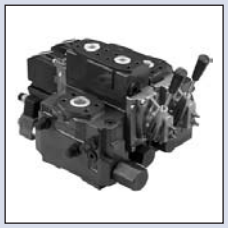
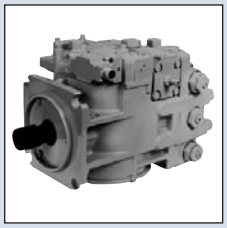
SAUER DANFOSS

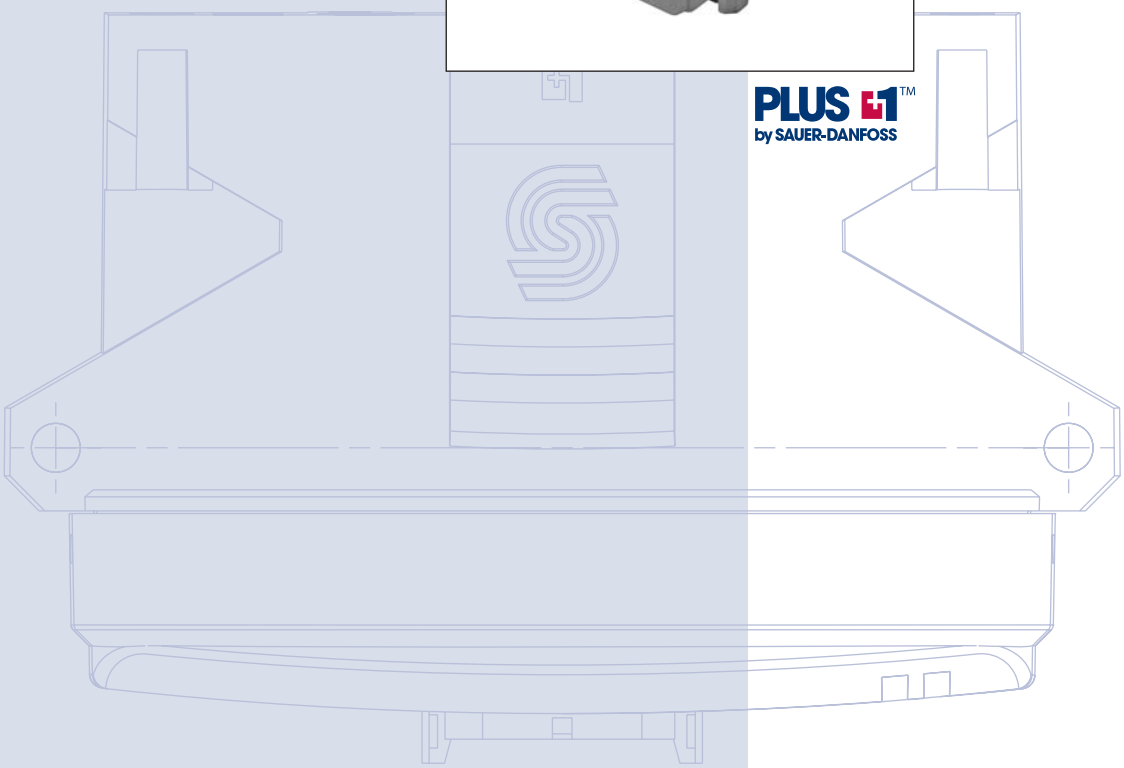
Input Configurations for PLUS+1™ Controllers

Tech Note





PLUS+1™ by SAUER-DANFOSS



Input Configurations for PLUS+1 Controllers Tech Note

ABOUT THIS MANUAL

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

Revision history

Revision date	Page	Change	Remarks
07/18/2005			Initial release
10/11/2005	8, 9	Content revision	Rev-A
12/08/2005	Various	Drawing and content changes	Rev-B

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PLUS+1 CONTROLLERS CONFIGURABLE INPUTS

Input Configurations for PLUS+1 Controllers
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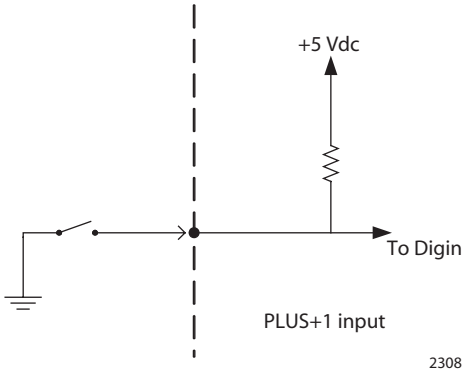
PLUS+1 controllers configurable inputs

OVERVIEW

PLUS+1 controllers have a number of different input types. Here are some examples and how to use them to interface with different types of external devices. Please refer to the **A**pplication **P**rogramming **I**nterface (API) for the particular hardware you are using for more details and the latest information on voltage ranges, etc. The API specifications for each hardware module are available in the *hardware* tab in PLUS+1 GUIDE.

