

APOLLO OPERATIONS HANDBOOK

CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---|---|--|---|---------------------------------|--|
| MDC-16 (Cont) | ABORT SYSTEM switches OX DUMP switch AUTO | Enables circuitry through a 61-second timer to automatically dump the C/M RCS oxidizer during a pad or low-altitude abort prior to 61 seconds after lift-off. | MASTER EVENT SEQ CONT- A LOGIC B- BAT A BAT B (MDC-22) | Logic bus in the master event sequence controller | None | The 61-second timer, enabled by CM PROP JETT-LOGIC switch (MDC-8), starts at lift-off. The auto dump capability is disabled after the 61-seconds. Dump time is approximately 11 seconds. |
| | RCS CMD AUTO | Disables the auto oxidizer dump and allows the G&N/SCS system to be automatically enabled upon C/M-S/M separation to control the command module RCS during descent. | None | L/V-IU batteries | L/V telemetry via IU | During normal ascent, the OX DUMP switch is moved to the RCS CMD AUTO position 61 seconds after lift-off. |
| | 2 ENG OUT switch AUTO | Activates the EDS for a two-engine out automatic abort capability by de-energizing the two-engine out auto abort deactivate relays. | | | | The two-engine out auto abort capability is also shut off automatically by the IU. |
| | OFF | Deactivates the EDS for a two-engine out automatic abort capability by energizing the two-engine out auto abort deactivate relays. | | | | |
| | L/V RATES switch AUTO | Activates the EDS for an excessive rates automatic abort capability by de-energizing the excessive rates auto abort deactivate relays. | | | | |
| | OFF | Deactivates the EDS for an excessive rates automatic abort capability by energizing the excessive rates auto abort deactivate relays. | | | | The excessive rates auto abort capability is also shut off automatically by the IU. |

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| MODE switches | Enables systems A and B to use the launch escape system in case of an abort. | MASTER EVENT SEQ CONT - A LOGIC B - BAT A (MDC-22) | a. Battery buses A and B when the MESC LOGIC/OFF switch is in the LOGIC position. b. EDS change over bus | None | The two switches are guarded. |
| LFS MODE | Initiates jettison of the LES tower and arms system A and B of the SPS abort circuitry. | | | CD0105X Tower jettison A CD0106X Tower jettison B | After LET jettison, all aborts must be manually initiated and made in the SPS mode. |
| TWR JETT SPS MODE | | | | | |
| REACTION CONTROL SYS Group | Energizes latching relay, connecting SCS jet selection logic to RCS engines. | MASTER EVENT SEQ CONT - A ARM B BAT A BAT B (MDC-22) | Battery buses A and B | None | Three-position toggle switch, spring-loaded to the center position. Switch allows manual inhibit-enable of SCS inputs to the automatic coils of the C/M or S/M RCS engines. Inhibit-enable functions provide backup capability to MESC control of the RCS latching relay. Switch is momentarily set to ON after adapter separation. This function is accomplished automatically by the MESC 0.8 seconds after initiation of adapter separation with the ADAPT SEP pushbutton (MDC-5). If LES abort occurs after T + 61 seconds, the MESC automatically closes the relay 1 second after abort initiation. If an SPS abort occurs, the MESC automatically closes the relay 2.5 seconds after abort initiation. The MESC baroswitch input automatically causes the relay to open at approximately 24,000 feet during C/M descent. |
| CMD switch | Enables MESC automatic control of latching relay. | | | | |
| ON | De-energizes latching relay, disconnecting SCS jet selection logic from RCS engines. | | | | |
| Center | | | | | |
| OFF | | | | | |

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| MDC-11 (Cont) | C/M PRESS switch Up Down | Activates helium isolation squib valves in both systems A and B. | MASTER EVENT SEQ CONT - A ARM B BAT A BAT B (MDC-22) | Battery buses A and B | None | |
| | | No function. | | | | |
| | TRANS switch C/M | Energizes motor switch causing the following: | RCS - C/M - S/M TRANSFER MN A MN B (MDC-25) | D-C main buses A and B | | Three-position switch, spring-loaded to the center position. Switch provides manual backup for automatic transfer function. |
| | | a. Connects C/M RCS engines to SCS jet selection logic control circuits. b. Disables translation controls. | | | | |
| | Center S/M | Enables MESC automatic control of motor switch. | | | | |
| | | Energizes motor switch, causing contacts to close which connect S/M RCS engines to SCS jet selection logic control circuits. | | | | |
| | EDS switch AUTO OFF | Prepares the L/V EDS auto abort circuitry for automatic enabling at lift-off. | MASTER EVENT SEQ CONT - A LOGIC B - BAT A BAT B (MDC-22) | Battery buses A and B | | Two-position toggle switch. |
| | | All auto abort capabilities are disabled. | | | | |
| | MAIN CHUTE RELEASE switch Up Down | Releases the main parachutes from the command module. | MASTER EVENT SEQ CONT - A LOGIC B - BAT A BAT B (MDC-22) | MESC logic buses A and B | CE0321X CE0322X (Main chute disconnect relays A and B) | The switch is electrically enabled when the 10,000 feet baroswitch closes during descent and will release the parachutes when actuated. The switch should never be moved to the up (release) position until after landing impact. The switch is spring-loaded to the down position and guarded. |
| | | Disables the parachutes release circuitry. | | | | |

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| MDC-18 | MASTER ALARM switch-light | Red light illuminates to alert crewman in RH couch of a malfunction or out-of-tolerance condition. This is indicated by illumination of applicable system status lights on MDC-10 or -11. | CAUT/ WARN- MN A MN B (MDC-25) | D-C main buses A and B | CS0150X (Master caution-warning on) | MASTER ALARM lights on MDC-3, -10, and LEB-103 are simultaneously illuminated, and an audio alarm tone is sent to each headset. The MASTER ALARM switch-light contains an integral push-switch. Pressing the switch-light will reset the master alarm circuit, extinguishing the MASTER ALARM lights and shutting off the audio alarm. |
| | pH HI event indicator Striped-line display Gray display | Indicates pH factor of water from selected fuel cell is over 9, indicating a leakage of KOH electrolyte into the potable water supply. Indicates pH factor of water from selected fuel cell is below 9. | | | SC2160Z (pH factor water condition F/C No. 1) SC2161Z (pH factor water condition F/C No. 2) SC2162Z (pH factor water condition F/C No. 3) | A pH factor of 7 designates pure water. (Water is potable with a pH factor below 9.) Fuel cell to be monitored is selected by FUEL CELL INDICATORS switch (MDC-18). The pH HI event indicator is part of the C&WS. |

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| MDC-18 (Cont) | F/C RAD TEMP LOW event indicator | Indicates selected fuel cell glycol temperature at radiator outlet has dropped to -30°F or less. | CAUT/ WARN- MN A MN B (MDC-25) | D-C main buses A and B | SC2087T (Temp F/C No. 1 radiator outlet) SC2088T (Temp F/C No. 2 radiator outlet) SC2089T (Temp F/C No. 3 radiator outlet) | Glycol operating range is -50° to +300°F. Fuel cell to be monitored is selected by FUEL CELL INDICATORS switch (MDC-18). The F/C RAD TEMP LOW event indicator is part of the C&WS. |
| | Striped-line display Gray display | Indicates selected fuel cell glycol temperature at radiator outlet is above -30°F. | | | | |
| | FUEL CELL indicators FLOW group H ₂ indicator | Indicates flow rate of H ₂ into selected fuel cell. | | | SC2139R (Flow rate H ₂ F/C No. 1) SC2140R (Flow rate H ₂ F/C No. 2) SC2141R (Flow rate H ₂ F/C No. 3) | Normal operating range (indicator green band) is 0.036 lb/hr to 0.163 lb/hr. Alarm limits to caution and lower, 0.153 lb/hr upper. Sensors for the indicator are located in the F/C H ₂ inlet lines. Fuel cell to be monitored is selected by FUEL CELL INDICATORS switch (MDC-18). |

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| MDC-18 (Cont) | O ₂ indicator | Indicates flow rate of O ₂ into selected fuel cell. | CAUT/ WARN- MN A MN B (MDC-25) | D-C main buses A and B | SC2142R (Flow rate O ₂ F/C No. 1) SC2143R (Flow rate O ₂ F/C No. 2) SC2144R (Flow rate O ₂ F/C No. 3) | Normal operating range (indicator green band) is 0.288 lb/hr to 1.304 lb/hr. Alarm limits to caution and warning system are 0.22 lb/hr lower, 1.22 lb/hr upper. Sensors for the indicator are located in the FUEL CELL O ₂ inlet lines. Fuel cell to be monitored is selected by FUEL CELL INDICATORS switch (MDC-18). |
| | MODULE TEMP group SKIN indicator | Indicates skin temperature of selected fuel cell. | | | SC2084T (Temp F/C No. 1 skin) SC2085T (Temp F/C No. 2 skin) SC2086T (Temp F/C No. 3 skin) | Normal indication is 385° to 500°F. Alarm limits to caution and warning system are 360°F lower, 500°F upper. Sensors for the indicator are located in the pressurized portion of the fuel cells. Fuel cell to be monitored is selected by FUEL CELL INDICATORS switch (MDC-18). |
| | COND EXH indicator | Indicates temperature of selected fuel cell condenser exhaust. | | | SC2081T (Temp F/C No. 1 cond exhaust) SC2082T (Temp F/C No. 2 cond exhaust) SC2083T (Temp F/C No. 3 cond exhaust) | Condenser exhaust operating range is 155°F to 175°F. Alarm limits to caution and warning system are 155°F to 175°F. Sensors for the indicator are located in the exhaust manifolds of the fuel cell condensers. Fuel cell to be monitored is selected by FUEL CELL INDICATORS switch (MDC-18). |

