

EG 44 / HOWARD

REVISIONS A 1-10-66

MH01-01380-216

INDEXING DATA
DATE OPR # I PGM SUBJECT SIGNATOR LOC
 10-6-65 NAA MH01-01380-216 R ADD * SILAGYI 085-15

APPROVALS

AUTHORIZED SIGNATURES	REPRESENTING	DATE
<i>W. H. Huber</i>	NAA/S&ID	9-1-65
D. G. Hoag by <i>W. Stameris</i>	MIT	6 Oct. 65

INTERFACE CONTROL DOCUMENT

DR BY	A. Silagyi	NORTH AMERICAN AVIATION, INC. SPACE and INFORMATION SYSTEMS DIVISION 12214 LAKEWOOD BLVD., DOWNEY, CALIFORNIA
CHK BY		
THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS AND NOTHING HEREIN CONTAINED SHALL BE DEEMED TO ALTER THE TERMS OF ANY CONTRACT OR PURCHASE ORDER BETWEEN ALL PARTIES AFFECTED		* COMMAND MODULE GUIDANCE COMPUTER ELECTRICAL INTERFACES BLOCK II NAA-MIT
CODE IDENT NO.	SIZE	MH01-01380-216
03953	A	
		SHEET 1 OF 64

E.O. 12812-1

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V36-3	V36-700001	Command Module Ser. No. 98,101-112	SID64-1347,1399,1350-2
MODEL	PART NO.	DESCRIPTION	APPLICABLE SPEC

**EFFECTIVITY AND SPECIFICATIONS
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SYM	DESCRIPTION	REQD	REP	DATE	APPROVED
A	<p>1. Sheet 2: Added Effectivity and Specifications Information</p> <p>2. Sheet 4: Remove Note (3)</p> <p>3. Sheet 5: Section 10 - Changed CGC to CMC.</p> <p>4. Sheet 8: (a) Changed CGC to CMC (b) Added Notes 1 & 2</p> <p>5. Sheet 11: (a) Added Connector Reference Designator (b) Added Notes 1 & 2</p> <p>6. Sheet 12: Added "Min" after Source Impedance "OFF" 0.5 Meg Ohms "MIN".</p> <p>7. Sheet 16: Added Connector Reference Designators and notes (1) & (2)</p> <p>8. Sheet 17: (a) Changed "Noise Susceptibility" TO: "Noise Rejection" (b) Changed "DS Open" to "ON" and Max Width 1 Millisec to "Max Width .5 Millisec." (c) Changed "DS Closed" to "OFF" and Maximum width 0.5 Millisec to "Maximum Width 1 Millisec".</p> <p>9. Sheet 20: Added Connector Reference Designator and Notes (1) & (2)</p> <p>10. Sheet 21: 3g Added "Spurious Pulses will not exceed one (1) per 100 second period" after last sentence.</p> <p>11. Sheet 24: Added Reference Designators and Notes (1) & (2)</p>				

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SYM	DESCRIPTION	REQD	REP	DATE	APPROVED
A	<p>12. Sheet 25: Changed "SCS Circuit".</p> <p>13. Sheets 29, 32, 44, 54, 57, 60: Added Reference Designators and Notes 1 and 2</p> <p>14. Sheet 45: Added Pot Taper.</p> <p>15. Sheet 52: Change "S-IVB Cutoff" to "Injection Seq. Start".</p> <p>16. Sheet 53: Changed S-IVB Injection Seq. Start" to "S-IVB Cutoff".</p> <p>17. Sheet 55: Changed W4 Current from "250MA" to "500MA".</p> <p>18. Sheet 58: Changed CGC to CMC.</p> <p>19. Sheet 61: (a) Added "Steady State" to voltage. (b) Changed "Transients" to "Variations to S.S".</p> <p>20. Sheet 48: (a) On Schematic, changed "Component Status and Advisory Indicators (typical 14 places)" to "Component Status and Caution Indicators (typical 14 places max. (b) Changed Current Spec. From Current: 0.180 amps per display 2.5 amps maximum drain on S/C System for Lamp Test only.</p>				

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SYM	DESCRIPTION	REQD	REP	DATE	APPROVED
A	<p>20. Sheet 48: <u>To</u></p> <p>Current: 0.180 amps/display (Caution Indicators) 0.225 amps/display (status Indicators) (2.5 amps max drain on S/C System for lamp test only."</p> <p>21. Add Sheet 11A: CM and SM RCS Jet Configuration</p>				

NAA/ S&ID	4/1/66	<i>R. Kennedy</i>
MIT	7 April 66	<i>W. Stamer</i>

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NOTE: Unless Otherwise Specified:

- ① Massachusetts Institute of Technology
Instrumentation Laboratory
Cambridge, Massachusetts
- ② North American Aviation, Inc.
Space and Information Systems Division
Downey, California

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TABLE OF CONTENTS

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- 2.0 Wave Form and Noise Measurement Techniques
- 3.0 Definition of Symbols
- 4.0 Reaction Control Jet Driver Signals
- 5.0 Control Mode and Status Signals
- 6.0 Attitude Signals from GDC/EMAG
- 7.0 Main Engine Signals
- 8.0 Rotational and Translational Controller Signals
- 9.0 Master Clock and Telemetry
- φ 10.0 CMC/DSKY Illumination
- 11.0 Computer to Computer Displays
- 12.0 Computer to S/C Displays
- 13.0 Computer to S/C Power

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1.0 SCOPE

This ICD defines all of the electrical interfaces that are associated with the Command Module Guidance Computer. It will specify the characteristics, wiring, and shielding of each.

There are various input and output circuits associated with the CMC. These circuits are categorized as follows:



- Y, YS - Y: Input transformer circuit; YS: source for "Y" circuit.
- X, XR - X: Output transformer circuit; XR: receiver of "X" circuit.
- D, DS - D: DC input circuitry; DS: source for the "D" circuit.
- C, CR - C: DC output circuit; CR: receiver for "C" circuit.
- S, SR - S: Switch closure; SR switch closure receiver.
- W, WR - W: Just a wire connection; WR: receiver for "W".
- R - R: DC power source.

The numbers following any particular designation (C2, X2, CR2, XR2, etc.) together with the section numbers uniquely designates a particular CMC output circuit or input circuit.



1.1 Grounding Symbology


The following drawing symbology shall be used throughout this ICD:

a) AC Grounds


- 1. AC Power 
- 2. AC Signal 

b) DC Ground

- 1. DC Power 
- 2. DC Signal Ground 

* c) Isolated Circuit Ground 

d) Structure Ground 

e) Vehicle Ground Point 

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2.0 Waveform and Noise Measurement Techniques

1. Pulse Measurements

- a. Measurements to be made at points indicated in appropriate sections of this ICD.
- b. Measurements to be made with Tektronix 540 series, type 1A1 differential preamp, 10/1 attenuator probes; or equivalent. Scope to be grounded at CMC only, if at all.

2. Noise Measurements

- a. Measurements to be made with Tektronix 540 series, type CA preamp, and P6016 current probe and type 131 amplifier; or equivalent.
- b. The current to voltage conversion factor will be the load pulse impedance (200 ohms; XR, Y) or DC impedance (22K ohms; CR, D) where applicable.

3. AC Measurements

- a. Hewlett-Packard 400D or equivalent.

4. DC Measurements

- a. Scope or equivalent.

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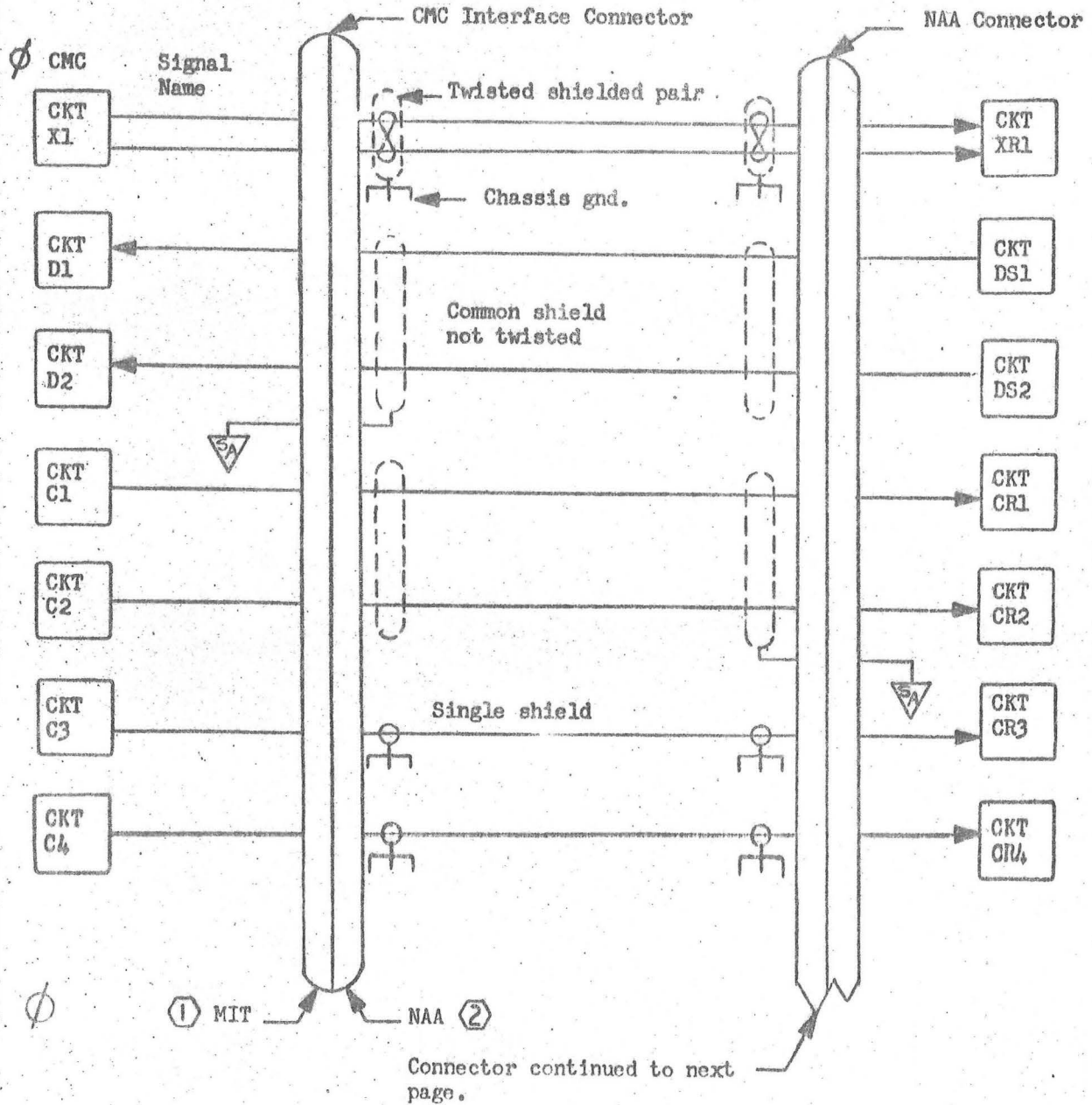
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3.0 DEFINITION OF SYMBOLS



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4.0 CMG to RCS Drivers

This section describes the interface between the Apollo Guidance Computer and the SCS Reaction Control System. The Apollo Guidance Computer will provide output-discretes to SCS reaction jet drivers to command reaction jet firing. There will be a total of 16 output lines provided, each line carrying the ignition command for one of the 16 S/M reaction jets for commanding vehicle rotation and translation or one of the 12 C/M reaction jets for commanding vehicle rotation only. The remaining four lines have no function after the SM is detached. The presence of high voltage on a line as referenced to spacecraft ground will indicate a jet OFF discrete.

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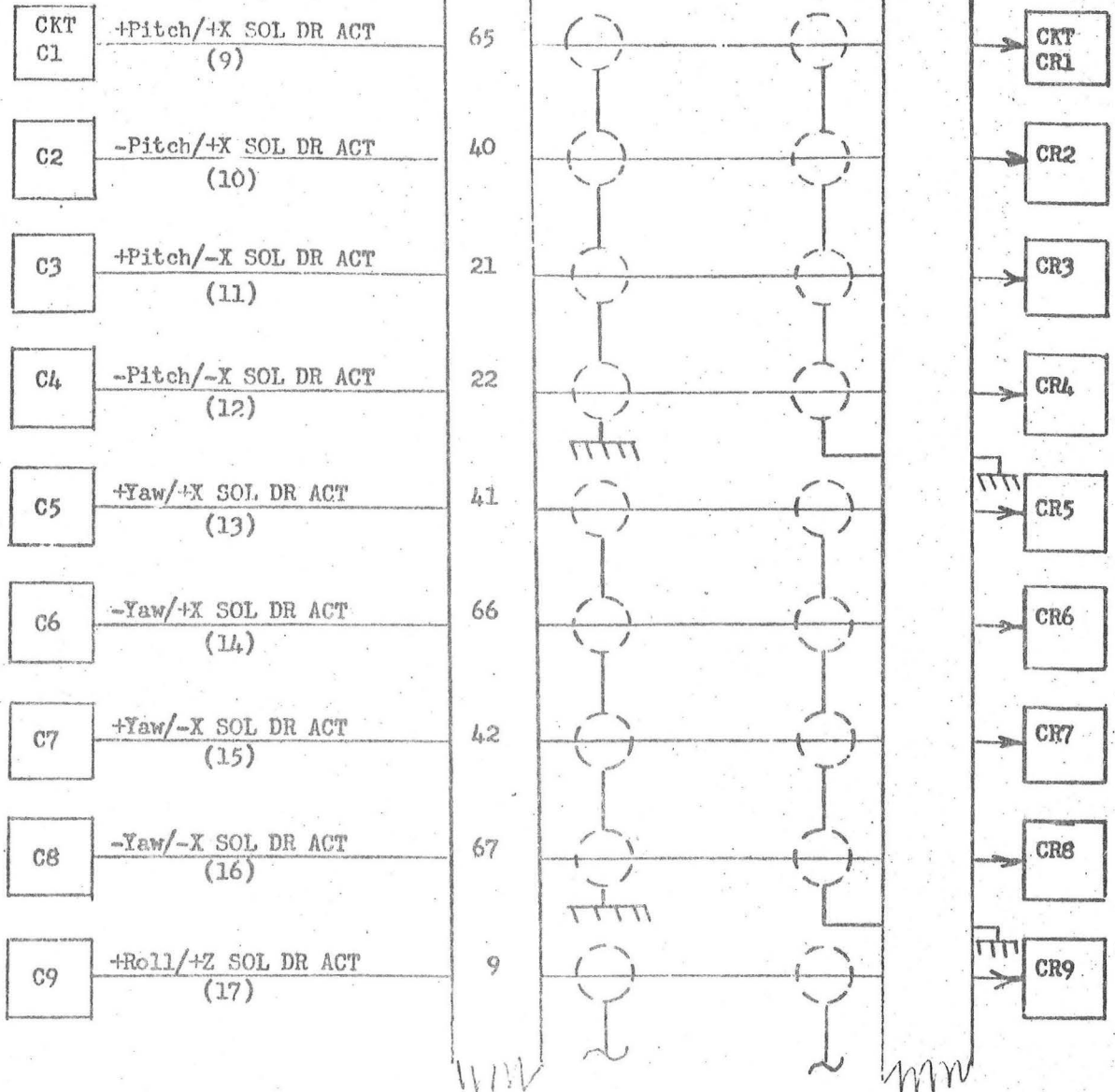
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4.1 Interface Wiring Data

CMC



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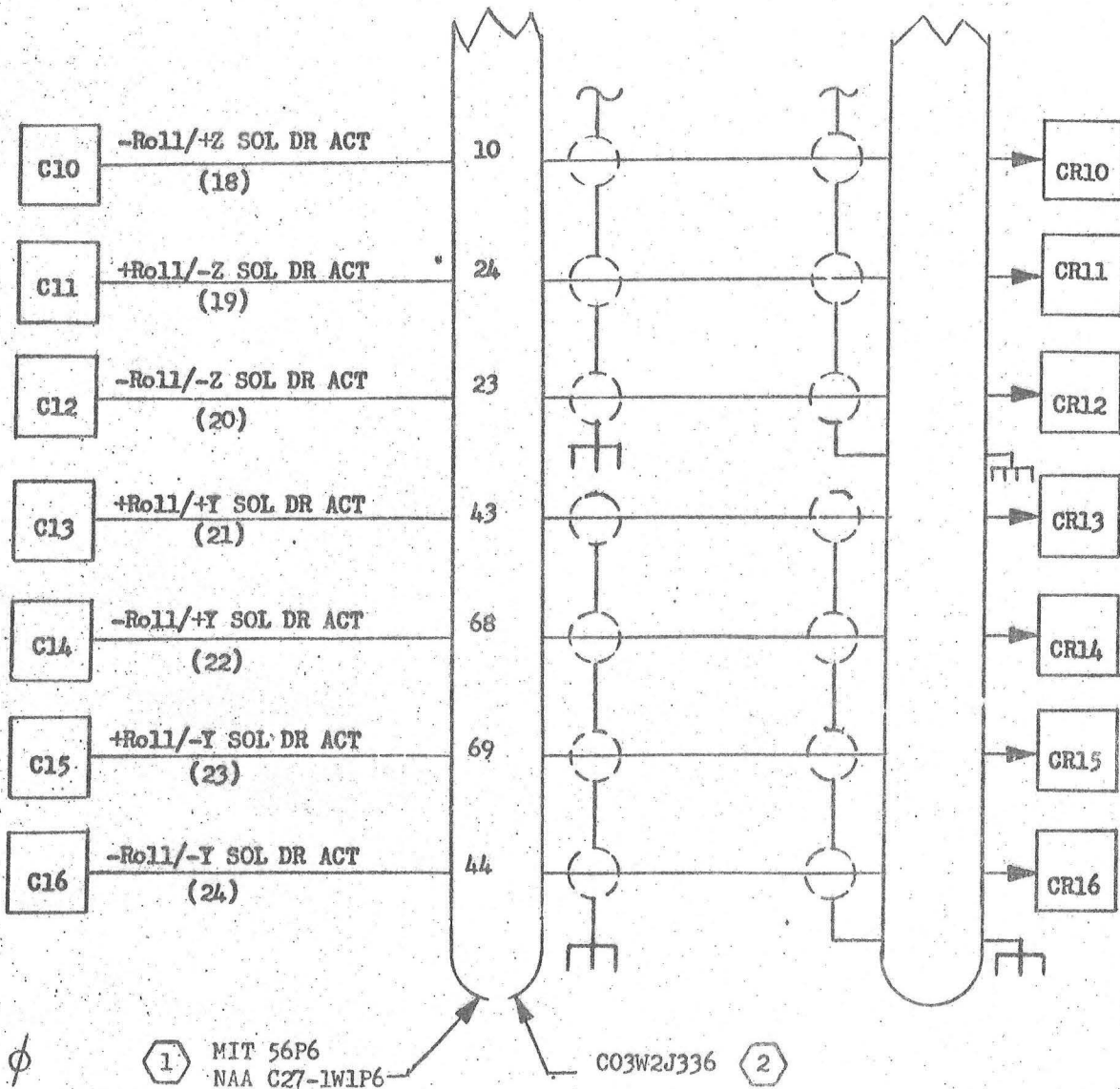
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4.1 Interface Wiring Data (Continued)



