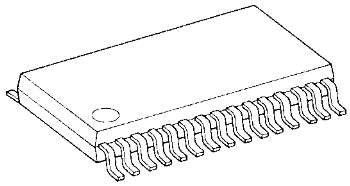
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA2154AFN

1.5 V 1 Chip Tuner IC (for Digital Tuning System)

TA2154AFN is developed for 1.5 V headphone stereos. It incorporates all the functions of an FM/TV front end, AM/FM IF, and FM multiplex.

The IC can be used for IF count digital tuning systems. Since the IC divides the buffer output frequency by 16 while suppressing the FM/TV local oscillation level, the IC can suppress unnecessary emission, facilitating conformance to the new FCC specifications (part 15).

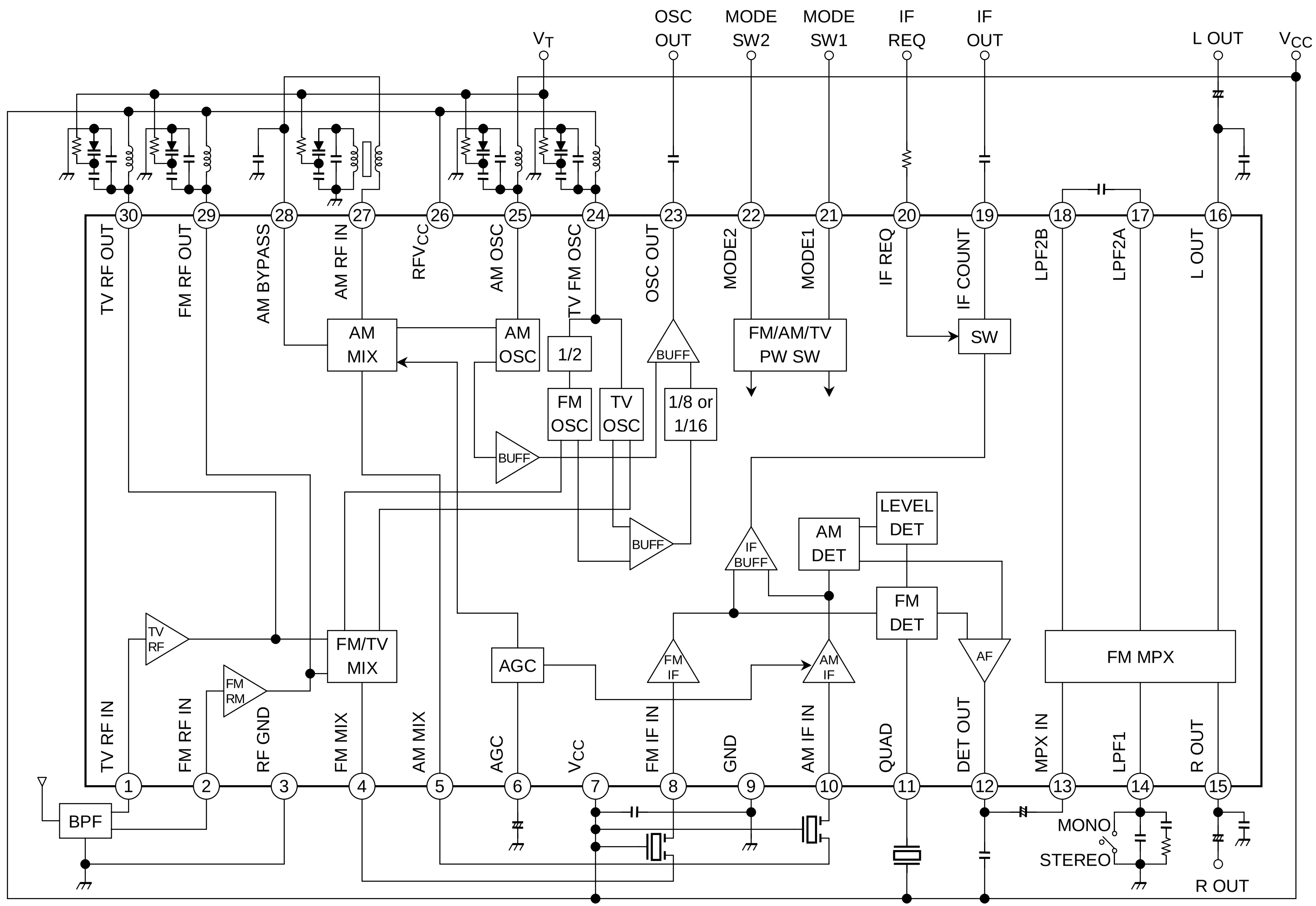


Weight: 0.17 g (typ.)

