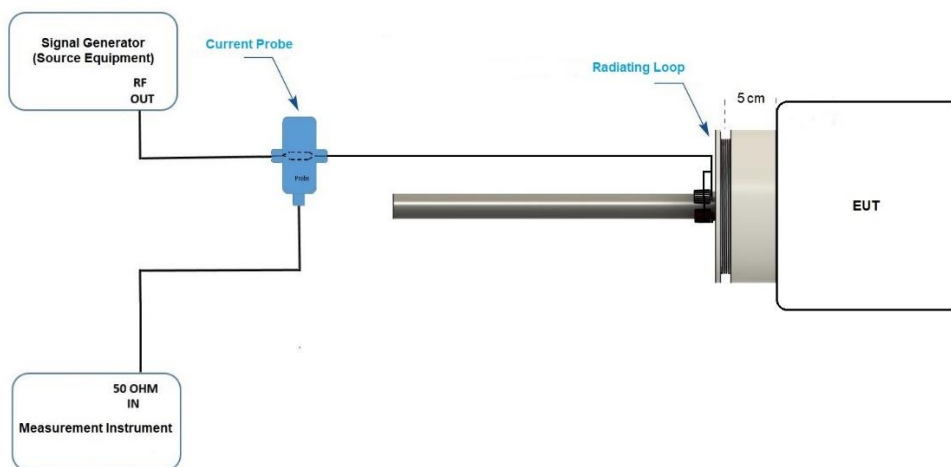# 30 Hz – 100 KHz RS101 Loop Antenna Set

1. Introduction

The MIL-STD-461G RS101 test determines the susceptibility of equipment installed in close proximity to large radiated magnetic fields, and their ability to withstand them in the frequency range 30 Hz–100 kHz.
The TBRS101 Loop Antenna Set consists of the TBRS101-TX Radiating Loop, TBRS101-RX Field Monitoring Loop and TBCCP1-2K70.

The TBRS101-TX Radiating Loop is used to generate the low frequency magnetic field emissions. The distance between the winding and EUT is 5 cm. This is accomplished when the front edge of the the radiating loop comes into contact with the EUT faces during testing. The test is applicable in the frequency range of 30 Hz to 100 KHz. Section 5.20 of MIL-STD-461G specifies the test setup and measuring procedures.

TBRS101 Typical Test Setup

30 Hz – 100 KHz RS101 Loop Antenna Set

The TBRS101-TX Radiating Loop is constructed of a 12 cm diameter coil with 20 turns of 12 AWG Gauge (2 mm) copper wire. The loop winding has a DC resistance of 50 mohms. The loop generates magnetic field strength or magnetic flux density normal to the containing plane by applying RF current to the input banana plugs.

The TBRS101-RX Field Monitoring Loop consists of a 4.1 cm diameter coil with 51 turns of 7 strand 41 AWG Litz wire inside a shielded body. The DC resistance of the loop winding is 4.1 ohms. The loop receives magnetic field radiation normal to the containing plane 5cm from the TBRS101-TX Radiating Loop winding and produces a voltage signal proportional to the intensity of the B-field/H-field radiation at the loop's output port.

A TekBox TBCCP1-2K70 coaxial RF current monitoring probe with a flat transfer impedance of 0 dBΩ (1V/A) from 9 kHz to 30 MHz when loaded with 50Ω is available as an optional accessory for calibration purposes.

