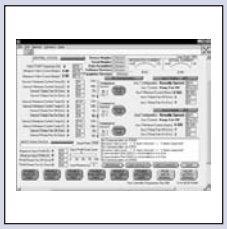
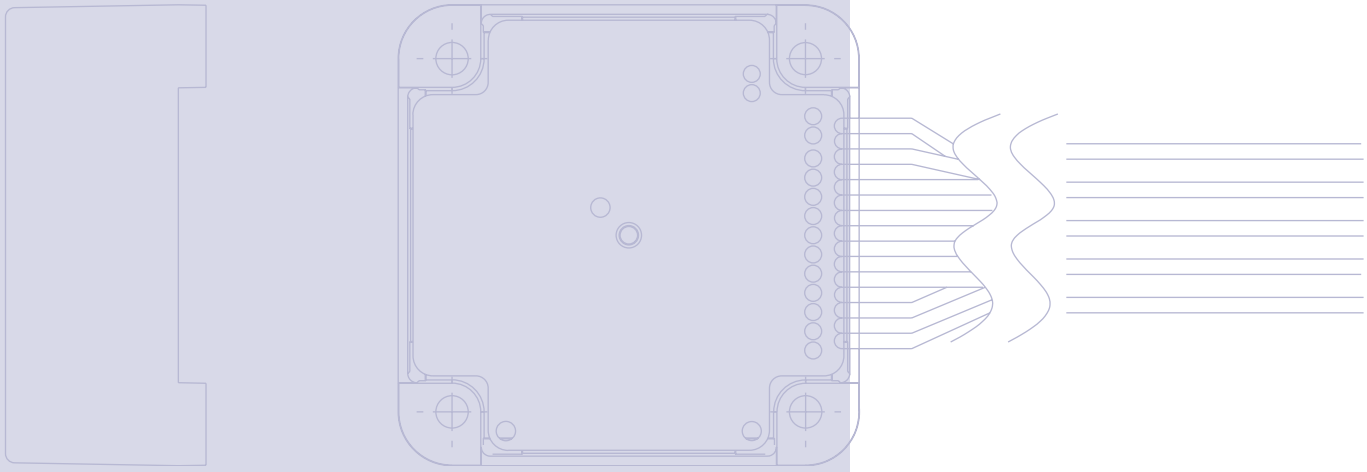
SAUER DANFOSS

FDC
Fan Drive Control

Technical Information





FDC Fan Drive Control
Technical Information
Contents

Revision history

Revision date	Page	Change	Remarks
03-06-2005		General content update	Replaces BLN-95-9064

Front cover illustrations: 2060B, F101395, 2059B, 2266, 2267

DESCRIPTION

Sauer-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 Sauer-Danfoss hydraulic fan drive system configurations.

Depending on hydraulic system components, fan drive control may be accomplished with either a stand-alone electronic Fan Drive Controller (FDC) or an integrated hydraulic valve/electronic control package designated Fan Drive Control Assembly (FDCA). The FDC is typically applied in either hydrostatic fan drive systems where the output signal drives a pump electrical displacement control (EDC) or in open circuit piston pump applications where the signal drives a proportional valve in the pump load sensing circuit.

The FDC features potted microelectronics mounted in a rugged, die cast housing. It supports 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 demand is sent to either a solenoid valve or EDC.

Refer to publication *FDCA Fan Drive Control Assembly Technical Information,* **11005337** for Fan Drive Control Assembly 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.
- Infrared communication eliminates exposed connector pins.
- High and low current output versions for proportional solenoid valves and EDCs.
- Robust application software controls all available Sauer-Danfoss fan drive system configurations.
- Input sensor and valve output parameters configured by easy-to-use set-up software.

THEORY OF OPERATION

The FDC is a six input, one output electronic fan speed controller. The application software program is loaded into the device at the factory and cannot be changed by the user. 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 default 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.

INPUTS

This section reviews all of the available FDC inputs. Refer to *FDC part number and wiring information,* pages 10 through 25 for enabled input options for specific FDC 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 default.

One engine electronic controller PWM input

This input can be hardware configured (per the *FDC ordering nomenclature*, page 8) 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 FDC 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 *FDC ordering nomenclature*, page 8).

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.

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

Communication

An infrared port is provided for asynchronous data communication between the FDC and a personal computer via an infrared communicator. This port follows protocol established for RS232 communication data transferred via an infrared interface.

Electrical connectors

Refer to pages 10 through 25 for connector information relating to specific FDC part numbers.

Connector pinout diagrams

Refer to pages 10 through 25 for connector information relating to specific FDC part numbers.

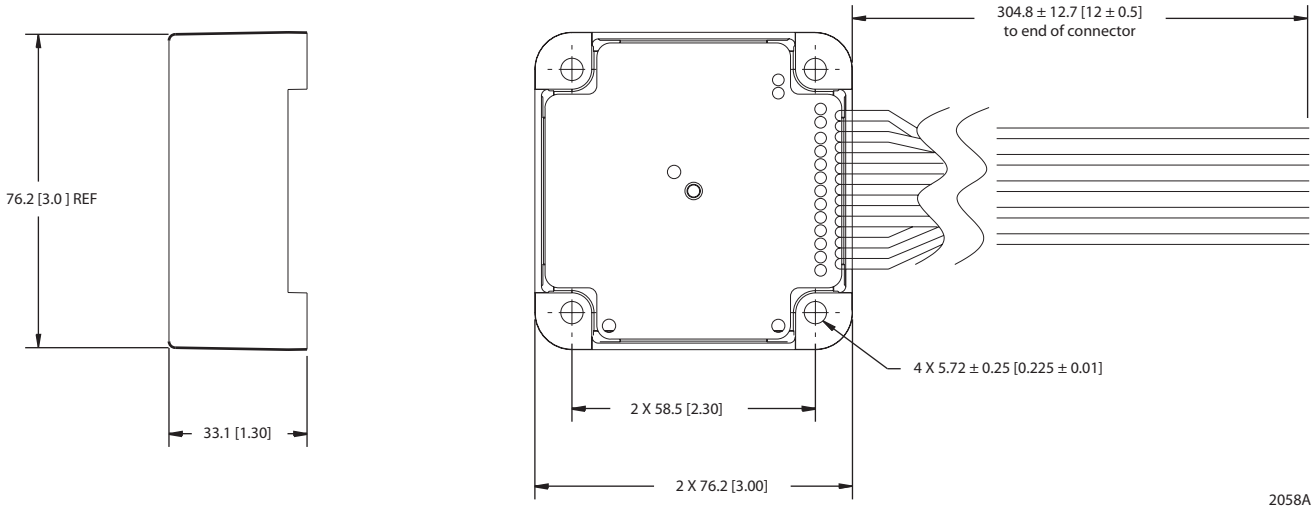
Environmental

Specifications

Operating temperature range
–40° C to 105° C (–40° F to 221° F)
Moisture
Protected against 95% relative humidity and high pressure washdowns. 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

