

# ***TX CONTROLLER***

## ***Model EM-IP***

### ***Instruction Manual***



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# 1. TX CONTROLLER at a glance

## Accessories

When receiving a GDD EM-IP TX Controller, ensure that it contains the following elements:

- One (1) Tx Controller
- EM surveys:
  - One (1) Synchronisation cable (to synchronize with GDD NordicEM24 TDEM Receivers)
  - One (1) Blunt-cut control cable (adaptable to EM Transmitters)
- IP surveys:
  - One (1) Master / Slave cable (to control GDD IP transmitters)
  - One (1) Blunt-cut control cable (adaptable to IP Transmitters)
- One (1) GDD IP Post-Process software User Guide
- One (1) GDD software CD / USB stick
- Two (2) red and black 50A connectors for current measurement with L-key
- One (1) Allen key for 50A connectors
- One (1) nano USB Flash Drive
- One (1) External GPS antenna (SMA connector)
- One (1) Power supply
- One (1) kit of international adaptors
- One (1) GDD blue carrying case
- One (1) GDD Instruction Manual
- One (1) USB communication cable (type B) for software updates

Do not hesitate to communicate with GDD Instrumentation Inc. if needed.

## Components

The components are described in this section.



## Power ON/OFF

**Power ON:** Press the Power button once to turn ON the unit.

**Power OFF / Reset:** Press and hold the Power button for 2 seconds to power OFF the unit. Press and hold for 10 seconds to force the system reset in case of malfunction.

## LED indicators

**ON:** Power ON

**CHARGE:** Charge in progress (red light will turn on when the Tx Controller batteries are charging and will turn off once the charge is completed)

**1PPS:** Slow blink : GPS is not detected. Fast blink : GPS is detected

**SYNC:** Synchronization completed

**DUTY CYCLE -:** Transmitter ON time, negative polarity

**DUTY CYCLE +:** Transmitter ON time, positive polarity

**HAZARD:** Warning, an electrical current is detected (DATA logger must be activated)

## Connectors

**SYNC/TX CTRL:**

- **Synchronization:** Connect the SYNC cable between the Tx Controller and the NordicEM24 receiver (for external/crystal synchronization mode only).
- **TX control:** Connect the appropriate TX CTRL cable between the Tx Controller and the EM or IP transmitter in order to control the transmitter cycle.

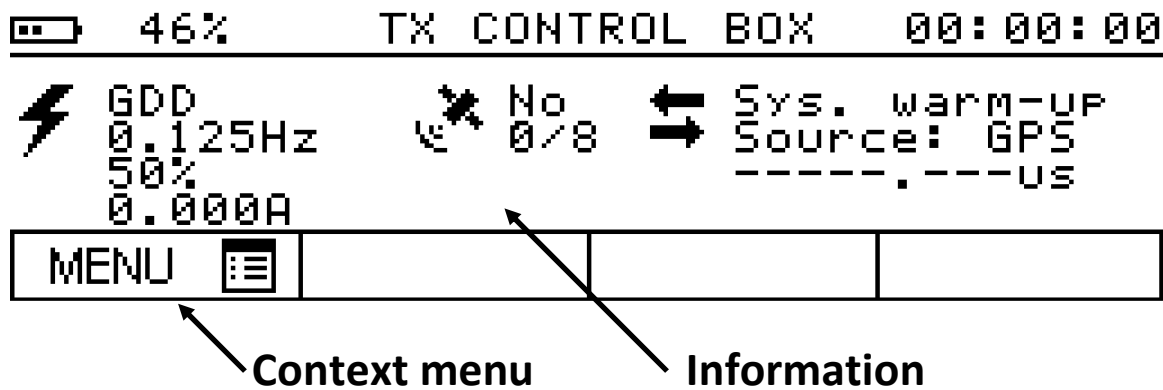
**Master/Slave:** Connect the Master/Slave cable between the Tx Controller and a GDD IP Transmitter in order to control the transmitter cycle. Only Time Bases of 1 sec ON and above will be allowed in this mode. The GDD IP Transmitter will be Slave to the EM-IP Tx controller.

