Arbiter Systems, Inc.
Satellite-Controlled Clocks

Option 32: Internal Network Time Protocol Server

1.0 General Description.

Option 32: Internal Network Time Protocol (NTP) Server, is used in the Arbiter Systems line of 19" rack mount Satellite-Controlled Clocks.

1.1 Option 32.

Option 32 allows the clock to act as time server over an ethernet network using the network time protocol operating in server mode - symmetric operation modes are not supported. Time is distributed over the network interface to computers, controllers and other equipment needing the correct time. Option 32 understands NTP Version 1, Version 2, and Version 3 frames, and optionally supports authentication via DES and MD5 cryptographic checksums. If authentication is not used, the controller can typically be used for hundreds of clients without overloading it. Authentication requires typically 40ms for checking and generating the cryptograms, which is covered and averaged out by the protocol. Option 32 supports full SNTP and all NTP functions required for reliable server operation. Functions not required for server operation are not implemented.

2.0   Hardware Configuration.

Option 32 consists of two building blocks; an OEM NTP module and an interface to the GPS clock. The NTP Server (Option 32) is connected to the main board via the standard 50 pin option cable. The NTP Server has two external connectors, an RS-232 (DB-9 male) and a 10/100 Base-T (RJ 45). In addition to the connectors there are three status LED's on the rear Panel. See figure 1.

2.1 External Connectors.
The RS-232 connector can be used to interrogate the clock or to configure the NTP module depending on the jumper settings (see section 2.3 Jumper Settings). The port parameters are set to 9600, N, 8, 1. This RS-232 port is not operational during normal use. The ethernet port is used to distribute time and can also be used to configure the NTP module.
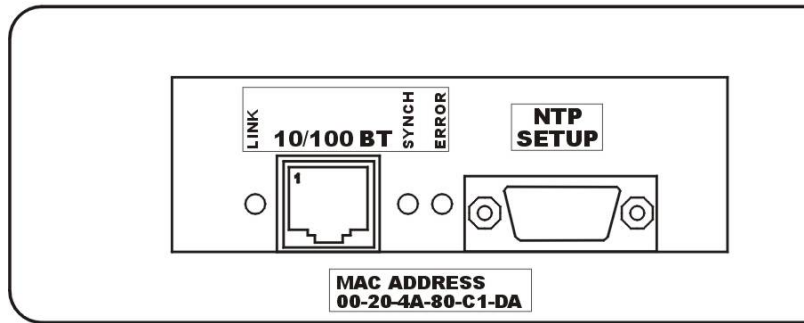
PD0028800B

Figure 1: Option 32 Rear Panel

2.1.1 RS-232..
The RS-232 port uses a 9 pin d-sub connector. This connector is configured as a DTE device with the following pin out:

Transmit (TXD)   Pin 2
Receive (RXD)   Pin 3
Ground (GND)   Pin 5

2.1.2 10/100 Base-T.
Option 32 uses the standard 10/100 base-T connection for connecting to an ethernet. Figure 1 indicates the location of pin 1.

Txd +   Pin 1
Txd -   Pin 2
Rxd +   Pin 3
Rxd-   Pin 6

2.2 Status LED's
There are three status LED's on the rear panel of Option 32. The LED's are Link (green), Synch (green) and Error (red). Option 32 will perform an initial self test when powered on. After the initial self-test phase, where all status LEDs should be lit, the LED's indicate the status of the NTP Server.

2.2.1 Link LED
Link (green) LED on: ethernet 10/100 base-T connection is good.

2.2.2 Synch LED
Synch (green) LED on: synchronized to the time signal, correct reception of time data, requires the satellite controlled clock to be synchronized.
Synch LED flashing 50% duty cycle: Some information received, but not yet synchronized reliably.

2.2.3 Error LED
If the Error LED is on or blinking the Synch LED will give a diagnostics code.

Error (red) LED stable on , Synch (green) LED flashing
>1x: EPROM-checksum error
>2x: RAM-error
>3x: Network controller error
>4x: E²PROM checksum error or bad
>5x: IP address already used on network

Error LED flashing, Synch LED flashing
>4x: Faulty network connection
>5x: No DHCP response was received

2.3 Jumper Settings.

There are three jumpers on Option 32. Jumpers 1 and 2 (JMP1 and JMP2 on figure 2) control the serial port. When JMP1 and JMP2 are in position A (top), Option 32 will operate as an NTP Server. Setting JMP1 and JMP2 to the B (middle) allows the clock to be interrogated. Both JMP1 and JMP2 must be placed in position C (bottom) to configure the NTP module via the RS-232 port. Jumper 3 (JMP3) is set according to clock model.

Table 1: JMP1 and JMP2 Settings.

Position	Function
A	Clock connected to the NTP module (default)
B	Clock connected to the external RS-232 port *
C	NTP module connected to the external RS-232 port.

*The clock must be configured for the second RS-232 Option 17A (Model 1088B) to allow bi-directional communication.

