

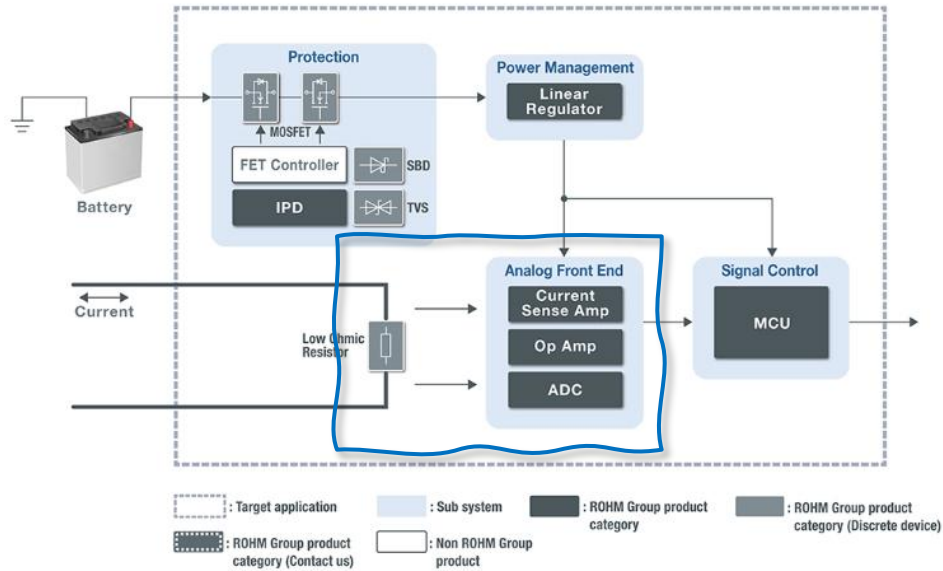


Electronics for the Future

# Shunt-based Current Sensing Reference Design

- REF68011 : for 12V System, 20A
- REF68012 : for 24V System, 30A
- REF68013 : for 48V System, 50A
- REF68014 : for 48V System, 100A
- REF68015 : for 48V System, 100A, Bi-direction

## Current Sensing | Function (Universal Functional Circuit)



In the automotive and industrial equipment fields, current sensing circuits are essential for applications such as current feedback, overcurrent limitation, and battery level monitoring. The shunt-based current sensing circuit is the most standard circuit for current measurement and monitoring. ROHM provides solutions that leverage the resistor technology it has developed since its founding, as well as the analog and thermal design technologies it has cultivated over many years, contributing to improved system performance, higher power efficiency, and higher reliability through high-precision current sensing.

The components you select will vary depending on the power supply system and detection current value. We have a lineup of reference designs for 12V, 24V, and 48V systems, as well as current sensing values from 20 to 100A. We publish not only the schematic design guide but also thermal evaluation data for shunt resistors. Thermal issues are an important factor in shunt-based current sensing. Please use these as design references to help reduce design man-hours.

Table. Line up

| Reference Design No. | Feature  | Amplifier                  |
|----------------------|--|----------------------------|
| REF68011             | For 12V system, 20A current sense, Uni-directional   | BD1421xG-LA Series         |
| REF68012             | For 24V system, 30A current sense, Uni-directional   | BD1422xG-C Series          |
| REF68013             | For 48V system, 50A current sense, Uni-directional   | BD1423xFVJ-C Series        |
| REF68014             | For 48V system, 100A current sense, Uni-directional  |                            |
| REF68015             | For 48V system, 100A current sense, Bi-directional   |                            |
| REFSENS002(*)        | For 5V system, 100A current sense, Uni-directional   | LMR1802xx-x Series (OpAmp) |
| REFSENS003(*)        | For 12V/24V system, 30A current sense, Uni-direction | BD1421xG-LA Series         |

(\*) For detailed specifications, please refer to the individual reference design pages.

