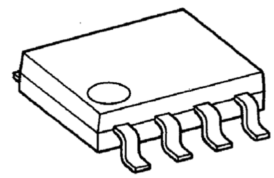
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA7371AFG

FM Front−End (1.5V USE)

The TA7371AFG is an FM front end IC designed for low voltage operation (1.5V), which is suitable for stereo headphone radio or radio cassette.
This IC contains RF amplifier, MIX, local oscillator and varactor diode for AFC.
It simplifies the design of front end circuit.



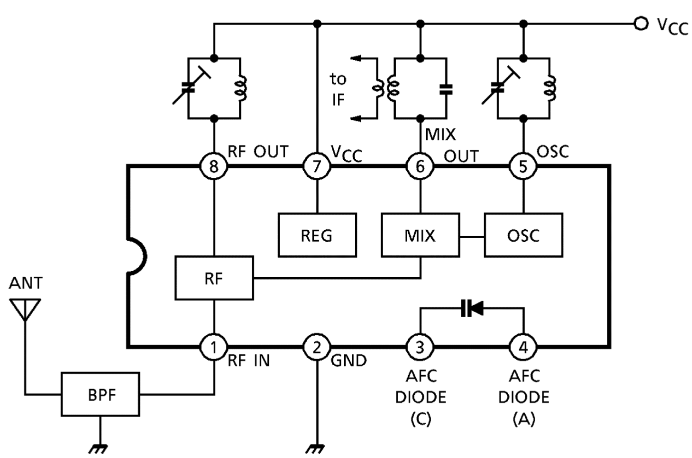
SOP8-P-225-1.27

Weight: 0.08g (typ.)

Features

- Clamping diode for mixer output.
- Varactor diode for AFC.
- Local OSC. stop voltage: V_{CC} = 0.85V (typ.)
- Low quiescent current
  I_{CC} = 1.8mA (typ.) (V_{CC} = 1.5V, Ta = 25°C)
- Low noise.
- Very few external parts.
- Operating supply voltage range.: V_{CC} = 0.95~5V (Ta = 25°C)

Block Diagram

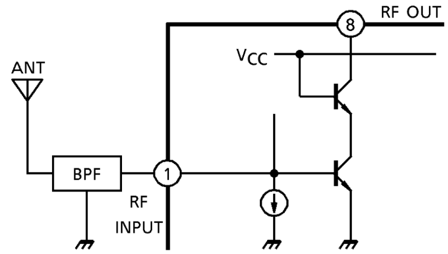


Explanation Of Inner Circuit And Functions

(1) RF block

The radio signal is applied to RF INPUT passed through the ANT and BPF.

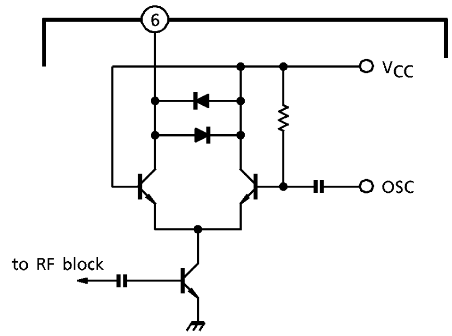
This RF block is composed of the common emitter amplifier. The output is designed to be the cascade connection, because of high sensitivity characteristic, and excellent spurious radiation. (Fig.1)



(Fig.1)

(2) MIX block

The MIX block is composed of the emitter coupled pair amplifier. (Fig.2)

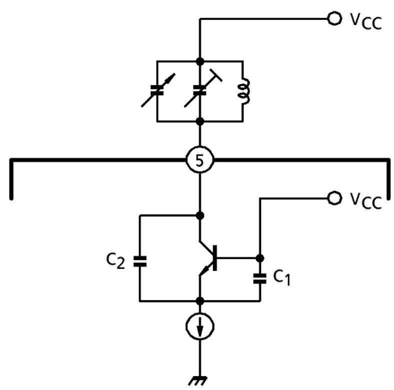


(Fig.2)

(3) OSC block

OSC block is composed of the colpitts oscillation circuit.

The capacitors C_1 and C_2 are built in this IC.



