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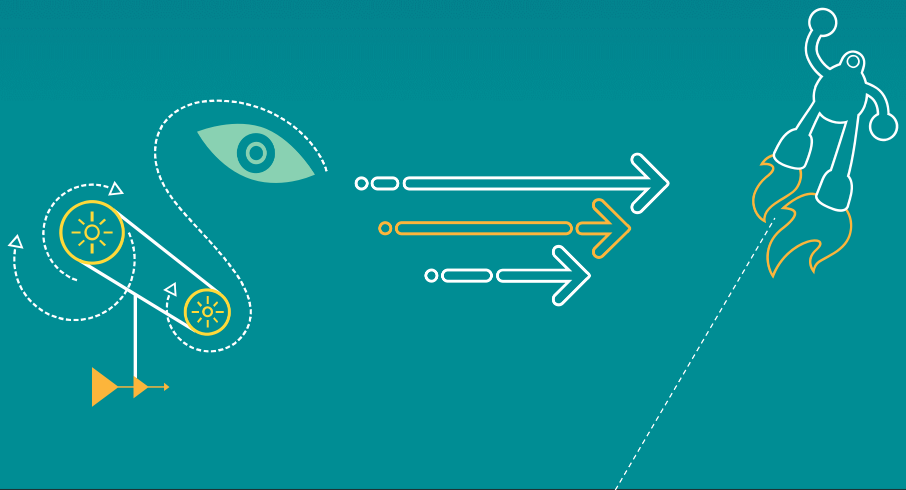
Qualcomm Technologies, Inc.



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Revision History

Revision	Date	Description
A	Apr 2016	Initial release

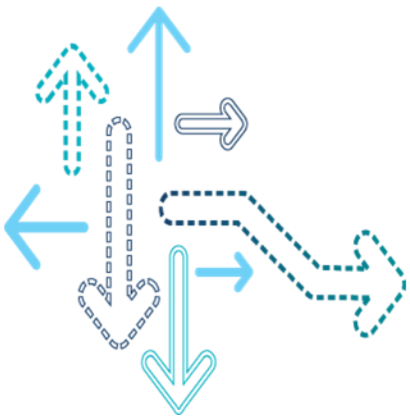
Note: There is no Rev. I, O, Q, S, X, or Z per Mil. standards.

Contents

- RF HW
- RF SW

1. RF HW Support flow chart for customer project life cycle
2. 1x2G support schedule update
3. MSM8998 and WTR5975 design FAQ
4. GSM APT output voltage abnormal issue

RF HW



RF HW case filing

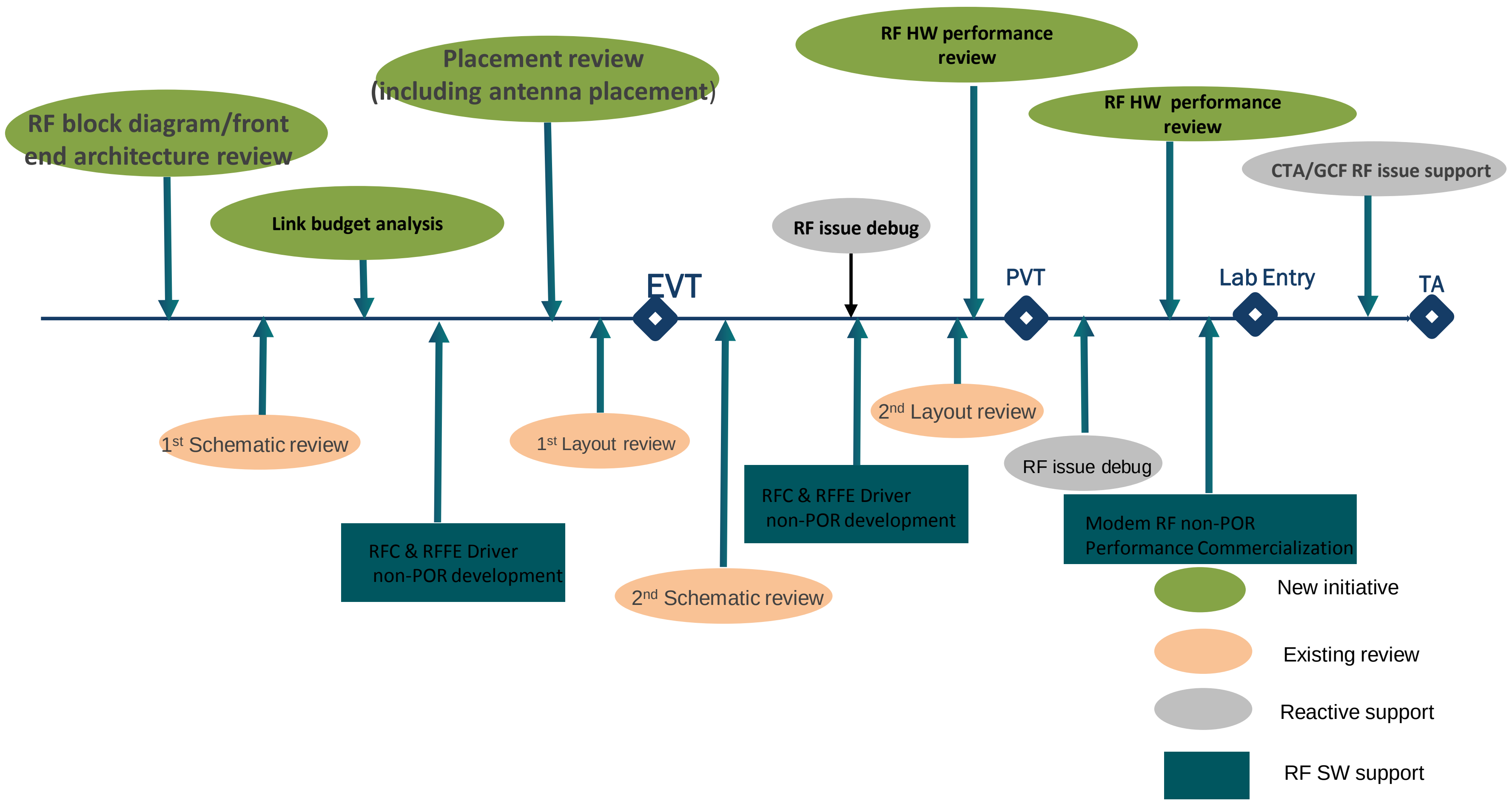
- 在正确的问题领域填写RF HW case很重要. 这将使问题分配到正确的支持团队,从而及时获得解决方案。射频硬件设计和问题调试请按照如下PA area选择：

Record Type	Wireless Device Support
Problem Area 1	RF Hardware (cellular)
Problem Area 2	Transceiver/RFFE/Antenna/EMC
Problem Area 3	GSM/CDMA/WCDMA/TDS/LTE….etc.

