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Title: **Platinium, LIMITS SPECIFICATION AND GOLDEN DEVICES FOR T16 PRODUCTION TEST BENCH**	*Filed in Intraprod on :* DHF/Platinium/MISC By : L. QUOIREZ

Abstract:

This document will describe the limits to use in production for the final RF tests and provide golden devices specifications for fixing the bench test offsets induced by the RF environment difference and for periodically controlling the bench calibration and accuracy.

Distribution of this document is limited to the following individuals (if not applicable left empty):

Validation	Name	Function	Signature	Date Month XX, YYYY
Prepared by	H. Guidetti	RF System engineer		
Review by	T. Scordilis	RF System Leader		
Review by	C. Chiavario	R&D Test engineer		
Review by	R. Portebois	EDD Manager		
Review by	A. Dubreuil	R&D Project Leader		
Approved by	G. Le Bel	QA Project Leader		

HISTORY / STORIA / HISTORIQUE

Rev.		Sect.	Change	Author	Release date
A			Creation	H. Guidetti	2014, June 23th
	00		Measurements of preliminary Golden devices in Meylan anechoic chamber	H. Guidetti	2014, July 28th
	01		- Modifications due to C. Chiavario comments - Addition of Golden device longevity	H. Guidetti	2014, Sept 26th
	03		- Reviewers and Approbator changes	H. Guidetti	2014, Sept 29th
	04	§2	- REQ1226 reference deleted	H. Guidetti	2014, Oct. 7th

Rev.	Change	Reason for Change	Release date
B	§2 §3.5.1.2 §4.1, §4.3	- Introduction of MISC2938, MISC1727, MISC2721 in reference documents. - Golden device longevity changed to 18 years minimum. - Modification of MICS TX output power for DF4-VR model.	16/03/2015

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1 INTRODUCTION

In order to facilitate the settings of the bench test (offsets), the **Golden devices will be initially verified by SORIN CRM RF team**.

However, due to the **increasing quantity of Golden devices~~,~~ it shall be wise to outsource their periodic verifications** (see mail from Hgi dated 2014, May 7th).

➔ **That investigation has to be completed by EDD / Manufacturing teams, with the support of RF team.**

2 REFERENCE DOCUMENTS

- **[1]** : **MISC1036** : ZL70102 Zarlink Design Manual.
- **[2]** : **MISC1553 :** ESW Platinium, Implant Software Interface for Production and Characterization tests.
- **[3]** : **MISC524** : ICD RF Test T16, Limits specification.
- **[4]** : **MISC1686** : RF simulation and measurements results on Platinium parts.
- **[5]** : **MISC2582** : RF specifications of Platinium device positioning in T16.
- **[6]** : **MISC2119** : Golden Device RF verification procedure.
- **[7]** : **PLAN1766** : Installation and qualification plan of anechoic chamber.
- **[8]** : **REP2903** : Installation and qualification report of anechoic chamber.
- **[9]** : **MISC2938** : Justification of ICD RF limits in T16 FFTRF.
- **[10]** : **MISC1727** : Platinium ICD/CRTD longevity and battery characteristics.
- **[11]** : **MISC2721** : Measurements on DF4 and DF1 Dev1b golden devices in T16 for evaluations on the device positioning in the RF cell in vertical plane.

3 MEASUREMENT CONDITIONS IN MEYLAN LAB

3.1 ANECHOIC CHAMBER

Measurements in Meylan lab occur in an anechoic chamber.
That measurement chamber is verified over the time, following the document **[7]** . Its measurement results are reported in document **[8]** .

3.2 DEVICE POSITIONNING

The documents **[5]** and **[11]** specify the device positioning in T16.
⇒ Therefore, measurements performed in Meylan anechoic chamber are performed in the following positioning configuration :

VPVP mode. **Azimuth angle = 80°.**

3.3 DEVIATION FACTORS

Some “Deviation factors” are applied to be able to translate Meylan measurements to T16 ones.

These “deviation factors” are illustrated below :.

