Signal Level Strength Meter Calibration and IARU Standards

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Figure-1
Signal Level Strength Meter
of a Ten-Tec Orion
Amateur Radio Transceiver

Figure-2
Signal Level Strength Meter
of a Collins KWM-2A
Amateur Radio Transceiver

A **Signal Level Strength Meter,** or "**S-Meter"** as it is normally called, is an indication meter provided on most RF Communications Equipment, such as Amateur Radio Transceivers and Short Wave Broadcast Receivers. **The meter scale markings are derived from a subjective system of reporting Received Signal Strengths from S1 through S9, as part of the Readability, Strength, Tone (RST) code developed in the early 20th century and was in wide-spread use by 1912.** The RST code is used by Amateur Radio Station Operators, Short Wave Listeners (SWL), and other Radio Hobbyists to exchange information about the quality of a Received Radio Signal.

The term **Signal Level Strength Unit**, or "**S-Unit"** as it is normally called, refers to the **"S-Meter" f**aceplate numerical markings. These are labeled from numbers '1' through '9' and in 10 dB steps above number '9'. The readings are a measurement of the Signal Strength of the Received Signal, required to move the **S-Meter** indication needle from one **S-Unit** marking to the next **S-Unit** marking. **Figure-1** shows an **S-Meter** of a Ten-Tec Orion Amateur Radio

Transceiver and **Figure-2** shows an **S-Meter** of a Collins KWM-2A Amateur Radio Transceiver.

1981 IARU Region 1 Technical Recommendation R.1

In 1981 the International Amateur Radio Union (**IARU**) Region 1, agreed on a technical recommendation for S-Meter calibration for MF / HF and VHF / UHF Transceivers.

IARU Region 1 Technical Recommendation R.1 defines:

1. **For the MF / HF bands, an 'S9' signal strength is a receiver input power of '-73 dBm'. This is a level of '50 μV' at the receiver's antenna input assuming the input impedance of the receiver is 50Ω.**

2. **For the VHF / UHF bands, an 'S9' signal strength is a receiver input power of '-93 dBm'. This is a level of '5 μV' at the receiver's antenna input assuming the input impedance of the receiver is 50 Ω.**

3. **The difference of one S-Unit corresponds to a difference of '6' Decibels' (6 dB), which is equivalent to a Power Ratio of four times (x4) and a Voltage Ratio of two times (x2).**

4. **Signals stronger than S9 are reported with an additional 10 dB rating. verbally stated as "S9 plus 50dB", or "50 dB over S9" or "50 Decibels over S9".**

Examples:

On the MF / HF bands 'a weak' S-Meter, S-Unit reading of **'S1'** corresponds to a received power of **'-121 dBm' or '0.20 μV' into 50 Ω.**

On the MF / HF bands 'a strong' S-Meter, S-Unit reading of **'S9'** corresponds to a received power of **'-73 dBm' or '50.15 μV' into 50 Ω.**

Some Signal Generators are calibrated in dB above 1 μV and have an ouput in EMF, and to set an MF / HF receiver's strength meter reading to S1, set the signal generator output to -14 dB above 1 μV, and to set the strength meter reading to S9, set the signal generator output to 34 dB above 1 μV.

Signal Level Strength Meter S-Unit Reading	Signal Generator "dBm" (50 Ohm)	Signal Generator "µV" (50 Ohm)	Signal Generator "EMF" above "dB" (50 Ohm)
S9+10dB	-63	160.00	44
S9	**-73**	**50.15**	**34**
S8	-79	25.13	28
S7	-85	12.60	22
S6	-91	6.31	16
S5	-97	3.16	10
S4	-103	1.59	4
S3	-109	0.79	-2
S2	-115	0.40	-8
S1	**-121**	**0.20**	**-14**

Accuracy

Most **S-Meters** are not accurately calibrated and in practice can only provide a relative measure of the received signal strength based on the receiver's AGC voltage. ***Most S-Meters are calibrated to read S9 for an input of -73 dBm but do not provide a correct '6 dB' per Signal Level Strength Unit (S-Unit) correspondence.***

Often the correlation between a radio listener's qualitative impression of signal strength and the actual strength of the received signal is poor, because the receiver's AGC holds the audio output fairly constant despite changes in input signal strength.

STANDARDISATION OF S-METER READINGS

1. One S-unit corresponds to a signal level difference of 6 dB.

2. On the bands below 30 MHz a meter deviation of S-9 corresponds to an available power of -73 dBm from a continuous wave signal generator connected to the receiver input terminals.

3. On the bands above 144 MHz this available power shall be -93 dBm.

4. The metering system shall be based on quasi-peak detection with an attack time of 10 ms ± 2 ms and a decay time constant of at least 500 msec.