2. Technical specifications

2.1 TBRS101-TX Radiating Loop Technical specifications

| Type	Radiating Loop Antenna
Frequency range	30 Hz–100 KHz
Standards	MIL-STD-461G / RS101
Loop Diameter	12 cm
Loop construction	20 turns of 12 AWG Gauge 2mm copper wire
DC resistance of the loop coil	50 mΩ (Nominal)
Self inductance of the loop coil	90 µH
Input connector	Male banana plugs
Mechanical Dimensions (No mounting pole)	L x W x H: 8.2 cm x 15.2 cm x 15.2 cm (3.23" x 5.98" x 5.98")
Mechanical Dimensions (mounting pole)	L x W x H: 38 cm x 15.2 cm x 15.2 cm (14.96" x 5.98" x 5.98")
Weight	0.5 kg (1.1 lbs)

2.2 TBRS101-RX Field Monitoring Loop Technical specifications

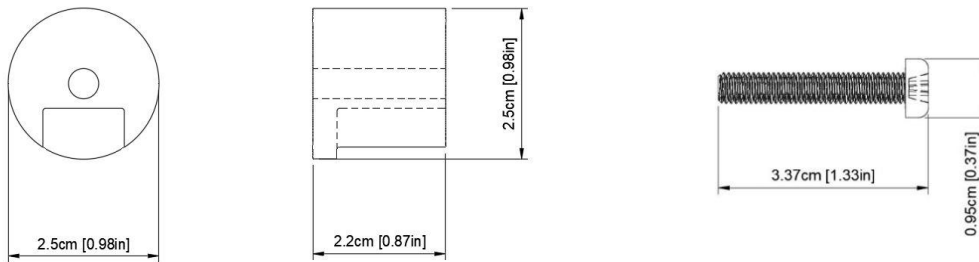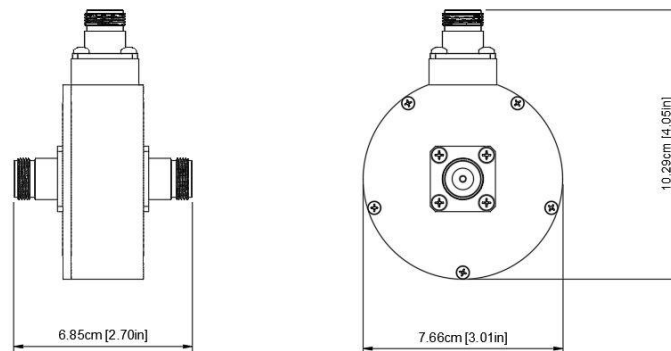| Type	Passive Monitoring Loop Antenna
Frequency range	30 Hz–100 KHz
Standards	MIL-STD-461G / RS101
Loop Diameter	4.1 cm
Loop construction	51 turns of 7 strand 41 AWG Litz wire
DC resistance of the loop coil	4.1 Ω (Nominal)
Self inductance of the loop coil	180 µH
Output connector	N-female, 50 Ω
Antenna conversion factor	Within ±3 dB compared to the theoretical validation factor for standard RS101 field monitoring loop in MIL-STD-461G
Mechanical Dimensions	L x W x H: 4.37 cm x5.42 cm x7.92 cm (1.72" x 2.13" x 3.12")
Weight	0.1 kg (0.22 lbs)

30 Hz – 100 KHz RS101 Loop Antenna Set
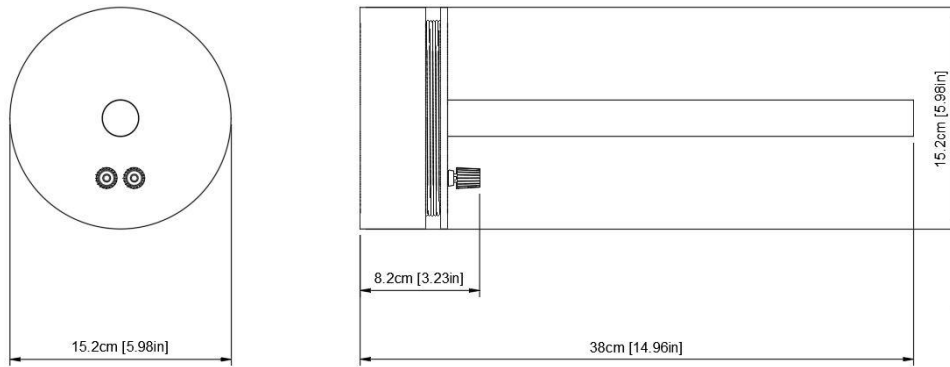
Dimensions of TBRS101-TX radiating loop with mounting pole
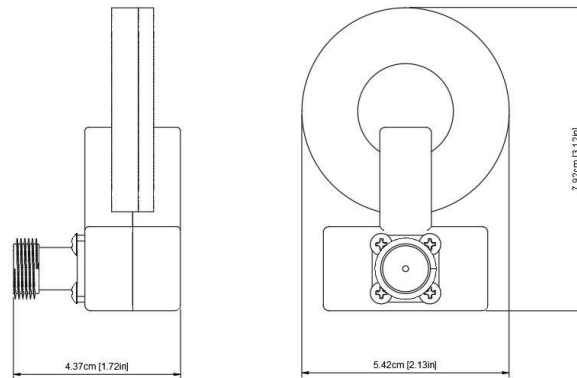
Dimensions of TBRS101-RX field monitoring loop

