



KOREA ELECTRONICS CO.,LTD.

SEMICONDUCTOR
TECHNICAL DATA

KIA6032AN/AF
BIPOLAR LINEAR INTEGRATED CIRCUIT

3V AM/FM IF+MPX
(for Digital Tuning System)

KIA6032AN/AF are the AM/FM IF+MPX system IC's, which are designed for DTS radios. These are included many functions and these can be used for digital tuning system with IF counter.

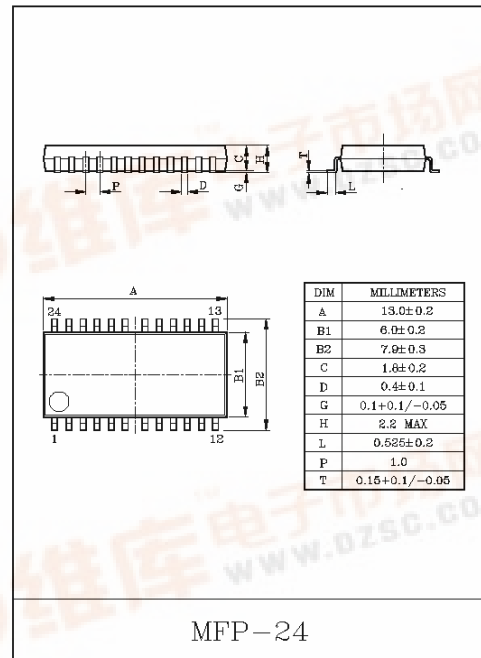
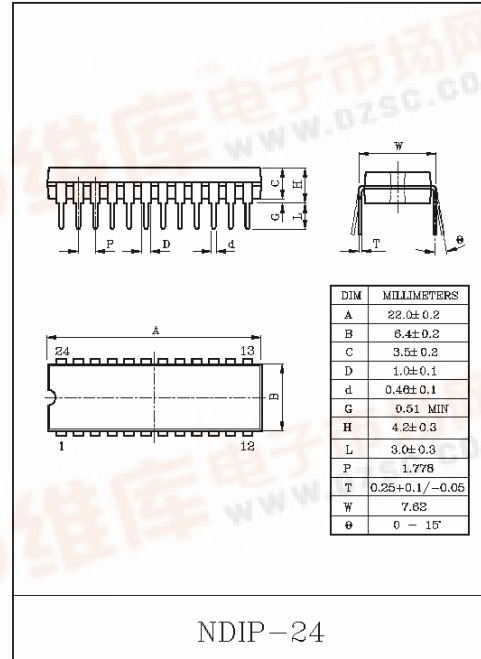
FEATURES

- Built-in AM/FM IF stereo PLL multiplex decoder.
- Suitable for combination with digital tuning system which is included IF counter.
 - : One terminal type AM/FM IF count output (auto stop signal) for IF counter of digital tuning system.
 - {FM : 10.7MHz Changeable by 1.3375MHz(1/8 dividing)} external switch
 - AM : 450kHz
 - : Built-in mute circuit for IF count output. It is controlled by the if request signal from digital tuning system.
 - pin ⑩ level : high → come out
 - low → non output
 - : Adjustable for IF count output sensitivity by external resistance of pin ②.
- For adopting ceramic discriminator and ceramic resonator, it is not necessary to adjust the FM quad detector circuit and MPX VCO circuit.
- Built-in one terminal type AM low cut circuit.
- Operating supply voltage range.
 - : V_{CC}=1.8~8.0V (Ta=25°C)

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Supply Voltage		V _{CC}	8	V
LED Current		I _{LED}	10	mA
LED Voltage		I _{LED}	8	V
Power Dissipation	KIA6032AN	P _D (Note)	1200	mW
	KIA6032AF		400	
Operating Temperature		T _{opr}	-25~75	°C
Storage Temperature		T _{stg}	-55~150	°C

Note : Derated above Ta=25°C in the proportion of 9.6mW/°C for KIA6032AN and of 3.2mW/°C for KIA6032AF



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ELECTRICAL CHARACTERISTICS

Unless otherwise specified, $T_a=25^{\circ}\text{C}$, $V_{CC}=3\text{V}$, $\text{SW}_1 \rightarrow 10\text{k}\Omega$, $\text{SW}_3 \rightarrow \text{OFF}$

FM IF: $f=10.7\text{MHz}$, $\Delta f = \pm 22.5\text{kHz}$, $f_m=1\text{kHz}$

AM: $f=1\text{MHz}$, $\text{Mod}=30\%$, $f_m=1\text{kHz}$, $\text{MPX}: f_m=1\text{kHz}$

