

DOCUMENT: HAT PROCEDURE W04 CTD/LAD WINCH  
 DOCUMENT ID: 100256-11102-A-HAT-W04  
 REVISION: B

DATE: 01.09.2017  
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## Appendix B – Slipping and cable test

This test has to be performed before the external equipments connected to the umbilical cable. This test represents only the scope of Seaonics supply. Reference is made to drawing **100256-141-ERE-001 sheet 10706**. The test of the complete cable connection from subsea equipment over patch panels to the scientific is not part of Seaonics delivery and not in scope of this test.

### Danger of High Voltage:

The test application is acting like a coil and can be charged during measurement. Before and after each test step, all conductor need to be discharged by connecting to ground for at least 10 seconds.

### TEST 1 - Insulation test power passes and conductors

Testing of electrical insulation of each connection of power passes from end of umbilical to terminals of the junction boxes on the winch stationary side. This test has to be performed with open terminals to vessel side. Tests with Megger tester to ground (PE and PA) are not allowed.

Test Step	Conductor	Potential	Megger Test	Test Time	Acceptance criteria	Measured Value	Passed
1.1	HV1 to HV2	4.5 kV AC/DC	1000 V	60 s	>1GΩ	116Ω	OK

Table 1 - Insulation test values

### TEST 2 - Measurement of resistance of power passes and conductors

This test has to be performed by measuring the resistance of each conductor from end of the umbilical to the terminals in the junction box. Required test equipment is Ohm-meter or multi-meter with minimum 20 MΩ input impedance. Single connectors in the junction box need to be connected as one pass with jumpers.

Test Step	Conductor	Terminals in +2MJB406	Length	Test Time	Acceptance criteria	Measured Value	Passed
2.1	HV_1	AI, BII	7000 m	60 s	≤145 Ω	143,6	OK
2.2	HV_2	CII, DII	7000 m	60 s	≤145 Ω	144	OK

Table 2 - Resistance test values

### TEST 3 - Test of fibre optic passes and fibres

This test has to be performed by checking the each fibre optic connection with a LED light source / LED test pen.

Test Step	Conductor	Terminals in +2MJB407	Length	Acceptance criteria	Passed
3.1	FO_1	-ST1	7000 m	LED light visible	✓
3.2	FO_2	-ST2	7000 m	LED light visible	✓
3.3	FO_3	-ST3	7000 m	LED light visible	✓
3.4	FO_4	ST4	7000 m	LED light visible	✓

Table 3 - Fibre optic test results

[www.seaonics.com](http://www.seaonics.com)

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DOCUMENT NAME: W04 – FIBER OPTIC ATTENUATION TEST  
 DOCUMENT ID: 100256-11102-A-ECA-003  
 REVISION: A

DATE: 14.12.2017  
 PAGE: Page 1 of 2

## W04 – FIBER OPTIC ATTENUATION TEST – ADDENDUM TO HAT PROCEDURE

This document is an addendum to the HAT procedure 100256-11102-A-HAT-W04, to provide a more thorough test of optical fibres. The test described may replace the simpler fiber test (TEST 3) included in the HAT procedure.

This document is meant only as a verification of Seaonics' part of the delivery meaning from the junction box on the winch to the end of the umbilical cable. The acceptance criteria is thus based on the specified attenuation of umbilical and slip ring with some added allowance for the connectors in both internal and external junction boxes.

### Equipment needed

Description
Optical power meter and source

All test equipment shall conform to industrial standard requirements with appropriate documentation and/or certifications.

### Arrangement prior to test:

- Umbilical is spooled onto winch, and connected to slip ring and junction boxes.
- Required connectors are installed at both ends of umbilical and junction box in order to connect power meter and light source

No.	Description	Performed.
1.1.1	Perform the following <ul style="list-style-type: none"> <li>- Measure fibre optic attenuation at 1310 nm &amp; 1550 nm</li> <li>- Record measured values in Table 1.</li> <li>- Verify values are within acceptance criteria</li> </ul>	✓

DOCUMENT NAME: W04 – FIBER OPTIC ATTENUATION TEST  
 DOCUMENT ID: 100256-11102-A-ECA-003  
 REVISION: A

DATE: 14.12.2017  
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Test Step	Fiber	Connectors in +1LJB104	Wavelength	Measured attenuation (Seaonics delivery) ✕	Acceptance criteria	Passed
4.1	FO_1	-ST1	1310 nm	20,31 ✕	<10 dB	✓
4.2			1550 nm	20,34 ✕	<8,5 dB	✓
4.3	FO_2	-ST2	1310 nm	21,15 ✕	<10 dB	✓
4.4			1550 nm	21,20 ✕	<8,5 dB	✓
4.5	FO_3	-ST3	1310 nm	20,6 ✕	<10 dB	✓
4.6			1550 nm	20,6 ✕	<8,5 dB	✓
4.7	FO_4	-ST4	1310 nm	N/A	<10 dB	
4.8			1550 nm	N/A	<8,5 dB	

Table 1 – Measured attenuation

Date: 24/02/18		Time:	
Seaonics AS	Class Society	Client	Yard
Representative name	N/A Representative name	Representative name	F.M. RINTORST Representative name
Signature	N/A Signature	Signature	F. Rintorst Signature
Comments: ✕ MEASURED ALL THE WAY FROM RACK FIELD B.W. SEE ATTACHED SPREADSHEET.			

DOCUMENT NAME: HAT PROCEDURE – W08 PLANKTON NETS WINCH  
 DOCUMENT ID: 100256-11102-A-HAT-W08  
 REVISION: C

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## 8 Umbilical testing

The purpose of this test is to verify the integrity of the umbilical as well as connections through slip ring and junction boxes. Three tests are performed in order to verify resistance and insulation are within specified limits, as well as verifying functioning optical fibres.

Measured values shall be recorded in **Appendix A** and included in the HAT report.

### Arrangement prior to test:

- Umbilical is spooled onto winch, and connected to slip ring and junction box
- ROV not connected to umbilical
- Cables/fibres from

No.	Description	Performed.
8.1.1	Perform insulation test according to <b>Appendix A – TEST 1</b> - Record measured values in Table 1. - Verify values are within acceptance criteria	✓
8.1.2	Perform insulation test according to <b>Appendix A – TEST 2</b> - Fill in measured values in Table 2 - Verify measured values are within acceptance criteria	✓
8.1.3	Perform insulation test according to <b>Appendix A – TEST 3</b> - Verify all fibres are functioning.	✓

Date: 20/02/18		Time:	
Seaonics AS	Class Society	Client	Yard
Representative name	N/A Representative name	Representative name	F. H. MONTEROSSO Representative name
Signature	N/A Signature	Signature	Signature
Comments:			

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DOCUMENT NAME: HAT PROCEDURE – W08 PLANKTON NETS WINCH  
 DOCUMENT ID: 100256-11102-A-HAT-W08  
 REVISION: C

DATE: 01.09.2017  
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## Appendix B – Slipping and cable test

This test has to be performed before the external equipments connected to the umbilical cable. This test represents only the scope of Seaonics supply. Reference is made to drawing 100256-141-ERE-001 sheet 10632. The test of the complete cable connection from subsea equipment over patch panels to the scientific is not part of Seaonics delivery and not in scope of this test.

### Danger of High Voltage:

The test application is acting like a coil and can be charged during measurement. Before and after each test step, all conductor need to be discharged by connecting to ground for at least 10 seconds.

### TEST 1 - Insulation test power passes and conductors

Testing of electrical insulation of each connection of power passes from end of umbilical to terminals of the junction boxes on the winch stationary side. This test has to be performed with open terminals to vessel side. Tests with Megger tester to ground (PE and PA) are not allowed.

Test Step	Conductor	Potential	Megger Test	Test Time	Acceptance criteria	Measured Value	Passed
1.1	HV1 to HV2	4.5 kV AC/DC	1000 V	60 s	>1,2GΩ	4,8	✓

Table 1 - Insulation test values

### TEST 2 - Measurement of resistance of power passes and conductors

This test has to be performed by measuring the resistance of each conductor from end of the umbilical to the terminals in the junction box. Required test equipment is Ohm-meter or multi-meter with minimum 20 MΩ input impedance. Single connectors in the junction box need to be connected as one pass with jumpers.

Test Step	Conductor	Terminals in +2MJB804	Length	Test Time	Acceptance criteria	Measured Value	Passed
2.1	HV_1	XE1; 1, 2	5000 m	60 s	≤105 Ω	98,2	✓
2.2	HV_2	XE1; 3, 4	5000 m	60 s	≤105 Ω	96,4	✓

Table 2 - Resistance test values

### TEST 3 - Test of fibre optic passes and fibres

This test has to be performed by checking the each fibre optic connection with a LED light source / LED test pen.

Test Step	Conductor	Terminals in +4SJB807	Length	Acceptance criteria	Passed
3.1	FO_1	-ST1	5000 m	LED light visible	✓
3.2	FO_2	-ST2	5000 m	LED light visible	✓
3.3	FO_3	-ST3	5000 m	LED light visible	✓
3.4	FO_4	ST4	5000 m	LED light visible	✓

Table 3 - Fibre optic test results

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DOCUMENT NAME: W08 – FIBER OPTIC ATTENUATION TEST  
 DOCUMENT ID: 100256-11102-A-ECA-004  
 REVISION: A

DATE: 14.12.2017  
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Test Step	Fiber	Connectors in +1LJB104	Wavelength	Measured attenuation (Seaonics delivery)	Acceptance criteria	Passed
4.1	FO_1	-ST1	1310 nm	17,24	<10 dB	✓
4.2			1550 nm	11,54	<8,5 dB	✓
4.3	FO_2	-ST2	1310 nm	19,283	<10 dB	✓
4.4			1550 nm	19,927	<8,5 dB	✓
4.5	FO_3	-ST3	1310 nm	26,152	<10 dB	✓
4.6			1550 nm	20,54	<8,5 dB	✓
4.7	FO_4	-ST4	1310 nm	20,341	<10 dB	✓
4.8			1550 nm	19,847	<8,5 dB	✓

Table 1 – Measured attenuation

Date: 24/02/18		Time: ✓	
Seaonics AS	Class Society	Client	Yard
Representative name	N/A Representative name	Representative name	F. H. Rønneby Representative name
Signature	N/A Signature	Signature	F. H. Rønneby Signature
Comments: * MEASURED ALL THE WAY FROM RACK FIELD BUS 7-62 AND LAB 319 TO WINCH. SEE ATTACHED SPREADSHEET.			

## W08 – FIBER OPTIC ATTENUATION TEST – ADDENDUM TO HAT PROCEDURE

This document is an addendum to the HAT procedure **100256-11102-A-HAT-W04**, to provide a more thorough test of optical fibres. The test described may replace the simpler fiber test (TEST 3) included in the HAT procedure.

This document is meant only as a verification of Seaonics' part of the delivery meaning from the junction box on the winch to the end of the umbilical cable. The acceptance criteria is based on the specified attenuation of umbilical and slip ring with some added allowance for the connectors in both internal and external junction boxes.

### Equipment needed

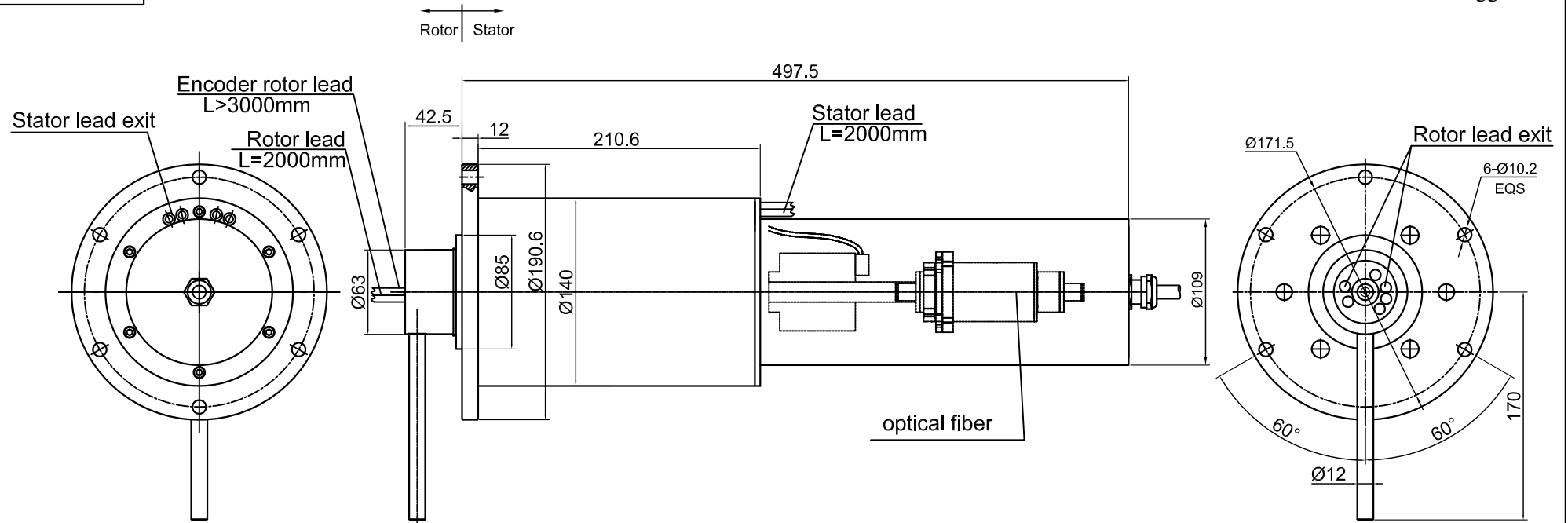
Description
Optical power meter and source

All test equipment shall conform to industrial standard requirements with appropriate documentation and/or certifications.

