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"[Embedded - Microcontrollers](#)" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "[Embedded - Microcontrollers](#)"

Details

Product Status	Not For New Designs
Core Processor	S08
Core Size	8-Bit
Speed	20MHz
Connectivity	LINbus, SPI, UART/USART
Peripherals	LVD, POR, PWM, WDT
Number of I/O	18
Program Memory Size	4KB (4K x 8)
Program Memory Type	FLASH
EEPROM Size	128 x 8
RAM Size	512 x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.5V
Data Converters	A/D 8x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	20-SOIC (0.295", 7.50mm Width)
Supplier Device Package	20-SOIC
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/mc9s08pa4vwjr

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1 Ordering parts

1.1 Determining valid orderable parts

Valid orderable part numbers are provided on the web. To determine the orderable part numbers for this device, go to nxp.com and perform a part number search for the following device numbers: PA4.

2 Part identification

2.1 Description

Part numbers for the chip have fields that identify the specific part. You can use the values of these fields to determine the specific part you have received.

2.2 Format

Part numbers for this device have the following format:

MC 9 S08 PA AA (V) B CC

2.3 Fields

This table lists the possible values for each field in the part number (not all combinations are valid):

Field	Description	Values
MC	Qualification status	<ul style="list-style-type: none"> MC = fully qualified, general market flow
9	Memory	<ul style="list-style-type: none"> 9 = flash based
S08	Core	<ul style="list-style-type: none"> S08 = 8-bit CPU
PA	Device family	<ul style="list-style-type: none"> PA
AA	Approximate flash size in KB	<ul style="list-style-type: none"> 4 = 4 KB
(V)	Mask set version	<ul style="list-style-type: none"> (blank) = Any version¹ A = Rev. 2 or later version, this is recommended for new design¹

Table continues on the next page...

Parameter Classification

Field	Description	Values
B	Operating temperature range (°C)	<ul style="list-style-type: none">• M = -40 to 125• V = -40 to 105
CC	Package designator	<ul style="list-style-type: none">• WJ = 20-SOIC• TJ = 20-TSSOP• TG = 16-TSSOP• DC = 8-DFN• SC = 8-SOIC

1. From June 1, 2017, (blank) and A share the same mask set version.

2.4 Example

This is an example part number:

MC9S08PA4AVWJ

3 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 1. 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.

4 Ratings

4.1 Thermal handling ratings

Symbol	Description	Min.	Max.	Unit	Notes
T _{STG}	Storage temperature	-55	150	°C	1
T _{SDR}	Solder temperature, lead-free	—	260	°C	2

1. Determined according to JEDEC Standard JESD22-A103, *High Temperature Storage Life*.
2. Determined according to IPC/JEDEC Standard J-STD-020, *Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices*.

4.2 Moisture handling ratings

Symbol	Description	Min.	Max.	Unit	Notes
MSL	Moisture sensitivity level	—	3	—	1

1. Determined according to IPC/JEDEC Standard J-STD-020, *Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices*.

4.3 ESD handling ratings

Symbol	Description	Min.	Max.	Unit	Notes
V _{HBM}	Electrostatic discharge voltage, human body model	-6000	+6000	V	1
V _{CDM}	Electrostatic discharge voltage, charged-device model	-500	+500	V	2
I _{LAT}	Latch-up current at ambient temperature of 125°C	-100	+100	mA	3

1. Determined according to JEDEC Standard JESD22-A114, *Electrostatic Discharge (ESD) Sensitivity Testing Human Body Model (HBM)*.
2. Determined according to JEDEC Standard JESD22-C101, *Field-Induced Charged-Device Model Test Method for Electrostatic-Discharge-Withstand Thresholds of Microelectronic Components*.
3. Determined according to JEDEC Standard JESD78D, IC Latch-up Test.
 - Test was performed at 125 °C case temperature (Class II).
 - I/O pins pass +100/-100 mA I-test with I_{DD} current limit at 200 mA.
 - I/O pins pass +20/-100 mA I-test with I_{DD} current limit at 1000mA.
 - Supply groups pass 1.5 V_{ccmax}.
 - RESET pin was only tested with negative I-test due to product conditioning requirement.

5 General

5.1 Nonswitching electrical specifications

5.1.1 DC characteristics

This section includes information about power supply requirements and I/O pin characteristics.

Table 2. DC characteristics

Symbol	C	Descriptions			Min	Typical ¹	Max	Unit
—	—	Operating voltage		—	2.7	—	5.5	V
V _{OH}	C	Output high voltage	All I/O pins, standard-drive strength	5 V, I _{load} = -5 mA	V _{DD} - 0.8	—	—	V
	C			3 V, I _{load} = -2.5 mA	V _{DD} - 0.8	—	—	V
	C	High current drive pins, high-drive strength ²	5 V, I _{load} = -20 mA	V _{DD} - 0.8	—	—	V	
	C		3 V, I _{load} = -10 mA	V _{DD} - 0.8	—	—	V	
I _{OHT}	D	Output high current	Max total I _{OH} for all ports	5 V	—	—	-100	mA
				3 V	—	—	-50	
V _{OL}	C	Output low voltage	All I/O pins, standard-drive strength	5 V, I _{load} = 5 mA	—	—	0.8	V
	C			3 V, I _{load} = 2.5 mA	—	—	0.8	V
	C	High current drive pins, high-drive strength ²	5 V, I _{load} =20 mA	—	—	0.8	V	
	C		3 V, I _{load} = 10 mA	—	—	0.8	V	
I _{OLT}	D	Output low current	Max total I _{OL} for all ports	5 V	—	—	100	mA
				3 V	—	—	50	
V _{IH}	P	Input high voltage	All digital inputs	V _{DD} >4.5V	0.70 × V _{DD}	—	—	V
	C			V _{DD} >2.7V	0.75 × V _{DD}	—	—	
V _{IL}	P	Input low voltage	All digital inputs	V _{DD} >4.5V	—	—	0.30 × V _{DD}	V
	C			V _{DD} >2.7V	—	—	0.35 × V _{DD}	
V _{hys}	C	Input hysteresis	All digital inputs	—	0.06 × V _{DD}	—	—	mV
I _{In}	P	Input leakage current	All input only pins (per pin)	V _{IN} = V _{DD} or V _{SS}	—	0.1	1	μA

Table continues on the next page...