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Supply Current		$I_{CC}(\text{FM})$	1	$V_{IN}=0$, FM Mode	-	11.0	14.0	mA	
		$I_{CC}(\text{AM})$	1	$V_{IN}=0$, AM Mode	-	10.5	13.5		
FM IF AM	Input Limiting Voltage	$V_{IN(\text{lim})}$	1	-3dB Limiting	41	46	51	dB μ	
	Recovered Output Voltage	V_{OD}	1	$V_{IN}=80\text{dB}\mu$	50	75	100	mV $_{\text{rms}}$	
	Signal to Noise Ratio	S/N	1	$V_{IN}=80\text{dB}\mu$	-	65	-	dB	
	Total Harmonic Distortion	THD	1	$V_{IN}=80\text{dB}\mu$	-	0.2	-	%	
	AM Rejection Ratio	AMR	1	$V_{IN}=80\text{dB}\mu$	-	38	-	dB	
	LED ON Sensitivity	V_L	1	$I_L=1\text{mA}$	48	53	58	dB μ	
	IF Count Output Frequency	IF	$f_{IF(\text{FM})}$	1	$V_{IN}=80\text{dB}\mu$, $\text{SW}_2 \rightarrow V_{CC}$, $\text{SW}_3 \rightarrow \text{ON}$	-	10.7	-	MHz
		1/8 IF	$f_{1/8\text{IF}(\text{FM})}$	1	$V_{IN}=80\text{dB}\mu$, $\text{SW}_2 \rightarrow \text{GND}$, $\text{SW}_3 \rightarrow \text{ON}$	1.3374	1.3375	1.3376	
	IF Count Output Voltage	IF	$V_{IF(\text{FM})}$	1	$V_{IN}=61\text{dB}\mu$, $\text{SW}_2 \rightarrow \text{GND}$, $\text{SW}_3 \rightarrow \text{ON}$	350	500	-	mV $_{\text{p-p}}$
		1/8 IF	$V_{1/8\text{IF}(\text{FM})}$	1	$V_{IN}=61\text{dB}\mu$, $\text{SW}_2 \rightarrow \text{GND}$, $\text{SW}_3 \rightarrow \text{ON}$	350	500	-	
IF Count Output Sensitivity		IFsens. (FM)	1	$\text{SW}_1 \rightarrow 0$, $\text{SW}_2 \rightarrow \text{GND}$, $\text{SW}_3 \rightarrow \text{ON}$	-	76	-	dB μ	
				$\text{SW}_1 \rightarrow 510\Omega$, $\text{SW}_2 \rightarrow \text{GND}$, $\text{SW}_3 \rightarrow \text{ON}$	-	68	-		
				$\text{SW}_1 \rightarrow 0$, $\text{SW}_2 \rightarrow V_{CC}$, $\text{SW}_3 \rightarrow \text{ON}$	-	77	-		
				$\text{SW}_1 \rightarrow 510\Omega$, $\text{SW}_2 \rightarrow V_{CC}$, $\text{SW}_3 \rightarrow \text{ON}$	-	69	-		

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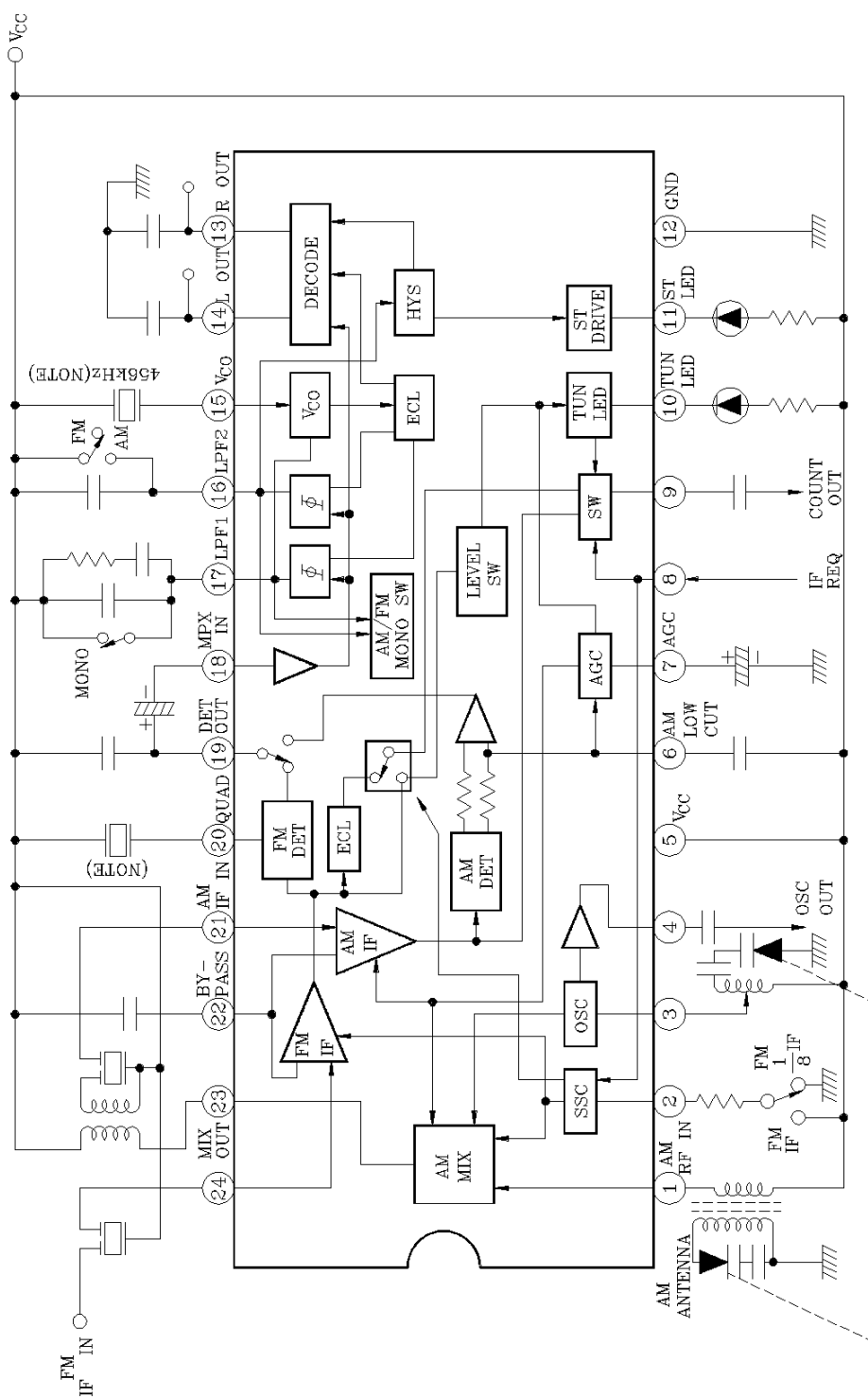
CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
AM	Gain	G_V	1	$V_{IN}=26dB\mu$	28	57	85	mV_{rms}
	Recovered Output Voltage	V_{OD}	1	$V_{IN}=60dB\mu$	50	75	100	
	Signal to Noise Ratio	S/N	1	$V_{IN}=60dB\mu$	-	41	-	dB
	Total Harmonic Distortion	THD	1	$V_{IN}=60dB\mu$	-	1.0	-	%
	LED ON Sensitivity	V_L	1	$I_L=1mA$	21	26	31	$dB\mu$
	Local OSC Buff. Output Voltage	$V_{OSC(AM)}$	1	$f_{OSC}=1.45MHz$	350	500	-	mV_{p-p}
				$f_{OSC}=27MHz$	-	500	-	
	IF Count Output Voltage	$V_{IF(AM)}$	1	$V_{IN}=39dB\mu, SW_3 \rightarrow ON$	350	500	-	mV_{p-p}
IF Count Output Sensitivity	IFsens. (AM)	1	$SW_1 \rightarrow 0, SW_2 \rightarrow GND, SW_3 \rightarrow ON$	-	49	-	$dB\mu$	
			$SW_1 \rightarrow 510\Omega, SW_2 \rightarrow GND, SW_3 \rightarrow ON$	-	42	-		
			$SW_1 \rightarrow 0, SW_2 \rightarrow V_{CC}, SW_3 \rightarrow ON$	-	49	-		
			$SW_1 \rightarrow 510\Omega, SW_2 \rightarrow V_{CC}, SW_3 \rightarrow ON$	-	42	-		
Pin 19 Output Resistance	R_{19}		FM Mode	-	0.6	-	$k\Omega$	
			AM Mode	-	12	-		

