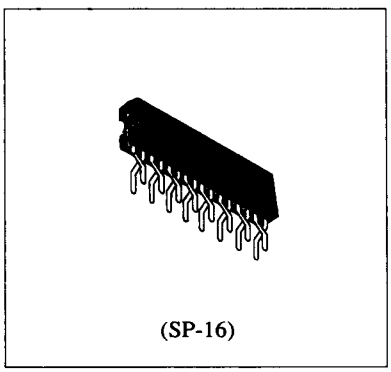
HA12442V

Narrow Band Width FM-IF

The HA12442V is an IC designed for narrow band width FM-IF and is available for 58 MHz. It provides the following functions and features.

Functions

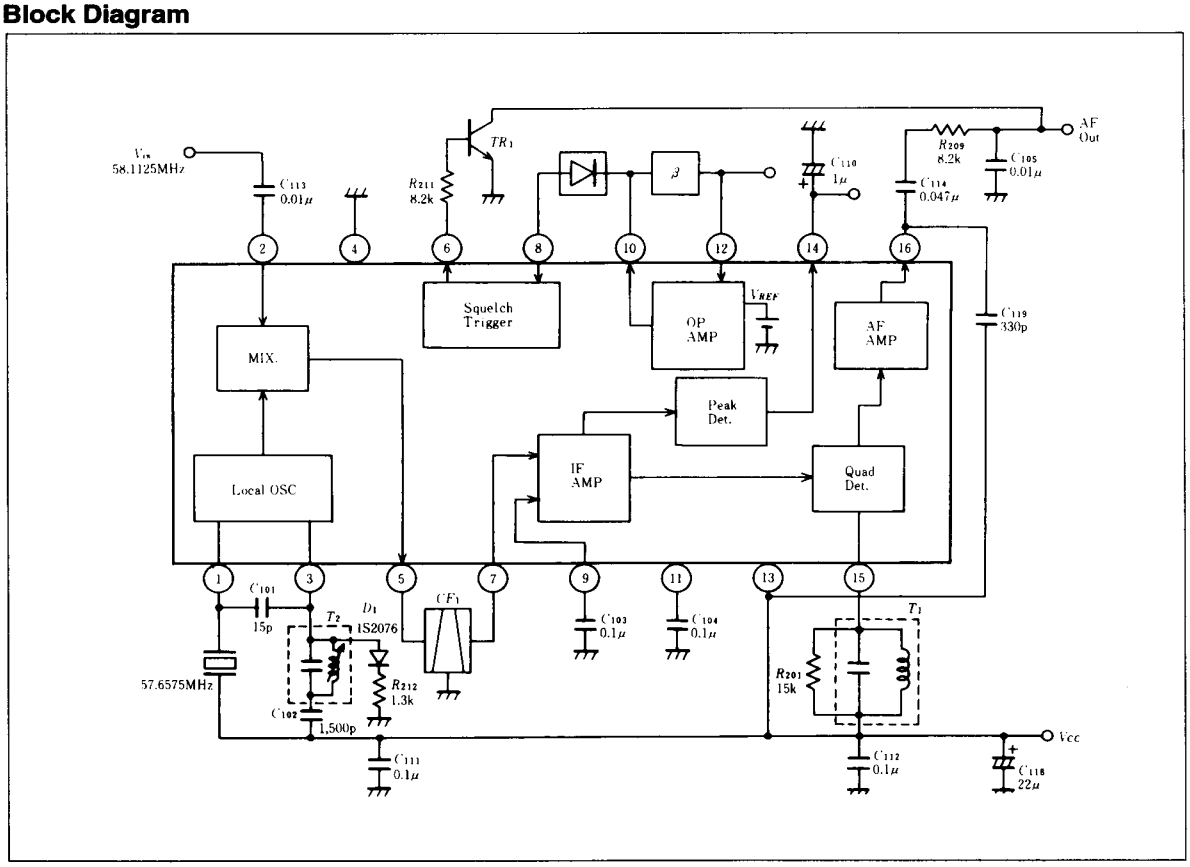
- Local Oscillator
- Mixer
- IF Amplifier
- FM Detector
- Electric Field-strength Detector
- Operational Amp (Filter Amplifier)
- Squelch Trigger



Features

- The smaller sized P.C.B. by applying vertical type package
- Small quiescent current
- Small external parts count
- Possible to use both the noise squelch by the operational amplifier and electric field-strength squelch
- Small electrical characteristics change to supply voltage change

Block Diagram



Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	V_{CC}	8	V
Power Dissipation*	P_T	100	mW
Operating Temperature Range	Topr	–30 to +75	°C
Storage Temperature Range	Tstg	–55 to +125	°C

