I/O MODULES

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USER'S MANUAL

Digital and Analog Input/Output Modules of DFI302

SEP / 14

I/O MODULES

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AVOIDING ELECTROSTATIC DISCHARGES

ATTENTION
Electrostatic discharges may damage semiconductor electronic components in printed circuit boards. They usually occur when touching components or connector pins from modules and racks, without wearing the appropriate equipment to prevent discharges. It is recommended to take the following precautions: • Before handling modules and racks, **r**emove the electrostatic charge from your body by wearing a proper wristband or touching grounded devices; • Avoid touching electronic components or connector pins from racks and modules.

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DF14 (2 Isolated Groups of 8 Digital Inputs 125 Vdc - Sink)

Description

The module senses the DC input voltage and converts it into a True (ON) or False (OFF) logic signal. It has 2 optically isolated groups from each other and IMB.

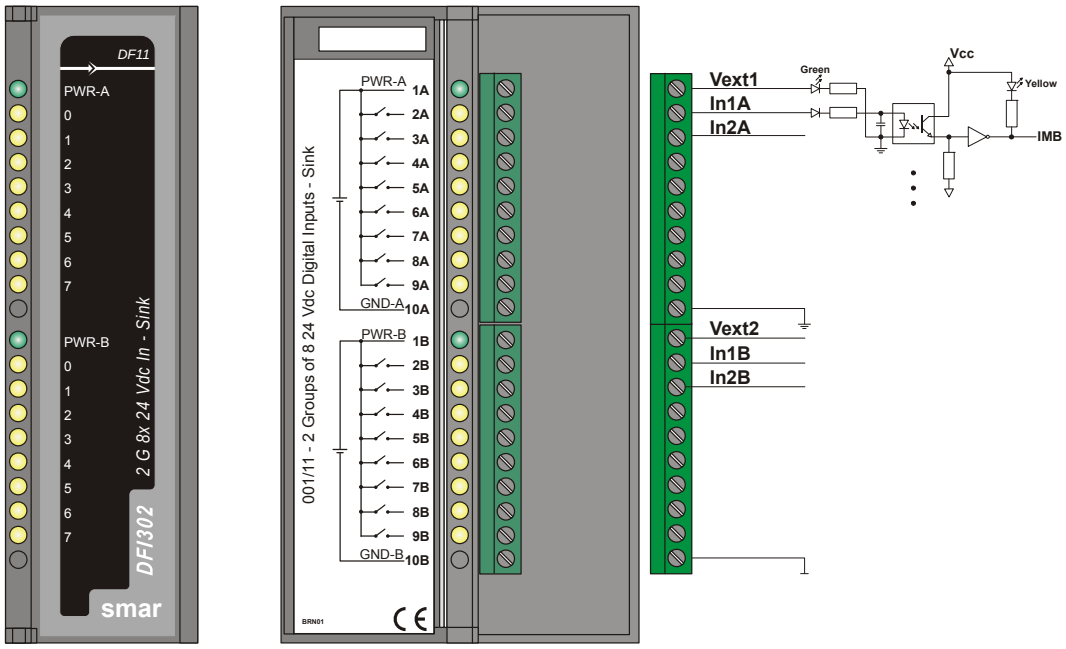


Figure 1 – Details of the DF11 Module

Technical Specifications

ARCHITECTURE	
Number of Inputs	16
Number of Groups	2
Number of Inputs per Group	8

ISOLATION	
Optical Isolation between Groups and IMB	5000 Vac

EXTERNAL POWER	
Power Supply per Group	20 - 30 Vdc (DF11) 36 - 60 Vdc (DF12) 45 - 75 Vdc (DF13) 95 - 140 Vdc (DF14)
Typical Consumption per Group	65 mA @ 24 Vdc (DF11) 65 mA @ 48 Vdc (DF12) 62 mA @ 60 Vdc (DF13) 40 mA @ 125 Vdc (DF14)
Power Supply Indicator	Green LED

INTERNAL POWER	
Provided by the IMB Bus	80 mA (maximum) @ 5 Vdc
Total Maximum Dissipation	0.4 W
Power Supply Indicator	None

INPUTS	
ON State Voltage Range (Logic “1”)	20 - 30 Vdc (DF11) 36 - 60 Vdc (DF12) 45 - 75 Vdc (DF13) 95 - 140 Vdc (DF14)
OFF State Voltage Range (Logic “0”)	0 - 5 Vdc (DF11) 0 - 9 Vdc (DF12) 0 - 12 Vdc (DF13) 0 - 25 Vdc (DF14)
Typical Impedance per Point	3.9 KΩ (DF11) 7.5 KΩ (DF12) 10 KΩ (DF13) 39 KΩ (DF14)
Typical Current per Point	8 mA @ 24 Vdc (DF11) 8 mA @ 48 Vdc (DF12) 7.5 mA @ 60 Vdc (DF13) 5 mA @ 125 Vdc (DF14)
Status Display	Yellow LED

SWITCHING INFORMATION	
Transition Time from “0” to “1”	30 μs
Transition Time from “1” to “0”	50 μs

TEMPERATURE	
Operation	-10 °C to 60 °C (14 ºF to 140 ºF)

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.285 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

DF15 - DIGITAL INPUTS MODULE DC (SOURCE)

DF15 (2 Groups of 8 Digital Inputs 24 Vdc - Source)

Description

The module senses the DC input voltage and converts it into a True (ON) or False (OFF) logic signal. It has 2 optically isolated groups from each other and IMB.

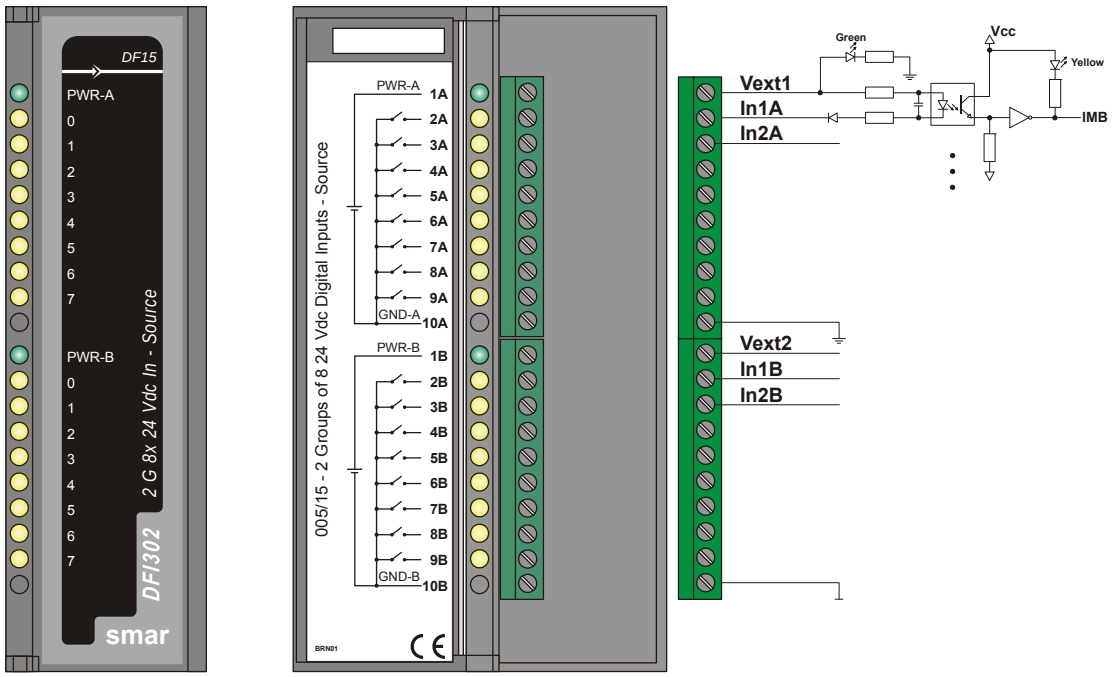


Figure 2– Details of the DF15 Module

Technical Specifications

ARCHITECTURE	
Number of Inputs	16
Number of Groups	2
Number of Inputs per Group	8

ISOLATION	
Optical Isolation between Groups and IMB	5000 Vac

EXTERNAL POWER	
Power Supply per Group	20 – 30 Vdc
Typical Consumption per Group	65 mA
Power Supply Indicator	Green LED

INTERNAL POWER	
Provided by the IMB	80 mA (maximum) @ 5 Vdc
Total Maximum Dissipation	0.4 W
Power Supply Indicator	None

INPUTS	
ON State Voltage Range (Logic “1”)	0 – 5 Vdc @ Z_{load} < 200 Ω
OFF State Voltage Range (Logic “0”)	20 – 30 Vdc @ Z_{load} >10 KΩ
Typical Impedance per Point	3.9 KΩ
Typical Current per Point	7.5 mA
Status Display	Yellow LED

SWITCHING INFORMATION	
Transition Time from “0” to “1”	30 µs
Transition Time from “1” to “0”	50 µs

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.285 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

DF16/17 - DIGITAL INPUTS MODULES - AC

DF16 (2 Groups of 4 Digital Inputs 120 Vac)
DF17 (2 Groups of 4 Digital Inputs 240 Vac)

Description

This module senses the AC input voltage and converts it to a True (ON) or False (OFF) logic signal. It has 2 optically isolated groups from each other and IMB.

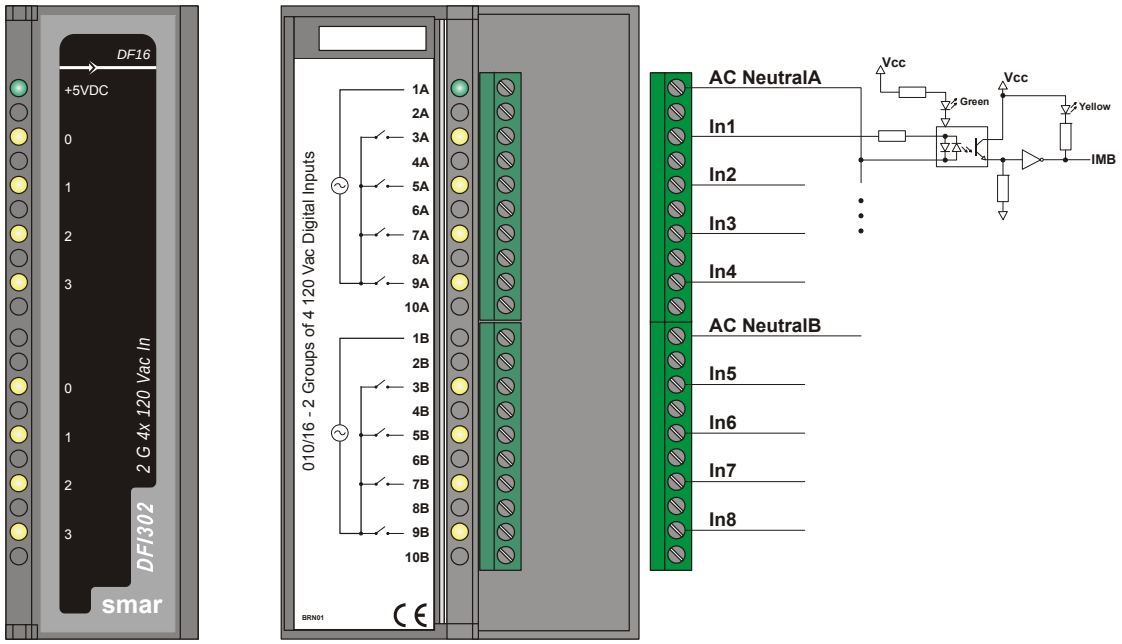


Figure 3 – Details of the DF16 Module

Technical Specifications

ARCHITECTURE	
Number of Inputs	8
Number of Groups	2
Number of Inputs per Group	4

ISOLATION	
Optical Isolation between Groups and IMB	5000 Vac

EXTERNAL POWER	
Power Supply per Group	120 Vac (DF16) 240 Vac (DF17)
Typical Consumption per Point	10 mA
Power Supply Indicator	None

INTERNAL POWER	
Provided by the IMB	50 mA (maximum) @ 5 Vdc
Total Maximum Dissipation	0.25 W
Power Supply Indicator	Green LED

INPUTS	
ON State Voltage Range (Logic “1”)	100 - 140 Vac (DF16) 200 - 264 Vac (DF17)
OFF State Voltage Range (Logic “0”)	0 - 30 Vac (DF16) 0 - 50 Vac (DF17)
Typical Current per Point	10 mA @ 60 Hz
Status Display	Yellow LED

SWITCHING INFORMATION	
Transition Time from “0” to “1”	5 ms
Transition Time from “1” to “0”	42 ms

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.285 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

DF18/DF19 - DIGITAL INPUTS MODULES AC HIGH DENSITY

DF18 (2 Groups of 8 Digital Inputs 120 Vac)
DF19 (2 Groups of 8 Digital Inputs 240 Vac)

Description

This module senses the AC input voltage and converts it to a True (ON) or False (OFF) logic signal. It has 2 optically isolated groups from each other and from IMB.

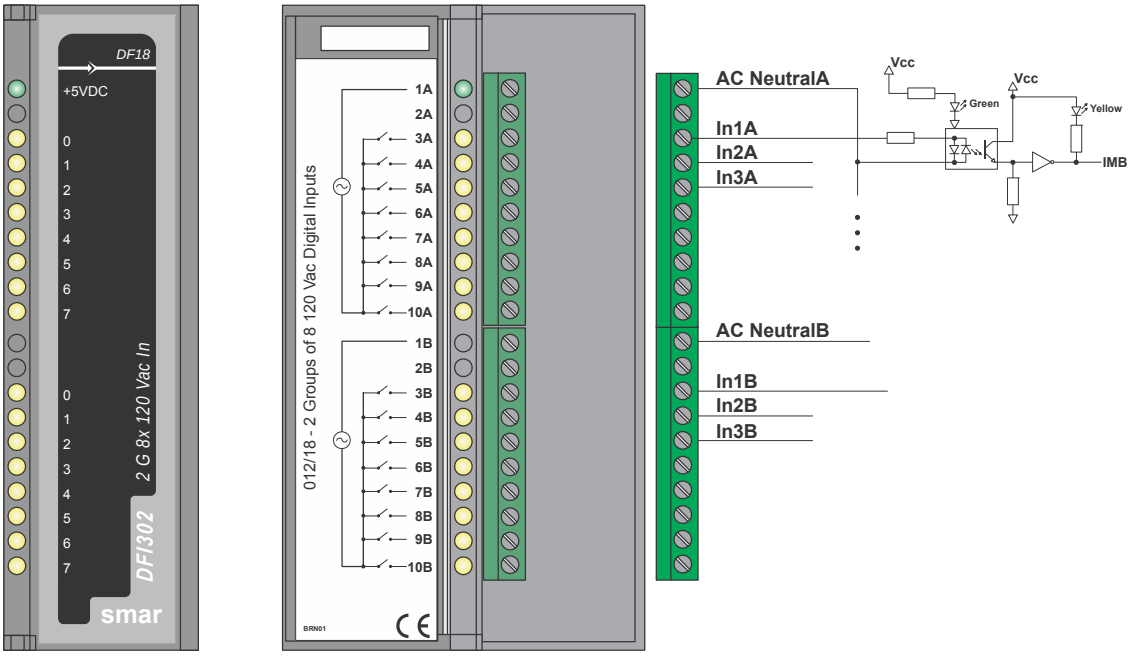


Figure 4 – Details of the DF18 Module

Technical Specifications

ARCHITECTURE	
Number of Inputs	16
Number of Groups	2
Number of Inputs per Group	8

ISOLATION	
Optical Isolation between Groups and IMB	5000 Vac

EXTERNAL POWER	
Power Supply per Group	120 Vac (DF18) 240 Vac (DF19)
Typical Consumption per Point	10 mA
Power Supply Indicator	None

INTERNAL POWER	
Provided by the IMB	87 mA (maximum) @ 5 Vdc
Total Maximum Dissipation	0.435 W
Power Supply Indicator	Green LED

INPUTS	
ON State Voltage Range (Logic “1”)	100 - 140 Vac (DF18) 200 - 264 Vac (DF19)
OFF State Voltage Range (Logic “0”)	0 - 30 Vac (DF18) 0 - 50 Vac (DF19)
Typical Current per Point	10 mA @ 60 Hz
Status Display	Yellow LED

SWITCHING INFORMATION	
Transition Time from “0” to “1”	5 ms
Transition Time from “1” to “0”	42 ms

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.300 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

DF20 - PUSH-BUTTON SWITCHES MODULE

DF20 (1 Group of 8 Push-Button Switches)

Description

This module simulates 8 discrete inputs through the use of switches. The module can be used as a set key. That may be useful to interact with the logic of the program or in the *debugging* process for verification of functionality and optimization.

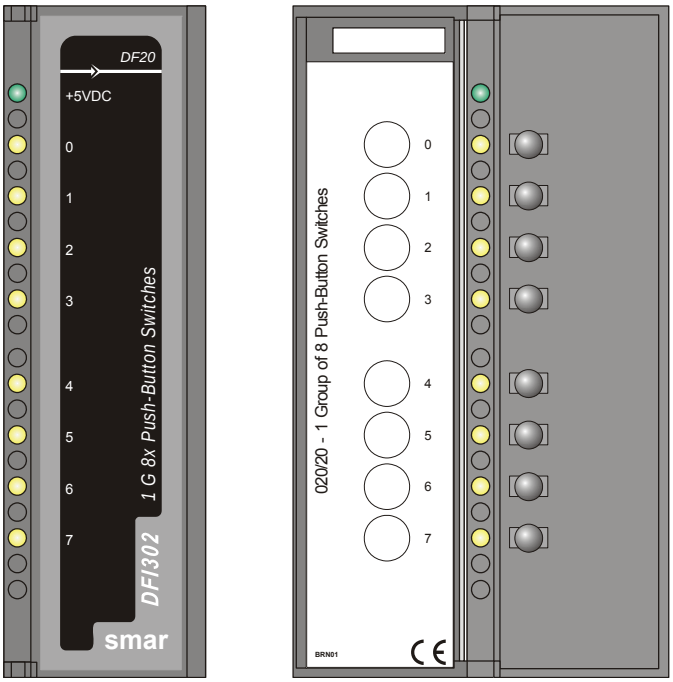


Figure 5 – Details of the DF20 Module

Technical Specifications

ARCHITECTURE	
Number of Inputs	8
Number of Groups	1
Number of Inputs per Group	8

INTERNAL POWER	
Provided by the IMB Bus	45 mA (maximum) @ 5 Vdc
Total Maximum Dissipation	0.225 W
Power Supply Indicator	Green LED

SWITCHES	
Status Display	Yellow LED
Indicator Logic	When Active

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.250 kg

DF21 - DIGITAL OUTPUTS MODULE DC (SINK)

DF21 (1 Group of 16 Digital Outputs 24 Vdc – Sink)

Description

This module is designed with open collector NPN transistors that are able to drive relays, incandescence lamps, solenoids and other loads with up to 0.5 A per output. It has one group optically isolated from IMB.

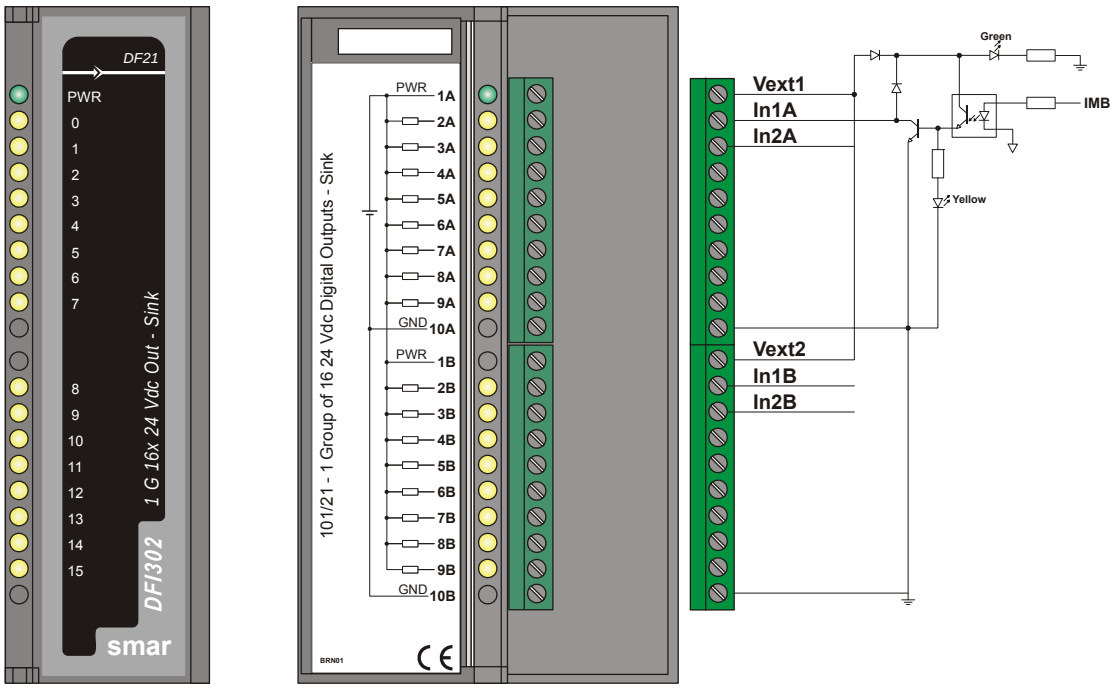


Figure 6 – Details of the DF21 Module

Technical Specifications

ARCHITECTURE	
Number of Outputs	16
Number of Groups	1
Number of Outputs per Group	16

ISOLATION	
Optical Isolation between Groups and IMB	5000 Vac

EXTERNAL POWER	
Power Supply	20 - 30 Vdc
Typical Consumption per Group	65 mA
Power Supply Indicator	Green LED

INTERNAL POWER	
Provided by the IMB	70 mA (maximum) @ 5 Vdc
Total Maximum Dissipation	0.35 W
Power Supply Indicator	None

OUTPUTS	
Maximum Switched Voltage	30 Vdc
Maximum Saturation Voltage	0.55 V @ 0.5 A
Maximum Current per Output	0.5 A
Indicator Logic	ON when the transistor is On.
Maximum Leakage Current	10 μA @ 30 Vdc
Switch Capacity for Bulbs	15 W
Status Display	Yellow LED

INDEPENDENT PROTECTION PER OUTPUT	
Thermal Shutdown	165 ºC
Thermal Hysteresis	15 ºC
Over-Current Protection	1.3 A (maximum) @ 25 Vdc

SWITCHING INFORMATION	
Transition Time from "0" to "1"	250 μs
Transition Time from "1" to "0"	3 μs

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.260 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

DF22 - DIGITAL OUTPUTS MODULE DC (SOURCE)

DF22 (2 Groups of 8 Digital Outputs 24 Vdc – Source)

Description

This module is designed with N_Chanel MOSFETS that are able to drive relays, incandescence lamps, solenoids and other loads with up to 1 A per output. It has two groups optically isolated.

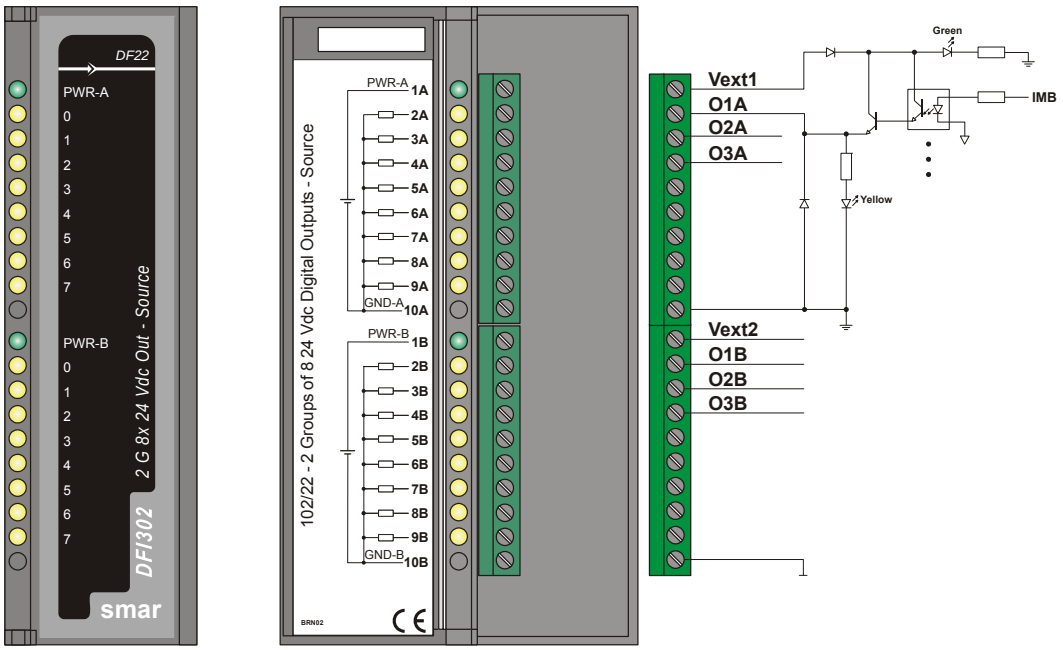


Figure 7 – Details of the DF22 Module

Technical Specifications

ARCHITECTURE	
Number of Outputs	16
Number of Groups	2
Number of Outputs per Group	8

ISOLATION	
Optical Isolation between Groups and IMB	5000 Vac

EXTERNAL POWER	
Power Supply per Group	20 - 35 Vdc
Typical Consumption per Group	65 mA
Power Supply Indicator	Green LED

INTERNAL POWER	
Provided by the IMB	70 mA (maximum) @ 5 Vdc
Total Maximum Dissipation	0.35 W
Power Supply Indicator	None

OUTPUTS	
Maximum Switched Voltage	35 Vdc
Maximum Saturation Voltage	1 A @ 0.3 Vdc
Maximum Current per Output	1 A
Indicator Logic	ON when the transistor is ON
Maximum Leakage Current	200 μA @ 35 Vdc
Switch Capacity for Bulbs	15 W
Status Display	Yellow LED

INDEPENDENT PROTECTION PER OUTPUT	
Over-current Protection	5.3 A

SWITCHING INFORMATION	
Transition Time from "0" to "1"	600 μs
Transition Time from "1" to "0"	300 μs

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.260 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

DF23 - DIGITAL OUTPUTS MODULE AC (TRIAC)

DF23 (2 Groups of 4 Digital Outputs 120/240 Vac – Triac)

Description

This module is designed to drive relays, pilot lamps, valves and other loads up to 1 A per output. It has 2 optically isolated groups from each other and from IMB. These outputs are able to switch any voltage from 20 to 240 Vac.

