

## 1 MHz to 3.9 GHz RF Upconverter Core Module

The SC5406B is a three-stage high dynamic range superheterodyne upconverter. Designed to convert low frequency broadband IF signals to higher RF signals, the SC5406B has 3<sup>rd</sup> order linearity and noise performance that rival direct-conversion devices, but without image and in-band LO leakages that are inherent to them. The SC5406B is also highly configurable to suit the intended application. For example, the device can be configured as biased towards linearity or towards a better signal-to-noise ratio (SNR).



The output compression-to-noise dynamic range is typically 150 dB and the spurious-free dynamic range is better than 110 dB. As an example, for a 0 dBm output signal the SNR is better than 130 dBc while achieving -70 dBc 3<sup>rd</sup> order inter-modulation distortion (IMD3). The SC5406B also has a wide gain range. Output signal levels as low as -110 dBm and as high as +16 dBm can be achieved.

The excellent spurious free dynamic range is accomplished through the use of low noise linear amplifiers, low loss mixers, and high performance solid state attenuators. Frequency accuracy is provided by an onboard 10 MHz temperature compensated crystal oscillator (TCXO) which can be phase locked to an external reference source if required, and it is recommended to do so in applications that may require a more stable and accurate base reference.

The SC5406B is designed with the intent of being paired with SignalCore downconverters to form transceiver pairs and are ideal for applications such as Record and Playback. As the IF frequencies are the same, the pair may also form a frequency re-allocator that would receive information on one band and transmit the same information on another. With an add-on feature, the SC5406B can be configured as a 1 MHz to 3.9 GHz sine-tone generator.

### Product Features

- Low residual phase noise better than -107 dBc/Hz @ 10 kHz offset, -141 dBc/Hz @ 1 MHz offset, measured on 1 GHz carrier
- 20 MHz signal bandwidth, 1 Hz tuning resolution (exact frequency)
- Output noise density -148 dBm/Hz @ 0 dBm output level
- < -110 dBm to 16 dBm output levels with 0 dBm at input level
- Output spurious signals < -75 dBc typical
- 3<sup>rd</sup> order intermodulation < -70 dBc @ 0 dBm output level
- LO leakage < -100 dBc @ 0 dBm output level
- Internal sine-tone generator

### Applications

- RF Instrumentation
- Wireless communications
- Broadcast monitoring
- Spectral Analysis
- Software-defined radio
- Signal Intelligence

## TECHNICAL SPECIFICATIONS (AT 25°C AMBIENT, SINE WAVEFORM)

### SPECTRAL SPECIFICATIONS

RF output frequency range .....	1 MHz to 3.9 GHz
IF input center frequency .....	70 MHz
Real-time IF Bandwidth .....	20 MHz
Amplitude flatness <sup>1</sup> .....	3 dB typical
Internal reference	
Stability <sup>2</sup> .....	±2.5 ppm
Aging .....	< 1 ppm after 1 year
Phase locking range .....	±5 ppm
Tuning	
Resolution .....	1 Hz
Speed (settled to 0.1 ppm) <sup>3</sup> .....	< 2 ms

Sideband phase noise <sup>4</sup>(typical, dBc/Hz)

Offset	RF Frequency			
	100 MHz	1 GHz	2 GHz	3 GHz
100 Hz	-88	-87	-85	-83
1 kHz	-100	-99	-98	-97
10 kHz	-108	-107	-106	-105
100 kHz	-119	-118	-117	-115
1 MHz	-143	-142	-142	-141
10 MHz	-150	-149	-149	-148

Sideband phase spurious signals

< 100 kHz .....	-70 dBc typical
> 100 kHz .....	-80 dBc typical

### AMPLITUDE SPECIFICATIONS

Output RF range .....	-110 dBm to 16 dBm
Max input (with 20 dB RF attenuation) .....	23 dBm
IF nominal input <sup>5</sup> .....	0 dBm
Attenuation range .....	0 to 150 dB
Attenuation resolution .....	1 dB
Gain .....	-120 dB to 30 dB typical
Gain accuracy (calibration applied) <sup>6</sup> .....	±1.0 dB
Output P1dB compression .....	18 dBm typical
IMD3 (two 0 dBm tones, 1 MHz apart) .....	< -70 dBc typical
2 <sup>nd</sup> order harmonics (0 dBm tone) .....	< -30 dBc
Output level accuracy <sup>7</sup>	
> -40 dBm to 7 dBm .....	< ±1.5 dB
< -40 dBm .....	< ±2.5 dB

Output noise floor density <sup>8</sup>

(0 dBm input and 0 dBm output)

Frequency	IMD3 = -40 dBc	IMD3 = -70 dBc
100 Hz	-150 dBm/Hz	-130 dBm/Hz
1 GHz	-149 dBm/Hz	-132 dBm/Hz
3.6 GHz	-148 dBm/Hz	-130 dBm/Hz

Spurious signals

Residual (system inherent) spurs .....	-75 dBc
LO leakage at RF terminal .....	< -100 dBc

### TERMINAL SPECIFICATIONS

RF input and IF output terminal

Impedance .....	50 Ω
Connector type .....	SMA female
Coupling .....	AC

Reference input terminal

Impedance (single ended) .....	50 Ω
Connector type .....	SMA female
Coupling .....	AC
Frequency .....	10 MHz
Amplitude range .....	-5 dBm to 10 dBm
Lock range .....	±5 ppm

Reference output terminal

Impedance (single ended) .....	50Ω
Connector type .....	SMA female
Coupling .....	AC
Frequency <sup>9</sup> .....	10/100 MHz
Amplitude .....	3 dBm

Communication interface .....

Power consumption .....

Weight .....

Dimensions (W x H x D, max envelope) .....

Warranty .....

1 year parts and labor on defects in materials or workmanship

### ORDER INFORMATION

7100059-01 .....	SC5406B, 1 MHz to 3.9 GHz RF Upconverter Core Module USB and SPI Interfaces
7100059-02 .....	SC5406B, 1 MHz to 3.9 GHz RF Upconverter Core Module USB and RS-232 Interfaces
7100021-01 .....	Sine-tone Generation Add-On to SC540X 3.9 GHz Upconverter Family

Specifications are subject to change without notice. For the most recent product specifications, please visit [www.signalcore.com](http://www.signalcore.com).

(1) The raw IF amplitude response over the bandwidth range.  
 (2) The internal reference is a TCXO. For better accuracies and stability one should phase lock to an external source.  
 (3) For step change of less than 50 MHz.  
 (4) The phase noise specs are for the YIG based oscillator in normal tuning speed setting.  
 (5) The nominal IF is set to 0 dBm. For generated signals less than -110 dBm, the driving IF signal must be less than 0 dBm.

(6) All units are factory calibrated and calibration is stored in onboard EEPROMs. The user must apply the calibration correction to the IF signal for output level accuracy to be valid.  
 (7) Only with Sine-tone Generation. Accuracies are limited by the step attenuation resolution.  
 (8) Shown in the table are two different settings; one set for improved SNR, the other set for improved 3<sup>rd</sup> order IMD.  
 (9) Reference clock frequency is user selectable between 10 MHz and 100 MHz.