

Bulk Current Injection Probe

1 Introduction

The TBBCI1-800K420 is a snap-on Bulk Current Injection probe, expanding the Tekbox product range of affordable EMC pre-compliance test equipment.

The BCI probe has been designed primarily for conducted immunity testing of automotive products in the frequency range 1 MHz to 400 MHz, according to standard ISO11452-4. The insertion loss is 5 dB for most of its bandwidth. In the frequency range 250 kHz to 230 MHz it is compliant with the insertion loss specification of ISO11452-4. The probe is individually characterized and usable in the frequency range 10 kHz – 450 MHz. The probe can be used to inject severity levels I (60mA), II (100mA), III (150mA), IV (200mA) and customer specific severity level V up to 350 mA.

The probe can also be used for RF current monitoring applications.



Picture 1: TBBCI1-800K420 Bulk Current Injection probe

The aperture of the RF current monitoring probe is 27 mm. The typical insertion loss is 5 dB and the typical transfer impedance is 26 dB Ohm.

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2 Specification

Compliance:	ISO 11452-4; IEC / EN 61000-4-6 insertion loss specification for BCI clamps above 250 kHz
Characterized freq. range:	10 kHz to 500 MHz
Insertion loss:	5 dB typ.; 50 Ohm system (100 Ohm loop impedance)
Transfer impedance:	29 dB Ohm typ.; 50 Ohm system (100 Ohm loop impedance)
Power rating:	capable of injecting severity levels I, II, III, IV according to ISO 11452 and customer specified level V up to 350 mA
Max. core temperature:	80 °C
Connector type:	N female
Aperture diameter:	27 mm
Outside diameter:	92 mm
Height:	76 mm
Weight:	1.2 kg

