

HA11571AF/BF

FM Demodulator IC for Broadcast Satellite Tuners

HITACHI

Preliminary
Rev. 0
Sep. 1993

Functions

- IF amplifier (with built-in IF automatic gain control)
- PLL-type FM detector
- AGC detector with RF AGC output
- Automatic frequency control (with input for keyed AFC)
- Digital AFC output
- Video amplifier

Features

- Usable with a single 5-V power supply.
- On-chip IF AGC gives a stable PLL demodulation characteristic.
- Usable at both Japanese standard frequency (IF = 403 MHz) and European standard frequency (IF = 480 MHz).
- AFC sensitivity can be adjusted by externally set constants.
- Digital AFC output is provided.
- A keyed AFC pulse input pin permits MUSE reception.
- Video output level can be adjusted by an external resistor. Maximum output: 1 V_{p-p}.

Ordering Information

Product Number	Package	Digital AFC Output Polarity
HA11571AF	28-pin plastic QFP with fins (FP-28T)	(L, L) during tuning
HA11571BF	28-pin plastic QFP with fins (FP-28T)	(H, H) during tuning

Absolute Maximum Ratings

Item	Symbol	Value	Unit
Power supply voltage	V _{CC}	6.0	V
Power dissipation	P _T	630	mW
Operating temperature	T _{opr}	-10 to +80	°C
Storage temperature	T _{stg}	-55 to +125	°C

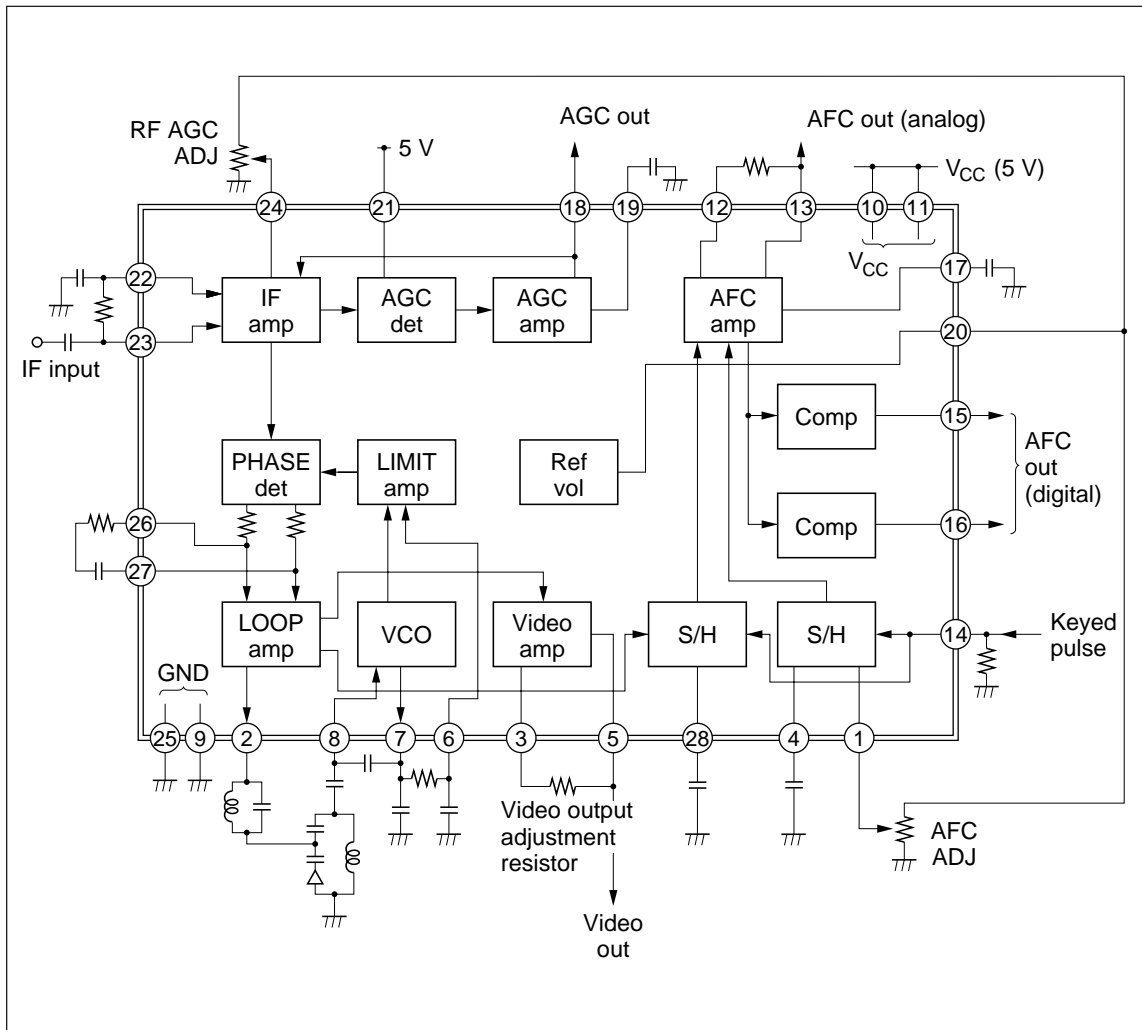
HA11571AF/BF

Electrical Characteristics (Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Pin Nos.	Test Conditions
Supply current 1	Icc1	3.5	5	6.5	mA	10	Pin 10 V _{CC} = 5 V
Supply current 2	Icc2	49	72	93	mA	11	Pin 11 V _{CC} = 5 V
IF input level range	V _{in}	(-45)		(-25)	dBm	22, 23	
PLL capture range [+]	f _{CRH}	10	25	—	MHz	5	
PLL capture range [-]	f _{URL}	—	-25	-10	MHz	5	
Video amplifier gain	G _{vA}	—	6	—	dB	5	f = 500 kHz
Video amplifier frequency characteristic	B _{vA}	-0.6	0	0.6	dB	5	f = 500 kHz to 8.1 MHz
AGC output voltage (high)	V _{AGH}	3.8	4.1	—	V	18	VCO not oscillating
AGC output voltage (low)	V _{AGL}	—	0.3	0.7	V	18	VCO not oscillating
Analog AFC output voltage (high)	V _{AFH}	3.2	3.5	3.8	V	13	
Analog AFC output voltage (low)	V _{AFL}	1.2	1.5	1.8	V	13	
Digital AFC output voltage (high)	V _{DFH}	4.5	4.8	—	V	15, 16	
Digital AFC output voltage (low)	V _{DFL}	—	0	0.5	V	15, 16	
Keyed AFC on-voltage	V _{kon}	0.4	—	—	V	14	
Keyed AFC off-voltage	V _{koff}	—	—	0.1	V	14	

