

Interconnecting Motorola GPS & Temex Smart Rubidium SynClock+®

Interconnecting & Evaluating the System Performance of Motorola UT+ Oncore GPS & Temex Smart SRO-100 Rubidium SynClock+®

Contents

<i>Introduction</i>	1
<i>Interconnecting the Smart GPS/SRO SynClock+® Timing System</i>	2
<i>Simple GPS/SynClock+® PC Interconnection</i>	2
<i>Smart GPS/SynClock+® PC Interconnection</i>	4
<i>Smart GPS/Jumpstart SynClock+® Designer Kit Interconnection</i>	6
<i>Evaluating the Smart GPS/SRO SynClock+® System Performance</i>	7
<i>Test Equipment & Diagram</i>	7
<i>System Performance</i>	7
<i>Fast Q&A Support</i>	9
<i>Ordering Temex Smart SynClock+®</i>	9

Introduction

In this AppNote, Temex's Smart SRO-100 Rubidium SynClock+® is referred to as the "Smart SynClock+®" and Motorola's UT+ Oncore GPS is referred to as the "GPS".

The patented SynClock+® is the industry's first smart Rubidium clock, integrating a host of complex timing and synchronization functions all in one low-cost, ultra-small package. It intelligently synchronizes, disciplines and controls any Stratum-1 reference such as GPS, Cesium, Hydrogen Maser, and T1/E1 at cutting-edge 1ns (nanosecond) resolution. The SynClock+® utilizes SmarTiming+™ technology to perform the following functions, which were previously implemented externally on a separate circuit board:

- Multi-vendor GPS interface with auto-adaptive reference filtering, disciplining, control, and Time RAIM/Position Hold signal optimization
- Auto-adaptive Stratum-1 reference disciplining and jitter/wander/noise filtering between 0-100,000 at 1ns resolution, exceeding MTIE/TDEV G.823/T1.101 standards for T1/E1 reference
- Auto-adaptive frequency stability over fast temperature changes at 0.1°C resolution
- Auto-adaptive frequency stability over temperature range within 2E-11
- Programmable 1PPS output phase/time offset adjustments between 0-1 sec through a 1ns-phase comparator
- Programmable or hardware Sync/Track setting mode to either a) phase align 1PPSout from a 1PPS GPS reference through the Sync mode or b) to frequency track 1PPSout from a 1PPS Stratum-1 reference through the Track mode
- Programmable EEPROM for TIE performance measurements, frequency calibration and backup setting in case of power failure, and seamless software upgrades
- Standard RS-232 communication interface with user-friendly ASCII commands for control, configuration, fault, and performance management

The purpose of this AppNote is to help engineers quickly design a complete GPS and Rubidium timing reference solution. The AppNote addresses the following design issues:

- How to connect, set up, and monitor the Smart GPS/SynClock+® timing system
- What kind of cutting-edge performance can be achieved through the Smart GPS/SynClock+® timing system

Interconnecting the Smart GPS/SRO SynClock+® Timing System

Three types of interconnection setup can be performed with the Smart GPS/SynClock+® as follows:

1. Simple GPS/SynClock+® PC interconnection
2. Smart GPS/SynClock+® PC interconnection
3. Smart GPS/Jumpstart SynClock+® Designer Kit interconnection

The software of Smart SynClock+® automatically configures, controls and optimizes the GPS during startup.

Simple GPS/SynClock+® PC Interconnection

Hardware Setup

Figure 1 illustrates how to easily interconnect the Smart GPS/SynClock+® timing system through a PC interface.

