

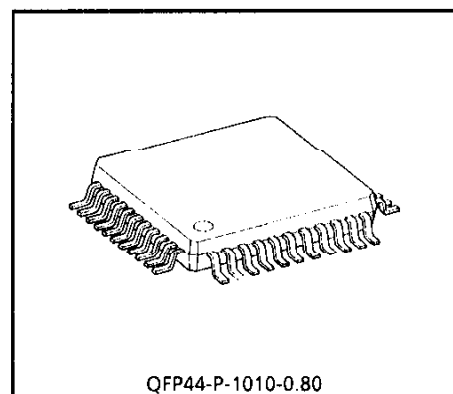
TC9287AF

2 CHANNEL 1BIT AD / DA CONVERTER FOR AUDIO

TC9287AF is 2nd order Σ - Δ modulation 1bit AD/DA converter for Digital Audio. This IC built-in 2 channel AD/DA converter and digital, analog filter, so construct hi-performance and low cost AD/DA converter system.

FEATURES

- Built in input and output digital analog filter circuit, so external filter is CR filter.
- Operating voltage is 5.0V.
- Power dissipation is 250mW ($V_{DD} = 5V$)
[At ADOFF mode, 190mW ($V_{DD} = 5V$)]
- Package is QFP44-P-1010-0.80.



Weight : 0.5g (Typ.)

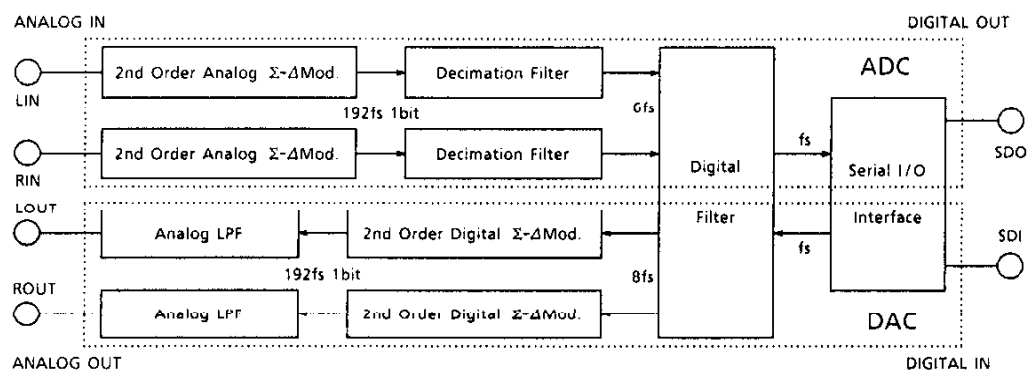
AD/DA AC characteristics is as follows.

	S/N RATIO (A-Weight)	THD + N	Units
AD converter	92 (Typ.)	- 82 (Typ.)	dB
DA converter	95 (Typ.)	- 87 (Typ.)	dB