### Arrangement prior to test:

- Umbilical is spooled onto winch, and connected to slip ring and junction boxes.
- Required connectors are installed at umbilical and junction box in order to connect power meter and light source

No.	Description	Performed.
1.1.1	Perform the following: <ul style="list-style-type: none"><li>- Measure fibre optic attenuation at 1310 nm &amp; 1550 nm, between junction box on winch and end of umbilical</li><li>- Record measured values in Table 1.</li><li>- Verify values are within acceptance criteria</li></ul>	✓



Number of circuits: 9 circuits

Insulation resistance: The 1-4circuits  $\geq 1000\text{M}\Omega/3000\text{VDC}$   
others  $200\text{M}\Omega/250\text{VDC}$

Dielectric strength: The 1-4circuits  $13000\text{VAC}@50\text{Hz}, 60\text{s}$   
others  $200\text{VAC}@50\text{Hz}, 60\text{s}$

Dynamic contact resistance:  $\leq 0.01\Omega$

Contact material: Silver alloy

Housing material: SS304

Operating temperature:  $-20^\circ\text{C} \sim +80^\circ\text{C}$

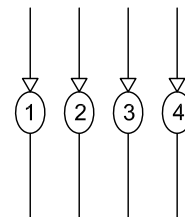
Operating Speed:  $0 \sim 100\text{rpm}$

Protection degree: IP65

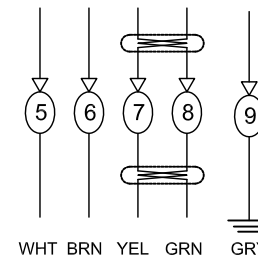
the cable number tube should be on the location of cable 500mm, 1000mm and 1500mm

4500V, 4A/circuit, 4circuits

diameter of shell  $\leq 6 \pm 0.50\text{mm}$




30V, 2A/circuit, 5circuits



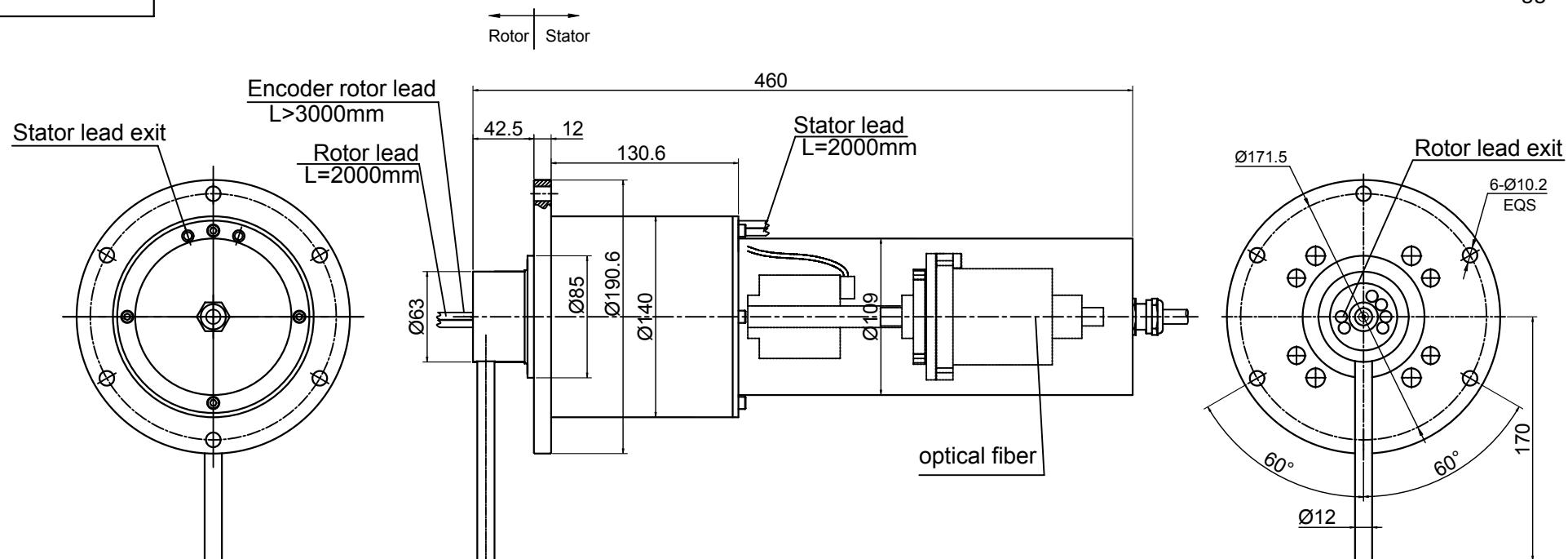
PENLINK	
Model	FOSR140F-9-MX3-W04
S/N	00000000
Voltage(max)	4500V
Current(max)	4A/string, 2A/string
Produce Date	06/2015
CE RoHS	

Optical fiber Model: MX3-155-28-030-ST

Encoder Model: Kubler 8.F5888.662M.2113.0050-C

				Appellation	Slip ring outline drawing				<b><u>PENLINK</u></b>
05	Improve the solution	DQ	15.08.07	Customer	FA010	Model	FOSR140F-9-MX3-W04		
04	Improve the solution	DQ	15.07.23	Designer	STEVEN-J	2015/05/04	Auditor		
03	Improve the solution	Steven-J	15.06.10	View					
02	Improve the solution	Steven-J	15.06.01						
Rev	Description	Name	Date						Rev 05





Number of circuits: 7 circuits

Insulation resistance: The 1-2circuits  $\geq 1000\text{M}\Omega/2000\text{VDC}$   
others  $200\text{M}\Omega/200\text{VDC}$

Dielectric strength: The 1-2circuits  $3000\text{VAC}@50\text{Hz}, 60\text{s}$   
others  $200\text{VAC}@50\text{Hz}, 60\text{s}$

Dynamic contact resistance:  $\leq 0.01\Omega$

Contact material: Silver alloy

Housing material: SS304

Operating temperature:  $-20^\circ\text{C} \sim +80^\circ\text{C}$

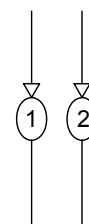
Operating Speed:  $0 \sim 100\text{rpm}$

Protection degree: IP65

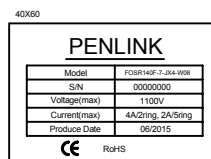
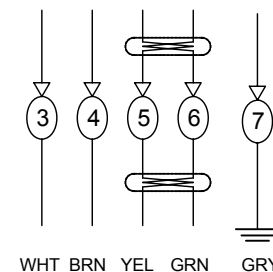
the cable number tube should be on the location of cable 500mm, 1000mm and 1500mm

1100V, 4A/circuit, 2circuits

diameter of shell  $\leq 5.5 \pm 0.50\text{mm}$

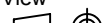


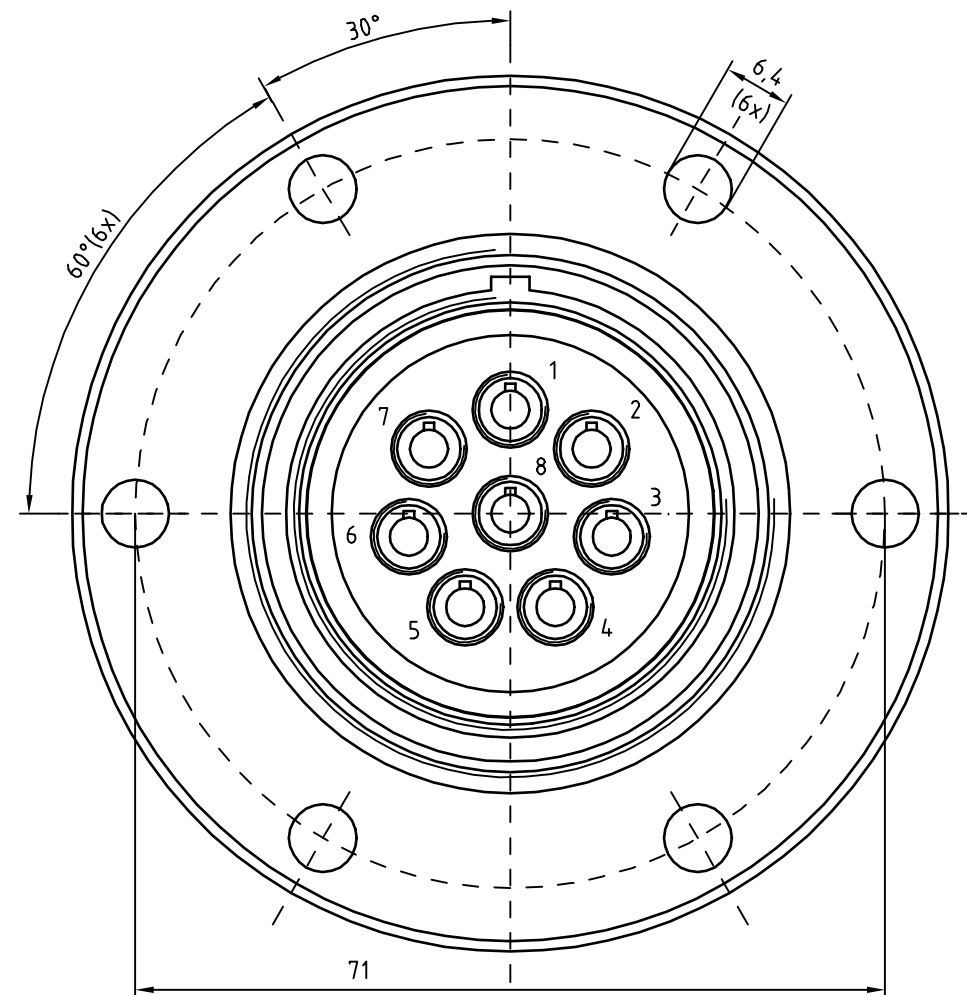
30V, 2A/circuit, 5circuits



Optical Fiber Model: JX4-155-28-030-ST

Encoder Model: Kubler 8.F5888.662M.2113.0050-C

				Appellation	Slip ring outline drawing				<b>PENLINK</b>
04	Improve the solution	DQ	15.07.23	Customer	FA010	Model	FOSR140F-7-JX4-W08		
03	Improve the solution	Steven-J	15.06.10	Designer	STEVEN-J	2015/05/04	Auditor		
02	Improve the solution	Steven-J	15.06.01	View					
Rev	Description	Name	Date						Rev 04



DIN ISO 1302				Maße ohne Toleranzangaben + / - 0,1		BR40		Maßstab 2 : 1		Gewicht	
								Werkstoff		Marinebronze (CW307G)	
				2004		Datum		Benennung		Einbaudose Gr.4 mit Flanschbefestigung bestückbar mit 8 Kontakten	
				Bearb.		14.09.		Schmidt			
				Gepr.		14.09.		Frerck			
				Norm							
								Zg.Nr.		Blatt	
								MB 40.00.4.08.2.10			
A		Grundausgabe		14.09.04		GfG		Ers. f.		Ers. d.	
Zust.		Änderungen		Datum		Name					

**Fra:** [Rune Kvamme](#)  
**Til:** [Bremnes, Jan](#)  
**Emne:** Gisma Serie 40  
**Dato:** mandag 11. februar 2019 14:06:20

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Hei Jan!

Svar fra Gisma!

Hi Rune,

Here are the required information for the electrical contacts:

Ø1mm-Kontakt: 1000 V DC / 707 V AC

Ø2mm-Kontakt: 630 V DC / 445 V AC

Vennlig hilsen/Best regards,

**Rune Kvamme**  
Senior Sales Engineer

**Transmark Subsea** 

**Transmark Subsea AS**

Nedre Nøttveit 16  
5238 Rådal, Norway

Mobil: +47 952 88 228  
Internett : [www.transmark-subsea.com](http://www.transmark-subsea.com)

## BIPOLAR INSULATION GUARD FOR LIVE NON-GROUNDED DC NETWORKS

## KPM169x



- Direct connection 12 to 48VDC systems, up to 1600VDC with RH adapter (up to 5000VDC on request)
- Precision reading unaffected of system voltage
- All inputs and outputs fully isolated
- Triple-zone insulation monitoring and Supervision relay
- "Pathfinder" Indicates polarity of dominant earth fault
- Response time: 125-165mS
- Analogue output proportional to meter reading (F/L-version)

## Specifications

## KPM169x for 9-60VDC systems

Scale range:	0-100kΩ - ∞ (open >100kΩ)
Network line voltage:	Nom: 12 - 48VDC (>9 - <60VDC)
Adjustments	Trip level      Delay
WARNING:	0-100kΩ      0-30secs
ALARM:	0-100kΩ      0,1-3secs

## KPM169x for 60-1600VDC systems

Scale range:	<10kΩ - 5MΩ
Network line voltage:	
Adapter RH2	Min. 60VDC - max. 200VDC
Adapter RH4	Min. 200VDC - max. 400VDC
Adapter RH8	Min. 400VDC - max. 800VDC
Adapter RH12	Min. 800VDC - max. 1200VDC
Adapter RH16	Min. 1200VDC - max. 1600VDC
	(Higher voltages up to 5000VDC on request)
Adjustments	Trip level      Delay
WARNING:	10kΩ - 5MΩ      0-30secs
ALARM:	10kΩ - 5MΩ      0,1-3secs

## General

Auxiliary Supply:	Nom: 12-48VDC as standard (>9 - <60VDC, Fuse 2A)
Optional Voltage:	100-120, 200-240, 380-415 or 440-460VAC, 40-70Hz (Fuse 0,5A)
Contact rating:	AC: 100VA - 250V/2A max. DC: 50W - 100V/1A max.
Analogue Output: (other on request)	Up to 20mA, max 500R Up to 10V, min 100kohm
Temperature:	-20 to +70°C
Weight:	0.62kgs
Front protection:	IP52 (IP65 optional)

The unit meets IEC60092-504 and the relevant environmental and EMC tests specified in IEC60068/60092 and IEC61000/60533 respectively, to comply with the requirements of the major Classification Societies.

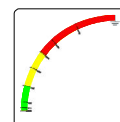
## Application

The digitally controlled KPM169x monitors insulation level between a live non-grounded (IT) battery or live DC network and its protective earth.

Only **ONE** KPM169x can be connected to the same DC-system. An AC or DC (standard) auxiliary voltage is required for the unit. A green LED indicates AUX POWER on. Start of monitoring function is delayed when auxiliary power is switched on (default 2 secs delay). In this way false tripping during power up, caused by initial charging of network spread capacitance, is avoided.

The DIN96 front-of-panel mounted instrument reads the insulation level directly in kΩ. The meter has reflection free glass. The ohmmeter and the triple-zone status LEDs at a glance gives the clear safety message:

- **ALARM** (red zone)
- **WARNING** (yellow zone)
- **HEALTHY** (green zone)



## General

## SEV MEASURING PRINCIPLE

Insulation is measured between the complete galvanically interconnected DC network and its protective earth. The signal flows to ground via the path of the insulation fault, the level of flow expresses the insulation resistance, the direction of flow expresses the fault polarity. The measuring accuracy is not influenced by any normal kind of load attached to the network. The detection time for an insulation fault is 125-165mS.

## PATHFINDER / POLARITY FUNCTION

During a Warning or Alarm condition the Polarity LED indicates the polarity causing the trip:

- POSITIVE EARTH FAULT: LED not lit**
- NEGATIVE EARTH FAULT: blue LED lit**

## RELAY OUTPUTS

The unit has non-latching C/O relay outputs for Warning (R1), Alarm (R2) and System Error (R3). The Alarm and error relays are fail to safety configured. A trip LED flashes when the trip level is passed, the relay trips after elapsed delay. The timer resets if the fault is removed during countdown. Trip levels and delays are settable on unit rear. Recommended trip level settings will depend on application and priority of safety hazards.

