

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

# TA2157F, TA2157FN

## Digital Servo Head Amp for CD System

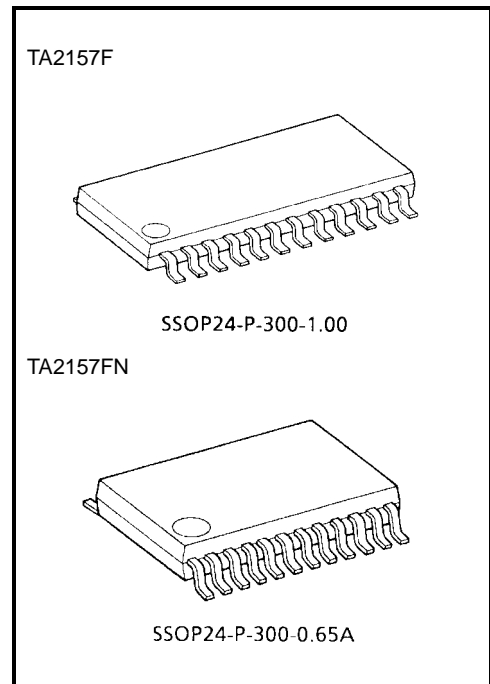
TA2157F/FN is a digital servo head amp for a 3-beam pickup used in CD systems.

Gain for RF signal generation amp can be freely set, supporting CD-RW.

Combining with single-chip processor TC94A14F/FA/FB, a CMOS digital servo, makes configuring CD systems simple.

### Features

- Low power dissipation digital servo head amp
- Built-in amplifier for generating reference voltage (VRO)
- Built-in auto laser power control (APC) amplifier
- Built-in RF amplifier
- Built-in RF signal automatic gain control (AGC) amplifier
- Built-in gain change circuit for CD-RW
- Built-in focus error and tracking error signal amplifiers
- Built-in track count signal amplifier
- Normal-, double-, and  $\times 4$ -speed operation
- 24-pin mini flat package