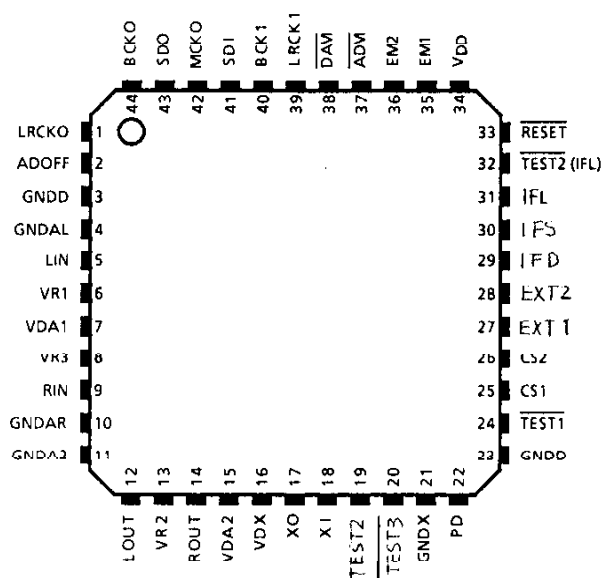
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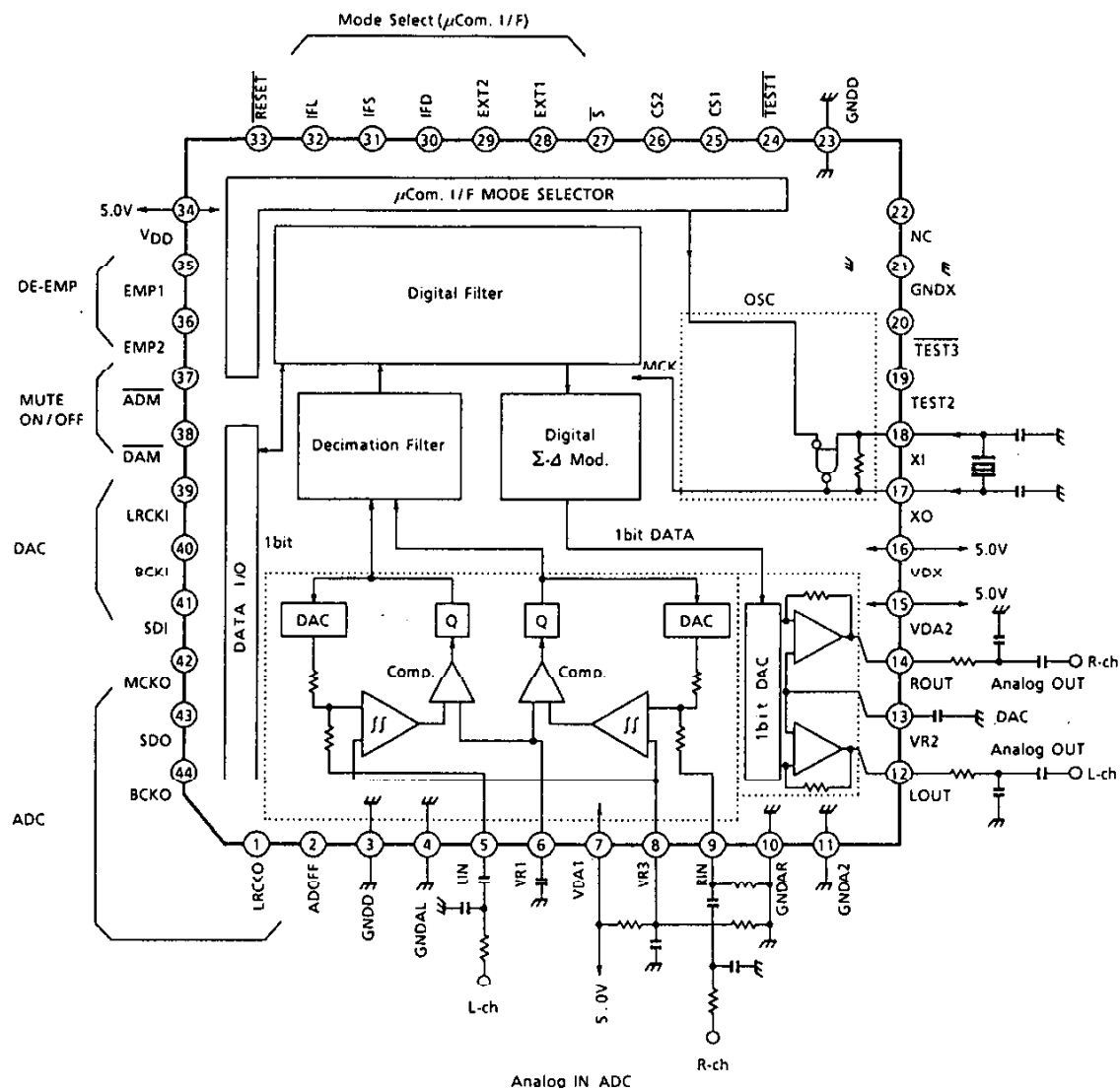
SYSTEM BLOCK