# Reference design line up

| Reference Design No.                                       |                         | REF68011   | REF68012                                      | REF68013   | REF68014                             | REF68015                   |
|--|-------------------------|--|---|--|--------------------------------------|----------------------------|
| Direction of current flow                                  |                         | Uni-direction  | Uni-direction                                 | Uni-direction  | Uni-direction                        | Bi-direction               |
| Assumption of the system voltage<br>(Current sensing node) |                         | 12V system<br>10.2V – 12.0V – 13.8V<br>(±15%)  | 24V system<br>20.4V – 24.0V – 27.6V<br>(±15%) | 48V system<br>40.8V – 48.0V – 55.2V<br>(±15%)<br><br>40.5V – 48.0V – 63.0V<br>(Lib 15cell : 2.7V – 3.2V – 4.2V /Cell ) |                                      |                            |
| Power supply for CSA                                       |                         | 2.7V to 5.5V   |   | 2.7V to 18V  |                                      |                            |
| Max. Current sensing value                                 |                         | 20A  | 30A   | 50A  | 100A                                 |                            |
| Sensing Error Rate (Err)                                   |                         | < 5% at maximum detection current (assuming system calibration)  |   |  |                                      |                            |
| Frequency characteristics of INPUT/OUTPUT filter           |                         | INPUT filter : 30kHz (Eliminates the parasitic inductance of the shunt resistor.)<br>OUTPUT filter : about 30kHz (Removes output sampling noise from the BD142xx series.)  |   |  |                                      |                            |
| Shunt resistor heat generation                             |                         | Evaluation with the actual device and board. (Please consider reselect shunt resistors, increase the number of parallel connections, change the board pattern, adding a heat dissipation mechanism, etc. according to the user's temperature design criteria.) |   |  |                                      |                            |
| Input terminal protection                                  |                         | Clamp the voltage with a TVS or similar  |   |  |                                      |                            |
| EVK Board No.  |                         | BD1422xG-EVK-001 *Manual modification of the board is required   |   | BD1423xFVJ-EVK-001 *Manual modification of the board is required   |                                      |                            |
| Major Components   | Current Sense amplifier | BD14211G-LA<br>26V, 50V/V  | BD14222G-C<br>40V, 100V/V                     | BD14232FVJ-C,<br>80V, 100V/V   |                                      | BD14231FVJ-C<br>80V, 50V/V |
|  | Shunt resistor          | PMR100HZPFV2L00<br>2mΩ   | PMR100HZP7FV1L00<br>1mΩ                       | PMR100HZP7FV1L50<br>2-pallarel 0.75mΩ  | PSR100KTQFF0L50<br>2-pallarel 0.25mΩ |                            |
|  | TVS diode               | VS20VUA1VWM<br>VS20VUA1VWMTF(for automotive)   | VS30VUA1VWM<br>VS30VUA1VWMTF(for automotive)  | VS64VLNVWM<br>VS64VLNVWMTF(for automotive)   |                                      |                            |
|  | Standard Resistor       | MCR01S Series<br>ESR01 Series  |   | MCR01S Series<br>ESR03 Series  |                                      |                            |

# Schematic and PCB pattern image

Note: If you use the reference design circuit, you will need to modify the EVK board.