SWITCH CONNECTED TO GROUND

Input schematic



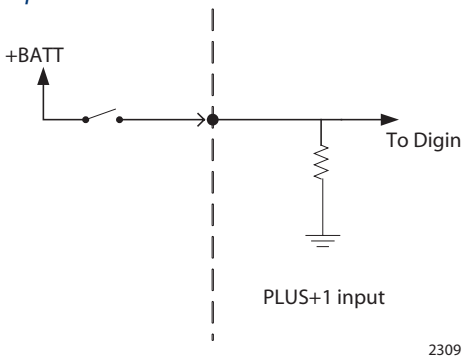
This type of input could be read by a number of different PLUS+1 input types.

PLUS+1 input types

Digital input (DIN)
Configuration should be set to provide an internal pull-up resistor to +5 Vdc. This will be activated with a ground signal. (PinConfig = 1)
Digital/analog input (DIN/AIN)
Configuration should be set to provide an internal pull-up resistor to +5 Vdc. (PinConfig0 = 1)
Configuration should be set to *5.25 Volt range*. (PinConfig1 = 0)
Multifunction: digital/analog/frequency input (DIN/AIN/FreqIN)
Configuration should be set to provide an internal pull-up resistor to +5 Vdc. (PinConfig0 = 1)
Configuration should be set to *5.25 Volt range*. (PinConfig1 = 0)
Frequency configuration, if available, should be set to provide no additional measurement modes.
Analog input (AIN)
Although this is **not a recommended method**, it could be used if all other input types have been used.
In this case an analog measurement is used and a GUIDE application must be developed to determine if the signal is *true* or *false*.
Configuration should be set to the normal analog input.

SWITCH CONNECTED TO +BATTERY

Input schematic



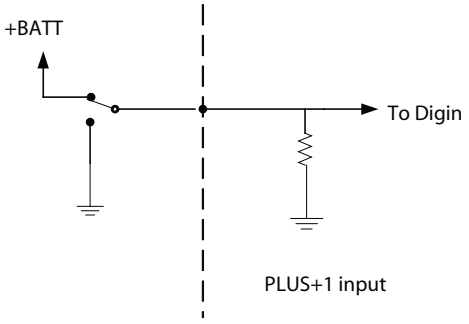
This type of input could be read by a number of different PLUS+1 input types.

PLUS+1 input types

Digital input (DIN)
Configuration should be set to provide an internal pull-down resistor to ground. This will be activated with a voltage from +5 Vdc to battery voltage. (PinConfig = 2)
Digital/analog input (DIN/AIN)
Configuration should be set to provide an internal pull-down resistor to ground. This will be activated with a voltage from +5 Vdc to battery voltage. (PinConfig0 = 2)
Configuration should be set to *5.25 Volt range*. This is necessary for proper operation as a digital input. (PinConfig1 = 0)
Multifunction: digital/analog/frequency input (DIN/AIN/FreqIN)
Configuration should be set to provide an internal pull-down resistor to ground. This will be activated with a voltage from +5 Vdc to battery voltage. (PinConfig0 = 2)
Configuration should be set to *5.25 Volt range*. This is necessary for proper operation as a digital input. (PinConfig1 = 0)
Frequency configuration, if available, should be set to provide no additional measurement modes.
Analog input (AIN)
Although this is **not a recommended method**, it could be used if all other input types have been used.
In this case an analog measurement is used and a GUIDE application must be developed to determine if the signal is *true* or *false*.
Configuration should be set to the normal analog input.
Normal range of the input is 0 to +5.25 Vdc. Obviously, battery voltage is higher than that, but the input will just saturate to the highest reading.

TWO POSITION SWITCH CONNECTED TO +BATTERY OR GROUND

Input schematic



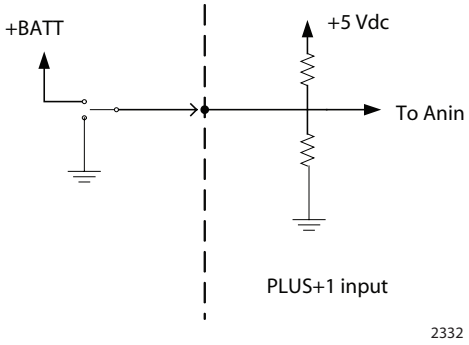
This type of input could be read by a number of different PLUS+1 input types.