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| MDC-18 (Cont) | REG OUT PRESS HI event indicators | <p>Indicates when output pressure of H₂ regulator rises to 75 psia or greater on selected fuel cell.</p> <p>Indicates pressure is less than 75 psia.</p> | CAUT/ WARN- MN A MN B (MDC-25) | D-C main buses A and B | SC2069P (H ₂ pressure F/C No. 1 regulated) | Fuel cell to be monitored is selected by FUEL CELL INDICATORS switch (MDC-18). The REG OUT PRESS HI event indicators are part of the C&WS. | | |
| | H ₂ event indicators | | | | | | SC2070P (H ₂ pressure F/C No. 2 regulated) | Sensors for the indicator are located in the hydrogen pressure regulators. |
| | Striped-line display | | | | | | SC2071P (H ₂ pressure F/C No. 3 regulated) | Normal regulator output pressure is 61.5 psia. |
| | Gray display | <p>Indicates when output pressure of O₂ regulator rises to 75 psia or greater on selected fuel cell.</p> <p>Indicates pressure is less than 75 psia.</p> | | | SC2066P (O ₂ pressure F/C No. 1 regulated) | Sensors for the indicator are located in the F/C oxygen pressure regulators. | | |
| | O ₂ event indicator | | | | | | SC2067P (O ₂ pressure F/C No. 2 regulated) | Normal regulator output pressure is 63.5 psia. |
| | Striped-line display | | | | | | SC2068P (O ₂ pressure F/C No. 3 regulated) | |
| | Gray display | | | | | | | |

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| MDC-18 (Cont) | N ₂ event indicator Striped-line display | Indicates when output pressure of N ₂ regulator rises to 70 psia or greater on selected fuel cell. | CAUT/ WARN- MN A MN B (MDC-25) | D-C main buses A and B | SC2060P (N ₂ pressure F/C No. 1 regulated) | Sensors for the indicator are located in the nitrogen pressure regulators. |
| | Gray display | Indicates pressure is less than 70 psia. | | | SC2061P (N ₂ pressure F/C No. 2 regulated) | Normal regulator output pressure is 53 psia. |
| | FUEL CELL switches | | | | | |
| | Purge group Switches 1, 2 and 3 | Accomplish purging of selected fuel cell. | FUEL CELL 1 - PURGE (MDC-22) | | None | When purging the selected fuel cell, the C&WS will alarm if the reactants flow rate increases beyond the maximum normal flow rate. Purging (when operating at a 1420 w/fuel cell power level) is accomplished every 7 hours, alternating every 3-1/2 hours between O ₂ and H ₂ . O ₂ purge time (switch ON) is 2 minutes and H ₂ purge time (switch ON) is 80 seconds. O ₂ and H ₂ maximum flow rates during purge is 0.6 and 0.75 lb/hr above normal flow rates, respectively. Effect of purge can be monitored by FUEL CELL INDICATORS switch and DC INDICATORS switch and their associated displays. |
| | H ₂ PURGE Center (off) | Opens purge valve on H ₂ side of selected fuel cell to purge impurities from H ₂ electrodes. Disconnects power from selected F/C O ₂ or H ₂ purge valve, closing valve (normal switch position). | FUEL CELL 2 - PURGE (MDC-22) | | | |
| | O ₂ PURGE | Opens purge valve on O ₂ side of selected fuel cell to purge impurities from O ₂ electrodes. | FUEL CELL 3 - PURGE (MDC-22) | | | |
| | REACTANTS group | Provides ON - OFF control of reactant flow (H ₂ and O ₂) for selected fuel cells. | | | | These switches control solenoid valves, which accomplish control of reactant flow. |

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| MDC-18 (Cont) | Switches 1, 2 and 3 ON (Center) OFF | Momentary switch position connects d-c power to selected fuel cell O ₂ and H ₂ shutoff valve actuators, driving valves to open position. Valves remain in last selected position (normal switch position). Momentary switch position connects d-c power to selected fuel cell O ₂ and H ₂ shutoff valve actuators, driving valves to closed position. | FUEL CELL 1 - H ₂ & O ₂ VALVE (MDC-22) FUEL CELL 2 - H ₂ & O ₂ VALVE (MDC-22) FUEL CELL 3 - H ₂ & O ₂ VALVE (MDC-22) | Battery relay bus | SC2323X (Fuel cell No. 1 shutoff monitor) SC2324X (Fuel cell No. 2 shutoff monitor) SC2325X (Fuel cell No. 3 shutoff monitor) | Event indicators, located directly below their respective switches, display striped lines when both H ₂ and O ₂ shutoff valves are in closed (abnormal) position. Warning Do not inadvertently position REACTANT switches OFF. Loss of fuel cell may result. |
| | Event Indicators 1, 2 and 3 Striped-line display Gray display | Indicates when H ₂ and O ₂ shutoff valves are closed on selected fuel cell. Indicates normal (open) position of valves. | FUEL CELL 1 - BUS CONT (MDC-22) FUEL CELL 2 - BUS CONT (MDC-22) FUEL CELL 3 - BUS CONT (MDC-22) | | SC2323X (Fuel cell No. 1 shutoff monitor) SC2324X (Fuel cell No. 2 shutoff monitor) SC2325X (Fuel cell No. 3 shutoff monitor) | Event indicators function in conjunction with their respective switches located directly above. |
| | MAIN BUS A group Switches 1, 2 and 3 ON (Center) | Controls fuel cells No. 1, 2 and 3 electrical output to d-c main bus A. Momentary switch position connects electrical output of selected fuel cell to d-c main bus A. Connects C&W alarm and F/C - BUS DISCONNECT indicator light (MDC-11) to selected fuel cell motor switch (normal position of switch). | FUEL CELL 1 - BUS CONT (MDC-22) FUEL CELL 2 - BUS CONT (MDC-22) FUEL CELL 3 - BUS CONT (MDC-22) | | SC2120X (Fuel cell No. 1 bus A disconnect) SC2121X (Fuel cell No. 2 bus A disconnect) SC2122X (Fuel cell No. 3 bus A disconnect) | When fuel cell main bus switches are placed to ON position, power is applied to a motor-driven switch located in an overload and reverse current sensing unit in the S/M. This accomplishes actual switching function required to apply output of selected fuel cell to d-c main bus A. Only one F/C BUS DISCONNECT status light (MDC-11) for all three F/C's. |

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| MDC-18 (Cont) | OFF | Disconnects electrical output of selected fuel cell from d-c main bus A. | FUEL CELL 1 - BUS CONT (MDC-22) FUEL CELL 2 - BUS CONT (MDC-22) FUEL CELL 3 - BUS CONT (MDC-22) | Battery relay bus | SC2120X (Fuel cell No. 1 bus A disconnect) SC2121X (Fuel cell No. 2 bus A disconnect) SC2122X (Fuel cell No. 3 bus A disconnect) | |
| | Reset switch | Provides capability of resetting d-c main bus A undervoltage protection circuit. | SNSR UNIT - DC BUS - A (MDC-21) | | None | D-C main bus A undervoltage sensing circuit energizes MN BUS A UNDER-VOLT warning light (MDC-11) when d-c voltage drops below 26.25 vdc. |
| | RESET (Center) | Momentary switch position resets d-c main bus A undervoltage sensing unit. Corrects MN BUS A UNDER-VOLT warning light to d-c bus A undervoltage sensing circuit. | | | | |
| | OFF | Disconnects MN BUS A UNDER-VOLT warning light from d-c bus A undervoltage sensing circuit. | | | | |
| | Event Indicators 1, 2 and 3 Striped-line display Gray display | Indicates when selected F/C is removed from d-c main bus A. Indicates selected F/C is connected to bus. | FUEL CELL 1 - BUS CONT (MDC-22) FUEL CELL 2 - BUS CONT (MDC-22) FUEL CELL 3 - BUS CONT (MDC-22) | | SC2120X (Fuel cell No. 1 bus A disconnect) SC2121X (Fuel cell No. 2 bus A disconnect) SC2122X (Fuel cell No. 3 bus A disconnect) | Event indicators function in conjunction with their respective switches located directly above. |

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| MDC-18 (Cont) | MAIN BUS B group Switches 1, 2 and 3 | Controls fuel cells No. 1, 2 and 3 electrical output to d-c main bus B. | FUEL CELL 1 - BUS CONT (MDC-22) | Battery relay bus | SC2125X (Fuel cell No. 1 bus B disconnect) | When fuel cell main bus switches are placed to ON position, power is applied to a motor-driven switch located in an overload and reverse current sensing unit in the S/M. This accomplishes actual switching function required to apply output of selected fuel cell to d-c main bus B. Only on F/C BUS DISCONNECT status light (MDC-11) for all three fuel cells. |
| | ON | Momentary switch position connects electrical output of selected fuel cell to d-c main bus B. | FUEL CELL 2 - BUS CONT (MDC-22) | | SC2126X (Fuel cell No. 2 bus B disconnect) | |
| | (Center) | Connects G&W alarm and F/C BUS DISCONNECT indicator light (MDC-11) to selected fuel cell motor switch (normal position of switch). | FUEL CELL 3 - BUS CONT (MDC-22) | | SC2127X (Fuel cell No. 3 bus B disconnect) | |
| | OFF | Disconnects electrical output of selected fuel cell from d-c main bus B. | | | | |
| | Reset Switch | Provides capability of resetting d-c main bus B undervoltage protection circuit. | SNSR UNIT - DC BUS - B (MDC-21) | | None | D-C main bus B undervoltage sensing circuit energizes MN BUS B UNDER-VOLT warning light (MDC-11) when d-c voltage drops below 26.25 vdc. |
| | RESET | Momentary switch position resets d-c main bus B undervoltage sensing circuit. | | | | |
| | (Center) | Connects MN BUS B UNDER-VOLT warning light to d-c bus B undervoltage sensing circuit. | | | | |
| | OFF | Disconnects MN BUS B UNDER-VOLT warning from d-c bus B undervoltage sensing circuit. | | | | |
| | Event Indicators 1, 2 and 3) | | FUEL CELL 1 - BUS CONT (MDC-22) | | SC2125X (Fuel cell No. 1 bus B disconnect) | Event indicators function in conjunction with their respective switches located directly above. |
| | Striped-line display | Indicates when selected fuel cell is removed from d-c main bus B. | FUEL CELL 2 - BUS CONT (MDC-22) | | SC2126X (Fuel cell No. 2 bus B disconnect) | |
| | Gray display | Indicates selected fuel cell is connected to bus. | FUEL CELL 3 - BUS CONT (MDC-22) | | SC2127X (Fuel cell No. 3 bus B disconnect) | |

