD
C	VSTBY	VDD	VSS	AN17	AN34	AN16	AN3	AN7	AN23	AN32	AN33	AN14-SDI	AN15 FCK	VSS	ALT_ MSEO0	TCK
D	VRC33	AN39	VDD	VSS	AN18	AN2	AN6	AN24	AN30	AN31	AN35	VDDEH7	VSS	TMS	ALT_EVTO	NIC[1]
E	ETPUA30	ETPUA31	NC[2]	VDD									VDDE7	TDI	ALT_ EVTI	ALT_ MSEO1
F	ETPUA28	ETPUA29	ETPUA26	NC[2]									VDDEH6	TDO	ALT_MCKO	JCOMP
G	ETPUA24	ETPUA27	ETPUA25	ETPUA21			VSS	VSS	VSS	VSS			DSPI_B_ SOUT	DSPI_B_ PCS3	DSPI_B_ SIN	DSPI_B_ PCS0
H	ETPUA23	ETPUA22	ETPUA17	ETPUA18			VSS	VSS	VSS	VSS			NC[2]	DSPI_B_ PCS4	DSPI_B_ PCS2	DSPI_B_ PCS1
J	ETPUA20	ETPUA19	ETPUA14	ETPUA13			VSS	VSS	VSS	VSS			DSPI_B_ PCS5	SCI_A_TX	NC[2]	DSPI_B_ SCK
K	ETPUA16	ETPUA15	ETPUA7	VDDEH1			VSS	VSS	VSS	VSS			CAN_C_ TX	SCI_A_RX	RSTOUT	VDDREG
L	ETPUA12	ETPUA11	ETPUA6	ETPUA0									SCI_B_TX	CAN_C_ RX	WKPCFG	RESET
M	ETPUA10	ETPUA9	ETPUA1	ETPUA5									SCI_B_RX	PLLREF	BOOTCFG1	VSSPLL
N	ETPUA8	ETPUA4	ETPUA0	VSS	VDD	VRC33	EMIOS2	EMIOS10	VDDEH1/6[3]	EMIOS12	eTPUA19[4]	VRC33	VSS	VRCCTL	NIC[1]	EXTAL
P	ETPUA3	ETPUA2	VSS	VDD	NC[2]	VDDE7	NIC[1]	EMIOS8	eTPUA29[3]	eTPUA2[3]	eTPUA21[3]	CAN_A_ TX	VDD	VSS	NIC[1]	XTAL
R	NIC[1]	VSS	VDD	NC[2]	EMIOS4	NIC[1]	EMIOS9	EMIOS11	EMIOS14	eTPUA27[3]	EMIOS23	CAN_A_ RX	NC[2]	VDD	VSS	VDDPLL
T	VSS	VDD	NIC[1]	EMIOS0	NC[2]	GPIO219	eTPUA25[3]	NC[2]	NC[2]	eTPUA4[3]	eTPUA13[3]	NIC[1]	VDDE5	CLKOUT	VDD	VSS

1 Pins marked “NIC” have no internal connection.
2 Pins marked “NC” may be connected to internal circuitry. Connections to external circuits or other pins on this device can result in unpredictable system behavior or damage.
3 This ball may be changed to “NC” (no connection) in a future revision.
4 eTPU output only channel.

Figure 6. 208-pin MAPBGA ballmap (MPC5633M; top view)

Table 2. MPC563xM signal properties (continued)

