CC85xx Production Test

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Keywords

- *CC85XX*
- *Production test*
- *External Host Interface*
- *EHIF*
- *CC85XXDK-HEADSET*
- *MSP430F5438*

1 Introduction

The purpose of this design note is to demonstrate the use of the External Host Interface (EHIF) for production testing of a CC85xx product. The EHIF is a set of SPI commands and an interrupt line. The interface lets an external MCU control the CC85xx to a certain extent depending on operational mode. The operational mode treated in this document is the Production Test mode. The SPI master chosen for this pupose is the MSP430F5438 mounted on the MSP-EXP430F5438 Experimenter Board. The DUT is chosen to be the CC85XX Headset board. Since this hardware setup could be used for all the commands included in the EHIF API (not just the ones for production testing), this design note also works as an introduction to EHIF in general.

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2 Abbreviations

API	Application Programming Interface
EHIF	External Host Inteface
DUT	Device Under Test
LCD	Liquid Crystal Display
PER	Packet Error Rate
SPI	Serial Peripheral Interface
USB	Universal Serial Bus

3 Hardware Setup and Preparations

3.1 Hardware needed

To perform the production test described in this document the following hardware is needed:

- 1 pcs CC85XX Headset board (DUT).
- 1 pcs USB Micro cable
- 1 pcs 3.5mm mini-jack to 3.5mm mini-jack
- 1 pcs CC Debugger
- 1 pcs MSP-EXP430F5438 experimenter board
- 1 pcs MSP430 Flash Emulation Tool (MSP-FET430UIF [6]) or equivalent programming tool

The CC85xx Headset board is included in the PurePath Wireless Headset Development Kit (CC85XXDK-HEADSET) [1]. Both cables and the CC Debugger [3] are also included in this kit.

The MSP-EXP430F5438 Experimenter Board [4] runs on 3.3 V meaning that the SPI signals presented to the CC85xx Headset board is 3.3V. This is not ideal as the CC85xx Headset board runs on 2.15 V, but for the commands used in the example code this is of no importance. It has been found that this could possibly affect the PER test commands resulting in reduced throughput while performing a PER test.

3.2 Generate a Production Test Image for the DUT

The CC85xx has three different operational modes i.e. Autonomous operation, Host Controlled operation and Production Test operation. The External Host Interface consists of 32 SPI commands, and only a few are available across all three operational modes.The SPI commands for production testing are only available in Production Test operation. The configuration of operational mode is done in the PurePath Wireless Configurator [2] which is a downloadable free of charge PC tool for configuring the CC85xx devices. In the PurePath Wireless Configurator open the example project “CC85XXDK-HEADSET Preloaded demo”. This can be found on the Start Page in the PurePath Wireless Configurator. In the Flash Programming Panel select one of the two device configurations depending on whether the DUT should be a Master or a Slave. **Then select “Production test” as image type** (see Figure 1). Connect the DUT to the PC via the CC Debugger, and program the device by hitting the “Program CC85xx device” button. See Figure 1 for a screenshot of the Flash Programming Panel.