* Ta = 75°C

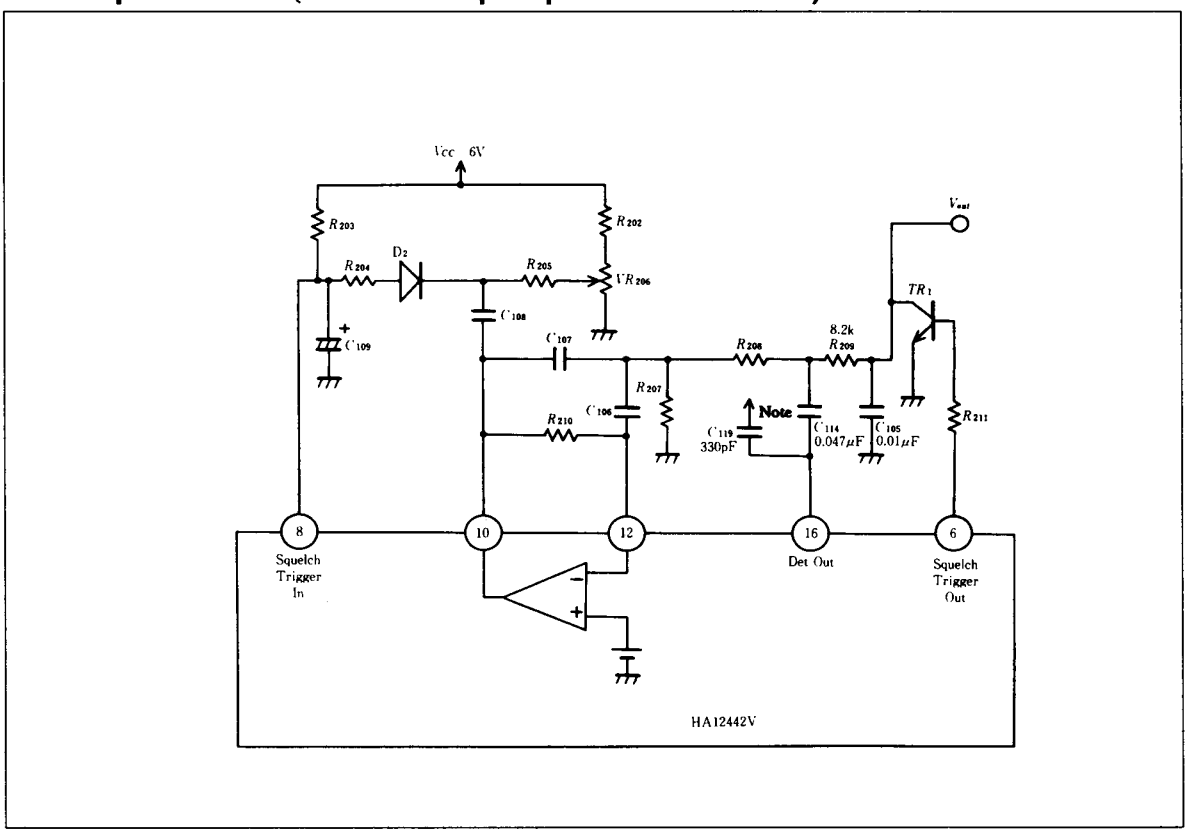
Electrical Characteristics (Ta = 25°C, V_{CC} = 6 V, fc = 58.1125 MHz, fm = 1 kHz, Δf = ±3 kHz and Vin = 100 dBμ unless otherwise specified.)

Item		Symbol	Test Condition	Min	Typ	Max	Unit
Quiescent Current	Squelch OFF	Icc (1)	no input	—	4.5	5.9	mA
	Squelch ON	Icc (2)	no input	—	5.4	6.9	mA
Limiting Sensitivity		Vin (lim)	at the point of –3 dB Vo (AF)	—	6.0	12.0	dBμ
Recovered AF Voltage		Vo (AF)	Vin = 100 dBμ	110	160	210	mV
Mixer Gain		Gv (MIX)	Vin = 60 dBμ	17	21	25	dB
Mixer Input Impedance		Zin (MIX)	DC Test	—	3	—	kΩ
Mixer Output Impedance		Zout (MIX)	DC Test	—	2.2	—	kΩ
IF Input Impedance		Zin (IF)	DC Test	—	2.2	—	kΩ
Squelch High Level Input Voltage		V6 (Hi)		—	5.9	—	V
Squelch Low Level Output Voltage		V6 (Lo)		—	0	0.2	V
Signal to Noise Ratio		S/N	Vin = 100 dBμ H.P. Filter (400 Hz at –3 dB)	58	65	—	dB
Squelch Hysteresis		HYST		100	150	190	mV
Lower Limit Operating Voltage		Vcc (–3 dB)	Detector output at Vcc = 6 V is the reference level. Vcc is lower limit operating voltage when detector output drops by –3 dB.	—	—	4.0	V
Signal Meter Voltage		V_{SM} (100)	Vin = 100 dBμ	1.9	2.4	3.0	V
Filter Amp Gain		Gv (amp)	Vin 12 = 0.15 mVrms, f = 10 kHz	45	48	—	dB

