



Power Recovery User Guide

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Requirements

Hardware	Suggestions	Software
Computer	<ul style="list-style-type: none"> • OS 64 bits • Windows, Linux or Mac 	<ul style="list-style-type: none"> • EMpower 2.9.0.9* or above
Receiver	<ul style="list-style-type: none"> • Supported receivers; for example an MTU-5C receiver 	<ul style="list-style-type: none"> • Firmware v2.9.0.5* or above • Only units shipped after June 2021 work with this feature
Field Installation	<ul style="list-style-type: none"> • Intermittent power supply that recharges a battery bank, preferably installed at least 100m away from any sensor (electrode or magnetic) of the measurement site to avoid noise • Large bank of lead acid batteries • Constant DC power line from battery bank to receiver 	

Advantages

The Automatic Power Recovery feature is intended to be used in semi-permanent installations with an intermittent power source (for example, solar panels), which is used to constantly recharge a large array of 12V lead acid batteries.

In this type of installation, when the *Power Recovery* feature is enabled in the recording configuration, in the event that the main power source fails and stops recharging the batteries, leading to the eventual depletion of batteries and a safe receiver power off, when the main power supply is reestablished, and recharges the array of batteries to an acceptable level, the MTU/RXU receiver will power up automatically and can start recording again.

- If internet access is available at the deployment site, the receiver can be controlled from a remote location by using two additional EMpower tools, **Remote Control** to send new configuration settings, and **Network Upload** used to send the recording data files to the a server (*see the Remote Data Upload System Guide and Receiver Remote Control System manual*)

How it works

The *Power Recovery* feature will only activate and power up a receiver automatically after a specific sequence of events, which matches the events expected in an installation with a large bank of batteries that are normally re-charged by an intermittent power source, but which can sporadically not get power from this source.

The sequence needed to activate *Power Recovery* is as follows:

1. The MTU/RXU is powered on with the Power Recovery feature enabled in the config file
2. This receiver powers off by itself due to a low battery condition
3. The right voltage appears back in the 12V power bus.

If all three of these conditions are not met in that exact sequence, the receiver will not power on by itself. For instance, this feature will not make the receiver power on after the power cable is disconnected and reconnected to the MTU/RXU, since this does not match the pattern of an unattended drain of a power battery bank connected to the receiver.

To help understand the scenarios in which the feature works, we will describe the steps of the sequence in more detail.

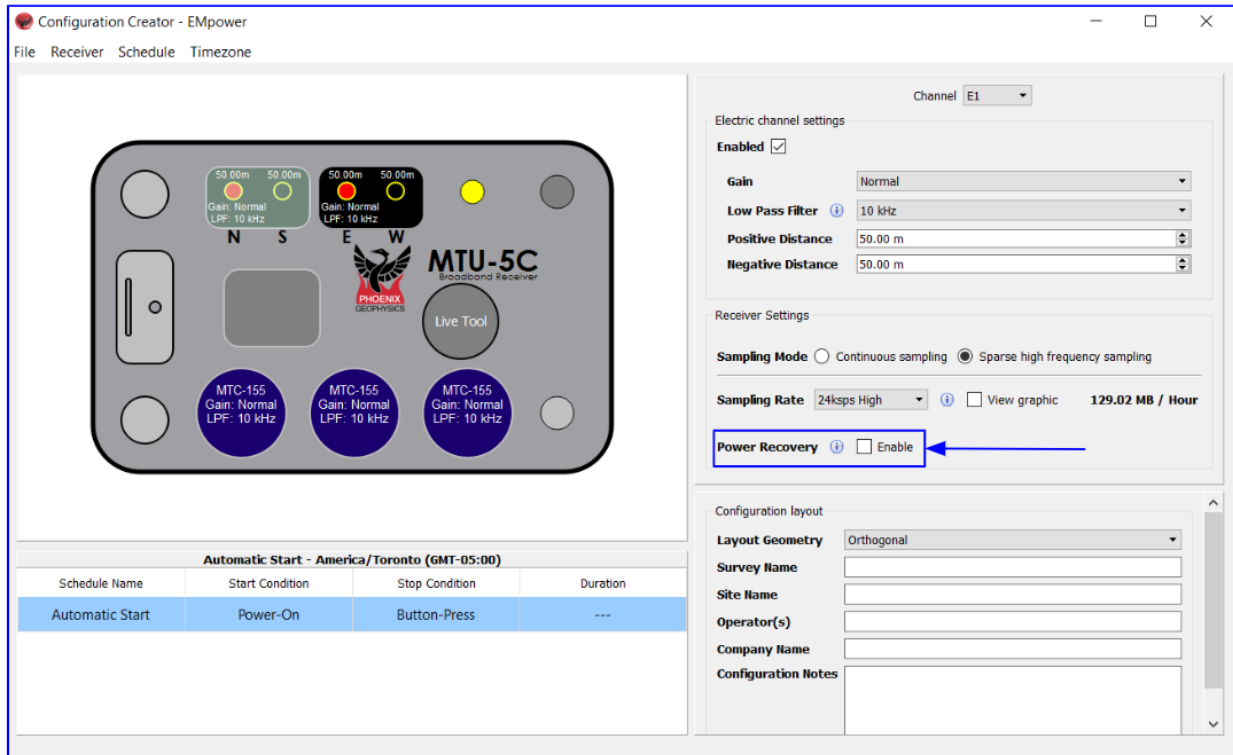
Using a config file with *Power Recovery* enabled

