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 J. Fukai	Oct, 4, '95
CHECKED BY N Kondy	Oct. 4. '95
APPROVED BY M. Tanaka	Oct. 4. '95

TOKO Inc.	TOKO P/No.	Drawing No. GC3-3010	1/27	REV B

1)Description

TK14581M is designed for the Digital telecomuniction '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)Stracture

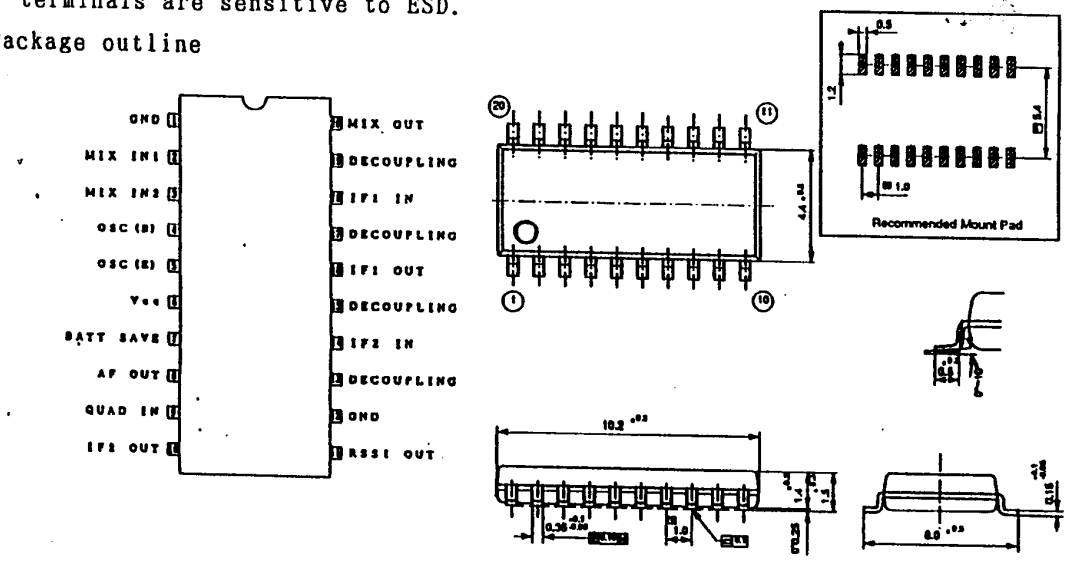
Silicon monolithic bipolar integrated circuit

5)Absolute maximum ratings (Ta=25℃)

Parameter	Symbol	Rating
Power supply voltage	VccMAX	6V
Storage temperature range	Tstg	-55～+150℃
Operating temperature range	Top	-35～80℃
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 ℃ , Power dissipation decreases at rate of 3.2mW/℃
This IC is implemented on a high frequency process, threfore some terminals are sensitive to ESD.

6)Package outline



Electric characteristics Operating condition: Ta=25℃ Vcc=3V

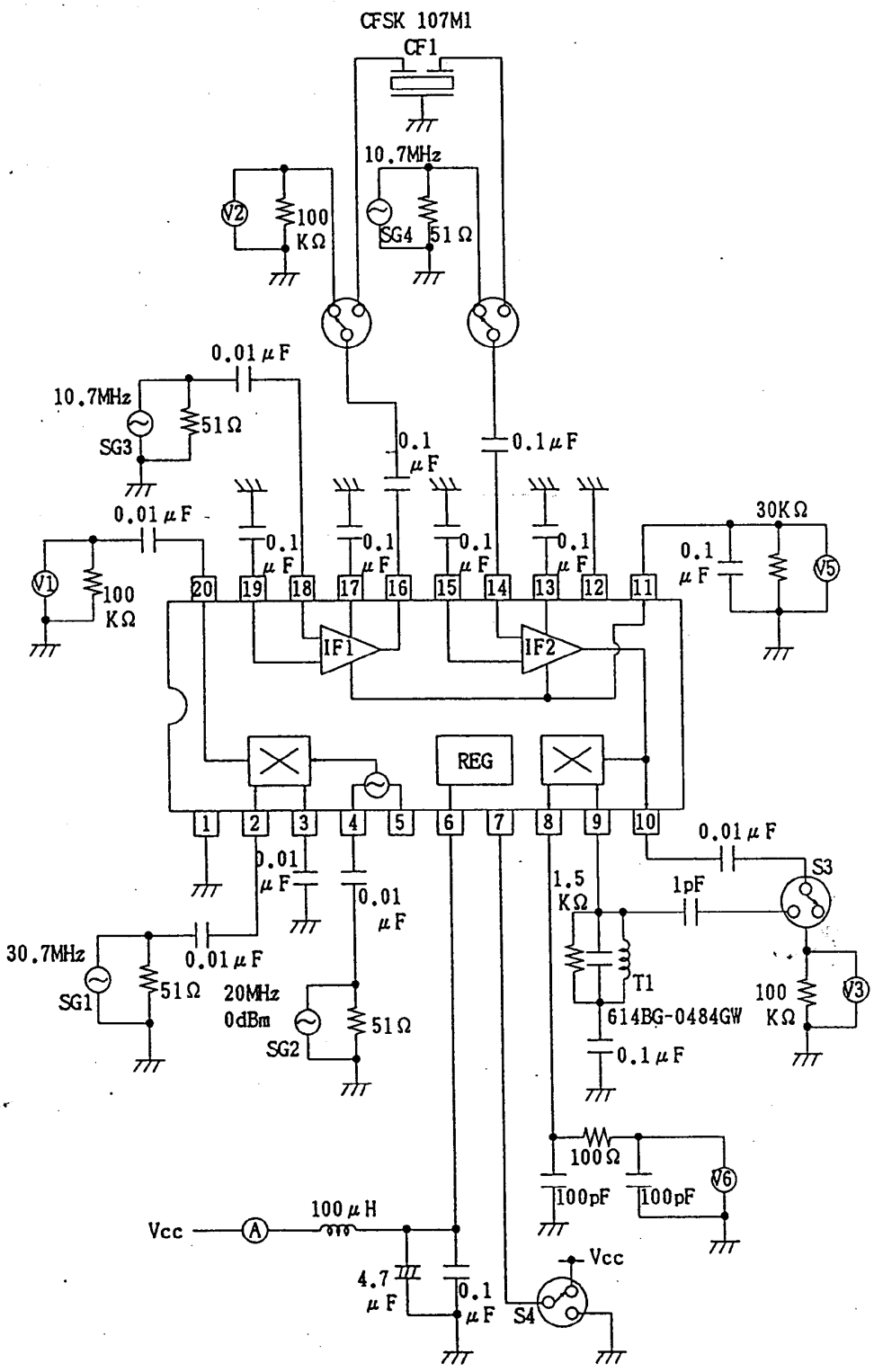
Parameter	Symbol	MIN	TYP	MAX	Unit	Condition
Supply Current 1	Icc 1	4.3	4.9	5.8	mA	None input, B.S OFF
Supply Current 2	Icc 2		1.2	1.9	mA	None input, B.S ON
Mixer Conversion Gain	Gv 1	11	14		dB	f_{RF}=30.7MHz, f_{OSC}=20MHz 0dBm
3rd order Intercept	Icp		0		dBm	
Mixer output impedance	Zom		330		ohms	
IF1 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.

