

TEST RECORD

NO. 04609-16-0267

THS Industria e Comercio Ltda.
Rua Ernesto Biester, 59
CEP 04777-120 - Sao Paulo
BRAZIL

CLIENT

1. THS Industria e Comercio Ltda.
2. Richards Manufacturing Co.

MANUFACTURER

Low-voltage fuses for cable protection

TEST OBJECT

1. ELETROPAULO No. 355521/22/23/26/27/28
2. Richards R5641/R5735

TYPE

Test samples

SERIAL NO.

Rated voltage	600 V AC	RATED CHARACTERISTICS GIVEN BY THE CLIENT
Cross-section	35/95/120/185/240/400 mm ² 500/750 MCM	
Interrupting rating High Current	200 kA	

UL 248-1: 2011
IEC 60269-2 Edition 5.0: 2013-07

NORMATIVE DOCUMENT

Verification of interrupting rating High Current at 600 V

TEST PERFORMED

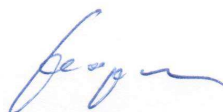
21 April 2016

DATE OF TEST

See Sub-clause 3.6

TEST RESULT

This test document comprises 20 sheets.



S. GEORGIAS
Test engineer in charge

Berlin, 25 April 2016

Contents	Sheet
1. Present at the test.....	2
2. Test performed.....	2
3. Verification of breaking capacity	3
3.1 Test laboratory	3
3.2 Normative document.....	3
3.3 Required test parameters.....	3
3.4 Test arrangement.....	3
3.5 Test and measuring circuits.....	4
3.6 Test results.....	5
4. Photos.....	7
5. Oscillograms.....	8
6. Drawings.....	18

1. Present at the test
.....

Mr. Georgias IPH test engineer in charge

2. Test performed
.....

Verification of interrupting rating High Current at 600 V

3. Verification of breaking capacity

3.1 Test laboratory

High-power test laboratory, high-current test cell

3.2 Normative document

UL 248-1: 2011

IEC 60269-2 Edition 5.0: 2013-07

3.3 Required test parameters

Test duty	High current
Power-frequency recovery voltage	600 V
Prospective current	200 kA
Making angle after voltage zero	Not applicable
Initiation of arcing after voltage zero	60 ... 90° el.
Power factor $\cos \varphi$	$\leq 0,2$
Test frequency	50 Hz

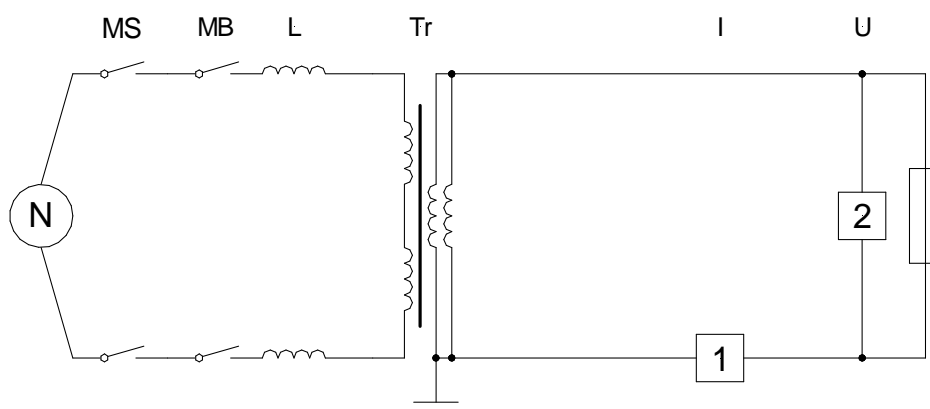
3.4 Test arrangement

According to UL 248-1: 2011

3.5 Test and measuring circuits

Technical data of test circuits

Test requirement	Verification of breaking capacity	
Test No.	116 2058 to 112 2067	
Number of phases (Test circuit)	2	
Number of poles/phases (Test object)	1	
Test frequency Hz	50	
Power factor $\cos \varphi$	< 0.2	
Earthing conditions	Grid	Not earthed
	Short-circuit transformer	Earthed
	Short-circuit point	--



N	Power supply (grid)	Tr	Short-circuit transformer
MS	Master breaker	I	Current measurement
MB	Making switch	U	Voltage measurement
L	Current limiting reactor	1, 2	Measuring points

Figure 1: Test circuits

Technical data of measuring circuits

Measuring point	Symbol	Measured quantity	Measuring sensor/device
1	i	Breaking current	Shunt
2	u	Voltage	RC divider

Recording instrument: AD 3000 transient recorder system

3.6 Test results

Test requirement: Test duty High Current
 Condition of test object before test: New

Test No.		1162060	1162061	1162062	1162063	1162064	1162065
Test sample No.		1	2	3	4	5	6
Type		355528	355527	355521	355522	355526	355523
Cross-section	mm ²	400	240	185	120	95	35
Test voltage	V	600	600	600	600	600	600
Prospective peak current	kA	526	526	526	526	526	526
Prospective breaking current I _p	kA	204	204	204	204	204	204
Power factor cos φ		0,07	0,07	0,07	0,07	0,07	0,07
Making angle	°el.	61,0	70,1	66,7	74,8	73,4	73,9
Initiation of arcing after voltage zero	°el.	73,3	75,5	69,6	79,2	78,1	76,5
Melting current i _s	kA	47,0	20,4	10,3	18,1	19,2	10,9
Cut-off current	kA	48,9	22,0	12,1	21,2	20,5	11,4
Melting time	ms	0,68	0,30	0,16	0,24	0,26	0,14
Arcing time	ms	2,49	3,11	3,53	3,07	3,52	3,54
Operating time	ms	3,17	3,41	3,70	3,31	3,78	3,69
Melting integral	10 ³ A ² s	503	47,4	6,68	27,4	32,9	5,99
Arcing integral	10 ³ A ² s	1158	206	77,7	211	134	26,5
Operating integral	10 ³ A ² s	1665	254	84,6	239	167	32,8
Arcing energy	kWs	39,9	14,5	8,77	15,1	11,6	4,69
Peak switching voltage	V	1446	1253	1176	1233	1304	1222
Recovery voltage	V	616	616	616	615	615	615
Note		-	-	-	-	-	-
Evaluation		OK	OK	OK	OK	OK	OK

Notes:

OK - The fuse is capable of correctly breaking the prospective current

Test No. 116 2058: Current setting of the prospective test values

Test No. 116 2059: Voltage operation

Test requirement: Test duty High Current
 Condition of test object before test: New

Test No.		1162066	1162067
Test sample No.		7	8
Type		R5641	R5735
Cross-section	mm ²	MCM500	MCM750
Test voltage	V	600	600
Prospective peak current	kA	526	526
Prospective breaking current I _p	kA	204	204
Power factor cos φ		0,07	0,07
Making angle	°el.	60,6	63,3
Initiation of arcing after voltage zero	°el.	73,6	78,4
Melting current i _s	kA	49,8	58,9
Cut-off current	kA	51,1	60,8
Melting time	ms	0,72	0,84
Arcing time	ms	3,14	3,09
Operating time	ms	3,87	3,92
Melting integral	10 ³ A ² s	601	972
Arcing integral	10 ³ A ² s	1282	2180
Operating integral	10 ³ A ² s	1889	3158
Arcing energy	kWs	43,8	60,5
Peak switching voltage	V	1456	1465
Recovery voltage	V	615	615
Note		-	-
Evaluation		OK	OK