Features

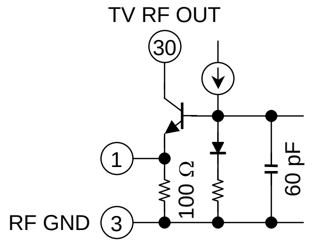
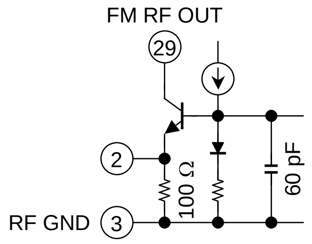
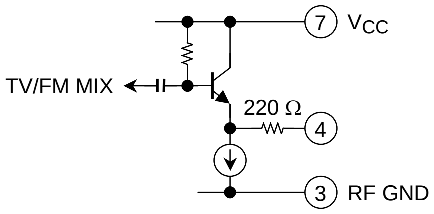
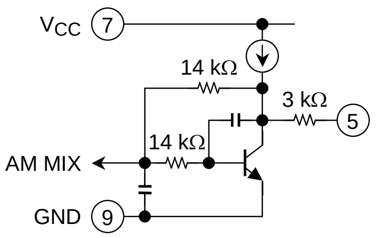
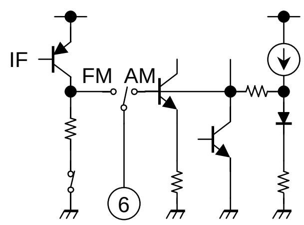
- FM/TV local oscillator level is low (Built-in auto level control circuit)
- Suitable for combination with digital tuning system, which is included IF counter.
- One terminal type AM/FM IF count output for IF counter of digital tuning system.
  - AM: 450 kHz
  - FM: 10.7 MHz
- One terminal type FM/TV local oscillator.
- Local oscillator buffer output terminal shared by AM, FM and TV
  - AM: 1/1
  - FM: 1/32
  - TV: 1/8
- For adopting ceramic discriminator, it is not necessary to adjust the FM quad detector circuit.
- Built-in FM MPX VCO circuit.
- Low supply current (V_{CC} = 1.2 V, Ta = 25°C)
  I_{ccq} (AM) = 5.0 mA (typ.)
  I_{ccq} (FM) = 13.0 mA (typ.)
  I_{ccq} (TV) = 13.5 mA (typ.)
- Operating supply voltage: V_{CC} = 1.0~2.2 V (Ta = 25°C)
- Monaural operating supply voltage: V_{CC} = 0.95~2.2 V (Ta = 25°C)

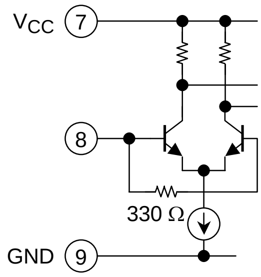
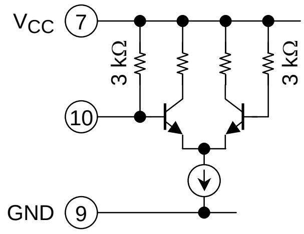
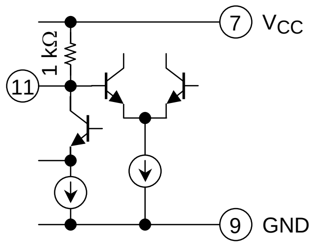
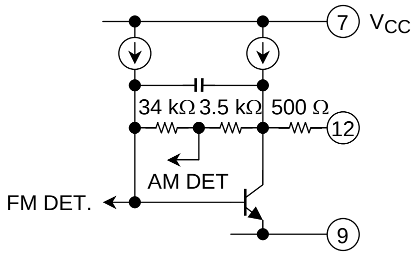
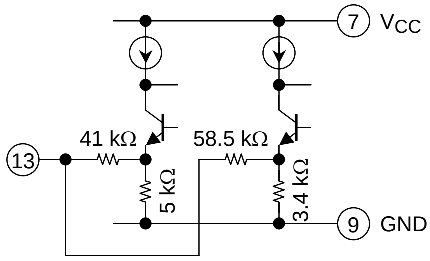
Block Diagram