*Dimensions of TBRS101-S mounting spacer*

Dimensions of TBRS101 Loop Antenna Set and Accessories

30 Hz – 100 KHz RS101 Loop Antenna Set

3. Antenna conversion factor

The conversion factor of the RS101 field monitoring loop is obtained by calculating the amount of generated magnetic flux density from the RS101 radiating loop (in dBpT) in 5 cm distance. Inject the corresponding current, measure the voltage at the output of the RS101 field monitoring loop (in dBμV), using a 50 Ohm impedance measurement instrument, and subtracting the former from the latter.

The generated magnetic flux density from the RS101 radiating loop and the output voltage of the RS101 field monitoring loop must be measured as a function of frequency in the 30 Hz to 100 KHz range, using the TBRS101 Antenna Conversion Factors Table in Chapter 4.
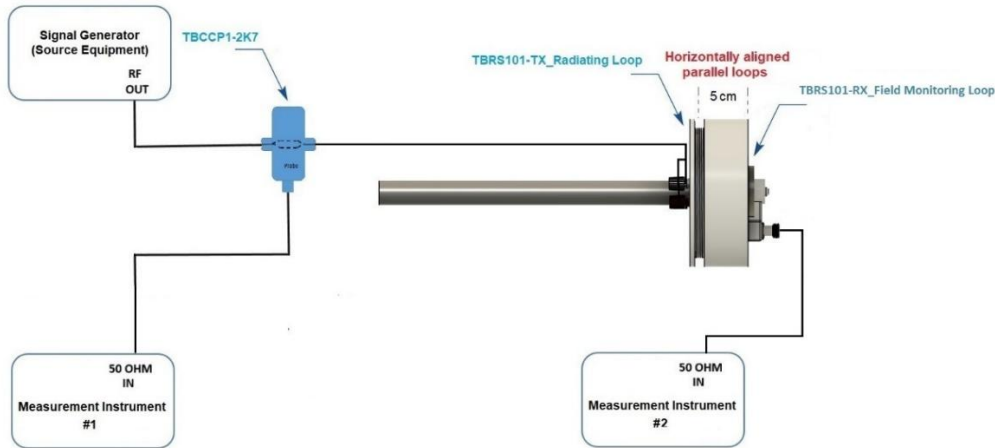
TBRS101 Typical Calibration Setup (RF Current Probe Method)

The conversion factor is provided in two formats: dBμV to dBpT and dBμV to dBμA/m. The former is 1.98 dB greater than the latter. If the observed antenna conversion factors are within ±3 dB of the theoretical antenna conversion factors of the MIL-STD-461G RS101 field monitoring loop over the antenna frequency range, they are considered useable and reliable.

Applying the antenna conversion factors converts the measured voltage at the TBRS101-RX Field Monitoring Loop output (in dBμV) to the magnetic flux density (in dBpT) and the magnetic field strength (in dBμA/m) respectively. The magnetic flux density values (in dBpT) are considered as the level of radiated disturbance from the radiating loop and can be adjusted for reaching the required radiated susceptibility levels of MIL-STD-461G RS101.