Squelch Application Circuit

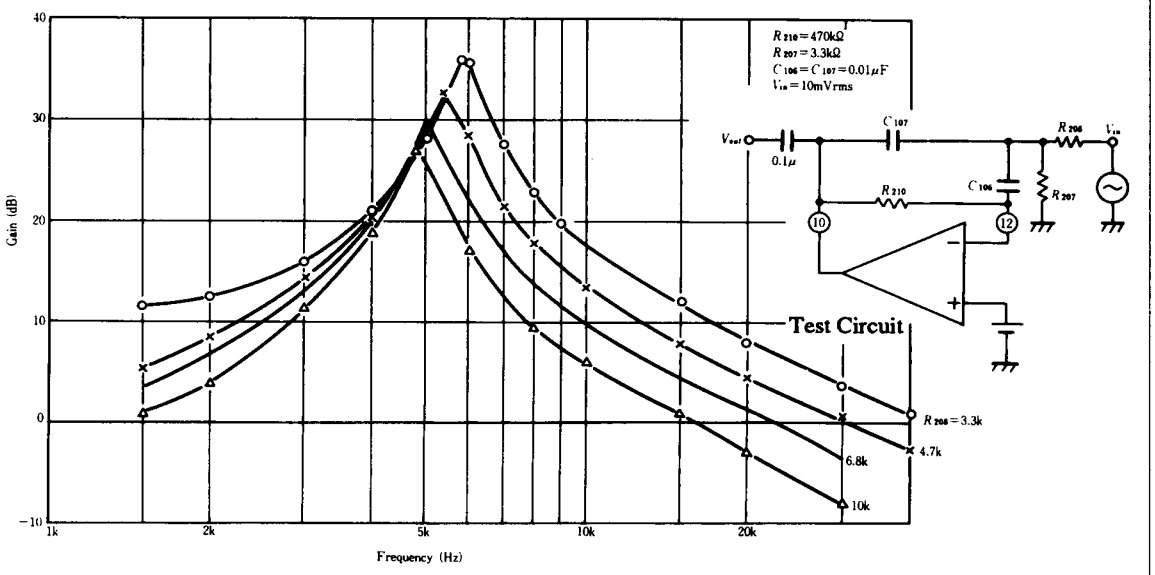
The internal Op amp and squelch trigger circuit can be used to construct a noise squelch circuit. An example of the application circuit usage is shown in the following figure. The center frequency for the band pass filter amp is chiefly determined by C106 and C107, while the gain for that amp by R208 and R210.

Noise Squelch Circuit (ß Circuit for Op Amp and Noise Detector)

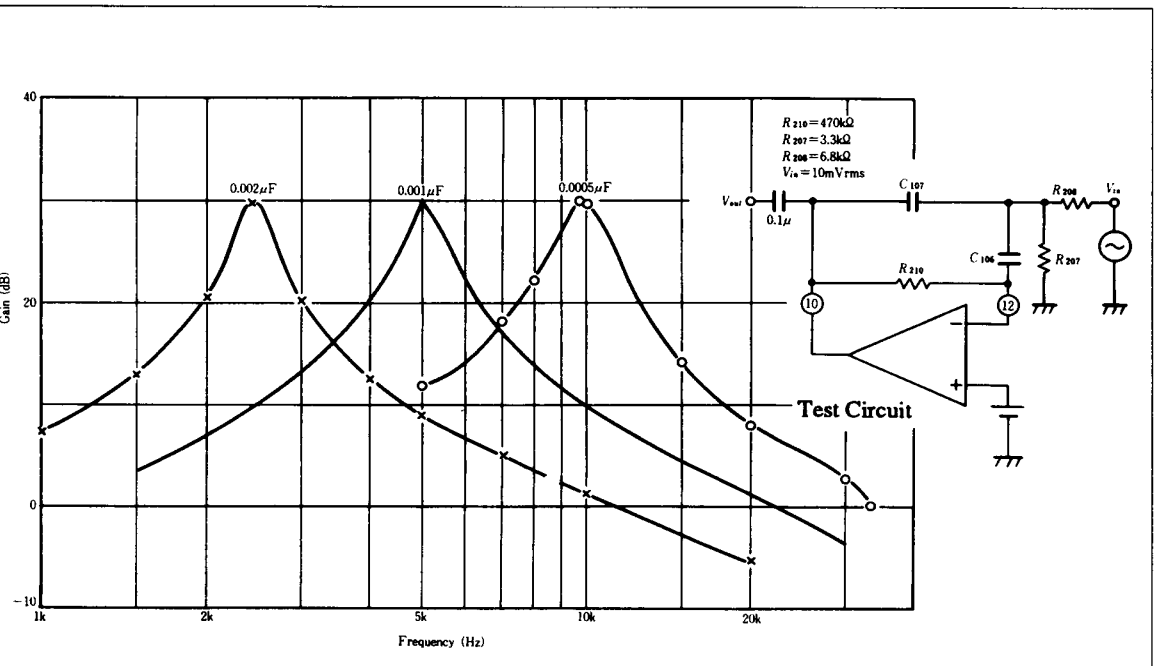


Note: Connect C119 to Vcc line as near to pin 13 as possible.

Filter Amplifier Frequency Characteristics

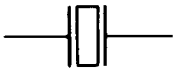


Filter Amplifier Frequency Characteristics



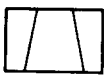
External Parts

X-tal Oscillator — NIHON DANPA TYPE NO. NC18C



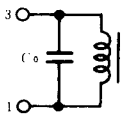
fo = 57.6575 MHz

Ceramic Filter — MURATA TYPE NO. CFW-455E



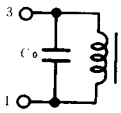
fo = 455 kHz

Detector Coil — TOKO (TRIAL PRODUCT) NO. 7MC-101000Z0



Co = 180pF
1–3: 146 t
Qu = 115 Typ
fo = 455 kHz

OSC Coil — SUMIDA (TRIAL PRODUCT) NO. 0210-7144-354



Co = 12pF
1–3: 9 t
Qu = Above 60 Typ
fo = 46 MHz

Parts for resisters and capacitors are as follows.

