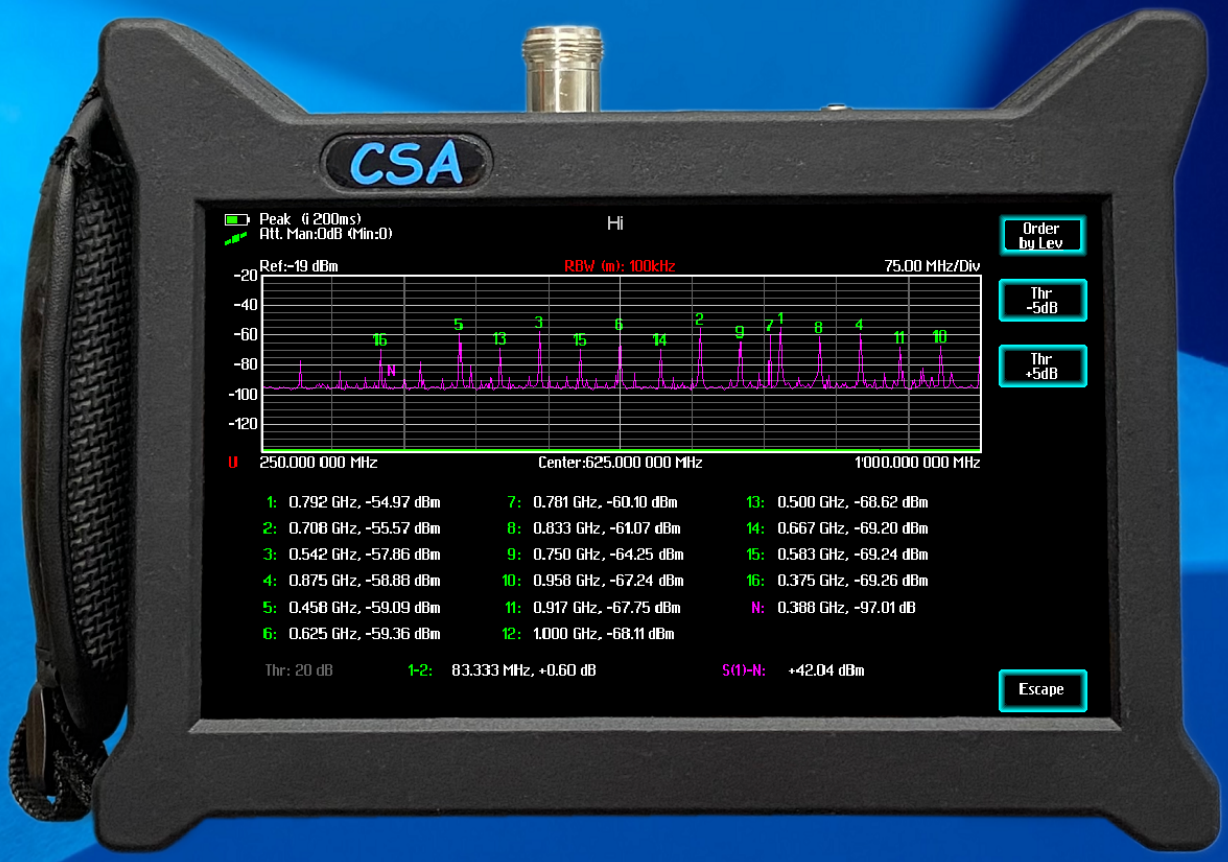
EM®CSA

Compact Spectrum Analyser



Super-light Handheld FFT-Spectrum Analyser

10 Hz – 4 GHz

Elettronica Monti
since 1977

KEY FEATURES

- ✓ Real-time (FFT) spectrum analyser.
- ✓ Tablet sized and light (less than 1350 g) handheld instrument.
- ✓ Less than 3 s switch-on time (ready for measurements) and null power-off time.
- ✓ User-replaceable 18650 Li-ion batteries.
- ✓ 10 Hz - 4 GHz frequency coverage.
- ✓ Dynamic range of 105 dB over the whole frequency spectrum.
- ✓ Displayed average noise level of -160 dBm/Hz up to 1 GHz (-170 dBm/Hz up to 30 MHz).
- ✓ +7 dBm 3rd order intercept at 1 GHz.
- ✓ Better than - 60 dBc 2nd harmonic distortion at 1 GHz.
- ✓ Isolated pulse and burst capturing capabilities.
- ✓ High-stability frequency thanks to a GPS-disciplined reference (<0.03 ppm).
- ✓ Vector modulation analysis supporting various QAM and APSK demodulations.