Table 2. DC characteristics (continued)

Symbol	C	Descriptions			Min	Typical ¹	Max	Unit
I _{OZ}	P	Hi-Z (off-state) leakage current	All input/output (per pin)	V _{IN} = V _{DD} or V _{SS}	—	0.1	1	μA
I _{OZTOT}	C	Total leakage combined for all inputs and Hi-Z pins	All input only and I/O	V _{IN} = V _{DD} or V _{SS}	—	—	2	μA
R _{PU}	P	Pullup resistors	All digital inputs, when enabled (all I/O pins other than PTB0)	—	30.0	—	50.0	kΩ
R _{PU} ³	P	Pullup resistors	PTB0 pin	—	30.0	—	60.0	kΩ
I _{IC}	D	DC injection current ^{4, 5, 6}	Single pin limit	V _{IN} < V _{SS} , V _{IN} > V _{DD}	-0.2	—	2	mA
			Total MCU limit, includes sum of all stressed pins		-5	—	25	
C _{In}	C	Input capacitance, all pins			—	—	7	pF
V _{RAM}	C	RAM retention voltage			—	2.0	—	V

1. Typical values are measured at 25 °C. Characterized, not tested.
2. Only PTB4, PTB5 support ultra high current output.
3. The specified resistor value is the actual value internal to the device. The pullup value may appear higher when measured externally on the pin.
4. All functional non-supply pins, except for PTB0, are internally clamped to V_{SS} and V_{DD} .
5. Input must be current-limited to the value specified. To determine the value of the required current-limiting resistor, calculate resistance values for positive and negative clamp voltages, then use the large one.
6. Power supply must maintain regulation within operating V_{DD} range during instantaneous and operating maximum current conditions. If the positive injection current ($V_{IN} > V_{DD}$) is higher than I_{DD} , the injection current may flow out of V_{DD} and could result in external power supply going out of regulation. Ensure that external V_{DD} load will shunt current higher than maximum injection current when the MCU is not consuming power, such as no system clock is present, or clock rate is very low (which would reduce overall power consumption).

Table 3. LVD and POR Specification

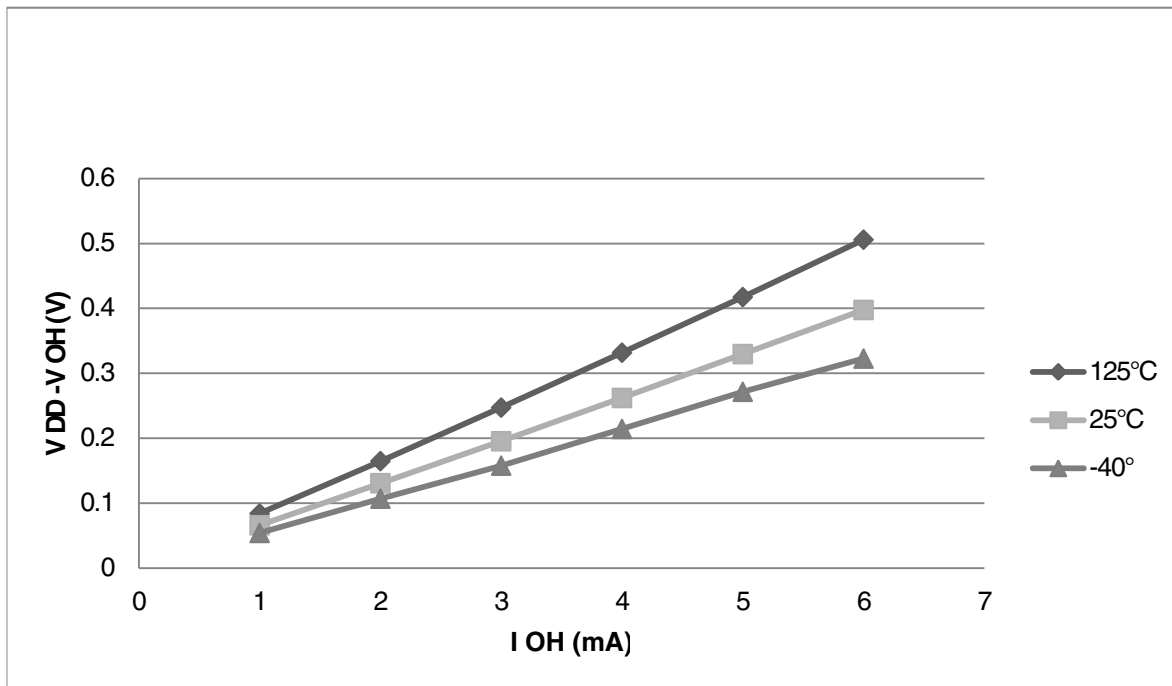
Symbol	C	Description		Min	Typ	Max	Unit
V_{POR}	D	POR re-arm voltage ^{1, 2}		1.5	1.75	2.0	V
V_{LVDH}	C	Falling low-voltage detect threshold - high range (LVDV = 1) ³		4.2	4.3	4.4	V
V_{LVW1H}	C	Falling low-voltage warning threshold - high range	Level 1 falling (LVWV = 00)	4.3	4.4	4.5	V
V_{LVW2H}	C		Level 2 falling (LVWV = 01)	4.5	4.5	4.6	V
V_{LVW3H}	C		Level 3 falling (LVWV = 10)	4.6	4.6	4.7	V
V_{LVW4H}	C		Level 4 falling (LVWV = 11)	4.7	4.7	4.8	V
V_{HYSH}	C	High range low-voltage detect/warning hysteresis		—	100	—	mV

Table continues on the next page...

Table 3. LVD and POR Specification (continued)

Symbol	C	Description		Min	Typ	Max	Unit
V _{LVDL}	C	Falling low-voltage detect threshold - low range (LVDV = 0)		2.56	2.61	2.66	V
V _{LVDW1L}	C	Falling low-voltage warning threshold - low range	Level 1 falling (LVWV = 00)	2.62	2.7	2.78	V
V _{LVDW2L}	C		Level 2 falling (LVWV = 01)	2.72	2.8	2.88	V
V _{LVDW3L}	C		Level 3 falling (LVWV = 10)	2.82	2.9	2.98	V
V _{LVDW4L}	C		Level 4 falling (LVWV = 11)	2.92	3.0	3.08	V
V _{HYSDL}	C	Low range low-voltage detect hysteresis		—	40	—	mV
V _{HYSWL}	C	Low range low-voltage warning hysteresis		—	80	—	mV
V _{BG}	P	Buffered bandgap output ⁴		1.14	1.16	1.18	V

1. Maximum is highest voltage that POR is guaranteed.
2. POR ramp time must be longer than 20 μ s/V to get a stable startup.
3. Rising thresholds are falling threshold + hysteresis.
4. Voltage factory trimmed at $V_{DD} = 5.0$ V, Temp = 25 °C