**Current:** Feed the electrodes or TX loop through these connectors for Data Logging.

## Charger

Connect the power supply between the Tx Controller and a power outlet to charge the internal batteries.

## 2. Main Menu



### Title bar

**Battery :** Battery level from 0 to 100%. Charging status: charging, not charging

**GPS Time:** UTC time, HH:MM:SS

### Information

Transmitter:	
GDD	TX type
0.125Hz	TX's Base Frequency
50%	TX Duty Cycle
0.000A	Measured Current (Data Logger must be activated)
GPS:	
No	GPS detected
0/8	Number of satellites tracked
Synchronisation:	
Sys. warm-UP	Operating mode
Source: GPS	Synchronisation source
-----.---US	Phase shift with NordicEM24 (External Sync mode)

**Measured current:** Average value over 1 sec. When TX frequency is above 0.5Hz, the value is only sampled during TX ON time and the polarity is removed.

**Operating mode:** System Warm-up, Frequency locking (coarse initial frequency adjustment), Phase Aligning (coarse 1PPS phase alignment), Phase locking (continuous fine phase alignment), Auto Holdover, Waiting for Reference (selected reference is not available).

**Synchronisation source:** GPS (default), EXT

**Phase shift:** Phase shift in  $\mu$ s between the receiver and the TX Controller when both instruments are synchronized and the sync cable is connected.

### 3. Sub menus

Use the keypad to navigate the context menus. Menu selection includes: TX SETTINGS, GPS, SYNC, DATA LOGGER, BATTERY, SETTINGS and ABOUT.

#### Transmitter settings

**TX Selection:** GDD, Zonge, Geonics, Phoenix, Crone

**TX Frequency:** 0.03125Hz, 0.05Hz, 0.0625Hz, 0.1Hz, 0.125Hz, 0.25Hz, 0.5Hz, 0.625Hz, 1Hz, 1.6666Hz, 2Hz, 2.0833Hz, 2.5Hz, 3Hz, 3.125Hz, 5Hz, 7.5Hz, 8.333Hz, 12.5Hz, 15Hz, 25Hz, 30Hz (default)

**TX duty cycle:** 50% (default). The other options are listed below:

TX Selection	25%	50%	75%	100%
GDD	X	X		
Geonics	X	X	X	
Zonge	X	X	X	X
Phoenix	X	X	X	
Crone		X		

#### GPS

**GPS status:**

Latitude: (-90° to 90°)

Longitude: (-180° to 180°)

Ellipsoid height: cm (-100000 to 1800000)

Satellite tracked: number of satellites tracked (0 to 8)

**Satellite info (1 to 8):**

ID: satellite ID (0 to 37)

TM: tracking mode

0 = code search

1 = code acquire

2 = AGC set

3 = Freq acquire

4 = bit sync detect

5 = message sync detect

6 = satellite time available

7 = ephemeris acquire

8 = available for position

NDR: carrier to noise density ratio (C/No) 0 to 255 dB Hz

SF: status flag (Byte). Each bit represents one of the following:

bit7 = using for fix position

bit3 = satellite reported inaccurate

bit6 = satellite momentum alert flag

bit2 = Spare

bit5 = satellite anti-spoof flag set

bit1 = using for time solution

bit4 = satellite reported unhealthy

bit0 = parity error



## SYNC

The TX Controller can be synchronised with the NordicEM24 receiver using the GPS or with the internal crystal. Both units should be configured using the same configuration. If the GPS signal is lost afterward, the internal crystal will maintain the synchronisation.

Note that the GPS synchronisation must be selected to use the Data Logger functionality.

