



HARMONIC FILTER DAMPING RESISTOR

TEST INSPECTION

Required by: Microelettrica Scientifica spa, Via del Lavoro 1, 20084 Lacchiarella (MI), with order n.08/A1/002749 of 04/07/08

Issued by

Cormano Head Offices, on 2008, July 09th

		
Ing. Guido Billi <i>Head of Structural Engineering Dept</i>	Ing. Pietro Villa <i>Head of Material Resistance Dept</i>	Ing. Davide Magagnini <i>Breda Engineering & Research</i>
WRITTEN	VERIFIED	APPROVED

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Società partecipata da Socio Unico - Società soggetta all'attività di direzione e coordinamento di Spezzapria s.r.l. - C.F 03180630240



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1. Introduction

RTM Breda has been required to attend, as a customer representative, to routine and type tests on one Harmonic Filter Damping Resistor (see Annex A), in order to certify that tests have been performed fulfilling with requirements.

2. Description

On July 2nd, 2008, Mr. Guido Billi (RTM Breda technician) was present during the tests.

The routine test procedure and the type test procedure are reported in the Annex B.

The scan of the routine and type test reports are reported in the Annex C. Looking at test reports, one can see that all tests, which have been strictly performed according to annexed procedures, are passed.

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Annex A – Harmonic Filter Damping Resistor

M.S RESISTANCES

TECHNICAL SPECIFICATION

File Name: O DA 08 02 010 - 1 # 1 Spec.doc	Project : RTE ~ PACA Area / 63kV Compensation	Date : 21/03/08	Page: 1 / 3
Internal Reference: O DA 08 02 010	Revision: 1	Customer: ABB AB	Customer's Reference:

Project:
RTE ~ PACA Area / 63kV Compensation

HARMONIC FILTER DAMPING RESISTORS

Relevant Standards:

- ✓ **Insulation co-ordination for equipment in three phase electrical equipment:**
↳ IEC 60071-1 and 60071-2
- ✓ **Metal enclosed high Voltage equipment for voltage up to 72,5 kV:**
↳ IEC 60298
- ✓ **Protection Degree of enclosure:**
↳ IEC 60529
- ✓ **High Voltage Bushings:**
↳ IEC 60137
- ✓ **Indoor post insulators of ceramic:**
↳ IEC 60273 & IEC 60168
- ✓ **Galvanizing Process :**
↳ ISO 1461

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M.S RESISTANCES

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Internal Reference: O DA 08 02 010	Revision: 1	Customer: ABB AB	Customer's Reference:

I Electrical Data:

- * System Voltage: 63kV (66kV max)
 - ↳ Insulation Level: 72.5kV
 - ✓ Power Frequency: 140kV_{rms} to ground / 140kV_{rms} across
 - ✓ Lightning Impulse: 325kV_{peak} to ground / 325kV_{peak} across
- * Ohmic Value:
 - ✓ At nominal Power: 400Ω (in "H" Arrangement) -0 ~ + 10%
 - ✓ At ambient: 306.5Ω (in "H" Arrangement) -0 ~ + 10%
 - ✓ On overload: 404Ω (in "H" Arrangement) -0 ~ + 10%
 - ✓ Inductance: 230μH
- * Duty Cycles:
 - ↳ Steady State:
 - ✓ Rated Current: 18.5A
 - ✓ Rated Power: 137kW
 - ↳ Overload (10 minutes)..... Design Power:
 - ✓ Current: 19A
 - ✓ Power: 144kW
- * Temperature Rises:
 - ✓ On Steady State: 320°k
 - ✓ On Overload: 335°k
- * Time Constant: 84sec

II Active Part Details:

- * The Resistive elements are made of "CL" Type grids. They are made from stainless steel alloy AISI 304 (18% Chromium – 9% Nickel)
 - ✓ Approximate temperature coefficient = $0.9 \times 10^{-3}/^{\circ}\text{k}$
- * The CL System is made from collection of cut metal grids linked to each other by hot spot welding & insulated from tie rod by ceramic rings & Teflon Tubes.

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M.S RESISTANCES

TECHNICAL SPECIFICATION

File Name: O DA 08 02 010 - 1 #1 Spec.doc	Projet : RTE ~ PACA Area / 63kV Compensation	Date : 21/03/08	Page: 3 / 3
Internal Reference: O DA 08 02 010	Revision: 1	Customer: ABB AB	Customer's Reference:

III Insulation Coordination:

- * The resistor Phases are designed in two (2) mid-potential connected cubicles.
The cubicles are stacked one over the other
- ↳ Insulation Coordination of each Cubicle
 - ✓ Main indoor insulators: 17.5kV - 38kV_{1min} & 95kV_{BIL} – Creepage: 200mm
 - ✓ “IN” & “OUT” Bushings: 17.5kV - 38kV_{1min} & 95kV_{BIL} – Creepage: 446mm
- ↳ Insulation Coordination between cubicles
 - ✓ Intermediate Insulators: 36kV - 70kV_{1min} & 170kV_{BIL} – Creepage: 720mm_{min}
... Type C8-170 II
- ↳ Insulation Coordination to ground
 - ✓ Bottom Insulators: 72.5kV - 140kV_{1min} & 325kV_{BIL} – Creepage: 1450mm_{min}
... Type C10-325 II

IV General Arrangement:

- ✓ Banks mounted between two End Plates & supported horizontally by porcelain insulators
- ✓ “Easy to remove” Panels on front & Rear faces.
- ✓ Weather Proof Roof.
- ✓ Protection against Rodents and Birds.
- ✓ Hot Dip Galvanized Steel Sheets Enclosures.
- ✓ Protection Degree: IP 23 (for Outdoor Use)
- ✓ Approx Net Weight: 1020kG

*Resistor Frames are alive!!
They must located in a fenced-off area*

V Dimensions:

- ✓ See Drawing: C DA 08 02 010 - 1

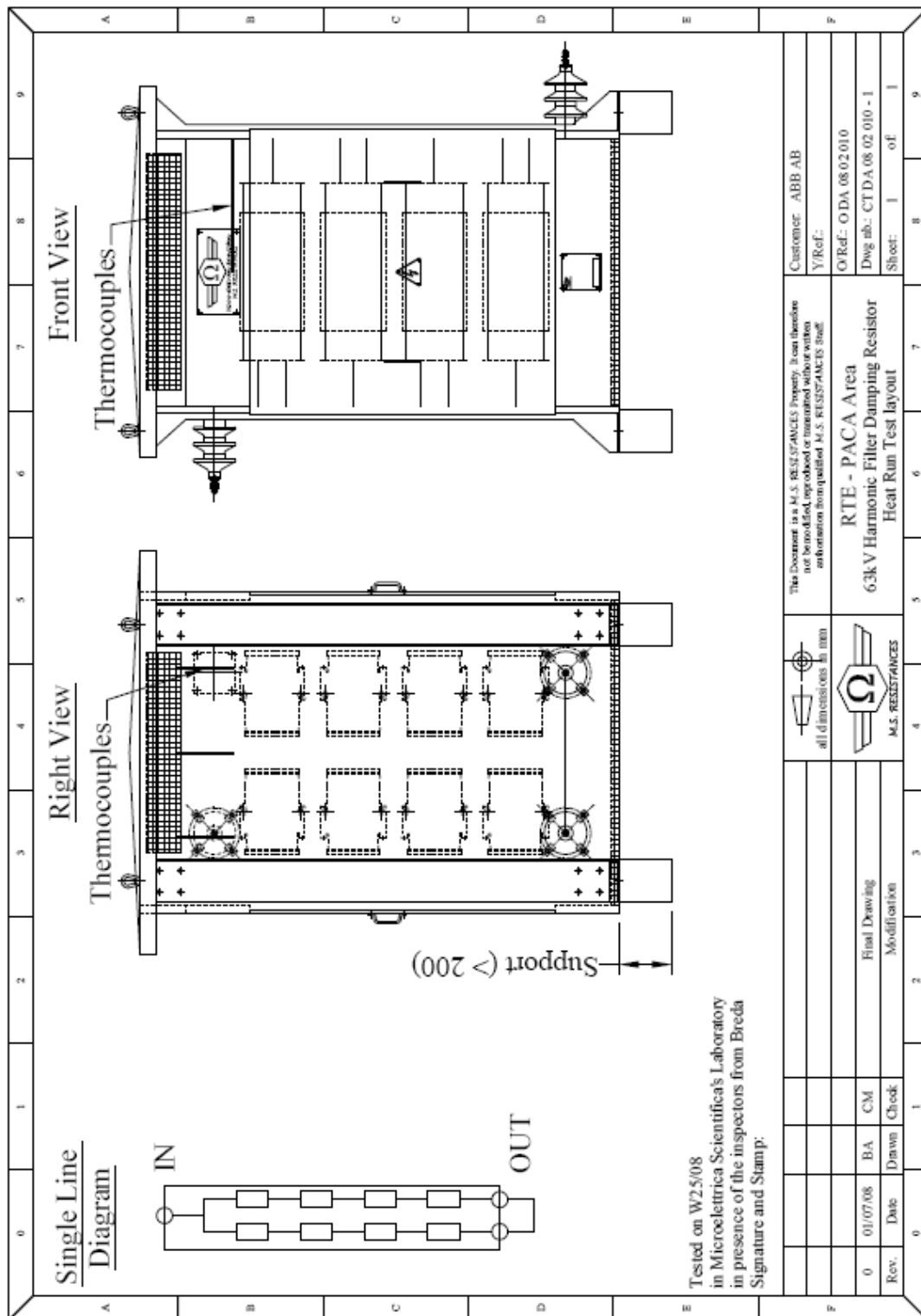
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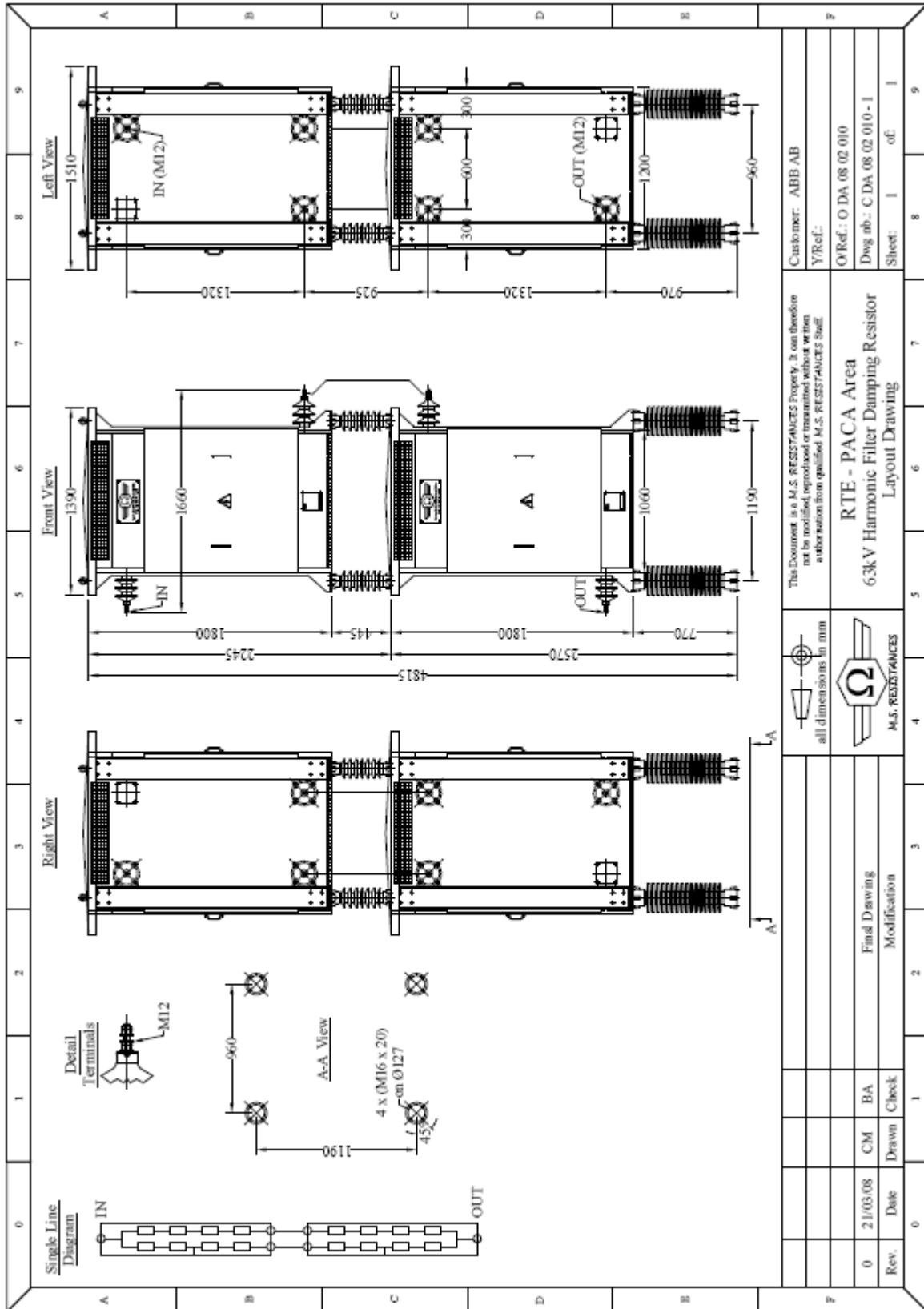
Tested on W25/08
 in Microelettrica Scientifica's Laboratory
 in presence of the inspectors from Breda
 Signature and Stamp:

		all dimensions in mm		M.S. RESISTANCES		Customer: ABB AB Y/Ref:	
				RTE - PAC A Area 63kV Harmonic Filter Damping Resistor Heat Run Test layout		O/Ref: O DA 08 02 010 Dwg nb: CTDA 08 02 010 - 1 Sheet: 1 of 1	
0	01/07/08	BA	CM	Final Drawing			
Rev.	Date	Drawn	Check	Modification			

Sigla redazione

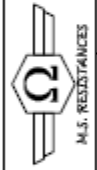


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all dimensions in mm

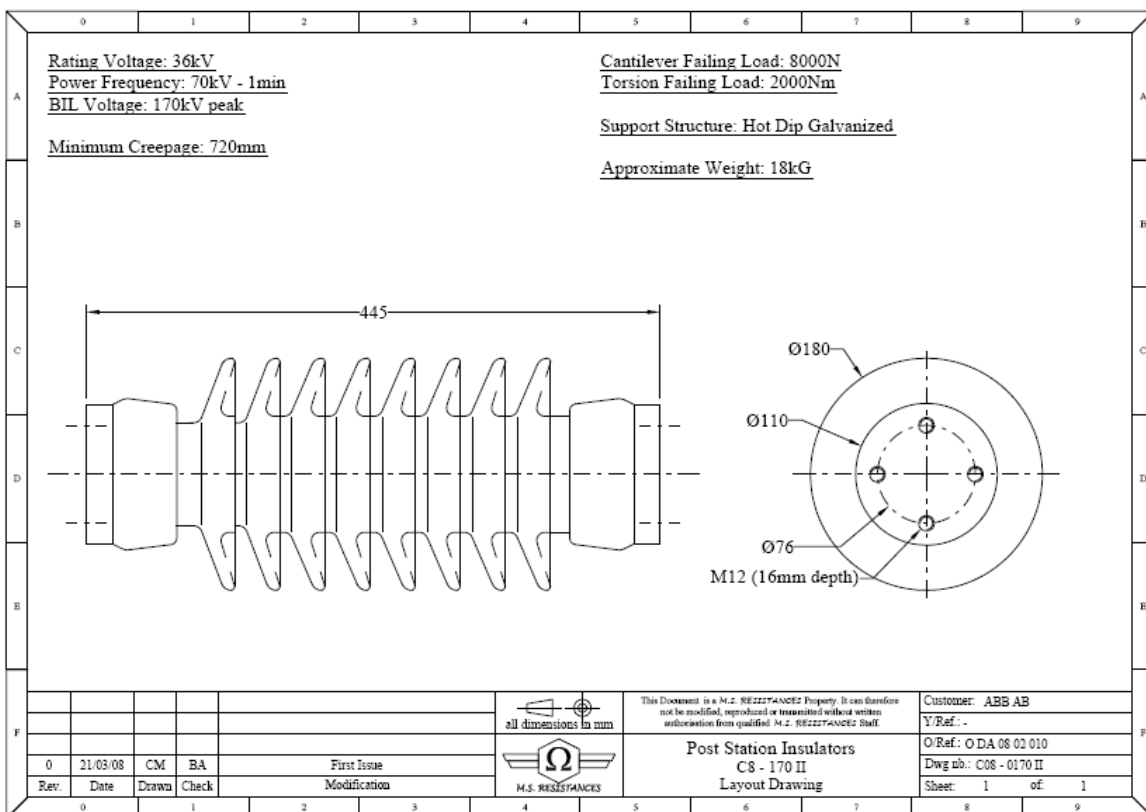
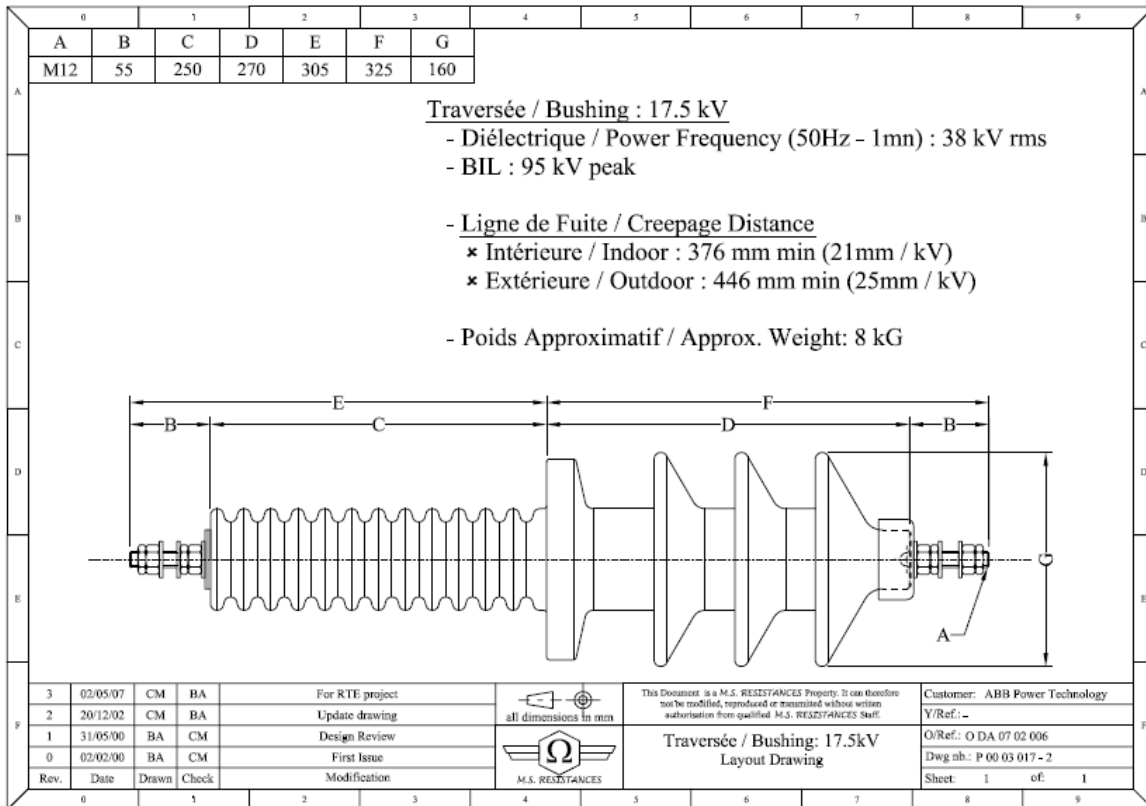


Customer: ABB AB									
Y/Ref.:									
O/Ref.: O DA 08 02 010									
Dwg ab.: C DA 08 02 010 - 1									
Sheet: 1 of 1									
RTE - PACA Area		6.3kV Harmonic Filter Damping Resistor							
Layout Drawing									
Rev.	Date	Drawn	Check	Final Drawing					
0	21/03/08	CM	BA	Modification					

