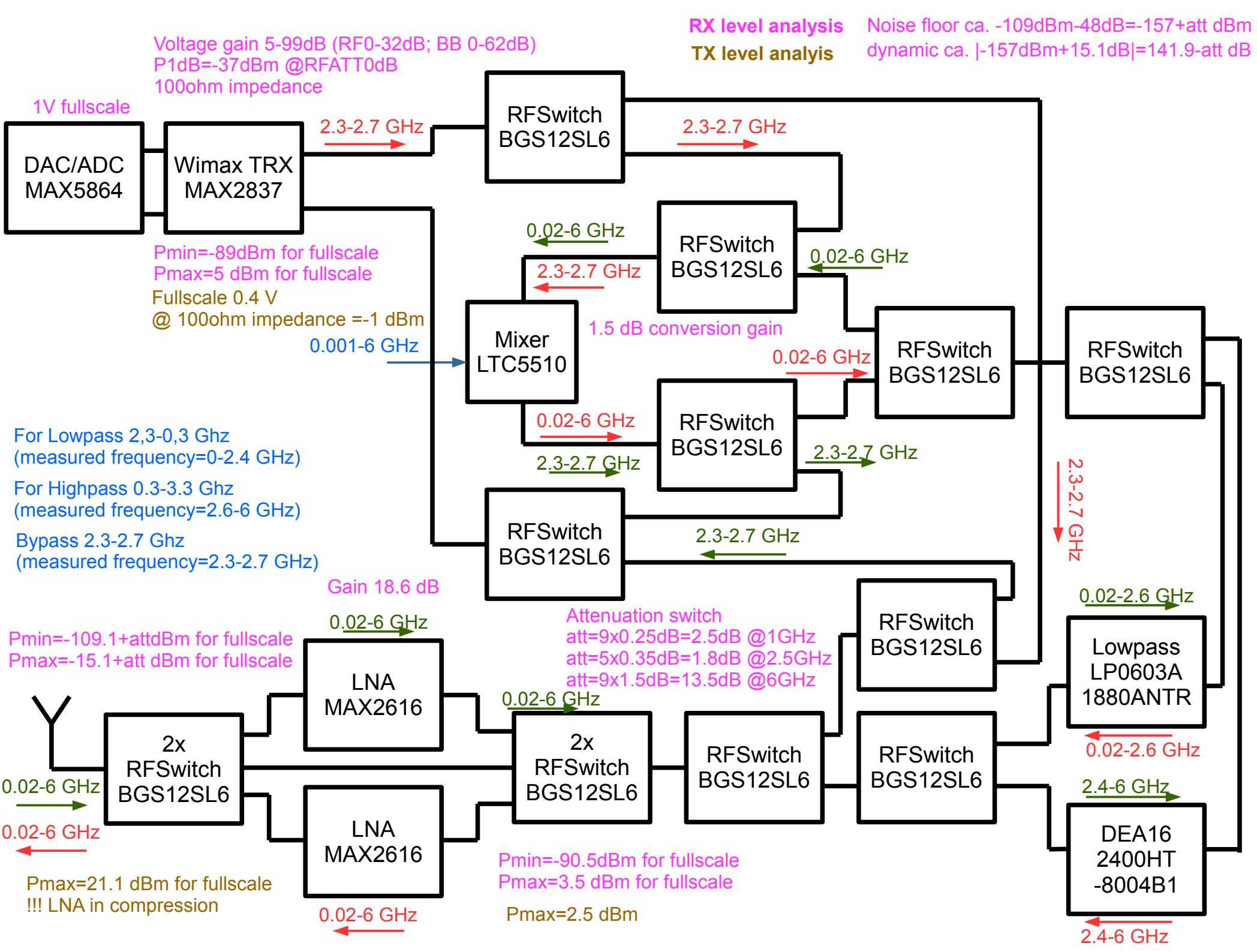
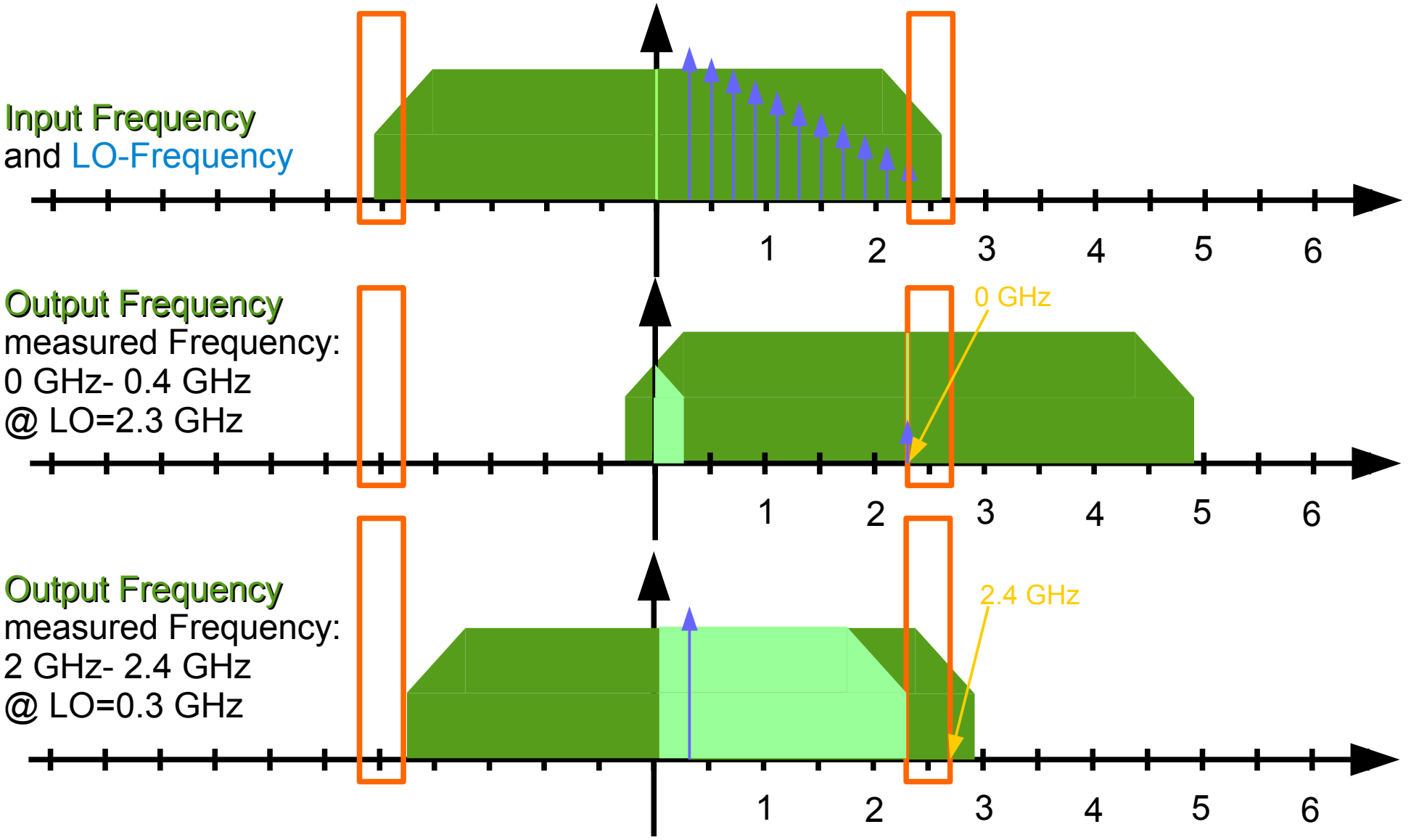

