NATIONAL RADIO ASTRONOMY OBSERVATORY
GREEN BANK, WEST VIRGINIA

Electronics Division Internal Report No. 182

140-FT MODCOMP INTERFACE
BUILT BY NRAO

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NOVEMBER 1977

NUMBER OF COPIES: 150
140-FOOT MODCOMP INTERFACE BUILT BY NRAO

Dwayne R. Schiebel

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</tr>
</tbody>
</table>
I. Introduction

This report describes all interface built by NRAO for the MODCOMP system installed at the 140-ft. Each interface is listed below:

Clock and Calendar
ULO Control
Data Taking Control Panel
A/D Converter
MODCOMP to H316 Link
MODCOMP from H316 Link
Telescope Control Panel
Autocorrelator
On-Line to Off-Line Computer Link

II. Programming

All interfaces have been designed for the following program flow for non-DMP devices:

1. Program issues a terminate command.*
2. Interface responds with a service interrupt.
3. Program issues an output command.
4. Interface responds with a data interrupt when it is ready for a data transfer.
5. Program will input or output the data. This data interrupt, data transfer continues until the block of data is transferred.
6. Interface issues a service interrupt when the block of data is transferred.

* Note: The service interrupt should be connected before issuing the terminate.

1. Clock and Calendar

Device Address 39 - Data Interrupt Entry Location B9
Priority 12 - Service Interrupt Entry Location F9
Service Interrupt Return Location 3A*
Data Interrupt Return Location 38*

*These addresses are the same for all devices.
**ISD Input Status.** This command inputs the status of the device. The following table lists the bits that are used:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1 = No Error Condition Exists, 0 = Error Condition Bits 13-15 Point to the Device</td>
</tr>
<tr>
<td>3</td>
<td>1 = Inoperable; this will always be the opposite state of Bit 0.</td>
</tr>
<tr>
<td>13</td>
<td>1 = -15 V Power Supply Failed.</td>
</tr>
<tr>
<td>14</td>
<td>1 = Clock Problems.</td>
</tr>
<tr>
<td>15</td>
<td>1 = Calendar Problems.</td>
</tr>
</tbody>
</table>

**OCD Output Command.** This command initiates a data transfer, or sends a terminate to the interface. The bit structure for these two commands are listed below:

<table>
<thead>
<tr>
<th>Bits</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer</td>
<td>1</td>
<td>0</td>
<td>D</td>
<td>S</td>
<td>1</td>
<td>I</td>
<td>G</td>
<td>N</td>
<td>O</td>
<td>R</td>
<td>E</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminate</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>I</td>
<td>G</td>
<td>N</td>
<td>O</td>
<td>R</td>
<td>E</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D = 1 Connect Data Interrupt  
S = 1 Connect Service Interrupt

**IDD Input Data Command.** This command will input data from the interface and should be executed in response to a data interrupt. Four words are required to input the clock and calendar data; their format is listed below:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Word 1</th>
<th>Word 2</th>
<th>Word 3</th>
<th>Word 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>40 sec.</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>20 hour</td>
<td>20 sec.</td>
<td>20</td>
<td>20 day</td>
</tr>
<tr>
<td>3</td>
<td>10 hour</td>
<td>10 sec.</td>
<td>10</td>
<td>10 day</td>
</tr>
<tr>
<td>4</td>
<td>8 hour</td>
<td>8 sec.</td>
<td>8</td>
<td>8 day</td>
</tr>
<tr>
<td>5</td>
<td>4 hour</td>
<td>4 sec.</td>
<td>4</td>
<td>4 day</td>
</tr>
<tr>
<td>6</td>
<td>2 hour</td>
<td>2 sec.</td>
<td>2</td>
<td>2 day</td>
</tr>
<tr>
<td>7</td>
<td>1 hour</td>
<td>1 sec.</td>
<td>1</td>
<td>1 day</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>.8 sec.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>40 min.</td>
<td>.4 sec.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>20 min.</td>
<td>.2 sec.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>10 min.</td>
<td>.1 sec.</td>
<td>10</td>
<td>month</td>
</tr>
<tr>
<td>12</td>
<td>8 min.</td>
<td>0</td>
<td>8</td>
<td>month</td>
</tr>
<tr>
<td>13</td>
<td>4 min.</td>
<td>0</td>
<td>4</td>
<td>month</td>
</tr>
<tr>
<td>14</td>
<td>2 min.</td>
<td>0</td>
<td>2</td>
<td>month</td>
</tr>
<tr>
<td>15</td>
<td>1 min.</td>
<td>20 hr. solar</td>
<td>1</td>
<td>month</td>
</tr>
</tbody>
</table>
2. **ULO Control**

Device Address 30 - Data Interrupt Entry Location B0
Priority 9 - Service Interrupt Entry Location F0

