



## Z86C04/C08 & C05/C07 CMOS Z8® 8-BIT LOW-COST 1K/2K-ROM MICROCONTROLLERS

### FEATURES

Part Number	ROM (Kbytes)	RAM* (Bytes)	Speed (MHz)	Auto Latch	Permanent WDT
Z86C04	1	125	8	Optional	Optional
Z86C08	2	125	12	Optional	Optional
Z86C05	1	125	8	None	Enabled
Z86C07	2	125	12	None	Enabled

\* General-Purpose

- 18-Pin DIP and SOIC Packages
- 3.0V to 5.5V Operating Range
- 14 Input / Output Lines
- Six Vectored, Prioritized Interrupts from Six Different Sources
- Two On-Board Comparators
- ROM Mask Options:
  - Low Noise
  - ROM Protect
  - Auto Latch
  - Permanent Watch-Dog Timer (WDT)
  - RC Oscillator
  - 32 KHz Operation
- Two Programmable 8-Bit Counter/Timers, Each with 6-Bit Programmable Prescaler
- Power-On Reset (POR) Timer
- On-Chip Oscillator that Accepts RC, Crystal, Ceramic Resonance, LC, or External Clock Drive
- Clock-Free WDT Reset
- Low-Power Consumption (50mw)
- Fast Instruction Pointer (1.5µs @ 8 MHz, 1.0 µs @ 12 MHz)
- Fourteen Digital Inputs at CMOS Levels; Schmitt-Triggered
- Software Enabled Watch-Dog Timer
- Programmable Interrupt Polarity
- Two Standby Modes: STOP and HALT
- Low-Voltage Protection

### GENERAL DESCRIPTION

Zilog's Z86C04/C08 and Z86C05/C07 Microcontrollers (MCU) are members of the Z8® single-chip microcontroller family which offer easy software/hardware system expansion.

For applications demanding powerful I/O capabilities, the Z86C04/C08 and Z86C05/C07's dedicated input and output lines are grouped into three ports, and are configurable under software control to provide timing, status signals, or parallel I/O.

Two on-chip counter/timers, with a large number of user selectable modes, offload the system of administering real-time tasks such as counting/timing and I/O data

communications. Additionally, two on-board comparators process analog signals with a common reference voltage (Figure 1).

Note: All Signals with a preceding front slash, "/", are active Low, e.g.: B/ /W (WORD is active Low); /B/W (BYTE is active Low, only).

Power connections follow conventional descriptions below:

Connection	Circuit	Device
Power Ground	V <sub>CC</sub> GND	V <sub>DD</sub> V <sub>SS</sub>

GENERAL DESCRIPTION (Continued)