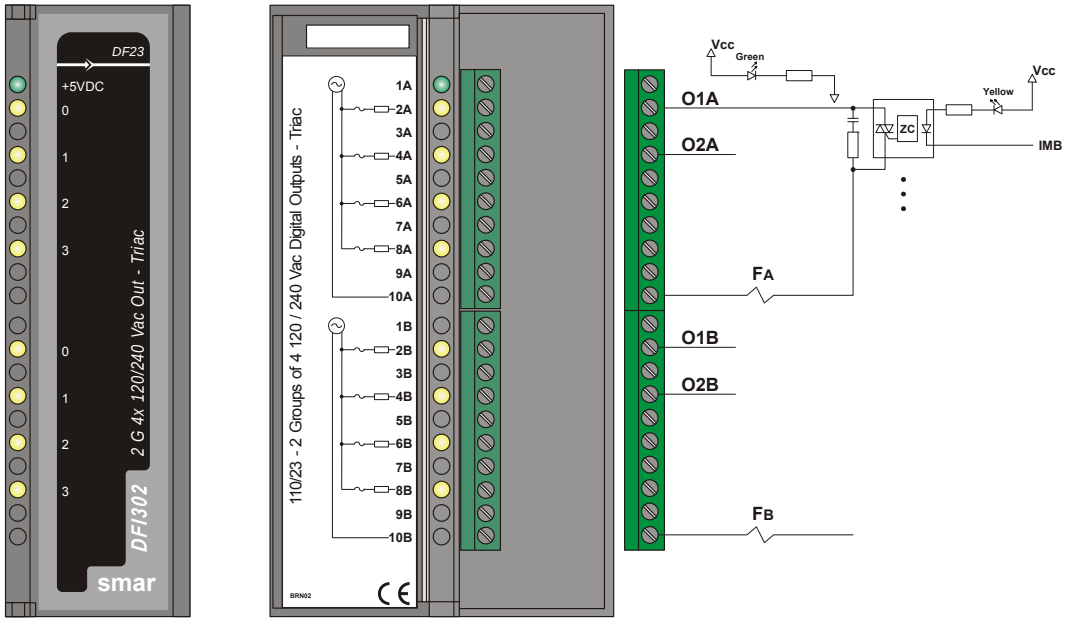


Figure 8– Details of the DF23 Module

Technical Specifications

ARCHITECTURE	
Number of Outputs	8
Number of Groups	2
Number of Outputs per Group	4

ISOLATION	
Optical Isolation between Groups and IMB	2500 Vac

EXTERNAL POWER	
Power Supply per Group	20 - 240 Vac; 45 - 65 Hz
Typical Consumption per Group	4 A
Power Supply Indicator	None
Protection	One fuse per group.

INTERNAL POWER	
Provided by the IMB	70 mA (maximum) @ 5 Vdc
Total Maximum Dissipation	0,35 W
Power Supply Indicator	Green LED

OUTPUTS	
Voltage Output	20 - 240 Vac, 45 - 65 Hz
Maximum Current per Output	1 A
Maximum Total Current per Group	4 A @ T_{amb} 0 - 40 ºC (32 - 104 ºF) 2 A @ T_{amb} 40 - 60 ºC (104 - 140 ºF)
Maximum Surge Current	15 A / ½ Cycle, 1 Surge per Minute Maximum
Indicator Logic	When Active
Off State Voltage Leakage Current	500 μA @ 100 Vac
On State Voltage Drop	1.5 Vac rms (maximum)
Over Load Protection per Output	Should be provided externally (fast acting fuse rated at 1.5 times user continuous current).
Status Display	Yellow LED

SWITCHING INFORMATION	
Transition Time from "0" to "1" (Zero Cross Operation)	½ Cycle
Transition Time from "1" to "0" (Zero Cross Operation)	½ Cycle
RC Protection Circuit	62 Ω in series with 0.01 μF.

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.295 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

DF24 - DIGITAL OUTPUTS MODULE AC (TRIAC) - HIGH DENSITY

DF24 (2 Groups of 8 Digital Outputs 120/240 Vac - Triac)

Description

This module is designed to drive relays, pilot lamps, valves and other loads up to 1 A per output. It has 2 optically isolated groups from each other and from IMB. These outputs are able to switch any voltage from 20 to 240 Vac.

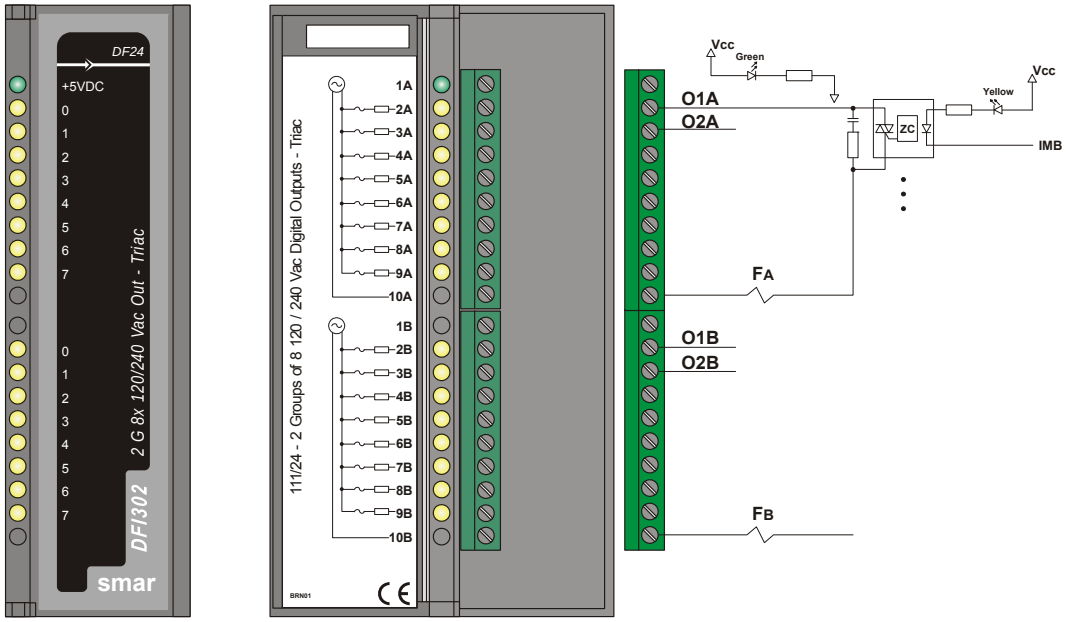


Figure 9 – Details of the DF24 Module

Technical Specifications

ARCHITECTURE	
Number of Outputs	16
Number of Groups	2
Number of Outputs per Group	8

ISOLATION	
Optical Isolation between Groups and IMB	2500 Vac

EXTERNAL POWER	
Power Supply per Group	20 - 240 Vac, 45 - 65 Hz
Typical Consumption per Group	4 A
Power Supply Indicator	None
Protection	One fuse per group.

INTERNAL POWER	
Provided by the IMB	115 mA (maximum) @ 5 Vdc
Total Maximum Dissipation	0.575 W
Power Supply Indicator	Green LED

OUTPUTS	
Voltage Output	20 - 240 Vac, 45 - 65 Hz
Maximum Current per Output	1 A
Maximum Total Current per Group	4 A @ T_{amb} 0 - 40 ºC (32 - 104 ºF) 2 A @ T_{amb} 40 - 60 ºC (104 - 140 ºF)
Maximum Surge Current	15 A / ½ Cycle (maximum 1 surge per minute)
Indicator Logic	When Active
Off State Voltage Leakage Current	500 μA @ 100 Vac
On State Voltage Drop	1.5 Vac rms (maximum)
Over Load Protection per Output	Should be provided externally (fast acting fuse rated at 1.5 times user rated current).
Status Display	Yellow LED

SWITCHING INFORMATION	
Transition Time from "0" to "1" (Zero Cross Operation)	½ Cycle
Transition Time from "1" to "0" (Zero Cross Operation)	½ Cycle
RC Protection Circuit	62 Ω in Series with 0.01 μF

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.330 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

DF25/DF26/DF27/DF29/DF30/DF31/DF71/DF72 DIGITAL OUTPUTS MODULES - DC/AC (RELAY)

DF25 (2 Groups of 4 NO Relay Outputs)
DF26 (2 Groups of 4 NC Relay Outputs)
DF27 (1 Group of 4 NO and 4 NC Relay Outputs)
DF29 (2 Groups of 4 NO Relay Outputs without RC Protection)
DF30 (2 Groups of 4 NC Relay Outputs without RC Protection)
DF31 (1 Group of 4 NO and 4 NC Relay Outputs without RC Protection)
DF71 (2 Groups of 4 NO Relay Outputs without RC Protection (Max 10 Ma))
DF72 (2 Groups of 4 NC Relay Outputs without RC Protection (Max 10 mA))

Description

This relay output module is designed to switch pilot lamps, valves, and relay coils up to 5 A per output. The relays can drive loads up to 125 Vdc or 250 Vac. Two screw terminals are reserved for each relay output. The two groups are separated optically isolated from each other and from IMB with individual common power grounds.

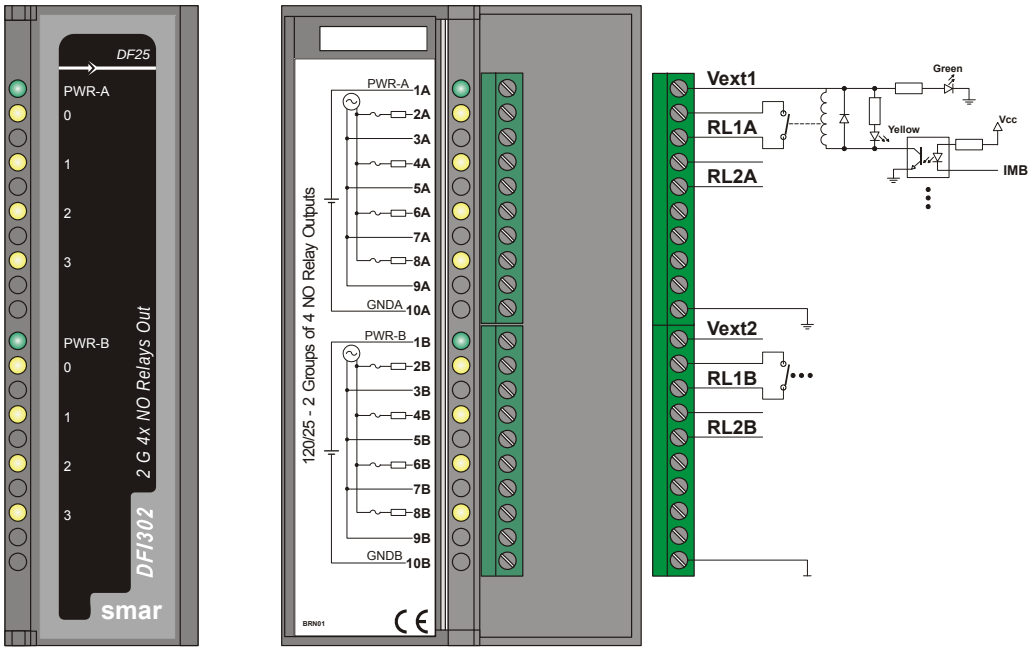


Figure 10– Details of the DF25 Module

Technical Specifications

ARCHITECTURE	
Number of Outputs	8
Number of Groups	2
Number of Outputs per Group	4

ISOLATION	
Optical Isolation between Groups and IMB	5000 Vac

EXTERNAL POWER	
Power Supply per Group	20 - 30 Vdc
Typical Consumption per Group	52 mA @ 24 Vdc
Power Supply Indicator	Green LED

INTERNAL POWER	
Provided by the IMB	20 mA (maximum) @ 5 Vdc
Total Maximum Dissipation	0.1 W
Power Supply Indicator	None

OUTPUTS	
Vac Range	20 – 250 Vac (DF25/DF26/DF27/DF29/DF30/DF31) 30 – 250 Vac (DF71/DF72)
Vdc Range	20 – 125 Vdc (DF25/DF26/DF27/DF29/DF30/DF31) 10 – 220 Vdc (DF71/DF72)
Maximum Current for 30 Vdc / 250 Vac	5A (Resistive); 2A (Inductive) (DF25/DF26/DF27/DF29/DF30/DF31) 10 mA (DF71/DF72)
Minimum Current	10 mA (DF25/DF26/DF27/DF29/DF30/DF31) 1 mA (DF71/DF72)
Maximum Initial Contact Resistance	30 mΩ (DF25/DF26/DF27/DF29/DF30/DF31) 75 mΩ (DF71/DF72)
Indicator Logic	ON if the relay's coil is active.
Leakage Current	500 μA @ 100 Vac (DF25/DF26/DF27) None (DF29/DF30/DF31/DF71/DF72)
Over Load Protection per Output	Should be provided externally.
Status Display	Yellow LED

SWITCHING INFORMATION	
RC Protection Circuit	62 Ω in Series with 0.01 μF (DF25/DF26/DF27) None (DF29/DF30/DF31/DF71/DF72)
Time to Activate Operate Time	10 ms Maximum (DF25/DF26/DF27/DF29/DF30/DF31) 4 ms Maximum (DF71/DF72)
Time to Deactivate Release Time	10 ms Maximum (DF25/DF26/DF27/DF29/DF30/DF31) 4 ms Maximum (DF71/DF72)

ELECTRICAL SERVICE LIFE	
Mechanical Switching Cycles	100.000 Minimum Operations @ 5 A (maximum current) (DF25/DF26/DF27/DF29/DF30/DF31) 100.000.000 Operations (DF71/DF72)

TEMPERATURE	
Operation (DF25/DF26/DF27/DF29/DF30/DF31)	-10 °C to 60 °C (14 ºF to 140 ºF)

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.305 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

NOTE
To increase the service life of the contacts and to protect the module from potential reverse voltage damage, externally connect a clamping diode in parallel with each inductive DC load or connect a RC snubber circuit in parallel with each inductive AC load.

DF28/DF69 - DIGITAL OUTPUTS MODULES DC/AC (RELAY) - HIGH DENSITY

DF28 (2 Groups of 8 NO Relay Outputs without RC Protection)
DF69 (2 Groups of 8 NO Relay Outputs)

Description

This high density module is designed to switch pilot lamps, valves, as well as other relay coils up to 5 A per output. The relays can drive loads ranging up to 30 Vdc or 250 Vac. Each group of 8 relays has a common terminal and just one screw terminal is reserved for each relay output. The groups are optically isolated from each other and from IMB.

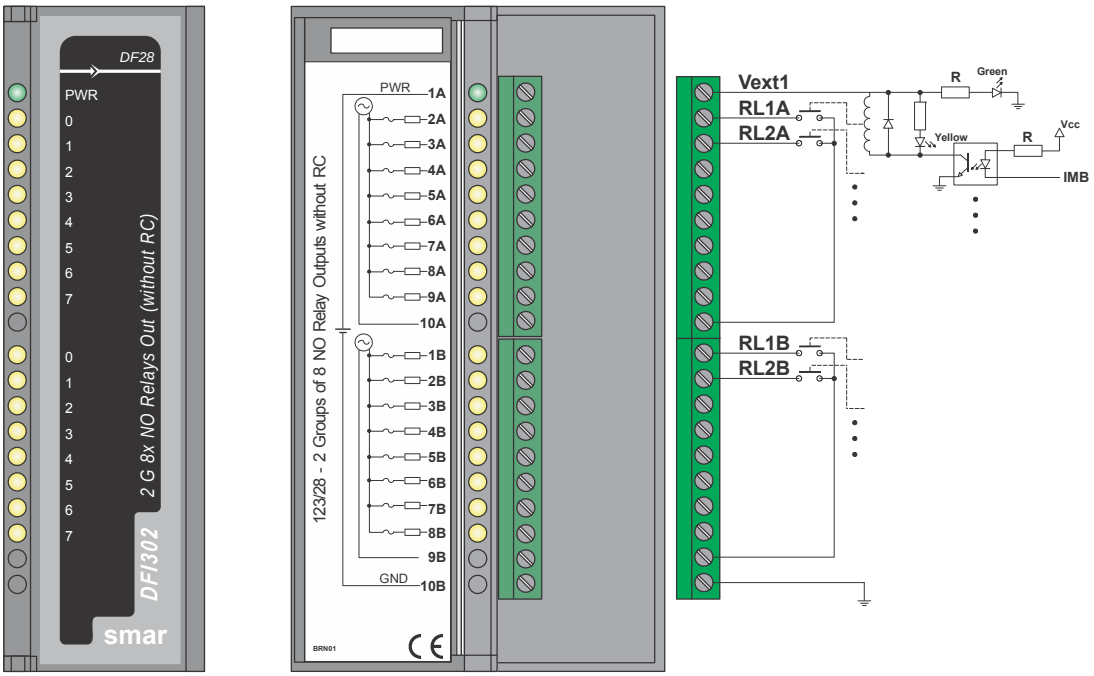


Figure 11– Details of the DF 28 Module

Technical Specifications

ARCHITECTURE	
Number of Outputs	16
Number of Groups	2
Number of Outputs per Group	8

ISOLATION	
Optical Isolation between Groups and IMB	5000 Vac

EXTERNAL POWER	
Power Supply	20 – 30 Vdc
Typical Consumption per Group	90 mA @ 24 Vdc
Power Supply Indicator	Green LED

INTERNAL POWER	
Provided by the IMB	30 mA (maximum) @ 5 Vdc
Total Maximum Dissipation	0.15 W
Power Supply Indicator	None

OUTPUTS	
Vac Range	20 – 250 Vac
Vdc Range	20 – 30 Vdc
Maximum Current for 250 Vac	5A (Resistive); 2A (Inductive)
Maximum Current for 30 Vdc	5A (Resistive); 2A (Inductive)
Maximum Total Current per Group	10 A
Maximum Initial Contact Resistance	100 mΩ
Indicator Logic	ON if the relay coil is active.
Leakage Current	DF28: None DF69: 500 µA @ 100 Vac
Over Load Protection per Output	Should be provided externally.
Status Display	Yellow LED

SWITCHING INFORMATION	
RC Protection Circuit	10 ms (maximum)
Release Time	10 ms (maximum)

ELECTRICAL SERVICE LIFE	
Mechanical Switching Cycles	20.000.000 Operations (minimum) @ 5 to 250 Vac

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.301 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

NOTE
To increase the service life of the contacts and to protect the DF28 module from potential reverse voltage damage, externally connect a clamping diode in parallel with each inductive DC load or connect a RC snubber circuit in parallel with each inductive AC load.

DF32 TO DF40 - DIGITAL OUTPUTS: DC/AC (RELAY) AND DIGITAL INPUTS: DC (SINK) MODULES

DF32 (1 Group of 8 24 Vdc Inputs and 1 Group of 4 NO Relay Outputs)
DF33 (1 Group of 8 48 Vdc Inputs and 1 Group of 4 NO Relay Outputs)
DF34 (1 Group of 8 60 Vdc Inputs and 1 Group of 4 NO Relay Outputs)
DF35 (1 Group of 8 24 Vdc Inputs and 1 Group of 4 NC Relay Outputs)
DF36 (1 Group of 8 48 Vdc Inputs and 1 Group of 4 NC Relay Outputs)
DF37 (1 Group of 8 60 Vdc Inputs and 1 Group of 4 NC Relay Outputs)
DF38 (1 Group of 8 24 Vdc Inputs and 1 Group of 2 NO and 2 NC Relay Outputs)
DF39 (1 Group of 8 48 Vdc Inputs and 1 Group of 2 NO and 2 NC Relay Outputs)
DF40 (1 Group of 8 60 Vdc Inputs and 1 Group of 2 NO and 2 NC Relay Outputs)

Description

This combo module with DC inputs and relay outputs is designed to drive relays, pilot lamps, valves and other loads up to 5 A and senses the DC input Voltage and converts them to a True or False logic signal. It has 1 group of 8 optically isolated 24/48/60 Vdc inputs and 4 relay outputs. The relays can drive loads up to 125 Vdc or 250 Vac. Two screw terminals are reserved for each relay output, though they are isolated between them.

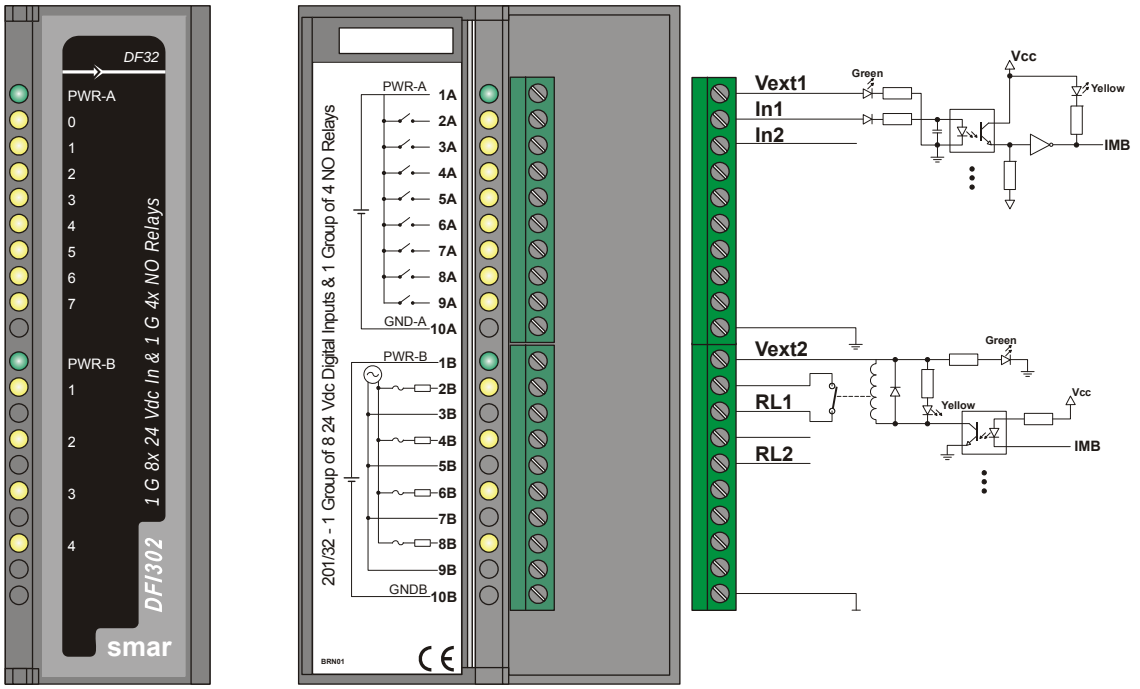


Figure 12– Details of the DF32 Module

Technical Specifications

ARCHITECTURE	
Number of Groups	2
Number of Vdc Inputs	8
Number of Relay Outputs	4

ISOLATION	
Optical Isolation between Groups and IMB	5000 Vac

INTERNAL POWER	
Provided by the IMB Bus	5 Vdc @ 60 mA Typical
Total Maximum Dissipation	0.3 W
Power Supply Indicator	None

For the Vdc Inputs

ARCHITECTURE	
Number of Inputs	8

ISOLATION	
Isolation up to	5000 Vac

EXTERNAL POWER	
Power Supply for Inputs	20 - 30 Vdc (DF32, DF35, DF38) 36 - 60 Vdc (DF33, DF36, DF39) 45 - 75 Vdc (DF34, DF37, DF40)
Maximum Consumption per Group	65 mA @ 24 Vdc (DF32, DF35, DF38) 65 mA @ 48 Vdc (DF33, DF36, DF39) 62 mA @ 60 Vdc (DF34, DF37, DF40)
Power Supply Indicator	Green LED

INPUTS	
ON State Voltage Range (Logic "1")	20 - 30 Vdc (DF32, DF35, DF38) 30 - 60 Vdc (DF33, DF36, DF39) 38 - 75 Vdc (DF34, DF37, DF40)
OFF State Voltage Range (Logic "0")	0 - 5 Vdc (DF32, DF35, DF38) 0 - 9 Vdc (DF33, DF36, DF39) 0 - 12 Vdc (DF34, DF37, DF40)
Input Impedance (Typical)	3.9 kΩ (DF32, DF35, DF38) 7.5 kΩ (DF33, DF36, DF39) 10 kΩ (DF34, DF37, DF40)
Input Current per Point	8 mA @ 24 Vdc (DF32, DF35, DF38) 8 mA @ 48 Vdc (DF33, DF36, DF39) 7.5 mA @ 60 Vdc (DF34, DF37, DF40)
Status Display	Yellow LED
Indicator Logic	On when active.

