

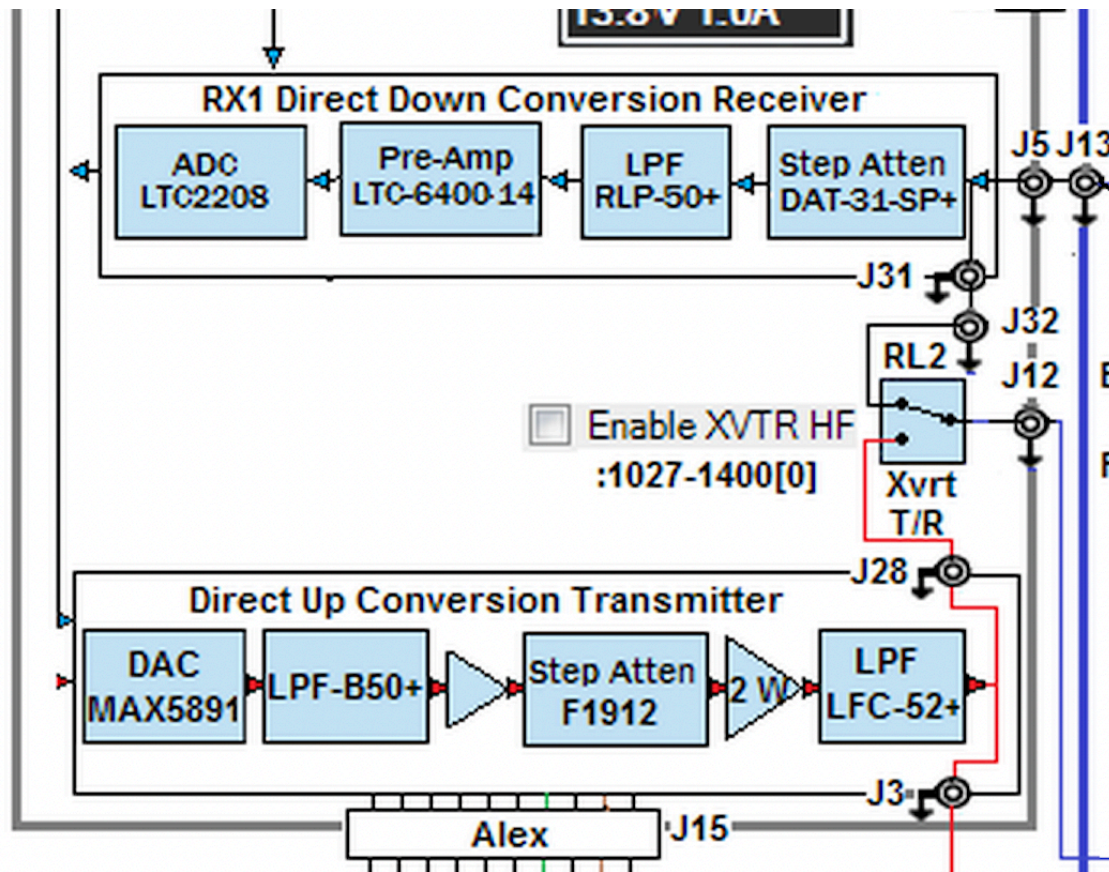
# Even Better PureSignal Performance on your Apache Labs radio

- ***Want up to 10 dB lower IMD when using PureSignal? Read on!***
- PureSignal operates by using feedback from the PA output to calculate the gain and phase characteristics of the PA. Then, the input to the PA is *'pre-distorted'* to compensate for the PA's gain and phase non-linearities.
- If this critical feedback signal is itself, in any way, distorted between the PA output and the A/D input where it's inserted back into the digital processing chain, this will clearly produce a sub-optimal PureSignal correction result. Our recent work has explored one significant mechanism by which this feedback signal can be distorted in at least some Apache Labs radio models.
- **A few symptoms of this issue:**
- The IMD reduction indicated on the panadapter (Thetis DUP mode) is better than that indicated on an external spectrum analyzer. [This is because the panadapter 'sees' the same feedback signal that PureSignal 'sees'.]
- Consistency of the panadapter and an external analyzer and even IMD performance may be better at higher PA power levels.
- IMD performance and inconsistency of the panadapter and an external analyzer may be worse at higher frequencies.

## Even Better PureSignal Performance on your Apache Labs radio

- The partial functional block diagram in the next slide shows connections of the Transverter jack on the rear panel to the N.O. and N.C. contacts of RL-2.

# Functional Block Diagram



Note that RL-2 N.C. contact J32 is connected to J31 which is connected directly to RX1 input. J31-to-J32 is a micro coaxial cable, see slides 94-99.

The N.O. contact is connected directly to the DUC 2-Watt TX output J28 & J3.

Therefore, TX output is "connected" to RX via the isolation of the RL2 contacts, a small signal relay. Review of the manufacturer specifications do not provide RF isolation specifications. Isolation is a function of frequency and likely to vary over the 160-6m range.

# Explanation of crosstalk-coupling problem

The 'desired' Feedback signal for PureSignal (whether internally or externally sourced) is ~0 dBm. Normally, only the output sample FB signal is supposed to be injected into RX1 during transmit with PS on.

To measure leakage of the RL-2 relay, a 0-dBm signal at 14 Mhz is applied to J3 (the TX Output) while measuring signal level at the RX1 input with the spectrum analyzer. As shown on Fig 1 in the next slide, a -54 dBm signal level is measured at RX1.

When the jumper is removed, ***the isolation is better than 90dB, no leakage signal is measurable, see Fig 2.*** This demonstrates direct contamination of the intended, or wanted FB signal. This crosstalk level *generally gets worse* as power level of the DUC increases.

Indeed, looking at the **G2 data** (slides 49-75), which includes both Jumper J7-J31 *installed* and *removed*, it appears that the negative effects of the relay/jumper are quite frequency dependent. Looking at PureSignal Improvement, there is little difference on 80M (0dB), moderate difference on 40M (3dB) and more significant difference on 20M (10dB).



# Explanation of crosstalk-coupling problem

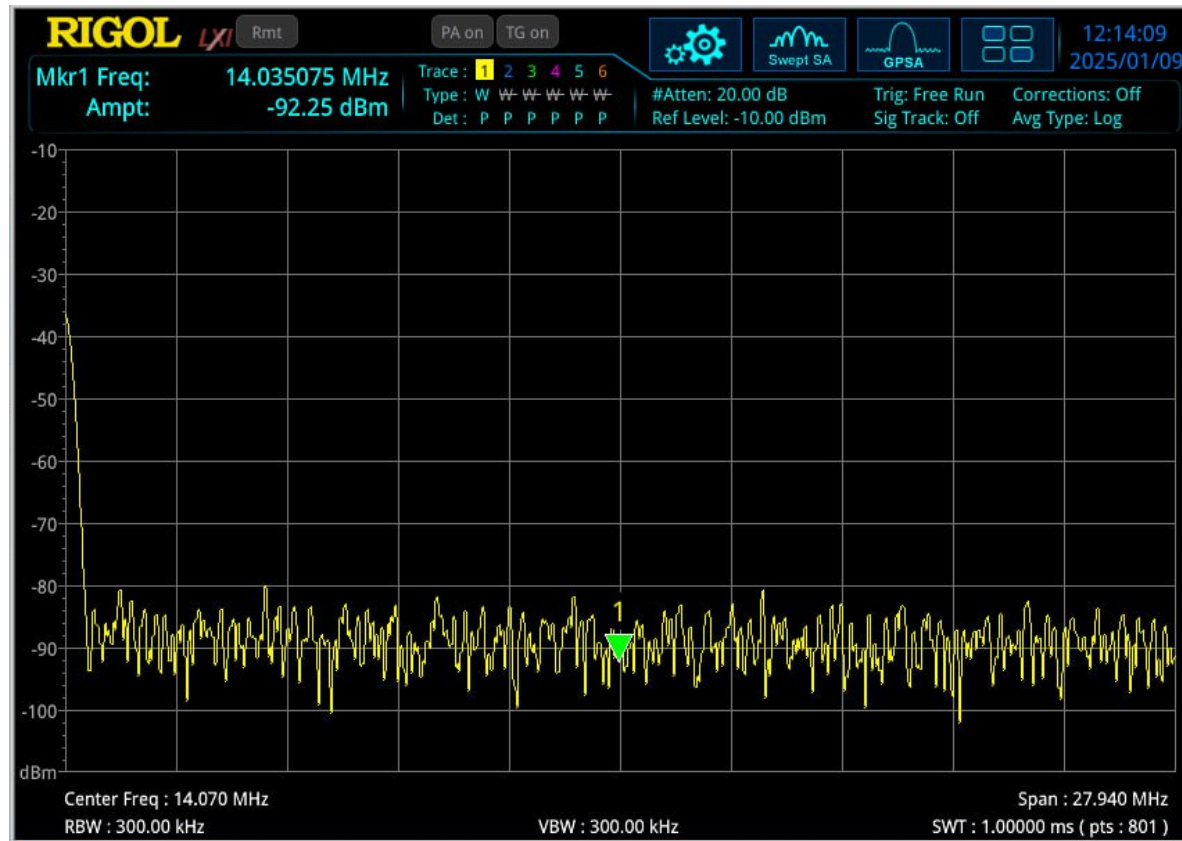
Attached on the next two slides is an isolation measurement made on the G2. Simulating the FB signal, a 0-dBm level signal at 14.02 Mhz was applied into J3 (TX output) with the offending **jumper removed**, Figure 1 shows the S/A measurement on J5 (RX1 input), note that there is NO SIGNAL present, that is, **it's > 90dB down**.

However, with the Jumper re-installed, note a leakage signal at -54dBm appears, so the isolation of the RL-2 relay N.O. to N.C. contacts of RL-2 [at 14Mhz] is only 54dB. Clearly, a different relay or routing method for the XVTR function is needed. In our case, we just pulled the jumper and ignore, as we do not plan to use the XVTR option.

# Functional Block Diagram Fig 1



# Functional Block Diagram Fig 2



# Summary

1. With the XVTR jumper removed, the Thetis Panadapter display (DUP Mode) now agrees very closely with the external Spectrum Analyzer measurements on all bands and at all power levels, typically within less than 1dB, see 7000DLE MKII dataset in the column header ***Thetis-S/A Difference***, slides 10, 23 & 36 that cover 40, 20 & 80m. Each measurement references the accompanying slide number showing the related Thetis or S/A measurement.
2. The improvement with PureSignal is both more consistent and 3<sup>rd</sup> order IMD is down by typically 60 ±3 dB on all bands and at all power levels.
3. When used to correct an external RF Amplifier, PureSignal corrects to even lower IMD: *typically* -60 dBc, versus -50 to -55 dBc previously with the jumper installed. See slides 79-93 for examples of tube and LDMOS RF amplifiers with PureSignal ON and OFF. PureSignal running on an Alpha 77DX with a single 8877 delivers -61 to -64 dBc 3<sup>rd</sup> order at 1500W and -56 to -60dBc on a Flex PGXL amplifier at 1500W.

PureSignal is arguably one of the most significant advances to the state-of-the-art in amateur radio in the past 30 years. These hardware improvements demonstrate what PureSignal is capable of and set the standard for adaptive pre-distortion in the amateur radio industry. The advent of LDMOS power amplifiers, and solid-state amplifiers in general, was a step backward in terms of IMD, typically demonstrating 3<sup>rd</sup> order products in the range of -25dBc versus tube-type PA's dating back to the 1980's that were -35dBc or better. PureSignal brings solid-state PA's back into the realm of decent spectral purity.

# Data Sets

Attached are data sets gathered on three models of Apache Labs radios. A 7000DLE MKII manufactured in 2019, a G2 built in 2024 and a 7000DLE manufactured in 2017. In all data sets, including those of the RF Amplifiers, final IMD values are based on worst case 3<sup>rd</sup> order level referenced to the lower of two f0 tones at 700 & 1900 Hz. Other models may have the same problem. If you have an other model, you're invited to make similar measurements and share your results.

## RF Power Amplifier Testing

Slide 79, and supporting Spectrum Analyzer measurements demonstrate PureSignal performance with both a tube PA and LDMOS PA with the crosstalk problem resolved.

An Alpha 77DX, using a single 3CX1500A7 shows 3<sup>rd</sup> order products down -61 dBc and 5<sup>th</sup> order down -64 dBc or better at 1500W output on 15, 20, 40 and 80m versus -35dBc w/o PureSignal.

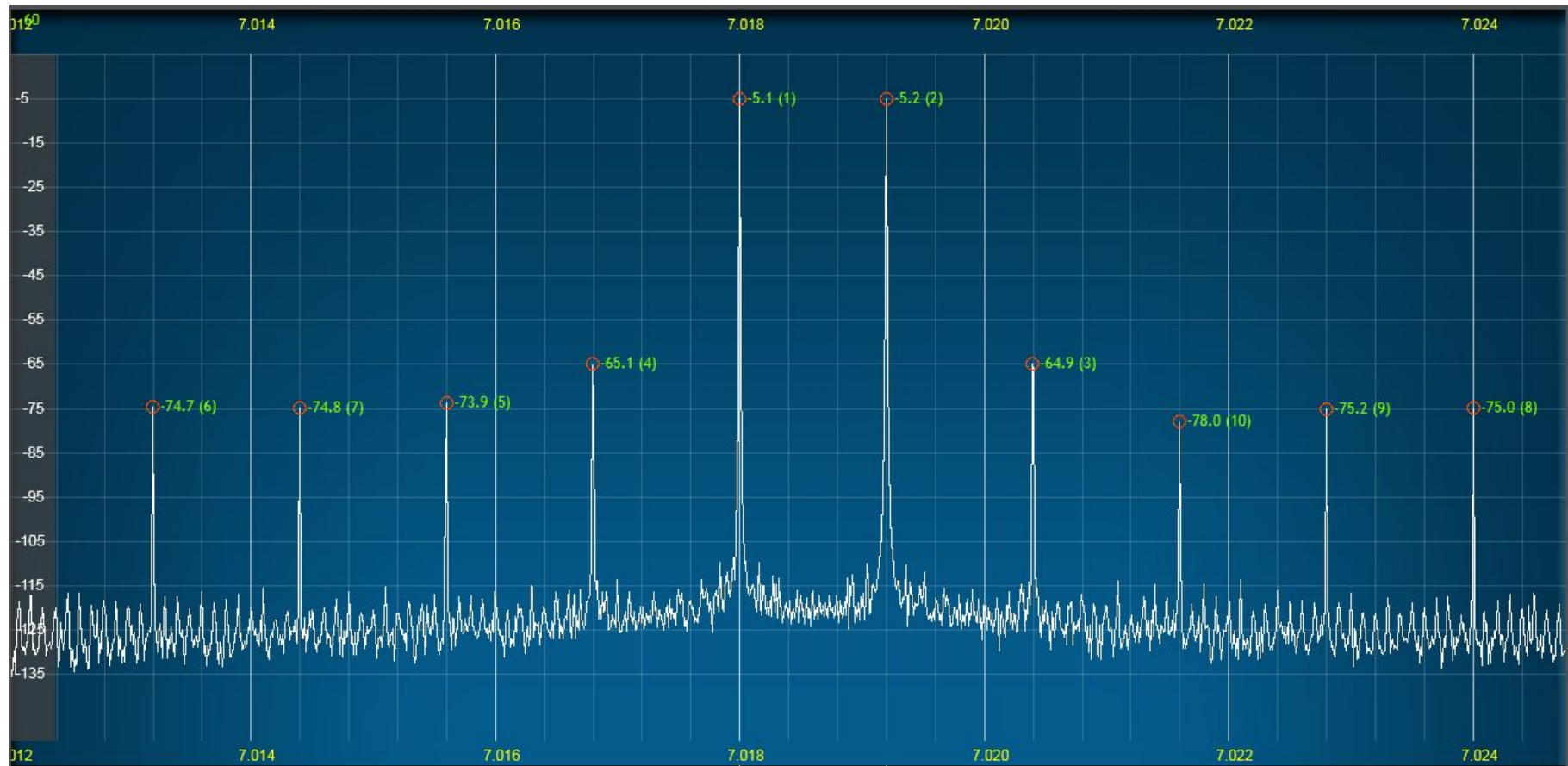
A Flex PGXL LDMOS amplifier shows 3<sup>rd</sup> order products down -56 dBc and 5<sup>th</sup> order down -62 dBc or better at 1500W output on 20, 40 and 80m versus -25 to -33 dBc w/o PureSignal.

These are extraordinary improvements, and worth the effort of updating your radios.

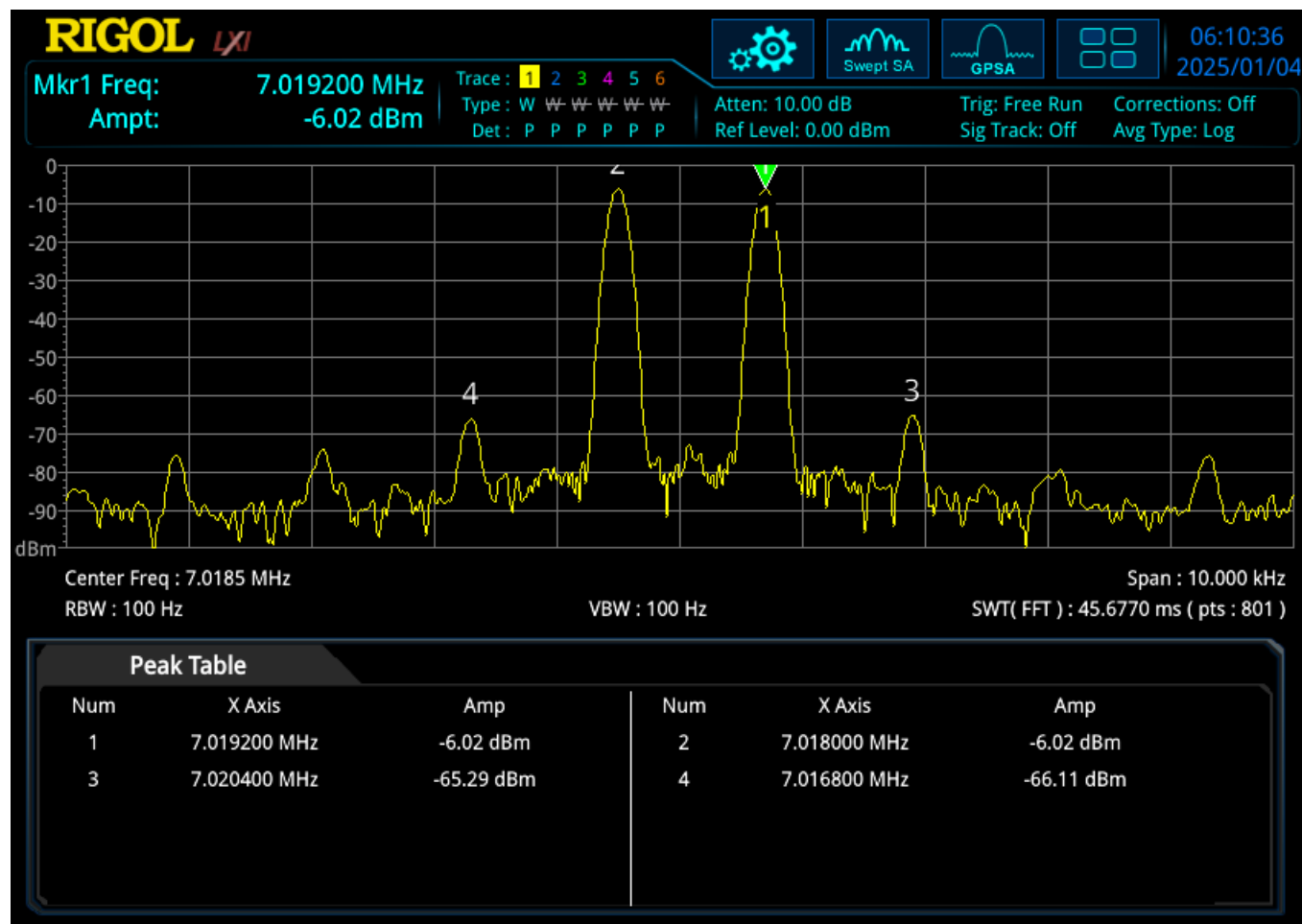
# 40m IMD Data 7000DLE MKII K1VF

K1VF Data		Pure Signal									
J31-J32 REMOVED		FREQ	POWER	ATT	ON/OFF	3rd Order		Result	Thetis-S/A	Pure Signal	Reference
3-Jan-25	SOURCE	Mhz	Watts	dB	INT FB	dBc	f-0	dBc	Difference	Improvement	Filename
40m Data											
K1VF 7000DLE MKII	Thetis	7.02	50	13	ON	-64.9	-5.2	-59.7		17.2	11
RSA3015N	S/A	7.02	50	13	ON	-65.3	-6.0	-59.3	-0.41	17.0	12
K1VF 7000DLE MKII	Thetis	7.02	100	16	ON	-60.7	-3.0	-57.7		32.7	13
RSA3015N	S/A	7.02	100	16	ON	-62.8	-6.0	-56.8	-0.93	32.2	14
K1VF 7000DLE MKII	Thetis	7.02	25	10	ON	-70.5	-9.1	-61.4		12.4	15
RSA3015N	S/A	7.02	25	10	ON	-66.9	-6.1	-60.9	-0.54	11.0	16
K1VF 7000DLE MKII	Thetis	7.02	50	13	OFF	-47.7	-5.2	-42.5			17
RSA3015N	S/A	7.02	50	13	OFF	-48.3	-6.0	-42.3	-0.17		18
K1VF 7000DLE MKII	Thetis	7.02	100	16	OFF	-27.5	-2.5	-25.0			19
RSA3015N	S/A	7.02	100	16	OFF	-30.6	-6.0	-24.6	-0.38		20
K1VF 7000DLE MKII	Thetis	7.02	25	10	OFF	-57.9	-8.9	-49.0			21
RSA3015N	S/A	7.02	25	10	OFF	-55.9	-6.0	-49.9	0.85		22

## 40m 50W PS ON THETIS 7K

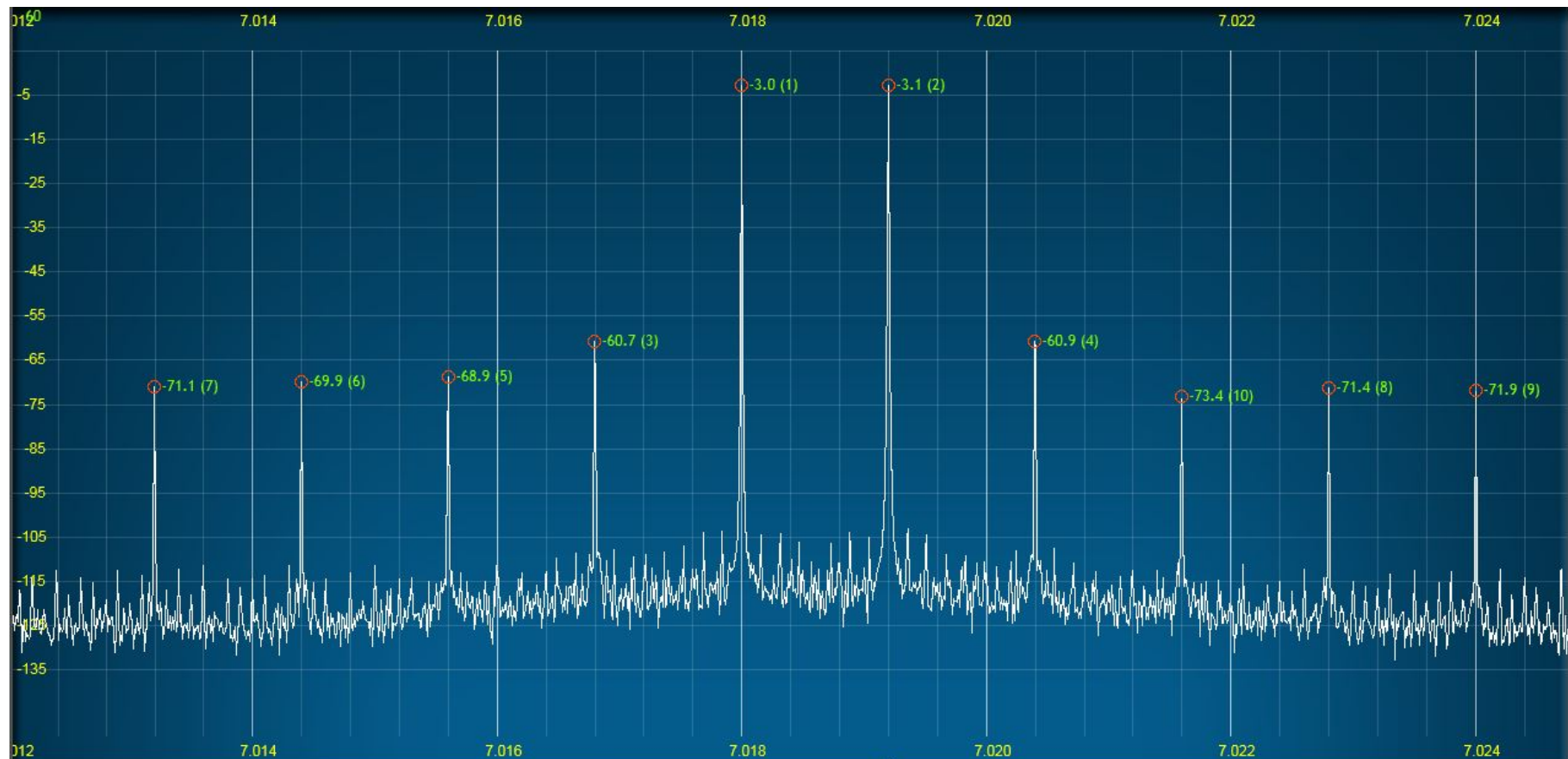


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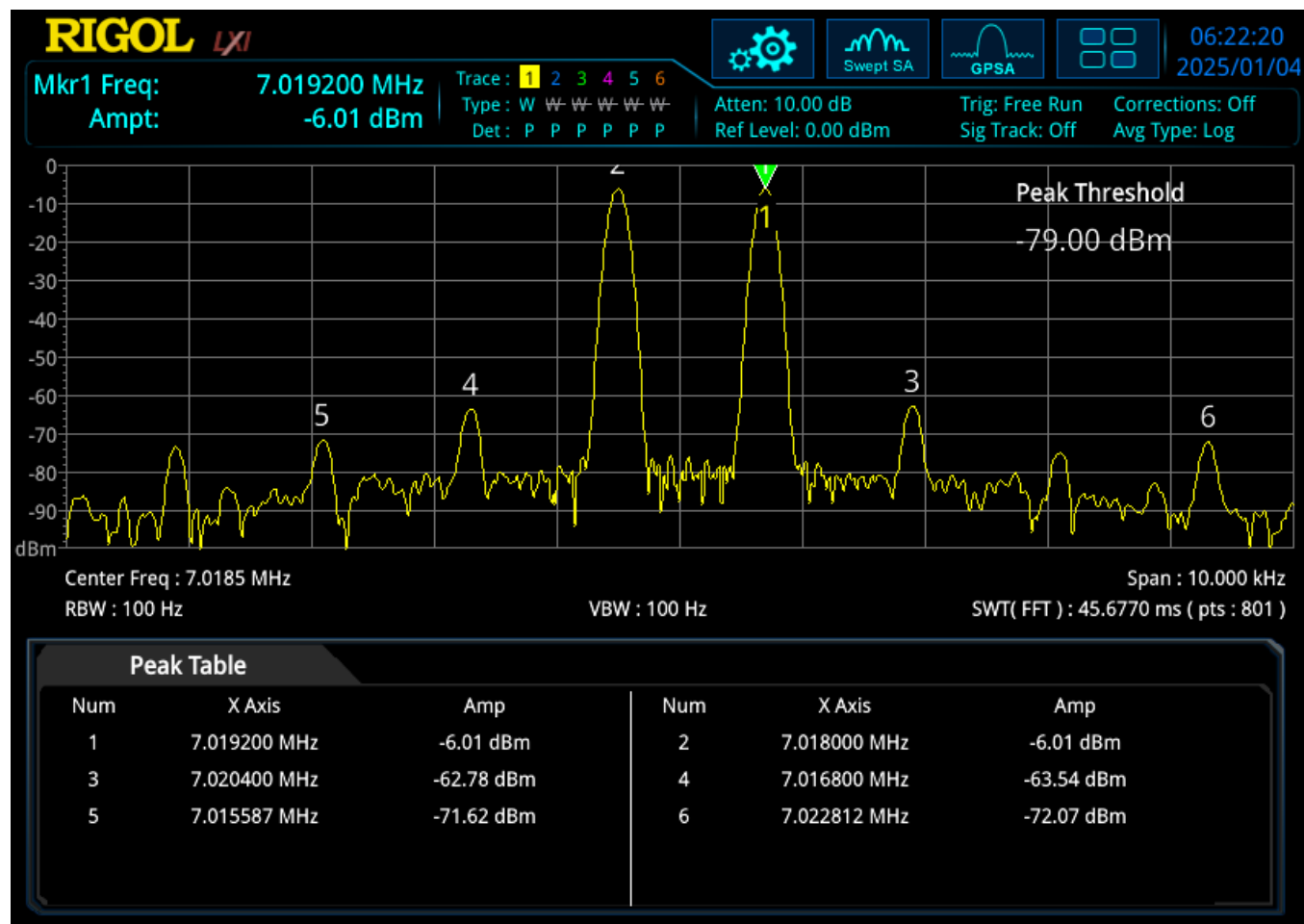