RX level analysis
TX level analysis
Noise floor ca. -109dBm-48dB=-157+att dBm
dynamic ca. |-157dBm+15.1dB|=141.9-att dB
Voltage gain 5-99dB (RF0-32dB; BB 0-62dB)
P1dB=-37dBm @RFATT0dB
100ohm impedance
1V fullscale
DAC/ADC MAX5864
Wimax TRX MAX2837
2.3-2.7 GHz
RFSwitch BGS12SL6
Pmin=-89dBm for fullscale
Pmax=5 dBm for fullscale
Fullscale 0.4 V
@ 100ohm impedance =-1 dBm
0.001-6 GHz
Mixer LTC5510
1.5 dB conversion gain
0.02-6 GHz
For Lowpass 2,3-0,3 Ghz
(measured frequency=0-2.4 GHz)
For Highpass 0.3-3.3 Ghz
(measured frequency=2.6-6 GHz)
Bypass 2.3-2.7 Ghz
(measured frequency=2.3-2.7 GHz)
Gain 18.6 dB
Pmin=-109.1+attdBm for fullscale
Pmax=-15.1+att dBm for fullscale
LNA MAX2616
2x RFSwitch BGS12SL6
Attenuation switch
att=9x0.25dB=2.5dB @1GHz
att=5x0.35dB=1.8dB @2.5GHz
att=9x1.5dB=13.5dB @6GHz
Pmax=21.1 dBm for fullscale
!!! LNA in compression
Pmin=-90.5dBm for fullscale
Pmax=3.5 dBm for fullscale
Pmax=2.5 dBm
Lowpass LP0603A 1880ANTR
0.02-2.6 GHz
2.4-6 GHz
DEA16 2400HT -8004B1

