
GPS 驯服钟
GPS DISCIPLINED OSCILLATOR
GPSDO

使 用 说 明 书 V1.1
USER MANUAL V1.1

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该用户手册描述如何安装和使用 GPS 驯服钟。

This manual describes how to install and use GPS Disciplined Oscillator (GPSDO).

如需帮助，请联系

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一，特点 Key Features

1， 输出 10MHz 高精度正弦波或方波，噪音低

Output 10MHz high accuracy sine or square wave signal, low noise

2， 输出 1PPS 秒脉冲信号，和 UTC 时间同步，

Output 1PPS second pulse, in sync with UTC time

3， GPS 灵敏度高，一线天也可锁定

Highly sensitive GPS receiver, needs only few satellites for signal lock

4， 带锁定指示，红灯灭即可使用

With lock indicator, red LED OFF => equipment locked

5， 供电简易，单 12V/1.5A 即可，可使用开关电源

Power supply 12VDC/1.5A, simple & easy, may use switched power supply

6， 价格低廉，体积小，使用方便，

Inexpensive, small size, convenient to use

7， 特有的去除 GPS 信号抖动算法，精度更高

Unique algorithm for removal of GPS signal jitter for higher accuracy

二，概述 Overview

GPSDO 英文名 GPS Disciplined Oscillator, 中文名称 GPS 驯服钟。是一种利用 GPS 输出准确时间信号去控制时钟的设备。本设备利用 GPS 输出的秒脉冲，控制板上的恒温晶振，并采用了特殊的滤波方式，将 GPS 的秒脉冲抖动去除，使到恒温晶振的输出频率精度非常高，并随时进行修正。

GPSDO (GPS Disciplined Oscillator), uses accurate GPS time signal to control clock equipment. This equipment uses GPS output 1 PPS to sync on board OCXO. Employs special algorithm to filter the GPS time jitter. Forces the OCXO clock output to lock onto GPS signal.

三，技术参数，

名称：GPS 驯服钟

Item: GPS Disciplined Oscillator (GPSDO)

供电：DC11.7-12.9V、 $\leq 15W$

Power Supply: DC11.7-12.9 VDC $\leq 15W$

GPS 天线供电：DC3.3V/50mA

GPS Antenna Power Supply: 3.3 VDC/50mA (optional 5 VDC/50 mA)

1PPS 输出波形，幅度：方波，3.3Vpp

1PPS Output Signal: Square Wave, 3.3Vpp

10MHz 输出波形幅度：正弦波，1Vrms, (10-15dBm), 方波，3.3/4.7Vpp

10MHz Signal: Sine Wave 1Vrms (10-15dBm), Square Wave 3.3/4.7Vpp

RS232 输出：GPS NMEA 信号

RS232 Output Signal: GPS NMEA Signal

精度：比恒温晶振高 2 个数量级

Precision: Above 2 orders of magnitude better than OCXO

外形尺寸：W*H*D=107*55*122mm (包含前面接头)

