IC for Multifunction Telephones
Monolithic IC LAG640

Outline

This IC was developed for use in multifunctional telephones with security features; it has the following functions.

Features

1. Incorporates efficient switching regulator with broad input voltage range
   V_{OUT} 5V±0.25 I_L 250mA (13~45V)
   V_{IN} 15~45V
2. Internal data transmission/reception circuits
   Data can be superposed on the power supply line for transmission.
   Can be switched between two different input modes
3. Internal system reset circuit
   5V line abnormal voltage detection circuit
   Watchdog timer reset circuit
4. Internal speaker amp
   260 mW typ. at 8Ω load
   Mute pin
5. Internal beep sound generator circuit
   With pin to vary audio volume (also used to turn beep sound on and off)

Package

SDIP-30A (LAG640D)

Absolute Maximum Ratings (Ta=25°C)

Item	Symbol	Ratings	Units
Operating temperature	T_{OPR}	–20~+70	°C
Storage temperature	T_{STG}	–40~+125	°C
Power supply current	V_{CC} max.	46	V
Allowable loss	Pd	750	mW

Electrical Characteristics (Except where noted otherwise, Ta=25°C, V_{CC}=30V)

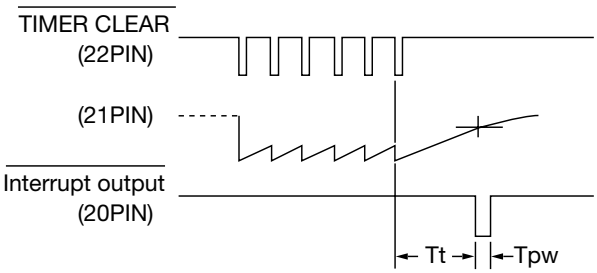
Item	Symbol	Measurement circuit	Measurement conditions	Min.	Typ.	Max.	Units
SWR unit							
Output voltage (5V)	V_{O1}	1	V_{CC}=15~45V I_L=0~250mA	4.75	5.00	5.25	V
Output voltage (5V)	V_{O2}	1	V_{CC}=13~45V I_L=0~200mA	4.70	5.00	5.25	V
Output ripple voltage	Vr	1	I_L=250mA			50	mV_{P-P}
Reactive current	Iccq	1	I_L=0mA Amp & Transmission unit		6	10	mA
SWR oscillation frequency	Fosc	1			80		kHz
Output current on short-circuit	Ios	1	Rs=0.2Ω	70	110	150	mA
Power supply voltage detection unit							
Detection voltage	Vs	2	*	4.30	4.50	4.80	V
Detection drop voltage	⊿Vs	2	⊿Vs=Vo–Vs	0.2			V
Output current while on	IRon	2	Vo=4V	10	20		mA
Leakage output current while off	IRoff	2	Vo=5.25V			1	µA

Note: The asterisk (*) indicates that the power supply voltage detection unit characteristics are standards in the transient power on/off states. However, for convenience the detection voltage is taken to be the value of V_0 when V_0 in measurement circuit 2 is varied and the pin 6 output state is switched from off to on.

Electrical Characteristics (Except where noted otherwise, Ta=25°C, V_{CC}=30V Faudio=1kHz)