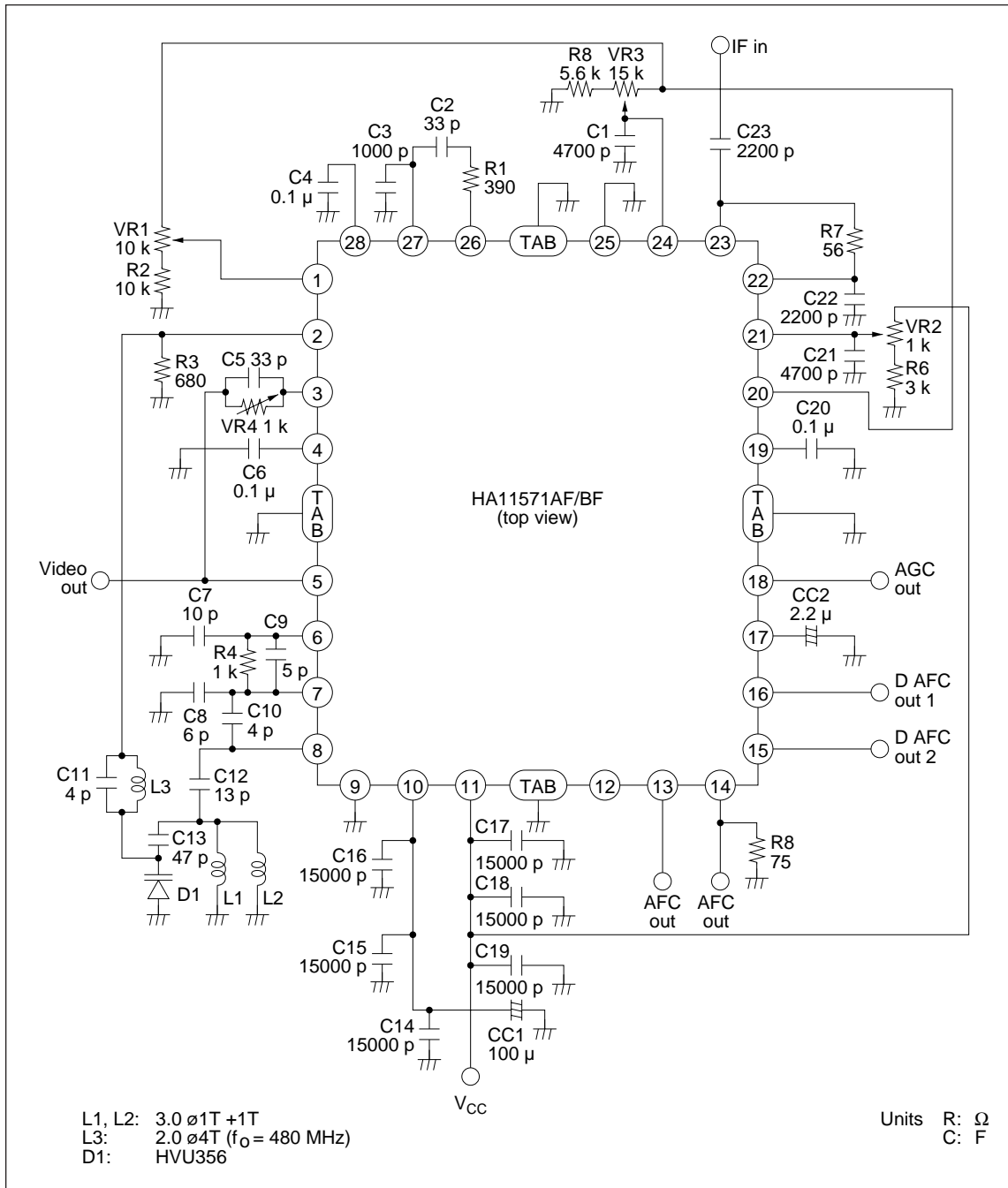
Operating supply voltage range: 5 V ±0.25 V

Block Diagram



HA11571AF/BF

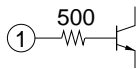
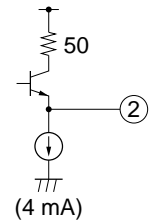
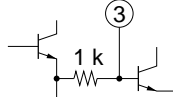
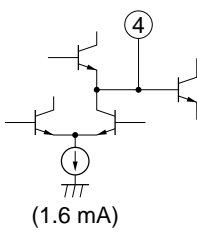
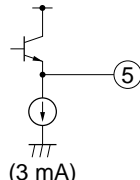
Standard External Circuits for HA11571AF/BF



IC Mounting Characteristics

Item		Symbol	Min	Typ	Max	Unit
Signal-to-noise ratio	CN = 14 dB	SN1	—	39	—	dB
Signal-to-noise ratio	CN = ∞	SN2	—	57	—	dB
Threshold C/N		CN	—	7	—	dB
Beat interference rejection ratio		Rcs	—	45	—	dB
Differential gain		DG	—	1	—	%
Differential phase		DP	—	1	—	deg

Pin Description

Pin No.	Function	Average DC Voltage* (V)	Circuit in IC
1	AFC adjustment	— (Adjust to 2.5 V when measuring voltage at other pins)	
2	Loop amplifier output	2.5	
3	Video amplifier feedback	2.3	
4	Sampling hold (reference voltage side)	3.2	
5	Video detector output	2.3	

* Input conditions: $f_{in} = 479.5 \text{ MHz CW}$, $V_{in} = -35 \text{ dBm}$

HA11571AF/BF

Pin Description (cont)

Pin No.	Function	Average DC Voltage* (V)	Circuit in IC
6	Limiter amplifier input	2.1	
7	Oscillator output	2.1	
8	Oscillator input	2.8	
9	Oscillator ground	—	—
10	Oscillator power (V_{CC})	—	—
11	V_{CC}	—	—
12	AFC feedback	1.9	
13	AFC output	2.5	
14	Keyed pulse input	—	

* Input conditions: $f_{in} = 479.5$ MHz CW, $V_{in} = -35$ dBm

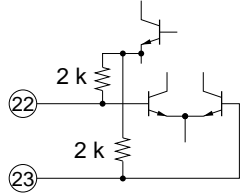
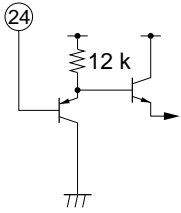
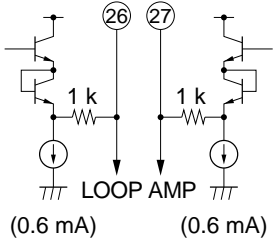
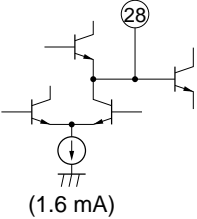
Pin Description (cont)

Pin No.	Function	Average DC Voltage* (V)	Circuit in IC
15 16	Digital AFC output	0	
17	AFC filter	2.5	
18	AGC output	2.4	
19	AGC filter	2.4	
20	Regulator voltage output	2.9	
21	Tuner AGC adjustment	— (Adjust to 5 V when measuring voltage at other pins)	

* Input conditions: $f_{in} = 479.5 \text{ MHz CW}$, $V_{in} = -35 \text{ dBm}$

HA11571AF/BF

Pin Description (cont)

Pin No.	Function	Average DC Voltage* (V)	Circuit in IC
22	IF input	2.5	
23		2.5	
24	IF AGC adjustment	— (Adjust to 1.4 V when measuring voltage at other pins)	
25	GND	—	—
26		3.0	
27		3.0	
28	Sampling hold (signal side)	3.2	

* Input conditions: $f_{in} = 479.5 \text{ MHz CW}$, $V_{in} = -35 \text{ dBm}$ **Functional Description**

Functional Description

AGC Circuit

This IC has a built-in RF AGC output circuit and IF AGC circuit. (See figure 1.) To stabilize IC input, AGC operation switches between IF and RF depending on the input level. In the type of AGC used by this IC, after AGC detection and amplification by the AGC amplifier, the AGC

output (pin 18) is supplied to both the IF AGC and RF AGC amplifiers. The output at pin 18 varies depending on the IC input level as shown in figure 2. The switchover point between IF AGC and RF AGC can be shifted by changing the voltage at pin 24. The switchover point should be determined by considering the gain distribution over both RF and IF stages. To ensure the IC's capture range characteristic, a setting from -35 dBm to -25 dBm is advisable.

