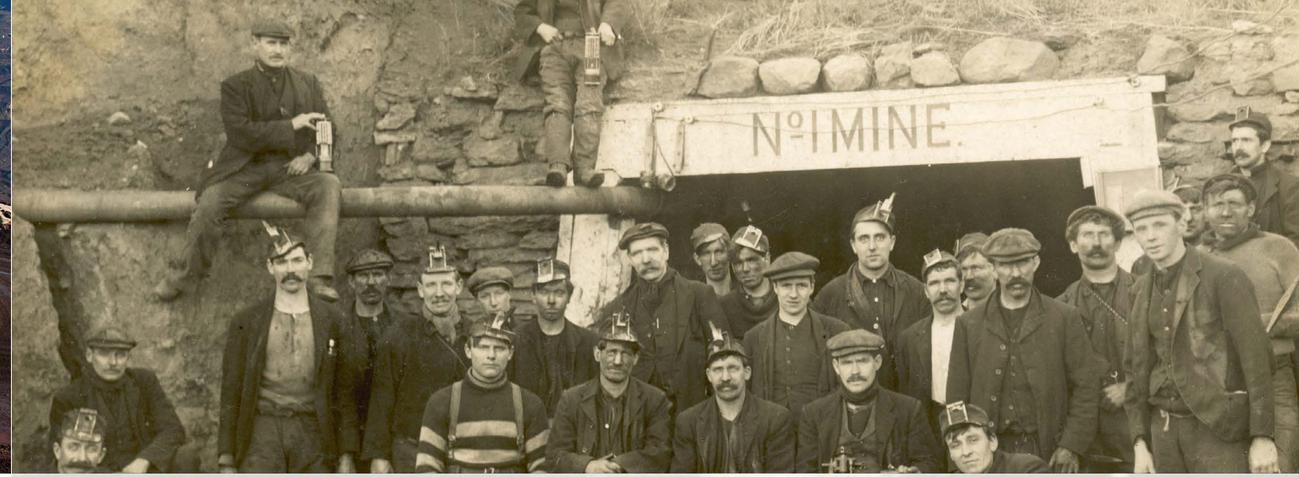
Mining

Electrical safety solutions

Design the future of energy

BENDER



For over 75 years, our mission has been to make electrical power safe. Our wide portfolio of cutting-edge electrical safety and monitoring products are used in virtually every industry — healthcare, solar, oil and gas, electric vehicle, mining and many more. With representatives in over 70 countries, Bender provides customized solutions and services to meet the individual needs of our customers.

An innovator in the mining industry

Mines have long been a harsh and potentially dangerous environment for people and equipment to work in. Records show that regulations requiring insulation resistance monitoring of ungrounded electrical power installations have existed since 1903. However, adequate products were not available until 1937, when recent engineering graduate Walther Bender invented the ISOMETER®, revolutionizing the safe use of electricity in mines.

Walther's work in mines began as an inspection engineer. He inspected mine electrical cables to ensure workers were protected if the insulation was failing. During the inspections, mines would have to be completely shut down. The lost production time quickly added up, and workers had to stay late into the night to make up the lost production.

