

Loop Antenna Pre-Amplifier

1 Introduction

The TBLNA-9K30 is a pre-amplifier for the TBMA6-P, expanding the dynamic range of the passive loop antenna.

The pre-amplifier is designed for the TBMA6-P, but it can be used together with any passive loop antenna for the frequency range 9 kHz – 30 MHz. The pre-amplifier is equipped with a charger for 12 pieces standard AA NiMh batteries. A ¼" thread at the bottom of the TBLAA1 permits connectivity to standard tripods.



Picture 1: TBMA6-P passive loop antenna with TBLNA-9K30 pre-amplifier

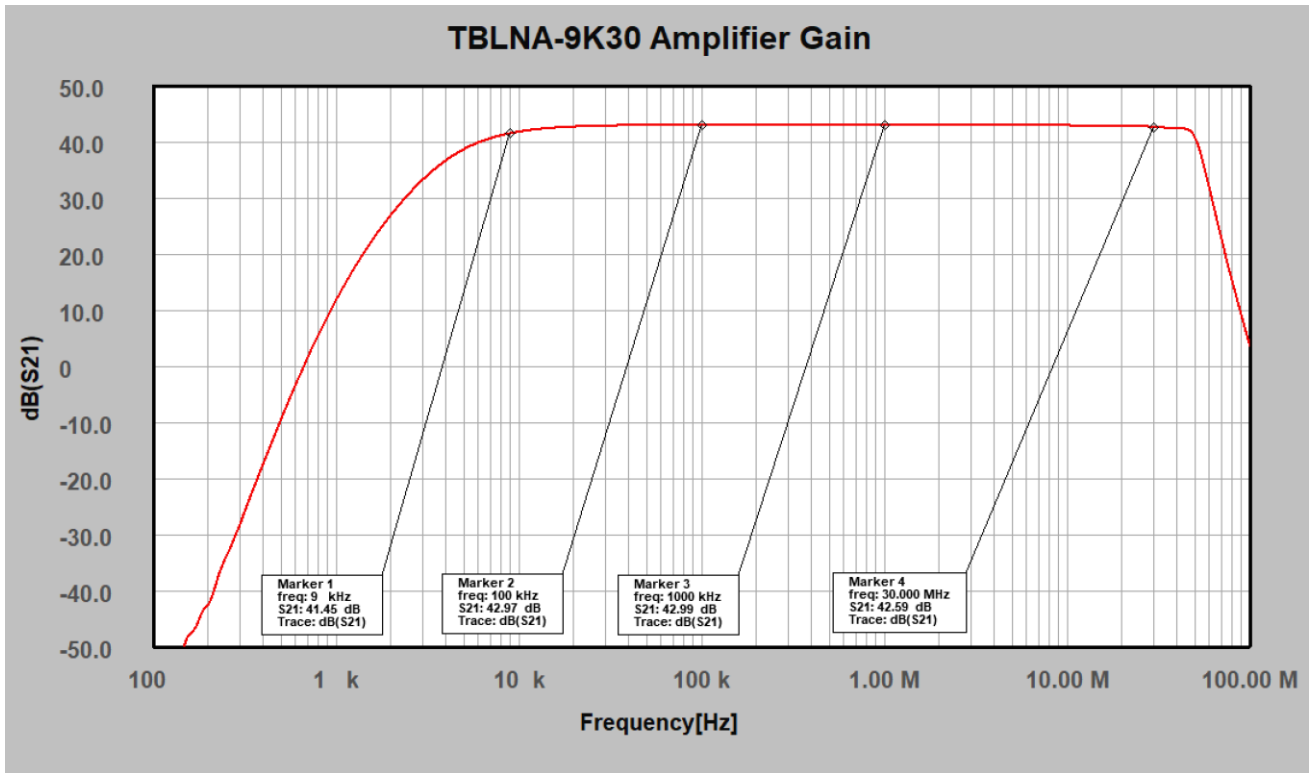
2 Specification

Frequency range:	9 kHz to 30 MHz
Gain:	43 dB, typ.
Input return loss:	< -15 dB @ 9 kHz to 30 MHz, typ.
Output return loss:	< -20 dB @ 9 kHz to 30 MHz, typ.
Noise voltage:	1nV / $\sqrt{\text{Hz}}$, typ.
P1dB _{out} :	+15 dBm (indicated with yellow LED)
IP3 _{out} :	+28 dBm
Connector type:	N female
Power supply:	12 pieces standard AA NiMh cells (not supplied)
Charger:	Mascot Type 2116
Current consumption:	120 mA
Operation time:	ca. 10 hours, depending on NiMh battery model
Indicators:	LED indicators for Pwr On, Low Battery, Saturation
Dimensions:	∅ 180 mm, height 52 mm
Weight:	1.7 kg
Tripod mount:	¼" thread