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CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT		
MPX	Input Resistance	R_{IN}	1		-	25	-	$k\Omega$		
	Output Resistance	R_{OUT}	1		-	5	-	$k\Omega$		
	Max. Composite Signal Input Voltage	V_{IN} MPX (STEREO)	1	L+R=90%, P=10% THD=3% SW9→LPF:ON	-	350	-	mV_{rms}		
	Separation		Sep	1	L+R=135 mV_{rms} P=15 mV_{rms} SW9→LPF:ON	fm=100Hz	-	42	-	dB
						fm=1kHz	35	42	-	
						fm=10kHz	-	42	-	
	Total Harmonic Distortion	Monaural	THD	1	$V_{IN}=150mV_{rms}$ (MONO)	-	0.2	-	%	
		Stereo	THD		L+R=135 mV_{rms} , P=15 mV_{rms} SW9→LPF:ON	-	0.2	-		
	Voltage Gain		G_V	1	$V_{IN}=150mV_{rms}$ (MONO)	-5	-3	-1	dB	
	Channel Balance		C.B.	1	$V_{IN}=150mV_{rms}$ (MONO)	-2	0	2	dB	
	Stereo LED Sensitivity	ON	$V_L(ON)$	1	Pilot Input	-	8	15	mV_{rms}	
		OFF	$V_L(OFF)$			2	6	-		
Stereo LED Hysteresis		V_H	1	To LED turn off from LED turn on	-	2	-	mV_{rms}		
Capture Range		C.R.	1	P=15 mV_{rms}	-	± 1.3	-	%		
Signal to Noise Ratio		S/N	1	$V_{IN}=150mV_{rms}$ (MONO)	-	78	-	dB		

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BLOCK DIAGRAM



(NOTE)

We recommend

Ceramic resonator : CSB456F18
 Ceramic discriminator : CDA10.7MG18
 (MURATA MFG CO., LTD)

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EXPLANATION OF TERMINALS

Pin NO.	ITEM	INTERNAL CIRCUIT	DC VOLTAGE(V) (at no signal)	
			AM	FM
1	AM RF IN		3.0	3.0
2	<ul style="list-style-type: none"> •IF Count Output Sensitivity Adjust Terminal •FM IF Divider Control Terminal 		-	-
3	AM OSC		3.0	3.0
4	AM OSC OUT		2.7	3.0
5	V _{CC}		3.0	3.0

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Pin NO.	ITEM	INTERNAL CIRCUIT	DC VOLTAGE(V) (at no signal)	
			AM	FM
6	AM LOW CUT		2.3	2.3
7	AGC		0.25	0.35
8	IF OUT SW		-	-
9	IF OUT		3.0	3.0
10	TUN LED (Tuning LED)		-	-

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Pin NO.	ITEM	INTERNAL CIRCUIT	DC VOLTAGE(V) (at no signal)	
			AM	FM
11	ST LED (Stereo LED)		-	-
12	GND		0	0
13 14	R-OUT L-OUT		1.0	1.0
15	VCO		2.5	2.5 (VCO STOP MODE)
16	LPF2 ·LPF Terminal for Synchronous Detector ·Bias Terminal for AM/AM SW Circuit $V_{16}=V_{CC} \rightarrow$ AM $V_{16}=\text{Open} \rightarrow$ FM		3.0	2.2
17	LPF1 ·LPF Terminal for Phase Detector VCO Stop Terminal $V_{17}=V_{CC} \rightarrow$ VCO Stop		2.7	2.2

