KEC
KOREA ELECTRONICS CO.,LTD.

SEMICONDUCTOR
TECHNICAL DATA

KIA6029Z
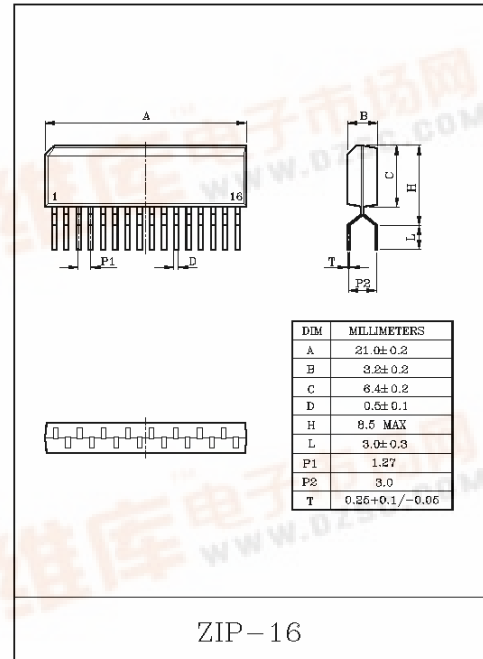BIPOLAR LINEAR INTEGRATED CIRCUIT

FM IF SYSTEM FOR CAR ETR.

KIA6029Z is an IC designed for car tuner, has a flexible muting function and a station detection function lead to make it possible to realize the feature appropriate to the specification of the car tuner.

FUNCTIONS
- Differential 6-Stage IF Limiter.
- Signal Meter Output.
- Differential Peak Detection.
- Station Detection.
- Bandwidth Muting.
- Signal Strength Muting.

FEATURES
- Application of differential peak detection is useful against multi-path distortion.
- With single tuned coil, low distortion ratio can be realized (0.05%, typical at $\triangle f=\pm 75kHz$ dev.)
- Sensitivity of signal strength muting, sensitivity of attenuation and stop signal, and bandwidth can freely be set with external resistance.
- Signal meter output proportioned to input signal strength can be obtained.
- AMR is excellent. (55dB, typical at $V_{IN}=80dB\mu$)
- S/N is excellent. (78dB, typical.)
- S curve variation against input voltage is reduced. ($\pm 100mV$, typical at $V_{IN}=0\sim 120dB\mu$)
- Operating supply voltage range : $V_{opr}=7\sim 16V(Ta=25℃)$

DIM	MILLIMETERS
A	21.0±0.2
B	3.2±0.2
C	6.4±0.2
D	0.5±0.1
H	8.5 MAX
L	3.0±0.3
P1	1.27
P2	3.0
T	0.25+0.1/−0.05

ZIP－16

MAXIMUM RATINGS (Ta=25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{CC}	16	V
Power Dissipation	P_D	750	mW
Operating Temperature	T_{opr}	−30～85	℃
Storage Temperature	T_{stg}	−55～150	℃
Tuning Indication Current	I7 MAX	20	mA
External Leak Current	I13 MAX	5	mA

