

**Technical Information** 

# **Fan Drive Control Assembly** FDCA







# **Revision history**

# Table of revisions

Date	Changed	Rev
November 2017	Updated Pinout information Yellow/Black J1-15	0202
May 2016	Updated to Engineering Tomorrow design and various updates	0201
May 2013	Service Parts	0100
March 2005	First edition, replaced BLN-95-9065	0000



# Contents

General Information		
	Description	4
	Features	4
	Theory of operation	4
Technical data		
	Inputs	6
	Outputs	6
	Specifications	6
	Dimensions	8
Ordering information		
-	Ordering nomenclature	9
	Accessories	
	Electrical mating connector kits	
	Service parts	11
Wiring		
	Machine wiring guidelines	
Set-up software		
	Establishing communication with the FDC	
	Using the Service Tool to Adjust FDC parameters	
	Parameter descriptions	
	Aux Switch 1, 2	
	PWM input	
	Sensor 1, 2, 3	
	Ramp Time	
	Output	



### General Information

#### Description

Danfoss electronic fan drive controllers are designed to control the speed of an engine fan in proportion to cooling demand by modulating oil flow to the hydraulic motor driving the fan. Flexible microcontroller hardware, comprehensive software and integrated hydraulic valve packaging allow one controller to be applied to all Danfoss hydraulic fan drive system configurations.

Depending on hydraulic system components, fan drive control may be accomplished with either a standalone electronic Fan Drive Controller (FDC) or an integrated hydraulic valve/electronic control package designated Fan Drive Control Assembly (FDCA).

The FDCA consists of a proportional solenoid cartridge valve mounted in an aluminum manifold to which an FDC electronics module is attached. The FDC electronics module supports the designated Fan Drive Control Manifold (FDCM) up to three analog temperature input signals, one engine computer PWM input signal and two auxiliary input switches. Input signal(s) sent to the FDC are processed by the microcontroller and an output signal proportional to the cooling circuit having the greatest cooling demand is sent to the solenoid valve.

The FDCA is typically used to control either gear pump/gear motor or open circuit piston pump/gear motor systems. In gear pump/gear motor systems the FDCA provides a pilot pressure signal to a flow divider valve located at the gear motor inlet. In open circuit piston pump applications, the FDCA is installed in the pump load sensing circuit.

Refer to publication *FDC Fan Drive Control Technical Information*, **BC00000005en-US** for Fan Drive Control product information.

#### Features

- Rugged hardware design, including die cast zinc housing and thermally conductive potted electronics, that withstands mobile machine operating conditions including shock, vibration, EMI/RFI, high pressure wash downs, temperature and humidity extremes.
- Hardened electronics operate over a range of 9 to 32 Volts with reverse battery, negative transient and load dump protection.
- Robust application software controls all available Danfoss fan drive system configurations.
- Input sensor and valve output parameters configured by easy-to-use set-up software.
- Integrated electronic and hydraulic packaging.
- Valve hysteresis less than 5% of rated pressure over operating range.
- Maximum pressure drop of 10.3 (150 psid) at full current.

#### Theory of operation

The FDCA modulates hydraulic fan drive system pilot pressure in response to input electrical signals from temperature sensors and switches. A current signal proportional to required cooling demand is sent from the FDC Electronics Module to the FDCA normally closed proportional solenoid valve causing pilot pressure to change. Increased current to the valve opens the valve, lowering pilot pressure. The pilot pressure provides a hydraulic signal to a flow control device which modulates fan motor oil flow and hence fan speed. Typical flow control devices are:

#### Switch valve

In a gear pump/gear motor fan drive system the switch valve, a normally closed flow diverter device, is usually located on the inlet to the gear motor. Changes in pilot pressure cause the valve to divert oil flow either to or away from the motor, thus modulating fan speed.

When cooling demand is high, the FDCA increases pilot pressure which signals the switch valve to proportionally divert more oil to the fan motor, thus increasing fan speed. Conversely when cooling demand diminishes, the FDCA decreases pilot pressure which signals the switch valve to by-pass flow away from the fan motor, thus decreasing fan speed.

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# **General Information**

#### Open circuit piston pump load sensing fan drive control

In an open circuit piston pump application, the pump load sensing control line is connected to the reservoir through the FDCA proportional solenoid valve. Pressure in the load sensing line is regulated by either opening or restricting flow across the proportional solenoid valve.

A command for increased cooling causes the FDCA output current to the proportional solenoid valve to drop, causing the valve to restrict flow, thus building pressure in the load sensing control line. This pressure is additive to the pump's load sensing spring setting and commands the pump to increase flow, hence fan motor speed, until a system pressure is reached that is high enough to balance the load sensing control. Conversely, a command for less cooling causes the FDCA proportional solenoid to open, thus reducing pressure in the load sensing line. This lower pressure commands the pump to lower flow, hence fan motor speed, until a system pressure is reached that is low enough to balance the load sensing control.

### Software

The FDC is a six input, one output electronic fan speed controller. The application software program is loaded into the device at the factory. Set-up software allows application software control parameters to be configured for specific engines, cooling system designs and temperature conditions. The following information describes the theory of operation of the application software.

On power-up the microcontroller initializes and starts the temperature control application program. Each time the program is executed, the microcontroller looks to see which of the temperature and switch inputs are enabled. For each enabled temperature input (analog temperature, PWM input), the program establishes a relationship between the measured temperature and the required current output for that temperature. The current output controls the flow of oil to the fan motor and hence fan speed by establishing the position of a proportional solenoid valve or EDC.

If more than one temperature input is enabled, the program compares all inputs, and the input requiring the most cooling (highest fan speed) is the input that controls the output current sent to the valve or EDC. If the microcontroller detects the absence of an enabled temperature input, it will fault the output to that required for maximum cooling.