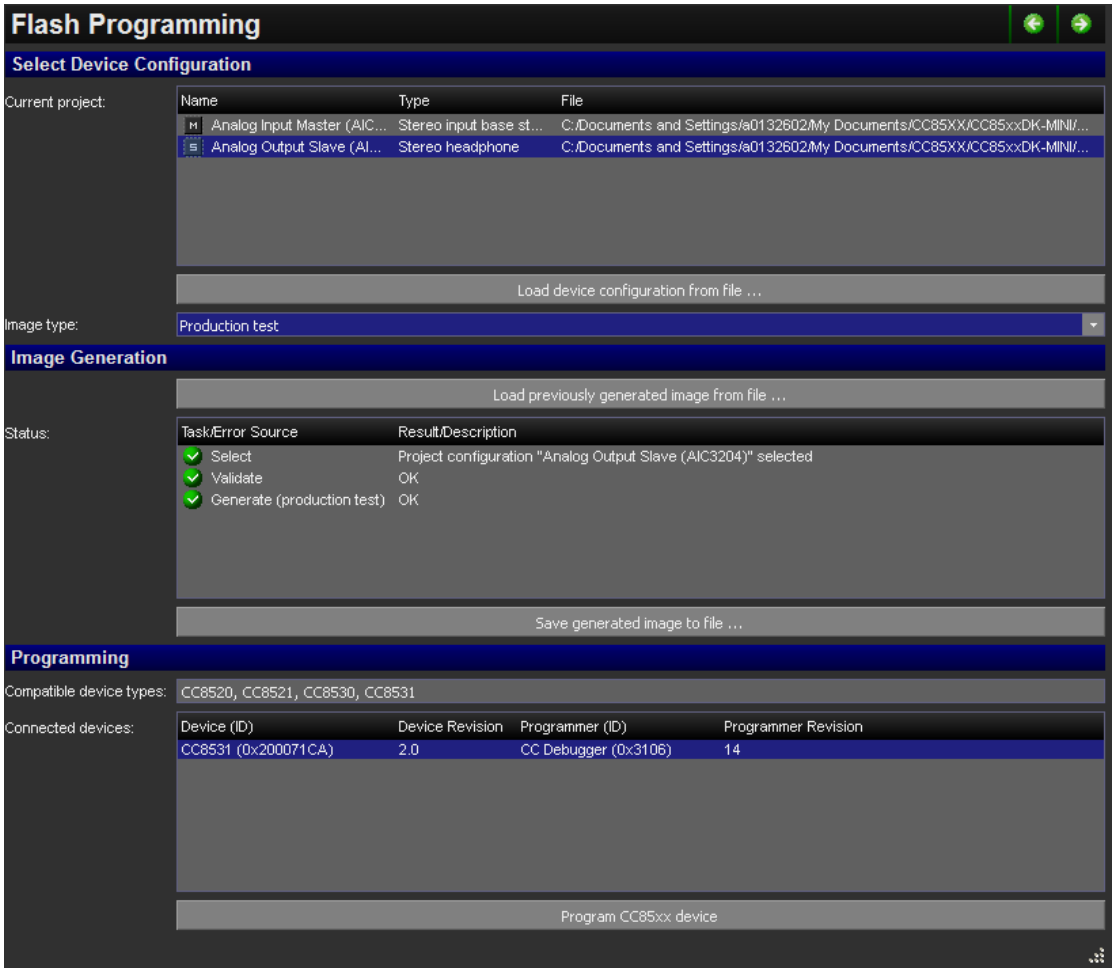

Figure 1. Screenshot of the flash programming panel when making a production test image for the DUT.

3.3 Connecting the MSP-EXP430F5438 to the CC85XX Headset Board

Figure 2 shows how to wire the MSP-EXP430F5438 Experimenter Board to the CC85XX Headset board.