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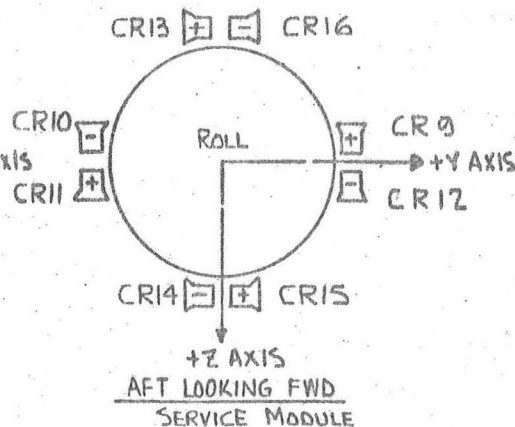
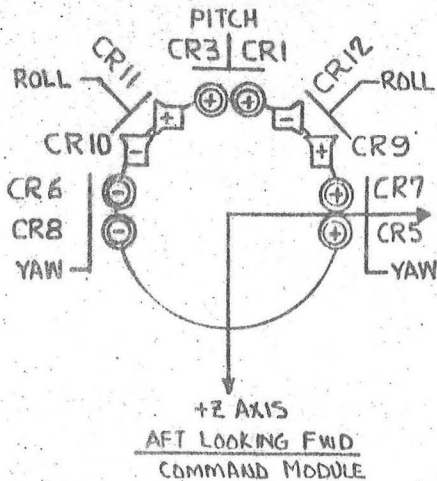
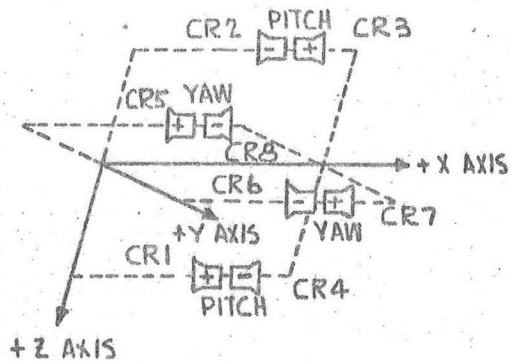
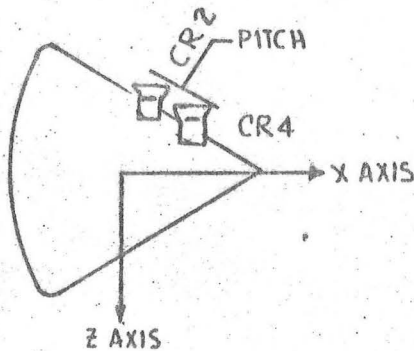
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4.1 Interface Wiring Data (Cont.)

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CM AND SM RCS JET CONFIGURATION



NOTE: CR 13, CR 14, CR 15, CR 16 are Not Used After CM/SM Separation
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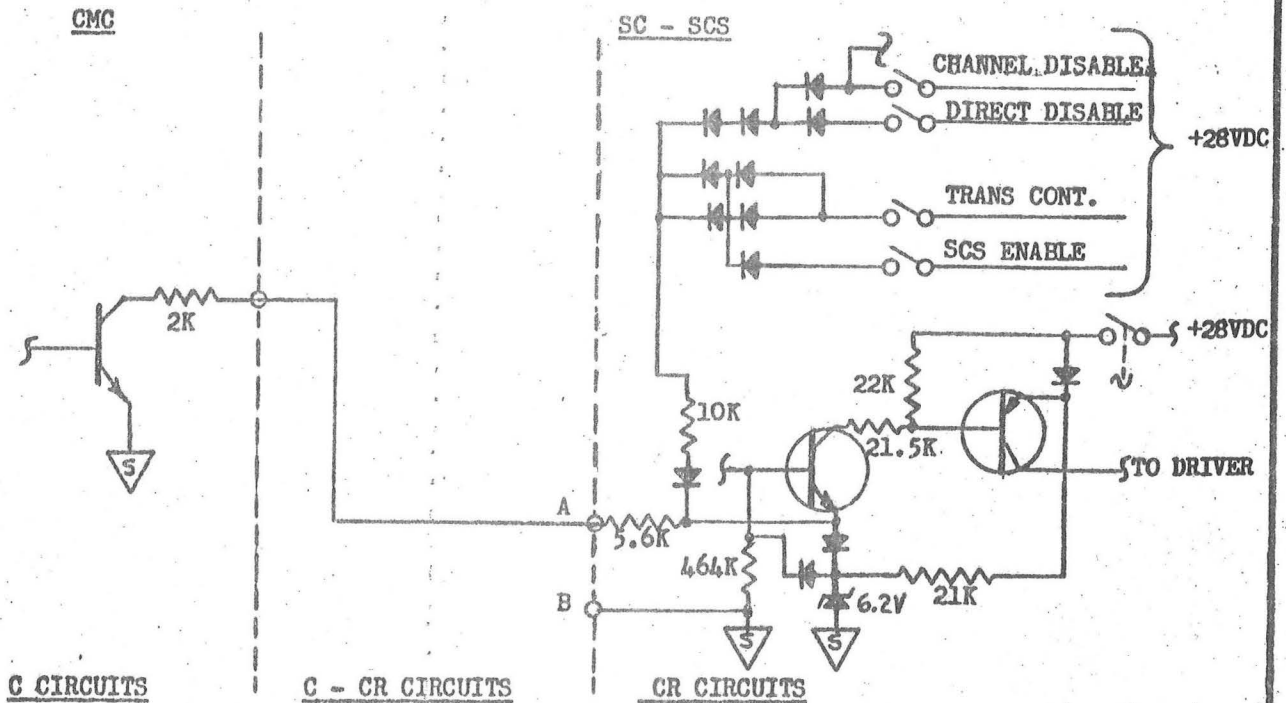
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4.2 Circuit and Signal Characteristics



All Measurements Made from A to B, B Ref.

Amplitude: "ON" 5VDC \pm 5 VDC
 "OFF" 28VDC \pm 5 VDC

Circuits: C1-C16 Shown Above
 CR1-CR16 Shown Above

Current: "ON" 5 MA Max.

Source Impedance: "ON" 3K Max to CMC Gnd, 0-5 MA Range
 "OFF" 0.5 Meg Ohms Min. 0-40 Volt Range

Source Rise Time: Less than 1 μ sec.

Noise Rejection: "ON" +80V Noise pulse, max width 0.5 millise, maximum rep rate 10 pps
 "OFF" -20V Noise pulse, max width 1 millise, maximum rep rate 10 pps

NOTE: SCHEMATICS SHOWN FOR REFERENCE ONLY

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5.0 CONTROL MODE AND STATUS SIGNALS

5.1 Signal Definitions

5.1.1 LEM Attached (ΔV CG, LEM/CSM - CSM)

The LEM Attached signal will be a switch closure on the Command Module Main Display Panel. This switch closure will be pilot initiated upon completion of LEM transposition and docking.

5.1.2 SPS Ready (ΔV Thrust, Normal - Off - Direct On)

The SPS Ready signal will be provided by a switch closure on the Command Module Main Display Panel. This switch closure will be pilot initiated and will indicate procedurally the completion of the pre Delta V checkout procedure. The SPS engine cannot be fired unless this discrete is present.

5.1.3 Attitude Hold (SC Control, CMC, Auto - Hold - Free)

The Attitude Hold signal will be a switch closure on the Command Module Main Display Panel. This switch will be pilot initiated at such time, during primary control, as it is desired to hold the present attitude of the spacecraft.

5.1.4 Free Drift (SC Control, CMC, Auto - Hold - Free)

The Free Drift signal will be a switch closure on the Command Module Main Display Panel. This switch will be pilot initiated at such time, during primary control, as it is desired to inhibit automatic control and permit manual control of the spacecraft through the CMC (hand controllers, minimum impulse).

5.1.5 Accept Uplink (UPTIM, Accept - Block)

The Accept Uplink signal will be a switch closure on the Command Module Main Display Panel. This switch will be pilot initiated at such time as it is desired to receive information via the updata link. A similar switch shall be provided in the LEB. Both switches must be in accept position to receive uplink data.

5.1.6 C/M - S/M Separate

The Service Module Separation signal will be a parallel contact closure within the SM/CM Reaction Jet Control Transfer unit. This contact closure indicates initiation of SM separation. The contact closure occurs 110 milliseconds prior to physical separation of CM/SM. The

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switch transfer time is 100 milliseconds maximum.

5.1.7 SIV-B Separate

The S-IVB Booster Separation Signal will be a contact closure within the Spacecraft Master Events, Sequence Controller. This contact closure indicates S-IVB booster separation and shall occur simultaneously with the firing of the Service Module, LEM Adapter (SLA) separation Pyros.

5.1.8 Lift Off

The "Lift Off" signal will be a switch closure in the S-IVB Instrumentation Unit. The signal indicates that the IU umbilical has been removed and that the vehicle is in the lift-off phase.

5.1.9 Guidance Reference Release

The Guidance Release signal will be a switch closure in the S-IVB Instrumentation Unit. This signal will indicate that the Saturn IU external pre-launch alignment control has been removed and the IU is inertially stabilized.

5.1.10 Ullage Thrust Present

The Thrust Monitor signal shall be a switch closure in the S-IVB Instrument Unit. The signal shall indicate the presence of thrust on the S-IVB due to ullage.

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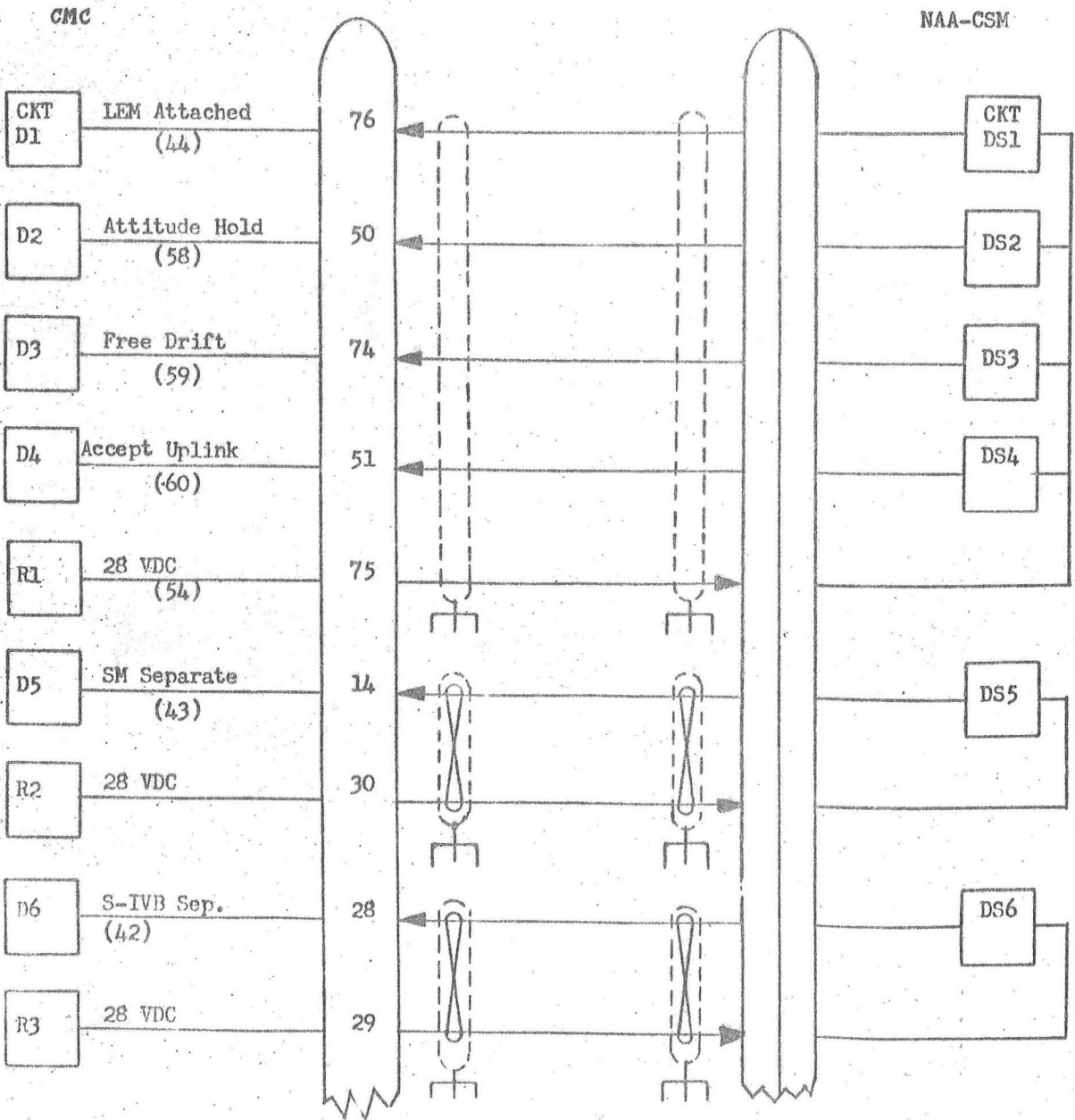
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5.2 Interface Wiring Data



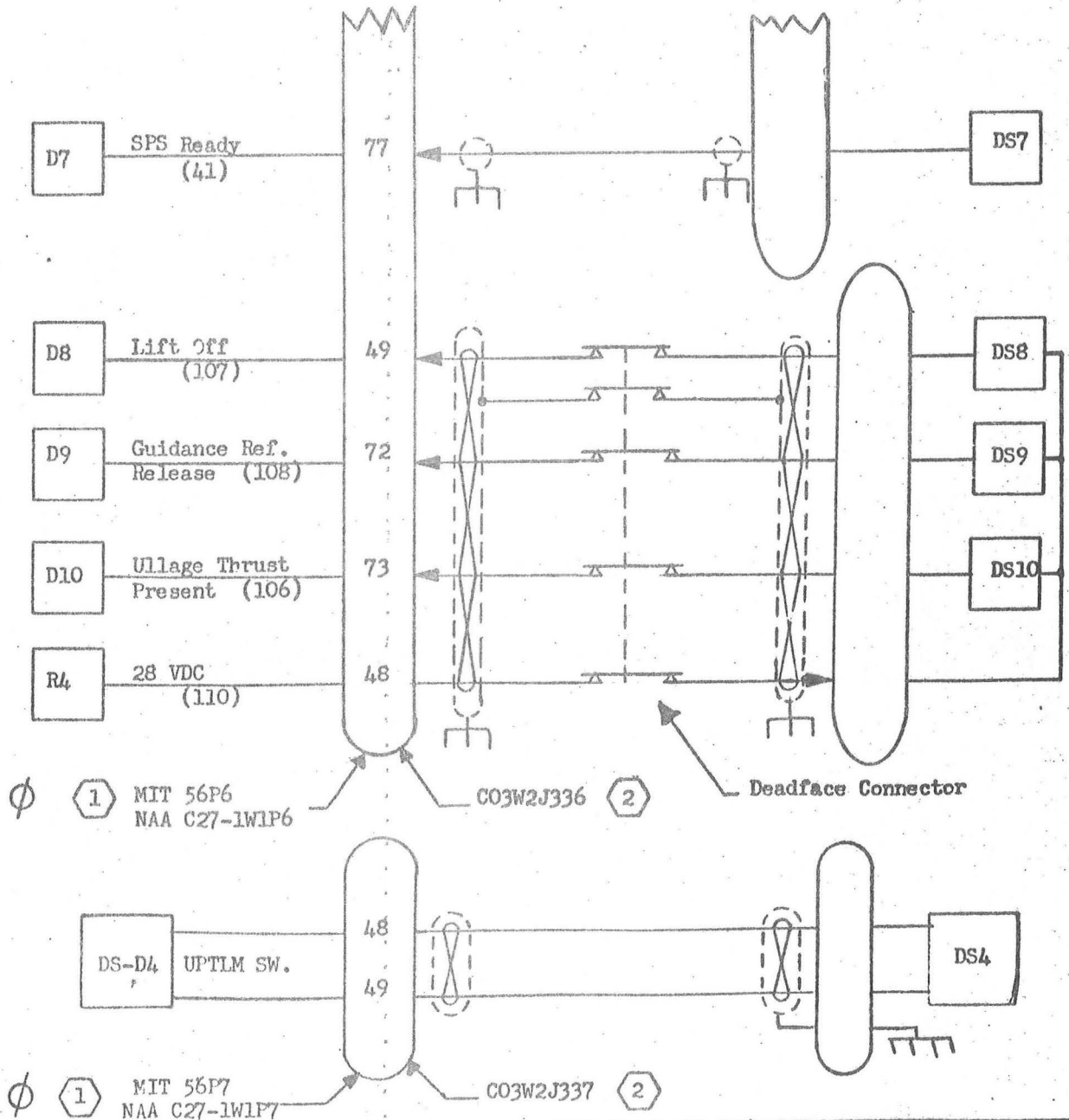
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5.2 Interface Wiring Data (Cont.)



