May 1990
Edition 2.0

FUJITSU

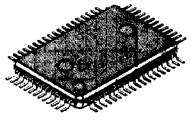
DATA SHEET

MB4509
TELEPHONE IC

TELEPHONE IC

The Fujitsu MB4509, utilizing Bipolar technology, is a telephone IC. The MB4509 has an on-chip speech network circuit, tone ringer circuit, dialer circuit.

- On-chip speech network circuit, tone ringer circuit, dialer circuit
- On-hook dialing function
- Redial function
- Tone ringer tone selection function
- 64-pin plastic flat package



FPT-64P-M01

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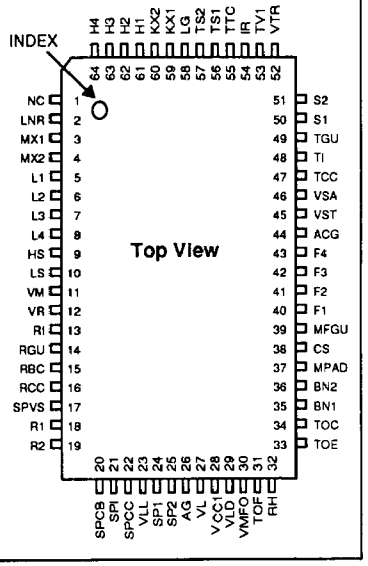
PIN ASSIGNMENT



ABSOLUTE MAXIMUM RATINGS (See NOTE) (TA = 25 °C)

Parameter		Symbol	Value	Unit
Transmit Section	Supply Voltage	V_{LM}	21	V
	Supply Current	I_{LM}	160	mA
Tone Ringer	Supply Voltage	V_{TM}	21	V
	Supply Current	I_{TM}	10	mA
Operating Ambient Temperature		T_A	−30 to 60	°C
Storage Temperature		T_{STG}	−55 to 125	°C

NOTE: Permanent device damage may occur if the above **Absolute Maximum Ratings** are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit.

Table 1 — PIN ASSIGNMENTS

Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol
1	NC	17	SPVS	33	TOE	49	TGU
2	LNR	18	R1	34	TOC	50	S1
3	MX1	19	R2	35	BN1	51	S2
4	MX2	20	SPCB	36	BN2	52	VTR
5	L1	21	SPI	37	MPAD	53	TV1
6	L2	22	SPCC	38	CS	54	IR
7	L3	23	VLL	39	MFGU	55	TTC
8	L4	24	SP1	40	F1	56	TS1
9	HS	25	SP2	41	F2	57	TS2
10	LS	26	AG	42	F3	58	LG
11	VM	27	VL	43	F4	59	KX1
12	VR	28	V_{CC1}	44	ACG	60	KX2
13	RI	29	VLD	45	VST	61	H1
14	RGU	30	VMFO	46	VSA	62	H2
15	RBC	31	TOF	47	TCC	63	H3
16	RCC	32	RH	48	TI	64	H4

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RECOMMENDED OPERATING CONDITIONS (T_A = 25 °C)

Parameter		Symbol	Value	Unit
Transmit Section	Supply Voltage	V_{LM}	20 max	V
	Supply Current	I_{LM}	20 to 150	mA
Tone Ringer	Supply Voltage	V_{TM}	20 max	V
	Supply Current	I_{TM}	7 max	mA

ELECTRICAL CHARACTERISTICS (f = 1.0 kHz; TA = 25 °C)

Parameter	Symbol	Measurement Condition		Values			Unit
			I_L (mA)	Min	Typ	Max	
DC Voltage	V_{L11}	Speeching	20	2.3	2.6	2.9	V
	V_{L12}*		90	4.95	5.70	6.45	V
	V_{L21}	Dialing	20	4.4	4.7	5.0	V
	V_{L22}*		90	6.3	7.8	9.3	V
Transmit Supply Voltage	V_{CC1}	Speeching	20	1.57	1.70	1.90	V
Telephone AC Impedance	Z_{TEL1}*	Speech handset	30.90	420	600	780	Ω
	Z_{TEL2}*	Loudspeaker	30.90	420	600	780	Ω
Transmit Voltage Gain	G_{TV1}	AUTO, V_i = -50 dBV	30	42.3	44.8	47.3	dB
	G_{TV2}	MAN, V_i = -50 dBV	30	40.6	43.3	46.0	dB
	G_{TV3}	AUTO, V_i = -50 dBV	90	40.9	43.8	46.7	dB
Transmit Dynamic Range	G_{TD1}	Distortion attenuation is 20 dB or more.	30	0.5	3.0		dBV
	G_{TD2}		90	4.5	6.0		dBV
Transmission Background Noise	NT*					-56	dBV
Reception Gain	G_{RV1}	AUTO, V_i = -30 dBV	30	11.6	14.1	16.6	dB
	G_{RV2}	MAN, V_i = -30 dBV	30	5.4	8.1	10.8	dB
	G_{RV3}	AUTO, V_i = -30 dBV	90	5.7	8.6	11.5	dB
Reception Dynamic Range	G_{RD1}	Attenuation is 20 dB or more.	30	-5.5	-1.0		dBV
	G_{RD2}		90	-1.0	0.0		dBV
Balancing Network Threshold Current	I_{FN}	Far to near		43	55	70	mA
	I_{NF}	Near to far		32.5	42.5	52.5	mA
	I_H	Hysteresis		9.0	12.5	27.5	mA
Speaker Gain	G_{SV}	V_i = -30 dBV	30	10.5	15.5	20.5	dB
Speaker Dynamic Range	G_{SD1}	Distortion attenuation is 20 dB or more.	30	-15	-12		dBV
	G_{SD2}		90	-4	-1		dBV
Tone Switch	LT*	For transmission V_i = -45 dBV	30	40	49		dB
	LS*	For loud drive V_i = -50 dBV	30	50	57		dB
	V_{TH}	Threshold level	30	-73	-69	-65	dBV
	t_{RL}	V_i = -50 dBV	30		7	10	ms

