



Marine & Offshore  
Division

Certificate number: 424ITB16

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## CERTIFICATE FOR FREQUENCY CONVERTER

**Manufacturer** : Mak Plus Power System UG (Köln - DEU)  
**Supplier** : Mak Plus Power System UG (Köln - DEU)  
**Purchaser's order N°** : 12.05.2016  
**Requirements** : Bureau Veritas Rules for the Classification of Steel Ships (Jul. 2016)

**Product description** : **3 PHASE FREQUENCY CONVERTER (INVERTER & RECTIFIER)**  
**Design review** : Reference(s) : AT13158\_IMO\_NO:\_9607344  
**Quantity** : 2 pcs

**Type** : CON-MAK  
**Protection index** : IP55  
**Declared as intended for** : GREATSHIP RAGINI / IMO NO: 9607344  
**Piece / Serial number(s)** : FC163500415050008, FC163500415050009  
**Power** : 500 kVA  
**Input/Output Voltage** : 440 V / 415 V  
**Input/Output Frequency** : 60 Hz / 50 Hz  
**DC Bus** : 550 V  
**Max. Internal Temperature** : 55° C (at 45° C ambient temperature)  
**Forced Cooling Type** : Air

**Enclosures / Remarks** : 1-Please see attached performance test report (8 pages).  
 2-Final acceptance will be granted on board.

This certificate is issued by Bureau Veritas as per the above Classification Rules and in compliance with the applicable technical requirements therein.

**Marking** : 424ITB16  
**Last survey** : 15 Aug 2016  
**Surveyor** : Gurcan Yilmaz

**Issuance date** : 18 Aug 2016  
**Office** : BV ISTANBUL



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# 3 PHASE FREQUENCY CONVERTER (INVERTER & RECTIFIER) TEST REPORT

Ver2.3

## 3 Phase Frequency Converter (Inverter & Rectifier) Test Report

Job Description					
Model	CON-MAK	Serial No	FC1635004150 50009	Date	10.08.2016
Project No	16-0043	Stock Code			

Nominal Values			
Power (kVA)	500	DC Bus (V)	550
Input Voltage (V)	254	Input Frequency (Hz)	60
Output Voltage (V)	240	Output Frequency (Hz)	50

Electronic Board Serials			
1001-Inverter DSP Board	AC293-11	IGBT Driver 1	I017-21
1006-Inverter Interface Board	Y020-15	IGBT Driver 2	I018-21
1001-Rectifier DSP Board A	AC037-11	IGBT Driver 3	I027-21
1001-Rectifier DSP Board B	AC477-11	IGBT Driver 4	I026-21
1006-Rectifier Interface Board	Y095-15	IGBT Driver 5	I020-21
1001-Monitor DSP Board	AC023-1	IGBT Driver 6	I022-21
1004-Alarm & Comm Interface	U154-31	1020-Power Supply Board A	E017-52C
1030-LCD Panel	T025-3	1020-Power Supply Board B	E037-52C
1057-Led Panel Board	D010-2	1020-Power Supply Board C	E032-52C
1032-PWM Distribution Board A	E030-1	1008-Thyristor Driver Board A	S224-3
1032-PWM Distribution Board B	E035-1	1008-Thyristor Driver Board B	S248-3
1056-Conveyor Board	-	1029-Thyristor Snubber Board A	U063-2A
		1029-Thyristor Snubber Board B	U068-2A

Specific Components (Brand and Model)	
IGBT	CM900DUC
Thyristor	MCC310-16i01

Software Versions			
Inverter DSP	2.03	Inverter uP	2.0
Rectifier DSP	2.34	Rectifier uP	2.0
Monitor DSP	4.01	Monitor uP	2.0

Electronic Measurements						
Power Supply Board A	Input	V	303.0			
	Output	V	+18.01		-19.07	
Power Supply Board B	Input	V	303.0			
	Output	V	+18.23		-19.11	
Power Supply Board C	Input	V	303.0			
	Output	V	+18.09		-19.05	
Power Supply Board (IGBT Driver)	Output	V	15.0	15.0	15.0	15.0

Measurements (10%)					
Input	Voltage	V	254.7	254.7	254.7
	Current	A	163.0	163.0	162.0
	Power	kW	34.51	34.41	34.18
	Power Factor	-	0.83	0.83	0.82
	Current THD	%	-	-	-
DC Bus	Voltage	V	545		
	Current	A	166		
Output	Voltage	V	240.8	240.7	240.6
	Voltage THD	%	1.5	1.4	1.4
	Current	A	134.5	130.2	140.0
	Power	kW	33.23	32.50	33.80
	Power Factor	-	1	1	1



