Symmetricom offers Advanced Timing Solutions to those customers whose time and frequency needs are so specialized that they warrant products that exactly match their specifications.

From one of a kind timing systems, such as the one we developed for US LORAN-C transmitter stations, to products that offer picosecond measurement, Advanced Timing Solutions products address the highest precision and most complex timing and frequency requirements.

We offer a wide selection of modular products and services, which makes it possible to integrate semi-custom timing systems from standard products and modules. We routinely work with customers to provide customized timing systems for a wide range of applications. Most Advanced Timing Solutions products have hot swap power supplies, hitless switching and many other features, which make these products suitable for high reliability applications.

TSC UTC

UTC Recovery System

KEY BENEFITS

- <15ns Synchronization to UTC (USNO), Assuming Proper Calibration
- Graphical User Interface (GUI)
- Compatible with all Symmetricom Modules to Generate Output Signals
- 5 MHz, 1PPS and IRIG-B (123 & 000) Outputs for Local Use or Distribution
- No Hard Drive: Utilization of Flash Memory Increases Reliability While Simplifying Code Updates
- Dual Fans, Visual and Network Status Indications, and Dual Power Supplies for Maximum Reliability
- GPS Processing Using Symmetricom's KAS-2© Timescale Software
- Operates with Any 5 MHz Clock Source (Any Cesium or Rubidium)

Symmetricom's UTC recovery system is a GPS disciplined cesium standard. It is integrated from a GPS Rx, 100ps 2-Channel Timer, RF Distribution Amplifier, Synthesizer, Sychronizable Divider, and Time Code Generator. The UTC recovery system generates frequency, 1PPS, and time codes that are all synchronized to UTC. The Kalman filter based software controls the divider and synthesizer without disturbing the cesium standard. A Graphical User Interface allows the user to control the system and monitor its performance.

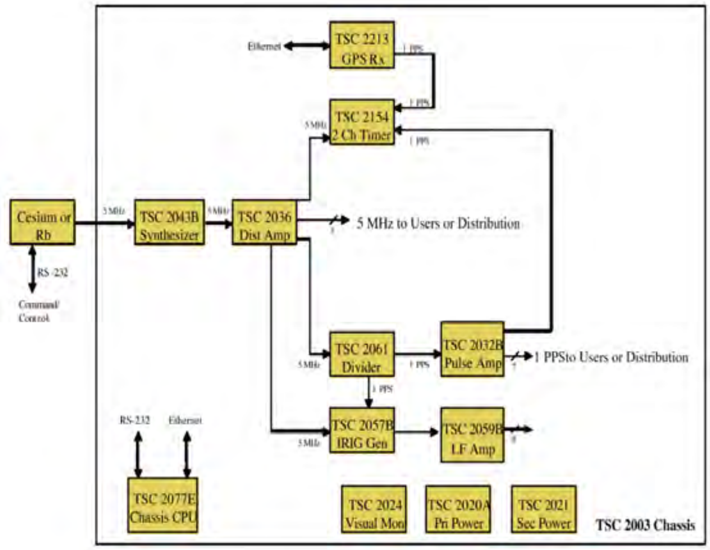
The UTC Recovery System can be configured to custom requirements.

Please contact Symmetricom with any specific requirements.

UTC Recovery System

OPERATION

Custom software provides a transportable X-based GUI interface for command and control of the system operation and for display of system performance. The GUI is divided into sections based on function. The GPS panel provides a polar plot of tracked satellites as well as a table of the tracking information for each satellite (including the reported offset to UTC). The system also includes a plot that shows raw GPS data and the filtered data used to steer the DDS. The GUI also contains Time code and alarm information.

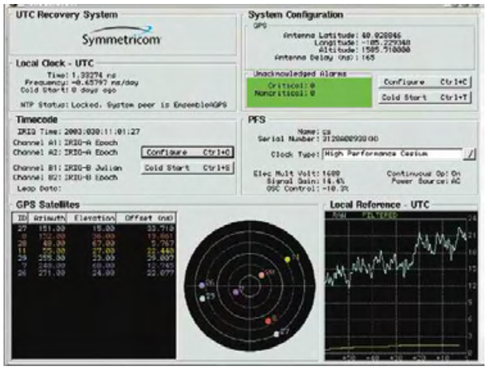


UTC Block Diagram

UTC RECOVERY SYSTEM SPECIFICATIONS

PERFORMANCE SPECIFICATIONS

- Offset to UTC(USNO): <15 ns (when properly calibrated)
- 1PPS
  - Rise time: <1ns
  - Jitter: <100ps
- 5 MHz (assuming cesium standard)
  - Harmonics: <40dBc
  - Spurious: <80dBc
  - Phase noise: Same specification as cesium (not degraded)
- IRIG-B (123)
  - Output level: <6 V P-P into 50Ω
  - 3:1 modulation ratio
- IRIG-B (000)
  - Output level: TTL into 50Ω
  - Resolution: 10 ms



UTC GUI

Multi-Channel Measurement System (MMS)

Flexibility, Reliability and Precision

KEY BENEFITS

- Flexibility: Can Measure Up to 28 RF Signal Inputs in a Single Chassis
- Multiple Frequency Inputs: Handles Up to Three Different Frequencies, with Eight Inputs Each
- High Resolution: Less than 100 Femtoseconds
- Low Noise Performance: Less than 5.0 x 10-13 Allan Deviation at 5 MHz (1 Second)
- Standard 19-inch Rack Mount Chassis
- Easily Expandable by Incorporating More Modules
- Reliable: Network-based Fault Reporting and Dual Cooling Fans
- Graphical Interface Available via Ethernet Connection to PC
- Network Based Phase Data Output
- Optional SQL Database Integrated with Stable 32

Symmetricom's Multi-Channel Measurement System (MMS) is a flexible, multi-channel system that is ideal for a full production environment. This advanced instrument offers customers a cost effective way to measure the phase difference between multiple continuous wave RF signals, enabling expansion from a base configuration of four signal inputs to a full 28 in a single chassis. Chassis can be added to increase signal measurement capacity. The MMS samples all inputs once every second and computes the phase difference relative to the 32 MHz internal oscillator. The system can also be configured to measure as many as three different frequencies simultaneously, with a frequency range of one to 20 MHz.

