



# EM65XX Datasheet

## MFP versions of EM66XX (Mask Rom)

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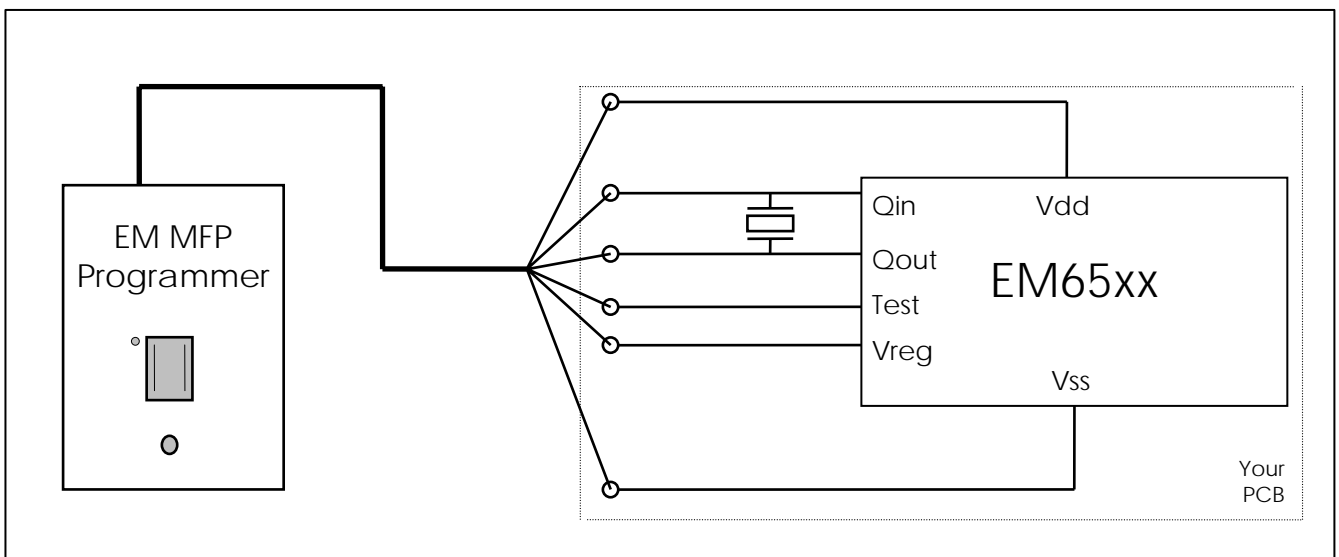
## 1. General

The EM65xx is the Multiple Field Programmable Version of the corresponding EM66xx 4 bit Microcontroller

The program ROM is replaced by non volatile memory, which can be programmed up to 100 times. Functionally, the two types are equal, except the metal options which are defined in the following pages.

Electrically, the MFP 's work above 2.0V and need more current, see the tables in the following description.

The programming is done with the EM MFP programmer, either by putting the device onto the programmer or connecting it with the connector at the back to your board.



### Handling Procedures

This devices have built-in protection against high static voltages or electric fields; however, anti-static precautions should be taken as for any other CMOS component.

Unless otherwise specified, proper operation can only occur when all terminal voltages are kept within the supply voltage range.

### Absolute maximum ratings

	Min.	Max.	Units
Power supply VDD-VSS	- 0.2	+ 5.5	V
Input voltage	VSS - 0.2	VDD+0.2	V
Storage temperature	- 40	+ 125	°C
Electrostatic discharge to MIL-STD-883C method 3015	-2000	+2000	V
Maximum soldering conditions		10s x 250°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.

### Ordering Information

The MFP's should be used for engineering purposes only. No volume production must be planned.



## 2. EM6503

### Input/Output ports

All ports if selected as outputs are Push-pull outputs (driving high / low).  
Inputs are not blocked when Output is selected and Outputs comes Hi-Z in Sleep mode.

### Input/Output Port Options

		Pull-Up Yes / No	Pull-Down Yes / No	Nch-open drain Yes / No	Input blocked when Output Yes / No	Output Hi-Z in SLEEP mode Yes / No
		0	1	4	5	6
A0	PA0 input	NO	NO			
A1	PA1 input	NO	NO			
A2	PA2 input	NO	NO			
A3	PA3 input	NO	NO			
B0	PB0 In/Out	NO	NO	NO	NO	YES
B1	PB1 In/Out	NO	NO	NO	NO	YES
B2	PB2 In/Out	NO	NO	NO	NO	YES
B3	PB3 In/Out	NO	NO	NO	NO	YES
C0	PC0 In/Out	NO	NO	NO	NO	YES
C1	PC1 In/Out	NO	NO	NO	NO	YES
C2	PC2 In/Out	NO	NO	NO	NO	YES
C3	PC3 In/Out	NO	NO	NO	NO	YES
D0	PD0 In/Out	NO	NO	NO	NO	YES
D1	PD1 In/Out	NO	NO	NO	NO	YES
D2	PD2 In/Out	NO	NO	NO	NO	YES
D3	PD3 In/Out	NO	NO	NO	NO	YES

### PortA reset

No PortA reset option is selected

		NO PortA reset combination	PA0 & PA1 logic AND input reset	PA0 & PA1 & PA2 logic AND input reset	PA0 & PA1 & PA2 & PA3 logic AND input reset
		0	1	2	3
RA	PortA RESET	X			

### Supply Voltage Level Detector

T= -10°C to 60°C

Symb.	Parameter	Min.	Typ.	Max.	Unit
VSVLD1	SVLD voltage Level1	2.25	2.5	2.75	V
VSVLD2	SVLD voltage Level2	3.15	3.5	3.85	V
VSVLD3	SVLD voltage Level3	3.87	4.3	4.73	V



## Electrical specifications

### Standard Operating Conditions

Parameter	Value	Description
Temperature	0°C...+60°C	
VDD	+2.0 ...+5.0V	
VSS	0 V (reference)	
CVreg	min. 100nF	Vreg logic supply capacitor
f <sub>q</sub>	32768 Hz	nominal frequency
R <sub>qs</sub>	35 kOhm	typical quartz serial resistor
CL	8.2pF	typical quartz load capacitance
df/f	+/- 30 ppm	quartz frequency tolerance

### DC characteristics - Power Supply Pins

VDD=3.0V, T=25°C (note4) (unless otherwise specified), Vreg not shorted to VDD

Parameter	Conditions	Symb.	Min.	Typ. (note1)	Max.	Unit
ACTIVE Supply Current	+25°C (note2)	IVDDa		9.0	15.0	μA
ACTIVE Supply Current (in active mode)	(note2) (note3) 0°C...+60°C	IVDDa			20.0	μA
STANDBY Supply Current	+25°C	IVDDh		1.7	4.0	μA
STANDBY Supply Current (in Halt mode)	(note3) 0°C...+60°C	IVDDh			7.0	μA
SLEEP Supply Current	+25°C	IVDDs		0.7	2.0	μA
SLEEP Supply Current (SLEEP =1)	(note3) 0°C...+60°C	IVDDs			5.0	μA
Regulated Voltage	0°C...+60°C	Vreg	1.6		2.5	V

VDD=5.0V, T=25°C (note4) (unless otherwise specified), Vreg not shorted to VDD

Parameter	Conditions	Symb.	Min.	Typ. (note1)	Max.	Unit
ACTIVE Supply Current	+25°C (note2)	IVDDa		13.0	18.0	μA
ACTIVE Supply Current (in active mode)	(note2) (note3) 0°C...+60°C	IVDDa			20.0	μA
STANDBY Supply Current	+25°C	IVDDh		1.8	5.0	μA
STANDBY Supply Current (in Halt mode)	(note3) 0°C...+60°C	IVDDh			10.0	μA
SLEEP Supply Current	+25°C	IVDDs		0.7	2.0	μA
SLEEP Supply Current (SLEEP =1)	(note3) 0°C...+60°C	IVDDs			5.0	μA

**Note1:** For current measurement typical quartz described in Operating Conditions is used.

All I/O pins without internal Pull Up/Down are pulled to VDD externally.

