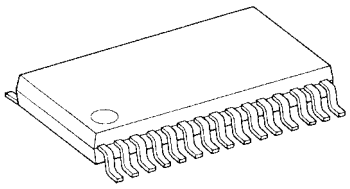
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA2151FN

RF Amplifier for Digital Servo CD System

TA2151FN is a 3-beam type PUH compatible RF Amplifier for Digital Servo to be used in the CD system.

In combination with a CMOS single chip processor TC9462F/TC9495F, a CD system can be composed very simply.

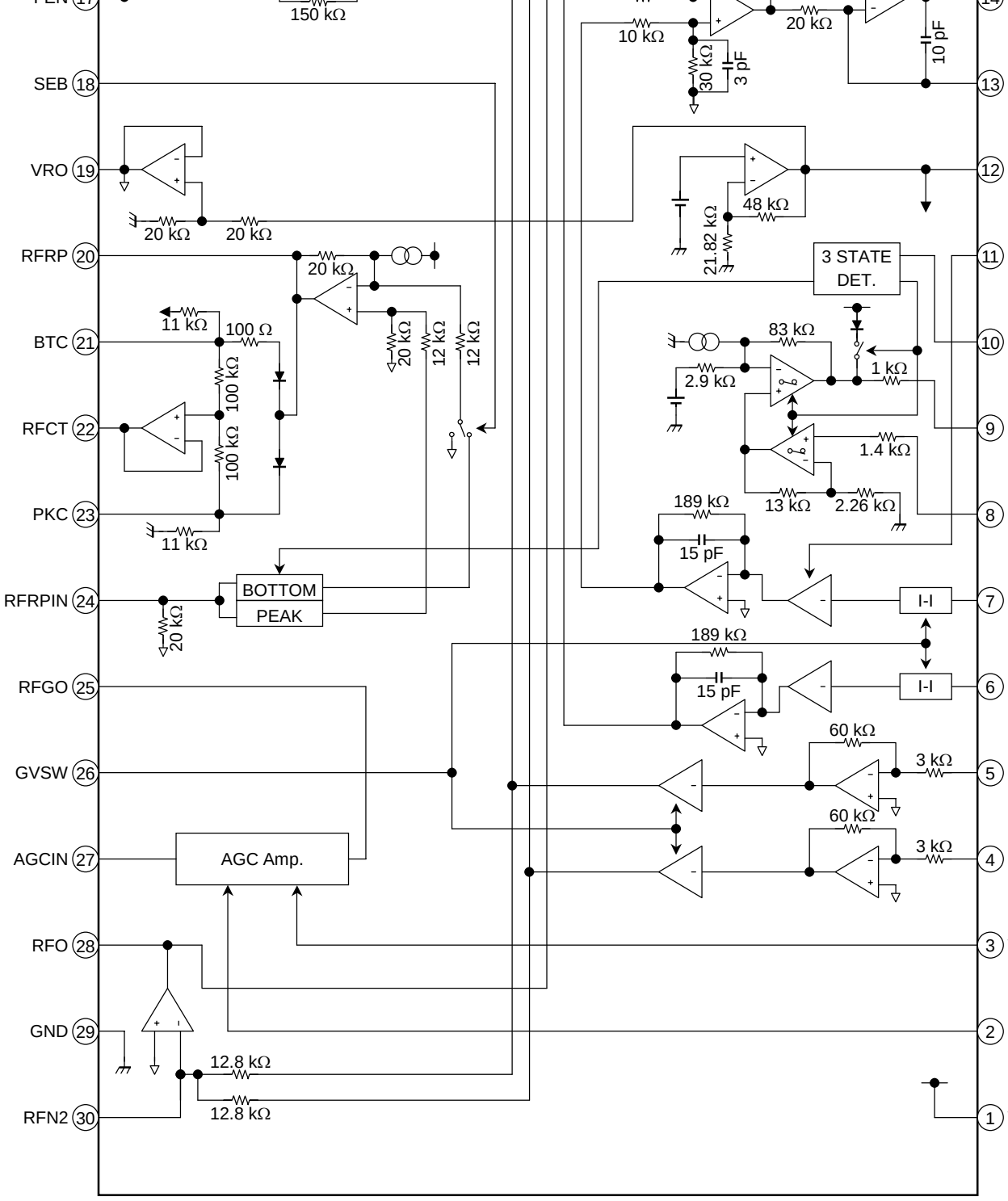


SSOP30-P-300-0.65

Weight: 0.17 g (typ.)

