Modular Time Code Processor

Model 9000

Precise Time and Frequency Processing
Plug-in Modules
Disciplined Oven Oscillator
GPS, VHF Receiver, & Time Code Sync Options

100 Nanosecond Precision
Built-in Fault Location
Remote Control & Monitoring
Nonvolatile Memory of Setups
Three Year Warranty

TRAK Systems Model 9000 Modular Time Code Processor is a single unit that can be customized to fit a multitude of different timing applications using available rear-panel plug-in modules. This versatile instrument can be configured as a stand-alone time code generator or can be synchronized to an external source. Modules are available for synchronizing to GPS (Global Positioning System), precise serial time codes (landline or VHF receiver module), tape reproducer time code outputs, and computer outputs. Available output modules include time code generators; TTL and sinewave rate generators; telecommunications signal generators; computer interfaces; multiple-output line drivers; and a tape search controller.

The design of the Model 9000 is the culmination of TRAK’s over 40 years experience in producing high quality timing instruments. It incorporates proven CPU and gate array designs for timekeeping, oscillator disciplining, housekeeping, fault location, and signal generation.

Although this single model replaces an entire product line of specialized instruments, there have been no sacrifices in any performance area. In fact, performance of the Model 9000 is superior at all levels, and many enhancements have been incorporated. Customization to meet specialized applications is now even easier using a broad selection of available plug-in modules.

The instrument is available as the Model 9000A with six module locations in a 1-3/4-inch high 19-inch rack-mount chassis and the Model 9000B with 12 module locations in a 3-1/2-inch high chassis. The two versions are identical with the exception of their size, option capacity and several upgrades in the 9000B.

Each of the available input and output modules can be inserted in any module location. The instrument automatically senses module types and locations and reports this information to the front panel display. This report, along with fault reports, additional status data, and unit serial number is also available to remote computers via rear panel ports. Other advanced features include front panel adjustment of output levels and a fault sensing system encompassing the main unit and all its installed modules. Any fault is isolated to the module level.
MODEL 9000 SPECIFICATIONS

Internal Oscillator
The Model 9000 has a disciplined crystal oscillator with nonvolatile digital storage of its center frequency. When the instrument is used as a stand-alone generator, the oscillator may be calibrated in the field using a precise external 1 PPS input. When the unit is synchronized by a precise time code or GPS, the oscillator is continuously disciplined by the input. The oscillator continues operation at its last disciplined frequency during sync loss. Two crystal oscillator types are offered. Each has an accuracy when disciplined of 1 X 10^{-12} for a 24-hour average.

**Type B4 OCXO (Std on 9000A)**
- 1 PPS sync accuracy: <200ns while disciplining
- Coasting freq. drift*: 1 X 10^{-9}/day (first week)
- Coasting time drift*: 1-3 µsec/hr (first 4 hrs)
- Temp. stability: ± 5 X 10^{-8} 0 to 60º C

**Type B12 OCXO (Std on 9000B, opt on 9000A)**
- 1 PPS sync accuracy: <100ns while disciplining
- Coasting freq. drift*: 2 X 10^{-10}/day (first week)
- Coasting time drift*: 8-15 µsec/day (first day)
- Temp. stability: ± 1 X 10^{-8} 0 to 60º C

* Coasting drifts apply only after synchronizing input (GPS or time code) fails or is removed.

Rubidium Oscillator Option
A Rubidium oscillator module (Model 9018, factory or field installed) is available for the Model 9000B. When this module is installed, it becomes the internal clock and the internal crystal oscillator becomes a hot standby. This option normally has application as a high-precision backup to GPS or other precise time code synchronization during periods of sync loss. Frequency accuracy is better than 1X10^{-12} for an averaging period of one day or greater. Drift while coasting (i.e., without a synchronizing input) is less than 10 microseconds per week.