JMP1 and JMP2 should be in the same position and are required to be in position A for normal operation of Option 32.

Table 2: JMP 3 Settings.

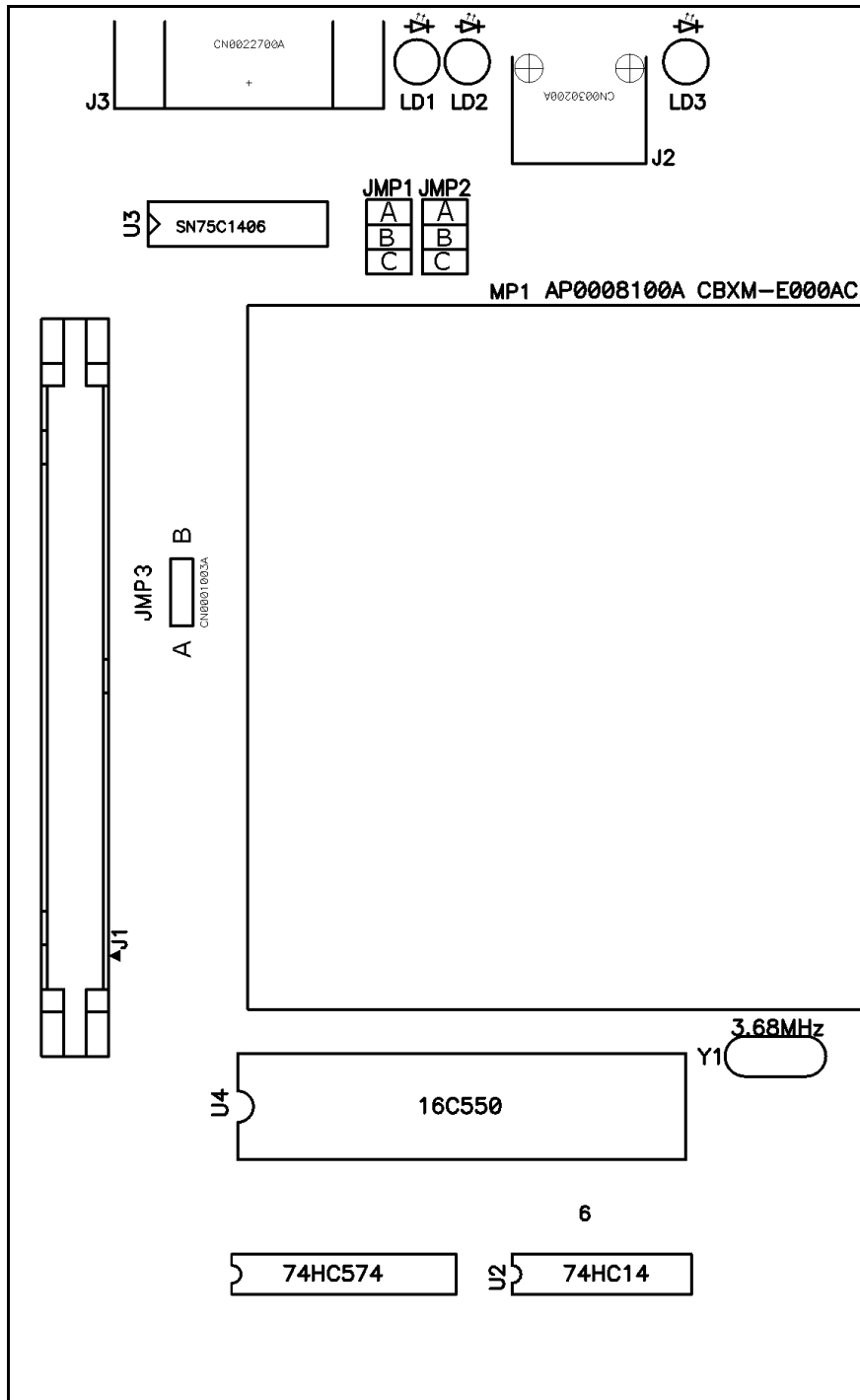| Position	Function
A	For installation in the Model 1088B
B	For installation in the Model 1084A/B/C or Model 1093A/B/C

Figure 2: Jumper Locations.

3.0 Firmware Configuration.

Firmware configuration for the Option 32 is performed in two parts: the first part involves setting the correct option number via the front panel; next requires configuring the ethernet port via the option RS-232 port or the ethernet port.

3.1 Front Panel.

1. Apply power and observe the front panel display, when 'CLOCK STATUS STARTUP' is displayed, press the SETUP key.

2. Navigate through the series of menu selections, using either the DOWN, UP or SETUP key, until SET OPTION BOARD? Appears (Slot B for the Model 1088B).

3. Press ENTER, and then press the UP key until Option 32 is displayed. Press ENTER.

Modifications to the operating parameters (such as Time Quality format or UTC/Local time) may be made without re-initialization after the board has been installed and initialized. If the basic option setup has changed then reinitialization may be necessary.

