

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

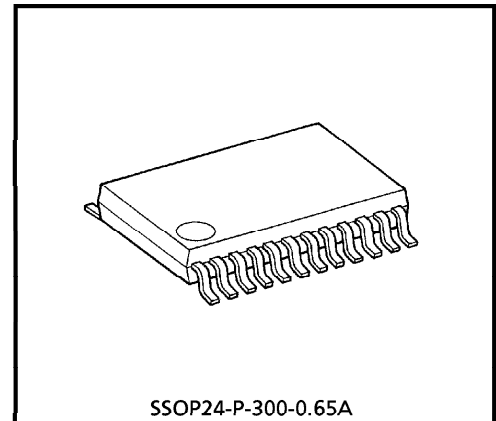
# TA1297AFN

## RF MODULATOR FOR VCR

The TA1297AFN is a PLL RF modulator for the UHF frequency range. The multi system can easily make the lineup development.

### FEATURES

- Phase locked loop frequency synthesizer for RF carrier and sound subcarrier
- Programmable of no adjustment sound subcarriers (4.5 MHz, 5.5 MHz, 6.0 MHz, 6.5 MHz)
- Possible to use for L-SECAM
- Programmable picture to sound ratio
- Bus controlled Test pattern Signal Generator
- Bus controlled one logic output port
- Bus controlled power save mode
- Controlled by I<sup>2</sup>C bus (Conforms to a fast-mode)
- The sound S/N ratio is improved from TA1243CFN



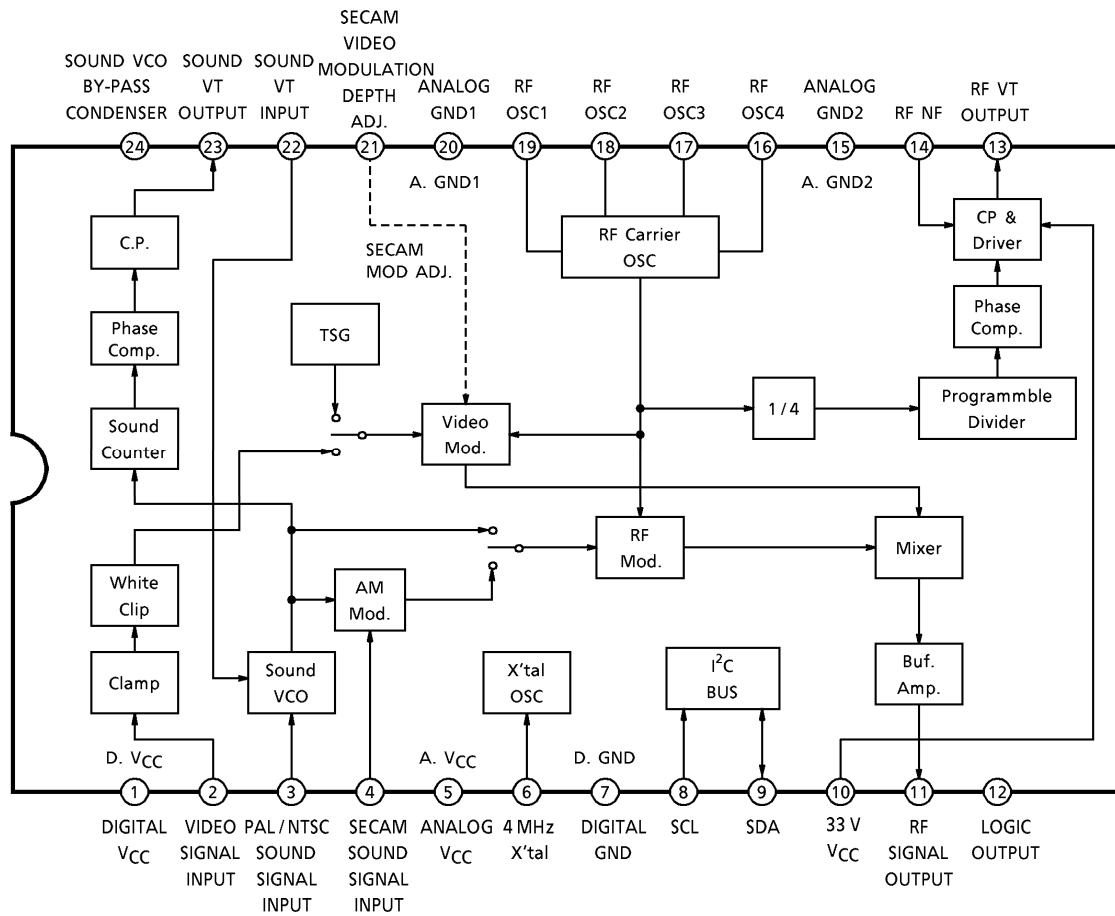
Weight : 0.14 g (Typ.)