Low pass Filter active 0-2.4 GHz

Wimax TRX receiving frequency 2.3 GHz- 2.7 GHz

LO Frequency

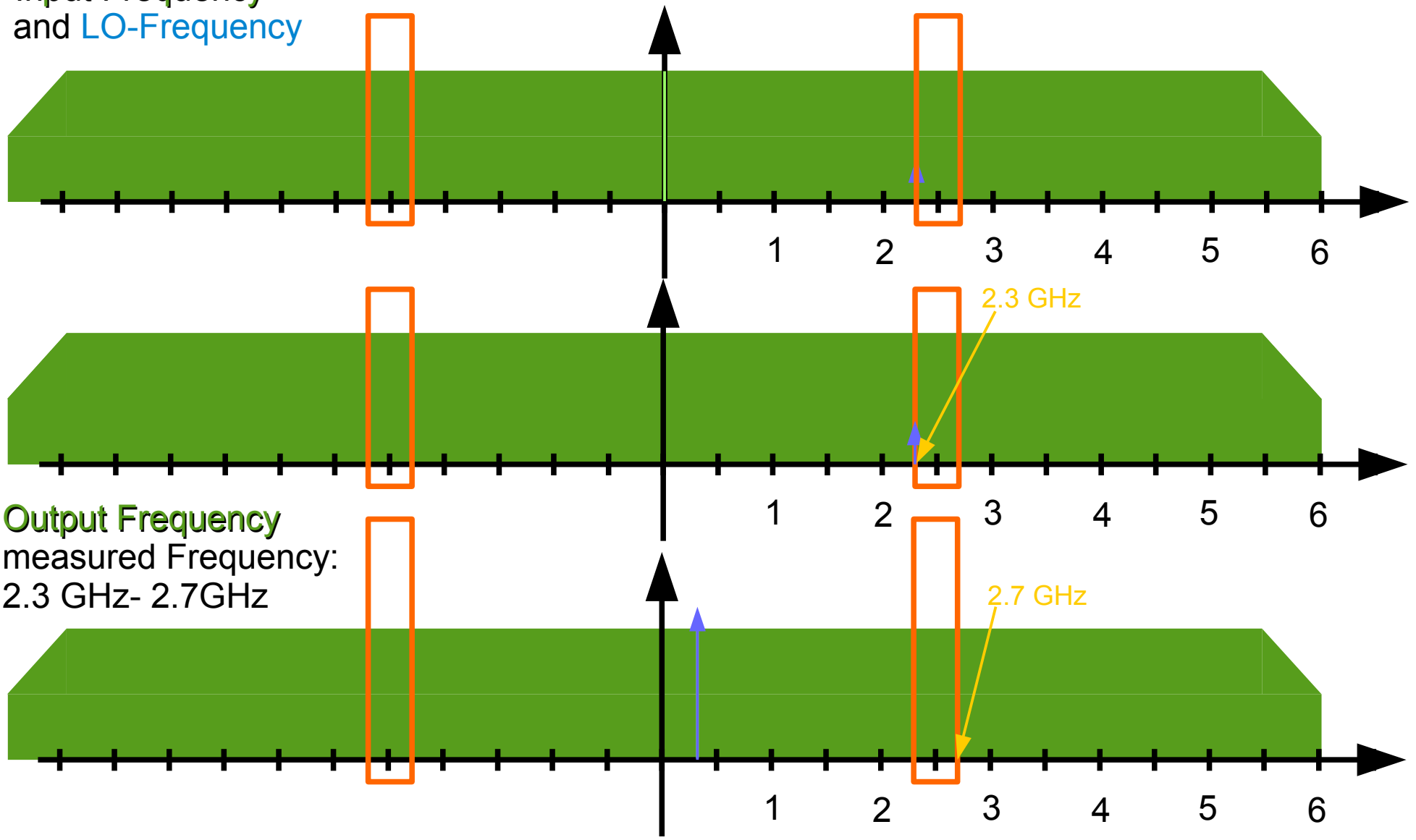


Byepass active 2.3-2.7 GHz

Wimax TRX receiving frequency 2.3 GHz- 2.7 GHz

LO Frequency

Input Frequency
and LO-Frequency

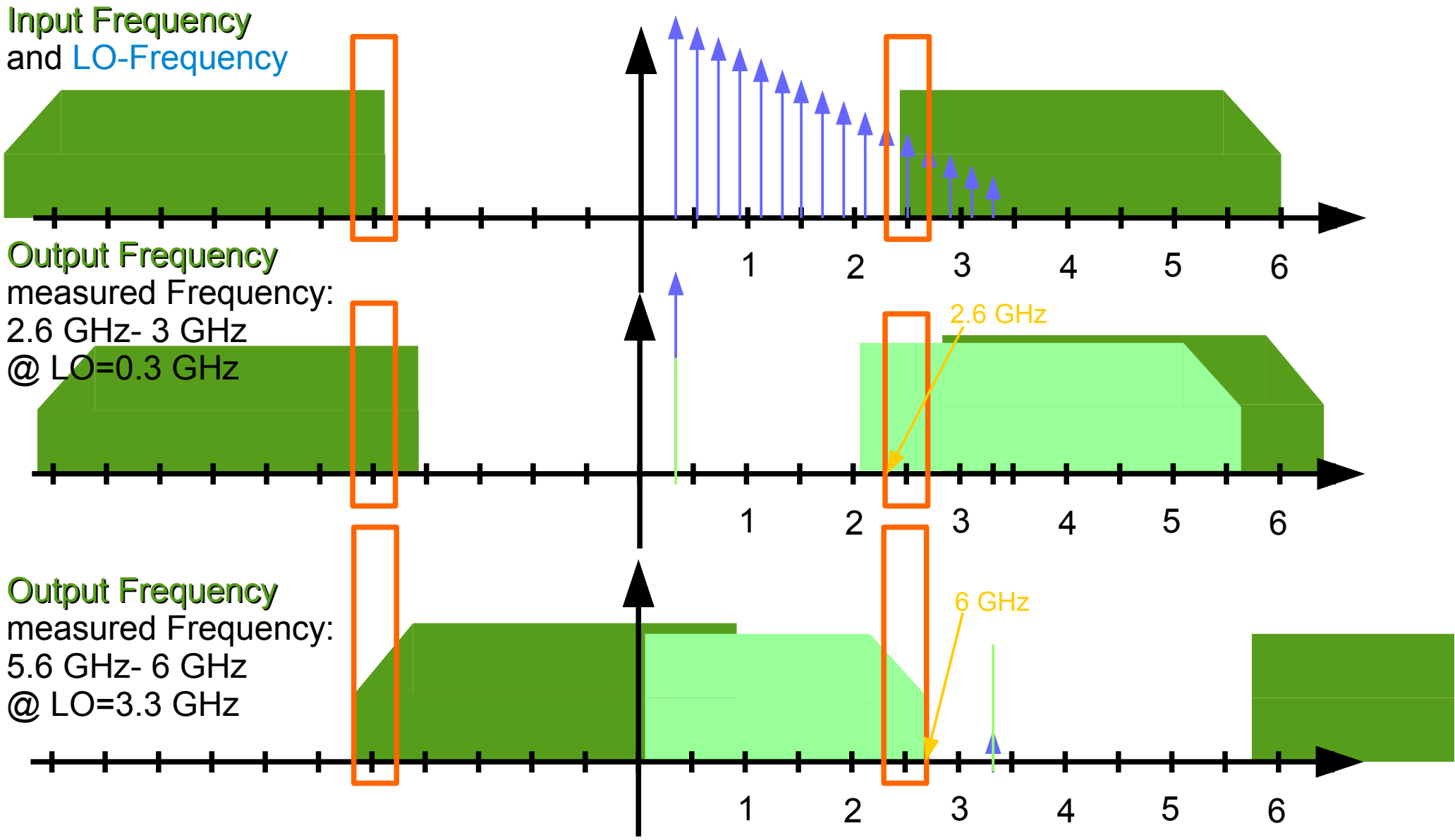


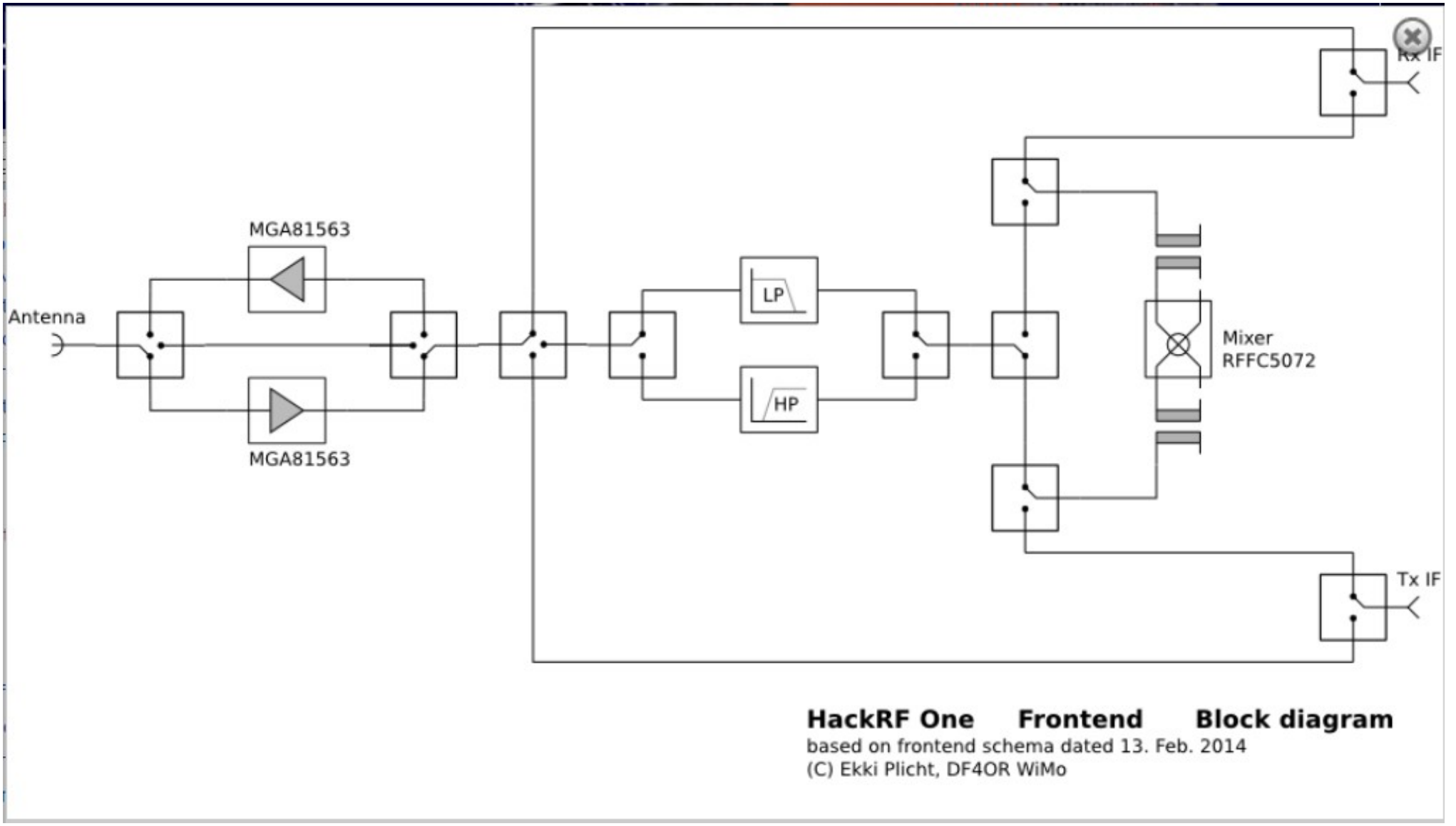
Output Frequency
measured Frequency:
2.3 GHz- 2.7GHz

