



EMI - TEST REPORT

- FCC Part 15.209 -

Type / Model Name : LF Trigger Antenna 433MHz

Product Description : TPMS LF Trigger Antenna

Applicant : bf1systems

Address : Technical Centre, Owen Road, Diss

Norfolk, England, IP22 4ER

Manufacturer : bf1systems

Address : Technical Centre, Owen Road, Diss

Norfolk, England, IP22 4ER

Licence holder : bf1systems

Address : Technical Centre, Owen Road, Diss

Norfolk, England, IP22 4ER

Test Result according to the standards listed in clause 1 test standards:

POSITIVE

Test Report No. : T41171-00-02HU

27. July 2016

Date of issue



Deutsche
Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (October, 2015)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (October, 2015)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements

ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
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ANSI C95.1:2005	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
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CISPR 16-4-2: 2003	Uncertainty in EMC measurement
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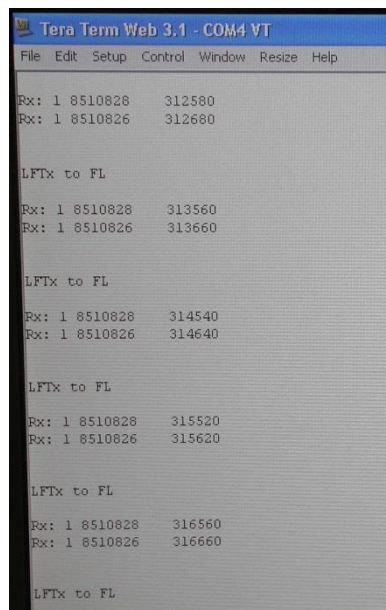
2 SUMMARY

GENERAL REMARKS:

The carrier frequency is 125.0 kHz

To set the EuT in the different operation modes, a Hyper Terminal Programm on a LapTop was used.

Screenshot of the test software:



```

Tera Term Web 3.1 - COM4 VT
File Edit Setup Control Window Resize Help

Rx: 1 8510828 312580
Rx: 1 8510826 312680

LFTx to FL
Rx: 1 8510828 313560
Rx: 1 8510826 313660

LFTx to FL
Rx: 1 8510828 314540
Rx: 1 8510826 314640

LFTx to FL
Rx: 1 8510828 315520
Rx: 1 8510826 315620

LFTx to FL
Rx: 1 8510828 316560
Rx: 1 8510826 316660

LFTx to FL
  
```

FINAL ASSESSMENT:

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 31. May 2016

Testing concluded on : 09. June 2016

Checked by:

Tested by:

Gegenfurtner Klaus
Teamleader Radio

Huber Markus

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – Detailed photos see Attachment A

3.2 Power supply system utilised

Power supply voltage: : 12.0 V / DC (Vehicle Battery)

3.3 Short description of the Equipment under Test (EUT)

The EuT is a LF Trigger Antenna, which will be used for a tire pressure monitoring system.

Number of tested samples: 1
Serial number: 0000001

EUT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- Tx mode at 125 kHz

-

-

EUT configuration:

The following peripheral devices and interface cables were connected during the measurements:

- | | |
|--------------------------------------|--|
| - <u>Laptop</u> | Model : <u>Supplied by CSA Group Bayern GmbH</u> |
| - <u>EMC Test ECU</u> | Model : <u>Supplied by manufacturer</u> |
| - <u>Adapter cable (ECU – RS232)</u> | Model : <u>Supplied by manufacturer</u> |
| - customer specific cables | |
| - unscreened power cables | |

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Statement regarding the usage of logos in test reports

The accreditation and notification body logos displayed in this test report are only valid for standards listed in the accreditation or notification scope of CSA Group Bayern GmbH.

4.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 ° C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.4 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.5 Measurement Protocol for FCC, VCCI and AUSTEL

4.5.1 GENERAL INFORMATION

4.5.1.1 Test Methodology

Conducted and radiated disturbance testing is performed according to the procedures set out by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

The test methods used comply with CISPR Publication 22, EN 55022 - "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.5.1.2 Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

5 TEST CONDITIONS AND RESULTS

5.1 Conducted emissions

For test instruments and accessories used see section 6 Part A 4.

5.1.1 Description of the test location

5.1.2 Photo documentation of the test set-up

5.1.3 Applicable standard

According to FCC Part 15, Section 15.207(a):

Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator 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.

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

5.1.4 Test result

Frequency range:

Min. limit margin

Remarks: The measurement is not applicable. The EuT is battery powered.

5.2 Field strength of the fundamental wave

For test instruments and accessories used see section 6 Part **CPR 1**.