Dev = Deviation factors between Meylan anechoic chamber and T16 tester *(dB)*	From June 2014
400MHz	**49.0**
2.440GHz (ICD with ZL70102)	**0** *(no power amplifier)*

The relation is : T16_measurement = Meylan_raw + Dev

3.4 MEASUREMENT PRECISION

3.4.1 MICS Output power

All MICS power measurements are performed within +/- 0.5 dB.

3.4.2 Frequencies

All frequencies measurements are performed within +/- 4 KHz.

3.4.3 ISM sensitivity

All ISM sensitivity measurements are performed within +/- 1.0 dB.

3.5 GOLDEN DEVICES VERIFICATION

This verification can be split into two subsections :

- Golden devices reference measurements
- Golden devices verification over the time

3.5.1.1 Golden devices reference measurements

This is the measurement that has to be done in order to fill in the form of the golden devices parameters. These parameters are measured precisely, since they are used for test bench calibration and verification. The golden devices measurement procedure is described in **[6]** .

3.5.1.2 Golden devices verification over the time

Since the Golden Device is part of the calibration, it has to be verified over the time.

It has been decided to verify its RF performances **once a year**. Taking into account the particular settings of the device (OOO mode, no sensors, RF wakeup OFF) and the **yearly 70mn RF time** (10min for periodic calibration & 10min every 2 months for T16 bench verification), its estimated longevity has been calculated to over **18 years**, as mentioned in document **[10]** .

Note: The correct duration of the device will be declared as defined in the product specification (this document will be reviewed accordingly).

3.6 MEASUREMENTS & CALIBRATIONS PHASES

The initial measurements by Meylan RF team has consisted in the following chronological phases :

1-) setting the right value for XOTRIM register (use the MICS CW routine with XOTRIM as a parameter in order to generate the CW on Channel 5 (403.65MHz)).

2-) running the following calibrations with inductive telemetry (ICD on lab bench):

- WUDetOffset.
- WURSSIOffset.
- WUNegrtrim1.
- WU2MHzOscDemod

3-) running the LNAFREQ calibration in the anechoic chamber.

4-) Perform 2.440GHz sensitivity measurement and MICS C5 measurements (power and frequency).

4 PLATINIUM ICD TEST LIMITS

4.1 OVERVIEW

This document will describe the **PRELIMINARY LIMITS** used for the different RF measurement during T16.
This document is based on :

- existing tests limits of document **[3]** (ParadymRF / ParadymRFJpnRdy / Intensia devices).
- Improvements and RF system tests completion and described in document **[9]** .

Note:
In a later step, when DEV2 devices will be available for V&V RF tests, a new set of measurements will be performed in parallel in order to define the EXACT TEST LIMITS and to characterize new DEV2 golden devices.

4.2 ABBREVIATIONS

For simplifications, let us use the following abbreviations :
- “WU 2MHz OSC” for “reg_wu_wk_rx_rtrimdemod” register.
- “WUDetOffset” for “reg_wu_wk_rx_detiostrim1” register.
- “WURssiOffset” for “reg_wu_wk_rx_rssivostrim” register.
- “WUNegrtrim1” for “reg_wu_wk_rx_lna_negrtrim1” register.
- “WULnafreq1” for “reg_wu_lnafreq1” register.

