NXP USA Inc. - MSC8122TVT6400 Datasheet

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Understanding Embedded - DSP (Digital Signal Processors)

Embedded - DSP (Digital Signal Processors) are specialized microprocessors designed to perform complex mathematical computations on digital signals in real-time. Unlike general-purpose processors, DSPs are optimized for high-speed numeric processing tasks, making them ideal for applications that require efficient and precise manipulation of digital data. These processors are fundamental in converting and processing signals in various forms, including audio, video, and communication signals, ensuring that data is accurately interpreted and utilized in embedded systems.

Applications of Embedded - DSP (Digital Signal Processors)

Details	
Product Status	Obsolete
Type	SC140 Core
Interface	DSI, Ethernet, RS-232
Clock Rate	400MHz
Non-Volatile Memory	External
On-Chip RAM	1.436MB
Voltage - I/O	3.30V
Voltage - Core	1.20V
Operating Temperature	-40°C ~ 105°C (TJ)
Mounting Type	Surface Mount
Package / Case	431-BFBGA, FCBGA
Supplier Device Package	431-FCPBGA (20x20)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/msc8122tvt6400

Top View

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
B		V_{DD}	GND	GND	NMI OUT	GND	V_{DD}	GND	V_{DD}	GND	V_{DD}	GND	V_{DD}	GND	V_{DD}	GND	V_{DD}	GPIO0	V_{DD}	V_{DD}	GND
C	GND	V_{DD}	TDO	S RESET	GPIO28	HCID1	GND	V_{DD}	GND	V_{DD}	GND	V_{DD}	GND	GND	GPIO30	GPIO2	GPIO1	GPIO7	GPIO3	GPIO5	GPIO6
D	TDI	EE0	EE1	GND	V_{DDH}	HCID2	HCID3	GND	V_{DD}	GND	V_{DD}	GND	V_{DD}	V_{DD}	GPIO31	GPIO29	V_{DDH}	GPIO4	V_{DDH}	GND	GPIO8
E	TCK	TRST	TMS	HRESET	GPIO27	HCID0	GND	V_{DD}	GND	V_{DD}	GND	V_{DD}	GND	GND	V_{DD}	GND	GND	GPIO9	GPIO13	GPIO10	GPIO12
F	PO RESET	RST CONF	NMI	HA29	HA22	GND	V_{DD}	V_{DD}	V_{DD}	GND	V_{DD}	GND	V_{DD}	ETHRX CLK	ETHTX CLK	GPIO20	GPIO18	GPIO16	GPIO11	GPIO14	GPIO19
G	HA24	HA27	HA25	HA23	HA17	PWE0	V_{DD}	V_{DD}	BADDR 31	BM0	ABB	V_{DD}	INT OUT	ETHCR S	V_{DD}	CS1	BCTL0	GPIO15	GND	GPIO17	GPIO22
H	HA20	HA28	V_{DD}	HA19	TEST	PSD CAS	PGTA	V_{DD}	BM1	ARTRY	AACK	DBB	HTA	V_{DD}	TT4	CS4	GPIO24	GPIO21	V_{DD}	V_{DDH}	A31
J	HA18	HA26	V_{DD}	HA13	GND	PSDA MUX	BADDR 27	V_{DD}	CLKIN	BM2	DBG	V_{DD}	GND	V_{DD}	TT3	PSDA10	BCTL1	GPIO23	GND	GPIO25	A30
K	HA15	HA21	HA16	PWE3	PWE1	POE	BADDR 30	Res.	GND	GND	GND	GND	CLKOUT	V_{DD}	TT2	ALE	CS2	GND	A26	A29	A28
L	HA12	HA14	HA11	V_{DDH}	V_{DDH}	BADDR 28	BADDR 29	GND	GND				GND	V_{DDH}	GND	GND	CS3	V_{DDH}	A27	A25	A22
M	HD28	HD31	V_{DDH}	GND	GND	GND	V_{DD}	V_{DDH}	GND		MSC8122		GND	V_{DDH}	HB RST	V_{DDH}	V_{DDH}	GND	V_{DDH}	A24	A21
N	HD26	HD30	HD29	HD24	PWE2	V_{DDH}	HWBS 0	HBCS	GND				GND	HRDS	BG	HCS	CS0	PSDWE	GPIO26	A23	A20
P	HD20	HD27	HD25	HD23	HWBS 3	HWBS 2	HWBS 1	HCLKIN	GND	GND_{SYN}	V_{CCSYN}	GND	GND	TA	BR	TEA	PSD VAL	DP0	V_{DDH}	GND	A19
R	HD18	V_{DDH}	GND	HD22	HWBS 6	HWBS 4	TSZ1	TSZ3	GBL	V_{DD}	V_{DD}	V_{DD}	TT0	DP7	DP6	DP3	TS	DP2	A17	A18	A16
T	HD17	HD21	HD1	HD0	HWBS 7	HWBS 5	TSZ0	TSZ2	TBST	V_{DD}	D16	TT1	D21	D23	DP5	DP4	DP1	D30	GND	A15	A14
U	HD16	HD19	HD2	D2	D3	D6	D8	D9	D11	D14	D15	D17	D19	D22	D25	D26	D28	D31	V_{DDH}	A12	A13
V	HD3	V_{DDH}	GND	D0	D1	D4	D5	D7	D10	D12	D13	D18	D20	GND	D24	D27	D29	A8	A9	A10	A11
W	HD6	HD5	HD4	GND	GND	V_{DDH}	V_{DDH}	GND	HDST1	HDST0	V_{DDH}	GND	HD40	V_{DDH}	HD33	V_{DDH}	HD32	GND	GND	A7	A6
Y	HD7	HD15	V_{DDH}	HD9	V_{DD}	HD60	HD58	GND	V_{DDH}	HD51	GND	V_{DDH}	HD43	GND	V_{DDH}	GND	HD37	HD34	V_{DDH}	A4	A5
AA	V_{DD}	HD14	HD12	HD10	HD63	HD59	GND	V_{DDH}	HD54	HD52	V_{DDH}	GND	V_{DDH}	HD46	GND	HD42	HD38	HD35	A0	A2	A3
AB	GND	HD13	HD11	HD8	HD62	HD61	HD57	HD56	HD55	HD53	HD50	HD49	HD48	HD47	HD45	HD44	HD41	HD39	HD36	A1	V_{DD}

Figure 3. MSC8122 Package, Top View

Table 1. MSC8122 Signal Listing by Ball Designator (continued)

Des.	Signal Name	Des.	Signal Name
E12	GND	G6	HA17
E13	V_{DD}	G7	PWE0/PSDDQM0/PBS0
E14	GND	G8	V_{DD}
E15	GND	G9	V_{DD}
E16	V_{DD}	G10	IRQ3/BADDR31
E17	GND	G11	BM0/TC0/BNKSEL0
E18	GND	G12	ABB/IRQ4
E19	GPIO9/TDM2TSYN/IRQ7/ETHMDIO	G13	V_{DD}
E20	GPIO13/TDM2RCLK/IRQ11/ETHMDC	G14	IRQ7/INT_OUT
E21	GPIO10/TDM2TCLK/IRQ8/ETHRX_DV/ETHCRS_DV/NC	G15	ETHCRS/ETHRXD
E22	GPIO12/TDM2RSYN/IRQ10/ETHRXD1/ETHSYNC	G16	V_{DD}
F2	PORESET	G17	CS1
F3	RSTCONF	G18	BCTL0
F4	NMI	G19	GPIO15/TDM1TSYN/DREQ1
F5	HA29	G20	GND
F6	HA22	G21	GPIO17/TDM1TDAT/DACK1
F7	GND	G22	GPIO22/TDM0TCLK/DONE2/DRACK2
F8	V_{DD}	H2	HA20
F9	V_{DD}	H3	HA28
F10	V_{DD}	H4	V_{DD}
F11	GND	H5	HA19
F12	V_{DD}	H6	TEST
F13	GND	H7	PSDCAS/PGPL3
F14	V_{DD}	H8	PGTA/PUPMWAIT/PGPL4/PPBS
F15	ETHRX_CLK/ETHSYNC_IN	H9	V_{DD}
F16	ETHTX_CLK/ETHREF_CLK/ETHCLOCK	H10	BM1/TC1/BNKSEL1
F17	GPIO20/TDM1RDAT	H11	ARTRY
F18	GPIO18/TDM1RSYN/DREQ2	H12	AACK
F19	GPIO16/TDM1TCLK/DONE1/DRACK1	H13	DBB/IRQ5
F20	GPIO11/TDM2TDAT/IRQ9/ETHRX_ER/ETHTXD	H14	HTA
F21	GPIO14/TDM2RDAT/IRQ12/ETHRXD0/NC	H15	V_{DD}
F22	GPIO19/TDM1RCLK/DACK2	H16	TT4/CS7
G2	HA24	H17	CS4
G3	HA27	H18	GPIO24/TDM0RSYN/IRQ14
G4	HA25	H19	GPIO21/TDM0TSYN
G5	HA23	H20	V_{DD}