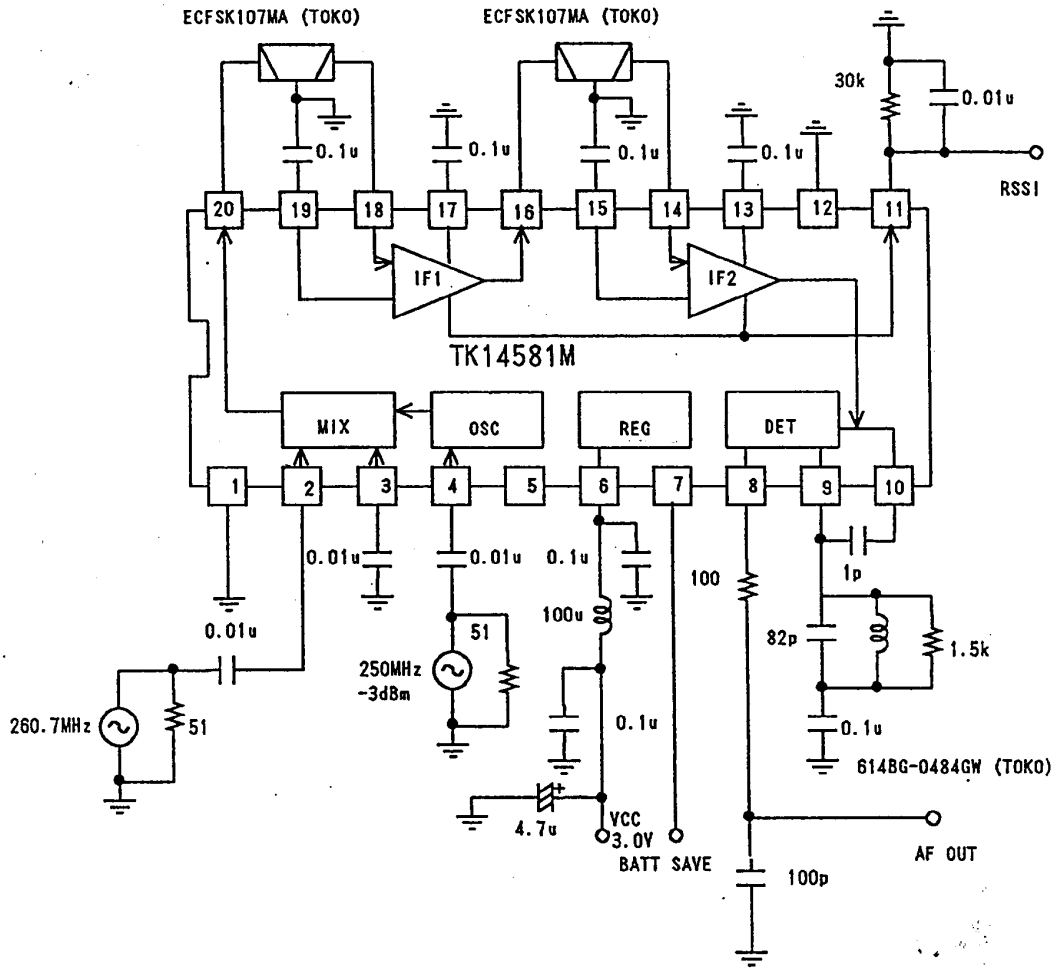
RSSI output voltage is measured, input signal added pin18 and ceramic filter connected between pin16 and pin14.

Test Circuit / Block Diagram



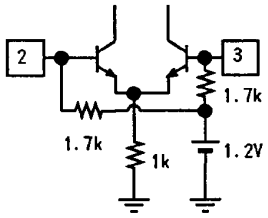
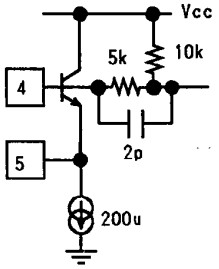
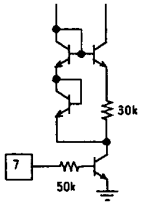
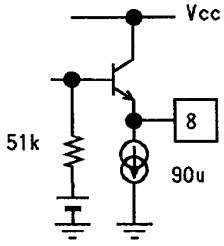
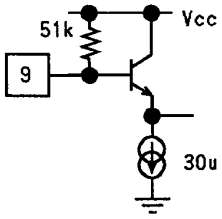
TOKO INC.	TOKO P/No. TK14581M	Drawing No. GC3-3010	4/27	REV B

Evaluation Board Circuit

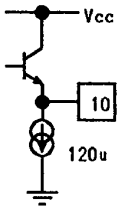
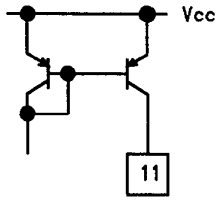
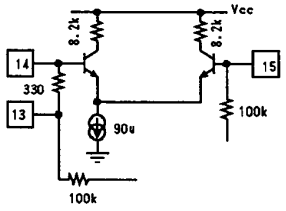
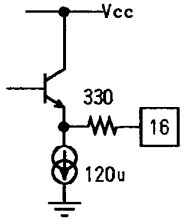
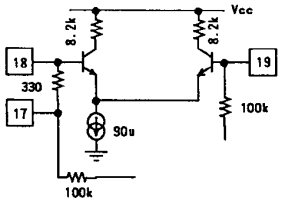


TOKO INC.	TOKO P/No. TK14581M	Drawing No. GC3-3010	5/27	REV B

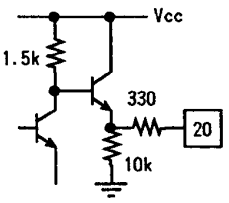
TK14581M PIN DESCRIPTION (1)

PIN	Symbol	Voltage (typ.)	Equivalent circuit	Description
1	GND	0V		Mixer ground
2 3	MIX IN1 MIX IN2	1.2V 1.2V		Mixer input Balance input is available. Connect capacitor between pin 3 and GND, in case unbalance input.
4 5	OSC (B) OSC (E)	2.8V 2.1V		Assemble Colpitts crystal oscillator circuit. When using external OSC, inject signal to pin4, and pin5 must be open.
6	Vcc	3.0V		Supply voltage
7	BATT SAVE	——		Battery save pin. GND : battery save 2.5V～:Operate Icc=1.5mA at GND
8	AF OUT	1.0V		Recovered audio output
9	QUAD IN	2.8V		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=0.01μF R=30KΩ 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.