TERMINAL LAYOUT



BLOCK DIAGRAM

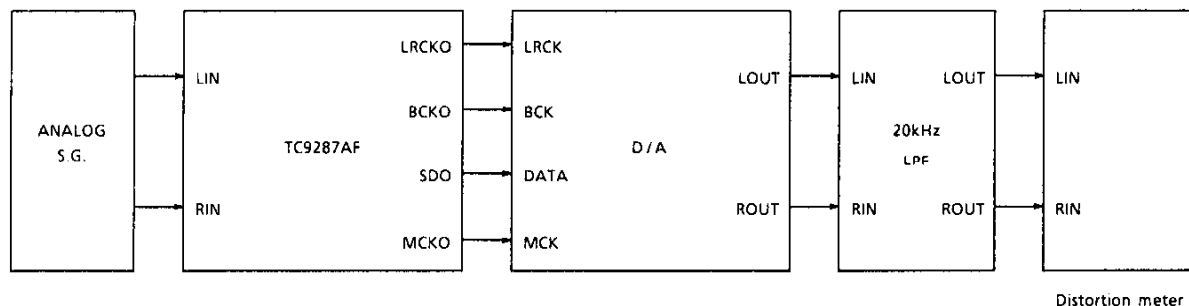


TERMINAL DESCRIPTION

NO.	TERMINAL	I/O	FUNCTION	REMARK
1	LRCKO	—	Channel clock (LRCK) output terminal	
2	ADOFF	I	AD converter off setting terminal. At "H" level, decimation filter OFF.	Pull-down
3	GNDD	—	Digital GND terminal.	0V
4	GNDAL	—	Analog GND terminal for AD converter L channel.	0V
5	LIN	I	AD converter L-ch signal input terminal.	$2.5V \pm \alpha$
6	VR1	I	Reference voltage terminal for AD converter comparator.	2.5V
7	VDA1	—	Voltage supply terminal for AD converter.	5.0V
8	VR3	I	Reference voltage terminal for AD converter.	2.5V
9	RIN	I	A/D converter R-ch signal input terminal.	$2.5V \pm \alpha$
10	GNDAR	—	Analog GND terminal for AD converter R-ch channel.	0V
11	GND A2	—	Analog GND terminal for DA converter.	0V
12	LOUT	O	DA converter L channel signal output terminal.	$2.5V - \alpha$
13	VR2	I	Reference voltage terminal for DA converter.	2.5V
14	ROUT	I	DA converter R channel signal output terminal.	$2.5V - \alpha$
15	VDA2	—	Voltage supply terminal for DA converter.	5.0V
16	VDX	—	Voltage supply terminal for Oscillator.	5.0V
17	XO	O	Crystal oscillator connection terminal.	
18	XI	I	Crystal oscillator connection terminal.	
19	TEST2	O	Test terminal 2.	
20	TEST3	I	Test terminal 3.	
21	GNDX	—	GND terminal for Oscillator.	0V
22	NC	O	Non-connecting terminal.	
23	GNDD	—	Digital GND terminal.	0V
24	TEST1	I	Test terminal 1. Usually use at "H" level.	Pull-up
25	CS1	I	Master mode setting terminal 1.	Pull-up
26	CS2	I	Master mode setting terminal 2.	Pull-up
27	$\bar{S}$	I	Serial mode switching terminal. (fixed "L")	Pull-up
28	EXT1	O	External output terminal 1.	Serial mode
29	EXT2	O	External output terminal 2.	Serial mode
30	IFD	I	MCU interface data input terminal.	Pull-up Serial mode
31	IFS	I	MCU interface shift clock input terminal.	Pull-up Serial mode
32	IFI	I	MCU interface latch pulse input terminal.	Serial mode