Notes:

OK - The fuse is capable of correctly breaking the prospective current

4. Photos



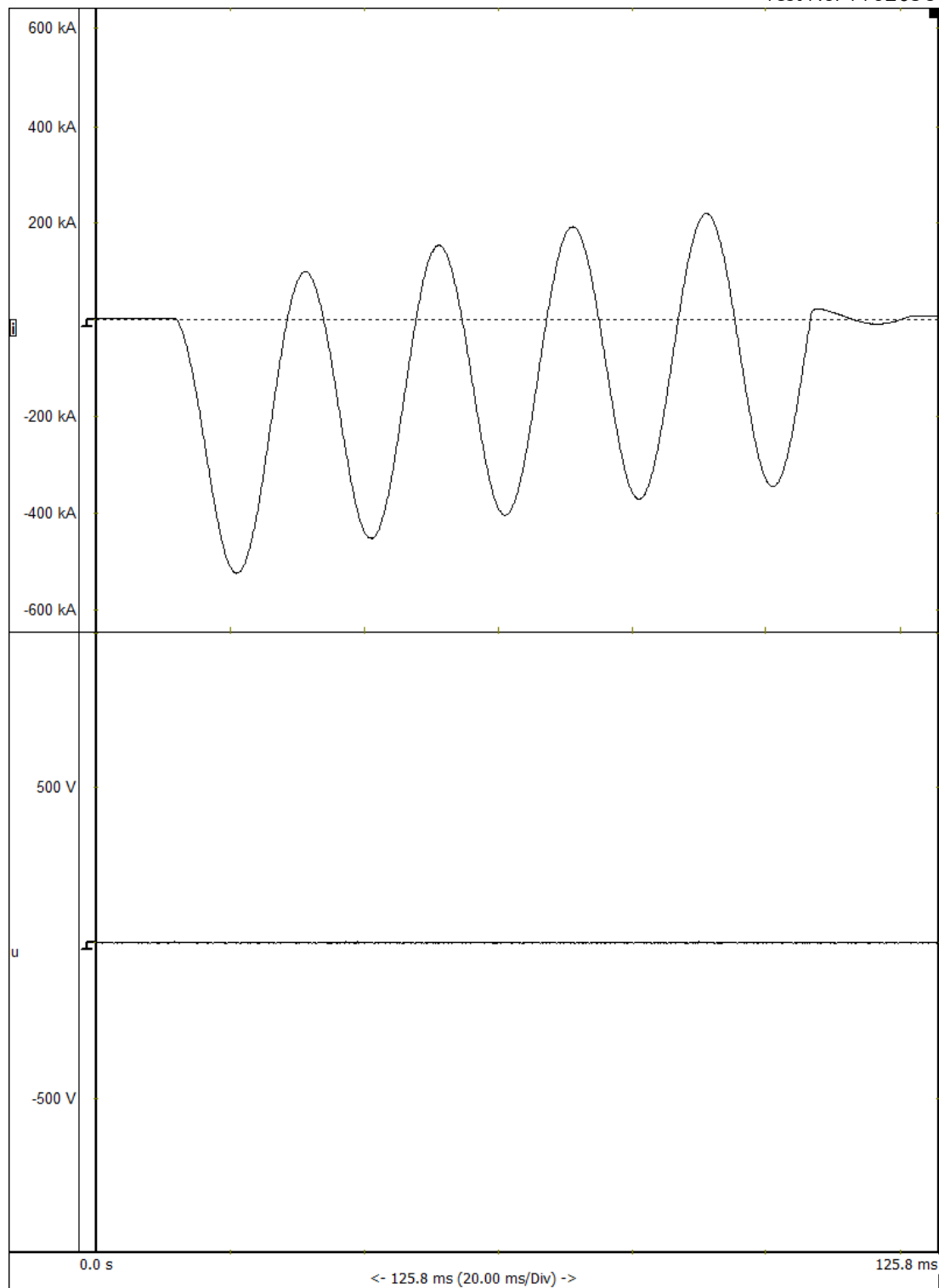
Photo 1: Test samples before tests



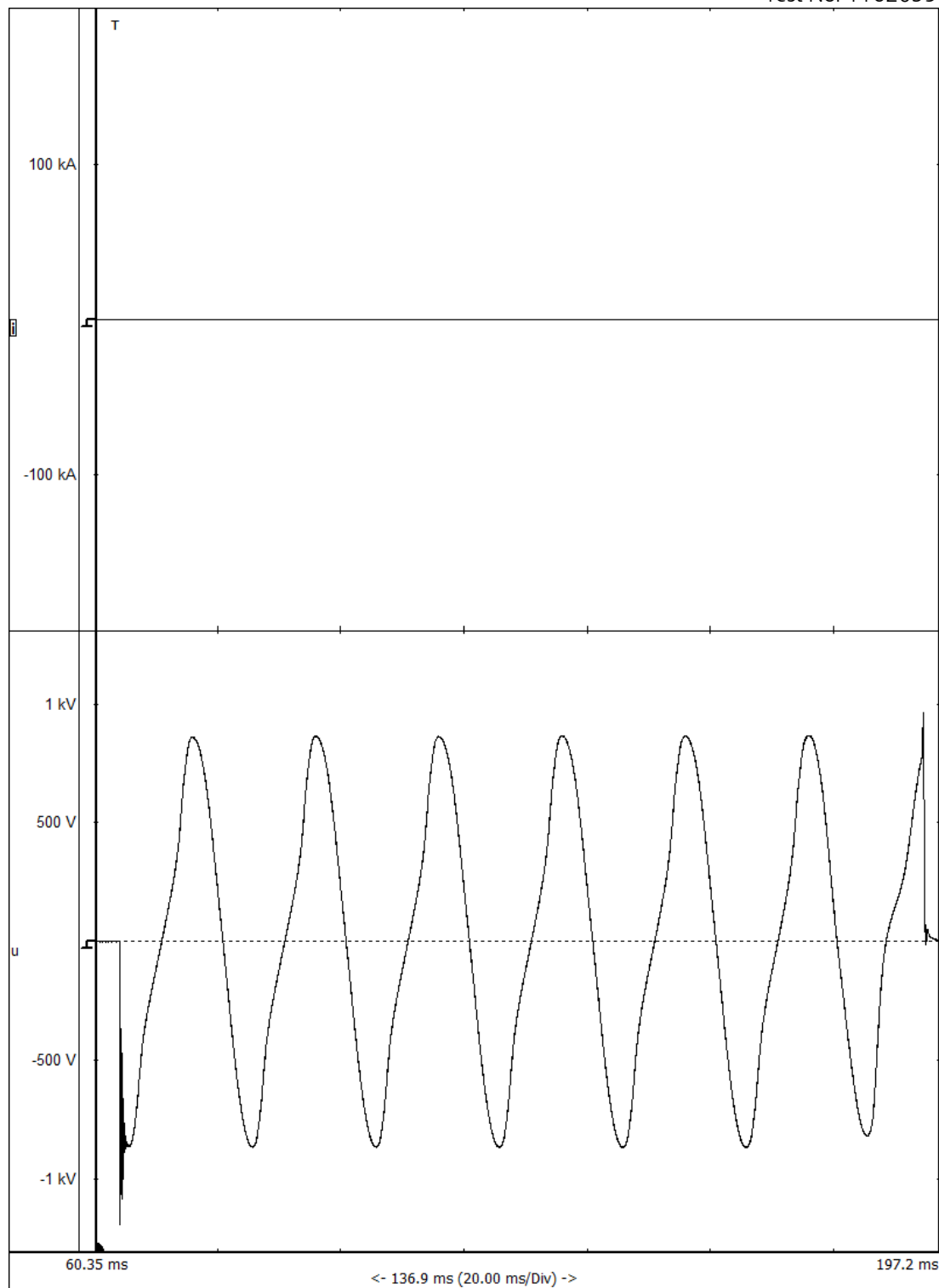