**Figure 1. Typical I_{OH} Vs. $V_{DD}-V_{OH}$ (standard drive strength) ($V_{DD} = 5$ V)**

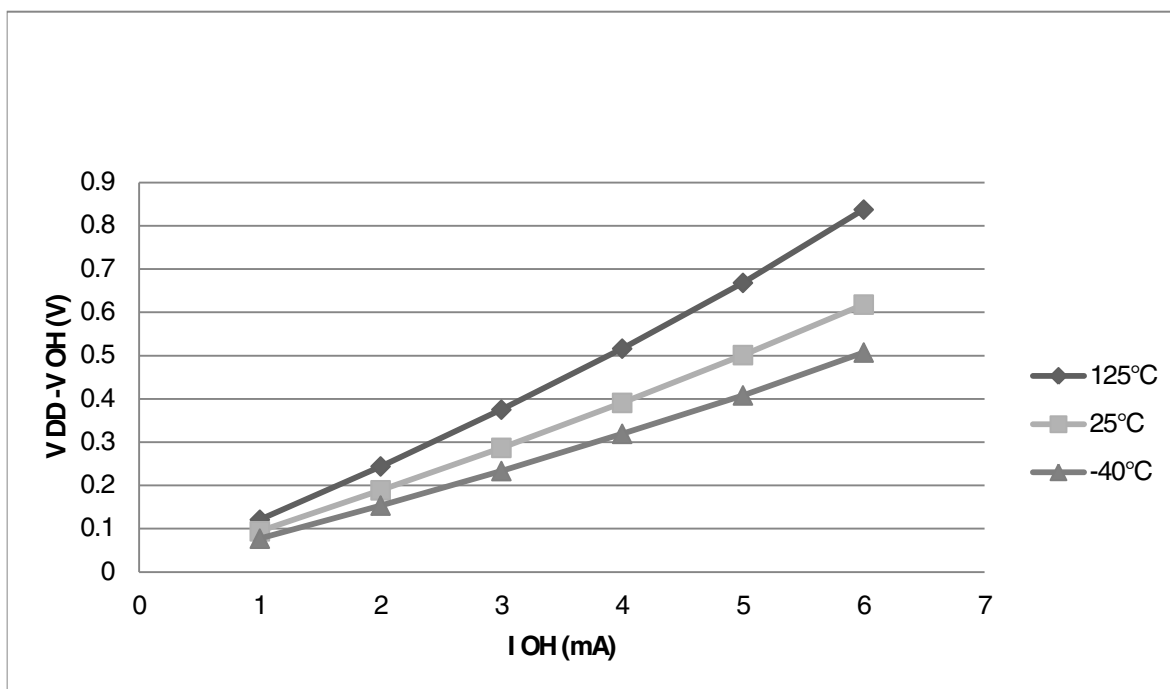


Figure 2. Typical I_{OH} Vs. $V_{DD}-V_{OH}$ (standard drive strength) ($V_{DD} = 3$ V)

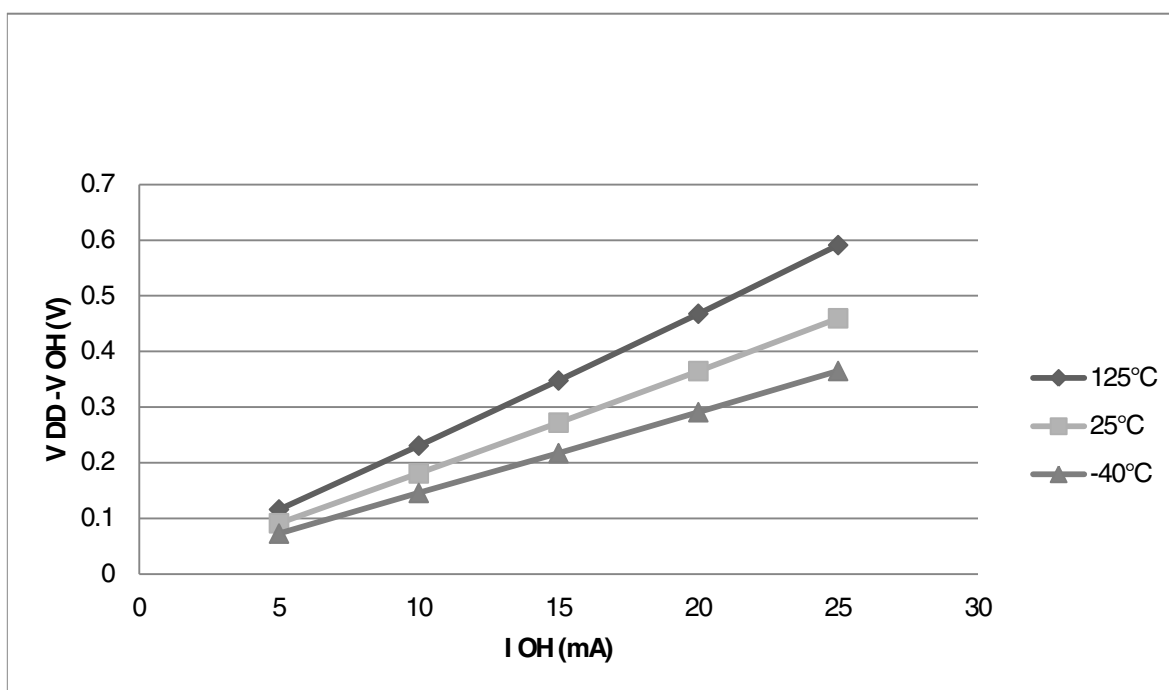


Figure 3. Typical I_{OH} Vs. $V_{DD}-V_{OH}$ (high drive strength) ($V_{DD} = 5$ V)