Features

- Built-in amplifier for reference (VRO, 2VRO) supply.
- Built-in Auto Laser Power Control circuit.
- Built-in RF amplifier.
- Built-in AGC amplifier.
- Built-in focus error amp and tracking error amp.
- Built-in gain change circuit for CD-RW.
- Capable of tracking balance control with TC9462F/TC9495F.
- Built-in signal amplifier for track counter.
- Capable of 4 times speed operation.
- 30 pin mini flat package.



SEL	LDC			RFRP Detect Frequency
	SW1	SW2	SW3	
GND	ON	OFF	OFF	Low
HiZ	OFF	ON	ON	
V_{CC}				High

GVSW	Mode
GND	CD-RW
HiZ	Normal
V_{CC}	

SEB	Bottom Detect
GND	ON
HiZ	
V_{CC}	OFF

Pin Function

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>I/O</th><th>Functional Description</th><th>Remarks</th></tr>
<tr><td>1</td><td>V_{CC}</td><td>—</td><td>Power supply input terminal.</td><td>—</td></tr>
<tr><td>2</td><td>RFGC</td><td>I</td><td>RF amplitude adjustment control signal input terminal.
Controlled by 3-PWM signals.
(PWM carrier = 88.2 kHz)
RFGC input voltage: VRO ± 1.5 V
AGC amplifier voltage again: ×0.7~1.5 (typ.)</td><td>—</td></tr>
<tr><td>3</td><td>VRIN</td><td>I</td><td>AGC amp. Reference voltage input terminal.</td><td>Connected to VRO</td></tr>
<tr><td>4</td><td>FNI</td><td>I</td><td>Main beam I-V amp input terminal.</td><td>Connected to pin diode output B + D (through resistor).</td></tr>
<tr><td>5</td><td>FPI</td><td>I</td><td>Main beam I-V amp input terminal.</td><td>Connected to pin diode output A + C (through resistor).</td></tr>
<tr><td>6</td><td>TPI</td><td>I</td><td>Sub beam I-V amp input terminal.</td><td>Connected to pin diode output F.</td></tr>
<tr><td>7</td><td>TNI</td><td>I</td><td>Sub beam I-V amp input terminal.</td><td>Connected to pin diode output E.</td></tr>
<tr><td>8</td><td>MDI</td><td>I</td><td>Monitor photo diode amp input terminal.</td><td>Connected to monitor photo diode.</td></tr>
<tr><td>9</td><td>LDO</td><td>O</td><td>Laser diode amp input terminal.</td><td>Connected to laser diode control circuit.</td></tr>
<tr><td>10</td><td>SEL</td><td>I</td><td>Laser diode control signal input terminal and APC circuit ON/OFF control signal terminal.
<table>
<tr><th>SEL Level</th><th>APC Circuit</th><th>LDO</th><th>Detect Frequency</th></tr>
<tr><td>GND</td><td>OFF</td><td>Connected to V_{CC} through resister (1 kΩ)</td><td rowspan="2">Low</td></tr>
<tr><td>HiZ</td><td rowspan="2">ON</td><td rowspan="2">Control signal output</td></tr>
<tr><td>V_{CC}</td><td>High</td></tr>
</table></td><td>3 signals input.
(V_{CC}, HiZ, GND)</td></tr>
<tr><td>11</td><td>TEB</td><td>I</td><td>Tracking error balance adjustment signal input terminal.
Controlled by 3-PWM signal.
(PWM carrier = 88.2 kHz)</td><td>3 signals input.
(2VRO, VRO, GND)</td></tr>
<tr><td>12</td><td>2VRO</td><td>O</td><td>Reference voltage (2VRO) output terminal.