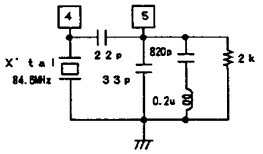
TK14581M PIN DESCRIPTION (3)

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

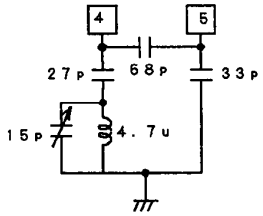
Applications

(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



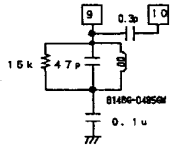
Vcc=3.0V
OSC frequency=14MHz

(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 irregurar.
We are prepared ceramic filter of TOKO ECFSK type.

(3) Demodulator

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

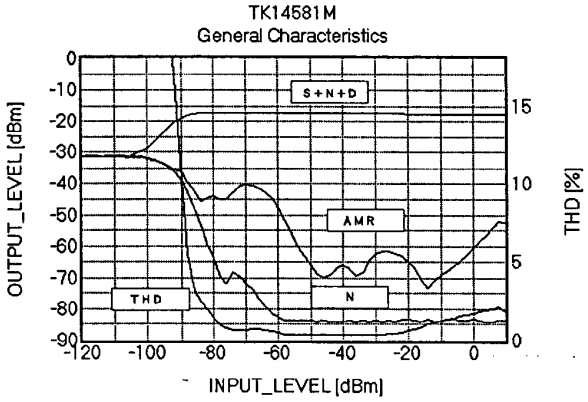


Vcc=3.0V
MOD DEV=±25kHz
fm=1kHz
AF output voltage=125mVrms

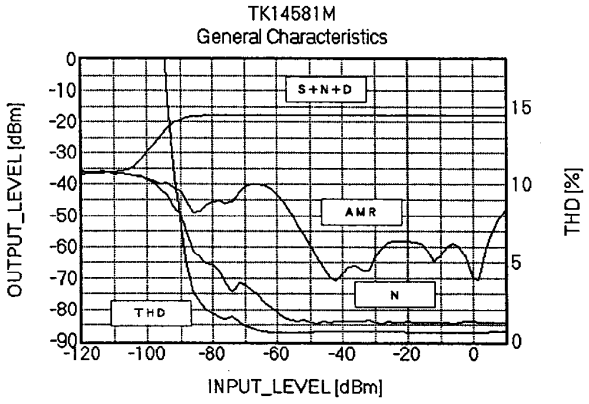
(4) Notice of using

This IC is implemented on a high frequency process, threfore some terminals are sensitive ESD.
Connct arround the IC's parts at shortly distance, and decoupling Inductor and capasitor at pin6, due to operate with high frequency and high gain.
We are prepared choke coil of TOKO 32CS type.

Overall Characterisics



Mixer input
fRF=260.7MHz
fOSC=250MHz
(−3dBm)
MOD : DEV=±99kHz
fm=1kHz
Vcc=3.0V



IF1 input
fRF=10.7MHz
MOD : DEV=±99kHz
fm=1kHz
Vcc=3.0V

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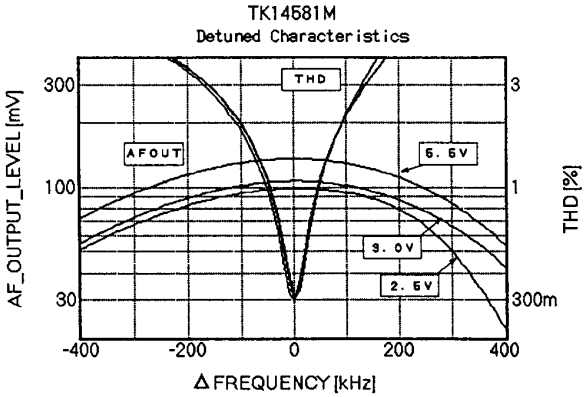
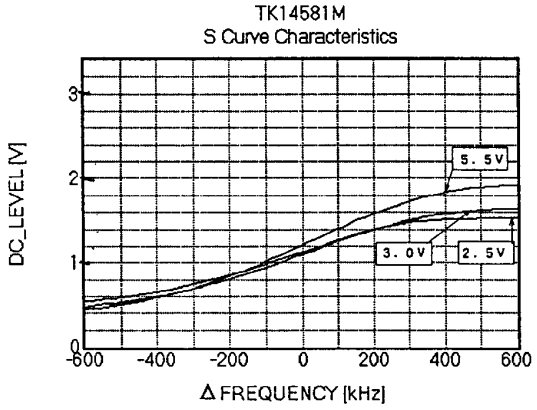
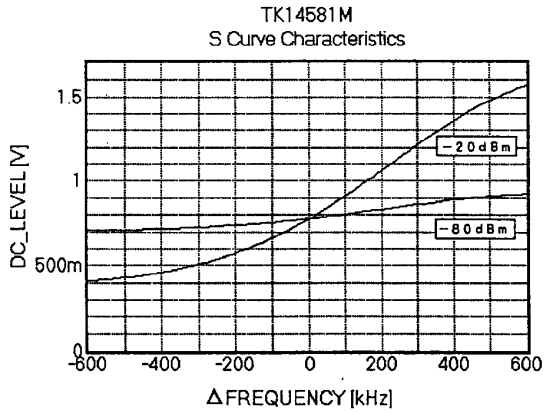
(1) Characteristics depend on supply voltage