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| MDC-18 (Cont) | FUEL CELL INDICATORS switch | Selects desired fuel cell to be monitored by the fuel cell display indicators. Applies selected outputs of fuel cell No. 1 to fuel cell display indicators. Applies selected outputs of fuel cell No. 2 to fuel cell display indicators. Applies selected outputs of fuel cell No. 3 to fuel cell display indicators. | | Dependent on position (insignificant) | None | Indicators associated with switch are as follows: a. FLOW indicators H ₂ and O ₂ b. MODULE TEMP indicators SKIN and COND EXH c. REG OUT PRESS HI - O ₂ d. REG OUT PRESS HI - H ₂ e. REG OUT PRESS HI - N ₂ f. pH HI g. F/C RAD TEMP LOW. NOTE Items a and b are analog signals. Items c through g are ON-OFF signals (event indicators). |
| | BATTERY CHARGER switch | Controls a-c and d-c power to battery charger, and selects battery to be charged. Disconnects electrical power from battery charger. | BATTERY CHARGER-MN A MN B AC PWR (MDC-22) | D-C main bus A and B and a-c bus No. 1 or No. 2 | CC0214V (D-C voltage bat charger out) CC0215C (D-C current bat charger out) | Switch actuates battery charger input power control relay, routing a-c and d-c voltages through relay contacts to battery charger. Current flow is negligible when a battery is fully charged. MAIN BUS TIE switches (MDC-22) for selected battery must be off before a battery can be charged. A-C power for the battery charger is selected from a-c bus No. 1 or a-c bus No. 2 by the BAT CHGR switch (MDC-22). |
| | OFF | | | | | |
| | A | Controls a-c and d-c power to battery charger and routes output of battery charger to entry battery A. | | | | |
| | B | Controls a-c and d-c power to battery charger and routes output of battery charger to entry battery B. | | | | |
| | C | Controls a-c and d-c power to battery charger and routes output of battery charger to post-landing battery C. | | | | |
| | SUIT PACK | No function. | | | | |

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| MDC-18 (Cont) | DC VOLTS meter | Indicates d-c voltage of selected source, unit, or bus. | | As selected by DC INDICATORS switch. | Refer to DC INDICATORS switch. | Meter functions in conjunction with DC INDICATORS switch. DC VOLTS meter range is 20 to 45 vdc. | |
| | DC AMPS meter | Indicates d-c current of selected source, unit, or bus. | | | | Meter functions in conjunction with DC INDICATORS switch. DC AMPS meter range is 0 to 100 amperes, 0 to 5 amperes expanded scale battery charger output. | |
| | DC INDICATORS switch | Selects power source, bus, or unit to be monitored by DC VOLT and DC AMPS meters. | | | | In some cases, only current or voltage is indicated by DC VOLTS and DC AMPS meters. In other cases, both voltage and current are indicated. These are listed in the function column associated with each position. The DC VOLTS meter will read slightly below 20 vdc when not in use. The DC AMPS meter will read zero amperes when not connected to a load. | |
| | FUEL CELL - 1 | Applies output of fuel cell No. 1 shunt to DC AMPS meter. | | Fuel cell No. 1 | SC2113C (D-C current F/C No. 1 output) | | |
| | FUEL CELL - 2 | Applies output of fuel cell No. 2 shunt to DC AMPS meter. | | Fuel cell No. 2 | SC2114C (D-C current F/C No. 2 output) | | |
| | FUEL CELL - 3 | Applies output of fuel cell No. 3 shunt to DC AMPS meter. | | Fuel cell No. 3 | SC2115C (D-C current F/C No. 3 output) | | |
| | MAIN BUS - A | Applies voltage of d-c main bus A to DC VOLTS meter. | | SNSR UNIT - DC BUS - A (MDC-21) | D-C main bus A | CC0206V (D-C voltage main bus A) | |
| | MAIN BUS - B | Applies voltage of d-c main bus B to DC VOLTS meter. | | SNSR UNIT - DC BUS - B (MDC-21) | D-C main bus B | CC0207V (D-C voltage main bus B) | |
| | BAT BUS - A | Applies both voltage and current of battery bus A to DC VOLTS and DC AMPS meters. | | | Battery bus A | CC0210V (D-C voltage battery bus A) | MASTER EVENT SEQ CONT-LOGIC-BAT A c/b (MDC-22) controls d-c voltage indication (voltage only) and measurement for telemetry. |
| | | | | | | CC0222C (D-C current battery A) | |

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| MDC-18 (Cont) | BAT BUS -B | Applies both voltage and current of battery bus B to DC VOLTS and DC AMPS meters. | | Battery bus B | CC0211V (D-C voltage battery bus B) | MASTER EVENT SE@ CONT-LOGIC-BAT B c/b (MDC-22) controls d-c voltage indication (voltage only) and measurement for telemetry. |
| | BAT CHARGER | Applies both voltage and current output of battery charger to DC VOLT and DC AMPS meter (inner scale 0 to 5 amps). | | Battery charger | CC0223C (D-C current battery B) | Charger current output will be according to charge required by battery (up to 2.5 amps). |
| | BAT C | Applies both voltage and current outputs of battery C to DC VOLTS and DC AMPS meters. | BAT CHGR BAT C (LEB-150) | Battery C | CC0214V (D-C voltage battery charger out) CC0215C (D-C current battery charger out) | Listed C/B will control d-c voltage indication and measurement for telemetry. |
| | PYRO BAT-A | Applies pyro battery A voltage to DC VOLTS meter when SEQ A cb is closed. | PYRO A - SEQ A | Pyro battery A | CC0224C (D-C current post-landing battery) | Normally closed cb. Open circuit nominal voltage of 37.2 vdc will be read on meter. |
| | PYRO BAT-B | Applies entry battery A voltage to DC VOLTS meter when BAT A to PYRO BUS TIE cb is closed. | BAT A TO PYRO BUS TIE | Entry battery A | | Normally open cb. Open circuit nominal voltage of 37.2 vdc, or load voltage of 28 vdc will be read on meter. |
| | PYRO BAT-B | Applies pyro battery B voltage to DC VOLTS meter when SEQ B cb is closed. | PYRO B - SEQ B | Pyro battery B | | Normally closed cb. Open circuit nominal voltage of 37.2 vdc will be read on meter. |
| | AC INVERTER switches | Applies entry battery B voltage to DC VOLTS meter when BAT B to PYRO BUS TIE cb is closed. | BAT B TO PYRO BUS TIE | Entry battery B | | Normally closed cb. Open circuit nominal voltage of 37.2 vdc, or load voltage of 28 vdc will be read on meter. |
| | | | | | Refer to AC INVERTER switches (MDC-18) prevents more than one inverter from being connected to any one bus at the same time. | |

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|-------------------|---|--|-------------------------------|--|---|
| MDC-18 (Cont) | Switch 1 | Controls d-c power to a-c inverter No. 1 by actuating a motor-driven switch which accomplishes actual switching function. | INVERTER CONTROL - 1 (MDC-22) | Battery relay bus | Refer to AC INDICATORS switch | Circuit breakers associated with delivering power to AC INVERTER No. 1 from d-c main bus A is INVERTER PWR - No. 1 - MN A on main circuit breaker panel (RHEB-203). |
| | MNA | Applies d-c power to a-c inverter No. 1. | | | | |
| | OFF | Disconnects d-c power from a-c inverter No. 1. | | | | |
| | Switch 2 | Controls d-c power to a-c inverter No. 2 by actuating a motor-driven switch which accomplishes actual switching function. | INVERTER CONTROL - 2 (MDC-22) | Refer to AC INDICATORS switch | Circuit breaker associated with delivering power to AC INVERTER No. 2 from d-c main bus B is INVERTER PWR - No. 2 - MN B on main circuit breaker panel (RHEB-203). | |
| | MNB | Applies d-c power to a-c inverter No. 2. | | | | |
| | OFF | Disconnects d-c power from a-c inverter No. 2. | | | | |
| | Switch 3 | Controls d-c power to a-c inverter No. 3 by actuating one of two motor-driven switches depending on bus selected. | INVERTER CONTROL - 3 (MDC-22) | Refer to AC INDICATORS switch | Inverter No. 3 can receive power from either d-c main bus A or d-c main bus B. Associated circuit breakers are INVERTER PWR - No. 3 - MN A and - MN B (RHEB-203). | |
| | MNA | Applies d-c power from main bus A to a-c inverter No. 3. | | | | |
| | OFF | Disconnects d-c power from a-c inverter No. 3. | | | | |
| | | MNB | Applies d-c power from main bus B to a-c inverter No. 3. | | | |
| | AC BUS 1 group | Switch 1 | Controls a-c output of inverter No. 1 to a-c bus No. 1 | INVERTER CONTROL - 1 (MDC-22) | | Actuates a motor-driven switch which accomplishes actual switching function. |
| | | ON | Applies a-c output of inverter No. 1 to a-c bus No. 1 | | | |
| | OFF | Disconnects a-c output of inverter No. 1 from a-c bus No. 1. | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | |
|------------------|-------------------|--|--|---------------------------------|---------------------------------|--|--|
| MDC-1R (Cont) | Switch 2 | Controls a-c output of inverter No. 2 to a-c bus No. 1. | INVERTER CONTROL - 2 (MDC-22) | Battery relay bus | Refer to AC INDICATORS switch | | |
| | ON | Applies a-c output of inverter No. 2 to a-c bus No. 1. | | | | | |
| | OFF | Disconnects a-c output of inverter No. 2 from a-c bus No. 1. | | | | | |
| | Switch 3 | Controls a-c output of inverter No. 3 to a-c bus No. 1. | INVERTER CONTROL - 3 (MDC-22) | | None | | |
| | ON | Applies a-c output of inverter No. 3 to a-c bus No. 1. | | | | | |
| | OFF | Disconnects a-c output of inverter No. 3 to a-c bus No. 1. | | | | | |
| | | RESET/OFF switch | Provides capability of resetting a-c bus No. 1 over undervoltage and overload sensing unit. Also releases relay which reconnects the operating inverter to a-c bus No. 1, if it had been tripped off due to overvoltage or overload. | SNSR UNIT - AC BUS - 1 (MDC-21) | | | Resetting a-c bus 1 over-undervoltage and overload sensing unit also turns AC BUS 1 FAIL and AC BUS 1 OVERLOAD caution and warning lights off. Circuit breaker associated with the a-c sensing lines on a-c bus No. 1 is AC SNSR SIG - AC1 (MDC-25). |
| | | RESET | Momentary position resets a-c bus No. 1 over-undervoltage and overload sensing unit. | | | | |
| | | (Center) | Energizes a-c bus No. 1 over-undervoltage and overload sensing unit. | | | | |
| | | OFF | Disconnects a-c bus No. 1 over-undervoltage and overload sensing unit from system. | | | | |
| | AC BUS 2 group | Controls output of inverter No. 1 to a-c bus No. 2. | INVERTER CONTROL - 1 (MDC-22) | | Refer to AC INDICATORS switch | Actuates a motor-driven switch which accomplishes actual switching function. | |
| | Switch 1 | Applies output of inverter No. 1 to a-c bus No. 2. | | | | | |
| | ON | Disconnects output of inverter No. 1 from a-c bus No. 2. | | | | | |
| | OFF | | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | | | |
|--------------------|----------------------|--|---|-------------------------------------|---------------------------------|--|--|--|--|
| Wiper 14 (Control) | Switch 2 | Controls output of inverter No. 2 to a-c bus No. 2. | INVERTER CONTROL - 2 (MDC-22) | Battery relay bus | Refer to AC INDICATORS switch | | | | |
| | ON | Applies output of inverter No. 2 to a-c bus No. 2. | | | | | | | |
| | OFF | Disconnects output of inverter No. 2 from a-c bus No. 2. | | | | | | | |
| | Switch 3 | Controls output of inverter No. 3 to a-c bus No. 2. | INVERTER CONTROL - 3 (MDC-22) | | | | | | |
| | ON | Applies output of inverter No. 3 to a-c bus No. 2. | | | | | | | |
| | OFF | Disconnects output of inverter No. 3 from a-c bus No. 2. | | | | | | | |
| | | RESET/OFF switch | Provides capability of resetting a-c bus No. 2 over-voltage and overload sensing unit. Also releases relay which reconnects the operating inverter to a-c bus No. 2 if it has been tripped off due to over-voltage or overload. | SNSR UNIT - AC BUS - 2 (MDC-21) | | None | Resetting a-c bus No. 2 over-voltage and overload sensing unit also turns AC BUS 2 r AIL and AC BUS 2 OVERLOAD caution and warning lights (MDC-11) ON. Circuit breaker associated with sensing lines on a-c bus No. 2 is AC SNSR SIG - AC2 (MDC-25). | | |
| | | RESET | Resets a-c bus No. 2 over-voltage and overload sensing unit. | | | | | | |
| | | (Center) | Energizes a-c bus No. 2 over-voltage and overload sensing unit. | | | | | | |
| | | OFF | Disconnects a-c bus No. 2 over-voltage and overload sensing unit from the system. | | | | | | |
| | AC VOLTS meter | Indicates a-c voltage of selected source and phase. | AC SNSR SIG - AC 1 AC 2 (MDC-25) | As selected by AC INDICATORS switch | Refer to AC INDICATORS switch | Meter functions in conjunction with AC INDICATORS switch. AC VOLTS meter range is 90 to 130 vac. | | | |
| | FREQ CPS meter | Indicates frequency of selected source and phase. | | | | | | | FREQ CPS meter range is 380 to 420 cps. |
| | AC INDICATORS switch | Provides means of monitoring 3Ø voltage and frequency output of a-c inverters. | | | | | | | Operating range for phase A, B, and C (a-c bus No. 1 or a-c bus No. 2) is 115 ±2 vac 400 cps, during emergency mode 393 to 407 cps. Only phase A frequency measurement of a-c buses 1 and 2 are telemetered to MSFN ground stations. |

