

Item# 3 Lot. 6

Test	Requirements for transformer oil	Results
1- FUNCTION		
Viscosity at 40°C	≤ 12 mm²/S	9.40
Viscosity at -30°C	≤ 1800 mm²/S	773
Pour Point	≤ 40°C	-48
Water Content	< 30 mg/kg	< 10
Dielectric Breakdown (as Received)	≥ 30KV	60
Dielectric Breakdown (after filtering)	≥ 70 kV	75
Density at 20°C	≤ 0.895 g/mL	0.864
Dissipation Factor at 90°C	≤ 0.005 absolute	0.001
2- REFINING/STABILITY		
Appearance	Clear & bright	Clear & bright
Acidity	≤ 0.01 mg KOH/g	<0.01
Intefacial Tension	No requirement (mN/m)	49
Total Sulfur content	No requirement (mg/kg)	184.5
Corrosive Sulfur	Non - corrosive	Non - corosive
Potentially corrosive sulfur	Non - corrosive	Non - corosive
DBDS	Non - detectable (<5mg/kg)	Non - detected
Metal Passivator additrves	Non - detectable (<5mg/kg)	Non - detected
Other additives	Not performed	
2- Furfural & Related compounds	Non - detectable (<0.05mg/kg) For each	Non - detected
Stray Gassing	No requirement	see Last page
3- PERFORMANCE		
Oxidation Stability	≤ 1.2mg KOH/g	Total Acids 0.29
	≤ 0.8 %	Total Sludge 0.08
	≤ 0.5 absolute	DDF at 90°C 0.079
ECT , static charge	No requirement	Run 1 1
		Run 2 1
		Run 3 1
		Average 1
3- HEALTH, SAFTY AND ENVIRONMENT (HSE)		
Flash point Closed cup	≥ 135°C	160
PCA Content	≤ 3%	0.9
PCB Content	Non - detectable (< 2 mg/kg)	Non - detected



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General Specifications			
Property	Test method	Limits	
		Transformer Oil	Low temperature switchgear oil
1- Function			
Viscosity at 40°C	ISO 3104	Max. 12mm ² /s	Max. 3,5mm ² /s
Viscosity at 30°C ^a	ISO 3104	Max. 1 800mm ² /s	--
Viscosity at - 40°C ^b	IEC 61868	--	Max. 400mm ² /s
Pour Point ^a	ISO 3016	Max. -40°C	Max. -60°C
Water content	IEC 60814	Max. 30mg/kg ^c / 40mg/kg ^d	
Breakdown voltage	IEC 60156	Min. 30 kV / 70kv ^e	
Density at 20°C	ISO 3675 or ISO 12185	Max. 0, 895 g/ml	
DDF at 90°C	IEC 60247 or IEC 61620	Max. 0,005	
2- Refining/ stability			
Appearance	--	Clear, free from sediment and suspended matter	
Acidity	IEC 62021 -1	Max. 0,01 mg KOH/g	
Interfacial tension	ISO 6295	No general requirement ^f	
Total sulfur content	BS 2000 Part 373 or ISO 14596	No general requirement	
Corrosive sulfur	DIN 51353	Not corrosive	
Antioxidant additive	IEC 60666	(U) uninhibited oil: not detectable (T) Trace inhibited oil: max. 0,08 % (I) inhibited oils: 0,08 – 0,40%	
2-Furfural Content	IEC 61198	Max. 0,1 mg/kg	
3- Performance			
Oxidation stability 1	IEC 61125 (method C) Test duration: (U)Uninhibited oil: 164h (T)Trace inhibited oil: 332h (I) Inhibited oil: 500h		
-Total acidity		Max. 1,2 mg KOH/g ¹	
-Sludge		Max. 0,8% ¹	
DDF at 90°C		Max. 0, 500 ¹	
Gassing		No general requirement	
4- Health, safety and environment (HSE)			
Flash point	ISO 2719	Min. 135 °C	Min. 100 °C
PCA content	BS 2000 Part 346	Max. 3%	
PCB content	IEC 61619	Not detectable	
<p>a. This is the standard LCSET for an transformer oil (see 5.1) and can be modified depending on the climatic condition of each country. Pour point should be minimum 10 K below LCSET.</p> <p>b. Standard LCSET for low temperature switch gear oil.</p> <p>c. For bulk supply.</p> <p>d. For delivery in drums and IBC.</p> <p>e. After laboratory treatment (See 6.4).</p> <p>f. Where it is used as a general requirement, a limit of minimum, 40 mN/m is recommended.</p>			



