TSW3065EVM – Standalone LO Source

This document describes the steps to properly operate and understand the TSW3065EVM Evaluation Module. TSW3065EVM eliminates expensive signal generators and also acts as a demo enabler for TI solutions such as, TSW3725, TSW6011, GC5330, GC5325, etc. TSW3065EVM can be used as standalone source as the dip switch enables no GUI usage with four significant pre-programmed frequencies, and the GUI can be enabled for detailed control. It can either be powered up with a 6-V DC adaptor supply or 5-V DC USB supply from a laptop/computer. It operates from 300 MHz to 4.8 GHz and provides output power more than 15 dBm up to 2.7 GHz.

Contents

1 Overview

TSW3065EVM is based on Texas Instruments integer-N / Fractional –N frequency synthesizer with integrated wideband VCO TRF3765. Its frequency ranges from 300 MHz to 4.8 GHz. It provides programmable output power with a combination of amplifier and programmable attenuator. TSW3065EVM has an option of on-board or off-board reference selection. The on-board reference is from 10 MHz crystal.

2 Hardware Description

TSW3065EVM uses a wideband synthesizer, TRF3765, which has four differentials LO outputs. The block diagram of the TSW3065EVM is shown in Figure 1.
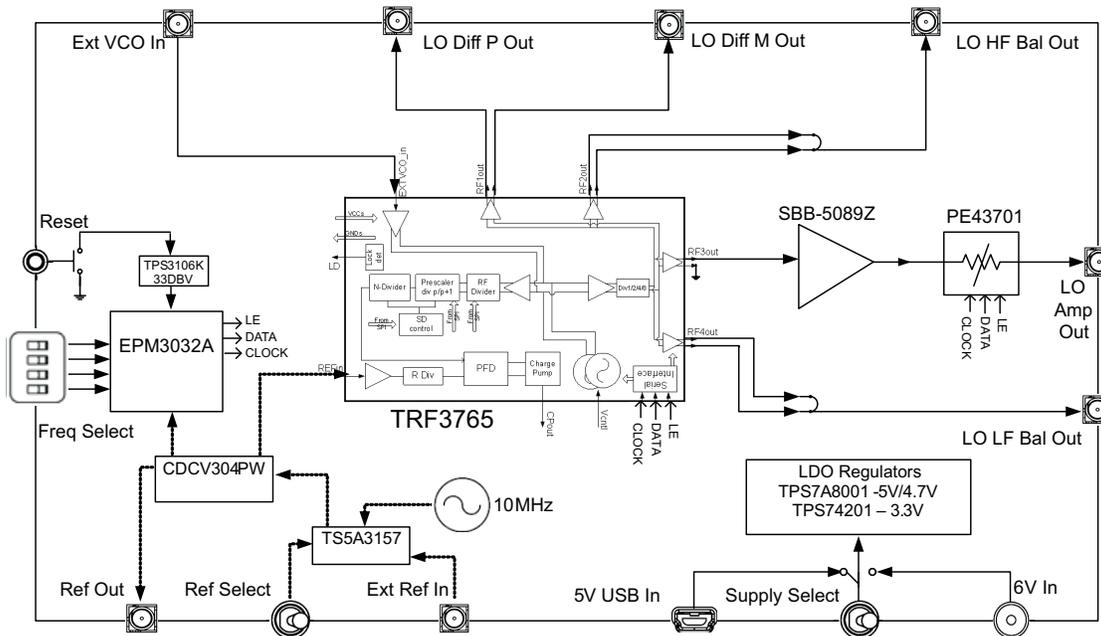
Figure 1. TSW3065EVM Block Diagram

The loop filter used is integer-N with f_{pfd} and f_{ref} 10 MHz. Loop filter details can be obtained from the TRF3765 data sheet (SLWS230). TSW3065EVM is enclosed within a metal housing with a plexi-glass top and is shown in Figure 2.

Figure 2. Picture of TSW3065EVM

2.1 LO Outputs

TSW3065EVM uses all four LO outputs of TRF3765. Figure 3 shows all the outputs along with 'Ext VCO In' connector.
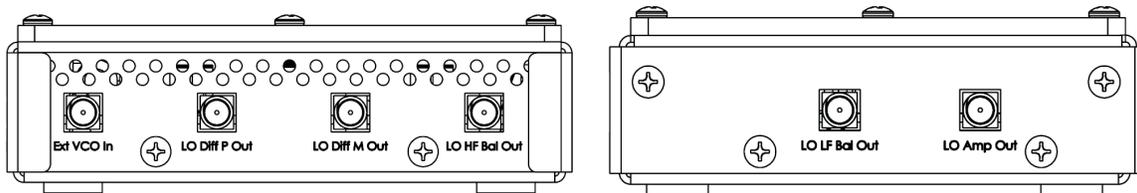
Figure 3. LO outputs and Ext VCO in

First, 'LO LF Bal Out' - SMA output uses a low frequency (900 MHz) balun to one of the four differential outputs of TRF3765.

Second, 'LO Amp out' - the main SMA output, is an amplified single ended line of TRF3765 second LO output. This chain uses a wide band amplifier and programmable attenuator.

Third, 'LO HF Bal Out' - SMA output uses high frequency (1900 MHz) balun to third TRF3765 LO output.

Finally, 'LO Diff P Out' and 'LO Diff M Out' - SMA outputs are the fourth differential output of TRF3765. 'Ext VCO In' - SMA is the external VCO input to TRF3765. Details of these outputs and 'Ext VCO In' are provided in TRF3765 data sheet (SLWS230).

2.2 Supply

A 6-V DC output power supply V-Infinity EMSA060300-P5P-SZ and a USB cable have been supplied along with the TSW3065EVM. The TSW3065EVM can either be powered up with 6-V DC adaptor supply or 5-V DC USB supply from laptop/computer using 'Supply Select' switch. When USB powered, the USB version should be either USB 2.0, USB 3.0 or higher i.e., with 5-V DC and ≥ 500 mA. TSW3065EVM uses Texas Instruments linear regulators TPS7A8001 and TPS74201, which regulates the supply voltage to 5-V DC (for adaptor supply) / 4.7-V DC (for USB supply) and 3.3-V DC, respectively. When powered with 6-V adaptor supply TSW3065EVM consumes 430 mA of current.

| CAUTION |
| --- |
| To minimize risk of damage to EVM and/or continued EVM compliance, use only the power supply provided with this EVM as stated above. |

2.3 Reference

TSW3065EVM can be locked either using an on board 10 MHz reference clock or an external 10 MHz, 12 dBm to 13 dBm reference using the 'Reference Select' switch. When 'Ref Select' switch is at the 'internal' position, it selects the internal reference, and when at the 'external' position, it selects the external reference. External reference signal is applied at the 'Ext Ref' connector. The reference used to lock TSW3065EVM is available at the 'Ref Out' SMA connector and can be used to lock other devices or instruments.

2.4 Frequency Selection

The TSW3065EVM has four significant pre-programmed frequencies. These frequencies can be selected using dip switch. Table 1, shows the positions of dip-switch with LED's D3, D4, D5, and D6 and respective programmed frequency. GUI could be used for advanced options or other desired frequency selections. Whenever the dip switch position is changed to one of the first four settings in Table 1, the respective frequency registers are loaded after resetting the board (i.e. by pressing 'Reset' push button). When the dip switch position 1111 is selected, the TSW3065EVM is in GUI controlled mode. Figure 4, shows the dip switch and 'reset' push button location.

Table 1. Dip Switch Frequency Selection

Dip Switch Position D6-D5-D4-D3	Frequency (MHz)
0001	950
0010	1960
0100	2140
1000	3500
1111	USB Control
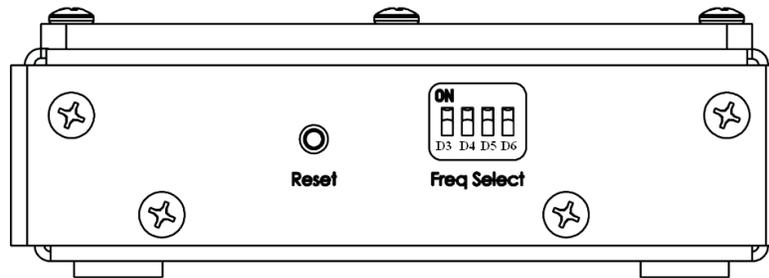
Figure 4. Dip Switch and Push Button

2.5 Regulatory Compliance

EMC Directive: 2004/108/EC relating to electromagnetic compatibility.

