Product Datasheet - Technical Specifications

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Passive Loop Antenna

1   Introduction

The TBMA6-P is a passive Loop Antenna, expanding the Tekbox product range of affordable EMC pre-compliance test equipment.
The loop antenna is designed for radiated emission measurements in the frequency range 9 kHz – 30 MHz, according to CISPR 16. The loop antenna has a diameter of 60 cm and provides sufficient sensitivity to carry out all relevant measurements specified in the corresponding CISPR standards for the frequency range 9 kHz – 30 MHz.

Picture 1: TBMA6-P passive loop antenna / transducer

The loop is built from corrugated coaxial cable and attached to the transducer with N-connectors. This construction provides flexibility to use it with various loop diameters. An attachment with a ¼" thread permits connectivity to standard tripods.

2   Specification

Characterized frequency range: 9 kHz to 30 MHz
Magnetic field antenna factor: -20 dB/Ωm   @ 30 MHz, typ.
Electric field antenna factor: 31,5 dB/m   @ 30 MHz, typ.
Sensitivity: -24 dBµA/m @ 30 MHz
Dimensions: Φ 60 cm
Weight: 800 g
Connector type: N female
Mount: ¼" thread

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3 Antenna factors

A spectrum analyzer or measurement receiver connected to the antenna will typically display measured power in dBm or voltage in dBµV.

The antenna factor AF is an antenna and frequency dependent parameter, which is required to convert the measured voltage into the corresponding electric or magnetic field strength. For magnetic field strength:

$$H[dB\mu A/m] = V[dB\mu V] + AF_H[dB/\Omega m]$$

Where AF_H is the magnetic antenna factor in [dB/Ωm] or [dBS/m]
In the far field, the free space impedance Z_0 = 377 Ω links electric field strength with magnetic field strength.

$$AF_E[dB/m] = AF_H[dB/\Omega m] + Z_0[dB\Omega]$$
$$AF_E[dB/m] = AF_H[dB/\Omega m] + 51.5\ dB\Omega$$
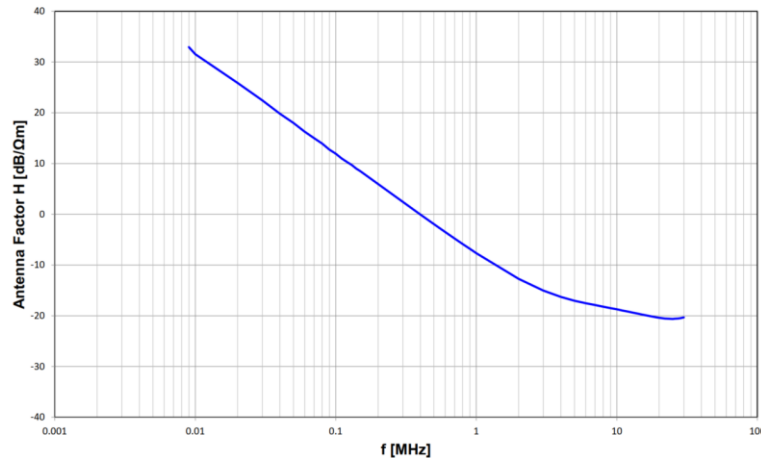

Figure 1: magnetic field antenna factor, TBMA6-P, 60 cm loop, 9 kHz – 30 MHz, typical data
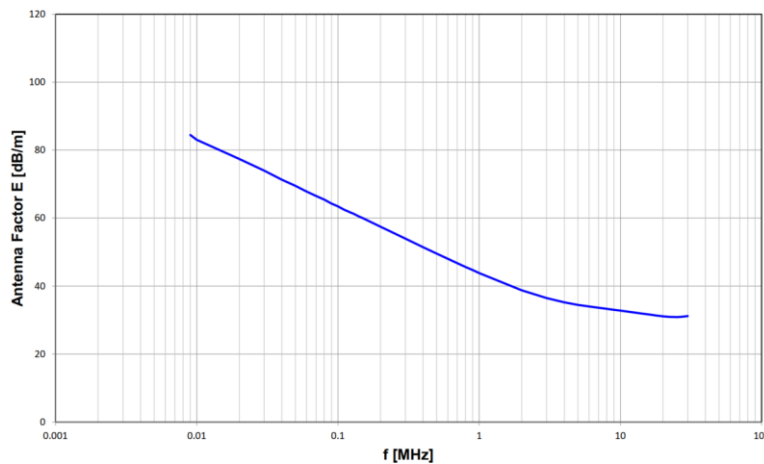