RF HW case filing

PA1	PA2	PA3
RF Hardware (cellular)	Transceiver	GSM
		CDMA
		WCDMA
		TDS
		LTE
		Coexistence
		Cal/NV
		other
	RFFE	QPA/Switch/PAMID
		Antenna Tuner
		QLN/DRX modules
		ET/APT
		Char/Cal/NV
		Other
	Antenna/EMC	EMC/Radiated Desense
		SAR
		TIS/TRP
		other

RF HW Support flow chart for customer project life cycle



1x2G support schedule update

CTA's enforcement of 1x2G TA keeps the same schedule of **10/1'16.** Pls make sure OEMs to CTA LE for all mode phone project after Oct.1,2016 adopt the following SP or later.

CTA将会要求2016/10/1 之后 TA的全网通项目支持1X2G，请所有客户10/1之后TA的项目务必使用以下基线或更新的版本:

	Tobasco	Jolokia	MSM 8937/17	MSM 8940	MSM 8953	MSM 8976/56	MSM 8976 Pro
	POR	POR	POR	POR	POR	POR	POR
1x2G TA	TA2.2	JO2.0	Jul'16 JO2.0	Jul'16 LA1.0/TA2.2	May'16 LA1.0/TA2.2	Sep'16 TBC LA1.1.1/TA2.3	Sep'16 TBC LA1.1.1/TA2.3

	Thor/Atlas	MSM8996	MSM8998
	POR	POR	POR
1x2G TA	TH2.0.1 (LTA)	Apr'16 LA.2.0/TH2.0.1	Oct'16 LA1.0/AT2.0

MSM8998 and WTR5975 design FAQ

- **Platform**: MSM8998
- **适用平台**： MSM8998
- **Background**: the solution 00031520 record some questions from customer visit and training about WTR5975。
- **背景**：Solution 00031520 记录汇总了一些客户拜访和培训的关于WTR5975的问题。

- FAQ:

1. What is the difference between QLINK and legacy IQ pair?

A: QLink is high speed digital interface, IQ pair is analog interface. QLink have less trace number, that can ease layout.

2. What is the layout requirement of QLink?

A: QLink is differential signals, each pair need to be protected by 4 side GND and control differential impedance to 85ohm. see detail from 80-NT066-114.

3. How much is the isolation between QLink lanes?

A: 36dB isolation is required. see detail from 80-NT066-114

4. Which market require 4DL CA?

A: NA and JP currently have 4DLCA requirement. For detail and updated information, please check with product marketing team.

5. Does HoRxD conflict to CA?

A: No, HoRXD and CA can work at same time, it is no different than 4*4 MIMO+CA.

MSM8998 and WTR5975 design FAQ

6. Does HoRxD need the network support?

A: No, HoRxD is a UE enhancement, not require network upgrade.

7 What is the WTR/QLN input gain?

A: the WTR work with QLN to generate total 8 gains for LTE and 7 gains for other tech. detail Gain value can be found from their devices spec.

8. For QLN ES/CS version chip. Does external connection/pcb need to be different?

A: There is no need to change PCB/schematic for QLN ES->CS. From ES to CS, the performance will be improved but no function loss, no PCB change requirement.

9. How far the QLN to WTR is acceptable?

A: the RF trace between QLN and WTR can be 4 inch maximum.

10. If don't support ULCA, how about assign LTE/W/C to Tx Chain0 and assign GSM to Tx Chain1?

A: Yes, it is ok.

11. For QLN1020, is the OUT1/2 port fixed for a band?

A: No, the port mapping is dynamic based on concurrency scenario defined by system for different CA combinations.

12. Since the RFFE3/4 are both 38.4MHz for QLN, when will we need to use two RFFE for a design?

A: if a design have both QLN10xx and TDK QLN module, the RFFE3 should be used for discrete QLN and RFFE4 should be used for TDK module. Because the module include switch as well.

13. Can QLN10xx be replaced by 3rd party eLNA?

A: No, WTR5975+QLN10xx is total solution for MSM8998 platform, we have co-designed WTR and QLN as part of common design flow to meet compatibility and maximize performance. this is important to meet TTM schedules of OEMs.

MSM8998 and WTR5975 design FAQ

14. What is the RF reference schematic of MSM8998+WTR5975?

A: Currently, below 4 reference schematic are released.

80-NT066-42	WTR5975/QLN10X0 + QUALCOMM RF360 WITH QFE43X5 GLOBAL SKU REFERENCE SCHEMATIC (PRELIMINARY)
80-NT066-43	WTR59X5 + QLN1020/QLN1035 + QUALCOMM RF360 WITH QFE43X5 AND QFE4340 4X4 MIMO REFERENCE SCHEMATIC (PRELIMINARY INFORMATION)
80-NT066-44	WTR59X5 + QLN10X0 + QUALCOMM RF360 WITH LB/MB/HB PAMID + DIVERSITY FRONT END MODULE (NA/EU)
80-NT066-45	WTR59X5 + QLN10X0 + QUALCOMM RF360 WITH LB/MB/HB PAMID + DIVERSITY FRONT-END MODULE (CHINA)

15. Can I do 3way HoRxD in my MSM8998 design?

A: No, only 4way HoRxD is supported due to modem limitation.

16. Is matching network needed between WTR5975 and QLN10xx Rx signal interface?

A: No, The WTR5975 and QLN10xx are designed to eliminate post QLN10xx SAW-filter and matching network.

17. Is the 5G LPF always required for FBRX path?

A: The 5G LPF is recommended for power control accuracy due to 5G WLAN jammer, but it may be eliminated rely on front end design. For power control accuracy, 20dB signal/jammer is required for WTR5975. If want to remove the 5G LPF, need to estimate the signal/jammer ratio based on the front end design. see detail from 80-NT066-5A.

18. There are three DL Qlink pairs between MSM and WTR, can some of them be removed if no any DLCA supported?

A: No, all the Qlink lanes are required for WTR5975 operation even if there is no CA supported.

