EUT: MQB BCM
FCC ID: 2AAJCMQBBCM

Date of issue: 2013-07-10

Deutsche Akkreditierungsstelle D-PL-12053-01-01

Test Report acc. to FCC Title 47 CFR Part 15
relating to
Robert Bosch GmbH
MQB BCM

Title 47 - Telecommunication
Part 15 - Radio Frequency Devices
Subpart B – Unintentional Radiators
Measurement Procedure:
ANSI C63.4-2009

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

Manufacturer's details	
Manufacturer	Robert Bosch GmbH
Manufacturer's grantee code	2AAJC
Manufacturer's address	Robert Bosch GmbH
	Daimlerstr. 6
	71229 Leonberg
	Germany
	Phone: +49 711 811-37874
	Fax: +49 711 811-509 874
	Email: slava.tihovsky@de.bosch.com
Relevant standard used	47 CFR Part 15B - Unintentional Radiators
	ANSI C63.4-2009

Test Report prepared by	
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Equipment **U**nder **T**est **(EUT)**	
Equipment category	Receiver
Trade name	BOSCH
Type designation	MQB BCM
Serial no.	---
Variants	---

1. Test results

Clause	Requirements headline	Test result			Report page number
8.1	Conducted limits	~~Pass~~	~~Fail~~	**N.t.***	9 to 11
8.2	Radiated emission limits	**Pass**	~~Fail~~	~~N.t.*~~	12 to 17

* Not tested

The equipment meets the requirements	**Yes**	~~No~~

Signature: ..... (Technician)

Signature: ..... (Manager)

Morsbach Bergisch Gladbach 2013.07.10 13:54:40 +02'00'

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m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

2. Introduction

This test report consists of:

- Test result summary
- List of contents
- Introduction and further information
- Performance assessment
- Detailed test information

All pages have been numbered consecutively and bear the m. dudde hochfrequenz-technik logo, the test report number, the date, the test specification in its current version as well as the type designation of the EUT. The total number of pages in this report is **19**.

The tests were carried out at:

- m. dudde hochfrequenz-technik, D-51429 Bergisch Gladbach

in a representative assembly and in accordance with the test methods and/or requirements stated in:

FCC Title 47 CFR Part 15 Subpart C & ANSI C63.4-2009

The sample of the product was received on:

- 2013-06-06

The tests were carried out in the following period of time:

- 2013-07-08 – 2013-07-08

3. Testing laboratory

m. dudde hochfrequenz-technik
Rottland 5a, 51429 Bergisch Gladbach, Germany

Phone: +49 - (0) 22 07 / 96 89-0
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- FCC Registration Number: **699717**

Accredited by:

DAkkS Deutsche Akkreditierungsstelle GmbH
DAkkS accreditation number: D-PL-12053-01

4. Applicant

Company name	: Robert Bosch GmbH
Address	: Daimlerstr. 6
	: 71229 Leonberg
Country	: Germany
Telephone	: +49 711 811-37874
Fax	: +49 711 811-509 874
Email	: slava.tihovsky@de.bosch.com
Date of order	: 2013-06-17
References	: Dr. Slava Tihovsky

5. Product and product documentation

Samples of the following apparatus were submitted for testing:

Manufacturer	: Robert Bosch GmbH
Trademark	: BOSCH
Type designation	: **MQB BCM**
Serial number	: ---
Hardware version	: ---
Software release	: ---
Type of equipment	: Receiver
Power used	: 12.0 V DC
Frequency used	: 315 MHz

For issuing this report the following product documentation was used:

Description	**Date**	**Identifications**
External photographs of the **E**quipment **U**nder **T**est (EUT)	2013-07-10	Annex no. 1
Internal photographs of the **E**quipment **U**nder **T**est (EUT)	2013-07-10	Annex no. 2
Channel occupancy / bandwidth	---	Annex no. 3
Label sample	2013-07-10	Annex no. 4
Functional description / User manual	2013-07-10	Annex no. 5
Test setup photos	2013-07-10	Annex no. 6
Block diagram	2013-07-10	Annex no. 7
Operational description	2013-07-10	Annex no. 8
Schematics	2013-07-10	Annex no. 9
Parts list	2013-07-10	Annex no. 10
Periodic operation characteristics / Transmission times	---	Annex no. 11
Antenna characteristics / Antenna description	---	Annex no. 12

6. Conclusions, observations and comments

The test report will be filed at m. dudde hochfrequenz-technik for a period of 10 years following the issue of this report. It may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of m. dudde hochfrequenz-technik.