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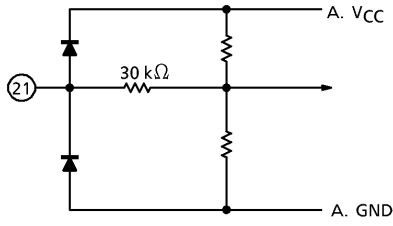
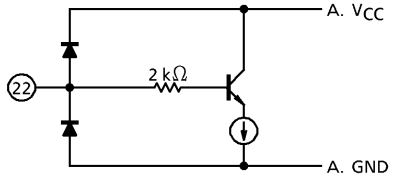
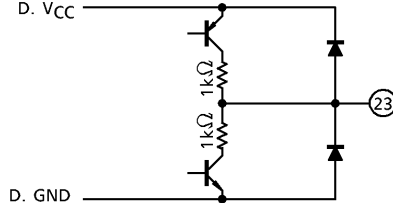
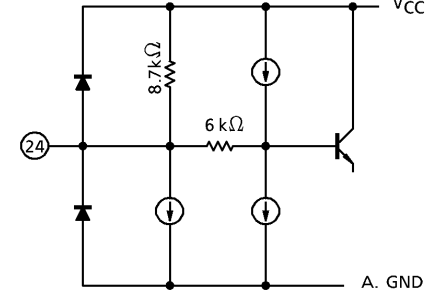
BLOCK DIAGRAM



**TERMINAL CHARACTERISTICS** ( $V_{CC1} = 5.0\text{ V}$ ,  $V_{CC2} = 33\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )

PIN No.	FUNCTION	TYP. DC VOLTAGE	TYP. AC VOLTAGE	INTERFACE	NOTE
1	Digital $V_{CC}$	(5.0 V)	—	—	—
2	Video Signal Input	2.4 V (Sync TIP)	0.5 V <sub>p-p</sub>		Sync TIP clamp input
3	PAL / NTSC Sound Signal Input	0 V	200 mV <sub>p-p</sub>		Switch terminal of normal mode and test mode. L : Normal mode (The voltage is under 2 V.) H : Test mode
4	SECAM Sound Signal Input	0 V	200 mV <sub>p-p</sub>		
5	Analog $V_{CC}$	(5.0 V)	—	—	Analog power supply
6	4 MHz X'tal	2.7 V	—		Switch terminal of internal oscillation and external input mode. (Refer to page 9)
7	Digital GND	(0 V)	—	—	Digital ground
8	SCL	OPEN BASE	5 V <sub>p-p</sub>		I <sup>2</sup> C BUS serial clock
9	SDA	OPEN BASE	5 V <sub>p-p</sub>		I <sup>2</sup> C BUS serial data
10	$V_{CC33}$	(33 V)	—	—	Tuning voltage power supply

PIN No.	FUNCTION	TYP. DC VOLTAGE	TYP. AC VOLTAGE	INTERFACE	NOTE
11	RF Signal Output	3.8 V	80 dB $\mu$ V (Picture)		
12	Logic Output	H : 4.3 V L : 0 V	—		BUS control $I_{max} = 10 \text{ mA}$
13	RF V <sub>T</sub> Output	—	—		Tuning voltage output
14	RF NF	—	—		
15	Analog GND2	(0 V)	—	—	Analog ground
16	RF OSC4	3.4 V	—		
17	RF OSC3	3.4 V			
18	RF OSC2	3.4 V			
19	RF OSC1	3.4 V			
20	Analog GND1	(0 V)	—	—	Analog ground

PIN No.	FUNCTION	TYP. DC VOLTAGE	TYP. AC VOLTAGE	INTERFACE	NOTE
21	SECAM Video Modulation depth Adj.	3.1 V	—		Possible to adjustment by the outside resistance. Resistance is inserted between VCC and 21 pin : Modulation depth decreases Resistance is inserted between GND and 21 pin : Modulation depth increases
22	Sound VT Input	—	—		
23	Sound VT Output	—	—		
24	Sound VCO by-pass condenser	—	—		

**I<sup>2</sup>C-BUS DATA FORMAT**

		MSB							LSB	ACK
Address Byte	ADR	1	1	0	0	1	0	1	0	ACK
Control Byte1	C1	1	(*)	(*)	(*)	PS2	PS1	PS0	LE	ACK
Control Byte2	C2	WO	PSA	LO	FA1	FA0	(*)	(*)	(*)	ACK
Prog. Data Byte1	PD1	0	TSG	N10	N9	N8	N7	N6	N5	ACK
Prog. Data Byte2	PD2	N4	N3	N2	N1	0	1	0	0	ACK

(\*) : Don't care

Bus data transmission : ADR + C1 + C2 + PD1 + PD2 or  
 ADR + PD1 + PD2 + C1 + C2 or  
 ADR + C1 + C2 or  
 ADR + PD1 + PD2

- PS2~PS0 : Picture to sound ratio setting (Video signal input : Stair case (B/W) 0.5 V<sub>p-p</sub>  
 Sound signal input : 1 kHz sin wave 0.2 V<sub>p-p</sub>)

