Application Report
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TSW3725: Modifying to use the TRF3705 for Performance and BOM Improvements

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ABSTRACT

The goal of this document is to provide a basic description of the TSW3725EVM, modification requirements and results of replacing the TSW3725EVM's default I/Q modulator TRF370315 with the TRF3705.

Document History

Version	Date	Author	Notes
1.0	September 2012	C. Pearson	First release

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1 TSW3725EVM Description

The TSW3725EVM is a small-cell RF transceiver reference design and evaluation platform. It was designed to support the 2G/3G/4G LTE and WCDMA markets for signal bandwidths up to 20 MHz. The default configuration supports Band 1, but its flexibility allows it to support most other LTE & WCDMA Bands. For a complete small-cell development platform the TSW3725EVM mates with Azcom's BTS digital reference design. The TSW3725EVM can also be evaluated as a standalone board with the TSW1400EVM family or with the TSW3100EVM as a digital source board and the TSW1200EVM as a digital capture board.

The TSW3725EVM supports a two transmit, two receive BTS architecture with a shared digital pre-distortion (DPD) observation receive path. Transmit path typical performance numbers for ACPR are less than -67 dBc and for EVM are less than 1% rms. Receive path typical performance numbers for EVM are less than 1% rms at very low input powers.

During the TSW3725EVM design phase the TRF3705 I/Q modulator was not available, however the board was designed to allow for an easy conversion to the TRF3705. As shown in the block diagram in Figure 1 the default schematic uses the TRF370315.