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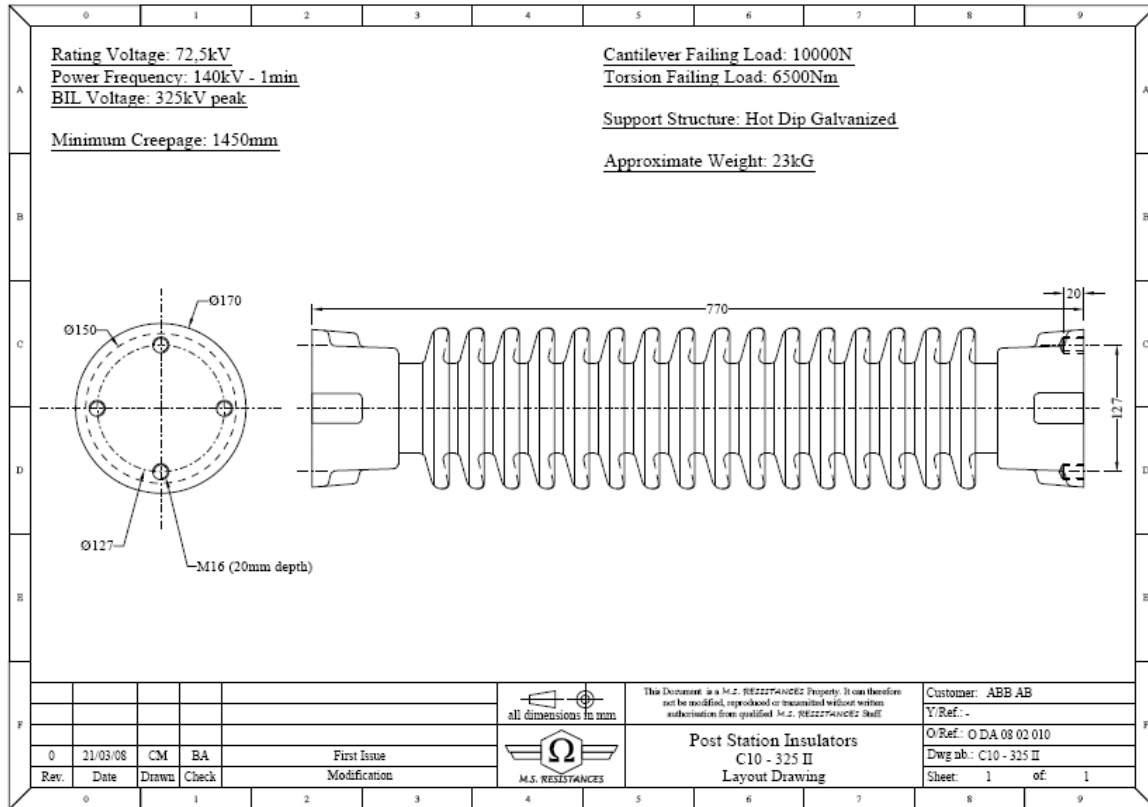
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Annex B – Routine and Type test procedures

 MICROELETTRICA SCIENTIFICA M.S. RESISTANCES		TYPE TEST SCHEDULE		 DIN EN ISO 9001:2000 Cert. N°: 73 100 19 24	
Date: 1 juil. 2008				Page 1 / 1	
Customer: ABB AB	Reference: RTE - 63kV	Project: RTE - PACA AREA	Internal Ref: ODA 08 02 010		
Equipment Specification -					
Item Description	Harmonic Filter Damping Resistor (63kV) 66kV - 400 Ohms ("H") @ warm - 18,5A / 137kW - Surge: 19A/144kW ~ 10min 325kVBIL to Ground & across - Creepage: 20mm/kV				
<p>1) Routine tests</p> <ul style="list-style-type: none"> ☞ Visual Inspection ☞ Dimensional Check ☞ Measurement of Insulation Resistance ☞ Measurement of Resistance (The resistor can be measured under DC and AC together) <i>Inductance Test @ 50 Hz will be avoided due to poor measurement stability for inductance</i> ☞ High Potential Test (Dielectric test @ 50Hz – 1min) <p>2) Resistors Cubicles Preparation</p> <ul style="list-style-type: none"> ☞ The resistor will be prepared for the heat run test which means <ul style="list-style-type: none"> ✓ Test made on one cubicles ✓ Internal connections will be modified by implementing 2 // paths. <i>The resistance Value at 20°C will be of 153.25 Ohms for a one cubicle.</i> ✓ Thermo-couples will be prepared and positioned at places we estimate to be the hottest <i>Additional thermo-couples can be used on customer demand</i> <p>3) Heat Run Tests Process</p> <ul style="list-style-type: none"> ☞ Preliminary measurement of Resistance at ambient temperature ☞ Verification of thermo-couples reading ☞ The power will be applied to the resistor (50 Hz) and adjusted to get 68.5 kW dissipation: <i>The dissipation is calculated from RMS measurements of voltage and current at steady state (power factor is negligible).</i> ☞ Calculated Values of Voltage & Current to reach 68.5 kW shall be at hot Stage: <ul style="list-style-type: none"> ✓ Voltage: 3701.4 V ✓ Current: 18.5 A × Temperature Rise will be directly measured though Thermo-couples × Hot Resistance Value will be calculated through $\bar{R} = U / I$ Formula where: <ul style="list-style-type: none"> ✓ R is the Hot Stage Resistance Value ✓ U is the stabilized RMS Voltage Value ✓ I is the stabilized RMS Current Value 					
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25/06/2008	0	TYPE TEST SCHEDULE - 1*0.DOC	C. MILLARD	B. AUDOUARD	H. ELASSAD
Date	Rev.	File	Written	Checked	Approved

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Annex C – Routine and Type test reports



