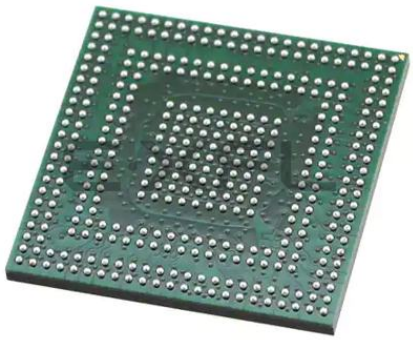

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Understanding Embedded - Microprocessors

Embedded microprocessors are specialized computing chips designed to perform specific tasks within an embedded system. Unlike general-purpose microprocessors found in personal computers, embedded microprocessors are tailored for dedicated functions within larger systems, offering optimized performance, efficiency, and reliability. These microprocessors are integral to the operation of countless electronic devices, providing the computational power necessary for controlling processes, handling data, and managing communications.

Applications of Embedded - Microprocessors

Embedded microprocessors are utilized across a broad spectrum of applications, making them indispensable in

Details	
Product Status	Obsolete
Core Processor	PowerPC e300c3
Number of Cores/Bus Width	1 Core, 32-Bit
Speed	133MHz
Co-Processors/DSP	Communications; QUICC Engine
RAM Controllers	DDR2
Graphics Acceleration	No
Display & Interface Controllers	-
Ethernet	10/100Mbps (3)
SATA	-
USB	USB 2.0 (1)
Voltage - I/O	1.8V, 3.3V
Operating Temperature	-40°C ~ 105°C (TA)
Security Features	-
Package / Case	369-LFBGA
Supplier Device Package	369-PBGA (19x19)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/ppc8306cvmabdca

- DMA Engine
  - Support for the DMA engine with the following features:
    - Sixteen DMA channels
    - All data movement via dual-address transfers: read from source, write to destination
    - Transfer control descriptor (TCD) organized to support two-deep, nested transfer operations
    - Channel activation via one of two methods (for both the methods, one activation per execution of the minor loop is required):
      - Explicit software initiation
      - Initiation via a channel-to-channel linking mechanism for continuous transfers (independent channel linking at end of minor loop and/or major loop)
    - Support for fixed-priority and round-robin channel arbitration
    - Channel completion reported via optional interrupt requests
  - Support for scatter/gather DMA processing
- DUART
  - Two 2-wire interfaces (RxD, TxD)
    - The same can be configured as one 4-wire interface (RxD, TxD, RTS, CTS)
  - Programming model compatible with the original 16450 UART and the PC16550D
- Serial peripheral interface (SPI)
  - Master or slave support
- Power managemnt controller (PMC)
  - Supports core doze/nap/sleep/ power management
  - Exits low power state and returns to full-on mode when
    - The core internal time base unit invokes a request to exit low power state
    - The power management controller detects that the system is not idle and there are outstanding transactions on the internal bus or an external interrupt.
- Parallel I/O
  - General-purpose I/O (GPIO)
    - 56 parallel I/O pins multiplexed on various chip interfaces
    - Interrupt capability
- System timers
  - Periodic interrupt timer
  - Software watchdog timer
  - Eight general-purpose timers
- Real time clock (RTC) module
  - Maintains a one-second count, unique over a period of thousands of years
  - Two possible clock sources:
    - External RTC clock (RTC_PIT_CLK)
    - CSB bus clock
- IEEE Std. 1149.1™ compliant JTAG boundary scan

2 Electrical Characteristics

This section provides the AC and DC electrical specifications and thermal characteristics for the MPC8306. The MPC8306 is currently targeted to these specifications. Some of these specifications are independent of the I/O cell, but are included for a more complete reference. These are not purely I/O buffer design specifications.

2.1 Overall DC Electrical Characteristics

This section covers the ratings, conditions, and other characteristics.

2.1.1 Absolute Maximum Ratings

The following table provides the absolute maximum ratings.

Table 1. Absolute Maximum Ratings[1]

Characteristic		Symbol	Max Value	Unit	Notes
Core supply voltage		V_{DD}	–0.3 to 1.26	V	—
PLL supply voltage		AV_{DD1} AV_{DD2} AV_{DD3}	–0.3 to 1.26	V	—
DDR2 DRAM I/O voltage		GV_{DD}	–0.3 to 1.98	V	—
Local bus, DUART, system control and power management, I^2C, SPI, MII, RMII, MII management, eSDHC, FlexCAN, USB and JTAG I/O voltage		OV_{DD}	–0.3 to 3.6	V	2
Input voltage	DDR2 DRAM signals	MV_{IN}	–0.3 to (GV_{DD} + 0.3)	V	3
	DDR2 DRAM reference	MV_{REF}	–0.3 to (GV_{DD} + 0.3)	V	3
	Local bus, DUART, SYS_CLK_IN, system control and power management, I^2C, SPI, and JTAG signals	OV_{IN}	–0.3 to (OV_{DD} + 0.3)	V	4
Storage temperature range		T_{STG}	–55 to 150	°C	—

Notes:

1. Functional and tested operating conditions are given in Table 2. Absolute maximum ratings are stress ratings only, and functional operation at the maximums is not guaranteed. Stresses beyond those listed may affect device reliability or cause permanent damage to the device.
2. OVDD here refers to NVDDA, NVDDB, NVDDC, NVDDF, NVDDG, and NVDDH from the ball map.
3. **Caution:** MV_{IN} must not exceed GV_{DD} by more than 0.3 V. This limit may be exceeded for a maximum of 100 ms during power-on reset and power-down sequences.
4. **Caution:** OV_{IN} must not exceed OV_{DD} by more than 0.3 V. This limit may be exceeded for a maximum of 100 ms during power-on reset and power-down sequences.

2.1.3 Output Driver Characteristics

The following table provides information on the characteristics of the output driver strengths.

Table 3. Output Drive Capability

Driver Type	Output Impedance (Ω)	Supply Voltage (V)
Local bus interface utilities signals	42	OV_{DD} = 3.3
DDR2 signal	18	GV_{DD} = 1.8
DUART, system control, I2C, SPI, JTAG	42	OV_{DD} = 3.3
GPIO signals	42	OV_{DD} = 3.3

2.1.4 Input Capacitance Specification

The following table describes the input capacitance for the SYS_CLK_IN pin in the MPC8306.

Table 4. Input Capacitance Specification

Parameter/Condition	Symbol	Min	Max	Unit	Note
Input capacitance for all pins except SYS_CLK_IN and QE_CLK_IN	C_I	6	8	pF	—
Input capacitance for SYS_CLK_IN and QE_CLK_IN	C_{ICLK_IN}	10	—	pF	1

Note:
1. The external clock generator should be able to drive 10 pF.

