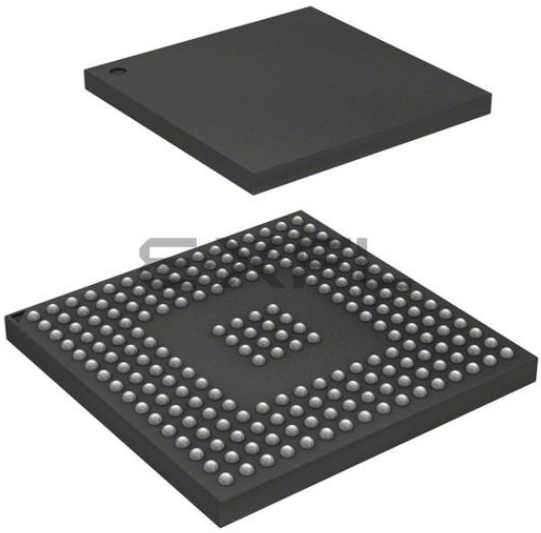

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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Not For New Designs
Core Processor	e200z6
Core Size	32-Bit Single-Core
Speed	80MHz
Connectivity	CANbus, EBI/EMI, Ethernet, SCI, SPI
Peripherals	DMA, POR, PWM, WDT
Number of I/O	192
Program Memory Size	1MB (1M x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	64K x 8
Voltage - Supply (Vcc/Vdd)	1.35V ~ 1.65V
Data Converters	A/D 34x12b
Oscillator Type	External
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/spc5534mvm80

The MPC5500 family of parts contains many new features coupled with high performance CMOS technology to provide significant performance improvement over the MPC565.

The host processor core of the MPC5534 also includes an instruction set enhancement allowing variable length encoding (VLE). This allows optional encoding of mixed 16- and 32-bit instructions. With this enhancement, it is possible to significantly reduce the code size footprint.

The MPC5534 has a single-level memory hierarchy consisting of 64-kilobytes (KB) on-chip SRAM and one megabyte (MB) of internal flash memory. Both the SRAM and the flash memory can hold instructions and data. The external bus interface (EBI) supports most standard memories used with the MPC5*xx* family.

The MPC5534 does not support arbitration with other masters on the external bus. The MPC5534 must be the only master on the external bus, or act as a slave-only device.

The complex input/output timer functions of the MPC5534 are performed by an enhanced time processor unit (eTPU) engine. The eTPU engine controls 32 hardware channels. The eTPU has been enhanced over the TPU by providing: 24-bit timers, double-action hardware channels, variable number of parameters per channel, angle clock hardware, and additional control and arithmetic instructions. The eTPU is programmed using a high-level programming language.

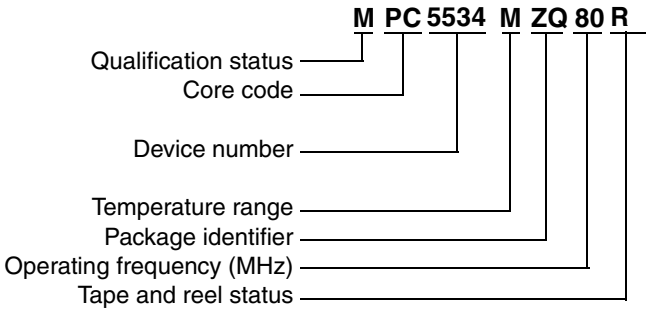
The less complex timer functions of the MPC5534 are performed by the enhanced modular input/output system (eMIOS). The eMIOS' 24 hardware channels are capable of single-action, double-action, pulse-width modulation (PWM), and modulus-counter operations. Motor control capabilities include edge-aligned and center-aligned PWM.

Off-chip communication is performed by a suite of serial protocols including controller area networks (FlexCANs), enhanced deserial/serial peripheral interfaces (DSPIs), and enhanced serial communications interfaces (eSCIs).

The MCU has an on-chip enhanced queued dual analog-to-digital converter (eQADC) with a 5 V conversion range. The 324 package has 40-channels; the 208 package has 34 channels.

The system integration unit (SIU) performs several chip-wide configuration functions. Pad configuration and general-purpose input and output (GPIO) are controlled from the SIU. External interrupts and reset control are also determined by the SIU. The internal multiplexer sub-block (IMUX) provides multiplexing of eQADC trigger sources and external interrupt signal multiplexing.

2 Ordering Information



Temperature Range
M = –40° C to 125° C

Package Identifier
VF = 208MAPBGA SnPb
VM = 208MAPBGA Pb-free
ZQ = 324PBGA SnPb
VZ = 324PBGA Pb-free

Operating Frequency
40 = 40 MHz
66 = 66 MHz
80 = 80 MHz

Tape and Reel Status
R = Tape and reel
(blank) = Trays

Qualification Status
P = Pre qualification
M = Fully spec. qualified, general market flow
S = Fully spec. qualified, automotive flow

Note: Not all options are available on all devices. Refer to Table 1.

Figure 1. MPC5500 Family Part Number Example

Unless noted in this data sheet, all specifications apply from T_L to T_H.

Table 1. Orderable Part Numbers

Freescale Part Number	Package Description	Speed (MHz)		Operating Temperature [1]	
		Nominal	Max. [2] (f_{MAX})	Min. (T_L)	Max. (T_H)
MPC5534MVZ80	MPC5534 324 package Lead-free (PbFree)	80	82	–40° C	125° C
MPC5534MVZ66		66	68		
MPC5534MVZ40		40	42		
MPC5534MVM80	MPC5534 208 package Lead-free (PbFree)	80	82	–40° C	125° C
MPC5534MVM66		66	68		
MPC5534MVM40		40	42		
MPC5534MZQ80	MPC5534 324 package Leaded (SnPb)	80	82	–40° C	125° C
MPC5534MZQ66		66	68		
MPC5534MZQ40		40	42		
MPC5534MVF80	MPC5534 208 package Leaded (SnPb)	80	82	–40° C	125° C
MPC5534MVF66		66	68		
MPC5534MVF40		40	42		

[1] The lowest ambient operating temperature is referenced by T_L; the highest ambient operating temperature is referenced by T_H.

[2] Speed is the nominal maximum frequency. Max. speed is the maximum speed allowed including frequency modulation (FM). 42 MHz parts allow for 40 MHz system clock + 2% FM; 68 MHz parts allow for 66 MHz system clock + 2% FM, and 82 MHz parts allow for 80 MHz system clock + 2% FM.

Table 6. V_{RC} and POR Electrical Specifications (continued)

Spec	Characteristic		Symbol	Min.	Max.	Units
9	Absolute value of slew rate on power supply pins		—	—	50	V/ms
10	Required gain at Tj: $I_{DD} \div I_{VRCCTL}$ (@ $f_{sys} = f_{MAX}$) 6, 7, 8, 9	– 40° C	BETA[10]	35	—	—
		25° C		40	—	—
		150° C		50	500	—

1 The internal POR signals are V_{POR15}, V_{POR33}, and V_{POR5}. On power up, assert $\overline{\text{RESET}}$ before the internal POR negates. $\overline{\text{RESET}}$ must remain asserted until the power supplies are within the operating conditions as specified in Table 9 DC Electrical Specifications. On power down, assert $\overline{\text{RESET}}$ before any power supplies fall outside the operating conditions and until the internal POR asserts.