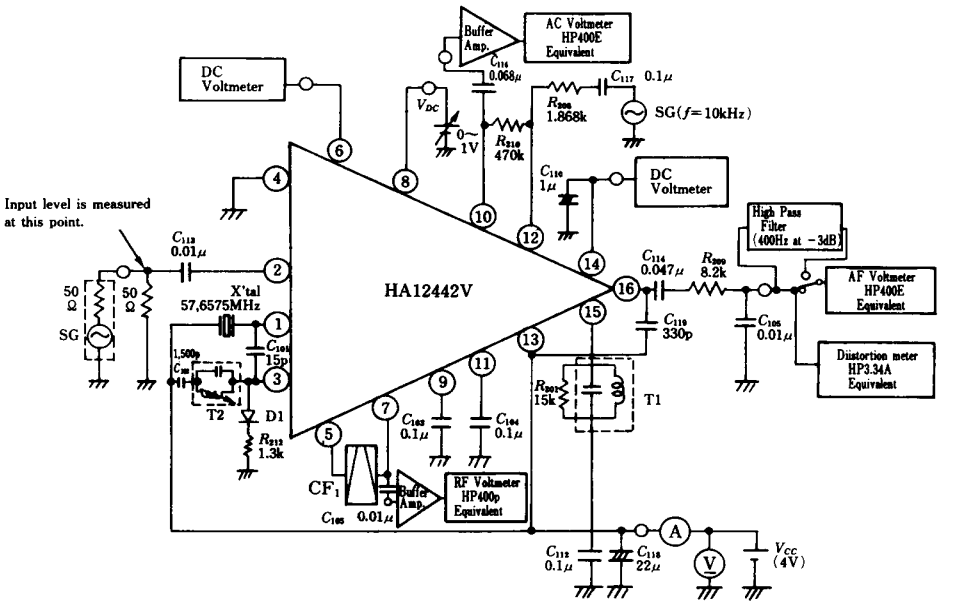
Part No.	Recommended Value	Function	Influence: Greater than Recommended Value	Influence: Smaller than Recommended Value
C101	15 pF	Local Feedback Circuit	High Level Oscillation	Low Level Oscillation
C102	1500 pF	Local DC Cut	—	—
C103	0.1 µF	IF Amp DC Feedback Decoupling	—	Decrease in IF Gain
C104	0.1 µF			
C105	0.01 µF	Recovered AF Carrier Attenuation	Load characteristics are influenced.	Load characteristics are influenced.
C106	0.001 µF	ß Circuit for Op Amp	Decrease in Center Frequency for Band Pass Filter	Increase in Center Frequency for Band Pass Filter
C107	0.001 µF		—	—
C108	0.1 µF	Detector for Noise Squelch Circuit	—	—
C109	4.7 µF		Poor Squelch Response	—
C110	1 µF	Meter Output De-coupling	Poor Meter Response	—
C111	0.1 µF	Power Supply Bypass Capacitor	Increase in Detector Output	Decrease in Detector Output
C112	0.1 µF			
C118	22 µF			
C113	0.01 µF	Input DC Cut	—	—
C114	0.047 µF	Recovered AF Voltage DC Cut	—	Low level frequency response is influenced
C119	330 pF	High Harmonic Wave Rejection	Poor stability	Poor S/N

Part No.	Recommended	Function	Influence	
			Greater than Recommended Value	Smaller than Recommended Value
R201	15 kΩ	Damping of Detector Coil	Increase in Detector Output	Decrease in Detector Output
R202	33 kΩ	Detector for Noise Squelch Circuit	Decrease in Vth Setting	Increase in Vth Setting
R203	150 kΩ			
R204	1 kΩ	Setting of Squelch Vth	Poor Squelch Response	Poor Squelch Stability
R205	4.7 kΩ		—	—
VR206	22 kΩ		—	—
R207	3.3 kΩ	ß Circuit for Op Amp	—	—
R208	6.8 kΩ		Decrease in Amp Gain	Increase in Amp Gain
R209	8.2 kΩ	Recovered AF Voltage Carrier Attenuation	Frequency response is influenced.	Frequency response is influenced.
R210	470 kΩ	ß Circuit for Op Amp	Increase in Amp Gain	Decrease in Amp Gain
R211	8.2 kΩ	Current Limitation of Squelch Transistor	Saturation of TR1 is stopped.	Poor Circuit Limiter effect

TRS, DIODE

Tr1: 2SC 458, D1: 1S2076, D2: 1S2076

Test Circuit



Function Description

Comparator (Local Oscillator & Mixer)

The local oscillator and mixer are separated in this device. The former performs local oscillation by positively feeding the output on pin 3 back to pin 1 through C101. A double balance mixer is employed for the latter. The mixer yields a gain of 21 dB (typ) (measured after the output on pin 5 passed the ceramic filter 1 (CF1)).

IF Amplifier

The IF amplifier is made up of five differential amplifiers.

The output on pin 5 from the mixer is applied to IF input pin (pin 7) through CF1. The input impedance on pin 7 is 2.2kΩ (typ)

Detector

Quadrature detection method is employed for the detector. This detector performs FM detection by the multiplification of the signal amplified by the IF amplifier and the signal 90° phase shifted by the internal capacitor.

