DNV·GL

Certificate No:
TAE000008A

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Frequency Converter

with type designation(s)
FC102 series,

Issued to
Danfoss Drives A/S
GRAASTEN, Denmark

is found to comply with
DNV GL rules for classification – Ships and offshore units

Application :

Frequency Converter for Asyncronous Motors Range: 1,1 kW to 1400 kW
200-240 / 380-480 / 525-690 VAC supply.

Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV GL.

This Certificate is valid until **2017-06-30**.
Issued at **Høvik** on **2015-11-16**

DNV GL local station: **Fredericia**

Approval Engineer: **Nicolay Horn**

for **DNV GL**
Digitally Signed By: Laumann, Marit
Location: DNV GL Høvik, Norway
Signing Date: 2015-11-27

Marit Laumann
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid.
The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

Name and place of manufacturer

Danfoss Drives A/S GRAASTEN Denmark	Danfoss LLC LOVES PARK IL, United States

Product description

Product: Frequency converter for use in various marine applications.

Model: VLT® HVAC Drive series FC-102

FC-102 power rating vs. enclosure type and IP rating

FC-102: 200-240V (T2)				
Power rating	**Enclosure type**			
[kW]	**IP20** (*1)	**IP21** (*2)	**IP55** (*3)	**IP66** (*4)
1,1	A2	A2 (*5)	A4+A5	A4+A5
1,5				
2,2				
3,0	A3	A3 (*5)		
3,7			A5	A5
5,5	B3	B1	B1	B1
7,5				
11				
15	B4	B2	B2	B2
18,5		C1	C1	C1
22	C3			
30				
37	C4	C2	C2	C2
45				

FC-102: 380-480V (T4)				
Power rating	**Enclosure type**			
[kW]	**IP20** (*1)	**IP21** (*2)	**IP55** (*3)	**IP66** (*4)
1,1	A2	A2 (*5)	A4+A5	A4+A5
1,5				
2,2				
3,0				
4,0	A2	A2 (*5)	A4+A5	A4+A5
5,5	A3	A3 (*5)	A5	A5
7,5				
11	B3	B1	B1	B1
15				
18,5	B3	B1	B1	B1
22	B4	B2	B2	B2
30				
37		C1	C1	C1
45	C3			
55				
75	C4	C2	C2	C2

FC-102: 380-480V (T4)				
Power rating	**Enclosure type**			
[kW]	**IP20** (*1)	**IP21** (*2)	**IP55** (*3)	**IP66** (*4)
90			N/A	
45	C3			
55				
75	D3h			
90				

FC-102: 380-480V (T4)				
Power rating [kW]	**Enclosure type**			
	IP20 (*1)	**IP00** (*1)	**IP21** (*2)	**IP54** (*3)
110	D3h	NA	D1h/D5h/D6h	D1h/D5h/D6h
132				
160				
200	D4h	NA	D2h/D7h/D8h	D2h/D7h/D8h
250				
315				
110	NA	D3	D1	D1
132				
160	NA	D4	D2	D2
200				
250				
315	NA	E2	E1	E1
355				
400				
450				
500	NA	NA	F1/F3	F1/F3
560				
630				
710				
800	NA	NA	F2/F4	F2/F4
1000	NA	NA	F2/F4	F2/F4

FC-102: 525-690V (T7)				
Power rating	**Enclosure type**			
[kW]	**IP20** (*1)	**IP21** (*2)	**IP55** (*3)	**IP66** (*4)
1,1	A3	N/A		
1,5				
2,2		B2	B2	B2
3,0				
3,7		N/A		
4,0		B2	B2	B2
5,5				
7,5				
11	B4			
15				
18,5				

FC-102: 525-690V (T7)				
Power rating	**Enclosure type**			
[kW]	**IP20** (*1)	**IP21** (*2)	**IP55** (*3)	**IP66** (*4)
22				
30				
37		C2	C2	C2
45	C3			
55				
75	D3h			
90				