RC47 rev.5 dal 10/01/07
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CERTIFICATO DI COLLAUDO RESISTENZE INDUSTRIA TEST REPORT FOR RESISTORS		O TT 08 02 010 - 1	
CLIENTE: CUSTOMER: ABB AB (Ludvika/Sweden)			
CONFERMA N°: ORDER ACKNOWLEDGMENT: O DA 08 02 010	DATA CONSEGNA: EX-W DELIVERY DATE: /	QUANTITA': QUANTITY: 1	
TIPO: TYPE: Filter Damping Resistor: 66kV - 400 ohms - 18,5A/137 kW	PRODUZIONE: PRODUCTION: settimana / week anno / year	27 2008	
N° DI SERIE SERIAL N°: O DA 08 02 010 - 1 / 001			
TEMPERATURA AMBIENTE: AMBIENT TEMPERATURE: 27 °C	ESAME VISIVO E DIMENSIONALE: VISUAL AND DIMENSIONAL EXAMINATION:		positivo passed <input type="checkbox"/>
VALORE OHMICO SPECIFICATO: RATED OHMIC VALUE: 153.25 Ohms	A At 20 °C	+10% = 168.575 Ohms -0% = 153.25 Ohms	
VALORE OHMICO MISURATO: MEASURED OHMIC VALUE: 157.6 Ohms	VALORE MODIFICATO A 20°C Corrected Value at 20°C: 155.00 Ohms		positivo passed <input type="checkbox"/>
VALORE INDUTTANZA MISURATO: INDUCTANCE VALUE MEASURED: 130 µH	RIGIDITA' DIELETTICA (60sec/50Hz) DIELECTRIC WITHSTAND (60sec/50Hz): 38 kV		positivo passed <input type="checkbox"/>
MISURA RESISTENZA DI ISOLAMENTO INSULATION TEST: 2 GOhms	> 200MΩ @ 1kV ₅₀		positivo passed <input type="checkbox"/>
ELENCO STRUMENTI USATI: MEASURED INSTRUMENTS:	Ohmetro elettronico - CROPICO DO4000 Electronic ohmmeter - CROPICO DO4000 Prova rigidità dielettrica - RISATTI E6/PR Dielectric test instruments - RISATTI E6/PR Megger elettronico - METRISO 5000A Electronic type megger - METRISO 5000A GW Instrument - LCR 189		(N° 0702) (N° 0070) (N° 0092) (N° 0093)
NORME DI RIFERIMENTO: REFERENCE STANDARDS:	IEC 60529: Degree of protection provided by enclosures (IP Code) IEC 62271-1: High-voltage switchgear and controlgear (Common specifications) IEC 62271-200: A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV IEEE-32: Requirements, Terminology & Test Procedure for Neutral Grounding Devices		
<p>No standard does clearly define how Harmonic Filter Damping Resistors are to be tested. The closest one are IEC 62271-1 & IEC 62271-200 As High Voltage Resistors a certainly the only high Voltage equipments where Temperature Rise can reach more than 350°C at Steady State, those standards cannot be taken word-by-word Temperature Rise Test is carried out to: - Check ohmic value on steady state - Check that equipment's Temperature Rise is under control and will not affect the good work duration of assembly Even though, IEEE-32 Standard does not apply to Harmonic Filter Damping Resistors, it provides limit concerning Temperature Rise on Steady State for Stainless Steel Resistors. This limit shall be 385°C</p>			
NOTE/REMARKS			

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Stabilimento di Lecco/Inverigo (MI) - Via del Lavoro, 1 - 20084 - Italy - Tel.: +39 025270700 - Fax: +39 0290076685



Krom-Schwarz Group

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CERTIFICATO DI COLLAUDO RESISTENZE INDUSTRIA TEST REPORT FOR RESISTORS		O TT 08 02 010 - 1
CLIENTE: CUSTOMER: ABB AB (Ludvika/Sweden)		
CONFERMA N°: ORDER ACKNOWLEDGMENT: O DA 08 02 010	DATA CONSEGNA: EX-W DELIVERY DATE: /	QUANTITA': QUANTITY: 1
TIPO: Filter Damping Resistor:	PRODUZIONE: settimana / week	27
TYPE: 66kV - 400 ohms - 18,5A/137 kW	PRODUCTION: anno / year	2008
N° DI SERIE SERIAL N°: O DA 08 02 010 - 1 / 001		
<p>DICHIARIAMO, CHE LA FORNITURA SOPRA DESCRITTA È CONFORME AI REQUISITI STABILITI NELL'ORDINE DI ACQUISTO. DICHIARIAMO INOLTRE CHE LA FORNITURA È STATA COLLAUDATA CON ESITO POSITIVO. LE DEVIAZIONI APPROVATE SONO ELENcate NELL'APPOSITO SPAZIO. TUTTE LE DOCUMENTAZIONI DI COLLAUDO VERRANNO CONSERVATE PER UN PERIODO DI ALMENO 10 ANNI E, PREVIO ACCORDO, SARANNO RESE ACCESSIBILI AL CLIENTE O AD UN SUO INCARICATO.</p> <p>IL PRESENTE DOCUMENTO È CONFORME ALLA NORMA UNI EN 10204 § 2.1 - 3.1 - 3.2 QUALORA RICHIESTO VERRÀ RILASCIATA APPOSITA DICHIARAZIONE CE (DIRETTIVE BT E EMC).</p> <p>WE HEREBY DECLARE, THAT THE ABOVE MENTIONED SUPPLY IS IN CONFORMITY WITH THE REQUIREMENTS INCLUDED IN THE PURCHASE ORDER. WE DECLARE THAT THE SUPPLY HAS BEEN INSPECTED AND TESTED WITH SATISFACTORY RESULTS. THE APPROVED DEVIATIONS ARE LISTED BELOW.</p> <p>ALL TEST DOCUMENTATIONS WILL BE KEPT FOR A PERIOD OF AT LEAST 10 YEARS AND, SUBJECT TO AGREEMENT, WILL BE ACCESSIBLE TO THE CUSTOMER OR TO AN ITS PERSON IN CHARGE.</p> <p>THIS DOCUMENT IS IN CONFORMITY WITH THE INTERNATIONAL STANDARD UNI EN 10204 § 2.1 - 3.1 - 3.2. IF REQUIRED, A SPECIAL CE DECLARATION (DIRECTIVE BT AND EMC) WILL BE ISSUED.</p>		
DEVIAZIONI / DEVIATIONS:		