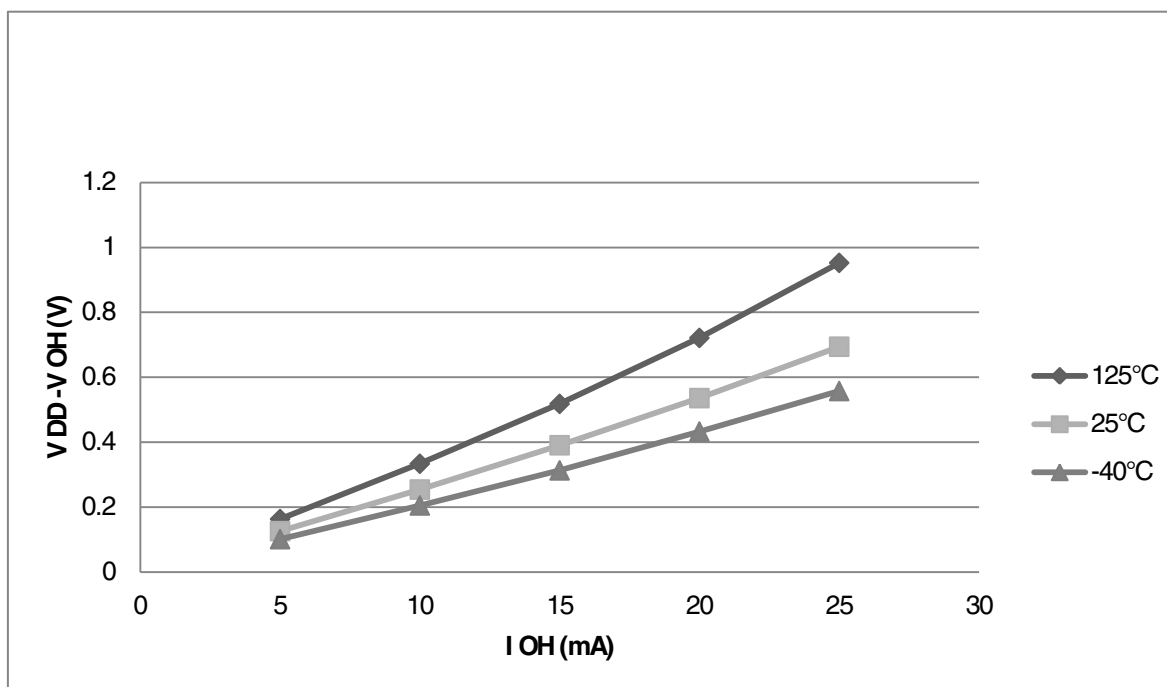


Figure 4. Typical I_{OH} Vs. $V_{DD} - V_{OH}$ (high drive strength) ($V_{DD} = 3$ V)

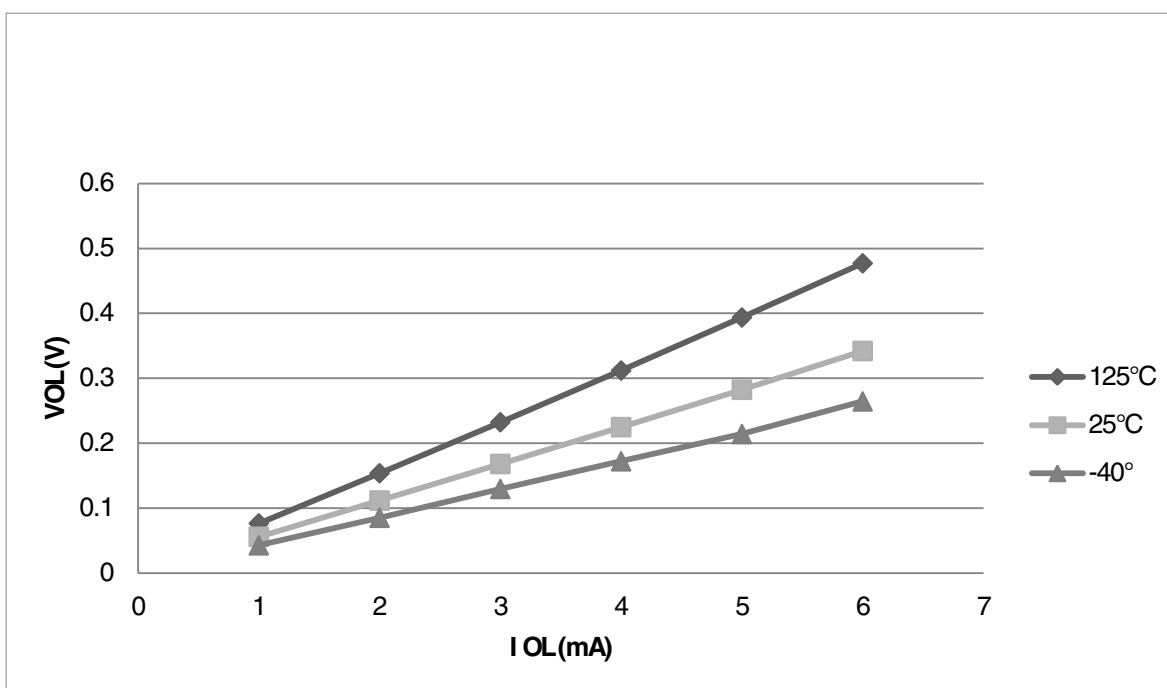


Figure 5. Typical I_{OL} Vs. V_{OL} (standard drive strength) ($V_{DD} = 5$ V)

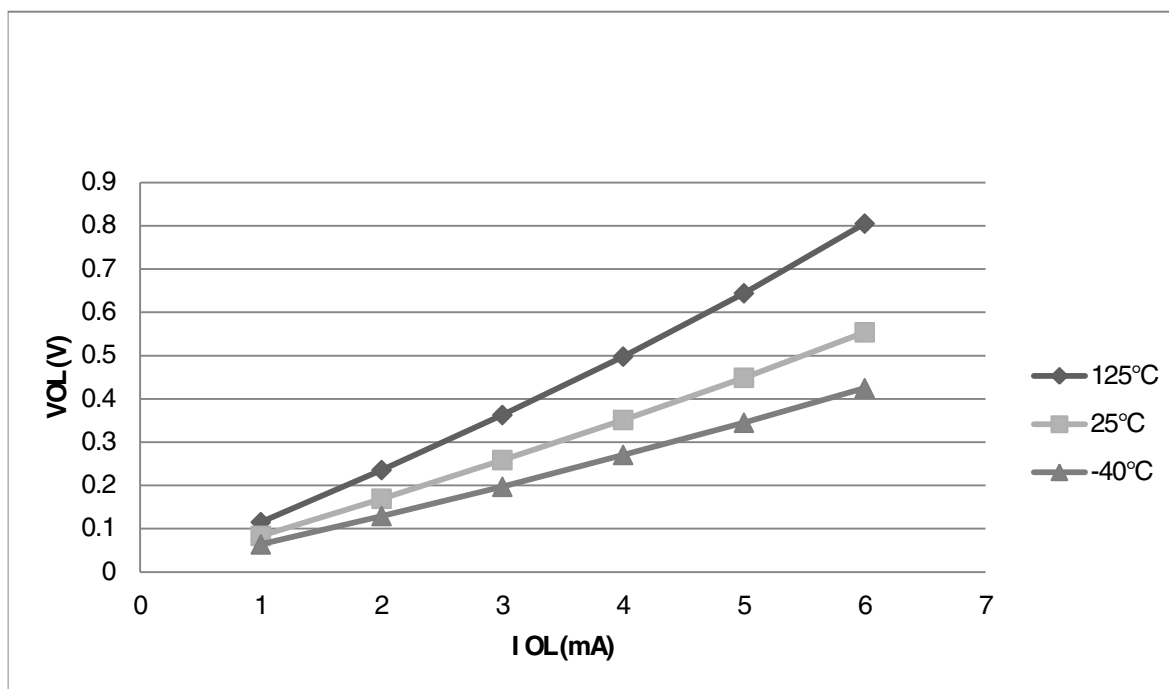


Figure 6. Typical I_{OL} Vs. V_{OL} (standard drive strength) ($V_{DD} = 3$ V)