FC-102 525-690V (T7)				
Power rating [kW]	**Enclosure type**			
	IP20 (*1)	**IP00** (*1)	**IP21** (*2)	**IP54** (*3)
75	D3h	NA	D1h/D5h/D6h	D1h/D5h/D6h
90				
110				
132				
160				
200	D4h	NA	D2h/D7h/D8h	D2h/D7h/D8h
250				
315				
400				
45	NA	D3	D1	D1
55				
75				
90				
110				
132				
160				
200	NA	D4	D2	D2
250				
315				
400				
450	NA	E2	E1	E1
500				
560				
630				
710	NA	NA	F1/F3	F1/F3
800				
900				
1000	NA	NA	F2/F4	F2/F4
1200				
1400				

12-Pulse Drives				
FC-202: 525-690V (T7)				
Power rating [kW]	Enclosure type			
	IP00 (*1)	IP21 (*2)	IP54 (*3)	
450	NA	F8/F9	F8/F9	
500				
560				
630				
710	NA	F10/F11	F10/F11	
800				
900				
1M0	NA	F12/F13	F12/F13	
1M2				
1M4				

Low Harmonic Drives				
FC-102: 380-480V (T4)				
Power rating [kW]	Enclosure type			
	IP00 (*1)	IP21 (*2)	IP54 (*3)	
160	NA	D11/D13	D11/D13	
200				
250				
315	NA	E7/E9	E7/E9	
355				
400				
450				
500	NA	F17/F18	F17/F18	
560				
630				
710				

(*1) IP00/IP20/Panel mount.
(*2) IP21/NEMA Type 1
(*3) IP54/NEMA Type 12
(*4) IP66/NEMA Type 4X.
(*5) IP20/Panel with IP21 upgrade kit

H1, H2, H3, H4, H5, B2, L2 and N2 RFI comply with IACS E10 requirements except radiated and conducted emissions.

Ruggedized boards, selection "R" in character 20, must be selected for D1h – D8h.

Selection types for Type Codes for FC-102

_ (character 24 – 39 software + options)
1 4 7 10 11 23

Basic string definitions:

Product Group (character 1-3)

FC- : Adjustable Frequency Converters

VLT series (character 4-6)
102 VLT HVAC Drive – Advanced version

Power size (character 7-10)
P110: 110 kW / 150 HP
N110: 110 kW/ 150 HP

Voltage: (character 11-12)
T2: Three phase 200-240 VAC
T4 : Three phase 380-480 VAC
T7 : Three Phase 525-690 VAC

Enclosure (character 13-15)
E00: IP00 / Chassis
E20: IP20 / Chassis
E2S: IP20 / Chassis (medium power D-Frame)
E21: IP21 / Type 1
E2D: IP21 / Type 1 (medium power D-Frame)
H21: IP21 / Type 1 with heater
E54: IP54/ Type 12
E55: IP55/ Type 12
H54: IP54 / Type 12 with heater
E5H: Hybrid IP54
E2M: IP20 / Type 1 with mains shield
E5M: IP54 / Type 12 with mains shield
E5D: IP54 / Type 12 (medium power D-Frame)
E66: IP66 / Type 4X

Hardware (character 16-23)
Hardware, RFI filter (character 16-17)
H2: 6 Pulse Drive RFI for Maritime (complies with IACS E10 requirements except radiated and conducted emissions)
H4: 6 Pulse Drive RFI for Maritime (complies with IACS E10 requirements except radiated and conducted emissions)
H5: 6 Pulse Drive RFI for Maritime (complies with IACS E10 requirements except radiated and conducted emissions)
H6: 6 Pulse Drive RFI for Maritime (complies with IACS E10 requirements)
B2: 12 Pulse Drive with RFI for Maritime (complies with IACS E10 requirements except radiated and conducted emissions)
L2: Low Harmonic Drive with RFI for Maritime (complies with IACS E10 requirements except radiated and conducted emissions)
N2: Low Harmonic Drive with RFI for Maritime (complies with IACS E10 requirements except radiated and conducted emissions)

Hardware, Brake & Stop (character 18)
Hardware, Display (character 19)
Hardware, Coating (character 20)
Hardware, Mains options (character 21)
Hardware, adaptation A (character 22)
Hardware, adaptation B (character 23)

Software (character 24-28)
Options – A (character 29-30)
Options – B (character 31-32)
Options – C (character 33-37)
Options – D (character 38-39)

Brand labelling and customer specific definitions

Brand labelling and customer specific drives are following the type codes except the characters 1-6 for product group and VLT series. Character 1-6 are used for customer specific definitions.

