



Patent Number : 50139, 51837, 61007 (R.O.C)
Patent Pending : 78101301,83216083 (R.O.C)

GENERAL DESCRIPTION

The EM22300 series is a series of single chip ASPCM voice synthesizers fully utilizing the VLSI technology. This full series ICs provide voice capacity ranging from 9 seconds to 60 seconds with 6K Hz sample rate. The voice content can be partitioned into sections with arbitrary length and several sections can be combined to form complete trigger group. In addition to multiple normal trigger inputs, ONEKEY trigger is provided to achieve random or sequential group play by triggering pin ONE. Besides, 4 trigger modes (level mode, one-shot with retrigger mode, one-shot without retrigger mode, and level mode with SAF1 active) of each trigger input, 3 output functions (stop pulse, active pulse and flash) and 4 output status (active high/inactive low; active low/inactive high, active high/inactive floating, active low/inactive floating) of control outputs are also provided to meet diverse applications.

FEATURES

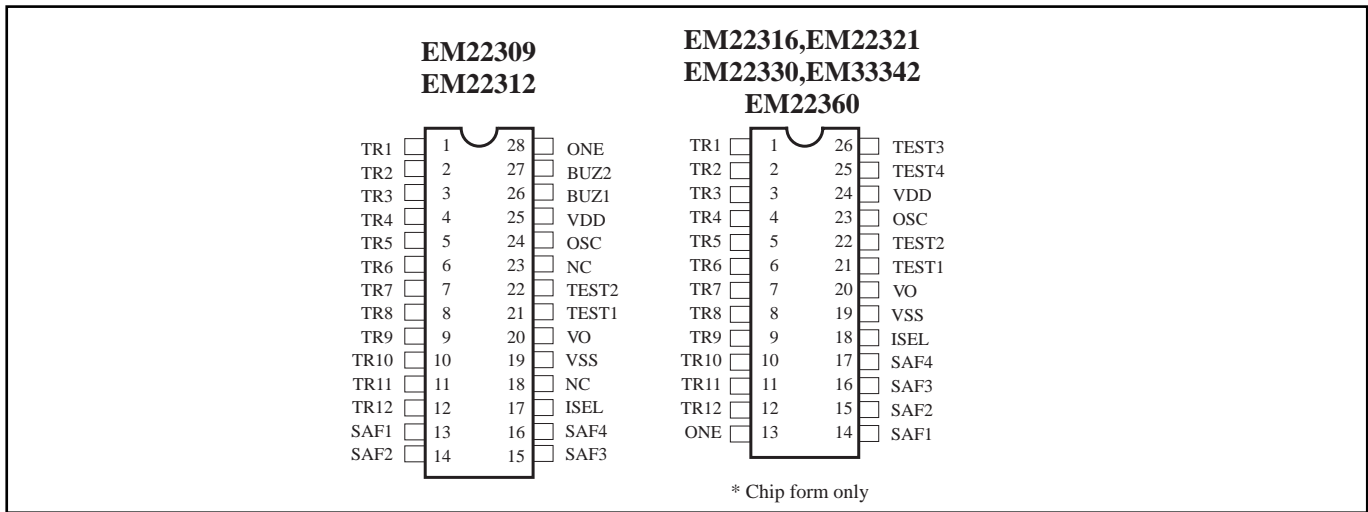
- Single power supply: 2.4V~5.0V.
- 9 seconds to 61 seconds of voice capacity (under 6K Hz sample rate) are provided as followed:

Device	22309	22312	22316	22321	22330	22342	22360
Capacity	9 sec.	12 sec.	16 sec.	21 sec.	30 sec.	42 sec.	61 sec.

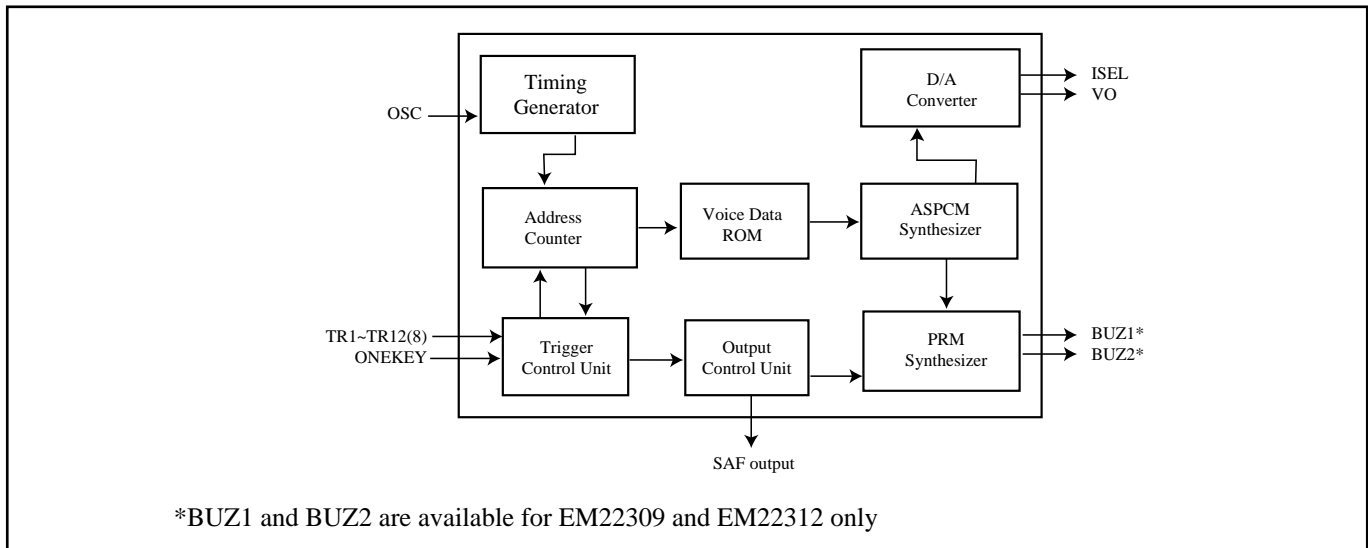
- 6K Hz / 8K Hz sample rates of each voice section is selective by mask option.
- Normal triggers and ONEKEY trigger (random/sequential) are provided.
- One of four trigger modes for each trigger input can be selected by mask option:
 - i. Level mode
 - ii. One-shot with retrigger mode
 - iii. One-shot without retrigger mode
 - iv. Level mode with SAF1 active
- Control output signals (SAF pins) for indicating or external device controlling are provided:
 - i. Three output functions, STOP, ACT and FLASH, are selectable for each control output (SAF) by mask option.
 - ii. Four output configurations, active high/active low, active low/inactive high, active high/inactive floating, and active low/inactive floating, are selectable for each control output by mask option.
- Built-in 20ms debouncing circuit for trigger inputs.
- Speaker output driver and buzzer output driver (EM22309 and EM22312) are provided.
- Selective speaker output current: 3 mA or 5 mA by pin option.



PIN ASSIGNMENT



FUNCTIONAL BLOCK DIAGRAM



PIN DESCRIPTIONS

Symbol	I/O	Function
TR1	I	Trigger input
TR2	I	Trigger input
TR3	I	Trigger input
TR4	I	Trigger input
TR5	I	Trigger input
TR6	I	Trigger input
TR7	I	Trigger input
TR8	I	Trigger input
TR9	I	Trigger input
TR10	I	Trigger input

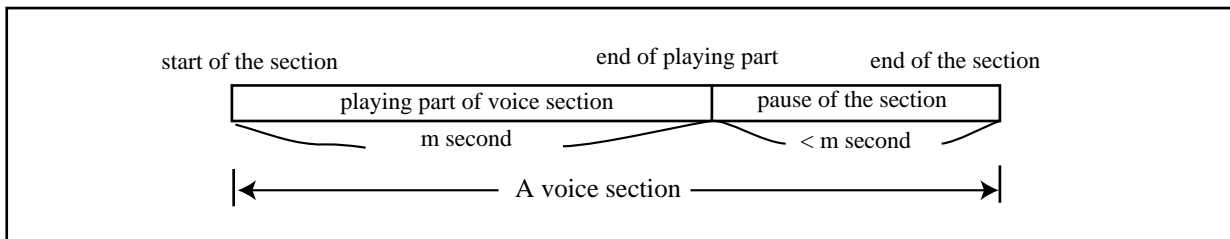
* This specification are subject to be changed without notice.

