

Trimble Thunderbolt GPS-DO

Target

Getting a 10 MHz absolute reference GPS-DO for locking the LO of a microwave ham transverter

Low-cost design, easy to find on eBay by 2 chinese sellers

Abstract

Power supply / Thunderbold association

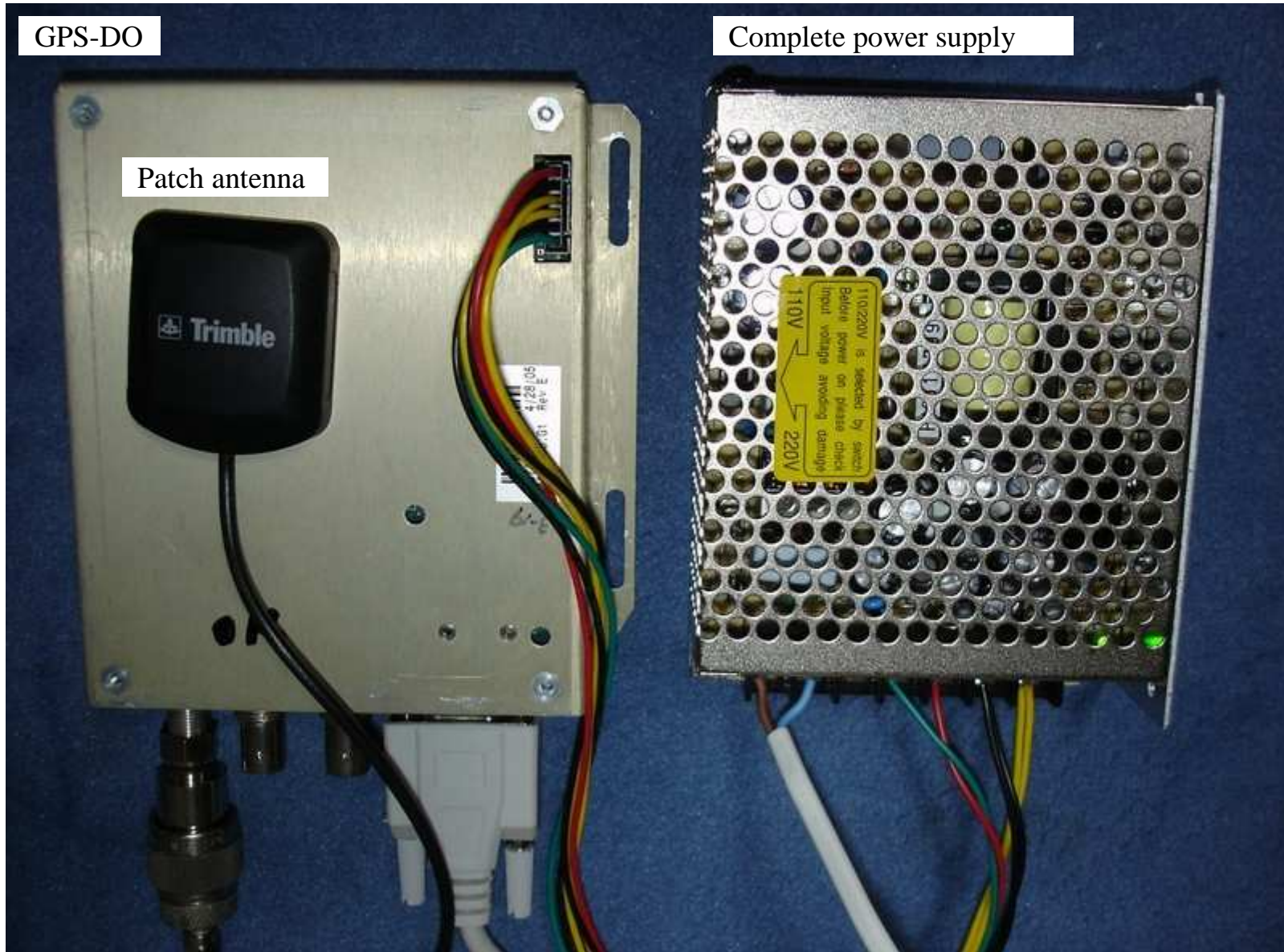
Using the PC soft Tboltmon.exe

- Self survey
- Optional : QTH real ASL heighth
- Accurate coordinates savings

Maximal locking, then disciplining time after savings

Final Lissajoux curve (ref = Tekelec epsilon GPS-DO)

