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SA606

Low-voltage high performance mixer FM IF system

Rev. 6 — 8 November 2013 Product data sheet

1. General description

The SA606 is a low-voltage high performance monolithic FM IF system incorporating a mixer/oscillator, two limiting intermediate frequency amplifiers, quadrature detector, logarithmic Received Signal Strength Indicator (RSSI), voltage regulator and audio and RSSI op amps. The SA606 is available in SO20 and SSOP20 packages.

The SA606 was designed for portable communication applications and will function down to 2.7 V. The RF section is similar to the famous SA605. The audio and RSSI outputs have amplifiers with access to the feedback path. This enables the designer to adjust the output levels or add filtering.

2. Features and benefits

- Low power consumption: 3.5 mA typical at 3 V
- Mixer input to >150 MHz
- Mixer conversion power gain of 17 dB at 45 MHz
- XTAL oscillator effective to 150 MHz (LC oscillator or external oscillator can be used at higher frequencies)
- 102 dB of IF amp/limiter gain
- 2 MHz IF amp/limiter small signal bandwidth
- Temperature compensated logarithmic RSSI with a 90 dB dynamic range
- Low external component count; suitable for crystal/ceramic/LC filters
- Excellent sensitivity: 0.31 μV into 50 Ω matching network for 12 dB SINAD (Signal-to-Noise-and-Distortion ratio) for 1 kHz tone with RF at 45 MHz and IF at 455 kHz
- SA606 meets cellular radio specifications
- Audio output internal op amp
- RSSI output internal op amp
- Internal op amps with rail-to-rail outputs
- ESD protection exceeds 2000 V HBM per JESD22-A114 and 1000 V CDM per JESD22-C101
- Latch-up testing is done to JEDEC Standard JESD78 Class II, Level B

3. Applications

- Portable cellular radio FM IF
- Cordless phones
- Wireless systems
- RF level meter

- Spectrum analyzer
- Instrumentation
- FSK and ASK data receivers
- Log amps
- Portable high performance communication receiver
- Single conversion VHF receivers

4. Ordering information

Table 1. Ordering information

T_{amb} = −40 °C to +85 °C

Type number	Topside mark	Package		
		Name	Description	Version
SA606D/01	SA606D	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
SA606DK/01	SA606DK	SSOP20	plastic shrink small outline package; 20 leads; body width 4.4 mm	SOT266-1
SA606DK/02	SA606DK	SSOP20	plastic shrink small outline package; 20 leads; body width 4.4 mm	SOT266-1
SA606DK/03	SA606DK	SSOP20	plastic shrink small outline package; 20 leads; body width 4.4 mm	SOT266-1

4.1 Ordering options

Table 2. Ordering options

Type number	Orderable part number	Package	Packing method	Minimum order quantity	Temperature
SA606D/01	SA606D/01,112	SO20	Standard marking *IC's tube - DSC bulk pack	1520	T_{amb} = −40 °C to +85 °C
	SA606D/01,118	SO20	Reel 13" Q1/T1 *Standard mark SMD	2000	T_{amb} = −40 °C to +85 °C
SA606DK/01	SA606DK/01,112	SSOP20	Standard marking *IC's tube - DSC bulk pack	1350	T_{amb} = −40 °C to +85 °C
	SA606DK/01,118	SSOP20	Reel 13" Q1/T1 *Standard mark SMD	2500	T_{amb} = −40 °C to +85 °C
SA606DK/02	SA606DK/02,118	SSOP20	Reel 13" Q1/T1 *Standard mark SMD	2500	T_{amb} = −40 °C to +85 °C
SA606DK/03	SA606DK/03,118	SSOP20	Reel 13" Q1/T1 *Standard mark SMD	2500	T_{amb} = −40 °C to +85 °C

5. Block diagram

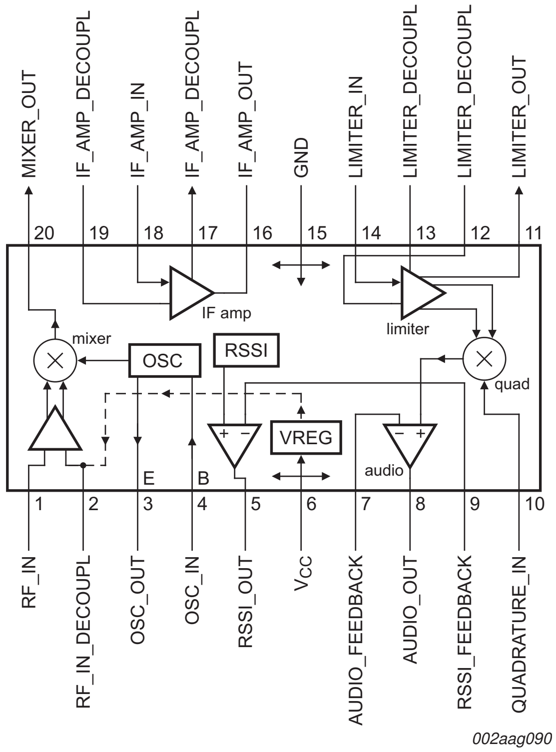


Fig 1. Block diagram of SA606

6. Pinning information

6.1 Pinning

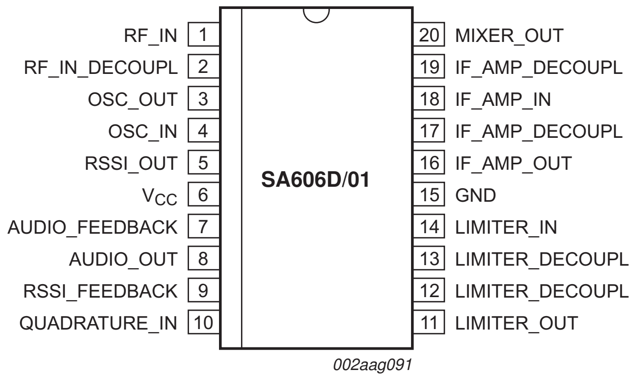


Fig 2. Pin configuration for SO20

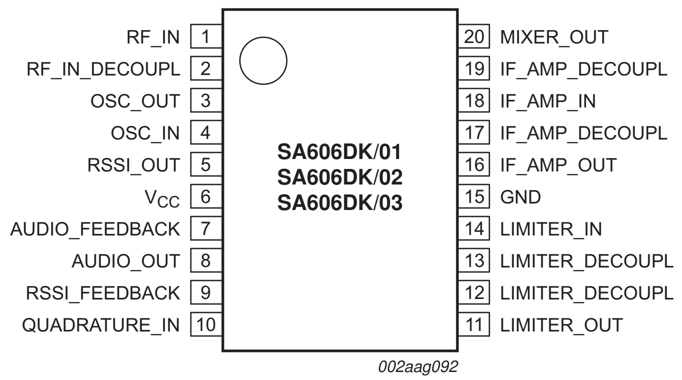


Fig 3. Pin configuration for SSOP20

6.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
RF_IN	1	RF input
RF_IN_DECOUPL	2	RF input decoupling pin
OSC_OUT	3	oscillator output
OSC_IN	4	oscillator input
RSSI_OUT	5	RSSI output
V_{CC}	6	positive supply voltage
AUDIO_FEEDBACK	7	audio amplifier negative feedback terminal
AUDIO_OUT	8	audio amplifier output
RSSI_FEEDBACK	9	RSSI amplifier negative feedback terminal
QUADRATURE_IN	10	quadrature detector input terminal
LIMITER_OUT	11	limiter amplifier output
LIMITER_DECOUPL	12	limiter amplifier decoupling pin
LIMITER_DECOUPL	13	limiter amplifier decoupling pin
LIMITER_IN	14	limiter amplifier input
GND	15	ground; negative supply
IF_AMP_OUT	16	IF amplifier output
IF_AMP_DECOUPL	17	IF amplifier decoupling pin
IF_AMP_IN	18	IF amplifier input
IF_AMP_DECOUPL	19	IF amplifier decoupling pin
MIXER_OUT	20	mixer output

7. Functional description

The SA606 is an IF signal processing system suitable for second IF systems with input frequency as high as 150 MHz. The bandwidth of the IF amplifier and limiter is at least 2 MHz with 90 dB of gain. The gain/bandwidth distribution is optimized for 455 kHz, 1.5 kΩ source applications. The overall system is well-suited to battery operation as well as high performance and high quality products of all types.

