

1. GENERAL DESCRIPTION

EM61000 series is an 8-bit micro-controller based music processor IC with audio function that delivers 8 channels instrument playback. The micro-controller includes a powerful 8-bit RISC CPU to handle most of the music functions, an 8K words program ROM, and a voice ROM that extends up to 512K bytes. There are eight melody channels that can be played back simultaneously. The micro-controller provides real instrument waveforms to obtain good quality audio melody. The EM61000 offers one 8-bit input port and one 8-bit I/O port with internal pull-low/wake-up functions for user's applications. In addition, up to three general I/O ports are provided. By programming the micro-controller, applications such as section combination, trigger mode, output control, keyboard matrix, and other logic functions can be easily implemented. Together, all these powerful features will inspire the user to realize a wide variety of ideas.

2. FEATURES

- Operating voltage: 2.4 ~ 5.5V.
- 8-bit RISC CPU.
- Three general-purpose timers.
- 8K word program ROM access and 8-level stacks.
- Multi melody channels can be played simultaneously (8 channels for EM61100~ EM61400, 4 channels for EM61001 and EM61002).
- On chip voice ROM will extend up to 512K Bytes.
- Uses real instrument waveforms for good quality audio melody.
- Built-in 8-bit by 8-bit hardware multiplier with 16-bit result.
- One 8-bit input port and one 8-bit I/O port with pull-low/wake-up functions.
- Provides additional general-purpose I/O ports (up to 3 ports).
- Provides crystal oscillation or internal oscillator (by connecting a resistor).
- 8-bit current DAC output: two for EM61100~EM61400; one for EM61001 & EM61002.
- Built-in watchdog timer (WDT).

3. Parts List

The EM61000 series have 8K×13 bit program ROM and 272 bytes RAM.

Part number	Voice ROM	Input pin	I/O pin	Output pin	DAC	Melody
EM61001	32K × 8 bits	8 (Port 1)	16 (Port 2, 3)	None	1	4 channel
EM61002	32K × 8 bits	None	8 (Port 2)	None	1	4 channel
EM61100	64K × 8 bits	8 (Port 1)	24 (Port 2, 3, 4)	None	2	8 channel
EM61200	128K × 8 bits	8 (Port 1)	24 (Port 2, 3, 4)	None	2	8 channel
EM61300	256K × 8 bits	8 (Port 1)	24 (Port 2, 3, 4)	None	2	8 channel
EM61400	512K × 8 bits	8 (Port 1)	24 (Port 2, 3, 4)	8 (Port 5)	2	8 channel

4. PIN DESCRIPTIONS

Symbol	I/O	Function
OSCI	I	Crystal in/Resistor.
OSCO	O	Clock output.
P1.0~7	I	Bit 0~7 of port 1 (except EM61002).
P2.0~7	I/O	Bit 0~7 of port 2.
P3.0~7	I/O	Bit 0~7 of port 3 (except EM61002).
P4.0~7	I/O	Bit 0~7 of port 4 (except EM61001, EM61002).
P5.0~7	O	Bit 0~7 of port 5 (except EM61001, EM61002, EM61100, EM61200, EM61300).
VO1	O	Current output of DAC 1.
VO2	O	Current output of DAC 2(except EM61001, EM61002).
VDD	-	Positive power supply.
VSS	-	Negative power supply.
TEST	I	For test only (normally floating).
RESET	I	Reset pin (active low, internal pull-high)

5. ABSOLUTE MAXIMUM RATINGS

Parameter	Specification
Supply voltage($V_{DD} - V_{SS}$)	-0.3V to +6.0V
Input voltage	$V_{SS} - 0.3V$ to $V_{DD} + 0.3V$
Operating Temperature	-20°C to 50°C
Storage Temperature	-55°C to 125°C

6. ELECTRICAL CHARACTERISTICS

(Temperature : 25°C, $V_{SS}=0V$)

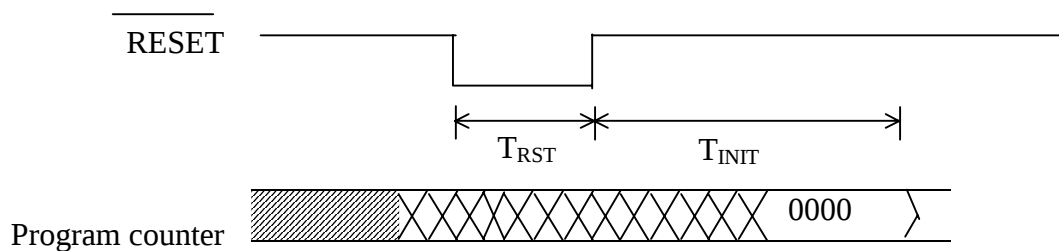
Items	Sym	Min.	Typ.	Max.	Unit	Condition
Operating Voltage	V_{DD}	2.4	-	5.5	V	
Standby Current	I_{SB}	-	1.0	5.0	μA	$V_{DD}=4.5V$
	I_{SB}	-	0.5	5.0	μA	$V_{DD}=3V$
Operating Current	I_{OP}	0.5	3	5	mA	$V_{DD}=4.5V$, $F_{OSC}=6MHz$, no load
	I_{OP}	0.2	1.5	3	mA	$V_{DD}=3V$, $F_{OSC}=4MHz$, no load
Drive Current of Port 2, 3, 4, 5	I_{OH}	10	15	23	mA	$V_{DD}=4.5V$, $V_{OH}=2V$
	I_{OH}	2	3.5	5.3	mA	$V_{DD}=3V$, $V_{OH}=2.4V$
Sink Current of Port 2, 3, 4, 5	I_{OL}	3.5	4.7	7.0	mA	$V_{DD}=4.5V$, $V_{OL}=0.4V$
	I_{OL}	11	18	26	mA	$V_{DD}=4.5V$, $V_{OL}=3V$
	I_{OL}	2.5	3.2	4.8	mA	$V_{DD}=3V$, $V_{OL}=0.4V$
	I_{OL}	4.8	7.7	12	mA	$V_{DD}=3V$, $V_{OL}=1.5V$
Input Voltage of All Input Ports	V_{IH}	1.8	4.5	4.5	V	$V_{DD}=4.5V$ (No internal Pull-low)
	V_{IL}	-	0	0.8	V	$V_{DD}=4.5V$ (No internal Pull-low)
	V_{IH}	1.4	3	3	V	$V_{DD}=3V$ (No internal Pull-low)
	V_{IL}	-	0	0.6	V	$V_{DD}=3V$ (No internal Pull-low)
Input Current	I_I	3	8	12	μA	$V_{DD}=4.5V$ (with Internal Pull-low)
	I_I	1.2	3	5	μA	$V_{DD}=3V$ (with Internal Pull-low)

D/A Output Current	IVO	2.5	3.5	4.5	mA	V _{DD} =4.5V, V _O =0.7V
	IVO	2.0	3.0	4.0	mA	V _{DD} =3V, V _O =0.7V
Operating Frequency	FOSC	1	4	6	MHz	V _{DD} =4.5 V
	FOSC	1	4	4	MHz	V _{DD} =3 V
Frequency Deviation		-	-	±7.5	%	V _{DD} =2.0~5.5 V for F _{OSC} =1~4 MHz
		-	-	±7.5	%	V _{DD} =3.0~5.5 V for F _{OSC} =1~6 MHz
Warm-up / Wake-up Time	Tw	12	18	24	ms	V _{DD} =4.5V