2VRO = 4.2 V when V_{CC} = 5 V</td><td>—</td></tr>
<tr><td>13</td><td>TEN</td><td>I</td><td>TE amp negative input terminal.</td><td>Connected to TEO through feedback resistor.</td></tr>
<tr><td>14</td><td>TEO</td><td>O</td><td>TE error signal output terminal.</td><td>—</td></tr>
<tr><td>15</td><td>RFDC</td><td>O</td><td>RF signal peak detect output terminal.</td><td>—</td></tr>
<tr><td>16</td><td>FEO</td><td>O</td><td>Focus error signal output terminal.</td><td>—</td></tr>
<tr><td>17</td><td>FEN</td><td>I</td><td>FE amp negative input terminal.</td><td>Connected to FEO through feedback resistor.</td></tr>
<tr><td>18</td><td>SEB</td><td>I</td><td>RFRP output circuit switching terminal.
<table>
<tr><th>SEB Level</th><th>Bottom Detection</th><th>Peak Detection</th></tr>
<tr><td>GND</td><td>ON</td><td rowspan="2">ON</td></tr>
<tr><td>V_{CC}</td><td>OFF</td></tr>
</table></td><td>Low (GND) is for normal use.</td></tr>
<tr><td>19</td><td>VRO</td><td>O</td><td>Reference voltage (VRO) output terminal.
VRO = 2.1 V when V_{CC} = 5 V</td><td>—</td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>I/O</th><th>Functional Description</th><th>Remarks</th></tr>
<tr><td>20</td><td>RFRP</td><td>O</td><td>Track count signal output terminal.</td><td>—</td></tr>
<tr><td>21</td><td>BTC</td><td>I</td><td>Time constant adjustment terminal for bottom detection.</td><td>Adjusted by capacitance.</td></tr>
<tr><td>22</td><td>RFCT</td><td>O</td><td>RFRP signal center level output terminal.</td><td>—</td></tr>
<tr><td>23</td><td>PKC</td><td>I</td><td>Time constant adjustment terminal for peak detection.</td><td>Adjusted by capacitance.</td></tr>
<tr><td>24</td><td>RFRPIN</td><td>I</td><td>Input terminal for track count signal output amp.</td><td>—</td></tr>
<tr><td>25</td><td>RFGO</td><td>O</td><td>Output terminal for RF signal amplitude adjustment amp.</td><td>—</td></tr>
<tr><td>26</td><td>GVSW</td><td>I</td><td>Amp (FE, TE) gain switching terminal.
<table><tr><th>GVSW</th><th>Mode</th></tr><tr><td>GND</td><td>CD-RW</td></tr><tr><td>HiZ</td><td rowspan="2">Normal</td></tr><tr><td>V_{CC}</td></tr></table></td><td>Low (GND) is for 5 times gain.</td></tr>
<tr><td>27</td><td>AGCIN</td><td>I</td><td>Input terminal for RF signal amplitude adjustment amp.</td><td>Connected to RFO through capacitance.</td></tr>
<tr><td>28</td><td>RFO</td><td>O</td><td>Output terminal for RF signal amp.</td><td>—</td></tr>
<tr><td>29</td><td>GND</td><td>—</td><td>Ground terminal.</td><td>—</td></tr>
<tr><td>30</td><td>RFN2</td><td>I</td><td>Input terminal for RF signal amp.</td><td>—</td></tr>
</table>

Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	8	V
Power dissipation	P_D	500	mW
Operating temperature	T_{opr}	−40~85	°C
Storage temperature	T_{stg}	−55~150	°C