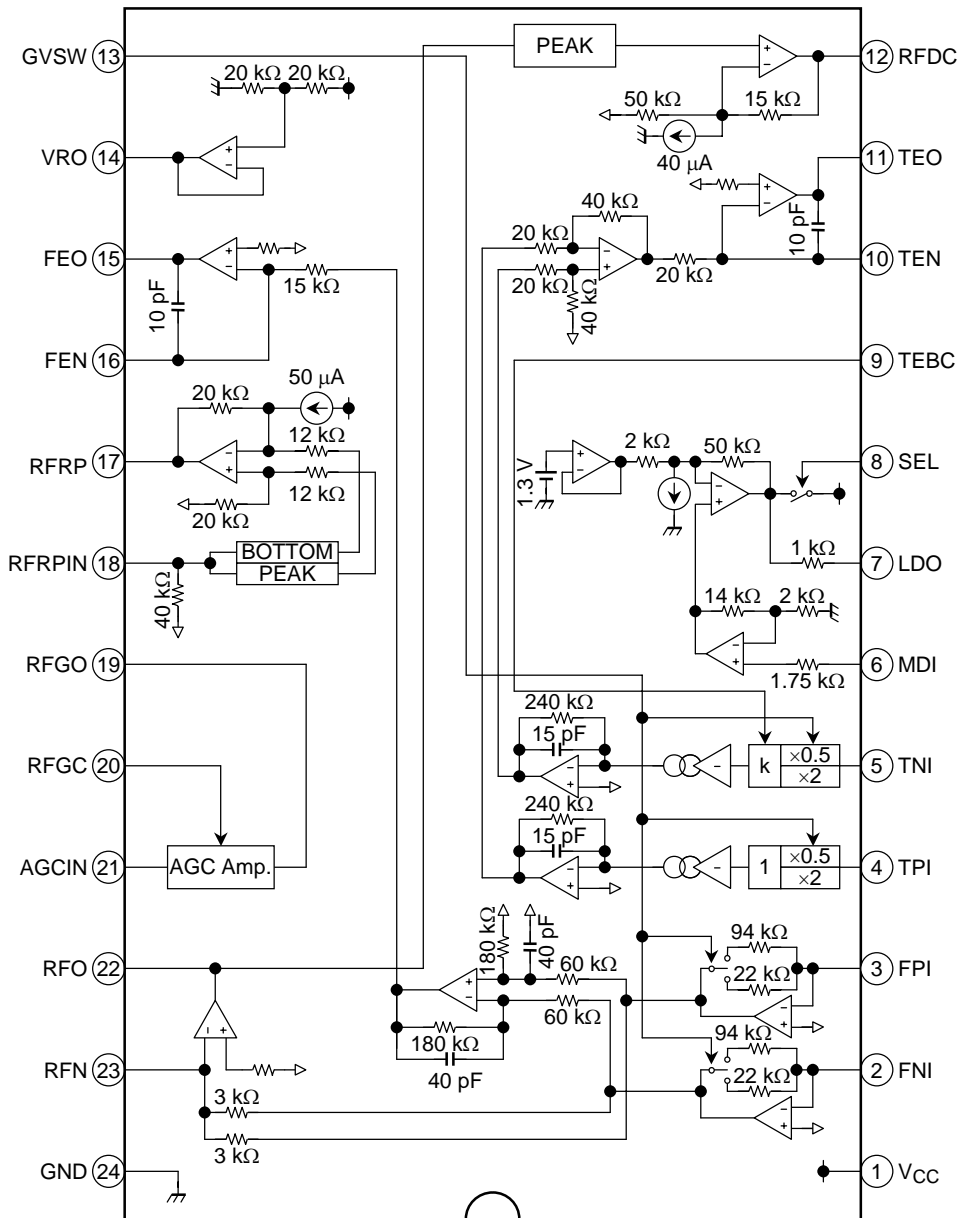


#### Weight

SSOP24-P-300-1.00: 0.3 g (typ.)

SSOP24-P-300-0.65A: 0.17 g (typ.)

**Block Diagram**



PIN V <sub>CTRL</sub>	SEL (APC SW)	TEB (TE BAL)	RFGC (AGC Gain)	GVSW
V <sub>CC</sub>	APC ON	-50%	+12dB	Normal mode (0dB)
HiZ	APC ON	0%	+6dB	Normal mode (0dB)
GND	APC OFF (LDO = H)	+50%	0dB	CD-RW mode (+12dB)

## Pin Function

Pin No.	Symbol	I/O	Function Description	Internal Circuit												
1	V <sub>CC</sub>	—	3.3 V power supply pin	—												
2	FNI	I	Main-beam amp input pin													
3	FPI	I	Main-beam amp input pin													
4	TPI	I	Sub-beam amp input pin													
5	TNI	I	Sub-beam amp input pin													
6	MDI	I	Monitor photo diode amp input pin													
7	LDO	O	Laser diode amp output pin	<p>ON: LD-OFF OFF: LD-ON</p>												
8	SEL	I	APC circuit ON/OFF control signal, laser diode (LDO) control signal input or bottom/peak detection frequency change pin.	<table border="1"> <thead> <tr> <th>SEL</th> <th>APC Circuit</th> <th>LDO</th> </tr> </thead> <tbody> <tr> <td>GND</td> <td>OFF</td> <td>Connected to V<sub>CC</sub> through 1 kΩ resistor</td> </tr> <tr> <td>HiZ</td> <td>ON</td> <td>Control signal output</td> </tr> <tr> <td>V<sub>CC</sub></td> <td>ON</td> <td>Control signal output</td> </tr> </tbody> </table>	SEL	APC Circuit	LDO	GND	OFF	Connected to V <sub>CC</sub> through 1 kΩ resistor	HiZ	ON	Control signal output	V <sub>CC</sub>	ON	Control signal output
SEL	APC Circuit	LDO														
GND	OFF	Connected to V <sub>CC</sub> through 1 kΩ resistor														
HiZ	ON	Control signal output														
V <sub>CC</sub>	ON	Control signal output														

Pin No.	Symbol	I/O	Function Description	Internal Circuit							
9	TEBC	I	Tracking error balance adjustment signal input pin Adjusts TE signal balance by eliminating carrier component from PWM signal (3-state output, PWM carrier = 88.2 kHz) output from TC94A14F/FA/FB TEBC pin using RC-LPF and inputting DC. TEBC input voltage: GND~V <sub>CC</sub>								
10	TEN	I	Tracking error signal generation amp negative-phase input pin								
11	TEO	O	Tracking error signal generation amp output pin. Combining TEO signal and RFRP signal with TC94A14F/FA/FB configures tracking search system.								
12	RFDC	O	RF signal peak detection output pin								
13	GVSW	I	AGC/FE/TE amp gain change pin <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>GVSW</td> <td>Mode</td> </tr> <tr> <td>GND</td> <td>CD-RW</td> </tr> <tr> <td>HiZ</td> <td rowspan="2">Normal</td> </tr> <tr> <td>V<sub>CC</sub></td> </tr> </table>	GVSW	Mode	GND	CD-RW	HiZ	Normal	V <sub>CC</sub>	
GVSW	Mode										
GND	CD-RW										
HiZ	Normal										
V <sub>CC</sub>											