Technical Data Sheet

Charging rectifier 1

Type: D415 G110/100 BWrug-VFz

General

Dimension (width x height x depth)	1000 x 600 x 2000 mm (W x D x H)
Type of cooling	Forced cooling above ventilator (start +35 °C)
Ambient temperature	0 °C by + 40 °C
Degree of efficiency	> 91 % at characteristics
Degree of protection	IP 31 as per DIN VDE 0470-T1 (DIN EN 60529)
Class of protection	1 as per DIN EN 50298 06/1999
Disconnection	safe electrical disconnection as per DIN VDE 0100 part 410 01/1997 and appendix A1 06/2003
Permissible radio interference voltage	Limit class "A", group 1 as per EN 55011
Permissible radio interference radiation	Limit class "A", group 1 as per EN 55011
Noise resistance against electrostatic discharges	2 kV with contact 4 kV free air gap (severity 1) as VDE 0847 part 4-2 (IEC EN 61000-4-2)
Noise resistance against electromagnetic fields	3 V/m (severity 2) as per VDE 0847 part 4-3 (IEC EN 61000-4-3)
Noise resistance against fast transient disturbances (Bursts)	2 kV (severity 3) as per VDE 0847 part 4-4 (IEC EN 61000-4-4)
Noise resistance against surge voltages (Surges)	Symmetric 1 kV (conductor-conductor) Unsymmetric 2 kV (conductor-earth) as per VDE 0847 part 4-5 (IEC EN 61000-4-5)



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Mains input

Nominal voltage	3 x 415 V
Tolerance input voltage	$\pm 10 \%$
Frequency	50 Hz $\pm 5 \%$
Nominal current	max. 3 x 26 A
Mains fuses	50A

DC-side

Characteristic Curve	IU as per DIN 41772
Nominal voltage	110 V _{DC}
Nominal current	100 A _{DC}
Output voltage – float charge	120,4 V _{DC} $\pm 1 \%$ $\triangle 2,23$ V/cell
Output voltage - boost charge (switching by hand)	129,6 V _{DC} $\pm 1 \%$ $\triangle 2,40$ V/cell
Current limiting	100 A _{DC} $\pm 2 \%$
Ripple voltage	5 %; peak value / peak value
Precision of regulation (static) voltage	$\pm 1 \%$
current	$\pm 2 \%$

Monitoring

AC-input

Mains monitoring A74 (DI 5)	415 V _{AC} / 240 V _{AC} +/-10 % / Asymetrie LED at -A74 (delay 5 sec.) LED „Alarm A“ at A10 (MU1000C) and X11: 1- 2 (delay 10 sec.)
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Thyristor fuses (-A1)	To tripping	Disconnection charger status signal rectifier undervoltage to A10 (DI 2) Fault signals to X11:1-2 LED „Alarm A“ to A10 MU1000C
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Rectifier monitoring

Undervoltage A23	$U_a \leq 105,0 \text{ V}$; Hysteresis 3% Time delay of response level 5 sec.	status signal from contacts A23 to A10 (DI 2) Fault signals to X11:1-2 LED „Alarm A“ to A10 MU1000C
Overvoltage A22	$U_a \geq 131,0 \text{ V}$; Hysteresis 3% Time delay of response level 3 sec. Holding yourself over assembly unlocking by OFF-/ON- switching the mains switch S1	Disconnection charger status signal from contact A22 to A10 (DI 1) Fault signals to X11:1-2 LED „Alarm A“ to A10 MU1000C
Fan fuses F13, F14	tripping F13 and F14 – the rectifier is switching off	status signal by contacts to A10 (DI 3) Fault signals to X11:1-2 LED „Alarm A“ to A10 MU1000C

battery-/consumer monitoring:

Battery circuit monitoring (A10, Udc3)	$U_{diff} < 1,2 \text{ V}$ Time delay 10 sec	Fault signals to X11:1-2 LED „Alarm A“ to A10 MU1000C
Earth monitoring A37	$R_{iso} < 100 \text{ k}\Omega$ Time delay 10 sec	Failure signals to X11:1-4 Signals from contacts A37 to A10 (DI 4) Fault signals to X11:1-2 LED „Alarm A“ to A10 MU1000C
Counter cell control (A10, Udc1)	Counter cell ON $U_{batt} = 120,0 \text{ V}$ Counter cell OFF $U_{batt} = 119,0 \text{ V}$ (MU1000C) and K8.1	Failure signals to X11:1-3 LED „Alarm B“ to A10 MU1000C
Overvoltage consumer (A10, Udc 2)	$U_a \geq 122,0 \text{ V}$; Hysteresis 1% Time delay 3 sec Holding yourself over assembly unlocking by OFF-/ON- switching the mains switch S1	Disconnection charger Fault signals to X11:1-2 and X11:1-8 LED „Alarm A“ to A10 (MU1000C)
Overvoltage battery (A10, Udc 1)	$U_a \geq 132,4 \text{ V}$; Hysteresis 1% Time delay 3 sec	Fault signals to X11:1-2 and X11:1-5 LED „Alarm A“ to A10 MU1000C LED „U“ to A10 (MU1000C)



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Undervoltage battery "Warning" (A10, Udc 1)	$U_a \leq 99,9V$;Hysteresis 3% ; Time delay 3 sec	Fault signals to X11:1-2 and X11:1-6 LED,,Alarm A"to A10 (MU1000C)
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Battery Deep Discharged (A10, Udc 1)	$U_a \leq 97,2V$;Hysteresis 3% ; Time delay 3 sec	Fault signals to X11:1-2 and X11:1-7 LED,,Alarm A"to A10 (MU1000C) LED „U<" (go out) to A10 MU1000C)
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Boost charge

Changing the set point value by MU 1000C (K1) LED „S1"
to A10 (MU1000C) and relay K2 for boost charging
(2,4 V/cell)

start - time recharge : $126,9 V \triangle 2,35 V/cell$
duration - time recharge : 1 - 15 h ; regulated to 6 h

All signals are summed up the same time to „common signal"
Contact X11: 1-2 , LED „Alarm A" to -A10 (MU1000C)

Permissible load of the potential-free contacts X11:	$U_{max.} = 250 V_{DC/AC}$; $I_{max.} = 0,8 A_{DC/AC}$ $P_{max.} = 30 W / 200 VA$
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Display MU 1000C (A10)

Ubat	LCD-Display
Ucons	LCD-Display
Ubat/2	LCD-Display
Ibat	LCD-Display
Icons	LCD-Display

Incidents memory MU 1000C (A10)

Battery circuit monitoring	LCD-Display
AC U<	LCD-Display
Rect. U<	LCD-Display
Rect. U>	LCD-Display
Ubat<Vmin1	LCD-Display



Ubat<Vwarn1

LCD-Display

Ubat>Vmax1

LCD-Display

Earth fault

LCD-Display

Fan fuse trip.

LCD-Display

Instruments

Input current (P1.1)

Ammeter EQ96 0-50/100A

Input voltage (P2.1)

Voltmeter EQ96 0-300/500V (L1-N, L2-N, L3-N, L1-L2,
L1-L3, L2-L3)

Output current (P1)

Ammeter PQ96 0-100A

Output voltage (P2)

Voltmeter PQ96 0-150V

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Technical Data Sheet

Charging rectifier 1

Type: D415 G110/100 BWrug-VFz

General

Dimension (width x height x depth)	1000 x 600 x 2000 mm (W x D x H)
Type of cooling	Forced cooling above ventilator (start +35 °C)
Ambient temperature	0 °C by + 40 °C
Degree of efficiency	> 91 % at characteristics
Degree of protection	IP 31 as per DIN VDE 0470-T1 (DIN EN 60529)
Class of protection	1 as per DIN EN 50298 06/1999
Disconnection	safe electrical disconnection as per DIN VDE 0100 part 410 01/1997 and appendix A1 06/2003
Permissible radio interference voltage	Limit class "A", group 1 as per EN 55011
Permissible radio interference radiation	Limit class "A", group 1 as per EN 55011
Noise resistance against electrostatic discharges	2 kV with contact 4 kV free air gap (severity 1) as VDE 0847 part 4-2 (IEC EN 61000-4-2)
Noise resistance against electromagnetic fields	3 V/m (severity 2) as per VDE 0847 part 4-3 (IEC EN 61000-4-3)
Noise resistance against fast transient disturbances (Bursts)	2 kV (severity 3) as per VDE 0847 part 4-4 (IEC EN 61000-4-4)
Noise resistance against surge voltages (Surges)	Symmetric 1 kV (conductor-conductor) Unsymmetric 2 kV (conductor-earth) as per VDE 0847 part 4-5 (IEC EN 61000-4-5)