3.2 NTP Module.

The NTP module can be configured over the ethernet port or the option RS-232 port. The ethernet is the preferred port, as no configuration changes are required to use this port.

3.2.1 Ethernet

To configure the NTP module over the network, a Telnet connection to port 9999 must be established. The default IP number for the ethernet is 192.168.0.232. If the IP address of the NTP Server (NTS) is unknown or undefined, the following sets a temporary IP address:

a) Set a static ARP with the desired IP address using the hardware address of the NTS, which is printed on the product label. The address can also be calculated from the serial number. Below is the command example for WinNT/Win95, using the DOS prompt, when the hardware address of the NTS is 00-20-4A-02-64-0B.

arp -s 192.168.0.232 00-20-4A-02-64-0B

NOTE: *In order for the ARP command to work in Windows, the ARP table on the PC must have at least one IP address defined other than its own. Type "ARP –A" at the DOS command prompt to verify that there is at least one entry in the ARP table. If there is no other entry beside the local machine, ping another IP machine on your network to build the ARP table. This has to be a host other than the machine that you're working on. Once there is at least one entry in the ARP table, use the listed commands to ARP an IP address to the NTP Server.*

The command example for most **Unix** systems is:
>   **arp -s 192.168.0.232 00:20:4A:02:64:0B**

b) Open a telnet connection to port number 1. This connection will fail, but the NTS will change its IP address to the desired one in that step. **telnet 192.168.0.232 1**

c) Open a telnet connection to port 9999 and set all required parameters. **telnet 192.168.0.232 9999**

NOTE: *The temporary IP address is reverted after every power reset of the NTS. Be sure to enter the configuration and store the parameters to make the changes permanent.*

3.2.2 Serial

An ASCII terminal or PC with a terminal emulation can be connected to the option RS-232 port, but JMP1 and JMP2 must be set to "C". The terminal (or PC) should be configured to 9600 Baud, no parity, 8 data-bit, 1- stop bit. The power must be cycled to enter the configuration mode. The self-test begins after power-up. About a half-second later the Error (red) LED starts blinking. Now send three lowercase 'x' characters to the NTP Server. These characters must all be sent within one second to start configuration mode.

NOTE: The easiest way to enter configuration mode is to hold down the 'x' key at the terminal (emulation) and then powering the NTP Server. This will ensure that the x characters will arrive in time

3.3   General Configuration
After configuration mode is entered (confirm with <CR>), the parameters can be changed; default values can be confirmed with the enter key. When leaving the setup mode – after selecting function 9 – all parameters are stored in a nonvolatile memory and the NTP server resets.

3.3.1 Basic Parameters
To change the basic parameters, type '0'. The following values can be set/changed:

Ethernet Interface: Set to (N).

IP Address: The IP address must be set to a unique value in your network. If the NTP Server is set to an address, which is already in use, it will display an error code with the LEDs (see "LED Status") and will not connect to the network.

Gateway IP Address: The router/gateway address is needed to communicate to other LAN segments. The default gateway must be set to address the router that connects these segments. This address must be within the local network. If in doubt, consult the network administrator.

Netmask: A netmask defines how many bits from the IP address are to be taken as the network section and how many bits are to be taken as the host section (reminder: Standard class A 8/24 (net/host), class B 16/16, class C 24/8 bits). If set to 0, the standard appropriate netmask for the actual IP address is used. The NTS prompts for the number of host bits, and then calculates the netmask. It is shown in standard format "255.255.xxx.xxx" when parameters are displayed.

Telnet Config Password: The Telnet configuration password can be set to disable unauthorized access to the setup menu through a Telnet connection to the setup port (9999). For the setup through the serial port, it is not necessary to enter the password. The controller can be configured over a Telnet connection to port 9999 (assuming the network parameters are set correctly and the NTS is connected to the network).

3.3.2 NTP Server Parameters

The network operations of the server are controlled by various parameters.
Antenna Type: Set type to 6=GPS/Arbiter

UDP-Port: The UDP port selects the port number for the NTP proprietary protocol.

Send Block Every n Minutes: This parameter determines how often the data block should be sent.

Send UDP-Broadcast: If the time information should be sent to all devices connected to this LAN (broadcast), set this parameter to "Y" = yes.

UDP-Target Address: This parameter determines the target addresses to which the data block should be sent. The data block can be sent over a Gateway or other devices to another part of the network. The maximum number of defined addresses is eight. NTP and UDP/time port numbers are fixed to the values defined in RFC-37 and RFC-123 respectively. If the authentication option is enabled, up to seven MD5 or DES keys can be entered (key numbers 1..7). All key input must be done in hexadecimal format; MD5 key length is limited to eight characters.

When leaving the setup mode – after selecting function 9 – all parameters are stored in a nonvolatile memory and the NTP server resets. Select 8 to exit without saving modifications.