2125119.0501-QUA/EMC

EMC test report for a MCCB, model: UPB 100 X (100 A).

Manufactured by Hyundai Heavy Industries Co. Ltd.

Arnhem, November 3, 2009

Author: G.H.J. van Wee
KEMA Quality B.V.

By order of Hyundai Heavy Industries Co., Ltd., at Ulsan Korea.

author : G.H.J. van Wee	reviewed : P.A. Witjes
B 28 pages 0 annexes MO	approved : A.T. van der Meijden

CONTENTS

page

CONCLUSION

The equipment under test (EUT) meets the essential requirements as listed in the summary in this test report.

The manufacturer declared the derived models UPB 250 X/L/H/S, UPB 160 X/L/H/S, UPB 100 L/H/S enclose the same electronic tripping device as the tested model UPB 100 X therefore the results of the tested model are also applicable for the derived model.

The conclusion and results stated in this test report are based on a non-recurrent examination of sample(s) provided by the applicant.

The tests described in this report do not result in the right to use any approval mark as conferred by KEMA. As far as the tests were based on certain specifications, these are mentioned in the report.

SUMMARY

This chapter presents an overview of standards and results. Refer to the next chapters for details of measured test results and applied test levels.

APPLIED STANDARDS		
Standard	Year	Title
IEC60947-2	2006	Low voltage switchgear and controlgear: Part-2 Circuit breakers
CISPR 11 +A1	2003 2004	Emission – Industrial, Scientific and Medical (ISM) equipment
IEC 61000-4-2 +A1 +A2	1995 1998 2000	Electrostatic discharge immunity test
IEC 61000-4-3 +A1	2002 2002	Radiated, radio-frequency, electromagnetic field immunity test
IEC 61000-4-4 +A1 +A2	1995 2000 2001	Electrical fast transient /burst immunity test
IEC 61000-4-5 +A1	1995 2000	Surge immunity test
IEC 61000-4-6 +A1	2003 2004	Immunity to conducted disturbances, induce by radio-frequency fields

Other EMC standards have been found not applicable for the EUT.

OVERVIEW EMISSION RESULTS	RESULT
Radiated electromagnetic field	**PASS**

OVERVIEW IMMUNITY RESULTS	RESULT
Electrostatic Discharges (ESD), F4.2	**PASS**
Radiated EM Field, F4.3	**PASS**
Radiated EM Field spot frequencies, F4.3	**PASS**
Electrical fast transient (EFT) / Burst transients, F4.4	**PASS**
Surge transients, F4.5	**PASS**
Conducted RF immunity, F4.6	**PASS**
Conducted RF immunity at spot frequencies, F4.6	**PASS**
Current dips, F4.7	**PASS**
Harmonic current immunity, F4.1	**PASS**

1 MODEL INFORMATION

1.1 Model description

The apparatus as supplied for the test is a Moulded Case Circuit Breaker (MCCB). The MCCB is manufactured by Hyundai Heavy Industries Co. The model is listed in S. 2.1. The model has 3 poles and is provided with an electronic tripping device.

The manufacturer declared the derived models UPB 250 X/L/H/S, UPB 160 X/L/H/S, UPB 100 L/H/S enclose the same electronic tripping device as the tested model UPB 100 X therefore the results of the tested model are also applicable for the derived model.

1.2 Settings during the EMC tests

Sample	Base current setting (I_0)	Ir setting	STD (I_m) x Ir	Trip time @ 2 x Ir (s)
UPB 100 X	x0,5	x0,8	2	60
	50A	40A	80A	