The two auxiliary input switches can be enabled through set-up software and can be configured to be either normally open or normally closed. Each switch can be configured to drive the microcontroller output to demand maximum (on) or minimum (off) cooling when the switch is activated. Each time the application program is executed, in addition to looking at temperature inputs, the program looks at enabled switch inputs. If an enabled switch input is configured to drive the fan to a pre-configured higher speed when the switch is activated, the program will give this output equal priority with the other calculated outputs. The higher speed is configured via set-up software. If a switch input is configured to drive the fan to off (minimum speed), this output is given priority over all other calculated outputs. This is an emergency fan shutdown condition.

Requested output current can be inverted through set-up software, allowing the use of one FDC software program in systems with normally open and normally closed proportional solenoid valves as well as with EDCs.

### Technical data

#### Inputs

This section reviews all of the available FDCA inputs. Refer to *Service parts* on page 11, and pages that follow, for enabled input options for specific FDCA part numbers.

#### Three analog temperature thermistor inputs

Each can be enabled or disabled by set-up software. Each sensor is powered by a protected FDC voltage source. No input can exceed the reference voltage of 5 Vdc. Sensor voltage is measured to determine temperature. Sensor temperature ranges and ramp rates for increases or decreases in fan speed are adjustable through set-up software. FDC software is designed to recognize open and grounded temperature inputs. Either condition will cause a full fan speed fault.

#### One engine electronic controller PWM input

This input can be hardware configured (per *Ordering nomenclature* on page 9) to be either pull up or pull down, depending on the type of engine controller. This input is assumed to be a square wave in the range of 40 to 100 Hz that is either open/grounded or open/battery voltage. The input PWM duty cycle is assumed to be directly proportional to engine cooling demand and, therefore, to required fan speed. The input maximum and minimum PWM duty cycles can be configured through the set-up software. Ramp rates for increases and decreases in fan speed are also configurable.

#### Two digital auxiliary inputs

Each switch input can be enabled or disabled and configured as normally open or closed using set-up software. Both can be configured to turn the fan on or off. If configured to turn the fan on, output current to the valve or EDC is configurable in set-up software, allowing less than full fan speed conditions. Ramp times for increases or decreases in fan speed are also configurable. Switches are powered by a protected internal FDC 5 Vdc power source.

#### Outputs

#### One valve output

Output is a PWM signal and can be either high current (defined as 1.25 A max.) for driving a single proportional solenoid or low current (defined as 0.125 A max.) for driving a single EDC.

User must specify which output is required when ordering (see Ordering nomenclature on page 9).

A smart FET solid state switch controls PWM output. When on, it acts like a low impedance connection to battery (+). When off, it appears as open. Output wave forms are adjustable through set-up software in a range of 40 Hz to 200 Hz. Output is fully protected from shorts or excessive loads.

#### **Specifications**

#### Power supply

The allowable input power range for the FDC electronic module is 9 to 32 Vdc. 12 V and 24 V coils are available for the FDCA solenoid.

User must specify whether supply voltage to the FDC is 12 V or 24 V when ordering.

#### Communication

A 3-pin DEUTSCH connector is provided for data communications between the FDC and a personal computer via CAN. Use the PLUS+1<sup>\*</sup> Service Tool, the P1D file, a CG150-2 and an adapter cable, that connects the CG150-2 to the FDC, to load new software files, adjust parameters, or troubleshoot a system.

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# **Technical data**

# Electrical connectors and pinout diagrams

Refer to *Service parts* on page 11, and pages that follow, for model specific connector information relating to specific FDCA and FDC part numbers.

# Valve specifications

Maximum inlet port pressure	241,4 bar (3500 psi)
Maximum outlet port pressure	6,9 bar (100 psi)
Maximum flow rate	1,9 lpm (0.5 gpm)
Internal relief pressure setting at zero current	206,9 + 20,7/-0 bar at 0.95 + 0.19/-0 lpm (3000 + -0 psi at 0.25 + 0.05/-0 gpm)
Pressure drop at full input current	10,3 bar max at 0.95 + 0.19/-0 lpm (150 psi max at 0.25 + 0.05/-0 gpm)

### **Environmental specifications**

Operating temperature range	-40° C to 105° C (-40° F to 221° F)
Moisture	Protected against 95% relative humidity and high pressure wash-downs. Meets NEMA 6+ and IP 67 ratings.
Vibration	5 to 2000 Hz with resonant dwell for 1 million cycles for each resonant point run from 1 to 10 Gs
Shock	50 Gs for 11 ms in all three axes for a total of 18 shocks
EMI/RFI	35 V/M in range of 1 MHz to 1 GHz



# Technical data

# Dimensions

Install FDCA such that the coil central axis is parallel to the horizon. Failure to do so may result in air entrapment in the control. If the control is to be mounted in any other manner, make sure that the air is bled from the system.

FDCA mounting dimensions





- 1 To end of connector (typical)
- 2 Pilot supply port -6 SAE port straight thread O-ring boss
- **3** 2X M8 x 1.25-6H THD x 12.7 [0.5] DP Torque fasteners to: 9.2 ± 0.56 Nm [81 ± 5 in lb]
- 4 Tank return port -6 SAE port straight thread O-ring boss



# Ordering nomenclature

The FDCA ordering nomenclature is information required to designate a part number. The FDCA ordering part number assigns both hardware and software.