High pass Filter active 2.6-6 GHz

Wimax TRX receiving frequency 2.3 GHz- 2.7 GHz

LO Frequency




MGA81563
Antenna
MGA81563
LP
HP
Mixer
RFFC5072
Rx IF
Tx IF
HackRF One Frontend Block diagram
based on frontend schema dated 13. Feb. 2014
(C) Ekki Plicht, DF4OR WiMo

Current consumtion

		mA	V
Mixer		105	3.3/5
LNA		2x81	3-5.5
Tranceiver	RX110 TX170		2.7-3.6
ADC		14	1.8-3.3
LPC4300		100	3.3
Switch		-	3.3/5

SUMRX	410mA
SUMTX	470mA

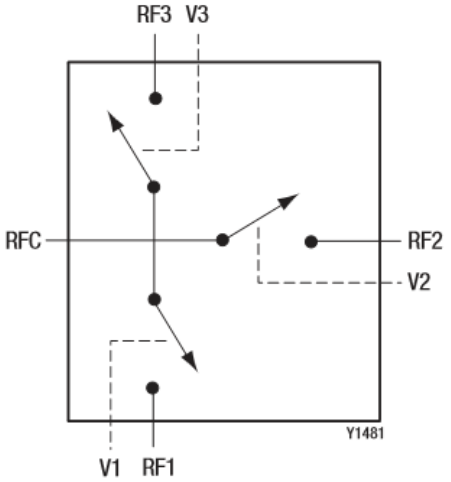
SKY13317-373LF: 20 MHz to 6.0 GHz pHEMT GaAs SP3T Switch

Applications

- 802.11 a/b/g/n WLAN networks
- Bluetooth® systems

Features

- Positive low voltage control: 0/1.8 to 5.0 V
- Low insertion loss: 0.5 dB @ 2.5 GHz, 0.9 dB @ 6 GHz
- High isolation: 25 dB up to 6 GHz
- Excellent linearity performance: P1dB = +29 dBm
- Miniature, ultra-thin MLP (8-pin, 1.5 x 1.5 mm) package (MSL1, 260 °C per JEDEC J-STD-020)



3rd Order Input Intercept Point	IIP3	900 to 2450 MHz, ΔF = 1 MHz, PIN = +17 dBm/tone				
		VLOW = 0 V, VHIGH = 2.1 V		+33		dBm
		VLOW = 0 V, VHIGH = 3.3 V		+50		dBm

Table 4. SKY13317-373LF Truth Table

Low Insertion Loss Path	V1 (Pin 3)	V2 (Pin 6)	V3 (Pin 7)
RFC to RF1	High	Low	Low
RFC to RF2	Low	High	Low
RFC to RF3	Low	Low	High

Note: "High" = 1.8 to 5.0 V. "Low" = 0 to 0.25 V. Any state other than described in this Table places the switch into an undefined state. An undefined state will not damage the device.

2.3GHz to 2.7GHz Wireless Broadband RF Transceiver

MAX2837

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Features

- 2.3GHz to 2.7GHz Wideband Operation
- Complete RF Transceiver, PA Driver, and Crystal Oscillator
  - 0dBm Linear OFDM Transmit Power
  - -70dBr Tx Spectral Emission Mask
  - 2.3dB Rx Noise Figure
  - Tx/Rx I/Q Error and LO Leakage Detection
  - Monolithic Low-Noise VCO with -39dBc Integrated Phase Noise
  - Programmable Tx I/Q Lowpass Anti-Aliasing Filter
  - Sigma-Delta Fractional-N PLL with 20Hz Step Size
  - 45dB Tx Gain-Control Range
  - 94dB Receive Gain-Control Range
  - 60dB Analog RSSI Instantaneous Dynamic Range
  - 4-Wire SPI™ Digital Interface
  - I/Q Analog Baseband Interface
  - Digitally Tuned Crystal Oscillator
  - On-Chip Digital Temperature Sensor Read-Out
- +2.7V to +3.6V Transceiver Supply
- Low-Power Shutdown Current
- Small 48-Pin Thin QFN Package (6mm x 6mm x 0.8mm)

Lowpass

Thin-Film Low Pass Filter

LP0603 Lead-Free LGA Type

GENERAL DESCRIPTION

The LP0603 ITF (Integrated Thin Film) Lead-Free LGA Low Pass Filter is based on thin-film multilayer technology. The technology provides a miniature part with excellent high frequency performance and rugged construction for reliable automatic assembly.

The ITF Low Pass Filters are offered in a variety of frequency bands compatible with various types of high frequency wireless systems.

FEATURES

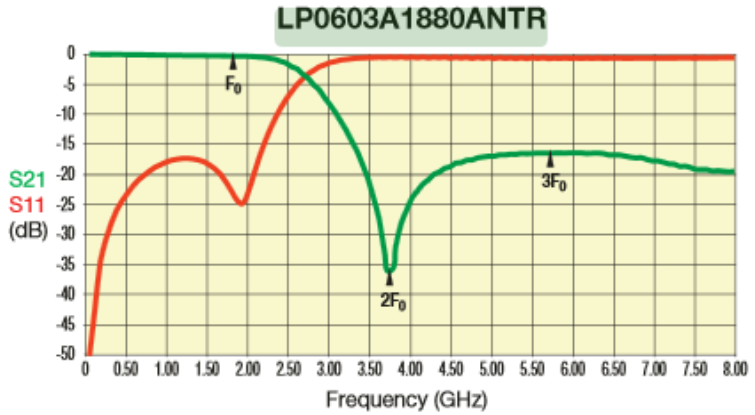
- Miniature Size: 0603
- Frequency Range: 900MHz-5.5HGz
- Characteristic Impedance: 50 Ohm
- Operating/Storage Temperature: -40°C to +85°C
- Power Rating: 3W Continuous
- Low Profile
- Rugged Construction
- Lead Free
- Taped and Reeled