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|---------------|-------------------|--|----------------------------------|------------------|--|---------|
| MDC-18 (Cont) | BUS 1 group ØA | Applies a-c phase A voltage from a-c bus No. 1 to AC VOLTS and FREQUENCY meters. | AC SNSR SIG - AC1 (MDC-25) | A-C bus No. 1 | CC0200V (A-C volt- age main bus 1 phase A) CC0213F (Frequency a-c bus 1 phase A) CC0201V (A-C volt- age main bus 1 phase B) CC0202V (A-C volt- age main bus 1 phase C) | |
| | ØB | Applies a-c phase B voltage from a-c bus No. 1 to AC VOLTS and FREQUENCY meters. | | | | |
| | ØC | Applies a-c phase C voltage from a-c bus No. 1 to AC VOLTS and FREQUENCY meters. | | | | |
| | BUS 2 group ØA | Applies a-c phase A voltage from a-c bus No. 2 to AC VOLTS and FREQUENCY meters. | AC SNSR SIG - AC2 (MDC-25) | A-C bus No. 2 | CC0203V (A-C volt- age main bus 2 phase A) CC0217F (Frequency a-c bus 2 - phase A) CC0204V (A-C volt- age main bus 2 - phase B) CC0205V (A-C volt- age main bus No. 2 phase C) | |
| | ØB | Applies a-c phase B voltage from a-c bus No. 2 to AC VOLTS and FREQUENCY meters. | | | | |
| | ØC | Applies a-c phase C voltage from a-c bus No. 2 to AC VOLTS and FREQUENCY meters. | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|----------|-----------------------------------|--|--|---|---|--|
| MHC-19 | ECS RAD OUT TEMP-1 indicator | Provides temperature indication of water-glycol at outlet of 6-tube circuit of radiator 1 (S/M sector V). | INSTRUMENT- NONESSENTIAL (MDC-22) also NONESSENTIAL-9 (RHEB-204) | NONESSENTIAL BUS No. 1 (D-C main buses A or B) | SF0671T (Tank ECS radiator outlet 1) | Sensors located in outlet lines of radiators 1A and 2A on S/M forward bulkhead. Normal radiator outlet temperatures should not decrease below 30°F. |
| | ECS RAD OUT TEMP-2 | Provides temperature indication of water-glycol at outlet of 6-tube circuit of radiator 2 (S/M sector II). | | | SF0672T (Tank ECS radiator outlet 2) | |
| | S-BAND ANT indicator | Indicates relative strength of signal being received by USBE. | N/A | USBE | CT0147V (S-Band RCVR AGC voltage) | Signal strength meter that operates off of voltage obtained from AGC circuitry in USBE. No calibration, tune for maximum signal by switching S-band antennas or rotating S/C for optimum reception. |
| | UP TLM CMD switch RESET | Applies 28 vdc to the reset windings of all real-time command relays in the UDL RTC relay box. This cancels any real-time commands previously received via the UDL and returns control to the S/C. None | T/C- GROUP 5 (MDC-22) | Flight and postlanding bus | None | DPDT switch, spring-loaded in the OFF position. |
| | OFF | | | | | |
| | FLIGHT QUAL RCDR switch RECORD | Activates FQR electronic circuits and tape transport mechanism to record flight qualification data. Tape moves in forward direction at 15 IPS. | RCDR NON ESS (MDC-22) | FQR (Refer to Remarks.) | CT0013X (Tape motion monitor R&D) | Power to the switch is provided by the FQR control logic. The non-essential bus supplies 28-vdc power to the FQR through the RCDR NON ESS circuit breaker (MDC-22). Three-phase a-c power from the TELCOM-NON ESS switch is supplied to the FQR through the T/C - GROUP 1 AC circuit breaker (MDC-22). |
| | F/C VALVES RESET | Provides +28 vdc to motor switch to disconnect holding voltage applied to the open solenoids of F/C 1, 2, and 3 reactant shutoff valves. Normal position of switch. | FUEL CELL H ₂ and O ₂ VALVE and FUEL CELL H ₂ and O ₂ VALVE (MDC-22) | BATTERY RELAY BUS | None | Switch operated to momentary RESET position only after earth orbit insertion. |
| | OFF | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|---------------|------------------------------|--|--|----------------------|---------------------------------|--|
| MDC-19 (Cont) | STOP | Remove power from FQR electronic circuits and tape transport mechanism. Tape is locked in place. | FUEL CELL 1 H ₂ and O ₂ VALVE and FUEL CELL 2 H ₂ and O ₂ VALVE (MDC-22) | BATTERY RELAY BUS | None | NOTE The total record time for the FQR is 30 minutes. Since there are no dumping capabilities, the FQR must be used conservatively. The rewind function is provided to allow the crewman to back the tape up to the beginning in case a launch hold occurs after the tape has begun to run or inadvertently left in RECORD. MSFN will direct time of rewind. |
| | REWIND | Activates FQR tape transport mechanism to rewind tape. Tape moves in reverse direction at 120 IPS. | | | | |
| | VOICE RECORD event indicator | Voice recorder inactive | RCDR NON ESS (MDC-22) | DC NON ESS BUS No. 1 | | Visible when not recording or when tape supply is exhausted. Recording in progress. |
| | Gray area | Voice recorder tape is in motion. | | | | |
| | Striped area | Voice recorder tape is in motion. | | | | |
| | F/C VALVES switch | Momentary switch position actuates motor switch to remove holding voltage from open side of all F/C reactant valves. | FUEL CELL 1-H ₂ &O ₂ VALVE (MDC-22) | Battery Relay Bus | None | Motor switch activated by GSE, provides open side of all F/C reactant valves with holding voltage to prevent inadvertent closing of reactant valves during launch, ascent, and orbital insertion. |
| | RESET (Down) | Normal switch position disconnects power to motor switch. | FUEL CELL 2-H ₂ &O ₂ VALVE (MDC-22) | | | NOTE To shut down a fuel cell when holding voltage is still applied to F/C reactant valves, F/C VALVES switch must be reset prior to closing F/C reactant valves. Once the F/C reactant valves holding voltage is removed, F/C VALVES switch is inoperative. |
| | SPS LINE HEATER switch A | Provides power to the 26 electrical system A element strip heaters on the tank feed and engine feed line brackets and the injector valve assembly. Switch would be placed to A if the propellant temperature indicator on panel 20 indicated -40°F (propellant temperature equivalent to +40°F). | SPS GAUGING MN A MN B (MDC-25) | D-C MAIN BUS A and B | None | The SPS HEATER switch provides power to the SPS electrical strip heaters mounted on the tank feed and engine feed line, brackets, and the injector valve assembly of the engine. The SPS HEATER switch will enable power to 26 electrical system A element strip heaters or will enable power to the 26 electrical system B element strip heaters, which will provide temperature control to the SPS engine compartment, thus the propellants. |
| | OFF | Removes power from electrical system A or B element strip heaters. Switch placed to OFF when propellant temperature indicator on panel 20 indicated +80°F (equivalent to propellant temperature of +120°F). | | | | |