(Fig.3)

Absolute Maximum Ratings (Ta = 25°C)

Characteristic	Symbol	Rating	Unit
Supply voltage	V_{CC}	5	V
Power dissipation	P_D (Note)	240	mW
Operating temperature	T_{opr}	−25~75	°C
Storage temperature	T_{stg}	−55~150	°C

(Note) Derated above Ta = 25°C in the proportion of 2mW / °C.

Electrical Characteristics

(unless otherwise specified, V_{CC} = 1.5V, Ta = 25°C, f = 83MHz, Δf = ±22.5kHz, f_m = 1kHz)

Characteristic	Symbol	Test Cir– cuit	Test Condition	Min.	Typ.	Max.	Unit
Supply current	I_{CC}	2	V_{in} = 0	—	1.8	2.6	mA
Input limiting sensitivity	V_{in} (lim)	2	−3dB limiting point	—	10	16	dBμV EMF
Quiescent sensitivity	Q_S	2	S / N = 30dB	—	12	—	dBμV EMF
Conversion gain	G_C	2	V_{if} = 20mV_{rms}	—	25	—	dB
Local oscillator voltage	V_{osc}	1	f = 60MHz	75	110	150	mV_{rms}
Local oscillator stop voltage	V_{stop}	1	f = 60MHz	—	0.85	0.95	V
AFC diode capacity	C_{AFC}	6	f = 70MHz, V_{AFC} = 3V	—	5.0	—	pF
Pin(1) input impedance	$R_{ip}1$	3	f = 83MHz	—	300	—	Ω
	$C_{ip}1$			—	8.7	—	pF
Pin(6) input impedance	$R_{op}2$	4	f = 10.7MHz	—	100	—	kΩ
	$C_{op}2$			—	3.8	—	pF
Pin(8) input impedance	$R_{op}3$	5	f = 83MHz	—	2.2	—	kΩ
	$C_{op}3$			—	4.8	—	pF

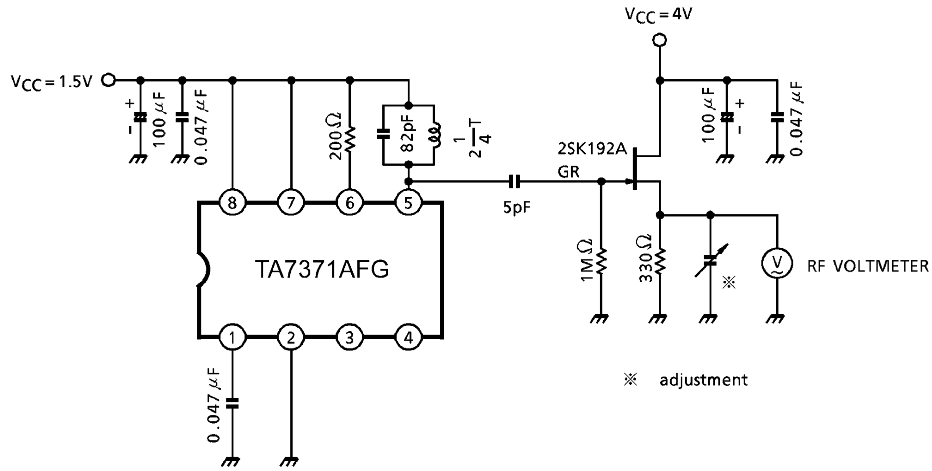
Terminal Voltage

Terminal Voltage at no Signal (V_{CC} = 1.5V, Ta = 25°C)