APPL

- Mobil
- Satelli
- GPS
- Vehicl
- Wirele
- RFID

LAND

- Inhere
- Self A
- Excell
- Low F
- Better

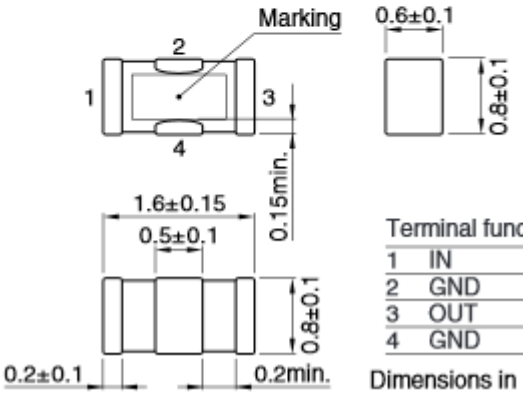


Highpass

Multilayer Chip High Pass Filters For Bluetooth & 2.4GHz W-LAN

DEA Series DEA162400HT-8004B1

SHAPES AND DIMENSIONS

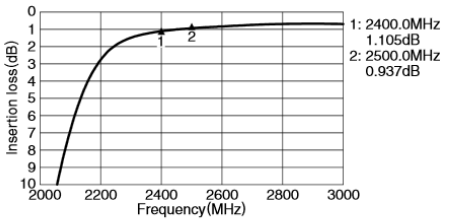


Terminal functions	
1	IN
2	GND
3	OUT
4	GND

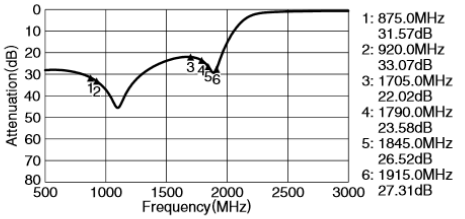
Dimensions in mm

FREQUENCY CHARACTERISTICS

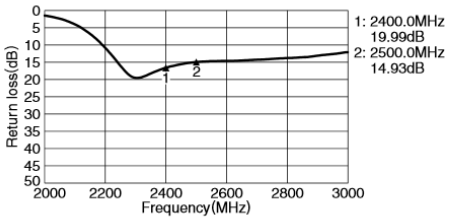
INSERTION LOSS



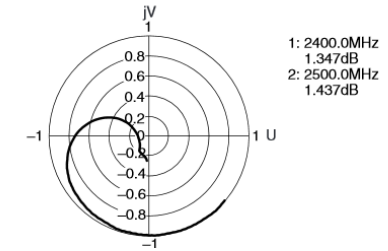
ATTENUATION



RETURN LOSS



VSWR



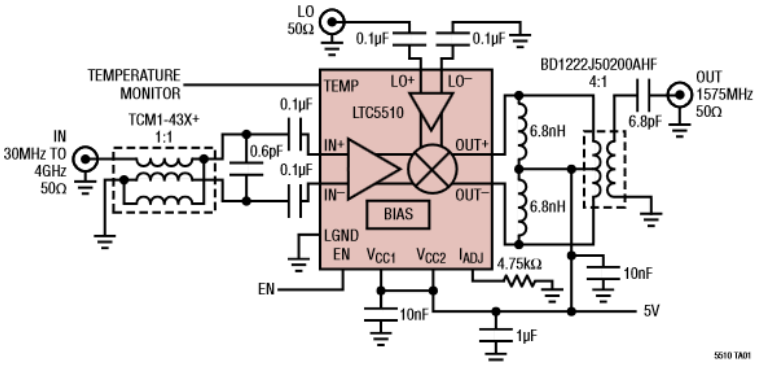
LTC5510

1MHz to 6GHz Wideband High Linearity Active Mixer

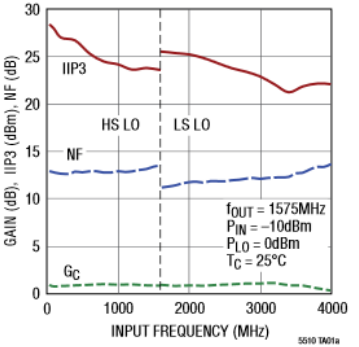
FEATURES

- Input/LO Frequency Range to 6GHz
- 50Ω Matched Input from 30MHz to >3GHz
- Capable of Up- or Down-Conversion
- OIP3: 27dBm at f_{OUT} = 1575MHz
- 1.5dB Conversion Gain
- Noise Figure: 11.6dB at f_{OUT} = 1575MHz
- High Input P1dB: 11dBm at 5V
- 5V or 3.3V Supply at 105mA
- Shutdown Control
- LO Input Impedance Always Matched
- 0dBm LO Drive Level
- On-Chip Temperature Monitor
- –40°C to 105°C Operation (T_C)
- 16-Lead (4mm × 4mm) QFN Package

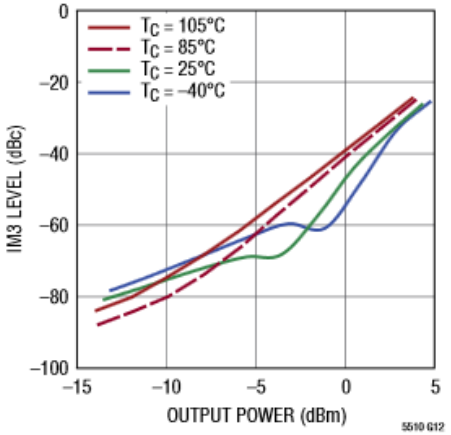
30MHz to 4GHz Up/Down Mixer for Wideband Receiver



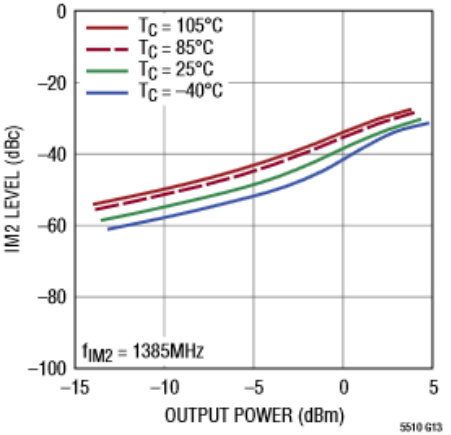
Conversion Gain, IIP3 and NF vs Input Frequency



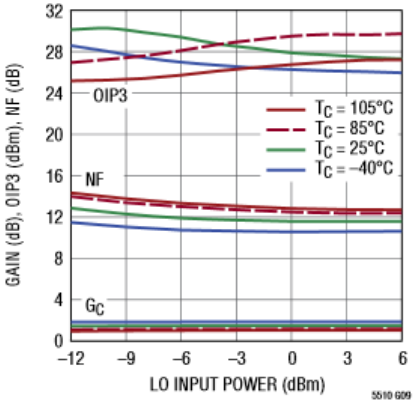
IM3 Level vs Output Power (2-Tone)