Photo 2: Test samples after tests

5. Oscillograms

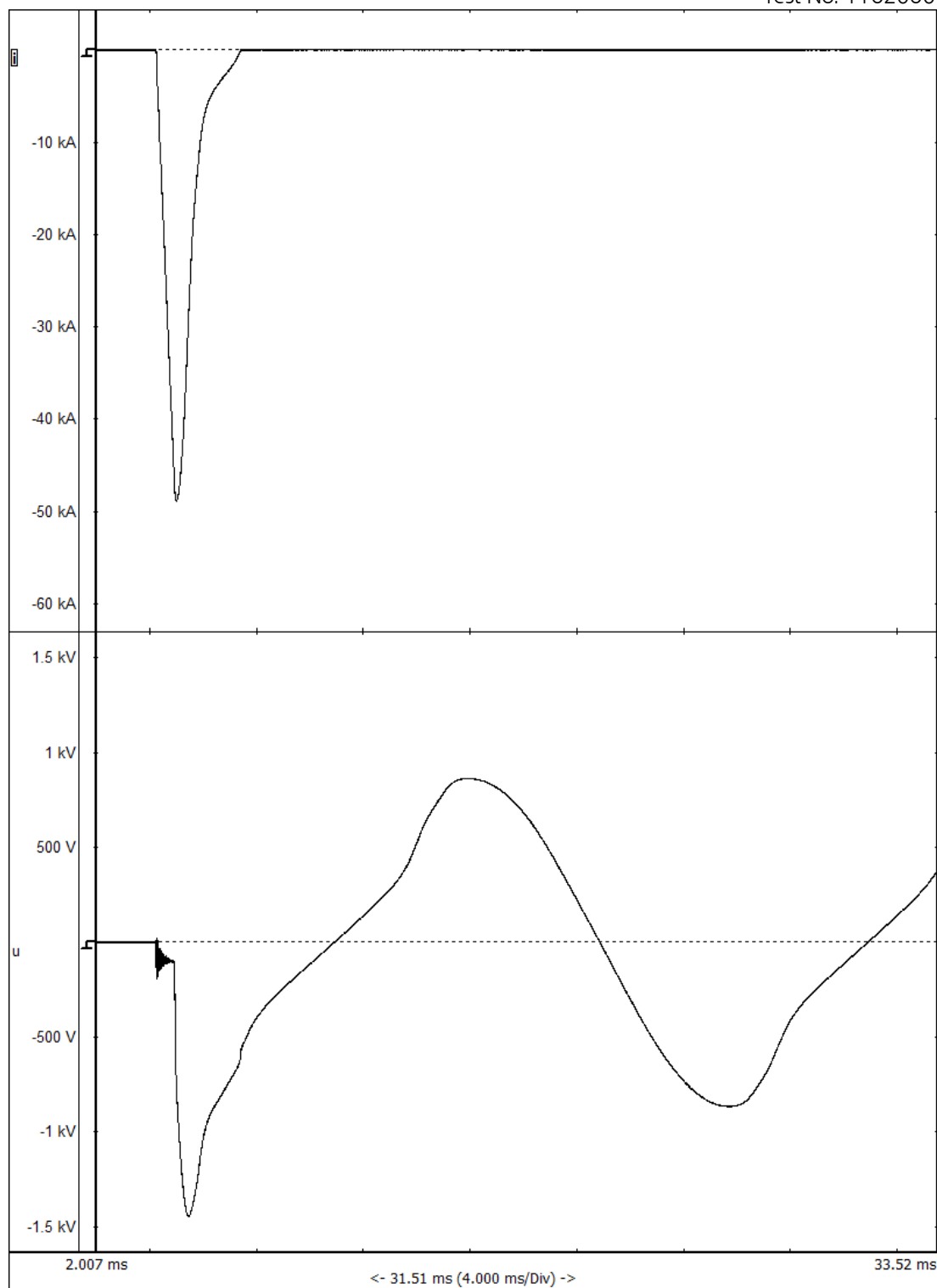
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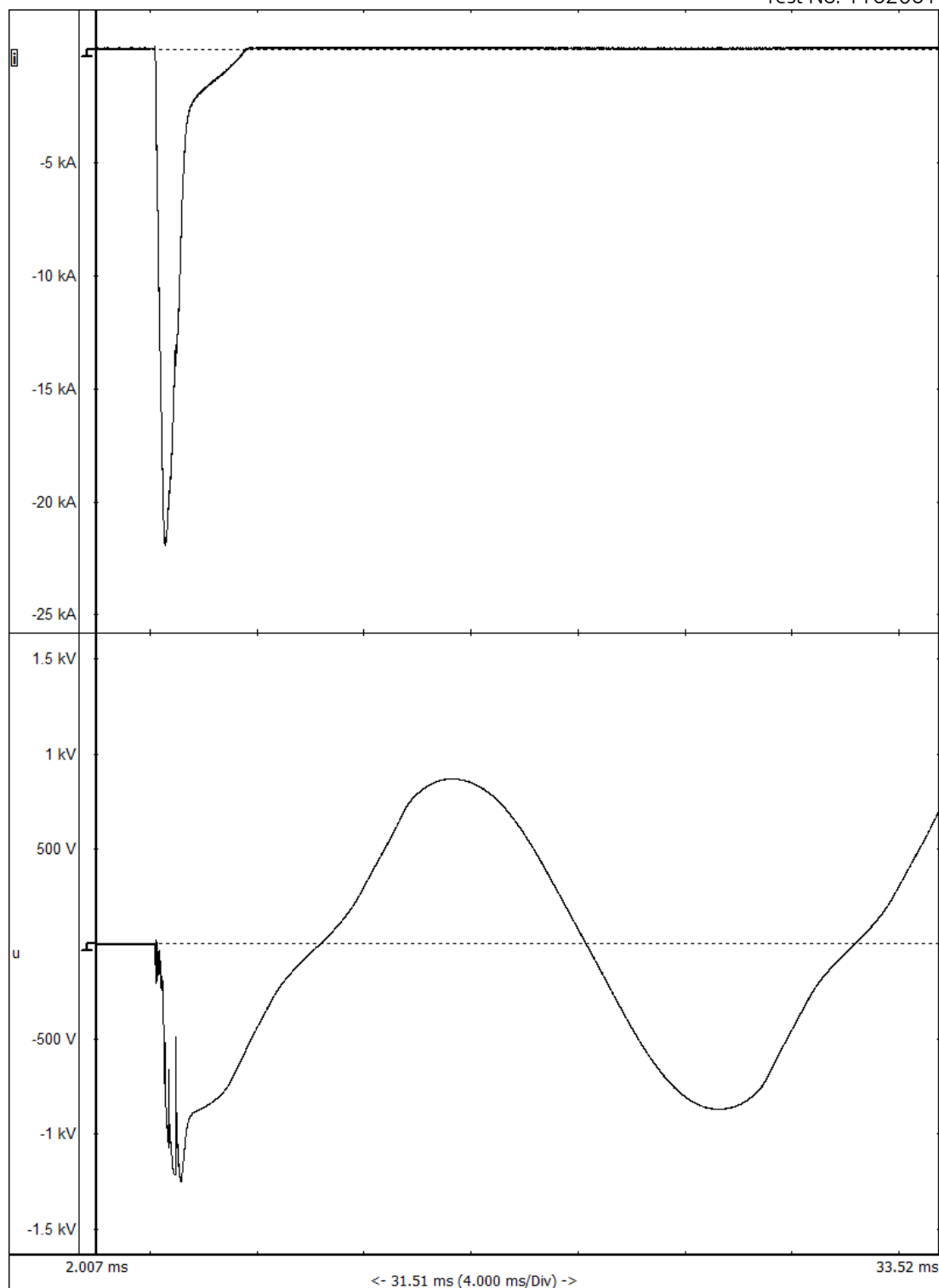
