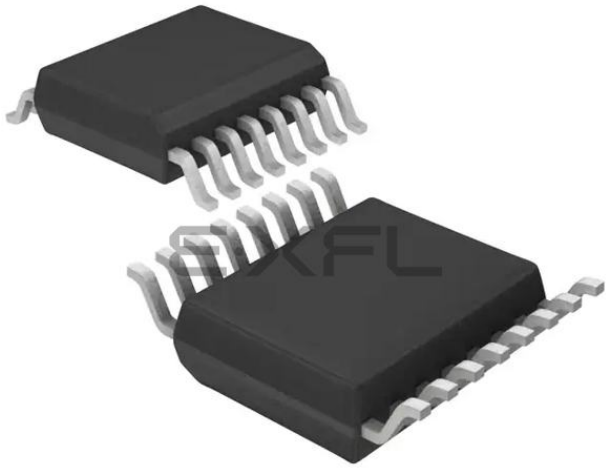

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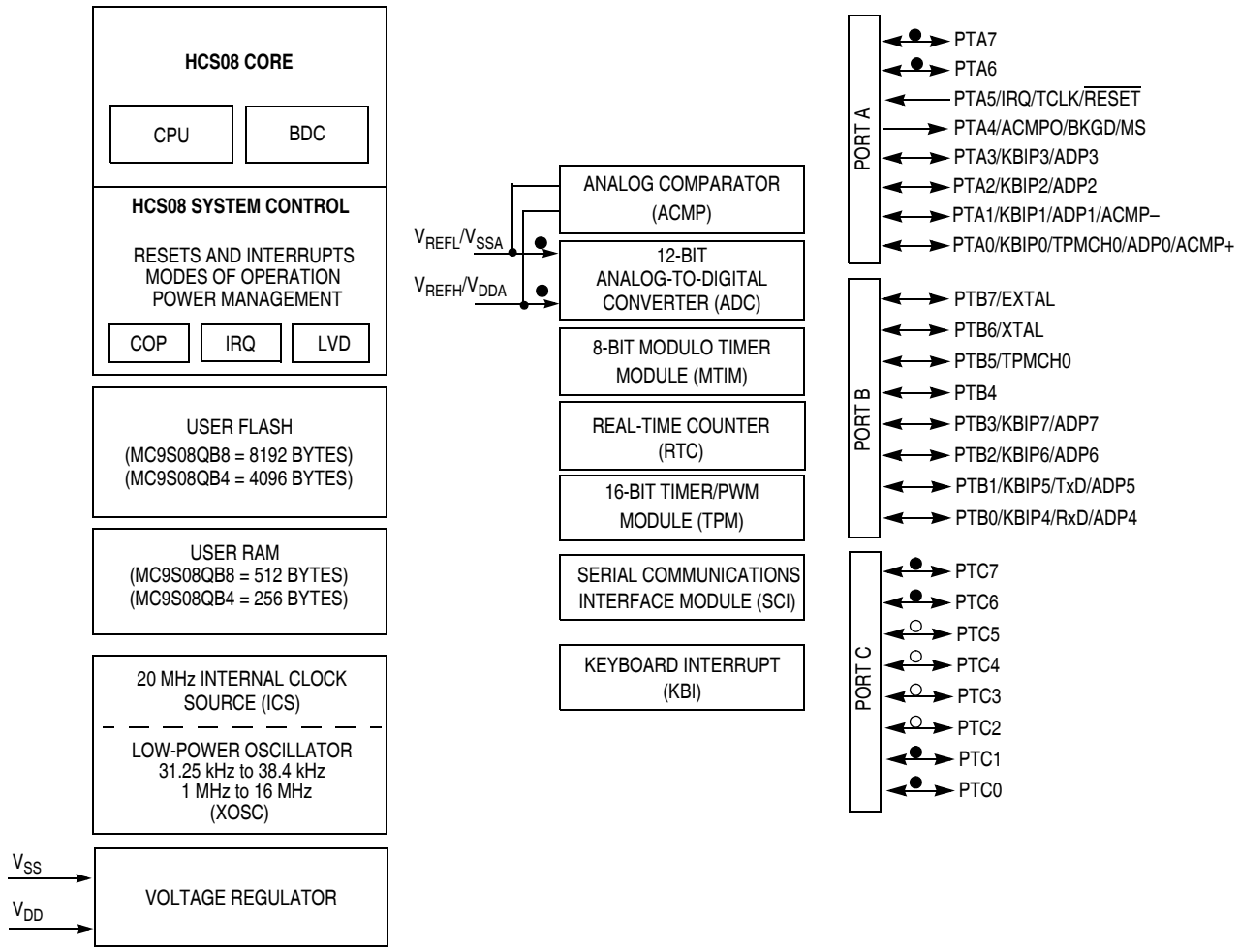
Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	S08
Core Size	8-Bit
Speed	20MHz
Connectivity	LINbus, SCI
Peripherals	LVD, PWM, WDT
Number of I/O	12
Program Memory Size	4KB (4K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	256 x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 3.6V
Data Converters	A/D 8x12b
Oscillator Type	External
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	16-TSSOP (0.173", 4.40mm Width)
Supplier Device Package	16-TSSOP
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/mc9s08qb4ctg

1 MCU Block Diagram

The block diagram shows the structure of the MC9S08QB8 MCU.



○ pins not available on 24-pin or 16-pin packages

● pins not available on 16-pin package

[1] V_{DDA}/V_{REFH} and V_{SSA}/V_{REFL} are double bonded to V_{DD} and V_{SS} respectively in16-pin package.