**Note2:** Test loop with successive writing and reading of two different addresses with an inverted values (five instructions should be reserved for this measurement),

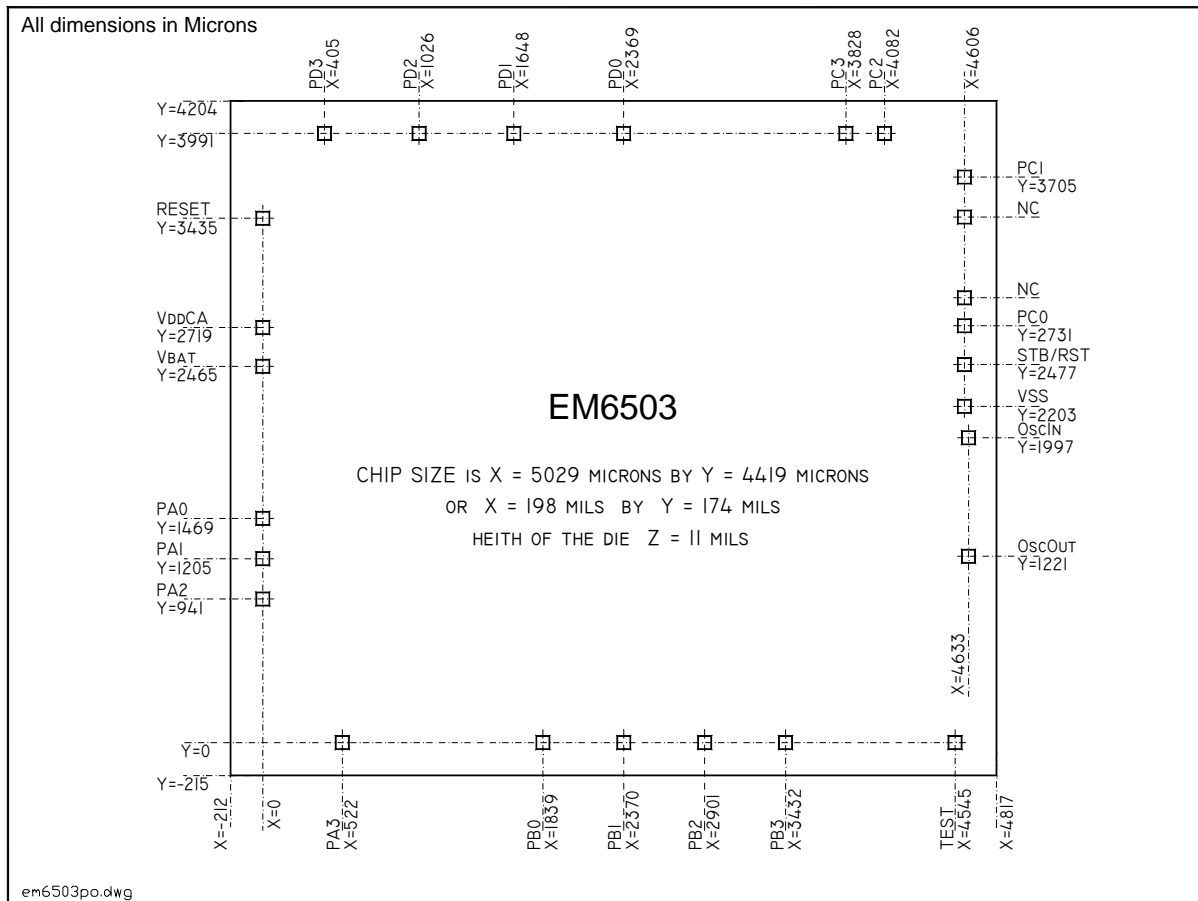
**Note3:** NOT tested at temperature if delivered in chip form.

**Note4:** Test conditions for ACTIVE and STANDBY Supply current mode are: Q<sub>in</sub> = external square wave, from rail to rail of Vreg (regulated voltage) with 100nF capacitor on Vreg. f<sub>Qin</sub> = 33kHz.

## Today's Versions

	I/O's	VLD levels	Remarks
EM6503P02	As defined	As defined	-

## Die, pad location and size



## Package

SO24 package. See dimensions in section 10.

## 3. EM6504

### Input / Output ports

The EM6504 - MFP version of EM6604 has no input pull-up or pull-down resistors. User has to put an external resistor if needed in the application. In metal ROM version (EM6604) user can select resistors described in Electrical parameters and Input/Output port mask option.

For PortC Input/Output selection there is an additional register in EM6504 (register **PcOE** at address 60hex) instead of metal mask in EM6604.

For PortA Rising/Falling Interrupt edge selection there is an additional register in EM6504 (register **PaIRQedge** at address 63hex) instead of metal mask in EM6604.

PortC Input/Output metal options are replaced by register **PcOE** in EM6504 MFP version. This register is described below.

### Input / Output ports option

		Output	Clocked Pull-Down R > 1M?	Clocked Pull-Up R > 1M?	Pull-Down R = 30k?	Pull-Down R = 150k?	Pull-Up R = 30k?	Pull-Up R = 150k?	No Input Pull-Up or Pull-Down
		0	1	2	3	4	5	6	7
A0	PA0 input								x
A1	PA1 input								x
A2	PA2 input								x
A3	PA3 input								x
C0	PC0 In/Out	PCoe0							x
C1	PC1 In/Out	PCoe1							x
C2	PC2 In/Out	PCoe2							x
C3	PC3 In/Out	PCoe3							x

the MFP EM6504 option selection is showed by « x » and « PCoex »

### PortA interrupt edge

This metal options are replaced by register **PaIRQedge** in EM6504 MFP version. The register is described below.

### PortA interrupt edge option

		Interrupt on Input's rising edge	Interrupt on Input's falling edge
		8	9
I0	PA0 – IRQ	PA0r = 1	PA0r = 0
I1	PA1 – IRQ	PA1r = 1	PA1r = 0
I2	PA2 – IRQ	PA2r = 1	PA2r = 0
I3	PA3 – IRQ	PA3r = 1	PA3r = 0

the MFP EM6504 PortA interrupt edge option is selected by values in register **PaIRQedge**

## Watchdog metal option

The Watch-Dog timer is always active.

## Watchdog metal option

		Watch-Dog timer ACTIVE	Watch-Dog timer INACTIVE
<b>W0</b>	<b>WD timer</b>	<b>x</b>	

## Supply Voltage Level Detector

T= -10°C to 60°C

Symb.	Parameter	Min.	Typ.	Max.	Unit
VSVLD1	SVLD voltage Level1	2.02	2.30	2.38	V

## Additional registers

In EM6504 there are two additional registers replacing metal options in EM6604.