Expansion is made easy by the fact that the base system is designed for mounting in a 19-inch rack. Customers can increase the number of additional inputs simply by adding more standard modules, with four inputs available per module. The modular nature of the Multi-Channel Measurement System makes the product ideal for a range of customer needs, and the ability to add modules as production demands increase streamlines the resulting ramp-up.

DATABASE MANAGEMENT SYSTEM

The powerful relational database management system from Symmetricom augments the Multi-Channel Measurement System's capabilities by enabling storage of as many as three years of one-second data and—through an ODBC/SQL interface—helps retrieve data rapidly.

MMS 4-Channel Configuration

MMS 28-Channel Configuration

OPERATION

The MMS is a multiple mixer measurement system. The instrument measures the phase difference between an RF signal from the clock under test and a reference RF signal that is common to all measurement channels on a four-channel measurement module. An internal numerical oscillator provides the reference RF signal. Phase differences are measured directly rather than by using time differences, because phase measurements do not require knowledge of absolute frequency. The measured phase differences are then converted to nominal time differences, dividing the phase difference by a user-supplied scale factor.

MMS SPECIFICATIONS

PERFORMANCE SPECIFICATIONS

- Allan deviation (1 s) — <5.0 x 10-13 at 5 MHz; <2.5 x 10-13 at 10 MHz

ELECTRICAL SPECIFICATIONS

- Frequency range: 1 – 20 MHz
- Input signal level: 3 dBm – 17 dBm
- Input impedance: 50Ω
- Input connectors: SMA
- Pentium 233 computer card
  - 64 MB flash
  - 4 MB RAM
  - SVGA adapter
  - PS/2 mouse port
  - PS/2 keyboard connector
  - 2 serial ports (RS-232)
  - 1 Ethernet port
- Power requirements
  - Input voltage: 100 to 240 VAC ±10%
  - Input frequency: 50/60 Hz
- Power consumption: 160 W maximum
- Connector type: IEC plug

PHYSICAL SPECIFICATIONS

- Weight: 40 kg (88 lbs.)
- Dimensions: 43.2 cm x 17.8 cm x 60.9 cm (17 inches x 7 inches x 24 inches)

ORDERING INFORMATION (single frequency)	**Part No.**
4 Channel Measurement System	TSC 12030-110
8 Channel Measurement System	TSC 12030-120
12 Channel Measurement System	TSC 12030-130
16 Channel Measurement System	TSC 12030-140
20 Channel Measurement System	TSC 12030-151
24 Channel Measurement System	TSC 12030-161
Measurement Database	TSC 4077-01

Contact factory for dual frequency configurations.

Commercial Time-Scale System

Fully Integrated, World-Class Turn-Key Timing System

STANDARD FEATURES

- Include Up To 7 High Performance Cs Clocks
- GPS Common View Time Comparison
- BIPM Reporting
- Frequency Accuracy +/- 1E-14 (Long Term)
- Time Accuracy to 5ns RMS to UTC (USNO)
- NTP
- Battery Back-Up
- Local GUI

OPTIONAL FEATURES

- Active H-Maser
- Multi-Channel Measurement System
- Hot Swap Distribution Chassis
- Multiple Outputs
- TWTT
- Data Storage

As the international standard time scale, Universal Coordinated Time (UTC) is the composite of clocks throughout the world. The time of each clock is reported to the International Bureau of Weights and Measures (BIPM) using either GPS common view (CV) or Two-Way Satellite Time and Frequency Transfer. National laboratories also compute a local time scale steered to agree with UTC designated as UTC(local). Local UTC time-scale systems have state-of-the-art frequency stability, phase noise performance, and system availability. To be incorporated in UTC, their internal clocks cannot themselves be steered by UTC and the CV data must be calculated and reported to the BIPM in accordance with its published method and format.

The Symmetricom Time-Scale System meets these requirements using Symmetricom manufactured commercial timing products. Compared to other solutions, Symmetricom offers faster deployment, lower ownership costs, higher product quality, spare parts that are easier and less expensive to get, and a single point of responsibility for all system support.

The Symmetricom solution unites these advantages with the world's most widely adopted frequency standards for UTC generation. (The Symmetricom 5071A, alone accounts for 76% of all UTC clocks and contributes 87% of UTC time.) The Symmetricom –Time-Scale System can combine up to seven high-performance frequency standards in a time scale that drives the local real-time clock (RTC) signal. A timing quality GPS receiver provides the information used to steer the system output to UTC and generates GPS common-view data. This allows the frequency standards to be reported to the BIPM for inclusion in the international time scale. As a fully integrated solution, the system provides industry-leading frequency stability, phase-noise performance, and time-scale availability in a unit as small as one instrument rack.
In short, it's now possible to purchase a fully integrated, world-class timing solution comparable to the best national laboratories with commercial hardware and software support included. A unique set of design features enables the state-of-the-art functionality, performance, and reliability needed to establish a national timing reference or a global or regional navigation satellite system.