2.2 Power Sequencing

The device does not require the core supply voltage (V_{DD}) and I/O supply voltages (GV_{DD} and OV_{DD}) to be applied in any particular order. Note that during power ramp-up, before the power supplies are stable and if the I/O voltages are supplied before the core voltage, there might be a period of time that all input and output pins are actively driven and cause contention and excessive current. In order to avoid actively driving the I/O pins and to eliminate excessive current draw, apply the core voltage (V_{DD}) before the I/O voltage (GV_{DD} and OV_{DD}) and assert $\overline{\text{PORESET}}$ before the power supplies fully ramp up. In the case where the core voltage is applied first, the core voltage supply must rise to 90% of its nominal value before the I/O supplies reach 0.7 V; see Figure 3. Once both the power supplies (I/O voltage and core voltage) are stable, wait for a minimum of 32 clock cycles before negating $\overline{\text{PORESET}}$.

NOTE

There is no specific power down sequence requirement for the device. I/O voltage supplies (GV_{DD} and OV_{DD}) do not have any ordering requirements with respect to one another.

The following table provides the PLL lock times.

Table 10. PLL Lock Times

Parameter/Condition	Min	Max	Unit	Note
PLL lock times	—	100	μs	—

5.1 Reset Signals DC Electrical Characteristics

The following table provides the DC electrical characteristics for the MPC8306 reset signals mentioned in Table 9.

Table 11. Reset Signals DC Electrical Characteristics

Characteristic	Symbol	Condition	Min	Max	Unit	Note
Output high voltage	V_{OH}	I_{OH} = –6.0 mA	2.4	—	V	1
Output low voltage	V_{OL}	I_{OL} = 6.0 mA	—	0.5	V	1
Output low voltage	V_{OL}	I_{OL} = 3.2 mA	—	0.4	V	1
Input high voltage	V_{IH}	—	2.0	OV_{DD} + 0.3	V	1
Input low voltage	V_{IL}	—	–0.3	0.8	V	—
Input current	I_{IN}	0 V ≤ V_{IN} ≤ OV_{DD}	—	±5	μA	—

Note:
1. This specification applies when operating from 3.3 V supply.

6 DDR2 SDRAM

This section describes the DC and AC electrical specifications for the DDR2 SDRAM interface of the MPC8306. Note that DDR2 SDRAM is GV_{DD}(typ) = 1.8 V.

6.1 DDR2 SDRAM DC Electrical Characteristics

The following table provides the recommended operating conditions for the DDR2 SDRAM component(s) of the MPC8306 when GV_{DD}(typ) = 1.8 V.

Table 12. DDR2 SDRAM DC Electrical Characteristics for GV_{DD}(typ) = 1.8 V

Parameter/Condition	Symbol	Min	Max	Unit	Note
I/O supply voltage	GV_{DD}	1.7	1.9	V	1
I/O reference voltage	MVREF	0.49 × GV_{DD}	0.51 × GV_{DD}	V	2
I/O termination voltage	V_{TT}	MVREF – 0.04	MVREF + 0.04	V	3
Input high voltage	V_{IH}	MVREF+ 0.125	GV_{DD} + 0.3	V	—
Input low voltage	V_{IL}	–0.3	MVREF – 0.125	V	—
Output leakage current	I_{OZ}	–9.9	9.9	μA	4

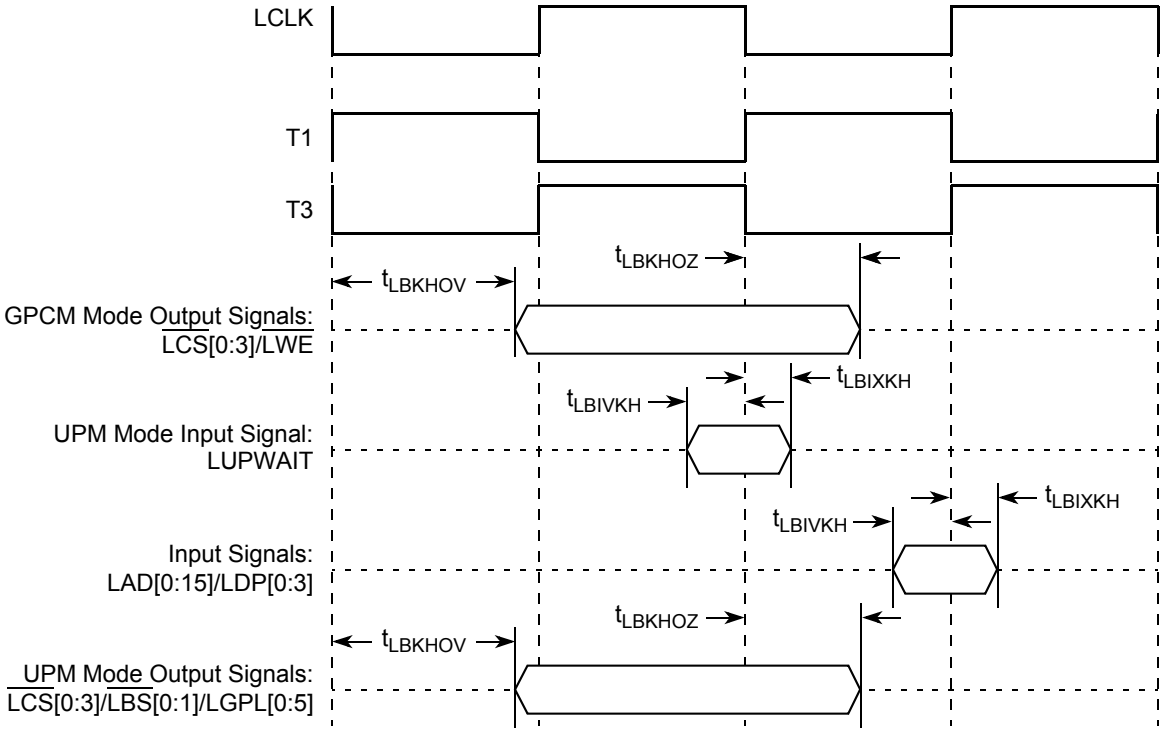


Figure 9. Local Bus Signals, GPCM/UPM Signals for LCRR[CLKDIV] = 2

The following figure provides the AC test load.