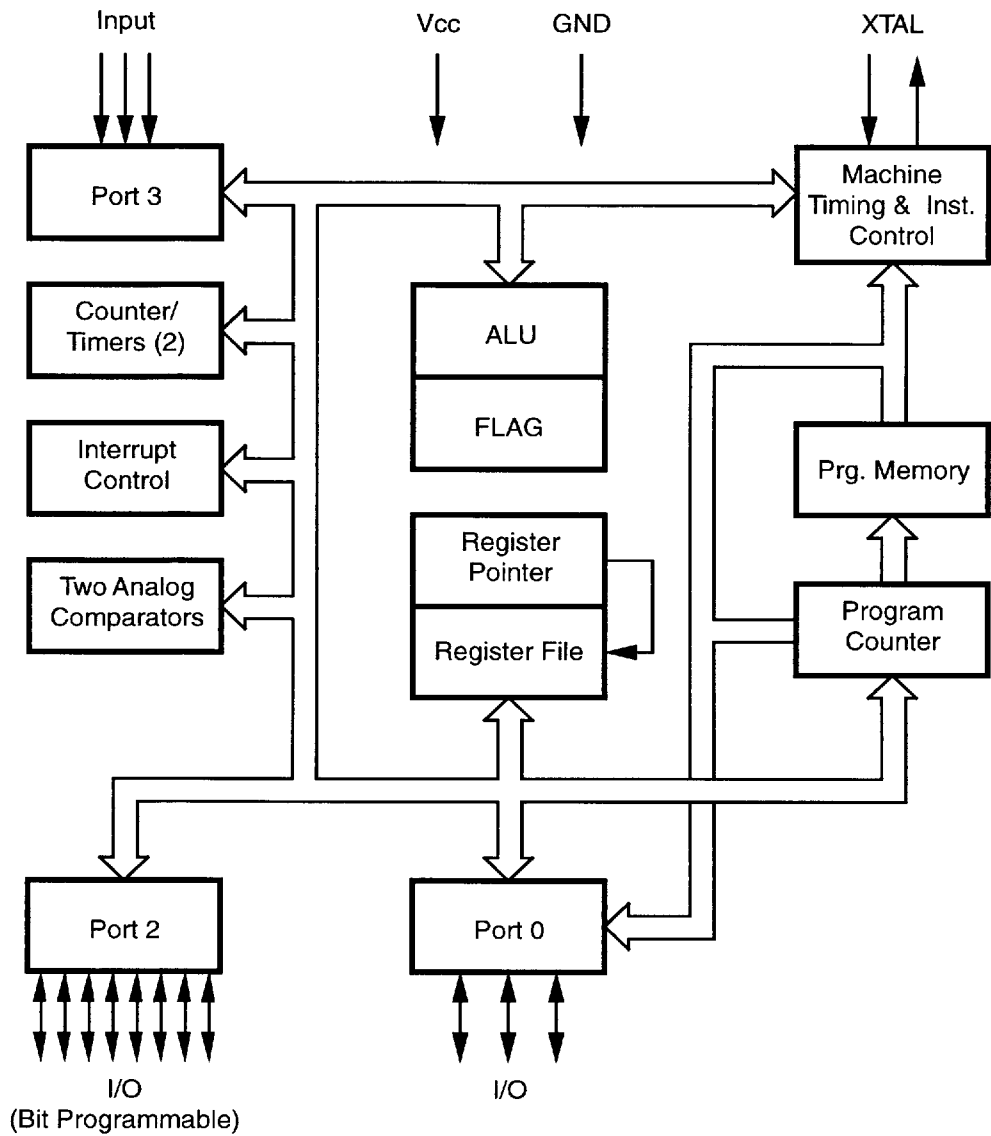


Figure 1. Z86C04/C08 and Z86C05/C07  
Functional Block Diagram

PIN DESCRIPTIONS

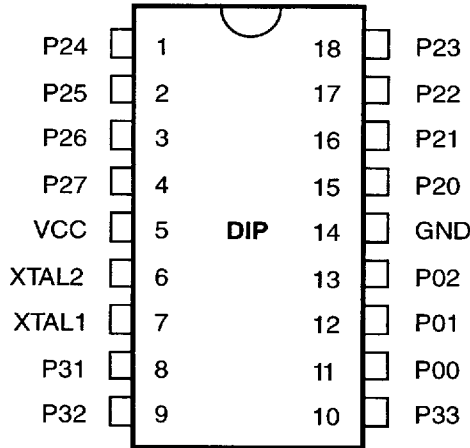


Table 1. 18-Pin DIP and SOIC Pin Identification

Pin #	Symbol	Function	Direction
1-4	P24-P27	Port 2, Pins 4, 5, 6, 7	In/Output
5	V <sub>cc</sub>	Power Supply	
6	XTAL2	Crystal Oscillator Clock	Output
7	XTAL1	Crystal Oscillator Clock	Input
8	P31	Port 3, Pin 1, AN1	Input
9	P32	Port 3, Pin 2, AN2	Input
10	P33	Port 3, Pin 3, REF	Input
11-13	P00-P02	Port 0, Pins 0, 1, 2	In/Output
14	GND	Ground	
15-18	P20-P23	Port 2, Pins 0, 1, 2, 3	In/Output

