LCD-GPS DISCIPLINED CLOCK

Instruction Manual V 1.0

This user's manual describes how to install and use the GPS disciplined clock.

For assistance ,contact：

WUTONG electronic

Longhua, Shenzhen, Guangdong, China

Website: http://bg7tbl.taobao.com

TEL/VX: 0086-134　2795　9750

Q　　Q: 1630 2767

Email: BG7TBL@GMAIL.COM/BG7TBL@QQ.COM/BG7TBL@126.COM

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Section 1:   Key Features

1,   10MHz low noise sine or square wave output

2,   1 Pulse Per Second (PPS) UTC synchronized output

3,   High sensitivity GPS receiver can achieve lock without direct line of sight

4,   RED LED warning reference is not yet stable

5,   12V / 1.5A power requirement

6,   Inexpensive, compact and easy operation

7,   Unique algorithm to remove GPS signal jitter and maintain high accuracy

8,   LCD Display monitors GPS Lock, signal strength and reference error

Section 2:   Overview

The GPSDO (GPS Disciplined Oscillator) utilizes GPS signals to steer a 10MHz Ovenized Crystal Oscillator (OCXO) as well as providing a GPS locked 1 Pulse Per Second (PPS) clock output.   A software algorithm filters GPS time jitter to improve overall accuracy.   The front panel LCD display provides GPS signal strength, time and reference frequency deviation.

Section 3:   Technical Parameters

NAME: LCD-GPS DISCIPLINED OSCILLATOR

POWER: DC11.7-12.9V, <= 15W

GPS ANT POWER: DC3.3V / 50mA

1PPS OUTPUT: Square Wave, 3.3Vpp

10M OUTPUT: Sine Wave, 1Vrms (10-15dBm); Square Wave, 3.3/4.7Vpp

RS232 OUTPUT: GPS NMEA SIGNAL

ACCURACY: 2 orders of magnitude higher than OCXO

SIZE: W*H*D=107*55*172mm (INCLUDE BNC CONNECT)

ACCESSORY: AC110-220-DC12V ADAPTER, 5 m GPS ANT.

Section 4:   Equipment Installation

4.1 Rear Panel

Rear Panel

1, Status LEDs

ALM: LED on indicates the OCXO reference is warming up and not yet stable

GPS LOCK: LED on indicates GPS signal is locked
RUN: Flashing LED indicates normal operation, otherwise there is a system fault

2, DB9 connector provides RS232 NMEA GPS data and 1PPS signal

3, GPS locked 1 PPS rising edge Square Wave output

4, 10MHz Sine Wave, or Square Wave reference output

5, Active GPS antenna SMA connector

6, External DC power input, 5.5mm/2.1mm, center positive, 11.7-12.9V, <15W

Accessory is 5m active GPS antenna, DC12V / 1.5A adapter. connect GPS antenna.   Standalone 10MHz reference can be provided without GPS signal.

ATTENTION: Power adaptor plug must be 5.5/2.1, unreliable operation will result if 5.5/2.5 is used.

4.2 Front Panel

Front Panel

LCD Display monitors GPS Lock, signal strength and reference error

4.3 Computer Connection

GPSDO-DB9   PC-DB9

PIN2-------------------PIN2

PIN3-------------------PIN3

PIN5-------------------PIN5

PIN8-------------------PIN8

-GPSDO-DB9 PIN2, PIN5, PIN8 is connect to PC-DB9 PIN2, PIN5, PIN8

-Baud rate is 9600bps, Baud rate is fixed.

4.4 Rear Panel Status LEDs

-Power up: All three LEDs will light momentarily followed by RUN (flashing), ALM (on), and GPS Lock (off)

-Power up current: less than 1.5 A.

-Preheat: The OCXO may require 30 minutes to fully warm.   Once the OCXO is at normal operating temp the ALM LED will turn off.   Once GPS Signal is locked, the GPS Lock LED will turn on indicating normal operation.

-Normal: RUN LED (flashing), GPS LOCK LED (on). ALM LED (off), means the GPSDO is operating normally.   When ALM LED is off, the accuracy is better than 0.05Hz@10MHz, with GPS lock for 5 hours, the accuracy should settle to better than 0.005Hz@10MHz.