Note : Derated above Ta=25℃ in the proportion of 6mW/℃ for KIA6029Z
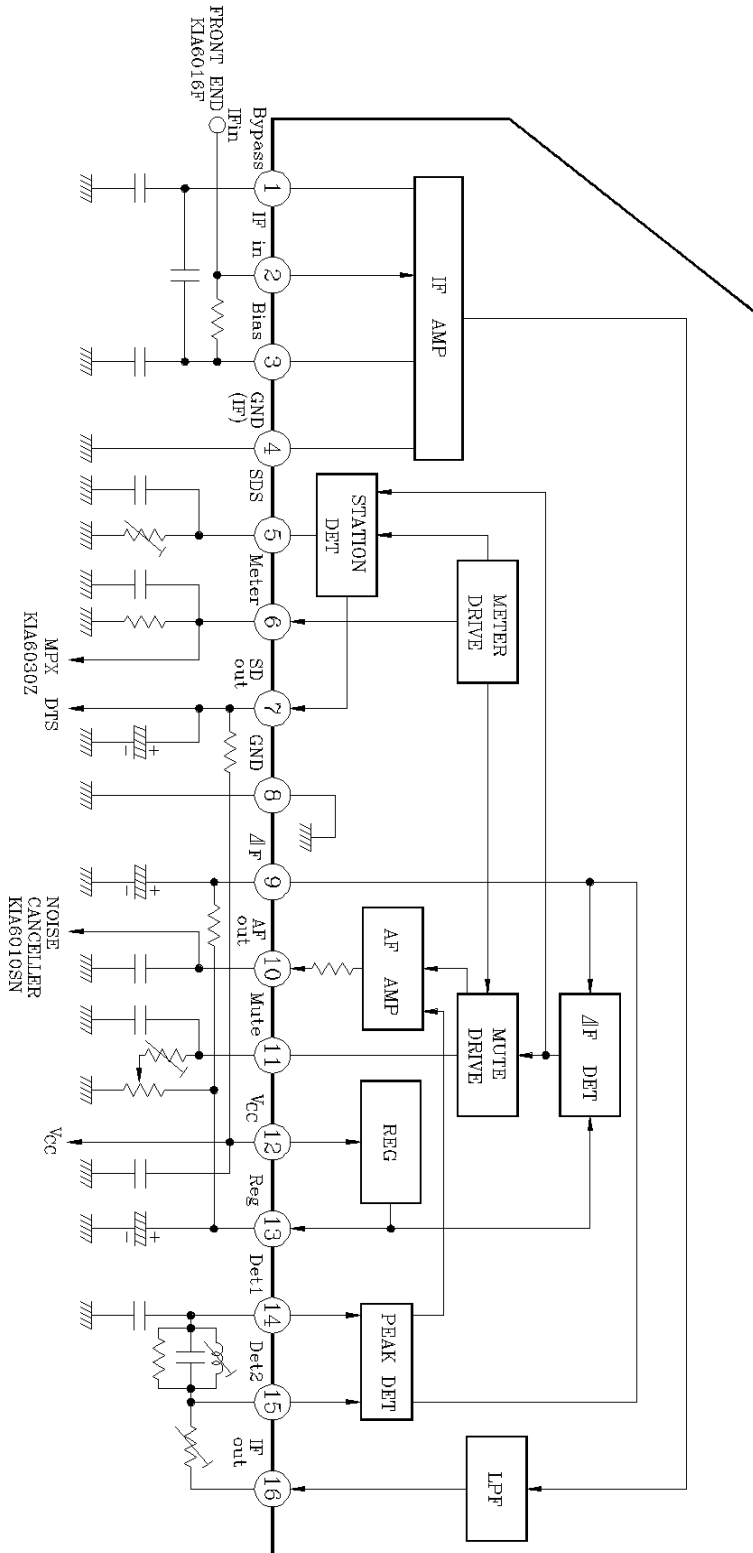
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ELECTRICAL CHARACTERISTICS
(Unless otherwise specified, V_{CC}=8.5V, f=10.7MHz, $\triangle$f=$\pm$75kHz, dev, fm=400Hz, V_{IN}=80dBμ, SW1=on(Mute off) Ta=25℃)

| CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Quiescent Current	I_{CCQ}	V_{IN}=0, SW1=off		10	15	21.5	mA
Limiting Sensitivity	$V_{IN(lim)}$			–	33	35	dBμ
Detection Output	V_{OD}			350	450	550	mV$_{rms}$
Total Harmonic Distortion Ratio	THD	$\triangle$f=$\pm$22.5kHz dev.		–	0.06	0.5	%
Signal to Noise Ratio	S/N			71	78	–	dB
AM Rejection Ratio	AMR	AM=30%		46	55	–	dB
Signal Meter Output	VSM 1	V_{IN}=0dBμ		–	0	0.3	V
	VSM 2-1	V_{IN}=50dBμ		0.5	1.5	2.5	
	VSM 2-2	V_{IN}=54dBμ		1.45	2.1	2.8	
	VSM 3	V_{IN}=70dBμ		2.6	3.8	5.1	
	VSM 4	V_{IN}=100dBμ		5.4	6.5	6.8	
Soft Muting Attenuation	ATT 1	V_{IN}=80dBμ→0dBμ	SW1=off	45	60	76	dB
Detuning Attenuation	ATT 2	fi=$\pm$200kHz		47	55	66	dB
Station Detection Sensitivity	V_{SS}	At the point of V_{SD}=L→H		35	50	65	dBμ
Station Detection Band	BW(S)			60	100	170	kHz
Muting Band	BW(M)	At the Point of V_{OD}=-3dB	SW1=off	80	150	220	kHz