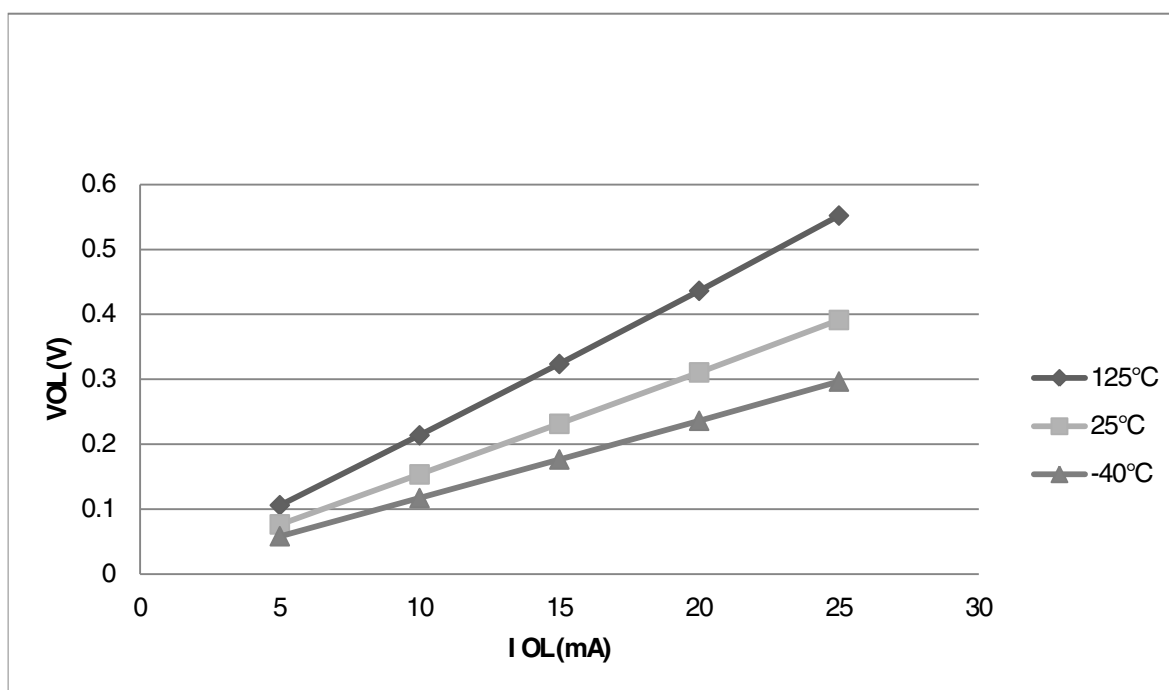


Figure 7. Typical I_{OL} Vs. V_{OL} (high drive strength) ($V_{DD} = 5$ V)

Table 4. Supply current characteristics in operating temperature range (continued)

Num	C	Parameter	Symbol	Bus Freq	V _{DD} (V)	Typical ¹	Max	Unit
	C			10 MHz		3.17	—	
				1 MHz		1.24	—	
4	P	Run supply current FBE mode, all modules off and gated; run from RAM	RI _{DD}	20 MHz	5	4.39	6.59	mA
	C			10 MHz		2.71	—	
				1 MHz		1.21	—	
	C			20 MHz	3	4.39	—	
				10 MHz		2.71	—	
				1 MHz		1.20	—	
5	C	Wait mode current FEI mode, all modules on	WI _{DD}	20 MHz	5	3.62	—	mA
	C			10 MHz		2.27	—	
				1 MHz		1.11	—	
	C		20 MHz	3	3.61	—		
			10 MHz		2.31	—		
			1 MHz		1.10	—		
6	C	Stop3 mode supply current no clocks active (except 1 kHz LPO clock) ^{2, 3}	S3I _{DD}	—	5	5.4	—	μA
	C			—	3	1.40	—	
7	C	ADC adder to stop3	—	—	5	96.0	—	μA
	C	ADLPC = 1 ADLSMP = 1 ADCO = 1 MODE = 10B ADICLK = 11B	—	—	3	88.3	—	
8	C	LVD adder to stop3 ⁴	—	—	5	129	—	μA
	C				3	126	—	

1. Data in Typical column was characterized at 5.0 V, 25 °C or is typical recommended value.

2. RTC adder cause <1 μA I_{DD} increase typically, RTC clock source is 1 kHz LPO clock.

3. ACMP adder cause <10 μA I_{DD} increase typically.

4. LVD is periodically woken up from stop3 by 5% duty cycle. The period is equal to or less than 2 ms.

5.1.3 EMC performance

Electromagnetic compatibility (EMC) performance is highly dependent on the environment in which the MCU resides. Board design and layout, circuit topology choices, location and characteristics of external components as well as MCU software operation all play a significant role in EMC performance. The system designer should consult NXP applications notes such as [AN2321](#), [AN1050](#), [AN1263](#), [AN2764](#), and [AN1259](#) for advice and guidance specifically targeted at optimizing EMC performance.

5.1.3.1 EMC radiated emissions operating behaviors

Table 5. EMC radiated emissions operating behaviors for 20-pin SOIC package

Symbol	Description	Frequency band (MHz)	Typ.	Unit	Notes
V _{RE1}	Radiated emissions voltage, band 1	0.15–50	7	dBμV	1, 2
V _{RE2}	Radiated emissions voltage, band 2	50–150	9	dBμV	
V _{RE3}	Radiated emissions voltage, band 3	150–500	8	dBμV	
V _{RE4}	Radiated emissions voltage, band 4	500–1000	5	dBμV	
V _{RE_IEC}	IEC level	0.15–1000	N	—	2, 3

1. Determined according to IEC Standard 61967-1, *Integrated Circuits - Measurement of Electromagnetic Emissions, 150 kHz to 1 GHz Part 1: General Conditions and Definitions* and IEC Standard 61967-2, *Integrated Circuits - Measurement of Electromagnetic Emissions, 150 kHz to 1 GHz Part 2: Measurement of Radiated Emissions—TEM Cell and Wideband TEM Cell Method*. Measurements were made while the microcontroller was running basic application code. The reported emission level is the value of the maximum measured emission, rounded up to the next whole number, from among the measured orientations in each frequency range.
2. V_{DD} = 5.0 V, T_A = 25 °C, f_{OSC} = 10 MHz (crystal), f_{SYS} = 20 MHz, f_{BUS} = 20 MHz
3. Specified according to Annex D of IEC Standard 61967-2, *Measurement of Radiated Emissions—TEM Cell and Wideband TEM Cell Method*