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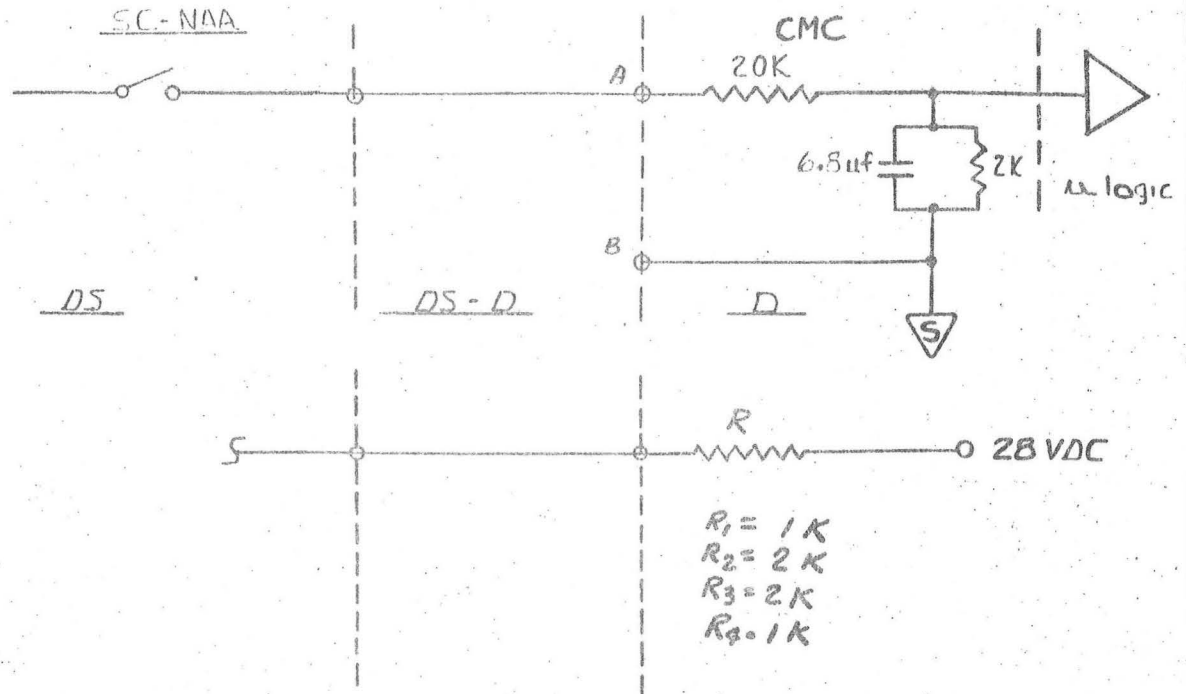
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5.3 Circuit and Signal Definition



All Measurements Between Points A, B, B Reference

Amplitude "1" 28 ± 11 VDC
 Amplitude "0" 0 ± 2 VDC

Noise Rejection:

∅

"ON": -80V Noise Pulse, Max Width .5 Millisecond, maximum Rep. Rate 10 pps
 "OFF": -20V Noise Pulse, Max Width 1.0 Millisecond, maximum Rep. rate 10 pps

Circuits

DL, 2, 3, 5, 6, 8, 9, 10
 DS1, 2, 3, 5, 6, 8, 9, 10 As Shown Above
 R1 - R4

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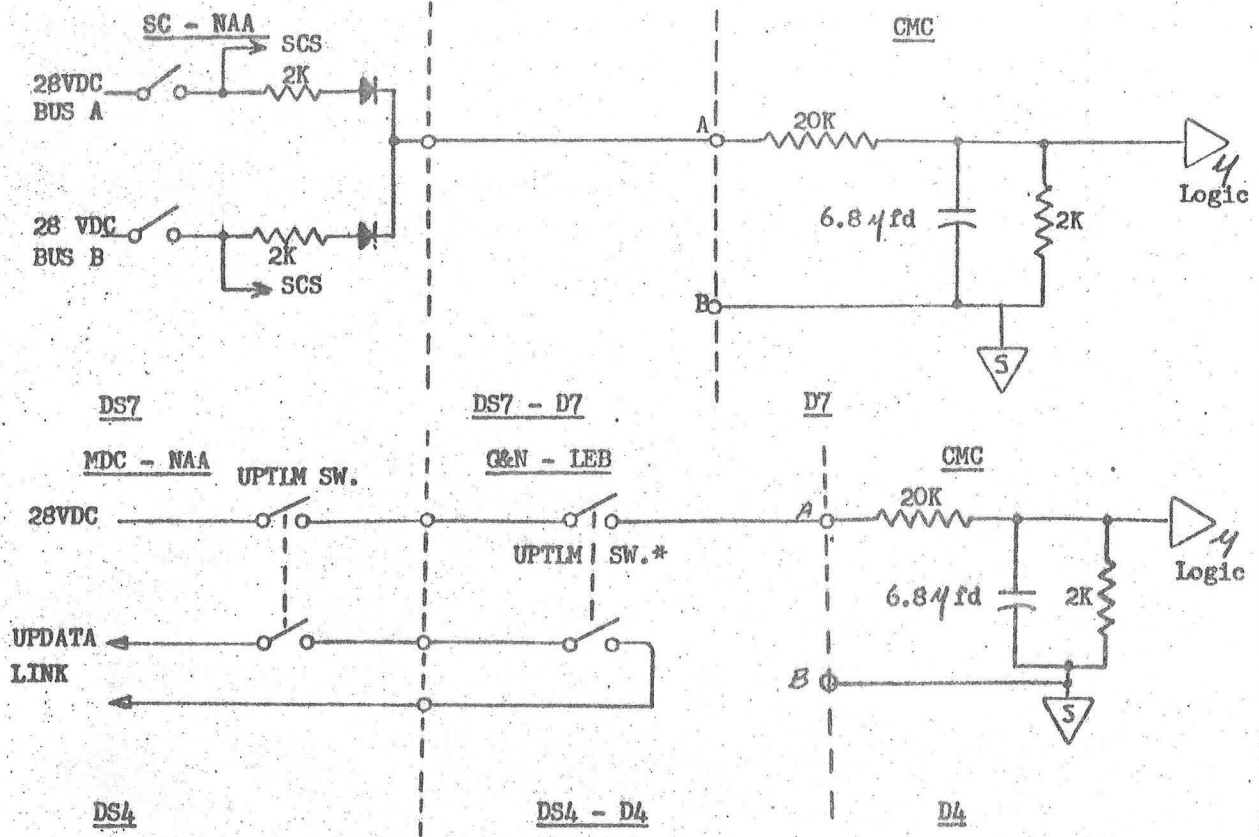
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5.3 Circuit and Signal Definition



All Measurements Between Points A, B, B Reference

Amplitude "1" 28 ± 11 VDC
 Amplitude "0" 0 ± 2 VDC

Noise Rejection:

"ON": +80V Noise Pulse, Max Width .5 Millisec, maximum Rep. Rate 10 pps
 "OFF": -20V Noise Pulse, Max Width 1.0 Millisec, maximum Rep. Rate 10 pps

*Note: Contact rating of "UPTLM SW.": 28 VDC, 0.5 Amps

Circuits: D4, D7 As Shown Above
 DS4, DS7

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6.0 ATTITUDE SIGNALS FROM GYRO DISPLAY COUPLER (GDC)

This section describes the interface between the CMC and GDC's in the SCS system. The GDC's, driven from the EMAG's, shall provide attitude information to the C&N CMC. The signals shall be in digital form transmitted as two wire signals isolated from ground in both the SCS and CMC. The interface shall consist of six signals (two wires per polarity per axis).

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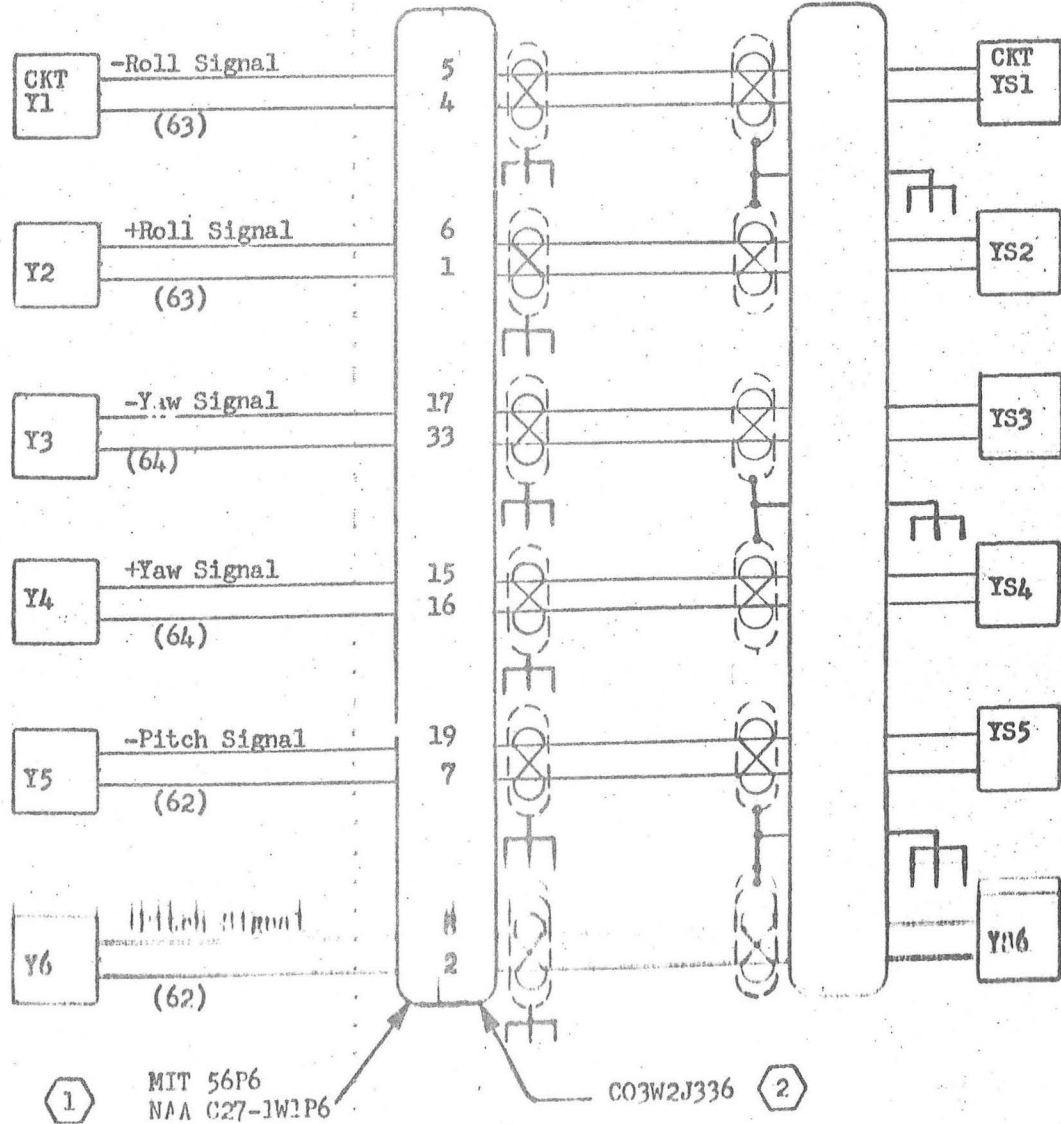
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REVISIONS

6.1 Interface Wiring Data

CMC

S/C-GDC/EMAG



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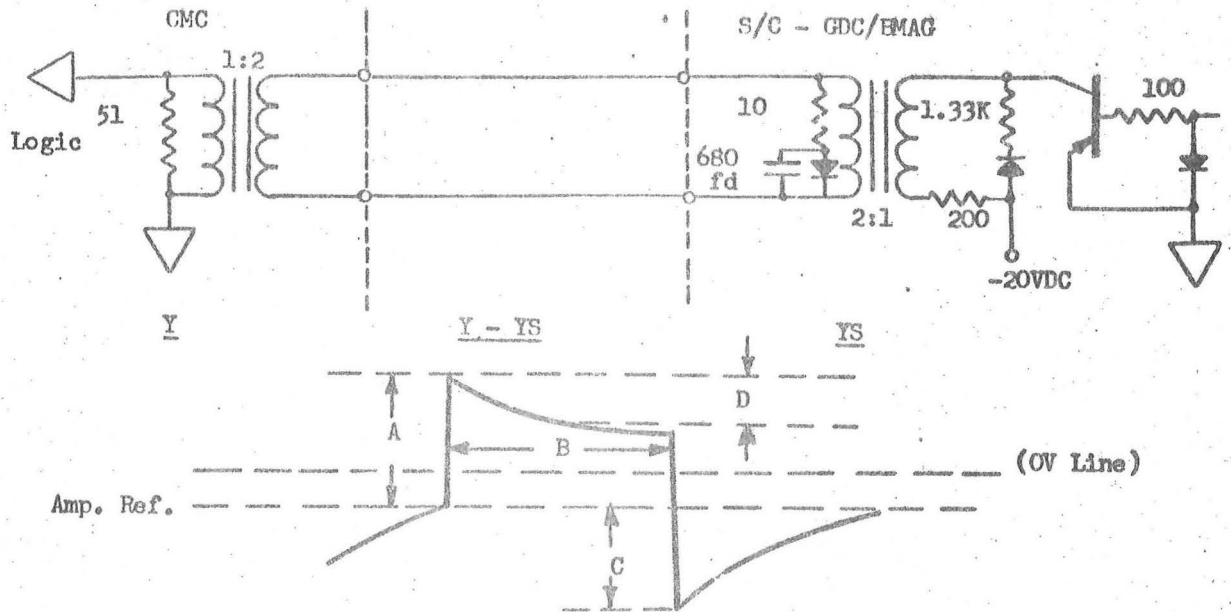
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6.2 Circuit and Signal Characteristics



Input Signal Specified at G&N Interface

1. Load Impedance: 200 ± 10% ohms
2. Source Impedance: 100 ohms maximum
3. Signal Characteristics:
 - a. Signal Amplitude: (A) 7 ± 3 volts
 - b. Pulse Width: (B) 2-6 μ sec (@A/2 point)
 - c. Backswing: (C) 4V maximum
 - d. Droop: (D) 20% at 2 μ sec point
 - e. Rise Time: (10-90% of A) 0.5 μ sec maximum
 - f. Zero Volt: The zero volt line is defined as the mean value of the waveform.
 - g. Delta Angle: Each pulse appearing on the line shall represent 0.1 ± .8% degrees. The maximum PRR is 640 pps.
 - h. Null Offset Effects: Less than one (1) pulse per 100 seconds output with equal to or greater than zero rate input to the gyro assembly.

NOTE: SCHEMATIC FOR REFERENCE ONLY

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6.2 (Continued)

h. Noise Specification

1. Noise during the transmission of the pulse:
The signal plus noise shall remain within the envelope of amplitude defined above (A,B).
 2. Noise during the absence of the pulse: +0.4 volts max, -4.0 volts max; measured with respect to the amplitude reference (See Figure).
1. Presence of the pulse shall indicate "ON" condition.
Absence of pulse shall indicate "OFF" condition.

Circuits

- Y1 - Y6 Shown above, CMC Transformer: NASA Drawing 1006319
- YS1 - YS6 Shown above

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E.O. IRN # 6282

7.0 MAIN ENGINE AND SATURN ENGINE CONTROL SIGNALS

This section describes the interface between the CMC and the SPS Drivers. The CMC provides an output-discrete signal to the SPS solenoid driver circuitry to command SPS firing. One line will be provided for this command. The presence of voltage on this line as referenced to spacecraft ground shall command main engine OFF.

In addition, the CMC will provide two signals to the S-IVB Instrument Unit. These signals are:

1. S-IVB Engine Fire Cycle

This signal will initiate the S-IVB engine firing sequence for translunar injection. The signal shall be a switch closure in the MDP-DSKY causing a 28 VDC signal to be sent to the Saturn Instrument Unit.

2. S-IVB Cutoff

This signal commands the termination of main engine thrusting. This signal will be initiated by a switch closure in the MDP-DSKY and will send Saturn 28 VDC power back to the Saturn IU.

The 28 VDC power for the above Saturn signals shall be routed from the Saturn Instrument Unit through the Saturn control switch to the DSKY relays on the Main Display Panel.