GSM APT output voltage abnormal issue

- **Platform**: MSM8953+WTR2965
- **适用平台**：MSM8953+WTR2965

- **Symptom**: GSM APT and bypass mode are controlled by ENH NV and PDM_TBL NV, which are configured as below. Normally, when GSM power>PL12, VBAT>3.7V, QFE2101 should go into APT mode, the output voltage should follow the value set in PDM_TBL. But when setting VBAT voltage, as long as VBAT>3.7V, whatever value is configured, QFE2101 cannot go into APT mode, output voltage always equals VBAT . Read back mode register 0x00=7, that means bypass mode.
- RFNV_GSM_C0_GSM900_ENH_APT_I=12,3500,3700
  RFNV_GSM_C0_GSM900_EXTENDED_SMPS_PDM_TBL_I=3300 for all items
-
- **问题现象**：控制GSM APT或bypass模式的两个NV按如下所示设置。正常来讲，当GSM Power>PL12, VBAT电压>3.7V, QFE2101会自动进入APT模式，输出电压就应该按照PDM_TBL表格的设置输出3.3V。但是问题是，只要设置的VBAT电压大于3.7V，无论设置什么电压，QFE2101都无法进入APT模式，输出电压始终等于VBAT。并且读回QFE2101模式注册器0x00=7，也表明是处于bypass模式。
- RFNV_GSM_C0_GSM900_ENH_APT_I=12,3500,3700
  RFNV_GSM_C0_GSM900_EXTENDED_SMPS_PDM_TBL_I=3300 for all items

GSM APT output voltage abnormal issue

- **Analysis**: configure VBAT>3.7V, GSM power>PL12, below QXDM log indicates ADC initial fail, and not updating Vbatt reading, should be related to SW. The issue can be reproduced on MTP with latest build.
- *MSG Radio Frequency/High rfgsm_core_vbatt_comp.c 00255 ADC init not done, ADC read will fail. Not updating Vbatt reading.*
  MSG Radio Frequency/High rfgsm_core_vbatt_comp.c 00388 |dev:4|Vbatt_update: Curr vbatt= 3700, Prev vbatt =0, rf_vbatt=0
  MSG Radio Frequency/High rfgsm_core_vbatt_comp.c 00396 |dev:4|Compensated vbatt is 0, per pa_state [0]=0, [1]=0, [2]=0, [3]=0

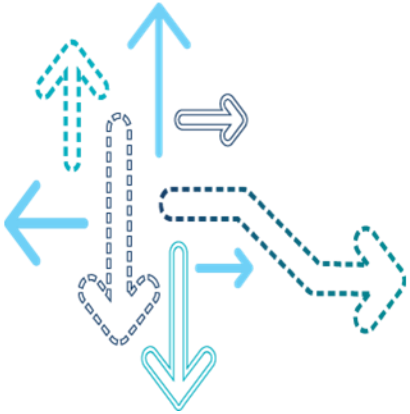
- **问题分析**: 设置VBAT>3.7V，GSM power>PL12，抓取QXDM log如下，表明ADC初始化失败，并且Vbatt读取失败，应该属于软件异常。在MTP上用最新build也可以复现该问题。
- *MSG Radio Frequency/High rfgsm_core_vbatt_comp.c 00255 ADC init not done, ADC read will fail. Not updating Vbatt reading.*
  MSG Radio Frequency/High rfgsm_core_vbatt_comp.c 00388 |dev:4|Vbatt_update: Curr vbatt= 3700, Prev vbatt =0, rf_vbatt=0
  MSG Radio Frequency/High rfgsm_core_vbatt_comp.c 00396 |dev:4|Compensated vbatt is 0, per pa_state [0]=0, [1]=0, [2]=0, [3]=0

GSM APT output voltage abnormal issue

- **Solution**: issue is fixed after applying CR993865.
- **解决办法**：合成CR993865，解决ADC初始化问题和正确读取Vbatt电压后，GSM APT下QFE2101输出电压正常。
-

1. RFC signal timing parameters
2. How to tune WCDMA PRACH preamble time mask and EVM vs chips
3. RF5425 current leakage issue and fix
4. LTE VS TDS PA Configuration

RF SW



RFC signal timing parameters

- **Platform**: All platforms having RFC signal timing parameters
- **适用平台**：有RFC signal timing参数的所有平台

- **Symptom**: Crash with rfc_common_tdd_update_timing recorded as last entry in the call stack.
- **问题描述**：死机，在堆栈中可以看到最后调用的函数为rfc_common_tdd_update_timing。

- Analysis: There are two types of RFC signals, one is for MIPI device timing control (only apply to GSM and TDSCDMA); the other is for GRFC signal control. Both of the signals have timing parameters, which need to be set correctly. For CDMA, WCDMA and LTE, both the start timing and stop timing should be 0. For GSM and TDSCDMA, the start timing and stop timing should not be 0, instead they need to be set to different values for different signal types. Customers could refer to the default values for their new added signals.
- 问题分析：RFC中有两类信号类型，一类是标识MIPI器件的timing控制信息（只应用于GSM和TDSCDMA）；另一类是用于GRFC信号控制。两类信号都带有timing参数，且需要被正确配置。对于CDMA，WCDMA和LTE来说，起始timing和结束timing的值都应该设为0。对GSM和TDSCDMA来说，则不能为0，需要给不同的信号类型设置不同的timing值。客户可以参考现有的timing值来为新增的信号设置合适的值。

