



# **Instruction Bulletin - 01.4IB.48060**

## **Modbus Current Sensor™**

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## Signal Words

As stated in ANSI Z535.4-2007, the signal word is a word that calls attention to the safety sign and designates a degree or level of hazard seriousness. The signal words for product safety signs are “**Danger**”, “**Warning**”, and “**Caution**”. These words are defined as:

**DANGER**

***DANGER** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.*

**WARNING**

***WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.*

**CAUTION**

***CAUTION**, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.*

**CAUTION**

***CAUTION**, used without the safety alert symbol, is used to address practices not related to personal injury.*

**NOTICE**

***NOTICE** is used to address practices not related to personal injury.*

## Qualified Person

For the purposes of this manual, a qualified person, as stated in NFPA 70E®, is one who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. In addition to the above qualifications, one must also be:

1. trained and authorized to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
2. trained in the proper care and use of personal protective equipment (PPE) such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
3. trained in rendering first aid if necessary.

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## Ch 1 General Information

### **WARNING**

***The equipment described in this document may contain high voltages and currents which can cause death or serious injury.***

The equipment is designed for use, installation, and maintenance by knowledgeable users of such equipment having experience and training in the field of high voltage electricity. This document and all other documentation shall be fully read, understood, and all warnings and cautions shall be abided by. If there are any discrepancies or questions, the user shall contact Powell immediately at 1.800.480.7273.

### **WARNING**

***Prior to adjustments, servicing, maintenance, or any act requiring the operator to make physical contact with the equipment, the power source must be disconnected and the equipment grounded. Failure to do so may result in death or serious injury.***

### **NOTICE**

***The information in this instruction bulletin is not intended to explain all details or variations of the Powell equipment, nor to provide for every possible contingency or hazard to be met in connection with installation, testing, operation, and maintenance of the equipment. For additional information and instructions for particular problems, which are not presented sufficiently for the user's purposes, contact Powell at 1.800.480.7273.***

### **NOTICE**

***Powell reserves the right to discontinue and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.***

**A. SCOPE**

The information in this instruction bulletin describes the following Modbus Current Sensor™:

- AP.MCS

**B. PURPOSE**

The information in this instruction bulletin is intended to provide details required to properly operate and maintain the Modbus Current Sensor described in **Ch 1 General Information, A. SCOPE**.

This instruction bulletin provides:

1. Safety guidelines
2. General descriptions of the operation and maintenance of the Modbus Current Sensor
3. Information for ordering renewal parts
4. Illustrations, photographs, and description of the Modbus Current Sensor

The illustrations contained in this document may not represent the exact construction details of each Modbus Current Sensor installation. The illustrations in this document are provided as general information to aid in showing component locations only.

*All illustrations and photos are shown using de-energized equipment.*

 **WARNING**

***Be sure to follow the appropriate safety precaution while handling any of the equipment. Failure to do so may result in serious injury or death.***

**C. APPROVALS AND CERTIFICATIONS**1) *FCC and ICES Statement*

This equipment has been tested and found to comply with the limits for a FCC CFR 47, Part 15 Subpart B, Class A digital device, as well as ICES-003 Issue 5, Class A. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

2) *EMC Directive*

The Modbus Current Sensor (MCS) has been designed and tested to meet the European Electromagnetic Compatibility Directive (EMC Directive, 2004/108/EC). The Declaration of Conformity for MCS lists the specific standards to which the

MCS was tested. Immunity of the MCS was tested for use in Power Station and Substation Environments according to IEC61000-6-5:2001.

**D. INSTRUCTION BULLETINS AVAILABLE ELECTRONICALLY****NOTICE**

***Changes to the instruction bulletin may be implemented at any time and without notice. Go to [powellind.com](http://powellind.com) to ensure use of the current instruction bulletin for the Powell equipment.***

To contact the Powell Service Division call 1.800.480.7273 or 713.944.6900, or email [info@powellservice.com](mailto:info@powellservice.com).

For specific questions or comments pertaining to this instruction bulletin email [documents@powellind.com](mailto:documents@powellind.com) with the Instruction Bulletin number in the subject line.

