

# GC5322

## Wideband Digital Pre-Distortion Transmit IC Solution



### Product Bulletin

The Texas Instruments GC5322 wireless transmit processor integrates digital radio functionality previously only available in discrete devices. The GC5322 linearizes the output of the power amplifier (PA) in the transmit signal chain, thus removing the need for more costly high-performance PA components, improving the PA's power efficiency and decreasing the overall power consumption of the base station. High-performance PAs can account for as much as 30 percent of the operational costs of a wireless base station in today's cellular infrastructure. The GC5322 solution gives wireless equipment manufacturers the opportunity to reduce the overall cost of their RF subsystems.

#### Integrated functionality

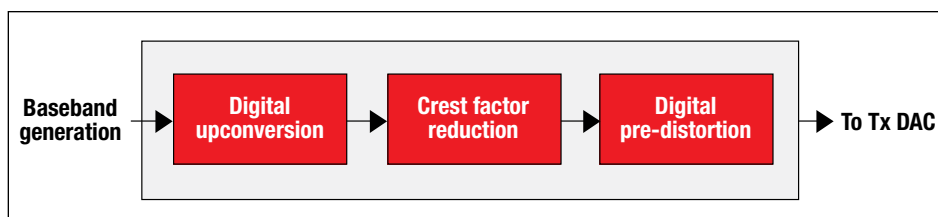
To optimize the overall system cost and performance of a base station, the GC5322 has integrated the critical functionality required in a wireless transmit processor. The key processing blocks in the GC5322 include wideband DUC, CFR and DPD to linearize the output of the PA. Both CFR and DPD increase

the power efficiency of the transmit chain's multi-carrier PA. The DPD algorithm improves the adjacent channel leakage ratio (ACLR) thereby increasing PA output power while adhering to spectral emission regulations. By integrating these three blocks into one device, the GC5322 simplifies the design of the base station RF subsystem, reduces procurement costs by minimizing chip counts, and decreases circuit board size. Additionally, the inherent flexibility of the software DPD algorithm allows the GC5322 to support multiple existing and emerging standards.

**Digital upconverter**—The DUC block of the GC5322 supports up to 40 MHz of signal bandwidth. The DUC combines up to 12 channels into one wideband, composite signal. Operating at a maximum 280-MHz clock rate, the DUC outputs up to 70 mega-samples per second (MSPS) for single antenna configurations. For each output channel, a number of parameters such as gain, phase, delay and equalization can be specified for smart antenna applications. When not in use, the DUC channels can be turned off to save power.

#### Key Features

- Integrated functional transmitter blocks include:
  - Digital upconverter (DUC), supporting wideband signals
  - Crest factor reduction (CFR) for greater PA power efficiency
  - Digital pre-distortion (DPD) for improved PA linearity
- Highly-integrated IC solution reduces design complexity, power consumption, development time, implementation size and BOM costs
- Advanced linearization solution relaxes multi-carrier power amplifier specifications and increases PA DC operating efficiency
- Flexible DSP algorithm supports existing and emerging wireless standards
- Integrated CFR and DPD increase efficiencies 25 percent or more for Class AB PAs and reaching 40 percent or more for Doherty PAs
- Integrated DPD reduces adjacent channel leakage ratio (ACLR) by 20 dB or more and corrects up to 7th order distortion products
- Integrated IQ imbalance correction and a fully automated channel equalizer
- Extremely fast DPD convergence times, typically less than 2 seconds
- Robust convergence algorithm allows dynamic carrier allocation, without disrupting cellular service
- Fast time to market and reduced risk as part of a complete TI-supplied signal chain solution
- Space-saving 352-ball TE-PBGA-II 27 x 27 mm package.

