MMWAVE RadarSS Release Notes

1 Introduction

RadarSS firmware is responsible for configuring RF/analog and digital front-end in real-time. It also schedules periodic temperature based calibrations and monitors. This enables the mm-Wave front-end to be autonomous and capable of adapting itself to handle temperature and ageing effects, and to enable significant ease-of-use.

2 Release Overview

2.1 Release version

Version	Type
RADARSS 6.3.2.6	RAM image

2.2 Platform and Device Support

The device and platforms supported with this release include:

Supported Devices	Release Status	Supported EVMs
AWR6843AQGABL (Automotive, QM, General Purpose)	Production Release	AWR6843AQGABL EVM + MMWAVEICBOOST carrier card
AWR6843ABGABL (Automotive, ASIL-B, General Purpose)	Production Release	AWR6843ABGABL EVM + MMWAVEICBOOST carrier card
AWR6843ABSABL (Automotive, ASIL-B, High Secure)	Production Release	AWR6843ABSABL EVM + MMWAVEICBOOST carrier card
IWR6443AQGABL (Industrial, QM, General	Production Release	IWR6443AQGABL ISK + MMWAVEICBOOST carrier card

Purpose)		
IWR6843AQGABL (Industrial, QM, General Purpose)	Production Release	IWR6843AQGABL ISK + MMWAVEICBOOST carrier card
IWR6843AQSABL (Industrial, QM, High Secure)	Production Release	IWR6843AQSABL ISK + MMWAVEICBOOST carrier card
IWR6843ABGABL (Industrial, SIL-2, General Purpose)	Production Release	IWR6843ABGABL ISK + MMWAVEICBOOST carrier card
AWR6443ABGABL (Automotive, ASIL-B, General Purpose)	Evaluation Release	AWR6443ABGABL EVM + MMWAVEICBOOST carrier card
IWR6843ARQGALP (Industrial, QM, General Purpose, AoP)	Evaluation Release	IWR6843ARQGALP ISK + MMWAVEICBOOST carrier card
IWR6843ARQSALP (Industrial, QM, High Secure, AoP)	Evaluation Release	IWR6843ARQSALP ISK + MMWAVEICBOOST carrier card
IWR6843ARBGALP (Industrial, SIL-2, General Purpose, AoP)	Evaluation Release	IWR6843ARBGALP ISK + MMWAVEICBOOST carrier card
AWR6843ARBGALP (Automotive, ASIL-B, General Purpose, AoP)	Evaluation Release	AWR6843ARBGALP EVM + MMWAVEICBOOST carrier card
AWR6843ARBSALP (Automotive, ASIL-B, High Secure, AoP)	Evaluation Release	AWR6843ARBSALP EVM + MMWAVEICBOOST carrier card

2.3 Memory Requirement

RadarSS firmware requires 256KB L3 memory from the radar cube shared memory for execution. User must allocate 256KB shared memory banks to RadarSS while flashing.

3 Release Contents

3.1 xWR6x43 RAM contents

3.1.1 Features and enhancements (DFP 6.2.0.0)

- xWR6843/xWR6443 devices are TI's 60GHz RF CMOS Radar. Features supported in this firmware release are:

    - Synthesizer RF frequency supported 60 – 64GHz
        - VCO2: 60 – 64GHz
    - Supports 3 TX and 4 RX
    - Supports 10MHz IF bandwidth
    - Supports 250MHz/us max slope
    - Supports uncalibrated TX output power control.
- Calibrations (Boot time and run time)
    - APLL
    - SYNTH 2
    - LODIST

3.1.2 Features and enhancements (DFP 6.2.0.7)

- Enabled all RF/Analog calibrations (Boot time)
    - APLL
    - SYNTH 2
    - LODIST
    - ADC DC
    - RX HPF
    - RX LPF
    - PD TRIM
    - TX POWER
    - RX GAIN
    - RX IQMM
    - TX PHASE
- Enabled all RF/Analog calibrations (Runtime)
    - APLL
    - SYNTH 2
    - LODIST
    - PD TRIM
    - TX POWER
    - RX GAIN
- Calibration data save/restore mechanisms now supported.
- BPM and TX phase-shifters are now supported in the DFP.
- Calibration/Monitoring frequency and TX power limits now supported.
- Improvements to IF stage calibrations (HPF and LPF)

- Updated RF gain targets for xWR6843/xWR6443 ES2.