Below are the equations used to calculate the radiated disturbance level:

Magnetic Flux Density [dBpt] = Measured Voltage [dBμV] + Antenna Conversion Factor [dBpT/μV]

Mag. Field Strength [dBμA/m] = Measured Voltage [dBμV] + Antenna Conversion Factor [dBμA/m/μV]
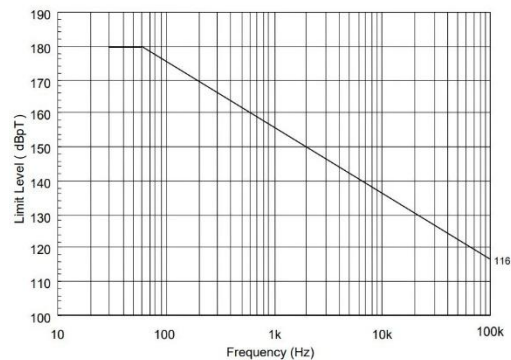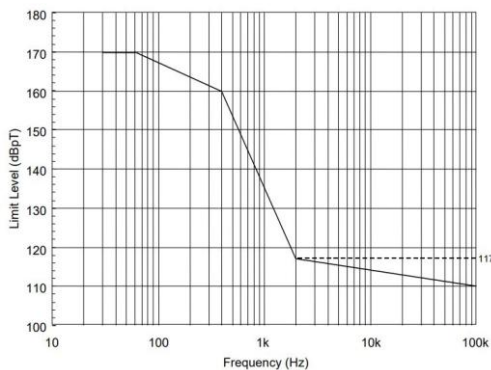
RS101 limits for all Navy & Army applications

TEKBOX
DIGITAL SOLUTIONS
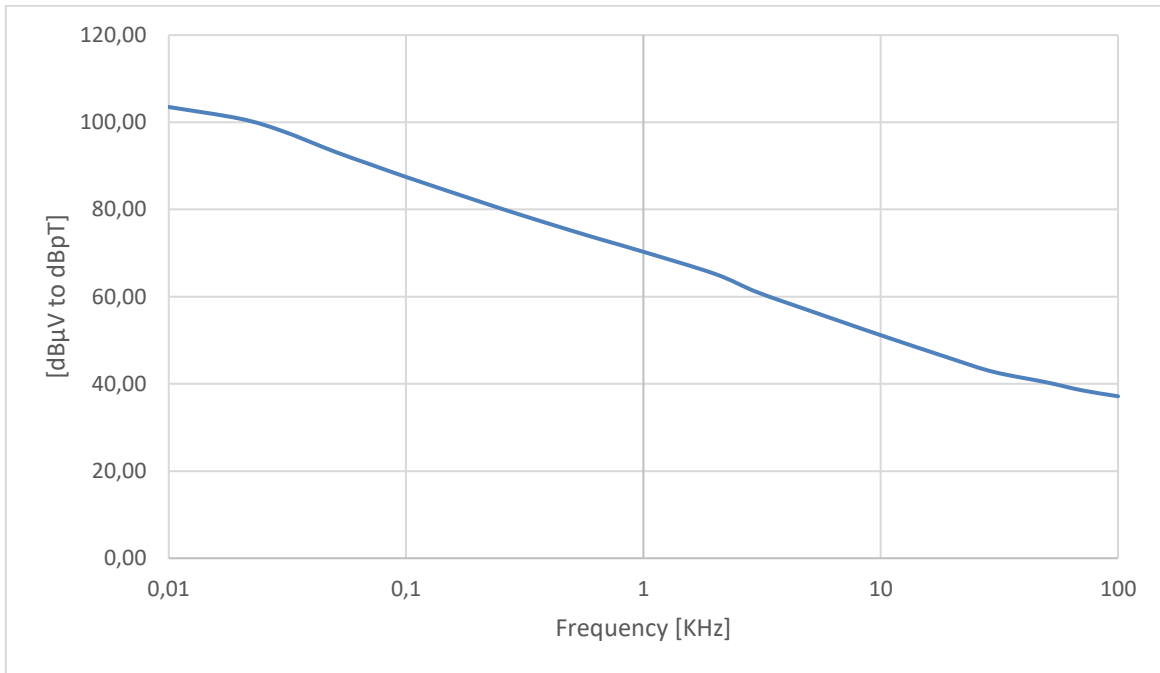
30 Hz – 100 KHz RS101 Loop Antenna Set