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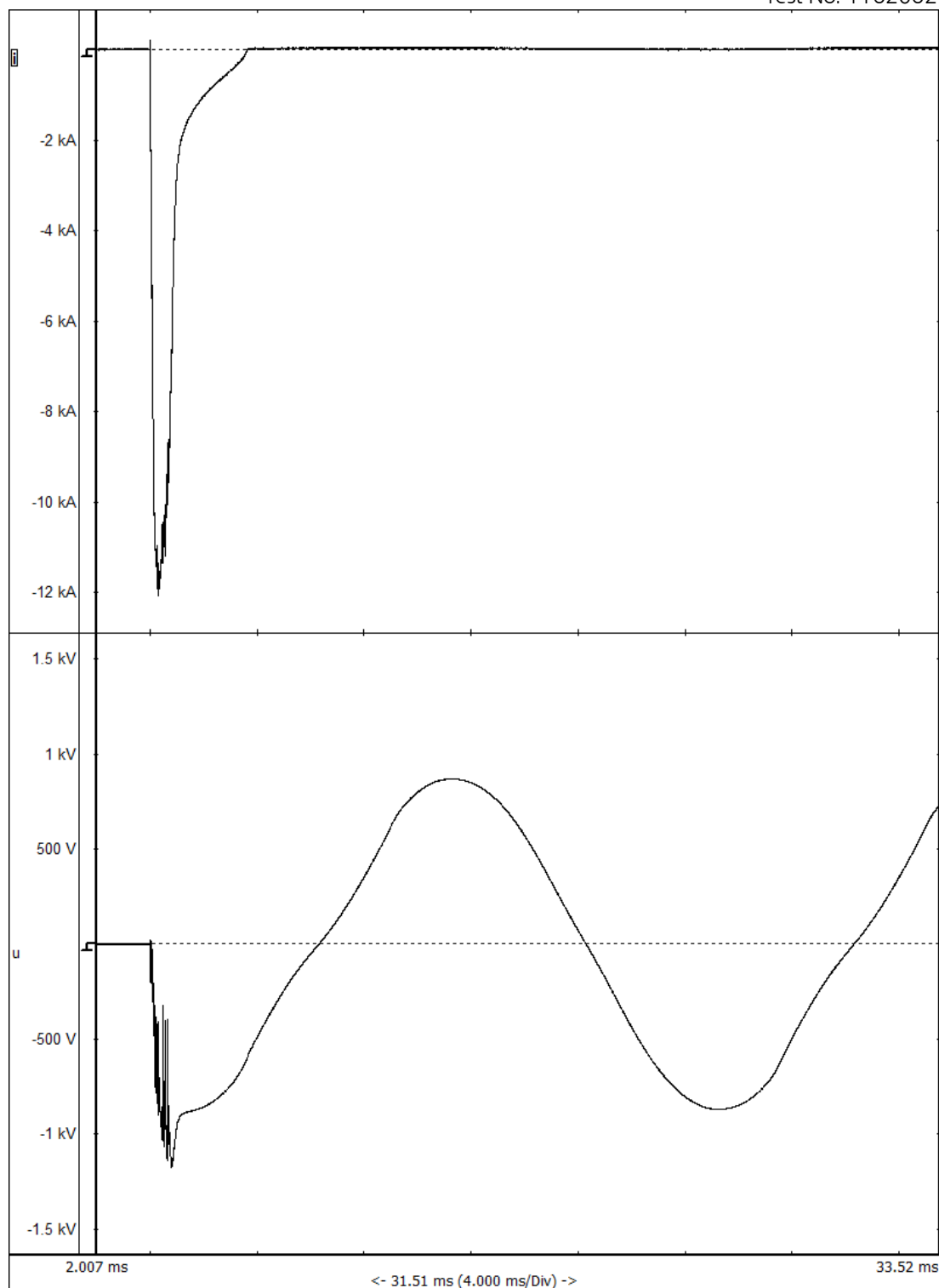
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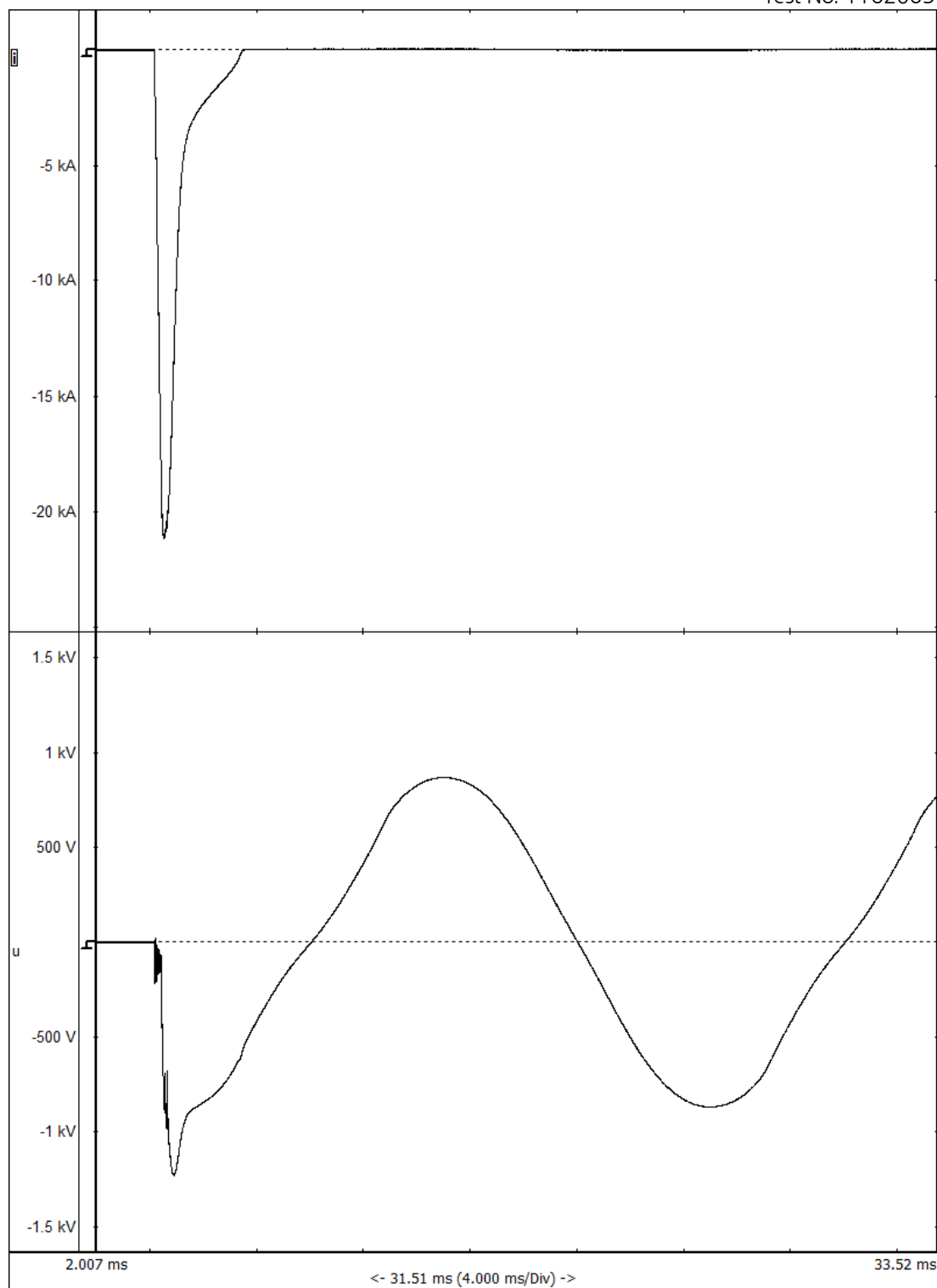