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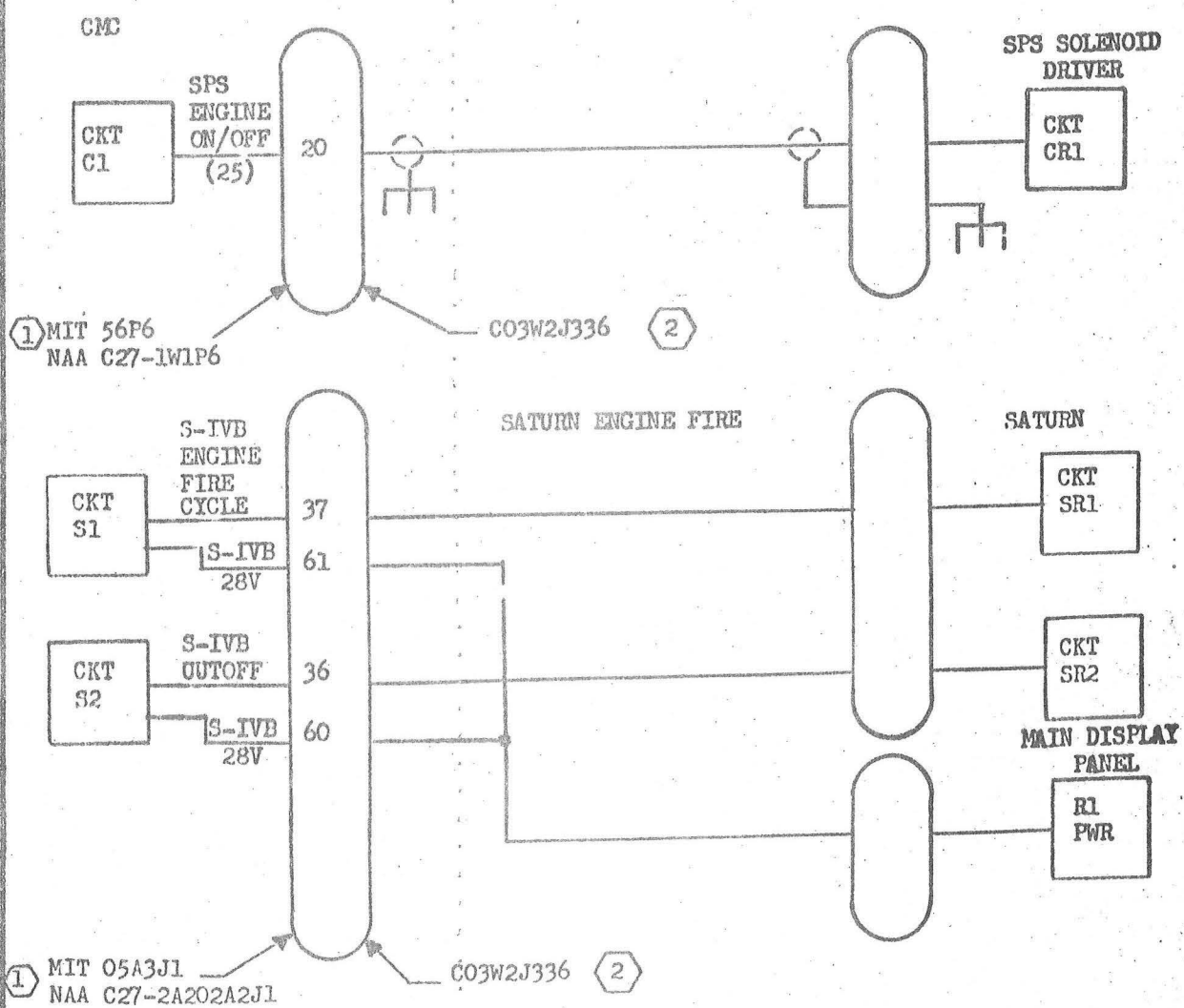
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7.1 Interface Wiring Data

MAIN ENGINE SIGNALS

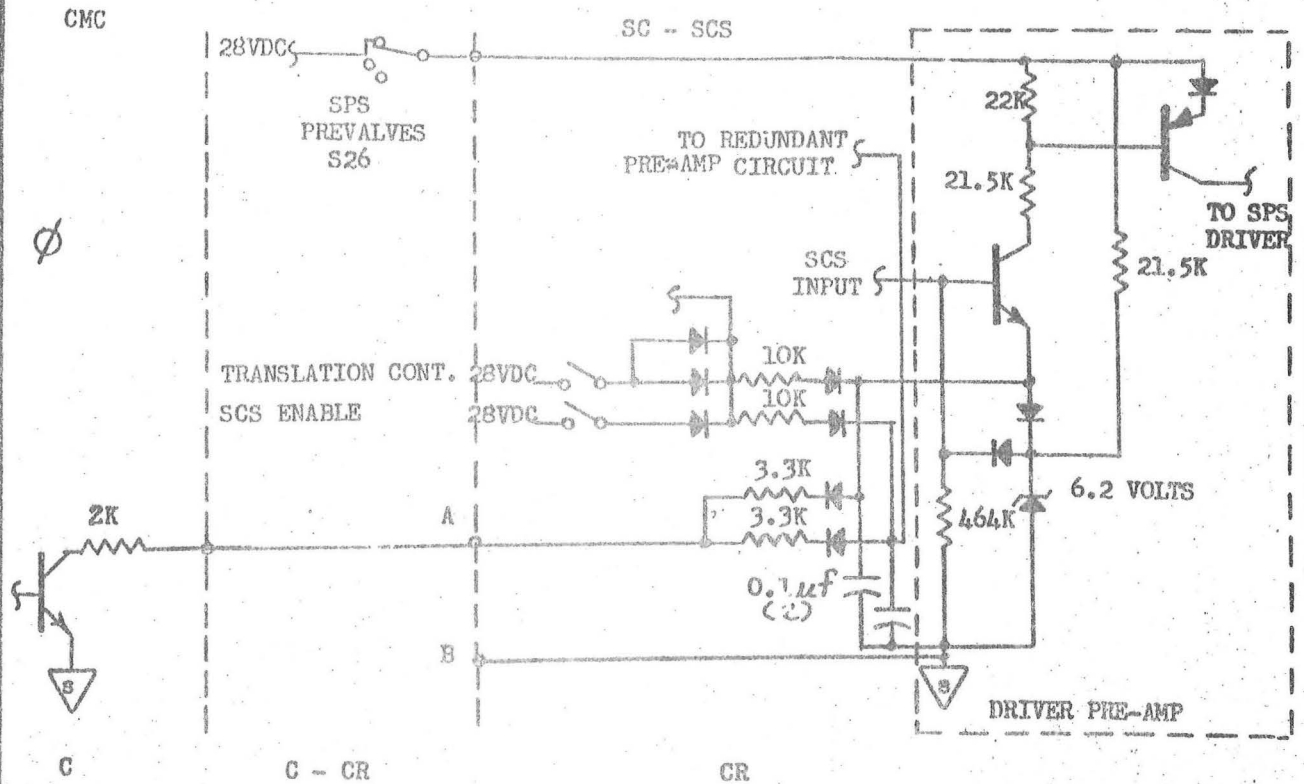


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7.2 Interface Circuit and Signal Characteristics



NOTE: SCHEMATICS SHOWN FOR REFERENCE ONLY

All Measurements Made from A to B, B Ref.

Amplitude: "ON" 5V ± 5V
 "OFF" 28V ± 5V

Circuits: C1 and C11

Current: ON 5 MA Maximum

Source Impedance: "ON" 3K Max to CMC Ground, 0-5MA Range
 "OFF" 0.5 Meg Ohms, 0-40 Volt Range

Source Rise Time: Less than 1μ sec.

Noise Rejection: "ON" +80V Noise Pulse, Max Width 0.5 Millisec, Maximum Rep. Rate 10 pps
 "OFF" -20V Noise Pulse, Max Width 1 Millisec, Maximum Rep. Rate 10 PPS

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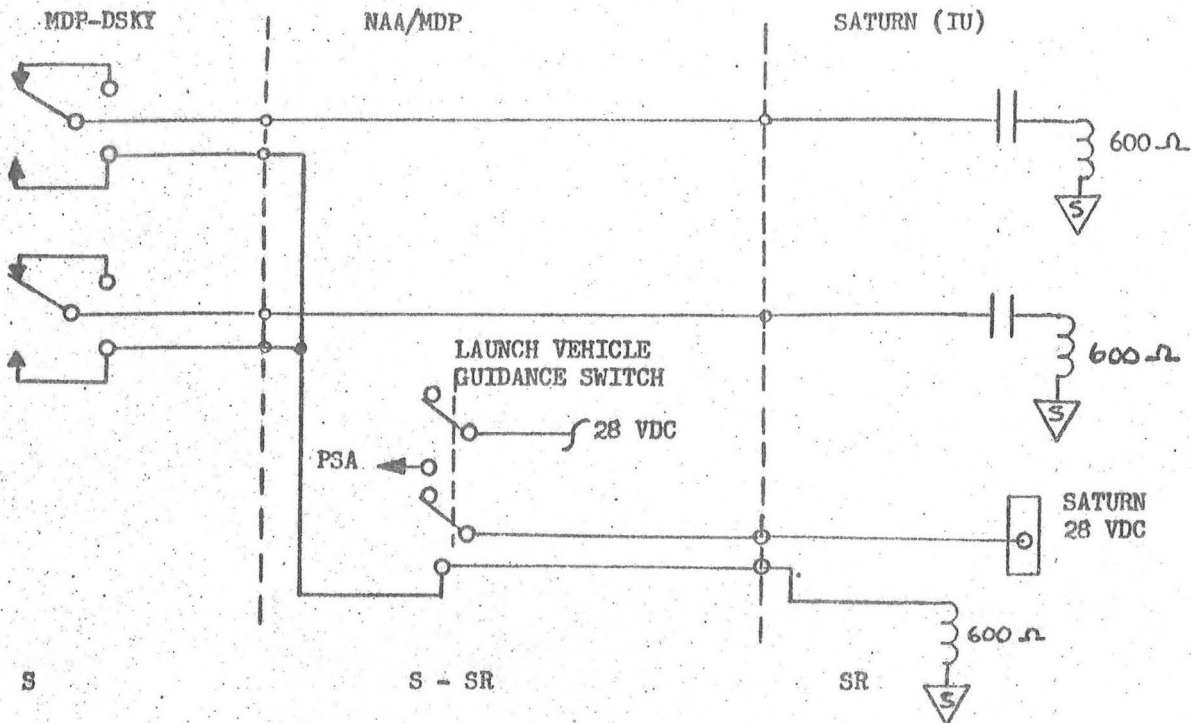
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7.2 Continued



Circuits:

S Circuit

Voltage: 28 ± 4 VDC

Current: 0.5 amps Maximum

Switch Shown in OFF Position

S-SR Circuits (Refer to ICD MH01-01344-216 for additional details)

Voltage: 28 ± 4 VDC

Current: 0.5 amps Maximum

SR Circuits

Voltage: 28 VDC

Current: 50 Milliamps

NOTE: SCHEMATICS SHOWN FOR REFERENCE ONLY

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E.O. 12812 #6282

8.0 Rotational and Translational Controller Signals

8.0.1 Rotational Hand Controller - The SCS shall provide discrete D-C output signals through the rotational hand controllers to the CMC whenever the controller is activated mechanically by astronaut motion. There shall be six lines representing commands of positive and negative rotation in all three axes from the two controllers.

8.0.2 Translational Hand Controller - The SCS shall provide discrete d-c output signals through the rotation control to the CMC whenever the controller is activated mechanically by astronaut motion. There shall be six lines representing commands of positive and negative translation in all three axes.

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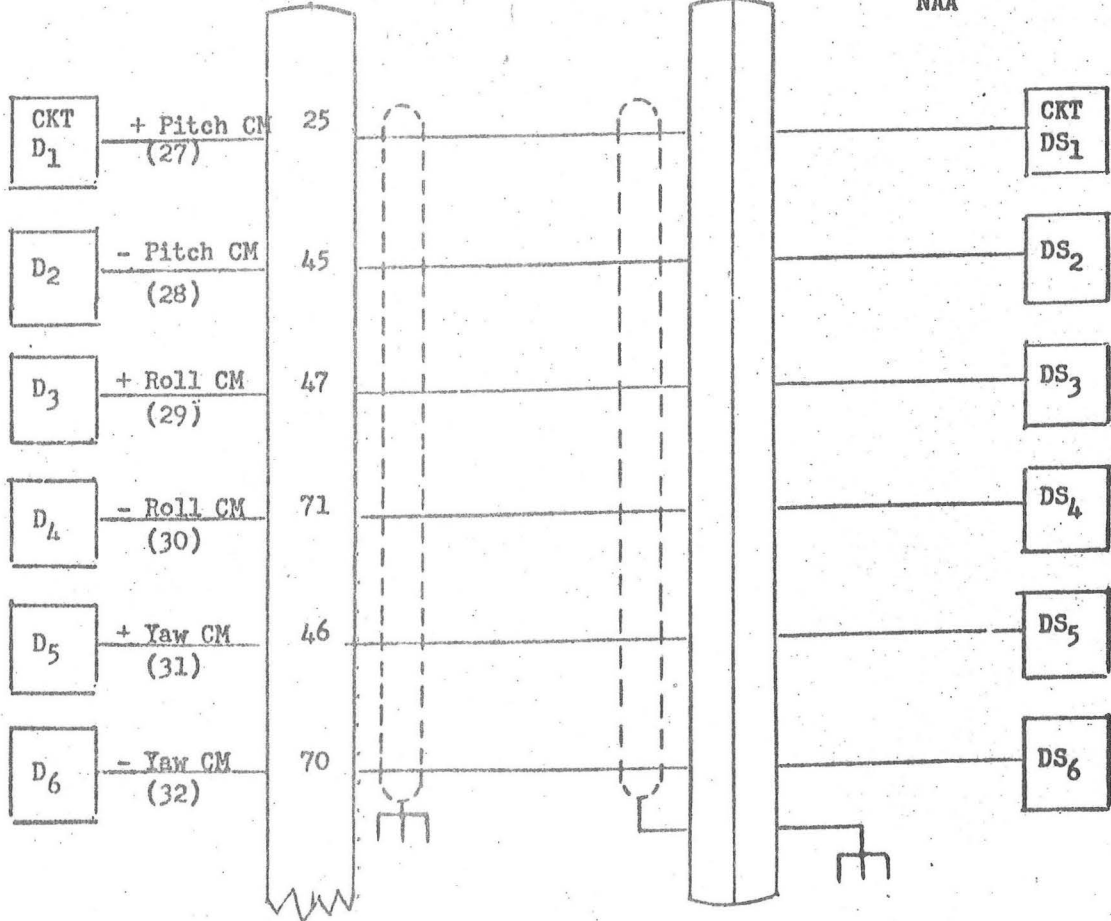
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8.1 Interface Wiring Data

ROTATIONAL CONTROLLER

CMC/MIT

Rotational Controller
NAA



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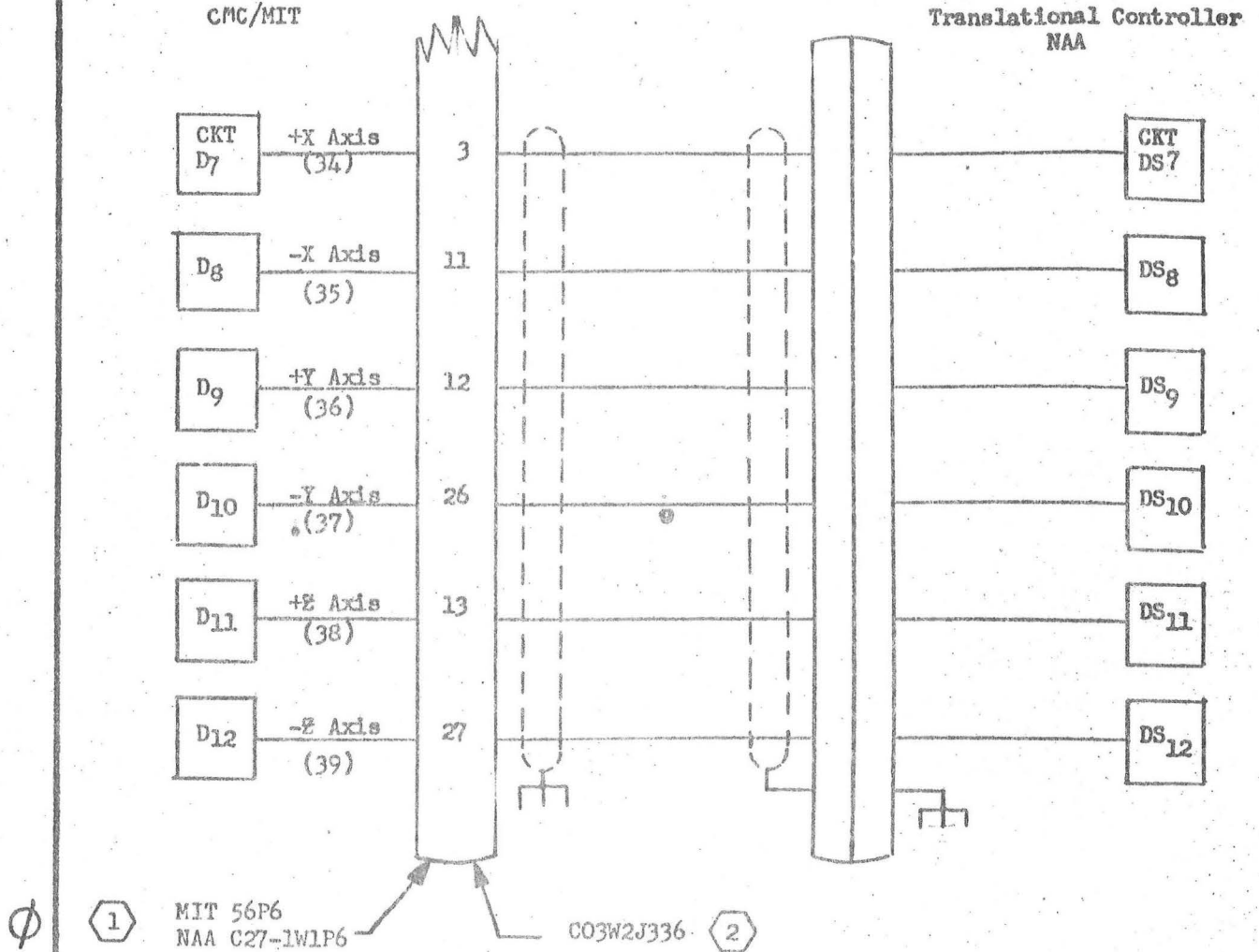
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SHEET 3/