RFC signal timing parameters

- For CDMA, WCDMA, LTE, the timing values should be 0.

```
rfc_sig_info_type rf_card_wtr2965_v2_chile_ca_4320_tx_on_rfm_device_4_cdma_bc0_sig_cfg =
{
  RFC_ENCODED_REVISION,
  {
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_RF_PATH_SEL_14,    { RFC_LOW, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_RF_PATH_SEL_08,    { RFC_LOW, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_TX_GTR_TH,    { RFC_CONFIG_ONLY, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_PA_IND,    { RFC_CONFIG_ONLY, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_SIG_LIST_END,    { RFC_LOW, 0 }, {RFC_LOW, 0 } }
  },
};

rfc_sig_info_type rf_card_wtr2965_v2_chile_ca_4320_tx_on_rfm_device_5_wcdma_b1_sig_cfg =
{
  RFC_ENCODED_REVISION,
  {
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_RF_PATH_SEL_05,    { RFC_HIGH, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_RF_PATH_SEL_14,    { RFC_LOW, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_RF_PATH_SEL_08,    { RFC_HIGH, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_TX_GTR_TH,    { RFC_CONFIG_ONLY, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_PA_IND,    { RFC_CONFIG_ONLY, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_SIG_LIST_END,    { RFC_LOW, 0 }, {RFC_LOW, 0 } }
  },
};

rfc_sig_info_type rf_card_wtr2965_v2_jp_ca_4320_tx_on_rfm_device_5_lte_b1_sig_cfg =
{
  RFC_ENCODED_REVISION,
  {
    { (int)RFC_WTR2965_V2_JP_CA_4320_RF_PATH_SEL_05,    { RFC_HIGH, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_WTR2965_V2_JP_CA_4320_RF_PATH_SEL_14,    { RFC_LOW, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_WTR2965_V2_JP_CA_4320_RF_PATH_SEL_08,    { RFC_HIGH, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_WTR2965_V2_JP_CA_4320_TX_GTR_TH,    { RFC_CONFIG_ONLY, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }
    { (int)RFC_WTR2965_V2_JP_CA_4320_PA_IND,    { RFC_CONFIG_ONLY, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_SIG_LIST_END,    { RFC_LOW, 0 }, {RFC_LOW, 0 } }
  },
};

rfc_sig_info_type rf_card_wtr2965_v2_jp_ca_4320_tx_on_rfm_device_5_lte_b41_sig_cfg =
{
  RFC_ENCODED_REVISION,
  {
    { (int)RFC_WTR2965_V2_JP_CA_4320_RF_PATH_SEL_05,    { RFC_LOW, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_WTR2965_V2_JP_CA_4320_TX_GTR_TH,    { RFC_CONFIG_ONLY, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }
    { (int)RFC_WTR2965_V2_JP_CA_4320_PA_IND,    { RFC_CONFIG_ONLY, 0/*Warning: Not specified*/ }, {RFC_LOW, 0/*Warning: Not specified*/ }  },
    { (int)RFC_SIG_LIST_END,    { RFC_LOW, 0 }, {RFC_LOW, 0 } }
  },
};
```

RFC signal timing parameters

- For GSM, TDSCDMA, both MIPI timing signals and GRFC signals need different timing values for different signal types.

```
rfc_sig_info_type rf_card_wtr2965_v2_chile_ca_4320_tx_on_rfm_device_5_gsm_g850_sig_cfg =
{
  RFC_ENCODED_REVISION,
  {
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_TIMING_PA_CTL,   { RFC_CONFIG_ONLY, -10 }, {RFC_LOW, 0 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_TIMING_PA_RANGE,   { RFC_CONFIG_ONLY, -3 }, {RFC_LOW, 0 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_TIMING_ASM_CTL,   { RFC_CONFIG_ONLY, -10 }, {RFC_LOW, 0 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_TIMING_TUNER_CTL,   { RFC_CONFIG_ONLY, -150 }, {RFC_LOW, 0 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_TIMING_PAPM_CTL,   { RFC_CONFIG_ONLY, -100 }, {RFC_LOW, 0 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_TIMING_PAPM_MULTISLOT_CTL,   { RFC_CONFIG_ONLY, -6 }, {RFC_CONFIG_ONLY, 0 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_GPDATA0_0,   { RFC_CONFIG_ONLY, 0/*Warning: Not specified*/ }, {RFC_CONFIG_ONLY, 0/*Warning: Not specified*/ }
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_INTERNAL_GNSS_BLANK,   { RFC_HIGH, -10 }, {RFC_LOW, 0 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_TX_GTR_TH,   { RFC_CONFIG_ONLY, -10 }, {RFC_LOW, 66 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_PA_IND,   { RFC_HIGH, -10 }, {RFC_LOW, 0 }  },
    { (int)RFC_SIG_LIST_END,   { RFC_LOW, 0 }, {RFC_LOW, 0 } }
  },
};

rfc_sig_info_type rf_card_wtr2965_v2_chile_ca_4320_tx_on_rfm_device_5_tdscdma_b34_sig_cfg =
{
  RFC_ENCODED_REVISION,
  {
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_TIMING_PA_CTL,   { RFC_CONFIG_ONLY, -4 }, {RFC_LOW, -4 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_TIMING_ASM_CTL,   { RFC_CONFIG_ONLY, 4 }, {RFC_LOW, -8 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_TIMING_PAPM_CTL,   { RFC_CONFIG_ONLY, -5 }, {RFC_LOW, 2 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_RF_PATH_SEL_05,   { RFC_HIGH, 0 }, {RFC_LOW, -6 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_RF_PATH_SEL_14,   { RFC_LOW, 0 }, {RFC_LOW, -6 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_RF_PATH_SEL_08,   { RFC_HIGH, 0 }, {RFC_LOW, -6 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_INTERNAL_GNSS_BLANK_CONCURRENCY,   { RFC_HIGH, -5 }, {RFC_LOW, -6 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_TX_GTR_TH,   { RFC_CONFIG_ONLY, -5 }, {RFC_LOW, -6 }  },
    { (int)RFC_WTR2965_V2_CHILE_CA_4320_PA_IND,   { RFC_CONFIG_ONLY, -5 }, {RFC_LOW, -6 }  },
    { (int)RFC_SIG_LIST_END,   { RFC_LOW, 0 }, {RFC_LOW, 0 } }
  },
};
```

RFC signal timing parameters

- **Solution**: Set correct timing values for all GSM and TDSCDMA signals. Refer to 80-NF238-16 for GSM RF Timing Adjustment, refer to 80-NP427-1 and 80-NT093-1 for TDSCDMA Timing Adjustment.

- **解决方案**：为GSM和TDSCDMA所有的信号设置正确的值。参考文档80-NF238-16进行GSM RF Timing调整，参考文档80-NP427-1和80-NT093-1进行TDSCDMA RF Timing调整。

How to tune WCDMA PRACH preamble time mask and EVM vs chips

- **Platform**: ALL
- **适用平台**：所有平台

- **Symptoms**:
- Recently many of customers reported 3GPP TS34.121 5.5.2 Transmit ON/OFF Time mask and TS34.121 5.13.4 PRACH preamble quality failure and further it is observed the abnormal EVM is in the first few chips of the preamble which would impact UE`s RACH capability in the worst case.

- **问题描述**：
- 最近有较多客户报告在PRACH preamble测试过程 3GPP TS34.121 5.5.2 Transmit ON/OFF Time mask 和 TS34.121 5.13.4 PRACH preamble quality 测试失败,并进一步观察到preamble开始的少量码片EVM异常.这种异常在最坏情况甚至会影响手机的RACH接入性能.