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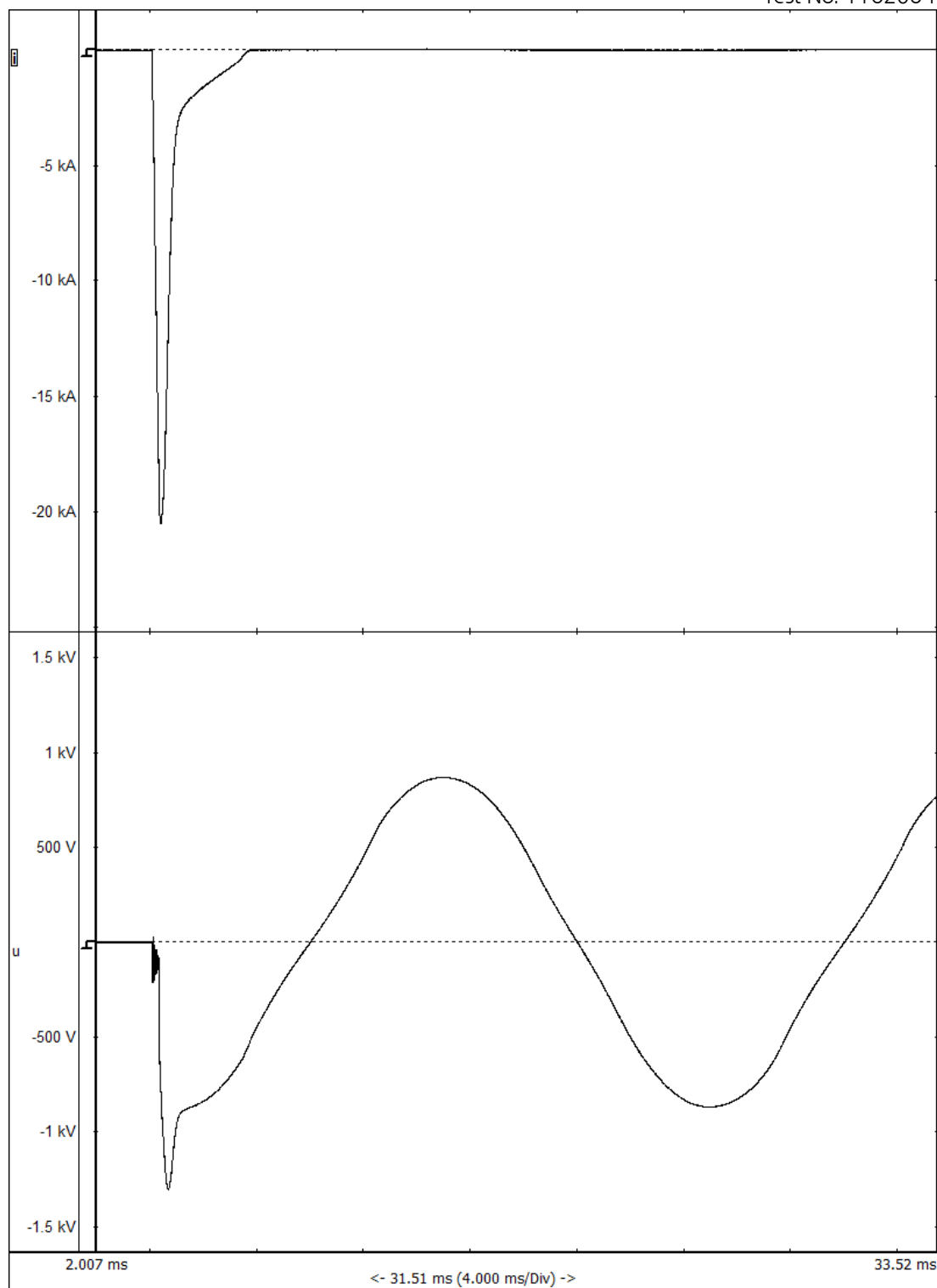
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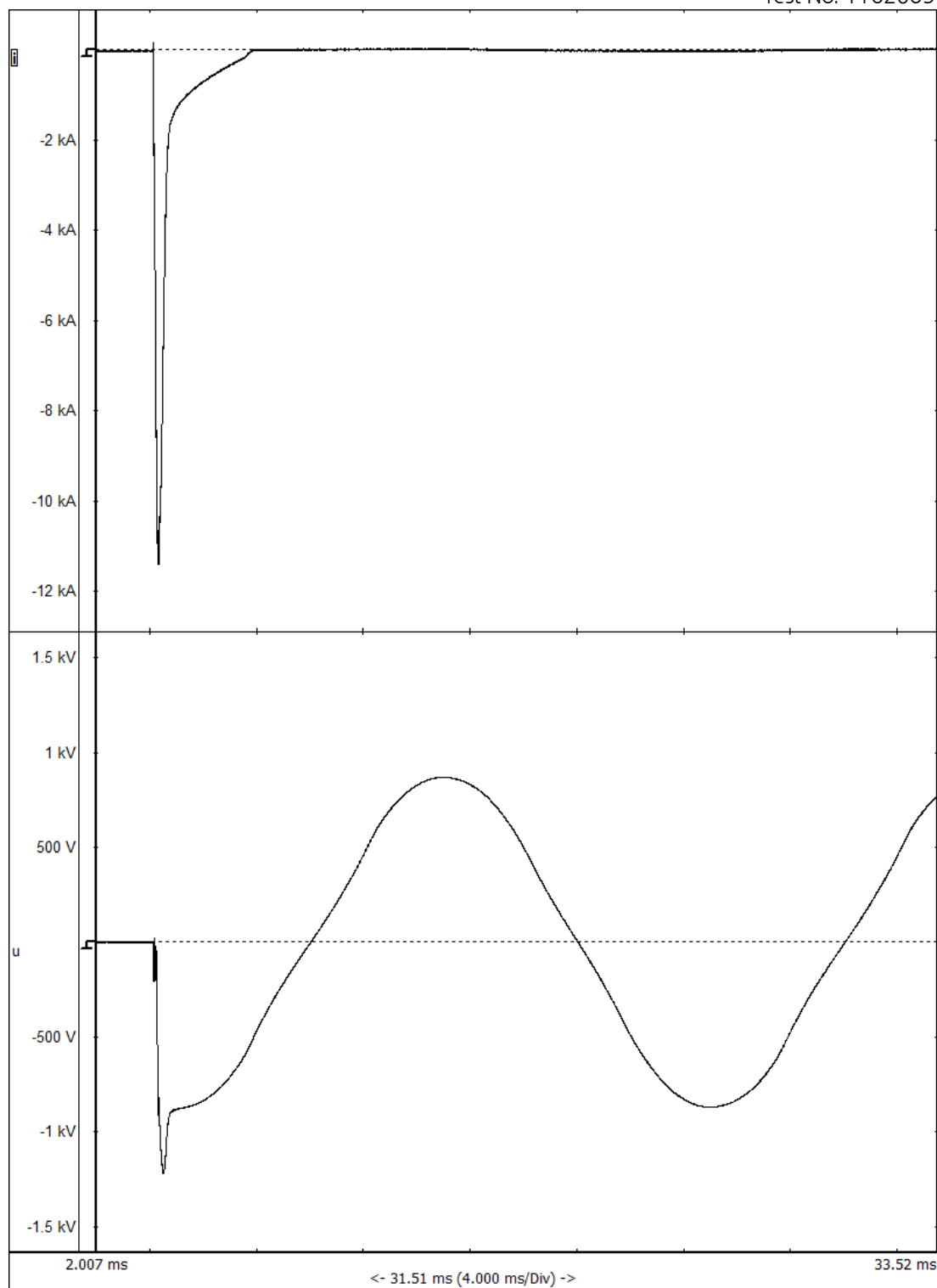
