RS485 Cellular Gateway

Installation Manual

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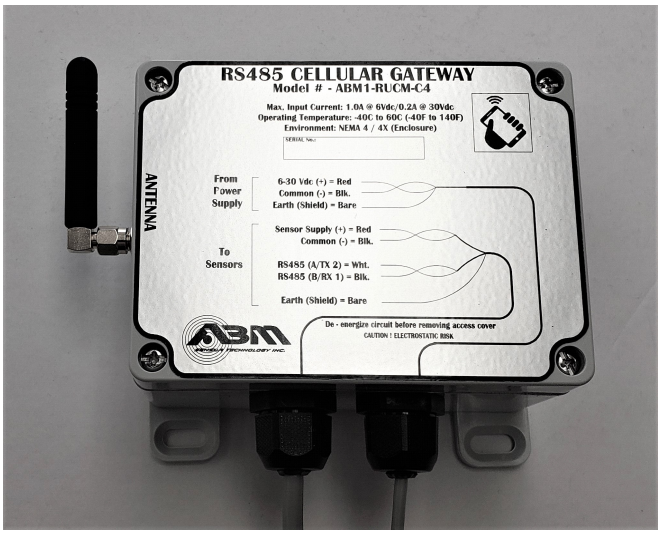
A - Introduction



This manual describes the requirements to successfully connect up to eight ABM level sensor products in an RS485 network hosted by the ABM RS485 Cellular Gateway.

The Gateway not only acquires data from these sensors but can also control them. Users have access to remotely change all alarm related functions, while ABM experts can remotely recalibrate and fine-tune the sensors for optimized performance in their respective environments.

The Gateway can also be used to power any DC version ABM level sensor (all ABM300 series sensors), facilitating the creation of a standalone battery-powered level monitoring system.

B - Requirements

Cellular Network

The key to reliable Gateway operation is suitable cellular phone network access. While urban and developed areas typically provide excellent cellular signal strength, there may be some installations where the cellular signal is weak. For such locations, it is highly recommended that the installer determine an optimal mounting location by using a cell phone display to assess the signal strength.

A remote antenna can be used in place of the enclosure-mounted antenna supplied with the unit, allowing the installer to, for instance, mount the antenna on top of a tank or structure for optimal signal strength while mounting the Gateway in a more sheltered or accessible area.

Note that for battery-powered systems, battery life will be adversely affected by weak cellular connections, as they will require significantly more energy to access.

Power Supply

The Gateway requires an input supply voltage of 6 to 30Vdc. Peak power is 6W (1A at 6V down to 0.2A at 30V). This peak only occurs for a very short period during cellular transmissions. As the Gateway is designed to operate on battery power, it can enter a sleep mode requiring only a few microwatts of power between measurement and reporting activities.

When the Gateway is connected to power DC version ABM sensors, it supplies a switched output of ≥20V, provided the following input supply requirements have been met:

- For 1 sensor, $V_{IN} \geq 6Vdc$
- For 2 sensors, $V_{IN} \geq 9Vdc$
- For 3 sensors, $V_{IN} \geq 12Vdc$
- For 4 sensors, $V_{IN} \geq 15Vdc$
- For 5 sensors, $V_{IN} \geq 18Vdc$
- For 6 to 8 sensors, $V_{IN} \geq 21Vdc$

The number and type of ABM sensors connected to the Gateway determine its total power requirement during a measurement cycle. Input current up to 600mA at 21-30Vdc may be required for an eight sensor configuration.

For extended battery life, the user can minimize average power consumption by programming the measurement and reporting intervals for longer periods, taking into account the worst-case system response time the user can allow. For instance, while capable of 2 minute measuring and reporting intervals, the Gateway could instead be set up for a measurement interval of 15 minutes and a reporting interval of 1 hour if that meets the response time requirements.

For remote locations where line power is not an option, the user can choose from many commercial battery and solar-powered systems that meet the above voltage and power requirements. However, ABM has available the following alkaline (non-rechargeable) battery pack for customer installation convenience:

- 300Wh @ 27V nominal (18 Alkaline Duracell MN1300 D-Cells); IP66 polycarbonate rated enclosure; -4°F to 130°F (-20°C to 54°C) temperature range.