Name	Function[1]	Pad Config. Register (PCR)[2]	PCR PA Field[3]	I/O Type	Voltage[4] / Pad Type	Reset State[5]	Function / State After Reset[6]	Pin No.		
								144 LQFP	176 LQFP	208 MAPBGA
eTPU_A[18] GPIO[132]	eTPU_A Ch. GPIO	PCR[132]	01 00	I/O I/O	VDDEH1b Slow	– / WKPCFG	– / WKPCFG	30	37	H4
eTPU_A[19] GPIO[133]	eTPU_A Ch. GPIO	PCR[133]	01 00	I/O I/O	VDDEH1b Slow	– / WKPCFG	– / WKPCFG	29	36	J2
eTPU_A[20] IRQ[8] GPIO[134]	eTPU_A Ch. External Interrupt Request GPIO	PCR[134]	01 10 00	I/O I I/O	VDDEH1b Slow	– / WKPCFG	– / WKPCFG	28	35	J1
eTPU_A[21] IRQ[9] GPIO[135]	eTPU_A Ch. External Interrupt Request GPIO	PCR[135]	01 10 00	I/O I I/O	VDDEH1a Slow	– / WKPCFG	– / WKPCFG	27	34	G4
eTPU_A[22] IRQ[10] eTPU_A[17] GPIO[136]	eTPU_A Ch. External Interrupt Request eTPU_A Ch. External GPIO	PCR[136]	001 010 100 000	I/O I O I/O	VDDEH1a Slow	– / WKPCFG	– / WKPCFG	25	32	H2
eTPU_A[23] IRQ[11] eTPU_A[21] GPIO[137]	eTPU_A Ch. External Interrupt Request eTPU_A Ch. External GPIO	PCR[137]	001 010 100 000	I/O I O I/O	VDDEH1a Slow	– / WKPCFG	– / WKPCFG	23	30	H1
eTPU_A[24][28] IRQ[12] DSPI_C_SCK_LVDS- GPIO[138]	eTPU_A Ch. External Interrupt Request DSPI_C Clock LVDS- GPIO	PCR[138]	001 010 100 000	I/O I O I/O	VDDEH1a Slow	– / WKPCFG	– / WKPCFG	21	28	G1
eTPU_A[25][28] IRQ[13] DSPI_C_SCK_LVDS+ GPIO[139]	eTPU_A Ch. External Interrupt Request DSPI _C Clock LVDS+ GPIO	PCR[139]	001 010 100 000	I/O I O I/O	VDDEH1a Medium	– / WKPCFG	– / WKPCFG	20	27	G3
eTPU_A[26][28] IRQ[14] DSPI_C_SOUT_LVDS- GPIO[140]	eTPU_A Ch. External Interrupt Request DSPI_C Data Output LVDS- GPIO	PCR[140]	001 010 100 000	I/O I O I/O	VDDEH1a Slow	– / WKPCFG	– / WKPCFG	19	26	F3
eTPU_A[27][28] IRQ[15] DSPI_C_SOUT_LVDS+ DSPI_B_SOUT GPIO[141]	eTPU_A Ch. External Interrupt Request DSPI_C Data Output LVDS+ DSPI_B Data Output GPIO	PCR[141]	0001 0010 0100 1000 0000	I/O I O O I/O	VDDEH1a Slow	– / WKPCFG	– / WKPCFG	18	25	G2

Table 4. Signal details (continued)

Signal	Module or Function	Description
EVTI	Nexus	EVTI is an input that is read on the negation of RESET to enable or disable the Nexus Debug port. After reset, the EVTI pin is used to initiate program synchronization messages or generate a breakpoint.
EVTO	Nexus	Output that provides timing to a development tool for a single watchpoint or breakpoint occurrence.
MCKO	Nexus	MCKO is a free running clock output to the development tools which is used for timing of the MDO and MSEO signals.
MDO[3:0]	Nexus	Trace message output to development tools. This pin also indicates the status of the crystal oscillator clock following a power-on reset, when MDO[0] is driven high until the crystal oscillator clock achieves stability and is then negated.
MSEO[1:0]	Nexus	Output pin—Indicates the start or end of the variable length message on the MDO pins
BOOTCFG[1]	SIU – Configuration	The BOOTCFG1 pin is sampled during the assertion of the RSTOUT signal, and the value is used to update the RSR and the BAM boot mode The following values are for BOOTCFG[0:1}: 0 Boot from internal flash memory 1 FlexCAN/eSCI boot
WKPCFG	SIU – Configuration	The WKPCFG pin is applied at the assertion of the internal reset signal (assertion of RSTOUT), and is sampled 4 clock cycles before the negation of the RSTOUT pin. The value is used to configure whether the eTPU and eMIOS pins are connected to internal weak pull up or weak pull down devices after reset. The value latched on the WKPCFG pin at reset is stored in the Reset Status Register (RSR), and is updated for all reset sources except the Debug Port Reset and Software External Reset. 0: Weak pulldown applied to eTPU and eMIOS pins at reset 1: Weak pullup applied to eTPU and eMIOS pins at reset.
ETRIG[2:3]	SIU – eQADC Triggers	External signal eTRIGx triggers eQADC CFIFOx
IRQ[0:15]	SIU – External Interrupts	The IRQ[0:15] pins connect to the SIU IRQ inputs. IMUX Select Register 1 is used to select the IRQ[0:15] pins as inputs to the IRQs.

Table 4. Signal details (continued)

Signal	Module or Function	Description
NMI	SIU – External Interrupts	Non-Maskable Interrupt
GPIO[n]	SIU – GPIO	Configurable general purpose I/O pins. Each GPIO input and output is separately controlled by an 8-bit input (GPDI) or output (GPDO) register. Additionally, each GPIO pins is configured using a dedicated SIU_PCR register. The GPIO pins are generally multiplexed with other I/O pin functions.
$\overline{\text{RESET}}$	SIU – Reset	The $\overline{\text{RESET}}$ pin is an active low input. The $\overline{\text{RESET}}$ pin is asserted by an external device during a power-on or external reset. The internal reset signal asserts only if the $\overline{\text{RESET}}$ pin asserts for 10 clock cycles. Assertion of the $\overline{\text{RESET}}$ pin while the device is in reset causes the reset cycle to start over. The $\overline{\text{RESET}}$ pin has a glitch detector which detects spikes greater than two clock cycles in duration that fall below the switch point of the input buffer logic of the VDDEH input pins. The switch point lies between the maximum VIL and minimum VIH specifications for the VDDEH input pins.
$\overline{\text{RSTOUT}}$	SIU – Reset	The $\overline{\text{RSTOUT}}$ pin is an active low output that uses a push/pull configuration. The $\overline{\text{RSTOUT}}$ pin is driven to the low state by the MCU for all internal and external reset sources. There is a delay between initiation of the reset and the assertion of the RSTOUT pin.