FIG 1 Turn Key Timing System

CONFIGURATION OPTIONS

One advantage of a modular solution is the ability to cost-effectively plug and play components to tailor the solution to a specific need. Symmetricom offers a variety of frequency standards and other configuration options. A minimum system consists of:

- Equipment rack
- 5071A cesium standard
- Monitor
- Keyboard
- Battery backup unit (BBU)
- Modular chassis with controller, synthesizer, RF distribution amplifier, and GPS receiver,

This minimum system provides a time scale steered to UTC, real time frequency and time references, NTP, and GPS common view data that may be used to contribute clock data to the BIPM for the UTC calculation. Additional clocks, the clock measurement system, supplemental power backup, the database, additional signal generation, and additional signal distribution may be added later. Table 1 shows the equipment provided in the standard configuration and available equipment upgrades.

Some of the options available within the framework of the standard Timescale System are:

- Adding a two-way time transfer modem
- Adding or deleting output signal types and distribution
- Adding or deleting cesium standards
- Adding one or more active hydrogen masers

The choice of frequency standards depends on the applications for the system's frequency and time outputs. All Symmetricom atomic clocks interface to the Timescale System and provide status and fault monitoring information.

Standard Configuration (Single Cesium Clock Steered to UTC) Produces a real time clock steered to UTC via GPS. The RTC has 5 outputs at 5 MHz and a single 1 PPS output.
5071A High Performance Cesium Standard
Real Time Clock Subsystem
Switch & Distribution Subsystem
Battery Backup Subsystem
UTC Recovery, Clock Steering and Common View Monitor & Control Software
Rack, monitor, keyboard and cables
Upgrade to include 8-Clock Measurement System:
8 Channel Multi Clock Measurement System
Database
Multiple Clock Upgrade
5071A High Performance Cesium Standard (S)
MHM2010 Active Hydrogen Maser (S)
1MHz, 10 MHz, and IRIG-B Upgrade
Additional RF and timecode outputs

Table 1 Symmetricom Timescale System Configurations

SYSTEM SPECIFICATIONS FOR STANDARD SYMMETRICOM TIME-SCALE SYSTEM

NUMBER OF CLOCKS: 3 or more high-performance 5071A cesium clocks

SYSTEM TIME AND FREQUENCY:
Time scale computed as the average of the clocks

Switching: automatic switching between clocks with no time or frequency discontinuities and long-term time or frequency errors

OUTPUTS

5 MHz (Steered system output)
Level: 13 ± 1 dBm, 50 W
Spurious: < -80 dBc
Harmonics: < -40 dBc
Phase noise:

Offset frequency (Hz)	dBc/Hz
1	-106
10	-136
100	-151
1 k	-156
10 k	-160
100 k	-160

SHORT-TERM STABILITY:

τ (s)	$\sigma y(t)$
1	$5x10^{-12}$
10	$3.5x10^{-12}$
100	$8.5x10^{-13}$
1 k	$2.7x10^{-13}$
10 k	$8.5x10^{-14}$
100 k	$2.7x10^{-14}$
500 k	$1x10^{-14}$

FREQUENCY ACCURACY: $\pm1x10^{-14}$ for 10 day averages after 10 days of continuous operation

FREQUENCY HOLDOVER: ±1x10-13 for 30 days over the full temperature range

1 PPS
Time accuracy: 5 ns RMS relative to UTC(USNO) at time of shipment
Time stability (wander): 3 ns RMS relative to UTC(USNO) via passive GPS
Time holdover: ± 300 ns relative to UTC over the full temperature range after 10 days of operation
Time transfer accuracy: 2 ns RMS relative to UTC via GNSS common view
Jitter: < 100 ps
Level: Logic 0 < 0.8 V, Logic 1 > 4.5 V into a 50 W load

NTP Transactions: > 200/s (without S250i)

DATA STORAGE: Sufficient to store all clock comparison measurements for 10 years

BATTERY BACKUP: 24 VDC Nominal
> 2 hrs

USER INTERFACE: All control through a local GUI using keyboard, mouse, and LCD display

STATUS MONITORING:
Outputs
System specifications
Clock parameters
Power supply voltages
Backup battery status
Faults stored in a database for analysis

TIME COMPARISON:
Passive GPS comparison with UTC via GPS (< 1 ns resolution)
-L2 codeless reception, GLONASS, and GALILEO upgrade optional

Two-way GPS comparison with UTC via BIPM Common-View and Clock Reports (< 2 ns RMS)

Time comparisons of 3 clocks and real-time steered clock < 1 ps

TIME SCALE
No discontinuity in time scale on clock additions or deletions

Clock models
- Cs clocks have white fm and random walk fm
- H masers have white pm, white fm, random walk fm, random walk frequency aging

Clock weighting to optimize short and long-term stability
- 3 weights per clock

Kalman filter time and frequency estimation
-Minimum squared error estimates
- Optimum transient response

Filter remains optimum even when measurement data are missing
- Bad data filtering
- Fast rejection based on matched filter response to known outlier types such as phase steps
- Robust outlier detection based on inconsistencies with the physical model

ENVIRONMENTAL
Power: 100, 120, 220, or 240 VAC nominal, 47-63 Hz, 1 kW maximum
24 VDC nominal

Ambient Temperature: 0 – 50 ºC

GNSS Antenna Location: Roof Mounted with clear view of sky above 10 degrees
Surveyed antenna position with accuracy < 0.5 m required (survey service optional)

SYSTEM SPECIFICATIONS FOR STANDARD TIME-SCALE SYSTEM WITH AT LEAST 1 ACTIVE HYDROGEN MASER

Adding active hydrogen masers to the Turn-key Timing System provides additional output signals with the best frequency stability commercially available. As with the 5071A units, the masers can be reported to the BIPM for inclusion in the international time scale

NUMBER OF CLOCKS:

2 or more high-performance 5071A cesium clocks

1 or more MHM-2010 active hydrogen masers

SYSTEM TIME AND FREQUENCY:

Time scale computed as the weighted average of the clocks

Switching: automatic switching between clocks with no time or frequency discontinuities and long-term time or frequency errors

OUTPUTS

5 MHz (Steered system output)

Level:	13 ± 1 dBm, 50 W
Spurious:	< -80 dBc
Harmonics:	< -40 dBc

Phase noise:

Offset frequency (Hz)	dBc/Hz
1	-106
10	-136
100	-151
1 k	-156
10 k	-160
100 k	-160

SHORT-TERM STABILITY (1 HZ MEASUREMENT BANDWIDTH):

τ (s)	σy(t)
1	$2.5x10^{-13}$
10	$5x10^{-14}$
100	$1.3x10^{-14}$
1 k	$3.2x10^{-15}$
10 k	$3x10^{-15}$
100 k	$3x10^{-15}$
500 k	$4x10^{-15}$

FREQUENCY ACCURACY:

±5x10-15 for 10 days after 10 days of continuous operation

FREQUENCY HOLDOVER:

±1x10-13 for 30 days over the full temperature range

1 PPS

Time accuracy:	5 ns RMS relative to UTC(USNO) at time of shipment
Time stability (wander):	3 ns RMS relative to UTC via passive GPS
Time holdover:	± 300 ns relative to UTC over the full temperature range after 10 days of operation
Time transfer accuracy:	2 ns RMS relative to UTC via GNSS common view
Jitter:	< 100 ps
Level:	Logic 0 < 0.8 V, Logic 1 > 4.5 V into a 50 W load

NTP

Transactions: > 200/s (without S250i Enterprise Time Servers)

DATA STORAGE: sufficient to store all clock comparison measurement for 10 years

BATTERY BACKUP: 24 VDC Nominal

> 1 hrs

Hotpack environmental chambers require facility backup power
(e.g. generator)

USER INTERFACE: All control through a local GUI using keyboard, mouse, and LCD display

STATUS MONITORING:

Outputs
System specifications
Clock parameters
Power supply voltages
Backup battery status
Faults stored in a database for analysis

TIME COMPARISON:

Passive GPS comparison with UTC via GPS (< 1 ns resolution)
- L2 codeless reception, GLONASS, and GALILEO upgrade optional

Two-way GPS comparison with UTC via BIPM Common-View and Clock Reports (< 2 ns RMS)

Time comparisons of 3 clocks and real-time steered clock < 1 ps

TIME SCALE

No discontinuity in time scale on clock additions or deletions

Clock models
- Cs clocks have white fm and random walk fm
- H masers have white pm, white fm, random walk fm, random walk frequency aging
- Clock weighting to optimize short and long-term stability
- 3 weights per clock

Kalman filter time and frequency estimation
- Minimum squared error estimates
- Optimum transient response
- Filter remains optimum even when measurement data are missing

Bad data filtering
- Fast rejection based on matched filter response to known outlier types such as phase steps
- Robust outlier detection based on inconsistencies with the physical model

ENVIRONMENTAL

Power: 100, 120, 220, or 240 VAC nominal, 47-63 Hz,
1 kW maximum
24 VDC nominal
Hotpack Environmental Chambers require 208/230 V, 3 kW each

Ambient Temperature: 0 – 50 ºC
Hotpack 0 - 30 ºC
Without Hotpack, masers located in a room with 23 ± 0.15 °C temperature control
GNSS Antenna Location: Roof mounted with clear view of sky above 10 degrees
Surveyed antenna position with accuracy < 0.5 m required (survey service optional)

TSC 4400

GPS Disciplined Rb Oscillator

KEY FEATURES

- Provides a Coherent Timing Signal Set
  - 1PPS: 4 Outputs
  - 10 MHz: 4 Outputs
  - IRIG-B: 4 Outputs
- Network Time Protocol (NTP) Server
- Capable of Steering an External Frequency Reference
- Front Panel LEDs Indicate System Status
- Status Information via Ethernet
- Operates with L1/L2 GPS Frequencies
- Includes GPS Antenna

The TSC 4400 is a time recovery system capable of generating precise timing signals traceable to UTC(USNO). It utilizes a GPS disciplined rubidium frequency reference to provide timing outputs characterized by the short-term stability of the atomic reference and the long-term stability of GPS.

The versatility of the TSC 4400 makes it suitable for a variety of applications. It is capable of steering external frequency references (e.g.: cesium) via RS232 to further improve timing performance. Its size allows for two units to be mounted side by side in a standard 19" rack providing full redundancy for those applications requiring uninterrupted timing signals.

The Ethernet connection also simplifies integration with complex systems by allowing health and status information to be monitored remotely.

The TSC 4400 can be configured to custom requirements.

Please contact Symmetricom with any specific requirements.

TSC 4400 GPS Disciplined Rb Oscillator

TSC 4400 SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

- 10 MHz Output

Connector:	SMA female
Level:	1 ± 0.1 V RMS
Impedance:	50 ± 5Ω
SSB Phase noise (Rb)	
1 Hz	-95 dBc/Hz
10 Hz	-130 dBc/Hz
100 Hz	-140 dBc/Hz
1 kHz	-150 dBc/Hz
10 kHz	-155 dBc/Hz
100 kHz	-155 dBc/Hz

- 1PPS Output

Connector:	SMA female
Level:	3.0 V
Impedance:	50 ± 5Ω
UTC offset accuracy:	15 ns RMS
Holdover accuracy:	50 ns @ 6 hours
	100 ns @ 12 hours
	300 ns @ 24 hours