Figure 2. 18-Pin DIP Configuration

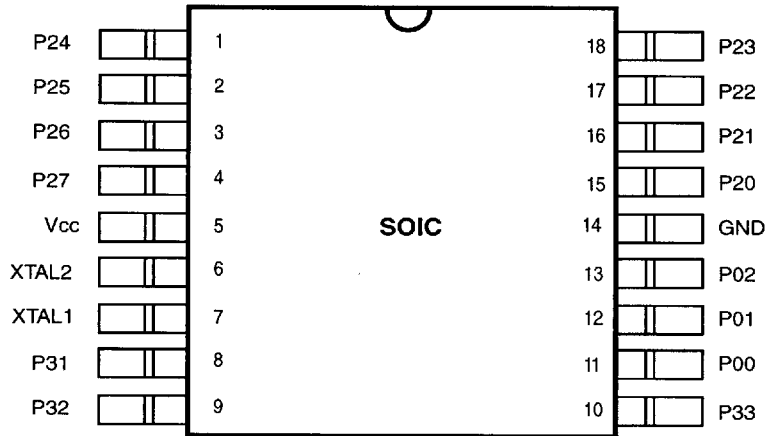


Figure 3. 18-Pin SOIC Pin Configuration

**ABSOLUTE MAXIMUM RATINGS**

Parameter	Min	Max	Units
Ambient Temperature under Bias	-40	+105	C
Storage Temperature	-65	+150	C
Voltage on any Pin with Respect to V <sub>SS</sub> [Note 1]	-0.6	+12	V
Voltage on V <sub>DD</sub> Pin with Respect to V <sub>SS</sub>	-0.3	+7	V
Voltage on Pin 7 with Respect to V <sub>SS</sub> [Note 2]	-0.6	V <sub>DD</sub> +1	V
Total Power Dissipation		462	mW
Maximum Current out of V <sub>SS</sub>		84	mA
Maximum Current into V <sub>DD</sub>		84	mA
Maximum Current into an Input Pin [Note 3]	-600	+600	μA
Maximum Current into an Open-Drain Pin [Note 4]	-600	+600	μA
Maximum Output Current Sunked by Any I/O Pin		12	mA
Maximum Output Current Sourced by Any I/O Pin		12	mA
Total Maximum Output Current Sunked by Port 2		70	mA
Total Maximum Output Current Sourced by Port 2		70	mA

**Notice:**

Stresses greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at any condition above those indicated in the operational sections of these specifications is not implied. Exposure to absolute maximum rating conditions for an extended period may affect device reliability. Total power dissipation should not exceed 462 mW for the package. Power dissipation is calculated as follows:

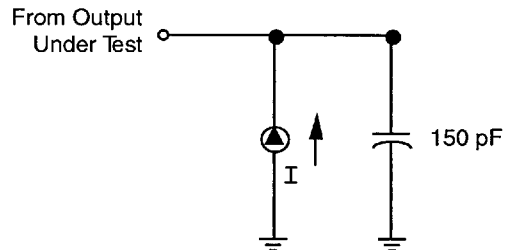
$$\text{Total Power dissipation} = V_{DD} \times [ I_{DD} - (\text{sum of } I_{OH}) ] + \text{sum of } [ (V_{DD} - V_{OH}) \times I_{OH} ] + \text{sum of } (V_{OL} \times I_{OL})$$

**Notes:**

- [1] This applies to all pins except where otherwise noted. Maximum current into pin must be ±600μA.
- [2] There is no input protection diode from pin to V<sub>DD</sub>.
- [3] This excludes Pin 6 and Pin 7.
- [4] Device pin is not at an output Low state.

**STANDARD TEST CONDITIONS**

The characteristics listed below apply for standard test conditions as noted. All voltages are referenced to Ground. Positive current flows into the referenced pin (Figure 4).



**Figure 4. Test Load Diagram**

**CAPACITANCE**

T<sub>A</sub> = 25°C, V<sub>CC</sub> = GND = 0V, f = 1.0 MHz, unmeasured pins returned to GND.