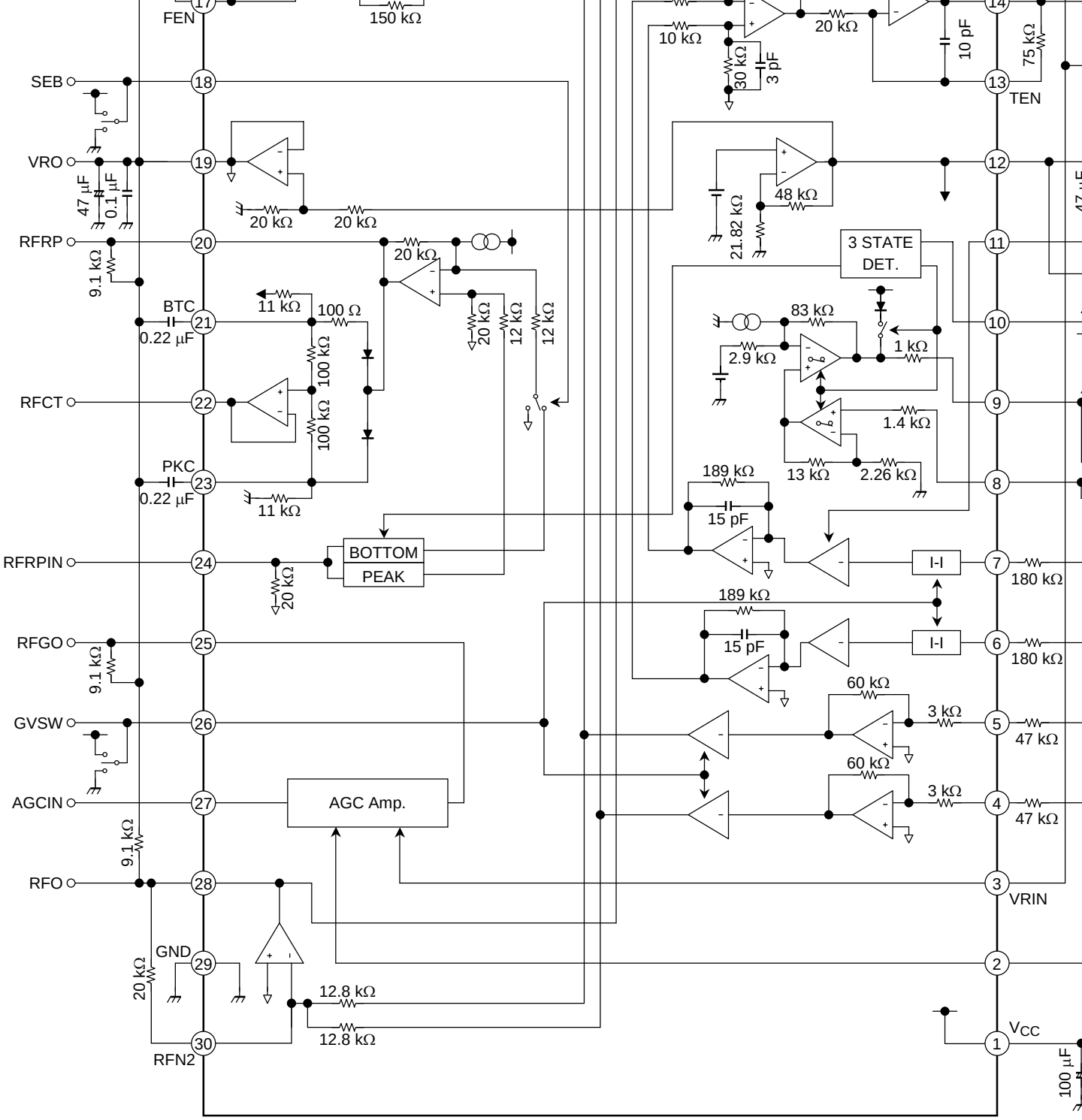
Electrical Characteristics
(unless otherwise specified, V_{CC} = 5 V, Ta = 25°C, RFGC = V_{CC}, GVSW = V_{CC})