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BLOCK DIAGRAM
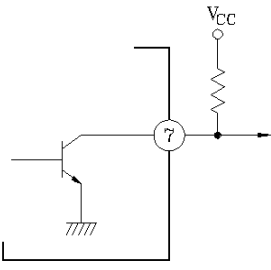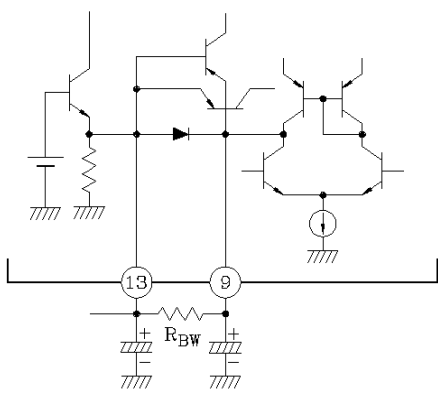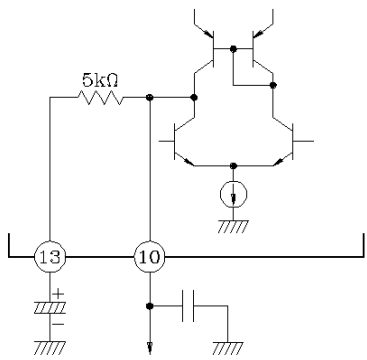
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TEST CIRCUIT
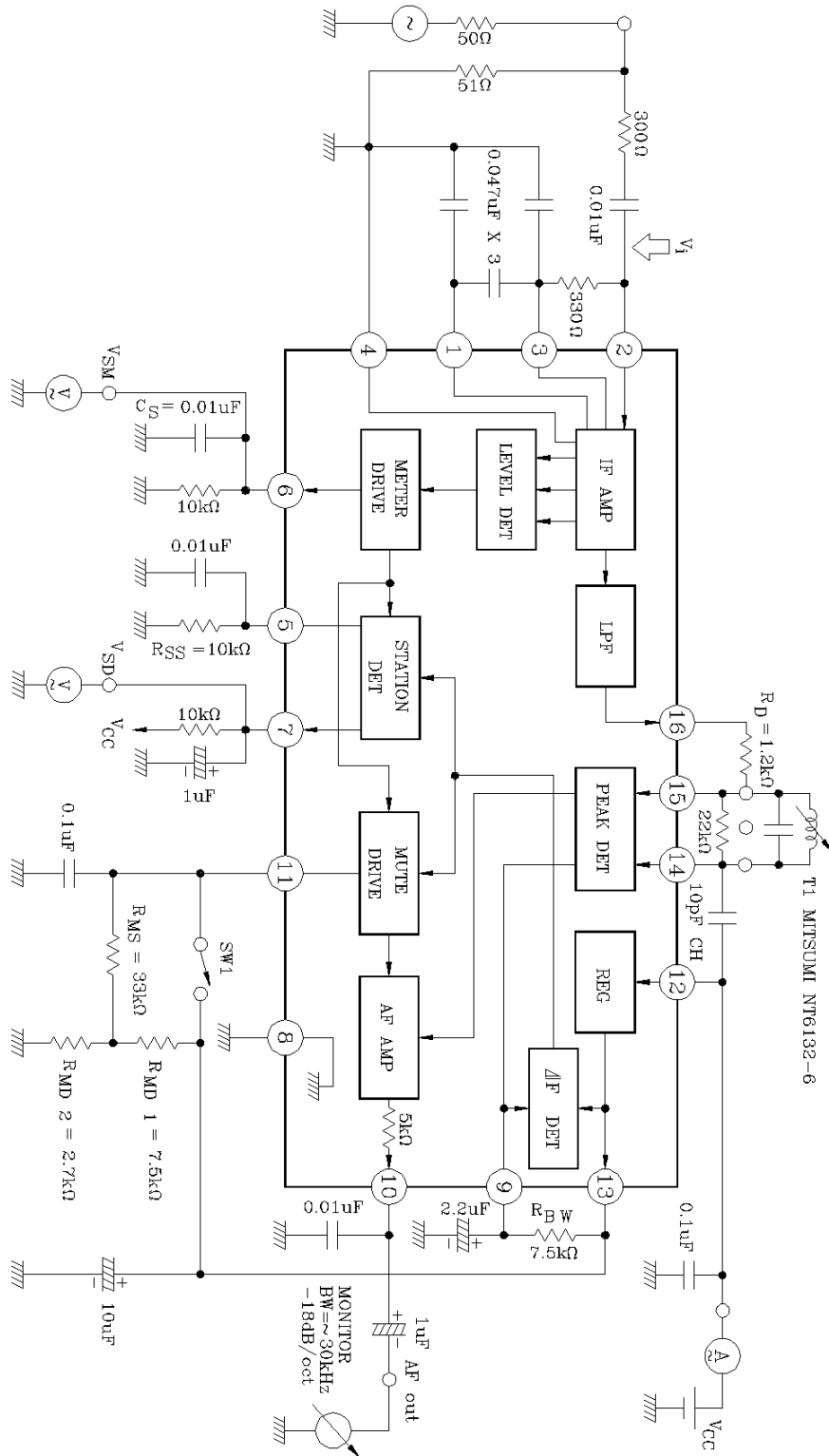
DESCRIPTION OF TERMINALS
(Terminal Voltage shows the value at V_{CC}=8.5V, Ta=25℃, and non-signal in measuring circuit.)