The input stage is a Gilbert cell mixer with oscillator. Typical mixer characteristics include a noise figure of 6.2 dB, conversion gain of 17 dB, and input third-order intercept of –9 dBm. The oscillator will operate in excess of 200 MHz in L/C tank configurations. Hartley or Colpitts circuits can be used up to 100 MHz for crystal configurations. Butler oscillators are recommended for crystal configurations up to 150 MHz.

The output impedance of the mixer is a 1.5 kΩ resistor permitting direct connection to a 455 kHz ceramic filter. The input resistance of the limiting IF amplifiers is also 1.5 kΩ. With most 455 kHz ceramic filters and many crystal filters, no impedance matching network is necessary. The IF amplifier has 43 dB of gain and 5.5 MHz bandwidth. The IF limiter has 60 dB of gain and 4.5 MHz bandwidth.

To achieve optimum linearity of the log signal strength indicator, there must be a 12 dBV insertion loss between the first and second IF stages. If the IF filter or interstage network does not cause 12 dBV insertion loss, a fixed or variable resistor or an L pad for simultaneous loss and impedance matching can be added between the first IF output (IF_AMP_OUT) and the interstage network. The overall gain will then be 90 dB with 2 MHz bandwidth.

The signal from the second limiting amplifier goes to a Gilbert cell quadrature detector. One port of the Gilbert cell is internally driven by the IF. The other output of the IF is AC-coupled to a tuned quadrature network. This signal, which now has a 90° phase relationship to the internal signal, drives the other port of the multiplier cell.

The demodulated output of the quadrature drives an internal op amp. This op amp can be configured as a unity gain buffer, or for simultaneous gain, filtering, and second-order temperature compensation if needed. It can drive an AC load as low as 5 kΩ with a rail-to-rail output.

A log signal strength indicator completes the circuitry. The output range is greater than 90 dB and is temperature compensated. This log signal strength indicator exceeds the criteria for AMPS or TACS cellular telephone. This signal drives an internal op amp. The op amp is capable of rail-to-rail output. It can be used for gain, filtering, or second-order temperature compensation of the RSSI, if needed.

Remark: dBV = 20log V_O/V_I.

8. Limiting values

Table 4. Limiting values
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-	7	V
T_{stg}	storage temperature		–65	+150	°C
T_{amb}	ambient temperature	operating	–40	+85	°C

9. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Max	Unit
$Z_{th(j-a)}$	transient thermal impedance from junction to ambient	SA606D/01 (SO20)	90	K/W
		SA606DK/01, SA606DK/02, SA606DK/03 (SSOP20)	117	K/W

10. Static characteristics

Table 6. Static characteristics
V_{CC} = 3 V; T_{amb} = 25 °C; unless specified otherwise.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		2.7	-	7.0	V
I_{CC}	supply current		-	3.5	4.2	mA

11. Dynamic characteristics

Table 7. Dynamic characteristics

T_{amb} = 25 °C; V_{CC} = 3 V; unless specified otherwise. RF frequency = 45 MHz + 14.5 dBV RF input step-up. IF frequency = 455 kHz; R17 = 2.4 kΩ and R18 = 3.3 kΩ. RF level = −45 dBm; FM modulation = 1 kHz with ±8 kHz peak deviation. Audio output with de-emphasis filter and C-message weighted filter. Test circuit Figure 19. The parameters listed below are tested using automatic test equipment to assure consistent electrical characteristics. The limits do not represent the ultimate performance limits of the device. Use of an optimized RF layout will improve many of the listed parameters.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Mixer/oscillator section (external LO = 220 mV RMS value)						
f_i	input frequency		-	150	-	MHz
f_{osc}	oscillator frequency		-	150	-	MHz
NF	noise figure	at 45 MHz	-	6.2	-	dB
$IP3_i$	input third-order intercept point	50 Ω source; f1 = 45.0 MHz; f2 = 45.06 MHz; input RF level = −52 dBm	-	−9	-	dB
$G_{p(conv)}$	conversion power gain	matched 14.5 dBV step-up	13.5	17	19.5	dB
		50 Ω source	-	2.5	-	dB
$R_{i(RF)}$	RF input resistance	single-ended input	-	8	-	kΩ
$C_{i(RF)}$	RF input capacitance		-	3.0	4.0	pF
$R_{o(mix)}$	mixer output resistance	MIXER_OUT pin	1.25	1.5	-	kΩ
IF section						
$G_{amp(IF)}$	IF amplifier gain	50 Ω source	-	44	-	dB
G_{lim}	limiter gain	50 Ω source	-	58	-	dB
$P_{i(IF)}$	IF input power	for −3 dB input limiting sensitivity; R17 = 2.4 kΩ; R18 = 3.3 kΩ (Figure 19); test at IF_AMP_IN pin	-	−109	-	dBm
α_{AM}	AM rejection	80 % AM 1 kHz	-	45	-	dB
$V_{o(aud)}$	audio output voltage	gain of two (2 kΩ AC load)	70	120	160	mV
SINAD	signal-to-noise-and-distortion ratio	IF level −110 dBm	-	17	-	dB
THD	total harmonic distortion		−35	−50	-	dB
S/N	signal-to-noise ratio	no modulation for noise	-	62	-	dB
$V_{o(RSSI)}$	RSSI output voltage	RF; R9 = 2 kΩ				
		RF level = −118 dBm	-	0.3	0.8	V
		SA606D/01, SA606DK/01; RF level = −68 dBm;	0.7	1.1	1.8	V
		SA606DK/02; RF level = −68 dBm	0.95	-	1.05	V
		SA606DK/03; RF level = −68 dBm	1.06	-	1.15	V
		RF level = −23 dBm	1.2	1.8	2.5	V
$\alpha_{RSSI(range)}$	RSSI range		-	90	-	dB
$\Delta\alpha_{RSSI}$	RSSI variation		-	±1.5	-	dB
$Z_{i(IF)}$	IF input impedance	IF_AMP_IN pin	1.3	1.5	-	kΩ
$Z_{o(IF)}$	IF output impedance	IF_AMP_OUT pin	-	0.3	-	kΩ
$Z_{i(lim)}$	limiter input impedance	LIMITER_IN pin	1.3	1.5	-	kΩ

Table 7. Dynamic characteristics *…continued*

T_{amb} = 25 °C; V_{CC} = 3 V; unless specified otherwise. RF frequency = 45 MHz + 14.5 dBV RF input step-up. IF frequency = 455 kHz; R17 = 2.4 kΩ and R18 = 3.3 kΩ. RF level = −45 dBm; FM modulation = 1 kHz with ±8 kHz peak deviation. Audio output with de-emphasis filter and C-message weighted filter. Test circuit Figure 19. The parameters listed below are tested using automatic test equipment to assure consistent electrical characteristics. The limits do not represent the ultimate performance limits of the device. Use of an optimized RF layout will improve many of the listed parameters.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$Z_{o(lim)}$	limiter output impedance	LIMITER_OUT pin	-	0.3	-	kΩ
$V_{o(RMS)}$	RMS output voltage	LIMITER_OUT pin	-	130	-	mV
RF/IF section (internal LO)						
$V_{o(aud)RMS}$	RMS audio output voltage	V_{CC} = 3 V; RF level = −27 dBm	-	120	-	mV
$V_{o(RSSI)}$	RSSI output voltage	system; V_{CC} = 3 V; RF level = −27 dBm	-	2.2	-	V
SINAD	signal-to-noise-and-distortion ratio	system; RF level = −117 dBm	-	12	-	dB