3 GUI Details

A TSW3065EVM GUI screen shot is shown in Figure 5. For the board to be GUI controlled, the dip switch position should be set to 1111. The frequency in the 'Frequency (Hz)' tab can be selected from 300 MHz to 4.8 GHz, and clicking the 'right' button enables the selected frequency. The attenuation settings can be varied from 0 to 31.75, and attenuation up to 30 dB can applied to the 'LO Amp Out' signal.

'LO LF BAL OUT' can be enable or disabled by turning ON and OFF the LO LF BAL OUT button. Similarly, others outputs can be turned ON and OFF. Turning ON and OFF 'LO DIFF OUT' enables and disables the 'LO DIFF P Out' and 'LO DIFF M Out' outputs, respectively. To modify the advance settings of TRF3765, the 'TRF3765 Advance Settings' tab can be used. See the TRF3765 data sheet for TRF3765 detailed settings. As shown in Figure 5, the GUI also displays the TSW3065EVM block diagram.

> **NOTE:**
> 1. When the TSW3065 GUI is launched, it displays only 'LO AMP OUT' turned ON, but by default at the initial start-up, all the output buffers are turned ON.
>
> 2. While operating TSW3065 between 2.06 GHz to 2.18 GHz, always turn OFF 'LO_LF_BAL_Out' output buffer.
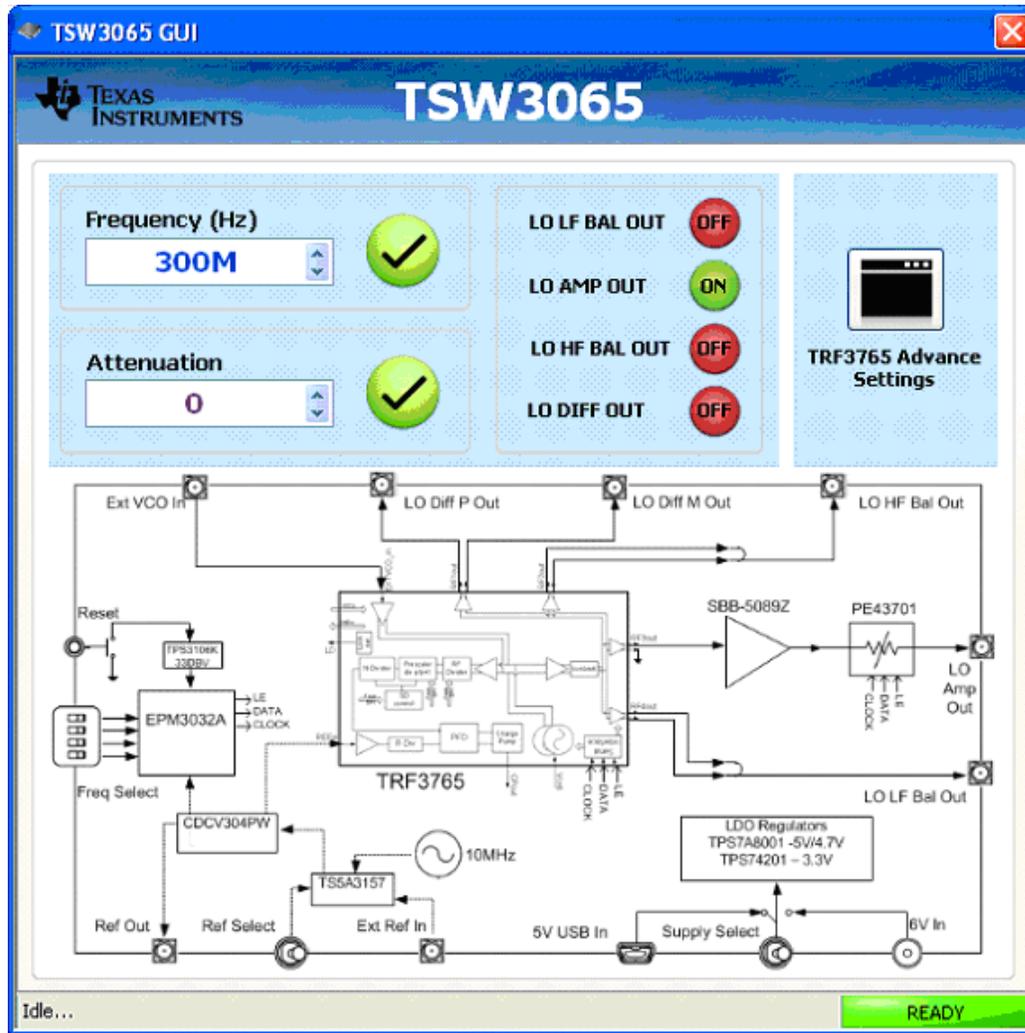
Figure 5. Screen shot of TSW3065EVM GUI

4   Setup Steps

Step 1.   To power up the board using a 5 V USB, connect one end of USB (USB2.0, USB3.0 or higher versions) cable to '5V USB In' and other end to a laptop/computer. Power from the USB is indicated when the yellow LED 'D2 USB Supply' is turned ON. Select the 'Supply Select' switch to the 'USB' location as shown in Figure 6. Figure 7(b) shows the TSW3065EVM setup with USB supply.
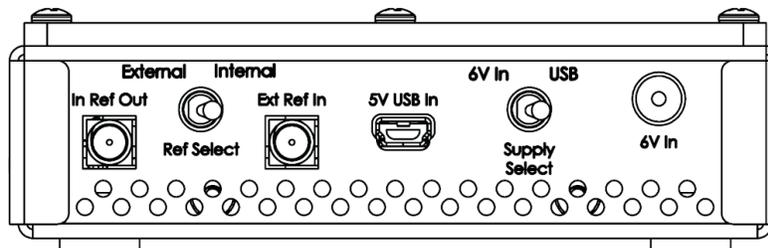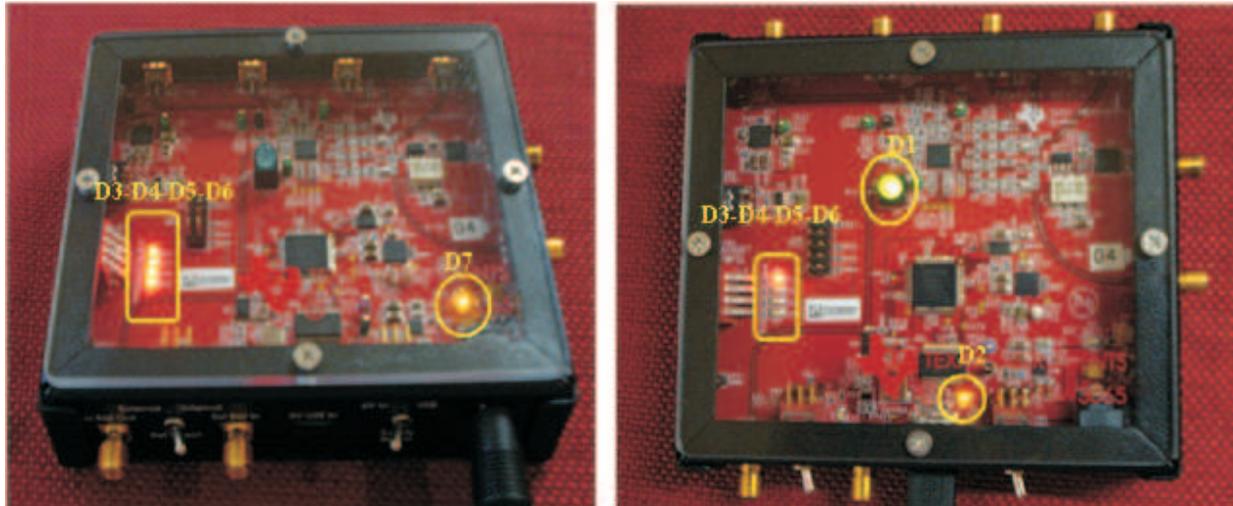

Figure 6. Supply and Reference

Step 2. To power up the TSW3065EVM using a 6 V adaptor supply, connect the adaptor supply at '6V In' connector. Power from 6 V adaptor supply is indicated when the yellow LED 'D7 Ext Supply' is turned ON. Select the 'Supply Select' switch to the '6V In' position. Figure 7(a) shows the TSW3065EVM setup with a 6 V adaptor supply.

