

Amplifier User Guide

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WARNING: Use special caution when working with lithium-ion cells. They are very sensitive to charging characteristics and may explode or burn if mishandled. Always charge on a fire-proof surface. Never leave charging batteries unattended. Do not make any modification to the batteries or chargers in any form or shape (including pack making). Only use the provided charger to charge the supplied lithium ion batteries. The supplied lithium ion batteries operate at more than twice the voltage of an alkaline battery and should only be used to power the amplifier.

Hardware Specifications

- One measurement channel with 500Hz storage, 500Hz Bluetooth transmission
- EMI filter and anti-alias low-pass sync filter and no DC filter in hardware
- 24 bit sample size
- Gain 12
- Range 750 mV peak to peak
- Removable microSDHC card with FAT file system

Configuration Settings

A file called config.txt can be found on the microSDHC card. This file is read by the device upon power up and it determines the operational configuration. The config.txt will be set by NemaMetric and requires no user modification except for one optional setting, WRITE_TO_SD, explained in more detail below. By default, the config.txt file settings are as follows:

```
WRITE_TO_SD           = 1
BLUETOOTH_ON          = 1
BLUETOOTH_DISCOVER    = 1
DEMO_MODE             = 0
NUMBER_SINGLE_ENDED   = 0
ENABLE_TRIGGER_CHANNEL = 0
NUMBER_EEG_CHANNELS   = 1
STORAGE_RATE          = 500
BLUETOOTH_TX_RATE     = 500
BIAS                  = 0
```

Use a text editor such as Notepad++ to adjust the config.txt file if needed.



Power Supply

The amplifier needs only one battery to run. A new fully charged single battery should last for roughly 12 hours of recording. Use two batteries for recordings exceeding 12 hours. Battery life, and thus viable recording time, will vary depending on battery charge. Ensure correct polarity of batteries. Negative side of both batteries must touch the spring contact.

To turn the amplifier on and begin recording press the keypad button. To turn it off and stop recording hold the keypad button down for more than two seconds.

Keypad Status Lights

- **Red:** Turns on and stays on if there is a problem. Problems include, but are not limited to, an invalid entry on the microSDHC card, a corrupt or full microSDHC card, or a low battery. To clear the red light, batteries must be removed and reinserted after the problem has been solved.
- **Blue:** Turns on briefly when inserting the first battery. Also turns on for about a second during power up initialization.
- **Green:** Turns on after successful power up. Stays on unless writing to the microSDHC card. If writing to the microSDHC card, it will blink during each write.

Recording to microSDHC (WRITE_TO_SD)

The NemaAcquire software can record all of the data locally on the PC, so recording to the microSDHC card is not required. However, writing to microSDHC may be desired as a failsafe. For example, if the computer hard drive fails or the computer is unable to record all of the data from the wireless connection, the data will be available for recovery on the microSDHC (assuming WRITE_TO_SD is set to 1). The only downside to enabling this option is that the user must take care to occasionally clear off files so that future recordings can be stored.

By default, the config.txt file is set to WRITE_TO_SD = 1 indicating that the data will be written to the microSDHC card. To disable this functionality, change the line to read WRITE_TO_SD = 0.

If a microSDHC card is present and WRITE_TO_SD = 1, then recording begins approximately two seconds after the device is powered on. Each file name has the format of yyyy_mm_dd_hh_mm_ss.rec corresponding to the start time of the recording. Periodically, a new file is started to keep file size manageable. To avoid possible file corruption, press and hold the keypad button for more than two seconds to close the file before removing the



microSDHC card or taking batteries out. Wireless (Bluetooth) communications will not interrupt recording.

Removing and Inserting the microSDHC

The microSDHC can be removed from the amplifier by gently pushing it (further) into the slot on the side of the device and allowing it to release. You can push on the card with a fingernail, tweezers or other small object. Once it is released, the card can be removed by pulling on it. In the event that it is hard to reach, tweezers may be helpful. Once the card is removed it can be placed into the provided SD adapter for reading on a computer. If your computer does not have an SD card slot, USB adapters are readily available. The amplifier microSDHC card is formatted with a FAT file system that can be read by most computers. Exercise caution while guiding the card back into the amplifier microSDHC socket. Push gently until the card is locked into place. The microSDHC card and a proper config file are required for the system to work properly.

Converting Counts to Volts

The recorded values are the raw counts from the 24-bit ADC. For a gain of 12, the range of each channel is 750mVpp. In order to convert counts to volts multiply by 0.750 and then divide by 2^{24} .

Wireless Functionality

When the amplifier is powered on, it is automatically made discoverable via Bluetooth. When a client computer connects via Bluetooth, it begins wireless transmission. Typical transmission range (under ideal conditions) is roughly up to 30m (100ft). Dropped frames could result from:

- PC performance and Bluetooth adapter performance
- External RF noise
- An obstructed line of sight between the device and the Bluetooth receiver
- Distance between computer and amplifier is more than 30m (100ft)
- Battery is running low

Real-Time Clock (RTC)

The time is automatically synchronized with the connecting computer.



Tips for Acquiring a Clean Signal

Testing set-up and environment are extremely important for preventing artifacts in biological signals. To acquire the cleanest signal possible:

- Care should be taken to minimize mains power frequency noise (50Hz or 60Hz) in the testing environment. Small changes in position of the amplifier and/or chip dock can sometimes have an impact on signal quality.
- Physical movements and vibrations can introduce large artifacts in the signal; attempt to minimize or eliminate these.

Troubleshooting

Problem	Solution
Red light comes on immediately after battery is inserted.	<ul style="list-style-type: none"> • Illegal specification in config.txt. Send config.txt to NemaMetrix to check
Amplifier unit runs for some time and then the light becomes red.	<ul style="list-style-type: none"> • Batteries are dead • MicroSD card is full • Confirm (with a Voltmeter, if possible) that battery voltage is 3.6V to 4V before turning Amplifier on • Open microSD and remove any unused files or folders
More than expected .rec files appear on the microSD card	<ul style="list-style-type: none"> • File duration has exceeded 12 hours • If the time set by a newly connected computer is more than 12 hours ahead of the previous device time, a new file will automatically be generated. This is not an error.
Cannot connect to amplifier	<ul style="list-style-type: none"> • Ensure device is paired with computer attempting connection • Ensure no other computers or devices are connected to the amplifier • If the amplifier still cannot connect, try repairing or rebooting the computer.