DIMENSIONS

FDC mounting dimensions in millimeters [inches]



ORDERING NOMENCLATURE CHART

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

FDC ordering nomenclature

FDC XX X X X X X X X X X X

Fan Drive Control

Machine battery voltage
12 = 12 Vdc
24 = 24 Vdc

FDC output current
H = High (1.25 A)
L = Low (0.125 A)

Software programming
F = Factory defaults
C = Customer specific

PWM input present
Y = Yes, pull up
(Detroit Diesel)
D = Yes, pull down
(Cummins, CAT, Deere)
N = No PWM

Number of temperature sensors present
0 = No sensors
1 = One sensor
2 = Two sensors
3 = Three sensors

*** Fifth connector descriptor specify type / number of pins**

*** Fourth connector descriptor specify type / number of pins**

*** Third connector descriptor specify type / number of pins**

*** Second connector descriptor specify type / number of pins**

*** First connector descriptor specify type / number of pins**

Number of auxilliary switches present
0 = No switch
1 = One switch
2 = Two switches

* Call customer service at 763 509-2084 for designation.

Ordering Information

ACCESSORIES

Temperature sensors

Sauer-Danfoss liquid and air temperature sensors must be used in conjunction with Sauer-Danfoss FDC devices. The liquid temperature sensor part number is 1090173. The air temperature sensor part number is 1090174. Refer to publication *1090173, 1090174 Fan Drive Control Temperature Sensors (DTS) Technical Information* **BLN-95-9063** for complete product information.

Set-up toolbox

An FDC Electronics Module Set-Up Toolbox, Sauer-Danfoss part number 1090457, is required to communicate with the FDC, allowing device software parameters to be configured. For a description of toolbox components, refer to *Set-up software toolbox*, pages 29 through 30.

Electrical mating connector kits

Sauer-Danfoss has assembled mating connector components into a kit for each FDC connector. Refer to *FDC part number and wiring information*, pages 10 through 25 for electrical mating connector kit part numbers.

SERVICE PARTS

FDC

The FDC electronics module is not repairable and must be replaced if a failure occurs.

FDC part number and wiring information, pages 10 through 25 contain hardware nomenclature and FDC part numbers, and mating connector wiring information, . For FDC software tuning parameter information call customer service at 763 509-2084.

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 24 L F Y 3 2 AMP 15	1090175
FDC 12 H F Y 3 2 AMP 15	1090194
FDC 12 L F N 2 1 AMP 15	1090504
FDC 12 L F Y 2 1 AMP15	1090556
FDC 24 L F D 3 2 AMP 15	1090565

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K23383 (J1)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 15 pin AMP® Mate-N-Lock on FDC			
Connector housing	AMP	350784-4	1
Plug	AMP	770377-1	5
Seal	AMP	794282-1	1
Terminal sockets	AMP	3500550-1	15

As a precautionary install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

Pinout information

Pin number	Function	FDC wire color
J1-1	Battery –	Brown
J1-2	Battery +	Red
J1-3	Valve +	Orange
J1-4	Valve –	Yellow
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

J1

2128

FDC service part cross reference and wiring information

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 24 L C N 2 1 DCR12	1090176

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K23344 (J1)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 12 pin Deutsch® receptacle connector on FDC			
Connector housing	Deutsch	DTM06-12SA	1
Lock	Deutsch	WM12S	1
Terminal sockets	Deutsch	046220120141	12
Seal plugs	Deutsch	0413-204-2005	4

Pinout information

Pin number	Function	FDC wire color
J1-1	Battery –	Brown
J1-2	Battery +	Red
J1-3	Valve +	Orange
J1-4	Valve –	Yellow
J1-5	Switch 1 +	Green
J1-6	Switch 1 –	Blue
J1-7	Plugged	
J1-8	Plugged	
J1-9	Temp S1 +	White
J1-10	Temp S1 –	Black
J1-11	Temp S2 +	Black/White
J1-12	Temp S2 –	Brown/White

J1

2134

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 24 PWPT1 PWPS2 HIRF3	1090491

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K23383 (J1), K22782 (J3)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 2 pin Delphi® Weather-Pack™ shroud on FDC			
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, 1 pin Delphi® Weather-Pack™ tower on FDC			
Connector housing	Delphi	12010996	1
Pin	Delphi	12089040	1
Seal	Delphi	12010293	1
Seal	Delphi	12015193	1
Seal	Delphi	12015323	1

Hirschmann HIRF3 connector J2 mates with solenoid valve connector on Sauer-Danfoss Fan Drive Control manifold.

Pinout information

Pin number	Function	FDC wire color
J1-A	Battery –	Brown
J1-B	Battery +	Red
J3	PWM	Yellow/Black
J2-1	Valve +	Orange
J2-2	Valve –	Yellow

2116, 2133, 2122

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 12 H C Y 1 1 HIRF3 PMPM8	1090501

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K24109 (J2)

Description	Vendor	Vendor part number	Quantity required
Mates with J2, 8 pin Delphi® Metri-Pack™ 150 series on FDC			
Connector housing	Delphi	12047937	1
Secondary lock	Delphi	12066304	1
Terminals, socket	Delphi	12048074	7
Seal	Delphi	12048086	7
Plug	Delphi	12059168	1

As a precautionary install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

Hirschmann HIRF3 connector J1 mates with solenoid valve connector on Sauer Danfoss Fan Drive Control manifold.

Pinout information

Pin number	Function	FDC wire color
J1-1	Valve +	Orange
J1-2	Valve –	Yellow
J2-A	Battery +	Red
J2-B	Battery –	Brown
J2-C	PWM input	Yelow/Black
J2-D	Temp S1 +	White
J2-E	Temp S1 –	Black
J2-F	Switch 1 +	Green
J2-G	Switch 1 –	Blue
J2-H	Plugged	

J1

J2

2133, 2127

FDC service part cross reference and wiring information

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 24 H C D 0 0 PMPM3 HIRF3	1090527
FDC 24 H C Y 0 0 PMPM3 HIRF3	1090529

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K29446 (J2)

Description	Vendor	Vendor part number	Quantity required
Mates with J2, 3 pin Delphi® Metri-Pack™ male on FDC			
Connector housing	Delphi	12110293	1
Pin	Delphi	18–20	3
Seal	Delphi	12048086	3
Lock	Delphi	12052845	1

Hirschmann HIRF3 connector J1 mates with solenoid valve connector on Sauer Danfoss Fan Drive Control manifold.

