To our customers,

Old Company Name in Catalogs and Other Documents

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April 1st, 2010
Renesas Electronics Corporation

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M61533FP

4ch Electronic Volume with AGC

REJ03F0059-0100Z
Rev.1.0
Sep.19.2003

Features

Function	Feature
Electric Volume	• 0 to -87dB, -∞/1dBstep • 4ch SL/SR/C/SW independent Electric Volume • Controlled by trim volume data + master volume data.
AGC	Vc=1.8Vrms<SWch>
LPF	Can be set externally <SWch>
Output Gain Control	0, +6, +9, +12dB 4step <SWch>
MUC I/F	Controlled by serial data from microcomputer

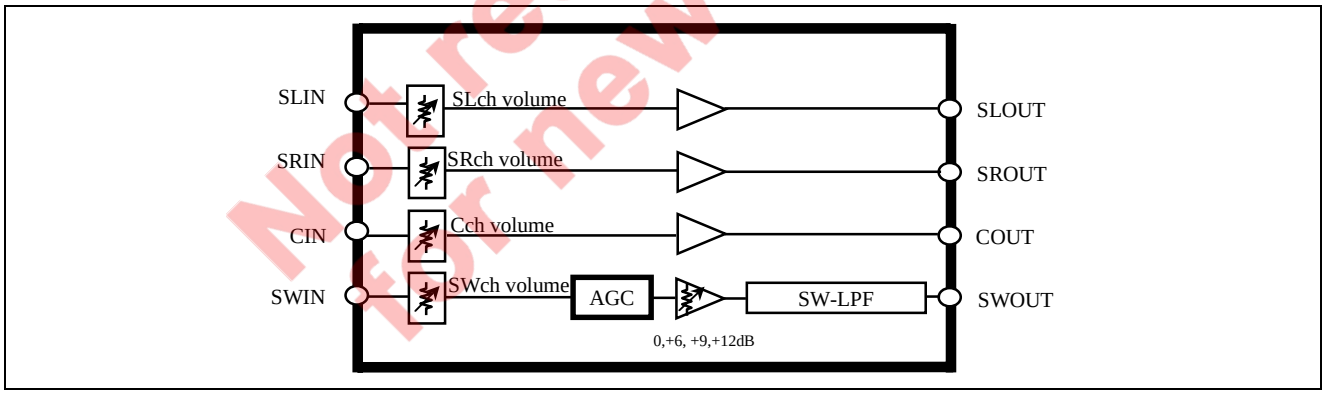
Application

Mini Stereo etc.

