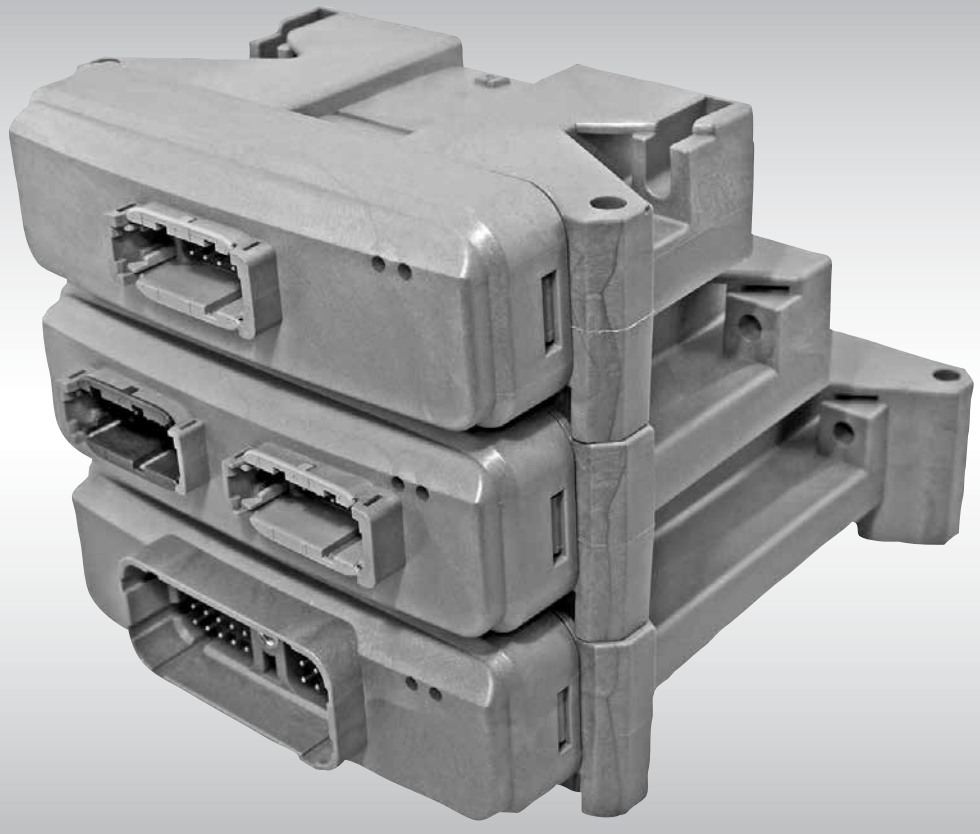
MAKING MODERN LIVING POSSIBLE

Technical Information

Output Configurations for PLUS+1® Controllers



Revisions

Revision History

Table of Revisions

Date	Page	Changed	Rev
17 Sep 2013	All	New layout	EA
11 Mar 2013	6	Single Pole Double Throw Switch drawing updated	DA
17 Oct, 2008	Various	Various content update and literature type changed from Tech Note to Technical Information	CA
11 Oct, 2005	5	Changed sentence “Use digital...”	B
13 Jul, 2005	1	PVG 120 photo updated	A

Contents

This publication is intended to share circuits, products and other useful application information not otherwise found in other Danfoss publications. It is written to inform and aid the reader in the successful application of Danfoss products.

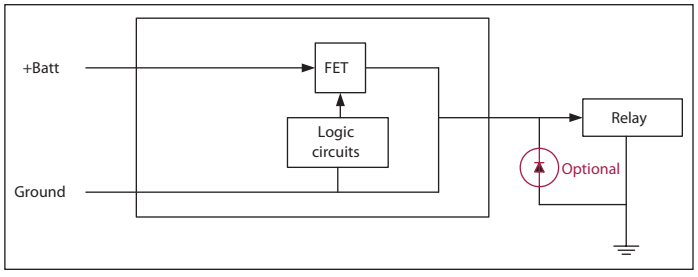
PLUS+1 Controllers Configurable Outputs

Driving Different Types of Loads

PLUS+1 controllers have configurable outputs that can be used to drive a variety of different loads. Danfoss recommends the following ways for using the PLUS+1 outputs to drive different types of loads.