Figure 2: electric field antenna factor, TBMA6-P, 60 cm loop, 9 kHz – 30 MHz, typical data

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4   Antenna factor table

Frequency [MHz]	Magnetic field antenna factor [dB/Ωm]	Electric field antenna factor [dB/m]	Uncertainty [dB]
0,009	32,934	84,454	±1,20
0,010	31,540	83,060	±1,20
0,020	25,870	77,390	±1,20
0,030	22,444	73,964	±1,20
0,040	19,803	71,323	±1,20
0,050	17,970	69,490	±1,20
0,060	16,273	67,793	±1,20
0,070	14,999	66,519	±1,20
0,080	13,928	65,448	±1,20
0,090	12,754	64,274	±1,20
0,100	11,944	63,464	±1,20
0,110	10,982	62,502	±1,20
0,120	10,297	61,817	±1,20
0,130	9,694	61,214	±1,20
0,140	8,994	60,514	±1,20
0,150	8,463	59,983	±1,20
0,200	5,956	57,476	±1,20
0,300	2,441	53,961	±1,20
0,400	-0,045	51,475	±1,20
0,500	-1,960	49,560	±1,20
0,600	-3,492	48,028	±1,20
0,700	-4,772	46,748	±1,20
0,800	-5,882	45,638	±1,20
0,900	-6,825	44,695	±1,20
1,000	-7,681	43,839	±1,20
2,000	-12,731	38,789	±1,20
3,000	-15,043	36,477	±1,20
4,000	-16,287	35,233	±1,20
5,000	-17,039	34,481	±1,20
6,000	-17,525	33,995	±1,20
7,000	-17,898	33,622	±1,20
8,000	-18,215	33,305	±1,20
9,000	-18,488	33,032	±1,20
10,000	-18,736	32,784	±1,20
11,000	-18,967	32,553	±1,20
12,000	-19,179	32,341	±1,20
13,000	-19,376	32,144	±1,20
14,000	-19,560	31,960	±1,20
15,000	-19,734	31,786	±1,20
16,000	-19,890	31,630	±1,20
17,000	-20,037	31,483	±1,20
18,000	-20,173	31,347	±1,20
19,000	-20,296	31,224	±1,20
20,000	-20,398	31,122	±1,20
21,000	-20,482	31,038	±1,20
22,000	-20,549	30,971	±1,20
23,000	-20,592	30,928	±1,20
24,000	-20,613	30,907	±1,20
25,000	-20,626	30,894	±1,20
26,000	-20,591	30,929	±1,20
27,000	-20,555	30,965	±1,20
28,000	-20,494	31,026	±1,20
29,000	-20,423	31,097	±1,20
30,000	-20,334	31,186	±1,20

Table 1: TBMA6-P, 60cm loop, antenna factors, 9 kHz – 30 MHz, typical values

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The antenna factors of the 60 cm loop can be used to estimate the antenna factors of loop antennas with different diameter.