Note: * Design guarantee

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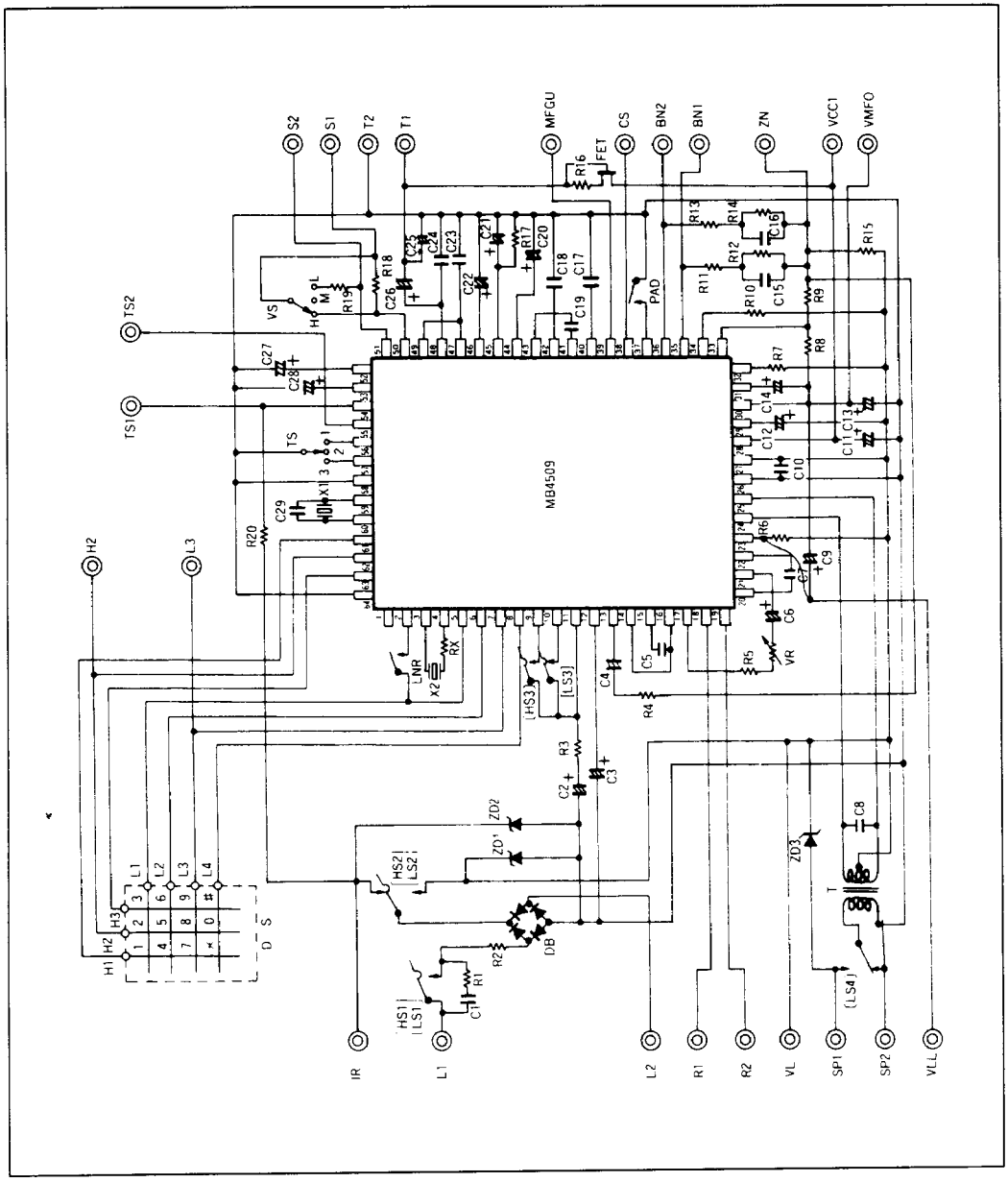
ELECTRICAL CHARACTERISTICS (Continued)

Parameter	Symbol	Measurement Condition		Values			Unit
			I_L (mA)	Min	Typ	Max	
Oscillation Frequency Deviation	$\%f_{L1}$	fL_1 = 697Hz	90	-0.9		0.9	%
	$\%f_{L2}$	fL_2 = 770 Hz		-0.9		0.9	%
	$\%f_{L3}$	fL_3 = 852 Hz		-0.9		0.9	%
	$\%f_{L4}$	fL_4 = 941 Hz		-0.9		0.9	%
	$\%f_{H1}$	fH_1 = 1209 Hz		-0.9		0.9	%
	$\%f_{H2}$	fH_2 = 1336 Hz		-0.9		0.9	%
	$\%f_{H3}$	fH_3 = 1477 Hz		-0.9		0.9	%
	$\%f_{H4}$	fH_4 = 1633 Hz		-0.9		0.9	%
Signal Level (button 8)	V_{PL11}	AUTO PAD	30	-9.4	-7.5	-5.6	dBm
	V_{PH11}			-8.4	-6.5	-4.6	dBm
	V_{PL12}	MAN. PAD	30	-11.9	-10.0	-8.1	dBm
	V_{PH12}			-10.9	-9.0	-7.1	dBm
	V_{PL13}	AUTO PAD	90	-11.9	-10.0	-8.1	dBm
	V_{PH13}			-10.9	-9.0	-7.1	dBm
Contact Resistance	R_{on} *	Transmit : OK	20			10	kΩ
	R_{off} *	Transmit : NO	20	500			kΩ
Distortion Attenuation (button 8)	D_{L20} *	AUTO PAD	20	23	30		dB
	D_{H20} *			23	30		dB
	D_{L90}	AUTO PAD	90	26	30		dB
	D_{H90}			26	30		dB
Switch Interface Guard Time	t_{PR} *	Rise *1	30	2		6	ms
	t_{PD} *	Fall	30	25	30	35	ms
Out-band Undesired Signal Level	V_{PS1} *	(4 through 8 kHz)	20			P-20	dB
	V_{PS2} *	(8 through 12 kHz)	20			P-40	dB
	V_{PS3} *	(12 kHz or more)	20			P-60	dB
Signal Level Increase	V_{PU} *		30	2.5	3.5	4.5	dB
MFO ON Resistance	R_{MFO}		30	1.7	3.2	4.4	Ω
CS Terminal ON Voltage	V_{CS} *	Sink current 1 mA	30			0.3	V
Tone Ringer Start Current	I_{TR}			1.5	2.25	3.0	mA
Guard Time	t_{TS} *			21	43	65	ms
Tone Ringer Output Voltage	V_{TR}	I_{TR} = 5 mA Tone: FA		30	34		V_{p-p}
Transmit Voltage Gain Increase	V_{TU} *	V_i = -50 dBV	30	3.0	4.0	5.0	dB
Reception Voltage Gain Increase	T_{RU} *	V_i = -50 dBV	30	3.0	4.0	5.0	dB

