

MIT (China) sharpened Homologation measurements FRDM-KW38 and KW36

Report

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06/2021



SECURE CONNECTIONS
FOR A SMARTER WORLD

CONDITION

MIIT (China) New 2.4 GHz stricter emissions rule

Limits for Special Frequency Band Protection

BT-SIG negotiations with MIIT has resulted in following adjustments

Frequency Range	Limit	Measurement Bandwidth	Detection Method
48.5-72.5MHz	-54dBm	100kHz	RMS
76-118MHz	-54dBm	100kHz	RMS
167-223MHz	-54dBm	100kHz	RMS
470-702MHz	-54dBm	100kHz	RMS
2300-2390MHz	-40dBm	1MHz	RMS
2390-2400MHz	-30dBm	100kHz	RMS
2483.5-2500MHz	-40dBm	1MHz	RMS
5150-5350MHz	-40dBm	1MHz	RMS
5725-5850MHz	-40dBm	1MHz	RMS

MIIT (China) New 2.4 GHz stricter emissions rule

- Current SRRC test requirements for 2.4 GHz are mainly based on Tx requirements from EN 300 328

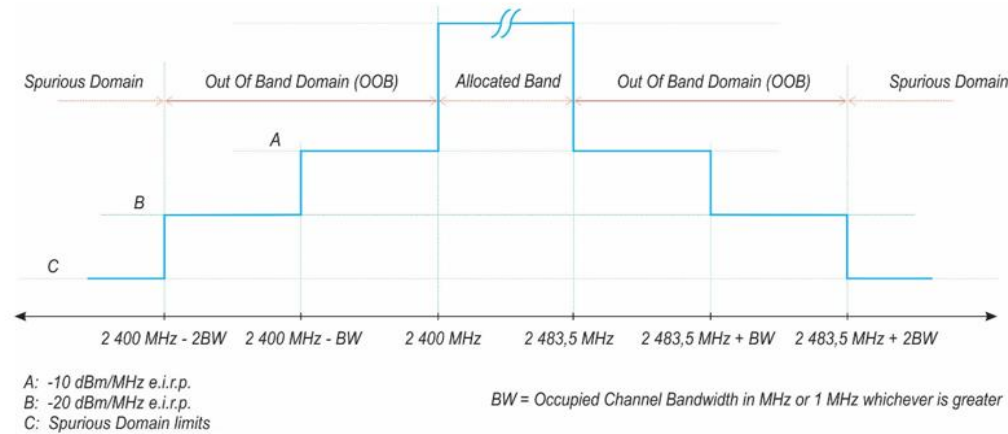


Figure 1: Transmit mask

- MIIT wanted to change it by imposing -40 dBm/MHz up to 2400 MHz (which creates compliance issues for most of the BLE implementations including NXP)
- Table below shows the proposed alternative by the SiG:

Initial values		Proposal	
Special protection band	Required limit value	Special protection band	Required limit value
2300-2400MHz	≤-40dBm/MHz	2300-2390MHz	≤-40dBm/MHz
		2390-2400MHz	≤ -30dBm/100kHz



KW36 & KW38 Results

KW38

Special protection band	Limit value	PA_RAMP_SEL=1us (SDK default setting)	PA_RAMP_SEL=2us
2300-2390MHz	$\leq -40\text{dBm/MHz}$	-40.5dBm	-43dBm
2390-2400MHz	$\leq -30\text{dBm}/100\text{kHz}$	-53dBm	-47dBm

KW36

Special protection band	Limit value	PA_RAMP_SEL=1us (SDK default setting)	PA_RAMP_SEL=2us
2300-2390MHz	$\leq -40\text{dBm/MHz}$	-41.5dBm	-43.5dBm
2390-2400MHz	$\leq -30\text{dBm}/100\text{kHz}$	-54dBm	-47.9dBm