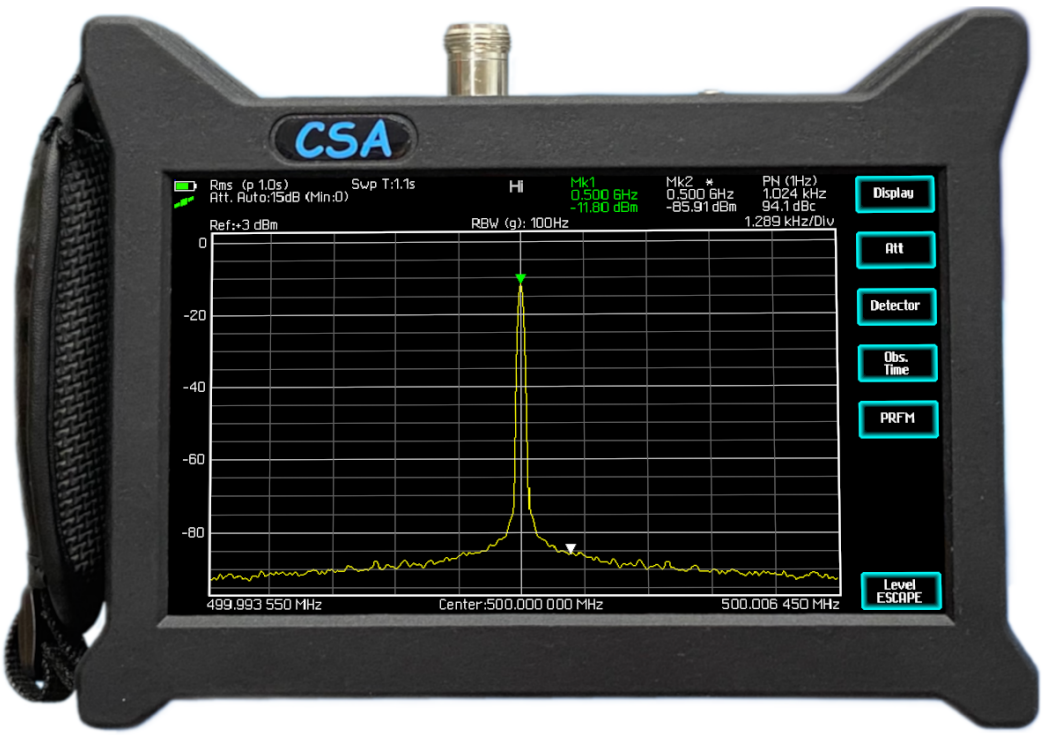


Figure 1: EM®CSA compact spectrum analyser

BENEFITS AT A GLANCE

Making measurements in the field has just become easier and faster.

The EM®CSA real-time spectrum analyser has been designed suiting the needs of field technicians. Its unique low weight, its simplicity and user-friendly interface, its almost-instantaneous startup and its user-replaceable batteries make it a handy, desirable tool for anyone who needs an efficient instrument for outdoor measurements. At the same time, the EM®CSA provides excellent RF performances and the most important RF analysis functions that assist the work of RF service technicians, networking operation engineers, installation and maintenance teams as well as RF system designers. For example, it can be used for maintaining or installing transmitter systems, checking cables, amplifiers and antennas, discovering design issues in RF systems, assessing signal quality in radio, TV and multimedia broadcasting, radiocommunications and service, measuring electric field strength in an environment or in lab applications and measurements. The EM®CSA can perform any of these tasks quickly, reliably and with high measurement accuracy. With the features and the performances of the EM®CSA, you can be confident of getting the job done wherever you go and get it done right. The EM®CSA is developed, manufactured and calibrated under the highest quality standards at the Elettronica Monti laboratories, Italy.

Figure 2: Installation and maintenance in arduous environments

Benchtop FFT-performance is finally available in a handheld instrument.

The EM®CSA matches conventional high-performance signal analysers. With a dynamic range of 105 dB, a TOI better than +5 dBm at 1 GHz, a SHI better than -60 dBc at 1 GHz and a DANL of -160 dBm/Hz up to 1 GHz (less than -170 dBm/Hz up to 30 MHz), the EM®CSA satisfies the demands of challenging spectrum analysis measurements. A toolset of useful signal measurements are available, such as channel power, occupied bandwidth, adjacent channel power, spectrum emission mask, AM/FM/PM, frequency counting and spurious measurements.

In addition to spectrum analysis, spectrograms display both frequency and amplitude changes over time. The EM®CSA offers an intuitive live colour view of signal transients changing over time in the frequency domain, giving you immediate confidence in the stability of your design, or instantly displaying a fault when it occurs. Events can be colour coded by rate of occurrence onto a bitmapped display, providing unparalleled insight into transient signal behaviour. Time-correlated measurement views can be selected to facilitate signal analysis that includes frequency hopping, pulse characteristics, modulation switching, settling time, bandwidth changes, and intermittent signals.