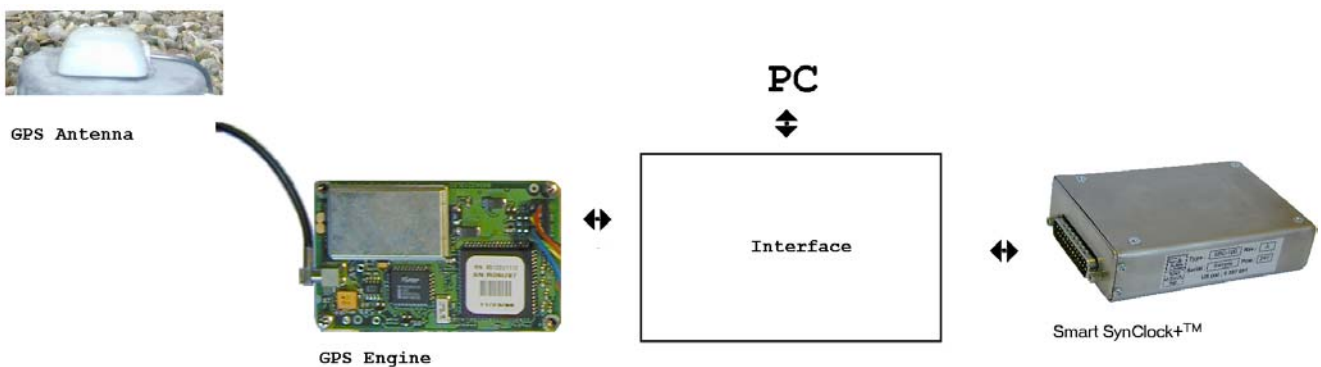


Figure 1 - Simple GPS/SynClock+® PC interconnection

PC Interconnection Interface

Figure 2 illustrates the PC interconnection interface, which allows communication to the Smart SynClock+®, but not to the GPS. The Smart GPS/SynClock+® PC interconnection allows communications with both the Smart SynClock+® and the GPS.

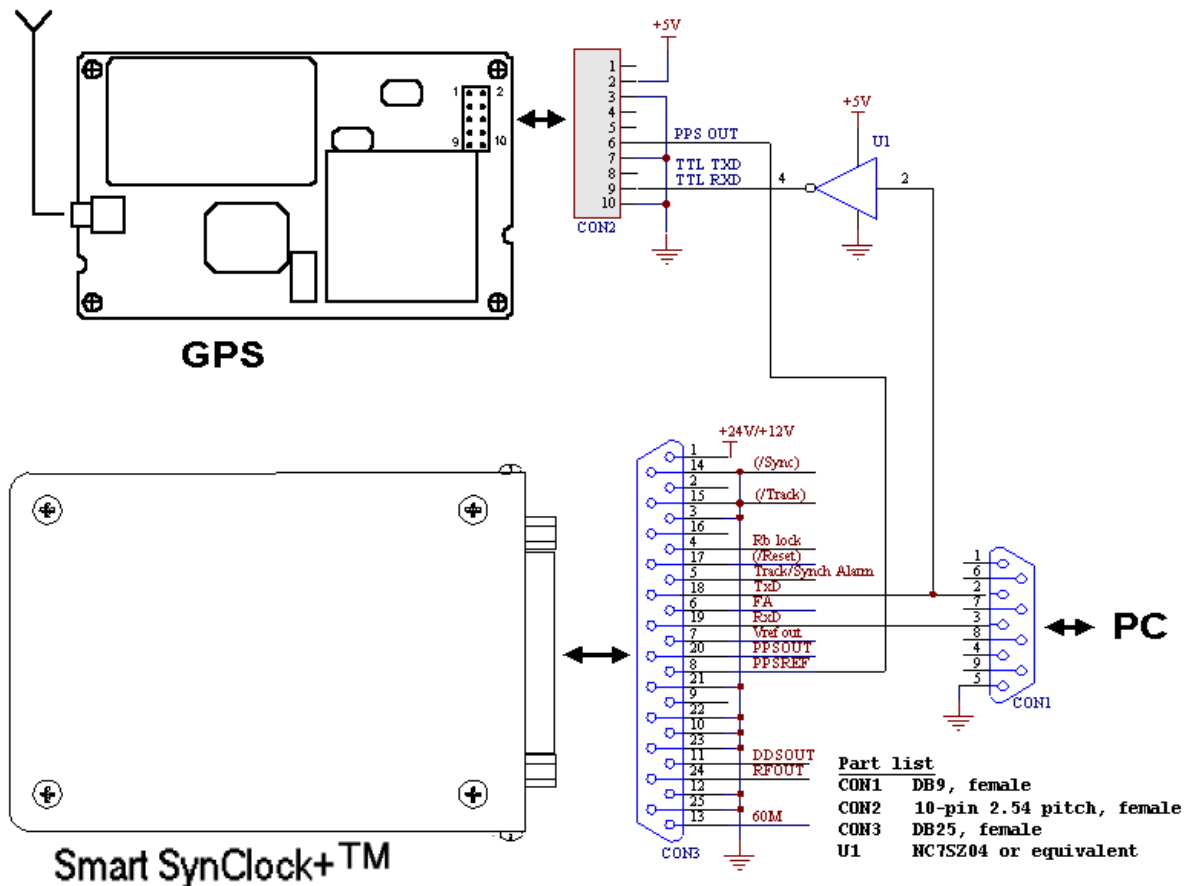


Figure 2 – PC Interconnection Interface

Software Setup

Simply follow the following instructions to set up the software interface of the Smart SynClock+®:

