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LP-009

Test report

Number:	**T251-0765/21**	Project file:	C20212182
		Date:	2022-06-23
		Pages:	9
Product:	**E-bike control module**		
Type reference:	**Bonnie & Clyde**		
Ratings:	9 - 45 Vdc Protection class: III		
Trademark:	COMODULE		
Applicant:	**COMODULE OÜ** **Dunkri 9, 10123 Tallinn, Estonia**		
Manufacturer:	COMODULE OÜ Dunkri 9, 10123 Tallinn, Estonia		
Place of manufacture:	COMODULE OÜ Dunkri 9, 10123 Tallinn, Estonia		

Summary of testing

Testing method:	EN IEC 62311:2020
Testing location:	SIQ Ljubljana, Mašera-Spasićeva 10, SI-1000 Ljubljana, Slovenia
Remarks:	Date of receipt of test items: 2021-06-28 Number of items tested: 1 Date of performance of tests: 2021-10-26 The test results presented in this report relate only to the items tested. The product complies with the requirements of the testing methods.

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1 GENERAL

History sheet			
Date	Report No.	Change	Revision
2022-06-23	T251-0765/21	Initial test report issued.	--

1.1 Equipment under test

E-bike control module
Type: **Bonnie & Clyde**
All batteries stated on first page contain identical RF module and are all covered by this report.

Environment: Uncontrolled / General Public
Equipment falls under product for mobile use