Parameter	Min	Max
Input capacitance	0	15 pF
Output capacitance	0	20 pF
I/O capacitance	0	25 pF

DC ELECTRICAL CHARACTERISTICS

Sym	Parameter	V <sub>CC</sub> [4]	T <sub>A</sub> =0°C to +70°C		T <sub>A</sub> =-40°C to +105°C		Typical @ 25°C	Units	Conditions	Notes
			Min	Max	Min	Max				
V <sub>CH</sub>	Clock Input High Voltage	3.0V	0.8V <sub>CC</sub>	V <sub>CC</sub> +0.3	0.8V <sub>CC</sub>	V <sub>CC</sub> +0.3	1.7	V	Driven by External Clock Generator	
		5.5V	0.8V <sub>CC</sub>	V <sub>CC</sub> +0.3	0.8V <sub>CC</sub>	V <sub>CC</sub> +0.3	2.8	V	Driven by External Clock Generator	
V <sub>CL</sub>	Clock Input Low Voltage	3.0V	V <sub>SS</sub> -0.3	0.2V <sub>CC</sub>	V <sub>SS</sub> -0.3	0.2V <sub>CC</sub>	0.8	V	Driven by External Clock Generator	
		5.5V	V <sub>SS</sub> -0.3	0.2V <sub>CC</sub>	V <sub>SS</sub> -0.3	0.2V <sub>CC</sub>	1.7	V	Driven by External Clock Generator	
V <sub>H</sub>	Input High Voltage	3.0V	0.7V <sub>CC</sub>	V <sub>CC</sub> +0.3	0.7V <sub>CC</sub>	V <sub>CC</sub> +0.3	1.8	V		[1]
		5.5V	0.7V <sub>CC</sub>	V <sub>CC</sub> +0.3	0.7V <sub>CC</sub>	V <sub>CC</sub> +0.3	2.8	V		[1]
V <sub>L</sub>	Input Low Voltage	3.0V	V <sub>SS</sub> -0.3	0.2V <sub>CC</sub>	V <sub>SS</sub> -0.3	0.2V <sub>CC</sub>	0.8	V		[1]
		5.5V	V <sub>SS</sub> -0.3	0.2V <sub>CC</sub>	V <sub>SS</sub> -0.3	0.2V <sub>CC</sub>	1.5	V		[1]
V <sub>OH</sub>	Output High Voltage	3.0V	V <sub>CC</sub> -0.4		V <sub>CC</sub> -0.4		3.0	V	I <sub>OH</sub> =-2.0mA	[5]
		5.5V	V <sub>CC</sub> -0.4		V <sub>CC</sub> -0.4		4.8	V	I <sub>OH</sub> =-2.0mA	[5]
		3.0V	V <sub>CC</sub> -0.4		V <sub>CC</sub> -0.4		3.0	V	Low Noise @ I <sub>OH</sub> =-0.5mA	
		5.5V	V <sub>CC</sub> -0.4		V <sub>CC</sub> -0.4		4.8	V	Low Noise @ I <sub>OH</sub> =-0.5mA	
V <sub>OL1</sub>	Output Low Voltage	3.0V		0.8		0.8	0.2	V	I <sub>OL</sub> =+4.0mA	[5]
		5.5V		0.4		0.4	0.1	V	I <sub>OL</sub> =+4.0mA	[5]
		3.0V		0.4		0.4	0.2	V	Low Noise @ I <sub>OL</sub> =1.0mA	
		5.5V		0.4		0.4	0.1	V	Low Noise @ I <sub>OL</sub> =1.0mA	
V <sub>OL2</sub>	Output Low Voltage	3.0V		1.0		1.0	0.8	V	I <sub>OL</sub> =+12mA	[5]
		5.5V		0.8		0.8	0.3	V	I <sub>OL</sub> =+12mA	[5]
V <sub>OFFSET</sub>	Comparator Input Offset Voltage	3.0V		25		25	10	mV		
		5.5V		25		25	10	mV		
V <sub>LV</sub>	V <sub>CC</sub> Low Voltage Auto Reset		22	28	20	30	26	V	Int. CLK Freq @ 6MHz Max. Int. CLK Freq @ 4MHz Max.	
I <sub>L</sub>	Input Leakage (Input Bias Current of Comparator)	3.0V	-1.0	1.0	-1.0	1.0		µA	V <sub>IN</sub> =0V, V <sub>CC</sub>	
		5.5V	-1.0	1.0	-1.0	1.0		µA	V <sub>IN</sub> =0V, V <sub>CC</sub>	
I <sub>OL</sub>	Output Leakage	3.0V	-1.0	1.0	-1.0	1.0		µA	V <sub>IN</sub> =0V, V <sub>CC</sub>	
		5.5V	-1.0	1.0	-1.0	1.0		µA	V <sub>IN</sub> =0V, V <sub>CC</sub>	
V <sub>VDR</sub>	Comparator Input Common Mode Voltage Range		0	V <sub>CC</sub> -1.0	0	V <sub>CC</sub> -1.5		V		