PS RATIO (SYSTEM L)	PS RATIO (OTHER THAN SYSTEM L)	PS2	PS1	PS0
- 6 dB	- 10 dB	0	0	0
- 7 dB	- 11 dB	0	0	1
- 8 dB	- 12 dB	0	1	0
- 9 dB	- 13 dB	0	1	1
- 10 dB	- 14 dB	1	0	0
- 11 dB	- 15 dB	1	0	1
- 12 dB	- 16 dB	1	1	0
- 13 dB	- 17 dB	1	1	1

- LE : System L enable

- ... This mode is SYSTEM L. Positive modulation for video and AM modulation for sound inter carrier at 6.5 MHz.  
 In this case, FA1 and FA2 don't care.
- ... Modes other than SYSTEM L. Negative modulation for video and FM modulation for sound inter carrier at 4.5 MHz, 5.5 MHz, 6.0 MHz, 6.5 MHz.  
 The system is selected by FA1 and FA2.

- WO : Control of white clip

- ... White clip off. The system L is used, and the characteristic of 100% modulations can be evaluated.
- ... White clip on.

## 4. PSA : Control of power save

- 1 ... Power save off. (normal operation)
- 0 ... Power save on. Becomes waiting for the bus data.  
And power supplies other than the bus decoder are turned off.

The data of the decoder is maintained while  $V_{CC}$  is added.

When  $V_{CC}$  is turned off, power on reset changes the data of the decoder by turning on  $V_{CC}$  again.

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## 5. LO : Control of logic out

- 1 ... 12 pin become high voltage.
- 0 ... 12 pin become low voltage.

## 6. FA1~FA0 : Sound Inter Carrier Frequencies setting

FA1	FA0	SOUND INTER CARRIER FREQUENCY	FREQUENCY DEVIATION
0	0	4.5 MHz	± 25 kHz
0	1	5.5 MHz	± 50 kHz
1	0	6.0 MHz	± 50 kHz
1	1	6.5 MHz	± 50 kHz

## 7. TPSG : Control of test pattern signal generator

- 1 ... ON
- 0 ... OFF (normal operation)

## 8. N10~N1 : Programmable Divider Data setting

The frequency of VCO is calculated by the next expression.

$$f_{VCO} = 31.25 \text{ kHz} \times 32 \times N + 250 \text{ kHz}$$

$$N = 512 \times N_{10} + 256 \times N_9 + 128 \times N_8 + 64 \times N_7 + 32 \times N_6 + 16 \times N_5 + 8 \times N_4 + 4 \times N_3 + 2 \times N_2 + N_1$$

The frequency step is 1 MHz, and 250 kHz is given in the IC.

The divider data N is made frequency -250 kHz of the set channel.

**POWER ON RESET MODE**

Power on reset functions when the power supply is turned on.

The decoder data is the data of power on reset until the bus data is received.

In this mode, because the power saving is turned on, the RF signal is not output.

- VCO Frequency Setting : 591.25 MHz (CCIR 36 ch)
- Television System : System G (Sound carrier frequency : 5.5 MHz,  
FM deviation : ± 50 kHz,  
Video modulation polarity : negative modulation)
- P/S Ratio Set Up : - 13 dB
- White Clip : ON
- Power Save : ON
- Logic Output : LOW
- TPSG : OFF

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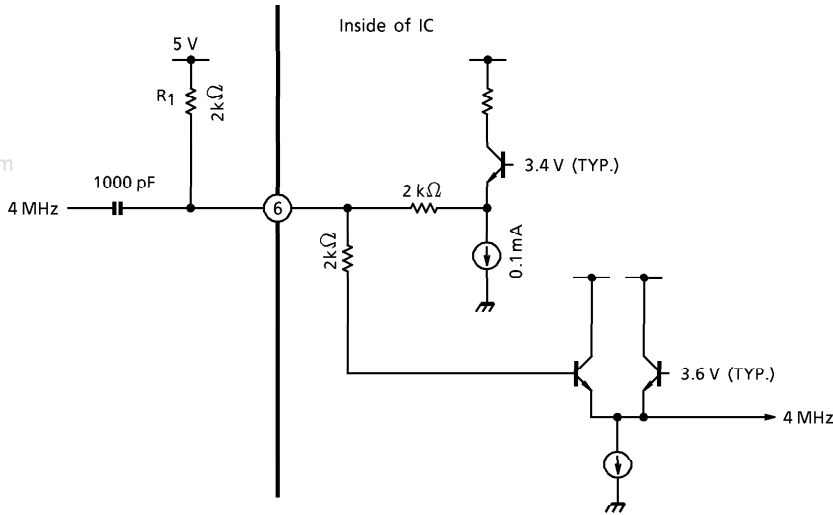
		MSB							LSB	ACK
Address Byte	ADR	1	1	0	0	1	0	1	0	ACK
Control Byte1	C1	1	(*)	(*)	(*)	0	1	1	0	ACK
Control Byte2	C2	0	0	0	0	1	(*)	(*)	(*)	ACK
Prog. Data Byte1	PD1	0	0	1	0	0	1	0	0	ACK
Prog. Data Byte2	PD2	1	1	1	1	0	1	0	0	ACK

(\*) : Don't care



**EXTERNAL 4 MHz INPUT MODE**

It is possible to change to external 4 MHz input mode by connecting resistance ( $R_1$ ) between terminal 6 and 5 V  $V_{CC}$ .