Table 1. MSC8122 Signal Listing by Ball Designator (continued)

Des.	Signal Name	Des.	Signal Name
W15	V_{DDH}	AA9	V_{DDH}
W16	HD33/D33/reserved	AA10	HD54/D54/ETHTX_EN
W17	V_{DDH}	AA11	HD52/D52
W18	HD32/D32/reserved	AA12	V_{DDH}
W19	GND	AA13	GND
W20	GND	AA14	V_{DDH}
W21	A7	AA15	HD46/D46/ETHTXT0
W22	A6	AA16	GND
Y2	HD7	AA17	HD42/D42/ETHRXD2/reserved
Y3	HD15	AA18	HD38/D38/reserved
Y4	V_{DDH}	AA19	HD35/D35/reserved
Y5	HD9	AA20	A0
Y6	V_{DD}	AA21	A2
Y7	HD60/D60/ETHCOL/reserved	AA22	A3
Y8	HD58/D58/ETHMDC	AB2	GND
Y9	GND	AB3	HD13
Y10	V_{DDH}	AB4	HD11
Y11	HD51/D51	AB5	HD8
Y12	GND	AB6	HD62/D62
Y13	V_{DDH}	AB7	HD61/D61
Y14	HD43/D43/ETHRXD3/reserved	AB8	HD57/D57/ETHRX_ER
Y15	GND	AB9	HD56/D56/ETHRX_DV/ETHCRS_DV
Y16	V_{DDH}	AB10	HD55/D55/ETHTX_ER/reserved
Y17	GND	AB11	HD53/D53
Y18	HD37/D37/reserved	AB12	HD50/D50
Y19	HD34/D34/reserved	AB13	HD49/D49/ETHTXD3/reserved
Y20	V_{DDH}	AB14	HD48/D48/ETHTXD2/reserved
Y21	A4	AB15	HD47/D47/ETHTXD1
Y22	A5	AB16	HD45/D45
AA2	V_{DD}	AB17	HD44/D44
AA3	HD14	AB18	HD41/D41/ETHRXD1
AA4	HD12	AB19	HD39/D39/reserved
AA5	HD10	AB20	HD36/D36/reserved
AA6	HD63/D63	AB21	A1
AA7	HD59/D59/ETHMDIO	AB22	V_{DD}
AA8	GND		

2 Electrical Characteristics

This document contains detailed information on power considerations, DC/AC electrical characteristics, and AC timing specifications. For additional information, see the *MSC8122 Reference Manual*.

2.1 Maximum Ratings

CAUTION

This device contains circuitry protecting against damage due to high static voltage or electrical fields; however, normal precautions should be taken to avoid exceeding maximum voltage ratings. Reliability is enhanced if unused inputs are tied to an appropriate logic voltage level (for example, either GND or V_{DD}).

In calculating timing requirements, adding a maximum value of one specification to a minimum value of another specification does not yield a reasonable sum. A maximum specification is calculated using a worst case variation of process parameter values in one direction. The minimum specification is calculated using the worst case for the same parameters in the opposite direction. Therefore, a “maximum” value for a specification never occurs in the same device with a “minimum” value for another specification; adding a maximum to a minimum represents a condition that can never exist.

Table 2 describes the maximum electrical ratings for the MSC8122.

Table 2. Absolute Maximum Ratings

Rating	Symbol	Value	Unit
Core and PLL supply voltage	V_{DD}	–0.2 to 1.6	V
I/O supply voltage	V_{DDH}	–0.2 to 4.0	V
Input voltage	V_{IN}	–0.2 to 4.0	V
Maximum operating temperature: • Standard range • Extended range	T_J	 90 105	 °C °C
Minimum operating temperature • Standard range • Extended range	T_J	 0 –40	 °C °C
Storage temperature range	T_{STG}	–55 to +150	°C

Notes:
1. Functional operating conditions are given in **Table 3.**
2. Absolute maximum ratings are stress ratings only, and functional operation at the maximum is not guaranteed. Stress beyond the listed limits may affect device reliability or cause permanent damage.
3. **Section 3.5**, *Thermal Considerations* includes a formula for computing the chip junction temperature (T_J).

2.2 Recommended Operating Conditions

Table 3 lists recommended operating conditions. Proper device operation outside of these conditions is not guaranteed.

Table 3. Recommended Operating Conditions

Rating	Symbol	Value	Unit
Core and PLL supply voltage: • Standard — 400 MHz — 500 MHz • Reduced (300 and 400 MHz)	V_{DD} V_{CCSYN}	 1.14 to 1.26 1.16 to 1.24 1.07 to 1.13	 V V V
I/O supply voltage	V_{DDH}	3.135 to 3.465	V
Input voltage	V_{IN}	–0.2 to V_{DDH}+0.2	V
Operating temperature range: • Standard • Extended	 T_J T_J	 0 to 90 –40 to 105	 °C °C

2.3 Thermal Characteristics

Table 4 describes thermal characteristics of the MSC8122 for the FC-PBGA packages.

Table 4. Thermal Characteristics for the MSC8122

Characteristic	Symbol	FC-PBGA 20 × 20 mm[5]		Unit
		Natural Convection	200 ft/min (1 m/s) airflow	
Junction-to-ambient[1, 2]	$R_{\theta JA}$	26	21	°C/W
Junction-to-ambient, four-layer board[1, 3]	$R_{\theta JA}$	19	15	°C/W
Junction-to-board (bottom)[4]	$R_{\theta JB}$	9		°C/W
Junction-to-case[5]	$R_{\theta JC}$	0.9		°C/W
Junction-to-package-top[6]	Ψ_{JT}	1		°C/W

Notes:
1. Junction temperature is a function of die size, 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.
2. Per SEMI G38-87 and JEDEC JESD51-2 with the single layer board horizontal.
3. Per JEDEC JESD51-6 with the board horizontal.
4. Thermal resistance between the die and the printed circuit board per JEDEC JESD 51-8. Board temperature is measured on the top surface of the board near the package.
5. Thermal resistance between the die and the case top surface as measured by the cold plate method (MIL SPEC-883 Method 1012.1).
6. Thermal characterization parameter indicating the temperature difference between package top and the junction temperature per JEDEC JESD51-2.

Section 3.5, *Thermal Considerations* provides a detailed explanation of these characteristics.

2.4 DC Electrical Characteristics

This section describes the DC electrical characteristics for the MSC8122. The measurements in **Table 5** assume the following system conditions:

- T_A = 25 °C
- V_{DD} =
  - — 300/400 MHz 1.1 V nominal = 1.07–1.13 V_{DC}
  - — 400 MHz 1.2 V nominal = 1.14–1.26 V_{DC}
  - — 500 MHz 1.2 V nominal = 1.16–1.24 V_{DC}
- V_{DDH} = 3.3 V ± 5% V_{DC}
- GND = 0 V_{DC}

Note: The leakage current is measured for nominal V_{DDH} and V_{DD}.