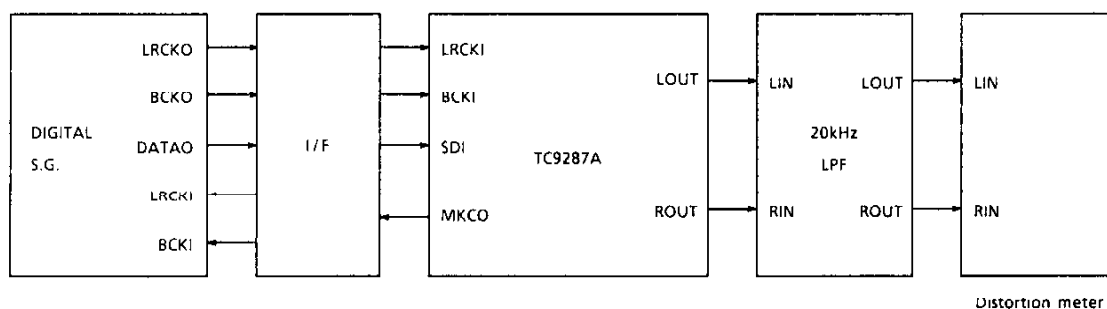
NO.	TERMINAL	I/O	FUNCTION	REMARK
33	RESET	I	Reset terminal.	Pull-up
34	VDD	—	Digital voltage supply terminal.	5.0V
35	EM1	I	De-emphasis Coefficient select terminal 1.	Pull-down
36	EM2	I	De-emphasis Coefficient select terminal 2.	Pull-down
37	ADM	I	AD converter output mute terminal. At "L" level, mute "ON".	Pull-up
38	DAM	I	AD converter output mute terminal. At "L" level, mute "ON".	Pull-up
39	LRCKI	I	External channel clock (LRCK) input terminal.	
40	BCKI	I	External bit clock (BCK) input terminal.	
41	SDI	I	Digital data input terminal. (DA converter serial data input)	
42	MCKO	O	384fs clock output terminal. (system clock)	
43	SDO	O	Digital data output terminal. (AD converter serial data output)	
44	BCKO	O	Bit clock (BCK) output terminal.	

TEST CIRCUIT 1 : A/D converter evaluation system



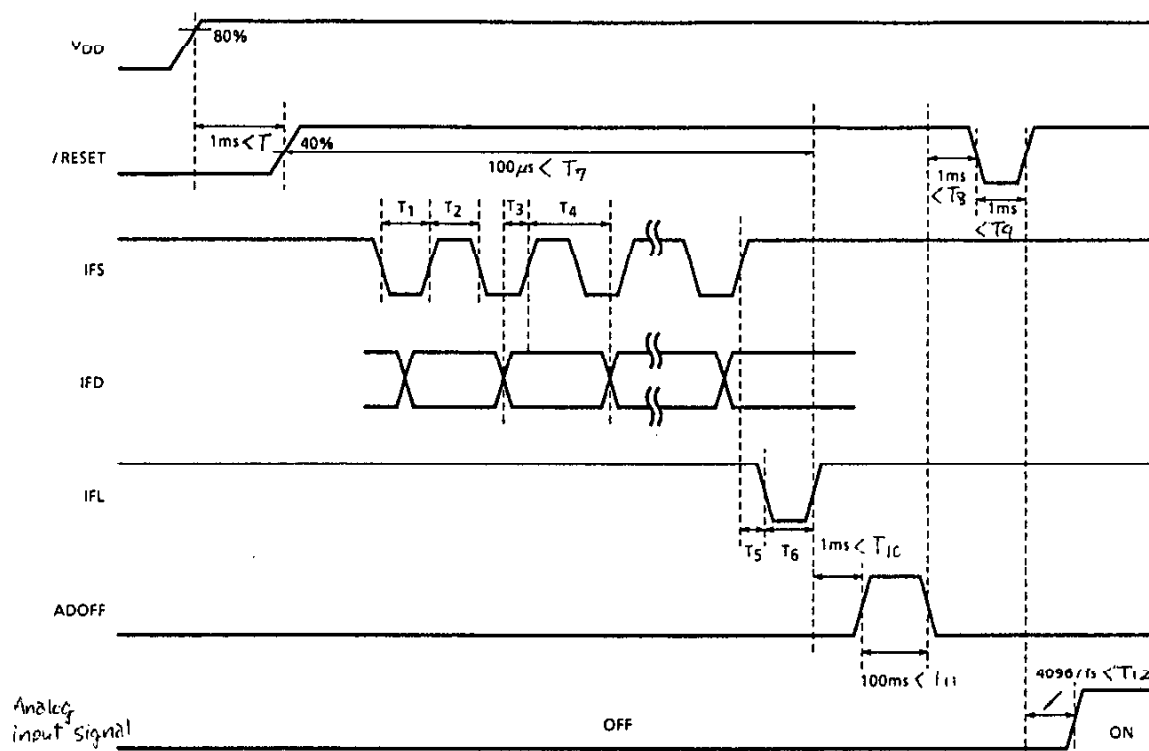
ANALOG S.G. : SHIBASOKU, AM51A
 20kHz LPF : SHIBASOKU, AM51A FILTER
 Distortion meter : SHIBASOKU, AM51A