PIN NO.	TERMINAL NAME	TERMINAL VOLTAGE (V)	INTERNAL EQUIVALENT CIRCUIT (Resistance and capacity show the typical value)	CONTENTS
1	Bypass	3.0		IF Amplifier Byass
2	IF in	3.0		IF Amplifier Input
3	Bias	3.0		IF Amplifier Bias
4	GND(IF)	0	———	IF Amplifier GND
5	SD.S	0		Setting of Station Detection Sensitivity
6	Meter	0		Signal Meter Output

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DESCRIPTION OF TERMINALS
(Terminal Voltage shows the value at V_{CC}=8.5V, Ta=25℃, and non-signal in measuring circuit.)

PIN NO.	TERMINAL NAME	TERMINAL VOLTAGE (V)	INTERNAL EQUIVALENT CIRCUIT (Resistance and capacity show the typical value)	CONTENTS
7	SD out	8.5		Station Detection Output
8	GND	0	————	GND except IF Amplifier
9	⊿f	4.8		S curve (⊿f) Detection
10	AF out	4.8		Audio Output

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DESCRIPTION OF TERMINALS
(Terminal Voltage shows the value at V_{CC}=8.5V, Ta=25℃, and non-signal in measuring circuit.)

PIN NO.	TERMINAL NAME	TERMINAL VOLTAGE (V)	INTERNAL EQUIVALENT CIRCUIT (Resistance and capacity show the typical value)	CONTENTS
11	Mute	4.8		Setting of Soft Mute Sensitivity and Mute Amount
12	V_{CC}	8.5	——————	Power Supply
13	Reg	4.8	Refer to items of ⑨ pin and ⑩ pin	Constant Voltage Source
14	Det 1	2.4		Peak Detection Demodulation Input THD at $\varDelta$f=±75kHz dev, fm=400Hz can be adjusted to about 0.05% by adjusting RD(500Ω VR) In case of making into the fixed resistance, 1.2kΩ becomes the typical value.
15	Det 2			
16	IF out	2.4		IF Output