Table 5. DC Electrical Characteristics

Characteristic	Symbol	Min	Typical	Max	Unit
Input high voltage[1], all inputs except CLKIN	V_{IH}	2.0	—	3.465	V
Input low voltage[1]	V_{IL}	GND	0	0.8	V
CLKIN input high voltage	V_{IHC}	2.4	3.0	3.465	V
CLKIN input low voltage	V_{ILC}	GND	0	0.8	V
Input leakage current, $V_{IN} = V_{DDH}$	I_{IN}	–1.0	0.09	1	μA
Tri-state (high impedance off state) leakage current, $V_{IN} = V_{DDH}$	I_{OZ}	–1.0	0.09	1	μA
Signal low input current, V_{IL} = 0.8 V[2]	I_L	–1.0	0.09	1	μA
Signal high input current, V_{IH} = 2.0 V[2]	I_H	–1.0	0.09	1	μA
Output high voltage, I_{OH} = –2 mA, except open drain pins	V_{OH}	2.0	3.0	—	V
Output low voltage, I_{OL}= 3.2 mA	V_{OL}	—	0	0.4	V
V_{CCSYN} PLL supply current	I_{VCCSYN}	—	2	4	mA
Internal supply current: • Wait mode • Stop mode	 I_{DDW} I_{DDS}	 — —	 375[3] 290[3]	 — —	 mA mA
Typical power 400 MHz at 1.2 V[4]	P	—	1.15	—	W

Notes:
1. See **Figure 5** for undershoot and overshoot voltages.
2. Not tested. Guaranteed by design.
3. Measured for 1.2 V core at 25°C junction temperature.
4. The typical power values were measured using an EFR code with the device running at a junction temperature of 25°C. No peripherals were enabled and the ICache was not enabled. The source code was optimized to use all the ALUs and AGUs and all four cores. It was created using CodeWarrior® 2.5. These values are provided as examples only. Power consumption is application dependent and varies widely. To assure proper board design with regard to thermal dissipation and maintaining proper operating temperatures, evaluate power consumption for your application and use the design guidelines in **Chapter 4** of this document and in *MSC8102, MSC8122, and MSC8126 Thermal Management Design Guidelines* (AN2601).

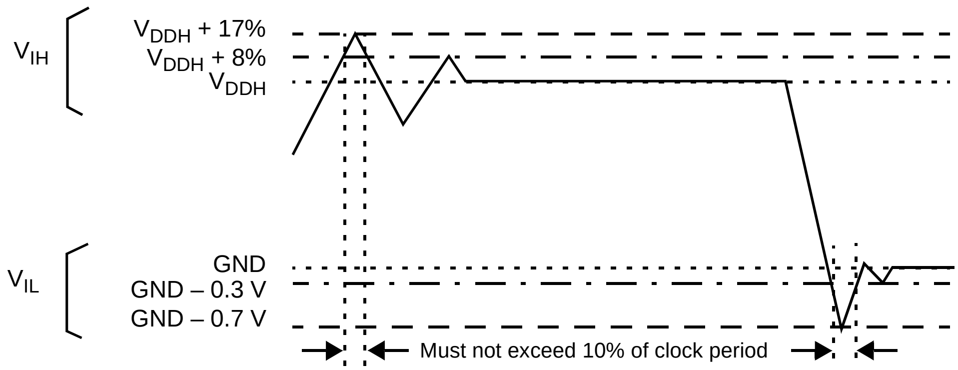


Figure 5. Overshoot/Undershoot Voltage for V_{IH} and V_{IL}

2.5 AC Timings

The following sections include illustrations and tables of clock diagrams, signals, and parallel I/O outputs and inputs. When systems such as DSP farms are developed using the DSI, use a device loading of 4 pF per pin. AC timings are based on a 20 pF load, except where noted otherwise, and a 50 Ω transmission line. For loads smaller than 20 pF, subtract 0.06 ns per pF down to 10 pF load. For loads larger than 20 pF, add 0.06 ns for SIU/Ethernet/DSI delay and 0.07 ns for GPIO/TDM/timer delay. When calculating overall loading, also consider additional RC delay.

2.5.1 Output Buffer Impedances

Table 6. Output Buffer Impedances

Output Buffers	Typical Impedance (Ω)
System bus	50
Memory controller	50
Parallel I/O	50
Note: These are typical values at 65°C. The impedance may vary by ±25% depending on device process and operating temperature.	

2.5.2 Start-Up Timing

Starting the device requires coordination among several input sequences including clocking, reset, and power. **Section 2.5.3** describes the clocking characteristics. **Section 2.5.4** describes the reset and power-up characteristics. You must use the following guidelines when starting up an MSC8122 device:

- $\overline{\text{PORESET}}$ and $\overline{\text{TRST}}$ must be asserted externally for the duration of the power-up sequence. See **Table 11** for timing.
- If possible, bring up the V_{DD} and V_{DDH} levels together. For designs with separate power supplies, bring up the V_{DD} levels and then the V_{DDH} levels (see **Figure 7**).
- CLKIN should start toggling at least 16 cycles (starting after V_{DDH} reaches its nominal level) before $\overline{\text{PORESET}}$ deassertion to guarantee correct device operation (see **Figure 6** and **Figure 7**).
- CLKIN must not be pulled high during V_{DDH} power-up. CLKIN can toggle during this period.

Note: See **Section 3.1** for start-up sequencing recommendations and **Section 3.2** for power supply design recommendations.

The following figures show acceptable start-up sequence examples. **Figure 6** shows a sequence in which V_{DD} and V_{DDH} are raised together. **Figure 7** shows a sequence in which V_{DDH} is raised after V_{DD} and CLKIN begins to toggle as V_{DDH} rises.

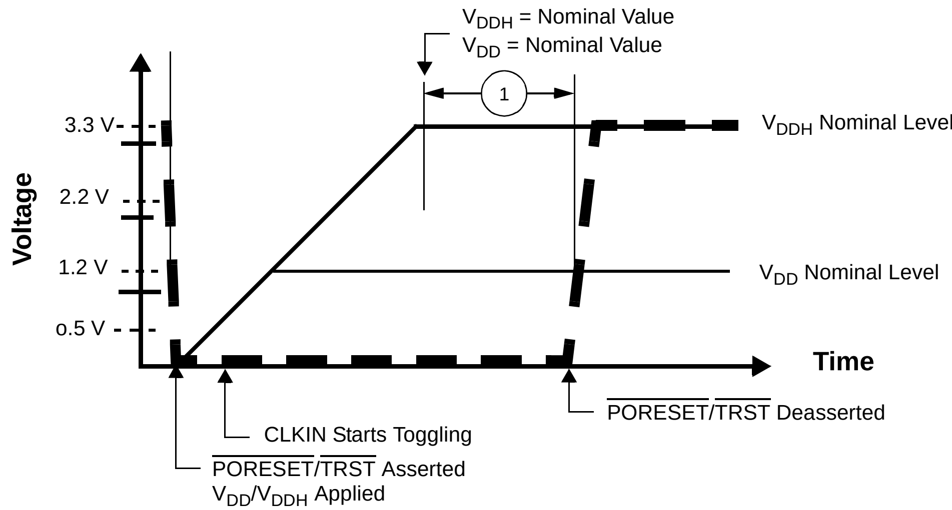


Figure 6. Start-Up Sequence: V_{DD} and V_{DDH} Raised Together

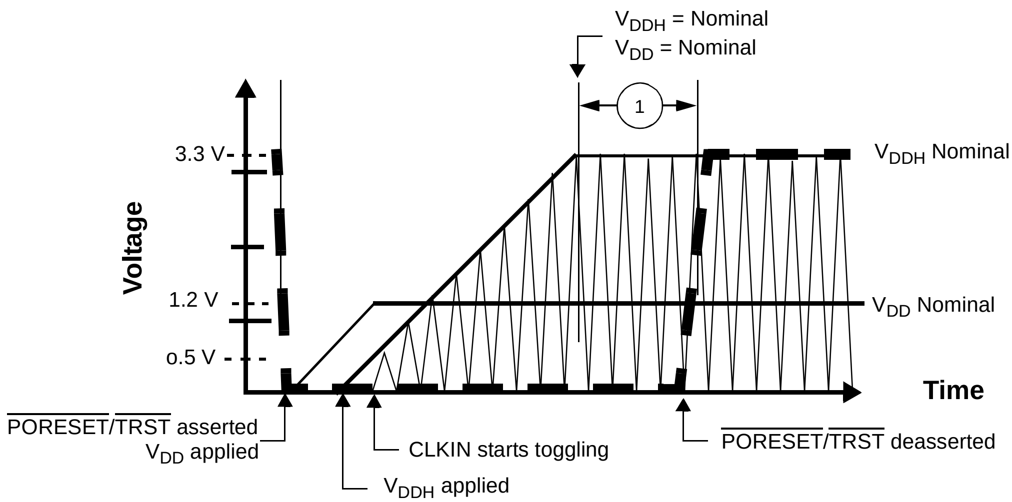


Figure 7. Start-Up Sequence: V_{DD} Raised Before V_{DDH} with CLKIN Started with V_{DDH}

Table 9. System Clock Parameters

Characteristic	Min	Max	Unit
Phase jitter between BCLK and CLKIN	—	0.3	ns
CLKIN frequency	20	see **Table 8**	MHz
CLKIN slope	—	3	ns
CLKIN period jitter[1]	—	150	ps
CLKIN jitter spectrum	150	—	KHz
PLL input clock (after predivider)	20	100	MHz
PLL output frequency (VCO output) • 300 MHz core • 400 MHz core • 500 MHz core	800	 1200 1600 2000	MHz MHz MHz MHz
CLKOUT frequency jitter[1]	—	200	ps
CLKOUT phase jitter[1] with CLKIN phase jitter of ±100 ps.	—	500	ps
Notes: **1.** Peak-to-peak. **2.** Not tested. Guaranteed by design.			