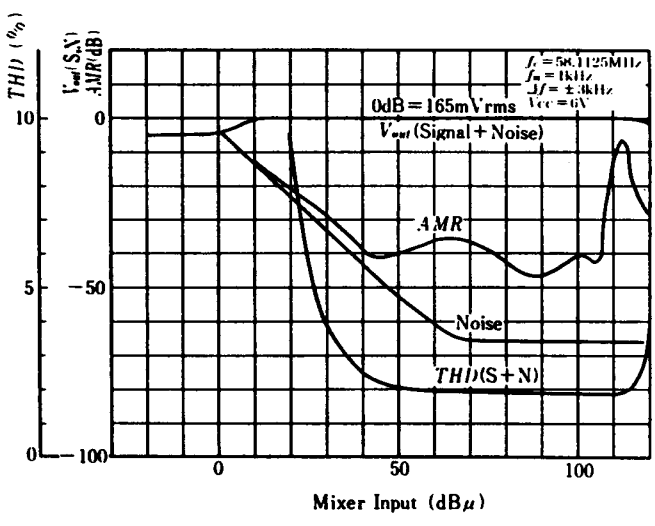
Signal Meter Driving Circuit

This device provides a method of detecting voltage peak of the signal from the IF amplifier for signal meter driving. C110 connected to pin 14 (output pin) is utilized for output voltage smoothing.

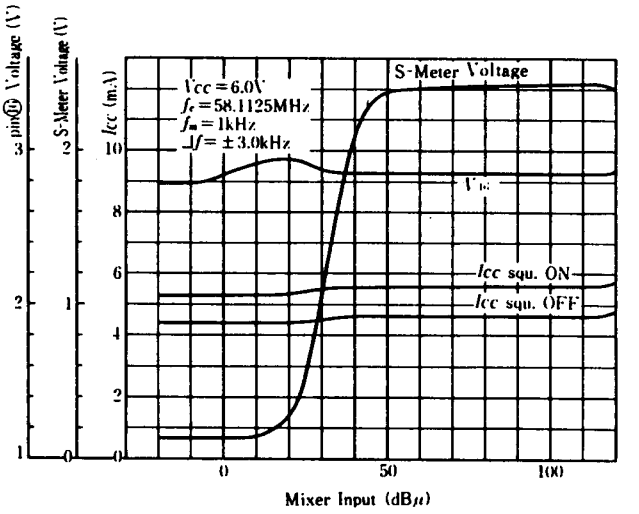
Squelch Circuit (Operational Amplifier & Squelch Trigger)

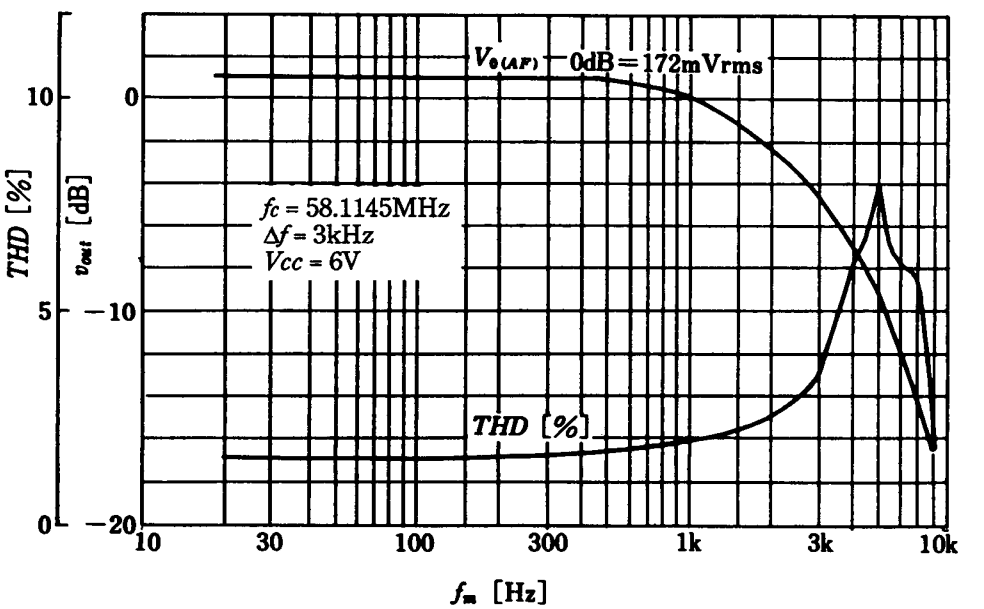
The noise squelch circuit is comprised of the internal operational amplifier and squelch trigger. The operational amplifier uses pins 12 and 10 for input and output, respectively. The filter amplifier has an input pin (pin 8) and output pin (pin 6) and causes a hysteresis of 150 mV (typ) at Vcc = 6 V.