- 1) Connect the PC to the Smart SynClock+® through the serial port
- 2) Configure the GPS by running the ISyncMgr.exe application of the Jumpstart SynClock+® Designer Kit (JSDK). The application is also available at www.temex.com.
- 3) Click on the Timing+Tracking/MCsd menu and set up the Smart SynClock+® as illustrated in Figure 3:



Figure 3 – Smart SynClock+® GPS Setup

Message #	Description
2	It's a custom user message that can be activated to indicate that the Smart SynClock+® is used with a GPS
4 & 5	These are automatic vendor-specific configuration commands for the GPS

- 4) Power Off/On the Smart SynClock+®. During startup, it sends out configuration commands to the GPS
- 5) Click on the Timing+Tracking/ST menu

After >10 minutes, the status of the Smart SynClock+® should read “3 Sync to PPSREF”, indicating that it is properly disciplining by the GPS receiver. This status information can be read on the iSyncMgr software of the Smart SynClock+® or by a simple command ST<CR><LF> through a Windows terminal program.

Smart GPS/SynClock+® PC Interconnection

PC Interconnection Interface

Figure 4 illustrates the PC interconnection interface, which allows communication to both the Smart SynClock+® and the GPS, for the GPS commands start with “@@..” and are not recognized or ignored by the Smart SynClock+®. To monitor the GPS, the user must install the software program provided by the GPS vendor.

