NATIONAL RADIO ASTRONOMY OBSERVATORY
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300-FOOT TELESCOPE POSITIONER II

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I. General

The position of the 300-foot telescope is displayed for the operator and electrical Binary Coded Decimal position data is available for recording. Automatic positioning of the telescope and automatic "wobbling" equipment has been recently added to the Positioner II.

The 300-foot scope has two decimal encoders, one at each end of the declination axis. The smallest encoder increment is 10 seconds of arc. The encoders are custom units (Model 1021 A) manufactured by Baldwin Electronics. Either encoder may be connected to the Positioner II.

The encoder is interrogated at approximately 10 times per second. The output is cyclic-excess-three for the decimal digits and cyclic-excess-one for the senary digits. The encoder data is stored in a register, then converted to a non-cyclic decimal (still gray) code. See Digital Drawing DL-750. The excess codes are converted to 10 line decimal code to drive the projection display on the console. The 10 line decimal code is converted to BCD 1-2-4-8 code for recording on to tape. The system output is displayed and recorded as N or S 99 degrees, 59 minutes, and 50 seconds.

II. Encoder Code and Code Conversions to Decimal

The encoder code is a cyclic-excess code. All encoders that do not include a "V-brush" arrangement require the use of a cyclic code. A decimal cyclic code for the number X and the number 9-X are interchanged depending upon the odd-even character of the previous digit.

		Code	
Number	Number + 3	Previous Digit-Odd	Previous Digit-Even
0	3	0010	1010
1	4	0110	1110
2	5	0111	1111
3	6	0101	1101
4	7	0100	1101
5	8	1100	0100
6	9	1101	0101
7	10	1111	0111
8	11	1110	0110
9	12	1010	0010

(between rows 4 and 5: "almost mirror image", with arrows)

The first digit (tens of degrees) assumes that the previous digit was odd.

The code is recognized as a "gray code" representation of three plus the number. The similar excess-one code for the senary digits is shown below.

		Code	
Number	Number + 1	Previous Digit-Odd	Previous Digit-Even
0	1	001	101
1	2	011	111
2	3	010	110
3	4	110	010
4	5	111	011
5	6	101	101

(between rows 2 and 3: "almost mirror image", with arrows)

The data from the flip-flop register is buffered by using lamp-drivers (LD-30) as amplifiers. The most significant binary digit of each decimal or senary number is reversed if the previous more significant decimal or senary number is even. The source of the "odd-even" data will be explained later. Each decimal or senary number is now independent of the other digits. The excess-three gray code is converted to ten-line decimal by a special card (DS 777). The excess-one gray senary code is converted to six-line senary by a special card (DS 775). These six and ten line signals control lamp-drivers which in turn drive the projection displays in the console.

III. Decimal to Binary Coded Decimal Conversion

The same six-line and ten-line signals that drive the projection displays are used to drive the "nand gates" on drawing DL 751. This drawing shows the logic required to obtain BCD outputs. Notice that the "one weight" (least significant BCD bit) is also an "odd-even" indicator. This "odd-even" signal was used in the conversion of cyclic gray to a gray code in which each decimal number is independent. The resistors to -18 volts on the BCD output lines are located on the special card (DS 776) in location AA. The DIT and scanner require the inverse or bar side of the BCD data signals. The lamp drivers that follow the nand gates provide the bar signals.

IV. Automatic Positioning and Automatic Wobble

The 300-foot scope is positioned to an approximate position by setting the new position on switches and starting the telescope position drive in the proper direction. When the proper location is reached, the scope is stopped automatically. The operator is required to bring the scope to the exact position. Although the equipment does not do the final positioning of the scope, it does relieve the operator from waiting for the scope to reach the approximate location.

Automatic wobbles of up to 59 minutes are done automatically. The scope is positioned between the two limits manually. The most northern limit and most southern limit of the wobble are set on switches. When the wobbler control switch is moved to ON the scope will move north until it reaches the north limit, wait one second, then move south until it reaches the south limit, wait one second, move north. This process will continue until the switch is moved to OFF. This process along with position markers on the analog record is used during focusing of the scope.

The logic required for these two automatic operations is shown in DL 752. The position signals from the Positioner II are picked up at the position displays in the console. The data is used in the position switches to indicate a comparison between the switches and the present position of the scope.

The wiring is shown in drawing DL 753. The output from the switches goes to the auto-position logic located near the Positioner II. A strobe pulse from the Positioner II logic is used to eliminate errors caused by the changing data. The output comparison logic drives mercury relays. These mercury relays are used to control power relays in telescope drive electrical system.

V. Special Purpose Cards

1. Interrogation Driver - DS 776

The interrogation driver consists of an emitter-follower driving an inverting amplifier. A potentiometer on the front panel controls the amplitude of the pulse generated by the amplifier. In addition to the amplifier, resistors are located on this card that enable LD-30 circuits (lamp drivers) to drive logic.

2. Excess three gray to 10 line decimal converter - DS 777

This card contains a diode matrix for the conversion. The output of the matrix feeds LD-30 circuits.

3.   <u>Excess one gray to 6 line senary converter - DS 775</u>

This card contains a diode matrix for the conversion.   This card is similar to the decimal converter except for the location of the diodes.

VI.   List of Applicable Drawings

300-Foot Positioner Model II Position Decimal Readout	----------	DL 750
300-Foot Positioner Model II Position BCD Readout	----------	DL 751
Gray to Senary Converter	----------	DS 775
Gray to Decimal Converter	----------	DS 777
300-Foot Positioner Model II Interrogate Driver	----------	DS 776
300-Foot Automatic Positioner Comparison Logic	----------	DL 752
300-Foot Automatic Positioner Switch Wiring	----------	DL 753

VII.   Encoder Data

Part No. 1021A.   Serial No. 62-122 (East) and 63-520 (West)

Replaceable Parts

<u>Baldwin No.</u>

905-2547	19th Channel level discriminator and negative output assembly
905-1965-3	Lamp assembly
905-1827	Level discriminator amplifier assembly
905-1843	Negative output module
905-1828	Power supply module
905-1826	Trigger module