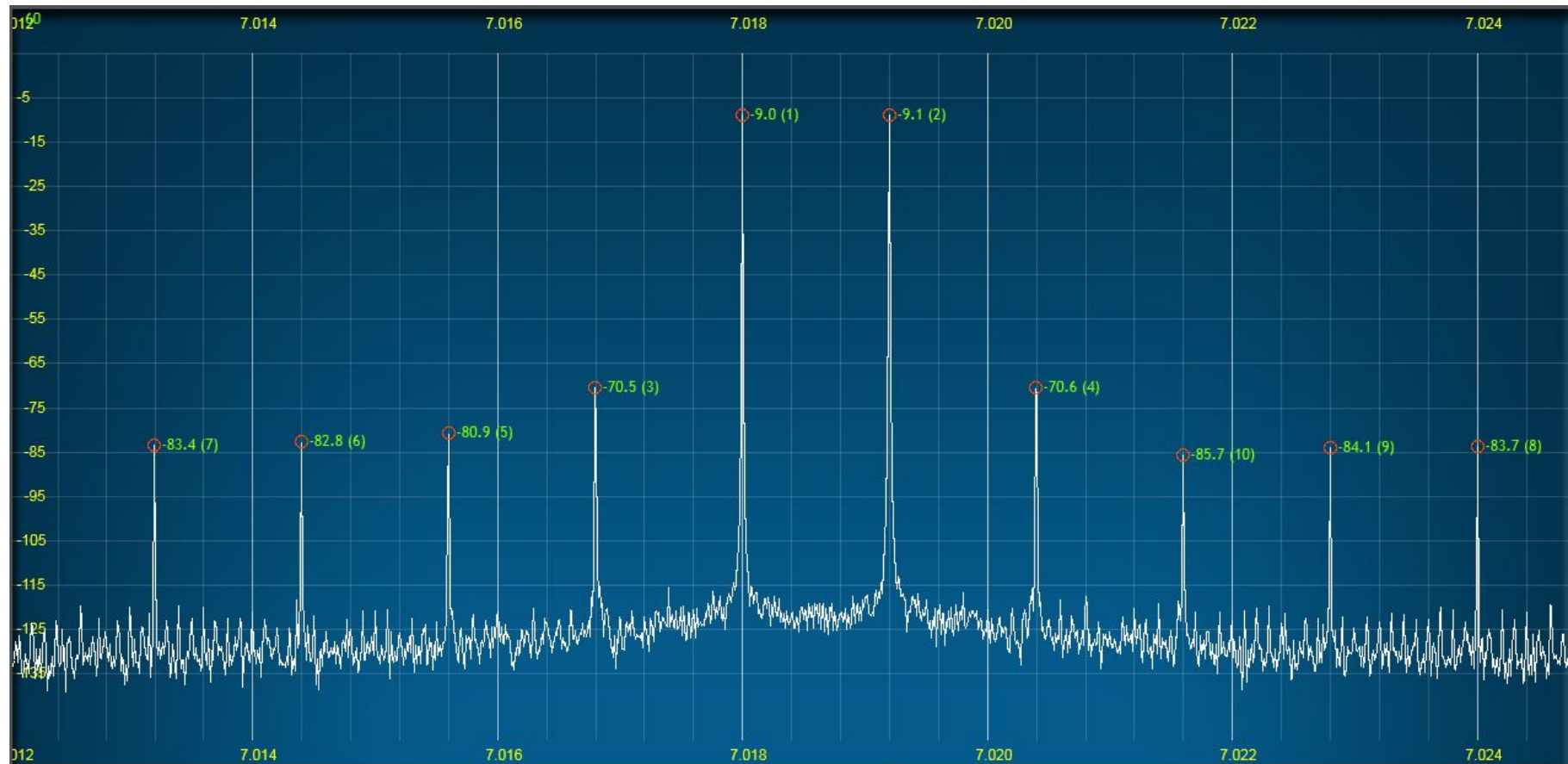
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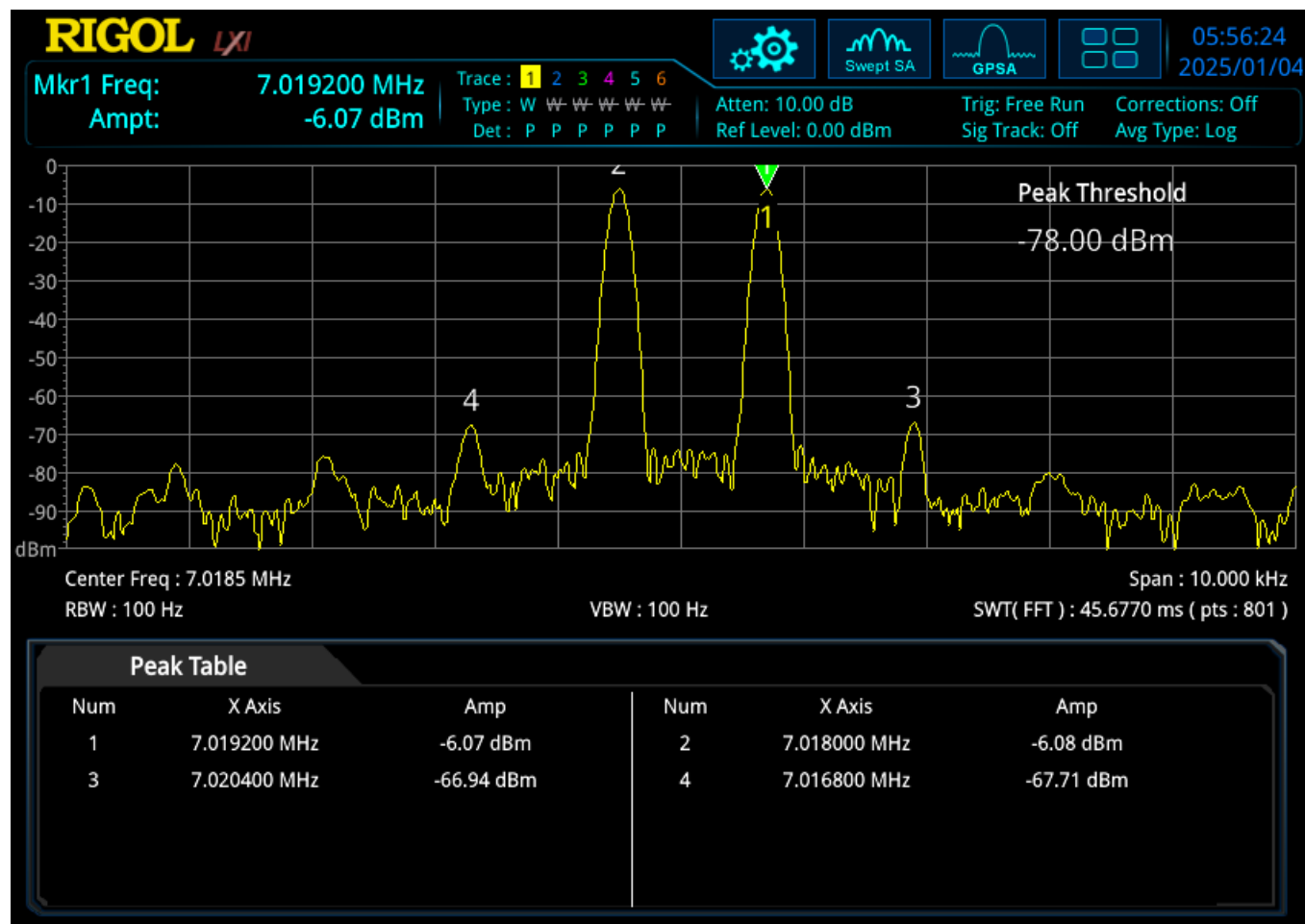
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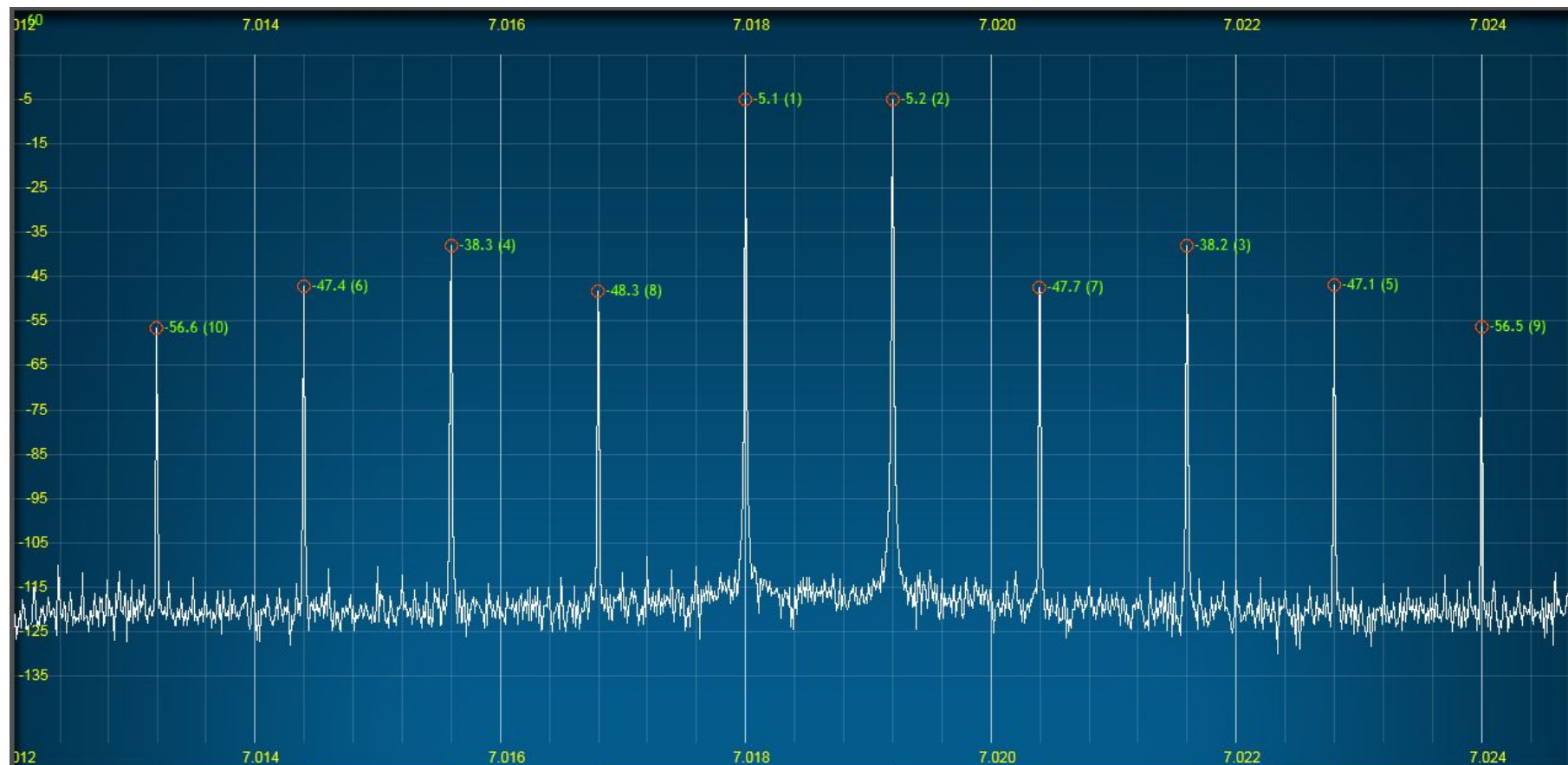
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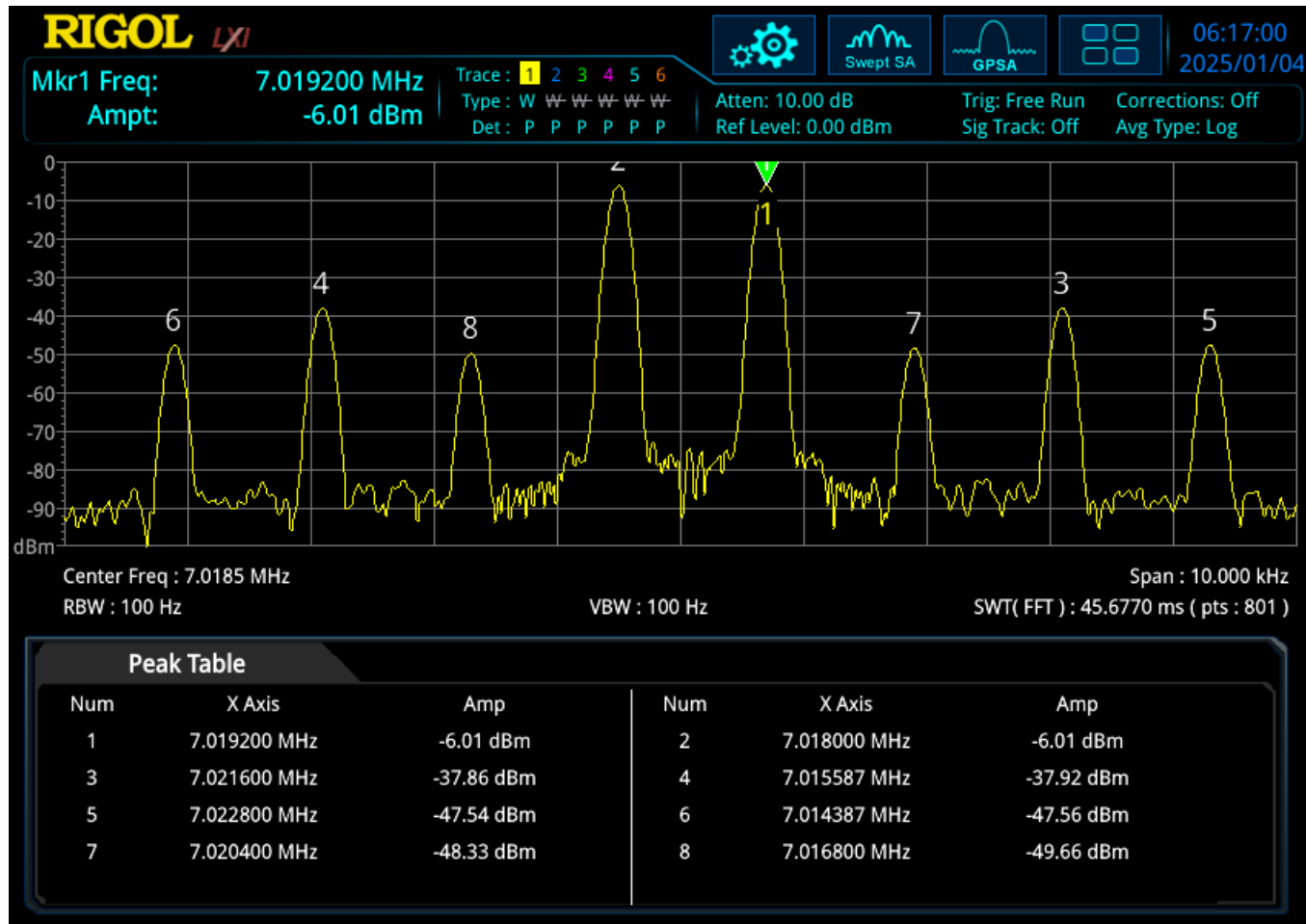
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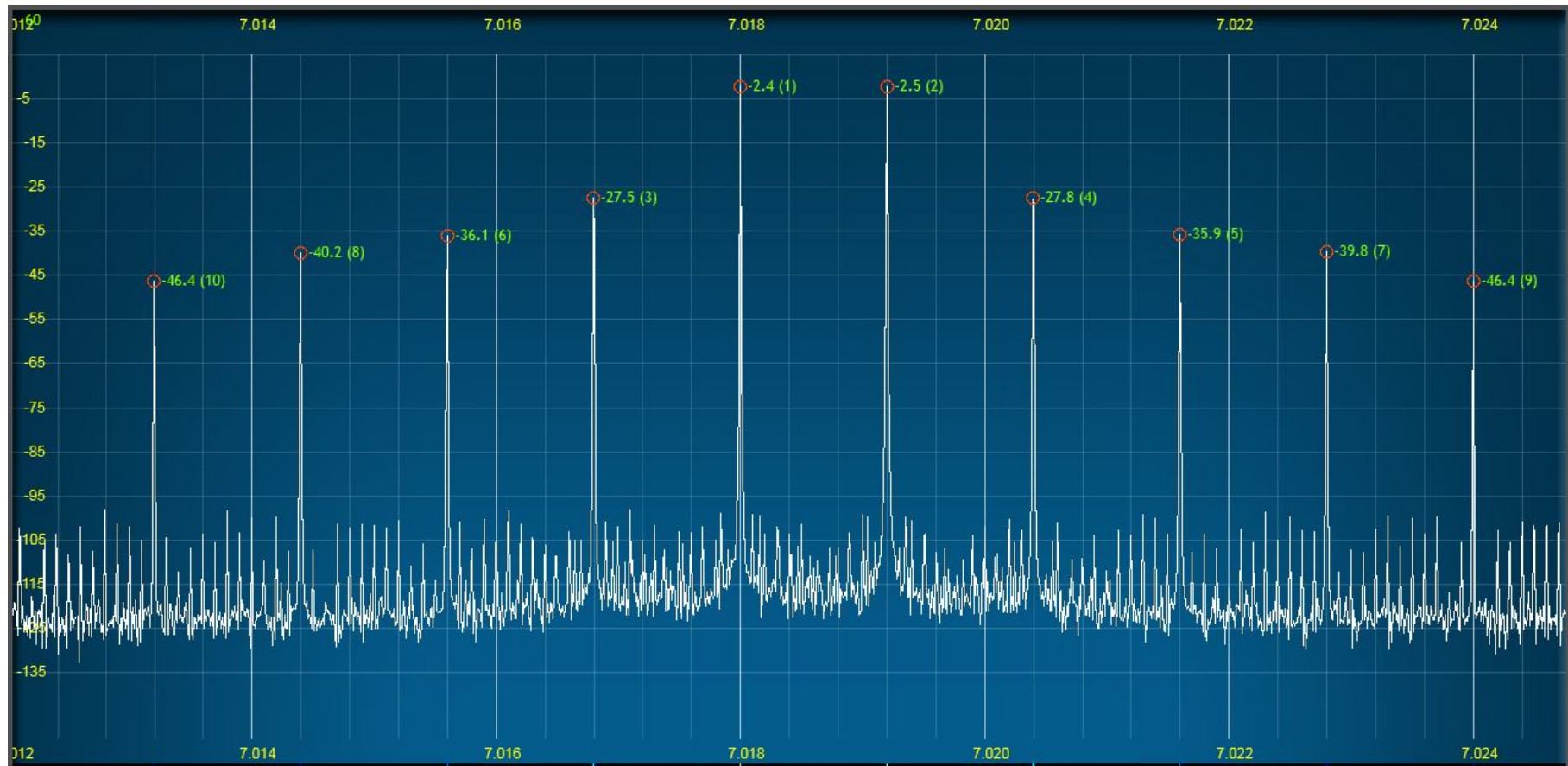
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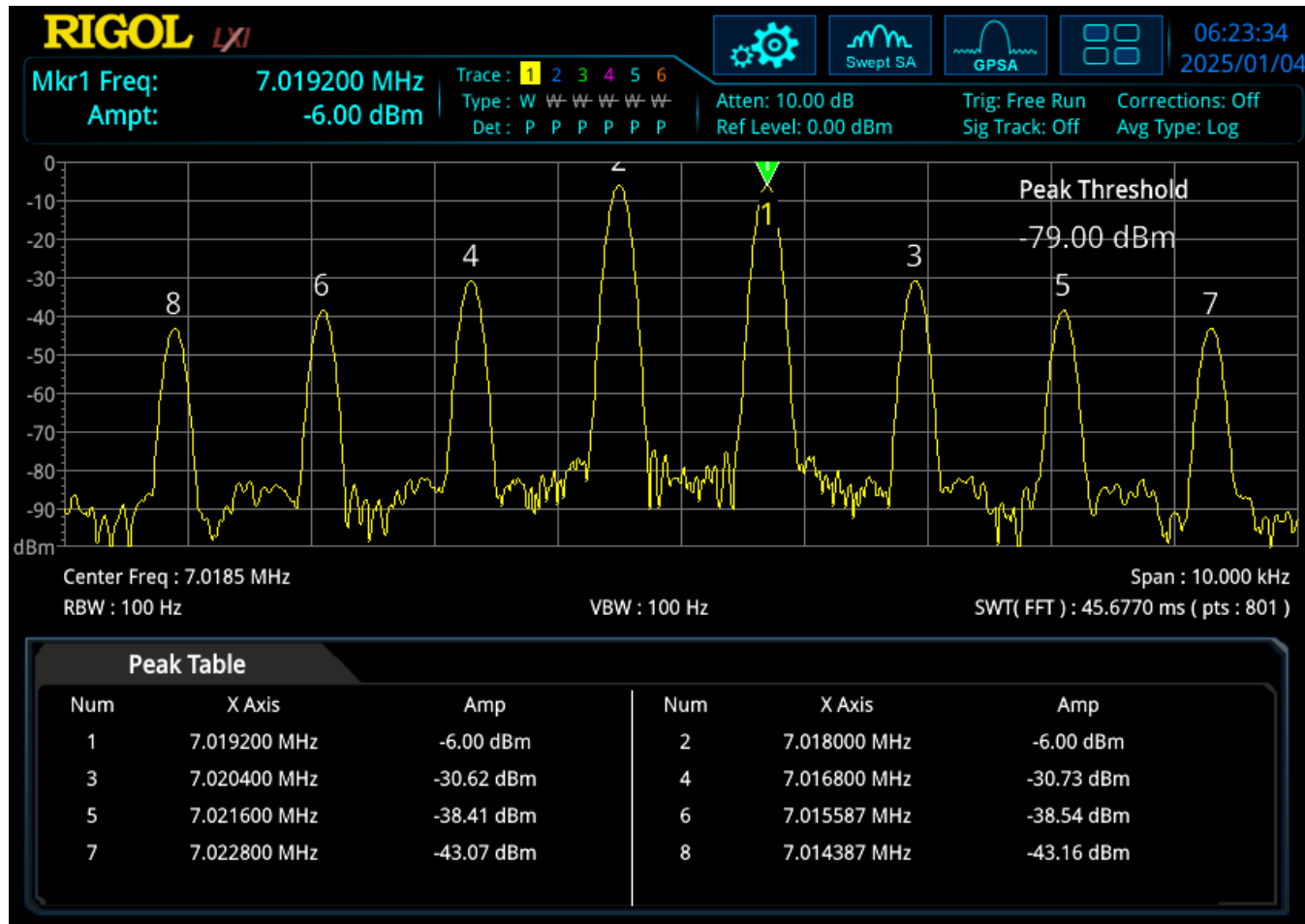
## 40m 50W PS OFF RIGOL



## 40m 100W PS OFF THETIS 7K

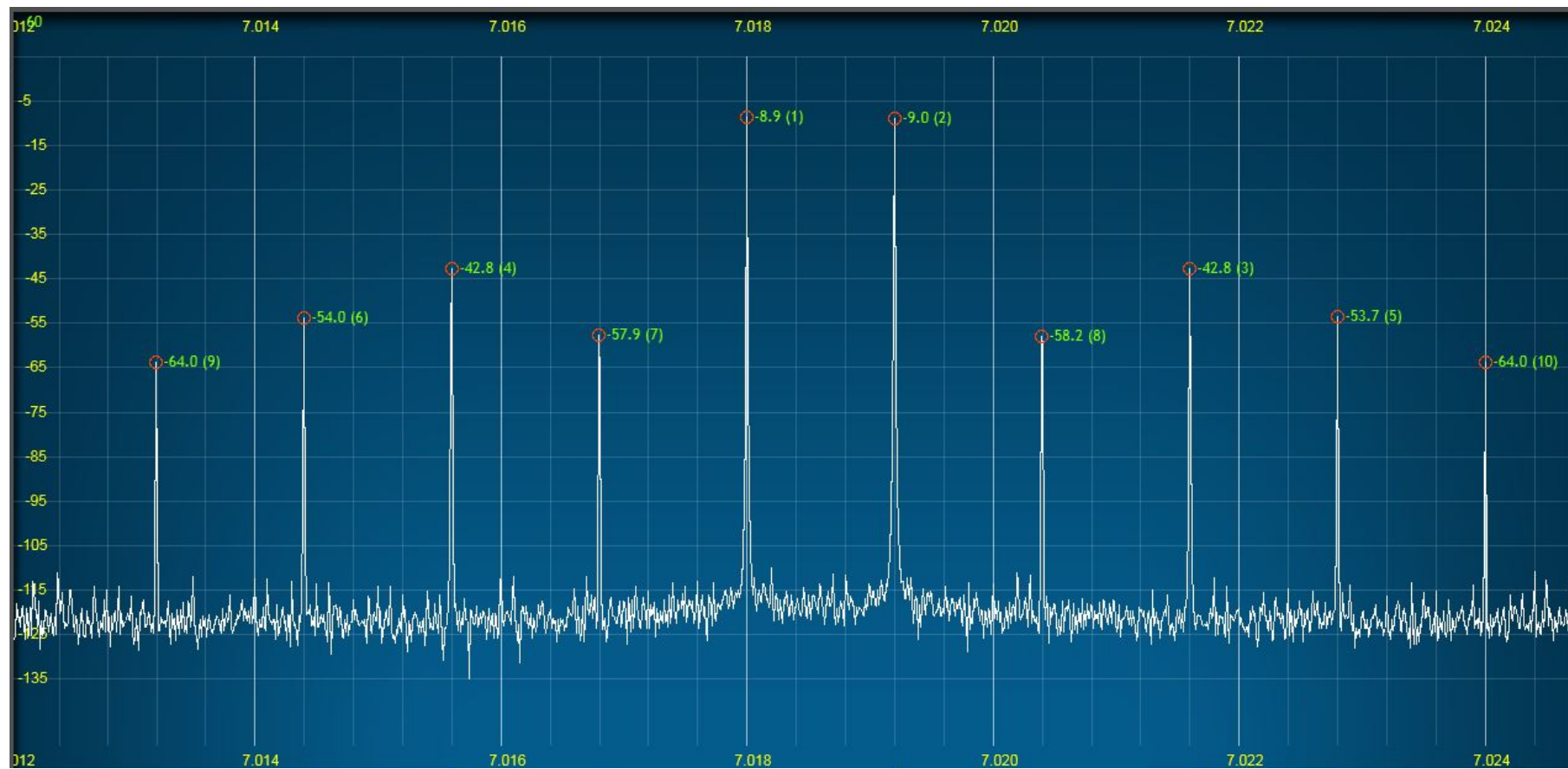


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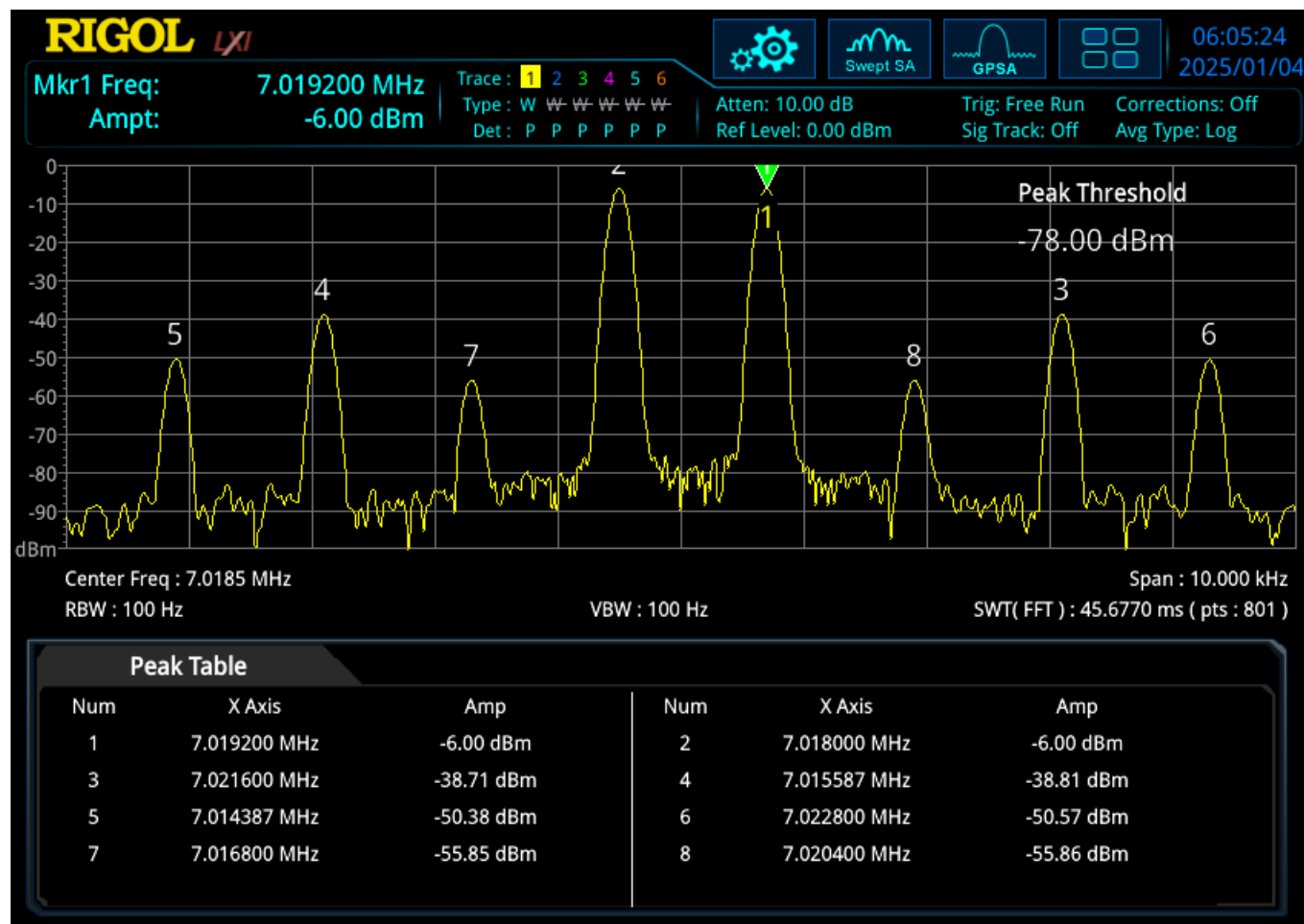




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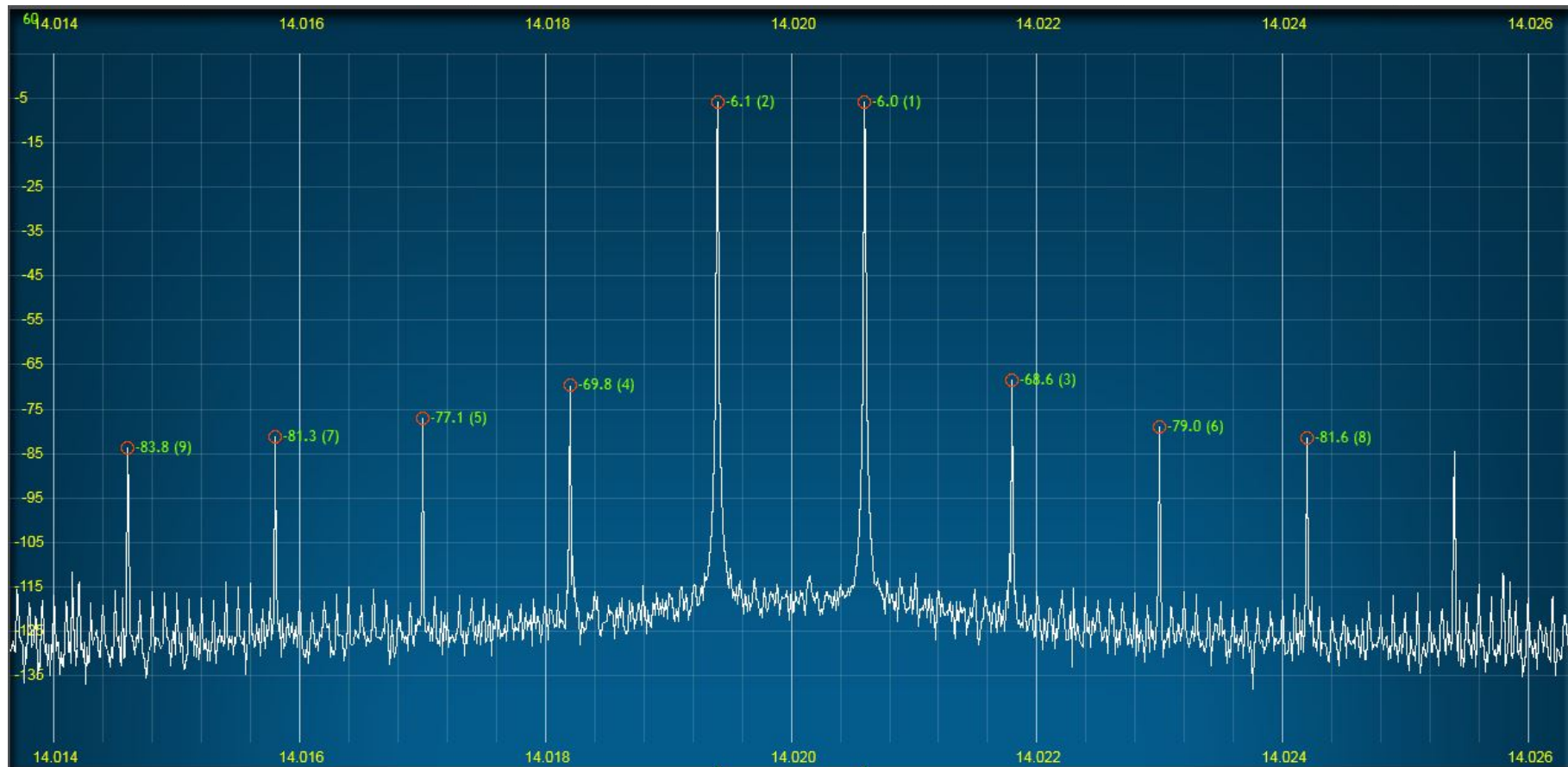
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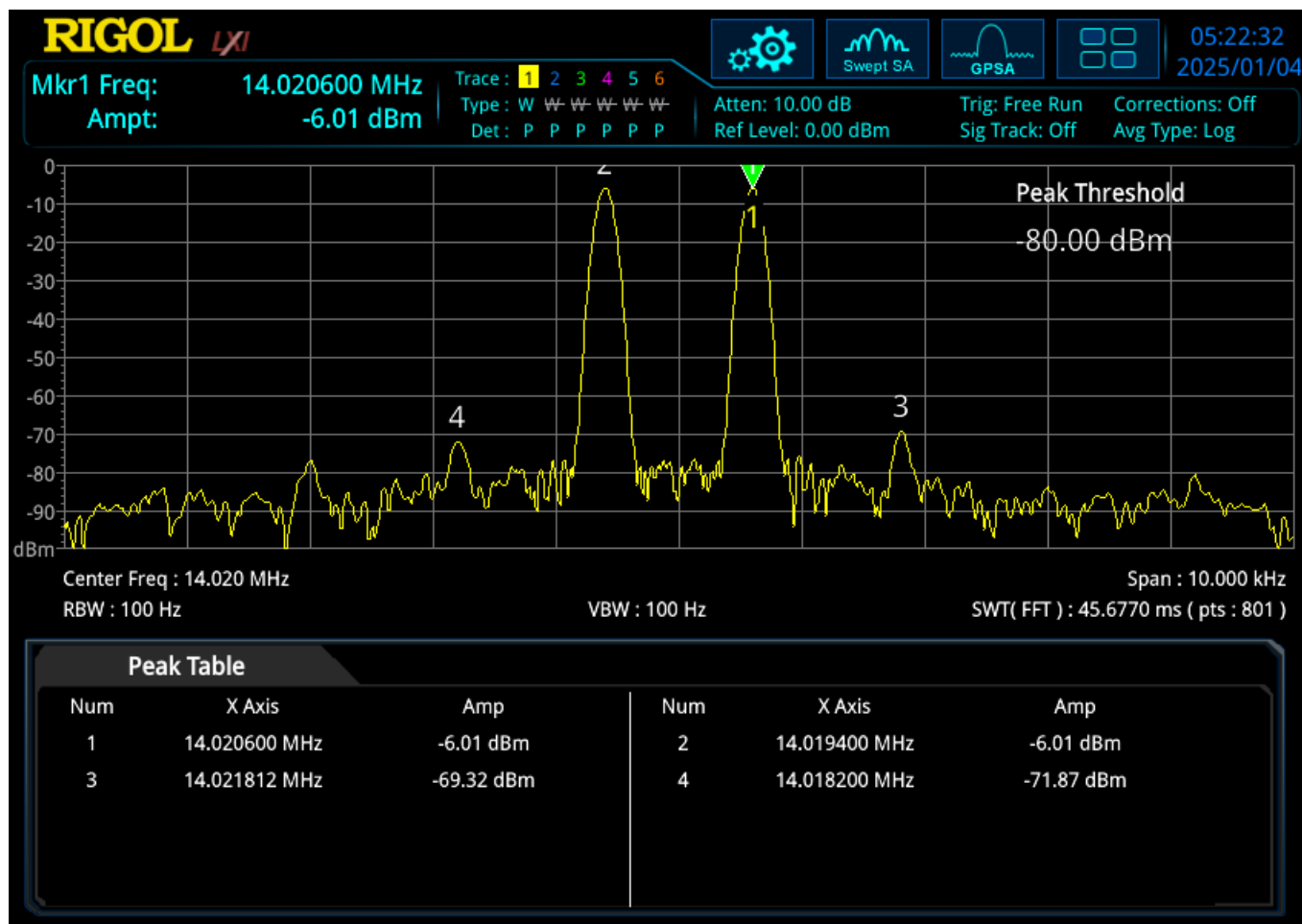
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J31-J32 REMOVED		FREQ	POWER	ATT	ON/OFF	3rd Order		Result	Thetis-S/A	Pure Signal	Reference
3-Jan-25	SOURCE	Mhz	Watts	dB	INT FB	dBc	f-0	dBc	Difference	Improvement	Filename
20m Data											
K1VF 7000DLE MKII	Thetis	14.02	50	13	ON	-68.6	-6.1	-62.5		18.1	24
RSA3015N	S/A	14.02	50	13	ON	-69.3	-6.0	-63.3	0.81	18.9	25
K1VF 7000DLE MKII	Thetis	14.02	100	16	ON	-61.6	-3.0	-58.6		30.5	26
RSA3015N	S/A	14.02	100	16	ON	-65.0	-6.0	-59.0	0.38	30.3	27
K1VF 7000DLE MKII	Thetis	14.02	25	10	ON	-75.5	-8.8	-66.7		34.5	28
RSA3015N	S/A	14.02	25	10	ON	-72.6	-6.0	-66.6	-0.08	33.6	29
K1VF 7000DLE MKII	Thetis	14.02	50	13	OFF	-50.2	-5.8	-44.4			30
RSA3015N	S/A	14.02	50	13	OFF	-50.3	-6.0	-44.4	-0.03		31
K1VF 7000DLE MKII	Thetis	14.02	100	16	OFF	-31.1	-3.0	-28.1			32
RSA3015N	S/A	14.02	100	16	OFF	-34.7	-6.1	-28.6	0.54		33
K1VF 7000DLE MKII	Thetis	14.02	25	10	OFF	-41.0	-8.8	-32.2			34
RSA3015N	S/A	14.02	25	10	OFF	-39.1	-6.1	-33.1	0.87		35

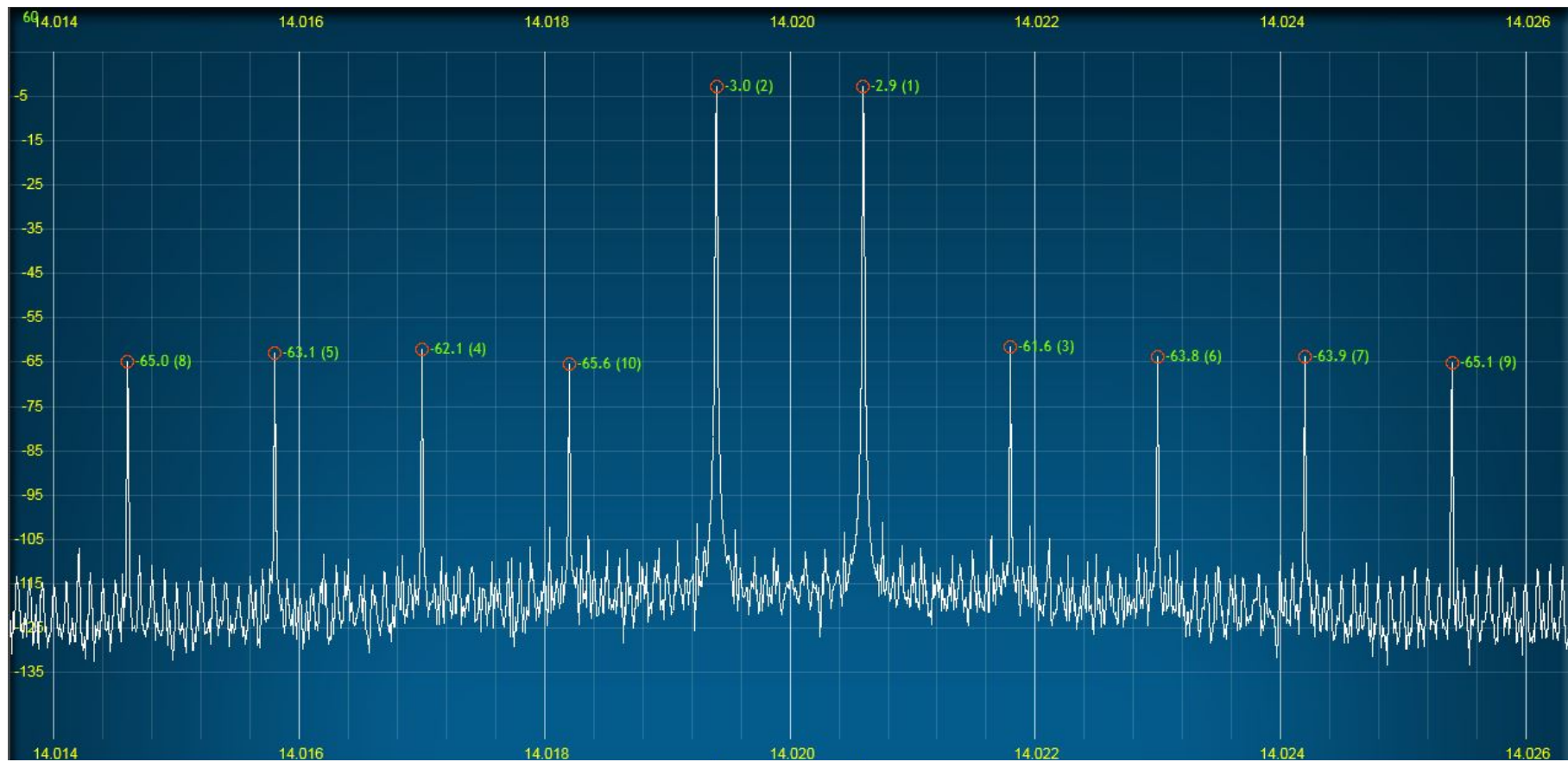
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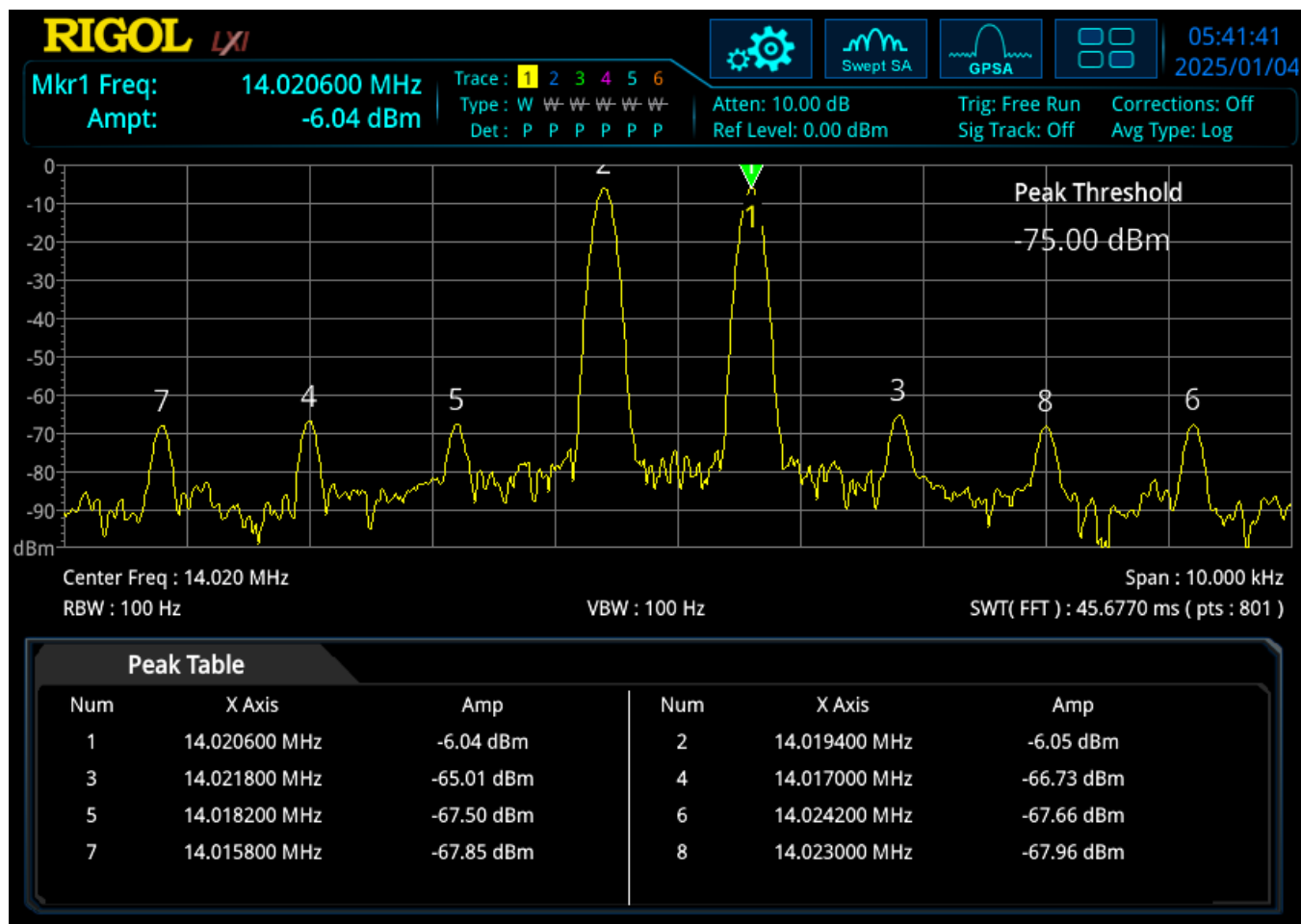
## 20m 50W PS ON RIGOL