External Standard Input
In the stand-alone generate mode, an external 1, 5, or 10 MHz input may be used in place of the internal oscillator. This input may also be used in conjunction with an external time code sync input if the two signals are derived from the same source; i.e., the time code and external standard must be phase locked to each other. A 1 PPS input disciplines the internal oscillator and may therefore also be used as an external standard.

Time And Status Display
Current time being processed is shown on a nine-digit LED display. Vital status data are indicated on individual small LED's at the bottom of this display. Intensity control is via the front panel keypad.

Keypad and Alphanumeric Display
Setup data are entered on an 18-key keypad. Setup, status, and housekeeping data are displayed on a two-line by 16 character alphanumeric LCD. The LCD is temperature compensated for consistent contrast.

A menu system directs the operator to all available system setup and status-request modes, eliminating the need for constant reference to the instruction manual. Nonvolatile memory stores all operating mode parameters when power is off.

The basic alphanumeric screens include:
- Mode
- Date
- List of installed modules
- Serial number
- Internal status and configuration reports
- Fault location
- Setup menus and parameters
- GPS system data (when GPS Module is installed)

The keypad, with the aid of the display, is also used for operational control (Preset, Slew, etc.) of the instrument.

Remote Setup and Monitoring
The Model 9000A incorporates an RS-232 I/O port as a standard feature. The Model 9000B (option on 9000A) has a second RS-232 port for output to a printer. An IEEE-488 port that duplicates the functions of the RS-232 port is an available option. Included I/O features are listed below. For a complete command listing, see the Model 9000 manual.
- Duplication of front-panel setup commands
- Duplication of front-panel status and fault reports
- Time output
- List of installed modules & housekeeping data
MODEL 9000 OPERATING MODES

A – Stand–Alone Mode: Without modules installed, the Model 9000 can be used as a stand-alone time accumulation instrument operating from its internal oscillator or from an external standard. The unit can be manually synchronized or started by an external pulse. Time output is available from the RS-232 port. Output modules may be added to obtain various time code, rate, and other signal outputs.

Slew Capability
When operating in the stand-alone mode with a precise external standard input, the time code and rate outputs can be manually synchronized or resynchronized relative to an external 1 PPS signal. Slew rates provided are 100 ns/sec through 100 ms/sec in decade rates. Both Advance and Retard directions are provided using the keypad arrows.

Synchronization Modes
In addition to the Stand-alone mode described above, the Model 9000 has three synchronization modes to cover applications ranging from ultra-precise UTC synchronization to high-speed analog tape reading. A Time Code Reader/Synchronizer (TCRS) module covers all three modes. Additionally, GPS and VHF receiver/synchronizers are available in the Synchronized Generator mode. When using a GPS or VHF synchronizer, a TCRS may be installed as a backup (redundant) synchronizer with automatic switchover in the event of primary synchronization failure or dropout.

B – Synchronized Generator Mode: This mode provides precise synchronization to a real time input that has been derived from a stable source such as a master timing station with an atomic frequency standard or to the GPS satellite system. In this mode, the internal oscillator is disciplined to the incoming signal. Tracking of the input is normally better than 300 ns rms. If the input signal drops out, time accumulation continues using the internal oscillator at its last-disciplined center frequency. If the synchronizing input comes back before the Model 9000 has drifted beyond a preset limit (normally 10 microseconds) the oscillator is smoothly corrected to avoid any time jumps and there is no long-term loss of synchronization accuracy. If the drift is greater than the preset limit, all counters are resynchronized.

C – Reader/Generator Mode:
This mode provides synchronization to a less-precise input such as a 1:1 playback of a time code from a tape producer. In this mode, a phase-locked loop (PLL) is used as a time base, following the input while reading the code and filling in during short-duration code dropouts. This PLL follows frequency variations of up to ± 5%. On long-duration code dropouts, clocking reverts to the internal oscillator.

D – Time Code Reader Mode:
High-speed forward and reverse time code reading is provided. In this mode, the code carrier frequency provides internal clocking and the code can be read at varying forward and reverse speeds.

