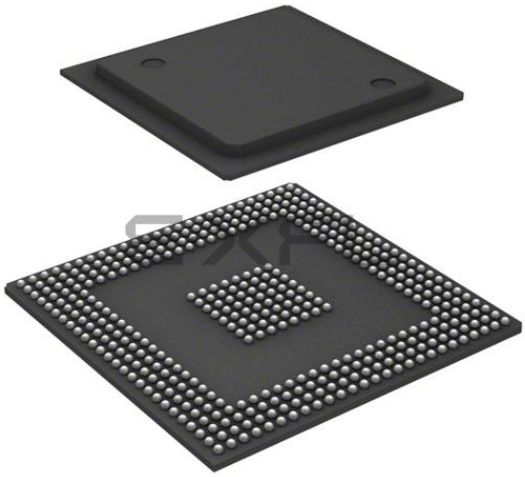


Welcome to E-XFL.COM

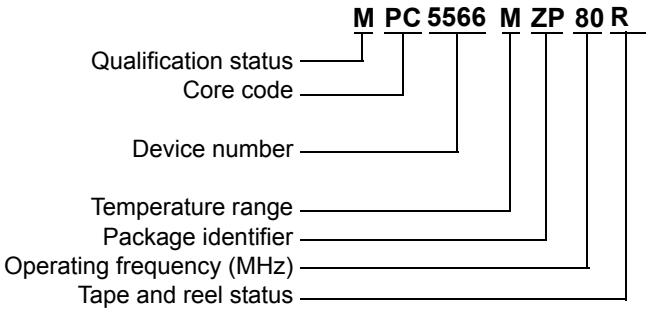
What is "Embedded - Microcontrollers"?

"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	e200z6
Core Size	32-Bit Single-Core
Speed	132MHz
Connectivity	CANbus, EBI/EMI, Ethernet, SCI, SPI
Peripherals	DMA, POR, PWM, WDT
Number of I/O	256
Program Memory Size	3MB (3M x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	128K x 8
Voltage - Supply (Vcc/Vdd)	1.35V ~ 1.65V
Data Converters	A/D 40x12b
Oscillator Type	External
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	416-BBGA
Supplier Device Package	416-PBGA (27x27)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/spc5566mvr132r

2 Ordering Information



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

Package Identifier
ZP = 416PBGA SnPb
VR = 416PBGA Pb-free

Operating Frequency
80 = 80 MHz
112 = 112 MHz
132 = 132 MHz
144 = 144 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[1]	Package Description	Speed (MHz)		Operating Temperature [2]	
		Nominal	Max. [3] (f_{MAX})	Min. (T_L)	Max. (T_H)
MPC5566MVR144	MPC5566 416 package Lead-free (PbFree)	144	147	–40° C	125° C
MPC5566MVR132		132	135		
MPC5566MVR112		112	114		
MPC5566MVR80		80	82		
MPC5566MZP144	MPC5566 416 package Leaded (SnPb)	144	147	–40° C	125° C
MPC5566MZP132		132	135		
MPC5566MZP112		112	114		
MPC5566MZP80		80	82		

1 All devices are PPC5566, rather than MPC5566 or SPC5566, until product qualifications are complete. Not all configurations are available in the PPC parts.

2 The lowest ambient operating temperature is referenced by T_L; the highest ambient operating temperature is referenced by T_H.

3 Speed is the nominal maximum frequency. Max. speed is the maximum speed allowed including frequency modulation (FM). 82 MHz parts allow for 80 MHz system clock + 2% FM; 114 MHz parts allow for 112 MHz system clock + 2% FM; 135 MHz parts allow for 132 MHz system clock + 2% FM; and 147 MHz parts allow for 144 MHz system clock + 2% FM.

At a known board temperature, the junction temperature is estimated using the following equation:

$$T_J = T_B + (R_{\theta JB} \times P_D)$$

where:

T_J = junction temperature (^oC)

T_B = board temperature at the package perimeter ($^oC/W$)

$R_{\theta JB}$ = junction-to-board thermal resistance ($^oC/W$) per JESD51-8

P_D = power dissipation in the package (W)

When the heat loss from the package case to the air does not factor into the calculation, an acceptable value for the junction temperature is predictable. Ensure the application board is similar to the thermal test condition, with the component soldered to a board with internal planes.

The thermal resistance is expressed as the sum of a junction-to-case thermal resistance plus a case-to-ambient thermal resistance:

$$R_{\theta JA} = R_{\theta JC} + R_{\theta CA}$$

where:

$R_{\theta JA}$ = junction-to-ambient thermal resistance ($^oC/W$)

$R_{\theta JC}$ = junction-to-case thermal resistance ($^oC/W$)

$R_{\theta CA}$ = case-to-ambient thermal resistance ($^oC/W$)

$R_{\theta JC}$ is device related and is not affected by other factors. The thermal environment can be controlled to change the case-to-ambient thermal resistance, $R_{\theta CA}$. For example, change the air flow around the device, add a heat sink, change the mounting arrangement on the printed circuit board, or change the thermal dissipation on the printed circuit board surrounding the device. This description is most useful for packages with heat sinks where 90% of the heat flow is through the case to heat sink to ambient. For most packages, a better model is required.

A more accurate two-resistor thermal model can be constructed from the junction-to-board thermal resistance and the junction-to-case thermal resistance. The junction-to-case thermal resistance describes when using a heat sink or where a substantial amount of heat is dissipated from the top of the package. The junction-to-board thermal resistance describes the thermal performance when most of the heat is conducted to the printed circuit board. This model can be used to generate simple estimations and for computational fluid dynamics (CFD) thermal models.

To determine the junction temperature of the device in the application on a prototype board, use the thermal characterization parameter (Ψ_{JT}) to determine the junction temperature by measuring the temperature at the top center of the package case using the following equation:

$$T_J = T_T + (\Psi_{JT} \times P_D)$$

where:

T_T = thermocouple temperature on top of the package (^oC)

Ψ_{JT} = thermal characterization parameter ($^oC/W$)

P_D = power dissipation in the package (W)

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 voltage on 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 V_{stby} 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.