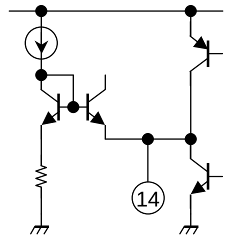
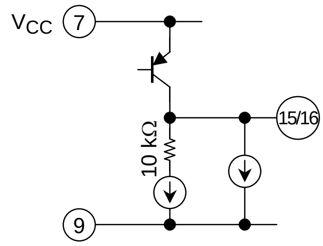
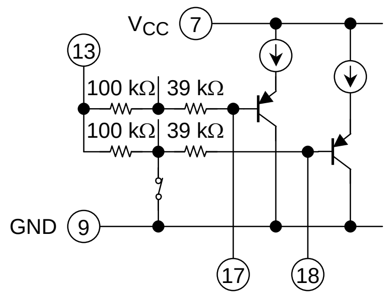
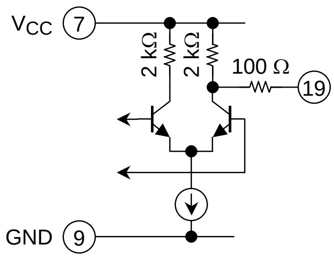
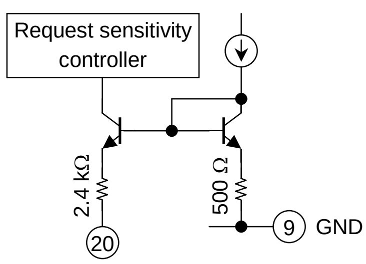


Explanation of Terminals

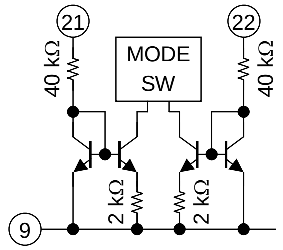
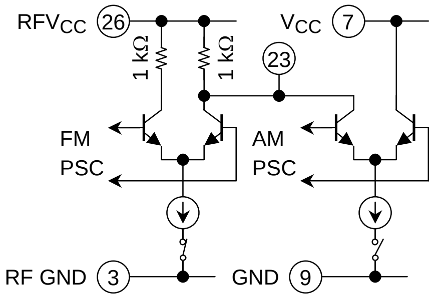
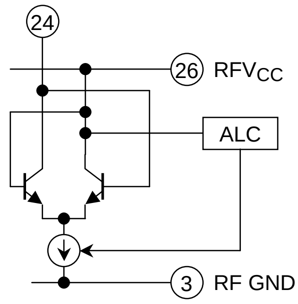
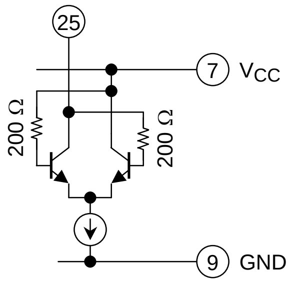
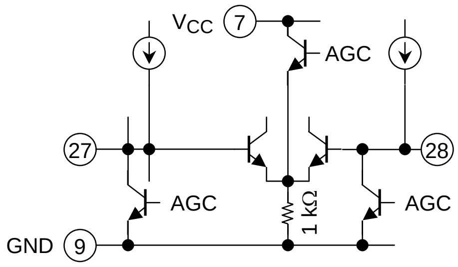
Terminal voltage: Typical terminal voltage at no signal with the test circuit (V_{CC} = 1.2 V, Ta = 25°C)

Pin No.	Name	Function	Internal Circuit	Terminal Voltage		
				AM	FM	TV
1	TV RF IN	Input of TV RF signal		0	0	0.1
2	FM RF IN	Input of FM RF signal		0	0.1	0
3	RF-GND	GND (GND for TV/FM stage)	—	0	0	0
4	FM MIX	Output of TV/FM signal		—	0.5	0.5
5	AM MIX	Output of AM IF signal		0.6	—	—
6	AGC	AGC • AGC time constant is determined by external capacitor		0	0	0
7	V_{CC}	V_{CC} (V_{CC} for AM, FM IF, MPX stage)	—	1.2	1.2	1.2