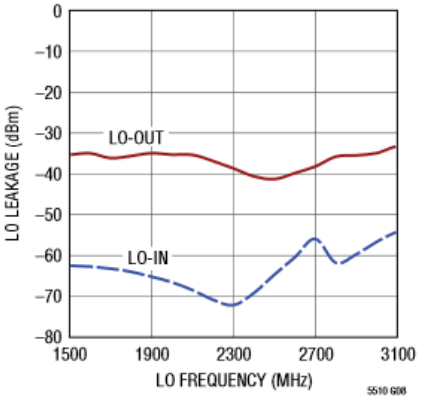
IM2 Level vs Output Power (2-Tone)



Conversion Gain, OIP3 and NF vs LO Power



LO Leakage vs LO Frequency



MAX2612–MAX2616

40MHz to 4GHz Linear Broadband Amplifiers

General Description

–MAX2616 is a family of high-performance
in blocks designed for use as a PA predriv-
ımplifier, or as a cascadable 50Ω amplifier
9.5dBm output power. These devices are
ıy applications that include cellular infra-
ate or commercial microwave radios, and
modems. The operating frequency range
10MHz to 4000MHz. The amplifier operates
+5.25V supply with input and output ports
:hed to 50Ω. The device family is available
compatible, compact 2mm x 3mm TDFN
tage.

Applications

Infrastructure
ave Radio
s LAN
d Measurement

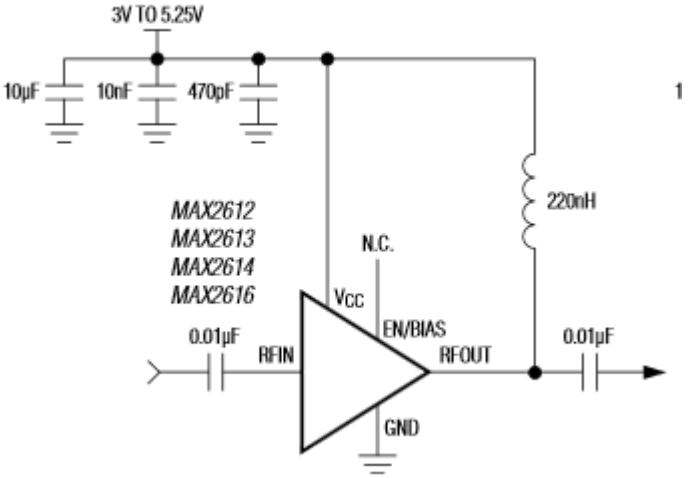
nation appears at end of data sheet.

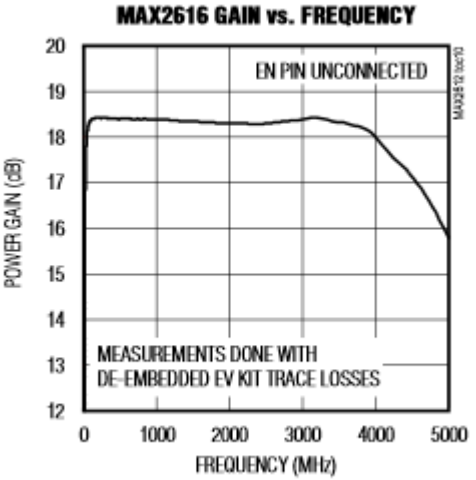
and recommended products to use with this part,
imintegrated.com/MAX2612.related.

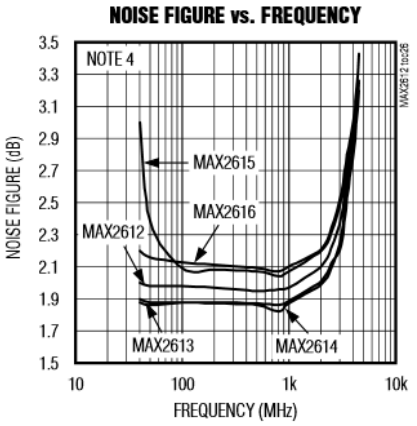
Features

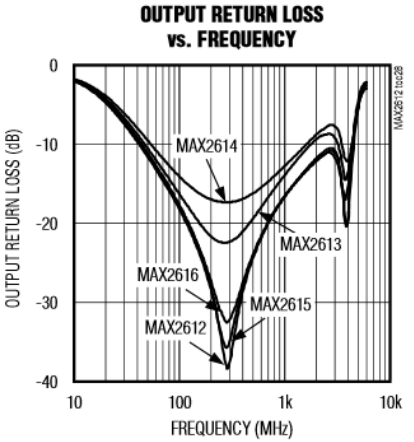
- **Extremely Flat Frequency Response**
  - **< 0.5dB, 1GHz to 4GHz**
- **Low Noise Figure: 2.0dB at f_{RFIN} = 2.0GHz**
- **40MHz to 4000MHz Frequency Range**
- **Industry's Highest Max P_{IN} Rating**
- **Large OIP3 Ranges**
  - **MAX2615/MAX2616: +37dBm**
  - **MAX2612: +35.2dBm**
  - **MAX2613: +31.2dBm**
  - **MAX2614: +30dBm**
- **Output P1dB: +19.5dBm (MAX2615/MAX2616)**
- **High Gain: 18.6dB**
- **Shutdown Mode (MAX2612/MAX2613/MAX2614/MAX2616)**
- **Adjustable Bias Current for Improved OIP3 (MAX2615)**
- **3.0V to 5.25V Supply Range**
- **Compact 2mm x 3mm TDFN Package**
- **Industry-High ESD Rating: 2.5kV HBM**