PLUS+1 input types

Digital input (DIN)
Configuration should be set to provide an internal pull-down resistor to ground. This will be activated with a voltage from +5 Vdc to battery voltage. (PinConfig = 2)
Digital/analog input (DIN/AIN)
Configuration should be set to provide an internal pull-down resistor to ground. This will be activated with a voltage from +5 Vdc to battery voltage. (PinConfig0 = 2)
Configuration should be set to *5.25 Volt range*. This is necessary for proper operation as a digital input. (PinConfig1 = 0)
Multifunction: digital/analog/frequency input (DIN/AIN/FreqIN)
Configuration should be set to provide an internal pull-down resistor to ground. This will be activated with a voltage from +5 Vdc to battery voltage. (PinConfig0 = 2)
Configuration should be set to *5.25 Volt range*. This is necessary for proper operation as a digital input. (PinConfig1 = 0)
Frequency configuration, if available, should be set to provide no additional measurement modes.
Analog input (AIN)
Although this is **not a recommended method**, it could be used if all other input types have been used.
In this case an analog measurement is used and a GUIDE application must be developed to determine if the signal is *true* or *false*.
Configuration should be set to the normal analog input.
Normal range of the input is 0 to +5.25 Vdc. Obviously, battery voltage is higher than that, but the input will just saturate to the highest reading.

THREE POSITION SWITCH CONNECTED TO +BATTERY OR GROUND

Input schematic



With this type of input an application could be setup to get three switch states from a single PLUS+1 input. This could be done with a multifunction input or possibly a digital/analog input. Switch states:

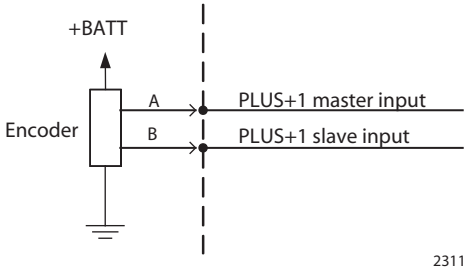
- When the switch is in the up position, +Batt voltage will be applied to the input. The analog reading will be at +Batt voltage.
- When the switch is in the middle position, no voltage will be applied to the input. The analog reading will be about 2.5 Vdc due to the internal voltage divider.
- When the switch is in the down position, ground will be applied to the input. The analog reading will be 0 Vdc.

PLUS+1 input types

Digital input (DIN)
This cannot be done by a straight digital input. It needs to be able to read the voltage.
Digital/analog input (DIN/AIN)
Configuration should be set to provide an internal pull-up/pull-down configuration. This configuration may not be available on some templates. (PinConfig0 = 3)
Configuration should be set to *36 Volt range*. (PinConfig1 = 1)
The application program can either use the Multi_Dig_In function block set for three outputs or the programmer can write his own application to decode the signal voltage levels.
Multifunction: digital/analog/frequency input (DIN/AIN/FreqIN)
Configuration should be set to provide an internal pull-up/pull-down configuration. (PinConfig0 = 3)
Configuration should be set to *36 Volt range*. (PinConfig1 = 2)
Frequency configuration, if available, should be set to provide no additional measurement modes.
The application program can either use the Multi_Dig_In function block set for three outputs or the programmer can write his own application to decode the signal voltage levels.
Analog input (AIN)
This type input cannot be used because the configuration cannot be set to provide an internal pull-up/pull-down configuration.

QUADRATURE ENCODER

Input schematic



This type of input can only be read by multifunction PLUS+1 inputs. Encoders must be connected to multifunction inputs that are setup for quadrature encoders. They can measure the number of counts that have occurred during the last loop time and the direction of rotation. They can also measure the amount of *phase shift* time (see *Phase shift measurement*, page 9).

The maximum input frequency for these measurements is 4 kHz. Above that frequency there is a chance that some pulses could be missed.