**Sync by crystal MonoRX:** Crystal mode, if the survey is done with a single receiver.

**Sync by crystal MultiRX:** Crystal mode, for multiple receivers survey.

**Sync by GPS:** GPS mode.

**Cancel Sync:** Cancel the synchronisation.

### External synchronisation (Crystal)

External synchronisation conditions:

- Synchronisation cable is connected between the Tx Controller and the receiver
- Tx Controller operating mode = Waiting for Reference
- Receiver operating mode = Phase locking or Auto Holdover

#### 1. *Mono Rx configuration*

- Connect the synchronisation cable between the Tx Controller and the receiver.
- From the main screen navigate to the SYNC menu and select *Cancel Sync*.
- Go back to the SYNC menu and select *Sync by crystal MonoRx*.
- Wait until the end of the synchronisation cycle.
- Check the Phase difference between the instruments. If it is too high, repeat this procedure.

#### 2. *Multi Rx configuration (Required when several receivers has to be synchronised)*

First receiver synchronisation

- Go through the MonoRx synchronisation as describe above (faster mode, for the first unit only). Not applicable for drift correction if more than one receiver is operated at the same time.

Remaining receivers synchronisation (or re-synchronisation to correct the drift)

- Connect the synchronisation cable between the Tx Controller and the receiver.
- From the main screen navigate to the SYNC menu and Select *Cancel Sync*.
- Go back to the SYNC menu and select *Sync by crystal MultiRx*.
- Wait until the end of the synchronisation cycle (may take up to 8 minutes).
- Check the Phase difference between the instruments. If it too high, repeat this procedure.
- Repeat the previous steps to synchronize another receiver.

## GPS Synchronisation

GPS synchronisation conditions:

- GPS detected = Yes
  - Operating mode = Phase locking (GPS tracked) or Auto Holdover (Standby mode with crystal clock back-up (reliable for a whole survey day))
  - Time = XX:XX:00 (synchronised every minutes)
3. Power ON-RESET (default) configuration
    - Power ON the Tx Controller and the receiver
    - Wait until the end of the GPS synchronisation cycle (SYNC led will illuminate)
  4. Manual configuration
    - From the main screen navigate to the SYNC menu.
    - Select *Cancel Sync*.
    - Go back to the SYNC menu and select *Sync by GPS*.
    - Wait until the end of the GPS synchronisation cycle.

## DATA LOGGER

Requirement:

- TX Controller must be synchronised by GPS
- USB Drive installed (FAT32 file system)
- 50A connectors connected to a loop or an electrode

The TX Controller can be used to record the transmitted current waveform with the following specifications:

Maximum current:	+/- 40A DC
Sampling rate:	1kHz
Output format:	Binary (use the GDD IP Post-Process software to visualise your data)

**Start data logging:** Create a new acquisition file and start recording. Note that the GPS sync is required. A USB drive must be installed before starting the acquisition.

**Stop data logging:** Stop the current acquisition and save the file to the USB drive named CURRxxxx.IFI

**USB state:** Diagnose the USB interface

USB Port ready:	Hardware is ready (Yes/No)
USB drive detected:	Drive and file system are recognised (Yes/No)
File opened:	File is being accessed during acquisition (Yes/No)

**Calibrate:** It is recommended to adjust the sensor offset once a day by running this calibration process. Make sure that both current electrodes are disconnected. We recommend that the calibration is carried out once the system temperature corresponds to survey conditions.

## BATTERY

### Charger:

Battery present:	Battery 1, 2, none
Battery charging:	Battery 1, 2, none
Powered by:	Battery 1, 2, AC
AC Present:	Yes, No

### Battery 1/2:

State of charge:	Battery level from 0 to 100%
Temperature:	Battery temperature in °C
Voltage:	Battery output voltage
Average current:	Battery current, positive when charging.
Average time to empty:	Estimated remaining battery life.
Average time to full:	Estimated remaining charge time.

## SETTINGS

**Brightness:** Adjust the display's Brightness: 12.5 to 100%.

**Screen saver:** The display will go blank after a user defined period of time to save battery life: Off, 5, 10, 15, 30, 45, 60 minutes.

## ABOUT

Firmware version.