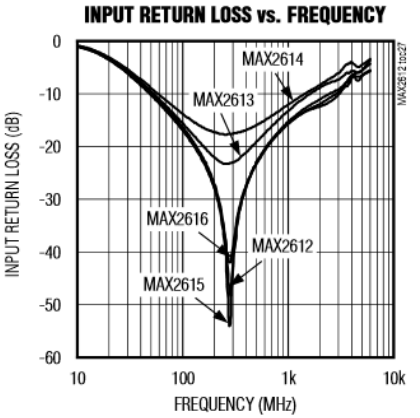
Current 80.6 mA











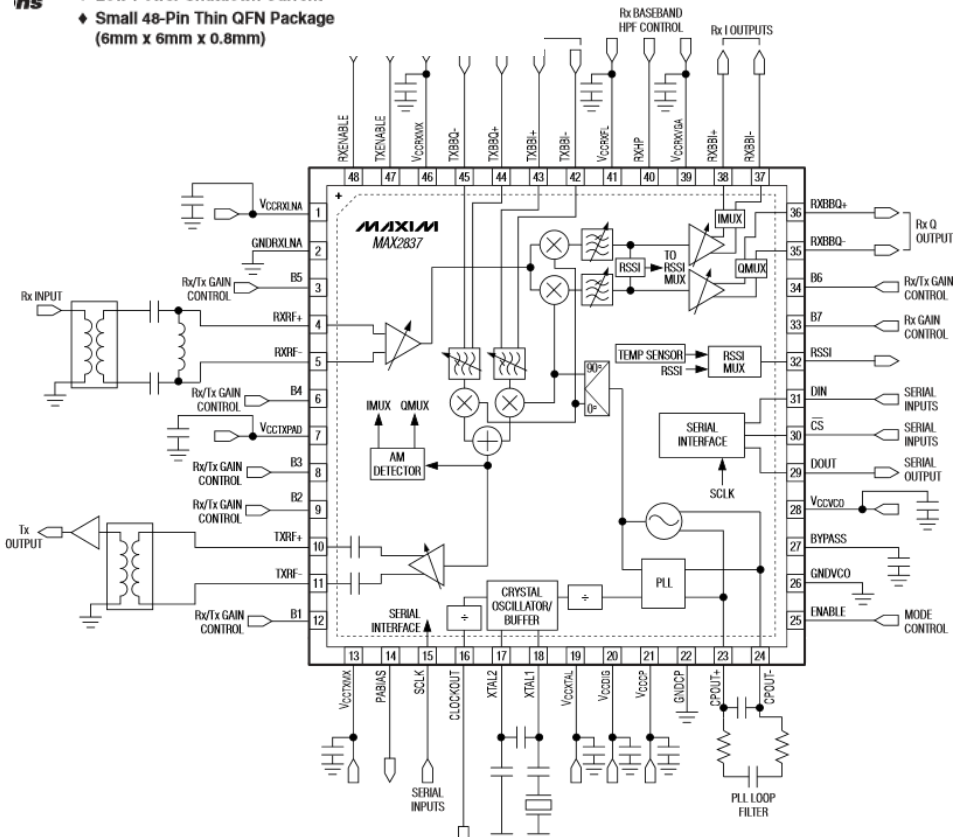
MAXIM

2.3GHz to 2.7GHz Wireless Broadband RF Transceiver

MAX2837

Features

- 2.3GHz to 2.7GHz Wideband Operation
- Complete RF Transceiver, PA Driver, and Crystal Oscillator
  - 0dBm Linear OFDM Transmit Power
  - -70dBr Tx Spectral Emission Mask
  - 2.3dB Rx Noise Figure
  - Tx/Rx I/Q Error and LO Leakage Detection
  - Monolithic Low-Noise VCO with -39dBc Integrated Phase Noise
  - Programmable Tx I/Q Lowpass Anti-Aliasing Filter
  - Sigma-Delta Fractional-N PLL with 20Hz Step Size
  - 45dB Tx Gain-Control Range
  - 94dB Receive Gain-Control Range
  - 60dB Analog RSSI Instantaneous Dynamic Range
  - 4-Wire SPI™ Digital Interface
  - I/Q Analog Baseband Interface
  - Digitally Tuned Crystal Oscillator
  - On-Chip Digital Temperature Sensor Read-Out
- +2.7V to +3.6V Transceiver Supply
- Low-Power Shutdown Current
- Small 48-Pin Thin QFN Package (6mm x 6mm x 0.8mm)



PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	$V_{CC\_}$	2.7		3.6	V
Supply Current	Shutdown mode, T_A = +25°C		10		µA
	Standby mode		35	45	mA
	Rx mode		91	110	
	Tx mode, T_A = +25°C		145	170	
	Rx calibration mode		135	160	
	Tx calibration mode		110	135	
Rx I/Q Output Common-Mode Voltage	D9:D8 = 00 in A4:A0 = 00100	0.85	1.0	1.20	V
	D9:D8 = 01 in A4:A0 = 00100		1.1		
	D9:D8 = 10 in A4:A0 = 00100		1.2		
	D9:D8 = 11 in A4:A0 = 00100		1.35		
Tx Baseband Input Common-Mode Voltage Operating Range	DC-coupled	0.5		1.2	V
Tx Baseband Input Bias Current	Source current		10	20	µA
LOGIC INPUTS: ENABLE, TXENABLE, RXENABLE, SCLK, DIN, $\overline{CS}$, B7:B1, RXHP					
Digital Input-Voltage High, V_{IH}		V_{CC} - 0.4			V
Digital Input-Voltage Low, V_{IL}				0.4	V
Digital Input-Current High, I_{IH}		-1		+1	µA
Digital Input-Current Low, I_{IL}		-1		+1	µA

AC ELECTRICAL CHARACTERISTICS—Rx MODE

(MAX2837 evaluation kit: $V_{CC\_}$ = 2.8V, f_{RF} = 2.502GHz, f_{LO} = 2.5GHz; receiver baseband I/Q outputs at 90mV$_{RMS}$ (-21dBV), f_{REF} = 40MHz, ENABLE = RXENABLE = $\overline{CS}$ = high, TXENABLE = SCLK = DIN = low, with power matching for the differential RF pins using the typical applications and registers set to default settings and corresponding test mode, T_A = +25°C, unless otherwise noted. Lowpass filter is set to 10MHz RF channel BW. Unmodulated single-tone RF input signal is used, unless otherwise indicated.) (Note 1)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
RECEIVER SECTION: LNA RF INPUT TO BASEBAND I/Q OUTPUTS						
RF Input Frequency Range			2.3		2.7	GHz
Peak-to-Peak Gain Variation over RF Input Frequency Range	Tested at band edges and band center			0.8		dB
RF Input Return Loss	All LNA gain settings			13		dB
Total Voltage Gain	T_A = -40°C to +85°C	Maximum gain, B7:B1 = 0000000	90	99		dB
		Minimum gain, B7:B1 = 1111111		5	13	
RF Gain Steps	From max RF gain to max RF gain - 8dB			8		dB
	From max RF gain to max RF gain - 16dB			16		
	From max RF gain to max RF gain - 32dB			32		
Gain Change Settling Time	Any RF or baseband gain change; gain settling to within ±1dB of steady state; RXHP = 1			0.2		µs
	Any RF or baseband gain change; gain settling to within ±0.1dB of steady state; RXHP = 1			2		
Baseband Gain Range	From maximum baseband gain (B5:B1 = 00000) to minimum baseband gain (B5:B1 = 11111), T_A = -40°C to +85°C		58	62	66	dB
Baseband Gain Minimum Step Size				2		dB
DSB Noise Figure	Voltage gain ≥ 65dB with max RF gain (B7:B6 = 00)			2.3		dB
	Voltage gain = 50dB with max RF gain - 8dB (B7:B6 = 01)			5.5		
	Voltage gain = 45dB with max RF gain - 16dB (B7:B6 = 10)			17		
	Voltage gain = 15dB with max RF gain - 32dB (B7:B6 = 11)			27		