FIRMA COLLAUDATORE
TESTING OPERATOR SIGNATURE

FIRMA ENTE COLLAUDO ESTERNO
CUSTOMER REPRESENTATIVE SIGNATURE

DATA
DATE

Microelettrica Scientifica SpA - Rozzano (MI) - Via Abernethy 56 / 58 - 20089 - Italy - Tel.: +39 02575731 - Fax +39 02575 10940
Stabilimento di Lacchiarella (MI) - Via del Lavoro, 1 - 20064 - Italy - Tel.: +39 0292270700 - Fax: +39 0290076685



Kier-Brenna Group

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R247 rev.6 dal 19/01/07
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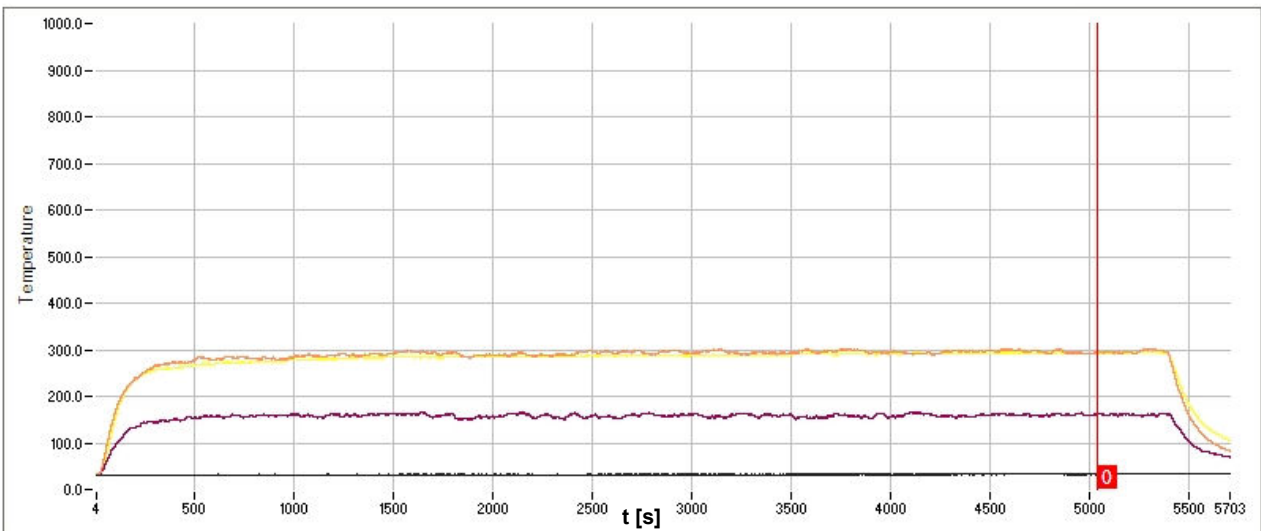
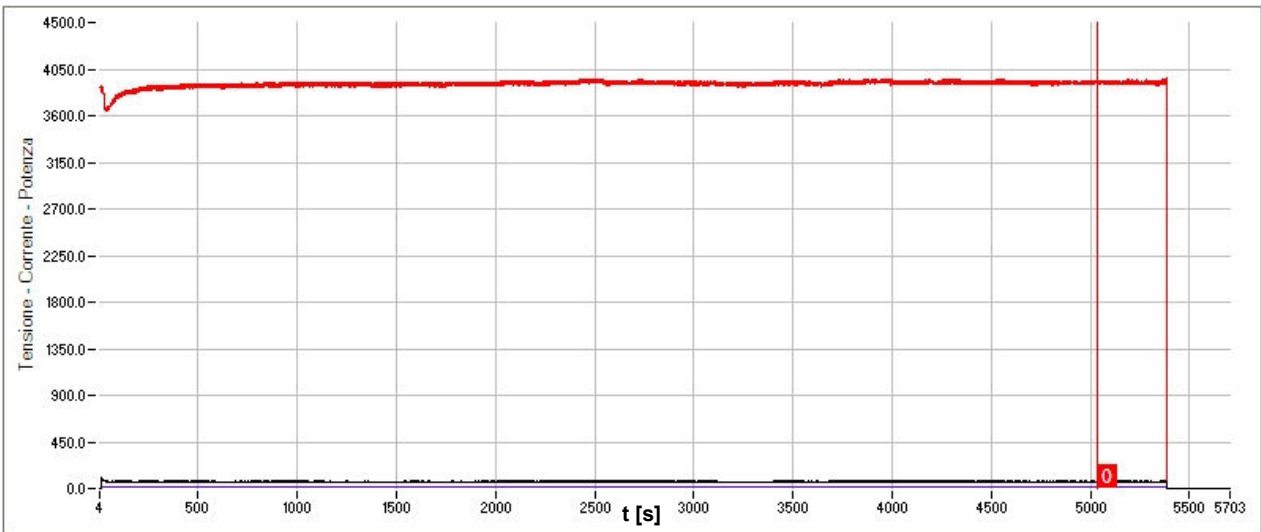
CERTIFICATO DI COLLAUDO RESISTENZE INDUSTRIA TEST REPORT FOR RESISTORS		O TT 08 02 010 - 1	
CLIENTE: CUSTOMER: ABB AB (Ludvika/Sweden)			
CONFERMA N°: ORDER ACKNOWLEDGMENT: O DA 08 02 010	DATA CONSEGNA: EX-W DELIVERY DATE: /	QUANTITA': QUANTITY: 1	
TIPO: TYPE: Filter Damping Resistor: 66kV - 400 ohms - 18,5A/137 kW	PRODUZIONE: PRODUCTION: settimana / week anno / year	27 2008	
N° DI SERIE SERIAL N°: O DA 08 02 010 - 1 / 001			
Allegato 1 / Enclosure 1			
Temperature Rise Test			
Power to be Injected during Test:	68.5 kW	in Steady State	
- Approx. Voltage to be injected	3701.4 V		
- Approx. Current to be injected	18.5 A		
Target Temperature Rise:	385 °k		
<i>Resistor will be considered in Steady State Condition once Measured Voltage & Current do not vary more than 1% within 15minutes</i>			
Voltage Measured on Steady State:	3,921 V		
Current Measured on Steady State:	17.6 A		
Calculated Injected Power:	69.0 kW		
Specified Rated Ohmic Value:	200 Ohms	At Hot	+10% -0%
Calculated Resulting Ohmic Value:	222.78 Ohms		
- Calculated Resulting $\alpha \Delta\theta$:	0.44	= $R_{test} / R_{cold} - 1$	
- as per Temperature Coefficient curve attached:	$\alpha = 1.65E-03 / ^\circ C$	&	$\Delta\theta = 260 ^\circ C$
Average Measured Temperature on Thermocouples:	255 °k		
Ohmic Value Measured after test:	158.60 Ohms	at 36 °c	(1 hour after end of Test)
Corrected Value at 20°c	152.73 Ohms	Ohmic Value Variation (After / Before test):	-1.46% (- 5%)
NOTE / REMARKS			
See attached "Type Test Schedule" See attached Resistor drawing showing modified connections & Thermocouples Position See attached Temperature Rise Curves			