Mains connection

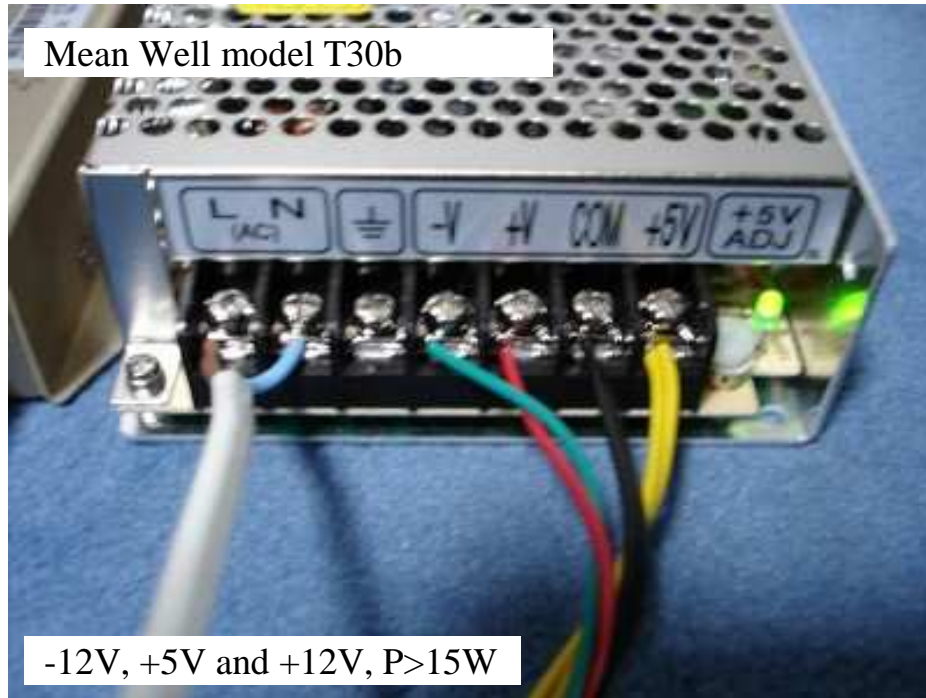


Mains connection

30W multiple output power supply

Trimble Thunderbolt

Only 15W needed



Tboltmon.exe soft : self survey

After DC switching on

After 5 minutes

Thunderbolt Monitor

Control Setup Window Help

Time: 00:00:05 Not Set
Date: Aug 22, 1999
Week: 1024 TOW: 5
UTC Offset: 0 No UTC Info

Position: Latitude 0.00000 degrees, Longitude 0.00000 degrees, Altitude 0.0 meters
Self-Survey Progress: 1%
Rcvr Mode: (4) Full Position (3D)
GPS Status: (1) No Time

Timing Outputs: PPS 0.00 ns GPS, 10 MHz 0.00 ppb

Critical Alarms: ROM Checksum, RAM Check, Power Supply, FPGA Check, Oscillator Control Voltage

Minor Alarms: Oscillator Control Voltage, Antenna Open, Antenna Short, Satellite Tracking, Oscillator Disciplining, Self-Survey Activity, Stored Position, Leap Second Pending, Test Mode, Position Questionable, EEPROM Invalid, Almanac

Disciplining Status: Mode (1) Power-up, Activity (6) Inactive, Holdover (sec) 0, Temp (deg C) 36.8

Signal Levels: SV AMU (1: 1, 0.0; 18: 0.0; 26: 0.0; 29: 0.0; 5: 0.0; 20: 0.0; 22: 0.0; 2: 0.0)