Table 5 gives the power/ground segmentation of the MPC563x MCU. Each segment provides the power and ground for the given set of I/O pins, and can be powered by any of the allowed voltages regardless of the power on the other segments.

Table 5. MPC563x Power/Ground Segmentation

Power Segment		144-LQFP Pin Number	176-LQFP Pin Number	208-BGA Pin Number	Voltage Range[1]	I/O Pins Powered by Segment
VDDA0		6	6	B11	5.0 V	AN[0:7], AN[9], AN[11], AN[16:18], AN[21:25], AN[27:28], AN[30:37], AN38, AN39, VRL, REFBYPC, VRH
VDDE5		—	—	T13	1.8 V – 3.3 V	CLKOUT
VDDEH1 (a,b)		24, 34	31, 41	K4	3.3 V – 5.0 V	PCKCFG[2], eTPU_A[0:31], eMIOS[0:2]

4.6.2 Recommended power transistors

The following NPN transistors are recommended for use with the on-chip voltage regulator controller: ON Semiconductor™ BCP68T1 or NJD2873 as well as Philips Semiconductor™ BCP68. The collector of the external transistor is preferably connected to the same voltage supply source as the output stage of the regulator.

Table 19. Recommended operating characteristics

Symbol	Parameter	Value	Unit
h_{FE} (β)	DC current gain (Beta)	60 – 550	—
P_D	Absolute minimum power dissipation	>1.0 (1.5 preferred)	W
I_{CMaxDC}	Minimum peak collector current	1.0	A
VCE_{SAT}	Collector-to-emitter saturation voltage	200–600[1]	mV
V_{BE}	Base-to-emitter voltage	0.4–1.0	V

[1] Adjust resistor at bipolar transistor collector for 3.3 V/5.0 V to avoid VCE < VCE_{SAT}

4.7 Power up/down sequencing

There is no power sequencing required among power sources during power up and power down, in order to operate within specification but use of the following sequence is strongly recommended when the internal regulator is bypassed:

5 V → 3.3 V and 1.2 V

This is also the normal sequence when the internal regulator is enabled.

Although there are no power up/down sequencing requirements to prevent issues like latch-up, excessive current spikes, etc., the state of the I/O pins during power up/down varies according to table Table 20 for all pins with fast pads and Table 21 for all pins with medium, slow and multi-voltage pads.[1]

Table 20. Power sequence pin states for fast pads

V_{DDE}	V_{RC33}	V_{DD}	Fast (pad_fc)
LOW	X	X	LOW
V_{DDE}	LOW	X	HIGH
V_{DDE}	V_{RC33}	LOW	HIGH IMPEDANCE
V_{DDE}	V_{RC33}	V_{DD}	FUNCTIONAL

Table 21. Power sequence pin states for medium, slow and multi-voltage pads

V_{DDEH}	V_{DD}	Medium (pad_msr_hv) Slow (pad_ssr_hv) Multi-voltage (pad_multv_hv)
LOW	X	LOW
V_{DDEH}	LOW	HIGH IMPEDANCE
V_{DDEH}	V_{DD}	FUNCTIONAL

1.If an external 3.3V external regulator is used to supply current to the 1.2V pass transistor and this supply also supplies current for the other 3.3V supplies, then the 5V supply must always be greater than or equal to the external 3.3V supply.

Table 32. Flash module life

Symbol		Parameter	Conditions	Value		Unit
				Min	Typ	
P/E	C	Number of program/erase cycles per block for 16 Kbyte blocks over the operating temperature range (T_J)	—	100,000	—	cycles
P/E	C	Number of program/erase cycles per block for 32 and 64 Kbyte blocks over operating temperature range (T_J)	—	10,000	100,000	cycles
P/E	C	Number of program/erase cycles per block for 128 Kbyte blocks over the operating temperature range (T_J)	—	1,000	100,000	cycles
Retention	C	Minimum data retention at 85 °C average ambient temperature[1]	Blocks with 0 – 1,000 P/E cycles	20	—	years
			Blocks with 10,000 P/E cycles	10	—	years
			Blocks with 100,000 P/E cycles	5	—	years

[1] Ambient temperature averaged over duration of application, not to exceed recommended product operating temperature range.