8.1 Interface Wiring Data (Continued)

TRANSLATIONAL COMMANDS



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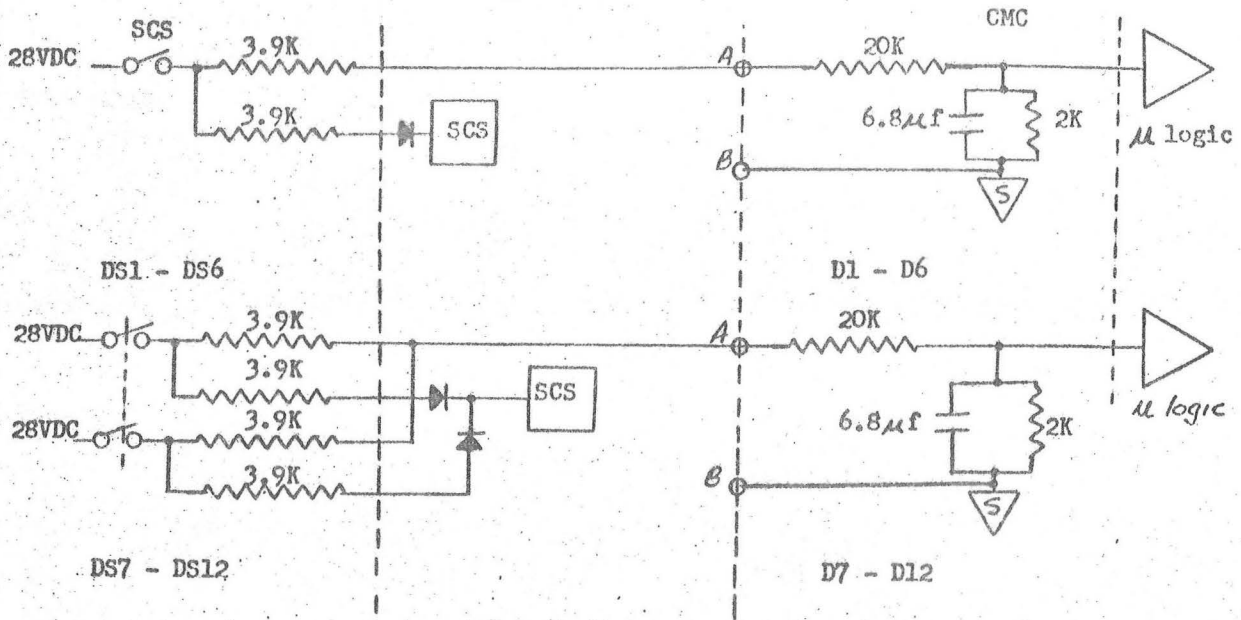
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8.2 Interface Circuit and Signal Characteristics



All measurements made from Points A to B, B Ref.

NOTE: SCHEMATIC FOR REFERENCE ONLY

Signal Characteristics:

a. "ON" Signal

- (1) Voltage: 28 + 11 VDC
- (2) Current: 0.01 Amps
- (3) Source Impedance: 3.9K Ohms Nominal - Rotation Control
1.95 Ohms Nominal - Translation Control

b. "OFF" Signal

- (1) Voltage: +2. -5 VDC
- (2) Source Impedance: 7 K (Minimum)

c. Noise Rejection

- (1) "ON" +80 V noise pulse, maximum width .5 millisecc maximum
rep rate 10 pps
- (2) "OFF" -20 V noise pulse, maximum width 1.0 millisecc maximum
rep rate 10 pps

Circuits

- D1 - D12 As shown
- DS1 - DS12 As shown

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E.O. 12812 #6282

9.0 MASTER CLOCK AND TELEMETRY

9.0.1 Master Clock

The G&N System shall provide a synchronizing pulse from the CMC. This timing pulse will be used to synchronize the NAA Central Timing Equipment with the Computer.

9.0.2 Telemetry

There will be two interfaces with PCM equipment:

1. Downlink - The Downlink shall consist of eight lines, two each for Downlink data, Downlink start, Downlink end, and Downlink sync. This link shall be used to transmit data to the ground via telemetry.
2. Uplink - The uplink will consist of four lines, two each for Uplink "0" and Uplink "1". This link shall be used to transmit data from the ground via Up-Data Link.

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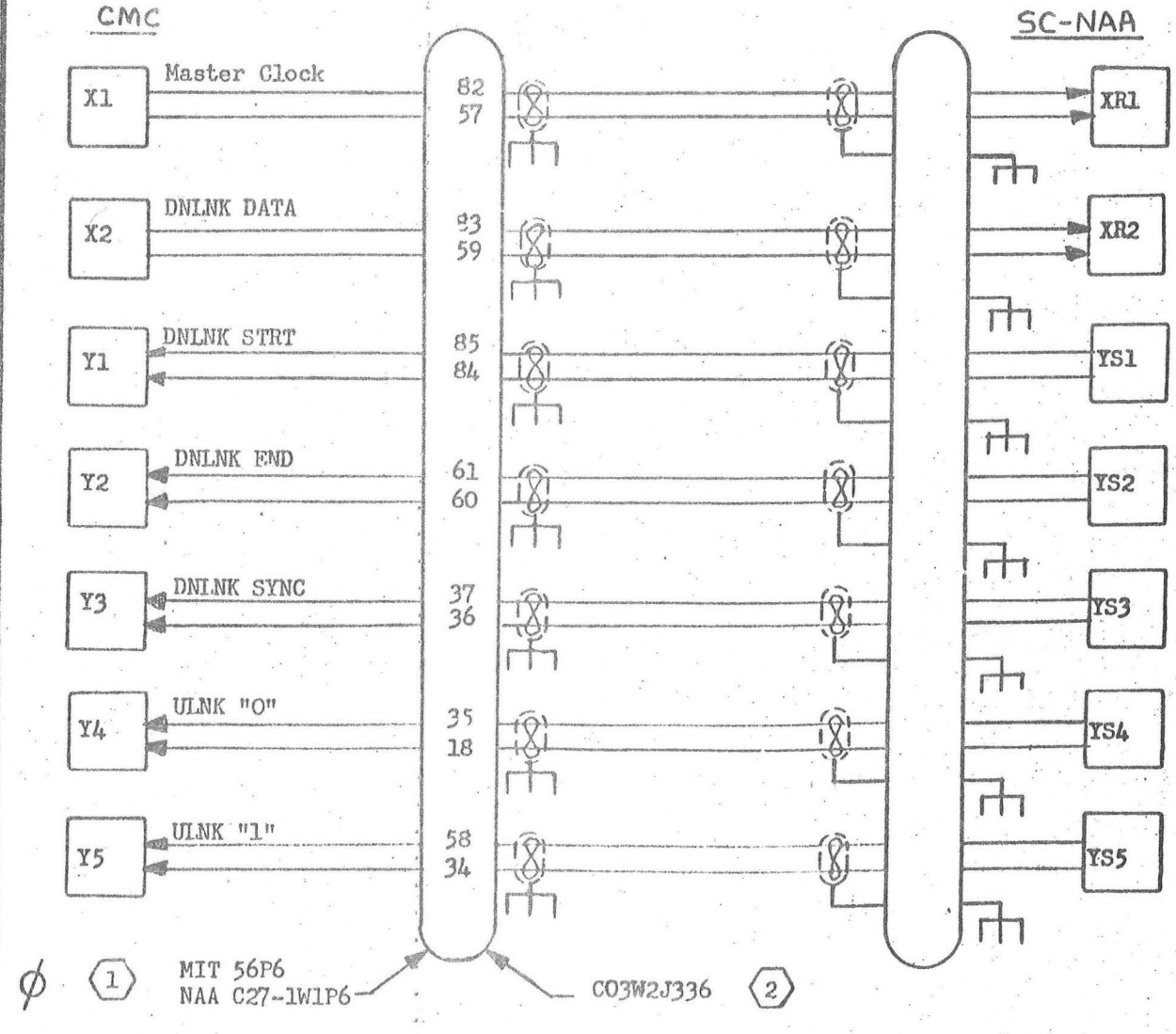
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9.1 Interface Wiring Data



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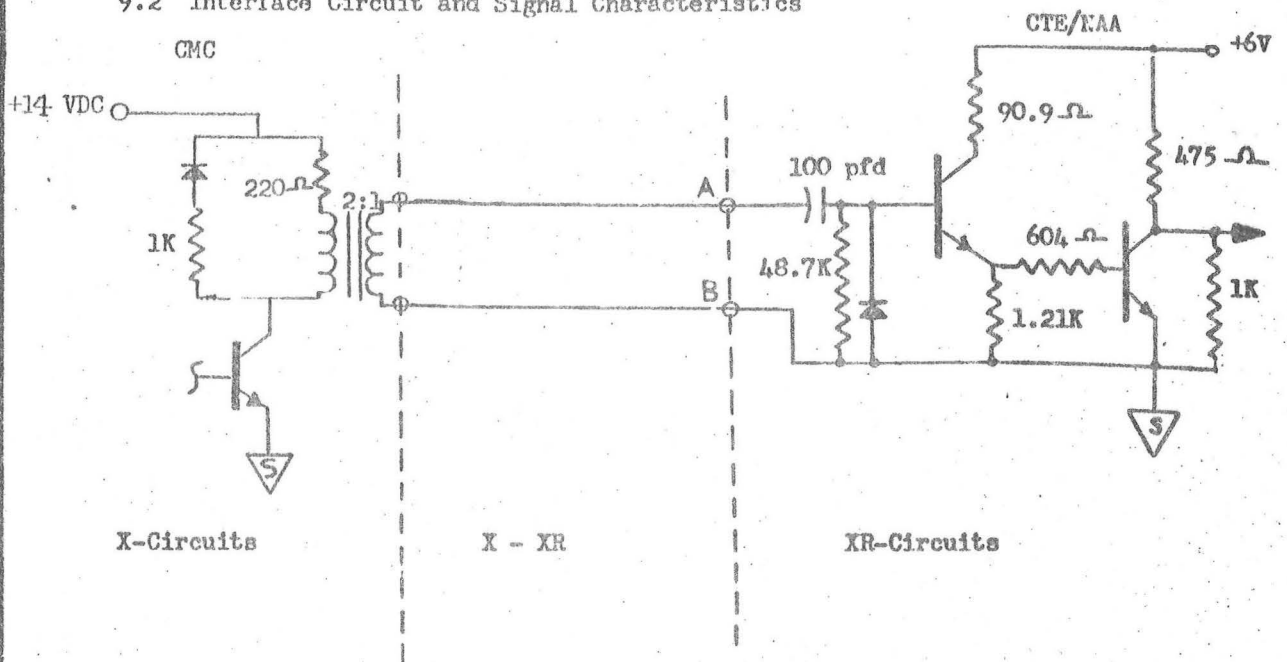
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9.2 Interface Circuit and Signal Characteristics



NOTE: Schematics Shown for Reference Only

All Measurements Made from A to B, B Ref.

1. Load Impedance - 500 ohms (approximate)
2. Source Impedance:
 - a. Impedance during pulse - 100 ohms (approx)
 - b. Resistance of Winding - 10 ohms maximum
 - c. Inductance of winding - 10 mh (maximum)

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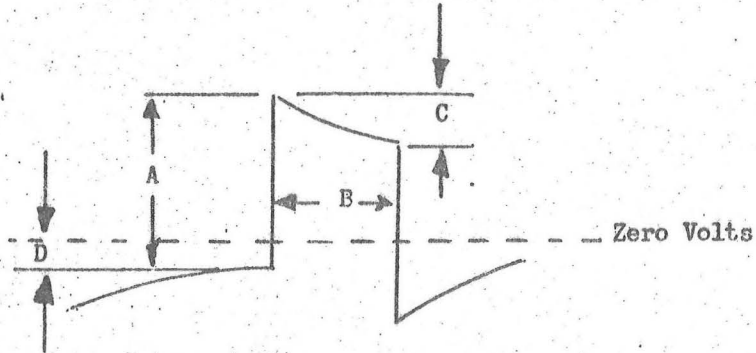
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9.2 Continued

3. Signal Characteristics at G&C Interface
(Test Load of 510 ohms)



- a) Amplitude (A) = 4 to 14 volts
- b) Pulse width (B) $0.5 \pm 0.25 \mu\text{sec.}$
- c) Zero Shift (D) = 50% of A (Approx.)
- d) Rise time (10% to 90% of A) = $0.2 \mu\text{sec. max.}$
- e) Noise and ripple = 0.2 volts max.
- f) Frequency = 1024 KC \pm 2 PPM
- g) Zero volt line is defined as the mean value of the waveform.
- h) Grounding: The master clock output signal end shall be ground isolated in the G&N System.
- i) Presence of pulse shall indicate "ON" condition.
Absence of pulse shall indicate "OFF" condition.

Circuits

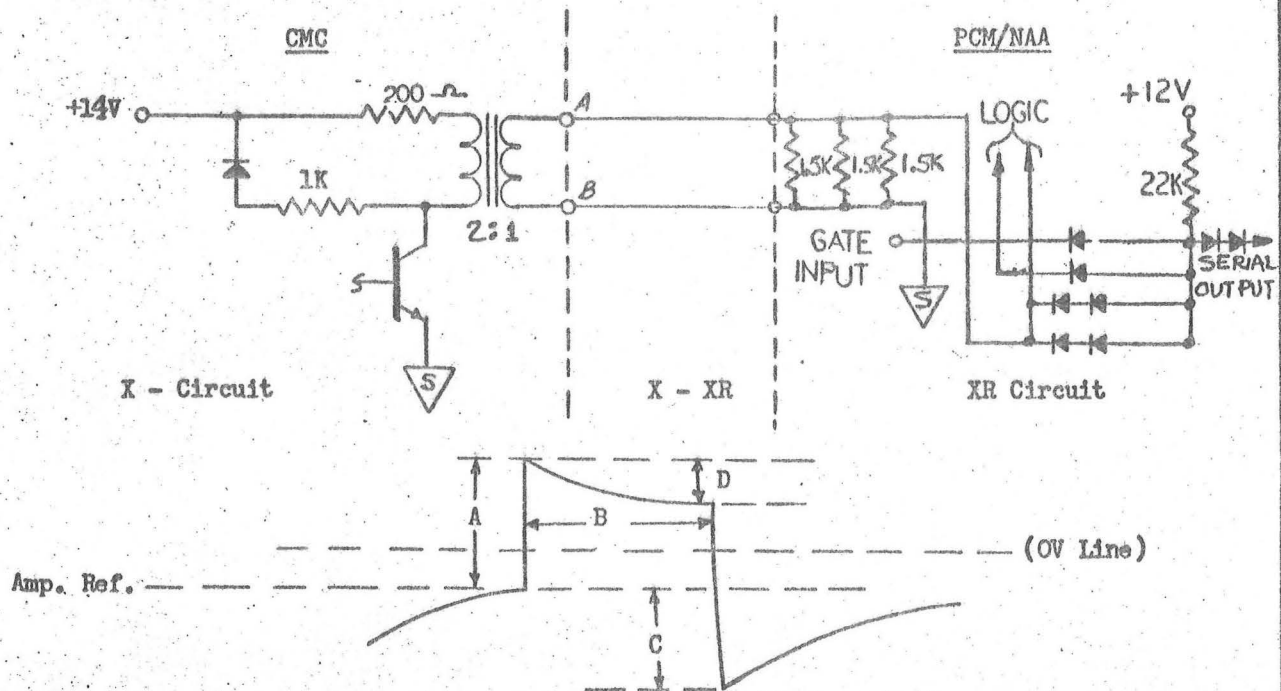
- X1 Shown above, CMC Transformer: NASA Drawing No. 1006319
- XRI Shown Above

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9.2 Continued



Interface Signal Specified at G&N Interface

1. Load Impedance: $500 \pm 10\%$ ohms nominal, note XR circuit above.
2. Source Impedance: 100 ohms maximum, note X circuit above.
3. Signal characteristics at the G&N Interface (Test load of 510 ohms $\pm 10\%$ acceptable)
 - a. Amplitude (A) $7 \pm 3V$
 - b. Pulse Width (B) 2.5 to 6 μ sec. at A/2 Point
 - c. Backswing (C) 6V maximum
 - d. Droop (D) 15% of "A" maximum at 2 μ sec. maximum

NOTE: SCHEMATICS SHOWN FOR REFERENCE ONLY

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9.2 Continued

- e. Rise Time (10-90% of, A) 0.2 μ sec maximum
- f. Zero Volt: The zero volt line is defined as the mean value of the waveform and is determined by the pulse shape and repetition rate.
- g. Noise Specification
 - 1. Noise during the transmission of the pulse:
The signal plus noise shall remain with the envelope of amplitude defined above (A,B).
 - 2. Noise during the absence of the pulse:
+0.4 volts max, -4.0 volts max; measured with respect to the amplitude reference (see Figure).
- h. Presence of the pulse shall indicate "ON" condition.
Absence of pulse shall indicate "OFF" condition.