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

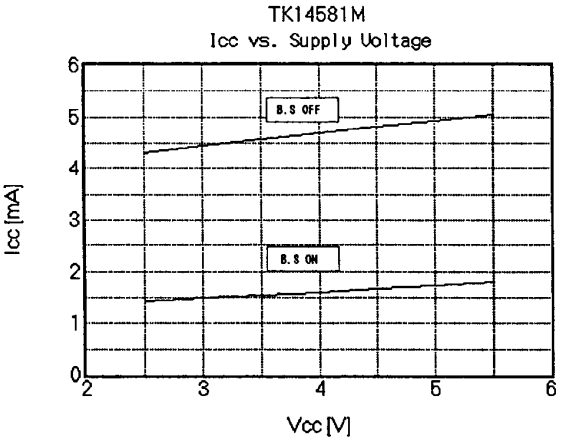


IF2 input
Freq=10.7MHz
LEVEL=−20dBm
MOD:None

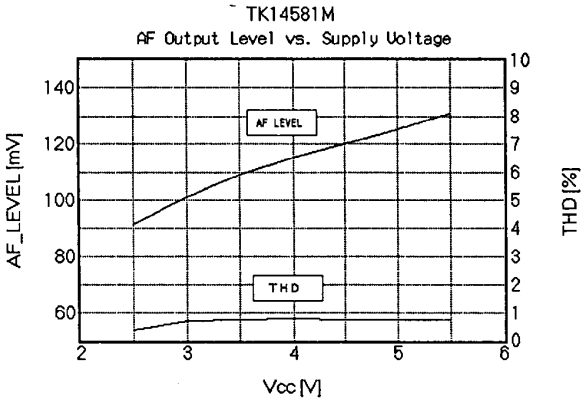


IF2 input
Freq=10.7MHz
Vcc=3.0V
MOD:None

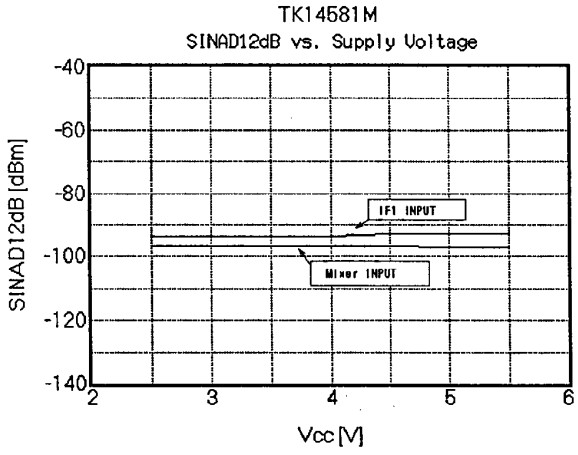
(2) Characteristics depend on supply voltage



None input



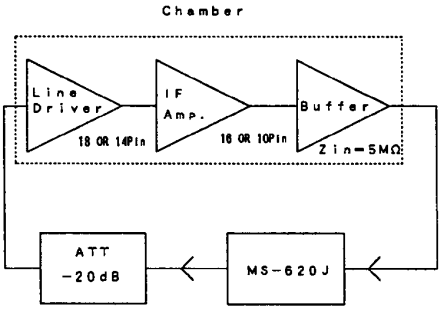
IF2 input
Freq=10.7MHz
Level=-20dBm
MOD : DEV=±99kHz
fm=1kHz