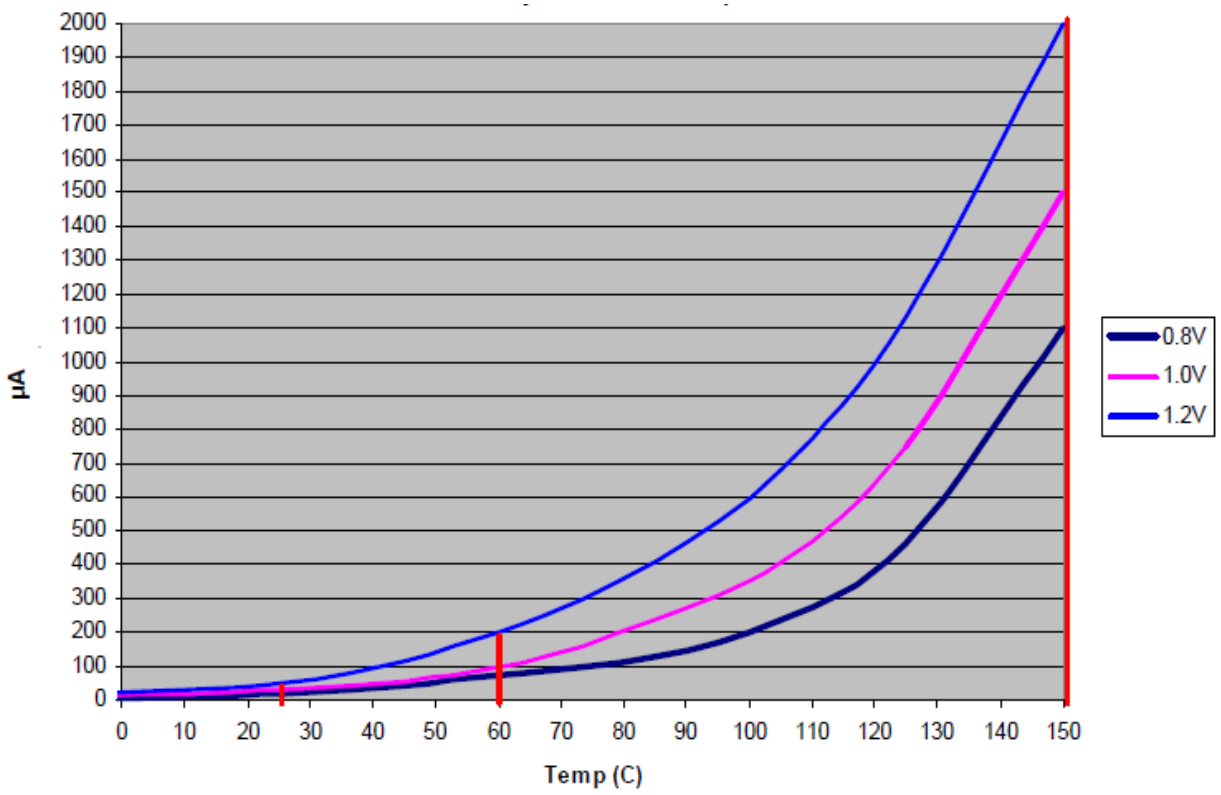


Figure 2. fI_{STBY} Worst-case Specifications

3.8 DC Electrical Specifications

Table 9. DC Electrical Specifications ($T_A = T_L$ to T_H)

Spec	Characteristic	Symbol	Min	Max.	Unit
1	Core supply voltage (average DC RMS voltage)	V_{DD}	1.35	1.65	V
2	Input/output supply voltage (fast input/output) [1]	V_{DDE}	1.62	3.6	V
3	Input/output supply voltage (slow and medium input/output)	V_{DDEH}	3.0	5.25	V
4	3.3 V input/output buffer voltage	V_{DD33}	3.0	3.6	V
5	Voltage regulator control input voltage	V_{RC33}	3.0	3.6	V
6	Analog supply voltage [2]	V_{DDA}	4.5	5.25	V
8	Flash programming voltage [3]	V_{PP}	4.5	5.25	V
9	Flash read voltage	V_{FLASH}	3.0	3.6	V
10	SRAM standby voltage [4]	V_{STBY}	0.8	1.2	V
11	Clock synthesizer operating voltage	V_{DDSYN}	3.0	3.6	V
12	Fast I/O input high voltage	V_{IH_F}	$0.65 \times V_{DDE}$	$V_{DDE} + 0.3$	V
13	Fast I/O input low voltage	V_{IL_F}	$V_{SS} - 0.3$	$0.35 \times V_{DDE}$	V
14	Medium and slow I/O input high voltage	V_{IH_S}	$0.65 \times V_{DDEH}$	$V_{DDEH} + 0.3$	V
15	Medium and slow I/O input low voltage	V_{IL_S}	$V_{SS} - 0.3$	$0.35 \times V_{DDEH}$	V
16	Fast input hysteresis	V_{HYS_F}	$0.1 \times V_{DDE}$		V
17	Medium and slow I/O input hysteresis	V_{HYS_S}	$0.1 \times V_{DDEH}$		V
18	Analog input voltage	V_{INDC}	$V_{SSA} - 0.3$	$V_{DDA} + 0.3$	V
19	Fast output high voltage (I_{OH_F} = –2.0 mA)	V_{OH_F}	$0.8 \times V_{DDE}$	—	V
20	Slow and medium output high voltage I_{OH_S} = –2.0 mA I_{OH_S} = –1.0 mA	V_{OH_S}	$0.80 \times V_{DDEH}$ $0.85 \times V_{DDEH}$	—	V
21	Fast output low voltage (I_{OL_F} = 2.0 mA)	V_{OL_F}	—	$0.2 \times V_{DDE}$	V
22	Slow and medium output low voltage I_{OL_S} = 2.0 mA I_{OL_S} = 1.0 mA	V_{OL_S}	—	 $0.20 \times V_{DDEH}$ $0.15 \times V_{DDEH}$	V
23	Load capacitance (fast I/O) [5] DSC (SIU_PCR[8:9]) = 0b00 = 0b01 = 0b10 = 0b11	C_L	 — — — —	 10 20 30 50	 pF pF pF pF
24	Input capacitance (digital pins)	C_{IN}	—	7	pF
25	Input capacitance (analog pins)	C_{IN_A}	—	10	pF
26	Input capacitance: (Shared digital and analog pins AN[12]_MA[0]_$\overline{SDS}$, AN[13]_MA[1]_SDO, AN[14]_MA[2]_SDI, and AN[15]_FCK)	C_{IN_M}	—	12	pF

Table 9. DC Electrical Specifications ($T_A = T_L$ to T_H) (continued)

Spec	Characteristic	Symbol	Min	Max.	Unit
28	Operating current 3.3 V supplies @ f_{MAX} MHz				
	V_{DD33} [13]	I_{DD_33}	—	2 + (values derived from procedure of footnote [13])	mA
	V_{FLASH}	I_{VFLASH}	—	10	mA
	V_{DDSYN}	I_{DDSYN}	—	15	mA
29	Operating current 5.0 V supplies (12 MHz ADCLK):				
	V_{DDA} (V_{DDA0} + V_{DDA1})	I_{DD_A}	—	20.0	mA
	Analog reference supply current (V_{RH}, V_{RL})	I_{REF}	—	1.0	mA
	V_{PP}	I_{PP}	—	25.0	mA
30	Operating current V_{DDE} supplies: [14]				
	V_{DDEH1}	I_{DD1}	—	Refer to footnote [14]	mA
	V_{DDE2}	I_{DD2}	—		mA
	V_{DDE3}	I_{DD3}	—		mA
	V_{DDEH4}	I_{DD4}	—		mA
	V_{DDE5}	I_{DD5}	—		mA
	V_{DDEH6}	I_{DD6}	—		mA
	V_{DDE7}	I_{DD7}	—		mA
	V_{DDEH8}	I_{DD8}	—		mA
	V_{DDEH9}	I_{DD9}	—		mA
31	Fast I/O weak pullup current [15]	I_{ACT_F}			
	1.62–1.98 V		10	110	µA
	2.25–2.75 V		20	130	µA
	3.00–3.60 V		20	170	µA
	Fast I/O weak pulldown current [15]				
	1.62–1.98 V		10	100	µA
	2.25–2.75 V		20	130	µA
	3.00–3.60 V		20	170	µA
32	Slow and medium I/O weak pullup/down current [15]	I_{ACT_S}			
	3.0–3.6 V		10	150	µA
	4.5–5.5 V		20	170	µA
33	I/O input leakage current [16]	I_{INACT_D}	–2.5	2.5	µA
34	DC injection current (per pin)	I_{IC}	–2.0	2.0	mA
35	Analog input current, channel off [17]	I_{INACT_A}	–150	150	nA
35a	Analog input current, shared analog / digital pins (AN[12], AN[13], AN[14], AN[15])	I_{INACT_AD}	–2.5	2.5	µA
36	V_{SS} to V_{SSA} differential voltage [18]	$V_{SS} - V_{SSA}$	–100	100	mV
37	Analog reference low voltage	V_{RL}	V_{SSA} – 0.1	V_{SSA} + 0.1	V
38	V_{RL} differential voltage	$V_{RL} - V_{SSA}$	–100	100	mV
39	Analog reference high voltage	V_{RH}	V_{DDA} – 0.1	V_{DDA} + 0.1	V
40	V_{REF} differential voltage	$V_{RH} - V_{RL}$	4.5	5.25	V

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 16 shows the FLASH_BIU settings versus frequency of operation. Refer to the device reference manual for definitions of these bit fields.

