

APPLICATION MANUAL

TK14581M

(FM-IF & Demodulation ICs Communication Equipment)

Features

- Maximum input frequency Mixer : 330 MHz, IF : 11 MHz
- Wide RSSI dynamic range
- Demodulation output frequency range DC~100 kHz

- Please note that the content of this application manual is subject to change without notice.

SIGNATURE		DATE	
DRAWN BY <i>I. Fukui</i>		<i>Oct. 4, '95</i>	
CHECKED BY <i>N. Honda</i>		<i>Oct. 4, '95</i>	
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Drawing No. GC3-3010		<i>1</i> / 27	REV B

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1)Description

TK14581M is designed for the Digital telecommunication 's apparatus.
 Input frequency limits, Mixer is up to 330MHz ,IF is up to 11MHz

2)Features

- Low Voltage operating
- Maximum input frequency Mixer: 330MHz IF: 11MHz
- Wide Mixer dynamic range.
- Demodurate output frequency range DC~100kHz.
- Wide RSSI dynamic range. 70dB~80dB at 11MHz

3)Function

- Oscillator,Mixer
- IF amplifier,Limiter amplifier
- Quadrature demodulator
- Battery save pin

4)Structure

Silicon monolithic bipolar integrated circuit

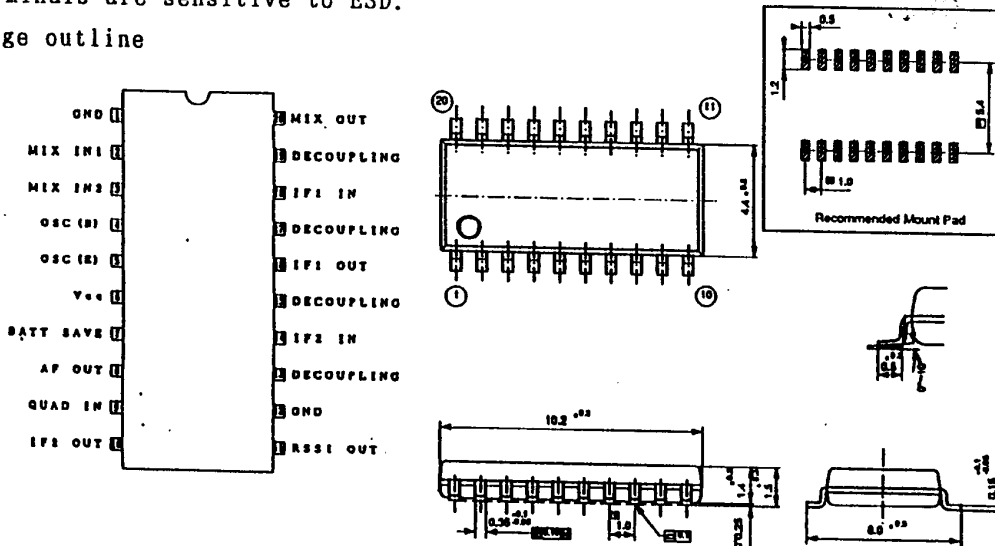
5)Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Rating
Power supply voltage	VccMAX	6V
Storage temperature range	Tstg	-55~+150°C
Operating temperature range	Top	-35~80°C
Operating power supply voltage	Vop	2.5~5.5V
Power dissipation	PD	400mW *
Mixer operating frequency range	fM	~330MHz
IF operating frequency range	fIF	~11MHz
Demodulator operating frequency range	fD	5~11MHz

* Above 25 °C , Power dissipation decreases at rate of 3.2mW/°C

This IC is implemented on a high frequency process, therefore some terminals are sensitive to ESD.

6)Package outline



Electric characteristics

Operating condition: Ta=25°C Vcc=3V

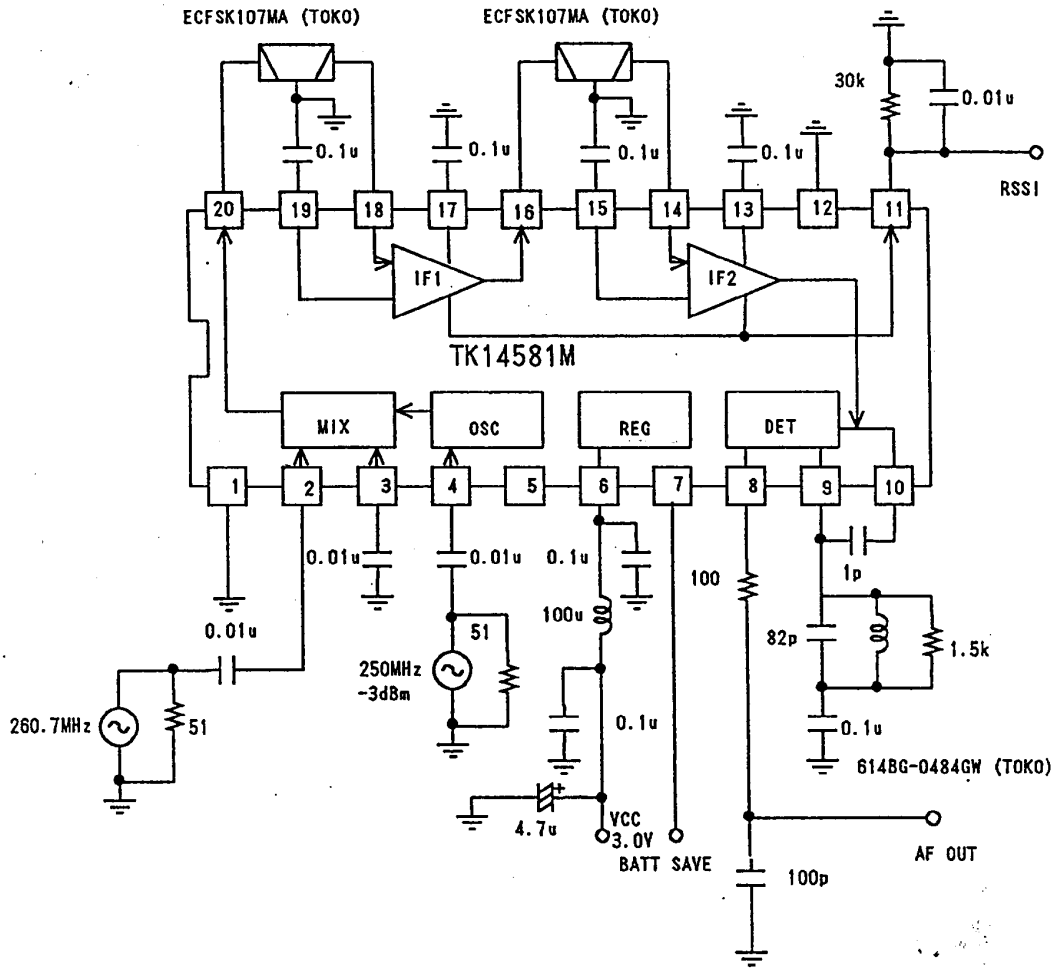
Parameter	Symbol	MIN	TYP	MAX	Unit	Condition
Supply Current 1	Icc 1	4.3	4.9	5.8	mA	None input, B.S OFF
Supply Current 2	Icc 2		1.2	1.9	mA	None input, B.S ON
Mixer Conversion Gain	Gv 1	11	14		dB	f _{RF} =30.7MHz, f _{osc} =20MHz 0dBm
3rd order Intercept	Icp		0		dBm	
Mixer output impedance	Zom		330		ohms	
IF1 gain	Gv 2	47	53		dB	SG3 input f=10.7MHz
IF1 input impedance	Zi 1		330		ohms	
IF1 output impedance	Zo 1		330		ohms	
IF2 gain	Gv 3	68	74		dB	SG4 input f=10.7MHz
IF2 input impedance	Zi 2		330		ohms	
IF2 output level	Vo	400	700		mVp-p	SG4 input f=10.7MHz
Recovered Audio	Vout	80	115	150	mVrms	SG4 input f _{mod} =1kHz Dev=±99kHz
DET frequency range	Bw	100			kHz	SG4 input Dev=±99kHz
RSSI output voltage	S1	0.02	0.22	0.42	V	f=10.7MHz, -120dBm
RSSI output voltage	S2	0.15	0.44	0.69	V	f=10.7MHz, -70dBm
RSSI output voltage	S3	0.69	0.99	1.29	V	f=10.7MHz, -30dBm
RSSI output voltage	S4	0.95	1.25	1.55	V	f=10.7MHz, 0dBm
B.S OFF voltage	Voff	2.0	2.5	Vcc	V	Operating
B.S ON voltage	Von	-0.3	0	0.2	V	None operating

