Strategic Defence Timing Systems
Air & Rail Infrastructure Network Timing
Public Information Displays
Power Utilities Monitoring & Control
Oil & Gas Exploration Logging
Communications Synchronisation

ISO 9001:2008 + AS9100D Compliant
Company Overview

Time and Frequency Solutions Limited is privately owned and operated by Brandywine Communications based in Tustin, California. The TFS factory based in Essex, U.K. provides an engineering, production, design and support function for TFS and Brandywine products sold and distributed throughout Europe, Australasia and the Far East.

Brandywine Communications own and operate a state of the art surface mount & conventional PCB manufacturing and assembly factory Santa Ana near the the Tustin Sales & R&D headquarters in California. Both companies have a highly respected and long standing history in the design and development of precision time and frequency measurements products and systems.

The combined strengths of both businesses give TFS & Brandywine an unrivalled portfolio and capability in the delivery of quality and value for their customers.

Reputation
40 years experience designing and manufacturing quality time and frequency synchronisation solutions for global markets.

Quality
All product built to AS9100D standards. Approved for Aerospace, Rail, ATC, Utilities and SatCom/Telecoms

Delivery
Complete in-house PCB manufacturing and product assembly capability – high quality, flexible, fast delivery.

Support
Global network of sales, distribution, service and support

Commercial
JOSCAR, ISO:9001-2008, AS9001D accredited

Integrity
A company wide core value we share with our valued prestigious client base.

Design
State of the art product development in both the UK & USA.

Solutions
TFS is a total solutions provider – from board level products to complete Satellite Communication rack installations.

AS9100D Certificate Number : C0210021-AS3
PRODUCT APPLICATIONS - Modular Master Clocks

Modular Master Clocks are common place in core infrastructure installations where a customer/application specific combination of functionality is required. In most instances, the modularity is used to satisfy a multiplicity of interface requirements within a single unit.

TFS specialise in GPS synchronised master clocks that can be linked to a broad selection of functional modules to implement industry standard and specialist functionality centred around the core precision time source.

Our modular master clocks are offered in a range of size and performance categories to suit budgets and function, ranging from the entry level triple module M210 unit through to the high end MMC unit with hot-swappable, dual redundant power supplies and front loading modules. Simply contact our sales department for more details.

AIRPORTS & ATC

With decades in the industry, Time and Frequency Solutions understand the individual requirements of the Airport Passenger Terminal and Air Traffic Control industry, enabling us to provide exact solutions to your particular airport timing application. Our products deliver precise time, both for passenger information, but more importantly for integration into their increasingly complex IT systems.

Airport timing systems create time ‘event-tagging’ which provides chronological audit trails for such key areas as safety and security. In Air Traffic Control, many vendors provide sub-systems requiring diverse inputs and outputs such as serial, time-code or even parallel signals for time data, hence a modular approach allows these interfaces to be incorporated either at the system design phase or at a later date. **TFS products are installed and approved in many airports and ATC centres around the world.**

RAILWAYS & METRO

Accurate and reliable timing plays a vital role in establishing event time stamping to provide an accurate, historical and chronological audit trail, which is vital for both safety and the management of system information. Track to train communications can also benefit from precise time – message transmission and reception must be precisely synchronised.

Our master clocks also distribute precise time for passengers viewing; ensuring passenger information displays and platform clocks are providing accurate, synchronised time. Station IT Systems such as CCTV, or computer networks also require an accurate and reliable time source. Time also plays an important role in pre-set announcements and even auto-control of heating and air conditioning systems. **TFS products centralise timing in many UK, European, US and Far Eastern rail and metro installations.**

POWER UTILITIES

In addition to providing precision time and frequency across multiple interfaces, application specific modules can be used to monitor the precise frequency and phase of the AC power distribution grid at various points thereby allowing the local energy generation to be adjusted for optimal load balancing.

Along with providing timing information, precise time measurement can be used as a highly effective solution for the location of network faults on long distance power lines. Using time tagging to measure the ‘reflection’ of a signal sent down a suspect line, synchronised time measurements can pinpoint faults to within a few metres. **TFS timing products serve many UK and overseas power utilities delivering both time and diagnostic functions.**
PRODUCT APPLICATIONS - Modular Master Clocks

OIL & GAS EXPLORATION

Precision time & frequency information is generally a pre-requisite for the management of oil, gas and other resource exploration and extraction installations in which traceable time stamping is required to provide an historical chronological event audit trail.

A trusted time source provides accurate, synchronised time to production and distribution networks enabling reliable time-stamping sequences to occur during operation. Dual redundancy and multiple time signal interfaces are a common requirement in ensuring installation systems can be effectively synchronised to one source.

*TFS products are installed and approved in high integrity exploration sites throughout the world.*

STRATEGIC INSTALLATIONS

TFS modular equipment is widely trusted and deployed across land, sea and airborne installations to deliver precision time and frequency information across a broad range of tactical interfaces demanding high integrity and availability.

Our modular systems are commonly used to derive specific application solutions for highly accurate and reliable time and frequency information and signalling.

*TFS products are extensively used and trusted at many strategic governmental installations around the world.*

TELECOMMUNICATIONS

Precision time and frequency signals are common place requirements for SatCom, Radar and Radio sync applications.

TFS products can be customised for ultra low-phase noise synchronisation applications, such as Up/Down satellite convertors, precision radar and frequency hoping digital radios.

Our modules provide mil-spec standard time-codes along with precision time and frequency signals with options for fibre optic and long distance signal distribution.

*TFS products are installed and trusted by military and commercial telecommunications companies worldwide.*

Why consider a TFS modular master clock system?

TFS have unrivalled experience in the design, manufacture and supply of modular master clock systems. All clocks and modules are manufactured under strict AS9100D quality standards ensuring performance, reliability and value as an investment.