Input/Output Characteristics

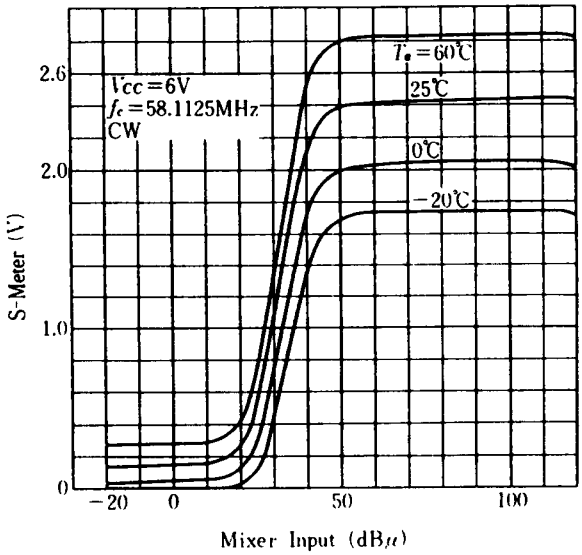


Input/Output Characteristics

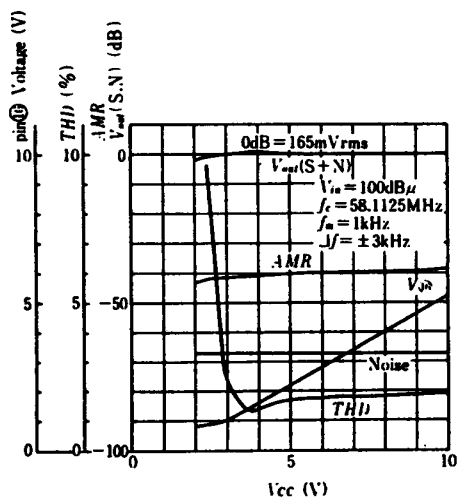




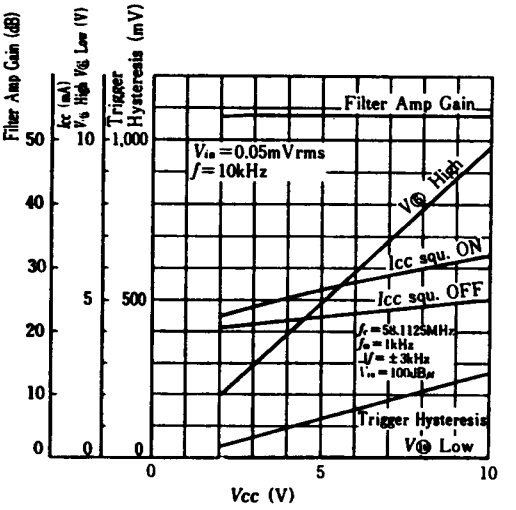
Temperature Characteristics



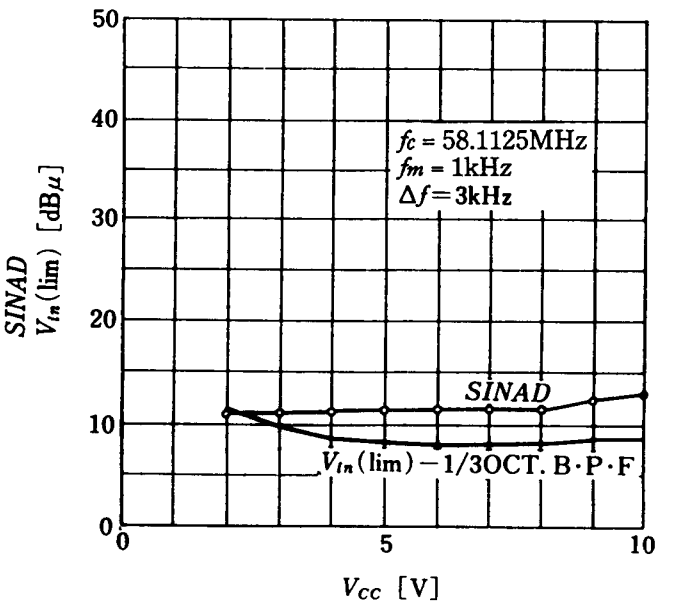
Supply Voltage Characteristics



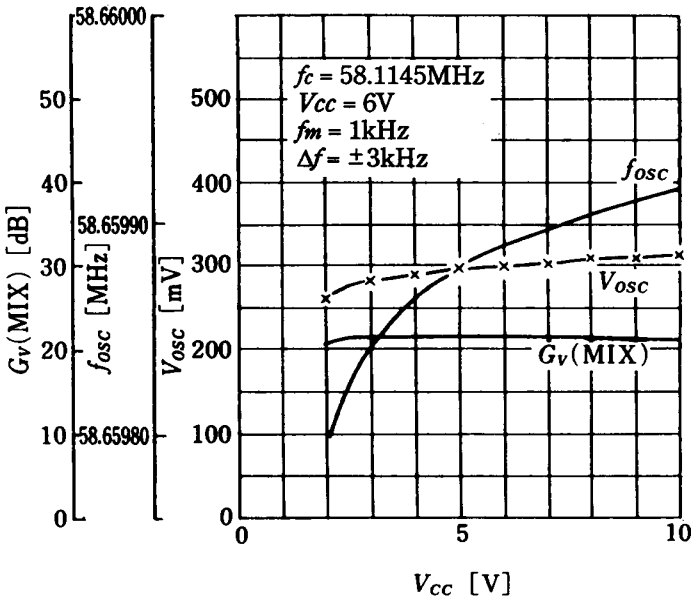
Supply Voltage Characteristics