2 V_{IL_S} (Table 9, Spec15) is guaranteed to scale with V_{DDEH6} down to V_{POR5}.

3 Supply full operating current for the 1.5 V supply when the 3.3 V supply reaches this range.

4 It is possible to reach the current limit during ramp up—do not treat this event as short circuit current.

5 At peak current for device.

6 Requires compliance with Freescale's recommended board requirements and transistor recommendations. Board signal traces/routing from the V_{RCCTL} package signal to the base of the external pass transistor and between the emitter of the pass transistor to the V_{DD} package signals must have a maximum of 100 nH inductance and minimal resistance (less than 1 Ω). V_{RCCTL} must have a nominal 1 μF phase compensation capacitor to ground. V_{DD} must have a 20 μF (nominal) bulk capacitor (greater than 4 μF over all conditions, including lifetime). Place high-frequency bypass capacitors consisting of eight 0.01 μF, two 0.1 μF, and one 1 μF capacitors around the package on the V_{DD} supply signals.

7 I_{VRCCTL} is measured at the following conditions: V_{DD} = 1.35 V, V_{RC33} = 3.1 V, V_{VRCCTL} = 2.2 V.

8 Refer to Table 1 for the maximum operating frequency.

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

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

3.7 Power-Up/Down Sequencing

Power sequencing between the 1.5 V power supply and V_{DDSYN} or the $\overline{\text{RESET}}$ power supplies is required if using an external 1.5 V power supply with V_{RC33} tied to ground (GND). To avoid power-sequencing, V_{RC33} must be powered up within the specified operating range, even if the on-chip voltage regulator controller is not used. Refer to Section 3.7.2, "Power-Up Sequence (VRC33 Grounded)," and Section 3.7.3, "Power-Down Sequence (VRC33 Grounded)."

Power sequencing requires that V_{DD33} must reach a certain voltage where the values are read as ones before the POR signal negates. Refer to Section 3.7.1, "Input Value of Pins During POR Dependent on VDD33."

Although power sequencing is not required between V_{RC33} and V_{DDSYN} during power up, V_{RC33} must not lead V_{DDSYN} by more than 600 mV or lag by more than 100 mV for the V_{RC} stage turn-on to operate within specification. Higher spikes in the emitter current of the pass transistor occur if V_{RC33} leads or lags V_{DDSYN} by more than these amounts. The value of that higher spike in current depends on the board power supply circuitry and the amount of board level capacitance.

Furthermore, when all of the PORs negate, the system clock starts to toggle, adding another large increase of the current consumed by V_{RC33}. If V_{RC33} lags V_{DDSYN} by more than 100 mV, the increase in current consumed can drop V_{DD} low enough to assert the 1.5 V POR again. Oscillations are possible when the 1.5 V POR asserts and stops the system clock, causing the voltage on V_{DD} to rise until the 1.5 V POR negates again. All oscillations stop when V_{RC33} is powered sufficiently.

When powering down, V_{RC33} and V_{DDSYN} have no delta requirement to each other, because the bypass capacitors internal and external to the device are already charged. When not powering up or down, no delta between V_{RC33} and V_{DDSYN} is required for the V_{RC} to operate within specification.

There are no power up/down sequencing requirements to prevent issues such as latch-up, excessive current spikes, and so on. Therefore, the state of the I/O pins during power up and power down varies depending on which supplies are powered.

Table 7 gives the pin state for the sequence cases for all pins with pad type pad_fc (fast type).

Table 7. Pin Status for Fast Pads During the Power Sequence

V_{DDE}	V_{DD33}	V_{DD}	POR	Pin Status for Fast Pad Output Driver pad_fc (fast)
Low	—	—	Asserted	Low
V_{DDE}	Low	Low	Asserted	High
V_{DDE}	Low	V_{DD}	Asserted	High
V_{DDE}	V_{DD33}	Low	Asserted	High impedance (Hi-Z)
V_{DDE}	V_{DD33}	V_{DD}	Asserted	Hi-Z
V_{DDE}	V_{DD33}	V_{DD}	Negated	Functional

Table 8 gives the pin state for the sequence cases for all pins with pad type pad_mh (medium type) and pad_sh (slow type).

Table 8. Pin Status for Medium and Slow Pads During the Power Sequence

V_{DDEH}	V_{DD}	POR	Pin Status for Medium and Slow Pad Output Driver pad_mh (medium) pad_sh (slow)
Low	—	Asserted	Low
V_{DDEH}	Low	Asserted	High impedance (Hi-Z)
V_{DDEH}	V_{DD}	Asserted	Hi-Z
V_{DDEH}	V_{DD}	Negated	Functional

The values in Table 7 and Table 8 do not include the effect of the weak-pull devices on the output pins during power up.

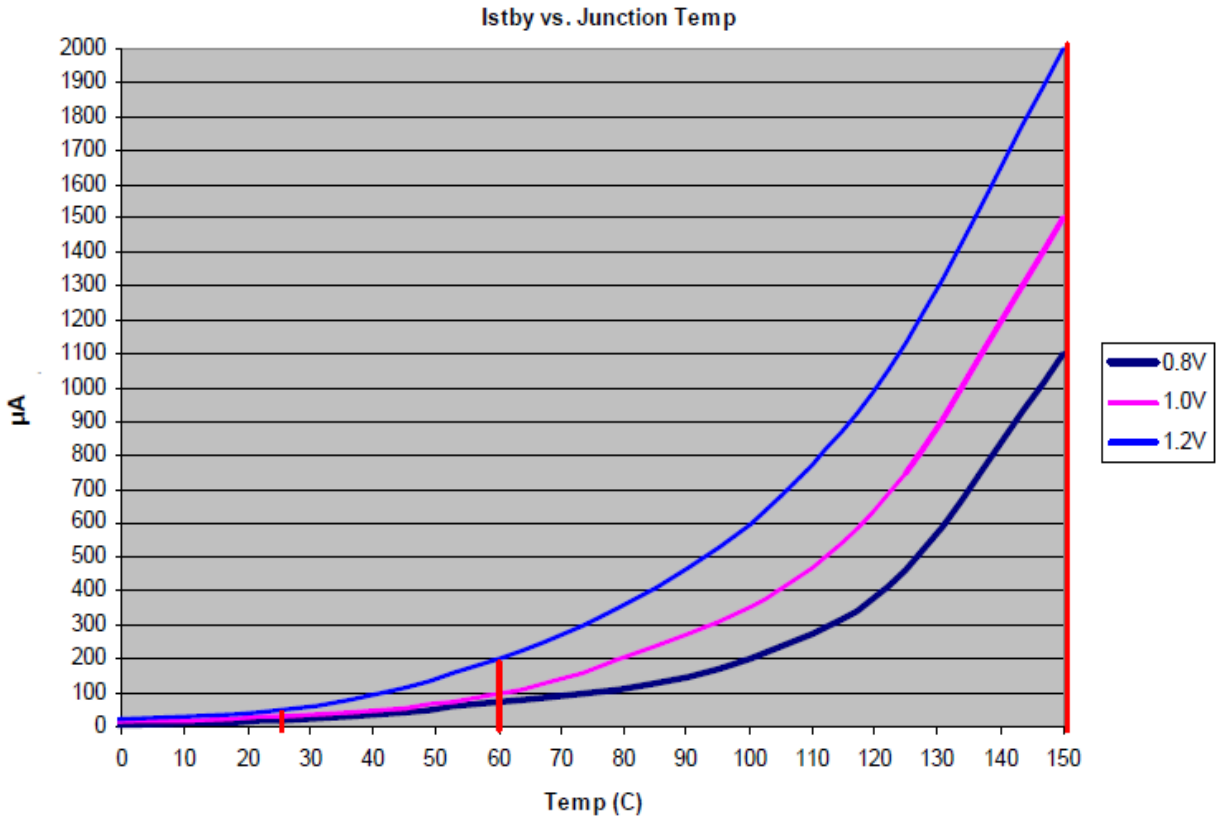
Before exiting the internal POR state, the pins go to a high-impedance state until POR negates. When the internal POR negates, the functional state of the signal during reset applies and the weak-pull devices (up or down) are enabled as defined in the device reference manual. If V_{DD} is too low to correctly propagate the logic signals, the weak-pull devices can pull the signals to V_{DDE} and V_{DDEH}.