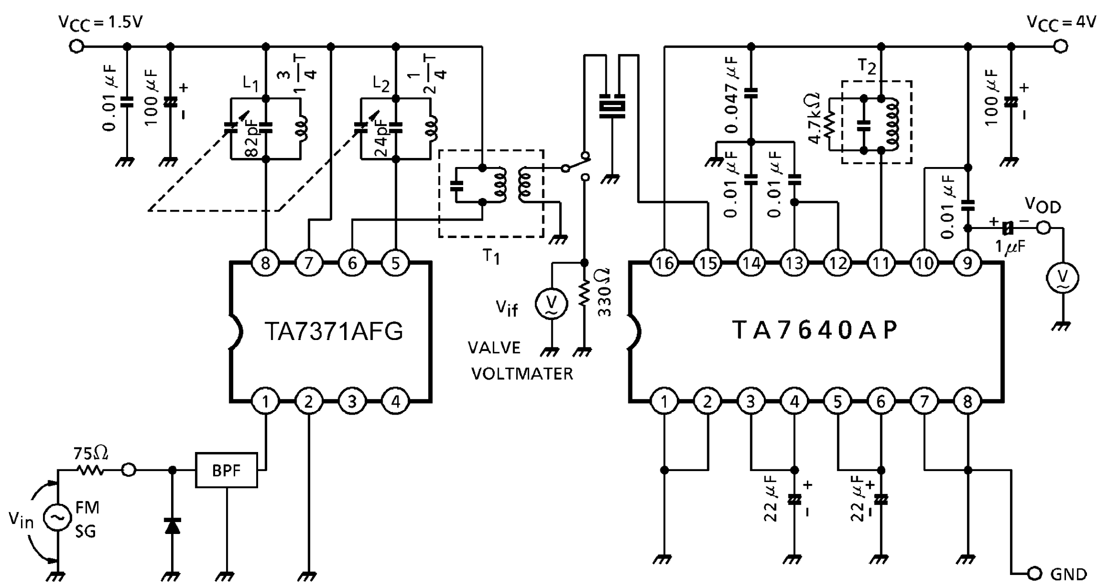
Terminal No.	Terminal Name	Terminal Voltage Typ. (V)
1	RF INPUT	0.7
2	GND	0
3	AFC DIODE (cathode)	—
4	AFC DIODE (anode)	—
5	LOCAL OSC	1.5
6	MIXER OUTPUT	1.5
7	V_{CC}	1.5
8	RF OUTPUT	1.5

Test Circuit 1

V_{osc}, V_{stop} TEST CIRCUIT



Test Circuit 2



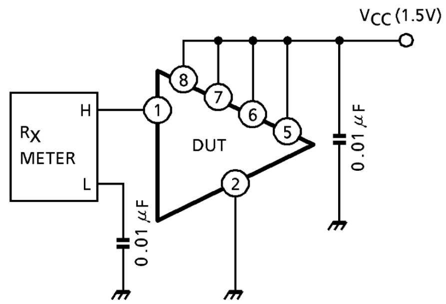
- Conversion gain: G_C (dB) = 20 ℓog $\frac{V_{if}}{V_{in}}$

Input / Output Impedance Test Circuit

Input / output impedance and AFC diode capacity test circuit

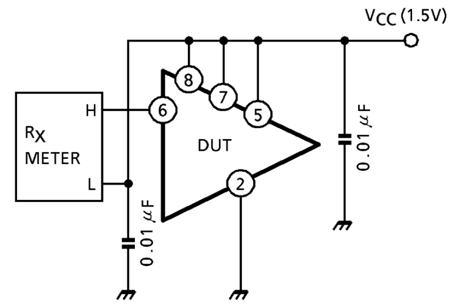
TEST CIRCUIT 3 (R_{ip} 1, C_{ip} 1)

Pin(1) input impedance



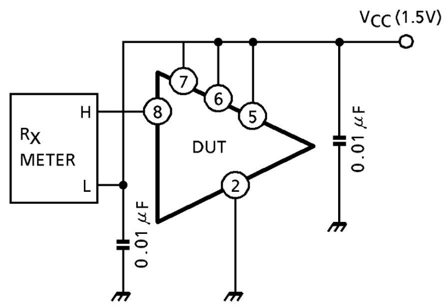
TEST CIRCUIT 4 (R_{op} 2, C_{op} 2)

Pin(6) output impedance



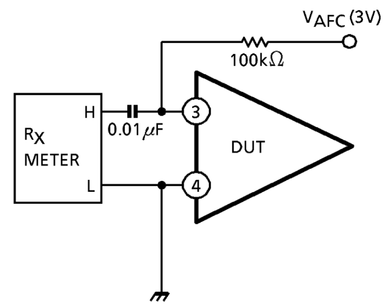
TEST CIRUCIT 5 (R_{op} 3, C_{op} 3)