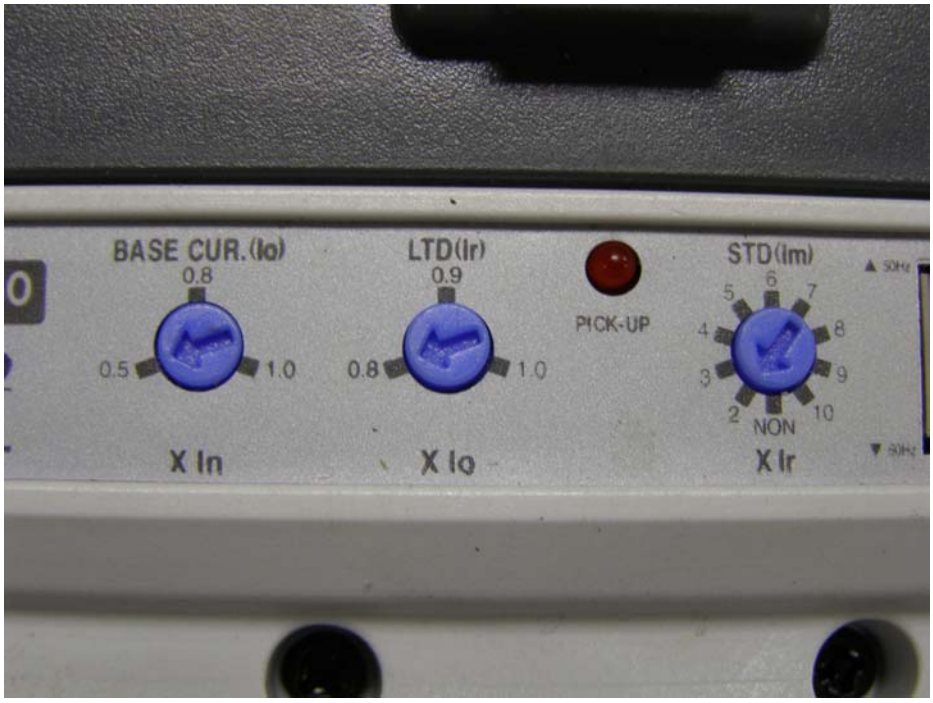

Figure 1 MCCB setting dials

Current settings

Model UPB 100 X:

I_0 = 100 x 0,5= 50A.

Ir = I_0 x 0,8 = 50 x 0,8 = 40A

Applied no tripping test current is Ir = 0,9 x 40A = 36A

Applied test current for tripping is Ir = 2x 40A = 80A

Derived timing from applicant tripping curve sheet;

Specified trip time at 2xIr:

- minimum 60s - 20% = 48s
- maximum 60s + 20 % = 72s

Limits of trip time for EMC immunity testing purpose (according Performance criterion A);

- minimum trip time x 0,9 = 43,2s
- maximum trip time x 1,1 = 79,2s

So the MCCB shall trip between 43,2s and 79,2s.

1.3 Environment

The requirements and standards apply to equipment intended for use in:

X	Residential (domestic) environment
X	Commercial and light-industrial environment
X	Industrial environment
	Medical environment – (Not) Life-Supporting

1.4 Classification

For the equipment under test the following classification is applicable.

	EN 55011 Class A	Equipment suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes
X	**EN 55011 Class B**	Equipment suitable for use in domestic establishments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes
X	**EN 55011 Group 1**	ISM equipment in which there is intentionally generated and/or used conductively coupled radio frequency energy which is necessary for the internal functioning of the equipment itself
	EN 55011 Group 2	ISM equipment in which radio frequency energy is intentionally generated and/or used in the form of electromagnetic radiation for the treatment of material, and spark erosion equipment

2 GENERAL INFORMATION

2.1 Product information

Equipment under test	MCCB (Molded Case Circuit Breaker)
Trade mark	Hyundai
Model	UPB 100 X (100A)
Derived models	UPB 250 X/L/H/S, UPB 160 X/L/H/S, UPB 100 L/H/S
Trip unit	MOR-25-SO
Serial number	sample
U nominal (Ue)	440 V_{AC}, 3 ph.
U insulation (Ui)	750 V_{AC}
Impulse withstand voltage	8 kV

2.2 Client information

Applicant	Hyundai Heavy Industries Co. Ltd.
Contact person	Mr. D.Y. Youn
Telephone	+82 52230845427
Telefax	+82 522308450
Address	1, Jeonha-dong Dong-ku
Place	Ulsan 682-792
Country	Korea, Repubic of

2.3 Test data

Location	KEMA Quality B.V., The Netherlands
Date	April, 2009
Engineer	A.J. Vet

2.4 Environmental conditions

Tests have been performed in a controlled laboratory environment, where the environmental conditions are maintained within the applicable ranges.

Ambient temperature	15 °C – 35 °C
Relative Humidity air	30% - 60%

2.5 Performance criteria

Performance criterion A:
For step 1, the circuit-breaker when loaded at 0,9 times the current setting shall not trip and the monitoring functions, if any, shall correctly indicate the status of the circuit-breaker.
For step 2, when loaded at 2,0 times the current setting, the circuit-breaker shall trip within 0,9 times the minimum value and 1,1 times the maximum value of the manufacturer's time current characteristic, and the monitoring functions, if any, shall correctly indicate the status of the circuit-breaker.

