

RSAxxx(N) EMI Mode – Getting Started

Introduction:

In this description you will find first steps of operation how to work with EMI Mode in RIGOL's RSA Series¹ and how to adjust different settings. The target should be, to understand the principle of this mode for pre-compliance analysis and perform easily adequate settings from the beginning.

The principle of EMI mode is, to make a pre-compliance analysis (conducted or radiated emission) and safe test time for that evaluation. In case a whole trace would be recorded with a valued detector (like quasi peak) the test time would be quite long. This EMI mode can do a fast scan of the trace with e.g. [Average] or [Peak] detector and search all peaks. With that peaks, the measurement of valued detectors (QP and/or CISPR AV) can be done and the result is available within minutes.

But saving test time is only one part. Failure debugging and design improvement is a second step. With the integrated measurement meter, customer can do a live debugging and can do an immediate improvement of each unwanted single peak. Last but not least, the mode allows you to generate a test report for your documentation. This mode contents a lot of features, for correction, pass / fail testing, and much more.

Default Window, EMI – Mode:

Activate the EMI Mode and see the window of *figure 1*.

The default mode is set to CISPR filter (6 dB filter). In case that for some evaluation 3 dB filter are required, please change this here: Please select [Mode Setup] \rightarrow [EMC Standard]: "None".

¹ RSA Series: RSA5032N, RSA5065N, RSA5032(-TG), RSA5065(-TG), RSA3015N, RSA3030N, RSA3045N, RSA3030(-TG), RSA3045(-TG), RSA3015E(-TG), RSA3030E(-TG)



		EMI 00 17:23:14 Scan EMI 00 2021/06/3	Frequency
Midspan Freq : 515.000000 Span : 970.000000	MHz Type: W W W W Ref Lev	vel: 106.99 dBuV Trig: Free Run #Atten(M): 10.00 dl	Frequency(Meter)
107			515.00000 MHz
97		Frequency(Meter)	Midspan Freq
77			515.00000 MHz
67 Window	for the trace(es)	Window for	Start Freq
57		the meter(s)	30.000000 MHz
37			Start Freq Mode
27			Manual Auto
dBuV		eak	Stop Freq
Start Freq : 30.000 MHz RBW(-6dB) : 120.00 kHz	VBW : 3.0000 MHz #SWT : *	Stop Freq : 1.0000 GHz 29.41 C 1.00000 ms (pts : 801) M:31.05 M:31.05	1.0000000 GHz
Signal Table			Stop Freq Mode
NO. Trc Freq	Peak Amp QP Amp CAvg Am	p Peak Lim1A QP Lim1A CAvg Lim1A	Manual Auto
	Scale Type		
	Log Lin		
	1 /1		
0			

Figure 1: Default Window of EMI Mode

Trace Settings:

For adjustment of different parameter, please select the button [**Meas Setup**]. A new side window is now opening with different menus (*see figure 2*).

RIGOL IX	Rmt	CISPR	Scan	EMI		Meas Setup
Frequency(Meter) : Midspan Freq : Span :	515.000000 MHz 515.000000 MHz 970.000000 MHz	race: 1 2 3 4 5 6 Type: W W W W W W Det: P P P N N N	Ref Level: 106.99 dBuV State: Idle	Trig: Free Run Corrections: Off	#Atten(M): 10.00 dB RBW(M): 120.0 kHz	Avg Setting >
97						Limit >
67						Signal Table >
37 27 17						Scan Table >
dBuV						Scan Sequence
Start Freq : 30.000 M RBW(-6dB) : 120.00	Hz kHz N	/BW : 3.0000 MHz	Stop Freq : 1.000 #SWT : 1.00000 ms (pts	00 GHz 28.30 : 801) M:32.27	Ø	Scan Only >
Signal Table						(Re)measure
NO. Trc	Freq Peak A	mp QP Amp CA	wg Amp Peak Lim	1∆ QP Lim1∆	CAvg Lim1Δ	Curr Signal >
						Detectors >
						◀ 1/2 ▶



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In this menu, the main settings of test setup can be realized. The first setting will be focus to the adjustment of frequency range according to the measured standard. This will be realized in [**Scan Table**] (*see figure 3*).

Here you can select the required frequency range.