Symbol	I/O	Function
TR11	I	Trigger input (not available for EM22306)
TR12	I	Trigger input (not available for EM22306)
SAF1	O	Control output
SAF2	O	Control output
SAF3	O	Control output
SAF4	O	Control output (not available for EM22306)
ISEL	I	Output current selection pin, V_{DD} for 5mA, V_{SS} for 3mA.
V_{SS}	-	Negative power supply
VO	O	Voice output to drive speaker
TEST1	I	Test pin
TEST2	I	Test pin
OSC	-	Oscillation component connection pin
VDD	-	Positive power supply
BUZ1	O	Buzzer output pin (EM22309 and EM22312 only)
BUZ2	O	Buzzer output pin (EM22309 and EM22312 only)
TEST3	O	Test pin (for EM22316~EM22360 only)
TEST4	O	Test pin (for EM22316~EM22360 only)
ONE	I	ONEKEY trigger input

FUNCTION DESCRIPTIONS

I. Voice content

In coding procedure, voice sources are separated into voice sections with arbitrary length. The sample rate of each section is selected as either 6K Hz or 8K Hz. Pause time of voice section is defined by each voice section. The maximum pause time can not exceed duration of the playing part of voice section.



A complete trigger group is formed by combining source voice sections.
For example,

Group1: sec3+sec1+sec3+sec5.

Group2: sec4+sec1+sec2+sec2+sec5.

The maximum section combination number in a trigger group and the total available section combination number for all trigger groups are limited. These limitations vary with devices as followed:

Device	EM22309/22312/22316/22321/22330/22342/22360
Available trigger groups	12
Max. source voice section number	31
Max. section combination for each trigger group	63
Total section combinations for all trigger groups	224

II. Trigger inputs

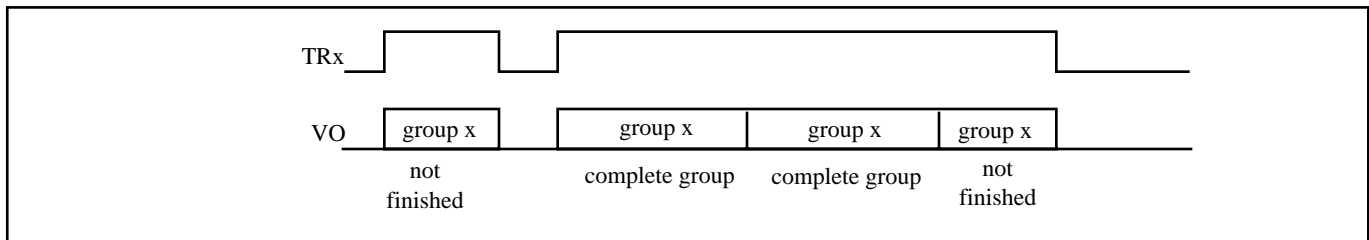
The full EM22300 series chips provide both normal trigger inputs and the ONEKEY trigger inputs. With normal trigger inputs, EM22300 plays corresponding trigger groups. The ONEKEY trigger, however, plays trigger groups sequentially or in random order by mask option. Besides, each trigger input has its own trigger mode independent to other trigger inputs. Furthermore, debouncing circuits are provided to avoid false trigger caused from noise or bouncing pulses of switches.

A. Trigger modes

There are four trigger modes which are selectable for each trigger input: level mode, one-shot with retrigger mode, one-shot without retrigger mode, and level mode with SAF1 active. Trigger modes of each trigger input are defined by mask option.

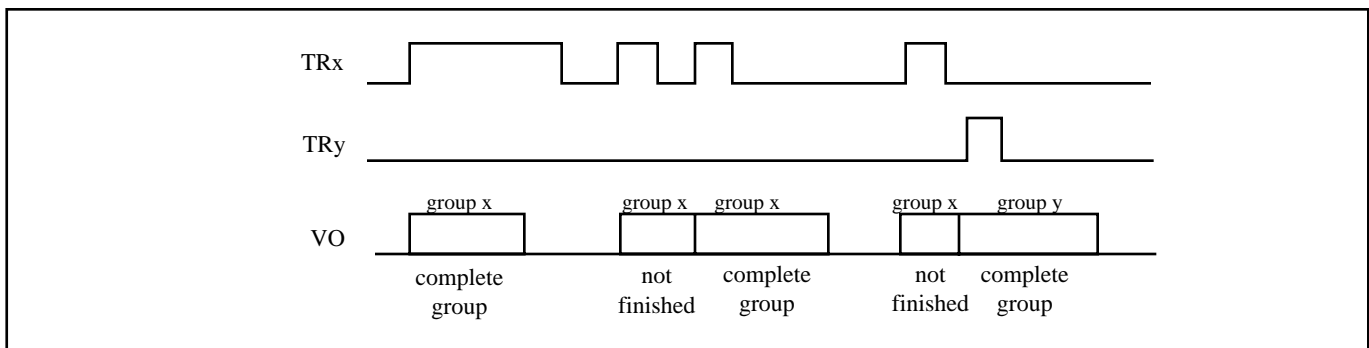
1.) Level mode

Under this mode, the trigger group corresponds to the trigger input pin (TR) will be played until the level of the TR goes low.



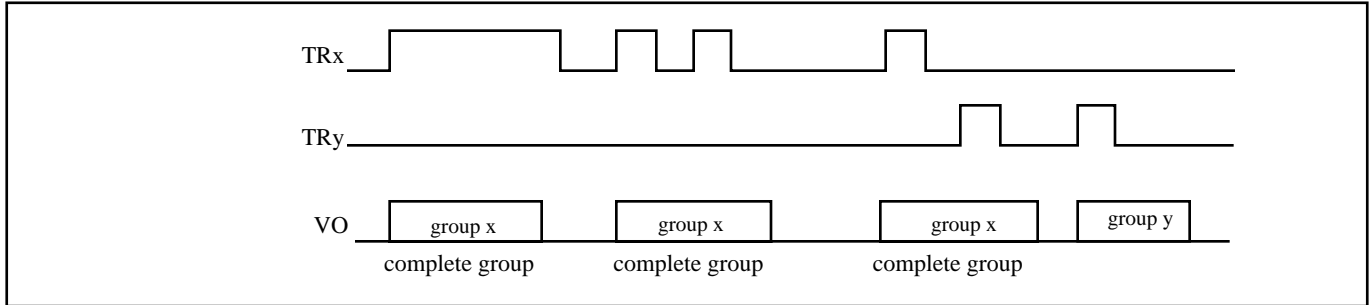
2.) One-shot with retrigger mode

Under this mode, the rising edge of TR pin triggers the corresponding trigger group. The trigger is accepted whenever a pulse is applied on the TR pin.