## 20m 100W PS ON THETIS 7K

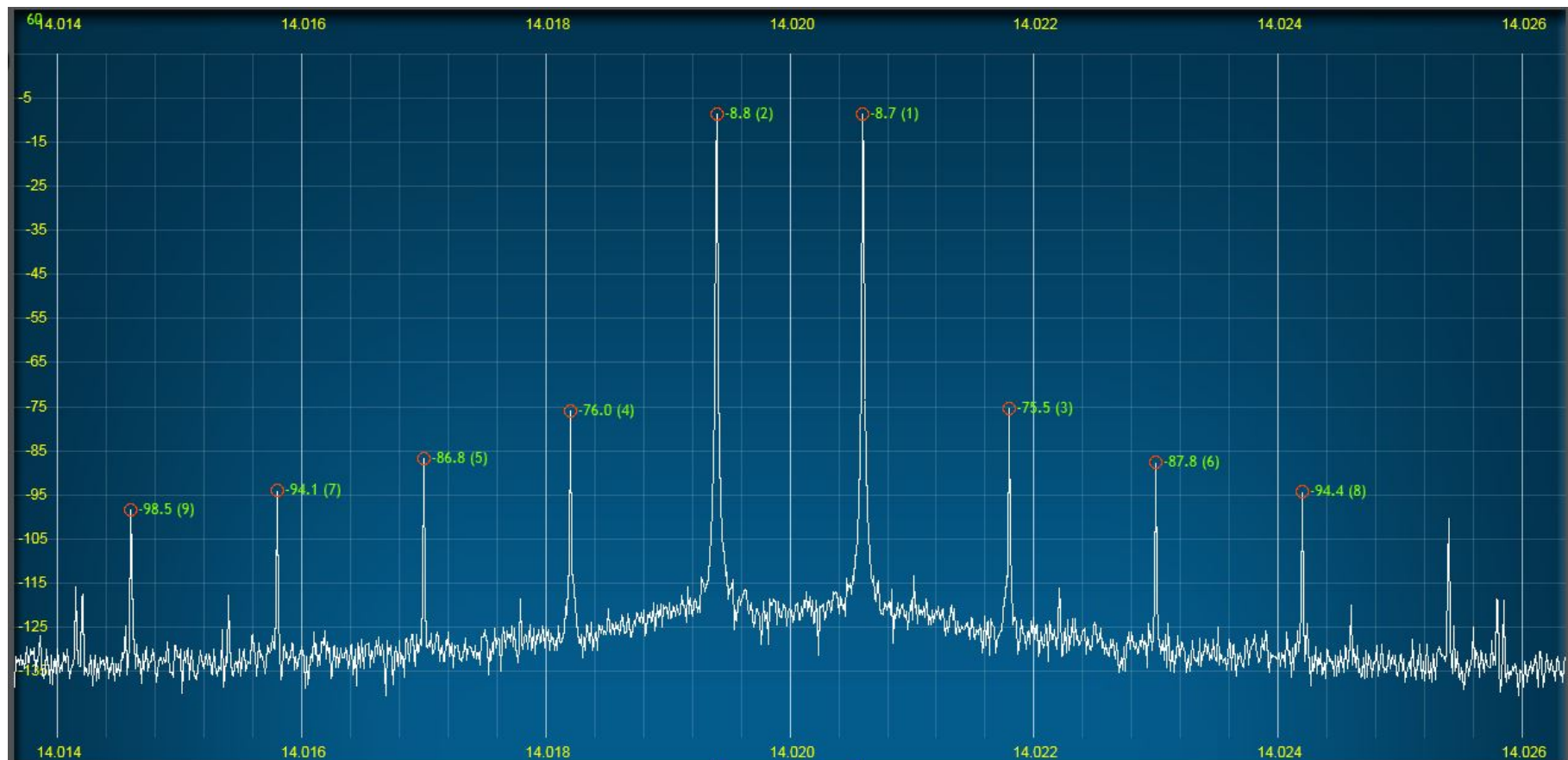


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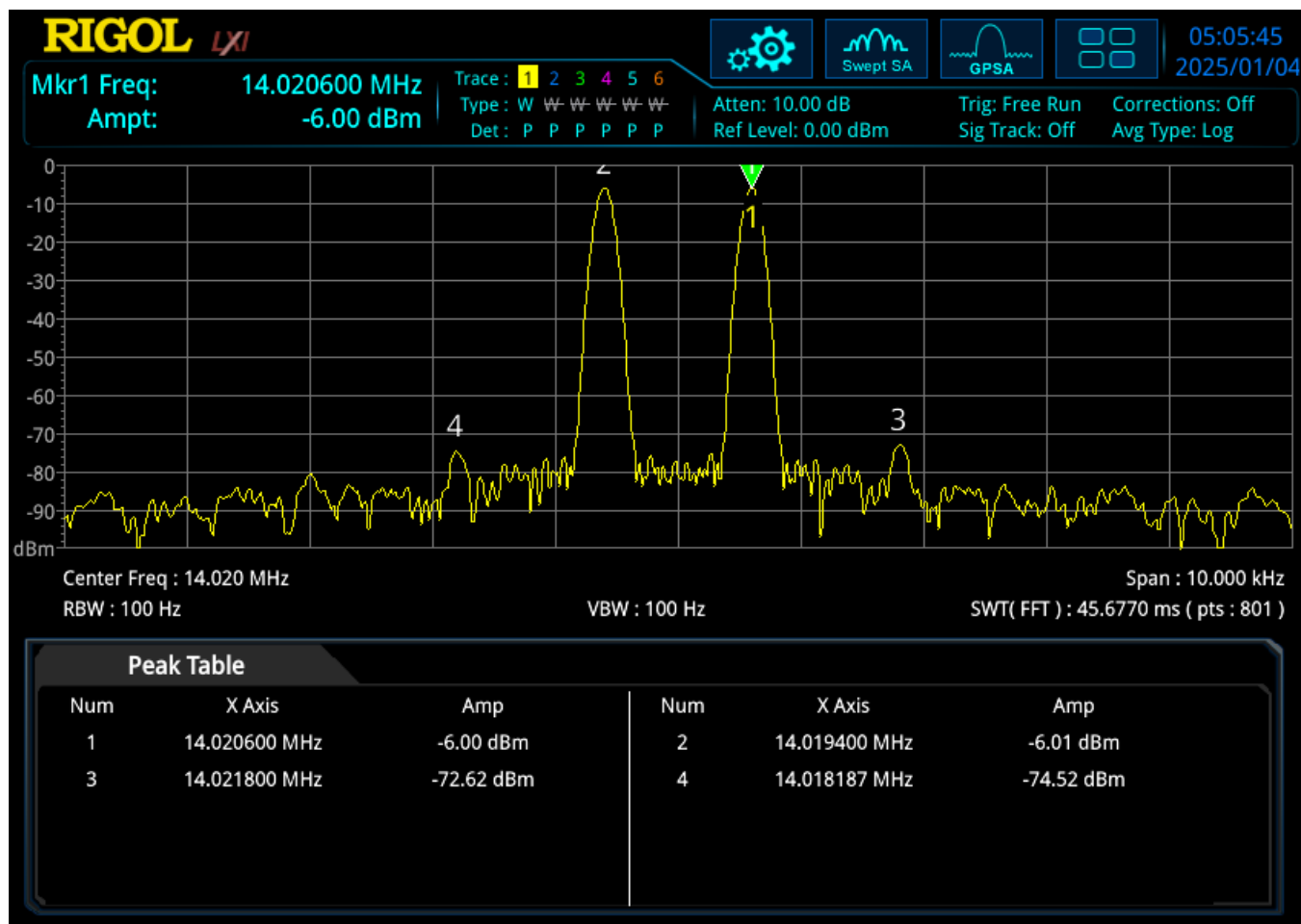


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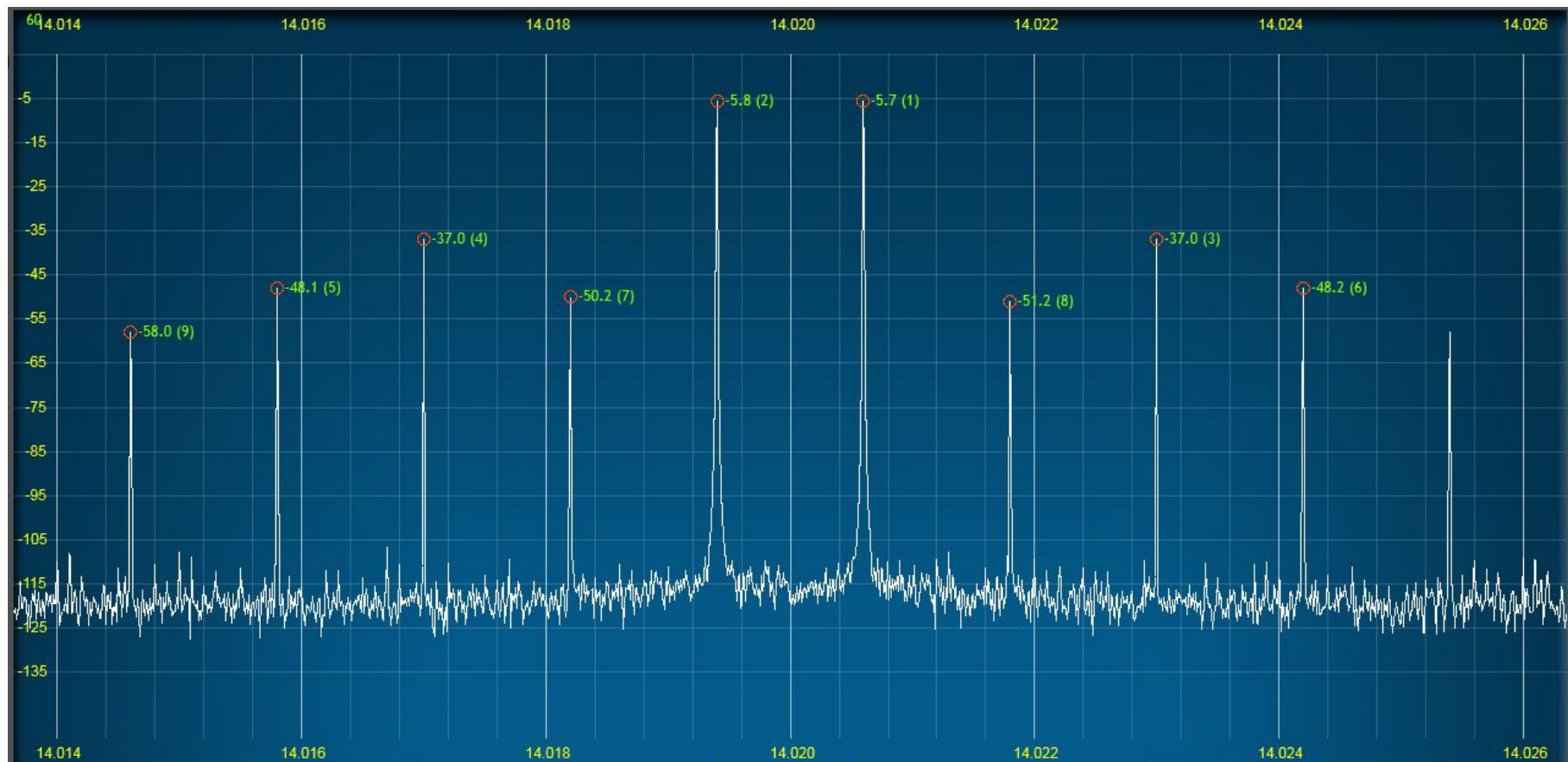




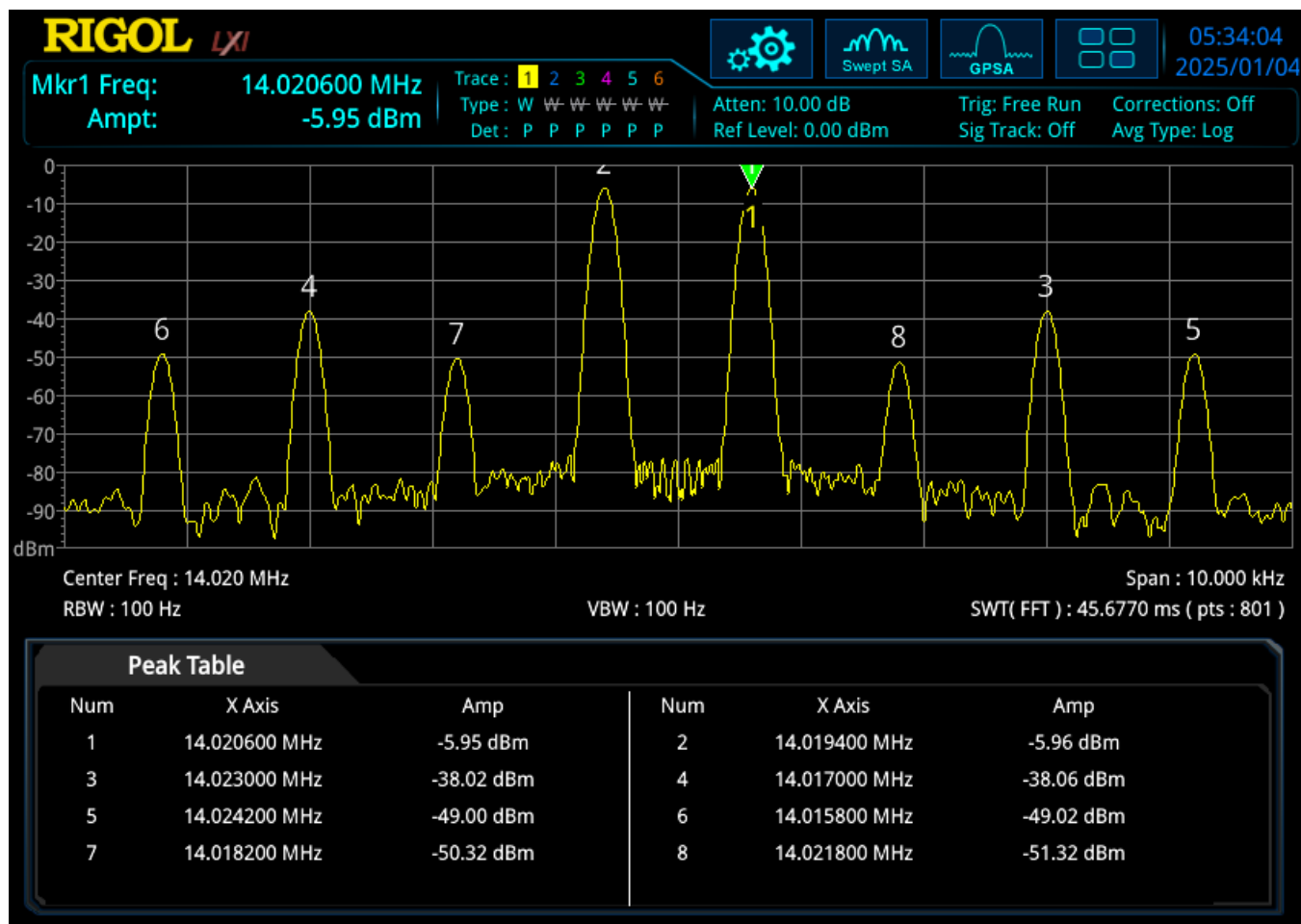
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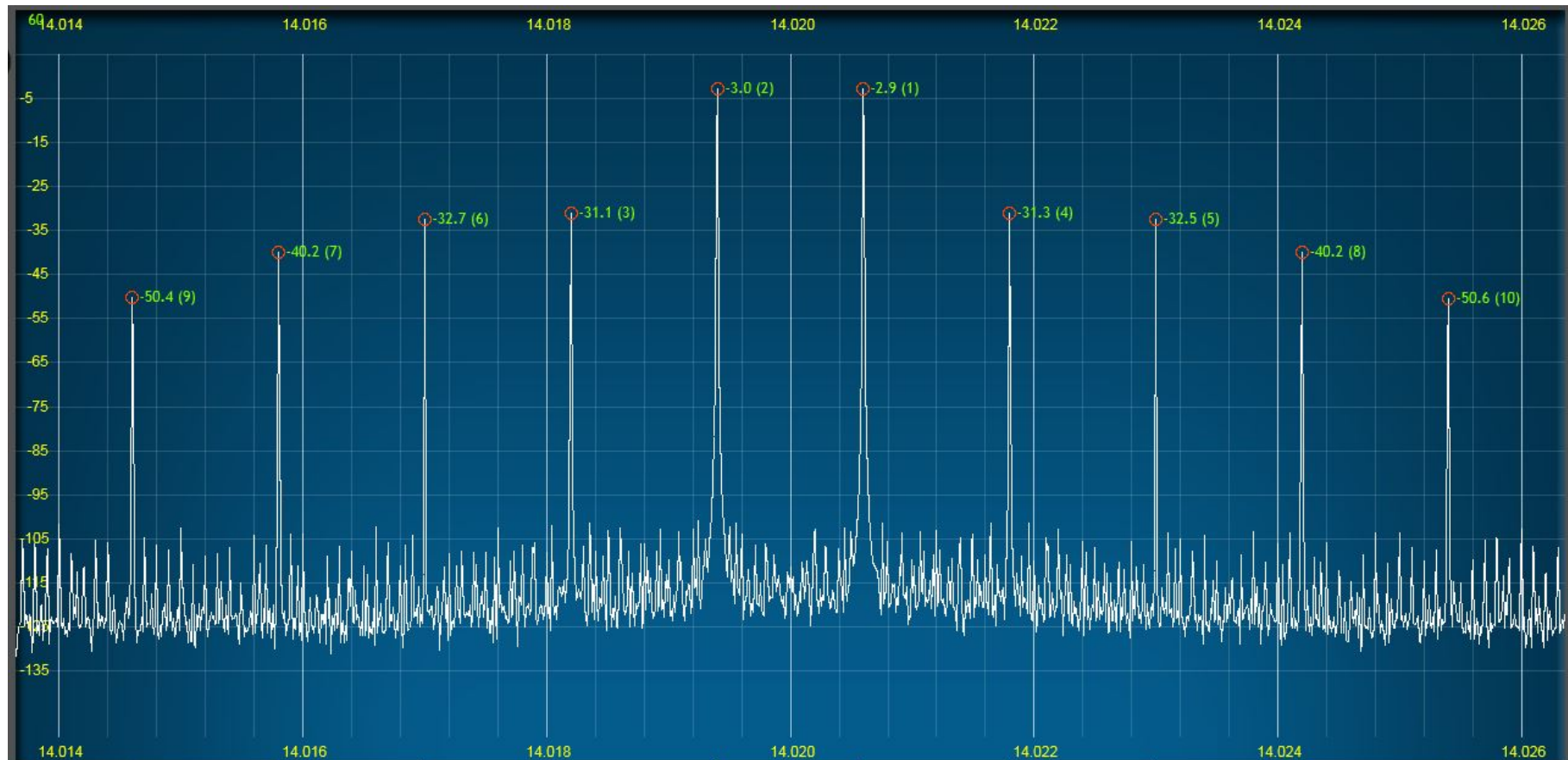
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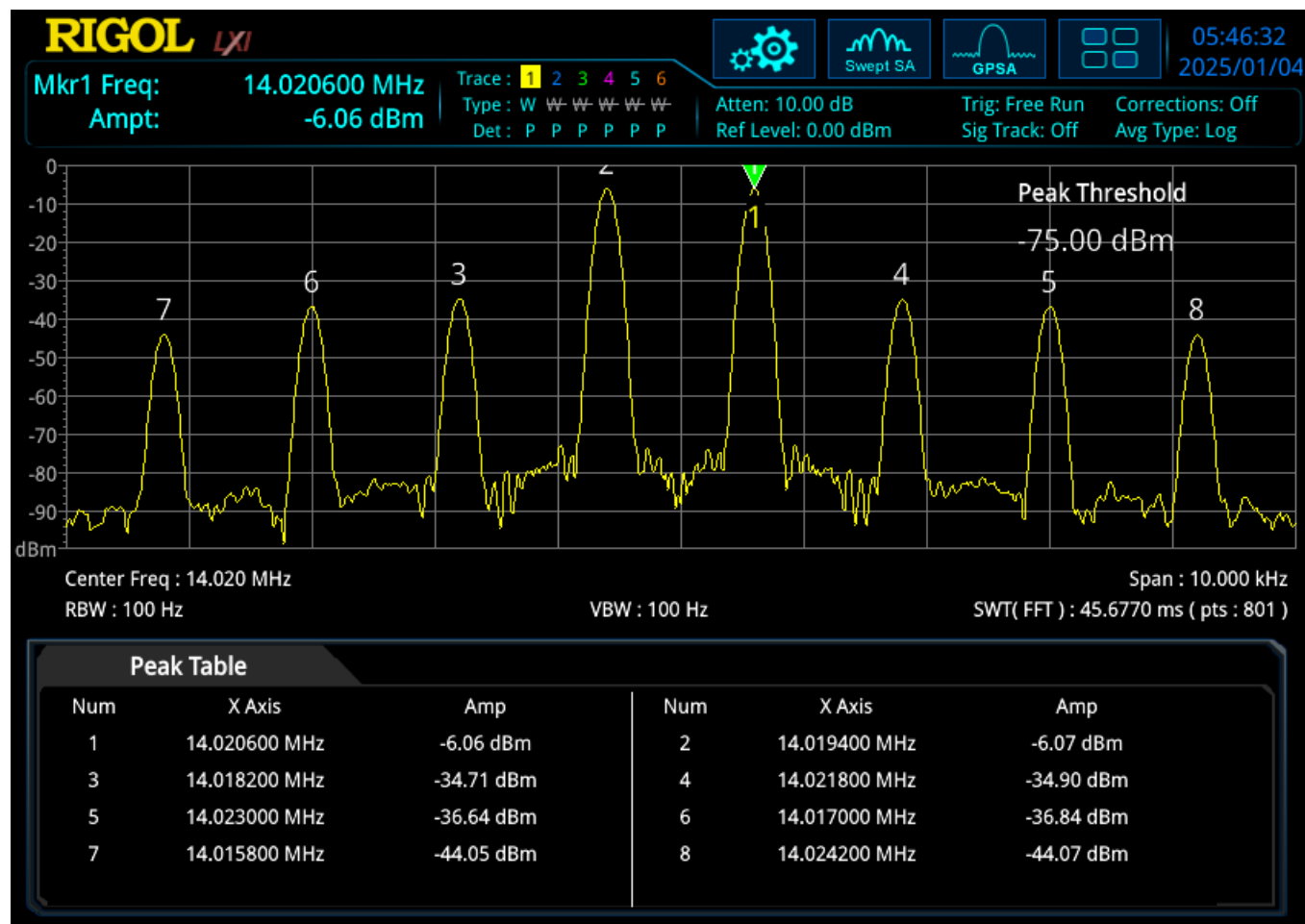
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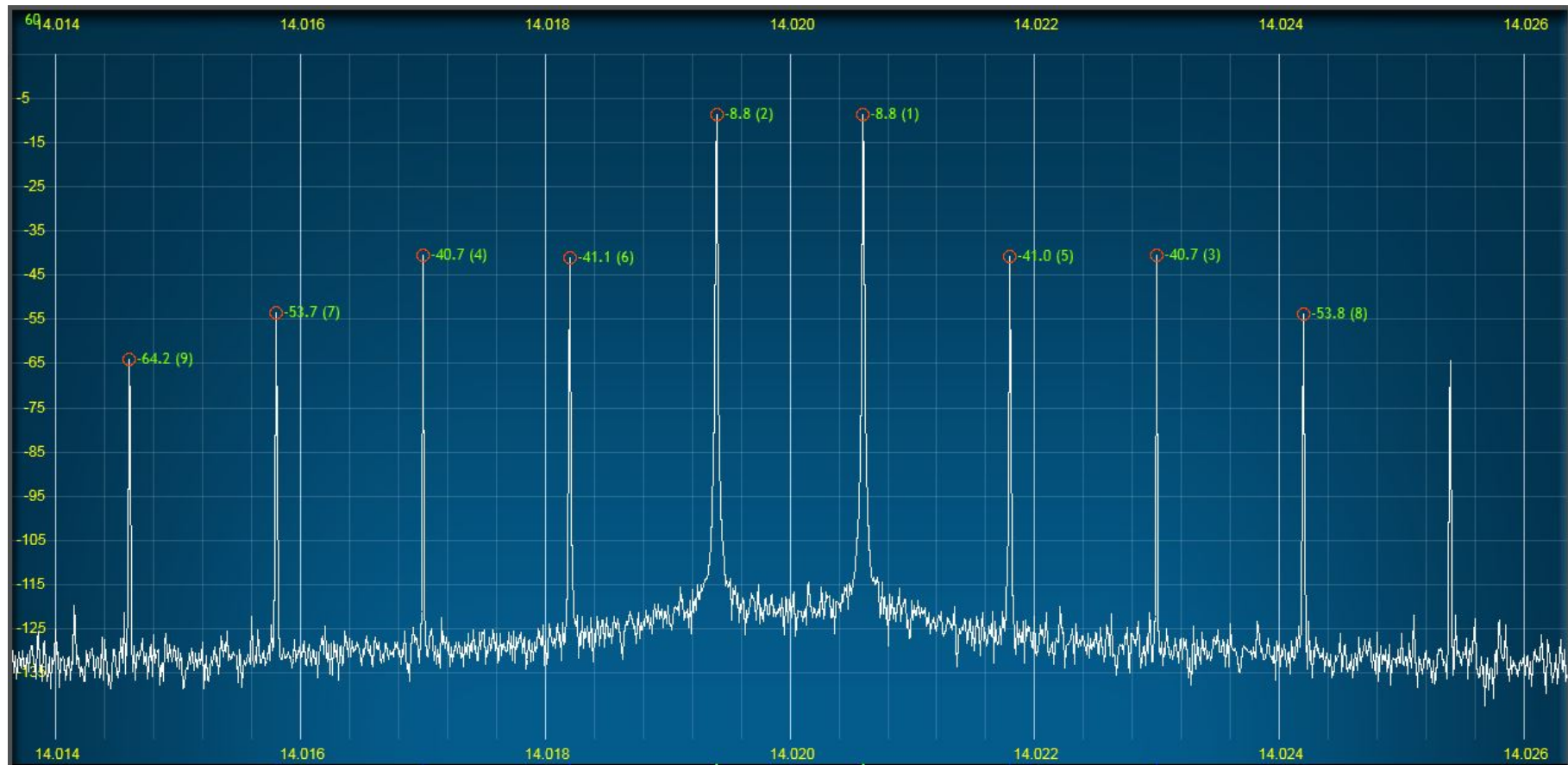
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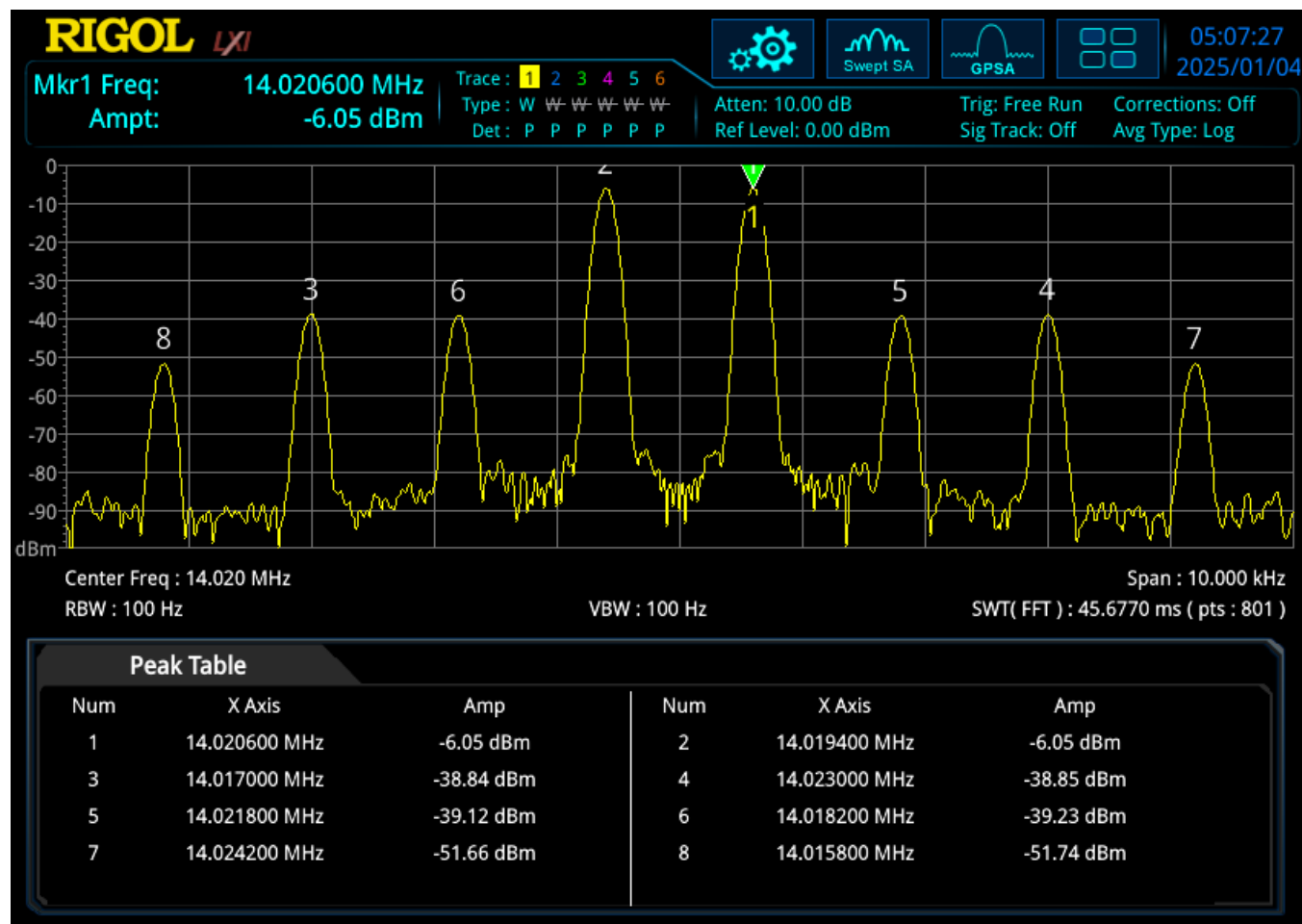
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## 20m 25W PS OFF THETIS 7K



## 20m 25W PS OFF RIGOL

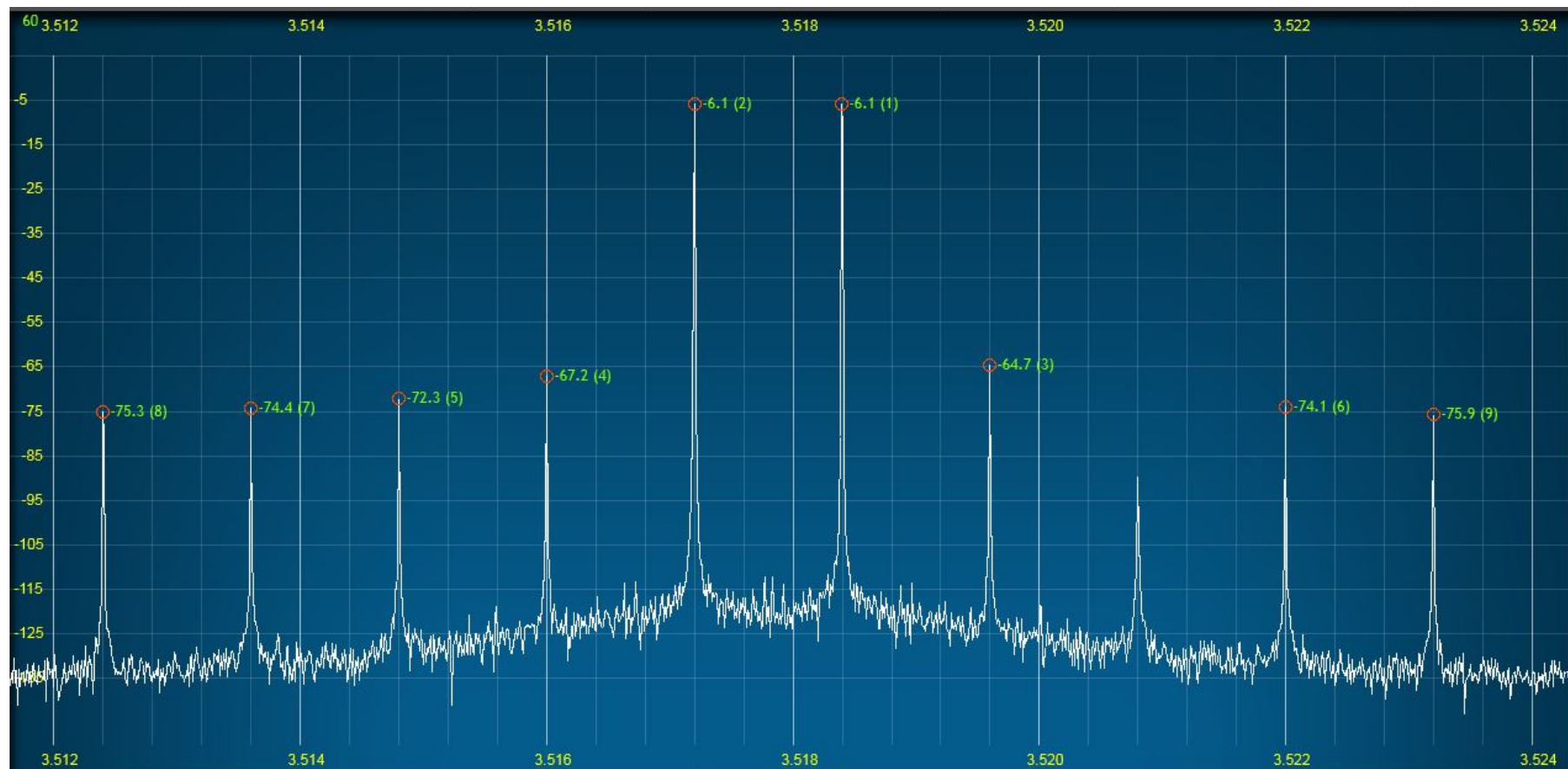


# 80m IMD Data 7000DLE MKII K1VF

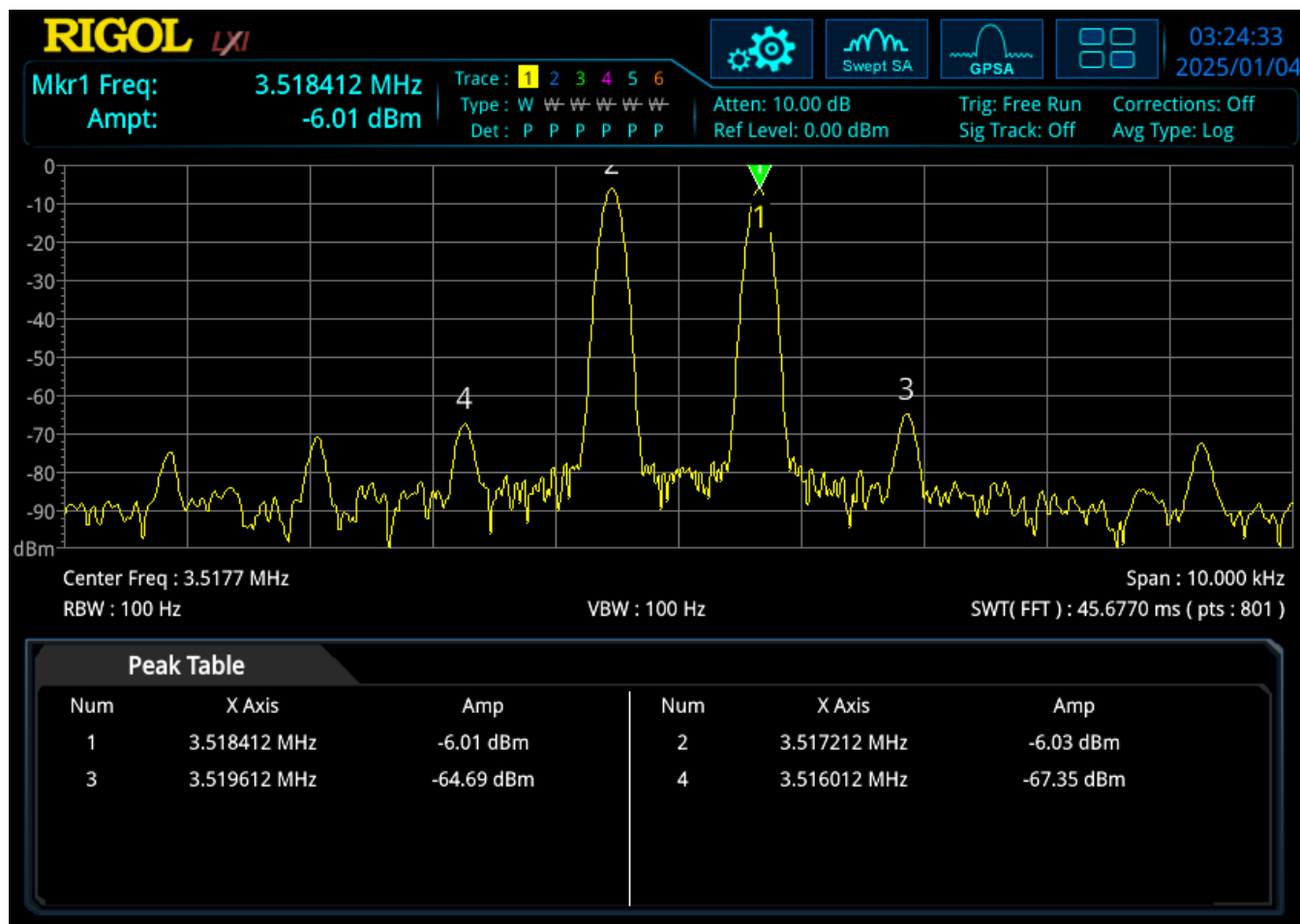
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J31-J32 REMOVED		FREQ	POWER	ATT	ON/OFF	3rd Order		Result	Thetis-S/A	Pure Signal	Slide
3-Jan-25	SOURCE	Mhz	Watts	dB	INT FB	dBc	f-0	dBc	Difference	Improvement	Reference
80m Data											
K1VF 7000DLE MKII	Thetis	3.52	50	13	ON	-64.7	-6.1	-58.6		21.9	37
RSA3015N	S/A	3.52	50	13	ON	-64.7	-6.0	-58.7	0.09	21.5	38
K1VF 7000DLE MKII	Thetis	3.52	100	16	ON	-60.6	-3.1	-57.5		30.2	39
RSA3015N	S/A	3.52	100	16	ON	-63.3	-6.1	-57.2	-0.27	30.5	40
K1VF 7000DLE MKII	Thetis	3.52	25	10	ON	-71.7	-9.2	-62.5		26.1	41
RSA3015N	S/A	3.52	25	10	ON	-67.7	-6.0	-61.7	-0.84	25.3	42
K1VF 7000DLE MKII	Thetis	3.52	50	13	OFF	-42.8	-6.1	-36.7			43
RSA3015N	S/A	3.52	50	13	OFF	-43.2	-6.1	-37.2	0.45		44
K1VF 7000DLE MKII	Thetis	3.52	100	16	OFF	-29.9	-2.6	-27.3			45
RSA3015N	S/A	3.52	100	16	OFF	-32.4	-5.7	-26.8	-0.55		46
K1VF 7000DLE MKII	Thetis	3.52	25	10	OFF	-45.5	-9.1	-36.4			47
RSA3015N	S/A	3.52	25	10	OFF	-42.4	-6.0	-36.4	-0.02		48