2.5.4 Reset Timing

The MSC8122 has several inputs to the reset logic:

- Power-on reset ($\overline{\text{PORESET}}$)
- External hard reset ($\overline{\text{HRESET}}$)
- External soft reset ($\overline{\text{SRESET}}$)
- Software watchdog reset
- Bus monitor reset
- Host reset command through JTAG

All MSC8122 reset sources are fed into the reset controller, which takes different actions depending on the source of the reset. The reset status register indicates the most recent sources to cause a reset. **Table 10** describes the reset sources.

Table 10. Reset Sources

Name	Direction	Description
Power-on reset ($\overline{\text{PORESET}}$)	Input	Initiates the power-on reset flow that resets the MSC8122 and configures various attributes of the MSC8122. On $\overline{\text{PORESET}}$, the entire MSC8122 device is reset. SPLL states is reset, $\overline{\text{HRESET}}$ and $\overline{\text{SRESET}}$ are driven, the SC140 extended cores are reset, and system configuration is sampled. The clock mode (MODCK bits), reset configuration mode, boot mode, Chip ID, and use of either a DSI 64 bits port or a System Bus 64 bits port are configured only when $\overline{\text{PORESET}}$ is asserted.
External hard reset ($\overline{\text{HRESET}}$)	Input/ Output	Initiates the hard reset flow that configures various attributes of the MSC8122. While $\overline{\text{HRESET}}$ is asserted, $\overline{\text{SRESET}}$ is also asserted. $\overline{\text{HRESET}}$ is an open-drain pin. Upon hard reset, $\overline{\text{HRESET}}$ and $\overline{\text{SRESET}}$ are driven, the SC140 extended cores are reset, and system configuration is sampled. The most configurable features are reconfigured. These features are defined in the 32-bit hard reset configuration word described in *Hard Reset Configuration Word* section of the *Reset* chapter in the *MSC8122 Reference Manual*.
External soft reset ($\overline{\text{SRESET}}$)	Input/ Output	Initiates the soft reset flow. The MSC8122 detects an external assertion of $\overline{\text{SRESET}}$ only if it occurs while the MSC8122 is not asserting reset. $\overline{\text{SRESET}}$ is an open-drain pin. Upon soft reset, $\overline{\text{SRESET}}$ is driven, the SC140 extended cores are reset, and system configuration is maintained.
Software watchdog reset	Internal	When the MSC8122 watchdog count reaches zero, a software watchdog reset is signalled. The enabled software watchdog event then generates an internal hard reset sequence.
Bus monitor reset	Internal	When the MSC8122 bus monitor count reaches zero, a bus monitor hard reset is asserted. The enabled bus monitor event then generates an internal hard reset sequence.
Host reset command through the TAP	Internal	When a host reset command is written through the Test Access Port (TAP), the TAP logic asserts the soft reset signal and an internal soft reset sequence is generated.

Table 11 summarizes the reset actions that occur as a result of the different reset sources.

Table 11. Reset Actions for Each Reset Source

Reset Action/Reset Source	Power-On Reset (PORESET)	Hard Reset (HRESET)	Soft Reset (SRESET)	
	External only	External or Internal (Software Watchdog or Bus Monitor)	External	JTAG Command: EXTEST, CLAMP, or HIGHZ
Configuration pins sampled (Refer to **Section 2.5.4.1** for details).	Yes	No	No	No
SPLL state reset	Yes	No	No	No
System reset configuration write through the DSI	Yes	No	No	No
System reset configuration write though the system bus	Yes	Yes	No	No
HRESET driven	Yes	Yes	No	No
SIU registers reset	Yes	Yes	No	No
IPBus modules reset (TDM, UART, Timers, DSI, IPBus master, GIC, HS, and GPIO)	Yes	Yes	Yes	Yes
SRESET driven	Yes	Yes	Yes	Depends on command
SC140 extended cores reset	Yes	Yes	Yes	Yes
MQBS reset	Yes	Yes	Yes	Yes

2.5.4.1 Power-On Reset (PORESET) Pin

Asserting PORESET initiates the power-on reset flow. PORESET must be asserted externally for at least 16 CLKIN cycles after V_{DD} and V_{DDH} are both at their nominal levels.

2.5.4.2 Reset Configuration

The MSC8122 has two mechanisms for writing the reset configuration:

- Through the direct slave interface (DSI)
- Through the system bus. When the reset configuration is written through the system bus, the MSC8122 acts as a configuration master or a configuration slave. If configuration slave is selected, but no special configuration word is written, a default configuration word is applied.

Fourteen signal levels (see **Chapter 1** for signal description details) are sampled on PORESET deassertion to define the Reset Configuration Mode and boot and operating conditions:

- RSTCONF
- CNFGS
- DSISYNC
- DSI64
- CHIP_ID[0–3]
- BM[0–2]
- SWTE
- MODCK[1–2]

The UPM machine and GPCM machine outputs change on the internal tick selected by the memory controller configuration. The AC timing specifications are relative to the internal tick. SDRAM machine outputs change only on the REFCLK rising edge.

Table 14. AC Timing for SIU Inputs

No.	Characteristic	Value for Bus Speed in MHz				Units
		Ref = CLKIN			Ref = CLKOUT	
		1.1 V	1.2 V	1.2 V	1.2 V	
		100/ 133	133	166	133	
10	Hold time for all signals after the 50% level of the REFCLK rising edge	0.5	0.5	0.5	0.5	ns
11a	ARTRY/ABB set-up time before the 50% level of the REFCLK rising edge	3.1	3.0	3.0	3.0	ns
11b	DBG/DBB/BG/BR/TC set-up time before the 50% level of the REFCLK rising edge	3.6	3.3	3.3	3.3	ns
11c	AACK set-up time before the 50% level of the REFCLK rising edge	3.0	2.9	2.9	2.9	ns
11d	TA/TEA/PSDVAL set-up time before the 50% level of the REFCLK rising edge • Data-pipeline mode • Non-pipeline mode	 3.5 4.4	 3.4 4.0	 3.4 4.0	 3.4 4.0	 ns ns
12	Data bus set-up time before REFCLK rising edge in Normal mode • Data-pipeline mode • Non-pipeline mode	 1.9 4.2	 1.8 4.0	 1.7 4.0	 1.8 4.0	 ns ns
13[1]	Data bus set-up time before the 50% level of the REFCLK rising edge in ECC and PARITY modes • Data-pipeline mode • Non-pipeline mode	 2.0 8.2	 2.0 7.3	 2.0 7.3	 2.0 7.3	 ns ns
14[1]	DP set-up time before the 50% level of the REFCLK rising edge • Data-pipeline mode • Non-pipeline mode	 2.0 7.9	 2.0 6.1	 2.0 6.1	 2.0 6.1	 ns ns
15a	TS and Address bus set-up time before the 50% level of the REFCLK rising edge • Extra cycle mode (SIUBCR[EXDD] = 0) • No extra cycle mode (SIUBCR[EXDD] = 1)	 4.2 5.5	 3.8 5.0	 3.8 5.0	 3.8 5.0	 ns ns
15b	Address attributes: TT/TBST/TSZ/GBL set-up time before the 50% level of the REFCLK rising edge • Extra cycle mode (SIUBCR[EXDD] = 0) • No extra cycle mode (SIUBCR[EXDD] = 1)	 3.7 4.8	 3.5 4.4	 3.5 4.4	 3.5 4.4	 ns ns
16	PUPMWAIT signal set-up time before the 50% level of the REFCLK rising edge	3.7	3.7	3.7	3.7	ns
17	IRQx setup time before the 50% level; of the REFCLK rising edge[3]	4.0	4.0	4.0	4.0	ns
18	IRQx minimum pulse width[3]	6.0 + T_{REFCLK}	6.0 + T_{REFCLK}	6.0 + T_{REFCLK}	6.0 + T_{REFCLK}	ns

Notes:
1. Timings specifications 13 and 14 in non-pipeline mode are more restrictive than MSC8102 timings.
2. Values are measured from the 50% TTL transition level relative to the 50% level of the REFCLK rising edge.
3. Guaranteed by design.