Specification given herein are subject to change without notice.

Please confirm when ordering.

RSSI output voltage is measured, input signal added pin18 and ceramic filter connected between pin16 and pin14.

Evaluation Board Circuit



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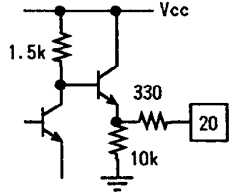
TK14581M PIN DESCRIPTION (1)

PIN	Symbol	Voltage (typ.)	Equivalent circuit	Description
1	GND	0 V		Mixer ground
2 3	MIX IN1 MIX IN2	1.2 V 1.2 V		Mixer input Balance input is available. Connect capacitor between pin 3 and GND, in case unbalance input.
4 5	OSC (B) OSC (E)	2.8 V 2.1 V		Assemble Colpitts crystal oscillator circuit. When using external OSC, inject signal to pin4, and pin5 must be open.
6	Vcc	3.0 V		Supply voltage
7	BATT SAVE	—		Battery save pin. GND : battery save 2.5V~:Operate Icc=1.5mA at GND
8	AF OUT	1.0 V		Recovered audio output
9	QUAD IN	2.8 V		Phase shifter

TK14581M PIN DESCRIPTION (2)

PIN	Symbol	Voltage (typ.)	Equivalent circuit	Description
10	IF2 OUT	1.8V		Limiter amplifier output
11	RSSI OUT	0.3V		Rise time : 1mSec. C = 0.01 μF R = 30 KΩ on battery save
12	IF GND	0V		IF1, IF2 GND
13 14 15	DE- COUPLING IF1 IN DE- COUPLING	1.8V 1.8V 1.8V		Limiter amplifier input. Pin 13 and pin 15 connect to ground by capacitors.
16	IF1 OUT	1.8V		IF amplifier output
17 18 19	DE- COUPLING IF1 IN DE- COUPLING	1.8V 1.8V 1.8V		IF amplifier input. Pin 17 and pin 19 connect to ground by capacitors.

TK14581M PIN DESCRIPTION (3)

PIN	Symbol	Voltage (typ.)	Equivalent circuit	Description
20	MIX OUT	1.7V		Mixer output

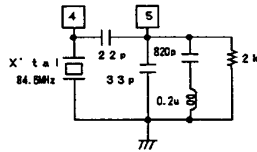
Applications

(1) Mixer

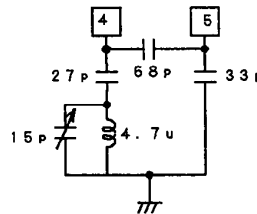
NF is about 10 dB with standard application.

Oscillator is possible to assemble colpitts type.

Some example show as follows.



Vcc=3.0V



Vcc=3.0V

OSC frequency=14MHz

(2) IF amplifier and RSSI

When you use one CF. Connect ceramic filter between IF1 and IF2.

It is profitable on sensitivity and RSSI dynamic range.

RSSI output is current output. Therefore,

It is possible to change RSSI voltage by changing resistor at pin11.

Use variable resistor due to lose irregular.

We are prepared ceramic filter of TOKO ECFSK type.

(3) Demodulator

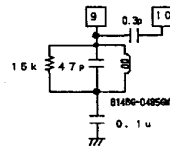
Standard application assume that deviation of digital communication's equipment is more than ± 99 kHz.

TK14581M is possible to detect various deviation with exchange of coil.

We are prepared detector coil of TOKO 5CCD type.

Inform us when using ceramic discriminator.

In case of IF frequency under 4MHz, We are prepared TK14580M.



Vcc=3.0V

MOD DEV= ± 25 kHz

fm=1kHz

AF output voltage=125mVrms

(4) Notice of using

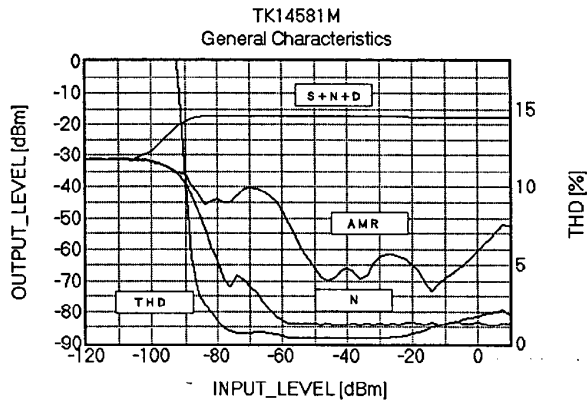
This IC is implemented on a high frequency process, therefore some terminals are sensitive ESD.

Connect around the IC's parts at shortly distance, and decoupling

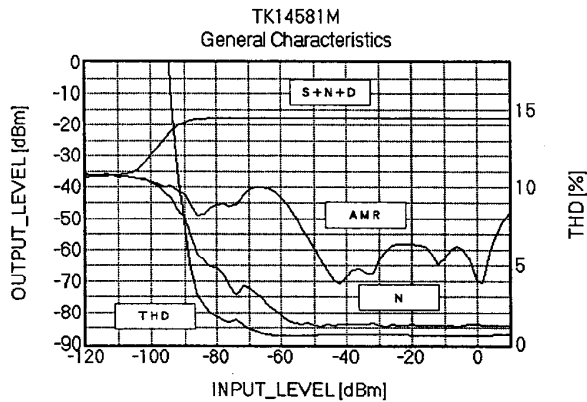
Inductor and capacitor at pin6, due to operate with high frequency and high gain.