Basic string definitions for brand labelling and customer specific drives:

Product Group and VLT series (character 1-6)

AF-600	Equals to FC-102
AKD102	Equals to FC-102
ADS102	Equals to FC-102
IVS102	Equals to FC-102
TR-200	Equals to FC-102
ITT102	Equals to FC-102
FC -103	Equals to FC-102

Application/Limitation

Supply voltage range:	200 - 240 V / 380 - 480 V / 525 - 690 V, 50/60 Hz
Voltage variation:	± 10 %, -15% reduced power rating
Frequency variation:	A, B and C frames: ± 10% D, E and F frames: ± 5% In accordance with Danfoss design guide
Output frequency:	A, B and C frames: 0 – 590 Hz D, E and F frames: 0 – 590 Hz In accordance with Danfoss design guide
Temperature range in operation:	In accordance with Danfoss design guide
Temperature range in operation:	0 - 45°C, 46-55 °C with current derating of 1.5 %/°C.
Temperature class:	A
Vibration class:	A
Humidity class:	B*
EMC class:	A**
Protection class:	IP00 / 20 / 21 / 54 / 55 / 66 & E4X***

The FC-102 shall be regarded as a component. The actual installation is to be designed according to Danfoss design guide MG11BC02 & MG16C202 and according to the applicable DNV Rules for the actual application.

Documents for the actual application are to be submitted for approval in each case in accordance with DNV Rules Pt.4, Ch.8, Sec.1 Table B2. A Product Certificate is required for converters ≥ 100 kW.

* Relative humidity 5 to 95%, no condensation allowed.

** Converters EMC classed C3 according to IEC 61800-3 can be installed in "special distribution zone" and "general power distribution zone" in accordance with IEC 60533 provided precautions are taken to attenuate these effects on the distribution system, so the safe operation is assured.

*** To be installed in an enclosure with an IP degree in accordance with DNV Rules w.r.t. location.

The Type Approval covers hardware and software for the basic controller.

Clause for software control:

All changes in software are to be recorded as long as the system is in use on board. The records of all changes are to be forwarded to DNV for evaluation and approval. Major changes in the software are to be approved before being installed in the converter.

Type Approval documentation

Technical info:
Product overview complete Marine approval document no. 00714813 Ref sequence A25, dated 2014-12-05

Test reports:
Part of CD: P424 _LHD & AAF" :

Danfoss test report no. 00708868, & 00708869 & 00708874 dated 2013-10-30. NTS test report nos CTR-11-0127 dated 2011-04-11 CTR-11-0145 & CTR-11-0125 dated 2011-08-24, CTR-1-0155 dated 2012. Danfoss doc. Nos 00703862, 00703684 dated 2011-09-25, 00705156 dated 2012-04-01. NTS Report: Danfoss Drives A10116 dated 2010-06-14, NTS Report: Danfoss Drives A11198 Report dated 2011-06-27. Danfoss report nos. 00596396 dated 2010-07-19, 00207667 dated 2013-03-01. Danfoss test reports 00709736, 00709737 & 00707738 dated 2012-08-07-

Part of CD 1 & 2 " Danfoss Loves Park Type Approval Submittal Package"

Danfoss test reports P454 Marine Vibration Report doc no. 00707038 dated 2012-03-06 and P454 Dry Heat Justification report doc. no. 00712217 dated 2012-12-26.UL test reports no. File E70524 V2 Project 05NK19968 dated Aug 18 2005, File E70524 V2 Project 05NK31571 dated Jan 05 2006, File E70524 V2 Project 07NK16874 dated Sept 10 2007, File E70524 V2 Project 08NK16638 dated July 29 2008, File E70524 V2 Project 09NK08421 dated May 21 2006, File E70524 V2 Project 09CA48648 dated Oct 06 2009. NTS test report no. A8366-500B0432 dated Dec 05 2008. DELTA EMC test report no.19K0441, dated 2007-03-02, Danak Report 19K0227-1, Danfoss test reports Tr100903 dated 2010-09-03, P401-151, -152, & -154 dated 2007-03-09, P404-363, -449, -682, -683, -684, -685, -686, -688, -689, -691, -692, -697, -698, & -699, Document version 1.00a, P407-16 and P407-142.