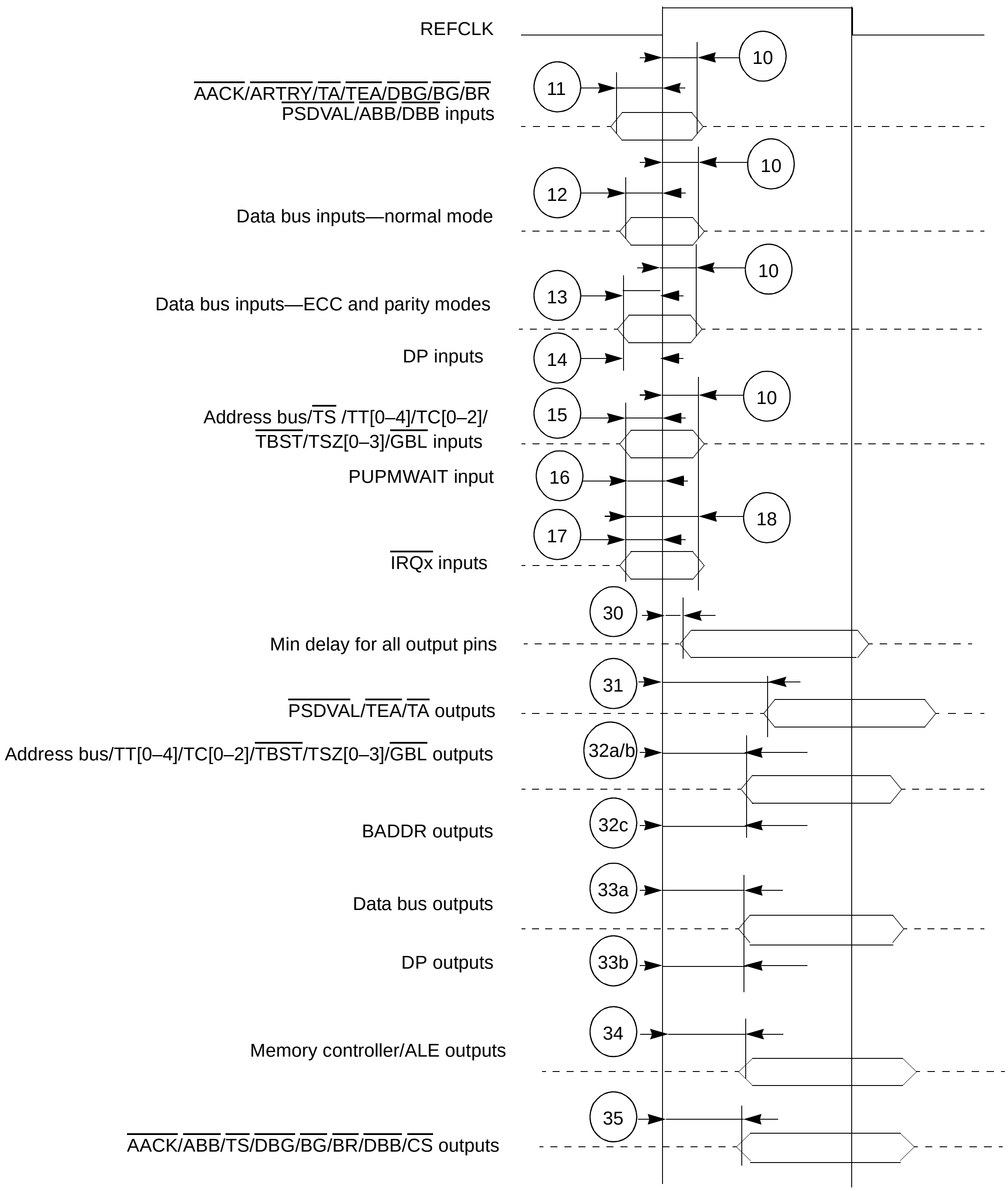
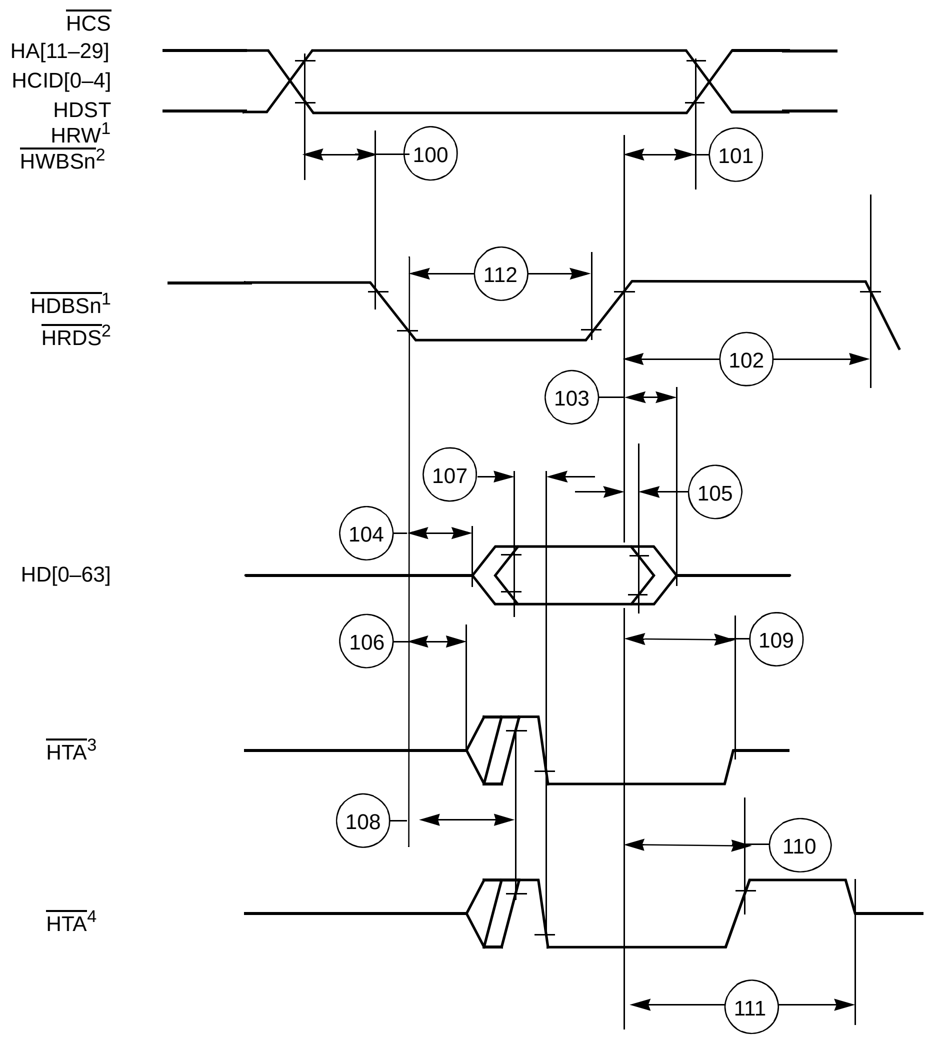


Figure 11. SIU Timing Diagram

Figure 14 shows DSI asynchronous read signals timing.



Notes:
1. Used for single-strobe mode access.
2. Used for dual-strobe mode access.
3. HTA released at logic 0 (DCR[HTAAD] = 0) at end of access; used with pull-down implementation.
4. HTA released at logic 1 (DCR[HTAAD] = 1) at end of access; used with pull-up implementation.

Figure 14. Asynchronous Single- and Dual-Strobe Modes Read Timing Diagram

2.5.6.2 DSI Synchronous Mode

Table 19. DSI Inputs in Synchronous Mode

No.	Characteristic	Expression	1.1 V Core		1.2 V Core		Units
			Min	Max	Min	Max	
120	HCLKIN cycle time[1,2]	HTC	10.0	55.6	10.0	55.6	ns
121	HCLKIN high pulse width	(0.5 ± 0.1) × HTC	4.0	33.3	4.0	33.3	ns
122	HCLKIN low pulse width	(0.5 ± 0.1) × HTC	4.0	33.3	4.0	33.3	ns
123	HA[11–29] inputs set-up time	—	1.2	—	1.2	—	ns
124	HD[0–63] inputs set-up time	—	0.6	—	0.4	—	ns
125	HCID[0–4] inputs set-up time	—	1.3	—	1.3	—	ns
126	All other inputs set-up time	—	1.2	—	1.2	—	ns
127	All inputs hold time	—	1.5	—	1.5	—	ns

Notes:
1. Values are based on a frequency range of 18–100 MHz.
2. Refer to **Table 7** for HCLKIN frequency limits.