(a) 6 V adaptor supply powered and dipswitch in GUI controlled position

(b) USB powered and dipswitch in pre-programmed frequency position

Figure 7. TSW3065EVM Setup

Step 3. Select 'Ref Select' switch to 'Internal' position as shown in Figure 6. This selects the internal onboard 10 MHz crystal oscillator as reference. To select an external reference select the 'Ref Select' switch to 'External' position. This turns on the yellow LED 'D8 Ext_Ref.' Apply 10 MHz, 13 dBm of the external reference signal at the 'Ext Ref In' connector. 'Ref Out' which is one of the buffered outputs of the reference used to lock TSW3065EVM can be used to lock other instruments or boards. Figure 7(a) and Figure 7(b) shows TSW3065EVM setup with internal reference selected.

NOTE: To obtain the best performance, operating the TSW3065 using an internal 10 MHz onboard crystal is recommended because crystal oscillators usually have a better performance than laboratory signal generators.

Step 4. To use pre-programmed frequencies, select the 'Freq Select' dip switch in one of the first four positions in Table 1 and press 'Reset' push button. This locks the TSW3065EVM to the respective frequency of dip switch position and the green LED 'D1 PLL LOCK' is turned ON. Figure 7(b) shows the TSW3065EVM setup in the first dip switch position of Table 1 with D1 turned ON, which indicates TSW3065EVM is locked. To use the board in GUI controlled mode, turn the dip switch to 1111 position as shown Figure 7(a).

5 Performance Plots

This section provides typical performance plots of the TSW3065EVM. Figure 8, shows the maximum output power at 'LO Amp Out' across frequencies 300 MHz to 4.8 GHz. TSW3065EVM provides output power more than 15 dBm up to 2.7 GHz and more than 11 dBm up to 4.5 GHz. Figure 9, shows the output phase noise response for each pre-programmed frequency of DIP switch at minimum attenuation settings. In-band phase noise performance is slightly degraded using a USB supply and is shown in Figure 10.
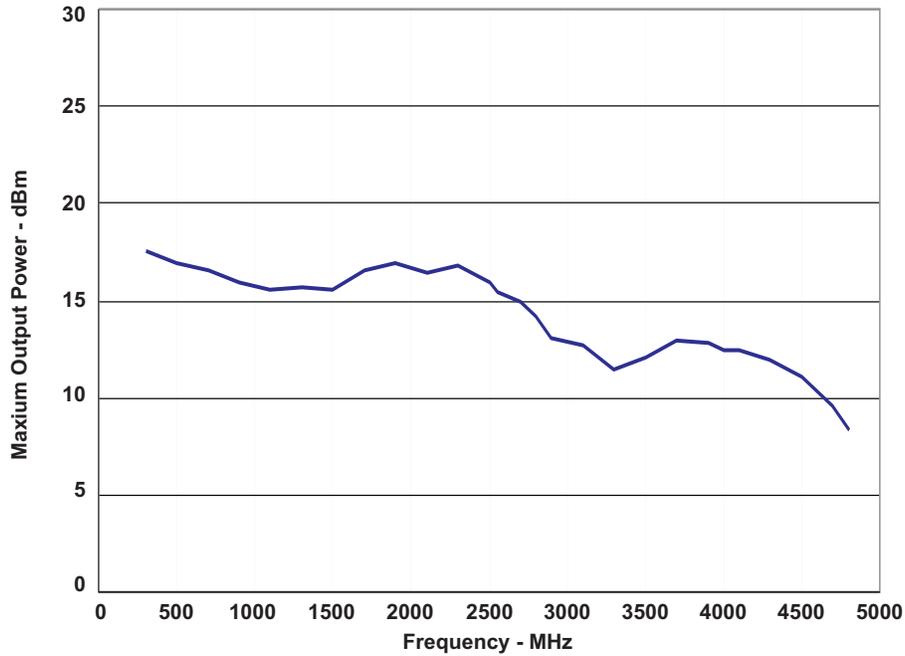
Figure 8. 'LO Amp Out' Maximum Output Power
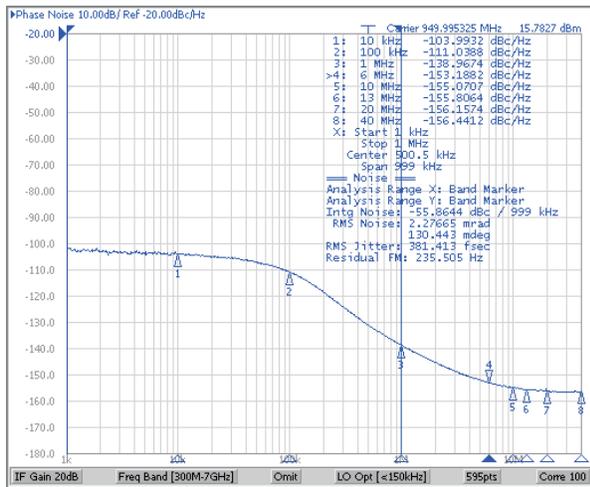
(a) Dip switch position at 0001 position - 950 MHz
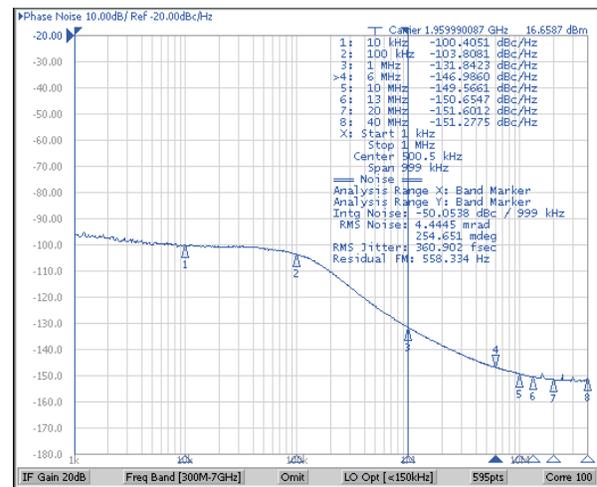
(b) Dip switch position at 0010 position - 1960 MHz
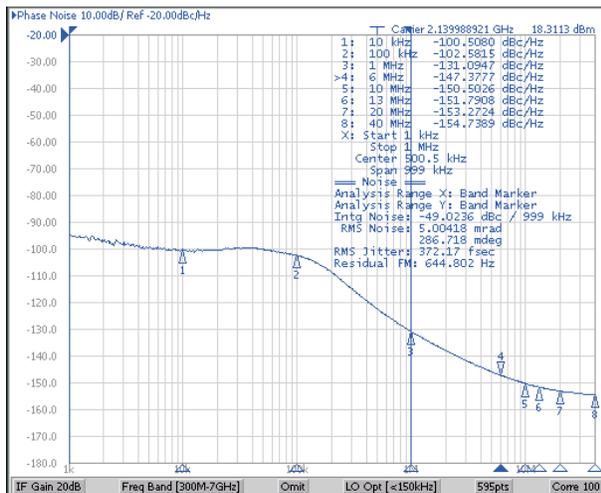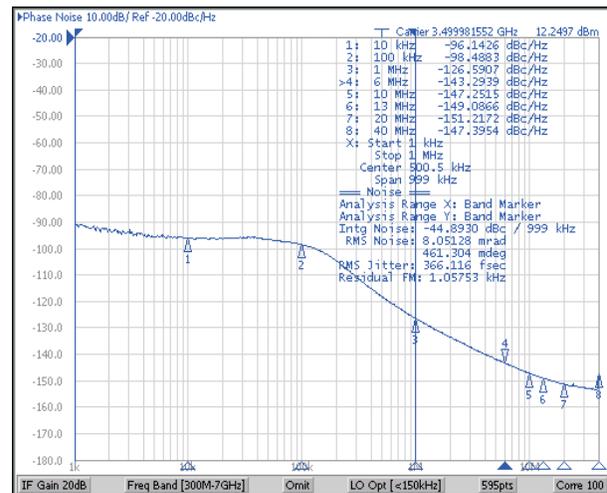
(c) Dip switch position at 0100 position - 2140 MHz

