

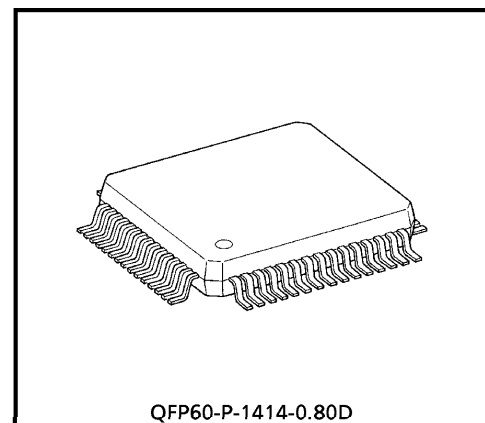
TC9444F

SINGLE-CHIP KARAOKE IC II

The TC9444F is a karaoke chip for such applications as equipment for CD/LD players, mini component stereo sets, radio-cassette players, and VCRs.

With its internal AD/DA converter system, the TC9444F can offer such karaoke functions as echo, vocal canceling, and key control on a single chip in addition to such digital signal processing (DSP) features as sound field control and bass/treble control.

Because the program and coefficients are stored on internal ROM, the IC can be controlled by simple settings.



QFP60-P-1414-0.80D

Weight : 1.08 g (Typ.)

FEATURES

- Incorporates an AD converter (three channels) with 2 times oversampling.
THD : -65 dB S/N ratio : 80 dB (typ.)
built-in pre-filter op-amp
- Incorporates a 1-bit $\Sigma\Delta$ -type DA converter (two channels).
THD : -86 dB S/N ratio: 93 dB (typ.)
built-in tertiary analog post filter
- Supports one port for digital input and one for digital output.
- Incorporates 64 Kbits of delay RAM
- Microcontroller interface : I²C bus mode as well as Toshiba's original three-lead mode
- Built-in boot ROM initializes coefficients at reset or via a boot command.