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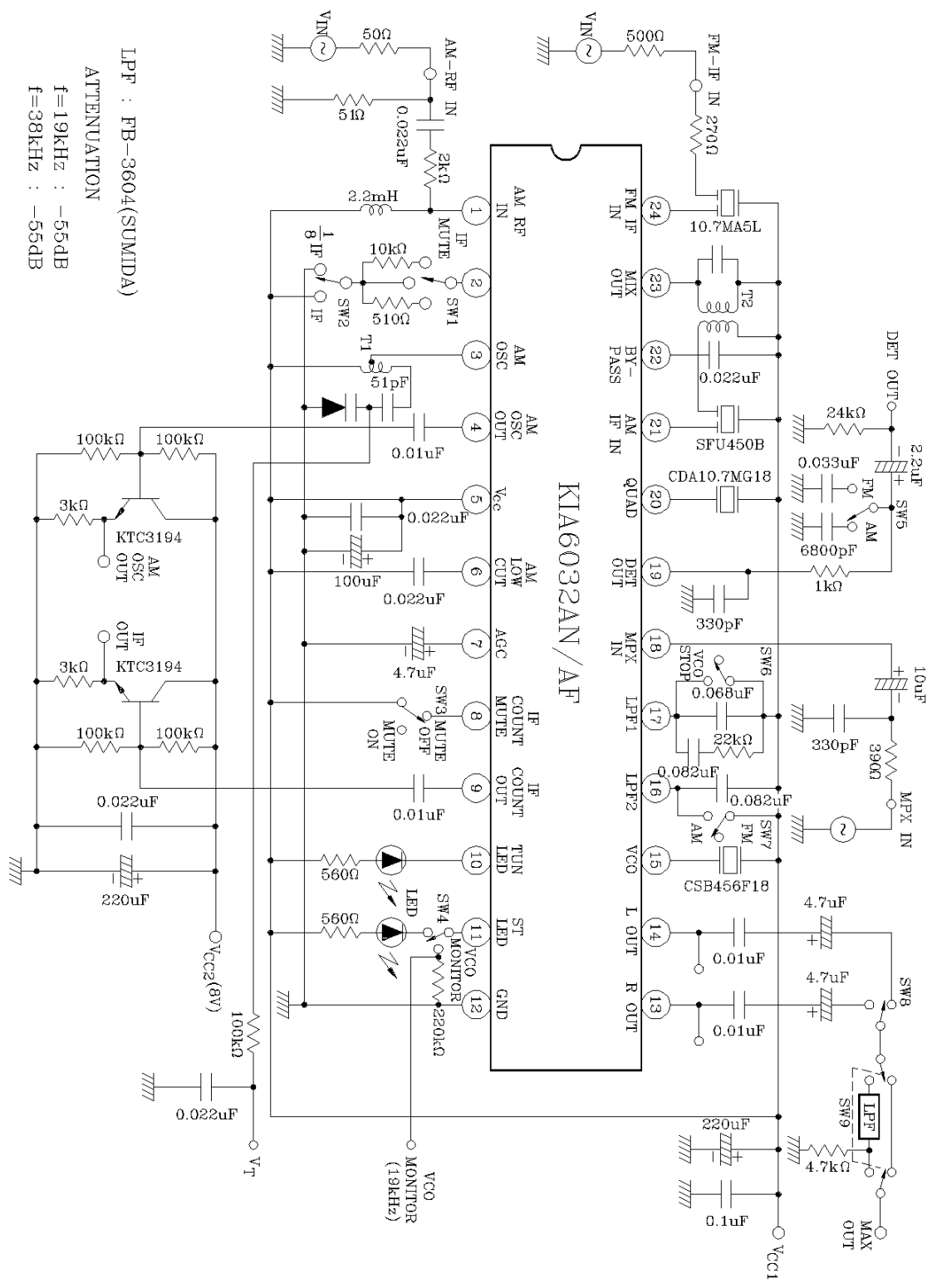
Pin NO.	ITEM	INTERNAL CIRCUIT	DC VOLTAGE(V) (at no signal)	
			AM	FM
18	MPX IN		0.7	0.7
19	DET OUT		1.1	1.1
20	QUAD (FM QUAD Detector)		2.4	2.1
21	AM IF IN		3.0	3.0
22	BY-PASS AM IF AMP } BY-PASS FM IF AMP }		2.3	2.8

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Pin NO.	ITEM	INTERNAL CIRCUIT	DC VOLTAGE(V) (at no signal)	
			AM	FM
23	AM MIX OUT		3.0	3.0
24	FM IF IN		3.0	3.0