Item	Symbol	Measurement circuit	Measurement conditions	Min.	Typ.	Max.	Units
Power amp unit							
Amp gain	G_V	1	Voa=0.775Vrms	37	40	43	dB
Maximum distortion-free output	P_O max.	1	THD=10%	150	260		mV
Distortion	THD	1	P_O=100mW			5	%
Attenuation at 100 Hz	GF1/GF0	1	F_O=1kHz, Fl=100Hz Voa=0.775Vrms		–14		dB
Attenuation at 10 Hz	GF2/GF0	1	F2=10 kHz, above conditions		–8		dB
Input IMP 1	$R_{IN}1$	3	Mute off	10	15		kΩ
Input IMP 2	$R_{IN}2$	3	Mute on	2.5	3.5		kΩ
Residual noise 1	Vno1	1	Mute on AUDIO IN 20mVrms I_L=10 70mA 1.5kHz Transmission unit on Ft=1kHz			0.5	mVrms
Residual noise 2	Vno2	1	Mute off AUDIO OFF I_L=10 70mA 1.5kHz Transmission unit on Ft=1kHz			1.2	mVrms
Beep sound generator unit							
Beep sound frequency	Fb	1		0.85	1.0	1.15	kHz
Beep off switching point	Ibsw	1	Pin 9 input current	20	35	48	µA
Beep sound output 1	Vob1	1	Pin 9 connected to GND through 4.7k Amp output voltage	1.0	1.4	1.8	Vrms
Beep sound output 2	Vob2	1	Pin 9 connected to GND through 47k	0.11	0.16	0.22	Vrms
Watchdog timer unit							
Timer time	Tt	1	cf. watchdog timer waveform diagram	2.4	3.0	3.6	S
Output pulse width	T_{PW}	1	cf. watchdog timer waveform diagram T=beep sound period	0.45 (1/2T)		1.1 (1T)	mS
Output voltage while on	V_{WON}	1				0.5	V
Leakage output current while off	I_{WOFF}	1				1	µA
Timer-clearing pulse width	Tcl	1		5			µS
Transmission circuit unit							
Transmission output voltage (1)	Vto1	2	R_L-110Ω, peak value across pins L3–L4	5.1	5.8	6.6	Vp-p
Transmission output voltage (2)	Vto2	2	R_L-1Ω, peak value across pins L3–L4	5.5	6.2	7.0	Vp-p
L3 pin voltage	VL3	2	No signal	4.0	4.4	4.8	V
L4 pin voltage	VL4	2	No signal	0.5	0.7	0.9	V
Reception sensitivity	Vrs	2		0.8	1.0	1.2	Vp-p
Input IMP	$R_{IN}3$	4	Both pins 7and 8	14	20	26	kΩ
Transmission delay time	Td1	2	cf. transmit/receive waveform diagrams		0.4		µS
Transmission delay time	Td2	2	cf. transmit/receive waveform diagrams		0.4		µS
Transmission delay time	Td3	2	cf. transmit/receive waveform diagrams		0.8		µS
Transmission delay time	Td4	2	cf. transmit/receive waveform diagrams		0.8		µS
Reception output H voltage	VroH	2	R_L=10kΩ	4.5			V
Reception output L voltage	VroL	2	R_L=1.5kΩ			0.5	V
General logic unit characteristics							
H level input voltage	ViH	3		2.4			V
L level input voltage	ViL	3				0.8	V
H level input current	IiH	3	V_{IN}=2.4V			10	µA
L level input current	IiL	3	V_{IN}=0.4V			–300	µA