Frame Error Bypass (FEB)
The FEB feature is provided for Time Code Synchronization modes C and D described above. In the Synchronized Generator mode (Mode B), the error bypass function is automated.
The Model 9000 synchronizes to an incoming time code only after finding a selected number of consecutive frames of valid time with proper time incrementing. The number of frames (0, 2, 4, 8) is selected by the operator. Bogus times such as 30 hours are rejected. Once synchronized, the unit does not attempt to resync until a selected number of incoming frames all disagree with current accumulated time. The number of frames bypassed is also operator selected as 0, 1, 2, 4, 8, 16, or ∞.

VHF Receiver Synchronization
The VHF Receiver allows synchronization of the Model 9000 using a time code transmitted via RF link. Coding is normally IRIG B. VHF synchronization is used only in the Synchronized Generator mode.

GPS Synchronization
The GPS module synchronizes the Model 9000 to the GPS satellite system. An antenna and 50 feet of lead-in cable are included with this option. Synchronization to Universal Time (UTC) is better than 300 ns rms. The Model 9001 GPS Synchronizer is described in the module section of this brochure. GPS Synchronization is used only in the Synchronized Generator mode.

When the GPS module is installed and operating, front panel and remote status reports include satellite tracking and navigation data.
Propagation Delay Compensation

Propagation delay compensation offsets time accumulation ahead of the synchronizing input to overcome delays introduced in transmitting from a master station to a local time code processor. This places the locally-generated signals in phase with the time at the master station (normally UTC).

Separate propagation delay compensation input and storage is provided for each of the following three modes:

1 – Stand-alone with external standard. 100 ns through 999.9999 ms in 100 ns steps.

2 – Precise translate. 100 ns through 499.9999 ms in 100 ns steps (provided for Reader/Synchronizer and VHF receivers).

3 – GPS. One ns through 999.999 µs in one ns steps.

Separate compensation is provided for each mode to allow switching between synchronizing sources having different delays.

Minor Scaler Offset

In addition to the propagation delay compensation settings, in the Sync Gen mode, a time offset can be applied to all outputs. This is an offset from internal UTC and can be set from 0 to ±499.9999 ms in 100 ns steps.

External 1 PPS Measurement

When an external 1 PPS signal is applied to the front panel IN connector in the Sync Gen mode, the unit measures the difference between this signal and internal 1 PPS (UTC) with a resolution of 10 ns. The positive-going edge of a +3 to +10 volt signal of any duration is measured. Input impedance is 50 ohms and range is 10 ns to 8 ms.

Leap Second Corrections

In the GPS mode, leap second corrections are automatic. In the Time Code Reader mode, there are three setup choices for leap second correction including manual, semi-automatic, or automatic correction using control bits in the code. In the Stand-alone mode, the operator can make a front panel or remote selection of the date for automatic correction.

Built-in Fault Monitoring

Each module of the Model 9000 has built-in fault detectors that locate a failure with a confidence level of at least 95%. On detection of a failure, the front panel LED time display flashes “FAIL” and the failure location is given on the LCD display. LCD fault indications are stored until the condition is cleared; the LED display returns to the time display after the LCD has been interrogated. The 9000B has a summary fault status BNC on the Aux I/O module.

Leap Year Selections

In the GPS mode, proper year-end rollover is automatic using a stored 100-year calendar.

In the Time Code Reader mode using codes without years data, the operator must preset the year if on-time year-end rollover is expected. Once preset, the unit automatically rolls over at each year end. If power is removed in one year and reapplied in another, the new year must be entered to assure correct rollover. A startup screen at power-up reminds the operator to enter the correct year. The unit also can read IRIG B codes with encoded years data.

In the Stand-alone mode the operator must preset the year when presetting the unit.