**ISD Input Status.** This command inputs the status of the device. The status bits and their meaning are listed below.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Always equal to a one.</td>
</tr>
<tr>
<td>6</td>
<td>0 = ULO #2 connected.</td>
</tr>
<tr>
<td>7</td>
<td>0 = ULO #2 comp./manual switch set to comp.</td>
</tr>
<tr>
<td>8</td>
<td>ULO #2 front panel switch; see below.</td>
</tr>
<tr>
<td>9</td>
<td>ULO #2 front panel switch; see below.</td>
</tr>
<tr>
<td>10</td>
<td>0 = ULO #1 connected.</td>
</tr>
<tr>
<td>11</td>
<td>0 = ULO #1 comp./manual switch set to comp.</td>
</tr>
<tr>
<td>12</td>
<td>ULO #1 front panel switch; see below.</td>
</tr>
<tr>
<td>13</td>
<td>ULO #1 front panel switch; see below.</td>
</tr>
<tr>
<td>14</td>
<td>ULO #1 front panel switch; see below.</td>
</tr>
<tr>
<td>15</td>
<td>ULO #1 front panel switch; see below.</td>
</tr>
</tbody>
</table>

Bit 8 9 10 ULO #2
13 14 15 ULO #1

<table>
<thead>
<tr>
<th>Bit</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 0 1 Modulate</td>
</tr>
<tr>
<td>0</td>
<td>0 1 0 FREF 1</td>
</tr>
<tr>
<td>0</td>
<td>0 1 1 FLO</td>
</tr>
<tr>
<td>1</td>
<td>0 0 0 FREF 2</td>
</tr>
<tr>
<td>1</td>
<td>1 1 1 Synthesizer in Local</td>
</tr>
</tbody>
</table>

**OCD Output Command.** This command initiates a data transfer or sends a terminate to the interface. The command format is listed below:

<table>
<thead>
<tr>
<th>Bits</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer</td>
<td>Ignored</td>
<td>U</td>
<td>N</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initiate</td>
<td></td>
<td>T</td>
<td>O</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminate</td>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ULO1  1 = Select ULO #1
ULO2  1 = Select ULO #2
IN1   1 = Input the ULO Counter
IN2   1 = Input the IF Processor Counter
OUT   1 = Output to the ULO
S     1 = Connect Service Interrupt
D     1 = Connect Data Interrupt
IDD Input Data. Data can be input from two devices depending on the transfer initiate command. The format for each device is listed below.

### ULO Counter

<table>
<thead>
<tr>
<th>Bits ...</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word 1</td>
<td></td>
<td></td>
<td>MSD</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Bands*</td>
<td>FLO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word 2</td>
<td></td>
<td></td>
<td>10 0 0</td>
<td>0 0 0 0</td>
<td>0 0 0 0</td>
<td>0 0 0 0</td>
<td>FREF 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word 3</td>
<td></td>
<td></td>
<td>SAME AS ABOVE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word 4</td>
<td></td>
<td></td>
<td>SAME AS ABOVE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word 5</td>
<td></td>
<td></td>
<td>SAME AS ABOVE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word 6</td>
<td></td>
<td></td>
<td>SAME AS ABOVE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word 7</td>
<td></td>
<td></td>
<td>SAME AS ABOVE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word 8</td>
<td></td>
<td></td>
<td>SAME AS ABOVE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word 9</td>
<td></td>
<td></td>
<td>SAME AS ABOVE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Bands - Bits 12 = 1 Add 1700 MHz to Counter Reading
13 = 1 Add 1300 MHz to Counter Reading
14 = 1 Add 900 MHz
15 = 1 Take Counter Reading as it is.

### IF Processor Counter

<table>
<thead>
<tr>
<th>Bits ...</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word 1</td>
<td>10's kHz</td>
<td>1's kHz</td>
<td>100's MHz</td>
<td>BA*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100's MHz</td>
<td>10's MHz</td>
<td>1's MHz</td>
<td>100's kHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* BA - Bits 12 13 14 15

0 0 0 0 0 LO A
0 0 0 1 0 LO B
0 0 1 0 0 LO C
0 0 1 1 0 LO D

ODD Output Data. Output data as in the table below to set the LO frequency. Data is in BCD; the maximum number for 100's MHz is four.

<table>
<thead>
<tr>
<th>Bits ...</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word 1</td>
<td>100's MHz</td>
<td>10's MHz</td>
<td>1's MHz</td>
<td>100's kHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100's MHz</td>
<td>10's MHz</td>
<td>1's MHz</td>
<td>100's kHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1's kHz</td>
<td>10's kHz</td>
<td>100's MHz</td>
<td>Hz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1's Hz</td>
<td>Hz</td>
<td>100's MHz</td>
<td>Hz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* FLO | FREF 1 | FREF 2
3. Data Taking Control Panel

Address 38  Data Interrupt Entry Location B8.
Priority 12  Service Interrupt Entry Location F8.