Pin No.	Symbol	I/O	Function Description	Internal Circuit
14	VRO	O	Reference voltage (VRO) output pin <ul style="list-style-type: none"> <li>VRO = 1/2 V<sub>CC</sub> when V<sub>CC</sub> = 3.3 V</li> </ul>	
15	FEO	O	Focus error signal generation amp output pin	
16	FEN	I	Focus error signal generation amp negative-phase input pin	
17	RFRP	O	Signal amp output pin for track count Combining RFRP signal and TEO signal with TC94A14F/FA/FB configures tracking search system.	
18	RFRPIN	I	Signal generation amp input pin for track count	

Pin No.	Symbol	I/O	Function Description	Internal Circuit
19	RFGO	O	RF signal amplitude adjustment amp output pin	
20	RFGC	I	RF amplitude adjustment control signal input pin Adjusts RF signal amplitude by eliminating carrier component from PWM signal (3-state output, PWM carrier = 88.2 kHz) output from TC94A14F/FA/FB RFGC pin using RC-LPF and inputting DC. • RFGC input voltage : GND~V <sub>CC</sub>	
21	AGCIN	I	RF signal amplitude adjustment amp input pin	
22	RFO	O	RF signal generation amp output pin	
23	RFN	I	RF signal generation amp input pin	
24	GND	—	GND pin	—

## Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Supply voltage		V <sub>CC</sub>	5	V
Power dissipation	TA2157F	P <sub>D</sub>	600	mW
	TA2157FN		500	
Operating temperature		T <sub>opr</sub>	-40 ~ +85	°C
Storage temperature		T <sub>stg</sub>	-55 ~ +150	°C

Note 1: TA2157F: Derated above 25°C in the proportion 4.76 mW/°C.

TA2157FN: Derated above 25°C in the proportion 4 mW/°C.

## Electrical Characteristics (unless otherwise specified, V<sub>CC</sub> = 3.3 V, V<sub>RO</sub> = 1.65 V, Ta = 25°C, R<sub>FGC</sub> = V<sub>RO</sub>, G<sub>VS</sub>W = V<sub>CC</sub>)

Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit	
Power supply	Assured power supply voltage	V <sub>CC</sub>	—	—	3.0	3.3	3.6	V	
	Power supply current (normal mode)	I <sub>CC1</sub>	—	SEL = HiZ TEBC = HiZ RFGC = HiZ	G <sub>VS</sub> W = V <sub>CC</sub>	13	19	25	mA
	Power supply current (CD-RW mode)	I <sub>CC2</sub>			G <sub>VS</sub> W = GND	12	18	24	
Reference voltage	Reference voltage	V <sub>RO</sub>	—	When V <sub>CC</sub> = 3.3 V	1.55	1.65	1.75	V	
	Output current	I <sub>OH</sub>	—	ΔV = -0.1 V	3	—	—	mA	
	Input current	I <sub>OL</sub>	—	ΔV = +0.1 V	3	—	—		
APC MD → LDO	Voltage gain	G <sub>VAPC</sub>	—	f = 1 kHz	—	200	—	V/V	
	Operating reference voltage	V <sub>MDI</sub>	—	V <sub>LDO</sub> = V <sub>CC</sub> - 1.3 V	170	178	186	mV	
	LD off voltage	V <sub>LDOP</sub>	—	V <sub>CC</sub> reference, SEL = GND	-0.75	-0.7	—	V	
	Input bias current	I <sub>IAPC</sub>	—	V <sub>MDI</sub> = 178 mV	-200	-50	0	nA	
RF FPI (FNI) → RFO	Transfer resistance 1 (normal mode)	R <sub>t1RF</sub>	—	f = 100 kHz R <sub>f</sub> = 12 kΩ	G <sub>VS</sub> W = V <sub>CC</sub>	74	85	95	kΩ
	Transfer resistance 2 (CD-RW mode)	R <sub>t2RF</sub>			G <sub>VS</sub> W = GND	325	370	414	
	Frequency characteristic 1 (normal mode)	f <sub>C1RF</sub>	—	-3dB point R <sub>f</sub> = 12 kΩ	G <sub>VS</sub> W = V <sub>CC</sub>	—	13	—	MHz
	Frequency characteristic 2 (CD-RW mode)	f <sub>C2RF</sub>			G <sub>VS</sub> W = GND	—	8	—	
	Output slew rate	S <sub>RRF</sub>	—	—	C <sub>RFO</sub> = 20 pF	—	35	—	V/μs
	Upper limit output voltage	V <sub>OHRF</sub>	—	—	GND reference	2.2	2.4	—	V
	Lower limit output voltage	V <sub>OLRF</sub>				—	0.2	0.4	
	Permissive load resistance	R <sub>LMRF</sub>	—	—	—	5	10	—	kΩ

Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit	
AGC AGCI → RFGO	Voltage gain 1	G <sub>V1AG</sub>	—	f = 1 MHz	RFGC = GND	-1.5	-0.5	0.5	dB
	Voltage gain 2	G <sub>V2AG</sub>			RFGC = HiZ	5.5	6.5	7.5	
	Voltage gain 3	G <sub>V3AG</sub>			RFGC = V <sub>CC</sub>	12	13.5	15	
	Frequency characteristic 1	f <sub>C1AG</sub>	—	-3dB point	RFGC = GND	—	15	—	MHz
	Frequency characteristic 2	f <sub>C2AG</sub>			RFGC = HiZ	—	15	—	
	Frequency characteristic 3	f <sub>C3AG</sub>			RFGC = V <sub>CC</sub>	—	15	—	
	Output slew rate	SR <sub>AG</sub>	—	C <sub>RFO</sub> = 20 pF		—	25	—	V/μs
	Upper limit output voltage	V <sub>OHAG</sub>	—	GND reference		2.2	2.4	—	V
	Lower limit output voltage	V <sub>OLAG</sub>				—	0.2	0.4	
	Permissible load resistance	R <sub>LMAG</sub>	—	—		5	10	—	kΩ
FE FPI (FNI) → FEO	Transfer resistance 1 (normal mode)	R <sub>t1FE</sub>	—	f = 1 kHz R <sub>FIN</sub> = 47 kΩ R <sub>FEFB</sub> = 33 kΩ	G <sub>VSW</sub> = V <sub>CC</sub>	127	145	162	kΩ
	Transfer resistance 2 (CD-RW mode)	R <sub>t2FE</sub>			G <sub>VSW</sub> = GND	545	620	694	
	Gain balance 1 (normal mode)	GB <sub>1FE</sub>	—	G <sub>VSW</sub> = V <sub>CC</sub> , ΔR <sub>t1FE</sub>		-1	0	+1	dB
	Gain balance 2 (CD-RW mode)	GB <sub>2FE</sub>		G <sub>VSW</sub> = GND, ΔR <sub>t2FE</sub>		-1	0	+1	
	Frequency characteristic 1 (normal mode)	f <sub>C1FE</sub>	—	-3dB point R <sub>FEFB</sub> = 33 kΩ	G <sub>VSW</sub> = V <sub>CC</sub>	—	20	—	kHz
	Frequency characteristic 2 (CD-RW mode)	f <sub>C2FE</sub>			G <sub>VSW</sub> = GND	—	20	—	
	Output offset voltage 1 (normal mode)	V <sub>OS1FE</sub>	—	VRO reference FPI/FNI open	G <sub>VSW</sub> = V <sub>CC</sub>	-50	0	+50	mV
	Output offset voltage 2 (CD-RW mode)	V <sub>OS2FE</sub>			G <sub>VSW</sub> = GND	-100	0	+100	
	Upper limit output voltage	V <sub>OHFE</sub>	—	GND reference		2.9	3.1	—	V
	Lower limit output voltage	V <sub>OLFE</sub>				—	0.1	0.3	
	Permissible load resistance	R <sub>LMFE</sub>	—	—		5	10	—	kΩ



Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit		
TE TPI (TNI) → TEO	Transfer resistance 1 (normal mode)	Rt1TE	—	f = 1 kHz TE <sub>RFB</sub> = 39 kΩ RTIN = 47 kΩ TEBC = HiZ	GVSW = V <sub>CC</sub>	411	468	525	kΩ	
	Transfer resistance 2 (CD-RW mode)	Rt2TE		GVSW = GND	1647	1872	2092			
	Gain balance adjustment width	H (DA)	ΔRt1	—	GVSW = V <sub>CC</sub>	TEBC = GND	+40	+50	+60	%
		L (DA)	ΔRt2			TEBC = V <sub>CC</sub>	-60	-50	-40	
	Gain balance 1 (normal mode)	GB1TE	—	GVSW = V <sub>CC</sub> , ΔRt1FE		-1	0	+1	dB	
	Gain balance 2 (CD-RW mode)	GB2TE		GVSW = GND, ΔRt2FE		-1	0	+1		
	Frequency characteristic 1 (normal mode)	f <sub>C1TE</sub>	—	-3dB point R <sub>TEFB</sub> = 39 kΩ	GVSW = V <sub>CC</sub>	—	40	—	kHz	
	Frequency characteristic 2 (CD-RW mode)	f <sub>C2TE</sub>			GVSW = GND	—	40	—		
	Output offset voltage 1 (normal mode)	V <sub>OS1TE</sub>	—	VRO reference TPI/TNI open	GVSW = V <sub>CC</sub>	-50	0	+50	mV	
	Output offset voltage 2 (CD-RW mode)	V <sub>OS2TE</sub>			GVSW = GND	-150	0	+150		
	Upper limit output voltage	V <sub>OHTE</sub>	—	GND reference		2.9	3.1	—	V	
	Lower limit output voltage	V <sub>OLTE</sub>				—	0.1	0.3		
	Permissible load resistance	R <sub>LMTE</sub>	—	—		5	10	—	kΩ	
RFDC FNI (FPI) → RFDC	Detection frequency	f <sub>DC</sub>	—	-3dB point at low-frequency with output amplitude = 0dB when RFO = 1.2 V <sub>pp</sub> /350 kHz in relation to V <sub>OP1DC</sub>	—	15	—	kHz		
	Operating reference voltage 1	V <sub>OP1DC</sub>	—	FNI/FPI open, VRO reference, RFN-V <sub>cc</sub> = 47 kΩ	-0.15	0	0.15	V		
	Operating reference voltage 2	V <sub>OP2DC</sub>		VRO reference, RFO = 1.2 V <sub>pp</sub> /350 kHz, RFN-V <sub>cc</sub> = 47 kΩ	0.6	0.75	0.9			
	Upper limit output voltage	V <sub>OHDC</sub>	—	GND reference		2.9	3.1	—	V	
	Lower limit output voltage	V <sub>OLDC</sub>				—	0.3	0.5		
	Permissible load resistance	R <sub>LMDC</sub>	—	—		5	10	—	kΩ	
RFRP RFRPIN → RFRP	Voltage gain	G <sub>VRP</sub>	—	AMP gain after detection	—	4.4	—	dB		
	Detection frequency	f <sub>CRP</sub>	—	-3dB point at low-frequency with output amplitude = 0dB when RFO = 1.2 V <sub>pp</sub> /700 kHz in relation to V <sub>OP1RP</sub>	—	35	—	kHz		
	Detection time constant	T <sub>RP</sub>	—	1.2 V <sub>pp</sub> /5 kHz square wave (C <sub>in</sub> > 1 μF)	—	37	—	V/ms		
	Operating reference voltage 1	V <sub>OP1RP</sub>	—	VRO reference, no input	-1.0	-0.85	-0.7	V		
	Operating reference voltage 2	V <sub>OP2RP</sub>		VRO reference, RFO = 700 kHz, 1.2 V <sub>pp</sub>	0.7	0.85	1.0			
	Upper limit output voltage	V <sub>OHRP</sub>	—	GND reference		2.9	3.1	—	V	
	Permissible load resistance	R <sub>LMRP</sub>	—	—		5	10	—	kΩ	

Note 2: (DA) : Normal mode

Note 3: If the IC is used abnormally (ex, wrongly mounted), it may be damaged or destroyed.

