Application Report
SWRU422A–September 2015–Revised December 2015

WL18xx .INI File

ABSTRACT

This guide explains the radio frequency (RF) parameters and tables in the .INI file and wlconf file of the WiLink™ WL18xxMOD, WL18xx, and WL18xxQ.

For definitions of the terms and abbreviations in this guide, see Table 1.

Contents

List of Figures

List of Tables

Table 1. Terms and Abbreviations

Abbbreviation	Definition
EIRP	Equivalent Isotropic Radiated Power
SPDT	Single-pole, double-throw RF switch
DPDT	Double-pole, double-throw RF switch
FW	Firmware
Psat	Power saturation level of internal power amplifier
BO	Back off from Psat
DUT	Device under test
RF	Radio frequency
OOB	Out of band
RSSI	Received signal strength indicator
SoC	System-on-chip

1 .INI File Description

1.1 Purpose of the .INI File

The .INI file is a platform and module-dependent initialization file for WiLink 8 technology. The file (an ASCII text file) includes platform specific radio frequency (RF) parameters used as follows:

- With the RTTT program as part of the wireless tools package for WLAN IP evaluation and preregulatory certification testing.
- Integrated into a complete solution as part of wl18xx-conf.bin file of the WiLink chipset official software release to comply with regulatory certification requirements.

Based on the regulatory certification for the TI modules, predefined official .INI files for WL1835MOD and WL1837MOD are provided as part of the solution. These files are located at the git repository WiLink 8 WLAN.ini files. The files are part of the official WiLink 8 WLAN NLCP package release located under the */usr/sbin/wlconf/official_inis/* folder by default.

As part of the integration process of the WiLink module into a host platform, a new script is available for one time configuration configure-device.sh , see *WiLink 8 Solutions – wlconf Application Report* (SWRA489).

To convert the .INI file into wlconf format to use on operational systems like Linux®, Android®, or RTOS, see *WiLink 8 Solutions – wlconf Application Report* (SWRA489).

To manually generate .INI regulatory-required fields for non-TI module solutions, refer to WL18xx_INI_fields_generator.

1.2 .INI File RF User-Defined Parameter Definitions

Parameter Name	Size	Description	Units	Default Values
HighBand_component_type	1 byte	0 × 9 – Default 5-GHz TX/RX SPDT RF switch 0 × A - 5-GHz TX/RX DPDT RF switch for antenna diversity (See *WL18xx 5-GHZ Antenna Diversity* Application Report [SWAA161].)	Hex	0x9
NumberOfAssembledAnt2_4	1 byte	Indicates the number of mounted antennas for 2.4-GHz band channels 0 × 1: 1 antenna assembled on board for a 2.4-GHz band channels 0 × 2: 2 antennas assembled on board for 2.4-GHz band channels	Hex	0x1
NumberOfAssembledAnt5	1 byte	Indicates the number of mounted antennas for 5-GHz band channels 0 × 0: No 5-GHz antennas 0 × 1: 1 antenna assembled on board for 5-GHz band channels 0 × 2: Diversity antenna configuration assembled on board for 5-GHz band channels.	Hex	0x1
PerChanBoMode11ABG	13 bytes	PerChanBoMode11ABG is 2 bits per channel array that defines the power back off (BO) mode per 2.4-GHz and 5-GHz band channels. This array is necessary to comply with regulations. For channel orientation, BO mode coding and settings, fixed BO settings, and examples, refer to Section 4 . **BO mode coding**: • 00 – Use Table BO: FW BO table per rate. • 01 – Use MAX [fixed BO, Table BO] for 11n and 11g rates only and apply 200-nsec TX windowing. • 10 – Use MCS7 output power for OFDM rates. 20-MHz OFDM rates align to MCS7 (20-MHz). 40-MHz OFDM rates align to MCS7 (40 MHz). • 11 – Use MAX [fixed BO, Table BO] for 11n, 11g, and 11b rates and apply 200-nsec TX windowing. **Channels orientation:** PerChanBoMode11ABG defines channels in 2.4-GHz and 5-GHz bands. There are 49 channels. 13 bytes are used. For example, the first byte contains BO mode for CH1 to CH4. The last 6 bits contain the fixed BO limitation configuration per rate group (11b/11g_11n 20 MHz/HT40). Fixed BO settings: For the fixed BO configuration: Bits[102:103] – Set the fixed BO for 11n and 11g for the 2.4- and 5-GHz band channels with static BW (20 MHz): • 00: 7-dB fixed BO; • 01: 9-dB fixed BO; • 10: 11-dB fixed BO; 11: 13-dB fixed BO; [100:101] - Set the fixed BO for 11n for the 2.4- and 5-GHz band channels with static BW (40 MHz): • 00: 7-dB fixed BO; • 01: 9-dB fixed BO; • 10: 11-dB fixed BO; • 11: 13-dB fixed BO; [98:99] – Set the fixed BO for 11b (Applied only on BO mode = 11): • 00: 5-dB fixed BO; • 01: 7-dB fixed BO; • 10: 9-dB fixed BO; • 11: 11-dB fixed BO;	Hex	0x0…0