SOLUTION PROPOSAL

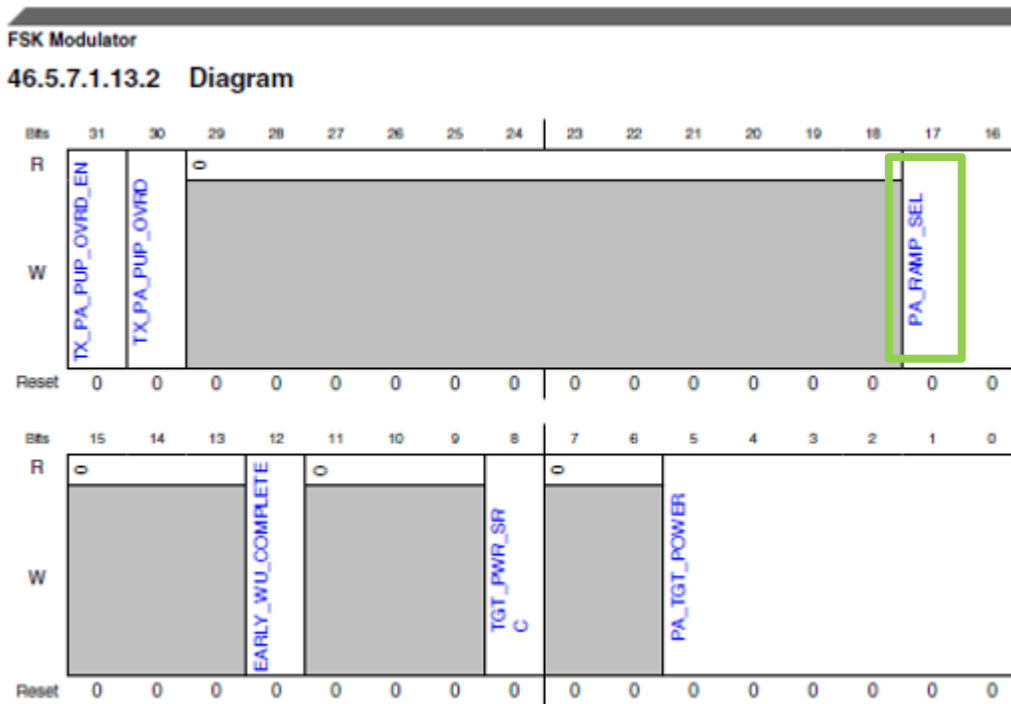


MIT (China) sharpened Homologation measurements

The PA ramp causes the lobes on each side of the wanted RF signal.
Increasing the PA ramp time decrease and shift the lobes.

Conclusion: PA_RAMP_SEL value must be set to 0x02h (2us) instead of 0x01h (1us default value)

Reference Manual extract:



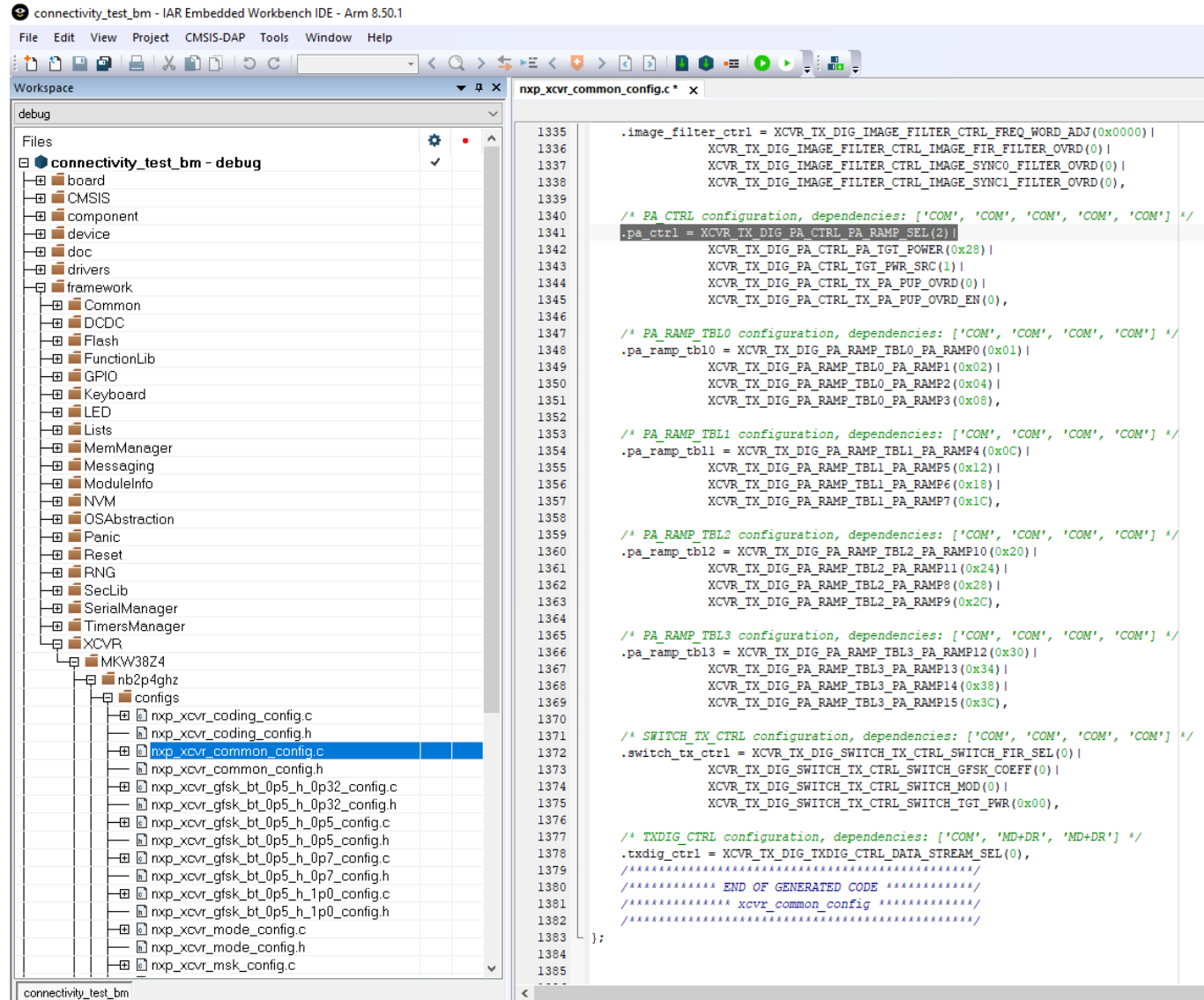
46.5.7.1.13.3 Fields

Field	Function
31 TX_PA_PUP_OVRD_EN	This bit enables the TX PA_PUP Control bit.
30 TX_PA_PUP_OVRD	If the TX_PA_PUP_OVRD_EN bit is set, then this bit turns on (=1) and off (=0) the Transmit TX_PA_PUP bit.
29-18 —	Reserved
17-16 PA_RAMP_SEL	Indicates the ramp duration or no ramp. 2'b00: Ramp disabled. 2'b01: Ramp = 1us. 2'b10: Ramp = 2us. 2'b11: Ramp = 4us.
15-13 —	Reserved
12 EARLY_WU_COMPLETE	

Table continues on the next page...

MIT (China) sharpened Homologation measurements

Modification: XCVR_TX_DIG_PA_CTRL_PA_RAMP_SEL(2) in the nxp_xcvr_common_config.c



The screenshot displays the IAR Embedded Workbench IDE interface. On the left, the 'Workspace' pane shows a project tree for 'connectivity_test_bm - debug'. The 'Files' pane lists various components, with 'nxp_xcvr_common_config.c' highlighted. The main editor window shows the source code for 'nxp_xcvr_common_config.c'. The code is a C preprocessor file defining configuration constants for an XCVR. The modification is highlighted in blue on line 1341: `.pa_ctrl = XCVR_TX_DIG_PA_CTRL_PA_RAMP_SEL(2)`. The code includes comments for various configurations such as PA_CTRL, PA_RAMP_TBL0, PA_RAMP_TBL1, PA_RAMP_TBL2, PA_RAMP_TBL3, SWITCH_TX_CTRL, and TXDIG_CTRL. The XCVR component is identified as MKW38Z4, and the specific configuration is for nb2p4ghz. The code is enclosed in a function definition with a closing brace on line 1385.