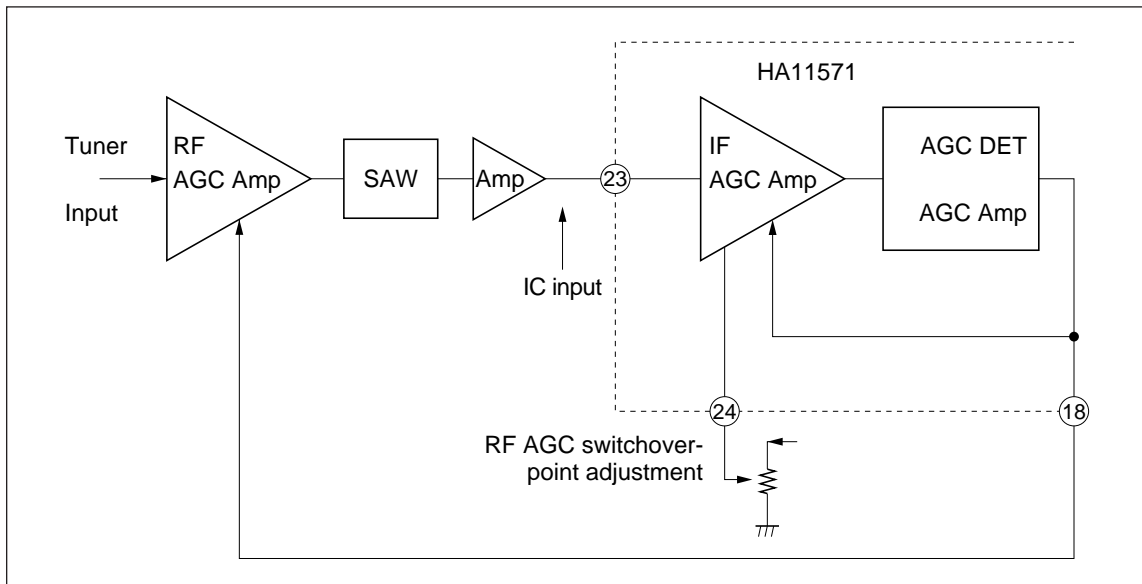


Figure 1 AGC Circuit

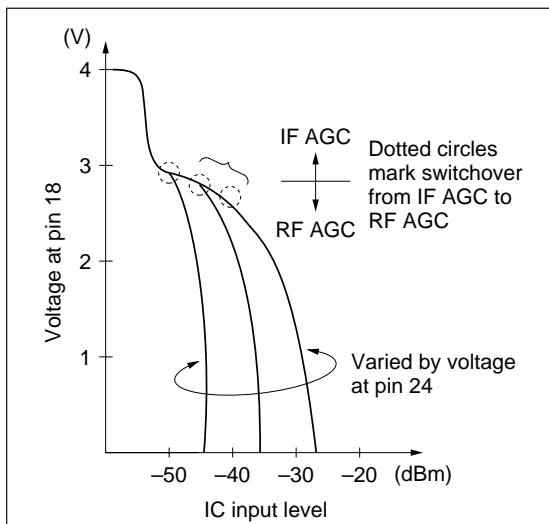


Figure 2 IC Input Level vs. AGC Voltage

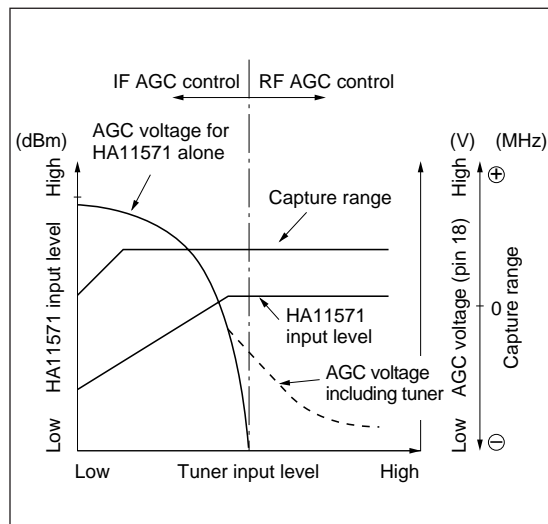


Figure 3 Tuner Input Level vs. AGC Voltage, IC Input Level, and Capture Range

HA11571AF/BF

AFC Circuit

The AFC circuit is shown in figure 4. This IC has both analog AFC output (pin 13) and digital AFC output (pins 15 and 16). The crossover point is selected by the voltage at pin 1.

With analog AFC output, the AFC sensitivity can be adjusted by the resistance between pins 12 and 13. (See figure 11.)

The digital AFC output voltages are 0 V (low) and 4.5 V (high). To prevent unstable operation, the crossover point between high and low has a hysteresis of approximately 50 kHz. The dead band is approximately 280 kHz. (See figure 13.) A keyed AFC pulse input pin (pin 14) enables reception of MUSE broadcasts.

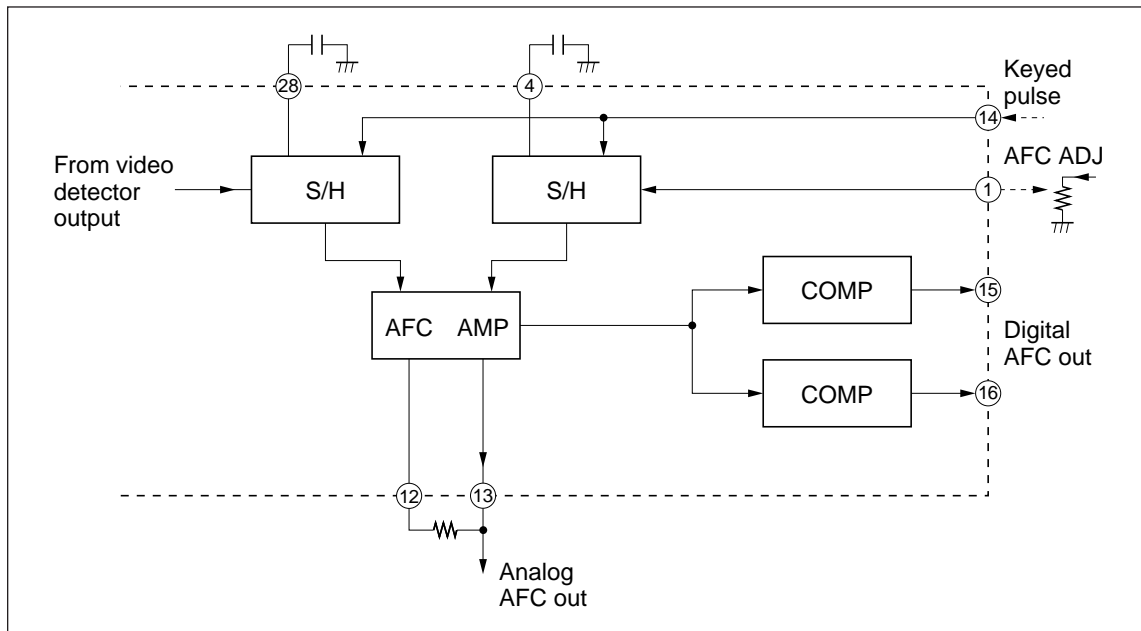


Figure 4 AFC Circuit

Video Amplifier Circuit

The output amplitude of the video amplifier can be adjusted to levels up to 1 V_{P-P} by varying the resistance between pins 3 and 5. (See figures 9 and 10.)

The frequency characteristic has a flat band up to 8.1 MHz. The frequency characteristic can be adjusted by connecting a capacitor between pins 3 and 5.

Regulator Output Circuit

Pin 20 is a 3-V voltage output pin. This pin is ideal

for use as a reference potential because its temperature characteristic has an extremely small voltage drop. The maximum current that can be drawn is 0.8 mA.

VCO Circuit

The VCO circuit is a Colpitts oscillator with a grounded collector. (See figure 5.) It can be used at both the Japanese standard frequency (403 MHz) and European standard frequency (480 MHz). Temperature drift of the oscillation frequency can be canceled by using temperature-compensating UJ capacitors for external components.