5.2 Switching specifications

5.2.1 Control timing

Table 6. Control timing

Num	C	Rating		Symbol	Min	Typical ¹	Max	Unit
1	P	Bus frequency (t _{cyc} = 1/f _{BUS})		f _{BUS}	DC	—	20	MHz
2	P	Internal low power oscillator frequency		f _{LPO}	0.67	1.0	1.25	KHz
3	D	External reset pulse width ²		t _{extrst}	1.5 × t _{cyc}	—	—	ns
4	D	Reset low drive		t _{rstdrv}	34 × 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	—	—	ns
7	D	IRQ pulse width	Asynchronous path ²	t _{ILIH}	100	—	—	ns
	D		Synchronous path ⁴	t _{IHIL}	1.5 × t _{cyc}	—	—	ns
8	D	Keyboard interrupt pulse width	Asynchronous path ²	t _{ILIH}	100	—	—	ns
	D		Synchronous path	t _{IHIL}	1.5 × t _{cyc}	—	—	ns
9	C	Port rise and fall time - standard drive strength (load = 50 pF) ⁵	—	t _{Rise}	—	10.2	—	ns
	C			t _{Fall}	—	9.5	—	ns

Table continues on the next page...

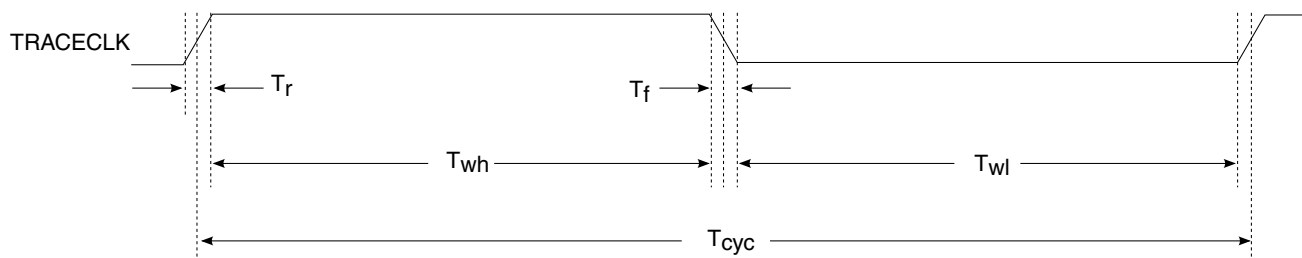


Figure 11. TRACE_CLKOUT specifications

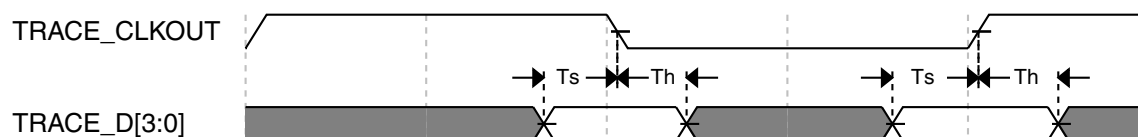


Figure 12. Trace data specifications

5.2.3 FTM module timing

Synchronizer circuits determine the shortest input pulses that can be recognized or the fastest clock that can be used as the optional external source to the timer counter. These synchronizers operate from the current bus rate clock.

Table 8. FTM input timing

No.	C	Function	Symbol	Min	Max	Unit
1	D	External clock frequency	f_{TCLK}	0	$f_{Bus}/4$	Hz
2	D	External clock period	t_{TCLK}	4	—	t_{cyc}
3	D	External clock high time	t_{clkh}	1.5	—	t_{cyc}
4	D	External clock low time	t_{clkl}	1.5	—	t_{cyc}
5	D	Input capture pulse width	t_{ICPW}	1.5	—	t_{cyc}

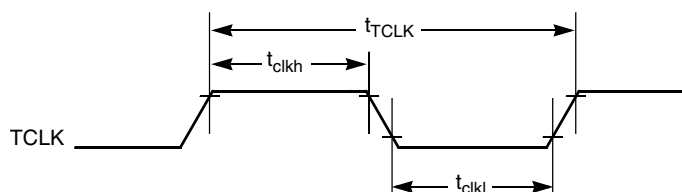


Figure 13. Timer external clock

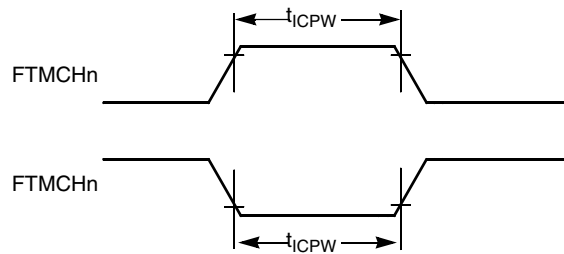


Figure 14. Timer input capture pulse

5.3 Thermal specifications

5.3.1 Thermal characteristics

This section provides information about operating temperature range, power dissipation, and package thermal resistance. Power dissipation on I/O pins is usually small compared to the power dissipation in on-chip logic and voltage regulator circuits, and it is user-determined rather than being controlled by the MCU design. To take $P_{I/O}$ into account in power calculations, determine the difference between actual pin voltage and V_{SS} or V_{DD} and multiply by the pin current for each I/O pin. Except in cases of unusually high pin current (heavy loads), the difference between pin voltage and V_{SS} or V_{DD} will be very small.

Table 9. Thermal characteristics

Rating	Symbol	Value	Unit
Operating temperature range (packaged)	T_A ¹	T_L to T_H <ul style="list-style-type: none"> -40 to 125 for MC9S08PA4Mxx parts -40 to 105 for MC9S08PA4Vxx parts 	°C
Junction temperature range	T_J	-40 to 150	°C
Thermal resistance single-layer board			
20-pin SOIC	$R_{\theta JA}$	82	°C/W
20-pin TSSOP	$R_{\theta JA}$	115	°C/W
16-pin TSSOP	$R_{\theta JA}$	130	°C/W
8-pin DFN	$R_{\theta JA}$	170	°C/W
8-pin SOIC	$R_{\theta JA}$	150	°C/W
Thermal resistance four-layer board			
20-pin SOIC	$R_{\theta JA}$	54	°C/W
20-pin TSSOP	$R_{\theta JA}$	76	°C/W
16-pin TSSOP	$R_{\theta JA}$	87	°C/W
8-pin DFN	$R_{\theta JA}$	43	°C/W
8-pin SOIC	$R_{\theta JA}$	87	°C/W

1. Maximum T_A can be exceeded only if the user ensures that T_J does not exceed the maximum. The simplest method to determine T_J is: $T_J = T_A + R_{\theta JA} \times \text{chip power dissipation}$.