TEST CIRCUIT 2 : D/A converter evaluation system



DIGITAL S.G. : ANRITSU, MG-22A
 20kHz LPF : SHIBASOKU, 725C FILTER
 Distortion meter : SHIBASOKU, 725C

7.



T_1, T_2, T_6 : Clock puls width $> 1\mu s$
 T_3 : Setup time $> 1\mu s$
 T_4 : Hold time $> 1\mu s$
 T_5 : Hold time $> 1\mu s$

Fig. Timing

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	記号	定格	単位
Supply Voltage	V _{DD}	-0.3 ~ 6.0	V
	V _{DX}	-0.3 ~ 6.0	
	V _{DA1}	-0.3 ~ 6.0	
	V _{DA2}	-0.3 ~ 6.0	
Input Voltage	V _{in}	-0.3 ~ V _{DD} + 0.6	V
Power Dissipation	P _D	250	mW
Operating Temperature	Topr	-30 ~ 85	°C
Storage Temperature	Tstg	-55 ~ 150	°C

ELECTRICAL CHARACTERISTIC (Unless otherwise specified, Ta=25°C, V_{DD}=V_{DX}=V_{DA1}=V_{DA2}=5.0V)
DC item

CHARACTERISTIC		SYMBOL	TEST CIR- CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Supply Voltage		V _{DD}	—	Ta=−35~85 °C	4.5	5.0	5.5	V
		V _{DX}						
		V _{DA1}						
		V _{DA2}						
Power Dissipation		I _{DD}	—	XI=16.9344MHz ADOFF="L"	—	50	90	mA
Power Dissipation (at ADOFF=OFF)				XI=16.9344MHz ADOFF="H"	—	35	63	
Input Voltage	"H" Level	V _{IH}	—		3.5	—	—	V
	"L" Level	V _{IL}			—	—	1.5	
Output Current	"H" Level	I _{OH}	—	42pin V _{OH} =0.4V	−9.4	—	−3.6	mA
				1, 28, 29, 43 and 44pin V _{OH} =0.4V	−5.0	—	−2.1	
	"L" Level	I _{OL}		42pin V _{OL} =4.6V	8.0	—	22.0	
				1, 28, 29, 43 and 44pin V _{OL} =4.6V	3.5	—	14.0	
Input Current		I _{IN}	—		−10.0	—	10.0	μ A
Pull Up / Down Resister		R _{U/D}	—		60	—	150	kΩ

AC Item

A / D converter

CHARACTERISTIC	SYMBOL	TEST CIR- CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Maximum Input Voltage	V _{IM}	1	Input Voltage= Output level of A/D converter is full scale	0.9	1.0	1.1	Vrms
Input Impedance	Z _{IN}	1		—	25.0	—	kΩ
S / N ratio	S / N _A	1	At A-Weight filter ON	88	92	—	dB
Total Harmonic Distortion + Noise	THD _A	1		—	−62	−77	dB
Cross-talk	CT _A	1	At A-Weight filter ON	—	−90	−85	dB
Output Offset	OFST	1	Input AC is short circuit	−100	0	+100	LSB