Thanks to the digital signal processing and the FFT approach performed directly on hardware and a dedicated DSP, the EM®CSA brings live analysis of transient events to spectrum analysers. The EM®CSA can sweep over the entire frequency range from 10 Hz up to 4 GHz in less than 350 ms, enabling the capturing of broadband short-persistence signals, previously unavailable in traditional spectrum analysers. Furthermore, the EM®CSA is able to perform a high-resolution measurement over the whole 4 GHz span (with a 10 kHz RBW) in less than 45 s, outperforming any other swept spectrum analyser on the market. The default built-in gap-less option provides gap-free spectral analysis with a band up to 17 MHz, thus enabling broadband transient capturing. Furthermore, with the EM®CSA, operators can watch for transient or intermittent events that last for less than 3.7 uS with a POI of 100 %.

Figure 3: Benchtop spectrum analysis in a lab environment

Figure 4: Cellular communication measurement

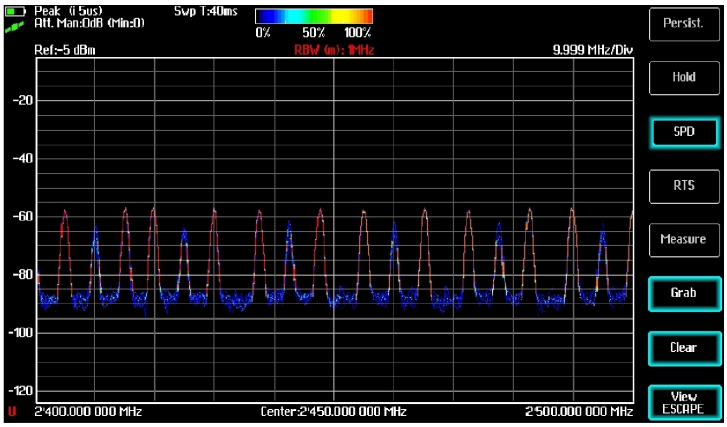


Figure 5: Statistical measurement utilities

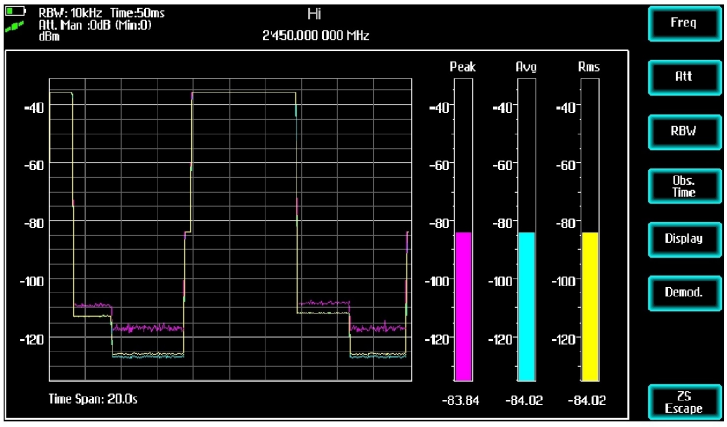


Figure 6: Zero span measurements

A super-light instrument that has a simple, fail-safe and user-friendly design.

Weighing less than 1350 g and with a size area of less than 280 cm^2, the EM®CSA is a really handy instrument, at least 50 % lighter and 50 % smaller than other leading-brand handheld analysers. All functions have their own virtual function keys, and more frequently used functions, such as frequency centring, tuning or zooming, can be performed simply via intuitive touch-gestures. The brilliant colour display is easy to read even under poor lighting conditions. The capacity of the EM®CSA battery enables uninterrupted operation for up to 4 hours. Batteries, which are standard 18650 Li-ion batteries, can be replaced by the user any time and anywhere within seconds.

The EM®CSA implements a customized bootloader, that has successfully been on the market for over 30 years and that guarantees fail-safe updates. No matter what happens, the EM®CSA is always guaranteed to recover to latest factory working conditions. Furthermore, differently from almost all other spectrum analysers on the market, the EM®CSA does not rely upon a commercial general purpose OS, but rather implements a proprietary high performance FW that manages data processing, visualisation and user interfaces. As a result, the EM®CSA is extremely responsive; it takes less than 3 s to be ready for measurements since powering on and null time to switch off.

The EM®CSA is a versatile tool covering a wide range of applications.

Nowadays the frequency band up to 4 GHz is extremely crowded, with countless services and applications even occupying the same frequencies in many cases. The EM®CSA covers the monitoring, analysis and troubleshooting for services that range from space to nautics and aeronautics and for applications that include modern wireless communications, radar, media broadcasting as well as cellular communication.

