COAXIAL RF CURRENT MONITORING PROBE

1 Introduction

The TBCCP1-2K70 is a coaxial RF current monitoring probe, expanding the Tekbox product range of affordable EMC pre-compliance test equipment.
The probe has a very flat response from 2 kHz to 70 MHz and is characterized over the frequency range from 10 Hz to 100 MHz. The TBCCP1-2K80 is designed to be used as transducer for large loop antennas or for applications that need to measure RF currents in coaxial cables. With a transimpedance of 0 dBΩ, it is compliant with the specifications for large loop antennas (LLA) in CISPR 15 (EN 555015) and CISPR 16-1-4

Picture 1: TBCCP1-2K70 RF current monitoring probe

2 Specification

Characterized frequency range:	10 Hz to 100 MHz
Transfer impedance:	0 dBΩ when loaded with 50Ω
3 dB bandwidth:	2 kHz to 70 MHz, typ.
Dimensions:	76 mm x 102 x 69 mm
Weight:	450 g
Connector type:	N female
Max. primary current (RF):	12 A
Max. core temperature:	125 °C

RoHS

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3 Transfer impedance

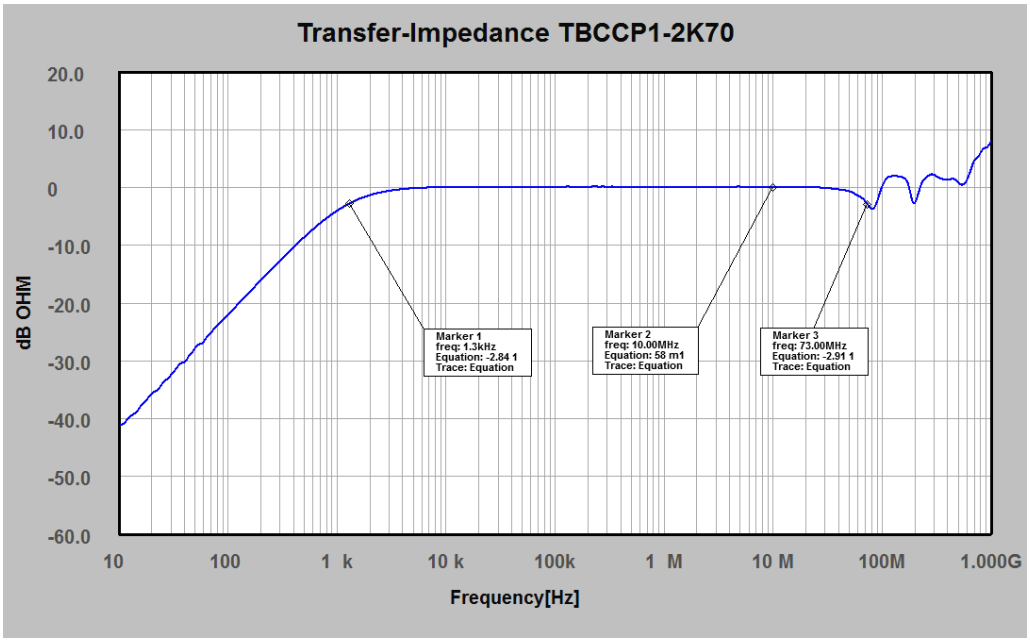