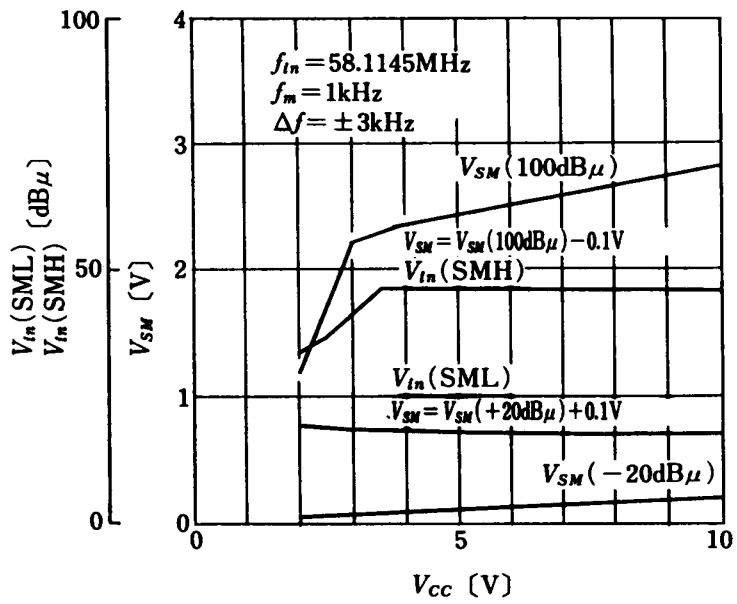
Input Sensitivity-Supply Voltage Characteristics



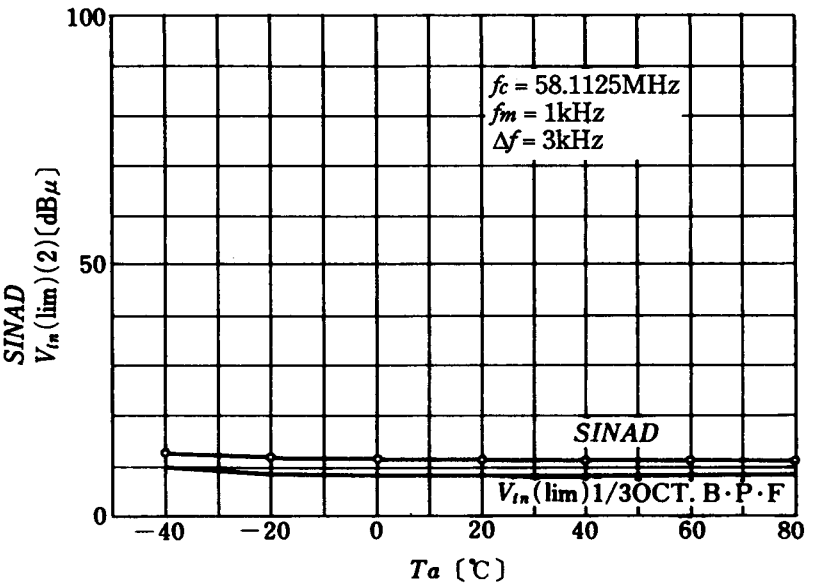
Converter Gain-Supply Voltage Characteristics



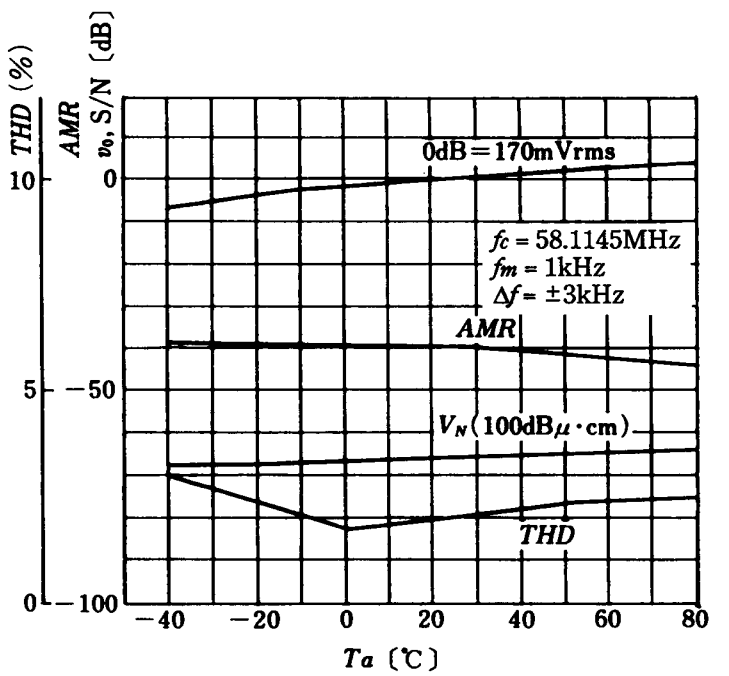
Signal Meter-Supply Voltage Characteristics



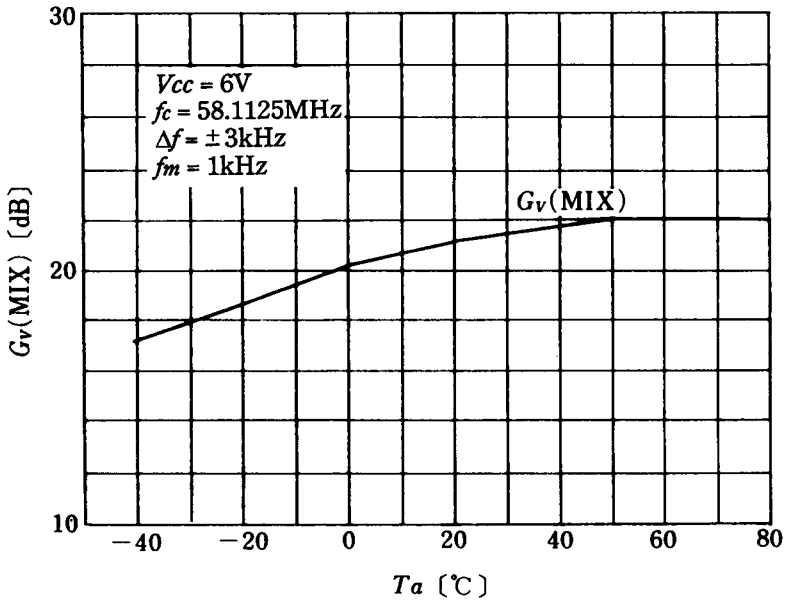
Input Sensitivity-Temperature Characteristics

