EM6603 - 4 bit Microcontroller

Features

- Low Power- typical 5µA active mode
  - typical 0.5µA standby mode
  - typical 0.1µA sleep mode @ 1.5V, 32kHz, 25 °C
- Low Voltage - 1.2 to 3.6 V
  - 2.0 to 5.5V
- buzzer - three tone
- ROM - 2k x 16 (Mask Programmed)
- RAM - 96 x 4 (User Read/Write)
- 2 clocks per instruction cycle
- RISC architecture
- 4 software configurable 4-bit ports
- Up to 16 inputs (4 ports)
- Up to 12 outputs (3 ports)
- Serial (Output) Write buffer - SWB
- Voltage level detection
- Analogue watchdog
- Timer watchdog
- 8 bit timer / event counter
- Internal interrupt sources (timer, event counter, prescaler)
- External interrupt sources (portA + portC)

Description

The EM66XX series is an advanced single chip low cost, mask programmed CMOS 4-bit microcontroller. It contains ROM, RAM, watchdog timer, oscillation detection circuit, combined timer / event counter, prescaler, voltage level detector and a number of clock functions. Its low voltage and low power operation make it the most suitable controller for battery, stand alone and mobile equipment. The EM66XXseries is manufactured using EM's Advanced Low Power CMOS Process.

Typical Applications

- sensor interfaces
- domestic appliances
- security systems
- bicycle computers
- automotive controls
- TV & audio remote controls
- measurement equipment
- R/F and IR. control

Figure 1.Architecture

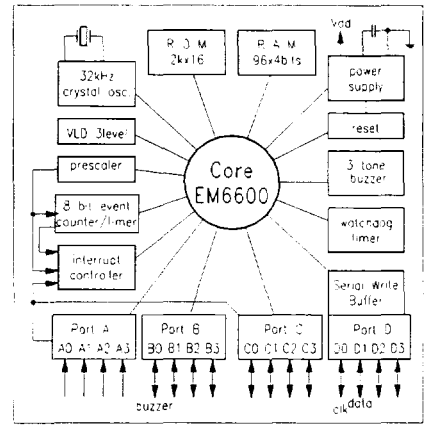
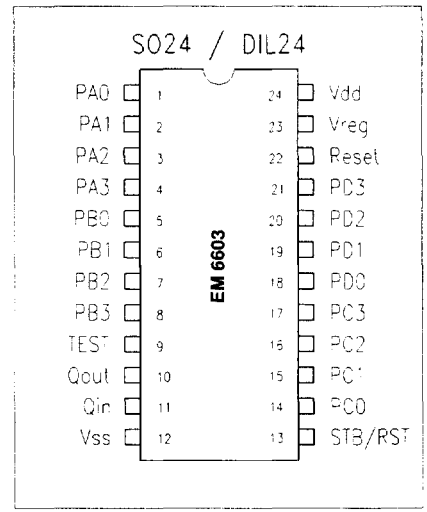


Figure 2.Pin Configuration



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EM6603 at a glance

• Power Supply
- Low Voltage, low power architecture including internal voltage regulator
- 1.2V ... 3.6 V battery voltage
- 5.0µA in active mode
- 0.5µA in standby mode
- 0.1µA in sleep mode
- 32 kHz Oscillator

• RAM
- 96 x 4 bit, direct addressable

• ROM
- 2048 x 16 bit metal mask programmable

• CPU
- 4 bit RISC architecture
- 2 clock cycles per instruction
- 72 basic instructions

• Main Operating Modes and Resets
- Active mode (CPU is running)
- Standby mode (CPU in Halt)
- Sleep mode (No clock, Reset State)
- Initial reset on Power-On (POR)
- External reset pin
- Watchdog timer (time-out) reset
- Oscillation detection watchdog reset
- Reset with input combination on PortA (metal option)

• 4-Bit Input PortA
- Direct input read
- Debounced or direct input mask selectable
- Interrupt request on input's rising or falling edge, selectable by metal mask.
- Pull-down or none, selectable by metal mask
- Software test variables for conditional jumps
- PA3 input for the event counter
- Reset with input combination on PortA (metal option)

• 4-Bit Input/Output PortB
- separate input or output selection by register
- Pull-up, Pull-down or none, selectable by metal mask if used as Input
- Buzzer output on PB0

• 4-Bit Input/Output PortC
- Input or Output port as a whole port
- Debounced or direct input mask selectable
- Interrupt request on input's rising or falling edge, selectable by metal mask.
- Pull-up, pull-down or none, selectable by metal mask if used as input
- CMOS or N-channel open drain mode