Note: * Design guarantll
*1 2ms .... No transmit.
6ms .... Transmit.

SYSTEM TEST SETUP

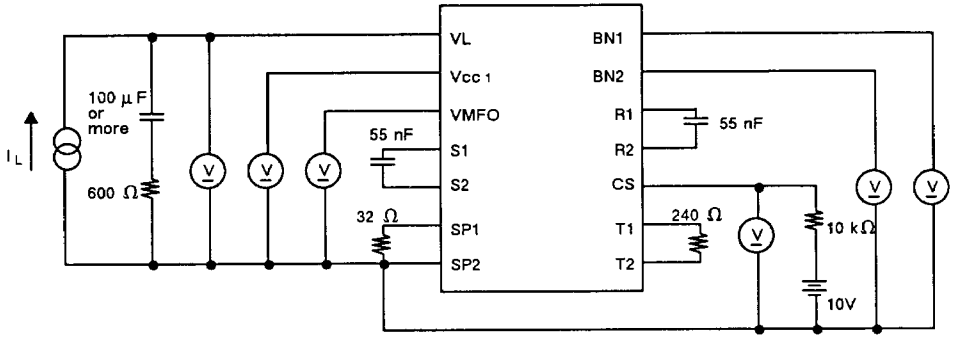


PARTS LIST FOR SYSTEM TEST SETUP

Symbol	Value	Symbol	Value
R1	150 Ω F, 1/2 W or more	C11	220 μF, 3 V or more, ± 5%
R2	1.0 Ω F, 1/4 W or more	C12	100 μF, 5 V or more, ± 5%
R3	180 Ω F, 1/16 W or more	C13	2.2 μF, 10 V or more, ± 5%
R4	470 Ω F, 1/16 W or more	C14	22 μF, 5 V or more, ± 5%
R5	2.2 kΩ F, 1/16 W or more	C15	0.015 μF, 20 V or more, ± 1%
R6	1.3 kΩ F, 1/16 W or more	C16	0.027 μF, 20 V or more, ± 1%
R7	56 Ω F, 1/2 W or more	C17	0.015 μF, 5 V or more, ± 1%
R8	18 Ω F, 1/4 W or more	C18	1500 pF, 5 V or more, ± 1%
R9	180 Ω F, 1/16 W or more	C19	0.022 μF, 5 V or more, ± 1%
R10	12 Ω F, 1/4 W or more	C20	47 μF, 3 V or more, ± 5%
R11	1.5 kΩ F, 1/16 W or more	C21	0.22 μF, 3 V or more, ± 1%
R12	6.2 kΩ F, 1/16 W or more	C22	1.5 μF, 3 V or more, ± 1%
R13	2.4 kΩ F, 1/16 W or more	C23	150 pF, 3 V or more, ± 5%
R14	8.2 kΩ F, 1/16 W or more	C24	100 pF, 3 V or more, ± 5%
R15	5.6 kΩ F, 1/16 W or more	C25	0.15 μF, 3 V or more, ± 1%
R16	3.0 kΩ F, 1/16 W or more	C26	0.47 μF, 3 V or more, ± 1%
R17	4.7 MΩ F, 1/16 W or more	C27	33 μF, 36 V or more, ± 5%
R18	12 kΩ F, 1/16 W or more	C28	2.2 μF, 3 V or more, ± 5%
R19	820 Ω F, 1/16 W or more	C29	82 pF, 3 V or more, ± 5%
R20	270 Ω F, 1/4 W or more	DB	SIVB40Z equivalent
RX	300 Ω F, 1/16 W or more (TA = 25 °C)	ZD1	1Z16, ST06-16 equivalent
C1	0.9 μF, 250 V ± 5%	ZD2	1Z27, ST06-27 equivalent
C2	0.012 F, 3 V or more	ZD3	Zener voltage 11 V, Power 1 W or more
C3	10 μF, 10 V or more, ± 5%	X1	f = 32.768 kHz
C4	1.1 μF, 5 V or more, ± 1%	X2	f = 3.579545 MHz
C5	100 pF, 3 V or more, ± 5%	T	1.2 kΩ: 32 Ω, 20 mW. Loss = 1 dB.
C6	1.0 μF, 5 V or more, ± 1%	VR	50 kΩ/B, 30 mW
C7	100 pF, 3 V or more, ± 5%	HS 1 to 4	
C8	0.047 μF, 5 V or more, ± 1%	LS 1 to 5	
C9	220 μF, 10 V or more, ± 5%	FET	2SK208-0 equivalent (ID = 200 μA)
C10	4700 pF, 20 V or more, ± 5%		

TEST PROCEDURES

Fig 1. — CS TEST SETUP



CONDITIONS:

I_L = Current source [AC impedance is 60 kΩ or more, (1 kHz, 30 mA)]
V = DC voltmeter
Hook switch HS = On; LS = Off; PAD (A), unless otherwise specified.