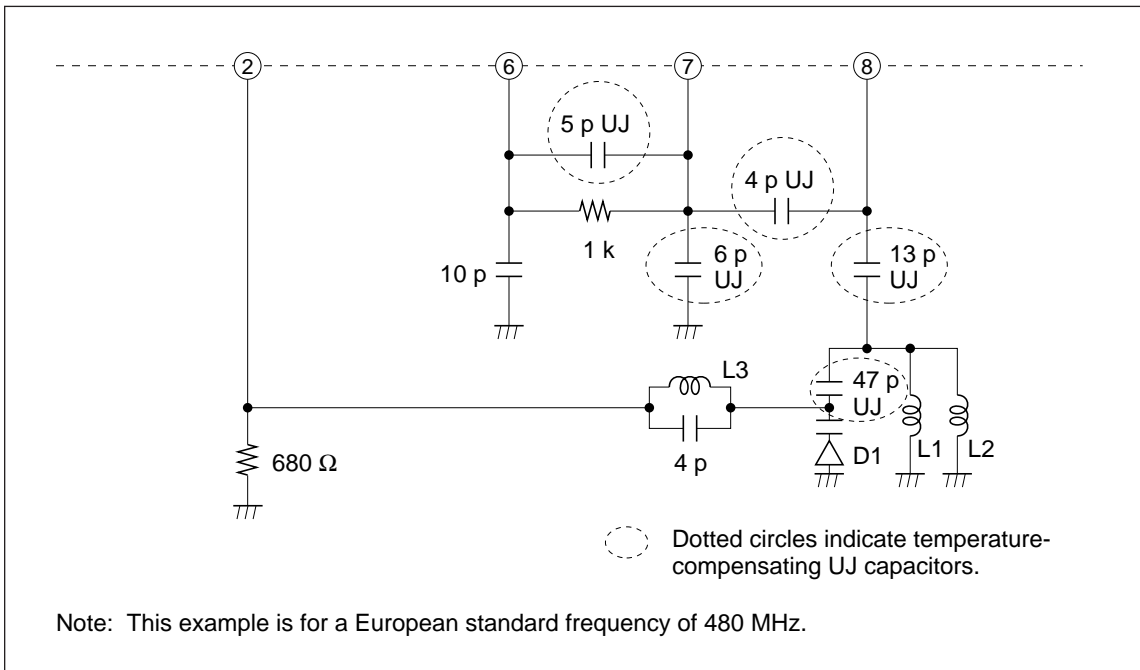


Figure 5 VCO Circuit

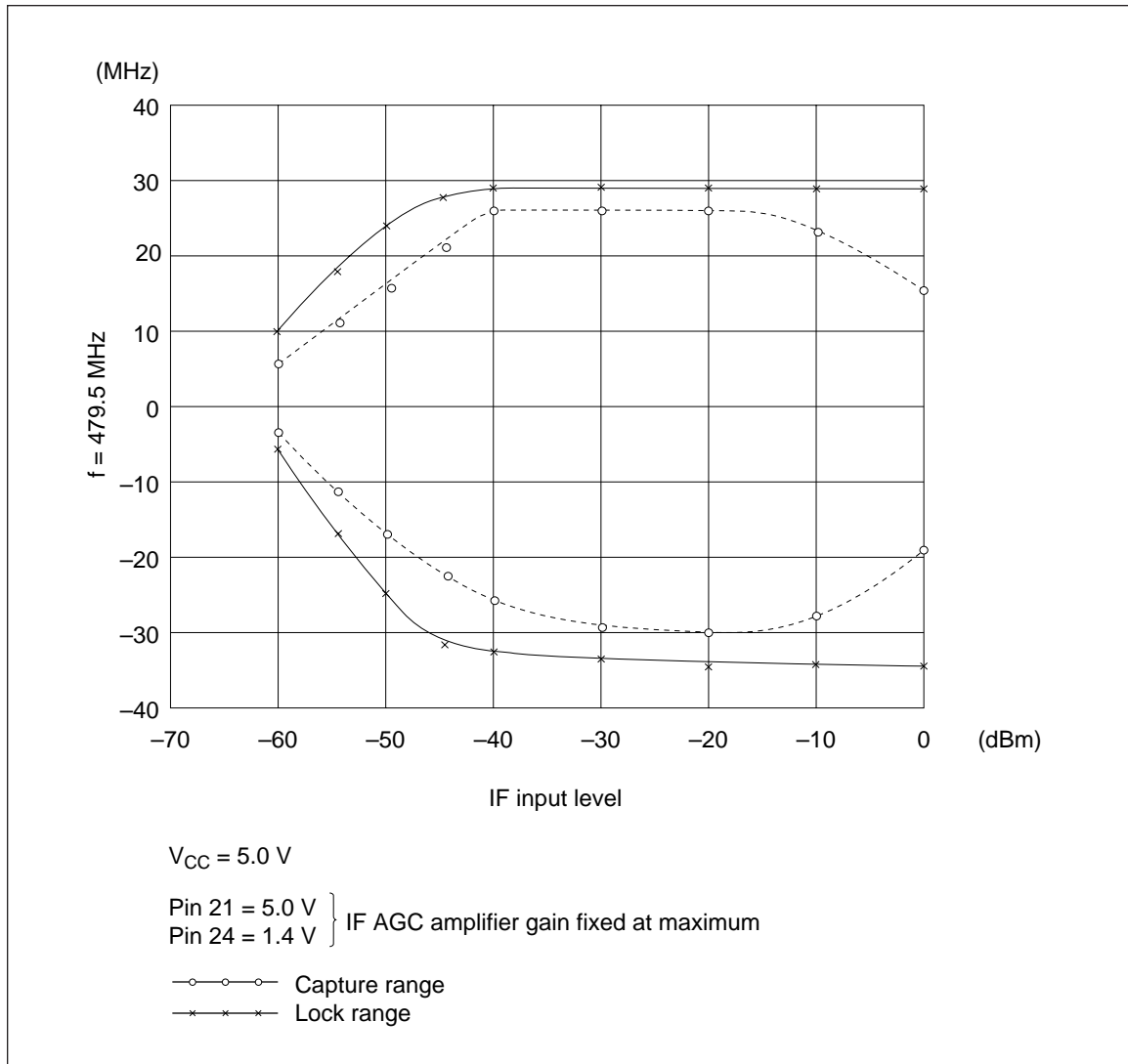


Figure 6 Capture Range and Lock Range

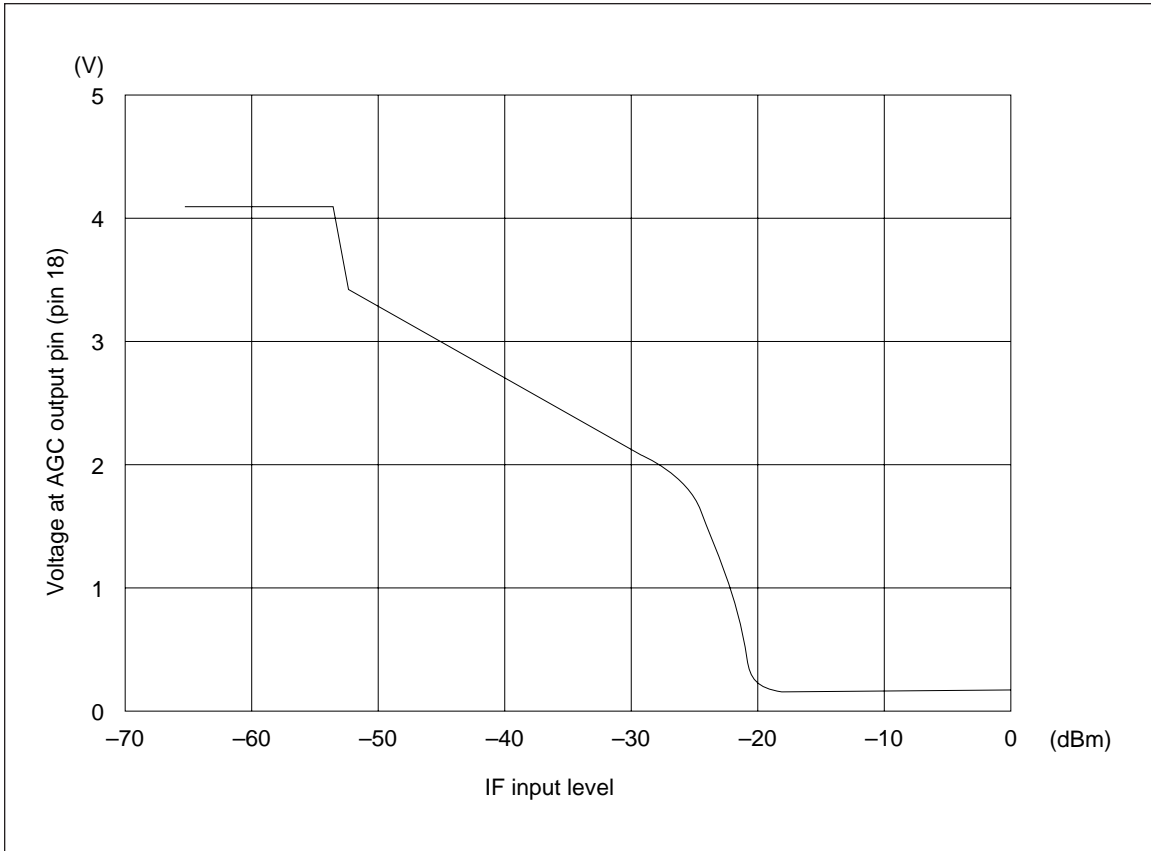