Power Supply

The unit operates from 85 to 265 Vac, 48 to 440 Hz (100 to 370 Vdc may also be used on this input). As an option, the Model 9000B (but not the 9000A) can have a DC backup power input of +19 to +29 volts. Power consumption is 25 watts nominal. When both AC and DC power inputs are present, the AC input has priority and the unit smoothly switches to the DC backup when AC is removed.

As an option, both the Model 9000A and Model 9000B can be ordered with a single 24 Vdc or 48 Vdc power input.

Physical

The Model 9000A chassis is 1-3/4 inches high and the Model 9000B chassis is 3-1/2 inches high. Both versions are designed for mounting in a standard 19-inch rack and have a depth of 18 inches. Chassis slides are optional. Operating temperature range is -10 to +60 °C.
## MODEL 9000 MODULES

The following pages describe the modules currently available for the Model 9000. Others will be added in the future. As needs arise, we encourage our customers to contact us with their requirements. Following is a tabulation of these modules:

<table>
<thead>
<tr>
<th>Model</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9001</td>
<td>GPS Synchronizer</td>
<td>GPS Receiver/Synchronizer</td>
</tr>
<tr>
<td>9002</td>
<td>Time Code Reader/Synchronizer</td>
<td>Sync to IRIG A, B, and G, modulated or DC (others avail)</td>
</tr>
<tr>
<td>9003</td>
<td>AUX I/O</td>
<td>Standard feature; One RS-232 I/O. Ext Std in; 1 PPS out</td>
</tr>
<tr>
<td>9004</td>
<td>IEEE-488 I/O</td>
<td>Duplicates RS-232 command/status set</td>
</tr>
<tr>
<td>9005-X</td>
<td>Dual Time Code Generator</td>
<td>Several versions available. IRIG, NASA, and NSA codes available. Each version has two code types in both modulated and DC format. See module writeup for details.</td>
</tr>
<tr>
<td>9005-6</td>
<td>HAVEQUICK TCG</td>
<td>Gen HAVEQUICK, 800 KHz &amp; 800 K PPS</td>
</tr>
<tr>
<td>9006*</td>
<td>4-Channel Digital Driver</td>
<td>Four additional 50 ohm outputs of a selected TTL code or rate signal.</td>
</tr>
<tr>
<td>9007*</td>
<td>4-Channel Differential Driver</td>
<td>Four additional outputs of a selected TTL signal at RS-422 levels.</td>
</tr>
<tr>
<td>9008*</td>
<td>4-Channel Linear Driver</td>
<td>Four additional 50 ohm outputs of a selected dc to 10 MHz signal.</td>
</tr>
<tr>
<td>9009</td>
<td>Sinewave Generator</td>
<td>Generates and buffers four separate sinewave frequencies.</td>
</tr>
<tr>
<td>9010</td>
<td>2-Channel RS-232 Time</td>
<td>Generates two separately addressable time outputs.</td>
</tr>
<tr>
<td>9011</td>
<td>Telecom Generator</td>
<td>Generates one T1 or E1 telecom rate (1.544 MHz or 2.048 MHz) and has 4 buffered outputs.</td>
</tr>
<tr>
<td>9012</td>
<td>Parallel Code Generator</td>
<td>Versions available for BCD- or Binary-coded time.</td>
</tr>
<tr>
<td>9013</td>
<td>Slow Code Generator</td>
<td>Generates one of 7 selected rates and has four buffered outputs of the selected rate.</td>
</tr>
<tr>
<td>9014-1</td>
<td>Digital Rate Generator</td>
<td>Generates and buffers four separate TTL rates selected by front panel keypad from library of 15 rates.</td>
</tr>
<tr>
<td>9014-2</td>
<td>Digital Rate Generator</td>
<td>Generates and buffers 2400, 4800, 9600 &amp; 19.2 KPPS.</td>
</tr>
<tr>
<td>9014-X</td>
<td>Digital Rate Generator</td>
<td>Generates and buffers four separate fixed TTL rates.</td>
</tr>
<tr>
<td>9016</td>
<td>Time Tag &amp; Event Trigger</td>
<td>(1) Captures external pulse events. (2) Produces a pulse at a preset time.</td>
</tr>
<tr>
<td>9017</td>
<td>VHF Receiver/Synchronizer</td>
<td>Synchronizes to IRIG B via RF link.</td>
</tr>
<tr>
<td>9018</td>
<td>Rubidium Oscillator</td>
<td>Disciplined to on-line sync input. Backed up by internal oscillator.</td>
</tr>
</tbody>
</table>