## Ch 2 Safety

### A. SAFE WORK CONDITION

The information in Section A is quoted from *NFPA 70E 2012 - Article 120, 120.1 Establishing an Electrically Safe Work Condition*.

#### 120.1 Process of Achieving an Electrically Safe Work Condition

1. Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.
2. After properly interrupting the load current, OPEN the disconnecting device(s) for each source.
3. Wherever possible, visually verify that all blades of the disconnecting devices are fully OPEN or that drawout type circuit breakers are withdrawn to the fully disconnected position.
4. Apply lockout/tagout devices in accordance with a documented and established policy.
5. Use an adequately rated voltage detector to test each phase conductor or circuit part to verify they are de-energized. Test each phase conductor or circuit part both phase-to-phase, and phase-to-ground. Before and after each test, determine that the voltage detector is operating satisfactorily.

**Informational Note:** See ANSI/ISA-61010-1 (82.02.01)/UL 61010-1, *Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements*, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 V and below.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being de-energized could contact other exposed energized conductors or circuit parts, apply ground connecting devices rated for the available fault duty.

### B. SAFETY GUIDELINES

Study this instruction bulletin and all other associated documentation before installing the Modbus Current Sensor.

Each user has the responsibility to instruct and supervise all personnel associated with usage, installation, operation, and maintenance of this equipment on all safety procedures. Furthermore, each user has the responsibility of establishing a safety program for each type of equipment encountered.

*The safety rules in this instruction bulletin are not intended to be a complete safety program. The rules are intended to cover only some of the important aspects of personnel safety related to Modbus Current Sensor™.*

**C. GENERAL**

1. Only supervised and qualified personnel trained in the usage, installation, operation, and maintenance of the sensor shall be allowed to work on this equipment. It is mandatory that this instruction bulletin, any supplements, and service advisories be studied, understood, and followed.
2. Maintenance programs must be consistent with both customer experience and manufacturer's recommendations, including service advisories and instruction bulletin(s).
3. Service conditions and equipment applications shall also be considered in the development of safety programs. Variables include ambient temperature; humidity; actual continuous current; thermal cycling; number of operations; interrupting duty; and any adverse local conditions including excessive dust, ash, corrosive atmosphere, vermin and insect infestations.

**D. SPECIFIC**

1. **DO NOT WORK ON ENERGIZED EQUIPMENT.** If work must be performed on a circuit breaker, remove it from service and remove it from the metal-clad switchgear.
2. **DO NOT WORK ON EQUIPMENT WITH THE CONTROL CIRCUIT ENERGIZED.**
3. **ALL COMPONENTS SHALL BE DISCONNECTED BY MEANS OF A VISIBLE BREAK AND SECURELY GROUNDED FOR SAFETY OF PERSONNEL PERFORMING MAINTENANCE OPERATIONS ON THE EQUIPMENT.**

4. Interlocks are provided to ensure the proper operating sequences of the equipment and for the safety of the user. If for any reason an interlock does not function as described, do not make any adjustments, modification, or deform the parts. **DO NOT FORCE THE PARTS INTO POSITION. CONTACT POWELL FOR INSTRUCTIONS.**

**E. SAFETY LABELS**

The equipment described in this document has **DANGER, WARNING, CAUTION**, and instruction labels attached to various locations. All equipment **DANGER, WARNING, CAUTION**, and instruction labels shall be observed when the circuit breaker is handled, operated, or maintained.

**NOTICE**

*Warning and Caution labels are located in various places in and on the switchgear and on the circuit breaker's removable element. Always observe these warnings and caution labels. Do NOT remove or deface any of these warning/caution labels.*