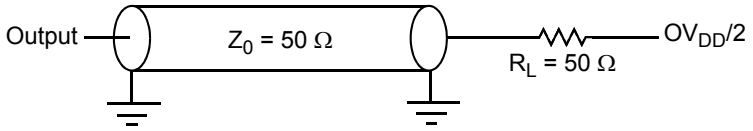


Figure 11. AC Test Load

The following figure shows the MII transmit AC timing diagram.

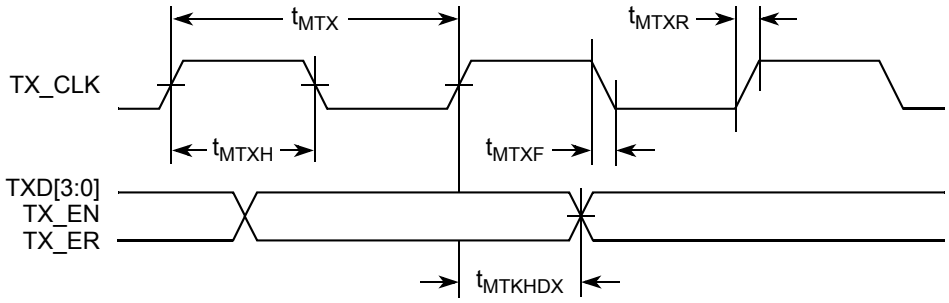


Figure 12. MII Transmit AC Timing Diagram

8.2.1.2 MII Receive AC Timing Specifications

The following table provides the MII receive AC timing specifications.

Table 21. MII Receive AC Timing Specifications

At recommended operating conditions with OV_{DD} of 3.3 V ± 300mV.

Parameter/Condition	Symbol[1]	Min	Typical	Max	Unit
RX_CLK clock period 10 Mbps	t_{MRX}	—	400	—	ns
RX_CLK clock period 100 Mbps	t_{MRX}	—	40	—	ns
RX_CLK duty cycle	t_{MRXH}/t_{MRX}	35	—	65	%
RXD[3:0], RX_DV, RX_ER setup time to RX_CLK	t_{MRDVKH}	10.0	—	—	ns
RXD[3:0], RX_DV, RX_ER hold time to RX_CLK	t_{MRDXKH}	10.0	—	—	ns
RX_CLK clock rise V_{IL}(max) to V_{IH}(min)	t_{MRXR}	1.0	—	4.0	ns
RX_CLK clock fall time V_{IH}(min) to V_{IL}(max)	t_{MRXF}	1.0	—	4.0	ns

Note:

1. The symbols used for timing specifications follow the pattern of $t_{\text{(first two letters of functional block)(signal)(state)(reference)(state)}}$ for inputs and $t_{\text{(first two letters of functional block)(reference)(state)(signal)(state)}}$ for outputs. For example, t_{MRDVKH} symbolizes MII receive timing (MR) with respect to the time data input signals (D) reach the valid state (V) relative to the t_{MRX} clock reference (K) going to the high (H) state or setup time. Also, t_{MRDXKL} symbolizes MII receive timing (GR) with respect to the time data input signals (D) went invalid (X) relative to the t_{MRX} clock reference (K) going to the low (L) state or hold time. Note that, in general, the clock reference symbol representation is based on three letters representing the clock of a particular functional. For example, the subscript of t_{MRX} represents the MII (M) receive (RX) clock. For rise and fall times, the latter convention is used with the appropriate letter: R (rise) or F (fall).

The following figure shows the RMII transmit AC timing diagram.

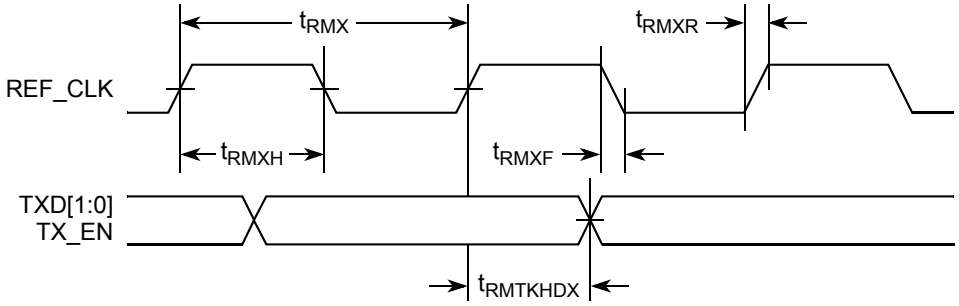


Figure 15. RMII Transmit AC Timing Diagram

8.2.2.2 RMII Receive AC Timing Specifications

The following table provides the RMII receive AC timing specifications.

Table 23. RMII Receive AC Timing Specifications

At recommended operating conditions with OV_{DD} of 3.3 V ± 300mV.

Parameter/Condition	Symbol[1]	Min	Typical	Max	Unit
REF_CLK clock period	t_{RMX}	—	20	—	ns
REF_CLK duty cycle	t_{RMXH}/t_{RMX}	35	—	65	%
RXD[1:0], CRS_DV, RX_ER setup time to REF_CLK	$t_{RMRDVKH}$	4.0	—	—	ns
RXD[1:0], CRS_DV, RX_ER hold time to REF_CLK	$t_{RMRDXKH}$	2.0	—	—	ns
REF_CLK clock rise V_{IL}(min) to V_{IH}(max)	t_{RMXR}	1.0	—	4.0	ns
REF_CLK clock fall time V_{IH}(max) to V_{IL}(min)	t_{RMXF}	1.0	—	4.0	ns

Note:

1. The symbols used for timing specifications follow the pattern of $t_{\text{(first three letters of functional block)(signal)(state)(reference)(state)}}$ for inputs and $t_{\text{(first two letters of functional block)(reference)(state)(signal)(state)}}$ for outputs. For example, $t_{RMRDVKH}$ symbolizes RMII receive timing (RMR) with respect to the time data input signals (D) reach the valid state (V) relative to the t_{RMX} clock reference (K) going to the high (H) state or setup time. Also, $t_{RMRDXKL}$ symbolizes RMII receive timing (RMR) with respect to the time data input signals (D) went invalid (X) relative to the t_{RMX} clock reference (K) going to the low (L) state or hold time. Note that, in general, the clock reference symbol representation is based on three letters representing the clock of a particular functional. For example, the subscript of t_{RMX} represents the RMII (RM) reference (X) clock. For rise and fall times, the latter convention is used with the appropriate letter: R (rise) or F (fall).

Table 26. IEEE 1588 DC Electrical Characteristics

Characteristic	Symbol	Condition	Min	Max	unit
Input high voltage	V_{IH}	—	2.0	OV_{DD} + 0.3	V
Input low voltage	V_{IL}	—	- 0.3	0.8	V
Input current	I_{IN}	$0V \le V_{IN} \le OV_{DD}$	—	± 5	μA

8.3.4 IEEE 1588 AC Specifications

The IEEE 1588 AC timing specifications are given in the following table.

