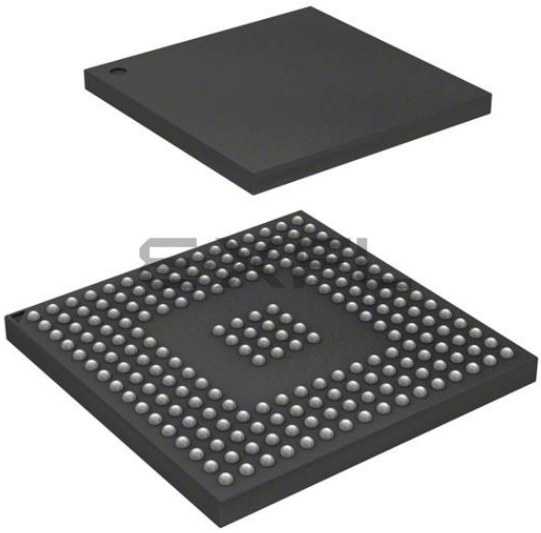

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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	e200z4
Core Size	32-Bit Single-Core
Speed	150MHz
Connectivity	CANbus, EBI/EMI, LINbus, SCI, SPI
Peripherals	DMA, POR, PWM, WDT
Number of I/O	120
Program Memory Size	4MB (4M x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	192K x 8
Voltage - Supply (Vcc/Vdd)	1.14V ~ 5.25V
Data Converters	A/D 40x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	208-BGA
Supplier Device Package	208-BGA (17x17)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/spc5644af0mmg1

and 128- and 256-bit read data interfaces to flash memory. The module contains a prefetch controller which prefetches sequential lines of data from the flash array into the buffers. Prefetch buffer hits allow no-wait responses.

The flash memory provides the following features:

- Supports a 64-bit data bus for instruction fetch, CPU loads and DMA access. Byte, halfword, word and doubleword reads are supported. Only aligned word and doubleword writes are supported.
- Fetch Accelerator
  - Architected to optimize the performance of the flash
  - Configurable read buffering and line prefetch support
  - Four-entry 256-bit wide line read buffer
  - Prefetch controller
- Hardware and software configurable read and write access protections on a per-master basis
- Interface to the flash array controller pipelined with a depth of one, allowing overlapped accesses to proceed in parallel for interleaved or pipelined flash array designs
- Configurable access timing usable in a wide range of system frequencies
- Multiple-mapping support and mapping-based block access timing (0-31 additional cycles) usable for emulation of other memory types
- Software programmable block program/erase restriction control
- Erase of selected block(s)
- Read page size of 128 bits (four words)
- ECC with single-bit correction, double-bit detection
- Program page size of 128 bits (four words) to accelerate programming
- ECC single-bit error corrections are visible to software
- Minimum program size is two consecutive 32-bit words, aligned on a 0-modulo-8 byte address, due to ECC
- Embedded hardware program and erase algorithm
- Erase suspend, program suspend and erase-suspended program
- Shadow information stored in non-volatile shadow block
- Independent program/erase of the shadow block

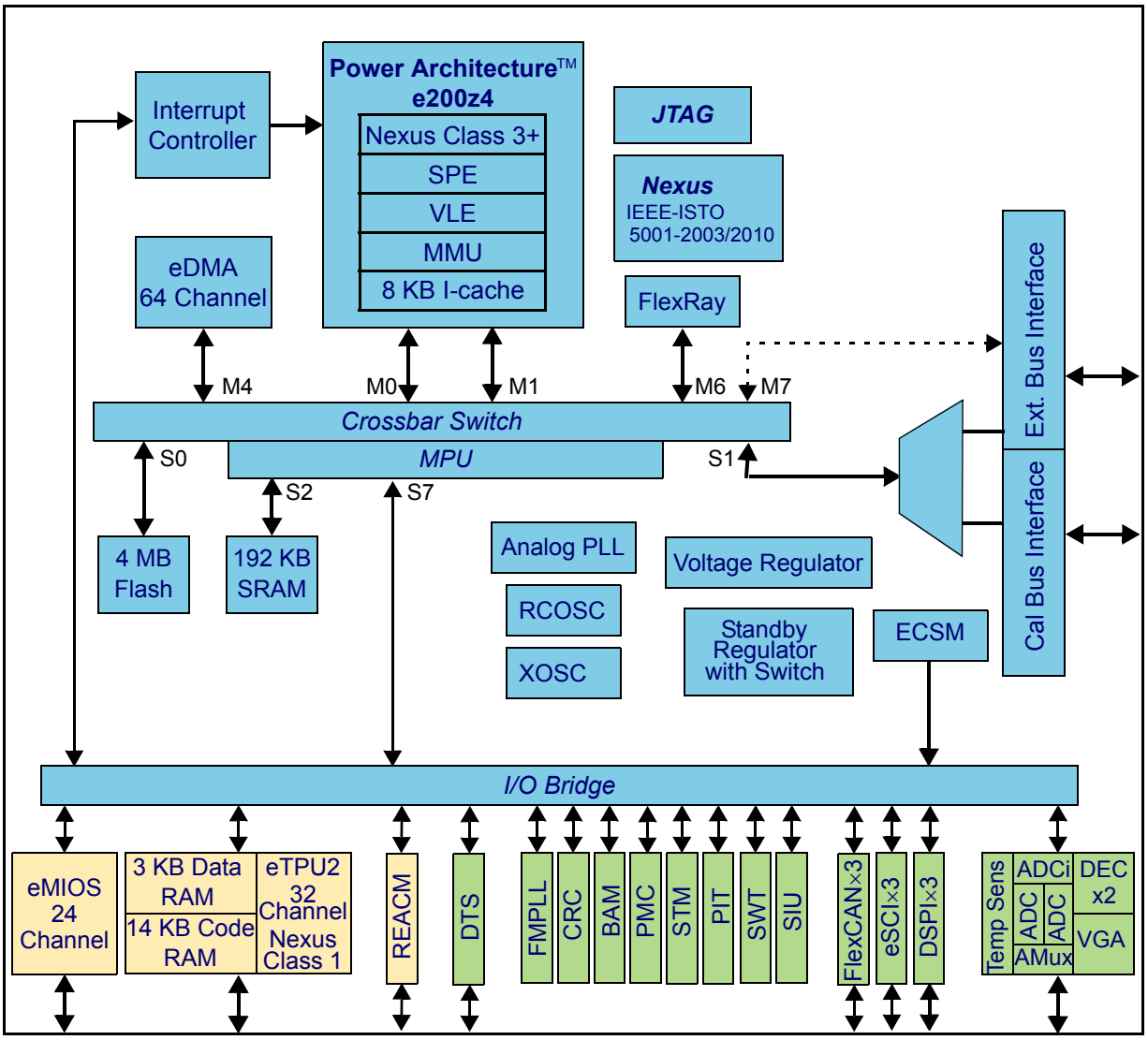
1.4.9 BAM

The BAM (Boot Assist Module) is a block of read-only memory that is programmed once by Freescale and is identical for all MPC5644A MCUs. The BAM program is executed every time the MCU is powered-on or reset in normal mode. The BAM supports different modes of booting. They are:

- Booting from internal flash memory
- Serial boot loading (A program is downloaded into RAM via eSCI or the FlexCAN and then executed)
- Booting from external memory on external bus

The BAM also reads the reset configuration half word (RCHW) from internal flash memory and configures the MPC5644A hardware accordingly. The BAM provides the following features:

- Sets up MMU to cover all resources and mapping of all physical addresses to logical addresses with minimum address translation
- Sets up MMU to allow user boot code to execute as either Power Architecture embedded category (default) or as Freescale VLE code
- Location and 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