Register name	add hex	add dec	reset value	write_bits	read_bits	Remarks
			b'3210	Read/Write_bits		
PaIRQedge	63	99	0000	0: PA0r 1: PA1r 2: PA2r 3: PA3r		Port A IRQ edge 1 = rising 0 = falling
PcOE	60	96	0000	0: PCoe0 1: PCoe1 2: PCoe2 3: PCoe3		Port C Output Enable 1 = output 0 = input

Because these two registers replace the metal option in EM6604 it is advised that they are written as first two instructions in the main program and that they are executed only once. They should not be changed later in the program because the metal options in EM6604 are fixed.

## Electrical specifications

### Standard Operating Conditions

Parameter	Value	Description
Temperature	0°C...+60°C	
VDD	+2.0 ...+5.0V	
VSS	0 V (reference)	
CVDDCA	min. 100nF (note1)	Vreg switched logic supply capacitor
f <sub>q</sub>	32768 Hz	nominal frequency
R <sub>qs</sub>	35 kOhm	typical quartz serial resistor
CL	8.2pF	typical quartz load capacitance
df/f	+/- 30 ppm	quartz frequency tolerance

**Note1:** This capacitor maintains the Regulated Supply to the core when the core has been isolated by the internal Supply switch during driving the high current outputs. The user should be aware that the selection of this capacitor will dictate the time that the core can be isolated.





## DC characteristics - Power Supply Pins

VDD=3.0V, T=25°C (unless otherwise specified)

Parameter	Conditions	Symb.	Min.	Typ.(note5)	Max.	Unit
ACTIVE Supply Current	+25°C (note2)	IVDDa		9.0	15	μA
ACTIVE Supply Current (in active mode)	(note2 / 3 / 4) 0°C...+60°C	IVDDa			20	μA
STANDBY Supply Current	+25°C	IVDDh		2	4	μA
STANDBY Supply Current (in Halt mode)	(note3 / 4) 0°C...+60°C	IVDDh			7	μA
RAM data retention		Vrd	1.3			V
VDDCA regulated voltage !!		VDDCA	1.6	2.0	2.6	V
POR voltage	0°C...+60°C	VPOR		0.9	1.40	V
SVLD voltage		VSULD	2.25	2.5	2.8	V

VDD=5.0V, T=25°C (unless otherwise specified)

Parameter	Conditions	Symb.	Min.	Typ.(note5)	Max.	Unit
ACTIVE Supply Current	+25°C (note2)	IVDDa		13	18	μA
ACTIVE Supply Current (in active mode)	(note2 / 3 / 4) 0°C...+60°C	IVDDa			20	μA
STANDBY Supply Current	+25°C	IVDDh		1.8	5	μA
STANDBY Supply Current (in Halt mode)	(note3 / 4) 0°C...+60°C	IVDDh			10	μA

**Note2:** test loop with successive writing and reading of two different addresses with an inverted values (five instructions should be reserved for this measurement),

**Note3:** NOT tested at temperature if delivered in chip form.

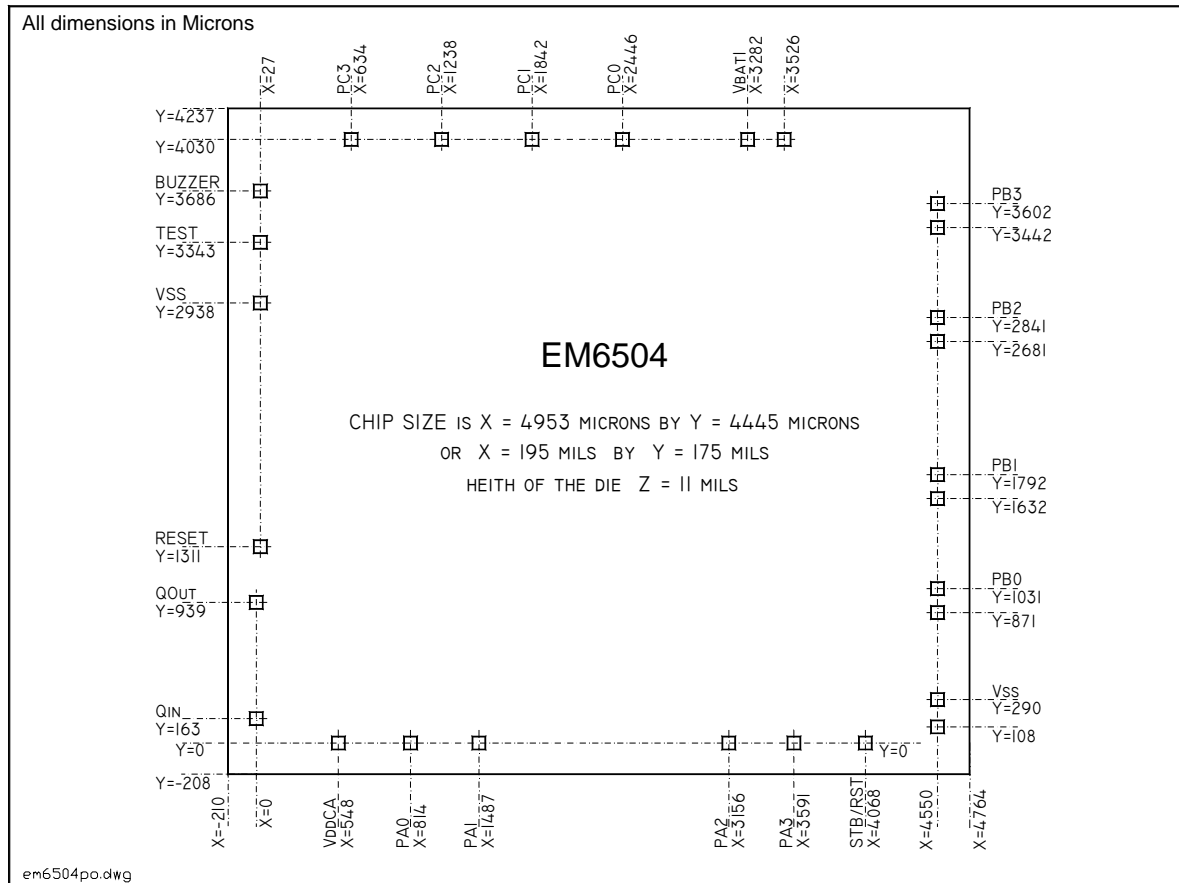
**Note4:** Test conditions for ACTIVE and STANDBY Supply current mode are: Qin = external square wave, from rail to rail of Vreg (regulated voltage) with 100nF capacitor on Vreg. fQin = 33kHz.

**Note5:** For current measurement typical quartz described in Operating Conditions is used. All I/O pins without internal Pull Up/Down are pulled to VDD externally.

## Today's Versions

	I/O's	VLD levels	Remarks
EM6504P02	As defined	As defined	-

## Die, pad location and size



## Package

SO24 package. See dimensions in section 10.



## 4. EM6505

### Input/Output ports

All ports if selected as outputs are Push-pull outputs (driving high / low).

Inputs are not blocked when Output is selected and Outputs stays active also in Sleep mode.