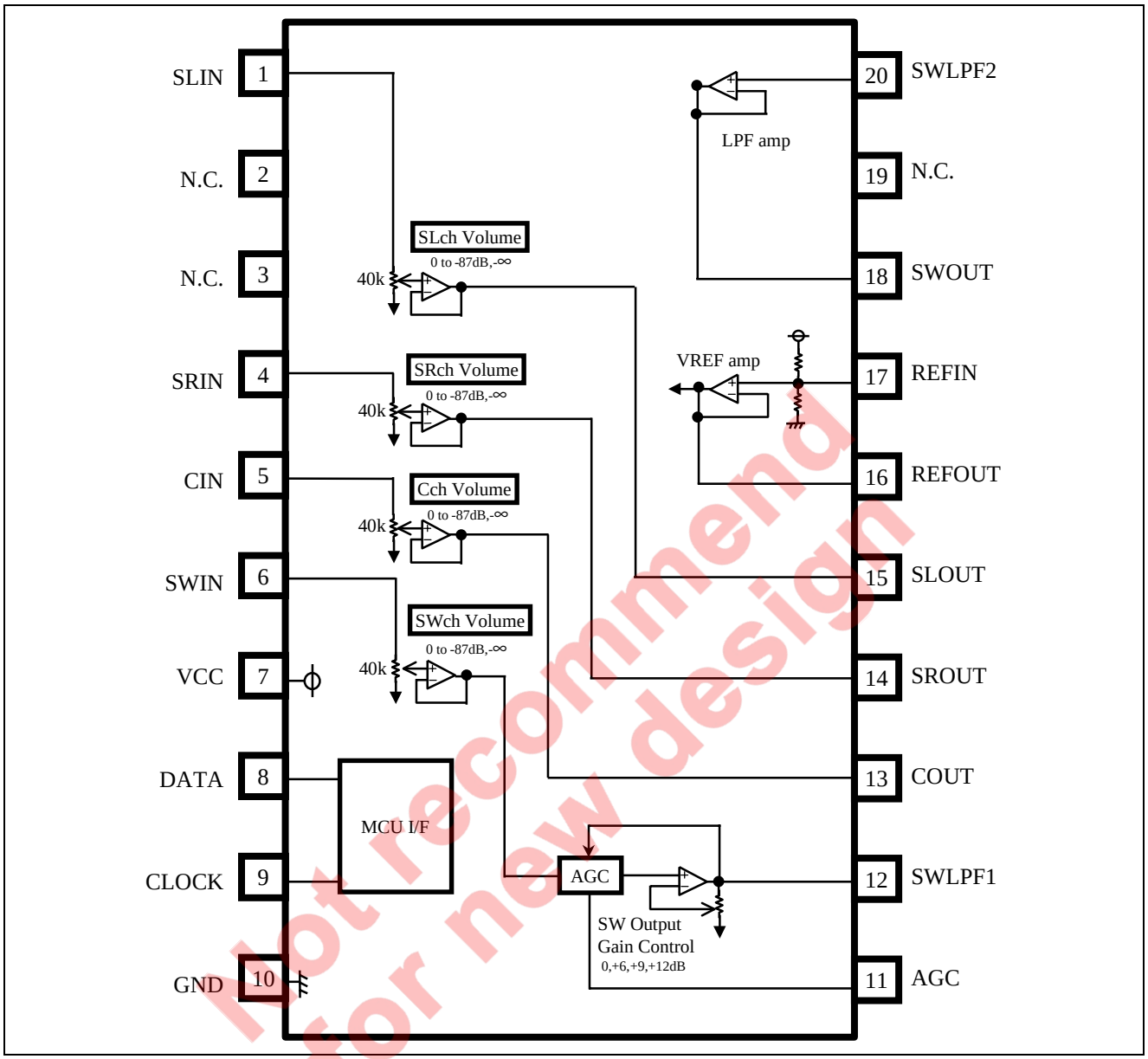
Recommended Operating Condition

Supply Voltage Range VCC= 8 to 10V Typ:VCC=9V

System Block Diagram



Block Diagram and Pin Configuration (Top view)



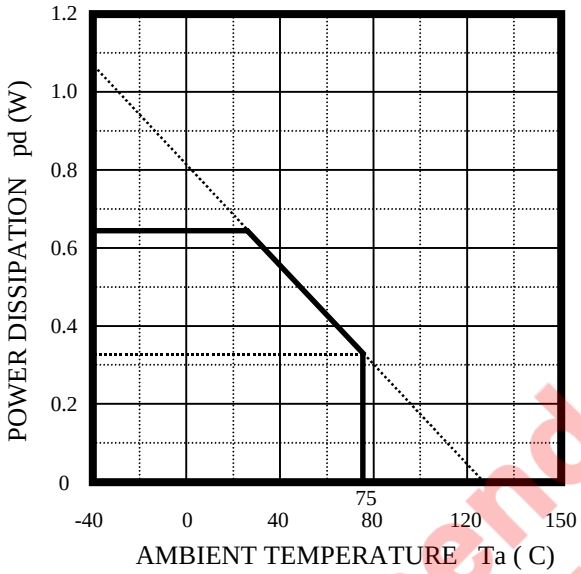
Pin Description

Pin No.	Name	Function
1	SLIN	SLch volume input pin
2	N.C.	N.C.
3	N.C.	N.C.
4	SRIN	SRch volume input pin
5	CIN	Cch volume input pin
6	SWIN	SWch volume input pin
7	VCC	Power supply (Typ:9V)
8	DATA	Input pin of Control data
9	CLOCK	Input pin of Control clock
10	GND	Ground
11	AGC	Attack/Recovery time control pin (by capacitor)
12	SWLPF1	SWch LPF (connected with resistance and capacitor)
13	COUT	Cch output pin
14	SROUT	SRch output pin
15	SLOUT	SLch output pin
16	REFOUT	Vref output pin
17	REFIN	Vref input pin
18	SWOUT	SWch output pin
19	N.C.	N.C.
20	SWLPF2	SWch LPF (connected with resistance and capacitor)

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Condition
Power Supply	Vcc	10.5	V	
Power dissipation	Pd	648	mW	Ta ≤ 25°C
Thermal derating	Kθ	6.48	mW/°C	Ta > 25°C
Operating temperature	Topr	–20 to 75	°C	
Storage temperature	Tstg	–40 to 125	°C	

THERMAL DERATINGS
(MAXIMUM RATING)