Figure 1. MC9S08QB8 Series Block Diagram

2 Pin Assignments

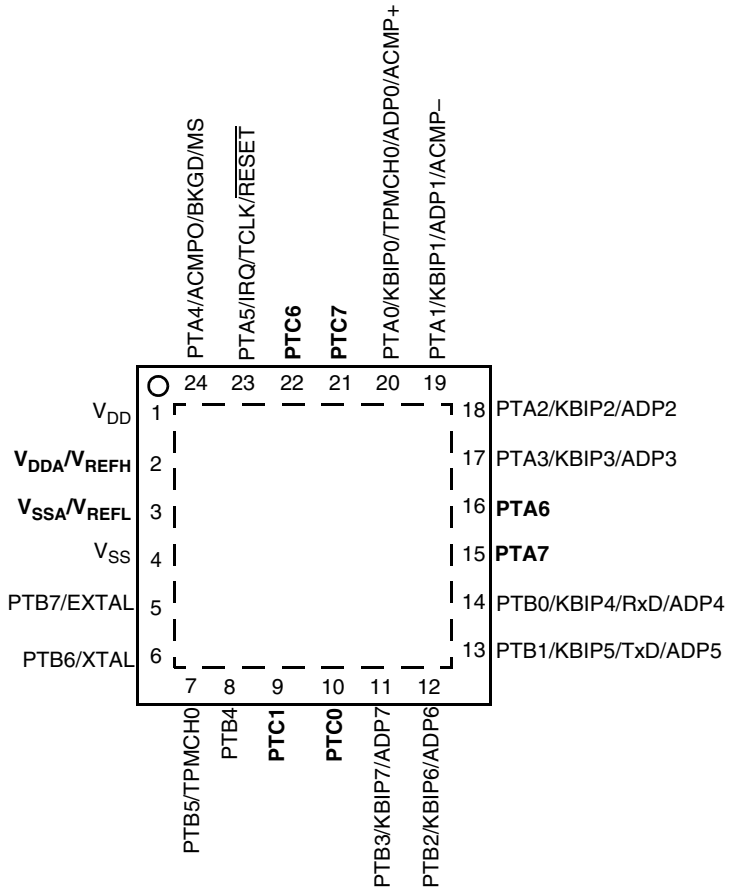
This chapter shows the pin assignments for the MC9S08QB8 series devices.

Table 1. Pin Availability by Package Pin-Count

Pin Number			<-- Lowest **Priority** --> Highest				
28	**24**	**16**	**Port Pin**	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 4**
1	—	—	PTC5				
2	—	—	PTC4				
3	23	1	PTA5	IRQ	TCLK	$\overline{\text{RESET}}$	
4	24	2	PTA4	ACMPO	BKGD	MS	
5	1	3					V_{DD}
6	2	—					V_{DDA}/V_{REFH}
7	3	—					V_{SSA}/V_{REFL}
8	4	4					V_{SS}
9	5	5	PTB7				EXTAL
10	6	6	PTB6				XTAL
11	7	7	PTB5	TPMCH0[1]			
12	8	8	PTB4				
13	—	—	PTC3				
14	—	—	PTC2				
15	9	—	PTC1				
16	10	—	PTC0				
17	11	9	PTB3	KBIP7		ADP7	
18	12	10	PTB2	KBIP6		ADP6	
19	13	11	PTB1	KBIP5	TxD	ADP5	
20	14	12	PTB0	KBIP4	RxD	ADP4	
21	15	—	PTA7				
22	16	—	PTA6				
23	17	13	PTA3	KBIP3		ADP3	
24	18	14	PTA2	KBIP2		ADP2	
25	19	15	PTA1	KBIP1		ADP1[2]	ACMP–[2]
26	20	16	PTA0	KBIP0	TPMCH0	ADP0[2]	ACMP+[2]
27	21	—	PTC7				
28	22	—	PTC6				

1 TPMCH0 pin can be repositioned using at PTB5 TPMCH0PS in SOPT2, default reset location is PTA0.

2 If ADC and ACMP are enabled, both modules will have access to the pin.



Pins shown in bold type are lost in the next lower pin count package.

Figure 3. MC9S08QB8 Series in 24-Pin QFN Packages

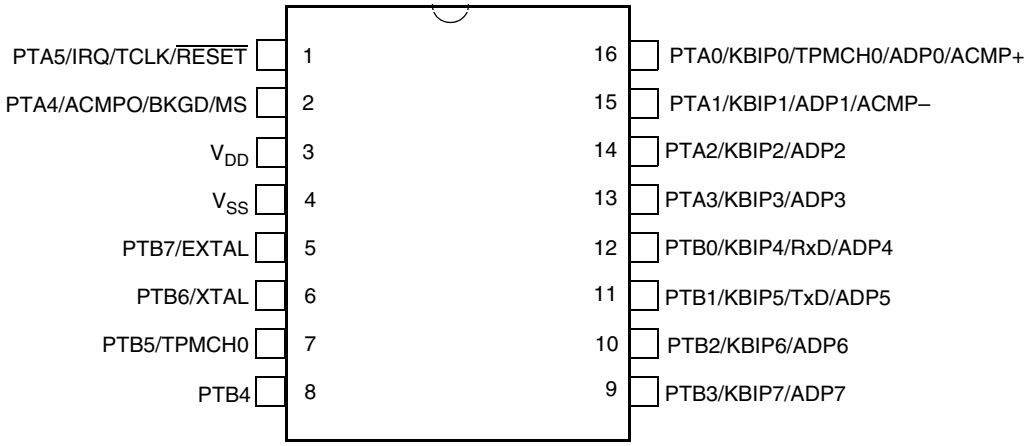


Figure 4. MC9S08QB8 Series in 16-Pin TSSOP Package

3 Electrical Characteristics

3.1 Introduction

This chapter contains electrical and timing specifications for the MC9S08QB8 series of microcontrollers available at the time of publication.

