2021

Insulation Monitors in Energy Storage

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Document ID.: 1SXU112002P0201 Rev.:

Why you need insulation monitoring

Energy storage system

Application

- Energy storage systems (ESSs) utilize ungrounded battery banks to hold power for later use
- ***NEC 706.30(D)*** *For BESS greater than 100V between conductors, circuits can be ungrounded if a ground fault detector is installed.*
- ***UL 9540:2020 Section 14.8*** *For BESS greater than 100V between conductors, circuits can be ungrounded if ground fault detector is installed.*

Ground fault issue

- Since they are ungrounded, ESSs have lessened protection against ground faults
- Ground fault = lower performance
- Ground fault = safety/ fire risk

Insulation monitoring

- Insulation monitoring devices (IMDs) help enhance safety by monitoring earth leakage
  - Detect unwanted leakage values before a fault occurs
  - Detect insulation deterioration in real time

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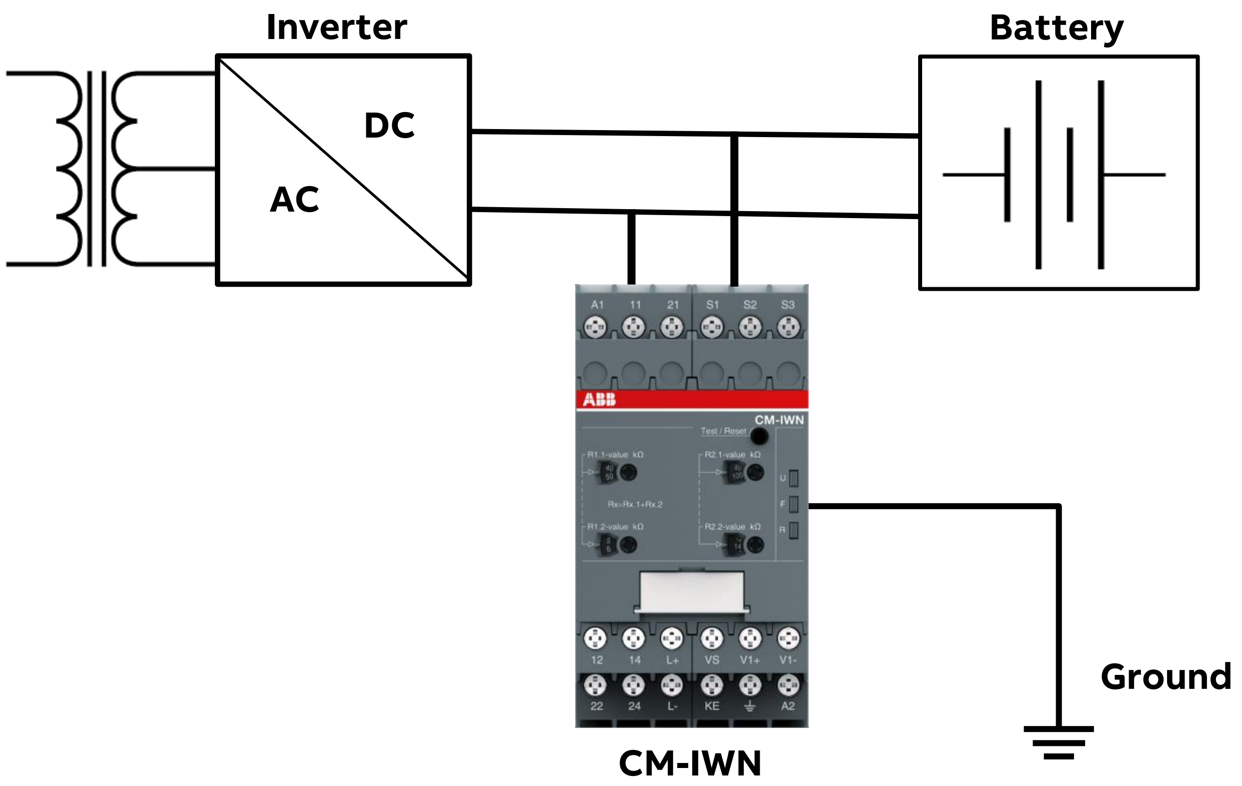
How it works

Energy storage system

Operating principle

- IMDs superimpose a test signal which measures the resistance to ground
- A resistance threshold is determined
- IMDs detect values outside the threshold



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Product Selection

Insulation monitoring relays

General Purpose (CM-IWS and CM-IWN)

Performance

- Up 0-400V AC or 0-600 V DC
- Up to 20µf Ce
- 1 SPDT contact each for pre-warning and warning
- Coupling unit CM-IVN allows monitoring at 690V AC or 1000V DC

Dimension

- 45mm width (90mm with CM-IVN)

Features

- LED status indication
- Adjustment/ DIP switches via front panel

Advanced Applications (CM-IWM)

Performance

- Up to 1500V DC or 1100V AC network voltage
- Up to 3000µf Ce
- High adjustable range up to 250kΩ
- 1 SPDT contact each for pre-warning and warning

