



Test Report No. P/13/01/48-2

Subject of test: **AFR 31 - Smart Load to Reduce Ferroresonance**
Manufacturer KMB systems, s.r.o.

Test standards: CSN EN 61000-4-3 ed3:2006 + A1 + A2
CSN EN 61000-4-4 ed2:2005 + A1
CSN EN 61000-4-5 ed.2:2007
CSN EN 61000-4-6 ed.3:2009
CSN EN 61000-4-18:2007 + A1
CSN EN 55011 ed2:2007 + A2 art. 5.2, 7.2
CSN EN 55022 ed2:2007 + A1 art. 6, 10

Related standards: CSN EN 61326-1:2006

Customer: KMB systems, s.r.o.
Dr. M. Horákové 559, 460 06 Liberec 7

Purchase Order Number: 201300284

Person in charge: Zdenek Stastny, laboratory manager

Hereafter presented test results are applied to the tested equipment exclusively and they must not substitute other documents.

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<u>Filing date of test subject:</u>	6. 6. 2013
<u>Time and place of test:</u>	6. 6. - 10. 6. 2013, Test Room ABEGU, a.s.
<u>Subject of test:</u>	AFR 31 - Smart Load to Reduce Ferroresonance
<u>Manufacturer:</u>	KMB systems, s.r.o.
<u>Customer:</u>	KMB systems, s.r.o.
<u>Customer assistant:</u>	Milan Sopr
<u>Documentation:</u>	Datasheet
<u>Goal of test:</u>	1. Check-up level of immunity against electromagnetic disturbance. 2. Check-up level of transmitted electromagnetic disturbance.
<u>Date of report issue:</u>	10. 6. 2013
<u>Number of report pages:</u>	10
<u>Number of attachment pages:</u>	0
<u>Elaborated by:</u>	Zdenek Stastny
<u>Reviewed by:</u>	Jan Rerabek
<u>Approved by:</u>	Zdenek Stastny, laboratory manager
<u>Distribution of test report:</u>	1. KMB systems, s.r.o. 2. ABEGU, a. s., ZKUSEBNA

Test classification, uncertainty of measurement:

1. Function of subject (equipment under test - EUT) is classified on the basic of operating condition and functional specification (functional criteria) resulting from standard CSN EN 61326-1 and following test standards CSN EN 61000-4-x:

- Criterion A: In the conditions of electromagnetic disturbance the EUT shall continue to operate as intended. The EUT keeps all properties guaranteed by the technical conditions.
- Criterion B: In the conditions of electromagnetic disturbance there will be short decrease of the EUT performance caused by disturbing signal. After switching it off all the guaranteed functions of the EUT will be automatically renewed. No degradation is allowed during the process.
- Criterion C: In the conditions of electromagnetic disturbance there will be temporary degradation or loss of function, which requires the service intervention or restoring the system.
- Criterion D: In the conditions of electromagnetic disturbance there will be permanent degradation or loss of function, which is not recoverable due to the damage of equipment (components) or software, or loss of data.

The formulation of uncertainty of measurement for the immunity test is not relevant.

2. Emission level of EUT is classified by the requirement of standard CSN EN 61326-1 and

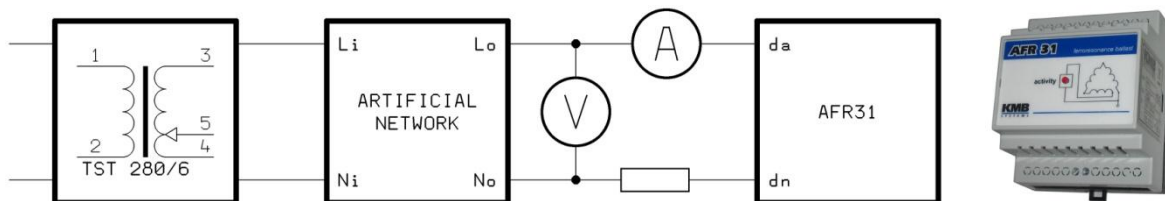
following test standards CSN EN 55011 / 55022. The results are presented with total uncertainty U . This uncertainty is defined as standard uncertainty multiplied by coefficient $k = 2$, which warrants confidence interval approximately 95 % for standard distribution.