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|---------------|-------------------|--|--|----------------------|---------------------------------|---------|
| MDC-19 (Cont) | B | Provides power to the 26 electrical system B element strip heaters on the tank feed and engine feed line brackets and the injector valve assembly. If switch was not placed to A, would be placed to B when the propellant temperature indicator on panel 20 is at -40°F (equivalent to +40°F propellant temperature). | SPS GAUG-ING MN A MN B (MDC-25) | D-C MAIN BUS A and B | None | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|----------|--|---|------------------------|----------------------------|---------------------------------|--|
| MDC-20 | S-BAND switches XPONDER/OFF/ XPONDER PWR AMPL switch XPONDER | Activates USBE, with or without S-band PA, and PMP circuitry which is required for S-band operations. a. De-energizes holding relay K2 in circuit utilization box which: 1. Applies 3-phase a-c power from the T/C - GROUP 2 AC circuit breaker to the USBE power supply 2. Applies 28-vdc power from the T/C - GROUP 5 circuit breaker to the 20 VDC voltage regulator in the PMP. (Refer to Remarks.) b. Applies 28-vdc power to the S-BAND ANTENNA switch. a. Energizes holding relay K2 in circuit utilization box which removes power from circuits described in Function a, XPONDER position. b. Removes 28-vdc power from the S-BAND ANTENNA switch. a. (Same as for XPONDER position, Function a.) b. (Same as for XPONDER position, Function b.) c. Energizes relay K1 in circuit utilization box which applies 3-phase a-c power from the T/C - SIG COND S-BAND PA AC circuit breaker (MDC-22) to the S-BAND PA. | T/C - GROUP 5 (MDC-22) | Flight and postlanding bus | None | This position can be selected to conserve power if S-band communications are good enough to permit operations without the S-band PA equipment. The 20 vdc regulator in the PMP supplies power to those circuits in the PMP which are required for S-band emergency voice, emergency key, and UDL operations. This position will normally be selected for S-band communications to ensure adequate strength of transmitted signal. After selecting this position, a 90-second delay occurs to allow for warmup before application of B+ and switching of RF signal to the PA. |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---------------------|--|-----------------|--|---------------------------------|--|
| MDC-20 (Cont) | PWR AMPL switch | Selects high-power (20-watt) output mode of S-BAND PA. Selects low-power (5-watt) output mode of S-BAND PA. | N/A | S-band PA internal circuitry | None | Supplies ground for S-band PA control relays. Effective only when S-BAND-XPONDER/OFF/XPONDER PWR AMPL switch is in XPONDER PWR AMPL position. |
| | HIGH | | | | | |
| | LOW | | | | | |
| | OSC switch | Selects primary oscillator frequency for USBE transmitter. It is obtained from USBE receiver VCO that is controlled by frequency of received S-band carrier to ensure doppler accuracy. Selects secondary oscillator frequency for USBE transmitter. It is obtained from a crystal-controlled auxiliary oscillator. | | USB | | Supplies ground for USBE control circuitry. The primary oscillator is selected for all S-band operations unless USBE receiver has a malfunction. |
| | PRIM | | | | | |
| | SEC | Used to determine USBE/PMP mode and select data to be transmitted via S-band carrier. Only one of the three switches may be moved from the OFF (center) position at any one time. With all three switches at the OFF (center) position the USBE will transmit real-time voice and PCM data in a PM mode. | | USB and PMP internal circuitry (Refer to Remarks.) | | The S-BAND-VOICE-RNG/RNG ONLY switch must also be in the off (center) position to enable selection of the secondary oscillator. (The secondary oscillator will be selected automatically when ever the S-BAND-EMER switch is set to VOICE.) Three DP3T switches; one pole of each is used to control PMP circuits; the other pole is used to control USBE circuits. Voice transmission controlled by cobra cable PTT pushbutton when audio centers (MDC-13, -23, -26) POWER switch is at either PTT or VOX. Cobra cable PTT/CW switches must be at PTT. Supplies ground returns for USBE and PMP control circuits. Closes a diode switch in the USBE transmitter which allows the PRN ranging signal from the USBE receiver to be modulated in the PM circuit. |
| | VOICE group | | | | | |
| | RNG/RNG ONLY switch | | | | | |
| | RNG | Enables PM transmission of received PRN ranging code in addition to real-time voice and PCM data. (Refer to VOICE group Function.) | | | | |
| | Off (center) | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|-------------------|---|-----------------|---|---------------------------------|---|
| MDC-20 (Cont) | RNG ONLY | Enables PM transmission of received PRN ranging code and real-time voice. PCM data is eliminated to reduce bandwidth and increase range. | N/A | USBE and PMP internal circuitry (Refer to Remarks.) | None | Removes power from PCM processing circuits in PMP. |
| | TAPE switch | | | | | One pole of this switch supplies ground for USBE control circuits. The other pole supplies 28-vdc control power obtained from the PMP power supply to PMP control circuits. |
| | TAPE | Enables FM transmission of real-time voice and stored PCM and/or analog data, as follows: a. Supplies 28-vdc control power to TAPE RECORDER - PLAY switch (MDC-20). b. Selects FM output mode of PMP. c. Selects FM transmission mode of USBE. (Refer to VOICE group Function.) | | | | Refer to TAPE RECORDER - PLAY switch (MDC-20) Function and Remarks for further discussion of recorded data transmission capabilities. |
| | Off (center) | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|----------------------------------|--|-----------------|--|---------------------------------|---|
| MDC-20 (Cont) | TV switch | <p>Enables FM transmission of real-time video data from the TV camera along with real-time voice and PCM data, as follows:</p> <ol style="list-style-type: none"> Closes diode switch in PMP to pass video signal to FM mixer. Selects FM output mode of PMP. Selects FM transmission mode of USBE. <p>(Refer to VOICE group Function.)</p> | N/A | <p>USBE and PMP internal circuitry (Refer to Remarks.)</p> | None | <p>One pole of this switch supplies ground for USBE control circuits. The other pole supplies 28-vdc control power obtained from the PMP power supply to PMP control circuits.</p> <p>ON/OFF slide switch on TV camera handle must also be set to ON.</p> |
| | <p>EMERG switch</p> <p>VOICE</p> | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---|---|------------------------|--|---------------------------------|---|
| MDC-20 (Cont) | Off (center) KEY | Allows normal USBE and PMP operation. Enables PM transmission of CW code, as follows: a. Activates a-c power control relay in PMP, turning off 28-vdc power supply that supplies power to non-essential PMP circuits. b. Applies 28-vdc power to emergency key circuitry in PMP. c. Selects PM transmission mode in USBE. Either the primary or secondary (auxiliary) oscillator frequency may be used. | T/C - GROUP 5 (MDC-22) | Flight and postlanding bus and USBE internal circuitry | None | Keying of transmitted CW code is accomplished by pressing the PTT pushbutton on cobra cables. (The cobra cable PTT/CW toggle switch must be set to CW.) |
| | Up-DATA switch S-BAND Off (center) UHF | Activates UDL equipment in S-band mode by applying 28-vdc power to UDL power supply only (UHF/FM receiver portion of UDL equipment is disabled). Removes power from UDL equipment. Activates UDL equipment in UHF mode by applying 28-vdc power to UDL power supply, UHF/FM receiver, and mode switch, all contained in UDL equipment. | | Flight and postlanding bus | | Reception of up-data from the MSFN in the S-band mode is via the USBE receiver and PMP up-data discriminator. |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|---------------|---|--|------------------------|---|---------------------------------|---|
| MDC-20 (Cont) | S-BAND ANTENNA switch | Applies 28-vdc control power to 2-KMC antenna switch, either directly or via the USBE threshold selector (when in AUTO position). | N/A | S-BAND - XPONDER/OFF/XPONDER PWR AMPL switch (MDC-20) | None | The 28-vdc power is supplied to the S-BAND ANTENNA switch when the S-BAND-XPONDER/OFF/XPONDER PWR AMPL switch (MDC-20) is in the XPONDER or XPONDER PWR AMPL position. This power comes from the flight and postlanding bus via the T/C-GROUP 5 circuit breaker (MDC-22). |
| | AUTO | Permits automatic selection of SCIN antenna for S-band transmission and reception. | | | | When in automatic mode, selection is made by a threshold selector in the USBE. Selection is based on strength of received signal. |
| | UPPER | Selects the upper (-Z) SCIN antenna for S-band transmission and reception. | | | | Upper or lower antenna selected manually. S-BAND ANTENNA meter (MDC-19) indicates received signal strength at selected antenna. |
| | LOWER | Selects the lower (+Z) SCIN antenna for S-band transmission and reception. | | | | |
| | VHF-AM controls SQUELCH control | Increases or decreases sensitivity of squelch gate. Position 9 most sensitive. | | VHF/AM transmitter-receiver internal circuitry | | Squelch gate sensitivity determines strength of received signal that is required to permit detected audio to pass to audio center equipment. |
| | T/R/OFF/REC switch T/R OFF REC | Applies power to transmitter and receiver circuitry in VHF/AM transmitter-receiver. Removes power from VHF/AM transmitter-receiver. Applies power to receiver circuitry only in VHF/AM transmitter-receiver. | T/C - GROUP 4 (MDC-22) | Flight and postlanding bus | | In the T/R mode the transmitter operates in standby with filaments lit; B+ is not applied until keying occurs by closing PTT pushbutton on cobra cable when PTT/CW switch is at PTT. |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|----------------------------------|--|------------------------|--|---------------------------------|--|
| MDC-20 (Cont) | RCVR switch 1 | Selects VHF/AM receive frequency No. 1 (296.8 mc). | N/A | VHF/AM transmitter-receiver internal circuitry | None | Receive 1 frequency is used for simplex communications. |
| | 2 | Selects VHF/AM receive frequency No. 2 (259.7 mc). | | | | Receive 2 frequency is used for duplex communications. |
| | C-BAND switch 1 PULSE | Activates C-band transponder in 1-pulse mode, as follows: a. Activates holding relay K3 in circuit utilization box which applies 3-phase a-c power from T/C - GROUP 1 AC circuit breaker (MDC-22) to C-band transponder power supply. b. Applies control to decoder circuit to select 2-pulse mode. | T/C - GROUP 5 (MDC-22) | Flight and postlanding bus | | The 1 PULSE mode is selected only when C-band tracking is required by a MSFN station having no capability for 2-pulse operations. One-pulse mode will be responsive to a 1- or 2-pulse MSFN station. One-pulse operation may be changed by UDL to 2-pulse mode. |
| | Off (center) 2 PULSE | Deactivates C-band transponder equipment. Activates C-band transponder in 2-pulse mode, as follows: a. Activates holding relay K3 in circuit utilization box which applies 3-phase a-c power from T/C - GROUP 1 AC circuit breaker (MDC-22) to C-band transponder power supply. b. Applies control to decoder circuit to select 2-pulse mode. | | | | UDL may turn on C-band in 2-pulse mode. The 2-pulse mode is selected for launch and when C-band tracking is required by MSFN stations having capability for 2-pulse operation. Activation of the C-band transponder in the 2-pulse mode can also be commanded by MSFN by a UDL real-time command. |
| | VHF - FM switch ON OFF | Activates VHF/FM transmitter by energizing a relay that applies 3-phase a-c power from the T/C - GROUP 1 AC circuit breaker (MDC-22) to its power supply. Deactivates VHF/FM transmitter. | | | | The VHF/FM transmitter is the primary means for transmitting PCM TLM, real time or stored. Activation of the VHF/FM transmitter can also be commanded by the MSFN by a UDL real-time command. This command occurs simultaneously with a command to the PCM TLM equipment for high bit-rate PCM. |