## ANALOGUE OUTPUT

All F and L versions have an isolated analogue output proportional to meter reading.

## SYSTEM SUPERVISION

If voltage of the monitored DC system not connected to the unit input or is too low, the NEG POLARITY LED will flash red, and relay 3 (System Error) will trip. If polarity of the input connection reversed, the NEG POLARITY LED will flash red and blue, and relay 3 will trip. Trip of relay 3 will inhibit operation of the warning and alarm relay and their respective trip LEDs.

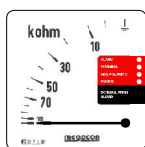
## SAFETY

When the Voltage Adapter is connected to the instrument, max output from RHx adapters is 60VDC.

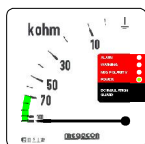
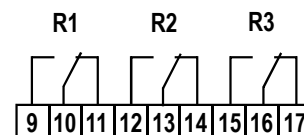
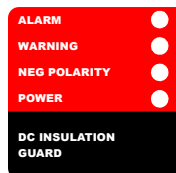
## BIPOLAR INSULATION GUARD FOR LIVE NON-GROUNDED DC NETWORKS

## KPM169x

## Relay and LED Operation

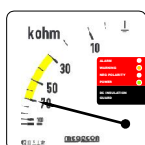
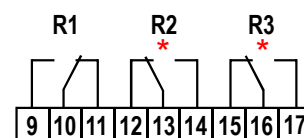
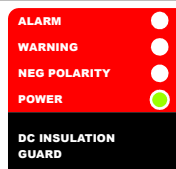
**POWER OFF**

All LED's are off. Relays shown de-energised.

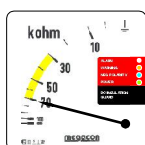
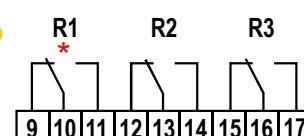
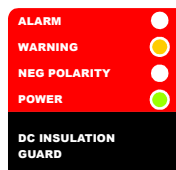
**POWER ON**

The **GREEN** LED (POWER) will lit when unit is powered in normal condition (Positive Polarity). Fail Safe relays R2 and R3 are activated.

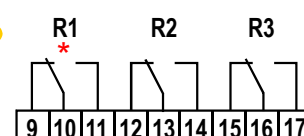
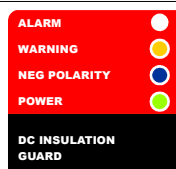
\*) **NB!** The **BLUE** LED (NEG POLARITY) will also lit if the unit detect a minor earth fault.

**WARNING POSITIVE**

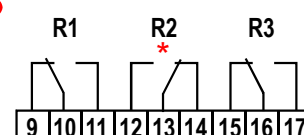
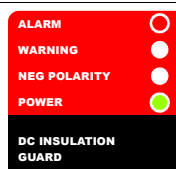
The **YELLOW** LED (WARNING) flashes when the trip level is passed, the warning relay R1 trips after elapsed delay. Steady light after countdown.

**WARNING NEGATIVE**

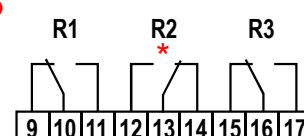
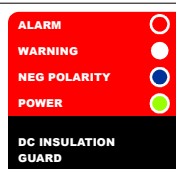
The **BLUE** LED (NEG POLARITY) will lit and the **YELLOW** LED (WARNING) flashes when the trip level is passed, the warning relay R1 trips after elapsed delay. Steady light after countdown.

**ALARM POSITIVE**

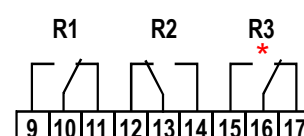
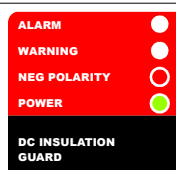
The **RED** LED (WARNING) flashes when the trip level is passed, the warning relay R2 trips after elapsed delay. Steady light after countdown.

**ALARM NEGATIVE**

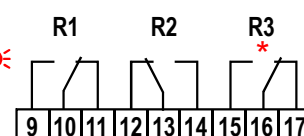
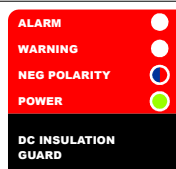
The **BLUE** LED (NEG POLARITY) will lit and the **RED** LED (WARNING) flashes when the trip level is passed, the warning relay R2 trips after elapsed delay. Steady light after countdown.

**FAULT STATUS / SYSTEM ERROR**

The **NEG POLARITY** LED (**RED**) flashes, this indicates missing measuring voltage (positive or negative) and status relay R3 will activate. In this mode the unit will **not** indicate any earth fault.

**FAULT STATUS / SYSTEM ERROR**

The **NEG POLARITY** LED flashes and changes colour between **BLUE** and **RED**. This will indicate reserved polarity and status relay R3 will activate. In this mode the unit may indicate earth fault but alarm and warning relays will not be activated.



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## BIPOLAR INSULATION GUARD FOR LIVE NON-GROUNDED DC NETWORKS

## KPM169x

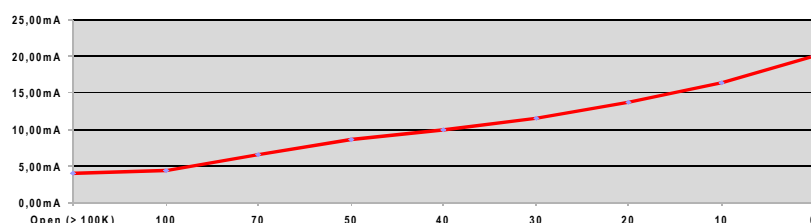
## Description

## KPM169x models for 9- 60VDC

These units are used for industrial, marine and offshore installations. Start of monitoring function is delayed when auxiliary power is switched on (default 2 secs delay).

Direct connection for 12, 24 or 48VDC systems.

## Output diagram



## Relay Operation

Scale range: 0-100k $\Omega$  -  $\infty$  (>100k $\Omega$ )

	Warning	Alarm	System Error	Fail Safe	Latch
R1	✓				
R2		✓		✓	✓
R3			✓	✓	

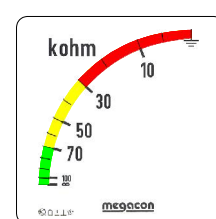
Model	Latch	Output	Fail-safe	Adjustments	Trip level	Delay
KPM169E	-	-	X	WARNING:	0-100k $\Omega$	0-30secs
KPM169F	-	X	X	ALARM:	0-100k $\Omega$	0,1-3secs
KPM169G	X	-	X			
KPM169GF	X	X	X			
KPM169EH	-	-	-			
KPM169FH	-	X	-			
KPM169GH	X	-	-			
KPM169GFH	X	X	-			

Coloured sectors show recommended areas of settings:  
 - Indicates alarm trip zone  
 - Indicates warning trip zone  
 - Indicates healthy zone

## Output table (example for 4-20mA)

Value (scale)	mA output
0k $\Omega$	20.00mA
10k $\Omega$	16.41mA
20k $\Omega$	13.66mA
30k $\Omega$	11.56mA
40k $\Omega$	9.91mA
50k $\Omega$	8.56mA
70k $\Omega$	6.51mA
100k $\Omega$	4.42mA
open (>100k $\Omega$ )	4.00mA

## Range



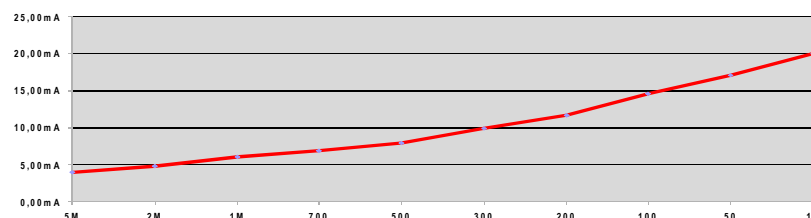
## Description

## KPM169x models for 60-200VDC

These units are used for industrial, marine and offshore installations. Start of monitoring function is delayed when auxiliary power is switched on (default 2 secs delay).

This unit use the voltage adapter RH2 for voltage from 60V to max.200VDC.

## Output diagram



## Relay Operation

Scale range: <10k $\Omega$ -5M $\Omega$

	Warning	Alarm	System Error	Fail Safe	Latch
R1	✓				
R2		✓		✓	✓
R3			✓	✓	

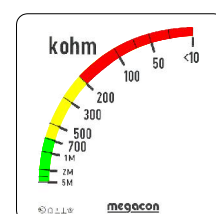
Model	Latch	Output	Fail-safe	Adjustments	Trip level	Delay
KPM169K2	-	-	X	WARNING:	10k $\Omega$ - 5M $\Omega$	0-30secs
KPM169L2	-	X	X	ALARM:	10k $\Omega$ - 5M $\Omega$	0,1-3secs
KPM169GK2	X	-	X			
KPM169GL2	X	X	X			
KPM169K2N	-	-	-			
KPM169L2N	-	X	-			
KPM169GK2N	X	-	-			
KPM169GL2N	X	X	-			

Coloured sectors show recommended areas of settings:  
 - Indicates alarm trip zone  
 - Indicates warning trip zone  
 - Indicates healthy zone

## Output table (example for 4-20mA)

Value (scale)	mA output
<10k $\Omega$	20.00mA
50k $\Omega$	17.05mA
100k $\Omega$	14.60mA
200k $\Omega$	11.62mA
300k $\Omega$	9.89mA
500k $\Omega$	7.95mA
700k $\Omega$	6.91mA
1M $\Omega$	5.91mA
2M $\Omega$	4.78mA
5M $\Omega$	4.00mA

## Range



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## BIPOLAR INSULATION GUARD FOR LIVE NON-GROUNDED DC NETWORKS

## KPM169x

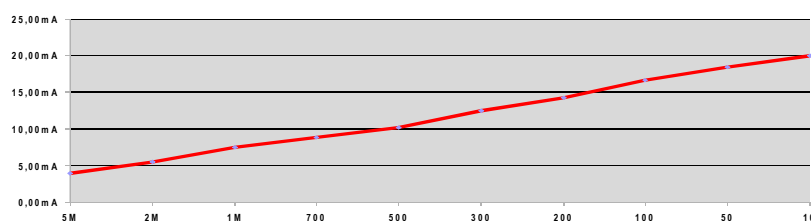
## Description

**KPM169x models for 200-400VDC**

These units are used for industrial, marine and offshore installations. Start of monitoring function is delayed when auxiliary power is switched on (default 2 secs delay).

This unit use the voltage adapter RH4 for voltage systems from 200V to max. 400VDC.

## Output diagram



## Relay Operation

Scale range: <10kΩ-5MΩ

	Warning	Alarm	System Error	Fail Safe	Latch
R1	✓				
R2		✓		✓	✓
R3			✓	✓	

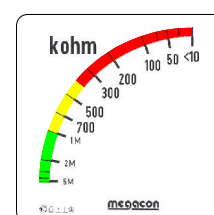
Model	Latch	Output	Fail-safe	Adjustments	Trip level	Delay
KPM169K4	-	-	X	WARNING:	10kΩ - 5MΩ	0-30secs
KPM169L4	-	X	X	ALARM:	10kΩ - 5MΩ	0,1-3secs
KPM169GK4	X	-	X			
KPM169GL4	X	X	X			
KPM169K4N	-	-	-			
KPM169L4N	-	X	-			
KPM169GK4N	X	-	-			
KPM169GL4N	X	X	-			

Coloured sectors show recommended areas of settings:  
 - Indicates alarm trip zone  
 - Indicates warning trip zone  
 - Indicates healthy zone

## Output table (example for 4-20mA)

Value (scale)	mA output
<10kΩ	20.00mA
50kΩ	18.40mA
100kΩ	16.69mA
200kΩ	14.24mA
300kΩ	12.51mA
500kΩ	10.24mA
700kΩ	8.83mA
1MΩ	7.50mA
2MΩ	5.50mA
5MΩ	4.00mA

## Range



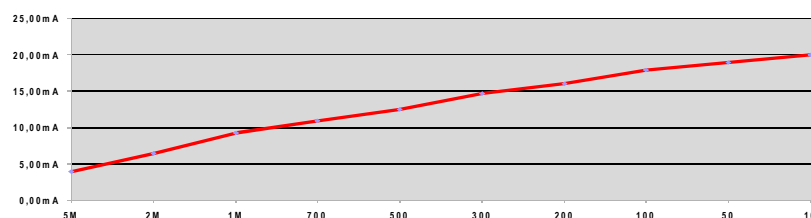
## Description

**KPM169x models for 400-800VDC**

These units are used for industrial, marine and offshore installations. Start of monitoring function is delayed when auxiliary power is switched on (default 2 secs delay).

This unit use the voltage adapter RH8 for voltage systems from 400V to max. 800VDC.

## Output diagram



## Relay Operation

Scale range: <10kΩ-5MΩ

	Warning	Alarm	System Error	Fail Safe	Latch
R1	✓				
R2		✓		✓	✓
R3			✓	✓	

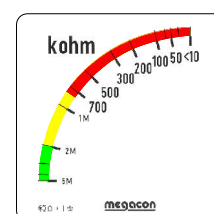
Model	Latch	Output	Fail-safe	Adjustments	Trip level	Delay
KPM169K8	-	-	X	WARNING:	10kΩ - 5MΩ	0-30secs
KPM169L8	-	X	X	ALARM:	10kΩ - 5MΩ	0,1-3secs
KPM169GK8	X	-	X			
KPM169GL8	X	X	X			
KPM169K8N	-	-	-			
KPM169L8N	-	X	-			
KPM169GK8N	X	-	-			
KPM169GL8N	X	X	-			

Coloured sectors show recommended areas of settings:  
 - Indicates alarm trip zone  
 - Indicates warning trip zone  
 - Indicates healthy zone

## Output table (example for 4-20mA)

Value (scale)	mA output
<10kΩ	20.00mA
50kΩ	18.98mA
100kΩ	17.89mA
200kΩ	16.07mA
300kΩ	14.64mA
500kΩ	12.49mA
700kΩ	10.95mA
1MΩ	9.31mA
2MΩ	6.47mA
5MΩ	4.00mA

## Range



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## BIPOLAR INSULATION GUARD FOR LIVE NON-GROUNDED DC NETWORKS

## KPM169x

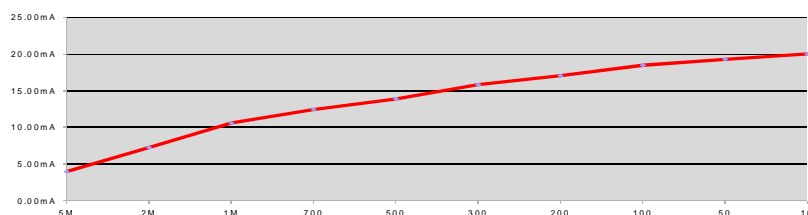
## Description

## KPM169x models for 800-1200VDC

These units are used for industrial, marine and offshore installations. Start of monitoring function is delayed when auxiliary power is switched on (default 2 secs delay).