ISD Input Status. The status format is listed below.

<table>
<thead>
<tr>
<th>Bit</th>
<th>0</th>
<th>1 = Device is in operation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>= Device is in operation.</td>
</tr>
</tbody>
</table>

OCD Output Command. The bit structure is listed below.

<table>
<thead>
<tr>
<th>Bits ...</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer</td>
<td>D</td>
<td>1</td>
<td>0</td>
<td>D</td>
<td>S</td>
<td>I</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Initiate</td>
<td>R</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Terminate</td>
<td></td>
<td>D</td>
<td>1</td>
<td>= Connect Data Interrupt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>1</td>
<td>= Connect Service Interrupt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DIR</td>
<td>1</td>
<td>= Input to Computer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>= Output to Panel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IDD Input Data. The panel has thirteen words of data to input; the bit structure is listed below.

Word 1  15 Push buttons; 1 = button was pressed
Word 2  Bit 6 = Cal On was pressed
         Bit 7 = Cal Off was pressed
         Bit 14 = Programable push button 1
         Bit 15 = Programable push button 2
Word 3  Bit 6 7 14 15
         0 0 Manual 0 0 GST
         0 1 Pulsed 0 1 GMT
         1 0 Timed 1 0 LST
         1 1 No-Cal 1 1 Sequential
Word 4  First 4 BCD digits of cal period.
Word 5  Last digit of cal period (bits 12-15)
Word 6  Integer part of integration period (bits 4-15)
Word 7  Fraction part of integration period (bits 4-15)
Word 8  Repeat count (4 BCD digits)
Word 9  HH MM from Start Register
Word 10 SS (bits 0-7) from Start Register and HH from Stop Register
Word 11 MM SS from Stop Register
Word 12 H MM (bits 4-15) from Duration Register
Word 13 SS (bits 8-15) from Duration Register
ODD Output Data. The control panel has nine words of output data.

Word 1 15 Push button lights; 1 = turn the light on. Each bit corresponds with word 1 of the input words.

Word 2 Bit 5 = Data Recorded light.
6 = Cal On light.
7 = Cal Off light.
13 = Chart marker.
14 = Programable push button 1.
15 = Programable push button 2.

Word 3 Most significant BCD digit of scan number (bits 12-15).

Word 4 Last four BCD digits of scan number.

Word 5 First two alphanumeric characters for programable push button 1 (bits 2-7 and bits 10-15), starting at the left.

Word 6 Next two alphanumeric characters for programable push button 1

Word 7 Last alphanumeric character for programable push button 1 and first character for programable push button 2 (bits 10-15).

Word 8 Next two alphanumeric characters for PPB 2.

Word 9 Last two alphanumeric characters for PPB 2.

The alphanumeric displays are programed using Table I.

4. A/D Converter

Device Address 20 Data Interrupt Entry Location AØ.
Priority 2 Service Interrupt Entry Location BØ.

ISC Input Status. The status format is listed below:

Bit 0 Always will be a one.
Bit 7 1 = A/D is doing a conversion.

OCC Output Command.

A/D Converter

<table>
<thead>
<tr>
<th>Starting Channel Number</th>
<th>Start Channel Number</th>
<th>Start Channel Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bits ...</td>
<td>0 1 D S 0 0 1 0 0 1 C C C C C C H H H H H H</td>
<td></td>
</tr>
<tr>
<td>Number of Channels to Read</td>
<td>0 1 D S 0 0 1 0 1 1 N N N N N N</td>
<td></td>
</tr>
<tr>
<td>Transfer Initiate</td>
<td>1 0 D S 0 0 0 0 0 0 0 0 0 0 0 0 0 1</td>
<td></td>
</tr>
<tr>
<td>Terminate</td>
<td>0 1 D S 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td></td>
</tr>
</tbody>
</table>

D = 1 = Connect Data Interrupt
S = 1 = Connect Service Interrupt
CH = Channel Number in Binary 0-63
N = Number of channels to read minus one.
(Zero for number of channels causes one channel to be read.)
OCC Output Command.

50-Channel Receiver

<table>
<thead>
<tr>
<th>Bits ...</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer Initiate</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>R</td>
<td>H</td>
<td>Z</td>
<td></td>
</tr>
</tbody>
</table>

D & S = Same as above.
R = 1 for reference, 0 = signal
H = 1 for Hold Initiate.
Z = 1 for Zero Test.

IDC Input Data.  This command inputs the 15 bit data word from the A/D.  Bit 15 will always be a zero.  Bit 0 is the sign bit.

5. MODCOMP to H316 Link

Device Address 1Ø   Data Interrupt Entry Location 9Ø
Priority 3         Service Interrupt Entry Location DØ
DMP CH Ø          Transfer Count Location 6Ø,
                  Transfer Address Location 7Ø

ISB Input Status.  The status is listed below:

Bit Ø   = 1 = The H316 is running.
  3 = 0 = The H316 is running.