12. Performance curves

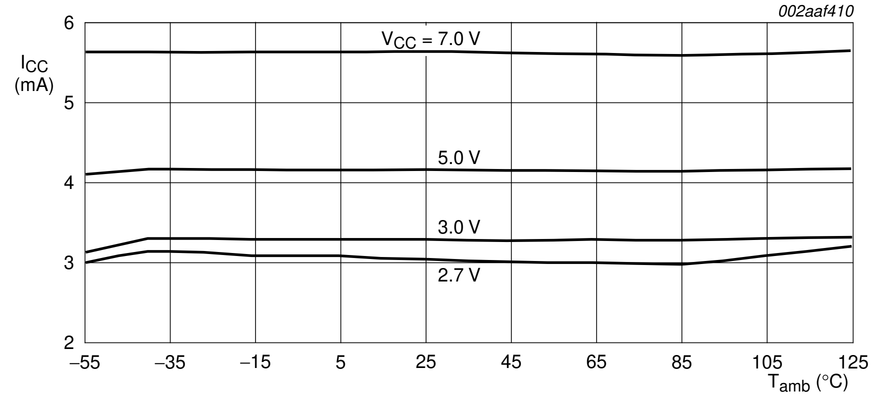


Fig 4. Supply current versus ambient temperature

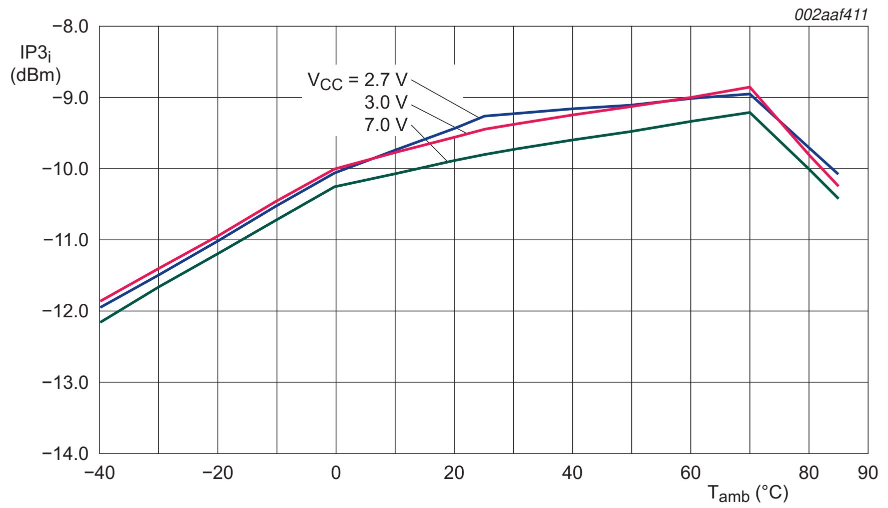


Fig 5. Third order intercept point versus ambient temperature and supply voltage

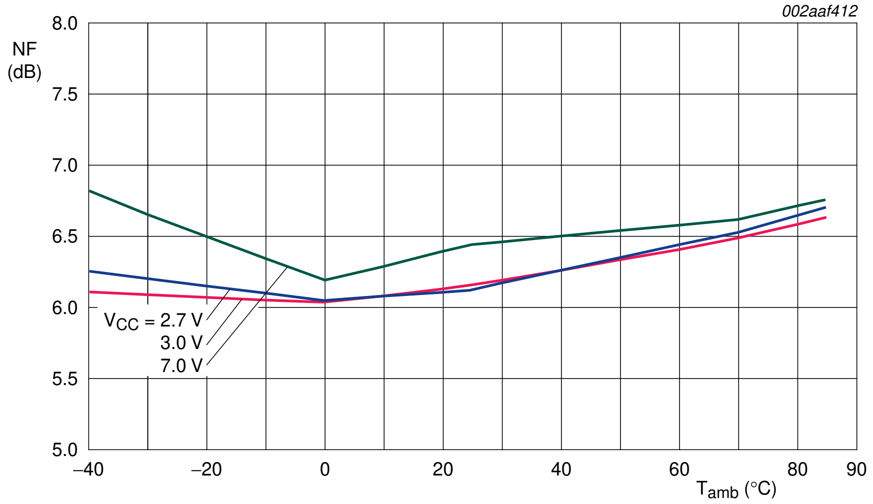


Fig 6. Mixer noise figure versus ambient temperature and supply voltage

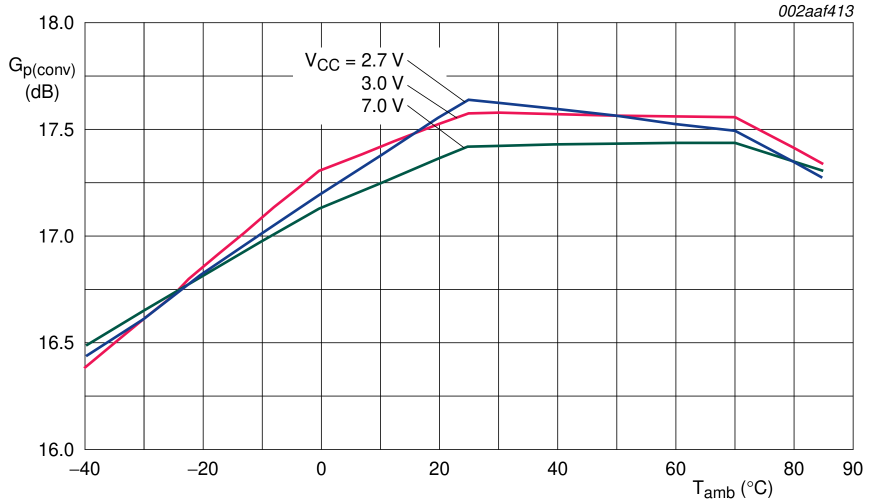
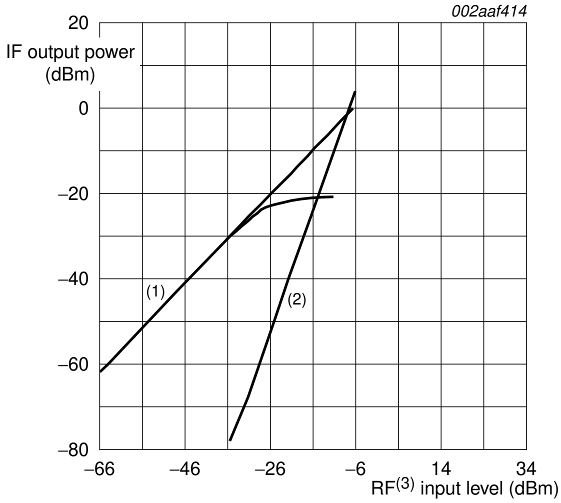