The results of the tests as stated in this report are exclusively applicable to the EUT as identified in this report. m. dudde hochfrequenz-technik cannot be held liable for properties of the EUT that have not been observed during these tests.

m. dudde hochfrequenz-technik assumes the sample to comply with the requirements of FCC Title 47 CFR Part 15 for the respective test sector, if the test results turn out positive.

Comments: ---

Date	: 2013-07-10	Date	: 2013-07-10
Name	: Ralf Trepper	Name	: Manfried Dudde
Function	: Technician	Function	: Manager
Signature	:	Signature	: .....

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7. Operational description

7.1 EUT details

MQB BCM is a body control module for vehicles intended for light control, central locking, miscellaneous drive control, other I/O and RF reception.

7.2 EUT configuration

MQB BCM operated in continuous reception mode after connecting the DC power line (Prepared sample only for RF radiated emission tests).

7.3 EUT measurement description

MQB BCM was tested in a typical fashion. During preliminary emission tests ***MQB BCM*** was operated in continuous reception mode for worst case emission mode investigation. Therefore, the final qualification testing was completed with ***MQB BCM*** operated in continuous mode.
All tests were performed with the applicant's typical voltage: 12.0 V DC
In order to establish the maximum radiation, firstly, there have been viewed all orthogonal adjustments of the test sample, secondly the test ample has been rotated at all adjustments around the own axis between 0° and 360°, and thirdly, the antenna polarization between horizontal and vertical had been varied.

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8. Compliance assessment

8.1 Conducted limits

8.1.1 Regulation

(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency of emission(MHz)	**Conducted limit (dBµV)**	
	Quasi-peak	**Average**
0.15 - 0.5	66 to 56*	56 to 46*
0.5 - 5	56	46
5 -30	60	50

*Decreases with the logarithm of the frequency

(b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms LISN. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission(MHz)	**Conducted limit (dBµV)**	
	Quasi-peak	**Average**
0.15 - 0.5	79	66
0.5 - 30	73	60

(c) The limits shown in paragraphs (a) and (b) of this section shall not apply to carrier current systems operating as unintentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current systems containing their fundamental emission within the frequency band 535–1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 µV within the frequency band 535–1705 kHz, as measured using a 50 µH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.109(e).

(d) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

8.1.2 Test equipment

Type	Manufacturer/ Model no.	Serial no.	Last calibration	Next calibration	Calibration executed by
Receiver (9 kHz - 30MHz)	Schwarzbeck FMLK 1518 (428)	1518294 9360	08/2010	08/2013	---
Panorama- Monitor FMLK / VUMA	PAZ1550 (429)	---	---	---	---
Protector limiter 9 kHz - 30MHz 10 dB	Rhode & Schwarz ESH 3Z2 (272)	357,881052	09/2011	09/2013	Dudde
V-LISN 50 ohms//(50 uH+5 ohms)	RFT NNB 11 (72)	13835240	07/2010	07/2013	Dudde
V-LISN 50 ohms//(50 uH+5 ohms)	EMCO (49b)	9512-1227	07/2011	07/2014	Dudde
RF- cable	Aircell 1.5m [BNC/N]	K30	04/2013	04/2014	Dudde

8.1.3 Test procedures

The EUT and the additional equipment (if required) are connected to the main power through a line impedance stabilization network (LISN). The LISN must be appropriate to ANSI C63.4-2009 Section 7.
Additional equipment must also be connected to a second LISN with the same specifications described in the above sentence (if required).