Table 20. DSI Outputs in Synchronous Mode

No.	Characteristic	1.1 V Core		1.2 V Core		Units
		Min	Max	Min	Max	
128	HCLKIN high to HD[0–63] output active	2.0	—	2.0	—	ns
129	HCLKIN high to HD[0–63] output valid	—	7.6	—	6.3	ns
130	HD[0–63] output hold time	1.7	—	1.7	—	ns
131	HCLKIN high to HD[0–63] output high impedance	—	8.3	—	7.6	ns
132	HCLKIN high to $\overline{HTA}$ output active	2.2	—	2.0	—	ns
133	HCLKIN high to $\overline{HTA}$ output valid	—	7.4	—	5.9	ns
134	$\overline{HTA}$ output hold time	1.7	—	1.7	—	ns
135	HCLKIN high to $\overline{HTA}$ high impedance	—	7.5	—	6.3	ns

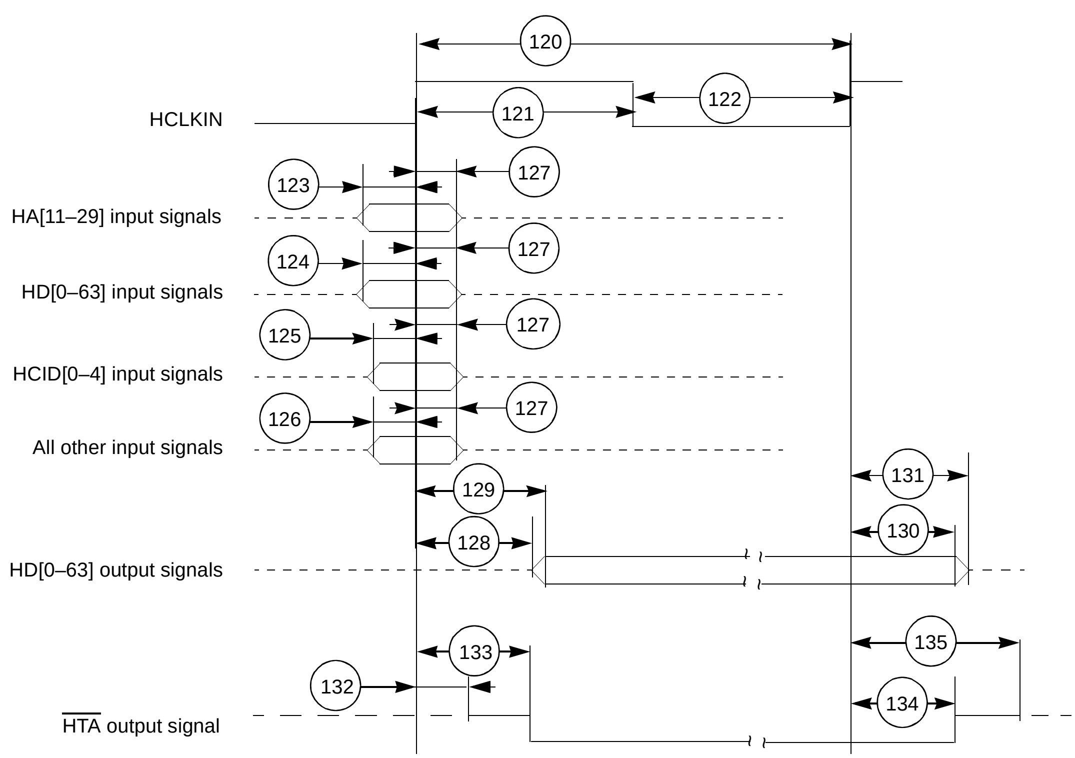


Figure 17. DSI Synchronous Mode Signals Timing Diagram

2.5.7 TDM Timing

Table 21. TDM Timing

No.	Characteristic	Expression	1.1 V Core		1.2 V Core		Units
			Min	Max	Min	Max	
300	TDMxRCLK/TDMxTCLK	TC[1]	16	—	16	—	ns
301	TDMxRCLK/TDMxTCLK high pulse width	(0.5 ± 0.1) × TC	7	—	7	—	ns
302	TDMxRCLK/TDMxTCLK low pulse width	(0.5 ± 0.1) × TC	7	—	7	—	ns
303	TDM receive all input set-up time		1.3	—	1.3	—	ns
304	TDM receive all input hold time		1.0	—	1.0	—	ns
305	TDMxTCLK high to TDMxTDAT/TDMxRCLK output active[2,3]		2.8	—	2.8	—	ns
306	TDMxTCLK high to TDMxTDAT/TDMxRCLK output		—	10.0	—	8.8	ns
307	All output hold time[4]		2.5	—	2.5	—	ns
308	TDMxTCLK high to TDmXTDAT/TDMxRCLK output high impedance[2,3]		—	10.7	—	10.5	ns
309	TDMxTCLK high to TDMXTSYN output valid[2]		—	9.7	—	8.5	ns
310	TDMxTSYN output hold time[4]		2.5	—	2.5	—	ns

Notes:
1. Values are based on a a maximum frequency of 62.5 MHz. The TDM interface supports any frequency below 62.5 MHz. Devices operating at 300 MHz are limited to a maximum TDMxRCLK/TDMxTCLK frequency of 50 MHz.
2. Values are based on 20 pF capacitive load.
3. When configured as an output, TDMxRCLK acts as a second data link. See the *MSC8122 Reference Manual* for details.
4. Values are based on 10 pF capacitive load.

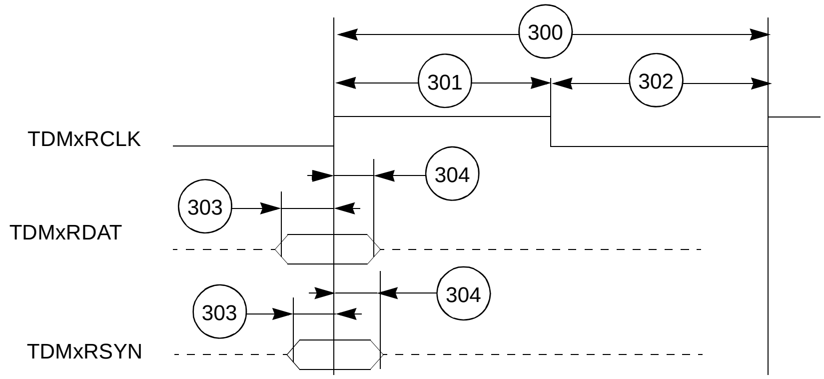


Figure 18. TDM Inputs Signals

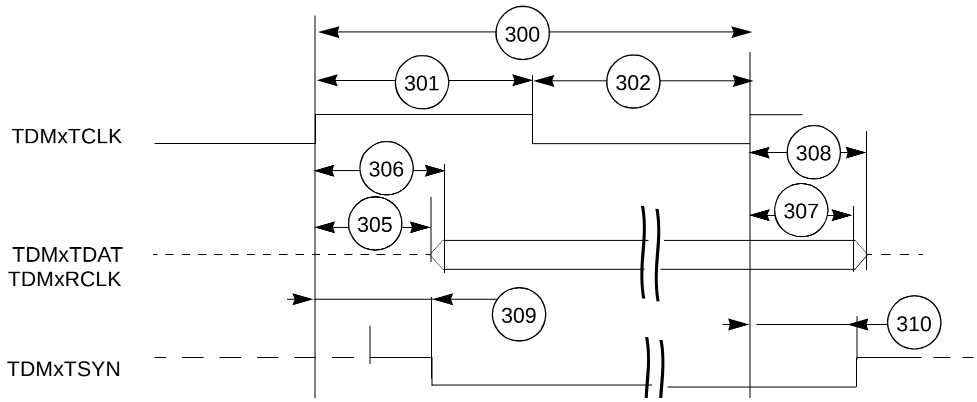


Figure 19. TDM Output Signals

2.5.10.2 MII Mode Timing

Table 25. MII Mode Signal Timing

No.	Characteristics	Min	Max	Unit
803	ETHRX_DV, ETHRXD[0–3], ETHRX_ER to ETHRX_CLK rising edge set-up time	3.5	—	ns
804	ETHRX_CLK rising edge to ETHRX_DV, ETHRXD[0–3], ETHRX_ER hold time	3.5	—	ns
805	ETHTX_CLK to ETHTX_EN, ETHTXD[0–3], ETHTX_ER output delay • 1.1 V core • 1.2 V core	 1 1	 14.6 12.6	 ns ns