SWITCHING INFORMATION	
Minimum Voltage for Logic Level "1"	20 Vdc (DF32, DF35, DF38) 30 Vdc (DF33, DF36, DF39) 38 Vdc (DF34, DF37, DF40)
Maximum Voltage for Logic Level "0"	5 Vdc (DF32, DF35, DF38) 9 Vdc (DF33, DF36, DF39) 12 Vdc (DF34, DF37, DF40)
Time from "0" to "1"	30 µs
Time from "1" to "0"	50 µs

For the Relay Outputs

ARCHITECTURE	
Number of Outputs	4

ISOLATION	
Optical Isolation between Groups and IMB	5000 Vac

EXTERNAL POWER	
Power Supply per Group	20 – 30 Vdc
Maximum Consumption per Group	52 mA @ 24 Vdc
Typical Consumption per Point	12 mA @ 24 Vdc
Power Supply Indicator per Group	Green LED

OUTPUTS	
Vac Range	20 – 250 Vac
Vdc Range	20 – 125 Vdc
Maximum Current for 250 Vac	5 A
Maximum Current for 30 Vdc	5 A
Status Display	Yellow LED
Indicator Logic	ON if the relay coil is active.
Leakage	500 μA @ 100 Vac

SWITCHING INFORMATION	
RC Protection Circuit	62 Ω in series with 0.01 μF
Time to Activate	10 ms
Time to Deactivate	10 ms

ELECTRICAL SERVICE LIFE	
Mechanic Switching Cycles	100.000 operations minimum @ 5 a 250 Vac

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm (1.57 x 5.39 x 5.57 in)
Weight	0.298 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

NOTE
To increase the service life of the contacts and to protect the module from potential reverse voltage damage, externally connect a clamping diode in parallel with each inductive DC load or connect a RC snubber circuit in parallel with each inductive AC load.

DF41/42 - PULSES INPUTS MODULES DC LOW/HIGH FREQUENCY

DF41 (2 Groups of 8 Low Frequency (0 – 100 Hz) 24 Vdc Pulse Inputs)
DF42 (2 Groups of 8 High Frequency (0 – 10 KHz) 24 Vdc Pulse Inputs)

NOTE
Although the hardware to support 10 KHz, for applications with AuditFlow (FC302 and HFC302) the maximum frequency is 4 KHz.

Description

This module has 2 of 8 inputs to count pulses and accumulate them until the processor module read them. Right after the processor reading, every individual counter will be cleared and the hardware is prepared for not loosing any input pulse in this acquisition process. The groups are optically isolated from each other and from IMB.

An associated PULSE Function Block was specifically designed to take advantage of this module in System 302 Studio. See details about this block in Function Blocks documentation.

The DF41 is dedicated for counting frequencies of up to 100 Hz and can be driven by a mechanical contact of a relay or reed-switch. A single pole internal filter has the cutting frequency in approximately 200 Hz.

The DF42 is intended to count from higher frequency sources that do not generate bouncing on level switching. It can read frequencies raging from 0 to 10 kHz. An internal single pole filter cuts around 20 kHz to eliminate high frequency noise.

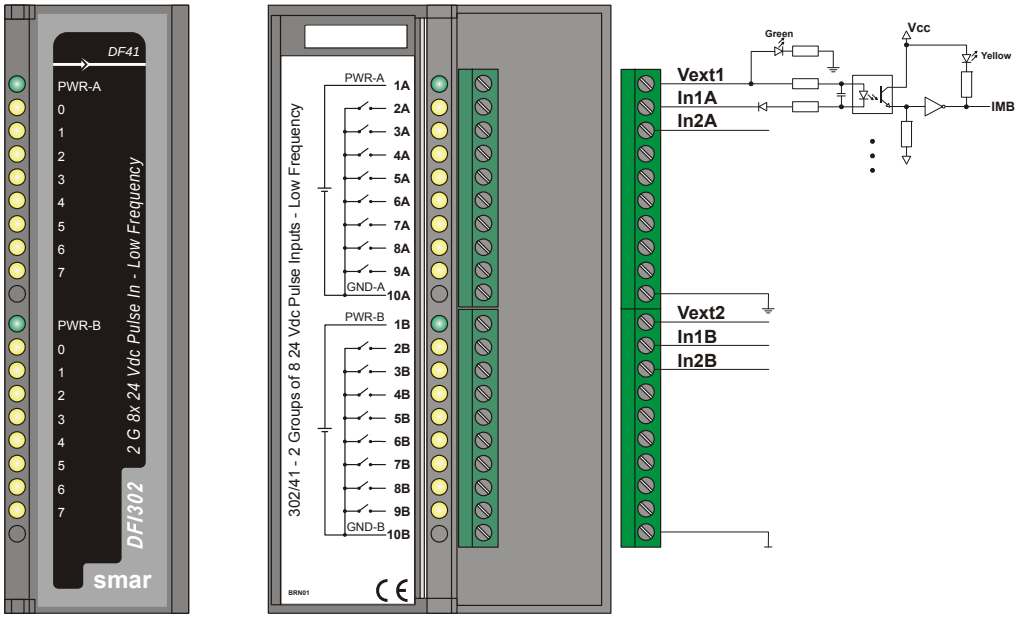


Figure 13– Details of the DF41 Module

NOTE
In order to attend EMC standards, use shielded cables in signals inputs (ground the shield in the panel only in one side of the cable) and cables less then 30 meters for power source inputs.

IMPORTANT
These modules have 12-bit counters to accumulate up to 4096 pulses, for each one of 16 channels, before an overflow occurs. Therefore, considering the maximum operation frequency, they have the following minimum overflow times: • DF41 : 4096 pulses / 100 Hz = 40,96 s • DF42 : 4096 pulses / 10000 Hz = 0,4096 s The system macro-cycle must be lower than the pulse counter modules overflow times.

Technical Specifications

ARCHITECTURE	
Number of Inputs	16
Number of Groups	2
Number of Inputs per Group	8

ISOLATION	
Optical Isolation between Groups and IMB	5000 Vac

EXTERNAL POWER	
Power Supply per Group	20 – 30 Vdc
Typical Consumption per Group	65 mA @ 24 Vdc
Power Supply Indicator	Green LED

INTERNAL POWER	
Provided by the IMB Bus	90 mA (maximum) @ 5 Vdc (DF41) 130 mA (maximum) @ 5 Vdc (DF42)
Maximum Dissipation	0.425 W (DF41) 0.650 W (DF42)
Power Supply Indicator	None (DF41/DF42)

INPUTS	
ON State Voltage Range (Logic “1”)	0 – 5 Vdc <200 Ω (DF41/DF42)
OFF State Voltage Range (Logic “0”)	20 – 30 Vdc >10 KΩ (DF41/DF42)
Typical Impedance per Point	3.9 KΩ
Typical Current per Point	7.5 mA
Frequency Range	0 – 100 Hz (DF41) 0 – 10 KHz (DF42)
Status Display	Yellow LED

DIMENSION AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.342 Kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

DF44/DF57 - ANALOG INPUTS MODULES VOLTAGE/CURRENT

DF44 (1 Group of 8 Voltage/Current Analog Inputs with Internal Shunt Resistors)
DF57 (1 Group of 8 Voltage/Current Differential Analog Inputs with Internal Shunt Resistors)

Description

These modules read 8 voltage or 8 current analog signals. The group is isolated from IMB. Only the module DF57 has differential inputs.

DF44: The inputs are individually configured to read:
- 0 - 5 V, 1 - 5 V, 0 - 10 V, ± 10 V, with the internal shunt resistor in the position "V"
- 0 - 20 mA, 4 - 20 mA, with the internal shunt resistor in the position "I"

DF57: The inputs are differential and are individually configured to read:
- 0 - 5 V, 1 - 5 V, 0 - 10 V, ± 10 V, with the internal shunt resistor in the position "V"
- 0 - 20 mA, 4 - 20 mA, with the internal shunt resistor in the position "I"

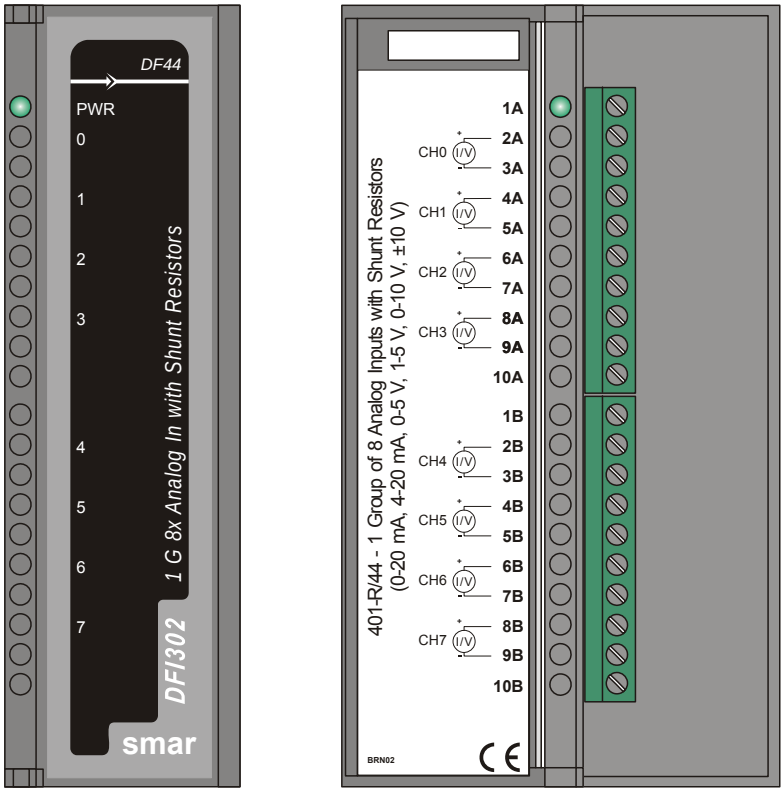


Figure 14 – Details of the DF44 Module

NOTES
• In order to attend EMC standards, use shielded cables in signals inputs (ground the shield in the panel only in one side of the cable).
• The scale for Analog Input and Output Modules is done using XD_SCALE parameter in AI and AO blocks, respectively. When using MAI or MAO, it is assumed a default range, 4 - 20mA or 1 - 5V without possibility to change. For MAI and MAO, input and output parameters are available in percentage of default range.

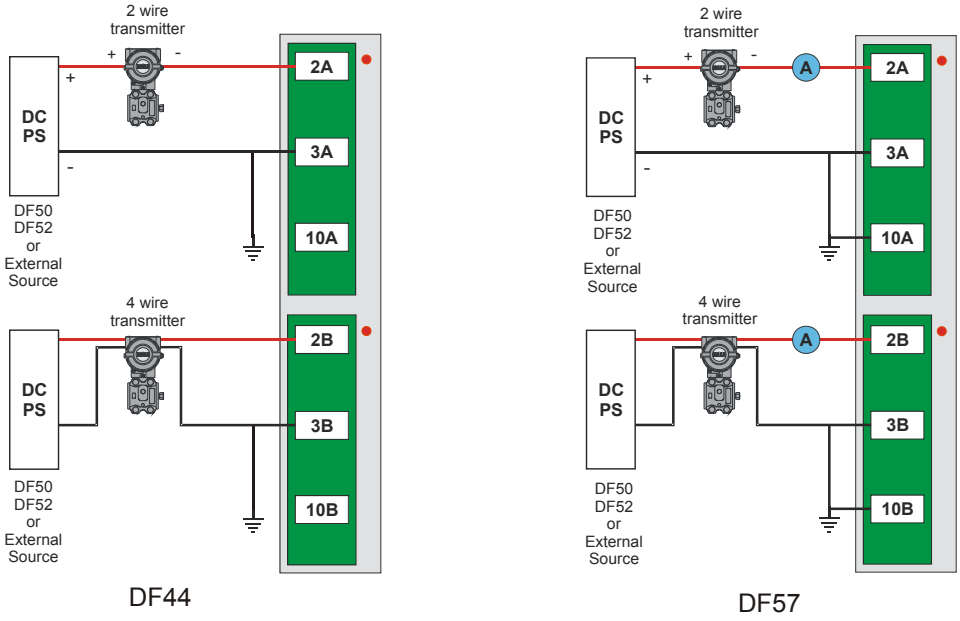


Figure 15 – Module connection example

Observation: In the picture above, the ammeter it is not mandatory.

Technical Specifications

ARCHITECTURE	
Number of Inputs	8
Number of Groups	1
Number of Inputs per Group	8

ISOLATION	
Optical Isolation between Group and IMB	Up to 1500 Vrms

INTERNAL POWER	
Provided by the IMB	320 mA (maximum) @ 5 Vdc
Total Maximum Dissipation	1.7 W
Power Supply Indicator	Green LED

INPUTS	
Linear Measuring Range	0 - 20 mA, 4 - 20 mA, 0 - 5 V, 1 - 5 V, 0 - 10 V, ± 10 V
Typical Impedance per Point	1 MΩ for Voltage Input 250 Ω for Current Input

A/D CONVERSION	
Conversion Time	20 ms/channel
Resolution	16 bits

ACCURACY AT 77 °F (25 °C)	
Range: 0 - 5 V, 1 - 5 V, 0 - 10 V	± 0.1% of Span (Linearity/Interference)
Range: 0 - 20 mA, 4 - 20 mA	± 0.12% of Span (Linearity/Interference)
Range: ±10 V	± 0.2% of Span (Linearity/Interference)

AMBIENT TEMPERATURE EFFECT	
Range: 0 - 20 mA, 4 - 20 mA, 0 - 5V, 1 - 5 V, 0 - 10 V	± 0.2% of Span/77 °F (25 °C)
Range: ± 10V	± 0.1% of Span/77 F (25 °C)

TEMPERATURE	
Operation (DF44)	-10 °C to 60 °C (14 ºF to 140 ºF)

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.210 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

DF45 - ANALOG INPUTS MODULE TEMPERATURE/LOW LEVEL SIGNALS

DF45 (1 Group of 8 Low Signal Analog Inputs for TC, RTD, mV and Ω)

Description

This module is able to measure temperature from a large variety of thermocouples (TC) and RTDs as well as millivolts and resistance with high precision. Temperature measurements are internally linearized and in the case of TCs cold junction compensation is already built-in close to the terminals the module. The group is isolated from IMB.

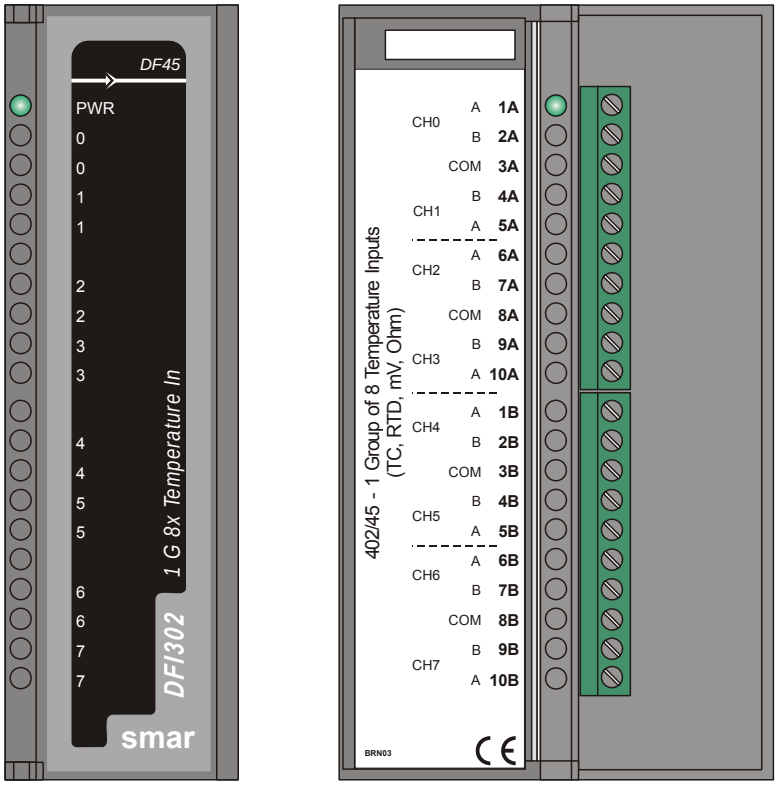


Figure 16 – Details of the DF 45 Module

NOTE

In order to attend EMC standards, use shielded cables in signals inputs (ground the shield in the panel only in one side of the cable).

The scale for Temperature Module is done using XD_SCALE parameter in AI and AO blocks respectively and a copy of this scale is done to TEMP transducer, in VALUE_RANGE_x parameters. In this particular case, the access to these parameters is read only. When using MAI or MAO, the VALUE_RANGE_x parameters are used to configuration and you should write to them.

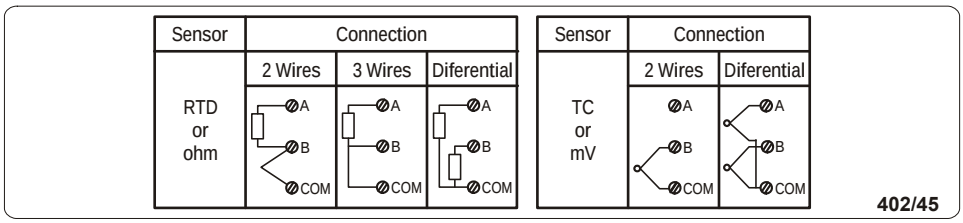


Figure 17– Sensor Connections

Technical Specifications

ARCHITECTURE	
Number of Inputs	8
Number of Groups	1
Number of Inputs per Group	8

ISOLATION	
Optical Isolation between Group and IMB	Up to 1500 Vrms

INTERNAL POWER	
Provided by the IMB	35 mA (maximum) @ 5 Vdc (During Operation)
	55 mA (maximum) @ 5 Vdc (During Configuration)
Total Maximum Dissipation	0.250 W
Power Supply Indicator	Green LED

INPUTS	
Typical Impedance per Point	1 MΩ

A/D CONVERSION	
Conversion Time	90 ms/channel
Resolution	16 bits
Precision at 77 ºF (25 ºC)	0.05% of span for the ranges 3 and 6*.
Effect of the Ambient Temperature	0.004% of maximum span/ ^{o}C.

* 0.15 % of span for the ranges 2 and 5.

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5 mm 1.57 x 5.39 x 5.57 in
Weight	0.202 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

SENSOR	2 OR 3 WIRES				DIFFERENTIAL	
	TYPE		RANGE [°C]	RANGE[°F]	RANGE [°C]	RANGE [°F]
RTD	Cu10 GE		-20 a 250	-4 a 482	-270 a 270	-486 a 486
	Ni 120 DIN		-50 a 270	-58 a 518	-320 a 320	-576 a 576
	Pt50 IEC		-200 a 850	-328 a 1562	-1050 a 1050	-1890 a 1890
	Pt100 IEC		-200 a 850	-328 a 1562	-1050 a 1050	-1890 a 1890
	Pt500 IEC		-200 a 450	-328 a 842	-650 a 650	-1170 a 1170
	Pt50 JIS		-200 a 600	-328 a 1112	-800 a 800	-1440 a 1440
	Pt100 JIS		-200 a 600	-328 a 1112	-800 a 800	-1440 a 1440
THERMO-COUPLE	B	NBS	+100 a 1800	+212 a 3272	-1700 a 1700	-3060 a 3060
	E	NBS	-100 a 1000	-148 a 1832	-1100 a 1100	-1980 a 1980
	J	NBS	-150 a 750	-238 a 1382	-900 a 900	-1620 a 1620
	K	NBS	-200 a 1350	-328 a 2462	-1550 a 1550	-2790 a 2790
	N	NBS	-100 a 1300	-148 a 2372	-1400 a 1400	-2520 a 2520
	R	NBS	0 a 1750	32 a 3182	-1750 a 1750	-3150 a 3150
	S	NBS	0 a 1750	32 a 3182	-1750 a 1750	-3150 a 3150
	T	NBS	-200 a 400	-328 a 752	-600 a 600	-1080 a 1080
	L	DIN	-200 a 900	-328 a 1652	-1100 a 1100	-1980 a 1980
	U	DIN	-200 a 600	-328 a 1112	-800 a 800	-1440 a 1440

	2 WIRES	DIFFERENTIAL	RANGE
SENSOR MV	-6 a 22 mV	-28 a 28 mV	1
	-10 a 100 mV	-110 a 110 mV	2
	-50 a 500 mV	-550 a 550 mV	3
	2 OR 3 WIRES	**DIFFERENTIAL**	**RANGE**
SENSOR Ω	0 a 100 Ω	-100 a 100 Ω	4
	0 a 400 Ω	-400 a 400 Ω	5
	0 a 2000 Ω	-2000 a 2000 Ω	6

DF46 - ANALOG OUTPUTS MODULE VOLTAGE/CURRENT

DF46 (1 Group of 4 Voltage/Current Analog Outputs)

Description

This module provides 4 pairs of analog outputs. Each pair is composed of one current output and one voltage output. When one output is selected, the corresponding pair is selected simultaneously. The current outputs can be configured individually on ranges 0 - 20 mA or 4 - 20 mA. For voltage outputs the range is 0 - 5 V, 1 - 5 V, ± 5 V, 0 - 10 V, 2 - 10 V or ± 10 V. The group is optically isolated from IMB.

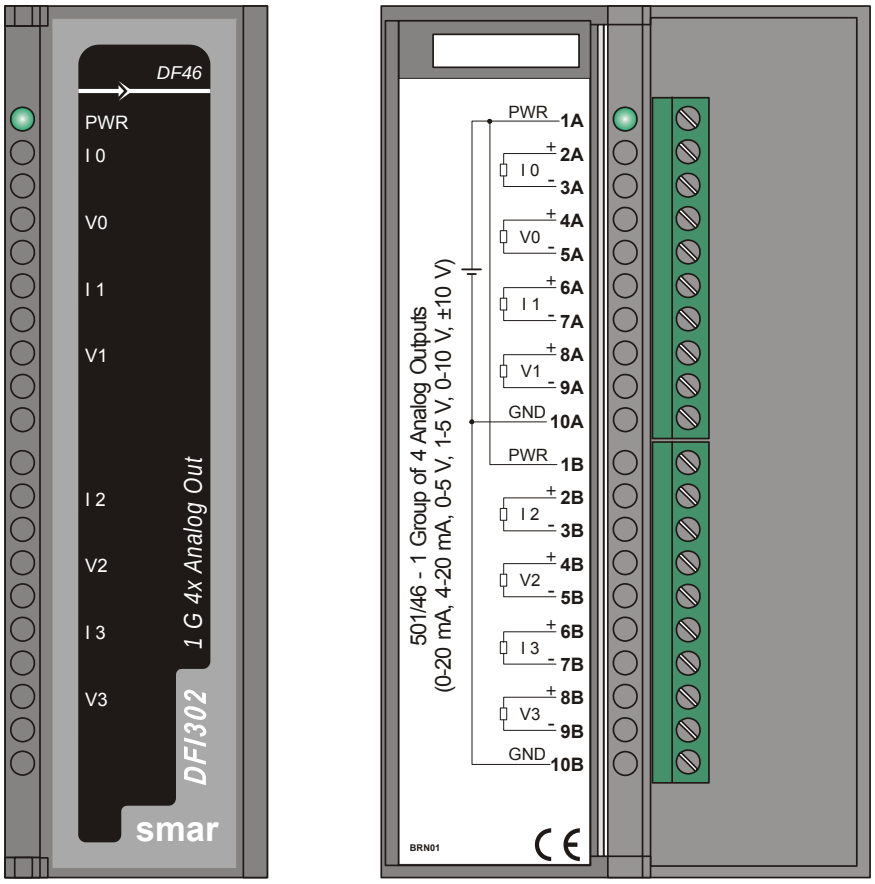


Figure 18 – Details of the DF46 Module

DIP SWITCHES CONFIGURATION
When using Voltage Mode, make sure to configure the Group of Ranges via DIP switches located UP and Down inside the box.

DIP switch 1 - UP Side: Configure the Group of Ranges of Channel 0 (I0/V0)
DIP switch 2 - UP Side: Configure the Group of Ranges of Channel 1 (I1/V1)
DIP switch 1 - DOWN Side: Configure the Group of Ranges of Channel 2 (I2/V2)
DIP switch 2 - DOWN Side: Configure the Group of Ranges of Channel 3 (I3/V3)

See under Technical Specifications (output range) the Group of Ranges.

NOTE
In order to attend EMC standards, use shielded cables in signals inputs (ground the shield in the panel only in one side of the cable) and cables less then 30 meters for power source inputs. The scale for Analog Input and Output Modules is done using XD_SCALE parameter in AI and AO blocks, respectively. When using MAI or MAO, it is assumed a default range, 4-20 mA or 1-5V without possibility to change. For MAI and MAO, input and output parameters are available in percentage of default range.

To set the DF46 card correctly, follow the instructions below:

RANGE	DIP SWITCHES	AO. XD_SCALE. EU_0	AO. XD_SCALE. EU_100	AO. XD_SCALE. UNITS	IF THE MAO BLOCK IS USED, THE OUTPUT WILL BE IN % [MINIMUM AND MAXIMUM VALUES]
4 to 20 mA	Not Applicable	4	20	mA	0 to 100
0 to 20 mA	Not Applicable	0	20	mA	-25 to 100
0 to 5 V	OFF	0	5	V	-25 to 100
1 to 5 V	OFF	1	5	V	0 to 100
-5 to 5 V	OFF	- 5	5	V	-150 to 100
0 to 10 V	ON	0	5	V	-25 to 100
2 to 10 V	ON	1	5	V	0 to 100
-10 to 10 V	ON	- 5	5	V	-150 to 100

It is important to use the AO block to work with the DF46 card, because the AO block allows the correct configuration of XD_SCALE parameter.