### 3 PHASE FREQUENCY CONVERTER (INVERTER & RECTIFIER) TEST REPORT

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Measurements (%100)					
Input	Voltage	V	253.7	253.7	254.2
	Current	A	548	595	590
	Power	kW	128.1	133.5	133.0
	Power Factor	-	0.92	0.90	0.90
	Current THD	%	8.0	8.0	8.0
	Rectifier 1 Current	A	384		
	Rectifier 2 Current	A	346		
DC Bus	Voltage	V	526.3		
	Current	A	730		
	Ripple	V	1.00		
ÇIKIŞ / Output	Voltage (R,S,T)	V	238.9	241.0	239.9
	Current	A	501.0	507.0	552.0
	Power	kW	120.0	122.0	132.0
	Power Factor	-	1	1	1
	Voltage THD	%	0.9	0.9	0.8
	Efficiency	%	94.7		
	Frequency (Variation %)	Hz	50.01		
Temperature Rise	Ambient Temp.	°C	31/37		
	Max. Internal Temp.	°C			
Humidity		%	78		
%125 load (10min.)			OK		
%150 load (1min.)			OK		

Functional Checks	OK	SHUT DOWN / N/A
Input CB Monitoring	N/A	N/A
Output CB Monitoring	OK	N/A
Battery CB Monitoring	N/A	N/A
DC Too Low Disconnect	OK	OK
Output Overload Alarm & Trip	OK	OK
Output Short Circuit Protection	OK	OK
Rectifier Over Temperature Trip	OK	OK
Inverter Over Temperature Trip	OK	OK
Buzzer	OK	N/A
LCD Panel Leds	OK	N/A
Fan Operation	OK	N/A
Alarm Kontakları	OK	N/A
Communication	OK	N/A
Fan Fuse	OK	N/A
LCD Panel Calibrations	OK	N/A
Dielectric Strength test (2000Vac)	OK	N/A
Insulation test (500Vdc)	OK	N/A
Instantaneous load test (100%kW)	OK	N/A
Redundant Operation (100%kW load instantaneously)	OK	N/A
Start & Stop Function	OK	OK
Emergency Stop Function	OK	OK

18V DC Control Supply Fail	OK
Rectifier	OK
Converter	OK
Main Control Supply	OK

Interlock Test	OK
Individual converters	OK
With both converters in standby	OK

### 3 PHASE FREQUENCY CONVERTER (INVERTER & RECTIFIER) TEST REPORT

Ver2.3

Black out Test	OK
Final Control	OK
Earth Continuity Control	OK
General view and cleanane (visual Inspection)	OK
Warning labels	OK
Model & Serial No Labels	OK
Protection covers	OK

Alarm and warning messages are displayed timely on the LCD display. Audible alarm is also provided at the mean time.

Possible alarm and warning messages are listed below.





Message	Meaning of the message	Result
OUTPUT FAIL (OVER VOLTAGE)	Indicates that the output voltage is out of the tolerances (over voltage under voltage etc.). Normal, that this message is displayed during stop mode.	OK
LINE FAILURE	Indicates that the rectifier AC input voltage is low or failed.	OK
12 PULSE FAILURE	Indicated that the 12 pulse controller has detected an error. In this case, the rectifier will limit its current to the half of the nominal to not to overload the 6 pulse bridge. (Option )	OK
DC LOW	Indicates that the frequency converter DC Bus voltage is lower than the adjustable DC LOW value. System continues to operate.	OK
DC HIGH	Indicates that the frequency converter DC Bus voltage is higher than the adjustable DC HIGH value. System continues to operate. In this case, the equipment will stop generating DC to prevent any damage to batteries or load.	OK
DC TOO LOW	Indicates that the frequency converter DC Bus voltage is lower than the adjustable DC TOO LOW value. In this case, the equipment will stop generating AC to prevent any damage to the input source, possibly batteries. (battery deep discharge cutoff)	OK
OVER TEMPERATURE	Indicates that the inverter and / or rectifier bridge temperature has exceeded limits. The equipment will stop generating AC.	OK
IGBT / IPM FAULT (SHORT CIRCUIT)	Indicates that the current of IGBT or IPM transistor of 3 phase inverter bridge, has exceeded the limits.or inicates power supply failure.To protect the IGBT / IPM, the equipment will stop generating AC.	OK
OVER CURRENT	Indicates that the output current exceeded nominal capacity.	OK
OVERLOAD BLOCK	Indicates that the output of the system is blocked because of the over current.	OK
BREAKER OPEN	Indicates that one of the input or output circuit breakers are open. (Option depending on user requirement)	OK
EARTH FAULT	Indicates there is a leakage current from any of the AC outputs to ground	OK
NO RESPONSE (NO CONNECTION)	Indicates that comminication error occured between the DSP boards	OK
BAD PHASE	Indicates that phase sequence is not convenient	OK

Note: Product elements are protected againts short circuit over current, over voltage and output distortion.