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TEST CIRCUIT1

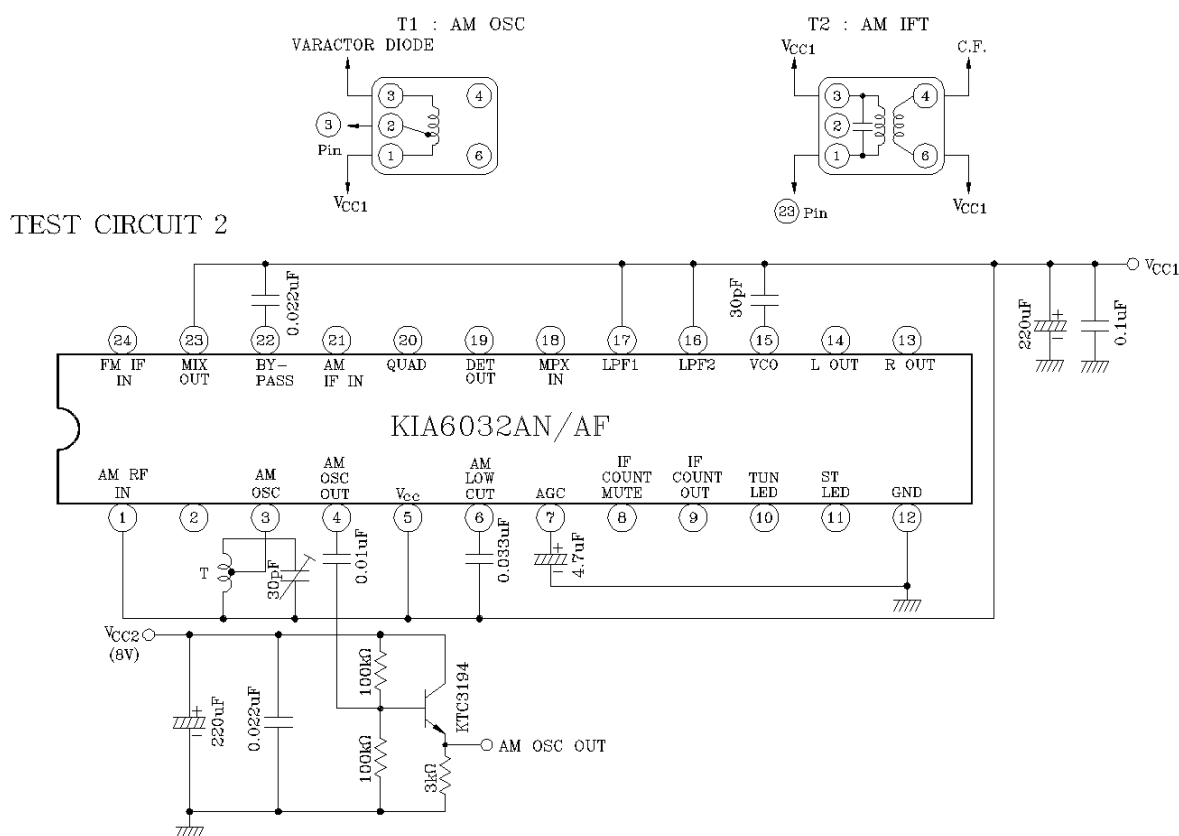


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COIL DATA (TEST CIRCUIT 1) (S) : SUMIDA ELECTRIC CO., LTD.

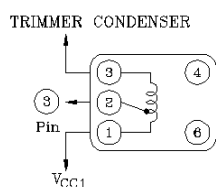
(K) : KWANG SUNG ELECTRONICS CO., LTD (Tel : 02)716-0034)

COIL NO.	f	L (μ H)	Co (pF)	Qo	TURNS				WIRE (mm)	REFERENCE (COIL NO.)
					1-2	2-3	1-3	4-6		
T ₁ AM OSC	796kHz	288	-	155	13	73	-	-	0.08 UEW	(S) 4147-1356-038 (K) KSA0406
T ₂ AM IFT	455kHz	-	180	120	-	-	180	15	0.08 UEW	(S) 2150-2162-165 (K) KSAM303



COIL DATA (TEST CIRCUIT 2)

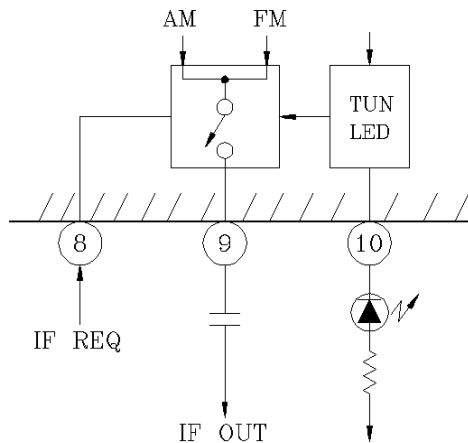
COIL NO.	f	L (μ H)	Co (pF)	Qo	TURNS				WIRE (mm)	REFERENCE (COIL NO.)
					1-2	2-3	1-3	4-6		
T AM IFT	7.6MHz	1.4	-	84	1	7	8	-	0.08 UEW	(K) KSAM0408



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APPLICATION NOTE

1. How to control the IF Count Output Signal (pin ⑨ output)



		TUN LED	
		ON	OFF
V8	H	Come out	Non output
	L	Non output	Non output

•Whether or not there is the IF count output signal (pin⑨ output) is determined by the AND of the pin ⑧ control voltage : V8 and tuning LED on/off switching.

In the condition of

V8 : High (Active High, $V_{IH}=0.8V(Typ.)$)

TUN LED : ON($V_{IN} \geq V_L + 2dB\mu(Typ.)$)

the IF count output signal comes out from the pin ⑨.

