Low voltage high performance mixer FM IF system with high-speed RSSI

SA636

DESCRIPTION

The SA636 is a low-voltage high performance monolithic FM IF system with high-speed RSSI incorporating a mixer/oscillator, two limiting intermediate frequency amplifiers, quadrature detector, logarithmic received signal strength indicator (RSSI), voltage regulator, wideband data output and fast RSSI op amps. The SA636 is available in 20-lead SOL (surface-mounted small outline large package) and 20-lead SSOP (shrink samll outline package).

The SA636 was designed for high bandwidth portable communication applications and will function down to 2.7V. The RF section is similar to the famous NE605. The data output is a current output with a minimum bandwidth of 600kHz. This is designed to demodulate wideband data. The RSSI output is amplified. The RSSI output has access to the feedback pin. This enables the designer to level adjust the outputs or add filtering.

SA636 incorporates a power down mode which powers down the device when Pin 8 is low. Power down logic levels are CMOS and TTL compatible with high input impedance.

APPLICATIONS

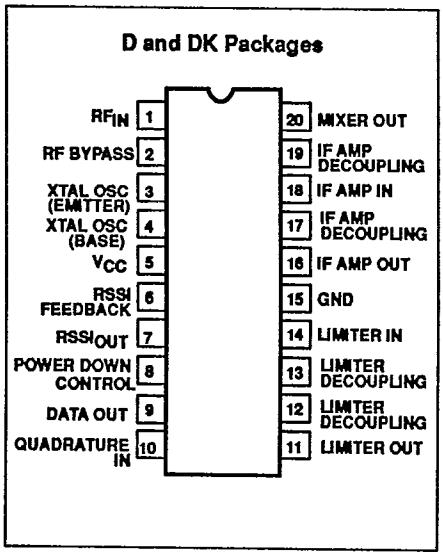
- DECT (Digital European Cordless Telephone)
- Digital cordless telephones
- Digital cellular telephones
- Portable high performance communications receivers
- Single conversion VHF/UHF receivers
- SCA receivers
- RF level meter
- Spectrum analyzer
- FSK and ASK data receivers
- Wideband low current amplification
- Wireless LANs

FEATURES

- Wideband data output (600kHz min.)
- Fast RSSI rise and fall times
- Low power consumption: 6.5mA typ at 3V
- Mixer input to >500MHz
- Mixer conversion power gain of 13dB at 240MHz
- Mixer noise figure of 11dB at 240MHz
- XTAL oscillator effective to 150MHz (L.C. oscillator to 1GHz local oscillator can be injected)
- 102dB of IF Amp/Limiter gain
- 25MHz limiter small signal bandwidth
- Temperature compensated logarithmic Received Signal Strength Indicator (RSSI) with a dynamic range in excess of 90dB
- RSSI output internal op amp
- Internal op amps with rail-to-rail outputs
- Low external component count; suitable for crystal/ceramic/LC filters
- Excellent sensitivity: 0.54μV into 50Ω matching network for 12dB SINAD (Signal to Noise and Distortion ratio) for 1kHz tone with RF at 240MHz and IF at 10.7MHz
- SA636 meets cellular radio specifications
- ESD hardened
- 10.7MHz filter matching (330Ω)
- Power down mode (I_{CC} = 200μA)

PIN CONFIGURATION

D and DK Packages



ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE	DWG #
20-Pin Plastic Small Outline Large (SOL) package (Surface-mount)	-40 to +85°C	SA636D	0172D
20-Pin Plastic Shrink Small Outline Package (Surface-mount)	-40 to +85°C	SA636DK	1563