COM: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Tx All

Tx Rx COM2: 9600, 8-N-1

Thunderbolt Monitor

Control Setup Window Help

Time: 10:43:28 GPS
Date: Sep 14, 2009
Week: 1549 TOW: 125008
UTC Offset: 0 No UTC Info

Position: Latitude 48.72354 degrees, Longitude 2.52457 degrees, Altitude 157.9 meters
Self-Survey Progress: 20%
Rcvr Mode: (4) Full Position (3D)
GPS Status: (3) PDOP Too High

Timing Outputs: PPS -31.14 ns GPS, 10 MHz -0.10 ppb

Critical Alarms: ROM Checksum, RAM Check, Power Supply, FPGA Check, Oscillator Control Voltage

Minor Alarms: Oscillator Control Voltage, Antenna Open, Antenna Short, Satellite Tracking, Oscillator Disciplining, Self-Survey Activity, Stored Position, Leap Second Pending, Test Mode, Position Questionable, EEPROM Invalid, Almanac

Disciplining Status: Mode (0) Normal, Activity (6) Inactive, Holdover (sec) 0, Temp (deg C) 28.7

Signal Levels: SV AMU (14: 9.8; 30: 11.2; 27: 2.8; 4: 3.0; 17: 0.0; 9: 3.4; 12: 10.6; 26: 14.8)

COM: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Tx All

Tx Rx COM2: 9600, 8-N-1

Tboltmon.exe soft : self survey

After 7 minutes

After 34 minutes

The screenshot shows the Thunderbolt Monitor interface at 10:45:29 on Sep 14, 2009. The self-survey progress is at 25%. The GPS status is "[0] Doing Fixes". The position is Latitude 48.72354 degrees and Longitude 2.52457 degrees. The altitude is 155.5 meters. The signal levels table shows SV 14 (7.2) and AMU 30 (13.8). The COM port is set to COM2: 9600, 8-N-1.

SV	AMU
14	7.2
30	13.8
27	2.4
4	2.4
9	3.0
12	17.0
26	8.6
0	0.0

The screenshot shows the Thunderbolt Monitor interface at 11:16:07 on Sep 14, 2009. The self-survey progress is now at 100%. The GPS status is "[0] Doing Fixes". The position is Latitude 48.72355 degrees and Longitude 2.52463 degrees. The altitude is 151.8 meters. The signal levels table shows SV 14 (3.2) and AMU 30 (5.8). The COM port is set to COM2: 9600, 8-N-1.

SV	AMU
14	3.2
30	5.8
27	-0.4
4	3.8
29	3.8
9	6.4
12	16.6
26	4.4

Self adjusting lat + long

Self adjusting QTH height !

Tboltmon.exe soft : self survey

After 1 hour & 34 minutes

After 2 hours

Thunderbolt Monitor
Control Setup Window Help

Time: 12:17:55 GPS
Date: Sep 14, 2009
Week: 1549 TOW: 130675
UTC Offset: 15 seconds

Position:
Latitude: 48.72355 degrees
Longitude: 2.52463 degrees
Altitude: 151.8 meters

Self-Survey Progress: 100%

Rcvr Mode: (7) Overdet Clock (Time)
GPS Status: (0) Doing Fixes

Timing Outputs:
PPS: 148.96 ns GPS
10 MHz: 0.05 ppb

Critical Alarms:
 ROM Checksum
 RAM Check
 Power Supply
 FPGA Check
 Oscillator Control Voltage

Minor Alarms:
 Oscillator Control Voltage
 Antenna Open
 Antenna Short
 Satellite Tracking
 Oscillator Disciplining
 Self-Survey Activity
 Stored Position
 Leap Second Pending
 Test Mode
 Position Questionable
 EEPROM Invalid
 Almanac

Disciplining Status:
 Mode: (0) Normal DAC Voltage: -0.015049
 Activity: (0) Phase Locking DAC Value: 0x7F9D6
 Holdover (sec): 78 Temp (deg C): 35.7

Signal Levels:
 SV AMU
 14 3.2
 30 18.4
 31 15.0
 2 7.4
 29 10.0
 4 3.0
 12 11.6
 26 3.2

COM: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 Tx All

ASL false !