Loop Antenna Pre-Amplifier

3 Measurement plots

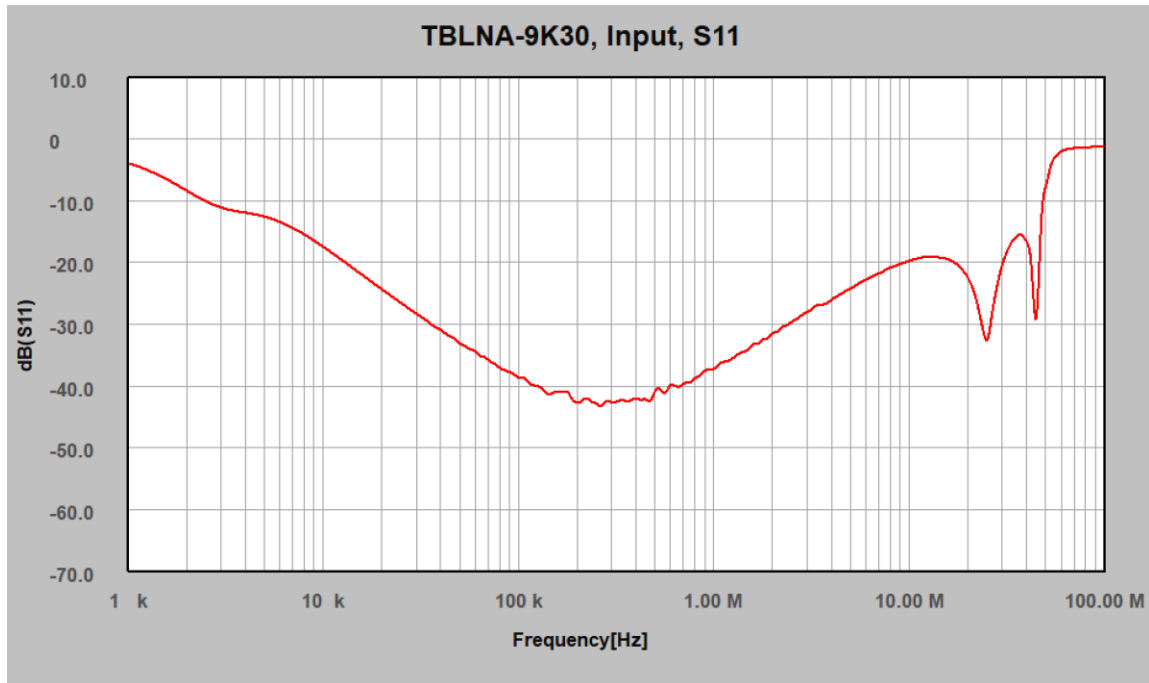


Picture 2: TBLNA-9kHz30MHz pre-amplifier gain; 100 Hz – 100 MHz

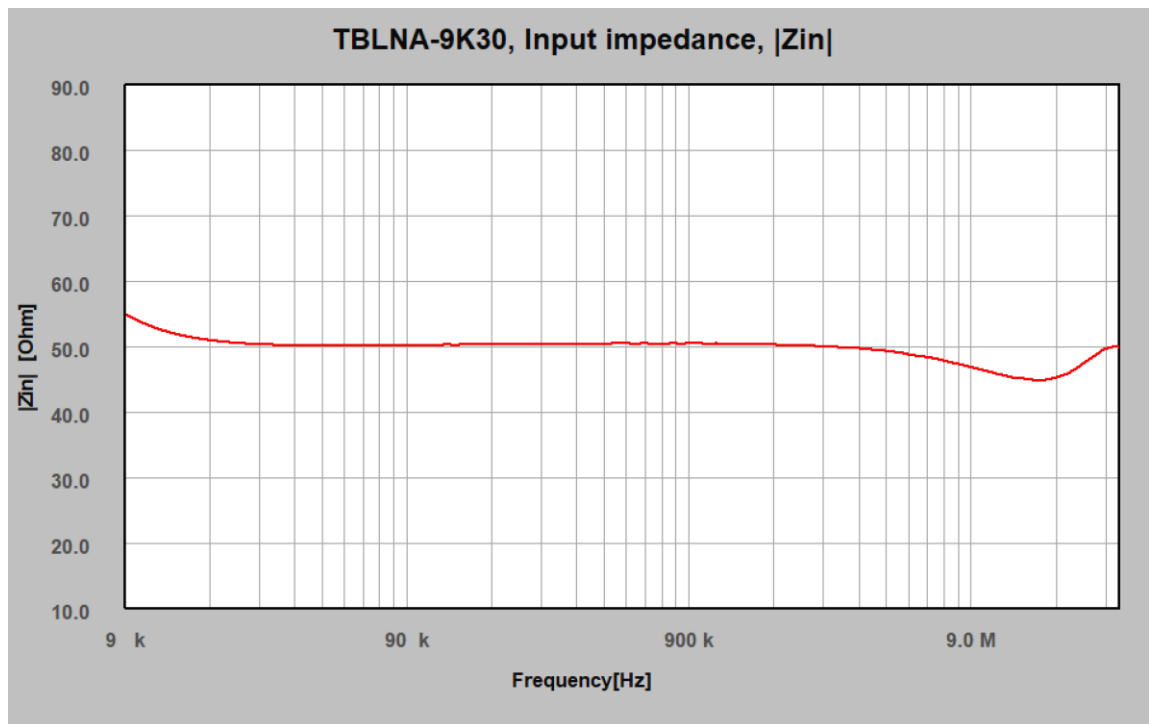
Frequency [MHz]	Gain [dB]	Frequency [MHz]	Gain [dB]	Frequency [MHz]	Gain [dB]
0,0001	-53,47	0,1	42,97	14	42,81
0,0002	-42,58	0,11	42,96	15	42,80
0,0003	-28,03	0,12	42,97	16	42,79
0,0004	-17,41	0,13	42,97	17	42,78
0,0005	-9,57	0,14	42,98	18	42,78
0,0006	-3,41	0,15	42,97	19	42,77
0,0007	1,49	0,2	42,98	20	42,76
0,0008	5,50	0,3	42,99	21	42,75
0,0009	8,84	0,4	42,98	22	42,75
0,001	11,68	0,5	42,99	23	42,73
0,002	26,91	0,6	42,99	24	42,72
0,003	33,24	0,7	42,99	25	42,70
0,004	36,63	0,8	42,99	26	42,69
0,005	38,59	0,9	42,99	27	42,67
0,006	39,78	1	42,99	28	42,65
0,007	40,56	2	42,99	29	42,62
0,008	41,08	3	42,97	30	42,59
0,009	41,45	4	42,96	35	42,40
0,01	41,72	5	42,95	40	42,29
0,02	42,64	6	42,94	45	42,18
0,03	42,82	7	42,91	50	40,74
0,04	42,89	8	42,90	55	36,71
0,05	42,92	9	42,88	60	31,73
0,06	42,94	10	42,86	70	22,63
0,07	42,95	11	42,85	80	15,14
0,08	42,96	12	42,83	90	8,92
0,09	42,96	13	42,82	100	3,54