FDCA ordering nomenclature

1	2	3	4	5	6	7	8	9	10	11	12	13	14
FDCA	ХХ	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	3000/ 210	ХХ

# Ordering code

Callout	Description	Code choices			Comment	
1	Fan Drive Control Assembly	FDCA			Product name	
2	Machine battery voltage	12		24		12 or 24 Vdc
3	FDC output current	Н		L		H = High (1.25 A) L = Low (0.125 A)
4	Software programming	F		С		F = Factory defaults C = Customer specific
5	PWM input present	Y	D	N		Y = Yes, pull up (Detroit Diesel) D = Yes, pull down (Cummins, CAT, Deere) N = No PWM
6	Number of temperature sensors present	0	1	2	3	0 = No sensors 1 = One sensor 2 = Two sensors 3 = Three sensors
7	Number of auxiliary switches present	0	1	2		0 = No switch 1 = One switch 2 = Two switches
8	First connector descriptor	Specify ty	Specify type/number of pins			Call Danfoss customer service for designation.
9	Second connector descriptor	Specify type/number of pins			-	
10	Third connector descriptor	Specify type/number of pins				
11	Fourth connector descriptor	Specify type/number of pins				
12	Fifth connector descriptor	Specify type/number of pins				
13	FDCA Valve Relief Setting	3000/210			3000/210 = 210 BAR (3000 PSI)	
14	FDCA Valve Logic	NC NO			NC = Normally closed NO = Normally open	



### Accessories

#### **Temperature sensors**

Danfoss liquid and air temperature sensors must be used in conjunction with Danfoss FDCA devices.

Temperature sensors part numbers

Temperature sensor	Part number
Liquid temperature sensor*	1090173
Air temperature sensor <sup>*</sup>	1090174

\* Refer to publication 1090173, 1090174 Fan Drive Control Temperature Sensors (DTS) Technical Information Manual, **BLN-95-9063** for complete product information.

#### PLUS+1° Service Tool

The PLUS+1° Service Tool is a free program that must be installed on a personal computer and is used to communicate with the FDC to change parameters, load new software or troubleshoot a system. Below is a link to download the free version of the PLUS+1° Service Tool.

http://powersolutions.danfoss.com/products/plus-1-guide/guide-service-tool-software-and-license/

### P1D file

The P1D file is a prebuilt file named **Next Generation Fan Drive** designed to allow for easy and intuitive parameter changes. Download the P1D file from: *http://powersolutions.danfoss.com/products/plus-1-guide/guide-service-tool-software-and-license/*.

#### CG150-2

The CG15-02 is a USB to CAN adapter.

#### Adapter cable

Adapter cable	Part number
Connects the DB9 connector of the CG150-2 cable to the 3-pin DEUTSCH connector on the FDC.	11168820



### **Electrical mating connector kits**

Danfoss has assembled mating connector components into a kit for each FDCA connector. Refer to *Service parts* on page 11, and pages that follow, for electrical mating connector kit part numbers.

Every FDC and FDCA contains a 3-pin DEUTSCH connector that provides a software interface connection. A 3-pin mating connector with blanking plugs is included for environmental protection.

Mates with communications connector, 3 pin DEUTSCH on FDC and FDCA

Description	Quantity	Ordering number
Connector housing	1	DEUTSCH DT06-3S-E003
Terminal socket (optional)	3	DEUTSCH 0462-201-16141
Lock	1	DEUTSCH WS3
Sealing plug	3	DEUTSCH 114017

DEUTSCH Plug DT series 3-pin assignments



#### Pinout information

Pin	Function	FDC wire color
A	CAN HI	Blue/white
В	CAN LO	Blue/black
С	CAN Ground	Green/white

#### **Service parts**

# FDC

The FDC electronics module is not repairable and must be replaced if a failure occurs. Since FDC must contain the same software tuning parameters as the original part, each FDCA has a specific FDC service part. Refer to pages that follow, for FDC service part numbers.

### FDCM

Available replacement FDCM modules

Supply voltage	FDCM ordering part number
12 Vdc	11040814
24 Vdc	11040015



# Cross reference and wiring information

#### Nomenclature

# Ordering part number

FDCA part number	Nomenclature	FDC part number
11163043	FDCA 12 HCD11 HIRF3 PMPM8 3000/210 NC	11163165
11163041	FDCA 12 HCD11 HIRF3 PMPM8 3000/210 NC	11163042

# Electrical mating connector kit part numbers and pinout information

# K24109 (J2)

Description	Vendor	Vendor part number	Quantity required	
Mates with J2, 8-pin Delphi Metri-Pack 150 series on FDCA				
Connector housing	Delphi	12047937	1	
Secondary lock	Delphi	12066304	1	
Terminals, socket	Delphi	12048074	8	
Seal	Delphi	12048086	8	

Pin number	Function	Wire color	
J2-A	Battery –	Brown	12
J2-B	Battery +	Red	
J2-C	PWM	Yellow/Black	
J2-D	Plugged		
J2-E	Plugged		
J2-F	Switch 1+	Green	
J2-G	Switch 1 –	Blue	
J2-H	Plugged		



# Cross reference and wiring information

#### Nomenclature

# Ordering part number

FDCA part number	Nomenclature	FDC part number
11162966	FDCA 12 HCN21 HIRF3 PWPS2 PWPS62 3000/210 NC	11162965
11162968	FDCA 12 HCN21 HIRF3 PWPS2 PWPS62 3000/210 NC	11162967
11162996	FDCA 24 HCN21 HIRF3 PWPS2 PWPS62 3000/210 NC	N/A

# Electrical mating connector kit part numbers and pinout information

# K03383 (J2), K28027 (J3)

Description	Vendor	Vendor part number	Quantity required	
Mates with J2, 2-pin Delph	i Weather-Pack shroud on Fl	DCA		
Connector housing	Delphi	12015792	1	
Sockets (18 to 20 AWG)	Delphi	12089188	2	
Sockets (14 to 16 AWG)	Delphi	12124580	2	
Seal	Delphi	12015323	2	
Seal	Delphi	12010293	2	
Seal	Delphi	12015193	2	
Mates with J3, 6-pin Delphi Weather-Pack shroud on FDCA				
Connector housing	Delphi	12020926	1	
Sockets (18 to 20 AWG)	Delphi	12089188	6	
Sockets (14 to 16 AWG)	Delphi	12124580	6	
Seal	Delphi	12015323	6	
Seal	Delphi	12010293	6	
Seal	Delphi	12015193	6	