4.3 TESTS LIMITS

Parameter	Description	min	typ	max	Unit
WU 2MHz OSC calibration	Calibration of the 2MHz oscillator used for WU baseband timings	**1** (4)	15	**62** (4)	*decimal*
WUDetOffset calibration	Calibration of the offset in the ISM detector (coarse trimming)	**8** (4)	32	**65** (4)	*decimal*
WURSSIOffset calibration	Calibration of the offset in the ISM detector (fine trimming)	**1** (4)	16	**30** (4)	*decimal*
WUNegrtrim1 calibration	Calibration of the gain of the LNA	**32** (4)	43	**62** (4)	*decimal*
WULnafreq1 calibration	Verification of the Lnafreq1 code used for optimal ISM sensitivity at **2.440GHz**	**7** (5)	11	**20** (5)	*decimal*
N Xotrim	Number of Xotrim calibration for averaging	NA	**10**	NA	*decimal*
Pout MISC	Output radiated power **for <u>all models except DF4-VR</u>**	**-20** (3,6)	-18	**-11** (1)	*dBm*
	Output radiated power **<u>for DF4-VR model ONLY</u>**	**-22.4** (6)	-18	**-11** (1)	*dBm*
Optimal ISM sensitivity, Trimming process	Radiated Sensitivity level in the ISM band at **2.440GHz** during the Lnafreq1 trimming process	**-24** (1)	NA	**-10** (3)	*dBm*
Optimal ISM sensitivity, Threshold	Radiated Sensitivity thresholds in the ISM band at **2.440GHz** for all models	**-26** (1)	NA	**-10** (3)	*dBm*
MICS Fo	Output frequency precision after averaging XO trim calibration on the following channels ➢ Channel 3 is used for the XO calibration (403.05MHz). ➢ Channel 5 is settled for the frequency measure (403.65MHz design value). Input power -40 dBm at least at device place for the calibration itself.	**-8** **403.642**	0 (2) 403.65	**8** **403.658**	*KHz* *MHz*

Notes:
1-) This min or max limit is defined in order to get a min & max set limits for the test even though there no reason to limit the max value for guaranteeing the RF feature performances.

2-) This stability is valid for each MICS channel (infradyne and supradyne architecture).

3-) The threshold values are the ones of document **[3]** . Moreover, these thresholds take into account the measurement precisions of Sorin Meylan lab.

4-) The defined threshold values are the ones of the ZL70441MEX RF module production test specification, document #141731.

5-) The defined threshold values are the ones mentioned in LNAFREQ tuning procedure of document **[2]**.

6-) The threshold values are the ones of document **[9]** .

4.4 WUDETOFFSET & WURSSIOFFSET TUNING PROCEDURES
Refer to document **[2].**

4.5 LNAFREQ1 TUNING PROCEDURE
Refer to document **[2]**.

4.6 NEGRTRIM1 TUNING PROCEDURE
Refer to document **[2].**

4.7 WU 2MHZ OSCILLATOR TUNING PROCEDURE
Refer to document **[2].**

4.8 DF1 HEADER PRELIMINARY GOLDEN DEVICES MEASUREMENTS IN MEYLAN ANECHOIC CHAMBER

4.8.1 Device DF1-SonR1-Dev1b-n105

- Device ESW firmware : ROMV2-Build27.
- The "RFPrg_TempBuf.buf" file used is the common one used with C. Chiavario in T16 for that device and is there attached :

RFPrg_TempBuf_Buil
d27_DF1-Dev1b-SonI

In that file, main RF parameters are :

Register name	Value in "RFPrg_TempBuf.buf"	
	(hex)	*(dec)*
XOTRIM	0x1B	27
WU2MHzOsc	0x0F	15
WUDetOffset	0x1D	29
WURSSIOffset	0x11	17
Lnabias	0x0C	12
Negrtrim1	0x2A	42
Lnafreq1	0x0E	14

⇨ **<u>In these conditions, measurements are</u>** :

Parameter	Description	Measure	Unit	Comments
Optimal ISM sensitivity	Radiated Sensitivity in the ISM band at 2.440GHz	-15	dBm	-15dBm raw rad. power in anechoic chamber (0dB deviation factor)
MICS C5 frequency measurement	Output radiated frequency in C5	403.653	MHz	/
MICS C5 output power	Output radiated power in C5	-17.9	dBm	-66.9dBm raw rad. power in anechoic chamber (49dB deviation factor)

4.8.2 Device DF1-SonR2-Dev1b-n116

- Device ESW firmware : ROMV2-Build27.
- The "RFPrg_TempBuf.buf" file used is the common one used with C. Chiavario in T16 for that device and is there attached :

RFPrg_TempBuf_Buil
d27_DF1-Dev1b-SonI

In that file, main RF parameters are :

Register name	Value in "RFPrg_TempBuf.buf"	
	(hex)	*(dec)*
XOTRIM	0x19	25
WU2MHzOsc	0x0C	12
WUDetOffset	0x2D	45
WURSSIOffset	0x0F	15
Lnabias	0x0C	12
Negrtrim1	0x28	40
Lnafreq1	0x0B	11