- IRIG-B Output

Connector:	SMA female
Time code:	IRIG-B 123
Impedance:	50 ± 5Ω
Accuracy:	<5 μs

ENVIRONMENTAL & PHYSICAL SPECIFICATIONS

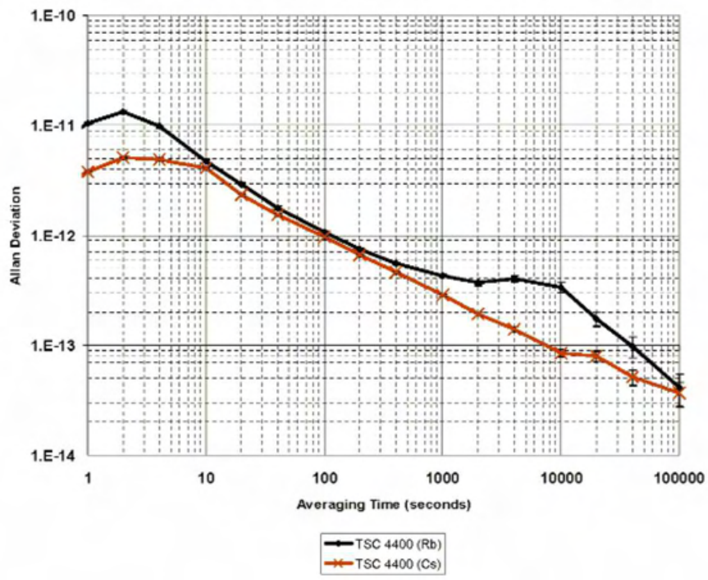
• Temperature:	0°C to 50°C
• Humidity:	0 to 95% non-condensing
• AC Input:	90 – 264 V AC, 85 W, 47 – 63 Hz
• Dimensions:	3.5" (8.89 cm) H x 9.5" (24.13 cm)W x 22" (55.88 cm) D
• Weight:	12 lb (5.5 kg)
• Color:	Parchment White

CONFIGURATION OPTIONS

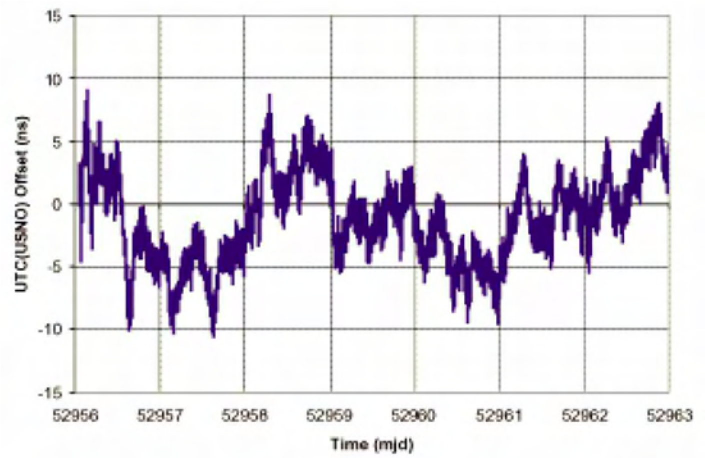
- Dual frequency receiver
  - 4400 Standard product
  - 4400-01 With rack Mount chassis
  - 4400-02 Fully redundant, includes rack mount
- Single frequency receiver
  - 4400-03 Single frequency L1 receiver
  - 4400-04 With rack mount chassis
  - 4400-05 Fully redundant, includes rack mount

ACCESSORIES

- OP001 30 m GPS antenna cable
- OP002 60 m GPS antenna cable
- OP003 Lightning arrestor



Typical Performance (10 MHz)



Typical Performance (1PPS)

Rear View

TSC UTCG

Multiplexes Frequencies, Time Codes, and Pulses on One Optical Fiber

KEY BENEFITS

- Transmits a Digital Signal Containing Both Time and Frequency Information
- Auto-detects the 5-,10-, or 100-MHz Input Reference
- Simple User Interface Enables Easy Configuration and Monitoring
- Redundant Power Supplies Can Be Hotswapped to Maintain Continuous Operation
- Holdover Capability in Case of Loss of Input Reference
- A Single UTCG Supports at Least 400 Remote Users

The Universal Time & Frequency System (UTFS) from Symmetricom is designed to achieve precise time and frequency signal distribution and synchronization via optical fiber to local areas as well as to widely dispersed locations. At the front end of the UTFS is the Universal Time Code Generator (UTCG), a state-of-the-art multiplexer that receives multiple inputs, including a frequency reference (required), 1PPS Sync signal (optional), and IRIG-B time code (optional). In turn, the UTCG simultaneously outputs all timing, RF, and time code on a single fiber to one or more Time Code Translators (TCTs) at remote locations.

HIGH-QUALITY SIGNALS

Because fiberoptic cable carries the time code to the TCT, the signal is of extremely high quality. There are no ground loops, crosstalk, or attenuation. No matter how many or what type of timing signals are needed at a remote location, only a single fiber pair is ever required. One fiber carries all timing signals to the TCT and the other optional fiber returns status information to the UTCG.

An optional Ethernet connection enables remote monitoring of system status and configuration. Electrical and visual alarm outputs are also available to allow continuous status monitoring.

In addition, the UTCG has the ability to compare its internal time to an external 1PPS signal. When this feature is enabled and the two signals are offset by more than 20 ns, the system automatically triggers an alarm. The UTCG is housed in a 4U 19-inch rack-mount modular chassis. The system includes dual redundant power supplies that can be hot-swapped to keep the system running if one fails.

TSC UTCG Universal Time Code Generator

OPERATION

The UTCG synchronizes its internal time to an external reference. The internal 100-MHz time base phase locks to a 5-, 10-, or 100-MHz reference input connected to the unit. If a 1PPS is also connected, it is used to define the start of second. IRIG-B time code can be utilized to set the internal epoch. Alternatively, the user can set the time from the front-panel interface.