Table 16. FLASH_BIU Settings vs. Frequency of Operation [1]

Maximum Frequency (MHz)	APC	RWSC	WWSC	DPFEN [2]	IPFEN [2]	PFLIM [3]	BFEN [4]
Up to and including 82 MHz [5]	0b001	0b001	0b01	0b00 0b01 0b11	0b00 0b01 0b11	0b000 to 0b110	0b0 0b1
Up to and including 102 MHz [6]	0b001	0b010	0b01	0b00 0b01 0b11	0b00 0b01 0b11	0b000 to 0b110	0b0 0b1
Up to and including 135 MHz [7]	0b010	0b011	0b01	0b00 0b01 0b11	0b00 0b01 0b11	0b000 to 0b110	0b0 0b1
Up to and including 147 MHz [8]	0b011	0b100	0b01	0b00 0b01 0b11	0b00 0b01 0b11	0b000 to 0b110	0b0 0b1
Default setting after reset	0b111	0b111	0b11	0b00	0b00	0b000	0b0

1 Illegal combinations exist. Use entries from the same row in this table.
2 For maximum flash performance, set to 0b11.
3 For maximum flash performance, set to 0b110.
4 For maximum flash performance, set to 0b1.
5 82 MHz parts allow for 80 MHz system clock + 2% frequency modulation (FM).
6 102 MHz parts allow for 100 MHz system clock + 2% FM.
7 135 MHz parts allow for 132 MHz system clock + 2% FM.
8 147 MHz parts allow for 144 MHz system clock + 2% FM.

3.12 AC Specifications

3.12.1 Pad AC Specifications

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

Spec	Pad	SRC / DSC (binary)	Out Delay [2, 3, 4] (ns)	Rise / Fall [4, 5] (ns)	Load Drive (pF)
1	Slow high voltage (SH)	11	26	15	50
			82	60	200
		01	75	40	50
			137	80	200
		00	377	200	50
			476	260	200

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

Spec	Pad	SRC/DSC (binary)	Out Delay [2, 3, 4] (ns)	Rise / Fall [3, 5] (ns)	Load Drive (pF)
3	Fast	00	3.2	2.4	10
		01		2.2	20
		10		2.1	30
		11		2.1	50
4	Pullup/down (3.6 V max)	—	—	7500	50
5	Pullup/down (5.5 V max)	—	—	9500	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} = 3.0–3.6 V; V_{DDEH} = 3.0–3.6 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 guaranteed by design (not tested).

3 The output delay, and the rise and fall, are calculated to 20% or 80% of the respective signal.

4 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.

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

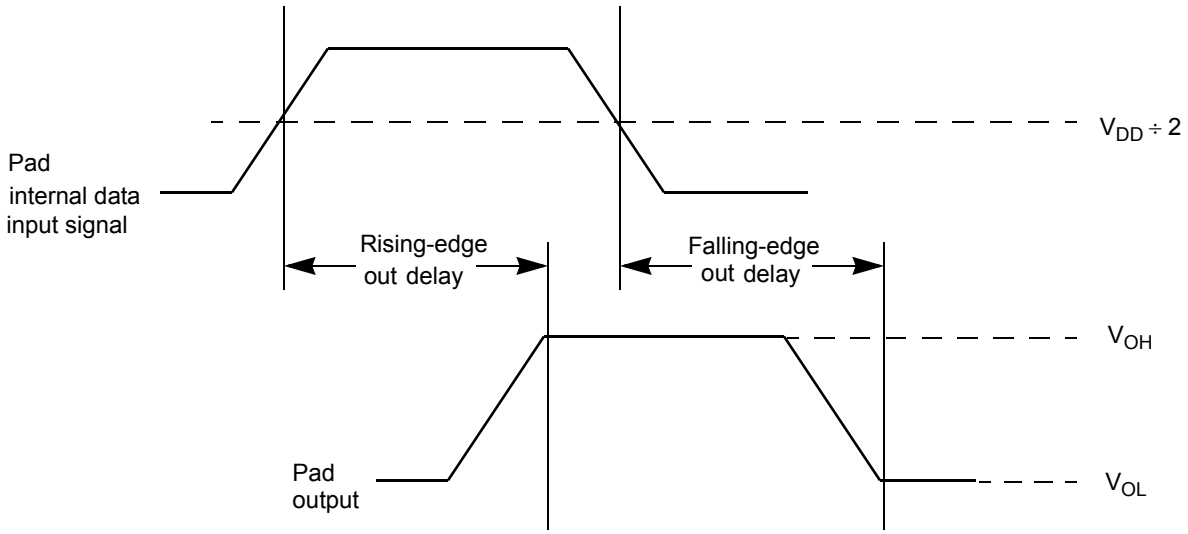


Figure 4. Pad Output Delay

3.13 AC Timing

3.13.1 Reset and Configuration Pin Timing

Table 19. Reset and Configuration Pin Timing [1]

Spec	Characteristic	Symbol	Min.	Max.	Unit
1	$\overline{\text{RESET}}$ pulse width	t_{RPW}	10	—	t_{CYC}
2	$\overline{\text{RESET}}$ glitch detect pulse width	t_{GPW}	2	—	t_{CYC}

3.13.3 Nexus Timing

Table 21. Nexus Debug Port Timing [1]

Spec	Characteristic	Symbol	Min.	Max.	Unit
1	MCKO cycle time	t_{MCYC}	1 [2]	8	t_{CYC}
2	MCKO duty cycle	t_{MDC}	40	60	%
3	MCKO low to MDO data valid [3]	t_{MDOV}	–1.5	3.0	ns
4	MCKO low to $\overline{\text{MSEO}}$ data valid [3]	t_{MSEOV}	–1.5	3.0	ns
5	MCKO low to $\overline{\text{EVTO}}$ data valid [3]	t_{EVTOV}	–1.5	3.0	ns
6	$\overline{\text{EVTI}}$ pulse width	t_{EVTIPW}	4.0	—	t_{TCYC}
7	$\overline{\text{EVTO}}$ pulse width	t_{EVTOPW}	1	—	t_{MCYC}
8	TCK cycle time	t_{TCYC}	4 [4]	—	t_{CYC}
9	TCK duty cycle	t_{TDC}	40	60	%
10	TDI, TMS data setup time	t_{NTDIS}, t_{NTMSS}	8	—	ns
11	TDI, TMS data hold time	t_{NTDIH}, t_{NTMSH}	5	—	ns
12	TCK low to TDO data valid V_{DDE} = 2.25–3.0 V V_{DDE} = 3.0–3.6 V	t_{JOV}	 0 0	 12 10	 ns ns
13	$\overline{\text{RDY}}$ valid to MCKO [5]	—	—	—	—

1 JTAG specifications apply when used for debug functionality. All Nexus timing relative to MCKO is measured from 50% of MCKO and 50% of the respective signal. Nexus timing specified at V_{DD} = 1.35–1.65 V, V_{DDE} = 2.25–3.6 V, V_{DD33} and V_{DDSYN} = 3.0–3.6 V, T_A = T_L to T_H, and CL = 30 pF with DSC = 0b10.