To avoid this condition, minimize the ramp time of the V_{DD} supply to a time period less than the time required to enable the external circuitry connected to the device outputs.

During initial power ramp-up, when vstby is 0.6v or above. a typical current of 1-3mA and maximum of 4mA may be seen until V_{DD} is applied. This current will not reoccur until V_{stby} is lowered below V_{stby} min specification.

Figure 2 shows an approximate interpolation of the I_{STBY} worst-case specification to estimate values at different voltages and temperatures. The vertical lines shown at 25 °C, 60 °C, and 150 °C in Figure 2 are the actual I_{DD_STBY} specifications (27d) listed in Table 9

Figure 2. fISTBY Worst-case Specifications



3.8.1 I/O Pad Current Specifications

The power consumption of an I/O segment depends on the usage of the pins on a particular segment. The power consumption is the sum of all output pin currents for a segment. The output pin current can be calculated from Table 10 based on the voltage, frequency, and load on the pin. Use linear scaling to calculate pin currents for voltage, frequency, and load parameters that fall outside the values given in Table 10.

Table 10. I/O Pad Average DC Current ($T_A = T_L$ to T_H)[1]

Spec	Pad Type	Symbol	Frequency (MHz)	Load[2] (pF)	Voltage (V)	Drive Select / Slew Rate Control Setting	Current (mA)
1	Slow	I_{DRV_SH}	25	50	5.25	11	8.0
2			10	50	5.25	01	3.2
3			2	50	5.25	00	0.7
4			2	200	5.25	00	2.4
5	Medium	I_{DRV_MH}	50	50	5.25	11	17.3
6			20	50	5.25	01	6.5
7			3.33	50	5.25	00	1.1
8			3.33	200	5.25	00	3.9
9	Fast	I_{DRV_FC}	66	10	3.6	00	2.8
10			66	20	3.6	01	5.2
11			66	30	3.6	10	8.5
12			66	50	3.6	11	11.0
13			66	10	1.98	00	1.6
14			66	20	1.98	01	2.9
15			66	30	1.98	10	4.2
16			66	50	1.98	11	6.7
17			56	10	3.6	00	2.4
18			56	20	3.6	01	4.4
19			56	30	3.6	10	7.2
20			56	50	3.6	11	9.3
21			56	10	1.98	00	1.3
22			56	20	1.98	01	2.5
23			56	30	1.98	10	3.5
24			56	50	1.98	11	5.7
25			40	10	3.6	00	1.7
26			40	20	3.6	01	3.1
27			40	30	3.6	10	5.1
28			40	50	3.6	11	6.6
29			40	10	1.98	00	1.0
30			40	20	1.98	01	1.8
31			40	30	1.98	10	2.5
32			40	50	1.98	11	4.0

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

2 All loads are lumped.

Table 12. FMPLL Electrical Specifications (continued)

(V_{DDSYN} = 3.0–3.6 V; V_{SS} = V_{SSSYN} = 0.0 V; T_A = T_L to T_H)

Spec	Characteristic	Symbol	Minimum	Maximum	Unit
19	CLKOUT period jitter, measured at f_{SYS} max: [13, 14] Peak-to-peak jitter (clock edge to clock edge) Long term jitter (averaged over a 2 ms interval)	C_{JITTER}	 — —	 5.0 0.01	% f_{CLKOUT}
20	Frequency modulation range limit [15] (do not exceed f_{sys} maximum)	C_{MOD}	0.8	2.4	$\%f_{SYS}$
21	ICO frequency f_{ico} = [$f_{ref\_crystal}$ × (MFD + 4)] ÷ (PREDIV + 1) [16] f_{ico} = [f_{ref_ext} × (MFD + 4)] ÷ (PREDIV + 1)	f_{ico}	48	80[17]	MHz
22	Predivider output frequency (to PLL)	f_{PREDIV}	4	20 [18]	MHz

1 Nominal crystal and external reference values are worst-case not more than 1%. The device operates correctly if the frequency remains within ± 5% of the specification limit. This tolerance range allows for a slight frequency drift of the crystals over time. The designer must thoroughly understand the drift margin of the source clock.

2 All internal registers retain data at 0 Hz.

3 Up to the maximum frequency rating of the device (refer to Table 1).

4 Loss of reference frequency is defined as the reference frequency detected internally, which transitions the PLL into self-clocked mode.

5 The PLL operates at self-clocked mode (SCM) frequency when the reference frequency falls below f_{LOR}. SCM frequency is measured on the CLKOUT ball with the divider set to divide-by-two of the system clock.
NOTE: In SCM, the MFD and PREDIV have no effect and the RFD is bypassed.

6 Use the EXTAL input high voltage parameter when using the FlexCAN oscillator in crystal mode (no quartz crystals or resonators). (V_{extal} – V_{xtal}) must be ≥ 400 mV for the oscillator's comparator to produce the output clock.

7 Use the EXTAL input low voltage parameter when using the FlexCAN oscillator in crystal mode (no quartz crystals or resonators). (V_{xtal} – V_{extal}) must be ≥ 400 mV for the oscillator's comparator to produce the output clock.

8 I_{xtal} is the oscillator bias current out of the XTAL pin with both EXTAL and XTAL pins grounded.

9 C_{PCB_EXTAL} and C_{PCB_XTAL} are the measured PCB stray capacitances on EXTAL and XTAL, respectively.

10 This specification applies to the period required for the PLL to relock after changing the MFD frequency control bits in the synthesizer control register (SYNCR). From power up with crystal oscillator reference, the lock time also includes the crystal startup time.

11 PLL is operating in 1:1 PLL mode.

12 V_{DDE} = 3.0–3.6 V.

13 Jitter is the average deviation from the programmed frequency measured over the specified interval at maximum f_{sys}. Measurements are made with the device powered by filtered supplies and clocked by a stable external clock signal. Noise injected into the PLL circuitry via V_{DDSYN} and V_{SSSYN} and variation in crystal oscillator frequency increase the jitter percentage for a given interval. CLKOUT divider is set to divide-by-two.

14 Values are with frequency modulation disabled. If frequency modulation is enabled, jitter is the sum of (jitter + Cmod).

15 Modulation depth selected must not result in f_{sys} value greater than the f_{sys} maximum specified value.

16 $f_{sys} = f_{ico} \div (2^{RFD})$.

17 The ICO frequency can be higher than the maximum allowable system frequency. For this case, set the FMPLL synthesizer control register reduced frequency divider (FMPLL_SYNCR[RFD]) to divide-by-two (RFD = 0b001). Therefore, for a 40 MHz maximum device (system frequency), program the FMPLL to generate 80 MHz at the ICO output and then divide-by-two the RFD to provide the 40 MHz clock.

18 Maximum value for dual controller (1:1) mode is ($f_{MAX} \div 2$) with the predivider set to 1 (FMPLL_SYNCR[PREDIV] = 0b001).

