wireflow

AC0117-004, rev B

WF 3169
User Manual

Contents

Support information

Technical support and Product information

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WireFlow headquarters

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SE-417 55 Göteborg

Please see appendix “Technical support and Professional services” for more information.

Important information

Copyright

The WF 3169 module and accompanying software driver is Copyright ©2018, WireFlow AB.

High risk activities

The software and hardware is not designed, manufactured or intended for use or resale as on-line control equipment in hazardous environments requiring fail-safe performance, such as in (but not limited to) the operation of nuclear facilities, aircraft navigation or communication systems, air traffic control, direct life support machines, or weapons systems, in which the failure of the Software could lead directly to death, personal injury, or severe physical or environmental damage ("High Risk Activities"). WireFlow and its suppliers specifically disclaim any express or implied warranty of fitness for High Risk Activities.

Safety Guidelines

Operate the WF 3169 only as described in this manual.

Make sure that installation and wiring is performed by qualified personnel according to the guidelines in this manual.

CAUTIONS

Electrostatic discharge (ESD) can damage components.
Please wear an ESD wrist strap when handling the module.

Compliance

CE - European Union EMC and Safety Compliance CE

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- Electromagnetic Compatibility (EMC) Directive 2014/30/EU
- RoHS Directive 2011/65/EU

Please contact WireFlow to get a copy of the Declaration of Conformity for the WF 3169 module

Device information

Introduction

The WF 3169 from WireFlow is a 24-channel battery monitoring device that includes an ADC and a high voltage input multiplexer. The module can measure up to 24 series-connected cells with a voltage up to 5V per cell.

The module is designed for the CompactRIO platform from National Instruments.

The module measurement circuitry is galvanically isolated from the other modules in the system and provides up to 1000 VDC channel-to-earth rated working voltage, making the module ideal for accurately monitoring large battery stacks. By using several WF 3169 modules connected in series it is possible to monitor every cell in a long string of series-connected cells.

The challenge of measuring a battery stack is that the “voltmeter” used to measure the voltage over each cell must withstand a high “common mode” voltage relative the ground of the series connected battery stack. Also, the multiplexer that is used to move the voltmeter between the cells must withstand this high common mode voltage.

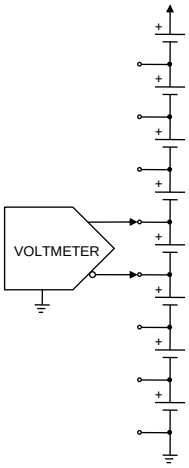


Figure 1 – Voltmeter on multiple cells

The minus pole of the bottom cell should always be connected to the chassis ground of the compact RIO chassis. Please note that the COM pin on the WF 3169 is isolated from chassis ground. So, by connecting the lowest battery to chassis ground you will also connect the COM pin of the WF 3169 to chassis ground.

It is possible to measure on more than 24 cells by using several WF 3169 modules connected in series. As always, the minus pole of the bottom cell should be connected to the chassis ground of the compact RIO chassis. By doing this you will connect the COM of the first WF 3169 to chassis ground.

The minus pole of the 25th cell (no 24) shall be connected to COM on the second WF 3169 and also to C23 of the first WF 3169. The illustration below shows an example where three WF 3169 are used to measure on 49 cells, (Cell0..Cell48). Cell49..Cell71 are unused.