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

IF amplifier characteristics depend on ambient temperature

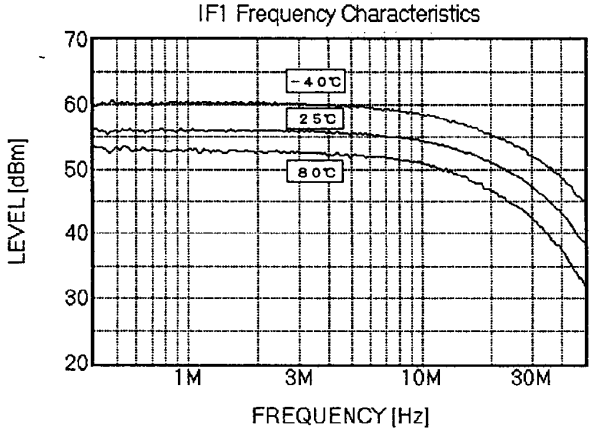
Measurement circuit



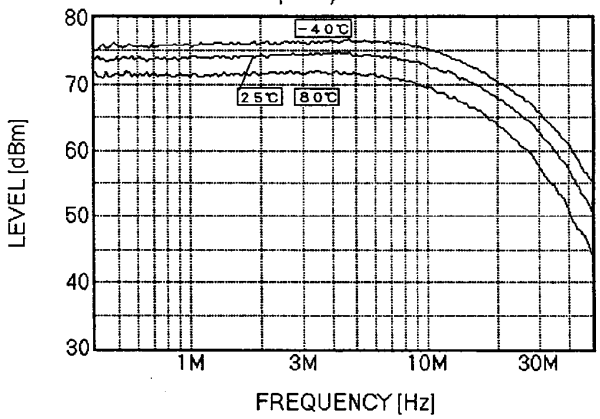
Measurement condition

Vcc=3.0V

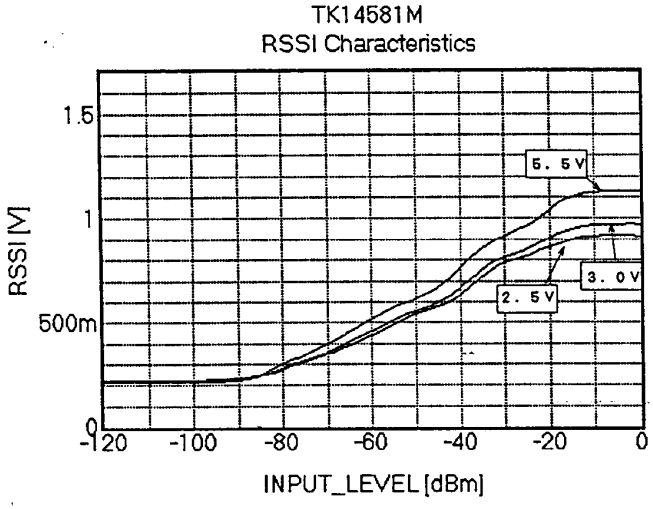
TK14581M
IF1 Frequency Characteristics



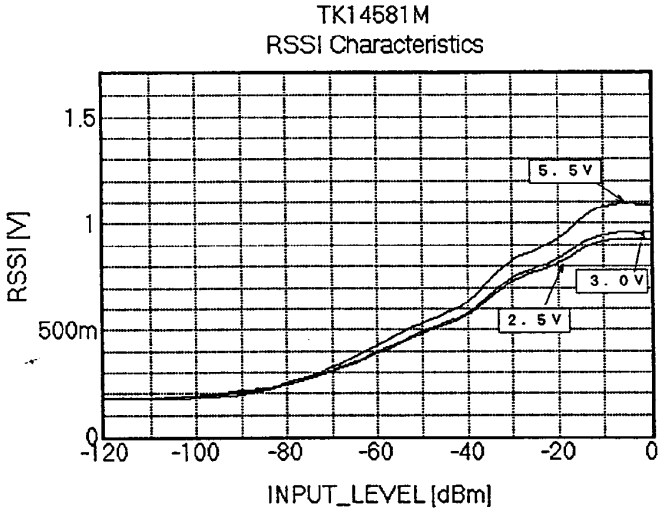
TK14581M
IF2 Frequency Characteristics



RSSI Characteristics



Mixer input
fRF=260.7MHz
fOSC=250MHz
(−3dBm)
MOD:None



IF1 input
fRF=10.7MHz
MOD:None

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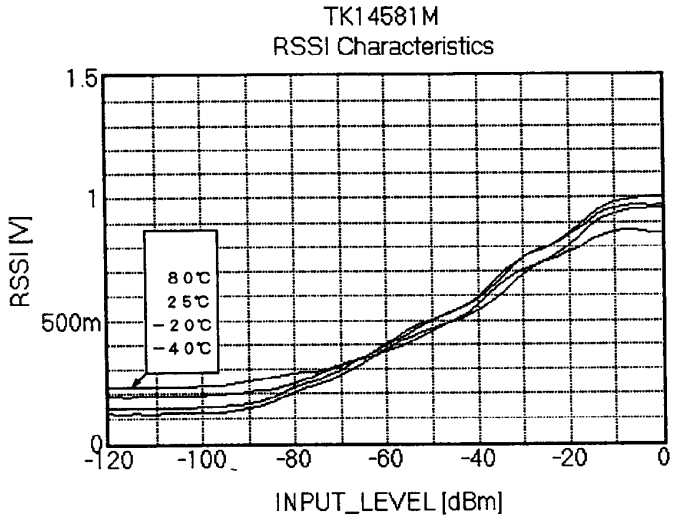
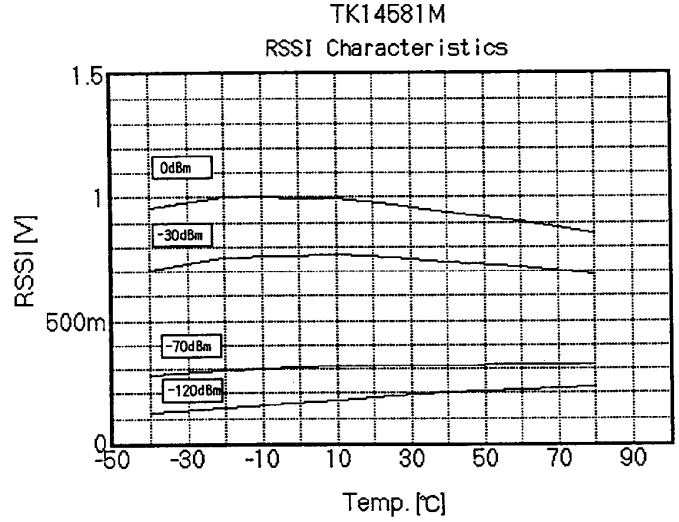
RSSI characteristics depend on ambient temperature



Measurement condition
Vcc=3.0V
fRF=10.7MHz
IF1 INPUT
CF=CFSK107M1
MOD: None



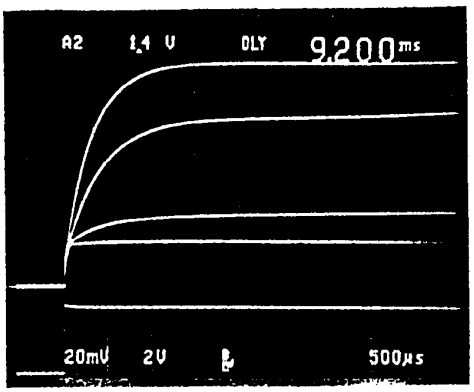
Measurement condition
Vcc=3.0V
fRF=10.7MHz
IF1 INPUT
CF=CFSK107M1
MOD: None

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) Cr=0.01μF

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

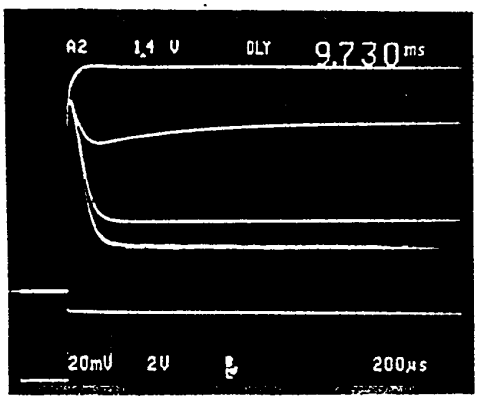


INPUT LEVEL

← B. S (7Pin)

2) Cr=1000pF

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

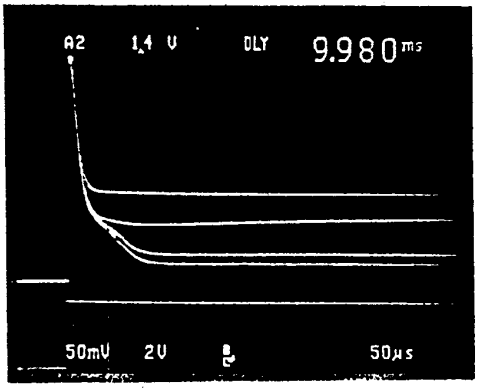


INPUT LEVEL

← B. S (7Pin)

3) Cr=120pF

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



INPUT LEVEL

← B. S (7Pin)

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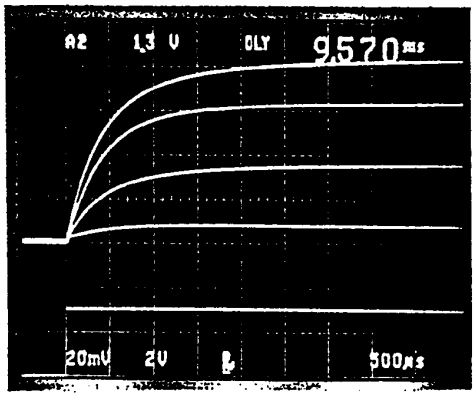
RSSI Rise Time Characteristics (RF INPUT ON/OFF)