How to tune WCDMA PRACH preamble time mask and EVM vs chips

- **Analysis**:
- To tune the preamble time mask and EVM failure, we need to understand the RF activities during the preamble burst transmitting.
- As shown in Figure 1, before the preamble burst transmitting, PA_ON and TX_ON event must be done in advance with enough time margin which is used for PA and WTR settling.
- Due to the characteristic of PA and the variation of the Tx path delay, the timing of PA_ON and TX_ON needs to be fine tuned for the timing alignment. Otherwise it would impact the time mask and EVM as pointed out in this topic.

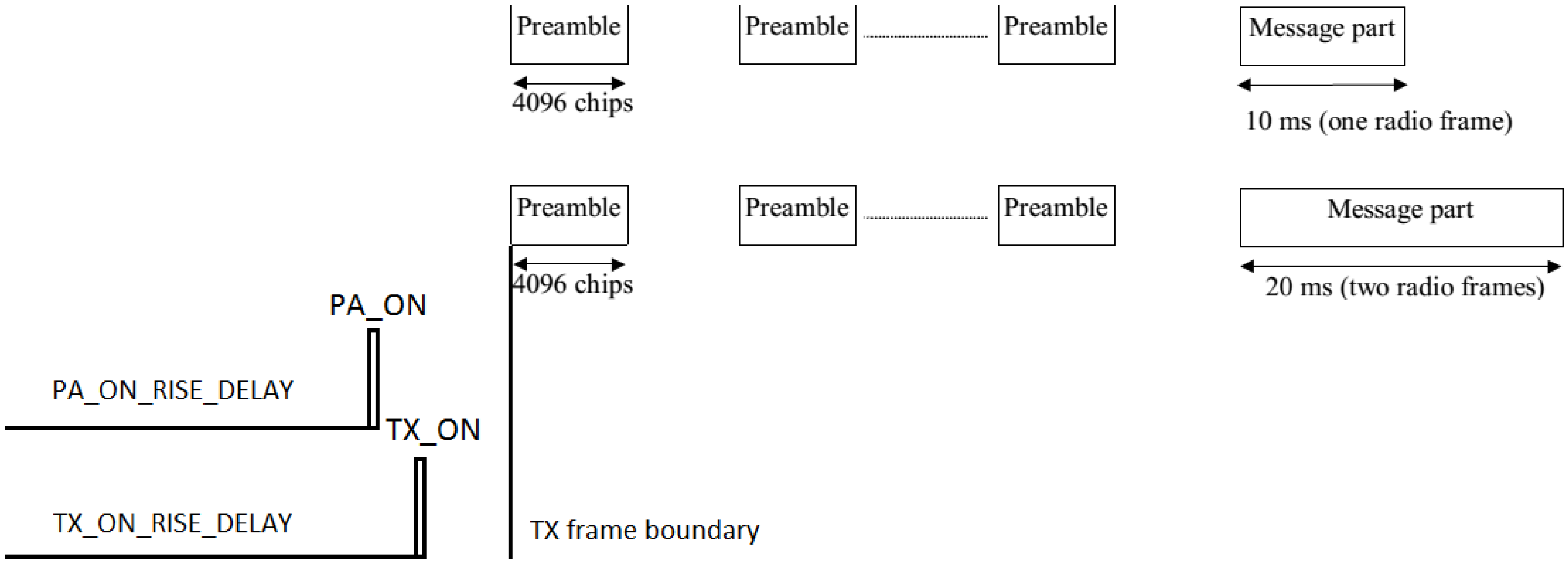


FIGURE 1

How to tune WCDMA PRACH preamble time mask and EVM vs chips

- **问题分析**：
- 在调试preamble time mask和EVM故障之前，我们来看下preamble burst 发射之前有哪些RF动作。
- 如图1所示， preamble burst发射之前，PA_ON和TX_ON必须提前足够的时间余量完成，足够的时间余量是用来确保PA和WTR进入稳状。
- 由于不同PA 特性以及板级发射通路时延的差异性，PA_ON和TX_ON定时需要进行微调来适应对齐这种差异性，否则会影响time mask和EVM，正如该主题所指出的问题。

How to tune WCDMA PRACH preamble time mask and EVM vs chips

- **Solution**:
- Next we would like to demonstrate how to tune the timing of PA_ON and TX_ON event to get PRACH preamble time mask and EVM passed. Figure 2 is an example of WCDMA band 1 preamble signal measurement with failed Time mask and EVM vs Chips, after zooming into [-100, 100] chip range, it is identified the first 10 chips having the bad EVM.
- To tune WCDMA PA_ON and TX_ON timing ,there are two NV items as below
- NV_WCDMA _<band>_AGC_TX_ON_RISE_DELAY_I
- NV_WCDMA_<band>_AGC_PA_ON_RISE_DELAY_I

Figure 2

How to tune WCDMA PRACH preamble time mask and EVM vs chips

- Please be noted the physical meaning of the 2 NVs are defined as the delay from the reference point to the PA_ON /TX_ON event , and also it reflects the timing relationship with the TX frame boundary.- if lowering the value, the PA_ON/TX_ON will be done earlier from the TX frame boundary and vice verse. And also the 2 NV items are in Cx8 resolution (1/8 chip per each unit).
- As shown in Figure 3, lowering both PA_ON_RISE_DELAY and TX_ON_RISE_DELAY NVs by 80 from the default value, the first 10 chips` amplitude and phase error observed fixed hence the good EVM and time mask now. The physical meaning of 80 units here is PA_ON and TX_ON event are moved by 10 chips earlier than the default setting hence for PA and WTR there would be 10 chips (2.6us) more time for settling before the preamble burst.

How to tune WCDMA PRACH preamble time mask and EVM vs chips

- To cover the board to board variation, we suggest to add more time margin based on the measured bad chip length, as shown in the table as the example, the final optimized PA_ON_RISE and TX_ON_RISE delay are 2240 and 3240, that means we add 10 chip time margin top of the measured 10 chips to cover board variation.
- Finally one frequently asked question is that, does the PA_ON and TX_ON delay still need to be tuned if the bad chips are observed within the transient period [-25,25]us? Our answer is yes, because per our observation, some strict test equipment would reject the preamble even the bad chips are within the transient period hence impacting the RACH capability.