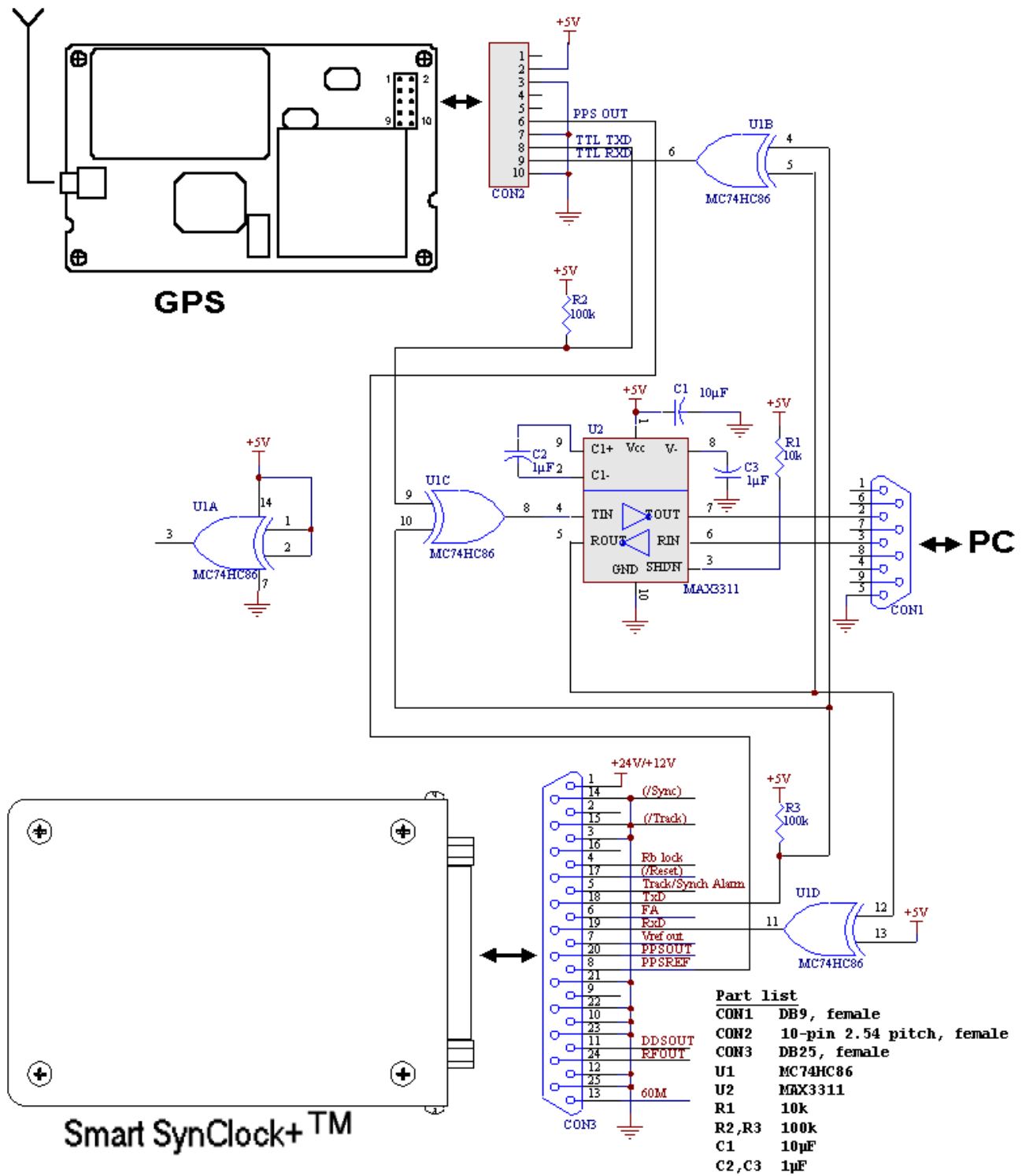


Figure 4 – Smart GPS/SynClock+® PC Interconnection

- Power Off/On the Smart SynClock+®. During startup, it sends out configuration commands to the GPS
- Click on the Timing+Tracking/ST menu

After >10 minutes, the green LED light on the JSDK should turn ON, indicating that the Smart SynClock+® is properly disciplining by the GPS receiver.

Evaluating the Smart GPS/SRO SynClock+® System Performance

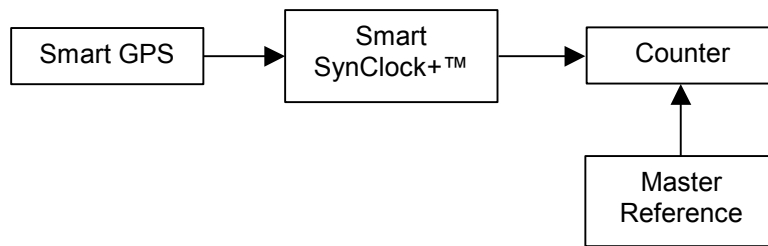
Below is a series of typical cutting-edge phase performance graphs that can be achieved through the Smart GPS/SynClock+® timing system.

Test Equipment & Diagram

The following equipment was used to test and measure the performance of the Smart GPS/SRO SynClock+® system:

GPS Vendor:	Motorola at www.motorola.com/ies/GPS
GPS Product:	Motorola UT + Oncore GPS receiver, type R5122U1112
GPS Antenna:	Active antenna, type GCNAC111A
Temex Master Reference:	Hydrogen Maser, type H-MASER EFOS-C
Temex Clock:	Smart SRO-100 Rubidium SynClock+®
Counter Vendor:	Agilent, type 53131A counter
Notes:	A frequency difference of 3E-12 between the Hydrogen Maser and the GPS was removed to compute the performance data.

The testing diagram is as follows:



System Performance

Figure 6 illustrates the performance of the GPS which was installed in a poor location where the reception of the GPS signal was weak. The GPS was located on the balcony of Temex's building in Neuchâtel, Switzerland. The building is located in a small valley which blocks the constant line-of-sight view of the satellites to the building's balcony.

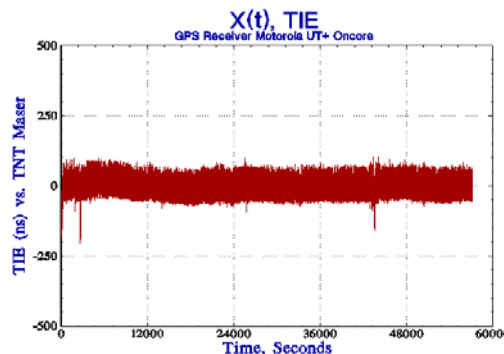


Figure 6 - GPS Time Interval Error Performance

The phase performance in Figure 6 is typical for a GPS receiver. The GPS was automatically set in Position Hold mode and the Time-RAIM was activated by the Smart SynClock+®.

The high noise of the GPS is called “clock granularity” by Motorola, and is due to the pulse generation system of the GPS.

Figure 7 illustrates the TIE holdover performance of Smart SynClock+® when the GPS reference is absent.