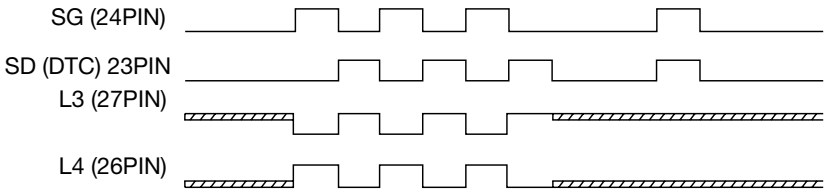
Watchdog Timer Waveform Diagrams



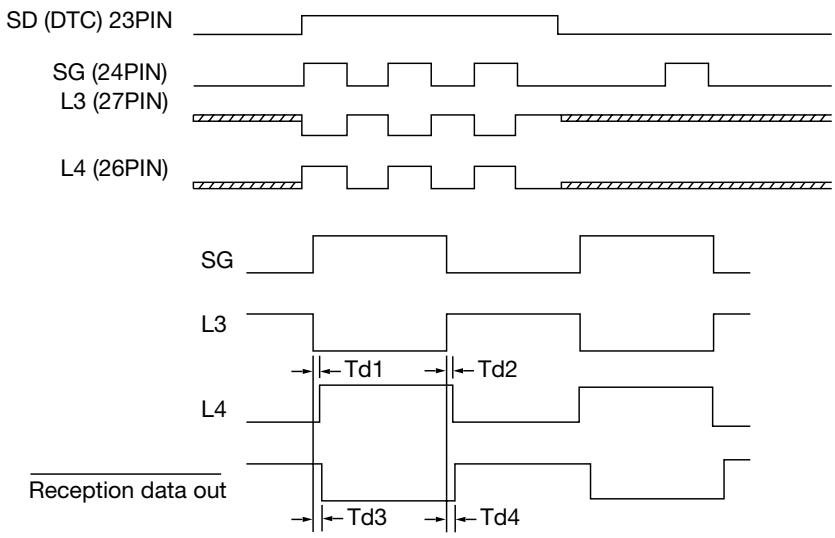
Note: Pulses to clear the timer must have a width of 5µs or more.

