

# High-performance, low-noise quadrature modulators: TRF3703 Family



## Product Bulletin

### High performance

The low-noise TRF3703 quadrature modulator family provides wireless infrastructure systems with an affordable means to directly convert complex modulated signals from baseband or IF to RF transmission levels. Working with TI DACs, the TRF3703 IQ modulator saves components, space, cost and power through direct up-conversion in wireless base stations and other transceiver systems. This next-generation modulator provides RF outputs of up to 4 GHz with exceptionally low noise to support a wide range of transmission standards, including:

- CDMA: IS-95, UMTS, CDMA2000, TD-SCDMA
- TDMA: GSM, IS-136, EDGE/UWC-136
- WiMAX/LTE

The TRF3703 provides a high level of performance at an economical price. The TRF3703 modulator complements TI's robust and cost-effective, complete signal chain solution. This solution uses leading processes, advanced

design techniques and effective partitioning to match the solution-to-system requirements, also saving developers time-to-market.

The TRF370317 offers additional improvements in linearity and noise floor as compared to the other members of the high-performance TRF3703 quadrature modulator family. Additionally, the TRF370317 offers up to 4.5 db better OIP3 than the nearest competitor.

### Low noise

Implemented with TI's leading SiGe process technology, the TRF3703 pushes low noise characterization to a new level. The device features an exceptionally low noise floor of  $-163$  dBm/Hz and outstanding linearity of 26.5 dBm OIP3. These features cut down on heat dissipation and eliminate the need for additional filtering. Adjacent channel power ratio (ACPR) is  $-76$  dBc for a  $-8$  dBm single-carrier WCDMA output signal, helping to ensure the clear separation of channels.

### Key features

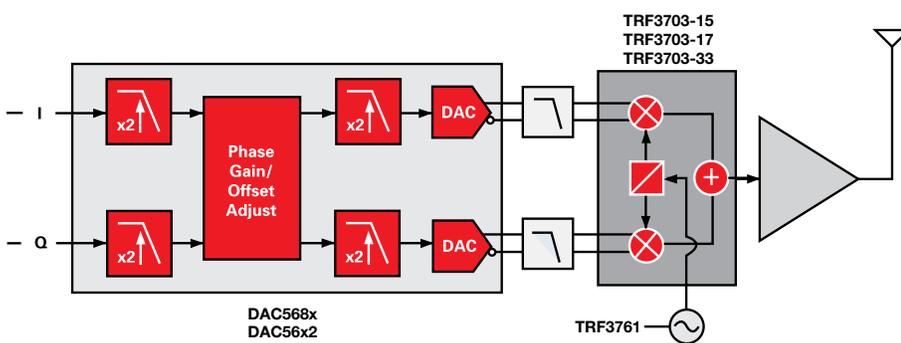
- Supports direct conversion from baseband or IF to RF
- Low output noise floor:  $-163$  dBm/Hz
- Higher output linearity: 26.5 dBm OIP3
- Frequency range up to 4 GHz
- Supports WCDMA, CDMA, TD-SCDMA, GSM and WiMAX/LTE
- Simplified interface to DAC568x and DAC56x2 family data converters

Other features that help keep signal quality high and simplify design include output compression (P1dB) of 12 dB, unadjusted carrier leakage of  $-40$  dBm (at 2 GHz), and unadjusted sideband suppression of  $-50$  dBc (at 2 GHz).

Capable of accepting modulated input signals ranging from zero (DC) to 350 MHz, the TRF3703 provides RF output modulation from 400 MHz up to 4 GHz. The modulator is implemented as a double-balanced mixer, and the RF output block consists of a differential to single-ended converter and an RF amplifier capable of driving a single-ended  $50\text{-}\Omega$  load without any external components. The device operates from a single 5 V supply and is available in a space-saving  $4 \times 4$  mm, 24-pin QFN lead (Pb)-Free, green\* package.

### Direct conversion

Using the TRF3703 IQ modulator and TI's DAC568x/56x2 family of data converters provides an easy-to-implement, complete solution for direct up-conversion in RF transmitters. The DAC-modulator solution replaces two RF up-conversion stages, saving mixers, buffer amps, local oscillators and RF filters.



Typical transmitter signal chain block diagram with the TRF3703 and TI high-performance analog solutions.

The low-noise DAC5688 saves on external implementation by integrating phase, gain and offset adjustment features for interfacing to IQ modulators. Transmitters designed using this architecture save space, power, components and cost compared with previously available conversion solutions.

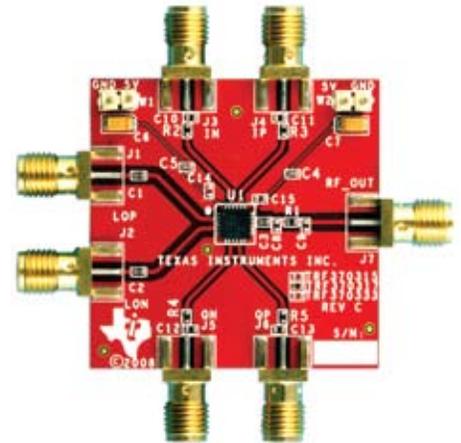
In addition to the TRF3703, TI offers a complete signal chain solution for wireless infrastructure applications. Products include high-speed data converters (ADS5546/45/00), up and down converters (GC1115/5016/5018), clocks and interfaces (CDCE72010), high-speed amplifiers

(THS4509), power management (T2 power modules), digital signal processors (TMS320TC16484), as well as ASIC and logic devices.

**For more information**

For more information about the TRF3703 direct quadrature modulator and how it can add performance and reduce BOM, visit [www.ti.com/TRF3703](http://www.ti.com/TRF3703)

To learn more about wireless infrastructure solutions from TI, visit [www.ti.com/wi](http://www.ti.com/wi)



The TRF3703-17 EVM allows designers to quickly evaluate critical performance criteria. Additional EVMs are available which have both the TRF3703 and a high performance dual interpolating DAC.

LO = 2.0 GHz	OIP3 (dBm)	P1dB (dBm)	Noise floor (dBm/Hz)	I/Q common-mode voltage (Typ)
TRF370317	26.5	12	-162.5	1.7
TRF370315	23	9.5	-160	1.5
TRF370333	21	9.5	-160	3.3

The NEW TRF370317 offers improved linearity and a lower noise floor resulting in excellent ACPR for a clearer separation of carrier channels.

Dual DAC part number	Resolution (bits)	Sample rate (MSPS)	Max data input rate (MSPS)	Interpolation	Mixing	PLL
DAC5688	16	800	250	8x	Fine	YES
DAC5687	16	500	250	8x	Fine	YES
DAC5682Z	16	1000	500*	4x	Coarse	YES
DAC5672A	14	275	275	NO	NO	NO
DAC5662A	12	275	275	NO	NO	NO
DAC5652A	10	275	275	NO	NO	NO

\* 1GSPS when in single channel mode

TI's family of dual DACs can seamlessly interface to the TRF3703 family of IQ modulators.

\* TI defines "green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1 percent by weight in homogeneous material).