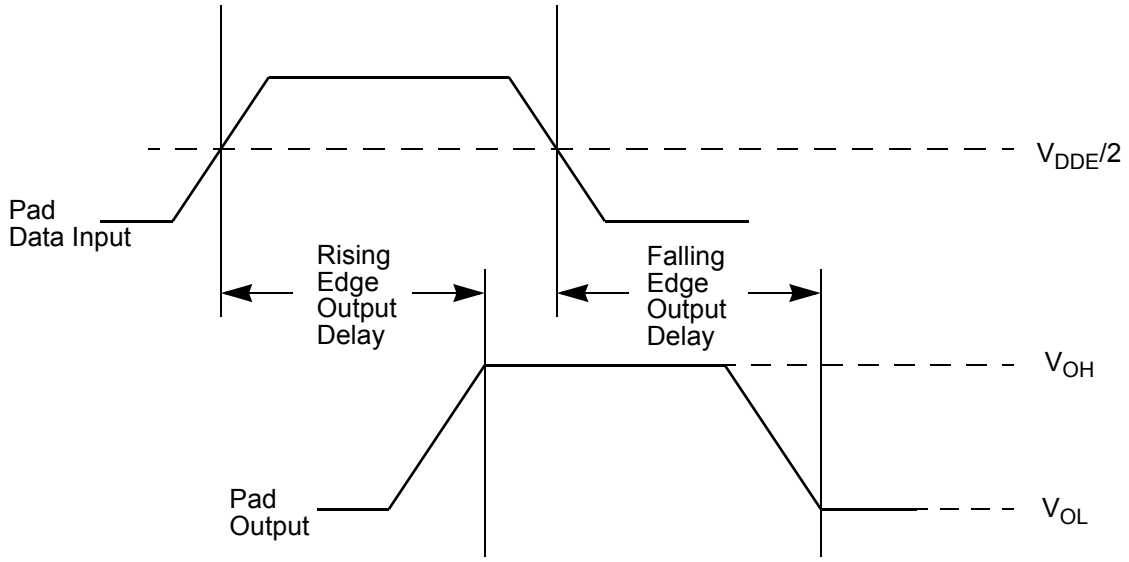


Figure 8. Pad output delay

4.16 AC timing

4.16.1 IEEE 1149.1 interface timing

Table 36. JTAG pin AC electrical characteristics[1]

#	Symbol		C	Characteristic	Min. Value	Max. Value	Unit
1	t_{JCYC}	CC	D	TCK Cycle Time	100	—	ns
2	t_{JDC}	CC	D	TCK Clock Pulse Width	40	60	ns
3	$t_{TCKRISE}$	CC	D	TCK Rise and Fall Times (40% – 70%)	—	3	ns
4	t_{TMSS}, t_{TDIS}	CC	D	TMS, TDI Data Setup Time	5	—	ns
5	t_{TMSH}, t_{TDIH}	CC	D	TMS, TDI Data Hold Time	25	—	ns
6	t_{TDOV}	CC	D	TCK Low to TDO Data Valid	—	23	ns
7	t_{TDOI}	CC	D	TCK Low to TDO Data Invalid	0	—	ns
8	t_{TDOHZ}	CC	D	TCK Low to TDO High Impedance	—	20	ns
9	t_{JCMPPW}	CC	D	JCOMP Assertion Time	100	—	ns
10	t_{JCMPS}	CC	D	JCOMP Setup Time to TCK Low	40	—	ns
11	t_{BSDV}	CC	D	TCK Falling Edge to Output Valid	—	50	ns