⇨ **<u>In these conditions, measurements are</u>** :

Parameter	Description	Measure	Unit	Comments
Optimal ISM sensitivity	Radiated Sensitivity in the ISM band at 2.440GHz	-14	dBm	-14dBm raw rad. power in anechoic chamber (0dB deviation factor)
MICS C5 frequency measurement	Output radiated frequency in C5	403.650	MHz	/
MICS C5 output power	Output radiated power in C5	-18.8	dBm	-67.8dBm raw rad. power in anechoic chamber (49dB deviation factor)

4.8.3 Device DF1-DR1-Dev1b-n118

- Device ESW firmware : ROMV2-Build27.
- The "RFPrg_TempBuf.buf" file used is the common one used with C. Chiavario in T16 for that device and is there attached :

RFPrg_TempBuf_Buil
d27_DF1-Dev1b-DR1

In that file, main RF parameters are :

Register name	Value in "RFPrg_TempBuf.buf"	
	(hex)	*(dec)*
XOTRIM	0x1B	27
WU2MHzOsc	0x0C	12
WUDetOffset	0x27	39
WURSSIOffset	0x0A	10
Lnabias	0x0C	12
Negrtrim1	0x28	40
Lnafreq1	0x0B	11

⇨ **<u>In these conditions, measurements are</u>** :

Parameter	Description	Measure	Unit	Comments
Optimal ISM sensitivity	Radiated Sensitivity in the ISM band at 2.440GHz	-11	dBm	-11dBm raw rad. power in anechoic chamber (0dB deviation factor)
MICS C5 frequency measurement	Output radiated frequency in C5	403.648	MHz	/
MICS C5 output power	Output radiated power in C5	-18.1	dBm	-67.1dBm raw rad. power in anechoic chamber (49dB deviation factor)

4.8.4 Device DF1-DR2-Dev1b-n119

- Device ESW firmware : ROMV2-Build27.
- The "RFPrg_TempBuf.buf" file used is the common one used with C. Chiavario in T16 for that device and is there attached :

RFPrg_TempBuf_Buil
d27_DF1-Dev1b-DR2

In that file, main RF parameters are :

Register name	Value in "RFPrg_TempBuf.buf"	
	(hex)	*(dec)*
XOTRIM	0x1A	26
WU2MHzOsc	0x0A	10
WUDetOffset	0x29	41
WURSSIOffset	0x10	16
Lnabias	0x0C	12
Negrtrim1	0x2A	42
Lnafreq1	0x0B	11

⇨ **<u>In these conditions, measurements are</u>** :

Parameter	Description	Measure	Unit	Comments
Optimal ISM sensitivity	Radiated Sensitivity in the ISM band at 2.440GHz	-12	dBm	-12dBm raw rad. power in anechoic chamber (0dB deviation factor)
MICS C5 frequency measurement	Output radiated frequency in C5	403.652	MHz	/
MICS C5 output power	Output radiated power in C5	-18.6	dBm	-67.6dBm raw rad. power in anechoic chamber (49dB deviation factor)

4.8.5 Device DF1-VR1-Dev1b-n106

- Device ESW firmware : ROMV2-Build27.
- The "RFPrg_TempBuf.buf" file used is the common one used with C. Chiavario in T16 for that device and is there attached :

RFPrg_TempBuf_Buil
d27_DF1-Dev1b-VR1

In that file, main RF parameters are :

Register name	Value in "RFPrg_TempBuf.buf"	
	(hex)	*(dec)*
XOTRIM	0x19	25
WU2MHzOsc	0x0E	14
WUDetOffset	0x25	37
WURSSIOffset	0x09	09
Lnabias	0x0C	12
Negrtrim1	0x29	41
Lnafreq1	0x0F	15

⇨ **<u>In these conditions, measurements are</u>** :

Parameter	Description	Measure	Unit	Comments
Optimal ISM sensitivity	Radiated Sensitivity in the ISM band at 2.440GHz	-18	dBm	-18dBm raw rad. power in anechoic chamber (0dB deviation factor)
MICS C5 frequency measurement	Output radiated frequency in C5	403.651	MHz	/
MICS C5 output power	Output radiated power in C5	-16.9	dBm	-65.9dBm raw rad. power in anechoic chamber (49dB deviation factor)