Table 1: TBLNA-9K30 pre-amplifier gain; 100 Hz – 100 MHz

Loop Antenna Pre-Amplifier

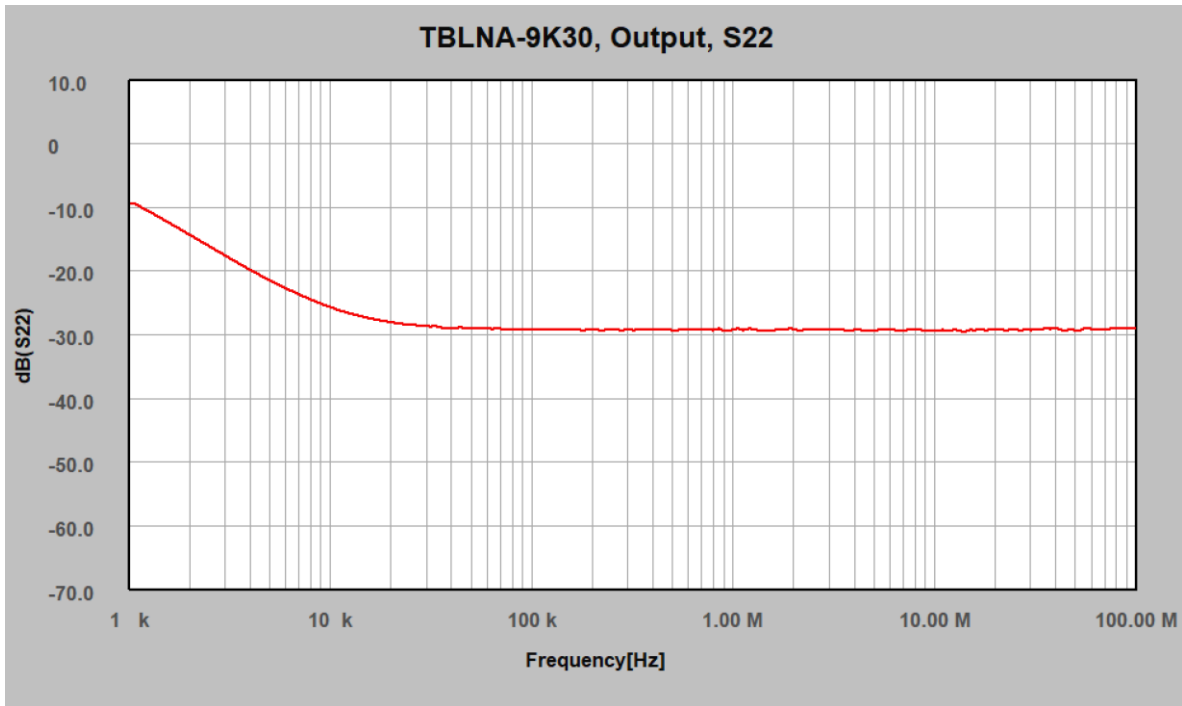


Picture 3: TBLNA-9K30 input return loss, 1kHz – 100 MHz, typical data

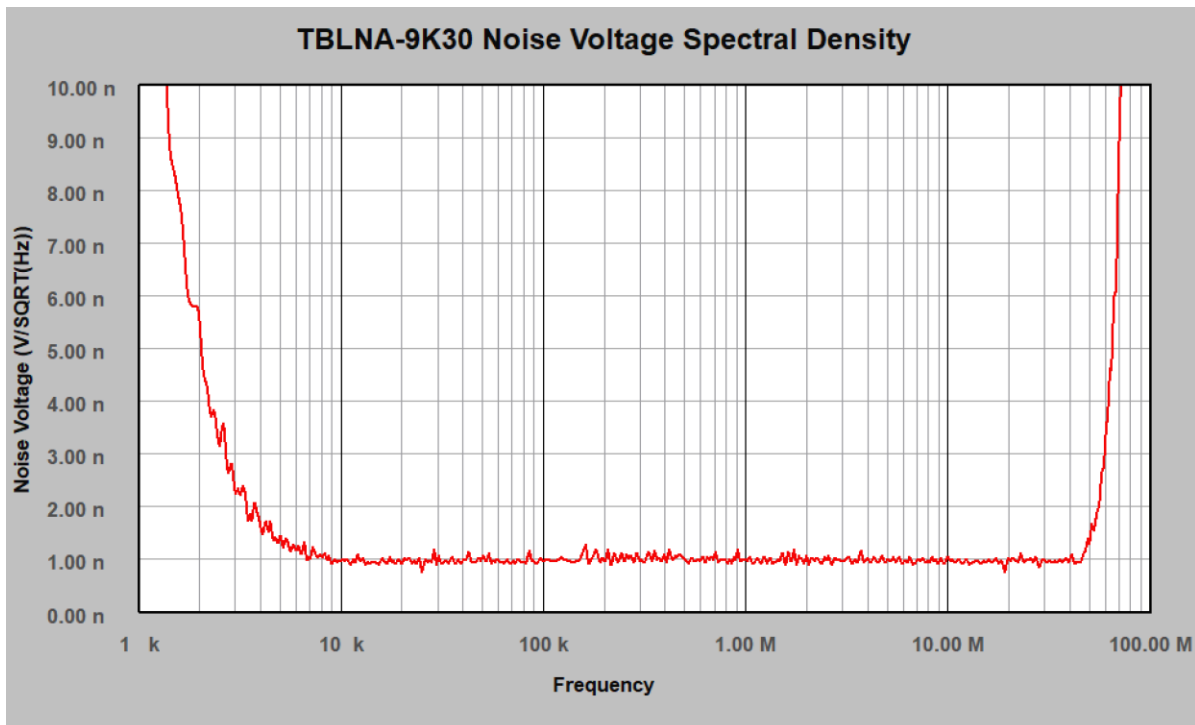


Picture 4: TBLNA-9K30 input impedance, 9kHz – 30 MHz, typical data