3 Transfer impedance

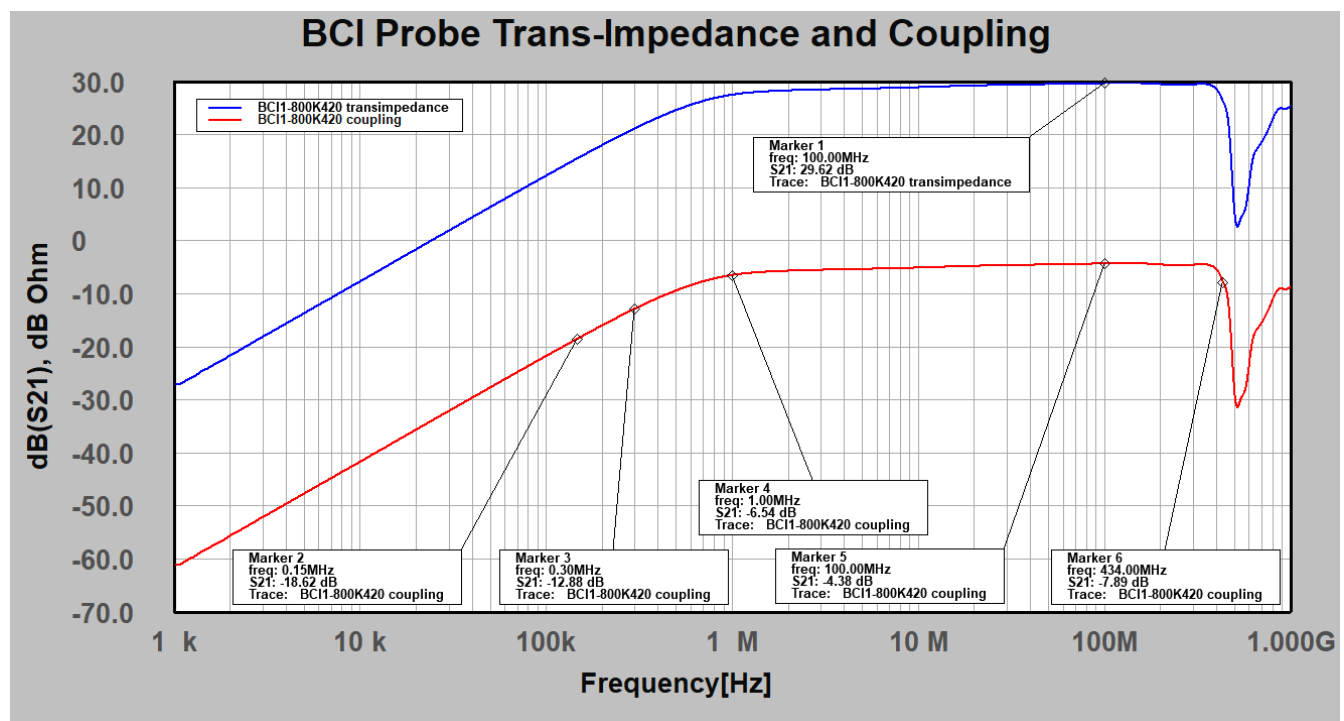


Figure1: typical insertion loss and transfer impedance: 1 kHz to 1 GHz logarithmic, 100 Ohm loop impedance

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4 Insertion loss and transfer impedance table

The table below shows typical insertion loss and transfer impedance data of a TBBCI1-800K420 BCI probe. Each current probe is delivered with its corresponding measurement protocol. This data can be used to calculate the required power for immunity testing or 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.

Frequency [MHz]	Insertion loss [dB]	Trans-impedance [dBΩ]	Frequency [MHz]	insertion loss [dB]	Trans-impedance [dBΩ]
0.01	-41,75	-7,75	130	-4,34	29,66
0.02	-35,70	-1,70	140	-4,34	29,66
0.03	-32,17	1,83	150	-4,36	29,64
0.04	-29,68	4,32	160	-4,39	29,61
0.05	-27,75	6,25	170	-4,41	29,59
0.06	-26,18	7,82	180	-4,45	29,55
0.07	-24,85	9,15	190	-4,51	29,49
0.08	-23,71	10,29	200	-4,56	29,44
0.09	-22,70	11,30	210	-4,61	29,39
0.1	-21,80	12,20	220	-4,66	29,34
0.2	-16,04	17,96	230	-4,69	29,31
0.3	-12,88	21,12	240	-4,72	29,28
0.4	-10,85	23,15	250	-4,73	29,27
0.5	-9,45	24,55	260	-4,73	29,27
0.6	-8,45	25,55	270	-4,71	29,29
0.7	-7,72	26,28	280	-4,69	29,31
0.8	-7,19	26,81	290	-4,66	29,34
0.9	-6,82	27,18	300	-4,62	29,38
1	-6,54	27,46	310	-4,58	29,42
2	-5,73	28,27	320	-4,55	29,45
3	-5,56	28,44	330	-4,52	29,48
4	-5,47	28,53	340	-4,52	29,48
5	-5,40	28,60	350	-4,54	29,46
6	-5,34	28,66	360	-4,61	29,39
7	-5,29	28,71	370	-4,73	29,27
8	-5,24	28,76	380	-4,91	29,09
9	-5,19	28,81	390	-5,15	28,85
10	-5,14	28,86	400	-5,51	28,49
20	-4,82	29,18	410	-6,05	27,95
30	-4,70	29,30	420	-6,77	27,23
40	-4,61	29,39	430	-7,57	26,43
50	-4,56	29,44	440	-8,33	25,67
60	-4,50	29,50	450	-9,26	24,74
70	-4,47	29,53	460	-11,03	22,97
80	-4,43	29,57	470	-14,36	19,64
90	-4,39	29,61	480	-19,31	14,69
100	-4,38	29,62	490	-24,65	9,35
110	-4,36	29,64	500	-28,97	5,03
120	-4,34	29,66			

Table1: Insertion loss and transfer impedance: 10 kHz to 500 MHz, typical data

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5 RF forward power requirements

ISO 11452-4 specifies BCI severity test levels as displayed in Table 2 and Figure 2:

Frequency band [MHz]	Test level I [mA]	Test level II [mA]	Test level II [mA]	Test level VI [mA]	Test level V [mA]
1 - 3	60 x $f \text{ [MHz]}/3$	100 x $f \text{ [MHz]}/3$	150 x $f \text{ [MHz]}/3$	200 x $f \text{ [MHz]}/3$	Specific values agreed between the users of this part of ISO 11452
3 - 200	60	100	150	200	
200 - 400	60 x 200/ $F \text{ [MHz]}$	100 x 200/ $F \text{ [MHz]}$	150 x 200/ $F \text{ [MHz]}$	200 x 200/ $F \text{ [MHz]}$	

Table 2: BCI test severity levels

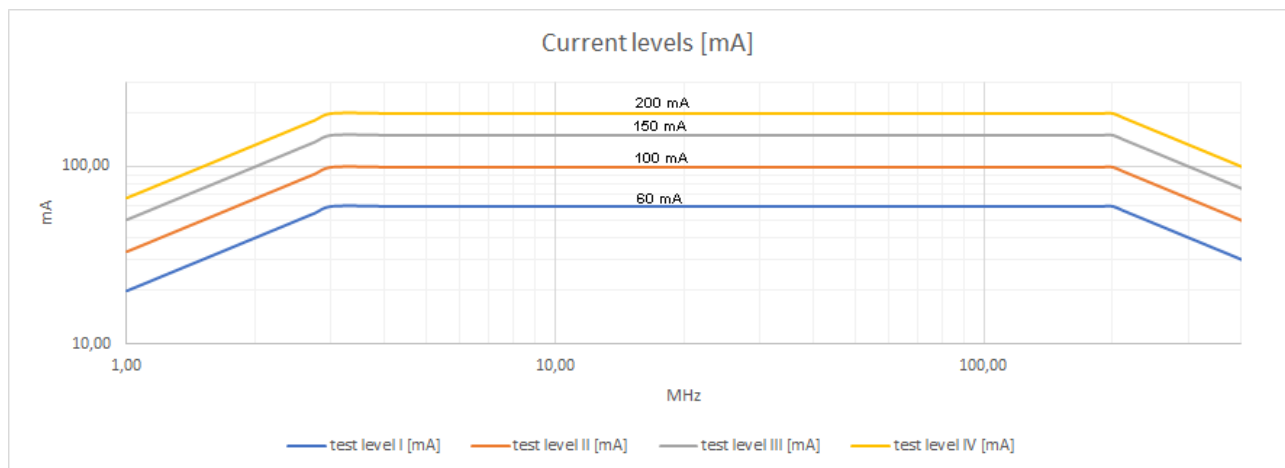


Figure 2: Current level test limits

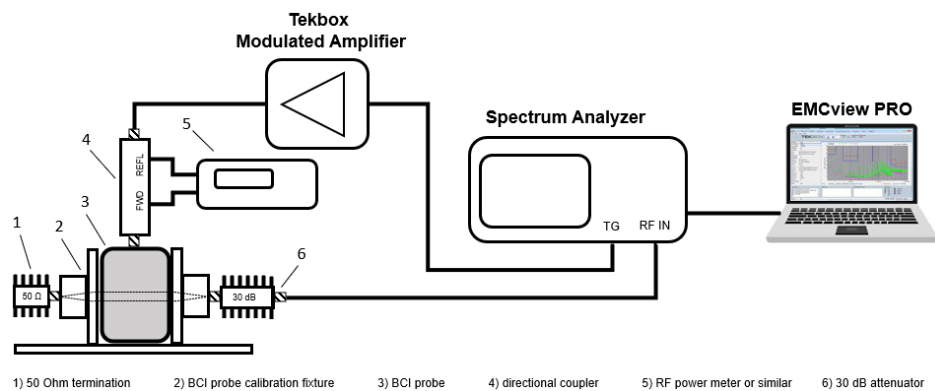


Figure 3: Substitution calibration method set-up example

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Maximum frequency step sizes should be not greater than the maximum frequency step sizes used in testing, and shown in Table 2.