Mains input

Nominal voltage	3 x 415 V
Tolerance input voltage	$\pm 10 \%$
Frequency	50 Hz $\pm 5 \%$
Nominal current	max. 3 x 26 A
Mains fuses	50A

DC-side

Characteristic Curve	IU as per DIN 41772
Nominal voltage	110 V _{DC}
Nominal current	100 A _{DC}
Output voltage – float charge	120,4 V _{DC} $\pm 1 \%$ \wedge 2,23 V/cell
Output voltage - boost charge (switching by hand)	129,6 V _{DC} $\pm 1 \%$ \wedge 2,40 V/cell
Current limiting	100 A _{DC} $\pm 2 \%$
Ripple voltage	5 %; peak value / peak value
Precision of regulation (static) voltage	$\pm 1 \%$
current	$\pm 2 \%$

Monitoring

AC-input

Mains monitoring A74 (DI 5)	415 V _{AC} / 240 V _{AC} +/-10 % / Asymetrie LED at –A74 (delay 5 sec.) LED „Alarm A“ at A10 (MU1000C) and X11: 1- 2 (delay 10 sec.)	
Thyristor fuses (–A1)	To tripping	Disconnection charger status signal rectifier undervoltage to A10 (DI 2) Fault signals to X11:1-2 LED „Alarm A“ to A10 MU1000C

Rectifier monitoring

Undervoltage A23	$U_a \leq 105,0 \text{ V}$; Hysteresis 3% Time delay of response level 5 sec.	status signal from contacts A23 to A10 (DI 2) Fault signals to X11:1-2 LED „Alarm A“ to A10 MU1000C
Overvoltage A22	$U_a \geq 131,0 \text{ V}$; Hysteresis 3% Time delay of response level 3 sec. Holding yourself over assembly unlocking by OFF-/ON- switching the mains switch S1	Disconnection charger status signal from contact A22 to A10 (DI 1) Fault signals to X11:1-2 LED „Alarm A“ to A10 MU1000C
Fan fuses F13, F14	tripping F13 and F14 – the rectifier is switching off	status signal by contacts to A10 (DI 3) Fault signals to X11:1-2 LED „Alarm A“ to A10 MU1000C

battery-/consumer monitoring:

Battery circuit monitoring (A10, Udc3)	$U_{diff} < 1,2 \text{ V}$ Time delay 10 sec	Fault signals to X11:1-2 LED „Alarm A“ to A10 MU1000C
Earth monitoring A37	$R_{iso} < 100 \text{ k}\Omega$ Time delay 10 sec	Failure signals to X11:1-4 Signals from contacts A37 to A10 (DI 4) Fault signals to X11:1-2 LED „Alarm A“ to A10 MU1000C Failure signals to X11:1-3 LED „Alarm B“ to A10 MU1000C
Counter cell control (A10, Udc1)	Counter cell ON $U_{batt} = 120,0 \text{ V}$ Counter cell OFF $U_{batt} = 119,0 \text{ V}$ (MU1000C) and K8.1	Relay K2 and LED „S2“ to A10
Overvoltage consumer (A10, Udc 2)	$U_a \geq 122,0 \text{ V}$; Hysteresis 1% Time delay 3 sec Holding yourself over assembly unlocking by OFF-/ON- switching the mains switch S1	Disconnection charger Fault signals to X11:1-2 and X11:1-8 LED „Alarm A“ to A10 (MU1000C)
Overvoltage battery (A10, Udc 1)	$U_a \geq 132,4 \text{ V}$; Hysteresis 1% Time delay 3 sec	Fault signals to X11:1-2 and X11:1-5 LED „Alarm A“ to A10 MU1000C LED „U>“ to A10 (MU1000C)