5.2.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.2.2 Photo documentation of the test set-up



5.2.1 Applicable standard

According to FCC Part 15C, Section 15.209:

The emissions from intentional radiators shall not exceed the effective field strength limits.

5.2.2 Description of Measurement

The spurious emissions of the EUT have to be measured at an open area test site in the frequency range from 9 kHz to 1000 MHz using a tuned EMI receiver. The set up of the equipment under test will be in accordance with ANSI C63.4. The measurement has been performed at 3 m. The results have been compared to the limits defined at 30 m or 300 m distances according to FCC Part 15C, Section 15.31(f)(2) using an inverse linear distance extrapolation factor of 40 dB/decade. The final measurement has been performed with the EMI receiver using Quasi peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used, according to Section 15.209(d).

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz: RBW: 200 Hz

150 kHz – 30 MHz: RBW: 9 kHz

Example:

Frequency (MHz)	Level (dBμV)	+	Factor (dB)	=	Level dB(μV/m)	-	Limit dB(μV/m)	=	Delta (dB)
1.705	5	+	20	=	25	-	30	=	-5

5.2.3 Test result

Measurement distance: 3 m

Frequency (MHz)	Level PK (dBμV)	Level QP (dBμV)	Level AV (dBμV)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μV/m)	Corrected Level QP dB(μV/m)	Corrected Level AV dB(μV/m)	Limit AV dB(μV/m)	Delta (dB)
0.125	80.1	64.1	59.8	0.2	20	100.1	84.1	79.8	105.67	-25.9

Calculated value at distance: 300 m

Frequency (MHz)	Level PK (dBμV)	Level QP (dBμV)	Level AV (dBμV)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μV/m)	Corrected Level QP dB(μV/m)	Corrected Level AV dB(μV/m)	Limit AV dB(μV/m)	Delta (dB)
0.125	0.1	-15.9	-20.2	0.2	20	20.1	4.1	-0.2	25.67	-25.9

Limit according to FCC Part 15C, Section 15.209(a):

Frequency (MHz)	Field strength of fundamental wave (μV/m)	Field strength of fundamental wave dB(μV/m)	Measurement distance (metres)
0.009-0.490	2400/F(kHz)	--	300
0.490-1.705	24000/F (kHz)	--	30
1.705-30.0	30	29.5	30

The requirements are **FULFILLED**.

Remarks:

5.3 Spurious emissions (magnetic field) 9 kHz – 30 MHz

For test instruments and accessories used see section 6 Part SER 1.

5.3.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.3.2 Photo documentation of the test set-up



5.3.3 Applicable standard

According to FCC Part 15C, Section 15.209:

The emissions from intentional radiators shall not exceed the effective field strength limits.

5.3.4 Description of Measurement

The spurious emissions of the EUT have to be measured at an open area test site in the frequency range from 9 kHz to 1000 MHz using a tuned EMI receiver. The set up of the equipment under test will be in accordance with ANSI C63.4. The measurement has been performed at 3 m. The results have been compared to the limits defined at 30 m or 300 m distances according to FCC Part 15C, Section 15.31(f)(2) using an inverse linear distance extrapolation factor of 40 dB/decade. The final measurement has been performed with the EMI receiver using Quasi peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used, according to Section 15.209(d).

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz: RBW: 200 Hz

150 kHz – 30 MHz: RBW: 9 kHz

5.3.5 Test result

Measurement distance: 3 m

Frequency (MHz)	Level PK (dBμV)	Level QP (dBμV)	Level AV (dBμV)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μV/m)	Corrected Level QP dB(μV/m)	Corrected Level AV dB(μV/m)	Limit AV dB(μV/m)	Delta (dB)
0.375	30.8	24.6	10.7	9	20	50.8	44.7	30.7	96.12	-65.4
0.625	25.3	18.7	6.1	9	20	45.3	38.7	26.1	71.7	-45.6

Calculated value at distance: 300m

Frequency (MHz)	Level PK (dBμV)	Level QP (dBμV)	Level AV (dBμV)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μV/m)	Corrected Level QP dB(μV/m)	Corrected Level AV dB(μV/m)	Limit AV dB(μV/m)	Delta (dB)
0.375	-49.2	-55.4	-69.3	9	20	-29.2	-35.4	-49.3	16.12	-65.4

Values at distance: 30m

Frequency (MHz)	Level PK (dBμV)	Level QP (dBμV)	Level AV (dBμV)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μV/m)	Corrected Level QP dB(μV/m)	Corrected Level AV dB(μV/m)	Limit dB(μV/m)	Delta (dB)
0.625	-14.7	-21.3	-33.9	9	20	5.3	-1.3	-13.9	31.7	-45.6
1.705 – 30.0				9	20				29.5	> 40

Limit according to FCC Part 15 Subpart 15.209(a):

Frequency (MHz)	Field strength of spurious emissions (μV/m)	Field strength of spurious emissions dB(μV/m)	Measurement distance (metres)
0.009-0.490	2400/F(kHz)	--	300
0.490-1.705	24000/F (kHz)	--	30
1.705-30.0	30	29.5	30

The requirements are **FULFILLED**.