7. INTERNAL OSCILLATOR FREQUENCY

External Resistor (R _{EXT})	System Frequency (F _{OSC})
200KΩ	1MHz
100KΩ	2MHz
50KΩ	4MHz
33.3 KΩ	6MHz

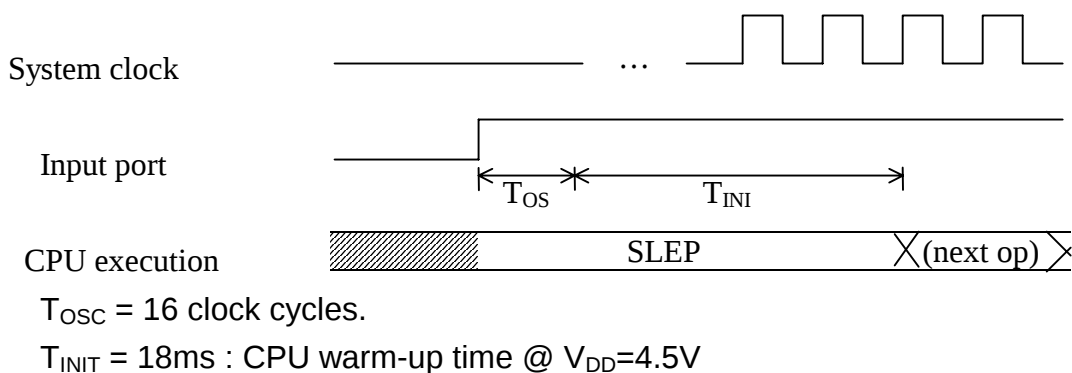
8. WARM UP TIMING



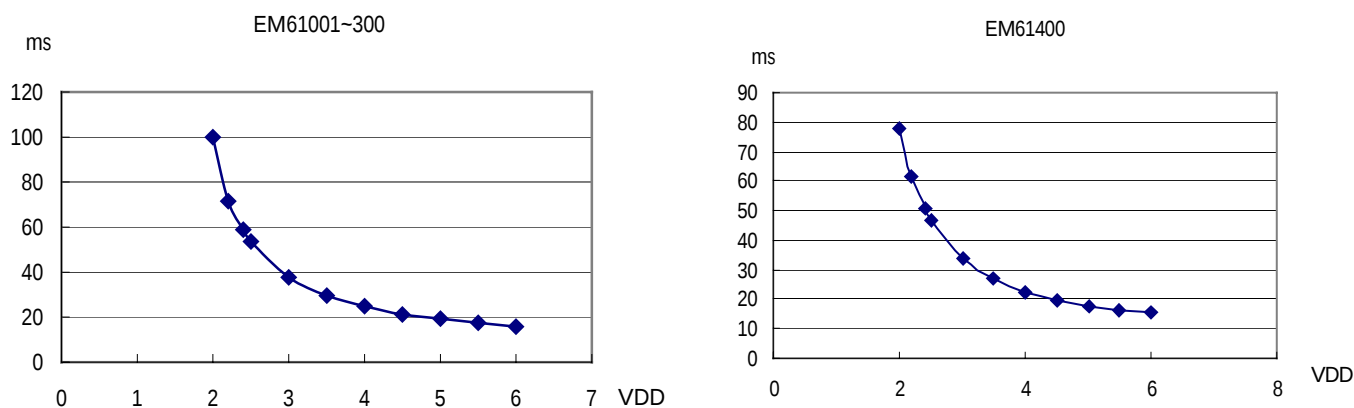
$T_{RST} > 100\text{ns}$: RESET pulse width

$T_{INIT} = 18\text{ms}$: CPU warm-up time @ V_{DD}=4.5V

9. WAKE UP TIMING



10. WARM UP TIME VS. V_{DD}

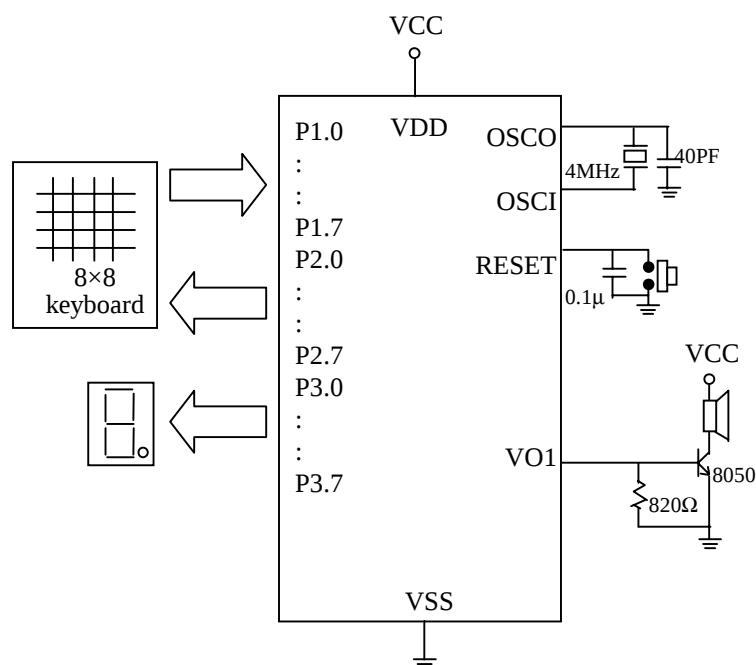


Note: When V_{DD} is greater than 3V, T_{INI} value will vary at $\pm 10\%$.

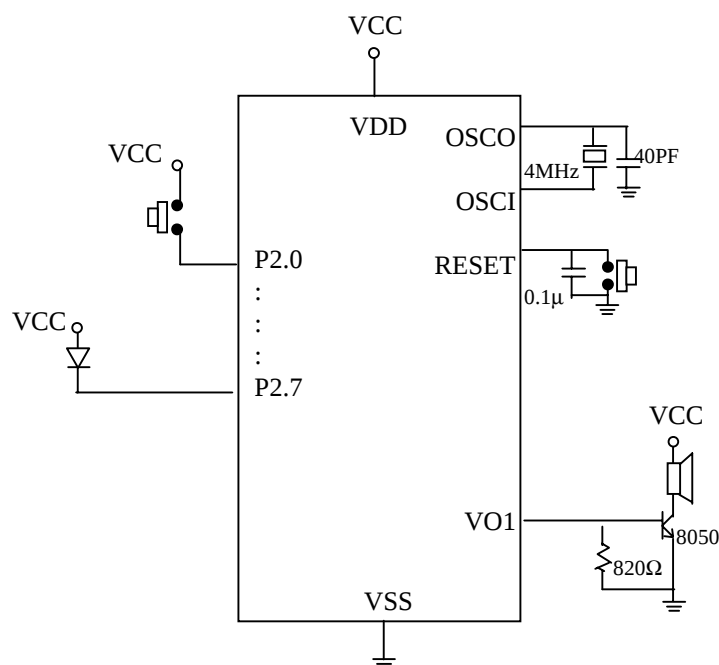
Likewise, when V_{DD} is smaller than 3V, T_{INI} value will vary at $\pm 30\%$.