Pin No.	Name	Function	Internal Circuit	Terminal Voltage		
				AM	FM	TV
8	FM IF IN	Input of FM IF signal Input impedance: 330 Ω (typ.)		—	0.7	0.7
9	GND	GND (GND for AM, FM IF, MPX stage)	—	0	0	0
10	AM IF IN	Input of AM IF signal Input impedance: 3 kΩ (typ.)		1.2	1.2	1.2
11	QUAD	FM QUAD detector		1.2	1.1	1.1
12	DET OUT	Detector output Output impedance AM: 4 kΩ (typ.) FM: 500 Ω (typ.)		0.6	0.8	0.8
13	MPX IN	Input of MPX		0.1	0.1	0.1

Pin No.	Name	Function	Internal Circuit	Terminal Voltage AM	Terminal Voltage FM	Terminal Voltage TV
14	LPF1	LPF terminal for PLL phase detection. Connecting this terminal to GND sets the IC to forced Monaural mode.		—	—	—
15	R OUT	Output of Stereo signal		0.5	0.5	0.5
16	L OUT					
17	LPF2A	LPF terminals for synchronous detector		—	—	—
18	LPF2B			—	—	—
19	IF COUNT	Output of IF count signal AM: 450 kHz FM: 10.7 MHz		1.2	1.2	1.2
20	IF REQ	IF request switch		—	—	—

<table>
<tr><th rowspan="2">Pin No.</th><th rowspan="2">Name</th><th rowspan="2">Function</th><th rowspan="2">Internal Circuit</th><th colspan="3">Terminal Voltage</th></tr>
<tr><th>AM</th><th>FM</th><th>TV</th></tr>
<tr><td>21</td><td>MODE1</td><td rowspan="2">Mode switch

| | MODE1 | MODE2 |
Standby: OPEN OPEN
AM: OPEN V_{CC}
FM: V_{CC} OPEN
TV: V_{CC} V_{CC}</td><td rowspan="2"></td><td>—</td><td>1.2</td><td>1.2</td></tr>
<tr><td>22</td><td>MODE2</td><td>1.2</td><td>—</td><td>1.2</td></tr>
<tr><td>23</td><td>OSC OUT</td><td>Local oscillation buffer output</td><td></td><td>1.0</td><td>1.0</td><td>1.0</td></tr>
<tr><td>24</td><td>TV/FM OSC</td><td>TV/FM OSC</td><td></td><td>1.2</td><td>1.2</td><td>1.2</td></tr>
<tr><td>25</td><td>AM OSC</td><td>AM OSC</td><td></td><td>1.2</td><td>1.2</td><td>1.2</td></tr>
<tr><td>26</td><td>RFV$_{CC}$</td><td>V_{CC} for TV/FM F/E stage</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>27</td><td>AM RF IN</td><td>Input of AM RF signal</td><td rowspan="2"></td><td>0.9</td><td>—</td><td>—</td></tr>
<tr><td>28</td><td>AM BYPASS</td><td>Referential voltage bypass terminal for AM RF</td><td>0.9</td><td>—</td><td>—</td></tr>
<tr><td>29</td><td>FM RF OUT</td><td>FM RF turning circuit</td><td>Cf. pin 2</td><td>1.2</td><td>1.2</td><td>1.2</td></tr>
<tr><td>30</td><td>TV RF OUT</td><td>TV RF turning circuit</td><td>Cf. pin 1</td><td>1.2</td><td>1.2</td><td>1.2</td></tr>
</table>

Application Note

1. Mode switch

   The IC controls the mode using pins 21 and 22. Switch conditions by modes are as listed below:

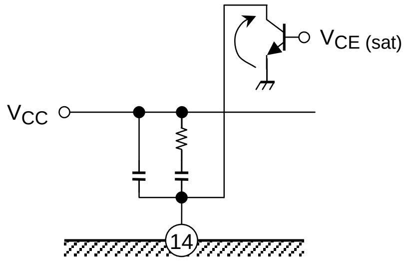
	MODE1 (pin 21)	MODE2 (pin 22)
Standby	OPEN	OPEN
AM	OPEN	V_{CC}
FM	V_{CC}	OPEN
TV	V_{CC}	V_{CC}

   To change mode, a 10 μA (typ.) current must flow from the IC to the pin connected to V_{CC}. When the pin is open, set the pin voltage to 0.2 V or less (typ.).