Remarks: All other unwanted emissions in the frequency range from 9 kHz to 30 MHz were
below < -10.5 dBμV/m.

5.4 Radiated emissions

For test instruments and accessories used see section 6 Part **SER 2**.

5.4.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.4.2 Photo documentation of the test set-up



5.4.3 Applicable standard

According to FCC Part 15B, Section 15.109 (a):

Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 m shall not exceed the given limit.

According to FCC Part 15C, Section 15.209:

The emissions from intentional radiators shall not exceed the effective field strength limits.

5.4.4 Description of Measurement

Radiated emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 dB(μ V/m) non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the equipment under test will be in accordance to ANSI C63.4. The interface cables that are closer than 40 cm to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 cm from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3 m horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres, measurement scans are made with horizontal and vertical antenna polarization and the EUT is rotated 360 degrees.

FCC ID: USXBF1TRANT

The resolution bandwidth during the measurement is as following:

30 MHz – 1000 MHz: RBW: 120 kHz

5.4.5 Test result

Frequency [MHz]	L: QP [dBμV]	Correct. [dB]	L: QP [dBμV/m]	Limit [dBμV/m]	Delta [dB]
33.78	3.7	13.4	17.1	40.0	-22.9
118.54	9.3	12.9	22.2	43.5	-21.3
517.43	4.8	21.9	26.7	46.0	-19.3

Note: No unwanted emissions from the EuT could be measured in the relevant frequency ranges.
Only ambient noises could be detected!

Limit according to FCC part 15B, Section 15.109(a):

Frequency (MHz)	Limit (μV/m)	Limit dB(μV/m)
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

The requirements are **FULFILLED**.

Remarks: The measurement was performed up to 1 GHz.

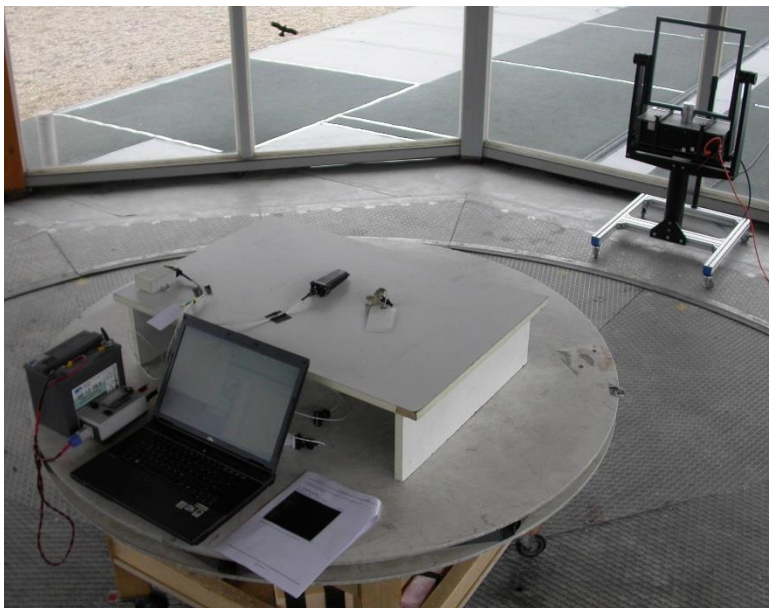
5.5 Emission Bandwidth

For test instruments and accessories used see section 6 Part MB.