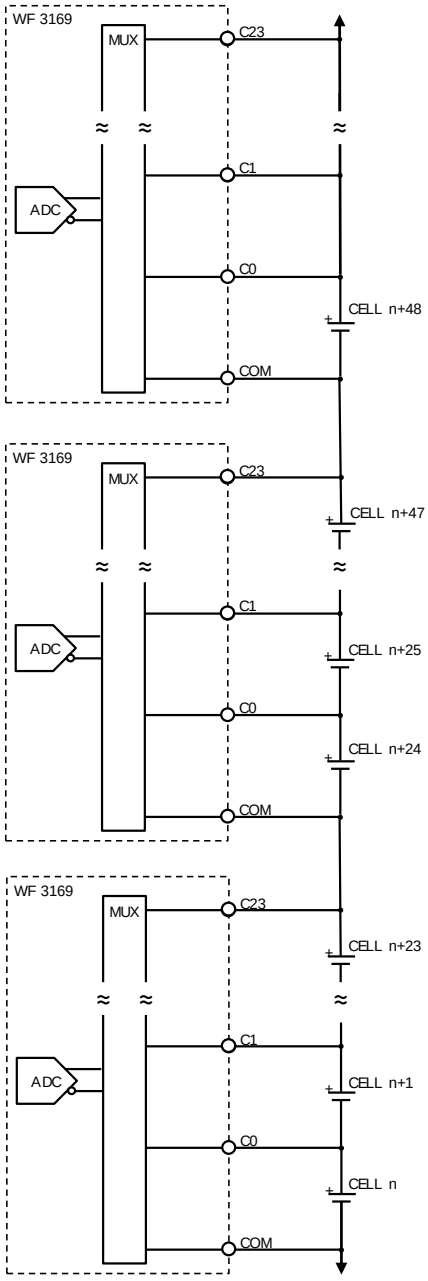


Figure 2 - Using multiple WF 3169

Specifications

Analog Input Characteristics	
Number of channels	24
Maximum voltage C_n to C_{n-1}	-0.3 to 8 V
Maximum voltage C_{23} to C_{11}	-0.3 to 75 V
Maximum voltage C_{11} to COM	-0.3 to 75 V
Measurement range C_n to C_{n-1}	0 to 5 V
Measurement resolution	0.1 mV *[1]
Measurement error (typical and (max))	2V: ±0.1mV (max ±0.8) 3.3V: ±0.2mV (max ±1.2) 4.2V: ±0.3mV (max ±1.6) *[2]*[3]
Max sampling rate	235 Hz
Input leakage current	10 nA typical
Input current when inputs are measured	±2 uA typical

Power Requirements	
Power consumption from chassis	580 mW maximum
Thermal dissipation	580 mW maximum

Isolation Voltages (rated working voltage)	
Channel-to-channel	None
Channel-to-earth ground, Continuous	1000 V

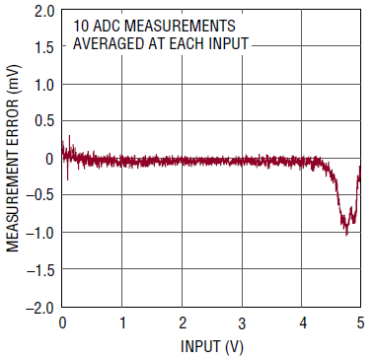
Environmental	
Operating temperature	-40 °C to 70 °C
Storage temperature	-40 °C to 85 °C
Pollution	Degree 2
Maximum altitude	2000 m
Indoor / Outdoor	Indoor use only

Calibration	
Calibration Interval	No calibration needed

*[1] ADC readings are scaled from 0.1mV to FXP with 0.061 mV resolution by the LabVIEW driver.

*[2] Data is for Non-noisy electromagnetic environments

*[3] Diagram below shows Measurement Error vs Input



Pinout

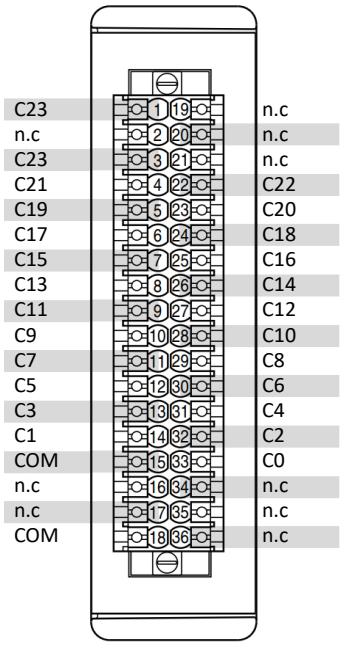


Figure 3 - Pinout on 36 pole spring-terminal

- COM Common reference connection to isolated ground
- Cx Analog input connections. For battery cells.
- n.c No connections

External wiring of battery cells

You can connect the battery cells like this:

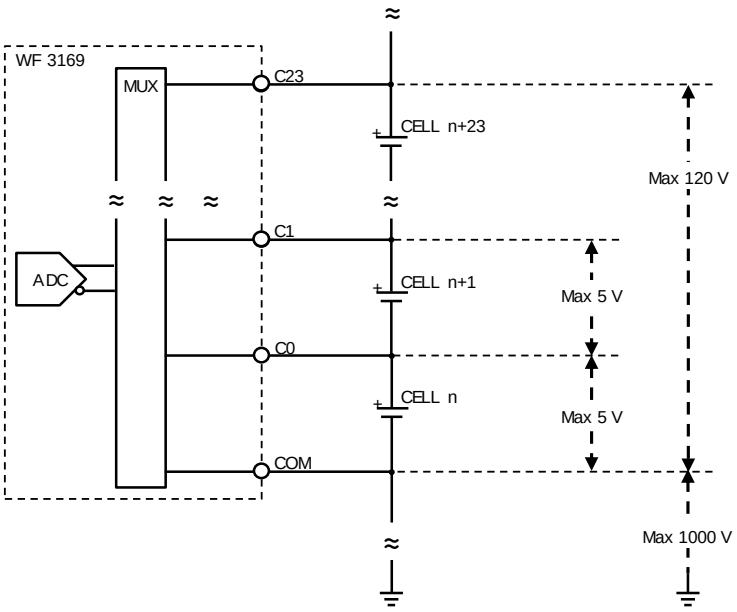


Figure 4 - External wiring of battery cells

If you have more inputs on your WF 3169 module(s) than you have cells, then it is recommended to start adding cells from bottom (COM) and upwards. Leave the top inputs without any cells. The recommendation is to short-circuit the unused Cx inputs where no cells are used.

If no cell is attached to an input then quite high voltages can be measured by the WF3169 module on that input. This is an expected behavior and is caused by the measurement IC that is used inside the WF3169 which will impart a very small current when the ADC takes a measurement. The switched cap design of the ADC is exceptionally accurate, so it won't add any offset error by adding input amplifier sections. Some of the glitch energy may also be coming from the MUX in the IC since there can be residual gate charge between switches that are at different potentials.

So, the conclusion is that the voltages seen on the empty inputs is an expected behavior and will not have any impact on the measurement accuracy when a battery is connected to the input. We recommend making a short-circuit over the unused inputs to minimize the voltages created by these small ADC currents.

The recommendation is also to connect the minus pole of the CELL 0 to chassis ground on the compactRIO. It shall also be connected to the COM connector on the WF 3169.

Software

The WF 3169 is delivered with a LabVIEW driver to manage the module using FPGA property nodes and IO nodes. This chapter describes the installation, requirements and basic usage.

Requirements

- LabVIEW Full (version >= 2017 SPI*)
- LabVIEW FPGA module
- NI-RIO (version >= 17.6)
- VIPM 2017 or higher

* Previous version of this driver (v1.0.0) is available on www.wireflow.se and supports LabVIEW 2014.

The WF 3169 driver currently requires the LabVIEW FPGA toolkit. The software for the WF 3169 is delivered as a VIPM packet (.vip) and requires the free version of VI Package Manager (VIPM) to be installed (available at jki.net or from ni.com).*

Installation

The easiest way to install/update the WF 3169 software is (when VIPM is already installed);

1. Double click the *.vip package
2. Follow the instructions in VIPM to select LabVIEW version where to install the driver
3. Restart LabVIEW

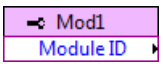
Once installed the necessary files should be installed in the LabVIEW application folders, see the API section for details.

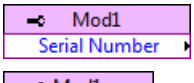
Supported Platforms

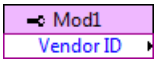
The WF 3169 module can be used in any C Series chassis, with LabVIEW FPGA programming enabled. This currently excludes the CompactDAQ series of chassis, but includes cRIO, EtherCAT and FPGA expansion chassis.

API

Once the WF 3169 module has been added to the project the module can be controlled using property nodes and I/O nodes. The property nodes return information about the current firmware, the information returned is;

- 

This is the identification number of the WF 3169 module
- 

Serial number of the module
- 

Vendor identification number (in this case WireFlow)

Voltage is read from the cells using IO nodes. The WF 3169 provides 24 IO nodes for reading the voltage from each individual cell. IO node AI0..AI23 corresponds to Cell0..Cell23. The voltage reading is only performed during IO node execution.

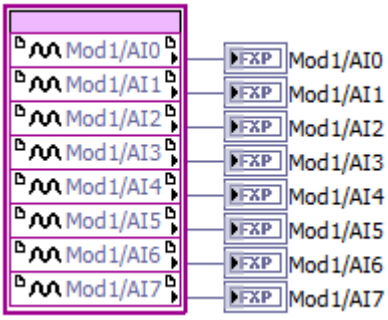


Figure 5 – IO node reading the voltages from Cell0..Cell7

Examples

The shipping example demonstrate the basic usage of the API driver methods. To find the example, open LabVIEW example finder and search for the WF 3169.