2 The Nexus AUX port runs up to 82 MHz. Set NPC_PCR[MCKO_DIV] to divide-by-two if the system frequency is greater than 82 MHz.

3 MDO, $\overline{\text{MSEO}}$, and $\overline{\text{EVTO}}$ data is held valid until the next MCKO low cycle occurs.

4 Limit the maximum frequency to approximately 16 MHz (V_{DDE} = 2.25–3.0 V) or 20 MHz (V_{DDE} = 3.0–3.6 V) to meet the timing specification for t_{JOV} of [0.2 x t_{JCYC}] as outlined in the IEEE-ISTO 5001-2003 specification.

5 The $\overline{\text{RDY}}$ pin timing is asynchronous to MCKO and is guaranteed by design to function correctly.

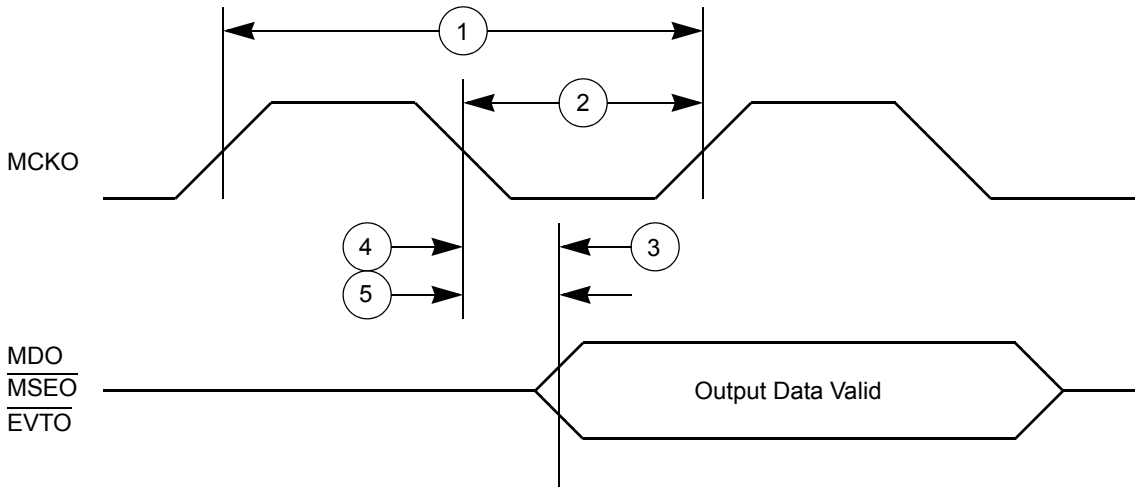


Figure 10. Nexus Output Timing

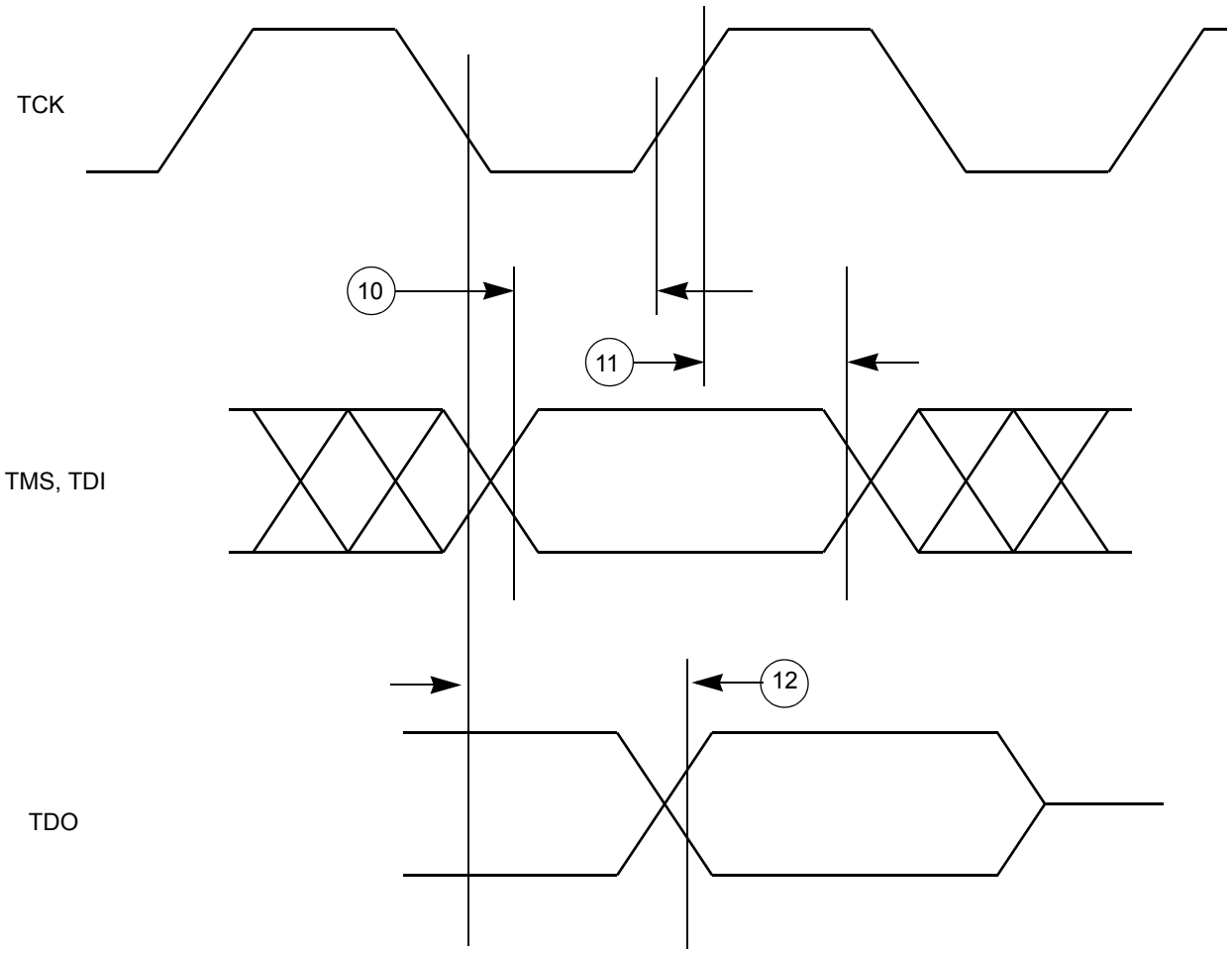


Figure 11. Nexus TDI, TMS, TDO Timing

3.13.4 External Bus Interface (EBI) Timing

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

Table 22. Bus Operation Timing [1]

