-48VCD-1

-48V TELECOM BATTERY VOLTAGE MONITOR

installation & user guide
If your “mission-critical” IT environment includes an extensive telecom network, you probably have a battery-backup system to insure that the telecom system stays “live” even in the event of a power failure. The ability to monitor the charge state of these batteries can be crucial, especially if they’re located in remote, unattended installations such as cell towers, central switching facilities located in suburban or rural areas, or even just a building on the other side of your company’s campus. But the standard –48V, positive-ground system used in telecommunications equipment presents a unique monitoring challenge, since its polarity is completely opposite to the voltages commonly used in other types of monitoring equipment (including the WeatherGoose). How do you monitor a positive-ground battery system when your monitoring devices are all designed for negative-ground sensors, without causing a short circuit between the two?

The 48VCD-1 Telecom Battery Monitor is an inexpensive solution to this problem. This simple device provides the necessary signal conditioning to convert the relatively high input voltage range of –16 ~ –60VDC to a proportional 0 ~ +5VDC signal suitable for use with the WeatherGoose monitoring system’s analog-sensor inputs, and also incorporates protection circuitry to help prevent incorrect hookups from destroying either the sensor device or the Goose itself. By setting appropriate trip points on the Goose’s alarm page, you can receive automatic notifications of potentially dead, discharged, or overcharged battery banks based on the measured voltage across the batteries, giving you advance notice of potential problems without needing to constantly send someone out to measure the battery voltages manually.

The 48VCD-1 Telecom Battery Monitor is directly compatible with any WeatherGoose (series I or series II) monitoring unit which has analog-sensor inputs; such models include the WeatherGoose, SuperGoose, and the MiniGoose/XP. Models which do not have built-in analog inputs, such as the MiniGoose, will require the use of an appropriately-programmed CCAT analog-to-digital converter to use an 48VCD-1. Models which do not provide connections for either analog or digital external sensors, such as the MicroGoose, are not compatible with the 48VCD-1.

NOTE: The 48VCD-1 has been manufactured in several physical variations since its initial appearance. The following installation and usage instructions assume that you are using the rev.B “tubular” version, pictured below. If your 48VCD-1 Telecom Battery Monitor does not look like this, you may want to refer to Appendix A to determine whether you have a rev.A model, and make note of the appropriate wiring instructions for that model before proceeding further. (Both models are identical in function, but their physical appearance and wire colors are different.)

48VCD-1 Telecom Battery Monitor, Rev.B (current model)
The first step is to connect your 48VCD-1 to the WeatherGoose unit. When you look at the 48VCD-1 device, you’ll see a set of wires coming out of each end:

One pair consists of two heavier-gauge wires, one red and one black, ending in ring terminals; this pair connects to the battery or batteries that you wish to monitor. The red wire connects to the (+) battery terminal, while the black wire connects to the (–) terminal.

The other wire pair consists of two thinner wires, also one red and one black, encased in white outer insulation. This is the signal pair, which connects to the WeatherGoose’s analog-input terminals or to an appropriately-programmed CCAT interface, depending on your installation and Goose model; this connection will be shown in more detail in the following sections.

**PLEASE NOTE THAT POLARITY IS IMPORTANT!** While the device is protected against backwards connections, you will not get the correct readings from the device if either the battery pair or the signal pair are connected improperly.

One of the protections included inside the device is a self-resetting fuse; in the unlikely event that an incorrect hookup results in a short circuit through the device, the fuse will open up to a high resistance to effectively cut off the current flow. If this happens, the fuse may take several seconds to reset once the voltage is disconnected, so if you hook up the 48VCD-1 and get no readings (or nonsense readings) from it, disconnect the device and let it “rest” for about 10~15 seconds before trying to reconnect it, to give the fuse time to reset itself.

The input range of the device is –16 ~ –60VDC, to provide sufficient overhead for increased voltage across the batteries during the charging cycle. Note that the 48VCD-1’s measurement circuitry is powered from the batteries it is connected to, so the batteries need to have a charge of at least –16V in order for the 48VCD-1 to operate; if the battery voltage falls below that level, the device will not operate correctly and will either read 0V, or give unstable readings that jump randomly between 0V and the incoming voltage level.