Environmental

The Gateway is designed for operation over the temperature range of -40°F to +140°F (-40°C to +60°C). However, if implementing a battery-powered system, one should consider how particular battery technologies are affected by colder temperatures. For instance, the alkaline-based battery pack mentioned above is rated for operation down to -4°F (-20°C), but at these lower temperatures, it will have less than half its nominal energy (Wh) capacity. Other battery technologies (such as Lithium and lead-acid) may be less affected by temperature than alkaline technology.

The Gateway enclosure is rated for NEMA 4/4X ingress protection – suitable for exposed outdoor applications. However, the selected antenna must be suitable for the installation environment. ABM offers the following:

- An indoor-only antenna that mounts directly on the enclosure's SMA connector (shown in the product photo).
- An SMA-mounted outdoor antenna (IP66 rated).
- A remote magnetic-mount outdoor antenna with SMA extension cable.

If installed outdoors and unsheltered, the Gateway must be mounted vertically, such that the wiring exits from the bottom and the antenna from the left side, to prevent a build up of water, snow or ice around the cable glands or the antenna (SMA connector). The mounting feet may be relocated to the sides of the enclosure (rather than the top and bottom as shown in the photo) to allow mounting flexibility.

C - Installation:

Physical Configuration

Following the proper installation of each sensor according to its corresponding instruction manual, the Gateway should then be installed in any location with suitable cellular reception and environmental conditions. The Gateway's 6ft (2m) pigtail can in many cases be wired directly to a sensor – otherwise, a junction box is required to connect it to the RS485 and DC power busses.

It is not necessary to install the Gateway at one end of the RS485 bus (as shown in several examples in Section D) – it can be located anywhere in the network. The RS485 cabling must be connected in a multi-drop or daisy-chain configuration, as star configurations (i.e. with long branches) are not recommended. Short stubs are acceptable (maximum 6ft/2m) when connecting pigtailed devices such as the Gateway or an ABM Mini Ultrasonic sensor to a junction box.

Cabling

The Gateway and the ABM Mini Ultrasound sensor are each supplied with 6ft (2m) #24AWG shielded twisted-pair pigtail cabling – the minimum recommended wire size. ABM supplies all other sensor products with terminal blocks suitable for up to #14AWG wires. These terminals also accept two #18AWG conductors, which allows for direct wiring without junction boxes in some cases (see Section D Example 5).

Several basic rules apply to cabling:

- For ingress protection, it is important that only one cable per cable gland be used. Each ABM300 sensor (except the Mini Ultrasound) is supplied with two cable entries, facilitating direct connection in a multi-drop network.
- AC versions sensors (ABM400 or ABM430) require one gland for AC power, leaving only one gland for network connections. Line voltage (AC) conductors must not share a cable with low voltage (DC) conductors such as RS485 or mA Output.
- When junction boxes are used to meet the above requirements, the branch cable must not exceed 2m/6' in length.
- Conduits can be used instead of cable glands to allow runs of multiple cables or wire pairs, but line voltage cables or conductors cannot share a conduit with low voltage cables or conductors.

Shielding

Shielding is required for all Gateway-connected cables. See the Appendix for identification by ABM model number of the sensors discussed in the following shielding rules:

- Most important: the shield shall be connected to earth-ground in only one location. Connections at multiple points will create a ground-loop that can result in significant ground differential voltages and currents, which can adversely affect communication and even damage installed equipment.
- Ideally, the sole earth-ground connection to the cable (system) shield should be made at either end (as opposed to somewhere in the middle) of a multi-drop cable run. In most cases, especially if a line-powered DC supply is used, it is best to ground it at the power supply.
- The shields of all low-voltage cables should be connected together. Twisting together is acceptable, but screw terminals, wire nuts or soldered connections are more reliable.
- The installer must prevent the bare shield wires from touching any metal housing or any other conductors.
- AC powered sensors must have an earth-ground wire directly connected to Terminal 6 for electrical safety, which is also internally connected to Terminal 3 (on all sensors). Therefore, the cabling system shield can use Terminal 3 on one AC sensor as its grounding point – as long as it is not already grounded elsewhere.
- DC powered sensors are not required to have an earth-ground wire connecting to Terminal 3 or 6, as low-voltage installation rules do not require such. However, DC sensors with metal housings (some ultrasonic and all radar models) may be indirectly grounded through their mounting – for instance, where a metal or otherwise conductive tank is grounded to earth through its base and the sensor is installed without an isolating mount such as an aimer. If a DC sensor is not indirectly grounded in this manner, nor grounded through an earth-ground wire connected to either Terminal 3 or 6, then the system shield wire should be connected to Terminal 3 or 6.