Our products have undergone extensive field testing and development and as such, carry many industry sector approvals.

We carry a large range of modules as stock and have the capability to design or customise modules to specific customer requirements. If you are considering a modular clock solution, why not call our friendly sales team who will be pleased to discuss your application and explain our systems in more detail.
Modular Master Clocks - M21x Series

Oscillators: Choice of TCXO, OCXO, or Rubidium
Sync Inputs: GPS & MSF, 1PPS, IRIG-B, Have Quick
Features: Fully configurable module based master timing system
Benefits: Extendable feature set, dual redundancy options.

Common Outputs: NTP, PTP, RS422, RS232, IRIG-B, 1PPS, AFNOR, 10MHz, PoE, Have Quick, Audio, Video, Relay Outputs.

Overview:
Highly established, very flexible modular system used extensively in ATC, Rail & Metro applications as well as key military applications requiring special options. Special industry sector modules are available for specialist functions such as AC measurement, video insertion and audio outputs.

Module Options:
- GPS Receiver module
- LF Receiver modules (MSF & DCF)
- Standard sinewave frequency output: 4 off 1MHz/5MHz/10MHz
- Multiple sinewave output: 2.4KHz, 100KHz, 1MHz, 5MHz, 10MHz + 1PPS, 1KPS, 1MPS
- Octal serial module with precision time inputs module
- SMPTE/EBU Timecode module
- Audio output module
- Video insertion module
- AC measurement module
- Three port NTP Time server module

Antenna Options:
- Standard GPS & MSF Antenna
- GPS DEMODULATOR MODULE (CAT5)
- GPS HEADEND (CAT5) (Allows long distance transmission of GPS signal)

Modular Master Clocks - MMC Series

Oscillators: Choice of TCXO, OCXO, or Rubidium
Sync Inputs: GPS, 1PPS, IRIG-B and IEEE-1588 PTP
Features: Hot swappable front loading modules, Touch screen
Benefits: Extendable feature set, dual redundancy options.

Overview:
The Modular Master Clock System is the next generation of modular timing systems offering state of the art performance, flexibility and capability. At the centre of the system are powerful dual-redundant Master Clock Modules, which are capable of receiving time from a GPS signal, either from a SAASM or standard CA code receiver, or can be synchronized from a standard time code input such as IRIG-B or HaveQuick with 1PPS. The output signals for the Modular Master Clock System are generated by up to 12 hot-swappable Output Signal Modules (OSM), and are ideal for custom solutions or future expansion.

Available modules include NTP, low-phase-noise frequency, IEEE-1588 PTP, time code modules such as IRIG A, B, G, H, and NASA 36, BCD, PPS, PPM, Have Quick as well as optical crosslink.
PRODUCT APPLICATIONS - Network Time Servers

Accurate and reliable time information is an essential part of modern network applications. Our range of Stratum 1 & 2 network time servers use NTP (Network Time Protocol) and PTP (Precise Time Protocol IEEE-1588) for network time synchronisation, delivering quality, reliability and accuracy.

Precise time is generally derived from a GPS source and then used to discipline an internal oscillator that will maintain time should the GPS signal drop out. On many models, provision is made for alternative time source signals that can be used to derive precise time.

Our broad range of Network Time servers are tailored to suit a wide range of budgetary, technical and performance requirements. All are built to AS9100D quality standards with many kept on the shelf.

NTP - Network Time Servers

PCle-5905

The PCIe-5905 Universal Timing Card provides an ultra-flexible means of providing precise time and frequency synchronization to a host computer, or a variety of external equipment, and is capable of operating as a stratum 0 NTP server over the PCIe bus.

The PCIe-5905 is unmatched in the industry for its flexibility and features, while maintaining a compact ½ height PCIe form factor.

NTP-80Plus

The NTP80 provides highly accurate yet economic time distribution over local area networks (LAN) using Network Time Protocol (NTP), the industry-standard means of time distribution over networks.

The NTP80 provides a cost-effective way of providing time from a trusted source, which is critical in many organizations such as airports, railways, financial institutions, telecommunications companies, etc.

Any business using devices on a network can benefit from using the NTP 80 - not only can it use a selection of highly accurate, trusted time sources, it is easily integrated into internal systems thus eliminating network security issues that arise from using external time source such as the internet.

Features
- Economic triple-port stratum 1 Network Time Server
- Can act as both host and server in peer-to-peer mode
- Capable of synchronising up to 3 discrete networks independently
- Client system accuracy to within 50 µs*
- Precision timing circuits ensure stability in event of synchronisation signal interruption.
- Configuration and alarm reporting capabilities using Simple Network Management Protocol (SNMP)
- 1pps output
- Supports up to 1500 clients

Input Options
- Satellite GPS via High Gain Active Antenna or Long Distance Remote Antenna System
- Analog timecode, e.g. IRIG-B, AFNOR NFS-87500
- NTP (Peer-to-Peer)
- LF (MSF, DCF-77, etc)
PRODUCT APPLICATIONS - Network Time Servers

NTP - Network Time Servers

ENTA II - Dual port network server

ENTA II - A Complete Network Time Server and Master Clock with GPS synchronization fully compliant with NENA requirements.

The Enhanced Network Time Appliance is a full function Master Clock and is designed to provide a full suite of precision time outputs including IRIG B, IRIG E, IEEE-1344, and Have Quick time codes. All outputs include signal level monitors to enable rapid fault detection and isolation. This product also features a dual 10/100BaseT Network interface with Network Time Protocol (NTP). This built in web-server provides a user friendly control system for configuring the unit. The ENTA is available in both single string and optional dual redundant versions.