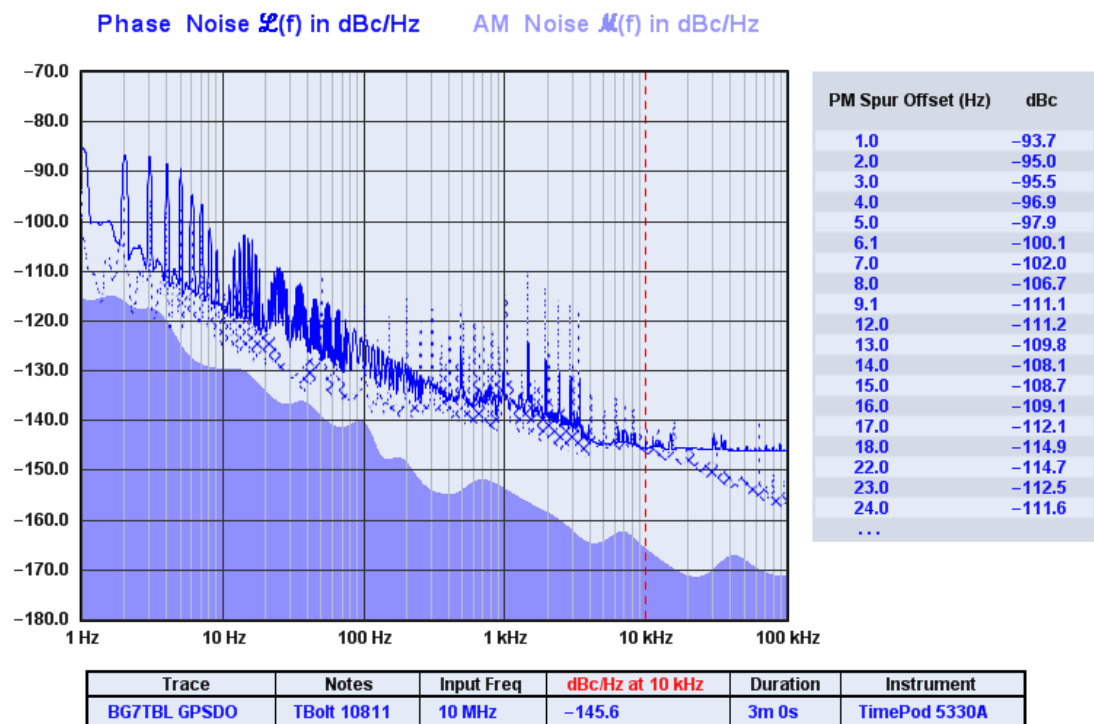
Dimensions: (WxHxD) 107 x 55 x 122mm (incl. BNC connectors)

附件：配套 AC110-220 / DC12V 变压器，5 米 GPS 天线，

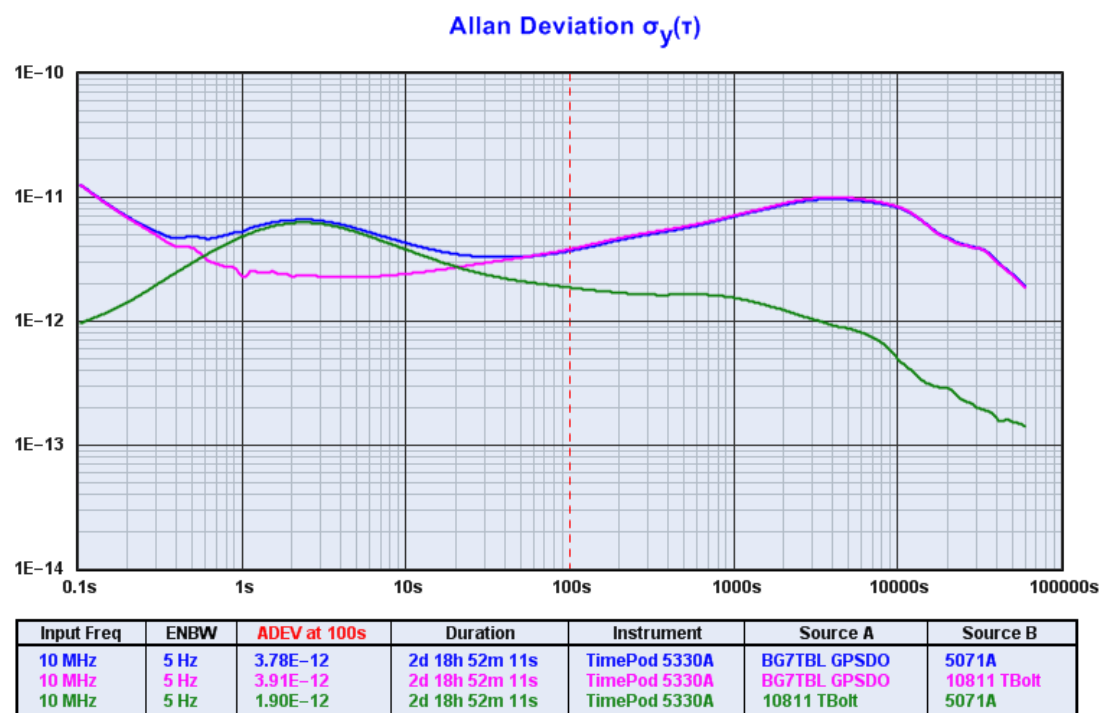
Accessories: AC110-220 / DC12V Adapter, GPS Antenna 5 m cable length