Fig 7. Conversion gain versus ambient temperature and supply voltage



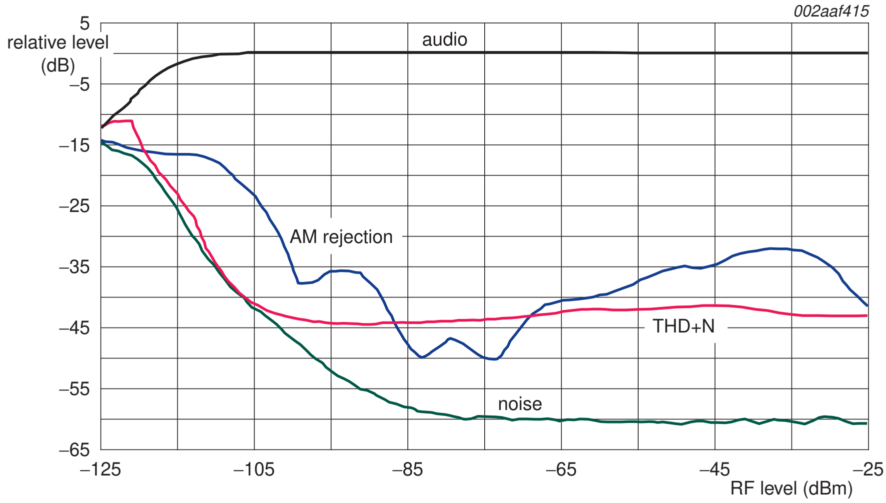
RF = 45 MHz; IF = 455 kHz.

(1) Fund product.

(2) Third order product.

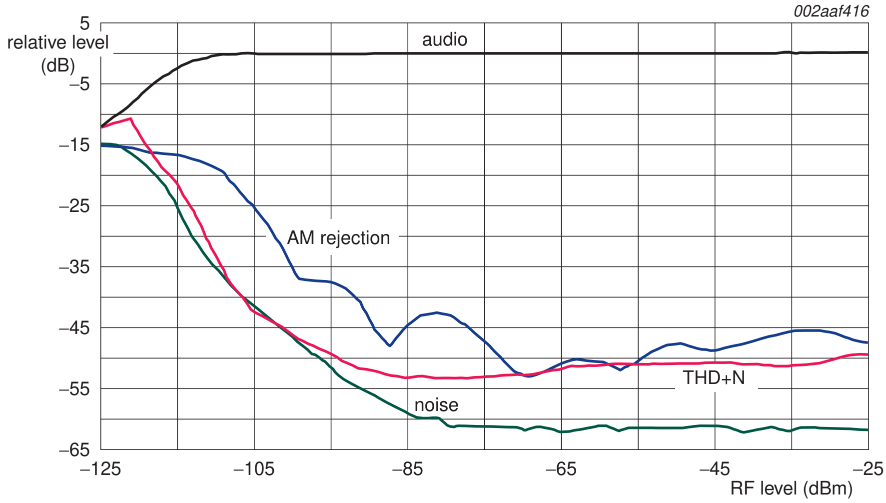
(3) 50 Ω input.

Fig 8. Mixer third order intercept and compression



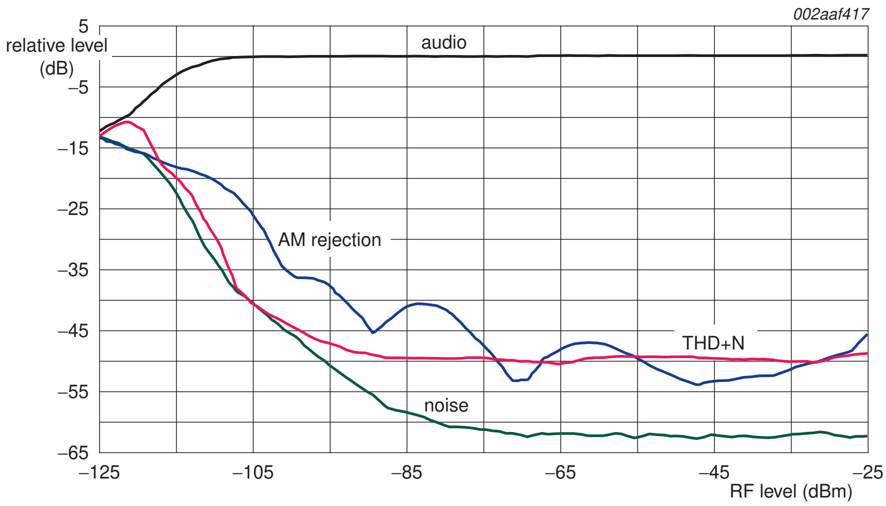
V_{CC} = 3 V; RF = 45 MHz; deviation = ±8 kHz; $V_{o(aud)RMS}$ = 104.9 mV.

Fig 9. Relative level of audio, AM rejection, THD+N and noise versus RF level (T_{amb} = −40 °C)



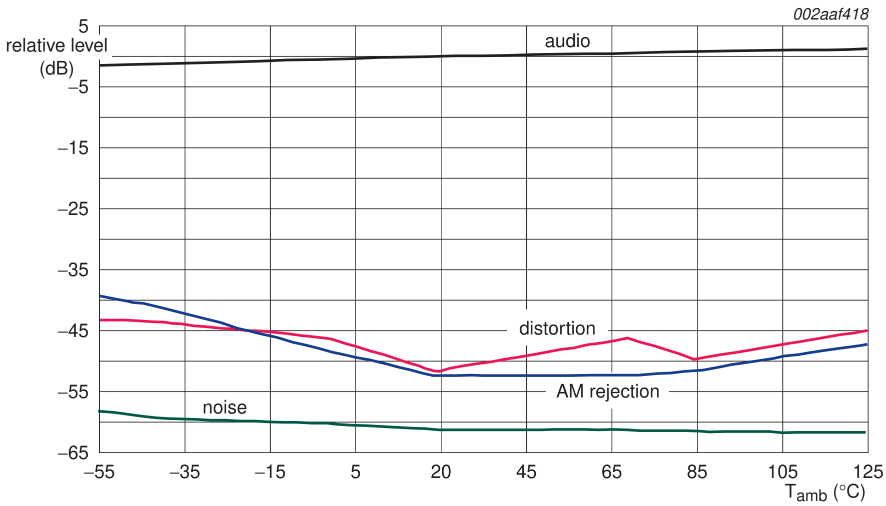
V_{CC} = 3 V; RF = 45 MHz; deviation = ±8 kHz; $V_{o(aud)RMS}$ = 117.6 mV.

Fig 10. Relative level of audio, AM rejection, THD+N and noise versus RF level (T_{amb} = +25 °C)



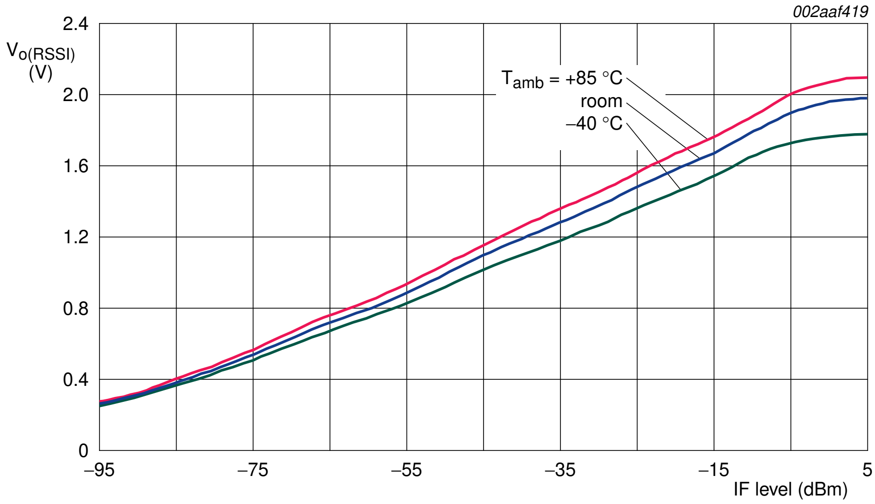
V_{CC} = 3 V; RF = 45 MHz; deviation = ±8 kHz; $V_{o(aud)RMS}$ = 127 mV.