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Power supply	Assured power supply voltage	V_{CC}	—	—		4.5	5.0	5.5	V
	Power supply current 1 (normal mode)	$I_{CC}1$	—	SEL = HiZ REGC = HiZ	GVSW = V_{CC}	23	33	43	mA
	Power supply current 2 (CD-RW mode)	$I_{CC}2$			GVSW = GVD				
Reference voltage (2VRO)	Reference voltage	2VR	—	—		4.0	4.2	4.4	V
	Output current	I_{OH2}	—	ΔV = −0.2 V		2.0	—	—	mA
	Input current	I_{OL2}		ΔV = +0.1 V		0.1	—	—	
Reference voltage (VRO)	Reference voltage	VR	—	—		2.0	2.1	2.2	V
	Reference voltage limit	ΔVR	—	2 × VR/2VR − 1		−3.0	0.0	—	%
	Output current	I_{OH1}	—	ΔV = −0.2 V		5.0	—	—	mA
	Input current	I_{OL1}		ΔV = +0.1 V		5.0	—	—	
RF1	Transfer resistance1 (normal mode)	R_{T1}	—	f = 100 kHz Rf = 20 kΩ	GVSW = V_{CC}	153	180	207	kΩ
	Transfer resistance2 (CD-RW mode)	R_{T2}			GVSW = GND	690	812	934	
	Frequency band width1 (normal mode)	fc1	—	−3dB point Rf = 20 kΩ	GVSW = V_{CC}	—	8	—	MHz
	Frequency band width2 (CD-RW mode)	fc2			GVSW = GND	—	8	—	
	Output slew rate	SR	—	C_{RFO} = 20 pF		—	20	—	V/μs
	Output offset voltage 1 (normal mode)	V_{OS1}	—	VR Reference Rf = 20 kΩ Input: Open	GVSW = V_{CC}	—	−50	—	mV
	Output offset voltage 2 (CD-RW mode)	V_{OS2}			GVSW = GND	—	−100	—	
	Upper limit output voltage	V_{OH}	—	GND Reference		3.8	—	—	V
	Lower limit output voltage	V_{OL}				—	—	0.9	
	Permissive load resistance	R_{LM}	—	—		10	—	—	kΩ
RF2 (AGC)	Lower limit voltage gain	G_{VL}	—	f = 100 kHz	RFGC = 0.6 V	0.6	0.7	0.8	V/V
	Upper limit voltage gain	G_{VH}			RFGC = 3.6 V	1.3	1.5	1.7	
	Frequency band width	fc	—	−3dB point		—	20	—	MHz
	Output slew rate	SR	—	C_{RFO} = 20 pF		—	20	—	V/μs
	Output offset voltage	V_{OS}	—	VR Reference, Input: Open		—	100	—	mV
	Upper limit output voltage	V_{OH}	—	GND Reference		3.8	—	—	V
	Lower limit output voltage	V_{OL}				—	—	0.9	
	Permissive load resistance	R_{LM}	—	—		10	—	—	kΩ
APC	Voltage gain	Gv	—	f = 1 kHz		—	200	—	V/V
	Operation ref. Voltage	V_{MDI}	—	V_{LDO} = 3.5 V_{DC}		170	178	192	mV
	LD off voltage	V_{LDOP}	—	SEL = GND, V_{CC} Reference		−0.7	—	—	V
	Input bias current	I_I	—	MDI = 178 mV		−200	—	200	nA