The above shielding rules are illustrated throughout the configuration examples in Section D.

Network Initialization

ABM sensors are supplied with a factory-default SID = 2, unless they were specifically ordered from ABM for a Gateway network configuration with a pre-assigned Serial ID (SID) sequence. The connection of more than one sensor having the same SID will result in communications failure.

Therefore, installation of more than one factory-default sensor to the Gateway requires that the installer only add one sensor at a time to the RS485 bus (the black/white twisted pair) to re-assign its SID to a unique number, as described in the Gateway User Manual.

D - Installation Examples

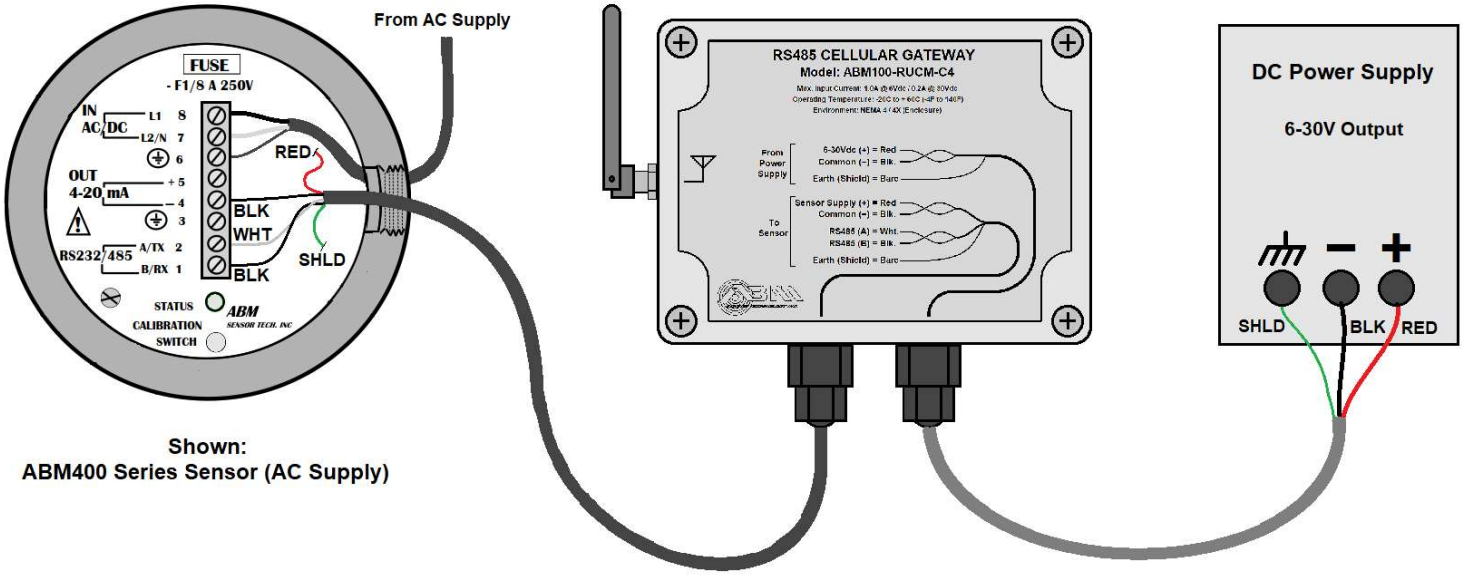
1. Single AC Powered Sensor; Line Powered DC Supply

The following example shows an AC powered sensor (ABM400 or ABM430 series), without a current output connection, connected to a Gateway. The DC supply is powered from an AC line supply.