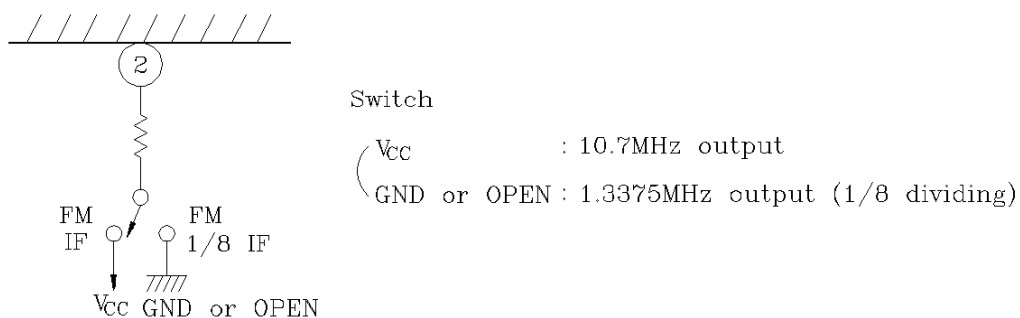
In the case of the Tuning LED function is not needed, it doesn't matter the pin ⑩ is opened.

•The output impedance of pin ⑨ is $1.5k\Omega$ (Typ.) (cf. P.4)

It is possible to reduce the IF count output signal level to add the resistance between the pin ⑨ and the V_{CC} line.

•The signal waveform is the rectangular wave, and the $500mV_{P-P}$ (Typ.)

2. How to control the Divider of FM IF

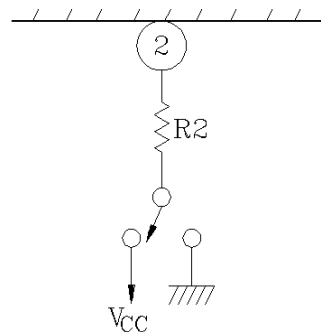


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3. How to adjust the IF count output sensitivity

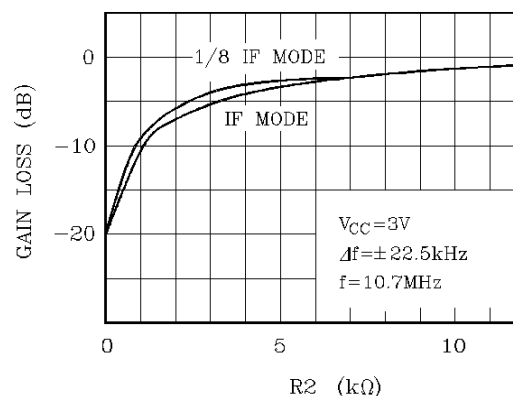
• The IF Count Output Sensitivity (Search sensitivity) can be adjusted by varying the IF AMP gain for FM and varying the Mixer gain for AM. This setting is made by changing the value of external resistance R2 which is connected to pin ②.

• However, this is only possible at the Auto-tuning Mode. (external voltage supplied to pin ③ is at High level.) The original again returns while receiving a broadcast station (supplied voltage to pin ③ is at LOW level.)



• The Gain Loss of FM IF AMP

		R2	
		0Ω	10kΩ (Note)
MODE	IF (10.7MHz)	-20dB	-1dB
	1/8IF (1.3375MHz)	-20dB	-1dB

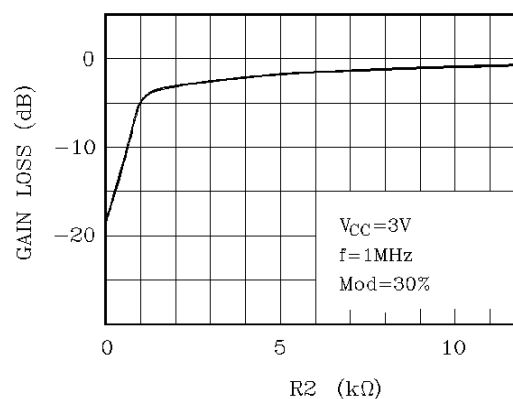


(Note)

- In the condition of the 1/8 IF Mode, it is possible to set up R2 = ∞ (open)
- In the condition of IF Mode, it is necessary to set up the value of R2 under 10kΩ. When the R2 is over 10kΩ it is feared that the Mode is change to the 1/8 IF Mode.

• The Gain Loss of AM Mixer

R2	
0Ω	10kΩ
-16dB	-1dB



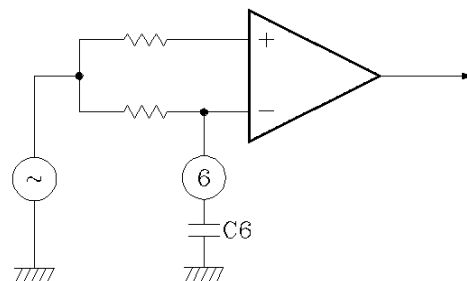
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4. AM Low-Cut Circuit

- The AM Low-Cut action is carried out by the bypass of the high frequency component of the positive-feedback signal at the AM AMP stage.
The external capacitor : C6 by-passes this component.
- The cut-off frequency f_L is determine by the internal resistance $22k\Omega$ (Typ.) and the external capacitor C6 as following :

$$f_L = \frac{1}{2 \times \pi \times 22 \times 10^3 \times C6} \text{ (Hz)}$$

- In the case of the AM Low-Cut function is not needed, set up the value of C6 over $0.47\mu\text{F}$. In the condition of $C6 \geq 0.47\mu\text{F}$, the frequency characteristic has flat response at the low frequency.