Figure 7 AGC Voltage Characteristic

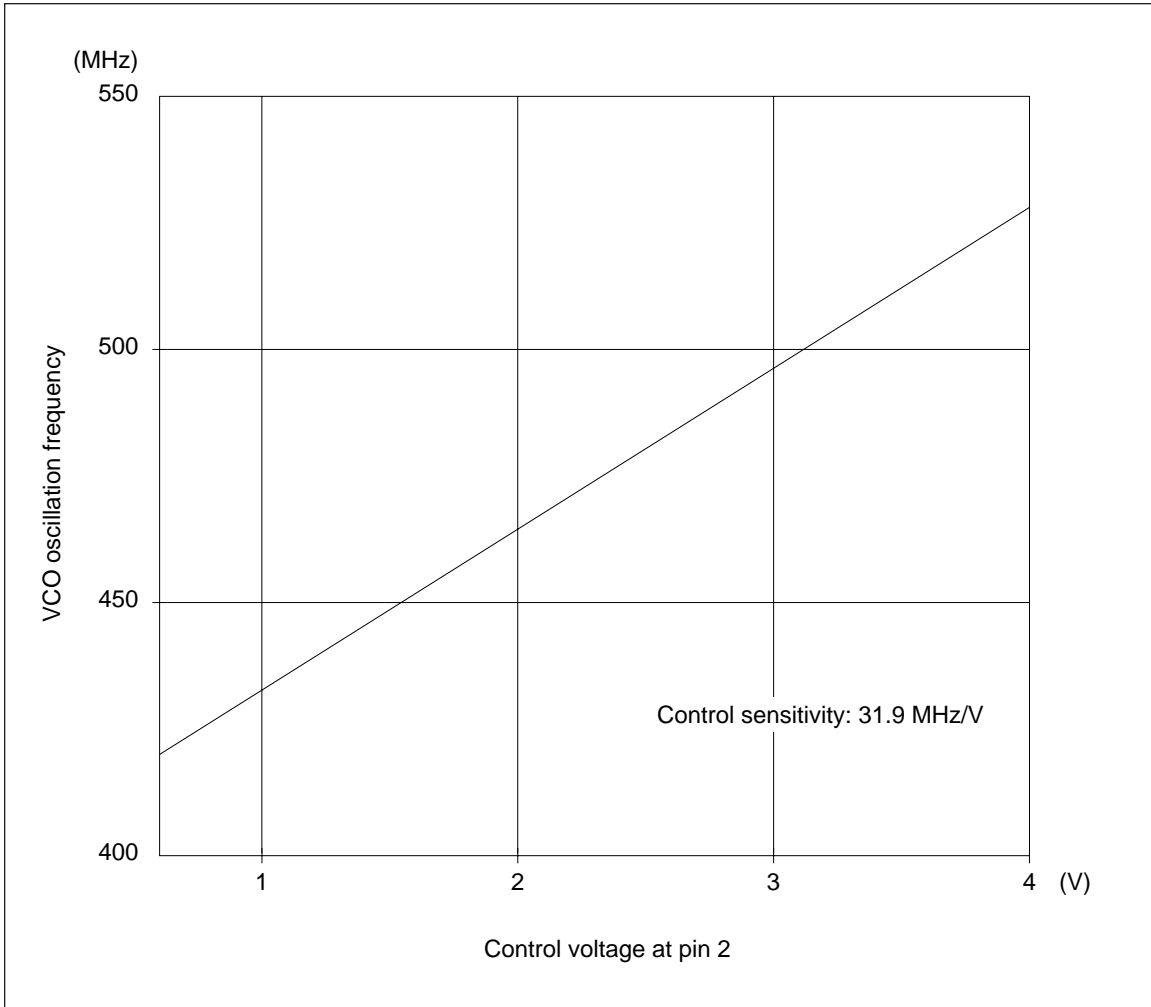


Figure 8 VCO Control Characteristic

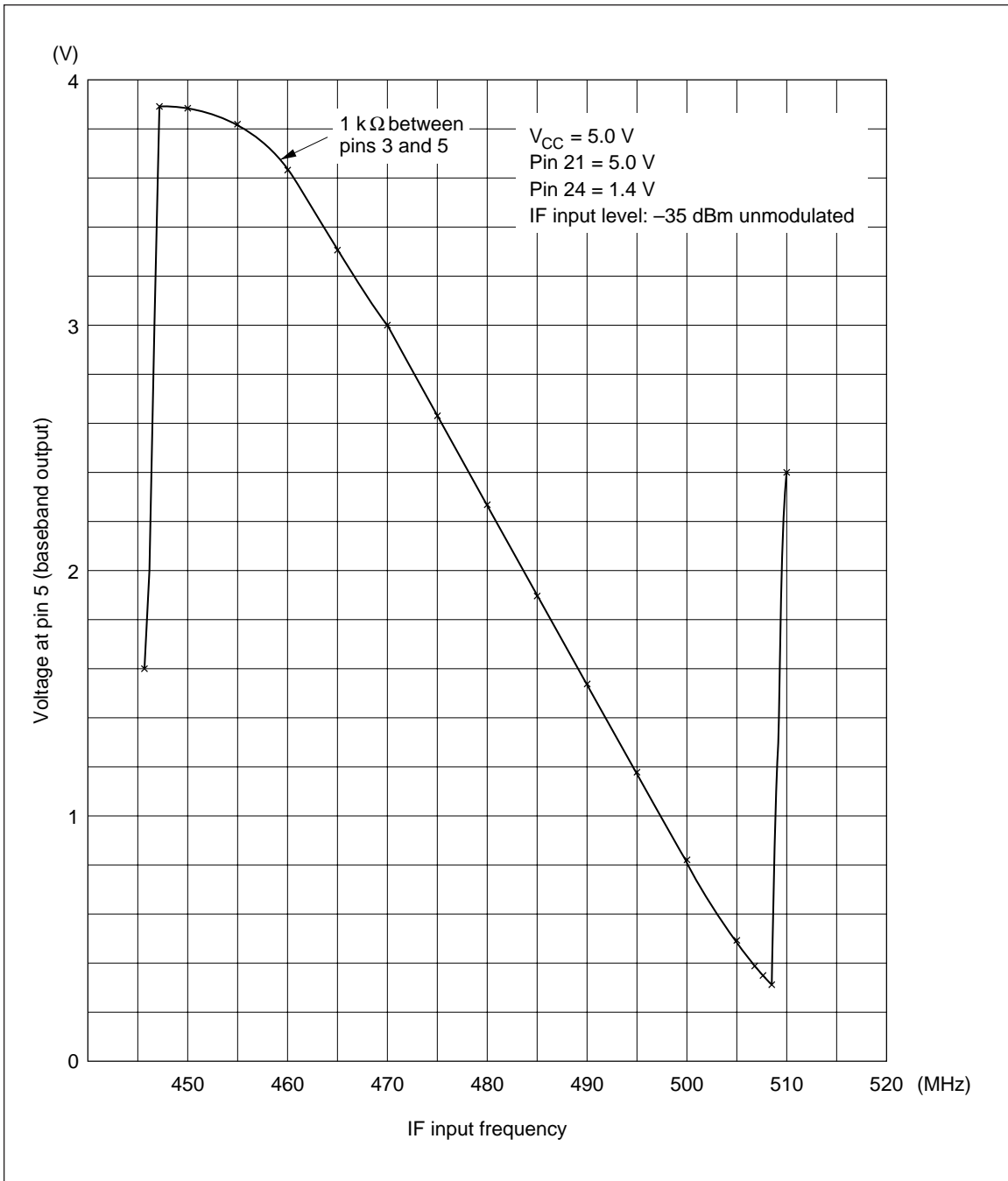


