

# M61509FP

QXpander built-in, Tone control, Volume control

REJ03F0215-0201

Rev.2.01

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## Description

The M61509FP is the sound controller powered by “QXpander” system.

The “QXpander” system produces normal and wide 3D sound expansion from any stereo input signal.

Note: This device is produced under license from QSound Lab, Ins. (Canada)

## Features

- Built-in “QXpander” sound technology
- Electronic volume.  
0 to -84 dB, the infinitesimal.
- 2-band tone control  
Bass (0 to +21 dB/3 dB STEP)  
Treble (0 to +9 dB/3 dB STEP)
- 5input selector (The fifth input can be used as REC OUT or MIC MIX.)

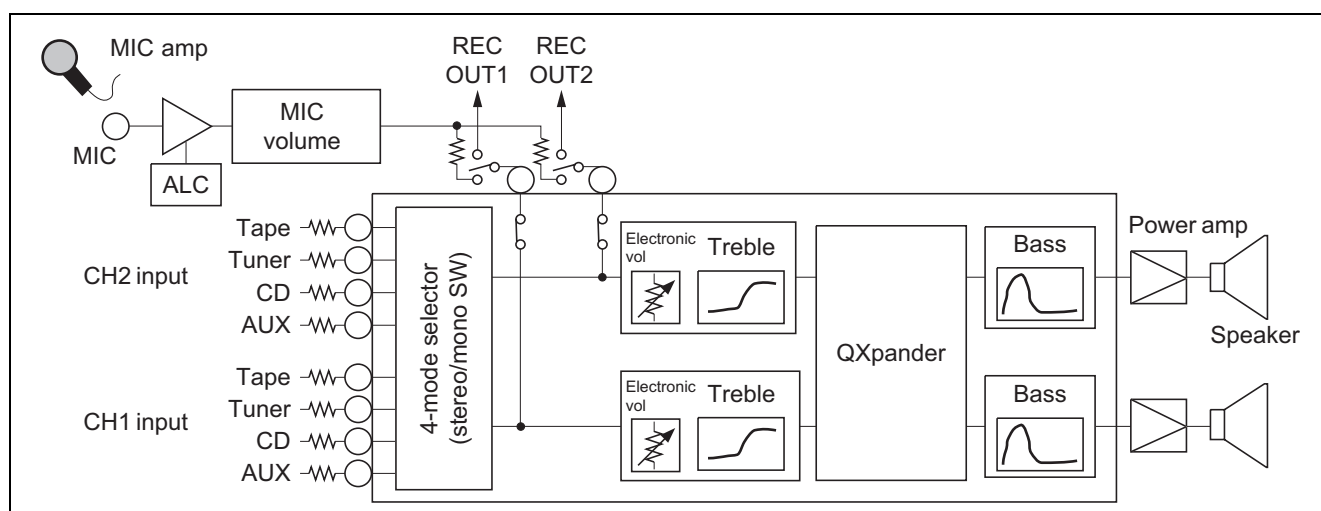
## Recommended Operating Condition

Supply voltage range:  $\pm 2.25$  to  $\pm 2.75$ V