3.1.3 Features and enhancements (DFP 6.2.1.5)

- HIS complexity and other compliance updates.
- HPF improvements.
- BPM is now implemented using the phase shifter HW module.
- SYNTH calibration updates for better performance across process and temperature corners

3.1.4 Features and enhancements (DFP 6.3.0)

- Digital and RF/Analog monitors are now supported.
- SYNTH frequency non-live monitoring supported.

3.1.5 Features and enhancements (DFP 6.3.1)

- Improved PD settings for more accurate TX power measurement and calibration.
- RX P1dB optimization across temperature.
- Added a new start frequency parameter in TX ball-break monitoring configuration API.
- Added an option to disable TX PS DAC monitoring as part of the TX Internal Analog Signal Monitoring API.

3.1.6 Features and enhancements (DFP 6.3.2)

- SYNTH frequency monitoring now uses the SOCC low frequency mode for improved stability.
- Updated loopback PGA gains used in RX gain monitor to improve flatness of the loopback power across the RF band.
- Added an option to disregard digital temperature sensors when computing min/max and delta temperature parameters in temperature monitoring.

3.2 Feature/Changes List

3.2.1 Changes in DFP 6.2.0.0 release (with respect to DFP 6.1 / IWR6843 ES1.0)

Item type	Key	Description
Enhancement	MMWAVE_DFP-140	Improved APLL calibration algorithm.
Enhancement	MMWAVE_DFP-339 MMWAVE_DFP-366	ES2.0 analog LUT updates. (LO-DIST, RX-IQGEN, TX back-off, etc) for xWR6843/xWR6443.

Enhancement	MMWAVE_DFP-337	Updated temperature/process based LUT for 20G sync module.
Enhancement	MMWAVE_DFP-345	Improved CTRIM search space for VCO1 and VCO2.
Enhancement	MMWAVE_DFP-138 MMWAVE_DFP-342	Added new RX linearity modes in xWR6843/xWR6443 ES2.0.
Enhancement	MMWAVE_DFP-349	Implemented the forced SDM DIV mode for VCO2.
Bug	MMWAVE_DFP-381	Fixed the incorrect time allocation for test source configuration during frames.
Bug	MMWAVE_DFP-388	Fixed the programNow option in Dynamic chirp config API

3.2.2 Changes in DFP 6.2.0.7 release

Item type	Key	Description
Enhancement	MMWAVE_DFP-424	Remove overrides on all supported calibrations in xWR6843/xWR6443 ES2.
Enhancement	MMWAVE_DFP-436	PD calibration updates in xWR6843/xWR6443 ES2.
Enhancement	MMWAVE_DFP-445	TX power calibration updates in xWR6843/xWR6443 ES2 to improve performance at high backoffs.
Enhancement	MMWAVE_DFP-458	Updated RX gain calibration constants for xWR6843/xWR6443 ES2.
Bug	MMWAVE_DFP-263	Fix for the issues with PA and PS loopback burst configuration in advance frame config API.
Enhancement	MMWAVE_DFP-328	Improved HPF calibration and monitoring
Enhancement	MMWAVE_DFP-360	Improved LPF calibration
Enhancement	MMWAVE_DFP-361	Improvements to Rx gain runtime and IQMM boot calibration
Enhancement	MMWAVE_DFP-371	Improvements to BSS calibration and monitoring Scheduler
Enhancement	MMWAVE_DFP-438	Updated calibration and inter-burst timings.
Bug	MMWAVE_DFP-469	Fixed an issue with PD trim reading which impacts TX output power and Rx gain calibration
Enhancement	MMWAVE_DFP-464	Clear all profile validity in RF init API, support to reset profile information.
Enhancement	MMWAVE_DFP-500	Updated Mixer bias settings for improved performance.
Bug	MMWAVE_DFP-502	Fixed the issue where process corners were incorrectly classified (weak device showing up as nominal).
Bug	MMWAVE_DFP-506	Fixed an error in AWR_CAL_MON_FREQUENCY_LIMITS API, which prevented users from setting frequencies in the 60G band.
Bug	MMWAVE_DFP-520	Fixed an error in the programmable filter configuration API.
Enhancement	MMWAVE_DFP-537	Updated power-up/down sequences of the SYNTH for better performance and stability.