Transmit/receive Waveform

1. When pulling pin 25 up to V_{DD} (+5V)

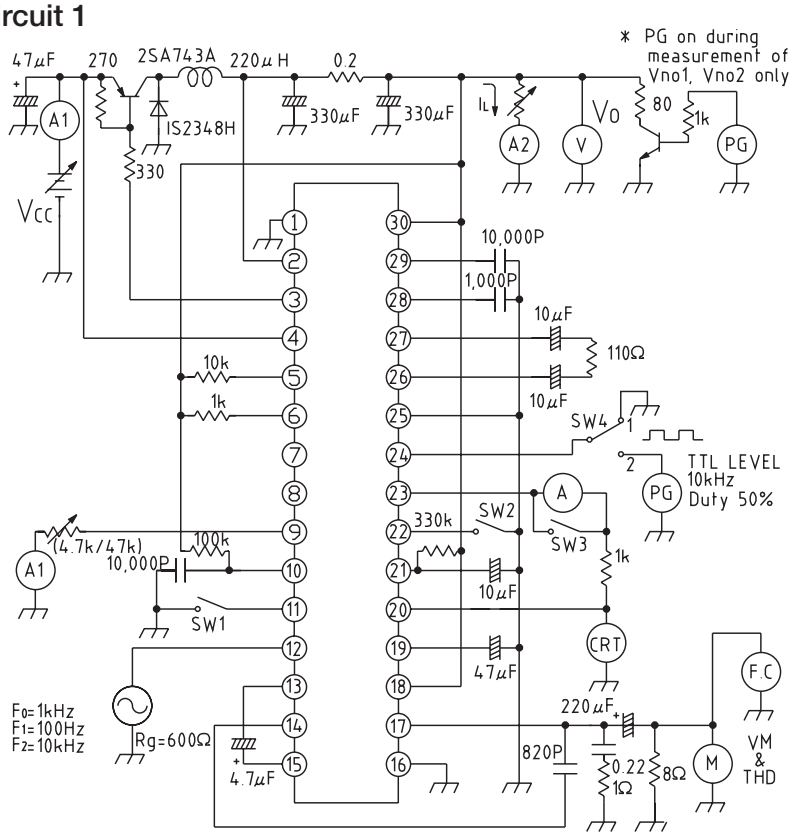


2. When shorting pin 25 to GND

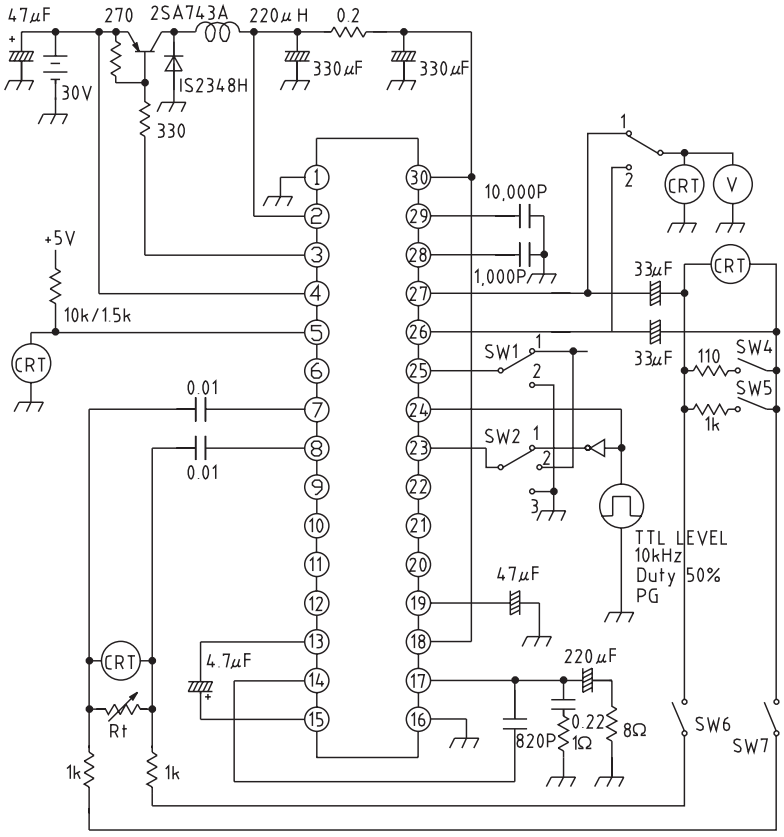


Measuring Circuit

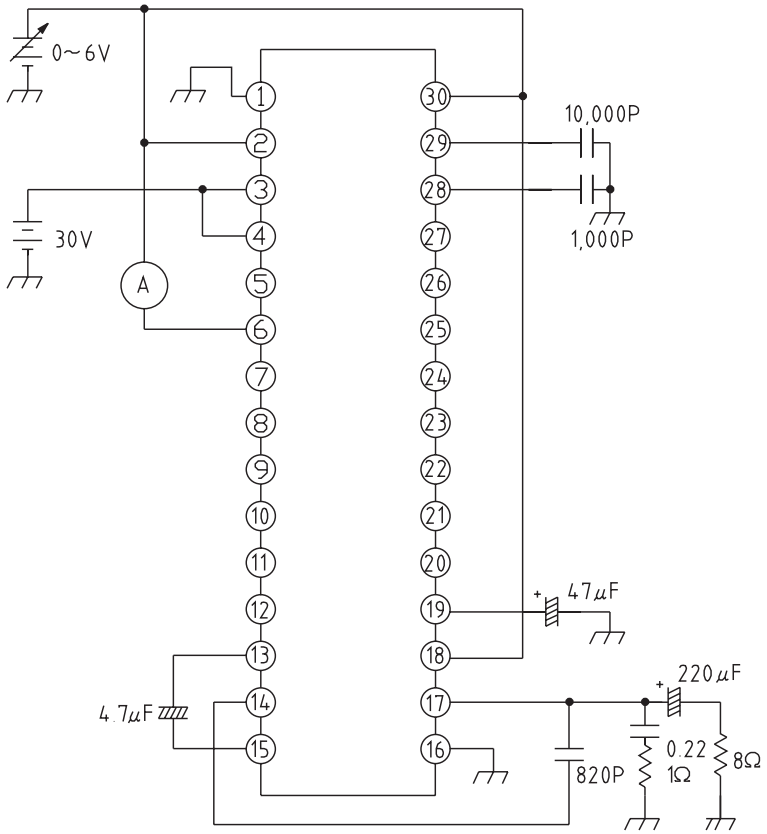
Measurement circuit 1



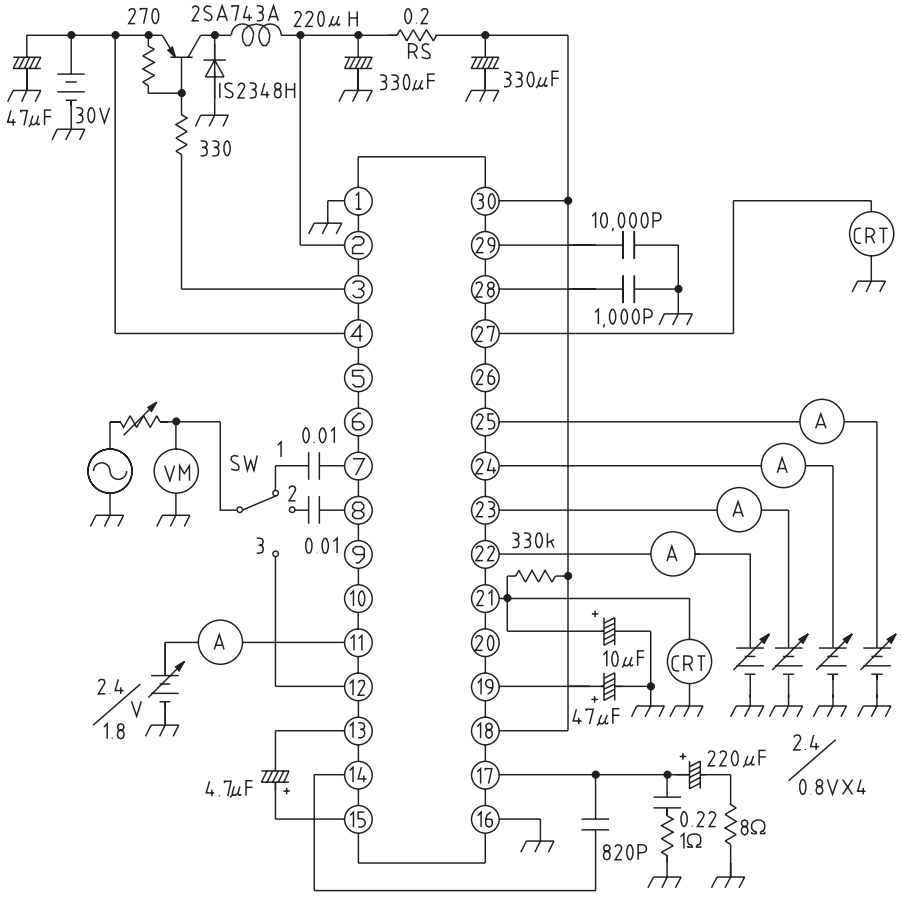
Measurement circuit 2



Measurement circuit 3



Measurement circuit 4



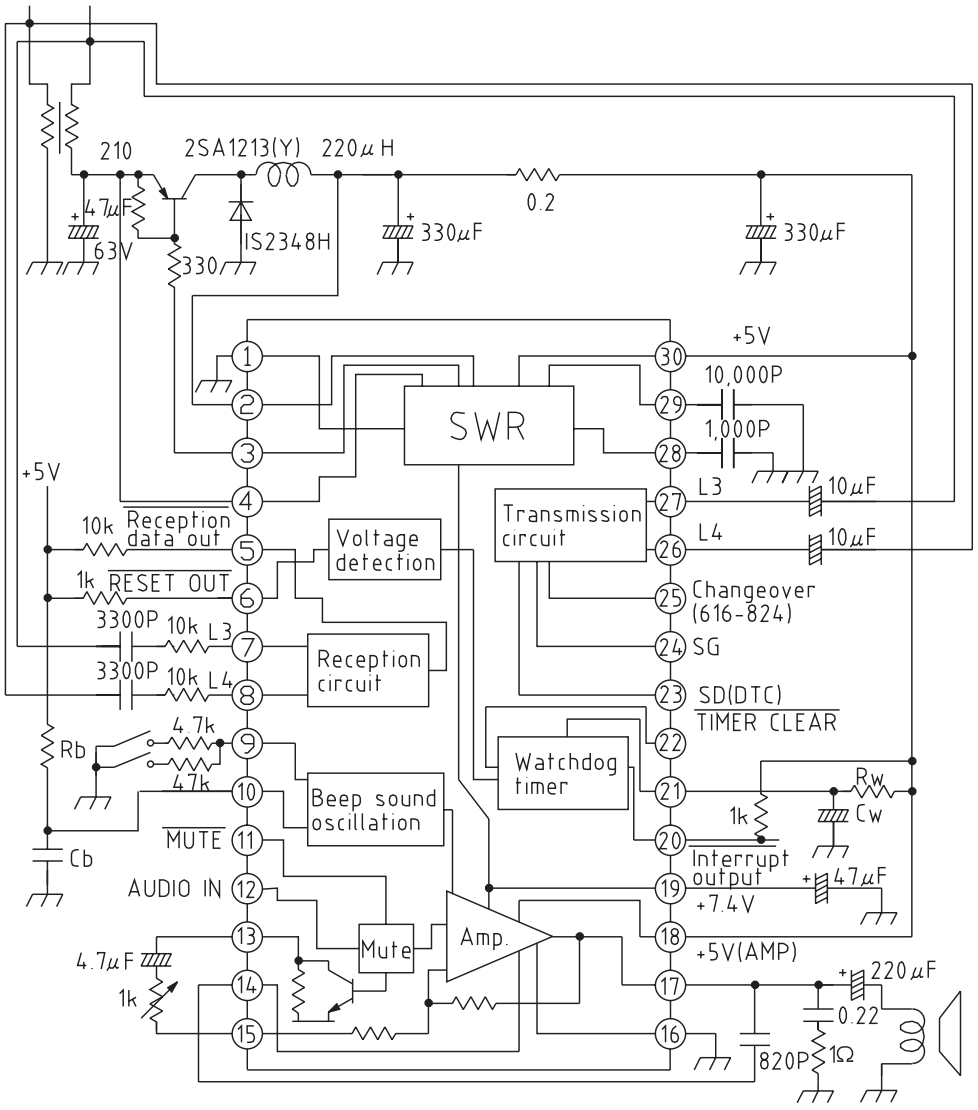