OCB Output Command.

<table>
<thead>
<tr>
<th>Bits ...</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start DMP Transfer</td>
<td>1</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Interrupt H316</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Terminate</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

D = 1 Enable Data Interrupt.
S = 1 Enable Service Interrupt.

6. MODCOMP from H316

Device Address 11   Data Interrupt Entry Location 91
Priority 6         Service Interrupt Entry Location D1
DMP CH 6           Transfer Count Location 66,
                  Transfer Address Location 76

ISB Input Status.  The status word is listed below:

Bit 0 = 1 = The H316 is running.
  3 = 0 = The H316 is running.
 15 = 1 = The H316 has generated a Service Interrupt.
OCB Output Command.

<table>
<thead>
<tr>
<th>Bits ...</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start DMP Transfer</td>
<td>1</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Reset Status Bit 15</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Terminate</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

D = 1 = Enable Data Interrupt.
S = 1 = Enable Service Interrupt.

7. Telescope Control Panel

Device Address 3A Data Interrupt Entry Location BA
Priority 12 Service Interrupt Entry Location FA

ISD Input Status. This command inputs the status of the device. The following table lists the bits that are used.

Bit 0 1 = Device is operational.
3 0 = Device is operational.

OCD Output Command. This command initiates a data transfer, or issues a terminate to the interface.

<table>
<thead>
<tr>
<th>Bits ...</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>1</td>
<td>0</td>
<td>D</td>
<td>S</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>1</td>
<td>0</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Terminate</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

D = 1 = Connect Data Interrupt.
S = 1 = Connect Service Interrupt.

IDD Input Data. This command will input the data from the control panel. Twenty-two words of data will be transferred.

Word 1 Two MSD of Epoch Date Bits 8-15
2 Four LSD of Epoch Date
3 Bit 3 = RA Pointing Correction sign 1 = +, 0 = -,
   Bits 4-15 = SS.S digits of RA Pointing Correction.
4 Bit 3 = Dec Pointing Correction sign 1 = +, 0 = -,
   Bits 4-15 = M:SS digits of Dec Pointing Correction.
5 Bits 2 3
   0 0 Blank
   0 1 West
   1 0 East
   Bits 4-15 3MSD of Position (RA, HA, etc.).
6 Four LSD of Position (RA, HA, etc.).
7 Bit 7 = Position sign 0 = +, 1 = -,
   bits 8-15 two MSD of Position (Dec, etc.).
8 Four LSD of Position (Dec, etc.).
9 Bit 7 = Sign of Rate (HA, RA, etc.), 0 = -, 1 = +,
   bits 8-15 2MSD of Rate (HA, RA, etc.).
Word 10  Four LSD of Rate (HA, RA, etc.).

11  Bits 6-7
    0 0 +
    0 1 -
    1 0 North
    1 1 South

Bits 8-15 two MSD of Rate (Dec).

12  Four LSD of Rate (Dec).

13  Bits 6-7
    0 0 +
    0 1 -
    1 0 East
    1 1 West

Bits 8-15 two MSD of Offset 1 (RA, HA, etc.).

14  Four LSD of Offset 1 (RA, HA, etc.).

15  Bits 6-7
    0 0 +
    0 1 -
    1 0 North
    1 1 South

Bits 8-15 two MSD of Offset 1 (Dec, etc.).

16  Four LSD of offset 1 (Dec, etc.).

17  Same as word 13, Offset 2

18  Same as word 14, Offset 2

19  Same as word 15, Offset 2

20  Same as word 16, Offset 2

21  Three octal words for Rotary Switch.
    Positions bits 0-2 = position, bits 3-5 = rate
    and bits 6-8 = offset. The octal number and
    its label is listed below.

    0 0 0 HA DEC
    0 0 1 RA DEC Epoch
    0 1 0 RA DEC Apparent
    0 1 1 L B
    1 0 0 AZ EL
    1 0 1 HV

22  Bits 0-11 Momentary Push Button Switches at top of
    panel. Bit 0 = switch to the left of the panel.
    Bit 12 is for pointing correction, 1 = Pointing
    Correction On. Bit 13 is a one when the auto
    position is selected on the H316 control panel.

ODD Output Data. This command outputs data to the control panel.
Two words of data will be transferred to the panel.

Word 1  Bits 0-11 will light lights in direct relation to
    the input bits 0-11 of word 22. Bit 12 = Pointing
    Correction Off light. Bit 13 = Pointing
    Correction On light. Bit 14 = auto light on
    H316 control panel.
Word 2  Bits 0-7 will light Indicator Lights beside the digi-switches. Bit 0 will light the indicator at the top of the panel and to the left. Bit 1 will light the indicator at the top and to the right. This continues to the bottom of the panel.