Pin number	Function	Wire color		
J2-A	Battery –	Brown	12	/3
J2-B	Battery +	Red	52	
J3-A	Switch 1 +	Green		
J3-B	Switch 1 –	Blue	O	
J3-C	Temp S1 +	White		
J3-D	Temp S1 –	Black		
J3-E	Temp S2 +	Black/White		
J3-F	Temp S2 –	Brown/White		



# Cross reference and wiring information

#### Nomenclature

# Ordering part number

FDCA part number	Nomenclature	FDC part number
11162956	FDCA 24 HCY00 HIRF3 PWPT1 PMPS2 3000/210 NC	11162955
11162997	FDCA 24 HCY00 HIRF3 PWPT1 PMPS2 3000/210 NC	N/A
11163001	FDCA 24 HCY00 HIRF3 PWPT1 PMPS2 3000/210 NC	11163000
11163035	FDCA 24 HYC00 HIRF3 PWPT1 PMPS2 3000/210 NC	N/A

# Electrical mating connector kit part numbers and pinout information

# K03383 (J1), K22782 (J3)

Description	Vendor	Vendor part number	Quantity required		
Mates with J1, 2-pin Delph	Mates with J1, 2-pin Delphi Weather-Pack shroud on FDCA				
Connector housing	Delphi	12015792	1		
Terminal, socket	Delphi	12089188	2		
Seal	Delphi	12015323	2		
Seal	Delphi	12010293	2		
Seal	Delphi	12015193	2		
Mates with J3, 1-pin Delphi Weather-Pack tower on FDCA					
Connector housing	Delphi	12010996	1		
Pin	Delphi	12089040	1		
Seal	Delphi	12010293	1		
Seal	Delphi	12015193	1		
Seal	Delphi	12015323	1		

Pin number	Function	Wire color		
J1-A	Battery +	Red	11	/3
J1-B	Battery –	Brown		
J3	PWM	Yellow/Black	8-20-	i EO



# Cross reference and wiring information

#### Nomenclature

### Ordering part number

FDCA part number	Nomenclature	FDC part number
11162936	FDCA 12 HFY32 HIRF3 AMP15 3000/210 NC	NA
11162942	FDCA 24 HFY32 HIRF3 AMP15 3000/210 NC	11162953
11162974	FDCA 24 HFD32 HIRF3 AMP15 3000/210 NC	11162973

# Electrical mating connector kit part numbers and pinout information

# K23383 (J1)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 15-pin AMP Mate-N-Lock on FDCA			
Connector housing	AMP	350784-1	1
Plug	AMP	770377-1	2
Seal	AMP	794282-1	1
Terminal sockets	AMP	350536-1	13

Install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

Pin number	Function	Wire color	
J1-1	Battery –	Brown	11
J1-2	Battery +	Red	
J1-3	Plugged		000
J1-4	Plugged		000
J1-5	Switch 1 +	Green	
J1-6	Switch 1 –	Blue	
J1-7	Switch 2 +	Violet	
J1-8	Switch 2 –	Gray	
J1-9	Temp S1 +	White	
J1-10	Temp S1 –	Black	
J1-11	Temp S2 +	Black/White	
J1-12	Temp S2 –	Brown/White	
J1-13	Temp S3 +	Red/White	
J1-14	Temp S3 –	Orange/Black	
J1-15	PWM input	Yellow/Black	



# **Cross reference and wiring information**

#### Nomenclature

#### Ordering part number

FDCA part number	Nomenclature	FDC part number
11163003	FDCA 12 HCD00 HIRF3 AMP15 3000/210 NC	11163002

# Electrical mating connector kit part numbers and pinout information

# K23383 (J2)

Description	Vendor	Vendor part number	Quantity required
Mates with J2, 15-pin AMP Mate-N-Lock on FDCA			
Connector housing	AMP	350784-1	1
Plug	AMP	770377-1	12
Seal	AMP	794282-1	1
Terminal sockets	AMP	350536-1	13

Install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

Pin number	Function	Wire color	
J1-1	Battery –	Brown	11
J1-2	Battery +	Red	
J1-3	Plugged		000
J1-4	Plugged		000
J1-5	Plugged		
J1-6	Plugged		
J1-7	Plugged		
J1-8	Plugged		
J1-9	Plugged		
J1-10	Plugged		
J1-11	Plugged		
J1-12	Plugged		
J1-13	Plugged		
J1-14	Plugged		
J1-15	PWM input	Yellow/Black	





# Cross reference and wiring information

#### Nomenclature

Ordering part number

FDCA part number	Nomenclature	FDC part number
11162992	FDCA 12 HCN31 HIRF3 PMPM8 PWPT2 3000/210 NC	NA

# Electrical mating connector kit part numbers and pinout information

K24109 (J2), K03377 (J3)

Description	Vendor	Vendor part number	Quantity required
Mates with J2, 8-pin Delph	i Metri-Pack 150 series on F[	DCA	
Connector housing	Delphi	12047937	1
Secondary lock	Delphi	12066304	1
Terminal, socket	Delphi	12048074	8
Seal	Delphi	12048086	8
Mates with J3, 2-pin Delph	i Weather-Pack tower on FD	CA	
Connector housing	Delphi	12010973	1
Pin	Delphi	12089040	2
Pin	Delphi	12124582	2
Seal	Delphi	12015323	2
Seal	Delphi	12010293	2
Seal	Delphi	12015193	2

Pin number	Function	Wire color		
J2-A	Battery –	Brown	J2	J3
J2-B	Battery +	Red		<b>6</b>
J2-C	Temp S2 +	Black/White	222	
J2-D	Temp S2 –	Brown/White		
Ј2-Е	Switch 1 +	Green		
J2-F	Switch 1 –	Blue		
J2-G	Temp S1 +	White		
J2-H	Temp S1 –	Black		
J3-A	Temp S3 +	Red/White		
J3-B	Temp S3 –	Orange/Black		