The MAO block uses a default SCALE and if the value is out of range, the block does not filter the value and the physical output level can get overflow. See the next example:

MAO block behavior:

MAO (%)	MODULE OUTPUT	
	DIP SWTICHES (V) ON	DIP SWTICHES (V) OFF
+200	-2	-1
+150	-6	-3
+100	+10	+5
0	+2	+1
-100	-6	-3
-150	-10	-5
-200	+6	+3

Technical Specifications

ARCHITECTURE	
Number of Outputs	4
Number of Groups	1
Number of Outputs per Group	4

ISOLATION	
Optical Isolation between Group and IMB	Up to 3700 Vrms
Isolation between External Power Supply	1500 Vac

INTERNAL POWER	
Provide by the IMB	20 mA (maximum) @ 5 Vdc
Total Maximum Dissipation	0.1 W
EXTERNAL POWER	

In Rush Current Consumption	2.3 A (maximum) @ 24 Vdc (10ms)
Power Supply	20 – 30 Vdc
Typical Consumption per Group	180 mA
Power Supply Indicator	Green LED

OUTPUTS	
Outputs Type	Single Ended (1 ground)
Load Impedance	5 V: 2 KΩ (minimum) 10 V: 5 KΩ (minimum) 20 mA: 750 Ω (maximum)

OUTPUTS RANGE	RANGE 1	RANGE 2	RANGE 3
Voltage Output Dipswitch OFF	1 V to 5 V	0 V to 5 V	-5 V to 5 V
Voltage Output Dipswitch ON	2 V to 10 V	0 V to 10 V	-10 V to 10 V
Current Output	4 mA to 20 mA	0 mA to 20 mA	0 mA to 20 mA

A/D CONVERSION	
Conversion Time	8 ms/channel
Resolution	12 bits
Accuracy at 77 °F (25 °C)	± 0.5% of Span

DIMENSIONS AND WEIGHT	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5mm 1.57 x 5.39 x 5.57 in
Weight	0.330 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

DF67 - PULSE INPUTS MODULE AC - HIGH FREQUENCY

DF67 (2 Groups of 8 High Frequency (0 – 10 KHz) AC Pulse Inputs)

NOTE
Although the hardware to support 10 KHz, for applications with AuditFlow (FC302 and HFC302) the maximum frequency is 4 KHz.

Description

This module was designed to be connected to sensors that generate AC signals. It has 2 groups with 8 inputs to count and store pulses until the processor module reads them. The DF67 can read AC frequencies ranging from 0 to 10 KHz. A single pole filter cuts off around 20 KHz in order to eliminate high frequency noises.

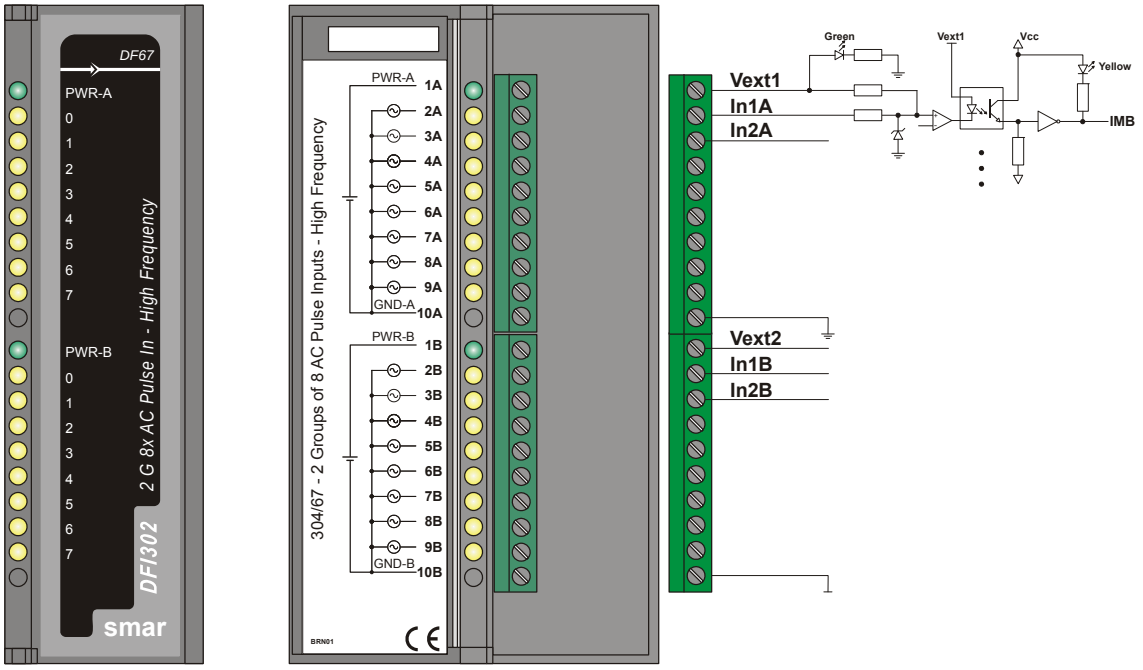


Figure 19 – Details of the DF67 Module

NOTE
In order to attend EMC standards, use shielded cables in signals inputs (ground the shield in the panel only in one side of the cable) and cables less then 30 meters for power source inputs.

IMPORTANT
This module has 12-bit counters to accumulate up to 4096 pulses, for each one of 16 channels, before an overflow occurs. Therefore, considering the maximum operation frequency, it has the following minimum overflow time: • DF67 : 4096 pulses / 10000 Hz = 0,4096 s The system macro cycle must be lower than the pulse counter module overflow time.

Technical Specifications

ARCHITECTURE	
Number of Inputs	16
Number of Groups	2
Number of Inputs per Group	8

ISOLATION	
Optical Isolation between Groups and IMB	Up to 5000 Vac

EXTERNAL POWER	
Power Supply per Group	20 – 30 Vdc
Typical Consumption per Group	12 mA @ 24 Vdc
Power Supply Indicator	Green LED

INTERNAL POWER	
Provided by the IMB	130 mA @ 5 Vdc
Total Maximum Dissipation	650 mW
Power Supply Indicator	None

INPUTS	
ON State Level → Voltage Range (Logic "1")	- 30 a - 1.5 V
OFF State Level → (Logic "0")	+ 1.5 V a + 30 V
Typical Impedance per Point	3.9 KΩ
Frequency Range	10 KHz
Status Display	Yellow LED

DIMENSION AND WEIGHT	
Dimension (W x D x H)	39.9 x 137.0 x 141.5mm 1.57 x 5.39 x 5.57 in
Weight	0.342 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

DF116/DF117 – HART MODULES

Description

The modules DF116 (input) and DF117 (output) of DFI302 family are the HART solution for **SYSTEM302**. The main purpose of these modules is allow Smar HSE controller to have access, through IMB (Inter Module Bus), to analog signals (4-20mA) and digital data from 4-20mA+HART equipment, to be used on control strategies, ladder logics, HMI, and also on configuration tools and Asset Management Software.

Using this solution, 4-20 mA+HART field devices have seamless integration to the FOUNDATION fieldbus system. Using HSE networks and other modules from DFI302 family, communication to other digital protocols is also possible, allowing better project flexibility.

The DF116 and DF117 modules follow all HART network standards, being compliant to all requirements of a primary HART master, based on version 5, 6 and 7 of specifications.

- Integral part of **SYSTEM302**;
- 8 independent, non-multiplexed, HART primary master communication channels;
- Each channel has dedicated input (DF116) and output (DF117) 4-20 mA circuits;
- Communication to HSE controller using IMB bus, on backplane;
- Power supply by existing backplane (5 Vdc@200mA);
- HART equipment shall be externally powered;
- Supports 1 HART equipment per channel (peer-to-peer, address 0);
- Supports equipment using version 5, 6 and 7 of HART protocol;
- HART communication in parallel to analog 4-20mA signal, without affecting analog signal;
- Possibility of access to all equipment variables by using HART command (universal, common and specific) using Bypass functionality;
- Module representation on FDT/DTM tools by its dedicated communication DTM;
- Simultaneous supervision of up to 8 process variables from HART equipment (user configurable);
- Possibility of HART equipment representation on a FOUNDATION fieldbus system, by standardized blocks present on Smar HSE controller;
- Support to equipment using Burst mode;
- Communication to HART equipment in cyclic mode (uninterrupted) allowing failure detection before they cause process halts, lowering halt time and risk of non-programmed halts;
- Variable from HART equipment can be used and “linked” on control strategies;
- Use of up to 16 DF116 and/or DF117 modules per HSE controller.

IMPORTANT
The characteristics described in this section are supported by the DF62, DF63, DF73, DF75, DF79, DF81, DF89, DF95 and DF97 controllers.

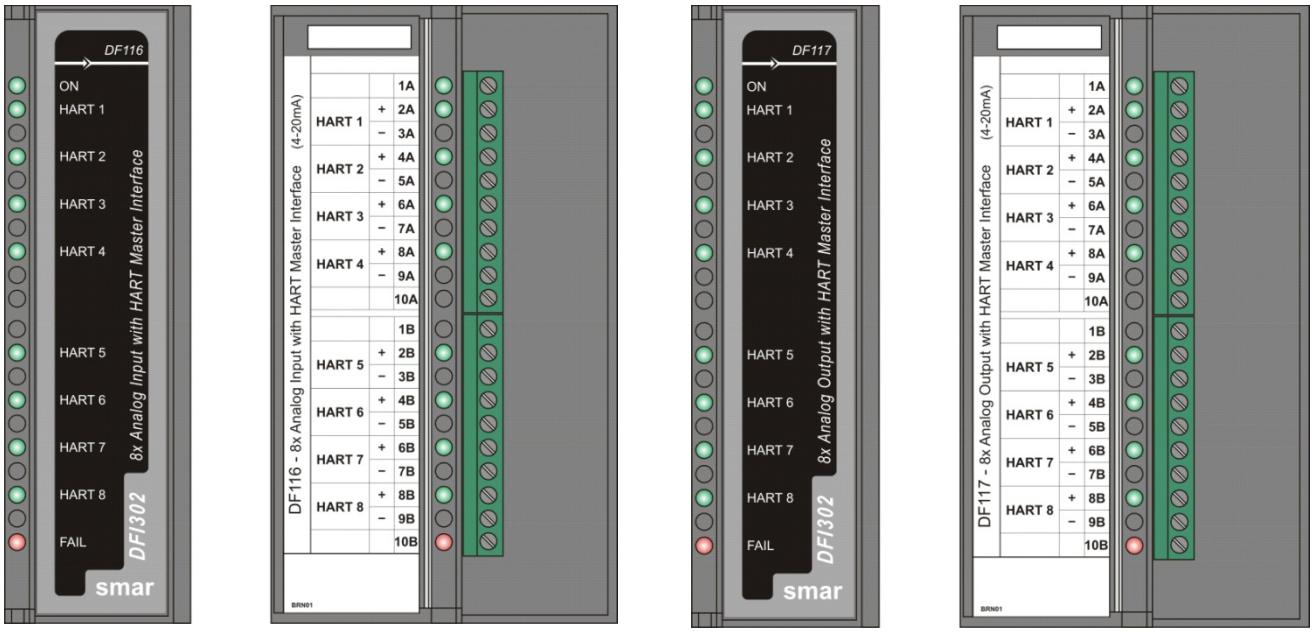


Figure 20 – Details of the DF116 and DF117 Modules

Technical Specifications

POWER SUPPLY	
Input Voltage	5 Vdc±5% @ 200 mA, maximum ripple of 20 mVpp, via rack
Maximum Consumption	1 W
Indication	Green LED – device is powered

PROCESSOR	
Processor	FPGA + NIOS 20 mHz
Indication	Red LED – Failure indicator

DF116 – ANALOG INPUT 4-20 MA	
Input Impedance	250 Ω.
A/D Converter	Range: 3.8 to 21 mA
	A/D converter: 16 bits
	Accuracy: +/- 0.05% of range
	Repeatability: +/- 0.01% of range
	Nonlinearity: +/- 0.01% of range
	Temperature effect: +/- 0.001%/ºC
Input Filter	Low pass filter: fc ~10 Hz
Isolation between IMB and Inputs	Galvanic isolation: 1000 Vrms. Inputs are not isolated from each other.
Power supply	Supply of the HART devices through external power supply.
Input Protections	Polarity inversion, over voltage, transients, etc.

DF117 – ANALOG OUTPUT 4-20 MA	
D/A Converter	Range: 3.8 to 21 mA
	D/A converter: 14 bits
	Accuracy: +/- 0.05% of range
	Repeatability: +/- 0.02% of range
	Nonlinearity: +/- 0.002% of range
	Temperature effect +/- 0.00025%/ºC

Isolation between IMB and Inputs	Galvanic isolation: 1000 Vrms. Outputs are not isolated from each other.
Power supply	Supply of the HART devices through external power supply.
Protection	Protected by TVS and zener diode
Current Control	Passive circuit, with current control: sink
Input Protections	Polarity inversion, over voltage, transients, etc.

HART	
Supported versions	Support to HART versions 5, 6 and 7.
Communication channels	8 HART Master channels
Indication	Green LED - indication of each channel status

CE CERTIFICATION	
CE Certification	The DF116/DF117 modules will be manufactured and tested in accordance to IEC-61326:2002 standard - Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements.

ENVIROMENTAL CONDITIONS	
Operation	-20 to 70 ºC
Storage	-40 to 70 ºC
Humidity	20 to 90% non-condensed relative humidity

DIMENSIONS AND WEIGHT	
Dimensions	142 x 40 x 126 mm
	5.6 x 1.6 x 5.0 pol
Weight	Weight: 450 g. With package 500g.

Indication LEDs

DF116 and DF117 modules have diagnostic LEDs to indicate normal operation and failure status, allowing easier problem solution. LED names, color, description and behaviors are shown on the following table:

LED	COLOR	DESCRIPTION	BEHAVIOR
ON	Green	Indicates when module is on.	Solid green when the module is powered.
FAIL	Red	Indicates hardware failure.	Solid red when there is a failure (hardware, IMB).
HART 1 – HART 8	Green	Indicates the operation mode of the HART channel.	**Steady ON** – indicates that HART device is still not identified. In case LED stays on this state for too long, please verify if HART device is correctly installed and if its address is 0. **Blinking** – LED will blink according to Send/Receive rate of HART messages to device installed in the channel. When on this state, HART device was correctly identified.

Installation

This topic deals with the main physical installation features, namely: mechanical and electrical elements.

IMPORTANT
All comments or considerations made in this manual refer to HART communication using FSK modulation (Frequency Shift Keying).

Mechanical Installation

The DF116 and DF117 modules are enclosed in the Smar standard plastic housing, like the DFI302 line. Therefore, they are fully interchangeable on the standard racks.

The DF116 and DF117 require **5V @ 200 mA** from the rack. You may use Smar DF50 power supply modules. Besides providing a high quality feeding, they also provide a "Power Fail" signal to prevent power failure or AC problems. However, the user can use another power supply provided it meets the minimum requirement of quality and safety.

ATTENTION ABOUT GROUNDING
The DF116 and DF117 modules are devices for industrial use that meets the rigorous international standards CE, HART, etc. For to offer the maximum of performance and safety to the users and the equipment connected is fundamental that there is an appropriate grounding, according to NBR-5410, NBR-5419, NBR-7117, IEC-200, IEEE-141 or IEEE-142 standards, or other more appropriate local standard. All the power supply, racks, rail, and shield of cables should be grounded appropriately. The grounding should be tested regularly, according to the maintenance plan of each installation, to guarantee the maintenance of its electric properties. As suggestion the safety recommendations of the NR 10 standards or another local standard on electric safety should be respected.

Electrical Connections

The minimum electrical connections for the DF116 and DF117 modules are the power supply, normally connected to the rack and to the connection with HART devices. See the following figure for details. Since the DF116 and DF117 do not supply the devices, it is necessary to use a power supply for them. The DF50 can be used if the devices' consumption does not exceed 300 mA (about 12 devices), otherwise the DF52 should be used as shown in the figure.

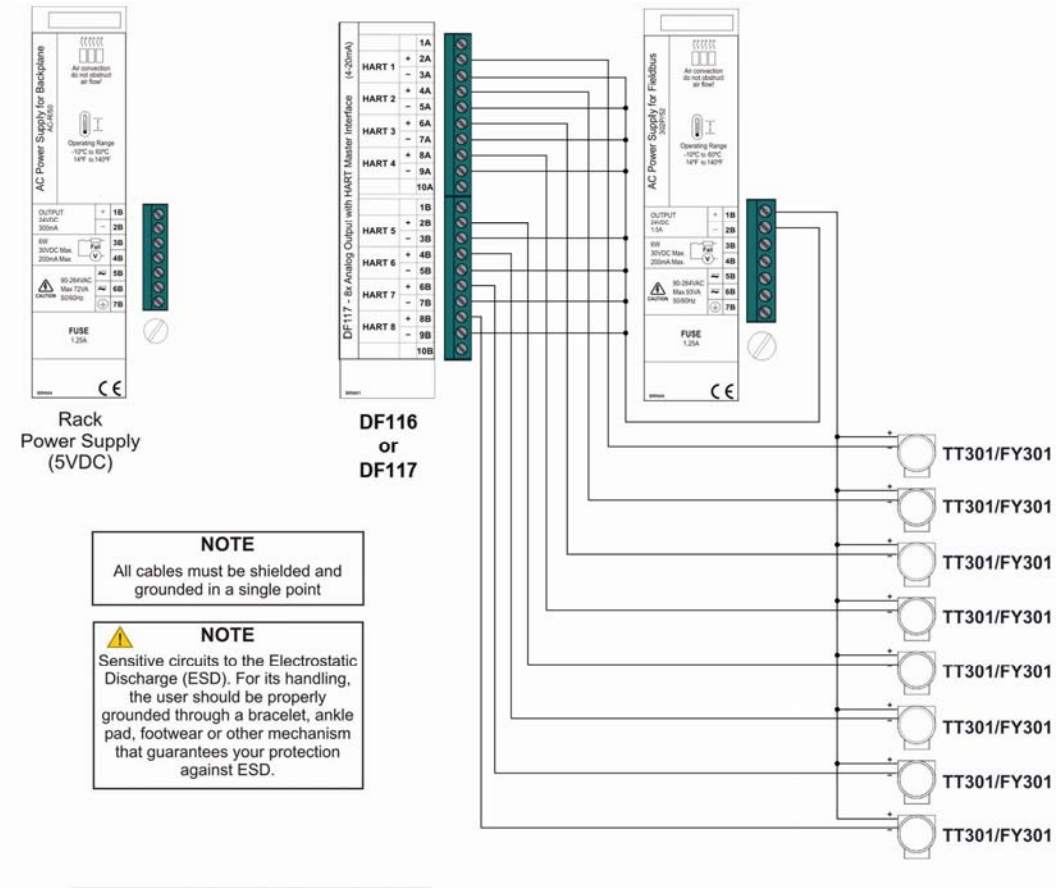


Figure 21 – Example of necessary connections for the DF116/DF117

IMPORTANT
The figure above shows the connection of devices supplied by the same power supply module. Remember that the DF116 and DF117 analog inputs and outputs are not isolated from each other, that is, they have the negative terminal internally connected.

HART Device Installation

Now we will describe the main communication features regarding the device installation. Concerned the HART communication, consider that the superimposition of a modulated signal on an analog current signal can deteriorate, if some precautions are not taken. It is important to mention that the HART communication **does not affect** the 4-20 mA analog signal, since the average value of a FSK modulated signal is zero.

Impedance

In the connections, using the DF116, the 250 Ω resistor in series with each device is not necessary, since there is a sample resistor of 4-20 mA signal in the analog board of the DF116 in series with the loop.

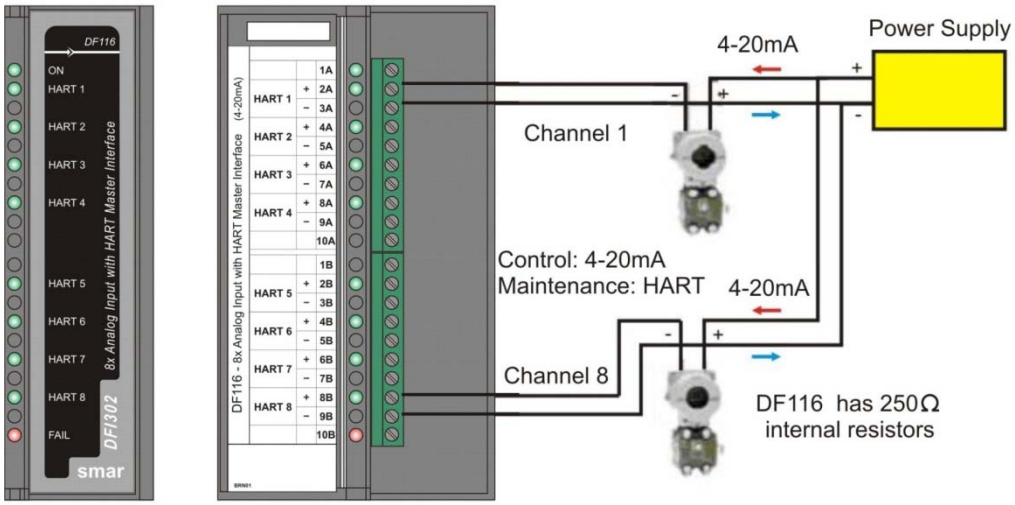


Figure 22 – Connection of DF116

In this topology, using the DF117, it is not necessary to use a resistor in series with the power supply, because the device's internal impedance and the actuator impedance ensures the minimum requirement for HART communication. However, the user should watch the minimum supply voltage required for total impedance (including the wiring impedance).

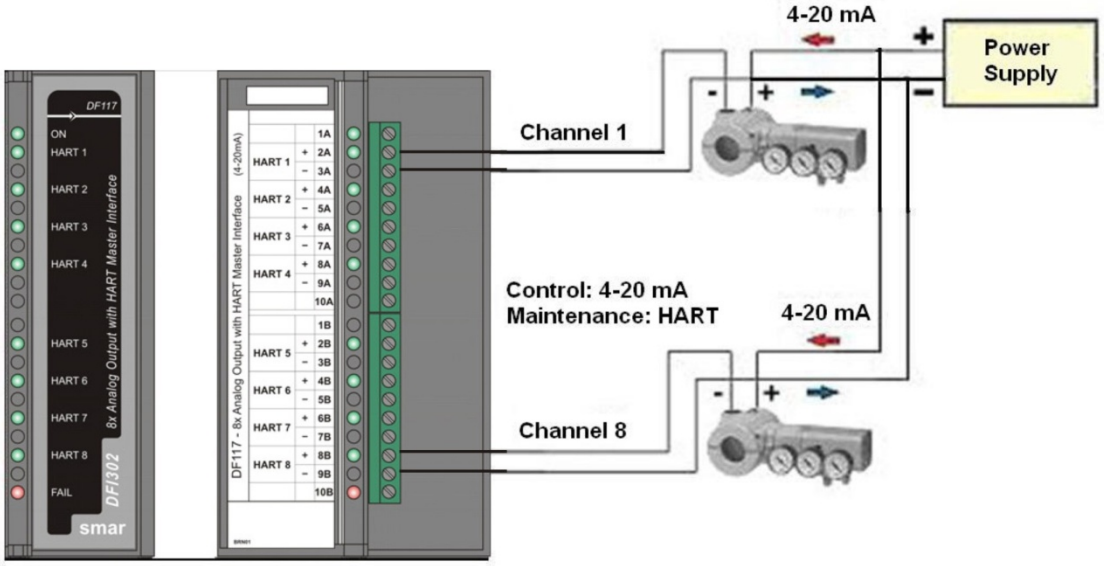


Figure 23 – Connection of DF117

Maximum Cable Length

The user may choose from a shielded pair of twisted cables, multipair cables with a single shield or a combination of these.

IMPORTANT
The shield can be overlooked if noise in the environment or any other interference does not affect the communication.

Use a 24 AWG (0.5 mm^2) cable for lengths up to 1500 meters (5000 ft). For lengths over 1500 meters, use at least a 20 AWG (0.8 mm^2) cable.

If a cable longer than 500 m is required, make a detailed analysis of the system to avoid operation failures. According to HCF (HART Communication Foundation), the maximum cable length depends on:

- The cable's resistance, capacitance and inductance.

- The device's resistance and capacitance on the HART channel, as well as the additional equipment.

Due to the complexity of the subject, users should read the HART Foundation Communication documentation, specially the FSK Physical Layer Specification. Consult Smar for further information.

Other devices in the loop

The control loop may have additional devices, besides the DF116/DF117 and HART devices. See some common types as follows.

Portable Configurator

As mentioned before, the DF116/DF117 operates as a primary master in most applications. So, there is no problem in using a portable configurator, such as the Smar HPC401 Plus. Whatever the installation topology, make sure to install a 250 Ω impedance in series with the power supply. If no active impedance or resistors are installed, the secondary master device will not communicate.

Indicators and Converters in general

Indicators and converters are very common in industrial installations. They usually have high impedance in the HART communication frequency (1200 to 2200 Hz). Sometimes the introduction of such elements in the loop can prevent communication. However, there is a simple and well known solution for this problem, by connecting a capacitor ranging from **0.1 to 1µF@200v** parallel to the device. This capacitor supplies an impedance of hundreds Ohms in parallel to the device's impedance, allowing the HART communication.