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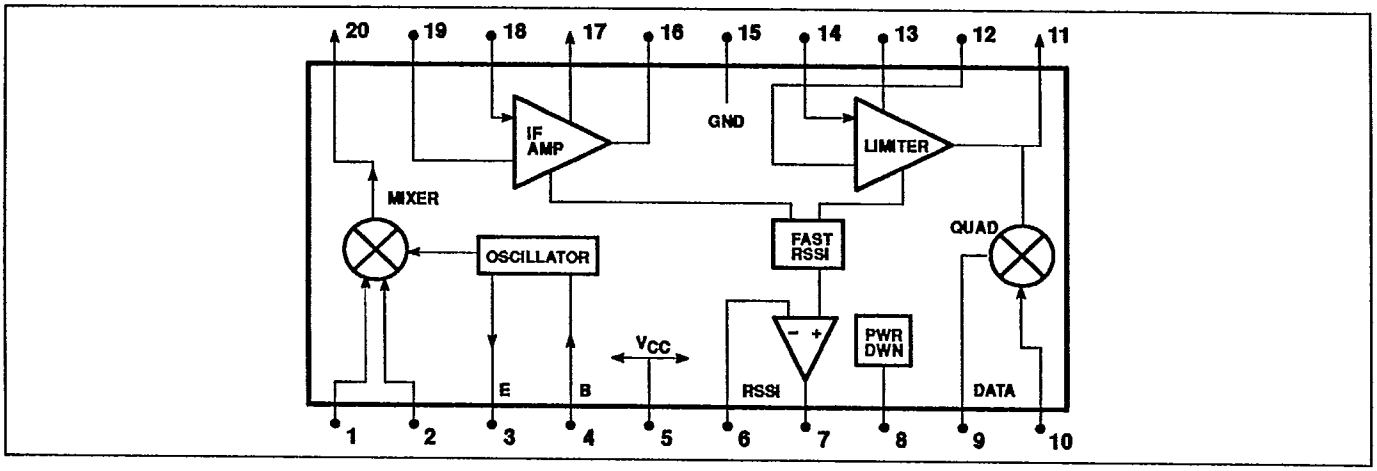
BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER		RATING	UNITS
V_{CC}	Single supply voltage		0.3 to 6	V
V_{IN}	Voltage applied to any other pin		−0.3 to (V_{CC}+0.3)	V
T_{STG}	Storage temperature range		-65 to +150	°C
T_A	Operating ambient temperature range SA636		−40 to +85	°C
θ_{JA}	Thermal impedance	D package	90	°C/W
		DK package	117	°C/W

DC ELECTRICAL CHARACTERISTICS

V_{CC} = +3V, T_A = 25°C; unless otherwise stated.

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNITS
			SA636			
			MIN	TYP	MAX	
V_{CC}	Power supply voltage range		2.7	3.0	5.5	V
I_{CC}	DC current drain	Pin 8 = HIGH		6.5		mA
I_{CC}	Standby	Pin 8 = LOW		200		µA
t_{ON}	Power up time	RSSI valid (10% to 90%)		10		µs
t_{OFF}	Power down time	RSSI invalid (90% to 10%)		5		µs

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AC ELECTRICAL CHARACTERISTICS