(d) Dip switch position at 1000 position - 3500 MHz

Figure 9. Phase Noise Response at 'LO Amp Out' at Maximum Output Power With (a), (b), (c) and (d)
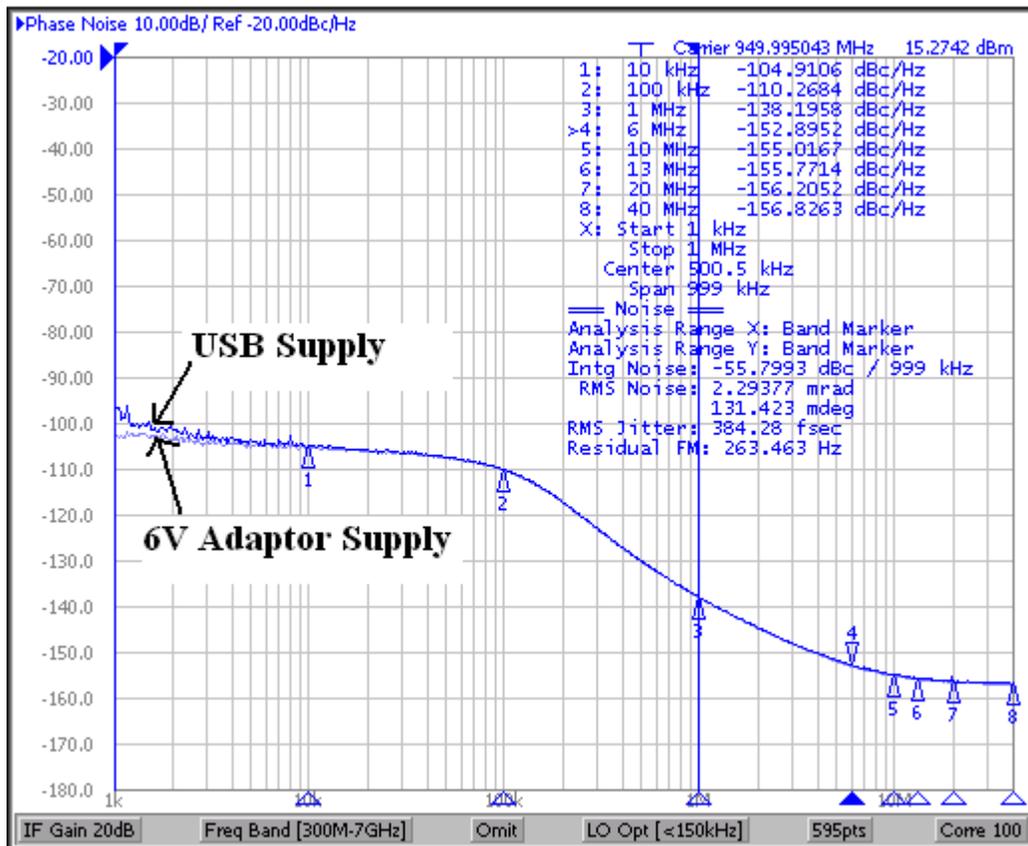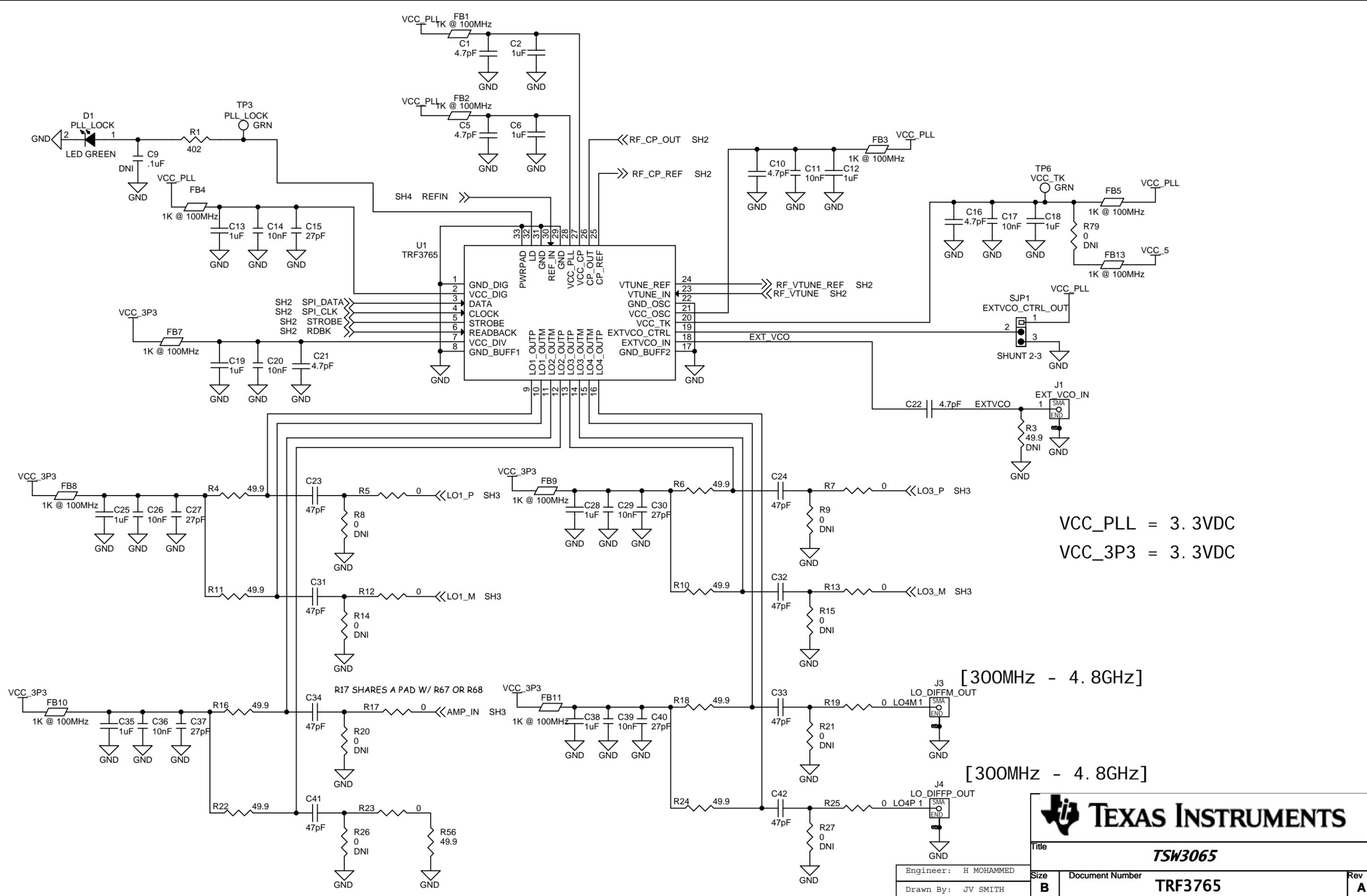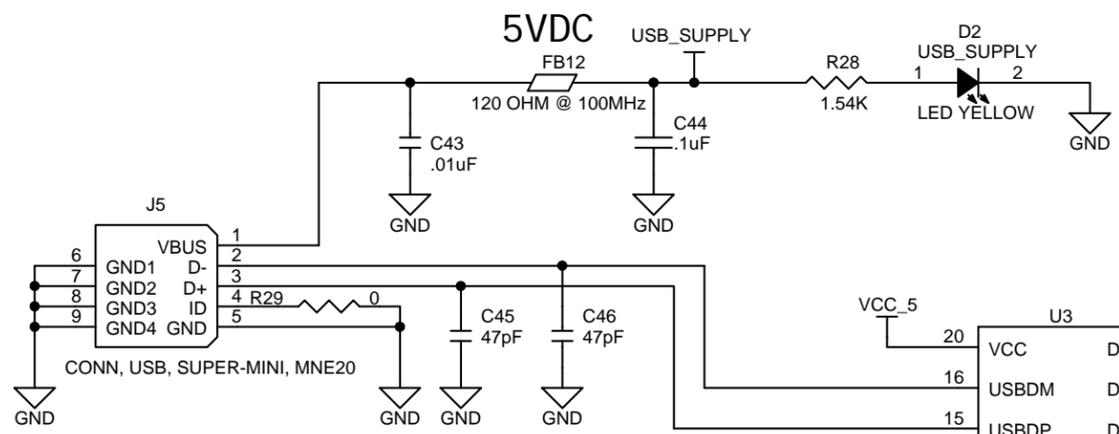
Figure 10. Phase Noise Comparison at 'LO Amp Out' at Maximum Output Power Using USB Supply and 6V Adaptor Supply with Dip Switch at Position 0001−950MHz