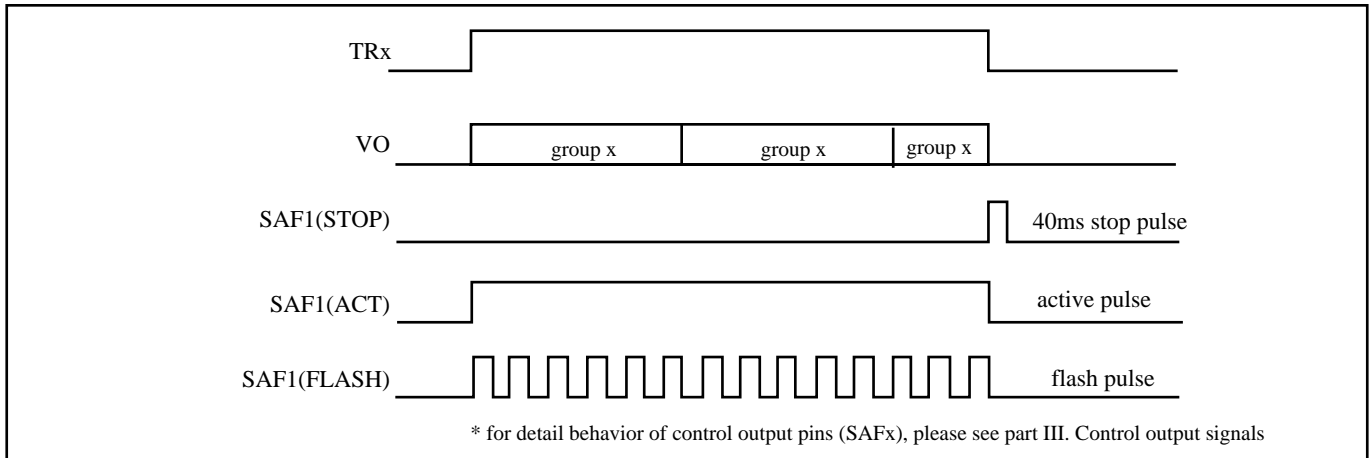
3.) One-shot without retrigger mode

Similar to one-shot with retrigger mode, rising edge of TR pin of this mode triggers the corresponding trigger group, too. The difference is that under one-shot without retrigger mode, however, triggers are accepted only when there's no voice playing.



4.) Level mode with SAF1 active

Like level mode, the triggered group plays recursively as long as the level of TR pin remains high. Furthermore, the output control pin SAF1 outputs active signal in response to the active trigger with this mode.



B. Normal triggers and ONEKEY trigger

Normal trigger plays its corresponding trigger group with its own trigger mode. On the contrary, ONEKEY trigger plays multiple voice groups with random or sequential order selected by mask option. Maximum ONEKEY play groups, which cannot exceed the total used trigger group, is defined by mask option. By triggering pin ONE, EM22300 plays groups within group 1 to this maximum ONEKEY play group number.

If the play mode of ONEKEY trigger is selected to be 'SEQUENTIAL', the 'RESET' function can be enabled/disabled by mask option. When 'RESET' is enabled, user can reset the sequential playing sequence to group one by triggering the highest trigger input pin (TR12 for other EM22300 bodies).

example (EM22312):

- a.) ONEKEY sequential play with "RESET" disabled, the maximum ONEKEY play group is optioned to be 5:
playing sequence: group1, group2, group12, group3, group4, group5, group1, group2, ... (playing sequence is not affected although TR12 is accepted).

- b.) ONEKEY sequential play with 'RESET' enabled, the maximum ONEKEY play group is optioned to be 5:
 playing sequence: group1, group2, group12, group1, group2, group3, group4, group5, group1, group2, ...
 (the playing sequence is reset to group 1 after TR12 is accepted).
- c.) ONEKEY random play, the maximum ONEKEY play group is optioned to be 6:
 playing sequence: group4, group1, group6, group2, group3, ...
 (trigger group lager than 6 will never appear).

C. Debouncing circuit

To prevent possible unwanted trigger caused from bouncing pulses or noise, any bouncing pulse shorter than 20ms is ignored by the debouncing circuit. User should be aware that sufficient trigger pulse width should be applied on trigger inputs when interfacing EM22300 to microprocessors.

III. Control output signals

EM22300 series offers several configurable control output signals for external control:

Device	Number of control outputs	Symbol
EM22309,EM22312,EM22316 EM22321,EM22330,EM22342,EM22360	4	SAF1, SAF2, SAF3, SAF4

There are three output functions for each control output pin optional by mask optin. These functions are defined as followed:

Output type	Description
STOP	Output a 40ms active pulse as soon as section playing is stop
ACT	Output a steady active pulse while voice section is playing
FLASH	Output flash pulses while voice section is playing

Whether an SAF pin issues control output signal or not is defined section by section in coding procedure. If the issue of an SAF pin is enabled by a section, it will send out control output signal according to the option of output function (STOP, ACT or FLASH).

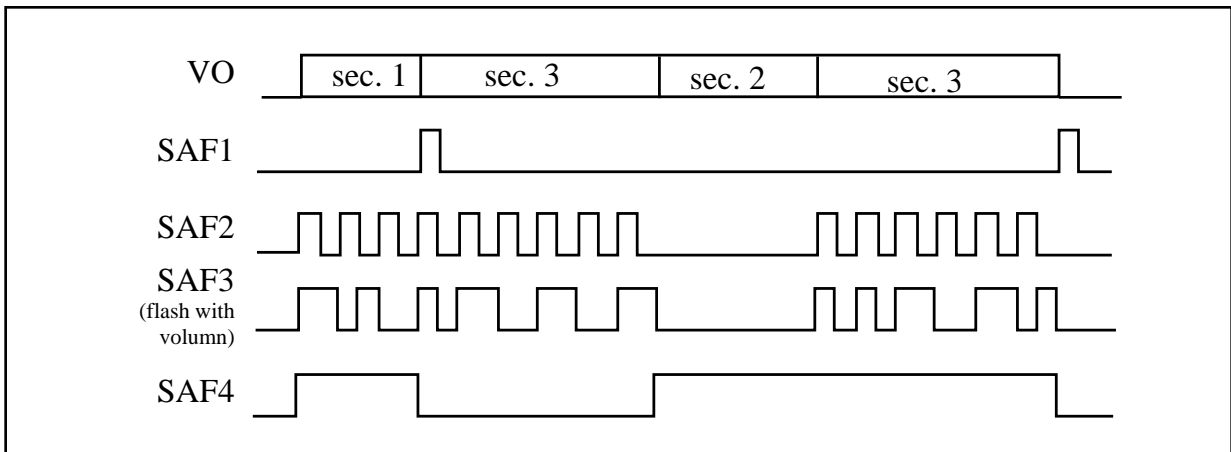
For example, the output function of SAF pins are set to be:

- SAF1 : STOP
- SAF2 : FLASH
- SAF3 : FLASH
- SAF4 : ACT

The option of control output signal corresponds to the sections in group m is:

Group m	sec.1	sec.3	sec.2	sec.3
SAF1:	enable	disable	disable	enable
SAF2:	enable	enable	disable	enable
SAF3:	enable	enable	disable	enable
SAF4:	enable	disable	enable	enable

When group m is playing, the output waveform is:



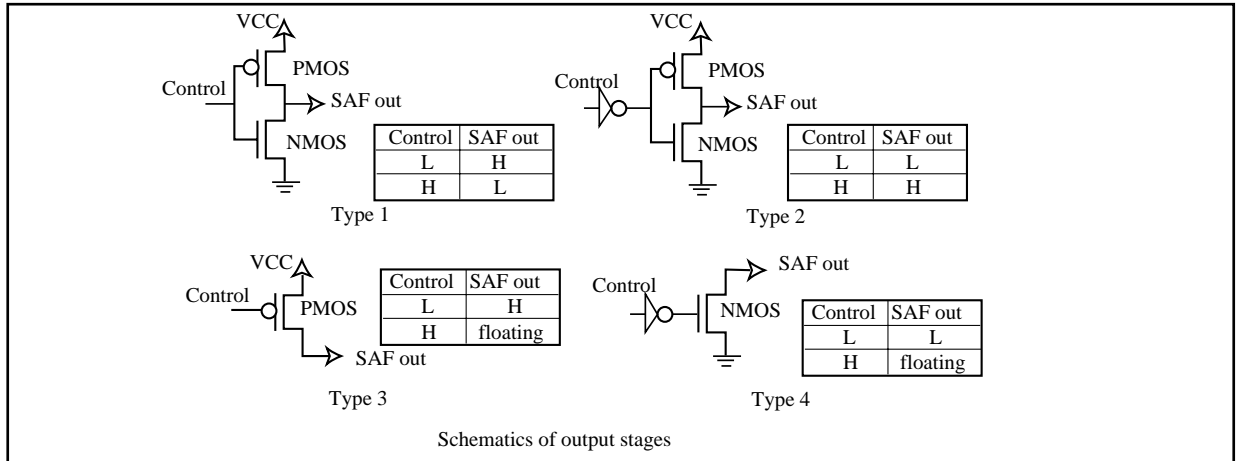
Note: For level with SAF1 active trigger mode, SAF1 is always enabled to issue the control output signal in response to the playing trigger group.