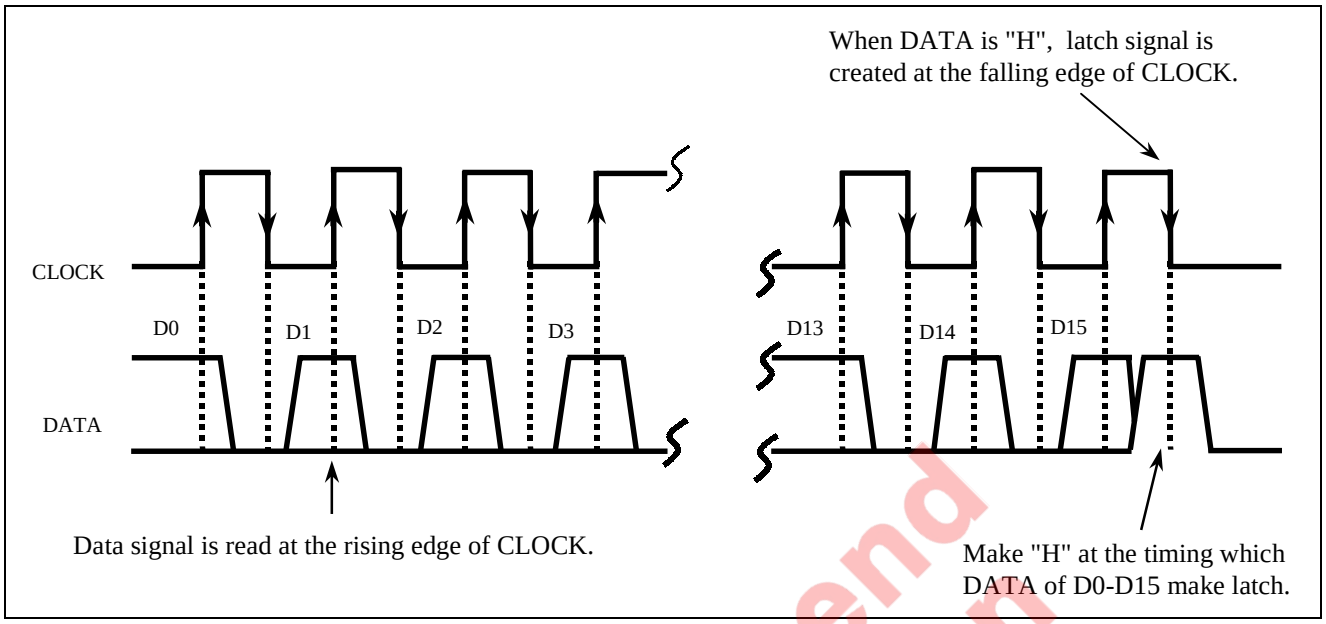


Recommended Conditions

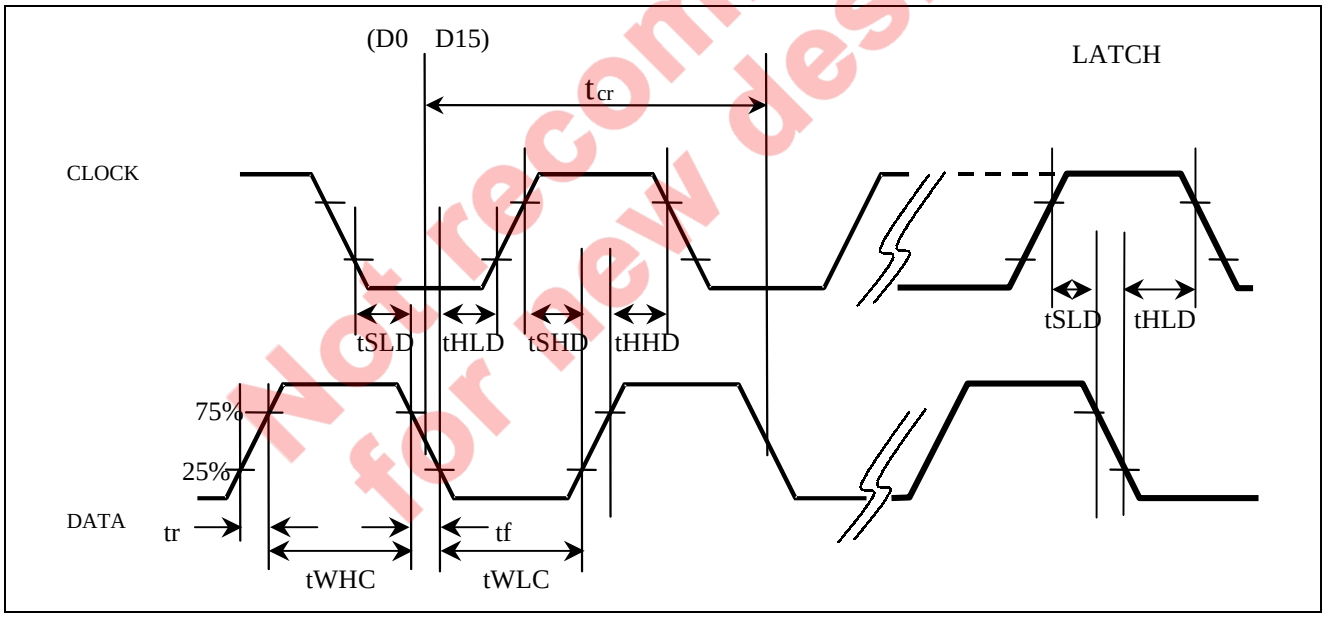
(Ta=25°C, Unless otherwise noted)

Parameter	Symbol	Limits			Unit	Conditions
		Min.	Typ.	Max.		
Power supply	Vcc	8	9	10	V	
Logic “H” level input voltage	VIH	2.2	—	5.5	V	VCC=9V GND reference
Logic “L” level input voltage	VIL	0	—	0.6	V	VCC=9V GND reference