VCC_PLL FB1
TK @ 100MHz
C1 4.7pF   C2 1uF
GND   GND

VCC_PLL FB2
TK @ 100MHz
C5 4.7pF   C6 1uF
GND   GND

RF_CP_OUT SH2
RF_CP_REF SH2

FB3 1K @ 100MHz VCC_PLL
C10 4.7pF C11 10nF C12 1uF
GND GND GND

TP6 VCC_TK GRN
FB5 1K @ 100MHz VCC_PLL
C16 4.7pF C17 10nF C18 1uF
R79 0 DNI
FB13 1K @ 100MHz VCC_5
GND GND GND

D1 PLL_LOCK
TP3 PLL_LOCK GRN
GND 2 — 1
LED GREEN
R1 402
C9 .1uF DNI
GND
VCC_PLL FB4
1K @ 100MHz
C13 1uF C14 10nF C15 27pF
GND GND GND

SH4 REFIN

VCC_3P3 FB7
1K @ 100MHz
C19 1uF C20 10nF C21 4.7pF
GND GND GND

SH2 SPI_DATA
SH2 SPI_CLK
SH2 STROBE
SH2 RDBK

U1 TRF3765
33 PWRPAD
32 GND
31 LD
30 REF_IN
29 VCC_PLL
28 VCC_CP
27 CP_OUT
26 CP_REF
25

1 GND_DIG
2 VCC_DIG
3 DATA
4 CLOCK
5 STROBE
6 READBACK
7 VCC_DIV
8 GND_BUFF1

24 VTUNE_REF
23 VTUNE_IN
22 GND_OSC
21 VCC_OSC
20 VCC_TK
19 EXTVCO_CTRL
18 EXTVCO_IN
17 GND_BUFF2

9 LO1_OUTP
10 LO1_OUTM
11 LO2_OUTP
12 LO2_OUTM
13 LO3_OUTP
14 LO3_OUTM
15 LO4_OUTM
16 LO4_OUTP

GND

RF_VTUNE_REF SH2
RF_VTUNE SH2

SJP1
EXTVCO_CTRL_OUT VCC_PLL
1
2
3
SHUNT 2-3 GND

EXT_VCO

J1 EXT_VCO_IN
C22 4.7pF EXTVCO
SMA END
R3 49.9 DNI
GND
GND

VCC_3P3 FB8
1K @ 100MHz
C25 1uF C26 10nF C27 27pF
GND GND GND
R4 49.9
C23 47pF
R5 0 LO1_P SH3
R8 0 DNI
GND
R11 49.9
C31 47pF
R12 0 LO1_M SH3
R14 0 DNI
GND

VCC_3P3 FB9
1K @ 100MHz
C28 1uF C29 10nF C30 27pF
GND GND GND
R6 49.9
C24 47pF
R7 0 LO3_P SH3
R9 0 DNI
GND
R10 49.9
C32 47pF
R13 0 LO3_M SH3
R15 0 DNI
GND

VCC_PLL = 3.3VDC
VCC_3P3 = 3.3VDC

R17 SHARES A PAD W/ R67 OR R68

VCC_3P3 FB10
1K @ 100MHz
C35 1uF C36 10nF C37 27pF
GND GND GND
R16 49.9
C34 47pF
R17 0 AMP_IN SH3
R20 0 DNI
GND
R22 49.9
C41 47pF
R23 0
R26 0 DNI
R56 49.9
GND GND

VCC_3P3 FB11
1K @ 100MHz
C38 1uF C39 10nF C40 27pF
GND GND GND
R18 49.9
C33 47pF
R19 0 LO4M 1
J3 LO_DIFFM_OUT
SMA END
R21 0 DNI
GND
[300MHz - 4.8GHz]
R24 49.9
C42 47pF
R25 0 LO4P 1
J4 LO_DIFFP_OUT
SMA END
R27 0 DNI
GND
[300MHz - 4.8GHz]

TEXAS INSTRUMENTS

Title: TSW3065
Engineer: H MOHAMMED
Drawn By: JV SMITH
Size B
Document Number: TRF3765
Rev A
Date: Thursday, October 06, 2011
Sheet 1 of 5

SERIAL INTERFACE

5VDC

USB_SUPPLY
FB12
120 OHM @ 100MHz
C43 .01uF
C44 .1uF
R28 1.54K
D2 USB_SUPPLY
LED YELLOW
GND

J5
VBUS
GND1 D-
GND2 D+
GND3 ID
GND4 GND
R29 0
CONN, USB, SUPER-MINI, MNE20
C45 47pF
C46 47pF
GND

VCC_5
C101 .1uF
GND

U3
FT245RL
VCC
USBDM
USBDP
VCCIO
NC1
RESET
NC2
OSCI
OSCO
3V3OUT
AGND
GND
GND
GND
TEST
D0
D1
D2
D3
D4
D5
D6
D7
RXF
TXE
RD
WR
PWREN
C47 .1uF
GND

PP11 DATA
PP12 CLK
PP14 LE
PP13 RDBK

PP3 SPI_CLK
PP4 SPI_ATT_LE
PP6 SPI_CLK_ATT
PP1 SPI_DATA
PP2 STROBE
PP5 RDBK
PP7 SPI_DATA_ATT

U2B
EPM3064A
IO1
IO2
IO3
IO4
IO5
IO6
IO7
IO8
IO9
IO10
IO11
IO12
IO13
IO26
IO25
IO24
IO23
IO22
IO21
IO20
IO19
IO18
IO17
IO16
IO15
IO14

SPI_DATA SH1
SPI_CLK SH1
STROBE SH1
SPI_ATT_LE SH3
SPI_CLK_ATT SH3
RDBK SH1
SPI_DATA_ATT SH3

VCC_3P3
SJP2
SHUNT 2-3 /WP
GND
GND

U7
25AA080
CS VCC
SO HOLD
WP SCK
VSS SI
R55 4.7K
VCC_3P3
C81 .1uF
C82 1uF
C80 10uF
GND

DIP SWITCH POSITION

D6, D5, D4, D3	FREQUENCY (MHz)
0001	950
0010	1960
0100	2140
1000	3500
1111	USB CONTROL

LO_OUT FREQUENCY SELECT

SW1
GND

R46 4.02K
R47 4.02K
R48 4.02K
R49 4.02K
VCC_3P3

D3 LED RED
D4 LED RED
D5 LED RED
D6 LED RED
GND

RF VCO SELECT

TP16 VTUNE
GRN
R37 1M
SH1 RF_CP_OUT
R33 2K
R32 0
RF_VTUNE SH1
C52 270pF
C53 4700pF
R30 2K
C51 56pF
C55 2.2pF DNI
SH1 RF_CP_REF
R61 0
R62 0
RF_VTUNE_REF SH1
VCC_PLL
R64 DNI
R63 0
GND