### Input/Output Port Options

		Pull-Up Yes / No	Pull-Down Yes / No	Nch-open drain Yes / No	Input blocked when Output Yes / No	Output Hi-Z in SLEEP mode Yes / No
		0	1	4	5	6
A0	PA0 input	NO	NO			
A1	PA1 input	NO	NO			
A2	PA2 input	NO	NO			
A3	PA3 input	NO	NO			
B0	PB0 In/Out	NO	NO	NO	NO	NO
B1	PB1 In/Out	NO	NO	NO	NO	NO
B2	PB2 In/Out	NO	NO	NO	NO	NO
B3	PB3 In/Out	NO	NO	NO	NO	NO
C0	PC0 In/Out	NO	NO	NO	NO	NO
C1	PC1 In/Out	NO	NO	NO	NO	NO
C2	PC2 In/Out	NO	NO	NO	NO	NO
C3	PC3 In/Out	NO	NO	NO	NO	NO
D0	PD0 In/Out	NO	NO	NO	NO	NO
D1	PD1 In/Out	NO	NO	NO	NO	NO
D2	PD2 In/Out	NO	NO	NO	NO	NO
D3	PD3 In/Out	NO	NO	NO	NO	NO

### PortA reset

No PortA RESET is selected.

		NO PortA reset combination	PA0 & PA1 logic AND input reset	PA0 & PA1 & PA2 logic AND input reset	PA0 & PA1 & PA2 & PA3 logic AND input reset
		0	1	2	3
<b>RA</b>	<b>PortA RESET</b>	<b>X</b>			

### Supply Voltage Level Detector

T= -10°C to 60°C

Symb.	Parameter	Min.	Typ.	Max.	Unit
VSVLD1	SVLD voltage Level1	2.02	2.30	2.38	V
VSVLD2	SVLD voltage Level2	3.70	4.00	4.30	V
VSVLD3	SVLD voltage Level3	4.15	4.50	4.86	V

## RC oscillator adjustment on the EM6505 (MFP version only)

Register name	add hex	add dec	power up value	write_bits	read_bits	Remarks
			b'3210	Read/Write_bits		
RC_Adj_Low	66	102	0001	0: OscAdj[0] 1: OscAdj[1] 2: OscAdj[2] 3: OscAdj[3]	----	Adjustment of RC oscillator (4 LSB)
RC_Adj_High	67	103	1000	0: OscAdj[4] 1: OscAdj[5] 2: OscAdj[6] 3: OscAdj[7]	----	Adjustment of RC oscillator (4 MSB)

On the EM6605 (ROM version), the adjustment of the RC oscillator is done by metal option (refer to chapter 14 of the EM6605 datasheet).

On the EM6505 (MFP version), there is no metal option to adjust the frequency range. Adjusting the 8 bits contained in registers “RC\_Adj\_Low” and “RC\_adj\_High” sets the frequency. The bit “OscAdj[7]” selects the frequency range: low or high frequency range (refer to chapter 4 of the EM6605 datasheet).

The others bits as well as the external resistor on Pin 10, are used to adjust more precisely the frequency.

The frequency has to be in the range of 30kHz to 300kHz (refer to chapter 17.7 of the EM6605 datasheet).

## Electrical specifications

### Standard Operating Conditions

Parameter	Value	Description
Temperature	0°C...+60°C	
VDD	+2.0 ...+5.0V	
VSS	0 V (reference)	
Cvreg	min. 100nF	regulated voltage capacitor tow. Vss
Rext	50kΩ - 400kΩ	external R to set clock frequency

Cvreg : This capacitor maintains the Regulated Supply to the internal logic.

## DC characteristics - Power Supply Pins

For Frequency range of 30 - 300 kHz

VDD=5.0V, T=25°C, f=32kHz (note1) (unless otherwise specified) Rext ≈ 330kΩ

Parameter	Conditions	Symb.	Min.	Typ. (note1)	Max.	Unit
ACTIVE Supply Current	+25°C (note2)	IVDDa		30.0	40.0	μA
ACTIVE Supply Current (in active mode)	(note2) (note3) 0°C...+60°C	IVDDa			50.0	μA
STANDBY Supply Current	+25°C	IVDDh		17.0	20.0	μA
STANDBY Supply Current (in Halt mode)	(note3) 0°C...+60°C	IVDDh			40.0	μA
SLEEP Supply Current	+25°C	IVDDs		1.0	2.0	μA
SLEEP Supply Current (SLEEP =1)	(note3) 0°C...+60°C	IVDDs			5.0	μA
Regulated Voltage	Vreg not at VDD	Vreg	1.5	2.0	2.5	V



VDD=5.0V, T=25°C, f=200kHz (note1) (unless otherwise specified) Rext ≈ 62kΩ

Parameter	Conditions	Symb.	Min.	Typ. (note1)	Max.	Unit
ACTIVE Supply Current	+25°C (note2)	IVDDa		80.0	100.0	μA
ACTIVE Supply Current (in active mode)	(note2) (note3) 0°C...+60°C	IVDDa			120.0	μA
STANDBY Supply Current	+25°C	IVDDh		30.0	40.0	μA
STANDBY Supply Current (in Halt mode)	(note3) 0°C...+60°C	IVDDh			50.0	μA
SLEEP Supply Current	+25°C	IVDDs		1.0	2.0	μA
SLEEP Supply Current (SLEEP =1)	(note3) 0°C...+60°C	IVDDs			5.0	μA

**Note1:** For current measurement the corresponding resistor for targeted frequency ±20% is selected; Rext : external resistor between the RCin and Vss pins.  
All I/O pins without internal Pull Up/Down are pulled to VDD externally.

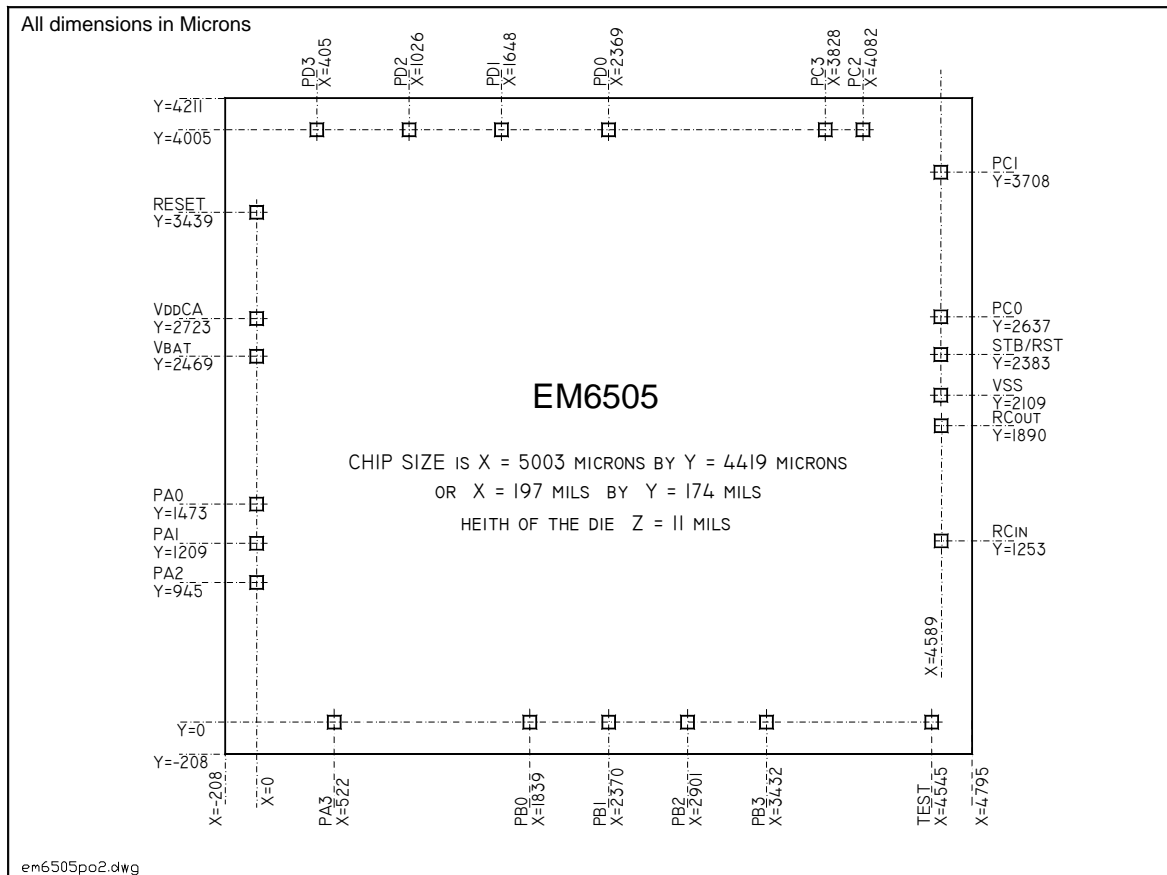
**Note2:** Test loop with successive writing and reading of two different addresses with an inverted values (five instructions should be reserved for this measurement),