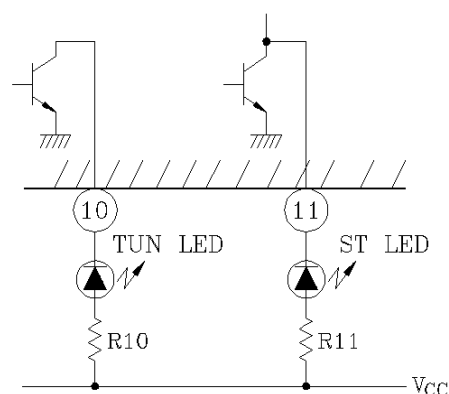


5. AM Local Oscillator Buffer Output

- The output impedance of AM Local Oscillator Buffer Output pin (pin④) is 750Ω (Typ.) (cf. P.3)
- It is possible to reduce the output level to add the resistance between the pin ④ and V_{CC} line. The signal waveform is the rectangular wave, and the level is $500\text{mV}_{\text{p-p}}$ ($f_{\text{osc}}=1.45\text{MHz}$, Typ.) The higher local oscillation frequency (focs) tobe, the lower buff output level to be owing to the load capacity. So, in the case that it is connected to other circuits, take care of the input capacity of these circuits and stray capacity of wire.

6. Tuning LED Driver and Stereo LED Driver.

- The Tuning LED Driver and stereo LED driver don't have current limit resistance shown in the right figure. So, it is necessary to add the current limit resistance : R10, R11.
- Set up the values of R10, R11 to keep the drive currents I_{D10} , I_{D11} under 10mA .



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7. FM Detection Circuit

For the FM detection circuit, detection coil is able to use instead of ceramic discriminator. Recommended circuit and recommended coil are as follows.

In this case, please take care the $V_{in(lim)}$ falls a little.



TEST FREQUENCY	Co (pF)	Qo	TURNS				WIRE (mm Φ)	REF
			1-2	2-3	1-3	4-6		
10.7MHz	100	100			12		SUMIDA ELECTRIC CO., LTD 2153-4095-189 or KWANG SUNG ELECTRONICS CO., LTD. KSFD505	

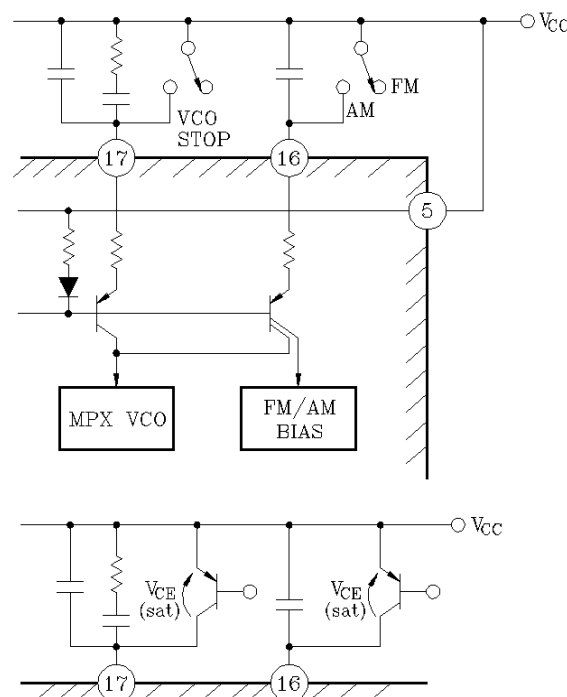
8. FM/AM Switch and Forced Monaural

Switch FM/AM switchover and stare/forced monaural switchover are done by internal PNP transistors ON/OFF which are connected to pin (16) and pin (17) respectively.

The threshold voltages of these PNP transistors are $V_{th}=V_{cc}$, and for switching, we recommend to use mechanical switch. (Direct short to V_{cc} line.)

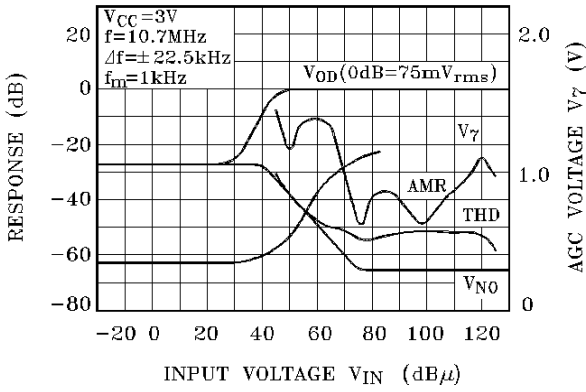
In the case of the electrical switchover by transistor, set up V_{CE} (saturation voltage between collector and base.)

50mV or less, otherwise there are some cases that it does not become the AM mode and force monaural mode. When these external switches are ON, the currents which flow into pin (16) and pin (17) are $100\mu A$ and $20\mu A$ respectively. (Typical value at $V_{cc}=3V$.)

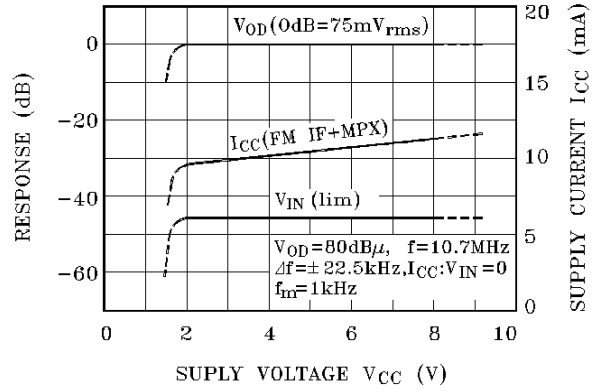


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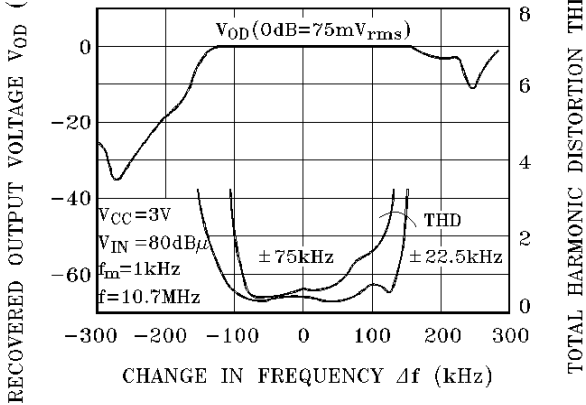
FM(IF)
 V_{OD} , V_{NO} , THD, AMR, $V_7 - V_{IN}$