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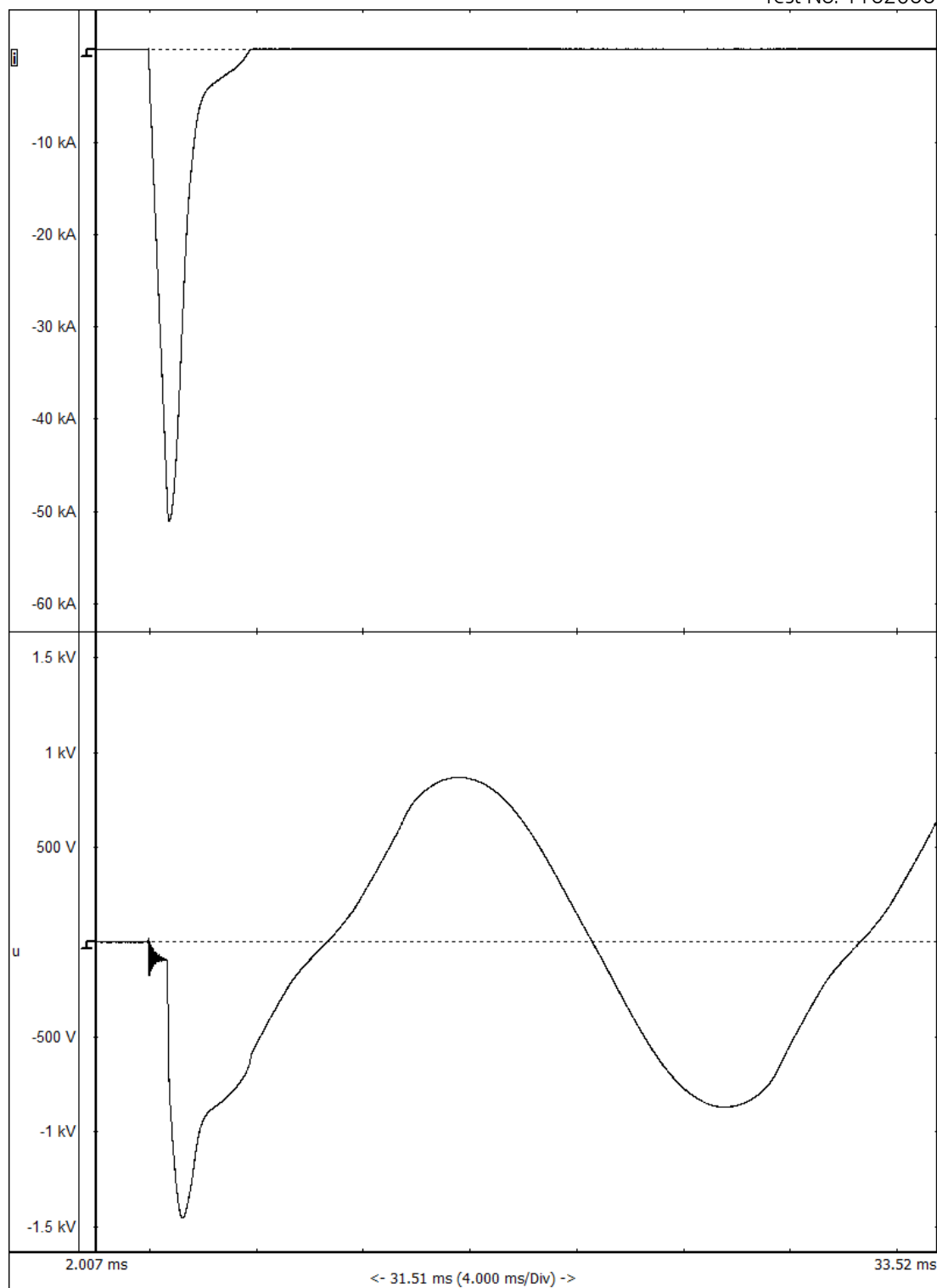
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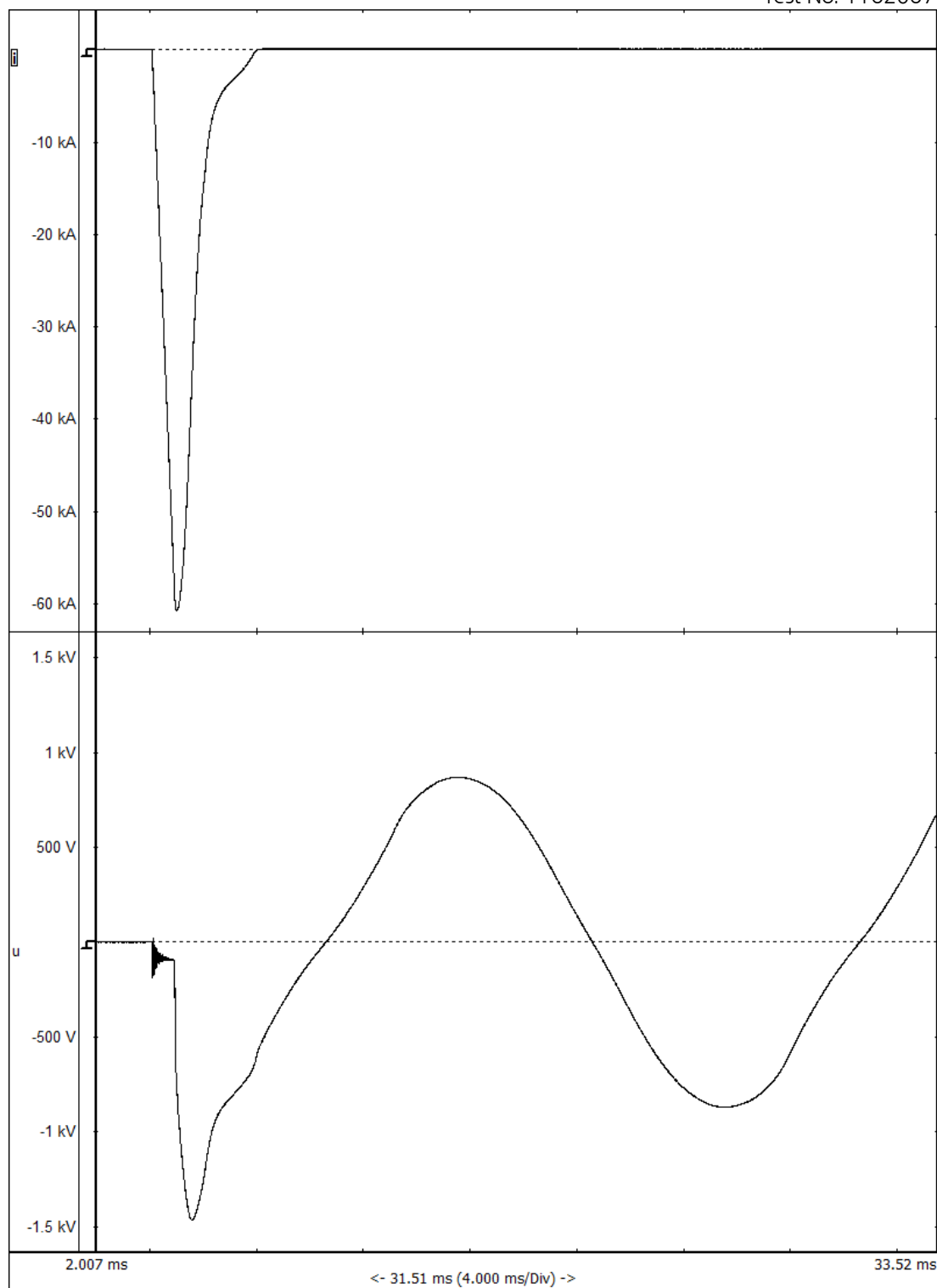
Test No: 1162065