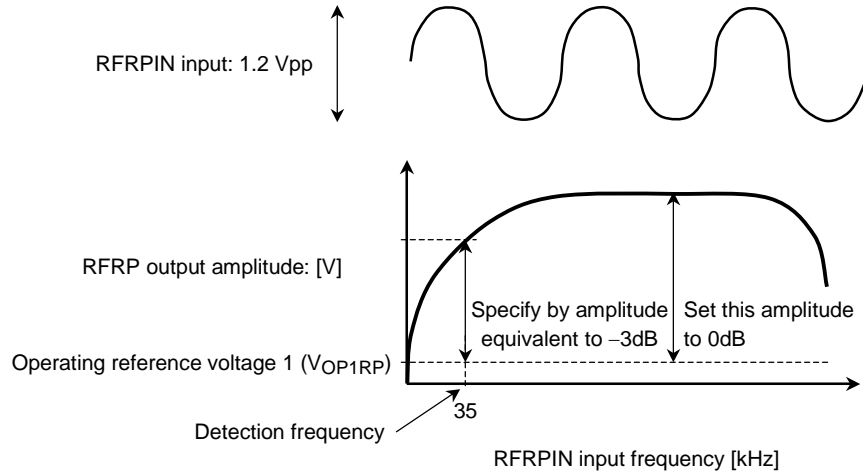
**Test Methods (supplementary)**

Note: Due to the relation with RFRP detection frequency, use feed search (track cross speed) at 80 kHz or less.

**1. Test method for RFRP detection frequency characteristic and detection time constant**

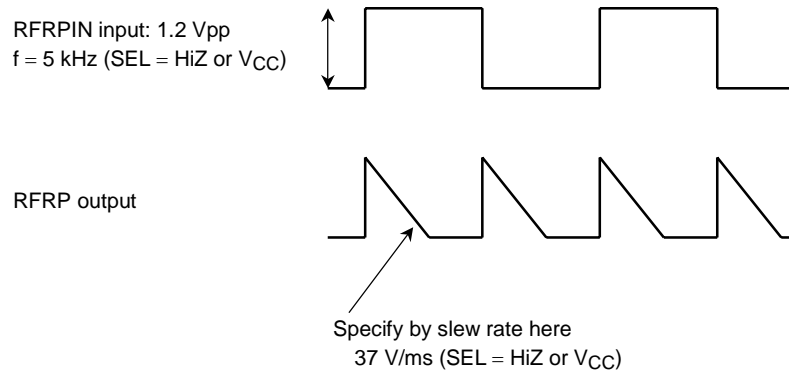
(1) Detection frequency

Set to 0dB the maximum output amplitude of the RFRP pin in relation to the operating reference voltage 1 ( $V_{OP1RP}$ ) when the sine wave shown in the figure below is input via a capacitor ( $C_{in} > 1 \mu F$ ) to the RFRPIN pin and specify a frequency whose amplitude is  $-3dB$ .