Loop Antenna Pre-Amplifier



Picture 5: TBLNA-9K30 output return loss, 1kHz – 100 MHz, typical data



Picture 6: TBLNA-9K30 noise voltage, 1kHz – 100 MHz, typical data

Loop Antenna Pre-Amplifier

4 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.

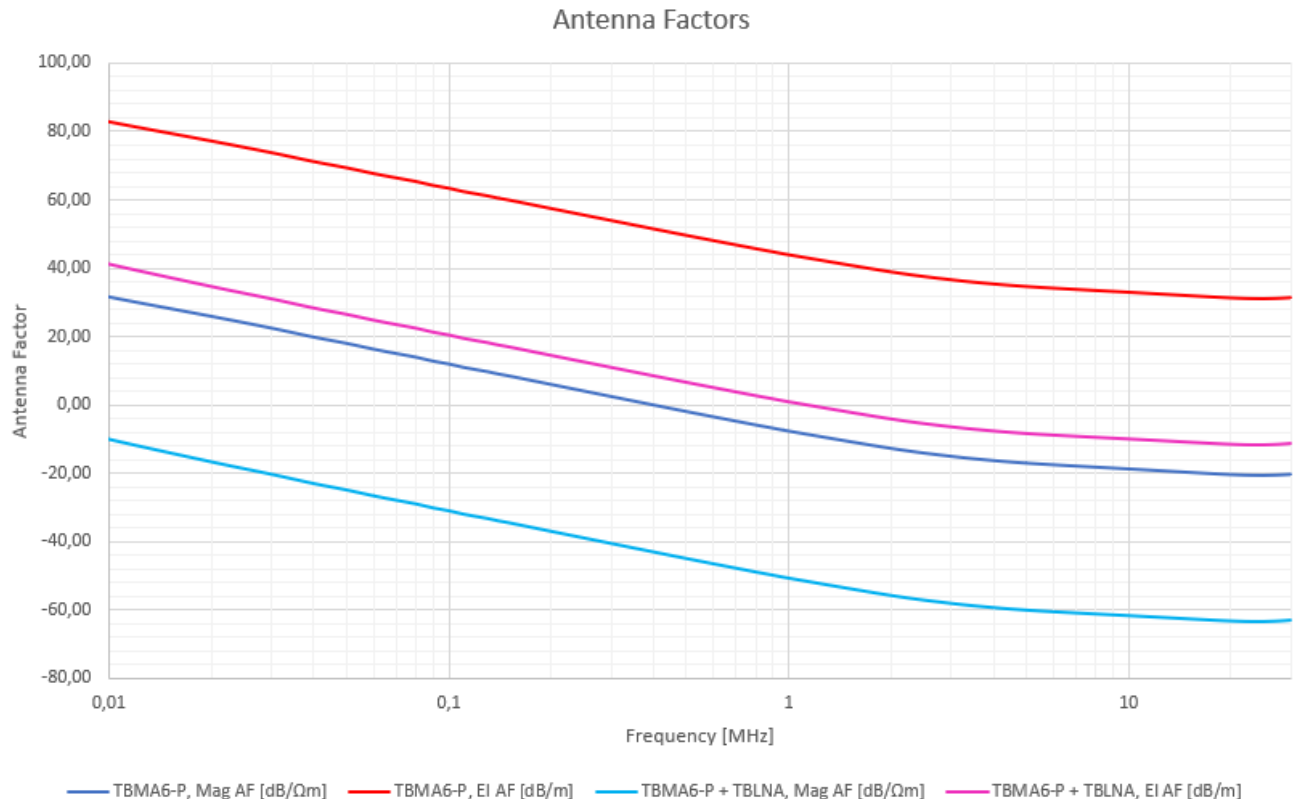
For magnetic field strength:

$$H[\text{dB}\mu\text{A/m}] = V[\text{dB}\mu\text{V}] + AF_H[\text{dB}/\Omega\text{m}] - \text{Gain}_{\text{TBLNA}}$$

Where AF_H is the magnetic antenna factor of the passive loop antenna in $[\text{dB}/\Omega\text{m}]$ or $[\text{dB}/\text{m}]$ and $\text{Gain}_{\text{TBLNA}}$ is the preamplifier gain.

In the far field, the free space impedance $Z_0 = 377 \Omega$ links electric field strength with magnetic field strength.

$$AF_E[\text{dB}/\text{m}] = AF_H[\text{dB}/\Omega\text{m}] + Z_0[\text{dB}\Omega] \text{ with } Z_0[\text{dB}\Omega] = 51.5 \text{ dB}\Omega$$



Picture 3: antenna factors, TBMA6-P, and TBMA6-P combined with TBLNA-9K30, 9 kHz – 30 MHz, typical data

Loop Antenna Pre-Amplifier

5 Antenna factor table

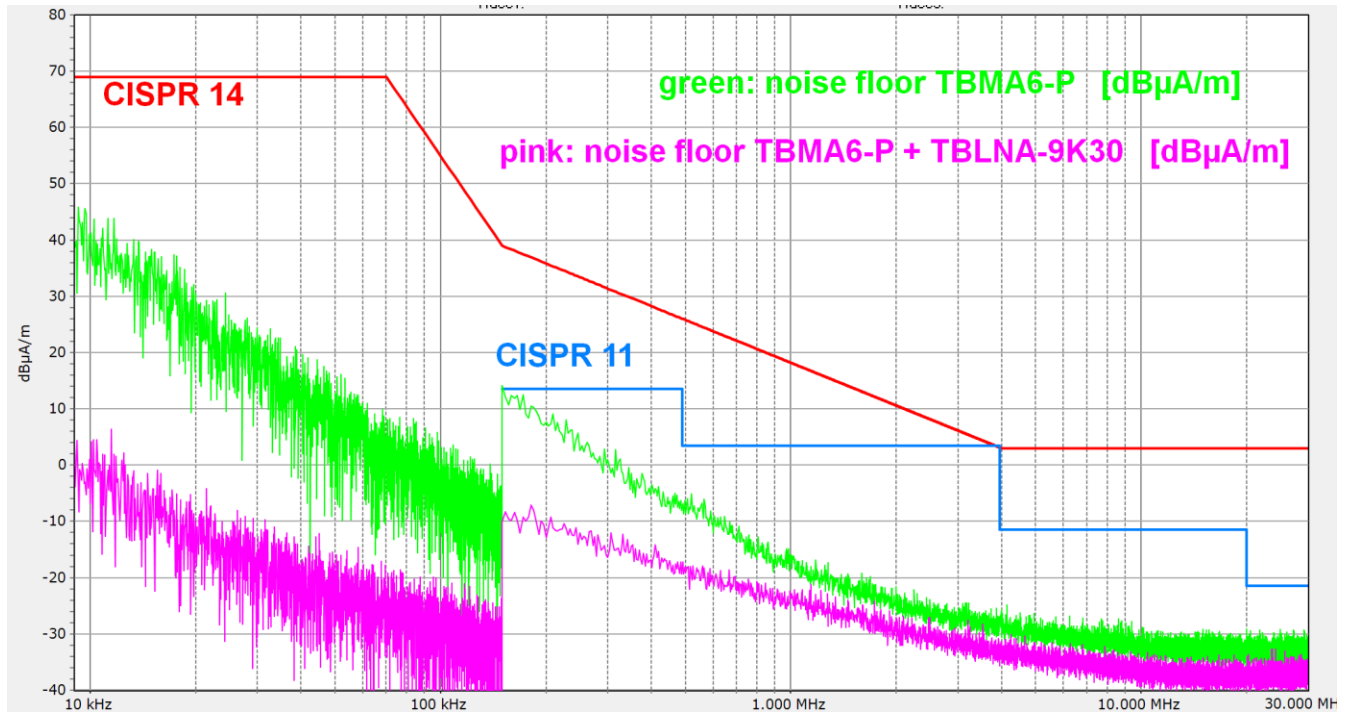
Frequency [MHz]	Magnetic field antenna factor TBMA6-P [dB/Qm]	Electric field antenna factor TBMA6-P [dB/m]	Magnetic field antenna factor TBMA6-P + TBLNA-9K30 [dB/Qm]	Electric field antenna factor TBMA6-P + TBLNA-9K30 [dB/m]	Uncertainty [dB]
0,009	32,93	84,45	-8,51	43,01	±1,50
0,010	31,54	83,06	-10,18	41,34	±1,50
0,020	25,87	77,39	-16,77	34,75	±1,50
0,030	22,44	73,96	-20,37	31,15	±1,50
0,040	19,80	71,32	-23,09	28,43	±1,50
0,050	17,97	69,49	-24,95	26,57	±1,50
0,060	16,27	67,79	-26,67	24,85	±1,50
0,070	15,00	66,52	-27,95	23,57	±1,50
0,080	13,93	65,45	-29,03	22,49	±1,50
0,090	12,75	64,27	-30,21	21,31	±1,50
0,100	11,94	63,46	-31,03	20,49	±1,50
0,110	10,98	62,50	-31,98	19,54	±1,50
0,120	10,30	61,82	-32,67	18,85	±1,50
0,130	9,69	61,21	-33,28	18,24	±1,50