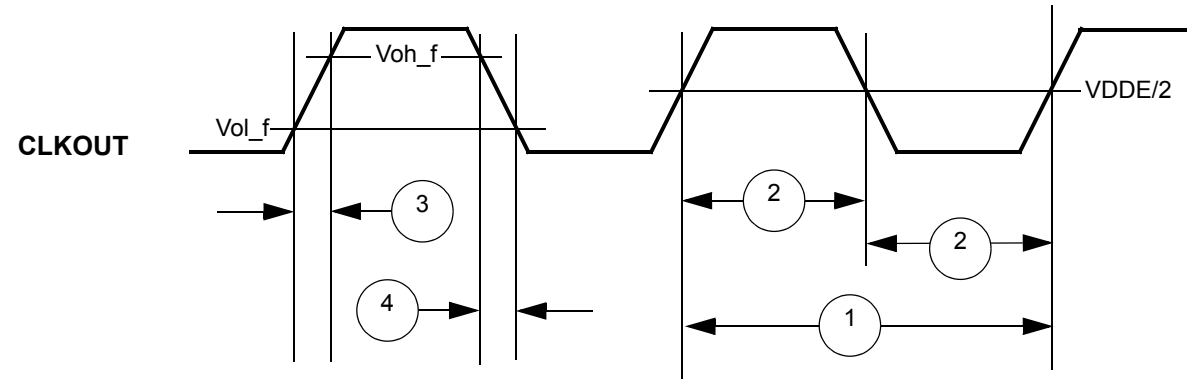


Figure 16. CLKOUT timing

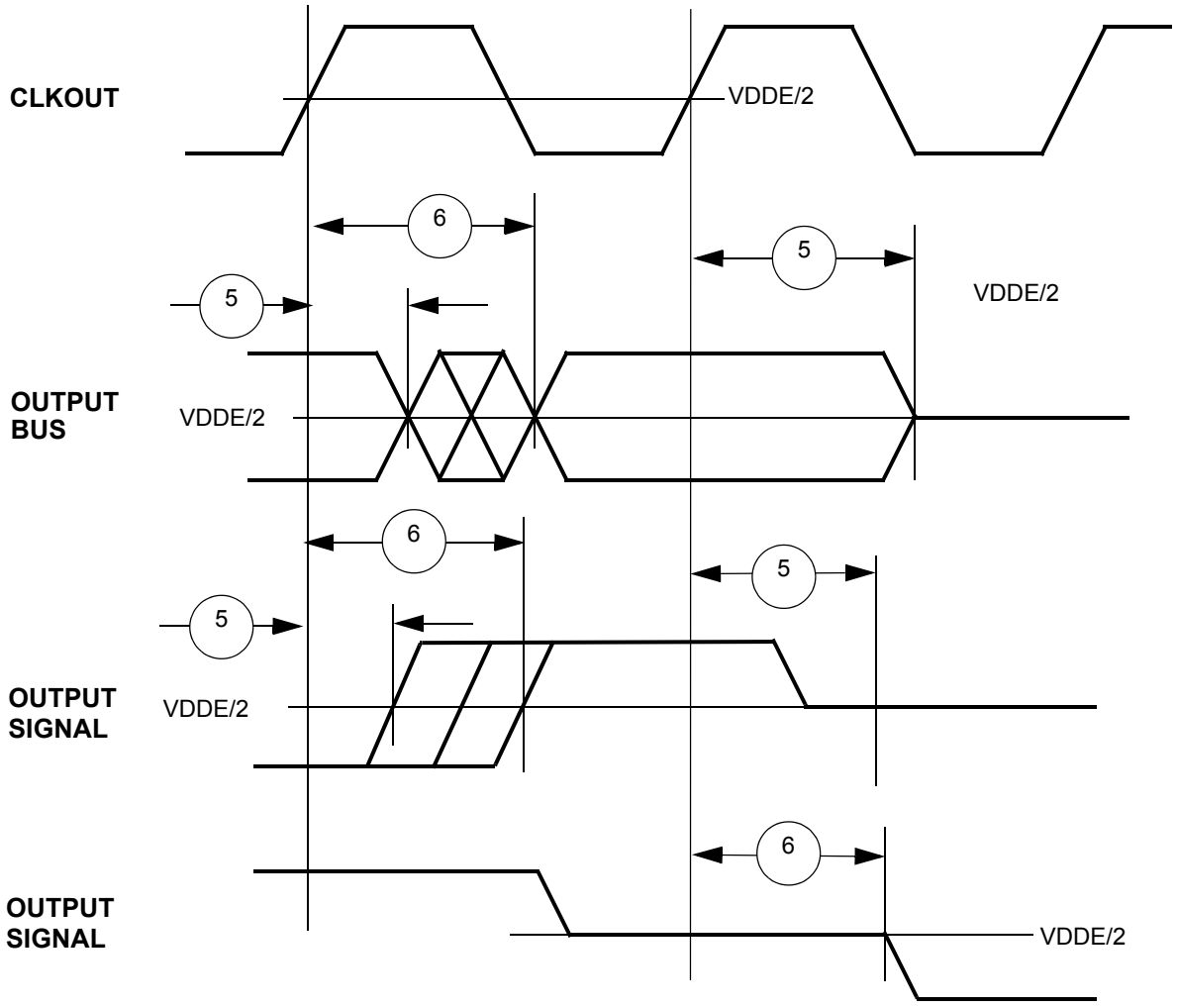