After the calibration is completed, RS101 testing may begin by precisely placing the radiating loop against the EUT to generate the specified magnetic field by injecting the necessary RF current into the loop. During testing, the magnetic field strength must be at least 10 dB larger than the specified limits, while the injected current should not exceed 15 Amps (183 dBpT).
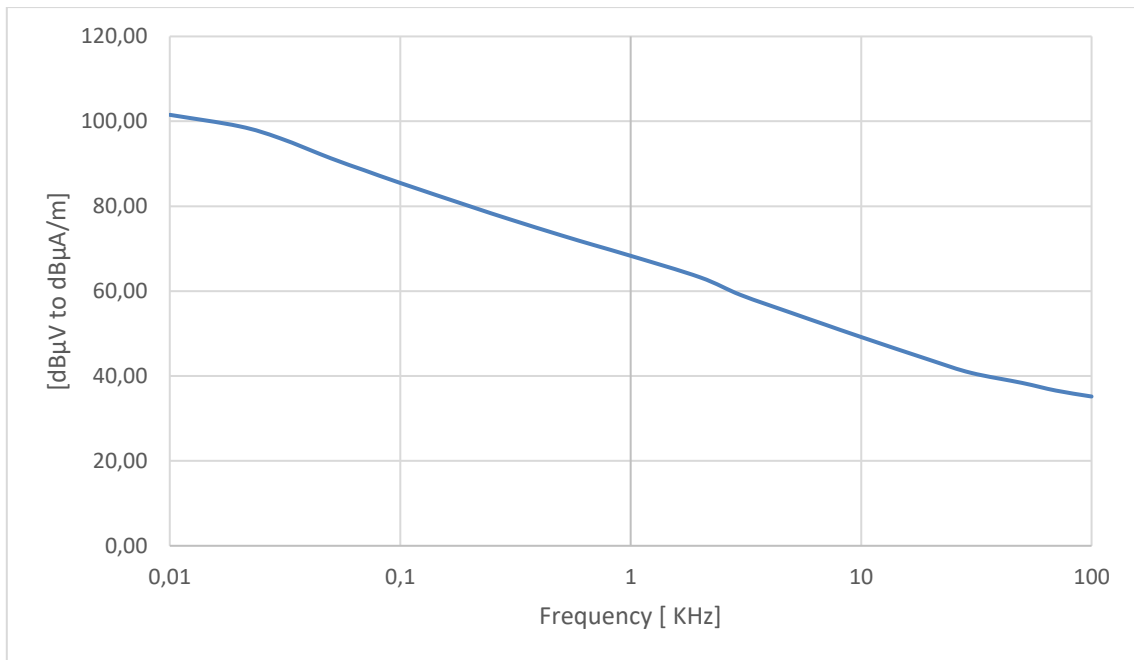
4. TBRS101 Antenna Conversion Factors