0,140	8,99	60,51	-33,98	17,54	±1,50
0,150	8,46	59,98	-34,51	17,01	±1,50
0,200	5,96	57,48	-37,03	14,49	±1,50
0,300	2,44	53,96	-40,55	10,97	±1,50
0,400	-0,05	51,48	-43,03	8,49	±1,50
0,500	-1,96	49,56	-44,95	6,57	±1,50
0,600	-3,49	48,03	-46,48	5,04	±1,50
0,700	-4,77	46,75	-47,77	3,75	±1,50
0,800	-5,88	45,64	-48,87	2,65	±1,50
0,900	-6,83	44,70	-49,81	1,71	±1,50
1,000	-7,68	43,84	-50,67	0,85	±1,50
2,000	-12,73	38,79	-55,72	-4,20	±1,50
3,000	-15,04	36,48	-58,01	-6,49	±1,50
4,000	-16,29	35,23	-59,25	-7,73	±1,50
5,000	-17,04	34,48	-59,99	-8,47	±1,50
6,000	-17,53	34,00	-60,46	-8,94	±1,50
7,000	-17,90	33,62	-60,81	-9,29	±1,50
8,000	-18,22	33,31	-61,11	-9,59	±1,50
9,000	-18,49	33,03	-61,37	-9,85	±1,50
10,000	-18,74	32,78	-61,60	-10,08	±1,50
11,000	-18,97	32,55	-61,82	-10,30	±1,50
12,000	-19,18	32,34	-62,01	-10,49	±1,50
13,000	-19,38	32,14	-62,20	-10,68	±1,50
14,000	-19,56	31,96	-62,37	-10,85	±1,50
15,000	-19,73	31,79	-62,54	-11,02	±1,50
16,000	-19,89	31,63	-62,68	-11,16	±1,50
17,000	-20,04	31,48	-62,82	-11,30	±1,50
18,000	-20,17	31,35	-62,95	-11,43	±1,50
19,000	-20,30	31,22	-63,07	-11,55	±1,50
20,000	-20,40	31,12	-63,16	-11,64	±1,50
21,000	-20,48	31,04	-63,23	-11,71	±1,50
22,000	-20,55	30,97	-63,30	-11,78	±1,50
23,000	-20,59	30,93	-63,32	-11,80	±1,50
24,000	-20,61	30,91	-63,33	-11,81	±1,50
25,000	-20,63	30,89	-63,33	-11,81	±1,50
26,000	-20,59	30,93	-63,28	-11,76	±1,50
27,000	-20,56	30,97	-63,22	-11,70	±1,50
28,000	-20,49	31,03	-63,14	-11,62	±1,50
29,000	-20,42	31,10	-63,05	-11,53	±1,50
30,000	-20,33	31,19	-62,92	-11,40	±1,50