Figure 9 Video Amplifier Amplitude Characteristic

HA11571AF/BF

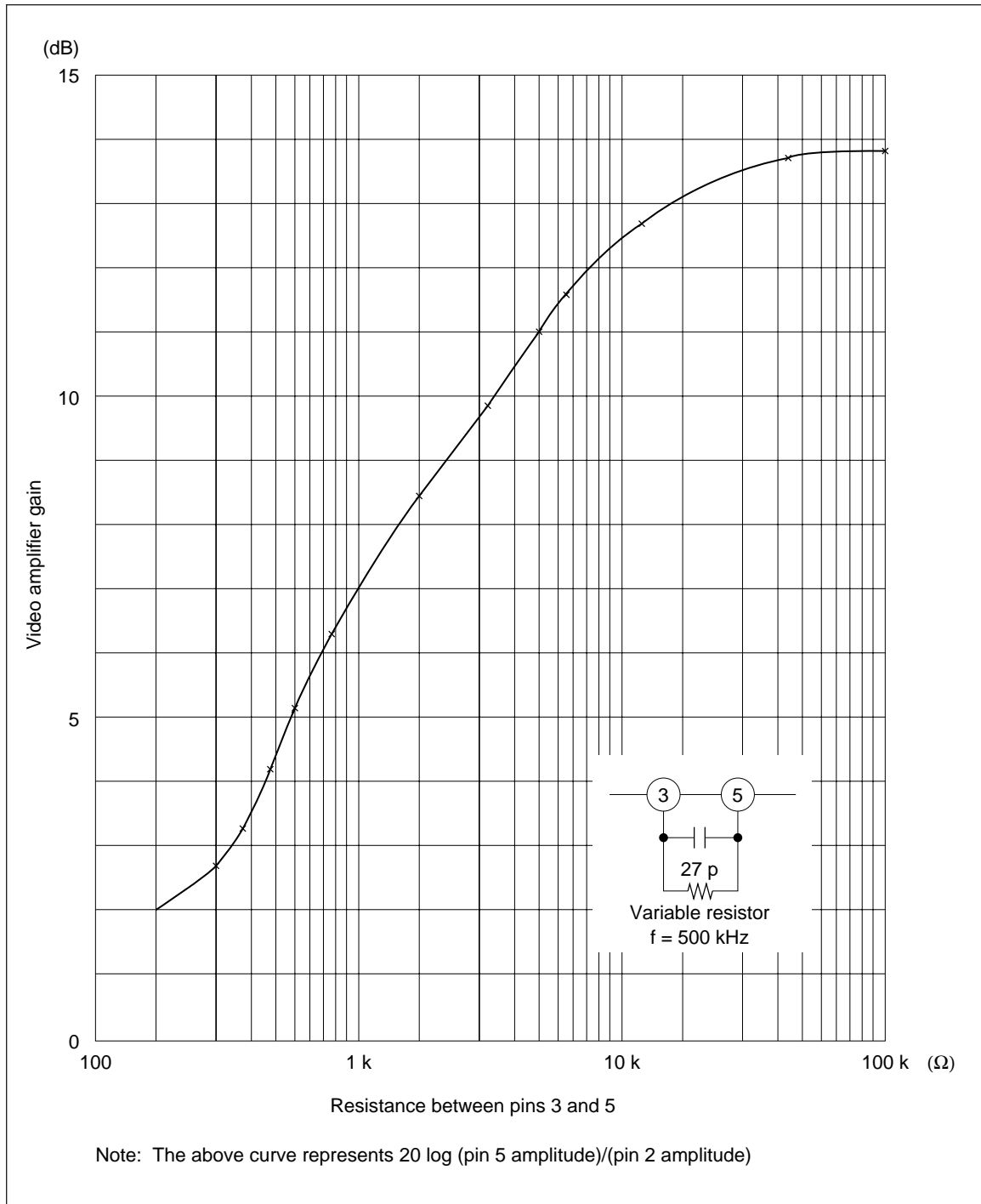


Figure 10 Video Amplifier Variable Gain Characteristic

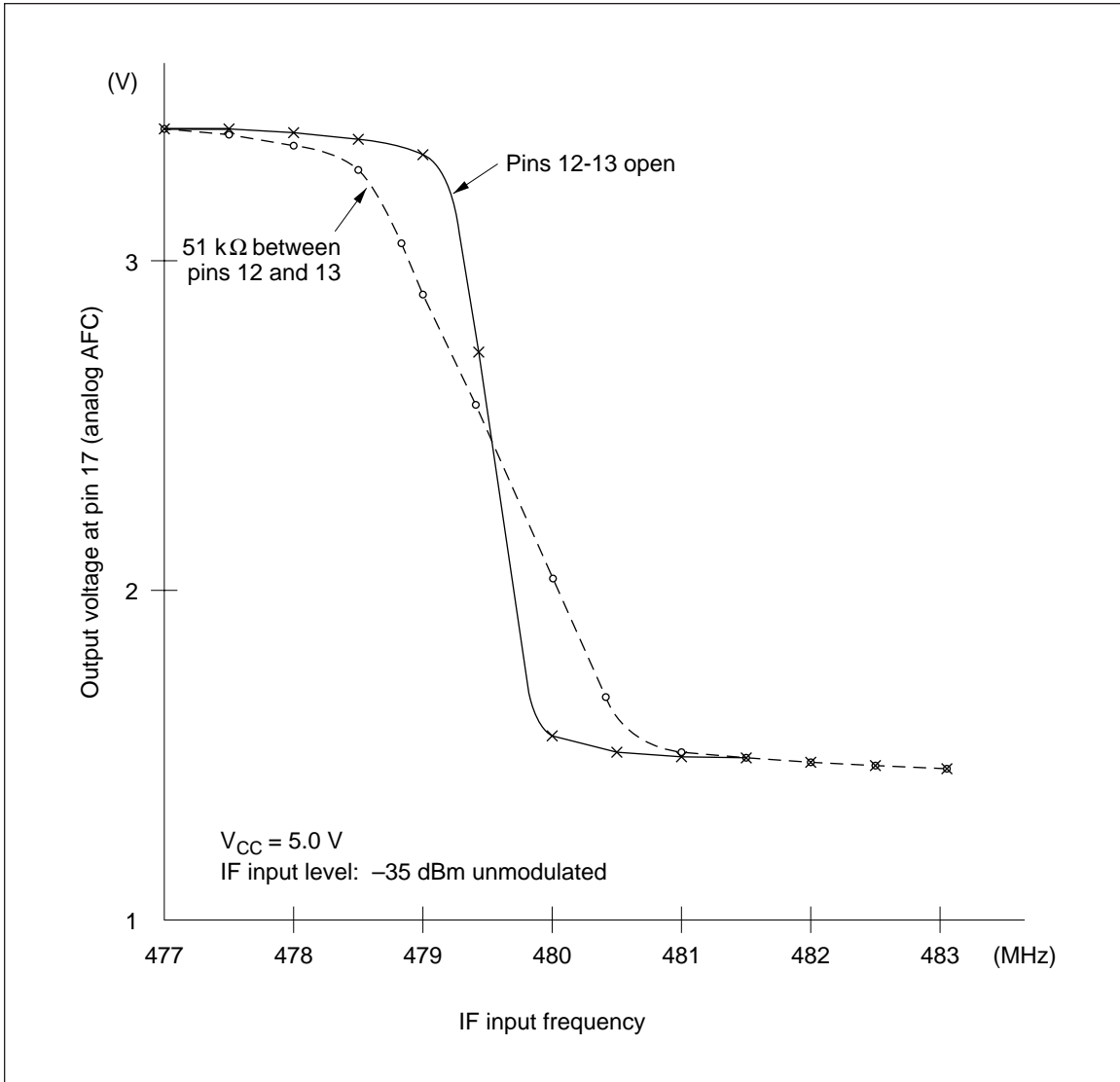