4.8.6 Device DF1-VR2-Dev1b-n117

- Device ESW firmware : ROMV2-Build27.
- The "RFPrg_TempBuf.buf" file used is the common one used with C. Chiavario in T16 for that device and is there attached :

RFPrg_TempBuf_Buil
d27_DF1-Dev1b-VR2

In that file, main RF parameters are :

Register name	Value in "RFPrg_TempBuf.buf"	
	(hex)	*(dec)*
XOTRIM	0x19	25
WU2MHzOsc	0x0D	13
WUDetOffset	0x1D	29
WURSSIOffset	0x0E	14
Lnabias	0x0C	12
Negrtrim1	0x2B	43
Lnafreq1	0x0A	10

⇨ **<u>In these conditions, measurements are</u>** :

Parameter	Description	Measure	Unit	Comments
Optimal ISM sensitivity	Radiated Sensitivity in the ISM band at 2.440GHz	-18	dBm	-18dBm raw rad. power in anechoic chamber (0dB deviation factor)
MICS C5 frequency measurement	Output radiated frequency in C5	403.651	MHz	/
MICS C5 output power	Output radiated power in C5	-16.6	dBm	-65.6dBm raw rad. power in anechoic chamber (49dB deviation factor)

4.9 DF4 HEADER PRELIMINARY GOLDEN DEVICES MEASUREMENTS IN MEYLAN ANECHOIC CHAMBER

4.9.1 Device DF4-SonR2-Dev1b-n95

- Device ESW firmware : ROMV2-Build27.
- The "RFPrg_TempBuf.buf" file used is the common one used with C. Chiavario in T16 for that device and is there attached :

RFPrg_TempBuf_Buil
d27_DF4-Dev1b-Sonl

In that file, main RF parameters are :

Register name	Value in "RFPrg_TempBuf.buf"	
	(hex)	*(dec)*
XOTRIM	0x19	25
WU2MHzOsc	0x0E	14
WUDetOffset	0x2D	45
WURSSIOffset	0x11	17
Lnabias	0x0C	12
Negrtrim1	0x2C	44
Lnafreq1	0x0B	11

⇨ **<u>In these conditions, measurements are</u>** :

Parameter	Description	Measure	Unit	Comments
Optimal ISM sensitivity	Radiated Sensitivity in the ISM band at 2.440GHz	-16	dBm	-16dBm raw rad. power in anechoic chamber (0dB deviation factor)
MICS C5 frequency measurement	Output radiated frequency in C5	403.653	MHz	/
MICS C5 output power	Output radiated power in C5	-17.7	dBm	-66.7dBm raw rad. power in anechoic chamber (49dB deviation factor)

4.9.2 Device DF4-DR1-Dev1b-n91

- Device ESW firmware : ROMV2-Build27.
- The "RFPrg_TempBuf.buf" file used is the common one used with C. Chiavario in T16 for that device and is there attached :

RFPrg_TempBuf_Buil
d27_DF4-Dev1b-DR1

In that file, main RF parameters are :

Register name	Value in "RFPrg_TempBuf.buf"	
	(hex)	*(dec)*
XOTRIM	0x19	25
WU2MHzOsc	0x0D	13
WUDetOffset	0x1F	31
WURSSIOffset	0x09	09
Lnabias	0x0C	12
Negrtrim1	0x27	39
Lnafreq1	0x0B	11

⇨ **<u>In these conditions, measurements are</u>** :

Parameter	Description	Measure	Unit	Comments
Optimal ISM sensitivity	Radiated Sensitivity in the ISM band at 2.440GHz	-18	dBm	-18dBm raw rad. power in anechoic chamber (0dB deviation factor)
MICS C5 frequency measurement	Output radiated frequency in C5	403.651	MHz	/
MICS C5 output power	Output radiated power in C5	-17.0	dBm	-66.0dBm raw rad. power in anechoic chamber (49dB deviation factor)