To create a config file that requests the *Power Recovery* from the MTU/RXU after battery depletion and later restoration of power, open the **Prepare** section in EMpower, select the desired receiver type and create a configuration file for MT operation. Then:

1. Since the objective is leaving the receiver unattended, it is desired that the receiver starts recording by itself after it recovers power. For this purpose, use an *Automatic Start* schedule, which will make the receiver start as soon as the receiver powers on and the clock is synchronized to the GPS constellation (A daily schedule might also work).
2. Define the Channels Settings, Sampling Settings and Layout Information as you would for a regular recording (*for more information consult the [quick start manuals](#)*)
3. Enable the Power Recovery by selecting the *Power Recovery* checkbox.

Once the MTU/RXU powers on with this configuration file in the SD card, it will save a flag in its internal memory, indicating that the MTU/RXU should attempt to power on automatically if it loses power as long as the sequence of discharge and power reappearance described before happens.

Note that this power recovery flag will remain stored in the memory of the MTU/RXU until the receiver boots up with a new configuration file which does not request power recovery. This includes special configuration files such as calibration, white noise or self-test files, which do not request to enable the power recovery feature.



If many months later someone tries to use this MTU/RXU with a regular config file (even if it does not request power recovery), the receiver will try to turn on automatically after a good battery is connected, since the flag of power recovery is still active until the receiver boots with the new SD card.

Power-off conditions needed for *Power Recovery* to work

The second step necessary in sequence to activate the Power Recovery feature is that the receiver does a soft power off by itself due to a low-battery condition.

An abrupt power failure does not allow for a soft power off, since the receiver requires some time to power off properly, stopping any ongoing recording, closing files and stopping its operating system.

Therefore, the receiver will enable the automatic power on feature requested via the *Power Recovery* feature only if it is powered off automatically due to a slow and gradual voltage drop in its power connector.

In such a case the receiver will start a soft power off when the voltage in its power connector is permanently 10.5V or less for a few tens of seconds. The soft power off will take approximately 1 minute or less to complete, which will end with the receiver in a powered off state.

Note that if the receiver is powered off manually or via any special command other than the soft power started from a low battery state, the auto power on of the *Power Recovery* feature will not be enabled. This means that even if the configuration file requests *Power Recovery*, if the receiver is powered off by the user by pressing the power button, the receiver will not attempt to power on automatically, since this does not match the pattern of events of power loss in an unattended installation.

Automatic power on upon power being restored to the receiver

If the receiver was configured for *Power Recovery*, and it shut down properly via a soft power off due to low battery, the receiver will attempt to power on in a delayed fashion when the proper voltage appears again in the power bus.

The delay is necessary to prevent damage to the equipment if a defective or overused battery is being used, which could cause the voltage to go back to 12V as soon as there is no load in the battery. The delay will protect the MTU/RXU from turning on and off in a very fast fashion if a bad battery is connected to the receiver.

When the receiver is powered off in this state, but it has a minimal voltage supplied to it, the receiver will continuously monitor the battery voltage to see if it meets the thresholds for automatically powering up. The receiver will provide user feedback through the SD LED.

Power Recovery sequence from the OFF state:

1. If the *Power Recovery* feature is turned on, the SD LED will begin blinking red slowly when the voltage is $>11.6V$. This helps the user to know that the Power Recovery feature is enabled, but that the MTU is waiting for more charge in the battery bank connected to it.



- If at this point the voltage drops below 11.3V, the SD LED will turn off again.



2. If the battery voltage rises above 12.3V, a 5 minute countdown timer is started.

- During the countdown, the SD LED will slowly blink blue, indicating that the receiver will power on soon.



- If the voltage drops below 12V, the countdown is reset and the receiver returns to step 1.



3. If, after 5 minutes, the battery voltage is above 12V, the receiver will power on.



Notes

- As mentioned earlier, the power recovery feature is designed to work in installations where an intermittent power source is used to constantly recharge a large array of 12V lead acid batteries. The feature is not designed or tested to work in any other type of setup.
- To obtain quality data in an installation with intermittent power sources, the power source must not generate noise in the band of measurement. Solar panel controllers and other switched power elements are known to bleed noise to nearby MT sensors. Therefore, it is recommended to install noisy power elements far away from the measurement site, sending only DC power over a long cable.
- The accuracy of the voltage measurement is roughly +/-1% (roughly 125mV), so the user can expect to see some variation in the thresholds as stated above.
- When the receiver is off with the *Power Recovery* feature enabled, and is waiting for good voltage in the battery bus, if the user presses the power button at any time during this waiting period, the receiver will immediately try to power up, ignoring any countdown timers or battery voltage.
- If for some reason the user changes the config file where power recovery is not enabled, and if previously *Power Recovery* was turned on by the low battery condition, this state is stored in the flash memory. So the next time adequate power is provided to the receiver it will automatically turn on, even though the current config file has the feature disabled.



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