Figure 11 Analog AFC Characteristic

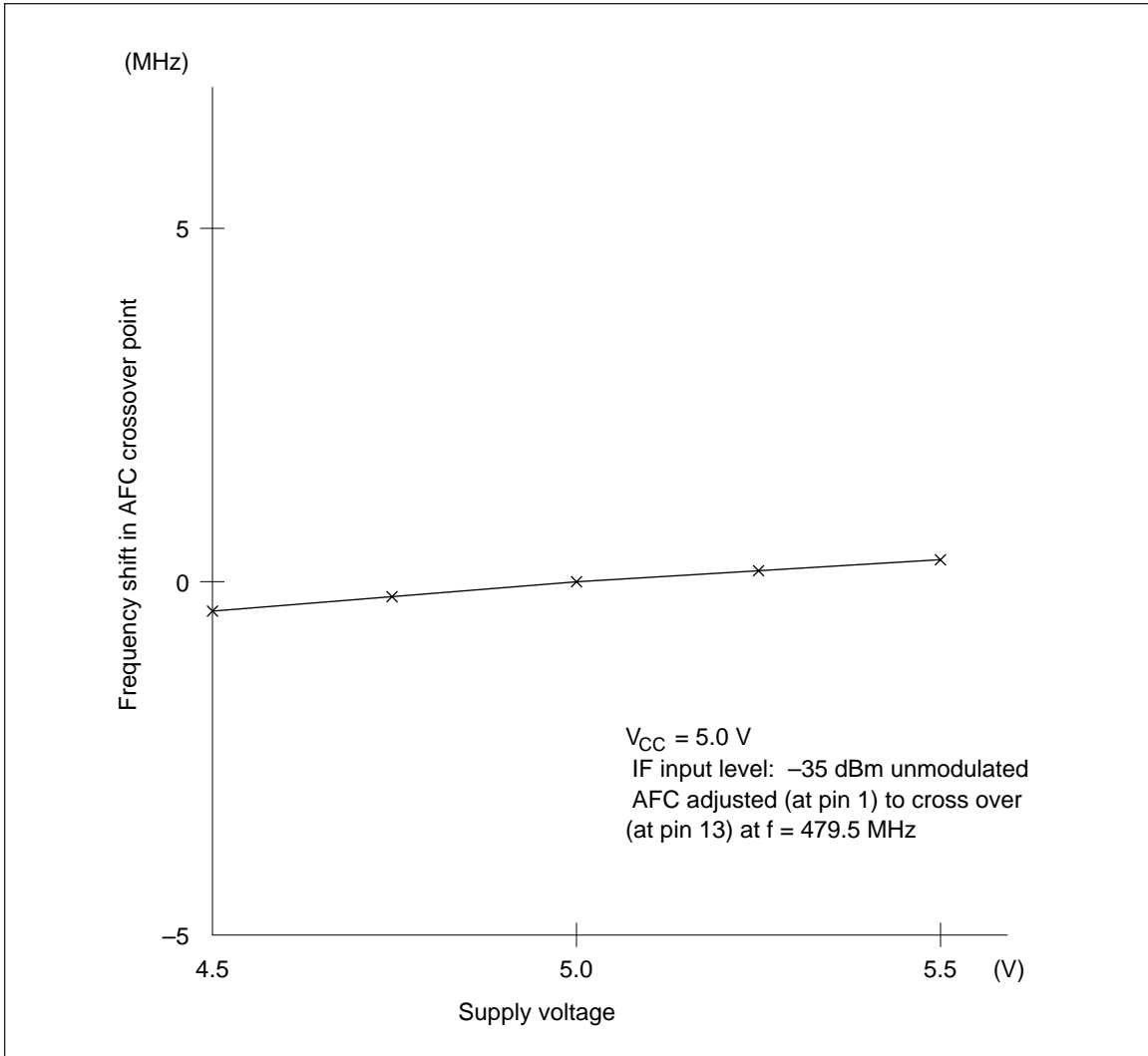


Figure 12 AFC Voltage Drop Characteristic

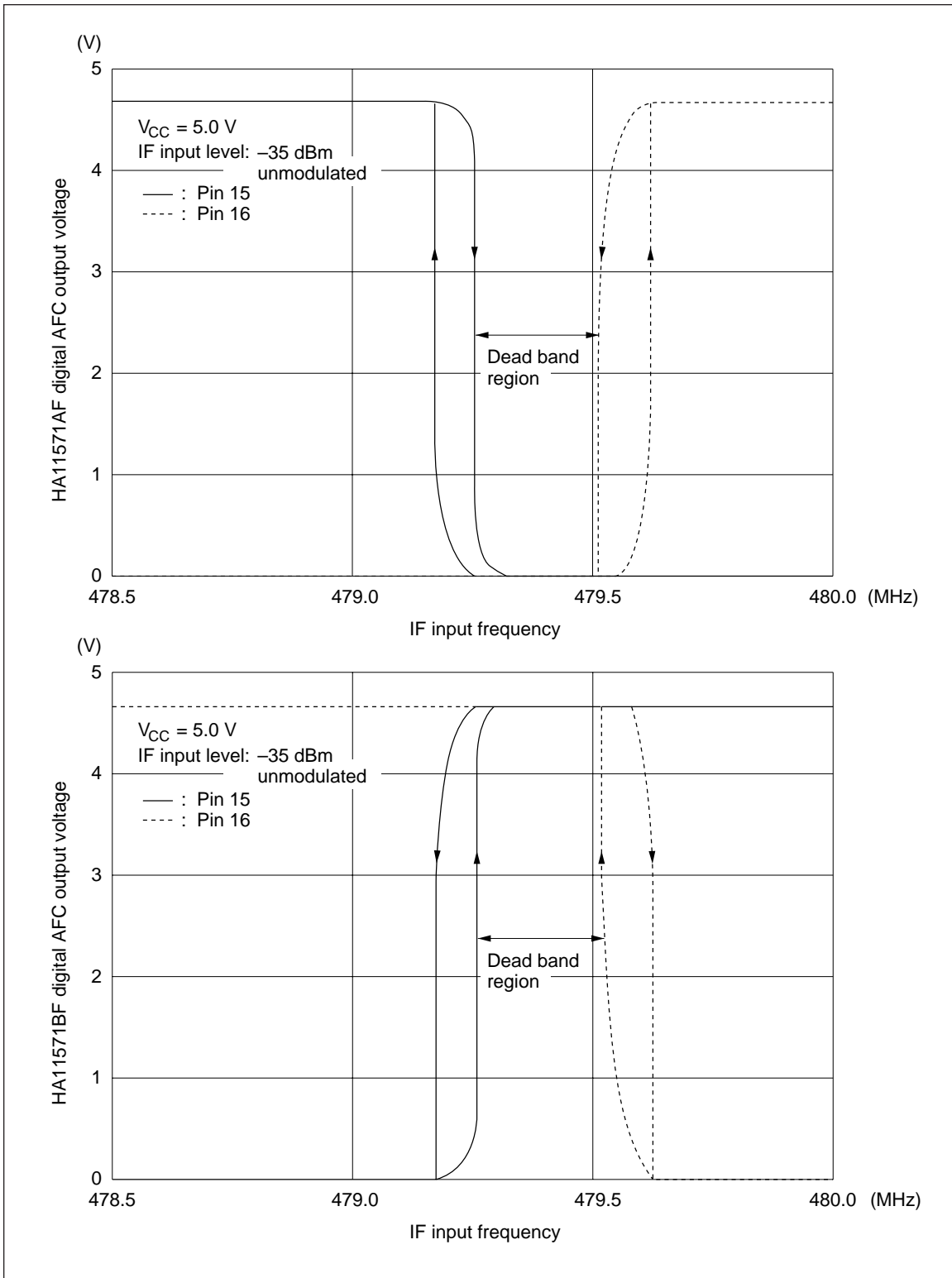


Figure 13 Digital AFC Characteristics