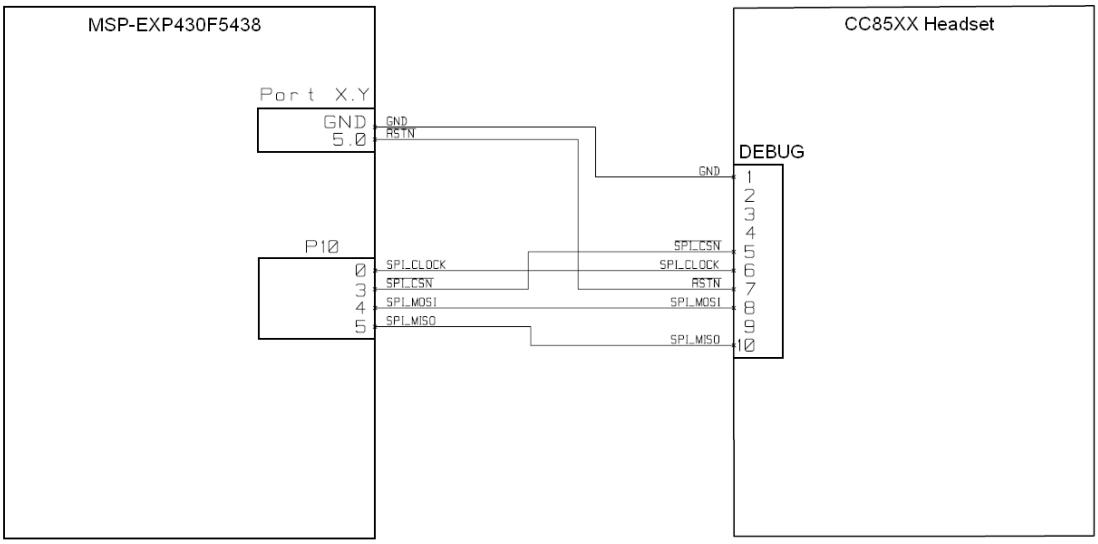

Figure 2. How to connect the MSP-EXP430F5438 to the CC85XX Headset board.

3.4 Program the MSP430 with the production test example code

Download and extract the associated zip. Download and run “SmartRF Flash Programmer” from the TI web [5]. Select the “Program CCxxxx SoC or MSP430” panel, and click the MSP430 tab as shown in Figure 3. With the MSP-FET430UIF connected between the PC and the experimenter board, the MSP430F5438 device should be visble in the device list. To select the correct flash image, hit the browse button, browse to the extracted folder and select “CC85xx_Production_Test.hex”. Select “Erase, program and verify” and hit the “Perform actions” button. The hex-file will now be downloaded to the MSP430F5438. Close the Smart RF Flash Programmer, and restart the MSP-FET430UIF by re-connecting the USB cable. The production test program will now run, and the LCD should start displaying info. The MSP430F5438 can also be programmed through different supported IDEs (“CC85xx_Production_Test.eww” included in the zip is a work space file for IAR).