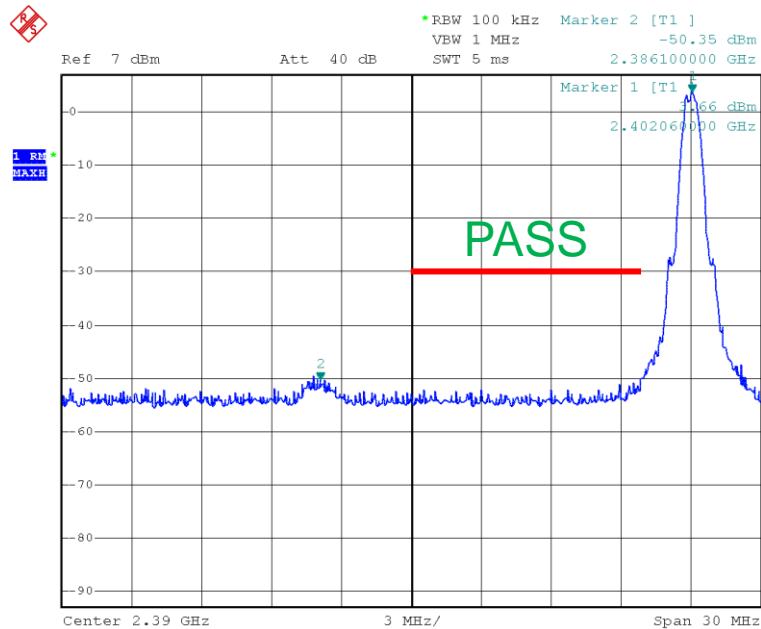
```
1335 .image_filter_ctrl = XCVR_TX_DIG_IMAGE_FILTER_CTRL_FREQ_WORD_ADJ(0x0000) |
1336 XCVR_TX_DIG_IMAGE_FILTER_CTRL_IMAGE_FIR_FILTER_OVRD(0) |
1337 XCVR_TX_DIG_IMAGE_FILTER_CTRL_IMAGE_SYNC0_FILTER_OVRD(0) |
1338 XCVR_TX_DIG_IMAGE_FILTER_CTRL_IMAGE_SYNC1_FILTER_OVRD(0),
1339
1340 /* PA CTRL configuration, dependencies: ['COM', 'COM', 'COM', 'COM', 'COM'] */
1341 .pa_ctrl = XCVR_TX_DIG_PA_CTRL_PA_RAMP_SEL(2)
1342 XCVR_TX_DIG_PA_CTRL_PA_TGT_POWER(0x28) |
1343 XCVR_TX_DIG_PA_CTRL_TGT_PWR_SRC(1) |
1344 XCVR_TX_DIG_PA_CTRL_TX_PA_PUP_OVRD(0) |
1345 XCVR_TX_DIG_PA_CTRL_TX_PA_PUP_OVRD_EN(0),
1346
1347 /* PA_RAMP_TBL0 configuration, dependencies: ['COM', 'COM', 'COM', 'COM'] */
1348 .pa_ramp_tbl0 = XCVR_TX_DIG_PA_RAMP_TBL0_PA_RAMP0(0x01) |
1349 XCVR_TX_DIG_PA_RAMP_TBL0_PA_RAMP1(0x02) |
1350 XCVR_TX_DIG_PA_RAMP_TBL0_PA_RAMP2(0x04) |
1351 XCVR_TX_DIG_PA_RAMP_TBL0_PA_RAMP3(0x08),
1352
1353 /* PA_RAMP_TBL1 configuration, dependencies: ['COM', 'COM', 'COM', 'COM'] */
1354 .pa_ramp_tbl1 = XCVR_TX_DIG_PA_RAMP_TBL1_PA_RAMP4(0x0C) |
1355 XCVR_TX_DIG_PA_RAMP_TBL1_PA_RAMP5(0x12) |
1356 XCVR_TX_DIG_PA_RAMP_TBL1_PA_RAMP6(0x18) |
1357 XCVR_TX_DIG_PA_RAMP_TBL1_PA_RAMP7(0x1C),
1358
1359 /* PA_RAMP_TBL2 configuration, dependencies: ['COM', 'COM', 'COM', 'COM'] */
1360 .pa_ramp_tbl2 = XCVR_TX_DIG_PA_RAMP_TBL2_PA_RAMP10(0x20) |
1361 XCVR_TX_DIG_PA_RAMP_TBL2_PA_RAMP11(0x24) |
1362 XCVR_TX_DIG_PA_RAMP_TBL2_PA_RAMP8(0x28) |
1363 XCVR_TX_DIG_PA_RAMP_TBL2_PA_RAMP9(0x2C),
1364
1365 /* PA_RAMP_TBL3 configuration, dependencies: ['COM', 'COM', 'COM', 'COM'] */
1366 .pa_ramp_tbl3 = XCVR_TX_DIG_PA_RAMP_TBL3_PA_RAMP12(0x30) |
1367 XCVR_TX_DIG_PA_RAMP_TBL3_PA_RAMP13(0x34) |
1368 XCVR_TX_DIG_PA_RAMP_TBL3_PA_RAMP14(0x38) |
1369 XCVR_TX_DIG_PA_RAMP_TBL3_PA_RAMP15(0x3C),
1370
1371 /* SWITCH_TX_CTRL configuration, dependencies: ['COM', 'COM', 'COM', 'COM'] */
1372 .switch_tx_ctrl = XCVR_TX_DIG_SWITCH_TX_CTRL_SWITCH_FIR_SEL(0) |
1373 XCVR_TX_DIG_SWITCH_TX_CTRL_SWITCH_GFSK_COEFF(0) |
1374 XCVR_TX_DIG_SWITCH_TX_CTRL_SWITCH_MOD(0) |
1375 XCVR_TX_DIG_SWITCH_TX_CTRL_SWITCH_TGT_PWR(0x00),
1376
1377 /* TXDIG_CTRL configuration, dependencies: ['COM', 'MD+DR', 'MD+DR'] */
1378 .txdig_ctrl = XCVR_TX_DIG_TXDIG_CTRL_DATA_STREAM_SEL(0),
1379 /* ***** END OF GENERATED CODE ***** */
1380 /* ***** nxp_xcvr_common_config ***** */
1381 /* ***** */
1382 };
1383
1384
1385
```