Pin(8) output impedance



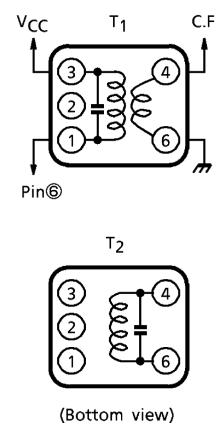
TEST CIRUCIT 6 (C_{AFC})

AFC diode



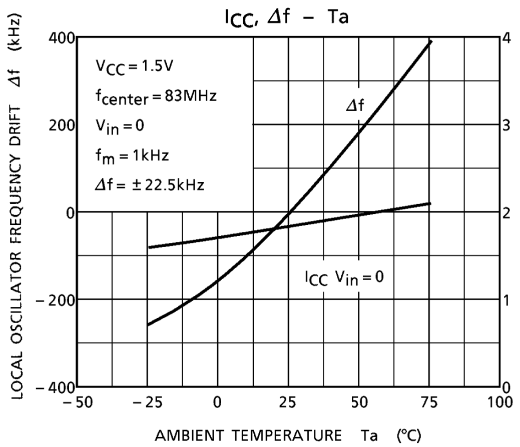
Coil Data For Test Circuit (lower side heterodyne type)

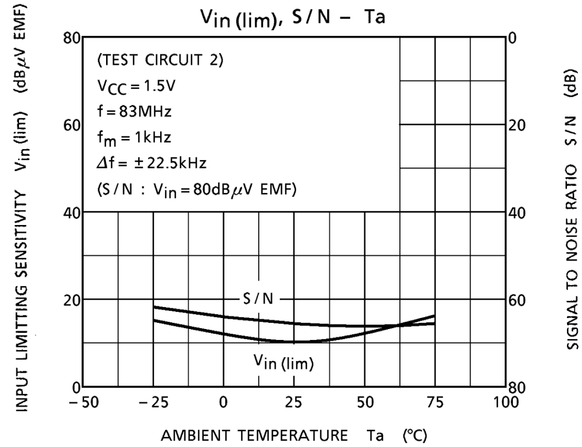
Coil Name	f_o	Q_o	Turn	Capacitance	Comment
L_1 RF	100MHz	85	(1)–(3) $1\frac{3}{4}$ T	82pF (external)	Bobbin with ferrite core ϕ0.5mm UEW
L_2 OSC	100MHz	100	(1)–(3) $2\frac{1}{4}$ T	24pF (external)	Bobbin with ferrite core ϕ0.5mm UEW
T_1 IFT	10.7MHz	115	(1)–(3) 12T (4)–(6) 1T	75pF	SUMIDA ELECTRIC Co. LTD. 0133–309–048
T_2 QUAD	10.7MHz	150	(4)–(6) 14T	47pF	SUMIDA ELECTRIC Co. LTD. 44M–037–933A