Figure1: transfer impedance, 10 Hz – 1 GHz, typical data

4 Coaxial Path – Insertion loss (S21)

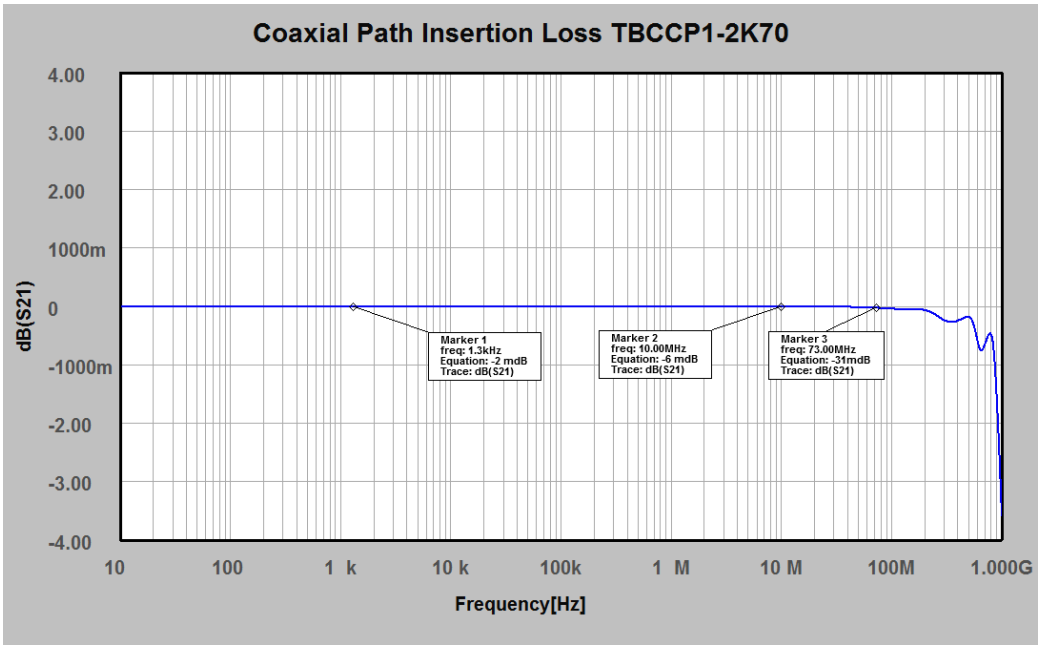

Figure2: S21, insertion loss of the coaxial path, 10 Hz – 1 GHz, typical data

5 Coaxial Path – Matching (S11)

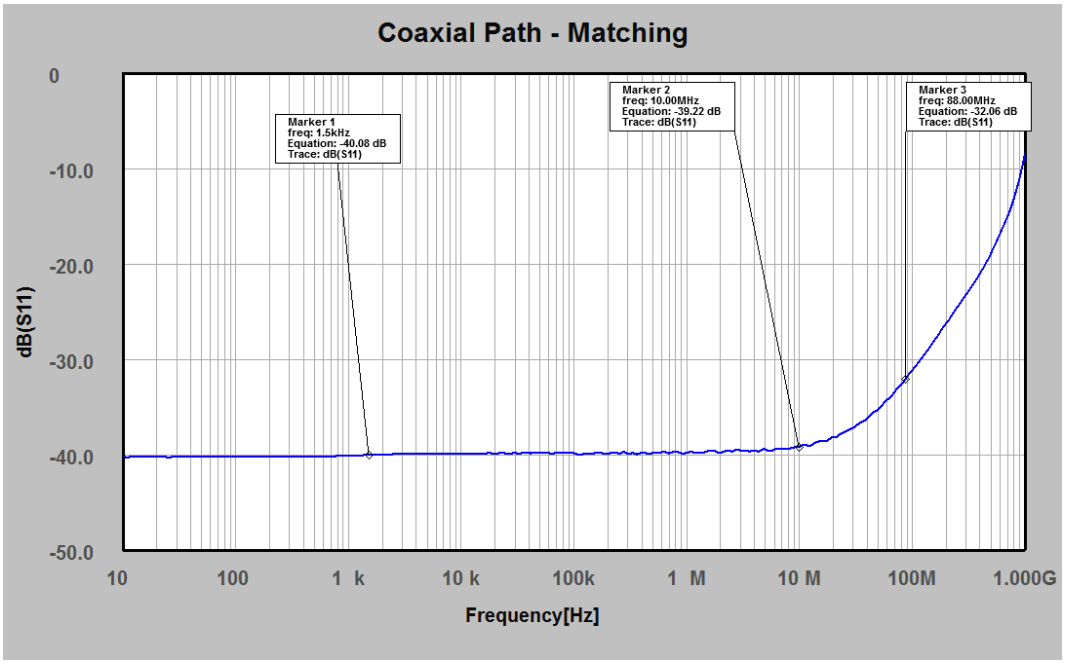

Figure3: S11, impedance matching of the coaxial path, 10 Hz – 1 GHz, typical data

6 Applications

Large loop antennas (LLA, 2m loop antenna, Van Veen antenna)

CISPR 16-1-4 and CISPR 15 specify a large triple loop antenna for radiated emission measurement of luminaries in the frequency range of 9 kHz to 30 MHz.

The loop antenna consists of 3 orthogonally oriented loops with a diameter of 2 meters or larger. The loops are constructed from coaxial cable. CISPR 16-1-4 specifies the requirements for the coaxial cable and the slits in the outer conducter. Depending on the dimensions of the luminaries the standard specifies the diameter of the loop, which could be 2m, 3m or 4m.
The luminary is positioned in the center of the loops. Radiated emissions are measured for each of the 3 loops.