Traceability to national standards of measurement:

1. external calibrations
2. factory reference standard - digital multimeter model 2000, No. E-4.1-010, external calibration by CMI
3. factory reference standard - digital scope HP 54616B, No. E-4.1-035, external calibration by CMI

Equipment configuration:

The Smart Load to Reduce Ferroresonance AFR 31 was connected to regulation transformer TST 280/6. Output voltage of transformer was set to value 18 V or 38 V. The 38 V value performed the active state of smart load (protection state). In case of need to idle protection state, the voltage was decreased to 18 V. All tests were made for both equipment states (active state and idle state).



Examined tests:

- A.02: Radiated, radio-frequency, electromagnetic field immunity test by CSN EN 61000-4-3
- A.03: Fast transient burst immunity test by CSN EN 61000-4-4
- A.04: Surge immunity test by CSN EN 61000-4-5
- A.05: Immunity to conducted disturbances induced by radio-frequency fields by CSN EN 61000-4-6
- A.13: Dumped oscillatory immunity test by CSN EN 61000-4-18
- B.03: Electromagnetic field intensity measuring by CSN EN 55011 / 55022

Tested interfaces:

- Analog input
- Equipment enclosure

Test procedure and result:

A.02 Radio-frequency field immunity test

Test standard: CSN EN 61000-4-3 ed.3:2006 + A1 + A2
 Test equipment: Signal generator SM 300, No. A-4.1-017
 Power amplifier 30W1000A, No. A-4.1-004
 Power amplifier 10S1G4A, No. A-4.1-018
 Log-periodical antenna AT 1080, No. A-4.1-005
 Horn antenna AT 4002A, No. A-4.1-019
 Electric field meter CTR 1001A, No. A-4.1-007
 Port under test: Enclosure, front and left side
 Coupling path: Electromagnetic
 Frequency range: 80 - 3000 MHz
 Polarization: horizontal, vertical
 Frequency step: 1 %
 Frequency time: 2 s
 Test values: 1 - 3 - 10 V/m
 Modulation: AM 80 %, 1 kHz
 Requirement: Criterion A
 Note: Test was made in the outside environment. Electric field transmitted by antenna was monitoring next to EUT and regulated to nominal value in the feedback loop.
 The test with lower value should not be necessary if the result of test with higher value is in criterion A.

Radiated, radio-frequency, electromagnetic field immunity test CSN EN 61000-4-3 ed.3:2006 + A1 + A2					
Subject of test	AFR 31 - Smart Load to Reduce Ferroresonance, s.n. 593, manufacturer KMB systems, s.r.o.				
Temperature:	22 ± 3 °C	Immunity level			Note
Humidity:	40 ± 5 %	1	2	3	
EUT configuration, Port under test	Test value (80MHz - 3GHz)			Coupling path: Electromagnetic, antennas AT 1080, AT 4002 Distance / height of antenna: 3,0 / 1,7 m	
	1 V/m	3 V/m	10 V/m		
	Criterion - HP, AM 80 %, 1 kHz				
Front side, active state	n.a.	n.a.	A		
Left side, active state	n.a.	n.a.	A		
Front side, idle state	n.a.	n.a.	A		
Left side, idle state	n.a.	n.a.	A		
	Criterion - VP, AM 80%, 1 kHz				
Front side, active state	n.a.	n.a.	A		
Left side, active state	n.a.	n.a.	A		
Front side, idle state	n.a.	n.a.	A		
Left side, idle state	n.a.	n.a.	A		
n.a. ... test value was not applied - see test program HP (VP) ... horizontal (vertical) antenna polarization AM (PWM) ... amplitude (pulse) modulation					
Test identification	Test sequence number	Date	Examined by		
A.02	5	10. 6. 2013	Rerabek		

No unacceptable changes were detected during the test.