Circuits

- X2 shown above, CMC transformer: NASA Drawing No. 1006319
- XR2 to be furnished, NAA

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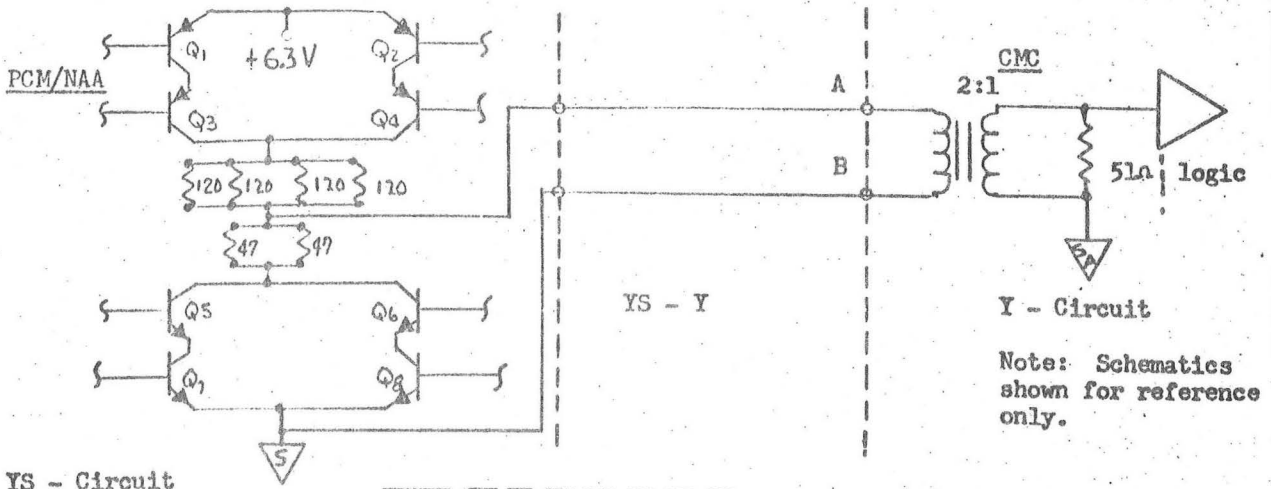
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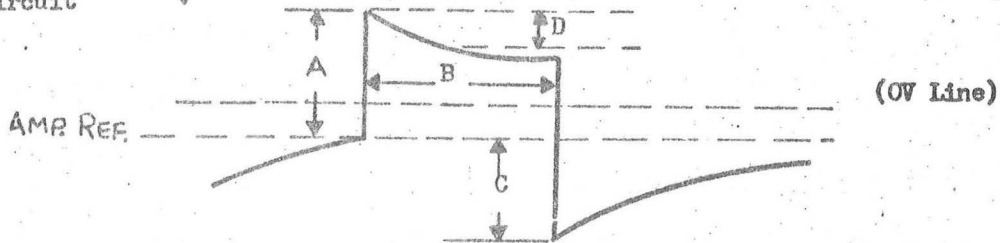
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9.2
Continued



YS - Circuit



Input Signal Specifications at G/N Interface

1. Load impedance: 200 ohms nominal, note Y circuit above.
2. Source Impedance: 100 ohms max.
3. Signal characteristics at G/N interface (Test load of 200 ohms \pm 10% acceptable)
 - a. Amplitude (A) $4.5 \pm 1V$
 - b. Pulse Width (B) $4.5 \pm 1.5\mu\text{sec}$ (at A/2 point)
 - c. Droop (D) 15 % of "A" at 2 μsec max
 - d. Rise Time (10-90% of A) 0.2 μsec max
 - e. Zero Volt: The zero volt line is defined as the mean value of the waveform and is determined by the pulse shape and repetition rate.

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9.2 Continued

g. Noise Specification

1. Noise during the transmission of the pulse:
The signal plus noise shall remain within the envelope of amplitude defined above (A,B).
 2. Noise during the absence of the pulse:
+0.4 volts max, -4.0 volts max; measured with respect to the amplitude reference (see Figure).
- h. Presence of the pulse shall indicate "ON" condition.
Absence of pulse shall indicate "OFF" condition.

Circuits

Y1 - Y3 shown above, CMC transformer: NASA Drawing No. 1006319
 YS1 - YS3 to be furnished, NAA

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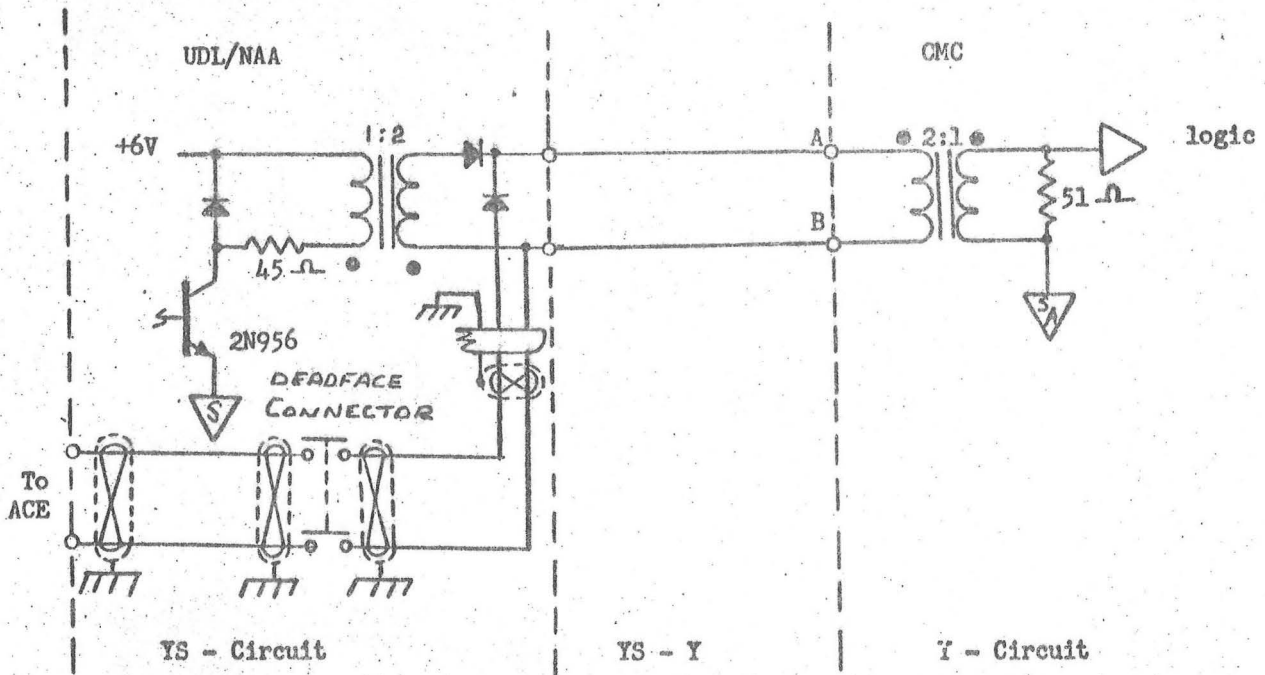
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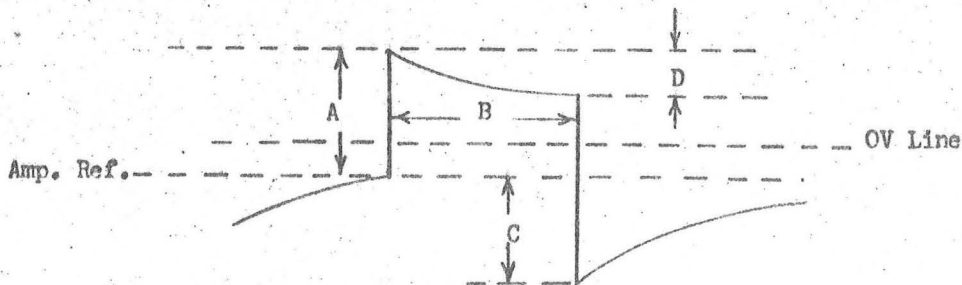
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9.2 Continued



NOTE: Schematics shown for reference only.



Input Signal Specifications at G&N Interface

1. Load Impedance: 200 ohms nominal, note Y circuit above.
2. Source Impedance: 220 Ω During Pulse (Maximum)

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3. Signal Characteristics at G&N Interface
(Test load of 200 ohms \pm 10% acceptable)

- a. Amplitude (A) $7 \pm 3V$
- b. Pulse Width (B) $2-6\frac{1}{2}$ sec (at A/2 point)
- c. Backswing (C) 4V maximum
- d. Droop (D) 20% of "A" maximum
- e. Rise Time (10-90% of A) 1.4 sec maximum
- f. Zero Volt: The zero volt line is defined as the mean value of the waveform and is determined by the pulse shape and repetition rate.
- g. Noise Specification
 - 1. Noise during the transmission of the pulse:
The signal plus noise shall remain within the envelope of amplitude defined above (A, B).
 - 2. Noise During the absence of the pulse:
+0.4 volts maximum, -4.0 volts maximum; measured with respect to the amplitude reference (see Figure).
- h. Presence of the pulse shall indicate "ON" condition. Absence of the pulse shall indicate "OFF" condition.

Circuits

- Y4 - Y5 Shown above, CMC transformer: NASA Drawing No. 1006319
- YS4 - YS5 To be furnished, NAA

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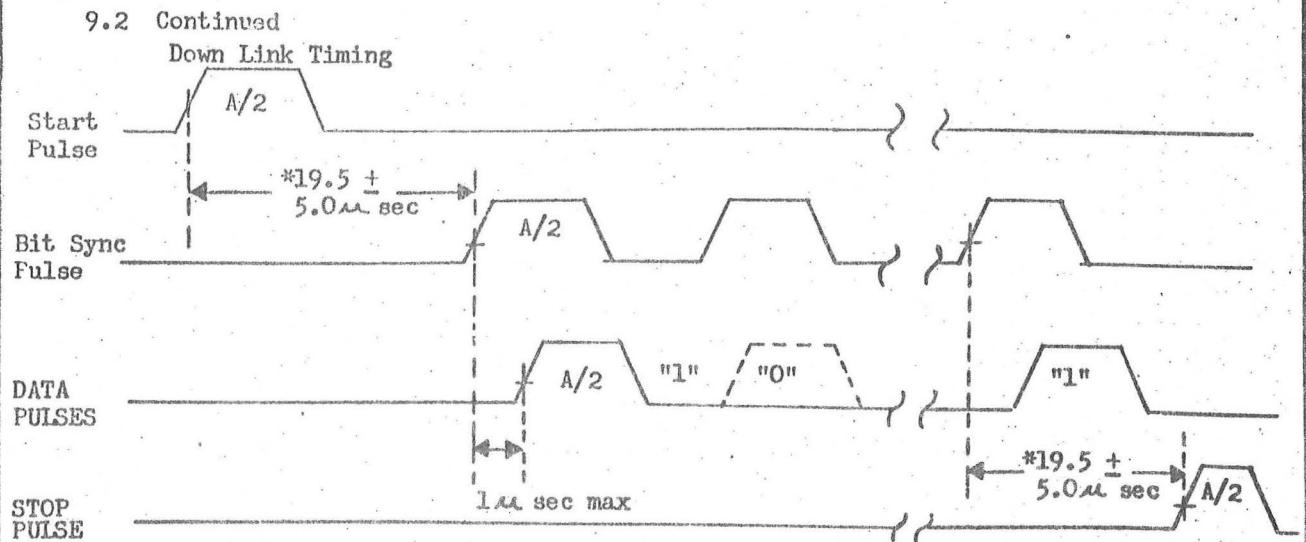
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- Start pulses: Normal rate 50 pps, low rate 10 pps.
- Bit sync pulses: Normal rate 51.2 Kpps, low rate 1.6 Kpps. There will be 40 pulses per burst.
- Data pulses: Frequency and width determined by bit sync pulses. A "1" is the presence of a pulse and a zero as the absence of a pulse with a bit sync pulse.
- Stop pulses: Normal rate 50 pps, low rate 10 pps.
- During CMC "Standby Mode", data is all "1's".

* Time shown hold for normal data rate; for low data rate replace $19.5 \pm 5 \mu\text{sec}$ by $625 \pm 156 \mu\text{sec}$.

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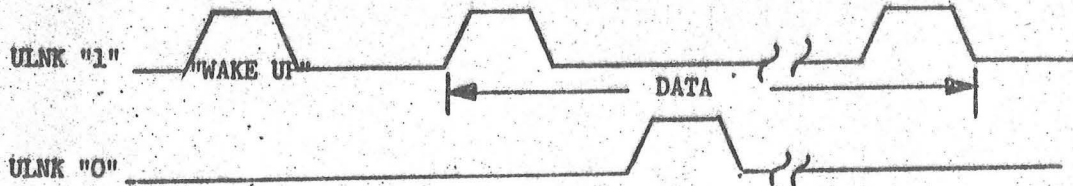
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9.2 (Continued)

Uplink Timing



- a. Bit rate of 0's and 1's is 1.1 Kpps maximum.
- b. 1 word is composed of 16 pulses; a "wake up" bit on the "1" line followed by 15 bits on the "1" or "0" lines.
- c. Minimum time between words is 0.1 seconds.

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10.0 CM Computer Display Keyboard (DSKY) Illumination Power

This section covers the electrical interface for the MDC-DSKY and the LEB-DSKY illumination. NAA will provide power and dimming controls for EL integral lighting (keys), alpha numerics, and the advisory and component status lights.

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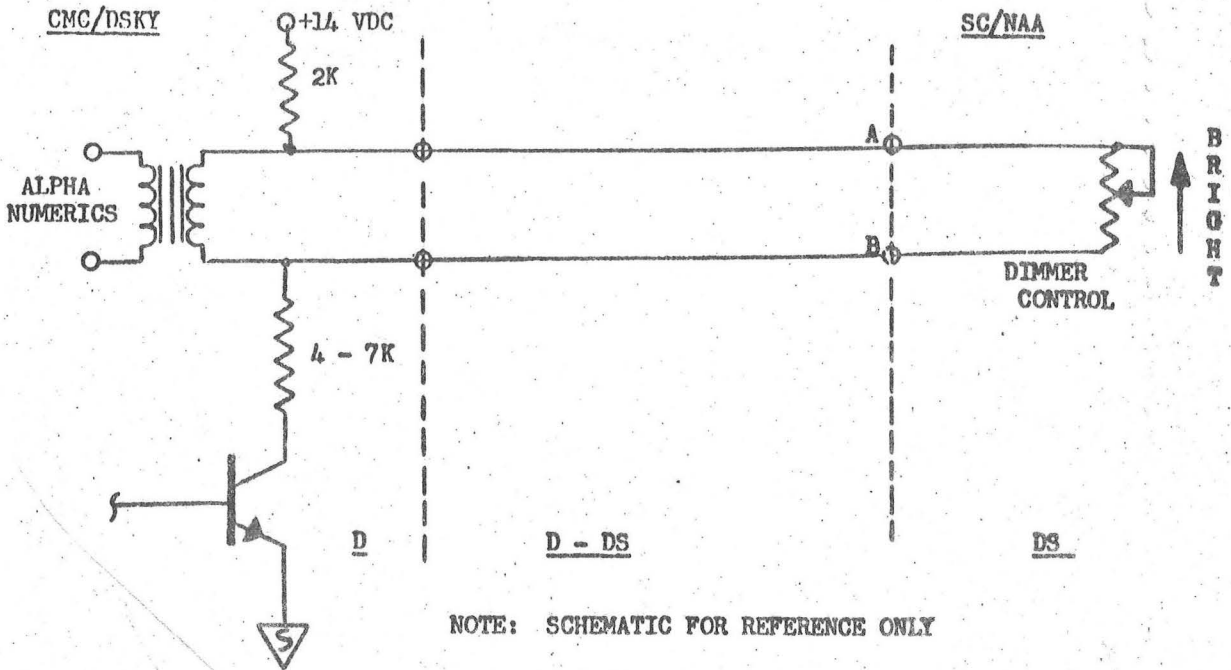
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10.2 Circuit and Signal Characteristics



All Measurements Made from A to B, B Reference

Waveform: 800 cps Square Wave, 14 VDC maximum

Current: 2MA Maximum

Dimmer Control:

Type - 10K \pm 5%

Taper - Linear

Circuits:

D₁ and D₂

DS₁ and DS₂

INTERFACE CONTROL DOCUMENT

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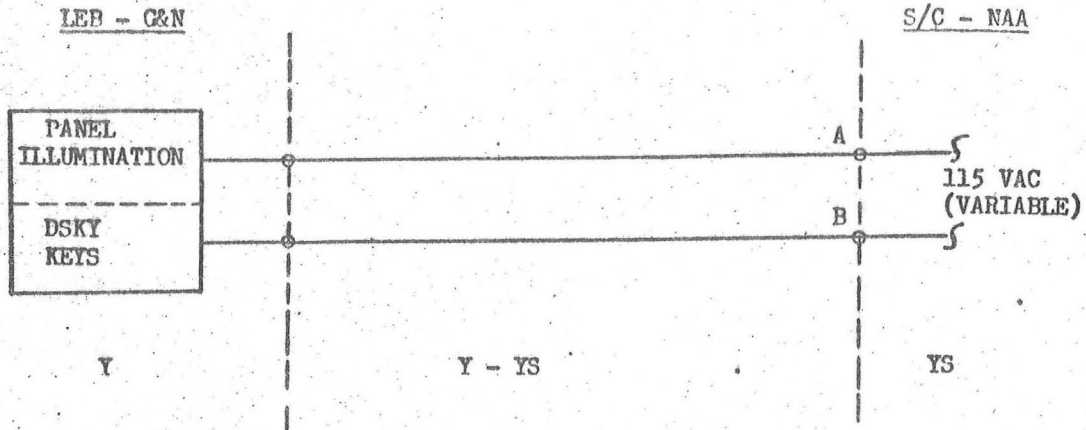
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SHEET 48

REVISIONS A 1-10-66

10.2 Circuit and Signal Characteristics (Continued)



NOTE: SCHEMATIC FOR REFERENCE ONLY

All Measurements Made from A to B, B Reference

Voltage: 115V ± 4.3 (Controlled 0 - 115 VAC)

Current: 317.5 MA @ 75V (APPROXIMATE)

Frequency: 400 cps ± 7 cps

VA: 23.8

Watts: 10.66 MAX.