Table 27. IEEE 1588 AC Timing Specifications

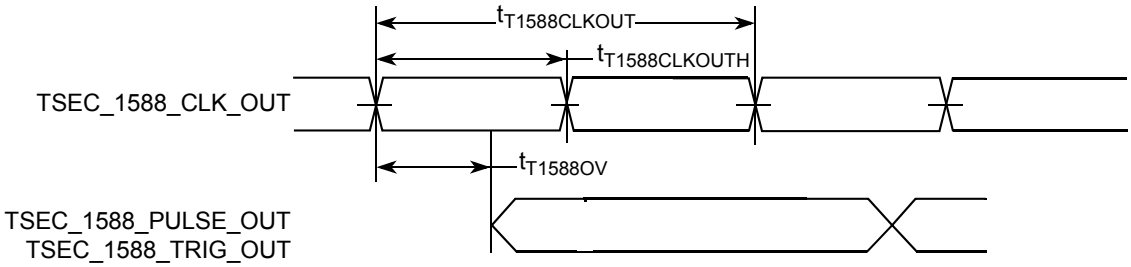
At recommended operating conditions with OV_{DD} of 3.3 V ± 300mV.

Parameter/Condition	Symbol	Min	Typ	Max	Unit	Note
QE_1588_CLK clock period	$t_{T1588CLK}$	2.5	—	$T_{RX\_CLK} \times 9$	ns	1, 3
QE_1588_CLK duty cycle	$t_{T1588CLKH}/t_{T1588CLK}$	40	50	60	%	—
QE_1588_CLK peak-to-peak jitter	$t_{T1588CLKINJ}$	—	—	250	ps	—
Rise time QE_1588_CLK (20%–80%)	$t_{T1588CLKINR}$	1.0	—	2.0	ns	—
Fall time QE_1588_CLK (80%–20%)	$t_{T1588CLKINF}$	1.0	—	2.0	ns	—
QE_1588_CLK_OUT clock period	$t_{T1588CLKOUT}$	$2 \times t_{T1588CLK}$	—	—	ns	—
QE_1588_CLK_OUT duty cycle	$t_{T1588CLKOTH}/t_{T1588CLKOUT}$	30	50	70	%	—
QE_1588_PULSE_OUT	$t_{T1588OV}$	0.5	—	3.0	ns	—
QE_1588_TRIG_IN pulse width	$t_{T1588TRIGH}$	$2 \times t_{T1588CLK\_MAX}$	—	—	ns	2

Notes:

1. T_{RX_CLK} is the max clock period of QUICC engine receiving clock selected by TMR_CTRL[CKSEL]. See the *MPC83068309 PowerQUICC II Pro Integrated Communications Processor Reference Manual,* for a description of TMR_CTRL registers.
2. It needs to be at least two times of clock period of clock selected by TMR_CTRL[CKSEL]. See the *MPC83068309 PowerQUICC II Pro Integrated Communications Processor Reference Manual,* for a description of TMR_CTRL registers.
3. The maximum value of $t_{T1588CLK}$ is not only defined by the value of T_{RX_CLK}, but also defined by the recovered clock. For example, for 10/100 Mbps modes, the maximum value of $t_{T1588CLK}$ is 3600 and 280ns, respectively.

The following figure provides the data and command output timing diagram.



Note: The output delay is count starting rising edge if $t_{T1588CLKOUT}$ is non-inverting. Otherwise, it is count starting falling edge.

Figure 18. IEEE1588 Output AC Timing

The following figure provides the data and command input timing diagram.

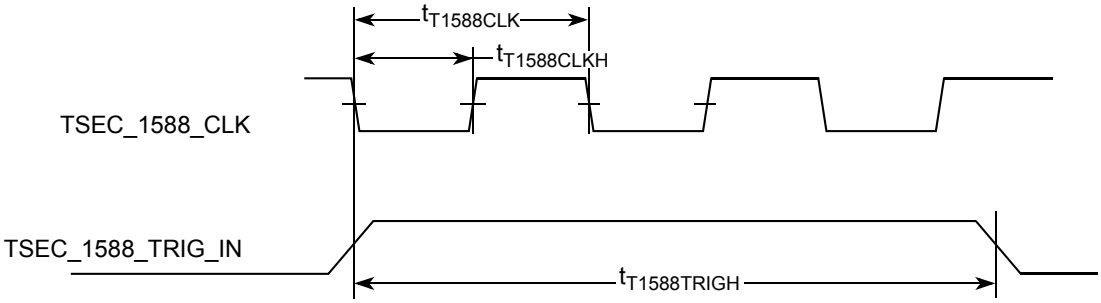


Figure 19. IEEE1588 Input AC Timing

9 TDM/SI

This section describes the DC and AC electrical specifications for the time-division-multiplexed and serial interface of the MPC8306.

9.1 TDM/SI DC Electrical Characteristics

The following table provides the DC electrical characteristics for the MPC8306 TDM/SI.

Table 28. TDM/SI DC Electrical Characteristics

Characteristic	Symbol	Condition	Min	Max	Unit
Output high voltage	V_{OH}	I_{OH} = –2.0 mA	2.4	—	V
Output low voltage	V_{OL}	I_{OL} = 3.2 mA	—	0.5	V
Input high voltage	V_{IH}	—	2.0	OV_{DD} + 0.3	V
Input low voltage	V_{IL}	—	–0.3	0.8	V
Input current	I_{IN}	$0 V \le V_{IN} \le OV_{DD}$	—	±5	μA

9.2 TDM/SI AC Timing Specifications

The following table provides the TDM/SI input and output AC timing specifications.

Table 29. TDM/SI AC Timing Specifications[1]

Characteristic	Symbol[2]	Min	Max	Unit
TDM/SI outputs—External clock delay	t_{SEKHOV}	2	14	ns
TDM/SI outputs—External clock High Impedance	t_{SEKHOX}	2	10	ns
TDM/SI inputs—External clock input setup time	t_{SEIVKH}	5	—	ns
TDM/SI inputs—External clock input hold time	t_{SEIXKH}	2	—	ns

Notes:
1. Output specifications are measured from the 50% level of the rising edge of QE_CLK_IN to the 50% level of the signal. Timings are measured at the pin.
2. The symbols used for timing specifications follow the pattern of $t_{\text{(first two letters of functional block)(signal)(state)(reference)(state)}}$ for inputs and $t_{\text{(first two letters of functional block)(reference)(state)(signal)(state)}}$ for outputs. For example, t_{SEKHOX} symbolizes the TDM/SI outputs external timing (SE) for the time $t_{TDM/SI}$ memory clock reference (K) goes from the high state (H) until outputs (O) are invalid (X).

