

## **TIMAC and Z-Stack Modifications for using CC2591 RF Front End with CC2530**

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### **Keywords**

- *PA*
- *LNA*
- *CC2591*
- *CC2530*
- *TI-MAC*
- *Z-Stack*

### **1 Introduction**

This application note describes how to modify the current TI-MAC (v1.3.0) / Z-Stack (v2.2.0) software releases for the CC2530 SoC to support CC2591 PA/LNA controls.

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## 2 Abbreviations

EM	Evaluation module
HAL	Hardware abstraction layer
HGM	High gain mode
HW	Hardware
LGM	Low gain mode
LNA	Low noise amplifier
PA	Power amplifier
RX	Receive
SoC	System on Chip
SW	Software

### 3 SW Modifications for CC2530 SoC + CC2591 PA/LNA combination

Below you can find the SW modifications needed when running the current TI-MAC (v1.3.0) / Z-Stack (v2.2.0) software releases on a CC2530 SoC in combination with a CC2591 PA/LNA. Later revisions of Z-stack or TI-MAC will have these additions already included in the distribution. For CC2590 PA/LNA users, please contact TI support for more information.

#### 3.1 CC2530-CC2591EM 2.0

CC2530 P0\_7, P1\_1, and P1\_4 GPIO pins are used to control CC2591 mode of operations in order to comply with ver 2.0 of the CC2530-CC2591 combo board EM. They are connected to CC2591 HGM, PAEN, and EN respectively. CC2591 is enabled by turning on the compiler switch, HAL\_PA\_LNA. This compiler switch should be added at the beginning of "hal\_board\_cfg.h". It is to be noted that once the HAL\_PA\_LNA compiler switch is turned on, the above mentioned pins are configured to be used ONLY for the control of the CC2591. The simple block diagram below shows the interconnect between the CC2530 and CC2591.

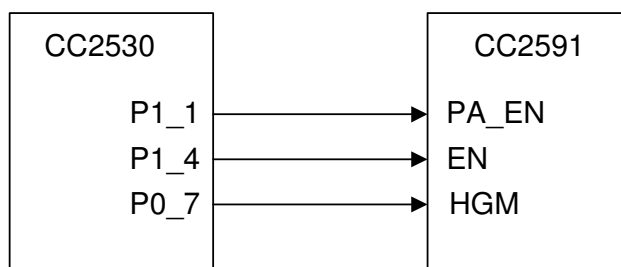


Figure 1. CC2530-CC2591 Interconnect

In order to change the pin assignment of these control signals, the user must be aware of the following:

- 1) P0\_7 can be moved to any GPIO pin, and the macros below HAL\_PA\_LNA\_RX\_LGM() and HAL\_PA\_LNA\_RX\_HGM() must be modified accordingly.
- 2) P1\_1 and P1\_4 are a subset of GPIO pins (only P1.0-P1.5) that can be configured to support special RF observation output control signals. PAEN and EN of the CC2591 are directly controlled by these signals via the radio core logic of the CC2530. See the CC253x User's Guide for more details. The user only needs to adjust the OBSSELx registers to change the pin assignment.

When the CC2591 is enabled, only LED1 is available to the users on the SmartRF05EB board due to the shared GPIO pins.

Two (2) APIs are provided to select between CC2591 RX LGM and RX HGM. CC2591 is initialized to RX HGM in HAL\_BOARD\_INIT().

### 3.1.1 HAL\_PA\_LNA\_RX\_LGM()

#### Description

This macro selects CC2591 RX low gain mode. To use this macro, "mac\_radio\_defs.h" must be included in your application.

#### Macro Definition

```
#define HAL_PA_LNA_RX_LGM() st(P0_7 = 0; )
```

#### Example

In your application, add HAL\_PA\_LNA\_RX\_LGM() to switch to RX LGM.

```
#include "mac_radio_defs.h"
...
/* Switch PA LNA to LGM */
HAL_PA_LNA_RX_LGM();
```

### 3.1.2 HAL\_PA\_LNA\_RX\_HGM()

#### Description

This macro selects CC2591 RX high gain mode. To use this macro, "hal\_board.h" must be included in your application. This macro should be added at the beginning of "hal\_board\_cfg.h".

#### Macro Definition

```
#define HAL_PA_LNA_RX_HGM() st(P0_7 = 1; )
```

#### Example

In your application, add HAL\_PA\_LNA\_RX\_HGM() to switch to RX HGM.

```
#include "mac_radio_defs.h"
...
/* Switch PA LNA to HGM */
HAL_PA_LNA_RX_HGM();
```

### 3.2 Special Note for Z-Stack (v2.2.0) users

If you use Z-Stack (v2.2.0) release, additional software changes are required. For CC2590 PA/LNA users, please contact TI support for more information.

#### 3.2.1 hal\_mac\_cfg.h

In "hal\_mac\_cfg.h", change the RSSI offset defines to:

```
/* CC2591 RSSI offset */
#define HAL_MAC_RSSI_LNA_HGM_OFFSET      -9
#define HAL_MAC_RSSI_LNA_LGM_OFFSET      4
```

#### 3.2.2 mac\_radio\_defs.h

In "mac\_radio\_defs.h", change the macRadioDefsTxPowerTable[] table to:

```
#if defined (HAL_PA_LNA)
const uint8 CODE macRadioDefsTxPowerTable[] =
{
    /* 0 dBm */ 0x05, /* characterized as -0.8 dBm in datasheet */
    /* 1 dBm */ 0x15, /* characterized as 0.70 dBm in datasheet */
    /* 2 dBm */ 0x25, /* characterized as 2.71 dBm in datasheet */
    /* 3 dBm */ 0x25,
    /* 4 dBm */ 0x35, /* characterized as 4.30 dBm in datasheet */
    /* 5 dBm */ 0x35,
    /* 6 dBm */ 0x45, /* characterized as 6.64 dBm in datasheet */
    /* 7 dBm */ 0x45,
    /* 8 dBm */ 0x55, /* characterized as 8.94 dBm in datasheet */
    /* 9 dBm */ 0x55,
    /* 10 dBm */ 0x55,
    /* 11 dBm */ 0x65, /* characterized as 10.97 dBm in datasheet */
    /* 12 dBm */ 0x75, /* characterized as 12.63 dBm in datasheet */
    /* 13 dBm */ 0x75,
    /* 14 dBm */ 0x85, /* characterized as 14.08 dBm in datasheet */
    /* 15 dBm */ 0x95, /* characterized as 15.06 dBm in datasheet */
    /* 16 dBm */ 0xA5, /* characterized as 16.42 dBm in datasheet */
    /* 17 dBm */ 0xB5, /* characterized as 17.37 dBm in datasheet */
    /* 18 dBm */ 0xD5, /* characterized as 18.45 dBm in datasheet */
    /* 19 dBm */ 0xF5 /* characterized as 19.36 dBm in datasheet */
};
```

#### 3.2.3 mac\_pib.c

In "mac\_pib.c", add the "hal\_board.h" include:

```
#include "hal_board.h"
```

## 4 References

- [1] TI-MAC - IEEE802.15.4 Medium Access Control (MAC) Software Stack ([TI-MAC](#))
- [2] Z-Stack - ZigBee Protocol Stack - Z-STACK - TI Software Folder ([Z-Stack](#))
- [3] CC253x User's Guide – SWRU191

## 5 General Information

### 5.1 Document History

Revision	Date	Description/Changes
SWRA290	2009.07.20	Initial release.

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