If the output function is selected to be "FLASH", 4 flash styles can be selected by mask option. These flash styles vary with control output pins as shown below:

Style	Function	Flash style available pins	Description
1	Regular flash	SAF1,SAF2	Output flash pulses of 6 Hz, 50% duty cycle
2	Regular flash	SAF1,SAF2	Output flash pulses of 12 Hz, 50% duty cycle
3	Flash inversely (INV)	SAF1,SAF2	If output types of SAF1 and SAF2 are both 'flash', they can be chosen to flash with opposite phase (INV) or synchronous (non-INV) to each other by mask option.
4	Flash with volume	SAF3,SAF4	Output flash pulses flash with voice volume

Besides, EM22300 provide four output configurations of each control output signals which offer users to achieve flexible application with external components. The four output configurations are shown below:

Type	Output configuration	Symbol
1	Active high, inactive low	HL
2	Active low,inactive high	LH
3	Active high,inactive floating	HF
4	Active low,inactive floating	LF



IV. Output driver

EM22300 series provide output circuits to drive speaker. Moreover, EM22309 and EM22312 provide driver to drive piezo-buzzer directly. Two selective output current levels of VO can be selected by pin ISEL. By connecting ISEL to V_{DD} , VO outputs driving current with high level which full scale is 5mA. VO outputs driving current with low level which full scale is 3mA if ISEL is connected to V_{SS} .

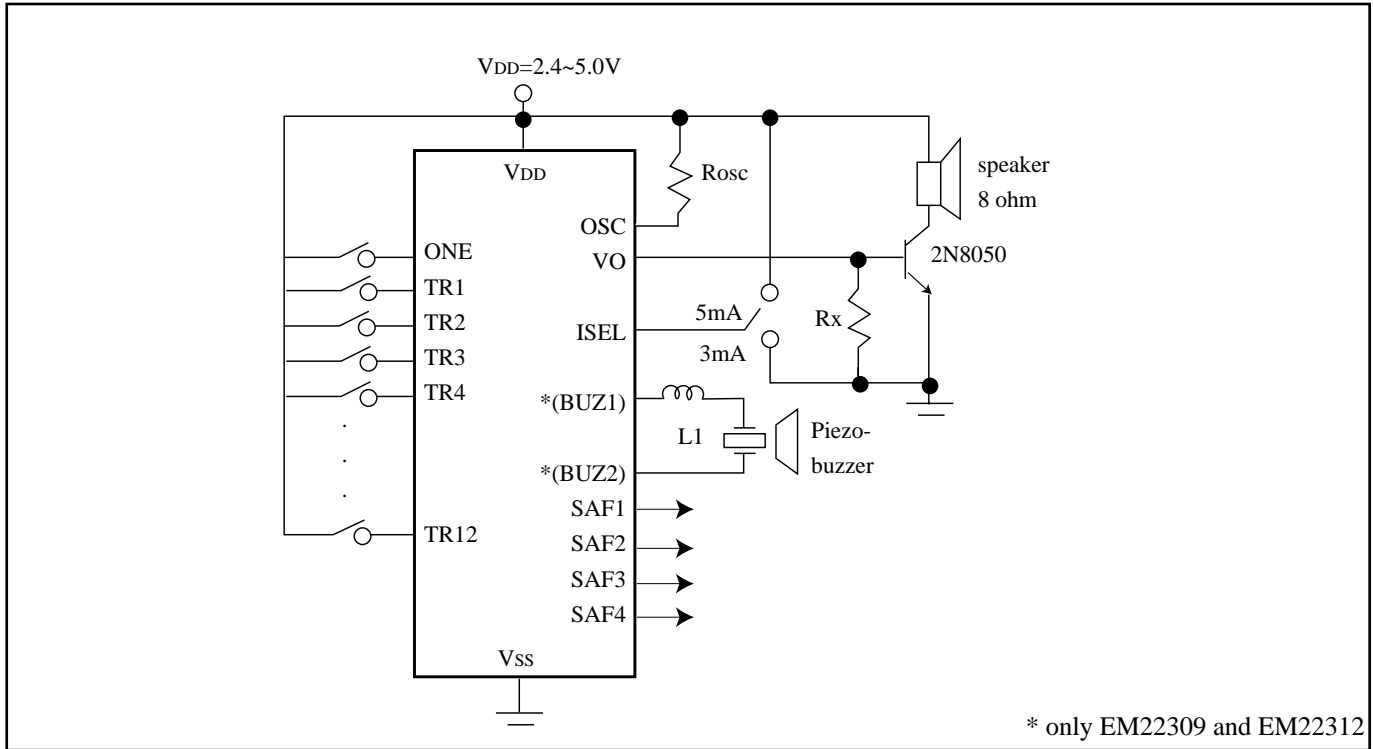
ABSOLUTE MAXIMUM RATING

Parameter	Symbol	Conditions	Rating	Unit
Power supply	$V_{DD} - V_{SS}$	-	-0.3 ~ +6.0	V
Input voltage	V_{IN}	All inputs	$V_{SS} - 0.3 \sim V_{DD} + 0.3$	V
Operating temperature	T_{OPR}	-	0 ~ 50	°C
Storage temperature	T_{STG}	-	-55 ~ +125	°C

ELECTRICAL CHARACTERISTICS ($T_{OPR} = 25^{\circ}C$)

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Operating voltage	V_{DD}	2.4	-	5.0	V	
Standby current	I_{dss}	-	-	1.0	μA	$V_{DD} = 3.0V$
Operating current	I_{ddo}	-	100	250	μA	$V_{DD} = 3.0V$, no load
Input current of trigger pins	I_{ih}	-	3.0	10	μA	$V_{DD} = 3.0V$
Full scale output current of VO	I_{vo}	2.0	3.0	4.0	mA	$V_{DD} = 2.6 \sim 5.0V$, VO=0.7V, ISEL='L'
		4.0	5.0	6.0		$V_{DD} = 2.6 \sim 5.0V$, VO=0.7V, ISEL='H'
Driver/sink current of BUZ1, BUZ2	I_{vob}	15	25	35	mA	$V_{DD} = 3.0V$, output voltage=1.5V
Driver current of SAF outputs	I_{oh}	1.0	-	-	mA	$V_{DD} = 3.0V$, output voltage=2.4V
Sink current of SAF outputs	I_{ol}	1.6	-	-	mA	$V_{DD} = 3.0V$, output voltage=0.4V
Oscillation resistor	R_{osc}	-	1.2	-	M Ω	for EM22309, EM22312, EM22342, EM22360
		-	820	-	K Ω	for EM22316, EM22321, EM22330