Switch Operation (Measurement circuit 1)

Measurement item	SW1	SW2	SW3	SW4	Other Conditions
Vo1, Vo2	○	×	○	1	
Vr	○	×	○	1	No spike noise
Iccq	○	×	○	1	A1 only
Ios	○	×	○	1	A2 only
Gv, Po max., THD GF1/GF0, GF2/GF0	×	×	○	1	THD measured after passing through 400Hz-15kHz BPF
Vno1	○	×	○	2	Using 400Hz-15kHz BPF
Vno2	×	×	○	2	Using 400Hz-15kHz BPF
Fb, IbSW, Vob1, Vob2	○	×	○	1	
Tt, TPW, Vwon, Tcl	–	× ↓ ○	○	1	cf. watchdog timer waveform diagram
IWOFF	–	×	×	1	

Switch Operation (Measurement circuit 2)

Measurement	SW1	SW2	SW3	SW4	SW5	SW6	SW7	
Vto1	1	1	–	○	×	×	×	Peak value across pins L3, L4
	2	2	–	○	×	×	×	Peak value across pins L3, L4
Vto2	1	1	–	×	○	×	×	Peak value across pins L3, L4
	2	2	–	×	○	×	×	Peak value across pins L3, L4
VL3	2	3	1	×	×	×	×	
VL4	2	3	2	×	×	×	×	
Vrs	2	2	–	○	×	○	○	Measured with Rt adjusted
Td1~Td4	2	2	–	○	×	○	○	cf. transmit/receive waveform diagrams
VroH, VroL	2	2	–	○	×	○	○	