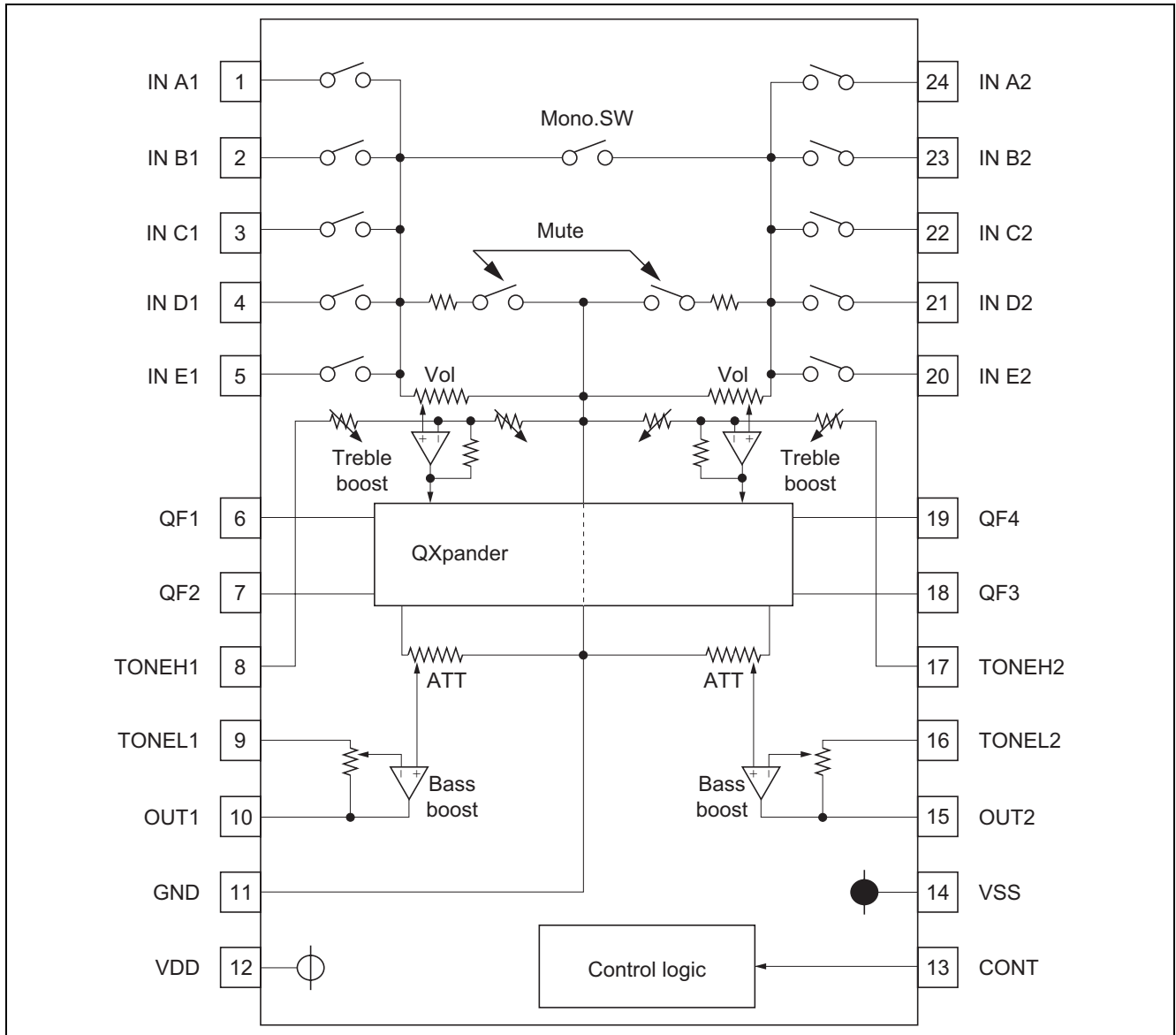
## Application

Radio Cassette Recorders, Mini-stereo Set, Audio Equipment

## System Block Diagram



## Block Diagram



## Pin Function Description

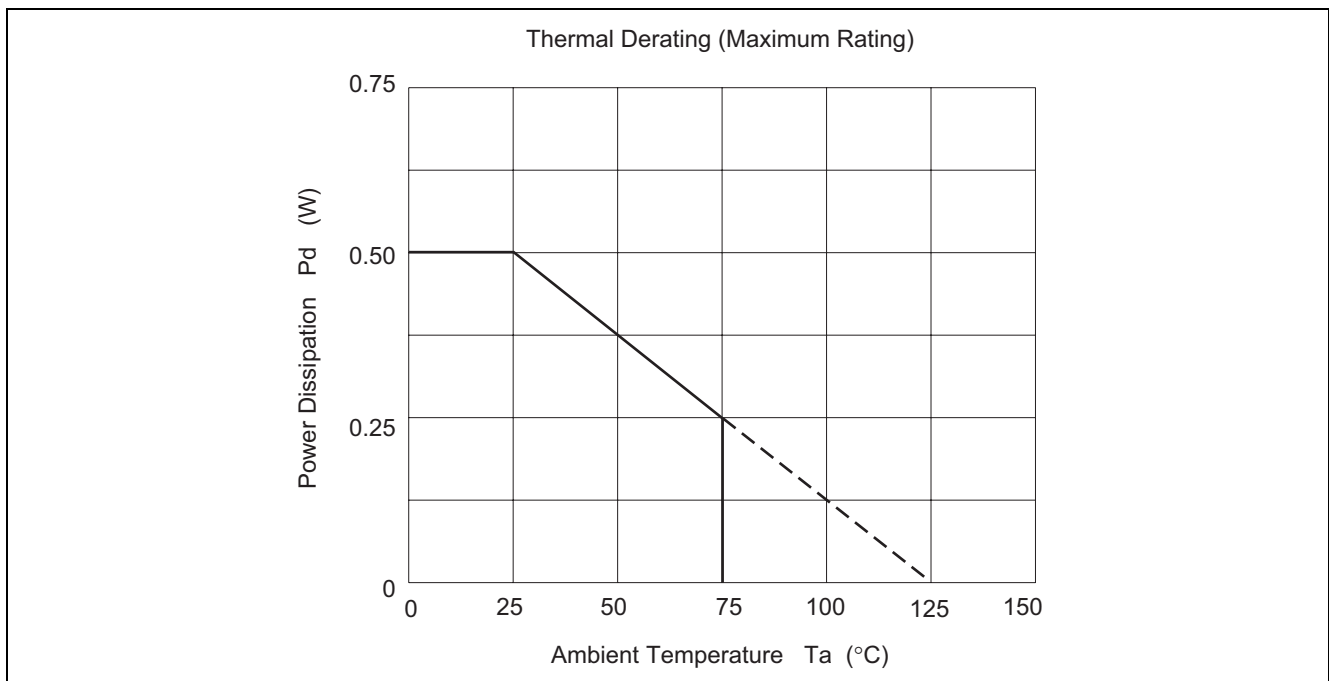
Pin No.	Name	Function
1	IN A1	INPUTs of the channel 1 The switch of INE can be controlled in dependently. Please set "ALL OFF" mode when the switch of E is only ON.
2	IN B1	
3	IN C1	
4	IN D1	
5	IN E1	
6	QF1	QXpander filter 1
7	QF2	QXpander filter 2
8	TONEH1	Treble control adjustment of the channel 1
9	TONEL1	Bass control adjustment of the channel 1
10	OUT1	OUTPUT of the channel 1
11	GND	Ground
12	VDD	Supply voltage (+)
13	CONT	Control data input from a microcontroller
14	VSS	Supply voltage (-)
15	OUT2	OUTPUT of the channel 2
16	TONEL2	Bass control adjustment of the channel 2
17	TONEH2	Treble control adjustment of the channel 2
18	QF3	QXpander filter 3
19	QF4	QXpander filter 4
20	IN E2	INPUTs of the channel 2 The switch of INE can be controlled independently. Please set "ALL OFF" mode when the switch of E is only ON.
21	IN D2	
22	IN C2	
23	IN B2	
24	IN A2	

## Absolute Maximum Ratings

(Ta = 25°C, unless otherwise noted)

Item	Symbol	Ratings	Unit	Test Condition
Supply voltage	VDD-VSS	6.0	V	
Thermal derating	K $\theta$	5	mW/°C	(Note)
Power dissipation	Pd	500	mW	
Operating temperature	Topr	–20 to 75	°C	
Storage temperature	Tstg	–40 to 125	°C	

Note: reference PC Board  
 Size: 70 mm × 70 mm  
 Thickness: 1.6 mm  
 Material: glass epoxy  
 Copper pattern dimension  
 Width: 0.25 mm  
 Length: 25 to 30 mm/lead  
 Thickness: 18  $\mu$ m