Condition of external 4 MHz input mode : In terminal 6, the voltage is above 3.8 V, the amplitude of 4 MHz signal is above 100 mV<sub>p-p</sub> (sine wave).

Please design  $R_1$ , and an external circuit to suit the condition.

**MAXIMUM RATINGS (Ta = 25°C)**

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage 5 V System	$V_{CC1}$	8	V
Supply Voltage 33 V System	$V_{CC2}$	35	V
Power Dissipation (Note)	$P_D$	850	mW
Input Terminal Voltage	$V_{IN}$	GND - 0.3~ $V_{CC}$ + 0.3	V
Operating Temperature	$T_{opr}$	- 20~75	°C
Storage Temperature	$T_{stg}$	- 55~150	°C

(Note) : Derated linearly above  $T_a = 25^\circ\text{C}$  in the proportion of 6.8 mW/°C.

Please note the product design of the board because the calorific value is large.

- The copper area is widened.
- Hole for heat radiation of shield case.
- Other enough consideration.

**RECOMMENDED OPERATING CONDITION**

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage 5 V System	$V_{CC1}$	4.5	5	5.5	V
Supply Voltage 33 V System	$V_{CC2}$	27	33	35	V

ELECTRICAL CHARACTERISTICS ( $V_{CC1} = 5.0\text{ V}$ ,  $V_{CC2} = 33\text{ V}$ ,  $T_a = 25^\circ\text{C}$ ,  $f_p = 591.25\text{ MHz}$ )

	No.	CHARACTERISTIC	SYMBOL	TEST CIRCUIT	MIN.	TYP.	MAX.	UNIT	NOTE
Whole	1-1	Supply Current 1 (A.V <sub>CC</sub> + D.V <sub>CC</sub> )	I <sub>CC1</sub>	—	41	58	66	mA	Power supply of 5 V part
	1-2	Supply Current 2 (A.V <sub>CC</sub> + D.V <sub>CC</sub> )	I <sub>CC2</sub>	—	4	6	8	mA	5 V power supply of power save
	1-3	Supply Current 3 (V <sub>CC</sub> 33 V)	I <sub>CC3</sub>	—	1.4	2.2	3.0	mA	Power supply of 33 V part
	1-4	Operating Frequency Range	f <sub>op</sub>	—	471.25	—	855.25	MHz	f <sub>p</sub> frequency
Video Part	2-1-1	Video RF Output Level (Negative Modulation)	V <sub>on</sub> (f <sub>p</sub> )	—	77	80	83	dB $\mu$ V	50 $\Omega$ Termination STAIR CASE (B / W) signal : 0.5 V <sub>p-p</sub> input
	2-1-2	Video RF Output Level (Positive Modulation)	V <sub>op</sub> (f <sub>p</sub> )						
	2-2-1	Video modulation Depth (Negative Modulation)	mpn	—	75	79	83	%	WHITE signal : 0.5 V <sub>p-p</sub> input
	2-2-2	Video modulation Depth (Positive Modulation)	mpp	—	85	89	93		
	2-3-1	White Clipping Level (Negative Modulation)	mpn (MAX)	—	90	94	98	%	WHITE signal : 1.0 V <sub>p-p</sub> input  DG / DP : 5% / 5°, WHITE CLIP : OFF
	2-3-2	White Clipping Level (Positive Modulation)	mpp (MAX)	—	210	230	—		
	2-4-1	Differential Gain (Negative Modulation)	DGn	—	—	$\pm 3$	$\pm 5$	%	STAIR CASE : 0.5 V <sub>p-p</sub> (chrominance signal 20 IRE)
	2-4-2	Differential Gain (Positive Modulation)	DGp						

