

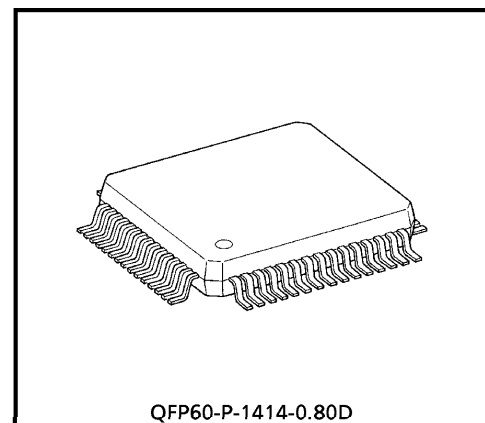
TC9444F

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.

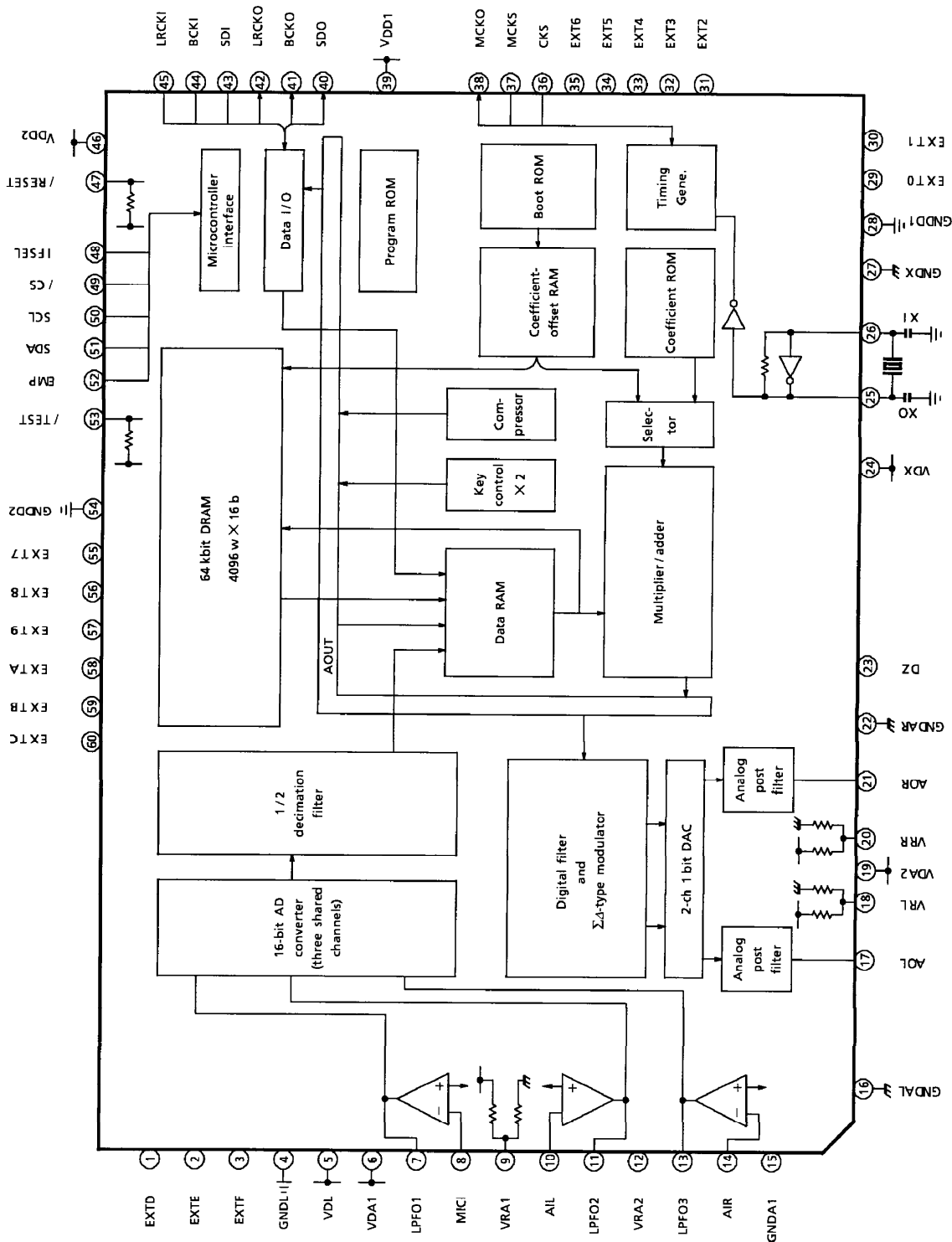
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COMPATIBLE SOFTWARE