Undervoltage battery “Warning” (A10, Udc 1)	$U_a \leq 99,9V$;Hysteresis 3% ; Time delay 3 sec	Fault signals to X11:1-2 and X11:1-6 LED,,Alarm A“to A10 (MU1000C)
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Battery Deep Discharged (A10, Udc 1)	$U_a \leq 97,2V$;Hysteresis 3% ; Time delay 3 sec	Fault signals to X11:1-2 and X11:1-7 LED,,Alarm A“to A10 (MU1000C) LED „U<“ (go out) to A10 MU1000C)
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Boost charge	Changing the set point value by MU 1000C (K1) LED „S1“ to A10 (MU1000C) and relay K2 for boost charging (2,4 V/cell) start - time recharge : $126,9 V \pm 2,35 V/cell$ duration - time recharge : 1 - 15 h ; regulated to 6 h All signals are summed up the same time to „common signal“ Contact X11: 1-2 , LED „Alarm A“ to -A10 (MU1000C)
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Permissible load of the potential-free contacts X11:	$U_{max.} = 250 V_{DC/AC}$; $I_{max.} = 0,8 A_{DC/AC}$ $P_{max.} = 30 W / 200 VA$
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Display MU 1000C (A10)

Ubat	LCD-Display
Ucons	LCD-Display
Ubat/2	LCD-Display
Ibat	LCD-Display
Icons	LCD-Display

Incidents memory MU 1000C (A10)

Battery circuit monitoring	LCD-Display
AC U<	LCD-Display
Rect. U<	LCD-Display
Rect. U>	LCD-Display
Ubat<Vmin1	LCD-Display

Ubat<Vwarn1	LCD-Display
Ubat>Vmax1	LCD-Display
Earth fault	LCD-Display
Fan fuse trip.	LCD-Display

Instruments

Input current (P1.1)	Ammeter EQ96 0-50/100A
Input voltage (P2.1)	Voltmeter EQ96 0-300/500V (L1-N, L2-N, L3-N, L1-L2, L1-L3, L2-L3)
Output current (P1)	Ammeter PQ96 0-100A
Output voltage (P2)	Voltmeter PQ96 0-150V

General Specifications			
Property	Test method	Limits	
		Transformer Oil	Low temperature switchgear oil
1- Function			
Viscosity at 40°C	ISO 3104	Max. 12mm ² /s	Max. 3,5mm ² /s
Viscosity at 30°C ^a	ISO 3104	Max. 1 800mm ² /s	--
Viscosity at - 40°C ^b	IEC 61868	--	Max. 400mm ² /s
Pour Point ^a	ISO 3016	Max. -40°C	Max. -60°C
Water content	IEC 60814	Max. 30mg/kg ^c / 40mg/kg ^d	
Breakdown voltage	IEC 60156	Min. 30 kV / 70kv ^e	
Density at 20°C	ISO 3675 or ISO 12185	Max. 0, 895 g/ml	
DDF at 90°C	IEC 60247 or IEC 61620	Max. 0,005	
2- Refining/ stability			
Appearance	--	Clear, free from sediment and suspended ,matter	
Acidity	IEC 62021 -1	Max. 0,01 mg KOH/g	
Interfacial tension	ISO 6295	No general requirement ^f	
Total sulfur content	BS 2000 Part 373 or ISO 14596	No general requirement	
Corrosive sulfur	DIN 51353	Not corrosive	
Antioxidant additive	IEC 60666	(U) uninhibited oil: not detectable (T) Trace inhibited oil: max. 0,08 % (I) inhibited oils: 0,08 – 0,40%	
2-Furfural Content	IEC 61198	Max. 0,1 mg/kg	
3- Performance			
Oxidation stability 1	IEC 61125 (method C) Test duration: (U)Uninhibited oil: 164h (T)Trace inhibited oil: 332h (I) Inhibited oil: 500h		
-Total acidity		Max. 1,2 mg KOH/g ¹	
-Sludge		Max. 0,8% ¹	
DDF at 90°C		Max. 0, 500 ¹	
Gassing		No general requirement	
4- Health, safety and environment (HSE)			
Flash point	ISO 2719	Min. 135 °C	Min. 100 °C
PCA content	BS 2000 Part 346	Max. 3%	
PCB content	IEC 61619	Not detectable	
<div>a. This is the standard LCSET for an transformer oil (see 5.1) and can be modified depending on the climatic condition of each country. Pour point should be minimum 10 K below LCSET.</div> <div>b. Standard LCSET for low temperature switch gear oil.</div> <div>c. For bulk supply.</div> <div>d. For delivery in drums and IBC.</div> <div>e. After laboratory treatment (See 6.4).</div> <div>f. Where it is used as a general requirement, a limit of minimum, 40 mN/m is recommended.</div>			

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Intefacial Tension	No requirement (mN/m)	49
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