3.2 Parameter Classification

The electrical parameters shown in this supplement are guaranteed by various methods. To give the customer a better understanding the following classification is used and the parameters are tagged accordingly in the tables where appropriate:

Table 2. Parameter Classifications

P	Those parameters are guaranteed during production testing on each individual device.
C	Those parameters are achieved by the design characterization by measuring a statistically relevant sample size across process variations.
T	Those parameters are achieved by design characterization on a small sample size from typical devices under typical conditions unless otherwise noted. All values shown in the typical column are within this category.
D	Those parameters are derived mainly from simulations.

NOTE

The classification is shown in the column labeled “C” in the parameter tables where appropriate.

3.3 Absolute Maximum Ratings

Absolute maximum ratings are stress ratings only, and functional operation at the maxima is not guaranteed. Stress beyond the limits specified in Table 3 may affect device reliability or cause permanent damage to the device. For functional operating conditions, refer to the remaining tables in this section.

This device contains circuitry protecting against damage due to high static voltage or electrical fields; however, it is advised that normal precautions be taken to avoid application of any voltages higher than maximum-rated voltages to this high-impedance circuit. Reliability of operation is enhanced if unused inputs are tied to an appropriate logic voltage level (for instance, either V_{SS} or V_{DD}) or the programmable pull-up resistor associated with the pin is enabled.

T_A = Ambient temperature, °C
θ_{JA} = Package thermal resistance, junction-to-ambient, °C/W
$P_D = P_{int} + P_{I/O}$
$P_{int} = I_{DD} \times V_{DD}$, Watts — chip internal power
$P_{I/O}$ = Power dissipation on input and output pins — user determined

For most applications, $P_{I/O} << P_{int}$ and can be neglected. An approximate relationship between P_D and T_J (if $P_{I/O}$ is neglected) is:

$$P_D = K \div (T_J + 273°C) \quad \textit{Eqn. 2}$$

Solving Equation 1 and Equation 2 for K gives:

$$K = P_D \times (T_A + 273°C) + \theta_{JA} \times (P_D)^2 \quad \textit{Eqn. 3}$$

where K is a constant pertaining to the particular part. K can be determined from equation 3 by measuring P_D (at equilibrium) for a known T_A. Using this value of K, the values of P_D and T_J can be obtained by solving Equation 1 and Equation 2 iteratively for any value of T_A.

3.5 ESD Protection and Latch-Up Immunity

Although damage from electrostatic discharge (ESD) is much less common on these devices than on early CMOS circuits, normal handling precautions should be taken to avoid exposure to static discharge. Qualification tests are performed to ensure that these devices can withstand exposure to reasonable levels of static without suffering any permanent damage.

All ESD testing is in conformity with AEC-Q100 Stress Test Qualification for Automotive Grade Integrated Circuits. During the device qualification, ESD stresses were performed for the human body model (HBM), the machine model (MM) and the charge device model (CDM).

A device is defined as a failure if after exposure to ESD pulses the device no longer meets the device specification. Complete DC parametric and functional testing is performed per the applicable device specification at room temperature followed by hot temperature, unless instructed otherwise in the device specification.

Table 5. ESD and Latch-up Test Conditions

Model	Description	Symbol	Value	Unit
Human Body	Series resistance	R1	1500	Ω
	Storage capacitance	C	100	pF
	Number of pulses per pin	—	3	
Machine	Series resistance	R1	0	Ω
	Storage capacitance	C	200	pF
	Number of pulses per pin	—	3	
Latch-up	Minimum input voltage limit		–2.5	V
	Maximum input voltage limit		7.5	V

Table 8. Supply Current Characteristics

Num	C	Parameter	Symbol	Bus Freq	V_{DD} (V)	Typical[1]	Max	Unit	Temp (°C)
1	P	Run supply current FEI mode, all modules on	RI_{DD}	10 MHz	3	5.60	6	mA	–40 to 85°C
	T			1 MHz		0.80	—		
2	T	Run supply current FEI mode, all modules off	RI_{DD}	10 MHz	3	3.60	—	mA	–40 to 85°C
	T			1 MHz		0.75	—		
3	T	Run supply current LPRS=0, all modules off	RI_{DD}	16 kHz FBILP	3	165	—	µA	–40 to 85°C
	T			16 kHz FBELP		105	—		
4	T	Run supply current LPRS=1, all modules off	RI_{DD}	16 kHz FBELP	3	7.3	—	µA	–40 to 85°C
5	T	Wait mode supply current FEI mode, all modules off	WI_{DD}	10 MHz	3	570	—	µA	–40 to 85°C
	T			1 MHz		290	—		
6	T	Wait mode supply current LPRS = 1, all mods off	WI_{DD}	16 kHz FBELP	3	1	—	µA	–40 to 85°C
7	P	Stop2 mode supply current	$S2I_{DD}$	—	3	0.25	0.65	µA	–40 to 25°C
	C			—		0.5	0.8		70°C
	P			—		1	2		85°C
	C			—	2	0.2	0.5		–40 to 25°C
	C			—		0.3	0.6		70°C
	C			—		0.7	1.6		85°C
8	P	Stop3 mode supply current no clocks active	$S3I_{DD}$	—	3	0.45	0.80	µA	–40 to 25°C
	C			—		1	1.8		70°C
	P			—		3	5.8		85°C
	C			—	2	0.3	0.6		–40 to 25°C
	C			—		0.8	1.5		70°C
	C			—		2.5	5.0		85°C

[1] Data in Typical column was characterized at 3.0 V, 25 °C or is typical recommended value.