No.	CHARACTERISTIC	SYMBOL	TEST CIRCUIT	MIN.	TYP.	MAX.	UNIT	NOTE
2-5-1	Differential Phase (Negative Modulation)	DPn	—	—	± 3	± 5	°	STAIR CASE : 0.5 V <sub>p-p</sub> (Chrominance signal 20 IRE)
2-5-2	Differential Phase (Positive Modulation)	DPp						
2-6-1	Video S / N Ratio (Negative Modulation)	mpn (S / N)	—	51	53	—	dB	0.1~5 MHz, Unweighting, WHITE 50% signal input
2-6-2	Video S / N Ratio (Positive Modulation)	mpp (S / N)						
2-7-1	Video Frequency Response (Negative Modulation)	f <sub>pn</sub>	—	—	± 1	± 2	dB	0.1~5 MHz 1 MHz Reference
2-7-2	Video Frequency Response (Positive Modulation)	f <sub>pp</sub>						
2-8	Average Picture Level Drift	mp (APL)	—	—	± 0.5	± 3.0	%	APL 10-90%, 50% Reference
2-9	Sync Crush Level	Δsync	—	—	1	3	%	{1 - (V <sub>sync</sub> / V <sub>white</sub> ) × (100 / 40) }
2-10-1	Chroma Beat (Negative Modulation)	V <sub>cn</sub>	—	—	- 75	- 70	dB	4.43 MHz sin wave : 0.5 V <sub>p-p</sub> input, Video carrier level reference, P / S = - 13 dB
2-10-2	Chroma Beat (Positive Modulation)	V <sub>cp</sub>						
2-11-1	RF Carrier 2'nd Harmonic Level	V <sub>2fp</sub>	—	—	- 26	- 20	dB	Reference = Video carrier level
2-11-2	RF Carrier 3'rd Harmonic Level	V <sub>3fp</sub>						
2-12	Video Signal 2nd Harmonic Level	V <sub>pH</sub>	—	—	- 55	- 50	dB	1 MHz sin wave : 0.5 V <sub>p-p</sub> input, f <sub>p</sub> + 1 MHz Reference, f <sub>p</sub> + 2 MHz measurement
2-13-1	Prescaller Spurious (f <sub>p</sub> × 1 / 2)	V <sub>PR1 / 2</sub>	—	—	0	10	dB <sub>μ</sub> V	—
2-13-2	Prescaller Spurious (f <sub>p</sub> × 3 / 2)	V <sub>PR3 / 2</sub>						
2-14-1	Video Carrier Frequency Accuracy	Δf <sub>p</sub>	—	—	—	± 100	kHz	X'tal series capacitor : 6 pF

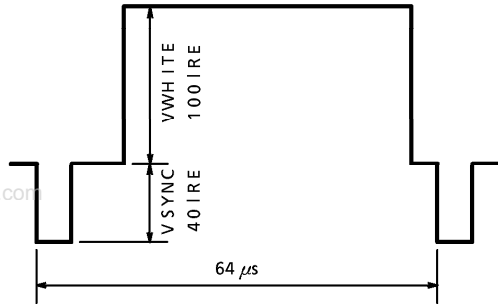
	No.	CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	MIN.	TYP.	MAX.	UNIT	NOTE
TPSG Part	3-1-1	TPSG Modulation Depth (Negative Modulation)	mpn (TPSG)	—	64	74	84	%	TPSG mode
	3-1-2	TPSG Modulation Depth (Positive Modulation)	mpp (TPSG)		82	92	97		
	3-2	TPSG V/S Ratio	V/S		2.0	2.4	2.8	—	
	3-3-1	TPSG Horizontal Sync Signal Cycle	Tsync		62	64	66	$\mu$ S	
	3-3-2	TPSG Horizontal Sync Signal Width	Wsync		3.6	4.0	4.4		
	3-4-1	TPSG SYNC-1'st Signal Time	W1		22	24	26		
	3-4-2	TPSG SYNC-2'nd Signal Time	W2		38	40	42		
Sound Part	4-1-1	P/S Ratio FM	R <sub>p/S</sub> FM	—	-15	-13	-11	dB	Set in -13 dB by bus, STAIR CASE (B/W) signal : 0.5 V <sub>p-p</sub> input, 1 kHz sin wave input : 0.2 V <sub>p-p</sub> (AM)
	4-1-2	P/S Ratio AM	R <sub>p/S</sub> AM	—	-11	-9	-7		
	4-2-1	Range of P/S Ratio	$\Delta$ R <sub>p/S</sub> FM	—	-17	—	-10	dB	P/S ratio can be adjusted by 1 dB. 1 kHz sin wave input : 0.2 V <sub>p-p</sub> (AM)
	4-2-2	Range of P/S Ratio	$\Delta$ R <sub>p/S</sub> AM	—	-13	—	-6		
	4-3-1	Sound Modulation Sensitivity FM1 (5.5 MHz/6.0 MHz/6.5 MHz)	$\beta_{FM1}$	—	0.558	0.62	0.682	kHz / mV $\beta_{FM}$ = $\Delta f$ (kHz) / 200 (mV)	1 kHz sin wave : 0.2 V <sub>p-p</sub> input,
	4-3-2	Sound Modulation Sensitivity FM2 (4.5 MHz)	$\beta_{FM2}$	—	0.279	0.31	0.341		
4-3-3	Sound Modulation Sensitivity AM	$\beta_{AM}$	—	63.9	71.0	78.1	%		