PROCEDURES:

Step 1: Telephone DC Voltage (during dialing).
With two diagonally adjacent buttons pressed (no signal).

Step 2: Balancing Network Changing.
I_{FN} : I_L (mA) at which V_{BN1} changes from 1.5 V to 3.5 V or more when I_L is changed from 30 mA to 70 mA.

I_{NF} : I_L (mA) at which V_{BN1} changes from 3.5 V to 1.5 V or less when I_L is changed from 70 mA to 30 mA.

Step 3: MFO On Resistance.
RMFO = VMFO/I_L (I_L = 30mA)

Step 4: CS Terminal On Voltage.
Voltage between CS and Sub when button 8 is pressed.

Step 5: Tolerance of load impedance at each terminal is ± 1%
(common to all test set-ups).

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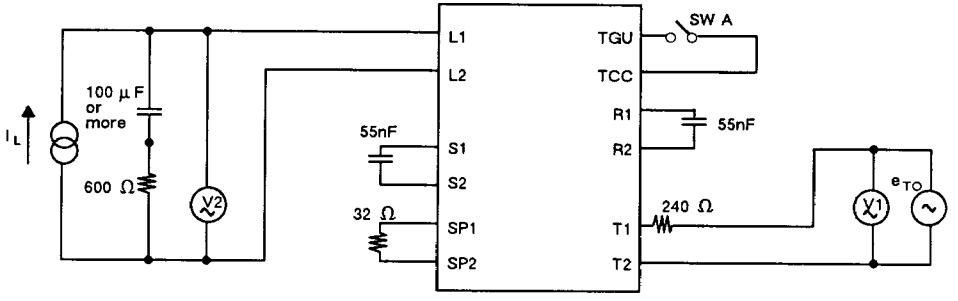
TEST PROCEDURES (Continued)

Fig. 2 — TRANSMIT TEST SETUP



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CONDITIONS:

e = Oscillator [Both output impedance and DC resistance are less than 4Ω (f = 1 kHz)]

I = Current source [AC impedance is 60 kΩ or more (1 kHz, 30 mA)]

V1 and V2 = AC voltmeters

Hook switch HS = On, LS = Off, PAD (A), unless otherwise specified.

Transmit amplifier voltage gain G_{TV} = 20 log (V2/V1) dB.

PROCEDURES:

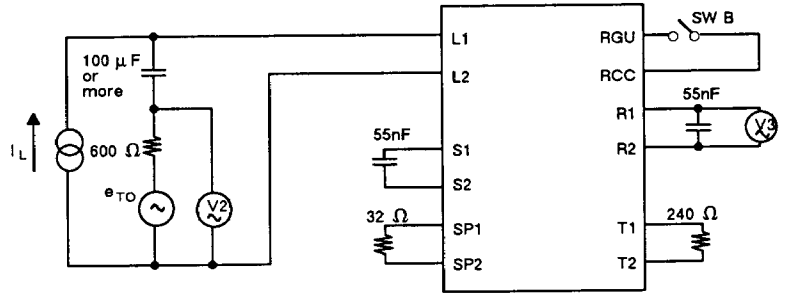
Step 1: Gain Increase.
Measure increase in AC signal level of V2 when SW A is off.

Step 2: Dynamic Range.
Measure distortion attenuation of 20 dB or more when output signal level is set to a prescribed value.

Step 3: Background Noise.
Measure output signal level with no transmit input signal.

TEST PROCEDURES (Continued)

Fig. 3 — TRANSMIT TEST SETUP



CONDITIONS:

e_{TO} = Oscillator [Both output impedance and DC resistance are less than 4Ω (f = 1 kHz)]

I_L = Current source [AC impedance is 60 kΩ or more (1 kHz, 30 mA)]

$\underset{\sim}{V2}$ and $\underset{\sim}{V3}$ = AC voltmeters

Hook switch HS = On, LS = Off, PAD (A), unless otherwise specified.

Reception amplifer voltage gain G_{RV} = 20 log (V3/V2) dB.

PROCEDURES:

Step 1: Gain Increase.
Measure AC signal increase level of V3 when SW B is off.

Step 2: Dynamic Range.
Measure distortion attenuation of 20 dB or more when output signal level is set to a prescribed value.

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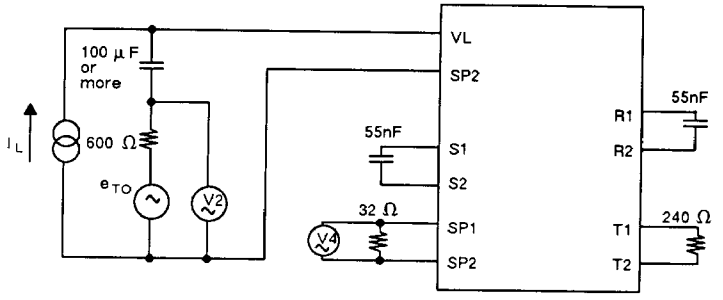
TEST PROCEDURES (Continued)

Fig. 4 — SPEAKER TEST SETUP



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CONDITIONS:

e_{TO} = Oscillator [Both output impedance and DC resistance are less than 4Ω (f = 1 kHz)]

I_L = Current source [AC impedance is 60 kΩ or more (1 kHz, 30 mA)]

$\underset{\sim}{V2}$ and $\underset{\sim}{V4}$ = AC voltmeters

Speaker volume adjustment = maximum

Hook switch HS = Off, LS = On, PAD (A), unless otherwise specified.