2. Forced monaural switch

   Forced monaural switch over is done by pin 14.

   In case of the electrical switch over by transistor, set up V_{CE} (saturation voltage between collector and emitter) 100 mV or less, otherwise there are some cases that it does not become forced monaural (VCO STOP) mode.



3. IF count output

   To output the signal for IF count, connect IF REQ (pin 20) to GND via R_{SEN} and input the IF count sensitivity or larger.

	Switch Condition			Output Frequency	Output Voltage	Output Impedance
	MODE1	MODE2	IF REQ			
AM	OPEN	V_{CC}	Grounded via R_{SEN}	450 kHz	180 mVp-p	2 kΩ
FM	V_{CC}	OPEN		10.7 MHz	190 mVp-p	
TV	V_{CC}	V_{CC}		10.7 MHz	190 mVp-p	

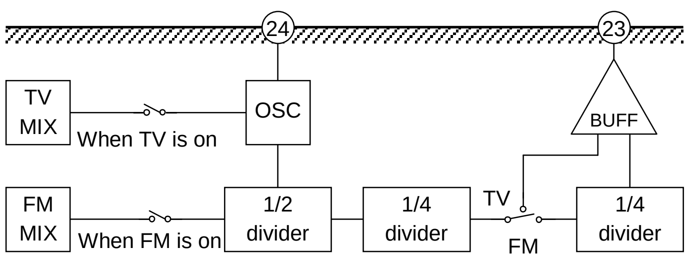
4. Constant of LPF

   Caputer range and Lock range is decided by constant of LPF, pin 14, 17, 18.

   Care should be taken in changing constant of LPF. Otherwise there are some cases that stereo characteristics may worse or IC may not operate stereo mode.

5. TV/FM local oscillator

   This IC uses the same oscillator for TV and FM. The circuit structure is shown below. In TV mode, the IC inputs the local oscillator frequency to the mixer as-is. In FM mode, the IC halves the local oscillator frequency then inputs it to the mixer. This is how the IC receives TV and FM band frequencies.



Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	4.5	V
Power dissipation	P_D (Note 2)	550	mW
Operating temperature	T_{opr}	−10~60	°C
Storage temperature	T_{stg}	−55~150	°C

Note 2: Derated above Ta = 25°C in the proportion of 4.4 mW/°C.