The ENTA includes both a built in GPS receiver and an IRIG B decoder, accommodating multiple time reference inputs. Another standard feature is a built in oven controlled crystal oscillator that provides continuous timekeeping accuracy in the event that GPS or IRIG signal inputs are lost.

The ENTA is becoming a critical product for the air traffic control markets and ship board timing systems for the military. This master clock is a great solution for anyone that requires good time signal characteristics with solid stability and dual NTP server ports.

NTV-100RG NTP Server

Brandywine Communications NTV-100RG is an affordable, convenient and flexible NTP Server. This network time server accurately time synchronizes computers, time displays, PBX’s, and a wide variety of other equipment. The NTV-100RG is a small, rack mounted NTP Server that can synchronize to GPS or to the IRIG B time code to provide NTP time.

With eight built-in channels in a compact 1U chassis, the NTV-100RG can also accept NTP and output serial time messages for synchronizing external devices such as time displays.

Features
- Compact size and low cost
- Uses Network Time Protocol to synchronize computers and other devices
- Programmable serial message compatible with almost any time display
- Browser based user interface for easy setup
- GPS synchronized
- LED colons indicate GPS lock status

Modular Master Clocks - NTP Servers

M210/M211 Series - A triple port, fully isolated NTP server module is available for M210/M211 units with secure web based user interface. Supports up to 1024 clients.

MMC Series - The MMC NTP Server Module enables the Modular Master Clock to act as an NTP server over an Ethernet network.

Designed with security in mind, the NTP server module uses a custom network stack that enables it to function as a dedicated NTP server, without introducing network vulnerabilities. Multiple NTP Ports can be added by network segregation. The MMC NTP Module supports NTPv4 and IPv6 with full authentication and privacy, including HDB5, and SHA-1.
PRODUCT APPLICATIONS - Network Time Servers

NTP - Network Time Servers

IDC-100 Network Time Device

The IDC-100 Network Time Device is commercial unit that provides a convenient and flexible means of accurately time synchronizing computers, time displays, PBXs, and a wide variety of other equipment using IRIG B as a reference such as airports and railways stations where GPS is not available.

The IDC-100 is a small, rack mounted Network Time Server that uses modulated IRIG B as an input reference to accurately synchronize its internal clock. The IDC then provides accurate time to clients on the network using the industry standard Network Time Protocol (NTP).

Management of the IDC internals is by means of a built-in web browser interface or RS-232. This password protected web page allows the user to set up the text string required for the equipment to be synchronized. Time zone offsets and daylight savings setup are also accessed through the same web page.

NTP Server comparison matrix

<table>
<thead>
<tr>
<th>Model</th>
<th>Display</th>
<th>Setup</th>
<th>SNMP</th>
<th>Input Reference</th>
<th>IRIG out</th>
<th>No. of ports</th>
<th>Osc. Options</th>
<th>Special</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDC-100</td>
<td>100 BaseT</td>
<td>1U</td>
<td>Yes</td>
<td>RS232 Console</td>
<td>Yes</td>
<td>V.1</td>
<td>IRIG B</td>
<td>No</td>
</tr>
<tr>
<td>NTV100RG NTV100DC</td>
<td>100 BASE-T</td>
<td>1U</td>
<td>Desk Mount</td>
<td>Browser</td>
<td>Yes</td>
<td>V.1</td>
<td>GPS &amp; IRIG B</td>
<td>No</td>
</tr>
<tr>
<td>ENTA II</td>
<td>100 BASE-T</td>
<td>1U</td>
<td>Yes</td>
<td>Browser</td>
<td>Yes</td>
<td>V.1</td>
<td>IRIG B</td>
<td>Yes</td>
</tr>
<tr>
<td>M210 M211</td>
<td>10 or 100 BASE-T</td>
<td>1U</td>
<td>Modular</td>
<td>Keypad</td>
<td>Terminal</td>
<td>Yes</td>
<td>IRIG B</td>
<td>Up to 2</td>
</tr>
<tr>
<td>NTP80</td>
<td>10 or 100 BASE-T</td>
<td>1U</td>
<td>Yes</td>
<td>Browser</td>
<td>SNMP</td>
<td>Keypad</td>
<td>IRIG B</td>
<td>Opt</td>
</tr>
</tbody>
</table>

CMS - Clock Management Systems

The CMS Clock Management System is a sophisticated Linux-based application that allows the user to monitor and control TFS products from a remote or central location via an Ethernet network.

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- Centralised or remote monitoring and control of TFS Timing System and constituent parts such as Submaster Clocks and time displays.
- User-friendly graphical interface, accessible by web browser, allows monitoring in overview or detail mode.
- Multiple access via web browser interface allows many users to simultaneously access the CMS.
- Web browser interface allows user access CMS from any location with Ethernet connectivity to CMS.
- Visual representation of equipment controls.
- Monitoring Status e.g. Equipment identity, Equipment configuration, Alarms, Software and Hardware Faults, Errors, and many other details.
- Fault log reporting on errors occurring in the Timing System.
- Delivered on a pre-configured PC.
- SMS text alerts when alarms are triggered.
PRODUCT APPLICATIONS - Network Time Servers

PTP - Network Time Servers

Precision Time Protocol (PTP), described in the IEEE 1588-2008 version 2 standard, allows for extremely precise synchronization of networks. An absolute timing accuracy of better than 100 nanoseconds to UTC can be achieved using this protocol as it uses hardware-generated timestamps. This provides significant improvements on the accuracy of network-distributed time over legacy Network Time Protocol (NTP) servers.

PCIE-1588

The PCIe-1588 Universal Timing Card provides an ultra-flexible means of providing precise time synchronization to a host computer, or a variety of external equipment. The PCIe-1588 is unmatched in the industry for its flexibility and features, while maintaining a compact PCIe form factor.