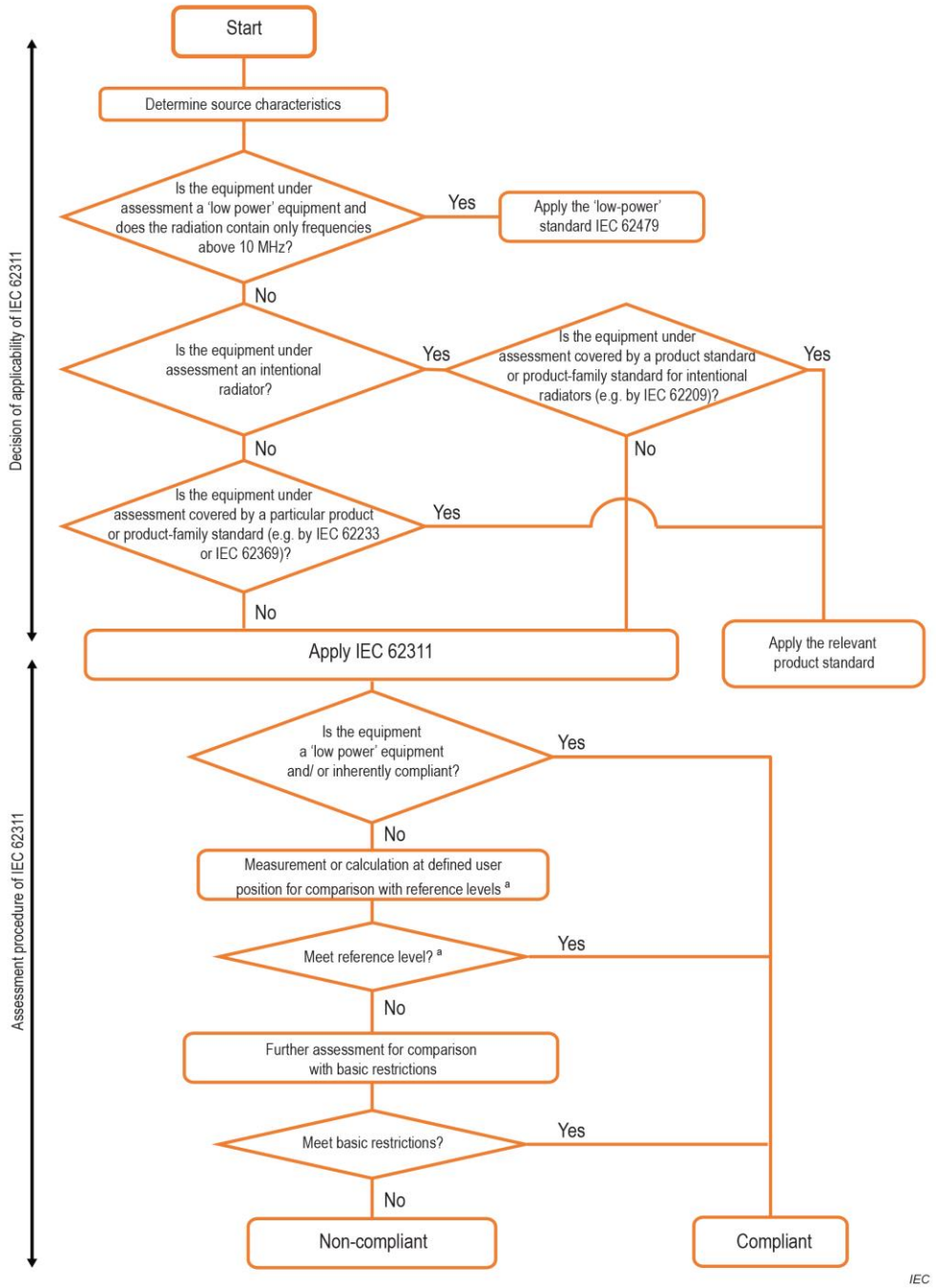
1.2 Reviewed / referenced documents

- Test report T251-0747/21 from SIQ Ljubljana
- Test report EMC_CTSMC-003-18001_CEMPE from CETECOM Inc.

2 Assessment

The method used is taken from Clause 5 of standard EN IEC 62311:2020.

The assessment is performed according to below flowchart and Table 1 – List of possible assessment methods from clause 5.1 of EN IEC 62311. Compliance is determined based on reference limits given in 1999/519/EC according to the exposure category declared by customer.



3 RF Exposure Measurement

3.1 Introduction

This International Standard provides simple conformity assessment methods for low- power electronic and electrical equipment to an exposure limit relevant to electromagnetic fields (EMF). If such equipment cannot be shown to comply with the applicable EMF exposure requirements using the methods included in this standard for EMF assessment, then other standards, including IEC 62311 or other (EMF) product standards, may be used for conformity assessment.

3.2 Compliance Criteria

Compliance of electromagnetic emissions from electronic and electrical equipment with the basic restrictions usually is determined by measurements and, in some cases, calculation of the exposure level. If the electrical power used by or radiated by the equipment is sufficiently low, the electromagnetic fields emitted will be incapable of producing exposures that exceed the basic restrictions. This standard provides simple EMF assessment procedures for this low power equipment.

Any relevant compliance assessment procedure which is consistent with the state of the art, reproducible and gives valid results can be used.

For transmitters intended for use with more than one antenna configuration option, the combination of transmitter and antenna(s) which generates the highest available antenna power and/or average total radiated power shall be assessed.