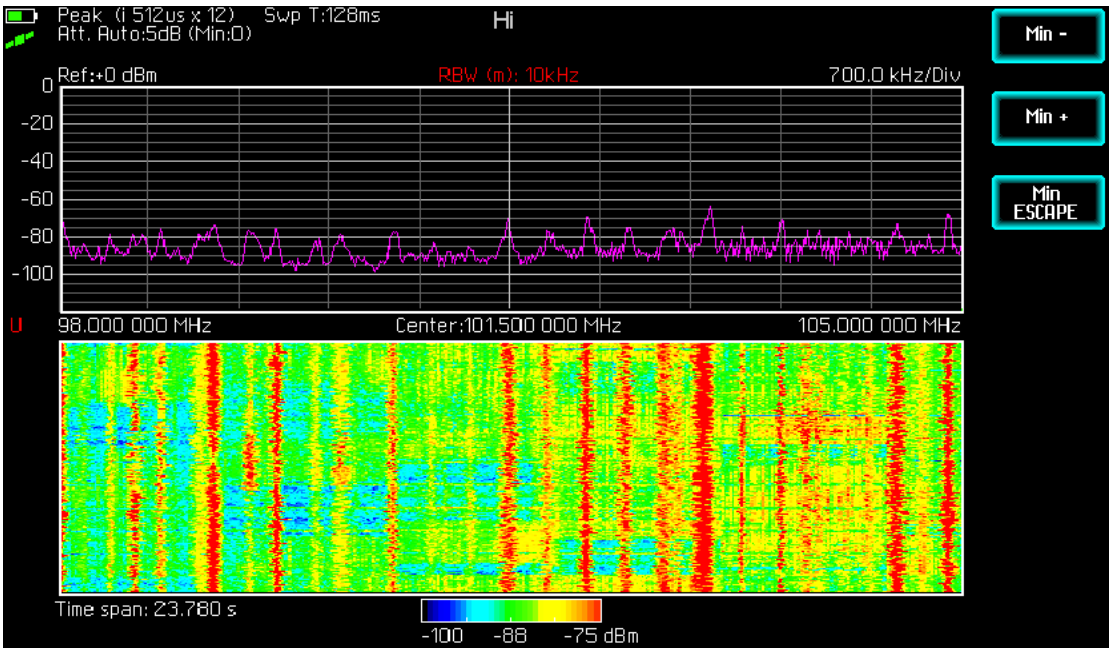


Figure 7: 3D-Real-time spectrogram

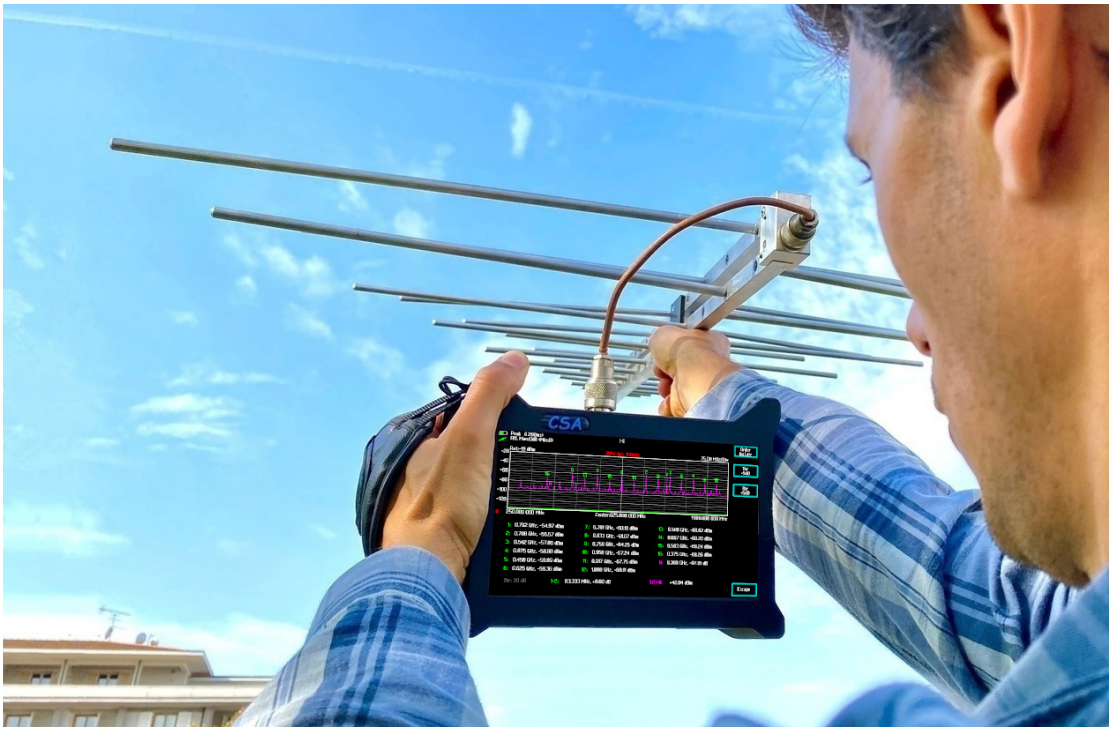


Figure 8: Rapid location of RF sources and interferences

Specifically, the EM®CSA covers the following ITU and IEEE bands:

- ✓ **SLF** (submarine communications)
- ✓ **ULF** (through-the-ground communications)
- ✓ **VLF** (navigation beacons and time signals, geophysical and atmospheric measurements, military, submarine and subterranean communications)
- ✓ **LF** (standard time signals, military communication, meteorological information broadcasts, radio navigation signals, radio broadcasting and identification)
- ✓ **MF** (AM broadcasting and maritime radio communications)
- ✓ **HF** (military and governmental, aviation, amateur radio, shortwave broadcasting, maritime, over-the-horizon radar, GMDSS, Citizen's Band Radio services)
- ✓ **VHF** (television and FM radio broadcasting, amateur radio, marine radio and aviation)
- ✓ **UHF** (mobile satellite, DAB broadcasting, terrestrial TV broadcasting, telemetry, telecontrol, aircraft landing and safety systems, ISM, LTE, GSM, 2G and 3G cellular communications, satellite services such as RNSS, GLONASS and GPS)
- ✓ **L** (radio astronomy, LTE-Advanced or UMTS/HSDPA base station downlink communication, aircraft ADS-B surveillance, DAB, DVB-H, DVB-SH, DVB-T2, T-DMB)
- ✓ **S** (WiFi 802.11b and 802.11g, Direct-to-Home satellite television, DARS, WiMAX)

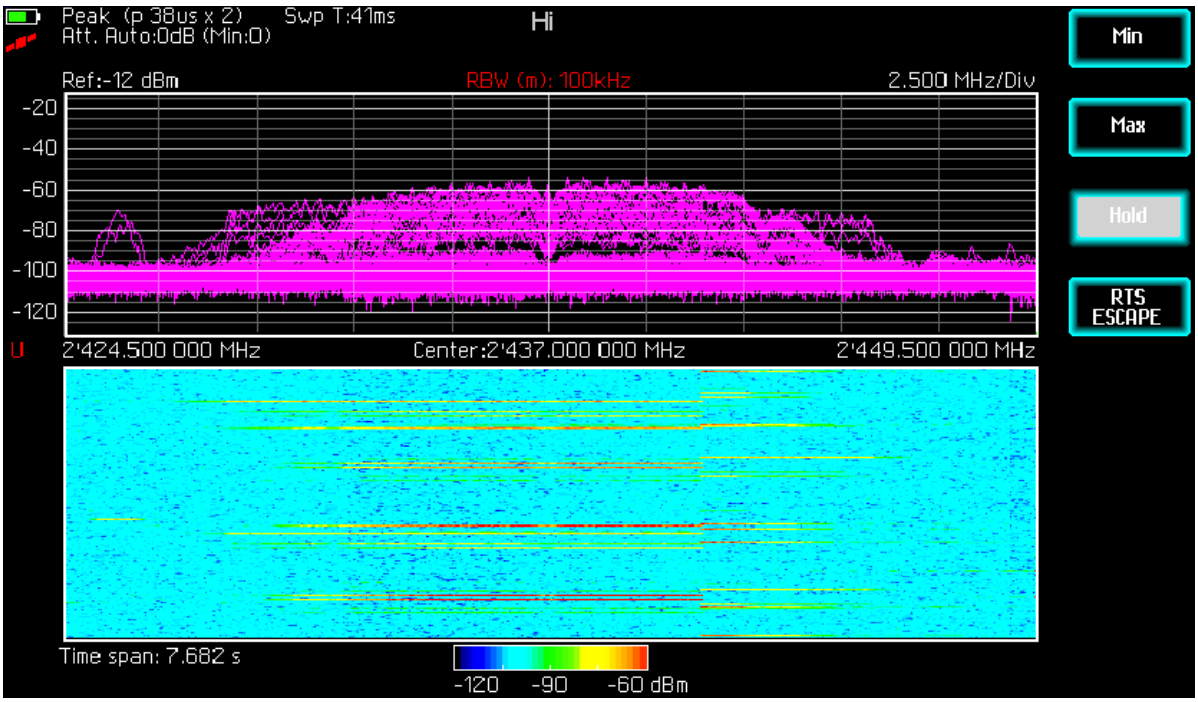
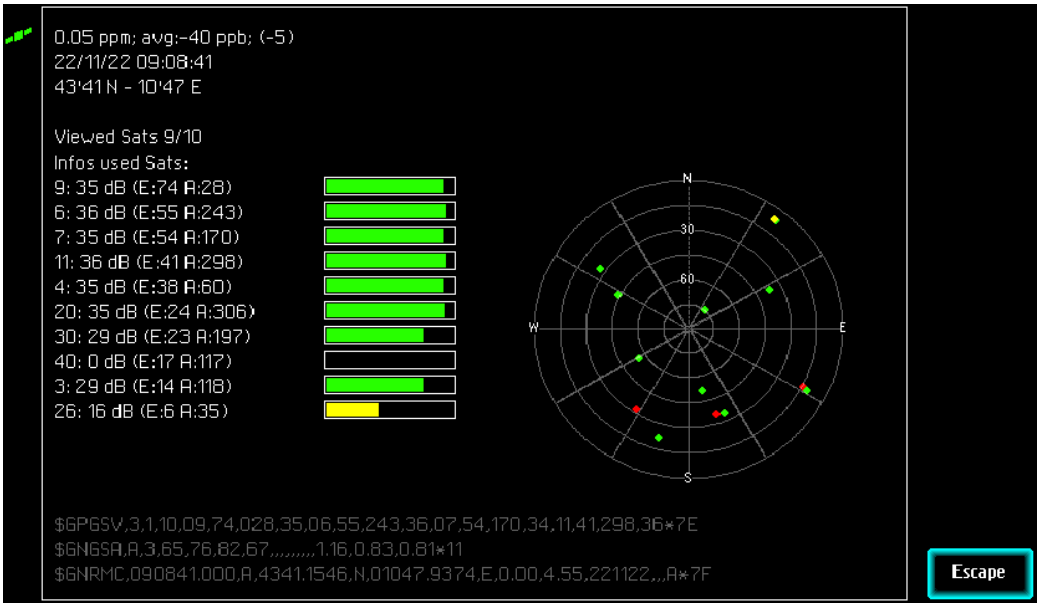