Thunderbolt Monitor
Control Setup Window Help

Time: 14:26:26 GPS
Date: Sep 14, 2009
Week: 1549 TOW: 138386
UTC Offset: 15 seconds

Position:
Latitude: 48.72355 degrees
Longitude: 2.52463 degrees
Altitude: 151.8 meters

Self-Survey Progress: 100%

Rcvr Mode: (7) Overdet Clock (Time)
GPS Status: (0) Doing Fixes

Timing Outputs:
PPS: -203.72 ns GPS
10 MHz: 0.05 ppb

Critical Alarms:
 ROM Checksum
 RAM Check
 Power Supply
 FPGA Check
 Oscillator Control Voltage

Minor Alarms:
 Oscillator Control Voltage
 Antenna Open
 Antenna Short
 Satellite Tracking
 Oscillator Disciplining
 Self-Survey Activity
 Stored Position
 Leap Second Pending
 Test Mode
 Position Questionable
 EEPROM Invalid
 Almanac

Disciplining Status:
 Mode: (0) Normal DAC Voltage: 0.026951
 Activity: (0) Phase Locking DAC Value: 0x80B0A
 Holdover (sec): 274 Temp (deg C): 34.7

Signal Levels:
 SV AMU
 23 7.0
 30 4.0
 31 8.6
 5 7.0
 29 8.8
 21 15.2
 10 4.8
 16 7.8

COM: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 Tx All

Optional : QTH real ASL heigth

According to www.topocoding.com

With exactly same longitude / latitude coordinates

the altitude profile.

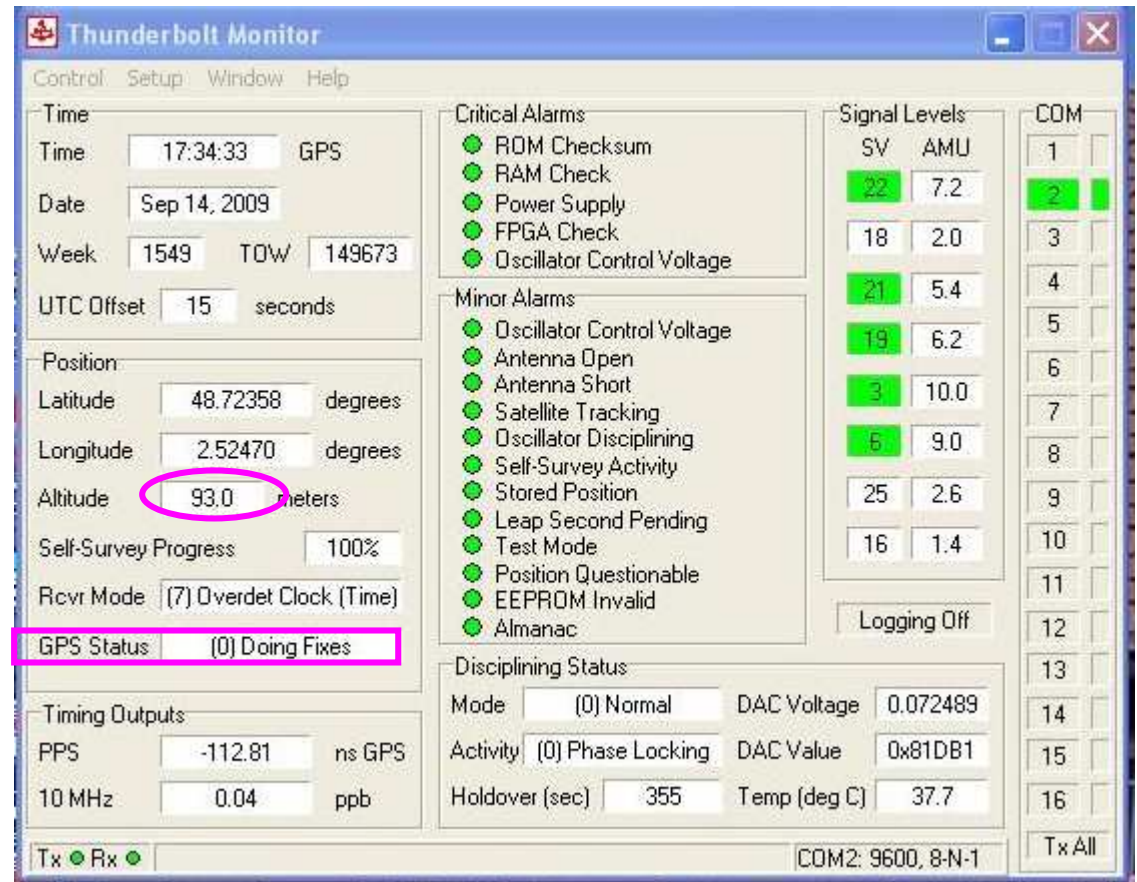
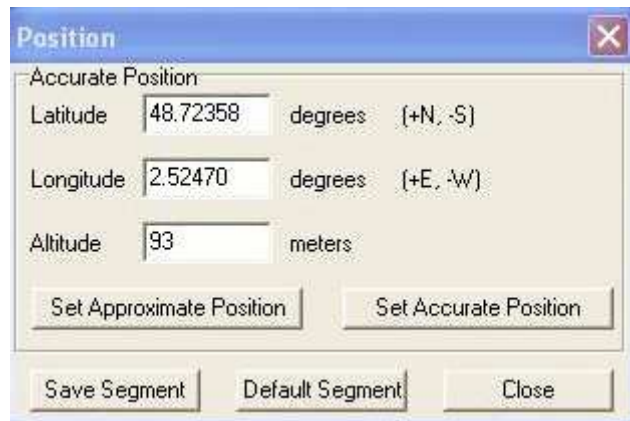
By clicking the map you add points to the path whose altitude profile can be displayed using the first button. The altitude profile may be used for example to evaluate the degree of difficulty for given path, or for verifying the visibility of the WiFi access point.