**Note3:** NOT tested at temperature if delivered in chip form.

## Today's Versions

	I/O's	VLD levels	Remarks
EM6505P02	As defined	As defined	-

## Die, pad location and size



## Package

SO24 package. See dimensions in section 10.



## 5. EM6517

A new complete specification exists on the EM6517. Please refer to this document on our web site. (<http://www.emmarin.com/>)

For more information or questions please contact EM headquarters or your local EM office.



## 6. EM6520

A new complete specification exists on the EM6520. Please refer to this document on our web site. (<http://www.emmarin.com/>)

For more information or questions please contact EM headquarters or your local EM office.





## 7. EM6521

A new complete specification exists on the EM6521. Please refer to this document on our web site. (<http://www.emmarin.com/>)

For more information or questions please contact EM headquarters or your local EM office.



## 8. EM6522

A new complete specification exists on the EM6522. Please refer to this document on our web site. (<http://www.emmarin.com/>)

For more information or questions please contact EM headquarters or your local EM office.



## 9. EM6540

### Standard Operating Conditions

Parameter	MIN	TYP	MAX	Unit	Description
Temperature	0	25	60	°C	
VDD	2.2	3.6	5.5	V	fq max 620 kHz
	2.5	3.6	5.5	V	fq max 680 kHz
VSS		0		V	Reference terminal
CVreg (note 1)	0.22	1		μF	regulated voltage capacitor
fq		600		kHz	nominal frequency

### DC characteristics - Power Supply Pins

VDD=3V, T=25°C (unless otherwise specified)

Parameter	Conditions	Symb.	Min.	Typ. (note1)	Max.	Unit
ACTIVE Supply Current	25°C	IVDDa		210		μA
ACTIVE Supply Current (in active mode)	(note2) (note3) 0°C...+60°C	IVDDa		210	250	μA
STANDBY Supply Current (in Halt mode)	(note3) 0°C...+60°C	IVDDh		10	15	μA
SLEEP Supply Current (SLEEP =1)	(note3) 0°C...+60°C	IVDDs		0.4	1	μA
POR voltage		VPOR		1.5		V
RAM data retention		Vrd	1.5			V
Regulated Voltage		Vreg		1.85		V

**Note1:** Measured at typical freq. of 600kHz, no load.

**Note2:** Test loop with successive writing and reading of two different addresses with an inverted values (five instructions should be reserved for this measurement),

**Note3:** NOT tested at temperature if delivered in chip form.

### Metal Options

Functionally the EM6640 and the EM6540 are the same except the metal options of the EM6540 which are set in their default state.



## Input/Output Port Options

		<b>Pull-Up</b> controlled by software	<b>Pull-Down</b> controlled by software
		0	1
A0	PA0 input	none	100k $\Omega$
A1	PA1 input	none	100k $\Omega$
A2	PA2 input	none	100k $\Omega$
A3	PA3 input	none	100k $\Omega$
B0	PB0 In/Out	100k $\Omega$	100k $\Omega$
B1	PB1 In/Out	100k $\Omega$	100k $\Omega$
B2	PB2 In/Out	100k $\Omega$	100k $\Omega$
B3	PB3 In/Out	100k $\Omega$	100k $\Omega$
C0	PC0 In/Out	100k $\Omega$	100k $\Omega$
C1	PC1 In/Out	100k $\Omega$	100k $\Omega$
C2	PC2 In/Out	100k $\Omega$	100k $\Omega$
C3	PC3 In/Out	100k $\Omega$	100k $\Omega$

## Digital Watchdog Option

<b>MDigWD</b>	Digital WatchDog	<b>YES</b>
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## SWBdataLevel Option

<b>MSWBdataLevel</b>	level of SWB data	<b>VDD</b>
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## Supply Voltage Level Detector

T= -10°C to 60°C

<b>Symb.</b>	<b>Parameter</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
VSVLD1	SVLD voltage Level1	2.02	2.20	2.37	V
VSVLD2	SVLD voltage Level2	2.30	2.50	2.70	V

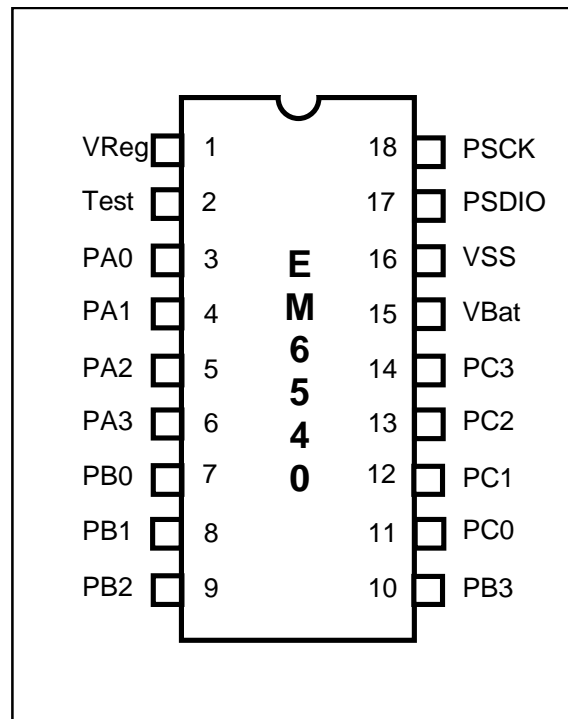
## Today's Versions

	I/O's	VLD levels	Remarks
EM6540P04	As defined	As defined	-

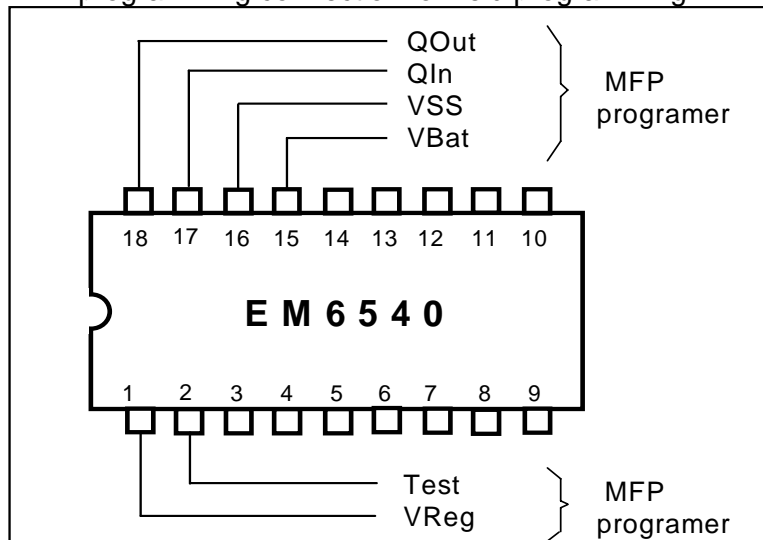


## Pin out for the EM6540 (MFP of the EM6640)

Package: SO18



## MFP programming connection for field programming



## 10. Package Dimensions

All MFPs are available in chip form on special request.