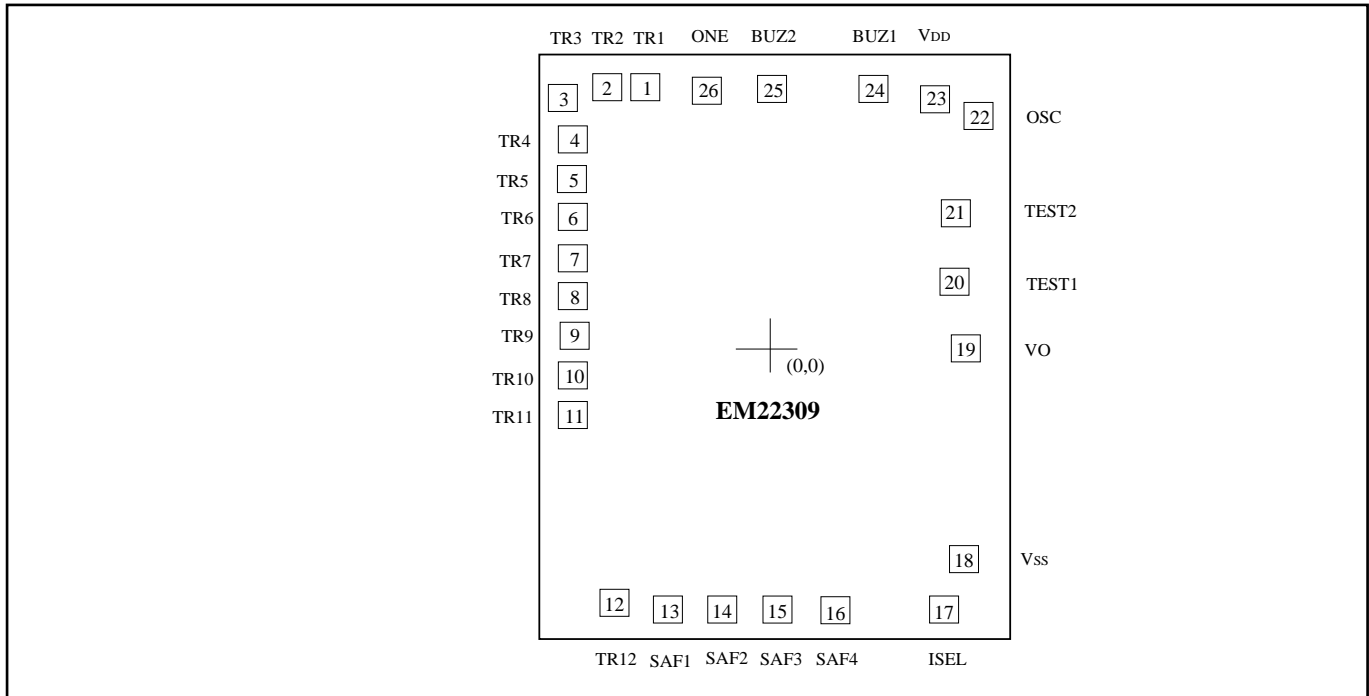
APPLICATION CIRCUIT



* only EM22309 and EM22312



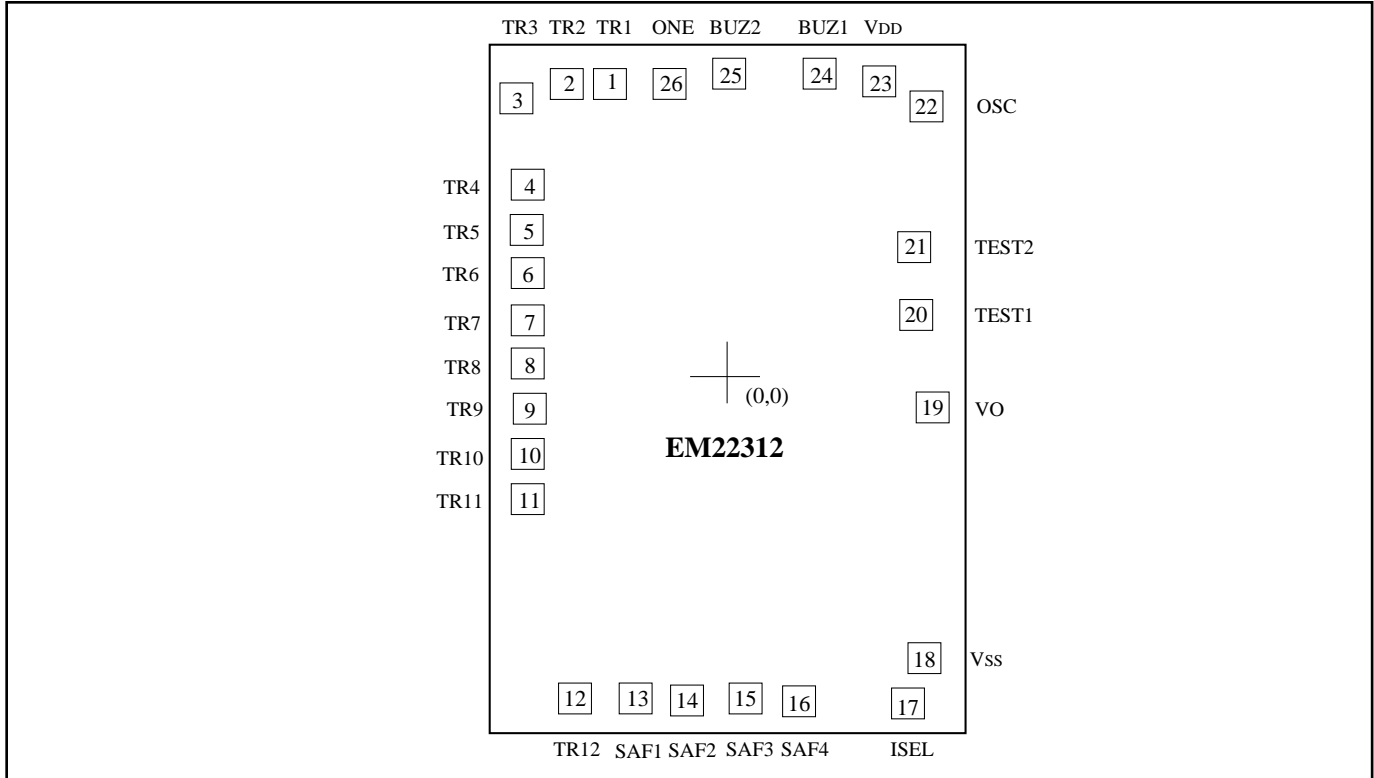
PAD DIAGRAM



Chip Size : 2040 x 2730 μm

Pad No.	Symbol	X	Y
1	TR1	-495.4	1151.8
2	TR2	-639.4	1151.8
3	TR3	-845.8	1115.1
4	TR4	-810.0	711.8
5	TR5	-810.0	552.5
6	TR6	-810.0	405.8
7	TR7	-810.0	246.5
8	TR8	-810.0	99.8
9	TR9	-810.0	-59.5
10	TR10	-810.0	-206.2
11	TR11	-810.0	-365.5
12	TR12	-665.1	-1191.1
13	SAF1	-416.6	-1201.0