Test No: 1162066



Test No: 1162067



6. Drawings

CARACTERÍSTICAS TÉCNICAS DE FUSIVEL SUBMERSIVEL PARA 400/600V COM SISTEMA DE PARAFUSO DE RUPTURA PROGRESSIVA (UNITORQ)

CM	FUSIVEL DIMENSÃO (mm)								PARA CABO	-----
	D1	D2	D3	A	B	C	D	E	DESCRIÇÃO	-----
355523	10±0.2	24±0.2	38±0.5	40±2	73±3	90±2	6.3±0.5	31,5± ^{0.5} / _{0.0}	35 mm² Al.	-----
355526	13±0.2	24±0.2	40±0.5	80±2	90±3	90±2	6.3±0.5	31,5± ^{0.5} / _{0.0}	95 mm² Al.	-----
355521	17.0±0.2	29.0±0.2	40±0.5	80±2	90±3	90±2	6.3±0.5	31,5± ^{0.5} / _{0.0}	185 mm² Al.	-----
355522	17.0±0.2	29.0±0.2	40±0.5	80±2	90±3	90±2	6.3±0.5	31,5± ^{0.5} / _{0.0}	120 mm² Cu.	-----
355527	20.0±0.2	37.0±0.2	46±0.5	80±2	90±3	90±2	6.3±0.5	37,9± ^{0.5} / _{0.0}	240 mm² Cu.	-----
355528	25.4±0.2	34.0±0.2	51±0.5	90±2	90±2	90±2	6.3±0.5	51,0± ^{0.5} / _{0.0}	400 mm² Cu.	-----

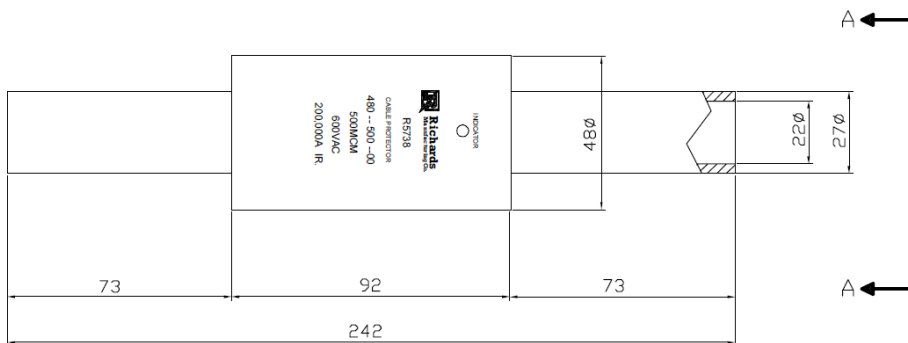
The drawing includes a side view of the fuse assembly with dimensions: D2, D1, A, B, C, D, E, 26, R9, Ø18, 16, 8, 50, 16. It also shows a cross-section of the fuse body with labels: 'Tubo Termocontrátil Isolação 1000V', 'D3Ø máx.', 'Circuito de sinal remoto (opcional)', 'Indicador de queima', and 'PARAFUSO UNITORQ TORQUE 20 a 26 Nm'. Two cross-sections are provided: 'CORTE: C-C' and 'CORTE: B-B'.