Driving a Relay or ON/OFF Valve

Danfoss recommends using a **digital output for ON/OFF loads**, such as a relay or valve. This encompasses outputs labeled as DOUT or DOUT/PVG Pwr. The recirculating diode across the relay coil is optional. The internal diode will provide the same functionality. These outputs always provide a high voltage (sourcing battery voltage) as the output when in the ON state.



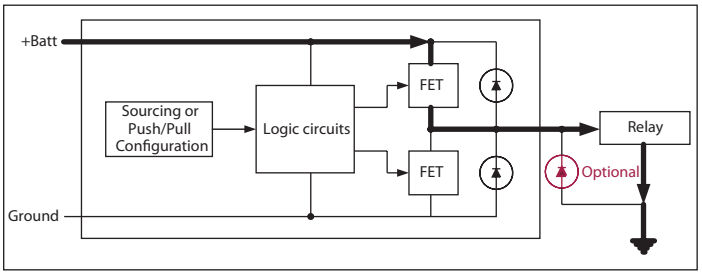
If you need to use a **multi-function PWM output for ON/OFF loads**, then set the configuration in the application program to one of the digital output selections. This can be push/pull, sourcing, or sinking. (PinConfig = 0, 1, or 2)

Sourcing and Sinking options are not available for all pins. Please refer to the API specification for the particular hardware.

Driving a Relay or ON/OFF Valve (continued)

It is recommended to use the push/pull configuration for every situation where a load is exclusively driven by the controller.

Sourcing configuration (PinConfig = 1 or 0)



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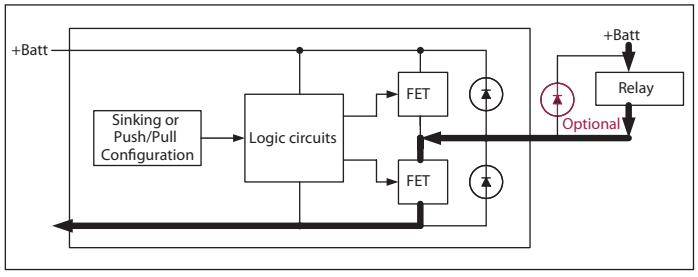
Sinking configuration (PinConfig = 2 or 0)



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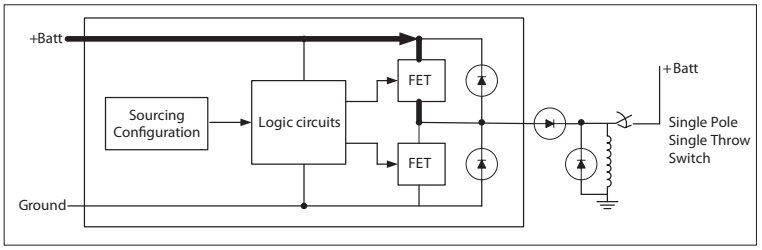
In the Sinking configuration, with the load tied to +Batt there is the potential for up to 5 milliamps leakage current through the output when it is in the OFF state.

Driving a Relay or ON/OFF Valve (continued)

Use sourcing or sinking when there are other sources tied in parallel, such as a jog switch.



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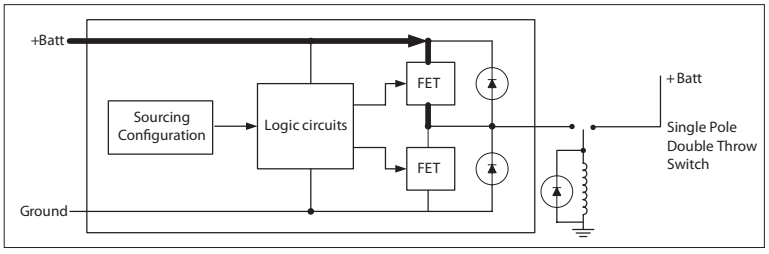

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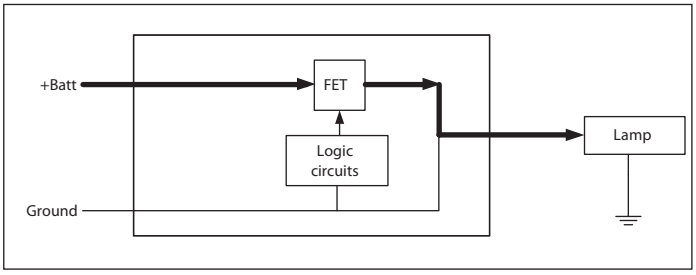
Driving an Incandescent Lamp

Danfoss only recommends using a digital output for driving incandescent lamps. This encompasses outputs labeled as DOUT or DOUT/PVG Pwr. These outputs always provide a high voltage (sourcing battery voltage) as the output when in the ON state.