Figure 9: WiFi channel monitoring

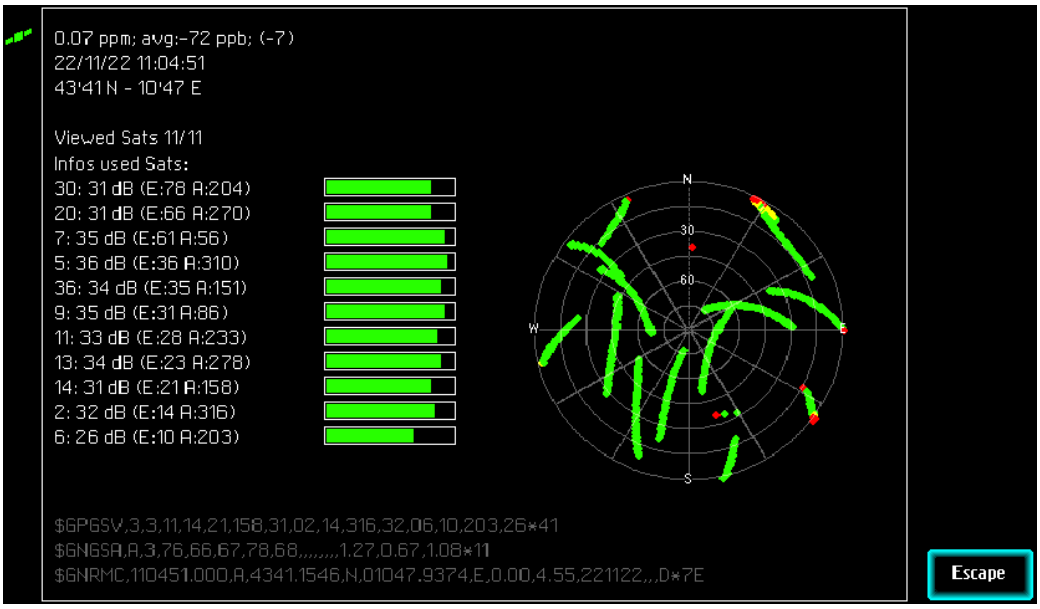
A built-in GPS receiver guarantees a high-stability frequency reference

The EM®CSA continuously receives GPS signals with its internal always-active GPS receiver. When the instrument is under a stable GPS coverage the EM®CSA reaches a frequency stability better than 0.03 ppm. In addition to the GPS-disciplined frequency reference, the EM®CSA can also show all related satellite information such as:

- ✓ number of satellites,
- ✓ position of satellites,
- ✓ displacement of satellites over time,
- ✓ NMEA sentences.