As the current output is unused, the Gateway, located within 6ft (2m), is shown directly wired to the sensor, utilizing one cable gland. The AC supply uses a second separate cable gland.

As the Gateway is not supplying sensor power, the red wire is either cut off or insulated with tape inside the sensor. The black wire from the red/black pair is still connected to provide a signal common for the RS485 link (the black/white pair).

The shield is shown grounded at the power supply and not connected in the sensor. As AC powered sensors have both Terminals 3 and 6 earth-grounded for electrical safety, the shield could instead have been left unconnected at the power supply and connected to Terminal 3 in the sensor.



Shown:
ABM400 Series Sensor (AC Supply)

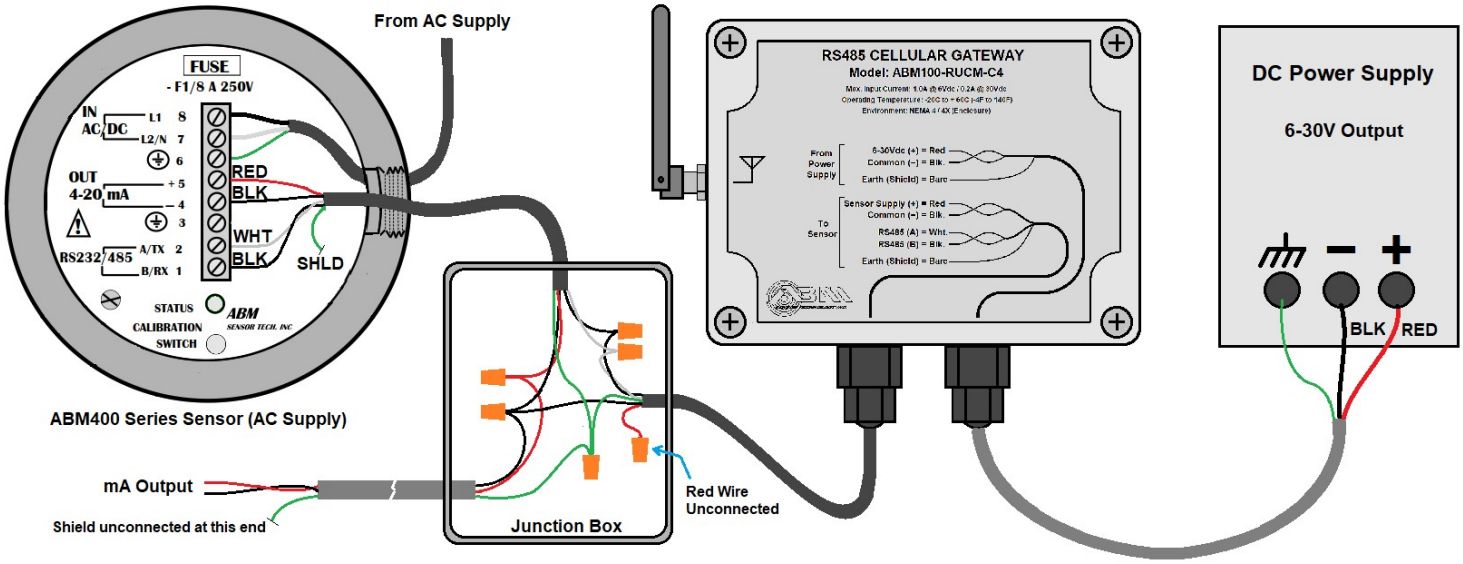
2. Single AC Powered Sensor with Current Output; Line Powered DC Supply

The following example is a variation of the first, but with the current output implemented.

As the sensor is AC supplied, there is only one free cable gland for all low voltage wiring, so an external junction box is required to break out the current output.

The shield is earth-grounded at the sensor since, being AC powered, Terminal 3 must be earthed anyways.

As Terminal 4 (mA Output "-") is the signal common for both the current output and the RS485 in the sensor, it is acceptable to provide this connection through the one black wire to the junction box as shown - thus avoiding the requirement for a 3-pair connection to the sensor.