Table 9. Stop Mode Adders

Num	C	Parameter	Condition	Temperature				Units
				–40°C	**25**°C	**70**°C	**85**°C	
1	T	LPO	—	50	75	100	150	nA
2	T	ERREFSTEN	RANGE = HGO = 0	1000	1000	1100	1500	nA
3	T	IREFSTEN[1]	—	63	70	77	81	µA

Table 9. Stop Mode Adders (continued)

Num	C	Parameter	Condition	Temperature				Units
				–40°C	25°C	70°C	85°C	
4	T	RTC	Does not include clock source current	50	75	100	150	nA
5	T	LVD[1]	LVDSE = 1	90	100	110	115	µA
6	T	ACMP[1]	Not using the bandgap (BGBE = 0)	18	20	22	23	µA
7	T	ADC[1]	ADLPC = ADLSMP = 1 Not using the bandgap (BGBE = 0)	95	106	114	120	µA

[1] Not available in stop2 mode.

3.8 External Oscillator (XOSC) Characteristics

Reference Figure 10 and Figure 11 for crystal or resonator circuits.

Table 10. XOSCVLP and ICS Specifications (Temperature Range = –40 to 85°C Ambient)

Num	C	Characteristic	Symbol	Min	Typ[1]	Max	Unit
1	C	Oscillator crystal or resonator (EREFS = 1, ERCLKEN = 1) Low range (RANGE = 0) High range (RANGE = 1), high gain (HGO = 1) High range (RANGE = 1), low power (HGO = 0)	 f_{lo} f_{hi} f_{hi}	 32 1 1	 — — —	 38.4 16 8	 kHz MHz MHz
2	D	Load capacitors Low range (RANGE=0), low power (HGO=0) Other oscillator settings	C_1, C_2	See Note [2] See Note [3]			
3	D	Feedback resistor Low range, low power (RANGE = 0, HGO = 0)[2] Low range, high gain (RANGE = 0, HGO = 1) High range (RANGE = 1, HGO = X)	R_F	 — — —	 — 10 1	 — — —	MΩ
4	D	Series resistor — Low range, low power (RANGE = 0, HGO = 0)[2] Low range, high gain (RANGE = 0, HGO = 1) High range, low power (RANGE = 1, HGO = 0) High range, high gain (RANGE = 1, HGO = 1) ≥ 8 MHz 4 MHz 1 MHz	R_S	 — — — — — —	 — 100 0 0 0 0	 — — — 0 10 20	kΩ
5	C	Crystal start-up time [4] Low range, low power Low range, high gain High range, low power High range, high gain	 t_{CSTL} t_{CSTH}	 — — — —	 600 400 5 15	 — — — —	ms
6	D	Square wave input clock frequency (EREFS = 0, ERCLKEN = 1) FEE mode FBE or FBELP mode	f_{extal}	 0.03125 0	 — —	 20 20	MHz

1 Data in Typical column was characterized at 3.0 V, 25 °C or is typical recommended value.
2 Load capacitors (C_1,C_2), feedback resistor (R_F) and series resistor (R_S) are incorporated internally when RANGE = HGO = 0.
3 See crystal or resonator manufacturer's recommendation.
4 Proper PC board layout procedures must be followed to achieve specifications.

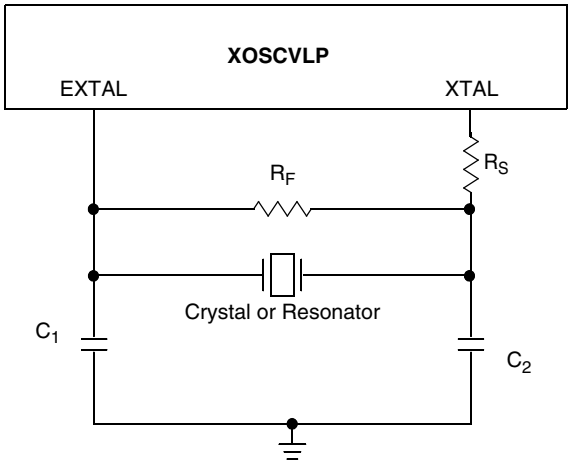


Figure 10. Typical Crystal or Resonator Circuit: High Range and Low Range/High Gain

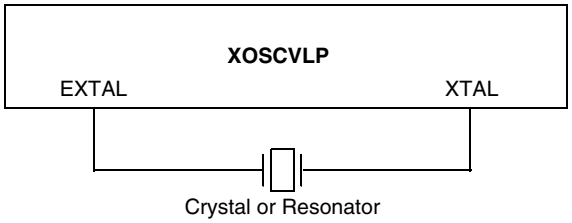


Figure 11. Typical Crystal or Resonator Circuit: Low Range/Low Power

3.9 Internal Clock Source (ICS) Characteristics

Table 11. ICS Frequency Specifications (Temperature Range = –40 to 85°C Ambient)

Num	C	Characteristic	Symbol	Min.	Typical[1]	Max.	Unit
1	P	Average internal reference frequency — factory trimmed at V_{DD} = 3.6 V and temperature = 25 °C	f_{int_t}	—	32.768	—	kHz
2	P	Internal reference frequency — user trimmed	f_{int_ut}	31.25	—	39.06	kHz
3	T	Internal reference start-up time	t_{IRST}	—	60	100	µs
4	P	DCO output frequency range — trimmed[2] — Low range (DRS = 00)	f_{dco_t}	16	—	20	MHz
5	P	DCO output frequency[2] Reference = 32768 Hz and DMX32 = 1	f_{dco_DMX32}	—	19.92	—	MHz
6	C	Resolution of trimmed DCO output frequency at fixed voltage and temperature (using FTRIM)	$\Delta f_{dco\_res\_t}$	—	±0.1	±0.2	$\%f_{dco}$

3.10 AC Characteristics

This section describes timing characteristics for each peripheral system.