KW38 RESULTS

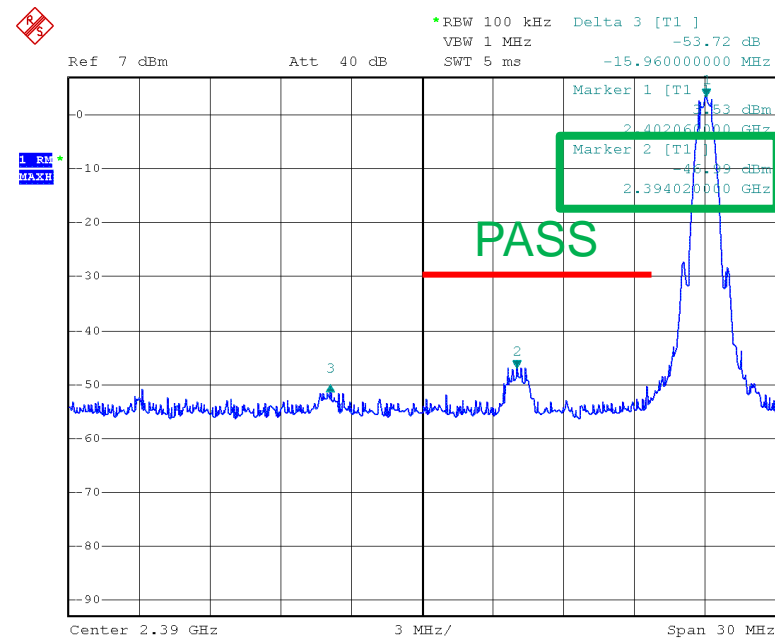
KW38 – Spectrum Analyser – 100kHz BW PA_RAMP_SEL

PA_RAMP_SEL=1us
(SDK default setting)