以下测试图来自 KE5FX, 非常感谢 KE5FE 的测试，
<http://www.ke5fx.com/gpscomp.htm>

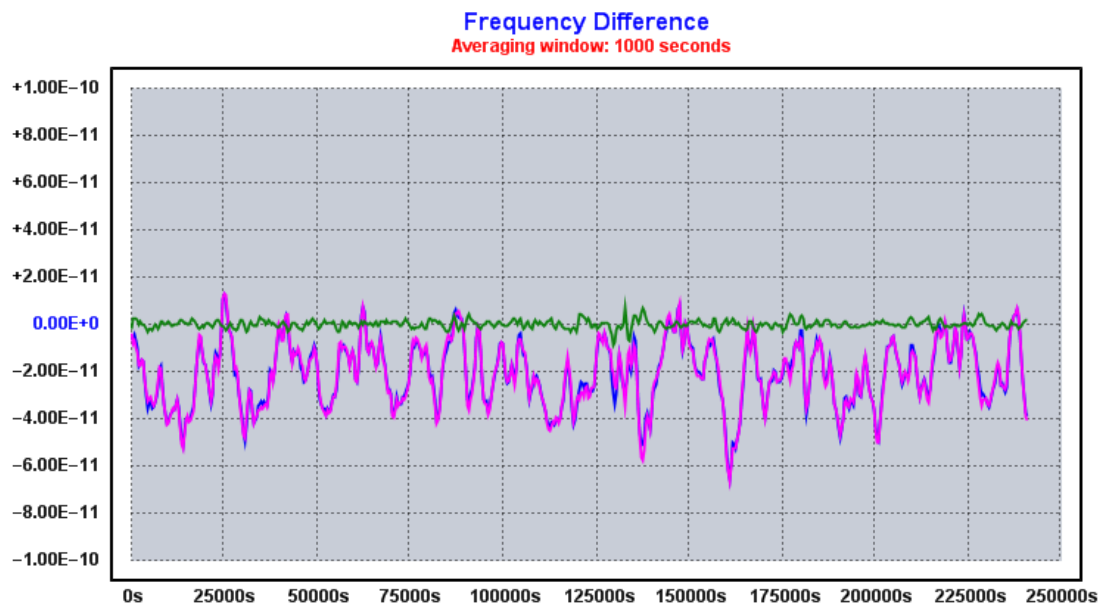
The following test charts are from the KE5FX. Thank you KE5FX.