Relationship Between Data and Clock



Clock and Data Timings



Timing Definition of Digital Block

Parameter	Symbol	Limits Min.	Typ.	Max.	Unit
CLOCK cycle time	tcr	4	—	—	µs
CLOCK pulse width(“H” level)	tWHC	1.6	—	—	
CLOCK pulse width (“L” level)	tWLC	1.6	—	—	
Rising time of clock and data	tr	—	—	0.4	
Falling time of clock and data	tf	—	—	0.4	
DATA setup time (Rising time of clock)	tSHD	0.8	—	—	
DATA setup time (Falling time of clock)	tSLD	0.8	—	—	
DATA hold time(“H” level)	tHHD	0.8	—	—	
DATA hold time(“L” level)	tHLD	0.8	—	—	

Data Control Specification

Four types of input format can be selected by changing the D14/D15 slot setting status.

(Initialize all data of the 4 formats when power supply(VCC) turn on.)

Note : No guarantee except for these code.

(1)

D0a	D1a	D2a	D3a	D4a	D5a	D6a	D7a	D8a	D9a	D10a	D11a	D12a	D13a	D14	D15
② SLch Trim volume				② SRch Trim volume				0	0	0	0	0	1	0	0

(2)

D0b	D1b	D2b	D3b	D4b	D5b	D6b	D7b	D8b	D9b	D10b	D11b	D12b	D13b	D14	D15
② Cch Trim volume				② SWch Trim volume				1	① SWch Output gain control		0	0	0	0	1

(3)

D0c	D1c	D2c	D3c	D4c	D5c	D6c	D7c	D8c	D9c	D10c	D11c	D12c	D13c	D14	D15
③ SLch Master volume					③ SRch Master volume					0	0	0	0	1	0

(4)

D0d	D1d	D2d	D3d	D4d	D5d	D6d	D7d	D8d	D9d	D10d	D11d	D12d	D13d	D14	D15
③ Cch Master volume					③ SWch Master volume					0	0	0	0	1	1

Setting Code

It's initial setting when VCC turn on.

① SWch Output gain control

	D9b	D10b
0dB	0	0
+6dB	0	1
+9dB	1	0
+12dB	1	1

② SL/SR/C/SWch Trim volume

ATT		D0a	D1a	D2a	D3a
	SLch				
	SRch	D4a	D5a	D6a	D7a
	Cch	D0b	D1b	D2b	D3b
	SWch	D4b	D5b	D6b	D7b
0dB		0	0	0	0
-1dB		0	0	0	1
-2dB		0	0	1	0
-3dB		0	0	1	1
-4dB		0	1	0	0
-5dB		0	1	0	1
-6dB		0	1	1	0
-7dB		0	1	1	1
-8dB		1	0	0	0
-9dB		1	0	0	1
-10dB		1	0	1	0
-11dB		1	0	1	1
-12dB		1	1	0	0
-13dB		1	1	0	1
-14dB		1	1	1	0
-15dB		1	1	1	1

③ SL/SR/C/SWch Master volume

ATT		D0c	D1c	D2c	D3c	D4c
	SLch					
	SRch	D5c	D6c	D7c	D8c	D9c
	Cch	D0d	D1d	D2d	D3d	D4d
	SWch	D5d	D6d	D7d	D8d	D9d
0dB		0	0	0	0	0
-2dB		0	0	0	0	1
-4dB		0	0	0	1	0
-6dB		0	0	0	1	1
-8dB		0	0	1	0	0
-10dB		0	0	1	0	1
-12dB		0	0	1	1	0
-14dB		0	0	1	1	1
-16dB		0	1	0	0	0
-18dB		0	1	0	0	1
-20dB		0	1	0	1	0
-22dB		0	1	0	1	1
-24dB		0	1	1	0	0
-26dB		0	1	1	0	1
-28dB		0	1	1	1	0
-30dB		0	1	1	1	1
-32dB		1	0	0	0	0
-34dB		1	0	0	0	1
-36dB		1	0	0	1	0
-38dB		1	0	0	1	1
-40dB		1	0	1	0	0
-42dB		1	0	1	0	1
-44dB		1	0	1	1	0
-48dB		1	0	1	1	1
-52dB		1	1	0	0	0
-56dB		1	1	0	0	1
-60dB		1	1	0	1	0
-64dB		1	1	0	1	1
-68dB		1	1	1	0	0
-72dB		1	1	1	0	1
-76dB		1	1	1	1	0
-∞ dB		1	1	1	1	1

Note1: Volume ATT controlled by trim volume data + master volume data.

Note2: When trim volume data + master volume data is under –87dB setting , volume ATT keep –87dB.

ex) When trim volume data:-15dB / master volume data -76dB setting , volume ATT keep –87dB.