Sym	Parameter	V <sub>CC</sub> [4]	T <sub>A</sub> =0°C to +70°C		T <sub>A</sub> =-40°C to +105°C		Typical @ 25°C	Units	Conditions	Notes
			Min	Max	Min	Max				
I <sub>CC</sub>	Supply Current	3.2V					80	μA	All Output and I/O Pins Floating @ 32kHz	[7]
		3.0V		35		35	15	nA	All Output and I/O Pins Floating @ 2MHz	[5]
		5.5V		70		70	38	nA	All Output and I/O Pins Floating @ 2MHz	[5]
		3.0V		80		80	30	nA	All Output and I/O Pins Floating @ 8MHz	[5]
		5.5V		110		110	44	nA	All Output and I/O Pins Floating @ 8MHz	[5]
		3.0V		10		10	36	nA	All Output and I/O Pins Floating @ 12MHz	[5,6]
		5.5V		15		15	90	nA	All Output and I/O Pins Floating @ 12MHz	[5,6]
I <sub>CC1</sub>	Standby Current	3.0V		25		25	0.7	nA	HALT mode V <sub>IN</sub> =0V, V <sub>CC</sub> @2MHz	[5]
		5.5V		40		40	25	nA	HALT mode V <sub>IN</sub> =0V, V <sub>CC</sub> @2MHz	[5]
		3.0V		40		40	1.0	nA	HALT mode V <sub>IN</sub> =0V, V <sub>CC</sub> @8MHz	[5]
		5.5V		50		50	3.0	nA	HALT mode V <sub>IN</sub> =0V, V <sub>CC</sub> @8MHz	[5]
		3.0V		45		45	1.5	nA	HALT mode V <sub>IN</sub> =0V, V <sub>CC</sub> @12MHz	[5,6]
		5.5V		70		70	4.0	nA	HALT mode V <sub>IN</sub> =0V, V <sub>CC</sub> @12MHz	[5,6]
I <sub>CC</sub>	Supply Current (Low Noise Mode)	3.0V		35		35	1.5	nA	All Output and I/O Pins Floating @ 1MHz	
		5.5V		70		70	3.8	nA	All Output and I/O Pins Floating @ 1MHz	
		3.0V		58		58	2.5	nA	All Output and I/O Pins Floating @ 2MHz	
		5.5V		90		90	4.0	nA	All Output and I/O Pins Floating @ 2MHz	
		3.0V		80		80	3.0	nA	All Output and I/O Pins Floating @ 4MHz	
		5.5V		110		110	4.4	nA	All Output and I/O Pins Floating @ 4MHz	

**DC ELECTRICAL CHARACTERISTICS** (Continued)

Sym	Parameter	V <sub>CC</sub> [4]	T <sub>A</sub> =0°C to +70°C		T <sub>A</sub> =-40°C to +105°C		Typical @ 25°C	Units	Conditions
			Min	Max	Min	Max			
I <sub>CC1</sub>	Standby Current (Low Noise Mode)	3.0V		25	25	0.7	nA	HALT mode V <sub>IN</sub> =0V, V <sub>CC</sub> @1MHz	
		5.5V		4.0	4.0	25	nA	HALT mode V <sub>IN</sub> =0V, V <sub>CC</sub> @1MHz	
		3.0V		3.0	3.0	0.9	nA	HALT mode V <sub>IN</sub> =0V, V <sub>CC</sub> @2MHz	
		5.5V		4.5	4.5	28	nA	HALT mode V <sub>IN</sub> =0V, V <sub>CC</sub> @2MHz	
		3.0V		4.0	4.0	1.0	nA	HALT mode V <sub>IN</sub> =0V, V <sub>CC</sub> @4MHz	
		5.5V		5.0	5.0	3.0	nA	HALT mode V <sub>IN</sub> =0V, V <sub>CC</sub> @4MHz	
I <sub>CC2</sub>	Standby Current	3.0V		10	20	1.0	µA	STOP mode V <sub>IN</sub> =0V, V <sub>CC</sub> WDT is not Running	
		5.5V		10	20	1.0	µA	STOP mode V <sub>IN</sub> =0V, V <sub>CC</sub> WDT is not Running	
I <sub>ALL</sub>	Auto Latch Low Current	3.0V		12	8.0	3.0	µA	0V < V <sub>IN</sub> < V <sub>CC</sub>	
		5.5V		32	30	16	µA	0V < V <sub>IN</sub> < V <sub>CC</sub>	
I <sub>ALH</sub>	Auto Latch High Current	3.0V		-8	-5.0	-1.5	µA	0V < V <sub>IN</sub> < V <sub>CC</sub>	
		5.5V		-16	-20	-8.0	µA	0V < V <sub>IN</sub> < V <sub>CC</sub>	