LEGEND

ADC	– Analog to Digital Converter	**JTAG**	– IEEE 1149.1 test controller
ADCi	– ADC interface	**MMU**	– Memory Management Unit
AMux	– Analog Multiplexer	**MPU**	– Memory Protection Unit
BAM	– Boot Assist Module	**PMC**	– Power Management Controller
CRC	– Cyclic Redundancy Check unit	**PIT**	– Periodic Interrupt Timer
DEC	– Decimation Filter	**RCOSC**	– low-speed RC oscillator
DTS	– Development Trigger Semaphore	**REACM**	– Reaction module
DSPI	– Deserial/Serial Peripheral Interface	**SIU**	– System Integration Unit
EBI	– External Bus Interface	**SPE**	– Signal Processing Extension
ECSM	– Error Correction Status Module	**SRAM**	– Static RAM
eDMA	– Enhanced Direct Memory Access	**STM**	– System Timer Module
eMIOS	– Enhanced Modular Input Output System	**SWT**	– Software Watchdog Timer
eSCI	– Enhanced Serial Communications Interface	**VGA**	– Variable Gain Amplifier
eTPU2	– Second gen. Enhanced Time Processing Unit	**VLE**	– Variable Length (instruction) Encoding
FlexCAN	– Controller Area Network (FlexCAN)	**XOSC**	– XTAL Oscillator
FMPLL	– Frequency-Modulated Phase Locked Loop		

Figure 1. MPC5644A series block diagram

Table 3. MPC5644A signal properties (continued)

Name	Function[1]	PAG[2]	PCR PA Field[3]	PCR[4]	I/O Type	Voltage[5] / Pad Type[6]	Status[7]		Package pin #		
							During Reset	After Reset	176	208	324
CAL_DATA[2]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_DATA[3]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_DATA[4]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_DATA[5]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_DATA[6]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_DATA[7]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_DATA[8]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_DATA[9]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_DATA[10]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_DATA[11]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_DATA[12]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_DATA[13]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_DATA[14]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_DATA[15]	Calibration data bus	P	01	341	I/O	VDDE12 Fast	— / Up	— / Up	—	—	—
CAL_RD_WR	Calibration read/write enable	P	01	342	O	VDDE12 Fast		— / —	—	—	—
CAL_$\overline{WE}$[0]/$\overline{BE}$[0]	Calibration write/byte enable	P	01	342	O	VDDE12 Fast		— / —	—	—	—

Table 3. MPC5644A signal properties (continued)

Name	Function[1]	PAG[2]	PCR PA Field[3]	PCR[4]	I/O Type	Voltage[5] / Pad Type[6]	Status[7]		Package pin #		
							During Reset	After Reset	176	208	324
CAL_$\overline{WE}$[1]/$\overline{BE}$[1]	Calibration write/byte enable	P	01	342	O	VDDE12 Fast		— / —	—	—	—
CAL_OE	Calibration output enable	P	01	342	O	VDDE12 Fast		— / —	—	—	—
CAL_TS CAL_ALE	Calibration transfer start Address Latch Enable	P A	01 10	343	O O	VDDE12 Fast		— / —	—	—	—
CAL_MDO[4]	Calibration Nexus Message Data Out	P	01	—	O	VDDE12 Fast	—	CAL_MDO[4] / —	—	—	—
CAL_MDO[5]	Calibration Nexus Message Data Out	P	01	—	O	VDDE12 Fast	—	CAL_MDO[5] / —	—	—	—
CAL_MDO[6]	Calibration Nexus Message Data Out	P	01	—	O	VDDE12 Fast	—	CAL_MDO[6] / —	—	—	—
CAL_MDO[7]	Calibration Nexus Message Data Out	P	01	—	O	VDDE12 Fast	—	CAL_MDO[7] / —	—	—	—
CAL_MDO[8]	Calibration Nexus Message Data Out	P	01	—	O	VDDE12 Fast	—	CAL_MDO[8] / —	—	—	—
CAL_MDO[9]	Calibration Nexus Message Data Out	P	01	—	O	VDDE12 Fast	—	CAL_MDO[9] / —	—	—	—
CAL_MDO[10]	Calibration Nexus Message Data Out	P	01	—	O	VDDE12 Fast	—	CAL_MDO[10] / —	—	—	—
CAL_MDO[11]	Calibration Nexus Message Data Out	P	01	—	O	VDDE12 Fast	—	CAL_MDO[11] / —	—	—	—
NEXUS											
$\overline{EVTI}$	Nexus event in	P	01	231	I	VDDEH7 MultiV[12,14]	— / Up	$\overline{EVTI}$ / Up	116	E15	H20
$\overline{EVTO}$	Nexus event out	P	01	227	O	VDDEH7 MultiV[12,14,15]	—	$\overline{EVTO}$ / —	120	D15	G20
MCKO	Nexus message clock out	P	—	219[11]	O	VRC33 Fast	—	MCKO / —	14	F15	F1
MDO0[16]	Nexus message data out	P	01	220	O	VRC33 Fast	—	MDO[0] / —	17	A14	F3
MDO1[16]	Nexus message data out	P	01	221	O	VRC33 Fast	—	MDO[1] / —	18	B14	G2

Table 3. MPC5644A signal properties (continued)

Name	Function[1]	PAG[2]	PCR PA Field[3]	PCR[4]	I/O Type	Voltage[5] / Pad Type[6]	Status[7]		Package pin #		
							During Reset	After Reset	176	208	324
TCK	JTAG test clock input	P	01	—	I	VDDEH7 MultiV[12]	TCK / Down	TCK / Down	128	C16	D21
TDI	JTAG test data input	P	01	232	I	VDDEH7 MultiV[12]	TDI / Up	TDI / Up	130	E14	D22
TDO	JTAG test data output	P	01	228	O	VDDEH7 MultiV[12]	TDO / Up	TDO / Up	123	F14	E21
TMS	JTAG test mode select input	P	01	—	I	VDDEH7 MultiV[12]	TMS / Up	TMS / Up	131	D14	E20
JCOMP	JTAG TAP controller enable	P	01	—	I	VDDEH7 MultiV[12]	JCOMP / Down	JCOMP / Down	121	F16	F20
FlexCAN											
CAN_A_TX SCI_A_TX GPIO[83]	FlexCAN A TX eSCI A TX GPIO	P A1 G	01 10 00	83	O O I/O	VDDEH6 Slow	— / Up	— / Up	81	P12	AB19
CAN_A_RX SCI_A_RX GPIO[84]	FlexCAN A RX eSCI A RX GPIO	P A1 G	01 10 00	84	I I I/O	VDDEH6 Slow	— / Up	— / Up	82	R12	Y19
CAN_B_TX DSPI_C_PCS[3] SCI_C_TX GPIO[85]	FlexCAN B TX DSPI C peripheral chip select eSCI C TX GPIO	P A1 A2 G	001 010 100 000	85	O O O I/O	VDDEH6 Slow	— / Up	— / Up	88	T12	Y22
CAN_B_RX DSPI_C_PCS[4] SCI_C_RX GPIO[86]	FlexCAN B RX DSPI C peripheral chip select eSCI C RX GPIO	P A1 A2 G	001 010 100 000	86	I O I I/O	VDDEH6 Slow	— / Up	— / Up	89	R13	W21
CAN_C_TX DSPI_D_PCS[3] GPIO[87]	FlexCAN C TX DSPI D peripheral chip select GPIO	P A1 G	01 10 00	87	O O I/O	VDDEH6 Medium	— / Up	— / Up	101	K13	P19
CAN_C_RX DSPI_D_PCS[4] GPIO[88]	FlexCAN C RX DSPI D peripheral chip select GPIO	P A1 G	01 10 00	88	I O I/O	VDDEH6 Slow	— / Up	— / Up	98	L14	V20
eSCI											