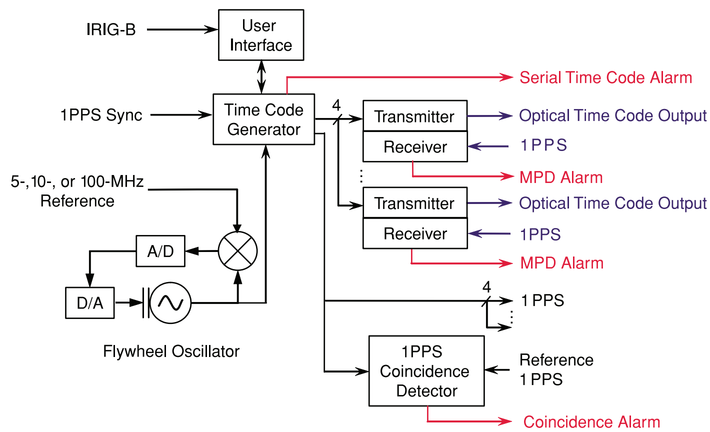
After initialization, the UTCG starts to produce a100-Mb/s serial time code. The unique feature of the UTCG is that the serial time code carries the start of second, the identification of the second, and the reference frequency, all in a single signal. This information is decoded at the receiver and used to produce the output signals. Once the fiberoptic output is enabled, the serial time code is modulated onto either a single-mode laser or a light emitting diode and transmitted via the appropriate optical fiber to the receiver.

The UTCG front panel allows the user to monitor and control operation of the unit. The time can be slewed relative to the initial time in increments of 10 ns. In addition, leap seconds can be programmed to occur according to their schedule. Front panel LEDs and optically isolated contact closures annunciate alarms for failure of a downstream device, loss of phase lock, clock slip relative to an external 1PPS, approaching the end of the VCXO control range, and power supply failure. An Ethernet port for control and monitoring is an optional feature. All modules, including the redundant power supplies, are hot-swappable.

TSC UTCG SPECIFICATIONS

GENERAL SPECIFICATIONS

- Frequency Reference Input (required)
  - Frequency: 5, 10, or 100 MHz
  - Holdover: Maximum shift 3.5 x 10-9 on loss of input signal
  - Long term drift: ±3.7 x 10-7 over 24 hours
  - Impedance: 50 ±5W
- Time code input: IRIG-B 123
- Synchronization input: 1PPS TTL
- Fiberoptic output (to TCT Module)
  - Quantity: Four
  - Output connector: LC
  - Optical fiber
    - Multi-mode: up to 2km
    - Single-mode: up to 30km
- Temperature range: 0-50 C (operating)
- Humidity: 0-90% non-condensing (operating)
- Settability: 5ns
- Input power (Redundant power supply standard)
  - Voltage range: 90-240 V~
  - Frequency: 45-65 Hz
  - Current (max): 0.20 A (90 V)
- Alarm output
  - Quantity: Two
  - Connector: SMA female
  - Type: Opto-isolated switch
- Physical
  - Size: 19-inch EIA rack-mount chassis, 4U high x 9" (22.9 cm) deep
  - Weight: <30 lb
- Control and status port (optional)
  - Physical layer: 10/100 Ethernet
  - Protocol: TCP/IP
  - Connector: RJ-45



TSC UTCG Block Diagram

TSC FEC

Expansion for Fiberoptic Time and Frequency Signals

KEY BENEFITS

- Cost-effective Upgrade Path
- Ability to Expand System Outputs as Needed (Add Outputs One At a Time)
- Capacity At the High End is Extensive
- Dual Redundant Power Supplies Can Be Hot-swapped to Maintain Continuous Operation

The Universal Time & Frequency System (UTFS) distributes precise time and frequency signals via optical fiber to local and remote locations. At the front end of the UTFS is the Universal Time Code Generator (UTCG), a state-of-the-art multiplexer that links to frequency, 1PPS and IRIG-B references. In turn, the UTCG simultaneously outputs all timing signals—RF signals, serial time codes and pulsed outputs—on a single fiber to as many as four Time Code Translators (TCTs) at remote locations.

The Fiberoptic Expansion Chassis (FEC) provides a means to expand beyond the four fiberoptic outputs from the UTCG. Customers starting out with a minimal configuration system can readily add functionality—in the form of additional Time Code Translators with accompanying output modules—as organizational needs and budgets increase.

EXPANSIVE CAPABILITY

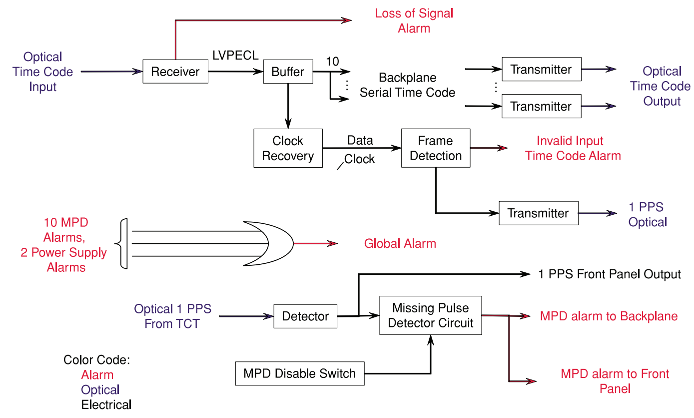
For example, a Fiberoptic Expansion Chassis with one input module and 10 output modules can multiply one UTCG output to 10. In this scenario, the customer can add 40 fiberoptic outputs to the system by adding four expansion chassis. By adding one more expansion chassis level, the number of fiberoptic outputs and potential TCTs in the system can increase to at least 400. And upgrading is as easy as adding hardware. No configuration is necessary. The Fiberoptic Expansion Chassis and power supplies are identical to the UTCG, greatly simplifying logistics.