The following figure provides the AC test load for the TDM/SI.

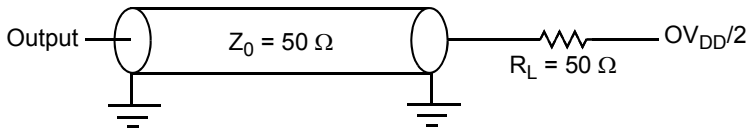
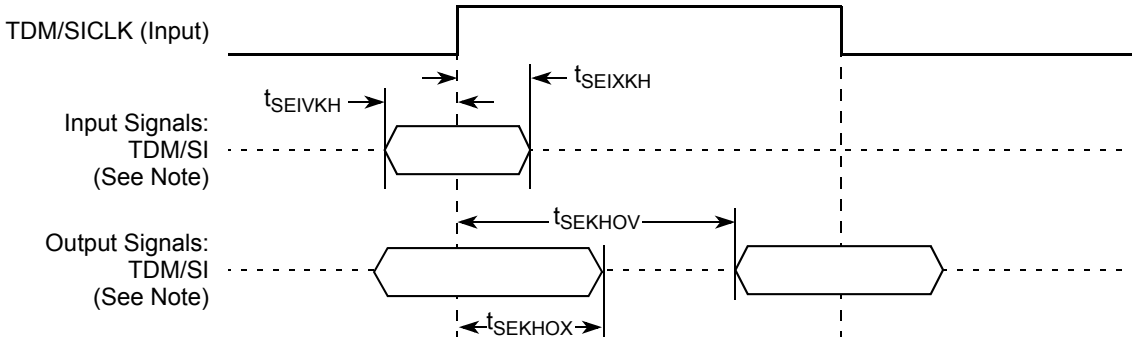


Figure 20. TDM/SI AC Test Load

The following figure represents the AC timing from Table 29. Note that although the specifications generally reference the rising edge of the clock, these AC timing diagrams also apply when the falling edge is the active edge.



Note: The clock edge is selectable on TDM/SI.

Figure 21. TDM/SI AC Timing (External Clock) Diagram

10 HDLC

This section describes the DC and AC electrical specifications for the high level data link control (HDLC), of the MPC8306.

12 DUART

This section describes the DC and AC electrical specifications for the DUART interface of the MPC8306.

12.1 DUART DC Electrical Characteristics

The following table provides the DC electrical characteristics for the DUART interface of the MPC8306.

Table 34. DUART DC Electrical Characteristics

Parameter	Symbol	Min	Max	Unit
High-level input voltage	V_{IH}	2	OV_{DD} + 0.3	V
Low-level input voltage OV_{DD}	V_{IL}	–0.3	0.8	V
High-level output voltage, I_{OH} = –100 μA	V_{OH}	OV_{DD} – 0.2	—	V
Low-level output voltage, I_{OL} = 100 μA	V_{OL}	—	0.2	V
Input current (0 V ≤ V_{IN} ≤ OV_{DD})[1]	I_{IN}	—	±5	μA

Note:
1. Note that the symbol V_{IN}, in this case, represents the OV_{IN} symbol referenced in Table 1 and Table 2.

12.2 DUART AC Electrical Specifications

The following table provides the AC timing parameters for the DUART interface of the MPC8306.

Table 35. DUART AC Timing Specifications

Parameter	Value	Unit	Note
Minimum baud rate	256	baud	—
Maximum baud rate	>1,000,000	baud	1
Oversample rate	16	—	2

Notes:
1. Actual attainable baud rate is limited by the latency of interrupt processing.
2. The middle of a start bit is detected as the 8^{th} sampled 0 after the 1-to-0 transition of the start bit. Subsequent bit values are sampled each 16^{th} sample.

18 IPIC

This section describes the DC and AC electrical specifications for the external interrupt pins of the MPC8306.

18.1 IPIC DC Electrical Characteristics

The following table provides the DC electrical characteristics for the external interrupt pins of the MPC8306.

Table 46. IPIC DC Electrical Characteristics[1,2]

Characteristic	Symbol	Condition	Min	Max	Unit
Input high voltage	V_{IH}	—	2.0	OV_{DD} + 0.3	V
Input low voltage	V_{IL}	—	–0.3	0.8	V
Input current	I_{IN}	—	—	±5	μA
Output High Voltage	V_{OH}	I_{OL} = -8.0 mA	2.4	—	V
Output low voltage	V_{OL}	I_{OL} = 6.0 mA	—	0.5	V
Output low voltage	V_{OL}	I_{OL} = 3.2 mA	—	0.4	V

Notes:
1. This table applies for pins $\overline{\text{IRQ}}$, $\overline{\text{MCP\_OUT}}$, and QE ports Interrupts.
2. $\overline{\text{MCP\_OUT}}$ is open drain pins, thus V_{OH} is not relevant for those pins.

18.2 IPIC AC Timing Specifications

The following table provides the IPIC input and output AC timing specifications.

Table 47. IPIC Input AC Timing Specifications[1]

Characteristic	Symbol[2]	Min	Unit
IPIC inputs—minimum pulse width	t_{PIWID}	20	ns

Notes:
1. Input specifications are measured from the 50% level of the signal to the 50% level of the rising edge of SYS_CLK_IN. Timings are measured at the pin.
2. IPIC inputs and outputs are asynchronous to any visible clock. IPIC outputs should be synchronized before use by any external synchronous logic. IPIC inputs are required to be valid for at least t_{PIWID} ns to ensure proper operation when working in edge triggered mode.

19 SPI

This section describes the DC and AC electrical specifications for the SPI of the MPC8306.

19.1 SPI DC Electrical Characteristics

The following table provides the DC electrical characteristics for the MPC8306 SPI.

Table 48. SPI DC Electrical Characteristics

Characteristic	Symbol	Condition	Min	Max	Unit
Output high voltage	V_{OH}	I_{OH} = –6.0 mA	2.4	—	V
Output low voltage	V_{OL}	I_{OL} = 6.0 mA	—	0.5	V
Output low voltage	V_{OL}	I_{OL} = 3.2 mA	—	0.4	V
Input high voltage	V_{IH}	—	2.0	OV_{DD} + 0.3	V
Input low voltage	V_{IL}	—	–0.3	0.8	V
Input current	I_{IN}	0 V ≤ V_{IN} ≤ OV_{DD}	—	±5	μA

19.2 SPI AC Timing Specifications

The following table and provide the SPI input and output AC timing specifications.