Parameter Name	Size	Description	Units	Default Values
PwrLimitReference11ABG	2 bytes	Defines the power Psat BO per channel for regulatory compliance purposes for **last 2 channels of 5 GHz (Only the last 4 bits are used)** For Psat BO mode coding and settings, fixed settings, and examples, refer to Section 5. Defines absolute output power value [dBm] limit. Serves as baseline for all perChanPwrLimitArrABG and defines the lower limit for output power clipping. Reference for output power in dBm, 0…25.5 dBm 0.1-dB resolution, applicable to all channels and modulation types	Hex	0x64
PerChanPwrLimitArr11ABG	150 bytes	PerChanPwrLimitArr11ABG is a 24 bit per channel array that defines 6 values (4 bits each, per channel) for 6 modulation types defined by TI (see Section 3). Those values range from 0x0 to 0xF representing 0 to 15 dB, respectively. Add this value to PwrLimitReference11ABG (set to 10 dBm by default) for the final TX output power limit to be 10 ÷ 25 dbm. For channel orientation, modulation types, and examples, refer to Section 6.	Hex	0xF…F
PerSubBandTxTraceLoss	10 bytes	PerSubBandTxTraceLoss defines the transmit trace loss from SoC output (BG1, BG2, or A) to antenna port (to account for losses of RF switch, filter, diplexer, and so forth). For the A band, define the trace loss per sub band (see the sub-band partition in Section 2). PerSubBandTxTraceLoss orientation: Byte 0: BG1 Byte 1: BG2 Byte [2..8]: A bands Byte 9: Reserved Each byte value can be 0 to 15.875 dB in 0.125-db resolution. For examples, refer to Section 7.	Hex	0x0…0
PerSubBandRxTraceLoss	18 bytes	PerSubBandRxTraceLoss defines the trace loss from the antenna port to the SoC input at the receive path to define the Ant-Point RSSI (as opposed to the SoC Point RSSI). For the A band, define the trace toss per sub band (see the sub-band partition in Section 2). PerSubBandTxTraceLoss orientation: Byte 0: BG1 Byte 1: BG2 Byte [2..8]: A bands Bytes [9:17] : Reserved Each byte value can be 0 to 15.875 dB in 0.125-dB resolution. The use of this parameter is similar to the PerSubBandTxTraceLoss field. For an example, refer to Section 7.	Hex	0x0…0

NOTE: The rest of the .INI fields are for TI internal use only.

1.3 Guidelines For PerChanBoMode11ABG vs PerChanPwrLimitArr11ABG

PerChanBoMode11ABG forces certain back-off (BO) from the PA Psat. Taking more BO produces a more linear signal. As a result, the out-of-band emission of the signal is lower.

PerChanPwrLimitArr11ABG forces certain output power, while keeping the Psat back-off in a level that meets IEEE Mask and EVM. For medium and low output power limits, the system performs PA gain steps to reduce current consumption.

For example, you can force the system to transmit 10 dBm in the following two modes:

- With the maximum PA steps and with a relatively large BO (by modifying the **PerChanBoMode11ABG** field)
- With few PA gain steps, which saves current consumption, and with a relatively small BO (by modifying the **PerChanPwrLimitArr11ABG** field)

If the regulatory certification criteria that limits the power comes from out-of-band emission threshold, use **PerChanBoMode11ABG**. If the limitation comes from certain output power target, use **PerChanPwrLimitArr11ABG.**

2 Sub-band Segmentation

The following table summarizes the sub-band segmentation for the 2.4-GHz and 5-GHz bands throughout the .INI file.

Table 2. Sub-band Segmentation

	2.4-GHz Band	5-GHz Band						
Sub-band	1	2	3	4	5	6	7	8
Channel tag	1 to 14	J1 to J4	J8, J12, J16	J34, 36, J38,40, J42, 44, J46, 48	52, 56, 60,64	100, 104, 108, 112, 116	120, 124, 128, 132, 136, 140	149, 153, 157, 161, 165
Number of channels	14	4	3	8	4	5	6	5
Start frequency [MHz]	2412	4920	5040	5170	5260	5500	5600	5745
Stop frequency [MHz]	2484	4980	5080	5240	5320	5580	5700	5825
Channel BW (MHz)	11/20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40

3 Modulation Types

The following table summarizes the modulation-type definition. For example, if channel 7 is set as the primary channel; CH7 is primary.