TSC FEC Fiberoptic Expansion Chassis

OPERATION

The Fiberoptic Expansion Chassis receives a single optical input and transmits from 2 to 10 identical optical outputs. The input module performs an optical-to-electrical conversion and puts the electrical serial time code on the chassis backplane. Each output module performs an electrical-to-optical conversion and forwards the time code without modification. All modules, including the redundant power supplies, are hot swappable.

The input module also decodes the input signal and validates the serial time code. The output module receives the optical 1PPS, which is optionally returned from each TCT, and produces an alarm when the 1PPS is missing. Missing 1PPS alarms are provided with enable/disable switches. These alarms, along with power supply alarms, are aggregated with the CRC and loss-of-signal alarms by the input module, and then transmitted via suppressed optical 1PPS to the upstream device, such as the UTCG.



FEC Block Diagram

TSC FEC SPECIFICATIONS

GENERAL SPECIFICATIONS

- Input module
  - Fiberoptic input and output
    - Connectors: LC
  - Optical fiber
    - Multi-mode: up to 2 km
    - Single-mode: up to 30 km
  - Alarm output on SMA connector for monitoring chassis alarm
  - LEDs
    - Loss of signal
    - CRC
    - Chassis
- Output module
  - Quantity: 2-10 per chassis
  - Connectors
    - Fiberoptic: LC
    - 1PPS monitor: SMA
  - Optical fiber
    - Multi-mode: up to 2 km
    - Single-mode: up to 30 km

PHYSICAL & ENVIRONMENTAL SPECIFICATIONS

- Temperature range: 0°C – 50°C (operating)
- Humidity: 0 – 90% Non-condensing (operating)
- Input power
  - Voltage range: 90-240 V~
  - Frequency: 45-65 Hz
  - Current (max): 0.20 A (90 V)
- Size: 19-inch EIA rack-mount chassis, 4U high x 9" (22.9 cm) deep
- Weight: 31.5 lbs with all modules installed

TSC TCT

Configurable Time and Frequency Outputs

KEY BENEFITS

- Fully Automatic Operation
- Advances the Time to Remove Synchronization Delay
- Can Produce Any Output Signal Needed:
  - Dual RS-232 Time Code
  - PB-1 Time Code
  - Parallel BCD Time Code
  - 5- or 10-MHz Signal
  - IRIG-B and NASA 36-bit Serial Time Code
  - Configurable Pulse Rate (1PPS -1MPPS)
- Additional Output Types Available on Request

The Time Code Translator (TCT), housed in a 1U 19-inch rack-mount chassis, receives all of the timing signals from the UTCG via fiberoptic cable and constructs and synchronizes the resulting output signals. The customer can configure every TCT with up to four different time and frequency outputs by selecting plugin modules.

Additional TCTs can be added to the system to expand signals as well as to provide redundancy. Another important TCT feature is the incorporation of "advance" capability, which compensates for fiberoptic path delays from the UTCG. The TCT includes a front-panel time display and panel alarm indicator for ease of monitoring.

If a fault interrupts the timing signal from the UTCG, then an internal holdover oscillator continues to maintain all output signals. When the signal returns, the TCT automatically resynchronizes itself to match the timing signal from the UTCG.

OPERATION

The TCT phase locks to the optical signal from the UTCG, reads the serial time code, and generates all of the electrical output signals. The frequency of the input reference is recovered by phase locking a VCXO to the received signal. The recovered clock is then used to determine the start of frame, which is the position of the 1PPS, and to decode the data, which contains the epoch of each second. If the input signal is lost, the TCT will go into flywheel mode, continuing to provide signals at the output module. An advance can be set so that the TCT removes the delay introduced by the optical fiber.

The recovered 100 MHz,1PPS, and time code are transmitted to each of the four output module slots. Each plug-in module synthesizes an output signal. Pulse rates are created by dividing and synchronizing with the 1PPS, frequencies are created by direct digital synthesis, and time codes are calculated from the internal time base. The modular architecture makes it easy for Symmetricom to add new signal types as users request them.

The TCT displays the time and its internal status on the front panel. The status includes loss of signal, time-code CRC error, internal error, resynchronization of the internal time base, PLL out of lock, VCXO control voltage near end of range, leap year, and leap second occurring today. In addition, the TCT produces an optical 1PPS, which may optionally be monitored by the upstream equipment. This 1 PPS is suppressed when there is a TCT failure, and transmits the failure event to the upstream equipment. The returned 1PPS may also be used to monitor the performance of the TCT. Transmission of detailed status information, in addition to the return PPS, is an optional feature.

TSC TCT Time Code Translator

TSC TCT SPECIFICATIONS

GENERAL SPECIFICATIONS

- Fiberoptic Input (from UTG or FEC)
  - Input connector: LC
  - Optical fiber: Multi-mode up to 2 km; Single-mode up to 30 km
- Display:
  - Year (two-digit), day, hour, minute, second
  - Leap second +
  - Leap second –
  - Leap year
  - Internal fault
  - Loss of input signal
  - VCXO unlock
  - Rate re-sync
  - Serial time code CRC error
  - Electronic frequency control out of range
- Holdover
  - Maximum shift: 3.5 x 10-9 on loss of input signal
  - Long term drift: ±3.7 x 10-7 over 24 hours
  - Thermal stability: ±10 ppm/C