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DIFFERENTIAL DETECTION

The differential peak detection system means a system for detecting the variation of voltages of e_1 and e_2 when the input frequency is varied and amplifying the DC voltage by a differential amplifier to take out the detection output.
In Figure2, the level of e_1 and e_2 for the input frequency is shown. the point where e_1 becomes minimum is the point where the impedance Z viewed from the point e_1 becomes minimum and the impedance Z_1 is expressed by the following equation.
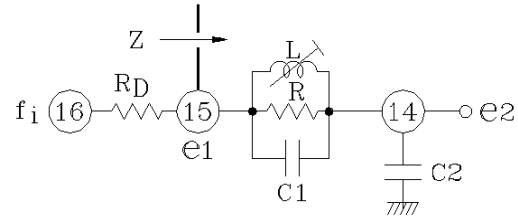

Fig.1

$$Z_1 = \frac{1 + S^2(C_1 + C_2)}{SC_2(1 + S^2 LC_1)} \quad \cdots \quad (1)$$

and f_L is expressed by the equation (2)

$$f_L = \frac{1}{2\pi\sqrt{L(C_1 + C_2)}} \quad \cdots \quad (2)$$

Also, the point where e_2 becomes minimum is the point where L and C_1 are oscillated in parallel, and f_H is expressed by the equation (3)

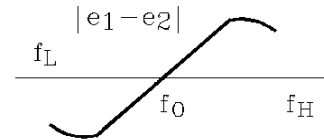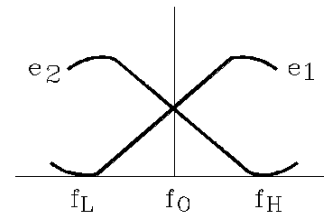$$f_H = \frac{1}{2\pi\sqrt{LC_1}} \quad \cdots \quad (3)$$

Fig.2

Further, the inductive susceptive of L and C_1 becomes f_O when it becomes 1/2 of the capacitive susceptive of C_2, and the f_o is expressed by the equation (4)

$$f_o = \frac{1}{2\pi\sqrt{L(C_1 + C_2/2)}} \quad \cdots \quad (4)$$

The detection output is determined by the width of $f_H - f_L$, it is proportional to the ratio (C_1/C_2) of C_1 and C_2. Figure 3 shows the variation of the detection output of $C_1 = 24pF$ to C_2.
It is necessary to pay attention when the detection output is reduced by decreasing C_1/C_2, the detection band is widened and S/N is somewhat lowered, Therefore, for reducing the detection output holding a high S/N, and R to adjust the output.

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In a conventional quadrature detection, a double tuning
coil is required for obtaining a low distortion factor,
but as the result, the cost is increased and adjustment
is troublesome (It is fairly difficult to make of
coincide with the minimum value of distortion)
In the KIA6029Z, fo adjustment can be performed by coil
and distortion adjustment by R_D, and cost can be reduced
and the adjustment time can be shortened.
When making R_D a fixed resistance, R_D 1.2k is typical for
the minimum value of distortion (under the condition of
measuring circuit) As described above, the linearity
(distortion) of S curve is determined by the R_D value.
However, on the other hand, it is necessary to vary the
R_D value so as to obtain the minimum value of distortion
by the value of C_1 and C_2 and especially, C_2 is most influenced.
Set R_1 for C_2 and C_2 by referring to the graph in Figure 3.
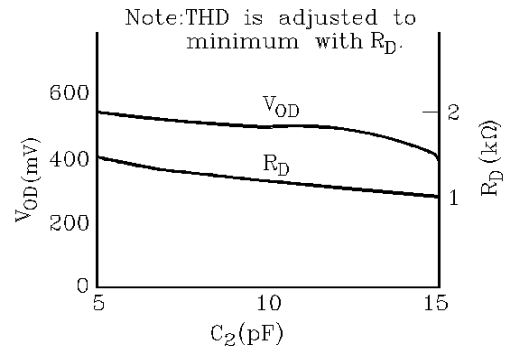
Note:THD is adjusted to
minimum with R_D.