The key function of the PCIe-1588 is to provide precision time with zero latency to the host computer through a PCI Express X1,X2,X4,X8,X16 or X32 slot. An on-board microprocessor automatically synchronizes the clock to reference signal inputs.

The reference signal inputs can be from the on-board GPS receiver, from a remote Precise Time Protocol (PTP) Grand Master, or from a serial time code. Both IRIG B and HaveQuick formats are supported. The clock can free run and be set by commands from the host over the PCI Express bus. When the GPS receiver is used, the PCIe-1588 can be configured to operate as a PTP Grand Master, supporting up to 32 clients. In this mode, the PTP slave function is used as a backup reference, and PTP biases due to network asymmetry are eliminated by calibration against GPS.

The PCIe-1588 will also synchronize to 1PPS, IRIG B, or Have Quick time code inputs and accepts user input reference input signal delay information.

PTP-8 Slave Network Time Client

The PTP Slave provides a high performance synchronization clock solution (SETS) for use in SDH/SONET back haul applications or as a replacement system, allowing for synchronization over packet switched networks (PSN). The PTP Slave Network Time Client also provides time distribution using PSN, IRIG B and RS232. This is done using Precision Time Protocol (PTP) over an Ethernet network.

Key Features

- Delivers highly economic end-to-end frequency synchronization
- Frequency accuracy better than 10ppb possible using Giga bit switches
- Precision timing circuits ensure stability in event of synchronization signal interruption
- Client system time accuracy better than 1 microsecond using Giga bit switches
- Configuration and alarm reporting capabilities using Simple Network Management Protocol (SNMP)
- Time of Day (TOD) is provided for support of legacy equipment using IRIG B and RS232

System Benefits

- Powerful network delay analysis delivers full time alignment over hostile networks (including Layer 2 and Layer 3 routing)
- Configured or automatic best master clock selection
- No need for antennas (GPS)
- E1 ITU G.703 synchronization clock signal is configurable via user menus
- Unicast operation ideal for use in Telecoms environment

Precision Time Protocol (PTP), described in the IEEE 1588-2008 version 2 standard, allows for extremely precise synchronization of networks. An absolute timing accuracy of better than 100 nanoseconds to UTC can be achieved using this protocol as it uses hardware-generated timestamps. This provides significant improvements on the accuracy of network-distributed time over legacy Network Time Protocol (NTP) servers.
PRODUCT APPLICATIONS - Network Time Servers

PTP - Network Time Servers

PTP-80 Elite Grandmaster Clock

The PTP80 uses an internal oscillator (OCXO as standard, factory upgradeable to Rubidium) disciplined by an integral GPS receiver as a highly stable time base. The use of precision oscillator options provides improved stability in holdover mode if the input source is interrupted for any reason.

The front panel has a large alphanumeric LCD, status indicator and 5-segment button for easy status and minimal configuration. The main configuration and monitoring is through a secondary network port providing web access. A range of additional output options are available, including serial, pulse, timecode and frequency.

Key Features
- Uses Precision Time Protocol (PTP) to IEEE-1588 v2
- Distributes time to remote PTP clients and slaves over a network
- Advanced hardware-generated timestamps
- GPS input source
- Provides ±100 nanosecond timing accuracy (when locked to GPS)
- Internal disciplined oscillator provides stability if input source interrupted
- Choice of outputs include 1PPS & 10MHz (IRIG-B & E1/T1 optional)
- 19 inch 1U high rack mountable chassis

PTP-8080 Grandmaster Clock

The PTP-8080 is a GPS Network Time Server (NTS) for NTP or PTP IEEE 1588 that provides secure, accurate and reliable time synchronization for networks and offers integrated fully managed switch capabilities for 8 (10/100/1000BASE) Gigabit Ethernet ports. The PTP-8080 can be used for data centers, test facilities, military installations, federal or municipal agencies, financial services and technology firms, and many other enterprises which need precision timing to support their network operations. The unit provides exact time over Ethernet either based on the well-established NTP/SNTP protocol or PTP according to IEEE 1588 Std 2008. It not only provides NTP and PTP timing capabilities, but also a variety of other time codes and signals, such as GPS emulation and IRIG-B. The unit also provides backwards compatibility for older timing systems.

The PTP-8080 platform supports 2-step clock modes and either E2E or P2P as the delay mechanism. This means that all possible PTP profiles can be supported. The platform maximizes PTP performance since all critical PTP functions are implemented in hardware. The switch functionality in the PTP-8080 series offer full management based on HTTP, telnet, CLI or SNMP. Network Redundancy is achieved based on the RSTP protocol. A full-suite of network protocols includes SNMP capability, support for enterprise directory servers to authenticate users, internal and external logging and monitoring of error messages through Syslog, DHCP for installation convenience, and IPv4.

Key Features
- NTP time server
- PTP v1 or v2 Grand Master Clock
- PTP v1 or v2 Transparent Clock
- PTP v1 or v2 Slave Clock

Combined NTP client and PTP protocol supports:
- Multicast
- Layer 2 or IP
- 2-step clock
- Peer-to-Peer (P2P) or End-to-End (E2E) delay mechanism

- Time accuracy to absolute time < 50ns (with GPS lock) PTP accuracy < 20 nanosecond (*)
- 4 x 10/100/1000BASE-T(x) ports 4 x 10/100/1000BASE-X combo ports
- 100-240AC power input
- Network redundancy: RSTP protocol Network management: Web, telnet, CLI and SNMP v1/v2/v3 with RMON Multicast filtering: IGMP snooping IEEE802.1Q VLAN
- Event notification: through Syslog, Email, and SNMP trap
PRODUCT APPLICATIONS - Signal References

GPS Time and Frequency References

NFS-200 / NFS-220 Plus

The NFS-220 is a low cost precision time and frequency standard for use in WI-FI, Wi-Max, satellite communications, telecommunications, and military communications. This unit utilizes a high performance 16 channel GPS receiver with automatic position-averaging that enables the best use of GPS when operating in a fixed location. The NFS220 includes 4 low phase noise 10MHz outputs, 3 x 1PPS outputs with individual propagation delay compensation, IRIG, Have Quick, and NTP outputs. The NFS-220 can also be synchronized to an external GPS receiver using 1PPS and/ or Have Quick time code. While the OCXO is standard a variety of internal oscillator options are available.