This unit use the voltage adapter RH12 for Voltage systems from 800V to max. 1200VDC.

## Output diagram



## Relay Operation

Scale range: <10kΩ-5MΩ

	Warning	Alarm	System Error	Fail Safe	Latch
R1	✓				
R2		✓		✓	✓
R3			✓	✓	

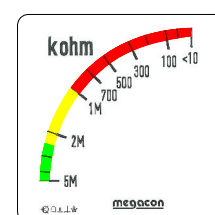
Model	Latch	Output	Fail-safe	Adjustments	Trip level	Delay
KPM169K12	-	-	X	WARNING:	10kΩ - 5MΩ	0-30secs
KPM169L12	-	X	X	ALARM:	10kΩ - 5MΩ	0,1-3secs
KPM169GK12	X	-	X			
KPM169GL12	X	X	X			
KPM169K12N	-	-	-			
KPM169L12N	-	X	-			
KPM169GK12N	X	-	-			
KPM169GL12N	X	X	-			

Coloured sectors show recommended areas of settings:  
 ■ - Indicates alarm trip zone  
 ■ - Indicates warning trip zone  
 ■ - Indicates healthy zone

## Output table (example for 4-20mA)

Value (scale)	mA output
<10kΩ	20.00mA
50kΩ	19.30mA
100kΩ	18.50mA
200kΩ	17.07mA
300kΩ	15.85mA
500kΩ	13.90mA
700kΩ	12.40mA
1MΩ	10.65mA
2MΩ	7.23mA
5MΩ	4.00mA

## Range



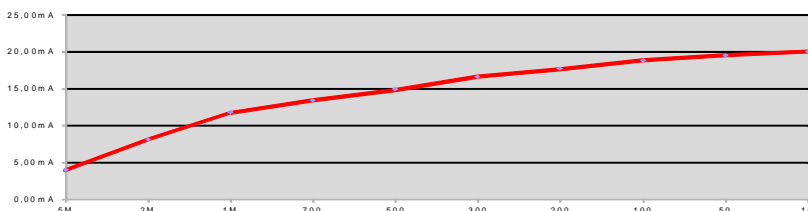
## Description

## KPM169x models for 1200-1600VDC

These units are used for industrial, marine and offshore installations. Start of monitoring function is delayed when auxiliary power is switched on (default 2 secs delay).

This unit use the voltage adapter RH16 for voltage from 1200V to max. 1600VDC.

## Output diagram



## Relay Operation

Scale range: <10kΩ-5MΩ

	Warning	Alarm	System Error	Fail Safe	Latch
R1	✓				
R2		✓		✓	✓
R3			✓	✓	

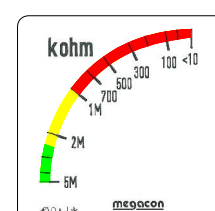
Model	Latch	Output	Fail-safe	Adjustments	Trip level	Delay
KPM169K16	-	-	X	WARNING:	10kΩ - 5MΩ	0-30secs
KPM169L16	-	X	X	ALARM:	10kΩ - 5MΩ	0,1-3secs
KPM169GK16	X	-	X			
KPM169GL16	X	X	X			
KPM169K16N	-	-	-			
KPM169L16N	-	X	-			
KPM169GK16N	X	-	-			
KPM169GL16N	X	X	-			

Coloured sectors show recommended areas of settings:  
 ■ - Indicates alarm trip zone  
 ■ - Indicates warning trip zone  
 ■ - Indicates healthy zone

## Output table (example for 4-20mA)

Value (scale)	mA output
<10kΩ	20.00mA
50kΩ	19.52mA
100kΩ	18.84mA
200kΩ	17.69mA
300kΩ	16.62mA
500kΩ	14.88mA
700kΩ	13.46mA
1MΩ	11.77mA
2MΩ	8.14mA
5MΩ	4.00mA

## Range



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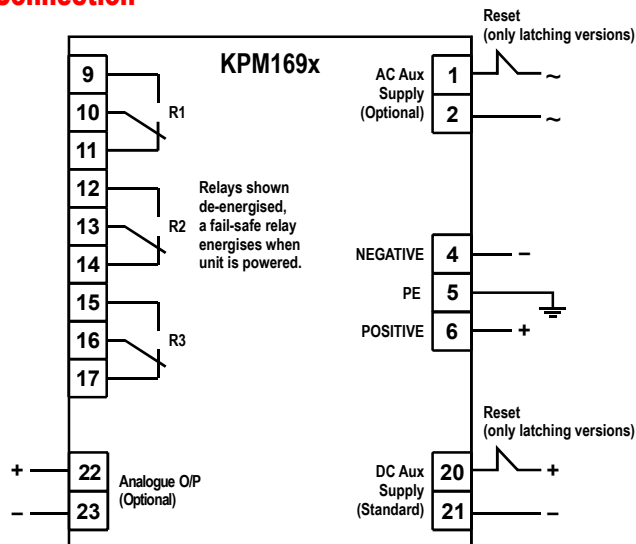
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# KPM169x

## Connection



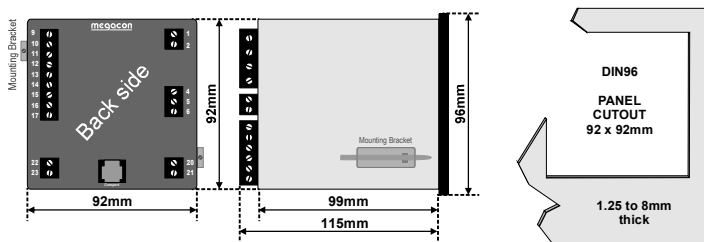
## Analogue Output

KPM169F, KPM169GF, KPM169L2, KPM169GL2, KPM169L4, KPM169GL4, KPM169L8, KPM169GL8, KPM169L12, KPM169GL12, KPM169L16 and KPM169GL16 have an analogue output proportional to meter reading. (Special outputs are available on request)

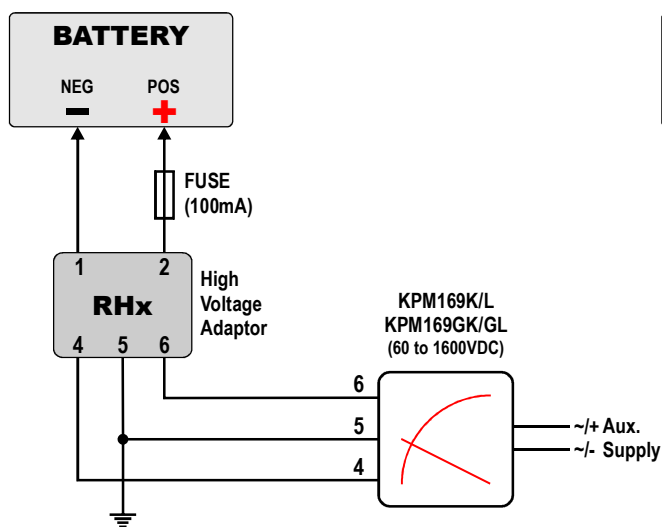
Add suffix from table below to type designation to specify output required:

O/P1	0 - 10mA	O/P6	N/A
O/P2	0 - 20mA	O/P7	N/A
O/P3	4 - 20mA	O/P8	0 - 10VDC
O/P4	N/A	O/P9	N/A
O/P5	N/A	O/P10	N/A

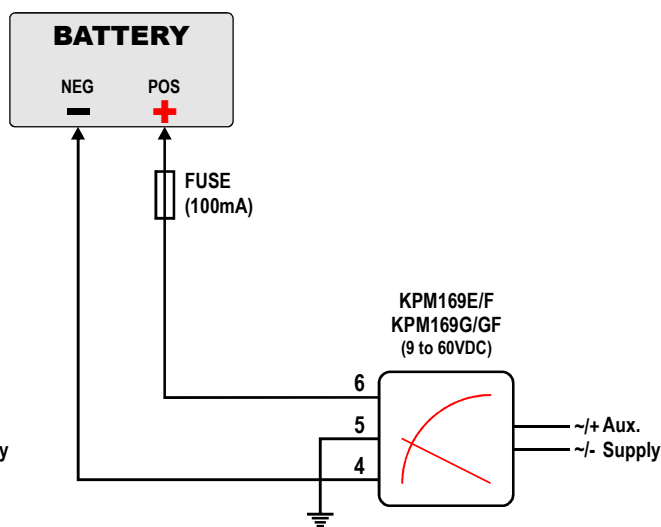
## Dimensions



## INPUT VIA RH ADAPTOR



## DIRECT INPUT <60VDC

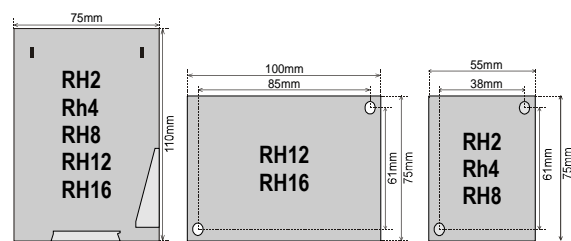


## High Voltage Adaptors (RHx) for KPM169Kx/Lx series

DC Voltage Adapter for use in conjunction with KPM169x series when the monitored DC voltage is higher than 60VDC. The adapter is a passive resistive/capacity unit and is potted in polyurethane for electrical safety. When the adapters is connected to the instrument the maximum voltage output is app. 60VDC.



## Dimensions for RHx series



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## ORDERING INFORMATION

Type	: KPM169F
Aux. Supply	: 230VAC
Network Voltage	: 24VDC
Analogue O/P	: 4-20mA
Range	: -

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## HIGH VOLTAGE DC ADAPTORS

## RHx



- High Voltage Adaptors for KPM169x DC Insulation Guards
- Up to 1600VDC (up to 5000VDC on request)
- Limits the measuring output signal to KPM169x series
- Epoxy filled for electrical insulation

## Specifications

Voltage range:	Up to 1600V (higher voltages on request)
Burden:	<0,5mA
Temperature range:	-10 to +54°C
Dimensions:	
RH2, RH4 & RH8	55 x 110 x 75mm
RH12 & RH16	100 x 110 x 75mm
Ingress Protection:	IP21
Weight:	
RH2, RH4 & RH8	app. 0,5kg
RH12 & RH16	app. 0,9kg

## Description

DC Voltage Adapter for use in conjunction with KPM169x series when the monitored DC voltage is higher than 60VDC

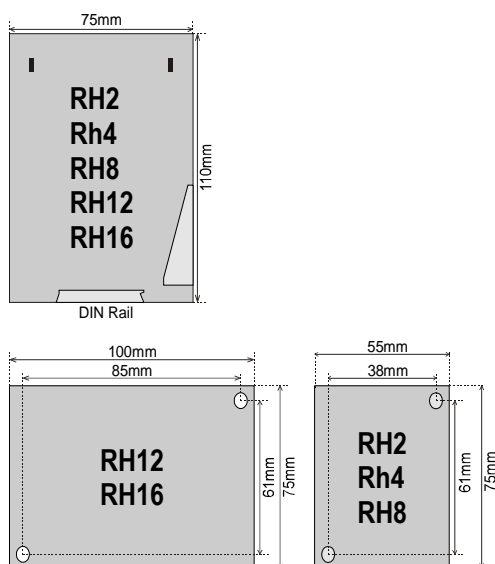
The adapter is a passive resistive/capacity unit and is potted in polyurethane for electrical safety.

When the adapters is connected to the instrument the maximum voltage output is app. 60VDC.

## Models

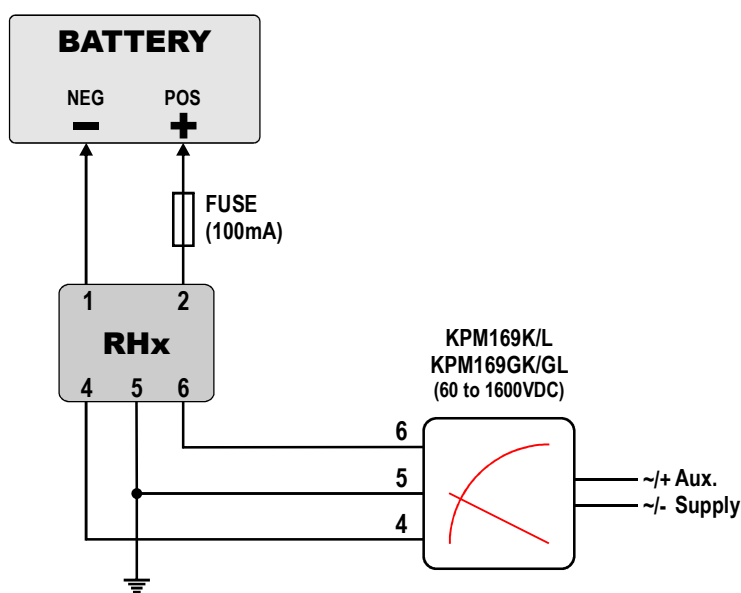
Type	Voltage range	
RH2:	min. 60VDC	max. 200VDC
RH4:	min. 200VDC	max. 400VDC
RH8:	min. 400VDC	max. 800VDC
RH12:	min. 800VDC	max. 1200VDC
RH16:	min. 1200VDC	max. 1600VDC

## Dimension



## Principle connection

## INPUT VIA RH ADAPTOR





## Test rapport

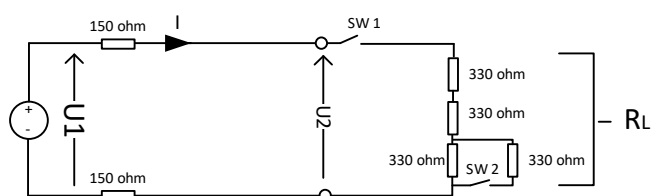
Test av Magna power supply på verksted

**Dato:** 28.04-2019

**Utført av:** Jan Bremnes

## Hensikt med testen

Hensikten med testen er å verifisere at Magna-power XR1250 kan kompensere for spenningsfall som oppstår over et kabelstrekk. Tanken er å teste poweret mot en last som varierer, samt stressteste poweret ved å ta bort lasten og legge til lasten.