相位噪音，JITTER



阿伦方差，Allan deviation

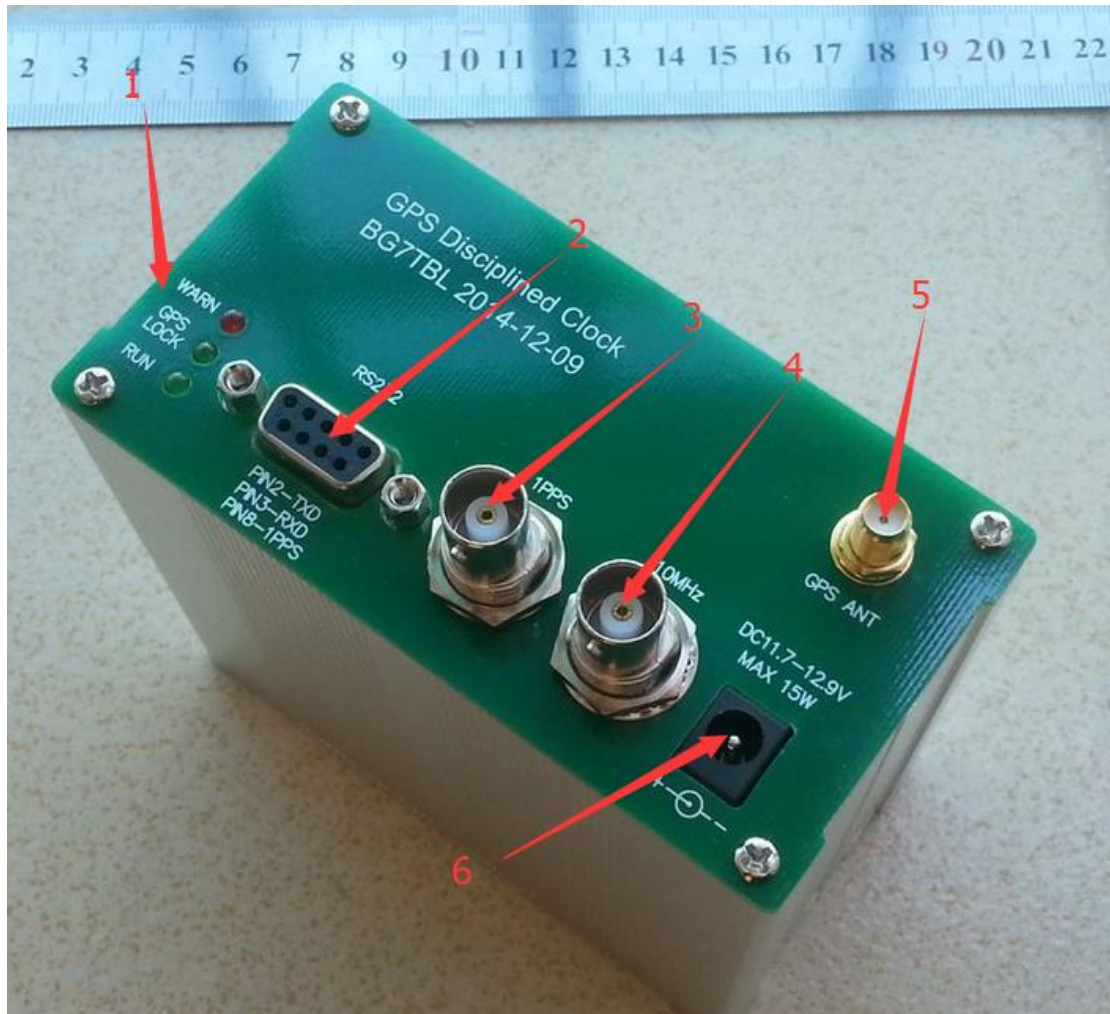


Input Freq	Sample Interval	Duration	Instrument	Source A	Source B
10 MHz	0.100 s	2d 18h 52m 11s	TimePod 5330A	BG7TBL GPSDO	5071A
10 MHz	0.100 s	2d 18h 52m 11s	TimePod 5330A	BG7TBL GPSDO	10811 TBolt
10 MHz	0.100 s	2d 18h 52m 11s	TimePod 5330A	10811 TBolt	5071A

频率偏差，Frequency Difference

四，设备安装,使用，Installation

4.1 设备面板，Front panel



设备面板，Front panel

1.工作状态指示灯，

Work status LEDs

WARN/ALM: 警告，该灯亮时候，设备输出精度比较低

WARN/ALM: Warning. If ON, accuracy of output frequency is low (OCXO)

GPS LOCK: GPS 锁定指示灯，GPS 3D 锁定时候，该灯亮

GPS LOCK: GPS lock indicator. While GPS “3D” locked: ON

RUN:运行指示灯，只要设备正常运行，该灯一直慢闪，如果不闪，设备内部有故障

RUN: Run LED. Slowly flashing: Normal, Not flashing: Fault.

2. DB9 接口, 输出 NMEA GPS 信息,秒脉冲信息, RS232 电平

DB9 connector: Output NMEA GPS flow, Output 1PPS signal, RS232 level

3. 秒脉冲输出, BNC 接口, 信号来自 GPS, 上升沿有效,

1PPS (Pulse Per Second): BNC connector. GPS signal: rising edge is valid

4. 10MHz 输出, BNC 接口, 输出正弦波或者方波,

10MHz Output: BNC connector, sine or square wave (depending on version)

5, 外接 GPS 主动天线, SMA 接口

SMA Connector: Active GPS antenna, 3.3 or 5 VDC supply

6, 电源接口, 内正外负, 使用 5.5mm/2.1mm DC 插头, 11.7-12.9V,最大 15W。

Ext. Power: 5.5mm/2.1mm DC plus Connector. Center: (+), Outside: (-)

Input: 11.7-12.9 VDC max 15 W

设备配套有 5 米长 GPS 天线, DC12V/1.5A 适配器, 到手后, 接上 GPS 天线, 将 GPS 天线放开阔处, 接上 DC12V 电源, 即可当 10M 基准使用。

Accessory: 5m active GPS antenna, DC12V/1.5A Adapter. Connections: GPS antenna, DC12V power supply. Output: 10MHz Standard frequency.