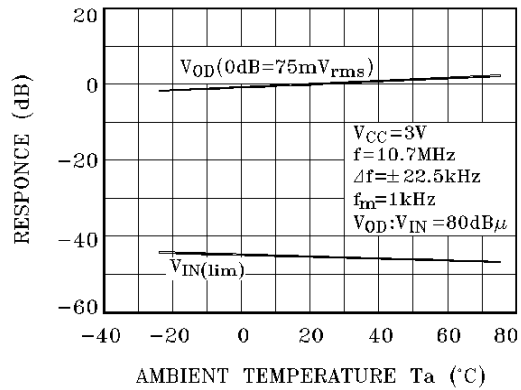
FM(IF)
 V_{OD} , $V_{IN(lim)}$, $I_{CC} - V_{CC}$



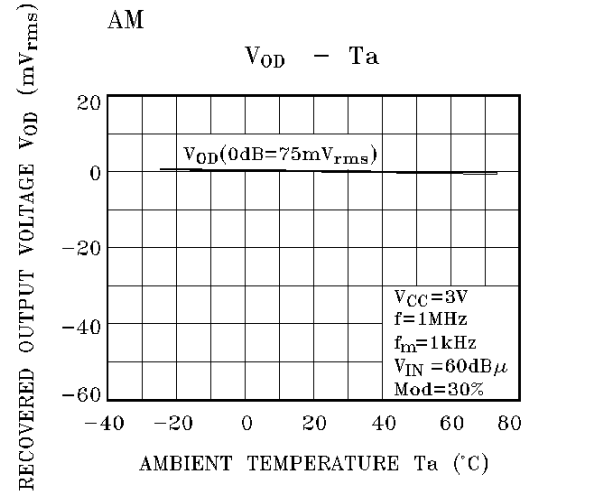
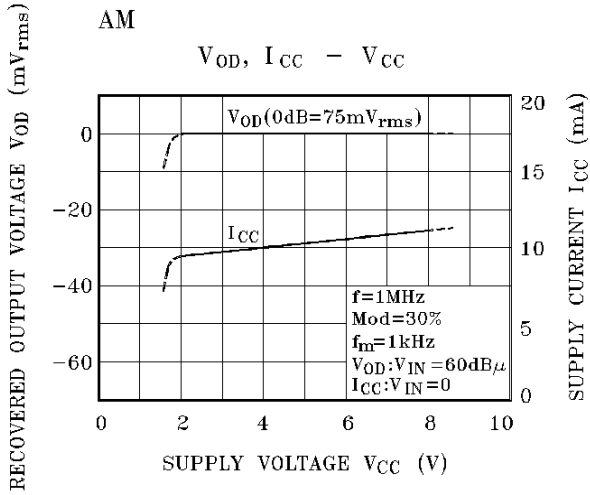
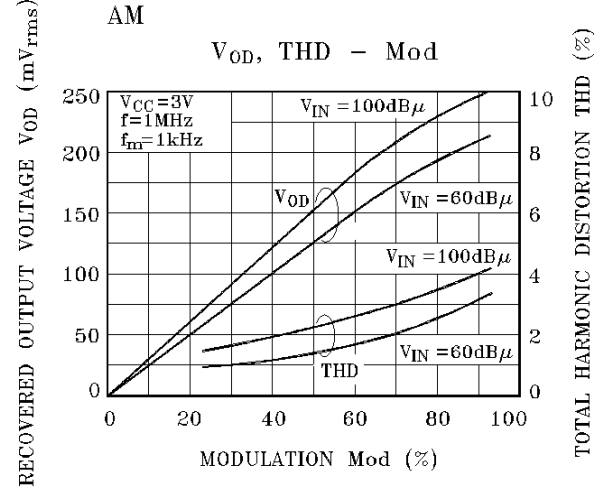
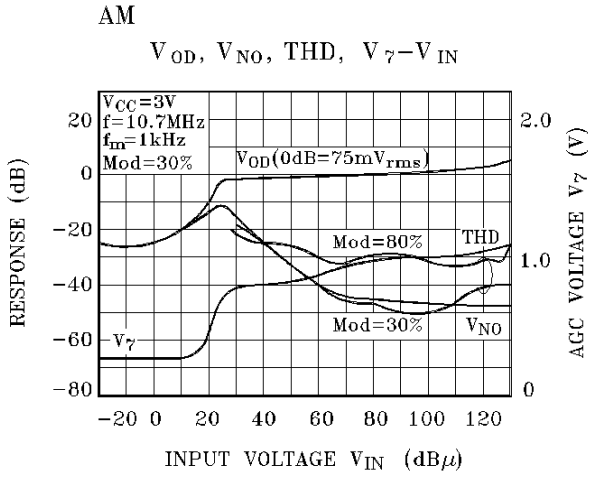
FM(IF)
 V_{OD} , THD - Δf



FM(IF)
 V_{OD} , $V_{IN(lim)}$ - T_a



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