D / A converter

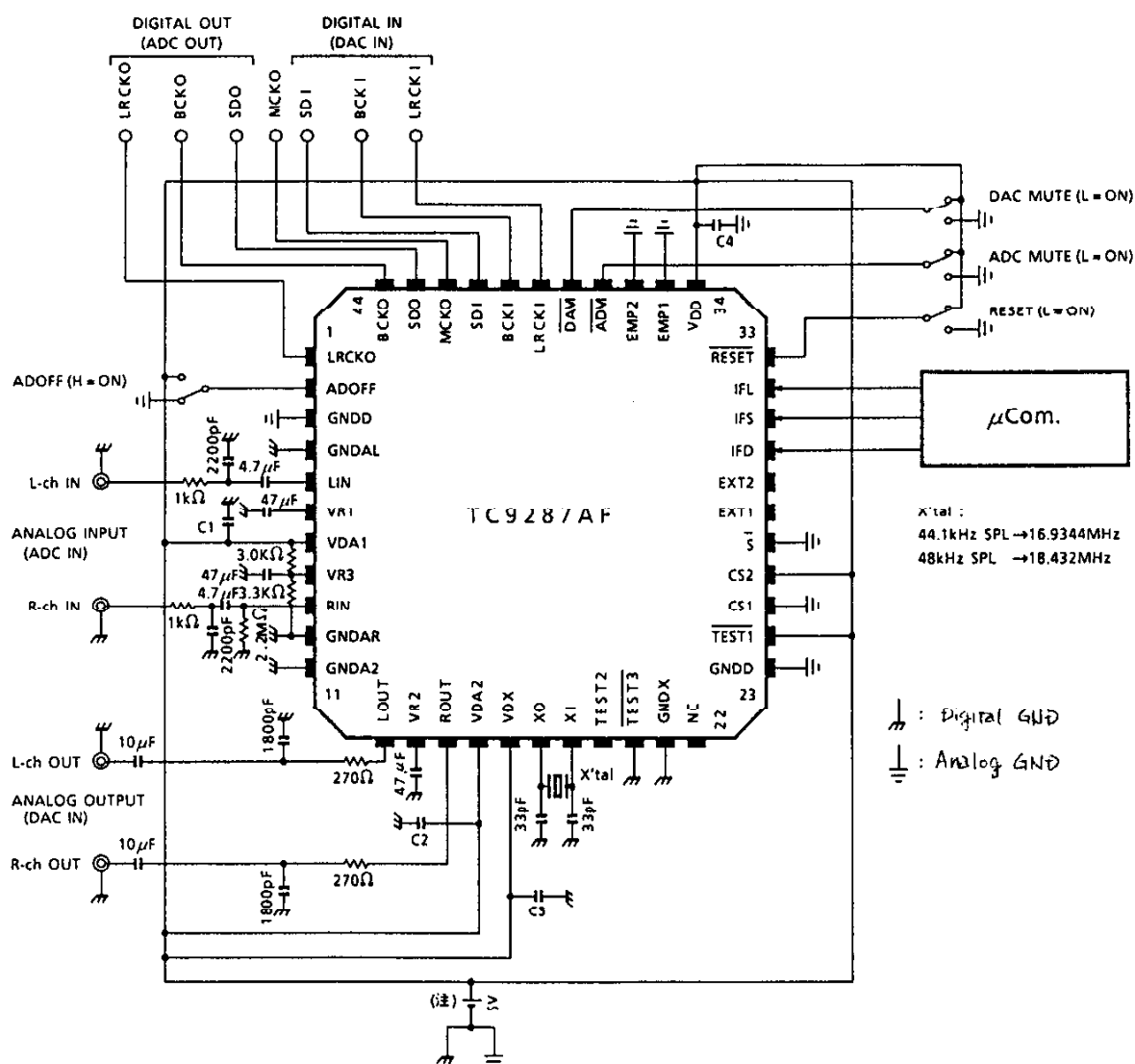
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Maximum output Voltage	V _{OM}	2	Output Voltage at full scale level input	—	1.25	—	V _{rms}
S / N ratio	S / N _D	2	At A-Weight filter ON	88	95	—	dB
Total Harmonic Distortion + Noise	THD _D	2		—	-87	-80	dB
Dynamic Range	DR _D	2	At A-Weight filter ON	85	92	—	dB
Cross-talk	CT _D	2	At A-Weight filter ON	—	-90	-85	dB