Dimension

- 90mm width

Features

- LED status indication
- LED indication for R
- Auto self test

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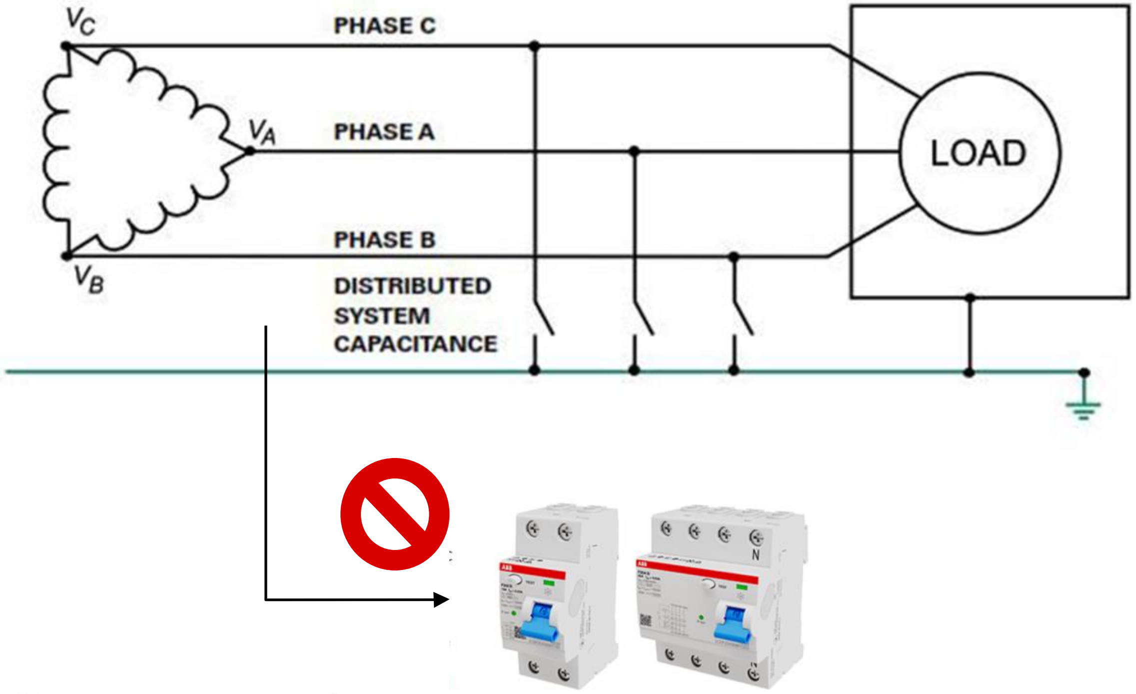
Why Insulation Monitoring

and not Residual Current Devices?

Principle

- A floating delta system cannot create the fault current magnitude needed for low impedance ground return path
- The system charging current is lower than the operating point of most RCDs
- The RCD device will never trip, not even if a bolted fault* existed for multiple days



$$I_F = \frac{V_{3G}}{R_{GF} + R_{GR} + R_{NG}}$$

I_F = Fault Current, an amperes
V_{3G} = Voltage between faulted phase and ground, in volts
R_{GF} = Resistance of the ground fault, in ohms
R_{GR} = Resistance of the ground-return path
R_{NG} = Resistance of neutral-to-ground bonding jumper

*Bolted fault: a very low impedance connection between a phase and ground

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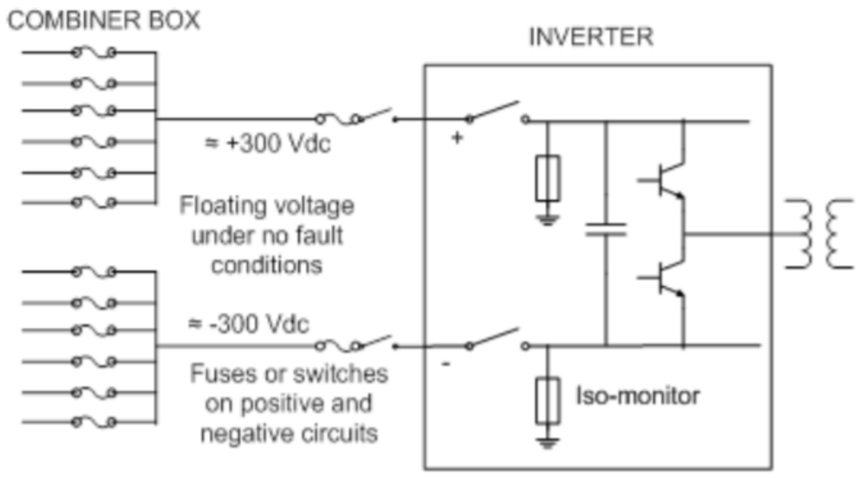
Why Insulation Monitoring

and not Residual Current Devices?

Principle

- Ground fault detection in ungrounded arrays is typically achieved by measuring the insulation resistance of each pole relative to ground
- Resistance values are measured in hundreds or thousands of kilo-ohms
- Ground fault is detected when the impedance to ground of either pole drops to a low level *(pre-warning and warning settings on IMDs)*



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