- Up to 10 ranges are displayed. Each range will use max. 10.000 test points. If more measurement points are required (e.g. to reach a frequency resolution of RBW/2) then ranges can be combined together with selecting several ranges. The default points are calculated to reach RBW/2 resolution.
- The RBW is adjusted by default according to CISPR norm (e.g. from 150 kHz to 30 MHz: RBW = 9 kHz),
- Scan time is the optimum for the test. But can be modified according to your need.
- For each range, the dynamic range can be modified. Eg. If you expect more small signals slightly above the noise floor, then you should use pre-amplifier and set the attenuator to 0 dB. If you are expecting high peaks, then pre-amp is "OFF" and the attenuator is set to a higher level according to your needs (e.g. 50 dB).
- In case you would need different dynamic range settings for different frequency ranges, then you can use several ranges according to your need and set for each single range the dynamic range you need. For example: range 1: attenuator: 0 dB and pre-amp: "ON" (in case you expect smaller signals here), range 2: attenuator: 30 dB and pre-amp: "OFF" (in case you expect higher signal values here) etc.

	RI(60	L IXI Rmt		CISPR		<u>.</u> ***		EMI				7:36:5	1	Sc	an Tabl	e
		S	can Table													RBW	
			Start	Stop	Points	Sc	an Time		RBW	Att(dB)		Pa		9.	000 kH	z
		1	9kHz	150kHz	1490	\bigcirc	65.25059s	\bigcirc	200Hz (E)	Attenu	ation		ON		Au	ito RBW	l i
	Ø	2	150kHz	30MHz	6634	\odot	7.426185s	Ø	9kHz (E)		0	Ø	ON		Off		On
		3	30MHz	300MHz	4500	\bigcirc	367.279ms	\oslash	120kHz (E)	\bigcirc	10		ON			ter Typ	e
		4	300MHz	600MHz	5000	\odot	408.088ms	\odot	120kHz (E)		10		ON		Gaus	s E	MI
		5	600MHz	1GHz	6667	\bigcirc	544.117ms	\oslash	120kHz (E)	Ø	10		ON	Ιţ	Add	0 dB	
di		6	1GHz	3.2GHz	4400	Ø	43.889ms	\oslash	1MHz (E)	Ø	10		ON		ļ	uto Att	
	0	7	3.2GHz	6.5GHz	6600	\bigcirc	65.833ms	\oslash	1MHz (E)	\bigcirc	10	O	ON		Off	_	On
		8	1.0001GHz	1.0002GHz	101		1ms	Ø	1MHz (E)	Ø	10		ON		R⊦ Off	Pream	o On
	0	9	1.0002GHz	1.0003GHz	101	Ø	1ms	\oslash	1MHz (E)	\bigcirc	10		ON		Sc	an Table	9
		10	1.0002GHz	1.0003GHz	101	Ø	1ms	\odot	1MHz (E)		10		ON		Off		On
																2/2	•

Figure 3: Menu [Scan Table] for basic adustment of measurement scan

Note 1: Please be carefully with dynamic range settings. Please set attenuator to the maximum value and turn off pre-amp in case you don't know the signal level to avoid to destroy the spectrum analyzer. If you are unsure about the interference level, please use additionally an external attenuator for the first test. This one can be removed for further tests when you are sure that the maximum interference level of your DUT are not higher than the reference level of your spectrum analyzer.

Note 2: Please be carefully with measurement with a LISN and use always a **transient limiter** for such tests to protect the spectrum analyzer.

Note 3: The dynamic range settings in [**Scan Table**] is only for the trace and not for the measurement meter. They need to be adjusted via [**Ampt**] button (**see description "Dynamic Range for Measurement Meter**")

For the **trace detector selection**, please select [**Trace**] \rightarrow [**Trace Det**] (e.g. Average). Here you can also activate a second or more traces with different detectors or adjustments

Scan Sequence Settings:

For the next adjustment please select again [Meas Setup] and select [Scan Sequence]

- In this menu, you can decide the sequence of your test.
- In case you want to record only the trace without any further measurements, you should select [Scan Only]
- In case you measured already a trace and you want to search for the peaks, please select [Search Only]



Figure 4: Scan Sequence adjustment with "Scan-Search-Measure"



- In case trace was measured and the peaks were already listed in the [Signal Table], and you want to start the final scan with measuring the valued detectors at these peaks only, please select [(Re)measure].
- You can combine all of them. For example: if you want to do all together, please select [Scan-Srch-Ms] (*see figure 4*)

Measurement Procedure of [Signal Table]:

- In [Meas Setup] → [(Re)measure] you can decide if all peaks or specific peaks will be measured.
 - if you want to select one specific peak in the [Signal Table] and you want to measure only this one, please select [Curr Signal]
 - If you want to measure all listed peaks in the [Signal Table], please select [All Signal]
 - In case you select several signals which should be measured, please select [Marked Sigs]

Detector Configuration for Final Scan:

- After search all peaks of the trace, they will be listed in the [Scan Table).
- Now you can start the final scan. Here the detectors, you selected will be measured. (e.g. the valued detectors like Quasi Peak) at the peaks, visible in the [**Signal Table**].
- You can select the different traces for Final Scan as follow: please select [Meas Setup] → [Detectors] and select the type of detector and the limit line which shall be used as reference for the pass / fail test. For example, "detector 1" refers to "limit 1", "detector 2" refers to "limit 2" etc....