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|------------------|-------------------|---|------------------------|----------------------------|---------------------------------|--|
| MDC-20 (Cont) | RECOVERY switches | | | | None | A CW signal is transmitted at 3-second intervals for a period of 2 seconds (2 seconds on, 3 seconds off). Activate following dereefing of main parachutes. |
| | VHF-BCN switch | Applies 28-vdc power to activate VHF recovery beacon. | T/C - GROUP 3 (MDC-22) | Flight and postlanding bus | | |
| | ON | Removes 28-vdc power from VHF recovery beacon. | | | | |
| | HF group | Activates HF transceiver, as follows: | T/C - GROUP 4 (MDC-22) | | | Activate following deployment of HF recovery antenna. |
| | ON/OFF switch | a. Applies 28-vdc power to receiver and oscillator circuits b. Applies 28-vdc control power to transmitter and antenna switching relays. (Refer to Remarks.) | | | | The transmitter keying relay controls application of 28-vdc power to transmitter circuits. The antenna switching relay disconnects antenna from receiver input and connects it to transmitter output. This provides for simplex HF operation. These relays will not energize until a ground return path is provided by keying the transmitter or selecting the beacon mode of operation. |
| | OFF | Deactivates HF transceiver. | | | | Supplies ground for mode control circuits. |
| | SSB/BCN/AM switch | Selects SSB mode of HF transceiver. | N/A | | | In the BCN mode, the HF transceiver emits a continuous unmodulated carrier. This mode will also energize the voice recorder power control relay, circumventing the normal VOX control. |
| | SSB | | | | | |
| | BCN | a. Selects BCN mode of HF transceiver. b. Provides ground to voice recorder power control relay | | | | |
| | AM | Selects AM mode of HF transceiver. | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | |
|------------------|------------------------|---|--|------------------------------------|---|---|--|
| MDC-20 (Cont) | TAPE RECORDER switches | Applies 28-vdc control power to appropriate PMP circuits and relays to select DSE outputs for transmission via USBE. Selects stored PCM data only. | N/A | S-BAND-VOICE TAPE switch, (MDC-20) | None | The PMP power supply, when activated, supplies 28 vdc to the S-BAND-VOICE-TAPE switch (MDC). When the TAPE position is selected, this 28 vdc is supplied to the TAPE RECORDER-PLAY switch. PCM and NORM perform same function. | |
| | PLAY switch | | | | | | |
| | PCM | | | | | | |
| | | NORM | Selects stored PCM and analog data. No real-time PCM data can be transmitted in this mode. | | | | |
| | | SPEED switch | Applies 28-vdc control power from TAPE RECORDER-FWD/REV switch (FWD or REV position) to DSE control logic. | | TAPE RECORDER-FWD/REV switch, FWD or REV position | CT0012X | DSE control logic reverts to 15 ips (NORM) tape speed if FWD/REV switch is lost. Used during DSE tape rewind and for playback of recorded LBR used for recording and playback of HBR. Used while recording LBR only. DSE cannot dump in LOW. |
| | | HIGH | Selects high tape speed (120 IPS). | | | | |
| | | Norm (center) | Selects normal tape speed (15 IPS). | | | | |
| | | LOW | Selects low tape speed (3.75 IPS). | | | | |
| | | RECORD/PLAY switch | Applies 28-vdc control power to DSE control logic. | T/C - GROUP 5 (MDC-22) | Flight and poststanding bus | | DSE control logic requires the switch to be placed at other than OFF and FWD or REV selected prior to tape motion. |
| | | RECORD | Activates DSE record electronics | | | | |
| | Off (center) | None | | | | | |
| | PLAY | Activates DSE playback electronics. | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---|--|------------------------|----------------------------|---------------------------------|---|
| MDC-20 (Cont) | FWD/REV switch FWD | Applies 28-vdc control power to: a. DSE control logic to activate tape transport in forward direction. b. TAPE RECORDER-SPEED switch. | T/C - GROUP 5 (MDC-22) | Flight and postlanding bus | None | DSE control logic requires this switch to be placed at other than OFF and RECORD or PLAY selected prior to tape motion. |
| | Off (center) REV | Removes 28 vdc from control logic and SPEED switches. Applies 28-vdc control power to: a. DSE control logic to activate tape transport in reverse direction. b. TAPE RECORDER-SPEED switch. | | | | |
| | PWR switches SCE switch ON OFF | Activates "latch" coil of relay in SCE, applying 3-phase a-c power from SIG COND S-BAND PA AC circuit breaker (MDC-22) to SCE power supply. Activates "unlatch" coil of relay in SCE, removing 3-phase a-c power. | | | | This switch set to ON prior to launch and should remain on throughout entire mission. |
| | PMP switch ON OFF | Allows 3-phase a-c power from T/C - GROUP 2 AC circuit breaker to be applied to PMP 28 vdc power supply. Activates relay in PMP to remove 3-phase a-c power from PMP 28 vdc power supply. | | | | OFF position causes loss of normal voice, TV, ranging and S-band PCM TLM. |

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|--------------|---------------------|--|--|---|---------------------------------|---|
| MDC-20 (Com) | TLM INPUTS switches | | N/A | PCM/TLM Equipment and TAPE RECORDER-RECORD/PLAY switch | None | Supplies 28-vdc control power from TAPE RECORDER-RECORD/PLAY switch (RECORD position) to the DSE control logic and ground for programmer control circuitry in the PCM/TLM equipment. The low (1.6 KBS) PCM bit-rate cannot also be commanded by the MSFN by an UDL real-time command in this position. UDL command from MSFN may change bit rate to high (51.2 kbs). Switch will, however, remain in LOW. |
| | PCM switch | <p>a. Selects wide-band PCM TLM data mode (51.2 KBPS bit-rate) in PCM/TLM equipment.</p> <p>b. Selects normal-speed assurance mode of DSE.</p> | | | | |
| | HIGH | <p>a. Selects narrow-band PCM TLM data mode (1.6 KBPS bit-rate) in PCM/TLM equipment.</p> <p>b. Selects low-speed assurance mode in DSE.</p> | | | | |
| | BIOMED switch | | BIOMED COMM-MN B (MDC-25) & T/C - GROUP 5 (MDC-22) | D-C main bus B & flight & postlanding bus (Refer to Remarks.) | | Supplies 28-vdc power from BIOMED COMM-MN B circuit breaker to physiological amplifier of selected astronaut, and supplied 28 vdc from T/C - GROUP 5 circuit breaker to control transmission of proper PCM signal to indicate position of switch to MSFN. |
| | 1 | Selects operational biomedical data from command pilot for transmission or storage in DSE. | | | | |
| | 2 | Selects operational biomedical data from senior pilot for transmission or storage in DSE. | | | | |
| | 3 | Selects operational biomedical data from pilot for transmission or storage in DSE. | | | | |
| | VHF ANTENNA switch | | T/C - GROUP 5 (MDC-22) | Flight and postlanding bus | | This position not used until after parachute deployment and disreefing. Upper and lower antennas manually selected to permit most advantageous reception and transmission of VHF-AM communications and VHF-FM telemetry. |
| | RECOVERY | Applies 28-vdc control power to VHF antenna switch latching relay circuits. | | | | |
| | UPPER | Connects VHF recovery antenna No. 2 to VHF multiplexer. Connects VHF portion of SCIN antenna on the -Z axis to VHF multiplexer. | | | | |

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|---------------|---|---|--|--|--|---|
| MDC-20 (Cont) | LOWER He TANK indicators PRESS N ₂ TK PRESS | Connects VHF portion of SCIN antenna on the +Z axis to VHF multiplexer Indicates SPS helium storage tank pressure when SPS TANK PRESS switch (MDC-20) is in the He position. Indicates SPS gaseous nitrogen storage tank pressure of engine pneumatic valve control system A and B when SPS TANK PRESS switch (MDC-20) is in the N ₂ A or N ₂ B position, respectively. | T/C - GROUP 5 (MDC-22) INSTRUMENTS - ESS MN A MN B (MDC-22) | Flight and postlanding bus D-C main buses A and B | None SP0001P (He tank pressure) SP0600P (N ₂ A tank pressure) SP0601P (N ₂ B tank pressure) | Lower antenna will burn off on entry. Each indicator consists of d'Arsonval-type meter with fixed dial and movable pointer. Pointer movement is vertical as observed from crew couch. Pressure indicator display is in psia, and range is 0 to 5000 psia. |
| | PRESSURE indicators FUEL OX | Provides constant monitoring of SPS fuel tank regulated helium pressure. Provides constant monitoring of SPS oxidizer tank regulated helium pressure. | | | SP0006P (fuel tank pressure) SP0003P (oxidizer tank pressure) | Four indicators are identical in operation. Each consists of d'Arsonval-type meter with fixed dial and movable pointer. Pointer movement is vertical as observed from crew couch. Each indicator is calibrated in psia with range of 0 to 300 psia. |
| | ENG INLET group FUEL OX | Provides constant monitoring of SPS fuel pressure at the engine main propellant valves. Provides constant monitoring of SPS oxidizer pressure at the engine main propellant valves. | | | SP0010P (fuel line engine inlet) SP0009P (oxidizer line engine inlet) | Same indicator as helium tank press. Propellant temperature is indicated in degrees Fahrenheit. The range of the indicator is -100° to +200°F. When the indicator reads -40°F (equivalent propellant temperature of +40°F) the SPS HEATER switch is placed to position A or B. When the indicator reads +80°F (equivalent propellant temperature +120°F) the SPS HEATER switch is placed to OFF. The indicator has red line markings at +80°F and -40°F. |
| | TEMPERATURE indicator ENGINE INLET PROPELLANT TEMP | Propellant temperature is monitored in the engine fuel feed line plumbing at the gimbal ring of the engine. The indicator displays the measurement as noted in the Remarks column: | | | SP0048T (fuel line engine inlet) | |