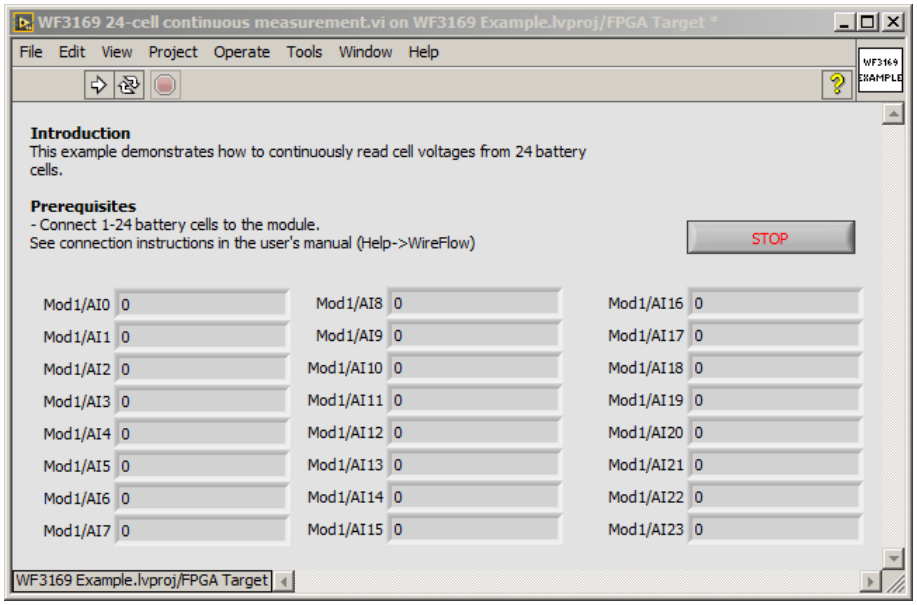


Figure 6 – 24-cell continuous measurement front panel

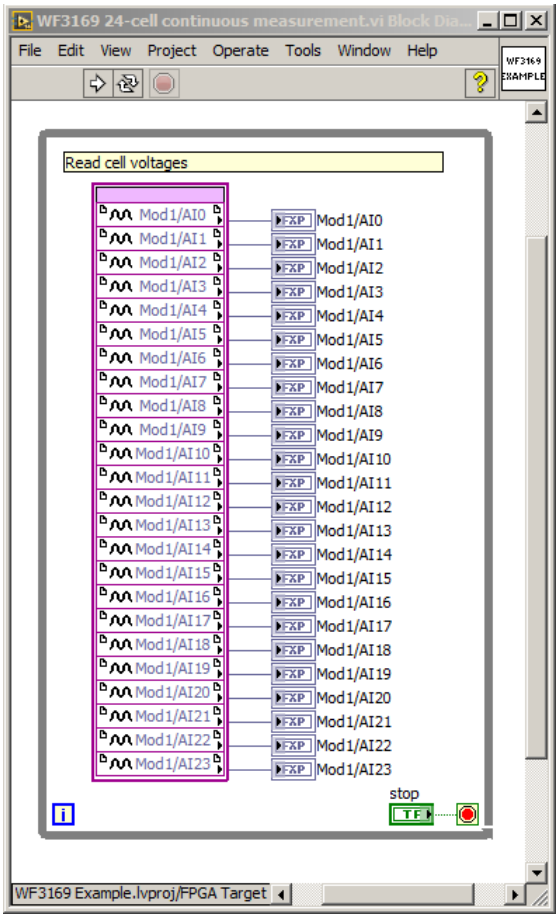


Figure 7 – 24-cell continuous measurement block diagram

Technical support and Professional services

If you need to contact support please include the following information for faster handling

- Product number
  printed on the side of the module, ACxxxx
- Serial number
  printed on the side of the module, s/n XXXXXX
- HW version
  printed on the side of the module, vX.X.X
- Driver version (as indicated in VIPM)
- LabVIEW version
- NI-RIO version
- NI-FPGA version
- Target platform
- General description of the problem.

If possible, please include sample code that exemplifies the problem.

Please send support questions to support@wireflow.se, and set the subject to "Support WF 3169

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the product life cycle, all products must be sent to a WEEE recycling center. For more information about how to, visit www.wireflow.se/weee.