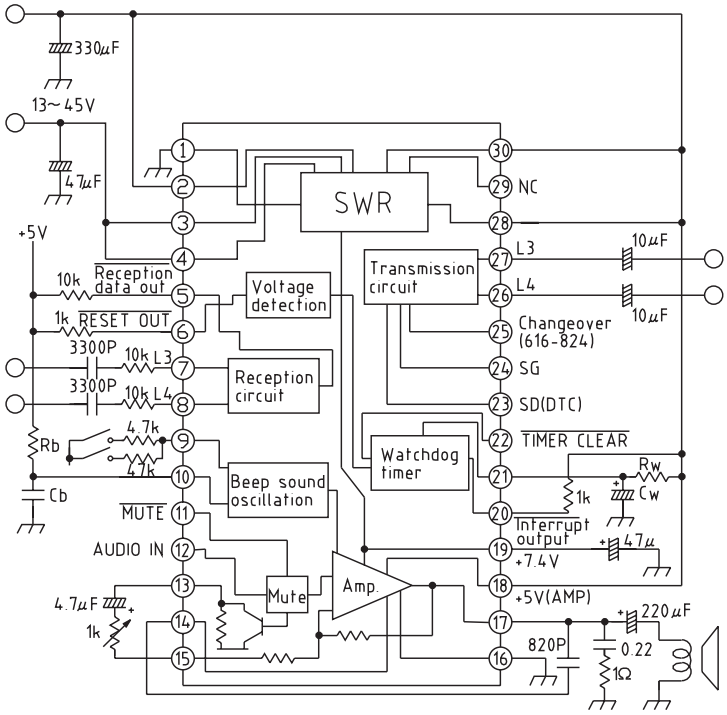
Block Diagram and Application Circuits



1. The watchdog timer time is determined by the values of Rw and Cw.
   Tt ≒ Rw · Cw where Rw is 56k to 560kΩ
   Cw is between 0.01μF and 10μF
2. The beep sound frequency is determined by Rb and Cb.
   Fb ≒ 1/Rb · Cb where Rb is 56k to 330kΩ
   Cb is between 4700PF and 22,000PF.
3. The beep sound volume can be varied through the resistance connected to pin 10.
   4.7kΩ the voltage is approx. $4V_{P-P}$, and at 47kΩ it is about $0.4V_{P-P}$.
4. In overload protection operation the voltage across pins 1 to 30 is tested, with a limit of 100 ±20mV.
   On load shorting, the test voltage is dropped to about 1/4 to conserve power.

Additional application example 1

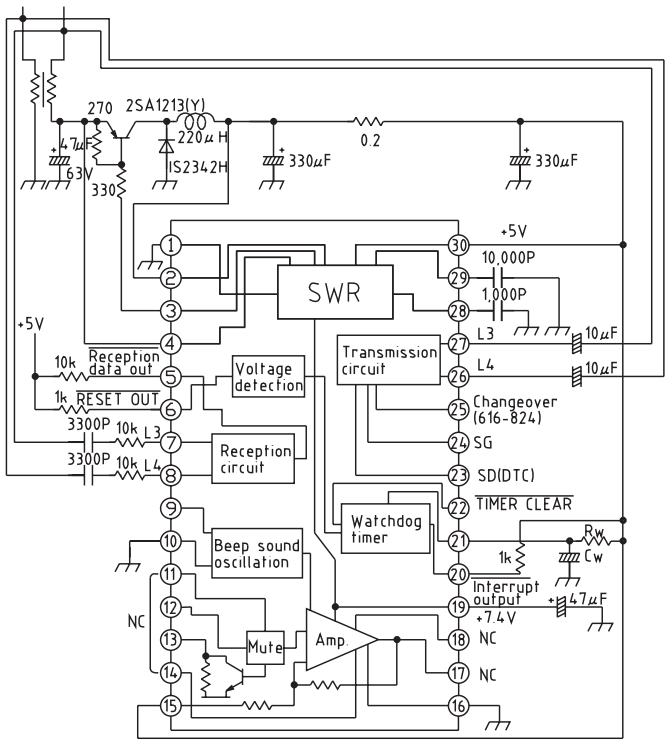
(SWR circuit not used)



Even when a 5V external voltage can be supplied, an addition voltage of 13 to 45V must be applied to pins 3 and 4 in order to obtain an internal biased power supply of 7.4V.