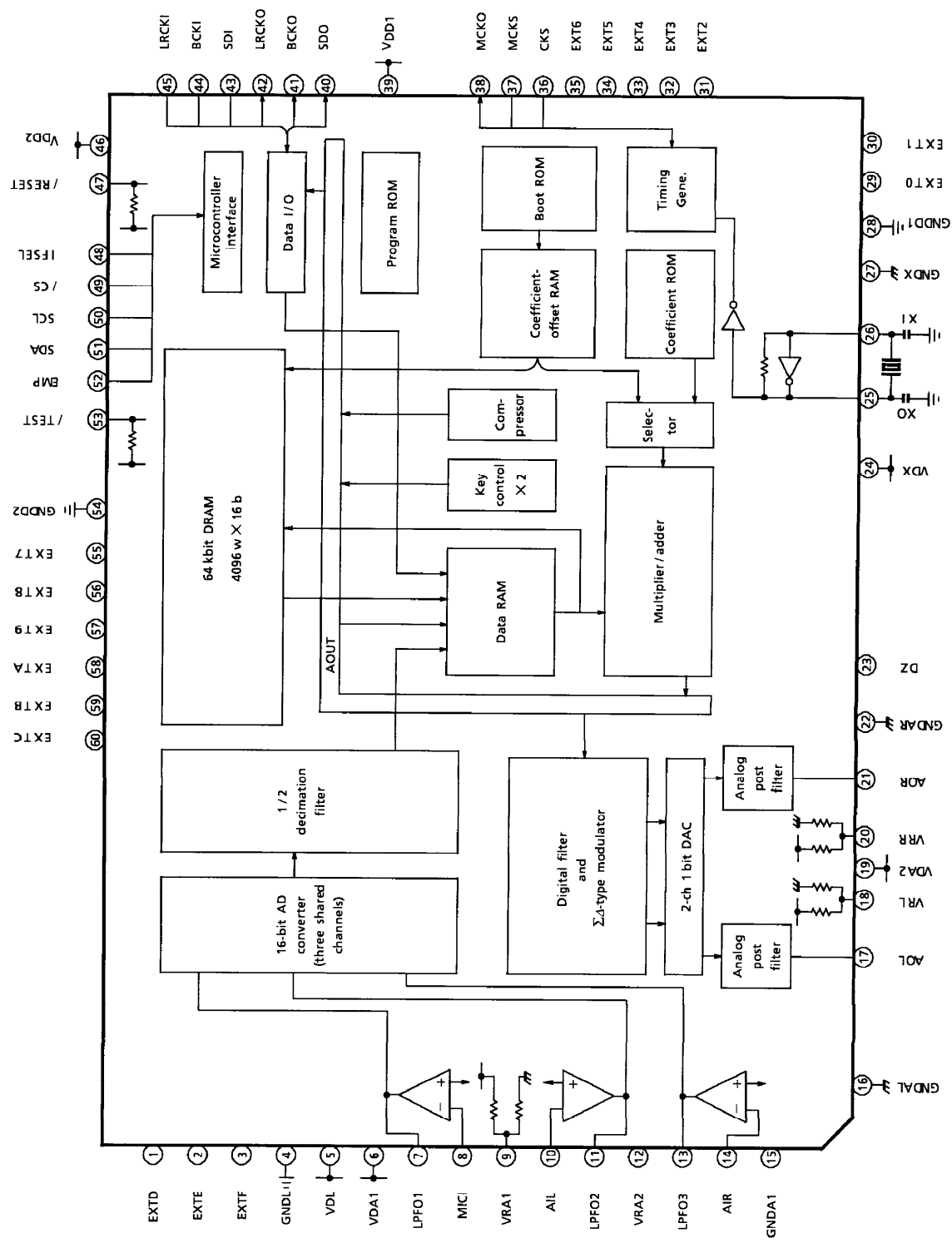
980910EBA1

- TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.

COMPATIBLE SOFTWARE

- Microphone echo : Variable delay time / level
- Vocal cancellation : Attenuates only vocals from standard source
- Vocal change : Vocals fade in / out depending on whether there is input from microphone
- Vocal key control : For chorus and duet functions
- Supports multi-sound sources : Various modes
- Pseudo stereo : Monaural sources enhanced by sense of spaciousness
- Key control : 14-step (max ± 1 octave) stereo key control
- Compressor or bass boost : Compression ratio selectable in range 6 to 36 dB. Compression effect (amount of boost) can be varied smoothly.
- Sound field control : Uses delay RAM to simulate such acoustic environments as churches, halls, sports stadiums, and discos.
- Equalizer : Characteristics switchable by coefficient or I / F bit settings
- 3D sound field : Offers 3-D sound.

BLOCK DIAGRAM/PIN ASSIGNMENT



PIN DESCRIPTIONS

PIN No.	PIN NAME	I/O	FUNCTION	REMARKS
1	EXTO	O	Extended output port D	
2	EXTE	O	Extended output port E	
3	EXTF	O	Extended output port F	
4	GNDL	—	DRAM ground	
5	VDL	—	DRAM power supply	
6	VDA1	—	ADC power supply	
7	LPFO1	O	Op-amp output for microphone input	
8	MICI	I	Op-amp input for microphone input	
9	VRA1	—	ADC reference voltage 1	
10	AIL	I	Op-amp input for line L-channel	
11	LPFO2	O	Op-amp output for line L-channel	
12	VRA2	—	ADC reference voltage 2	
13	LPFO3	O	Op-amp output for line R-channel	
14	AIR	I	Op-amp input for line R-channel	
15	GNDA1	—	ADC ground	
16	GNDAL	—	DAC L-channel ground	
17	AOL	O	DAC L-channel output	
18	VRL	—	DAC reference voltage	
19	VDA2	—	DAC power supply	
20	VRR	—	DAC reference voltage	
21	AOR	O	DAC R-channel output	
22	GNDAR	—	DAC R-channel ground	
23	DZ	O	Digital zero input detection ("H" = zero detection)	
24	VDX	—	Oscillator block power supply	
25	XO	O	Oscillator connection	
26	XI	I	Oscillator connection or clock input	
27	GNDX	—	Oscillator block ground	
28	GNDD1	—	Digital ground 1	
29	EXT0	O	Extended output port 0	
30	EXT1	O	Extended output port 1	
31	EXT2	O	Extended output port 2	
32	EXT3	O	Extended output port 3	
33	EXT4	O	Extended output port 4	
34	EXT5	O	Extended output port 5	
35	EXT6	O	Extended output port 6	
36	CKS	I	System clock selection ("H" = 512 fs, "L" = 384 fs)	Schmitt input
37	MCKS	I	MCKO output clock selection ("H" = 1/1, "L" = 1/2 divider)	Schmitt input
38	MCKO	O	System clock output	
39	VDD1	—	Digital power supply 1	
40	SDO	O	Digital audio data output	