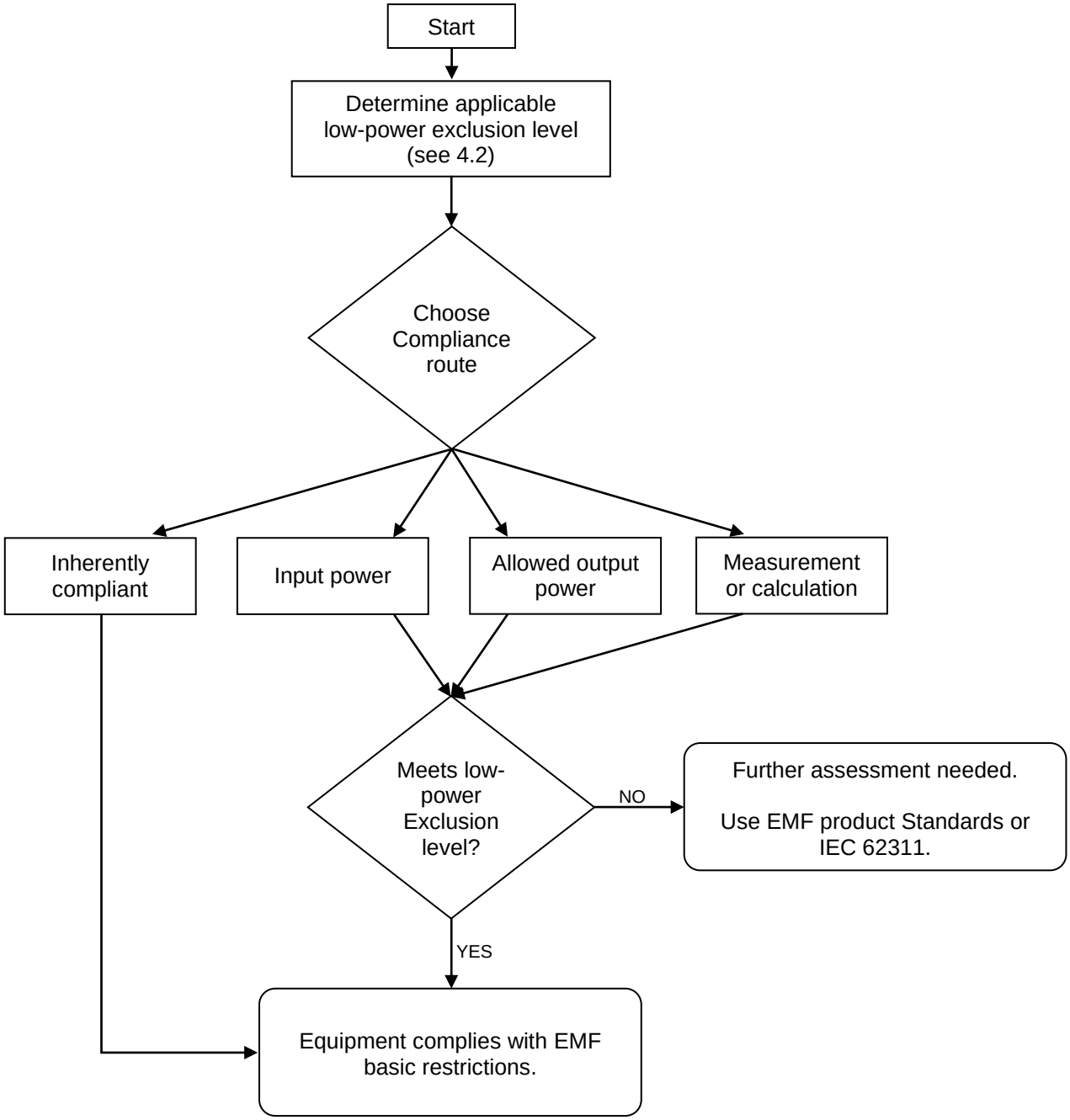
3.3 Normative Reference

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Publication	Year	Title	EN/HD	Year
IEC 62311 (mod)	-	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz – 300 GHz)	EN IEC 62311:2020	-

Note: When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

3.4 Routes To Show Compliance With Low-Power Exclusion Level in EN 62479



4 RF-Exposure classifications (Reference levels)

Example values of SAR-based P_{max} for some cases described by ICNIRP, IEEE Std C95.1-1999 and IEEE Std C95.1-2005

Guideline / Standard	SAR limit, SAR_{max} W/kg	Averaging mass, m g	P_{max} mW	Exposure tier[a]	Region of body[a]
ICNIRP [1]	2	10	20	General public	Head and trunk
	4	10	40	General public	Limbs
	10	10	100	Occupational	Head and trunk
	20	10	200	Occupational	Limbs
IEEE Std C95.1-1999 [2]	1,6	1	1,6	Uncontrolled environment	Head, trunk, arms, legs
	4	10	40	Uncontrolled environment	Hands, wrists, feet and ankles
	8	1	8	Controlled environment	Head, trunk, arms, legs
	20	10	200	Controlled environment	Hands, wrists, feet and ankles
IEEE Std C95.1-2005 [3]	2	10	20	Action level	Body except extremities and pinnae
	4	10	40	Action level	Extremities and pinnae
	10	10	100	Controlled environment	Body except extremities and pinnae
	20	10	200	Controlled environment	Extremities and pinnae

[a] Consult the appropriate standard for more information and definitions of terms.