Figur 1 testkrets

Testkretsen i figur 1 ble brukt i testen. For å simulere resistans i umbilicalen ble det brukt 3 stk.  $50\ \Omega$  effektmotstandere som hver tåler 100 W i serie. Lasten består av totalt 4 stk.  $330\ \Omega$  effektmotstander, som hver kan tåle 300 W. En effektmotstand er koplet i parallell over en av de 3 motstandene som står i serie (figur 1) ved hjelp av en bryter. Jeg har lagt inn to brytere, en som bryter strømmen til lasten (SW 1) og en som legger inn og ut motstanden som er parallellkoblet. SW 1 simulerer hva som skjer dersom lasten skulle falle bort eller bli lagt inn momentant. SW 2 simulerer en last endring mellom  $825\ \Omega$  og  $990\ \Omega$ .

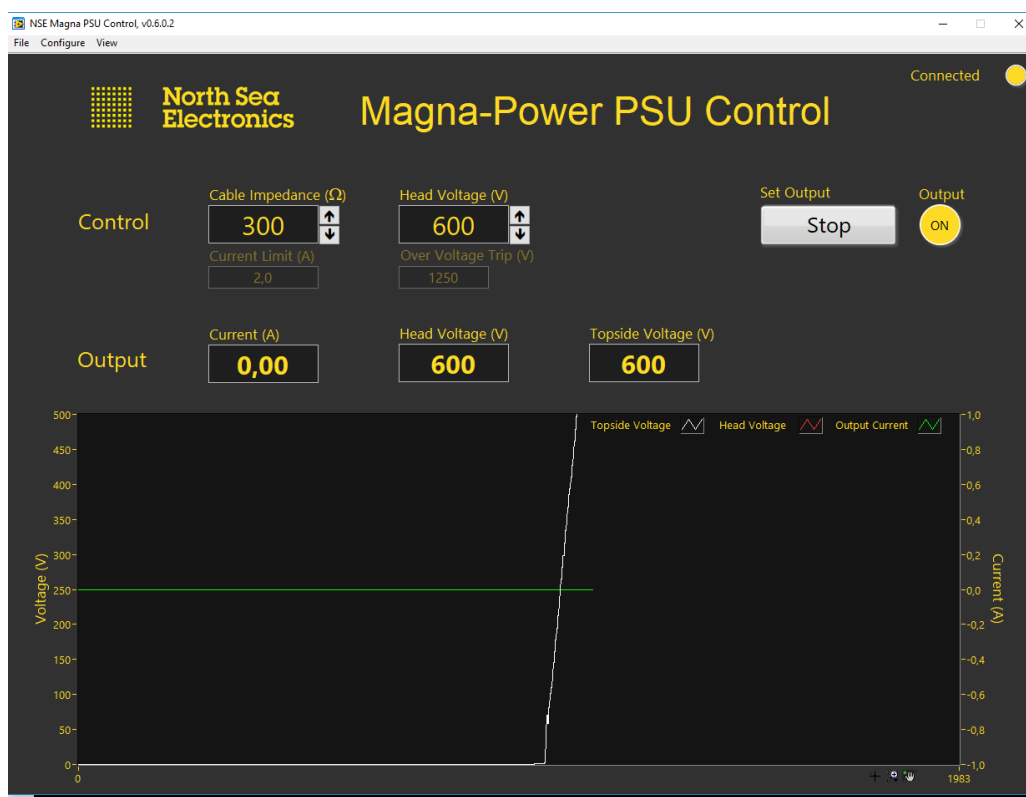
## Utstyrs liste:

Enhet	Fabrikant	Model	Kommentar
Power supply	Magna-Power	XR1250	
Oscilloscope	Fluke	123	
Multimeter	Fluke	115 True RMS multimeter	Brukt for å måle strømmen I

Multimeter	AMPROBE	HD11C	Brukt for å måle U2
Effektmostander	ARCOL	HS 330	Brukt for å simulere last
Bryter	ELCO	1pol RS16/1 PH Elko	Brukt som SW 1 og SW 2

## Test

I programvaren til Magna-poweret la jeg inn «head voltage» (U2) lik 600 V og kabelimpedans lik  $300\Omega$ .



Figur 2: Magna-Power PSU control

Fluke 123 scopmeter ble brukt for å se på hvordan spenningen U2 varieret over tid ved de forskjellige endringene.

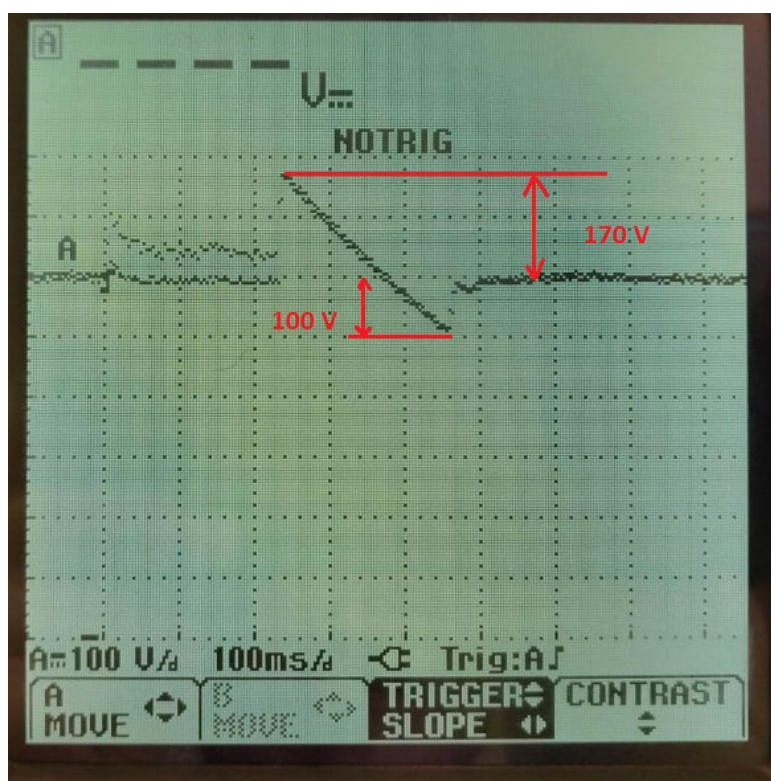
Som første forsøk hadde jeg SW 2 åpen, noe som gir en last på  $990\Omega$ . Jeg ønsket å se hvordan U2 ble regulert når jeg luket SW 1 slik at power supplet «fikk» lasten. Jeg registeret ingen endring på oscilloskopet når SW 1 ble lukket.

Målte følgende:

RL	990 $\Omega$
U1	781 V
U2	600 V
I	0.604 A
P	$P = U \cdot I = 600 \text{ V} \cdot 0.604 \text{ A} = 362.4 \text{ W}$

Poweret ble belastet med effekt på 362.4 W uten at man kunne registrere noe spenningsfall på U2.

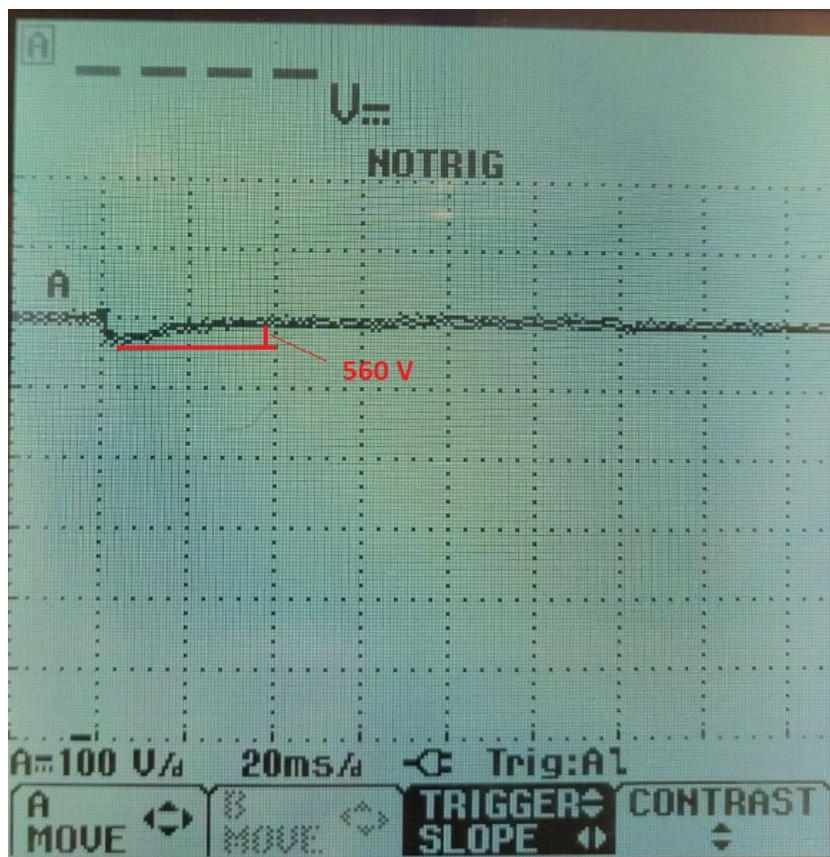
Ved å åpne SW 1 fjerner jeg lasten fra poweret. Det ble da registrert en endring i U2, som gikk bratt opp til ca. 770 V før den justerte seg ned til 500 V for så å stabilisere seg på 600 V. Poweret bruker rundt. 200 ms på å regulere seg inn til 600 V (se figur 4).



Figur 3: Scop bilde når lasten blir tatt bort

Ifølge databladet skal poweret bruke 4 ms på spenningsendringer fra 0 til 63%. I denne testen brukte den ca. 200 ms på å regulere spenningen tilbake til ønsket nivå. Dette kan forklares med at ved åpen krets, har ikke strømmen noen vei å gå, og det tar følgelig litt tid før all energi er drenert. Dette sammenfaller også med test rapport fra NSE datert 26.11.2014.

For å teste hvordan poweret reagerer på last endringer lukket jeg SW 2. Når SW 2 lukkes endrer lasten seg fra  $990\Omega$  til  $825\Omega$ . Dette medfører at belastningen øker fra  $362.4\text{ W}$  til  $431.4\text{ W}$ . Det ble da registrert en endring i  $U_2$  som falt ned til  $560\text{ V}$ . Poweret brukte  $20\text{ ms}$  for å regulere seg inn til  $600\text{ V}$  (Figur 5).



Figur 4: Scop bilde ved lastendring fra  $990\Omega$  til  $825\Omega$

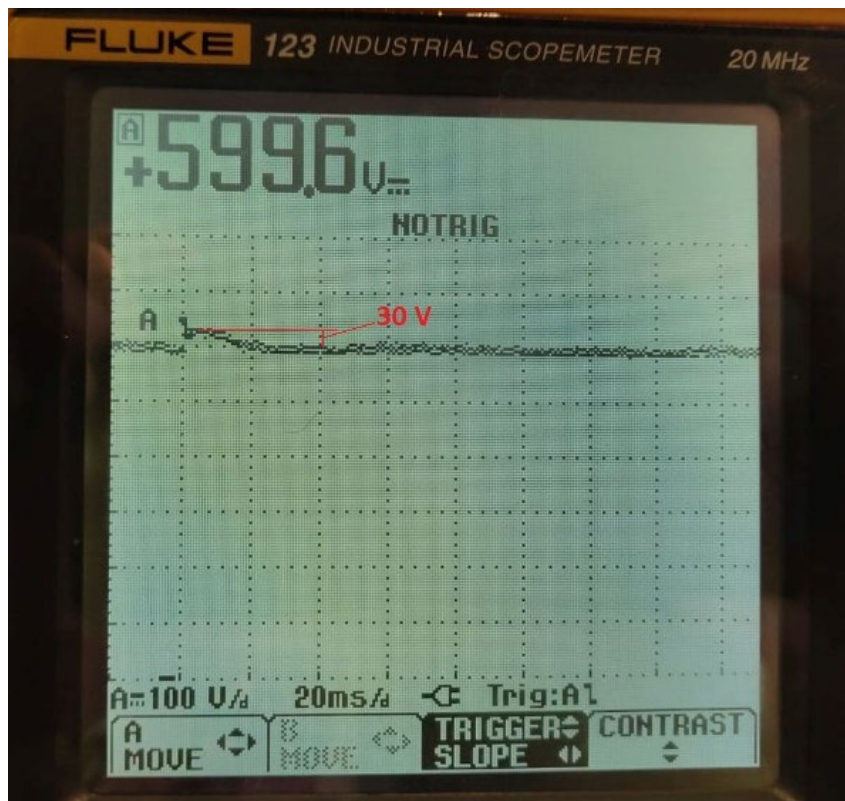
Jeg målte følgende:

RL	$825\Omega$
U1	$816\text{ V}$
U2	$600\text{ V}$
I	$0.719\text{ A}$
P	$P = U \cdot I = 600\text{ V} \cdot 0.719\text{ A} = 431.4\text{ W}$

Tabell 1

Vi ser at poweret regulerer seg inn til ønsket spenning relativt raskt (ca.  $20\text{ ms}$ ) ved denne endringen.

Resultatet i figur 6 viser  $U_2$  som funksjon av tid når vi endrer RL fra  $825\ \Omega$  til  $990\ \Omega$ .



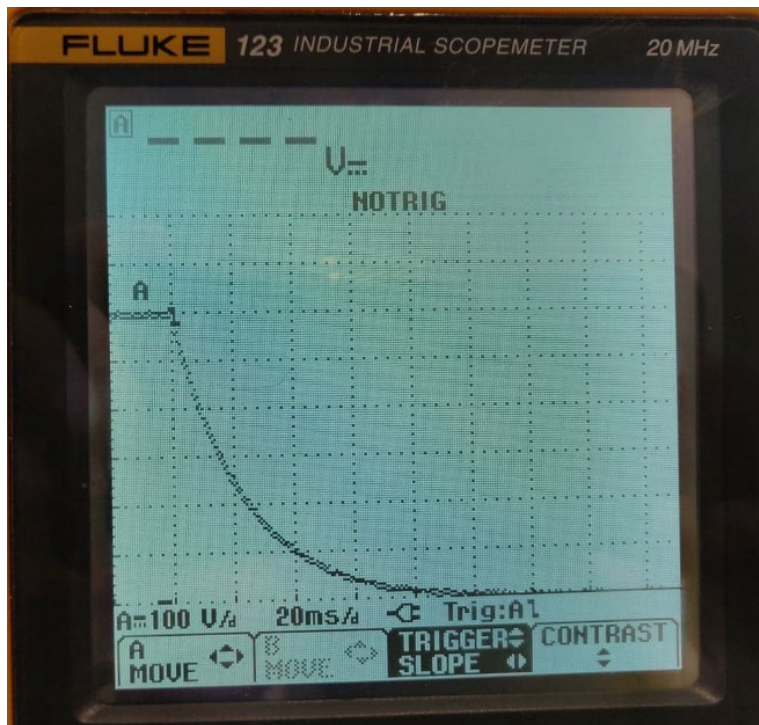
Figur 5: Scop bilde ved lastendring fra  $825\ \Omega$  til  $925\ \Omega$

Poweret regulerer spenningen  $U_2$  inn i løpet av 20 ms i løpet av denne tiden har spenningen  $U_2$  630 V.