Limit Lines for Pass / Fail Analysis:

- The EMI mode contents many pre-installed limit lines which can be recalled as follow:
 - Please select [**Recall**] \rightarrow [**Limit**] \rightarrow (decide which limit you want to load, e.g. to "limit 1" which is selected in "Detectors" above) \rightarrow [**File Explorer**] \rightarrow select [**Preloadlimit**] \rightarrow and select a folder of your reference (e.g. "EN").
 - Note 1: You can select a folder and select [browse] and it will open
 - Now select the standard of your need (example "EN" \rightarrow "55022")
 - In this window, please select [File Type] → [All Files (*.*)] and you can see all the integrated limits for this standard and you can select yours of your need (e.g. "Conducted Emission, Class B, Average")
 - In case you want to load a second (or more) limits (e.g. for QP) please select [**Recall**] \rightarrow [Limit] and "limit 2" (or higher).
- After you selected your limits from pre-integrated storage, please select [Meas Setup] → [Limit] and select [Test Limit]: "ON" and [Limit State]: "ON" for all your loaded limit lines.



• In [Edit Limit] you can create your own limit line or you can modify the pre-loaded one according to your need (e.g. use a margin for pass / fail test) (*see figure 5*)



Figure 5: [Edit limit] for creation or modification of own limit line or add margin for pass / fail test

Activation of Measurement Meter:

The measurement meter is a very good tool for debugging peaks with different detectors. Max three meter can be activated in parallel. It can be connected with selection of peaks. In case one peak is selected and the engineer try a design improvement, the result of this peak will be immediate visible in the meter and a case by case improvement of engineers DUT is possible.

- To activate more than one meter with different detectors, please select [Mode Setup] → [Meters Control] → [Meters]:
 - Here you can activate meter (max three meter in parallel)
 - \circ $\;$ You can decide which detector is used at each meter $\;$
 - You can add a limit line with pass fail result for the meter
- Furthermore you can decide to couple the meter to a signal. In case you select a peak in the [Signal Table] the meter will jump to this peak and you can measure it.
- See figure 6 with three activated meter with different detectors (here: peak, QP, CISPR AV) including pass fail limit and [Coupled to a Signal] is selected.
- The pink line in trace screen show the position of measurement meter.



RIG		CISPR	scan	EMI	22:50:24	Meters	Control
Frequency(Me Midspan	eter) : 515.00000 Freq : 15.07500 Span : 29.85000	00 MHz Trace: 1 2 3 00 MHz Type: W W W W 00 MHz Det: P P P	V W W Ref Level: 106.99 dBo V N N State: Idle	uV Trig: Free Run Corrections: Off	#Atten(M): 20.00 dB RBW(M): 120.0 kHz	Meter	s >
07 97 Pa	ass					- 45	
87 Li	imit 1 - Trace 1 : Pass					Dwell	Time
77	imit 2 - Trace 1 : Pass				IIII	1.000	00 s
67				lim			
57					lim	Peak Hold	Time >
37						Reset Pe	ak Hold
17 uV				Preas	¢₽ Q₽	Couple t	o Signal
Start Free RBW(-6d	q : 150.00 kHz iB) : 120.00 kHz	VBW : 3.0000 MH	Stop Freq : 30. z #SWT : 1.00000 ms (p	.000 MHz 41.72 ots : 801) M:44.05	37.15 29.55 C	Off	On
S	Signal Table					Couple to	Marker
NO.	Trc Freq	Avg Amp QP Ar	mp CAvg Amp 📗 Avg Lir	n1Δ QP Lim2Δ	CAvg Lim1Δ	Off	On
						4 11	

Figure 6: Adjustment of measurement meter with different detectors and coupled to signal

Dynamic Range of Measurement Meter:

• As mentioned before, the dynamic range of measurement meter can't be adjusted in [Scan Sequence] settings because different ranges could be used with different dynamic range settings