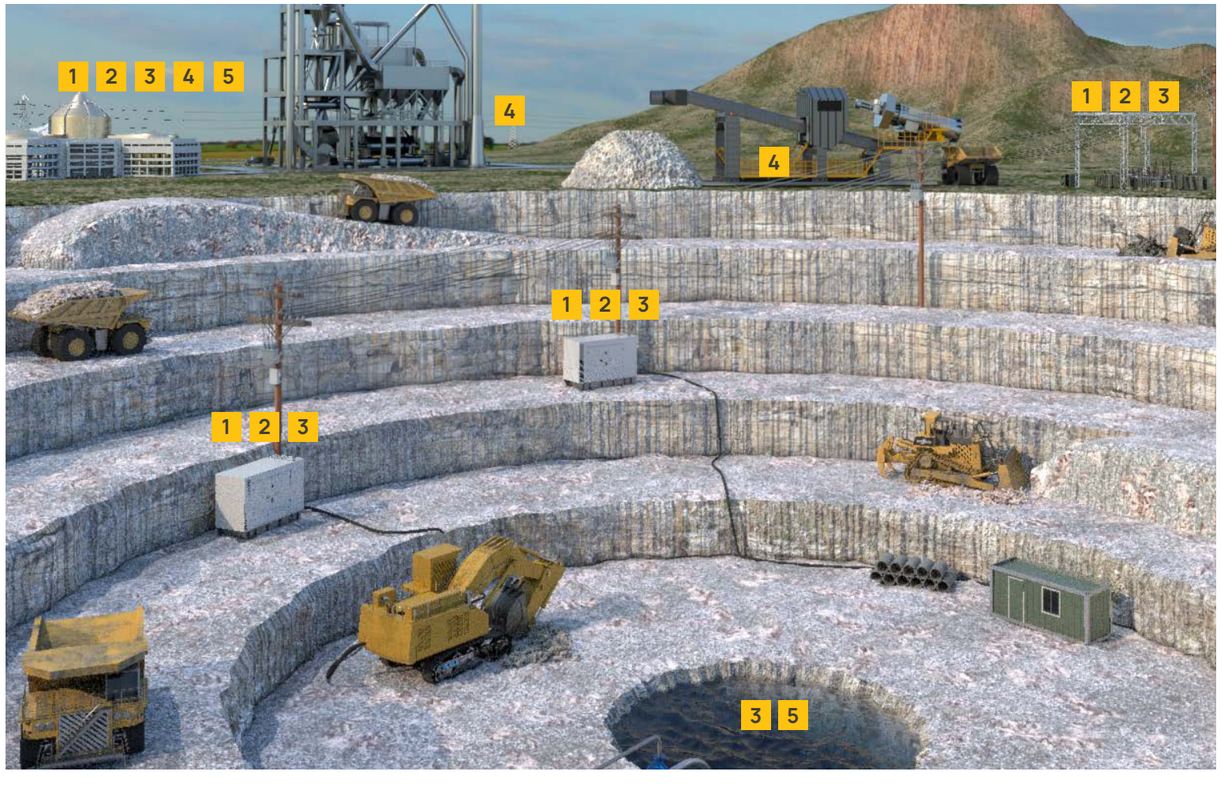
To help with this problem, Walther invented and patented an insulation monitoring and ground-fault detection device for three-phase systems under today's well-known name: ISOMETER. With this device, mines no longer had to shut down for him to conduct his inspections and workers were able to go home on time. Once invented, the ISOMETER was installed in ungrounded 500 V three-phase systems in open-pit mines.

Our roots in mining run deep and the need for insulation monitoring devices in those systems are still vast. The iso685 ground-fault monitor has many uses in mining applications, from monitoring the DC field in dragline MG sets to monitoring the ungrounded outputs on sophisticated medium voltage AC drives, and monitoring battery systems when battery energy storage solutions (BESS) are used. Our newest ISOMETER product, the iso415R, is a simplified, compact, cost-effective solution for many applications, including 125 VDC control power systems.

The evolution of the Bender ISOMETER

1953 1970 1974 2003 2014 2021

Solutions for mines



1 **High Resistance Grounded Systems (HRG Series)**
Limit ground-fault current to minimize equipment damage and maximize safety

- Enables continued operation of critical loads during ground-fault conditions
- Enhances safety with NGR's (in process areas where alarm only systems are allowed) to limit fault current to control touch potential on portable loads
- Offers multiple options for simple substation mounted resistors to integrated packages that save time and money in locating ground faults in refining and processing areas

2 **Neutral-grounding Resistor Monitors (NGRM Series, RC48N)**
NGR failure detection to ensure system grounding