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

1) Cr=0.01μF

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

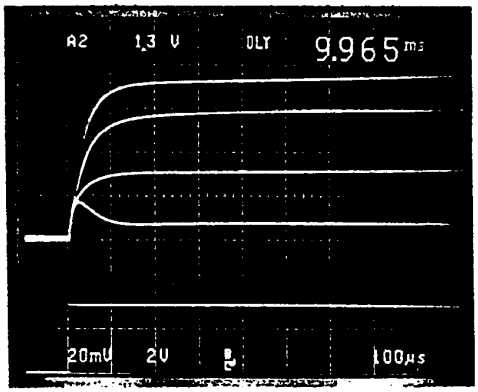


INPUT LEVEL

← GATE PULSE

2) Cr=1000pF

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

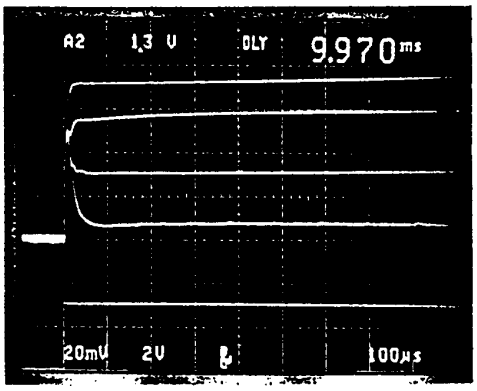


INPUT LEVEL

← GATE PULSE

3) Cr=120pF

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



INPUT LEVEL

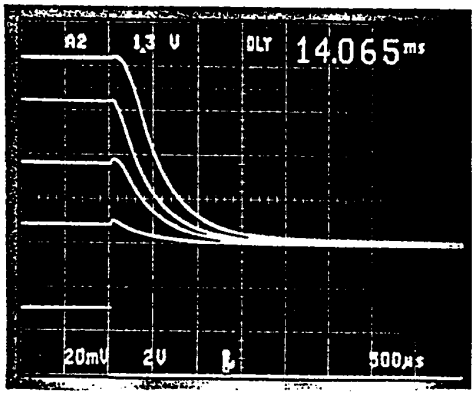
← GATE PULSE

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=0.01μF

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

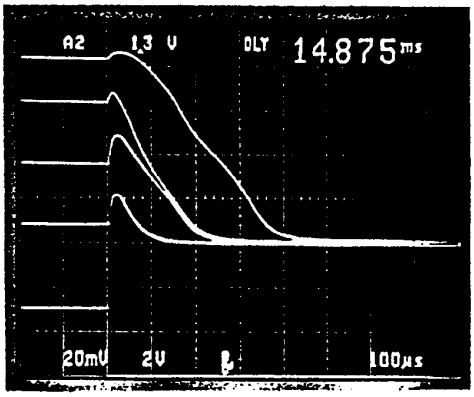


INPUT LEVEL

← GATE PULSE

2) Cr=1000pF

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

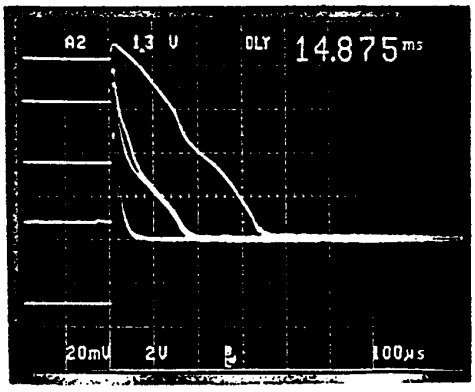


INPUT LEVEL

←GATE PULSE

3) Cr=120pF

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



INPUT LEVEL

← GATE PULSE

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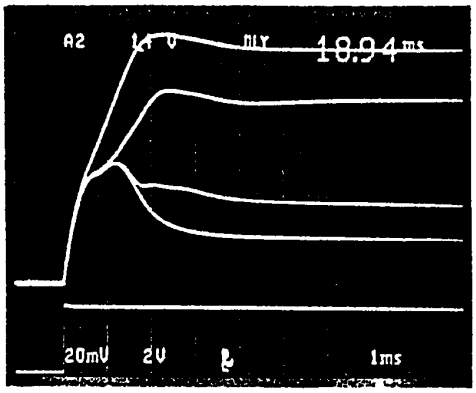
RSSI Rise Time Characteristics (Vcc ON/OFF)

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

1) Cr=0.01μF

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

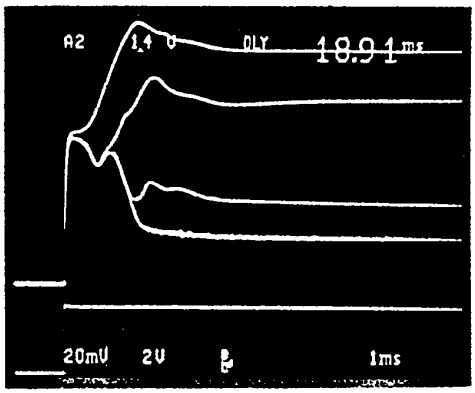


INPUT LEVEL

← Vcc (6Pin)

2) Cr=1000pF

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

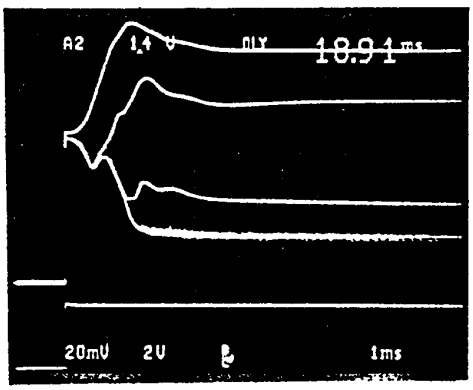


INPUT LEVEL

← Vcc (6Pin)

3) Cr=120pF

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

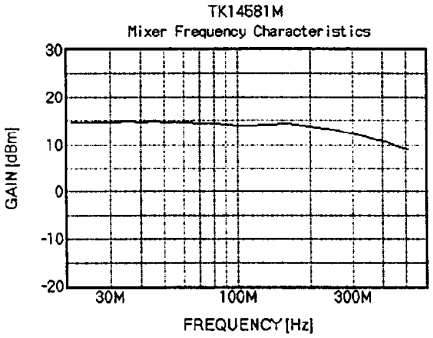


INPUT LEVEL

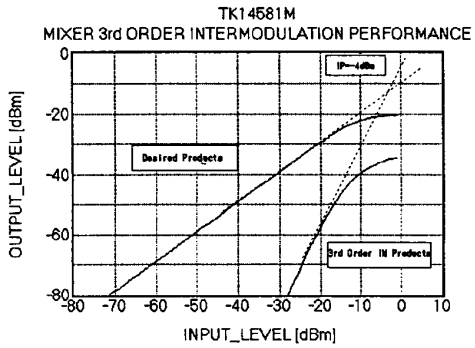
← Vcc (6Pin)

M I X e r

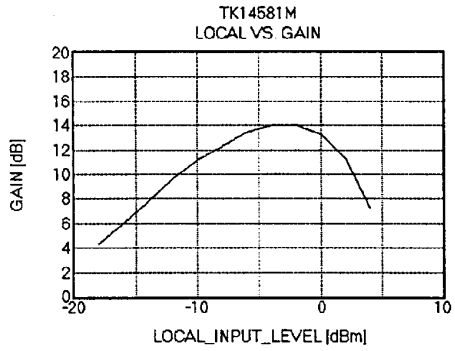
None Load



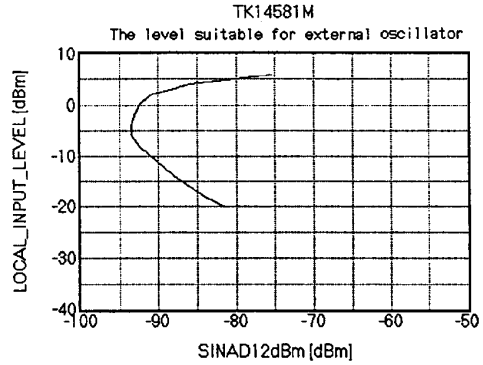
f RF = f OSC + 1 0 . 7 M H z
L e v e l = − 6 0 d B m
f OSC = 1 0 M H z ～ 5 0 0 M H z
L e v e l = − 3 d B m
V c c = 3 . 0 V



f RF = 2 6 0 . 7 M H z
f RF1 = 2 6 0 . 6 8 M H z
f RF2 = 2 6 0 . 6 9 M H z
f OSC = 2 5 0 M H z
L e v e l = − 3 d B m
V c c = 3 . 0 V



f RF = 2 6 0 . 7 M H z
L e v e l = − 6 0 d B m
f OSC = 2 5 0 M H z
V c c = 3 . 0 V