No.	CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	MIN.	TYP.	MAX.	UNIT	NOTE	
Sound Part	4-4-1	Sound S/N Ratio FM1 (5.5 MHz / 6.0 MHz / 6.5 MHz)	S / N (FM1)	—	54	59	—	dB	1kHz sin wave input : ± 50 kHz dev. = 0 dB Inter Carrier demod., de-emph = 1N, Colorbar signal : 0.5 V <sub>p-p</sub> input
	4-4-2	Sound S/N Ratio FM2 (4.5 MHz)	S / N (FM2)	—	50	55	—		1 kHz sin wave input : ± 25 kHz dev. = 0 dB Inter Carrier demod., de-emph = 1N, Colorbar signal : 0.5 V <sub>p-p</sub> input
	4-4-3	Sound S/N Ratio AM	S / N (AM)	—	50	55	—		1 kHz sin wave input : 60% mod. = 0 dB de-emph = 1N, Colorbar signal : 0.5 V <sub>p-p</sub> input
	4-5-1	Sound Distortion FM	THD (FM)	—	—	0.25	0.5	%	1 kHz sin wave : ± 50 (25) kHz dev.
	4-5-2	Sound Distortion AM	THD (AM)	—					1 kHz sin wave : 60% MOD.
	4-6-1	Sound Frequency Response FM	f <sub>s</sub> (FM)	—	—	± 1	± 2	dB	100 Hz~20 kHz, 1 kHz reference
	4-6-2	Sound Frequency Response AM	f <sub>s</sub> (AM)	—	—	± 0.5	± 1		
	4-7-1	Sound 2'nd Harmonic Level	V <sub>SH1</sub>	—	—	- 65	- 60	dB	P/S ratio = - 13 dB, Video carrier level reference
	4-7-2	Sound 3'rd Harmonic Level	V <sub>SH2</sub>	—	—	- 70	- 65		
4-8	Sound Inter-Carrier Frequency Accuracy	Δf <sub>s</sub>	—	—	—	± 750	Hz	X'tal series capacitor : 6 pF	

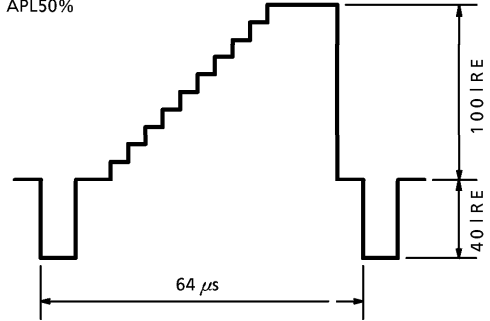
No.	CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	MIN.	TYP.	MAX.	UNIT	NOTE	
Logic part	5-1	Input LOW Voltage of both SDA and SCL Lines	$V_L$	—	0	—	1.8	V	
	5-2	Input HIGH Voltage of both SDA and SCL Lines	$V_H$	—	2.8	—	$V_{CC}$		
	5-3	Maximum Output LOW Voltage of SDA Line	$V_{ACK}$	—	—	—	0.4	V	$I_{sync} = 3 \text{ mA}$ , During the acknowledge clock pulse
	5-4	Threshold Voltage of Power on Reset	$V_{RESET}$	—	2.0	2.8	3.6	V	
	5-5	Threshold Voltage of External Reference Signal Input Mode	$V_{EXT}$	—	3.4	3.6	3.8	V	Voltage of terminal 6 L : Internal oscillation H : External input
	5-6	Threshold Voltage of Test mode	$V_{TEST}$	—	2.0	3.5	4.5	V	Voltage of terminal 3 L : Normal mode H : Test mode
	5-7	Logic Out Current	$I_{LOGIC}$	—	—	—	10	mA	Mounts on the board of power dissipation 830 mW. $T_a (\text{MAX}) = 75^\circ\text{C}$
—	6-1	Negative Resistance of X'tal Oscillator	$R_{XO}$	—	-1	—	—	k $\Omega$	—
	6-2	Input Signal Level of External Reference Signal	$V_{EXREF}$	—	100	—	—	mV <sub>p-p</sub>	External 4 MHz input mode, sine wave