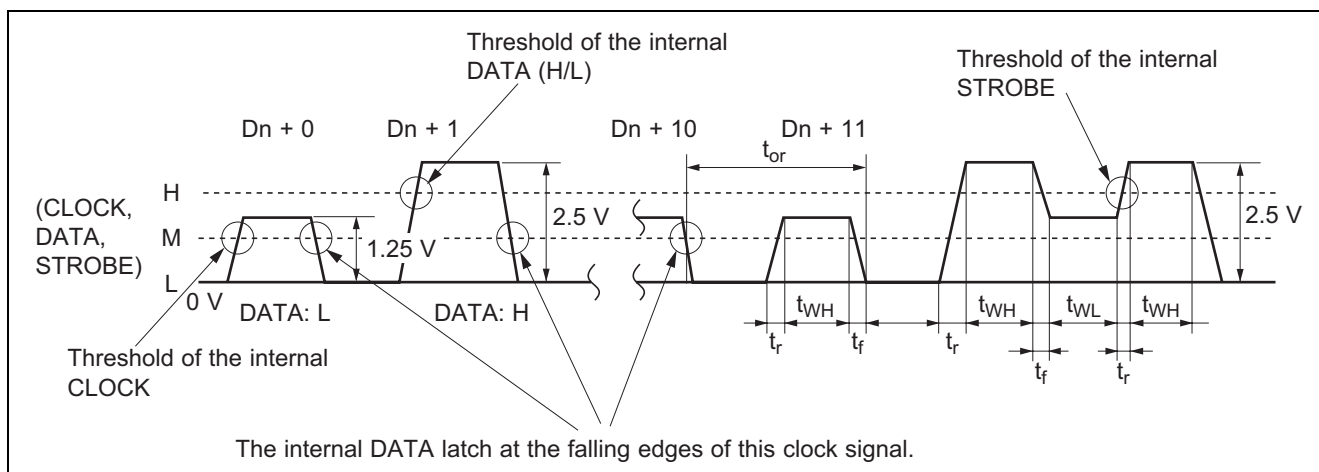


## Recommended Operating Conditions

Item	Symbol	Pin No.	Limits			Unit	Condition
			Min	Typ	Max		
Supply voltage (+)	VDD	12	2.25	2.5	2.75	V	
Supply voltage (–)	VSS	14	–2.75	–2.5	–2.25		
Control data input voltage	CONT	13	GND	—	VDD		

## Control Signals Specification

### (1) Wave Form



### (2) Voltage Control Signal

Digital input signal		Limits			Unit	Condition
		Min	Typ	Max		
L signal	L	GND	—	0.4	V	VDD = 2.5 V, VSS = -2.5 V
M signal	M	1.0	1.25 (VDD/2)	1.5		VDD = 2.5 V, VSS = -2.5 V
H signal	H	2.1	—	VDD		VDD = 2.5 V, VSS = -2.5 V

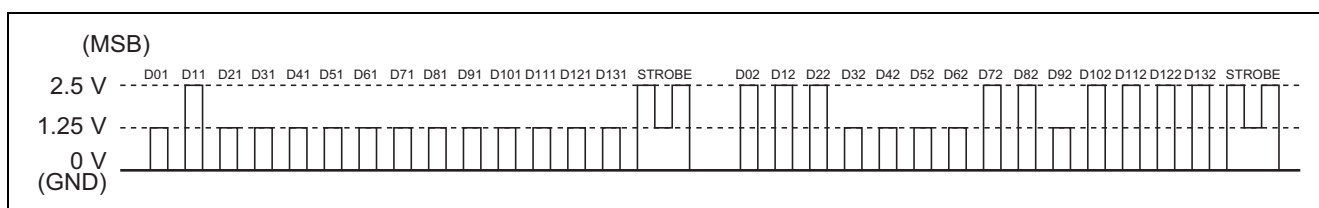
### (3) Timing Control Signal

Item	Symbol	Limits			Unit
		Min	Typ	Max	
Cycle time of digital signal	$t_{cr}$	8	—	—	$\mu\text{s}$
Pulse width of digital signal ("H" level)	$t_{WH}$	3.6	—	—	
Pulse width of digital signal ("L" level)	$t_{WLC}$	3.6	—	—	
Rise time of digital signal	$t_r$	—	—	0.4	
Fall time of digital signal	$t_f$	—	—	0.4	

### (4) Control Signal Example (Refer to the "Control Data Format")

An example of the mode control

- Bypass/QXpander SW: QXpander
- VOL/Treble Share AMP Gain: 20 dB
- Input: IN A,
- Volume: 0 dB
- Mute: OFF
- Mode: STEREO
- Bass: 18 dB
- Treble: 6 dB
- Recout: ON (IN E)



## Control Data Format

It is necessary to set up the all control data after power on.