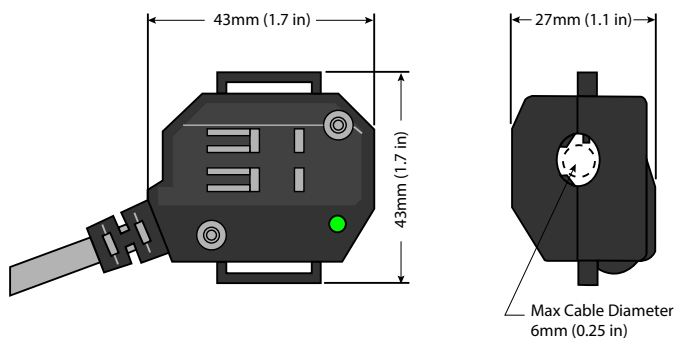
### Ch 3 Equipment Description

#### A. GENERAL

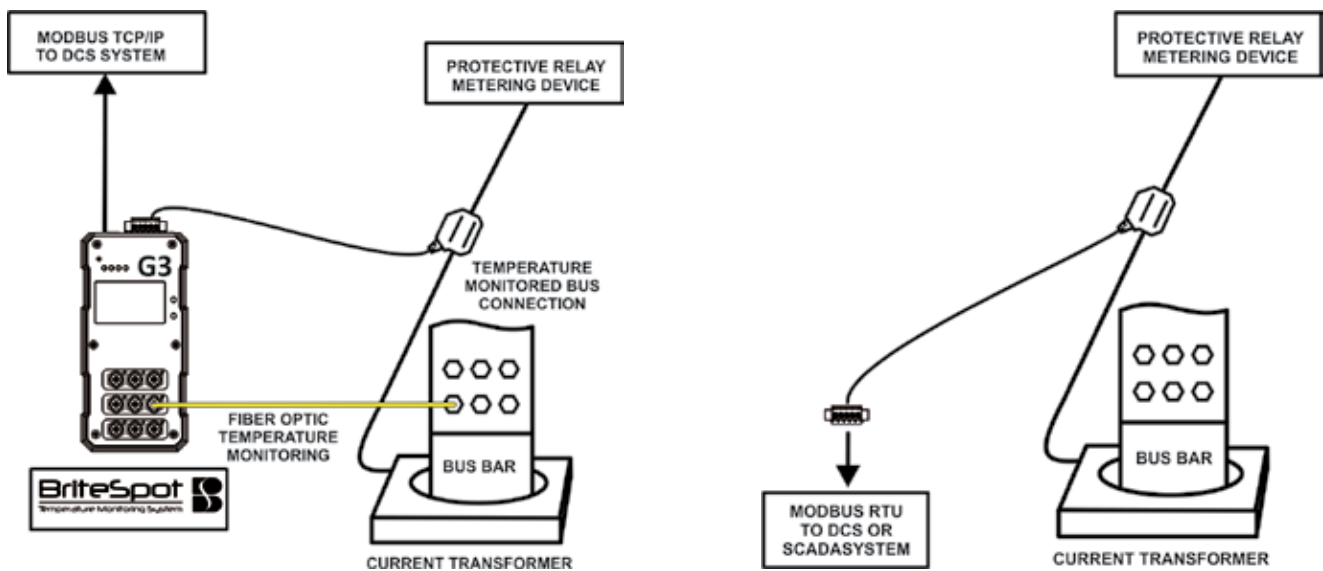
The Modbus Current Sensor™ is a hall effect, split-core device which communicates current transformer data via Modbus registers. It is secured to the one amp or five amp secondary wire of a current transformer.

| Color          | Description                      |
|----------------|----------------------------------|
| Flashing Green | MCS is powered and running       |
| Red Blip       | MCS is communicating to the host |

**Figure 1 Modbus Current Sensor Dimensions**



**Figure 2 System Level Diagrams**





## Ch 4 Installation

### A. RECEIVING

When the Modbus Current Sensor™ (MCS) is received, check for signs of damage. If damage is found or suspected, file claims as soon as possible with the transportation company and notify the nearest Powell representative.

Estimated size and weight for shipping the Modbus Current Sensor:

- Size: 1.7" long x 1.6" high x 1.1" wide
- Weight: < 1lb

### B. HANDLING

After removing the MCS from its packaging, the device is available for installation.

## CAUTION

***Do not carry the MCS by its connecting wire or drop the it as damage may occur.***

### C. STORAGE

Shipping and storage of electrical equipment requires measures to prevent the deterioration of the apparatus over a long unused period. The mechanical and dielectric integrity must be protected. Electrical equipment is designed for use in a variety of environments. When the equipment is in transit and storage, these design considerations are not fully functional. In general, the following measures must be considered.