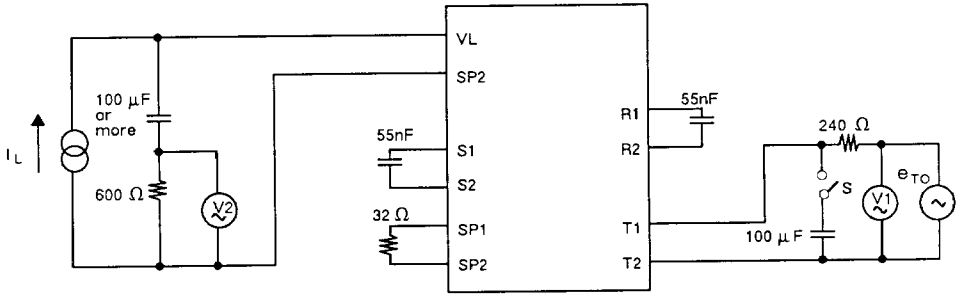
Speaker amplifier voltage gain G_{SV} = 20 log (V4/V2) dB.

PROCEDURE:

Dynamic Range.
Measure distortion attenuation of 20 dB or more when output signal level is set to a prescribed value.

TEST PROCEDURES (Continued)

Fig. 5 — VOICE SWITCH ATTENUATION TEST SETUP #1



CONDITIONS:

e_{TO} = Oscillator [Both output impedance and DC resistance are less than 4Ω (f = 1 kHz)]

I_L = Current source [AC impedance is 60 kΩ or more (1 kHz, 30 mA)]

$\underset{\sim}{V}1$ and $\underset{\sim}{V}2$ = AC voltmeters

PROCEDURES:

Step 1: Transmit Insertion Loss.

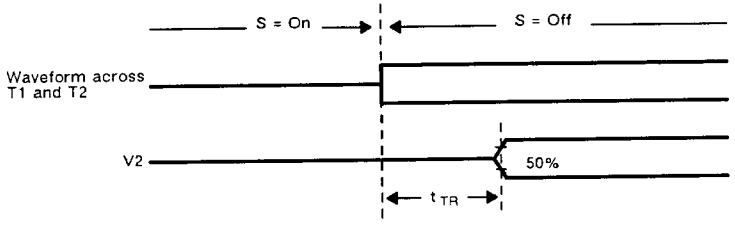
$L_{TV} = G_{TV}(1) - G_{TV}(4)$, ($I_L$ = 30 mA and V_I = -45 dBV)

$G_{TV}(1)$ = total gain of transmit system when handset is used.

$G_{TV}(4)$ = total gain of transmit system with loudspeaker reception.

Step 2: Tramsmit Rise Time.

Hook switch HS = On; LS = On; PAD (A); (I_L = 30 mA; V_I = -50 dBV)



Step 3: Threshold Level (V_{TH})

V_I value at which transmit gain changes discontinuously, that is, when V_I is changed from small to large value in handset and loudspeaker (LS, HS = On).

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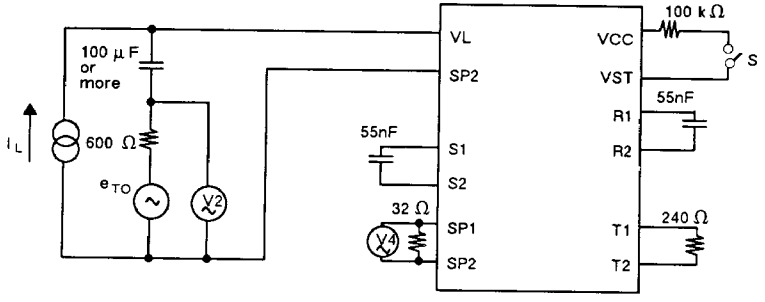
TEST PROCEDURES (Continued)

Fig. 6 — VOICE SWITCH ATTENUATION TEST SETUP #2



CONDITIONS:

e_{TO} = Oscillator [Both output impedance and DC resistance are less than 4Ω (f = 1 kHz)]

I_L = Current source [AC impedance is 60 kΩ or more (1 kHz, 30 mA)]

$\underset{\sim}{V}2$ and $\underset{\sim}{V}4$ = AC voltmeters

PROCEDURE:

Speaker Insertion Loss,

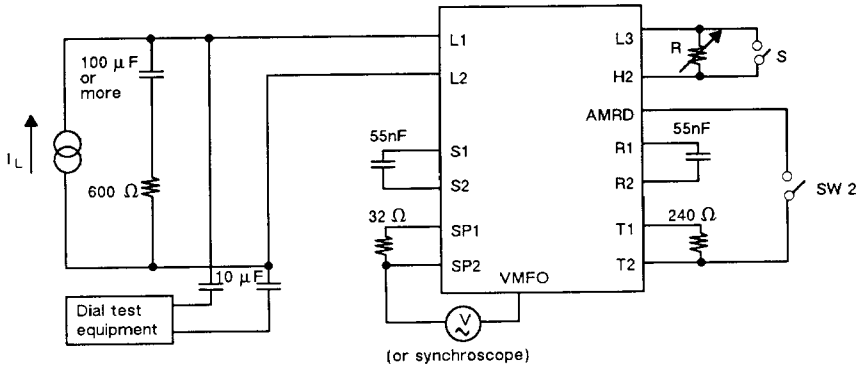
$L_{SV} = G_{SV} - G_{SV1}$ (I_L = 30mA, V_2 = 50 dBV)

G_{SV} = total gain of speaker system with loudspeaker reception

G_{SV1} = total gain of speaker system with handset reception (S = On)

TEST PROCEDURES (Continued)

Fig. 7 — DIAL SIGNAL TEST SETUP



TEST EQUIPMENT REQUIRED:

- 600 P signal measuring equipment (NTT standards 1212)
- PB signal distortion attenuation measuring equipment (NTT standards 1214) or equivalent

PROCEDURES:

Step 1: Contact Resistance.
Set R; check whether dialing tone signal is on or off (S = Off, SW 2 = On).