Key Features

- High performance GPS disciplined Time/Frequency standard
- Ethernet Interface for management and control
- Network Time Protocol (NTP)
- Multiple 1PPS outputs with individual delay compensation
- Multiple Low Phase Noise 10MHz outputs with software programmable level
- Time Code outputs including Have Quick, IRIG A, IRIG B, IRIG E, IRIG G Sync to GPS or to Have Quick/1PPS per ICD-GPS-060
- Choice of internal disciplined TCXO, OCXO, Rubidium Oscillator or ultra low noise OCXO locked to Rubidium.

RG-2100 / RG2110

The RG-2100 is a redundant reference frequency generator that uses Global Positioning System (GPS) to steer two internal low phase noise OCXO's. Each GPS Disciplined Module provides a set of 3 low phase noise 10 MHz sine waves, 1PPS, monitor and control interface to a user interface output panel.

If a failure is sensed in one module the unit will switch outputs to the other GPS Disciplined Module to provide continuous service. These outputs are accurate daily to 1 x 10^-12 when slaved to an internal GPS tracking receiver’s time. Dual redundant hot swappable power supplies make the RG-2100 perfect for military communications, telecommunications and sitcom telecommunications. Option dual redundant NTP outputs.

GPS Disciplined Oscillator Module - OEM applications

The GPS Disciplined Oscillator Module is a small Commercial Off-the-Shelf (COTS) GPSDO that has been designed to meet military requirements such as MIL-STD-188-164A. At only 4.1” x 2.75” x 1” (104.0 x 70.0 x 26.0 mm) in size, the unit provides Stratum 1 performance. The GPSDO supplies three isolated, low noise precision 10 MHz frequency reference signal outputs. These outputs are accurate to 1 x 10^-12 when slaved to a timing supply from an internal GPS tracking receiver. This frequency standard is also able to slave to an external 1PPS signal to steer and hold the internal oscillator and clock system precisely in time. Time and frequency information maintains its high accuracy with the internal oscillator even when no satellites can be tracked. A serial data port is provided to report time, date, position, and GPS satellite health and signal strength. The GPSDO module also has dual power supply inputs and can operate off either supply input. Optional capabilities include automatic interface to an external military GPS receiver such as the Defense Advanced GPS Receiver (DAGR), Ethernet Interface for NTP time service and SNMP status monitoring. Standard frequency output is 10 MHZ, but other frequencies are possible.

Miniature GPS Disciplined Oscillator

The miniature GPS Disciplined Oscillator combines the power of our existing disciplined oscillators in a footprint the size of an OCXO. Designed with interoperability in mind, the Miniature GPS Disciplined Oscillator meets military requirements such as MIL-STD-188-164A. The GPSDO supplies a low noise, precision 10 MHz frequency reference signal output. This output is accurate to 1 x 10^-12 when slaved to a GPS.
PRODUCT APPLICATIONS - Signal Distribution

Intelligent Distribution Amplifiers

FTSU-100D - 8 Channels

The FTSU-100D is an advanced network enabled distribution amplifier. The FTSU-100D will accept 1PPS and a reference frequency such as 10MHz from two sources. A second frequency can be synthesized internally. Eight channels of the reference and synthesized frequency and 1PPS are generated. Input reference failure results in hitless switchover. The output frequencies have programmable amplitude and propagation delay compensation.

The 8 reference frequency outputs are generated from a low phase noise ovenized quartz oscillator (OCXO) that is phase-locked to the reference frequency input. In the event of reference input failure the phase-locked oscillator will continue to provide referenced frequency outputs with a stability of 3X10^-9 over temperature. Changeover between references is smooth with no glitch on the output.

A 10/100 baseT Ethernet interface provides full control over the functionality of the system, including reference reflection, output amplitude (on a per channel basis), 1PPS propagation delay (on a per channel basis). User control of the unit is via a built-in Web Browser with user-friendly graphical interface, or via SNMP for system applications.

Key Features

- Network Enabled Distribution Amplifier
- Low Phase Noise Reference Frequency Outputs
- Fault Alarm Output
- Frequency Synthesizer Option
- Hitless Switching of Reference
- Programmable Amplitude Propagation Delay Compensation

FDU-160i - 16 Channels

The FDU-160i uses the next-generation HTML5 web interface to enable the unit to be monitored and controlled from any PC, smart phone, or tablet.

The FDU-160i accepts frequency inputs from two sources and can automatically switch over to a secondary input if the primary fails. The unique web interface allows for each frequency output to be individually set and adjusted, without affecting the other outputs. With dual-redundant power-supplies standard, the FDU-160i is designed for high-reliability and high-availability applications, such as satellite ground stations, secure military communications, facility reference distribution, and range timing compensation.

FDU-180i - 16 Channels

Built on the FDU-160i, the FDU-180i expands the capabilities of the FDU-160i by incorporating a clean-up oscillator, reducing phase noise while allowing the unit to maintain frequency synchronization. A high-performance tracking loop ensures phase continuity of the outputs when switching references for true hitless switching.

IBU-180i - 16 Channels

Bringing the next-generation of distribution amplifiers to time code distribution is the IBU-160i. Converting dual-redundant IRIG A, B or G time code inputs into 16 isolated outputs, the IBU-160i fits into a 1U chassis. The IBU-160i incorporates the next-generation HTML5 interface to allow it to be monitored and controlled from any PC, tablet or smart phone.