Performance criterion B:
During the test, the circuit-breaker when loaded at 0,9 times the current setting shall not trip. After the test, the circuit-breaker shall comply with the manufacturer's time current characteristic when loaded at 2,0 times the current setting and the monitoring functions, if any, shall correctly indicate the status of the circuit-breaker.

2.6 Monitored check

	Motor speed		Illumination
	Switching		Display data
	Standby mode		Data storage
	Temperature		Sensor functions
	Power consumption		Audible signals
	Heating	**X**	Others: LED's
X	Timing	**X**	Others: -Tripping within specified trip time -No tripping

3 EMISSION TEST RESULTS

3.1 Radiated EM Field emission

Standard	EN 55011 Group 1 Class B
Measuring distance	10 meters

Frequency [MHz]	QP [dB(μV/m)]
30 – 230	30
230 – 1000	37

Port	Enclosure with cabling
Test set-up	According IEC 60947-2 figure J.2 and F.2

Results

No significant emission were measured at both horizontal and vertical antenna polarisation.

Conclusion

PASS

4 IMMUNITY TEST RESULTS

4.1 Electrostatic discharge immunity

Electrostatic discharges (ESD) are the result of persons or objects that accumulate static electricity due to for instance walking on synthetic carpets. The ESD can influence the operation of equipment or damage its electronics, either by a direct discharge or indirectly by coupling or radiation. Both effects are simulated during the tests.

Requirements

Standard	IEC 60947-2
Basic standard	IEC 61000-4-2
Port/test setup	Metal enclosure/according fig. F16
Performance criterion	B: - During the test no tripping allowed at 0,9 times the current setting - After the test the circuit breaker shall trip at 2 times the current setting within the specification
Air discharges	8 kV
Contact discharges	8 kV
Number of discharges	≥ 10 per polarity with ≥ 1 sec interval

Performed tests

Air discharges		2 kV	**X**	4 kV	**X**	8 kV		15 kV
Contact discharges		2 kV	**X**	4 kV	**X**	6 kV	**X**	8 kV
Via coupling planes	**X**	Metal enclosure						
Polarity	**X**	Positive			**X**	Negative		
Set-up	**X**	Table-top				Floor standing		
Test circuit	According figures F.2 and J.3 of IEC 60947-2							
Discharge location	All external locations accessible by hand							
Ambient temperature	22 °C							
Relative Humidity air	37%							

Observations

No tripping occurred at 0,9 times the current setting, the EUT functioned as intended, no unacceptable loss of performance was observed.

After the test: Trip time within specification at 2,0 times the current setting.

Measured trip time:

Model	Trip time [s]	Limit time [s]
UPB 100 X	59,0	43,2 < t < 79,2

Conclusion

PASS

4.2 Radiated EM field immunity

During the test it is verified if the equipment under test has sufficient immunity against radiated electromagnetic fields. Walkie-talkies, radio transmitters, television transmitters, and telecommunication equipment including cellular telephones and other emitting devices, like industrial electromagnetic sources can generate these fields.

Requirements

Standard	IEC 60947-2
Basic standard	IEC 61000-4-3
Port	Enclosure
Performance criterion	A; - No tripping allowed at 0,9 times the current setting
Test set-up	According IEC 60947-2 figure F.16, F.17 and F.2
Frequency range	80 - 1000 MHz 1,4 – 2,0 GHz
Modulation	1 kHz - 80% AM
Field strength	10 V/m

Performed tests

Frequency range	80 - 1000 MHz 1,4 – 2,0 GHz
Tested field strength	10 V/m
Dwell time	1 second
Test set-up	Full Anechoic Chamber

Observations

No tripping occurred at 0,9 times the current setting, the EUT functioned as intended, no unacceptable loss of performance was observed.

Conclusion

PASS

4.3 Radiated EM field immunity (spot frequencies)

During the test it is verified if the equipment under test has sufficient immunity against radiated electromagnetic fields. Walkie-talkies, radio transmitters, television transmitters, and telecommunication equipment including cellular telephones and other emitting devices, like industrial electromagnetic sources can generate these fields.