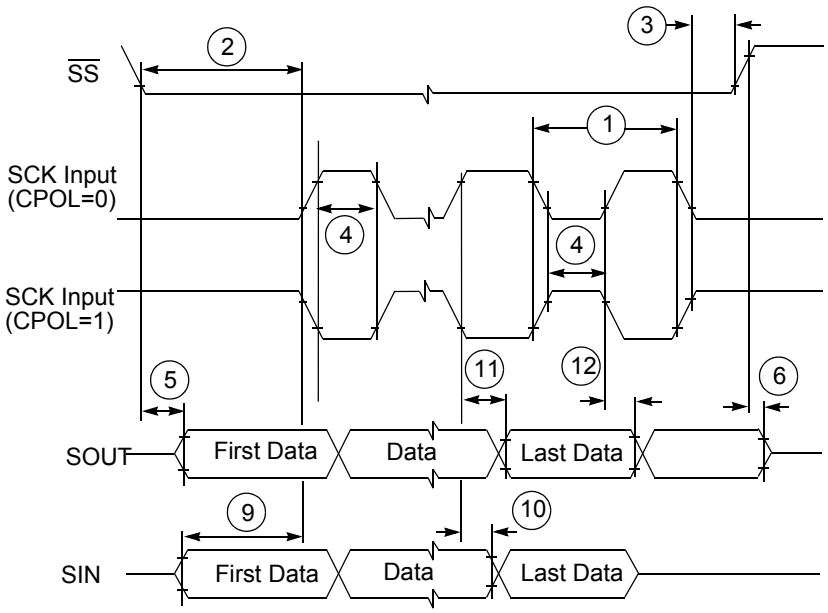
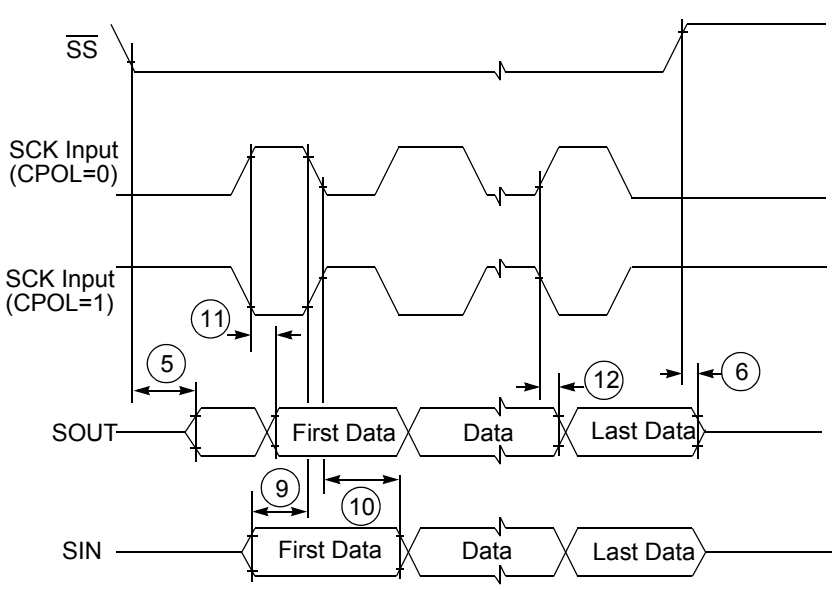