Pinout information

Pin number	Function	FDC wire color
J1-1	Valve +	Orange
J1-2	Valve –	Yellow
J2-A	Power +	Red
J2-B	PWM input	Yellow/Black
J2-C	Power –	Brown

J1 *J2*

2133, 2132

FDC service part cross reference and wiring information

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 12 H C N 2 1 HIRF3 PWPS2 PWPS62	1090645
FDC 12 H C N 2 1 HIRF3 PWPS2 PWPS62	1090646

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K03383 (J2), K28027 (J3)

Description	Vendor	Vendor part number	Quantity required
Mates with J2, 2 pin Delphi® Weather-Pack™ shroud on FDCA			
Connector housing	Delphi	12015792	1
Sockets (18 – 20 AWG)	Delphi	12089188	2
Sockets (14 – 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 – 20 AWG)	Delphi	12089188	6
Sockets (14 – 16 AWG)	Delphi	12124580	6
Seal	Delphi	12015323	6
Seal	Delphi	12010293	6
Seal	Delphi	12015193	6

Hirschmann HIRF3 connector J1 mates with solenoid valve connector on Sauer Danfoss Fan Drive Control manifold.

Pinout information

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

J1

J2

J3

2133, 2116, 2117

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 24 H C N 2 0 PWPT4 PWPT2X2	1090664
FDC 24 H C N 2 0 PWPT4 PWPT2X2	1090752
FDC 24 H C N 2 0 PWPT4 PWPT2X2	1090798

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K03378 (J1), K31227 (J2)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 4 pin Delphi® Weather-Pack™ tower on FDC			
Connector housing	Delphi	12010974	1
Pin	Delphi	12080040	4
Seal	Delphi	12010293	4
Seal	Delphi	12015193	4
Seal	Delphi	12015323	4
Mates with J2, 4 pin Delphi ®Weather-Pack™ tower on FDC			
Connector housing	Delphi	12015024	1
Pin	Delphi	12080040	4
Seal	Delphi	12010293	4
Seal	Delphi	12015193	4
Seal	Delphi	12015323	4

Pinout information

Pin number	Function	FDC wire color
J1-A	Battery +	Red
J1-B	Valve +	Orange
J1-C	Valve –	Yellow
J1-D	Battery –	Brown
J2-A	Temp S1 +	White
J2-B	Temp S1 –	Black
J2-C	Temp S2 +	Black/White
J2-D	Temp S2 –	Brown/White

J1

J2

2258, 2260

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 24 H F N 3 1 AMP15	1090709

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K23383 (J1)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 15 pin AMP® Mate-N-Lock on FDC			
Connector housing	AMP	350784-1	1
Plug	AMP	770377-1	3
Seal	AMP	794282-1	1
Terminal sockets	AMP	3500550-1	12

As a precautionary install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

Pinout information

Pin number	Function	FDC wire color
J1-1	Battery –	Brown
J1-2	Battery +	Red
J1-3	Valve +	Orange
J1-4	Valve –	Yellow
J1-5	Switch 1 +	Green
J1-6	Switch 1 –	Blue
J1-7	Plugged	
J1-8	Plugged	
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	Plugged	

J1

2128

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 24 H C Y 0 0 PWPS2 PMPF2 PWPT1	1090758
FDC 12 H C Y 0 0 PWPS2 PMPF2 PWPT1	1090925

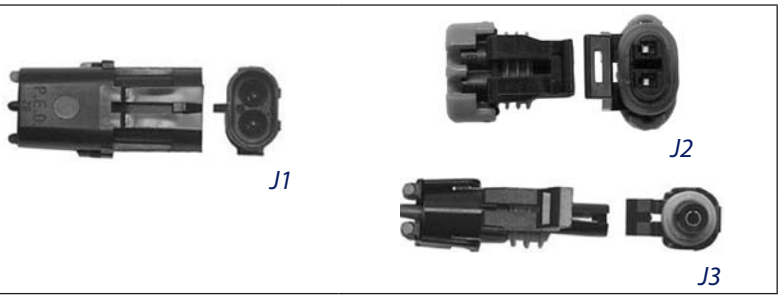
ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K03383 (J1), K23022 (J2), K22782 (J3)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 2 pin Delphi® Weather-Pack™ shroud on FDC			
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, 2 pin Delphi® Metri-Pack™ shroud on FDC			
TPA	Delphi	12052634	1
Connector housing	Delphi	12162000	1
Pin	Delphi	12045773	2
Seal	Delphi	12048086	1
Mates with J3, 1 pin Delphi® Weather-Pack™ tower on FDC			
Connector housing	Delphi	12010996	1
Pin	Delphi	12080040	1
Seal	Delphi	12010293	1
Seal	Delphi	12015193	1
Seal	Delphi	12015323	1

Pinout information

Pin number	Function	FDC wire color
J1-A	Valve +	Orange
J1-B	Valve –	Yellow
J2-A	Battery –	Brown
J2-B	Battery +	Red
J3	PWM	Yellow/Black



2116, 2123, 2122

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 24 H C N 3 0 DCR2 DCR3 DCP2 DCP3 DCP2	1090801

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

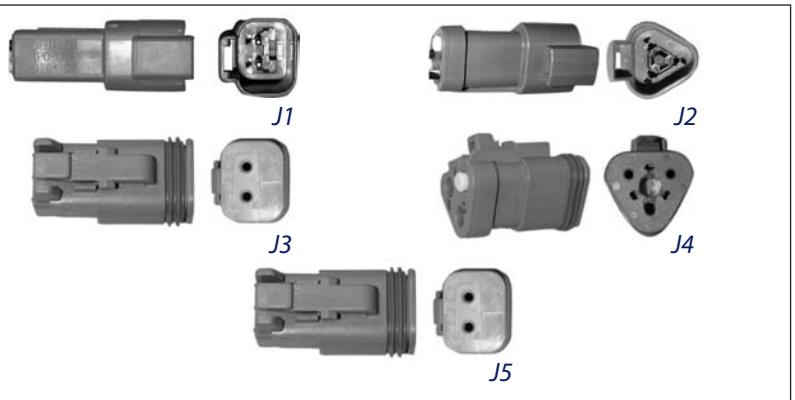
K29657 (J1), K22335 (J2), K26445 (J3) (J5), K32429 (J4)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 2 pin Deutsch® on FDC			
Connector housing	Deutsch	DT06-2S-E003	1
Terminal socket	Deutsch	0462-201-16141	2
With lock	Deutsch	W2S	1
Mates with J2, 3 pin Deutsch® on FDC			
Connector housing	Deutsch	DT06-3S-E003	1
Terminal socket	Deutsch	0462-201-16141	3
With lock	Deutsch	W3S	1
Mates with J3 and J5, 2 pin Deutsch® on FDC			
Connector housing	Deutsch	DT04-2P	1
Terminal pin	Deutsch	0460-202-16141	2
With lock	Deutsch	W2P	1
Mates with J4, 3 pin Deutsch® on FDC			
Connector housing	Deutsch	DT04-3P-E003	1
Terminal pin	Deutsch	0460-202-16141	3
With lock	Deutsch	W3P	1