The screenshot displays the topocoding.com interface. At the top, there are map style buttons: Plan, Satellite, Mixte, and Relief. The map shows a blue path with a red pin at the end. A callout box indicates the altitude at that point: **Altitude = 93 m / 305 ft**. Below the map, there are controls for the altitude profile: English units, Update altitude profile, and Remove last path segment. At the bottom, there are input fields for address and point coordinates. The point coordinates are: **Latitude = 48.72355** and **Longitude = 2.52463**. There are also buttons for Center to address, Add address, Center to point, and Add point.

Tboltmon.exe soft : accurate coordonates savings

Accurate position entering

Lat + long + Alt saved



Tboltmon.exe soft : max locking time after savings

After new DC switching on

After 3 minutes : GPS locked !

The screenshot shows the Thunderbolt Monitor interface with the following data:

- Time:** 00:00:05, Not Set
- Date:** Aug 22, 1999
- Week:** 1024, TOW 5
- UTC Offset:** 0, No UTC Info
- Position:** Latitude 48.72358 degrees, Longitude 2.52470 degrees, Altitude 93.0 meters
- Self-Survey Progress:** 0%
- Rcvr Mode:** (7) Overdet Clock (Time)
- GPS Status:** (1) No Time
- Timing Outputs:** PPS 0.00 ns GPS, 10 MHz 0.00 ppb
- Critical Alarms:** ROM Checksum, RAM Check, Power Supply, FPGA Check, Oscillator Control Voltage (all green)
- Minor Alarms:** Oscillator Control Voltage (green), Antenna Open (green), Antenna Short (green), Satellite Tracking (yellow), Oscillator Disciplining (green), Self-Survey Activity (green), Stored Position (green), Leap Second Pending (green), Test Mode (green), Position Questionable (green), EEPROM Invalid (green), Almanac (yellow)
- Disciplining Status:** Mode (1) Power-up, DAC Voltage 0.000000, Activity (6) Inactive, DAC Value 0x800000, Holdover (sec) 0, Temp (deg C) 27.8
- Signal Levels:** SV 1, AMU 0.0; SV 18, AMU 0.0; SV 26, AMU 0.0; SV 29, AMU 0.0; SV 5, AMU 0.0; SV 20, AMU 0.0; SV 22, AMU 0.0; SV 2, AMU 0.0
- COM:** 1, 2 (highlighted), 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
- Logging:** Logging Off
- COM2:** 9600, 8-N-1