Most standards specify a horizontal distance between loop antenna and EUT and specify the limits in magnetic fieldstrength units. In contrary, CISPR 15 limits refer to the current induced into the 2m loops. As the specified current transducer has a transimpedance of 0 dBΩ, the

readings of the analyzer or measurement receiver in dBµV are equivalent to the induced current in dBµA. Consequently, no antenna factor is required.

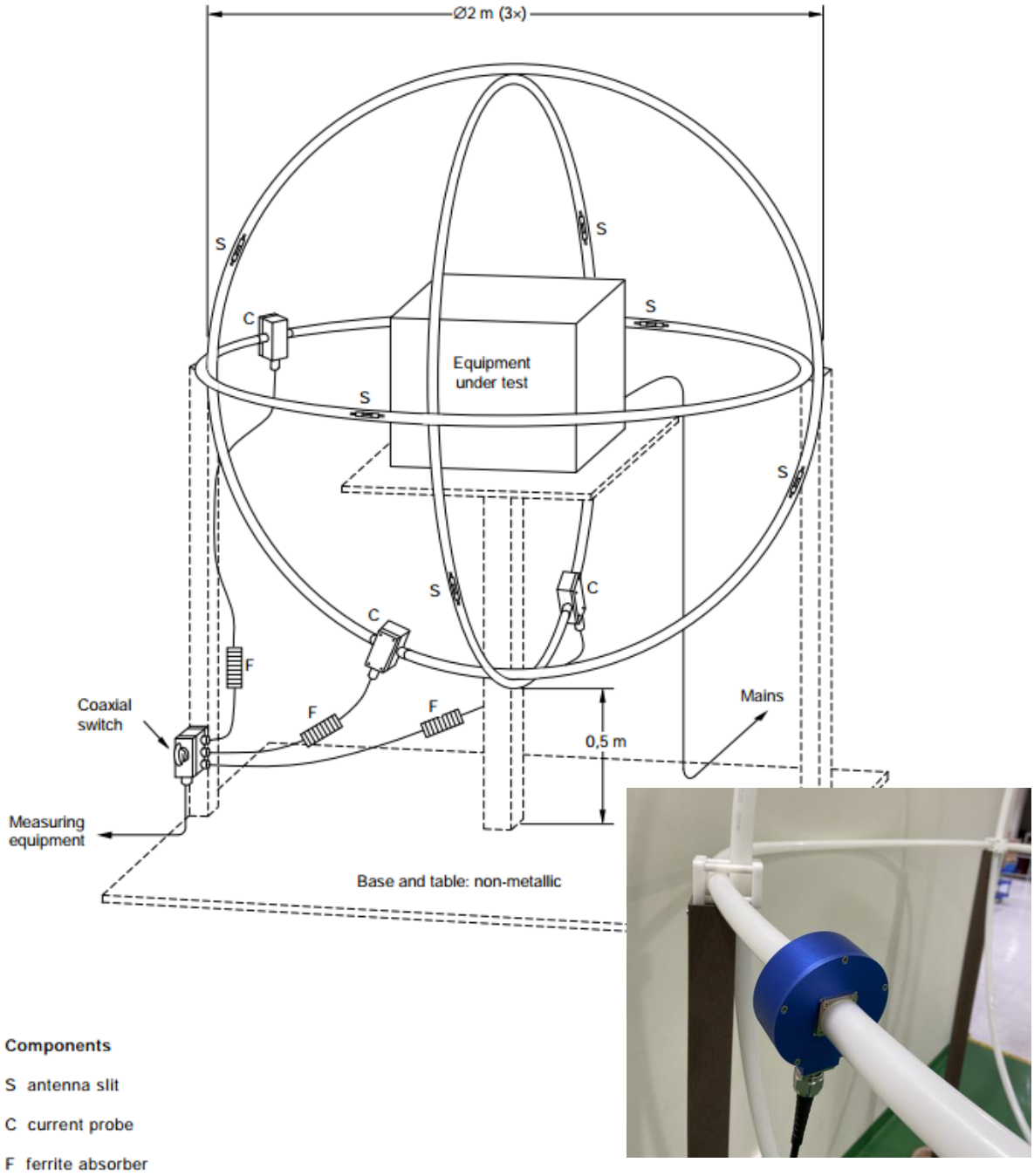

Figure 4: CISPR 16-1-4 / CISPR 15 large loop antenna

7 CISPR15 Limits for the frequency range from 9 kHz to 30 MHz

The quasi-peak limits of the magnetic component of the radiated disturbance field strength in the frequency range 9 kHz to 30 MHz, measured as a current in 2m, 3m or 4m loop antennas around the lighting equipment, are given in the table below.
The limits for the 2 m loop diameter apply to equipment not exceeding a length of 1,6m, those for the 3m loop diameter for equipment having a length in between 1,6m and 2,6m and those for the 4m loop diameter for equipment having a length in between 2,6m and 3,6m.