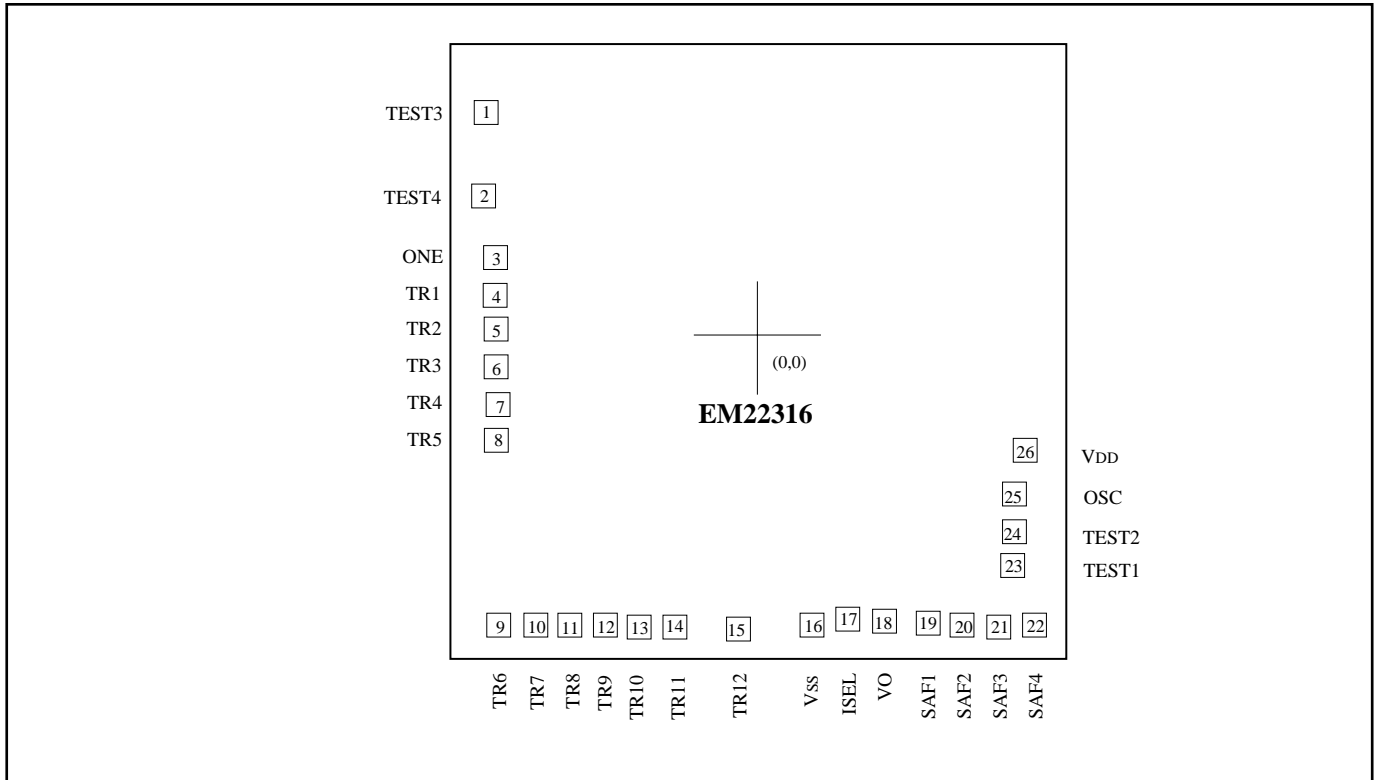
Pad No.	Symbol	X	Y
14	SAF2	-184.9	-1201.0
15	SAF3	46.2	-1201.0
16	SAF4	277.9	-1201.0
17	ISEL	708.1	-1201.0
18	V _{SS}	825.7	-1049.4
19	VO	821.0	8.7
20	TEST1	772.8	199.2
21	TEST2	772.8	494.2
22	OSC	839.2	1085.9
23	V _{DD}	646.3	1129.5
24	BUZ1	415.8	1161.7
25	BUZZ	-31.7	1161.7
26	ONE	-245.7	1151.8



Chip Size : 2040 x 2730 μm

Pad No.	Symbol	X	Y
1	TR1	-495.4	1151.8
2	TR2	-639.4	1151.8
3	TR3	-845.8	1115.1
4	TR4	-810.0	711.8
5	TR5	-810.0	552.5
6	TR6	-810.0	405.8
7	TR7	-810.0	246.5
8	TR8	-810.0	99.8
9	TR9	-810.0	-59.5
10	TR10	-810.0	-206.2
11	TR11	-810.0	-365.5
12	TR12	-665.1	-1191.1
13	SAF1	-416.6	-1201.0

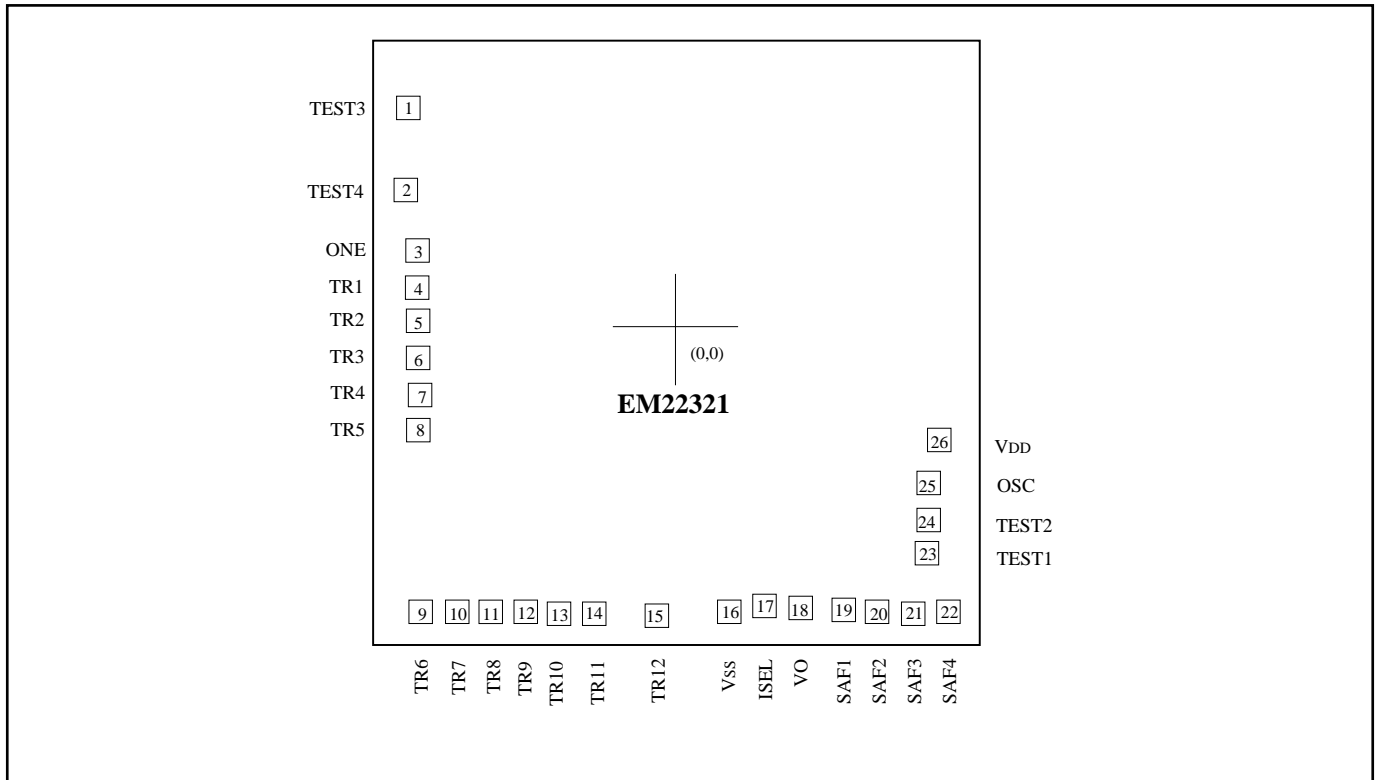
Pad No.	Symbol	X	Y
14	SAF2	-184.9	-1201.0
15	SAF3	46.2	-1201.0
16	SAF4	277.9	-1201.0
17	ISEL	708.1	-1201.0
18	V _{SS}	825.7	-1049.4
19	VO	821.0	8.7
20	TEST1	772.8	199.2
21	TEST2	772.8	494.2
22	OSC	839.2	1085.9
23	V _{DD}	646.3	1129.5
24	BUZ1	415.8	1161.7
25	BUZ2	-31.7	1161.7
26	ONE	-245.7	1151.8



Chip Size : 2950 x 2940 μm

Pad No.	Symbol	X	Y
1	TEST3	-1286.2	1091.9
2	TEST4	-1286.2	640.8
3	ONE	-1258.8	379.0
4	TR1	-1258.8	229.6
5	TR2	-1258.8	70.3
6	TR3	-1258.8	-79.1
7	TR4	-1258.8	-238.4
8	TR5	-1258.8	-387.8
9	TR6	-1246.6	-1253.8
10	TR7	-1087.5	-1253.8
11	TR8	-938.1	-1253.8
12	TR9	-778.9	-1253.8
13	TR10	-629.5	-1253.8