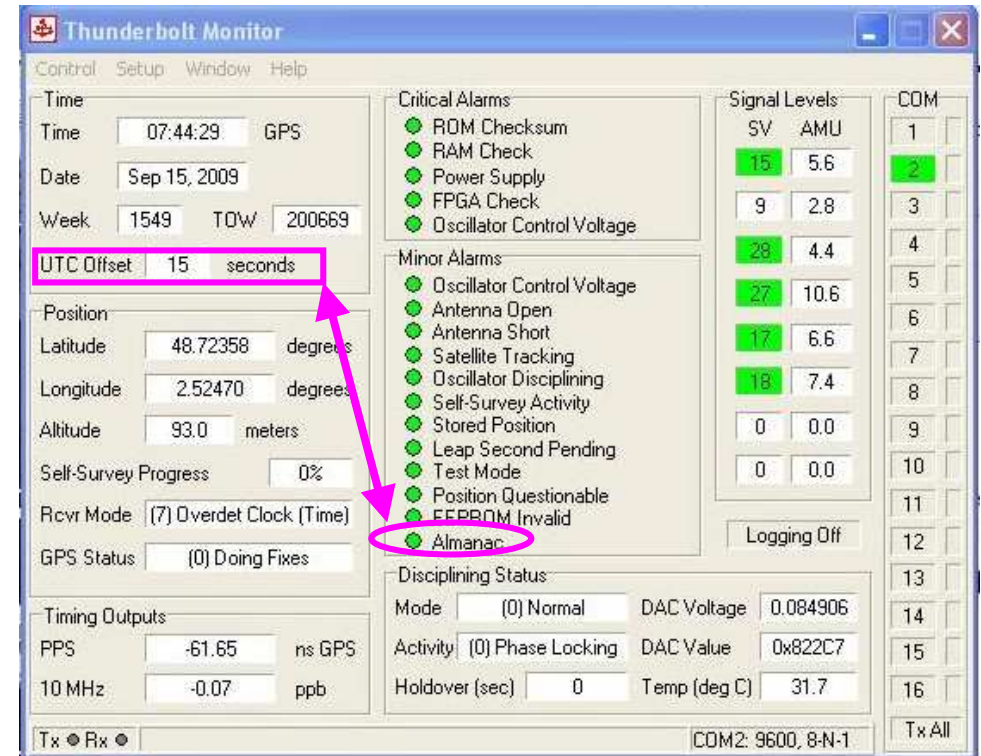
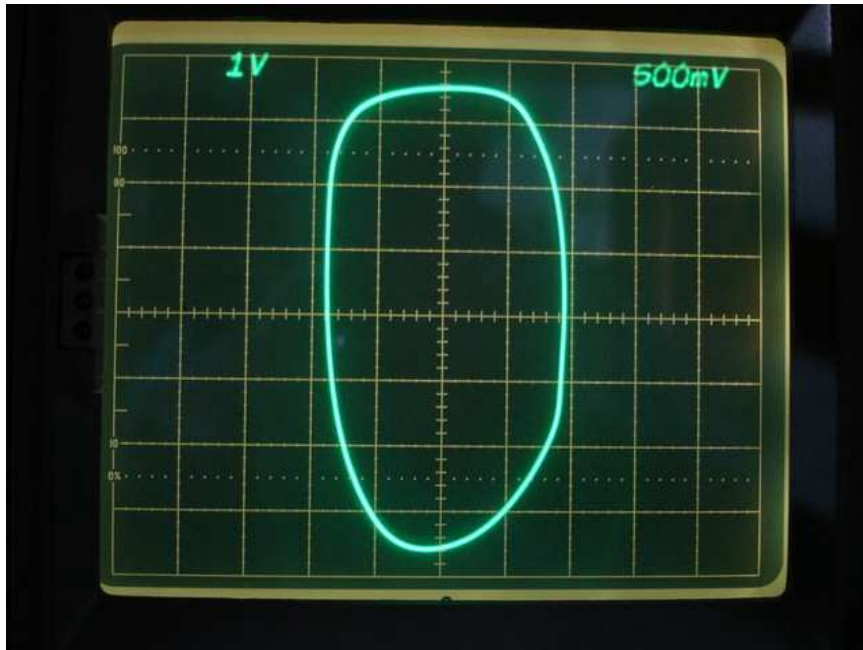
The screenshot shows the Thunderbolt Monitor interface with the following data:

- Time:** 07:31:58, GPS
- Date:** Sep 15, 2009
- Week:** 1549, TOW 199918
- UTC Offset:** 0, No UTC Info
- Position:** Latitude 48.72358 degrees, Longitude 2.52470 degrees, Altitude 93.0 meters
- Self-Survey Progress:** 0%
- Rcvr Mode:** (7) Overdet Clock (Time)
- GPS Status:** (0) Doing Fixes (highlighted)
- Timing Outputs:** PPS 26.85 ns GPS, 10 MHz -36.49 ppb
- Critical Alarms:** ROM Checksum, RAM Check, Power Supply, FPGA Check, Oscillator Control Voltage (all green)
- Minor Alarms:** Oscillator Control Voltage (green), Antenna Open (green), Antenna Short (green), Satellite Tracking (green, circled), Oscillator Disciplining (green, circled), Self-Survey Activity (green), Stored Position (green), Leap Second Pending (green), Test Mode (green), Position Questionable (green), EEPROM Invalid (green), Almanac (yellow)
- Disciplining Status:** Mode (1) Power-up, DAC Voltage 0.000000, Activity (1) Osc Warm-up, DAC Value 0x800000, Holdover (sec) 0, Temp (deg C) 27.9
- Signal Levels:** SV 15, AMU 10.2; SV 7, AMU 0.0; SV 4, AMU 0.0; SV 24, AMU 0.0; SV 28, AMU 3.2; SV 19, AMU 0.0; SV 9, AMU 0.0; SV 25, AMU 0.0
- COM:** 1, 2 (highlighted), 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
- Logging:** Logging Off
- COM2:** 9600, 8-N-1

Tboltmon.exe soft : max locking time after savings

T < 5 minutes : GPS totally disciplined

After 15 minutes



Thunderbolt Monitor

Control Setup Window Help

Time: 07:44:29 GPS
Date: Sep 15, 2009
Week: 1549 TOW: 200669

UTC Offset: 15 seconds

Position:
Latitude: 48.72358 degrees
Longitude: 2.52470 degrees
Altitude: 93.0 meters

Self-Survey Progress: 0%

Rcvr Mode: (7) Overdet Clock (Time)
GPS Status: (0) Doing Fixes

Timing Outputs:
PPS: -61.65 ns GPS
10 MHz: -0.07 ppb

Critical Alarms:
 ROM Checksum
 RAM Check
 Power Supply
 FPGA Check
 Oscillator Control Voltage

Minor Alarms:
 Oscillator Control Voltage
 Antenna Open
 Antenna Short
 Satellite Tracking
 Oscillator Disciplining
 Self-Survey Activity
 Stored Position
 Leap Second Pending
 Test Mode
 Position Questionable
 EEPROM Invalid
 Almanac

Disciplining Status:
Mode: (0) Normal DAC Voltage: 0.084906
Activity: (0) Phase Locking DAC Value: 0x822C7
Holdover (sec): 0 Temp (deg C): 31.7