FDA-160i - 16 Channels

The FDA-160i is a wideband frequency distribution unit, built on the versatile platform of the FDU-160i, the FDA-160i distributes dual-redundant wideband frequency signals between 1 and 30MHz across sixteen outputs. Each output is individually adjustable for voltage level.
PRODUCT APPLICATIONS - Display Clocks

Brandywine and TFS offer a wide range of Digital Time Displays to suit all requirements. These products are available in a wide range of styles, sizes, and formats including exterior displays, interior displays, console displays, with single or double-sided formats.

Additionally a wide range of Analogue Clocks is also available in many styles, sizes and formats, including single and double sided with and without internal illumination.

Wall mounted, desk mounted, inbuilt console and ceiling mounted options are available for all display products.

**M350 LED Console Time Displays**

Ideally suited for use in Control Room panel consoles. Offered with NTP, timecode or serial synchronisation. Can be AC or PoE powered.

- High-intensity LED digits
- Excellent readability
- Suitable for interior applications
- User configuration via web browser
- Standard DIN IEC 61554 (DIN 43700) dimensions
- Red/Yellow/Green - 13mm / 20mm(13mm) / 25mm(20mm) / 25mm Digits

**M355 LED Console Time Displays**

Suitable for any interior application where clearly presented time or date information is required. A range of sizes, formats (single/double sided), synchronisation sources (NTP, timecode or serial) are available. Can be AC or PoE powered.

- High-intensity LED digits 4 or 6
- Excellent readability
- Suitable for interior applications
- User configuration via web browser
- Single or double sided
- 4 (HH:MM) / 6 (HH:MM:SS)
- Red/Yellow/Green
- 60mm / 100mm / 150mm / 200mm

**M373 LED Digital Time Displays**

Robust IP65 unit suitable for a wide range of exterior public time display applications. A range of sizes, formats (single/double sided), synchronisation sources (NTP, timecode or serial) are available. Can be AC or PoE powered.

- High-intensity LED digits 4 or 6
- Excellent readability
- Suitable for interior applications
- User configuration via web browser
- Single or double sided
- 4 (HH:MM) / 6 (HH:MM:SS)
- Red/Yellow/Green
- 60mm / 100mm / 100(60)mm

**M385 Analogue Clocks**

a range of sizes, formats (single/double sided), synchronisation sources (NTP or serial), with and without illumination (fluorescent or LED backlit) are available. Can be AC or PoE powered.

- Excellent readability
- Suitable for interior & Exterior applications
- Single or double sided
- Options for Hours/Minutes or Hours/Minutes/Seconds
- Clock diameter : 300mm / 400mm / 500mm / 600mm / 800mm
Time & Frequency Measurement and Validation

TimeSpy

An easy to use, portable battery backed precision GPS referenced instrument that measures the time and frequency accuracy of a wide range of inputs against an internal precision UTC reference.

TimeSpy provides an unambiguous measure of time or frequency error at the point of use for systems where time is distributed over large distances.

With Gigabit Ethernet capability plus an SFP connection for use with alternative media e.g. fibre, this instrument can measure time of day precisely in virtually any format, including PTP, NTP, Time Code and pulse rates.

TimeSpy also accommodates laboratory standard inputs (1PPS/10MHz) to use as a time reference. TimeSpy is available in Quartz and Rubidium models.

Measurement Reference Source:

- Internal C/A Code GPS Receiver with case-mounted antenna
- Time Accuracy (1σ) 30ns over 24hrs with GPS reception
- Internal Time Interval Measurement: 0.2ns resolution with built-in self-calibration
- Optional connection to external GPS Antenna

<table>
<thead>
<tr>
<th>Measurement Interfaces</th>
<th>Connector</th>
<th>Input Measurement Accuracy Against GPS</th>
<th>Input Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse (1ppm / 1ppm / 1pph)</td>
<td>Fibre ST</td>
<td>25ns 0.2ns</td>
<td>820nm - 7,65dBm max (or 1300nm -11dBm max - to special order)</td>
</tr>
<tr>
<td>Differential</td>
<td>Twin BNC</td>
<td>25ns 0.6ns</td>
<td>Common mode - 7V ± 1V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Differential threshold -0.3V min +0.3V max</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Input Impedance 22kΩ min</td>
</tr>
<tr>
<td>TTL 50 Ohm BNC</td>
<td>25ns 0.2ns</td>
<td>Nominal Input 0V to 2.5V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low: 0–0.6V, High: Min 1.4V–5V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Input Impedance 1.2kΩ min</td>
</tr>
<tr>
<td>Relay / optocoupler</td>
<td>Twin BNC</td>
<td>25ns 0.2ns</td>
<td>Isolated inputs. TimeAcc connects 1.2kΩ from +5V to contacts from isolated supply</td>
</tr>
<tr>
<td>1kHz AC Timedec*</td>
<td>50 Ohm BNI</td>
<td>1µs 100ns</td>
<td>Nominal Input: 10ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Peak to Peak Min / Max: 2.07ppm /12ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Input Impedance: 60kΩmin</td>
</tr>
<tr>
<td>DCLS/ Have Quick/ DG777/ DG Timecodes*</td>
<td>Fibre ST</td>
<td>25ns 0.2ns</td>
<td>820nm -7.65dBm max (or 1300nm -11dBm max - to special order)</td>
</tr>
<tr>
<td>Differential</td>
<td>Twin BNC</td>
<td>25ns 0.6ns</td>
<td>Common mode -7V±12V</td>
</tr>
<tr>
<td></td>
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<td></td>
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<td>Input Impedance 22kΩ min</td>
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<td>Low: 0–0.6V, High: Min 1.4V–5V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Input Impedance 1.2kΩ min</td>
</tr>
<tr>
<td>Network Connections</td>
<td>NTP / SNTP / PTP*</td>
<td>RJ-45</td>
<td>70ns 20ns</td>
</tr>
<tr>
<td>RS422/RS485 Serial Message Start and NMEA plus Pulse</td>
<td>9-pin D-type</td>
<td>160ns 0.2ns</td>
<td>Common mode -7V±12V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Differential threshold -0.3V min +0.3V max</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Input Impedance 22kΩ min</td>
</tr>
<tr>
<td>RS232 Serial Message Start and NMEA plus Pulse</td>
<td>9-pin D-type</td>
<td>1µs 0.2ns</td>
<td>Input Voltage Range ±30V max</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low threshold 0.6V max; High threshold 2.4V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Input Impedance 3kOhm min 7kOhm max</td>
</tr>
</tbody>
</table>
# BUS Level Timing Products