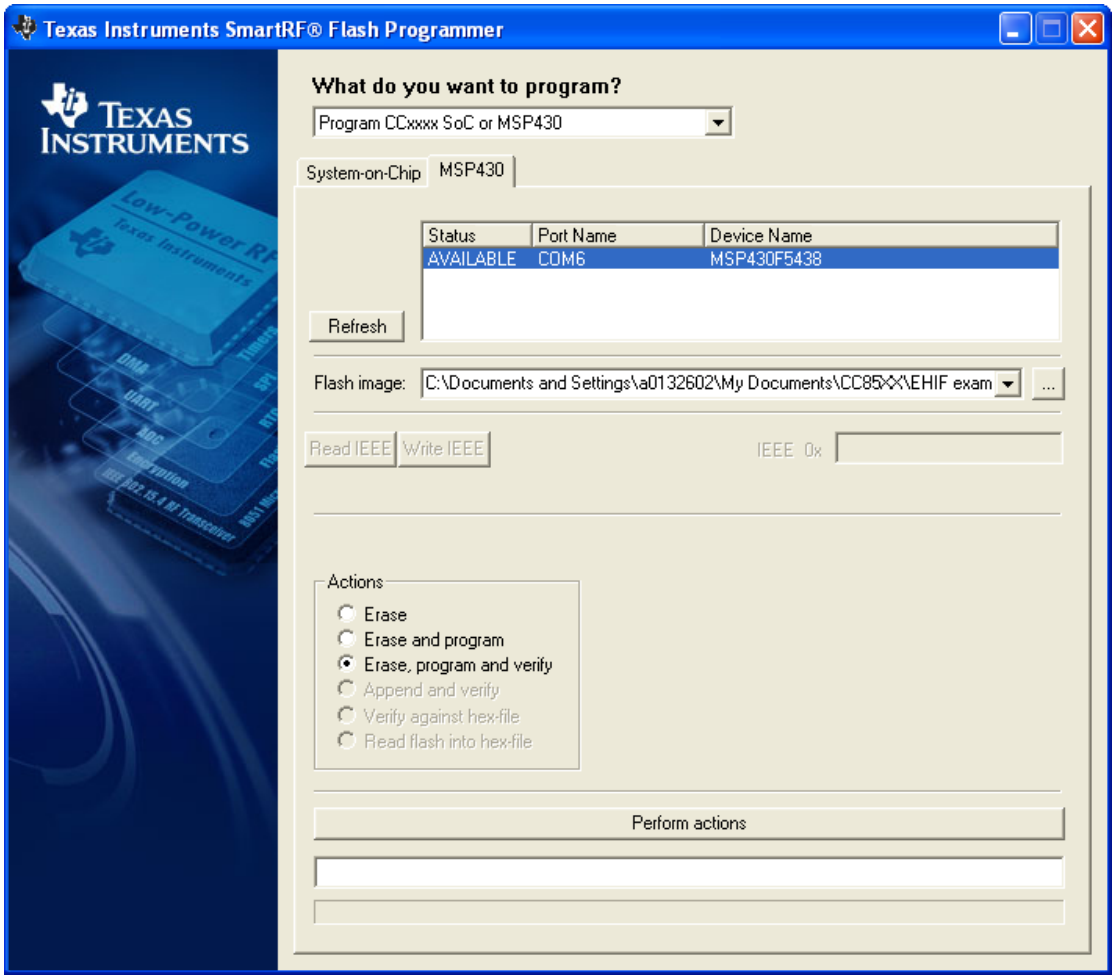

Figure 3. Screenshot of the Smart RF Flash Programmer

4 Production Test Flow

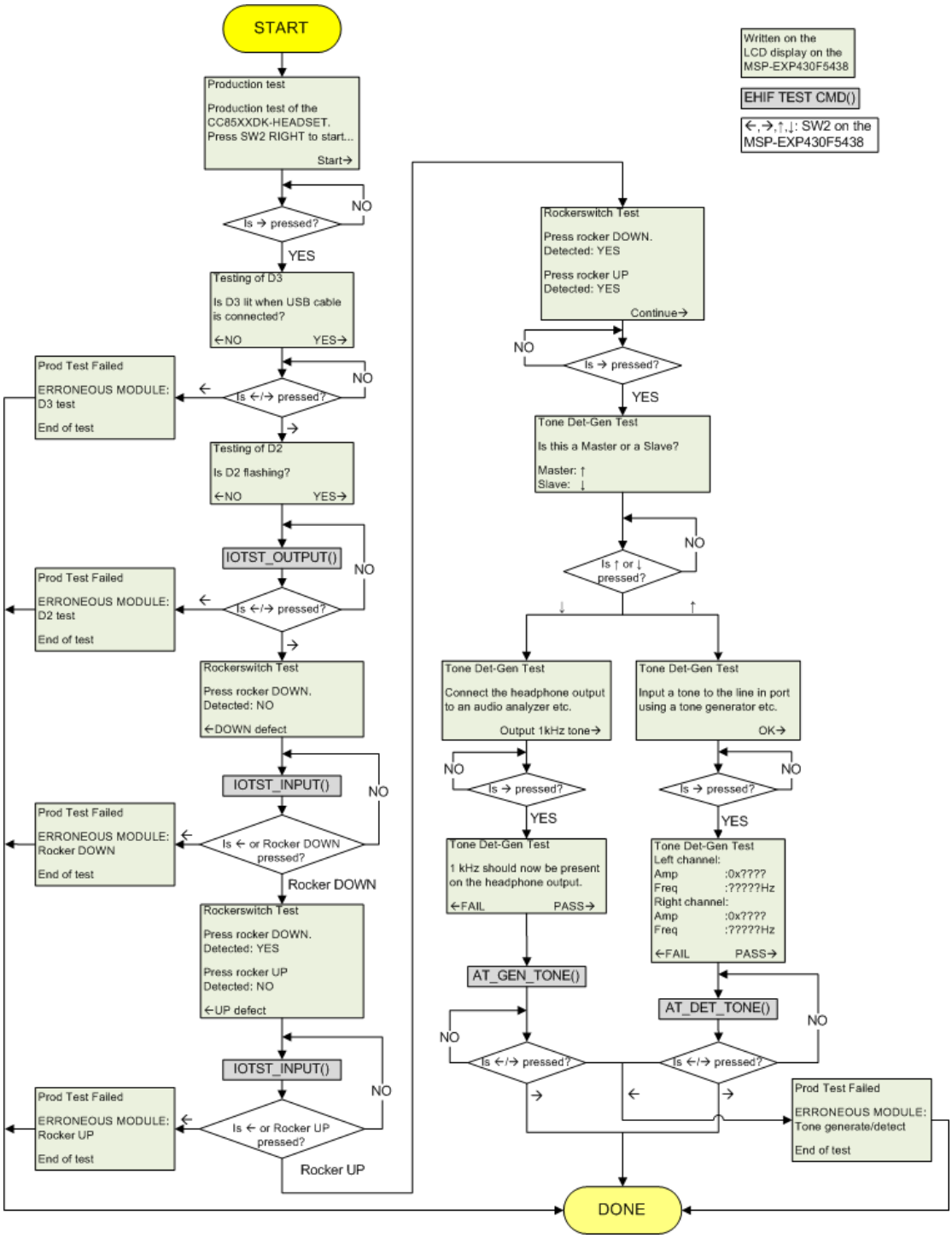

Figure 4. The flow of the production test.

Figure 4 shows a flow chart for the production test of the CC85XX Headset board. The green boxes show what is displayed on the LCD display on the MSP-EXP430F5438 during the test. The grey boxes show which EHIF test command that is used to perform the different tests. A detailed description of each command is presented in section 5. This production test has to be executed by an operator, and it's the operator that decides whether a subtest passes or fails based on what is observed and read on the LCD display. If the operator is not paying proper attention he could possibly make the decision to fail a test that is actually passing or wise versa. This test could have been implemented more automatically in order to minimize the

probability of human errors, but the purpose of this test is to illustrate the use of the EHIF test commands and provide the example code.

5 EHIF Test Commands

Descriptions about the EHIF commands used are listed below. For a detailed description of the complete EHIF API see the CC85xx Family User's Guide [7].

Table 1. IOTST_OUTPUT

Command	IOTST_OUTPUT		
Description	Selected pins are configured as output and driven to the logical value in PIN_VAL		
SPI Operations	`CMD_REQ(0x23, 8, pars, sw)`		
(pars)	**[Byte][bit] index**	**Field**	**Description**
	[0]	-	Reserved, write 0
	[1]	-	Reserved, write 0
	[2][7]	-	Reserved, write 0
	[2][6]	GIO15_SEL	Write GIO15 if set
	[2][5]	GIO14_SEL	Write GIO14 if set
			...
	[2][0]	GIO9_SEL	Write GIO9 if set