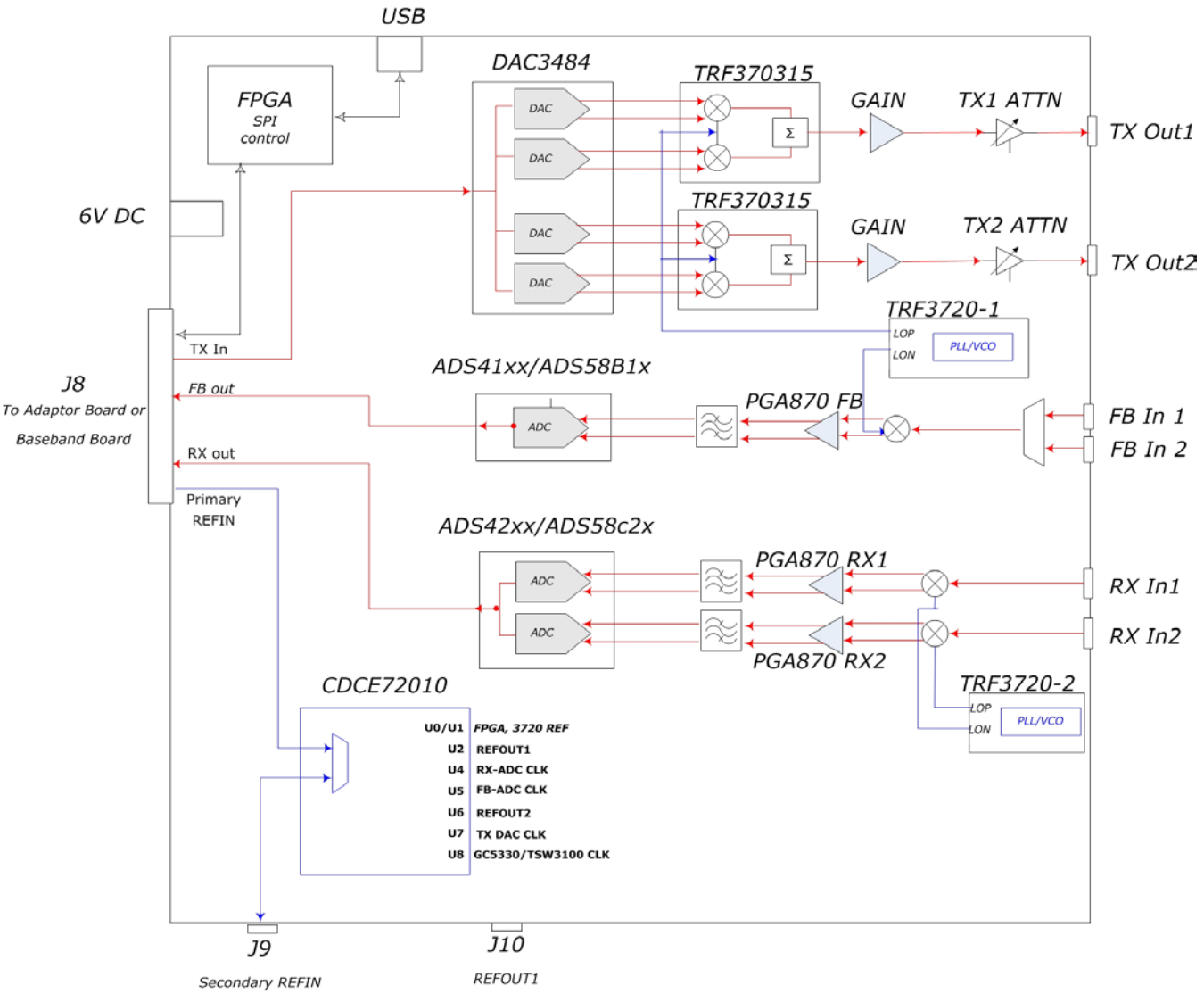

Figure 1. TSW3725EVM Block Diagram

Modifying the TSW3725 to use TRF3705 has the following advantages over the TRF370315:

a. Improved linearity: the TRF3705 has better performance than the TRF370315 in common LTE bands.

b. Higher output power and reduced BOM: the TRF3705's common mode input voltage (Vcm) of 0.25 V allows a seamless connection with the TSW3725's DAC3484. The TRF370315 common mode input voltage of 1.5 V requires a common mode voltage translation network between the DAC3484 and TRF370315. This translation network requires 24 SMT components and causes a 2.7 dB loss in baseband signal amplitude.

c. The TRF3705 has additional digital pins for power down and gain control.

2 Hardware and Software Modification Requirements

To modify the TSW3725EVM for use with the TRF3705, the BOM changes shown in Table 1 are required. Figures 2 and 3 highlight in blue where these components are located on the TSW3725EVM. These changes account for the supply voltage, power down pin option, and common mode voltage differences between the TRF3705 and the TRF370315.

After these BOM changes are made, no software modifications are required when evaluating the TSW3725EVM as a standalone board using the TSW3725EVM GUI's default configuration. If the TSW3725EVM is being used in conjunction with other hardware, be aware these hardware modifications result in a 2 dB higher output power on the TX1 and TX2 ports. This increase in output power may or may not result in some software changes elsewhere in the system.

Please note the TSW3725EVM hardwires the TRF3705 power down pin (PD) to ground so that the TRF3705 is always on. Also, the TRF3705 also has a gain control (GC) pin that was not connected in the TSW3725EVM schematic. The GC pin has an internal pull down resistor that sets the TRF3705 to low gain mode on the TSW3725EVM. If creating a schematic with the TRF3705, please note that the high gain mode is enabled by setting the GC pin high. High gain mode provides 3 dB more output power. If high gain mode is desired, then account for it when selecting the proper gain stage to follow the TRF3705. The TSW3725's current fixed gain stage after the TRF3705 starts to degrade linearity performance with this increased input level.