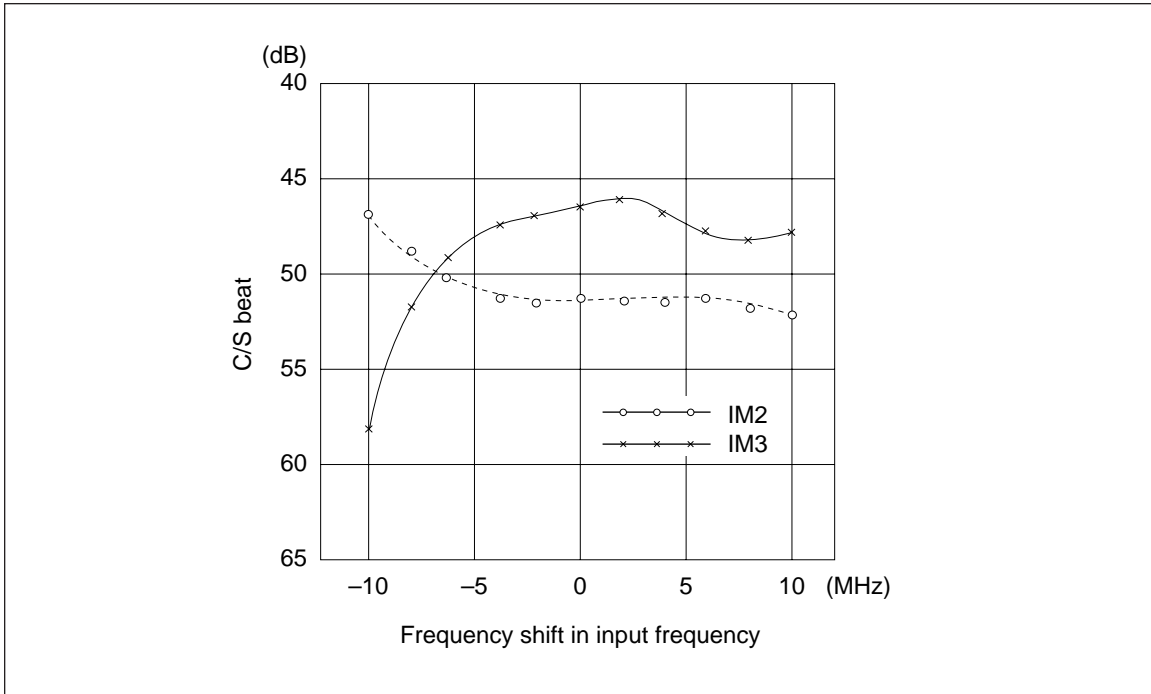


Figure 14 CS Beat

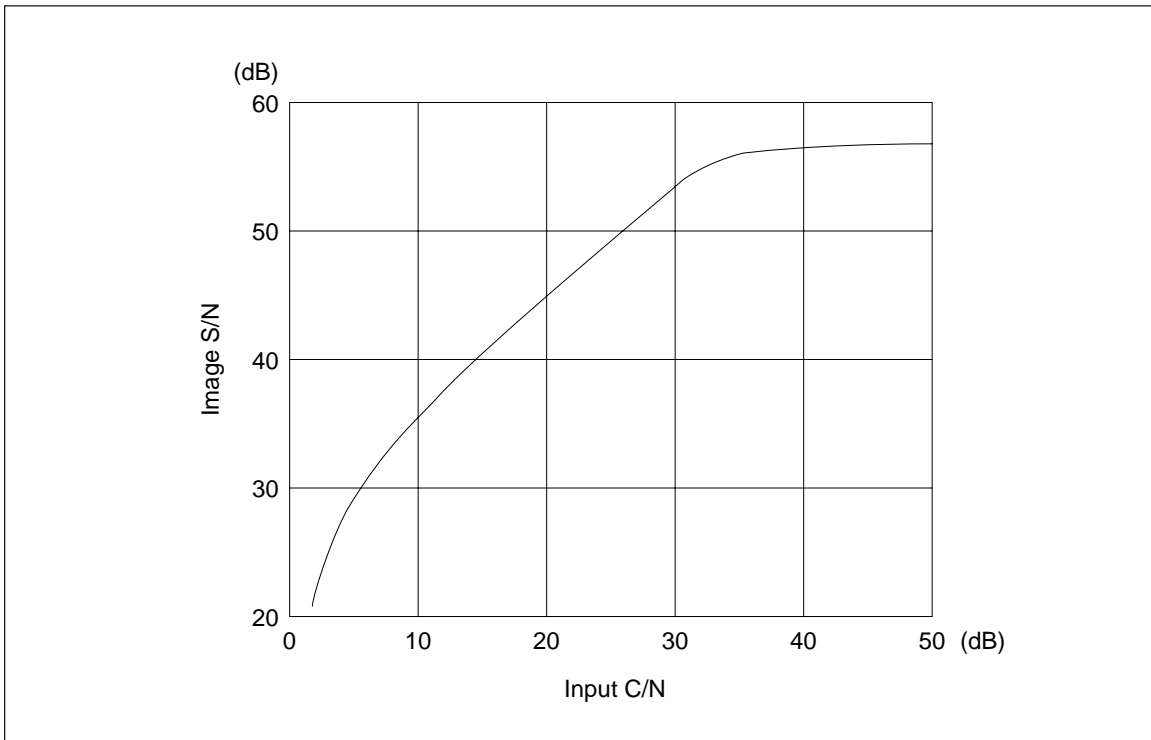


Figure 15 C/N vs. S/N Characteristics

Package Dimensions

Unit : mm