Fig 11. Relative level of audio, AM rejection, THD+N and noise versus RF level (T_{amb} = +85 °C)



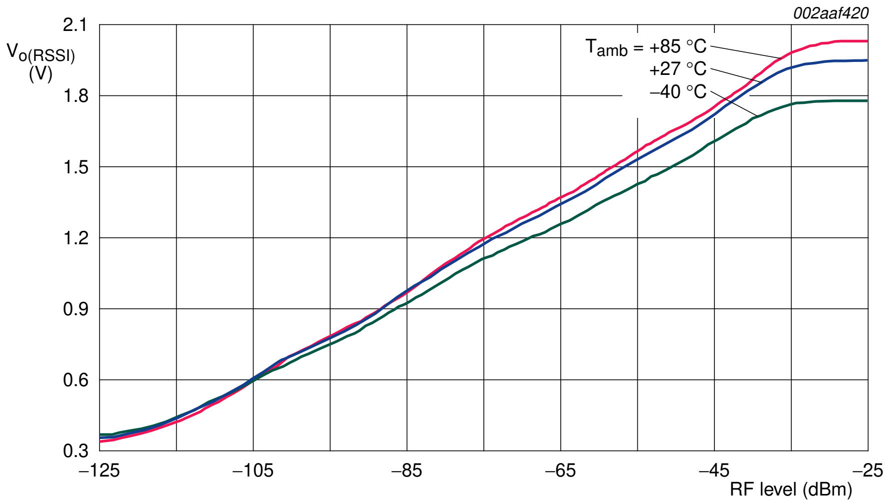
V_{CC} = 3 V; RF = 45 MHz; RF level = −45 dBm; deviation = ±8 kHz; $V_{o(aud)RMS}$ = +117.6 mV.

Fig 12. Relative audio level, distortion, AM rejection and noise versus ambient temperature



455 kHz IF at 3 V.

Fig 13. RSSI output voltage versus IF level (SA606D/01; SA606DK/01)



V_{CC} = 3 V

Fig 14. RSSI output voltage versus RF level (SA606D/01; SA606DK/01)

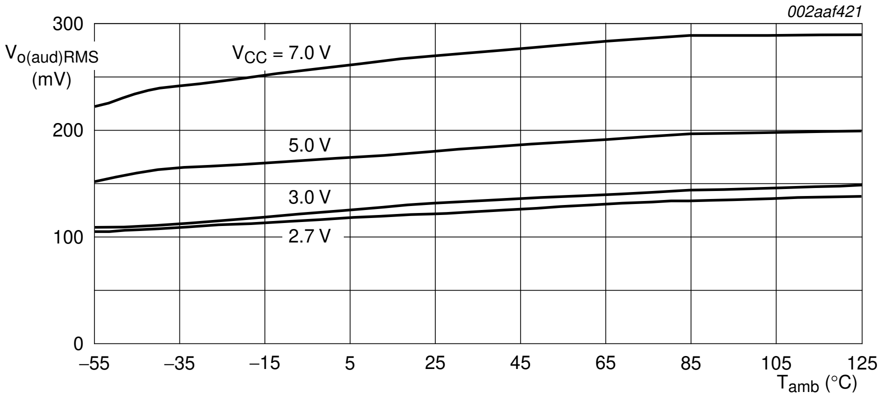
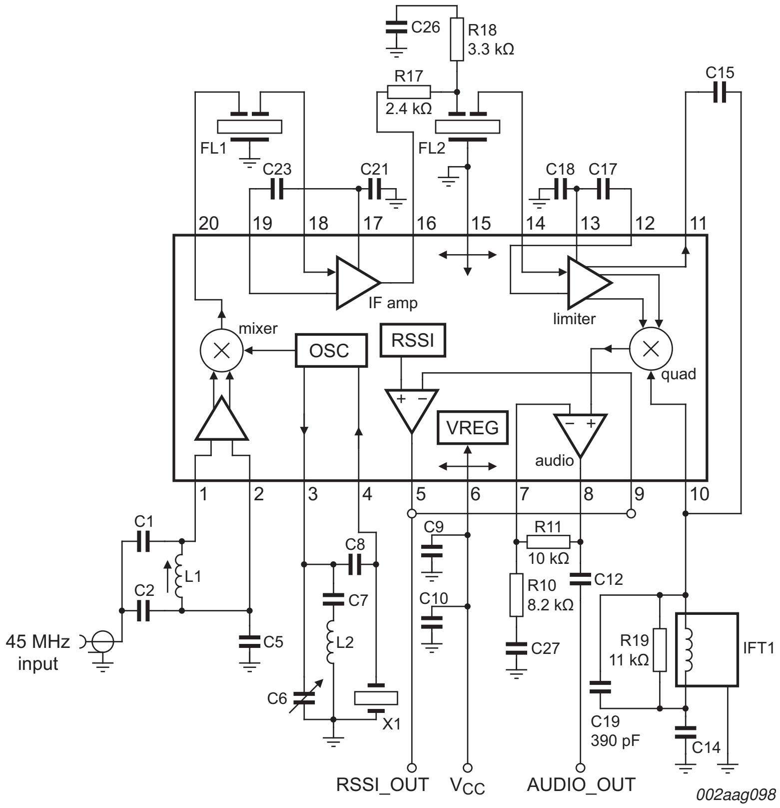


Fig 15. RMS audio output voltage versus ambient temperature

13. Application information



The layout is very critical in the performance of the receiver. We highly recommend our demo board layout.

All of the inductors, the quad tank, and their shield must be grounded. A 10 μF to 15 μF or higher value tantalum capacitor on the supply line is essential. A low frequency ESR screening test on this capacitor will ensure consistent good sensitivity in production. A 0.1 μF bypass capacitor on the supply pin, and grounded near the 44.545 MHz oscillator improves sensitivity by 2 dB to 3 dB.

Fig 16. SA606 45 MHz application circuit (SA606DK demo board)

Table 8. SA606DK demo board component list

Component	Description
C1	51 pF NPO ceramic
C2	220 pF NPO ceramic
C5, C9, C14, C17, C18, C21, C23, C26	100 nF ± 10 % monolithic ceramic
C6	5 pF to 30 pF trim cap
C7	1 nF ceramic
C8, C15	10.0 pF NPO ceramic
C10	10 μF tantalum (minimum)
C12	2.2 μF ± 10 % tantalum
C19	390 pF ± 10 % monolithic ceramic
C27	2.2 μF tantalum
FL1, FL2[1]	ceramic filter Murata CFUKF455KB4X-R0
IFT1	330 μH Toko 836AN-0129Z
L1	0.33 μH Toko SCB-1320Z
L2	1.2 μH
X1	44.545 MHz crystal ICM4712701
R5[2]	not used in application board
R10	8.2 kΩ ± 5 % 1/4W carbon composition
R11	10 kΩ ± 5 % 1/4W carbon composition
R17	2.4 kΩ ± 5 % 1/4W carbon composition
R18	3.3 kΩ ± 5 % 1/4W carbon composition
R19	11 kΩ ± 5 % 1/4W carbon composition

[1] This a 30 kHz bandwidth 455 kHz ceramic filter. All the characterization and testing are done with this wideband filter. A more narrowband 15 kHz bandwidth 455 kHz ceramic filter that may be used as an alternative selection is Murata CFUKG455KE4A-R0.