# Cross reference and wiring information

#### Nomenclature

### Ordering part number

FDCA part number	Nomenclature	FDC part number
11162963	FDCA 12 HCD00 PWPT1 PMPF2 HIRF3 3000/210 NC	11162962
11162941	FDCA 12 HCY00 PWPT1 PMPF2 HIRF3 3000/210 NC	11162941
11162957	FDCA 12 HCY00 PWPT1 PMPF2 HIRF3 3000/210 NC	N/A
11162959	FDCA 12 HCY00 PWPT1 PMPF2 HIRF3 3000/210 NC	11162958
11162961	FDCA 12 HCY00 PWPT1 PMPF2 HIRF3 3000/210 NC	N/A
11162977	FDCA 12 HCY00 PWPT1 PMPF2 HIRF3 3000/210 NC	N/A
11162943	FDCA 24 HCY00 PWPT1 PMPF2 HIRF3 3000/210 NC	11162954
11162969	FDCA 24 HCY00 PWPT1 PMPF2 HIRF3 3000/210 NC	N/A
11162964	FDCA 24 HCD00 PWPT1 PMPF2 HIRF3 3000/210 NC	N/A
11162985	FDCA 12 HCD00 PWPT1 PMPF2 HIRF3 3000/210 NC	N/A
11162989	FDCA 12 HCY00 PWPT1 PMPF2 HIRF3 3000/210 NC	N/A
11163006	FDCA 24 HCD00 PWPT1 PMPF2 HIRF3 3000/210 NC	11163008
11163013	FDCA 12 HCD00 PWPT1 PMPF2 HIRF3 3000/210 NC	11163012
11163032	FDCA 12 HCD00 PWPT1 PMPF2 HIRF3 3000/210 NC	N/A

# Electrical mating connector kit part numbers and pinout information

# K23022 (J1), K22782 (J3)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 2-pin Delph	i Weather-Pack shroud on F	DCA	
ТРА	Delphi	12052634	1
Connector housing	Delphi	12162000	1
Pin	Delphi	12045773	2
Seal	Delphi	12048086	2
Mates with J3, 1-pin Delph	i Weather-Pack tower on FD	CA	
Connector housing	Delphi	12010996	1
Pin	Delphi	12089040	1
Seal	Delphi	12010293	1
Seal	Delphi	12015193	1
Seal	Delphi	12015323	1

Pin number	Function	Wire color		
J1-A	Battery –	Brown	J1	J3
J1-B	Battery +	Red	-	
J3	PWM	Yellow/Black		EO





# Cross reference and wiring information

#### Nomenclature

Ordering part number

FDCA part number	Nomenclature	FDC part number
11163007	FDCA 12 HCD10 HIRF3 PMPF2 PWPS2 PWPT1 3000/210 NC	N/A

# Electrical mating connector kit part numbers and pinout information

# K23022 (J2), K03383 (J3), K22782 (J4)

Description	Vendor	Vendor part number	Quantity required	
Mates with J2, 2-pin Delphi Metri-Pack shroud on FDCA				
ТРА	Delphi	12052634	1	
Connector housing	Delphi	12162000	1	
Pin	Delphi	12045773	2	
Seal	Delphi	12048086	1	
Mates with J3, 2-pin Delphi	Weather-Pack shroud on F	DCA		
Connector housing	Delphi	12015792	1	
Term, socket	Delphi	12089188	2	
Seal	Delphi	12015323	2	
Seal	Delphi	12010293	2	
Seal	Delphi	12015193	2	
Mates with J4, 1-pin Delphi	Weather-Pack tower on FD	CA		
Connector housing	Delphi	12010996	1	
Pin	Delphi	12080040	1	
Seal	Delphi	12010293	1	
Seal	Delphi	12015193	1	
Seal	Delphi	12015323	1	

Pin number	Function	Wire color		
J2-A	Battery –	Brown	12	/3
J2-B	Battery +	Red	-	
J3-A	Temp S1 +	White	Either FLO	
J3-B	Temp S1 –	Black		
J4	PWM	Yellow/Black	J4	



# Cross reference and wiring information

#### Nomenclature

# Ordering Part Number

FDCA part number	Nomenclature	FDC part number
11162970	FDCA 24 HCN20 PWPS6 HIRF3 3000/210 NC	N/A
11163009	FDCA 24 HCN20 PWPS6 HIRF3 3000/210 NC	N/A

# Electrical mating connector kit part numbers and pinout information

# K11351 (J2)

Description	Vendor	Vendor part number	Quantity required
Mates with J2, 6-pin Delphi Metri-Pack shroud on FDCA			
Connector housing	Delphi	12015799	1
Terminal socket 18-20	Delphi	12089188	6
Terminal socket 14-16	Delphi	12124580	6
Cable seal	Delphi	12015323	6
Cable seal	Delphi	12010293	6
Cable seal	Delphi	12015193	6

Pin number	Function	Wire color	
J2-A	Battery –	Brown	12
J2-B	Battery +	Red	
J2-C	Temp S1 +	White	
J2-D	Temp S1 –	Black	
J2-E	Temp S2 +	Black/White	
J2-F	Temp S1 –	Black/White	





# Cross reference and wiring information

#### Nomenclature

# Ordering part number

FDCA part number	Nomenclature	FDC part number
11162979	FDCA 24 HCN30 DCP6 DCR8 HIRF3 3000/210 NC	11162978
11163011	FDCA 24 HCN30 DCP6 DCR8 HIRF3 3000/210 NC	N/A
11163038	FDCA 24 HCN30 HIRF3 DCR8 DCP6 3000/210 NC	N/A

# K29620 (J2), K29623 (J3)

Description	Vendor	Vendor part number	Quantity required		
Mates with J2, 8-pin DEUTS	Mates with J2, 8-pin DEUTSCH on FDCA				
Connector housing	DEUTSCH	DTM 06-85A	1		
With lock	DEUTSCH	WM-8S	1		
Socket terminals	DEUTSCH	046220120141	8		
S plug	DEUTSCH	0413-204-2005	4		
Mates with J3, 6-pin DEUTSCH on FDCA					
Connector housing	DEUTSCH	DTM 04-6P	1		
With lock	DEUTSCH	WM-6P	1		
Terminal pin	DEUTSCH	046020220141	6		
S plug	DEUTSCH	0413-204-2005	4		