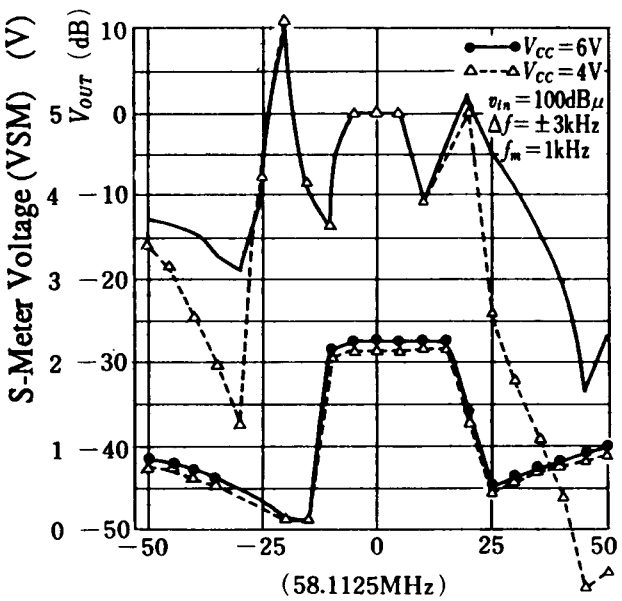


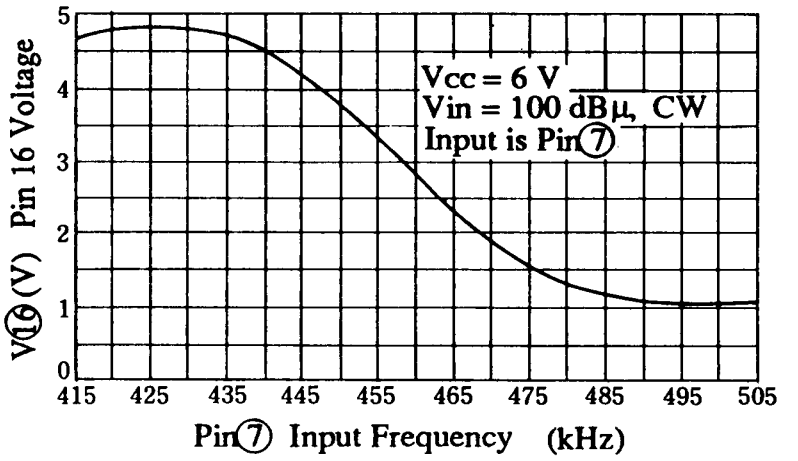
Output-Temperature Characteristics

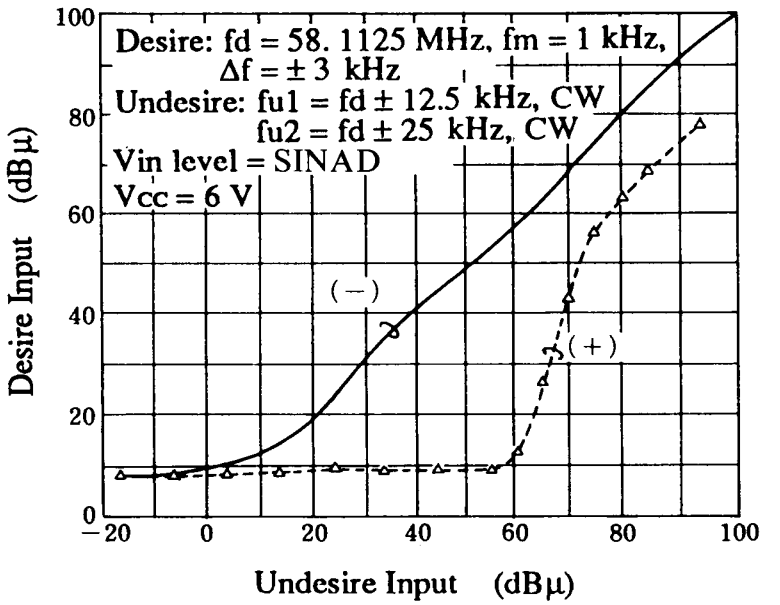


Converter Gain-Temperature Characteristics






Vcc = 6 V
Vin = 100 dBμ, CW
Input is Pin⑦
V⑯ (V) Pin 16 Voltage
Pin⑦ Input Frequency (kHz)
0
1
2
3
4
5
415
425
435
445
455
465
475
485
495
505


Desire: fd = 58. 1125 MHz, fm = 1 kHz,
Δf = ± 3 kHz
Undesire: fu1 = fd ± 12.5 kHz, CW
fu2 = fd ± 25 kHz, CW
Vin level = SINAD
Vcc = 6 V
(−)
(+)
Desire Input (dBμ)
Undesire Input (dBμ)
0
20
40
60
80
100
−20
0
20
40
60
80
100