Common item

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating frequency	f _{opr}	—	V _{DD} =V _{DA} =V _{DD} ≥ 4.5V	10	16 9344	19.2	MHz
Input frequency	f _{LRCKI}	—		30	44.1	100	kHz
	f _{BCKI}			1	1.41	6.2	
Rise Time of input signal	t _{ri}	—	LRCKI, BCKI terminal (10~90 %)	—	—	15	ns
Fall Time of input signal	t _{fi}	—		—	—	15	
Delay Time of input signal	t _{di}	—	The falling edge of BCKI → LRCKI, SDI	—	—	40	
MCU I / F	Rise Time of input signal	t _{rim}	IFL, IFS terminal (10~90 %)	—	—	15	
	Fall Time of input signal	t _{fiM}		—	—	15	
	Delay Time of input signal	t _{dIM}	The falling edge of IFS → IFL, IFD	—	—	40	
Rise Time of output signal	t _{ro}	—	LRCKO, BCKO terminal (10~90 %)	—	—	15	
Fall Time of output signal	t _{fo}	—		—	—	15	
Delay Time of Output signal	t _{do}	—	The falling edge of BCKO → LRCKO, SDO	—	—	40	

APPLICATION CIRCUIT

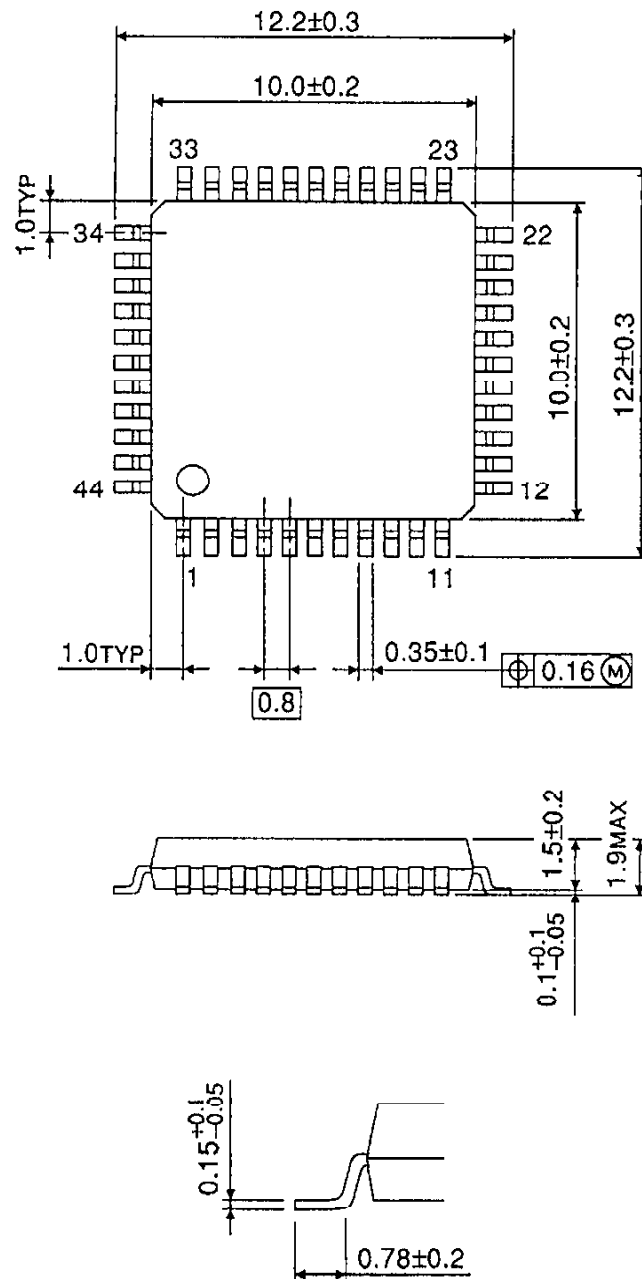
(use Crystal Oscillator)



OUTLINE DRAWING

QFP44-P-1010-0.80

Unit : mm



Weight : 0.5g (Typ.)