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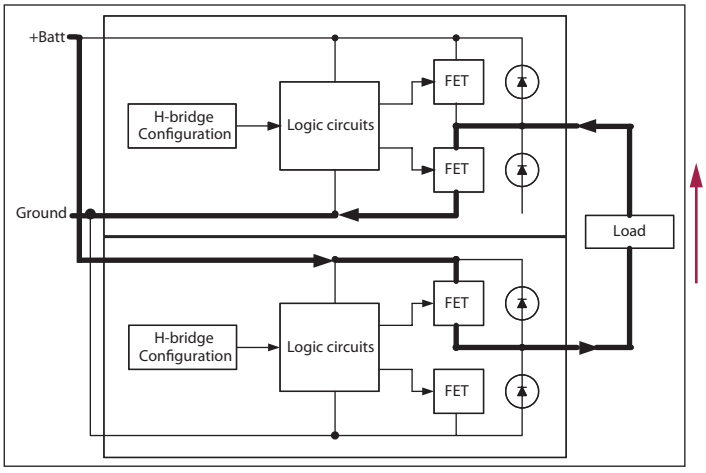
It is not recommended to use multi-function PWM outputs for driving incandescent lamps. There are limitations when driving incandescent lamps from multi-function outputs. An incandescent lamp has an "inrush" current. Inrush is a spike in current just as you turn the lamp on when the filament is cold. Multi-function outputs have a hard current limit which will trip the output off if this limit is exceeded. When driving an incandescent lamp this can happen even though the average current requirements for the lamp are well within the output pin's drive capability. Depending on the inrush current, it cannot be guaranteed that the multi-fuction output will reliably drive an incandescent lamp. This has sometimes been effectively addressed by setting the output to open loop PWM (PinConfig = 3) and then ramping the PWM percentage from 0 to 100 percent, but this is not guaranteed to work for all applications.

Driving a Bidirectional Proportional Valve

Option 1 – H bridge configuration for single coil
Certain output pin pairs may be set for the H bridge configuration. Please refer to the API specification for the pinouts on a particular hardware. This is an open loop PWM configuration (PinConfig = 7).



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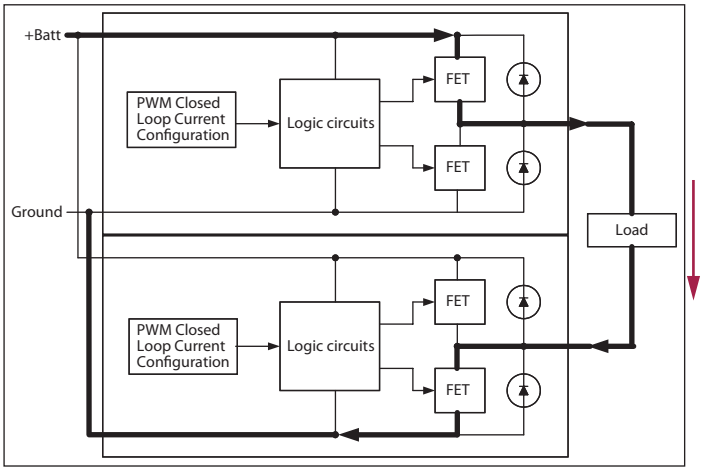