3.10.1 Control Timing

Table 12. Control Timing

Num	C	Rating	Symbol	Min	Typical[1]	Max	Unit
1	D	Bus frequency ($t_{cyc} = 1/f_{Bus}$)	f_{Bus}	DC	—	10	MHz
2	D	Internal low power oscillator period	t_{LPO}	700	—	1300	μs
3	D	External reset pulse width[2]	t_{extrst}	100	—	—	ns
4	D	Reset low drive	t_{rstdrv}	34 x t_{cyc}	—	—	ns
5	D	BKGD/MS setup time after issuing background debug force reset to enter user or BDM modes	t_{MSSU}	500	—	—	ns
6	D	BKGD/MS hold time after issuing background debug force reset to enter user or BDM modes [3]	t_{MSH}	100	—	—	μs
7	D	IRQ pulse width Asynchronous path[2] Synchronous path[4]	t_{ILIH}, t_{IHIL}	100 1.5 x t_{cyc}	— —	— —	ns
8	D	Keyboard interrupt pulse width Asynchronous path[2] Synchronous path[4]	t_{ILIH}, t_{IHIL}	100 1.5 x t_{cyc}	— —	— —	ns
9	D	Port rise and fall time — Low output drive (PTxDS = 0) (load = 50 pF)[5] Slew rate control disabled (PTxSE = 0) Slew rate control enabled (PTxSE = 1)	t_{Rise}, t_{Fall}	 — —	 16 23	 — —	ns
		Port rise and fall time — High output drive (PTxDS = 1) (load = 50 pF)[5] Slew rate control disabled (PTxSE = 0) Slew rate control enabled (PTxSE = 1)	t_{Rise}, t_{Fall}	 — —	 5 9	 — —	ns
10	D	Voltage regulator recovery time	t_{VRR}	—	4	—	μs

1 Typical values are based on characterization data at V_{DD} = 3.0 V, 25 °C unless otherwise stated.

2 This is the shortest pulse that is guaranteed to be recognized as a reset pin request.

3 To enter BDM mode following a POR, BKGD/MS should be held low during the power-up and for a hold time of t_{MSH} after V_{DD} rises above V_{LVD}.

4 This is the minimum pulse width that is guaranteed to pass through the pin synchronization circuitry. Shorter pulses may or may not be recognized. In stop mode, the synchronizer is bypassed so shorter pulses can be recognized.

5 Timing is shown with respect to 20% V_{DD} and 80% V_{DD} levels. Temperature range –40°C to 85°C.

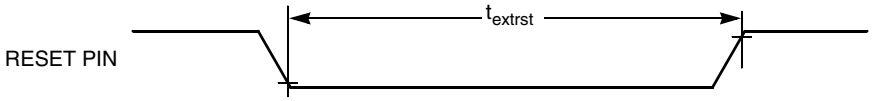


Figure 13. Reset Timing

3.11 Analog Comparator (ACMP) Electricals

Table 14. Analog Comparator Electrical Specifications

C	Characteristic	Symbol	Min	Typical	Max	Unit
D	Supply voltage	V_{PWR}	1.8	—	3.6	V
D	Supply current (active)	I_{DDAC}	—	20	35	μA
D	Analog input voltage	V_{AIN}	V_{SS} – 0.3	—	V_{DD}	V
P	Analog input offset voltage	V_{AIO}	—	20	40	mV
C	Analog comparator hysteresis	V_H	3.0	9.0	15.0	mV
P	Analog input leakage current	I_{ALKG}	—	—	1.0	μA
C	Analog comparator initialization delay	t_{AINIT}	—	—	1.0	μs

3.12 ADC Characteristics

Table 15. 12-Bit ADC Operating Conditions

Characteristic	Conditions	Symbol	Min	Typical[1]	Max	Unit	Comment
Supply voltage	Absolute	V_{DDA}	1.8	—	3.6	V	
	Delta to V_{DD} (V_{DD} – V_{DDA})[2]	ΔV_{DDA}	–100	0	100	mV	
Ground voltage	Delta to V_{SS} (V_{SS} – V_{SSA})[2]	ΔV_{SSA}	–100	0	100	mV	
Supply Current	Stop, Reset, Module Off	I_{DDAD}	—	0.007	0.8	μA	
Input Voltage		V_{ADIN}	V_{REFL}	—	V_{REFH}	V	
Input Capacitance		C_{ADIN}	—	4.5	5.5	pF	
Input Resistance		R_{ADIN}	—	5	7	kΩ	
Analog Source Resistance	12 bit mode f_{ADCK} > 4MHz f_{ADCK} < 4MHz	R_{AS}	 — —	 — —	 2 5	kΩ	External to MCU
	10 bit mode f_{ADCK} > 4MHz f_{ADCK} < 4MHz		 — —	 — —	 5 10		
	8 bit mode (all valid f_{ADCK})		—	—	10		
ADC Conversion Clock Freq.	High Speed (ADLPC = 0)	f_{ADCK}	0.4	—	8.0	MHz	
	Low Power (ADLPC = 1)		0.4	—	4.0		

1 Typical values assume V_{DDA} = 3.0 V, Temp = 25 °C, f_{ADCK} = 1.0 MHz unless otherwise stated. Typical values are for reference only and are not tested in production.