Figure 17. Synchronous output timing



These numbers reference Table 40.

Figure 26. DSPI modified transfer format timing – slave, CPHA =0



These numbers reference Table 40.

Figure 27. DSPI modified transfer format timing – slave, CPHA =1

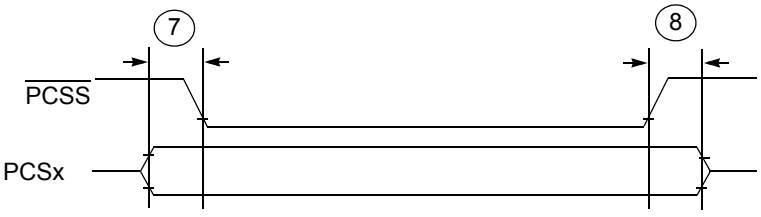


Figure 28. DSPI PCS strobe ($\overline{\text{PCSS}}$) timing

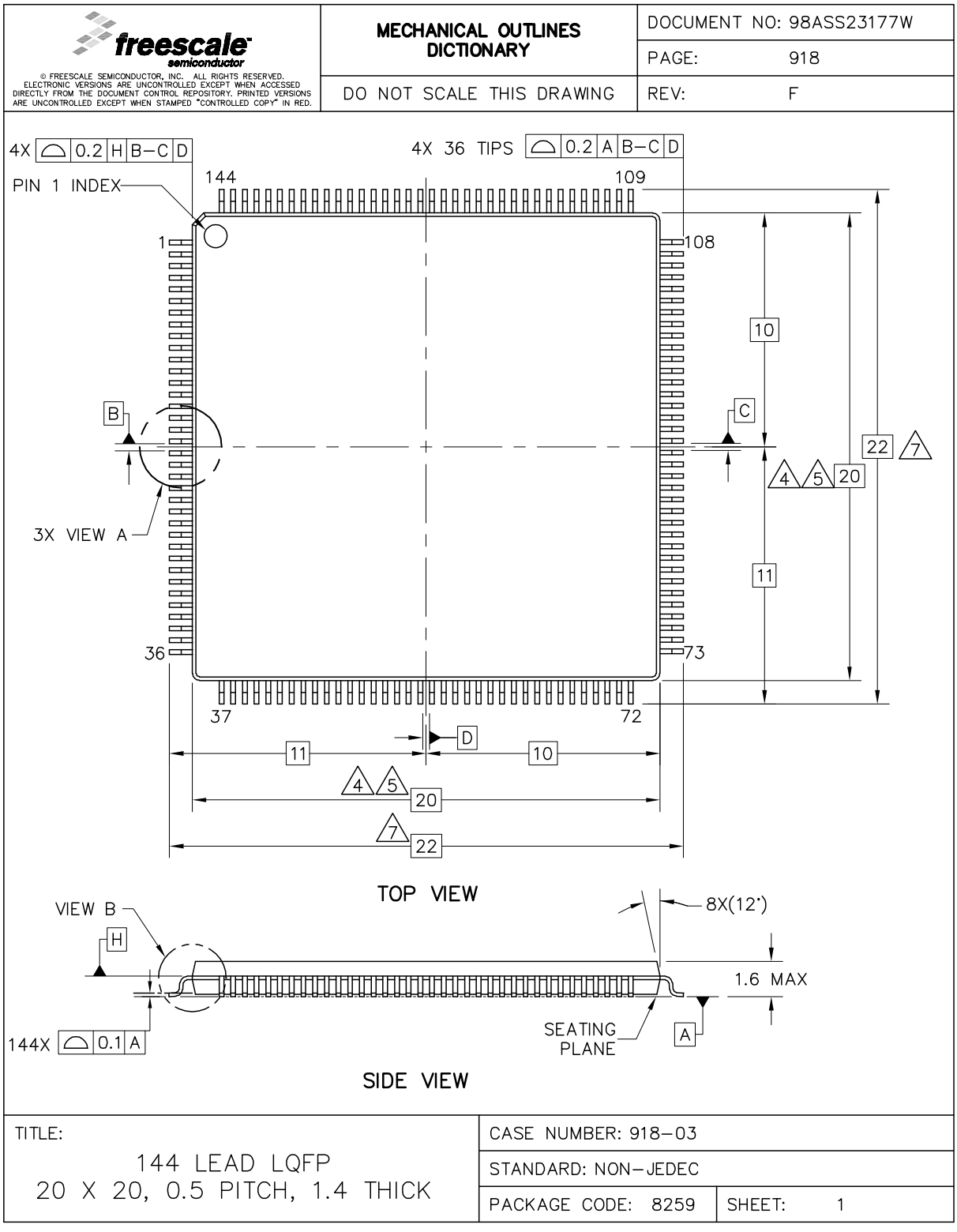
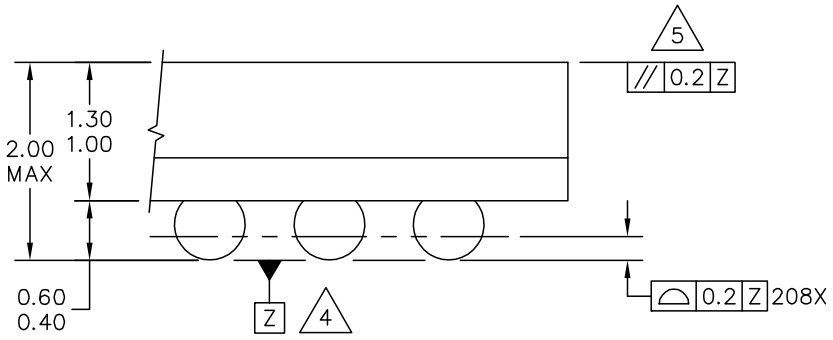


Figure 30. 144 LQFP package mechanical drawing (part 1)

freescale semiconductor	MECHANICAL OUTLINES DICTIONARY	DOCUMENT NO: 98ARS23882W
		PAGE: 1159A
	DO NOT SCALE THIS DRAWING	REV: D



DETAIL K
(ROTATED 90° CLOCKWISE)

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. DIMENSION b IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER, PARALLEL TO DATUM PLANE Z.
4. DATUM Z (SEATING PLANE) IS DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
5. PARALLELISM MEASUREMENT SHALL EXCLUDE ANY EFFECT OF MARK ON TOP SURFACE OF PACKAGE.

TITLE: 208 I/O MAP BGA, 17 X 17 PKG, 1–MM PITCH	CASE NUMBER: 1159A–01	
	STANDARD: JEDEC MO–151 AAF–1	
	PACKAGE CODE: 5253	SHEET: 2 OF 3

Figure 37. 208 MAPBGA package mechanical drawing (part 2)

6 Ordering information

Table 42 shows the orderable part numbers for the MPC5634M series.