Table 3. MPC5644A signal properties (continued)

Name	Function[1]	PAG[2]	PCR PA Field[3]	PCR[4]	I/O Type	Voltage[5] / Pad Type[6]	Status[7]		Package pin #		
							During Reset	After Reset	176	208	324
eQADC											
AN0[18] DAN0+	Single Ended Analog Input Positive Terminal Diff. Input	P	—	—	I I	VDDA Analog	I / —	AN[0] / —	172	B5	C6
AN1[18] DAN0-	Single Ended Analog Input Negative Terminal Diff. Input	P	—	—	I I	VDDA Analog	I / —	AN[1] / —	171	A6	C7
AN2[18] DAN1+	Single Ended Analog Input Positive Terminal Diff. Input	P	—	—	I I	VDDA Analog	I / —	AN[2] / —	170	D6	D7
AN3[18] DAN1-	Single Ended Analog Input Negative Terminal Diff. Input	P	—	—	I I	VDDA Analog	I / —	AN[3] / —	169	C7	D8
AN4[18] DAN2+	Single Ended Analog Input Positive Terminal Diff. Input	P	—	—	I I	VDDA Analog	I / —	AN[4] / —	168	B6	B7
AN5[18] DAN2-	Single Ended Analog Input Negative Terminal Diff. Input	P	—	—	I I	VDDA Analog	I / —	AN[5] / —	167	A7	B8
AN6[18] DAN3+	Single Ended Analog Input Positive Terminal Diff. Input	P	—	—	I I	VDDA Analog	I / —	AN[6] / —	166	D7	C8
AN7[18] DAN3-	Single Ended Analog Input Negative Terminal Diff. Input	P	—	—	I I	VDDA Analog	I / —	AN[7] / —	165	C8	C9
AN8 ANW	Single-ended Analog Input Multiplexed Analog Input	P	01	—	I	VDDA Analog	I / —	AN[8] / —	9	B3	E1
AN9 ANX	Single-ended Analog Input External Multiplexed Analog Input	P	01	—	I I	VDDA Analog	I / —	AN[9] / —	5	A2	C2
AN10 ANY	Single-ended Analog Input Multiplexed Analog Input	P	01	—	I	VDDA Analog	I / —	AN[10] / —	—	—	D1
AN11 ANZ	Single-ended Analog Input Multiplexed Analog Input	P	01	—	I	VDDA Analog	I / —	AN[11] / —	4	A3	C1
AN12 - SDS MA0 ETPUA19_O[8] $\overline{SDS}$	Single-ended Analog Input MUX Address 0 eTPU A channel (output only) eQADC Serial Data Select	P A1 A2 G	001 010 100 000	215	I O O I/O	VDDEH7[19] Medium	I / —	AN[12] / —	148	A12	C13
AN13 - SDO MA1 ETPUA21_O[8] SDO	Single-ended Analog Input MUX Address 1 eTPU A channel (output only) eQADC Serial Data Out	P A1 A2 G	001 010 100 000	216	I O O O	VDDEH7[19] Medium	I / —	AN[13] / —	147	B12	B13

Table 3. MPC5644A signal properties (continued)

Name	Function[1]	PAG[2]	PCR PA Field[3]	PCR[4]	I/O Type	Voltage[5] / Pad Type[6]	Status[7]		Package pin #		
							During Reset	After Reset	176	208	324
AN14 - SDI MA2 ETPUA27_O[8] SDI	Single-ended Analog Input MUX Address 2 eTPU A channel (output only) eQADC Serial Data In	P A1 A2 G	001 010 100 000	217	I O O I	VDDEH7[19] Medium	I / —	AN[14] / —	146	C12	A13
AN15 - FCK FCK ETPUA29_O[8]	Single-ended Analog Input eQADC Free Running Clock eTPU A channel (output only)	P A1 A2	001 010 100	218	I O O	VDDEH7[19] Medium	I / —	AN[15] / —	145	C13	A14
AN16	Single-ended Analog Input	P	—	—	I	VDDA Analog	I / —	AN[16] / —	3	C6	A3
AN17	Single-ended Analog Input	P	—	—	I	VDDA Analog	I / —	AN[17] / —	2	C4	A4
AN18	Single-ended Analog Input	P	—	—	I	VDDA Analog	I / —	AN[18] / —	1	D5	B4
AN19	Single-ended Analog Input	P	—	—	I	VDDA Analog	I / —	AN[19] / —	—	—	D6
AN20	Single-ended Analog Input	P	—	—	I	VDDA Analog	I / —	AN[20] / —	—	—	C5
AN21	Single-ended Analog Input	P	—	—	I	VDDA Analog	I / —	AN[21] / —	173	B4	B6
AN22	Single-ended Analog Input	P	—	—	I	VDDA Analog	I / —	AN[22] / —	161	B8	D9
AN23	Single-ended Analog Input	P	—	—	I	VDDA Analog	I / —	AN[23] / —	160	C9	A8
AN24	Single-ended Analog Input	P	—	—	I	VDDA Analog	I / —	AN[24] / —	159	D8	B9
AN25	Single-ended Analog Input	P	—	—	I	VDDA Analog	I / —	AN[25] / —	158	B9	A9
AN26	Single-ended Analog Input	P	—	—	I	VDDA Analog	I / —	AN[26] / —	—	—	D10
AN27	Single-ended Analog Input	P	—	—	I	VDDA Analog	I / —	AN[27] / —	157	A10	C10
AN28	Single-ended Analog Input	P	—	—	I	VDDA Analog	I / —	AN[28] / —	156	B10	D11

Table 3. MPC5644A signal properties (continued)

Name	Function[1]	PAG[2]	PCR PA Field[3]	PCR[4]	I/O Type	Voltage[5] / Pad Type[6]	Status[7]		Package pin #		
							During Reset	After Reset	176	208	324
ETPUA25 IRQ[13] DSPI_C_SCK_LVDS+ GPIO[139]	eTPU A channel External interrupt request LVDS positive DSPI clock GPIO	P A1 A2 G	001 010 100 000	139	I/O I O I/O	VDDEH1 Medium + LVDS	— / WKPCFG	— / WKPCFG	27	G3	M3
ETPUA26 IRQ[14] DSPI_C_SOUT_LVDS- GPIO[140]	eTPU A channel External interrupt request LVDS negative DSPI data out GPIO	P A1 A2 G	001 010 100 000	140	I/O I O I/O	VDDEH1 Slow + LVDS	— / WKPCFG	— / WKPCFG	26	F3	L2
ETPUA27 IRQ[15] DSPI_C_SOUT_LVDS+ DSPI_B_SOUT GPIO[141]	eTPU A channel External interrupt request LVDS positive DSPI data out DSPI data out GPIO	P A1 A2 A3 G	0001 0010 0100 1000 0000	141	I/O I O O I/O	VDDEH1 Slow + LVDS	— / WKPCFG	— / WKPCFG	25	G2	L1
ETPUA28 DSPI_C_PCS[1] RCH5_B GPIO[142]	eTPU A channel DSPI C peripheral chip select Reaction channel 5B GPIO	P A1 A2 G	001 010 100 000	142	I/O O O I/O	VDDEH1 Medium	— / WKPCFG	— / WKPCFG	24	F1	M4
ETPUA29 DSPI_C_PCS[2] RCH5_C GPIO[143]	eTPU A channel DSPI C peripheral chip select Reaction channel 5C GPIO	P A1 A2 G	001 010 100 000	143	I/O O O I/O	VDDEH1 Medium	— / WKPCFG	— / WKPCFG	23	F2	L3
ETPUA30 DSPI_C_PCS[3] ETPUA11_O[8] GPIO[144]	eTPU A channel DSPI C peripheral chip select eTPU A channel (output only) GPIO	P A1 A2 G	001 010 100 000	144	I/O O O I/O	VDDEH1 Medium	— / WKPCFG	— / WKPCFG	22	E1	L4
ETPUA31 DSPI_C_PCS[4] ETPUA13_O[8] GPIO[145]	eTPU A channel DSPI C peripheral chip select eTPU A channel (output only) GPIO	P A1 A2 G	001 010 100 000	145	I/O O O I/O	VDDEH1 Medium	— / WKPCFG	— / WKPCFG	21	E2	K1
eMIOS											
EMIOS0 ETPUA0_O[8] ETPUA25_O[8] GPIO[179]	eMIOS channel eTPU A channel (output only) eTPU A channel (output only) GPIO	P A1 A2 G	001 010 100 000	179	I/O O O I/O	VDDEH4 Slow	— / Up	— / Up	63	T4	AA12