Electrical Characteristics

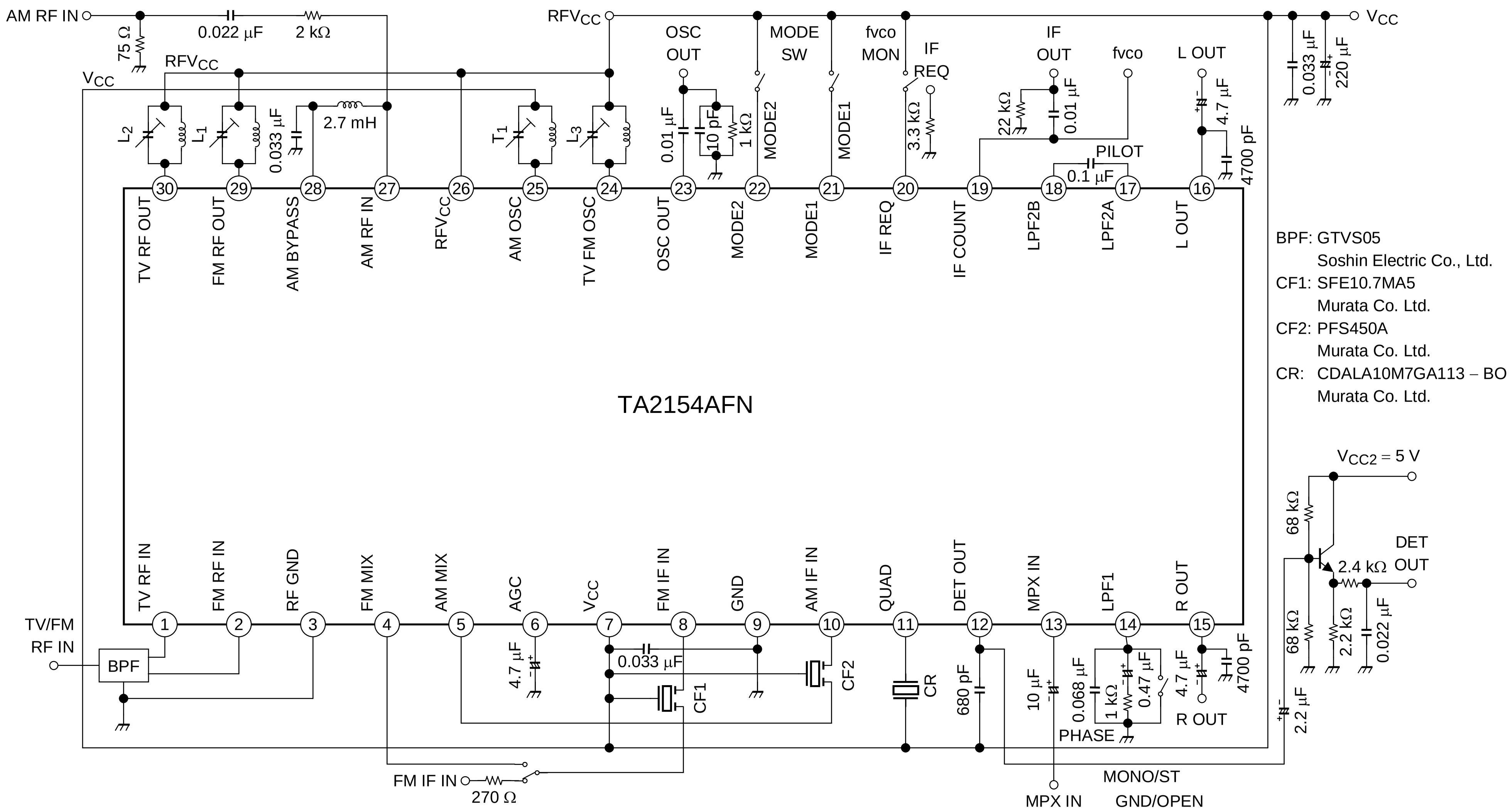
Unless otherwise specified

: V_{CC} = 1.2 V, Ta = 25°C, FM F/E: f = 98 MHz, f_m = 1 kHz, Δf = ±75 kHz, V_{in} = 60dBμV EMF
FM IF: f = 10.7 MHz, f_m = 1 kHz, Δf = ±75 kHz, V_{in} = 80dBμV EMF
AM: f = 1000 kHz, f_m = 1 kHz, MOD = 30%, V_{in} = 60dBμV EMF
MPX: f_m = 1 kHz, f_p = 19 kHz

Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Supply current		I_{CC1}	—	PW SW off			20	μA
		I_{CC2}	—	AM mode, V_{in} = 0		5.0	7	mA
		I_{CC3}	—	FM mode, V_{in} = 0		13.0	17	
		I_{CC4}	—	TV mode, V_{in} = 0		13.5	17	
FM F/E	Input limiting voltage	$V_{in\ (lim)}$	—	Point where detection output is −3dB with Vin = 60dBμV EMF as reference	—	12	—	dBμV EMF
	Local OSC buffer output voltage	V_{osc} (Buff) FM	—	f_{osc} = 6.79375 MHz (217.4 MHz divided by 32)	150	200	—	mVp-p
TV F/E	Input limiting voltage	$V_{in\ (lim)}$	—	Point where detection output is −3dB with V_{in} = 60dBμV EMF as reference		14		dBμV EMF
	Local oscillator buffer output	V_{osc} (Buff) TV	—	f_{osc} = 26.3375 MHz (210.7 MHz divided by 8)	150	200		mVp-p
FM IF	Input limiting voltage	$V_{in\ (lim)}$	—	Point where detection output is −3dB with V_{in} = 80dBμV EMF as reference	37	42	47	dBμV EMF
	Recovered output voltage	$V_{OD\ (FM)}$	—	—	115	140	180	mVrms
	Signal to noise ratio 1	S/N (FM)	—	—	—	73	—	dB
	Total harmonic distortion 1	THD (FM)	—	—	—	0.2	—	%
	AM rejection ration	AMR (FM)	—	MOD = 30%	—	62	—	dB
	IF count output voltage	$V_{IF\ (FM)}$	—	—	150	190	—	mVp-p
	IF count sensitivity	$IF_{SENS\ (FM)}$	—	R_{SEN} = 3.3 kΩ	48	53	58	dBμV EMF
AM	Gain	G_v	—	V_{in} = 32dBμV EMF	19	29	51	mVrms
	Recovered output voltage	$V_{OD\ (AM)}$	—	—	27	40	54	mVrms
	Signal to noise ratio 2	S/N (AM)	—	—	—	37	—	dB
	Total harmonic distortion 2	THD (AM)	—	—	—	13	—	%
	Local OSC buffer output voltage	V_{osc} (Buff) AM	—	f_{osc} = 14.5 MHz	130	180	—	mVp-p
	IF count output voltage	$V_{IF\ (AM)}$	—	—	140	180	—	mVp-p
	IF count sensitivity	$IF_{SENS\ (AM)}$	—	R_{SEN} = 3.3 kΩ	27	32	37	dBμV EMF