(a)

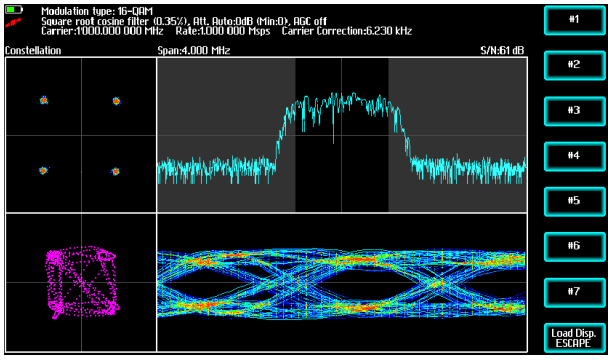


(b)

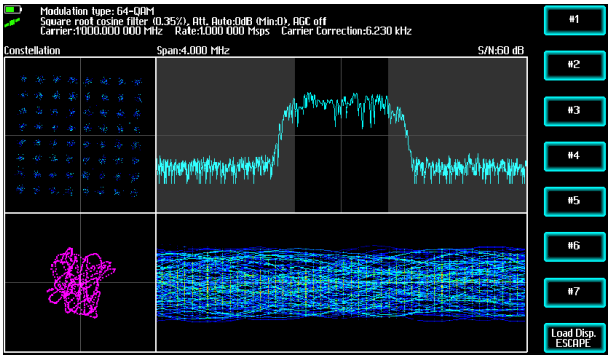
Figure 10: Built-in GPS utilities showing the position (a) and displacement (b) of satellites

Vector Modulation Analysis

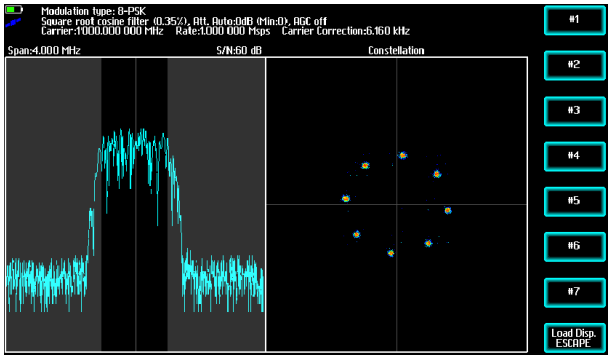
The EM®CSA can perform a number of different IQ demodulation types. They are divided into two groups: (i) PSK Type Demodulation, which are variations in the phase only of a constant frequency carrier wave and (ii) Amplitude Type Demodulation, which are variations in the amplitude and phase of a high-frequency carrier wave. The EM®CSA supports OOK, 4-ASK, 4-QAM, 16-QAM, 64-QAM, BPSK, QPSK, OQPSK, PI/4 DQPSK, 8-PSK, 16-APSK and 32-PSK demodulation. Four different visualisation modes are available at runtime: the spectrum with indications on the bandwidth related to the symbol rate of the modulation, the time-domain eye diagram, as well as raw and filtered symbol maps.



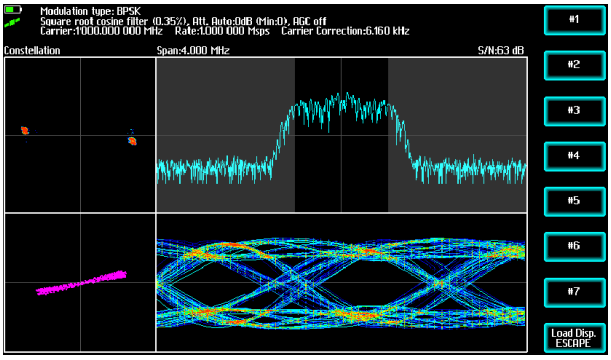
(a) 4 QAM



(b) 64 QAM



(c) 8 PSK



(d) BPSK

Figure 10: Examples of IQ demodulation

SPECIFICATIONS

Frequency

Frequency range	10 Hz to 4 GHz	
	Low band	10 Hz to 30 MHz
	High band	15 MHz to 4 GHz
Frequency resolution	1 Hz	
Reference frequency ageing per day	0.04E-6	
Reference frequency temperature range	-30 °C to +70 °C	
Achievable initial calibration accuracy	0.1E-6	
Frequency stability	0.3E-6	
	< 30E-9	when GPS disciplined
Marker resolution	1 Hz	
Frequency counter resolution	1 Hz	
Frequency counter uncertainty	SNR > 40 dB	± (frequency ∗ reference stability + $\frac{1}{2}$ (last digit)
		± 1 Hz when GPS disciplined
Frequency span	0 Hz, 1 kHz to 4 GHz	
Span uncertainty	$\mathrm{MAX}\left(\frac{RBW}{2}, 0.3\text{E-}6\right)$	
Spectral purity SSB phase noise	f = 500 MHz	
Carrier offset @ 1 Hz, 10 kHz RBW	10 kHz	< -100 dBc
	100 kHz	< -110 dBc
	1 MHz	< -130 dBc

Sweep time

Peak, PRFM POI, 2 MHz	30 MHz	< 25 ms
	100 MHz	< 30 ms
	1 GHz	< 70 ms
	4 GHz	< 300 ms
Peak, PRFM POI, 10 kHz	30 MHz	≤ 250 ms
	100 MHz	≤ 800 ms
	1 GHz	≤ 7.5 s
	4 GHz	≤ 30 s