### (1) Input Data

(MSB) ← input order

#### Slot1

D01	D11	D21	D31	D41	D51	D61	D71	D81	D91	D101	D111	D121	D131
0	Bypass/QXpander SW	Vol/Treble share amp gain SW 0: 20 dB 1: 18 dB 2: 16 dB 3: 14 dB		Input 0: IN A 1: IN B 2: IN C 3: IN D		D2 to D6: (a) Master volume condition					Mute ON/OFF 0: OFF 1: ON (Input ALL OFF)	CHIP/SLOT Select 0: select 1: no select 2: no select 3: no select	

#### Slot2

D02	D12	D22	D32	D42	D52	D62	D72	D82	D92	D102	D112	D122	D132
1	1	0	1	Mode select 0: stereo 1: mono1 only 2: mono2 only 3: mono 1+2		Bass (boost) 0: 0 dB, 1: 3 dB, 2: 6 dB, 3: 9 dB, 4: 12 dB, 5: 15 dB, 6: 18 dB, 7: 21 dB			Treble (boost) 0: 0 dB, 1: 3 dB, 2: 6 dB, 3: 9 dB		IN E ON/OFF 0: OFF 1: ON	CHIP/SLOT Select 0: no select 1: no select 2: no select 3: select	

(a) Master Volume

ATT	D61	D71	D81	D91	D101
-0.0 dB	0	0	0	0	0
-2.0 dB	1	0	0	0	0
-4.0 dB	0	1	0	0	0
-6.0 dB	1	1	0	0	0
-8.0 dB	0	0	1	0	0
-10.0 dB	1	0	1	0	0
-12.0 dB	0	1	1	0	0
-14.0 dB	1	1	1	0	0
-16.0 dB	0	0	0	1	0
-18.0 dB	1	0	0	1	0
-20.0 dB	0	1	0	1	0
-22.0 dB	1	1	0	1	0
-24.0 dB	0	0	1	1	0
-26.0 dB	1	0	1	1	0
-28.0 dB	0	1	1	1	0
-30.0 dB	1	1	1	1	0
-32.0 dB	0	0	0	0	1
-34.0 dB	1	0	0	0	1
-36.0 dB	0	1	0	0	1
-40.0 dB	1	1	0	0	1
-44.0 dB	0	0	1	0	1
-48.0 dB	1	0	1	0	1
-52.0 dB	0	1	1	0	1
-56.0 dB	1	1	1	0	1
-60.0 dB	0	0	0	1	1
-64.0 dB	1	0	0	1	1
-68.0 dB	0	1	0	1	1
-72.0 dB	1	1	0	1	1
-76.0 dB	0	0	1	1	1
-80.0 dB	1	0	1	1	1
-84.0 dB	0	1	1	1	1
The infinitesimal	1	1	1	1	1

## (b) Input Select

Input select		D41	D51	D111	D112
IN A	IN E off	0	0	0	0
IN B		1	0		
IN C		0	1		
IN D		1	1		
IN A to D all OFF	IN E on	*	*	1	1 <sup>(Note 1)</sup>
IN A-D select		A: 0	0	0	1 <sup>(Note 2)</sup>
		B: 1	0		
		C: 0	1		
		D: 1	1		

Notes: 1. The input impedance is about 5 k as input IN E.

2. IN E can be controlled independently.

It can be used as Rec output.