Step 2: Guard Time (R = ∞, SW 2 = Off).
Rise guard time : Time in which VMFO builds up from S = On state.
Fall guard time : Time in which VMFO falls from S = Off state.

Step 3: Signal Level Increase (R = ∞, S = Off).
Signal level variation when SW 2 is set from On to Off.

REDIALING TEST:

Step 1: Set HS and LS to On, dial 16 arbitrary digits, and hang up. Now, when the phone is taken off-the-hook, the 16-digit signal must be correctly transmitted if the redial button is pressed.

Step 2: With the same switching as Step 1, press any digit. The arbitrary digit and the second through sixteenth digits of Step 1 (16 digits in all) must be correctly transmitted when the redial button is pressed.

Step 3: Repeat the switching arrangement of Step 1 and press any two digits. The resulting dial tone (17 digits in all) must not be transmitted.

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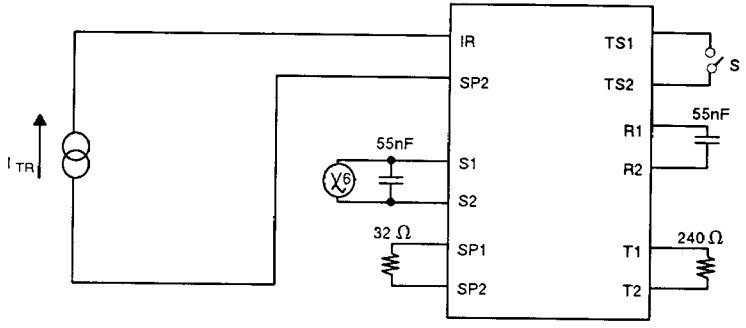
TEST PROCEDURES (Continued)

Fig. 8 — TONE RINGER TEST SETUP



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CONDITIONS:

Hook Switch : Incoming call waiting state (HS = Off, LS = Off)
Tone Ringer Volume : Maximum
Tone Type : FA
V6 = AC Voltmeter

PROCEDURES:

Step 1: Guard Time.
With DC applied and switch S closed, check that ringing stops after switch closure.

Step 2: Output Voltage.
With I_{TR} = 5 mA, check that V6 voltage level.

Step 3: Ringing Start Current.
I_{TR} at which V6 exceeds $8V_{P-P}$ when I_{TR} is increased from OV.

TYPICAL CHARACTERISTICS CURVES

Fig. 9 - VOLTAGE VS. SUPPLY CURRENT

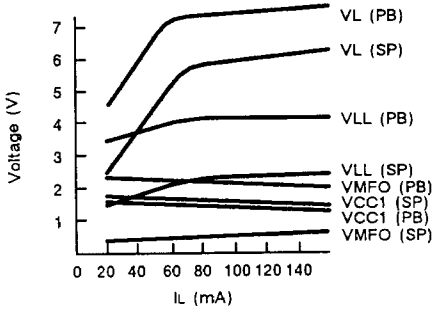


Fig. 10 -VMFO OUTPUT VOLTAGE VS. SUPPLY CURRENT

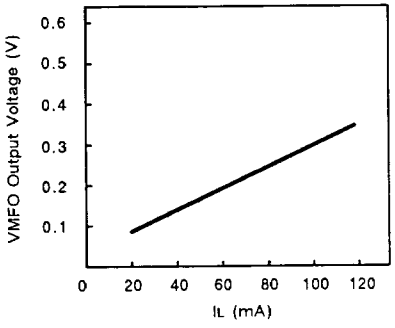


Fig. 11 -TELEPHONE AC IMPEDANCE VS. SUPPLY CURRENT

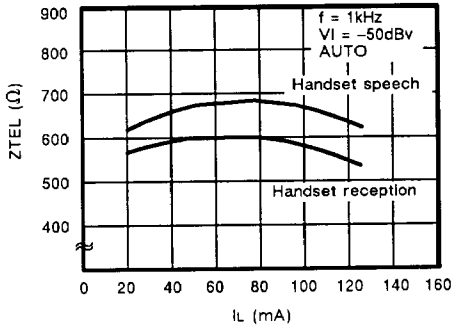


Fig. 12 -TRANSMIT TOTAL GAIN VS. SUPPLY CURRENT

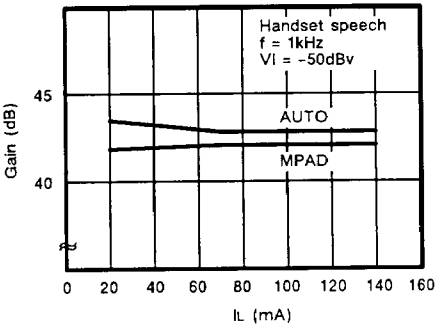


Fig. 13 - TRANSMIT TOTAL GAIN VS. FREQUENCY

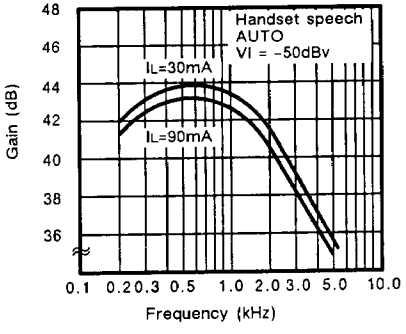
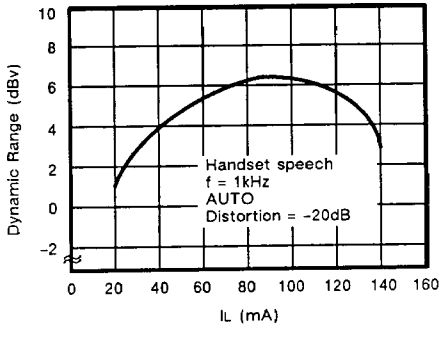


Fig. 14 - TRANSMIT DYNAMIC RANGE VS. SUPPLY CURRENT



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TYPICAL CHARACTERISTICS CURVES (Continued)