Time and Frequency Solutions indisputably offers the widest range of timing plug-in board form factors in the business. From the classic PCI to our advanced conduction cooled PMC model these boards offer the latest technology as well as the most extensive list of standard features and options available. Most boards include IRIG, NASA, and 1PPS sync inputs as well as optional GPS synchronisation. Zero latency time to the microsecond, external event time capture to 100ns, and three programmable rate generators are standard on most models.

A variety of options are available. Some of the more common options are: GPS Synchronisation, extended temperature range, eight external event inputs, TCXO and OCXO time bases, multiple output codes.

## PCI Express

<table>
<thead>
<tr>
<th>PCle-5905 Universal Timing Board</th>
<th>Mini PCIe SyncClock32</th>
</tr>
</thead>
<tbody>
<tr>
<td>The PCle-5905 Universal Timing Card provides an ultra-flexible means of providing precise time synchronisation to a host computer, or a variety of external equipment. The PCle-5905 is unmatched in the industry for its flexibility and features, while maintaining a compact ½ height PCIe form factor.</td>
<td>Ideal for mobile and small form factor installations, the Mini PCIe SyncClock32 provides precision time with low latency to the host in the mini PCIe form factor. Capable of receiving time from 1PPS, IRIG or NASA time codes.</td>
</tr>
</tbody>
</table>

## Legacy Busses

<table>
<thead>
<tr>
<th>VME-SyncClock32</th>
<th>PCI Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tried and true hardware &amp; software, easy to program, many features including on-board GPS option.</td>
<td>PCI-SyncClock 32 Models are available to support all PCI bus variants. Time code synchronisation is standard, GPS sync is optional.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PMC-SyncClock32</th>
<th>Conduction Cooled PMC-GPS Clock</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMC Models support all variants of PMC form factors. A version is available that supports onboard GPS.</td>
<td>Latest conduction cooling technology and many of the same features and options as the other PMC products, including on-board GPS.</td>
</tr>
</tbody>
</table>

## PC-104 Family

<table>
<thead>
<tr>
<th>PC104-SG</th>
<th>PC104 Plus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideal for engineer's that want hardware and software design control. 16-bit ISA interface.</td>
<td>ROHS Compliant Latest PC104 offering features 32 bit universal PCI performance in PC/104 form factor. GPS available and maintains single slot configurations. Many options available.</td>
</tr>
</tbody>
</table>

| CPC1-SyncClock32 3U | |
|---------------------| |
| Supports all standard SyncClock features and options in both 3U and 6U form factors, including onboard GPS. Compliant with RoHS. | |
### Satisfied customers include:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB Singapore</td>
<td>Singapore</td>
</tr>
<tr>
<td>Airbus Defence &amp; Space</td>
<td>Europe, Middle East, Africa, Australia</td>
</tr>
<tr>
<td>ASML Technologies Ltd</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Atkins</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>Babcock International</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>BAE Systems</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>BBC</td>
<td>United Kingdom</td>
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<td>BP</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>CMC Engineering Malaysia</td>
<td>Malaysia</td>
</tr>
<tr>
<td>EDF Energy</td>
<td>France</td>
</tr>
<tr>
<td>Indian Navy</td>
<td>India</td>
</tr>
<tr>
<td>Leonardo Electronics Defence And Security</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>London Stock Exchange</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>MBDA Ltd</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>MTPE Hong Kong</td>
<td>China, Hong Kong &amp; Macau</td>
</tr>
<tr>
<td>National Air Traffic Services</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>NASA</td>
<td>United States</td>
</tr>
<tr>
<td>NEC</td>
<td>Japan</td>
</tr>
<tr>
<td>Network Rail</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>Northrop Grumman Park Air Systems Ltd</td>
<td>USA</td>
</tr>
<tr>
<td>Qatar</td>
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</tr>
<tr>
<td>Raytheon Systems Ltd</td>
<td>United States</td>
</tr>
<tr>
<td>Rockwell Automation</td>
<td>United States</td>
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<tr>
<td>SBS Transit Singapore</td>
<td>Singapore</td>
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<tr>
<td>Siemens</td>
<td>Germany</td>
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<td>SSS Singapore</td>
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<td>Siemens Transportation</td>
<td>United States</td>
</tr>
<tr>
<td>Singapore Stock Exchange</td>
<td>Malaysia</td>
</tr>
<tr>
<td>Talent Technology Services Limited</td>
<td>United States</td>
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<tr>
<td>Telent</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>Thames UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>Transport For London</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>Viamcon</td>
<td>United States</td>
</tr>
</tbody>
</table>

### Sales Contacts and Global Representatives

### TFS UK Head Office

**Mrs Laura Cain**  
**Sales Coordinator**  
**TFS, Witham, CM8 3AL, UK**  
**Tel:** +44 (0) 1376 514114  
**Email:** laura.cain@timefreq.com