- Enhances system safety with full frequency ground-fault detection and active monitoring of open and shorted grounding resistors
- Offers programmable filtering in order to prevent nuisance operation on harmonic-rich systems
- Utilizes remote access to ground-fault and NGR health information, saving time and minimizing need for human interaction
- Designed for reliable operation at remotely-located mine sites, including high altitude-rated versions

3 **Ground-fault Ground-check Monitors (RC48C)**
Trailing cable ground-continuity and ground-fault detection

- Enhances safety by ensuring ground connection to portable loads and rapidly clearing ground faults
- Lowers installation costs with easily installed DIN rail mounted relay
- Enables automatic tripping of loads that are faulted with either undervoltage release or shunt trip-compatible contact operation

4 * **Residual Current Monitors (RCM, RCMA, RCMS, RCMB Series)**
Monitor AC and DC Solidly Grounded and/or Resistance Grounded Systems

- Offers small footprint for monitoring of 1, 4 or 12 circuits with automatic tripping and alarming
- Recognizes, locates and prevents destructive ground-fault conditions for service entrance equipment, automatic transfer switches and power distribution units
- Minimizes unplanned outages and eliminates the need to interrupt power to identify faulty circuits
- Monitors a wide range of frequencies and filters select harmonics that contribute toward nuisance tripping

5 * **Insulation Monitoring Devices (iso Series and EDS Series)**
Monitor AC and DC Ungrounded Power Systems with Automatic Fault Location

- Quick and efficient alarm to notify of insulation failure in AC or DC circuits
- Detects trending insulation deterioration, eliminating larger problems down the road
- Enables remote access to system data, eliminating need to enter hazardous environments
- Accurately stores system health information, saving money over time and allowing for most effective use of maintenance resources
- Enhances medium voltage drive protection where isolation limits CT based ground-fault protection

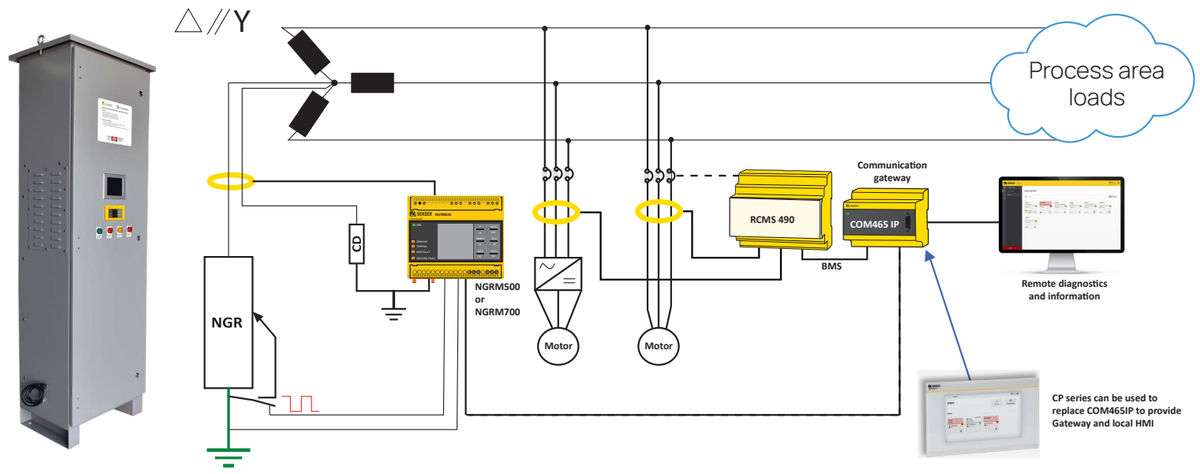
* This symbol indicates the product technology has unique features either patented by or exclusive to Bender