Fig. 15 – RECEPTION TOTAL GAIN VS. SUPPLY CURRENT

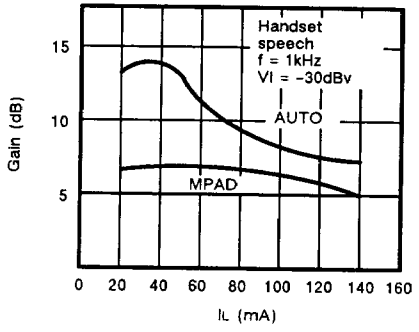


Fig. 16 – RECEPTION TOTAL GAIN VS. FREQUENCY

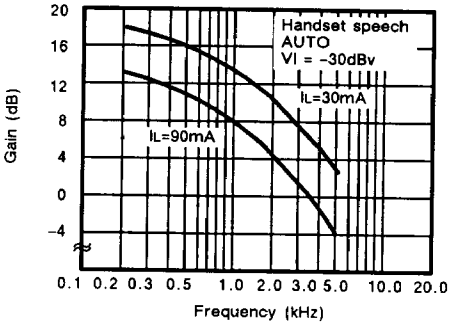


Fig. 17 – RECEPTION DYNAMIC RANGE VS. SUPPLY CURRENT

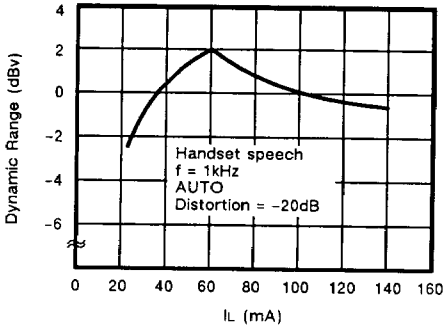


Fig. 18 – SPEAKER TOTAL GAIN VS. SUPPLY CURRENT

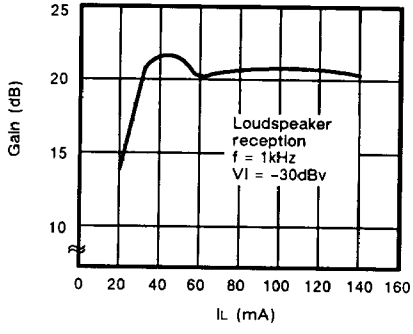


Fig. 19 – SPEAKER TOTAL GAIN VS. FREQUENCY

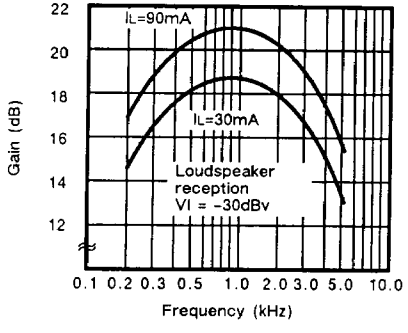
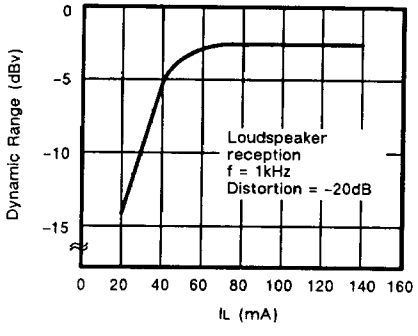


Fig. 20 – SPEAKER DYNAMIC RANGE VS. SUPPLY CURRENT



TYPICAL CHARACTERISTICS CURVES (Continued)