6 Peripheral operating requirements and behaviors

6.1 External oscillator (XOSC) and ICS characteristics

Table 10. XOSC and ICS specifications in operating temperature range

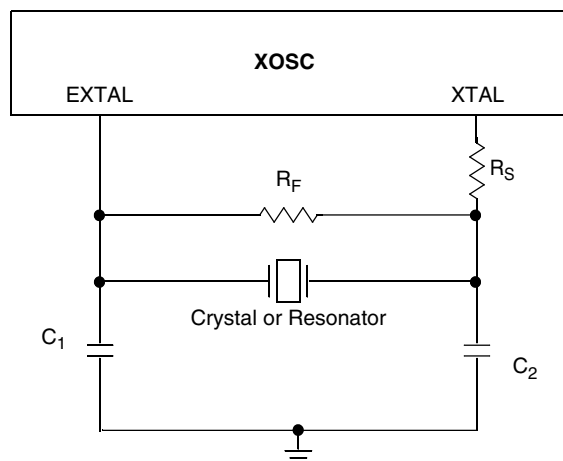
Num	C	Characteristic		Symbol	Min	Typical ¹	Max	Unit
1	C	Oscillator crystal or resonator	Low range (RANGE = 0)	f_{lo}	31.25	32.768	39.0625	kHz
	C		High range (RANGE = 1) FEE or FBE mode ²	f_{hi}	4	—	20	MHz
	C		High range (RANGE = 1), high gain (HGO = 1), FBELP mode	f_{hi}	4	—	20	MHz
	C		High range (RANGE = 1), low power (HGO = 0), FBELP mode	f_{hi}	4	—	20	MHz
2	D	Load capacitors		C1, C2	See Note ³			
3	D	Feedback resistor	Low Frequency, Low-Power Mode ⁴	R_F	—	—	—	MΩ
			Low Frequency, High-Gain Mode		—	10	—	MΩ
			High Frequency, Low-Power Mode		—	1	—	MΩ
			High Frequency, High-Gain Mode		—	1	—	MΩ
4	D	Series resistor - Low Frequency	Low-Power Mode ⁴	R_S	—	—	—	kΩ
			High-Gain Mode		—	200	—	kΩ
5	D	Series resistor - High Frequency	Low-Power Mode ⁴	R_S	—	—	—	kΩ
	D	Series resistor - High Frequency, High-Gain Mode	4 MHz		—	0	—	kΩ
	D		8 MHz		—	0	—	kΩ
	D		16 MHz		—	0	—	kΩ
6	C	Crystal start-up time Low range = 32.768 kHz crystal; High range = 20 MHz crystal ^{5, 6}	Low range, low power	t_{CSTL}	—	1000	—	ms
	C		Low range, high power	t_{CSTL}	—	800	—	ms
	C		High range, low power	t_{CSTH}	—	3	—	ms
	C		High range, high power	t_{CSTH}	—	1.5	—	ms
7	T	Internal reference start-up time		t_{IRST}	—	20	50	μs
8	D	Square wave input clock frequency	FEE or FBE mode ²	f_{extal}	0.03125	—	5	MHz
	D		FBELP mode		0	—	20	MHz

Table continues on the next page...

Table 10. XOSC and ICS specifications in operating temperature range (continued)

Num	C	Characteristic		Symbol	Min	Typical ¹	Max	Unit
9	P	Average internal reference frequency - trimmed		f_{int_t}	—	31.25	—	kHz
10	P	DCO output frequency range - trimmed		f_{dco_t}	16	—	20	MHz
11	P	Total deviation of DCO output from trimmed frequency ⁵	Over full voltage and temperature range	Δf_{dco_t}	—	—	±2.0	% f_{dco}
	C		Over fixed voltage and temperature range of 0 to 70 °C				±1.0	
12	C	FLL acquisition time ^{5, 7}		$t_{Acquire}$	—	—	2	ms
13	C	Long term jitter of DCO output clock (averaged over 2 ms interval) ⁸		C_{Jitter}	—	0.02	0.2	% f_{dco}

1. Data in Typical column was characterized at 5.0 V, 25 °C or is typical recommended value.
2. When ICS is configured for FEE or FBE mode, input clock source must be divisible using RDIV to within the range of 31.25 kHz to 39.0625 kHz.
3. See crystal or resonator manufacturer's recommendation.
4. Load capacitors (C_1, C_2), feedback resistor (R_F) and series resistor (R_S) are incorporated internally when RANGE = HGO = 0.
5. This parameter is characterized and not tested on each device.
6. Proper PC board layout procedures must be followed to achieve specifications.
7. This specification applies to any time the FLL reference source or reference divider is changed, trim value changed, or changing from FLL disabled (FBELP, FBILP) to FLL enabled (FEI, FEE, FBE, FBI). If a crystal/resonator is being used as the reference, this specification assumes it is already running.
8. Jitter is the average deviation from the programmed frequency measured over the specified interval at maximum f_{Bus} . Measurements are made with the device powered by filtered supplies and clocked by a stable external clock signal. Noise injected into the FLL circuitry via V_{DD} and V_{SS} and variation in crystal oscillator frequency increase the C_{Jitter} percentage for a given interval.

**Figure 15. Typical crystal or resonator circuit**

Program and erase operations do not require any special power sources other than the normal V_{DD} supply. For more detailed information about program/erase operations, see the Memory section.

6.3 Analog

6.3.1 ADC characteristics

Table 12. 5 V 12-bit ADC operating conditions

Characteristic	Conditions	Symb	Min	Typ ¹	Max	Unit	Comment
Supply voltage	Absolute	V_{DDA}	2.7	—	5.5	V	—
	Delta to V_{DD} ($V_{DD}-V_{DDAD}$)	ΔV_{DDA}	-100	0	+100	mV	
Ground voltage	Delta to V_{SS} ($V_{SS}-V_{SSA}$) ²	ΔV_{SSA}	-100	0	+100	mV	
Input voltage		V_{ADIN}	V_{REFL}	—	V_{REFH}	V	
Input capacitance		C_{ADIN}	—	4.5	5.5	pF	
Input resistance		R_{ADIN}	—	3	5	k Ω	—
Analog source resistance	12-bit mode	R_{AS}	—	—	2	k Ω	External to MCU
	• $f_{ADCK} > 4$ MHz		—	—	5		
	• $f_{ADCK} < 4$ MHz		—	—	5		
	10-bit mode		—	—	5		
	• $f_{ADCK} > 4$ MHz		—	—	10		
	• $f_{ADCK} < 4$ MHz		—	—	10		
	8-bit mode		—	—	10		
ADC conversion clock frequency	High speed (ADLPC=0)	f_{ADCK}	0.4	—	8.0	MHz	—
	Low power (ADLPC=1)		0.4	—	4.0		