PIN No.	PIN NAME	I/O	FUNCTION	REMARKS
41	BCKO	O	Bit clock output	
42	LRCKO	O	Channel clock output	
43	SDI	I	Digital audio data input	Schmitt input
44	BCKI	I	Bit clock input	Schmitt input
45	LRCKI	I	Channel clock input	Schmitt input
46	VDD2	—	Digital power supply 2	
47	/RESET	I (U)	Reset ("L" = reset)	With pull-up resistor Schmitt input
48	IFSEL	I	Microcontroller interface selection ("H" = three-lead mode, "L" = I ² C mode)	Schmitt input
49	/CS	I	Three-lead mode : Command send start signal I ² C : chip select	Schmitt input
50	SCL	I	Microcontroller interface serial clock	Schmitt input
51	SDA	O	Microcontroller interface serial data	Schmitt input
52	EMP	—	De-emphasis setting ("H" = ON)	Schmitt input
53	/TEST	I (U)	Test mode setting ("H" = fixed)	With pull-up resistor Schmitt input
54	GNDD2	I	Digital ground 2	
55	EXT7	O	Extended output port 7	
56	EXT8	O	Extended output port 8	
57	EXT9	O	Extended output port 9	
58	EXTA	O	Extended output port A	
59	EXTB	O	Extended output port B	
60	EXTC	O	Extended output port C	

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Supply Voltage	V _{DD}	- 0.3~6.0	V
Input Voltage	V _{in}	- 0.3~V _{DD} + 0.3	V
Power Dissipation	P _D	500	mW
Operating Temperature	T _{opr}	- 40~85	°C
Storage Temperature	T _{stg}	- 55~150	°C

ELECTRICAL CHARACTERISTICS (unless otherwise specified, Ta = 25°C、V_{DD} = 5.0 V)

DC Characteristics

CHARACTERISTIC		SYMBOL	TEST CIR- CUIT	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
Operating Voltage		V _{DD}	—	Ta = - 40~85°C	4.5	5.0	5.5	V
Current Consumption		I _{DD}	—	XI = 16.9 MHz, 384 fs mode	—	57	80	mA
Input Voltage	"H" level	V _{IH}	—	Digital input pins	V _{DD} × 0.8	—	—	V
	"L" level	V _{IL}			0	—	V _{DD} × 0.2	
Input Current	"H" level	I _{IH}	—	Digital input pins	—	—	1.0	μA
	"L" level	I _{IL}			- 1.0	—	—	
Output Current 1 (*1)	"H" level	I _{OH1}	—	When V _{OH} = 4.5 V	- 2.0	—	—	mA
	"L" level	I _{OL1}		When V _{OH} = 0.5 V	—	—	2.0	
Output Current 2 (*2)	"H" level	I _{OH2}	—	When V _{OH} = 4.5 V	- 4.0	—	—	
	"L" level	I _{OL2}		When V _{OH} = 0.5 V	—	—	4.0	
Pull-up Resistors		R _{up}	—	/ RESET, / TEST pin	—	50	—	kΩ

(*1) : DZ, XT0 to F, LRCKO, BCKO, SDO, DA pins

In I²C bus mode, the SDA pin is "L" output only (open drain).

(*2) : MCKO pin

AC Characteristics
DA converter

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
Maximum Input Level	Ain	1	V _{DD} = 5.0 V	—	1.15	1.20	V _{rms}
S / (N + D) Ratio	S / N (AD)	1	- 50 dB, 1 kHz sine wave input	72	80	—	dB
THD + N	THD (AD)	1	- 0 dB, 1 kHz sine wave input	—	- 65	- 57	
Crosstalk	CT (AD)	1	—	—	- 68	- 60	