Bit-Dynamik 20*log(2^8)=48dB

KIT
E

MAXIM

Ultra-Low-Power, High-Dynamic-Performance, 22Msps Analog Front End

MAX5864

General Description

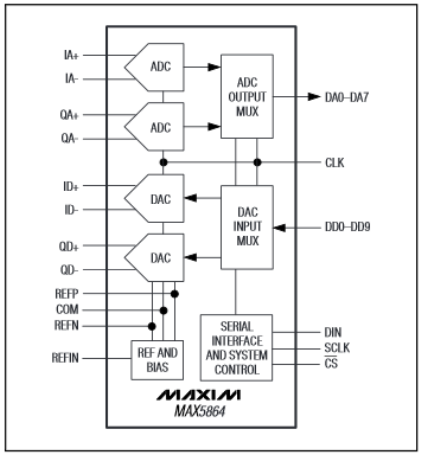
-low-power, highly integrated analog
r portable communication equipment
PDAs, WLAN, and 3G wireless termi-
integrates dual 8-bit receive ADCs
ısmit DACs while providing the high-
nance at ultra-low power. The ADCs'
ımplifiers are fully differential and
scale signals. Typical I-Q channel
s ±0.1° and amplitude matching is
s feature 48.5dB SINAD and 69dBc
ic range (SFDR) at f_{IN} = 5.5MHz and
e DACs' analog I-Q outputs are fully
0mV full-scale output, and 1.4V com-
ypical I-Q channel phase match is
le match is ±0.05dB. The DACs also
resolution with 71.7dBc SFDR, and
2.2MHz and f_{CLK} = 22MHz.

's operate simultaneously or indepen-
-division duplex (FDD) and time-divi-
) modes. A 3-wire serial interface
/n and transceiver modes of opera-
perating power is 42mW at f_{CLK} =

Features

- Integrated Dual 8-Bit ADCs and Dual 10-Bit DACs
- Ultra-Low Power
  - 42mW at f_{CLK} = 22MHz (Transceiver Mode)
  - 34mW at f_{CLK} = 15.36MHz (Transceiver Mode)
  - Low-Current Idle and Shutdown Modes
- Excellent Dynamic Performance
  - 48.5dB SINAD at f_{IN} = 5.5MHz (ADC)
  - 71.7dB SFDR at f_{OUT} = 2.2MHz (DAC)
- Excellent Gain/Phase Match
  - ±0.1° Phase, ±0.03dB Gain at f_{IN} = 5.5MHz (ADC)
- Internal/External Reference Option
- +1.8V to +3.3V Digital Output Level (TTL/CMOS Compatible)
- Multiplexed Parallel Digital Input/Output for ADCs/DACs
- Miniature 48-Pin Thin QFN Package (7mm × 7mm)
- Evaluation Kit Available (Order MAX5865EVKIT)

Functional Diagram



ELECTRICAL CHARACTERISTICS

(V_{DD} = 3V, OV_{DD} = 1.8V, internal reference (1.024V), C_L = 10pF on all digital outputs, f_{CLK} = 22MHz, ADC input amplitude = -0.5dBFS, DAC output amplitude = 0dBFS, differential ADC input, differential DAC output, C_{REFP} = C_{REFN} = C_{COM} = 0.33µF, Xcvr mode, unless otherwise noted. Typical values are at T_A = +25°C, unless otherwise noted.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
POWER REQUIREMENTS						
Analog Supply Voltage	V_{DD}		2.7	3.0	3.3	V
Output Supply Voltage	OV_{DD}		1.8		V_{DD}	V
V_{DD} Supply Current		ADC operating mode, f_{IN} = 5.5MHz, f_{CLK} = 22MHz, DAC operating mode, f_{OUT} = 2.2MHz		14	16.5	mA
		ADC operating mode, f_{IN} = 5.5MHz, f_{CLK} = 15.36MHz, DAC operating mode, f_{OUT} = 2.2MHz		11.4		
		ADC operating mode (Rx), f_{IN} = 5.5MHz, f_{CLK} = 15.36MHz, DAC off, DAC digital inputs at zero or DV_{DD}		8.25		
		DAC operating mode (Tx), f_{OUT} = 2.2MHz, f_{CLK} = 15.36MHz, ADC off		8		
		Standby mode, DAC digital inputs and CLK at zero or OV_{DD}			2.0	
		Idle mode, DAC digital inputs at zero or OV_{DD}, f_{CLK} = 22MHz			6.7	
		Shutdown mode, digital inputs and CLK at zero or OV_{DD}, $\overline{CS}$ = OV_{DD}		1		µA
OV_{DD} Supply Current		ADC operating mode, f_{IN} = 5.5MHz, f_{CLK} = 22MHz, DAC operating mode, f_{OUT} = 2.2MHz		2.3		mA
		Idle mode, DAC digital inputs at zero or OV_{DD}, f_{CLK} = 22MHz		20.6		µA
		Shutdown mode, DAC digital inputs and CLK at zero or OV_{DD}, $\overline{CS}$ = OV_{DD}		1		

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
ADC DC ACCURACY						
Resolution			8			Bits
Integral Nonlinearity	INL			±0.15		LSB
Differential Nonlinearity	DNL	No missing codes over temperature		±0.15		LSB
Offset Error		Residual DC offset error		±0.24	±5	%FS
Gain Error		Includes reference error		±0.77	±5	%FS
DC Gain Matching				±0.03	±0.25	dB
Offset Matching				±3		LSB
Gain Temperature Coefficient				±59		ppm/°C
Power-Supply Rejection	PSRR	Offset error (V_{DD} ±5%)		±0.2		LSB
		Gain error (V_{DD} ±5%)		±0.07		
ADC ANALOG INPUT						
Input Differential Range	V_{ID}	Differential or single-ended inputs		±0.512		V
Input Common-Mode Voltage Range				V_{DD} / 2		V
Input Impedance	R_{IN}	Switched capacitor load		245		kΩ
	C_{IN}			5		pF
ADC CONVERSION RATE						
Maximum Clock Frequency	f_{CLK}	(Note 2)			22	MHz
Data Latency		Channel I		5		Clock cycles
		Channel Q		5.5		
ADC DYNAMIC CHARACTERISTICS (Note 3)						
Signal-to-Noise Ratio	SNR	f_{IN} = 5.5MHz	47	48.6		dB
		f_{IN} = 11MHz		48.6		
Signal-to-Noise and Distortion Ratio	SINAD	f_{IN} = 5.5MHz	46.5	48.5		dB
		f_{IN} = 11MHz		48.5		
Spurious-Free Dynamic Range	SFDR	f_{IN} = 5.5MHz	58	69		dBc
		f_{IN} = 11MHz		71.5		
Third-Harmonic Distortion	HD3	f_{IN} = 5.5MHz		-70.3		dBc
		f_{IN} = 11MHz		-75.5		
Intermodulation Distortion	IMD	f_1 = 2MHz, -7dBFS; f_2 = 2.01MHz, -7dBFS		-64		dBc
Third-Order Intermodulation Distortion	IM3	f_1 = 2MHz, -7dBFS; f_2 = 2.01MHz, -7dBFS		-67		dBc
Total Harmonic Distortion	THD	f_{IN} = 5.5MHz		-68.2	-57	dBc