Characteristics			Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
MPX	Input resistance		R_{IN}	—	—		—	26	—	kΩ
	Output resistance		R_{OUT}	—	—		—	10	—	kΩ
	Voltage gain		G_V	—	V_{in} = 150 mVrms (MONO)		−2.5	−0.5	+1.5	dB
	Channel balance		C.B.	—	V_{in} = 150 mVrms (MONO)		−2.0	0	+2.0	dB
	Max composite signal input level		$V_{in\ (max)}$	—	L + R = 90%, P = 10%, THD = 3%		—	250	—	mVrms
	Separation		SEP.	—	L + R = 135 mVrms, P = 15 mVrms	f_m = 100 Hz	—	40	—	dB
						f_m = 1 kHz	30	40	—	dB
						f_m = 10 kHz	—	40	—	dB
	Total harmonic distortion	MONO	THD (MONO)	—	V_{in} = 150 mVrms (MONO)		—	0.2	—	%
		ST	THD (ST)	—	L + R = 135 mVrms, P = 15 mVrms		—	0.4	—	%
	ST indicator sensitivity	ON	ST (ON)	—	—		—	5.7	8.5	mVrms
		OFF	ST (OFF)	—	—		1.0	3.2	—	mVrms
	Stereo indicator hysteresis		V_H	—	To indicator turn OFF from turn ON		—	2.5	—	mVrms
	Capture range		C.R.	—	P = 15 mVrms		—	14	—	%
	Signal to noise ratio		S/N3	—	V_{in} = 150 mVrms (MONO)		—	70	—	dB

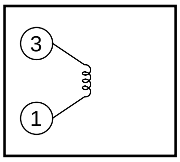
Test Circuit



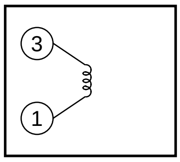
Coil Data

Coil	Test Frequency	L (μH)	Co (pF)	Q0	Turns				Wire (mmφ)	
					1-2	2-3	1-3	4-6		
L_1 FM RF	100 MHz	—	—	79	—	—	$2\frac{1}{2}$	—	0.16UEW	TOKO 666SNF-305NK
L_2 TV RF	100 MHz	—	—	73	—	—	$1\frac{1}{4}$	—	0.16UEW	TOKO 666SNF-381NK
L_3 TV/FM OSC	100 MHz	—	—	73	—	—	$1\frac{1}{4}$	—	0.16UEW	TOKO 666SNF-381NK
T_1 AM OSC	796 kHz	268	—	65	19	95	—	—	0.05UEW	TOKO 5PNR-4957Y

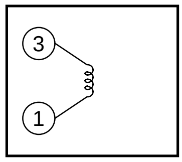
L_1: FM RF



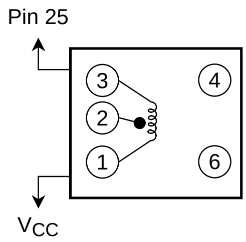
L_2: TV RF



L_3: TV/FM OSC



T_1: AM OSC



(BOTTOM VIEW)

Package Dimensions

Weight: 0.17 g (typ.)

RESTRICTIONS ON PRODUCT USE