Fig.3

SIGNAL INTENSITY MUTING PROPERTIES

The muting circuit of the KIA6029Z is constituted of an AF amplifier where gain is varied
by control voltage and a control voltage generation circuit (Mute Drive) proportional to a
signal meter output. Figure 4 shows the outline of the muting circuit. The signal meter
output is converted into the current by 10kΩ externally provided on ⑥ pin and I/3 current
is output in ⑪ pin in 1:1/3 current mirror circuit. This current is converted into a control
voltage by R_{MS} and V_H connected outside.
The attenuation amount at non-signal is substantially determined by the value of V_M since the
current output in ⑪ pin is about 0. The V_M is set by the output of the volume R_{MD} of about
10kΩ connected to the constant voltage output (⑬ pin) of 4.8V. The variation ratio (gradient)
of attenuation amount of a detection output is determined by the ratio of the variation
of the ⑪ pin voltage V_{MD} to the level of an input signal, that is, the variation of the
signal meter voltage. Accordingly, as R_{MS} becomes larger, the gradient becomes steep.
It is presumed that usually, the value of R_{MS} is preferably about 33kΩ.

Principle of R_{MD}

- Attenuation amount
  at non-input → Adjust by R_{MD}
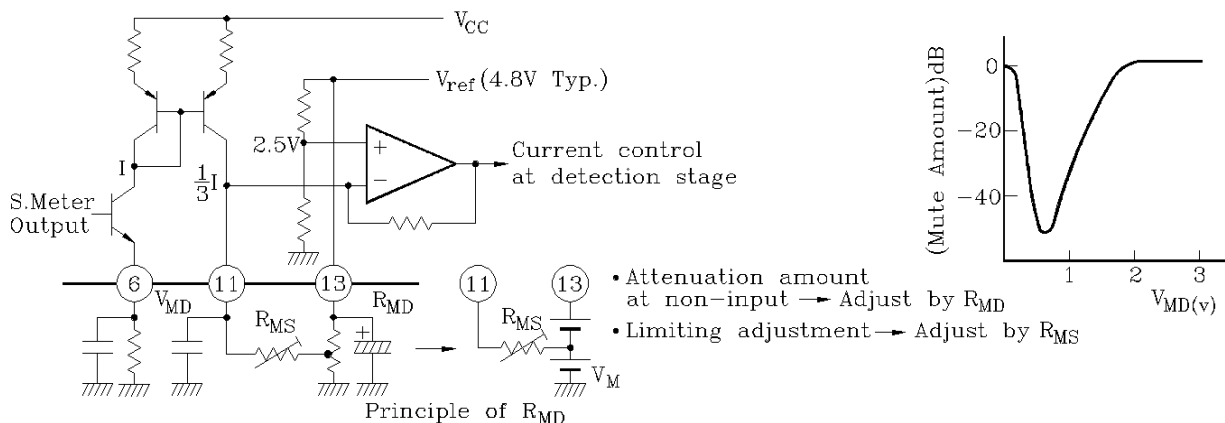- Limiting adjustment → Adjust by R_{MS}

Fig.4

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MUTING PROPERTIES FOR DETUNING

In the ⑨ pin of AFC terminal, ±currents proportional to the S curve are generated. The AC component of them is smoothed by an external capacity and a DC voltage is generated in ⑨ pin by R_{BW} connected between ⑨ pin and ⑬ pin. When the DC voltage generated by R_{BW} becomes over about ±0.7V, the detection circuit (Δf Det) is operated to attenuate the AF amplifier by about 40dB. The width of muting for detuning is determined by the resistance value of R_{BW}, but the coil previously described is varied by setting, and set the value of R_{BW} after setting of the coil. The property when varying R_{BW} on the condition of the measuring circuit is shown figure 5.
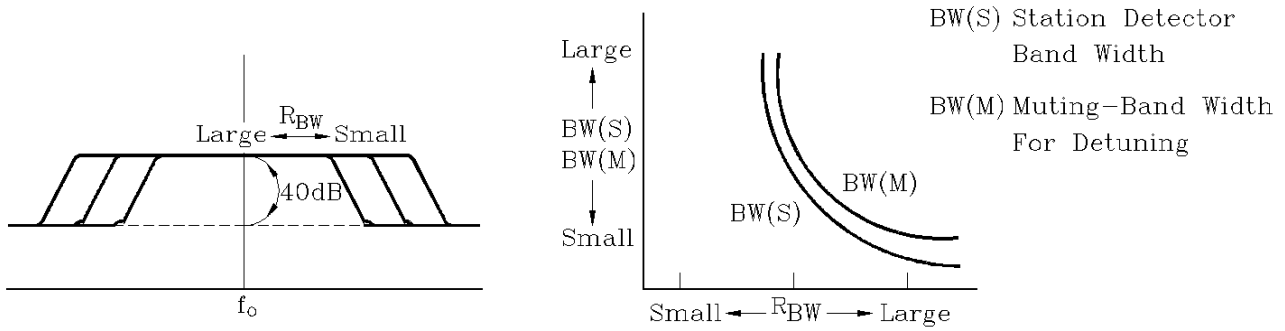