Enhancement	MMWAVE_DFP-547	Disabled the power cycling of certain modules (LDOs) during the inter-burst/frame time period.
Enhancement	MMWAVE_DFP-563	The RX coupler loss constants and the RF gain targets have been updated to reflect the xWR6843/xWR6443 ES2 device more closely.
Enhancement	MMWAVE_DFP-585	RX LPF LUT updates for improving the LPF accuracy and flatness.
Enhancement	MMWAVE_DFP-584	PD-DAC IREF increased to improve TX internal power readings for strong devices at high temperatures.

3.2.3 Changes in DFP 6.2.1.5 release

Item type	Key	Description
Enhancement	MMWAVE_DFP-481 MMWAVE_DFP-479	BPM API now implemented through using the phase shifter hardware instead of the BPM HW. This does not impact any of the BPM API configuration or performance parameters.
Bug	MMWAVE_DFP-551	Fixed an issue with WDT.
Enhancement	MMWAVE_DFP-555	Profiled chirp cycle time, pre-burst time and improved timings.
Enhancement	MMWAVE_DFP-542	Added a few new error codes for APIs.
Bug	MMWAVE_DFP-566	Updated all calibrations and monitors to conform to the cal-mon limits set in the API.
Bug	MMWAVE_DFP-635	Updated process corner criteria for SYNTH DIV LDO increase.
Enhancement	MMWAVE_DFP-637	Stop WDT and FRC when firmware hits safe state
Enhancement	MMWAVE_DFP-599 MMWAVE_DFP-633	HPF calibration updates.
Bug	MMWAVE_DFP-689	xWR6843/xWR6443 specific TX IQGEN PS settings are now being used during calibrations.
Enhancement	MMWAVE_DFP-537	Updated minimum inter-burst interval to 150us.
Enhancement	MMWAVE_DFP-640	Update Synth RTRIM in all profile registers after calibration and updated synth default BW setting
Enhancement	MMWAVE_DFP-504 MMWAVE_DFP-512 MMWAVE_DFP-521 MMWAVE_DFP-588 MMWAVE_DFP-560 MMWAVE_DFP-350 MMWAVE_DFP-587 MMWAVE_DFP-619 MMWAVE_DFP-647 MMWAVE_DFP-641	HIS cyclomatic complexity reduction, static analysis violations and MISRA C compliance changes.

	MMWAVE_DFP-649	
Bug	MMWAVE_DFP-603 MMWAVE_DFP-642 MMWAVE_DFP-652 MMWAVE_DFP-666 MMWAVE_DFP-569	Fixed RX IQMM / RX Gain calibration issues due to the incorrect multiplier bias setting.
Bug	MMWAVE_DFP-715	Fixed firmware bug when using non-zero TX power limits during calibrations.
Enhancement	MMWAVE_DFP-710	Improved SYNTH overshoot/undershoot behavior for low bandwidth chirps.
Bug	MMWAVE_DFP-792	Noise jumps observed in the ADC data when operating in regular mode has been fixed.
Enhancement	MMWAVE_DFP-775	VMON disabled in the BSS boot sequence to avoid issues with poor on-board power supplies.
Enhancement	MMWAVE_DFP-772 MMWAVE_DFP-781	SYNTH calibration updates for better performance across process and temperature corners.

3.2.4 Changes in DFP 6.3.0 release

Item type	Key	Description
Enhancement	MMWAVE_DFP-735	Enable all supported analog and digital monitors.
Bug	MMWAVE_DFP-748 MMWAVE_DFP-795	Periodic configuration register monitoring updated to ensure that only unintended modifications are reported as failures.