1. Equipment designed for indoor installation must be stored indoors in a climate controlled environment to prevent condensation of moisture. Exposure to rain and the elements, even for a short period, can permanently damage the equipment. The temperature should be kept above (33°F/1°C) and below (140°F/60°C). The relative humidity should be kept below 60% or a dew point of (59°F/15°C).
2. If prolonged storage is anticipated, humidity controlling desiccant materials should be utilized. Desiccant packets should be installed in all packing containers.

**D. MOUNTING THE MCS TO THE CIRCUIT BREAKER**

The mounting of the Modbus Current Sensor™ is the same for the Standalone or with the BSG3 Integration versions.

**CAUTION**

*During installation, it is important to ensure no dirt, debris, or swarf enters the device. When opened (Figure 3) the core's surface is exposed and susceptible to retaining debris due to the tacky grease coating (used in corrosion prevention). Any debris on the core surface will cause significant error in the current values measured by the MCS. If debris is found on the surface of the core it must be removed while avoiding removal of the corrosion preventative silicone grease.*

Perform the following to mount the MCS in the circuit breaker:

- The mounting is intended to be across the secondary side of the current transformer (CT).
- Locate the wire and open the top of the MCS by unscrewing the captive screws (1/16" hex driver).
- With the secondary wire going through the current sense hole, close the MCS and hand tighten the screws. The secondary wire must have an outer diameter equal to or less than 1/4". Be careful not to pinch the wire when tightening the screws.
- Secure the MCS to a wire bundle or nearby support with a tie wrap.

**Figure 3** Open Modbus Current Sensor





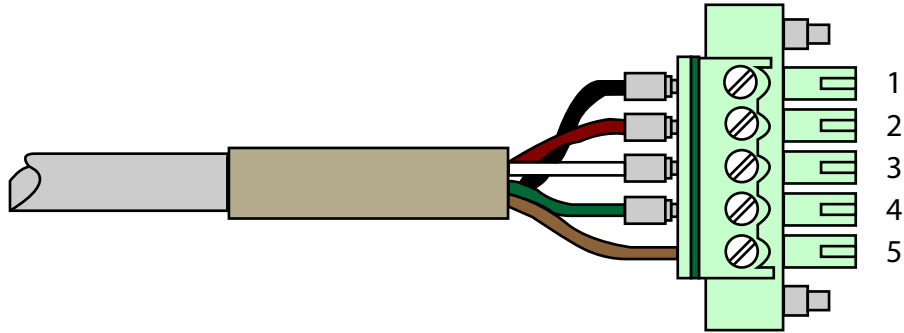


**Figure 4** Typical Mounting in Stand Alone Construction



**Figure 5** Typical Mounting in BSG3 Construction



**E. CONNECTIONS**
**Figure 6 Plug Wiring**


- Pin 1 - Ground (Black Negative)*
- Pin 2 - +12V to +24V (Red Positive)*
- Pin 3 - RS485 +COM (White Com)*
- Pin 4 - RS485 -COM (Green Com)*
- Pin 5 - Earth Ground (Shield)*

**F. STAND ALONE OPERATION**
**Table B Communication Setup**

| Parameter                  | Value     |
|----------------------------|-----------|
| Baud Rate                  | 9600 Baud |
| Data Bits                  | 8         |
| Parity                     | None      |
| Top Bits                   | 1         |
| Default Client ID          | 1         |
| Max # of Input Registers   | 32        |
| Max # of Holding Registers | 16        |
| Max Polling Rate           | 100 ms    |