8.1.4 Test results

Tested with external AC power supply

CONDUCTED EMISSIONS (Section 15.107)						
Tested line	Emission frequency [MHz]	Receiver bandwidth [kHz]	Result quasi-peak [dBµV]	Spec. limit (average) [dBµV]	Margin [dB]	Remarks
L1	0.181	9		55.8		*[2]
N	0.181	9		55.8		*[2]
L1	0.301	9		51.7		*[2]
N	0.301	9		51.7		*[2]
L1	0.475	9	-2	47	49.0	*[1]
N	0.475	9	-2	47	49.0	*[1]
L1	0.600	9	-2	46	48.0	*[1]
N	0.600	9	-2	46	48.0	*[1]
L1	0.775	9		46		*[2]
N	0.775	9		46		*[2]
L1	0.850	9	-2	46	48.0	*[1]
N	0.850	9	-2	46	48.0	*[1]
L1	1.000	9	-2	46	48.0	*[1]
N	1.000	9	-2	46	48.0	*[1]
L1	1.254	9		46		*[2]
N	1.254	9		46		*[2]
L1	2.000	9	-2	46	48.0	*[1]
N	2.000	9	-2	46	48.0	*[1]
L1	4.000	9	-2	46	48.0	*[1]
N	4.000	9	-2	46	48.0	*[1]
L1	6.7644	9	-2	50	52.0	*[1]
N	6.7644	9	-2	50	52.0	*[1]
L1	13.5288	9	-2	50	52.0	*[1]
N	13.5288	9	-2	50	52.0	*[1]
L1	20.2931	9	-2	50	52.0	*[1]
N	20.2931	9	-2	50	52.0	*[1]
L1	27.0575	9	-2	50	52.0	*[1]
N	27.0575	9	-2	50	52.0	*[1]

Remark: *[1] Noise level of the measuring instrument ≤ -2dBµV (0.009 – 30MHz)
Remark: *[2] Quasi peak measurements lower than "Specified Average Limit"

The equipment meets the requirements	~~Yes~~	~~No~~	**N.t.**[1]

Further test results are attached	~~Yes~~	**No**	Page no.

N.t.* See page no. 18

8.2 Radiated emission limits

8.2.1 Regulation

(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission(MHz)	Field strength (microvolts/meter)
30 - 88	100
88 - 216	150
216 -960	200
Above 960	500

(b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following:

Frequency of emission(MHz)	Field strength (microvolts/meter)
30 - 88	90
88 - 216	150
216 -960	210
Above 960	300

(c) In the emission tables above, the tighter limit applies at the band edges. Sections 15.33 and 15.35 which specify the frequency range over which radiated emissions are to be measured and the detector functions and other measurement standards apply.

(d) For CB receivers, the field strength of radiated emissions within the frequency range of 25–30 MHz shall not exceed 40 microvolts/meter at a distance of 3 meters. The field strength of radiated emissions above 30 MHz from such devices shall comply with the limits in paragraph (a) of this section.

(e) Carrier current systems used as unintentional radiators or other unintentional radiators that are designed to conduct their radio frequency emissions via connecting wires or cables and that operate in the frequency range of 9 kHz to 30 MHz, including devices that deliver the radio frequency energy to transducers, such as ultrasonic devices not covered under part 18 of this chapter, shall comply with the radiated emission limits for intentional radiators provided in §15.209 for the frequency range of 9 kHz to 30 MHz. As an alternative, carrier current systems used as unintentional radiators and operating in the frequency range of 525 kHz to 1705 kHz may comply with the radiated emission limits provided in §15.221(a). At frequencies above 30 MHz, the limits in paragraph (a), (b), or (g) of this section, as appropriate, apply.

(f) For a receiver which employs terminals for the connection of an external receiving antenna, the receiver shall be tested to demonstrate compliance with the provisions of this section with an antenna connected to the antenna terminals unless the antenna conducted power is measured as specified in §15.111(a). If a permanently attached receiving antenna is used, the receiver shall be tested to demonstrate compliance with the provisions of this section.

(g) As an alternative to the radiated emission limits shown in paragraphs (a) and (b) of this section, digital devices may be shown to comply with the standards contained in Third Edition of the International Special Committee on Radio Interference (CISPR), Pub. 22, “Information Technology Equipment—Radio Disturbance Characteristics—Limits and Methods of Measurement” (incorporated by reference, see §15.38). In addition:

(1) The test procedure and other requirements specified in this part shall continue to apply to digital devices.

(2) If, in accordance with §15.33 of this part, measurements must be performed above 1000 MHz, compliance above 1000 MHz shall be demonstrated with the emission limit in paragraph (a) or (b) of this section, as appropriate. Measurements above 1000 MHz may be performed at the distance specified in the CISPR 22 publications for measurements below 1000 MHz provided the limits in paragraphs (a) and (b) of this section are extrapolated to the new measurement distance using an inverse linear distance extrapolation factor (20 dB/decade), e.g., the radiated limit above 1000 MHz for a Class B digital device is 150 uV/m, as measured at a distance of 10 meters.