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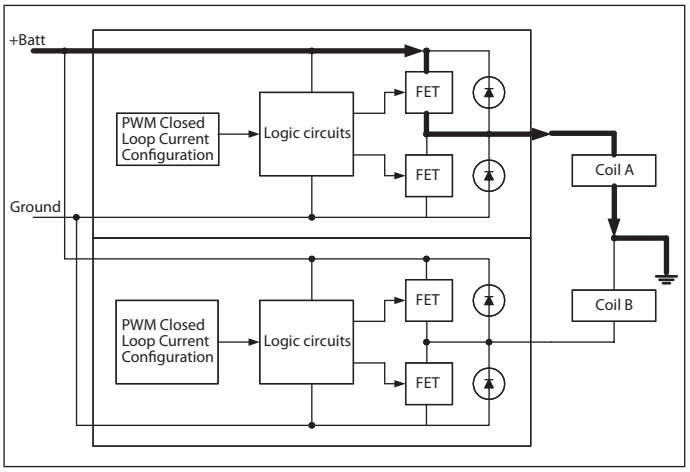
Option 2 – closed loop current controlled configuration for single coil
You may also use two outputs configured for closed loop current control to drive a bi-directional valve. Certain output pin pairs may be used for this configuration (PinConfig = 8). Set the current command to the desired milliamps. Please refer to the API specification for the pinout pairs available on a particular hardware.

Driving a Bidirectional Proportional Valve (continued)

Option 3 – push/pull configuration for dual coil

You may also use two outputs to drive a bidirectional dual coil valve such as a dual coil EDC when wired as shown below. This configuration will allow you to check the resistance of the coils for more accurate diagnostics. Setting PinConfig = 4 on both outputs will give closed loop current control.

Refererence *FMEA Considerations*, pages 10 and 11.



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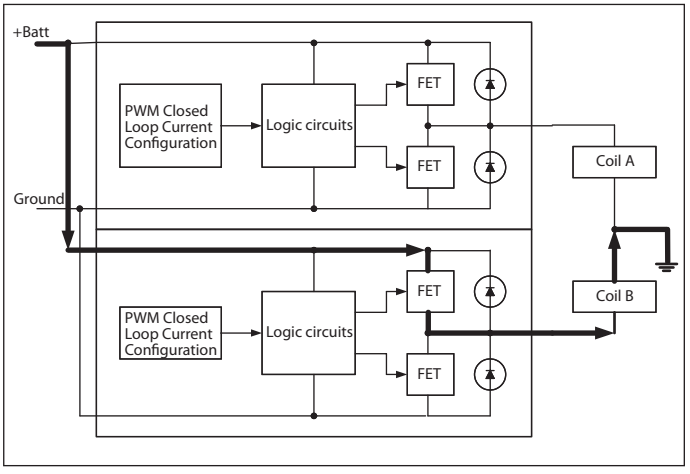

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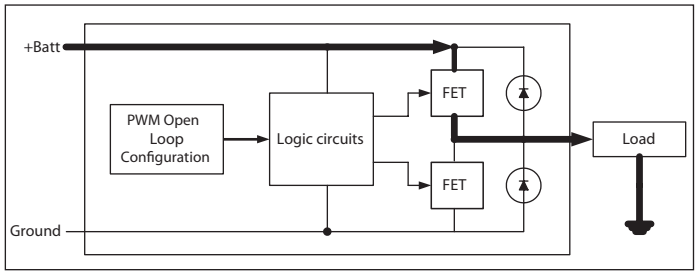
Driving a Unidirectional Proportional Valve

It is recommended to use PWM configuration for unidirectional proportional valves. This may be set for open loop PWM (PinConfig = 3) or closed loop current control (PinConfig = 4 or 5). Recirculating diodes across the load should never be used if the valve requires closed loop current control. They are optional for open loop PWM control.

Refererence *FMEA Considerations*, pages 10 and 11.



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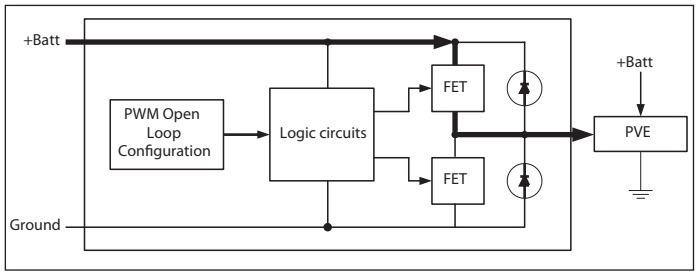
Driving a PVE Valve

When driving a Danfoss PVE valve, it is recommended to use the PVE output configuration (PinConfig = 6). Set the PWM frequency at 4000 Hz.



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Driving a 4-20 mA Device

Driving a 4-20 mA device is not recommended. The minimum controllable current is presently about 10 mA in the closed loop push/pull configuration.