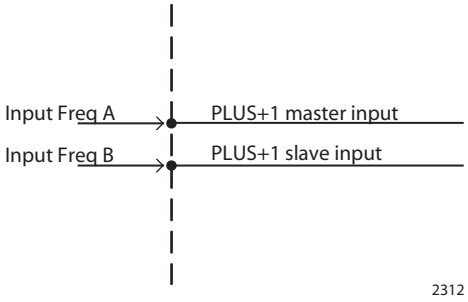
PLUS+1 input type

Multifunction: Digital/analog/frequency input (DIN/AIN/FreqIN)
Only certain multifunction inputs are capable of handling quadrature encoders. Please refer to the API for the particular hardware you are using for more details.
Quadrature encoders must be connected to multifunction inputs in pairs. The *A* channel should be connected to the master input and the *B* channel should be connected to the slave input.
Configuration should be set to provide an internal pull-up/pull-down configuration depending on the output structure of the encoder. Check the vendor specifications.
Configuration should be set to *5.25 Volt range*. This is necessary for proper operation as a digital input. (PinConfig1 = 0)
Frequency configuration should be set to *quad encoder enabled*. (FreqConfig = 1)

When *quad encoder* measurement is enabled, then the *QuadCount* value will be valid. When read, this value will give the number of measured counts during the last loop time. The sign of the value will indicate the direction of rotation.

PHASE SHIFT MEASUREMENT

Input schematic



Phase shift between two input frequencies can be read by multifunction PLUS+1 inputs. The signals must be connected to multifunction inputs that are setup for quadrature encoders.

The maximum input frequency for these measurements is 4 kHz. Above that frequency there is a chance that some pulses could be missed.

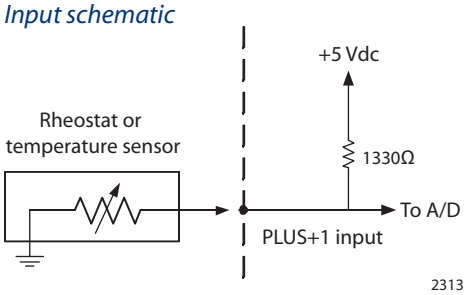
PLUS+1 input type

Multifunction: Digital/analog/frequency input (DIN/AIN/FreqIN)
Only certain multifunction inputs are capable of handling *phase shift* measurements. Please refer to the API for the particular hardware you are using for more details.
Phase shift measurements must be connected to multifunction inputs in pairs. One channel should be connected to the master input and the other channel should be connected to the slave input.
Configuration should be set to provide an internal pull-up/pull-down configuration depending on the output structure of the sensors providing the frequency inputs. Check the vendor specifications.
Configuration should be set to *5.25 Volt range*. This is necessary for proper operation as a digital input. (PinConfig1 = 0)
Frequency configuration should be set to *phase shift enabled*. (FreqConfig = 2)

When *phase shift* measurement is enabled, then the *phase* value will be valid. When read, this value will give the time of the *phase shift* between the *A* and *B* signals in tenths of microseconds. The sign of the value will indicate the direction of rotation.

TEMPERATURE SENSOR OR RHEOSTAT

Input schematic



This type of input can only be read by a temperature/rheostat PLUS+1 input type.

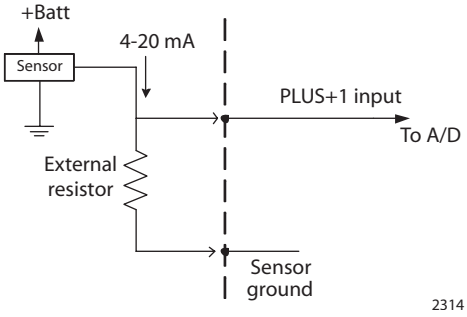
- This input is capable of measuring an external variable resistance of 0 to 10kΩ.
- Although it can go as high as 10kΩ, the measurement will have better resolution at the lower resistance values due to the non-linearity of the resultant voltage to the A/D.
- For best results use sensors or rheostats that have a maximum resistance of less than 1kΩ.

PLUS+1 input type

Analog/temperature/rheostat input (AIN/TEMP/RHEO)
Configuration should be set to *temperature/rheostat mode.* (PinConfig = 1)
Value is read in ohms.

4-20 MILLIAMPERE SENSOR

Input schematic



There is not a PLUS+1 input specifically designed for a 4-20 mA sensor. However, this type of input could be read by a multifunction input, if it is wired as shown above with an external resistor. An 18Ω resistor provides an input signal voltage range of 0.072 to 0.36 Vdc. A 200Ω resistor provides an input signal voltage range of 0.8 to 4.0 Vdc.