Requirements

Standard	IEC 60947-2
Basic standard	IEC 61000-4-3
Port	Enclosure
Performance criterion	A; Operation as intended - trip time is measured
Test set-up	According IEC 60947-2 figure F.16, F.17 and F.2
Modulation	1 kHz - 80% AM
Field strength	10 V/m
Test mode	Test current 2 times the current setting

Performed tests

Frequency range	80 - 1000 MHz 1,4 – 2,0 GHz
Tested field strength	10 V/m
Dwell time	Till MCCB tripped
Test set-up	Full Anechoic Chamber

Observations

Limit trip time according section 1.2 at 2,0 times the current setting (Ir = 80 A).

Frequency [MHz]	Trip time [s] Hor.	Trip time [s] Vert.	Limit time [s]
80	59,8	70,4	43,2 < t < 79,2
100	61,1	70,4	43,2 < t < 79,2
120	59,7	63,1	43,2 < t < 79,2
180	58,8	60,5	43,2 < t < 79,2
240	61,1	67,0	43,2 < t < 79,2
320	60,7	66,1	43,2 < t < 79,2
480	63,4	65,0	43,2 < t < 79,2
640	65,0	57,4	43,2 < t < 79,2
960	63,7	61,2	43,2 < t < 79,2
1400	57,5	64,3	43,2 < t < 79,2
1920	71,1	61,0	43,2 < t < 79,2

Conclusion

PASS

4.4 Electrical Fast Transient immunity

The EFT immunity test simulates disturbances by bursts of very short transients caused for example by switching off loads such as an AC motor or bouncing relay contacts. The transients are likely to disturb electronics but less likely to cause damage.

Requirements

Standard	IEC 60947-2			
Basic standard	IEC 61000-4-4			
Performance criterion	B: - During the test no tripping allowed at 0,9 times the current setting - After the test the circuit breaker shall trip at 2 times the current setting within the specification			
Test set-up	According IEC 60947-2 figure F.16, F.18 and F.6			
Pulse characteristics	5/50 ns			
Peak Voltage; Port	4 kV; AC input power port			
Repetition frequency	**X**	5 kHz		2,5 kHz

Performed tests

Tested Voltage; Port	4 kV; AC input power port			
Injection method	**X**	CDN		Capacitive clamp
Polarity	**X**	Positive	**X**	Negative
Set-up		Table-top	**X**	Floor standing

Observations

No tripping occurred at 0,9 times the current setting, the EUT functioned as intended, no unacceptable loss of performance was observed.
After the test: Trip time within specification at 2,0 times the current setting.

Measured trip time:

Model	Trip time [s]	Limit time [s]
UPB 100 X	60,0	43,2 < t < 79,2

Conclusion

PASS

4.5 Surge transient immunity

The surge transient immunity test simulates the surges that are caused by over-voltages due to indirect (induced) lightning transients. The pulse is a slow transient with high-energy contents and due to its long duration may cause damage to an unprotected EUT.

Requirements

Standard	IEC 60947-2
Basic standard	IEC 61000-4-5
Performance criterion	B: - During the test no tripping allowed at 0,9 times the current setting. - After the test the circuit breaker shall trip at 2 times the current setting within the specification
Test set-up	According IEC 60947-2 figure F9 and F12, and table J.1
Pulse characteristics	1,2/50 µs
Peak Voltage; Port	2 kV; AC input power port (line to line) 4 kV; AC input power port (line to earth)

Performed tests

Tested Voltage; Port	2 kV; AC input power port (line to line) 4 kV; AC input power port (line to earth)			
Polarity	**X**	Positive	**X**	Negative

Observations

No tripping occurred at 0,9 times the current setting, the EUT functioned as intended, no unacceptable loss of performance was observed.
After the test: Limit trip time according section 1.2 at 2,0 times the current setting.

Measured trip time:

Model	Trip time [s]	Limit time [s]
UPB 100 X	59,5	43,2 < t < 79,2

Conclusion

PASS

4.6 RF Conducted immunity

During this test the immunity of the equipment for induced or conducted electromagnetic fields is checked. Fields generated by radio and other transmitters cause RF voltages in long cables like the mains network. This test reproduces these induced disturbing voltages by injecting them to the EUT via the cabling.