HOT SWAP

The DF116/DF117 is equipped with a HOT SWAP controller that allows the insertion or removal of the module with the power supply on. This is important when the DF116/DF117 is being supplied by a shared power supply, e.g., in a rack with others DF116/DF117 modules or DFI302 controllers.

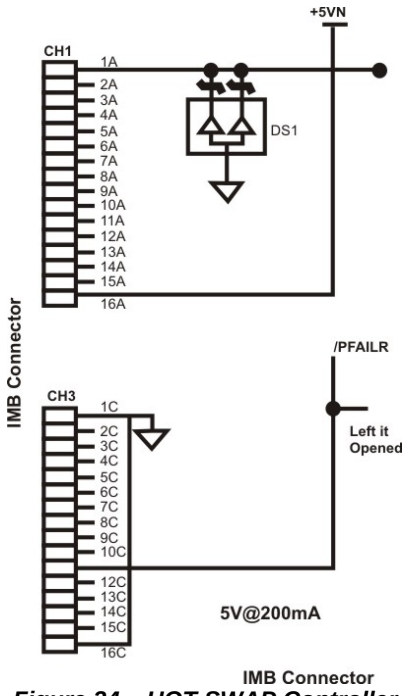


Figure 24 – HOT SWAP Controller

Protections

The DF116/DF117 has advanced specific components for protection against ESD and voltage surges. However, keep in mind that good ground wiring is fundamental.

Electrostatic Discharge (ESD)

The power input and all the communication channels are protected against electrostatic discharges by specific components (zener diodes) with high response speed and good power absorbing capacity (24W @

1ms @ 25 °C). In addition to this protection, there are sparklers built on the printed circuit board, on every LEDs and on all front connector pins. They are designed to sparkle within 200 to 300V voltages, depending on the air humidity.

Surges, High Voltage and Grounding

Voltage surges, whether inducted or conducted, occur often in industrial environments due to electric motors, frequency inverters, semiconductors switching and many other factors. Besides, there is always the danger from atmospheric discharges that may permanently damage the equipment. The modules have components highly efficient against these surges, with high absorption capacity (400W @ 1 ms @ 25°C) and () good response speed, typically less than 1 ns, in addition to the PCI built-in sparklers. However, this protection is practically useless without good wire grounding.

ATTENTION
Indispensably, a good quality grounding (< 5Ω) must be connected to the system, either on the DIN rail, on the power supply, or directly to the module grounding terminal. Without this, all protection for the DF116/DF117 modules, as well as for other equipment, WILL NOT WORK. Note that grounding resistance must be measured every 2 years.

HART Communication

The DF116/DF117 modules have 8 channels for HART master communication, with capacitive and galvanic isolation. All channels also are protected against ESD and surges.

On DF116 an external resistor for communication is not necessary, because it already has on board a 150R resistor + Shunt (100R).

Every HART channel has a LED, controlled by the UART, indicating the several statuses of the channel's work.

4-20mA Analog Conversion (DF116)

The DF116 model has an additional circuit that converts the transmitter's analog signal by means of a signal conditioning circuit and a low pass filter with a cut frequency of approximately 10Hz, a 16 bits AD converter. These circuits are protected against high voltage by zener diodes, against overheating and inverted polarity. The DF116 indicates the current measured value by a MAI (or AI) block, to be utilized on any control loop. All circuits forming the analog acquisition are isolated from the others by a DC-DC converter and by optical couplers. The reading update is approximately 200 ms.

4-20mA Analog Conversion (DF117)

In a similar way, a board with analog output circuits is capable of controlling a current used by actuators, for example. These circuits are protected against high voltage by zener diodes, against overheating and against inverted polarity. The output module uses a 14 bits DA converter. These circuits make up 8 independent channels for current control working in parallel to HART digital communication.

All circuits forming the analog acquisition are isolated from the others by means of a DC-DC converter and optical couplers. On the DF117 a circuit informs if the current loop is open or not. The output update period is approximately 200 ms.

Access to the HART device variables in the FOUNDATION fieldbus system

The DF116 and DF117 modules work together the Smar HSE controller allowing that the 4-20mA+HART field devices are fully integrated to the FOUNDATION fieldbus system. The controller has the required function blocks to make possible this integration.

The **TBH** block (RIO HART Transducer Block) represents the HART device in the system. Through it the user can access any variable of the device.

This block contains parameters for the process to be used in the control strategy and ladder logic, identification parameters, Burst and diagnosis, as well as Bypass parameters (**HART_CMD**, **HART_RESP** and **HART_COM_STAT**) that are used by the configuration and asset management tools for transmission and reception of HART messages.

For each HART device installed must exist one corresponding **TBH** block on the system. The association of this block to the physical device must be done through the **RRSGP** parameter, following the rule **RRSGP** where **RR**: rack, **S**: slot, **G**: group (0 - 7) and **P**: point (9). Examples:

209 – Rack 0, Slot 2, group 0 and point 9
12319 – Rack 12, slot 3, group 1 and point 9

The group represents the HART device. The DF116/DF117 modules support up to 8 HART devices.

The point has to be configured with 9 because it represents the access to all available variables in the HART device: **HART_PV**, **HART_SV**, **HART_TV**, **HART_QV**, **HART_5V**, **HART_6V**, **HART_7V**, **HART_8V** and **ANALOG_VALUE**.

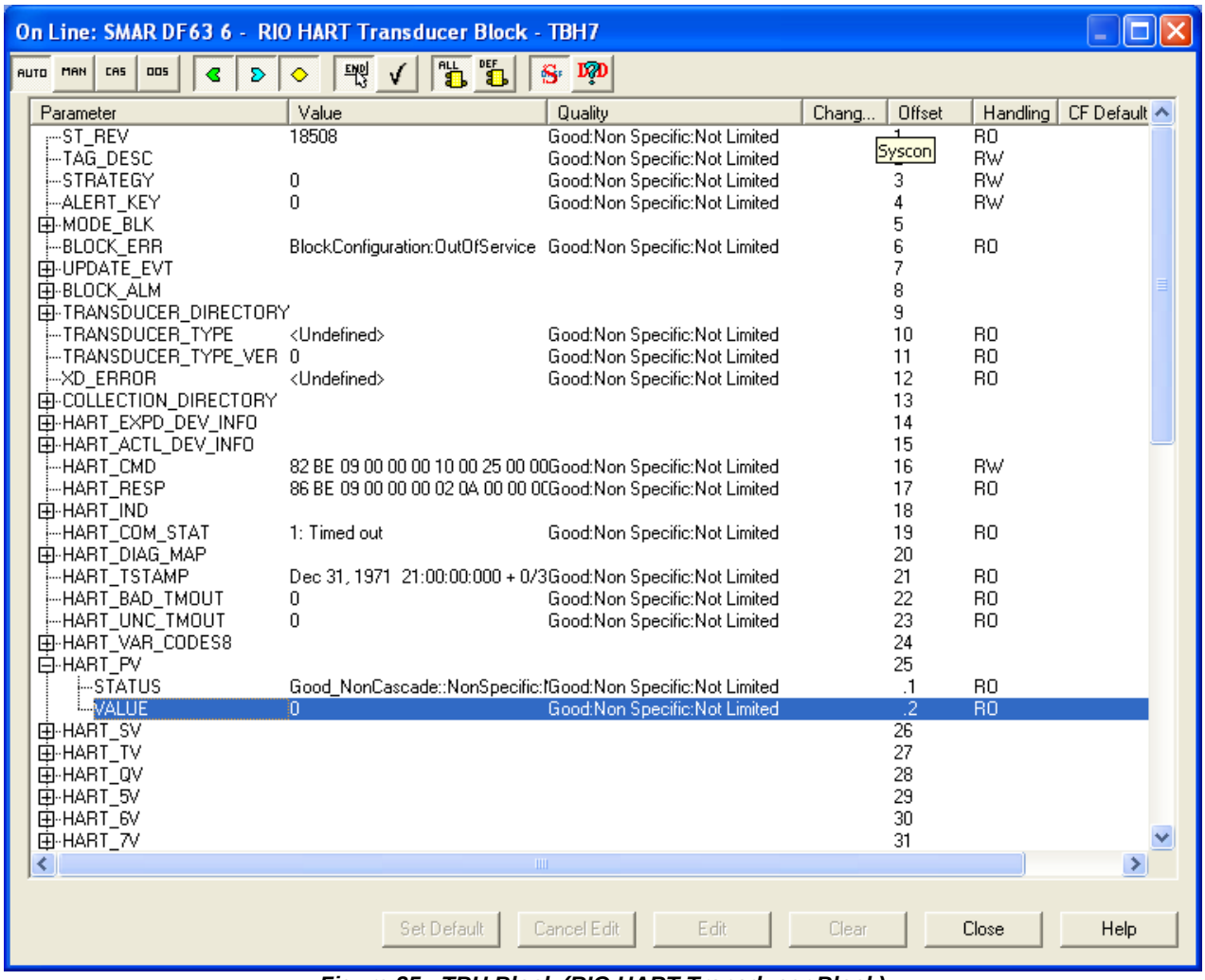


Figure 25 - TBH Block (RIO HART Transducer Block)

Configuration of the dynamic variables in the TBH block

The **TBH** block is flexible and allows the user to configure up to 8 digital variables to be dynamically read from the HART device. The configuration has to be done in the **HART_VAR_CODES8** parameter using indexes. The value and status of the variable for the index are shown on the corresponding parameter. See the following table.

HART_VAR_CODES8
[1] – HART_PV
[2] – HART_SV
[3] – HART_TV
[4] – HART_QV
[5] – HART_5V
[6] – HART_6V
[7] – HART_7V
[8] – HART_8V

Table – HART_VAR_CODES8[n]

The index configured in the **HART_VAR_CODES8[n]** parameter defines which variable has to be read from the device and also the HART command used by the DF116/DF117 module to read the variable. See the following table.

HART_VAR_CODES8[1..8] = 250	HART_VAR_CODES8[n] = (0 - 249)
Read the variable by the **HART #3** command. The **#3** command is flexible and can return information with up to 4 process variables (PV, SV, TV, and QV). The number of variables returned by this command is determined by the device manufacturer according to their functionality. If the **HART_VAR_CODES8[n]** parameter is configured with the value 250, but there is not corresponding variable on **#3** command, the default value should appear in the associated parameter.	HART command used to read the variable in question depends on the version of the HART device. HART 5: **#33** command HART 6 and 7: **#9** command Both commands return information from variables whose indexes (Device Variable Code) are defined on HART request message. These commands are flexible and accept up to 4 indexes, except the **#9** command of HART 7 which accepts up to 8 indexes. For a list of indexes supported by the device, and the associated variables, is necessary to consult the manual or the manufacturer of the device. The list of variables of Smar's devices can be obtained in the "Indexes of Smar HART devices variables" topic on this document. If the index configured in the **HART_VAR_CODES8[n]** parameter does not exist in the device, the corresponding parameter and other parameters whose indexes are part of the same request message should appear with the default value.

HART commands

NOTE
HART command is a data structure used by the HART protocol to group variables and features of the device. Each command has an identification number, some commands, and therefore their IDs, are pre-defined by the HART specification. Other commands can be defined by the device manufacturer according to its functionality.

The composition/structure of HART and FOUNDATION fieldbus protocols differ in some points. Therefore, to ensure the integration of HART devices in FOUNDATION fieldbus systems in a transparent manner, some adjustments and conversions are required.

One of the necessary adjustments is related to the status of parameters associated to **HART_VAR_CODES8** (see table HART_VAR_CODES8[n]). In the HART protocol only the **#9** command

returns the variable status on its response.

Thus the parameters status whose variables are read by the # 3 or # 33 commands are obtained by interpreting the **DEVICE_STATUS** byte present in responses from all messages from the HART device. The following table shows how the **DEVICE_STATUS** bits are interpreted.

STATUS BIT	DEVICE_STATUS	HART STATUS
2	Loop Current Saturated	PoorAccuracy:NotLimited
3	Loop Current Fixed	ManualFixed:Constant
1	Non-Primary Variable Out of Limits	PoorAccuracy:NotLimited
0	Primary Variable Out of Limits	Bad:NotLimited
7	Device Malfunction	Bad:Constant
--	-- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --	Good:Constant

The HART commands **(#3, #9** and **#33**) also return the measurement unit of the variable that can be seen in the **VAR_UNITS9[n]** parameter in the same position of the **HART_VAR_CODES8** parameter where the index variable was configured.

Conversion of HART Status to FOUNDATION fieldbus

The status from the HART device is converted to the corresponding FOUNDATION fieldbus status to fill the **TBH** block parameters that have status. See the following table:

HART STATUS	FOUNDATION FIELDBUS STATUS
Good:Constant	GoodNonCascade:GoodNCNonSpecific:Constant
Good:Low Limited	GoodNonCascade:GoodNCNonSpecific:LowLimited
Good:High Limited	GoodNonCascade:GoodNCNonSpecific:HighLimited
Good:Not Limited	GoodNonCascade:GoodNCNonSpecific:NotLimited
Poor Accuracy:Constant	Uncertain:UncertainNonSpecific:Constant
Poor Accuracy:Low Limited	Uncertain:UncertainNonSpecific:LowLimited
Poor Accuracy:High Limited	Uncertain:UncertainNonSpecific:HighLimited
Poor Accuracy: Not Limited	Uncertain:UncertainNonSpecific:NotLimited
Manual Fixed:Constant	GoodNonCascade:GoodNCNonSpecific:Constant
Manual Fixed:Low Limited	GoodNonCascade:GoodNCNonSpecific:LowLimited
Manual Fixed:High Limited	GoodNonCascade:GoodNCNonSpecific:HighLimited
Manual Fixed:Not Limited	GoodNonCascade:GoodNCNonSpecific:NotLimited
Bad:Constant	Bad:BadNonSpecific:Constant
Bad:Low Limited	Bad:BadNonSpecific:LowLimited
Bad:High Limited	Bad:BadNonSpecific:HighLimited
Bad : Not Limited	Bad:BadNonSpecific:NotLimited

Access to current analog signal (4-20 mA)

Each one of the 8 channels of DF116 and DF117 modules has analog circuit that allows the 4-20 mA current signal to be accessed in parallel to HART communication, without disturbing the communication signal. For it is essential that the physical installation of the module is correct.

The access to the input current (DF116) or to the output current (DF117) of the channel is done in the FOUNDATION fieldbus system through the **ANALOG_VALUE** parameter of **TBH** block. In each channel must be installed only one HART device and its address must be 0. The multidrop mode is not allowed. The **ANALOG_VALUE** parameter is associated to the current signal of the channel where the device is

installed.

The status of **ANALOG_VALUE** parameter is in compliance with the Namur Standard adapted to the standard of FOUNDATION fieldbus status as in the following table.

CURRENT	FOUNDATION FIELDBUS STATUS
3.8 mA < current < 20.5 mA	GoodNonCascade:GoodNCNonSpecific:Constant
3.6 mA < current ≤ 3.8 mA	Uncertain:UncertainNonSpecific:LowLimited
20.5 mA ≤ current < 21.0 mA	Uncertain:UncertainNonSpecific:HighLimited
Current ≤ 3.6 mA	Bad:NonSpecific:Constant
Current ≥ 21.0 mA	Bad:NonSpecific:Constant

The unit of **ANALOG_VALUE** parameter is available in the **VAR_UNITS[9]** parameter of the **TBH** block.

The DF117 module has a safe mode configured by the **SAFE_BEHAVIOR** parameter of the **TBH** block, with the following values: 3.6 mA and 21 mA. These values represent the current value that will be controlled by the DF117 when, due to some fault in the controller, there is not data exchange between them.

Default value of HART parameters of TBH block

In situations where it could not read the required information from the HART device by the HART parameter of **TBH** block, this will appear with the default value. The most common conditions for this to happen are:

- HART device has not yet been identified (startup, wrong address, wrong installation);
- No HART device installed in the channel indicated by the **RRSGP** parameter of the block;
- Parameter does not exist on HART device. This depends on the HART protocol version of the device and is also mandatory implementation of the HART command that reads the parameter in question;
- Invalid index in **HART_VAR_CODES8.**

The table below shows the default value of some HART parameters of the block

PARAMETER	DEFAULT VALUE
HART_PV.VALUE	NAN (Not a number)
HART_PV.STATUS	Bad: Constant
HART_SV.VALUE	NAN (Not a number)
HART_SV.STATUS	Bad: Constant
HART_TV.VALUE	NAN (Not a number)
HART_TV.STATUS	Bad: Constant
HART_5V.VALUE	NAN (Not a number)
HART_5V.STATUS	Bad: Constant
HART_6V.VALUE	NAN (Not a number)
HART_6V.STATUS	Bad: Constant
HART_7V.VALUE	NAN (Not a number)
HART_7V.STATUS	Bad: Constant
HART_8V.VALUE	NAN (Not a number)
HART_8V.STATUS	Bad: Constant
VARUNITS9.[1]	0 (None Units)
VARUNITS9.[2]	0 (None Units)
VARUNITS9.[3]	0 (None Units)
VARUNITS9.[4]	0 (None Units)
VARUNITS9.[5]	0 (None Units)
VARUNITS9.[6]	0 (None Units)

VARUNITS9.[7]	0 (None Units)
VARUNITS9.[8]	0 (None Units)

Input/output parameters (link) of TBH block

The **TBH** block has 9 parameters that can be linked to other blocks to be used in the control strategy. The link is done through the **RRSGP** parameter according to the rule **RRSGP**.

The update time of HART parameters in the **TBH** block is indicated by **HART_TSTAMP** parameter.

Burst Mode

The Burst mode is used to decrease the access time to the dynamic variables of HART device. Once configured and enabled, the device periodically sends the HART message according to the command configured without the Host doing a request.

In version 5 and 6 of the HART protocol is possible to configure only one command at a time to work in Burst mode, while in version 7 several commands can be used simultaneously and at different intervals.

The Burst mode is not a mandatory feature on HART device, but when supported, enabled, and the Burst command is equals to that used in polling of **TBH** block dynamic variables (see **HART_VAR_CODES** parameter) the DF116/DF117 modules stop sending request messages and they use the information from the burst commands.

The **HART_BURST_CTRL_N** parameter of **TBH** block has a set of parameters that are related to the burst message. These parameters are read-only, so changes in the burst message must be done through a handheld configurator or any other HART configurator that acts as secondary master on the HART network. Depending on the HART version some of these parameters does not exist in the HART device and should appear as the default value in the block.

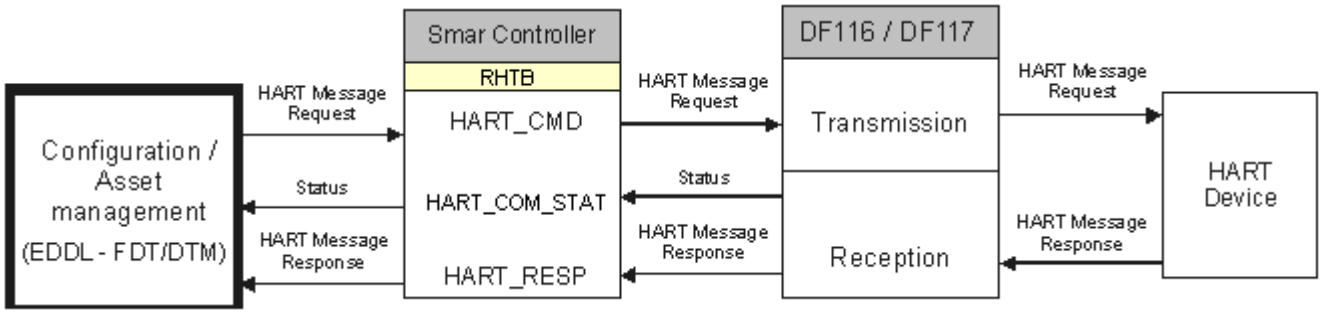
PARAMETER	HART			DEFAULT	DESCRIPTION
	5	6	7		
PUBLISH_CONTROL	x	x	x	0	Publish data mode control code: (0 = Off, 1 = Enable Publish on token-passing data-link layer only (wired); 3 = Enable Publish on TDMA and token-passing data-link layers)
HART_COMMAND_EXPANSION			x	0	HART Command Expansion: 31 (0x1F) or LSB of the Publish data command number
DEVICE_VARIABLE_CODE_0	x	x	x	0	Device variable code assigned to Slot 0, value ‘250’ for unused slot
DEVICE_VARIABLE_CODE_1	x	x	x	0	Device variable code assigned to Slot 1, value ‘250’ for unused slot
DEVICE_VARIABLE_CODE_2	x	x	x	0	Device variable code assigned to Slot 2, value ‘250’ for unused slot
DEVICE_VARIABLE_CODE_3	x	x	x	0	Device variable code assigned to Slot 3, value ‘250’ for unused slot
DEVICE_VARIABLE_CODE_4			x	0	Device variable code assigned to Slot 4, value ‘250’ for unused slot
DEVICE_VARIABLE_CODE_5			x	0	Device variable code assigned to Slot 5, value ‘250’ for unused slot
DEVICE_VARIABLE_CODE_6			x	0	Device variable code assigned to Slot 6, value ‘250’ for unused slot
DEVICE_VARIABLE_CODE_7			x	0	Device variable code assigned to Slot 7, value ‘250’ for unused slot
PUBLISH_DATA_REF			x	0	Reference to one set of published data in all read and write requests and responses for that set
MAX_PUBLISH_COUNT			x	0	Maximum number of Publish data messages supported by the device
HART_COMMAND_NUMBER	x	x	x	0	Extended HART command number
MINIMUM_UODATE_PERIOD			x	0	The duration between two successive publications of the specified data, if the trigger conditions are met. I.e., shortest inter-update duration
MAXIMUM_UPDATE_PERIOD			x	0	The duration between two successive publications of the specified data, if the trigger conditions are met. I.e., longest inter-update duration
TRIGGER_MODE			x	0	(0 = Continuous or Normal [Always send at maximum period]; 1 = Window or Delta Save [Send at minimum update period if current value exceeds last published value ± Trigger level]; 2 = High [Send at minimum update period if current value is above Trigger level]; 3 = [Send at minimum update period if current value is below Trigger]; 4 = On Change [Send on change---for discrete values])
DEVICE_VARIABLE_CLASS			x	0	Function performed by the device variables as specified in HCF_SPEC-

					183
HART_UNIT			x	0	Measurement unit of the primary variables as specified in HCF_SPEC-183
TRIGGER_LEVEL			x	0	Window (delta value) or the level that is used to trigger the publishing

BYPASS Parameters

The **TBH** block consists a set of HART parameters related to the process, the reading/writing of these commands is done through standard HART commands.

During the startup phase and maintenance may be necessary to configure the HART device using specific parameters that are not mapped on **TBH** block. For this, the configuration tools and asset management can use the **BYPASS** parameters of **TBH** block to send and receive messages directly in the standard format of HART command. Such feature is ideal for tools that make use of the DTM and EDDL technologies because they allow access to all variables of the equipment through the command groups of HART protocol (universal, common and specific).



According to the figure above, the HART request message has to be written in the **HART_CMD** parameter of **TBH** block. The written content on this parameter is used in the construction of the HART command that is sent to the channel when it is free. In order to simplify, only a few fields that form the HART message should be provided in **HART_CMD** parameter, as shown in the following figure.

Delimiter	**Address**	**[Expansion Bytes]**	**Command**	**Byte Count**	**[Data]**	**Check Byte**

The first byte of **HART_CMD** parameter has to indicate the total number of bytes of the message (Command + Byte Count + Data)

NOTE
The DF116 and DF117 modules include the fields of HART message that are not in the **HART_CMD** parameter. The application has the responsibility to ensure the quality of sent messages and interpretation of responses.

The response of the HART device related to the request message sent through the **HART_CMD** parameter is available on the **HART_RESP** parameter.

The **HART_COM_STAT** parameter indicates message transaction status; it may have the following values:

- **IDLE** – the channel is available to send **BYPASS** message.
- **BUSY –** the channel is unavailable to send **BYPASS** message, because is processing a previous message.

Sequence for sending a HART message via BYPASS mode

- Check if the **HART_COM_STAT** parameter is in **IDLE**, **TIMEOUT** or **COMPLETED**. If positive, the message can be written in the **HART_CMD** parameter. After that, the user must write the **WRITTING** status in the **HART_COM_STAT** parameter**.** The HART module will check if the channel is available and in the first possibility will transmit the full contents of the parameter.

- While the **HART_COM_STAT** parameter is in **AWAITING RESPONSE**, the HART module is waiting the response or is repeating the request up to limit of retries.

- The **HART_COM_STAT** parameter goes to **COMPLETED** if it has received a valid message and goes to **TIMEOUT** if it has not received a valid message yet.

Examples

Example of HART commands that were sent to the device and the received responses by the device.

Command #0: 02 00 00
Response: 10 00 0E 00 02 FE 3E 02 05 05 03 24 09 00 0C 72 29

Command #33: 06 21 04 01 02 03 04
Response: 1C 21 1A 00 42 01 39 42 C8 05 14 02 25 42 C8 05 14 03 20 7F FF FF FF 04 39 42 C8 05 14

Firmware Version

The firmware version is essential for troubleshooting. If something is not working properly, check the version of the device before contacting Smar technical support.

The firmware version is on a tag pasted on the FPGA reference U21, GLL1386 of the DF116.

Indexes of Smar HART devices variables

The variables of these tables can be accessed by the **#9** and **#33** HART commands through the correct configuration of indexes in the **HART_VAR_CODES8[n**] parameter of **TBH** block. Remember that the **#9** command is accessible only to devices with version 6 and 7 of the HART protocol. On this section, only some devices are described. See the device's manual for further information.