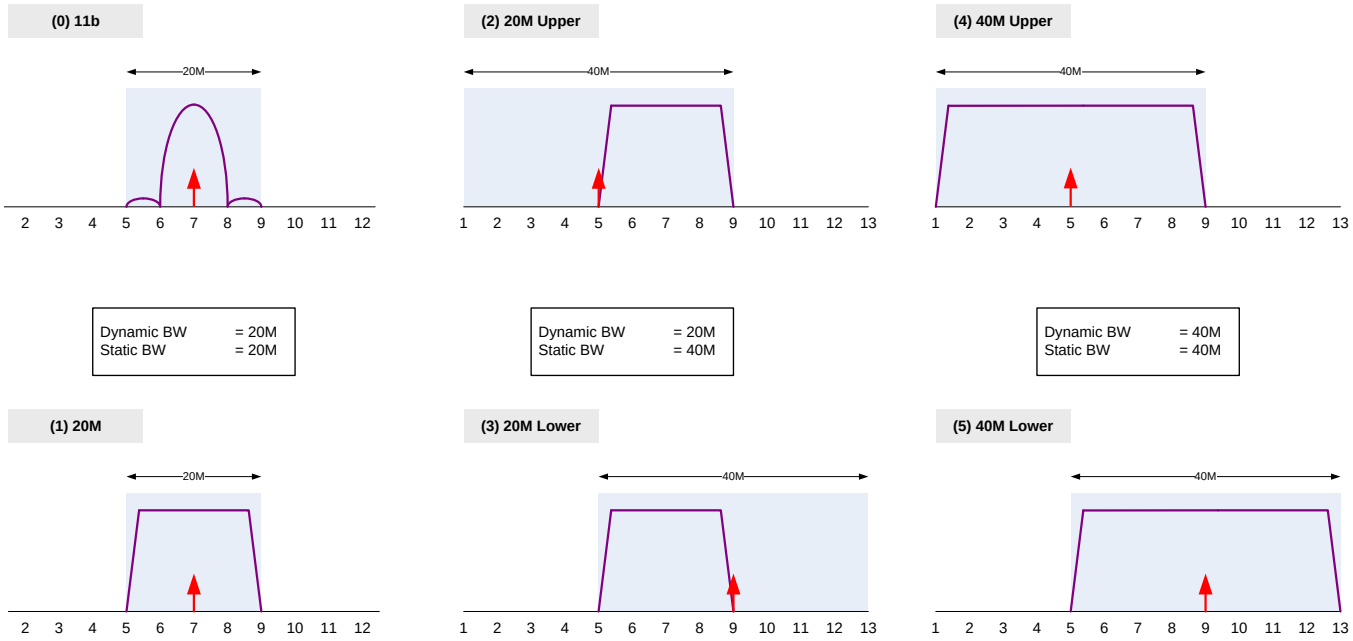

Figure 1. Modulation Types

4 An Example of PerChanBoMode11ABG Usage

PerChanBoMode11ABG is a 2-bit per channel array that defines the BO mode limit per channel to comply with certifications.

BO mode coding:

- 00 – Use Table BO: FW BO table per rate.
- 01 – Use MAX [fixed BO, Table BO] for 11n and 11g rates and apply 200-nsec TX windowing.
- 10 – Use MCS7 output power for all OFDM rates. 20- to 40-MHz OFDM rates align to MCS7 (20-MHz). 40-MHz OFDM rates will be set to MCS7 default BO power limit.
- 11 – Use MAX [fixed BO, Table BO] for 11n, 11g, and 11b rates and apply 200-nsec TX windowing.

Channels orientation:

PerChanBoMode11ABG defines channels in 2.4-GHz and 5-GHz bands. There are 49 channels and 13 bytes are used to code channels.

The first byte contains the BO mode for CH1 to CH4.

The last byte contains the BO mode for CH 165 + 6 bits. The last 6 bits contain the fixed BO limitation configuration per rate group (11b/11g_11n 20 MHz/HT40).

Fixed BO settings:

PerChanBoMode11ABG [103:98] are used for fixed BO configuration as follows:

[102:103] – Set fixed BO for 11n and 11g. Set fixed BO for OFDM rates with static BW of 20 MHz:

- 00: 7-dB fixed BO;
- 01: 9-dB fixed BO;
- 10: 11-dB fixed BO;
- 11: 13-dB fixed BO;

[100:101] – Set fixed BO for OFDM rates with static BW of 40 MHz.

- 00: 7-dB fixed BO;
- 01: 9-dB fixed BO;
- 10: 11-dB fixed BO;
- 11: 13-dB fixed BO;

[98:99] – Set fixed BO for 11b (applied only on BO mode = 11):

- 00: 5-dB fixed BO;
- 01: 7-dB fixed BO;
- 10: 9-dB fixed BO;
- 11: 11-dB fixed BO;

PerChanBoMode11ABG Outline:

The following figure describes PerChanBoMode11ABG channel orientation, BO modem, and fixed BO settings.

13 Bytes, 104 bits:	0	1	2	3	…	96	97	98	99	100	101	102	103
BoModePerChan11ABG	ch1		ch2		…	ch 49 (165)		fixed BO for 11 b		BO for 11 ng 40 M 2.4 G		BO for 11 ng 20 M 2.4 G	
	{bit 1, bit 0}		{bit 1, bit 0}		…	{bit 1, bit 0}		{bit 1, bit 0}		{bit 1, bit 0}		{bit 1, bit 0}	
Default	0	0	0	0	…	0	0	0	0	0	0	0	0

Figure 2. PerChanBoMode11ABG Outline

Example:

PerChanBoMode11ABG = **4**0 00 00 **4**0 00 00 00 00 00 00 00 00 0**b**

- CH01 get BO_Mode= 01,
- CH13 get BO_Mode= 01,
- Other channels get BO_Mode= 00,
- Set fixed BO for OFDM rates with static BW of 20 MHz is 13 dB.
- Set fixed BO for OFDM rates with static BW of 40 MHz is 11 dB.

5 An Example of PerChanBoMode11P Usage

PerChanBoMode11P defines the power BO mode limit to comply with regulations of the last four 5-GHz channels unused by PerChanBoMode11ABG.

BO mode coding:

- 00 – Use Table BO: FW BO table per rate
- 01 – Same as 11
- 10 – Use MCS7 output power for OFDM rates. 20-MHz OFDM rates align to MCS7 (20-MHz). 40-MHz OFDM rates align to MCS7 (40-MHz).
- 11 – Use MAX [fixed BO, Table BO] for 11n and 11a rates and apply 200-nsec TX windowing.

Channels orientation:

The last byte contains 4 bits that detail the fixed BO configuration.