3.2.5 Changes in DFP 6.3.1 release

Item type	Key	Description
Bug	MMWAVE_DFP-806	Updated firmware limits for PMCLKLO DC BIST monitors.
Enhancement	MMWAVE_DFP-822	Improved PD settings for more accurate TX power measurement and calibration.
Enhancement	MMWAVE_DFP-833	Added new API parameters to allow modification of APLL VCO RTRIMs to set the desired bandwidth.
Bug	MMWAVE_DFP-813	Update to RX gain computation formulae using the measurements from RX gain monitor.
Enhancement	MMWAVE_DFP-864	RX P1dB optimization across temperature.
Bug	MMWAVE_DFP-852	Corrected a couple of erroneous firmware limits on LO MULT LDO signals in DC BIST monitoring.
Enhancement	MMWAVE_DFP-871	Added a new start frequency parameter in TX-x ball-break monitoring configuration API to allow the user to select the frequency at which the ball-break monitor will run irrespective of what is set in calibration and monitoring frequency limits

		API.
Enhancement	MMWAVE_DFP-882	Added an option to disable TX PS DAC monitoring as part of the TX Internal Analog Signal Monitoring API.
Enhancement	MMWAVE_DFP-44	Added a new API to support RF and APLL power down states.
Enhancement	MMWAVE_DFP-901	Updated RF monitoring durations.
Enhancement	MMWAVE_DFP-942	Low Power ADC mode re-defined to remove IF bandwidth restrictions.

3.2.6 Changes in DFP 6.3.2 release

Item type	Key	Description
Bug	MMWAVE_DFP-964	Fixed the issue of periodic APLL calibration getting blocked after exiting from RADARSS power down states.
Enhancement	MMWAVE_DFP-967	SYNTH frequency monitors now use the SOCC low frequency mode for improved stability.
Enhancement	MMWAVE_DFP-978 MMWAVE_DFP-1002	Updated PS LB PGA gains in RX gain monitor for improved flatness of the loopback power across RF frequencies.
Enhancement	MMWAVE_DFP-984	SYNTH parking control voltage has been increased to prevent potential issues with the control voltage dropping down to 0V.
Enhancement	MMWAVE_DFP-994	Added an option to disregard the digital temperature sensors when computing min/max and delta values in temperature monitoring.

4 Unsupported features and APIs (applicable to all DFP releases)

The following APIs and features are not validated fully at system level, it is recommended not to use these APIs in this and all previous DFP releases. This list of unsupported features is in addition to the list mentioned in known issues.

4.1 Functional APIs

API	Feature	Description
RAMPGEN 100M monitor feature in AWR_MONITOR_DUAL_CLOCK_COMP_CONF_SB	Rampgen 100MHz clock monitor	The rampgen 100MHz clock monitor is not supported and this feature has been removed from API.
PCR self-test feature in AWR MONITOR_RF_DIG_LATENTFAULT_CONF_SB	PCR self-test	The PCR self-test is not supported in latent fault configuration API and this feature has been removed from API.
AWR_INTERCHIRP_BLOCKCONTROLS_SB	Inter-chirp power saving timing configurations	This API is not validated at system level. It is recommended not to use the same.
AWR INTER RX GAIN PHASE	Inter-RX gain	This API is not supported in

CONTROL SB	phase configuration	xWR6843/xWR6443.
AWR RF DFE STATISTICS REPORT GET SB	DFE statistics report	This API is not validated at system level. It is recommended not to use the same.
AWR RX GAIN TEMPLUT SET SB AWR TX GAIN TEMPLUT SET SB	RX and TX gain calibration override	The RX and TX gain override APIs are not validated at system level. It is recommended not to use the same.
AWR_MONITOR_RX_NOISE_FIGURE_CONF_SB	RX noise figure monitor	RX noise figure monitor is susceptible to corruption by interference from other radar sensors. The monitors may result in false alarms under the influence of interference, it is recommended to use only for debug.
AWR_MONITOR_RX_MIXER_IN_POWER_CONF_SB	Rx mixer input power monitor	The RX mixer input power monitor is susceptible to corruption by interference from other radar sensors. The monitors may result in false alarms under the influence of interference, it is recommended to use only for debug.
LPF CUTOFF FREQ ERROR THRESH feature in AWR MONITOR RX IFSTAGE CONF SB	LPF cutoff frequency monitor	The LPF cutoff frequency monitor is not supported in IF stage monitor. It is recommended not to use the same.
AWR_MONITOR_TX_GAIN_PHASE_MISMATCH_CONF_SB	TX gain phase monitor	This monitor is not supported.
AWR_MONITOR_TX0_BPM_CONF_SB AWR_MONITOR_TX1_BPM_CONF_SB AWR_MONITOR_TX2_BPM_CONF_SB	TX BPM monitor	This monitor is not supported.
AWR_APLL_SYNTH_BW_CONTROL_SB	APLL and Synth BW control API	This API is not recommended unless specifically required by TI for special use-cases.
Programmable filters AWR_PROG_FILT_CONF_SET_SB AWR_PROG_FILT_COEFF_RAM_SET_SB	Programmable filters.	Programmable filter is not supported.
CASCADING CFG and CASCADING PINOUTCFG in AWR_CHAN_CONF_SET_SB 20G SYNC monitor	Cascade features	Cascading is not supported.
SYNTH VCO1 and VCO2 SLOPE monitor status in AWR_MONITOR_PLL_CONTROL_VOLTAGE_REPORT_AE_SB AE.	PLL control voltage monitor	SYNTH VCO1 and VCO2 SLOPE monitor status in AWR_MONITOR_PLL_CONTROL_VOLTAGE_REPORT_AE_SB is not accurate across temperature.
LOOPBACK_POWER field in AWR_MONITOR_RX_GAIN_PHASE_REPORT_AE_SB	Measured loopback power in RX gain	The measured loop-back power reported as part of the RX gain monitoring is only intended as a debug feature and is not