Electrical safety devices for the mining industry

Application	Ground Fault Detection Ungrounded Systems		Ground Fault Monitoring Grounded and High-Resistance Systems		Neutral Grounding Resistor Monitor		Offline Equipment Any Systems	Voltage and Frequency	Load Current	Portable Loads
Devices										
Application	Mining Processes, Power Generation, and Power Distribution		Mining Processes, Power Generation, and Mobile Generators		Surface and Underground Power Distribution Substations		Offline / Standby Equipment	Power Distribution	Power Distribution	Trailing Cables
System Type	1Ø AC Systems up to 300 V	1Ø and 3Ø, AC/DC, Pure DC, and Variable Frequency Drives (VFDs)	AC Systems, 1Ø and 3Ø	1Ø and 3Ø, AC/DC, Pure DC, and Variable Frequency Drives (VFDs)	HRG/LRG Systems up to 25 kV	HRG/LRG Systems up to 5 kV	AC Systems	AC Systems, 3Ø	AC Systems, 3Ø	AC Systems
Image(s)										
Name(s)	IR420-D4	iso685	RCM410r (above), RCM420	RCMA423 (above), RCMB300 Series, RCMS Series	NGRM500 (above), NGRM550, NGRM700, NGRM750)	RC48N	IR420-D6	VMD420	CMD420	RC48C
Description(s)	AC Ground Fault Detector	AC/DC Ground Fault Detector	AC Ground Fault Relay	AC/DC Ground Fault Relay	NGR Monitor and AC/DC Ground-Fault Relay	NGR Monitor and AC Ground-Fault Relay	Ground Fault Monitor for Offline Equipment	Monitoring Relay for Voltage, Frequency, Phase Sequence, and Phase Loss	Monitoring Relay for Overcurrent and Undercurrent	Ground Fault and Ground Continuity

Devices			
Application	Mining Processes, Power Generation, and Power Distribution		EV
System Type	Serial Communications to TCP/IP Network		Ungrounded DC
Image(s)			
Name(s)	CP907-I, CP915-I	COM465IP	isoEV425
Description(s)	HMI and Communications Gateway	Communications Gateway	Insulation Monitor for DC Batteries

Bender High Resistance Grounded System With Ground-Fault Location



NGRMs

NGRM500
NGRM550*

The **NGRM500** detects NGR (neutral-ground resistor) failure and ground faults in high-resistance-grounded power systems. The **NGRM550** is used for low-resistance grounded power systems.

Features

- Open and shorted (HRG only) NGR detection
- AC/DC ground-fault detection
- Integrated web server, Modbus TCP/IP, and Modbus RTU
- HMI (Human-Machine Interface) that displays measured values and provides easy programming in selectable languages

Benefits

- Improves safety by monitoring of the grounding connection
- AC/DC ground-fault protection/detection to properly monitor non-linear loads, such as adjustable-speed drives
- Preventative maintenance – sensitive ground-fault pickup levels allow early warning of insulation degradation
- Simplified design - Controls pulsing contactor in pulsing HRG systems
- Compact DIN rail mount solutions for application in smaller control panels also removes the necessity of wiring to the panel door

NGRM700
NGRM750*

In addition to the features of the NGRM500, the **NGRM700** and **NGRM750** offer unique packaging that allows easy installation of the base unit and removal of the HMI for panel mounting. One Cat5 cable connects the two parts. The NGRM700 and 750 have all features of the NGRM500 in a different form factor plus:

Features

- Detachable HMI
- Phase to-phase and phase-to-ground voltage monitoring

Benefits

- Altitude rating of 5,000 meters above sea-level
- Program and display information without opening doors
- Faulted-phase indication

*NGRM550 and NGRM750 relays are now available to provide NGR open detection on low-resistance grounded applications often found at the main power transformers feeding the entire mining facility. These devices offer improved integration with multiple source systems and allow the digital input to switch them to passive mode when necessary.

Additional Resistance Grounding System Components

RC48C

The RC48C ground-fault ground-continuity monitor is used to monitor the residual current in high-resistance grounded installations. It is particularly suitable for trailing cable protection. Trailing cables are very susceptible to mechanical damage and must be monitored for safety.