Electrical characteristics

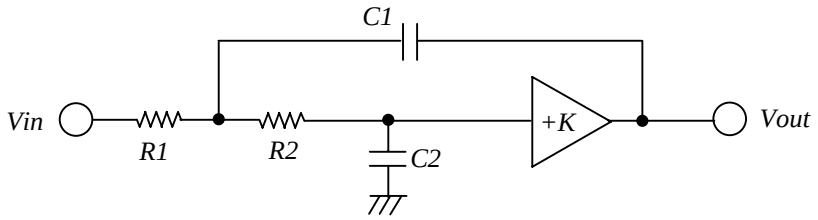
Unless otherwise noted, Ta=25°C, Vcc=9V, f=1kHz, Trim/Master Volume=0dB, Output Gain Control=0dB, SWch LPF fc=300Hz

Parameter	Symbol	Limits Min.	Typ.	Max.	Unit	Test conditions	
Power circuit current	IACC	—	15	30	mA	when no signal is provided	
Input/output							
Maximum input voltage	VIM	—	—	2.0*	Vrms	(1,4,5,6)PIN input,(13,14,15,18)PIN output, RL=10kΩ, THD=1%	
Maximum output voltage	VOM1	1.4	1.8	—	Vrms	6PIN input, 18PIN output, RL=10kΩ, THD=5% , f=100Hz	
	VOM2	1.6	2.0	—	Vrms	(1,4,5)PIN input , (13,14,15)output, RL=10kΩ, THD=5%	
Pass gain	GV	–2	0	+2	dB	(1,4,5,6)PIN input, (13,14,15,18) output, Vi=0.5Vrms, FLAT	
Output noise voltage	Vno1	—	1.3	4.0	µVrms	JIS-A, when no signal is provided, (1,4,5)PIN Rg=0 Ω, (13,14,15)PIN output	SL/SR/Cch volume =0dB
		—	1.3	4.0	µVrms		SL/SR/Cch volume =-∞dB
	Vno2	—	8.0	16	µVrms	JIS-A, when no signal is provided, 6PIN Rg=0 Ω, 18PIN output,	SWch volume =0dB
		—	8.0	16	µVrms		SWch volume =-∞dB
Distortion	THD1	—	0.005	0.1	%	(1,4,5)PIN input, (13,14,15)output, BW:400 30kHz, Vo=0.5Vrms, RL=10kΩ	
	THD2	—	0.05	0.2	%	6PIN input,12PIN output, 30kHz L.P.F, f=100Hz, Output Gain Control =0dB, Vi=0.5Vrms(AGC:off), RL=10kΩ	
	THD3	—	5	—	%	6PIN input, 12PIN output, 30kHz L.P.F, f=100Hz, Output Gain Control =+12dB, Vi=0.7Vrms(AGC:on), RL=10kΩ	
Maximum attenuation	ATT	—	–92	–87	dB	Vo=1Vrms, (12,13,14,15) PIN output, JIS-A, VOL=-∞	
Maximum gain	GVM	+10	+12	+14	dB	6PIN input, 12PIN output, f=100Hz, Vi=0.1Vrms, FLAT, Output Gain Control =+12dB	
Cross talk between channels	CT	—	–70	–55	dB	(1,4,5,6)PIN input, (12,13,14,15)PIN output, Vi=0.5Vrms, JIS-A, RL=47kΩ, Rg=0kΩ	
AGC							
Attack time	TAGCAT	—	40	—	ms	6PIN input, 12PIN output, RL=10kΩ, Output Gain Control =+12dB	
Recovery time	TAGCRE	—	850	—	ms	6PIN input, 12PIN output, RL=10kΩ, Output Gain Control =+12dB	

* Note : The signal can not be inputted to more than 2Vrms. Keep this limit.

LPF

Equivalent circuit of LPF



$$F(s) = \frac{Vout}{Vin} = \frac{\frac{1}{R1R2C1C2}K}{S^2 + \left[\frac{1}{R1\,C1} + \frac{1}{R2\,C1} + (1-K)\frac{1}{R2\,C2}\right]S + \frac{1}{R1R2C1C2}}$$