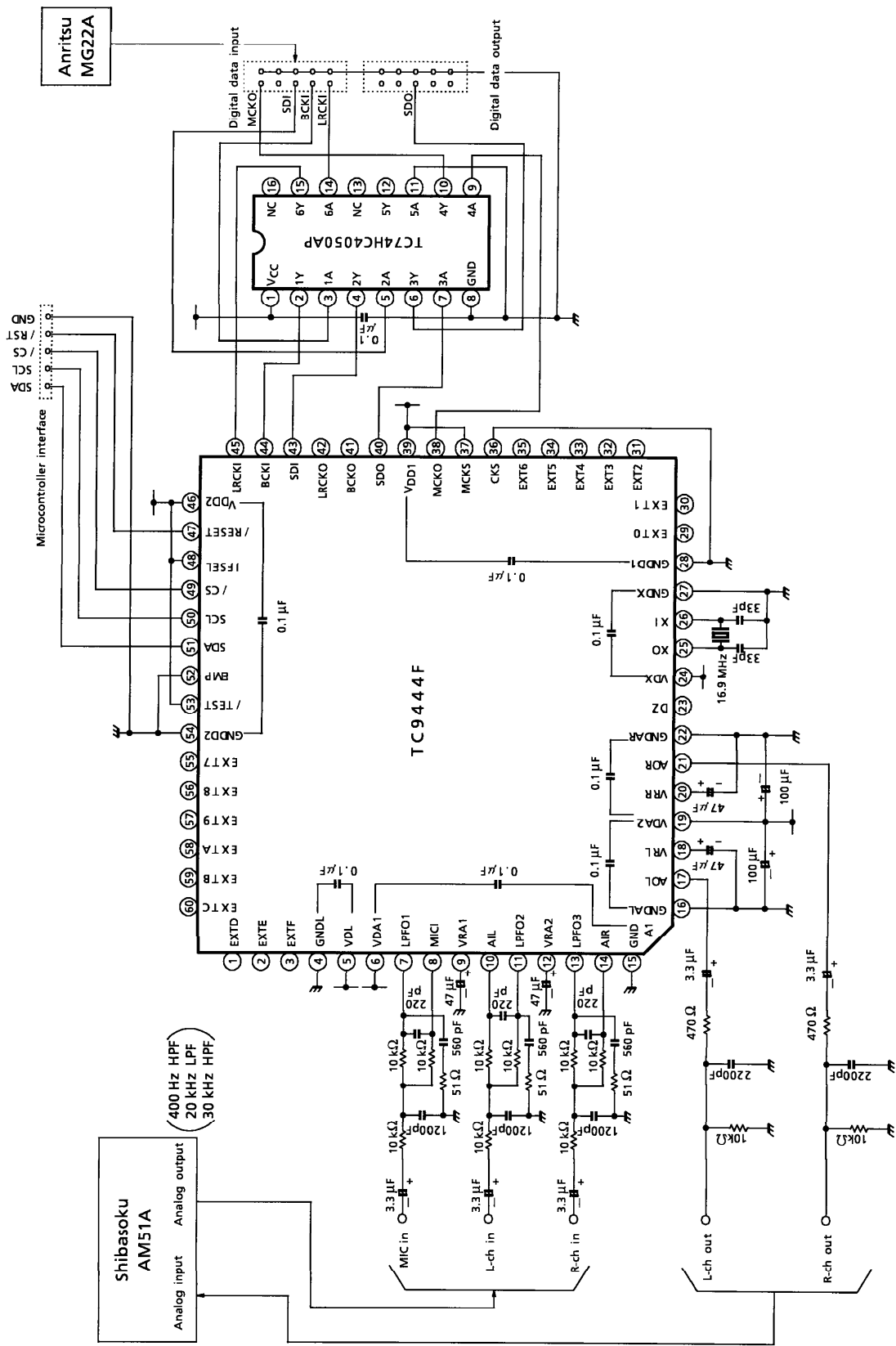
DA converter

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
Output Level	Aout	1	—	—	1.2	—	V _{rms}
S / N Ratio	S / N (DA)	1	- 30 dB, 1 kHz sine wave input	84	93	—	dB
THD + N	THD (DA)	1	- 0 dB, 1 kHz sine wave input	—	- 86	- 78	
	THD (DA)	1	- 0 dB, 10 kHz sine wave input	—	- 83	- 75	
Crosstalk	CT (DA)	1	—	—	- 88	- 83	

Timings

CHARACTERISTIC		SYMBOL	TEST CIR- CUIT	TEST CONDITIONS, REMARKS	MIN	TYP.	MAX	UNIT
Rise Time		t _r	—	CL = 50 pF, LRCKO, BCKO, SDO	—	—	30	ns
				MCKO	—	—	20	
Fall Time		t _r	—	CL = 50 pF, LRCKO, BCKO, SDO	—	—	30	ns
				MCKO	—	—	20	
Delay Time	Common	t _{d1}	—	XI→MCKO	—	—	20	ns
		t _{d2}		BCKO→SDO	—	—	5	
	In master mode	t _{d3}		XI→BCKO	—	—	15	ns
		t _{d4}		XI→LRCKO	—	—	30	
	In slave mode	t _{d5}		BCKI→BCKO	—	—	30	ns
		t _{d6}		LRCKI→LRCKO	—	—	30	
SDI Setup Time		t _{DI_s}	—	—	50	—	—	ns
SDI Hold Time		t _{DI_h}	—	—	50	—	—	ns
LRCKI Setup Time		t _{LR_s}	—	—	50	—	—	ns
LRCKI Hold Time		t _{LR_h}	—	—	50	—	—	ns
Interface Setup Time		T ₁	—	—	0.2	—	—	μs
Interface Shift Clock Pulse Width		T ₂ , T ₃	—	—	0.2	—	—	μs
Interface Data Setup Time		T ₄	—	—	0.2	—	—	μs
Interface Data Hold Time		T ₅	—	—	0.2	—	—	μs
Interface Hold Time		T ₆	—	—	0.2	—	—	μs
Interface / CS Signal “H” Duration		T ₇	—	—	0.2	—	—	μs
Coefficient and Offset RAM Write Cycle		T ₈	—	—	1 / fs	—	—	s
Power-on Reset Time		T _{RST}	—	—	1	—	—	ms
Reset Pulse Width		T _{Rw}	—	—	0.2	—	—	μs
Boot Time		T _{BOOT}	—	Time required for boot	—	—	50	μs