T_A = 25°C; V_{CC} = +3V, unless otherwise stated. RF frequency = 240.05MHz + 14.5dBV RF input step-up; IF frequency = 10.7MHz; RF level = -45dBm; FM modulation = 1kHz with ±125kHz peak deviation. Audio output with C-message weighted filter and de-emphasis capacitor. Test circuit Figure 1. The parameters listed below are tested using automatic test equipment to assure consistent electrical characterristics. 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	TEST CONDITIONS	LIMITS SA636 MIN	LIMITS SA636 TYP	LIMITS SA636 MAX	UNITS
Mixer/Osc section (ext LO = 160mV$_{RMS}$)						
f_{IN}	Input signal frequency			500		MHz
f_{OSC}	External oscillator (buffer)			500		MHz
	Noise figure at 240MHz			11		dB
	Third-order input intercept point	Matched f1=240.05; f2=240.35MHz		-18		dBm
	Conversion power gain	Matched 14.5dBV step-up		14		dB
	RF input resistance	Single-ended input		800		Ω
	RF input capacitance			3.5		pF
	Mixer output resistance	(Pin 20)		330		Ω
IF section						
	IF amp gain			44		dB
	Limiter gain			58		dB
	Input limiting -3dB	Test at Pin 18		–105		dBm
	AM rejection	80% AM 1kHz		34		dB
	Data level	R_{LOAD} = 100kΩ		130		mV$_{RMS}$
	Maximum data bandwidth		600	2000		kHz
	SINAD sensitivity	RF level = -111dBm		16		dB
THD	Total harmonic distortion			-42		dB
S/N	Signal-to-noise ratio	No modulation for noise		60		dB
	IF RSSI output with buffer	IF level = -118dBm		0.2		V
		IF level = -68dBm		1.1		V
		IF level = -18dBm		1.8		V
	IF RSSI output rise time (10kHz pulse, no 10.7MHz filter) (no RSSI bypass capacitor)	IF frequency = 10.7MHz RF level = -56dBm		1.2		µs
		RF level = -28dBm		1.1		µs
	IF RSSI output fall time (10kHz pulse, no 10.7MHz filter) (no RSSI bypass capacitor)	IF frequency = 10.7MHz RF level = -56dBm		2.0		µs
		RF level = -28dBm		7.3		µs
	RSSI range			90		dB
	RSSI accuracy			±1.5		dB
	IF input impedance			330		Ω
	IF output impedance			330		Ω
	Limiter intput impedance			330		Ω
	Limiter output impedance			300		Ω
	Limiter output level with no load			130		mV$_{RMS}$
RF/IF section (Int LO)						
	System RSSI output	RF level = -27dBm		2.0		V
	System SINAD	RF level = -110dBm		12		dB

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CIRCUIT DESCRIPTION

The SA636 is an IF signal processing system suitable for second IF or single conversion systems with input frequency as high as 1GHz. The bandwidth of the IF amplifier is about 40MHz, with 44dB(v) of gain from a 50Ω source. The bandwidth of the limiter is about 28MHz with about 58dB(v) of gain from a 50Ω source. However, the gain/bandwidth distribution is optimized for 10.7MHz, 330Ω source applications. The overall system is well-suited to battery operation as well as high performance and high quality products of all types, such as cordless and cellular hand-held phones.

The input stage is a Gilbert cell mixer with oscillator. Typical mixer characteristics include a noise figure of 11dB, conversion gain of 13dB, and input third-order intercept of -11dBm. The oscillator will operate in excess of 1GHz in L/C tank configurations. Hartley or Colpitts circuits can be used up to 100MHz for xtal configurations. Butler oscillators are recommended for xtal configurations up to 150MHz.

The output of the mixer is internally loaded with a 330Ω resistor permitting direct connection to a 10.7MHz ceramic filter. The input resistance of the limiting IF amplifiers is also 330Ω. With most 10.7MHz ceramic filters and many crystal filters, no impedance matching network is necessary. To achieve optimum linearity of the log signal strength indicator, there must be a 6dB(v) insertion loss between the first and second IF stages. If the IF filter or interstage network does not cause 6dB(v) insertion loss, a fixed or variable resistor can be added between the first IF output (Pin 16) and the interstage network.

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.

Overall, the IF section has a gain of 90dB. For operation at intermediate frequency at 10.7MHz. Special care must be given to layout, termination, and interstage loss to avoid instability.

The demodulated output (DATA) of the quadrature is a current output. This output is designed to handle a minimum bandwidth of 600kHz. This is designed to demodulate wideband data, such as in DECT applications.

A Receive Signal Strength Indicator (RSSI) completes the circuitry. The output range is greater than 90dB and is temperature compensated. This log signal strength indicator exceeds the criteria for AMPS or TACS cellular telephone, DECT and RCR-28 cordless 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 2nd-order temperature compensation of the RSSI, if needed.

NOTE: $dB(v) = 20\log V_{OUT}/V_{IN}$

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