Fig.5

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STATION DETECTOR

The station detector (stop signal generator of DTS) detects detuning by the signal intensity of input and Δf detection circuit (Δf Det) respectively and outputs through AND circuit. As shown in Figure 6, the signal meter output is converted into the current I by the 10kΩ connected to ⑥ pin and outputs the current I in ⑤ pin by a current mirror circuit. This current is converted to -INPUT of the comparator where 1V is added to +INPUT. Therefore, the stop signal sensitivity can be adjusted by varying the value of the Rss connected to ⑤ pin. Also, the variable width of the stop signal sensitivity is set widely as about 40dBμ by IF input voltage (when Rss=2kΩ~10kΩ). The band width is varied by R_{BW} as shown in Figure 5.

Fig.6

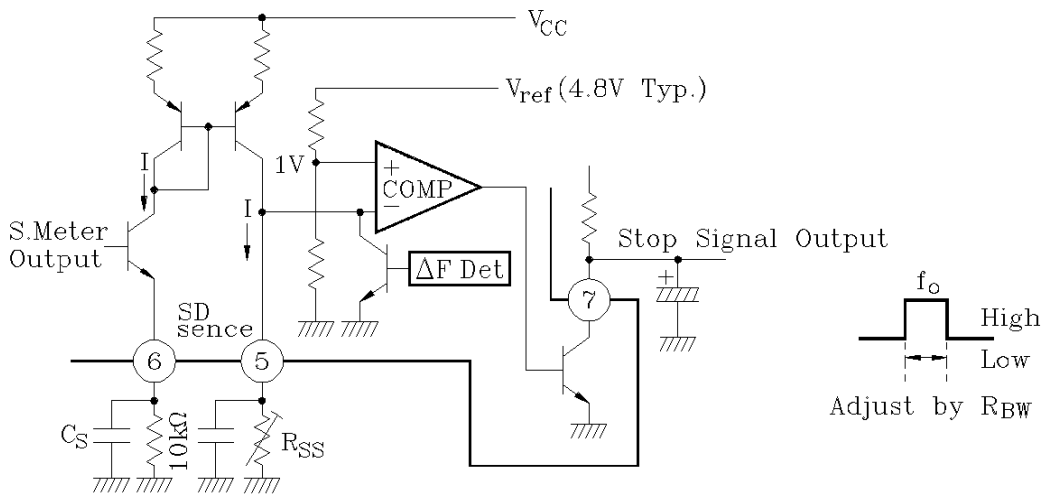## ADJUSTMENT METHOD OF KIA6029Z
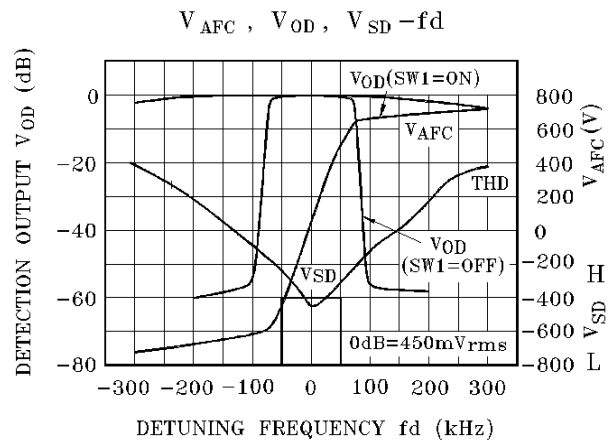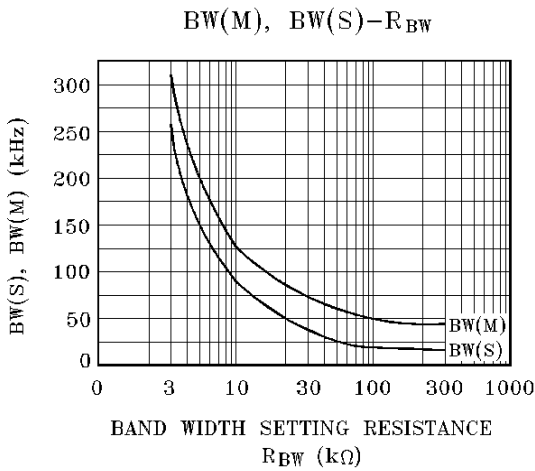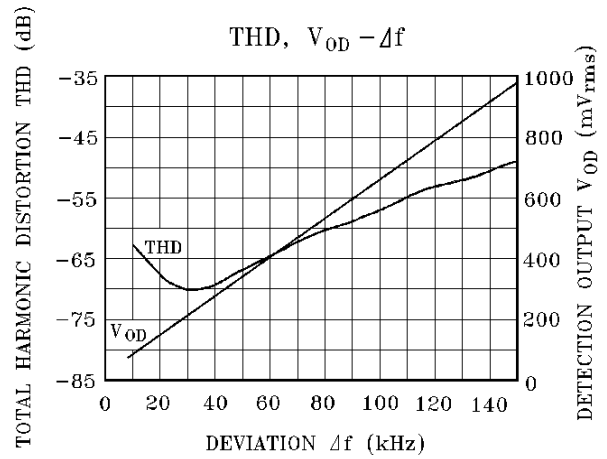·Apply the signal of 10.7MHz, 80dBμ to input.
·Connect a voltmeter between ⑨ pin and ⑬ pin.
·Adjust T_1 and set the indication of the voltmeter to about 0V.
·Adjust R_D so that the detection distortion becomes minimum.
 (When R_D is a variable resistance)