Table 49. SPI AC Timing Specifications[1]

Characteristic	Symbol[2]	Min	Max	Unit
SPI outputs—Master mode (internal clock) delay	t_{NIKHOV}	0.5	6	ns
SPI outputs—Slave mode (external clock) delay	t_{NEKHOV}	2	8	ns
SPI inputs—Master mode (internal clock) input setup time	t_{NIIVKH}	6	—	ns
SPI inputs—Master mode (internal clock) input hold time	t_{NIIXKH}	0	—	ns
SPI inputs—Slave mode (external clock) input setup time	t_{NEIVKH}	4	—	ns
SPI inputs—Slave mode (external clock) input hold time	t_{NEIXKH}	2	—	ns

Notes:
1. Output specifications are measured from the 50% level of the rising edge of SPICLK to the 50% level of the signal. Timings are measured at the pin.
2. The symbols used for timing specifications follow the pattern of $t_{\text{(first two letters of functional block)(signal)(state)(reference)(state)}}$ for inputs and $t_{\text{(first two letters of functional block)(reference)(state)(signal)(state)}}$ for outputs. For example, t_{NIKHOV} symbolizes the NMSI outputs internal timing (NI) for the time t_{SPI} memory clock reference (K) goes from the high state (H) until outputs (O) are valid (V).
3. All units of output delay must be enabled for 8306 output port spimosi (SPI Master Mode)
4. delay units must not be enabled for Slave Mode.

The following figure provides the AC test load for the SPI.

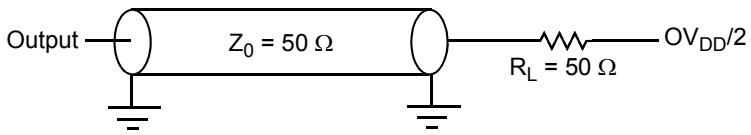
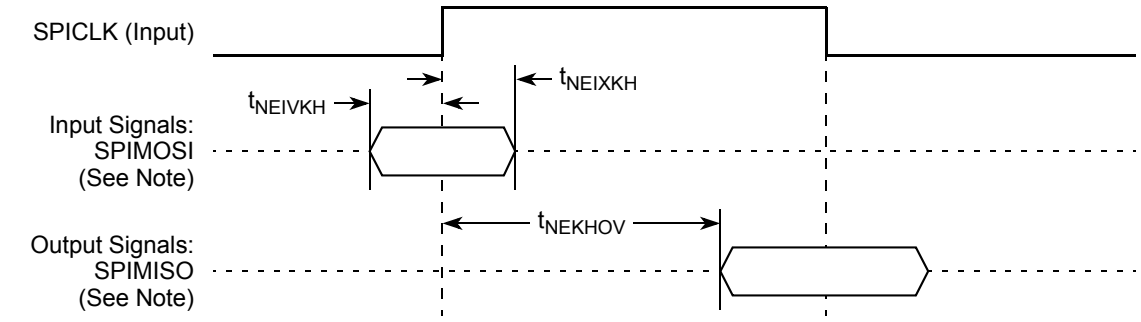


Figure 33. SPI AC Test Load

Figure 34 and Figure 35 represent the AC timing from Table 49. Note that although the specifications generally reference the rising edge of the clock, these AC timing diagrams also apply when the falling edge is the active edge.

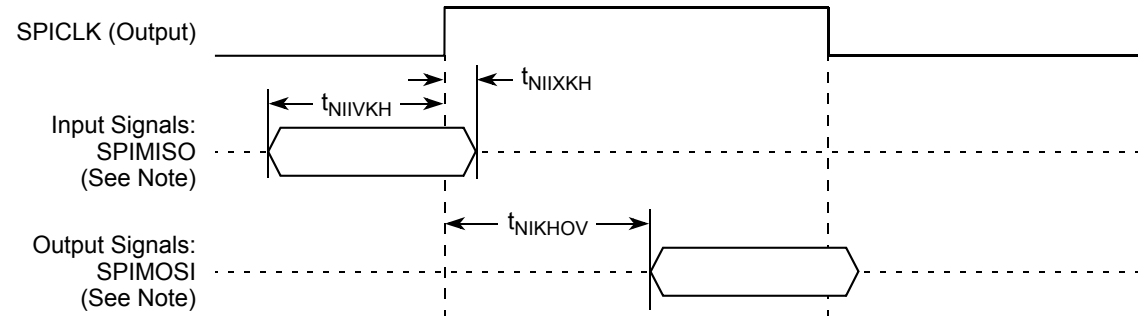
The following figure shows the SPI timing in slave mode (external clock).



Note: The clock edge is selectable on SPI.

Figure 34. SPI AC Timing in Slave Mode (External Clock) Diagram

The following figure shows the SPI timing in master mode (internal clock).



Note: The clock edge is selectable on SPI.

Figure 35. SPI AC Timing in Master Mode (Internal Clock) Diagram

20 JTAG

This section describes the DC and AC electrical specifications for the IEEE Std. 1149.1™ (JTAG) interface of the MPC8306.

20.1 JTAG DC Electrical Characteristics

The following table provides the DC electrical characteristics for the IEEE Std. 1149.1 (JTAG) interface of the MPC8306.

Table 50. JTAG Interface DC Electrical Characteristics

Characteristic	Symbol	Condition	Min	Max	Unit
Output high voltage	V_{OH}	I_{OH} = –6.0 mA	2.4	—	V
Output low voltage	V_{OL}	I_{OL} = 6.0 mA	—	0.5	V
Output low voltage	V_{OL}	I_{OL} = 3.2 mA	—	0.4	V

Table 52. MPC8306 Pinout Listing (continued)