	PA on CISPR		EMI	22:58:59	Amplitude	
Frequency(Meter) : 515.000000 MHz Midspan Freq : 15.075000 MHz Span : 29.850000 MHz	Trace: 1 2 3 4 5 6 Type: W W W W W Det: P P P N N N	Ref Level: 97.00 dBuV State: Idle	Trig: Free Run Corrections: Off	#Atten(M): 0.00 dB RBW(M): 120.0 kHz	Ref Level	
97			Att/Met	ar)	97.00 dBu\	V
87 Pass Limit 1 - Trace 1 : Pass				lim	Att(Meter)	
67 Limit 2 - Trace 1 : Pass					0 dB	
57					RF Preamp(Met	ter)
47					Off O	n
27					Y Axis Unit	
7				q ç	dBuV	>
tuV			a a a a a a a a a a a a a a a a a a a		Scale/Div	
Start Freq : 150.00 kHz RBW(-6dB) : 120.00 kHz	VBW : 3.0000 MHz	Stop Freq : 30.000 #SWT : 1.00000 ms (pts :	MHz 2.43 801) M:3.20	-2.16 -9.72 💭 M:-2.12 M:-9.71	10.00 dB	
Signal Table					Ref Offset	
NO. Trc Freq Avg	Amp QP Amp C	Avg Amp Avg Lim1.	∆ QP Lim2∆	CAvg Lim1∆	0.00 dB	
					4 1/1	

Figure 7: Set dynamic range of measurement meter and the reference level of the test in [AMPT]

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• Therefore you must select separately the dynamic range of the measurement meter as follow: Please select [AMPT] and adjust attenuator and pre-amplifier / reference level according to your need (*see figure 7*).

Correction:

In case you using external components like attenuators, amplifiers, cable, LISN, etc. you can add a correction which will be take into account into the result of trace, measurement meter and signal table.

• To insert correction, please select [Input Output] and [Corrections]

Start The Measurement:

After you finalized all the setup of your need, you can start the test.



• Please select [Sweep] \rightarrow [Start]

Figure 8: Result of measurement after finalization of test with the settings described above

Signal Table Settings:

- Signal table displays all the peaks which are detected in the trace according to your adjusted search criteria.
- The numbers of detected peaks can be adjusted in the signal table as follow: Select [Meas Setup]
 → [Signal Table] and insert the settings for search criteria and sort of signals according to your need.
- You can also select one peak and [Zoom In] for deeper analysis.



- You can also select the number of peak you want to mark
- In case the measurement meter are coupled to the signal, then the meter jump to the selected peak and measure it (*see figure 8*).

Generate a Test Report for Documentation:

- The EMI Mode has the possibility to store the *.csv file of the trace or generate a test report as follow:
 - Please select [Save] → [Meas Data] → [Data Type] ([Trace] = csv, [Meas Result] = test report)
 - In menu [Meas Data] → [Meas Results] you can make adjustments like print as pdf or HTML, use inverted screen (save print color) and decide what all should be in the report. You can also fill in the heather (e.g. temperature, name of DUT, test place, etc., see figure 9).



Figure 9: Template to generate a test report for documentation

Storage of Settings:

• You can store the limit lines and the settings in [Save].

Note: Limit lines and correction needs to be stored separately. The main adjustments (e.g. activation of limit line) is stored in [**State**] but not the limit line itself.



Window Adjustments:

- For some tests its important to see the whole trace without meter on the screen. You can realize this with selecting [System] → [Display] → [Meters Display]: Off (*see figure 10*).
- In case you need to display the measurement in horizontal linear axis instead of logarithmic view, then you can change this here: [Freq] → [Scalar Type]: "Lin"

	PA on CISPR	EMI 00 14:30:28	Disp	lay
Frequency(Meter) : 1.225554 MH Midspan Freq : 15.075000 MH Span : 29.850000 MH	z Trace: 1 2 3 4 5 6 z Type: W W W W W Ref Level: 73.0 z Det: V P P N N N State: Idle1/0	0 dBuV Trig: Free Run #Atten(M): 0.00 dB Corrections: Off RBW(M): 9.000 kHz	Meters I	Display
73			Off	On
63 Pass			Meters Fr	eq Line
43 Limit 2 Trace 1 : Pass.			Off	On
33			Next Range	e Display
23- 13-			Off	On
3 -7 -7 -17	14 Mar variety toronales desired as a bar secondary or an asso days.	at the second default of the second	Next R	ange
dBuV	and the second	ور معادل المحمد المحمد المحمد عن المحمد و معاد المحمد ال	Web Co	ontrol
Start Freq : 150.00 kHz RBW(-6dB) : 9.000 kHz	VBW : 10.000 kHz	Stop Freq : 30.000 MHz SWT : 7.42618 s (pts : 6634)	Off	On
Signal Table				
NO. Trc Freq Av	vg Amp QP Amp CAvg Amp Av	vg Lim1∆ QP Lim2∆ CAvg Lim1∆		
			4 2/2	2

Figure 10: Display modification for bigger trace visibility

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