2.39GHz

PA_RAMP_SEL=2us

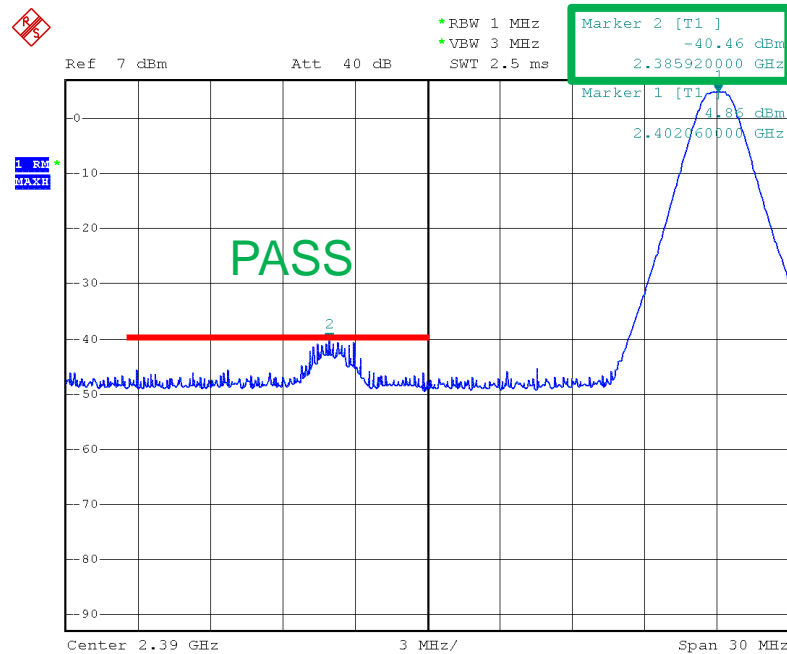


2.39GHz

KW38 – Spectrum Analyser – 1MHz BW

PA_RAMP_SEL

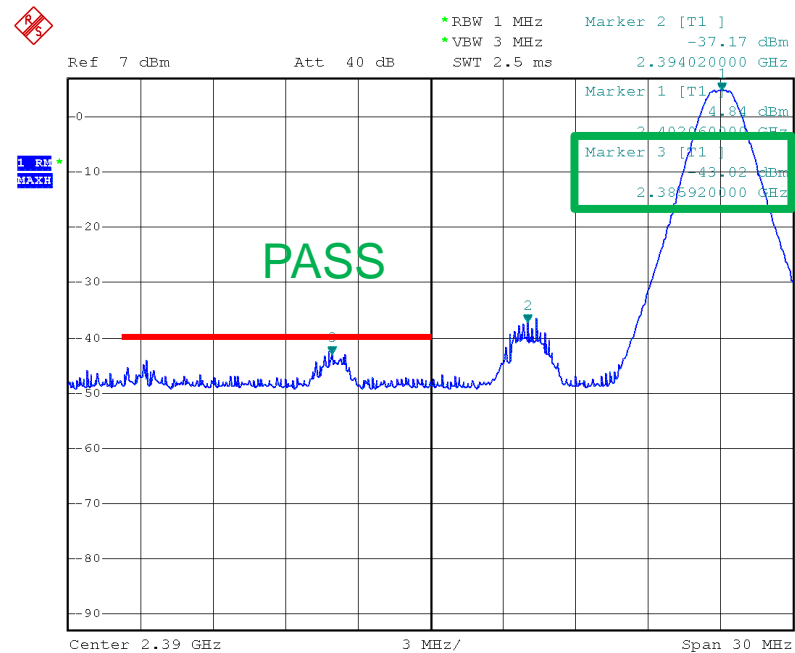
PA_RAMP_SEL=1us
(SDK default setting)