11.APPLICATION CIRCUIT

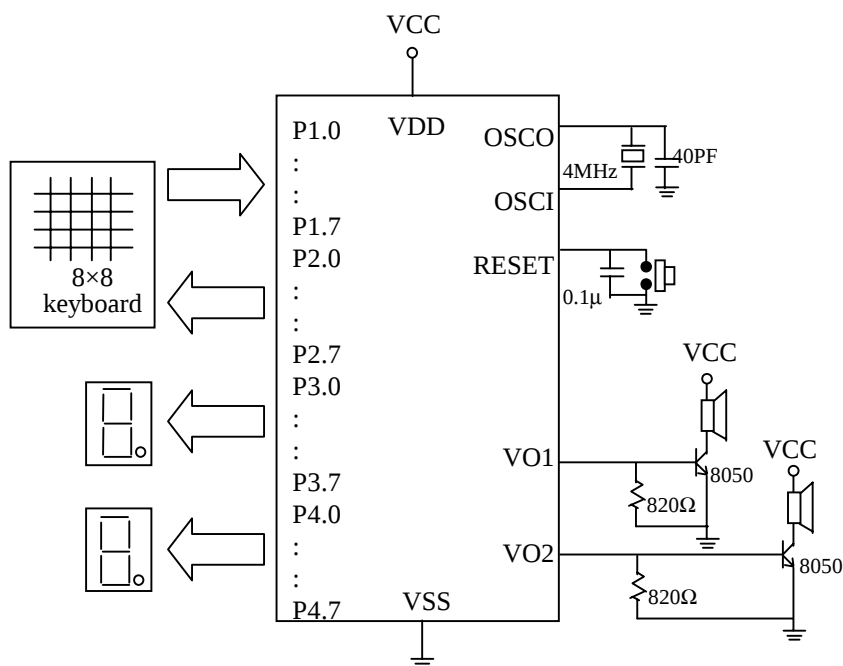
EM61001 Application circuit



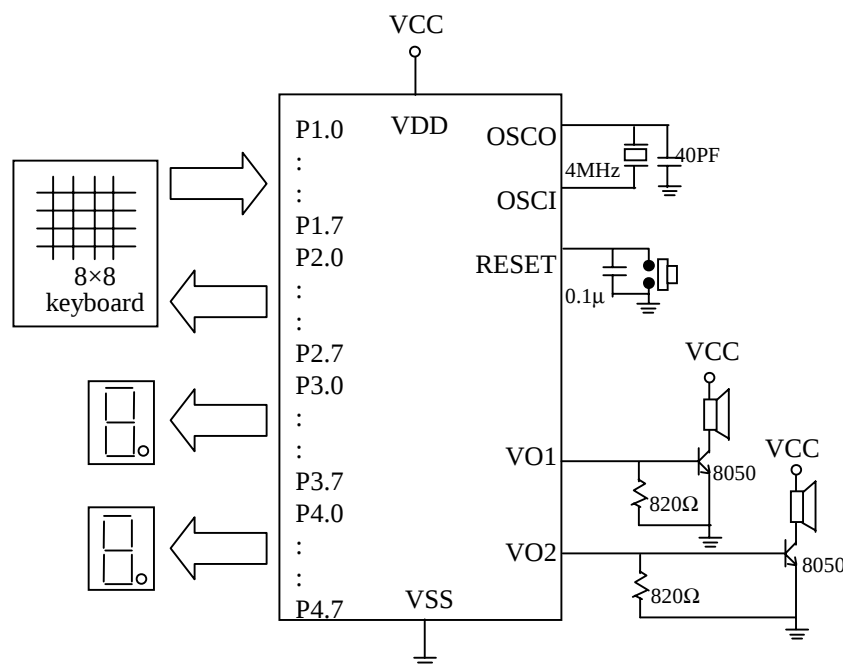
EM61002 Application circuit



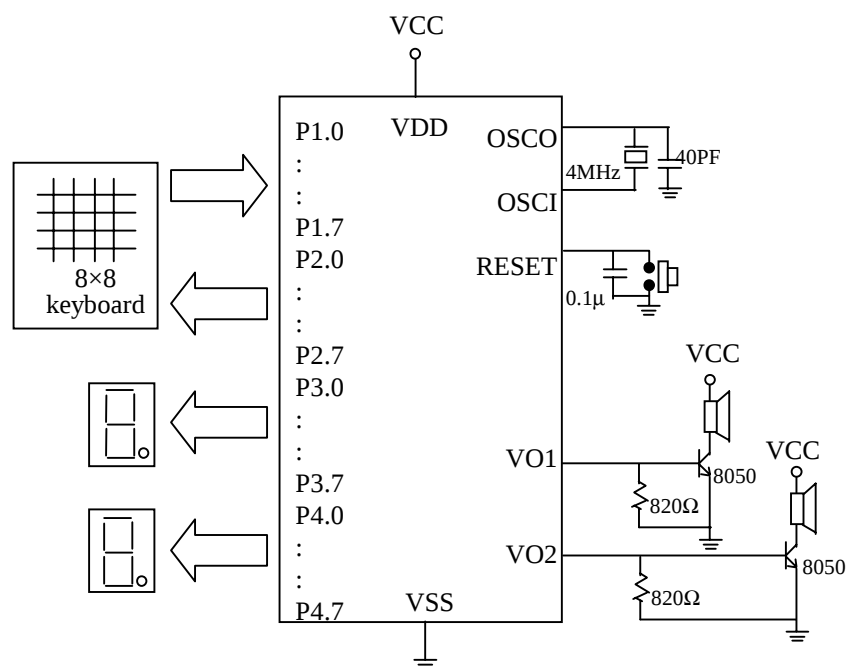
EM61100 Application circuit



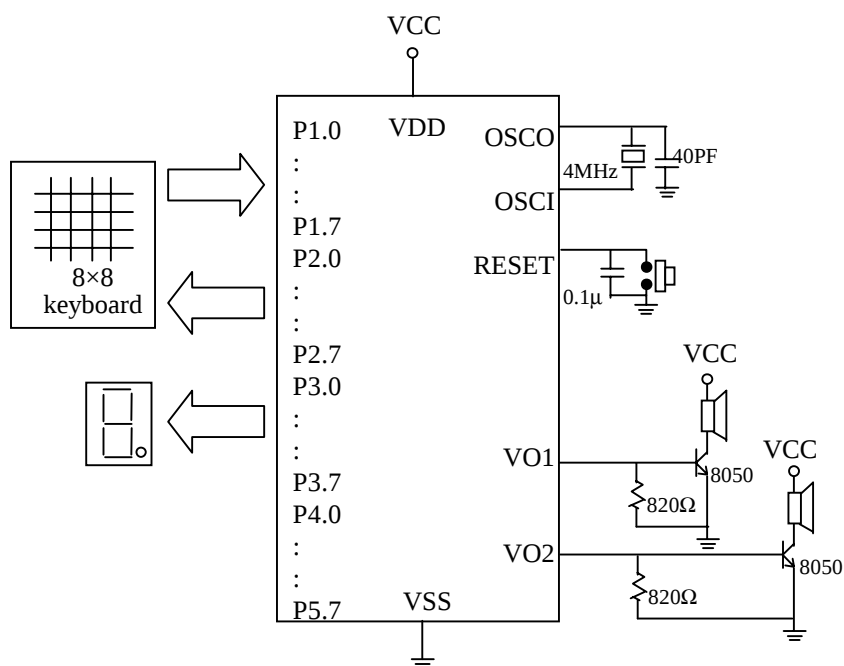
EM61200 Application circuit



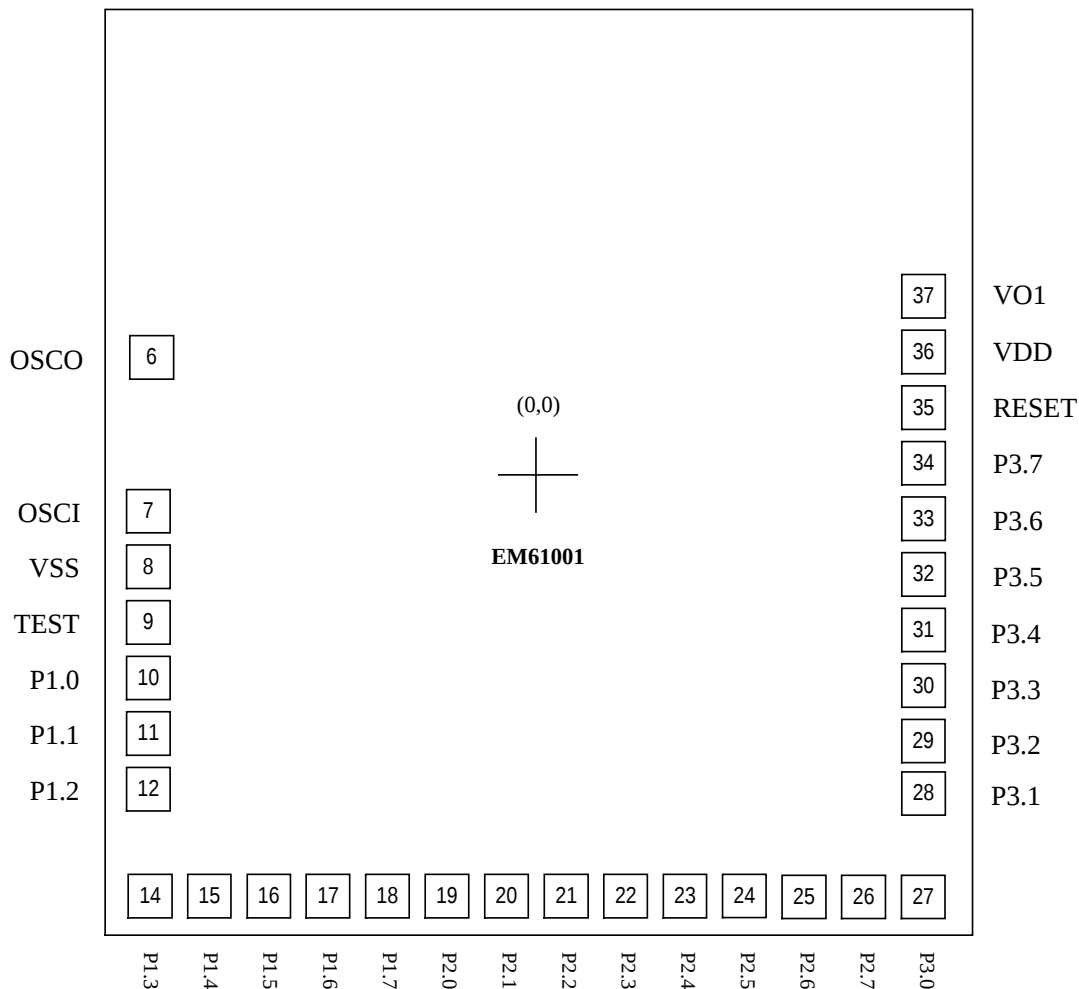
EM61300 Application circuit



EM61400 Application circuit



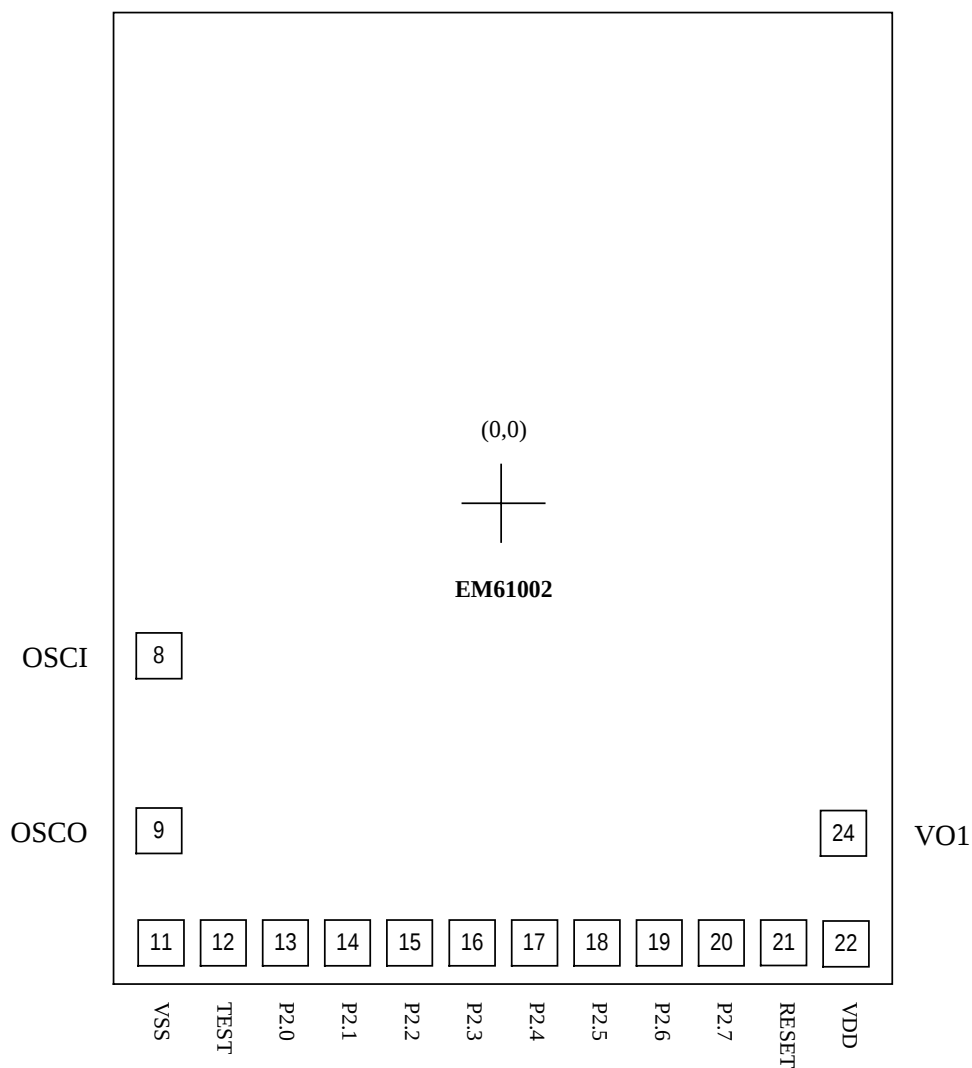
12. PAD DIAGRAM



Pin NO.	Symbol	X	Y	Pin NO.	Symbol	X	Y
1	NC			21	P2.2	60.0	-945.0
2	NC			22	P2.3	180.0	-945.0
3	NC			23	P2.4	300.0	-945.0
4	NC			24	P2.5	420.0	-945.0