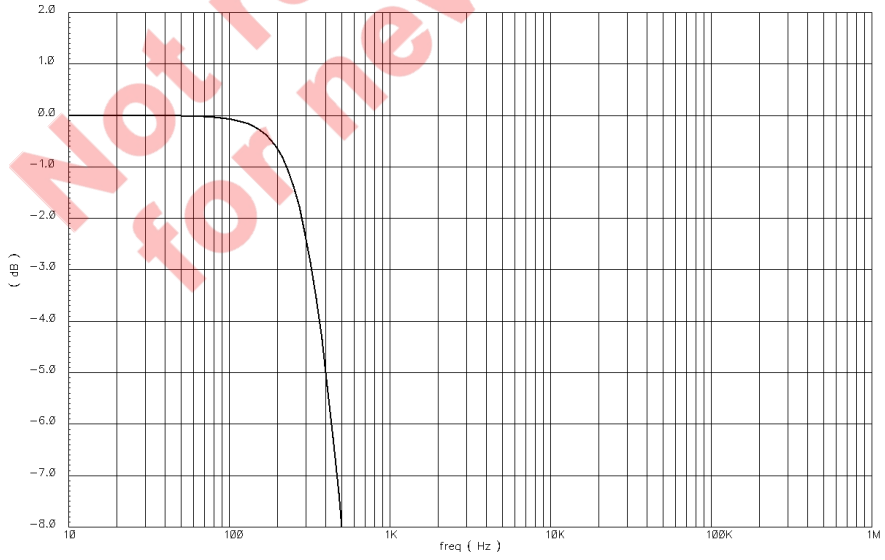
$$\omega 0 = \sqrt{\frac{1}{R1R2C1C2}} \qquad Q = \frac{1}{\sqrt{\frac{R2C2}{R1\,C1}} + \sqrt{\frac{R1C2}{R2\,C1}} + (1-K)\sqrt{\frac{R1C1}{R2\,C2}}}$$

Frequency characteristics (SWch LPF)

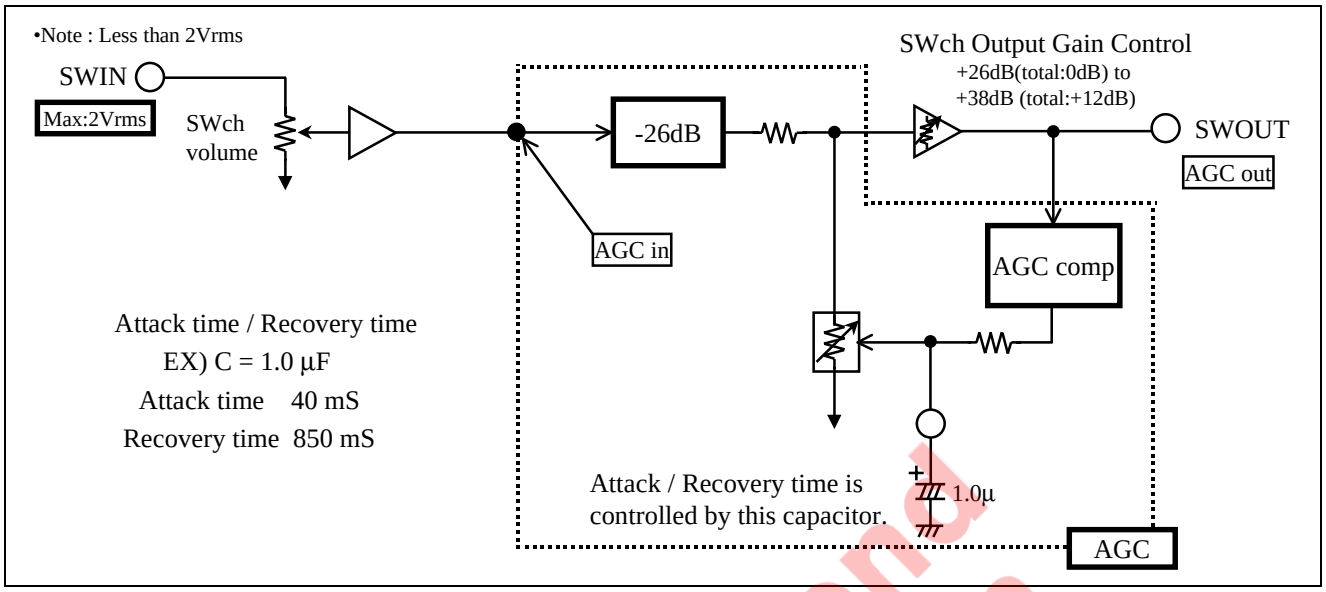
R1=2.2kΩ, R2=4.7kΩ, C1=0.22μF, C2= 0.1μF, K=1