Table 1. BOM Changes

Part Reference	Default BOM	BOM Changes for TRF3705	Change Description
U2, U3	TRF3703-15IRGE	TRF3705IRGE	I/Q Modulator Change
U7	TPS76750QPWP	TPS76733QPWP	5-V LDO to 3.3-V LDO
R22, R49	DNI	0 Ω (0402)	Accounts for TRF3705 PD pin
R12, R18, R28, R34, R39, R45, R55, R61	1 kΩ (0402)	0 Ω (0402)	Removes TRF370315 Vcm translation network
R13, R21, R29, R37, R40, R48, R56, R64	2.74 kΩ (0402)	DNI	Removes TRF370315 Vcm translation network
C50, C54, C71, C75, C76, C80, C97, C101	1 µF (0402)	DNI	Removes TRF370315 Vcm translation network

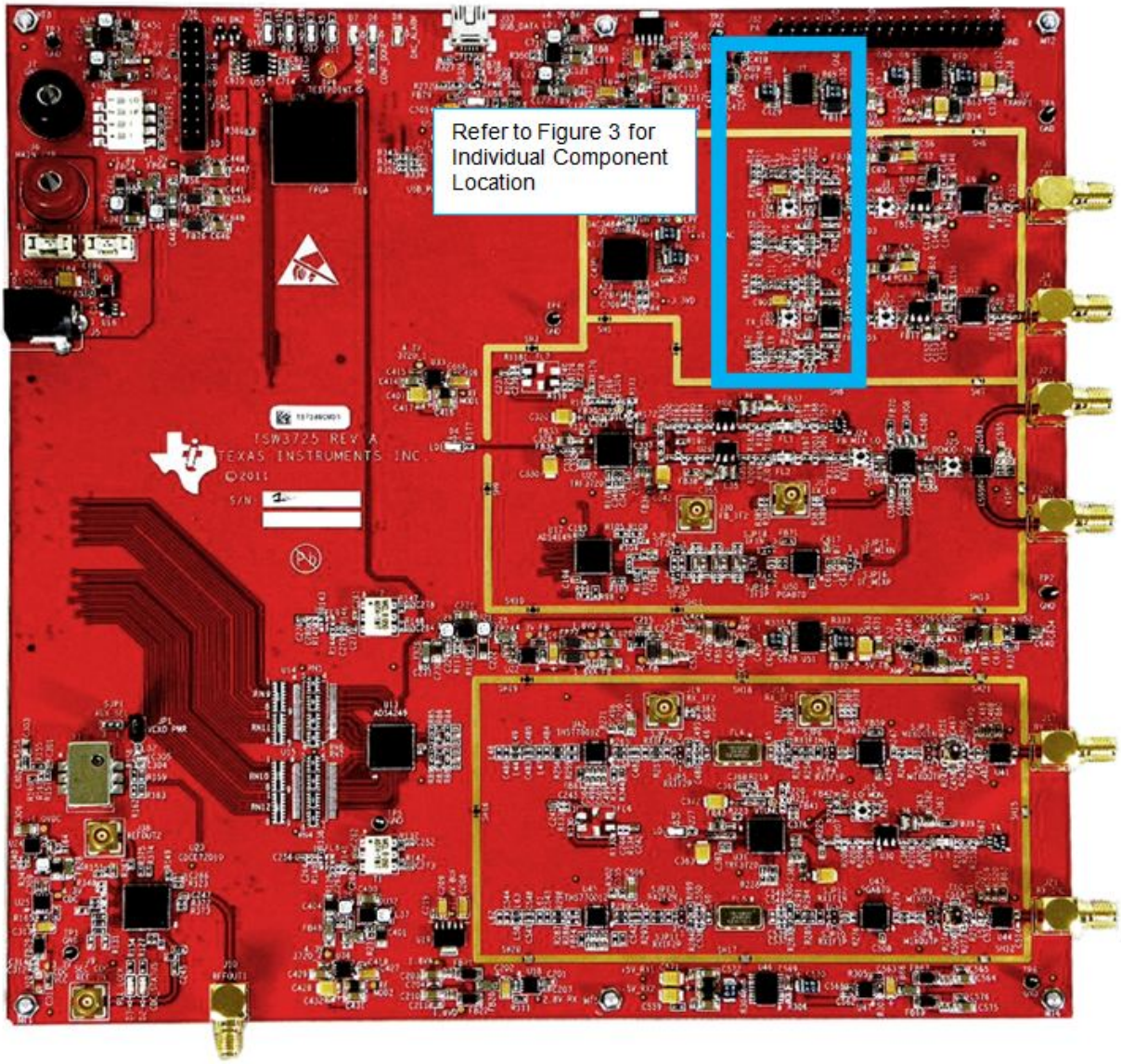

Figure 2. TSW3725EVM Modification Area

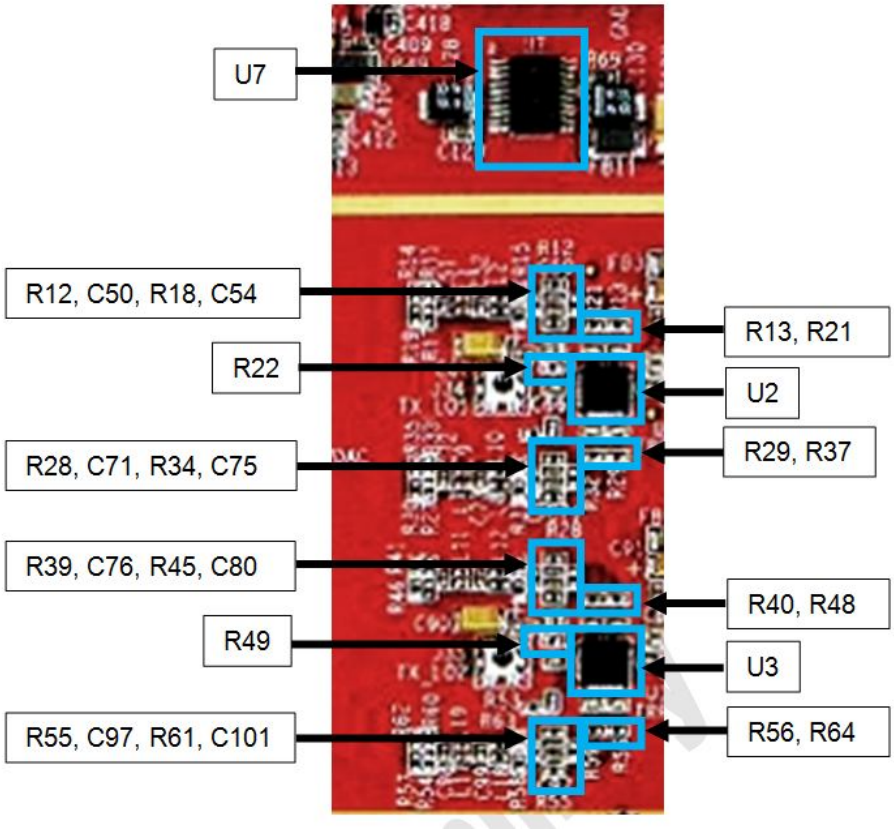

Figure 3. TSW3725EVM Component Changes

3 TRF3705 versus TRF370315: LTE Band 1 ACPR Results

Figures 4 and 5 compare ACPR results of the TRF370315 and TRF3705, respectively. These plots were created by following the LTE demonstration section in the TSW3725 User's Guide. The TRF3705 in Figure 5 provides 2-dB higher output gain and slightly better ACPR performance when compared to the TRF370315 in Figure 4.