NV item	WB1 NV num	default value	tuned value	finalized value
PA_ON_RISE_DELAY	1196	2400	2320	2240
TX_ON_RISE_DELAY	1198	3400	3320	3240

How to tune WCDMA PRACH preamble time mask and EVM vs chips

- **解决方案**：
- 接下来我们将演示如何通过调整PA_ON和TX_ON定时来修复preamble time mask 和EVM问题，图2是WCDMA band 1 preamble 信号测量结果，从图中可以看到time mask和EVM vs chips出现了失败的情况， 将时间轴放到到[-100,100]chip范围内，确认preamble开始的10chips EVM超标了。
- 调整WCDMA PA_ON和TX_ON定时则通过以下两个NV项。
- NV_WCDMA _<band>_AGC_TX_ON_RISE_DELAY_I
- NV_WCDMA_<band>_AGC_PA_ON_RISE_DELAY_I

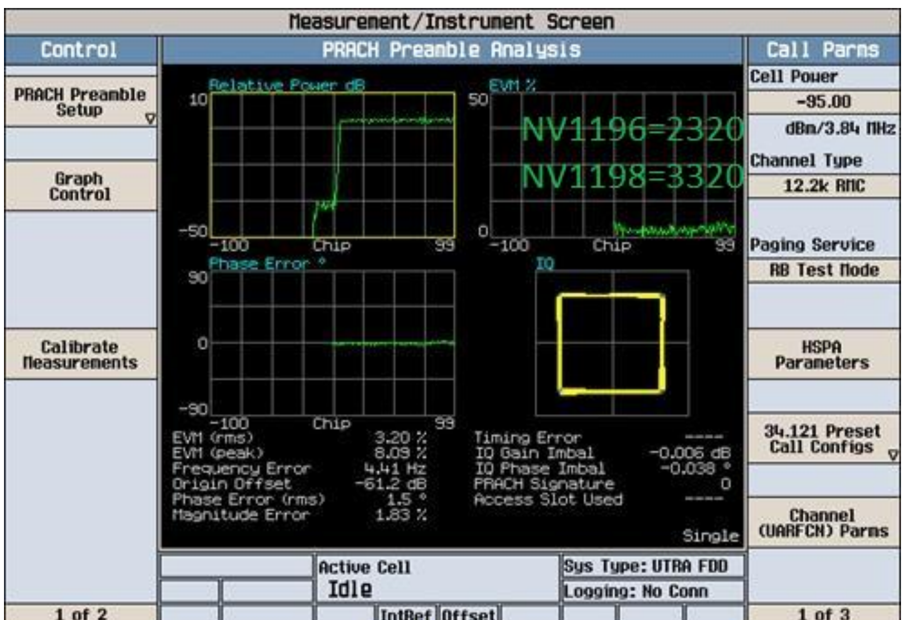


Figure 3

How to tune WCDMA PRACH preamble time mask and EVM vs chips

- 请注意这两个NV项的物理意义是PA_ON和TX_ON事件相对于参考点的延迟，同时也反映出与发射帧边界的定时关系-如果减小这两个NV值， PA_ON和TX_ON会更早于发射帧边界完成，反之则延后完成。并且请注意这两个NV项是Cx8单位（1/8 chip每单位）
- 如图3所示，将PA_ON_RISE_DELAY和TX_ON_RISE_DELAY从默认值减小 80单位后前10个chip的幅度和相位误差就修复了因此能测量到好的EVM和time mask。这里调整80单位的物理意义是PA_ON和TX_ON较之前默认设置提前10chips完成因此对于PA和WTR而言在发射preamble之前增加了10chips(2.6us)用于进入稳态。
- 为了覆盖板级之间的差异型，我们建议在测量到坏的chip长度基础上增加更多的时间余量，如下表所示，最终优化的PA_ON_RISE 和 TX_ON_RISE delay 分别是2240和3240， 也就是在测量到的10chips基础上又增加了10chips,目的就是为了覆盖板级的差异性。
- 最后一个经常被问的问题是如果坏的chips是在transient范围内[-25，25]us，PA_ON和TX_ON的定时是否还需要调整？我们的答案是是的。因为据我们观察某些严格的测试仪表仍然会拒绝preamble即使损坏的chips是在transient范围内，这种情况就会影响手机的接入能力了。

RF5425 current leakage issue and fix

- **Platform**: TA/TH/JO/DPM
- **适用平台**：TA/TH/JO/DPM

- **Symptom**: When phone is in sleep mode or standby mode, 0.4mA extra current could be measured when RF5425 is on board.
- **问题描述**：当手机处在睡眠模式或者待机模式下，RF5425会额外消耗0.4mA的待机电流。

- Analysis: This issue happens on the LB RFFE of RF5425. The LSB of register 0x0 is band selection bit for LB/VLB. If the bit is set to 1 (default) with VIO applied, Ibat current is ~380uA (@Vbat=3.7V). If the bit is set to 0 with VIO applied, Ibat current is ~4.3uA. Since then, we need add extra initialization for register 0x0 after power up. It's the same for RF5422.
- 问题分析：RF5425中有中/高频和低频两个独立的MIPI器件。其中低频器件寄存器0的最低bit用来选择低频/甚低频。当该bit为1时，只要VIO有正常供电，会产生约380uA (@Vbat=3.7V)的额外消耗。若该bit为0，则电流消耗为4.3uA。而该bit的默认值为1。 因此需要在器件上电后，对寄存器0x0进行额外的初始化，使得LSB为0。RF5422和RF5425的修改相同。

RF5425 current leakage issue and fix

- **Solution**:
- Step1, In RF5425 PA source codes, add INIT data structure, write 0 to register 0x0.
- **解决方案**：
- 步骤1，在RF5425的PA代码中，增加初始化的数据结构, 给寄存器0x0写0。

```
#define RFDEVICE_PA_QORVO_RF5425_LB_PA_INIT_NUM_REGS 1
static uint8 rfdevice_pa_qorvo_rf5425_lb_pa_init_regs[RFDEVICE_PA_QORVO_RF5425_LB_PA_INIT_NUM_REGS] =  {0x00, };
static int16 rfdevice_pa_qorvo_rf5425_lb_pa_init_data[RFDEVICE_PA_QORVO_RF5425_LB_NUM_PORTS][RFDEVICE_PA_QORVO_RF5425_LB_PA_INIT_NUM_REGS] =
{
  { /* PORT NUM: 0 */
    0x00,
  },
  { /* PORT NUM: 1 */
    0x00,
  },
  { /* PORT NUM: 2 */
    0x00,
  },
  { /* PORT NUM: 3 */
    0x00,
  },
  { /* PORT NUM: 4 */
```