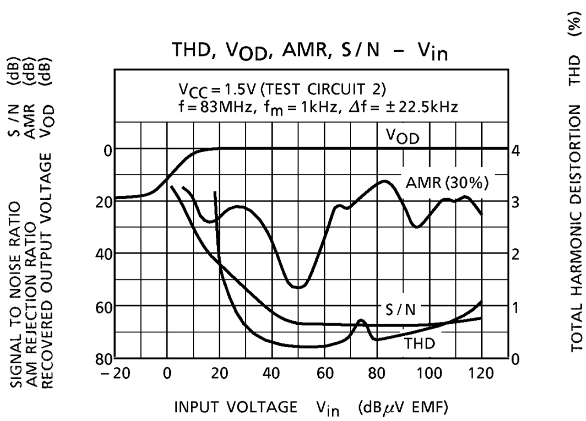


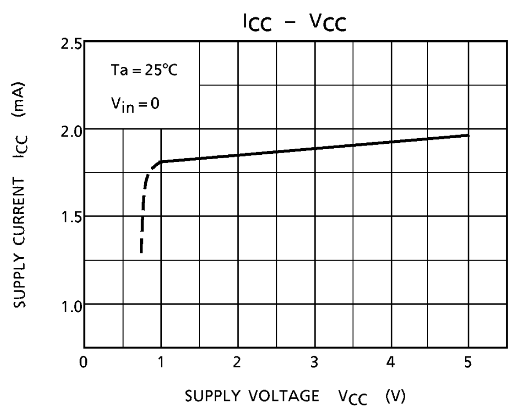
RF BPF SOSHIN ELECTRIC Co. LTD. BPW B6A

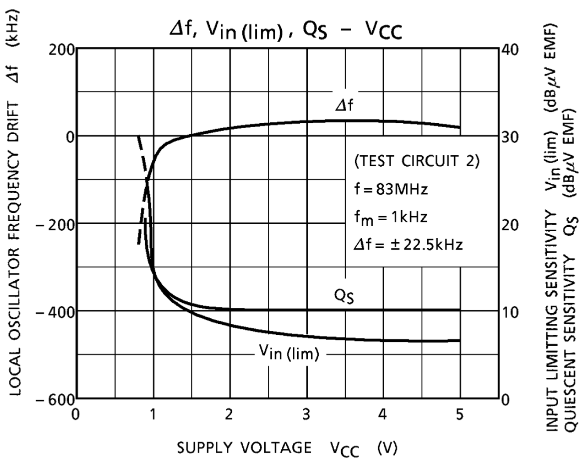
IF BPF MURATA ELECTRIC Co. LTD. SFE 10.7 MA5

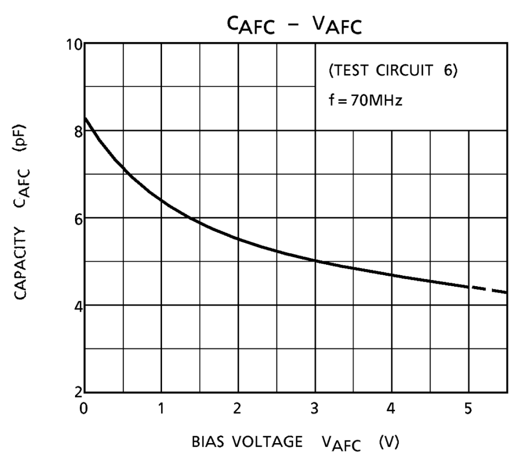

ICC, Δf – Ta
VCC = 1.5V
fcenter = 83MHz
Vin = 0
fm = 1kHz
Δf = ±22.5kHz
Δf
ICC Vin = 0
LOCAL OSCILLATOR FREQUENCY DRIFT Δf (kHz)
SUPPLY CURRENT ICC (mA)
AMBIENT TEMPERATURE Ta (°C)
400
200
0
–200
–400
4
3
2
1
0
–50
–25
0
25
50
75
100


Vin (lim), S / N – Ta
(TEST CIRCUIT 2)
VCC = 1.5V
f = 83MHz
fm = 1kHz
Δf = ±22.5kHz
(S / N : Vin = 80dBμV EMF)
S / N
Vin (lim)
INPUT LIMITTING SENSITIVITY Vin (lim) (dBμV EMF)
SIGNAL TO NOISE RATIO S / N (dB)
AMBIENT TEMPERATURE Ta (°C)
80
60
40
20
0
0
20
40
60
80
–50
–25
0
25
50
75
100


THD, VOD, AMR, S / N – Vin
VCC = 1.5V (TEST CIRCUIT 2)
f = 83MHz, fm = 1kHz, Δf = ±22.5kHz
VOD
AMR (30%)
S / N
THD
SIGNAL TO NOISE RATIO S / N (dB)
AM REJECTION RATIO AMR (dB)
RECOVERED OUTPUT VOLTAGE VOD (dB)
TOTAL HARMONIC DEISTORTION THD (%)
INPUT VOLTAGE Vin (dBμV EMF)
0
20
40
60
80
4
3
2
1
0
–20
0
20
40
60
80
100
120