Table 4. Pad types

Pad Type	Name	I/O Voltage Range
Slow	pad_ssr_hv	3.0V - 5.5 V
Medium	pad_msr_hv	3.0 V - 5.5 V
Fast	pad_fc	3.0 V - 3.6 V
MultiV[1,2]	pad_multv_hv	3.0 V - 5.5 V (high swing mode) 3.0 V - 3.6 V (low swing mode)
Analog	pad_ae_hv	0.0 - 5.5 V
LVDS	pad_lo_lv	—

1 Multivoltage pads are automatically configured in low swing mode when a JTAG or Nexus function is selected, otherwise they are high swing.

2 VDDEH7 supply cannot be below 4.5 V when in low-swing mode.

2.5 Signal details

Table 5. Signal details

Signal	Module or Function	Description
CLKOUT	Clock Generation	MPC5644A clock output for the external/calibration bus interface
ENGCLK	Clock Generation	Clock for external ASIC devices
EXTAL	Clock Generation	Input pin for an external crystal oscillator or an external clock source based on the value driven on the PLLREF pin at reset.
PLLREF	Clock Generation Reset/Configuration	PLLREF is used to select whether the oscillator operates in xtal mode or external reference mode from reset. PLLREF=0 selects external reference mode. On the 324BGA package, PLLREF is bonded to the ball used for PLLCFG[0] for compatibility with MPC55xx devices . For the 176-pin QFP and 208-ball BGA packages: 0: External reference clock is selected. 1: XTAL oscillator mode is selected For the 324 ball BGA package: If RSTCFG is 0: 0: External reference clock is selected. 1: XTAL oscillator mode is selected. If RSTCFG is 1, XTAL oscillator mode is selected.
XTAL	Clock Generation	Crystal oscillator input
DSPI_B_SCK_LVDS- DSPI_B_SCK_LVDS+	DSPI	LVDS pair used for DSPI_B TSB mode transmission
DSPI_B_SOUT_LVDS- DSPI_B_SOUT_LVDS+	DSPI	LVDS pair used for DSPI_B TSB mode transmission
DSPI_C_SCK_LVDS- DSPI_C_SCK_LVDS+	DSPI	LVDS pair used for DSPI_C TSB mode transmission

Table 15. PMC Electrical Characteristics

ID	Name			Parameter	Min	Typ	Max	Unit	Notes
1	VBG	CC	C	Nominal bandgap voltage reference	—	1.219	—	V	
1a	—	CC	P	Untrimmed bandgap reference voltage	VBG - 7%	VBG	Vbg + 6%	V	
1b	—	CC	P	Trimmed bandgap reference voltage (5 V, 27 °C)	VBG -10mV	VBG	VBG + 10mV	V	
1c	—	CC	C	Bandgap reference temperature variation	—	100	—	ppm /°C	
1d	—	CC	C	Bandgap reference supply voltage variation	—	3000	—	ppm /V	
2	Vdd	CC	C	Nominal V_{DD} core supply internal regulator target DC output voltage[1]	—	1.28	—	V	
2a	—	CC	P	Nominal V_{DD} core supply internal regulator target DC output voltage variation at power-on reset	Vdd - 6%	Vdd	Vdd + 10%	V	
2b	—	CC	P	Nominal V_{DD} core supply internal regulator target DC output voltage variation after power-on reset	Vdd - 10%[2]	Vdd	Vdd + 3%	V	
2c	—	CC	C	Trimming step Vdd	—	20	—	mV	
2d	Ivrcctl	CC	C	Voltage regulator controller for core supply maximum DC output current	20	—	—	mA	
3	Lvi1p2	CC	C	Nominal LVI for rising core supply[3]	—	1.160	—	V	
3a	—	CC	C	Variation of LVI for rising core supply at power-on reset	1.120	1.200	1.280	V	See note [4]
3b	—	CC	C	Variation of LVI for rising core supply after power-on reset	Lvi1p2 - 3%	Lvi1p2	Lvi1p2 + 3%	V	See note 4
3c	—	CC	C	Trimming step LVI core supply	—	20	—	mV	
3d	Lvi1p2_h	CC	C	LVI core supply hysteresis	—	40	—	mV	
4	Por1.2V_r	CC	C	POR 1.2 V rising	—	0.709	—	V	
4a	—	CC	C	POR 1.2 V rising variation	Por1.2V_r - 35%	Por1.2V_r	Por1.2V_r + 35%	V	
4b	Por1.2V_f	CC	C	POR 1.2 V falling	—	0.638	—	V	
4c	—	CC	C	POR 1.2 V falling variation	Por1.2V_f - 35%	Por1.2V_f	Por1.2V_f+ 35%	V	

2 BETA represents the worst-case external transistor. It is measured on a per-part basis and calculated as ($I_{DD} \div I_{VRCCTL}$).

3 Refer to Table 52 for the maximum operating frequency.

4 Values are based on I_{DD} from high-use applications as explained in the I_{DD} Electrical Specification.

3.6.2 Regulator Example

In designs where the MPC5644A microcontroller's internal regulators are used, a ballast is required for generation of the 1.2 V internal supply. No ballast is required when an external 1.2 V supply is used.