Signal	Package Pin Number	Pin Type	Power Supply	Notes
MEMC_MA[8]	T1	O	GV_{DD}	—
MEMC_MA[9]	P4	O	GV_{DD}	—
MEMC_MA[10]	L4	O	GV_{DD}	—
MEMC_MA[11]	T2	O	GV_{DD}	—
MEMC_MA[12]	U1	O	GV_{DD}	—
MEMC_MA[13]	U2	O	GV_{DD}	—
MEMC_MWE_B	K1	O	GV_{DD}	—
MEMC_MRAS_B	K2	O	GV_{DD}	—
MEMC_MCAS_B	J1	O	GV_{DD}	—
MEMC_MCS_B[0]	J4	O	GV_{DD}	—
MEMC_MCS_B[1]	H1	O	GV_{DD}	—
MEMC_MCKE[0]	U4	O	GV_{DD}	—
MEMC_MCK[0]	V1	O	GV_{DD}	—
MEMC_MCK_B[0]	W1	O	GV_{DD}	—
MEMC_MODT[0]	H2	O	GV_{DD}	—
MEMC_MODT[1]	H4	O	GV_{DD}	—
MEMC_MVREF	L8		GV_{DD}	—
Local Bus Controller Interface				
LAD[0]	B7	IO	OV_{DD}	—
LAD[1]	D9	IO	OV_{DD}	—
LAD[2]	A6	IO	OV_{DD}	—
LAD[3]	B8	IO	OV_{DD}	—
LAD[4]	A7	IO	OV_{DD}	—
LAD[5]	A8	IO	OV_{DD}	—
LAD[6]	A9	IO	OV_{DD}	—
LAD[7]	D10	IO	OV_{DD}	—
LAD[8]	B10	IO	OV_{DD}	—
LAD[9]	A10	IO	OV_{DD}	—
LAD[10]	B11	IO	OV_{DD}	—
LAD[11]	D12	IO	OV_{DD}	—
LAD[12]	D11	IO	OV_{DD}	—
LAD[13]	A11	IO	OV_{DD}	—
LAD[14]	A12	IO	OV_{DD}	—
LAD[15]	B13	IO	OV_{DD}	—
LA[16]	A13	IO	OV_{DD}	—

Table 52. MPC8306 Pinout Listing (continued)

Signal	Package Pin Number	Pin Type	Power Supply	Notes
LA[17]	B14	O	OV_{DD}	—
LA[18]	A14	O	OV_{DD}	—
LA[19]	A15	O	OV_{DD}	—
LA[20]	A16	O	OV_{DD}	—
LA[21]	B16	O	OV_{DD}	—
LA[22]	A17	O	OV_{DD}	—
LA[23]	B17	O	OV_{DD}	—
LA[24]	A18	O	OV_{DD}	—
LA[25]	B19	O	OV_{DD}	—
LCS_B[0]	A19	O	OV_{DD}	3
LCS_B[1]	B20	O	OV_{DD}	3
LCS_B[2]	A20	O	OV_{DD}	3
LCS_B[3]	A21	O	OV_{DD}	3
LCLK[0]	D13	O	OV_{DD}	—
LGPL[0]/LFCLE	B22	O	OV_{DD}	—
LGPL[1]/LFALE	D16	O	OV_{DD}	—
LGPL[2]/LOE_B/LFRE_B	D19	O	OV_{DD}	—
LGPL[3]/LFWP_B	D17	O	OV_{DD}	—
LGPL[4]/LGTA_B/LUPWAIT/LFRB_B	E18	IO	OV_{DD}	—
LGPL[5]	E19	O	OV_{DD}	—
LWE_B[0]/LFWE_B[0]/LBS_B[0]	D15	O	OV_{DD}	—
LWE_B[1]/LBS_B[1]	D14	O	OV_{DD}	—
LBCTL	A22	O	OV_{DD}	—
LALE	B23	O	OV_{DD}	—
JTAG				
TCK	A3	I	OV_{DD}	—
TDI	B5	I	OV_{DD}	3
TDO	D7	O	OV_{DD}	—
TMS	A4	I	OV_{DD}	3
TRST_B	D8	I	OV_{DD}	3
Test Interface				
TEST_MODE	A5	I	OV_{DD}	—
System Control Signals				
HRESET_B	U20	IO	OV_{DD}	1
PORESET_B	V20	I	OV_{DD}	—

Table 52. MPC8306 Pinout Listing (continued)

Signal	Package Pin Number	Pin Type	Power Supply	Notes
Clock Interface				
QE_CLK_IN	P23	I	OV_{DD}	—
SYS_CLK_IN	R23	I	OV_{DD}	—
RTC_PIT_CLOCK	V23	I	OV_{DD}	—
Miscellaneous Signals				
QUIESCE_B	A2	O	OV_{DD}	—
THERM0	D6	I	OV_{DD}	—
GPIO/FlexCAN/eSDHC				
GPIO[0]/RXCAN1/ SD_CLK/MSRCID0 (DDR ID)	E5	IO	OV_{DD}	—
GPIO[1]/TXCAN1/SD_CMD/MSRCID1 (DDR ID)	E6	IO	OV_{DD}	—
GPIO[2]/RXCAN2/SD_CD/MSRCID2 (DDR ID)	D4	IO	OV_{DD}	—
GPIO[3]/TXCAN2/SD_WP/MSRCID3 (DDR ID)	C2	IO	OV_{DD}	—
GPIO[4]/RXCAN3/SD_DAT0/MSRCID4 (DDR ID)	C1	IO	OV_{DD}	—
GPIO[5]/TXCAN3/SD_DAT1/MDVAL (DDR ID)	B1	IO	OV_{DD}	—
GPIO[6]/RXCAN4/SD_DAT2/QE_EXT_REQ_3	B3	IO	OV_{DD}	—
GPIO[7]/TXCAN4/SD_DAT3/QE_EXT_REQ_1	B2	IO	OV_{DD}	—
USB				
USBDR_PWRFAULT/IIC_SDA2/CE_PIO_1	AC4	IO	OV_{DD}	2
USBDR_CLK/UART2_SIN[2]/UART2_CTS_B[1]	Y9	I	OV_{DD}	
USBDR_DIR/IIC_SCL2	AC3	IO	OV_{DD}	2
USBDR_NXT/UART2_SIN[1]/QE_EXT_REQ_4	AC2	IO	OV_{DD}	—
USBDR_PCTL[0]/UART2_SOUT[1]/ LB_POR_CFG_BOOT_ECC	AB3	IO	OV_{DD}	—
USBDR_PCTL[1]/UART2_SOUT[2]/ UART2_RTS_B1/LB_POR_BOOT_ERR	Y8	O	OV_{DD}	—
USBDR_STP/QE_EXT_REQ_2	W6	IO	OV_{DD}	—
USBDR_TXDRXD[0]/UART1_SOUT[1]/ GPIO[32]	AB7	IO	OV_{DD}	—
USBDR_TXDRXD[1]/UART1_SIN[1]/GPIO[33]	AB8	IO	OV_{DD}	—
USBDR_TXDRXD[2]/UART1_SOUT[2]/ UART1_RTS_B1/QE_BRG[1]	AC6	IO	OV_{DD}	—
USBDR_TXDRXD[3]/UART1_SIN[2]/ UART1_CTS_B1/QE_BRG[2]	AC5	IO	OV_{DD}	—
USBDR_TXDRXD[4]/GPIO[34]/QE_BRG[3]	AB5	IO	OV_{DD}	—
USBDR_TXDRXD[5]/GPIO[35]/QE_BRG[4]	Y7	IO	OV_{DD}	—
USBDR_TXDRXD[6]/GPIO[36]/QE_BRG[9]	Y6	IO	OV_{DD}	—

Table 55. System PLL Multiplication Factors

RCWL[SPMF]	System PLL Multiplication Factor
0000	Reserved
0001	Reserved
0010	× 2
0011	× 3
0100	× 4
0101	× 5
0110	× 6
0111–1111	Reserved

coherent system bus clock (*csb_clk*). The following table shows the expected frequency values for the CSB frequency for selected *csb_clk* to *SYS_CLK_IN* ratios.