A.03 Fast transient burst immunity test

Test standard: CSN EN 61000-4-4 ed.2:2005 + A1
 Test equipment: Test generator PPG 4kV FAST, No. A-4.1-021a
 Port under test: Analog input, terminals da, dn
 Coupling path: Internal artificial network PPG 4kV
 Test values: 0,5 - 1 - 2 - 4 kV, positive and negative polarity, pulse frequency 5 kHz, burst time 15 ms
 Requirement: Criterion B
 Time of test: 60 s for each coupling, test value and polarity

Fast transient burst immunity test CSN EN 61000-4-4 ed.2:2005 + A1						
Subject of test	AFR 31 - Smart Load to Reduce Ferroresonance, s.n. 593, manufacturer KMB systems, s.r.o.					
Temperature:	22 ± 3 °C	Immunity level				Note
Humidity:	40 ± 5 %	1	2	3	4	
EUT configuration	Test value				Coupling path: Internal Artificial network PPG 4kV	
Port under test	500 V	1 kV	2 kV	4 kV		
	Criterion for $f_{imp} = 5 \text{ kHz}$					
Analog input, terminal da, active state	A	A	A	A		
Analog input, terminal dn, active state	A	A	A	A		
Analog input, terminals da+dn, active st.	A	A	A	A		
Analog input, terminal da, idle state	A	A	A	A		
Analog input, terminal dn, idle state	A	A	A	A		
Analog input, terminals da+dn, idle state	A	A	A	A		
Test identification	Test sequence number	Date		Examined by		
A.03	1	6. 6. 2013		Mlejnek		

No unacceptable changes were detected during the test.

A.04 Surge immunity test

Test standard: CSN EN 61000-4-5 ed.2:2007
 Test equipment: Test generator PPG 4kV SLOW, No. A-4.1-021b
 Coupling network SRF 511, No. A-4.1-010a
 Port under test: Analog input, line to line mode da-dn
 Coupling path: Artificial network - coupling device SRF 511
 Test values: 0,5 - 1 - 2 kV for line to line mode, positive and negative polarity, phase shift 0 - 90 - 180 - 270°, output generator impedance 42 Ω
 Requirement: Criterion B
 Number of pulses: 5 for each level and polarity, time among two pulses not less than 10 s

Surge immunity test CSN EN 61000-4-5 ed.2:2007						
Subject of test	AFR 31 - Smart Load to Reduce Ferroresonance, s.n. 593, manufacturer KMB systems, s.r.o.					
Temperature:	22 ± 3 °C	Immunity level				Note
Humidity:	40 ± 5 %	1	2	3	4	
EUT configuration, Port under test		Test value - line to line mode				Coupling path: Artificial network SRF 511, output generator impedance 42 Ω
		n.d.	0,5 kV	1 kV	2 kV	
		Criterion				
Analog input da-dn, active state	-	A	A	A		
Analog input da-dn, idle state	-	A	A	A		
n.a. ... test value was not applied - see test program n.d. ... Immunity level was not defined - see test standard						
Test identification	Test sequence number	Date		Examined by		
A.04	3	10. 6. 2013		Balatka		

No unacceptable changes were detected during the test.

A.05 Immunity to conducted disturbances induced by radio-frequency

Test standard: CSN EN 61000-4-6 ed.3:2009
 Test equipment: Signal generator SM 300, No. A-4.1-017
 Power amplifier 25A250A, No. A-4.1-011
 Ferrite clamp F-2031, No. A-4.1-012
 Frequency range: 0,15 - 80 MHz
 Frequency step: 1 %
 Frequency time: 2 s
 Port under test: Analog input, terminals da, dn
 Coupling path: Electromagnetic - ferrite clamp F-2031
 Test values: 1 - 3 V
 Modulation: AM 80 %, 1 kHz
 Requirement: Criterion A
 Notice: The test with lower value should not be necessary if the result of test with higher value is in criterion A.

Immunity to conducted disturbances induced by radio-frequency CSN EN 61000-4-6 ed.3:2009				
Subject of test	AFR 31 - Smart Load to Reduce Ferroresonance, s.n. 593, manufacturer KMB systems, s.r.o.			
Temperature:	22 ± 3 °C	Immunity level		Note
Humidity:	40 ± 5 %	1	2	3
EUT configuration, Port under test	Test value (0,15 - 80 MHz)			Coupling path: Electromagnetic - ferrite clamp F-2031
	1 V	3 V	10 V	
	Criterion - AM 80%, 1 kHz			
Analog input, da+dn, active state	n.a.	A	n.a.	
Analog input, da+dn, idle state	n.a.	A	n.a.	
n.a. ... test value was not applied - see test program AM (PWM) ... amplitude (pulse) modulation				
Test identification	Test sequence number	Date	Examined by	
A.05	4	10. 6. 2013	Balatka	

No unacceptable changes were detected during the test.