P.F.: 0.5

Noise: Modulation: 0.5 percent

Transients: 50 to 150 volts RMS Recovery in 30 milliseconds to steady state.

Circuits: Y₁
YS₁

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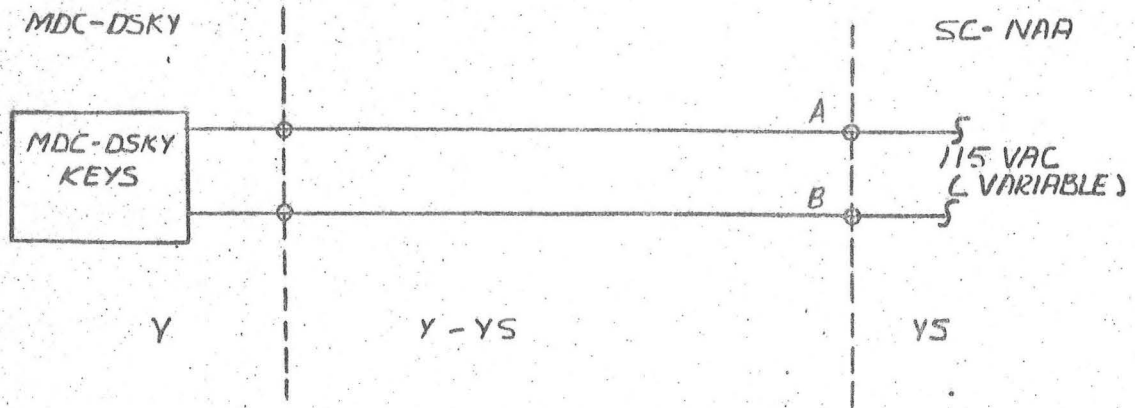
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E.O. 12812 #6282

REVISIONS A 1-10-66

10.2 Circuit and Signal Characteristics (Cont.)



NOTE & SCHEMATIC REF. ONLY

All Measurements made from A to B, B Reference

Voltage: 115V ± 4.3 (Controlled 0 - 115 VAC)

Current: 17.5 MA @ 75V (APPROXIMATE)

Frequency: 400 cps ± 7 cps

VA: 1.32

Watts: 0.66 MAX.

P.F.: 0.50

Noise: Modulation: 0.5 percent

Transients: 50 to 150 volts RMS Recovery in 30 milliseconds to Steady State.

Circuits:

Y₂

YS₂

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SHEET 50

11.0 Computer to Computer Displays

This section describes the interface between the Computer and Main Display Panel DSKY. The interfaces consist of 47 lines which carry signals from the DSKY to the Computer.

INTERFACE CONTROL DOCUMENT

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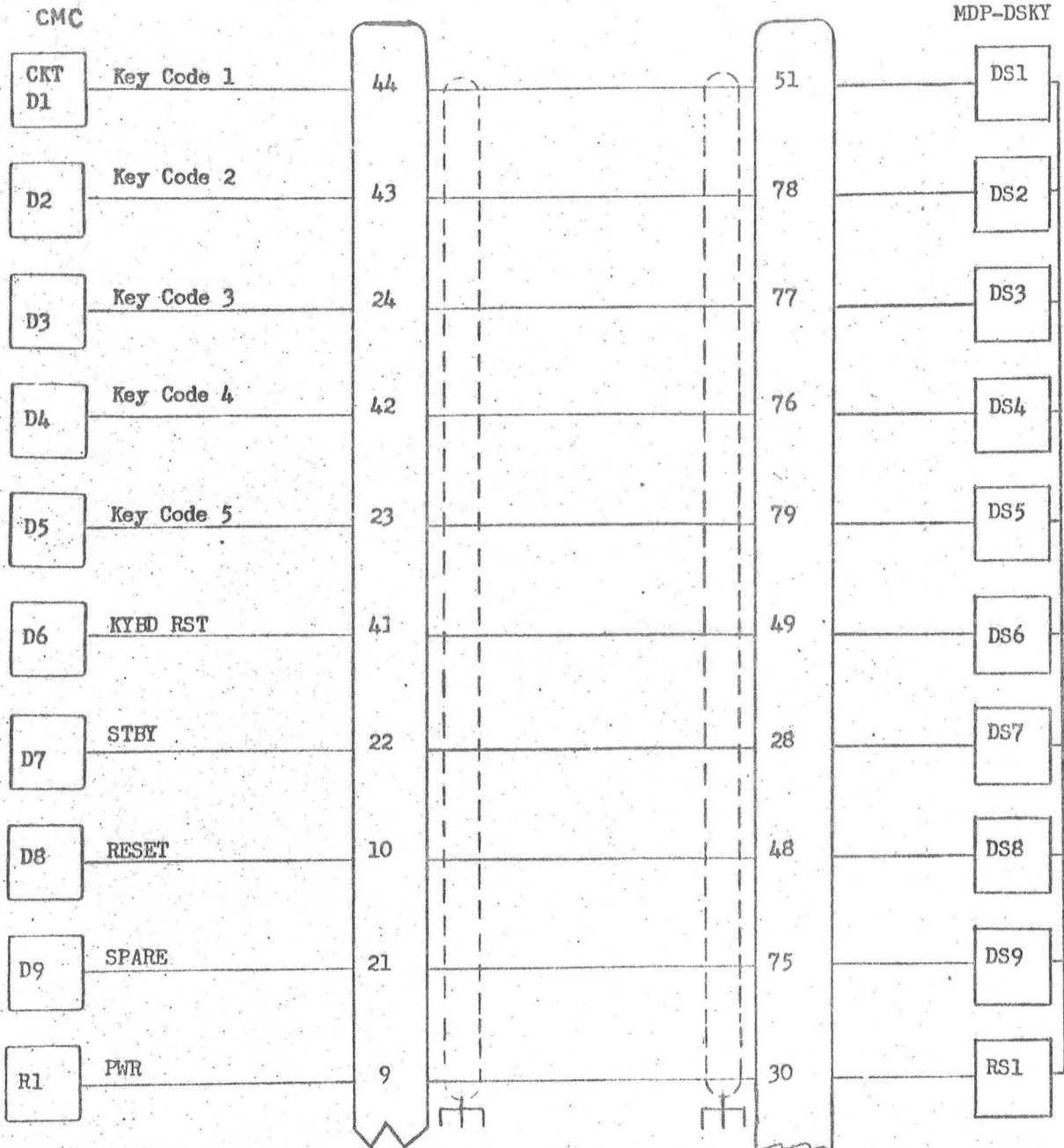
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SHEET 52

11.1 Interface Wiring Data



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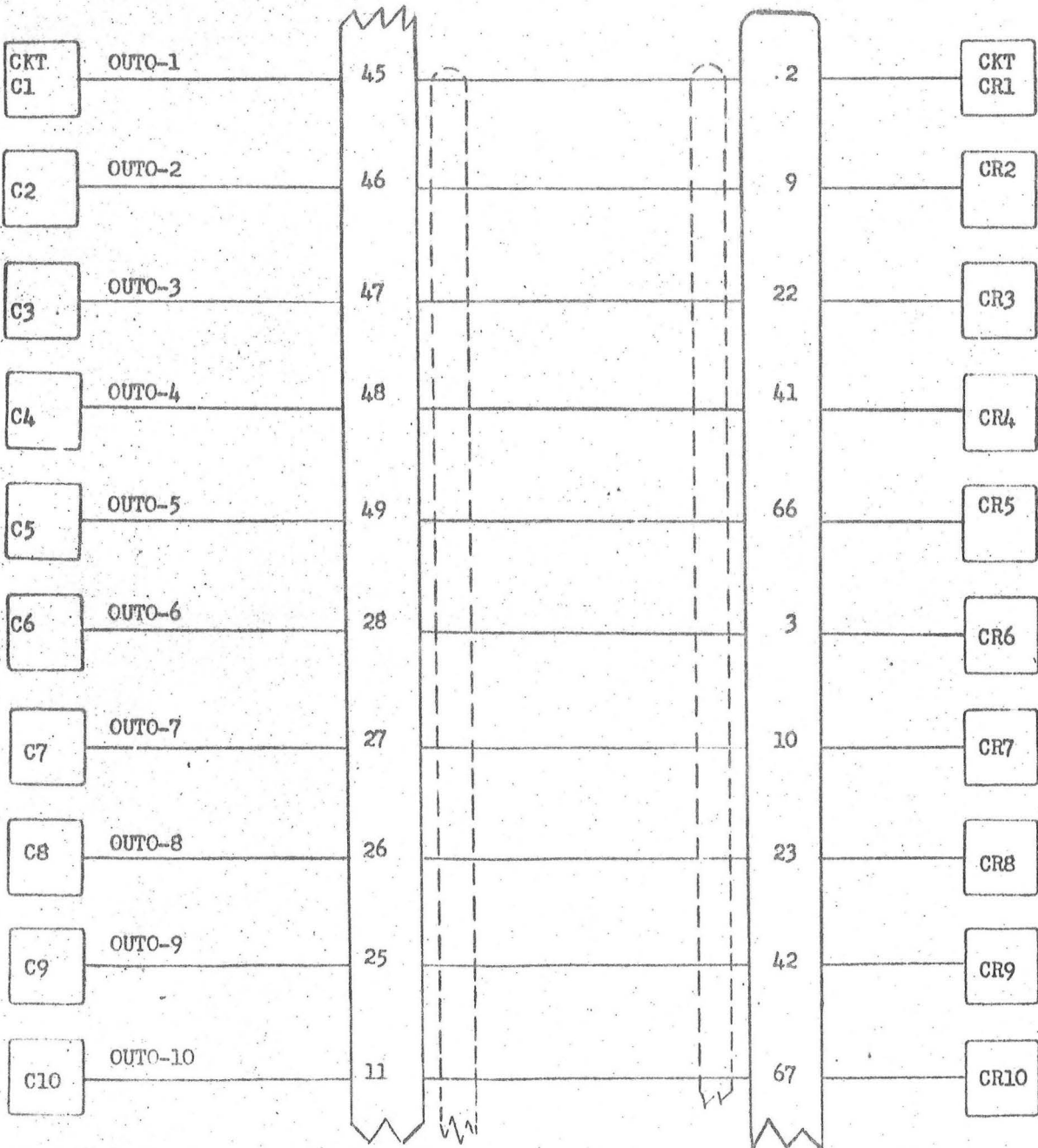
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11.1 (Cont)



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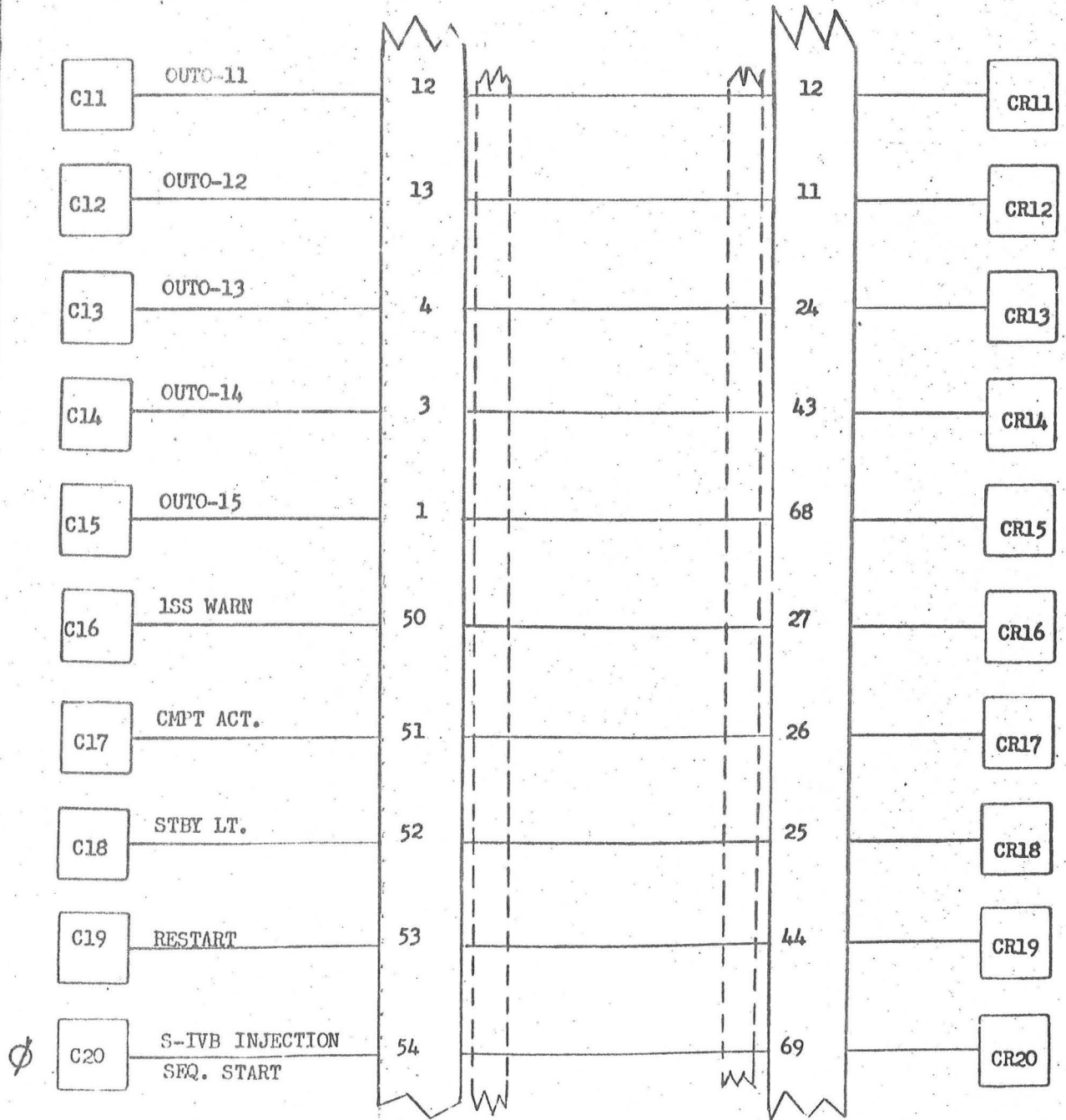
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SHEET

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REVISIONS A 1-10-66

11.1 (Cont.)



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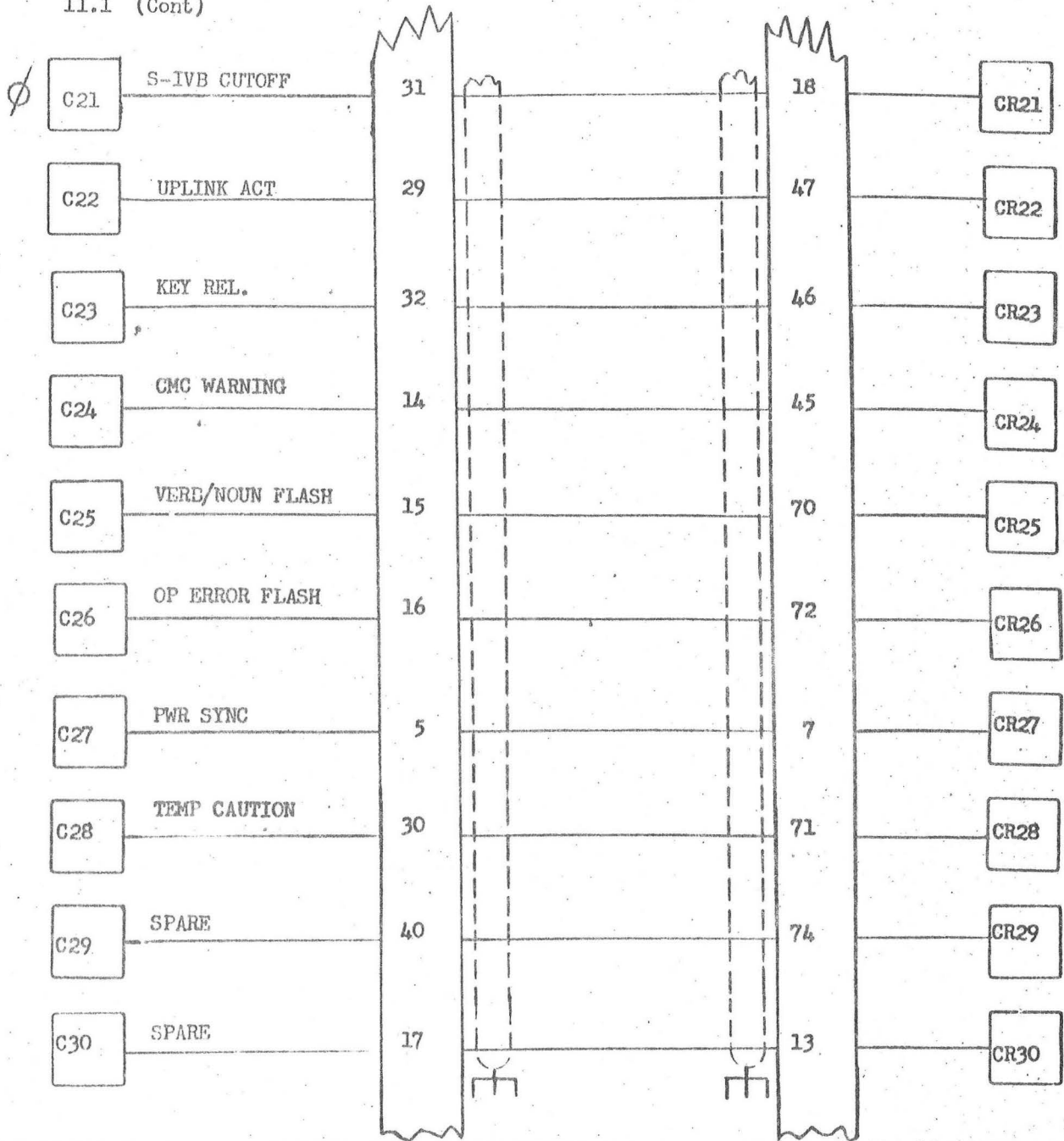
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REVISIONS A 1-10-66