(3) The measurement distances shown in CISPR Pub. 22, including measurements made in accordance with this paragraph above 1000 MHz, are considered, for the purpose of §15.31(f)(4) of this part, to be the measurement distances specified in this part.

(4) If the radiated emissions are measured to demonstrate compliance with the alternative standards in this paragraph, compliance must also be demonstrated with the conducted limits shown in §15.107(e).

(h) Radar detectors shall comply with the emission limits in paragraph (a) of this section over the frequency range of 11.7–12.2 GHz.

8.2.2 Test equipment

Type	Manufacturer/ Model no.	Serial no.	Last calibration	Next calibration	Calibration executed by
Magnetic loop antenna (9 kHz - 30 MHz)	Schwarzbeck FMZB 1516 (23)	---	05/2013	05/2016	Dudde
OATS	Dudde (103)	---	05/2012	05/2014	Dudde
OATS	Dudde (104)	---	10/2012	10/2014	Dudde
Digital Multimeter	GW GDM-8045G (144)	0090256	08/2011	08/2014	Dudde
Pre-amplifier (100kHz - 1.3GHz)	Hewlett Packard 8447 E (166a)	1726A00705	01/2012	01/2014	Dudde
Hornantenna (2.0-14.0 GHz)	Schwarzbeck BBHA 9120 C (169)	305	09/2012	09/2015	Dudde
Receiver (9 kHz –18.0 GHz)	Rohde & Schwarz Spectrum Analyzer FSL 18 (171a)	100.117	09/2012	09/2014	Rohde & Schwarz
Hornantenna (0.86-8.5 GHz)	Schwarzbeck BBHA 9120 A (284)	236	09/2012	09/2015	Dudde
Pre-amplifier (1GHz - 18GHz)	Narda --- (345)	---	01/2012	01/2014	Dudde
Bilog-antenna (30- 1000 MHz)	Schwarzbeck VULP 9168 (406)	---	04/2011	04/2014	Schwarzbeck
Logt. Per, Antenne (1- 18 GHz)	Schwarzbeck STLP 9148 (445)	---	09/2012	09/2015	Schwarzbeck

Cable list

Type	Manufacturer/ Model no.	Cable no.	Last calibration	Next calibration	Calibration executed by
RF- cable	Kabelmetal 18m [N]	K1a	03/2013	03/2014	Dudde
RF- cable	Aircell 1.5m [BNC/N]	K30	03/2013	03/2014	Dudde
RF- cable	Aircell 0.5m [BNC]	K40	03/2013	03/2014	Dudde
RF- cable	Sucoflex 104 Suhner [N] 1 m	K52	03/2013	03/2014	Dudde
RF- cable	Aircell 1m [BNC/N]	K56	03/2013	03/2014	Dudde
RF- cable	Sucoflex 100 Suhner [N] 1 m	K61	03/2013	03/2014	Dudde
RF- cable	Sucoflex 106 Suhner 6,4m [N]	K74	03/2013	03/2014	Dudde
RF- cable	Sucoflex 106 Suhner 6,4m [N]	K75	03/2013	03/2014	Dudde
RF- cable	Sucoflex Suhner 13 m [N]	K144	03/2013	03/2014	Dudde
RF- cable	Sucoflex Suhner 8m [SMA]	K145	03/2013	03/2014	Dudde
RF- cable	Sucoflex Suhner 8m [SMA]	K146	03/2013	03/2014	Dudde

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8.2.3 Test procedure

The EUT and this peripheral (when additional equipment exists) are placed on a turn table which is 0.8 m above the ground. The turn table would be allowed to rotate 360 degrees to determine the position of the maximum emission level. The test distance between the EUT and the receiving antenna are 3m. To find the maximum emission, the polarization of the receiving antenna is changed in horizontal and vertical polarization; the position of the EUT was changed in different orthogonal determinations.

ANSI C63.4-2009 Section 8 “Radiated Emissions Testing”

Measurement procedures for electric field radiated emissions above 1 GHz are covered in Clause 8 of ANSI C63.4-2009. The ANSI C63.4-2009 measurement procedure consists of both an exploratory test and a final measurement. The exploratory test is critical to determine the frequency of all significant emissions. For each mode of operation required to be tested, the frequency spectrum is monitored. Variations in antenna height, antenna orientation, antenna polarization, EUT azimuth, and cable or wire placement is explored to produce the emission that has the highest amplitude relative to the limit.