[2] R5 can be used to bias the oscillator transistor at a higher current for operation above 45 MHz. Recommended value is 10 kΩ.

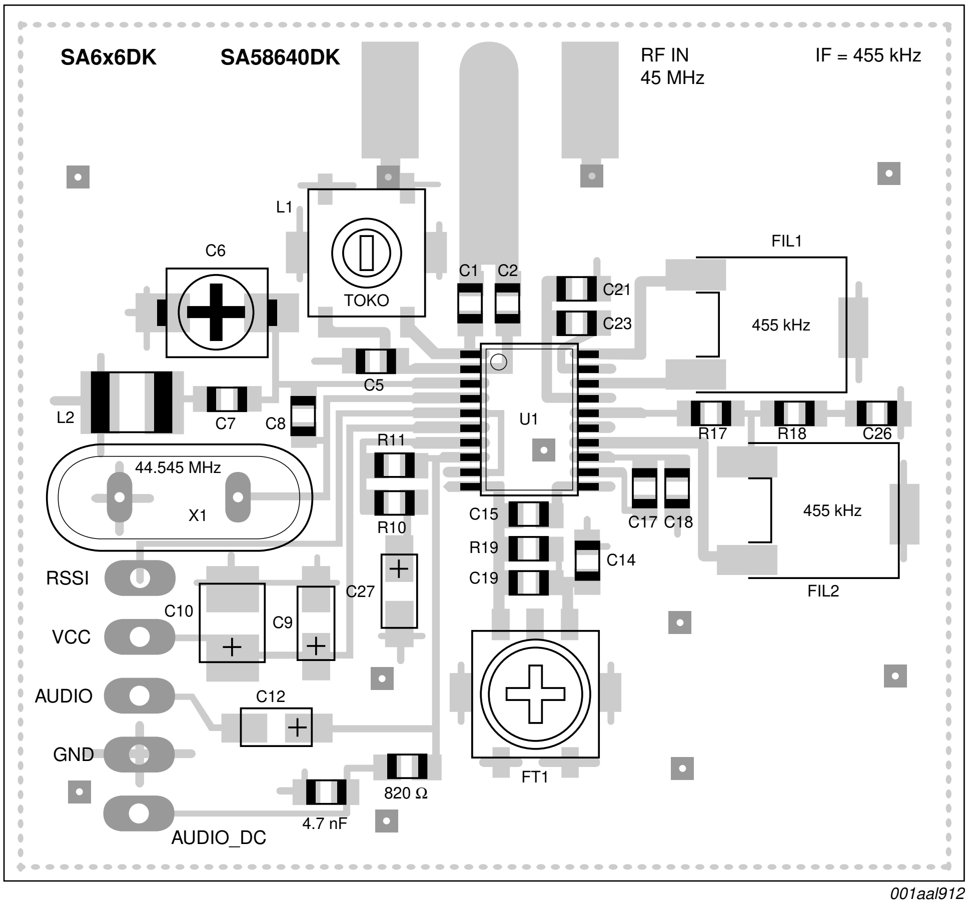


Fig 17. SA6x6DK/SA58640DK top view with components

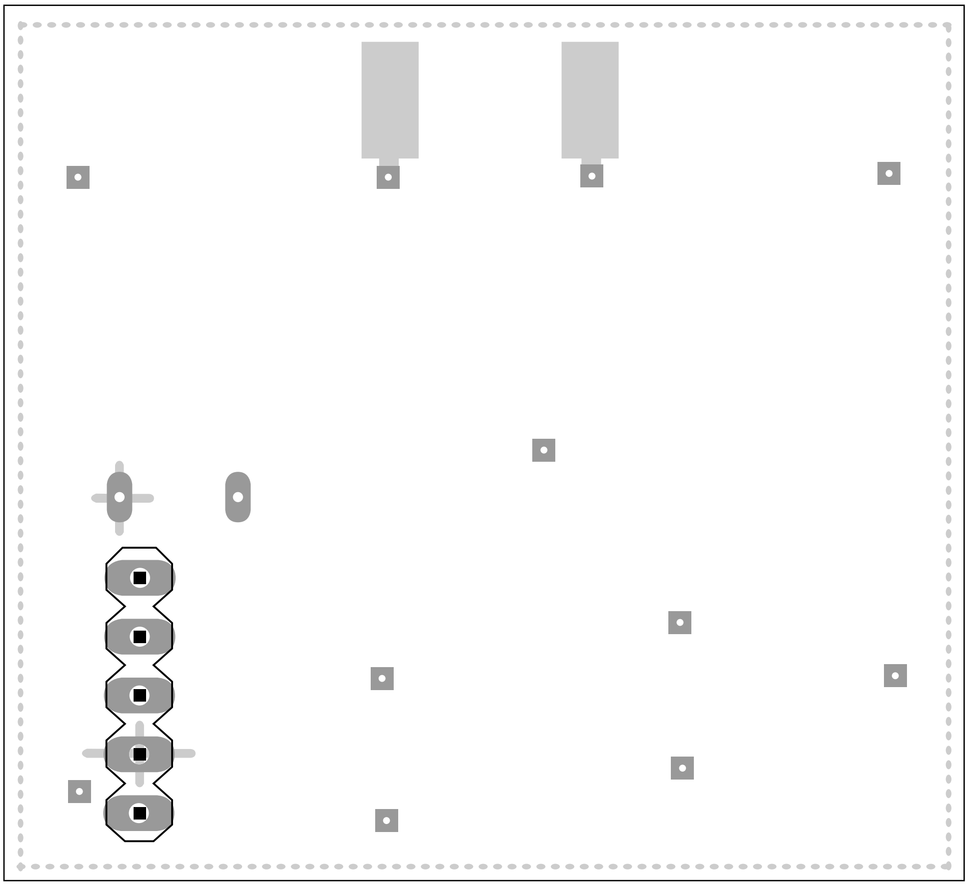


Fig 18. SA6x6DK/SA58640DK bottom view (viewed from top)