Spec	Characteristic and Description	Symbol	External Bus Frequency [2, 3]								Unit	Notes
			40 MHz		56 MHz		67 MHz		72 MHz			
			Min	Max	Min	Max	Min	Max	Min	Max		
1	CLKOUT period	T_C	25.0	—	17.9	—	15.2	—	13.3	—	ns	Signals are measured at 50% V_{DDE}.
2	CLKOUT duty cycle	t_{CDC}	45%	55%	45%	55%	45%	55%	45%	55%	T_C	
3	CLKOUT rise time	t_{CRT}	—	— [4]	—	— [4]	—	— [4]	—	— [4]	ns	
4	CLKOUT fall time	t_{CFT}	—	— [4]	—	— [4]	—	— [4]	—	— [4]	ns	
5	CLKOUT positive edge to output signal *invalid* or Hi-Z (hold time) External bus interface CS[0:3] ADDR[8:31] DATA[0:31] BDIP BG [5] BR [7] BB OE RD_WR TA TEA TS TSIZ[0:1] WE/BE[0:3]	t_{COH}	1.0 [6] 1.5	—	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.
	CLKOUT positive edge to output signal *invalid* or Hi-Z (hold time) Calibration bus interface CAL_CS[0:3] CAL_ADDR[9:30] CAL_DATA[0:15] CAL_OE CAL_RD_WR CAL_TS CAL_WE/BE[0:1]	t_{CCOH}	1.0 [6] 1.5	—	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.