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|------------------|---|---|--|----------------------------|--|--|
| MDC-20 (Cont) | SPS ENGINE INJECT VALVE indicators 1 (2, 3, 4) | Provides visual indication of SPS engine main propellant valves open or closed condition (one oxidizer and one fuel valve per pair and one indicator for each pair of valves). | T/C - GROUP 5 (MDC-22) | Flight and postlanding bus | Valve position: A-1 SP0022H A-2 SP0023H B-3 SP0024H B-4 SP0025H NOTE Separate pickoffs for display and T/M signals. | Four identical indicators. Each is needle-movement-type meter with inputs supplied by position potentiometer located on valve actuator arm. Left needle deflection indicates CLOSE; right deflection indicates OPEN. |
| | SPS TANK PRESS switch He N ₂ A N ₂ B | Connects SPS helium storage tank pressure output to He TANK PRESS indicator (MDC-20). Connects SPS gaseous nitrogen storage tank pressure output of engine control valve system A to TK PRESS indicator (MDC-20). Connects SPS gaseous nitrogen storage tank pressure output of engine control valve system B to TK PRESS indicator (MDC-20). | N/A | N/A | None | Three-position toggle switch used to select SPS helium or nitrogen tank pressure input to He TANK PRESS or N ₂ TK PRESS indicator on MDC-20. |
| | SPS HELIUM switches (two, left hand and right hand) AUTO OFF | Two operationally identical switches. Provides for automatic application and removal of power from helium isolation valve solenoid. Removes power from helium isolation valve solenoid. | SPS-He VALVE MN A MN B (MDC-25) | D-C main buses A and B | | Each switch is a three-way toggle switch. With this switch in the AUTO position, valve opening and closing is controlled automatically by G&N system and/or SCS. Complete manual control of valve position can be maintained by utilizing ON - OFF switch positions. D-C main buses A and B provide power to helium pressurizing systems A and B, respectively. |

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|------------------|---|--|--|---|---------------------------------|--|
| MDC-20 (Cont) | ON | Applies power to helium isolation valve solenoid. | SPS-He VALVE MN A MN B (MDC-25) | D-C main buses A and B | None | Each switch controls helium flow to one of two redundant pressure regulator assemblies. |
| | SPS HELIUM event indicators (two) | Striped-line display indicates open conditions of valve controlled by switch located directly below indicator. Gray display indicates closed condition. | | | | Two identical indicators. Each is two-condition device with striped-line display controlled by solenoid action and gray display controlled by permanent magnet action. |
| | QUANTITY display windows OXID FUEL | Digital counter display window indicating total oxidizer tank quantity remaining (in pounds times 20). Digital counter display window indicating total fuel tank quantity remaining (in pounds times 10). | SPS-GAUGING MN A MN B AC 1 AC 2 (MDC-25) | 400-cps a-c input from quantity gauging system control unit | | Digital display in oxidizer quantity (OXID) window and fuel quantity (FUEL) window represent remaining tank quantities and are marked X20 and X10, respectively. These markings facilitate determination of correct remaining propellant quantities. Since desired oxidizer/fuel ratio is 2:1, digital display in both windows should be identical when propellant ratio is correct. |
| | UNBALANCE indicator | Indicates unbalance of remaining SPS propellants. | | | | Indicator is graduated into six major divisions, each representing 100 pounds of propellant unbalance. Upper half indicates increased oxidizer flow required; lower half, decreased flow. Indicator needle at 0 (horizontal position) indicates desired propellant ratio. |
| | TEST/AUTO/TEST switch TEST (up) AUTO TEST (down) | Applies simulated input to propellant quantity gauging and utilization system control unit, causing digital display counters and UNBALANCE indicator to function for test check. Normal operating position. Applies simulated input for same purposes as TEST (up) position, except in reverse polarity. | | D-C and a-c test inputs from quantity gauging system control unit | | Three-position toggle switch, spring-loaded to AUTO position. TEST position allows for visual check of proper electrical and mechanical operation of propellant indicating devices. In addition to indicator checks, TEST position may be used to aid in isolating a malfunction in either primary or auxiliary propellant quantity sensing system. Test rate for OXID digits is approximately 3 digits/second; FUEL 1.5 digits/second. |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|----------------------------|--|---|---|---------------------------------|---|
| MDC-20 (Cont) | OXID FLOW switch | | SPS— GAUGING MN A MN B AC 1 AC 2 (MDC-25) | D-C and a-c test inputs from quantity gauging system control unit | None | Three-position toggle switch used as required to regulate oxidizer flow rate to maintain proper propellant utilization. Remaining propellant SPS unbalance may be determined by monitoring UNEBALANCE meter or by calculations, utilizing information displayed in OXID and FUEL quantity digital display windows. Maximum PU valve response time from increase to decrease position in 3.5 seconds. |
| | INCREASE | Supplies increased signal to propellant utilization valve PRI or SEC motor selected by VALVE switch. INCREASE position — 46.65 lb/sec. | | | | |
| | NORM | Supplies normal signal to propellant utilization valve PRI or SEC motor selected by VALVE switch. NORM position — 45.27 lb/sec at 70°F and 168±4 PSIG. | | | | |
| | DECREASE | Supplies decreased signal to propellant utilization valve PRI or SEC motor selected by VALVE switch. DECREASE position — 43.87 lb/sec. | | | | Two identical indicators. Each is a two-condition device controlled by servo action. When propellant utilization valve is in normal oxidizer flow rate position, gray display will appear in both indicator windows. |
| | OXID FLOW event indicators | | | | | |
| | Upper indicator | Striped-line display indicates propellant utilization valve is in increased oxidizer flow rate position; gray display indicates it is not. | | | | |
| | Lower indicator | Striped-line display indicates propellant utilization valve is in decreased oxidizer flow rate position; gray display indicates it is not. | | | | |
| | VALVE switch | | | D-C input from quantity gauging system | | Two-position toggle switch which provides manual selection of primary or secondary gates in propellant utilization valve. The PU valve secondary gate is capable of adjusting for increased, decreased, or normal oxidizer flow area regardless of a primary gate failure in any position. |
| | PRI | Applies power to propellant utilization valve primary servo amplifier. | | | | |
| | SEC | Applies power to propellant utilization valve secondary servo amplifier. | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|--|--|--|---|---------------------------------|--|
| MDC-20 (Cont) | SENSOR switch PRI NORM AUX | Applies output from primary propellant quantity sensing system to propellant quantity indicating and warning devices. Applies outputs from both primary and auxiliary sensing systems to propellant quantity warning devices and output from primary propellant sensing system to propellant quantity indicating devices. Applies output from auxiliary propellant sensing system to propellant quantity indicating and warning devices. | SPS— GAUGING MN A MN B AC 1 AC 2 (MDC-25) | 400-cps a-c input from quantity gauging system control unit | None | Three-position toggle switch, with switch in NORM position during normal operation. This switch, when used in conjunction with TEST switch (MDC-20), can be useful in isolating a malfunction in propellant quantity sensing system. |
| MDC-21 | SUIT COMPRESSOR selector switch COMPR 1 AC 2 AC 1 | Applies a-c power to motor of suit compressor No. 1 from bus No. 2. Applies a-c power to motor of suit compressor No. 1 from bus No. 1. | ECS-SUIT COM- PRESSORS AC 2 ØA ØB ØC (MDC-22) ECS-SUIT COM- PRESSORS AC 1 ØA ØB ØC (MDC-22) | A-C bus No. 2 A-C bus No. 1 | None | Only one suit compressor is normally operated at a time, with second compressor for standby redundancy. Output of each compressor is as follows: a. Prelaunch mode - 32.7 cfm and ΔP of 0.7 to 0.9 psi. b. Normal mode - 35 cfm and ΔP of 0.3 to 0.4 psi. c. Emergency mode - 33.6 cfm and ΔP of 0.2 to 0.3 psi. |
| | OFF COMPR 2 AC 1 | Removes a-c power from motors of suit compressors. Applies a-c power to motor of suit compressor No. 2 from bus No. 1. | | | | |

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|------------------|---|--|--|--------------------------|---------------------------------|--|
| MDC-21 (Cont) | AC 1/1 AC 2/2 | Applies a-c power to the following motors: a. NO. 1 suit compressor from bus NO. 1. b. NO. 2 suit compressor from bus NO. 2. | ECS-SUIT COM- PRESSORS AC 1 Ø A Ø B Ø C and AC 2 Ø A Ø B Ø C (MDC-22) | A-C buses No. 1 and 2 | None | Switch position permits simultaneous operation of both suit compressors during periods of high suit heat loads. |
| | ECS GLYCOL pump selector switch PUMP 1 AC 2 | Applies a-c power to motor of No. 1 water-glycol pump from bus No. 2 | ECS- GLYCOL PUMPS- AC 2 Ø A Ø B Ø C (MDC-22) | A-C bus No. 2 | | Only one water-glycol pump can be operated at a time, with second pump for standby redundancy. |
| | AC 1 | Applies a-c power to motor of No. 1 water-glycol pump from bus No. 1 | ECS- GLYCOL PUMPS- AC 1 Ø A Ø B Ø C (MDC-22) | A-C bus No. 1 | | Pump design specification figures are 200 lb/hr flow at a pressure rise of 29.5 psi, with a pump inlet of 7.5x1.5 psig at 100°F (max). Actual flow varies inversely with system pressure drop. |
| | OFF | Removes a-c power from motors of water-glycol pumps. | | | | |
| | PUMP 2 AC 1 | Applies a-c power to motor of No. 2 water-glycol pump from bus No. 1 | | | | |