FY301 - Intelligent Valve Positioner

INDEX	VARIABLE
0	Input Current in milliamperes
1	Process Variable in percentage
2	Current Setpoint in percentage
3	PID MV in percentage
4	PID ERRO in percentage
5	Desired Pos in percentage
6	Setpoint in percentage
7	PID Integral in percentage
8	Hall
9	Temperature in °C
10	Piezo Voltage
11	Temperature in °F
12	Travel
13	Strokes
14	Reversals
15	Lowest Temperature
16	Highest Temperature
17	None
18	None

19	None
20	Opening Time
21	Closing Time
22	Setup Watchdog
23	Out Press 1
24	Out Press 2
25	In Press

LD301 and LD291 - Intelligent Pressure Transmitters

INDEX	VARIABLE
0	Output In Milliamperes
1	Output In Percent
2	Pressure (Primary Variable)
3	Process Variable Percent
4	Process Variable
5	Temperature (Secondary Variable)
6	Setpoint Percent
7	Setpoint
8	Error
9	Total

TT301 - Intelligent Temperature Transmitter

INDEX	VARIABLE
0	Output in milliamperes - Out
1	Output in percent - Out%
2	Temperature - (PV)
3	Environment temperature - Temp
4	Process variable percent- PV%
5	Setpoint percent - SP%
6	Setpoint - SP
7	Setpoint time - SPTIME
8	Error - ER%
9	PID_KP -KP
10	PID_TR - TR
11	PID_TD - TD
12	Damping - Damp
13	Manual register - MV
14-24	Reserved
25	Input variable (used for trim)

DT301 - Intelligent Density Transmitter

INDEX	VARIABLE
0	Output in milliamperes - Out
1	Output in percent - Out%
2	Temperature - (PV)
3	Environment temperature - Temp
4	Process variable percent- PV%
5	Setpoint percent - SP%
6	Setpoint - SP
7	Setpoint time - SPTIME
8	Error - ER%
9	PID_KP - KP
10	PID_TR - TR
11	PID_TD - TD

TP301 - Smart Position Transmitter

INDEX	VARIABLE
0	Position in percentage
1	Output in milliamperes
2	Temperature in °C
3	Temperature in ºF
4	Hall
5	PV (EU) position unit
6	% of Hall

TT400 HART - Intelligent Temperature Transmitter

INDEX	VARIABLE
0	Output Variable related to analog output
1	Process Variable in percentage units
2	Process Variable in engineering units
3	Secondary Variable related to sensor temperature
4	Backup Sensor Value
5	Output Current Feedback in percentage
6	Output Current Feedback

LD400 HART - Smart Pressure Transmitter

INDEX	VARIABLE
0	Output Variable related to analog output
1	Ranged Output Variable related to analog output
2	Primary Variable related to measured pressure
3	Ranged Process Variable
4	Process Variable in engineering units
5	Secondary Variable related to sensor temperature
6	Totalization
7	Ranged Setpoint
8	Setpoint in engineering units
9	Deviation (PV% - SP%)

FY400 – Smart Valve Positioner

INDEX	VARIABLE
00	Setpoint in percentage
01	Input Current in milliamperes
02	Input Current in percentage
03	Primary Variable in percentage
04	Hall Digital
05	PID ERROR in percentage
06	PID Integral
07	PID MV in percentage
08	Piezo Voltage
09	Temperature in °C
10	Temperature in °F
11	Lowest Temperature
12	Highest Temperature
13	In Press
14	Out Press 1
15	Out Press 2
16	Load Factor
17	Pressure Difference
18	Actuator Reversal Counter
19	Valve Reversal Counter
20	Actuator Reversal Operation Time
21	Valve Reversal Operation Time
22	Stroke Limit Counter
23	Stroke Limit First Time Activated
24	Stroke Limit Last Time Activated
25	Stroke Limit Operation Time
26	Stroke Limit Measured Time
27	Load Factor Counter
28	Load Factor Counter First Time Act.
29	Load Factor Counter Last Time Act.
30	Load Factor Operation Time
31	Actuator Reversal First Time Act.
32	Valve Reversal First Time Act.
33	Actuator Reversal Last Time Act.
34	Valve Reversal Last Time Act.
35	PST Valve Breakout
36	Deviation Counter
37	Deviation Counter First Time Act.
38	Deviation Counter Last Time Act.
39	Deviation Counter Accumulated Time
40	Deviation Counter Operation Time
41	Deviation Alarm Measured Time
42	Pressure Problem Counter
43	Press. Problem Counter Accumulated Time
44	Press. Problem Counter First Time Activated
45	Press. Problem Counter Last Time Activated
46	Pressure Operation Time
47	Actuator Travel Mileage
48	Valve Travel Mileage
49	Deviation Alarm Measured Value

INSTALLING MODULES IN THE RACK

Follow the steps below to install a module in the rack.

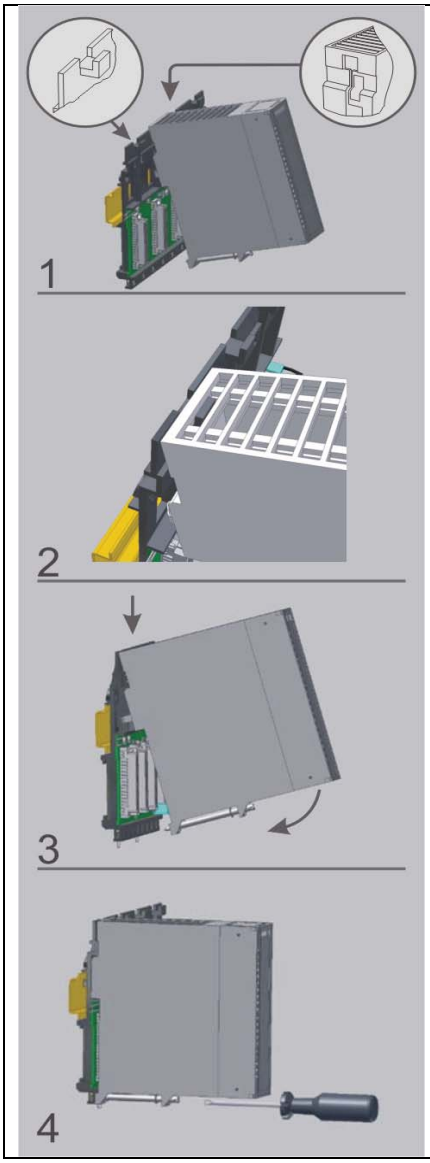
	Attach the top of the module (with a 45° inclination) to the module support located on the upper part of the rack. Mounting detail. Push the module fixing it to the module connector. Next, fix the module to the rack using a screwdriver, and fasten the fixation screw at the bottom of the module.

Figure 26 – Installing the Module in the Rack

R-SERIES – REDUNDANT I/O MODULES

Introduction

To meet the requirements for fault tolerance, system availability and safety in the industrial process, the DFI302 controllers work with a Hot Standby redundancy strategy, where all the levels, including conventional Input and Outputs signals, may be configured and installed in a redundant manner.

In this strategy, the Primary and the Secondary controllers are connected to a set of redundant I/O scanners, which are dedicated to read and write the redundant I/O cards. The complete path from sensor until operation station is totally redundant. In case of one fault, an event will alarm the user, and the availability will be granted in a bumpless way.

IMPORTANT
The characteristics described in this section are supported by the DF62, DF63 and DF75 controllers at this time. Ask to check availability to other DFI302 controllers.

R-Series Ordering Codes

The following components are necessary to build R-Series I/O Redundancy in DFI302.

RACKS AND ACCESSORIES	
DF106	Master Rack - 6 slots for I/O redundancy
DF110 -1	Slave Rack - 10 slots for I/O redundancy - Terminal blocks
DF110 -2	Slave Rack - 10 slots for I/O redundancy – Interface cabling
DF109	Thin stub cable (0,40m)
DF119	Thick cable (1,0m) for DF106-DF109 or DF106-DF110
SCANNERS	
DF107	Master Scanner for I/O Redundancy
DF108	Slave Scanner for I/O Redundancy
I/O MODULES	
DF111	1 Group of 16 Redundant Digital Inputs 24 Vdc - Source
DF112	1 Group of 16 Redundant Digital Outputs 24 Vdc - Sink
DF113	1 Group of 8 Redundant Current Analog Inputs
DF114	1 Group of 8 Redundant Current Analog Outputs

The following components may complement R-Series IO Redundancy in DFI302.

Code	Description
DF87	Power Supply for Backplane 20-30VDC (5A, Advanced Diagnostic)
DF0-R	Box Used In Empty Slots
ITF-CR-10 ITF-CR-15 ITF-CR-20 ITF-CR-25 ITF-CR-30 ITF-CR-35 ITF-CR-40 ITF-CR-45 ITF-CR-50	Interface cabling (1 m to 5 m)
ITF-DIG	Passive Interface Panel for 16 Digital Input and/or Output Module - DC *Obs. The active components must be external connected*

ITF-AN-IOR	Interface Panel for 8 Analog Input and/or Output Module *Obs. Exclusive for R-Series*

R-Series IO Redundant System Overview

In order to have a true Conventional I/O redundant system, all the parts and paths must be redundant. The hardware topology for Input and Output Redundant segments based on DFI302 controllers can be seen in the following figure. The system supports up to 16 pairs of R-Series I/O modules. This means 128 analog or 256 discrete I/O values, or a mix of them.

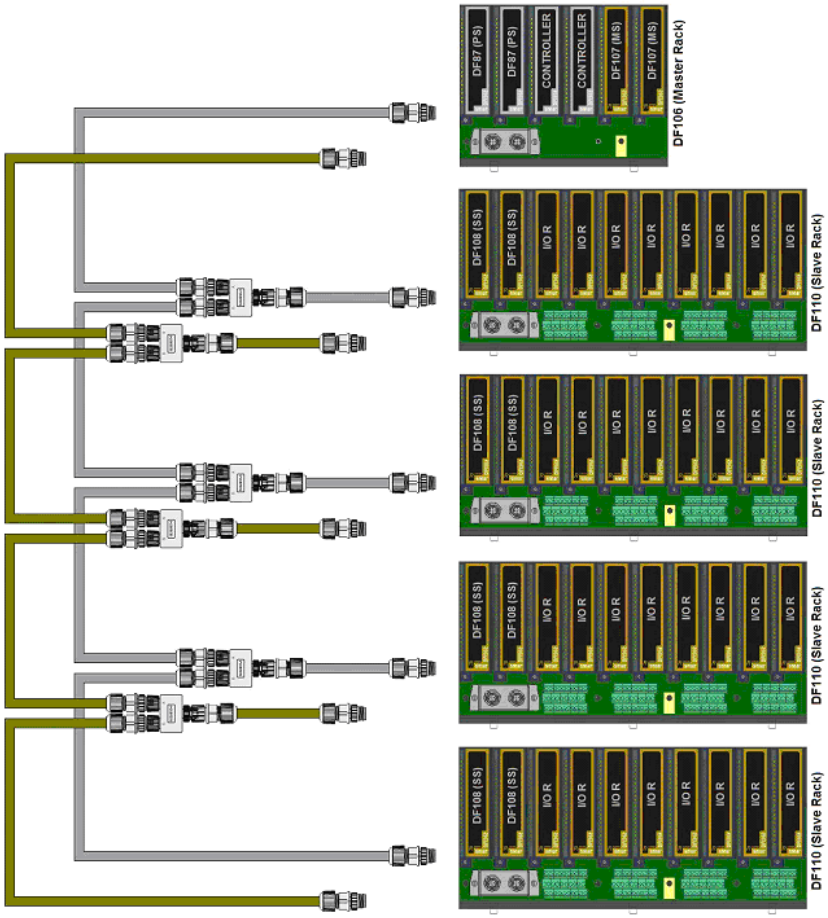


Figure 27 - I/O Redundant System Overview

The **SYSTEM302** software logic tool, **LogicView for FFB**, select the **IO redundancy** option during hardware configuration phase, and after that, no extra configuration is need once the I/O redundancy is totally transparent to the control logic perspective.

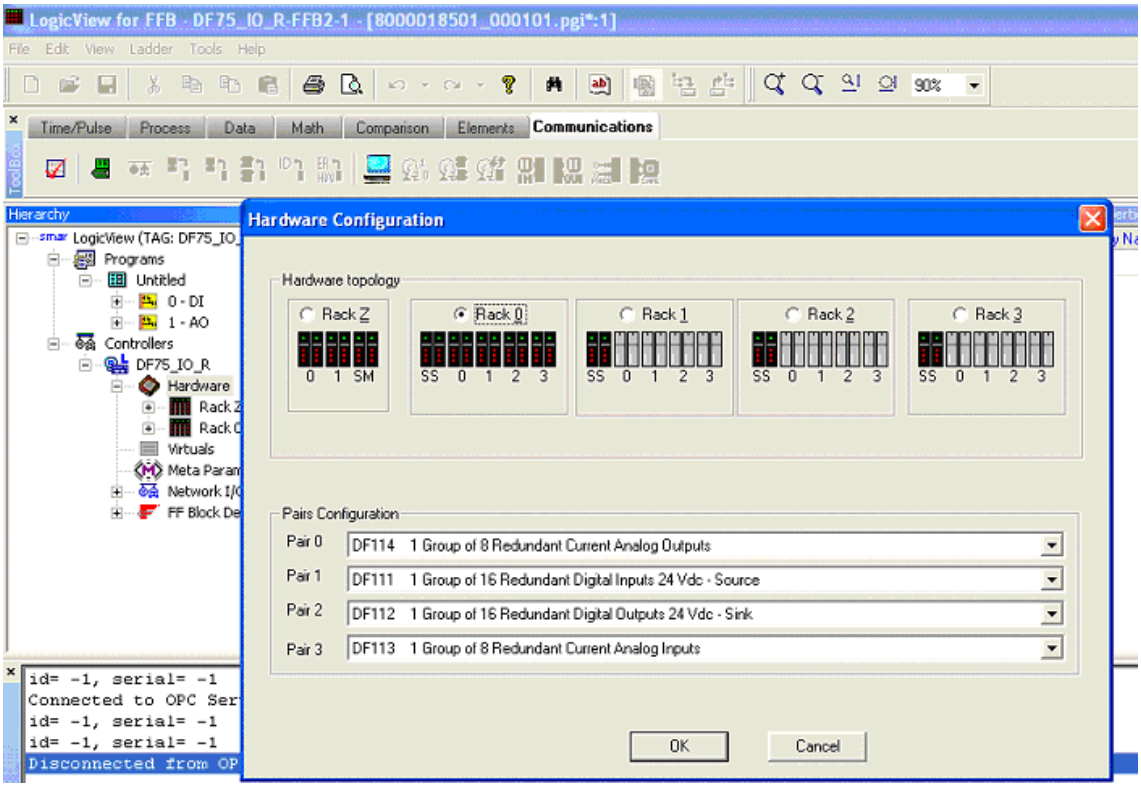


Figure 28 - Configuring redundant I/O modules on LogicView for FFB

Each pair of redundant I/O modules checks the health of each other, working in an independent manner ahead of the main controller scan and grants the switchover in less than 100 microseconds. In case of a fault in the primary I/O module, the secondary I/O module takes the control ensuring that the digital field instruments remain powered and that the process is undisturbed.

No single point of failure exists on this architecture, which means that any hardware failure is covered by a second hardware working in a hot standby way. During operation, each I/O module makes use of an internal high precise reference which is used for analog I/O cards to self-diagnostic. The output I/O card also makes use of a digital feedback circuitry to make sure its output matches the main controller request.

Scanners continually measure the health of each I/O modules to update the main controllers. The main controllers may use the status of the I/O modules in the control logic as safety interlock and provide the same rich information to HMI Stations.

The diagnostic status for the whole system is available, as OPC and Simple Network Management Protocol (SNMP) parameters, available to HMI stations through its respective servers.

When maintenance is needed, the system permits hot swap of the modules, including power supplies, controllers, scanners and I/O modules.

The racks were built to avoid any kind of maintenance. No active component is mounted in this rack.

DF106 – The Master Rack

The Master Rack (DF106) was built to avoid any kind of maintenance. No active component is mounted in this rack. It is possible to connect one pair of redundant power supplies, one pair of redundant controllers and one pair of redundant master scanners.

Figure 29 - Master Rack with
(a) Redundant power supplies
(b) Redundant Controllers
(c) Redundant Master Scanners

DF110 – The Slave Rack

The Slave Rack (DF110) was built to avoid any kind of maintenance. No active component is mounted in this rack. It is possible to connect one pair of redundant slave scanners and up to four pairs of redundant I/O modules per slave rack. Four slave racks is the maximum per master rack.

Two DF110 models are available:

- DF110-1 (Terminal blocks)
- DF110-2 (Interface cabling)

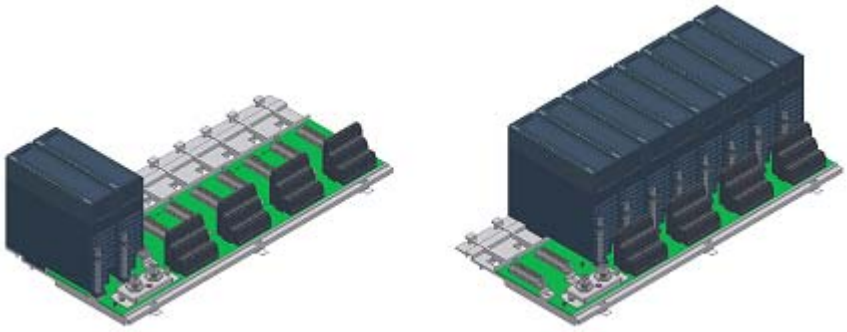


Figure 30 - Slave Rack with
(a) Redundant Slave Scanners

(b) Redundant IO modules

DF107 – The Master Scanner

Additional to redundant power supplies and controllers, the Master Scanner (DF107) is necessary to support conventional I/O in a redundant way. Connected to a passive rack (DF106), these master scanners will grant access to up to four redundant I/O racks (DF110).

Technical Specifications

INTERNAL POWER	
Provided by the IMB	5 Vdc
Maximum Consumption	120 mA

DISSIPATED POWER	
Maximum per Scanner	0.60 W

INDICATION LEDs		
LED	**COLOR**	**DESCRIPTION**
+5VDC A	Green	It indicates voltage provided by the redundant power supply A (left)
+5VDC B	Green	It indicates voltage provided by the redundant power supply B (right)
FAIL	Red	Scanner failure
CTRL	Green	It indicates communication with the controller.
SS-RX	Green	Communication activity – reception of slave scanner.
SS-TX	Green	Communication activity – transmission of slave scanner.
MS-RED	Green	Redundant partner (is necessary at least a pair of slave scanner properly connected to DF110-x rack).

TEMPERATURE	
Operation	0 °C to 60 °C (32 ºF to 140 ºF)

DIMENSIONS	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5mm 1.57 x 5.39 x 5.57 in

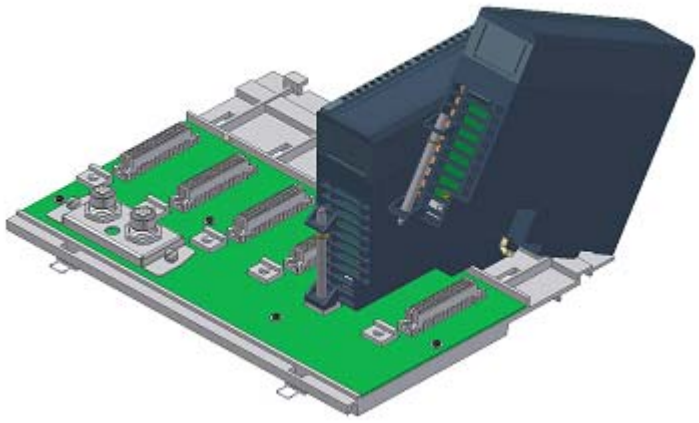


Figure 31 - Extracting the redundant Master Scanner

DF108 – The Slave Scanner

Using a double path, through DF109 and DF119 cables, the pair of Slave Scanners (DF108) is connected to Master Scanners (DF107), and grant real time access to until 16 pairs of I/O modules.

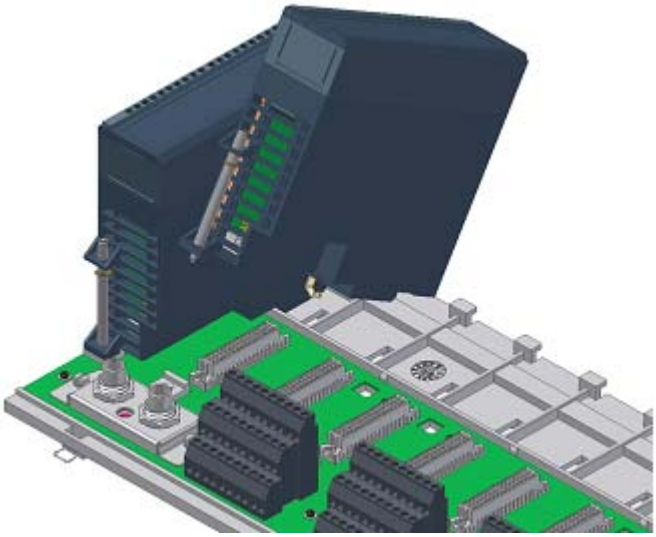
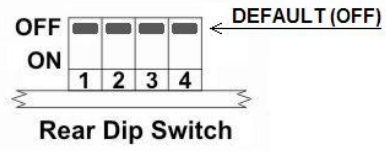


Figure 32 - Extracting the redundant Slave Scanner

Up to 4 DF110-x (slave racks) may be used in the R-Series system where the slave rack address is internally adjusted via DIP switches in the DF108 (slave scanners) modules. Necessarily the DF108 pair located in the same rack must have the same address.



ADDRESS	DIP SWITCH			
	1	2	3	4
RACK 0	OFF	OFF	OFF	OFF
RACK 1	ON	OFF	OFF	OFF
RACK 2	OFF	ON	OFF	OFF
RACK 3	ON	ON	OFF	OFF

Figure 33 – Rack addressing on DF108 – SW1 (rear)

An additional mechanical keying was added in the DF108 modules as a way to avoid that during maintenance process, the DF108 modules position is changed between slave racks.

Three white pins are screwed by factory in the DF108 module, therefore there are no white pins screwed by factory in the DF110-x slave rack. To create a proper keying, it is suggested the following configuration between DF108 and DF110-x, before powering up the system.

Consider from top to bottom the pins A, B and C. The modules should be keyed as following:

- Rack 0 - Pins B and C screwed in the DF108 module and Pin A screwed in the rack DF110-x.
- Rack 1 - Pins A and C screwed in the DF108 module and Pin B screwed in the rack DF110-x.
- Rack 2 - Pins A and B screwed in the DF108 module and Pin C screwed in the rack DF110-x.
- Rack 3 - Pin C screwed in the DF108 module and Pins A and B screwed in the rack DF110-x.

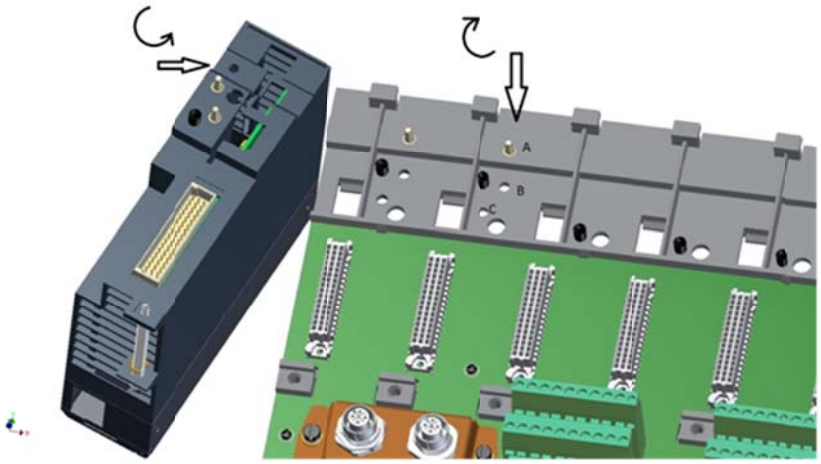


Figure 34 – Rack 0 - Pins B and C screwed in the DF108 module and Pin A screwed in the rack DF110-1

Technical Specifications

INTERNAL POWER	
Provided by the IMB	5 Vdc
Maximum Consumption	106 mA

DISSIPATED POWER	
Maximum per Scanner	0.53 W

TEMPERATURE	
Operation	0 °C to 60 °C (32 ºF to 140 ºF)

DIMENSIONS	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5mm 1.57 x 5.39 x 5.57 in

INDICATION LEDs		
LED	**COLOR**	**DESCRIPTION**
+5VDC A	Green	It indicates voltage provided by the redundant power supply A (left).
+5VDC B	Green	It indicates voltage provided by the redundant power supply B (right).
FAIL	Red	Scanner failure.
MS-RX	Green	Communication activity – reception of master scanner
MS-TX	Green	Communication activity – transmission of master scanner
IO-RX	Green	Communication activity – reception of I/O modules
IO-TX	Green	Communication activity – transmission I/O modules
SS-RED	Green	Redundant partner.

Redundant Input and Output modules

These modules are designed to be used together with Redundant I/O Rack (DF110), supporting redundancy, hot swap and diagnostic.