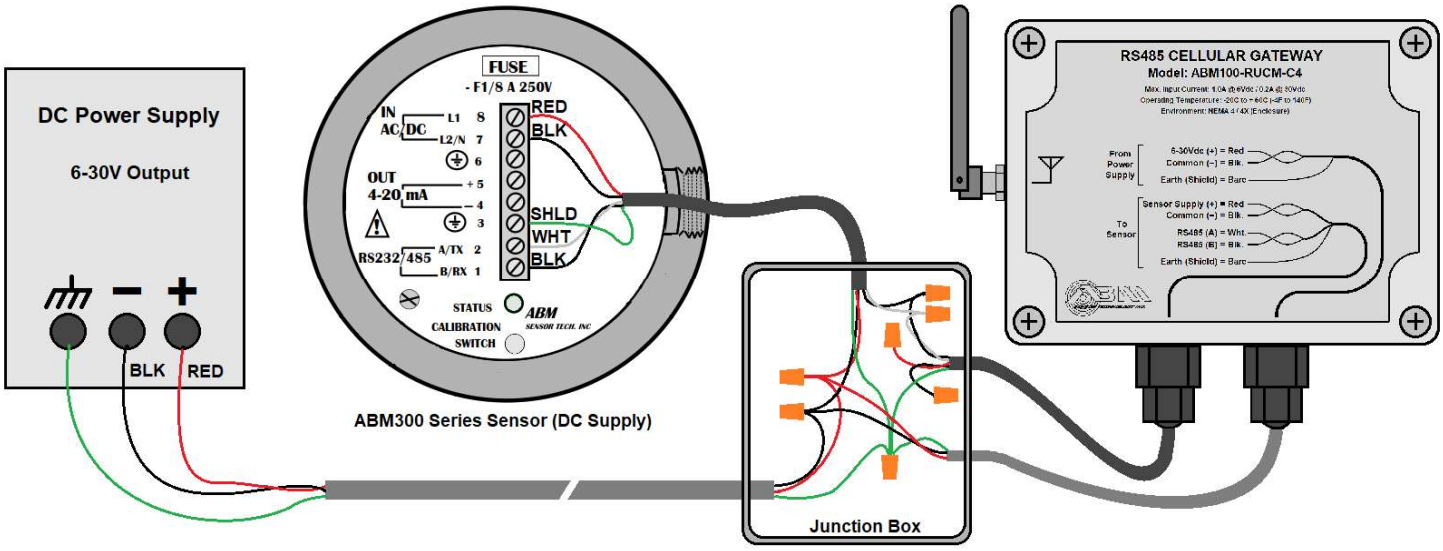
3. Single DC Powered Sensor; Remote Line Powered DC Supply

The following example is a variation of the previous two, except that the line-powered DC supply is remotely located. In this case, since it is not operating on a battery, there is no need to implement the low-power connection.

The junction box is required, since there are conductors from three cables that need to be routed to the sensor. In this case, the Gateway supply input is connected in parallel with the sensor supply, such that the Gateway supply output pair (red/black) is not connected.

Note that the common (black wire) of the Gateway supply cable is internally connected to the common of the Gateway sensor cable (black of the red/black pair). Only one of these should be connected for signal common.