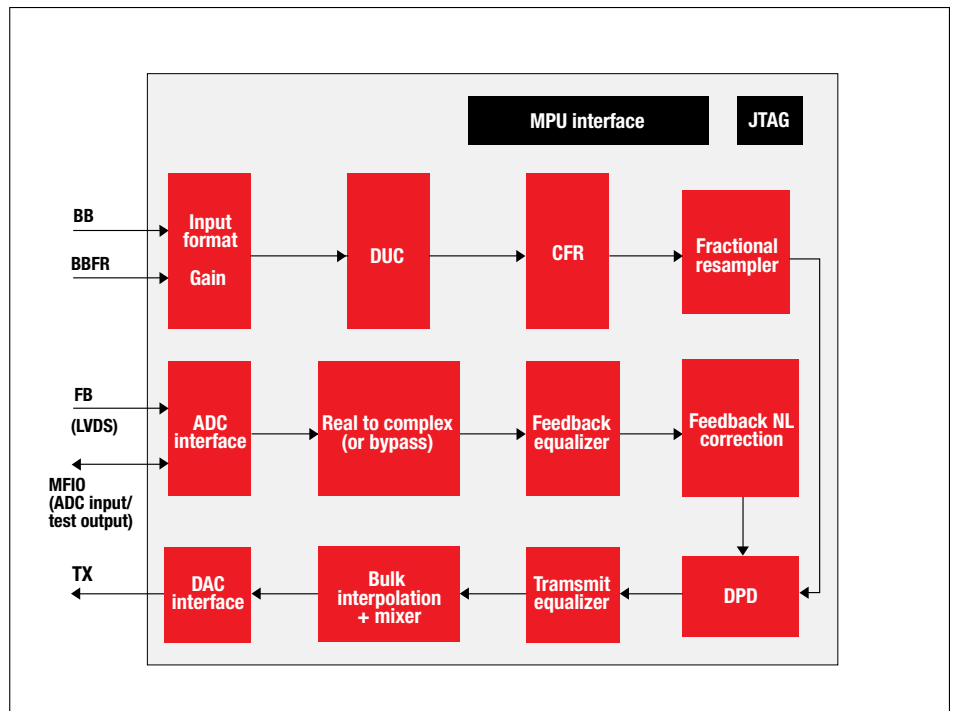


▲ The GC5322 integrates digital upconversion, crest factor reduction, and digital pre-distortion

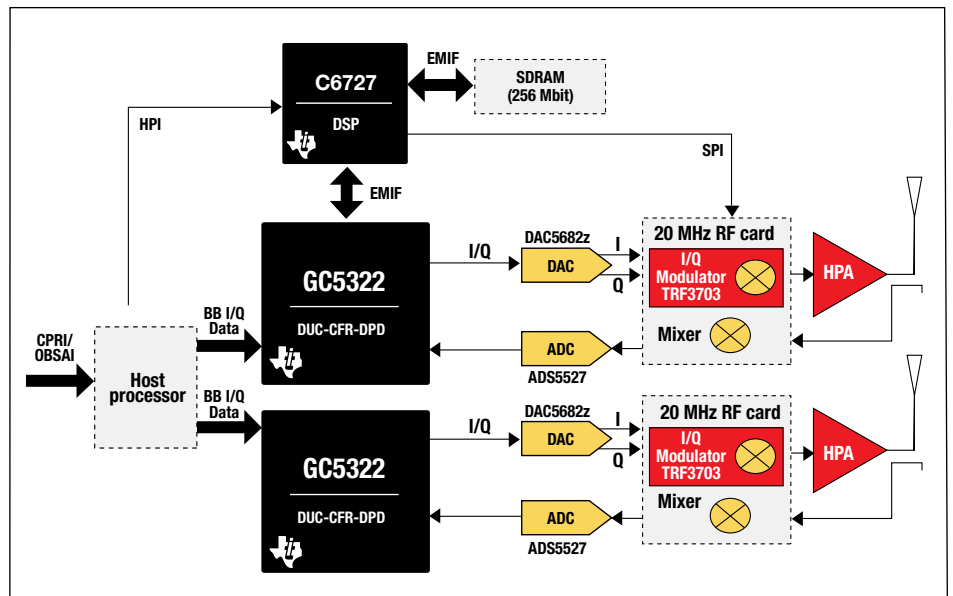
**Crest factor reduction** – Based on field-proven technology, the GC5322's CFR processing block reduces the peak-to-average ratio (PAR) for multi-channel/multi-carrier signals by adding spectrally-shaped cancellation noise. The CFR block has multiple stages, each having configurable peak thresholds. This allows for significant PAR reduction. Breakthrough power efficiencies are achieved in the PA, while maintaining spectral requirements and EVM performance.

**Digital pre-distortion** – To limit possible distortion in the transmit signal, the GC5322 includes an integrated DPD processing block. The DPD block linearizes the PA, greatly improving the adjacent channel leakage ratio (ACLR). This allows PAs to meet stringent spectral regulations and interference requirements. Depending upon the PA, the DPD block achieves ACLR improvements of 20 to 30 dB or more.

The GC5322 interfaces directly to TI's TMS320C6727 DSP, which executes the real-time adaptation algorithm. A real-time feedback loop monitors the integrity of the output signal to control the DPD's operation. The flexible algorithm supports multiple PA architectures and emerging standards, such as CDMA2000, WCDMA, TD-SCDMA, OFDMA (WiMAX, LTE), HSPA and HSPA+.



▲ A detailed block diagram of the GC5322 showing the integration of three critical transmit functions: DUC, CFR and DPD



▲ GC5322 in a dual-antenna configuration with up to 20 MHz of signal bandwidth

## Improved efficiency

The combination of CFR and DPD functionality in the GC5322 significantly improves the efficiency of LDMOS Doherty PAs, reaching 40 percent or more, while Class AB PAs can reach efficiencies greater than 25 percent. As a result, the PA can be driven harder to yield higher output power. Smaller, less costly PAs can be used, while still ensuring the required output power level. This maximizes overall system performance and cost savings.