Frequency band [MHz]	$1 < f \leq 10$	$10 < f \leq 200$	$200 < f \leq 400$
Linear step [MHz]	1	5	10

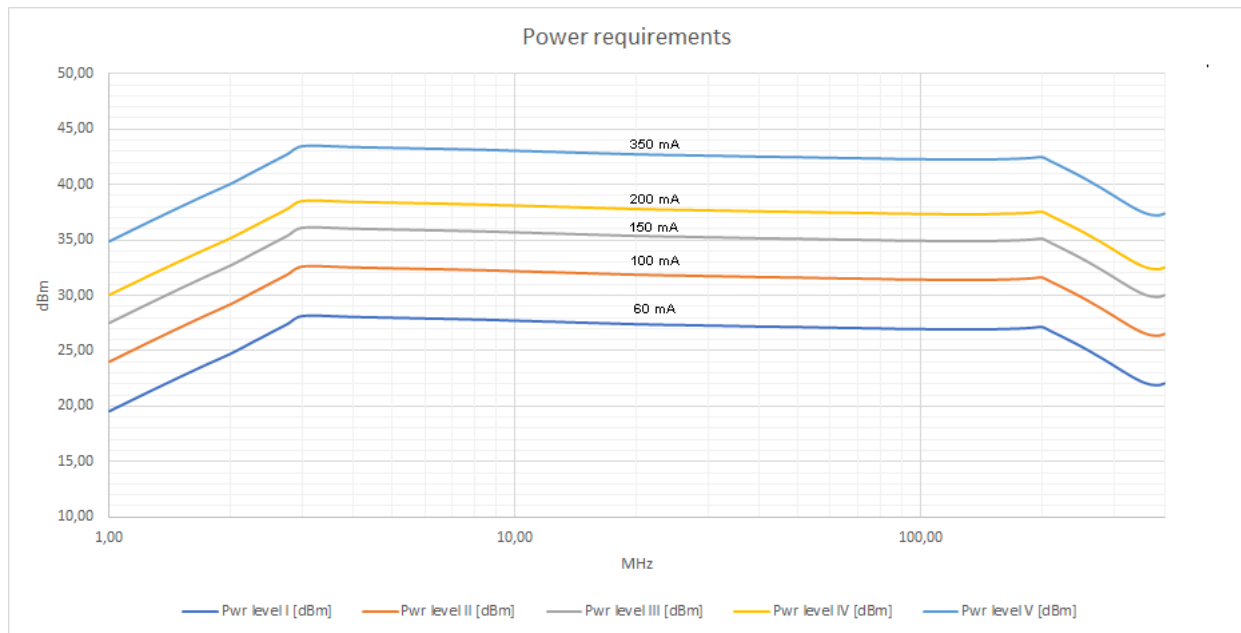


Figure 4: corresponding required RMS forward power into the TBBCI1-800K420 BCI probe

Note that the power is given as RMS power. The PA has to be able to deliver a 5.1 dB higher peak power to achieve the required RMS power for an 80% AM modulated signal. At injected currents above 350 mA, the core will go into saturation.