As a precautionary install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

Pinout information

Pin number	Function	FDC wire color
J1-1	Valve +	Orange
J1-2	Valve –	Yellow
J2-A	Battery +	Red
J2-B	Plugged	
J2-C	Battery –	Brown
J3-1	Temp S1 +	White
J3-2	Temp S1 –	Black
J4-A	Plugged	
J4-B	Temp S2 +	Black/White
J4-C	Temp S2 –	Brown/White
J5-1	Temp S3 –	Orange/Black
J5-2	Temp S3 +	Red/White



2261, 2262, 2263, 2264,

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 12 H C N 3 2 AMP15	1091020

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K23383 (J1)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 15 pin AMP® Mate-N-Lock on FDC			
Connector housing	AMP	350784-1	1
Plug	AMP	770377-1	1
Seal	AMP	794282-1	1
Terminal sockets	AMP	3500550-1	14

As a precautionary install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

Pinout information

Pin number	Function	FDC wire color
J1-1	Battery –	Brown
J1-2	Battery +	Red
J1-3	Valve +	Orange
J1-4	Valve –	Yellow
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	Plugged	

J1

2128

FDC service part cross reference and wiring information

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 24 H C D 0 1 HIRF3 PMPF2 PMPM2 PWPT1	1091035

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

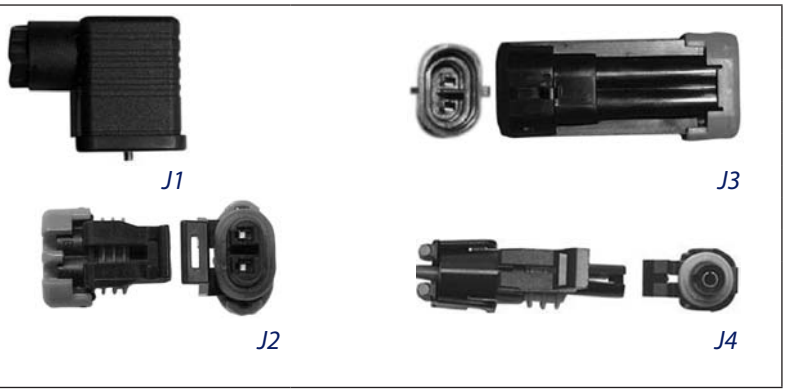
K23022 (J2), K22569 (J3) , K22782 (J4)

Description	Vendor	Vendor part number	Quantity required
Mates with J2, 2 pin Delphi® Metri-Pack™ on FDC			
TPA	Delphi	12052634	1
Connector housing	Delphi	12162000	1
Pin	Delphi	12045773	2
Seal	Delphi	12048086	2
Mates with J3, 2 pin Delphi® Metri-Pack™ tower on FDC			
Connector housing	Delphi	12052641	1
Terminal, socket	Delphi	12048074	2
Seal	Delphi	12048086	2
TPA	Delphi	12052634	1
Mates with J4, 1 pin Delphi® Weather-Pack™ tower on FDC			
Connector housing	Delphi	12010996	1
Pin	Delphi	12089040	1
Seal	Delphi	12010293	1
Seal	Delphi	12015193	1
Seal	Delphi	12015323	1

Hirschmann HIRF3 connector J1 mates with solenoid valve connector on Sauer-Danfoss Fan Drive Control manifold.

Pinout information

Pin number	Function	FDC wire color
J1-1	Valve +	Orange
J1-2	Valve –	Yellow
J2-A	Battery –	Brown
J2-B	Battery +	Red
J3-A	SW1 +	Green
J3-B	SW1 –	Blue
J4	PWM	Yellow/Black



2133, 2123, 2390, 2122

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 12 H C D 0 0 PMPF2 PWPT1 HIRF3	1091053

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

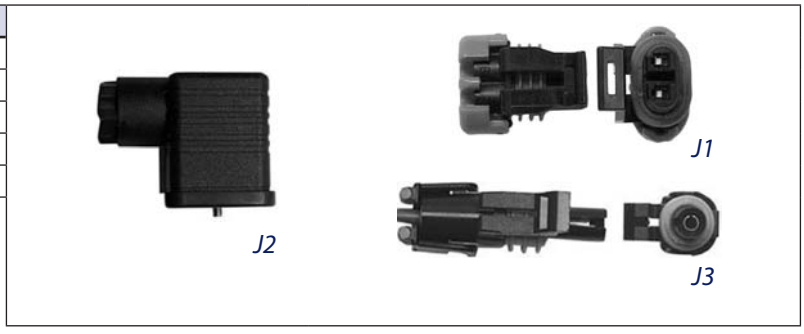
K23022 (J1), K22782 (J3)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 2 pin Delphi® Metri-Pack™ on FDC			
TPA	Delphi	12052634	1
Connector housing	Delphi	12162000	1
Pin	Delphi	12045773	2
Seal	Delphi	12048086	2
Mates with J3, 1 pin Delphi® Weather-Pack™ tower on FDC			
Connector housing	Delphi	12010996	1
Pin	Delphi	12089040	1
Seal	Delphi	12010293	1
Seal	Delphi	12015193	1
Seal	Delphi	12015323	1

Hirschmann HIRF3 connector J2 mates with solenoid valve connector on Sauer-Danfoss Fan Drive Control manifold.