The illustration below shows a (much simplified) example of how to connect the 48VCD-1 to a battery bank and charger. Here, each battery is a 24-volt deep-cycle lead-acid battery, with the six batteries wired in a series-parallel combination; each pair of 24V batteries wired in series (via the blue wires) provides 48V (with the positive side going to ground), and the three pairs wired in parallel (via the red and black wires) provide increased current capacity. The 48VCD-1, connected across the paralleled sets, monitors the voltage of the battery bank as a whole.
Connecting the 48VCD-1 to the Analog-Input terminals:

The following diagrams demonstrate how to connect your 48VCD-1 Telecom Battery Monitor directly to the spring-loaded analog-input terminals used on most of the standard series-I and series-II WeatherGoose product lines. (Note that specialized models, such as the PowerGoose and RelayGoose, use different styles of terminal blocks; while the connections will be the same electrically, the mechanical nature of the connector will be different than the one shown here. If necessary, refer to the manuals for those specific models for further details on how to connect analog sensor devices.) Each terminal consists of two openings; a larger, square opening at the bottom, where the wire will be inserted, and a smaller, narrower opening above which is used to open the spring-loaded jaws inside the terminal block so the wire can be inserted.

Note that the neither the terminal jaws on the WeatherGoose, nor the terminal block on the current transformer itself, are insulation-piercing types; therefore, the insulation must be stripped at least ½” prior to insertion.

First, insert a small flat-blade screwdriver into the upper slot...

...pry upwards to open the spring-loaded jaw...

...slip the sensor wire into the larger bottom opening...

...then pull out the screwdriver to allow the jaw to close around and grip the wire.

This diagram shows the correct polarity to connect a 48VCD-1 to the analog-input terminals on a WeatherGoose.

Note that this applies to all models of the WeatherGoose family, regardless of series or model; the 48VCD-1 must be connected with the correct polarity, or the unit will not function and the Goose’s input circuitry could be damaged by incorrect connections!

**CAUTION:** unlike some types of analog sensors, the 48VCD-1 cannot be “doubled up”; i.e. you cannot connect two or more of them in series or parallel so that they share a single analog input! Attempting to do so can damage both the sensors, and possibly the WeatherGoose analog inputs as well!

**Red wire** (+) can go into any numbered terminal

**Black wire** (-) can go into either **C** (common) terminal

**BLACK** wire with ring terminal goes to (−) battery terminal

**RED** wire with ring terminal goes to (+) battery terminal

**TO ANALOG-SENSOR INPUT TERMINALS**
Sensor operation and behavior:

Once you’ve successfully connected the 48VCD-1 Telecom Battery Monitor to your WeatherGoose, the internal-sensors display block of the Sensors page will look something like this: (NOTE: for purposes of this example, the 48VCD-1 has been connected to Analog Input #1 of a WeatherGoose-II with v3.3 firmware; the use and operation of the 48VCD-1 will be similar for other models, but the on-screen displays may differ somewhat.)

In this first screenshot, the 48VCD-1 is connected, but there is no voltage present at its input terminals. Notice, however, that the displayed reading at the Analog-1 input is not “0”, as would normally be expected; instead, it’s showing a reading of “16”. This is an unavoidable consequence of the way the 48VCD-1’s circuitry works, in combination with the weak pull-up resistor built in to the WeatherGoose’s generic analog inputs. With no input voltage to the 48VCD-1, its signal-generation circuitry has no power to operate, so the Analog-1 input on the WeatherGoose is able to “float” to a level slightly above zero as the internal pull-up resistor, which normally supplies a small amount of loop current for dry-contact switch-type devices, tries to pull the input up towards 5V. (The protection diodes inside the 48VCD-1 prevent the input from floating all the way up to 5V). At first glance, this would seem to be a problem for getting accurate readings from your battery bank – however, a reading of “16” on the WeatherGoose display would represent an input voltage of less than -10V at the 48VCD-1 terminals (more on how this is calculated in a moment), which is actually below the device’s specified operating range of –16 ~ –60VDC anyway. (Plus, in practical terms, a –48V telecom battery bank would typically be considered functionally “dead” long before its output falls to –10V, or even –16V, to begin with.)

Here, we have applied –24VDC to the sensor’s input terminals, and the WeatherGoose is now showing a reading of “31”. Why 31, and not 24? This, too, is a characteristic of the way the generic Analog Inputs work on a WeatherGoose work. The WeatherGoose has no way of knowing what kind of sensor is actually attached to the Analog Input, so it simply scales the 0~5V input to a generic reading of 0~99; it is up to the user to interpret the reading in terms of what type of sensor is actually connected to the input terminals.