### Asia, China, India, Japan

**Mr Neil Pitman**  
**Director of Sales - Asia**  
**China, India, Japan**  
**Mobile:** +44 (0) 7973 859342  
**Email:** neil.pitman@timefreq.com

### Company Addresses

- **Austria, Germany & Switzerland:**  
  **Semic RF Electronic GmbH**  
  **Contact:** Wolgang Gruber  
  **Tel:** +49 814 1520  
  **Email:** sales@semic.de  
  **Web:** www.semic.de

- **Australia & New Zealand:**  
  **Unitronix**  
  **Contact:** Tim Marshall  
  **Tel:** +61 3 5931 7399  
  **Email:** sales@unitronix.com.au  
  **Web:** www.unitronix.com.au

- **Brazil:**  
  **Sigtron Instrumentos e Servicos Ltda**  
  **Contact:** Estevano Simariaca  
  **Tel:** +55 21 3686 8100  
  **Email:** eduardo@sigtron.com.br  
  **Web:** http://sigtron.com.br/

- **China, Hong Kong & Macau:**  
  **Spectrum & Master Comms. Technologies**  
  **Contact:** Mr William Li  
  **Tel:** +852 2529 1111 / Mobile: +852 9378 9271  
  **Email:** smchik@netvigator.com  
  **Web:** www.brandywinecomm.com

- **India:**  
  **PDAC Microsystems Pvt Ltd**  
  **Contact:** Mr Pradeep Dhar  
  **Tel:** +91 40 4247 6726 / Mobile: +91 80082 95670  
  **Email:** pradeep@pdac.in  
  **Web:** www.pdac.in

- **Indochina (Vietnam, Laos, Cambodia):**  
  **Hanova JSC**  
  **Contact:** Mr. Ha Le  
  **Tel:** +84 91 351 4905  
  **Email:** ha.le@hanova.vn  
  **Web:** www.hanova.vn

- **Israel:**  
  **IES Electronics Agencies (1986) Ltd**  
  **Contact:** Mr Haim Taddakoro  
  **Tel:** +972 3 575 2599  
  **Email:** taddakoro@naclite.co.il  
  **Web:** www.naclite.co.il

- **Italy:**  
  **Millimetrica RF & Microwave Components SRL**  
  **Contact:** Mr Aldo Cagno  
  **Tel:** +39 011 317 9910  
  **Email:** acagno@millimetrica.it  
  **Web:** www.millimetrica.it

- **Japan:**  
  **Nacelle Co Ltd**  
  **Contact:** Mr Hayato Tadokoro  
  **Tel:** +81 3 5921 5099  
  **Email:** tadokoro@nacelle.co.jp  
  **Web:** www.nacelle.co.jp

- **Korea:**  
  **Etoob**  
  **Contact:** Jaydon Lee  
  **Tel:** +82-2-6677 3409  
  **Email:** jaydon.lee@etoob.co.kr  
  **Web:** www.etoob.co.kr

- **Malaysia:**  
  **Alam Sinar Teknik Sdn Bhd.**  
  **Contact:** Mr H. Chew  
  **Tel:** +60 3 7874 5825 / Mobile: +60 13 5131068  
  **Email:** hitech@alamsinerteknik.com  
  **Web:** www.alamsinerteknik.com

- **North Africa, Mauritania, Morocco, Tunisia, Algeria, Libya, Egypt, Chad, Mali:**  
  **ProComSat**  
  **Contact:** Hussein El Sani  
  **Tel:** +212 531545418  
  **Email:** hussen@procomsat.com  
  **Web:** www.procomsat.com

- **North America, USA & Canada:**  
  **Brandywine Communications Inc.**  
  **Contact:** Mr Neil Pitman  
  **Tel:** +1 817 367 7992 / Mobile: +1 714 755 0175  
  **Email:** sales@brandywinecomm.com  
  **Web:** www.brandywinecomm.com

- **Spain & Portugal:**  
  **Tecnologia GPS S.A.**  
  **Contact:** Jose Luis Esteban  
  **Tel:** +34 91 384 7256 / Mobile: +34 664314360  
  **Email:** commercial@tecnogps.es  
  **Web:** www.tecnogps.es

- **South Africa:**  
  **Satellite 2000 Systems International Ltd**  
  **Contact:** Fred Joubert  
  **Tel:** +27 818 391 9794  
  **Email:** sales@sat-2k.com  
  **Web:** www.sat-2k.com

- **Philippines:**  
  **Imaginet International Inc**  
  **Contact:** Mr Ralain Amablas  
  **Tel:** +63 2 957 3327 / Mobile: +63 915 330 4026  
  **Email:** ralain@imaginetechnologies.com  
  **Web:** www.imaginet.com.ph

- **Singapore:**  
  **PROGRESO Networks (S) Pte Ltd**  
  **Contact:** Victor Tang  
  **Tel:** +65 6509 9000 / Mobile: +65 9735 1700  
  **Email:** victor@progreso.com.sg  
  **Web:** www.progreso.com.sg

- **Turkey:**  
  **Merit Elektronik**  
  **Contact:** Larente Celid  
  **Tel:** +4090 312 472 7495  
  **Email:** lwertl@mequantum.com.tr  
  **Web:** www.meritetelektronik.com.tr

- **U.A.E.:**  
  **Zener Fire & Security LLC**  
  **Contact:** Ranjith Nambar  
  **Tel:** +971 3621548818  
  **Email:** ranjith@zenerfire.com  
  **Web:** www.zenerfire.com

### Time & Frequency Solutions

**25 Eastways, Witham, Essex, CM8 3AL, UK**  
**Phone:** +44 (0) 1376 514114  
**Fax:** +44 (0) 1376 516116  
**Email:** enquiries@timefreq.com

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