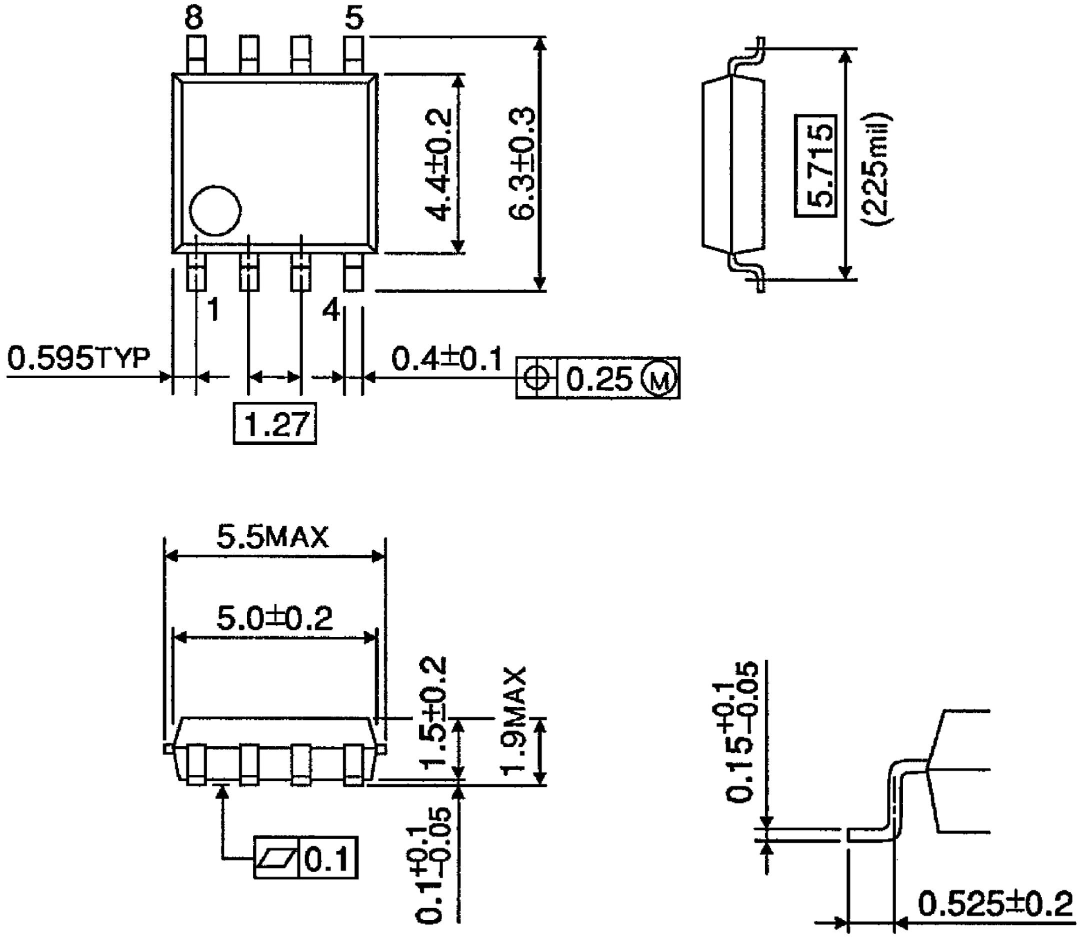

ICC – VCC
Ta = 25°C
Vin = 0
SUPPLY CURRENT ICC (mA)
SUPPLY VOLTAGE VCC (V)
2.5
2.0
1.5
1.0
0
1
2
3
4
5


Δf, Vin (lim), QS – VCC
Δf
(TEST CIRCUIT 2)
f = 83MHz
fm = 1kHz
Δf = ±22.5kHz
QS
Vin (lim)
LOCAL OSCILLATOR FREQUENCY DRIFT Δf (kHz)
INPUT LIMITTING SENSITIVITY Vin (lim) (dBμV EMF)
QUIESCENT SENSITIVITY QS (dBμV EMF)
SUPPLY VOLTAGE VCC (V)
200
0
–200
–400
–600
40
30
20
10
0
0
1
2
3
4
5


CAFC – VAFC
(TEST CIRCUIT 6)
f = 70MHz
CAPACITY CAFC (pF)
BIAS VOLTAGE VAFC (V)
10
8
6
4
2
0
1
2
3
4
5

Package Dimensions

SOP8-P-225-1.27 Unit : mm



Weight: 0.08g (typ.)