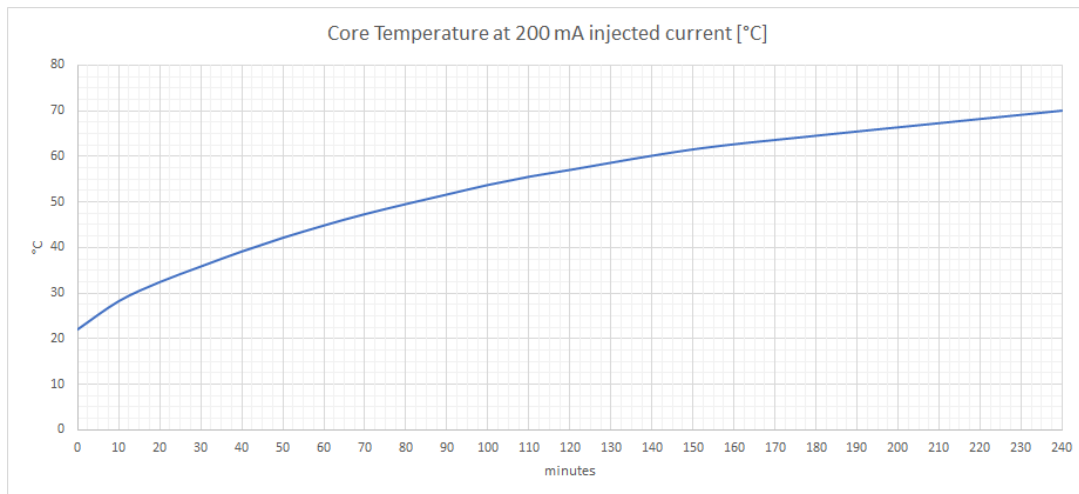
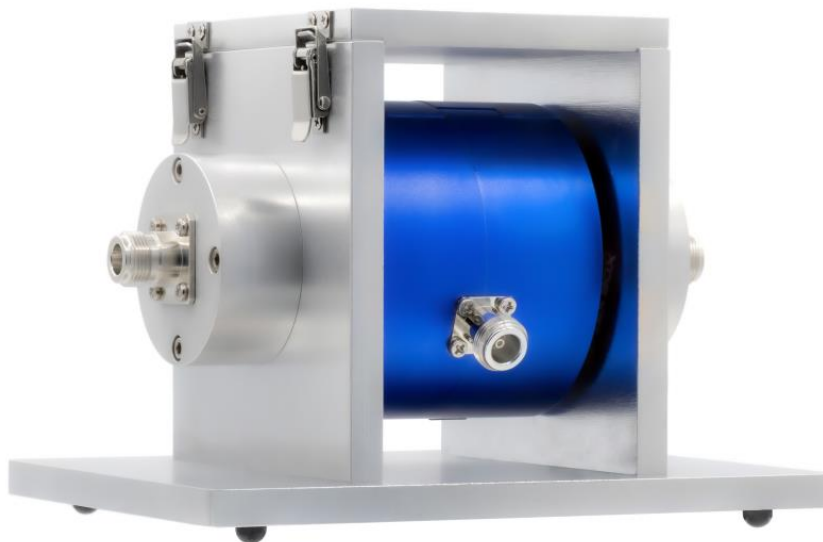


Figure 5: Core temperature increase over time

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6 Accessories

Tekbox supplies a calibration fixture for the TBBCI1 series of snap on BCI probes:



Picture 2: TBBCI1-CAL BCI probe calibration fixture

In order to create a complete immunity test set-up, Tekbox supplies further accessories such as 150 Ohm to 50 Ohm transitions, attenuators, modulated wideband RF power amplifiers, RF current monitoring probes and EMCview PRO software for automated calibration and measurement.

7 Ordering Information

Part Number	Description
TBBCI1-800K420	Snap on BCI probe, beech-wood box, calibration protocol
TBBCI1-CAL	Calibration fixture for TBBCI1 current probe series
TBCDN-50-150	50 Ohm to 150 Ohm adapter, N-male to N-female, 4W
TBATT-6dB-10W	6 dB attenuator, N-male to N-female, 10W
TBATT-6dB-25W	6 dB attenuator, N-male to N-female, 25W
TBATT-6dB-50W	6 dB attenuator, N-male to N-female, 50W
TBATT-6dB-100W	6 dB attenuator, N-male to N-female, 100W

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TBATT-30dB-10W	30 dB attenuator, N-male to N-female, 10W
TBATT-30dB-25W	30 dB attenuator, N-male to N-female, 25W
TBATT-30dB-50W	30 dB attenuator, N-male to N-female, 50W
TBATT-30dB-100W	30 dB attenuator, N-male to N-female, 100W
TBMDA5	RF amplifier, 150kHz-400 MHz, 2W, AM/PM modulator
TBMDA6	RF amplifier, 150kHz-250 MHz, 25W, AM/PM modulator
EMCview PRO	EMC software for emission and immunity testing

8 History

Version	Date	Author	Changes
V 1.0	29.9.2022	Mayerhofer	Creation of the preliminary document
V 1.1	11.12.2022	Mayerhofer	Chapter 5 updated

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