4.5 Front Panel LCD Status
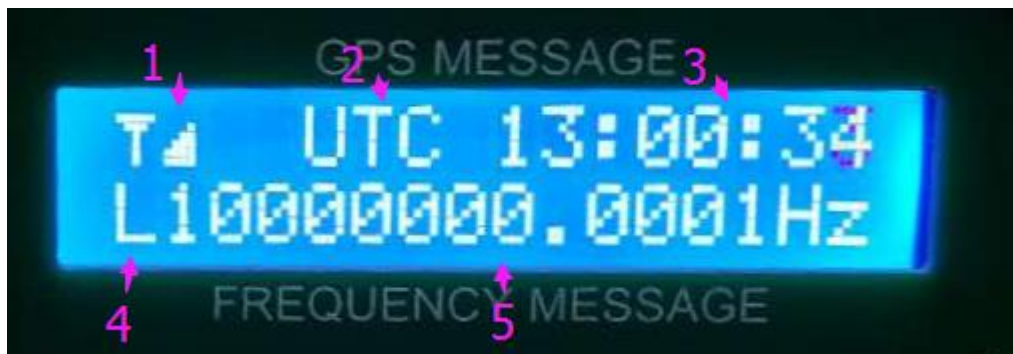
The 1602 LCD is used, i.e. the display area has 2 lines with 16 characters each.

1, GPS signal strength, 1 to 6 bars, 1 bar being weak and 6 bars a strong signal.

2, User defined 6-character display area

3, Time Display, user programmable for Time Zone

4, GPS Disciplined state display, 'L' is indicated when is at highest accuracy

5, Reference output frequency display area

-At power up, LCD display will momentarily light solid to test, then display;

'GPSDO UTC +/- XX:XX', shows UTC time offset

'BG7TBL V20171210', display author and version

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-After, the display will enter the normal state

'GPS NO FIX' will be displayed at the bottom of the LCD until GPS lock is archived

4.6 Display Command

-An Internal PCB jumper is used to set the display frequency mode, 6 character area, or UTC offset.

-Baud rate is 9600bps, data bit 8, stop bit 1, check bit NONE, flow control NONE

-The instructions are in ASCII code starting with '$ GPGTC,' then 12 bits, ending with 'T *'

<$ GPGTC, X1 X2 X3 X4 X5 X6 X7 X8 X9 X10 X11 X12 T *>

X1, sets frequency display mode

'0' for "10000000.0000Hz" format

'1' for "10M +/- 0.0000Hz" format

'2' for "10M +/- 000.00ppb" format

'3' for "10M +/- 0.00000ppm" format

X2 - X7, sets the user defined 6-character area (default is ' UTC ')

X8, sets positive or negative time offset from UTC, '+' or '-'

X9 & X10, two-digit hour offset, '00'-'23'

X11 & X12, two-digit minute offset, '00'-'59'

-Example 1: ppb format frequency display mode, user defined display of 'BJT', UTC time offset of + 8:00, the command would be;

'$ GPGTC, 2 BJT + 0800T *'

-Example 2: 10000000.0000Hz format frequency display mode, user defined display of 'GMT', UTC time offset of + 0:00, the command would be;

'$ GPGTC, 0 GMT + 0000T *'

-Example 3: ppm format frequency display mode, user defined display of 'EST', UTC time offset of -5:00, the command would be;

'$ GPGTC, 3 EST + 0500T *'

-After the command is sent successfully, the device will return the 'OK' character.

4.7 Notes

LCD display frequency is reference only, there is deviation with actual output.

-The GPSDO surface will become warm during operation, this is normal.

-For best GPS signal lock, place the antenna in a clear view of the sky, avoid interference sources such as high voltage power lines.   GPS Lock can be achieved without direct view of the sky but accuracy and jitter will likely suffer.