11.1 (Cont)



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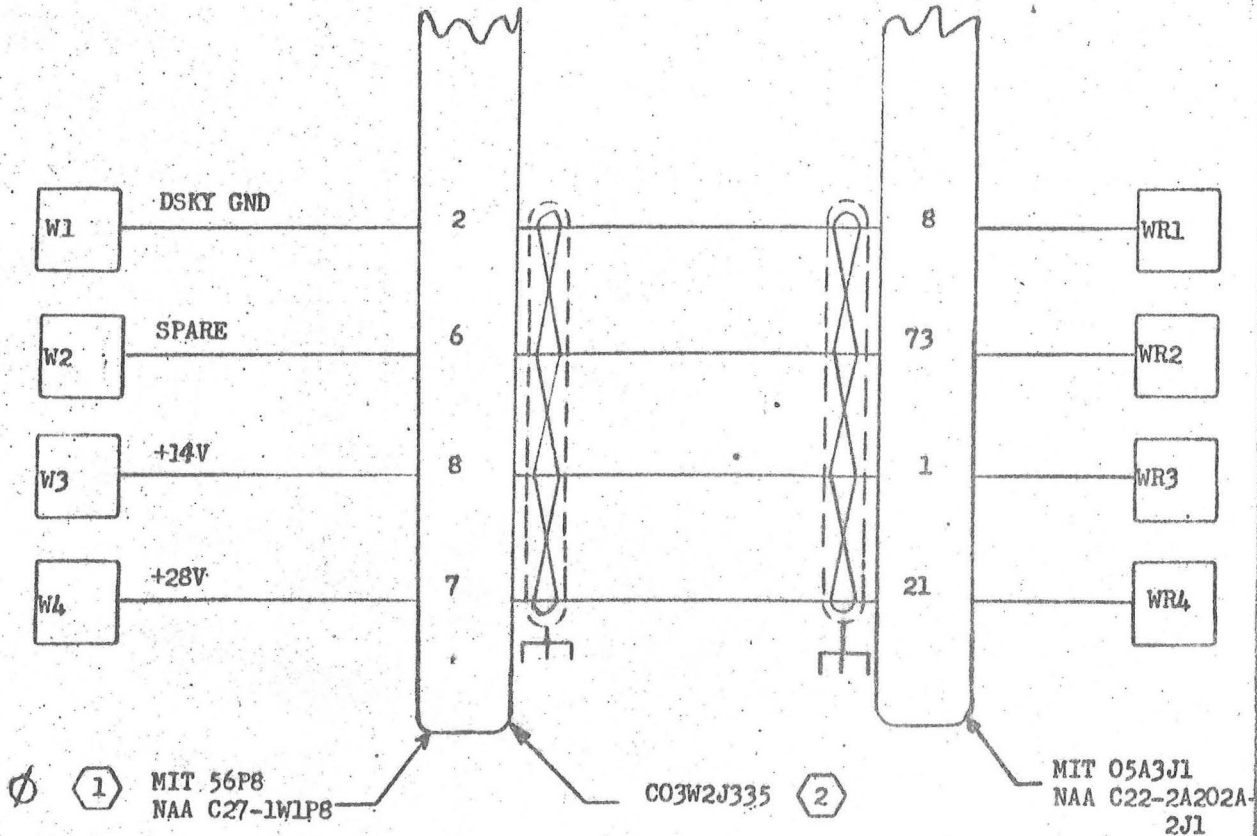
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SHEET 56

11.1 Continued



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SHEET 59

E.O. 12812 #6282

11.2 Circuit and Signal Characteristics

Waveform Specs

D Circuit

Volt Amp. 0 - 28
 Rise Time $< 1 \mu$ sec.
 Current Amp 2 MA Maximum
 Rise Time $< 1 \mu$ sec.
 Frequency 2 pps Maximum

C Circuit

Volt. Amp. 0 - 28
 Rise Time $< 1 \mu$ sec.
 Current Amp. 5 MA Maximum
 Rise Time $< 1 \mu$ sec.

W Circuit

W1 Ground
 W2 Spare
 W3 Current 100 MA or Less
 W4 Current 500 MA (pulsating)

∅

INTERFACE CONTROL DOCUMENT

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SHEET 58

12.0 CMC MDC DSKY to Spacecraft Displays

This interface covers the signals from the CMC which illuminate the caution and warning lights in the "Caution and Warning" subsystem.

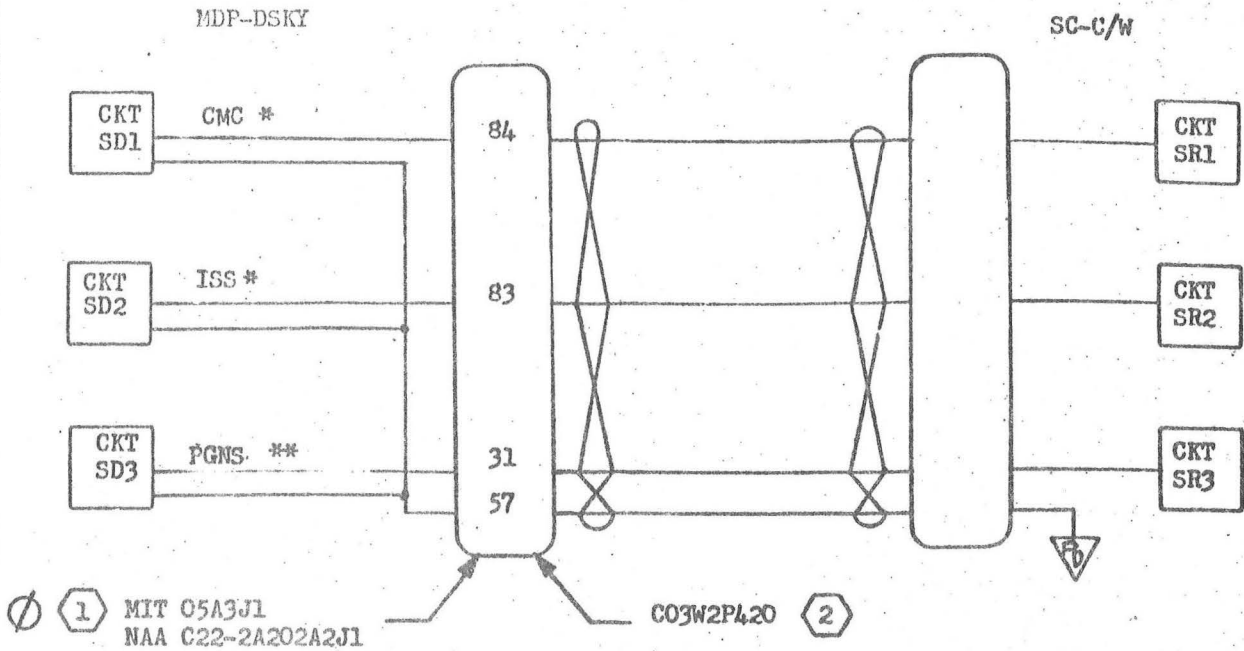
There shall be three signals:

1. CMC (Warning) - Indicates a malfunction in the CMC Power Supply or CMC Circuit
2. ISS (Warning) Inertial Subsystem - Indicates a malfunction in the IMU, PIPA Loop, CDU.
3. PGNS (Caution) Primary Navigation/Guidance System - Indicates Gimbal Lock, IMU Temp out of Tolerance, Radar Failure, Program Alarm, Restart (computer).

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		<p>SHEET 59</p>

12.1 Interface Wiring Data



* Red Light
** Yellow Light

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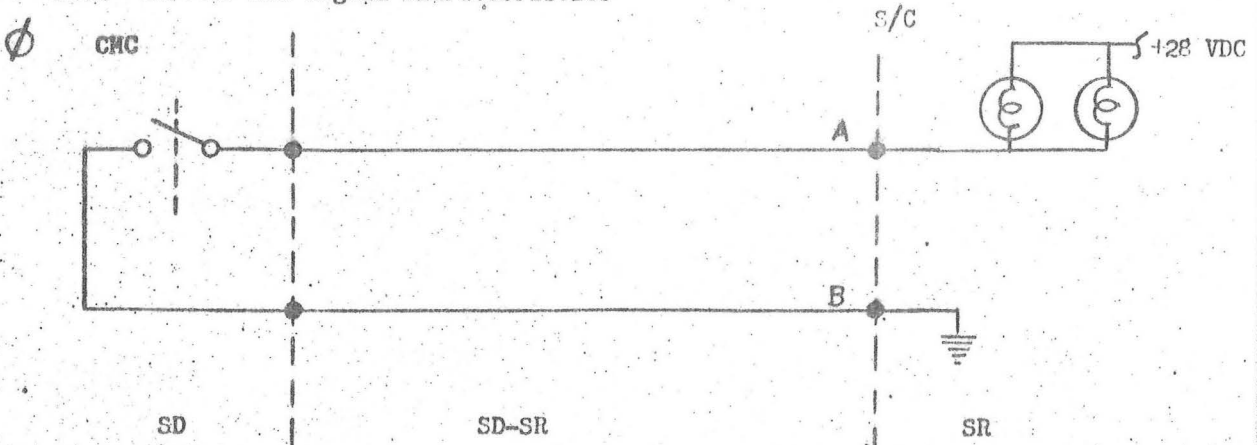
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SHEET 60

12.2 Circuit and Signal Characteristics



All measurements made from A to B, B Ref.

Voltage: 28 VDC (nominal from S/C bus)

Current: 120 ma Steady State
1 amp peak for 10 milliseconds

Contact Rating: 0.5 ampé (+28 VDC into lamp load)

Circuits

SD1 - SD3 as shown above

SR1 - SR3

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SHEET 61

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13.0 Computer to Spacecraft Power

This interface covers the Power interface to the AGC and is included in this ICD for reference only. The Power Interface for the G/N and C shall be covered in ICD MH01-01327-216.

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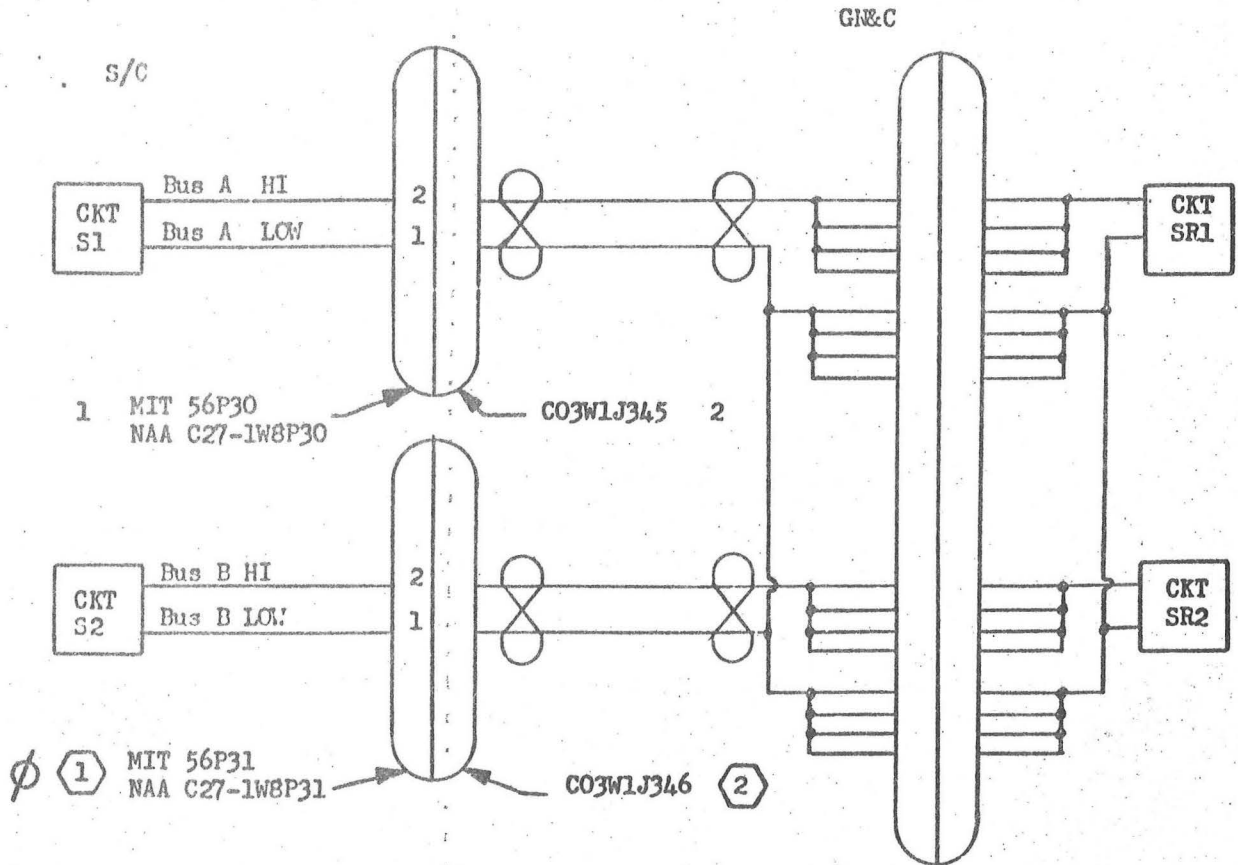
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SHEET 62

13.1 Interface Wiring Data



NOTE: For Reference Only

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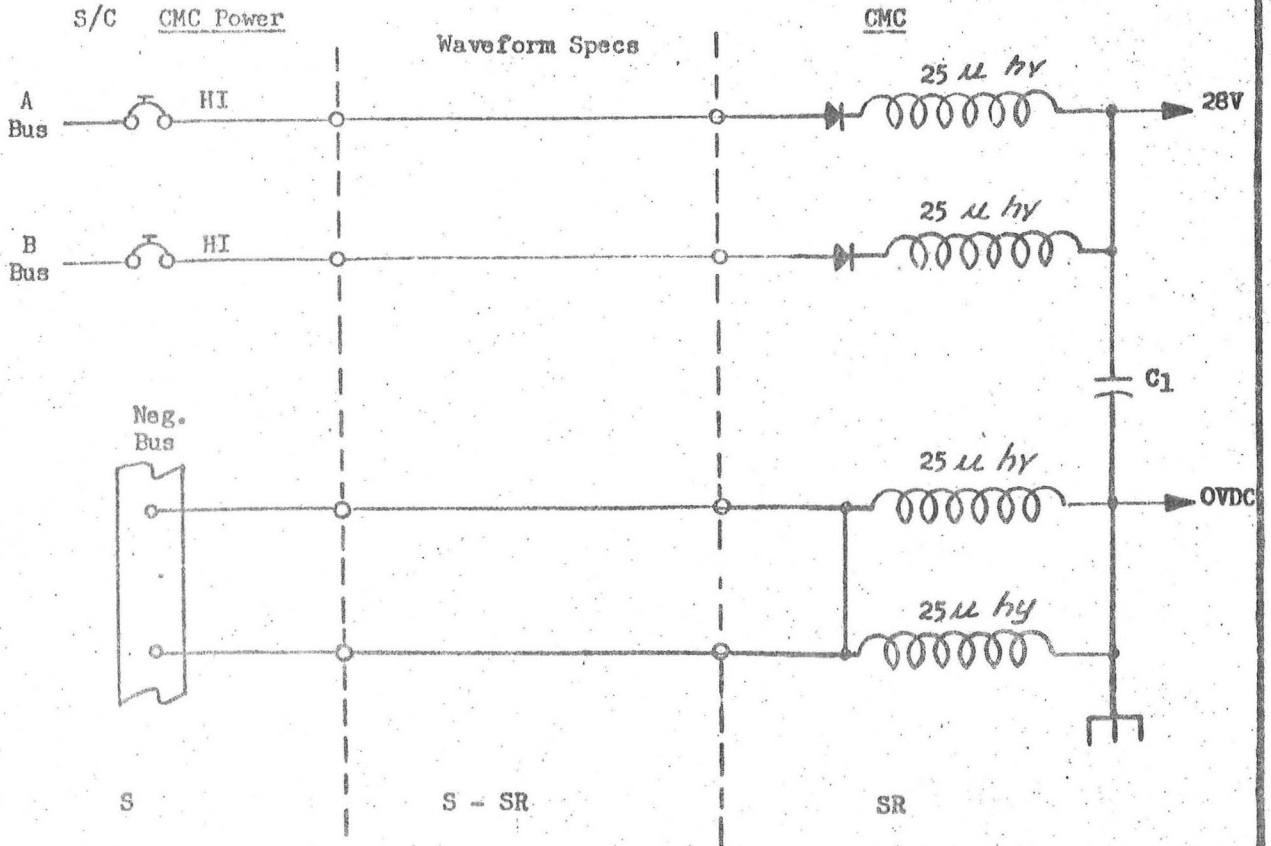
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13.2 Interface Circuit and Signal Characteristics



All Measurements at CMC Interface

Steady State Voltage: 25.8 to 30.8 at CMC Interface
 Variations to S.S.: Per MH01-01327-216
 Current: 4.2 amps maximum

Circuits

S1, S2
 SR1, SR2

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