Frequency	TBRS101 Conversion	TBRS101 Conversion	MIL-STD-461G Conversion
[KHz]	[dBµV to dBpT]	[dBµV to dBµA/m]	[dBµV to dBpT]
0.01	103.51	101.53	108.57
0.02	100.82	98.84	102.55
0.03	98.02	96.04	99.03
0.05	93.27	91.29	94.59
0.07	90.43	88.45	91.67
0.1	87.46	85.48	88.57
0.2	81.98	80.00	82.55
0.3	78.86	76.88	79.03
0.5	75.11	73.13	74.59
0.7	72.75	70.77	71.67
1	70.29	68.31	68.57
2	65.23	63.25	62.56
3	61.08	59.10	59.04
5	56.82	54.84	54.64
7	54.06	52.08	51.76
10	51.16	49.18	48.76
20	45.71	43.73	43.25
30	42.72	40.74	40.47
50	40.35	38.37	37.81
70	38.55	36.57	36.65
100	37.15	35.17	35.88

Typical Antenna Conversion Factors Table (50 Ohm Load Impedance)
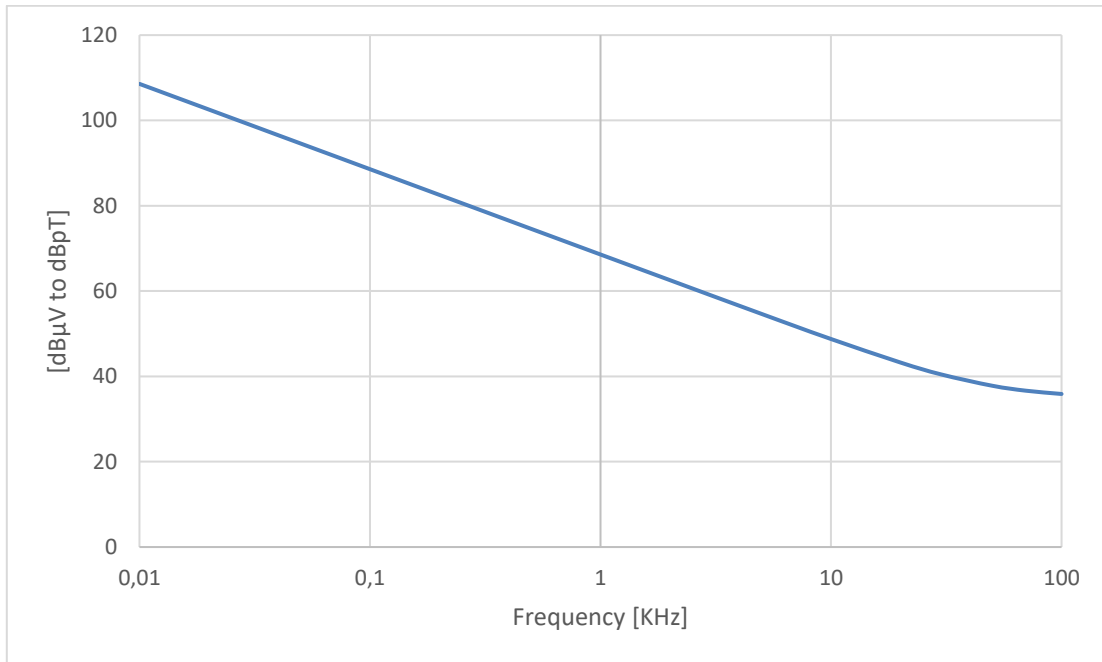
30 Hz – 100 KHz RS101 Loop Antenna Set