The final measurements are made based on the findings in the exploratory testing. When making exploratory and final measurements it is necessary to maximize the measured radiated emission. Subclause 8.3.1.2 of ANSI C63.4-2009 states that the measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” We consider the “cone of radiation” to be the 3 dB beam width of the measurement antenna.

While the “bore-sighting” technique is not explicitly mentioned in ANSI C63.4-2009, it is a useful technique for measurements using a directional antenna, such as a double-ridged waveguide antenna. Several precautions must be observed, including: knowledge of the beam width of the antenna and the resulting illumination area relative to the size of the EUT, estimation for source of the emission and general location within larger EUTS, measuring system sensitivity, etc.

ANSI C63.4-2009 requires that the measurement antenna is kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. That means that if the directional radiation pattern of the EUT results in a maximum emission at an upwards angle from the EUT, when a directional antenna is used to make the measurement it will be necessary for it to be pointed towards the source of the emission within the EUT. This can be done by either pointing the antenna at an angle towards the source of the emission, or by rotating the EUT, in both height and polarization, to maximize the measured emission. The emission must be kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT is measured.

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Radiated emissions test characteristics	
Frequency range	30 MHz - 4,000 MHz
Test distance	3 m*
Test instrumentation resolution bandwidth	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (1000 MHz - 12,750 MHz)
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Vertical/horizontal

* According to Section 15.31 (f) (1): At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

8.2.4 Calculation of the field strength

The field strength is calculated by the following calculation:

Corrected Level = Receiver Level + Correction Factor (without the use of a pre-amplifier)

Corrected Level = Receiver Level + Correction Factor – Pre-amplifier (with the use of a pre-amplifier)

Receiver Level : Receiver reading without correction factors
Correction Factor : Antenna factor + cable loss

For example:
The receiver reading is 32.7 dBµV. The antenna factor for the measured frequency is +2.5 dB (1/m) and the cable factor for the measured frequency is 0.71 dB, giving a field strength of 35.91dBµV/m.
The 35.91dBµV/m value can be mathematically converted to its corresponding level in µV/m.

Level in µV/m = Common Antilogarithm (35.91/20) = 39.8

For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f) (1) the field strength is calculated by adding additionally an extrapolation factor of 20 dB/decade (inverse linear distance for field strength measurements).

8.2.5 Test results

RADIATED EMISSIONS (Section 15.109)										
f (MHz)	Bandwidth (kHz), Type of detector	Noted receiver level dBµV	Test distance m	Correction factor dB	Distance extrapol. factor dB	Level corrected dBµV/m	Limit dBµV/m	Margin dBµV/m	Polaris. EUT / antenna	Antenna height cm
314.726	100 / QPK	10.6	3	-5.9	0	4.7	46.0	41.3	60° / V	155
Measurement uncertainty 4 dB										

Bandwidth = the measuring receiver bandwidth

Remark: *[1] noise floor noise level of the measuring instrument ≤ 3.5dBµV @ 3m distance (30 – 1,000 MHz)
Remark: *[2] noise floor noise level of the measuring instrument ≤ 4.5dBµV @ 3m distance (1,000 – 2,000 MHz)
Remark: *[3] noise floor noise level of the measuring instrument ≤ 10dBµV @ 3m distance (2,000 – 5,500 MHz)
Remark: *[4] noise floor noise level of the measuring instrument ≤ 14dBµV @ 3m distance (5,500 – 14,500 MHz)
Remark: *[5] for using a pre-amplifier in the range between 100 kHz and 1,000 MHz
Remark: *[6] for using a pre-amplifier in the range between 1.0 GHz and 18.0 GHz

The equipment meets the requirements	**Yes***	~~No~~	~~N.t.~~

Further test results are attached	~~Yes~~	**No**	Page no.

*** All other emissions are lower than the noise level of the measuring equipment!**

N.t.* See page no. 18

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9. Additional information to the test report

Remarks

N.t.[1] Not tested, because not applicable to the EUT

N.t.[2] Not tested, because not ordered

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End of test report

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