Requirements

Standard	IEC 60947-2
Basic standard	IEC 61000-4-6
Performance criterion	A; - No tripping allowed at 0,9 times the current setting
Test set-up	According IEC 60947-2 figure F.20, F.21 and F.2
Frequency range	0,15 – 80 MHz
Modulation	1 kHz – 80% AM
Test level; Port	10 V; AC input power port

Performed tests

Tested level; Port	10 V; AC input power port			
Frequency range	0,15 – 80 MHz			
Dwell time	1 second			
Injection method	**X**	CDN-M2		EM clamp

Observations (all models)

No tripping occurred at 0,9 times the current setting, the EUT functioned as intended, no unacceptable loss of performance was observed.

Conclusion

PASS

4.7 RF Conducted immunity (spot frequencies)

During this test the immunity of the equipment for induced or conducted electromagnetic fields is checked. Fields generated by radio and other transmitters cause RF voltages in long cables like the mains network. This test reproduces these induced disturbing voltages by injecting them to the EUT via the cabling.

Requirements

Standard	IEC 60947-2
Basic standard	IEC 61000-4-6
Performance criterion	A: Operation as intended - trip time is measured
Test set-up	According IEC60947-2 figure F.20, F.21 and F.2
Frequency range	0,15 – 80 MHz
Modulation	1 kHz – 80% AM
Test level; Port	10 V; AC input power port
Test mode	2 times the current setting

Performed tests

Tested level; Port	10 V; AC input power port			
Frequency range	0,15 – 80 MHz			
Dwell time	Till MCCB tripped			
Injection method	**X**	CDN-M2		EM clamp

Observations

Limit trip time according section 1.2 at 2,0 times the current setting (80 A).

Frequency [MHz]	Trip time [s]	Limit time [s]
0,150	56,5	43,2 < t < 79,2
0,300	63,1	43,2 < t < 79,2
0,450	63,7	43,2 < t < 79,2
0,600	68,1	43,2 < t < 79,2
0,900	63,3	43,2 < t < 79,2
1,20	69,9	43,2 < t < 79,2
1,80	59,0	43,2 < t < 79,2
2,40	57,5	43,2 < t < 79,2
3,60	57,8	43,2 < t < 79,2
4,80	59,5	43,2 < t < 79,2
7,20	64,0	43,2 < t < 79,2
9,60	57,4	43,2 < t < 79,2
12,00	57,5	43,2 < t < 79,2
19,20	57,5	43,2 < t < 79,2
27,00	59,8	43,2 < t < 79,2
49,40	53,7	43,2 < t < 79,2
72,00	59,4	43,2 < t < 79,2
80,00	56,5	43,2 < t < 79,2

Conclusion

PASS

4.8 Current dips

Requirements

Standard	IEC 60947-2
Performance criterion	A; No tripping allowed at 0,9 times the current setting
Test set-up	According IEC 60947-2 figure F.2

Performed tests

Test no	I dip	Delta t	Result
1	0	0,5	PASS
2	0	1	PASS
3	0	5	PASS
4	0	25	PASS
5	0	50	PASS
6	0,4 * Ir	10	PASS
7	0,4 * Ir	25	PASS
8	0,4 * Ir	50	PASS
9	0,7 * Ir	10	PASS
19	0,7 * Ir	25	PASS
11	0,7 * Ir	50	PASS

Observations

No tripping occurred at 0,9 times the current setting. The EUT functioned as intended, no unacceptable loss of performance was observed.

Conclusion

PASS

4.9 Harmonic currents Immunity

Requirements

Standard	IEC 60947–2
Performance criterion	A
Current characteristics	Waveform a; 50 Hz plus 150 Hz, 72 % - 88% Harmonic current Waveform b; 50 Hz plus 250 Hz, 45 % - 55% Harmonic current

Performed tests

Current characteristics	Waveform a; 50 Hz plus 150 Hz, 75 % Harmonic current Waveform b; 50 Hz plus 250 Hz, 50 % Harmonic current
Current level	Step 1: Total RMS value = 0,9 times the current setting Step 2: Total RMS value = 2 times the current setting

Observations

No tripping at 0,9 times the current setting.

After the test: Trip time within specification at 2,0 times the current setting

Measured trip time:

Model	Trip time [s]	Limit time [s]
UPB 100 X	59,0	43,2 < t < 79,2

Conclusion

PASS

5 IDENTIFICATION OF THE EQUIPMENT UNDER TEST

The photographs show the tested device.

EUT: UPB 100 X

EUT: label information