	monitoring report	supported for production use-cases.
RX_LO_AMP_FAULT and TX_LO_AMP_FAULT injections in AWR_ANALOG_FAULT_INJECTION_CONF_SB	Analog Fault injection API	The RX_LO_AMP_FAULT and TX_LO_AMP_FAULTs are de-featured.
SYNTH_VCO_OPENLOOP in SYNTH FAULT in AWR_ANALOG_FAULT_INJECTION_CONF_SB	Analog Fault injection API	SYNTH VCO OPENLOOP fault is not supported.
The Synthesizer frequency monitor of Live chirps in AWR_MONITOR_SYNTHESIZER_FREQUENCY_CONF_SB	Synthesizer frequency monitor API	The Synthesizer frequency monitor of Live chirps is not supported.
CONST_BPM_VAL_TXn_TXOFF fields in AWR_BPM_CHIRP_CONF_SET_SB	BPM chirp config API	The TXOFF_BPM control bits of TX 0, 1, and 2 in AWR_BPM_CHIRP_CONF_SET_SB API are not supported.
TXn POWER_BACKOFF fields in AWR_CAL_MON_FREQUENCY_TX_POWER_LIMITS_SB	Calibration and Monitoring Frequency and TX Power limits API	Recommended to perform factory calibration with 0dB back-off set in AWR_CAL_MON_FREQUENCY_TX_POWER_LIMITS_SB API and, store and restore the calibration data from non-volatile memory. With this option, user can set nonzero back-off option in AWR_CAL_MON_FREQUENCY_TX_POWER_LIMITS_SB API during normal runs to back-off monitor/calibration chirps power.
LDO_SC_MONITORING_EN field in AWR_MONITOR_ANALOG_ENABLES_CONF_SB	Short Circuit Monitoring	Short circuit monitoring has not been validated at the system level. It is recommended not to use the same.

4.2 Debug APIs

API	Feature	Description
AWR_RF_PALOOPBACK_CFG_SB AWR_RF_PSLOOPBACK_CFG_SB AWR_RF_IFLOOPBACK_CFG_SB	Loopback enables	PA, PS and IF loopback APIs are not supported in functional mode, recommended to use only for debug.
AWR_RF_TEST_SOURCE_CONFIG_SET_SB AWR_RF_TEST_SOURCE_ENABLE_SET_SB	Test source feature	Test source feature is not supported in functional mode, recommended to use only for debug.
AWR_CONT_STREAMING_MODE_CONF_SET_SB AWR_CONT_STREAMING_MODE_EN_SB	Continuous streaming mode	Continuous streaming mode is not supported in functional mode, recommended to use only for debug.