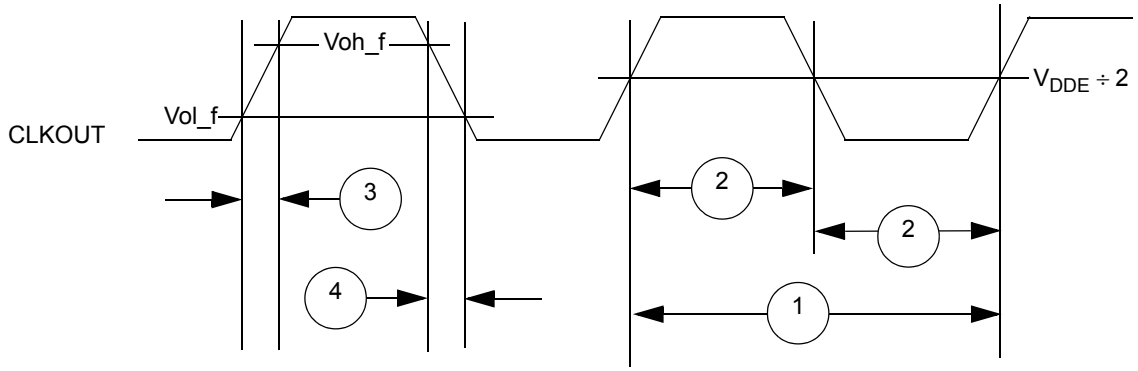


Figure 12. CLKOUT Timing

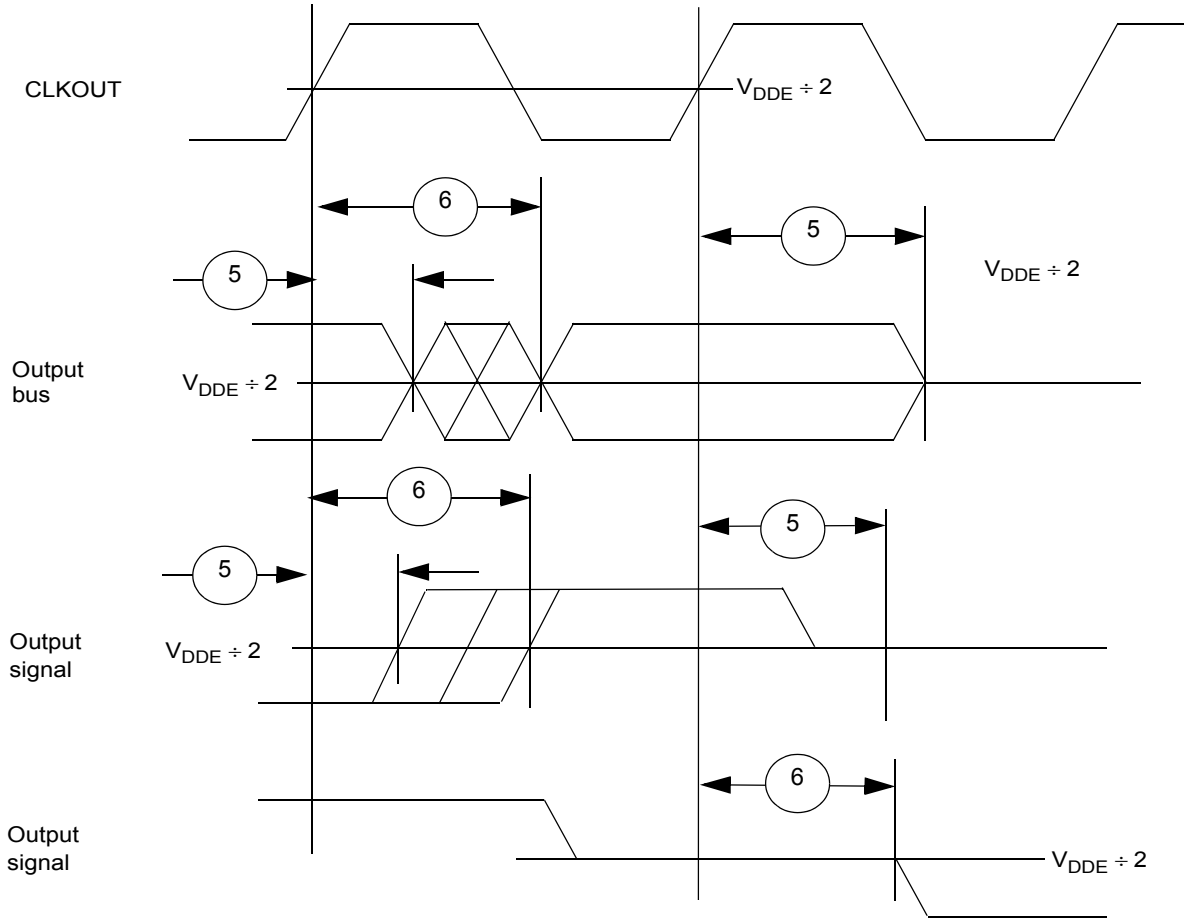


Figure 13. Synchronous Output Timing

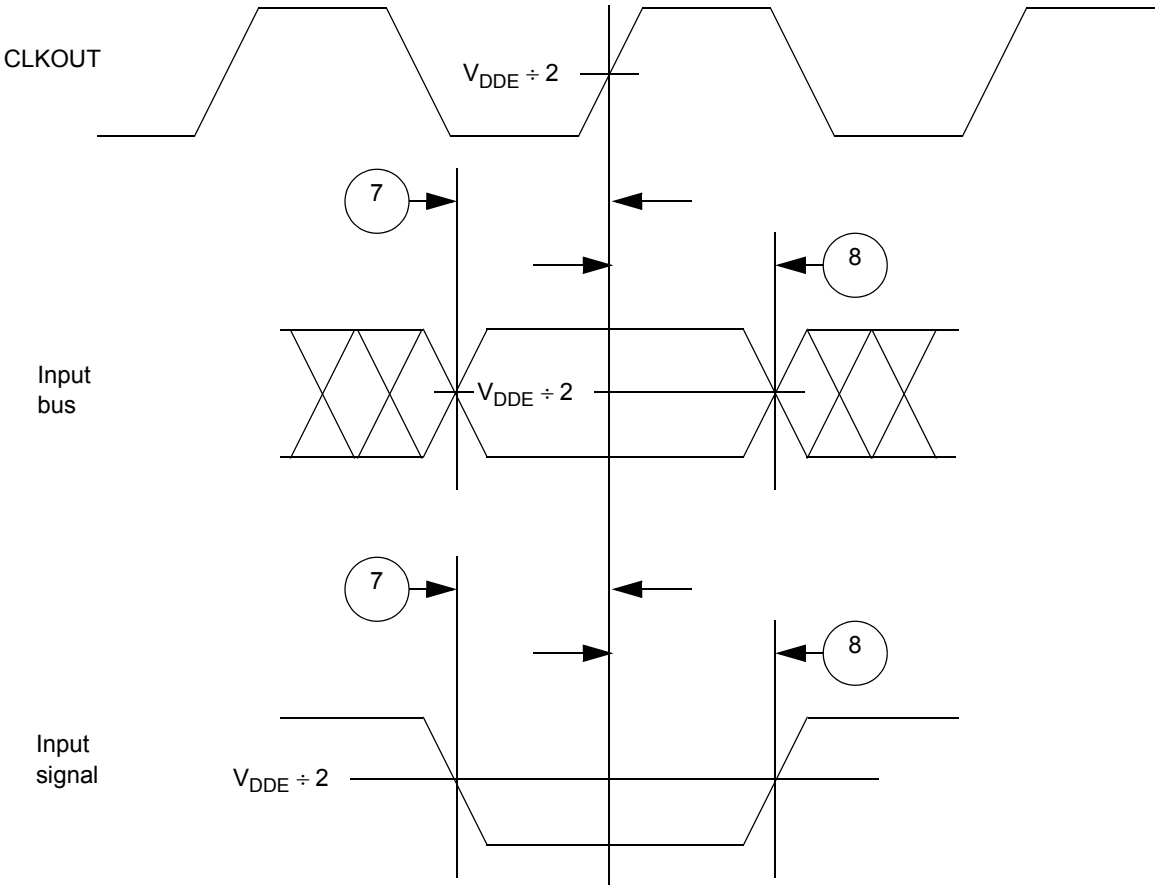


Figure 14. Synchronous Input Timing

3.13.5 External Interrupt Timing (IRQ Signals)

Table 23. External Interrupt Timing [1]

Spec	Characteristic	Symbol	Min.	Max.	Unit
1	IRQ pulse-width low	t_{IPWL}	3	—	t_{CYC}
2	IRQ pulse-width high	T_{IPWH}	3	—	t_{CYC}
3	IRQ edge-to-edge time [2]	t_{ICYC}	6	—	t_{CYC}

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

2 Applies when IRQ signals are configured for rising-edge or falling-edge events, but not both.

3.14 Fast Ethernet AC Timing Specifications

Media Independent Interface (MII) Fast Ethernet Controller (FEC) signals use transistor-to-transistor logic (TTL) signal levels compatible with devices operating at 3.3 V. The timing specifications for the MII FEC signals are independent of the system clock frequency (part speed designation).

3.14.1 MII FEC Receive Signal Timing FEC_RXD[3:0], FEC_RX_DV, FEC_RX_ER, and FEC_RX_CLK

The receive functions correctly up to an FEC_RX_CLK maximum frequency of 25 MHz plus one percent. There is no minimum frequency requirement. The processor clock frequency must exceed four times the FEC_RX_CLK frequency.

Table 28 lists MII FEC receive channel timings.

Table 28. MII FEC Receive Signal Timing

Spec	Characteristic	Min.	Max	Unit
1	FEC_RXD[3:0], FEC_RX_DV, FEC_RX_ER to FEC_RX_CLK setup	5	—	ns
2	FEC_RX_CLK to FEC_RXD[3:0], FEC_RX_DV, FEC_RX_ER hold	5	—	ns
3	FEC_RX_CLK pulse-width high	35%	65%	FEC_RX_CLK period
4	FEC_RX_CLK pulse-width low	35%	65%	FEC_RX_CLK period

Figure 28 shows MII FEC receive signal timings listed in Table 28.

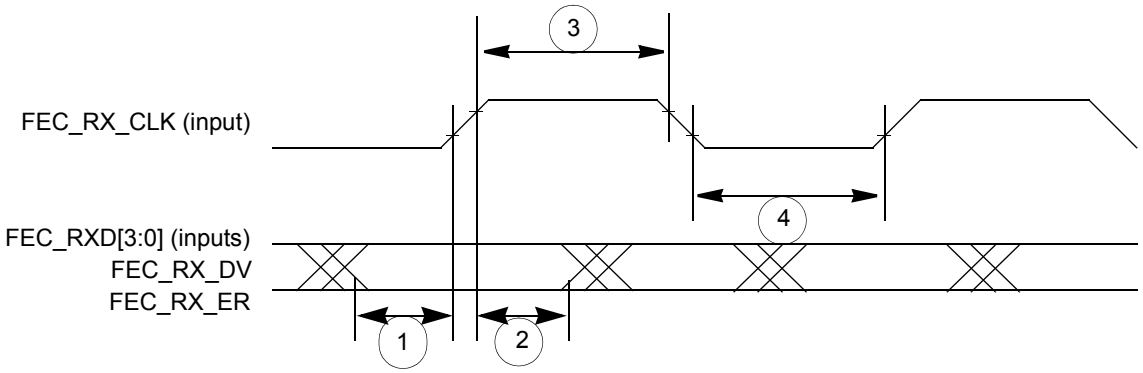


Figure 28. MII FEC Receive Signal Timing Diagram

4 Mechanicals

4.1 MPC5566 416 PBGA Pinout

Figure 32, Figure 33, and Figure 34 show the pinout for the MPC5566 416 PBGA package. The alternate Fast Ethernet Controller (FEC) signals are multiplexed with the data calibration bus signals.