PLUS+1 input types

Digital/analog input (DIN/AIN)
Recommended external resistor is 200Ω. Other resistor values can be utilized, but the voltage range will be different than 0.8 to 4.0 Vdc.
Configuration should be set to provide no pull-up or pull-down resistor. This will be activated with a voltage from +5 Vdc to battery voltage. (PinConfig0 = 0)
Configuration should be set to *5.25 Volt range*. (PinConfig1 = 0)
Multifunction: digital/analog/frequency input (DIN/AIN/FreqIN)
Recommended external resistor is 18Ω. Other resistor values can be utilized, but the voltage range will be different than 0.072 to 0.36 Vdc. This input could also use the 200Ω value, if desired, by setting the voltage range to 5.25 Vdc.
Set the configuration to provide no pull-up or pull-down resistor. This will be activated with a voltage from +5 Vdc to battery voltage. (PinConfig0 = 0)
Set the voltage range to 0.3675 Vdc. (PinConfig1 = 1)
Frequency configuration, if available, should be set to provide no additional measurement modes.
Analog/temperature/rheostat input (AIN/TEMP/RHEO)
Not recommended since the minimum voltage range is 0 to 5.25 Vdc
Analog/CAN shield input (AIN/CAN/Shield)
Not recommended since the minimum voltage range is 0 to 5.25 Vdc

PULSE PICKUPS (PPU)

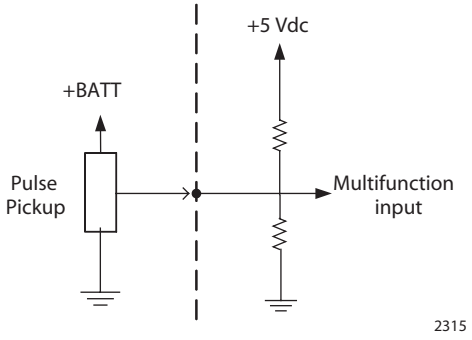
PLUS+1 hardware will work with virtually any Pulse Pickup (PPU). This is because a number of voltage ranges and pull-up/pull-down configurations are available. The user should refer to the API document for details of the voltage ranges and the threshold values for a particular PLUS+1 hardware. Users should also refer to the pulse pickup manufacturer's data sheet for details on the PPU output configuration.

The PPU can only be read by a PLUS+1 multifunction (DIN/AIN/FreqIN) input. Frequency configuration can be set to any mode, but normally no additional measurement mode is needed.

Available measurements are frequency, period, pulse counting, or duty cycle.

Battery operated PPU

Input schematic

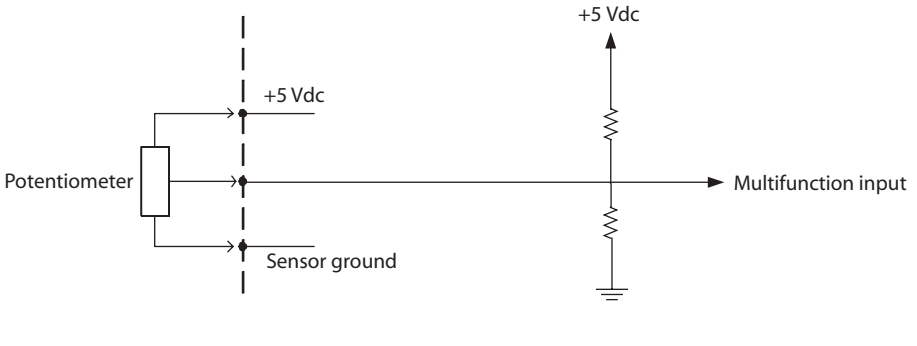


PLUS+1 multifunction input type

Battery operated PPU
Configuration should be set to provide an internal pull-up/pull-down configuration. (PinConfig0 = 3)
Configuration should be set to *5.25 Volt range*. (PinConfig1 = 0)

+5 Vdc operated PPU

Input schematic



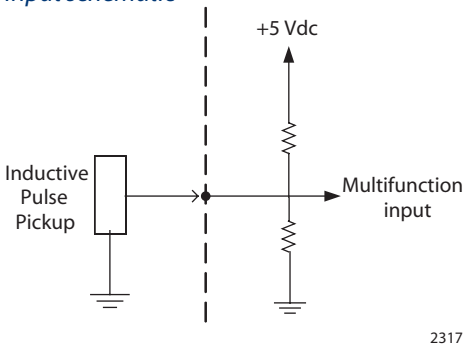
PLUS+1 multifunction input type

+5 Vdc operated PPU
Configuration should be set to provide an internal pull-up/pull-down configuration. (PinConfig0 = 3)
Configuration should be set to *5.25 Volt range*. (PinConfig1 = 0)