Signal Levels:
SV AMU
15 5.6
9 2.8
28 4.4
27 10.6
17 6.6
18 7.4
0 0.0
0 0.0

Logging Off

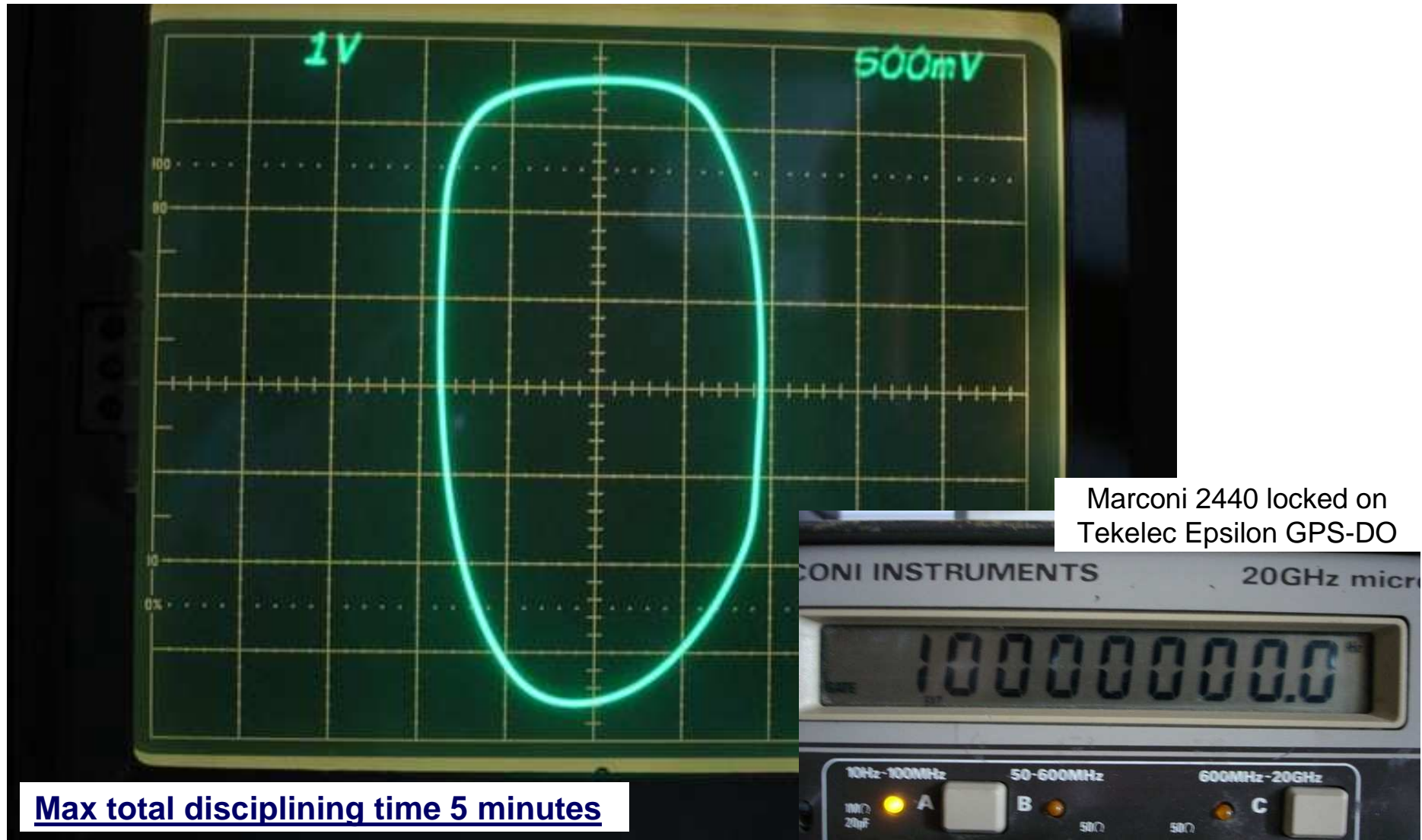
Tx Rx COM2: 9600, 8-N-1 Tx All

Almanac = all visible satellites totally « explored »

Conclusion

Final Lissajous curve after savings

10 MHz outputs from respectively Thunderbolt and Tekelec Epsilon GPS-DOs



Marconi 2440 locked on
Tekelec Epsilon GPS-DO