Characteristics			Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
FE	Transfer resistance 1 (normal mode)		R_{T1}	—	f = 1 kHz R_{NF} = 91 kΩ	GVSW = V_{CC}	197	232	267	kΩ
	Transfer resistance 2 (CD-RW mode)		R_{T2}			GVSW = GND	0.89	1.05	1.20	MΩ
	Gain balance 1 (normal mode)		GB1	—	f = 1 kHz R_{NF} = 91 kΩ	GVSW = V_{CC}	−1.0	—	1.0	dB
	Gain balance 2 (CD-RW mode)		GB2			GVSW = GND	−1.0	—	1.0	
	Frequency band width1 (normal mode)		fc1	—	−3dB point R_{NF} = 91 kΩ	GVSW = V_{CC}	—	26.5	—	kHz
	Frequency band width2 (CD-RW mode)		fc2			GVSW = GND	—	26.5	—	
	Output offset voltage 1 (normal mode)		V_{OS1}	—	R_{NF} = 91 kΩ VR Reference	GVSW = V_{CC}	−20	—	20	mV
	Output offset voltage 2 (CD-RW mode)		V_{OS2}			GVSW = GND	−50	—	50	
	Upper limit output voltage		V_{OH}	—	GND Reference		3.8	—	—	V
	Lower limit output voltage		V_{OL}				—	—	0.5	
	Permissive load resistance		R_{LM}	—	—		10	—	—	kΩ
TE	Transfer resistance 1 (normal mode)		R_{T1}	—	f = 1 kHz R_{NF} = 75 kΩ TEB = HiZ	GVSW = V_{CC}	1.81	2.13	2.45	MΩ
	Transfer resistance 2 (CD-RW mode)		R_{T2}			GVSW = GND	8.15	9.59	11.02	
	Voltage gain adjustable range	max voltage ratio	ΔGv	—	T_{NI} input R_{NF} = 75 kΩ TEB = VR Reference	TEB = GND	—	45	—	%
		min voltage ratio				TEB = 2VR	—	−45	—	
	Gain balance 1 (normal mode)		GB1	—	f = 1 kHz R_{NF} = 75 kΩ TEB = VR	GVSW = V_{CC}	−1.0	—	1.0	dB
	Gain balance 2 (CD-RW mode)		GB2			GVSW = GND	−1.0	—	1.0	
	Frequency band width1 (normal mode)		fc1	—	−3dB point R_{NF} = 75 kΩ	GVSW = V_{CC}	—	44	—	kHz
	Frequency band width2 (CD-RW mode)		fc2			GVSW = GND	—	44	—	
	Output offset voltage 1 (normal mode)		V_{OS1}	—	R_{NF} = 75 kΩ VR Reference	GVSW = V_{CC}	−80	—	80	mV
	Output offset voltage 2 (CD-RW mode)		V_{OS2}			GVSW = GND	−300	—	300	
	Upper limit output voltage		V_{OH}	—	GND Reference		3.8	—	—	V
	Lower limit output voltage		V_{OL}				—	—	0.5	
	Permissive load resistance		R_{LM}	—	—		10	—	—	kΩ
RFDC FNI (FPI) → RFDC	Detection frequency		f_C	—	—		—	40	—	kHz
	Upper limit output voltage		V_{OH}	—	GND Reference		3.3	—	—	V
	Lower limit output voltage		V_{OL}				—	—	0.9	
	Permissive load resistance		R_{LM}	—	—		10	—	—	kΩ