Fixed BO settings:

PerChanBoMode11P 4 MSBS, PerChanBoMode11P [31:28] are for fixed BO configuration as follows:

[30:31] – Set fixed BO for OFDM rates with static BW of 20 MHz:

- 00: 7-dB fixed BO;
- 01: 9-dB fixed BO;
- 10: 11-dB fixed BO;
- 11: 13-dB fixed BO;

[28:29] – Set fixed BO for OFDM rates with static BW of 40 MHz:

- 00: 7-dB fixed BO;
- 01: 9-dB fixed BO;
- 10: 11-dB fixed BO;
- 11: 13-dB fixed BO;

PerChanBoMode11P Outline:

The following figure describes PerChanBoMode11P channel orientation, BO mode, and fixed BO settings:

4 Bytes, 32 bits:	0	1	…	26	27	28	29	30	31
BoModePerChan11P	TI reserved		…	TI reserved		BO for 11na 40 M 5 G		BO for 11na 20 M 5 G	
	TI reserved		…	TI reserved		{bit 1, bit 0}		{bit 1, bit 0}	
Default	0	0	…	0	0	0	0	0	0

Figure 3. PerChanBoMode11P Outline

Example:

PerChanBoMode11P = 00 00 00 0**b**

Applies to the following:

- Set fixed BO for OFDM rates with static BW of 20 MHz is 13 dB.
- Set fixed BO for OFDM rates with static BW of 40 MHz is 11 dB.

6 An Example of PerChanPwrLimitArr11ABG Usage

PerChanPwrLimitArr11ABG is 24-bit per channel array that defines 6 values (4 bits each), per 6 modulation types (see Section 3) defined by TI, with a range of 0x0 to 0xF which represents 0 dB to 15 dB, respectively (1-dB resolution). This values are summed with PwrLimitReference11ABG (set to 10 dBm by default) resulting with the final TX output power limit (the sum of both ANTs for MIMO TX) at the antenna for a specific channel in specific modulation type.

NOTE: If the trace loss parameter is applied through PerSubBandTxTraceLoss, the SoC power is the sum of the power limit set in PerChanPwrLimitArr11ABG and trace loss set by PerSubBandTxTraceLoss parameter resulting with the required power at the antenna.

Channels orientation:

PerChanPwrLimitArr11ABG defines channels in 2.4-GHz and 5-GHz bands. There are 49 channels. 147 bytes are used and 3 bytes are unused.

The first 3 bytes contain 6 limits for CH1 per 6 modulation type.

Modulation type orientation:

Refer to Section 3.

PerChanPwrLimitArr11ABG Outline:

Figure 4 shows PerChanPwrLimitArr11ABG channel orientation and modulation types limits settings.

1 byte	0																								
PwrLimitReference	All CH's																								
Default	0x64																								
150 bytes:	0		1		2		3		4		5			144		145		146		Sp 147		148		149	
	Ch1						Ch2						…	Ch49 ("165")						are 3 Bytes					
PerChanPwrLimitArr	mod0	mod1	mod2	mod3	mod4	mod5	mod0	mod1	mod2	mod3	mod4	mod5	…	mod0	mod1	mod2	mod3	mod4	mod5						
Default	0xf	0xf	0xf	0xf	0xf	0xf	0xf	0xf	0xf	0xf	0xf	0xf	…	0xf	0xf	0xf	0xf	0xf	0xf	0xff		0xff		0xff	

Figure 4. PerChanPwrLimitArr11ABG Outline

Example:

PerChanPwrLimitArr11ABG = **ff ff ff** ff ff ff **a9 87 65** ff ff ff … ff ff ff

Applies to the following:

All channels set to FF (no limit) = 25 dBm (10 dBm + 15 dB).

For CH3: All 11b rates (modulation type 0) are limited as follows:

- PwrLimitReference11ABG + PerChanPwrLimitArr11ABG = 10 dBm + **10** dB = 20 dBm

20-MHz channel BW OFDM rates (modulation type 1) are limited to as follows:

- PwrLimitReference11ABG + PerChanPwrLimitArr11ABG = 10 dBm + **9** dB = 19 dBm

40-MHz channel BW OFDM rates with 20-MHz static BW upper channel (modulation type 2) are limited as follows:

- PwrLimitReference11ABG + PerChanPwrLimitArr11ABG = 10 dBm + **8** dB = 18 dBm

40-MHz channel BW OFDM rates with 20-MHz static BW lower channel (modulation type 3) are limited as follows:

- PwrLimitReference11ABG + PerChanPwrLimitArr11ABG= 10 dBm + **7** dB = 17 dBm

40-MHz channel BW OFDM rates with 40-MHz static BW upper channel (modulation type 4) are limited as follows:

- PwrLimitReference11ABG + PerChanPwrLimitArr11ABG = 10 dBm + **6** dB = 16 dBm

40-MHz-channel BW OFDM rates with 40-MHz static BW lower channel (modulation type 5) are limited as follows:

- PwrLimitReference11ABG + PerChanPwrLimitArr11ABG = 10 dBm + **5** dB = 15 dBm

7 An Example of PerSubBandTxTraceLoss Usage

PerSubBandTxTraceLoss defines the transmit trace loss from SoC output (BG1, BG2, or A) to an antenna port (to account for losses of RF switch, filter, diplexer, and so forth). For the A bands, define different trace losses per band.

PerSubBandTxTraceLoss orientation:

Byte 0: BG1

Byte 1: BG2

Byte [2..8]: 5-GHz sub-band. (see Section 2)

0 to 15.875 dB in 0.125-dB resolution.