注意: 需要使用 5.5/2.1 的电源插头, 如果使用 5.5/2.5 的, 会接触不良。

ATTENTION: Must use 5.5/2.1 DC plus, if 5.5/2.5 => poor contact !

4.2 和电脑连线, Connect a PC

GPSDO-DB9	PC-DB9
PIN2-----	PIN2
PIN5-----	PIN5
PIN8-----	PIN8

DB9 的 PIN2 和电脑串口的 PIN2 连接，DB9 的 PIN5 和电脑的 PIN5 连接，
DB9 的 PIN8 和电脑的 PIN8 连接。

GPSDO-DB9 Pin2, Pin5, Pin8 is connect to PC-DB9 Pin2, Pin5, Pin8.

通信波特率是 4800BPS 或者是 9600BPS,波特率不可调

Baud rate is 4800BPS or 9600BPS. Baud rate is fixed.

4.3 工作状态，Nomal Use

上电：3 个状态灯全亮，然后 RUN 灯闪，GPS 锁定灯灭，WARN 灯亮

Power On: All three LED on. After that “RUN” LED slowly flashing, “GPS LOCK” LED off, “WARN/ALM” LED on.

上电电流：小于 1.5A

Power startup current: Less than 1.5 A.

预热：由于内部的 OCXO 预热需要 30 分钟，上电一段时间后，电流会慢慢下降，一直到 GPS LOCK 灯亮，WARN 灯灭，表示设备工作正常。

Preheat: An OCXO is on board, needs ~30 minutes to stabilize. After that time, the current will slowly reduce. Equipment is working normally when “GPS LOCK” LED on, “WARN/ALM” LED off.

正常：RUN 灯闪，GPS LOCK 灯亮，WARN 灯灭，表示设备正常运行。只要 WARN 灯灭，[GPSDO 输出精度会达到 0.05Hz@10MHz](#)。保持 GPS 锁定状态开机 5 小时，[精度基本达到 0.005Hz@10MHz](#)。

GPSDO working normally: “RUN” LED flashing slowly, “GPS LOCK” LED on. “WARN” LED off. When “WARN” LED off, accuracy is better than [0.05Hz@10MHz](#), if GPS stays locked for at least 5 hours, accuracy improves further to better than 0.005Hz@10MHz.