* Signal inputs to the Driver modules are via the backplane from any installed signal generation module. Four patches permit buffering of four different signal types.
GPS Synchronizer

Model 9001

Accurate Time and Frequency Sync
Accuracy Within 100 ns of UTC
Parallel Tracking of Eight Satellites

Antenna and Cable Included
Lead-in Options to 2000 Feet
Time, Navigation, and Status Outputs

This module adds GPS synchronization to a Model 9000 Modular Time Code Processor. When the Model 9001 is installed and operating, all of the Model 9000 frequency and time code outputs are synchronized to within 100 nanoseconds of Universal Time (UTC), and long term frequency accuracy is locked to United States Naval Observatory (USNO) standards.

The Model 9001 is a modernized and enhanced version of the successful field-proven designs in TRAK Systems 8800 Series GPS Station Clocks. Once position has been defined, reception is required from only one satellite to maintain GPS synchronization. An averaging mode is provided for initial position definition using three or four satellites, and modes are provided for moving platforms.

The Model 9001 outputs position, satellite data, and fault status to the Model 9000 main logic system for front panel and remote reporting of module or antenna failures. Antenna lead-in propagation delay compensation is provided from the Model 9000.

MODEL 9001 SPECIFICATIONS

Synchronization
The position of the antenna is determined by measuring the pseudo-range to four satellites and computing the position of these satellites using ephemeris data. The receiver basic specifications are as follows:

- **Receiver Description**: L1 C/A code pseudo-ranging
- **Channels**: Eight independent, continuous tracking channels
- **Frequency**: 1575.42 MHz
- **Acquisition time**: Typically less than two minutes

Navigation Outputs
Latitude, longitude, and height with a position accuracy of ± 30 meters, 2 drms (without S/A) are displayed on the Model 9000 front panel LCD display and are available through the RS-232 I/O port and the optional IEEE-488 module.
Timekeeping
The Model 9001 processes Universal Time (UTC). By front panel or remote RS-232 command, this may be changed to local time. When local time is used, automatic daylight savings time adjustments are made at preprogrammed dates. Leap second and leap year adjustments are made automatically.

Fault Isolation
The Model 9001 contains the following built-in test functions:

1 PPS signal failure Monitors presence of signal
EXT STD failure Monitors presence of signal
GPS Receiver Fault output produced after receiver has not been tracking for a selected timeout period.
Antenna disconnected Fault output produced when dc current interrupted.
Computer Operating Detects software errors; e.g., software is no longer being executed. Also monitors the CPU clock.

ANTENNA OPTIONS

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L9</td>
<td>GPS antenna, no cable</td>
</tr>
<tr>
<td>L10</td>
<td>L9 antenna and 50 feet of RG-58 coax cable (included in standard pricing)</td>
</tr>
<tr>
<td>L11</td>
<td>L9 antenna and 100 feet of RG-213 coax cable</td>
</tr>
<tr>
<td>L22</td>
<td>L9 antenna and 250 feet of 9913 cable</td>
</tr>
<tr>
<td>L23</td>
<td>L9 antenna and 500 feet of 9913 cable and one 15 dB in-line amplifier</td>
</tr>
<tr>
<td>L24</td>
<td>L9 antenna and 750 feet of 9913 cable, and one 30 dB in-line amplifier</td>
</tr>
<tr>
<td>L25</td>
<td>L9 antenna and 1000 feet of 9913 cable, and two 25 dB in-line amplifiers</td>
</tr>
<tr>
<td>L26-29</td>
<td>See AN-3A for options up to 2000 feet</td>
</tr>
</tbody>
</table>

Cable lengths over 2000 feet can be provided.