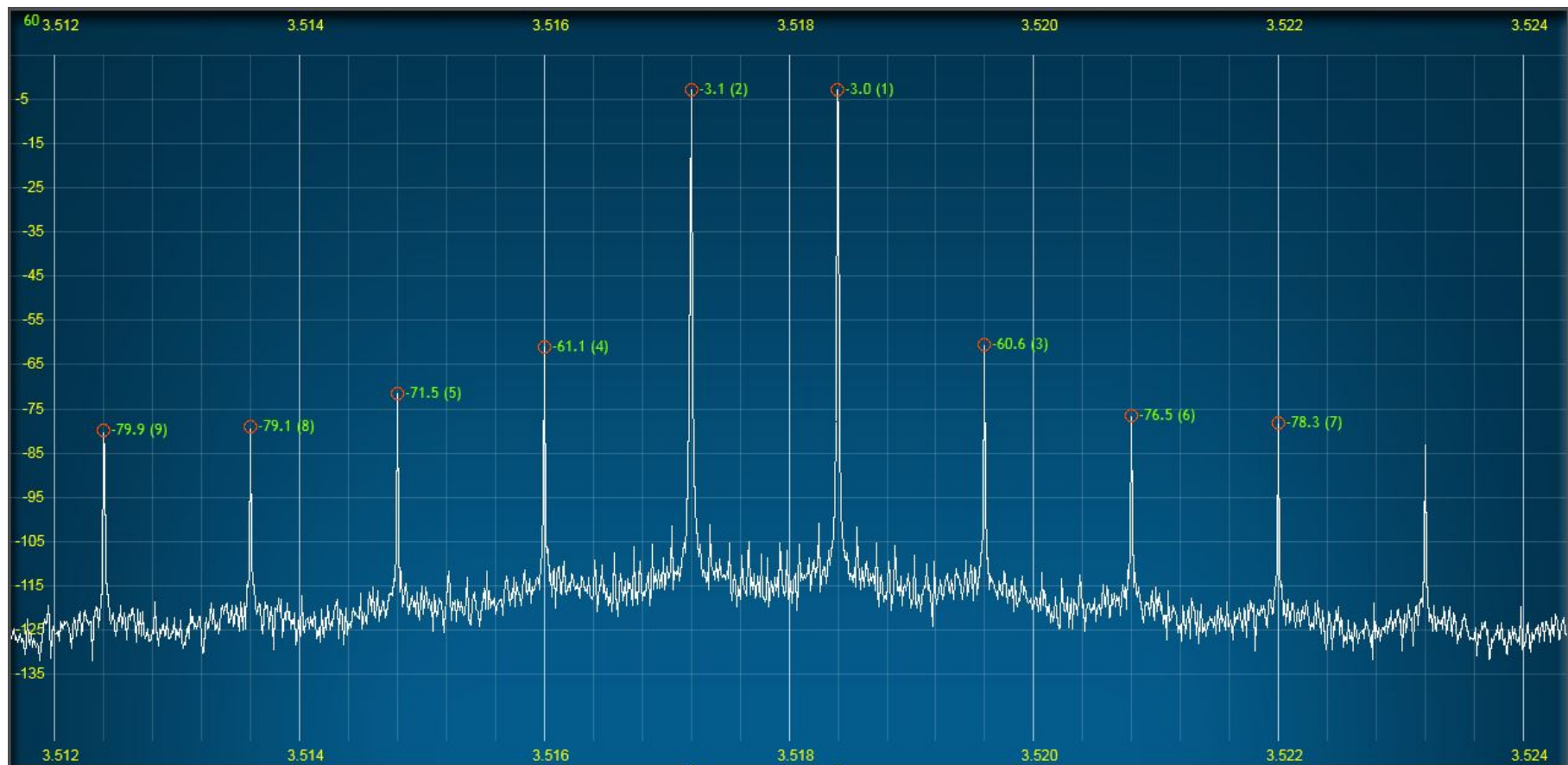
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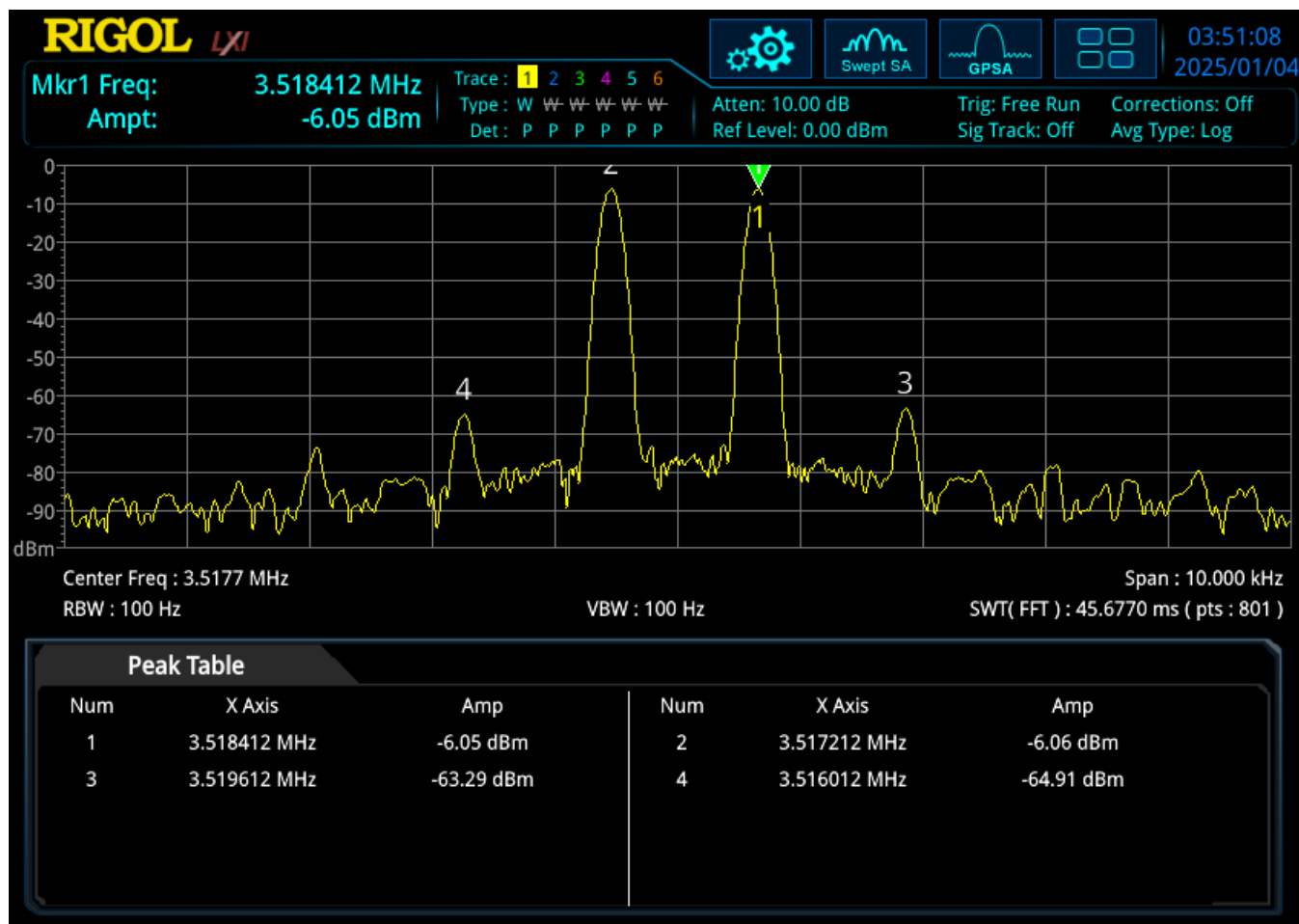
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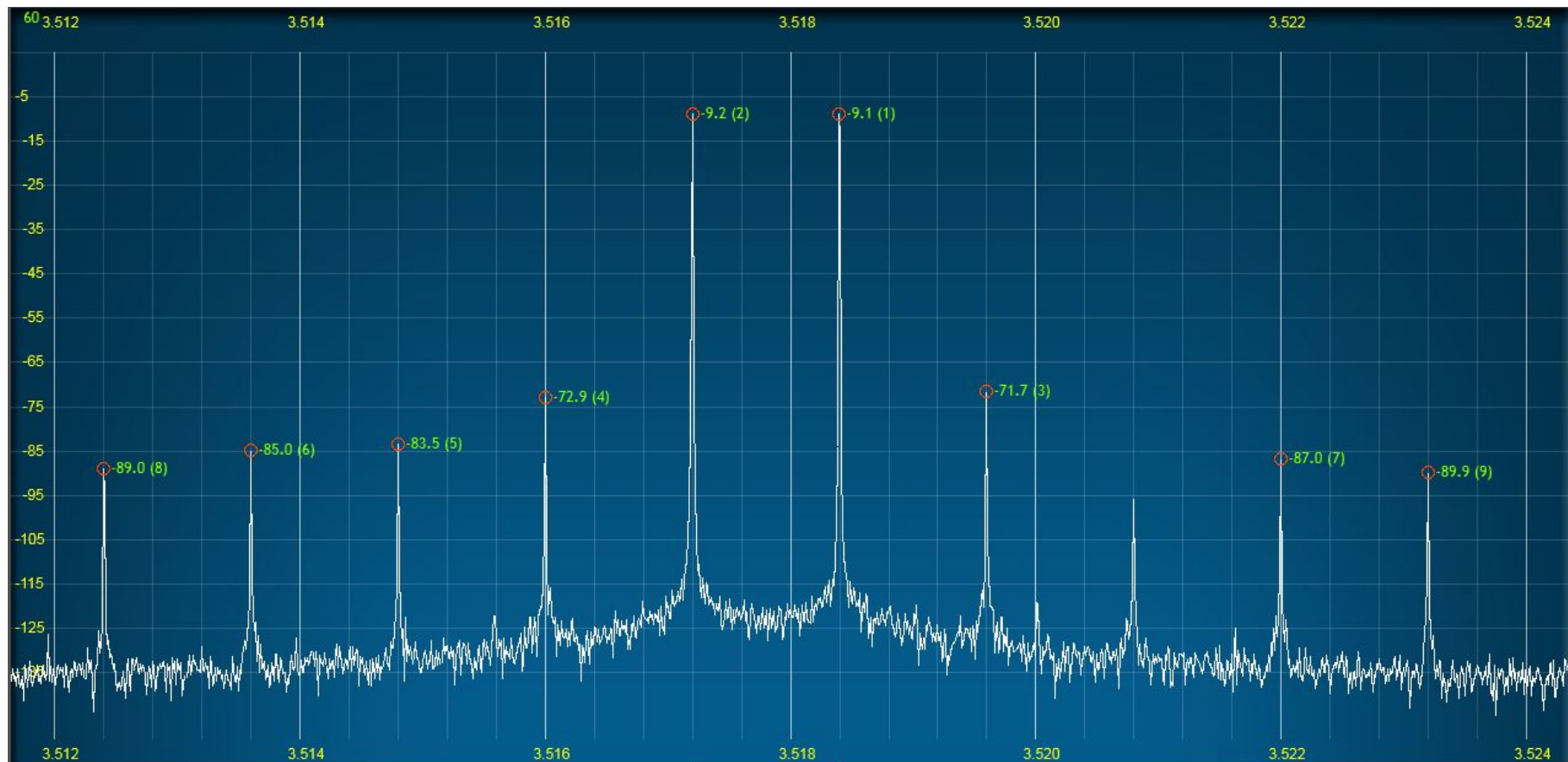
## 80m 100W PS ON THETIS 7K



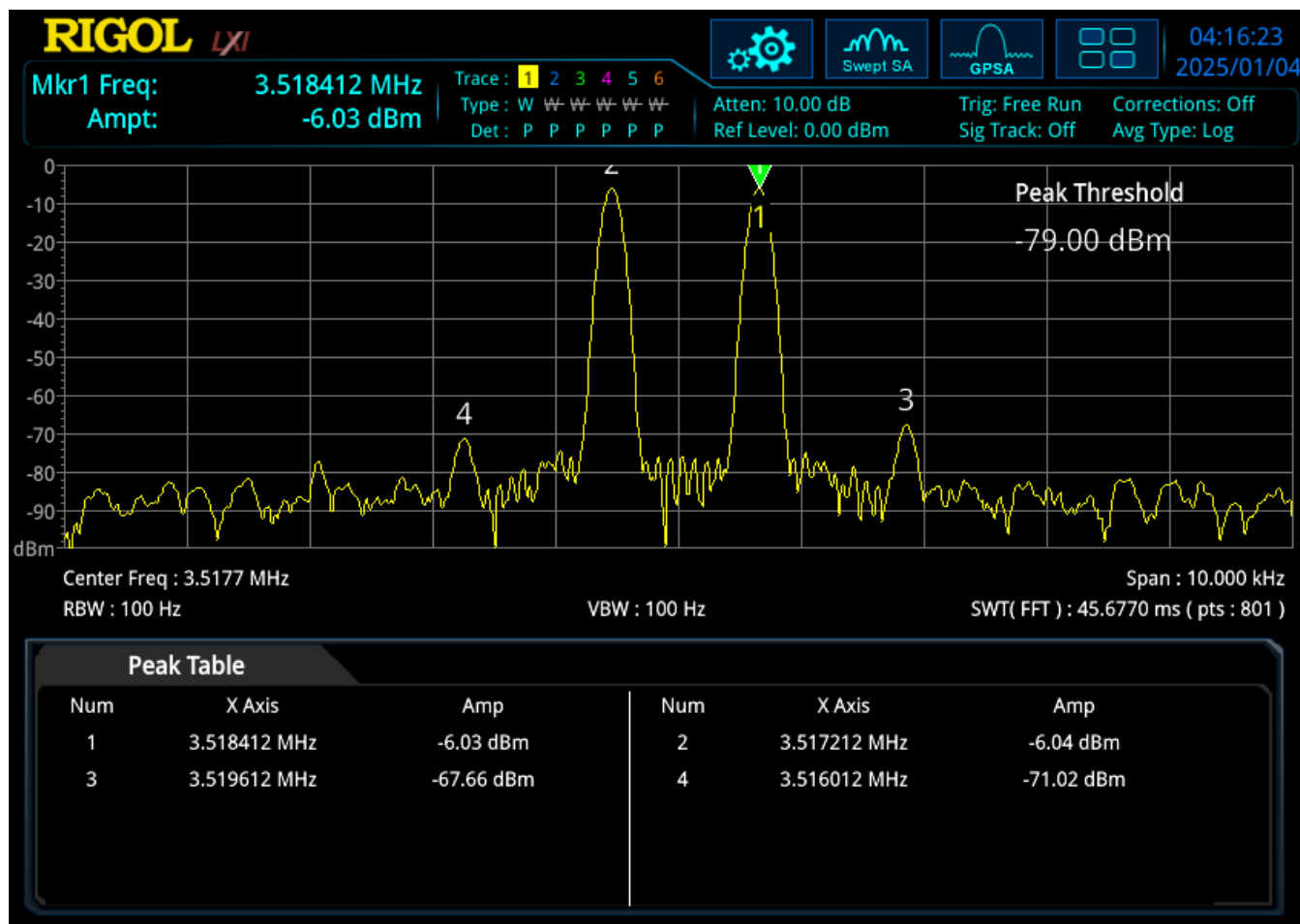
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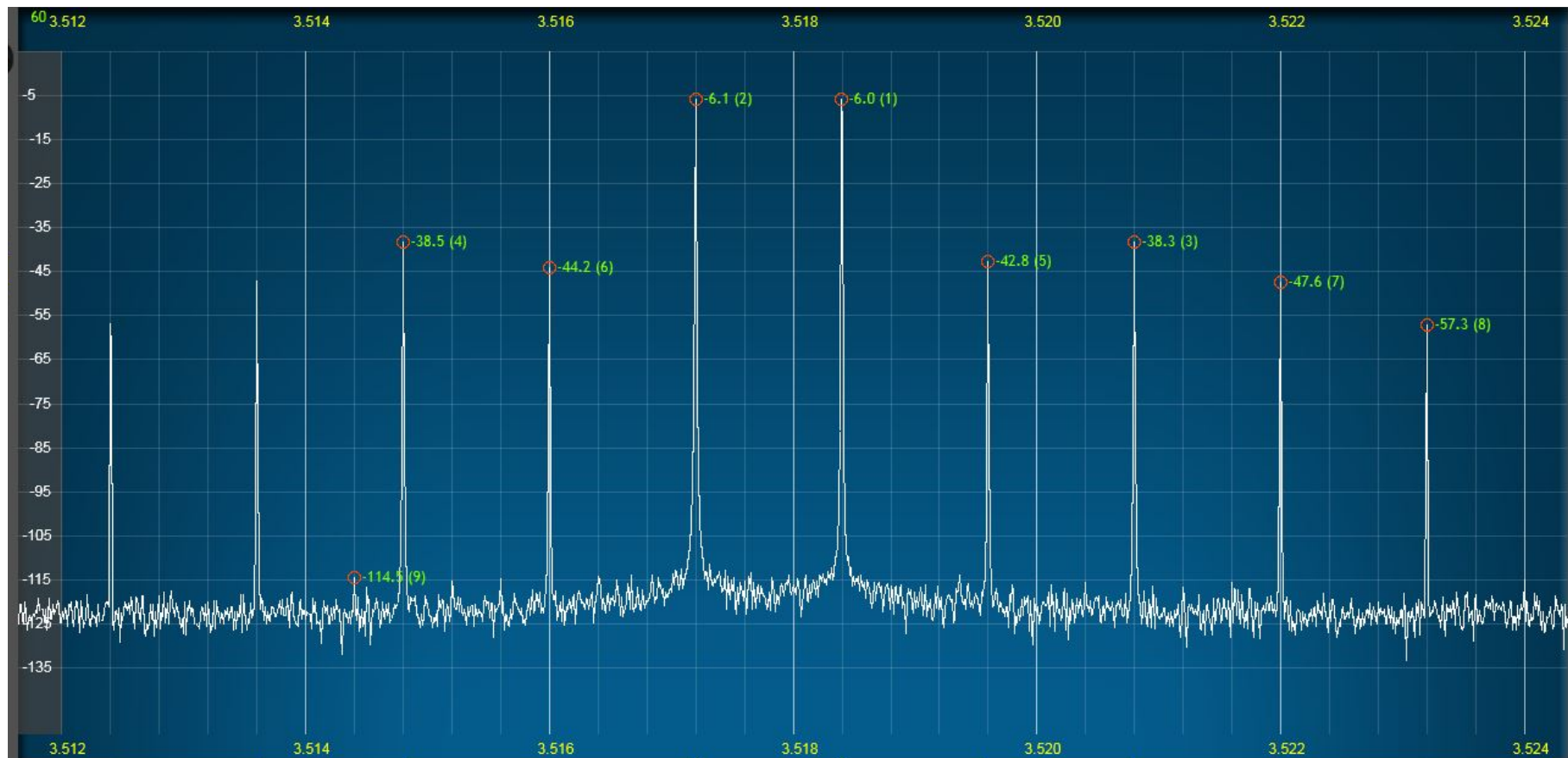
## 80M 25W PS ON THETIS 7K



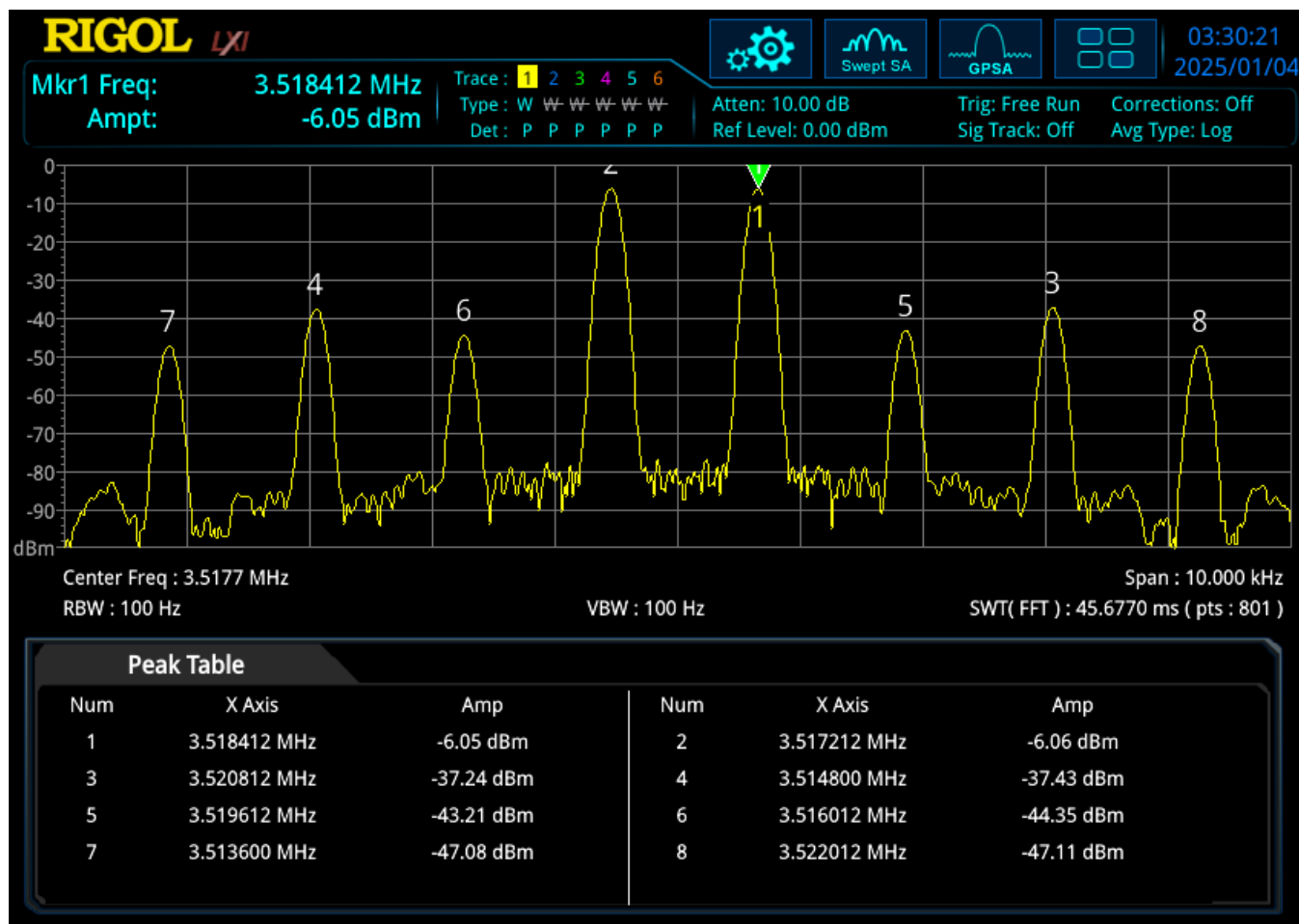
## 80M 25W PS ON RIGOL



## 80m 50W PS OFF THETIS 7K

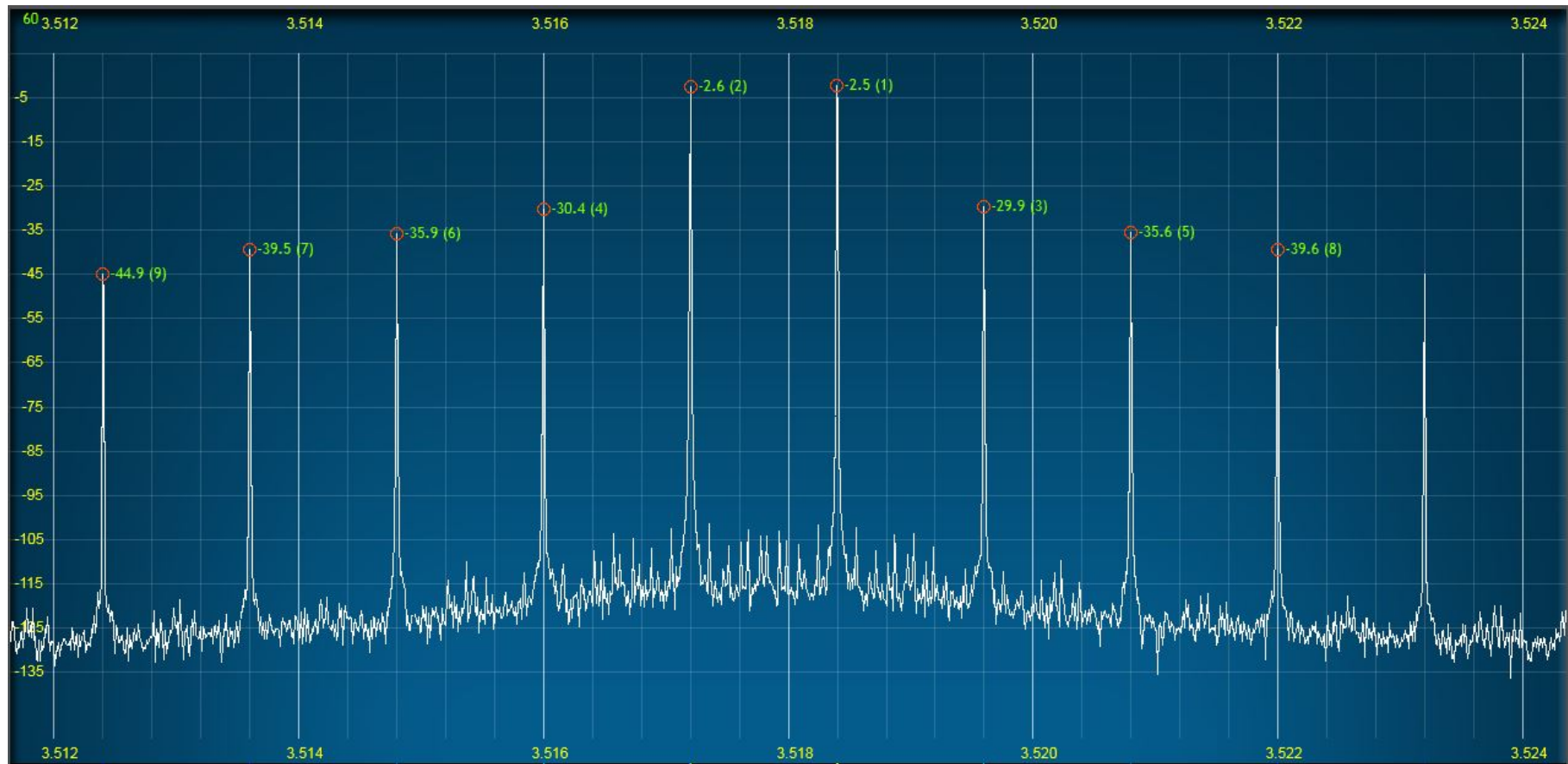


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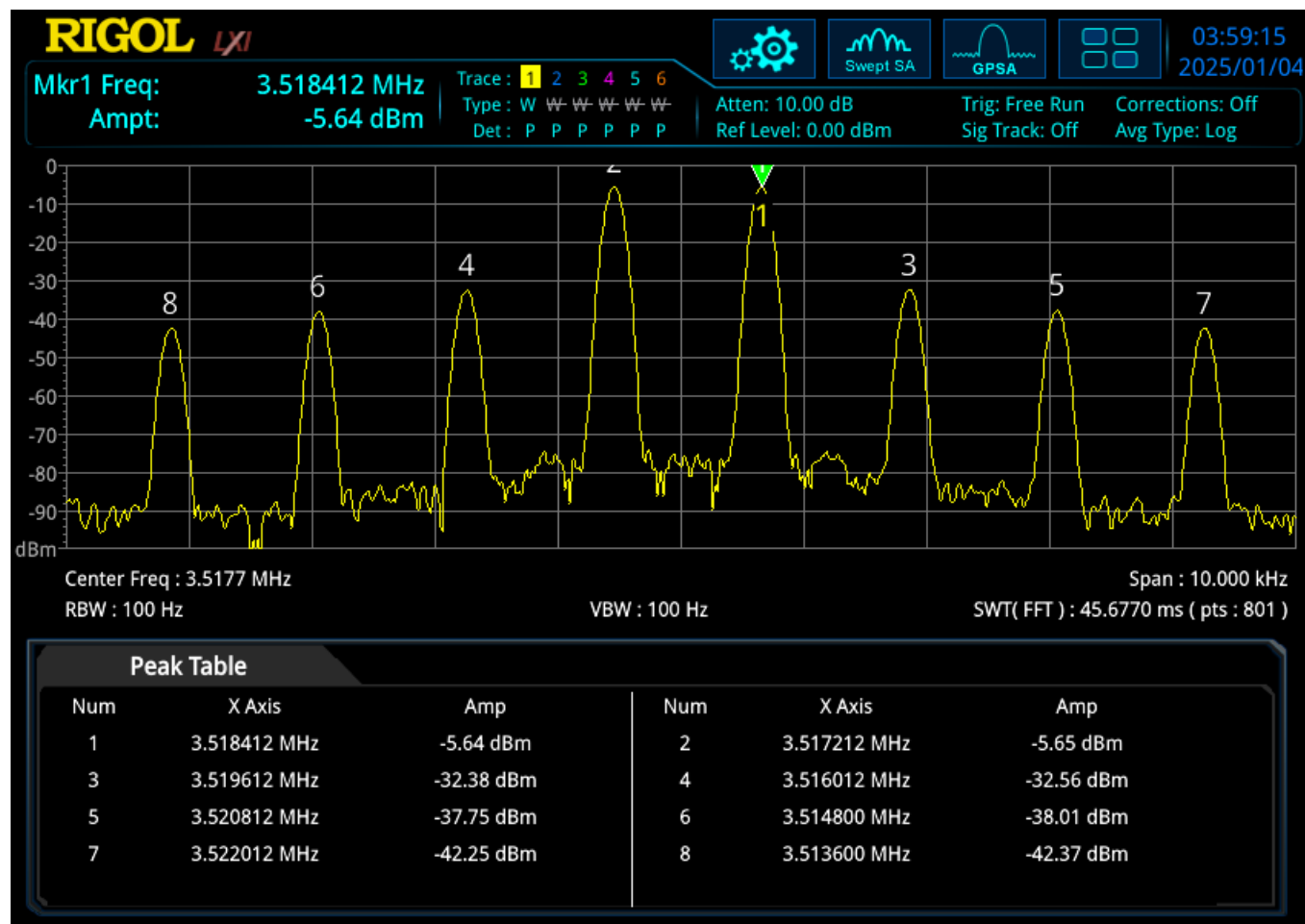




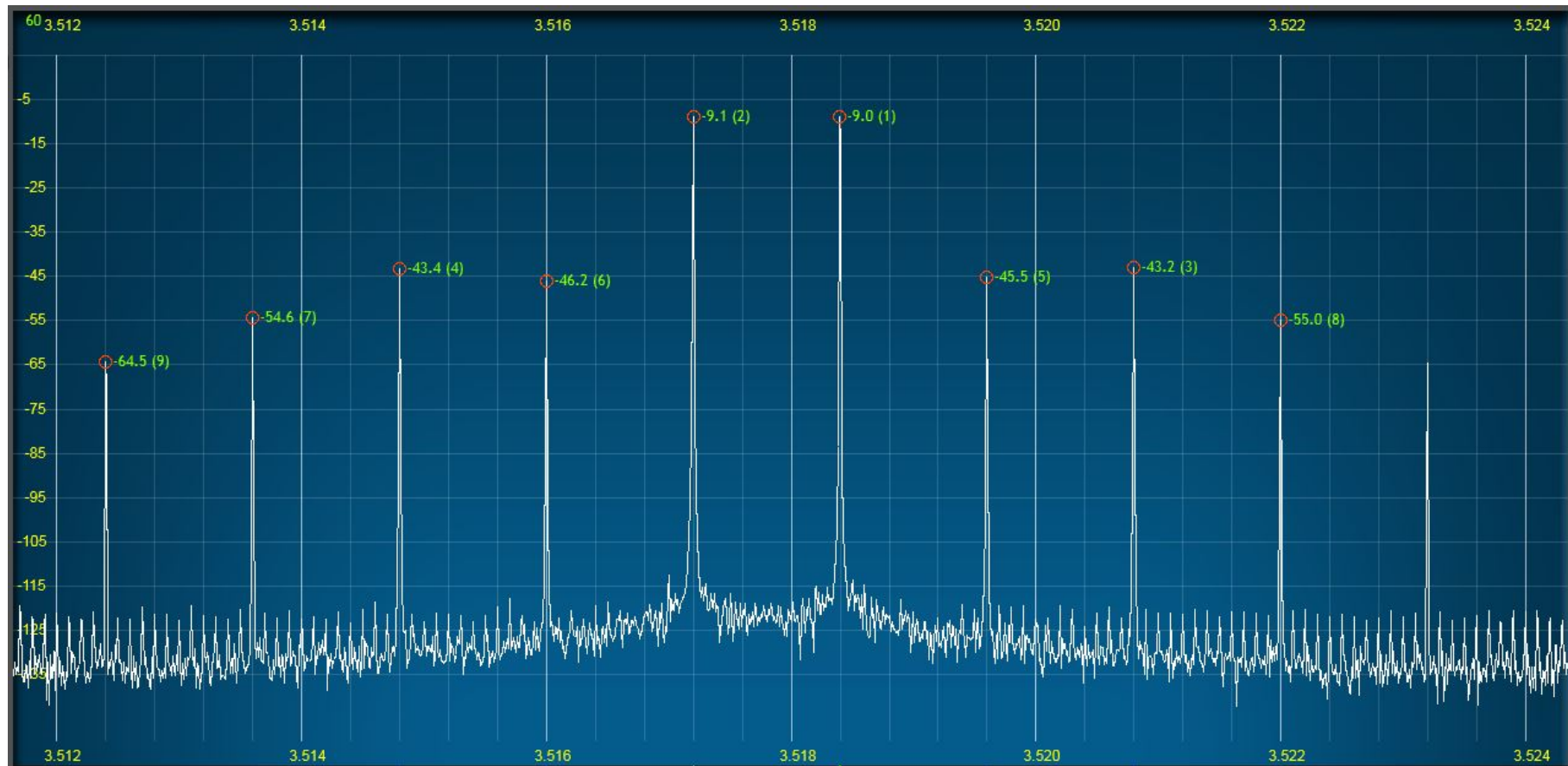
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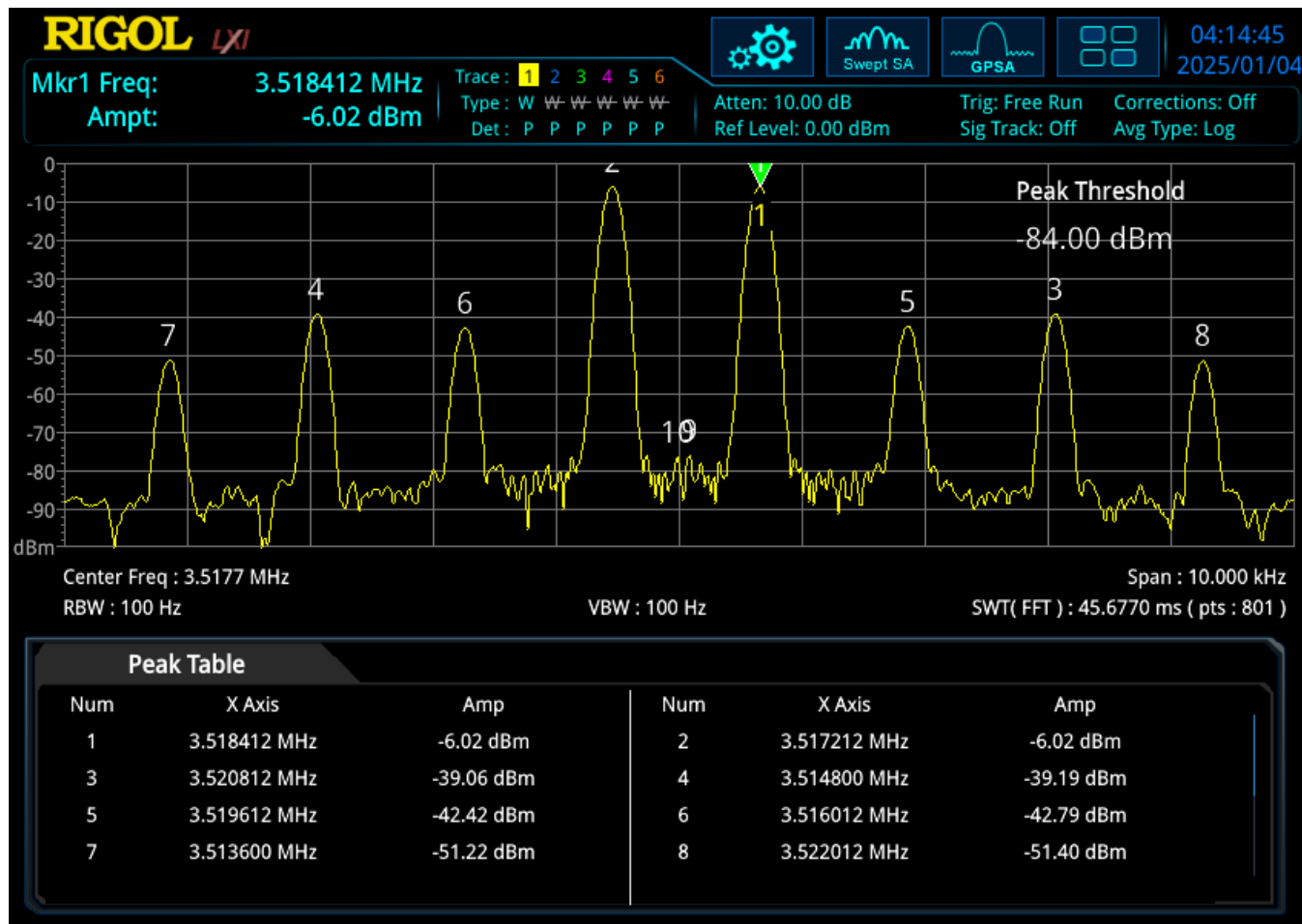
## 80M 100W PS OFF RIGOL