Tested by	Approved by
UFAK SEPCİ	92517016
	10.08.16

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Model	CON-MAK	Serial No	FC1635004150 50008	Date	10.08.2016
Project No	16-0043	Stock Code			

Nominal Values			
Power (kVA)	500	DC Bus (V)	550
Input Voltage (V)	254	Input Frequency (Hz)	60
Output Voltage (V)	240	Output Frequency (Hz)	50

Electronic Board Serials			
1001-Inverter DSP Board	AC331-11	IGBT Driver 1	I008-21
1006-Inverter Interface Board	Y010-15	IGBT Driver 2	I005-21
1001-Rectifier DSP Board A	AC496-11	IGBT Driver 3	I041-21
1001-Rectifier DSP Board B	AC058-11	IGBT Driver 4	I037-21
1006-Rectifier Interface Board	Y163-15	IGBT Driver 5	I023-21
1001-Monitor DSP Board	AC075-1	IGBT Driver 6	I007-21
1004-Alarm & Comm Interface	U173-31	1020-Power Supply Board A	E035-52C
1030-LCD Panel	T211-3	1020-Power Supply Board B	E021-52C
1057-Led Panel Board	D132-2	1020-Power Supply Board C	E039-52C
1032-PWM Distribution Board A	E050-1	1008-Thyristor Driver Board A	S251-3
1032-PWM Distribution Board B	E031-1	1008-Thyristor Driver Board B	S254-3
1056-Conveyor Board	-	1029-Thyristor Snubber Board A	U077-2A
		1029-Thyristor Snubber Board B	U080-2A

Specific Components (Brand and Model)	
IGBT	CM900DUC
Thyristor	MCC310-16i01

Software Versions			
Inverter DSP	2.03	Inverter uP	2.0
Rectifier DSP	2.34	Rectifier uP	2.0
Monitor DSP	4.01	Monitor uP	2.0

Electronic Measurements						
Power Supply Board A	Input	V	303.0			
	Output	V	+18.03		-19.08	
Power Supply Board B	Input	V	303.0			
	Output	V	+18.22		-19.13	
Power Supply Board C	Input	V	303.0			
	Output	V	+18.11		-19.06	
Power Supply Board (IGBT Driver)	Output	V	15.0	15.0	15.0	15.0

Measurements (10%)					
Input	Voltage	V	253.5	253.7	253.8
	Current	A	148.0	148.4	148.0
	Power	kW	34.33	34.12	34.22
	Power Factor	-	0.91	0.91	0.91
	Current THD	%	-	-	-
DC Bus	Voltage	V	550		
	Current	A	178		
Output	Voltage	V	240.8	241.2	240.6
	Voltage THD	%	1.3	1.3	1.3
	Current	A	127.1	123.3	138.9
	Power	kW	30.49	29.61	33.36
	Power Factor	-	1.0	1.0	1.0



### 3 PHASE FREQUENCY CONVERTER (INVERTER & RECTIFIER) TEST REPORT

Ver2.3

Measurements (%100)					
Input	Voltage	V	252.5	252.9	253.8
	Current	A	612	611	609
	Power	kW	137.0	137.0	136.4
	Power Factor	-	0.88	0.88	0.90
	Current THD	%	7.9	7.9	8.0
	Rectifier 1 Current	A	396		
	Rectifier 2 Current	A	367		
DC Bus	Voltage	V	523		
	Current	A	763		
	Ripple	V	0.900		
ÇIKIŞ / Output	Voltage (R,S,T)	V	239.5	240.3	240.4
	Current	A	555.0	536.0	584.0
	Power	kW	132.0	128.0	130.0
	Power Factor	-	1	1	1
	Voltage THD	%	0.7	0.8	0.6
	Efficiency	%	95.0		
	Frequency (Variation %)	Hz	50.00		
Temperature Rise	Ambient Temp.	°C	31/42		
	Max. Internal Temp.	°C			
Humidity		%	78		
%125 load (10min.)			OK		
%150 load (1min.)			OK		

Functional Checks	OK	SHUT DOWN / N/A
Input CB Monitoring	N/A	N/A
Output CB Monitoring	OK	N/A
Battery CB Monitoring	N/A	N/A
DC Too Low Disconnect	OK	OK
Output Overload Alarm & Trip	OK	OK
Output Short Circuit Protection	OK	OK
Rectifier Over Temperature Trip	OK	OK
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Buzzer	OK	N/A
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Start & Stop Function	OK	OK
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<p>Tested by</p> <p>ENERJİ ve GÜÇ DÖNÜŞÜM SİSTEMLERİ Sİ. SAN. VE TİC. A.Ş. Esenşehir Mah. Akmerkez Kat:K1 Kat:No:11 Daire:2-3 Madenköy Ümraniye/İSTANBUL Tel:0216 499 54 54 - Faks: 0216 499 54 90 Sarıgazi Y/D: 33K 051 9085 İstanbul Tic.Sicil No: 565503</p>	<p>Approved by</p> <p>62517215 10.08.16 GÖRÜNTÜLE SUNUYOR Gürhan Vartan İstanbul</p>
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