Figure 1. SOP 18 Pin Package

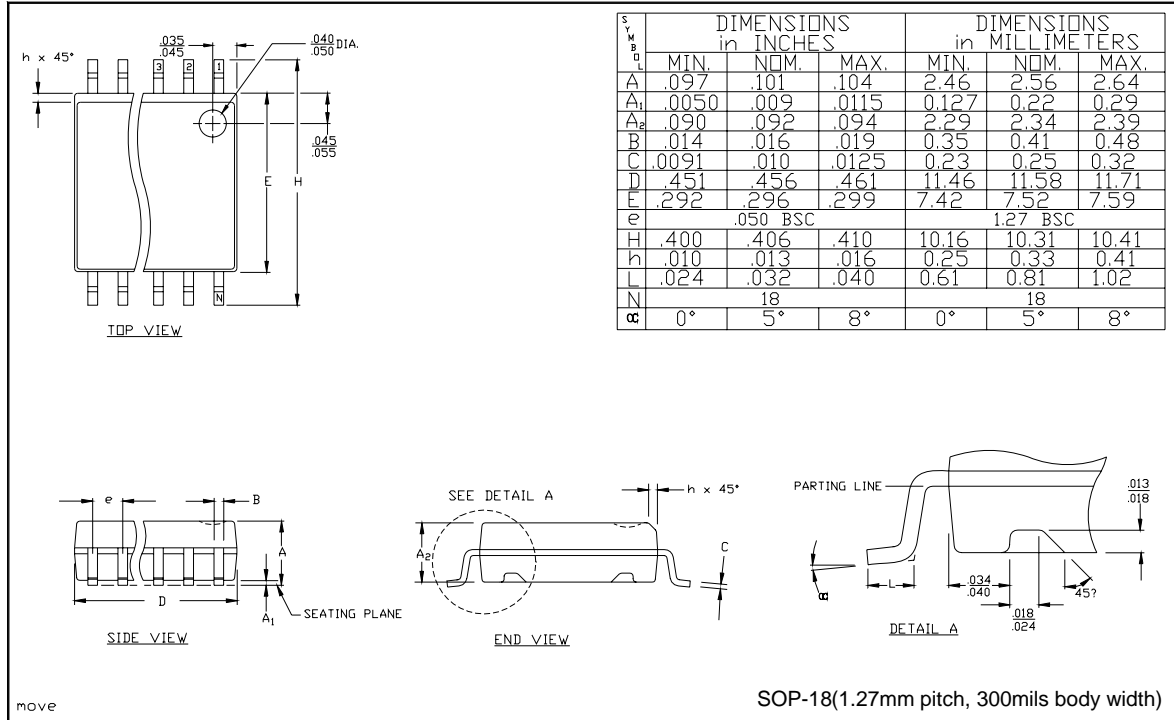
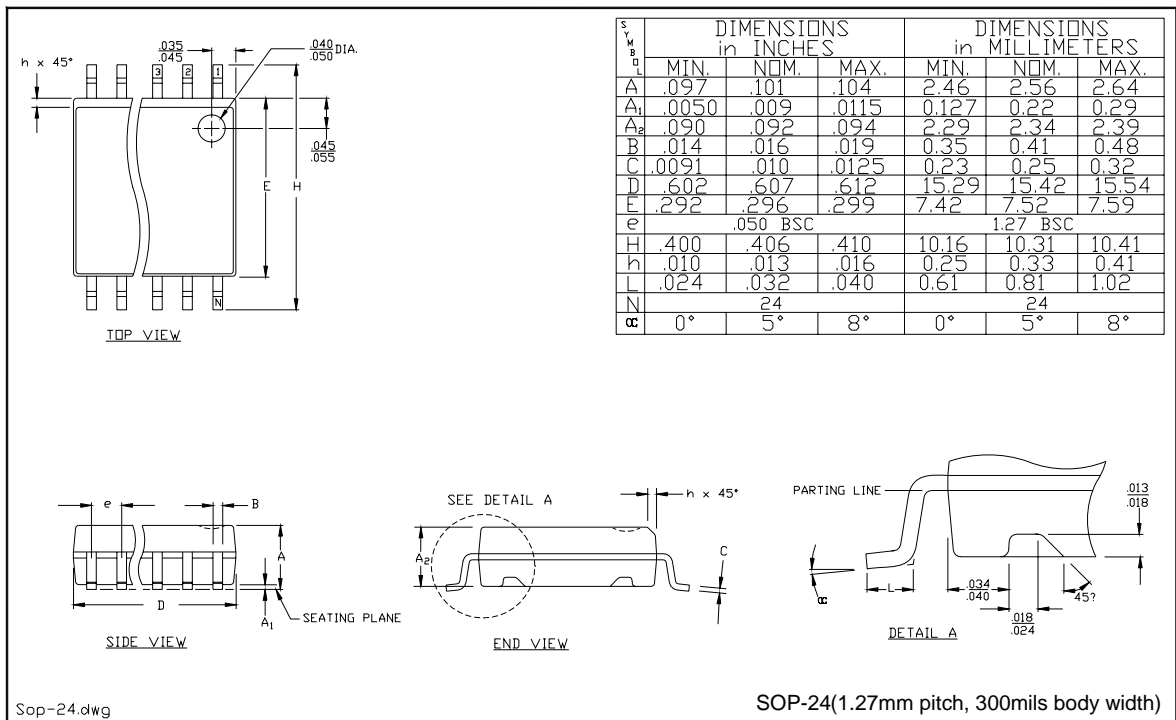