14. Test information

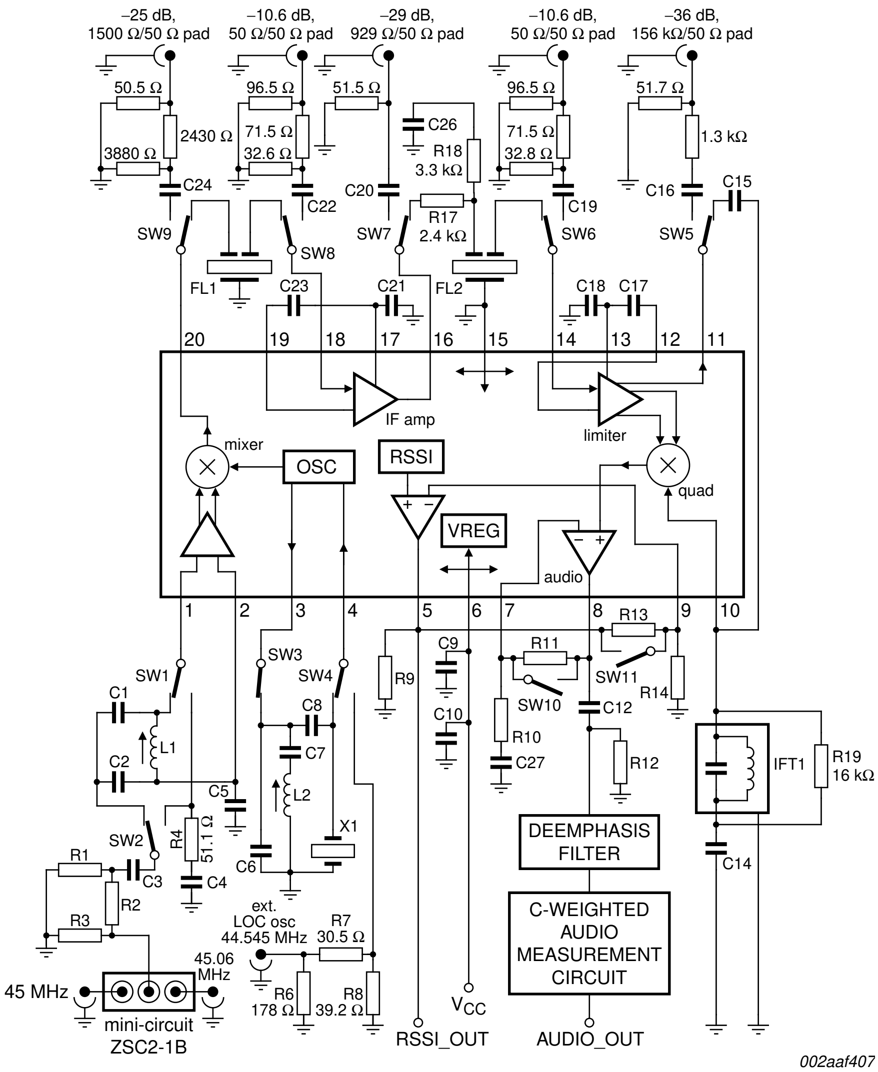


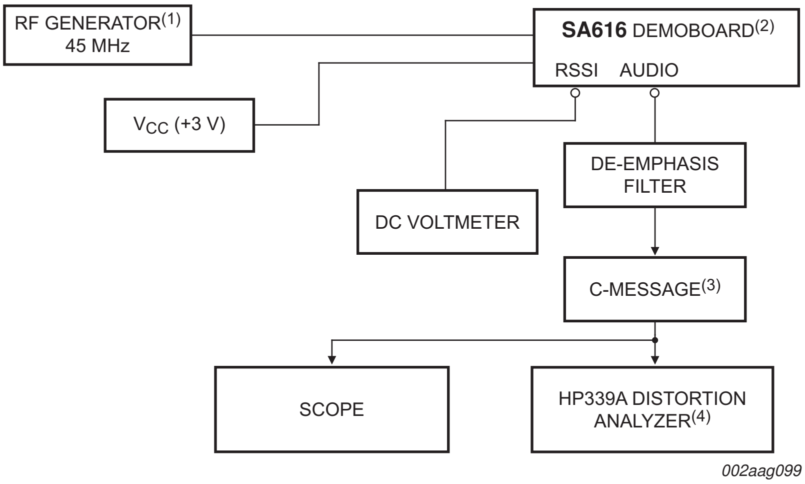
Fig 19. SA606 45 MHz test circuit (relays as shown)

Table 9. Automatic test circuit component list

Component	Description
C1	100 pF NPO ceramic
C2	390 pF NPO ceramic
C5, C9, C14, C17, C18, C21, C23, C25, C26, C27	100 nF ± 10 % monolithic ceramic
C6	22 pF NPO ceramic
C7	1 nF ceramic
C8, C15	10 pF NPO ceramic
C10	10 μF[1] tantalum (minimum)
C12	2.2 μF
C27	2.2 μF ± 10 % monolithic ceramic
FL1, FL2[2]	ceramic filter Murata CFUKF455KB4X-R0
IFT1	455 kHz (Ce = 180 pF) Toko RMC-2A6597H
L1	147 nH to 160 nH Coilcraft UNI-10/142-04J08S
L2	0.8 μH nominal; Toko 292CNS-T1038Z
R9	2 kΩ ± 1 % 1/4 W metal film
R10	10 kΩ ± 1 %
R11, R14	10 kΩ ± 1 %
R12	2 kΩ ± 1 %
R13	20 kΩ ± 1 %
R17	2.4 kΩ ± 5 % 1/4 W carbon composition
R18	3.3 kΩ
R19	16 kΩ
X1	44.545 MHz crystal ICM4712701

[1] This value can be reduced when a battery is the power source.

[2] This a 30 kHz bandwidth 455 kHz ceramic filter. All the characterization and testing are done with this wideband filter. A more narrowband 15 kHz bandwidth 455 kHz ceramic filter that may be used as an alternative selection is Murata CFUKG455KE4A-R0.



(1) Set RF generator at 45.000 MHz; use a 1 kHz modulation frequency and a 6 kHz deviation if using 16 kHz filters, or 8 kHz if using 30 kHz filters.

(2) The smallest RSSI voltage (i.e., when no RF input is present and the input is terminated) is a measure of the quality of the layout and design. If the lowest RSSI voltage is 500 mV or higher, it means the receiver is in regenerative mode. In that case, the receiver sensitivity will be worse than expected.

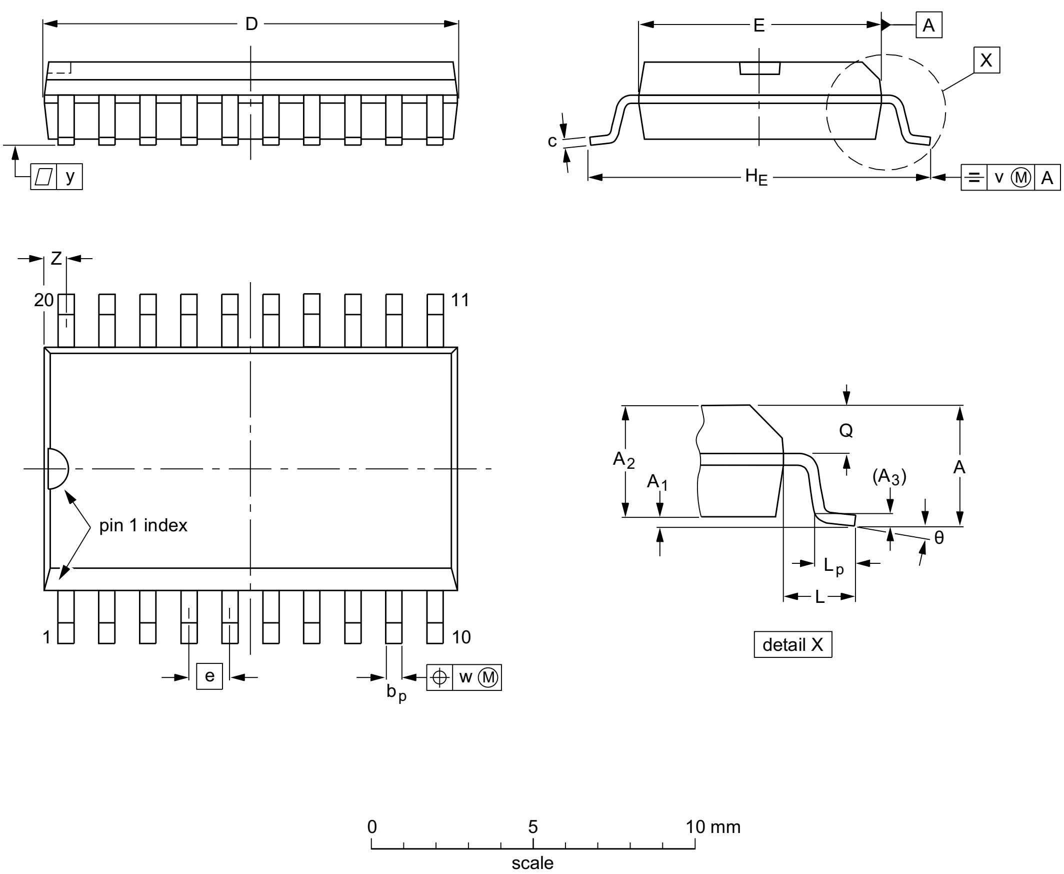
(3) The C-message and de-emphasis filter combination has a peak gain of 10 dB for accurate measurements. Without the gain, the measurements may be affected by the noise of the scope and HP339 analyzer. The de-emphasis filter has a fixed −6 dB/octave slope between 300 Hz and 3 kHz.