INPUT WAVE FORM

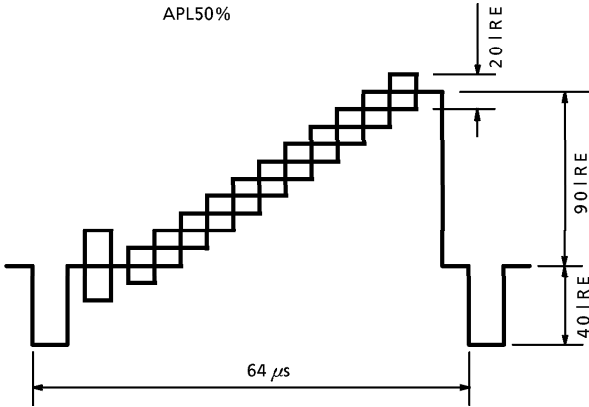
WHITE SIGNAL



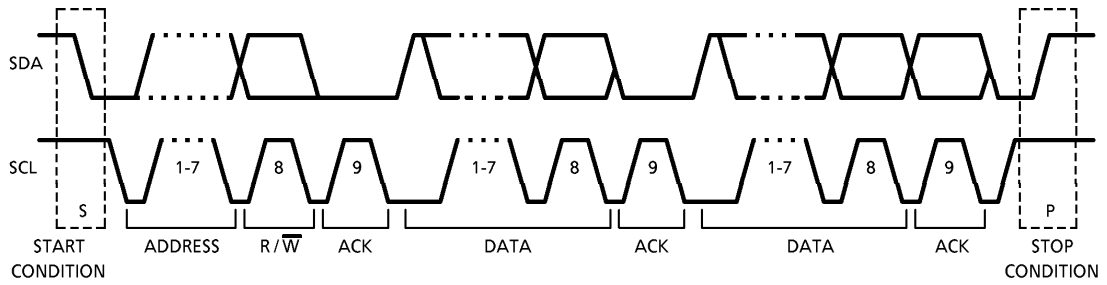
STAIRCASE (B/W) SIGNAL  
APL50%



STAIRCASE SIGNAL (Sub-carrier 20 IRE)  
APL50%

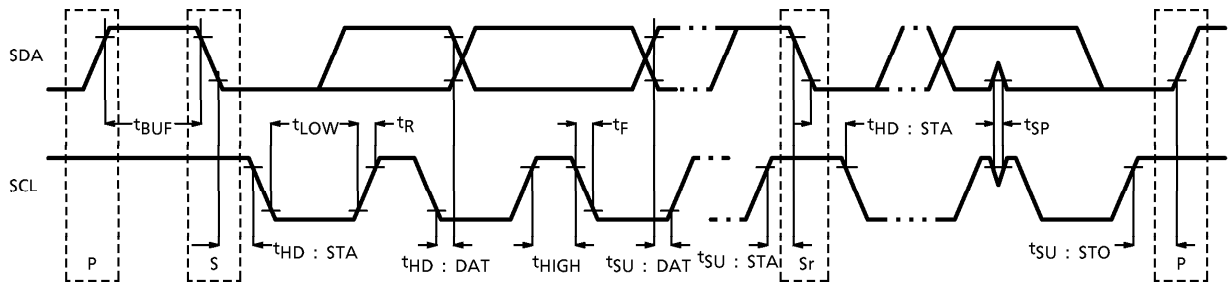


**DATA TRANSFER ON THE I<sup>2</sup>C-BUS**



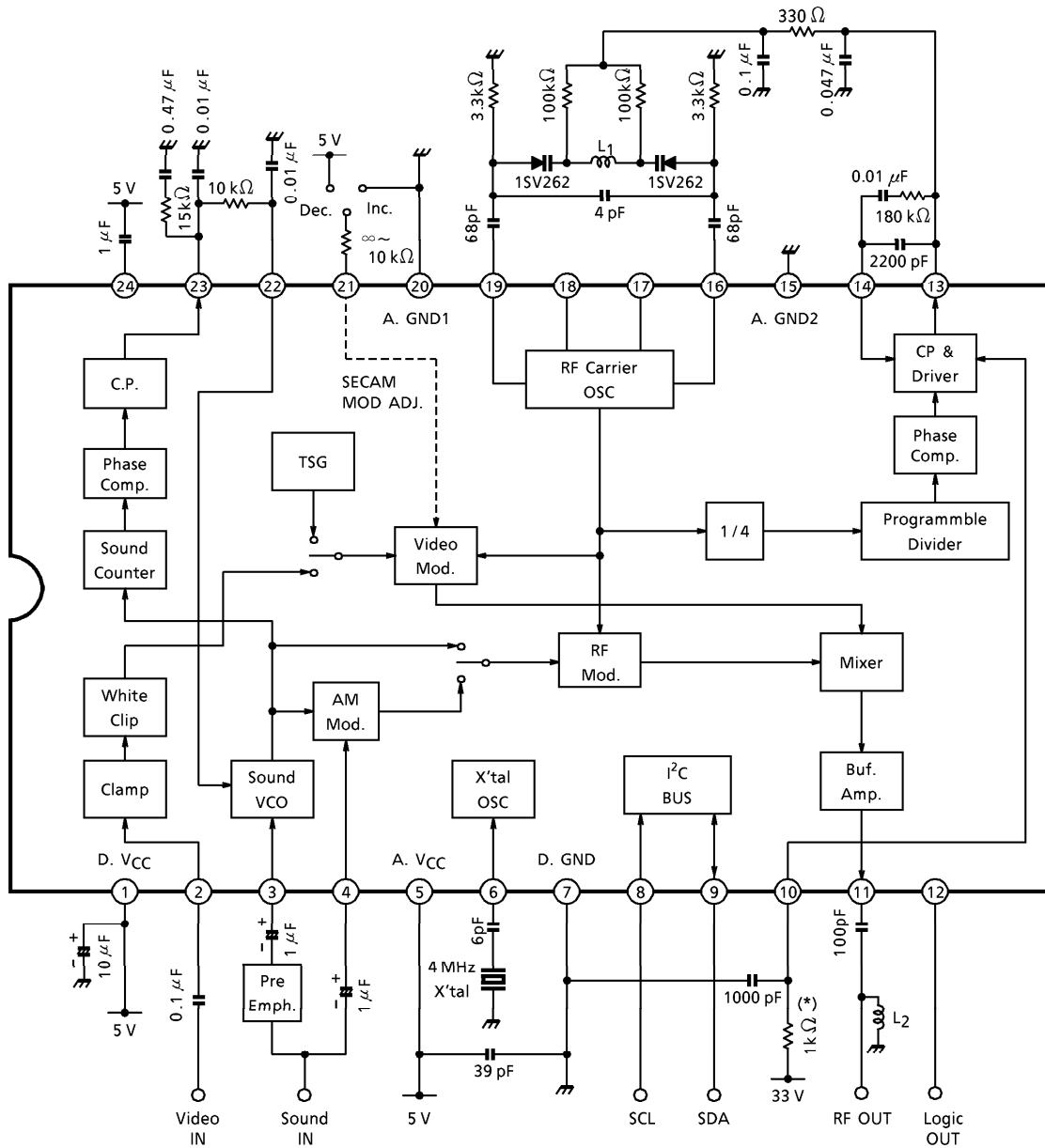
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**TIMING REQUIREMENTS FOR THE I<sup>2</sup>C-BUS**