Section 5: Block diagram
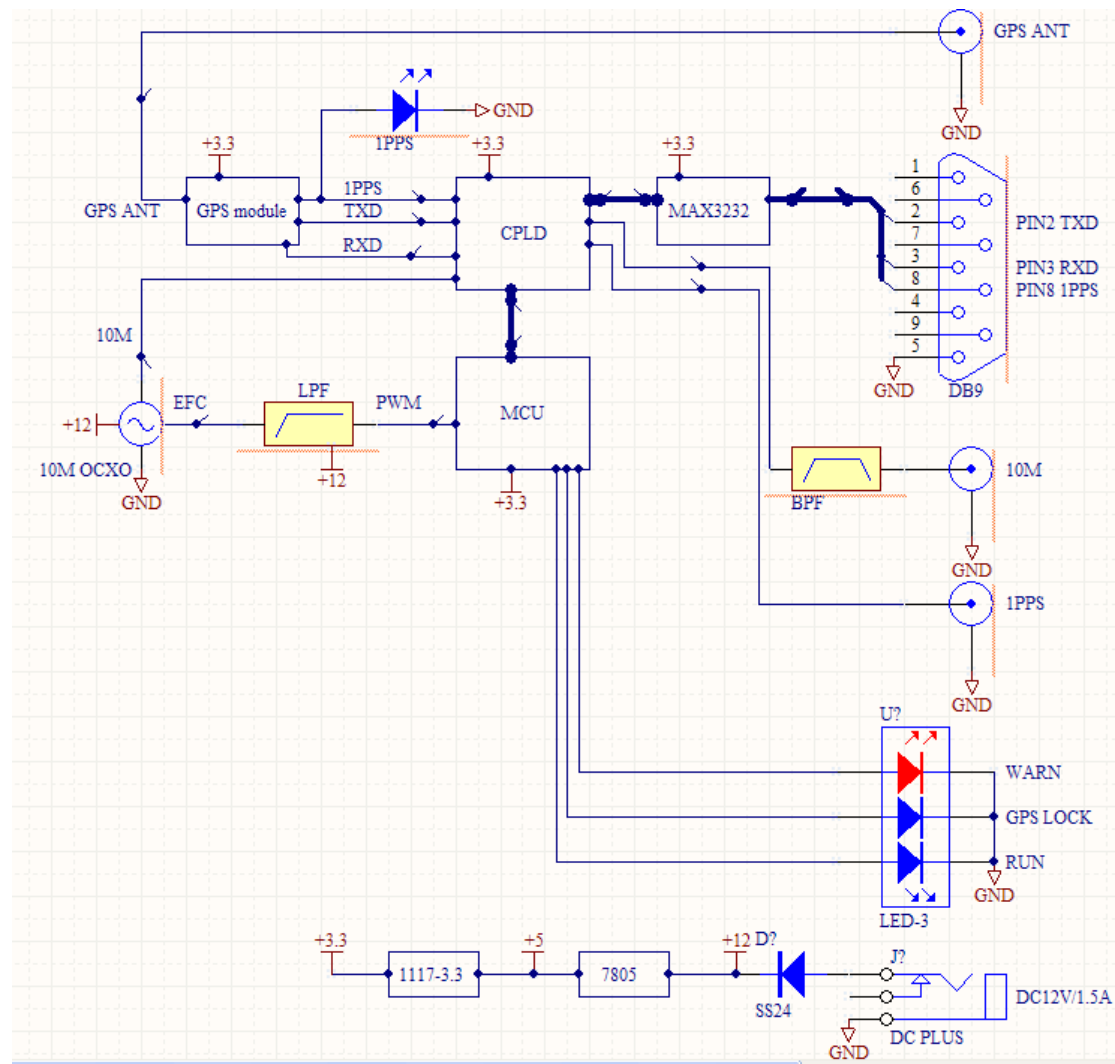
Block Diagram

Signal Flow: 1575.42MHz (L1) signal from GPS antenna into GPS module. Module output 1PPS and GPS lock signal, leading to the CPLD and MCU, with 1PPS as the gate, 10M signal error measurement, feedback to OCXO voltage control terminal for frequency correction.

Section 6: FAQ

Q : How can I tell if the device is working?

A : After powering on for a while, the RED ALM LED should turn off

Q : How can I tell if the MCU is working?

A : When powered on, all the LEDs will light momentarily, then the RUN LED will flash and the RED ALM will be lit indicating the MCU is operating.

Q: The 5m GPS active antenna cable is too short or cannot be connected?

A: A 50 Ohm GPS antenna extension cable can be used, such as an additional 5m, 10m, 15m, 20m.   The GPSDO will operate in fallback OCXO mode if the GSP antenna cannot be connected or a GPS signal obtained

Q: I use a frequency counter and the frequency of the device shows a difference, what should I do?

A: The LCD frequency of the device is for reference only, the actual test frequency will have a certain deviation. However, when the machine displays L10000000.000xHz or L other frequencies, the accuracy is high.   Need to ensure that the reference frequency of the measurement of 0.001Hz statistical accuracy.

Q: The displayed GPS signal strength changes, high, low.

A: This is normal. The signal strength is affected by the satellite position, the weather and the any obstructions between the antenna and sky.