4.4 使用注意事项，Usage Notes

长时间开机，机器表面稍热，属于正常现象。

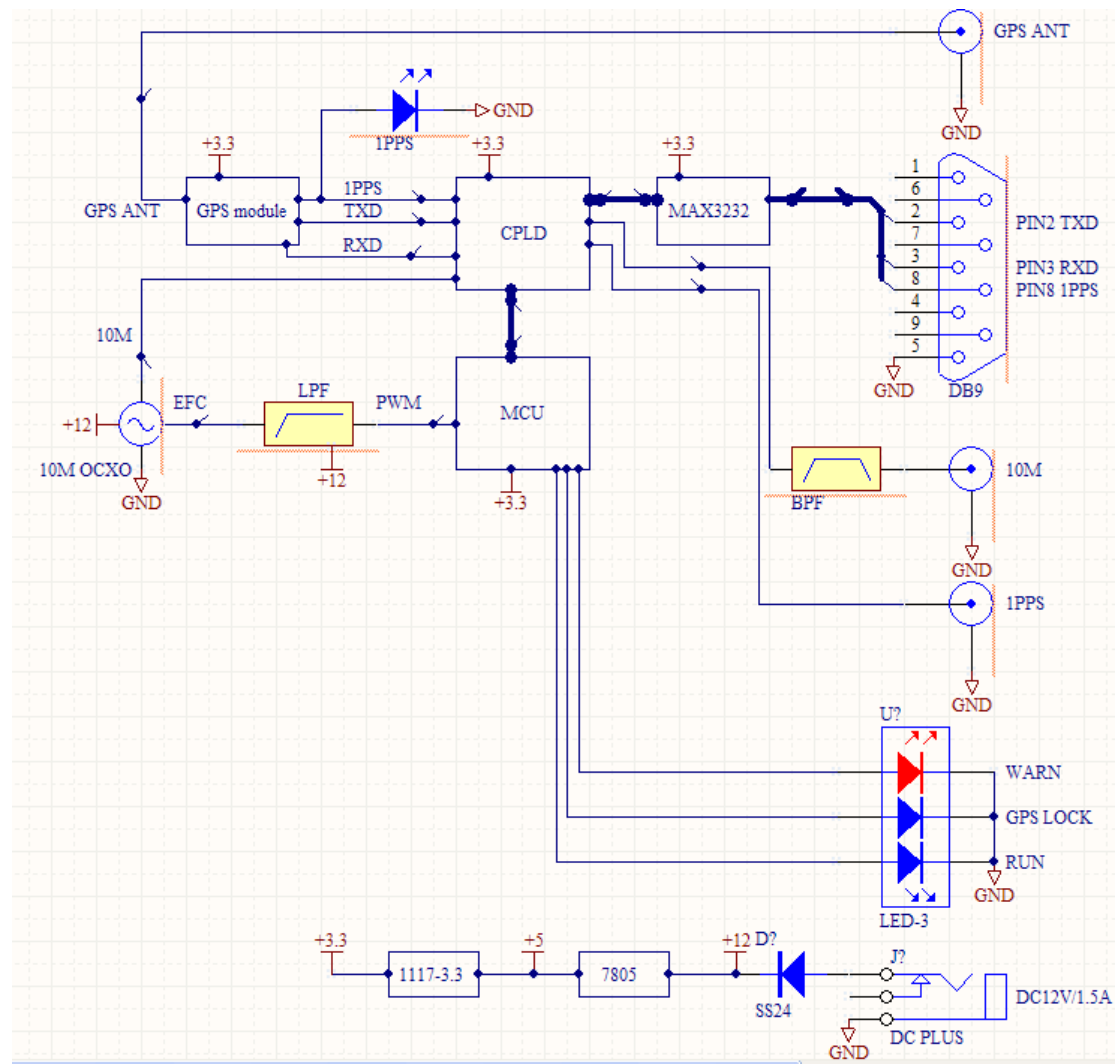
When the GPSDO is running for a longer period of time, the housing gets warm.

This is considered normal.

GPS 天线要避开干扰，避开高压，避开雷电。尽量放置于开阔地，一线天也可以锁定，但是精度会略差，信号抖动也比较大。

Attention: Please avoid interference, high voltage and lighting etc. near GPS antenna. It is recommended to place the antenna with good view to an open sky. Inside a building it may eventually lock, but accuracy and jitter will be worse.

五，电路方框图，Block diagram



方框图 Block diagram

信号流程：来自 GPS 天线的 1575M 信号，进入 GPS 模块。模块输出 1PPS 和 GPS 锁定信号，通到 CPLD 和 MCU，用 1PPS 为闸门，对 10M 信号进行误差测量，反馈给 OCXO 压控端，进行频率修正。

Signal flow: 1575MHz signal from GPS antenna to the GPS module, GPS output 1PPS and NMEA GPS lock signal. Use 1PPS for gating via CPLD and MCU output EFC signal to synchronize the OCXO output frequency.

六，常见问题问答 FAQ

问：如何判断机器是好的

Q : How do I know that the equipment is OK ?

答：上电一段时间后，红灯灭，表示机器良好

A : At Power on => red LED off => equipment works fine.

问：如何判断 MCU 运行良好

Q : How do I know that the MCU is OK.

答：上电时候，所有 LED 全亮，然后 RUN 灯满闪，红灯亮，MCU 即良好。

A : When power On, all LED will go on, after that “RUN” LED flashes, red LED is on => MCU is good.

问：GPS 天线不够长怎么办，可以不接 GPS 天线吗.

Q: 5m GPS active antenna is to short, what to do? Can't connect GPS antenna or no signal ?

A: GPS 天线不够长时候，可以用延长线，比如 5 米，10 米，15 米，20 米的延长线， 可以不接 GPS 天线，此时就是一个普通的 OCXO

A: Use GPS extension cable, such as 5m, 10m, 15m, 20m extension cable. If no GPS antenna connected or no GPS signal available, then built-in OCXO is used.