Additional application example 2

(Speaker amp not used)



In order to prevent abnormal oscillation of the amplification circuit, a 5 V power supply must be connected to pin 15 to halt amplification functions.

Notes on Use

1. Protection from high-frequency noise

   In consideration of applications in which telephone sets are connected over long distances, this IC is designed for high withstand and static breakdown voltages at pins 3 and 4, which are in danger of being exposed to electrostatic charge and high-frequency noise.

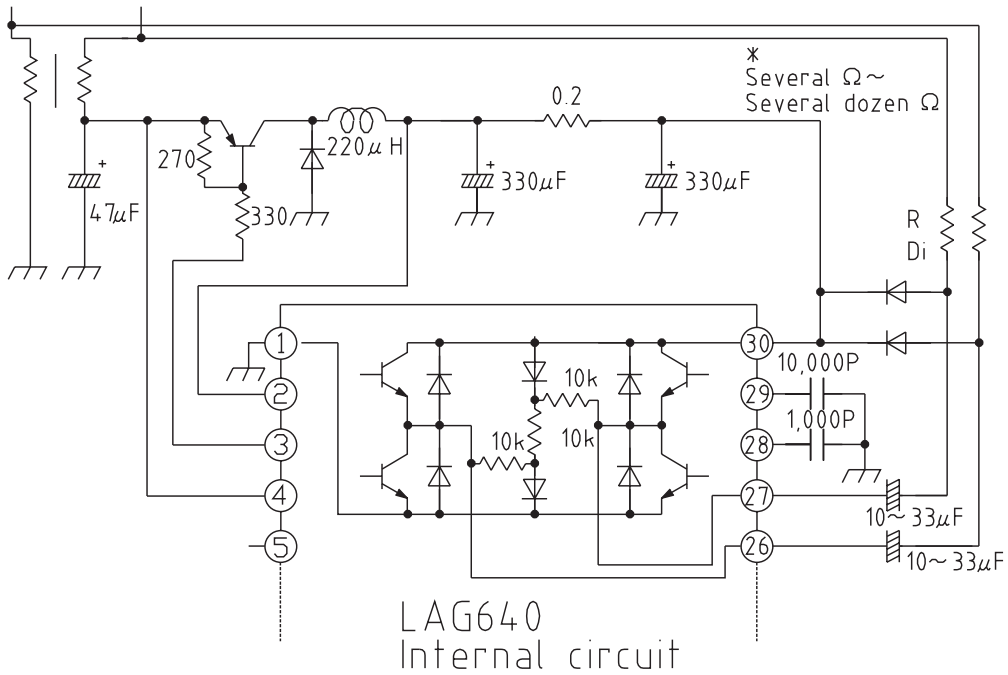
Pins 3 and 4	DC withstand voltage	46V or higher
	Static breakdown voltage	±1000V or higher
	(human body buildup method, 200pF, 0Ω)	
Other pins	DC withstand voltage	15V or higher
	Static breakdown voltage	±300V or higher
	(human body buildup method, 200pF, 0Ω)	

   However, the IC may be damaged by adverse mounting or use conditions, and so it is recommended that a surge suppressor be inserted between pin 4 and GND.

2. Protection from surge currents

   A diode for capacitor charging is connected between data transmission output pins 26 and 27 as shown below; the surge current ratings shown below should not be exceeded.
   If these ratings are to be exceeded, it is recommended that a resistance R for surge current limiting or a diode Dt for absorption be inserted.

Internal diode maximum ratings	Io	100mA
	IF (peak)	500mA
	IF (surge)	700mA



LAG640
Internal circuit