We are prepared choke coil of TOKO 32CS type.

Overall Characteristics



Mixer input
 $f_{RF} = 260.7 \text{ MHz}$
 $f_{OSC} = 250 \text{ MHz}$
 (-3 dBm)
 MOD: DEV = $\pm 99 \text{ kHz}$
 $f_m = 1 \text{ kHz}$
 $V_{CC} = 3.0 \text{ V}$



IF1 input
 $f_{RF} = 10.7 \text{ MHz}$
 MOD: DEV = $\pm 99 \text{ kHz}$
 $f_m = 1 \text{ kHz}$
 $V_{CC} = 3.0 \text{ V}$

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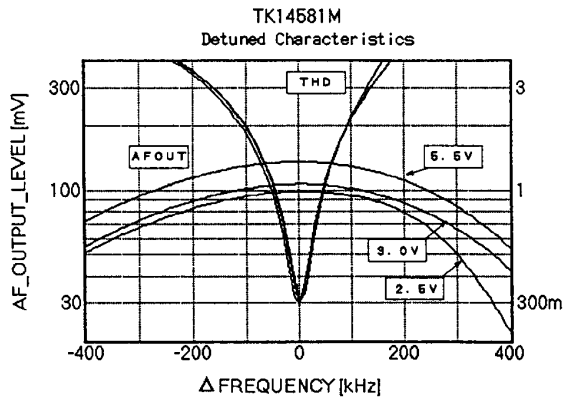
Drawing No.

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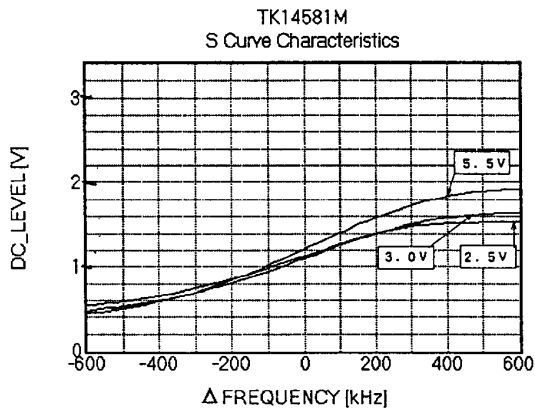
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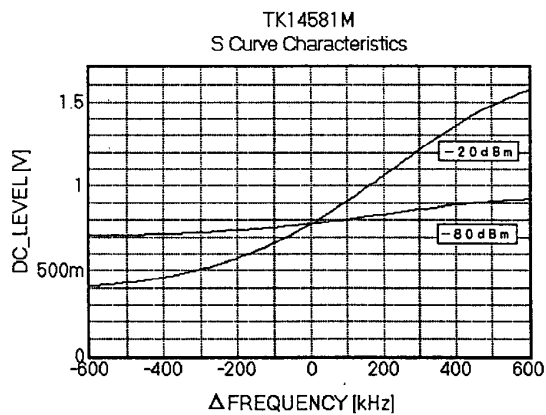
(1) Characteristics depend on supply voltage



IF2 input
 Freq = 10.7 MHz
 LEVEL = -20 dBm
 MOD DEV = ±99 kHz
 fm = 1 kHz

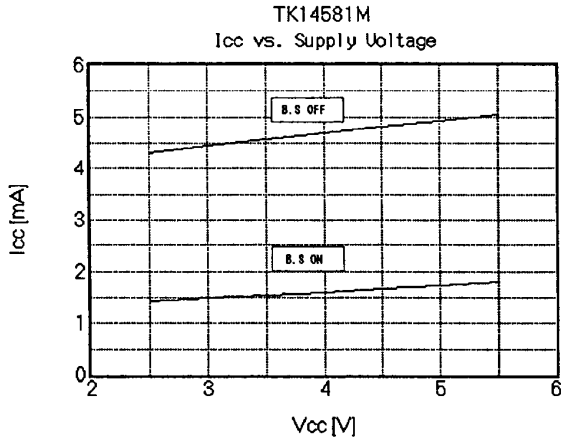


IF2 input
 Freq = 10.7 MHz
 LEVEL = -20 dBm
 MOD : None

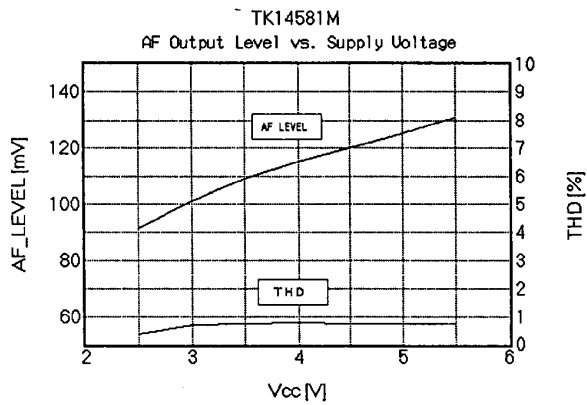


IF2 input
 Freq = 10.7 MHz
 Vcc = 3.0V
 MOD : None

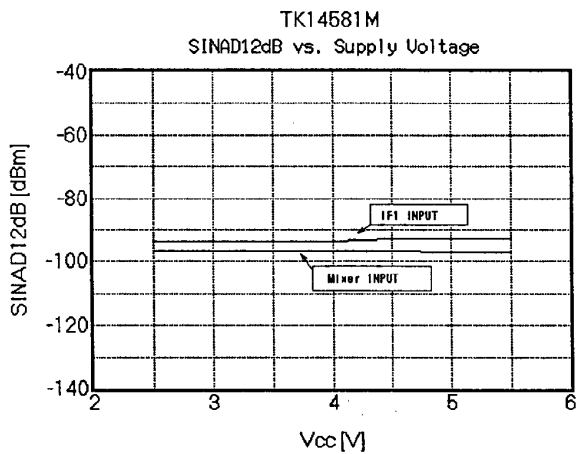
(2) Characteristics depend on supply voltage



None input



IF2 input
 Freq = 10.7 MHz
 Level = -20 dBm
 MOD: DEV = ± 99 kHz
 fm = 1 kHz



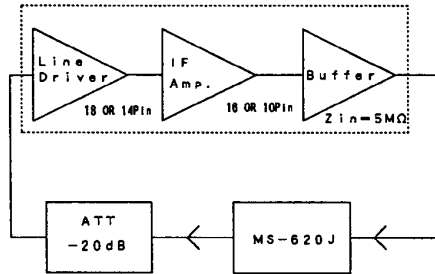
IF1 input
 Freq = 10.7 MHz
 Mixer input
 fRF = 260.7 MHz
 fosc = 250 MHz (-3dBm)
 MOD: DEV = ± 99 kHz
 fm = 1 kHz