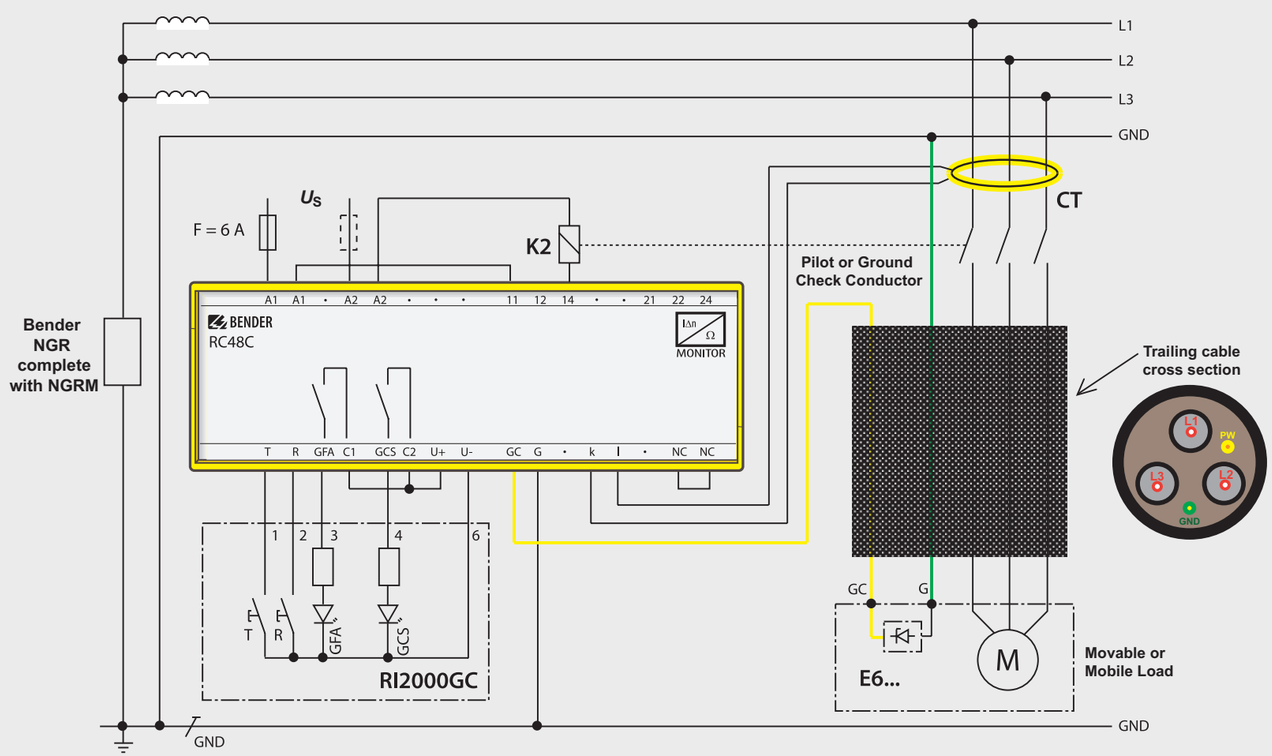
Features

- Ground-fault protection with selectable filtering for trailing-cable supplied loads
- Ground-wire monitoring with remote-starter capability

Benefits

- Protects people and equipment while minimizing nuisance trips
- Trips when cable damage defeats ground-fault protection and permits remote equipment starts