## (c) Mode Control

Mode	D42	D52
stereo	0	0
mono 1 only	1	0
mono 2 only	0	1
mono 1+2	1	1

## (d) Treble Control

Treble	D92	D102
0 dB	0	0
3 dB	1	0
6 dB	0	1
9 dB	1	1

## (e) Bass Control

Bass	D62	D72	D82
0 dB	0	0	0
3 dB	1	0	0
6 dB	0	1	0
9 dB	1	1	0
12 dB	0	0	1
15 dB	1	0	1
18 dB	0	1	1
21 dB	1	1	1



## (f) Chip/Slot Control

Chip/Slot	D12*	D13*
select (slot1)	0	0
no select	1	0
no select	0	1
select (slot1)	1	1

## (g) Treble Amp Gain SW

Gain SW	D21	D31
20 dB	0	0
18 dB	1	0
16 dB	0	1
14 dB	1	1

## (h) Bypass/QXpander SW

Bypass/QXpander SW	D11
Bypass	0
QXpander	1

## (2) Notice of Control Data

1. use only the control data of (1) Input Data.
2. The interval of data transmission from the microcontroller is over 0.1 s.  
: This is the waiting time for the “soft-switching” to reduce the shock noise. (The “soft-switching” is available at the volume and QXpander.)

Note:

- (1) The “Slot1” and the “Slot2” are independent data.

Each data need each waiting time.

- (2) The some function of the volume and other function have no “soft-switching”.

Example1:

When the volume is set as “infinitesimal”, it’s immediately attenuated (but, it needs the waiting time to reach the final attenuation).

Example2:

The change of tone control is immediately executed.

3. It is necessary to set the all control data after power-on, although the internal circuit is forced as below, when (VDD-VSS) ≤ 3.3 V (Typ).

Item	Condition
Gain SW	18 dB
Input select	ALL OFF
Master volume	infinitesimal
MUTE	ON (Input ALL OFF)
Bypass/QXpander	Bypass
Mode select	stereo
Bass	0 dB
Treble	0 dB
IN E	ON

## Electrical Characteristics

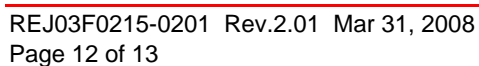
(VDD = 2.5 V, VSS = -2.5 V, f = 1 kHz, Vi = 100 mV(rms), Vol = 0 dB, Bass = 0 dB, Treble = 0 dB, Vol/Treble Share AMP = 18 dB, Surround = Bypass, RL = 10 kΩ, Ta = 25°C, unless otherwise noted)

Item	Symbol	Limits			Unit	Conditions	
		Min	Typ	Max			
Circuit current of positive power supply	IDD	—	30	45	mA	Quiescent	
Circuit current of negative power supply	ISS	—	-30	-45	mA	Quiescent	
Voltage gain (selector)	Gv1	16	18	20	dB	Vol/Treble share amp gain = 18 dB Bypass	
Voltage gain (tone control)	Gv2	25.5	27.5	29.5	dB	Vol/Treble share amp gain = 18 dB QXpander mode Vi = 20 mVrms	
Maximum output voltage	Vomax	1.2	1.6	—	Vrms	RL = 10 k, THD = 1%	
Total harmonic distortion	THD	—	0.02	0.08	%	BW = 400 to 30 kHz	
Output noise voltage	No1	—	6	15	μVrms	JIS-A, Rg = 5.1 k, VOL = the infinitesimal BYPASS	
	No2	—	11	30	μVrms	JIS-A, Rg = 5.1 k, VOL = the infinitesimal QXpander mode	
Maximum attenuation	ATTmax	—	-95	-90	dB	Output reference level (Vo = 1 Vrms), ATT = the infinitesimal, JIS-A	
Bass boost	GB1	1.5	3	4.5	dB	3 dB	f = 1 kHz, Vo = 80 mVrms
	GB2	4.5	6	7.5		6 dB	
	GB3	7.5	9	10.5		9 dB	
	GB4	10.5	12	13.5		12 dB	
	GB5	13.5	15	16.5		15 dB	
	GB6	16.5	18	19.5		18 dB	
	GB7	19.5	21	22.5		21 dB	
Treble boost	GT1	1.5	3	4.5	dB	3 dB	f = 1 kHz, Vo = 80 mVrms
	GT2	4.5	6	7.5		6 dB	
	GT3	7.5	9	10.5		9 dB	