Denne testen konkluderer med at poweret regulerer spenningen  $U_2$  slik som ønsket. Man registrerer at det bruker noe lenger tid for å regulere seg inn dersom lasten momentant forsvinner.

For å se hvordan poweret reagerer når det blir slått av så jeg på  $U_2$  som funksjon av tid når spenningen ble slått av.





Figur 6: Scop bilde viser spenning som funksjon av tid ved power off

Figur 26 viser at «poweret ramper» ned spenningen til 0 volt før det slår seg av.

## Test rapport

Test av Magna power supply og DC-DC konvertere ombord på G. O. Sars

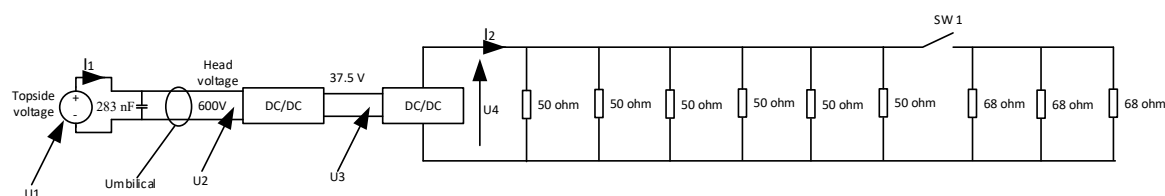
**Dato:** 25.04-2019

**Utført av:** Jan Bremnes

## Hensikt med testen

Hensikten med testen er å verifisere at Magna-power XR1250 kan kompensere for spenningsfall som oppstår over et kabelstrekk, samt se at DC/DC konverteren som er valgt i prosjektet fungerer hensiktsmessig. Tanken er å teste poweret og DC/DC konverteren mot en last som varierer, samt stressteste poweret ved å ta bort lasten og legge til lasten. Testen blir utført på en umbilical som har en kapasitans og vil også verifisere at løsningen er egnet når den henger på en kabel som er kapazitiv.

## Test oppsett



Figur 1: Testkrets

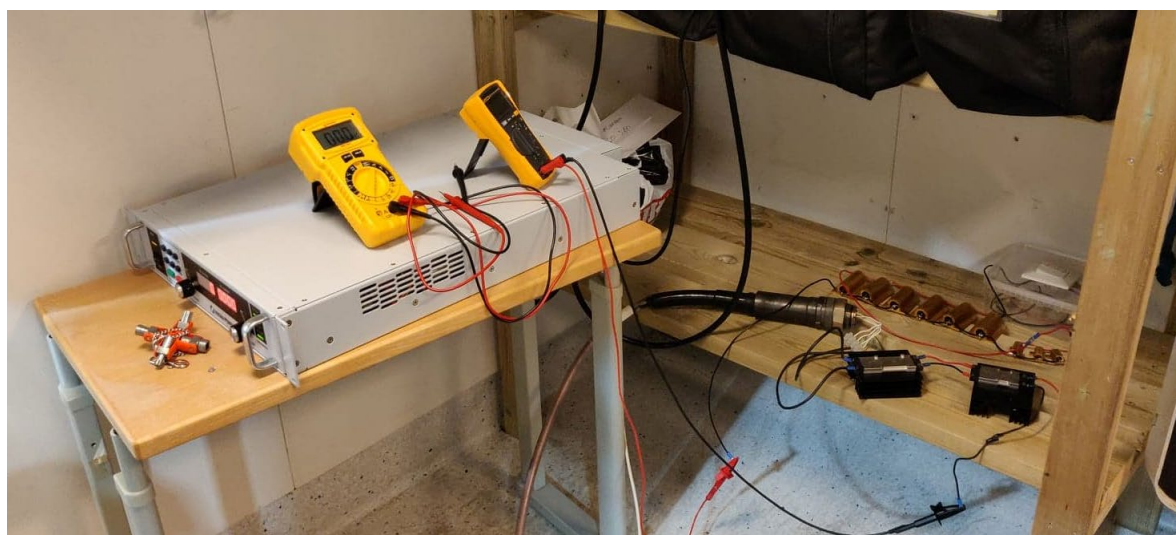
Testkretsen i figur 1 ble brukt under testen. For å simulere last ble det laget et motstandsnettverk bestående av 6 stk.  $50\Omega$  koplet i parallell jeg la inn en svitsj SW1 hvor det var 3 stk  $68\Omega$  motstander i parallell. Jeg brukte BCM4414VG0F4440C02 for å konvertere ned spenningen fra 600 V til 37.5. DCM3414V50M26C2C01 ble brukt for å konvertere spenningen til 2 V. Umbilicalen på G. O. Sars er 4130 m lang og ble målt til  $157\Omega$  og 283 nF.

## Utstyrs liste:

Enhet	Fabrikant	Model	Kommentar
Power supply	Magna-Power	XR1250	

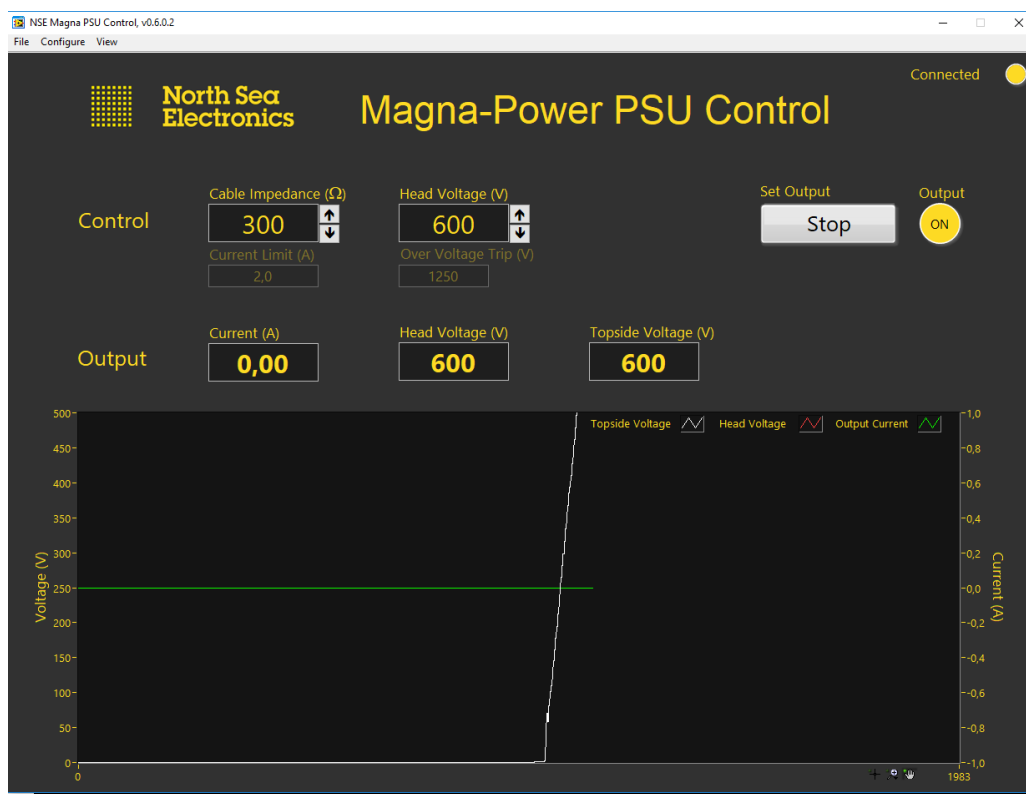
Oscilloscope	Fluke	123	
Multimeter	Fluke	115 True RMS multimeter	Brukt for å måle strømmen I
Multimeter	AMPROBE	HD11C	Brukt for å måle U2
Effektmostander	ARCOL	HS 100	Brukt for å simulere last
Effektmostander	ARCOL	HS 25	Brukt for å simulere last
Bryter	ELCO	1pol RS16/1 PH Elko	Brukt som SW 1
Umbilical	Nexans	ARAMID ARMoured UMBILICAL	

## Test



Figur 2: Oppkopling av testkrets

I programvaren til Magna-poweret la jeg inn en «head voltage» (U2) lik 600 V og kabelimpedans lik 300Ω.



Figur 3: Magna-Power PSU control

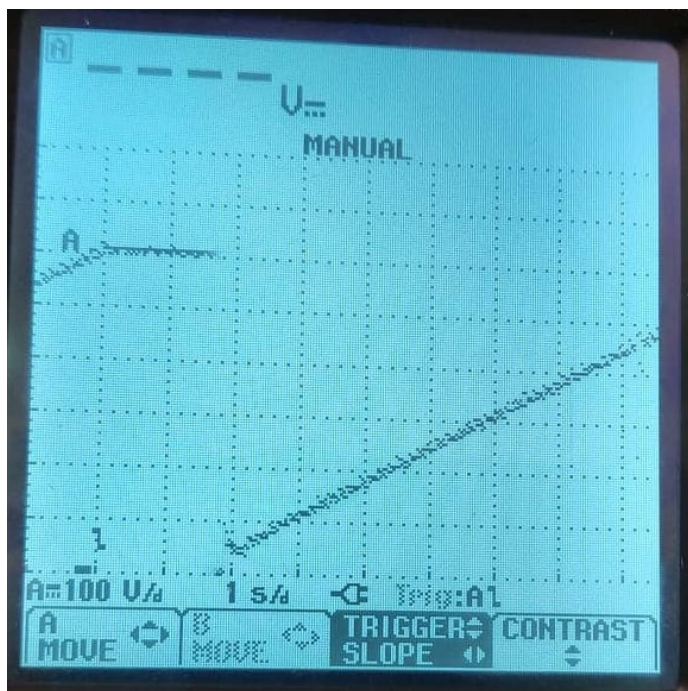
Jeg målte motstand i de 6 parallell koplede 50  $\Omega$  effektmotstandene til 8.5 $\Omega$ . Teoretisk verdi skal være:

$$R = \frac{1}{\frac{1}{50\Omega} + \frac{1}{50\Omega} + \frac{1}{50\Omega} + \frac{1}{50\Omega} + \frac{1}{50\Omega} + \frac{1}{50\Omega}} = 8.33\Omega$$

Jeg målte motstanden når SW 1 var lukket til 6.2  $\Omega$ , slik at de 3 68  $\Omega$  effektmotstandene i parallell kom med i kretsen. Teoretisk verdi skal være:

$$R = \frac{1}{\frac{1}{50\Omega} + \frac{1}{50\Omega} + \frac{1}{50\Omega} + \frac{1}{50\Omega} + \frac{1}{50\Omega} + \frac{1}{50\Omega} + \frac{1}{68\Omega} + \frac{1}{68\Omega} + \frac{1}{68\Omega}} = 6.1\Omega$$

Jeg startet power supplyet da SW 1 var åpen og fikk følgende startkurve:



Figur 4: Scop bilde viser spenning som funksjon av tid ved power on

Vi ser at power supliet bruker ca. 7 sekunder for å komme opp i en spenning på 600 V. Måler følgende verdier:

RL	8.5 $\Omega$
U1	624 V
U2	600 V
U3	37.6 V
U4	24
I1	0.15 A
I2	2.84 A
PU1	$PU1=U1 \cdot I1=624V \cdot 0.15A=93.5W$
PU2	$PU1=U2 \cdot I1=600V \cdot 0.15A=90W$



PU3	PU1=U3*I1=24V * 2.84A=68.2W
-----	-----------------------------

Lukket SW 1 og målte følgende verdier:

RL	6.2 $\Omega$
U1	631 V
U2	600 V
U3	37.6 V
U4	24
I1	0.20 A
I2	3.88 A
PU1	PU1=U1*I1=631V * 0.15A=126.2W
PU2	PU1=U2*I1=600V * 0.20A=120W
PU3	PU1=U3*I1=24V * 3.88A=93.1W

Det ble ikke registret noe spenningsfall i U3 når jeg endret lasten fra 8.5 $\Omega$  til 6.2  $\Omega$ .

Effekt tap:

Effekt tapet i kabelen er på 3.5 W når lasten er 8.5 og 6.2 W når lasten er 6.2  $\Omega$ . Effekttapet i kabelen kan utledes:

$$P = \frac{\Delta U^2}{R} = \frac{(624V - 600V)^2}{157 \Omega} = 3.67W \text{ når lasten er } 8.5 \Omega$$

Og

$$P = \frac{\Delta U^2}{R} = \frac{(631V - 600V)^2}{157 \Omega} = 6.12W \text{ når lasten er } 6.2 \Omega$$

Vi har to tap til i denne kretsen og det er tapet over de to DC/DC-konverterne. Vi kan regne ut det reelle effekttapet ved å bruke de verdiene som vi målte i testen vår, når vi belastet systemet med henholdsvis 8.5  $\Omega$  og 6.2  $\Omega$ . Vicor har på hjemmesidene sine et verktøy kalt» VICOR powerBench»

<http://spicewebprd.vicorpower.com/PowerBench-Whiteboard/MultiOutputSolutionProcessor.do> man kan bruke for å regne ut effekttapet. Det er dette som er vist i figur 5 og 6.