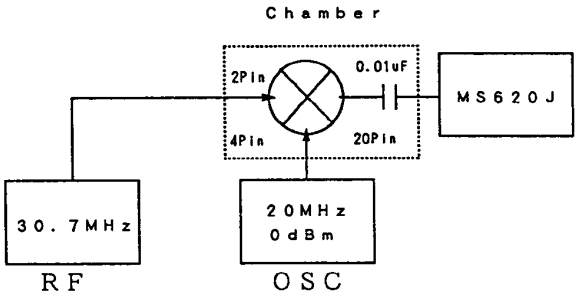


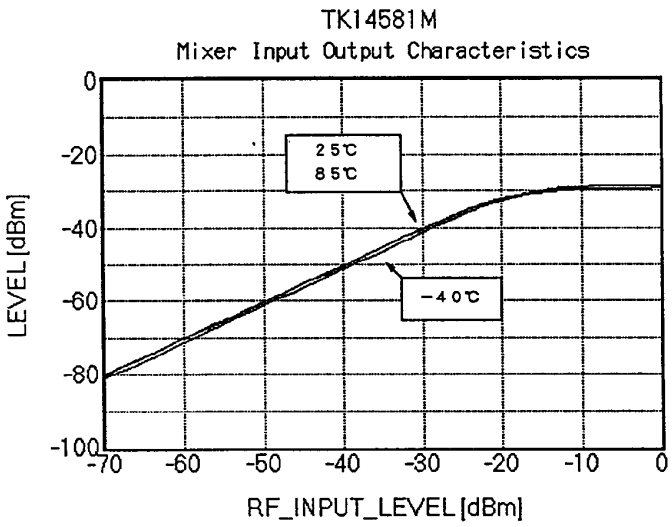
f RF = 2 6 0 . 7 M H z
f OSC = 2 5 0 M H z
V c c = 3 . 0 V

Mixer dynamic range

Measurement circuit

Vcc=3.0V

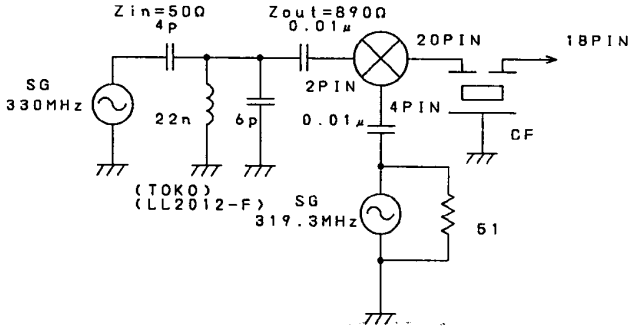




Mixer Characteristics (case of 330MHz input)

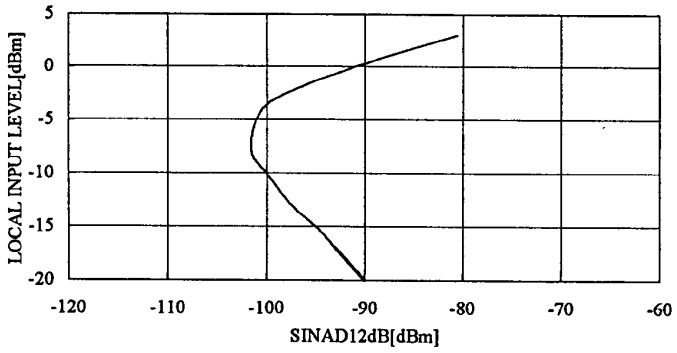
This application circuit shows that, it is possible to operate mixer up to 330MHz, using for receiving part of Keyless entry system, radio microphone and others.

The matching circuit shows as follows.



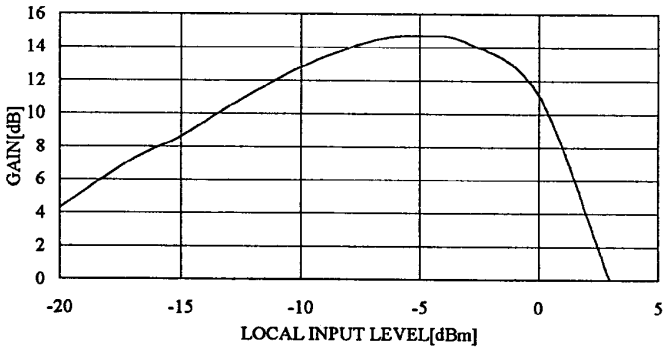
The result of evaluation

The level suitable for external local oscilator



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

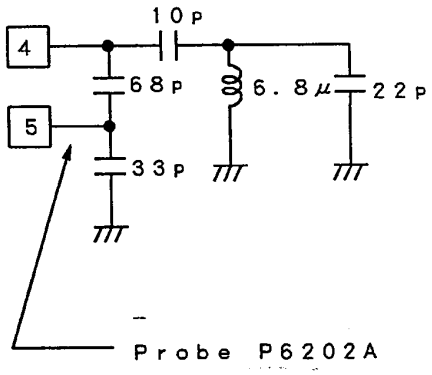
GAIN VS. LOCAL INPUT LEVEL



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

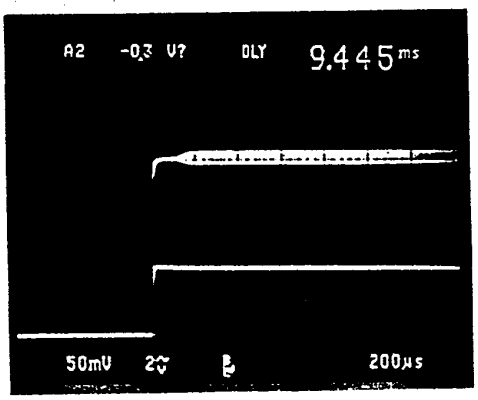
Oscillator Transient Characteristics (Vcc ON/OFF)