NOTE 1

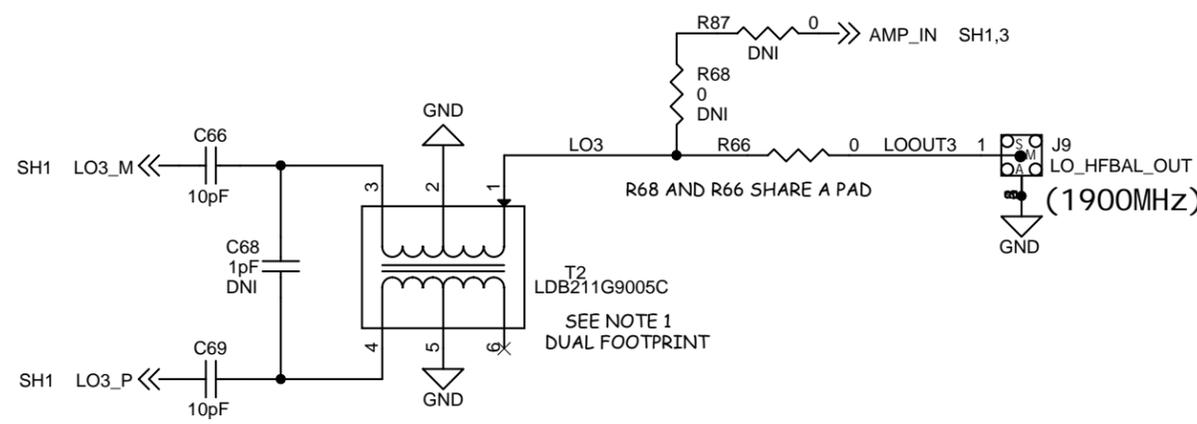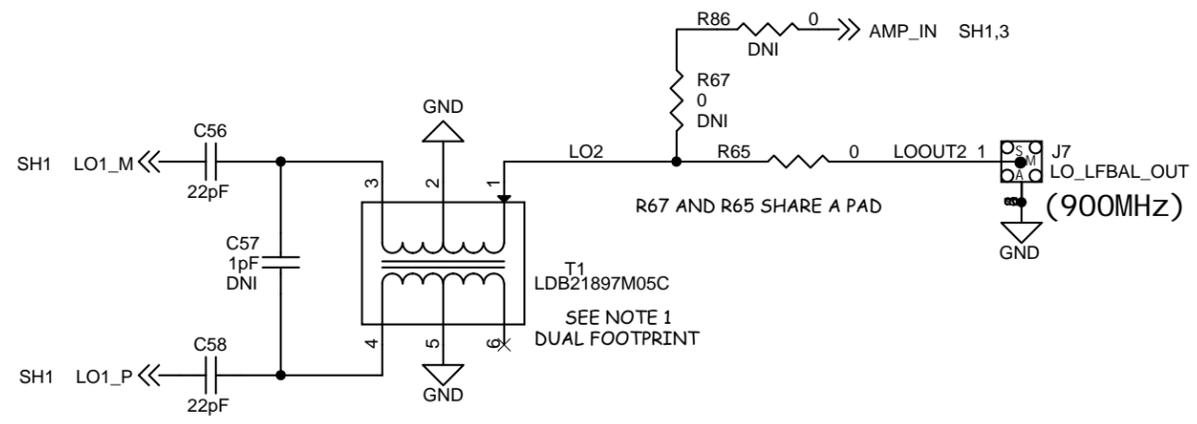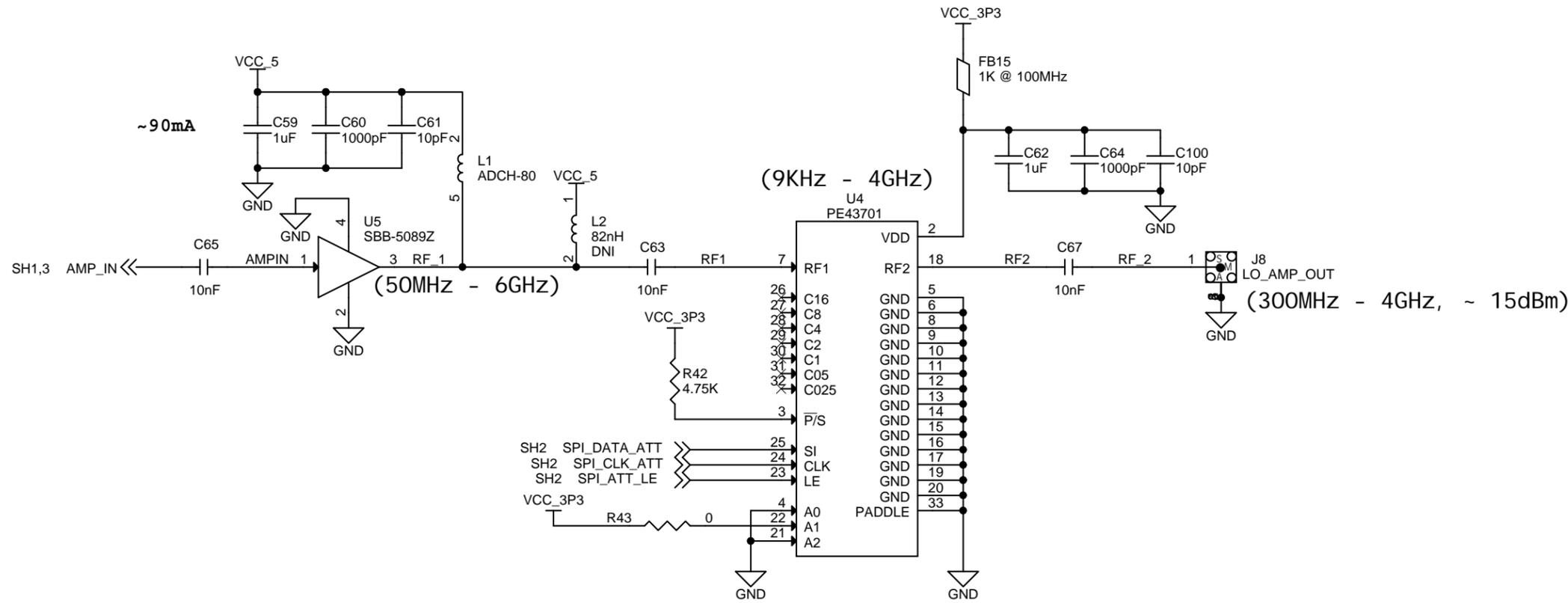| FREQUENCY	RF BALUN	CAP
897MHz +/- 100MHz	MURATA LDB21897M005C-001	22pF
1800MHz +/- 100MHz	MURATA LDB211G8005C-001	10pF
1900MHz +/- 100MHz	MURATA LDB211G9005C-001	10pF
2.3GHz - 2.7GHz	MURATA LDB212G4005C-001	4.7pF
3.3GHz - 3.8GHz	JOHANSON 3600BL14M050E	3.9pF