3.10 eQADC Electrical Characteristics

Table 13. eQADC Conversion Specifications ($T_A = T_L$ to T_H)

Spec	Characteristic	Symbol	Minimum	Maximum	Unit
1	ADC clock (ADCLK) frequency [1]	F_{ADCLK}	1	12	MHz
2	Conversion cycles Differential Single ended	CC	 13 + 2 (15) 14 + 2 (16)	 13 + 128 (141) 14 + 128 (142)	ADCLK cycles
3	Stop mode recovery time [2]	T_{SR}	10	—	µs
4	Resolution [3]	—	1.25	—	mV
5	INL: 6 MHz ADC clock	INL6	–4	4	Counts [3]
6	INL: 12 MHz ADC clock	INL12	–8	8	Counts
7	DNL: 6 MHz ADC clock	DNL6	–3 [4]	3 [4]	Counts
8	DNL: 12 MHz ADC clock	DNL12	–6 [4]	6 [4]	Counts
9	Offset error with calibration	OFFWC	–4 [5]	4 [5]	Counts
10	Full-scale gain error with calibration	GAINWC	–8 [6]	8 [6]	Counts
11	Disruptive input injection current [7, 8, 9, 10]	I_{INJ}	–1	1	mA
12	Incremental error due to injection current. All channels are 10 kΩ < Rs <100 kΩ Channel under test has Rs = 10 kΩ, $I_{INJ} = I_{INJMAX}$, I_{INJMIN}	E_{INJ}	–4	4	Counts
13	Total unadjusted error (TUE) for single ended conversions with calibration [11, 12, 13, 14, 15]	TUE	–4	4	Counts

[1] Conversion characteristics vary with F_{ADCLK} rate. Reduced conversion accuracy occurs at maximum F_{ADCLK} rate. The maximum value is based on 800 KS/s and the minimum value is based on 20 MHz oscillator clock frequency divided by a maximum 16 factor.

[2] Stop mode recovery time begins when the ADC control register enable bits are set until the ADC is ready to perform conversions.

[3] At $V_{RH} - V_{RL}$ = 5.12 V, one least significant bit (LSB) = 1.25, mV = one count.

[4] Guaranteed 10-bit mono tonicity.

[5] The absolute value of the offset error without calibration ≤ 100 counts.

[6] The absolute value of the full scale gain error without calibration ≤ 120 counts.

[7] Below disruptive current conditions, the channel being stressed has conversion values of: 0x3FF for analog inputs greater than V_{RH}, and 0x000 for values less than V_{RL}. This assumes that $V_{RH} \leq V_{DDA}$ and $V_{RL} \geq V_{SSA}$ due to the presence of the sample amplifier. Other channels are not affected by non-disruptive conditions.

[8] Exceeding the limit can cause a conversion error on both stressed and unstressed channels. Transitions within the limit do not affect device reliability or cause permanent damage.

[9] Input must be current limited to the value specified. To determine the value of the required current-limiting resistor, calculate resistance values using $V_{POSCLAMP} = V_{DDA} + 0.5$ V and $V_{NEGCLAMP} = -0.3$ V, then use the larger of the calculated values.

[10] This condition applies to two adjacent pads on the internal pad.

[11] The TUE specification is always less than the sum of the INL, DNL, offset, and gain errors due to canceling errors.

[12] TUE does not apply to differential conversions.

[13] Measured at 6 MHz ADC clock. TUE with a 12 MHz ADC clock is: –16 counts < TUE < 16 counts.

[14] TUE includes all internal device errors such as internal reference variation (75% Ref, 25% Ref).

[15] Depending on the input impedance, the analog input leakage current (Table 9. DC Electrical Specifications, spec 35a) can affect the actual TUE measured on analog channels AN[12], AN[13], AN[14], AN[15].

Table 17. Pad AC Specifications (V_{DDEH} = 5.0 V, V_{DDE} = 1.8 V) [1] (continued)

Spec	Pad	SRC / DSC (binary)	Out Delay [2, 3, 4] (ns)	Rise / Fall [4, 5] (ns)	Load Drive (pF)
2	Medium high voltage (MH)	11	16	8	50
			43	30	200
		01	34	15	50
			61	35	200
		00	192	100	50
			239	125	200
3	Fast	00	3.1	2.7	10
		01		2.5	20
		10		2.4	30
		11		2.3	50
4	Pullup/down (3.6 V max)	—	—	7500	50
5	Pullup/down (5.5 V max)	—	—	9000	50

1 These are worst-case values that are estimated from simulation (not tested). The values in the table are simulated at: V_{DD} = 1.35–1.65 V; V_{DDE} = 1.62–1.98 V; V_{DDEH} = 4.5–5.25 V; V_{DD33} and V_{DDSYN} = 3.0–3.6 V; and $T_A = T_L$ to T_H.

2 This parameter is supplied for reference and is guaranteed by design (not tested).

3 The output delay is shown in Figure 4. To calculate the output delay with respect to the system clock, add a maximum of one system clock to the output delay.

4 The output delay and rise and fall are measured to 20% or 80% of the respective signal.

5 This parameter is guaranteed by characterization rather than 100% tested.

Table 18. Derated Pad AC Specifications (V_{DDEH} = 3.3 V, V_{DDE} = 3.3 V) [1]

Spec	Pad	SRC/DSC (binary)	Out Delay [2, 3, 4] (ns)	Rise / Fall [3, 5] (ns)	Load Drive (pF)
1	Slow high voltage (SH)	11	39	23	50
			120	87	200
		01	101	52	50
			188	111	200
		00	507	248	50
			597	312	200
2	Medium high voltage (MH)	11	23	12	50
			64	44	200
		01	50	22	50
			90	50	200
		00	261	123	50
			305	156	200

Table 19. Reset and Configuration Pin Timing [1] (continued)

Spec	Characteristic	Symbol	Min.	Max.	Unit
3	PLLCFG, BOOTCFG, WKPCFG, $\overline{\text{RSTCFG}}$ setup time to $\overline{\text{RSTOUT}}$ valid	t_{RCSU}	10	—	t_{CYC}
4	PLLCFG, BOOTCFG, WKPCFG, $\overline{\text{RSTCFG}}$ hold time from $\overline{\text{RSTOUT}}$ valid	t_{RCH}	0	—	t_{CYC}

[1] Reset timing specified at: V_{DDEH} = 3.0–5.25 V and $T_A = T_L$ to T_H.