2 DC potential difference.

Table 16. 12-Bit ADC Characteristics (V_{REFH} = V_{DDA}, V_{REFL} = V_{SSA}) (continued)

Characteristic	Conditions	C	Symbol	Min	Typical[1]	Max	Unit	Comment
Integral Non-Linearity	12-bit mode	T	INL	—	±1.5	—	LSB[2]	
	10-bit mode	C		—	±0.5	—		
	8-bit mode			—	±0.3	—		
Zero-Scale Error	12-bit mode	C	E_{ZS}	—	±1.5	—	LSB[2]	For 28-pin and 24-pin packages only. V_{ADIN} = V_{SSA}
	10-bit mode	P		—	±0.5	±1.5		
	8-bit mode	T		—	±0.5	±0.5		
Zero-Scale Error	10-bit mode	P	E_{ZS}	—	±1.5	±2.1	LSB[2]	For 16-pin package only. V_{ADIN} = V_{SSA}
	8-bit mode	T		—	±0.5	±0.7		
Full-Scale Error	12-bit mode	T	E_{FS}	—	±1	—	LSB[2]	For 28-pin and 24-pin packages only. V_{ADIN} = V_{DDA}
	10-bit mode	P		—	±0.5	±1		
	8-bit mode	T		—	±0.5	±0.5		
Full-Scale Error	10-bit mode	T	E_{FS}	—	±1	±1.5	LSB[2]	For 16-pin package only. V_{ADIN} = V_{DDA}
	8-bit mode	T		—	±0.5	±0.5		
Quantization Error	12-bit mode	D	E_Q	—	–1 to 0	—	LSB[2]	
	10-bit mode			—	—	±0.5		
	8-bit mode			—	—	±0.5		
Input Leakage Error	12-bit mode	D	E_{IL}	—	±1	—	LSB[2]	Pad leakage[3] * R_{AS}
	10-bit mode			0	±0.2	±4		
	8-bit mode			0	±0.1	±1.2		
Temp Sensor Slope	–40°C– 25°C	D	m	—	1.646	—	mV/°C	
	25°C– 85°C			—	1.769	—		
Temp Sensor Voltage	25°C	D	V_{TEMP25}	—	701.2	—	mV	

1 Typical values assume V_{DDA} = 3.0 V, Temp = 25 °C, f_{ADCK}=1.0 MHz unless otherwise stated. Typical values are for reference only and are not tested in production.

2 1 LSB = $(V_{REFH} - V_{REFL})/2^N$

3 Based on input pad leakage current. Refer to pad electricals.

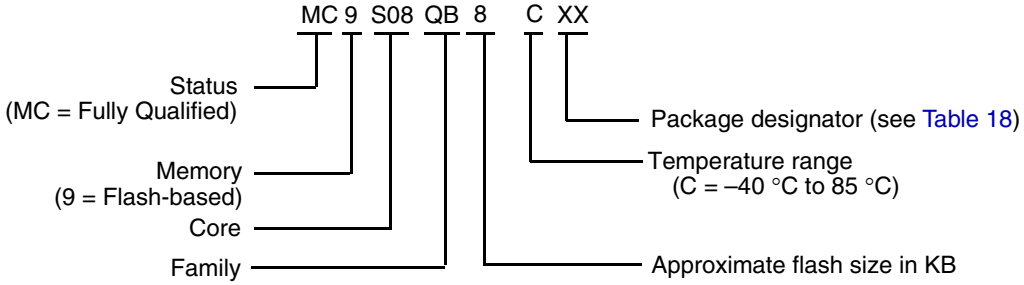
3.13 Flash Specifications

This section provides details about program/erase times and program-erase endurance for the flash memory.

4 Ordering Information

This section contains ordering information for the device numbering system.

Example of the device numbering system:



5 Package Information

Table 18. Package Descriptions

Pin Count	Package Type	Abbreviation	Designator	Case No.	Document No.
28	Small Outline Integrated Circuit	SOIC	WL	751F	98ASB42345B
24	Quad Flat Non-Leaded	QFN	GK	1982-01	98ARL10608D
16	Thin Shrink Small Outline Package	TSSOP	TG	948F	98ASH70247A

5.1 Mechanical Drawings

The following pages are mechanical drawings for the packages described in Table 18.

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.

2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994.

3. THIS DIMENSION DOES NOT INCLUDE MOLD PROTRUSION. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

4. 751F–01 THRU –04 OBSOLETE. NEW STANDARD: 751F–05

5. THIS DIMENSION DOES NOT INCLUDE DAM BAR PROTRUSION ALLOWABLE DAM BAR PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF THIS DIMENSION AT MAXIMUM MATERIAL CONDITION.