5	NC			25	P2.6	540.0	-945.0
6	OSCO	-785.0	266.1	26	P2.7	660.0	-945.0
7	OSCI	-785.0	-94.7	27	P3.0	780.0	-945.0
8	VSS	-785.0	-214.7	28	P3.1	785.0	-694.7
9	TEST	-785.0	-334.7	29	P3.2	785.0	-574.7
10	P1.0	-785.0	-454.7	30	P3.3	785.0	-454.7
11	P1.1	-785.0	-574.7	31	P3.4	785.0	-334.7
12	P1.2	-785.0	-694.7	32	P3.5	785.0	-214.7
13	NC			33	P3.6	785.0	-94.7
14	P1.3	-780.0	-945.0	34	P3.7	785.0	25.3
15	P1.4	-660.0	-945.0	35	RESET	785.0	145.3
16	P1.5	-540.0	-945.0	36	VDD	785.0	265.5
17	P1.6	-420.0	-945.0	37	VO1	785.0	395.3
18	P1.7	-300.0	-945.0	38	NC		
19	P2.0	-180.0	-945.0	39	NC		
20	P2.1	-60.0	-945.0	40	NC		

Chip size : 1860 * 2180 um

For PCB layout, IC substrate must be connected to Vss.

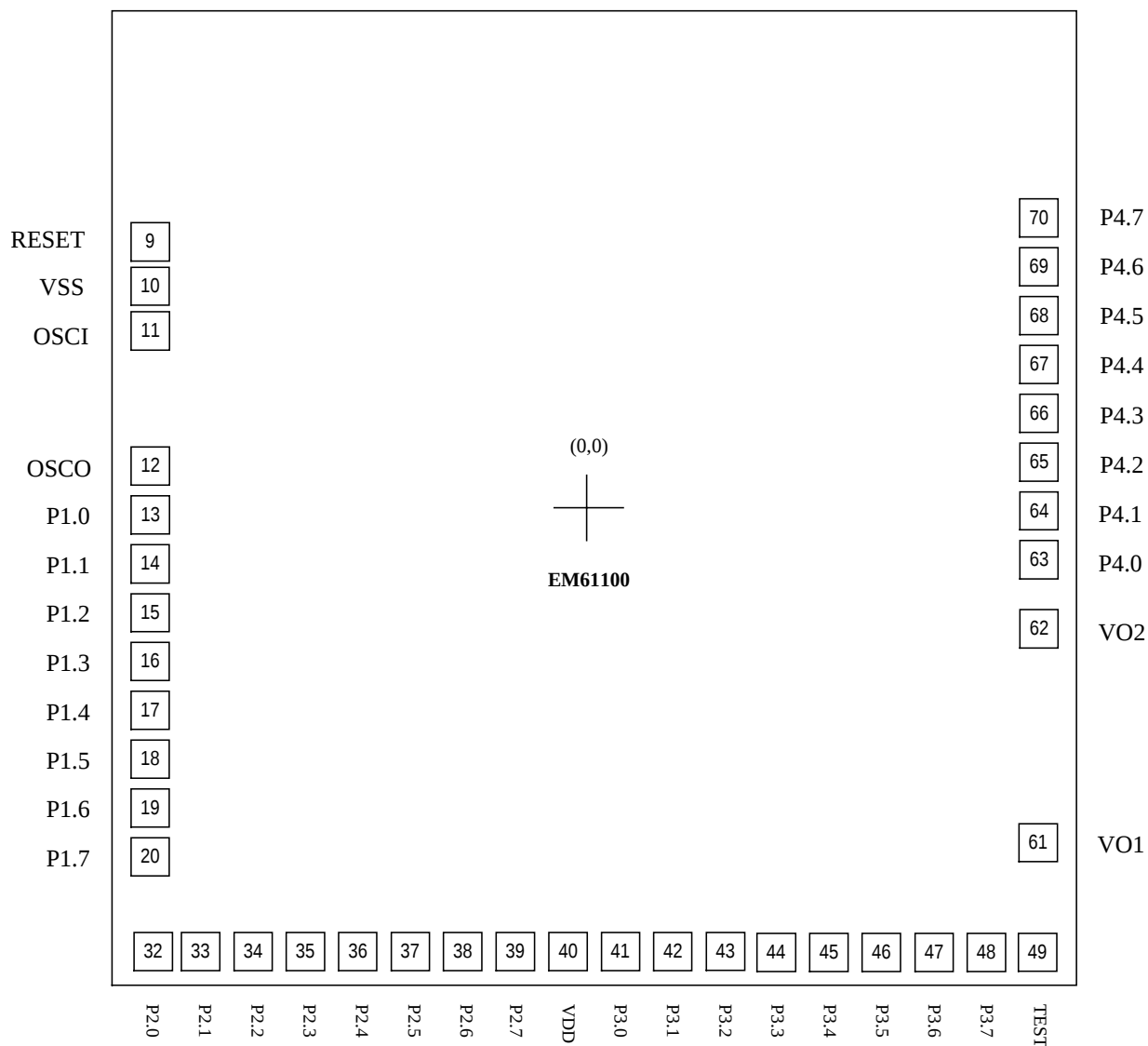


Pin NO.	Symbol	X	Y
1	NC		
2	NC		
3	NC		
4	NC		
5	NC		
6	NC		
7	NC		
8	OSCI	-670.0	-278.9
9	OSCO	-670.0	-639.7
10	NC		
11	VSS	-660.0	-895.0
12	TEST	-540.0	-895.0
13	P2.0	-420.0	-895.0
14	P2.1	-300.0	-895.0
15	P2.2	-180.0	-895.0
16	P2.3	-60.0	-895.0

Pin NO.	Symbol	X	Y
17	P2.4	60.0	-895.0
18	P2.5	180.0	-895.0
19	P2.6	300.0	-895.0
20	P2.7	420.0	-895.0
21	RESET	540.0	-895.0
22	VDD	660.0	-895.0
23	NC		
24	VO1	670.0	-639.7
25	NC		
26	NC		
27	NC		
28	NC		
29	NC		
30	NC		
31	NC		
32	NC		