## 80M 25W PS OFF THETIS 7K



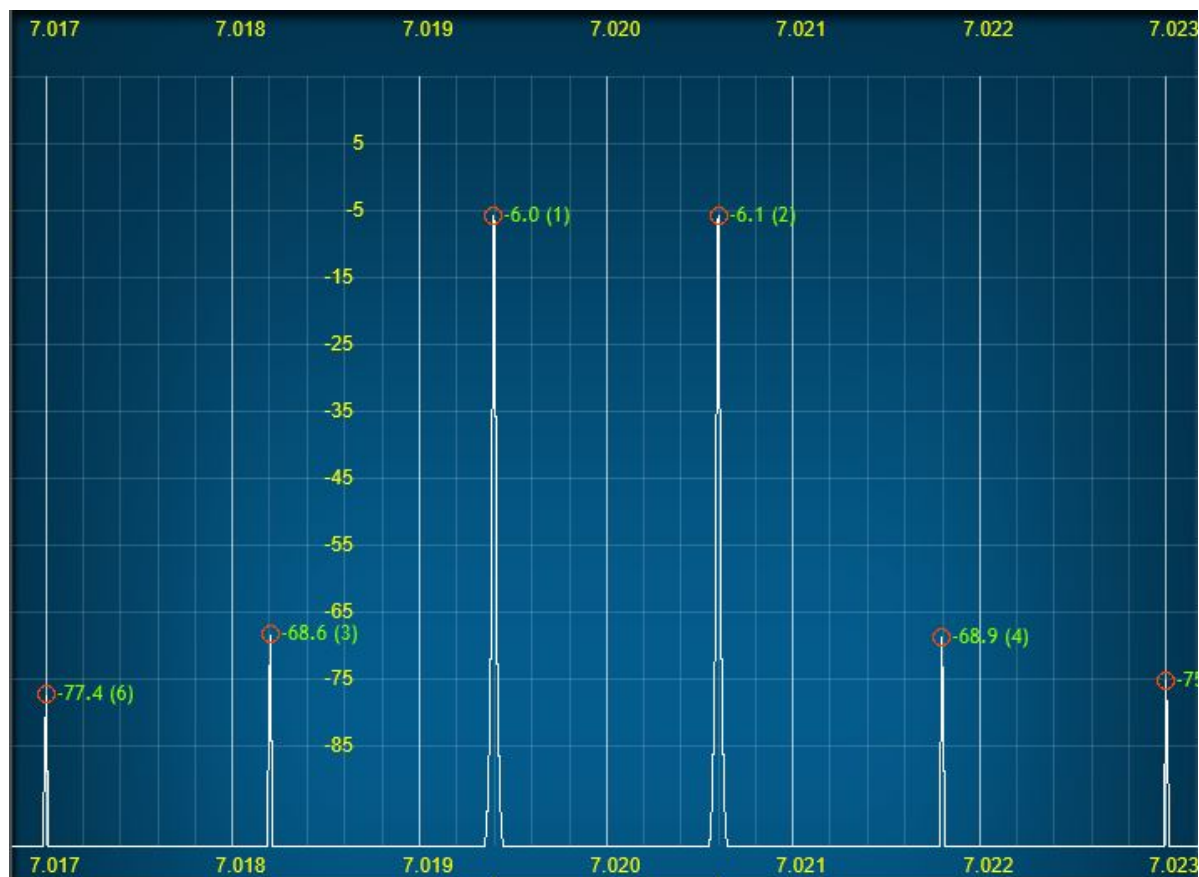
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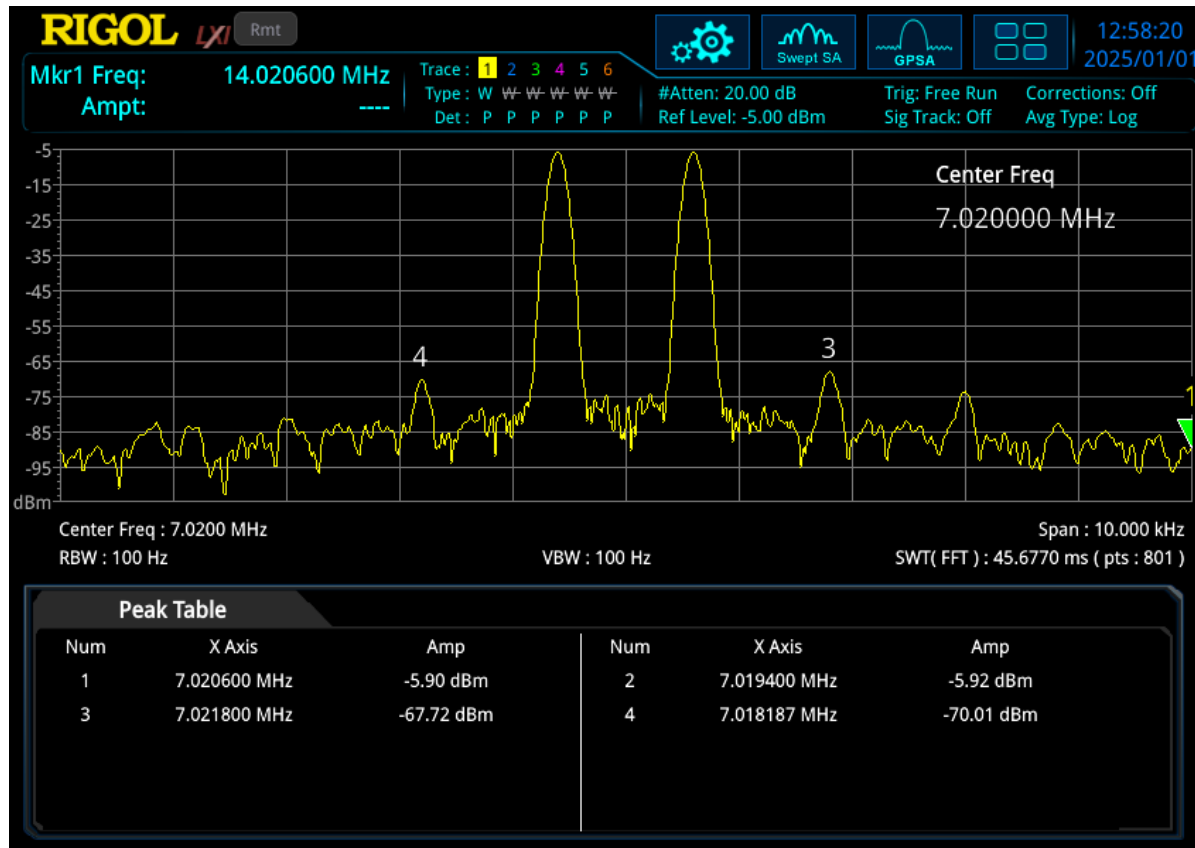
# 40m IMD Data G2 KJ7TEA

KJ7TEA G2 Data		FREQ	POWER	Pure Signal	XVTR Jumper		3rd Order		Result	Thetis-S/A	Pure Signal	Slide
1-Jan-25	SOURCE	Mhz	Watts	ON/OFF	J7-J31	FB Sample	dBc	f-0	dBc	Difference	Improvement	Reference
40m Data												
KJ7TEA G2	Thetis	7.02	50	ON	REMOVED	INTERNAL	-68.6	-6.1	-62.5		35.8	50
RSA3015N	S/A	7.02	50	ON	REMOVED	INTERNAL	-67.7	-5.9	-61.8	-0.7	34.5	51
KJ7TEA G2	Thetis	7.02	50	OFF	REMOVED	INTERNAL	-33.0	-6.3	-26.7			52
RSA3015N	S/A	7.02	50	OFF	REMOVED	INTERNAL	-33.5	-6.2	-27.3	0.61		53
KJ7TEA G2	Thetis	7.02	50	ON	INSTALLED	INTERNAL	-68.6	-6.3	-62.3		35.5	54
RSA3015N	S/A	7.02	50	ON	INSTALLED	INTERNAL	-65.7	-6.3	-59.4	-2.86	31.8	55
KJ7TEA G2	Thetis	7.02	50	OFF	INSTALLED	INTERNAL	-33.3	-6.5	-26.8			56
RSA3015N	S/A	7.02	50	OFF	INSTALLED	INTERNAL	-34.2	-6.5	-27.7	0.88		57

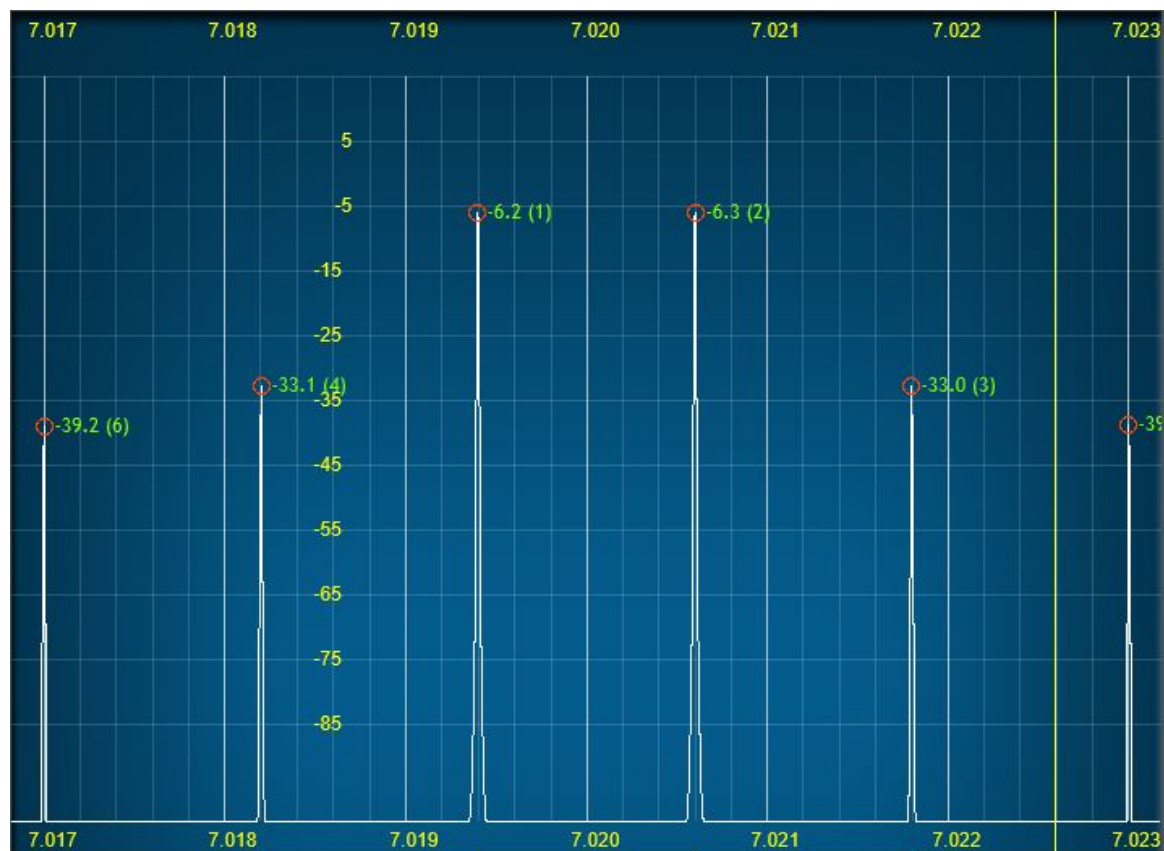
# 40m 50W PS ON THETIS G2 J7-J31 REMOVED



# 40m 50W PS ON RIGOL G2 J7-J31 REMOVED

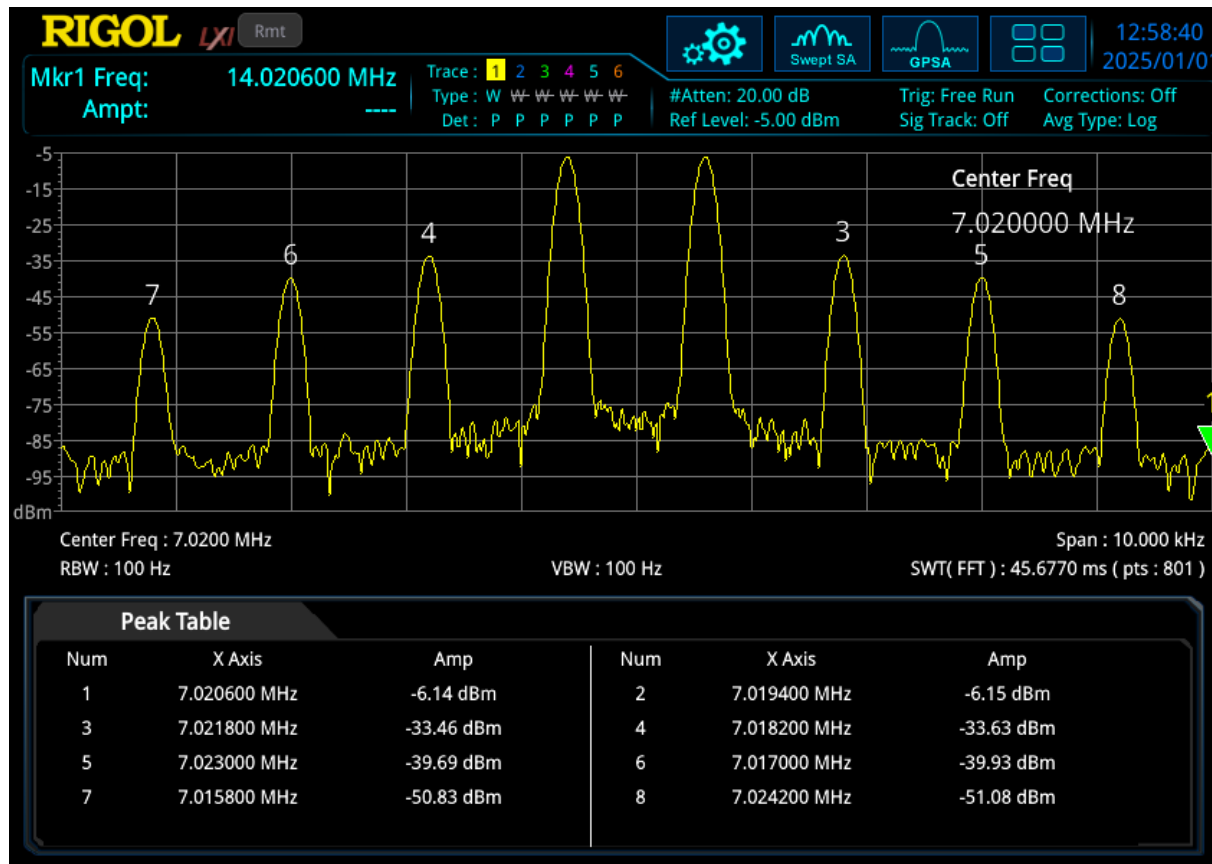


# 40m 50W PS OFF THETIS G2 J7-J31 REMOVED

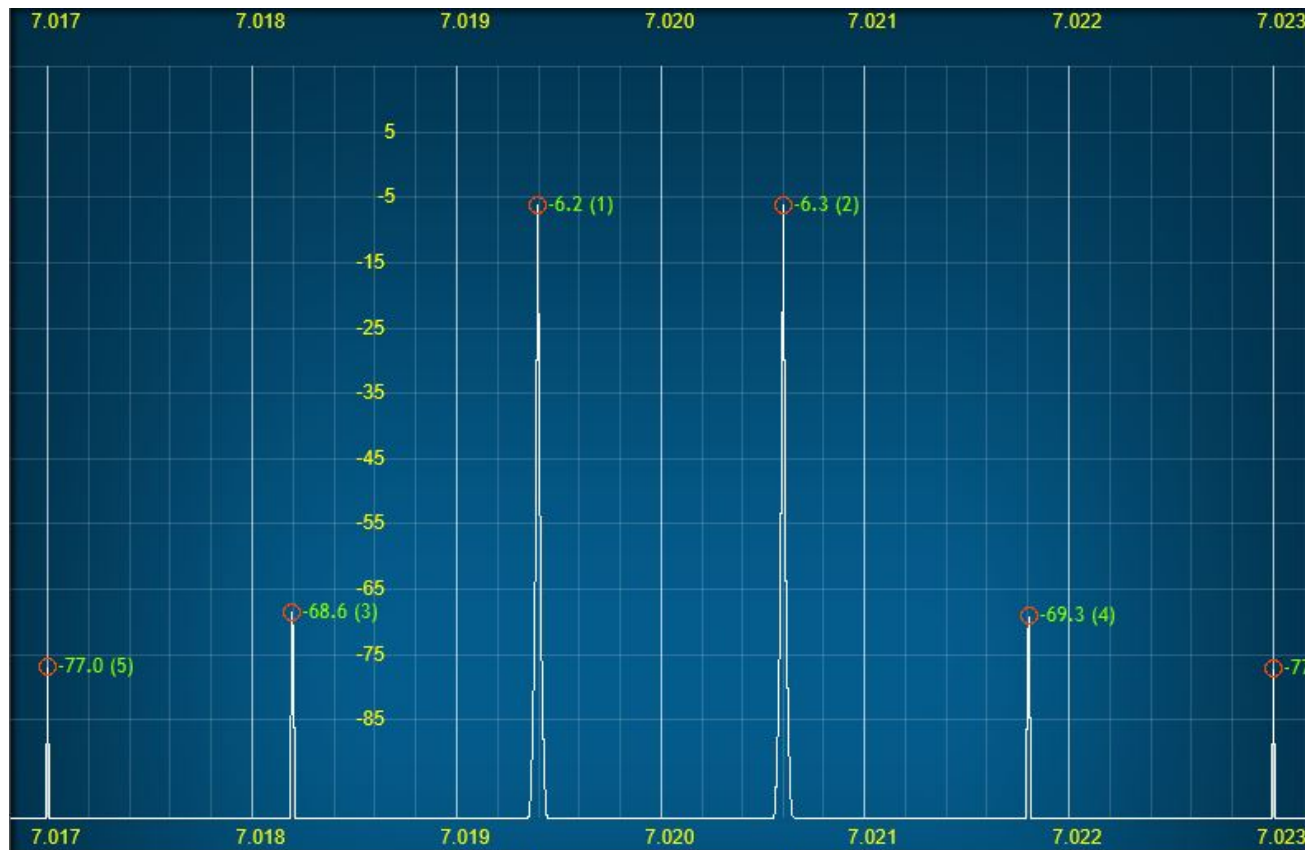




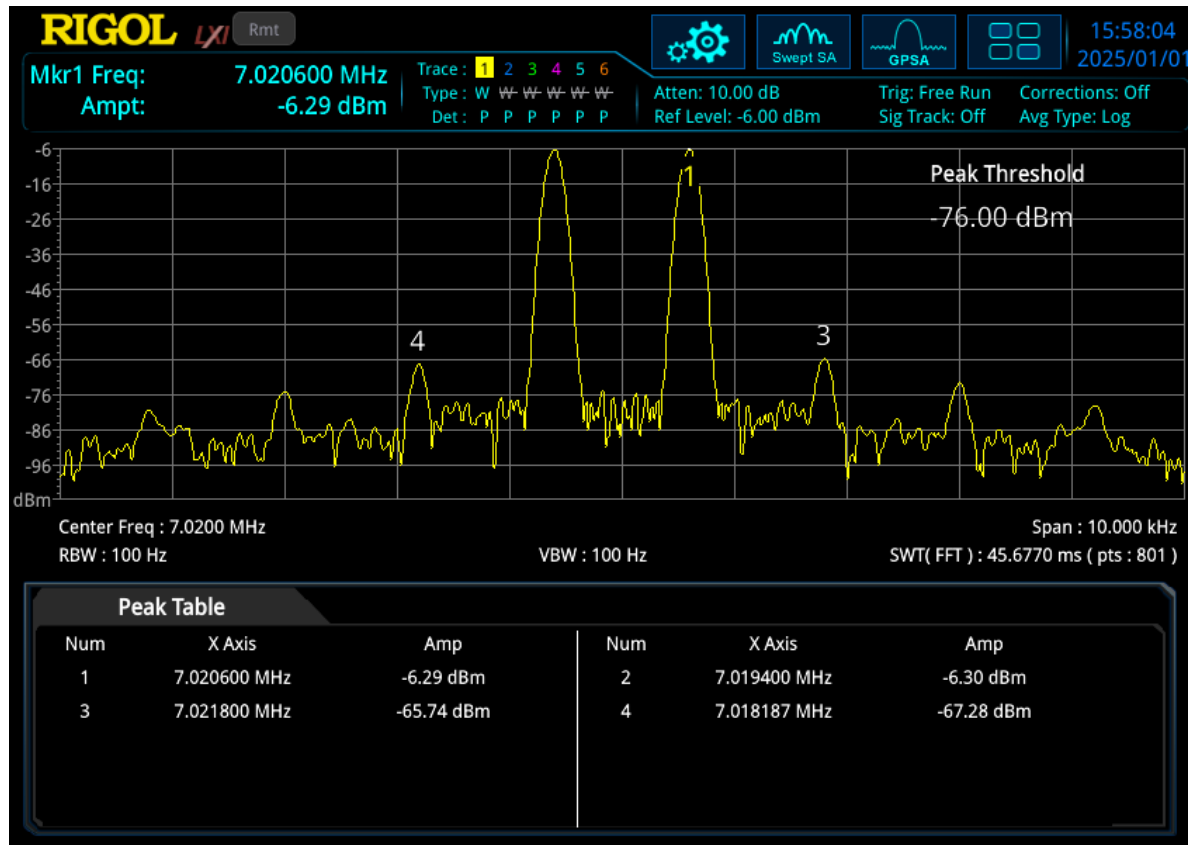
# 40m 50W PS OFF RIGOL G2 J7-J31 REMOVED



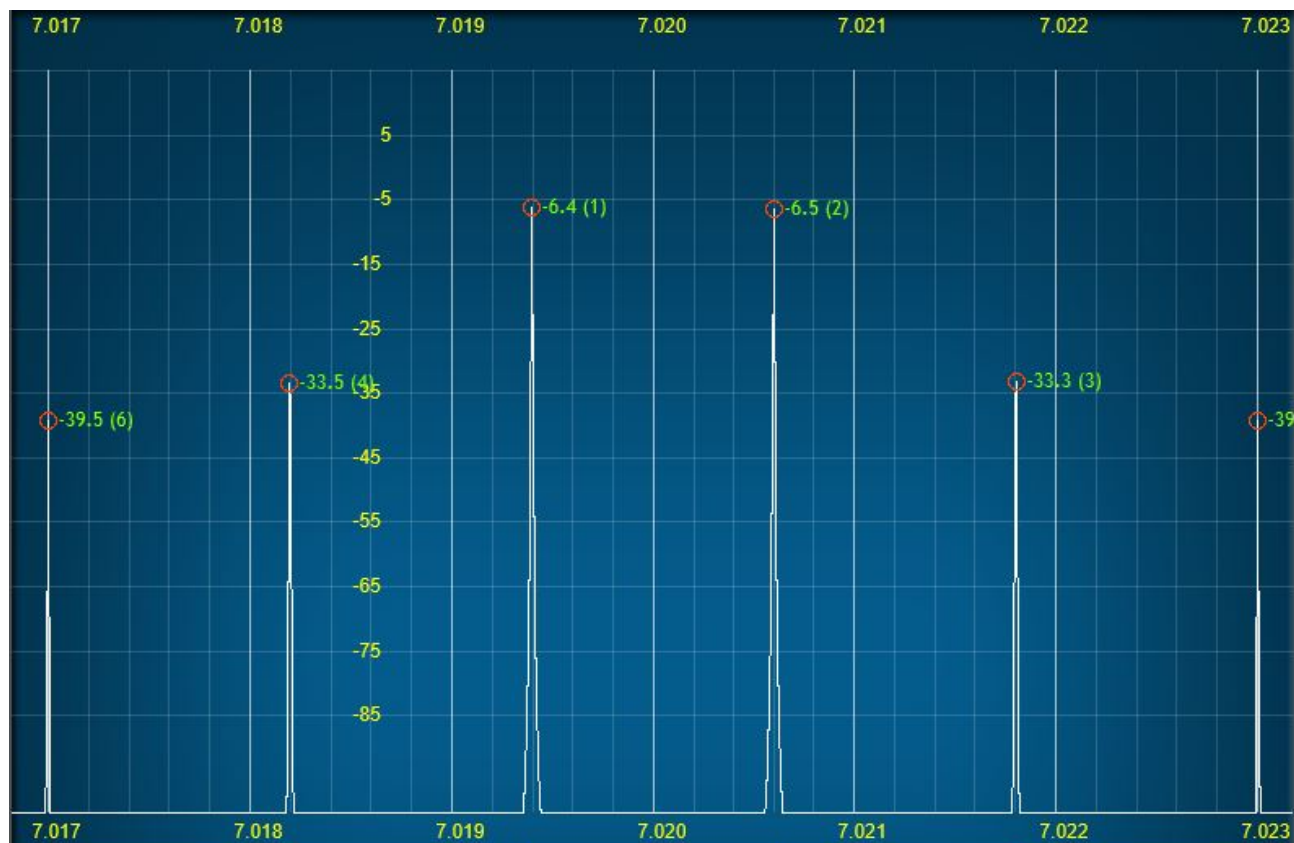
# 40m 50W PS ON THETIS G2 J7-J31 INSTALLED



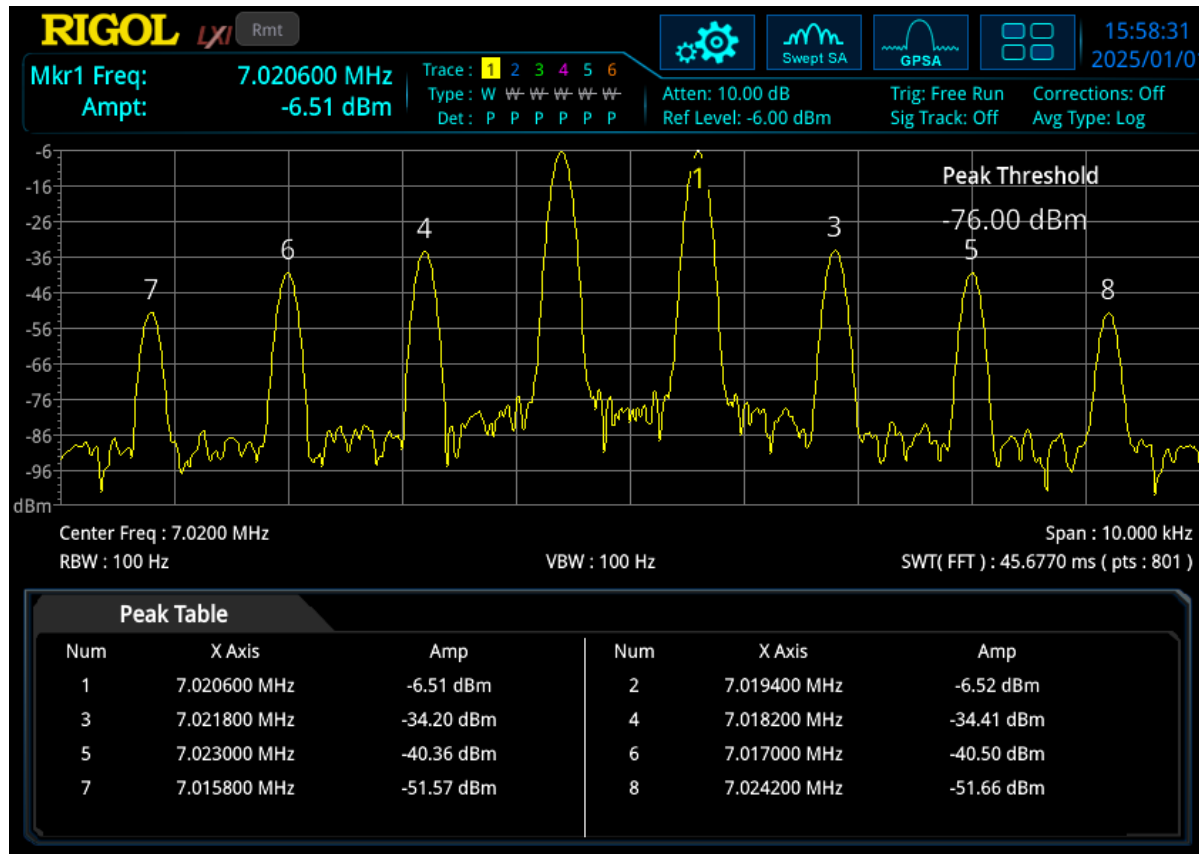
# 40m 50W PS ON RIGOL G2 J7-J31 INSTALLED



# 40m 50W PS OFF THETIS G2 J7-J31 INSTALLED



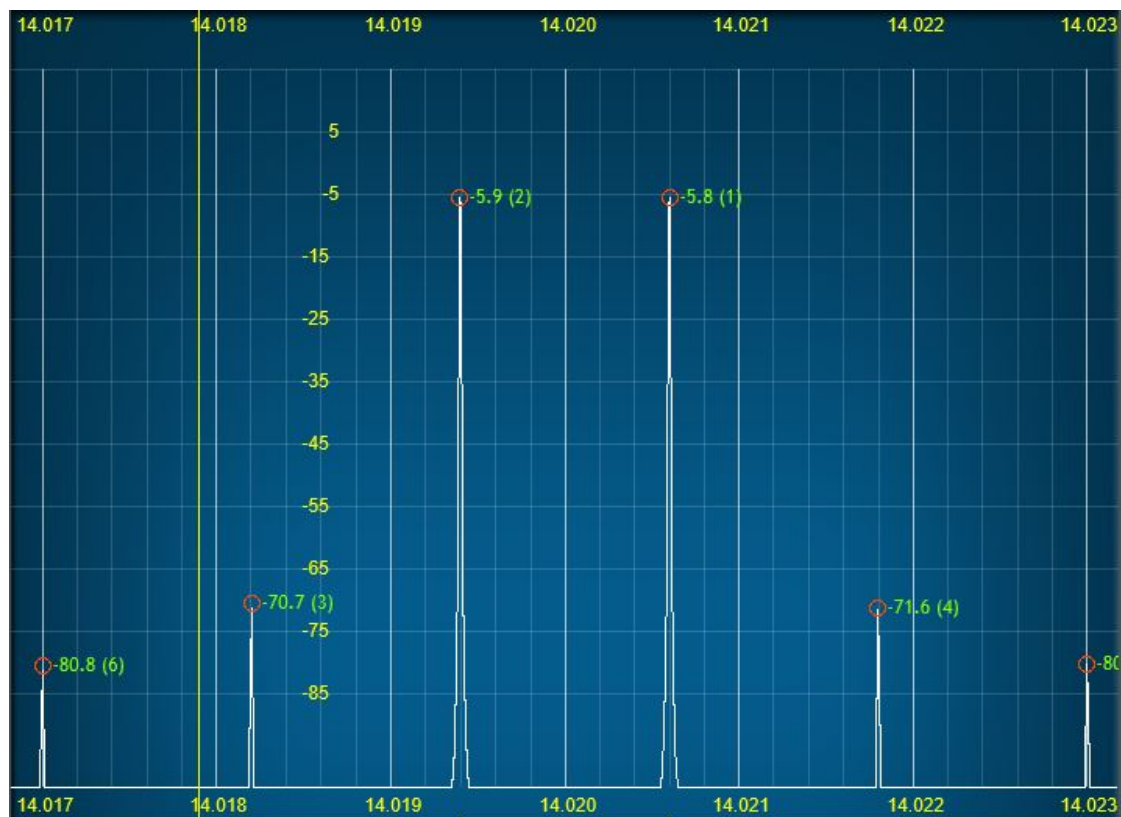
# 40m 50W PS OFF RIGOL G2 J7-J31 INSTALLED



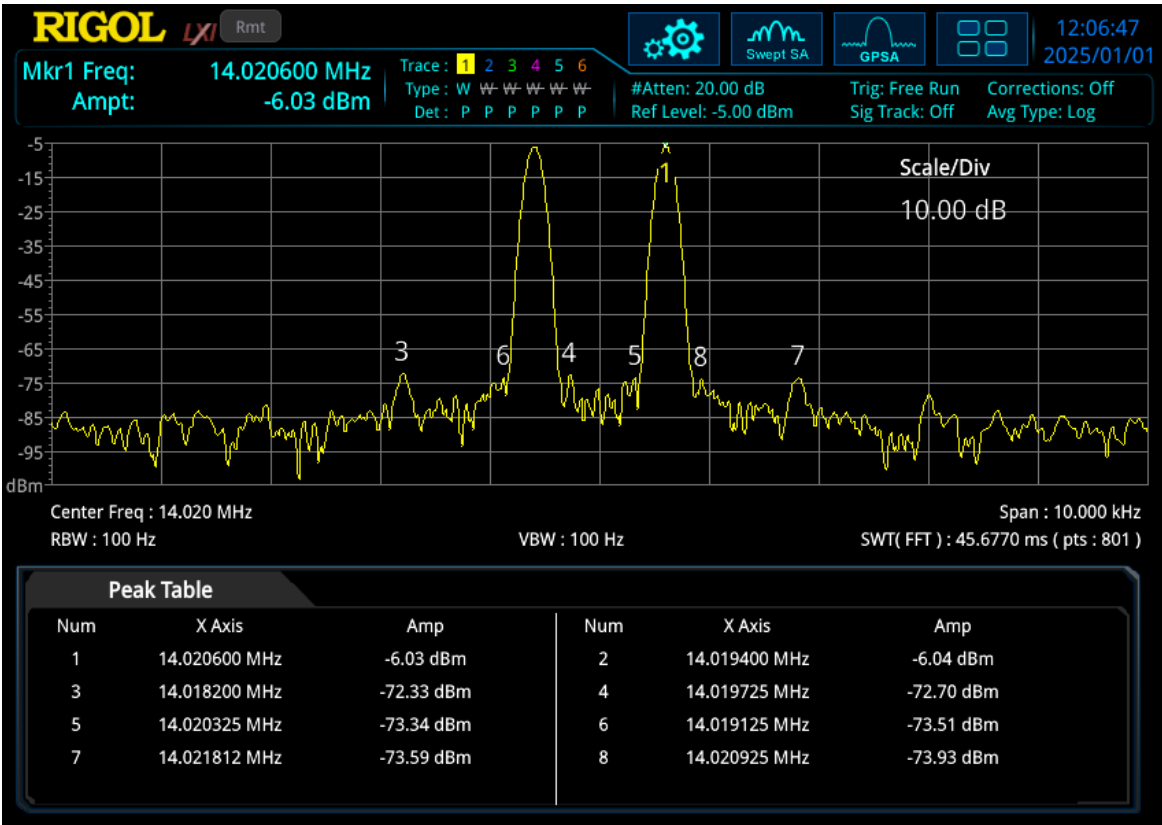
## 20m IMD Data G2 KJ7TEA

KJ7TEA G2 Data		FREQ	POWER	Pure Signal	XVTR Jumper		3rd Order		Result	Thetis-S/A	Pure Signal	Slide
1-Jan-25	SOURCE	Mhz	Watts	ON/OFF	J7-J31	FB Sample	dBc	f-0	dBc	Difference	Improvement	Reference
20m Data												
KJ7TEA G2	Thetis	14.02	50	ON	REMOVED	INTERNAL	-70.7	-5.9	-64.8		40.1	59
RSA3015N	S/A	14.02	50	ON	REMOVED	INTERNAL	-72.3	-6.0	-66.3	1.49	41.0	60
KJ7TEA G2	Thetis	14.02	50	OFF	REMOVED	INTERNAL	-31.0	-6.3	-24.7			61
RSA3015N	S/A	14.02	50	OFF	REMOVED	INTERNAL	-31.6	-6.4	-25.3	0.55		62
KJ7TEA G2	Thetis	14.02	50	ON	INSTALLED	INTERNAL	-70.4	-6.4	-64.0		39.5	63
RSA3015N	S/A	14.02	50	ON	INSTALLED	INTERNAL	-60.2	-6.3	-54.0	-10.03	28.7	64
KJ7TEA G2	Thetis	14.02	50	OFF	INSTALLED	INTERNAL	-31.3	-6.8	-24.5			65
RSA3015N	S/A	14.02	50	OFF	INSTALLED	INTERNAL	-31.9	-6.6	-25.3	0.79		66