Unit: [dB]

Example:

PerSubBandTxTraceLoss = 00 **18** 00 00 00 **28** 00 00 00 00

Applies to the following:

Trace loss from the SoC point BG2 to the antenna set to [0x**18**] = 24; 24 × 0.125 dB = 3 dB .

Trace loss from the SoC point TX-A to the antenna is set to [0x**28**] = 40; 40 × 0.125 dB = 5 dB for channels 52, 56, 60, and 64 (sub-band 5).

For the BG2, consider the following:

- If 10 dBm is required at the antenna port and the trace loss from the SoC to antenna is set to 3 dB, the SoC delivers 13 dBm on the SoC ball to meet the requirement.
- If 10 dBm is required at the antenna port and the trace loss from SoC to antenna is set to 3 dB but the power is limited to 8 dBm using the PerChanPwrLimitArr11ABG parameter, the SoC will deliver 11 dBm on SoC ball to meet both requirements.

8 1835 TI Module .INI File Description

WARNING

As configured, this device has been granted US Federal Communications Commission (FCC) equipment authorization, FCC Identifier: Z64-WL18SBMOD. Any modifications to the device software or configuration, including but not limited to the .ini file(s), can cause the device performance to vary beyond the scope of the currently referenced FCC authorization. If you modify the device software or configuration, you may be required to seek FCC and other regulatory authorizations before distributing or marketing the devices or products.

The 1835 TI module has the following .INI file settings at the following path:

WL1835MOD_INI.ini

R8.6 NLCP release:

- WiLink 8 WLAN NLCP package release: The NLCP package contains the installation package, a precompiled object, and the source of the TI Linux Open-Source Wi-Fi® image to upgrade the default LINUX EZSDK release with the TI WiLink family NLCP Wi-Fi driver.
- WiLink 8 WLAN.ini files

NOTE: R8.6 is the git tag for latest release.

For automatic integration of the .INI file into the wlconf, refer to the configuration script in *WiLink 8 Solutions– wlconf* Application Report (SWRA489).

PerChanBoMode11ABG = 40 00 04 70 00 00 00 00 00 00 00 00 18

For FCC and ETSI:

- CH01, 11, 13 BO_mode = 01 – Psat BO is at least 7 dB and 9 dB for 20 MHz and 40-MHz OFDM, respectively.
- HT40 CH5 upper and CH7 lower are limited by same parameter as HT40 CH1 lower and CH11 upper, respectively.

For Telec: Occupied BW requirements for 11b channel 14 in TELEC is applied by the parameter (PHY FW 218 onwards sets this BO in the firmware by default).

Trace Loss:

PerSubBandTxTraceLoss = 10 18 00 00 00 00 00 00 00 00

PerSubBandRxTraceLoss = 10 18 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

The values represent the following:

- 08 → 1 dB on the TX/RX BG1 RF path to ANT
- 18 → 3 dB on the TX/RX BG2 RF path to ANT

The Trace Loss parameters configure the RX and TX trace insertion loss to the antenna path.

RX path – for the correct RSSI reading on the solution boundary

TX path – for accurate power if setting a non-maximum power level

PwrLimitReference11ABG = 64 (Set the reference power limit to 10 dBm.)

PerChanPwrLimitArr11ABG = ff ff ff ff ff ff ff ff ff ff ff ff ff ff 2f ff ff ff ff ff f2 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff

The two nibbles set to 2 dB in the array limit the following:

- CH7 40-MHz upper
- CH1 40-MHz lower

The power limit as in **PerChanPwrLimitArr11ABG** represents the power at the antenna. The power limit is set to 10 dBm in **PwrLimitReference11ABG** + 2 dBm in **PerChanPwrLimitArr11ABG**. With trace loss set by PerSubBandTxTraceLoss to 3 dB, the SoC delivers power of up to 12 + 3 = 15 dBm (unless clipped by the BO constraints to meet EVM/Mask).

8.1 1835 TI Module C2PC .INI File Description

> **WARNING**
>
> **As configured, this device has been granted US Federal Communications Commission (FCC) equipment authorization, FCC Identifier: Z64-WL18SBMOD. Any modifications to the device software or configuration, including but not limited to the .ini file(s), can cause the device performance to vary beyond the scope of the currently referenced FCC authorization. If you modify the device software or configuration, you may be required to seek FCC and other regulatory authorizations before distributing or marketing the devices or products.**

The 1835 TI module has the following .INI file settings at WL1835MOD_C2PC.INI.

PerChanBoMode11ABG = 40 00 04 30 00 00 00 00 00 00 00 00 19

- CH01, 11 BO_mode = 01 – Psat BO is at least 7 dB and 9 dB for 20 MHz and 40-MHz OFDM, respectively.

For FCC and ETSI:

- CH01, 11 BO_mode = 01 – Psat BO is at least 7 dB and 9 dB for 20 MHz and 40-MHz OFDM, respectively.

For Telec: Occupied BW requirements for 11b channel 14 in TELEC is applied by the parameter (PHY FW 218 onwards sets this BO in the firmware by default).

- Ch14 BO_mode = 11 – Psat B0 is at least 7 dB.

Fixed BO for 11b = 01 9 dB – fixed BO

Fixed BO for 11ng 40M 2.4G = 11 – 13 dB fixed BO

Fixed BO for 11ng 20M 2.4G = 01 – 9 dB fixed BO

Other channels get BO_mode = 00. Those channels are limited by the FW BO that gives maximum possible power while keeping EVM/Mask requirements as defined by IEEE.