RF5425 current leakage issue and fix

- Step2,In rfdevice_pa_qorvo_rf5425_lb_data_ag::settings_data_get(), add API for request=RFDEVICE_PA_INIT_DATA（code in red）.
- 步骤2，在 rfdevice_pa_qorvo_rf5425_lb_data_ag::settings_data_get()中增加request= RFDEVICE_PA_INIT_DATA的API（如红色代码）。

```
boolean rfdevice_pa_qorvo_rf5425_lb_data_ag::settings_data_get( rfdevice_pa_cfg_params_type *cfg,
                                                        rfdevice_pa_reg_settings_type *settings)
{
  boolean ret_val = FALSE;

  if (NULL == settings || NULL == cfg)
  {
    return FALSE;
  }

  if (cfg->port >= RFDEVICE_PA_QORVO_RF5425_LB_NUM_PORTS )
  {
    settings->addr = NULL;
    settings->data = NULL;
    settings->num_regs = 0;
    return FALSE;
  }

  if ( (cfg->req == RFDEVICE_PA_INIT_DATA) )
  {
    settings->addr = &(rfdevice_pa_qorvo_rf5425_lb_pa_init_regs[0]);
    settings->data = &(rfdevice_pa_qorvo_rf5425_lb_pa_init_data[cfg->port][0]);
    settings->num_regs = RFDEVICE_PA_QORVO_RF5425_LB_PA_INIT_NUM_REGS;
    ret_val = TRUE;
  }
```

RF5425 current leakage issue and fix

- Step3, request= RFDEVICE_PA_INIT_DATA is already in rfdevice_pa_common::init(), need add trigger option.
- 步骤3，在rfdevice_pa_common::init()，已经有了RFDEVICE_PA_INIT_DATA，需要增加RFDEVICE_PA_TRIGGER_DATA，使得初始化配置生效。

```
void rfdevice_pa_common::init()
{

  boolean status = TRUE;
  rfdevice_pa_cfg_params_type pa_params_cfg= {RFDEVICE_PA_DATA_REQ_INVALID,0,0,0};
  rfdevice_pa_reg_settings_type pa_reg_ag = { 0 };
  uint8 num_trans = 0;
  uint8 num_idx = 0;
  uint8 port_num = RFDEVICE_PA_INVALID_PORT;
  int16 timing;

  pa_params_cfg.port  = 0;

  pa_params_cfg.req = RFDEVICE_PA_INIT_DATA;

  //Setup the requested PA configuration

  /*Obtain the ag settings from PA ag file */
  status &= pa_data_ptr->settings_data_get(&pa_params_cfg, &pa_reg_ag);

  /*Prepare the script buffer with the obtained ag settings*/
  status &= prepare_buffer(&pa_reg_ag, NULL, RFDEVICE_EXECUTE_IMMEDIATE, 0, &num_trans);

  /*Trigger PA INIT*/

          pa_params_cfg.port = 0;
      pa_params_cfg.req = RFDEVICE_PA_TRIGGER_DATA;  /* PA Trigger INIT settings */
      status &= pa_data_ptr->settings_data_get(&pa_params_cfg, &pa_reg_ag);
      status &= prepare_buffer(&pa_reg_ag, NULL, RFDEVICE_EXECUTE_IMMEDIATE, 0, &num_trans);

      if(!status)
      {
         RF_MSG(RF_ERROR, "PA INIT failed in trigger");
         return;
      }
```

RF5425 current leakage issue and fix

- Step4, call function init() at the end of rfdevice_pa_common::rfdevice_pa_common().
- 步骤4，在rfdevice_pa_common::rfdevice_pa_common()的最后,调用 init()函数.

```
    /*set default port switch state*/
    for(i = 0; i < RFCOM_NUM_LTE_BANDS; i++)
    {
      this->switch_state_lte[i] = DEFAULT_PA_SWITCH_STATE;
    }

    /* set all Tdscdma port information to invalid*/
    for(i = 0; i < RFCOM_NUM_TDSCDMA_BANDS; i++)
    {
      this->switch_state_tdscdma[i] = DEFAULT_PA_SWITCH_STATE;
    }
  }
  /* Need to do PA INIT after PA object created*/
   init();
}
```

LTE VS TDS PA Configuration

- In the topic, we will introduce LTE and TDS PA RANGE MAP and PA RISE FALL threshold configuration in parallel, will benefit your daily works by comparing these two technologies' PA configuration。
- 我们将在这个话题中并行地介绍LTE和TDSCDMA的PA RANGE MAP和PA RISE FALL配置，通过对比这两个技术的PA配置的异同点，这将更有益于日常工作的开展。

- Take a third party PA with two PA states as an example.
- 以一个具有两个PA states的第三方PA做为例。

- Whether a GRFC PA or MIPI PA, supposes we have below PA Range Map.
- 不管是GRFC PA还是MIPI PA，假设我们有下面PA Range MAP.

Gain	GRFC PA		MIPI PA	PA RANGE Fill Value
	Bit 0 (PA_R0)	Bit 1 (PA_R1)	PA Range Index	
Low Gain	High	Low	1	1
High Gain	Low	Low	0	0

LTE VS TDS PA Configuration - LTE PA RANGE MAP Configuration

- **Platform**: All platforms use below NVs
- **适用平台**：所有用到下面NV的平台
  - LTE NV: NV_LTE_Bx_PA_RANGE_MAP_I
    NV_LTE_Bx_PA_RISE_FALL_THRESHOLD_I

- For old platform, PA_RANAGE_MAP gain is descending, configuration as below.
- 对于老平台，PA_RANGE_MAP 增益是递减的，配置如下。

Gain	NV_LTE_Bx_PA_RANGE_MAP_I[i]
High gain	NV_LTE_Bx_PA_RANGE_MAP_I[0] = 0
..	NV_LTE_Bx_PA_RANGE_MAP_I[1] = 0
..	NV_LTE_Bx_PA_RANGE_MAP_I[2] = 0
Low gain	NV_LTE_Bx_PA_RANGE_MAP_I[3] = 1

LTE VS TDS PA Configuration - LTE PA RANGE MAP Configuration

- For new platform, PA_RANAGE_MAP gain is increasing, configuration as below.
- 对于新平台，PA_RANGE_MAP 增益是递增的，配置如下。

Gain	NV_LTE_Bx_PA_RANGE_MAP_I[i]
Low gain	NV_LTE_Bx_PA_RANGE_MAP_I[0] = 1
..	NV_LTE_Bx_PA_RANGE_MAP_I[1] = 0
..	NV_LTE_Bx_PA_RANGE_MAP_I[2] = 0
High gain	NV_LTE_Bx_PA_RANGE_MAP_I[3] = 0

LTE VS TDS PA Configuration - LTE PA RISE FALL Configuration

- **Platform**: All platforms use below NVs
- **适用平台**：所有用到下面NV的平台
  - LTE NV: NV_LTE_Bx_PA_RISE_FALL_THRESHOLD_I

- For old platform, you can set below several PA RISE FALL optional configuration.
- 对于老平台，你能设置如下几种可选PA RISE FALL配置。
- Option 1 (prefer) (选项 1): you need to do tx calibration for pa state 2, 3.