Antenna Description
Antenna unit is 3.5 inches diameter by 2 inches high. Weight is 7 ounces. It is connected to the main chassis via a coaxial cable. A 50 foot cable with TNC connectors is supplied. Operating temperature is -40 to +70 °C.

Setup and Status
The following is a partial list of local and remote settings and status parameters available for the GPS Synchronizer via the Model 9000 computer ports and front-panel keypad & LCD display:

Set/Request position mode
Set position averaging mode
Set/Request UTC/LOCAL time
Set/Request local time offset
Set/Request local position
Request navigation data
Request tracking/locked status
Request satellites being tracked
Request time offset data
Time Code Reader/Synchronizer

Model 9002

General Description
This module adds time code synchronization to the Model 9000 Time Code Processor. When the Model 9002 is installed and operating, it synchronizes the Model 9000 to an incoming serial modulated or DC time code. Three modes of synchronization, as described in the body of this brochure, are provided.

MODEL 9002 SPECIFICATIONS

Modulated Code Input
Formats: IRIG A, B, G, NASA 36-Bit*
Modulation: 2:1 to 6:1
Frequency 125 Hz to 1.5 MHz (single-ended)
125 Hz to 200 KHz (transformer coupled)
Level: 0.3 to 12 volts peak to peak
Impedance: 50 kΩ (single-ended) or
600 Ω transformer coupled (by front panel setup)
Polarity: Front panel setup provides normal, inverted, or automatic polarity selection. Default is automatic.
Connection: BNC

DC Code Input
Function: Used in place of modulated code for synchronization at real time rate only.
Formats: IRIG A, B, G or NASA 36-Bit*
Level: ZERO = 0 to 1.5 Vdc
ONE = 3.5 to 10 Vdc
Impedance: Greater than 10 kΩ
Connection: BNC

1 PPS Input
Function: Overrides the on-time reference extracted from the time code input and becomes the reference for synchronizing minor time. 1 PPS and code input must be phase coherent.
Active edge: Positive-going
Logic level: ZERO = 0 to 0.5 Vdc
ONE = 3.5 to 10 Vdc
Impedance: Greater than 10 kΩ
Connection: BNC

Time Code Output
Description: Buffered Time Code input
Drive: 50 Ω
Connection: BNC

Fault Isolation
The module includes input dropout detection, COP, and other fault detectors to assure a 95% confidence level.

* Other common codes will be added.
Contact TRAK with requirements.
Dual Time Code Generator

Model 9005

- Two Output Formats
- Modulated & DC Codes
- Front Panel Level Adjustments

General Description
The Model 9005 Dual Time Code Generator module is a component of the Model 9000 Modular Time Code Processor. This module generates and outputs two codes in amplitude modulated and DC level-shift formats. Standard module configurations include IRIG, NASA, NSA, and DoD codes. On-board fault isolation detects the loss of any output signal. Faults are reported to the Model 9000 front panel display and remote interface(s).

MODEL 9005 SPECIFICATIONS

<table>
<thead>
<tr>
<th>Standard configurations</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRIG A &amp; B modulated and DC</td>
<td>9005-1</td>
</tr>
<tr>
<td>IRIG E &amp; G modulated and DC</td>
<td>9005-2</td>
</tr>
<tr>
<td>IRIG D &amp; H mod (1 kHz) and DC</td>
<td>9005-3</td>
</tr>
<tr>
<td>IRIG B &amp; NASA 36 mod and DC</td>
<td>9005-4</td>
</tr>
<tr>
<td>XR3 &amp; 2137 modulated and DC</td>
<td>9005-5</td>
</tr>
<tr>
<td>HAVEQUICK, 800 KPPS, &amp; 800 kHz</td>
<td>9005-6</td>
</tr>
<tr>
<td>IRIG B &amp; G modulated and DC</td>
<td>9005-7</td>
</tr>
<tr>
<td>IRIG E &amp; H modulated and DC</td>
<td>9005-8</td>
</tr>
<tr>
<td>Consult factory for special code options.</td>
<td></td>
</tr>
</tbody>
</table>