1. Typical values assume $V_{DDA} = 5.0$ 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 15. Pin availability by package pin-count

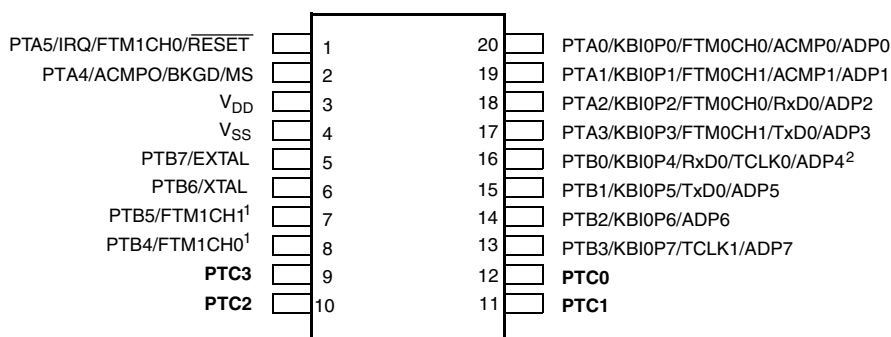
Pin Number			Lowest Priority <-- --> Highest				
20-SOIC/ TSSOP	16-TSSOP	8-DFN/SOIC	Port Pin	Alt 1	Alt 2	Alt 3	Alt 4
1	1	1	PTA5	IRQ	FTM1CH0	—	RESET
2	2	2	PTA4	—	ACMPO	BKGD	MS
3	3	3	—	—	—	—	V _{DD}
4	4	4	—	—	—	—	V _{SS}
5	5	—	PTB7	—	—	—	EXTAL
6	6	—	PTB6	—	—	—	XTAL
7	7	—	PTB5 ¹	—	FTM1CH1	—	—
8	8	—	PTB4 ¹	—	FTM1CH0	—	—
9	—	—	PTC3	—	—	—	—
10	—	—	PTC2	—	—	—	—
11	—	—	PTC1	—	—	—	—
12	—	—	PTC0	—	—	—	—
13	9	—	PTB3	KBIOP7	—	TCLK1	ADP7
14	10	—	PTB2	KBIOP6	—	—	ADP6
15	11	—	PTB1	KBIOP5	TxD0	—	ADP5
16	12	—	PTB0 ²	KBIOP4	RxD0	TCLK0	ADP4
17	13	5	PTA3	KBIOP3	FTM0CH1	TxD0	ADP3
18	14	6	PTA2	KBIOP2	FTM0CH0	RxD0	ADP2
19	15	7	PTA1	KBIOP1	FTM0CH1	ACMP1	ADP1
20	16	8	PTA0	KBIOP0	FTM0CH0	ACMP0	ADP0

1. This is a high current drive pin when operated as output.
2. This is a true open-drain pin when operated as output.

Note

When an alternative function is first enabled, it is possible to get a spurious edge to the module. User software must clear any associated flags before interrupts are enabled. The table above illustrates the priority if multiple modules are enabled. The highest priority module will have control over the pin. Selecting a higher priority pin function with a lower priority function already enabled can cause spurious edges to the lower priority module. Disable all modules that share a pin before enabling another module.

8.2 Device pin assignment

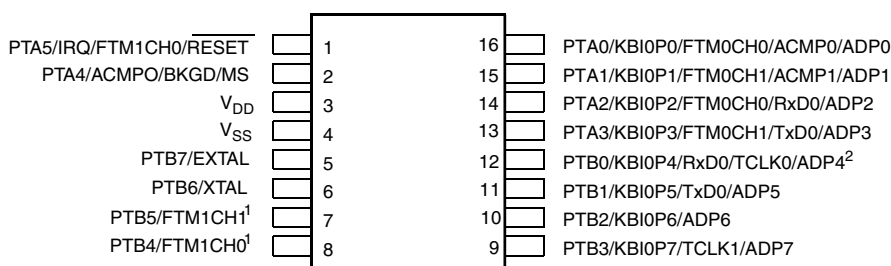


Pins in **bold** are not available on less pin-count packages.

1. High source/sink current pins

2. True open drain pins

Figure 17. MC9S08PA4 20-pin SOIC/TSSOP packages



Pins in **bold** are not available on less pin-count packages.

1. High source/sink current pins

2. True open drain pins

Figure 18. 16-pin TSSOP package

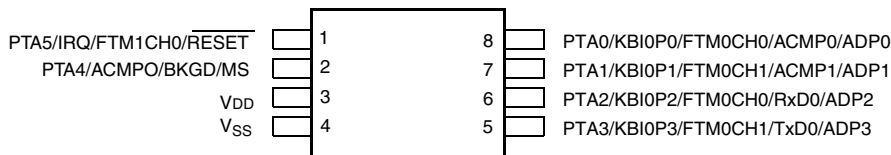


Figure 19. 8-pin DFN/SOIC packages

9 Revision history

The following table provides a revision history for this document.

Table 16. Revision history

Rev. No.	Date	Substantial Changes
2	12/2012	Initial public release
3	5/2014	<ul style="list-style-type: none"> Renamed the low drive strength to standard drive strength. Updated V_{DIO}. Added footnote on the S3I_{DD}

Table continues on the next page...

Table 16. Revision history (continued)

Rev. No.	Date	Substantial Changes
		<ul style="list-style-type: none"> Updated EMC test conditions to be $f_{OSC} = 10$ MHz and $f_{SYS} = 20$ MHz Updated f_{int_t} Updated Flash characteristics Updated the rating descriptions for t_{Rise} and t_{Fall} Updated footnote on $t_{Acquire}$ Added new part of MC9S08PA4MTG with operating temperature range from -40 to 125 °C Updated I_{LAT}
3.1	09/2014	<ul style="list-style-type: none"> Updated the part number format to add new field for new part numbers in Fields.
4	06/2015	<ul style="list-style-type: none"> Corrected the Min. of the t_{extrst} in Control timing Updated Thermal characteristics to add footnote to the T_A and removed redundant information..
5	01/2017	<ul style="list-style-type: none"> Updated to add FTM2 module.
6	08/2017	<ul style="list-style-type: none"> Updated to add new package of 8-pin DFN.
7	12/2017	<ul style="list-style-type: none"> Updated to add new packages of 20-pin TSSOP and 8-pin SOIC.
8	08/2018	<ul style="list-style-type: none"> Add a note in Fields.