NOTE

The MPC5500 devices are pin compatible for software portability and use the primary function names to label the pins in the BGA diagram. Although some devices do not support all the primary functions shown in the BGA diagram, the muxed and GPIO signals on those pins remain available. See the signals chapter in the device reference manual for the signal muxing.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
A	VSS	VSTBY	AN37	AN11	VDDA1	AN16	AN1	AN5	VRH	AN23	AN27	AN28	AN35	VSSA0	AN15	ETRIG 1	ETPUB 18	ETPUB 20	ETPUB 24	ETPUB 27	GPIO 205	MDO11	MDO8	VDD	VDD33	VSS	A
B	VDD	VSS	AN36	AN39	AN19	AN20	AN0	AN4	REF BYPC	AN22	AN26	AN31	AN32	VSSA0	AN14	ETRIG 0	ETPUB 21	ETPUB 25	ETPUB 28	ETPUB 31	MDO10	MDO7	MDO4	MDO0	VSS	VDDE7	B
C	VDD33	VDD	VSS	AN8	AN17	VSSA1	AN21	AN3	AN7	VRL	AN25	AN30	AN33	VDDA0	AN13	ETPUB 19	ETPUB 22	ETPUB 26	ETPUB 30	MDO9	MDO6	MDO3	MDO1	VSS	VDDE7	VDD	C
D	ETPUA 30	ETPUA 31	VDD	VSS	AN38	AN9	AN10	AN18	AN2	AN6	AN24	AN29	AN34	VDDEH 9	AN12	ETPUB 16	ETPUB 17	ETPUB 23	ETPUB 29	MDO5	MDO2	VDDEH 8	VSS	VDDE7	TCK	TDI	D
E	ETPUA 28	ETPUA 29	VDDEH 1	VDD																			VDDE7	TMS	TDO	TEST	E
F	ETPUA 24	ETPUA 27	ETPUA 26	VDDEH 1																			MSEO0	JCOMP	EVTI	EVTO	F
G	ETPUA 23	ETPUA 22	ETPUA 25	ETPUA 21																			MSEO1	MCKO	GPIO 204	ETPUB 15	G
H	ETPUA 20	ETPUA 19	ETPUA 18	ETPUA 17																			RDY	GPIO 203	ETPUB 14	ETPUB 13	H
J	ETPUA 16	ETPUA 15	ETPUA 14	ETPUA 13																			VDDEH 6	ETPUB 12	ETPUB 11	ETPUB 9	J
K	ETPUA 12	ETPUA 11	ETPUA 10	ETPUA 9						VSS	VSS	VSS	VSS	VDDE7	VDDE7	VDDE7	VDDE7						ETPUB 10	ETPUB 8	ETPUB 7	ETPUB 5	K
L	ETPUA 8	ETPUA 7	ETPUA 6	ETPUA 5						VSS	VSS	VSS	VSS	VSS	VSS	VSS	VDDE7						ETPUB 6	ETPUB 4	ETPUB 3	ETPUB 2	L
M	ETPUA 4	ETPUA 3	ETPUA 2	ETPUA 1						VDDE2	VDDE2	VSS	VSS	VSS	VSS	VSS	VDDE7						TCRCLK B	ETPUB 1	ETPUB 0	SINB	M
N	BDIP	TEA	ETPUA 0	TCRCLK A						VDDE2	VDDE2	VSS	VSS	VSS	VSS	VSS	VDDE7						SOUTB	PCSB3	PCSB0	PCSB1	N
P	CS3	CS2	CS1	CS0						VDDE2	VDDE2	VSS	VSS	VSS	VSS	VSS	VSS						PCSA3	PCSB4	SCKB	PCSB2	P
R	WE3	WE2	WE1	WE0						VDDE2	VDDE2	VSS	VSS	VSS	VSS	VSS	VSS						PCSB5	SOUTA	SINA	SCKA	R
T	VDDE2	TSIZ0	RD_WR	VDDE2						VDDE2	VSS	VDDE2	VDDE2	VDDE2	VDDE2	VSS	VSS						PCSA1	PCSA0	PCSA2	VPP	T
U	ADDR 16	TSIZ1	TA	VDD33						VSS	VDDE2	VDDE2	VDDE2	VDDE2	VDDE2	VSS	VSS						PCSA4	TXDA	PCSA5	VFLASH	U
V	ADDR 18	ADDR 17	TS	ADDR 8																			CNTXC	RXDA	RSTOUT	RST CFG	V
W	ADDR 20	ADDR 19	ADDR 9	ADDR 10																			RXDB	CNRXC	TXDB	RESET	W
Y	ADDR 22	ADDR 21	ADDR 11	VDDE2						Note:	NC	No connect. AC22 & AD23 reserved											WKP CFG	BOOT CFG1	VRC VSS	VSS SYN	Y
AA	ADDR 24	ADDR 23	ADDR 13	ADDR 12																			VDDEH 6	PLL CFG1	BOOT CFG0	EXTAL	AA
AB	VDDE2	ADDR 25	ADDR 15	ADDR 14																			VDD	VRC CTL	PLL CFG0	XTAL	AB
AC	ADDR 26	ADDR 27	ADDR 31	VSS	VDD	DATA 26	DATA 28	VDDE2	DATA 30	DATA 31	DATA 8	DATA 10	VDDE2	DATA 12	DATA 14	EMIOS 2	EMIOS 8	EMIOS 12	EMIOS 21	VDDEH 4	VDDE5	NC	VSS	VDD	VRC33	VDD SYN	AC
AD	ADDR 28	ADDR 30	VSS	VDD	DATA 24	DATA 25	DATA 27	DATA 29	VDD33	GPIO 207	DATA 9	DATA 11	DATA 13	DATA 15	EMIOS 3	EMIOS 6	EMIOS 10	EMIOS 15	EMIOS 17	EMIOS 22	CNTXA	VDDE5	NC	VSS	VDD	VDD33	AD
AE	ADDR 29	VSS	VDD	DATA 17	DATA 19	DATA 21	DATA 23	DATA 0	DATA 2	DATA 4	DATA 6	OE	BR	BG	EMIOS 1	EMIOS 5	EMIOS 9	EMIOS 13	EMIOS 16	EMIOS 19	EMIOS 23	CNRXA	VDDE5	CLKOUT	VSS	VDD	AE
AF	VSS	VDD	DATA 16	DATA 18	VDDE2	DATA 20	DATA 22	GPIO 206	DATA 1	DATA 3	VDDE2	DATA 5	DATA 7	BB	EMIOS 0	EMIOS 4	EMIOS 7	EMIOS 11	EMIOS 14	EMIOS 18	EMIOS 20	CNTXB	CNRXB	VDDE5	ENG CLK	VSS	AF
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	

Figure 32. MPC5566 416 Package

5 Revision History for the MPC5566 Data Sheet

The history of revisions made to this data sheet are listed and described in this section. The information that has changed from a previous revision of this document to the current revision is listed for each revision and are grouped in the following categories:

- Global and text changes
- Table and figure changes

Within each category, the information that has changed is listed in sequential order.

5.1 Information Changed Between Revisions 2.0 and 3.0

The following table lists the information that changed in the tables between Rev. 2.0 and 3.0. Click the links to see the change.

Table 32. Changes Between Rev. 2.0 and 3.0

Location	Description of Changes
Section 3.7, "Power-Up/Down Sequencing"	Added the following paragraph in Section 3.7, "Power-Up/Down Sequencing" "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 VDD is applied. This current will not reoccur until Vstby is lowered below Vstby min. specification".
	Moved Figure 2 (fISTBY Worst-case Specifications) to Section 3.7, "Power-Up/Down Sequencing".
Section 3.8, "DC Electrical Specifications	In Table 9 (DC Electrical Specifications ($T_A = T_{L\ to}\ T_H$)) for Spec 27d the Characteristic "Refer to Figure 3 for an interpolation of this data" changed to "RAM standby current".
	Changed the footnote attached to IDD_STBY to "The current specification relates to average standby operation after SRAM has been loaded with data. For power up current see Section 3.7, "Power-Up/Down Sequencing",Figure 2 (fISTBY Worst-case Specifications).
	Removed the footnote "Figure 3 shows an illustration of the IDD_STBY values interpolated for these temperature values".

5.2 Information Changed Between Revisions 1.0 and 2.0

The following table lists the information that changed in the tables between Rev. 1.0 and 2.0. Click the links to see the change.