TBRS101 Typical Antenna Conversion Factor (50 Ohm Load Impedance)
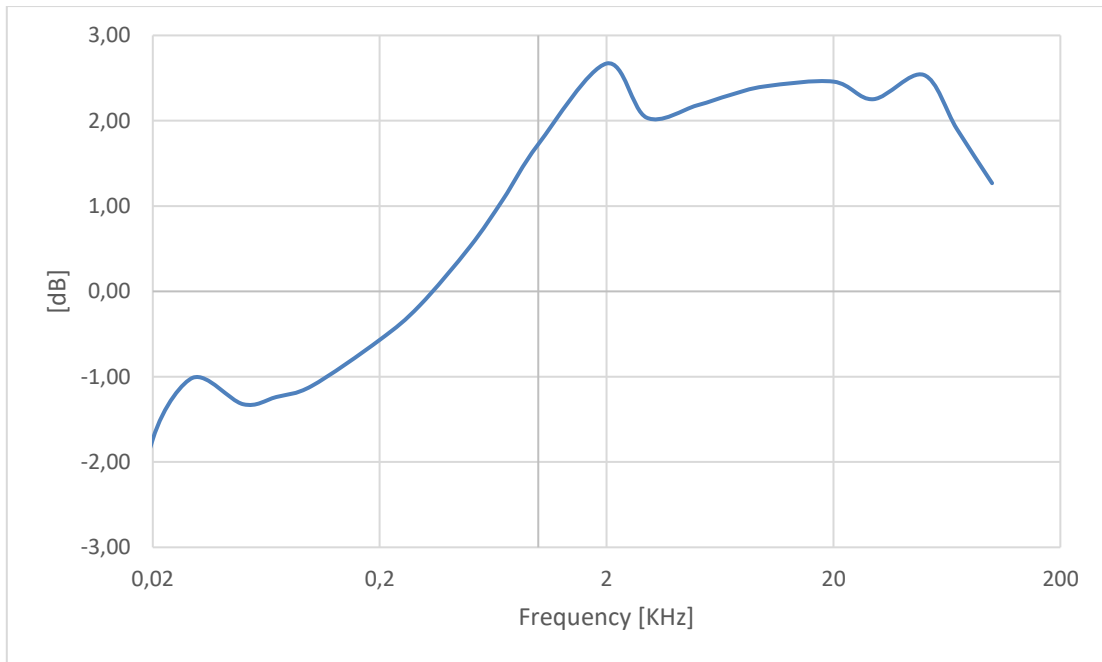

TBRS101 Typical Antenna Conversion Factor (50 Ohm Load Impedance)

30 Hz – 100 KHz RS101 Loop Antenna Set

MIL-STD-461G RS101 Field Monitoring Loop Conversion Factor (50 Ohm Load Impedance)

Deviation from MIL-STD-461G RS101 Field Monitoring Loop Conversion Factor (50 Ohm Load Impedance)

30 Hz – 100 KHz RS101 Loop Antenna Set

5. Calibration

The TBRS101-TX comes with a factory calibration protocol. The calibration accessories including TBRS101-RX Field Monitoring Loop, TBRS101-S mounting spacer, TBCCP1-2K70 coaxial RF current monitoring probe, 50 Ohm RF termination, BNC Female to 4mm Banana Plug and the interconnecting cables enable periodic re-calibration or validation of the performance, if required. The validation process for measurement system integrity check is based on the method explained in chapter 5.20.3.4 of MIL-STD-461G standard.

6. Ordering Information

Part Number	Description
TBRS101-TX	Radiating loop for generating magnetic fields in the range of 30 Hz to 100 KHz; comes with a threaded mounting pole, factory calibration protocol, user manual
TBRS101-RX	Field monitoring loop for measuring magnetic fields in the range of 30 Hz to 100 KHz, factory calibration protocol, user manual Also includes TBRS101-S spacer (teflon spacer for mounting field monitoring loop on the radiating loop during the calibration; M5 nylon screw)
TBCCP1-2K70	Coaxial RF current monitoring probe for measuring the injected current into the radiating loop
TBRS101-SET	Consists of TBRS101-TX, TBCCP1-2K70, TBRS101-TX_PAI 25mm POM adapter for TBTP3 tripod, Banana-male to BNC-female adapter, 50Ω termination
TBRS101-AS	Acryllic stand for TBRS101-TX

7. History

Version	Date	Author	Changes
V1.0	7.2.2025	Mayerhofer	Creation of the document

TekBox Digital Solutions Vietnam Pte. Ltd.   **www.tekbox.com**

Factory 4, F4, Lot I-3B-1, Saigon Hi-Tech Park, Tan Phu Ward, District 9, Ho Chi Minh City, Vietnam