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MicroElettrica Scientifica
Prove Termiche Resistori di Trazione

Descrizione prova: O DA 08 02 010 Data: 07-03-2008
 Cliente: ABB AB Ora: 08:25:55

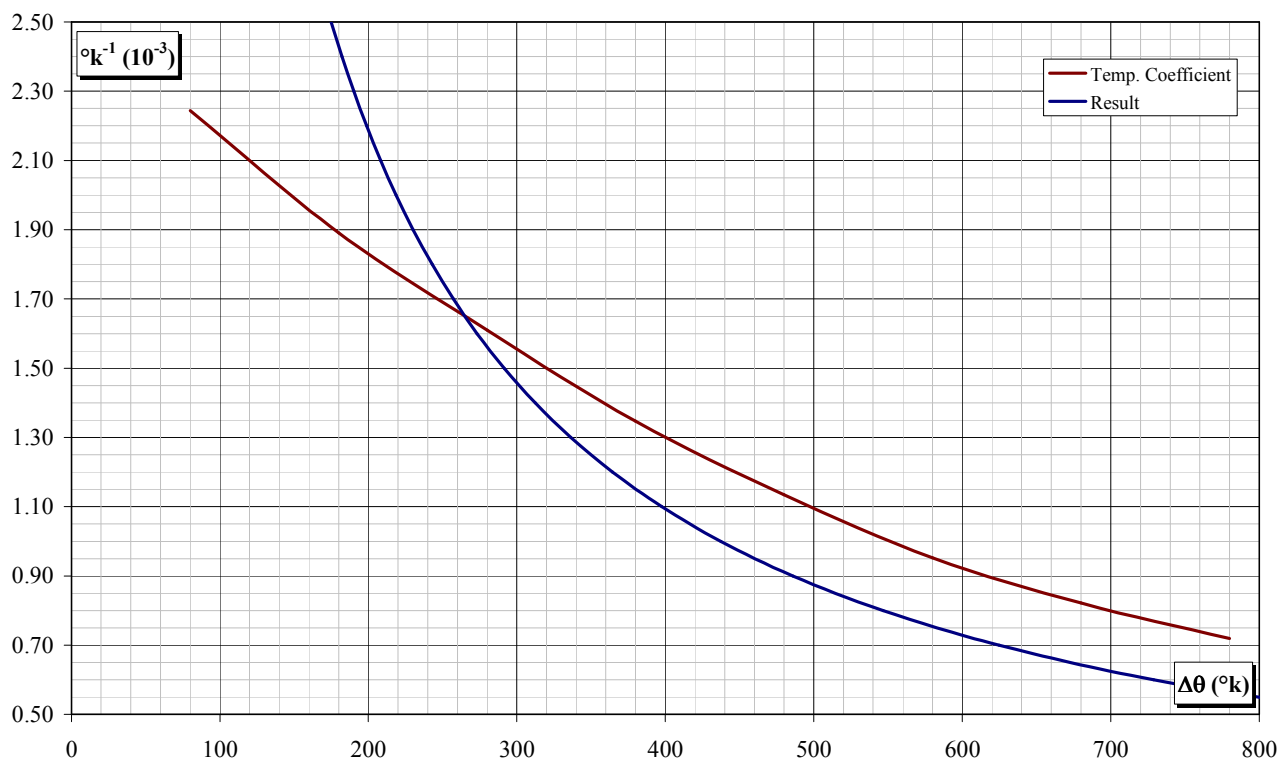


Punti d'interesse						
Potenza	T1	T2	T3	Voltage	Current H	Tamb
KWatt	°C	°C	°C	Volt	A	°C
00: 68.8	291.4	162.1	295.5	3920.7	17.6	34.1

c:\Documents and Settings\spitalegi\Desktop\RTE 63Kv 02.07.08 2.ptr

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AISI 304
Resistance Temperature Coefficient



Sigla redazione