8. Autocorrelator/Signal Averager (SA)

Device Address 12  Data Interrupt Entry Location 92
Priority 5     Service Interrupt Entry Location D2
DMP CH 5      Transfer Count Location 65,
              Transfer Address Location 75

ISB Input Status. The status word is listed below:

<table>
<thead>
<tr>
<th>Bit</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Bit 0 1 = Device operational.
- Bit 0 0 = Device operational.
- Bit 11 1 = 1 word transfer from SA.
- Bit 12 1 = 1K word transfer from SA.
- Bit 13 1 = 2K word transfer from SA.
- Bit 14 1 = 4K word transfer from SA.
- Bit 15 1 = Service interrupt was from external device.

OCB Control Command.

<table>
<thead>
<tr>
<th>Bits ...</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reset Status</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Sync A/C III</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>DMP Initiate</td>
<td>1</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Terminate</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

D = 1 = Connect Data Interrupt.
S = 1 = Connect Service Interrupt.

It should be pointed out that if several instructions exist between the Output Control Command for NOP connect data and service interrupt and the Terminate Command an external interrupt could occur.

When using the signal averager, if a terminate is issued after a service interrupt from the SA, the status bits will be reset.

9. On Line to Off Line Link. This is a one way link in that the on line computer transmits data to the off line computer.

Device Address 3  Data Interrupt Entry Location 83
Priority 10    Service Interrupt Entry Location C3
DMP CH 3      Transfer Count Location 63,
              Transfer Address Location 73
ISA Input Status. Input status for both computers is listed below:

**On Line**
- Bit 1 = Device operational.
- Bit 3 = Device operational.

**Off Line**
- Bit 1 = Device operational.
- Bit 3 = Device operational.
- Bit 15 = On line computer generated a Service Interrupt.

OCA Output Command. The output commands for both computers are listed below:

**On Line**

<table>
<thead>
<tr>
<th>Bits</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start DMP</td>
<td>1</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Interrupt Off Line</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Terminate</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Off Line**

<table>
<thead>
<tr>
<th>Bits</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start DMP</td>
<td>1</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Reset Status</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Terminate</td>
<td>0</td>
<td>1</td>
<td>D</td>
<td>S</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

\( D = 1 = \text{Connect Data Interrupt.} \)
\( S = 1 = \text{Connect Service Interrupt.} \)

**III. Electronics**

All interface was built on a MODCOMP general purpose controller (GPC). Each GPC uses a half plane in a peripheral controller interface (PCI). Each GPC requires wiring to satisfy variable I/O functions. These functions and their GPC page number is listed below:

<table>
<thead>
<tr>
<th>Function</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority Selection</td>
<td>1</td>
</tr>
<tr>
<td>Address Selection</td>
<td>1</td>
</tr>
<tr>
<td>Service Interrupt Request</td>
<td>1</td>
</tr>
<tr>
<td>Source ID</td>
<td>2</td>
</tr>
<tr>
<td>Data to Device</td>
<td>4</td>
</tr>
<tr>
<td>Status Information</td>
<td>5</td>
</tr>
<tr>
<td>Data to Computer</td>
<td>5</td>
</tr>
<tr>
<td>DMP Logic</td>
<td>6</td>
</tr>
</tbody>
</table>

The signals most often used by the custom logic is listed below:
1. Clock and Calendar

This interface provides the computer with four data interrupts, one interrupt for each data word. The data is input as shown in the programming section. A service interrupt is generated when the computer issues a terminate or when four data transfers have taken place.

The data from the clock is level converted with 8820's. Data from the calendar was changed to TTL levels by changing the "Computer Buffer Card #3" (see EDIR #120) to a card that provides TTL levels instead of 0/-6. This data is passed to the computer via 4-line to 1-line switches. These switches are controlled by a counter that counts input data commands.

A status word is provided to tell the computer that the clock and calendar is connected and -15 V is present for the level converters. Illegal BCD numbers were used to determine if the clock or calendar has been disconnected. An optical isolated gate was used to monitor the -15 V power supply.

2. ULO Control

This interface connects the MODCOMP to the universal local oscillator (EDIR #144). The interface was designed to simulate a DDP116. This interface outputs to the ULO, reads a counter in the ULO and also reads a counter in the IF Processor. The capability exists to control two ULO's. As in other devices the service interrupt is generated by a terminate from the computer or when the desired number of data words have been transferred.

To input from the ULO the computer will do an OCD command which will select which device to input from and generate the
2. Continued:

appropriate address to the ULO. This command will also de-
termine the number of data interrupts to generate. There
will be nine data interrupts to input the ULO counter and
eight for the IF Processor counter. The input data is buf-
fered for the MODCOMP.

For an output transfer the computer will do an OCD command
which will generate the appropriate address to the ULO. Nine
data interrupts will be generated for output to the ULO. The
first data interrupt is caused by the OCD. The output data
is buffered.