5 Known Issues (applicable to all DFP releases)

Key	Severity	Description
MMWAVESYS-159	S2-Major	The following monitors are susceptible to corruption by interference from other radar sensors. This might lead to false alarms reported by the monitor. a. RX gain phase monitor. **Workaround:** It is recommended to avoid using monitors which are susceptible to interference from other radar sensors. RX gain phase monitoring report can be used to detect interference levels. The following boot-time calibrations are susceptible to corruption by interference. This might cause false configuration of the RF analog sections due to corruption by interference during the calibration measurements. a. Boot RX gain calibration b. Boot TX Phase calibration c. Boot RX IQMM calibration It is also mandated by regulatory standards that transmissions in non-ISM band are capped to -10dBm. The following calibrations could violate these standards if executed in the field. a. Boot TX power calibration. b. Boot TX Phase calibration c. Boot RX IQMM calibration **Workaround**: To get the best RF performance, it is recommended that all the above calibrations are performed at maximum TX power in the factory at room temperature, saved into a non-volatile memory and then restored on the field.
MMWAVE_RFANA-256	S2-Major	Phase shifter accuracy worsens when the frequency is farther away from the calibration frequency. **Workaround**: For low bandwidth chirps, set the frequency limits close to the required TX frequency using AWR CAL MON FREQUENCY LIMITS SB.
MMWAVE_DFP-1023	S2-Major	Using non-zero TX power back-off cal-mon limit can cause calibration failures. **Workaround:** Recommended to perform factory calibration at room temperature with 0dB back-off set in AWR_CAL_MON_FREQUENCY_TX_POWER_LIMITS_SB API, store and restore the calibration data from non-volatile memory. With this option, user can set nonzero back-off option in AWR_CAL_MON_FREQUENCY_TX_POWER_LIMITS_SB API during normal runs to back-off monitor/calibration chirps power. However, with this approach, the following directions need to be followed. a. Run-time TX power calibration needs to be enabled in

<table>
<tr><td></td><td></td><td>OLPC+CLPC mode by setting TX_POWER_CAL_MODE to 0.
b. One-time calibrations in AWR_RUN_TIME_CALIBRATION_CONF_AND_TRIGGER_SB will have to be triggered every time the profile TX back-off is modified.</td></tr>
<tr><td>MMWAVE_DFP-867</td><td>S2-Major</td><td>Rounding errors in slope & start frequency parameters
In certain cases, the realized slope and start frequency can have an error equivalent to 1 LSB bit compared to the programmed values. This is due to a round-off error in the synthesizer configuration.

Implication: The slope error of 1-bit can cause errors in range estimation and also affect RF bandwidth.

Workaround:
The below parameters need to be programmed to even code values. This will ensure there are no round-off errors.

<table>
<tr><th>API</th><th>Parameter to be programmed with even code</th></tr>
<tr><td>AWR_PROFILE_CONF_SB</td><td>PF_FREQ_START_CONST</td></tr>
<tr><td>AWR_PROFILE_CONF_SB</td><td>PF_FREQ_SLOPE_CONST</td></tr>
<tr><td>AWR_CHIRP_CONF_SET_SB</td><td>CHIRP_FREQ_START_VAR</td></tr>
<tr><td>AWR_CHIRP_CONF_SET_SB</td><td>CHIRP_FREQ_SLOPE_VAR</td></tr>
<tr><td>AWR_CONT_STREAMING_MODE_CONF_SET_SB</td><td>PF_FREQ_START_CONST</td></tr>
<tr><td>AWR_LOOPBACK_BURST_CONF_SET_SB</td><td>FREQ_CONST</td></tr>
<tr><td>AWR_LOOPBACK_BURST_CONF_SET_SB</td><td>SLOPE_CONST</td></tr>
<tr><td>AWR_DYN_CHIRP_CONF_SET_SB</td><td>FREQ_SLOPE_VAR</td></tr>
<tr><td>AWR_DYN_CHIRP_CONF_SET_SB</td><td>FREQ_START_VAR</td></tr>
<tr><td>AWR_MONITOR_TX0_BALLBREAK_CONF_SB</td><td>MON_START_FREQ_CONST</td></tr>
<tr><td>AWR_MONITOR_TX1_BALLBREAK_CONF_SB</td><td>MON_START_FREQ_CONST</td></tr>
<tr><td>AWR_MONITOR_TX2_BALLBREAK_CONF_SB</td><td>MON_START_FREQ_CONST</td></tr>
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