Chip size : 1630 * 2090 um

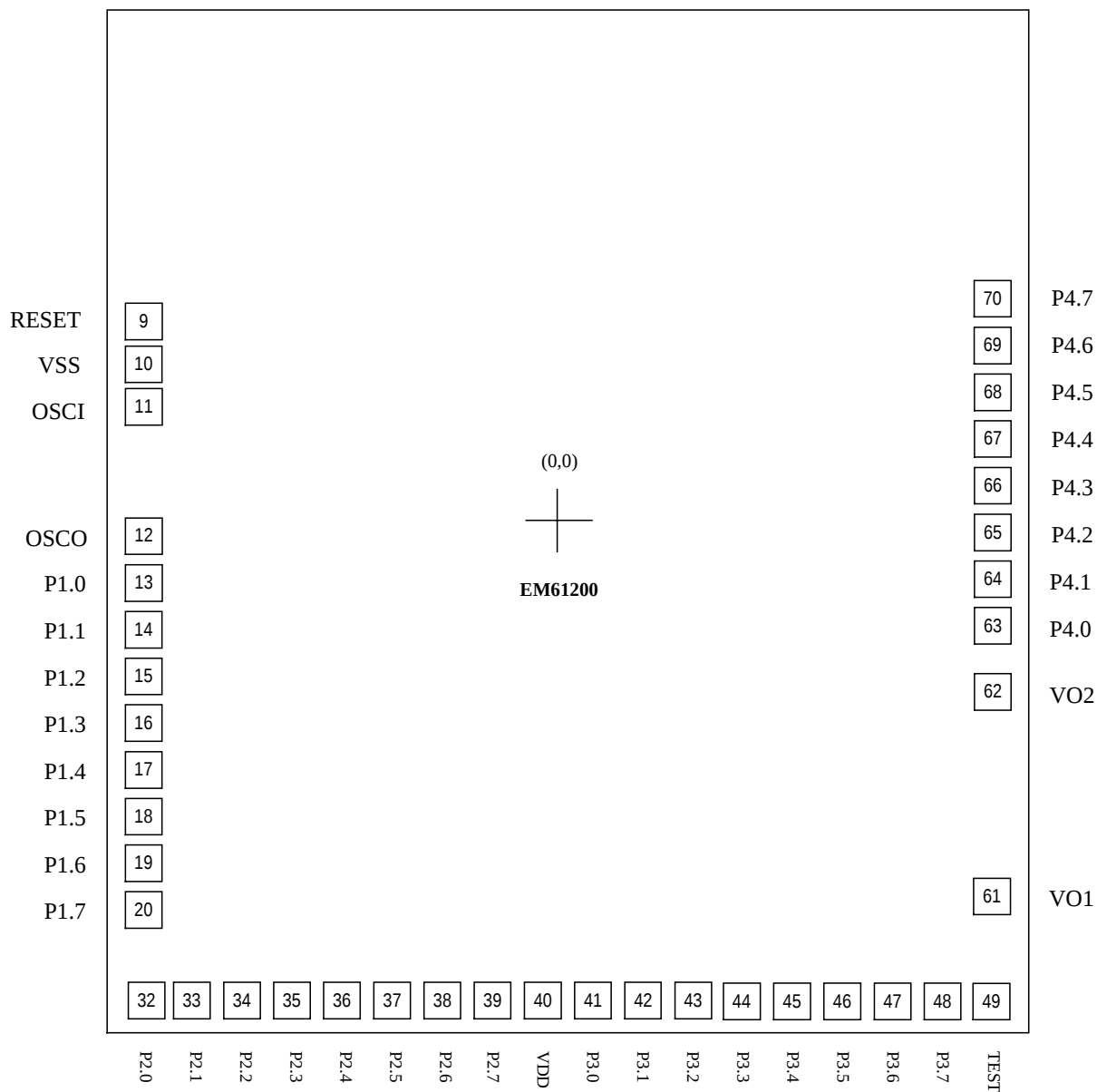
For PCB layout, IC substrate must be connected to Vss.



Pin NO.	Symbol	X	Y	Pin NO.	Symbol	X	Y
1	NC			51	NC		
2	NC			52	NC		
3	NC			53	NC		
4	NC			54	NC		
5	NC			55	NC		
6	NC			56	NC		
7	NC			57	NC		
8	NC			58	NC		
9	RESET	-1025.0	701.0	59	NC		
10	VSS	-1025.0	581.0	60	NC		
11	OSCI	-1025.0	461.0	61	VO1	1024.3	-839.4
12	OSCO	-1025.0	100.2	62	VO2	1024.3	-274.0
13	P1.0	-1025.0	-19.8	63	P4.0	1024.3	-125.0
14	P1.0	-1025.0	-139.8	64	P4.1	1024.3	-5.0
15	P1.0	-1025.0	-259.8	65	P4.2	1024.3	115.0
16	P1.0	-1025.0	-379.8	66	P4.3	1024.3	235.0
17	P1.0	-1025.0	-499.8	67	P4.4	1024.3	355.0
18	P1.0	-1025.0	-619.8	68	P4.5	1024.3	475.0
19	P1.0	-1025.0	-739.8	69	P4.6	1024.3	595.0
20	P1.0	-1025.0	-859.8	70	P4.7	1024.3	715.0
21	NC			71	NC		
22	NC			72	NC		
23	NC			73	NC		
24	NC			74	NC		
25	NC			75	NC		
26	NC			76	NC		
27	NC			77	NC		
28	NC			78	NC		
29	NC			79	NC		
30	NC			80	NC		
31	NC			81	NC		
32	P2.0	-1025.0	-1110.0	82	NC		
33	P2.1	-905.0	-1110.0	83	NC		
34	P2.2	-785.0	-1110.0	84	NC		
35	P2.3	-665.0	-1110.0	85	NC		
36	P2.4	-545.0	-1110.0	86	NC		
37	P2.5	-425.0	-1110.0	87	NC		
38	P2.6	-305.0	-1110.0	88	NC		
39	P2.7	-185.0	-1110.0	89	NC		
40	VDD	-65.0	-1110.0	90	NC		
41	P3.0	55.0	-1110.0	91	NC		
42	P3.1	175.0	-1110.0	92	NC		
43	P3.2	295.0	-1110.0	93	NC		
44	P3.3	415.0	-1110.0	94	NC		
45	P3.4	535.0	-1110.0	95	NC		
46	P3.5	655.0	-1110.0	96	NC		
47	P3.6	775.0	-1110.0	97	NC		
48	P3.7	895.0	-1110.0	98	NC		
49	TEST	1015.0	-1110.0	99	NC		
50	NC			100	NC		