# 20m 50W PS ON THETIS G2 J7-J31 REMOVED

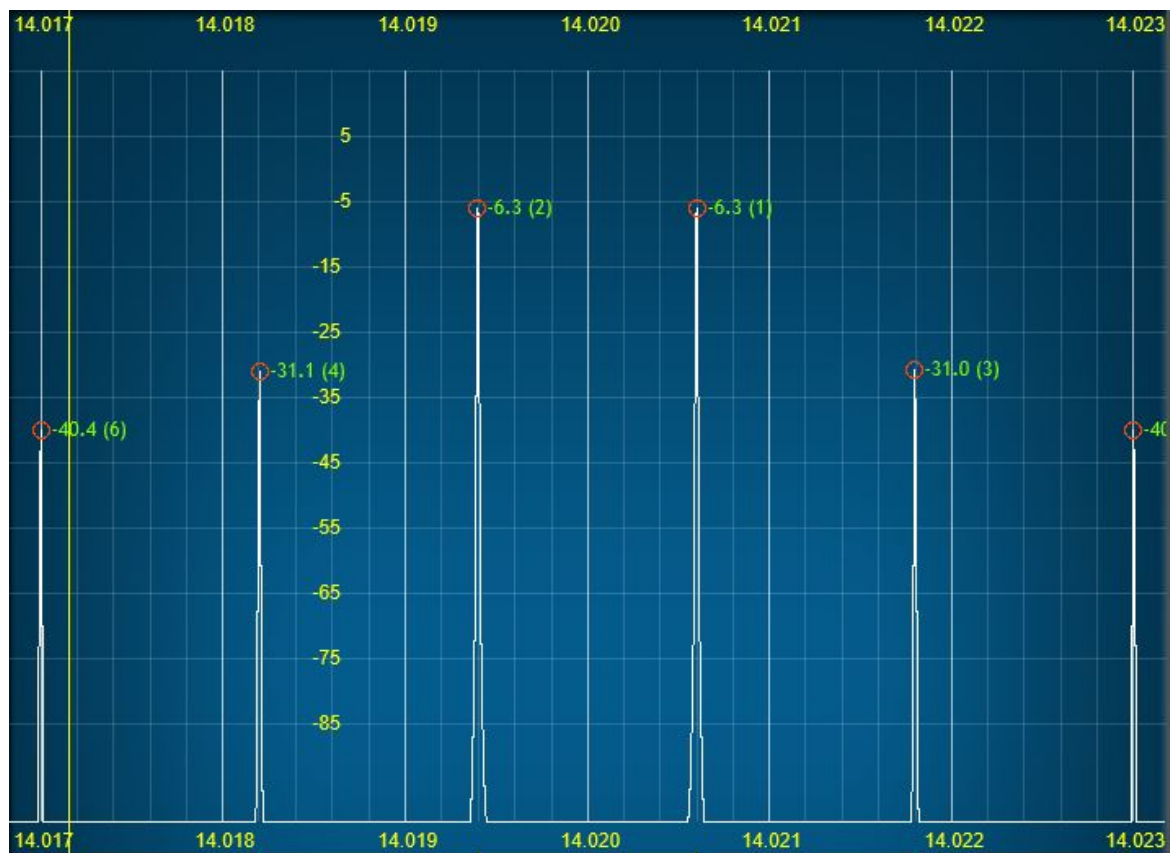


# 20m 50W PS ON RIGOL G2 J7-J31 REMOVED

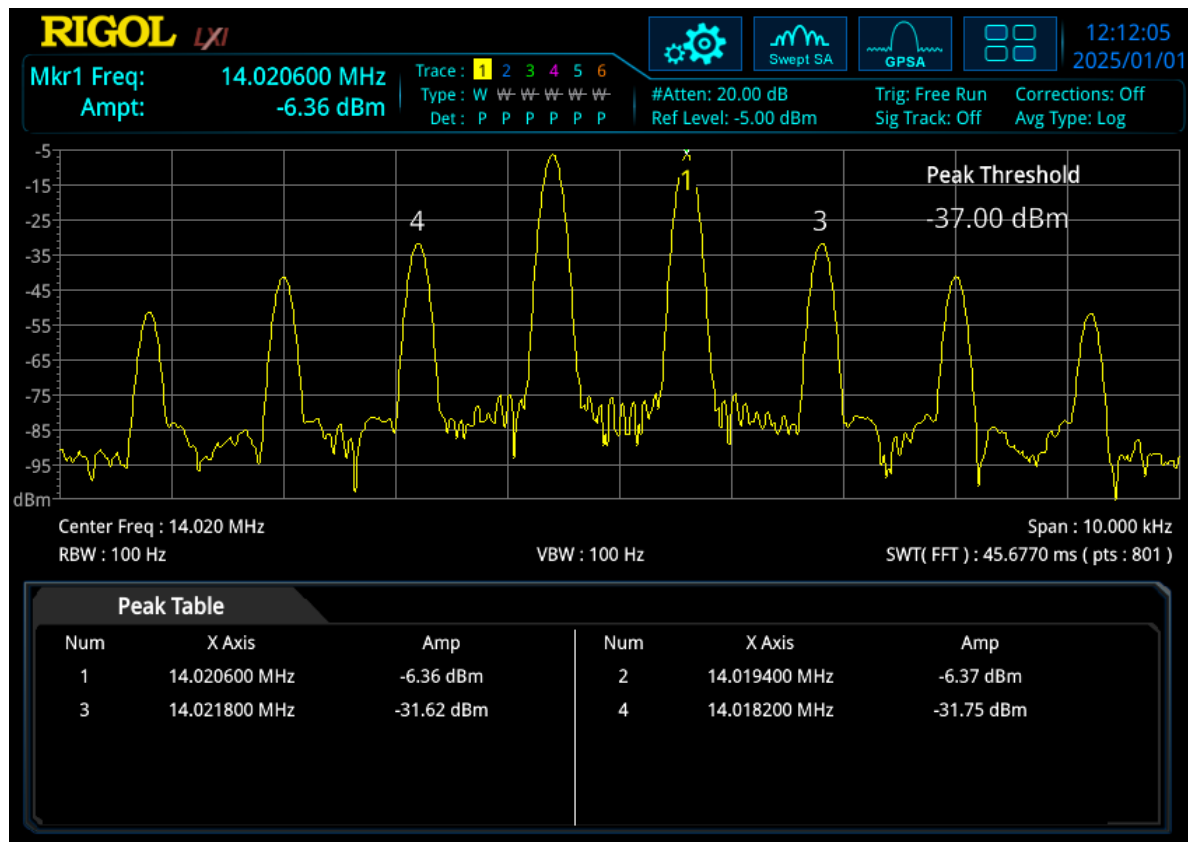




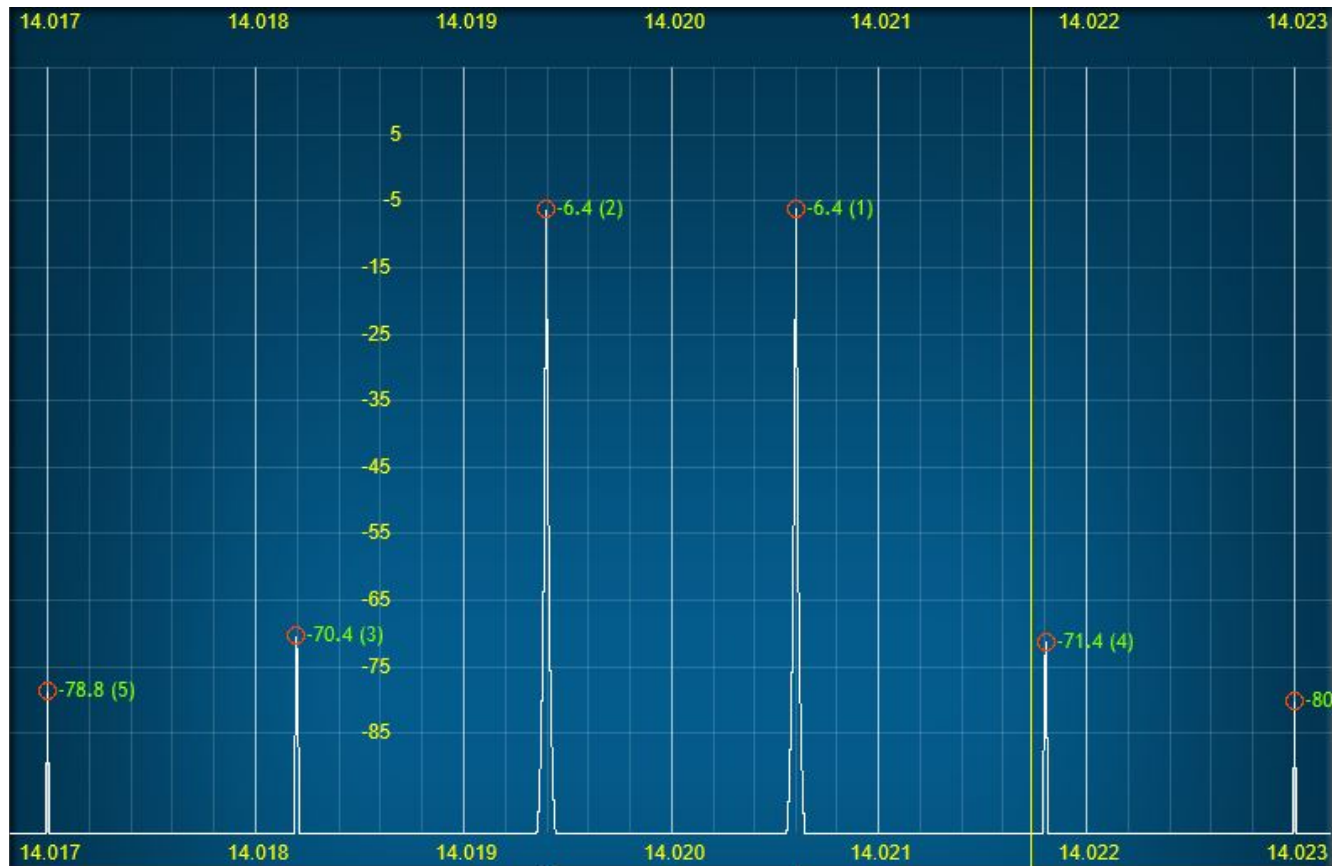
## 20m 50W PS OFF THETIS G2 J7-J31 REMOVED



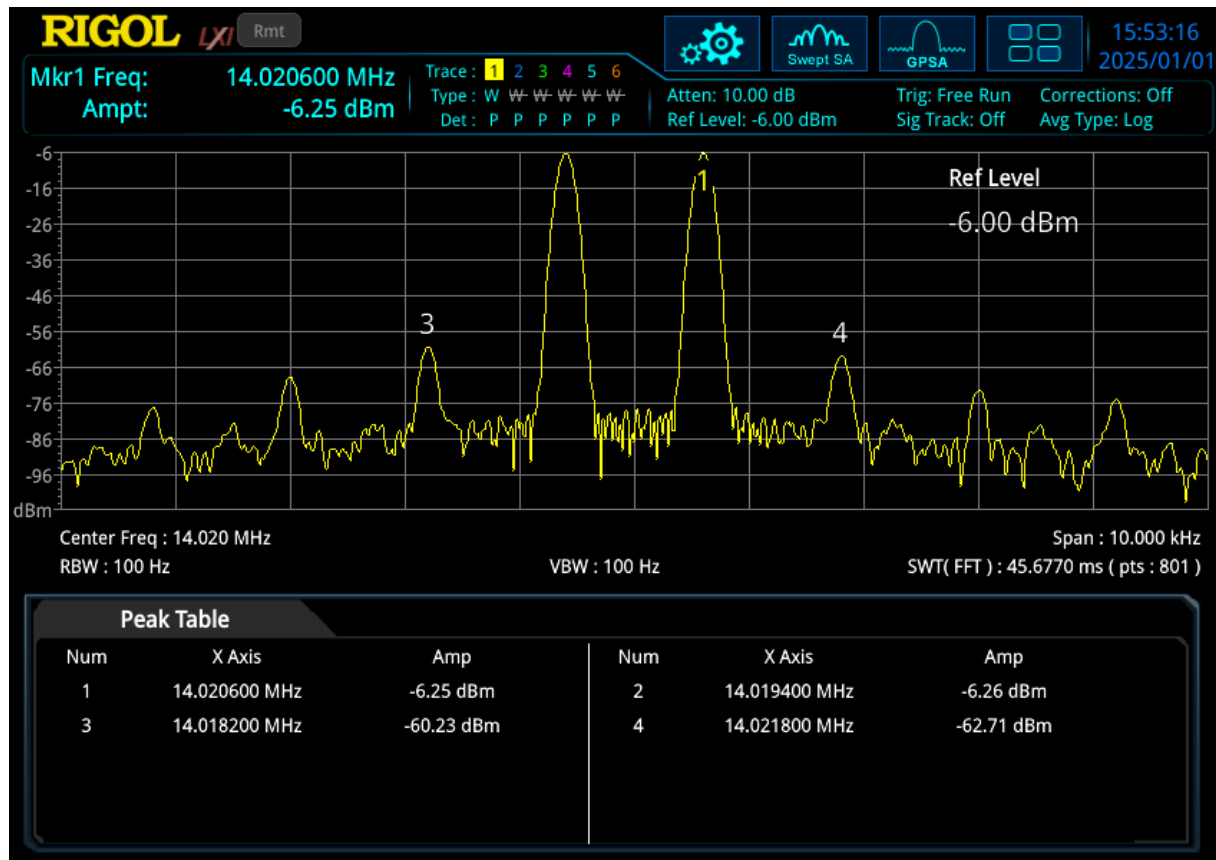
# 20m 50W PS OFF RIGOL G2 J7-J31 REMOVED



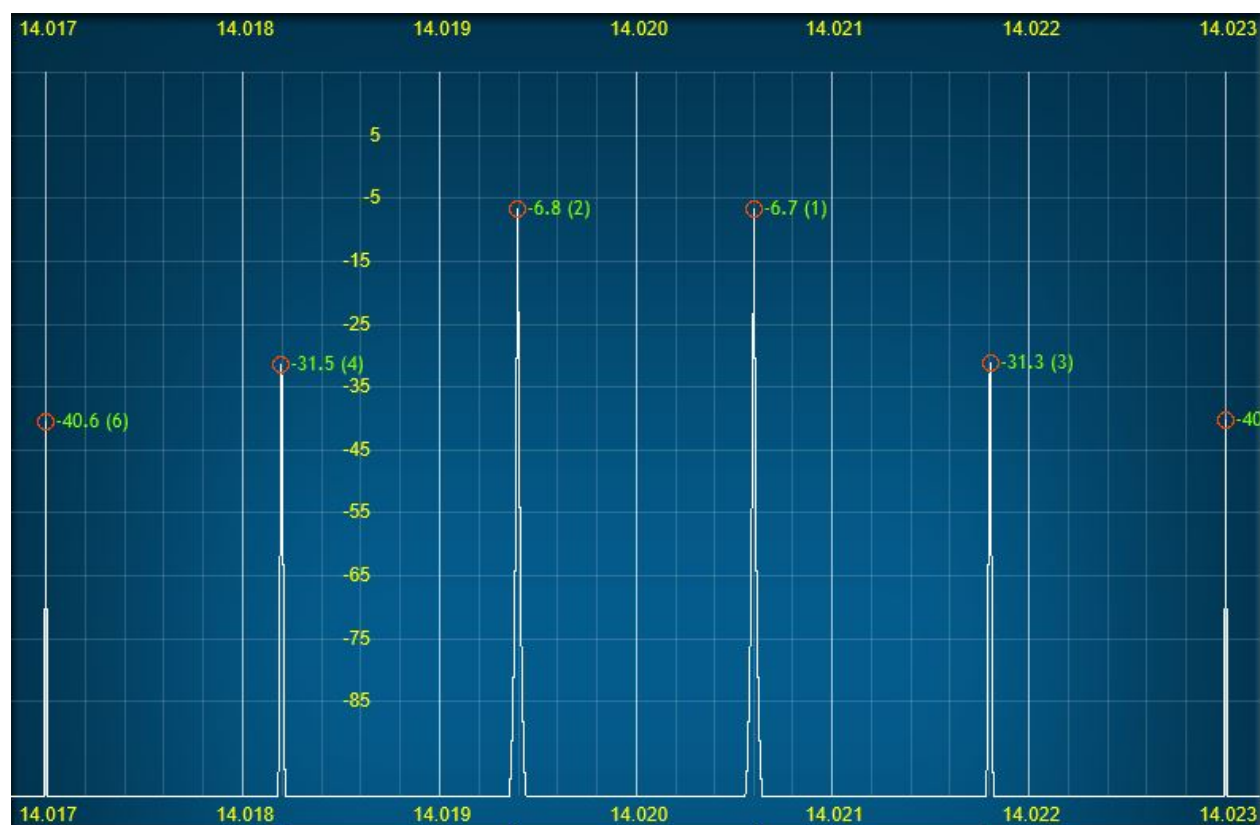
# 20m 50W PS ON THETIS G2 J7-J31 INSTALLED



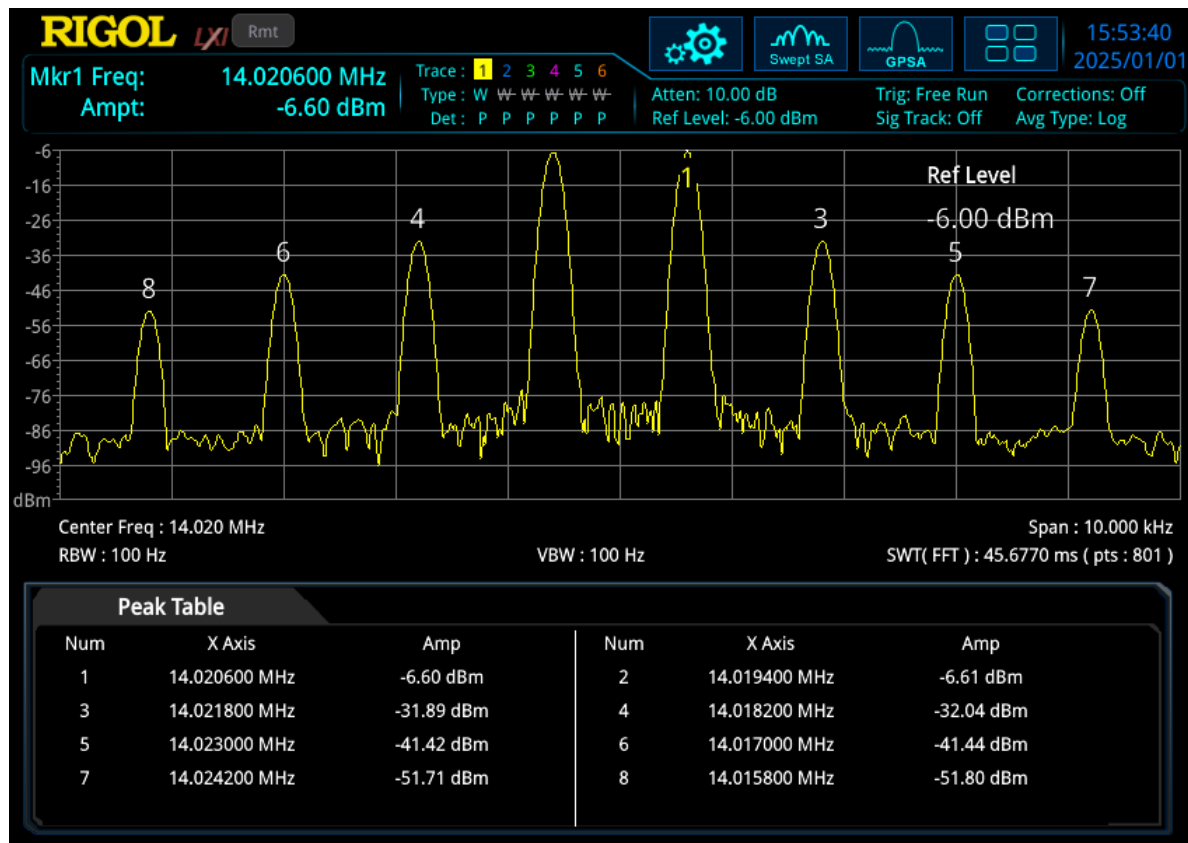
# 20m 50W PS ON RIGOL G2 J7-J31 INSTALLED



# 20m 50W PS OFF THETIS G2 J7-J31 INSTALLED



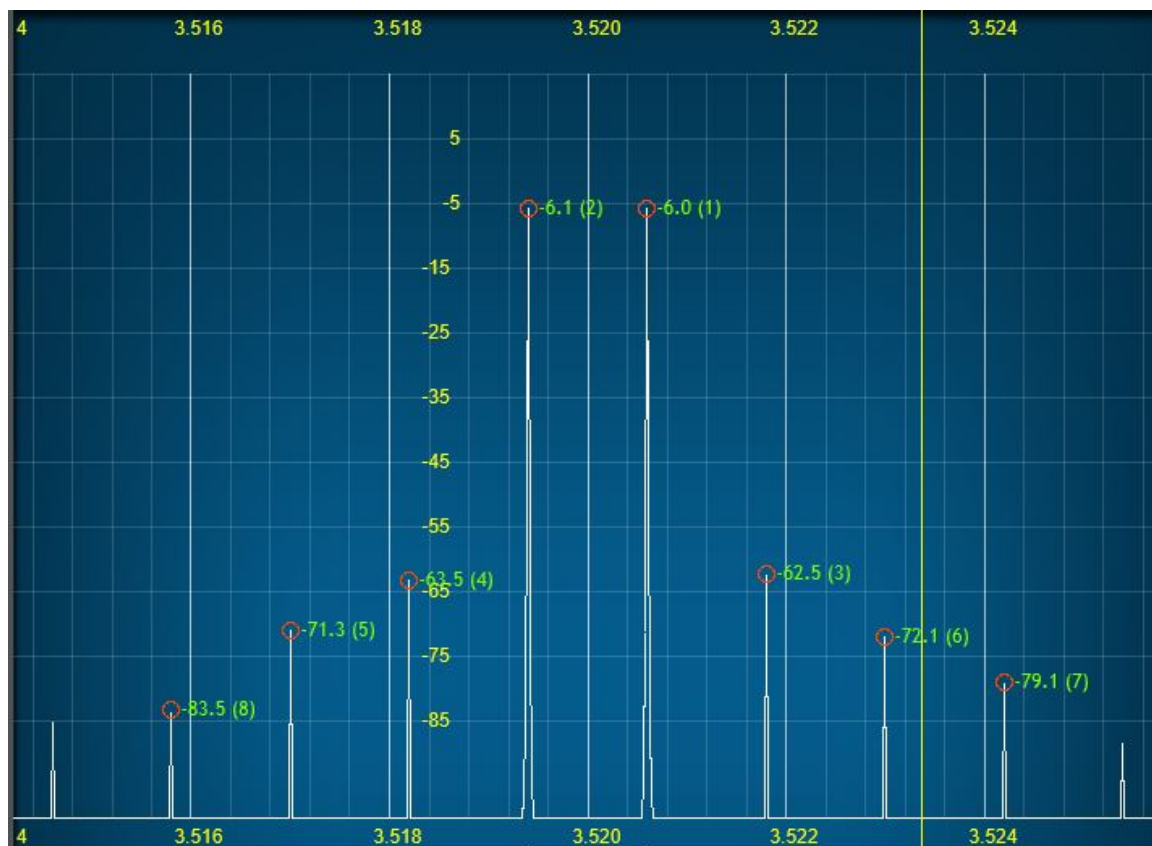
# 20m 50W PS OFF RIGOL G2 J7-J31 INSTALLED



# 80m IMD Data G2 KJ7TEA

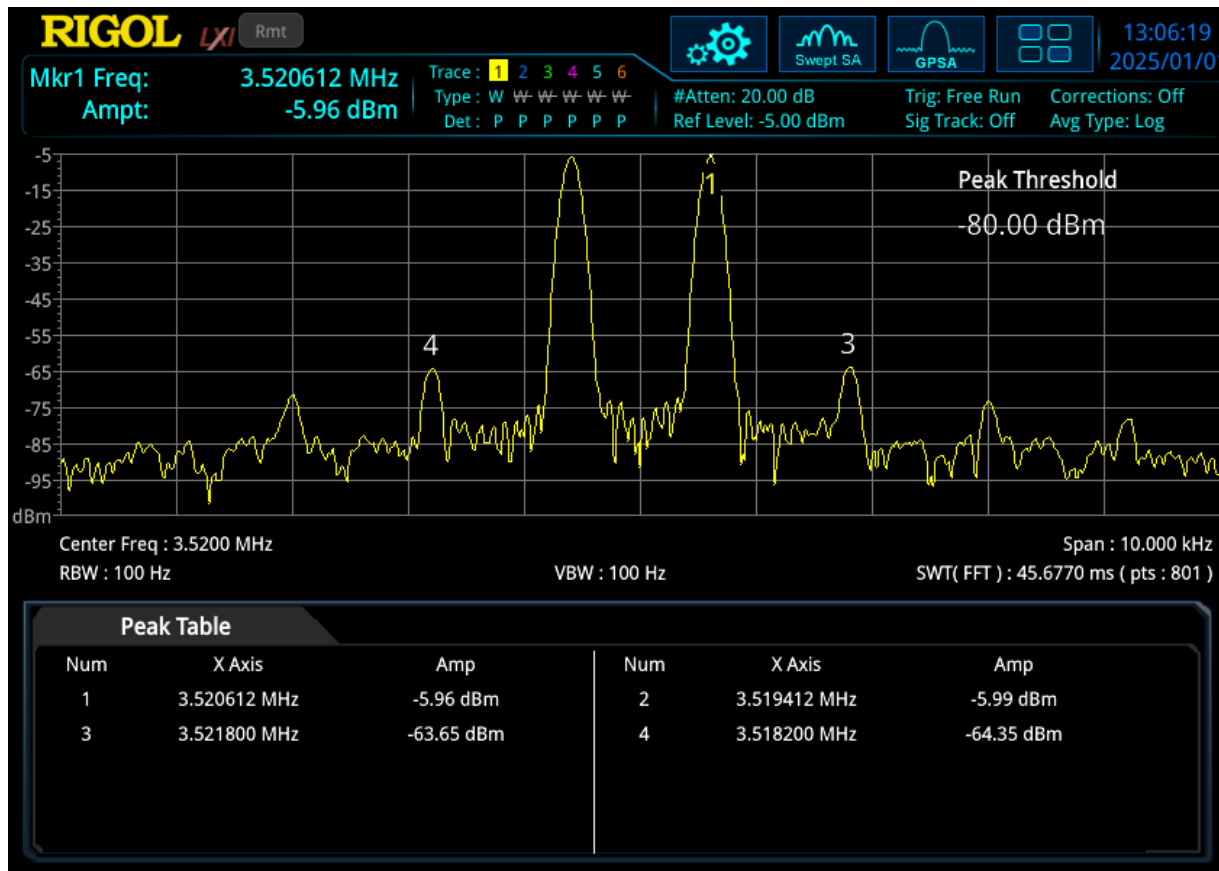
KJ7TEA G2 Data		FREQ	POWER	Pure Signal	XVTR Jumper		3rd Order		Result	Thetis-S/A	Pure Signal	Slide
1-Jan-25	SOURCE	Mhz	Watts	ON/OFF	J7-J31	FB Sample	dBc	f-0	dBc	Difference	Improvement	Reference
80m Data												
KJ7TEA G2	Thetis	3.52	50	ON	REMOVED	INTERNAL	-62.5	-6.0	-56.5		28.4	68
RSA3015N	S/A	3.52	50	ON	REMOVED	INTERNAL	-63.7	-6.0	-57.7	1.16	28.8	69
KJ7TEA G2	Thetis	3.52	50	OFF	REMOVED	INTERNAL	-34.3	-6.2	-28.1			70
RSA3015N	S/A	3.52	50	OFF	REMOVED	INTERNAL	-35.0	-6.1	-28.9	0.75		71
KJ7TEA G2	Thetis	3.52	50	ON	INSTALLED	INTERNAL	-63.2	-6.1	-57.1		28.9	72
RSA3015N	S/A	3.52	50	ON	INSTALLED	INTERNAL	-63.4	-6.4	-57.1	-0.05	28.0	73
KJ7TEA G2	Thetis	3.52	50	OFF	INSTALLED	INTERNAL	-34.4	-6.2	-28.2			74
RSA3015N	S/A	3.52	50	OFF	INSTALLED	INTERNAL	-35.6	-6.5	-29.1	0.87		75

# 80m 50W PS ON THETIS G2 J7-J31 REMOVED

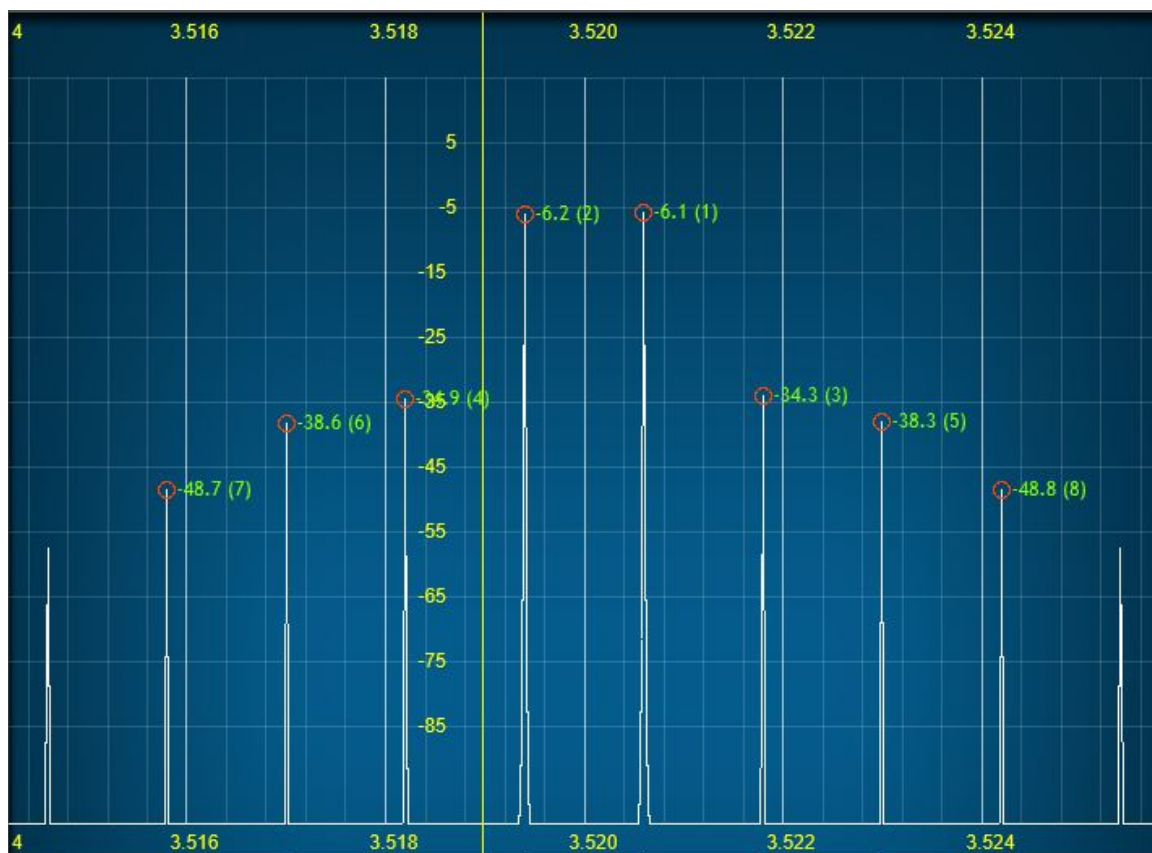




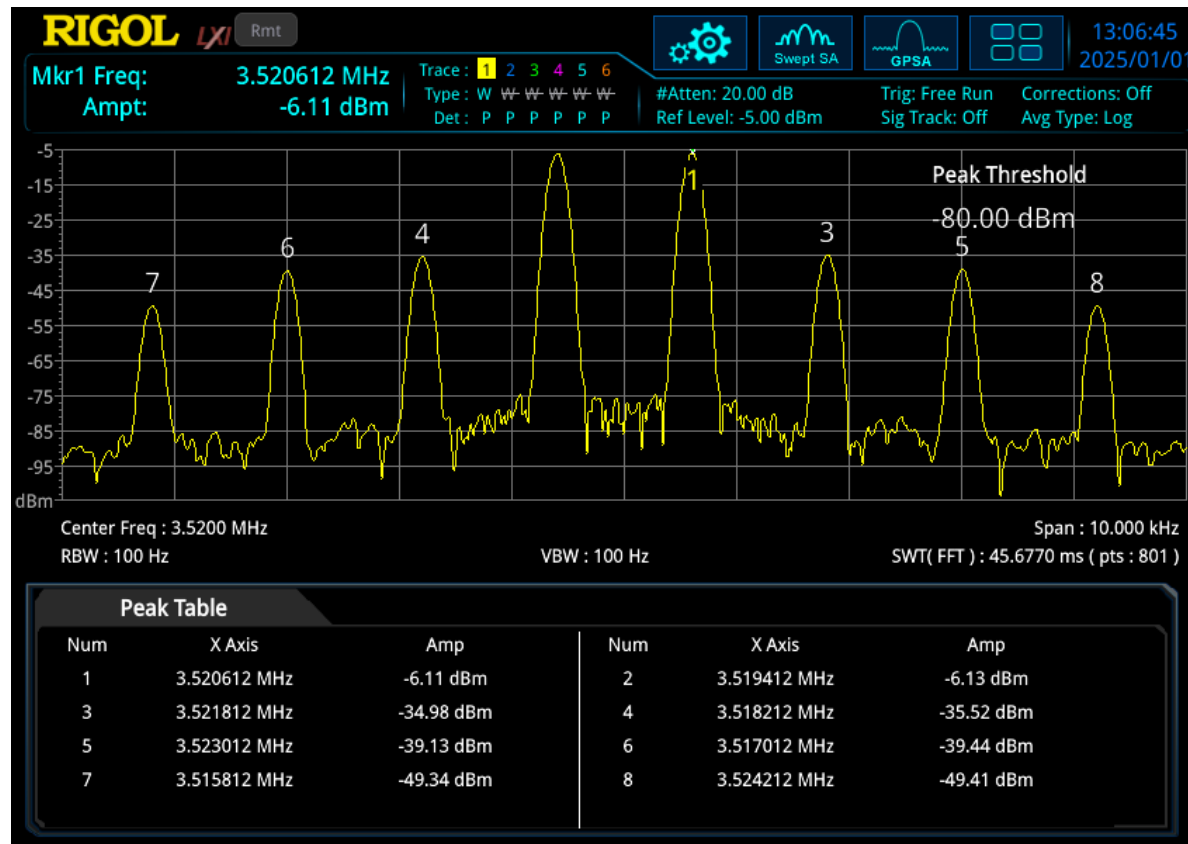
# 80m 50W PS ON RIGOL G2 J7-J31 REMOVED



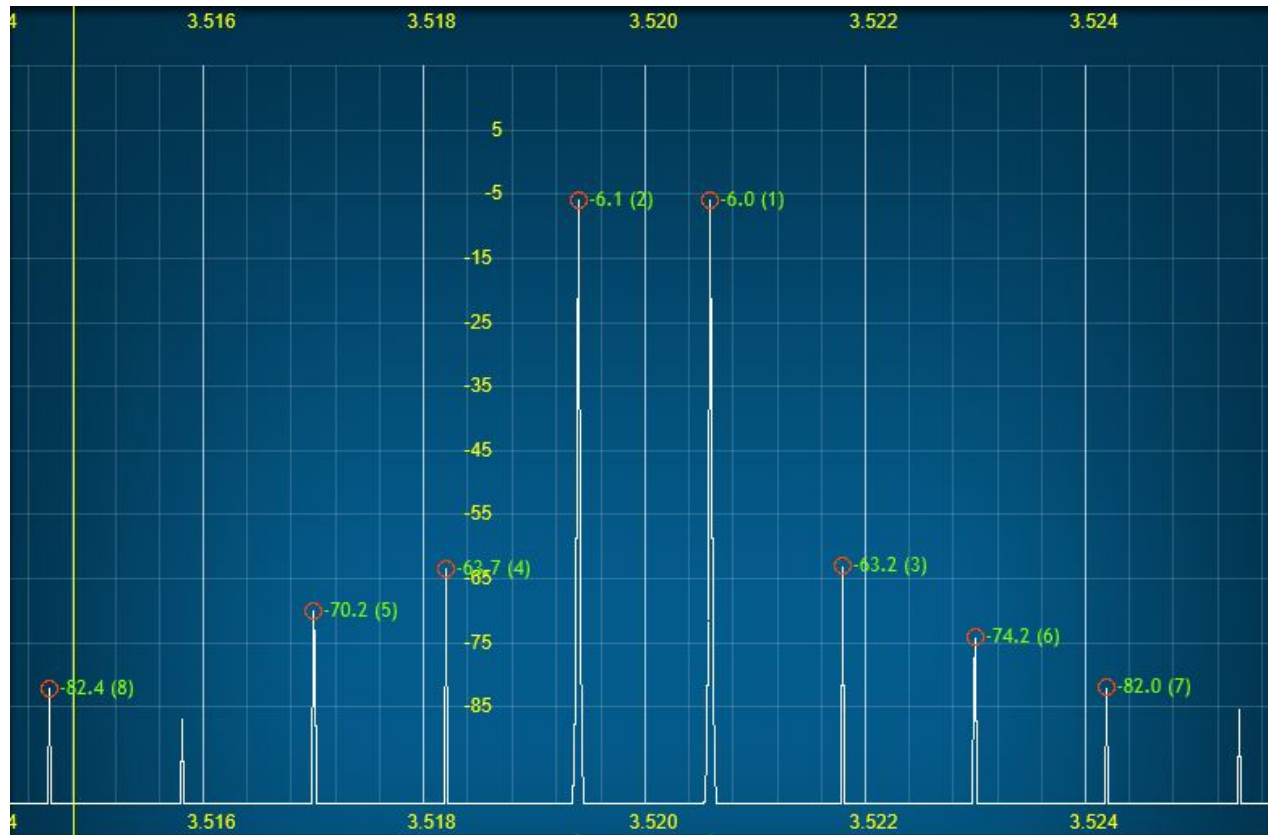
# 80m 50W PS OFF THETIS G2 J7-J31 REMOVED



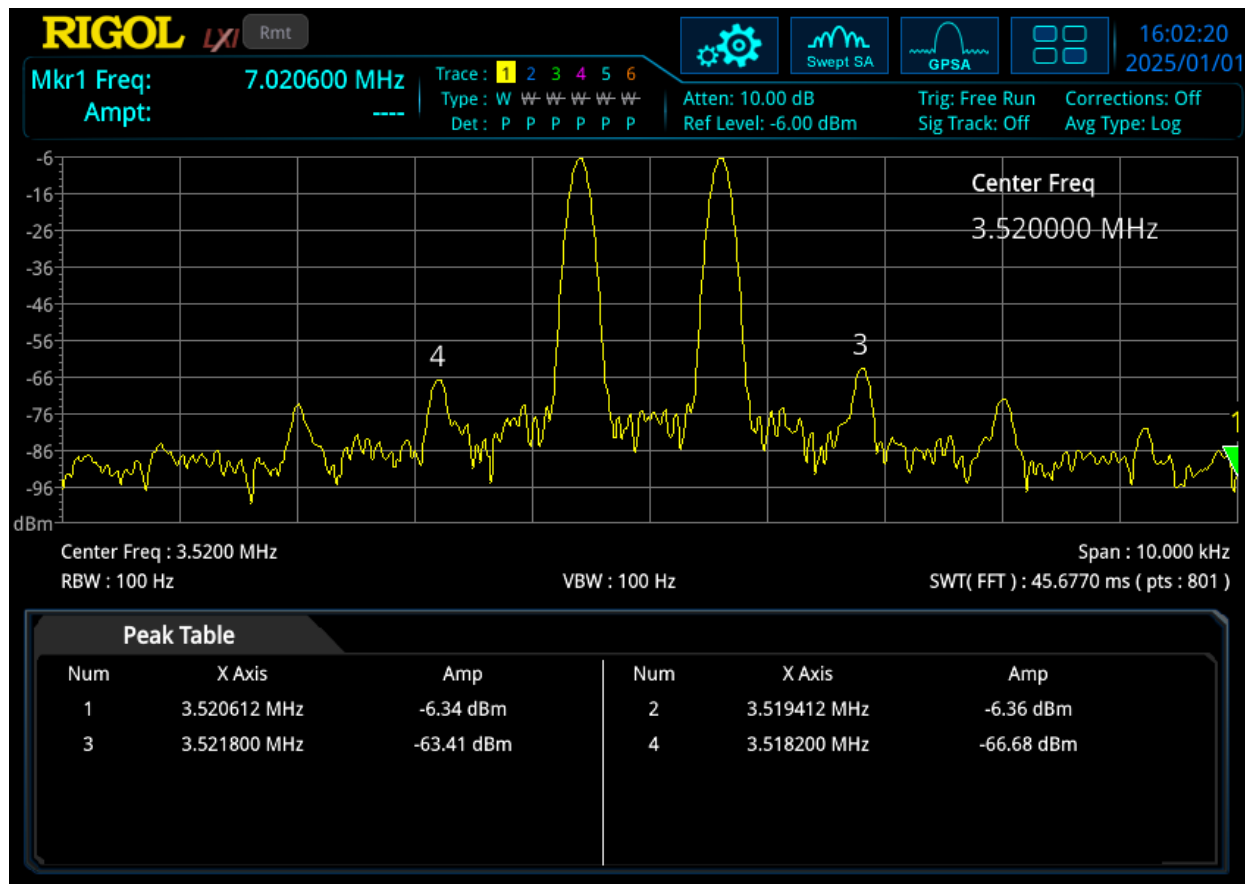
# 80m 50W PS OFF RIGOL G2 J7-J31 REMOVED