### Ved $R_L=8.5\ \Omega$

Fra VICOR powerBench:



Figur 5: Utregning av effekt ved  $8.5\Omega$  last

Beregnet effekttap er 22.73 W, virkningsgrad 75 %

Målt effekttap er 21.8 W, virkningsgrad =  $\frac{68.2W}{90W} \cdot 100\% = 75.8\%$

### Ved $R_L=6.2\ \Omega$

Fra VICOR powerBench:

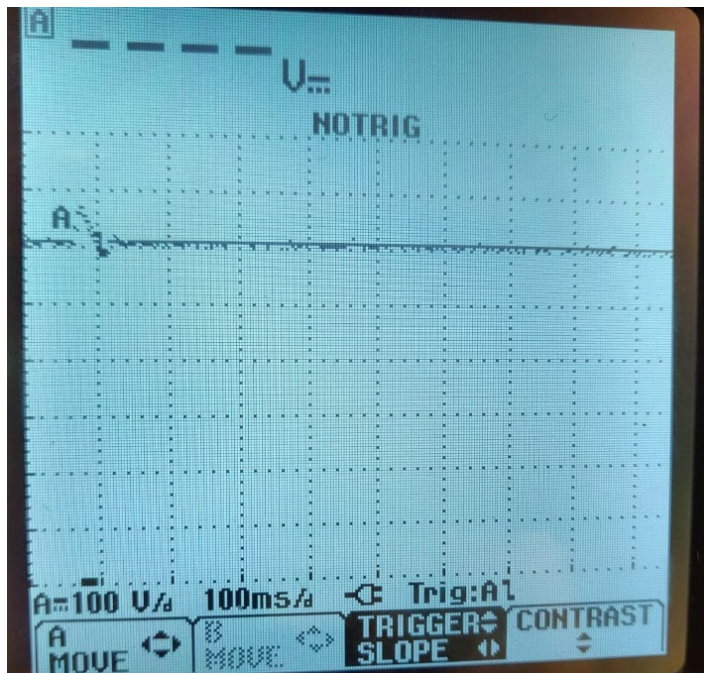


Figur 6: Utregning av effekt ved  $8.5\Omega$  last

Beregnet effekttap er 24.37 W, virkningsgrad 75,2 %

Målt effekttap er 26.88 W, virkningsgrad =  $\frac{93.1W}{120W} \cdot 100\% = 77.6\%$

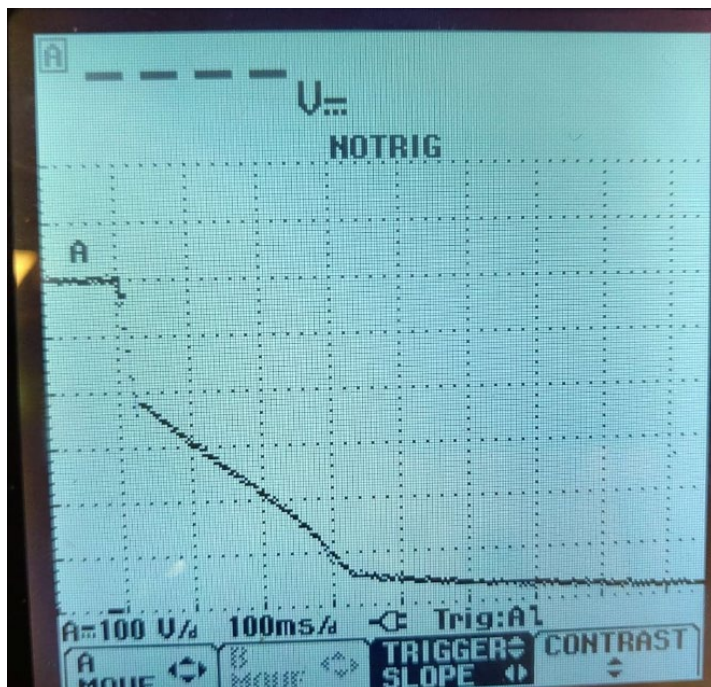
Jeg fjernet last ved å trekke ut kabelen til DC/DC-konverteren som gir ut 24 V. Ser på spenningen U2 som funksjon av tiden, for å se hvordan power supplet regulerer seg inn etter at lasten har falt ut med et oscilloskop.



Figur 7: Scop bilde viser spenningen som funksjon av tid etter at lasten er borte

Fra figur 7 ser vi at  $U_2$  går opp til 670 V før power suppliet starter å regulere. Det tar 50 ms før power suppliet klarer å regulere spenningen til 600 V.

Figur 8 viser hvordan spenningen reguleres ned når man slår av poweret.



Figur 8: Scop bilde viser spenning som funksjon av tid ved power off

Vi ser at poweret «ramper» ned spenningen til 0 volt før det slår seg av.



North Sea  
Electronics

# Test Report Cable Compensation

## Product:

Magna Power Supplies

NSE-550100

### REVISION HISTORY

REV	DATE	DESCRIPTION	PREP	CHECK	APPR	COMPANY
A	26.11.2014	Initial revision	RFY	GLK	GLK	NSE
B						
C						
D						
E						

PAGES DOCUMENT: **11**

PAGES APPENDICES: **0**

NSE DOCUMENT NUMBER: **NSE-550100-015**

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## 1 Introduction

### 1.1 Purpose of testing

The purpose of this test is to verify the performance of the Magna Power supply internal cable compensation. The idea is to stress it to worst-case scenarios and measure the time it needs to regulate voltage in different variable load scenarios.

## 2 Test setup and equipment:

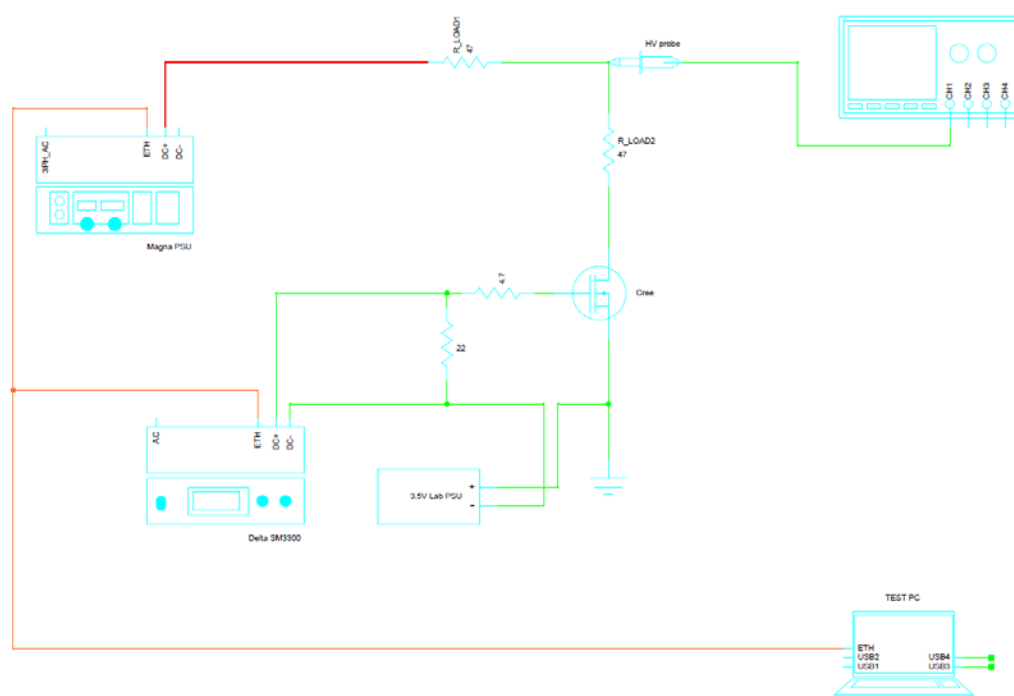
### 2.1 Administrative

Test date: 29.07.2014  
 Tested by: MPA/RFY

### 2.2 Equipment list

Device	Manufacturer	Model	Comment
Power supply	Magna PSU	TDS1250-8.3	
NSE load cabinet	NSE	6 X 47ohm, 2000W	
Power supply	Delta 660V	SM3300	Used to turn on and off the load switch
Power supply	Low volt		Used to turn on and off the load switch
Load switch transistor	Cree		
Oscilloscope	Agilent		Connected with HV probe

### 2.3 Test setup drawing





## 2.4 Overshoot and settling time at various loads and cable resistances

The purpose of this test is to measure how much overshoot the PSU has and how long it takes to settle during worst case load removal.

With reference to the test setup drawing the R\_load1 is the cable resistance and R\_load2 is the load resistance that is being switched in and out.

In some of the tests, there is also a resistance in parallel with the load resistance and switch transistor in order to create constant bias current even when the load resistance is disconnected.

In the final test, the cable simulating resistance is replaced by actual Camesa wireline cable.

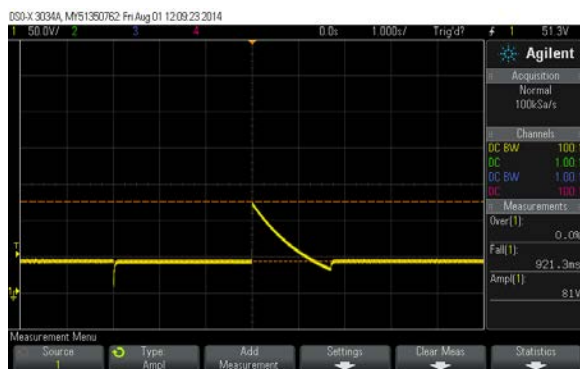
Product: **Magna PSU**  
 Title: **Test Report – Cable Compensation**  
 Document No: **NSE-550100-015**

Page: **5 of 11**  
 Date: **26.11.2014**  
 Revision **A**

### 2.4.1 Test case #1 – 47ohm / Open circuit – 47ohm cable resistance

Cable resistance: 47ohm – resistive load  
 Load resistance: 47ohm – resistive load  
 Off resistance: Open circuit

Test-current	Load Voltage	PSU Voltage	Load Power (Watt)	PSU Power (Watt)	Voltage Overshoot (Volt)	Fall Time (ms)	Voltage Drop	Rise Time (ms)
1	47	94	47	94	81	921	38	51
3	141	282	423	846	235	973	103	44
6.5	306	611	1986	3972	500	926	210	87



Voltage drop and overshoot with 1A test current



Voltage drop and overshoot with 3A test current



Voltage drop and overshoot with 6.5A test current

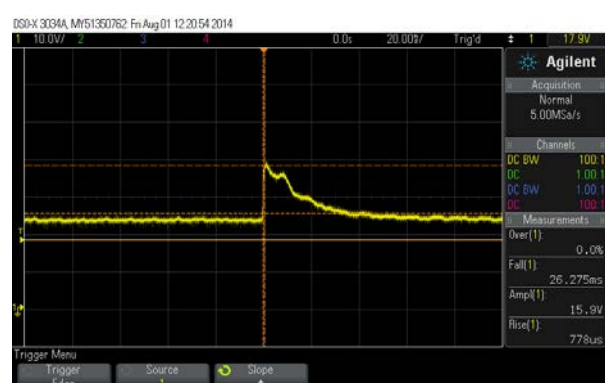
Product: **Magna PSU**  
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 Date: **26.11.2014**  
 Revision: **A**

## 2.4.2 Test case #2 – 23.5ohm / 47ohm – 47ohm cable resistance

Cable resistance: 47ohm – resistive load  
 Load resistance: 23.5ohm – resistive load  
 Off resistance: 47ohm – resistive load

Test-current	Load Voltage	PSU Voltage	Load Power (Watt)	PSU Power (Watt)	Voltage Overshoot (Volt)	Fall Time (ms)	Voltage Drop	Rise Time (ms)
1	24	71	24	71	15.9	26	11.7	48
3	71	212	212	635	44	34	33	46
6.5	153	458	993	2979	94	49	68	59



Voltage overshoot with 1A test current



Voltage drop and overshoot with 3A test current



Voltage drop and overshoot with 6.5A test current

### 2.4.3 Test case #3 – 94ohm / open circuit – 47ohm cable resistance

Cable resistance: 47ohm – resistive load  
Load resistance: 94ohm – resistive load  
Off resistance: open circuit

Test-current	Load Voltage	PSU Voltage	Load Power (Watt)	PSU Power (Watt)	Voltage Overshoot (Volt)	Fall Time (ms)	Voltage Drop	Rise Time (ms)
1	94	141	94	141	83	585	55	23
3	282	423	846	1269	243	618	151	43
6.5	611	917	3972	5957	530	614	310	90



Voltage drop and overshoot with 1A test current



Voltage drop and overshoot with 3A test current



Voltage drop and overshoot with 6.5A test current

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 Document No: **NSE-550100-015**

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 Date: **26.11.2014**  
 Revision: **A**

#### 2.4.4 Test case #4 – 47ohm / 94ohm – 47ohm cable resistance

Cable resistance: 47ohm – resistive load  
 Load resistance: 47ohm – resistive load  
 Off resistance: 94ohm – resistive load

Test-current	Load Voltage	PSU Voltage	Load Power (Watt)	PSU Power (Watt)	Voltage Overshoot (Volt)	Fall Time (ms)	Voltage Drop	Rise Time (ms)
1	47	141	47	141	29	23	18.7	32
3	141	423	423	1269	83	38	60	48



Voltage drop and overshoot with 1A test current



Voltage drop and overshoot with 3A test current



## 2.4.5 Test case #5 – 23.5ohm / Open circuit – 47ohm cable resistance

Cable resistance: 47ohm – resistive load  
 Load resistance: 23.5ohm – resistive load  
 Off resistance: Open circuit

Test-current	Load Voltage	PSU Voltage	Load Power (Watt)	PSU Power (Watt)	Voltage Overshoot (Volt)	Fall Time (ms)	Voltage Drop	Rise Time (ms)
1	24	47	24	47	57	1134	24	28
4	94	188	376	752	212	1200	75	31
8	188	376	1504	3008	509	1287	142	51



Voltage drop and overshoot with 1A test current



Voltage drop and overshoot with 4A test current



Voltage drop and overshoot with 8A test current



Product: **Magna PSU**  
 Title: **Test Report – Cable Compensation**  
 Document No: **NSE-550100-015**

Page: **10 of 11**  
 Date: **26.11.2014**  
 Revision **A**

#### 2.4.6 Test case #6 – 47ohm / Open circuit – Camesa wireline 1N32WTZ – 47ohm

Cable resistance: Camesa Cable, 4.7km, 1N32WTZ-S77, 47ohm  
 Load resistance: 47ohm – resistive load  
 Off resistance: Open circuit

Test-current	Load Voltage	PSU Voltage	Load Power (Watt)	PSU Power (Watt)	Voltage Overshoot (Volt)	Fall Time (ms)	Voltage Drop	Rise Time (ms)
1	47	96	47	96	240	781	41	343
3	141	288	423	864	730	721	126	220



Voltage drop and overshoot with 1A test current



Voltage drop and overshoot with 3A test current

Do note how the inductance of the cable adds to a more “sharp” overshoot profile. This underlines the importance of having an overvoltage clamp on the downhole side, if the equipment cannot take such high voltage pulses.

It should however be noted that the test is done with total disconnection of load, so there is nowhere for the current to float in this test, and this adds to the high voltage here.