2.39GHz

+0.46dB margin

PA_RAMP_SEL=2us

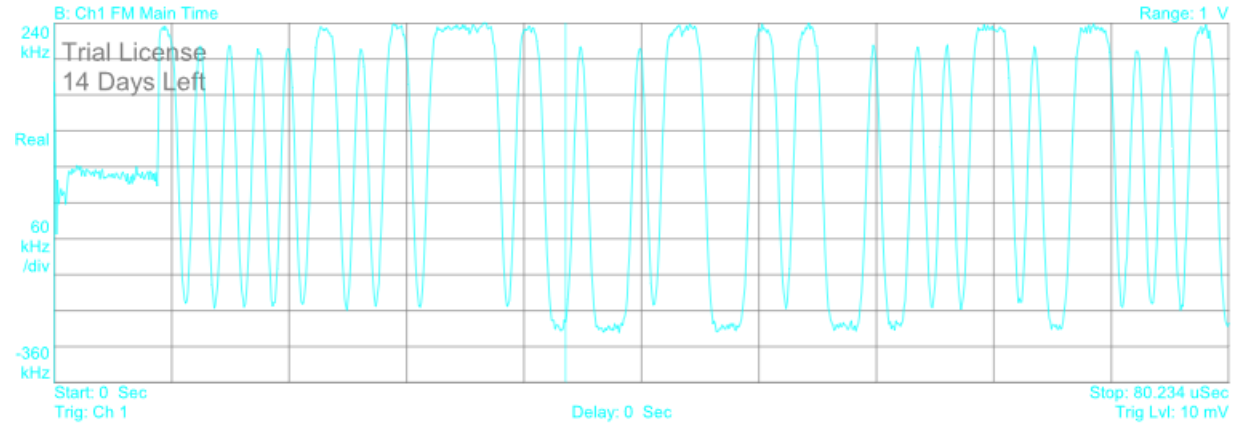


2.39GHz

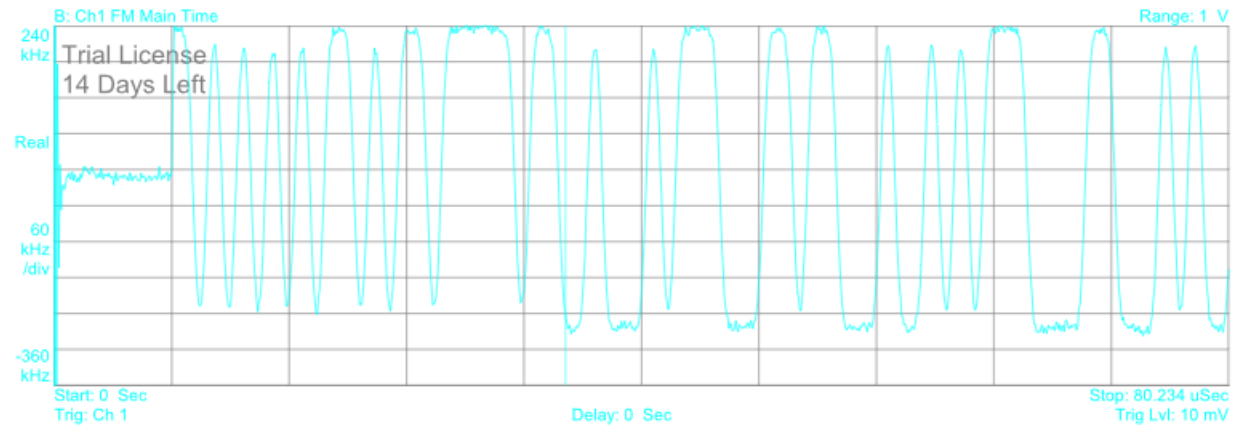
+3dB margin

KW38 – VSA - PA_RAMP_SEL

PA_RAMP_SEL=1us



PA_RAMP_SEL=2us



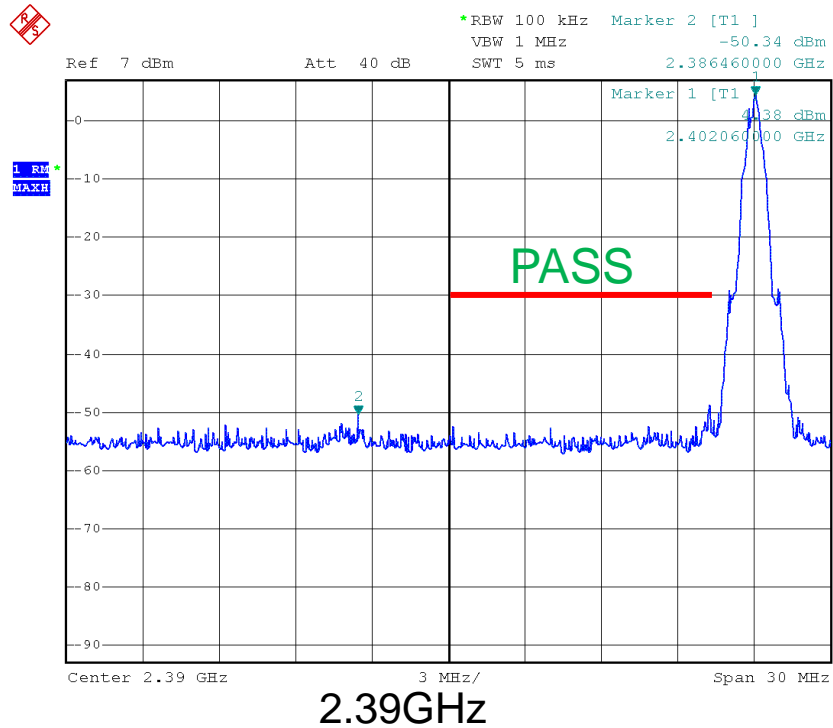
KW36 RESULTS



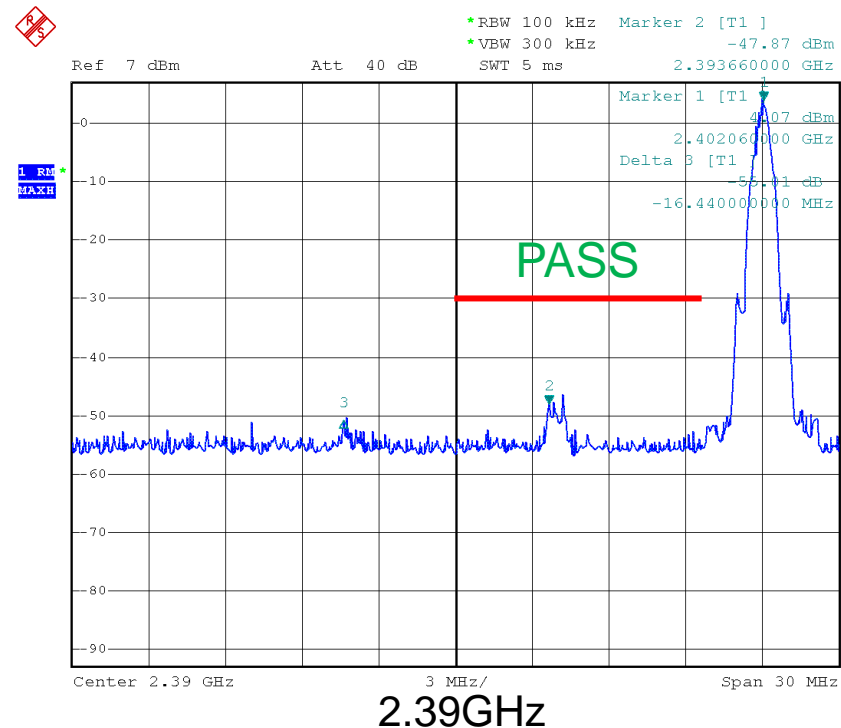
KW36 – Spectrum Analyser – 100kHz BW