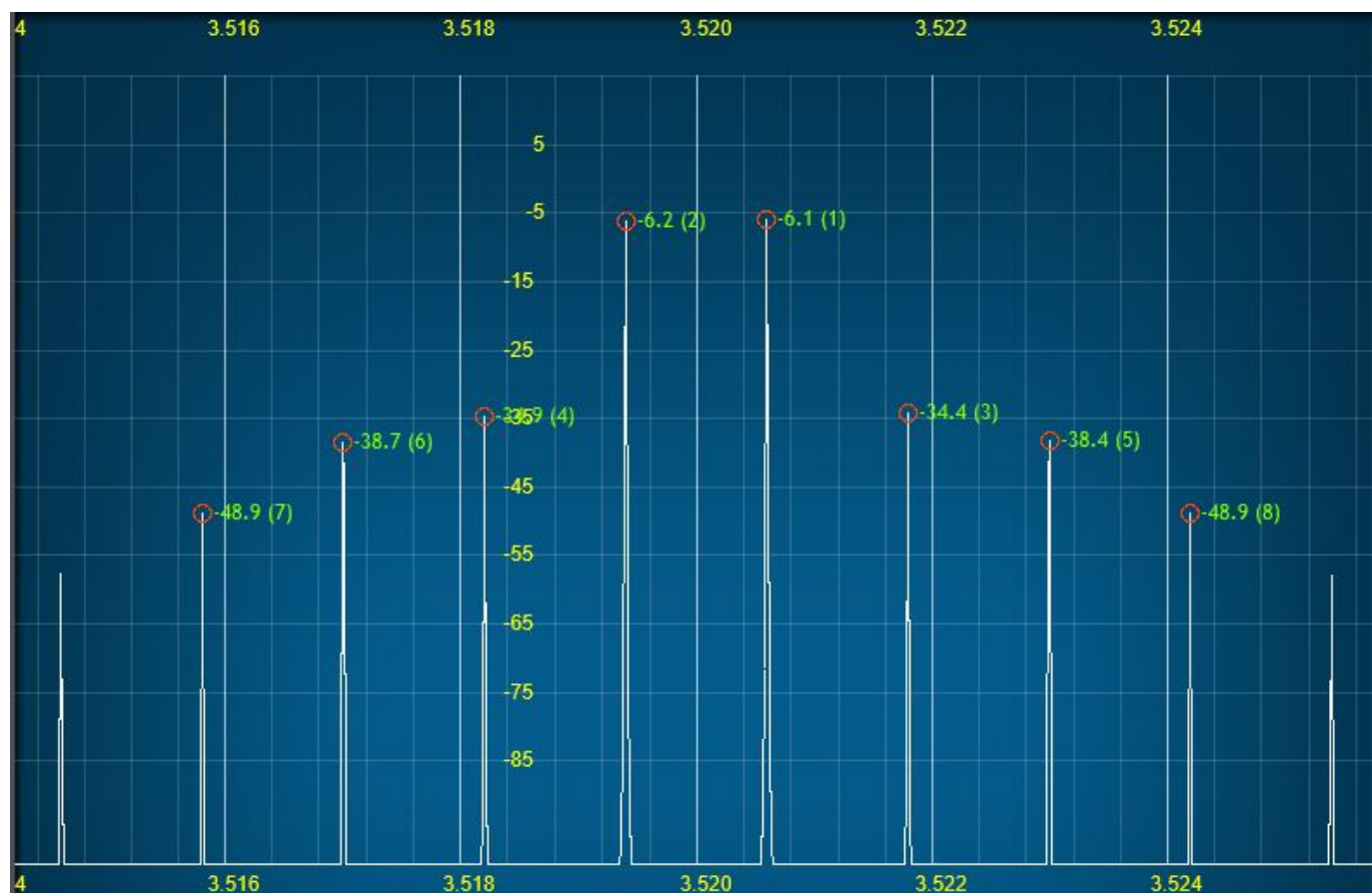
# 80m 50W PS ON THETIS G2 J7-J31 INSTALLED



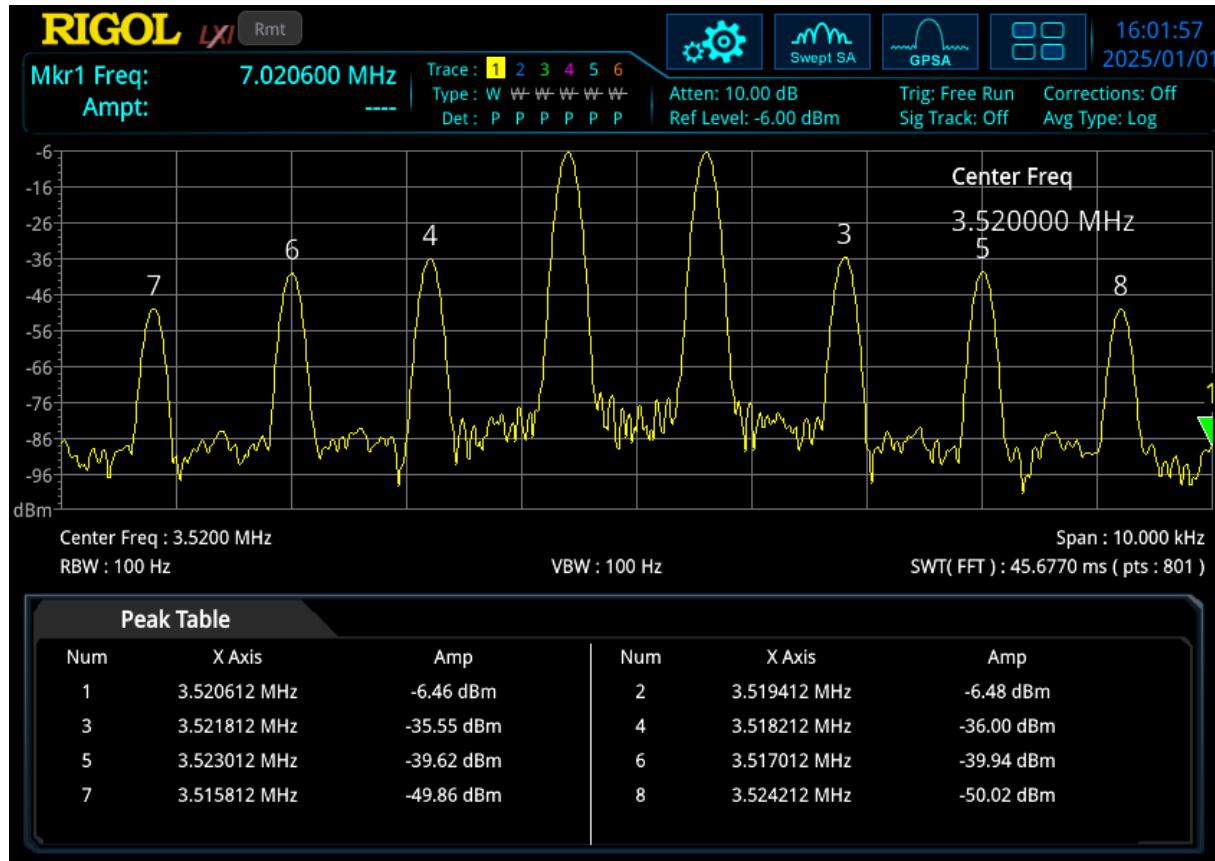
# 80m 50W PS ON RIGOL G2 J7-J31 INSTALLED



# 80m 50W PS OFF THETIS G2 J7-J31 INSTALLED



# 80m 50W PS OFF RIGOL G2 J7-J31 INSTALLED



# 40m IMD Data 7000DLE K1WPO

K1WPO Data										
J31-J32 REMOVED		FREQ	POWER	Int FB ATT	Pure Signal	3rd Order		Result	Thetis-S/A	Pure Signal
9-Jan-25	SOURCE	Mhz	Watts	dB	ON/OFF	dBc	f-0	dBc	Difference	Improvement
40m Data										
K1WPO 7000DLE hp3585A	Thetis	7.02	50	14	ON	-61.7	-6.0	-55.7		25.0
	S/A	7.02	50	14	ON	-61.6	-6.6	-55.0	-0.7	25.1
K1WPO 7000DLE hp3585A	Thetis	7.02	100	17	ON	-64.0	-3.1	-60.9		38.1
	S/A	7.02	100	17	ON	-64.3	-3.8	-60.5	-0.4	37.9
K1WPO 7000DLE hp3585A	Thetis	7.02	25	11	ON	-65.1	-9.0	-56.1		20.6
	S/A	7.02	25	11	ON	-64.8	-9.6	-55.2	-0.9	20.2
K1WPO 7000DLE hp3585A	Thetis	7.02	50		OFF	-36.3	-5.6	-30.7		
	S/A	7.02	50		OFF	-36.1	-6.2	-29.9	-0.8	
K1WPO 7000DLE hp3585A	Thetis	7.02	100		OFF	-25.1	-2.3	-22.8		
	S/A	7.02	100		OFF	-25.6	-3.0	-22.6	-0.2	
K1WPO 7000DLE hp3585A	Thetis	7.02	25		OFF	-44.3	-8.8	-35.5		
	S/A	7.02	25		OFF	-44.3	-9.3	-35.0	-0.5	



## 20m IMD Data 7000DLE K1WPO

K1WPO Data										
J31-J32 REMOVED		FREQ	POWER	Int FB ATT	Pure Signal	3rd Order		Result	Thetis-S/A	Pure Signal
9-Jan-25	SOURCE	Mhz	Watts	dB	ON/OFF	dBc	f-0	dBc	Difference	Improvement
20m Data										
K1WPO 7000DLE hp3585A	Thetis	14.02	50	15	ON	-63.7	-6.3	-57.4		18.4
	S/A	14.02	50	15	ON	-62.1	-5.7	-56.4	-1	18.8
K1WPO 7000DLE hp3585A	Thetis	14.02	100	18	ON	-58.5	-3.7	-54.8		35.6
	S/A	14.02	100	18	ON	-58.0	-3.5	-54.5	-0.3	35.5
K1WPO 7000DLE hp3585A	Thetis	14.02	25	12	ON	-64.9	-9.3	-55.6		19.3
	S/A	14.02	25	12	ON	-63.6	-8.8	-54.8	-0.8	20.1
K1WPO 7000DLE hp3585A	Thetis	14.02	50		OFF	-45.0	-6.0	-39.0		
	S/A	14.02	50		OFF	-43.0	-5.4	-37.6	-1.4	
K1WPO 7000DLE hp3585A	Thetis	14.02	100		OFF	-21.6	-2.4	-19.2		
	S/A	14.02	100		OFF	-21.0	-2.0	-19.0	-0.2	
K1WPO 7000DLE hp3585A	Thetis	14.02	25		OFF	-45.3	-9.0	-36.3		
	S/A	14.02	25		OFF	-43.2	-8.5	-34.7	-1.6	

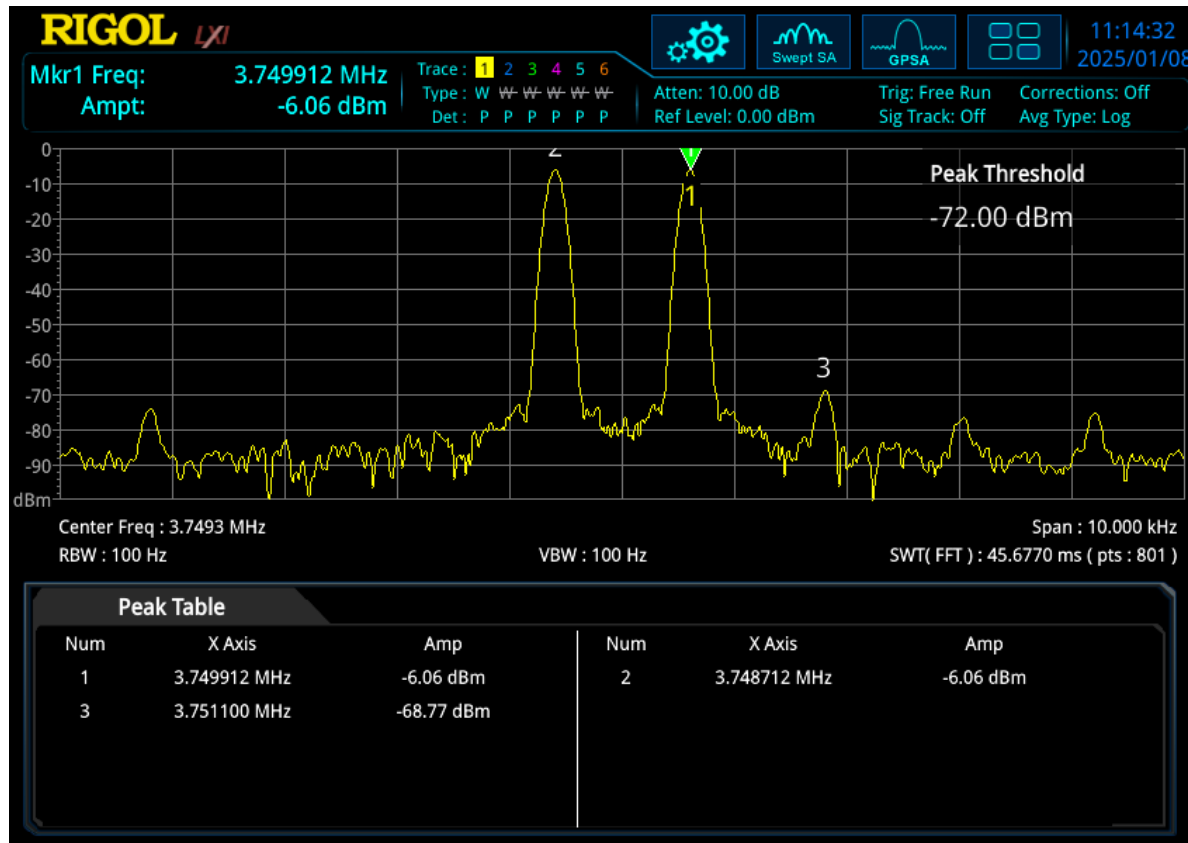
# 80m IMD Data 7000DLE K1WPO

K1WPO Data										
J31-J32 REMOVED		FREQ	POWER	Int FB ATT	Pure Signal	3rd Order		Result	Thetis-S/A	Pure Signal
9-Jan-25	SOURCE	Mhz	Watts	dB	ON/OFF	dBc	f-0	dBc	Difference	Improvement
80m Data										
K1WPO 7000DLE hp3585A	Thetis	3.52	50	13	ON	-64.5	-6.2	-58.3		27.3
	S/A	3.52	50	13	ON	-64.0	-5.8	-58.2	-0.1	27.1
K1WPO 7000DLE hp3585A	Thetis	3.52	100	16	ON	-60.6	-3.1	-57.5		30.2
	S/A	3.52	100	16	ON	-63.3	-6.1	-57.2	-0.27	30.5
K1WPO 7000DLE hp3585A	Thetis	3.52	25	11	ON	-68.4	-8.7	-59.7		17.2
	S/A	3.52	25	11	ON	-70.0	-9.4	-60.6	0.9	18.9
K1WPO 7000DLE hp3585A	Thetis	3.52	50		OFF	-36.8	-5.8	-31.0		
	S/A	3.52	50		OFF	-36.5	-5.4	-31.1	0.1	
K1WPO 7000DLE hp3585A	Thetis	3.52	100		OFF	-29.9	-2.6	-27.3		
	S/A	3.52	100		OFF	-32.4	-5.7	-26.8	-0.55	
K1WPO 7000DLE hp3585A	Thetis	3.52	25		OFF	-51.0	-8.5	-42.5		
	S/A	3.52	25		OFF	-51.0	-9.3	-41.7	-0.8	

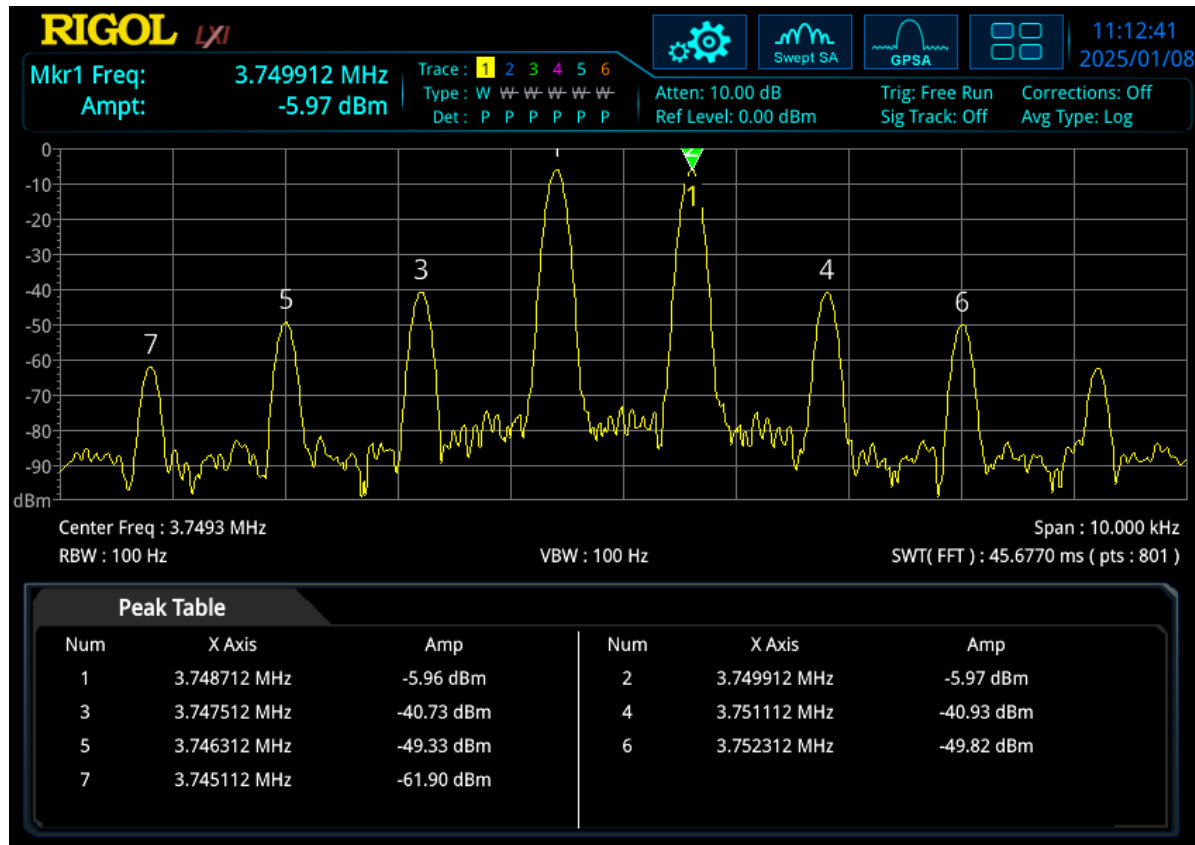
## Pure Signal w/ Tube and LDMOS PA's Jumper Removed

K1VF Data	SOURCE	FREQ Mhz	POWER Watts	Pure Signal		3rd Order dBc	3rd Order Result dBc	Pure Signal Improvement	5th Order dBc	5th Order Result dBc	Pure Signal Improvement	Slide Reference
				ON/OFF	f-0							
7-Jan-25				INT FB								
Exciter		ALPHA 77DX IMD DATA										
K1VF 7000DLE MKII	S/A	3.75	1500	ON	-6.1	-68.8	-62.7		-75	-68.9		80
RSA3015N	S/A	3.75	1500	OFF	-6.0	-40.7	-34.7	-27.94	-49.33	-43.3	-25.57	81
K1VF 7000DLE MKII	S/A	7.10	1500	ON	-5.9	-69.8	-63.9		-72	-66.1		82
RSA3015N	S/A	7.10	1500	OFF	-5.8	-66.5	-60.7	-3.2	-40.1	-34.3	-31.8	83
K1VF 7000DLE MKII	S/A	14.20	1500	ON	-6.2	-67.5	-61.3		-70.4	-64.2		84
RSA3015N	S/A	14.20	1500	OFF	-6.2	-50.6	-44.4	-16.9	-61.3	-55.1	-9.1	84
K1VF 7000DLE MKII	S/A	21.10	1500	ON	-6.1	-67.3	-61.2		-75	-68.9		86
RSA3015N	S/A	21.10	1500	OFF	-6.2	-39.1	-32.9	-28.35	-43.6	-37.4	-31.5	87
Exciter		FLEX PowerGenius XL										
KJ7TEA G2	S/A	3.52	1500	ON	-17.4	-73.3	-55.9		-79	-61.6		88
RSA3015N	S/A	3.52	1500	OFF	-16.9	-46.4	-29.5	-26.39	-55	-38.1	-23.49	89
KJ7TEA	S/A	7.02	1500	ON	-17.4	-74.1	-56.7		-82	-64.6		90
RSA3015N	S/A	7.02	1500	OFF	-17.8	-42.9	-25.1	-31.56	-49.9	-32.2	-32.45	91
KJ7TEA G2	S/A	14.02	1500	ON	-16.1	-75.8	-59.7		-81	-64.9		92
RSA3015N	S/A	14.02	1500	OFF	-16.3	-41.2	-24.9	-34.83	-48.6	-32.3	-32.64	93

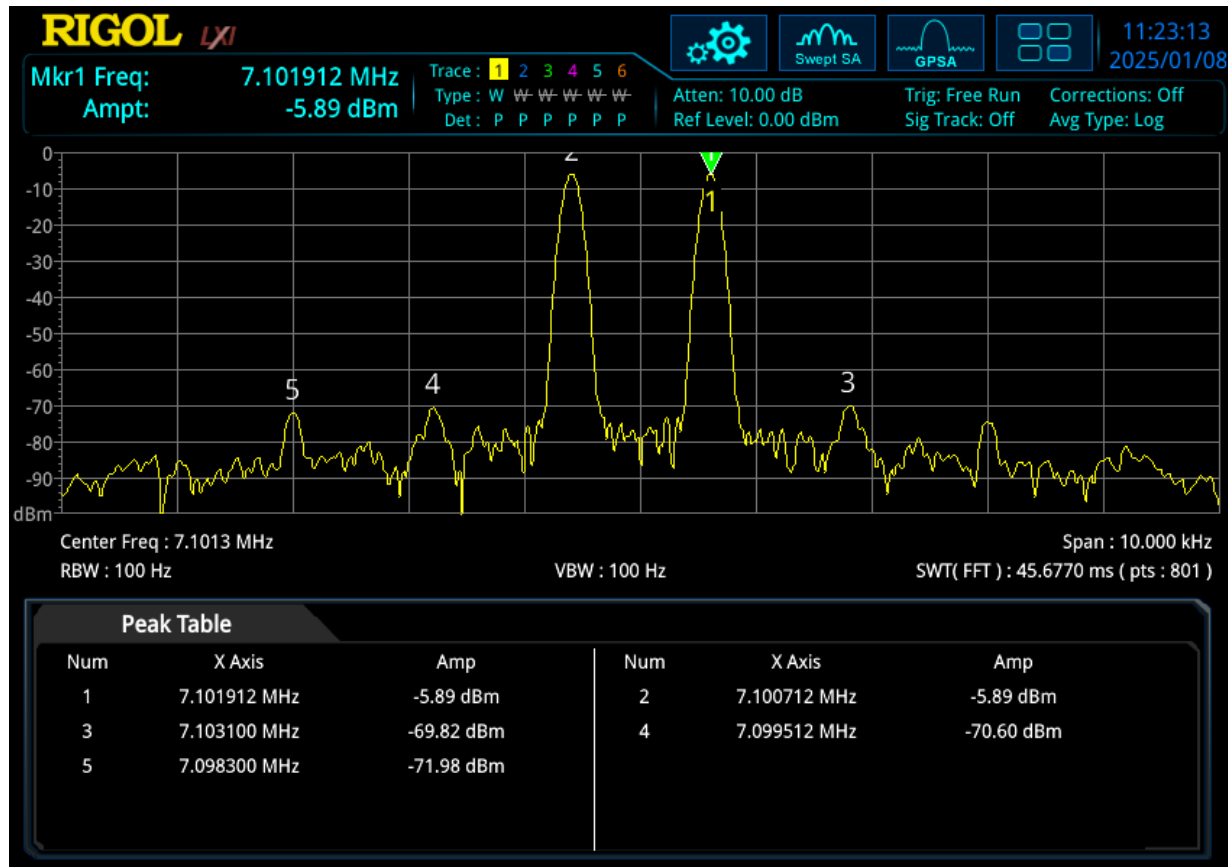
# Alpha 77DX 80m Pure Signal ON - Jumper Removed



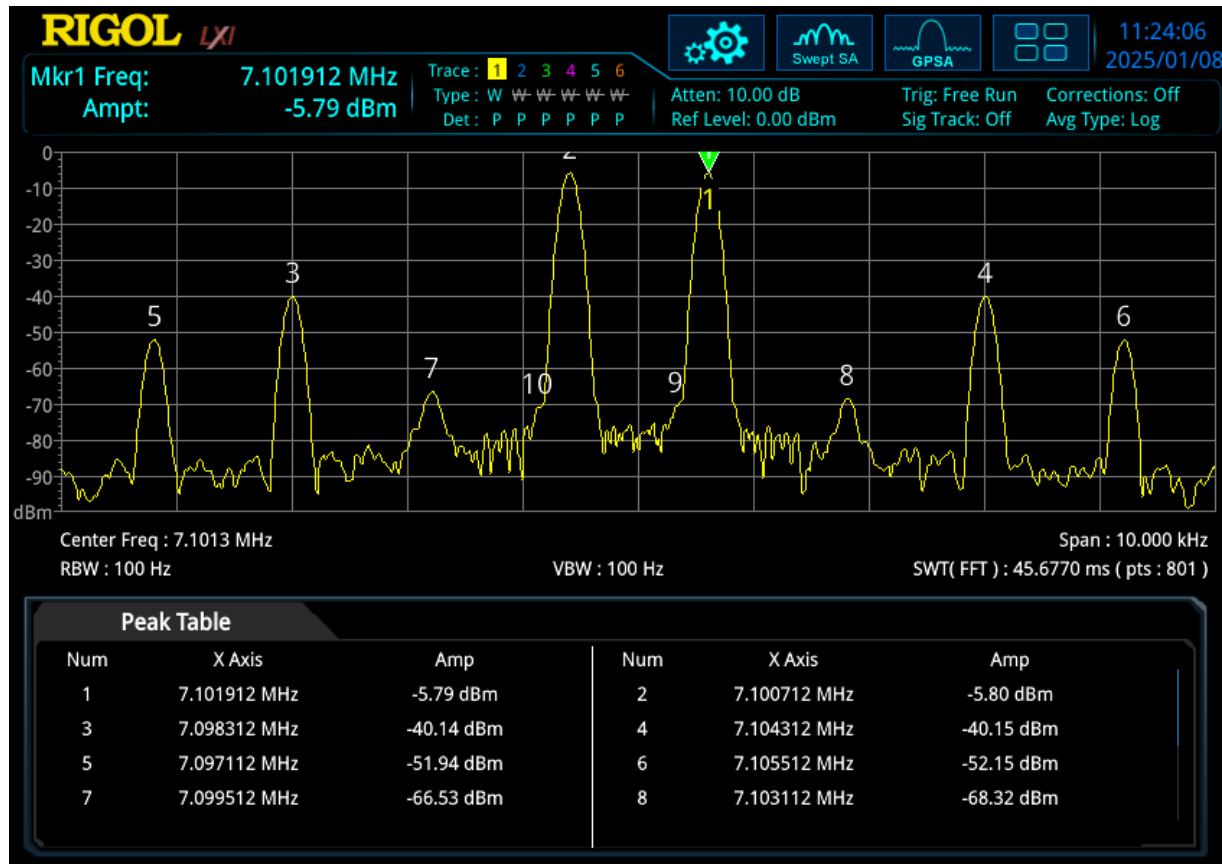
# Alpha 77DX 80m Pure Signal OFF



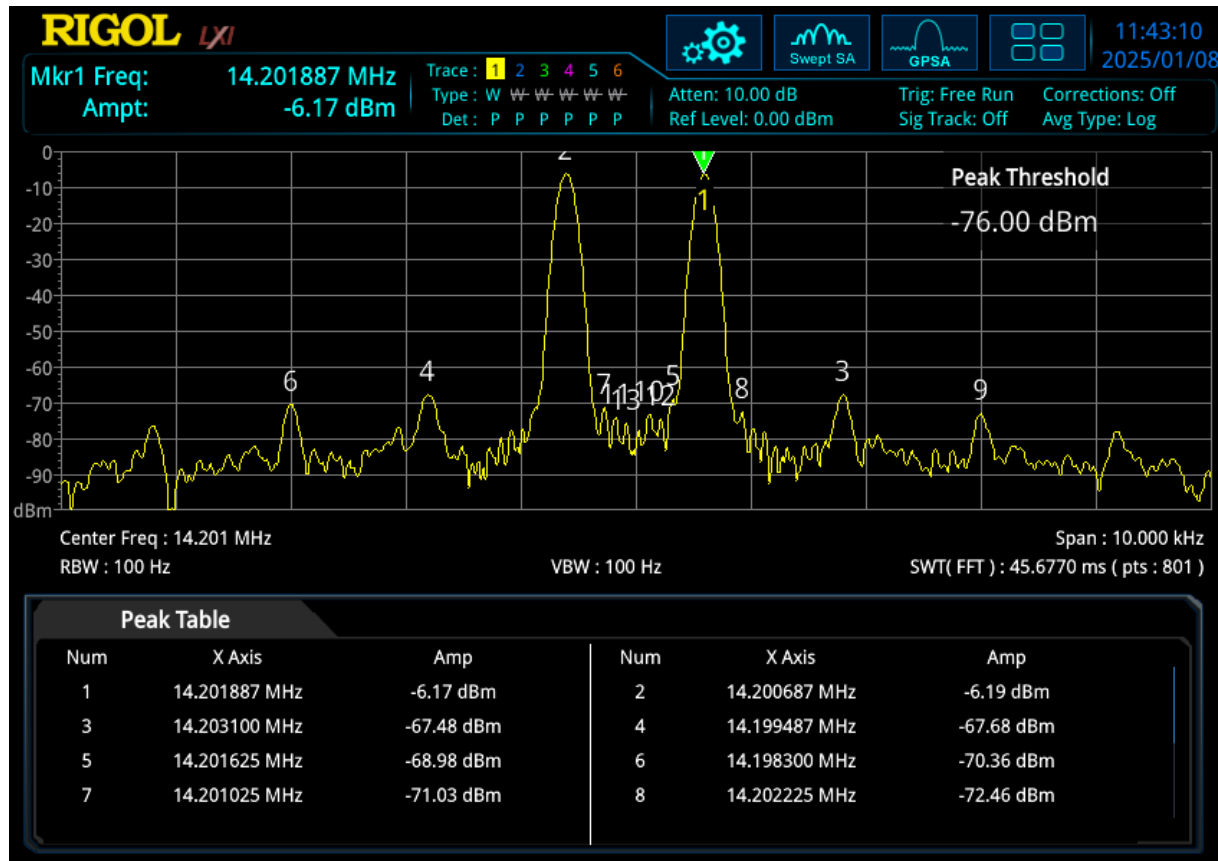
# Alpha 77DX 40m Pure Signal ON - Jumper Removed



# Alpha 77DX 40m Pure Signal OFF

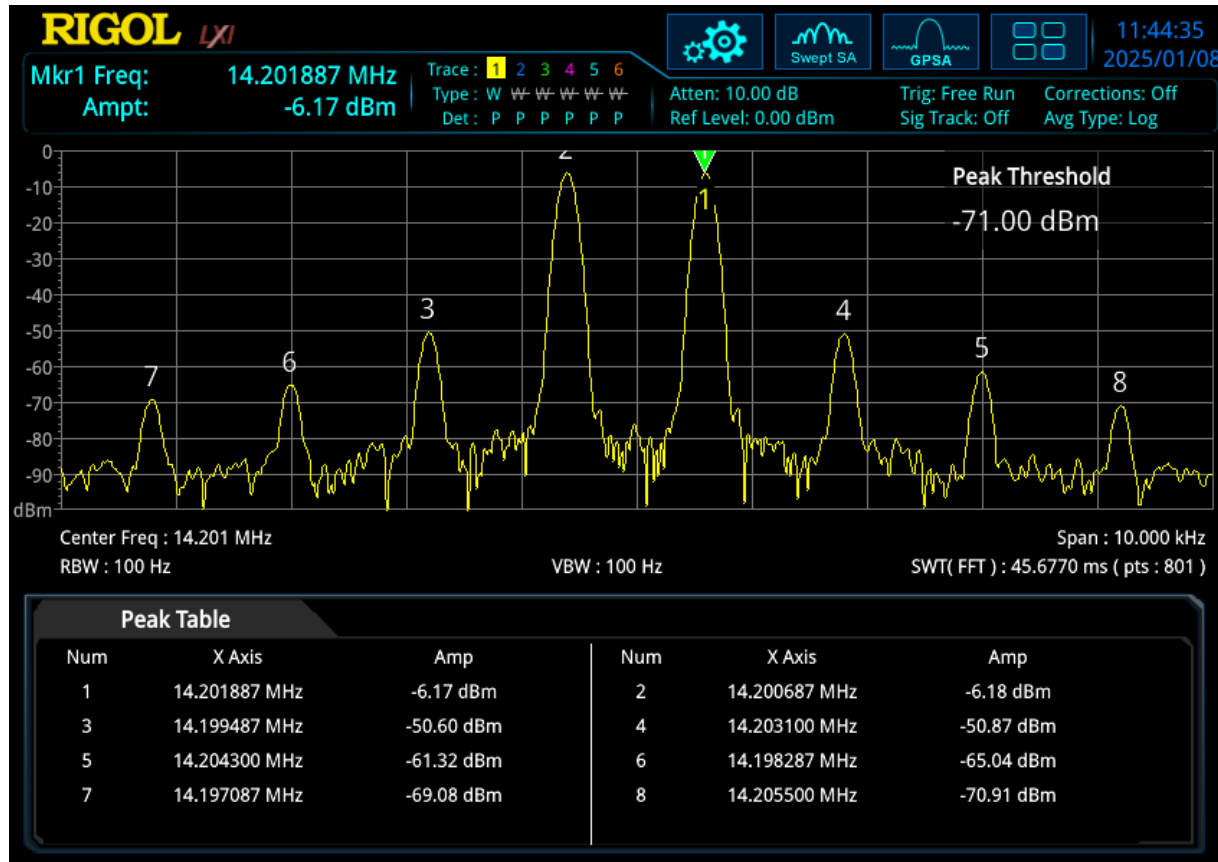


# Alpha 77DX 20m Pure Signal ON - Jumper Removed

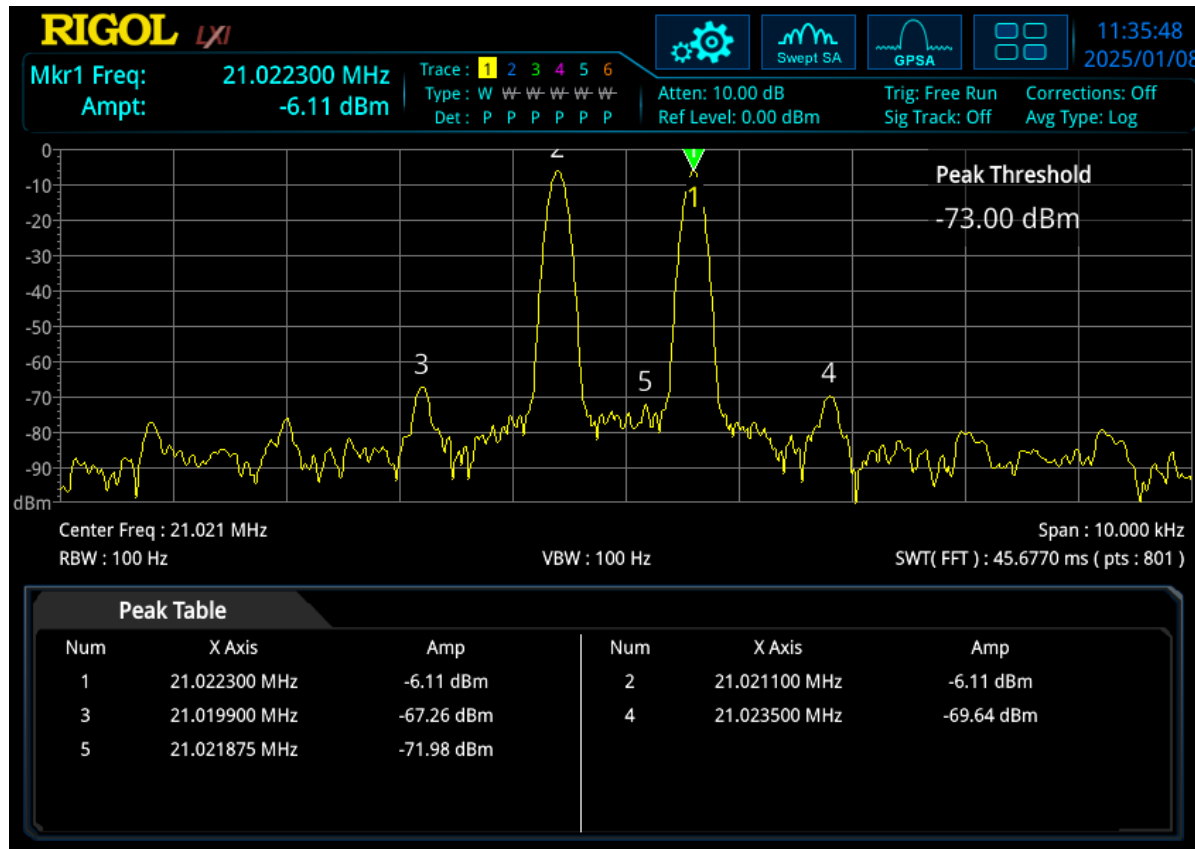




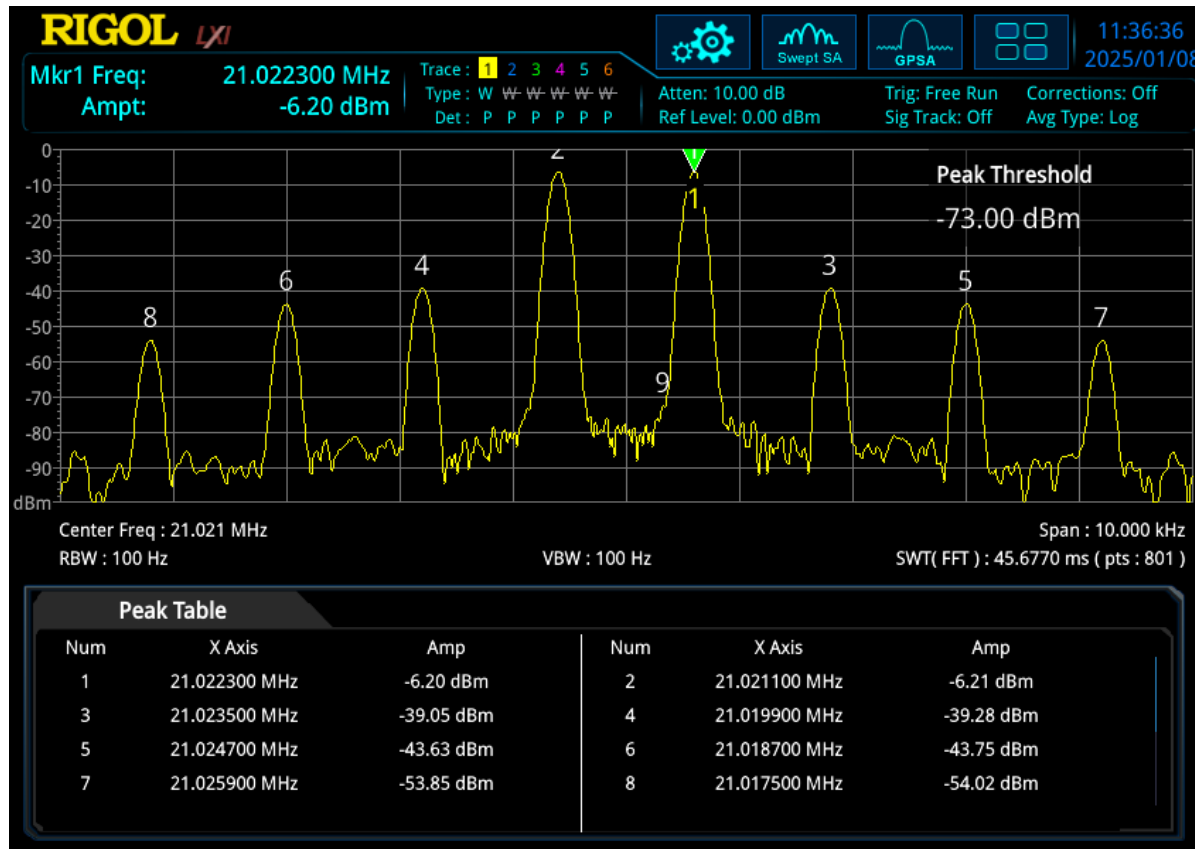
# Alpha 77DX 20m Pure Signal OFF



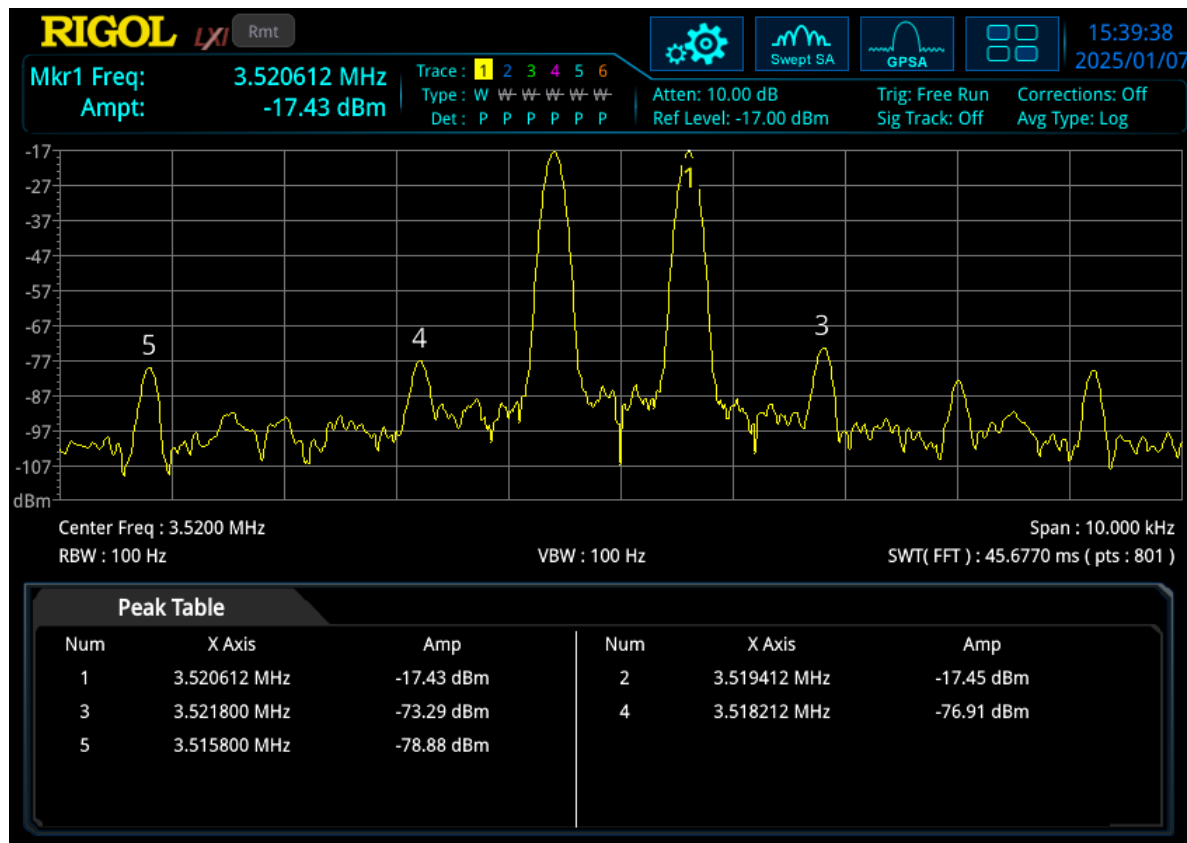
# Alpha 77DX 15m Pure Signal ON - Jumper Removed