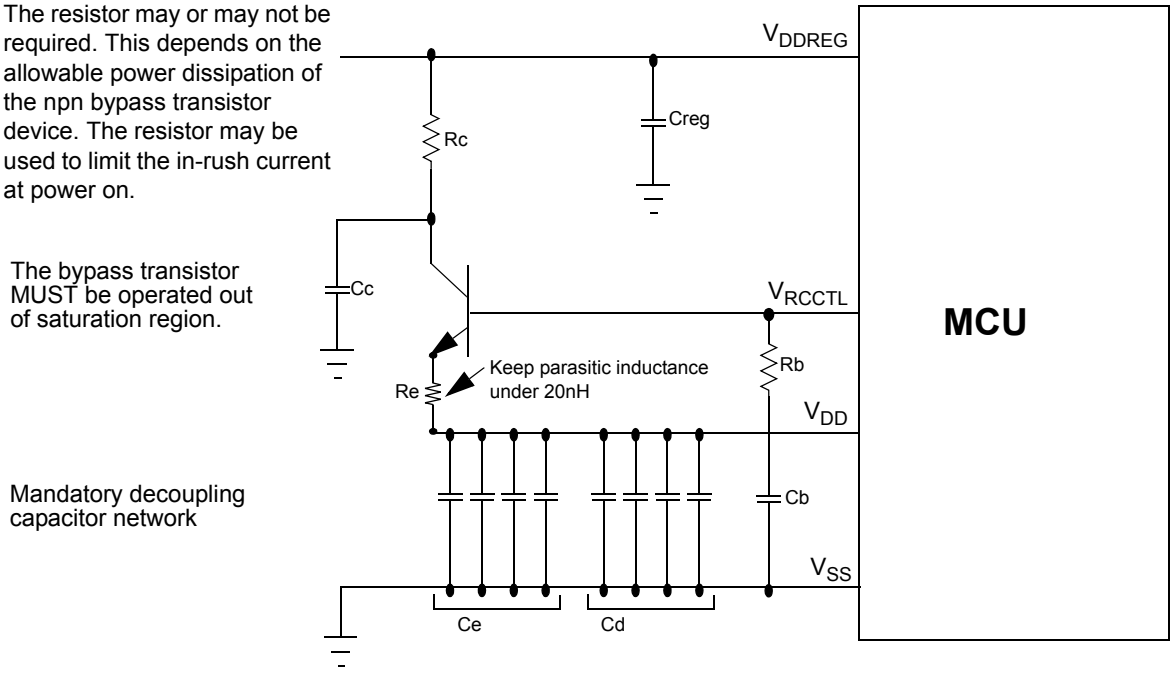


Figure 8. Core voltage regulator controller external components preferred configuration

Table 17. MPC5644A External network specification

External Network Parameter	Min	Typ	Max	Comment
T1				NJD2873 or BCP68 only
Cb	1.1 µF	2.2µF	2.97µF	X7R,-50%/+35%
Ce	3*2.35µF+5µF	3*4.7µF+10µF	3*6.35µF+13.5µF	X7R, -50%/+35%
Equivalent ESR of Ce capacitors	5mΩ		50mΩ	
Cd	4*50nF	4*100nF	4*135nF	X7R, -50%/+35%
Rb	9Ω	10Ω	11Ω	+/-10%

Table 21. DC electrical specifications (continued)

Symbol		C	Parameter	Conditions	Value			Unit
					min	typ	max	
V_{DDREG}	SR	—	Voltage regulator supply voltage	—	4.75	—	5.25	V
V_{DDPLL}	SR	—	Clock synthesizer operating voltage	—	1.14	—	1.32	V
V_{SSPLL} – V_{SS}	SR	—	V_{SSPLL} to V_{SS} differential voltage	—	–100	—	100	mV
V_{IL_S}	CC	C	Slow/medium I/O pad input low voltage	Hysteresis enabled	V_{SS}-0.3	—	0.35*V_{DDEH}	V
		P		Hysteresis disabled	V_{SS}-0.3	—	0.40*V_{DDEH}	
V_{IL_F}	CC	C	Fast pad I/O input low voltage	Hysteresis enabled	V_{SS}-0.3	—	0.35*V_{DDE}	V
		P		Hysteresis disabled	V_{SS}-0.3	—	0.40*V_{DDE}	
V_{IL_LS}	CC	C	Multi-voltage I/O pad input low voltage in Low-swing-mode[5,6,7,8]	Hysteresis enabled	V_{SS}-0.3	—	0.8	V
		P		Hysteresis disabled	V_{SS}-0.3	—	1.1	
V_{IL_HS}	CC	C	Multi-voltage pad I/O input low voltage in high-swing-mode	Hysteresis enabled	V_{SS}-0.3	—	0.35 V_{DDEH}	V
		P		Hysteresis disabled	V_{SS}-0.3	—	0.4 V_{DDEH}	
V_{IH_S}	CC	C	Slow/medium pad I/O input high voltage[9]	Hysteresis enabled	0.65 V_{DDEH}	—	V_{DDEH}+0.3	V
		P		Hysteresis disabled	0.55 V_{DDEH}	—	V_{DDEH}+0.3	
V_{IH_F}	CC	C	Fast I/O input high voltage	Hysteresis enabled	0.65 V_{DDE}	—	V_{DDE}+0.3	V
		P		Hysteresis disabled	0.58 V_{DDE}	—	V_{DDE}+0.3	
V_{IH_LS}	CC	C	Multi-voltage pad I/O input high voltage in low-swing-mode[5,6,7,8]	Hysteresis enabled	2.5	—	V_{DDEH}+0.3	V
		P		Hysteresis disabled	2.2	—	V_{DDEH}+0.3	
V_{IH_HS}	CC	C	Multi-voltage I/O input high voltage in high-swing-mode	Hysteresis enabled	0.65 V_{DDEH}	—	V_{DDEH}+0.3	V
		P		Hysteresis disabled	0.55 V_{DDEH}	—	V_{DDEH}+0.3	

Table 21. DC electrical specifications (continued)

Symbol		C	Parameter	Conditions	Value			Unit
					min	typ	max	
C_L	CC	D	Load capacitance (fast I/O)[18]	DSC(PCR[8:9]) = 0b00	—		10	pF
		D		DSC(PCR[8:9]) = 0b01	—		20	
		D		DSC(PCR[8:9]) = 0b10	—		30	
		D		DSC(PCR[8:9]) = 0b11	—		50	
C_{IN}	CC	D	Input capacitance (digital pins)	—	—		7	pF
C_{IN_A}	CC	D	Input capacitance (analog pins)	—	—		10	pF
C_{IN_M}	CC	D	Input capacitance (digital and analog pins[19])	—	—		12	pF
$R_{PUPD200K}$	SR	P	Weak Pull-Up/Down Resistance[20], 200 kΩ Option	—	130	—	280	kΩ
$R_{PUPD100K}$	SR	P	Weak Pull-Up/Down Resistance[20], 100 kΩ Option	—	65	—	140	kΩ
R_{PUPD5K}	SR	C	Weak Pull-Up/Down Resistance[20], 5 kΩ Option	5 V ± 5% supply	1.4	—	7.5	kΩ
$R_{PUPDMTCH}$	CC	C	Pull-up/Down Resistance matching ratios (100K/200K)	Pull-up and pull-down resistances both enabled and settings are equal.	–2.5	—	2.5	%
T_A (T_L to T_H)	SR	—	Operating temperature range - ambient (packaged)	—	–40.0		125.0	°C
—	SR	—	Slew rate on power supply pins	—	—		25	V/ms

1 These specifications apply when V_{RC33} is supplied externally, after disabling the internal regulator (V_{DDREG} = 0).

2 ADC is functional with 4 V ≤ V_{DDA} ≤ 4.75 V but with derated accuracy. This means the ADC will continue to function at full speed with no undesirable behavior, but the accuracy will be degraded.

3 The V_{DDF} supply is connected to V_{DD} in the package substrate. This specification applies to calibration package devices only.

3.9.1 I/O pad V_{RC33} current specifications

The power consumption of the V_{RC33} supply is dependent on the usage of the pins on all I/O segments. The power consumption is the sum of all input and output pin V_{RC33} currents for all I/O segments. The output pin V_{RC33} current can be calculated from Table 23 based on the voltage, frequency, and load on all fast pad pins. The input pin V_{RC33} current can be calculated from Table 23 based on the voltage, frequency, and load on all medium-speed pads. Use linear scaling to calculate pin currents for voltage, frequency, and load parameters that fall outside the values given in Table 23.