IF amplifier characteristics depend on ambient temperature

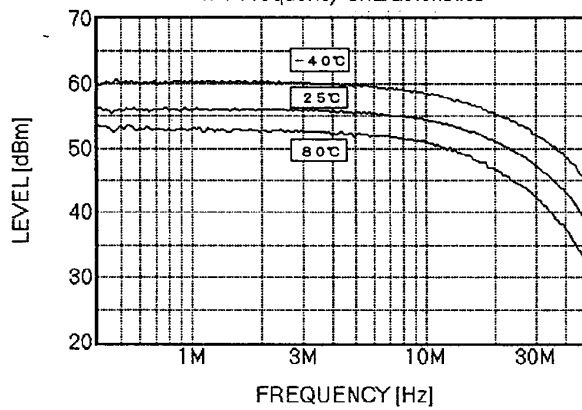
Measurement circuit
Chamber

Measurement condition

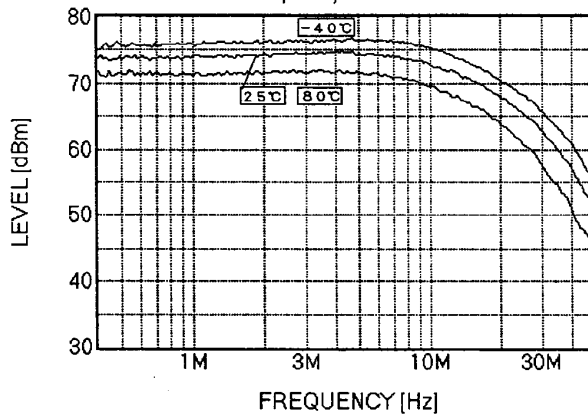
V_{cc} = 3.0 V



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IF1 Frequency Characteristics



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IF2 Frequency Characteristics



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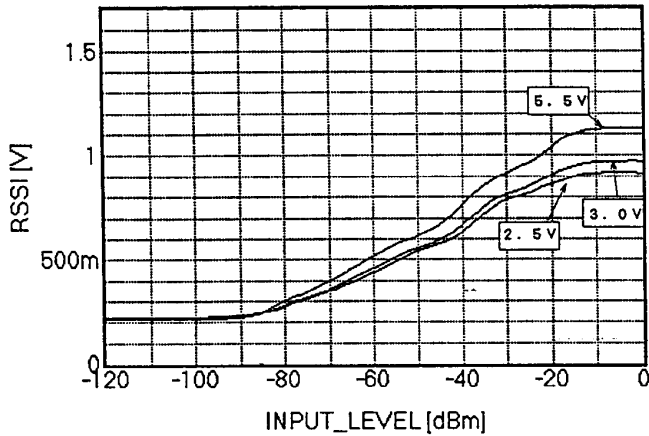
Drawing No. **GC3-3010**

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REV B

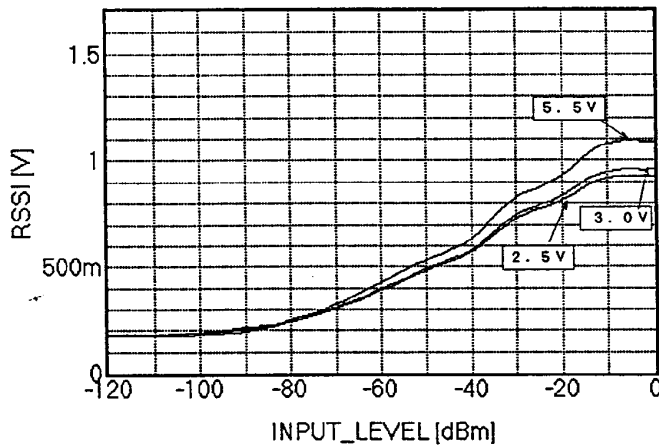
RSSI Characteristics

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RSSI Characteristics



Mixer input
 $f_{RF} = 260.7 \text{ MHz}$
 $f_{OSC} = 250 \text{ MHz}$
 (-3 dBm)
 MOD: None

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RSSI Characteristics



IF1 input
 $f_{RF} = 10.7 \text{ MHz}$
 MOD: None

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Drawing No.

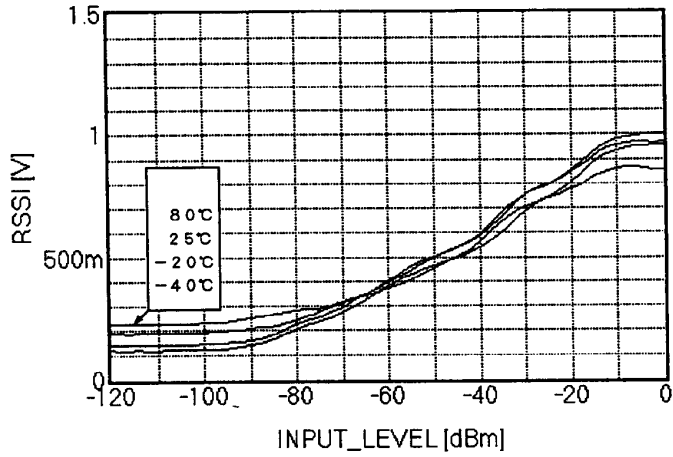
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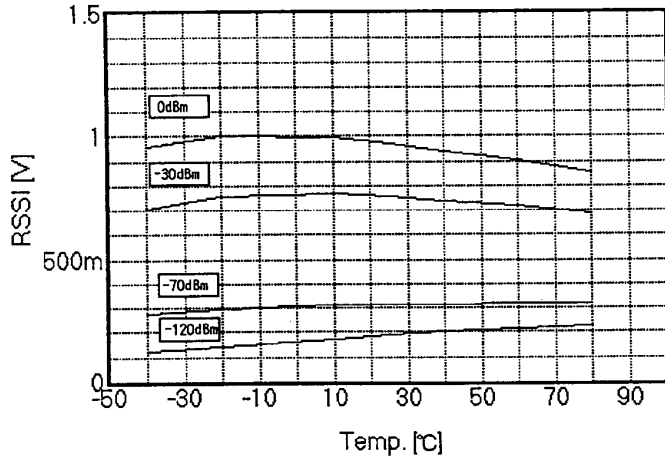
RSSI characteristics depend on ambient temperature

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RSSI Characteristics



Measurement condition
 $V_{cc} = 3.0\text{ V}$
 $f_{RF} = 10.7\text{ MHz}$
 IF1 INPUT
 $CF = \text{CFSK107M1}$
 MOD: None

TK14581M
RSSI Characteristics



Measurement condition
 $V_{cc} = 3.0\text{ V}$
 $f_{RF} = 10.7\text{ MHz}$
 IF1 INPUT
 $CF = \text{CFSK107M1}$
 MOD: None