DD-DS3 P420 - Marine test overview version 1.00

P462-91_R0132T02v200c dated 2012-07-03
P462-120_R0101T02v200a dated 2012-11-20
P462-122_R0102T01v300b dated 2013-04-30
P462-159_R0132T04v100d dated 2013-05-28
P462-164_R0134T05v210a dated 2013-11-18
P462-308 _R0132T02v200c dated 2013-11-18
P462-321_R0123T03v110a dated 2013-04-30
P462-329_R0101T02v200a dated 2012-11-20
P462-308_R0132T02v200c dated 2012-07-03
P462-355_R0134T05v210c dated 2013-11-18
P462-91_R0132T02v200c dated 2012-07-03
P462-362_R0102T01v300b dated 2013-04-30
P462-367_R0123T03v110a dated 2013-04-30
P462-391_R0102T01v300b dated 2013-04-30
P462-395_R0101T02v200a dated 2012-11-20
P462-451_R0124T02v110a dated 2013-07-03
P462-454_R0123T03v110a dated 2013-04-30
P462-456_R0132T02v200c dated 2013-07-03
P462-459_R0134T05v210 dated 2013-11-18
P462-473_R0122T01v110a dated 2013-09-18
P420-541_R0123T04v110a dated 2007-12-19
P420-321_R0123T03v110a dated 2007-12-19
P420-367_R0123T03v110a dated 2007-12-19
P420-368_R0123T04v110a dated 2007-12-19

P420-454_R0123T03v110a dated 2007-12-19
P429 -58_R0101T01v220a "Visual inspection, dated 2009-12-19
P429 -81_R0111T01v201a "Temperature test" dated 2008-06-02
P429 -151_R0126T02v100a "Burst – fast transient" dated 2008-11-25
P429 -162_R0126T02v100a "Burst – fast transient" dated 2008-11-25
P429 -150_R0126T02v100a "Electrostatic discharge" dated 2008-11-25
P429 -161_R0126T02v100a "Electrostatic discharge" dated 2008-11-25
P429 -159_R0127T02v100b "Conducted emission" dated 2008-11-25
P429 -231_R0127T02v100c "Conducted emission" dated 2008-11-25
P429 -165_R0122T01v110a "Power supply variation and interruptions" dated 2008-11-25
P429 -154_R0122T02v110a "Power supply variation and interruptions" dated 2008-11-25
P429 -144_R0123T01v110a "Dry heat test" dated 2008-11-25
P429 -155_R0123T01v110a "Dry heat test" dated 2008-11-25
P429 -163_R0124T01v100a "Wide band random" dated 2008-11-26
P429 -164_R0124T01v100a "Wide band random" dated 2008-12-22

DocCM 00708685, DocCM 00709825, DocCM 0071489
CTR 13-0120 dated 2013-05-17

130R0319 – Marine test overview FC302PK25T5 – FC302P7K5T5
130R0320 – Marine test overview FC302P11KT5 – FC302P75KT5
DANAK EMC test report no.19K0123, dated 2004-05-26
DANAK EMC test report no.19K0337, dated 2006-04-11
DANAK EMC test report no.19K0351, dated 2006-04-11
Danfoss test reports P401-749, -758,--1093, -1094,-1095,-1096, -1098 & -1129, Document version 1.00a
Danfoss test reports P404-363, -682, -683, -684, -685, -686, -688, -689, -698, -691, -692, -697, & -699, Document version 1.00a.

Tests carried out

Visual inspection, Performance, Power supply failure, Power supply variations, Voltage/frequency variation, Vibration/shock, Dry heat, Damp heat, Insulation resistance, High voltage.
EMC: Electrical fast transient (Burst), electrical slow transient (Surge), RF-common mode Voltage, radiated RF-electromagnetic fields, electric discharge (ESD), radiated and conducted emission.

Marking of product

Danfoss – Type designation – Power – Voltage

Periodical assessment

The scope of the periodical assessment is to verify that the conditions stipulated for the Type Approval is complied with and that no alterations are made to the product design or choice of materials.

The main elements of the survey are:
- Inspection on factory samples, selected at random from the production line (where practicable)
- Results from Production Sample Tests (PST) and Routines (RT) checked (if not available tests according to PST and RT to be carried out)
- Review of type approval documentation
- Review of possible change in design, materials and performance
- Ensuring traceability between manufacturer's product type marking and Type Approval Certificate.

Survey to be performed at least every second year.

END OF CERTIFICATE