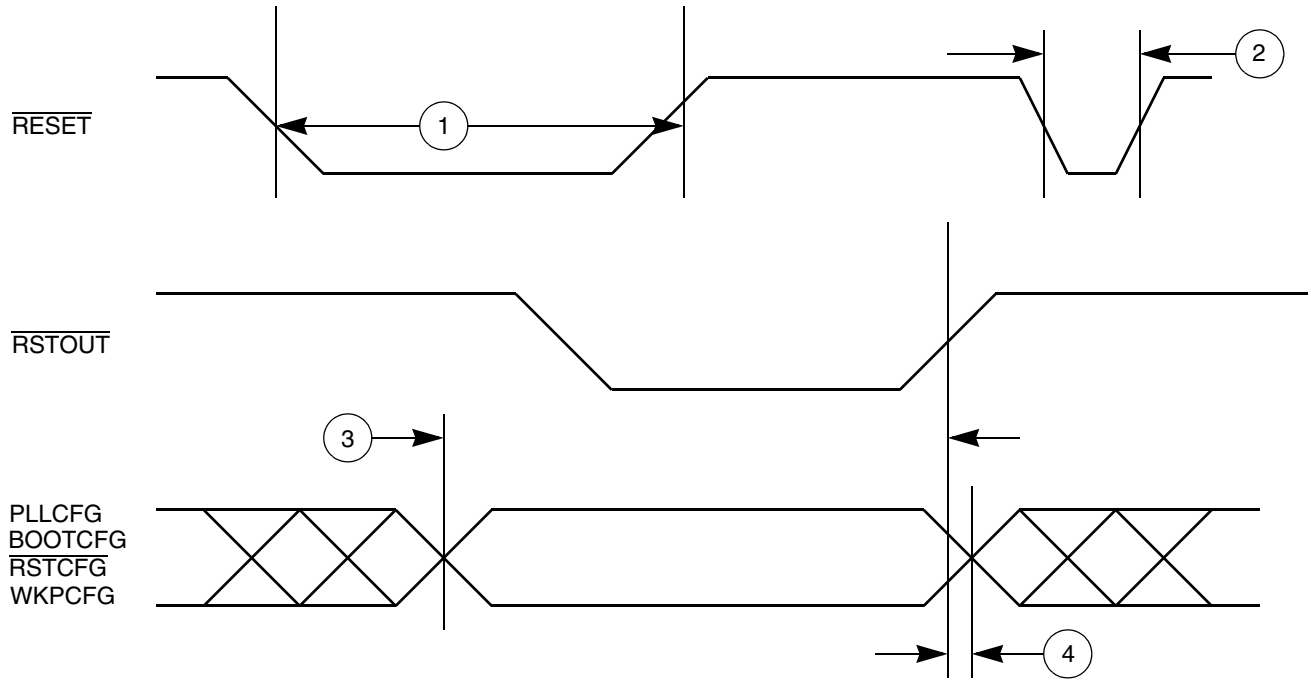


Figure 5. Reset and Configuration Pin Timing

3.13.2 IEEE 1149.1 Interface Timing

Table 20. JTAG Pin AC Electrical Characteristics [1]

Spec	Characteristic	Symbol	Min.	Max.	Unit
1	TCK cycle time	t_{JCYC}	100	—	ns
2	TCK clock pulse width (measured at $V_{DDE} \div 2$)	t_{JDC}	40	60	ns
3	TCK rise and fall times (40% to 70%)	$t_{TCKRISE}$	—	3	ns
4	TMS, TDI data setup time	t_{TMSS}, t_{TDIS}	5	—	ns
5	TMS, TDI data hold time	t_{TMSH}, t_{TDIH}	25	—	ns
6	TCK low to TDO data valid	t_{TDOV}	—	20	ns
7	TCK low to TDO data invalid	t_{TDOI}	0	—	ns
8	TCK low to TDO high impedance	t_{TDOHZ}	—	20	ns
9	JCOMP assertion time	t_{JCMPPW}	100	—	ns
10	JCOMP setup time to TCK low	t_{JCMPS}	40	—	ns
11	TCK falling-edge to output valid	t_{BSDV}	—	50	ns

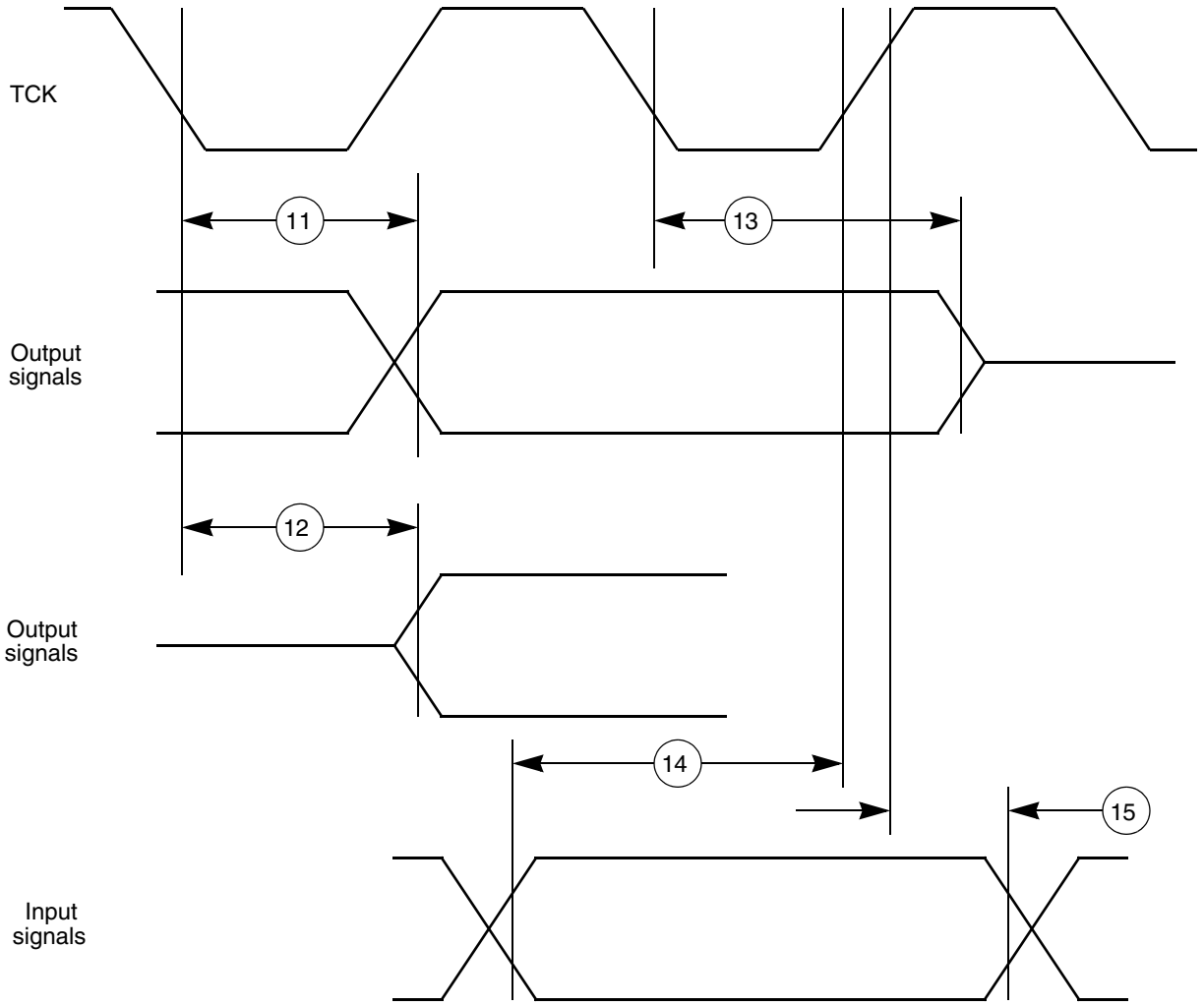


Figure 9. JTAG Boundary Scan Timing

3.13.4 External Bus Interface (EBI) Timing

Table 22 lists the timing information for the external bus interface (EBI).