Modulated Code Outputs
- Level: Adjustable from 1 to 5 Vpp into 50 ohms. Adjusted through front panel keypad/alphanumeric display.
- Modulation Ratio: Adjustable from 2:1 to 6:1
- Drive: 50 ohms
- Coherence: Less than ±1° of one carrier cycle with reference to on-time
- Connections: BNC

DC Code Outputs
- Logic levels: ZERO: 0.2 ± 0.2 Vdc
- ONE: 4.5 ± 0.5 Vdc
- Drive: 50 ohms
- Coherence: Within ±50 ns of on-time
- Connections: BNC

Bus Output Connections
- Function: Buffered time code outputs to backplane for connection to distribution modules.
- Number: Four outputs (modulated & DC) can be patched to four available busses.

Fault Isolation
Each code output is examined for dropout and proper encoding. Fault condition is latched and sent to front panel displays. Latch is reset when fault is cleared and a reset is received from the front panel.
4 Channel Digital Driver

- 15 ns Rise and Fall Times

**General Description**

a single digital signal. Signal input is via the backplane board fault isolation compares each output against the display.

**Bus Input Connections**

the four backplane busses.

<table>
<thead>
<tr>
<th>Rise and fall</th>
<th>15 ns</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTL high is</td>
<td>4.5</td>
</tr>
<tr>
<td>Vdc</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Drive:

Connectors:

Protection: ground.

The fault output is activated when an output signal does latched and is cleared only when fault condition has been 9000 front panel.
4-Channel Differential Driver

Model 9007

- Four RS-422 Drivers per Module
- On-Board Fault Isolation

General Description
This module provides four RS-422 differential TTL outputs of a single digital signal. Signal input is via the backplane from a rate generator or DC code generator module. On-board fault isolation compares each output against the module input and reports failures to the front panel display.

SPECIFICATIONS

Bus Input Connections
An on-board jumper selects the signal from one of the four backplane busses.

Output Characteristics
- Output drive: Designed to drive 120 Ω differential lines.
- Connectors: Twin BNC
- Protection: Outputs withstand continuous shorts to ground.

Fault Isolation
The fault output is activated when an output signal does not compare to the input signal. Fault condition is latched and is cleared only when fault has been cleared and a reset has been received from the Model 9000 front panel.
4-Channel Linear Driver

Model 9008

- Four DC to 10 MHz Drivers Per Module
- 10 Volts Peak-to-Peak Into 50 Ohms
- On-Board Fault Isolation

**General Description**

This module provides four independently buffered outputs of a single analog signal in the dc to 10 MHz range. Signal input is via the backplane from a sinewave rate generator or a time code generator module. On-board fault detectors detect output dropouts and report failures to the front panel display.

**SPECIFICATIONS**

**Bus Input Connections**

An on-board jumper selects the signal from one of the four backplane busses.

**Output Characteristics**

Frequency response: DC to 10 MHz ± 1 dB into 50

**Output Characteristics (cont)**

Level: Same as programmed input signal.

Drive: 50 Ω

Connectors: BNC

Protection: Outputs withstand continuous shorts to ground.

**Fault Isolation**

The fault output is activated when any output signal falls below a preset level. Fault condition is latched and is cleared only when fault has been cleared and a reset has been received from the Model 9000 front panel.
Sinewave Rate Generator

![Sinewave Rate Generator](image)

**Model 9009**

- Four Independent Sinewave Outputs
- Front Panel Level Adjustments

This module generates four sinewave frequencies in the range of 100 Hz to 10 MHz. Outputs are also available to the backplane for patching to 4-Channel Linear Drivers. Output levels are adjustable from 1 to 5 Vpp into 50 ohms.