Pin number	Function	Wire color		
J2-1	Battery –	Brown	12	/3
J2-2	Battery +	Red		
J2-3	Switch 1 +	Green		
J2-4	Switch 1 –	Blue		
J2-5	Switch 2 +	Violet		
J2-6	Switch 2 –	Grey		
J2-7	PWM	Yellow/Black		
J2-8	Plugged			
J3-1	Temp S1 +	White		
J3-2	Temp S1 –	Black		
J3-3	Temp S2 +	Black/White		
J3-4	Temp S2 –	Brown/White		
J3-5	Temp S3 +	Red/White	]	
J3-6	Temp S3 –	Orange/Black	1	



# Cross reference and wiring information

#### Nomenclature

# Ordering part number

FDCA part number	Nomenclature	FDC part number
11163014	FDCA 24 HCN11 HIRF3 PWPS2 PWPS62 3000/210 NC	N/A

# Electrical mating connector kit part numbers and pinout information

# K03383 (J2), K28027 (J3)

Description	Vendor	Vendor part number	Quantity required
Mates with J2, 2-pin Delph	i Weather-Pack shroud on Fl	DCA	
Connector housing	Delphi	12015792	1
Sockets (18 to 20 AWG)	Delphi	12089188	2
Sockets (14 to 16 AWG)	Delphi	12124580	2
Seal	Delphi	12015323	2
Seal	Delphi	12010293	2
Seal	Delphi	12015193	2
Mates with J3, 6-pin Delph	i Weather-Pack shroud on Fl	DCA	
Connector housing	Delphi	12020926	1
Sockets (18 to 20 AWG)	Delphi	12089188	5
Sockets (14 to 16 AWG)	Delphi	12124580	5
Seal	Delphi	12015323	5
Seal	Delphi	12010293	5
Seal	Delphi	12015193	5

Pin number	Function	Wire color		
J2-A	Battery –	Brown	12	13
J2-B	Battery +	Red		
J3-A	Switch 1 +	Green	8-210	
J3-B	Switch 1 –	Blue		
J3-C	Temp S1 +	White		
J3-D	Temp S1 –	Black		
J3-E	Plugged			
J3-F	Plugged			



# Cross reference and wiring information

#### Nomenclature

# Ordering part number

FDCA part number	Nomenclature	FDC part number
11162944	FDCA 12 HCN21 PMPM8 HIRF3 3000/210 NC	N/A
11162945	FDCA 12 HCN21 PMPM8 HIRF3 3000/210 NC	11162950
11162946	FDCA 12 HCN21 PMPM8 HIRF3 3000/210 NC	11162951
11162947	FDCA 12 HCN21 PMPM8 HIRF3 3000/210 NC	11162952
11162948	FDCA 12 HCN21 PMPM8 HIRF3 3000/210 NC	N/A
11162971	FDCA 12 HCN21 PMPM8 HIRF3 3000/210 NC	N/A
11162960	FDCA 12 HCN21 PMPM8 HIRF3 3000/210 NC	N/A
11162991	FDCA 12 HCN21 PMPM8 HIRF3 3000/210 NC	11162993
11163004	FDCA 12 HCN21 PMPM8 HIRF3 3000/210 NC	N/A
11163016	FDCA 12 HCN21 PMPM8 HIRF3 3000/210 NC	N/A

# Electrical mating connector kit part numbers and pinout information

# K24109 (J1)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 8-pin Delphi Metri-Pack 150 series on FDCA			
Connector housing	Delphi	12047937	1
Secondary lock	Delphi	12066304	1
Terminals, socket	Delphi	12048074	8
Seal	Delphi	12048086	8

Pin number	Function	Wire color	
J1-A	Battery –	Brown	11
J1-B	Battery +	Red	
J1-C	Temp S2 +	Black/White	
J1-D	Temp S2 –	Brown/White	
J1-E	Switch 1 +	Green	
J1-F	Switch 1 –	Blue	
J1-G	Temp S1 +	White	
J1-H	Temp S1 –	Black	



# **Cross reference and wiring information**

#### Nomenclature

#### Ordering part number

FDCA part number	Nomenclature	FDC part number
11163015	FDCA 24 HCN11 HIRF3 PMPS2 PWPS6 3000/210 NC	N/A

# Electrical mating connector kit part numbers and pinout information

# K03383 (J1), K11351 (J2)

Description	Vendor	Vendor part number	Quantity required		
Mates with J1, 2-pin Delph	Mates with J1, 2-pin Delphi Weather-Pack shroud on FDCA				
Connector housing	Delphi	12015792	1		
Term, socket	Delphi	12089188	2		
Seal	Delphi	12015323	2		
Seal	Delphi	12010293	2		
Seal	Delphi	12015193	2		
Mates with J2, 6-pin Delph	Mates with J2, 6-pin Delphi Metri-Pack shroud on FDCA				
Connector housing	Delphi	12015799	1		
Sockets (18 to 20 AWG)	Delphi	12089188	4		
Sockets (14 to 16 AWG)	Delphi	12124580	4		
Cable seal	Delphi	12015323	4		
Cable seal	Delphi	12010293	4		
Cable seal	Delphi	12015193	4		
Plug	Delphi	12010300	2		

Install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

Pin number	Function	Wire color		
J1-A	Battery –	Brown	11	12
J1-B	Battery +	Red		
J2-A	Switch 1 +	Green		
J2-B	Switch 1 –	Blue		
J2-C	Plugged			
J2-D	Plugged			
J2-E	Temp S2 +	Black/White		
J2-F	Temp S2 –	Brown/White		