Fig. 21 - VOICE SWITCH THRESHOLD VS. SUPPLY CURRENT

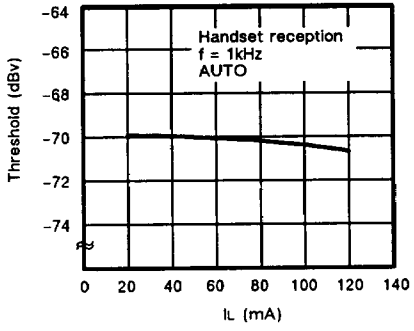


Fig. 22 - VOICE SWITCH THRESHOLD VS. FREQUENCY

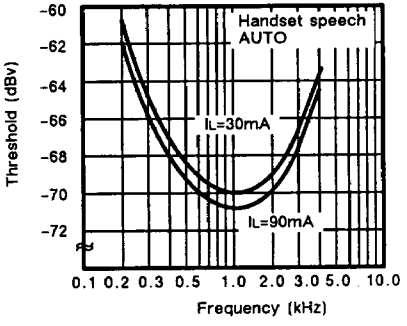


Fig. 23 - VOICE SWITCH RISE TIME VS. SUPPLY CURRENT

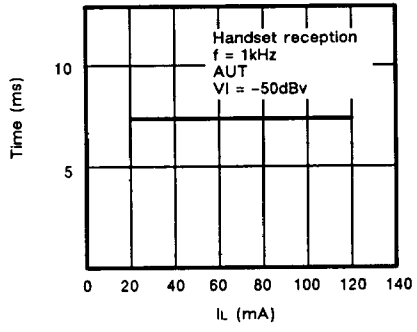


Fig. 24 - VOICE SWITCH TRANSMIT INSERT LOSS VS. SUPPLY CURRENT

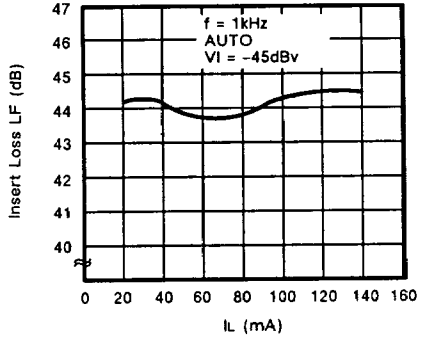


Fig. 25 - VOICE SWITCH SPEAKER INSERT LOSS VS. SUPPLY CURRENT

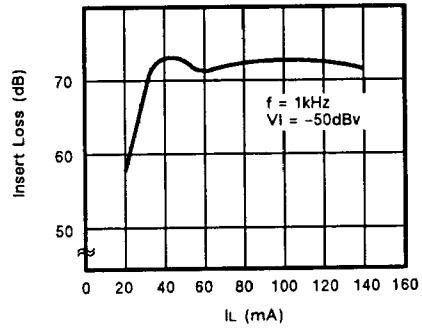
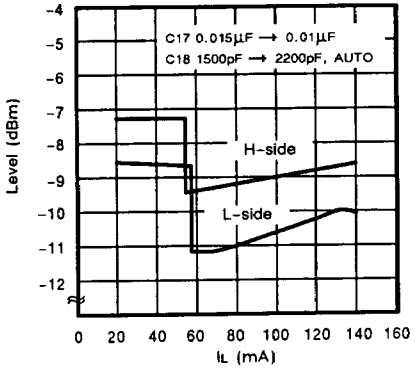


Fig. 26 - PB SIGNAL LEVEL VS. SUPPLY CURRENT



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TYPICAL CHARACTERISTICS CURVES (Continued)

Fig. 27 - PB SIGNAL LEVEL VS. SUPPLY CURRENT

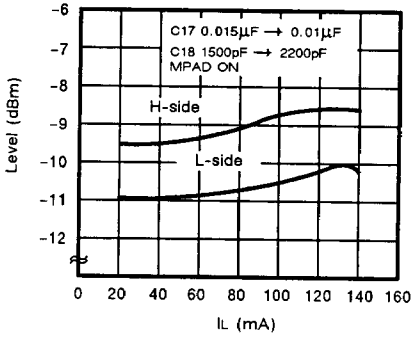

Fig. 28 - DISTORTION ATTENUATION VS. SUPPLY CURRENT

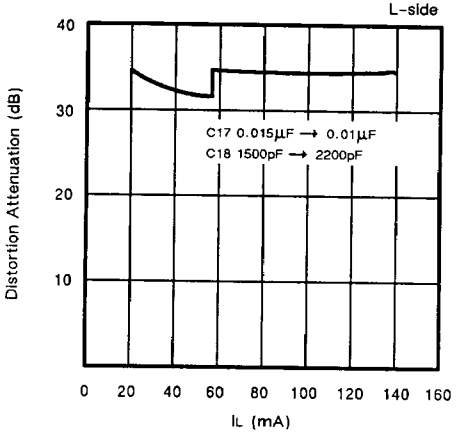

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Fig. 29 - TONE RINGER OUTPUT VOLTAGE VS. SUPPLY CURRENT

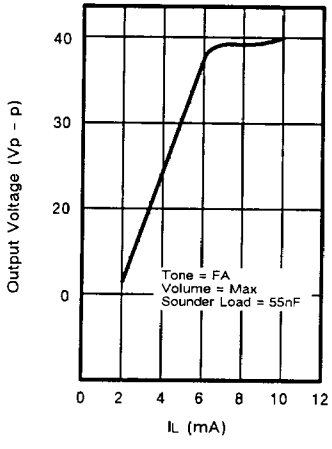
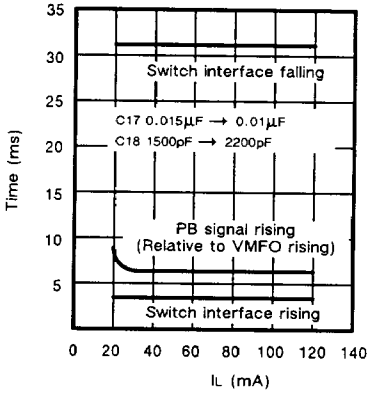
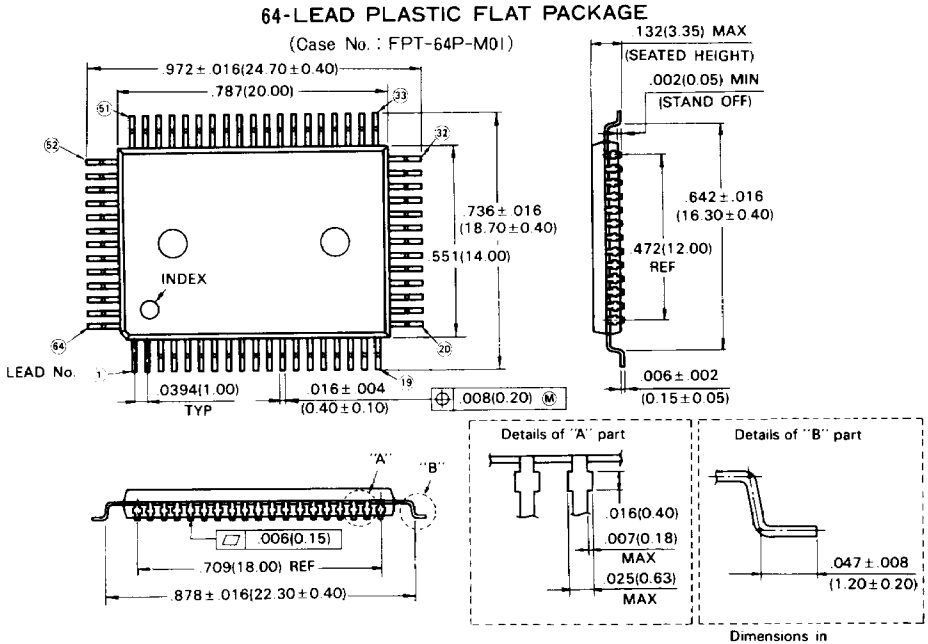


Fig. 30 - SWITCH INTERFACE GUARD TIME VS. SUPPLY CURRENT



PACKAGE DIMENSIONS



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