Table 56. CSB Frequency Options

SPMF	csb_clk : sys_clk_in Ratio	SYS_CLK_IN(MHz)		
		25	33.33	66.67
		csb_clk Frequency (MHz)		
0010	2:1			133
0011	3:1			
0100	4:1		133	
0101	5:1	125	167	
0110	6:1			

22.3 Core PLL Configuration

RCWL[COREPLL] selects the ratio between the internal coherent system bus clock (*csb_clk*) and the e300 core clock (*core_clk*). The following table shows the encodings for RCWL[COREPLL]. COREPLL values not listed, and should be considered reserved.

Table 57. e300 Core PLL Configuration

RCWL[COREPLL]			*core_clk* : *csb_clk* Ratio	VCO Divider
0-1	2-5	6		
nn	0000	n	PLL bypassed (PLL off, *csb_clk* clocks core directly)	PLL bypassed (PLL off, *csb_clk* clocks core directly)
00	0001	0	1:1	÷2
01	0001	0	1:1	÷4
10	0001	0	1:1	÷8
11	0001	0	1:1	÷8

Table 58. QUICC Engine PLL Multiplication Factors (continued)

RCWL[CEPMF]	RCWL[CEPDF]	QUICC Engine PLL Multiplication Factor = RCWL[CEPMF]/ (1 + RCWL[CEPDF)
00111	0	× 7
01000	0	× 8
01001–11111	0	Reserved

The RCWL[CEVCOD] denotes the QUICC Engine PLL VCO internal frequency as shown in the following table.

Table 59. QUICC Engine PLL VCO Divider

RCWL[CEVCOD]	VCO Divider
00	2
01	4
10	8
11	Reserved

NOTE

The VCO divider (RCWL[CEVCOD]) must be set properly so that the QUICC Engine VCO frequency is in the range of 300–600 MHz. The QUICC Engine frequency is not restricted by the CSB and core frequencies. The CSB, core, and QUICC Engine frequencies should be selected according to the performance requirements.

The QUICC Engine VCO frequency is derived from the following equations:

qe_clk = (primary clock input × CEPMF) ÷ (1 + CEPDF)

QUICC Engine VCO Frequency = *qe_clk* × VCO divider × (1 + CEPDF)

22.5 Suggested PLL Configurations

To simplify the PLL configurations, the MPC8306 might be separated into two clock domains. The first domain contains the CSB PLL and the core PLL. The core PLL is connected serially to the CSB PLL, and has the csb_clk as its input clock. The second clock domain has the QUICC Engine PLL. The clock domains are independent, and each of their PLLs is configured separately.

The following table shows suggested PLL configurations for 33 and 66 MHz input clocks.

24.2 PLL Power Supply Filtering

Each of the PLLs listed above is provided with power through independent power supply pins. The voltage level at each $AV_{DD}n$ pin should always be equivalent to V_{DD}, and preferably these voltages are derived directly from V_{DD} through a low frequency filter scheme such as the following.

There are a number of ways to reliably provide power to the PLLs, but the recommended solution is to provide independent filter circuits as illustrated in Figure 44, one to each of the three AV_{DD} pins. By providing independent filters to each PLL the opportunity to cause noise injection from one PLL to the other is reduced.

This circuit is intended to filter noise in the PLLs resonant frequency range from a 500 kHz to 10 MHz range. It should be built with surface mount capacitors with minimum effective series inductance (ESL). Consistent with the recommendations of Dr. Howard Johnson in *High Speed Digital Design: A Handbook of Black Magic* (Prentice Hall, 1993), multiple small capacitors of equal value are recommended over a single large value capacitor.

Each circuit should be placed as close as possible to the specific AV_{DD} pin being supplied to minimize noise coupled from nearby circuits. It should be possible to route directly from the capacitors to the AV_{DD} pin, which is on the periphery of package, without the inductance of vias.

The following figure shows the PLL power supply filter circuit.

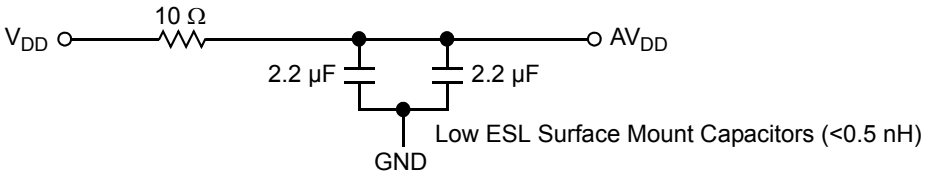


Figure 44. PLL Power Supply Filter Circuit

24.3 Decoupling Recommendations

Due to large address and data buses, and high operating frequencies, the MPC8306 can generate transient power surges and high frequency noise in its power supply, especially while driving large capacitive loads. This noise must be prevented from reaching other components in the MPC8306 system, and MPC8306 itself requires a clean, tightly regulated source of power. Therefore, it is recommended that the system designer place at least one decoupling capacitor at each V_{DD}, OV_{DD}, and GV_{DD} pins of the MPC8306. These decoupling capacitors should receive their power from separate V_{DD}, OV_{DD}, GV_{DD}, and GND power planes in the PCB, utilizing short traces to minimize inductance. Capacitors may be placed directly under the device using a standard escape pattern. Others may surround the part.

These capacitors should have a value of 0.01 or 0.1 µF. Only ceramic SMT (surface mount technology) capacitors should be used to minimize lead inductance, preferably 0402 or 0603 sizes.

In addition, it is recommended that there be several bulk storage capacitors distributed around the PCB, feeding the V_{DD}, OV_{DD}, and GV_{DD} planes, to enable quick recharging of the smaller chip capacitors. These bulk capacitors should have a low ESR (equivalent series resistance) rating to ensure the quick response time necessary. They should also be connected to the power and ground planes through two vias