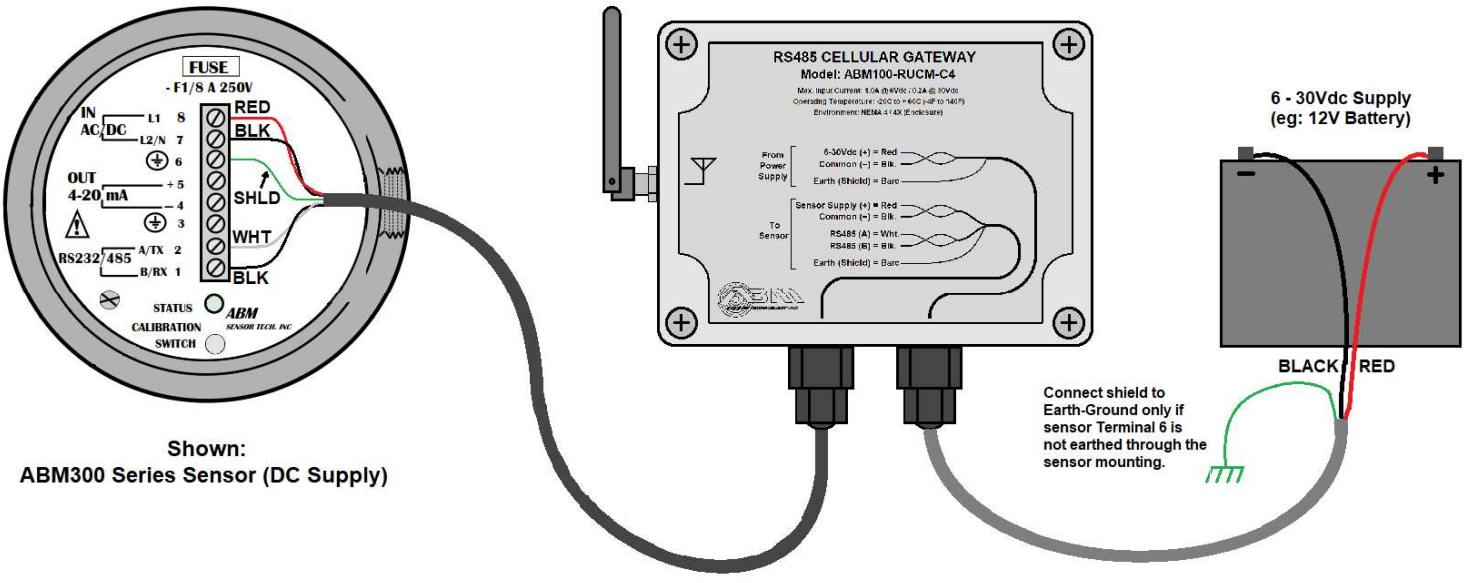
This example illustrates the case where the sensor body is not providing an earth-ground connection, wherein the shield wire must be connected to Terminal 3 in the sensor.



4. Single DC Powered Sensor; Low-Power Battery Configuration

The following example shows the Gateway wired to control the sensor power supply to power it intermittently (for low power consumption).

The shield in this example is shown grounded at the battery, as it is not grounded through the sensor body and its mounting hardware (eg: if it has a PVC housing or if it has a metal housing but is otherwise isolated from earth-ground).