Element	Switch point
NV_LTE_Bx_PA_RISE_FALL_I[0]->rise_threshold	1023
NV_LTE_Bx_PA_RISE_FALL_I[1]->fall_threshold	1023
NV_LTE_Bx_PA_RISE_FALL_I[2]->rise_threshold	1023
NV_LTE_Bx_PA_RISE_FALL_I[3]->fall_threshold	1023
NV_LTE_Bx_PA_RISE_FALL_I[4]->rise_threshold	830
NV_LTE_Bx_PA_RISE_FALL_I[5]->fall_threshold	800

LTE VS TDS PA Configuration - LTE PA RISE FALL Configuration

- Option 2 (prefer) (选项 2): you need to do tx calibration for pa state 1, 3.

Element	Switch point
NV_LTE_Bx_PA_RISE_FALL_I[0]->rise_threshold	1023
NV_LTE_Bx_PA_RISE_FALL_I[1]->fall_threshold	1023
NV_LTE_Bx_PA_RISE_FALL_I[2]->rise_threshold	830
NV_LTE_Bx_PA_RISE_FALL_I[3]->fall_threshold	800
NV_LTE_Bx_PA_RISE_FALL_I[4]->rise_threshold	830
NV_LTE_Bx_PA_RISE_FALL_I[5]->fall_threshold	800

- Option 3 (prefer) (选项 3): you need to do tx calibration for pa state 0, 3.

Element	Switch point
NV_LTE_Bx_PA_RISE_FALL_I[0]->rise_threshold	830
NV_LTE_Bx_PA_RISE_FALL_I[1]->fall_threshold	800
NV_LTE_Bx_PA_RISE_FALL_I[2]->rise_threshold	830
NV_LTE_Bx_PA_RISE_FALL_I[3]->fall_threshold	800
NV_LTE_Bx_PA_RISE_FALL_I[4]->rise_threshold	830
NV_LTE_Bx_PA_RISE_FALL_I[5]->fall_threshold	800

LTE VS TDS PA Configuration - LTE PA RISE FALL Configuration

- For new platform, you can set below several PA RISE FALL optional configuration.
- 对于新平台，你能设置如下几种可选PA RISE FALL配置。
- Option 1 (prefer) (选项 1): you need to do tx calibration for pa state 0, 1.

Element	Switch point
NV_LTE_Bx_PA_RISE_FALL_I[0]->rise_threshold	830
NV_LTE_Bx_PA_RISE_FALL_I[1]->fall_threshold	800
NV_LTE_Bx_PA_RISE_FALL_I[2]->rise_threshold	2047
NV_LTE_Bx_PA_RISE_FALL_I[3]->fall_threshold	2047
NV_LTE_Bx_PA_RISE_FALL_I[4]->rise_threshold	2047
NV_LTE_Bx_PA_RISE_FALL_I[5]->fall_threshold	2047

LTE VS TDS PA Configuration - LTE PA RISE FALL Configuration

- Option 2 (prefer) (选项 2): you need to do tx calibration for pa state 0, 2.

Element	Switch point
NV_LTE_Bx_PA_RISE_FALL_I[0]->rise_threshold	830
NV_LTE_Bx_PA_RISE_FALL_I[1]->fall_threshold	800
NV_LTE_Bx_PA_RISE_FALL_I[2]->rise_threshold	830
NV_LTE_Bx_PA_RISE_FALL_I[3]->fall_threshold	800
NV_LTE_Bx_PA_RISE_FALL_I[4]->rise_threshold	2047
NV_LTE_Bx_PA_RISE_FALL_I[5]->fall_threshold	2047

- Option 3 (prefer) (选项 3): you need to do tx calibration for pa state 0, 3.

Element	Switch point
NV_LTE_Bx_PA_RISE_FALL_I[0]->rise_threshold	830
NV_LTE_Bx_PA_RISE_FALL_I[1]->fall_threshold	800
NV_LTE_Bx_PA_RISE_FALL_I[2]->rise_threshold	830
NV_LTE_Bx_PA_RISE_FALL_I[3]->fall_threshold	800
NV_LTE_Bx_PA_RISE_FALL_I[4]->rise_threshold	830
NV_LTE_Bx_PA_RISE_FALL_I[5]->fall_threshold	800

LTE VS TDS PA Configuration - TDS PA RANGE MAP Configuration

- **Platform**: All platforms use below NVs
- **适用平台**：所有用到下面NV的平台
  - TDS NV: RFNV_TDSCDMA_Bx_PA_RANGE_MAP_I
    RFNV_TDSCDMA_Bx_PA_RISE_FALL_I

- PA_RANAGE_MAP gain is increasing, configuration as below.
- PA_RANGE_MAP 增益是递增的，配置如下。

Gain	NV_TDSCDMA_Bx_PA_RANGE_MAP_I[i]
Low gain	RFNV_TDSCDMA_Bx_PA_RANGE_MAP_I[0] = 1
..	RFNV_TDSCDMA_Bx_PA_RANGE_MAP_I[1] = 0
..	RFNV_TDSCDMA_Bx_PA_RANGE_MAP_I[2] = 0
High gain	RFNV_TDSCDMA_Bx_PA_RANGE_MAP_I[3] = 0

LTE VS TDS PA Configuration - TDS PA RISE FALL Configuration

- You can just set below several PA RISE FALL configuration as below.
- 你仅能设置如下PA RISE FALL配置。
- Yon need to do tx calibration for pa state 0, 1. other options like LTE do not work for TDS, It requires PA states are sequential, otherwise, it will meet Tx Lin load crash.

Element	Switch point
NV_LTE_Bx_PA_RISE_FALL_I[0]->rise_threshold	800
NV_LTE_Bx_PA_RISE_FALL_I[1]->fall_threshold	800
NV_LTE_Bx_PA_RISE_FALL_I[2]->rise_threshold	2047
NV_LTE_Bx_PA_RISE_FALL_I[3]->fall_threshold	2047
NV_LTE_Bx_PA_RISE_FALL_I[4]->rise_threshold	2047
NV_LTE_Bx_PA_RISE_FALL_I[5]->fall_threshold	2047

Questions?

https://support.cdmatech.com