Limits according to 1999/519/EC - exposure of the general public to electromagnetic fields

Frequency range	Electric field strength (V/m)	Magnetic field strength (A/m)	B-field (μT)	Equivalent plane wave power density S_{eq} (W/m2)
0 – 1 Hz		$3,2 \times 10^4$	4×10^4	
1 – 8 Hz	10000	$3,2 \times 10^4/f^2$	$4 \times 10^4/f^2$	
8 – 25 Hz	10000	4000/f	5000/f	
0,025 – 0,8 Hz	250/f	4/f	5/f	
0,82 – 3 Hz	250/f	5	6,25	
3 – 150 kHz	87	5	6,25	
0,15 – 1 MHz	87	0,73/f	0,92/f	
1 – 10 MHz	$87/f^{1/2}$	0,73/f	0,92/f	
10 – 400 MHz	28	0,073	0,092	2
400 – 2000 MHz	$1,375\ f^{1/2}$	$0,0037\ f^{1/2}$	$0,0046\ f^{1/2}$	f/200
2 – 300 GHz	61	0,16	0,2	10

- For frequencies between 100 kHz and 10 GHz, S_{eq}, E^2, H^2, and B^2 are to be averaged over any six-minute period.
- For frequencies exceeding 10 GHz, S_{eq}, E^2, H^2 and B^2 are to be averaged over any $68/f^{1.05}$ -minute period (f in GHz).

NOTE: unless otherwise specified stricter limits apply

5 Calculations

The calculations are to determine the far-field or radiating near-field or reactive near-field and/or value for r_c, the distance at which the far-field and cylindrical wave models produce the same value of power flux density. Calculation used depends on the position of the object for which the assessment is made.

Far-field Calculation
For calculating the field in the far-field region the free space formula below is used to determine the electric field or power flux density at a distance r from the transmitting antenna.

$$E = \frac{\sqrt{30PG}}{r}$$

Where:
E is Field Strength in V/m
P is power in watts radiated from a point uniformly over the surface of sphere of radius R
G is the antenna gain relative to an isotropic antenna
r is the distance from observation point to the antenna

$$S = \frac{PG}{4\pi r^2}$$

Where:
S is Power flux density W/m2
P is power in watts radiated from a point uniformly over the surface of sphere of radius R
G is the antenna gain relative to an isotropic antenna
r is the distance from observation point to the antenna

Radiating near field
Calculation methods are the synthetic model or cylindrical wave model.
The synthetic model splits the antenna into n small sources and the field is calculated:

$$E = \sum \alpha_n \frac{\sqrt{30.P_n G_n}}{r_n} e^{j(\gamma_n + \frac{2\pi r_n}{\lambda})}$$

where
E is Field Strength in V/m
P_n is Power in Watts radiated by element n
G_n is Gain of antenna element n
r_n is Distance in meters from element n

The cylindrical wave model allows direct calculation of the power flux density, S, using:

$$S = \frac{P}{\pi D r} \frac{180}{\delta}$$

where
S is Power flux density W/m2
P is Power in watts radiated (W)
D is Length of antenna (m)
r is Distance in meters from the antenna

The cylindrical wave model is valid for a range of distances where r_c lies in the radiating near-field, and where the distance is less than r_c. At distances greater than r_c the far field model is more appropriate.

Reactive near field
When human exposure is in the reactive near-field the reference method is a SAR evaluation. Localized SAR evaluations are used. Localized SAR evaluations are limited to operating frequencies between 0.8 and 3 GHz, antenna apertures less than 0.6m x 0.3m and investigation distances of less than 40cm. The alternative to SAR measurements are E-field and H-field measurements.

6 Technical specifications of the antenna

Antennas have gain of 0 dBi. Length of the maximal GSM antenna is app. 4 cm.

7 Assessment results

a) evaluation @ 20 cm distance:

Evaluation for GSM, GPRS and LTE is performed in test report EMC_CTSMC-003-18001_CEMPE.

Frequency (MHz)	Condition	Max. EIRP (dBm)	Max. EIRP (mW)	Calculated E-field @ 20 cm (V/m)	Limit (V/m)	Result
2402	Extreme	7,2	5,25	1,98	61	PASS
2440	Normal	7,2	5,25	1,98	61	PASS
2480	Extreme	7,5	5,62	2,05	61	PASS
Maximal declared 2402-2480	/	8	6,31	2,18	61	PASS

Final result: Device complies with requirements at 20 cm distance.

b) obtaining smallest distance for compliance:

Lowest frequency (MHz)	Average conducted P_{OUT} (dBm)	Antenna gain (dBi)	Calculated min. distance for compliance (cm)	Calculated E-field (V/m)	Limit (V/m)	Result
880	28,15 @ 4Tx slot	0	11	40,24	40,79	PASS

NOTE: GSM result taken from test report EMC_CTSMC-003-18001_CEMPE.

Final result: Device still fulfills with requirements at minimum 11 cm distance.