NOTAS:

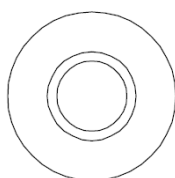
- 1) Material / Acabamento:
 - 1.1) Terminais - Barra de cobre eletrolítico, 1.2) Elemento fusível: prata com 99,99 % de pureza, 1.3) Meio extintor de arco: areia com alto teor de sílica, 1.4) Corpo de fibra de vidro auto-extinguível, 1.5) Com indicador de queima, 1.6) Com circuito de sinal remoto (contato NA.) 1.7) Terminal de tubo com parafusos de ruptura com torque controlada (Unitorq)
- 2) Características nominais: Classe de tensão de 600Vac, Cap. de rup. 200KA, Curva de atuação conf. norma IEC
- 3) Fusível sujeito a operação submersa, 4) Fusíveis devem ser fornecidos com pasta anti-óxido nos terminais correspondentes a conexão de cabos com condutor de alumínio. 5) Utilização com conexões de cabos isolados de baixa tensão em barramentos de câmaras transformadores e poços de inspeção e saídas de transformadores.

CABLE PROTECTORS FUSES

FOR COPPER AND ALUMINUM CABLE 500MCM - 600VAC - 200KA



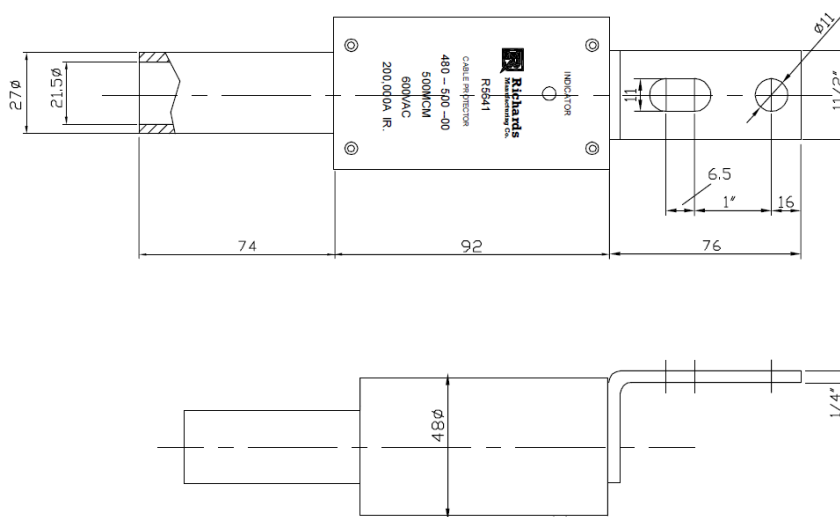
- high breaking capacity
- low power dissipation
- high current limiting
- silver plated contacts
- low I²t
- low switching voltage
- silver element



A A

	Richards Manufacturing Co.
CABLE PROTECTOR 500MCM / 200KA	
DESIGN Nr. 5738	

FOR COPPER AND ALUMINUM CABLE 500MCM - 600VAC - 200KA

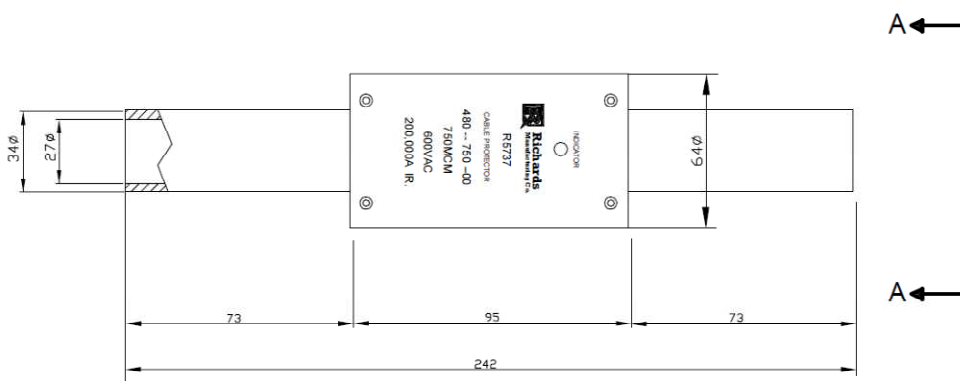


- high breaking capacity
- low power dissipation
- high current limiting
- silver plated contacts
- low I²t
- low switching voltage
- silver element

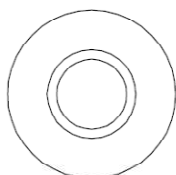
	Richards Manufacturing Co.
CABLE PROTECTOR 500MCM / 200KA	
DESIGN Nr. 5641	

CABLE PROTECTORS FUSES

FOR COPPER AND ALUMINUM CABLE 750MCM - 600VAC - 200KA



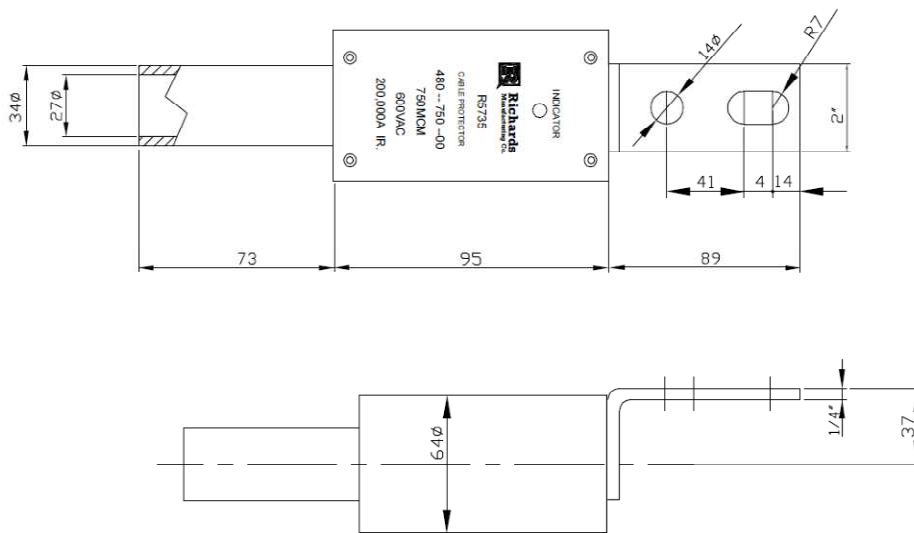
- high breaking capacity
- low power dissipation
- high current limiting
- silver plated contacts
- low I²t
- low switching voltage
- silver element



A A

	Richards Manufacturing Co.
CABLE PROTECTOR 750MCM - 200KA	
DIEBRO	
Nr. 5737	

FOR COPPER AND ALUMINUM CABLE 750MCM - 600VAC - 200KA



- high breaking capacity
- low power dissipation
- high current limiting
- silver plated contacts
- low I²t
- low switching voltage
- silver element

	Richards Manufacturing Co.
CABLE PROTECTOR 750MCM / 200KA	
DIEBRO	
Nr. 5735	