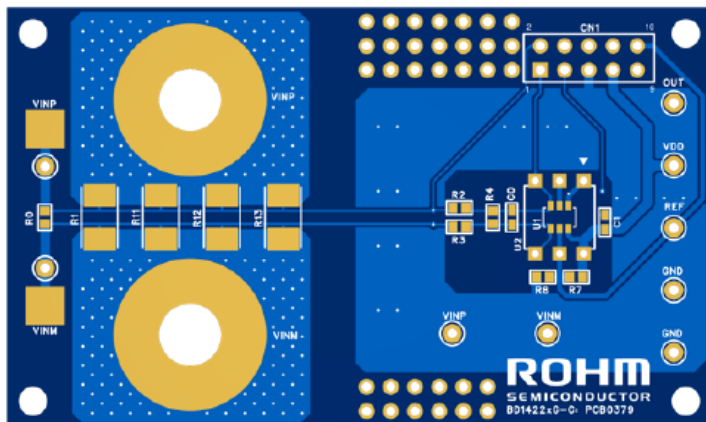
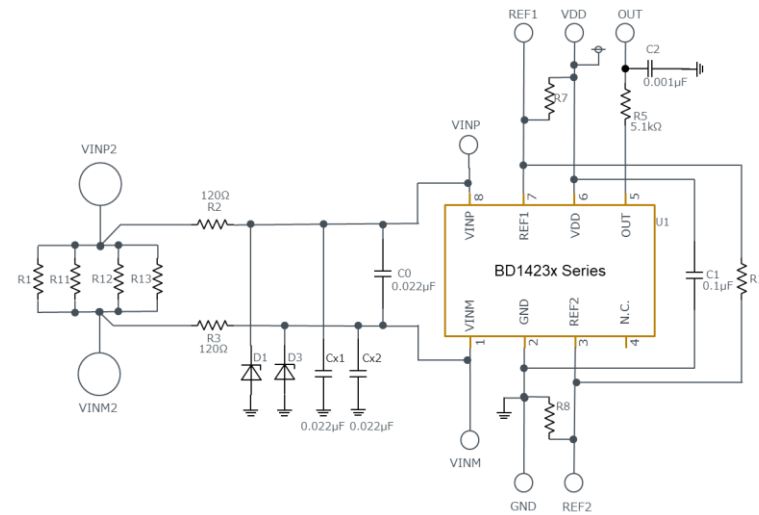
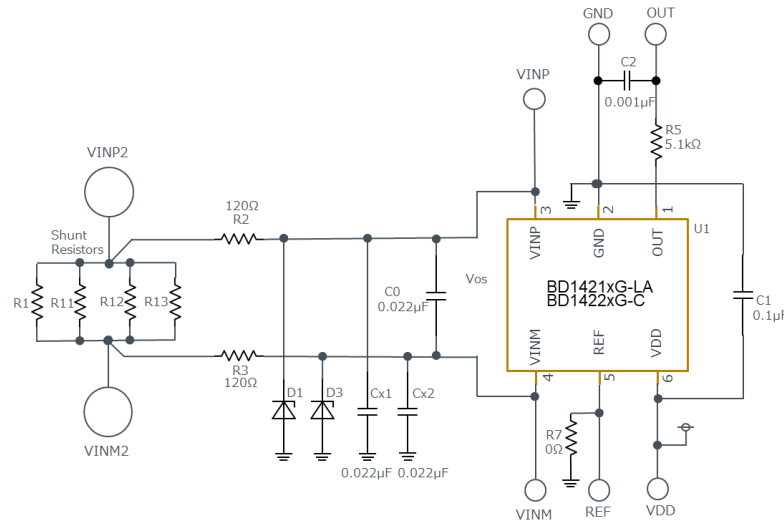
REF68011 : 12V, 20A

REF68012 : 24V, 30A

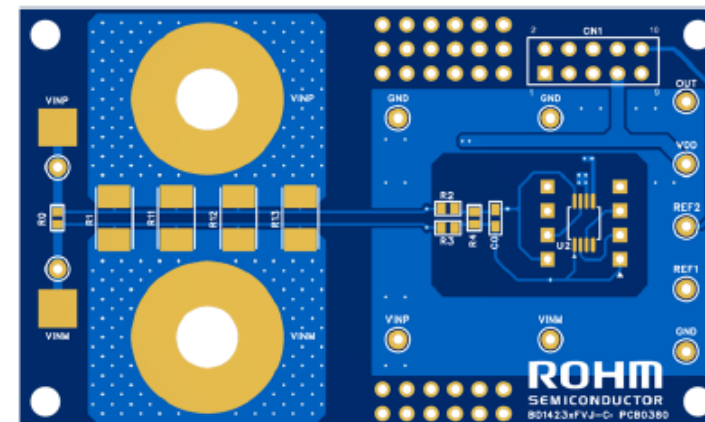
REF68013 : 48V, 50A

REF68014 : 48V, 100A

REF68015 : 48V, 100A, bi-direction



Reusing the BD1422xG-EVK-001 board



Reusing the BD1423xFVJ-EVK-001 board



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- 2) ROHM provides reference designs (including, but not limited to, circuit diagrams, layout data, parts lists, reference boards and their evaluation results, etc.) and all materials related to evaluation boards (hereinafter collectively referred to as "Reference Designs, etc.") to customers for the purpose of referencing them in the development of devices, equipment, software, etc. incorporating ROHM products (hereinafter collectively referred to as "Customer Products"). The design, verification, etc. required for the development of the Customer's Product shall be done at the customer's responsibility and expense. In no event shall the customer use the Reference Designs, etc. for any purpose other than the purpose mentioned above.
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