5.5.1 Description of the test location

Test location: OATS 1

5.5.2 Photo documentation of the test set-up

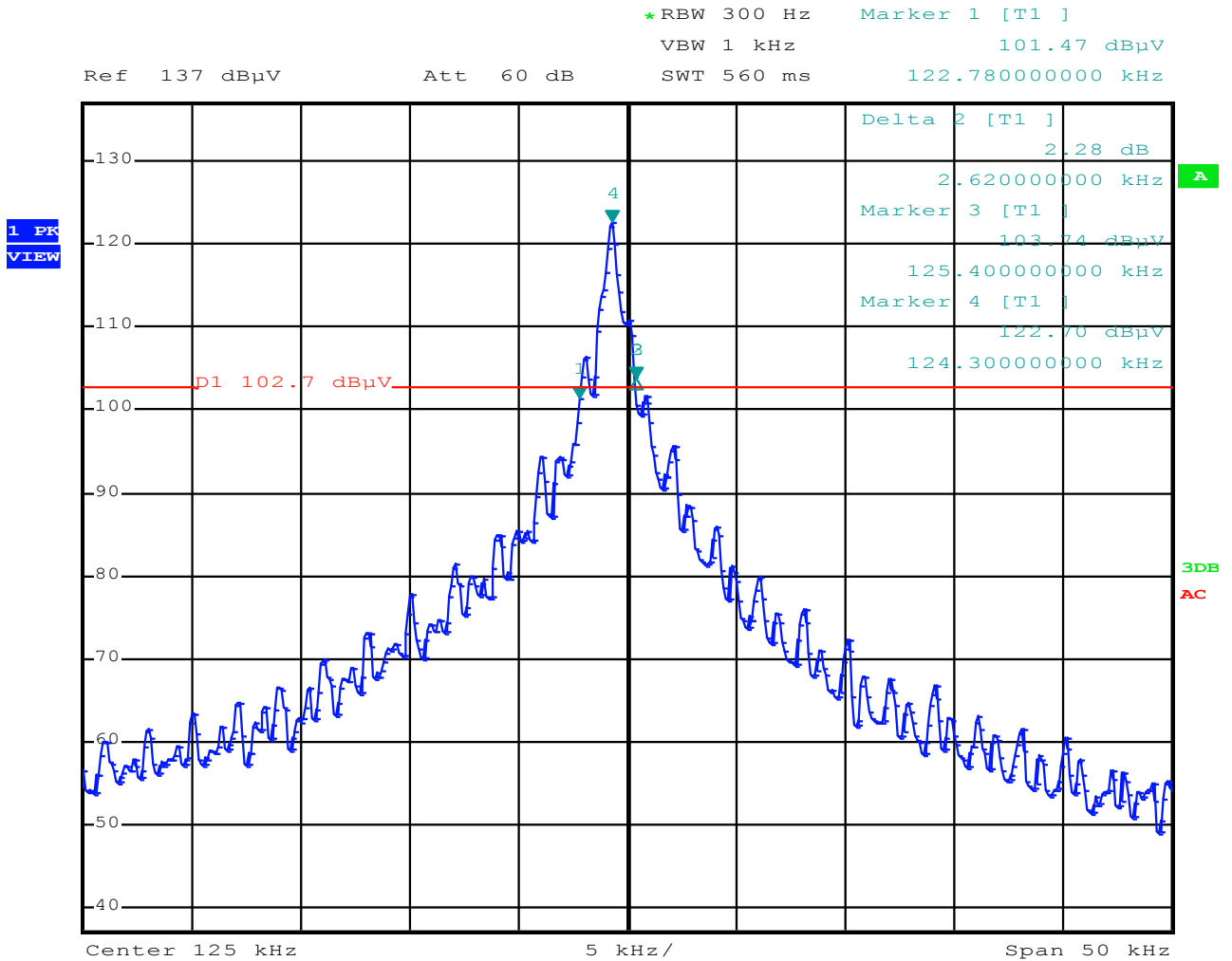


Fundamental [kHz] See Plot 1	20dB Bandwidth F1	20dB Bandwidth F2	Measured Bandwidth [kHz]
125.00	122.78	125.40	2.62

Remarks:

5.5.3 Test protocol

Emission Bandwidth plots



6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
CPR 1	FMZB 1516	01-02/24-01-018			21/01/2017	21/01/2016
	ESCI	02-02/03-05-004	17/09/2016	17/09/2015		
	INA 265 A / CAS 3025	02-02/50-05-028	13/04/2017	13/04/2016		
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
MB	FMZB 1516	01-02/24-01-018			21/01/2017	21/01/2016
	ESCI	02-02/03-05-004	17/09/2016	17/09/2015		
	KK-EF393-21N-16	02-02/50-05-035				
	NW-2000-NB	02-02/50-05-113				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 1	FMZB 1516	01-02/24-01-018			21/01/2017	21/01/2016
	ESCI	02-02/03-05-004	17/09/2016	17/09/2015		
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 2	ESVS 30	02-02/03-05-006	26/06/2016	26/06/2015	20/11/2015	20/05/2015
	VULB 9168	02-02/24-05-005	17/04/2016	17/04/2015		
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				