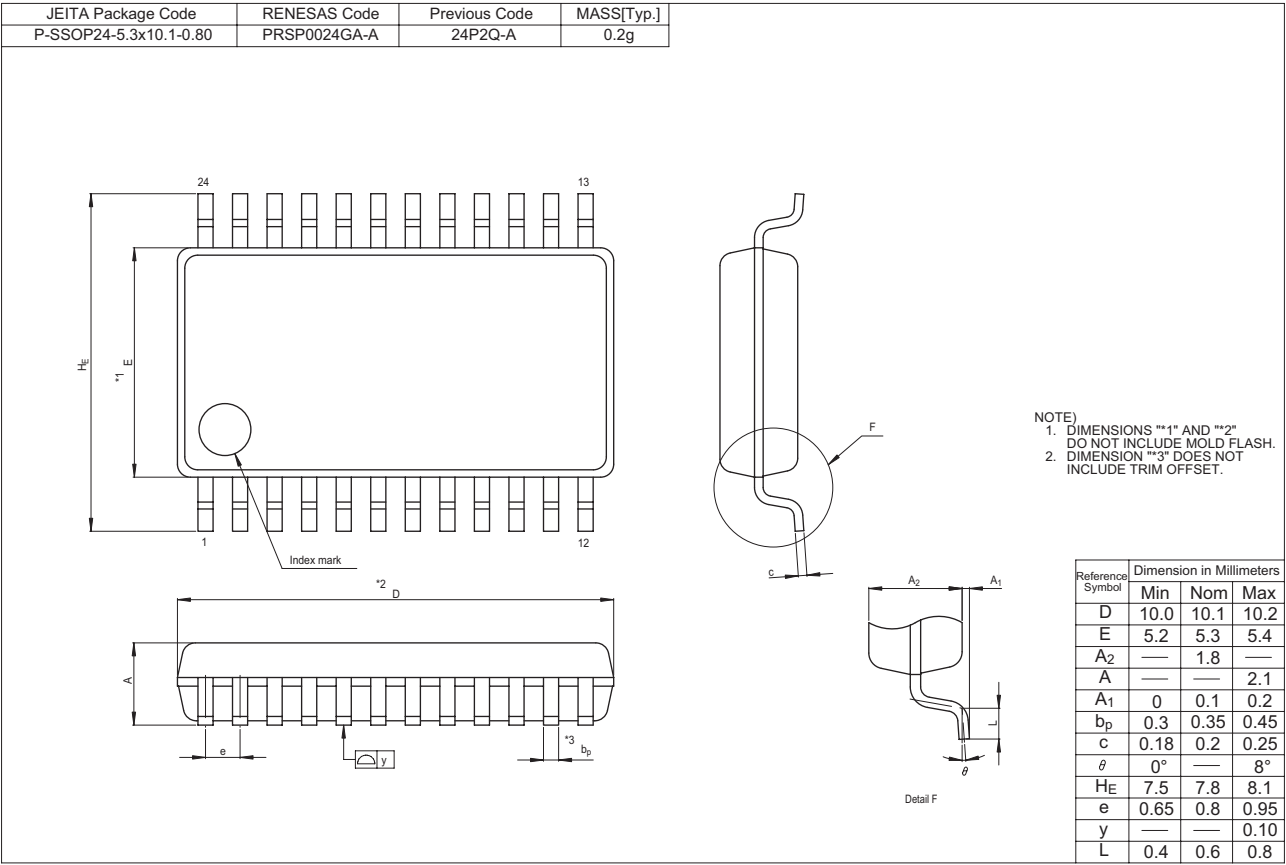


**R1, R3 (typical)**

## Application Example



Package Dimensions



Notes:

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Tel: <852> 2265-6688, Fax: <852> 2377-3473

**Renesas Technology Taiwan Co., Ltd.**  
10th Floor, No.99, Fushing North Road, Taipei, Taiwan  
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**Renesas Technology Singapore Pte. Ltd.**  
1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632  
Tel: <65> 6213-0200, Fax: <65> 6278-8001

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Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea  
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

**Renesas Technology Malaysia Sdn. Bhd**  
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: <603> 7955-9390, Fax: <603> 7955-9510