TEXAS INSTRUMENTS

Title
TSW3065

Size **B**
Document Number
RF CHAIN
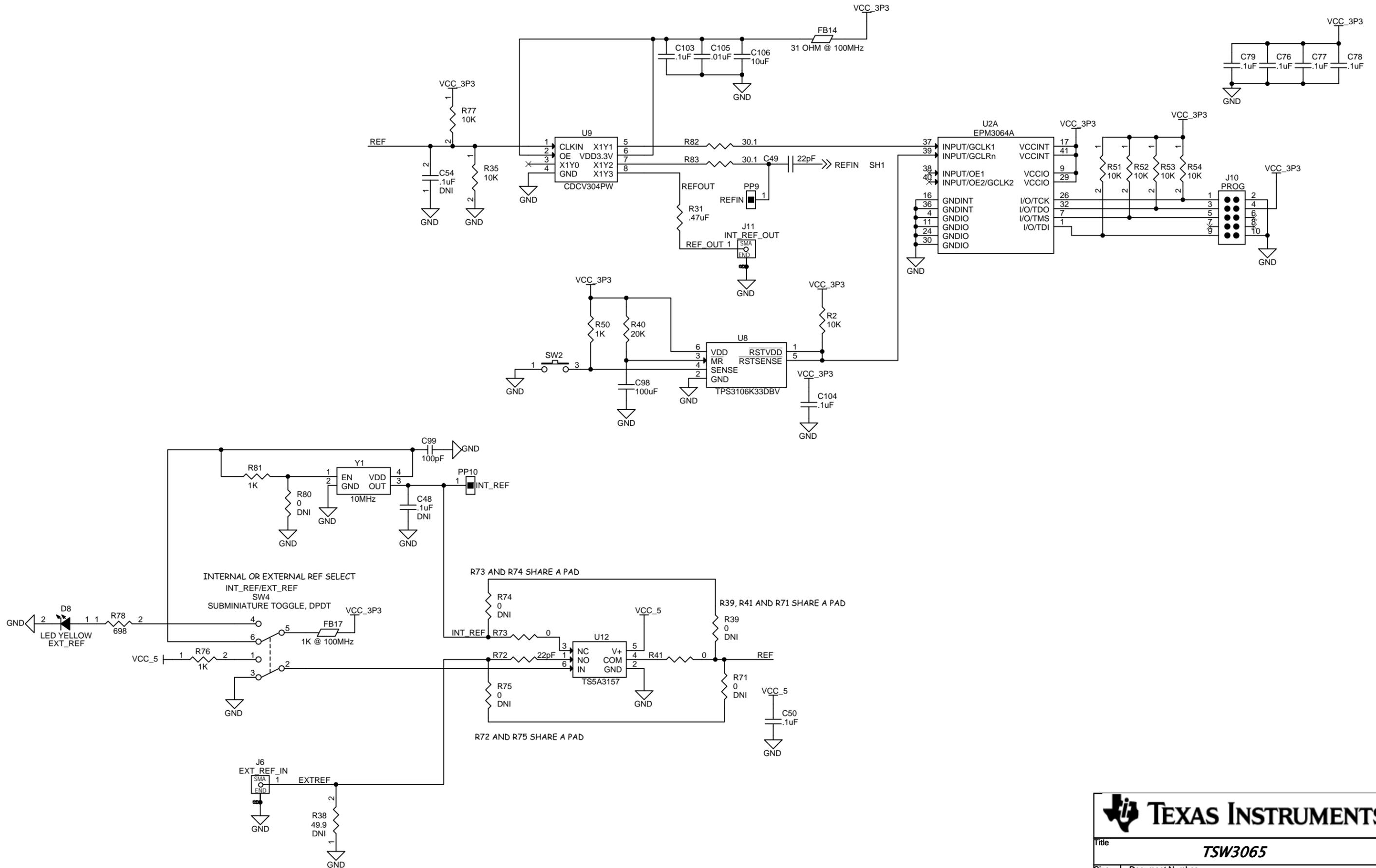Rev **A**
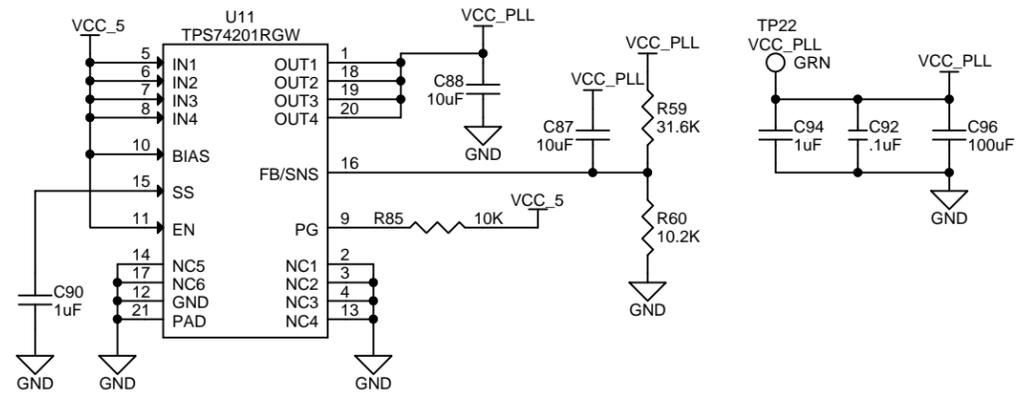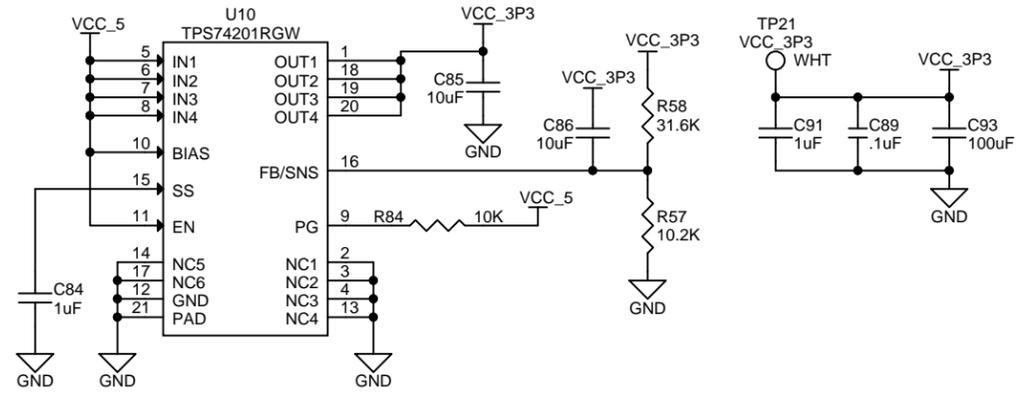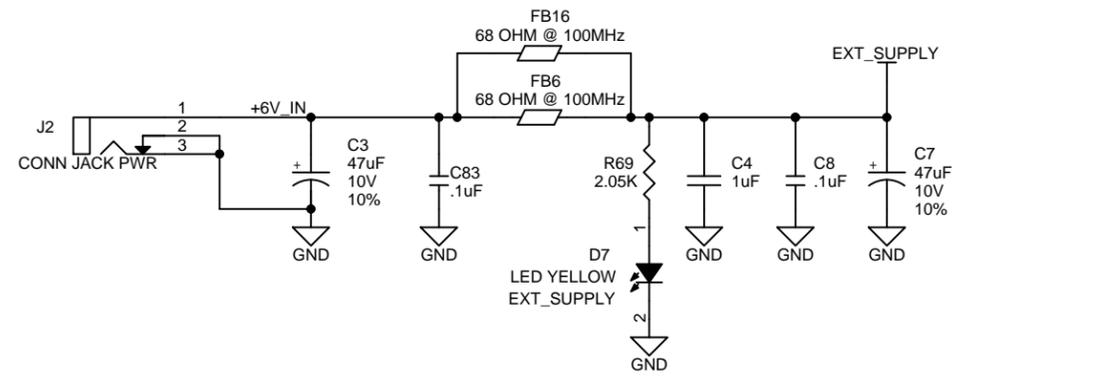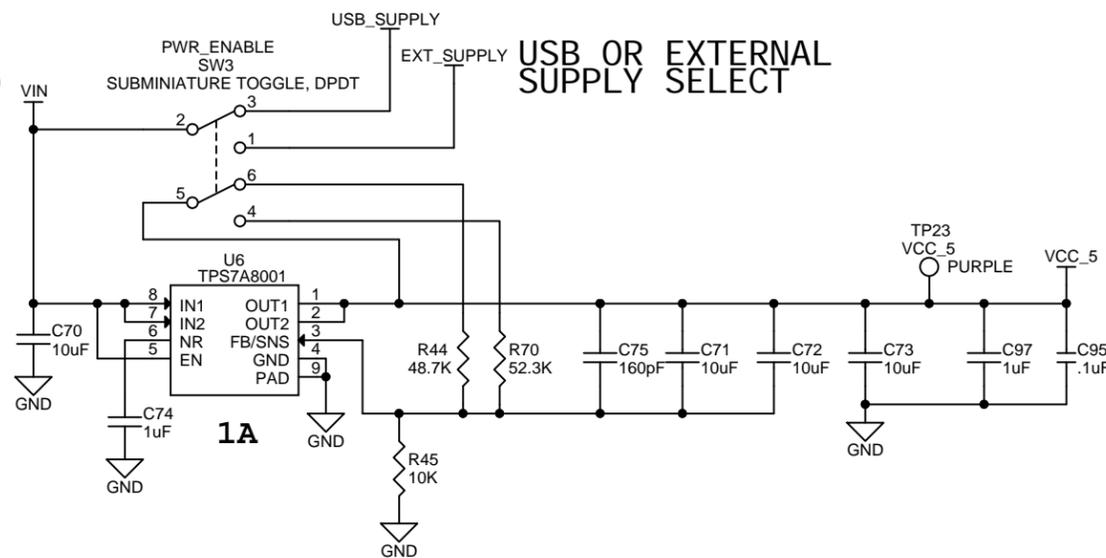
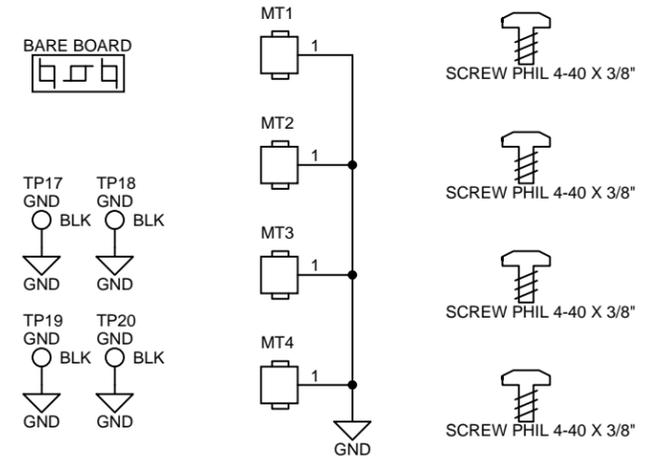Date: Thursday, October 06, 2011   Sheet 3 of 5