Table 1: TBMA6-P / TBMA6-P + TBLNA-6K30, antenna factors, 9 kHz – 30 MHz, typical values

6 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.

Loop Antenna Pre-Amplifier



The green graph in the screenshot above shows the magnetic field noise floor of a set up consisting of a low-cost spectrum analyzer and the TBMA6-P loop antenna.

The pink graph in the screenshot above shows the magnetic field noise floor of a set up consisting of a low-cost spectrum analyzer and the TBMA6-P loop antenna combined with the TBLNA9K30 pre-amplifier.

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

Red limit line: CISPR 14 Magnetic field strength limits for 9 kHz – 30 MHz

Blue limit line: CISPR 11 Class A, Group 1, in situ

The limit lines represent the toughest limits of all CISPR standards in the range 9 kHz to 30 MHz.

7 Ordering Information

Part Number	Description
TBLNA-9K30	Pre-amplifier for active loop antenna, Mascot Type 2116 charger, N-male to N-male coaxial adapter (NiMh AA batteries not included)

Loop Antenna Pre-Amplifier

Related Products

Part Number	Description
TBMA6-P	Passive loop antenna, 9 kHz – 30 MHz, consisting of TBMA6-P transducer + corrugated, slotted coaxial cable for 60 cm loop + pistol grip tripod; beech wood box for transducer
TBMR-110M	Measurement receiver, 1 Hz – 110 MHz, CISPR and MIL-STD

Accessories

Part Number	Description
TBTP1	Carbon fibre tripod, load bearing 6 kg, 1/4" screw
TBTP3	wooden tripod, load bearing 8 kg, 1/4" screw
NM-NM/125/RG223	Coaxial cable, N-male / N-male, RG223, 1.25 meter
NM-NM/300/RG142	Coaxial cable, N-male / N-male, RG142, 3 meter
NM-NM/500/RG223	Coaxial cable, N-male / N-male, RG223, 5 meter

8 History

Version	Date	Author	Changes
V 1.0	24.1.2025	Mayerhofer	Creation of the preliminary document

www.tekbox.com

TekBox Digital Solutions Vietnam Pte. Ltd.

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