A.13 Damped oscillatory immunity test

Test standard: CSN EN 61000-4-18:2007 + A1
 Test equipment: Test generator SRG 1120, No. A-4.1-015
 Coupling network SRF 511, No. A-4.1-010a
 Coupling device SRF 512, No. A-4.1-010c
 Port under test: Analog input, line to line mode da-dn
 Coupling path: Artificial network - coupling device SRF 511 + SRF 512
 Test values: 0,25 - 0,5 - 1 kV for line to line mode, positive and negative polarity of first half wavelength, output generator impedance 200 Ω
 Oscillation frequency: 100 kHz, 1 MHz (repeating frequency 40 / 400 Hz)
 Requirement: Criterion B
 Time of test: 5 x 5 s for each coupling, test value, polarity and oscillation frequency

Damped oscillatory wave immunity test						
CSN EN 61000-4-18:2007						
Subject of test	AFR 31 - Smart Load to Reduce Ferroresonance, s.n. 593, manufacturer KMB systems, s.r.o.					
Temperature:	22 ± 3 °C	Immunity level				Note
Humidity:	40 ± 5 %	1	2	3		
EUT configuration, Port under test	Test value - line to line mode				Coupling path: Artificial network SRF 511+512, output generator impedance 200 Ω	
	0,25 kV	0,5 kV	1 kV			
	Criterion for oscillation 100 kHz 1 MHz					
Analog input da-dn, active state	A	A	A	A	A	A
Analog input da-dn, idle state	A	A	A	A	A	A
n.a. ... test value was not applied - see test program						
Test identification	Test sequence number		Date		Examined by	
A.13	2		10. 6. 2013		Balatka	

No unacceptable changes were detected during the test.

B.03 Electromagnetic field intensity measurement (high-frequency disturbance)

Test standard: CSN EN 55022 ed.2:2007 + A1 art. 6, 10
CSN EN 55011 ed.2:2007 + A2 art. 5.2, 7.2

Test equipment: Spectral analyzer FSP 7, No. B-4.1-027
Broadband preamplifier LN 1000A, No. B-4.1-004a
Biconical antenna BC 01, No. B-4.1-026a
Log-periodical antenna LP 02, No. B-4.1-026b
Software (Fsp)7_ep_30m.xls

Port under test: Enclosure, front and left side

Coupling path: Electromagnetic

Frequency range: 30 to 200 MHz (BC 01)
200 to 1000 MHz (LP 02)