Frequency range [MHz]	Coupling device	RBW	Detector	2m loop [dBµA]	3m loop [dBµA]	4m loop [dBµA]
0.009 – 0.07	Magnetic loop antenna	200 Hz	Quasi Peak	88	81	75
0.07 – 0.15				88 – 58 decreasing linearly with logarithm of frequency	81 – 51 decreasing linearly with logarithm of frequency	75 – 45 decreasing linearly with logarithm of frequency
0.15 - 3		9 kHz		58 – 22 decreasing linearly with logarithm of frequency	51 – 15 decreasing linearly with logarithm of frequency	45 – 9 decreasing linearly with logarithm of frequency
3 - 30				22	15 – 16 increasing linearly with logarithm of frequency	9 – 12 increasing linearly with logarithm of frequency

Table 1: CISPR 15 Limits for radiated emissions, 9 kHz – 30 MHz

For electrodeless lamps and luminaires, the limit in the frequency range of 2.2 MHz to 3.0 MHz is 58 dBµA for 2m, 51 dBµA for 3m and 45 dBµA for 4m loop diameter.

8 Typical transfer impedance table

The table below shows typical transfer impedance data of a TBCCP1-2K70 current probe. Each current probe is delivered with its corresponding measurement protocol. This data can be used for the creation of a correction file for EMCview or similar EMC measurement software. The transfer impedance in dBΩ subtracted from the analyzer reading in dBµV gives the corrected reading in dBµA.
Refer to the application notes of EMCview on how to create a current probe correction file, download a file with typical data from the Tekbox website or simply select the file from the installed correction file directory.

Frequency [MHz]	transfer impedance [dBΩ]	Frequency [MHz]	transfer impedance [dBΩ]
0.00001	-41.31	0.25	0.13
0.000025	-34.19	0.5	0.14
0.00005	-28.00	0.75	0.15
0.000075	-24.56	1	0.15
0.0001	-22.00	2.5	0.16
0.00025	-14.18	5	0.12
0.0005	-8.60	7.5	0.12
0.00075	-5.74	10	0.13
0.001	-4.03	20	0.05
0.00125	-2.93	30	-0.08
0.0015	-2.20	40	-0.37
0.00175	-1.69	50	-0.65
0.002	-1.33	55	-1.00
0.00225	-1.06	60	-1.40
0.0025	-0.85	65	-1.83
0.005	-0.13	70	-2.43
0.0075	0.02	75	-3.14
0.01	0.07	80	-3.65
0.025	0.13	85	-3.42
0.05	0.13	90	-2.33
0.075	0.14	95	-0.98
0.1	0.14	100	0.24

Table 2: Transfer impedance: 10 Hz to 100 MHz, typical data

9 Calibration

Tekbox coaxial RF current monitoring probes do not need a calibration fixture for the measurement of the transfer impedance.

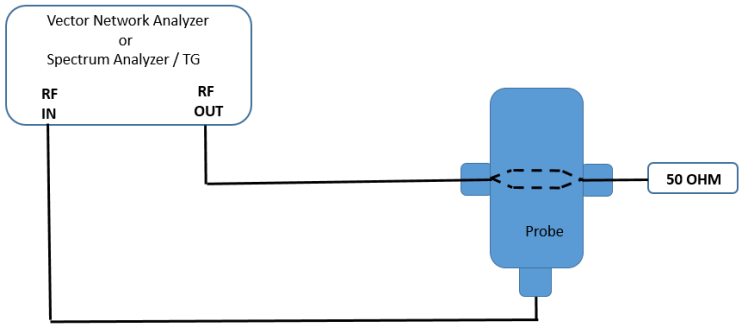

Figure 4: S21, transimpedance measurement set up

Calculate the transfer impedance Z_T using the formula below:

Z_T [dBΩ] = Pin [dBm] – Pprobe [dBm] +34 dB

or simply

Z_T [dBΩ] = S21 [dB] +34 dB

10 Ordering Information

Part Number	Description
TBCCP1-2K70	Coaxial RF current monitoring probe, beech-wood box, calibration protocol 10 Hz – 100 MHz

11 History

Version	Date	Author	Changes
V 1.0	27.6.2022	Mayerhofer	Creation of the preliminary document

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