(4) The measured typical sensitivity for 12 dB SINAD should be 0.35 μV or −116 dBm at the RF input. (Also see Figure 10.)

Fig 20. SA606 application circuit test setup

15. Package outline

SO20: plastic small outline package; 20 leads; body width 7.5 mm **SOT163-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.1	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.05	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

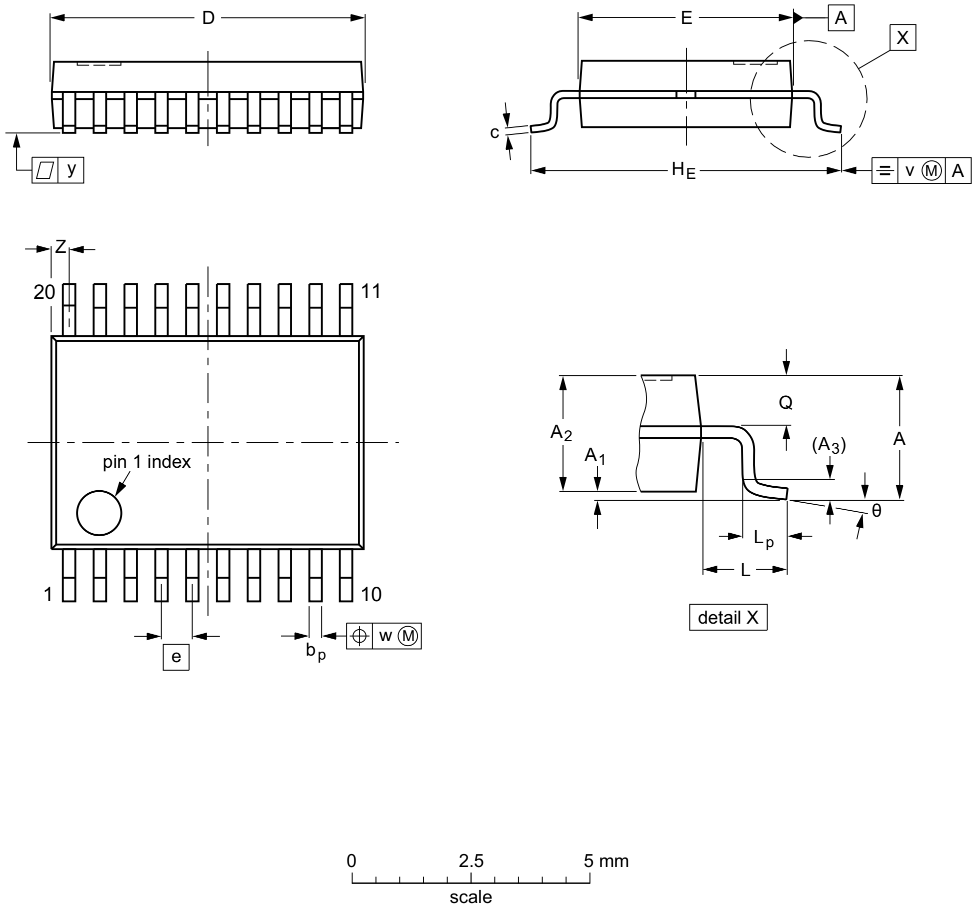
Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT163-1	075E04	MS-013				~~99-12-27~~ 03-02-19

Fig 21. Package outline SOT163-1 (SO20)

SSOP20: plastic shrink small outline package; 20 leads; body width 4.4 mm **SOT266-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	1.5	0.15 0	1.4 1.2	0.25	0.32 0.20	0.20 0.13	6.6 6.4	4.5 4.3	0.65	6.6 6.2	1	0.75 0.45	0.65 0.45	0.2	0.13	0.1	0.48 0.18	10° 0°

Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

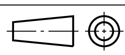
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT266-1		MO-152				~~99-12-27~~ 03-02-19

Fig 22. Package outline SOT266-1 (SSOP20)

16. Soldering of SMD packages

This text provides a very brief insight into a complex technology. A more in-depth account of soldering ICs can be found in Application Note *AN10365 "Surface mount reflow soldering description"*.

16.1 Introduction to soldering

Soldering is one of the most common methods through which packages are attached to Printed Circuit Boards (PCBs), to form electrical circuits. The soldered joint provides both the mechanical and the electrical connection. There is no single soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and Surface Mount Devices (SMDs) are mixed on one printed wiring board; however, it is not suitable for fine pitch SMDs. Reflow soldering is ideal for the small pitches and high densities that come with increased miniaturization.

16.2 Wave and reflow soldering

Wave soldering is a joining technology in which the joints are made by solder coming from a standing wave of liquid solder. The wave soldering process is suitable for the following:

- Through-hole components
- Leaded or leadless SMDs, which are glued to the surface of the printed circuit board

Not all SMDs can be wave soldered. Packages with solder balls, and some leadless packages which have solder lands underneath the body, cannot be wave soldered. Also, leaded SMDs with leads having a pitch smaller than ~0.6 mm cannot be wave soldered, due to an increased probability of bridging.

The reflow soldering process involves applying solder paste to a board, followed by component placement and exposure to a temperature profile. Leaded packages, packages with solder balls, and leadless packages are all reflow solderable.

Key characteristics in both wave and reflow soldering are:

- Board specifications, including the board finish, solder masks and vias
- Package footprints, including solder thieves and orientation
- The moisture sensitivity level of the packages
- Package placement
- Inspection and repair
- Lead-free soldering versus SnPb soldering

16.3 Wave soldering

Key characteristics in wave soldering are:

- Process issues, such as application of adhesive and flux, clinching of leads, board transport, the solder wave parameters, and the time during which components are exposed to the wave
- Solder bath specifications, including temperature and impurities

16.4 Reflow soldering

Key characteristics in reflow soldering are:

- Lead-free versus SnPb soldering; note that a lead-free reflow process usually leads to higher minimum peak temperatures (see Figure 23) than a SnPb process, thus reducing the process window
- Solder paste printing issues including smearing, release, and adjusting the process window for a mix of large and small components on one board
- Reflow temperature profile; this profile includes preheat, reflow (in which the board is heated to the peak temperature) and cooling down. It is imperative that the peak temperature is high enough for the solder to make reliable solder joints (a solder paste characteristic). In addition, the peak temperature must be low enough that the packages and/or boards are not damaged. The peak temperature of the package depends on package thickness and volume and is classified in accordance with Table 10 and 11

Table 10. SnPb eutectic process (from J-STD-020D)

Package thickness (mm)	Package reflow temperature (°C)	
	Volume (mm^3)	
	< 350	≥ 350
< 2.5	235	220
≥ 2.5	220	220

Table 11. Lead-free process (from J-STD-020D)

Package thickness (mm)	Package reflow temperature (°C)		
	Volume (mm^3)		
	< 350	350 to 2000	> 2000
< 1.6	260	260	260
1.6 to 2.5	260	250	245
> 2.5	250	245	245

Moisture sensitivity precautions, as indicated on the packing, must be respected at all times.

Studies have shown that small packages reach higher temperatures during reflow soldering, see Figure 23.