# Cross reference and wiring information

#### Nomenclature

Ordering part number

FDCA part number	Nomenclature	FDC part number
11163020	FDCA 12 HCD00 HIRF3 AMP15 3000/210 NC	11163018

# Electrical mating connector kit part numbers and pinout information

# K23383 (J1)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 15-pin AMP Mate-N-Lock on FDCA			
Connector housing	AMP	350784-1	1
Plug	AMP	770377-1	2
Seal	AMP	794282-1	1
Terminal sockets	AMP	350536-1	13

Install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

Pin number	Function	Wire color	
J1-1	Battery –	Brown	11
J1-2	Battery +	Red	
J1-3	Plugged		000
J1-4	Plugged		000
J1-5	Plugged		
J1-6	Plugged		
J1-7	Plugged		
J1-8	Plugged		
J1-9	Plugged		
J1-10	Plugged		
J1-11	Plugged		
J1-12	Plugged		
J1-13	Plugged		
J1-14	Plugged		
J1-15	Plugged	Yellow/Black	



# **Cross reference and wiring information**

#### Nomenclature

#### Ordering part number

FDCA part number	Nomenclature	FDC part number
11163021	FDCA 12 HCD00 HIRF3 PMPM8 3000/210 NC	N/A

# Electrical mating connector kit part numbers and pinout information

# K24109 (J1)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 8-pin Delphi Metri-Pack 150 series on FDCA			
Connector housing	Delphi	12047937	1
Secondary lock	Delphi	12066304	1
Terminals, socket	Delphi	12048074	3
Seal	Delphi	12048086	3
Plug	Delphi	12059168	5

Install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

Pin number	Function	Wire color	
J2-A	Battery –	Brown	12
J2-B	Battery +	Red	
J2-C	Plugged		
J2-D	Plugged		
J2-E	Plugged		
J2-F	Plugged		
J2-G	Plugged		
J2-H	PWM	Yellow/Black	



# Cross reference and wiring information

#### Nomenclature

Ordering part number

FDCA part number	Nomenclature	FDC part number
11163028	FDCA 12 HCD01 HIRF3 PMPM8 3000/210 NC	11163026

# Electrical mating connector kit part numbers and pinout information

# K24109 (J2)

Description	Vendor	Vendor part number	Quantity required
Mates with J2, 8-pin Delphi Metri-Pack 150 series on FDCA			
Connector housing	Delphi	12047937	1
Secondary lock	Delphi	12066304	1
Terminals, socket	Delphi	12048074	8
Seal	Delphi	12048086	8

Pin number	Function	Wire color	
J2-A	Battery –	Brown	12
J2-B	Battery +	Red	
J2-C	PWM	Yellow/Black	
J2-D	Plugged		
J2-E	Plugged		
J2-F	Switch 1+	Green	
J2-G	Switch 1 –	Blue	
J2-H	Plugged		



# Cross reference and wiring information

#### Nomenclature

# Ordering part number

FDCA part number	Nomenclature	FDC part number
11163034	FDCA 24 HCN30 HIRF3 PMPS2 PWPS6 3000/210 NC	N/A

# Electrical mating connector kit part numbers and pinout information

# K03383 (J2), K11351 (J3)

Description	Vendor	Vendor part number	Quantity required			
Mates with J2, 2-pin Delphi Weather-Pack shroud on FDCA						
Connector housing	Delphi	12015792	1			
Term, socket	Delphi	12089188	2			
Seal	Delphi	12015323	2			
Seal	Delphi	12010293	2			
Seal	Delphi	12015193	2			
Mates with J3 6-pin Delphi Weather-Pack shroud on FDCA						
Connector housing	Delphi	12015799	1			
Sockets (18 to 20 AWG)	Delphi	12089188	6			
Sockets (14 to 16 AWG)	Delphi	12124580	6			
Cable seal	Delphi	12015323	6			
Cable seal	Delphi	12010293	6			
Cable seal	Delphi	12015193	6			

Pin number	Function	Wire color		
J2-A	Battery –	Brown	12	/3
J2-B	Battery +	Red		-0
J3-A	Temp S1 +	White		
J3-B	Temp S1 –	Black		
J3-C	Temp S2 +	Black/White		
J3-D	Temp S2 –	Brown/White		
ЈЗ-Е	Temp S3 +	Red/White		
J3-F	Temp S3 –	Orange/Black		

# Danfoss

### Wiring

Install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

### Machine wiring guidelines

# A Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. Improperly protected power input lines against over current conditions may cause damage to the hardware. Properly protect all power input lines against over-current conditions. To protect against unintended movement, secure the machine.

# Caution

Unused pins on mating connectors may cause intermittent product performance or premature failure. Plug all pins on mating connectors.

- · Protect wires from mechanical abuse, run wires in flexible metal or plastic conduits.
- Use 85° C (185° F) wire with abrasion resistant insulation and 105° C (221° F) wire should be considered near hot surfaces.
- Use a wire size that is appropriate for the module connector.
- Separate high current wires such as solenoids, lights, alternators or fuel pumps from sensor and other noise-sensitive input wires.
- Run wires along the inside of, or close to, metal machine surfaces where possible, this simulates a shield which will minimize the effects of EMI/RFI radiation.
- Do not run wires near sharp metal corners, consider running wires through a grommet when rounding a corner.
- Do not run wires near hot machine members.
- Provide strain relief for all wires.
- Avoid running wires near moving or vibrating components.
- Avoid long, unsupported wire spans.
- Ground electronic modules to a dedicated conductor of sufficient size that is connected to the battery (-).
- Power the sensors and valve drive circuits by their dedicated wired power sources and ground returns.
- Twist sensor lines about one turn every 10 cm (4 in).
- Use wire harness anchors that will allow wires to float with respect to the machine rather than rigid anchors.