To convert the displayed reading into the “true” voltage, use the following formula:

\[ \text{voltage} = (–0.72 \times \text{displayed reading}) \]

In this case, \(-0.72 \times 31 = –22.32V\) – which is a bit low, but still within the 48VCD-1’s rated accuracy of ±5% combined with the WeatherGoose’s sampling accuracy of ±2% on the Analog Input ports. These measurements are, admittedly, not quite as accurate as those from a properly-calibrated voltmeter, but they are the inherent result of the technical trade-offs necessary to make a simple-to-use sensor that could both self-power itself from the same voltage source it’s trying to measure (eliminating the need for an additional power supply or internal battery) and provide shunt-diode and fuse protection to both itself and the WeatherGoose unit in case of incorrect accidental hookups. However, this accuracy is easily good enough to track charge/discharge trends, especially for a typical lead-acid battery bank which generally show a wide swing between the typical charged, discharged, and overcharged conditions to begin with.
Finally, we see the unit with –48VDC applied to the sensor. The reading of “70”, multiplied by the conversion factor of –0.72, gives a value of –50.4V, which is still within the combined accuracies of the 48VCD-1 and the WeatherGoose.

The graph shown below demonstrates the range of displayed readings vs. battery voltage typical of the 48VCD-1 Telecom Battery Monitor when it is connected directly to the Analog Input terminals of a WeatherGoose monitoring system.
Alarm-threshold settings when connected directly to an Analog Input:

If you are using a Series-II unit:

To set an alarm threshold to notify you when the 48VCD-1 detects that the battery voltage has dropped below your desired limit, simply go to the Alarms page, click the Add New Alarm button under the Goose’s internal-sensors block, choose the Analog Input to which the 48VCD-1 is connected (Analog-1 in this example), set trips if: to Below and the threshold to the desired voltage level as calculated above; then, select the alarm actions you wish this alarm threshold to trigger, along with a trigger delay or alarm-repeat interval if desired, and click Save Changes.

To calculate the proper threshold for the desired voltage, simply divide the desired voltage by –0.72, as follows:

\[
\text{alarm threshold} = \left( \frac{\text{voltage}}{–0.72} \right)
\]

(Note: don’t forget to keep your signs correct; i.e. make sure you divide a negative voltage by the negative conversion factor to get a positive alarm threshold! If you miscalculate and put a negative alarm threshold into the alarm-settings box, the alarm will never trip because an analog-input reading cannot go below zero!)

In the example shown here, we are setting an alarm threshold of –36V by setting the trip point to “50” (i.e. –36 divided by –0.72), so the associated alarm notifications will trip if the battery voltage falls below –36V. If you also want to set an overvoltage threshold, simply set trips if: type to Above instead of Below. (Be sure to take the battery-charging system’s output voltage into account, or else your “overcharge” alarm will keep tripping every time the battery charger kicks in!) If you wish to monitor for both over- and under-voltage conditions, then simply repeat this “Add New Alarm” process to attach a second alarm threshold to the analog input, and set the thresholds and actions accordingly. (You can also set “escalating” thresholds this way, by adding multiple alarms to a given sensor; refer to the user guide for your particular model of climate monitor for more information on how to do this.)

If you are using a Series-II unit with a firmware revision prior to v3.4.x, your alarm-settings block will look like this. Alarm-threshold settings are calculated and programmed the same way as above; the only difference (aside from the lack of trigger-delay and alarm-repeat intervals, which were introduced in v3.4) is that the alarm types are named High Trip and Low Trip instead of Above and Below, respectively. High Trip alarms are tripped when the reading goes higher than the set threshold, while Low Trip alarms are tripped when the reading goes below the threshold.
If you are using a Series-I unit:

Find the sensor block on the **Alarms** page for the Goose unit’s internal sensors, then set the **Low Trip** threshold to the desired voltage threshold and the **High Trip** threshold to 110, as shown here, for the input which the 48VCD-1 is connected to, then set the **Alarm State** to the action(s) you wish to take place when the trip threshold(s) are exceeded and click **Save Changes**. (The input being used here, #1, is highlighted for clarity.) Since the Analog input cannot go above 99, this will effectively disable the High Trip event, which is generally not needed if you are only monitoring for a low-battery condition. Thresholds are calculated using the same formula as given above, regardless of series or firmware revision.

If you wish to monitor for overvoltage as well, then set both the **High Trip** and **Low Trip** thresholds to the desired voltages.