PwrLimitReference11ABG = 55

PwrLimitReference11ABG (set to 8.5 dBm), with PerChanPwrLimitArr11ABG and the PerSubBandTxTraceLoss parameters, gives the final TX output power limit at the antenna for a specific channel in specific modulation type.

PerChanPwrLimitArr11ABG = 78 88 88 78 88 88 78 88 88 78 88 88 78 88 18 78 88 88 78 88 82 78 88 88 78 88 88 78 88 88 78 88 88 78 88 88 78 88 88 FF FF FF ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff

The power limit is set to 8.5 dBm (PwrLimitReference11ABG) + X dB set by PerChanPwrLimitArr11ABG + Y-dB trace loss set by PerSubBandTxTraceLoss. The SoC delivers up to 8.5 + X + Y [dBm].

9 1837 TI Module .INI File Description

WARNING

As configured, this device has been granted US Federal Communications Commission (FCC) equipment authorization, FCC Identifier: Z64-WL18DBMOD. Any modifications to the device software or configuration, including but not limited to the .ini file(s), can cause the device performance to vary beyond the scope of the currently referenced FCC authorization. If you modify the device software or configuration, you may be required to seek FCC and other regulatory authorizations before distributing or marketing the devices or products.

The 1837 TI module has the following .INI file settings at the following path:

WL1837MOD_INI_FCC_CE.ini

WL1837MOD_INI_FCC_CE_JP.ini

R8.6 NLCP release:

- WiLink 8 WLAN NLCP package release: The NLCP package contains the installation package, a precompiled object, and the source of the TI Linux Open-Source Wi-Fi image to upgrade the default LINUX EZSDK release with the TI WiLink family NLCP Wi-Fi driver.
- WiLink 8 WLAN.ini files

NOTE: R8.6 is the git tag for latest release.

For automatic integration of the .INI file into the wlconf, refer to the configuration script in *WiLink 8 Solutions– wlconf Application Report* (SWRA489).

BO Limitation:

PerChanBoMode11ABG = 40 00 04 30 00 00 00 00 00 00 00 40 19

PerChanBoMode11P = 00 00 00 01

For FCC and ETSI:

- CH 1, 11 20-MHz BO_mode = 01 – Psat BO is at least 9 dB for 20-MHz OFDM rates
- CH 1, 11 20-MHz BO_mode = 10 – Psat BO is at least 11 dB for 40-MHz OFDM rates

CH 149 – BO_mode = 01 – Psat BO is at least 9-dB and 7-dB BO for 40-MHz OFDM rates, which are also limited by **PerChanPwrLimitArr11ABG**.

For JP:

CH 14 (11b only) BO_mode = 01 – Psat BO is at least 7 dB for 11b rates (This limitation is essential to comply with occupied BW requirements for 11b channel 14 in TELEC [PHY FW 218 onwards sets this BO as default]).

Trace loss:

PerSubBandTxTraceLoss = 08 18 10 10 10 10 10 10 10 10

PerSubBandRxTraceLoss = 08 18 10 10 10 10 10 10 10 10 00 00 00 00 00 00 00 00

The previous parameters show the board insertion losses. The values represent the following:

- 08 → 1 dB on the TX/RX BG1 RF path to ANT
- 18 → 3 dB on the TX/RX BG2 RF path to ANT
- 10 → 2 dB on the TX/RX entire A band RF path to ANT

RX path – for correct RSSI reading on the solution boundary

TX path – for accurate power if setting non maximum power level to ensure proper power limitation for the regulatory constraints

9.1 Description of Regulatory Constraints Requiring BO Limitations

CH1 – 2310-MHz to 2390–MHz FCC restricted band (Criterion 500 uV/m)

CH11 – 2483.5-MHz to 2500-MHz FCC restricted band (Criterion 500 uV/m)

CH149 – To comply with FCC U-NII Undesirable Emissions as follows:

Lower Channel	Upper Channel	Lower Range [GHz]	Upper Range [GHz]	Criterion [dBm/MHz]
149	161	5.715 to 5.725	5.825 to 5.835	–17
		1 to 5.715	5.835 to 36.5	–27

The rest of the channels are set to 0 (no extra limitation applied). These channels are limited by the firmware BO per rate that provides maximum power while complying with EVM and mask requirements defined by the IEEE.

9.2 Description of Regulatory Constraints Requiring Power Limitations

PwrLimitReference11ABG = 55

PwrLimitReference11ABG (set to 8.5 dBm), with PerChanPwrLimitArr11ABG and the PerSubBandTxTraceLoss parameters, gives the final TX output power limit at the antenna for a specific channel in specific modulation type.

Color Legend:

The WL1837MOD_INI_FCC_CE.ini file that complies with both: FCC/ETSI

The WL1837MOD_INI_FCC_CE_JP.ini file that complies with all: FCC/ETSI/JP

The power limitations marked JP are 0xFF in the WL1837MOD_INI_FCC_CE.ini file.