### Establishing communication with the FDC



Service Tool example, Fan Drive System Overview screen

kwa1459429295493

Machine battery voltage must be applied to the FDC when changing tuning parameters or to perform proper diagnostics/servicing.

- Your PC must have the Danfoss PLUS+1° Service Tool installed to establish communication with the FDC to change parameters, load new software, or troubleshoot a system. Download a free version of the PLUS+1° Service Tool: http://powersolutions.danfoss.com/products/plus-1-guide/guide-service-toolsoftware-and-license/.
- Your PC must also have the diagnostic (P1D) file loaded. The P1D file is a prebuilt file named Next Generation Fan Drive designed to allow for easy and intuitive parameter changes. Download the P1D file: http://powersolutions.danfoss.com/products/plus-1-guide/guide-service-tool-software-andlicense/.
- 3. Remove the 3-pin DEUTSCH protection connector from the FDC harness.
- 4. Connect the PC to the FDC by using the CG150-2 and the adapter harness.
- 5. On your PC, double click on the P1D file named Next Generation Fan Drive. The Danfoss PLUS+1° Service Tool will open to the Fan Drive System Overview screen.

You can tell if you are connected by looking at the data at the bottom of the screen. If everything is okay the dot will be blue and **Logging** will be displayed.

- 6. If the dot is green and Connected is displayed, press Start Logging (F5) on the top menu bar.
- 7. If the dot is red and **Disconnected** is displayed, re-check your setup to make sure that power is applied and that all cables are properly connected.



### Using the Service Tool to Adjust FDC parameters



Service Tool example, Fan Drive System Overview screen

kwa1459429295493

Once communication has been established with the FDC, the PLUS+1<sup>®</sup> Service Tool can be used to troubleshoot or tune a system. The Service Tool page reads left to right starting with the inputs on the left, system calculations in the center, and finishing with the output settings along the right side.

In the **Fan Drive System Overview** example we see that this system has temperature sensor 1 activated and that it is reporting a temperature reading of 70° C. As you move through the screen, you see that the system has calculated that a 70° C reading results in a cooling command of 50%. Ramping is then applied, and in this case it is 25 seconds. Next, the system shows which input is in control. In systems that employ multiple temperature sensors and switches, a priority is assigned to the switch inputs followed but the sensor inputs with the highest cooling demand. As you move to the Output section of the page, the 50% cooling demand calculates to a 675 mA current output to the valve.

Parameter changes are easy to make with the PLUS+1<sup>°</sup> Service Tool. Use the check boxes to make desired input selections and use the up/down arrows or just type in new values for temperature ranges, ramp times, and output currents. Hover over each field to see the minimum/maximum default and actual values. Once the new values are entered, press the green down arrow in the menu bar (**F4**) to load them into the FDC.



# **Parameter descriptions**

Parameters can only be adjusted if the FDC hardware supports that function.

### Aux Switch 1, 2

Left section of Service Tool screen — Aux Switch 1, 2



- 1. Active Each Aux switch can be active/de-active by selecting the check boxes.
  - Fan On Each switch can be configured for the action that will occur when the logic changes, Fan Off or Fan On by selecting the check boxes.
  - NC Each Aux switch can be configured to be Normally Open or Normally Closed (NC) by selecting the check boxes.
- 2. Sw 1Sw 2 Indicate the switch status.

If an auxiliary switch is configured to turn the fan off when the switch logic changes, this input to the FDC has priority over all other inputs. The microcontroller will drive the fan to an off condition.



# PWM input

Left section of Service Tool screen——PWM input



- 1. Max %
   The minimum and maximum PWM % can be adjusted using the up/down arrows or by entering the value directly.
- 2. **PWM Active** The PWM input can be made active by selecting PWM Active. **PWM Invert** The signal can be inverted by selecting the PWM Invert.
- 3. HZ The frequency and duty cycle of the PWM signal along with status of the signal are displayed. Duty cycle

#### Sensor 1, 2, 3

Left section of Service Tool screen — Sensor 1, 2, 3



- 1. Max C The control ranges for each sensor can be adjusted using the up/down arrows or by entering the value directly.
- Sensor 1 Active
   Up to three temperature sensors can be connected to the FDC. The method of changing

   Sensor 2 Active
   parameters is the same for each sensor. Each sensor can be activated/deactivated by selecting

   Sensor 3 Active
   check boxes.
- 3. **Dual Range** Sensors 1 and 2 also have the option of selecting dual range check boxes. Doing so shifts the control range of the input.
- 4. **Deg C** The current temperature and the status of the signal are displayed.

Selecting the Dual Range option for sensors 1 and 2 should only be done after consulting the factory.





# Ramp Time

Center section of Service Tool screen——Ramp Time

	2	3
Calculate %	Ramp Time Dn 25 Sec Off 25 Sec On 25 Sec Off 25 Sec	Select Input
0.00	On 25 💭 Sec Off 25 💭	
50.00	On 25 Sec Off 25	Temp Sen 1 Fan % 50.00
0.00	On 25 Sec Off 25 Sec	Ramp Time On 25 Sec Ramp Time Of 25 Sec
0.00	On 25 Sec Of 25 Sec	

- 1. **Ramp Time** Each of the active inputs can be set and adjusted by using the up/down arrows or by entering the value.
- 2. **Calculate %** The calculated percent of cooling demand.
- 3. Select Input Inputs currently commanding system cooling, percent of cooling demand is present, and the ramp times applied to that input.

### Output

Right section of Service Tool screen—Output



1.	Aux 1 Min mA	Minimum current setting for auxiliary switch 1	2.	Aux 2 Min mA	Minimum current setting for auxiliary switch 2
3.	Fan Current	Indicates the current presently applied to the valve	4.	Invert Valve Out	Inverts the valve output
5.	Fan Min mA	Minimum current setting for Fan	6.	Fan Max mA	Maximum current setting for Fan
7.	Valve PWM Freq	Setting for valve PWM frequency			

Selecting the Invert Valve Output option should only be done after consulting the factory.







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