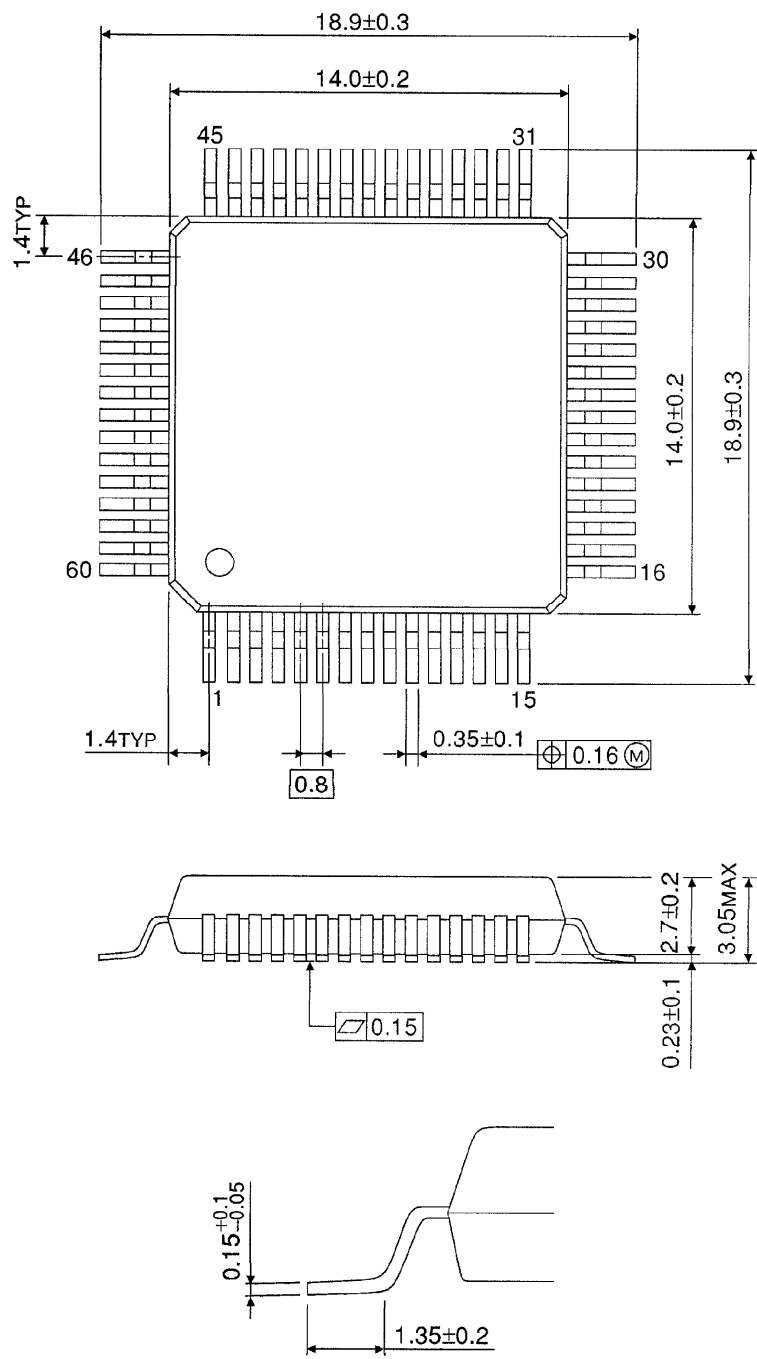
TEST CIRCUIT 1



TC9444F-8

PACKAGE DIMENSIONS
QFP60-P-1414-0.80D

Unit : mm



Weight : 1.08 g (Typ.)