If, for some reason, you wish to only monitor for the over-voltage condition, and not for under-voltage, then set the **High Trip** threshold to the desired voltage limit, and set the **Low Trip** threshold to −10 to disable it.
Using the 48VCD-1 via a CCAT-48 analog-to-digital bus interface module:

Connecting the 48VCD-1 to the CCAT-48:
If you are using an ITWatchdogs monitoring device which does not have built-in analog inputs, such as the MiniGoose-II, or if you have already used up all of your analog inputs on other sensors, then you will need to attach the 48VCD-1 Telecom Battery Monitor via an appropriately-programmed CCAT analog-to-digital bus interface module, available from IT Watchdogs. The following diagram shows how to hook up and use a 48VCD-1 in combination with a CCAT-48 interface module.

(Note: the CCAT has been manufactured in a couple of different physical variations over the lifetime of the product. If your CCAT does not seem to match the appearance of the one shown below, you may have an earlier model, and may wish to consult the CCAT User Guide to insure the correct hookups.)

Note that the same cautions apply to using the CCAT as to the internal Analog Inputs; i.e. correct polarity must be observed when connecting the 48VCD-1, and multiple units may not be connected in series or parallel to share a single CCAT connection! Again, the wires will need to be stripped, as the terminals are not of an insulation-piercing type. However, they do not need to be stripped back as far as they do for the Analog Input block; a ¼-inch of exposed wire will generally be sufficient for the style of terminals used on the CCAT.

Sensor operation and behavior when connected via a CCAT-48:
Once you’ve connected the CCAT-48 to the monitoring unit, a new sensor block will appear, initially titled “-48Vdc Sensor.” (This name can, of course, be changed from the Display page to something more specific to your installation.) If your CCAT does not initially display as “-48Vdc Sensor”, do not proceed further, as your CCAT is not correctly programmed for this sensor and will not display its status properly! (In this event, contact IT Watchdogs technical support for assistance.)

In this first screenshot, the 48VCD-1 is connected to the CCAT-48, but there is no voltage present at the 48VCD-1’s input terminals. (Note that if you have connected the CCAT-48, but have not yet wired up the 48VCD-1 to it, the reading shown may drift randomly; this is normal for a floating input on a voltage-measurement circuit such as the CCAT’s A/D converter chip, and nothing to worry about.)

Notice that the displayed reading is not actually “0.00V”; rather, it is drifting randomly around –1 ~ –1.25V. This is not unusual; with no input voltage to the 48VCD-1, or at voltages below the device’s specified operating range of –16 ~ –60VDC, its signal-generation circuitry has no power to operate, so the input to the CCAT-48’s analog-to-digital measurement chip is able to “float” and drift slightly away from a “true” 0V level.
Here, we have applied –24VDC to the sensor’s input terminals. The actual displayed voltage is –22.61V – which is a bit low, but still within the 48VCD-1’s rated accuracy of ±5% combined with the average sampling accuracy of ±2% on the A/D measurement chip used in the CCAT. These measurements are, admittedly, not quite as accurate as those from a properly-calibrated voltmeter, but they are the inherent result of the technical trade-offs necessary to make a simple-to-use sensor that could both self-power itself from the same voltage source it’s trying to measure (eliminating the need for an additional power supply or internal battery) and provide shunt-diode and fuse protection to both itself and the WeatherGoose unit in case of incorrect accidental hookups. However, this accuracy is easily good enough to track charge/discharge trends, especially for a typical lead-acid battery bank which generally show a wide swing between the typical charged, discharged, and overcharged conditions to begin with.

Finally, we see the unit with –48VDC applied to the sensor. The displayed voltage, –50.33V, is now reading a bit high – but still within the combined accuracies of the 48VCD-1 and the CCAT-48.
Alarm-threshold settings when connected via a CCAT-48:

If you are using a Series-II device:

When you go to the Alarms page, you’ll find that a new settings block has been added there as well, also titled “48Vdc Sensor.” To set an alarm threshold to notify you when the 48VCD-1 detects that the battery voltage has dropped below your desired limit, simply simply scroll down to this new settings block, click the Add New Alarm button, set set trips if: to Above and the threshold to the desired voltage level; then, select the alarm actions you wish this alarm threshold to trigger, along with a trigger delay or alarm-repeat interval if desired, and click Save Changes. Note that since the CCAT-48 displays the sensor reading as a properly-scaled 0 ~ –60V value, there is no need to convert the desired voltage threshold into a 0~99 value using a formula; simply enter the desired voltage threshold directly.