**Notes:**

- [1] Port 0, 2, and 3 only.
- [2] V<sub>SS</sub> = 0V = GND.
- [3] The device operates down to V<sub>LV</sub>. The minimum operational V<sub>CC</sub> is determined on the value of the voltage V<sub>LV</sub> at the ambient temperature. The V<sub>LV</sub> increases as the temperature decreases.
- [4] V<sub>CC</sub> = 3.0V to 5.5V, typical values measured at V<sub>CC</sub> = 3.3V and V<sub>CC</sub> = 5.0V.
- [5] Standard Mode (not Low EMI mode).
- [6] Z86C07/C08 only.
- [7] CL1 = 100 pF, CL2 = 220 pF, RF = 30 kOhm

AC ELECTRICAL CHARACTERISTICS

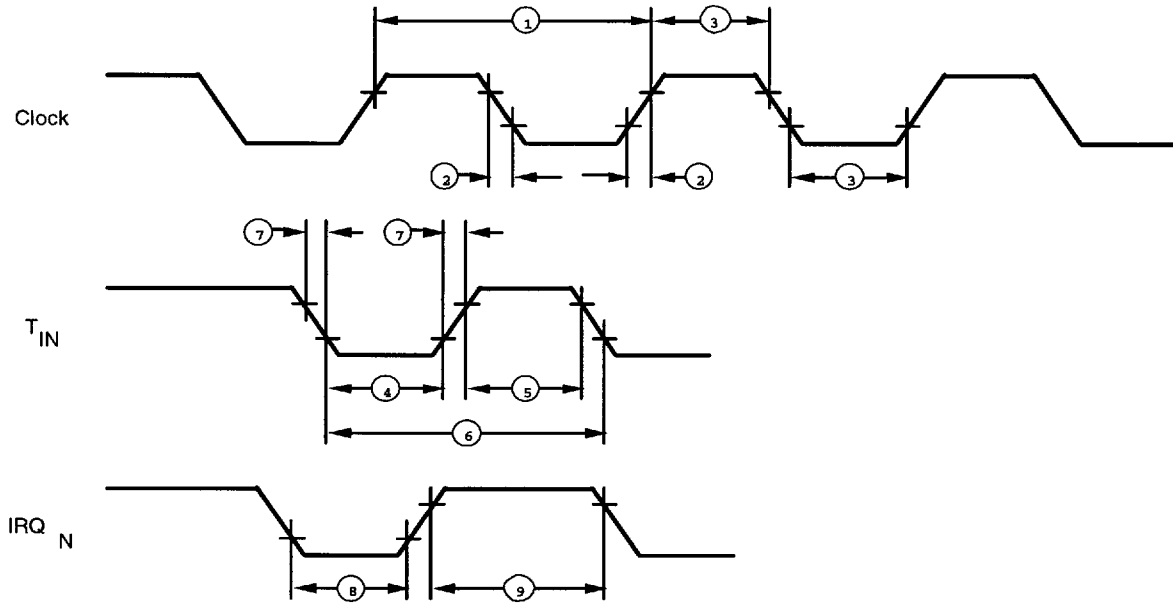


Figure 5. AC Electrical Timing Diagram



**AC ELECTRICAL CHARACTERISTICS**

Timing Table (Standard Mode for SCLK/TCLK = XTAL/2)