FMEA Considerations

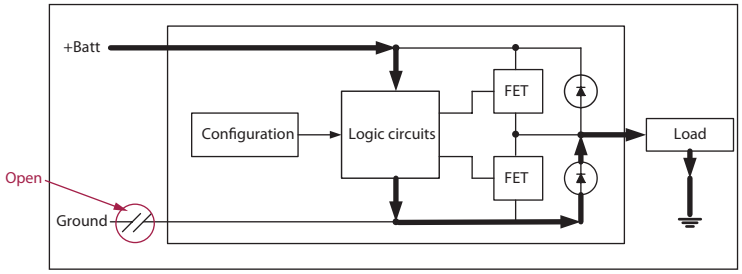
One consideration during a system FMEA (Failure Mode Effects Analysis) on an application is the possibility of an open wiring connection. Here are three examples.

Open Ground Wire to Controller

Effects of an Open Ground

Losing the ground connection can cause the battery current to find another path to ground if it is available. When the load is grounded externally, rather than through the controller, such a path is available. Current will find its way through the load even when the output is in the OFF state. This may result in unintentional movement of the function that is controlled by the load.

Below is a simple schematic to show how this can happen. The arrows indicate the path of current.



The only way to remove the current completely is to return the load current back to the controller, through another output. If you are driving an EDC type load (dual coil) and are driving both coils to get a forward / reverse type function, this could be done by driving one coil bi-directionally with no additional outputs consumed.

If there are enough valves connected to the controller to provide multiple current paths, you might be able to reduce the amount of current in each valve enough so that it is no longer above the threshold of any one valve.

If you have multiple ground connections to the controller, you might be able to reduce the occurrence of the fault enough so that it no longer a significant risk (rates below 100 on the System FMEA.) You may also be able to improve the wiring integrity to minimize the occurrence of the fault.

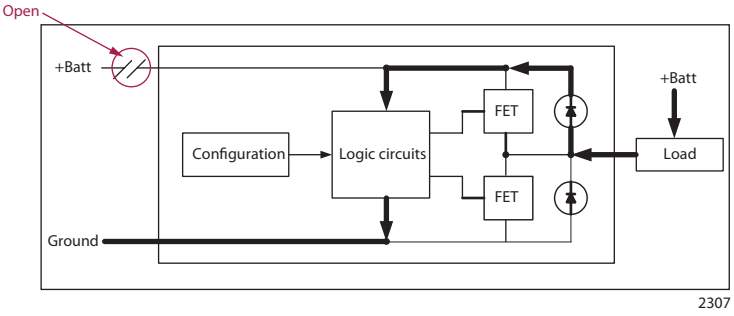
Open Battery+ Wire to Controller

Open Battery+ Wire

Losing the Battery + connection can cause the battery current to find another path to ground if it is available. When the load is tied to Battery+ externally, rather than through the controller, such a path is available. Current will find its way through the load even if the output is in the OFF state. This may result in unintentional movement of the function that is controlled by the load.

Open Battery+ Wire to Controller (continued)

Below is a simple schematic to show how this can happen. The arrows indicate the path of current.



The only way to remove the current completely is to source the load current from the controller, through another output. If you are driving an EDC type load (dual coil) and are driving both coils to get a forward / reverse type function, this could be done by driving one coil bi-directionally with no additional outputs consumed.

If there are enough valves connected to the controller to provide multiple current paths, you might be able to reduce the amount of current in each valve enough so that it is no longer above the threshold of any one valve.

If you have multiple power connections to the controller, you might be able to reduce the occurrence of the fault enough so that it no longer a significant risk (rates below 100 on the System FMEA). You may also be able to improve the wiring integrity to minimize the occurrence of the fault.

Open Ground Wire to Load

Open Load Ground Wire

If you are using a dual coil device with a common ground for bidirectional control, this could be a problem if the common ground wire is open. When using this configuration, the current can flow out of the sourcing output and will try to find a path to ground. If you have the other coil connected to a low impedance source, the current can flow through both coils. This may cause unintended or erroneous movement of the controlled device. Connecting the non-active coil to a high impedance source will prevent this from occurring. See the recommended configurations *Open Battery+ Wire to Controller*, page 10 and above, for driving this type of load.

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