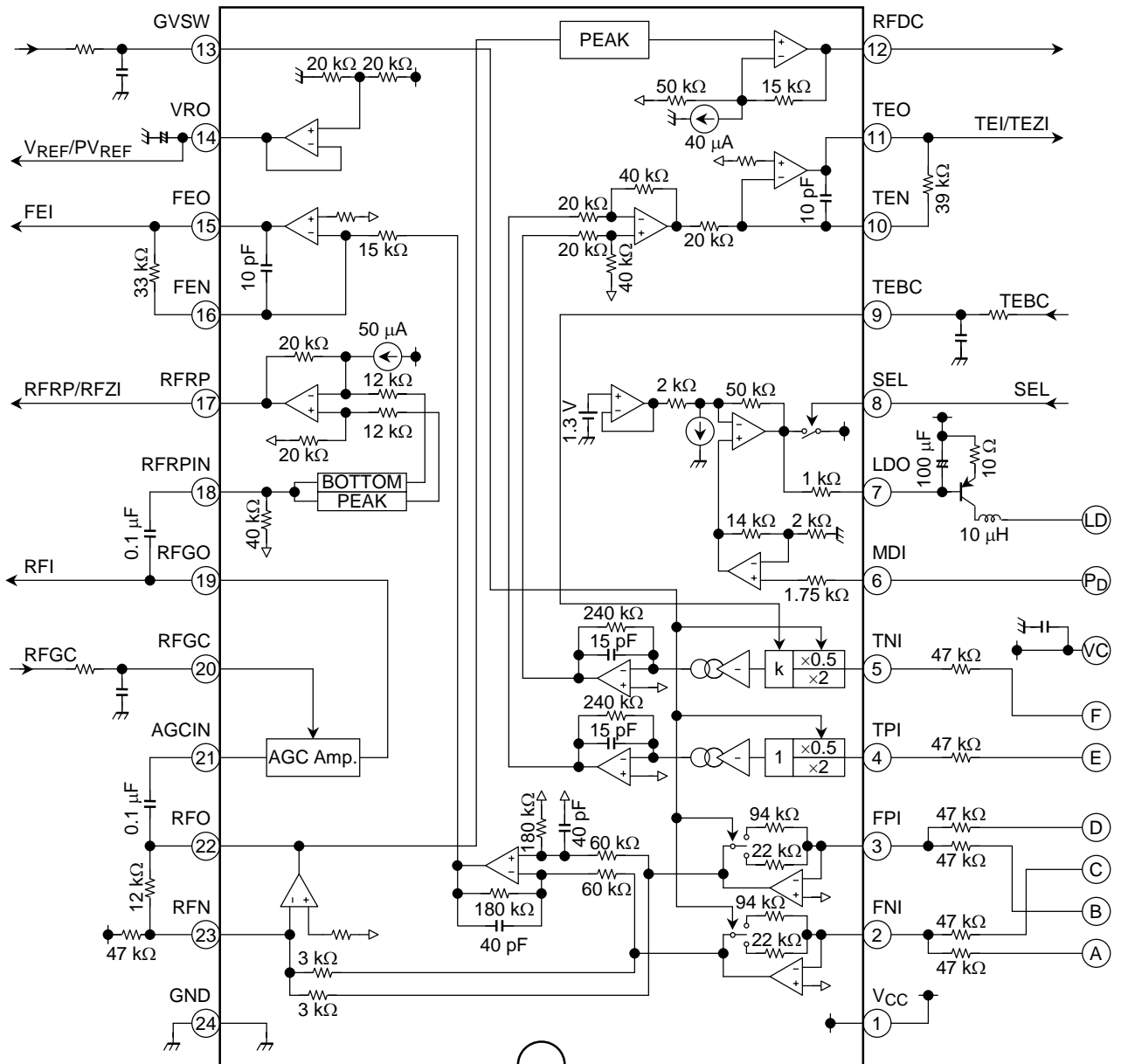


(2) Detection time constant

Specify the time constant for peak and bottom detection frequencies when the square wave shown in the figure below is input via a capacitor ( $C_{in} > 1 \mu F$ ) to the RFRPIN pin at the slew rate of the RFRP pin output sawtooth wave.



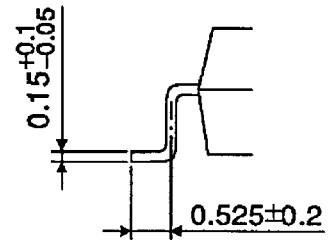
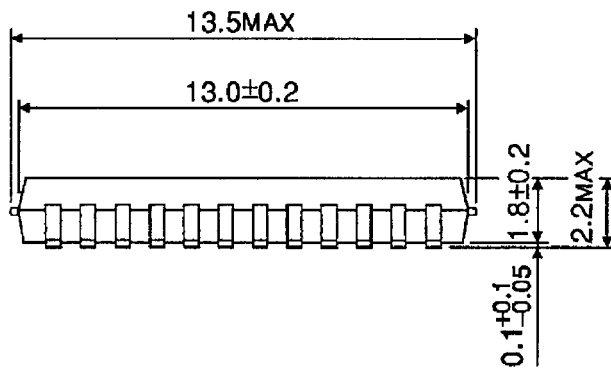
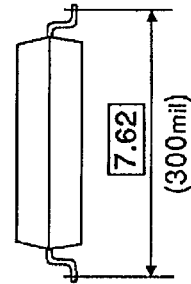
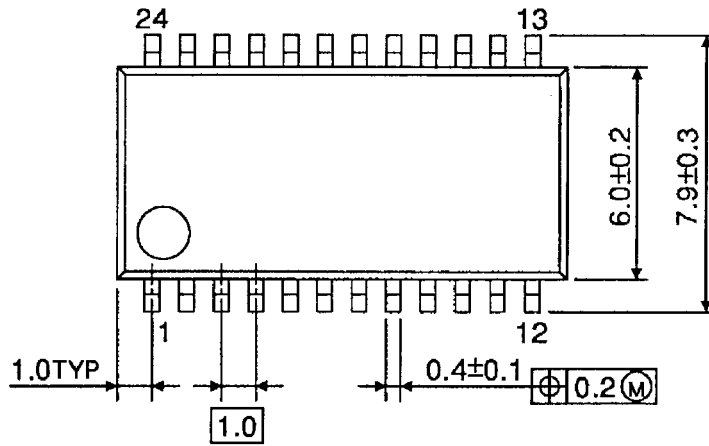
## Test Circuit