PRECAUTION
When the capacity value of the by-pass capacitor Cs connected to ⑥ pin of S meter output is fairly large, the audio signal corresponding to AM wave flows and the AMR properties are deteriorated. Use at under 0.01 μF.

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APPLICATION CIRCUIT

COIL DATA (Typical)

Coil No.	Stage	Test freq. (MHz)	L (μH)	Co (pF)	Qo	Turns				Wire (mm)	Note
						1-2	2-3	1-3	4-6		
T1	Det	10.7	–	24 (PH)	40	–	–	–	36	0.07 UEW	MT6132-6 MITSUMI
T1	Det	10.7	–	24	40	–	–	–	40	0.07 2UEW	7KL-2816 TOKO

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V_{OD}, AMR, THD, V_{NO}, $V_{SM} - V_{IN}$

V_{OD}, V_{NO}, V_{SC}, $V_{MD} - V_{IN}$ (MUTING ON)

ATT(MUTE) − V_{MD}

THD, $V_{OD} - \Delta f$

BW(M), BW(S) − R_{BW}

V_{AFC}, V_{OD}, $V_{SD} - fd$

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V_{OD}, $V_{NO}-V_{IN}$ (R_{MS}, R_{MD} CHANGE)

$V_{IN(LIM)}$ — R_{MS}

(a) ATT $\doteqdot$ 30dB at V_{IN}=−20dB
R_{MD1}=7.5kΩ R_{MD2}=2.7kΩ

(b) ATT $\doteqdot$ 20dB at V_{IN}=−20dB
R_{MD1}=6.2kΩ R_{MD2}=3.3kΩ

(c) ATT $\doteqdot$ 10dB at V_{IN}=−20dB
R_{MD1}=5.1kW R_{MD2}=3.6kW

V_{SM} — V_{CC}

I_{CCQ} — V_{CC}

V_{OD}, THD, AMR, V_{NO}, $V_{IN(LIM)}$−V_{CC}

V_{SS} — R_{SS}