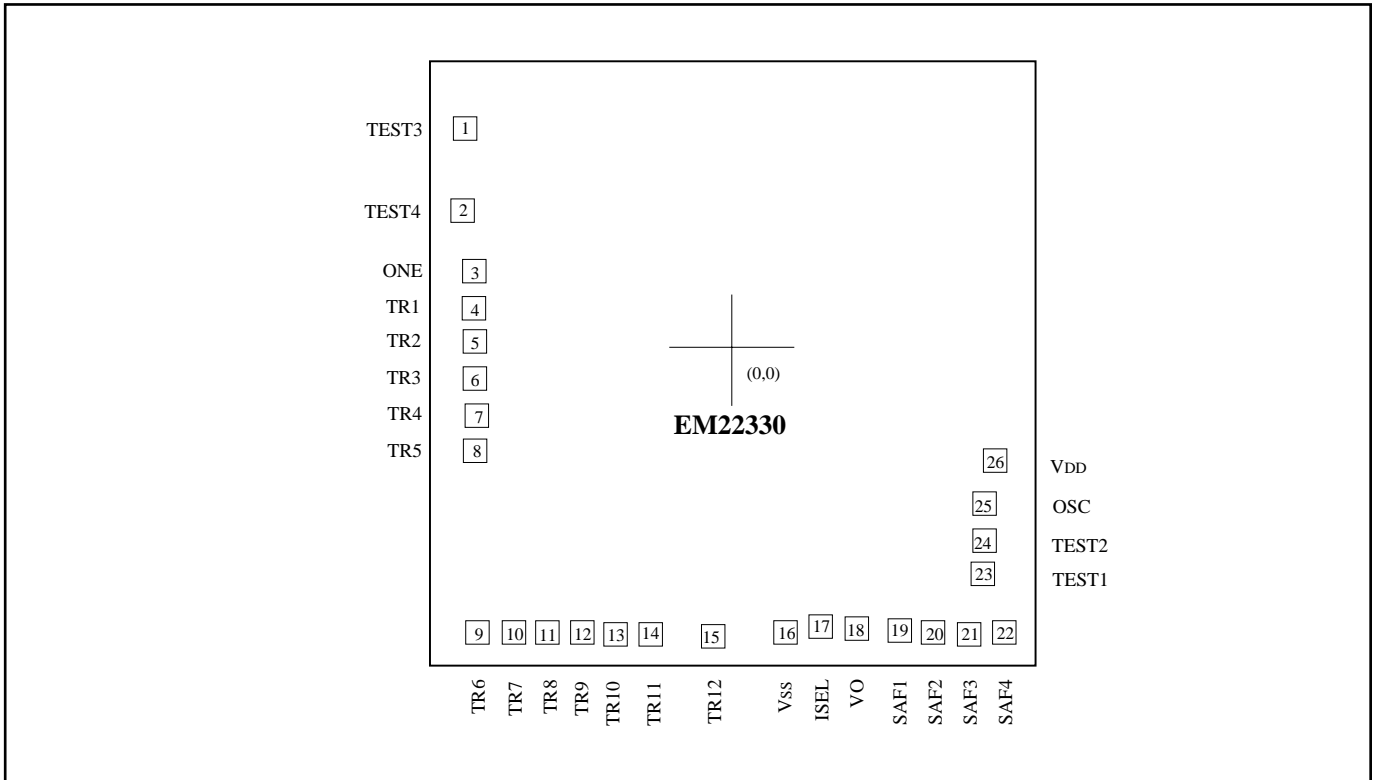
Pad No.	Symbol	X	Y
14	TR11	-470.4	-1253.8
15	TR12	-129.5	-1253.8
16	V _{SS}	280.1	-1253.8
17	ISEL	429.6	-1222.5
18	VO	596.1	-1227.6
19	SAF1	793.6	-1223.7
20	SAF2	942.1	-1223.7
21	SAF3	1103.0	-1223.7
22	SAF4	1251.5	-1223.7
23	TEST1	1216.8	-981.0
24	TEST2	1216.8	-837.0
25	OSC	1215.2	-660.8
26	V _{DD}	1275.3	-500.1



Chip Size : 2950 x 2940 μm

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1	TEST3	-1286.2	1091.9
2	TEST4	-1286.2	640.8
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7	TR4	-1258.8	-238.4
8	TR5	-1258.8	-387.8
9	TR6	-1246.6	-1253.8
10	TR7	-1087.5	-1253.8
11	TR8	-938.1	-1253.8
12	TR9	-778.9	-1253.8
13	TR10	-629.5	-1253.8

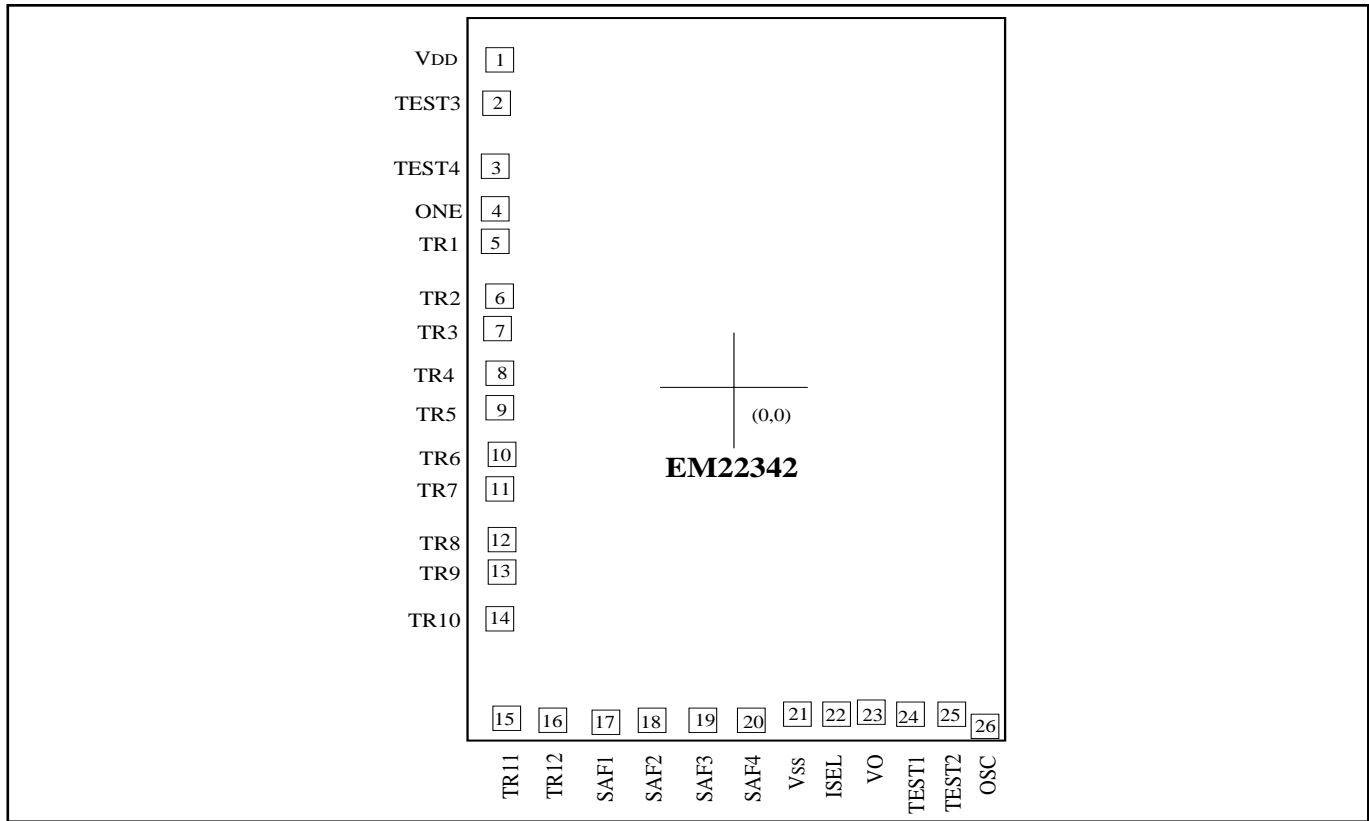
Pad No.	Symbol	X	Y
14	TR11	-470.4	-1253.8
15	TR12	-129.5	-1253.8
16	V _{ss}	280.1	-1253.8
17	ISEL	429.6	-1222.5
18	VO	596.1	-1227.6
19	SAF1	793.6	-1223.7
20	SAF2	942.1	-1223.7
21	SAF3	1103.0	-1223.7
22	SAF4	1251.5	-1223.7
23	TEST1	1216.8	-981.0
24	TEST2	1216.8	-837.0
25	OSC	1215.2	-660.8
26	V _{DD}	1275.3	-500.1