Measurement circuit



1) Oscillator rise waveforms

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

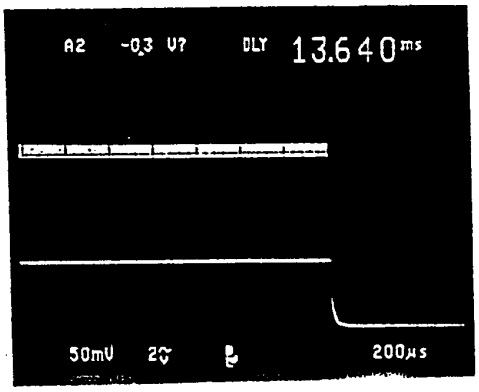


OSC LEVEL

Vcc

2) Oscillator fall waveforms

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



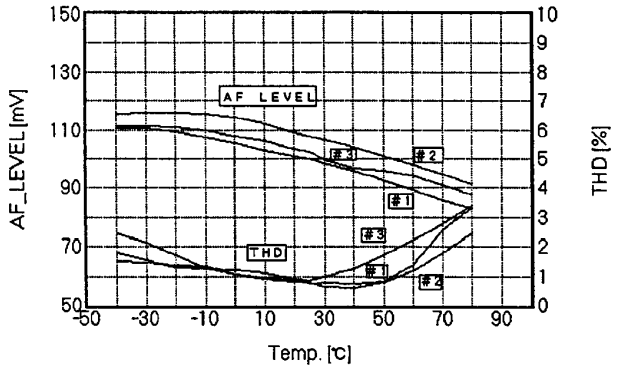
OSC LEVEL

Vcc

Characteristics depend on ambient temperature

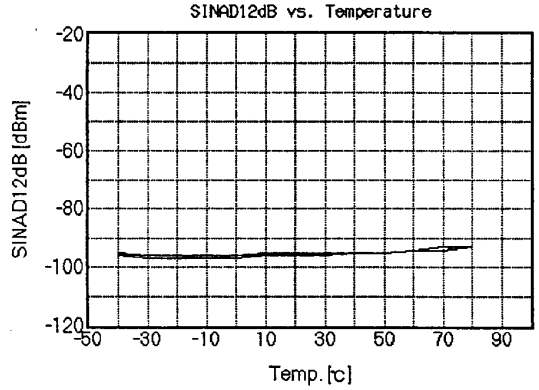
Measurement sample is 3 PCS.

TK14581M
AF Output Level vs. temperature



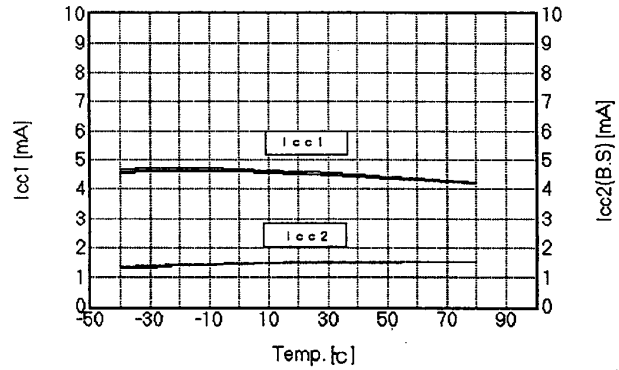
Measurement condition
Vcc=3.0V
fRF=10.7MHz
IF1 INPUT
CF=CFSK107M1
MOD DEV=±99kHz
fm=1kHz

TK14581M
SINAD12dB vs. Temperature



Measurement condition
Vcc=3.0V
fRF=10.7MHz
IF1+IF2
CF=CFSK107M1
MOD DEV=±99kHz
fm=1kHz

TK14581M
Icc vs. Temperature

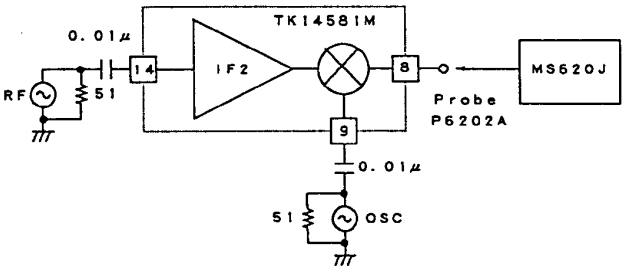


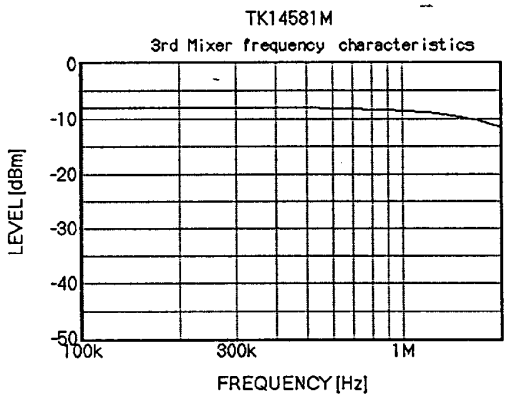
Measurement condition
Vcc=3.0V
None input

TOKO INC.	TOKO P/No. TK14581M	Drawing No. GC3-3010	24/27	REV B

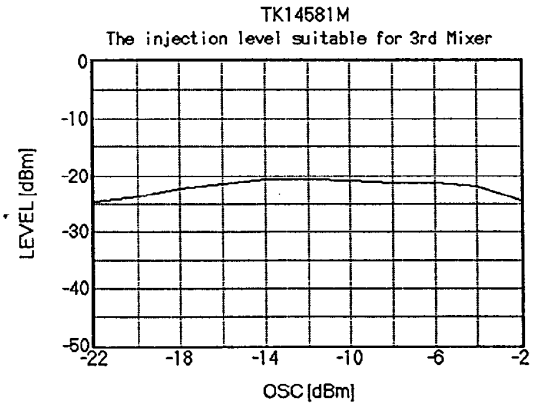
(1) AF Output Frequency Characteristics

Measurement circuit



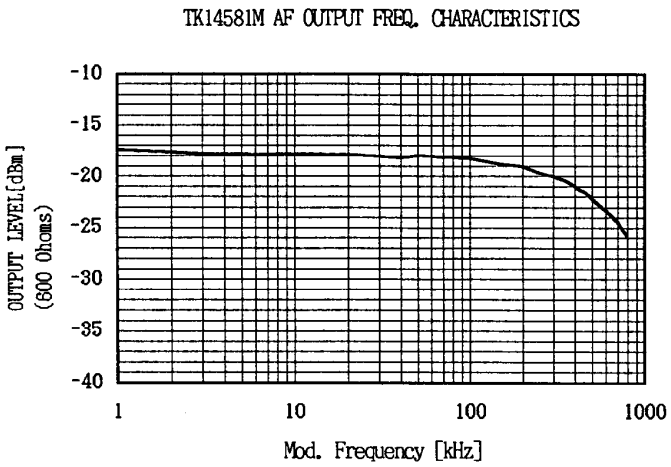


freq=10.7MHz
Level=-60dBm
fOSC=10.8~12.7MHz
Level=-12dBm
Vcc=3.0V



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

(2)AF Output Frequency Characteristics



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

Demodurated band width is determined with external phase-shifter's characteristics.
Above data shows single tune discriminator application.
If more wide demodurated band width is needed, we recommend double-tune type discriminator application.
Internal analog multiplier for discriminator, its frequency response, up to 1MHz.

○ 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.
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