• 4-Bit Input/Output PortD
- Input or Output port as a whole port
- Pull-up, Pull-down or none, selectable by metal mask if used as Input
- CMOS or N-channel open drain mode
- Serial Write Buffer clock and data output

• Serial (output) Write Buffer
- max. 256 bits long clocked with 16/8/2/1kHz
- automatic send mode
- interactive send mode : interrupt request when buffer is empty

• Buzzer Output
- if used output on PB0
- 3 tone buzzer - 1kHz, 2kHz, 2.66kHz

• Prescaler
- 15 stage system clok devider down to 1 Hz
- 3 interrupt requests : 1Hz/8Hz/32Hz
- Prescaler reset (from 8kHz to 1Hz)

• 8-bit Timer / Event Counter
- 8-bit auto-reload count-down timer
- 6 different clocks from prescaler
- or event counter from debounced PA3 input
- parallel load
- interrupt request when comes to 00 hex.

• Supply Voltage Level Detector
- 3 software selectable levels (1.3V, 2.0V, 2.3V)
- Busy flag during measure
- Active only on request during measurement to reduce power consumption

• Interrupt Controller
- 4 external interrupt sources from PortA
- 3 internal interrupt sources, prescaler, timer and Serial Write Buffer
- each interrupt request is individually maskable
- interrupt request flag is cleared automatically on register read

1. EM6603 Electrical specifications

1.1: Absolute maximum ratings

	min.	max.	unit
Supply voltage VDD-VSS	- 0.2	+ 5.5	V
Input voltage	VSS - 0.2	VDD+0.2	V
Storage temperature	- 40	+ 125	°C

Stresses above these listed maximum ratings may cause permanent damage to the device. Exposure beyond specified electrical characteristics may affect device reliability or cause malfunction.

1.2: Standard Operating Conditions

Parameter	value	Description
Temperature	-20°C...+85°C	
VDD	+1.2 ...+3.8V	
VSS	0 V (reference)	
CVreg	min. 100nF	regulated voltage capacitor
fq	32768 Hz	nominal frequency
Rqs	35 kOhm	typical quartz serial resistor
CL	8.2pF	typical quartz load capacitance
df/f	+/- 30 ppm	quartz frequency tolerance

1.3: DC characteristics - Power Supply Pins

Operating conditions as shown in Table 15.2, (unless otherwise specified)

Vdd=1.5V

Parameter	Conditions	Symb.	Min.	Typ. (note 1)	Max.	Unit
ACTIVE Supply Current (in active mode)	(note2) test loop	IDDa		2.7	5.0	µA µA
STANDBY Supply Current (in Halt mode)	(note3)	IDDh		0.3	0,5	µA µA
SLEEP Supply Current (SLEEP =1)	Vdd=1.5V Osc2 = VSS	IDDs		0.1	0,2	µA µA
POR voltage		VPOR	0.5		1.1	V
RAM data retention		Vrd	1.1			V
Regulated Voltage	Vdd=1.5V	Vreg	1.1		1.5	V

Note 1: The TYPICAL values are based on characterization results at 25°C.
For current measurement typical quartz described in Operating Conditions is used.
All I/O pins without internal Pull Up/Down are pulled to Vdd externaly.

Note 2: Test loop with succesive writing and reading of two differnet addresses with an inverted values (five instructions should be reserved for this measurement),

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Vdd=3.0V

Parameter	Conditions	Symb.	Min.	Typ. (note 1)	Max.	Unit
ACTIVE Supply Current (in active mode)	(note2) test loop	IDDa		 3.5	8.0	µA µA
STANDBY Supply Current (in Halt mode)	(note3)	IDDh		 0.3	1.0	µA µA
SLEEP Supply Current (SLEEP =1)	Vdd=3.0V Osc2 = VSS	IDDs		 0.1	0,4	µA µA
Regulated Voltage	Vdd=3.0V	Vreg	1.1		1.8	V

Note 3: Test conditions for ACTIVE and STANDBY Supply current mode are: Osc2=external square wave, from rail to rail of Vreg (regulated voltage) with 100nF capacitor on Vreg. fOsc2 = 33kHz. For test reasons user has to provide an address with HALT instruction.