4.9.3 Device DF4-DR2-Dev1b-n104

- Device ESW firmware : ROMV2-Build27.
- The "RFPrg_TempBuf.buf" file used is the common one used with C. Chiavario in T16 for that device and is there attached :

RFPrg_TempBuf_Buil
d27_DF4-Dev1b-DR2

In that file, main RF parameters are :

Register name	Value in "RFPrg_TempBuf.buf"	
	(hex)	*(dec)*
XOTRIM	0x1B	27
WU2MHzOsc	0x0F	15
WUDetOffset	0x22	34
WURSSIOffset	0x12	18
Lnabias	0x0C	12
Negrtrim1	0x29	41
Lnafreq1	0x0E	14

⇨ **<u>In these conditions, measurements are</u>** :

Parameter	Description	Measure	Unit	Comments
Optimal ISM sensitivity	Radiated Sensitivity in the ISM band at 2.440GHz	-17	dBm	-17dBm raw rad. power in anechoic chamber (0dB deviation factor)
MICS C5 frequency measurement	Output radiated frequency in C5	403.652	MHz	/
MICS C5 output power	Output radiated power in C5	-16.3	dBm	-65.3dBm raw rad. power in anechoic chamber (49dB deviation factor)

4.9.4 Device DF4-VR1-Dev1b-n93

- Device ESW firmware : ROMV2-Build27.
- The "RFPrg_TempBuf.buf" file used is the common one used with C. Chiavario in T16 for that device and is there attached :

RFPrg_TempBuf_Buil
d27_DF4-Dev1b-VR1

In that file, main RF parameters are :

Register name	Value in "RFPrg_TempBuf.buf"	
	(hex)	*(dec)*
XOTRIM	0x19	25
WU2MHzOsc	0x0C	12
WUDetOffset	0x22	34
WURSSIOffset	0x0A	10
Lnabias	0x0C	12
Negrtrim1	0x2B	43
Lnafreq1	0x0D	13

⇨ **<u>In these conditions, measurements are</u>** :

Parameter	Description	Measure	Unit	Comments
Optimal ISM sensitivity	Radiated Sensitivity in the ISM band at 2.440GHz	-6 (*)	dBm	-6dBm raw rad. power in anechoic chamber (0dB deviation factor)
MICS C5 frequency measurement	Output radiated frequency in C5	403.651	MHz	/
MICS C5 output power	Output radiated power in C5	-21.0	dBm	-70.0dBm raw rad. power in anechoic chamber (49dB deviation factor)

(*) : Analysis after device rework has confirmed a SMD assembly issue on that device (some SMT components had been changed manually in lab on the hybrid before final assembly)

4.9.5 Device DF4-VR2-Dev1b-n115

- Device ESW firmware : ROMV2-Build27.
- The "RFPrg_TempBuf.buf" file used is the common one used with C. Chiavario in T16 for that device and is there attached :

RFPrg_TempBuf_Buil
d27_DF4-Dev1b-VR2

In that file, main RF parameters are :

Register name	Value in "RFPrg_TempBuf.buf"	
	(hex)	*(dec)*
XOTRIM	0x1A	26
WU2MHzOsc	0x0D	13
WUDetOffset	0x34	52
WURSSIOffset	0x06	06
Lnabias	0x0C	12
Negrtrim1	0x2A	42
Lnafreq1	0x0B	11

⇨ **<u>In these conditions, measurements are</u>** :

Parameter	Description	Measure	Unit	Comments
Optimal ISM sensitivity	Radiated Sensitivity in the ISM band at 2.440GHz	-17	dBm	-17dBm raw rad. power in anechoic chamber (0dB deviation factor)
MICS C5 frequency measurement	Output radiated frequency in C5	403.648	MHz	/
MICS C5 output power	Output radiated power in C5	-21.3	dBm	-70.3dBm raw rad. power in anechoic chamber (49dB deviation factor)

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Review by	R. Portebois	EDD Manager	R Portebois	Mar 13th, 2015
Review by	A. Dubreuil	R&D Project Leader		March 12th 2015
Approved by	G. Le Bel	QA Project Leader		16.3.2015

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