PULSE PICKUPS (PPU) (continued)

Inductive 2-wire PPU

Input schematic

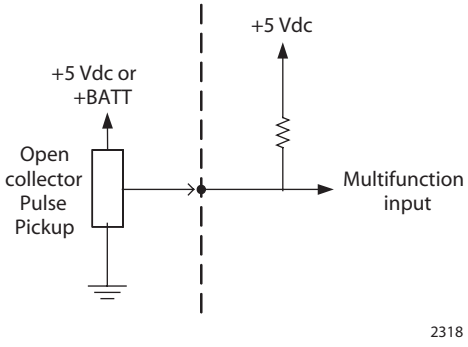


PLUS+1 multifunction input type

Inductive 2-wire PPU
Configuration should be set to provide an internal pull-up/pull-down configuration. (PinConfig0 = 3)
Configuration should be set to *5.25 Volt range*. (PinConfig1 = 0)

Open collector PPU

Input schematic



For an open collector PPU, you must have a pull up resistor that is external to the PPU. This can be provided by the PLUS+1 controller by setting the input pin configurations as follows.

PLUS+1 multifunction input type

Open collector PPU
Configuration should be set to provide an internal pull-up resistor to +5 Vdc. (PinConfig0 = 1)
Configuration should be set to *5.25 Volt range*. (PinConfig1 = 0)

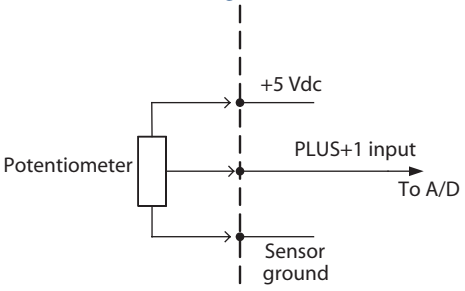
POTENTIOMETERS (CONTROL HANDLES, SETPOINT KNOBS, ETC.)

As shown below there are two ways to wire a potentiometer to a PLUS+1 controller. The first method is recommended. The second method is acceptable, if you can deal with the limitations.

Recommended wiring—this will give you the most accurate readings. The +5 Vdc supply from the PLUS+1 controller is regulated and the ground return goes back to the controller.

Alternate wiring—this will give you roughly the same results. However, the battery voltage can fluctuate and there may be some voltage differential between the ground of the potentiometer and the ground in the PLUS+1 controller. Either of these two conditions can cause the analog voltage reading to fluctuate. Of course you will also need to use the high voltage range on the analog input.

Recommended wiring



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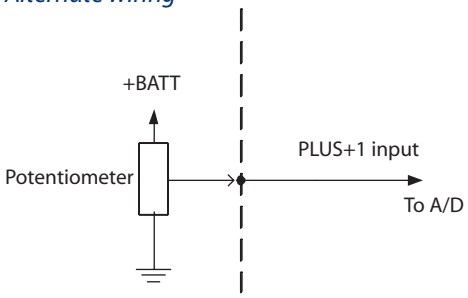
Alternate wiring



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PLUS+1 input types

Analog input (AIN)
No configuration is necessary.
Range is normally 0 to 5.25 Vdc so the alternate wiring shown above is not applicable.
Digital/analog input (DIN/AIN)
Configuration should be set to provide no pull-up or pull-down resistor. This will be activated with a voltage from +5 Vdc to battery voltage. (PinConfig0 = 0)
For 5 Vdc input set the configuration to *5.25 Volt range*. (PinConfig1 = 0)
For up to 36 Vdc input set the configuration to *36 Volt range*. (PinConfig1 = 1)
Multifunction (digital/analog/frequency) input (DIN/AIN/FreqIN)
Configuration should be set to provide no pull-up or pull-down resistor. This will be activated with a voltage from +5 Vdc to battery voltage. (PinConfig0 = 0)
For 5 Vdc input set the configuration to *5.25 Volt range*. (PinConfig1 = 0)
For up to 36 Vdc input set the configuration to *36 Volt range*. (PinConfig1 = 2)
Frequency configuration, if available, should be set to provide no additional measurement modes
Analog/temperature/rheostat input (AIN/TEMP/RHEO)
Configuration should be set to *normal analog input*
No range configuration – this is usable for the 5 Vdc input only
Analog/CAN shield input (AIN/CAN Shield)
No range configuration – this is usable for the 5 Vdc input only
This input can be used if a CAN shield is not used in the system

Notes

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