Table 42. Orderable part number summary

Part Number	Flash/SRAM (Kbytes)	Package	Speed (MHz)
SPC5632MF2MLQ60	768 / 48	144 LQFP Pb-free	60
SPC5632MF2MLQ40	768 / 48	144 LQFP Pb-free	40
SPC5633MF2MMG80	1024 / 64	208 MAPBGA Pb-free	80
SPC5633MF2MLU80	1024 / 64	176 LQFP Pb-free	80
SPC5633MF2MLQ80	1024 / 64	144 LQFP Pb-free	80
SPC5633MF2MMG60	1024 / 64	208 MAPBGA Pb-free	60
SPC5633MF2MLU60	1024 / 64	176 LQFP Pb-free	60
SPC5633MF2MLQ60	1024 / 64	144 LQFP Pb-free	60
SPC5633MF2MLQ40	1024 / 64	144 LQFP Pb-free	40
SPC5634MF2MMG80	1536 / 94	208 MAPBGA Pb-free	80
SPC5634MF2MLU80	1536 / 94	176 LQFP Pb-free	80
SPC5634MF2MLQ80	1536 / 94	144 LQFP Pb-free	80
SPC5634MF2MMG60	1536 / 94	208 MAPBGA Pb-free	60
SPC5634MF2MLU60	1536 / 94	176 LQFP Pb-free	60
SPC5634MF2MLQ60	1536 / 94	144 LQFP Pb-free	60
SPC563M60L3CPBY			
SPC563M60L3CPAY			

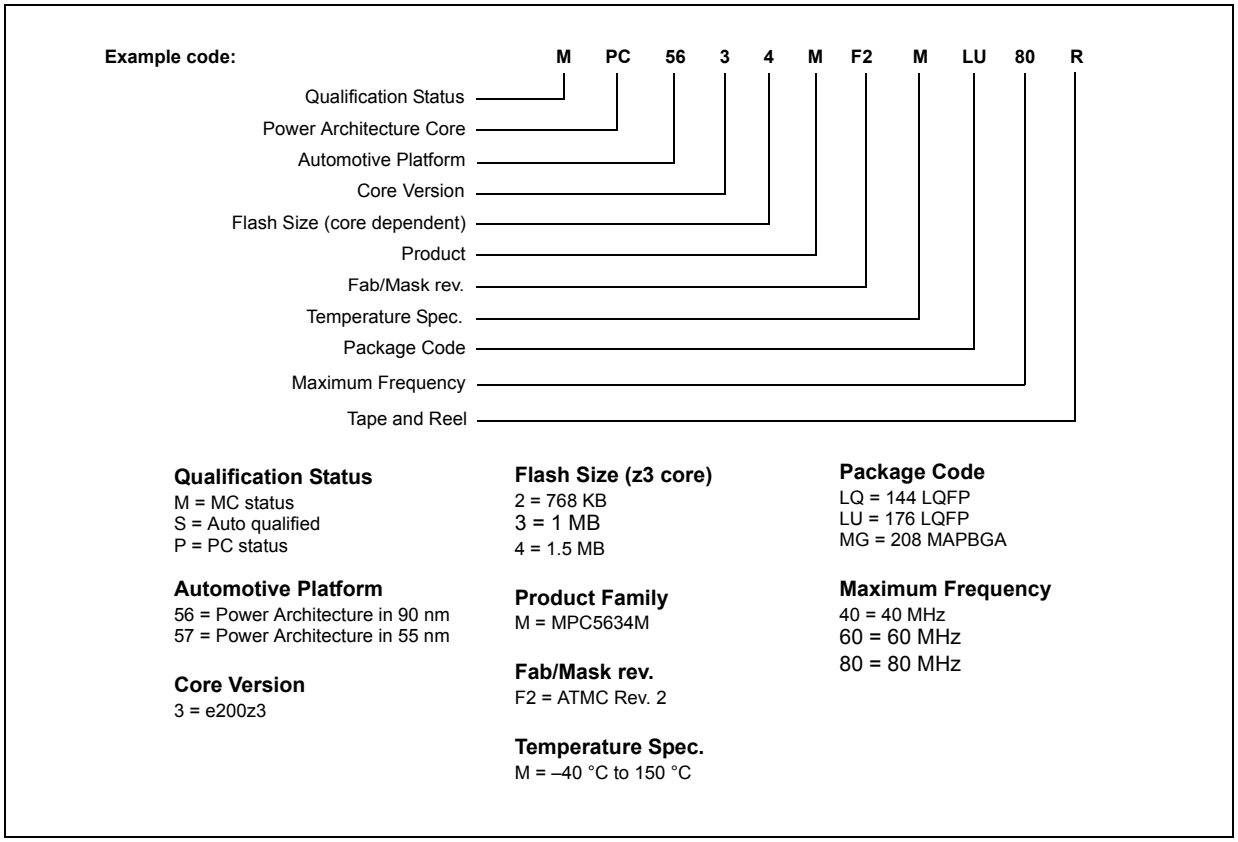


Figure 38. Commercial product code structure