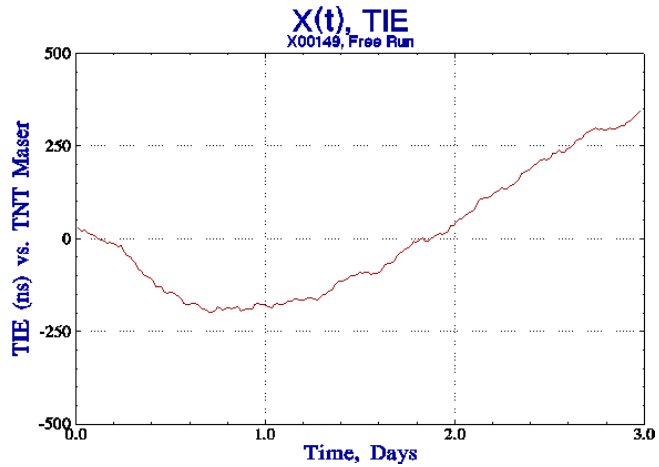


Figure 7 – Smart SynClock+® Holdover Performance

Figure 8 illustrates the MTIE Holdover performance of the Smart SynClock+® versus Stratum-1 ITU-T G.811 and ANSI T1.101 standard masks. The measurements were performed in a non-air-conditioned room, with typical temperature deviations of +/- 2°C.

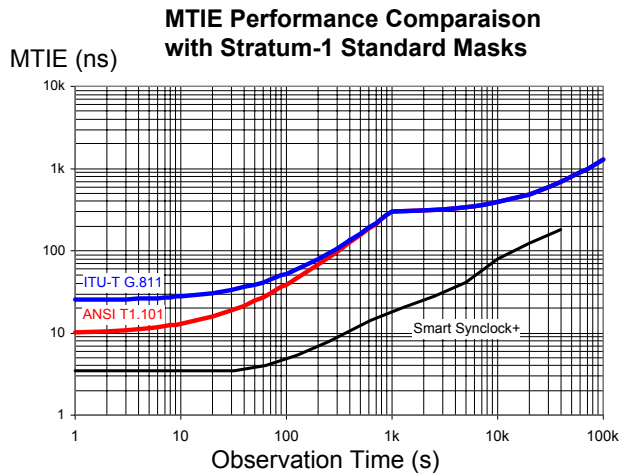


Figure 8 – Smart SynClock+® Holdover Performance vs. Stratum-1 Standard Masks

Figure 9 illustrates the TIE tracking performance of the Smart SynClock+® when locked to the GPS.

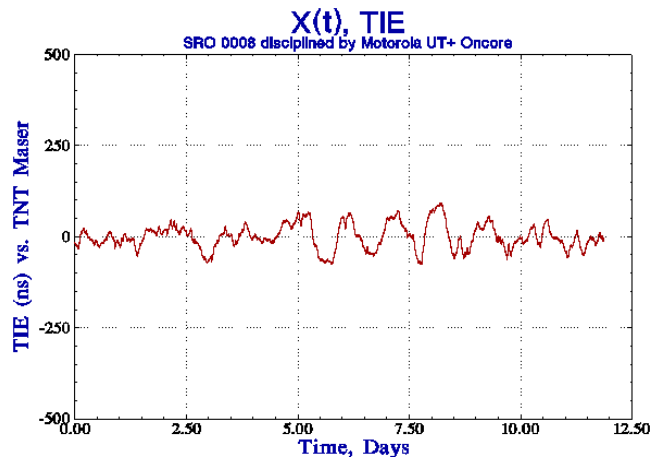


Figure 9 – Smart GPS/SynClock+® Tracking Performance

Figure 10 illustrates the MTIE tracking performance of the Smart GPS/SynClock+® versus Stratum-1 ITU-T G.811 and ANSI T1.101 standard masks.

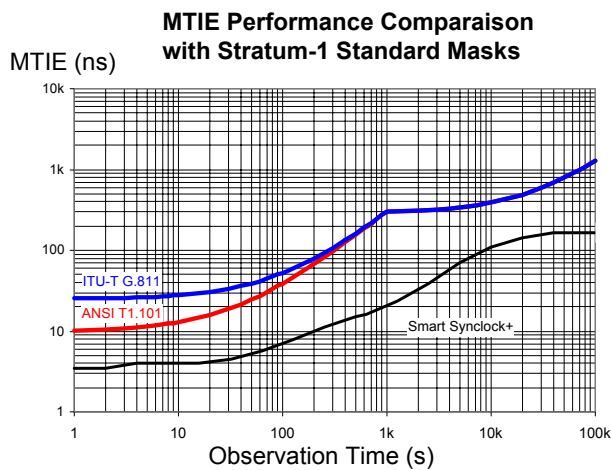


Figure 10 - Smart SynClock+® GPS Tracking Performance vs. Stratum-1 Standard Masks

Fast Q&A Support

If you have any questions about this AppNote or need tech support with your specific timing design and requirements, please feel free to contact us at fastsupport@temex.com.

Ordering Temex Smart SynClock+®

If you are interested in ordering the Smart SynClock+®, please contact us at sales@temex.com. For ordering the GPS, please contact Motorola at www.motorola.com.