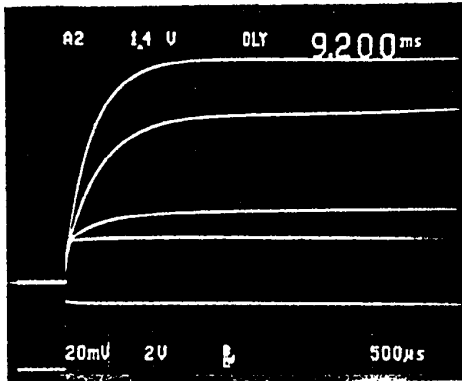
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RSSI Rise Time Characteristics (B.S ON/OFF)

FRF=10.7MHz
 RF INPUT LEVEL=-120,-70,-30, 0dBm
 RSSI RESISTOR=30k
 RSSI SMOOTHING CAPACITOR Cr=0.01uF,1000pF,120pF

1) $C_r = 0.01 \mu F$

RSSI 200mV/DIV
 Vcc 2V/DIV
 Time 500uSec/DIV

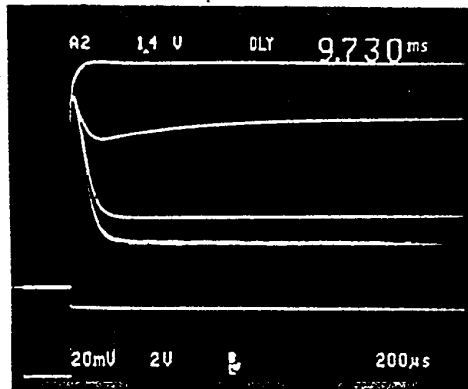


INPUT LEVEL

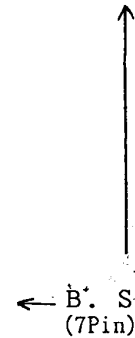


2) $C_r = 1000 p F$

RSSI 200mV/DIV
 Vcc 2V/DIV
 Time 200uSec/DIV

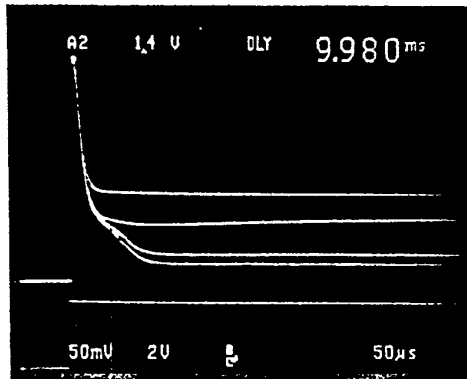


INPUT LEVEL

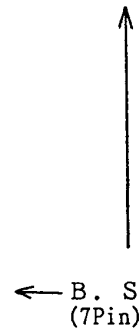


3) $C_r = 120 p F$

RSSI 200mV/DIV
 Vcc 2V/DIV
 Time 50uSec/DIV



INPUT LEVEL

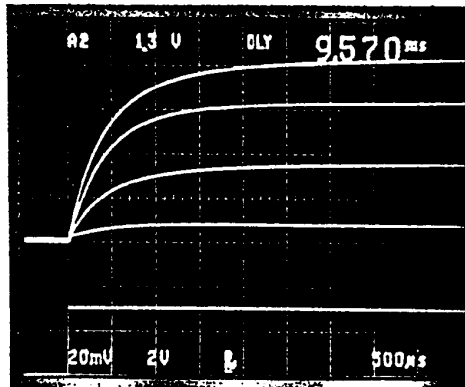


RSSI Rise Time Characteristics (RF INPUT ON/OFF)

FRF=10.7MHz
 RF INPUT LEVEL=-80,-50,-30,-10dBm
 RSSI RESISTOR=30k
 RSSI SMOOTHING CAPACITOR Cr=0.01uF,1000pF,120pF

1) Cr = 0.01 μF

RSSI 200mV/DIV
 Vg 2V/DIV
 Time 500uSec/DIV



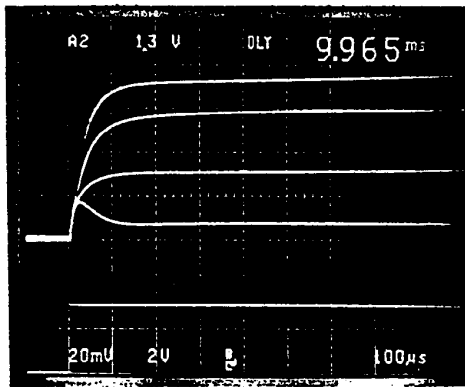
INPUT LEVEL



← GATE PULSE

2) Cr = 1000 pF

RSSI 200mV/DIV
 Vg 2V/DIV
 Time 100uSec/DIV



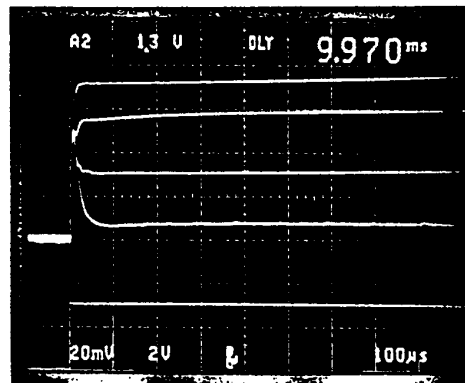
INPUT LEVEL



← GATE PULSE

3) Cr = 120 pF

RSSI 200mV/DIV
 Vg 2V/DIV
 Time 100uSec



INPUT LEVEL



← GATE PULSE

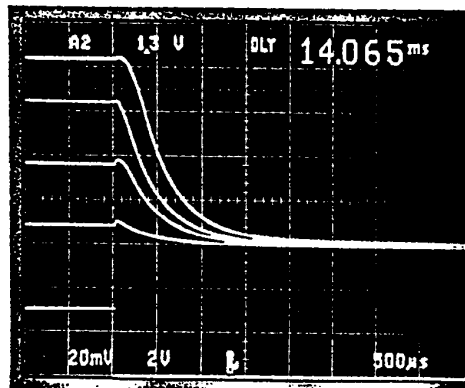
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RSSI Fall Time Characteristics (RF INPUT ON/OFF)