RC48C Connection Diagram



HRG Series

Product			
	 Series 1	 Series 2	 Series 3
Ground-fault current limitation	1 - 10 A	1 - 10 A	1 - 10 A
Ground-fault detection	AC	AC/DC Harmonic filtering	AC/DC Harmonic filtering
Ground-fault function	Pulsing	Pulsing	Pulsing
Outputs	Provides external fault indication or interruption where first-fault tripping is required	Provides external fault indication or interruption where first-fault tripping is required Detects faults in systems with power conversion equipment, including variable frequency drives (VFD) and battery backup systems (UPS)	Provides external fault indication or interruption where first-fault tripping is required Detects faults in systems with power conversion equipment, including variable frequency drives (VFD) and battery backup systems (UPS)
Commmunication	X	Modbus TCP/IP	Modbus TCP/IP
Feeders	Up to 12	Up to 60	Up to 120
Design	Wall-mount galvanized steel enclosure	Wall or floor mount	Floor mount
Standard dimensions			
Metering	Analog or digital	Digital	Digital
Display	LEDs, analog gauges, HMIs	LED	Touch screen HMI PLC - ground-fault location annunciation
Web-server	X	✓	✓
Data logging	X	✓	✓
NGR monitoring Detection of open and shorted NGRs	Optional	NGRM500/700 Series Prevents loss of ground-fault detection and dangerously high fault currents	NGRM500/700 Series Prevents loss of ground-fault detection and dangerously high fault currents
Standards	cULus listed IEEE C57.32 CSA 295	cULus listed IEEE C57.32 CSA 295	cULus listed IEEE C57.32 CSA 295
Optional Features	AC/DC ground-fault detection Zig-zag transformer - Available to convert an ungrounded system to an HRG system	Main-tie-main connections Zig-zag transformer - Available to convert an ungrounded system to an HRG system	Main-tie-main connections Multi-fault prioritization - Prioritizes circuit tripping in the event of a second ground-fault, allowing critical circuits to remain in operation Zig-zag transformer - Available to convert an ungrounded system to an HRG system

LRG Series

Product	
	 LRG
Ground-fault current limitation	1 - 10 A
Ground-fault detection	AC
Ground-fault function	Pulsing
Outputs	Provides external fault indication or interruption where first-fault tripping is required
Commmunication	X
Feeders	Up to 12
Design	Wall-mount galvanized steel enclosure
Standard dimensions	
Metering	Analog or digital

- NGRM550 and NGRM750 monitor LRG system resistor, and ground connection and ground faults
- Ample current is available for tripping LSIG circuit breakers
- Current range is 100s to 1,000s of Amps
- Available for medium-voltage applications
- Optional sensitive ground-fault protection to indicate an increasing trend in leakage current to allow preventative maintenance

Additional options

- Separate NGR and controls - All series available in two separate enclosures (controls and NGR)

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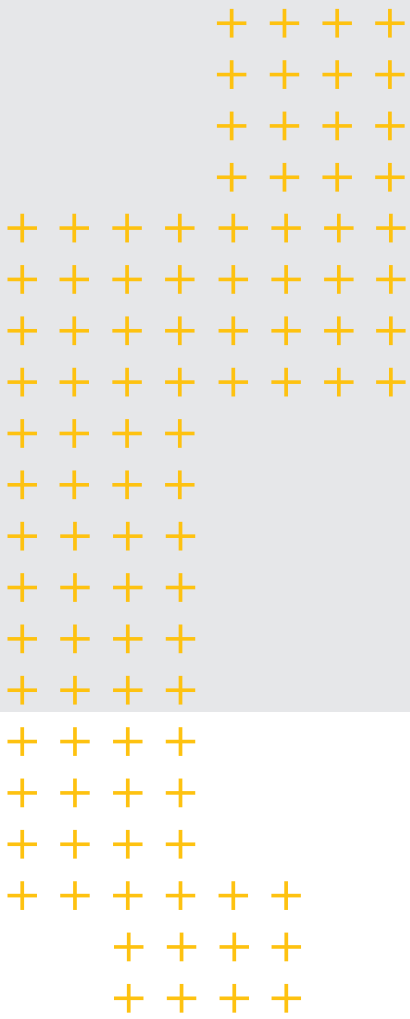

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