Table 23. I/O pad V_{RC33} average I_{DDE} specifications[1]

Pad Type	Symbol		C	Period (ns)	Load[2] (pF)	Drive Select	I_{DD33} Avg (µA)	I_{DD33} RMS (µA)
Slow	$I_{DRV\_SSR\_HV}$	CC	D	100	50	11	0.8	235.7
		CC	D	200	50	01	0.04	87.4
		CC	D	800	50	00	0.06	47.4
		CC	D	800	200	00	0.009	47
Medium	$I_{DRV\_MSR\_HV}$	CC	D	40	50	11	2.75	258
		CC	D	100	50	01	0.11	76.5
		CC	D	500	50	00	0.02	56.2
		CC	D	500	200	00	0.01	56.2
MultiV[3] (High Swing Mode)	$I_{DRV\_MULTV\_HV}$	CC	D	20	50	11	33.4	35.4
		CC	D	30	50	01	33.4	34.8
		CC	D	117	50	00	33.4	33.8
		CC	D	212	200	00	33.4	33.7
MultiV[4] (Low Swing Mode)	$I_{DRV\_MULTV\_HV}$	CC	D	30	30	11	33.4	34.9

1 These are typical values that are estimated from simulation and not tested. Currents apply to output pins only.

2 All loads are lumped.

3 Average current is for pad configured as output only.

4 In low swing mode, multi-voltage pads must operate in highest slew rate setting.

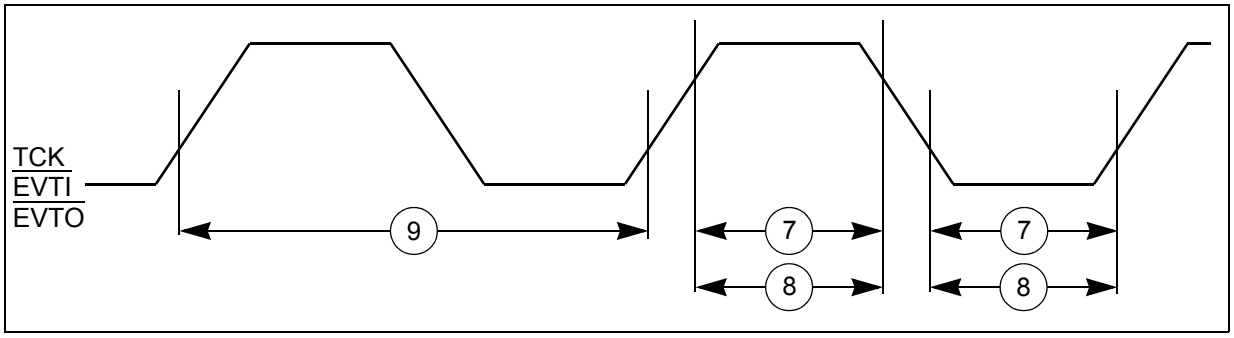


Figure 16. Nexus event trigger and test clock timings

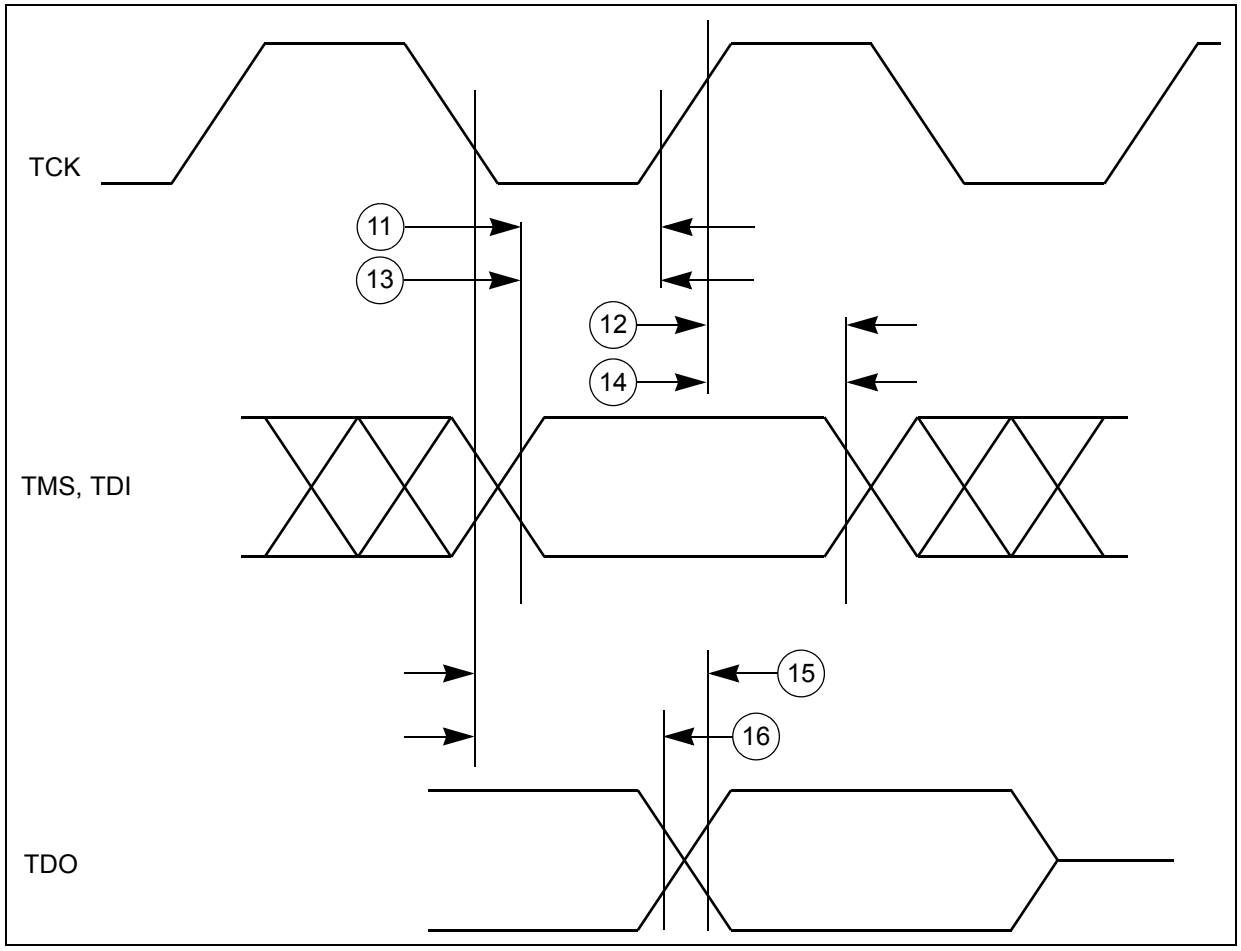


Figure 17. Nexus TDI, TMS, TDO timing

3.17.4 External Bus Interface (EBI) and calibration bus interface timing

Table 41. External Bus Interface maximum operating frequency

Port Width	Multiplexed Mode	ADDR[12:15] Pin Usage	ADDR[16:31] Pin Usage	DATA[0:15] Pin Usage	Max. Operating Frequency
16-bit	Yes	ADDR[12:15]	GPIO	ADDR[16:31] DATA[0:15]	66 MHz[1]
16-bit	No	ADDR[12:15]	ADDR[16:31]	DATA[0:15]	33 MHz[2,3]
32-bit	Yes	ADDR[12:15]	ADDR[16:31] DATA[16:31]	DATA[0:15]	33 MHz[2,3]

1 Set SIU_ECCR[EBDF] to divide by two or divide by four if the system frequency is greater than 66 MHz.

2 System Frequency must be ≤132 MHz and SIU_ECCR[EBDF] set to divide by four.

3 Pad restrictions limit the maximum operating frequency.

Table 42. Calibration bus interface maximum operating frequency

Port Width	Multiplexed Mode	CAL_ADDR[12:15] Pin Usage	CAL_ADDR[16:30] Pin Usage	CAL_DATA[0:15] Pin Usage	Max. Operating Frequency
16-bit	Yes	GPIO	GPIO	CAL_ADDR[12:30] CAL_DATA[0:15]	66 MHz[1]
16-bit	No	CAL_ADDR[12:15]	CAL_ADDR[16:30]	CAL_DATA[0:15]	66 MHz[1]
32-bit	Yes	CAL_WE[2:3] CAL_DATA[31]	CAL_ADDR[16:30] CAL_DATA[16:30]	CAL_ADDR[0:15] CAL_DATA[0:15]	66 MHz[1]