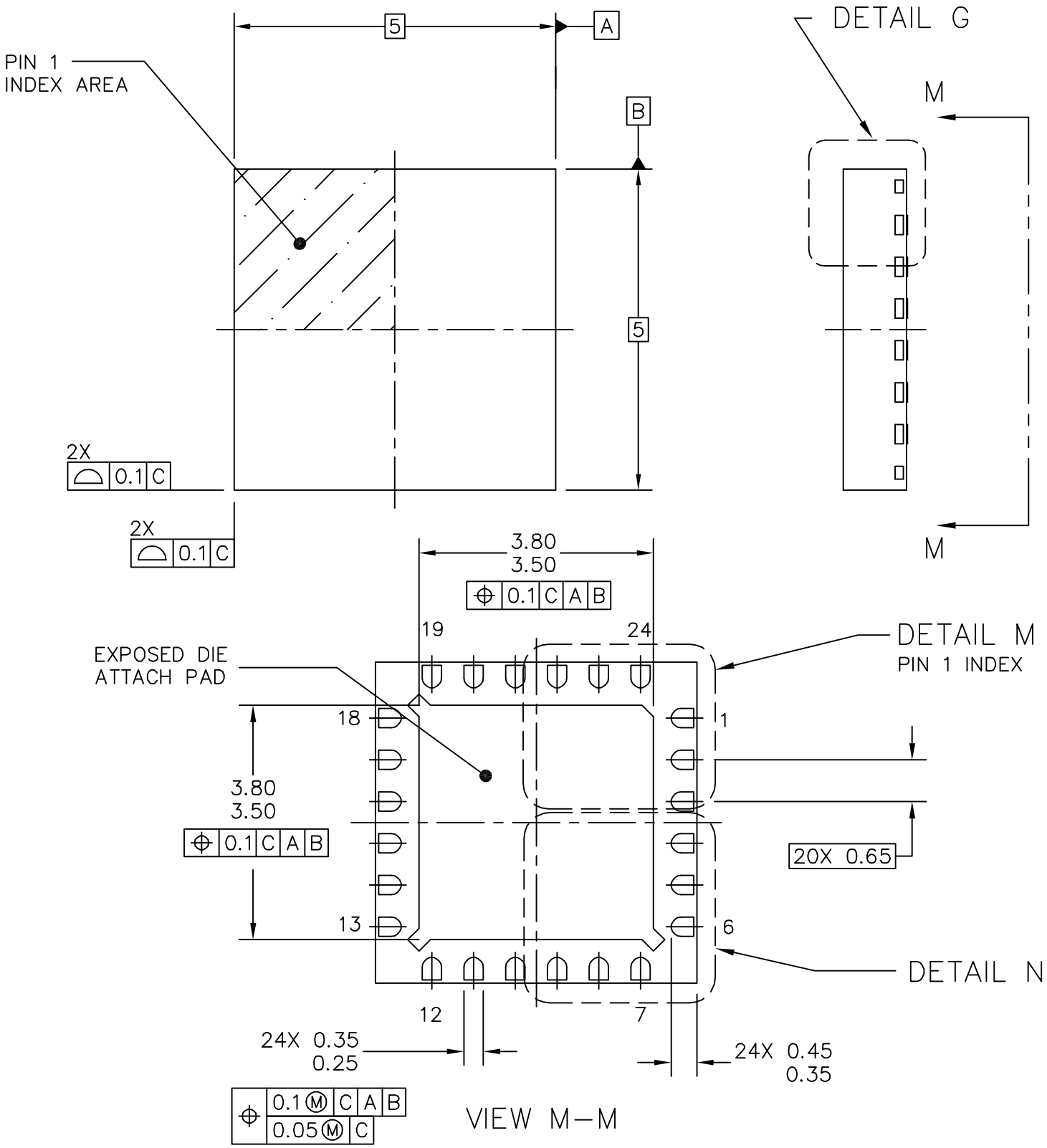
MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE

TITLE: SOIC, WIDE BODY, 28 LEAD CASEOUTLINE	DOCUMENT NO: 98ASB42345B	REV: G
	CASE NUMBER: 751F–05	10 MAR 2005
	STANDARD: MS–013AE	