A status word is provided which informs the computer of the
position of front panel switches on the ULO and if one or
both ULO's are connected.

3. Data Taking Control Panel

This interface consists of two separate sections of logic.
The first section is on a general purpose controller located
in the MODCOMP. The second section of logic is behind the
control panel.

A. MODCOMP GPC

This logic will generate data interrupts for each data
transfer and a service interrupt for a terminate and at the
end of each data block.

On input the computer will issue an OCD command which will
cause the computer to receive 13 data interrupts. A counter
is used to count these data interrupt sequences.

This BCD count is sent to the control panel to enable multi-
plexing of the data from the control panel. The data
interrupt sequence also generates an input strobe which is
used in the control panel by the "Push Button Switch Input
Card".

To output, the computer will issue the appropriate OCD
command. This will cause a sequence of nine data interrupts.
A counter is used to count these data interrupt sequences;
this count is also sent to the control panel to enable multi-
plexing the data. An output strobe is also generated to
latch data in buffers in the control panel.

B. Control Panel Logic

The control panel logic consists of four logic cards --
two for input data and two for output data.
1. **Address Decode Input Data.** This card decodes the BCD count from the MODCOMP and also contains the logic to multiplex the data from the digi-switches and the "Push Button Switch Input Card". This data is then passed to the input section of the general purpose controller. Through the use of optical-isolated gates the power supplies in the control panel are monitored on this card and this generates a status word for the MODCOMP.

2. **Push Button Switch Input.** This card stores the fact that a button has been pushed until the MODCOMP reads the data. The circuitry necessary to generate the cal signal is also contained on this card. The normal 0/-6 plus a TTL level cal signal is provided.

3. **Address Decode Output Data Buffer.** This card decodes the BCD count received from the MODCOMP. This card also provides buffers for all output words except the alphanumeric display.

4. **Alphanumeric Display Buffer.** All the buffers necessary for the alphanumeric display are contained on the card.

5. **Scan Monitor.** This is on a separate chassis above the control panel. It gives an audible indication of the beginning and ending of a scan. This monitor receives the data recorded signal for its control.

4. **A/D Converter**

   The interface for the A/D converter contains the logic to read a given number of channels starting on a specified channel.

   To select the starting channel the computer issues the proper OCC command to set an up counter to the desired channel number. This counter then provides the A/D converter with a random address. This address gets incremented each time the A/D completes a conversion.

   The number of channels to read are loaded into a down counter by an OCC command. This counter decrements each time the computer inputs a data word. When this counter gets to zero, data interrupts are inhibited and a service interrupt is generated. Each time the data is taken another conversion is started.

   Logic to control the 50-channel receiver is also contained in this general purpose controller.

5. **MODCOMP to 316 Link**

   This is the first DMP device discussed, so some attention should be given the DMP logic on the GPC drawing on page 6. Two signals
5. Continued:

from the custom logic are needed for DMP operation. These are listed below:

**DATARS** This is a data request signal that requests a data transfer. The direction of transfer is determined by the logic level on gate U2B, pin 5 (U4B, pin 5 on the old GPC, such as the one the autocorrelator interface is on). The logic level would be a logic one for output from the computer.

**DMPSRS** This signal enables the DMP logic to cause the computer to store the transfer address from a register back into core. Since these registers are a helpful troubleshooting aid they may be found by the formula below.

\[
\text{Transfer Count} = \text{Register 20} + \text{DMP. CH. #} \\
\text{Transfer Address} = \text{Register 28} + \text{DMP. CH. #}
\]

(Use base 16 arithmetic.)

Another point which is a useful sync point is on gate U5A, pin 12 (on both model GPC). This point causes the DMP to be initialized and is generated when the computer issues an output control command for a DMP transfer.

The source ID is also a useful group of signals to look at. These are labeled DRID0N - DRID5N on page 6 of the GPC logic. It should be noted that these signals are common with signals on page 2 (used for data and service interrupts). The generation of this source ID is complicated by the fact that it is possible to generate two correct source ID's for the same DMP channel. The table below is an attempt to show the expected source ID for any type DMP transfer.

<table>
<thead>
<tr>
<th>DRID</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Channel X ...</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Input Channel X ...</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Output Channel X ...</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Output Channel X ...</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Store Current TA ...</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Store Current TA ...</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Initialize CH X ...</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Initialize CH X ...</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
For a more detailed explanation of the DMP logic, refer to MODCOMP's general purpose controller technical manual.

The custom logic provides the necessary DMP signals and those required by the H316 computer. When the program issues an output control command for a DMP transfer, the transmit flip flop is set and a "DATARS" signal is generated. When the computer outputs a data word, this data is stored and a "MCRDY" signal tells the 316 that data is on line. If the 316 is in the receive mode, this ready signal causes the 316 to input the data. At the time the 316 takes the data "SET 116 DIL" is sent to the MODCOMP generating another "DATARS". This cycle keeps up until the MODCOMP transfers its block of data. When the 316 takes the last data word, a service interrupt is generated.