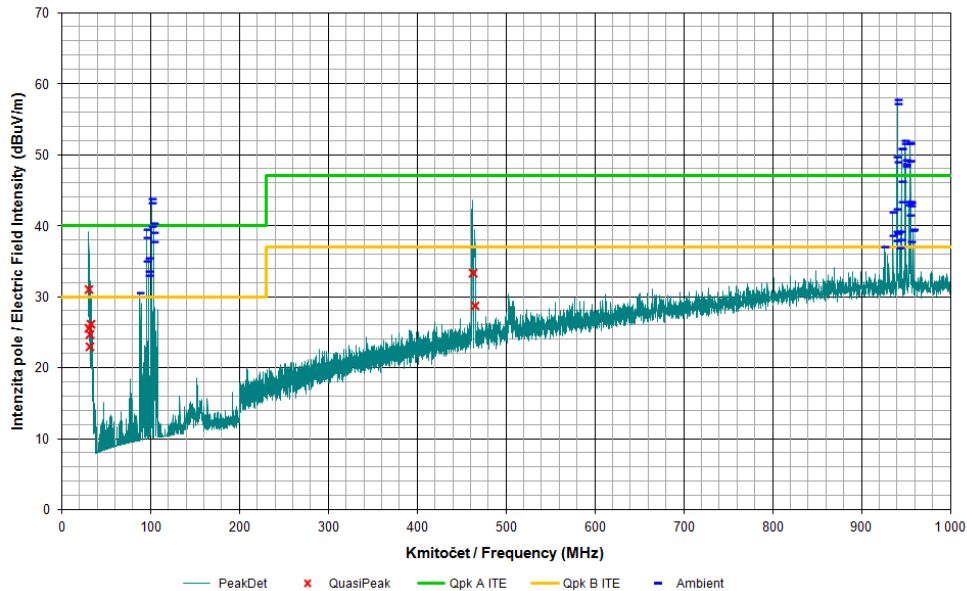
Bandwidth: 120 kHz

Detector: Peak, quasi-peak, average

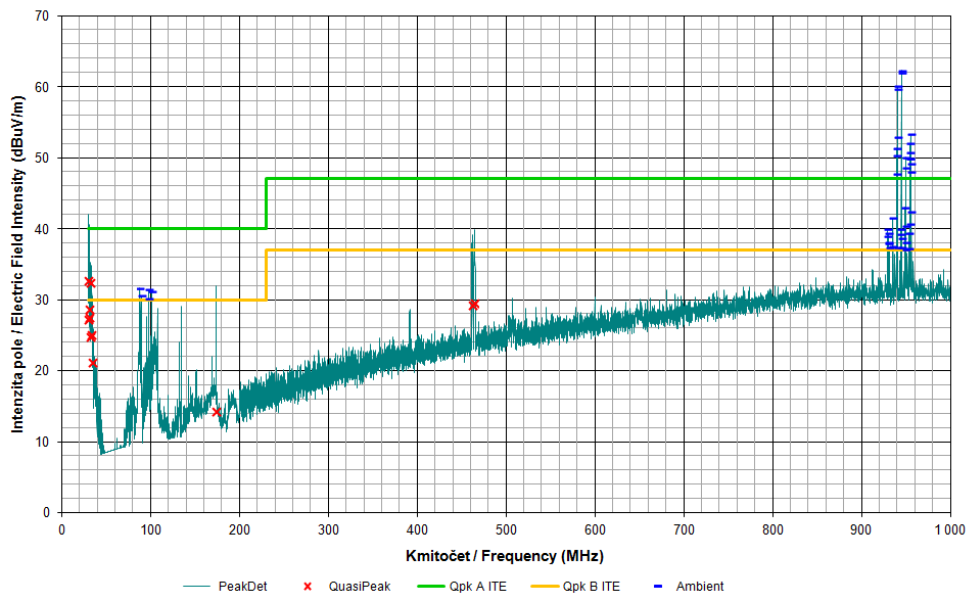
Note: The procedure by appendix B in CSN EN 55022 was used for measuring data evaluation.
The test was made in the non-shielding room. The procedure by art. 8 in CSN EN 55022 was used for measuring data evaluation.

Electromagnetic field measurement - high frequency disturbance																																																																																																	
CSN EN 55011 ed.2:2007 + A2 art. 5.2, 7.2 / CSN EN 55022 ed.2:2007 + A1 art. 6, 10																																																																																																	
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Electromagnetic field measurement - high frequency disturbance CSN EN 55011 ed.2:2007 + A2 art. 5.2, 7.2 / CSN EN 55022 ed.2:2007 + A1 art. 6, 10	
Subject of test	AFR 31 - Smart Load to Reduce Ferroresonance, s.n. 593, manufacturer KMB systems, s.r.o.



Electromagnetic field frequency characteristic – horizontal polarization



Electromagnetic field frequency characteristic – vertical polarization

The uncertainty is determined by calculation, based on known interval of values on condition of uniform distribution input value. The calculation process is present either in document Test Laboratory Records - Measuring Uncertainty or in Calibration Certificate.

Uncertainty of electromagnetic field intensity measurement: $U_{epFSP7} = 4,2 \text{ dB (k = 2)}$

Test identification	Test sequence number	Date	Examined by
B.03	6	10. 6. 2013	Stastny

Result evaluation (interpretation): The intensity of electromagnetic field did not exceed limit values according to CSN EN 55022 ed.2 for class A. The result is in accordance with requirement of standard CSN EN 61326-1.