Resolution Bandwidths

Range	-6 dB bandwidth	20 Hz to 10 MHz in 1/2/3/5 sequence
Bandwidth accuracy	≤ 10 kHz	< 2 % (nom.)
	> 10 kHz	< 5 % (nom.)
Selectivity 60 dB : 6 dB	≤ 3 (Gaussian type filters)	

Level

Dynamic range	8 dB to 120 dB
Scale	1 dB/Div and 5 dB/Div
Setting range of reference level	-130 dBm to +30 dBm
Units of level axis	dBm, dBμV
Conversion factors	user-definable, up to 7
Detectors	peak, AVG, RMS
Absolute values	-170 dBm to + 5 dBm
Maximum DC voltage input	10 V
Maximum CW RF power input	33 dBm (= 2 W)
Level measurement uncertainty	±1.5 dB

RF

Third-order intercept (TOI)	RF attenuation = 0 dB	
	f_{in} = 1 GHz	+ 7 dBm (meas.)
	f_{in} = 10 MHz	+ 10 dBm (meas.)
Second-harmonic intercept (SHI)	RF attenuation = 0 dB	
	f_{in} = 1 GHz	- 60 dBc (nom.)
	f_{in} = 10 MHz	- 80 dBc (nom.)
Displayed average noise level (DANL)	RF attenuation = 0 dB, termination = 50 Ω, normalised to 1 Hz	
	10 Hz to 30 MHz	- 170 dBm (typ.)
	15 MHz to 1 GHz	- 160 dBm (typ.)
	1 GHz to 4 GHz	- 146 dBm (typ.)
Image frequencies	$f_{in} - 2 * 5130$ MHz	- 70 dBc (nom.)
	$f_{in} - 2 * 140$ MHz	- 70 dBc (nom.)
Intermediate frequencies	140 MHz, 5130 MHz	- 60 dBc (nom.)
Other interfering signals		
Residual spurious response		
Input impedance	50 Ω (nom.)	
Input connector	N female	
Input attenuator	Low band	0 dB to 40 dB in 10 dB steps
	High band	0 dB to 40 dB in 1 dB steps

General

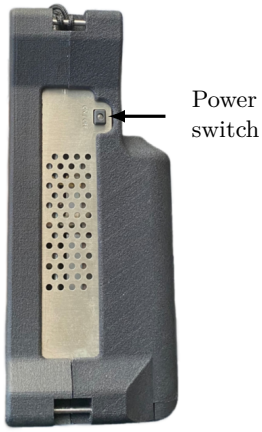
Dymensions (W x H x D)	192 mm x 143 mm x 60 mm	
Weight	1350 g	
Display resolution	800 x 480 pixel	
Batteries	4 standard 18650 Li-ion batteries	
AC power supply	24 V, 50 W	
Temperature	operating temperature range	- 10 °C to + 55 °C
	battery charging mode	0 °C to + 40 °C
Operating time with new fully charged batteries	4 hours	
Interface	micro USB	
	user port UART	
Included accessories	easy-grip hand strap	
	shoulder strap	
	AC power supply	
	carrying case	
Optional accessories	backpack	
	4 spare batteries	

EM®CSA OVERVIEW

(a) Top

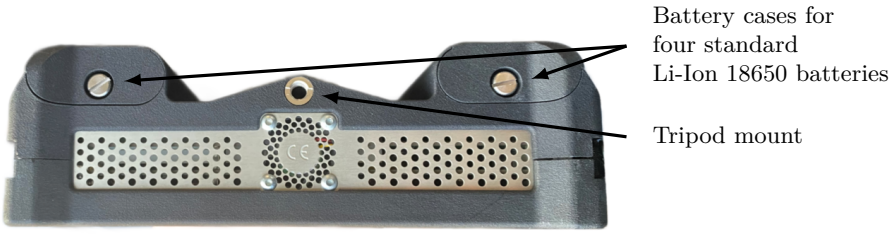
(b) Left Side

(c) Front



(d) Right Side

(e) Rear



(f) Bottom

Figure 11: EM®CSA overview

PRODUCT KIT

The EM®CSA comes in a handy shock resistant carrying case with padding. An AC power supply charger and a shoulder strap are provided. Additionally, there are three slots in the padding to comfortably carry along other accessories (not provided). As an optional there is the possibility to order a practical backpack for the case and spare batteries.

Figure 12: Carrycase including charger and shoulder strap

Figure 13: Optional backpack

SERVICES FOR YOUR EM®CSA

- Fail-safe, free, user-upgradeable firmware whenever required
- Factory calibration certificate included
- Accredited calibration certificate upon request
- 2 Years warranty

Figure 14: EM®CSA carrying case

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