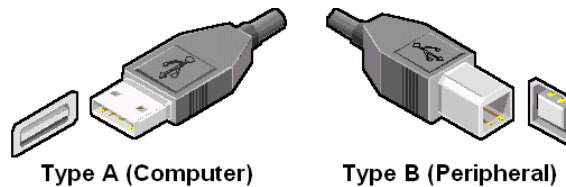
## 4. Updating the firmware

### Requirements

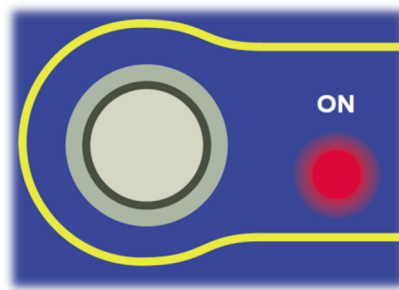
- PC running on windows equipped with a USB port
- Standard USB type A male to type B male cable
- Firmware update file .xml
- Firmware Downloader tool FlashTool.exe

**It is recommended to plug the power cable during the update procedure.**

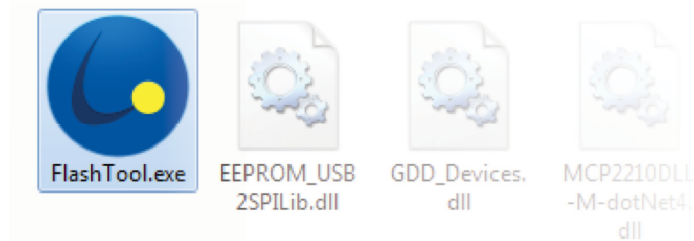
1. Connect the type B connector of the TX Controller to a PC using the USB-A/B cable.



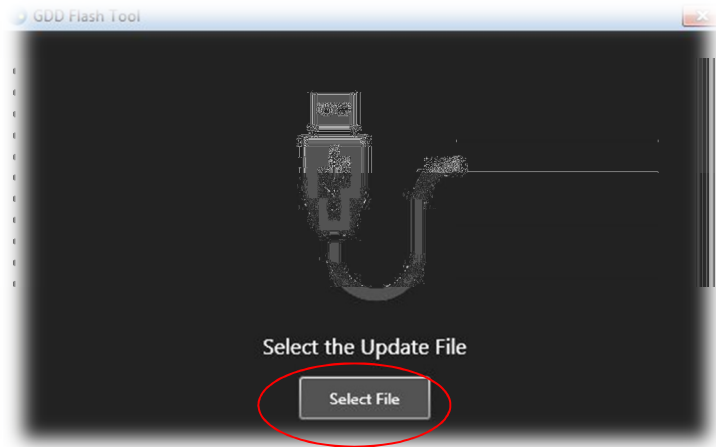
2. Power ON the TX Controller.



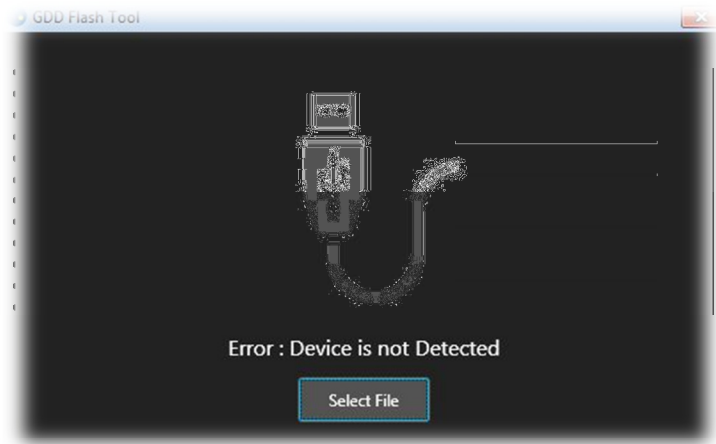
3. Copy the program *FlashTool.exe* on your computer. Make sure to keep the associated .dll files in the same folder than the .exe file. Double click on the program to open it.