## Package Dimensions

SSOP24-P-300-1.00

Unit : mm

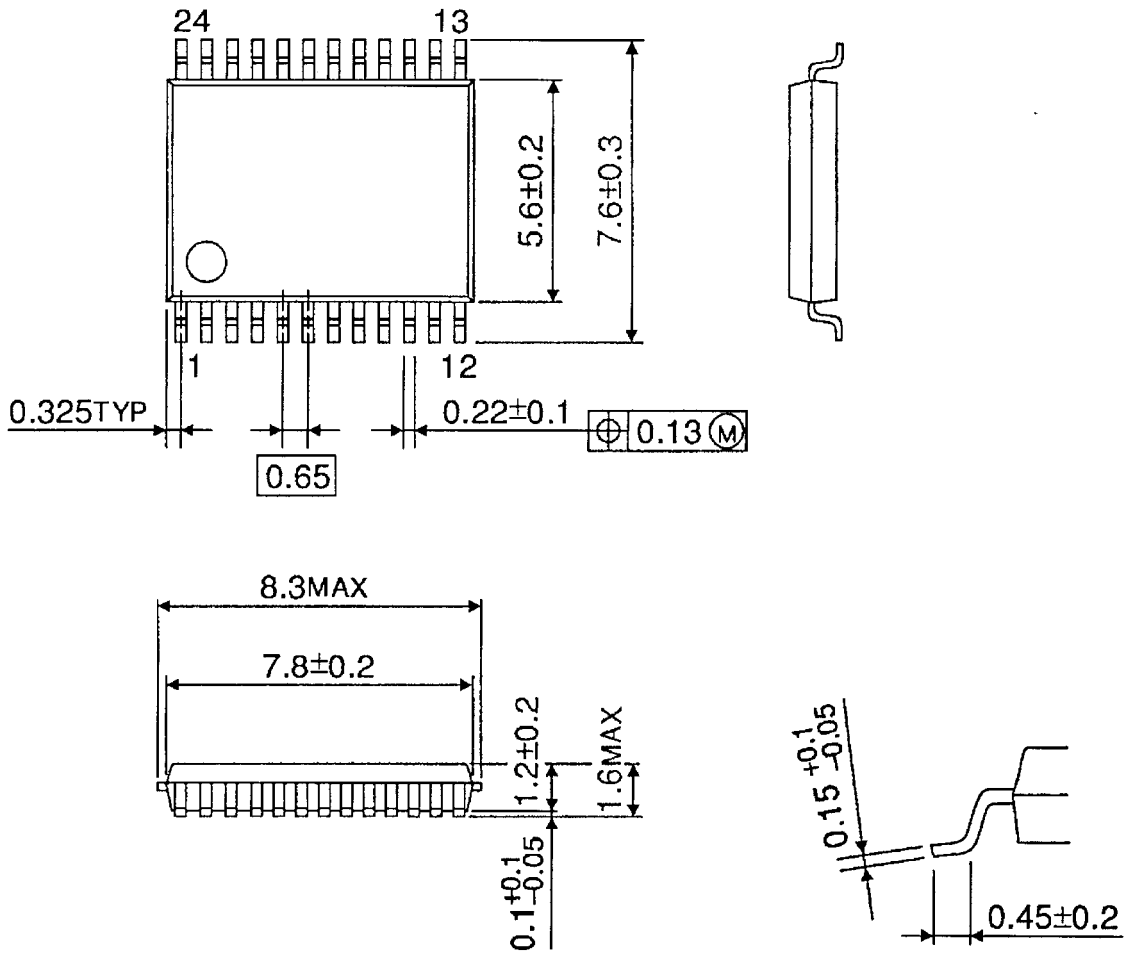


Weight: 0.3 g (typ.)

**Package Dimensions**

SSOP24-P-300-0.65A

Unit : mm



Weight: 0.17 g (typ.)

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000707EBA

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