1 Set SIU_ECCR[EBDF] to divide by two or divide by four if the system frequency is greater than 66 MHz

Table 43. External bus interface (EBI) and calibration bus operation timing [1]

#	Symbol		C	Characteristic	66 MHz (ext. bus)[2]		Unit	Notes
					Min	Max		
1	T_C	CC	P	CLKOUT Period	15.2	—	ns	Signals are measured at 50% V_{DDE}.
2	t_{CDC}	CC	D	CLKOUT duty cycle	45%	55%	T_C	
3	t_{CRT}	CC	D	CLKOUT rise time	—	[3]	ns	
4	t_{CFT}	CC	D	CLKOUT fall time	—	[3]	ns	
5	t_{COH}	CC	D	CLKOUT Posedge to Output Signal Invalid or High Z(Hold Time) • ADDR[8:31] • CS[0:3] • DATA[0:31] • OE • RD_WR • TS • WE[0:3]/BE[0:3]	1.3	—	ns	

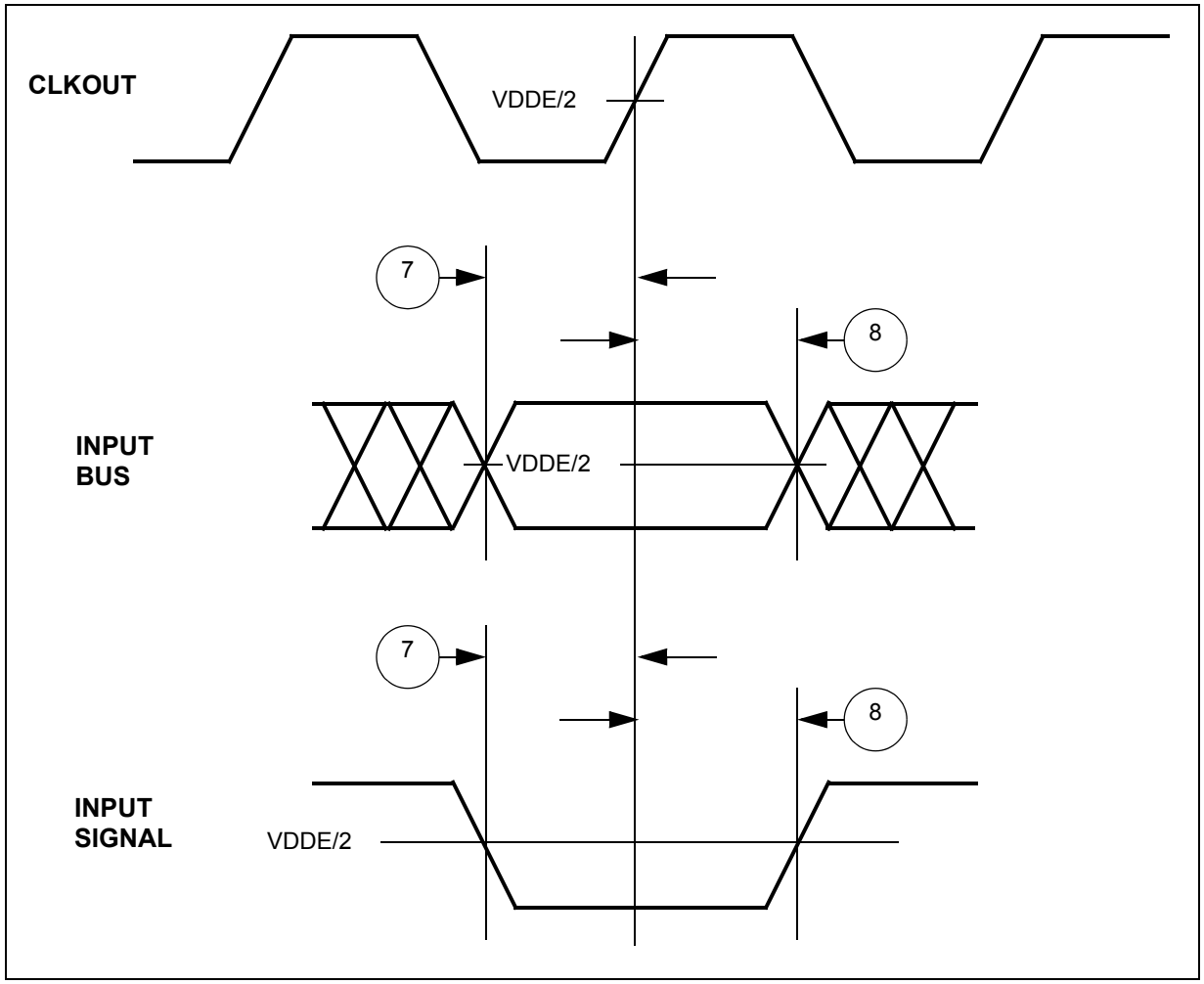


Figure 20. Synchronous input timing

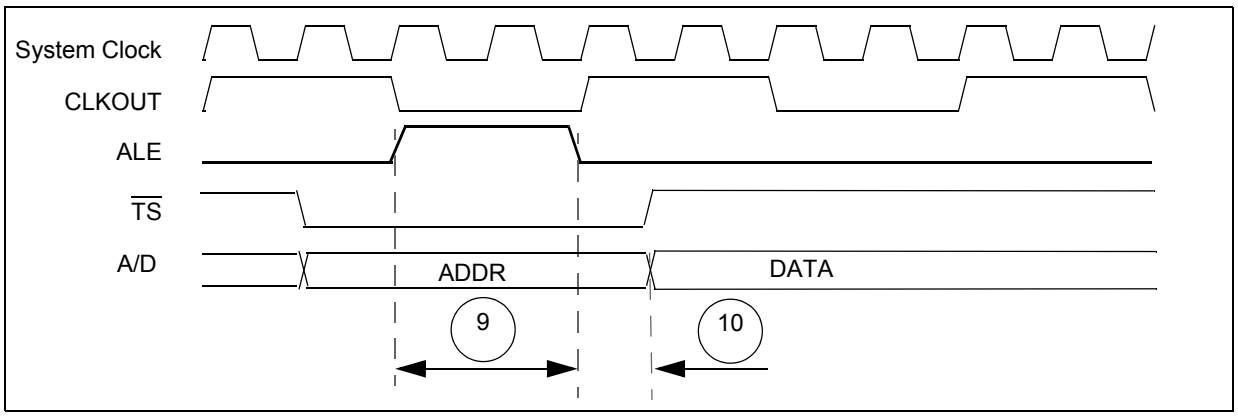


Figure 21. ALE signal timing

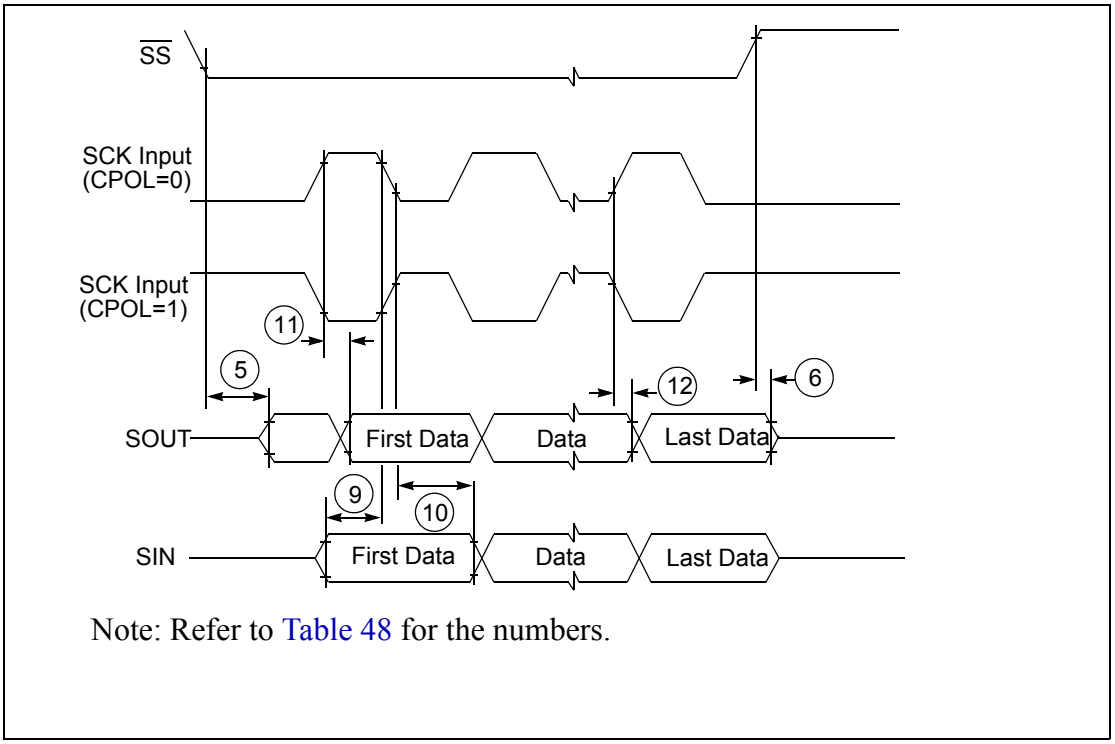


Figure 30. DSPI modified transfer format timing — slave, CPHA =1

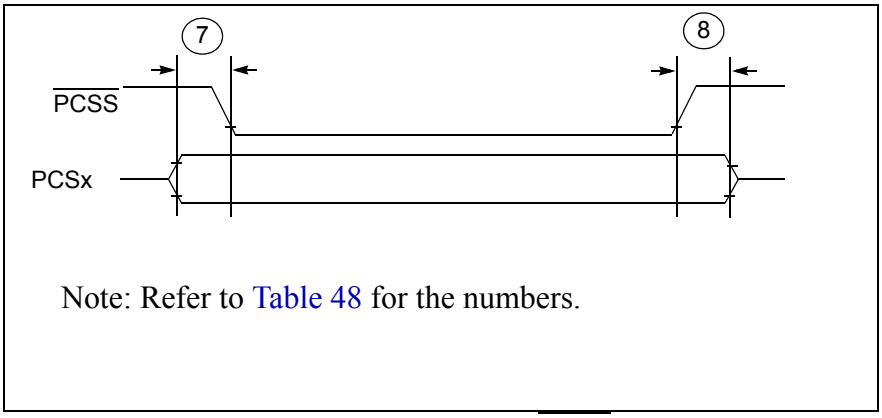


Figure 31. DSPI PCS strobe (PCSS) timing

NOTES:

1. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25MM PER SIDE. DIMENSIONS D1 AND E1 DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE DATUM H.

2. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED THE MAXIMUM b DIMENSION BY MORE THEN 0.08MM. DAMBAR CAN NOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM BETWEEN PROTRUSION AND AN ADJACENT LEAD IS 0.07MM FOR 0.4MM AND 0.5MM PITCH PACKAGES.

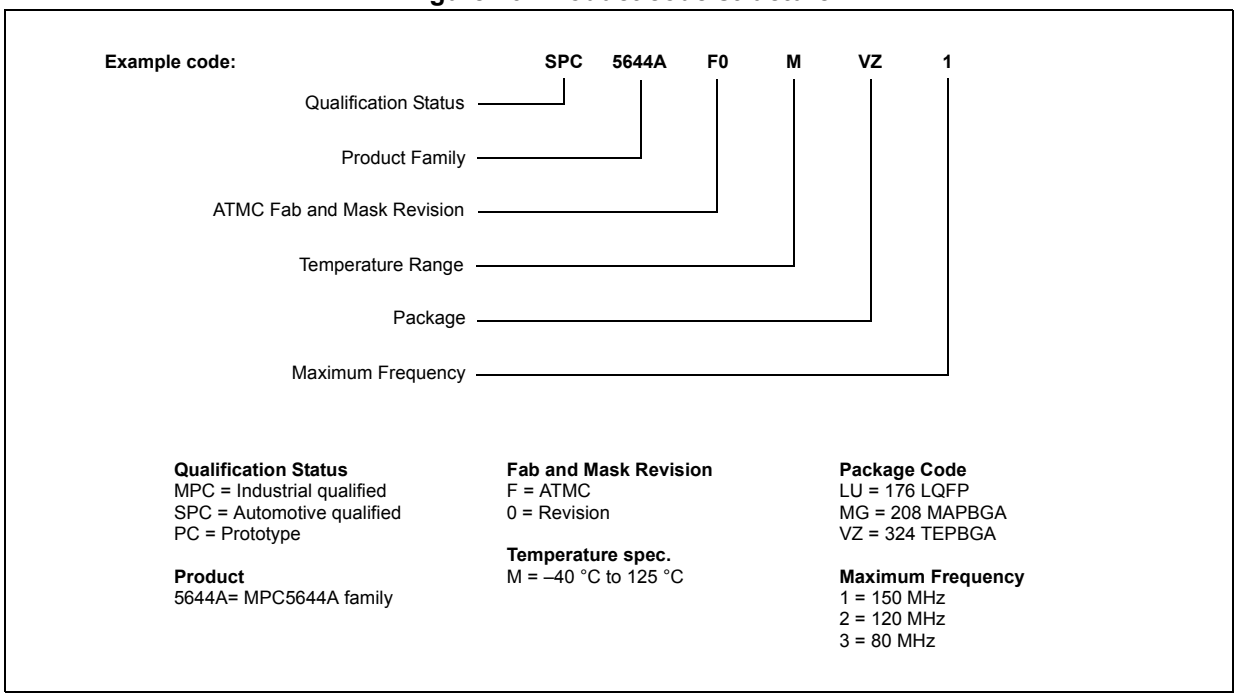
DIM	MIN	NOM	MAX	DIM	MIN	NOM	MAX	DIM	MIN	NOM	MAX
A	---		1.6	L1		1 REF					
A1	0.05		0.15	R1	0.08		---				
A2	1.35	1.4	1.45	R2	0.08		0.2				
b	0.17	0.22	0.27	S		0.2 REF					
b1	0.17	0.2	0.23	θ	0°	3.5°	7°				
c	0.09		0.2	θ1	0°		---				
c1	0.09		0.16	θ2	11°	12°	13°				
D		26 BSC		θ3	11°	12°	13°				
D1		24 BSC									
e		0.5 BSC									
E		26 BSC									
E1		24 BSC									
L	0.45	0.6	0.75								

UNIT	DIMENSION AND TOLERANCES	REFERANCE DOCUMENT
MM	ASME Y14.5M	64-06-280-1392

TITLE:		
LQFP 176LD 24X24X1.4 PKG 0.5 PITCH POD 2mm FOOTPRINT		
	SHEET	3

Figure 35. 176 LQFP package mechanical drawing (part 3)

Figure 40. Product code structure



6 Document revision history

Table 53 summarizes revisions to this document.

Table 53. Revision history

Revision	Date	Substantive changes
Rev. 1	4/2008	Initial release