Pinout information

Pin number	Function	FDC wire color
J1-A	Battery –	Brown
J1-B	Battery +	Red
J2-1	Valve +	Orange
J2-2	Valve –	Yellow
J3-1	PWM	Yellow/Black



2123, 2133, 2122

FDC service part cross reference and wiring information

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 24 HCY10 DCP2 PMPM8	1091070

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K26445 (J1), K24109 (J2)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 2 pin Deutsch® on FDC			
Connector housing	Deutsch	DT04-2P	1
Terminal pin	Deutsch	0460-202-16141	2
W/lock	Deutsch	W2P	1
Mates with J2, 8 pin Delphi® Metri-Pack™ 150 series on FDC			
Connector housing	Delphi	12047937	1
Secondary lock	Delphi	12066304	1
Terminals, socket	Delphi	12048074	5
Seal	Delphi	12048086	5

As a precautionary install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

Pinout information

Pin number	Function	FDC wire color
J1-1	Valve +	Orange
J1-2	Valve –	Yellow
J2-A	Battery –	Brown
J2-B	Battery +	Red
J2-C	Temp S1 +	White
J2-D	Temp S1 –	Black
J2-E	PWM	Yellow/Black
J2-F	Plugged	
J2-G	Plugged	
J2-H	Plugged	

J1

J2

2263, 2127

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 24 H C N 1 0 DCP2 PMPM8	1091147

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K26445 (J1), K24109 (J2)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 2 pin Deutsch® on FDC			
Connector housing	Deutsch	DT04-2P	1
Terminal pin	Deutsch	0460-202-16141	2
With lock	Deutsch	W2P	1
Mates with J2, 8 pin Delphi® Metri-Pack™ 150 series on FDC			
Connector housing	Delphi	12047937	1
Secondary lock	Delphi	12066304	1
Terminals, socket	Delphi	12048074	4
Seal	Delphi	12048086	4

As a precautionary install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

Pinout information

Pin number	Function	FDC wire color
J1-1	Valve +	Orange
J1-2	Valve –	Yellow
J2-A	Battery –	Brown
J2-B	Battery +	Red
J2-C	Temp S1 +	White
J2-D	Temp S1 –	Black
J2-E	Plugged	
J2-F	Plugged	
J2-G	Plugged	
J2-H	Plugged	

J1

J2

2263, 2127

FDC service part cross reference and wiring information

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 24 H C N 1 0 DCP2 PWPT4	1091148

ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

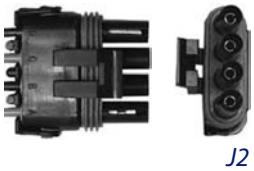
K26445 (J1), K03378 (J2)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 2 pin Deutsch® on FDC			
Connector housing	Deutsch	DT04-2P	1
Terminal pin	Deutsch	0460-202-16141	2
With lock	Deutsch	W2P	1
Mates with J2, 4 pin Delphi® Weather-Pack™ tower on FDC			
Connector housing	Delphi	12010974	1
Pin	Delphi	12124582	4
Seal	Delphi	12015323	4
Pin	Delphi	12089040	4
Seal	Delphi	12010293	4
Seal	Delphi	12015193	4

Pinout information

Pin number	Function	FDC wire color
J1-1	Valve +	Orange
J1-2	Valve –	Yellow
J2-A	Battery –	Brown
J2-B	Battery +	Red
J2-C	Temp S1 +	White
J2-D	Temp S1 –	Black

J1



J2

2263, 2258

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 12 H C D 0 0 DCP2 PMPF2 PWPT1	1091167
FDC 12 H C D 0 0 DCP2 PMPF2 PWPT1	1091169

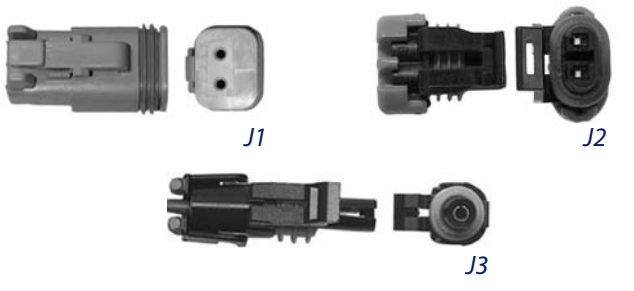
ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K26445 (J1), K23022 (J2), K22782 (J3)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 2 pin Deutsch® on FDC			
Connector housing	Deutsch	DT04-2P	1
Terminal pin	Deutsch	0460-202-16141	2
With lock	Deutsch	W2P	1
Mates with J2, 2 pin Delphi® Metri-Pack™ female on FDC			
TPA	Delphi	12052634	1
Connector housing	Delphi	12162000	1
Pin	Delphi	12045773	2
Seal	Delphi	12048086	1
Mates with J3, 1 pin Delphi® Weather-Pack™ tower on FDC			
Connector housing	Delphil	12010996	1
Pin	Delphi	12080040	1
Seal	Delphi	12010293	1
Seal	Delphi	12015193	1
Seal	Delphi	12015323	1

Pinout information

Pin number	Function	FDC wire color
J1-1	Valve +	Orange
J1-2	Valve –	Yellow
J2-A	Battery –	Brown
J2-B	Battery +	Red
J3-1	PWM	Yelow/Black



2263, 2123, 2122

NOMENCLATURE

Ordering part number

Nomenclature	FDC part number
FDC 24 H C D 0 0 PWPS2 DCP2 PWPT1	1091178

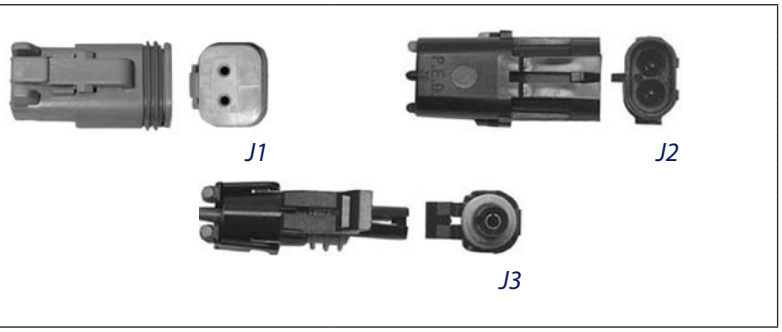
ELECTRICAL MATING CONNECTOR KIT PART NUMBER(S) AND PINOUT INFORMATION

K26445 (J1), K03383 (J2), K22782 (J3)

Description	Vendor	Vendor part number	Quantity required
Mates with J1, 2 pin Deutsch® on FDC			
Connector housing	Deutsch	DT04-2P	1
Terminal pin	Deutsch	0460-202-16141	2
W/lock	Deutsch	W2P	1
Mates with J2, 2 pin Delphi® Weather-Pack™ shroud on FDC			
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 FDC			
Connector housing	Delphi	12010996	1
Pin	Delphi	12089040	1
Seal	Delphi	12010293	1
Seal	Delphi	12015193	1
Seal	Delphi	12015323	1

Pinout information

Pin number	Function	FDC wire color
J1-1	Valve +	Orange
J1-2	Valve –	Yellow
J2-A	Battery +	Red
J2-B	Battery –	Brown
J3-1	PWM	Yellow/Black



2263, 2116, 2122

GENERAL MACHINE WIRING GUIDELINES

As a precautionary install plugs on unused mating connector pins to prevent intermittent product performance and/or premature failure.