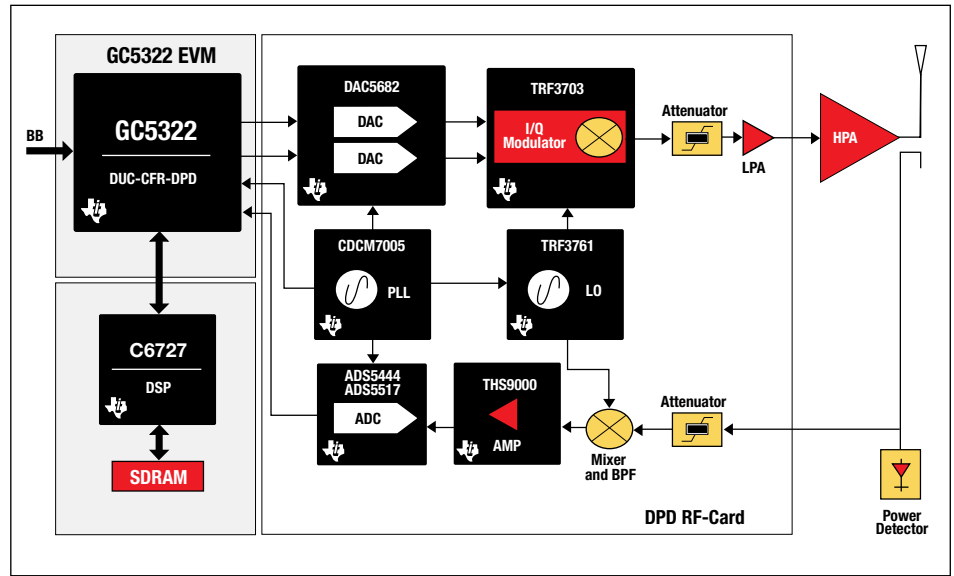
## Reduced power consumption

The resulting efficiency improvement reduces RF subsystem power requirements and provides a reduction in cooling infrastructure and operating costs leading to significantly decreased operating expenses for the base station.

## Complete signal chain solution

The GC5322 DPD architecture is supported by a system evaluation kit (GC5322SEK). The GC5322SEK is a fully-tested DPD wireless transmit signal chain solution comprised of both TI high-performance analog and RF products. The GC5322SEK can be used as a reference design to shorten time to market. Since most of the transmit signal chain is provided by TI, applications support is simplified.

The TI devices that complement the GC5322 device in the transmit signal chain include the following:

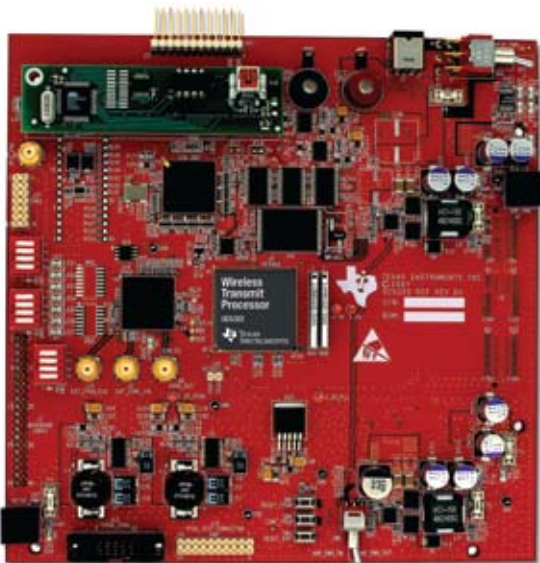


▲ A complete digital pre-distortion transmit signal chain with the GC5322SEK (System Evaluation Kit) based on TI high-speed analog and DSP technology

- TMS320C6727 digital signal processor
- DAC5682Z dual 16-bit, 1 GSPS DAC (transmit path)
- ADS5444 13-bit 250-MSPS ADC or ADS5517 11-bit 200-MSPS ADC (feedback path)
- CDCM7005 clock generator
- TRF3761 integrated VCO/PLL RF synthesizer
- TRF3703 quadrature modulator
- THS9000 IF amplifier
- AMC7823 analog monitoring and control circuit

## For more information

To learn more about the GC5322 wireless transmit processor and other TI products for wireless infrastructure systems, contact your local TI field sales office or see [www.ti.com/gc5322](http://www.ti.com/gc5322)



▲ GC5322SEK: GC5322 EVM Card



▲ GC5322SEK: 20-MHz Bandwidth RF Card

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