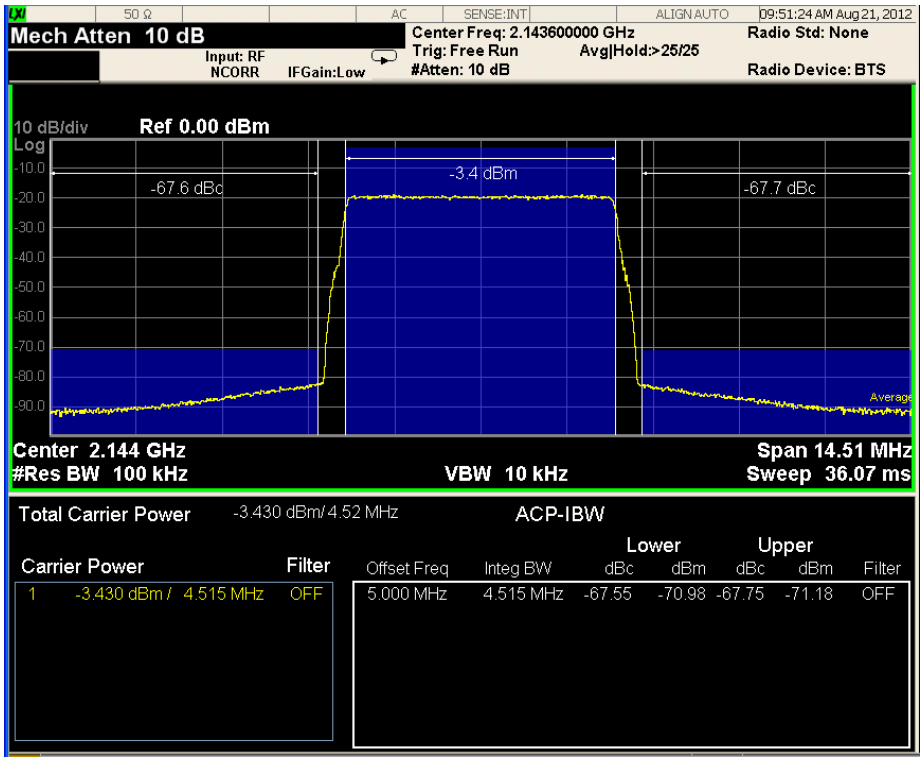

Figure 4. TSW3725 Band 1 ACPR, TRF370315

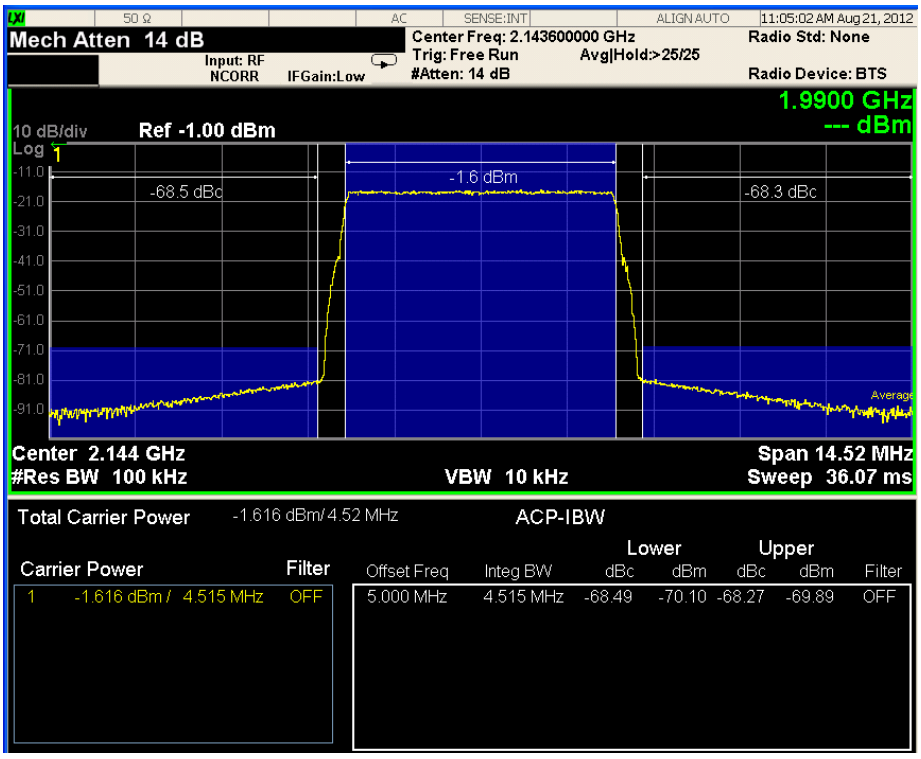

Figure 5. TSW3725 Band 1 ACPR, TRF3705

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