An output control command is also used to interrupt the 316 computer; this signal is called "MC OCP 401". This command could be used to inform the 316 about a condition in the MODCOMP.

Two circuits have been added to the logic as a diagnostic aid. The first uses a discrete component holder which, if its position is changed in an IC location, the logic will run without a reply signal from the 316. This enabled testing when the 316 was not available. The second aid was a counter that counts data transfers. This gives a light emitting diode indication of the number of transfers in binary.

6. MODCOMP from 316 Link

This logic is very similar to the logic for the MODCOMP to 316 link. When the computer issues an output control command for a DMP transfer initiate, the receive flip flop is set. When the 316 has data available (316 ready), DATARS will be generated after a delay of 75 μs. At the time the MODCOMP takes the data it responds with "RESET 316 RDY". This causes the 316 to put another word of data on line. This process keeps up until the block of data has been transferred at which time a service interrupt will be generated.

The 316 also has the ability to interrupt the MODCOMP via a service interrupt. When this occurs (316 restart or error condition), bit 15 of the status word will be set. This enables the program to distinguish one service interrupt from the other. The program must issue an output control command to reset this status bit.

The diagnostic aids are also in this logic. These aids enable the logic to run without a 316 and counts data transfers.
7. Telescope Control Panel

This logic was designed to make the MODCOMP look like a DDP-116 as far as the control panel was concerned. Most of the custom logic is used to count data transfers and generate a service interrupt when the correct number of input or output words have been transferred. Since this device is not a DMP device, data interrupts must be generated for each data transfer. The following signals have been generated to simulate the DDP116.

- **ADBXX** Nine address lines to select the telescope control panel.
- **OCP** Control signal to the control panel. This signal initializes the control panel for input or output.
- **RRL** Signal to the control panel that the computer has taken the data.
- **OTP** Signal to the control panel that data is on line.

8. Autocorrelator

The autocorrelator has been interfaced to a DMP channel; the signal averager will also connect to this interface.

Since the autocorrelator was designed to interface with negative logic (0/-6), all signals from the A/C had to be level converted. To be able to program the signal averager it was necessary to store the four most significant data bits of the first word. It was also necessary to store the fact that the A/C has generated the service interrupt. This information is presented to the computer as a status word which must be reset by an output control command.

The autocorrelator makes life difficult for the program because the computer must take data when the A/C is ready to transmit it. This is accomplished by waiting for a service interrupt, then checking the status word for bit 15 being set. When this happens the program issues an output control command for a DMP transfer initiate. This causes a flip flop to be set (V4L, pin 5) and if the DRL flip flop has been set by the A/C the signal "DATARS" will be generated. "DATARS" will cause the computer to input a word of data.

When the computer takes the data, the DRL flip flop is reset and a signal called "RRLAC" is sent to the autocorrelator. When the A/C receives "RRLAC", it puts another data word on line and sets the DRL flip flop. This keeps up until the whole block...
8. Continued:

of data has been transferred. At this time the interface will generate a data and service interrupt and bit 15 of the status word will not be set.

The signal averager works in much the same way as the autocorrelator except the program will transfer one word blocks and the S/A informs the program (4 bits in the status word) of how many words it must transfer for the long data blocks.

9. On Line to Off Line Computer Link

The interface that links the two MODCOMP computers is an exact duplicate of the logic designed to transmit and receive data from the H316. The only difference is in address, priority, and DMP channel.

The on line computer (control) has the logic that was designed to transmit data to the H316.

The off line computer (analysis) has the logic that was designed to receive data from the H316.

IV. Credits

Credit should be given to George Patton for his design of the A/D interface and to Ron Weimer for his design of the telescope control panel and the autocorrelator interface. Credit should also be given to W. Vrable, L. Miller, and J. Turner for their help in all the construction work involved in this project.
CLK / CAL

ADDRESS 39
PRIORIT Y 12
DATA INTERRUPT SOURCE ID CONTROL

GENERAL PURPOSE CONTROLLER NO. 2

TOLERANCE EXCEPT AS NOTED
FRACTIONAL: ±0.005
DECIMAL: ±0.005

NOTES:
- Connect for appropriate SIDS.
- Datas are to be supplied by custom logic.
COMPONENT SIDE

RESIZE DRAWING NO.

GENERAL PURPOSE CONTROLLER NO.2.

CODE IDENT NO.

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED. ALL PARTS AND SURFACES TO BE FREE OF SCRATCHES, BURRS, AND SHARP EDGES, ETC. BEFORE FINISH IS APPLIED.

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TOLERANCES EXCEPT AS NOTED

± 1/2.