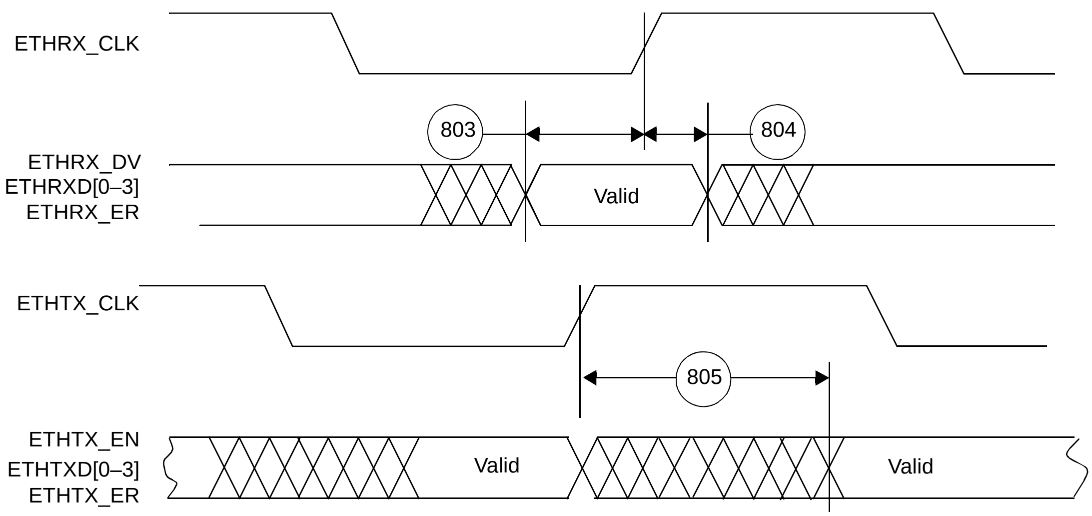


Figure 24. MII Mode Signal Timing

2.5.10.3 RMII Mode

Table 26. RMII Mode Signal Timing

No.	Characteristics	1.1 V Core		1.2 V Core		Unit
		Min	Max	Min	Max	
806	ETHTX_EN,ETHRXD[0–1], ETHCRS_DV, ETHRX_ER to ETHREF_CLK rising edge set-up time	1.6	—	2	—	ns
807	ETHREF_CLK rising edge to ETHRXD[0–1], ETHCRS_DV, ETHRX_ER hold time	1.6	—	1.6	—	ns
811	ETHREF_CLK rising edge to ETHTXD[0–1], ETHTX_EN output delay.	3	12.5	3	11	ns

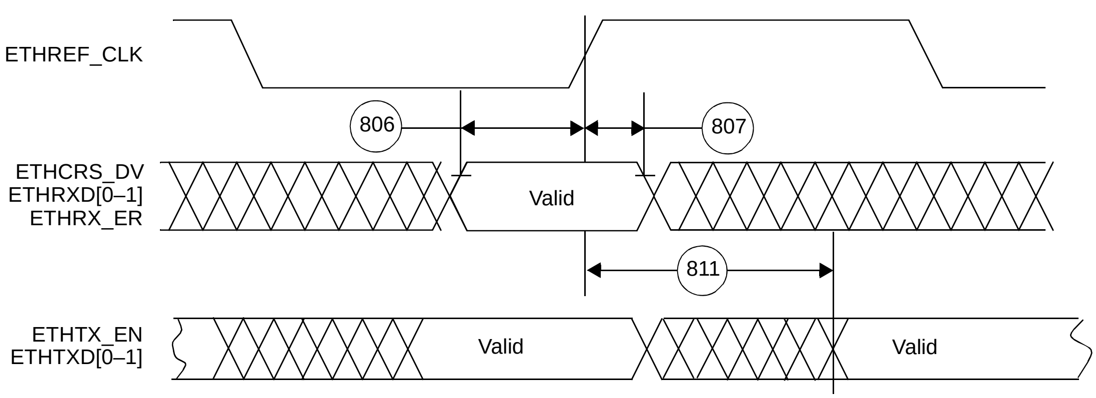


Figure 25. RMII Mode Signal Timing

2.5.10.4 SMII Mode

Table 27. SMII Mode Signal Timing

No.	Characteristics	Min	Max	Unit
808	ETHSYNC_IN, ETHRXD to ETHCLOCK rising edge set-up time	1.0	—	ns
809	ETHCLOCK rising edge to ETHSYNC_IN, ETHRXD hold time	1.0	—	ns
810	ETHCLOCK rising edge to ETHSYNC, ETHTXD output delay • 1.1 V core. • 1.2 V core.	 1.5[1] 1.5[1]	 6.0[2] 5.0[2]	 ns ns
Notes:	**1.** Measured using a 5 pF load. **2.** Measured using a 15 pF load.			

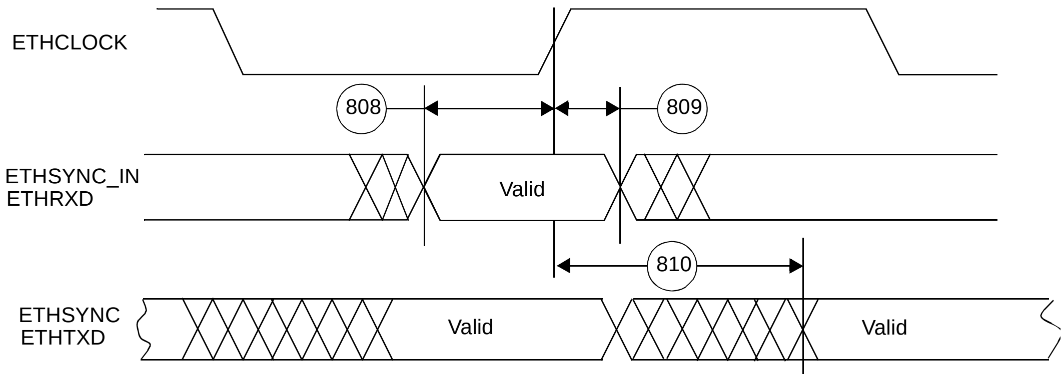


Figure 26. SMII Mode Signal Timing

2.5.11 GPIO Timing

Table 28. GPIO Timing

No.	Characteristics	Ref = CLKIN		Ref = CLKOUT (1.2 V only)		Unit
		Min	Max	Min	Max	
601	REFCLK edge to GPIO out valid (GPIO out delay time)	—	6.1	—	6.9	ns
602	REFCLK edge to GPIO out not valid (GPIO out hold time)	1.1	—	1.3	—	ns
603	REFCLK edge to high impedance on GPIO out	—	5.4	—	6.2	ns
604	GPIO in valid to REFCLK edge (GPIO in set-up time)	3.5	—	3.7	—	ns
605	REFCLK edge to GPIO in not valid (GPIO in hold time)	0.5	—	0.5	—	ns