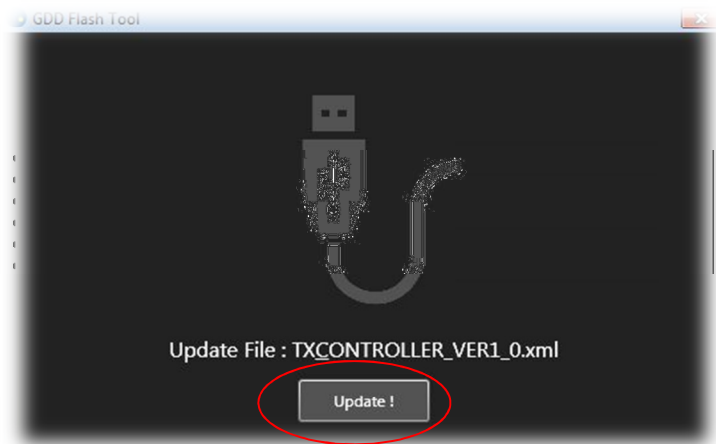
4. In the main window, click on **Select File** and select the firmware update file \*.xml



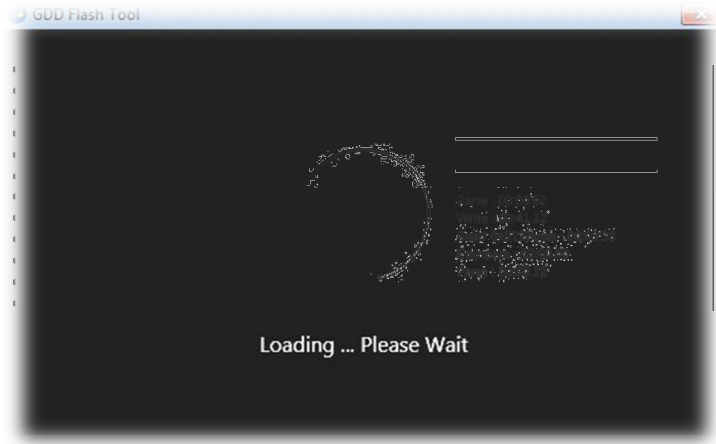
5. If the following error occur make sure that the TX Controller is powered ON and that the USB Cable is connected to the computer.



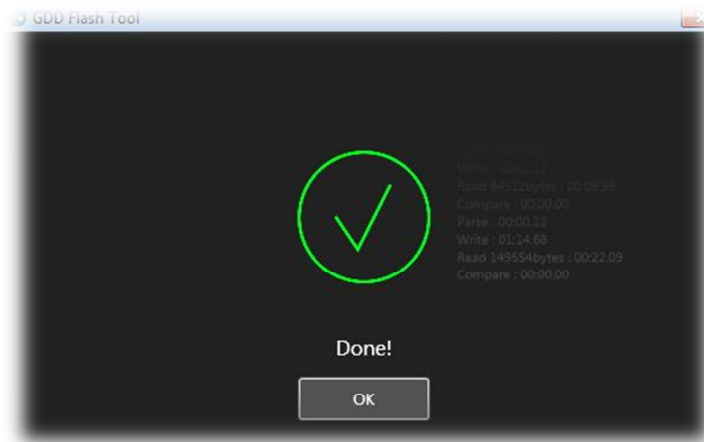
6. Click on the Update button



7. The update process may take a few minutes to complete. Do not disconnect your device until the update has finished.



8. Once successfully completed, the following message will be displayed



## 5. TX Control Connector Pinout and Current file format

### TX control connector

The following table contains the pin description that can be used to build a custom control cable to fit the EM or IP transmitter.

Function	PT06A-12-14P(SR)
DUTY CYCLE	H
GND	L
POLARITY	M

### Current File Format (\*.ifi)

Different parameters are saved in the header of the binary file based on the escape-sequence. The escape symbol chosen is a byte of 255. The file is composed of a header followed by the data. The content of the header is monitored for occasional bytes coinciding with the escape symbol and treated accordingly by adding an extra escape symbol, while in the data section it is not.

Each parameter is preceded with a tag consisting of an escape symbol and the byte containing an individual parameter number represented in big-endian. The content of the parameter varies depending on the parameter nature.