PLACE DEC. ± .02 BEND RADIUS

LM 511-10011(p

6 PLACE DEC. ± .005 I ANGLES
- 24V IN
- 12V
- 100M
- 2N5464 P-CHAN
- 2N4393 N-CHAN
- 2K
- 1K
- 15K

ECC B03004

CATHODE

SOURCE

GATE

DRAIN

GATE

FRONT FLAT SIDE

NRAD CALENDAR
COMPUTER BUFFER
CARD #3, SLOT J
TTL LEVELS OUT

POWER SUPPLY DELAY CIRCUIT
5 SEC. DELAY TO OPERATE

REF EDIR 120

FIG. 5
ULO

ADDRESS 30
PRIORITY 9
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DATA CONTROL PANEL

Address 38
Priority 12
NOTE: CONNECT FOR APPROPRIATE SLOTS.
DATA SOURCES TO BE SUPPLIED BY CUSTOM USER.
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This is a technical diagram related to a control logic system. The diagram includes various components such as registers, logic gates, and control lines. Annotations and labels indicate specific functions and connections. The layout is complex, with numerous lines and symbols indicating the flow of data and control signals. The diagram is likely used for designing or troubleshooting a control system for a more general purpose controller.
DATA REC. IN

DIODES 1N914

CAPS 470 PF

DIODES 1N914

555 IN A
14 PIN CHIP

555 IN A
14 PIN CHIP

POWER WIRING NOTES
WIRE FROM ELCO CONNECTOR TO CHIPS
WITH 24 GAUGE WIRE, RUN GND.
FROM CHIPS PINS 5, 6, 7 TO EACH
CHIPS GND, RUN +V FROM CHIPS
PINS 8, 11, 12 TO EACH CHIPS +V, USE
30 GAUGE WIRE FOR THESE RUNS,

CHIP LAYOUT W/ W/ PIN SIDE
14 PIN CHIPS EXCEPT THOSE NOTED

SCAN MONITOR
PAGE 1 OF 1
A/D CONVERTER

ADDRESS 20
PRIORITY 2
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MODCOMP TO H316

ADDRESS 10
PRIORITY 3
DMP Ch. 0
NOTE 1: WIRE TO CN94C-3AL AND NOT TO V11-15
MODCOMP RECEIVE

ADDRESS  11
PRIORITY  6
DMP Ch.   6
GENERAL PURPOSE CONTROLLER NO. 2
GENERAL PURPOSE CONTROLLER No.2

[Diagram of command decode logic flowchart with various inputs and outputs, including
- CONTROL
- BUS
- COMMAND
- INPUT STATUS
- OUTPUT DATA]

NOTE: MO/TO BE SUPPLIED BY CUSTOM LOGIC

TO LEAVE EXCEPT AS NOTED
FRACTIONAL ± 1/64
DECIMAL ± 0.05 (1/32 place)
0.02 (1/16 place)

ELECTRONICULAR

DRAWING NO.
520-1002.60

GENERAL PURPOSE CONTROLLER

No. 2

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DECIMAL ± 0.05 (1/32 place)
0.02 (1/16 place)

ELECTRONICULAR
TELESCOPE CONTROL PANEL

Address 3A
Priority 12
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BAENIDER RADIUS TOLERANCE EXCEPT AS NOTED.

GENERAL PURPOSE CONTROLLER 1.102.

REV LTR.
MODCOMP TO MODCOMP LINK

MODCOMP RECEIVE (LOCATED IN OFF-LINE COMP.)

ADDRESS 3
PRIORITY 10
DMP CH. 3
TO TEST UNIT BY ITSELF MOVE THE DISCRETE COMPONENT TO THE LOWER HALF OF THE CHIP SPARES.
GENERAL PURPOSE CONTROLLER PRINT

LIMITED TO

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED. ALL PARTS AND SURFACES TO BE FREE OF SCRATCHES, BURRS, AND SHARP EDGES, ETC. BEFORE FINISH IS APPLIED.

DESCRIPTION

L R

DATE IAPPNOV

REVISIONS

RELEASED, BINVER 00.0.0

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TOLERANCE EXCEPT AS NOTED

PLACE DEC ± 0.02

BEND RADIUS ± 0.005

ANGLES ± .005

PLACE DEC. ± .001
MODCOMP TO MODCOMP LINK

MODCOMP Transmit (Located in on-line comp.)

Address  3
Priority  10
DMP Ch.   3
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GENERAL PURPOSE CONTROLLER

CODE IDENT NO.

DRAWING NO.

520-100260

REV

SI

SHEET

5 OF LTR

INPUT DATA BUFFERS

I. THE UNUSED I41

TO GROUND.
GENERAL PURPOSE

DMP CONTROL LOGIC
AUTOCORRELATOR

Address  12
Priority  5
DMP Ch.   5
GENERAL PURPOSE CONTROL