Chip size : 2350 * 2520 um

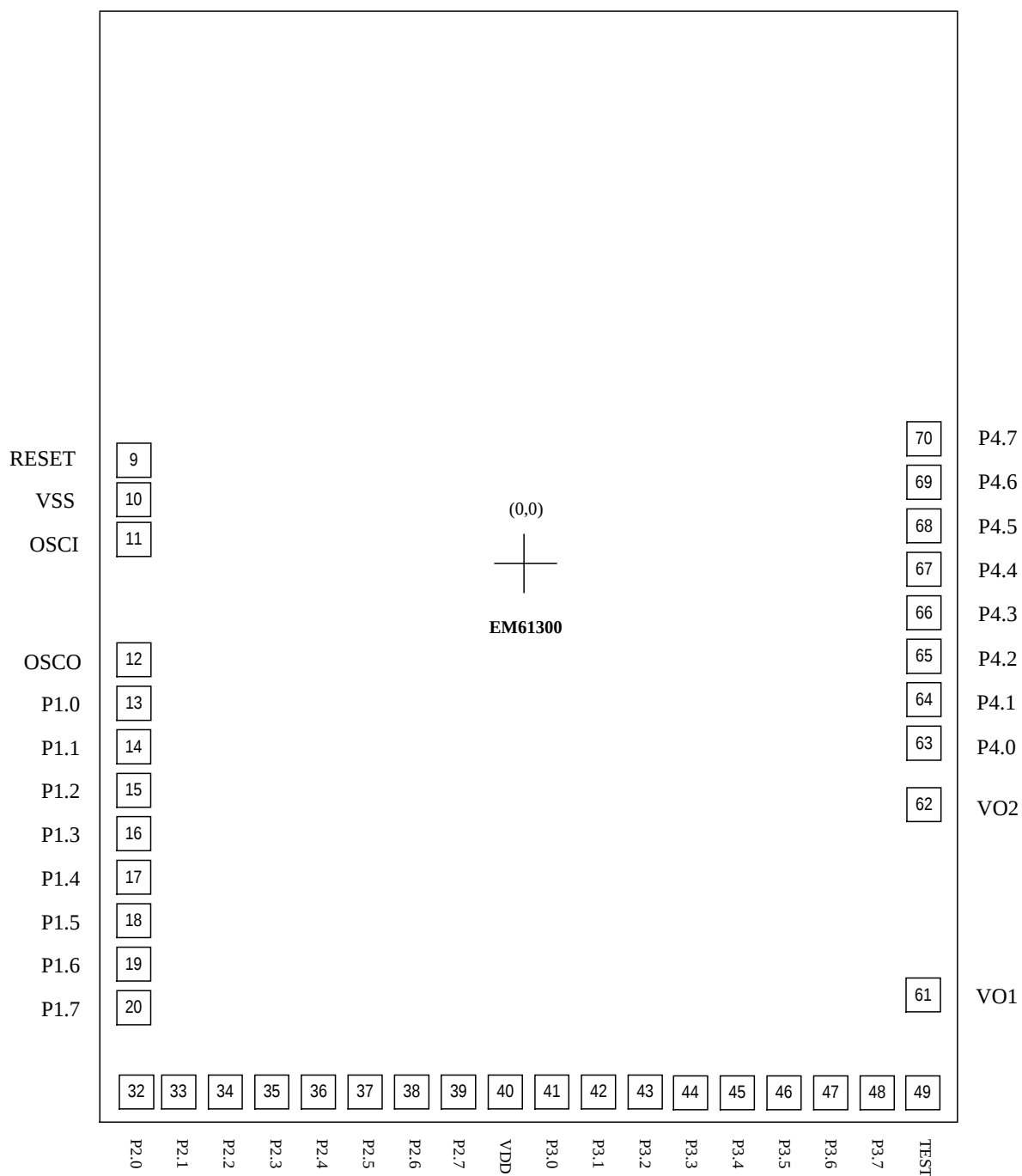
For PCB layout, IC substrate must be connected to Vss.



Pin NO.	Symbol	X	Y	Pin NO.	Symbol	X	Y
1	NC			51	NC		
2	NC			52	NC		
3	NC			53	NC		
4	NC			54	NC		
5	NC			55	NC		
6	NC			56	NC		
7	NC			57	NC		
8	NC			58	NC		
9	RESET	-1025.0	566.0	59	NC		
10	VSS	-1025.0	446.0	60	NC		
11	OSCI	-1025.0	326.0	61	VO1	1024.3	-794.4
12	OSCO	-1025.0	-34.8	62	VO2	1024.3	-409.0
13	P1.0	-1025.0	-154.8	63	P4.0	1024.3	-260.0
14	P1.0	-1025.0	-274.8	64	P4.1	1024.3	-140.0
15	P1.0	-1025.0	-394.8	65	P4.2	1024.3	-20.0
16	P1.0	-1025.0	-514.8	66	P4.3	1024.3	100.0
17	P1.0	-1025.0	-634.8	67	P4.4	1024.3	220.0
18	P1.0	-1025.0	-754.8	68	P4.5	1024.3	340.0
19	P1.0	-1025.0	-874.8	69	P4.6	1024.3	460.0
20	P1.0	-1025.0	-994.8	70	P4.7	1024.3	580.0
21	NC			71	NC		
22	NC			72	NC		
23	NC			73	NC		
24	NC			74	NC		
25	NC			75	NC		
26	NC			76	NC		
27	NC			77	NC		
28	NC			78	NC		
29	NC			79	NC		
30	NC			80	NC		
31	NC			81	NC		
32	P2.0	-1025.0	-1245.0	82	NC		
33	P2.1	-905.0	-1245.0	83	NC		
34	P2.2	-785.0	-1245.0	84	NC		
35	P2.3	-665.0	-1245.0	85	NC		
36	P2.4	-545.0	-1245.0	86	NC		
37	P2.5	-425.0	-1245.0	87	NC		
38	P2.6	-305.0	-1245.0	88	NC		
39	P2.7	-185.0	-1245.0	89	NC		
40	VDD	-65.0	-1245.0	90	NC		
41	P3.0	55.0	-1245.0	91	NC		
42	P3.1	175.0	-1245.0	92	NC		
43	P3.2	295.0	-1245.0	93	NC		
44	P3.3	415.0	-1245.0	94	NC		
45	P3.4	535.0	-1245.0	95	NC		
46	P3.5	655.0	-1245.0	96	NC		
47	P3.6	775.0	-1245.0	97	NC		
48	P3.7	895.0	-1245.0	98	NC		
49	TEST	1015.0	-1245.0	99	NC		
50	NC			100	NC		

Chip size : 2350 * 2790 um

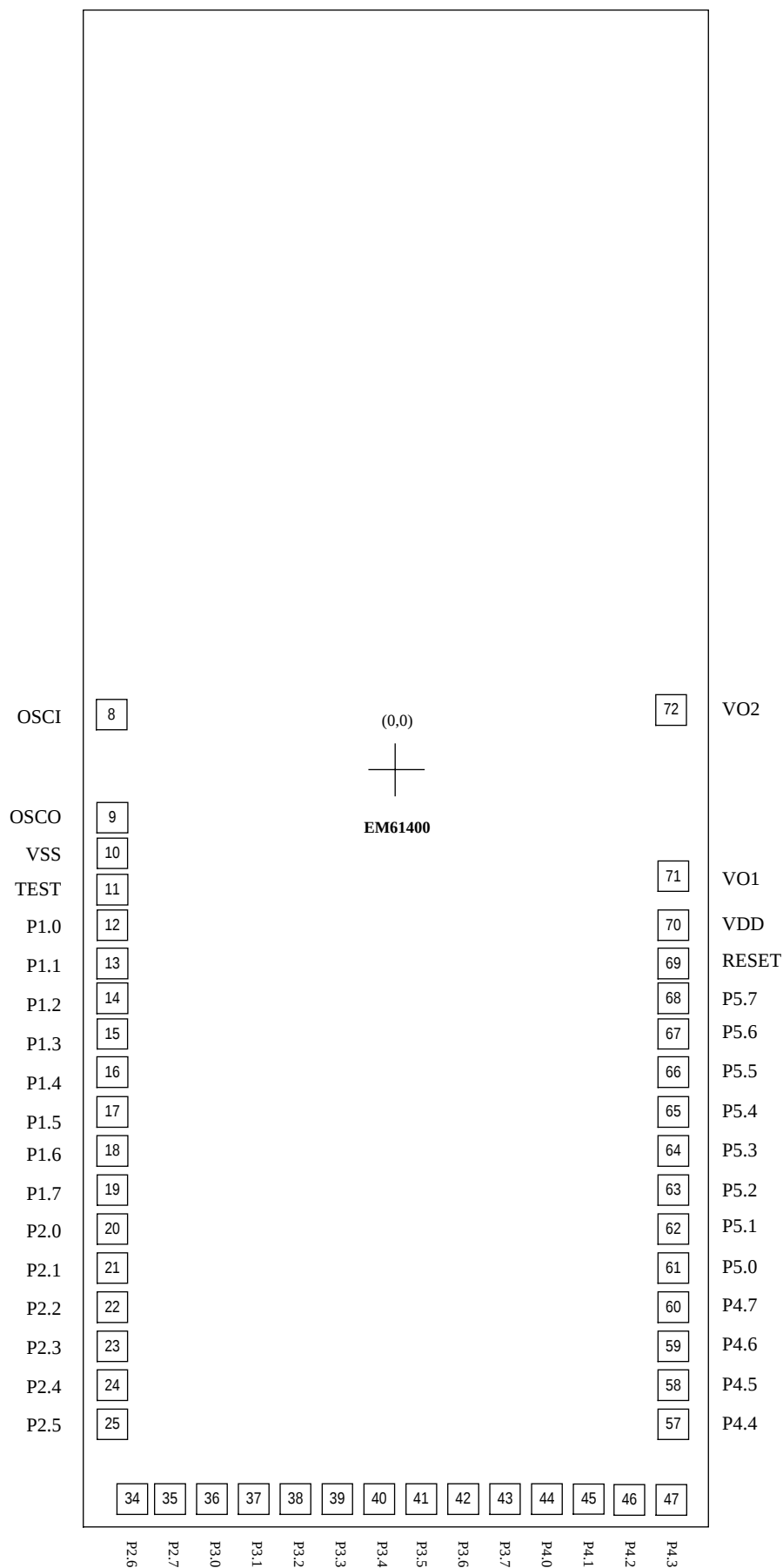
For PCB layout, IC substrate must be connected to Vss.