**Table C Input Registers**

| Address | Name                 | Description  | Unit |
|---------|----------------------|--|------|
| 30001   | IR_SN_LO             | Lower 16 bits of the Serial Number                                       | -    |
| 30002   | IR_SN_HI             | Upper 16 bits of the Serial Number                                       | -    |
| 30003   | IR_FW-REV            | Firmware Revision  | -    |
| 30004   | IR_CT_SEC_I          | CT secondary current rating (ex. the 5 in 600:5)                         | -    |
| 30005   | IR_CT_PRI_I          | CT primary current rating (ex. the 600 in 600:5)                         | -    |
| 30006   | IR_DC_OFFSET         | User adjustable zero offset  | mA   |
| 30007   | IR_MANU_DAY          | Day of the month when calibrated (manufacture date)                      | DD   |
| 30008   | IR_MANU_MONTH        | The month when calibrated (manufacture date)                             | MM   |
| 30009   | IR_MANU_YEAR         | The year when calibrated (manufacture date)                              | YYYY |
| 30010   | IR_MA_DC_LO          | Lower 16 bits of the DC current in milliamps                             | mA   |
| 30011   | IR_MA_DC_HI          | Upper 16 bits of the DC current in milliamps                             | mA   |
| 30012   | IR_MA_RMS            | AC RMS current in mA   | mA   |
| 30013   | IR_A_PRIMARY_RMS     | Primary side (after the turns ratio) of the AC RMS current in A          | A    |
| 30014   | IR_AVG_MA_RMS        | Averaged AC RMS current in mA  | mA   |
| 30015   | IR_AVG_A_PRIMARY_RMS | Averaged primary side (after the turns ratio) of the AC RMS current in A | A    |
| 30016   | IR_MAX_PEAK_LO       | Lower 16 bits of the peak-to-peak current                                | mA   |
| 30017   | IR_MAX_PEAK_HI       | Upper 16 bits of the peak-to-peak current                                | mA   |
| 30018   | IR_CREST             | Cresting factor of the RMS reading as %                                  | %    |
| 30019   | IR_FREQUENCY         | Frequency of the current (triggers from +/- 100 ADC signal)              | Hz   |
| 30020   | IR_TICK              | MCS's tick to verify live operation                                      | -    |
| 30021   | IR_TEMP              | Reference temperature of the MCS PCB                                     | °C   |
| 30022   | IR_MS_MA_LO          | Lower 16 bits of the instantaneous squared mean current in mA            | mA   |
| 30023   | IR_MS_MA_HI          | Upper 16 bits of the instantaneous squared mean current in mA            | mA   |

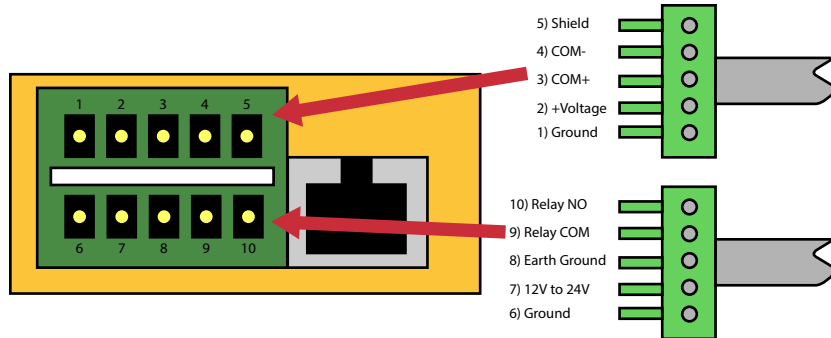
**Table D Holding Register**

| Address | Name         | Description                                      | Unit | Range     |
|---------|--------------|--|------|-----------|
| 40003   | HR_CLIENT_ID | Client address of the Modbus channel             | -    | 1 to 31   |
| 40004   | IR_CT_SEC_I  | CT secondary current rating (ex. the 5 in 600:5) | -    | -         |
| 40005   | IR_CT_PRI_I  | CT primary current rating (ex. the 600 in 600:5) | -    | -         |
| 40006   | HR_DC_OFFSET | User adjustable zero offset                      | mA   | 0 to 1000 |

**G. BSG3 INTEGRATION**

The BriteSpot™ BSG3 must be put into MCS mode to be able to read the MCS. Make sure the MCS Client ID is at its default value of 1. Refer to the BriteSpot BSG3 instruction bulletin for details on how to put the BSG3 into MCS mode.

**Figure 7 Connecting to the BSG3**



*Note: Pins 1 and 6 are internally connected.  
Pins 2 and 7 are internally connected.*



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May 2017