FRF=10.7MHz
 RF INPUT LEVEL=-80,-50,-30,-10dBm
 RSSI RESISTOR=30k
 RSSI SMOOTHING CAPACITOR Cr=0.01uF,1000pF,120pF

1) Cr = 0.01 μF

RSSI 200mSec/DIV
 Vg 2V/DIV
 Time 500uSec/DIV

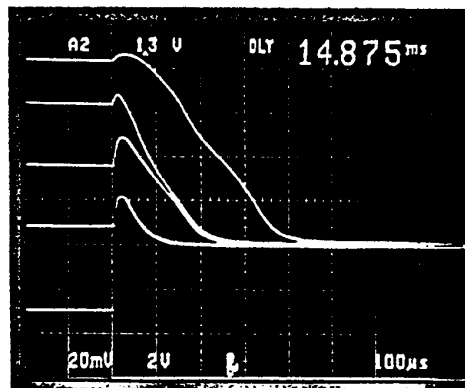


INPUT LEVEL

← GATE PULSE

2) Cr = 1000 pF

RSSI 200mV/DIV
 Vg 2V/DIV
 Time 100uSec/DIV

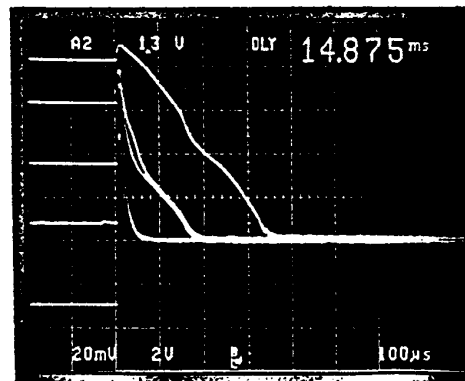


INPUT LEVEL

← GATE PULSE

3) Cr = 120 pF

RSSI 200mV/DIV
 Vg 2V/DIV
 Time 100uSec/DIV



INPUT LEVEL

← GATE PULSE

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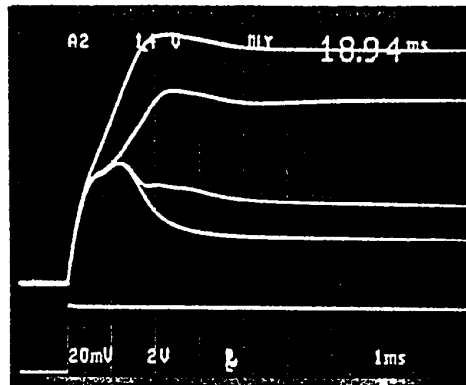
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RSSI Rise Time Characteristics (Vcc ON/OFF)

FRF=10.7MHz
 RF INPUT LEVEL=-120,-70,-30, 0dBm
 RSSI RESISTOR=30k
 RSSI SMOOTHING CAPACITOR Cr=0.01uF,1000pF,120pF

1) $C_r = 0.01 \mu F$

RSSI 200mV/DIV
 Vcc 2V/DIV
 Time 1mSec/DIV

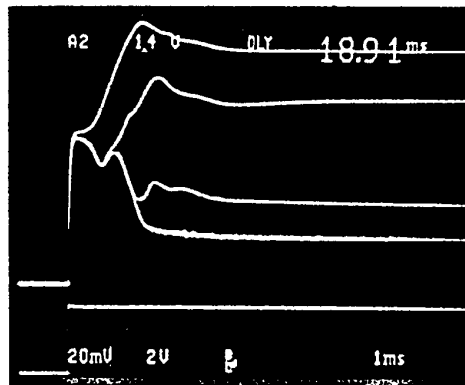


INPUT LEVEL

Vcc (6Pin)

2) $C_r = 1000 pF$

RSSI 200mV/DIV
 Vcc 2V/DIV
 Time 1mSec/DIV

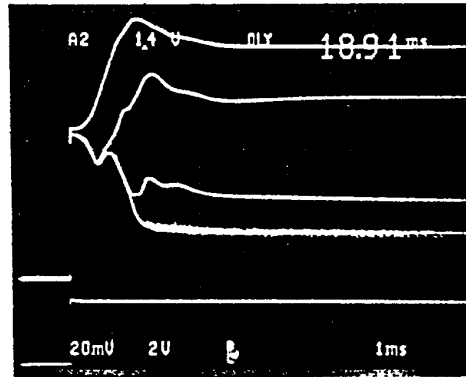


INPUT LEVEL

Vcc (6Pin)

3) $C_r = 120 pF$

RSSI 200mV/DIV
 Vcc 2V/DIV
 Time 1mSec/DIV



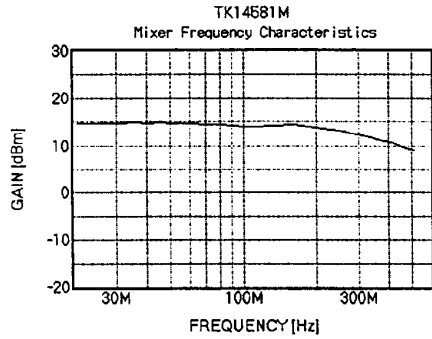
INPUT LEVEL

Vcc (6Pin)

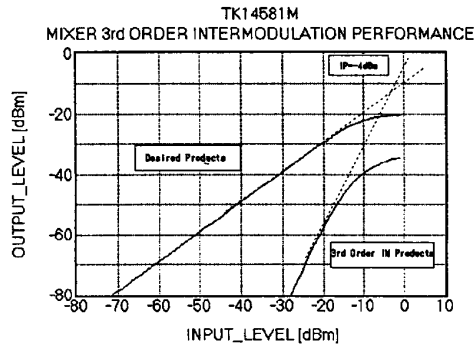
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M I X e r

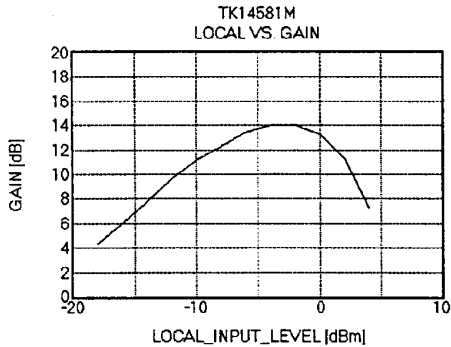
None Load



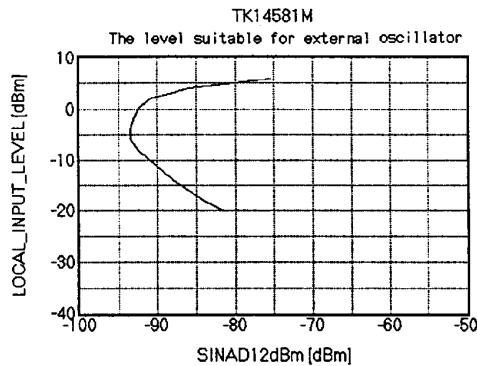
$f_{RF} = f_{OSC} + 10.7 \text{ MHz}$
 Level = -60 dBm
 $f_{OSC} = 10 \text{ MHz} \sim 500 \text{ MHz}$
 Level = -3 dBm
 $V_{CC} = 3.0 \text{ V}$



$f_{RF} = 260.7 \text{ MHz}$
 $f_{RF1} = 260.68 \text{ MHz}$
 $f_{RF2} = 260.69 \text{ MHz}$
 $f_{OSC} = 250 \text{ MHz}$
 Level = -3 dBm
 $V_{CC} = 3.0 \text{ V}$



$f_{RF} = 260.7 \text{ MHz}$
 Level = -60 dBm
 $f_{OSC} = 250 \text{ MHz}$
 $V_{CC} = 3.0 \text{ V}$