Figure 2. SOP 24 Pin Package



**Figure 3. SOP 28 Pin Package**

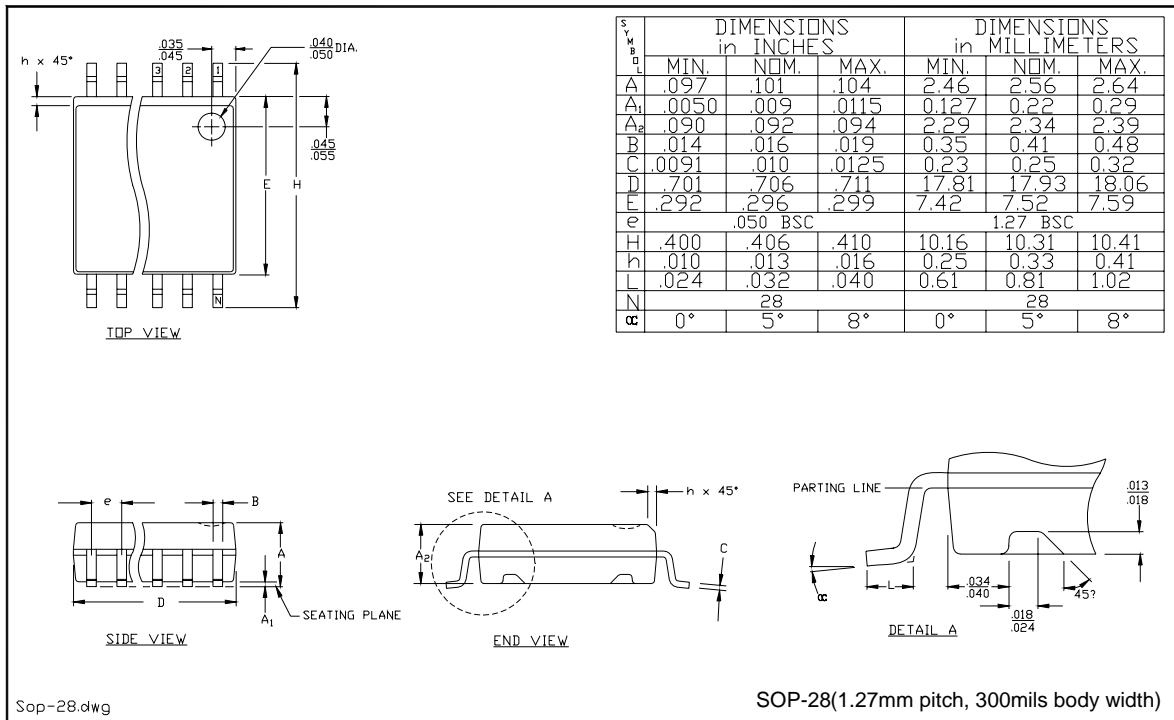




Figure 4. TQF 44 Pin Package

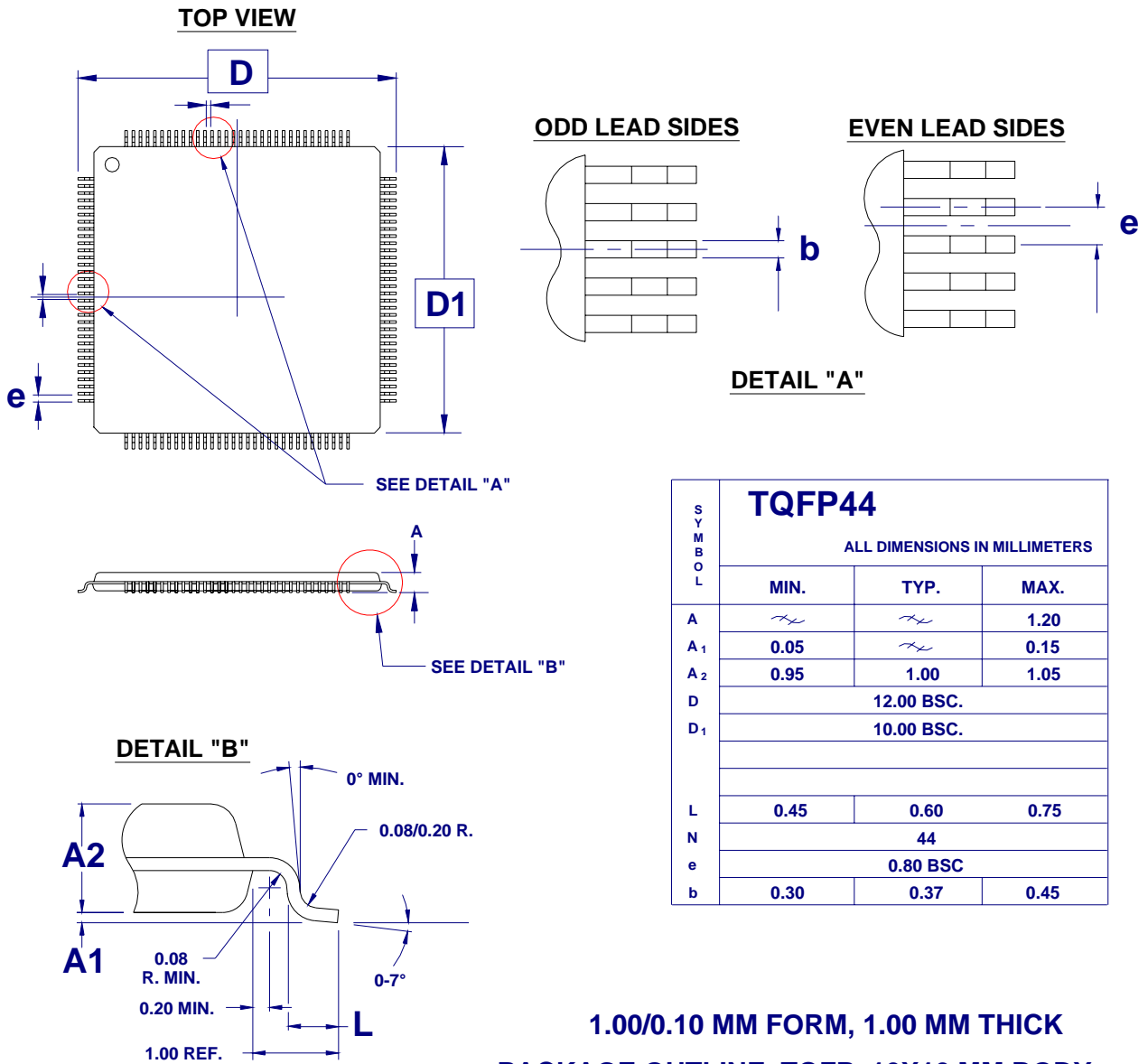


Figure 5. TQF 52 Pin Package

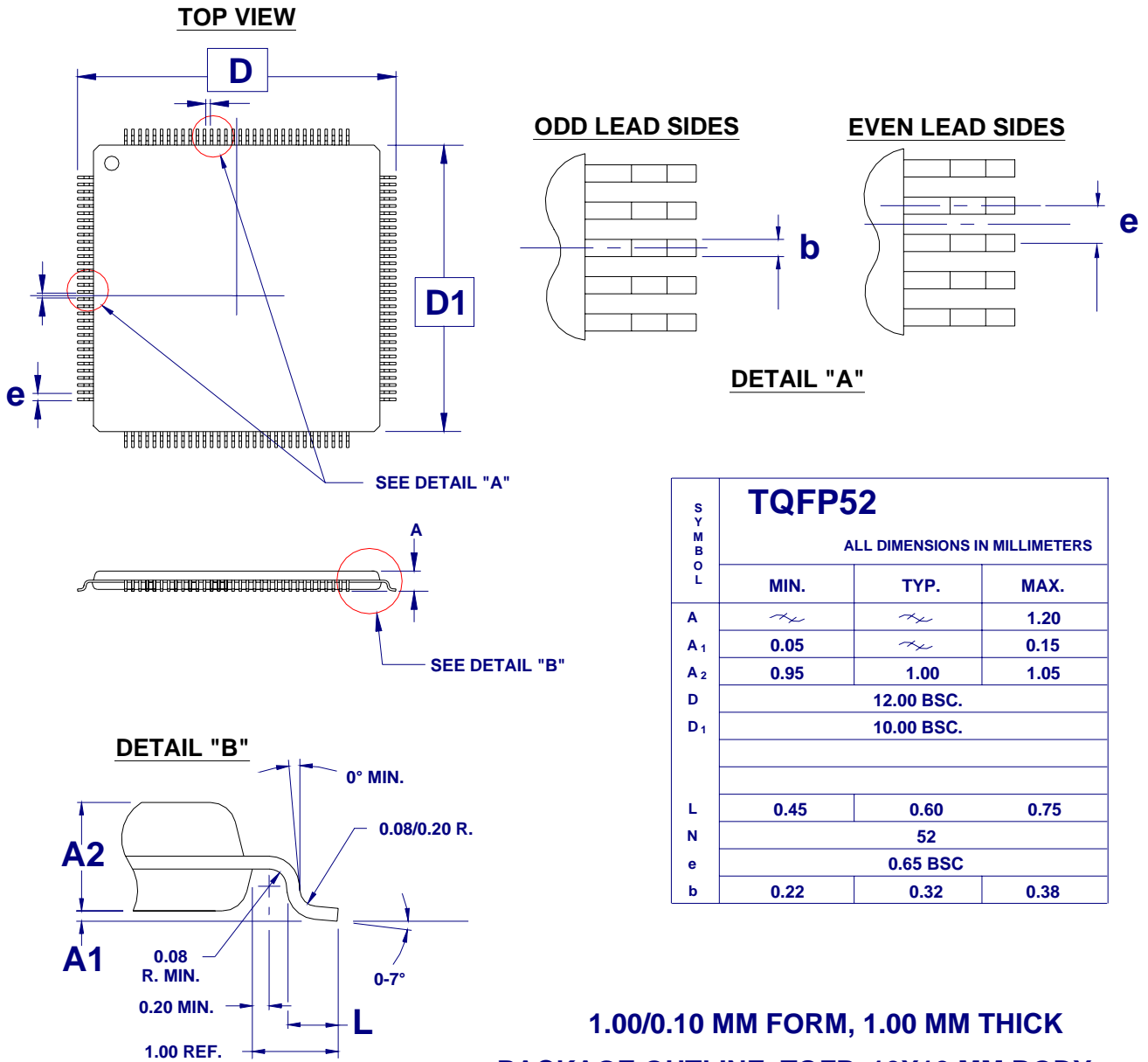
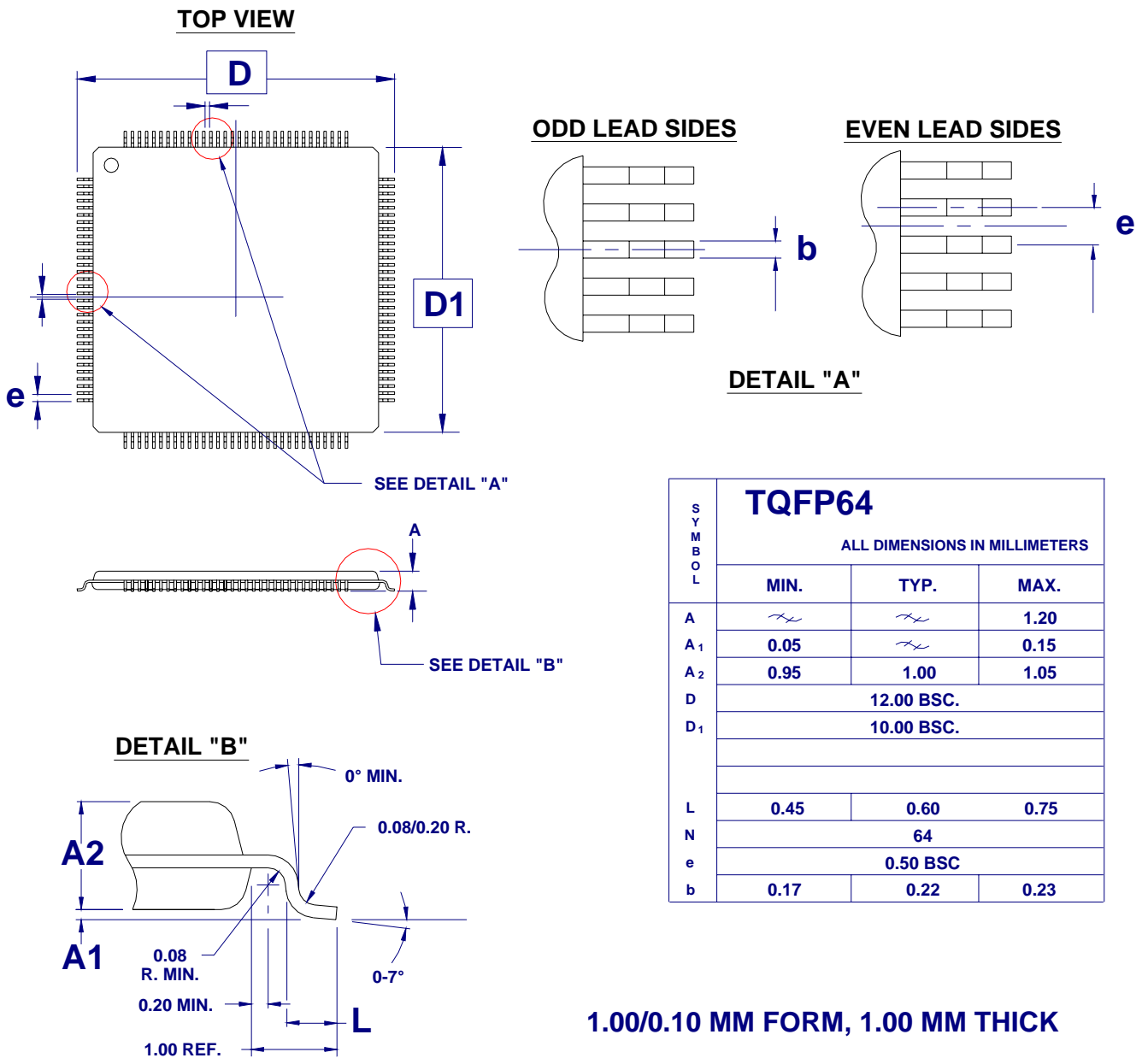


Figure 6. TQF 64 Pin Package



For more information or questions please contact EM headquarters or your local EM office.



## 11. Ordering Information

### Ordering Part Number

Part Number	Package/Die Form	Delivery Form/ Thickness
EM6503%%SO24A	24 pin SOIC	Stick
EM6503%%WP11	Die in waffle pack	11 mils
EM6504%%SO24A	24 pin SOIC	Stick
EM6504%%WP11	Die in waffle pack	11 mils
EM6505%%SO24A	24 pin SOIC	Stick
EM6505%%WP11	Die in waffle pack	11 mils
EM6517%%SO28A	28 pin SOIC	Stick
EM6517%%WP11	Die in waffle pack	11 mils
EM6520%%TQ44D	TQFP 44 pin	Trays (Plate)
EM6520%%WP11	Die in waffle pack	11 mils
EM6521%%TQ52D	TQFP 52 pin	Trays (Plate)
EM6521%%WP11	Die in waffle pack	11 mils
EM6522%%TQ64D	TQFP 64 pin	Trays (Plate)
EM6522%%WP11	Die in waffle pack	11 mils
EM6540%%SO18A	18 pin SOIC	Stick
EM6540%%WP11	Die in waffle pack	11 mils

Please make sure to give the complete Part Number when ordering, including the 3-digit version. The version is made of 3 digits %%%: the first one is a letter and the last two are numbers, e.g. P04 , P07, P12, etc.  
For other delivery forms, please contact EM Microelectronic-Marin S.A.

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