Nb	Symbol	Parameter	V <sub>CC</sub>	T <sub>A</sub> =0°C to +70°C				T <sub>A</sub> =-40°C to +105°C				Units	Notes
				8MHz(C04/05)		12MHz(C07/08)		8MHz(C04/05)		12MHz(C07/08)			
				Min	Max	Min	Max	Min	Max	Min	Max		
1	TpC	InputClockPeriod	30V	125	∞	88	∞	125	∞	88	∞	ns	[1]
			55V	125	∞	88	∞	125	∞	88	∞	ns	[1]
2	TrC,TfC	ClockInputRise andFallTimes	30V		25		15		25		15	ns	[1]
			55V		25		15		25		15	ns	[1]
3	TmC	InputClockWidth	30V	62		41		62		41		ns	[1]
			55V	62		41		62		41		ns	[1]
4	TwTinL	TimerInputLowWidth	30V	100		100		100		100		ns	[1]
			55V	70		70		70		70		ns	[1]
5	TwTinH	TimerInputHighWidth	30V	5tpC		5tpC		5tpC		5tpC			[1]
			55V	5tpC		5tpC		5tpC		5tpC			[1]
6	TpTin	TimerInputPeriod	30V	8tpC		8tpC		8tpC		8tpC			[1]
			55V	8tpC		8tpC		8tpC		8tpC			[1]
7	TrTin, TfTin	TimerInputRise andFallTimer	30V		100		100		100		100	ns	[1]
			55V		100		100		100		100	ns	[1]
8	TwL	Int.RequestInput LowTime	30V	100		100		100		100		ns	[1,2]
			55V	70		70		70		70		ns	[1,2]
9	TwH	Int.RequestInput HighTime	30V	5tpC		5tpC		5tpC		5tpC			[1]
			55V	5tpC		5tpC		5tpC		5tpC			[1,2]
10	Twot	Watch-DogTimer DelayTime	30V		25		25		25		25	ns	[1]
			55V		12		12		10		10	ns	[1]
11	Tpor		30V	24		24		24		24		ns	[1]
			55V	12		12		12		12		ns	[1]

**Notes:**

 [1] Timing Reference uses 0.7 V<sub>CC</sub> for a logic 1 and 0.2 V<sub>CC</sub> for a logic 0.

[2] Interrupt request through Port 3 (P33-P31).

**AC ELECTRICAL CHARACTERISTICS**

Low Noise Mode

Nb	Symbol	Parameter	V <sub>CC</sub>	T <sub>A</sub> =0°C to +70°C				T <sub>A</sub> =-40°C to +105°C				Units	Notes
				1 MHz		4 MHz		1 MHz		4 MHz			
1	TFC	InputClockPeriod	30V	1000	∞	250	∞	1000	∞	250	∞	ns	[1]
			55V	1000	∞	250	∞	1000	∞	250	∞	ns	[1]
2	TIC TIC	ClockInputRise andFallTimes	30V		25		25		25		25	ns	[1]
			55V		25		25		25		25	ns	[1]
3	TWC	InputClockWidth	30V	500		125		500		125		ns	[1]
			55V	500		125		500		125		ns	[1]
4	TwTnL	TimerInputLowWidth	30V	100		100		100		100		ns	[1]
			55V	70		70		70		70		ns	[1]
5	TwTnH	TimerInputHighWidth	30V	25TpC		25TpC		25TpC		25TpC			[1]
			55V	25TpC		25TpC		25TpC		25TpC			[1]
6	TpTn	TimerInputPeriod	30V	4TpC		4TpC		4TpC		4TpC			[1]
			55V	4TpC		4TpC		4TpC		4TpC			[1]
7	TrTn, TfTn	TimerInputRise andFallTimer	30V		100		100		100		100	ns	[1]
			55V		100		100		100		100	ns	[1]
8	TwL	Int.RequestInput LowTime	30V	100		100		100		100		ns	[1,2]
			55V	70		70		70		70		ns	[1,2]
9	TwH	Int.RequestInput HighTime	30V	25TpC		25TpC		25TpC		25TpC			[1]
			55V	25TpC		25TpC		25TpC		25TpC			[1,2]
10	Twdt	Watch-DogTimer DelayTime	30V		25		25		25		25	ns	[1]
			55V		12		12		10		10	ns	[1]

**Notes:**

- [1] Timing Reference uses 0.7 V<sub>CC</sub> for a logic 1 and 0.2 V<sub>CC</sub> for a logic 0.  
 [2] Interrupt request through Port 3 (P33-P31).