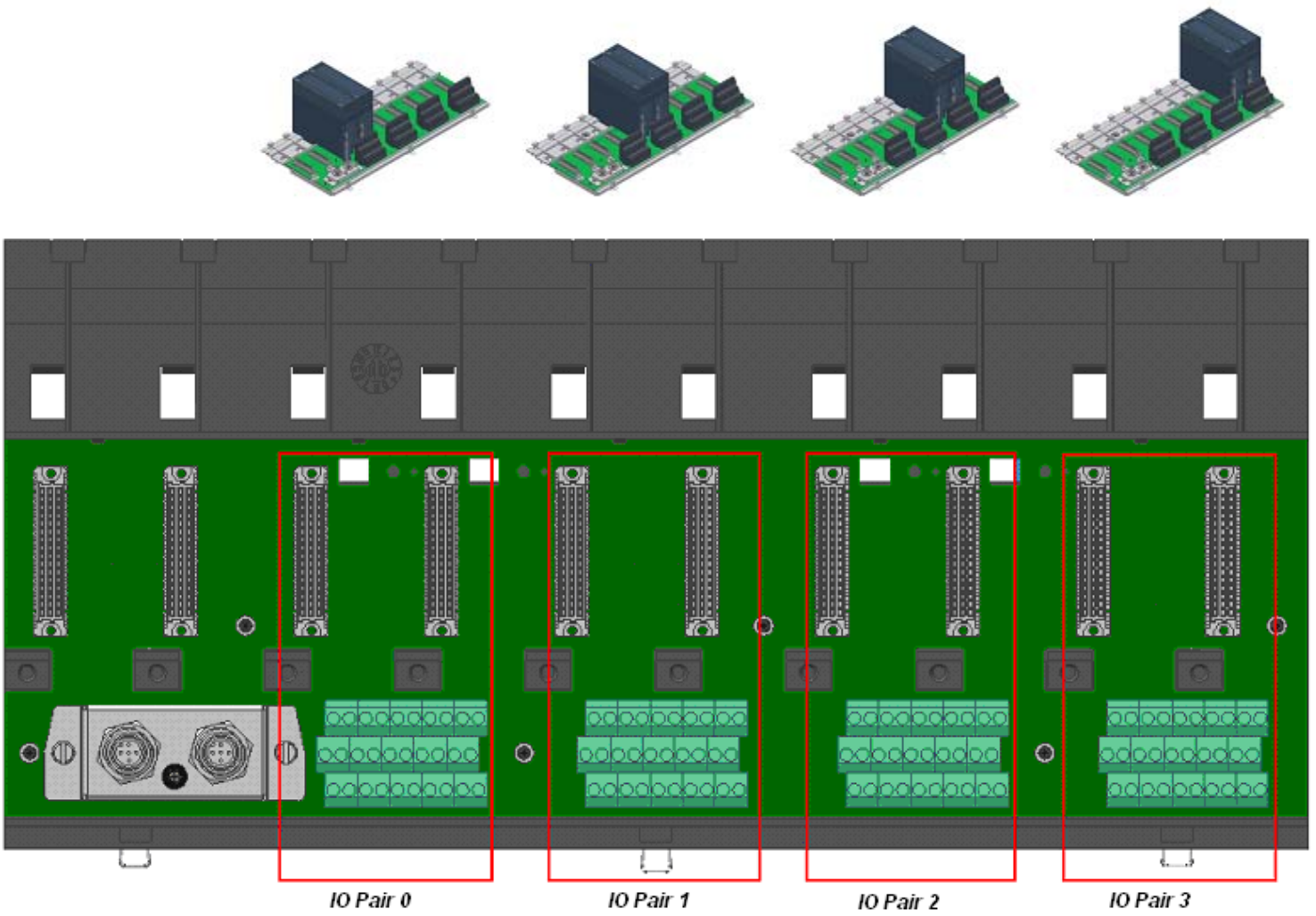


Figure 35 - Available positions for I/O modules in DF110-1

Grounding the Shield Terminal

In order to proper grounding the system, a main terminal shield is available in both DF110-1 and DF110-2 models and must be connected to ground. Refer to SYSTEM302 Electric Installation Guide for further information about proper system grounding.

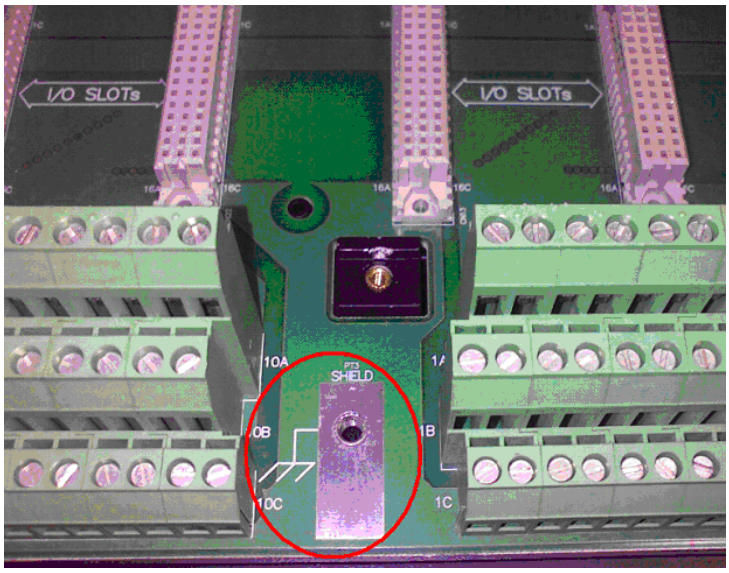


Figure 36 - Shield Terminal in DF110-1

DF111 – REDUNDANT DIGITAL INPUT MODULE - DC (SOURCE)

DF111 (1 Group of 16 Redundant Digital Inputs 24 Vdc - Source)

Description

This module provides 16 digital inputs (DC type SOURCE) and converts them into a True (ON) or False (OFF) logic signals. It has one group optically isolated from IMB.

Figure 37 – Details of the DF111 Module

NOTE
DIP SWITCHES: Reserved use, keep all switches OFF.

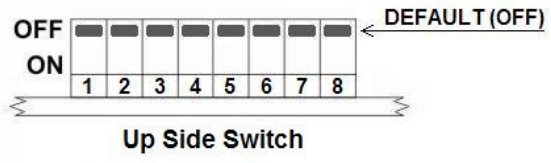


Figure 38 – Configuration of module DIP switches – SW9 (upside)

Technical Specifications

ARCHITECTURE	
Number of Inputs	16
Number of Groups	1
Number of Inputs per Group	16

ISOLATION	
Between Group and IMB	5000 Vrms

INTERNAL POWER	
Provided by the IMB	5 Vdc
Maximum Consumption	80 mA

EXTERNAL POWER	
Power Supply (VEXT)	20 - 30 Vdc
Typical Consumption per module	160 mA @ 24Vdc and all channels activated (ON)

INPUTS	
ON State Voltage Range (Logic "1")	0 – 5 Vdc @ Zload < 200 Ω
OFF State Voltage Range (Logic "0")	20 – 30 Vdc @ Zload >10 KΩ
Typical Current per Point	8 mA @ 24 Vdc

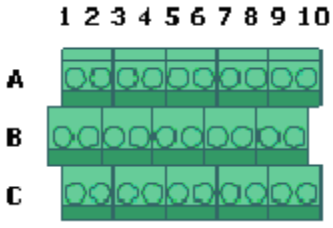
DISSIPATED POWER	
Typical per Module	4.24 W @ 24Vdc and all channels activated (ON)

INDICATION LEDs		
LED	**COLOR**	**DESCRIPTION**
ON / FAIL	Green/Red	It indicates the module status – good or fail.
STANDBY	Green	It indicates that the module operation status is standby when green, otherwise it is off.
0 ~ 15	Yellow	It indicates the logic level of digital input channel. (Logic Level 1: ON)

TEMPERATURE	
Operation	0 °C to 60 °C (32 ºF to 140 ºF)

DIMENSIONS	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5mm 1.57 x 5.39 x 5.57 in

Terminal Block diagram of Rack DF110-1



NOTE
To use the DF111 module with the panel interfaces solution of Smar, the user must use the DF110-2 rack and ITF-DIG interface. For further details refer to the Panel Interfaces manual.

Terminal	1	2	3	4	5	6	7	8	9	10
A	DI_00	DI_01	DI_02	DI_03	DI_04	DI_05	DI_06	DI_07	VEXT_A	VEXT_B
B	DI_08	DI_09	DI_10	DI_11	DI_12	DI_13	DI_14	DI_15	GND	GND
C	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	GND	GND

Abbreviations

DI_XX	Digital Input XX
GND	Ground connection (all four GND terminals are connected internally and are independent of the other GND in the rack)
SHIELD	Shield connection (all eight shield terminals are connected internally to main terminal shield in the rack – see figure Shield Terminal in DF110-1)
VEXT_A	External power supply A - 24Vdc (+)
VEXT_B	External power supply B - 24Vdc (+)
GND	Ground connection (-) of the power supplies A and B (all four GND terminals of a pair of modules are connected internally and are independent from the GND terminals of the other pairs of modules)

NOTE

The voltage applied to VEXT_A will power the I/O module at left of the redundant pair and the power supply applied to VEXT_B will power the I/O module at right of the redundant pair.

For redundancy availability, for external power supplies, the rack should be powered with two different external power supplies, one to VEXT_A and another to VEXT_B.

When using only one external power supply, power both terminals VEXT_A and VEXT_B with the same power supply, so the two modules of the redundant pair are powered.

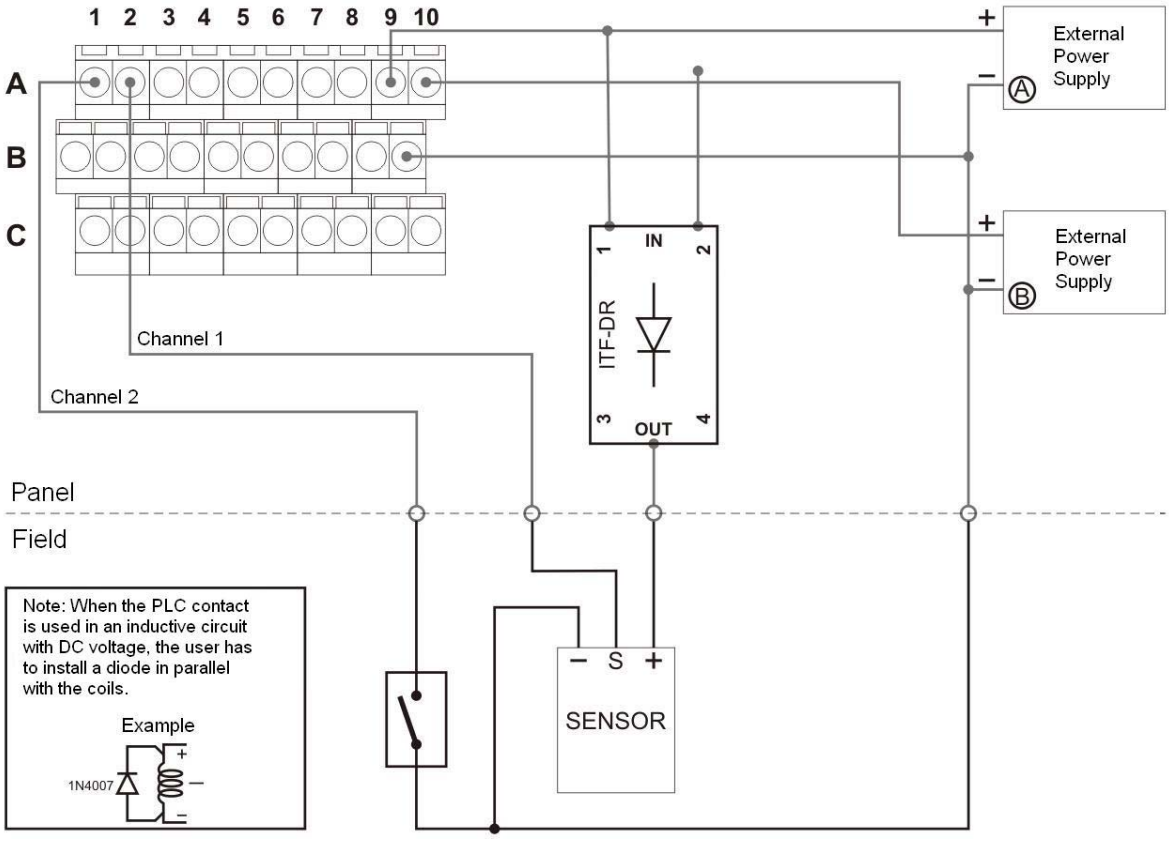


Figure 39 – Connection example of DF111 module with rack DF110-1

DF112 - REDUNDANT DIGITAL OUTPUT MODULE - DC (SINK)

DF112 (1 Group of 16 Redundant Digital Outputs 24 Vdc – Sink)

Description

This module provides 16 digital outputs (DC type SINK) that are able to drive loads with up to 100 mA per output. It has one group optically isolated from IMB.

Figure 40 – Details of the DF112 Module

NOTE
DIP SWITCHES: Reserved use, keep all switches OFF.

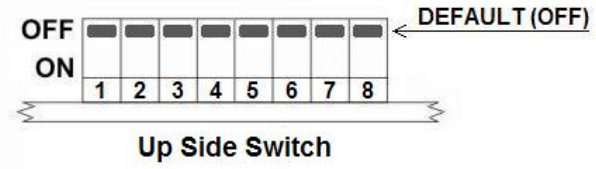


Figure 41 – Configuration of module DIP switches – SW9 (upside)

NOTE
In case of failure of both controllers, the outputs will go individually to the Safe Behavior state (Last Value, Safe Value) as configured using the LogicView for FFB.

Technical Specifications

ARCHITECTURE	
Number of Outputs	16
Number of Groups	1
Number of Outputs per Group	16

ISOLATION	
Between Group and IMB	5000 Vrms

INTERNAL POWER	
Provided by the IMB	5 Vdc
Maximum Consumption	80 mA

EXTERNAL POWER	
Power Supply (VEXT)	20 – 30 Vdc
Typical Consumption per module	180 mA @ 24Vdc and all channels activated (ON)

OUTPUTS	
Maximum Switched Voltage	30 Vdc
Maximum Current per Output	100 mA
Indicator Logic	ON when the transistor is conducting.

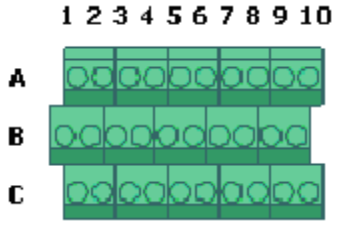
DISSIPATED POWER	
Typical per Module	4.72 W @ 24Vdc and all channels activated (ON)

INDICATION LEDs		
LED	**COLOR**	**DESCRIPTION**
ON / FAIL	Green/Red	It indicates the module status.
STANDBY	Green	It indicates that the module operation status is standby when green, otherwise it is off.
0 ~ 15	Yellow	It indicates the logic level of digital output channel. (Logic Level 1: ON)

TEMPERATURE	
Operation	0 °C to 60 °C (32 ºF to 140 ºF)

DIMENSIONS	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5mm 1.57 x 5.39 x 5.57 in

Terminal Block diagram of Rack DF110-1



NOTE
To use the DF112 module with the panel interfaces solution of Smar, the user must use the DF110-2 rack and ITF-DIG interface. For further details refer to the Panel Interfaces manual.

Terminal	1	2	3	4	5	6	7	8	9	10
A	DO_00	DO_01	DO_02	DO_03	DO_04	DO_05	DO_06	DO_07	VEXT_A	VEXT_B
B	DO_08	DO_09	DO_10	DO_11	DO_12	DO_13	DO_14	DO_15	GND	GND
C	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	GND	GND

Abbreviations

DO_XX	Digital Output XX
SHIELD	Shield connection (all eight shield terminals are connected internally to main terminal shield in the rack – see figure Shield Terminal in DF110-1)
VEXT_A	External power supply A - 24Vdc (+)
VEXT_B	External power supply B - 24Vdc (+)
GND	Ground connection (-) of the power supplies A and B (all four GND terminals of a pair of modules are connected internally and are independent from the GND terminals of the other pairs of modules)

NOTE

The voltage applied to VEXT_A will power the I/O module at left of the redundant pair and the power supply applied to VEXT_B will power the I/O module at right of the redundant pair.

For redundancy availability, for external power supplies, the rack should be powered with two different external power supplies, one to VEXT_A and another to VEXT_B.

When using only one external power supply, power both terminals VEXT_A and VEXT_B with the same power supply, so the two modules of the redundant pair are powered.

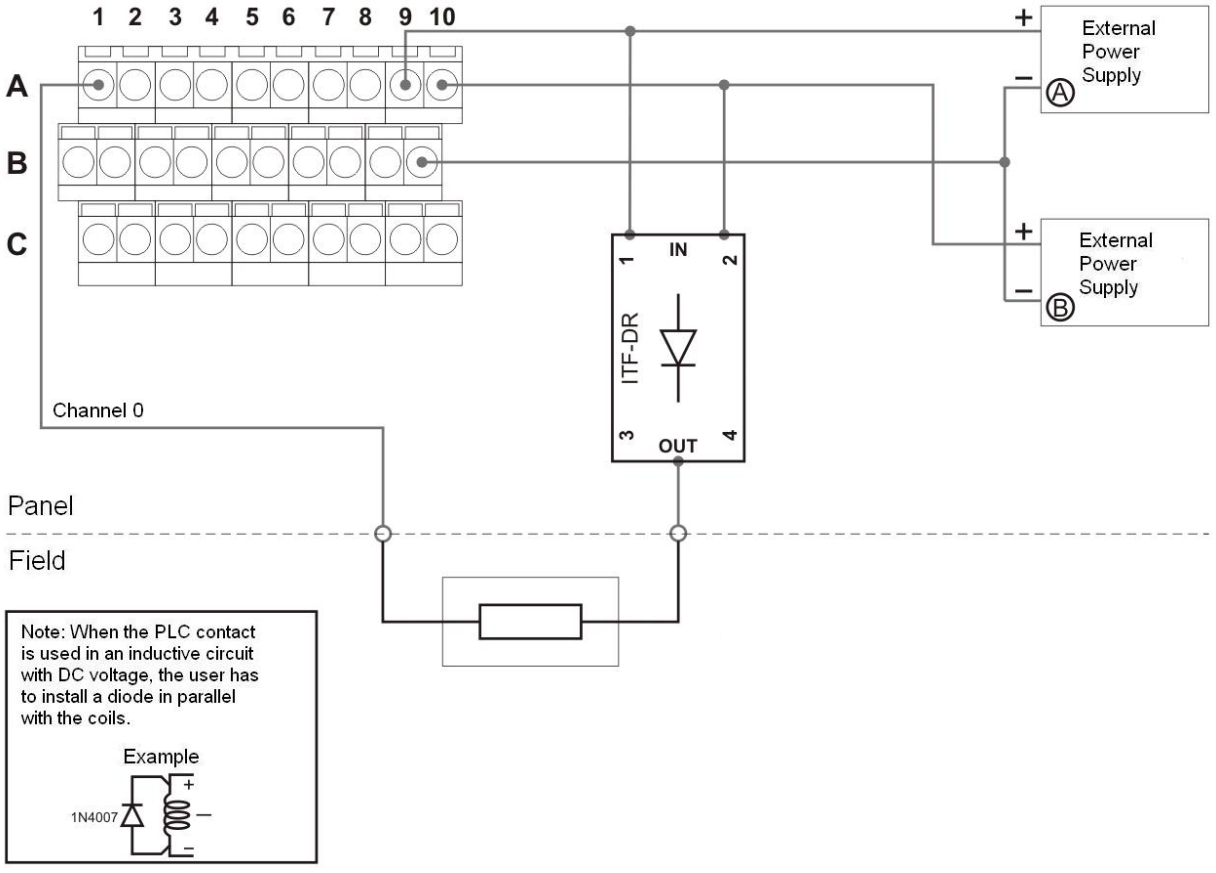


Figure 42 – Connection example of DF112 module with rack DF110-1

DF113 – REDUNDANT ANALOG INPUT MODULE - CURRENT

DF113 (1 Group of 8 Redundant Current Analog Inputs)

Description

This module provides 8 current analog inputs. The inputs are individually configured to read 0 to 20 mA or 4 to 20 mA. The group is isolated from IMB.

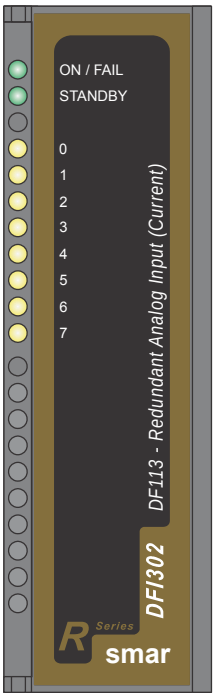


Figure 43 – Details of the DF113 Module

NOTE
DIP SWITCHES: Reserved use, keep all switches OFF.

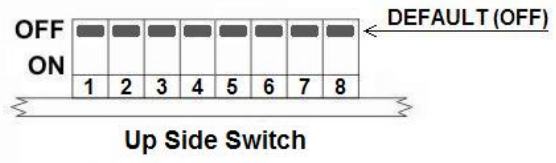


Figure 44 – Configuration of module DIP switches – SW9 (upside)

Technical Specifications

ARCHITECTURE	
Number of Inputs	8
Number of Groups	1
Number of Inputs per Group	8

ISOLATION	
Between Group and IMB	5000 Vrms

INTERNAL POWER	
Provided by the IMB	5 Vdc
Maximum Consumption	80 mA

EXTERNAL POWER	
Power Supply (VEXT)	20 – 30 Vdc
Typical Consumption per module	60 mA @ 24Vdc and 20 mA in all channels

INPUTS	
Inputs Type	Single Ended (1 ground)
Typical Impedance per Point	250 Ω

INPUTS RANGE	RANGE 1	RANGE 2
Current Input	4 mA to 20 mA	0 mA to 20 mA

A/D CONVERSION	
Resolution	16 bits

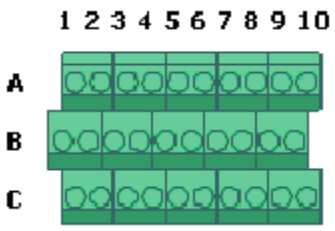
DISSIPATED POWER	
Typical per Module	2.78 W @ 24Vdc and 20 mA in all channels

INDICATION LEDs		
LED	**COLOR**	**DESCRIPTION**
ON / FAIL	Green/Red	It indicates the module status.
STANDBY	Green	It indicates that the module operation status is standby when green, otherwise it is off.
0 ~ 7	Yellow	It indicates the status of analog output channel. (GOOD: ON)

TEMPERATURE	
Operation	0 °C to 60 °C (32 ºF to 140 ºF)

DIMENSIONS	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5mm 1.57 x 5.39 x 5.57 in

Terminal Block diagram of Rack DF110-1



NOTE
To use the DF113 module with the panel interfaces solution of Smar, the user must use the DF110-2 rack and ITF-AN-IOR interface. For further details refer to the Panel Interfaces manual.

Terminal	1	2	3	4	5	6	7	8	9	10
A	AI_00(+)	AI_01(+)	AI_02(+)	AI_03(+)	AI_04(+)	AI_05(+)	AI_06(+)	AI_07(+)	VEXT_A	VEXT_B
B	AI_00(-)	AI_01(-)	AI_02(-)	AI_03(-)	AI_04(-)	AI_05(-)	AI_06(-)	AI_07(-)	GND	GND
C	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	GND	GND

Abbreviations

AI_XX(+)	Analog Input XX (+)
AI_XX(-)	Analog Input XX (-)
SHIELD	Shield connection (all eight shield terminals are connected internally to main Terminal Shield in the Rack – see figure Shield Terminal in DF110-1)
VEXT_A	External power supply A - 24Vdc (+)
VEXT_B	External power supply B - 24Vdc (+)
GND	Ground connection (-) of the power supplies A and B (all four GND terminals of a pair of modules are connected internally and are independent from the GND terminals of the other pairs of modules)

NOTE

The voltage applied to VEXT_A will power the I/O module at left of the redundant pair and the power supply applied to VEXT_B will power the I/O module at right of the redundant pair.

For redundancy availability, for external power supplies, the rack should be powered with two different external power supplies, one to VEXT_A and another to VEXT_B.

When using only one external power supply, power both terminals VEXT_A and VEXT_B with the same power supply, so the two modules of the redundant pair are powered.