Chip Size : 2950 x 2940 μm

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1	TEST3	-1286.2	1091.9
2	TEST4	-1286.2	640.8
3	ONE	-1258.8	379.0
4	TR1	-1258.8	229.6
5	TR2	-1258.8	70.3
6	TR3	-1258.8	-79.1
7	TR4	-1258.8	-238.4
8	TR5	-1258.8	-387.8
9	TR6	-1246.6	-1253.8
10	TR7	-1087.5	-1253.8
11	TR8	-938.1	-1253.8
12	TR9	-778.9	-1253.8
13	TR10	-629.5	-1253.8

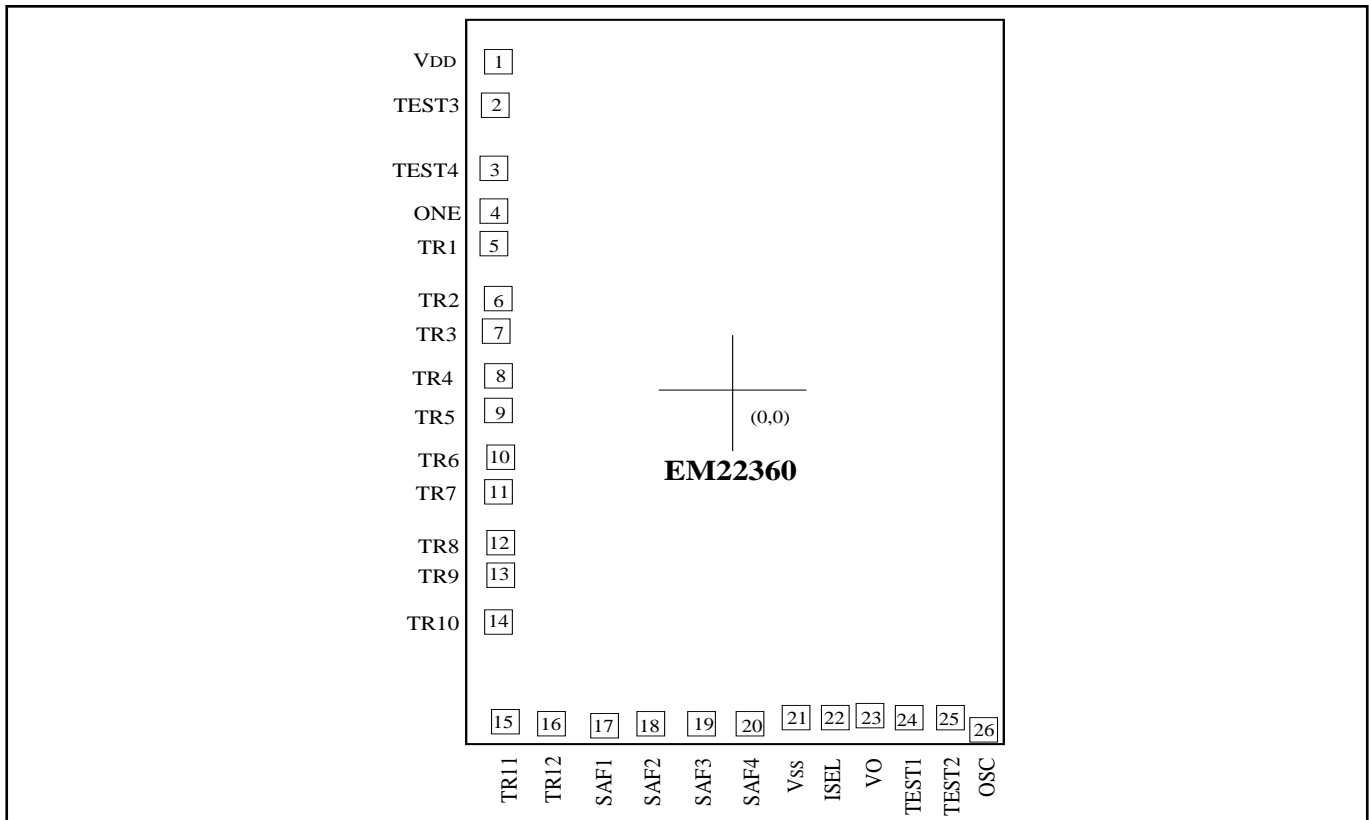
Pad No.	Symbol	X	Y
14	TR11	-470.4	-1253.8
15	TR12	-129.5	-1253.8
16	V _{SS}	280.1	-1253.8
17	ISEL	429.6	-1222.5
18	VO	596.1	-1227.6
19	SAF1	793.6	-1223.7
20	SAF2	942.1	-1223.7
21	SAF3	1103.0	-1223.7
22	SAF4	1251.5	-1223.7
23	TEST1	1216.8	-981.0
24	TEST2	1216.8	-837.0
25	OSC	1215.2	-660.8
26	V _{DD}	1275.3	-500.1



Chip Size : 2880 x 4280 μm

Pad No.	Symbol	X	Y
1	V _{DD}	-1243.9	1869.8
2	TEST3	-1276.0	1625.0
3	TEST4	-1276.0	1173.9
4	ONE	-1266.1	864.0
5	TR1	-1266.1	720.0
6	TR2	-1266.1	462.6
7	TR3	-1266.1	318.6
8	TR4	-1266.1	61.2
9	TR5	-1266.1	-82.8
10	TR6	-1266.1	-340.2
11	TR7	-1266.1	-484.2
12	TR8	-1266.1	-741.6
13	TR9	-1266.1	-885.6

Pad No.	Symbol	X	Y
14	TR10	-1266.1	-1143.0
15	TR11	-1145.5	-1966.1
16	TR12	-828.3	-1966.1
17	SAF1	-575.9	-1976.0
18	SAF2	-344.3	-1976.0
19	SAF3	-113.1	-1976.0
20	SAF4	118.5	-1976.0
21	V _{SS}	335.3	-1948.3
22	ISEL	489.3	-1892.5
23	VO	655.8	-1897.7
24	TEST1	875.9	-1885.5
25	TEST2	1019.9	-1885.5
26	OSC	1250.9	-1943.6



Chip Size : 2880 x 4280 μm

Pad No.	Symbol	X	Y
1	V _{DD}	-1243.9	1869.8
2	TEST3	-1276.0	1625.0
3	TEST4	-1276.0	1173.9
4	ONE	-1266.1	864.0
5	TR1	-1266.1	720.0
6	TR2	-1266.1	462.6
7	TR3	-1266.1	318.6
8	TR4	-1266.1	61.2
9	TR5	-1266.1	-82.8
10	TR6	-1266.1	-340.2
11	TR7	-1266.1	-484.2
12	TR8	-1266.1	-741.6
13	TR9	-1266.1	-885.6

Pad No.	Symbol	X	Y
14	TR10	-1266.1	-1143.0
15	TR11	-1145.5	-1966.1
16	TR12	-828.3	-1966.1
17	SAF1	-575.9	-1976.0
18	SAF2	-344.3	-1976.0
19	SAF3	-113.1	-1976.0
20	SAF4	118.5	-1976.0
21	V _{SS}	335.3	-1948.3
22	ISEL	489.3	-1892.5
23	VO	655.8	-1897.7
24	TEST1	875.9	-1885.5
25	TEST2	1019.9	-1885.5
26	OSC	1250.9	-1943.6