- 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	

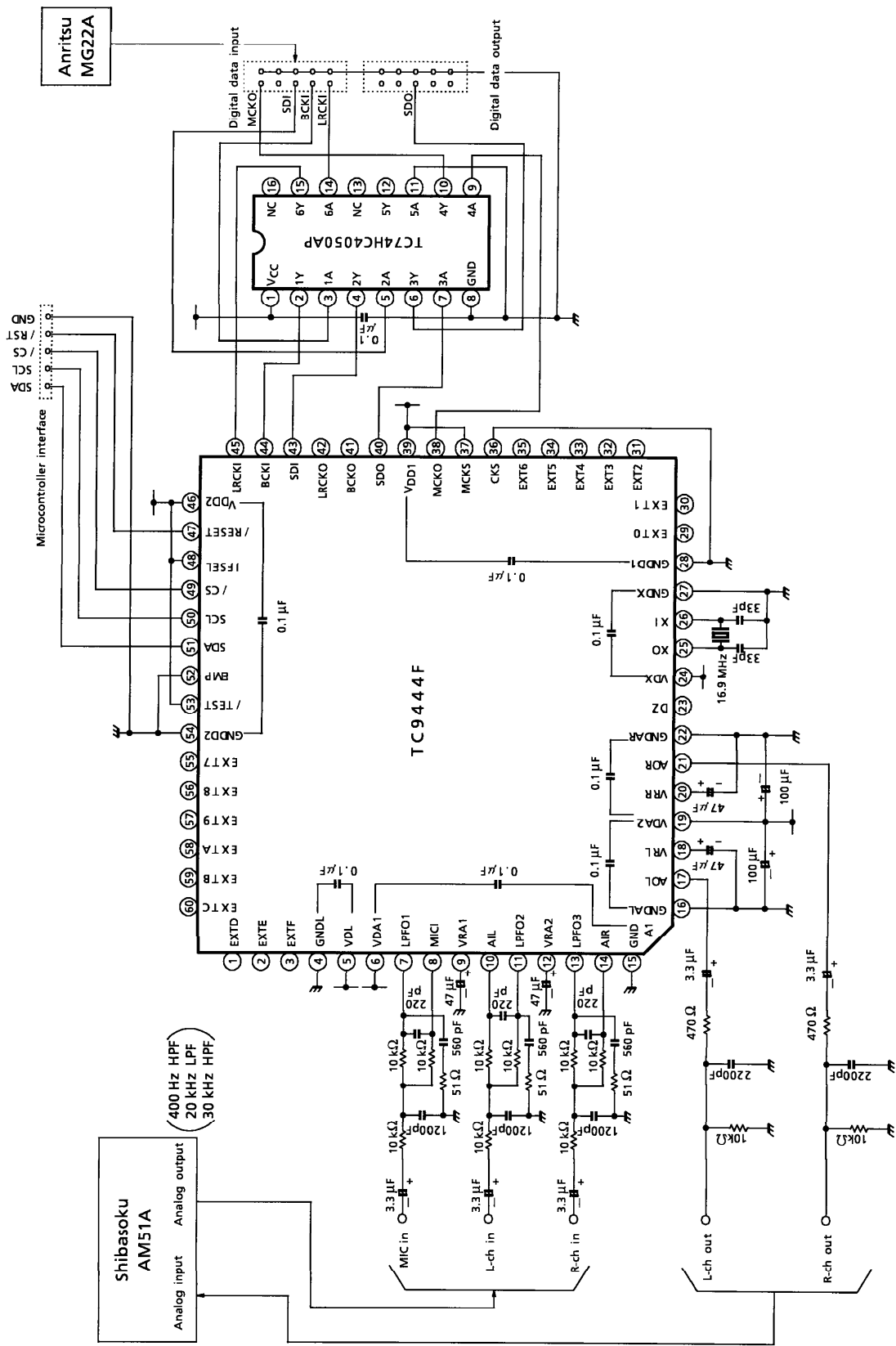
DA converter

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

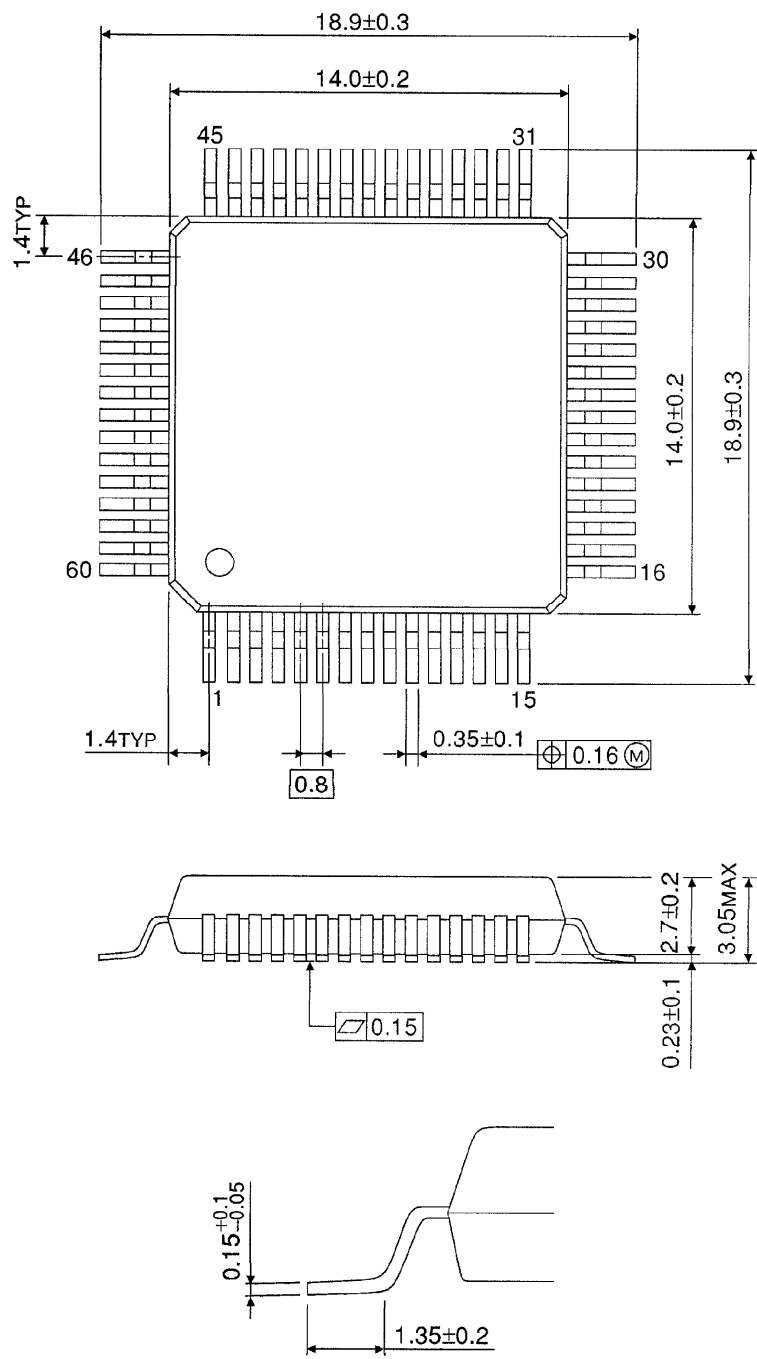
CHARACTERISTIC		SYMBOL	TEST CIR- CUI	TEST CONDITIONS, REMARKS	MIN	TYP.	MAX	UNIT
Rise Time		t _r	—	CL = 50 pF, LRCKO, BCKO, SDO	—	—	30	ns
				MCKO	—	—	20	
Fall Time		t _r	—	CL = 50 pF, LRCKO, BCKO, SDO	—	—	30	ns
				MCKO	—	—	20	
Delay Time	Common	t _{d1}	—	XI→MCKO	—	—	20	ns
		t _{d2}		BCKO→SDO	—	—	5	
	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



PACKAGE DIMENSIONS
QFP60-P-1414-0.80D

Unit : mm



Weight : 1.08 g (Typ.)