NATIONAL RADIO ASTRONOMY OBSERVATORY
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DIGITAL SIDEREAL CLOCK SYSTEM

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Requirements

Sidereal time is part of the data recorded at several of the scopes. The time is also necessary for calculating Right Ascension of a Polar Scope like the 85-foot. All Standard Identification Data is recorded as Binary Coded Decimal numbers. A standard frequency could be counted at each scope to provide the sidereal time or the standard frequency could be counted at a central location and the Binary-Coded Decimal Time Signals transmitted to the scopes. The second system was chosen and thus noise on the BCD data lines causes only a temporary error.

General

Binary Coded Decimal signals are generated by the Clock Master by counting a 1 kc standard signal. These signals are transmitted to several scopes by a telephone cable. Clock slaves convert the telephone-cable signals to noise-free logic-level signals.

This document covers the following:

Clock Master

Clock Slave - 85-Foot Telescope No. 1

Clock Slave - 85-Foot Telescope No. 2

300-Foot Clock Slave and Time Comparator (slave portion only)

The following drawings are available:

DL 550	300-Foot Clock Slave and Time Comparator
DS 975	BCD-Decimal Converter
DL 1150	85-Foot Telescope No. 2 Clock Slave
DL 2150	85-Foot Telescope No. 1 Clock Slave
	Telephone Cable (from Telescope Operations)

Clock Master

The Clock Master is located in the basement of the Jansky Lab building. A chassis and one Computer Control Corporation logic bloc are used. Fourteen logic cards are required. Twenty-six mercury relays (HGS 5015 or JML 1160-81) are used as line drivers. One relay is used to drive the "arm" lamp.

The BC logic cards count the 1 kc clock and drive mercury relays. The relays drive the display lamps and the telephone lines. One side of each pair of wires is grounded at the master and the other side is connected to -18 or to +12 volts by the relay contacts. Tenths of seconds and all higher digits are on the cable. Two additional relays provide ΔT and $0.1\,\Delta T$ signals. The ΔT signal occurs for 0.1 second before and 0.1 second after the beginning of each second. The $0.1\,\Delta T$ signal occurs for 0.01 second before and 0.01 second after the beginning of each tenth of a second.

Lamps are used to display the Binary Coded Decimal state of the counter modules. The -18 volt state of the telephone line lights the lamp. BCD time is displayed to units of seconds (tenths of seconds not displayed).

The Master Clock is set (corrected) by setting switches on the front panel to a future correct time. Refer to Digital Drawing No. DL 550. The setting circuit is "armed" by moving the toggle switch to the "arm" position and releasing it. The "armed light" will light. The setting circuit may be reset to a "no action" state without changing the state of the counters by momentarily moving the switch to the "reset" position. Assuming the "arm light" is "on" and the "normal test switch" is in the "normal" position, the counters may be set to the number on the switches by operating the "trigger" switch. The "armed light" will extinguish. An electrical trigger input is provided, but a trigger generator has not been designed. A device that produces a pulse at each "tick" of WWV would be useful. The operator could select the proper "tick".

Basic Clock Slave

The Basic Clock Slave uses mercury relays (GHS 1114) to generate clean logic BCD signals from the data on the telephone cable. The low side of the telephone pair is connected to the relay common circuit. This circuit is connected neither to chassis

nor to earth at the Slave. Ground (earth) potential problems are eliminated in this way. The high side of the telephone pair is connected to the input (high) side of the bipolar relay (HGS 1114). Refer to digital drawings DL 950 (300-foot), DL 1150 (85-foot No. 2) and DL 2150 (85-foot No. 1).

The Decimal Display at the 300-Foot Telescope

A decimal readout is provided at each Clock Slave. The 300-foot system uses a special card (digital drawing DS 975) to convert from BCD to Decimal. The decimal signal drives a Lamp-Driver Card. The Lamp-Driver operates the decimal projection displays (rear projection type by Industrial Electronic Engineers, Inc.) in the console.

The Decimal Display at the 85-2 Telescope

The Decimal Display is done with Nixie tubes and BCD to NIXIE decoder. Refer to drawing DL 1150. The readout display was purchased from Electronic Control Products and uses the following items:

Six B-100	Nixie Decoders
One BD-412	6-Unit Bezel With Filter
Six B-5092	Wide Angle Nixie Tubes

The Decoder is controlled by the relay logic outputs. A 200 volt power supply is required to power the Nixie tubes. The Electronic Control Products organization has been purchased by Coltronics, Inc., Bound Brook, New Jersey.

The Decimal Display at the 85-1 Telescope

The Decimal Display uses a Nixie system similar to the one at the 85-2. Refer to digital drawing DL 2150. The parts were purchased from Burroughs Corporation and consist of the following items:

One BEZ 59-7-8	Bezel (special)
Seven B-5991	Rectangular Nixie Tubes
Seven BIP 8211S	Binary Decoder.

The Decimal Display at the 85-1 Telescope (Continued)

This Decoder is also driven by standard logic levels from the relays. The Nixies are powered by a 200 volt supply.

E R R A T A

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THE FLUX DENSITY VALUES OF STANDARD SOURCES
USED FOR ANTENNA CALIBRATIONS

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Replace equation (1) by:

$$S(\varphi_E) = \overline{S} \{1 + p - 2\, p \sin^2(\varphi_p - \varphi_E)\}$$

(9/9/64)