Table 22. External Bus Operation Timing[1, 2]

Spec	Characteristic and Description	Symbol	External Bus Frequency [3]						Unit	Notes
			20 MHz		33 MHz		40 MHz			
			Min.	Max	Min.	Max	Min.	Max		
1	CLKOUT period	T_C	24.4	—	17.5	—	14.9	—	ns	Signals are measured at 50% V_{DDE}.
2	CLKOUT duty cycle	t_{CDC}	45%	55%	45%	55%	45%	55%	T_C	
3	CLKOUT rise time	t_{CRT}	—	—[4]	—	—	—	—[4]	ns	
4	CLKOUT fall time	t_{CFT}	—	—[4]	—	—[4]	—	—[4]	ns	
5[5]	CLKOUT positive edge to output signal *invalid* or Hi-Z (hold time) External bus interface $\overline{CS}$[0:3] ADDR[8:31] DATA[0:15] RD_$\overline{WR}$ $\overline{BDIP}$ $\overline{WE}$/$\overline{BE}$[0:1] $\overline{OE}$ $\overline{TS}$ $\overline{TA}$	t_{COH}	1.0[6] 1.5	—	1.0[6] 1.5	—	1.0[6] 1.5	—	ns	EBTS = 0 EBTS = 1 Hold time selectable via SIU_ECCR [EBTS] bit.
5	Calibration bus interface CAL_$\overline{CS}$[0, 2:3] CAL_ADDR[10:30] CAL_DATA[0:15] CAL_RD_$\overline{WR}$ CAL_$\overline{WE}$[0:1] CAL_$\overline{OE}$ CAL_$\overline{TS}$	t_{CCOH}	1.0 [6] 1.5	—	1.0 [6] 1.5	—	1.0 [6] 1.5	—	ns	EBTS = 0 EBTS = 1 Hold time selectable via SIU_ECCR [EBTS] bit.
6[5]	CLKOUT positive edge to output signal *valid* (output delay) External bus interface $\overline{CS}$[0:3] ADDR[8:31] DATA[0:15] RD_$\overline{WR}$ $\overline{BDIP}$ $\overline{WE}$/$\overline{BE}$[0:1] $\overline{OE}$ $\overline{TS}$ $\overline{TA}$	t_{COV}	—	10.0[6] 11.0	—	10.0[6] 11.0	—	10.0[6] 11.0	ns	EBTS = 0 EBTS = 1 Output valid time selectable via SIU_ECCR [EBTS] bit.

[3] Speed is the nominal maximum frequency. Max speed is the maximum speed allowed including frequency modulation (FM). 42 MHz parts allow for 40 MHz system clock + 2% FM; 68 MHz parts allow for a 66 MHz system clock + 2% FM, and 82 MHz parts allow for 80 MHz system clock + 2% FM.

[4] Refer to fast pad timing in Table 17 and Table 18 (different values for 1.8 V and 3.3 V).

[5] Available on the 324 package only; not available on the 208 package.

[6] EBTS = 0 timings are tested and valid at V_{DDE} = 2.25–3.6 V only; EBTS = 1 timings are tested and valid at V_{DDE} = 1.6–3.6 V.

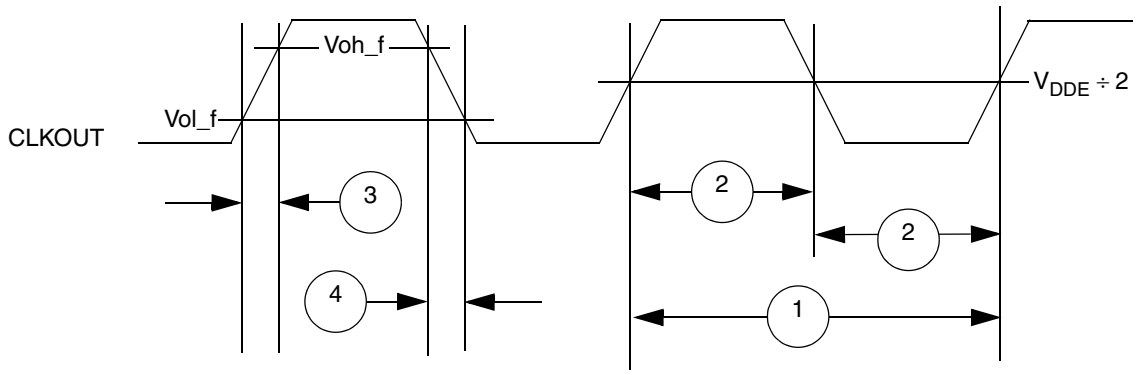


Figure 12. CLKOUT Timing

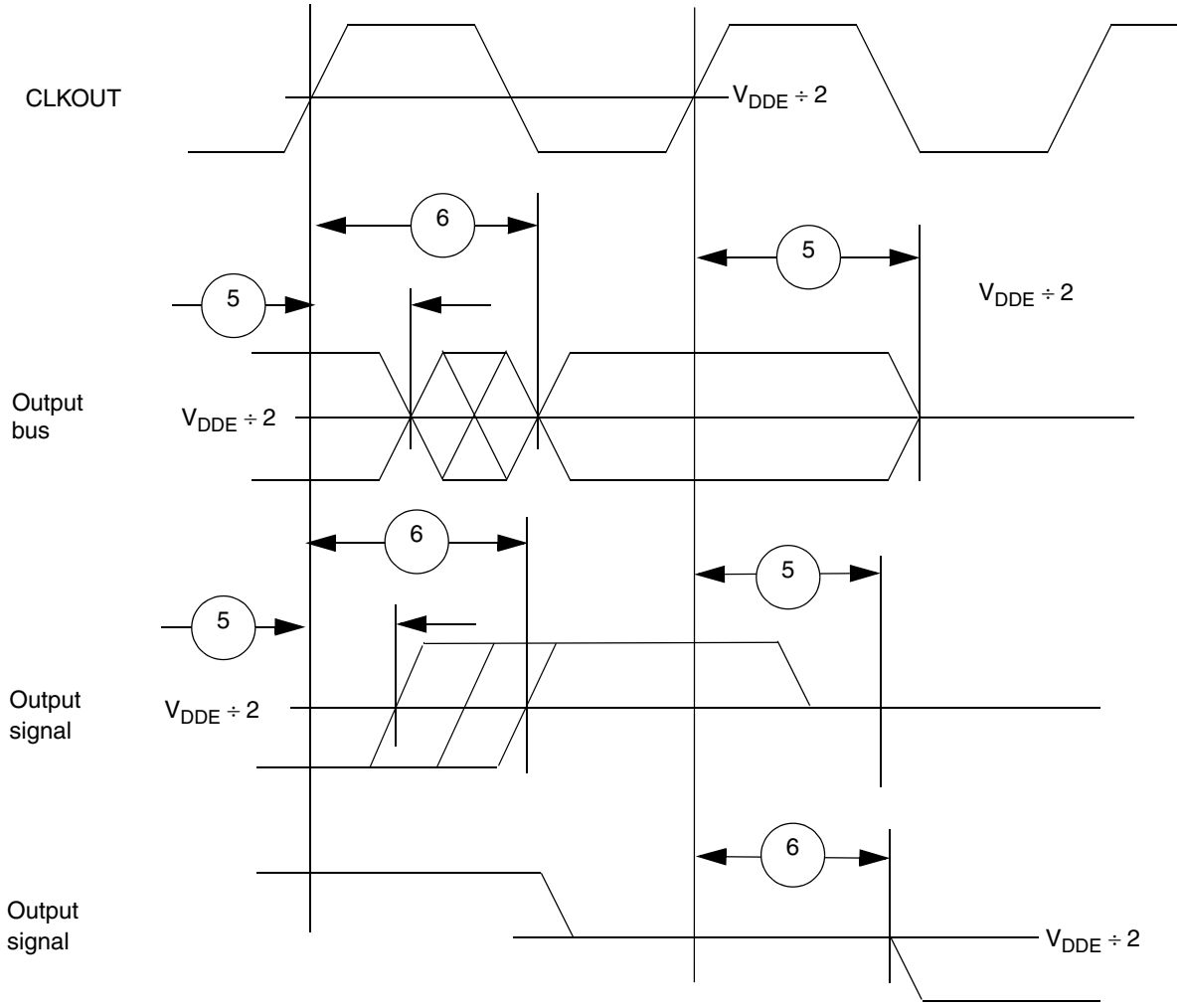


Figure 13. Synchronous Output Timing

NOTES:

1. ALL DIMENSIONS IN MILLIMETERS.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994.
3. MAXIMUM SOLDER BALL DIAMETER MEASURED PARALLEL TO DATUM A.
4. DATUM A, THE SEATING PLANE, IS DETERMINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
5. PARALLELISM MEASUREMENT SHALL EXCLUDE ANY EFFECT OF MARK ON TOP SURFACE OF PACKAGE.

MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: PBGA, 324 I/O, 23 X 23 PKG, 1 MM PITCH (OMPAC)	DOCUMENT NO: 98ASS23840W	REV: D
	CASE NUMBER: 1158–03	26 APR 2006
	STANDARD: JEDEC MS–034 AAJ–1	

Figure 31. MPC5534 324 TEPBGA Package (continued)

Table 28. Text Changes Between Rev. 4.0 and 5.0 (continued)

Location	Description of Changes
Section 3.7, "Power-Up/Down Sequencing	
	Last paragraph: Changed the first sentence FROM . . . the voltage on the pins goes to high-impedance until . . . TO. . .the pins go to a high-impedance state until . . .

5.3 Changes Between Revisions 3.0 and 4.0

The following table lists the substantive text changes made to paragraphs.

Table 29. Text Changes Between Rev. 3.0 and 4.0

Location	Description of Changes
Title Page:	
	Changed the Revision number from 3.0 to 4.0. Changed the date format to DD MMM YYYY. Made the same changes in the lower left corner of the back page.
Section 1, "Overview":	
	Added the sentence directly preceding Table 1: 'Unless noted in this data sheet, all specifications apply from T_L to T_H.'
Sections 3.7.1, 3.7.2 and 3.7.3: Reordered sections resulting in the following order and section renumbering:	
	• Section 3.7.1, "Input Value of Pins During POR Dependent on VDD33," then • Section 3.7.2, "Power-Up Sequence (VRC33 Grounded)," then • Section 3.7.3, "Power-Down Sequence (VRC33 Grounded).
Section 3.7.1, "Input Value of Pins During POR Dependent on VDD33:"	
	Added the following text directly before this section and after Table 8 *Pin Status for Medium and Slow Pads During the Power-on Sequence*: 'The values in Table 7 and Table 8 do not include the effect of the weak pull devices on the output pins during power up. Before exiting the internal POR state, the voltage on the pins goes to high-impedance until POR negates. When the internal POR negates, the functional state of the signal during reset applies and the weak pull devices (up or down) are enabled as defined in the device *Reference Manual*. If V_{DD} is too low to correctly propagate the logic signals, the weak-pull devices can pull the signals to V_{DDE} and V_{DDEH}. To avoid this condition, minimize the ramp time of the V_{DD} supply to a time period less than the time required to enable the external circuitry connected to the device outputs.'
Section 3.7.3, "Power-Down Sequence (VRC33 Grounded)"	Deleted the underscore in ORed_POR to become ORed POR.

The following table describes the changes made to information in tables and figures, and is presented in sequential page number order.

Table 30. Table and Figure Changes Between Rev. 3.0 and 4.0

Location	Description of Changes
Figure 1, MPC5500 Family Part Numbers:	
	• Removed the 2 in the tape and reel designator in both the graphic and in the Tape and Reel Status text. • Changed Qualification Status by adding ', general market flow' to the M designator, and added an 'S' designator with the description of 'Fully spec. qualified, automotive flow.
Table 1, Orderable Part Numbers:	
	• Footnote 1 added that reads: All devices are PPC5534, rather than MPC5534 or SPC5534, until product qualifications are complete. Not all configurations are available in the PPC parts. • Reordered rows to group devices by lead-free package types in descending frequency order, and leaded package types. • Footnote 2 added that reads:' The lowest ambient operating temperature is referenced by T_L; the highest ambient operating temperature is referenced by T_H.' • Footnote 3 added that reads: 'Speed is the nominal maximum frequency. Max speed is the maximum speed allowed including frequency modulation (FM). 42 MHz parts allow for 40 MHz system clock + 2% FM; 68 MHz parts allow for 66 MHz system clock + 2% FM, and 82 MHz parts allow for 80 MHz system clock + 2% FM.'
Table 2, Absolute Maximum Ratings:	
	• Deleted Spec 3, "Flash core voltage." • Spec 12 "DC Input Voltage": Deleted from second line'. . .except for eTPUB[15] and SINB (DSPI_B_SIN)' leaving V_{DDEH} powered I/O pads. Deleted third line 'V_{DDEH} powered by I/O pads (eTPUB[15] and SINB), including the min. and max values of -0.3 and 6.5 respectively, and deleted old footnote 7. • Spec 12 "DC Input Voltage": Added footnote 8 to second line "V_{DDE} powered I/O pads" that reads: 'Internal structures hold the input voltage less than the maximum voltage on all pads powered by the V_{DDE} supplies, if the maximum injection current specification is met (s mA for all pins) and V_{DDE} is within the operating voltage specifications. • Spec 14, column 2, changed: 'V_{SS} differential voltage' to 'V_{SS} to V_{SSA} differential voltage.' • Spec 15, column 2, changed: 'V_{DD} differential voltage' to 'V_{DD} to V_{DDA} differential voltage.' • Spec 21, Added the name of the spec, '*V_{RC33} to V_{DDSYN} differential voltage,'* as well as the name and cross reference to Table 9, *DC Electrical Specifications*, to which the Spec was moved. • Spec 28 "Maximum Solder Temperature": Added two lines: Lead free (PbFree) and Leaded (SnPb) with maximum values of 260 C and 245 C respectively. • Footnote 1, added: 'any of' between 'beyond' and 'the listed maxima.' • Deleted footnote 2: 'Absolute maximum voltages are currently maximum burn-in voltages. Absolute maximum specifications for device stress have not yet been determined.'Spec 26 "Maximum Operating Temperature Range": replaced -40 C with. • Footnote 6 (now footnote 5): Changed the end of the last sentence as follows; "Internal structures hold the input voltage greater than -1.0 V if the injection current limit of 2 mA is met. Keep the negative DC voltage greater than -0.6 V on eTPU[15] and on SINB during the internal power-on reset (POR) state."
Table 3, MPC5534 Thermal Characteristics:	
	Changed for production purposes, footnote 1 from: Junction temperature is a function of on-chip power dissipation, package thermal resistance, mounting site (board) temperature, ambient temperature, air flow, power dissipation of other *components on the board*, and board thermal resistance. to: Junction temperature is a function of on-chip power dissipation, package thermal resistance, mounting site (board) temperature, ambient temperature, air flow, power dissipation of other *board components*, and board thermal resistance.