- Use an appropriate power supply fuse to ensure that a large current does not continuously flow in case of over current and/or IC failure. The IC will fully break down when used under conditions that exceed its absolute maximum ratings, when the wiring is routed improperly or when an abnormal pulse noise occurs from the wiring or load, causing a large current to continuously flow and the breakdown can lead smoke or ignition. To minimize the effects of the flow of a large current in case of breakdown, appropriate settings, such as fuse capacity, fusing time and insertion circuit location, are required.

- If your design includes an inductive load such as a motor coil, incorporate a protection circuit into the design to prevent device malfunction or breakdown caused by the current resulting from the inrush current at power ON or the negative current resulting from the back electromotive force at power OFF. For details on how to connect a protection circuit such as a current limiting resistor or back electromotive force adsorption diode, refer to individual IC datasheets or the IC databook. IC breakdown may cause injury, smoke or ignition.

- Use a stable power supply with ICs with built-in protection functions. If the power supply is unstable, the protection function may not operate, causing IC breakdown. IC breakdown may cause injury, smoke or ignition.

- Carefully select external components (such as inputs and negative feedback capacitors) and load components (such as speakers), for example, power amp and regulator. If there is a large amount of leakage current such as input or negative feedback condenser, the IC output DC voltage will increase. If this output voltage is connected to a speaker with low input withstand voltage, overcurrent or IC failure can cause smoke or ignition. (The over current can cause smoke or ignition from the IC itself.) In particular, please pay attention when using a Bridge Tied Load (BTL) connection type IC that inputs output DC voltage to a speaker directly.

- Over current Protection Circuit
  Over current protection circuits (referred to as current limiter circuits) do not necessarily protect ICs under all circumstances. If the Over current protection circuits operate against the over current, clear the over current status immediately. Depending on the method of use and usage conditions, such as exceeding absolute maximum ratings can cause the over current protection circuit to not operate properly or IC breakdown before operation. In addition, depending on the method of use and usage conditions, if over current continues to flow for a long time after operation, the IC may generate heat resulting in breakdown.

- Thermal Shutdown Circuit
  Thermal shutdown circuits do not necessarily protect ICs under all circumstances. If the Thermal shutdown circuits operate against the over temperature, clear the heat generation status immediately. Depending on the method of use and usage conditions, such as exceeding absolute maximum ratings can cause the thermal shutdown circuit to not operate properly or IC breakdown before operation.

- Heat Radiation Design
  When using an IC with large current flow such as power amp, regulator or driver, please design the device so that heat is appropriately radiated, not to exceed the specified junction temperature (Tj) at any time and condition. These ICs generate heat even during normal use. An inadequate IC heat radiation design can lead to decrease in IC life, deterioration of IC characteristics or IC breakdown. In addition, please design the device taking into considerate the effect of IC heat radiation with peripheral components.

- Installation to Heat Sink
  Please install the power IC to the heat sink not to apply excessive mechanical stress to the IC. Excessive mechanical stress can lead to package cracks, resulting in a reduction in reliability or breakdown of internal IC chip. In addition, depending on the IC, the use of silicon rubber may be prohibited. Check whether the use of silicon rubber is prohibited for the IC you intend to use, or not. For details of power IC heat radiation design and heat sink installation, refer to individual technical datasheets or IC databooks.

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About solderability, following conditions were confirmed

- Solderability

  (1) Use of Sn-37Pb solder Bath
  - solder bath temperature = 230°C
  - dipping time = 5 seconds
  - the number of times = once
  - use of R-type flux

  (2) Use of Sn-3.0Ag-0.5Cu solder Bath
  - solder bath temperature = 245°C
  - dipping time = 5 seconds
  - the number of times = once
  - use of R-type flux