1. All wires must be protected from mechanical abuse. Wire can be run in flexible metal or plastic conduits.
2. Use 85°C wire with abrasion resistant insulation. 105°C wire should be considered near hot surfaces.
3. Use #18 gage wire.
4. Separate high current wires such as solenoids, lights, alternators, or fuel pumps from control wires.
5. Run wires along the inside of, or close to metal machine frame surfaces where possible. This simulates a shield which will minimize the effects of EMI/RFI radiation.
6. Do not run the wires near sharp metal corners. Consider running the wire through a grommet when rounding a corner.
7. Do not run wires near hot machine members.
8. Provide strain relief for all wires.
9. Avoid running wires near moving or vibrating components.
10. Long unsupported wire spans should be avoided.
11. All sensors and valve drive circuits have dedicated wired power sources and ground returns. They should be used.
12. Sensor lines should be twisted about one turn every 10 cm [4 in].
13. It is better to use harness anchors which will allow wires to "float" with respect to the machine frame rather than rigid anchors.

SET-UP SOFTWARE TOOLBOX

The Sauer-Danfoss FDC Set-up Toolbox, part number 1090457, provides all of the accessories required to communicate with, and change control parameters in Sauer-Danfoss fan drive controllers (FDC). FDC temperature control software can be configured for a wide array of vehicle cooling applications by using set-up software installed on a personal computer (PC) to change parameters. Serial communication between a PC and the FDC is accomplished using an infrared communicator. The infrared communicator is connected to the PC by a DB9 serial cable and interfaces with infrared sensors located on the underside of the FDC, allowing serial transfer of data to the FDC.

The toolbox consists of an infrared communicator, power supply for the communicator, alignment fixture, serial cable and FDC set-up software.

Toolbox component part numbers

Serial cable
K22565
Fan Drive Controller set-up software, CD media
1090456
Fan Drive Controller infrared communicator
1090087
Infrared communicator power supply
K23047
Fan Drive Controller alignment fixture
K27183
Two Fan Drive Controller alignment fixture screws
K20352

Technical Information

Serial cable
The cable is 6 feet long, DB9 style RS232, male/female extension cable. It connects the PC to the Infrared Communicator.
FDC set-up software
The set-up software allows the user to read and write application parameters such as temperature ranges and ramp rates, and enables and disables FDC application software options. FDC set-up software is designed to be installed on personal computers running the Windows 95 operating system. For a detailed explanation of how to use FDC set-up software to change parameters, see *Using FDC Set-up Software*, pages 31 through 32.
Infrared communicator
The infrared communicator serves as the interface between the FDC and a PC. Infrared sensors on the Communicator interface with infrared sensors on the FDC allowing serial transfer of parameter data.
Communicator power supply
The Toolbox infrared communicator operates on a 5 Vdc, 750 mA power supply. The power supply is designed to be plugged into a 110 volt ac outlet.
Alignment fixture
The alignment fixture allows the FDC and communicator infrared sensors to be held in a fixed geometric relationship with each other, ensuring trouble free communication between the FDC and PC (see *Alignment Fixture with Communicator* and *FDC diagram*, below). The FDC is attached to the alignment fixture using the two screws included with the fixture. The infrared communicator is clamped to the opposite end of the alignment fixture from the FDC. Be sure that the infrared sensors on the FDC are facing the infrared sensors on the communicator.

SET-UP SOFTWARE TOOLBOX (continued)

Caution

Unsuitable operating environment or mishandling may prevent the service tools ability to perform proper diagnostics or service, and/or could lead to the permanent failure of the service tool. The communicator is designed to be used in indoor or sheltered, non-hazardous environments. Operation in bright sunlight may cause intermittent communication disconnects. Do not expose the communicator or its power supply to moisture. Provide operating temperature range from –20° C to +50° C (–4° F to 122° F).

Alignment fixture with communicator and FDC

2060B

ESTABLISHING COMMUNICATION WITH THE FDC

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

1. Follow installation instructions found on the software package to install fan drive set-up software on a PC. Minimum PC requirements are a 486/66 MHz processor with 12 MB of memory running Windows 95. Sauer-Danfoss logo icon will be installed on the PC desktop.

2. Remove the FDC from its mounting bracket and attach it to the alignment fixture using the screws provided with the alignment fixture.

3. Clamp the infrared communicator to the opposite end of the alignment fixture, making sure that the infrared sensors on the communicator are facing the sensors on the bottom of the FDC.

4. Connect the serial cable to the infrared communicator and PC.

5. Connect the infrared communicator power supply.

6. Click on the Sauer-Danfoss icon to run the set-up software parameter change screen.

7. Click on the arrow (run) icon located in the upper left corner of the parameter change screen.

8. The communication dialog box on the parameter change screen will indicate that communications have been established. It may be necessary to adjust the alignment of the communicator and FDC to establish communications.

USING SET-UP SOFTWARE TO ADJUST FDC CONFIGURATION PARAMETERS

Power must be connected to the infrared communicator power supply when changing tuning parameters to perform proper diagnostics or service.

How to use the parameter set-up screen to configure a FDC

To access FDC set-up software and establish communications with the device, click on the Sauer-Danfoss icon on the PC desktop as described above. *Apply power to the FDC* and click on the arrow (run) icon located in the upper left corner of the parameter change screen ('Screen").

When communications have been established, the *FDC device number, software revision number, date assembled* and *parameter revision number* will be displayed in the upper center of the screen.

The yellow communications dialog box in the lower right corner of the screen displays communications messages. These messages will indicate the status of communications between the PC and FDC. Communications baud rate is indicated in the lower left of the communications dialog box.

USING SET-UP SOFTWARE TO ADJUST FDC CONFIGURATION PARAMETERS (continued)

Function buttons below the communications dialog box

Program
Clicking on this button will download control parameters that have been entered on the PC screen into FDC memory.

This button *must* be used to save changes made on the screen to FDC memory.

Load defaults
Clicking on this button will load the factory-set default parameters into FDC memory.

Undo changes
Clicking on this button will undo parameter changes made since the last time communication was established with the FDC.

Exit
Clicking on this button will exit the set-up program.

A *communication status color bar* is located in the upper center of the screen. If this bar is green, communications between the set-up software and FDC are established. If red, no communication is occurring. The yellow communications dialog box will report fault information.