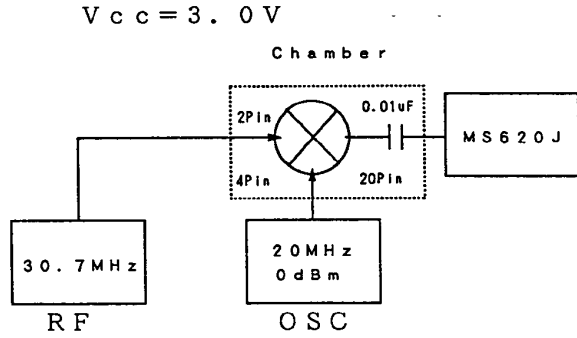


$f_{RF} = 260.7 \text{ MHz}$
 $f_{OSC} = 250 \text{ MHz}$
 $V_{CC} = 3.0 \text{ V}$

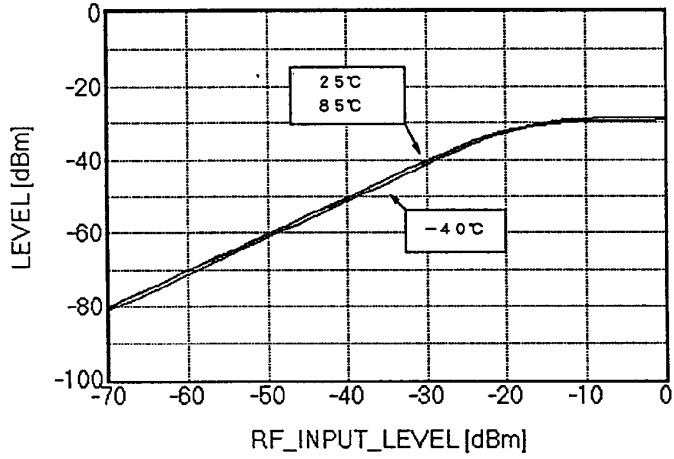
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Mixer dynamic range

Measurement circuit



TK14581M
Mixer Input Output Characteristics



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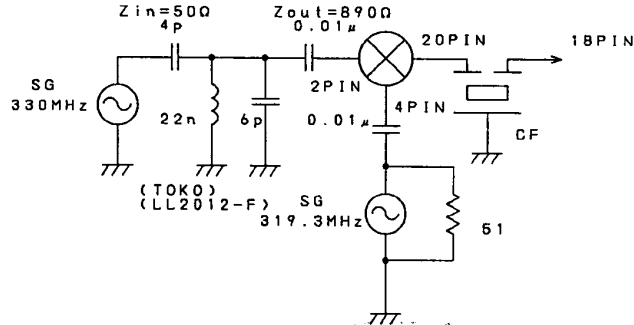
Drawing No.
GC3-3010

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Mixer Characteristics (case of 330MHz input)

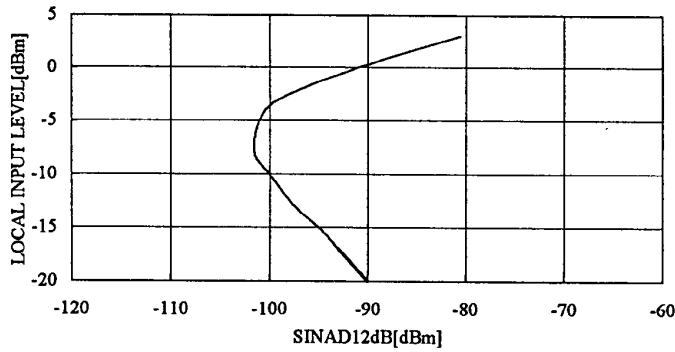
This application circuit shows that, it is possible to operate mixer up to 330MHz, using for receiving part of Keyless entry system, radio microphone and others.

The matching circuit shows as follows.



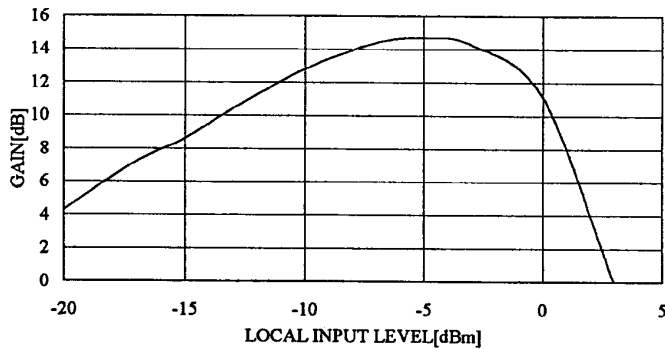
The result of evaluation

The level suitable for external local oscillator



Vcc=3.0V
MOD DEV=±99kHz
fm=1kHz
with C message filter

GAIN VS. LOCAL INPUT LEVEL



Vcc=3.0V
RF LEVEL=-70dBm
opened mixer output
with FET Probe(P6202A).
spectrum analyzer

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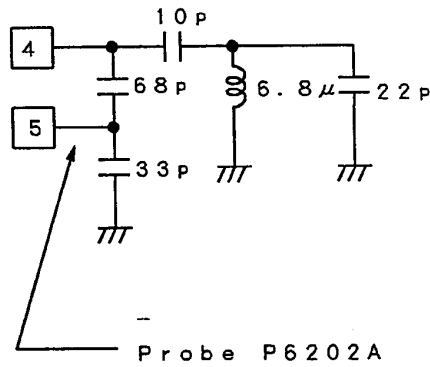
GC3-3010

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REV
B

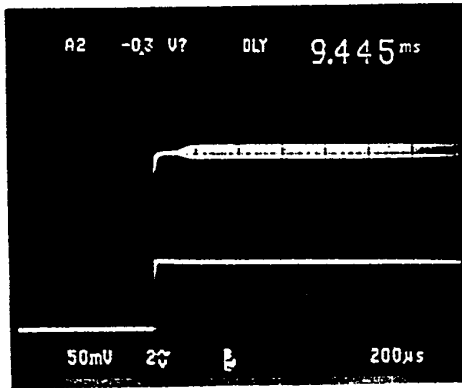
Oscillator Transient Characteristics (Vcc ON/OFF)

Measurement circuit



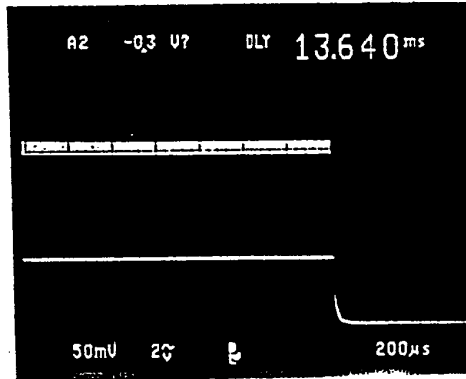
1) Oscillator rise waveforms

OSC LEVEL 500mV/DIV
 Vcc 2V/DIV
 Time 200uSec/DIV



2) Oscillator fall waveforms

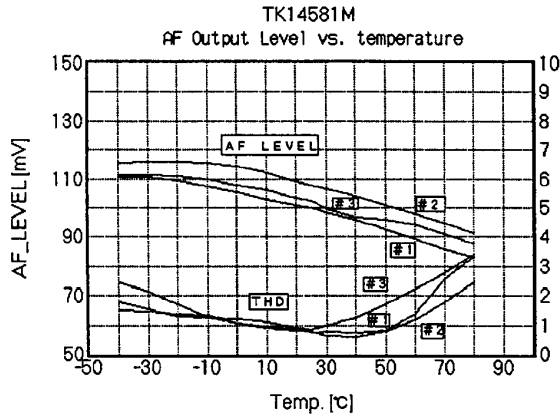
OSC LEVEL 500mV/DIV
 Vcc 2V/DIV
 Time 200uSec/DIV