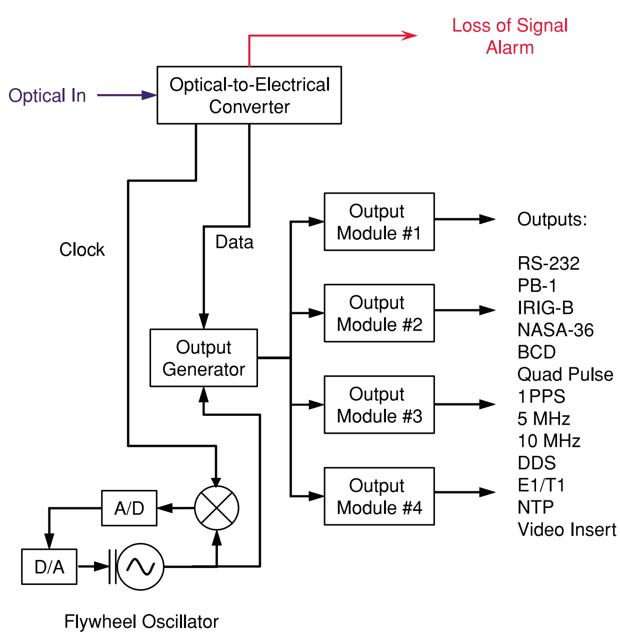
PHYSICAL & ENVIRONMENTAL SPECIFICATIONS

- Size: 19-inch EIA rack chassis, 1U high x 16.75" (42.5 cm) deep
- Weight: 12 lb (5.5 kg)
- Temperature range: 0°C – 50°C (operating)
- Humidity: 0 – 90% non-condensing (operating)
- Altitude: 3,048 m maximum (10,000 feet)
- Input power
  - Voltage range: 90 – 240 V~
  - Frequency: 45 – 65 Hz
  - Current (max): 0.20 A (90 V~)

OUTPUT MODULES

- Configurable pulse rate (1,10,100 and 1 kPPS, or quad 1PPS – 1M PPS)
  - Height: 1TCT module slot; Four outputs per module
  - Connector: 50Ω TNC female
  - Skew: <±2 ns
  - Jitter: <200 ps
- RF (1, 5, or 10 MHz)
  - Height: 1TCT module slot; Four outputs per module
  - Impedance: 50Ω
  - Connector: TNC female
  - Output level: 1 V RMS (13 ±1dBm)
  - Output Isolation: >100 dB
  - Harmonic distortion: <-40 dBc
  - Phase noise:
    - 1Hz: -115 dBc
    - 10 Hz: -125 dBc
    - 100 Hz: -125 dBc
    - 1kHz: -135 dBc
    - 10 kHz: -140 dBc
    - 100 kHz: -150 dBc
- Parallel BCD time code
  - Height: 1 TCT module slot
  - Connector: DB-62 female
  - Output format: Parallel BCD ms load
  - TTL Compatible
  - Leap second: subtract or add
  - Transition times: All bits settle within 100 ns
- Dual time code (IRIG-B and NASA 36)
  - Height: 1TCT module slot
  - Connectors: 4 TNC female, 2 each code type
  - Modulated code outputs
    - Frequency: 1 kHz
    - Level: Fixed, 5 ±0.5 Vpp into 50Ω
    - Modulation ratio: Fixed 3.3:1
    - Impedance: 50Ω
    - TTL Compatible
- Parallel PB-1 code
  - Height: 1TCT module slot
  - Connector: DB-62 female
  - Format: Parallel Binary PB-1 (IRIG STD 205-87); 27-bit binary ms of the day; 9-bit binary day; parity bits P1 and P2; and read enable pulse
  - TTL Compatible
  - Transition times: All bits settle within 100 ns (one hundred nanoseconds)
- Dual RS-232 time code
  - Height: 1TCT module slot
  - Connectors: Two DB-9 female
  - Time output: Once per second
  - Time encoded: Binary-coded decimal
  - Character format: Start bit, 7 data bits, odd parity bit, Stop bit
  - Baud rates: 9,600 and 19,200 baud (selectable)
  - Four-digit year: Jumper-configurable option

Rear View



TSC TCT Block Diagram

4340A

Fiberoptic Distribution Amplifier

KEY FEATURES

- Cost-Effective Upgrade Path
- Ability to Expand System Outputs as Needed (Add Outputs One at a Time)
- Capacity at the High End is Extensive
- Dual Redundant Power Supplies Can Be Hot-Swapped to Maintain Continuous Operation
- 1U Rack Mount Chassis
- SFP Transceiver Sockets Enable Easy Reconfiguration

The Universal Time & Frequency System (UTFS) distributes precise time and frequency signals via optical fiber to local and remote locations. At the front end of the UTFS is the Universal Time Code Generator (UTCG), a state-of-the-art multiplexer that links to
frequency, 1PPS and IRIG-B references. In turn, the UTCG simultaneously outputs all timing signals—RF signals, serial time codes and pulsed outputs—on a single fiber to as many as four Time Code Translators (TCTs) at remote locations.

The Fiberoptic Distribution Amplifier provides a means to expand beyond the four fiberoptic outputs from the UTCG. Customers starting out with a minimal configuration system
can readily add functionality—in the form of additional Time Code Translators with accompanying output modules—as organizational needs and budgets increase.

EXPANSIVE CAPABILITY

For example, a Fiberoptic Distribution Amplifier with one input transceiver and 8 output transceivers can multiply one UTCG output to 8. In this scenario, the customer can add 32 fiberoptic outputs to the system by adding four expansion chassis. By adding one more distribution level, the number of fiberoptic outputs and potential TCTs in the system can increase to at least 256. And upgrading is as easy as adding hardware. No configuration is necessary. Hot swap SFP sockets for fiber optic transceivers provides easy expansion or transceiver replacement for different networks. An AC or DC hot swap redundant supply can be ordered with the unit.

TSC 4340A Fiberoptic Distribution Amplifier