Pin NO.	Symbol	X	Y	Pin NO.	Symbol	X	Y
1	NC			51	NC		
2	NC			52	NC		
3	NC			53	NC		
4	NC			54	NC		
5	NC			55	NC		
6	NC			56	NC		
7	NC			57	NC		
8	NC			58	NC		
9	RESET	-1025.0	306.0	59	NC		
10	VSS	-1025.0	186.0	60	NC		
11	OSCI	-1025.0	66.0	61	VO1	1024.3	-1234.4
12	OSCO	-1025.0	-294.8	62	VO2	1024.3	-669.0
13	P1.0	-1025.0	-414.8	63	P4.0	1024.3	-520.0
14	P1.1	-1025.0	-534.8	64	P4.1	1024.3	-400.0
15	P1.2	-1025.0	-654.8	65	P4.2	1024.3	-280.0
16	P1.3	-1025.0	-774.8	66	P4.3	1024.3	-160.0
17	P1.4	-1025.0	-894.8	67	P4.4	1024.3	-40.0
18	P1.5	-1025.0	-1017.8	68	P4.5	1024.3	80.0
19	P1.6	-1025.0	-1134.8	69	P4.6	1024.3	200.0
20	P1.7	-1025.0	-1254.8	70	P4.7	1024.3	320.0
21	NC			71	NC		
22	NC			72	NC		
23	NC			73	NC		
24	NC			74	NC		
25	NC			75	NC		
26	NC			76	NC		
27	NC			77	NC		
28	NC			78	NC		
29	NC			79	NC		
30	NC			80	NC		
31	NC			81	NC		
32	P2.0	-1025.0	-1505.0	82	NC		
33	P2.1	-905.0	-1505.0	83	NC		
34	P2.2	-785.0	-1505.0	84	NC		
35	P2.3	-665.0	-1505.0	85	NC		
36	P2.4	-545.0	-1505.0	86	NC		
37	P2.5	-425.0	-1505.0	87	NC		
38	P2.6	-305.0	-1505.0	88	NC		
39	P2.7	-185.0	-1505.0	89	NC		
40	VDD	-65.0	-1505.0	90	NC		
41	P3.0	55.0	-1505.0	91	NC		
42	P3.1	175.0	-1505.0	92	NC		
43	P3.2	295.0	-1505.0	93	NC		
44	P3.3	415.0	-1505.0	94	NC		
45	P3.4	535.0	-1505.0	95	NC		
46	P3.5	655.0	-1505.0	96	NC		
47	P3.6	775.0	-1505.0	97	NC		
48	P3.7	895.0	-1505.0	98	NC		
49	TEST	1015.0	-1505.0	99	NC		
50	NC			100	NC		

Chip size : 2390 * 3530 um

For PCB layout, IC substrate must be connected to Vss.



Pin NO.	Symbol	X	Y	Pin NO.	Symbol	X	Y
1	NC			51	NC		
2	NC			52	NC		
3	NC			53	NC		
4	NC			54	NC		
5	NC			55	NC		
6	NC			56	NC		
7	NC			57	P4.4	745.0	-1975.0
8	OSCI	-745.0	180.5	58	P4.5	745.0	-1865.0
9	OSCO	-745.0	-205.0	59	P4.6	745.0	-1755.0
10	VSS	-745.0	-315.0	60	P4.7	745.0	-1645.0
11	TEST	-745.0	-425.0	61	P5.0	745.0	-1535.0
12	P1.0	-745.0	-535.0	62	P5.1	745.0	-1425.0
13	P1.1	-745.0	-645.0	63	P5.2	745.0	-1315.0
14	P1.2	-745.0	-755.0	64	P5.3	745.0	-1205.0
15	P1.3	-745.0	-865.0	65	P5.4	745.0	-1095.0
16	P1.4	-745.0	-975.0	66	P5.5	745.0	-985.0
17	P1.5	-745.0	-1085.0	67	P5.6	745.0	-875.0
18	P1.6	-745.0	-1195.0	68	P5.7	745.0	-765.0
19	P1.7	-745.0	-1305.0	69	RESET	745.0	-655.0
20	P2.0	-745.0	-1415.0	70	VDD	745.0	-545.0
21	P2.1	-745.0	-1525.0	71	VO1	755.0	-375.4
22	P2.2	-745.0	-1635.0	72	VO2	755.0	188.7
23	P2.3	-745.0	-1745.0	73	NC		
24	P2.4	-745.0	-1855.0	74	NC		
25	P2.5	-745.0	-1965.0	75	NC		
26	NC			76	NC		
27	NC			77	NC		
28	NC			78	NC		
29	NC			79	NC		
30	NC			80	NC		
31	NC			81	NC		
32	NC			82	NC		
33	NC			83	NC		
34	P2.6	-690.0	-2235.0	84	NC		
35	P2.7	-580.0	-2235.0	85	NC		
36	P3.0	-470.0	-2235.0	86	NC		
37	P3.1	-360.0	-2235.0	87	NC		
38	P3.2	-250.0	-2235.0	88	NC		
39	P3.3	-140.0	-2235.0	89	NC		
40	P3.4	-30.0	-2235.0	90	NC		
41	P3.5	80.0	-2235.0	91	NC		
42	P3.6	190.0	-2235.0	92	NC		
43	P3.7	300.0	-2235.0	93	NC		
44	P4.0	410.0	-2235.0	94	NC		
45	P4.1	520.0	-2235.0	95	NC		
46	P4.2	630.0	-2235.0	96	NC		
47	P4.3	740.0	-2235.0	97	NC		
48	NC			98	NC		
49	NC			99	NC		
50	NC			100	NC		

Chip size : 1780 * 4760 um

For PCB layout, IC substrate must be connected to Vss.