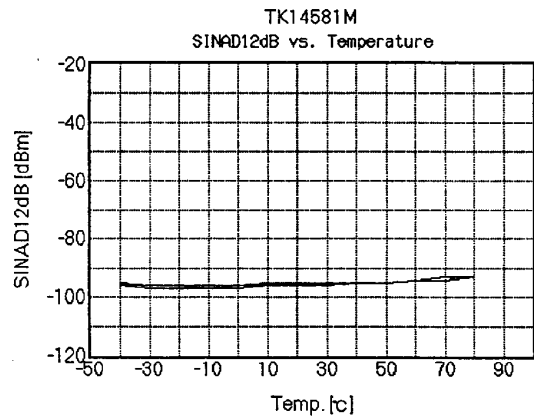
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Characteristics depend on ambient temperature

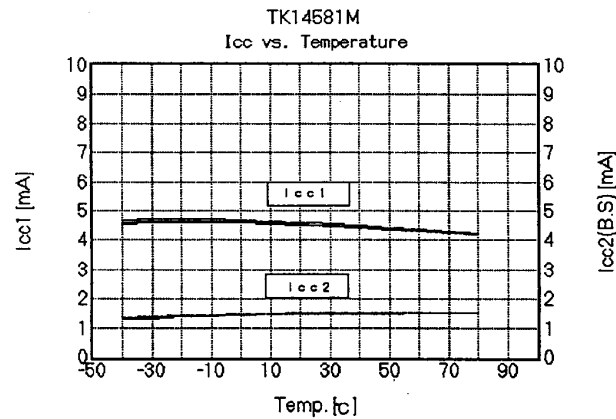
Measurement sample is 3 PCS.



Measurement condition
 $V_{cc} = 3.0V$
 $f_{RF} = 10.7MHz$
 IF1 INPUT
 $CF = CFSK107M1$
 $MOD\ DEV = \pm 99kHz$
 $f_m = 1kHz$



Measurement condition
 $V_{cc} = 3.0V$
 $f_{RF} = 10.7MHz$
 IF1 + IF2
 $CF = CFSK107M1$
 $MOD\ DEV = \pm 99kHz$
 $f_m = 1kHz$



Measurement condition
 $V_{cc} = 3.0V$
 None input

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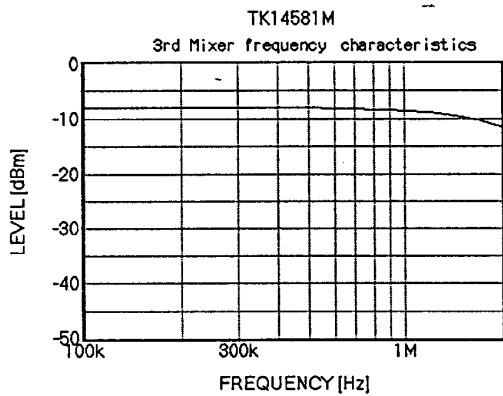
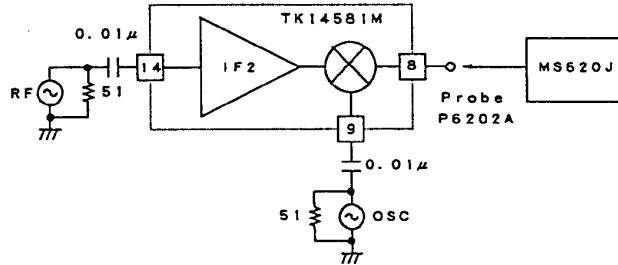
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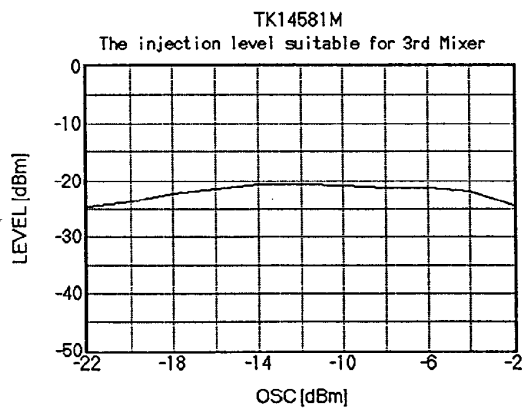
REV
B

(1) AF Output Frequency Characteristics

Measurement circuit



freq = 10.7 MHz
Level = -60 dBm
f OSC = 10.8 ~ 12.7 MHz
Level = -12 dBm
Vcc = 3.0 V



freq = 10.7 MHz
Level = -90 dBm
f OSC = 10.8 MHz
Vcc = 3.0 V

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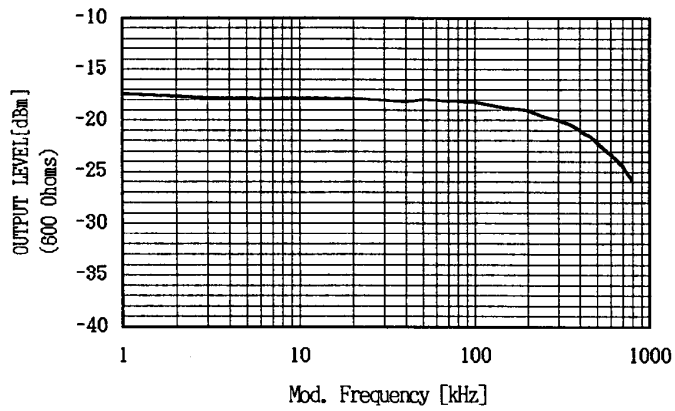
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(2)AF Output Frequency Characteristics

TK14581M AF OUTPUT FREQ. CHARACTERISTICS



IF2 Input
 Vcc=3.0V
 Frequency=10.7MHz
 Input level=-20dBm
 Mod. Dev.=±100kHz

Demodulated band width is determined with external phase-shifter's characteristics.

Above data shows single tune discriminator application.

If more wide demodulated band width is needed, we recommend double-tune type discriminator application.

Internal analog multiplier for discriminator, its frequency response, up to 1MHz.

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○ Additional Items

1. Examples of characteristics given here are typical for each product and being technical data, these do not constitute a guarantee of characteristics or conditions of use.

The circuits shown in this application manual are intended to explain typical applications of the products concerned. Accordingly, TOKO is not responsible for any circuit problems, nor for any infringement of third party patents or any other intellectual property rights that may arise from the use of these circuits. Moreover, this catalog does not signify that TOKO agrees implicitly or explicitly to license any patent rights or other intellectual property rights which it holds.

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