In the example shown here, we are setting an alarm threshold of –36.0V, to notify us of when the battery voltage falls below –36V. So why, you may be wondering, is trips if: set to “Above” rather than “Below”, if we’re looking for a voltage lower than the set threshold? Because we’re dealing with negative numbers and mathematically speaking, –35 is greater than –36, even though in real-world terms it represents a lower battery voltage – and since the WeatherGoose, being a computer, “thinks” in strictly mathematical terms, when it goes to compare the current sensor measurements against the alarm threshold(s) set for that sensor, it’s going to see this alarm as a condition of “–35 is greater (“higher”) than –36, therefore trip the alarm”, or “–37 is less (“lower”) than –36, therefore don’t trip the alarm”, regardless of how counterintuitive that might seem to its human operator. Therefore, it is very important to keep this mathematical behavior in mind when setting your alarm types and thresholds, or the alarms will not work as expected!

To set an over-voltage threshold, simply set the alarm type to Below instead of Above, then set your threshold accordingly. (Be sure to take the battery-charging system’s output voltage into account, or else your “overcharge” alarm will keep tripping every time the battery charger kicks in!) If you wish to monitor for both over- and under-voltage conditions, then simply repeat this “Add New Alarm” process to attach a second alarm threshold to the –48Vdc Sensor block, and set the thresholds and actions accordingly. (You can also set “escalating” thresholds this way, by adding multiple alarms to a given sensor; refer to the user guide for your particular model of climate monitor for more information on how to do this.)

If you are using a Series-II unit with a firmware revision prior to v3.4.x, your alarm-settings block will look like this. Alarm settings are programmed the same way as above; the only difference (aside from the lack of trigger-delay and alarm-repeat intervals, which were introduced in v3.4) is that the alarm types are named High Trip and Low Trip instead of Above and Below, respectively. High Trip alarms are tripped when the reading goes higher than the set threshold, while Low Trip alarms are tripped when the reading goes below the threshold. Otherwise, the behavior is the same as above, including the need to keep the strict-mathematics behavior described above in mind.
If you are using a Series-I unit:

Find the sensor block on the *Alarms* page for newly-connected CCAT-48, then set the *High Trip* threshold to the desired voltage threshold and the *Low Trip* threshold to −99, as shown here, for the input which the 48VCD-1 is connected to, then set the *Alarm State* to the action(s) you wish to take place when the trip threshold(s) are exceeded click *Save Changes*. This will place the Low Trip event well below the 48VCD-1’s operating range of −16 ~ −60VDC, effectively disabling it since it isn’t needed for this application.

If you wish to monitor for overvoltage as well, then set both the *High Trip* and *Low Trip* thresholds to the desired voltages.

If, for some reason, you wish to only monitor for the over-voltage condition, and not for under-voltage, then set the *Low Trip* threshold to the desired voltage limit, and set the *High Trip* threshold to 99. Since the reading on a CCAT-48 can never exceed 0 (i.e. go into positive voltages), this will disable the High Trip event, which is not needed if you are only interested in overvoltage.

When setting your thresholds, be sure to take into account the “strict mathematics” behavior of the WeatherGoose unit, as described in the section above; this behavior applies to both series-I and series-II devices.
The Telecom Battery Monitor device has been manufactured in two different physical variations over the lifetime of the product: the current “grey tube” design, also known as the Rev.B model, and an older Rev.A “black box” design. Although both are functionally identical, their appearance is somewhat different, especially when it comes to the wire colors. While the Rev.A “black box” has long been discontinued in favor of the current Rev.B “grey tube” design, the following information is provided as a convenience to those users who may have purchased the older model in the past and still have it in service.

**Telecom Battery Monitor, revision A:**

The Rev.A model, pictured here, consists of a small circuit board sealed in a small, black rectangular box, with a set of paired wires coming out of each end.

The first pair, consisting of a yellow wire and a white wire, are connected to the battery, with the white wire going to the positive terminal and the yellow wire going to the negative terminal. The second pair, consisting of a red wire and a green wire within a white outer insulation sheath, is the signal-carrying pair which goes to the WeatherGoose’s analog-input terminals or to the CCAT-48, with the green wire going to the (C or (-) terminal and the red wire going to the numbered analog input or (+) terminal.

The Rev.A model’s behavior is otherwise identical to that of the Rev.B, so the rest of the information in this user guide can be followed without modification when it comes to alarm settings and sensor-page readings.