	[3][7]	GIO8_SEL	Write GIO8 if set
			...
	[3][0]	GIO1_SEL	Write GIO1 if set
	[4]	-	Reserved, write 0
	[5]	-	Reserved, write 0
	[6][7]	-	Reserved, write 0
	[6][6]	GIO15_VAL	Value of GIO15
	[6][5]	GIO14_VAL	Value of GIO14
			...
	[6][0]	GIO9_VAL	Value of GIO9
	[7][7]	GIO8_VAL	Value of GIO8
			...
	[7][0]	GIO1_VAL	Value of GIO1
Related events	-		
Usage limitations	Only available in production test operation		
Notes	The pin-direction will not be returned to its original configuration, so a device reset is required if the original pin-configuration is to be used.		

Table 2. IOTST_INPUT

Command	IOTST_INPUT		
Description	Selected pins are configured as input and read. Their logical value is returned.		
SPI Operations	`CMD_REQ(0x22, 4, pars, sw)`		
(pars)	**[Byte][bit] index**	**Field**	**Description**
	[0]	-	Reserved, write 0
	[1]	-	Reserved, write 0
	[2][7]	-	Reserved, write 0
	[2][6]	GIO15_SEL	Read GIO15 if set
	[2][5]	GIO14_SEL	Read GIO14 if set
			...
	[2][0]	GIO9_SEL	Read GIO9 if set
	[3][7]	GIO8_SEL	Read GIO8 if set
			...
	[3][0]	GIO1_SEL	Read GIO1 if set
	`READ(4, sw, data)`		
(data)	**[Byte][bit] index**	**Field**	**Description**
	[0]	-	Reserved, ignore value
	[1]	-	Reserved, ignore value
	[2][7]	-	Reserved, ignore value
	[2][6]	GIO15_VAL	Value of GIO15
	[2][5]	GIO14_VAL	Value of GIO14
			...
	[2][0]	GIO9_VAL	Value of GIO9
	[3][7]	GIO8_VAL	Value of GIO8
			...
	[3][0]	GIO1_VAL	Value of GIO1
Related events	-		
Usage limitations	Only available in production test operation		
Notes	The pins will revert to their original states when the GIOn_SEL is released. Note that overriding pins for audio clock input to CC85xx (BCLK and WCLK from external source) is not recommended.		