Table 30. Table and Figure Changes Between Rev. 3.0 and 4.0 (continued)

Location	Description of Changes
Table 12, FMPLL Electrical Characteristics:	• Spec 1, footnote 1 in column 2: *'PLL reference frequency range*': Added that reads 'Nominal crystal and external reference values are worst-case not more than 1%. The device operates correctly if the frequency remains within ± 5% of the specification limit. This tolerance range allows for a slight frequency drift of the crystals over time. The designer must thoroughly understand the drift margin of the source clock.' • Spec 1, footnote 2 in column 1: Changed to: 'The 8–20 MHz crystal or external reference values have PLLCFG[2] pulled low' and applies to spec 1, column 2, crystal reference and external reference. • Spec 21, column 2: Changed $f_{ref\_crystal}$ to f_{ref} in ICO frequency equation, and added the same equation but substituted f_{ref_ext} for f_{ref} for the external reference clock, giving: $f_{ico} = [f_{ref\_crystal} \times (MFD + 4)] \div (PREDIV + 1)$ $f_{ico} = [f_{ref\_ext} \times (MFD + 4)] \div (PREDIV + 1)$ • Spec 21: Changed column 5 from 'f_{SYS}' MHz' to: 'f_{MAX}'. • Spec 22: Changed column 4, *Max Value* from f_{MAX} to 20, and added footnote 17 to read, 'Maximum value for dual controller (1:1) mode is ($f_{MAX} \div 2$) and the predivider set to 1 (FMPLL_SYNCR[PREDIV] = 0b001).'
Table 13, eQADC Conversion Specifications: Changed '(Operating)' to '($T_A = T_L - T_H$)' to the table title.	
Table 14, Flash Program and Erase Specifications*:*	• Added ($T_A = T_L - T_H$) to the table title. • Spec 8, 128 KB block pre-program and erase time, Max column value from 15,000 to 7,500. • Moved footnote 1 from the table title to directly after the 'Typical' in the column 5 header. • Footnote 2: Changed from: 'Initial factory condition: ≤ 100 program/erase cycles, 25 ^oC, typical supply voltage, 80 MHz minimum system frequency.' To: 'Initial factory condition: ≤ 100 program/erase cycles, 25 ^oC, using a typical supply voltage measured at a minimum system frequency of 80 MHz.'
Table 15, Flash EEPROM Module Life:	• Replaced (Full Temperature Range) with ($T_A = T_L - T_H$) in the table title. • Spec 1b, Min. column value changed from 10,000 to 1,000.
Table 16, FLash BIU Settings vs. Frequency of Operations:	• 'Added footnote 1 to the end of the table title, The footnote reads: 'Illegal combinations exist. Use entries from the same row in this table.' • Moved footnote 2:' For maximum flash performance, set to 0b11' to the 'DPFEN' column header. • Deleted the x-refs in the 'DPFEN' column for the rows. • Created a x-ref for footnote 2 and inserted in the 'IPFEN' column header. • Deleted the x-refs in the 'IPFEN' column for the rows. • Added to the PFLIM binary values a leading 0 so that 0bxx became 0b0xx. • Moved footnote 3:' For maximum flash performance, set to 0b110' to the 'PFLIM' column header. • Deleted the x-refs in the 'PFLIM' column for the rows. • Moved footnote 4:' For maximum flash performance, set to 0b1' to the 'BFEN' column header. • Deleted the x-refs in the 'BFEN' column for the rows. • Added footnotes 4, 6, 7, and 8: -- footnote 4 27 MHz parts allow for 25 MHz system clock + 2% frequency modulation (FM). -- footnote 5 52 MHz parts allow for 50 MHz system clock + 2% FM. -- footnote 6 77 MHz parts allow for 75 MHz system clock + 2% FM. -- footnote 7 82 MHz parts allow for 80 MHz system clock + 2% FM.

Table 30. Table and Figure Changes Between Rev. 3.0 and 4.0 (continued)

Location	Description of Changes
Table 25, eMIOS Timing:	• Deleted (MTS) from the heading, table, and footnotes. • Footnote 1: Changed 'V_{DDEH} = 3.0–5.5;' to 'V_{DDEH} = 3.0–5.25;' • Footnote 1: Deleted 'F_{SYS} = 80 MHz,' 'V_{DD} = 1.35–1.65 V', 'V_{DD33} and V_{DDSYN} = 3.0–3.6 V' and 'and CL = 200 pF with SRC = 0b11.' • Added Footnote 2: 'This specification does not include the rise and fall times. When calculating the minimum eMIOS pulse width, include the rise and fall times defined in the slew rate control fields (SRC) of the pad configuration registers (PCR).'
Figure 17, eMIOS Timing: Added figure.	
Table 26, DSPI Timing:	• Table Title: Added footnote that reads: Speed is the nominal maximum frequency. Max speed is the maximum speed allowed including frequency modulation (FM). 42 MHz parts allow for 40 MHz system clock + 2% FM; 68 MHz parts allow for 66 MHz system clock + 2% FM, and 82 MHz parts allow for 80 MHz system clock + 2% FM. • Spec1:*SCK Cycle Time*: changes to values: 40 MHz, min. = 48.8 ns, max = 5.8 ms; 66 MHz, min. = 28.4 ns, max = 3.5 ms; 80 MHz min. = 24.4 ns, max = 2.9 ms. • Spec 2: *PCS to SCK delay*: 40 MHz, min. = 46 ns; 66 MHz, min. = 26 ns; 80 MHz min. = 22 ns. • Spec 3: *After SCK delay*: 40 MHz, min. = 45 ns; 66 MHz, min. = 25 ns; 80 MHz min. = 21 ns. • Spec 9: *Data setup time for inputs, Master (MTFE = 1, CPHA = 0)*: 66 MHz, min. = 6 ns; 80 MHz min. = 8 ns. • Spec 10: *Data hold time for inputs, Master (MTFE = 1, CPHA = 0)*: 40 MHz, min. = 45 ns; 66 MHz, min. = 25 ns; 80 MHz min. = 21 ns. • Spec 11: *Data valid (after SCK edge), Master (MTFE = 1, CPHA = 0)*: 40 MHz, max. = 45 ns; 66 MHz, max. = 25 ns; 80 MHz max. = 21 ns. • Footnote 1: Changed 'V_{DDEH} = 3.0–5.5;' to 'V_{DDEH} = 3.0–5.25;' • Footnote 1: Added to beginning of footnote 1 'All DSPI timing specifications use the fastest slew rate (SRC = 0b11) on pad type M or MH. DSPI signals using pad types of S or SH have an additional delay based on the slew rate.' • Footnote 1: Deleted 'V_{DD} = 1.35–1.65 V' and 'V_{DD33} and V_{DDSYN} = 3.0–3.6 V.
Table 27, EQADC SSI Timing Characteristics:	• Footnote 1: Changed 'V_{DDEH} = 3.0–5.5;' to 'V_{DDEH} = 3.0–5.25;' • Deleted from table title '(Pads at 3.3 V or 5.0 V)' • Deleted 1st line in table 'CLOAD = 25 pF on all outputs. Pad drive strength set to maximum.' • Spec 1: FCK frequency -- removed. • Combined footnotes 1 and 2, and moved the new footnote to Spec 2. Moved old footnote 3 that is now footnote 2 to Spec 2. • Footnote 1, deleted 'V_{DD} = 1.35–1.65 V' and 'V_{DD33} and V_{DDSYN} = 3.0–3.6V.' Changed 'CL = 50 pF' to 'CL = 25 pF.' • Footnote 2: added 'cycle' after 'duty' to read: FCK duty cycle is not 50% when . . . .
Figure 28, MPC5534 208 Package and Figure 29 MPC5534 324 Package: Deleted the version number and date.	
Figure 30, MPC5534 208 Package Dimensions and Figure 31 MPC5534 324 Package Dimensions:	Deleted the version number and date.

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