Product: **Magna PSU**Page: **11 of 11**Title: **Test Report – Cable Compensation**Date: **26.11.2014**Document No: **NSE-550100-015**Revision **A**

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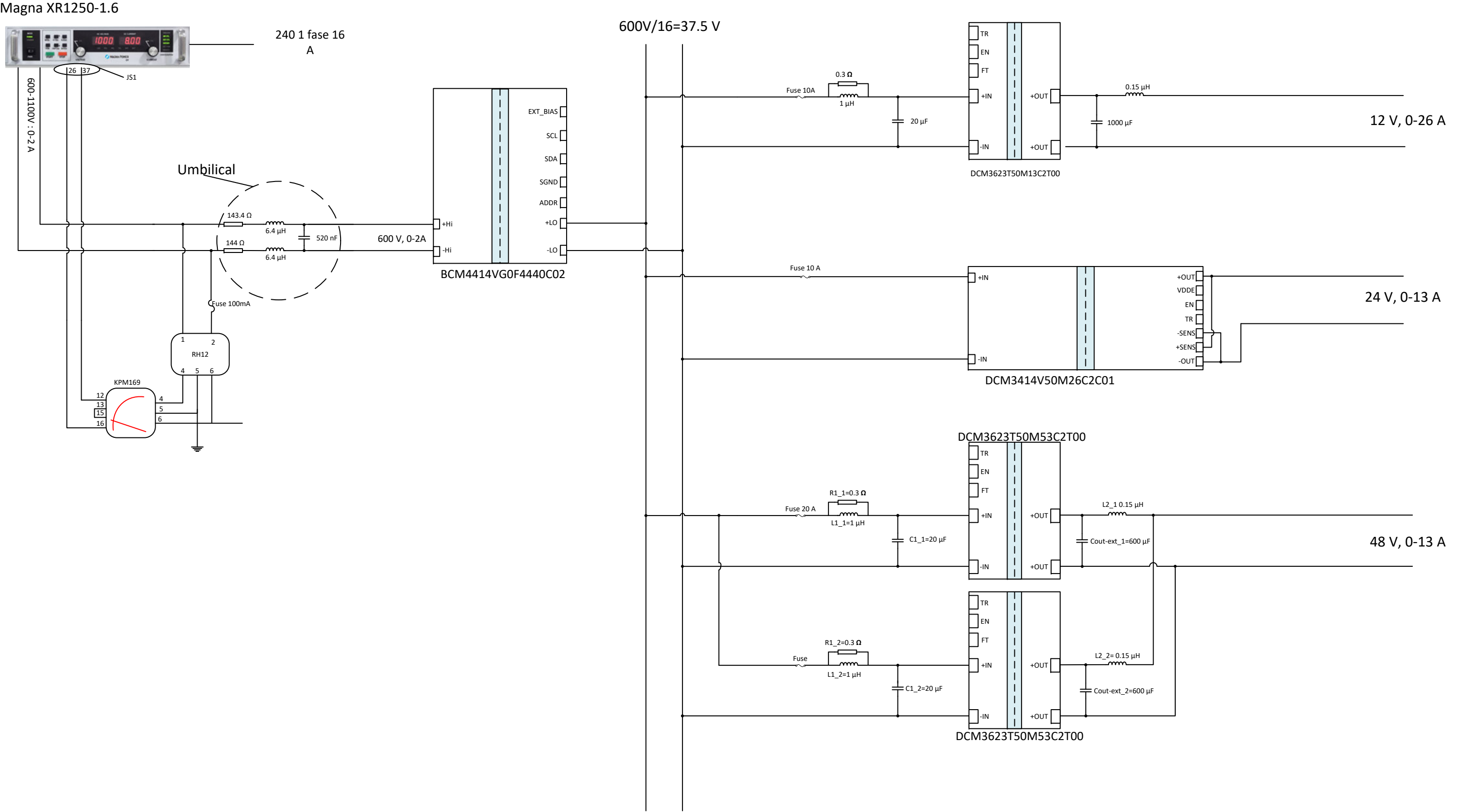
### 3 Conclusion and observations:

The regulation of the voltage at the end of the cable seems to be stable and no oscillation of the voltage has been observed during testing.

As can be expected, there is significant voltage drop and overshoot when adding and removing load at the end of the cable.

The voltage drop should be compensated by the internal cable compensation of the power supply and should last as short as possible, and the PSU perform well here. For example in *3.2.3- Test case #3 – 94ohm / open circuit – 47ohm cable resistance*” We see that when 6.5A load is directly applied, the voltage drop last in 90ms with a maximum amplitude of 300V.

The voltage overshoot is stems from the fact that the PSU need some time to regulate down and that the internal capacitor bank of the PSU needs to be discharge. The effect of the PSU output capacitor bank is clearly visible in the situations where the load is removed completely to an open circuit. Here, the magnitude and time of the overshoot is largely determined by the capacitor bank and not so much the regulation itself.



A	14.05.2019	Første utgave	JBR	Titel Kraftforsyning av instrumentering over en umbilical
Rev	Dato	Beskrivelse	Tegnet av	
				Tegnings type Skjema

<b>Kostnadsoverslag kraftforsyning instrumentering</b>				
Produkt nummer	Beskrivelse	antall	stykk pris	totalt
DCM3623T50M13C2T00	DC DC CONVERTER 12V 320W	1	1731,38	1731,38
BCM4414VG0F4440C02	DC/DC CONVERTER 400-700V DIGITAL	2	4710,54	9421,08
DCM3623T50M53C2T00	DC DC CONVERTER 48V 320W	2	1731,38	3462,76
DCM3414V50M26C2C01	DC/DC CONVERTER 24V 320W	1	3398,2	3398,2
XR1250-1.6	Maga-power power supply med/ Ethernet interface USB converter High Slew Rate	1	37200	37200
KPM169K12	Isolasjonsvakt, 10kohm - 5Mohm	1	5 510,00	5510
RH 12	DC VOLTAGE ADAPTOR 800-1200VDC	1	4 805,00	4805
Totalt				65528,42

## Test rapport

Test av jordfeildeteksjon/vern på verksted

**Dato:** 15.05-2019

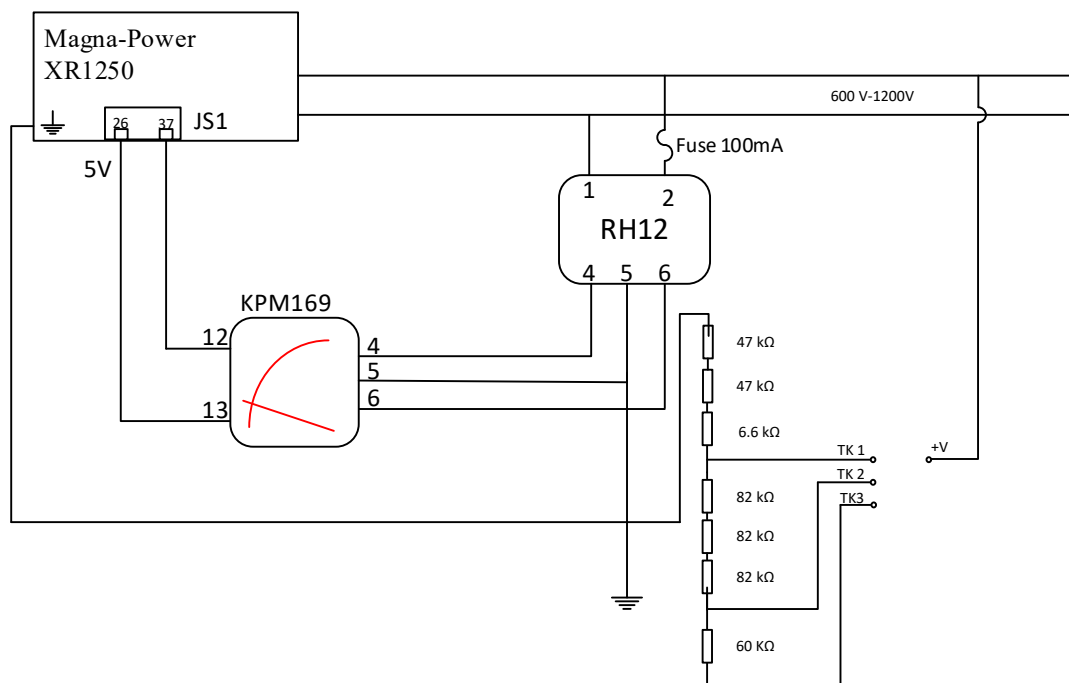
**Utført av:** Jan Bremnes

## Hensikt med testen

Hensikten med testen er å verifiser at løsningen for jordfeilvern virker i henhold til design.

## Virkemåte for kretsen

Den passive isolasjons måler KPM169 ble stilt inn slik at den skal gi en varsling når resistansen mellom jord og pluss spenningen kom under ca.  $346.6 \text{ k}\Omega$ . Når resistansen mellom pluss spenningen og jord blir under  $100.6 \text{ k}\Omega$  skal måleren gi alarm. Tidsforsinkelsen for varsling ble satt til 3 s og tidsforsinkelsen for alarm var satt til det laveste verdien 100 ms. Ved alarm skal forbindelsen mellom pinne 12 og pinne 13 brytes. Magna-power har en digital I/O port JS1 (37-pinns konnektor) som kan gi ut 5 V på pinne 26. Pinne 37 er en interlock inngang som må ha 5 V for at power supplyet skal gi ut spenning. Dersom dette 5 V signalet forsvinner slår power supplyet seg av. For å kople isolasjonsmåleren mot Magna-poweret brukes et «high-voltage» adapter (RH12). Dette adapteret sørger for at det aldri vil være mer enn 60 V på inngangen til KPM169.



Figur 1: Testkrets

## Utstyrs liste:

Enhet	Fabrikant	Model	Kommentar
Power supply	Magna-Power	XR1250	
Isolasjons måler	Megacon	KPM169	
Adapter	Megacon	RH 12	
Resistans	COMP-CARD	CCR-122	Diverse resistanser brukt for å simulere resistans til jord

## Test

Figur 1 viser 3 tilkoplings punkter (TK1, TK2 og TK3) samt +V. Ved å laske et av tilkoblingspunktene til +V introduserer en jordfeil. Dersom det ikke er jordfeil, måler isolasjonsmåleren resistans over 5 M $\Omega$ .

- Lask mellom TK 1 og +V fører til en resistans mellom leder og jord på 100.6 k $\Omega$  skal gi alarm.
- Lask mellom TK 2 og +V fører til en resistans mellom leder og jord på 346.6 k $\Omega$  skal gi varsel.
- Lask mellom TK 3 og +V fører til en resistans mellom leder og jord på 406.6 k $\Omega$  grønt lys ingen alarm eller varsel.

Startet opp Magna-poweret og KPM169 viste resistans over 5 M $\Omega$  med grønt lys. Økte spenningen til 1200 V og registrerte det samme.



Figur 2: ingen tilkopling mellom jord og +V

Koplet mellom tilkoplings punkt 3 til +V og KPM169 viste resistans på ca 400 k $\Omega$  ingen alarm eller varslings. Økte spenningen til 1200 V og registrerte det samme.





Figur 3: Tilkoplings punkt 3 tilkoplet +V

Koplet tilkoplings punkt 2 til +V og KPM169 viste resistans på ca. 320 kΩ den gule varsellampen ble tent. Økte spenningen til 1200 V og registrerte det samme.



Figur 4: Tilkoplings punkt 2 tilkoplet +V

Koplet tilkoplings punkt 1 til +V og KPM169 viste resistans på ca. 90 kΩ den røde alarmlampen ble tent relet R2 åpnet og forbindelsen mellom pine 26 og 37 ble brutt. Økte spenningen til 1200 V og registrerte det samme. Utgangen til Magna-poweret slo seg av i begge tilfelle når varsellampen ble tent.



Figur 5: Tilkoplings punkt 1 tilkoplet +V

**Fra:** [Sigurd Tangerud HAGA](#)  
**Til:** [Bremnes, Jan](#)  
**Kopi:** [Lars-Oyvind MOEN](#)  
**Emne:** RE: Effekt i umbilical  
**Dato:** onsdag 20. mars 2019 09:07:24

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Hei Jan,

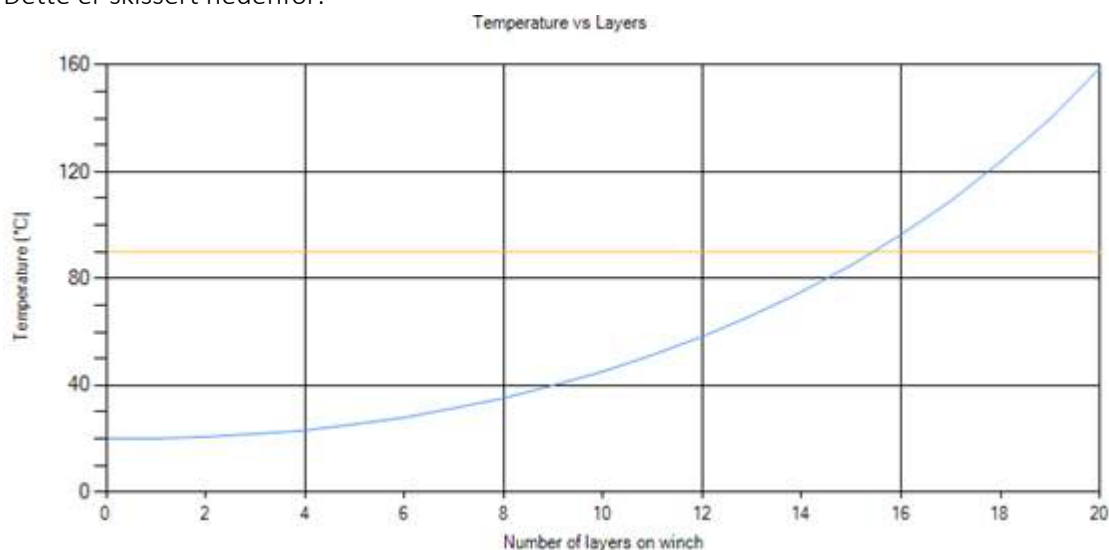
Jeg har antatt en RA427 kabel med 8490m kontinuerlig lengde.

Mine beregninger viser at spenningsfallet vil være relativt høyt (ca. 35% med fulle vinsjlag), men spenningen vil ikke overgå ledernes spenningsrating (4.5kV).

Videre så anbefales det maks 14-15 lag på vinsj under kontinuerlig full operasjon for å unngå for høy kabeltemperatur.

Da har jeg antatt 20 grader omgivelsestemperatur, og vinsj lokalisert ute på dekk.

Dette er skissert nedenfor:



Med vennlig hilsen / Best regards,  
Sigurd T. Haga  
Lead Engineer

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**From:** Bremnes, Jan <jan.bremnes@hi.no>  
**Sent:** 19. mars 2019 15:47  
**To:** Sigurd Tangerud HAGA <sigurd\_tangerud.haga@nexans.com>  
**Subject:** Effekt i umbilical

Hei

Jeg holder på å lage en strømforsyning for instrumentering som skal monteres på vedlagt umbilical fra dere. Power supplyet som skal levere power til utstyret har maks 2 kW. Det jeg lurer på er hvor mye effekt kabelen tåler. Ved normal drift kan det bli maks 909 W i kabelen. Da påtrykkes det 1150 V med 1.8 amper. Ved feil kan man få all effekten 2000 W i kabelen. Det jeg lurere på er om kabelen vil ta skade dersom den blir utsatt for 2000 W. Kan du si noe om det?

Best regards

**Jan Bremnes**

*Senior Engineer*

*Institute of Marine Research*

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