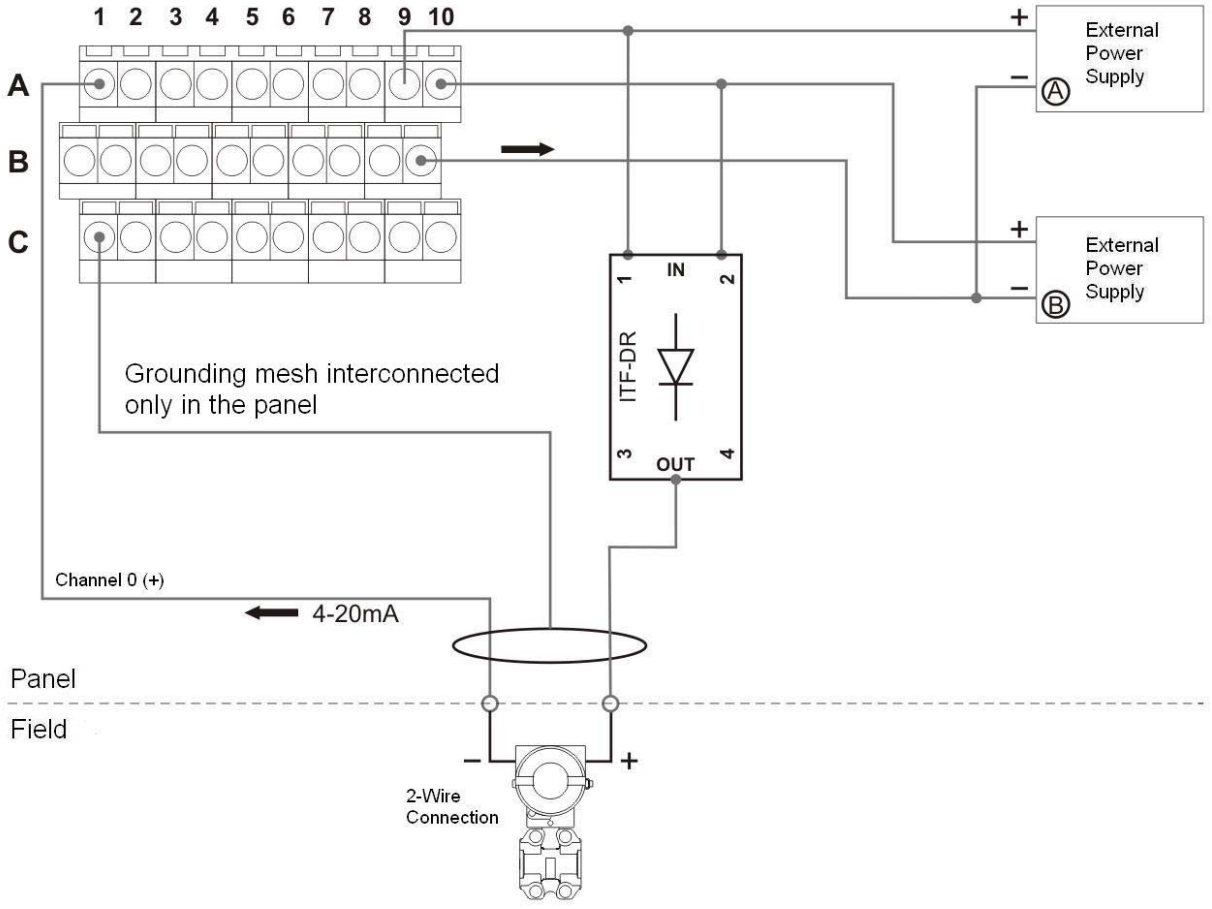


Figure 45 – Connection example (2-wire) of DF113 module with rack DF110-1

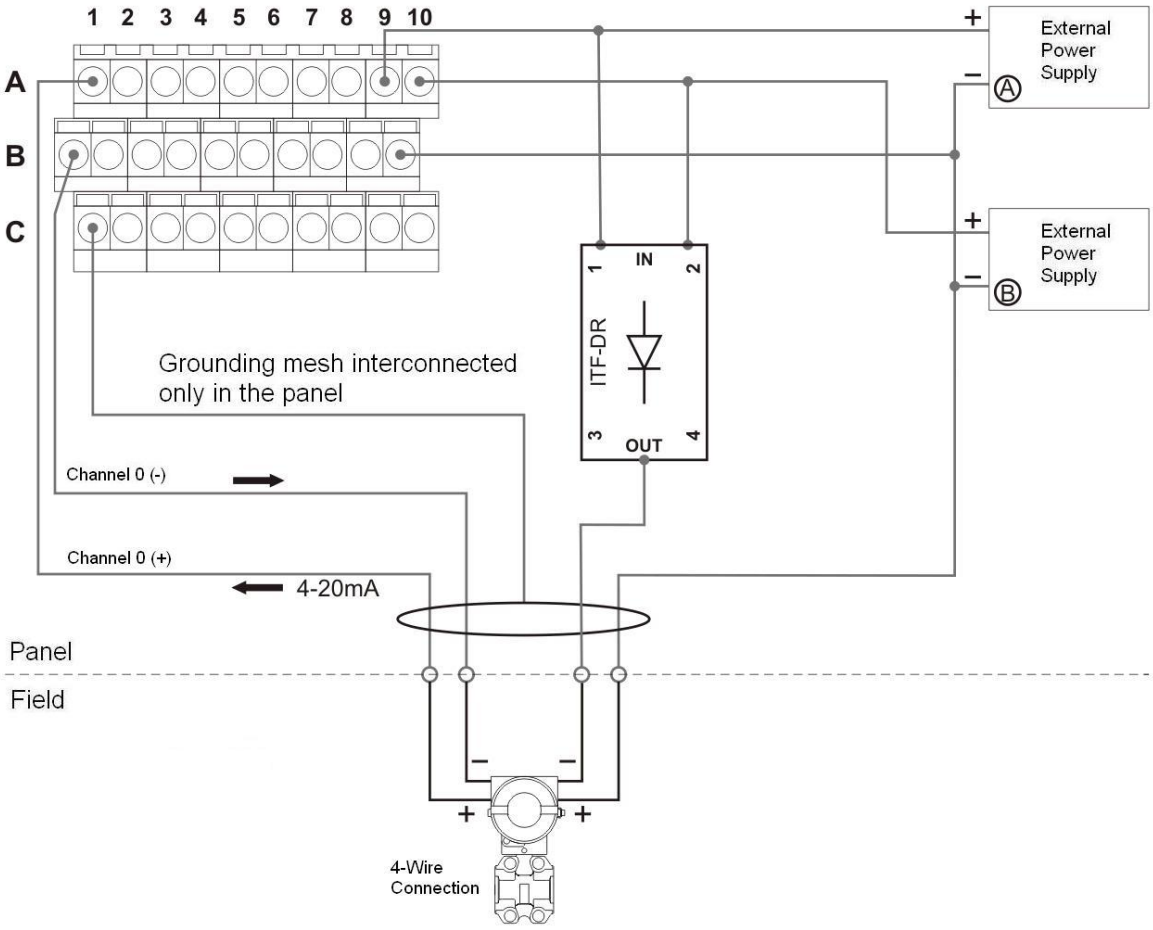


Figure 46 – Connection example (4-wire) of DF113 module with rack DF110-1

DF114 - REDUNDANT ANALOG OUTPUT MODULE - CURRENT

DF114 (1 Group of 8 Redundant Current Analog Outputs)

Description

This module provides 8 current analog outputs. The current outputs can be configured individually on ranges 0 to 20 mA, 0 to 21 mA or 4 to 20 mA. The group is optically isolated from IMB.

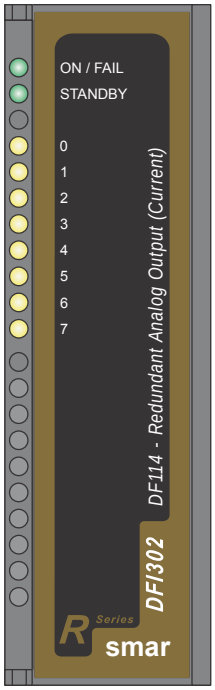


Figure 47 – Details of the DF114 Module

NOTE
DIP SWITCHES: Reserved use, keep all switches OFF.

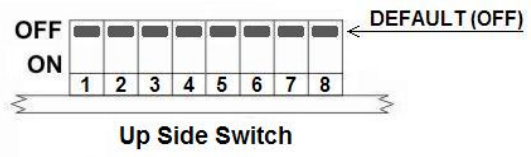


Figure 48 – Configuration of module DIP switches – SW9 (upside)

NOTE
In case of failure of both controllers, the outputs will go individually to the Safe Behavior state (3.6 mA, 21 mA, Last Value, Safe Value) as configured using the LogicView for FFB.

Technical Specifications

ARCHITECTURE	
Number of Outputs	8
Number of Groups	1
Number of Outputs per Group	8

ISOLATION	
Between Group and IMB	5000 Vrms

INTERNAL POWER	
Provided by the IMB	5 Vdc
Maximum Consumption	80 mA

EXTERNAL POWER	
Power Supply (VEXT)	20 – 30 Vdc
Typical Consumption per Module	270 mA @ 24Vdc and 21 mA in all channels

OUTPUTS	
Outputs Type	Single Ended (1 ground)
Impedance per Point[1]	750 Ω @ > 24 Vdc

OUTPUTS RANGE	RANGE 1	RANGE 2	RANGE 3
Current Output	4 mA to 20 mA	0 mA to 20 mA	0 mA to 21 mA

D/A CONVERSION	
Resolution	12 bits

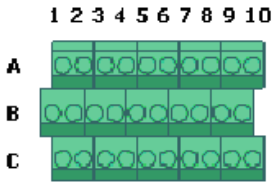
DISSIPATED POWER	
Typical per Module	6.88 W @ 24Vdc and 21 mA in all channels

INDICATION LEDs		
LED	**COLOR**	**DESCRIPTION**
ON / FAIL	Green/Red	It indicates the module status.
STANDBY	Green	It indicates that the module operation status is standby when green is on, otherwise it is off.
0 ~ 7	Yellow	It indicates the status of analog output channel. (GOOD: ON)

TEMPERATURE	
Operation	0 °C to 60 °C (32 ºF to 140 ºF)

DIMENSIONS	
Dimensions (W x D x H)	39.9 x 137.0 x 141.5mm 1.57 x 5.39 x 5.57 in

Terminal Block diagram of Rack DF110-1



[1] - With the channel equivalent impedance at around 550 Ω, the operation voltage can vary between 20 and 30 V.
- When there is a need to get the best module accuracy, particularly at high temperatures, it is required that the minimum equivalent impedance of the channel is 750 Ω. For this, it may be necessary to add a residual resistor in series in each channel. In this case, it will be necessary that the operation voltage is equal or greater than 24 V.

NOTE

To use the DF114 module with the panel interfaces solution of Smar, the user must use the DF110-2 rack and ITF-AN-IOR interface. For further details refer to the Panel Interfaces manual.

Terminal	1	2	3	4	5	6	7	8	9	10
A	AO_00(+)	AO_01(+)	AO_02(+)	AO_03(+)	AO_04(+)	AO_05(+)	AO_06(+)	AO_07(+)	VEXT_A	VEXT_B
B	AO_00(-)	AO_01(-)	AO_02(-)	AO_03(-)	AO_04(-)	AO_05(-)	AO_06(-)	AO_07(-)	GND	GND
C	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	SHIELD	GND	GND

Abbreviations

AO_XX(+)	Analog Output XX (+)
AO_XX(-)	Analog Output XX (-)
SHIELD	Shield connection (all eight shield terminals are connected internally to main Terminal Shield in the Rack – see figure Shield Terminal in DF110-1)
VEXT_A	External power supply A - 24Vdc (+)
VEXT_B	External power supply B - 24Vdc (+)
GND	Ground connection (-) of the power supplies A and B (all four GND terminals of a pair of modules are connected internally and are independent from the GND terminals of the other pairs of modules)

NOTE

The voltage applied to VEXT_A will power the I/O module at left of the redundant pair and the power supply applied to VEXT_B will power the I/O module at right of the redundant pair.

For redundancy availability, for external power supplies, the rack should be powered with two different external power supplies, one to VEXT_A and another to VEXT_B.

When using only one external power supply, power both terminals VEXT_A and VEXT_B with the same power supply, so the two modules of the redundant pair are powered.

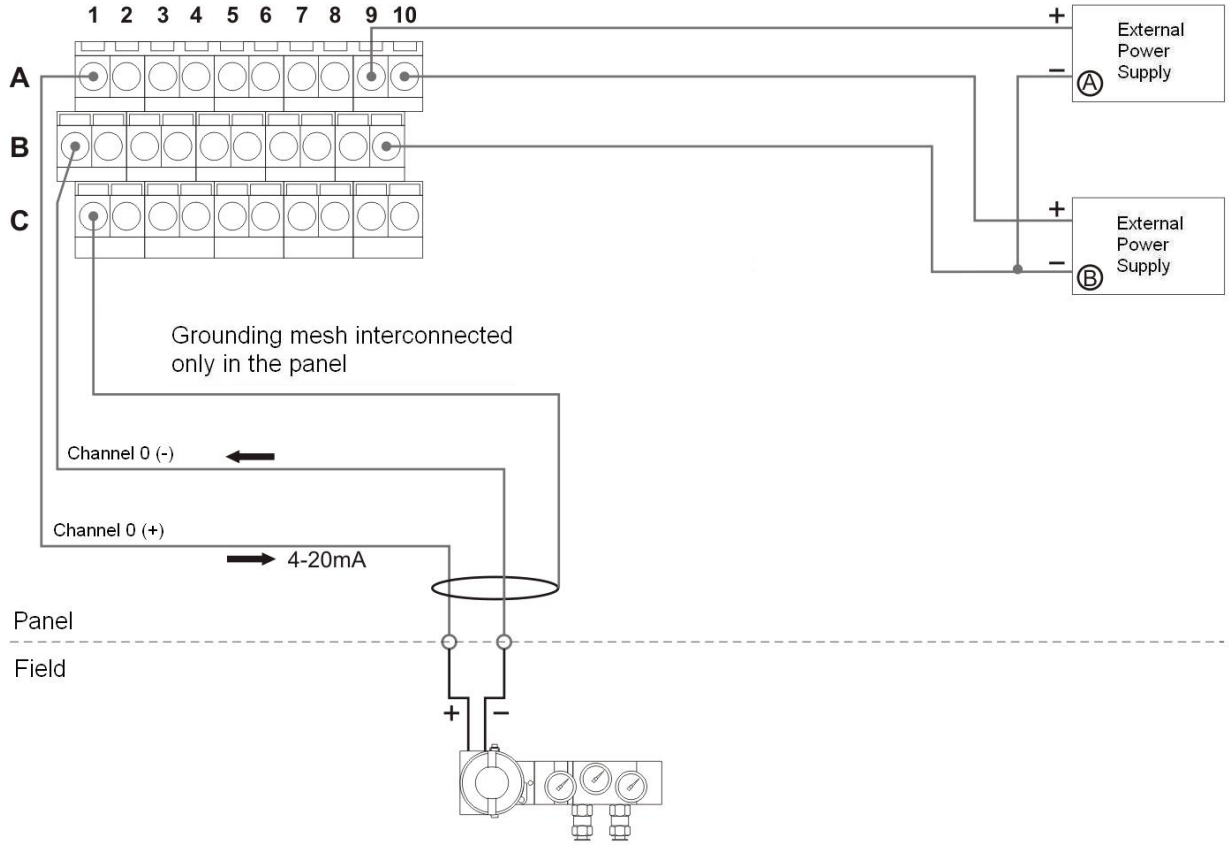


Figure 49 – Connection example of DF114 module with rack DF110-1

Dimensional Drawings

Dimensions are in mm (inches).

DF106

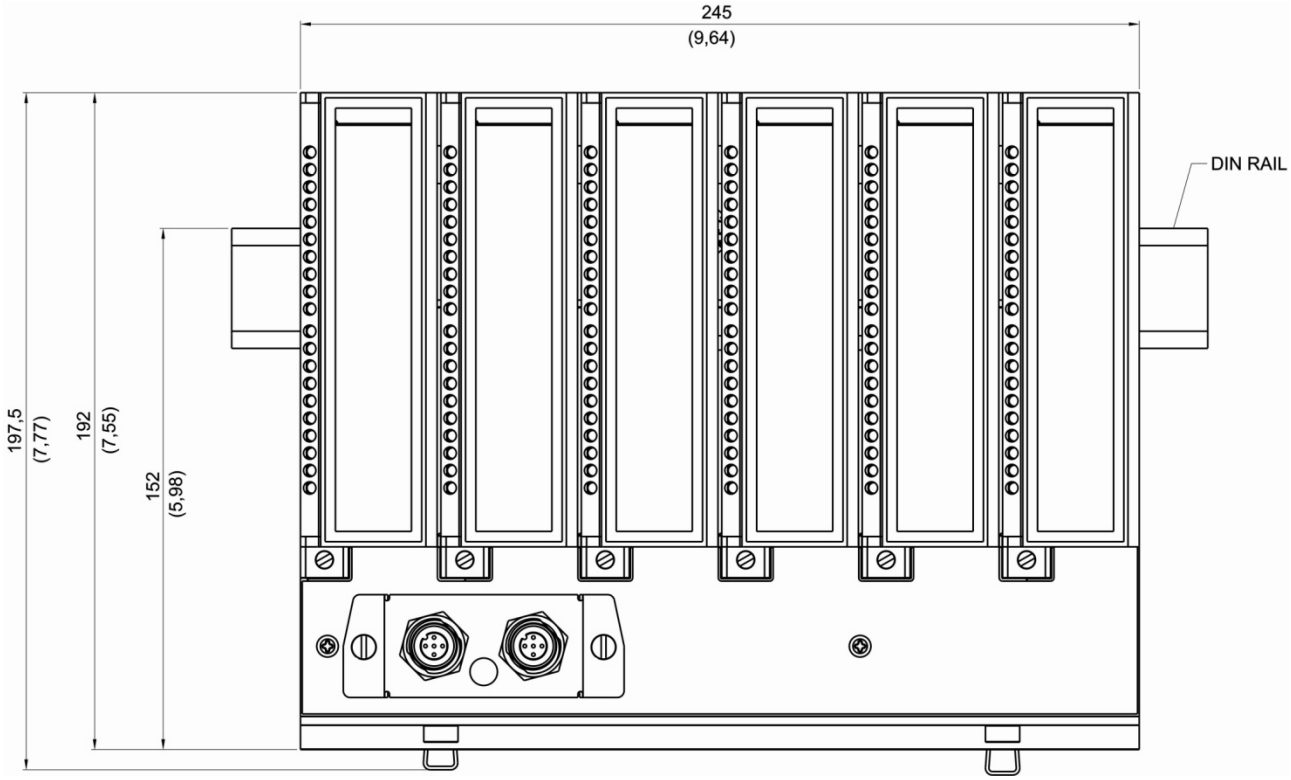


Figure 50 – DF106 dimensions

DF110

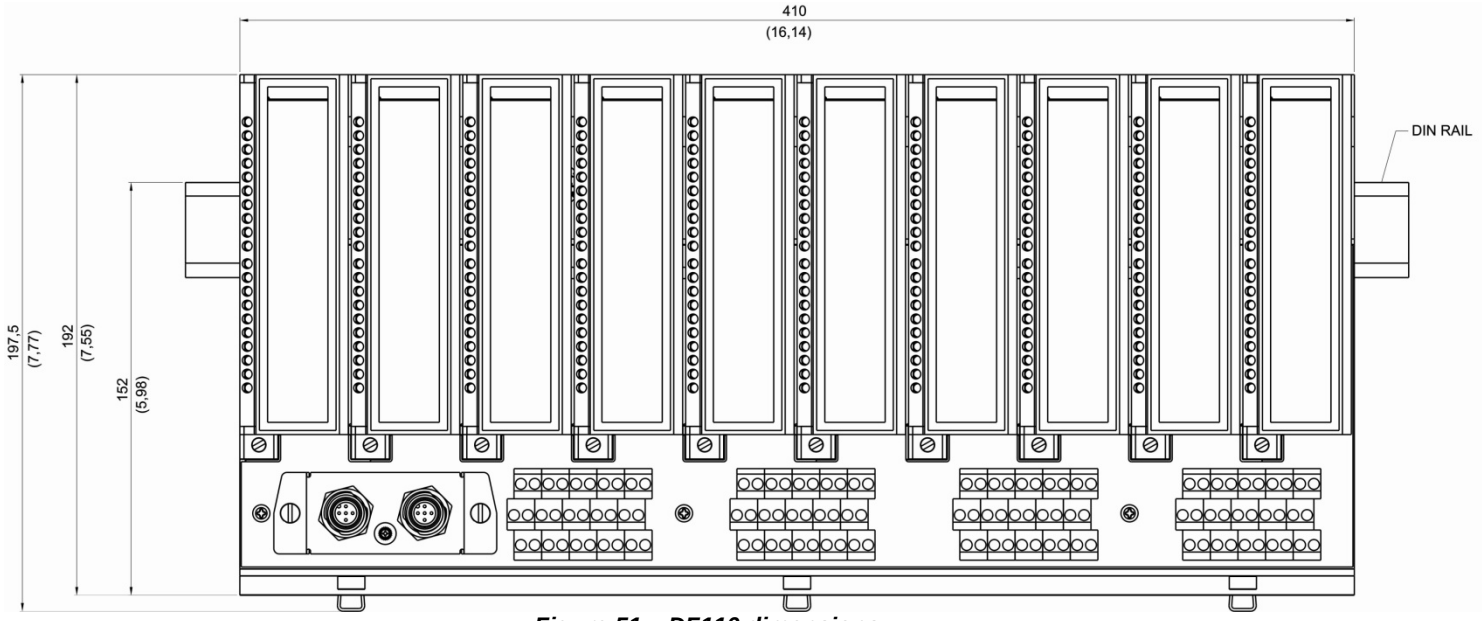
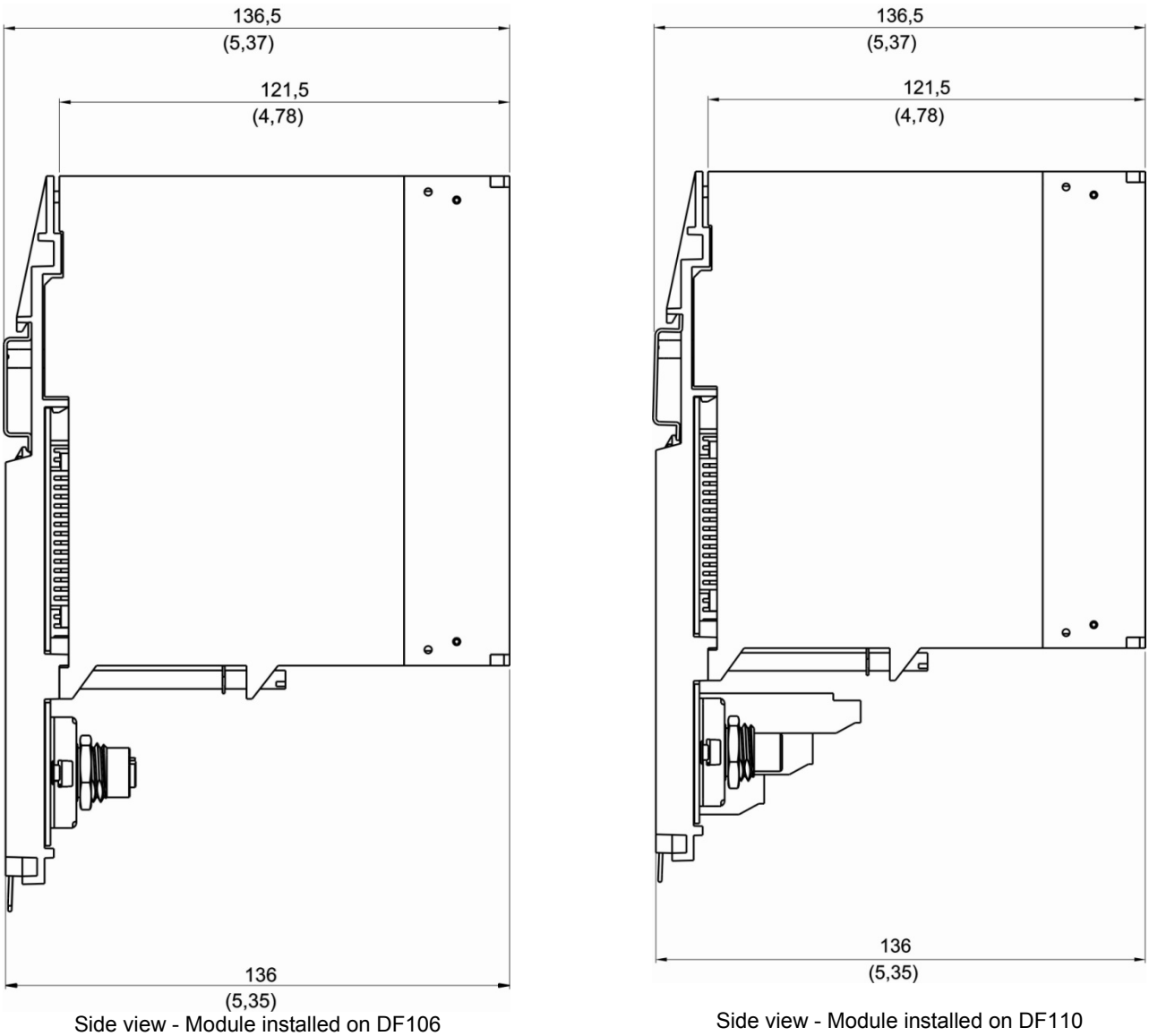


Figure 51 – DF110 dimensions



Side view - Module installed on DF106

Side view - Module installed on DF110

Figure 52 – Side views of modules installed on DF106 and DF110 racks

Appendix A

smar	SRF – Service Request Form	
	DFI302 – Fieldbus Universal Bridge	Proposal Nº:

COMPANY INFORMATION

Company: _____

Unit: _____

Invoice: _____

COMMERCIAL CONTACT

Full Name: _____

Phone: _____ _____ _____ _____ **Fax:** _____

E-mail: _____

TECHNICAL CONTACT

Full Name: _____

Phone: _____ _____ _____ _____ **Extension:** _____

E-mail: _____

EQUIPMENT DATA

Model: _____

Serial Number: _____

PROCESS DATA

Process Type (Ex. boiler control)**:** _____

Operation Time: _____

Failure Date: _____

FAILURE DESCRIPTON

(Please, describe the failure. Can the error be reproduced? Is it repetitive?)

_____

_____

_____

_____

OBSERVATIONS

_____

_____

_____

_____

USER INFORMATION

Company: _____

Contact: _____

Section: _____

Title: _____ **Signature:** _____

Phone: _____ _____ _____ _____ **Extension:** _____

E-mail: _____ **Date:** _____/ _____/ _____

For warranty or non-warranty repair, please contact your representative.
Further information about address and contacts can be found on **www.smar.com/contactus.asp**