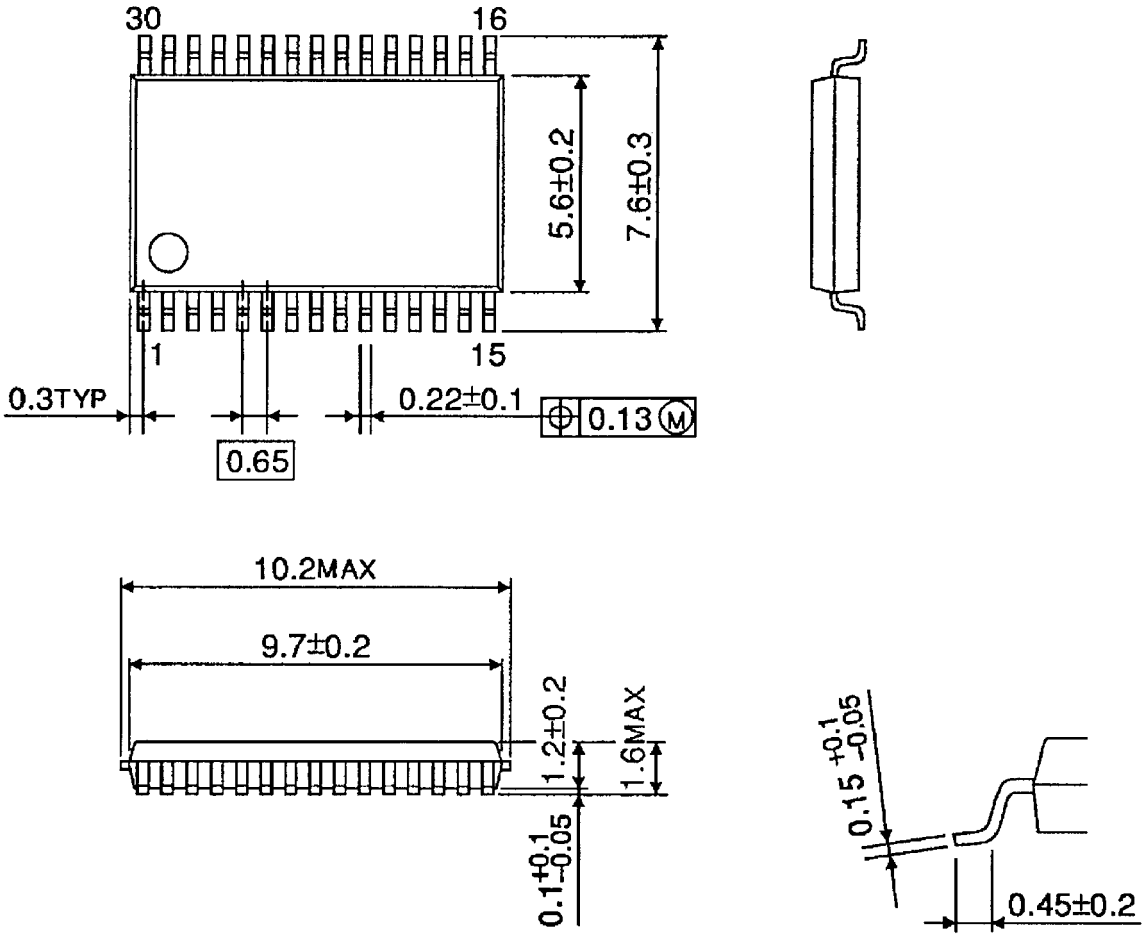
Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
RFRP	Voltage gain	Gv	—	—	—	1.7	—	V/V
	Detection frequency characteristic 1	fc1	—	SEL = HiZ	—	100	—	kHz
	Detection frequency characteristic 2	fc2		SEL = V_{CC}	—	200	—	
	Operation reference voltage 1	V_{OPR1}	—	VR Reference No Input	−1.1	−1.0	−0.9	V
	Operation reference voltage 2	V_{OPR2}		VR Reference 700 kHz, 1.2 Vp-p	0.7	0.8	0.9	
	Permissive load resistance	R_{LM}	—	—	10	—	—	kΩ
RFCT	Detection frequency characteristic 1	fc1	—	C_{BTC} = 0.22 μF	—	70	—	Hz
RFRP →RFCT	Detection frequency characteristic 2	fc2		C_{PKC} = 0.22 μF	—	70	—	
	Output offset voltage	V_{OS}	—	RFRP Reference, RFCT	−50	—	50	mV

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


FEN
150 kΩ
SEB
VRO
47 µF
0.1 µF
20 kΩ
20 kΩ
RFRP
9.1 kΩ
BTC
0.22 µF
11 kΩ
100 Ω
100 kΩ
100 kΩ
20 kΩ
20 kΩ
12 kΩ
12 kΩ
RFCT
PKC
0.22 µF
11 kΩ
RFRPIN
20 kΩ
BOTTOM
PEAK
RFGO
9.1 kΩ
GVSW
AGCIN
AGC Amp.
9.1 kΩ
RFO
GND
20 kΩ
12.8 kΩ
12.8 kΩ
RFN2
10 kΩ
30 kΩ
3 pF
20 kΩ
10 pF
75 kΩ
TEN
48 kΩ
21.82 kΩ
3 STATE
DET.
83 kΩ
2.9 kΩ
1 kΩ
1.4 kΩ
13 kΩ
2.26 kΩ
189 kΩ
15 pF
I-I
180 kΩ
189 kΩ
15 pF
I-I
180 kΩ
60 kΩ
3 kΩ
47 kΩ
60 kΩ
3 kΩ
47 kΩ
VRIN
VCC
100 µF
17
18
19
20
21
22
23
24
25
26
27
28
29
30
14
13
12
11
10
9
8
7
6
5
4
3
2
1

Package Dimensions

SSOP30-P-300-0.65 Unit : mm



Weight: 0.17 g (typ.)

RESTRICTIONS ON PRODUCT USE

000707EBA

- TOSHIBA is continually working to improve the quality and 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 comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products 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 TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer’s own risk.
- 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.