MECHANICAL OUTLINES DICTIONARY

DO NOT SCALE THIS DRAWING

DOCUMENT NO: 98ARL10608D
PAGE: 1982
REV: O

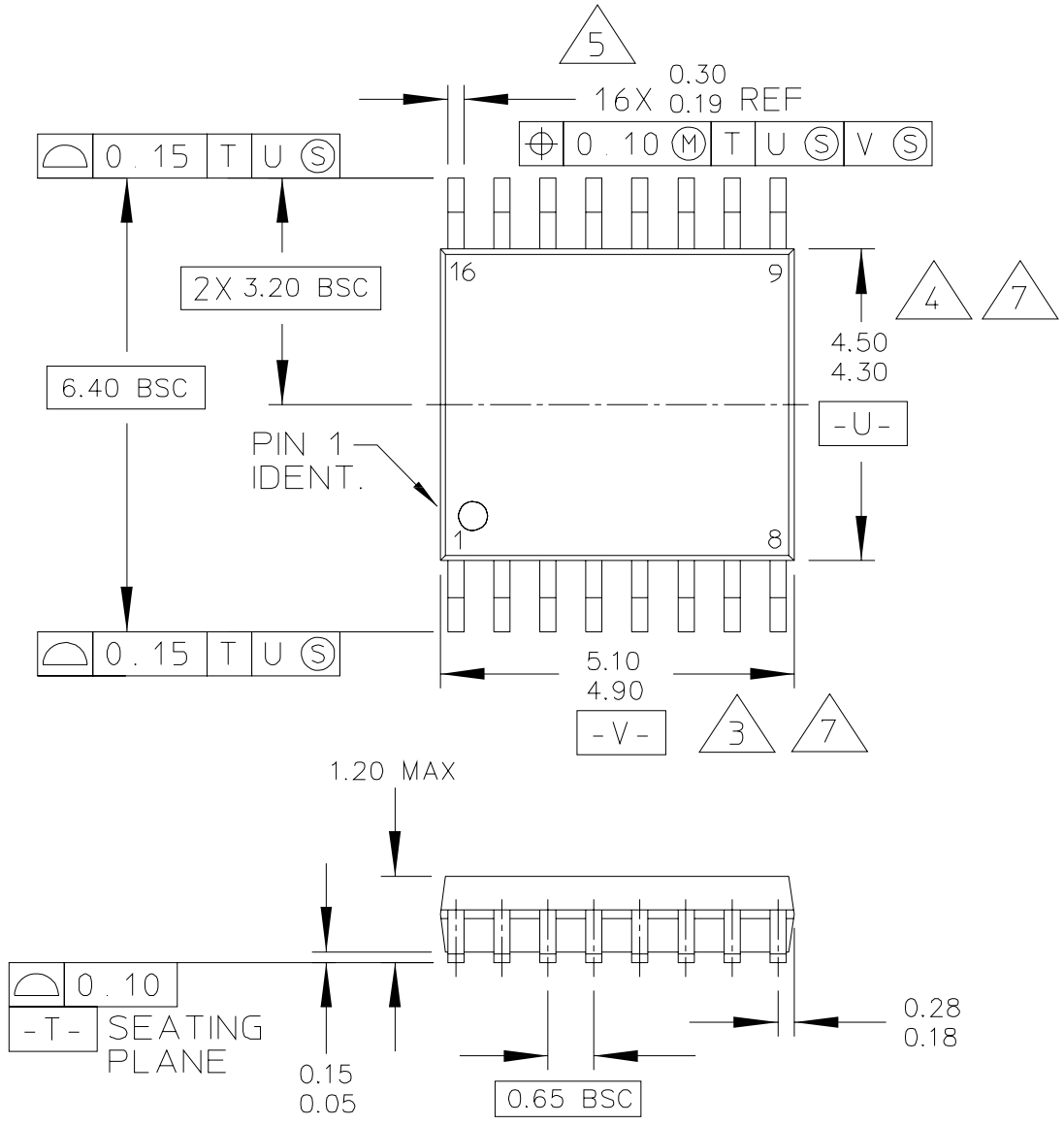


TITLE: THERMALLY ENHANCED QUAD FLAT NON–LEADED PACKAGE (QFN) 24 TERMINAL, 0.65 PITCH (5 X 5 X 1)

CASE NUMBER: 1982–01
STANDARD: JEDEC–MO–220 VHHC–1
PACKAGE CODE: 6238
SHEET: 1 OF 4

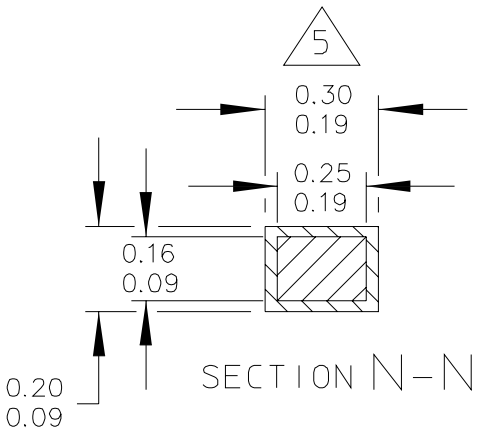
NOTES:

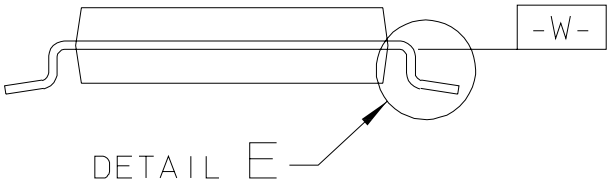
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. THE COMPLETE JEDEC DESIGNATOR FOR THIS PACKAGE IS: HF–PQFN.
4. COPLANARITY APPLIES TO LEADS, CORNER LEADS, AND DIE ATTACH PAD.
5. MIN METAL GAP SHOULD BE 0.2MM.

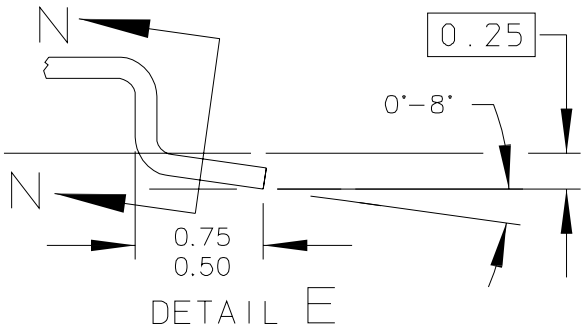


MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE

TITLE:	DOCUMENT NO: 98ASH70247A	REV: B
16 LD TSSOP, PITCH 0.65MM	CASE NUMBER: 948F-01	19 MAY 2005
	STANDARD: JEDEC	







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16 LD TSSOP, PITCH 0.65MM	CASE NUMBER: 948F-01	19 MAY 2005
	STANDARD: JEDEC	

NOTES:

1. CONTROLLING DIMENSION: MILLIMETER
2. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982.
3. DIMENSION DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE.
4. DIMENSION DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 PER SIDE.
5. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF THE DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSIONS ARE TO BE DETERMINED AT DATUM PLANE -W-.

MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE

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