**LOW NOISE VERSION**

**Low EMI Emission**

The Z8® can be programmed to operate in a Low EMI emission mode by means of a mask ROM bit option. Use of this feature results in:

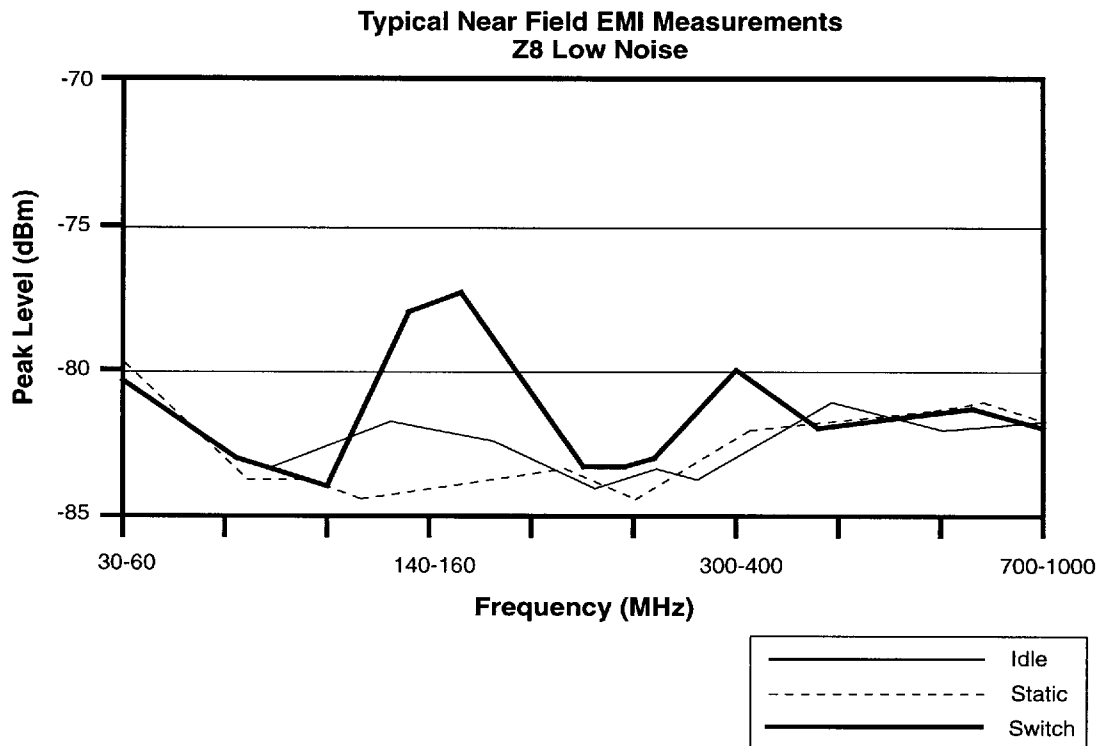
- All pre-driver slew rates reduced to 10 ns typical.
- Internal SCLK/TCLK operation limited to a maximum of 4 MHz - 250 ns cycle time.
- Output drivers have resistances of 200 ohms (typical).
- Oscillator divide-by-two circuitry eliminated.

The Low EMI mode is mask-programmable to be selected by the customer at the time the ROM code is submitted.

**EMI Characteristics**

The Z8 operating in the Low EMI mode generates EMI as measured in the following chart:

The measurements, shown in Figure 6, were made while operating the Z8 in three states: (1) idle condition; (2) static output; (3) switched output.



**Figure 6. Typical Low Noise Measurements**

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**Pre-Characterization Product:**

The product represented by this CPS is newly introduced and Zilog has not completed the full characterization of the product. The CPS states what Zilog knows about this product at this time, but additional features or non-conformance with some aspects of the CPS may be found,

either by Zilog or its customers in the course of further application and characterization work. In addition, Zilog cautions that delivery may be uncertain at times, due to start-up yield issues.

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