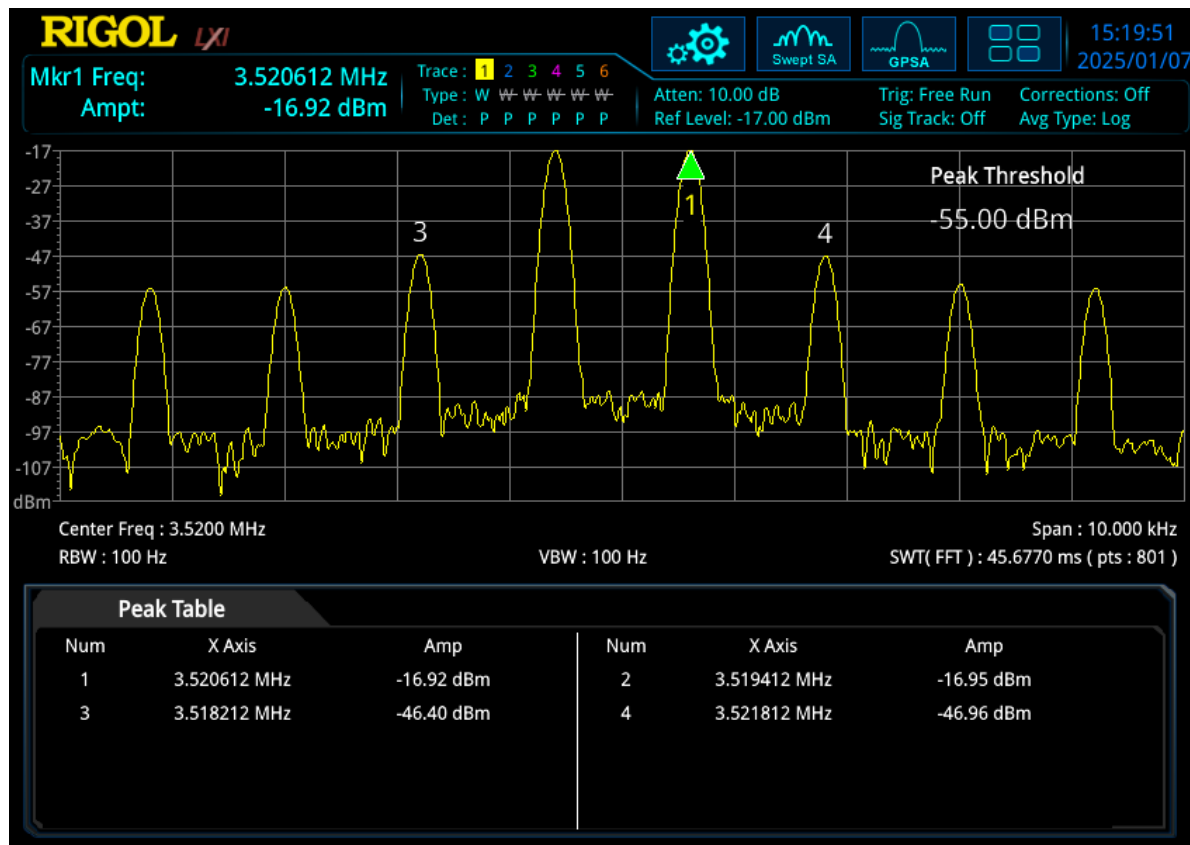
# Alpha 77DX 15m Pure Signal OFF



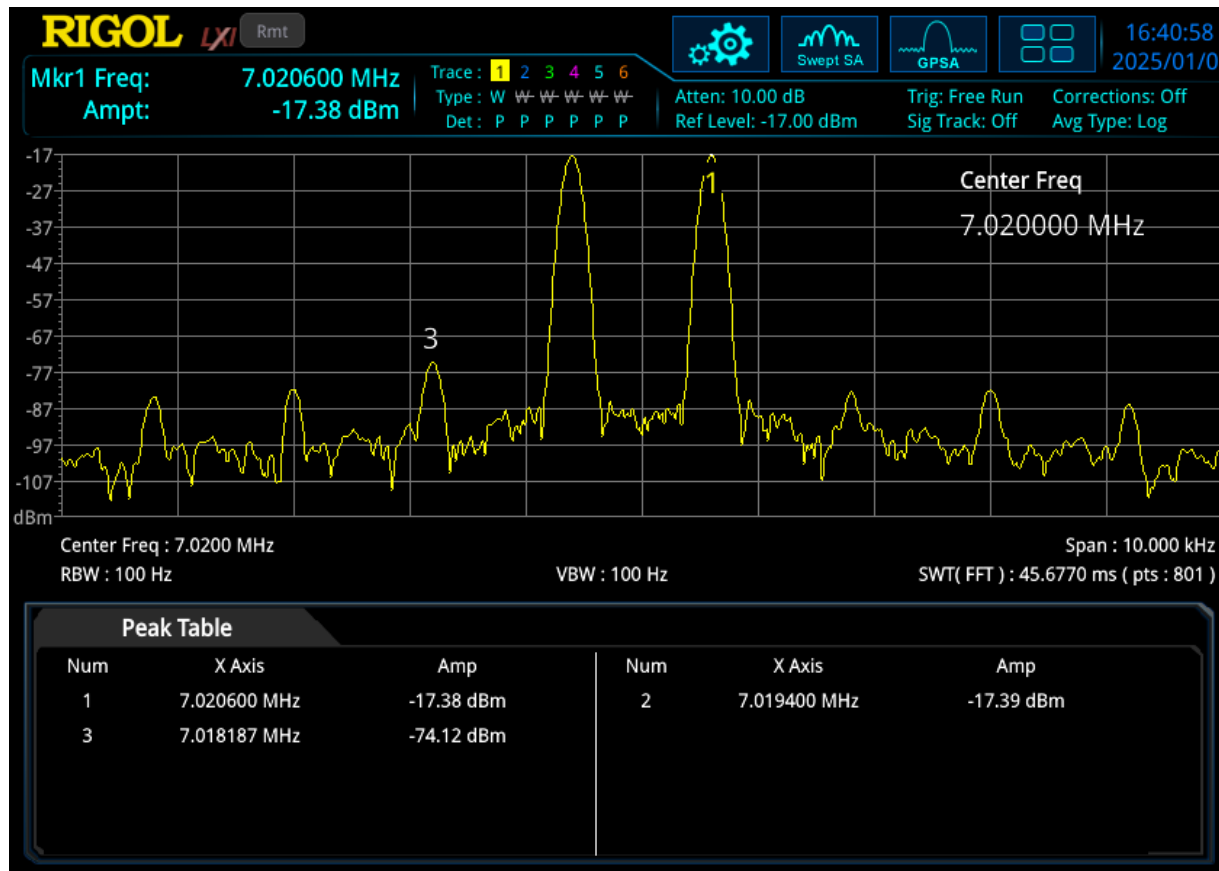
# Flex PGXL 80m Pure Signal ON - Jumper Removed



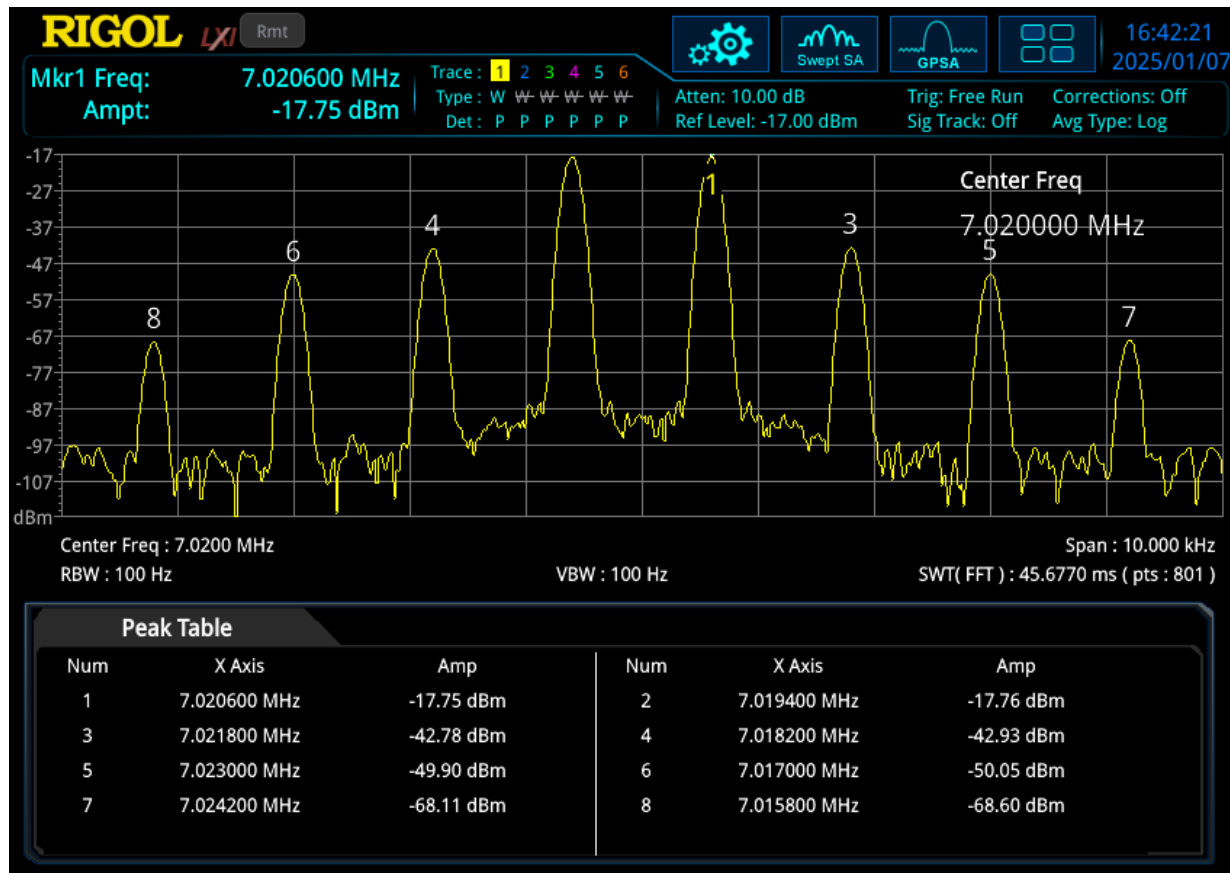
# Flex PGXL 80m Pure Signal OFF



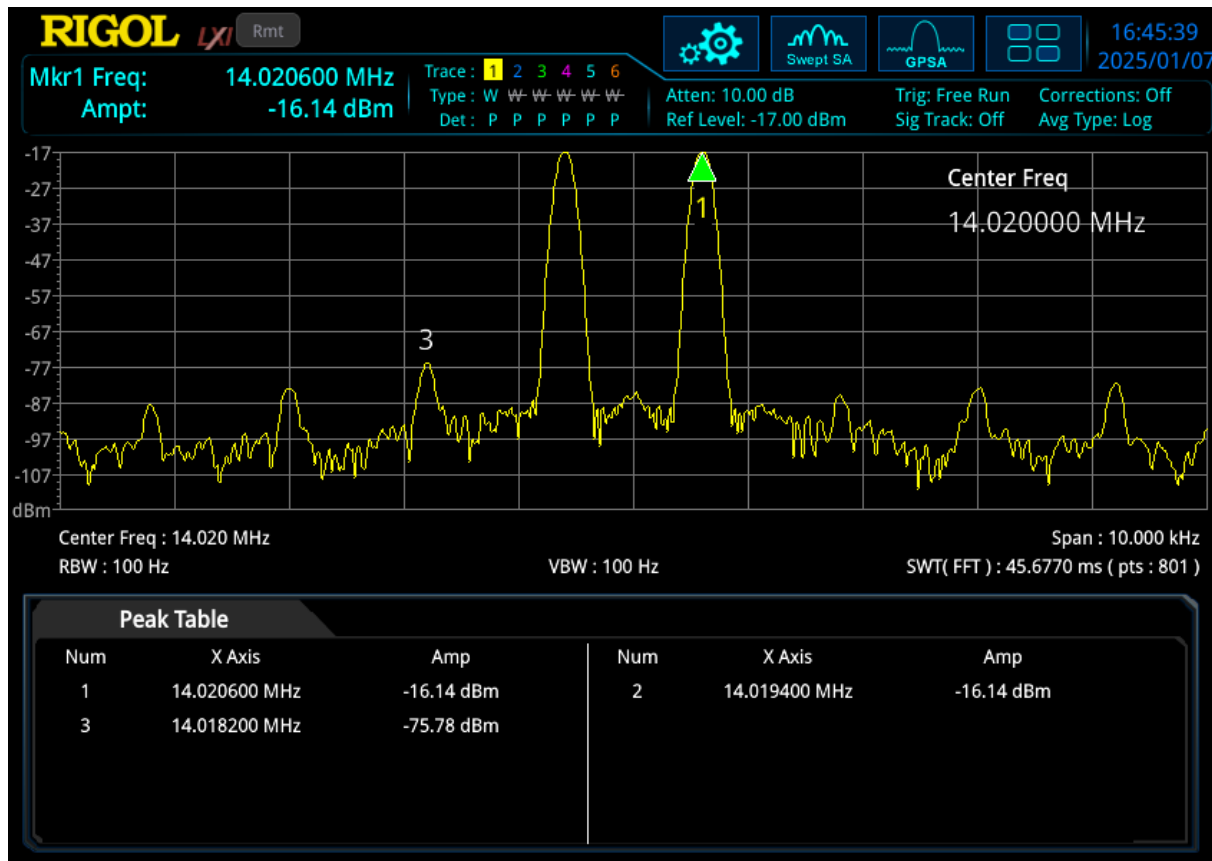
# Flex PGXL 40m Pure Signal ON - Jumper Removed



# Flex PGXL 40m Pure Signal OFF

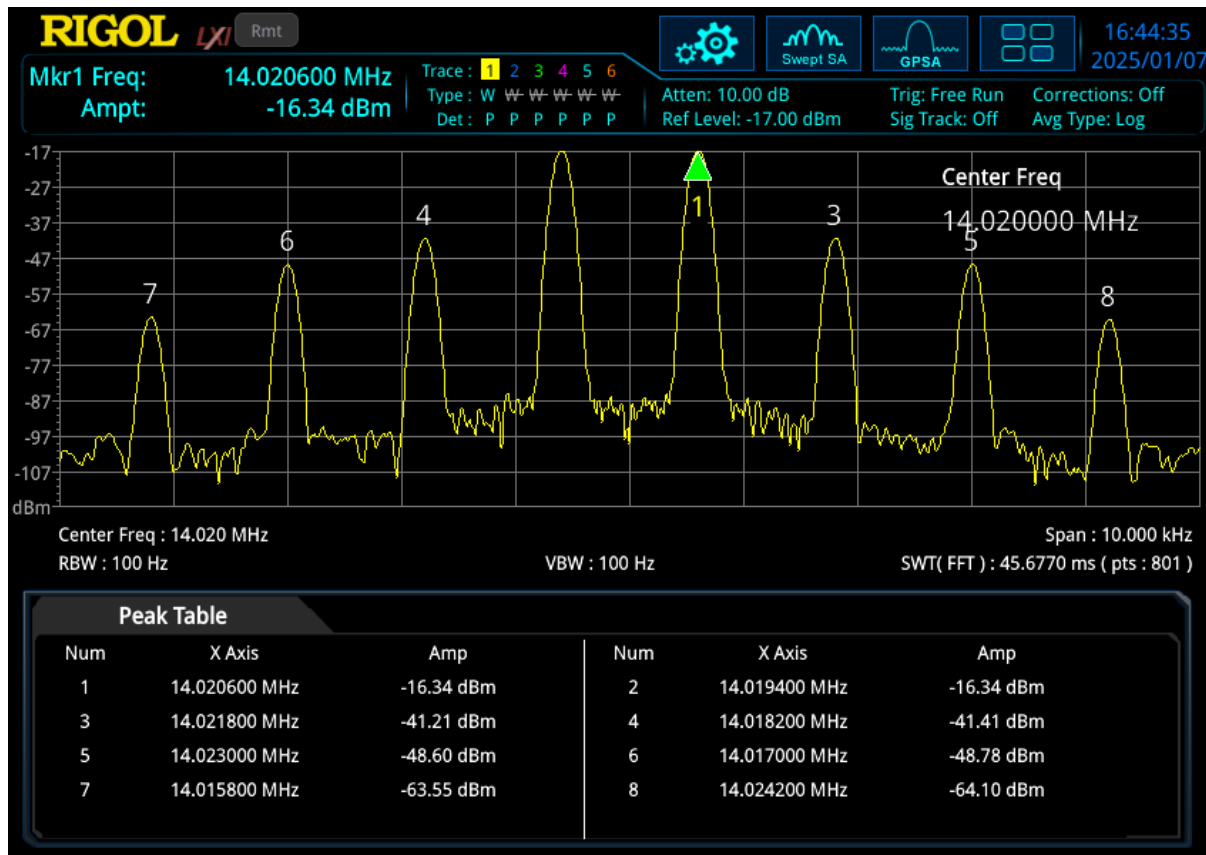


# Flex PGXL 20m Pure Signal ON - Jumper Removed





# Flex PGXL 20m Pure Signal OFF



# Photos of Jumper to be removed

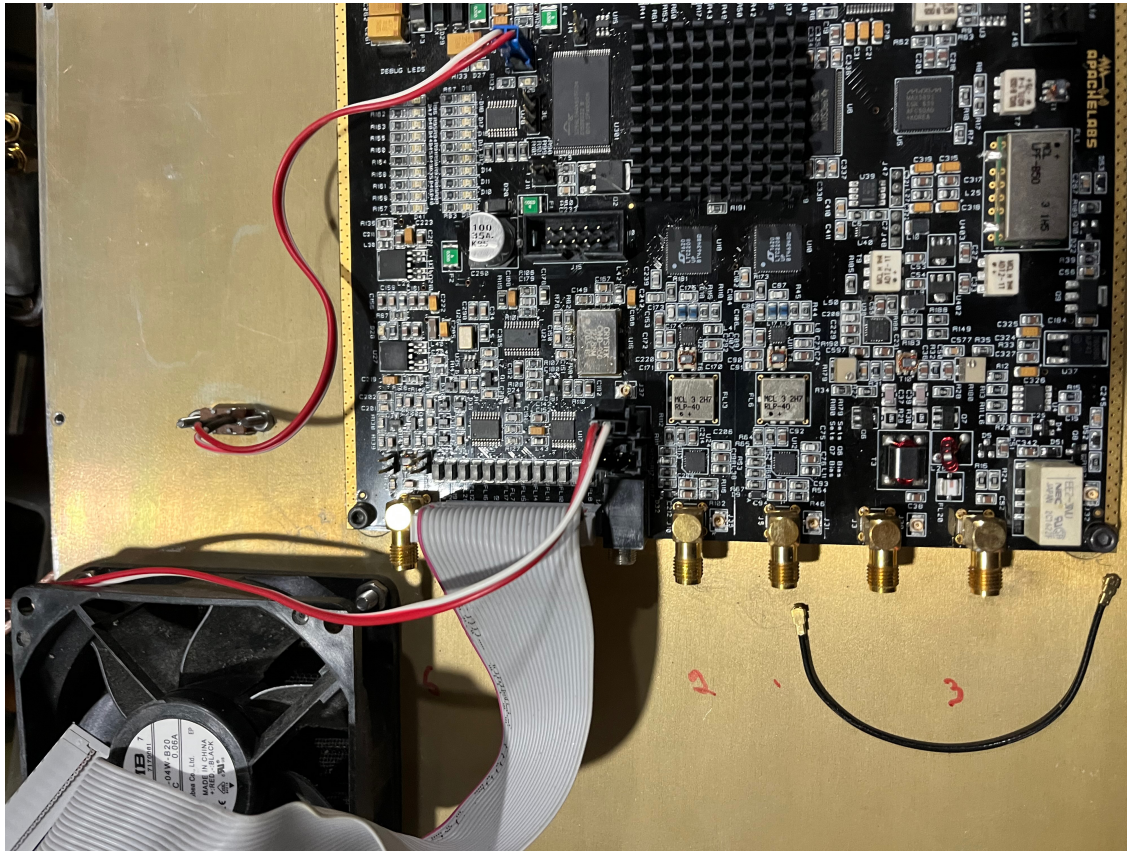
- **MODELS Tested and photos of micro coaxial jumper removed**
- 7000DLE 2017-2018
- 7000MKII 2019
- G2 2024

## **NOTE**

Removing the jumper will disable the XVTR function and capability of your radio.



# Location of XVTR Jumper Model: 7000DLE

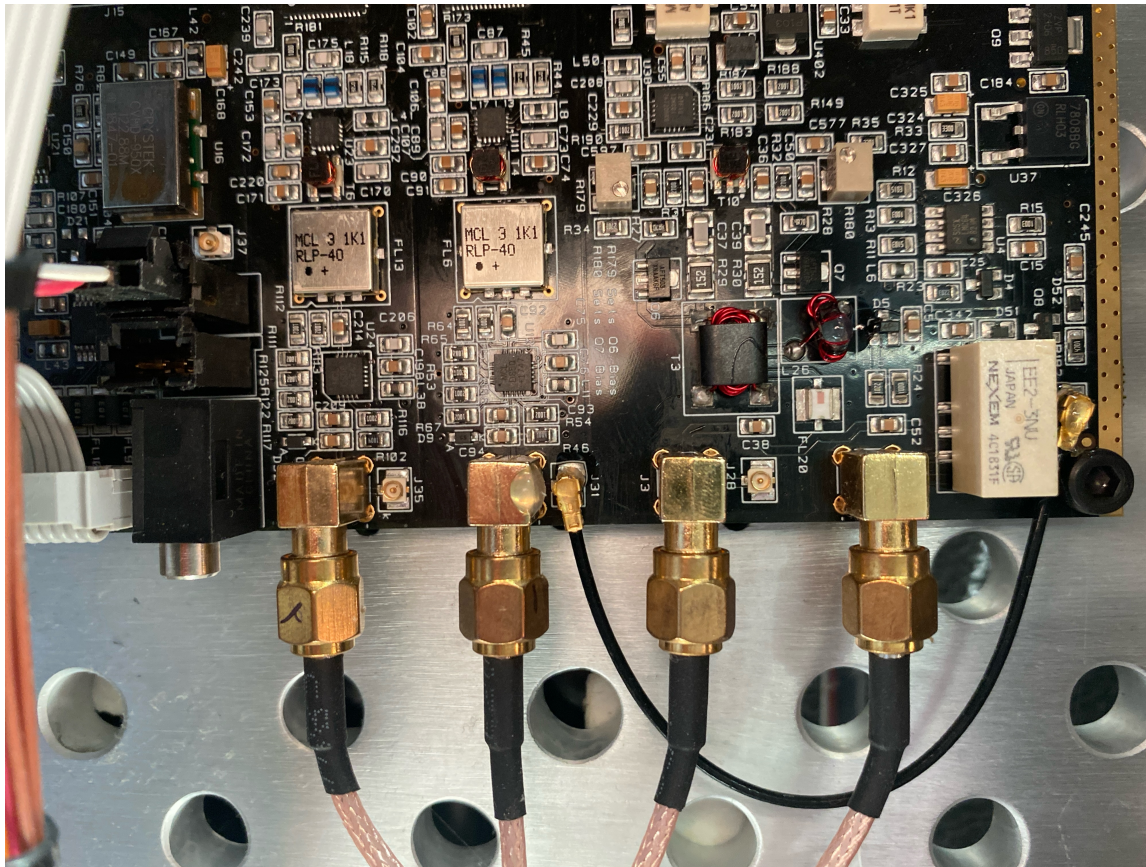


Model 7000DLE S/N 0022 Blue Case

XVTR Jumper Designator: J31-J32

Purchase Date 30 NOV 2017

# Location of XVTR Jumper Model: 7000DLE MKII



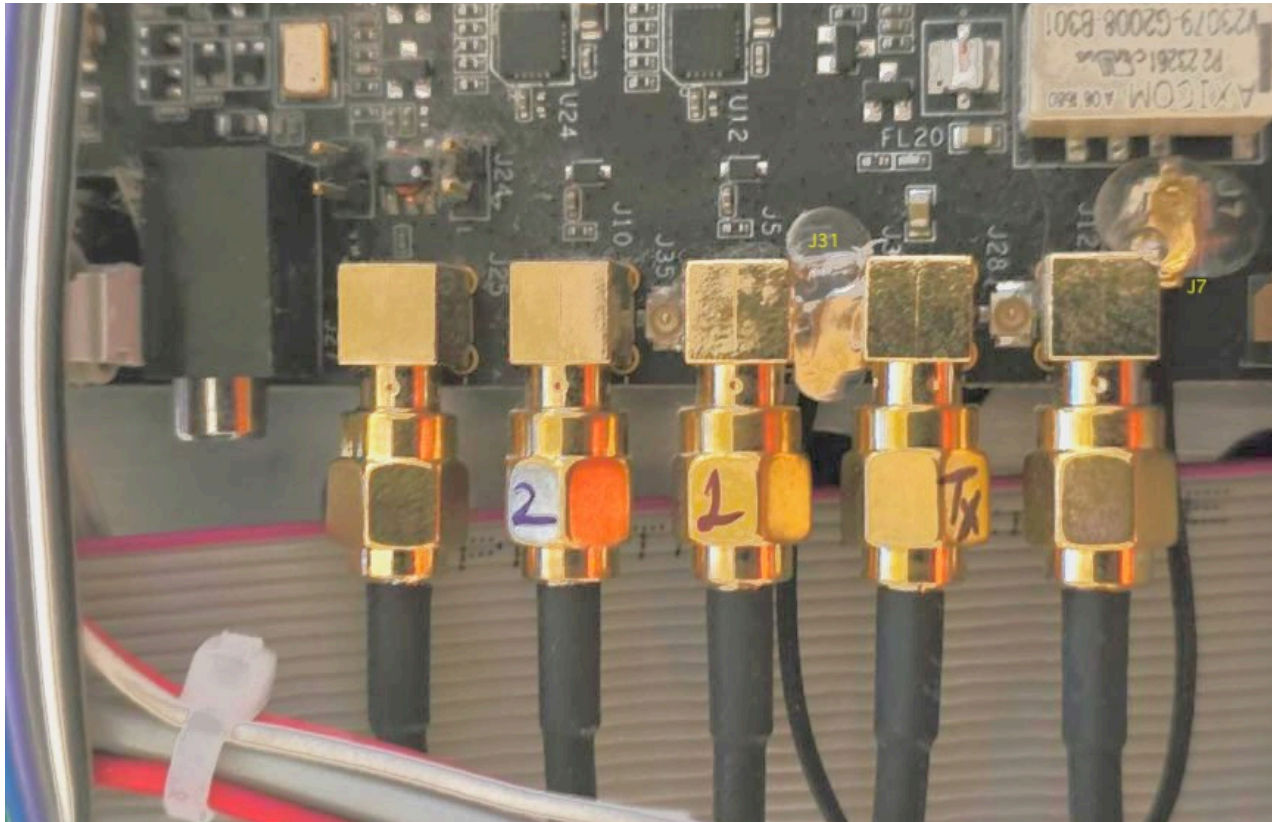
Model 7000DLE MKII S/N 015  
Gray Steel Case - no CPU

Purchase Date May 2019

XVTR Jumper Designator: J31-J32



# Location of XVTR Jumper Model: G2



Model G2 100W no S/N

Purchase Date May 2024

XVTR Jumper Designator:  
J7-J31

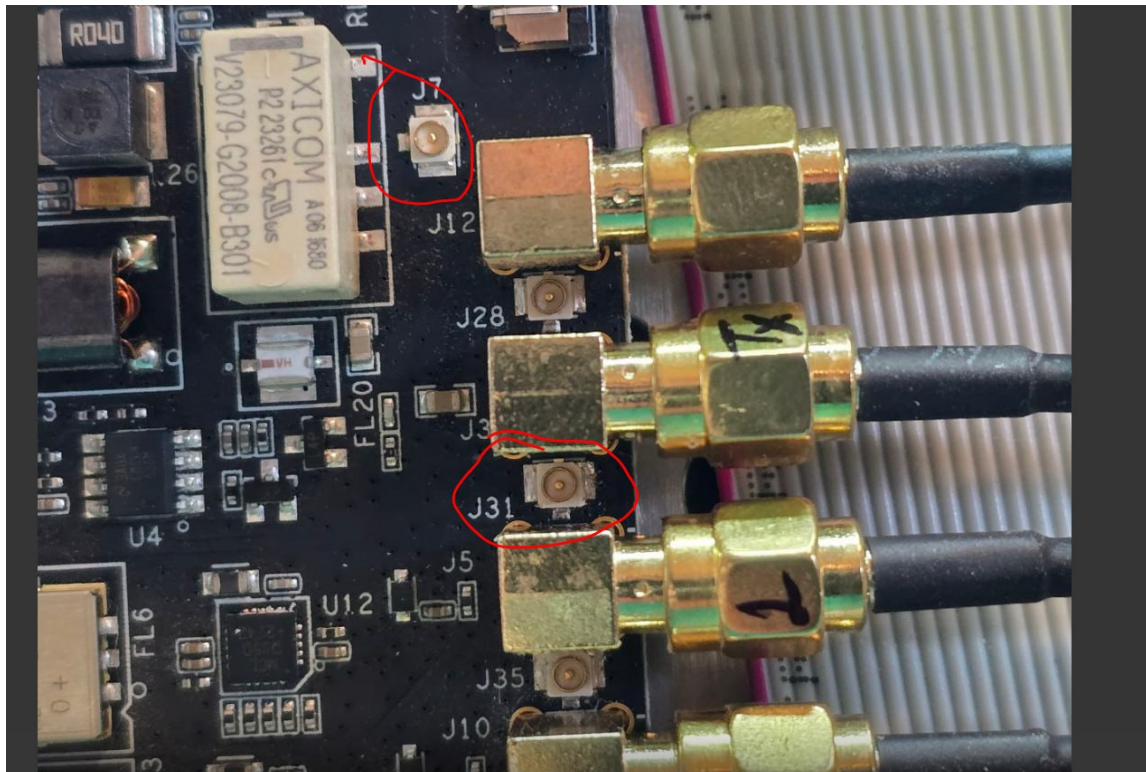
Board: Saturn\_SDR\_REV2\_1

A close-up photograph of the Saturn SDR board. The central component is the TPA0202 DAC chip (U21), which is a black square chip with gold pins. It is surrounded by several small surface-mount components, including resistors and capacitors. To the left of U21 is a small black chip labeled U448. Above U21 is a small black chip labeled U25. To the right of U21 is a small black chip labeled U55. The board is populated with various other components, including a 3P3VA voltage regulator, a 4923 resistor, and a 3.3V voltage regulator. The board is labeled SATURN\_SDR\_REV2\_1 and H3.

Board: Saturn\_SDR\_REV2\_1

SATURN\_SDR\_REV2\_1

## G2 J7-J31 Removed



Model G2 100W S/N ?

Purchase Date May 2024

XVTR Jumper Designator: J7-J31

Board: Saturn\_SDR\_REV2\_1

# Research contributors

Thanks to Joe, K1WPO and Tom, KJ7TEA who collected extensive datasets for the 7000DLE and G2, as well as the Alpha 77DX and Flex PGXL amplifier. They tirelessly collected data on both sampling type spectrum analyzers as well as older hp and Tektronix analog type instruments to ensure data integrity with the newer Rigol sampling type of instrumentation.

Thanks to Bill Diaz for the functional block diagrams that so clearly showed the RL2 RF connection paths that made chasing down the source of the problem much easier. Thanks to Rob Sherwood for his assistance in evaluation of IMD performance, and white noise analysis.

Finally, thanks to Warren Pratt, developer of PureSignal, for his consulting support, advice and suggestion to look for any potential form of signal contamination that might be present in the hardware.

Vince, K1VF



# Appendix 1

## **K1VF 7000DLE MK II S/N 015**

Purchase Date 29 MAR 2019

Firmware Ver: 2.0.0

ID: OrionMKII

Protocol 2 (v3.8)

Thetis v2.10.0 x64 (06/19/23)

## **KJ7TEA G2**

Purchase Date 28 MAY 2024

Firmware Ver: 2.0.0

ID: Saturn

Protocol 2 (v3.9)

Thetis v2.10.0 x64 (06/19/23)

## **K1WPO 7000DLE S/N 0022**

Purchase Date 30 NOV 2017

Firmware Ver: 2.2.4

ID: OrionMKII

Protocol 2 (v4.3)

Thetis v2.10.3.8 x64 (12/31/24)

# Appendix 2

## **K1VF 7000DLE MK II S/N 015**

Rigol RSA3015N, hp8591E

Bird 4266 Bi-Directional Coupler, AC2IQ Directional Coupler, Bird 50-ohm terminations, step-attenuators

## **KJ7TEA G2**

Rigol RSA3015N, Tektronix 492AP

Bird 4266 Bi-Directional Coupler, Bird 50-ohm terminations, step-attenuators

## **K1WPO 7000DLE S/N 0022**

hp3585A

AC2IQ Directional Coupler, Bird 50-ohm terminations, step-attenuators

# Appendix 3

## RL-2 Isolation Measurement on Apache Labs Model G2

Signal Generator: Rigol DG1032

Power Meter: hp438a with calibrated probe

Spectrum Analyzer: Rigol RSA3015N