Q ≒ 0.68, fc ≒ 300Hz

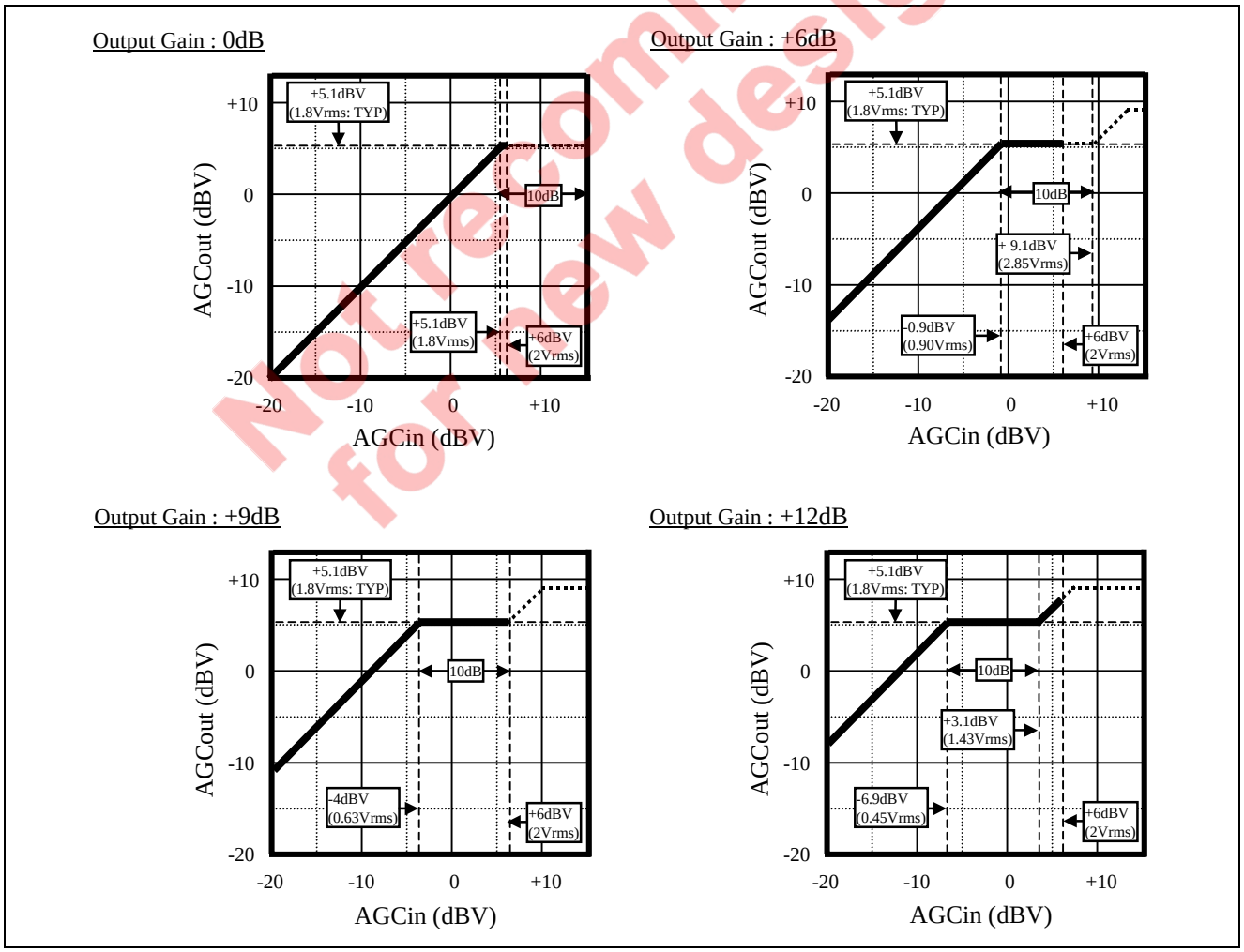
*This frequency response is a simulation result.