Dual RS-232 Time Output

![Dual RS-232 Time Output](image)

**Model 9010**

This module has two independent RS-232 ports that output time with a resolution of one millisecond. Time on each port is available by request, continuously once per second or continuously ten times per second.

Telecommunication Signal Generator

![Telecommunication Signal Generator](image)

**Model 9011**

This module generates a T1 or E1 signal per ITU and other worldwide standards. Rates are 1.544 MPPS or 2.048 MPPS. Other rates are available.
Parallel Code Generator

Model 9012

This module provides parallel BCD or Binary time outputs. The standard module produces BCD time of year to a resolution of 100 ns. Outputs are TTL logic levels at ± 6 ma. Two configurations are available — one with Busy & Strobe lines; the other with Data Freeze.

Slow Code Generator

Model 9013

This module has four outputs of a bi-level slow code. One of seven different frame rates from 1 second to 10 minutes is selected from the front panel.

Digital Rate Generator

Model 9014

This module generates four TTL signals capable of driving 50 ohm loads with 15 nanosecond rise and fall times. The standard module can be programmed from the Model 9000 front panel for up to four of the rates shown below. Other rates are available on special order. The module has two independent generators that are compared against each other for fault detection purposes.

SELECTABLE RATES & WIDTHS (Model 9014-1)

<table>
<thead>
<tr>
<th>Rate</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 PPS</td>
<td>100 µs</td>
</tr>
<tr>
<td>5 PPS</td>
<td>100 µs</td>
</tr>
<tr>
<td>10 PPS</td>
<td>100 µs</td>
</tr>
<tr>
<td>20 PPS</td>
<td>100 µs</td>
</tr>
<tr>
<td>100 PPS</td>
<td>100 µs</td>
</tr>
<tr>
<td>1 KPPS</td>
<td>100 µs</td>
</tr>
<tr>
<td>10 KPPS</td>
<td>1 µs</td>
</tr>
<tr>
<td>100 KPPS</td>
<td>1 µs</td>
</tr>
<tr>
<td>1 MPPS</td>
<td>SQ</td>
</tr>
<tr>
<td>2 MPPS</td>
<td>SQ</td>
</tr>
<tr>
<td>10 MPPS</td>
<td>SQ</td>
</tr>
<tr>
<td>10 PPM</td>
<td>1 sec</td>
</tr>
<tr>
<td>100 PPM</td>
<td>1 sec</td>
</tr>
<tr>
<td>5 PPH</td>
<td>1 sec</td>
</tr>
<tr>
<td>10 PPH</td>
<td>1 sec</td>
</tr>
<tr>
<td>12 PPH</td>
<td>1 sec</td>
</tr>
</tbody>
</table>
Time Tag & Event Trigger

Model 9016

This module has two independent functions: (1) Time Tag Port captures external pulse events and stores their time of occurrence for output on the RS-232 port. Resolution is 20 ns. (2) An output (EVENT) pulse is generated at a preset time with a resolution of 1 ms.

VHF Receiver/Synchronizer

Model 9017

This module receives an IRIG B signal frequency modulated on a 139-144 MHz carrier. The IRIG B output from the receiver section synchronizes the Model 9000 in the Synchronized Generator mode. Two carrier frequencies may be specified. The module contains a frequency selection switch.

Rubidium Oscillator

Model 9018

This module adds a disciplined rubidium oscillator to the Model 9000B. When a synchronizer is installed in the Model 9000, its output disciplines the Model 9018. When the module is installed, it becomes the main frequency source, and the internal crystal oscillator becomes a hot standby in the event of a failure in the Model 9018.
Typical Front & Rear Panel Views

Typical 9000A Front Panel

Typical 9000B Front Panel

Typical 9000A Rear Panel

Typical 9000B Rear Panel