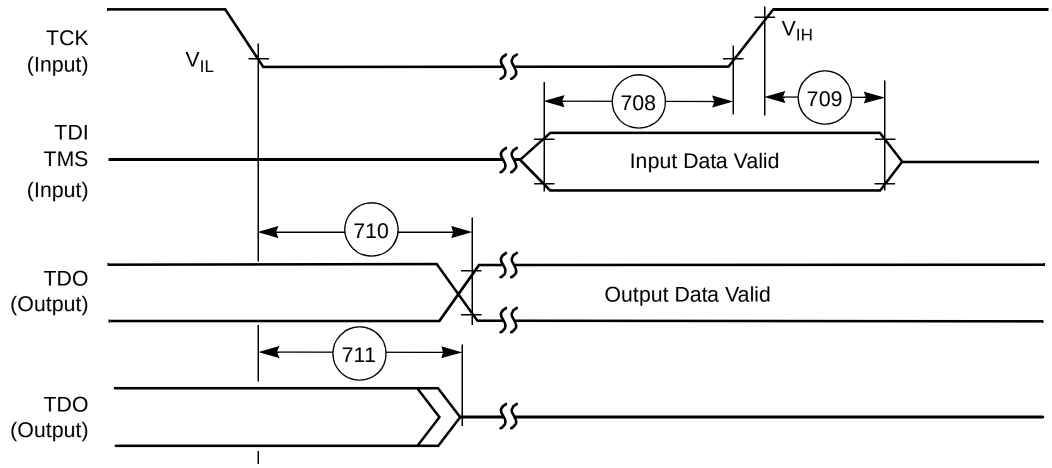


Figure 31. Test Access Port Timing Diagram

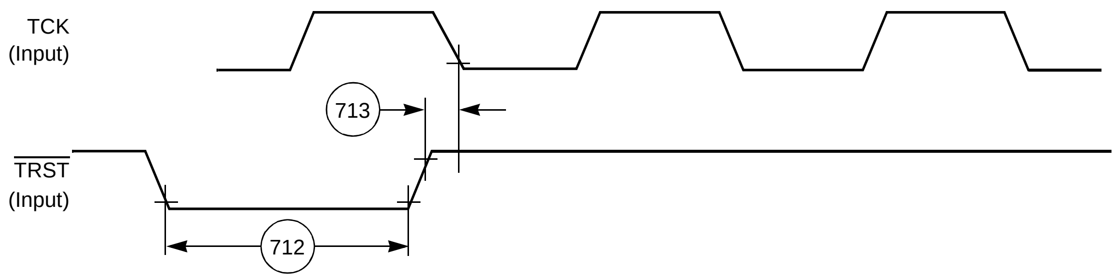


Figure 32. $\overline{\text{TRST}}$ Timing Diagram

3 Hardware Design Considerations

The following sections discuss areas to consider when the MSC8122 device is designed into a system.

3.1 Start-up Sequencing Recommendations

Use the following guidelines for start-up and power-down sequences:

- Assert $\overline{\text{PORESET}}$ and $\overline{\text{TRST}}$ before applying power and keep the signals driven low until the power reaches the required minimum power levels. This can be implemented via weak pull-down resistors.
- CLKIN can be held low or allowed to toggle during the beginning of the power-up sequence. However, CLKIN must start toggling before the deassertion of $\overline{\text{PORESET}}$ and after both power supplies have reached nominal voltage levels.
- If possible, bring up V_{DD}/V_{CCSYN} and V_{DDH} together. If it is not possible, raise V_{DD}/V_{CCSYN} first and then bring up V_{DDH}. V_{DDH} should not exceed V_{DD}/V_{CCSYN} until V_{DD}/V_{CCSYN} reaches its nominal voltage level. Similarly, bring both voltage levels down together. If that is not possible reverse the power-up sequence, with V_{DDH} going down first and then V_{DD}/V_{CCSYN}.

Note: This recommended power sequencing for the MSC8122 is different from the MSC8102. See **Section 2.5.2** for start-up timing specifications.

External voltage applied to any input line must not exceed the I/O supply V_{DDH} by more than 0.8 V at any time, including during power-up. Some designs require pull-up voltages applied to selected input lines during power-up for configuration purposes. This is an acceptable exception to the rule. However, each such input can draw up to 80 mA per input pin per device in the system during start-up.

During the power-up sequence, if V_{DD} rises before V_{DDH} (see **Figure 6**), current can pass from the V_{DD} supply through the device ESD protection circuits to the V_{DDH} supply. The ESD protection diode can allow this to occur when V_{DD} exceeds V_{DDH} by more than 0.8 V. Design the power supply to prevent or minimize this effect using one of the following optional methods:

- Never allow V_{DD} to exceed V_{DDH} + 0.8V.
- Design the V_{DDH} supply to prevent reverse current flow by adding a minimum 10 Ω resistor to GND to limit the current. Such a design yields an initial V_{DDH} level of V_{DD} – 0.8 V before it is enabled.

After power-up, V_{DDH} must not exceed V_{DD}/V_{CCSYN} by more than 2.6 V.

3.2 Power Supply Design Considerations

When used as a drop-in replacement in MSC8102 applications or when implementing a new design, use the guidelines described in *Migrating Designs from the MSC8102 to the MSC8122* (AN2716) and the *MSC8122 Design Checklist* (AN3374 for optimal system performance. *MSC8122 and MSC8126 Power Circuit Design Recommendations and Examples* (AN2937) provides detailed design information. See **Section 2.5.2** for start-up timing specifications.

Figure 33 shows the recommended power decoupling circuit for the core power supply. The voltage regulator and the decoupling capacitors should supply the required device current without any drop in voltage on the device pins. The voltage on the package pins should not drop below the minimum specified voltage level even for a very short spikes. This can be achieved by using the following guidelines:

- For the core supply, use a voltage regulator rated at 1.2 V with nominal rating of at least 3 A. This rating does not reflect actual average current draw, but is recommended because it resists changes imposed by transient spikes and has better voltage recovery time than supplies with lower current ratings.
- Decouple the supply using low-ESR capacitors mounted as close as possible to the socket. **Figure 33** shows three capacitors in parallel to reduce the resistance. Three capacitors is a recommended minimum number. If possible, mount at least one of the capacitors directly below the MSC8122 device.

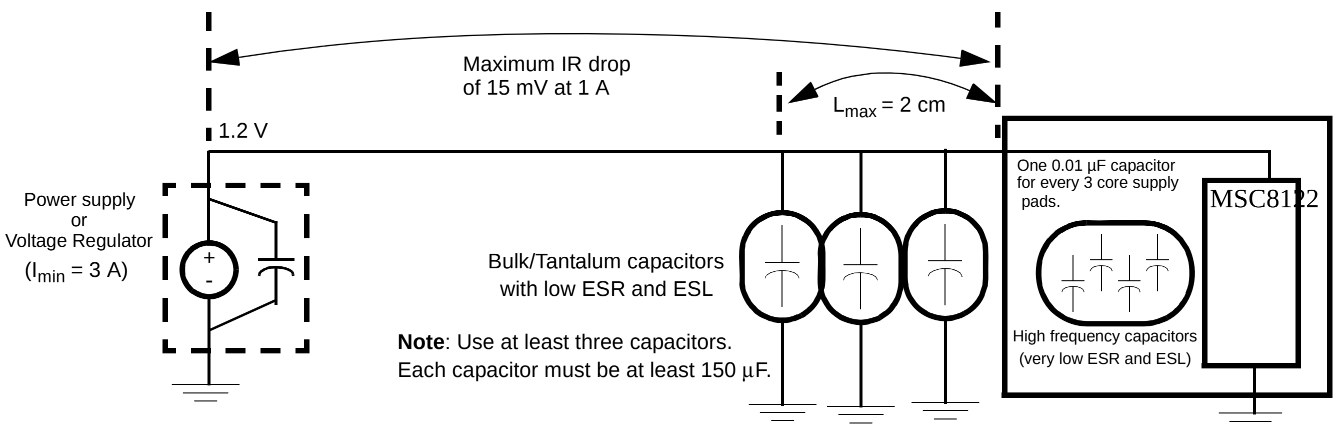


Figure 33. Core Power Supply Decoupling

Each V_{CC} and V_{DD} pin on the MSC8122 device should have a low-impedance path to the board power supply. Similarly, each GND pin should have a low-impedance path to the ground plane. The power supply pins drive distinct groups of logic on the chip. The V_{CC} power supply should have at least four 0.1 µF by-pass capacitors to ground located as closely as possible to the four sides of the package. The capacitor leads and associated printed circuit traces connecting to chip V_{CC}, V_{DD}, and GND should be kept to less than half an inch per capacitor lead. A four-layer board is recommended, employing two inner layers as V_{CC} and GND planes.

All output pins on the MSC8122 have fast rise and fall times. PCB trace interconnection length should be minimized to minimize undershoot and reflections caused by these fast output switching times. This recommendation particularly applies to the address and data buses. Maximum PCB trace lengths of six inches are recommended. For the DSI control signals in synchronous mode, ensure that the layout supports the DSI AC timing requirements and minimizes any signal crosstalk. Capacitance calculations should consider all device loads as well as parasitic capacitances due to the PCB traces. Attention to proper PCB layout and bypassing becomes especially critical in systems with higher capacitive loads because these loads create higher transient currents in the V_{CC}, V_{DD}, and GND circuits. Pull up all unused inputs or signals that will be inputs during reset.

Special care should be taken to minimize the noise levels on the PLL supply pins. There is one pair of PLL supply pins: V_{CCSYN}-GND_{SYN}. To ensure internal clock stability, filter the power to the V_{CCSYN} input with a circuit similar to the one in