AGC

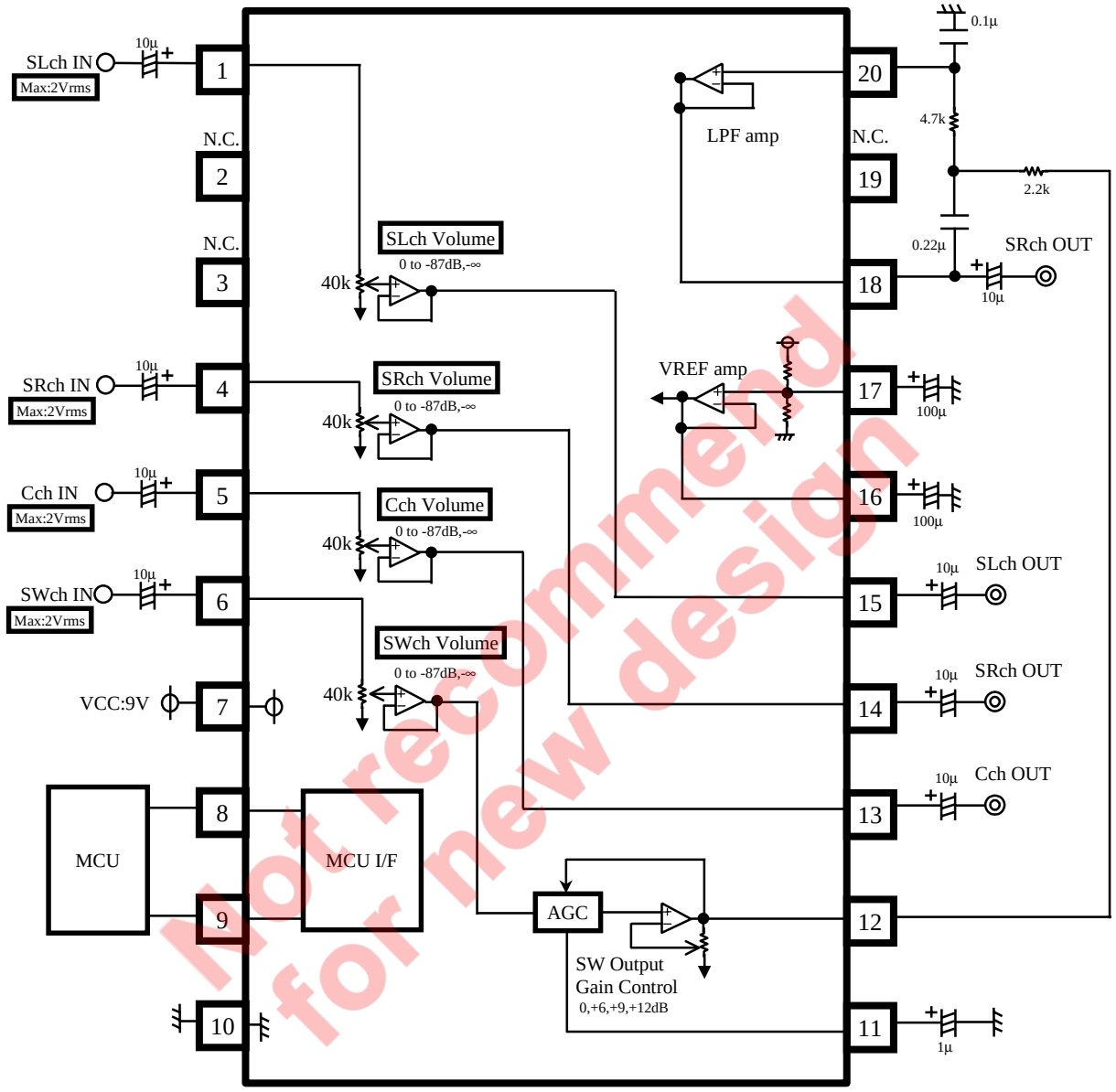


AGC characteristics



Application Example

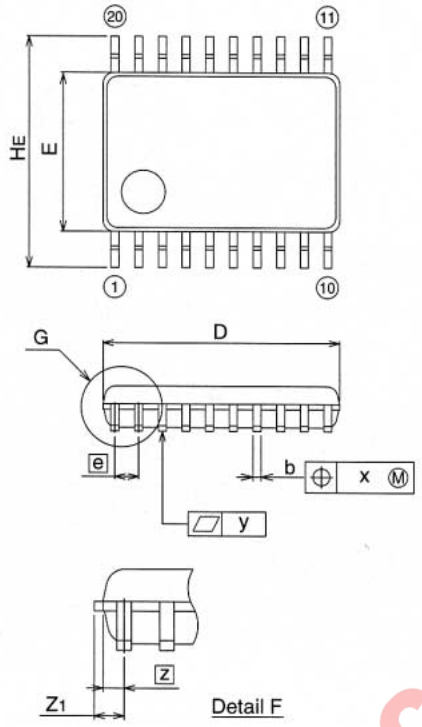
*** Note : The signal can not be inputted to more than 2Vrms.**

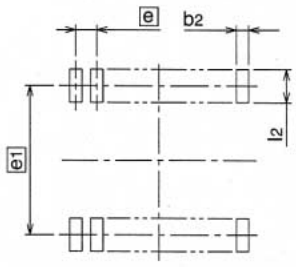


Package Dimensions

20P2F-A (MMP) — **Plastic 20pin 255mil SSOP**

EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
SSOP20-P-255-0.65	–	–	Cu Alloy





Recommended Mount Pad

Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	–	–	1.45
A1	0	0.1	0.2
A2	–	1.15	–
b	0.17	0.22	0.32
c	0.13	0.15	0.2
D	6.4	6.5	6.6
E	4.3	4.4	4.5
e	–	0.65	–
HE	6.2	6.4	6.6
L	0.3	0.5	0.7
L1	–	1.0	–
Z	–	0.325	–
Z1	–	–	0.475
x	–	–	0.13
y	–	–	0.1
θ	0°	–	10°
b2	–	0.35	–
e1	–	5.8	–
l2	1.0	–	–

Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

RENESAS SALES OFFICES

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Renesas Technology America, Inc.
450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500 Fax: <1> (408) 382-7501

Renesas Technology Europe Limited.
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, United Kingdom
Tel: <44> (1628) 585 100, Fax: <44> (1628) 585 900

Renesas Technology Europe GmbH
Dornacher Str. 3, D-85622 Feldkirchen, Germany
Tel: <49> (89) 380 70 0, Fax: <49> (89) 929 30 11

Renesas Technology Hong Kong Ltd.
7/F., North Tower, World Finance Centre, Harbour City, Canton Road, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2375-6836

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FL 10, #99, Fu-Hsing N. Rd., Taipei, Taiwan
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Renesas Technology (Shanghai) Co., Ltd.
26/F., Ruijin Building, No.205 Maoming Road (S), Shanghai 200020, China
Tel: <86> (21) 6472-1001, Fax: <86> (21) 6415-2952

Renesas Technology Singapore Pte. Ltd.
1, Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
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