Symbol (hex)	Parameter
FF A0	(Uint) Sampling rate (Hz). Constant to 1000Hz in the current version.
FF 88	GPS Time Stamp of the first sample. This parameter is split in two 32 bits words. The first word is the integer part of the UTC Time and corresponds to the elapsed seconds since January 1st 2001. The second part is the fractional value and is weighted 100ns per units. For example, 0x1C76429C0069E3D5 correspond to : DATE:18/02/2016,TIME: 18:19:08.693960
FF A1, FF A2, FF A3	Internal use
FF A4	ADC Factor (float). Represent the full scale value of the ADC data. To convert in amp, use the following formula : $(Factor * data) / (2^{23})$
FF A5	Internal use
FF C8	Data (24bits 2's complement).

The data itself can be easily accessed by its tag (0xFFC8). The only thing required beforehand is the factor to convert the amplitude in Amp. Each data point consists of three-byte snippets, where each snippet represents a signed integer – the actual measured value as outputted by the ADC.

## 6. Troubleshooting section

The screen saver will only be active in the main menu. Make sure to go back to the main menu to spare on the battery life.

### The Tx Controller cannot detect the satellites

Remember that the system needs to warm-up for approximately 15 minutes before being synchronized. Make sure that the GPS antenna is not shielded and as high as possible from the ground. Move to an open area and make sure to synchronize GPS at the beginning of the day. You can then rely on the crystal clock back-up for the whole survey day.

### Batteries are not charging

If the batteries are too cold, they might not charge when the power supply is connected. Allow the batteries to warm up above 0°C to re-enable the charging circuit. In addition, the charger will not start charging a battery when its capacity exceeds 95%.

### Switching from GPS sync to External source (Crystal) sync.

If you wish to force an External source (Crystal) synchronisation while the system is already synchronized by GPS, you need to:

- Connect the synchronisation cable between the Tx Controller and the NordicEM24 receiver.
- In the SYNC menu select *Cancel Sync*. **It is recommended to *Cancel Sync* when the clock starts a new minute (XX:XX:01) to have enough time to switch the synchronisation source to External. Otherwise the module might have time to resynchronise with GPS as it is done every minutes.**

### Can I use my own Memory stick (USB drive)?

Yes. Just make sure it is formatted with FAT32 file system.

### Combination to other EM or IP Transmitters

The EM-IP Tx Controller and NordicEM24 Receiver can control the following commercial EM transmitters. (Contact GDD regarding the possibility of controlling commercial IP Transmitters). Note that a “blunt cut cable” is provided with the EM-IP Tx Controller and customers can adapt it to their transmitter.

MANUFACTURER	OPTIONAL GDD CABLES
<i>Geonics Ltd.</i>	Tx.CTRL.B4 cable (use “Duty cycle” end)
<i>Zonge International</i>	Tx.Zonge.M
<i>Crone Geophysics</i>	Tx.Crone.M
<i>Phoenix Geophysics</i>	Tx.CTRL.Phoenix.M



## 7. Safety considerations

As high currents (0 – 40A) will flow in the current measurement connectors, it is mandatory to use the two (2) 50A connectors provided with this equipment. This model of connector (*Supercon #PS50GB (black) & #PS50GR (red)*) is rated for currents reaching up to 50A and is designed to avoid exposing the stripped wire.

Always make sure that both current measurement connectors are connected into the EM-IP Tx Controller when turning on the EM or IP transmitter. If one wire is disconnected by accident, turn off the transmitter as soon as possible and avoid a direct contact with the connectors.

## 8. Technical Support

If you encounter a problem not described in this manual, do not hesitate to contact **Instrumentation GDD Inc.** for assistance at:

Tel.: (418) 877-4249  
Fax: (418) 877-4054  
Toll free line: 1 877 977-4249 (Canada)  
**e-mail:** [support-technique@gdd.ca](mailto:support-technique@gdd.ca)

Emergency out of business hours:

Pierre Gaucher: Home phone: (418) 657-5870  
Cell phone: (418) 261-5552  
Régis Desbiens: Home phone: (418) 658-8539  
Cell phone: (418) 570-3408