PerChanPwrLimitArr11ABG =

CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9
78 88 88	78 88 88	78 88 88	78 88 88	78 88 18	78 88 88	78 88 82	78 88 88	78 88 88
CH10	CH11	CH12	CH13	CH14	j1	j2	j3	j4
78 88 88	78 88 88	78 88 88	78 88 88	FF FF FF	F8 FF FF	F8 FF FF	F8 FF FF	F8 FF FF
j8	j12	j16	j34	36	j38	40	j42	44
F8 FF FF	F8 FF FF	F8 FF FF	F8 FF FF	F7 22 22	F8 FF FF	F7 22 22	F8 FF FF	F7 66 66
j46	48	52	56	60	64	100	104	108
F8 FF FF	F7 66 66	F4 44 55	F4 44 55	F4 22 22	F4 22 22	F6 44 44	F7 44 44	F7 66 66
112	116	120	124	128	132	136	140	149
F7 66 66	F7 66 66	F7 66 66	F7 66 66	F7 66 66	F7 66 55	F7 44 55	F4 FF FF	FF 33 22
153	157	161	165	spare				
FF 33 22	FF 66 66	FF 44 66	F6 FF FF	FF FF FF				

The power limit in **PerChanPwrLimitArr11ABG** represents the desired power at the antenna.

The power limit is set to 8.5 dBm (**PwrLimitReference11AB**G) + X dB set **by PerChanPwrLimitArr11ABG** + Y-dB trace loss set by PerSubBandTxTraceLoss. The SoC delivers up to 8.5 + X + Y [dBm].

9.2.1 2.4 GHz Channels

Regulatory constraints set the following limitations:

- CH5 40-MHz upper (the same as CH1 40-MHz lower) – The power is limited to 9.5 dBM at the antenna.
- CH7 40-MHz lower (the same as CH11 40-MHz upper) – The power is limited to 10.5 dBm at the antenna.
- Due to ETSI constraints (Section 4.3.2.1 of ETSI EN 300 328 V1.8.1), the power of the 2.4-GHz band is limited to 20-dBm EIRP. This translates to 16.5 dBm at the antenna because antenna gain of approximately 3.5 dBi (maximum antenna gain of approximately 3.5 dBi is for certification). To comply with these constraints, set the power limits as follows:
  - 11b rates are limited to 15.5 dBm.
  - OFDM rates are limited to 16.5 dbm (including MIMO rates).

9.2.2 RF Output Power

NOTE: The following information in section (*10.2 RF output power*) is taken from section 4.3.2.1 in ETSI EN 300 328 V1.8.1 (2012-04). (1)

This requirement applies to all types of equipment using wide band modulations other than FHSS.

Definition

The RF output power is defined as the mean equivalent isotropic radiated power (E.I.R.P.) of the equipment during a transmission burst.

Limit

For adaptive equipment using wideband modulations other than FHSS, the maximum RF output must be 20 dBm.

The maximum RF output power for non-adaptive equipment must be declared by the supplier and must not exceed 20 dbm. See clause 5.3.1 m. For non-adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be equal to or less than the value declared by the supplier.

This limit shall apply for any combination of power level and intended antenna assembly.

NOTE: This concludes the quoted material from (*Limits for RF output power and power density at the highest power level*) is taken from section 4.3.2.1 in ETSI EN 300 328 V1.8.1 (2012-04).

(1)

9.2.3 5-GHz Channels

9.2.3.1 Channels J1, J2, J3, J4

The power of these channels is limited to 16.5 dBm to comply with JP regulations of 10 dBm/MHz for the 4.9-GHz band. The power is limited to 16.5 dBm.

9.2.3.2 Channel 36 Lower + Channel 40 Upper

To comply with 5150-MHz restricted band requirement and with OOB emission for FCC U-NII Undesirable Emissions, adhere to the following guidelines.

Lower Range [GHz]	Upper Range [GHz]	Criterion [dBm/MHz]
1 to 5.15	5.35 to 36.5	–27

NOTE: If the DUT fails to meet the criteria of –27 dBm/MHz beyond 5.15-GHz to 5.35-GHz range but complies with the requirements of the restricted band emission levels (that is, –41.2 dBm/MHz and –21.2 dBm/MHz for average and peak, respectively), the DUT passes according to FCC guidelines.

See the following:

[2] II.G.2(c) quotes: “However, an out-of-band emission that complies with both the peak and average limits of § 15.209 is not required to satisfy the –27 dBm/MHz or –17 dBm/MHz maximum emission limit.”. This was also further rationalized in a previous version of the same document “If the peak-to-average ratio of an emission exceeds 14.2 dB, then a non-restricted-band emission could potentially satisfy the restricted band emission limits, which are equivalent to –41.2 dBm/MHz average and –21.2 dBm/MHz peak, but fail to satisfy the –27 dBm/MHz peak emission limit. The FCC laboratory has found that the out-of-band spectral shoulders surrounding an OFDM transmission due to intermodulation can have peak-to-average ratios significantly exceeding 14 dB. This provision ensures that non-restricted band emission limits are not more restrictive than the restricted band limits.”

9.2.3.3 Channels 36, 40, 44, 48, 52, 56, 60, 64 for ETSI

The following section describes the limits for RF output power to comply with PSD requirements of ETSI EN 301 893.

NOTE: The following information (*Limits for RF output power and power density at the highest power level*) is taken from section 4.4.2.2 in ETSI EN 300 328 V1.8.1 (2012-04).

Limits for RF output power and power density at the highest power level

TPC is not required for channels whose nominal bandwidth falls completely within the band 5 ISO MHz to 5 250 MHz

For devices with TPC, the RF output power and the power density when configured to operate at the highest-stated power level of the TPC range shall not exceed the levels given in Table 3.

Devices are allowed to operate without TPC. See Table 3 for the applicable limits in this case.