The *Control Status* dialog box in the upper left corner of the screen indicates which of the inputs is controlling the FDC output. The color bar to the right of the words "control status" will be green under normal conditions. Red indicates either an abnormal condition or a normal condition where no input is requesting a cooling output. The yellow communications dialog box will report the abnormal condition.

Buttons along the bottom of the screen allow the user to enable or disable each of the three analog temperature inputs, one *PWM* input and two auxiliary switch inputs.

If an input is disabled, the microcontroller will ignore a sensor, signal or switch connected to the disabled input.

The *PWM input normal* button allows the user to reverse the logic of the input PWM signal. In normal condition, a low PWM duty cycle indicates high cooling demand and therefore a high fan speed. Clicking on the button will cause the PWM input to be inverted so that a low PWM duty cycle indicates low cooling demand. The *Valve Output Normal* button has two modes: Normal, meaning output PWM is connected to a normally closed valve (increases in output duty cycle reduce fan speed) and inverted meaning that the PWM output is connected to a normally open valve (increases in output duty cycle increase fan speed).

CONFIGURING SENSOR INPUTS AND OUTPUTS

Parameters for the output PWM signal, three input temperature sensors, and one input PWM signal are configured using the displays along the left side of the screen:

Displays

VALVE PWM FREQUENCY (HZ)
Sets the output PWM frequency being sent to the proportional solenoid valve or EDC. Available range is 40 to 200 Hz.
MINIMUM VALVE CURRENT (AMPS)
Adjusts the PWM duty cycle to deliver the minimum effective current to the valve, defined as the minimum amount of current required to initiate valve movement. Available range is 0 to 1.25 A for high output current FDCs and 0 to 125 mA for low output current FDCs.
MAXIMUM VALVE CURRENT (AMPS)
Adjusts the PWM duty cycle to deliver the maximum effective current to the valve, defined as the amount of current required to fully stroke the valve. Available range is 0 to 1.25 A for high output current FDCs and 0 to 125 mA for low output current FDCs. The two meters in the upper right corner of the screen indicate the status of the output current. The requested current meter indicates the output current required to satisfy the controlling input. The actual current meter indicates the current actually being output to the proportional solenoid valve or EDC. The difference between the two meters shows the effect of configured ramp rates.
SENSOR 1, 2, 3
Up to three analog temperature sensors can be connected to the FDC. The method of changing parameters is the same for each sensor.
MAXIMUM CONTROL TEMPERATURE (C)
Sets the upper end of the temperature control range. Maximum control temperature is 125° C (257° F).
MINIMUM CONTROL TEMPERATURE (C)
Sets the lower end of the temperature control range. Minimum control temperature is 50° C (122° F).
RAMP FAN OFF (SEC)
Sets the time required for an output signal controlled by this sensor to cause the fan to go from maximum to minimum speed. Available range is 0 to 250 sec.
RAMP FAN ON (SEC)
Sets the time required for an output signal controlled by this sensor to cause the fan to go from minimum to maximum speed. Available range is 0 to 250 sec.

Each temperature sensor has a visual bar graph and digital indication of the actual temperature being measured by the temperature sensor. Each sensor has a fault indicator button.

If red, a fault condition exists whereby a sensor that has been enabled is not communicating to the microcontroller. This fault will cause the FDC output to direct maximum fan speed.

Displays

INPUT PWM
Status dialog box indicates the status of the input PWM signal, if enabled. The color bar to the right of the words "Input PWM" will be green under normal conditions. Red indicates abnormal conditions. The abnormal condition will be reported in the PWM status dialog box.
MAXIMUM INPUT PWM (PERCENT DUTY CYCLE)
Signal expected from the engine computer. Maximum value accepted is 100%.
MINIMUM INPUT PWM (PERCENT DUTY CYCLE)
Signal expected from the engine computer. Minimum value accepted is 0%.
PWM RAMP FAN OFF (SEC)
Sets the time required for the fan to go from full on to full off as the PWM input signal travels full range. Available ramp time range is 0 to 250 sec.

CONFIGURING SENSOR INPUTS AND OUTPUTS (continued)

Displays (continued)

PWM RAMP FAN ON (SEC)
Sets the time required for the fan to go from full off to full on as the PWM input signal travels full range. Available ramp time range is 0 to 250 sec.
INPUT PWM DUTY CYCLE
Is indicated (in percent) digitally and visually on the bar graph to the right of the PWM parameters. Input PWM frequency is also displaced.
AUXILIARY 1 SWITCH
Two auxiliary switches can be connected to the FDC. The Auxiliary 1 Switch description also applies to the Auxiliary 2 Switch. The method of changing parameters is the same for both switches. The color bar above each set of auxiliary switch parameters indicates whether the switch is on or off. Red is off. Green is on.
AUXILIARY 1 CONFIGURATION
Each auxiliary switch can be configured to be normally open or normally closed.
AUXILIARY 1 CONTROL
Configures the control action that will occur when the switch logic changes from normal condition. Available control actions: Fan on or Fan off.
AUXILIARY 1 MINIMUM CURRENT (AMPS)
Is the current that will be sent to the valve when the switch logic changes from normal condition. Range is from 0 to 1.25 A for the high current FDC or 0 to 125 mA for the low current FDC.