1.4: DC characteristics - Input/Output Pins

Parameter	Conditions	Symb.	Min.	Typ.	Max.	Unit
Input Low voltage						
I/O ports A,B,C,D	Pin at hi-impedance	V_{IL}	Vss		0.3V_{DD}	V
TEST			Vss		0.3V_{DD}	V
Reset			Vss		0.3V_{DD}	V
Osc2 (Note4)			Vss		0.3V_{reg}	V
Input High voltage						
I/O ports A,B,C,D	Pin at hi-impedance	V_{IH}	0.6V_{DD}		V_{DD}	V
TEST			0.6V_{DD}		V_{DD}	V
Reset			0.6V_{DD}		V_{DD}	V
Osc2 (Note4)			0.7Vreg		Vreg	V
Output Low voltage						
I/O ports B,C,D	I_{OL} = 650 µA, V_{DD} = 1.5V	V_{OL}			0.3	V
	I_{OL} = 1.0 mA, V_{DD} = 3.0V				0.4	V
	I_{OL} = 1.2 mA, V_{DD} = 5.0V				0.4	V
Output Low voltage						
STB/RST (Strobe/Reset)	I_{OL} = 400 µA, V_{DD} = 1.5V	V_{OL}			0.3	V
	I_{OL} = 0.8 mA, V_{DD} = 3.0V				0.4	V
	I_{OL} = 0.9 mA, V_{DD} = 5.0V				0.4	V
Output High voltage						
I/O ports B,C,D	I_{OL} = -500µA, V_{DD} = 1.5V	V_{OH}	1.2			V
	I_{OL} = -1.0mA, V_{DD} = 3.0V		2.5			V
	I_{OL} = -2.5mA, V_{DD} = 5.0V		4.0			V
Output High voltage						
STB/RST (Strobe/Reset)	I_{OL} = -300µA, V_{DD} = 1.5V	V_{OH}	1.2			V
	I_{OL} = -0.8mA, V_{DD} = 3.0V		2.5			V
	I_{OL} = -2.0mA, V_{DD} = 5.0V		4.0			V
Input pull-down						
I/O ports A,B,C,D (option)	Pin at V_{DD} = 1.5V		5	13	20	µA
TEST	Pin at V_{DD} = 1.5V		50	100	200	µA
Reset	Pin at V_{DD} = 1.5V		7	15	30	µA
Input pull-down (option)						
I/O ports A,B,C,D (option)	Pin at V_{DD} = 3.0V		6	18	50	µA
TEST	Pin at V_{DD} = 3.0V		80	100	350	µA
Reset	Pin at V_{DD} = 3.0V		10	30	55	µA
Input pull-up (option)						
I/O ports B	Pin at Vss		100			kOhm
I/O ports C,D	Pin at Vss		150			kOhm

Note 4: Osc1 is used only with quartz

1.5: DC characteristics - Supply Voltage Detector Levels

Parameter	Conditions	Symb.	Min.	Typ.	Max.	Unit
Supply Voltage Detector						
2.50V level		V_{L3}	2.15	2.30	2.45	V
2.00V level		V_{L2}	1.85	2.00	2.15	V
1.25V level		V_{L1}	1.15	1.30	1.40	V
SVLD current consumptionion when activated	1.5V<VDD<3V	ISVLD		3.0		µA

1.6: Oscillator

Parameter	Conditions	Symb.	Min.	Typ.	Max.	Unit
Temperature stability	15 - 35 °C	Df / f * DT			0,3 ppm	1/°C
Voltage stability	1,4 - 1,6 V	Df /f * DU			5 ppm	1/V
Input capacitor		C_{Osc2}	7,6	9	10.4	pF
Output capacitor		C_{Osc1}	12,1	14	15.9	pF
Transconductance		Gm	2.5		15.0	µA/V
Oscillator Start voltage	Tstart < 10 s	Ustart	1,2			V
Oscillator start time	Vdd>1.2V	tdosc		1.5	10	s
System start time (oscillator+cold start reset)	Vdd>1.2V	tdsys		2.5	11	s
Oscillation detector frequency	Vdd>1.5V & Vdd<3.0V	f_{OD}		4.0	12	kHz

1.7: Inputs Timing characteristics

Parameter	Conditions	Symb.	Min.	Typ.	Max.	Unit
RESET detection time exiting SLEEP mode	RESET from SLEEP	tRESsl	10			µs
RESET debounce time	DebCkl = 0	tdeb0	2			ms
PortA , B debounce time	DebCkl = 0	tdeb0	2			ms
RESET debounce time	DebCkl = 1	tdeb1	16			ms
PortA , B debounce time	DebCkl = 1	tdeb1	16			ms

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