Table 3. Mean E.I.R.P. limits for RF output power and power density at the highest power level

Frequency range [MHz]	Mean E.I.R.P. limit [dBm]		Mean E.I.R.P. density limit [dBm/MHz]	
	with TPC	without TPC	with TPC	without TPC
5150 to 5350	23	20/23 (see (1))	10	7/10 (see (2))

(1) The applicable limit is 20 dBm, except for transmissions whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz, in which case the applicable limit is 23 dBm.

(2) The applicable limit is 7 dBm/MHz, except for transmissions whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz, in which case the limit is 10 dBm/MHz.

Table 3. Mean E.I.R.P. limits for RF output power and power density at the highest power level (continued)

Frequency range [MHz]	Mean E.I.R.P. limit [dBm]		Mean E.I.R.P. density limit [dBm/MHz]	
	with TPC	without TPC	with TPC	without TPC
5470 to 5725	30 (see [3])	27 (see [3])	17 (see [3])	14 (see [3])

[3] Slave devices without a Radar Interference Detection function shall comply with the limits for the band 5 250 MHZ to 5 350 MHZ.

NOTE: This concludes the quoted material from (*Limits for RF output power and power density at the highest power level*) is taken from section 4.4.2.2 in ETSI EN 300 328 V1.8.1 (2012-04). [1]

[1] © European Telecommunications Standards Institute, 2012. All rights reserved.

9.2.4 Channels 44 to 56

20-MHz channels are limited to 10 dBm/MHz EIRP though ETSI also limits these channels.

In addition, JP certification limits the 40-MHz channels by the following settings:

- 40-MHz 44, 48 channel: 5 dBm/MHz → limiting to 14.5 dBm
- 40-MHz 52, 56 channel: 4 dBm/MHz → limiting to 13.5 dBm

9.2.5 Channel 60 Lower + Channel 64 Upper

To comply with 5350-MHz band restrictions for FCC U-NII Undesirable Emissions, adhere to the following requirements.

Lower Range [GHz]	Upper Range [GHz]	Criterion [dBm/MHz]
1 to 5.25	5.35 to 36.5	–27

NOTE: If the DUT fails to meet the criteria of –27 dBm/MHz beyond 5.15-GHz to 5.35-GHz range but complies with the requirements of the restricted band emission levels (that is, –41.2 dBm/MHz and –21.2 dBm/MHz for average and peak, respectively), the DUT passes according to FCC guidelines.

See the following:

[2] II.G.2(c) quotes: “However, an out-of-band emission that complies with both the peak and average limits of § 15.209 is not required to satisfy the –27 dBm/MHz or –17 dBm/MHz maximum emission limit.” This was also further rationalized in a previous version of the same document “If the peak-to-average ratio of an emission exceeds 14.2 dB, then a non-restricted-band emission could potentially satisfy the restricted band emission limits, which are equivalent to –41.2 dBm/MHz average and –21.2 dBm/MHz peak, but fail to satisfy the –27 dBm/MHz peak emission limit. The FCC laboratory has found that the out-of-band spectral shoulders surrounding an OFDM transmission due to intermodulation can have peak-to-average ratios significantly exceeding 14 dB. This provision ensures that non-restricted band emission limits are not more restrictive than the restricted band limits.”

9.2.6 Channel 100 Lower + Channel 104 Upper + Channel 132 Lower + Channel 134 Upper + Channel 140 (20 MHz)

To comply with OOB emission for FCC U-NII Undesirable Emissions, adhere to the following requirements.

Lower Range [GHz]	Upper Range [GHz]	Criterion [dBm/MHz]
1 to 5.25	5.725 to 36.5	–27

9.2.7 Channels 104, 108, 112, 116, 120, 124, 128, 132, 136

Band W56 (5470 to 5725 MHz) requires ±50% power accuracy across the band. This translates to {–3 dB … 1.7 dB} or a 4.7dB range across the band per rate. See the following table for details.

Items	Technical Requirements				
	20- MHz System		40-MHz System	80-MHz System	160-MHz System
Communication Method	One-way, Simplex, Half-Duplex, Duplex				
Modulation Method	DSSS and so forth		OFDM		
Type of Emission	—				
Frequency Allocation	5.50 GHz, 5.52 GHz, 5.54 GHz, 5.58 GHz, 5.60 GHz, 5.62 GHz, 5.64 GHz, 5.66 GHz, 5.68 GHz, 5.70 GHz		5.51 GHz, 5.55 GHz, 5.59 GHz, 5.63 GHz, 5.67 GHz	5.53 GHz, 5.61 GHz	5.57 GHz
Frequency Tolerance	±20 ppm				
Antenna Power	DSSS: 10 mW/MHz Others: 10 mW	10 mW/MHz	5 mW/MHz	2.5 mW/MHz	1.25 mW/MHz
Antenna Power Tolerance	50%, –50%				
EIRP (with TPC)	50 mW/MHz		25 mW/MHz	12.5 mW/MHz	6.25 mW/MHz
EIRP (without TPC)	25 mW/MHz		12.5 mW/MHz	6.25 mw/MHz	3.125 mW/MHz

The power was aligned to meet the requirement.

Channel 149 Lower + Channel 153 Upper + Channel 157 Lower + Channel 161 Upper + Channel 165 (20 MHz)

To comply with OOB emission for FCC U-NII Undesirable Emissions, adhere to the following requirements.

Lower Range [GHz]	Upper Range [GHz]	Criterion [dBm/MHz]
5.715 to 5.725	5.825 to 5.835	–17
1 to 5.715	5.835 to 36.5	–27

Revision History

Changes from Original (September 2015) to A Revision	Page
• Added section 8.1	15

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265