APPLICATION CIRCUIT



- L1 : Coil Diameter 3.2 mm, Wire Diameter 0.4 mm, 2.5 turns, Air coil.
- L2 : For frequency response correction.
- (\*) : Protection resistance for prevention of overshoot.

**HANDLING PRECAUTIONS**

1. The device should not be inserted into or removed from the test jig while the voltage is being applied: otherwise the device may be degraded or break down.

Do not abruptly increase or decrease the power supply to the device either.

Overshoot or chattering of the power supply may cause the IC to be degraded.

To avoid this filters should be incorporated on the power supply line.

2. The application circuits described in this datasheet are given only as system examples for evaluating the device's performance. Toshiba Intend neither to recommend the configuration or related values of the peripheral circuits nor to manufacture such application system in large quantities.

Please note that high-frequency characteristics of the device may vary depending on the external components, mounting method and other factors relating to the application design.

Therefore, the characteristics of application circuits must be evaluated at the responsibility of the users incorporating the device into their design.

Toshiba only guarantee the quality and characteristics of the device as described in this detasheet and do not assume any responsibility for the customers application design.

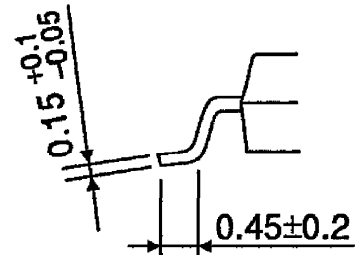
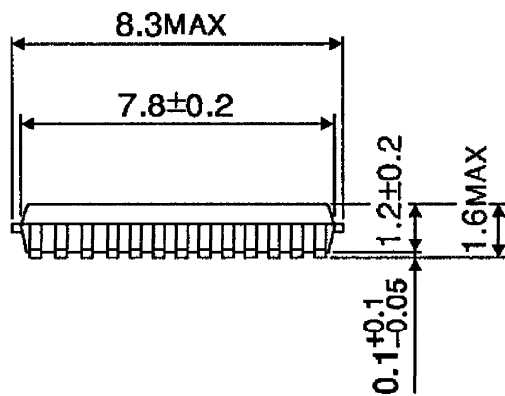
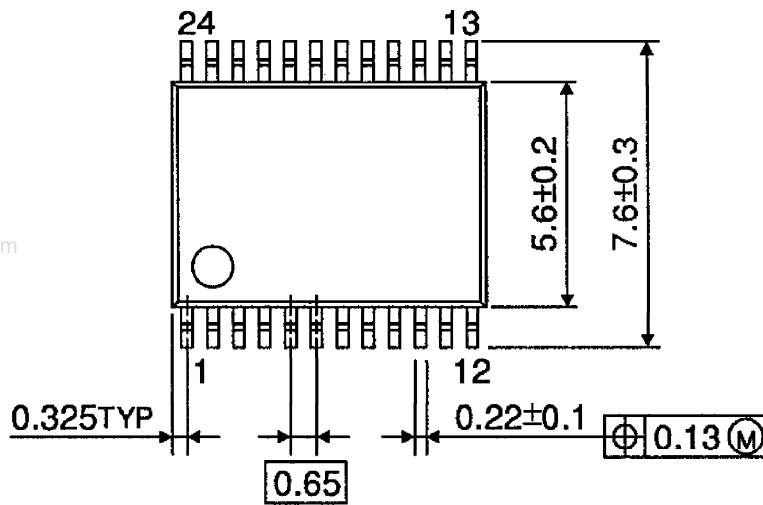
3. In order to better understand the quality and reliability of Toshiba semiconductor products and to incorporate them into design in an appropriate manner, please refer to the latest Semiconductor Reliability Handbook (Integrated Circuit) published by Toshiba Semiconductor Company.

The handbook can also be viewed online at

<http://www.semicon.toshiba.co.jp/noseek/us/sinrai/sinraifm.htm>

PACKAGE DIMENSIONS  
SSOP24-P-300-0.65A

Unit : mm



Weight : 0.14 g (Typ.)