RF/IF FREQ REF INTERFACE

VCC_3P3

FB14
31 OHM @ 100MHz

C103 .1uF
C105 .01uF
C106 10uF
GND

VCC_3P3
C79 .1uF C76 .1uF C77 .1uF C78 .1uF
GND

VCC_3P3
R77 10K

REF

C54 .1uF DNI
GND

R35 10K
GND

U9
1 CLKIN X1Y1 5
2 OE VDD3.3V 6
3 X1Y0 X1Y2 7
4 GND X1Y3 8
CDCV304PW

GND

R82 30.1
R83 30.1 C49 22pF REFIN SH1

REFOUT
R31 .47uF

PP9
REFIN 1

J11
INT_REF_OUT
SMA END
REF_OUT 1
GND

U2A
EPM3064A
37 INPUT/GCLK1 VCCINT 17
39 INPUT/GCLRn VCCINT 41
38 INPUT/OE1 VCCIO 9
40 INPUT/OE2/GCLK2 VCCIO 29
16 GNDINT I/O/TCK 26
36 GNDINT I/O/TDO 32
4 GNDIO I/O/TMS 7
11 GNDIO I/O/TDI 1
24 GNDIO
30 GNDIO

GND

VCC_3P3
R51 10K R52 10K R53 10K R54 10K

VCC_3P3
J10 PROG
1 2
3 4
5 6
7 8
9 10
GND

VCC_3P3
R50 1K R40 20K

SW2
1   3

U8
6 VDD RSTVDD 1
3 MR RSTSENSE 5
4 SENSE
2 GND
TPS3106K33DBV

C98 100uF
GND

GND

VCC_3P3
R2 10K

VCC_3P3
C104 .1uF
GND

C99 100pF GND

R81 1K

Y1
1 EN VDD 4
2 GND OUT 3
10MHz

R80 0 DNI
GND

C48 .1uF DNI
GND

PP10
INT_REF 1

INTERNAL OR EXTERNAL REF SELECT
INT_REF/EXT_REF
SW4
SUBMINIATURE TOGGLE, DPDT

D8
LED YELLOW
EXT_REF
GND

R78 698

VCC_3P3
FB17
1K @ 100MHz

R76 1K
VCC_5

GND

R73 AND R74 SHARE A PAD

R74 0 DNI

INT_REF R73 0

R72 22pF

R75 0 DNI

R72 AND R75 SHARE A PAD

U12
3 NC V+ 5
1 NO COM 4
6 IN GND 2
TS5A3157

VCC_5
R39 0 DNI

R39, R41 AND R71 SHARE A PAD

R41 0 REF

R71 0 DNI

VCC_5
C50 .1uF
GND

GND

J6
EXT_REF_IN
SMA END
1 EXTREF

R38 49.9 DNI
GND
GND

MOUNTING HOLES AND HARDWARE

BARE BOARD

MT1
1
SCREW PHIL 4-40 X 3/8"

MT2
1
SCREW PHIL 4-40 X 3/8"

MT3
1
SCREW PHIL 4-40 X 3/8"

MT4
1
SCREW PHIL 4-40 X 3/8"

GND

TP17
GND
BLK
GND

TP18
GND
BLK
GND

TP19
GND
BLK
GND

TP20
GND
BLK
GND

FB16
68 OHM @ 100MHz

FB6
68 OHM @ 100MHz

EXT_SUPPLY

J2
1
2
3
CONN JACK PWR

+6V_IN

C3
47uF
10V
10%
GND

C83
.1uF
GND

R69
2.05K

D7
LED YELLOW
EXT_SUPPLY
GND

C4
1uF
GND

C8
.1uF
GND

C7
47uF
10V
10%
GND

U10
TPS74201RGW
5 IN1   OUT1 18
6 IN2   OUT2 19
7 IN3   OUT3 20
8 IN4   OUT4
10 BIAS
15 SS   FB/SNS 16
11 EN   PG 9
14 NC5   NC1 2
17 NC6   NC2 3
12 GND   NC3 4
21 PAD   NC4 13

VCC_5

C84
1uF
GND

GND   GND   GND

VCC_3P3
C85
10uF
GND

VCC_3P3
C86
10uF

R58
31.6K

R84 10K VCC_5

R57
10.2K
GND

VCC_3P3

TP21
VCC_3P3
WHT

C91
1uF

C89
.1uF

VCC_3P3
C93
100uF
GND

U11
TPS74201RGW
5 IN1   OUT1 18
6 IN2   OUT2 19
7 IN3   OUT3 20
8 IN4   OUT4
10 BIAS
15 SS   FB/SNS 16
11 EN   PG 9
14 NC5   NC1 2
17 NC6   NC2 3
12 GND   NC3 4
21 PAD   NC4 13

VCC_5

C90
1uF
GND

GND   GND   GND

VCC_PLL
C88
10uF
GND

VCC_PLL
C87
10uF

R59
31.6K

R85 10K VCC_5

R60
10.2K
GND

VCC_PLL

TP22
VCC_PLL
GRN

C94
1uF

C92
.1uF

VCC_PLL
C96
100uF
GND

VIN = 6V (EXT_SUPPLY)
   = 5V (USB_SUPPLY)

USB_SUPPLY

PWR_ENABLE
SW3
SUBMINIATURE TOGGLE, DPDT

EXT_SUPPLY

USB OR EXTERNAL
SUPPLY SELECT

VIN

2 3
   1
5 6
   4

U6
TPS7A8001
8 IN1   OUT1 1
7 IN2   OUT2 2
6 NR   FB/SNS 3
5 EN   GND 4
         PAD 9

1A

C70
10uF
GND

C74
1uF
GND

R44
48.7K

R70
52.3K

R45
10K
GND

C75
160pF

C71
10uF

C72
10uF

C73
10uF
GND

TP23
VCC_5
PURPLE

C97
1uF

VCC_5

C95
.1uF

VCC_5 = 5V (EXT_SUPPLY)
     = 4.7V (USB_SUPPLY)

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/ kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

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REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this is strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

~

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan!

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

(1) Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,

(2) Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or

(3) Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product.

Also, please do not transfer this product, unless you give the same notice above to the transferee.

Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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【ご使用にあたっての注意】

本開発キットは技術基準適合証明を受けておりません。

本製品のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

（1）電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。

（2）実験局の免許を取得後ご使用いただく。

（3）技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。

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EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.

2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.

3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.

4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

IMPORTANT NOTICE