Loop diameter	AF
1 m	+4.5 dB
60 cm	0 dB
30 cm	-6 dB
25 cm	-8 dB

Table 2: antenna factor conversion for different loop diameters

5   Sensitivity

The sensitivity of a radiated noise measurement set up looks at the base noise of the available spectrum analyzer or measurement receiver. Applying the antenna factor gives the resulting noise floor with respect to the magnetic field. According to CISPR 16, this noise floor has to be at least 6 dB below the emission limits of the applied standard.
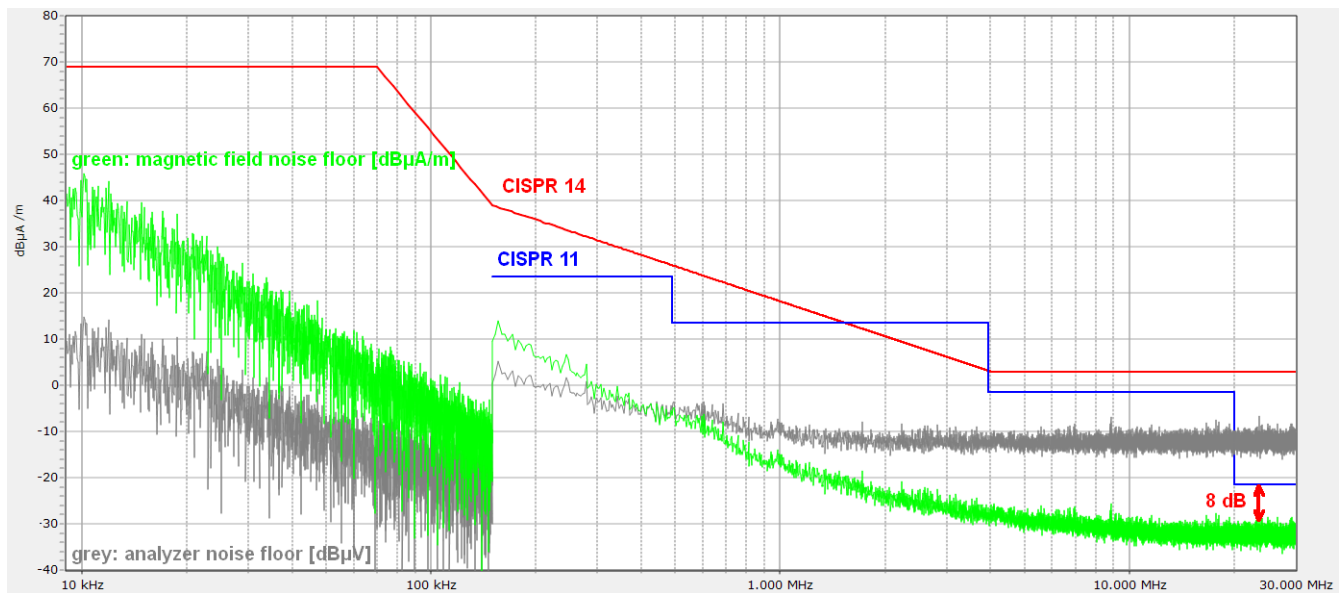
The above screenshot shows the magnetic field noise floor of a set up consisting of a low-cost spectrum analyzer and the TBMA6-P loop antenna.
Analyzer Model: Siglent SSA3021X-Plus
Internal attenuator: 0 dB; internal pre-amplifier: ON; 9 kHz - 150 kHz: 200 Hz RBW; 150 kHz – 30 MHz: 9kHz RBW; Peak detector; sweep time according to CISPR 16 specification

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Red limit line: CISPR 14 Magnetic field strength limits for induction cooking appliances
Blue limit line: CISPR 11 Class A, Group 2, 30 meters, in situ

The blue line represents the toughest limit of all CISPR standards in the range 150 kHz to 30 MHz.
The red line represents the toughest limit of all CISPR standards in the range 9 kHz to 150 kHz.

Comparing the magnetic field base noise with the limit lines shows that the TBMA6-P together with the Siglent SSA3021X-Plus provide sufficient sensitivity for all CISPR specified radiated emission measurements in the range 9 kHz to 30 MHz

6   Ordering Information

Part Number	Description
TBMA6-P	TBMA6-P transducer + corrugated, slotted coaxial cable for 60 cm loop + pistol grip tripod; beech wood box for transducer
TBMA6-CC30CM-D	corrugated, slotted coaxial cable for 30 cm loop

7   History

Version	Date	Author	Changes
V 1.0	22.9.2022	Mayerhofer	Creation of the preliminary document