PA_RAMP_SEL

PA_RAMP_SEL=1us

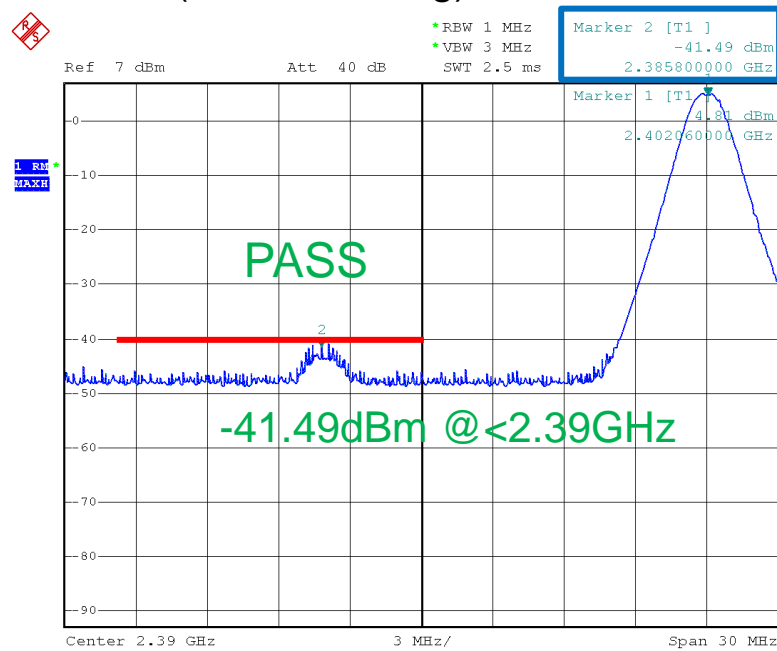


PA_RAMP_SEL=2us



KW36 – Spectrum Analyser – 1MHz BW PA_RAMP_SEL

PA_RAMP_SEL=1us
(default setting)



2.39GHz

+1.5dB margin

PA_RAMP_SEL=2us

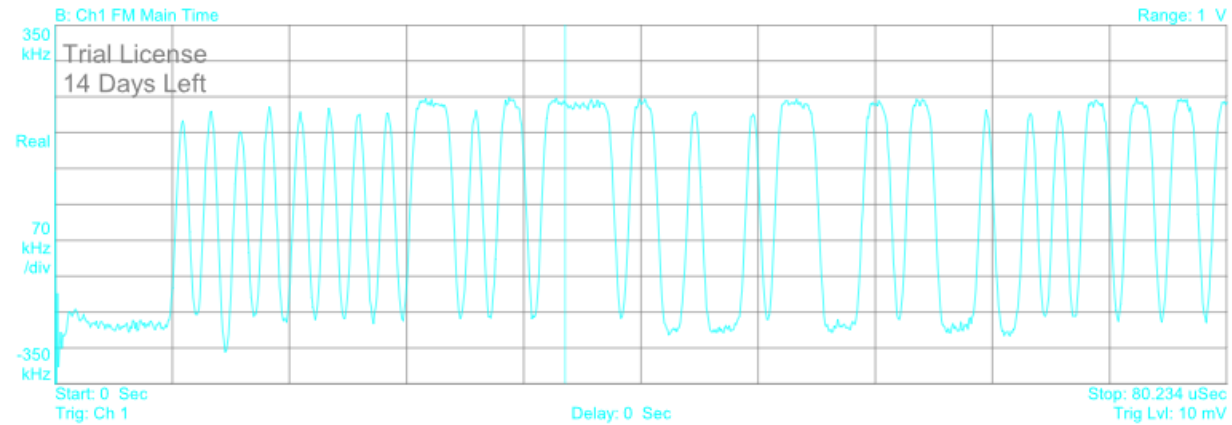


2.39GHz

+3.5dB margin

KW36 – VSA - PA_RAMP_SEL

PA_RAMP_SEL=1us



PA_RAMP_SEL=2us