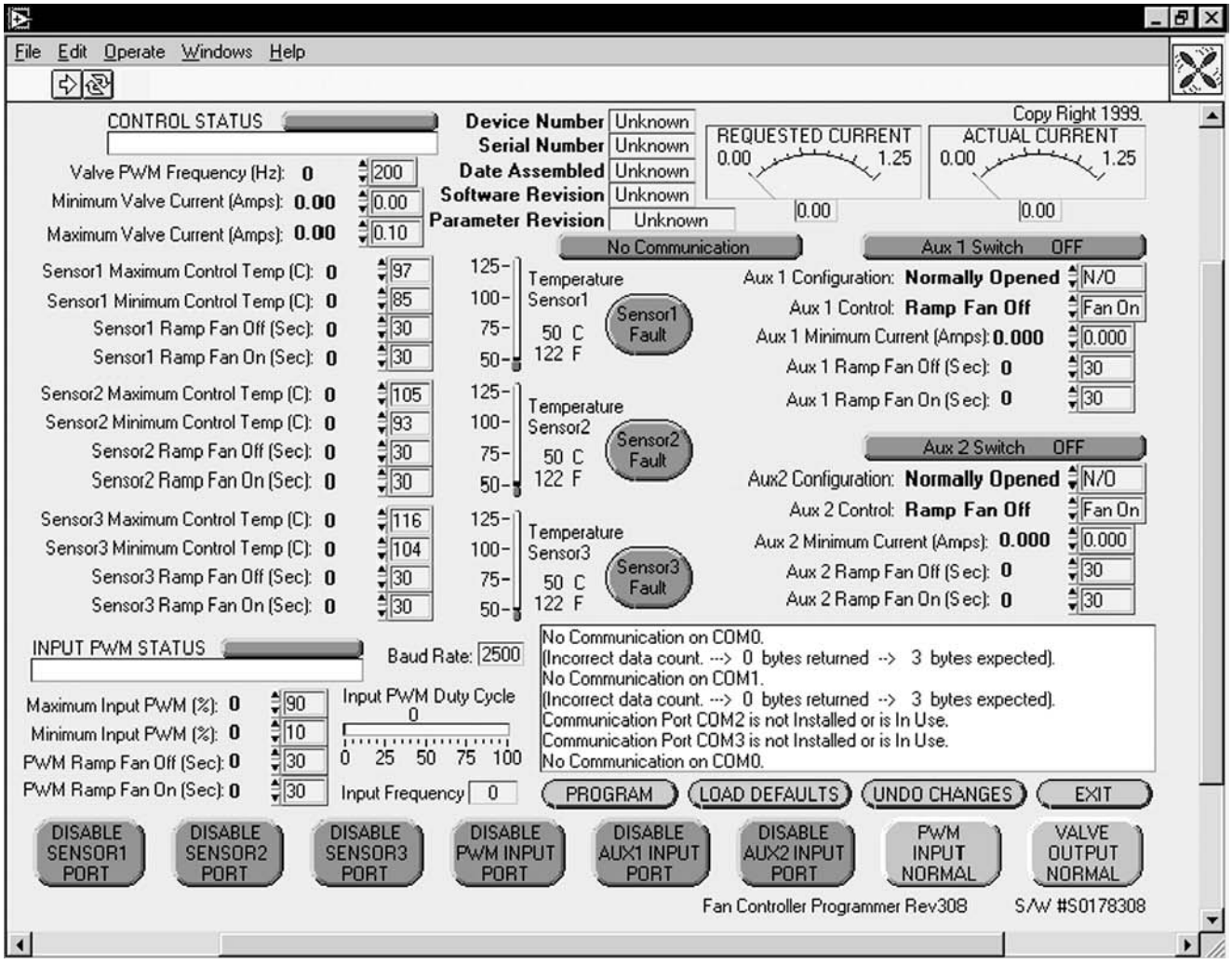
This parameter allows the user to command the fan speed to some intermediate position between full off and full on.

AUXILIARY 1 RAMP FAN OFF (SEC)
Sets the time required for the fan to go from a full on to a full off condition. Auxiliary switch 1 has a maximum ramp time of 1000 seconds. Auxiliary switch 2 has a maximum ramp time of 250 seconds.
AUXILIARY 1 RAMP FAN ON (SEC)
Sets the time required for the fan to go from a full off to a full on condition. Auxiliary switch 1 has a maximum ramp time of 1000 seconds. Auxiliary switch 2 has a maximum ramp time of 250 seconds.

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

CONFIGURING SENSOR INPUTS AND OUTPUTS (continued)

Set-up software parameter change screen



2059B

SET-UP SOFTWARE PARAMETER LOG

Parameter log

Signal	Parameter	Setting
Input PWM	Maximum input PWM (%) Minimum input PWM (%) PWM ramp fan off (Sec) PWM ramp fan on (Sec)	
Sensor 1	Maximum control temp (°C) Minimum control temp (°C) Ramp fan off (Sec) Ramp fan on (Sec)	
Sensor 2	Maximum control temp (°C) Minimum control temp (°C) Ramp fan off (Sec) Ramp fan on (Sec)	
Sensor 3	Maximum control temp (°C) Minimum control temp (°C) Ramp fan off (Sec) Ramp fan on (Sec)	
AUX 1 switch	Configuration (NO or NC) Control (ramp fan on or off) Minimum current (AMPs) Ramp fan off (Sec) Ramp fan on (Sec)	
AUX 2 switch	Configuration (NO or NC) Control (ramp fan on or off) Minimum current (amps) Ramp fan off (seconds) Ramp fan on (seconds)	
Control output	Valve PWM frequency (Hz) Minimum valve current (amps) Maximum valve current (amps)	
PWM input	Normal or inverted	
Valve output	Normal or inverted	

For FDC software tuning parameter information call customer service at 763-509-2084.

Notes

Notes

Notes

SAUER DANFOSS

OUR PRODUCTS

Hydrostatic transmissions

Hydraulic power steering

Electric power steering

Electrohydraulic power steering

Closed and open circuit axial piston pumps and motors

Gear pumps and motors

Bent axis motors

Orbital motors

Transit mixer drives

Planetary compact gears

Proportional valves

Directional spool valves

Cartridge valves

Hydraulic integrated circuits

Hydrostatic transaxles

Integrated systems

Fan drive systems

Electrohydraulics

Microcontrollers and software

Electric motors and inverters

Joysticks and control handles

Displays

Sensors

Sauer-Danfoss Mobile Power and Control Systems – Market Leaders Worldwide

Sauer-Danfoss is a comprehensive supplier providing complete systems to the global mobile market.

Sauer-Danfoss serves markets such as agriculture, construction, road building, material handling, municipal, forestry, turf care, and many others.

We offer our customers optimum solutions for their needs and develop new products and systems in close cooperation and partnership with them.

Sauer-Danfoss specializes in integrating a full range of system components to provide vehicle designers with the most advanced total system design.

Sauer-Danfoss provides comprehensive worldwide service for its products through an extensive network of Global Service Partners strategically located in all parts of the world.

Local address:

Sauer-Danfoss (US) Company
2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239-6000
Fax: +1 515 239 6618

Sauer-Danfoss ApS
DK-6430 Nordborg, Denmark
Phone: +45 7488 4444
Fax: +45 7488 4400

Sauer-Danfoss GmbH & Co. OHG
Postfach 2460, D-24531 Neumünster
Krokamp 35, D-24539 Neumünster, Germany
Phone: +49 4321 871-0
Fax: +49 4321 871 122

Sauer-Danfoss-Daikin LTD
Sannomiya Grand Bldg. 8F
2-2-21 Isogami-dori, Chuo-ku
Kobe, Hyogo 651-0086, Japan
Phone: +81 78 231 5001
Fax: +81 78 231 5004

11005336 • March 2006

www.sauer-danfoss.com