Table 35. Table and Figure Changes Between Rev. 0.0 and Rev. 1.0 (continued)

Location	Description of Changes
Table 9, DC Electrical Specifications:	• Spelled out meaning of the slash '/' as 'and' as well as 'I/O' as 'input/output.' Sentence still very confusing. Deleted 'input/output' from the specs to improve clarity. • Spec 20, column 2, *Characteristics*,' Slow and medium output high voltage (I_{OH_S} = –2.0 mA):' Created a left-justified second line and moved 'I_{OH_S} = –2.0 mA' from the 1st line to the second line and deleted the parentheses. Created a left-justified third line that reads 'I_{OH_S} = –1.0 mA.' • Spec 20, column 4, *Min*: Added a blank line before and after '0.80 × V_{DDEH}' and put '0.85 × V_{DDEH}' on the last line. • Spec 22, column 2, '*Slow and medium output low voltage (I_{OL_S} = 2.0 mA)*:' Created a left-justified second line and moved 'I_{OL_S} = 2.0 mA.' from the 1st line to the second line and deleted the parentheses. Created a left-justified third line that reads 'I_{OL_S} = 1.0 mA.' • Spec 22, column 5, *Max*: Added a blank line before and after '0.20 × V_{DDEH}' and put '0.15 × V_{DDEH}' on the last line. • Spec 26: Changed 'AN[12]_MA[1]_SDO' to 'AN[13]_MA[1]_SDO'. • Added footnote 10 to specs 27a, b, and c on the 4-way cache line that reads: Four-way cache enabled (L1CSR0[CORG] = 0b1) or (L1CSR0[CORG] = 0b0 with L1CSR0[WAM] = 0b1, L1CSR0[WID] = 0b1111, L1CSR0[WDD] = 0b1111, L1CSR0[AWID] = 0b1, and L1CSR0[AWDD] = 0b1). • Added footnote 11 to specs 27a, b, and c on the max numeric values: "Preliminary. Specification pending final characterization." • Added footnote 12 to specs 27a, b, and c on the max TBD values: "Specification pending final characterization." • Spec 27a: *Operating current 1.5 V supplies @ 132 MHz*: Changed 132 MHz to 135 MHz. Changed maximum values for 8-way cache: All 8-way cache max values have footnote 18. -- 1.65 typical = 630 -- 1.35 typical = 500 -- 1.65 high = 785 -- 1.35 high = 630 Changed 4-way cache with footnote 10: -- 1.65 high = 685 -- 1.35 high = TBD with footnote 19. • Spec 27b, *Operating current 1.5 V supplies @ 114 MHz*: Changed maximum values for 8-way cache. All 8-way cache max values have footnote 18: -- 1.65 typical = 600 -- 1.35 typical = 450 -- 1.65 high = 680 -- 1.35 high = 500 Changed 4-way cache values: -- 1.65 high = TBD with footnote 19 -- 1.35 high = TBD with footnote 19 • Spec 27c, *Operating current 1.5 V supplies @ 82 MHz*: Changed maximum values for 8-way cache: All 8-way cache max values have footnote 18. -- 1.65 typical = 490, -- 1.35 typical = 360, -- 1.65 high = 520, -- 1.35 high = 390. Changed 4-way cache values: -- 1.65 high = TBD with footnote 19 -- 1.35 high = TBD with footnote 19

Table 35. Table and Figure Changes Between Rev. 0.0 and Rev. 1.0 (continued)

Location	Description of Changes
Table 22, Bus Operation Timing:	• Added a column to the table for 72 MHz minimum and maximum bus frequencies. • Spec 1: 72 MHz Min. column = 13.3. • Specs 5 and 6: *CLKOUT positive edge to output signals invalid of high*: Corrected format to show the bus timing values for various frequencies with EBTS bit = 0 and EBTS bit = 1. • Specs 5, and 6: Added the $\overline{BB}$ signal for arbitration. Added the following calibration signals: CAL_ADDR[9:30], CAL_$\overline{CS}$[0:3], CAL_DATA[0:15], CAL_$\overline{OE}$, CAL_RD_$\overline{WR}$, CAL_$\overline{TS}$, CAL_$\overline{WE}$/$\overline{BE}$[0:1]. • Spec 5: EBI and Calibration sections, 72 MHz Min column, EBTS = 0 is 1.0, EBTS = 1 is 1.5. • Spec 6: EBI section, 72 MHz Max column, EBTS = 0 is 5.0, EBTS = 1 is 6.0. • Spec 6a: Calibration section, 72 MHz Max column, EBTS = 0 is 6.0, EBTS = 1 is 7.0 • Specs 7 and 8: Added the $\overline{BB}$ signal for arbitration. Added the following calibration signals: CAL_ADDR[9:30], CAL_DATA[0:15], CAL_RD_$\overline{WR}$, CAL_$\overline{TS}$.
Table 23, External Interrupt Timing:	• Footnote 1: Deleted '. . F_{SYS} = 132 MHz', 'V_{DD33} and V_{DDSYN} = 3.0–3.6 V' and ' .and CL = 200 pF with SRC = 0b11.' • Deleted second figure after table 'External Interrupt Setup Timing.'
Table 24, eTPU Timing	• Footnote 1: Deleted '. . .F_{SYS} = 132 MHz', 'V_{DD33} and V_{DDSYN} = 3.0–3.6 V' and 'and CL = 200 pF with SRC = 0b11.' • Deleted second figure, '*eTPU Input/Output Timing*' after this table. • Added Footnote 2: 'This specification does not include the rise and fall times. When calculating the minimum eTPU pulse width, include the rise and fall times defined in the slew rate control fields (SRC) of the pad configuration registers (PCR).'
Table 25, eMIOS Timing:	• Deleted (MTS) from the heading, table, and footnotes. • Footnote 1: Deleted '. . .F_{SYS} = 132 MHz, '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:	• Added 144 MHz column to the table. • Spec1:*SCK Cycle Time*: changes to values: 80 MHz, min. = 24.4; 112 MHz, min. = 17.5, max = 2.1; 132 MHz, min. = 14.8, max = 1.8; 144 MHz, min. = 13.6, max = 1.6. • Spec1:*SCK Cycle Time*: Added footnote 4 to the 144 MHz min. and max values that reads: Preliminary. Specification pending final characterization • Spec 2, *PCS to SCK delay*, 144 MHz, min. TBD • Spec 3, *After SCK delay*, 144 MHz, min. TBD • Spec 9, *Master (MTFE = 1, CPHA = 0)*, 144 MHz, min. TBD • Spec 10, *Master (MTFE = 1, CPHA = 0)*, 144 MHz, min. TBD • Spec 11, *Master (MTFE = 1, CPHA = 0)*, 144 MHz, max TBD • Spec 12, *Master (MTFE = 1, CPHA = 0)*, 144 MHz, min. TBD • 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 35. Table and Figure Changes Between Rev. 0.0 and Rev. 1.0 (continued)

Location	Description of Changes
Table 27, EQADC SSI Timing Characteristics:	• 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} = 3.0–3.6 V.' Changed 'CL = 50 pF' to 'CL = 25 pF.' • Footnote 2: added 'cycle' after 'duty' to read: FCK duty cycle is not 50% when . . . .
Figure 35, MPC5566 416 Package: Deleted the version number and date.	