5. Multiple DC Powered Sensors; Low-Power Battery Configuration

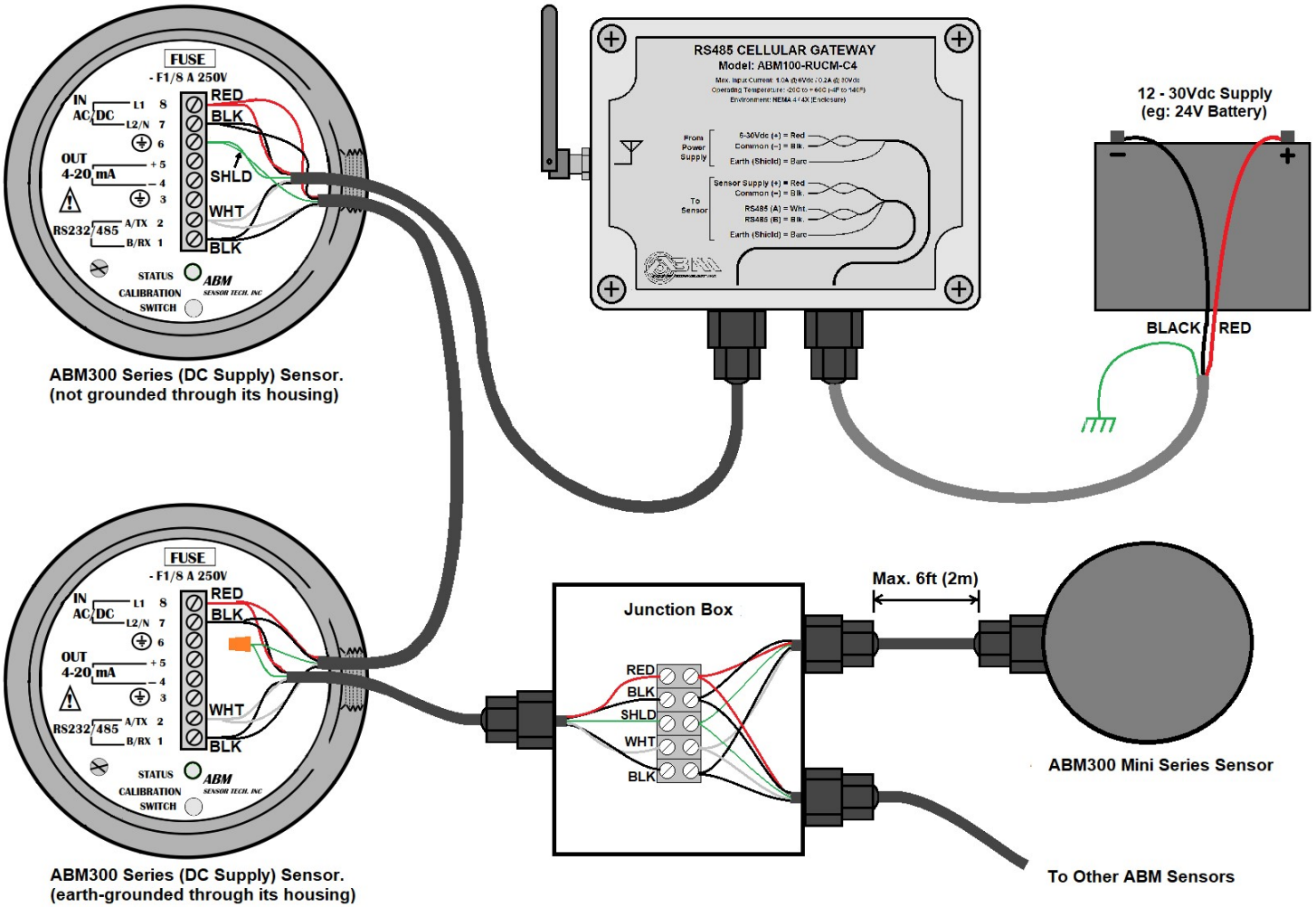
The following example shows the Gateway wired to control multiple sensors' power supply to power them intermittently (for low power consumption).

As shown, there is one ABM300 sensor that is grounded through its metal housing, so the shield wire should not connect to either Terminals 3 or 6 in that sensor. The other sensors are isolated, so the shield wires are connected to each of those.

Technically, the shield could have been earth-grounded at the grounded sensor, but it is generally preferable to have the grounding point of the shield at one end or the other of the entire cable run – hence the grounding at the battery end. There are exceptions, of course, depending on the total length of the cable, proximity of electrical noise sources (such as motors) and the quality of the grounding connection available. For instance, a sensor grounded through a metal tank mounted on dry ground may not be as effective as a connection to the earth-ground from the AC line supply – the latter typically implemented with a buried grounding rod or plate. For longer networks, sometimes experimentation is required to determine the best grounding location.

The ABM300 Mini sensor, as shown, requires a junction box since this product is only supplied with a 6ft (2m) pigtail and has no user-accessible connection points inside its housing.

In multiple sensor configurations powered by the Gateway, the voltage of the power supply must be adequate (see “Power Supply” in the “Requirements” section above) to be able to meet the load requirements.



E - Appendix

Following is a list of ABM sensors that are compatible for use with the Gateway.

Description	ABM Model #	Notes
DC Ultrasound - PVC	ABM300-xxxULC4-PVxxx	
DC Ultrasound - Metal	ABM300-xxxULC4-ALxxx ABM300-xxxULC4-SSxxx	May be indirectly earth-grounded through its mounting configuration.
DC Mini Ultrasound	ABM300-xxxUMC4-PVxxx	
DC Radar	ABM300-xxxYYC4-xxxxxxx	May be indirectly earth-grounded through its mounting configuration.
AC Ultrasound	ABM400-xxxULC4-xxxxx ABM430-xxxULC4-xxxxx	Connect only RS485 communications and Common. Not to be powered by the Gateway.
AC Radar	ABM400-xxx**YY**C4-xxxxxxxx ABM430-xxx**YY**C4-xxxxxxxx	

Note: For Radar products, **YY** = any one of the following: R2, R5, R6, R2R7 or R6R2