Table 3. AT_GEN_TONE

Command	AT_GEN_TONE		
Description	Generates a tone at the specified audio channel. Only valid for audio channels that are configured (in the Configurator) as output on the audio interface		
SPI Operations	`CMD_REQ(0x20, 5, pars, sw)`		
(pars)	**[Byte][bit] index**	**Field**	**Description**
	[0]	CHANNEL	Internal channel index (0: mono output, 0/1:stereo output)
	[1]	–	Reserved, write 0
	[2]	AMP_TONE	Unsigned 8-bit multiplier
	[3:4]	FREQ_TONE	Frequency in steps of 10 Hz
Related events	–		
Usage limitations	Only available in production test operation		
Notes	Tone is generated with minimum 60dB SNR at full scale. The command is ignored if CHANNEL parameter is invalid. Only one channel can be active at a time. Amplitude scaling using AMP_TONE allows the user to generate tones with amplitude ranging from 2^{15} down to 2^{8}. Lower amplitudes are not supported – except 0, (ie. Amplitude = AMP_TONE * 256) Supports tone generation from 100Hz to 20kHz.		

Table 4. AT_DET_TONE

Command	AT_DET_TONE		
Description	Estimates amplitude and frequency on the specified audio channel. Only valid for audio channels that are configured (in the Configurator) as input on the audio interface.		
SPI Operations	`CMD_REQ(0x21, 1, pars, sw)`		
(pars)	**[Byte][bit] index**	**Field**	**Description**
	[0]	CHANNEL	Internal channel index (0: mono output, 0/1:stereo output)
	`READ(4, sw, data)`		
(data)	**[Byte][bit] index**	**Field**	**Description**
	[0:1]	AMP_TONE	Estimated amplitude
	[2:3]	FREQ_TONE	Estimated frequency (in steps of 10 Hz)
Related events	-		
Usage limitations	Only available in production test operation		
Notes	The tone detector needs ~10ms (@44.1kHz) to estimate amplitude and frequency. Executing this command before sufficient data has been collected will return random data. Any value may be returned in AMP_TONE and FREQ_TONE if CHANNEL parameter is invalid. Can accurately estimate tones ranging from 250 Hz to 18kHz with amplitudes from $[2^{6};2^{15}]$. Results outside these ranges can deviate significantly from expected results.		

6 References

[1] PurePath Wireless Headset Development Kit
http://focus.ti.com/docs/toolsw/folders/print/cc85xxdk-headset.html

[2] PurePath Wireless Configurator
http://focus.ti.com/docs/toolsw/folders/print/purepath-wl-cfg.html

[3] CC Debugger Product Page
http://focus.ti.com/docs/toolsw/folders/print/cc-debugger.html

[4] MSP-EXP430F5438 Experimenter Board Product Page
http://focus.ti.com/docs/toolsw/folders/print/msp-exp430f5438.html

[5] SmartRF Flash Programmer Product Page
http://focus.ti.com/docs/toolsw/folders/print/flash-programmer.html

[6] MSP430 USB Debugging Interface Product Page
http://focus.ti.com/docs/toolsw/folders/print/msp-fet430uif.html

[7] CC85xx Family User's Guide
http://www.ti.com/lit/swru250

7 General Information

7.1 Document History

Revision	Date	Description/Changes
SWRA369	2011.06.16	Initial release.

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