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|------------------|--|--|--|---------------|---------------------------------|--|
| MDC-21 (Cont) | AC 2 | Applies a-c power to motor of No. 2 water-glycol pump from bus No. 2. | ECS-GLYCOL PUMPS-AC 2 Ø A Ø B Ø C (MDC-22) | A-C bus No. 2 | None | |
| | CABIN AIR FAN switches 1 switch ON | Applies a-c power to motor of No. 1 cabin air fan, directing airflow through cabin heat exchanger. | ECS-CABIN AIR FAN 1 Ø A Ø B Ø C (MDC-22) | A-C bus No. 1 | | Cabin air fans No. 1 and No. 2 are operated simultaneously to obtain adequate cooling. Output of fan is as follows: a. Prelaunch mode - 171.45 cfm. b. Normal mode - 170.67 cfm. c. Emergency mode - 0 cfm (fan off). In event of malfunction, fan No. 1 is turned off and fan-closure cover manually installed over inlet to prevent backflow. |
| | OFF | Removes a-c power from motor of No. 1 cabin air fan. | | | | |
| | 2 switch ON | Applies a-c power to motor of No. 2 cabin air fan, directing airflow through cabin heat exchanger. | ECS-CABIN AIR FAN 2 Ø A Ø B Ø C (MDC-22) | A-C bus No. 2 | | Cabin air fans No. 1 and No. 2 are operated simultaneously to obtain adequate cooling. Output of fan is as follows: a. Prelaunch mode - 171.45 cfm. b. Normal mode - 170.67 cfm. c. Emergency mode - 0 cfm (fan off). In event of malfunction, fan No. 2 is shut down and fan closure cover is manually installed over inlet to prevent backflow. |
| | OFF | Removes a-c power from motor of No. 2 cabin air fan. | | | | |

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|------------------|--|--|---|------------------------|---------------------------------|---|
| MDC-21 (Cont) | POT H ₂ O HEATER switch MN A | Applies d-c power to potable water heater from main bus A. | ECS-POT H ₂ O HTR MN A (MDC-22) | D-C main bus A | None | Two heating elements totaling 45 watts (20 and 25 watts each) are mounted at separate locations inside the food preparation water unit. Operating simultaneously, they heat the water from an inlet temperature of 60°F to 154±4°F. The maximum time to heat 1.9 lb of water (reservoir capacity) is approximately 2 hours. |
| | OFF | Removes d-c power from potable water heater. | | | | |
| | MN B | Applies d-c power to potable water heater from main bus B. | ECS-POT H ₂ O HTR MN B (MDC-22) | D-C main bus B | | |
| | ECS RADIATOR switches Group 1 | | | | | |
| | A (on) | Applies a-c power to actuator of space radiator isolation valve 1A to place valve in open position, permitting water-glycol flow to the six-tube circuit of the radiator located in S/M sector V (-Y axis). | ECS-RAD VALVE AC 1 1A (MDC-22) | A-C bus No. 1 #A | | Under most normal conditions all space radiator valves are placed in the open position. Exceptions to this are during ground checkout and ascent. The only other time a valve is closed is when a radiator circuit is isolated in event of leakage. |
| | OFF | Applies a-c power to actuator of space radiator isolation valve 1A to place valve in closed position, cutting off water-glycol flow to the radiator tube circuit. | | | | Space radiator valves, which must be in the full open or full closed position, require 17 seconds (max) for full travel. |
| | B (on) | Applies a-c power to actuator of space radiator isolation valve 1B to place valve in open position, permitting water-glycol flow to the four-tube circuit of the radiator located in S/M sector V (-Y axis). | ECS-RAD VALVE AC 2 1B (MDC-22) | A-C bus No. 2 #A | | |
| | OFF | Applies a-c power to actuator of space radiator isolation valve 1B to place valve in closed position, cutting off water-glycol flow to the radiator tube circuit. | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---|--|--------------------------------|------------------|---------------------------------|--|
| MDC-21 (Cont) | Group 2 A (on) | Applies a-c power to actuator of space radiator isolation valve 2A to place valve in open position, permitting water-glycol flow to the six-tube circuit of the radiator located in S/M sector II (+Y axis). | ECS-RAD VALVE AC 2 2A (MDC-22) | A-C bus No. 2 ØC | None | |
| | OFF | Applies a-c power to actuator of space radiator isolation valve 2A to place valve in closed position, cutting off water-glycol flow to the radiator tube circuit. | | | | |
| | B (on) | Applies a-c power to actuator of space radiator isolation valve 2B to place valve in open position, permitting water-glycol flow to the four-tube circuit of the radiator located in S/M sector II (+Y axis). | ECS-RAD VALVE AC 1 2B (MDC-22) | A-C bus No. 1 ØB | | |
| | OFF | Applies a-c power to actuator of space radiator isolation valve 2B to place valve in closed position, cutting off water-glycol flow to the radiator tube circuit. | | | | |
| | RCS HEATERS circuit breakers A MN B (20 amp) | Applies power from d-c main bus B to the following: a. SM RCS quad A package heater b. Normally open contacts of relay activated by CM RCS HTRS switch (RHFE-200) for CM RCS system B engine injector valve direct coils utilized for engine preheating. | N/A | +28 vdc | | Thermal, push-pull manual reset-type circuit breakers with the amperage rating of each denoted by a white placard. |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | |
|------------------|----------------------------|---|-----------------|--------------|---------------------------------|--|--|
| MDC-21 (Cont) | B MN A (20 amp) | Applies power from d-c main bus A to the following: a. SM RCS quad B package heater b. Normally open contacts of relay activated by CM RCS HTRS switch (RHFEB-200) for CM RCS system A engine injector valve direct coils utilized for engine preheating. | N/A | +28 vdc | None | | |
| | C MN B (5 amp) | Applies power from d-c main bus B to package heater in S/M RCS quad C. | | | | | |
| | D MN A (5 amp) | Applies power from d-c main bus A to package heater in S/M RCS quad D. | | | | | |
| | SNSR UNIT circuit breakers | | | | | | |
| | DC BUS group | | | | | | |
| | A (5 amp) | Applies d-c power from battery relay bus through MAIN BUS A-RESET switch to d-c main bus A undervoltage sensing unit. | | | | Sensing unit is inoperative when MAIN BUS A-RESET switch is in the OFF position. | |
| | B (5 amp) | Applies d-c power from battery relay bus through MAIN BUS B-RESET switch to d-c main bus B undervoltage sensing unit. | | | | Sensing unit is inoperative when MAIN BUS B-RESET switch is in the OFF position. | |
| | AC BUS group | | | | | | |
| | 1 (5 amp) | Applies d-c power from battery relay bus through AC BUS 1-RESET switch to a-c bus No. 1 over-undervoltage and overload sensing unit. | | | | Sensing unit is inoperative when AC BUS 1-RESET switch is in the OFF position. | |
| | 2 (5 amp) | Applies d-c power from battery relay bus through AC BUS 2-RESET switch to a-c bus No. 2 over-undervoltage and overload sensing unit. | | | | Sensing unit is inoperative when AC BUS 2-RESET switch is in the OFF position. | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|----------|--|---|---|---------------|---------------------------------|---|
| MDC-22 | FUEL CELL PUMP switches | | | | | |
| | Switch 1 | Is capable of selecting a-c bus No. 1, a-c bus No. 2, or off for fuel cell No. 1 pump motors. | FUEL CELL 1 - CIR & SEP MOTORS (MDC-22) | A-C bus No. 1 | None | Two parallel pump motors are associated with each fuel cell. One motor drives the H ₂ circulating pump and the other motor drives the glycol circulating pump. Switches are located between bus and c/b's. |
| | AC 1 | Controls 3Ø a-c power from a-c bus No. 1 to fuel cell No. 1 pump motors. | | | | |
| | OFF | Disconnects 3Ø a-c power from pump motors. | | | | |
| | AC 2 | Controls 3Ø a-c power from a-c bus No. 2 to fuel cell No. 1 pump motors. | | | A-C bus No. 2 | |
| | Switch 2 | Is capable of selecting a-c bus No. 1, a-c bus No. 2, or off for fuel cell No. 2 pump motors. | FUEL CELL 2 - CIR & SEP MOTORS (MDC-22) | A-C bus No. 1 | | |
| | AC 1 | Controls 3Ø a-c power from a-c bus No. 1 to fuel cell No. 2 pump motors. | | | | |
| | OFF | Disconnect 3Ø a-c power from pump motors. | | | A-C bus No. 2 | |
| | AC 2 | Controls 3Ø a-c power from a-c bus No. 2 to fuel cell No. 2 pump motors. | | | | |
| | Switch 3 | Is capable of selecting a-c bus No. 1, a-c bus No. 2, or off for fuel cell No. 3 pump motors. | FUEL CELL 3 - CIR & SEP MOTORS (MDC-22) | A-C bus No. 1 | | |
| | AC 1 | Controls 3Ø a-c power from a-c bus No. 1 to fuel cell No. 3 pump motors. | | | | |
| | OFF | Disconnects 3Ø a-c power from pump motors. | | | A-C bus No. 2 | |
| AC 2 | Controls 3Ø a-c power from a-c bus No. 2 to fuel cell No. 3 pump motors. | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---|--|-------------------------------------|---------------|---------------------------------|--|
| MDC-22 (Copt) | MAIN BUS TIE switches BAT A & C/AUTO/ OFF switch BAT A & C | Allows manual control of bus tie motor switch to: a. Connect battery bus A to d-c main bus A and battery C to d-c main bus B. b. Disconnect BATTERY CHARGER selector switch (MDC-18) from battery bus A and battery C. In the event of an LES abort or normal CSM separation, this position allows the C/M RCS control box to control bus tie motor switch connecting battery bus A to d-c main bus A and battery C to d-c main bus B and disconnects BATTERY CHARGER selector switch (MDC-18). | BATTERY CHARGER-BAT A CHGE (MDC-22) | Battery bus A | | Actuates motor-driven switch which accomplishes actual switching function. |
| | AUTO | | | | | |
| | OFF | Allows manual control of motor switch to: a. Disconnect battery bus A from d-c main bus A and battery C from d-c main bus B. b. Connects BATTERY CHARGER selector switch (MDC-18) to battery bus A and battery C. | | | | |
| | BAT B & C/AUTO/ OFF switch BAT B & C | Allows manual control of bus tie motor switch to: a. Connect battery bus B to d-c main bus B and Battery C to d-c main bus A. b. Disconnects BATTERY CHARGER selector switch (MDC-18) from battery bus B and battery C. | BATTERY CHARGER-BAT B CHGE (MDC-22) | Battery bus B | | Actuates motor-driven switch which accomplishes actual switching function. |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|---------------|--------------------|---|-------------------------------------|----------------------------------|---------------------------------|---|
| MDC-22 (Cont) | AUTO | In the event of an LES abort or normal CSM separation, this position allows the C/M RCS control box to control bus tie motor switch connecting battery bus B to d-c main bus B and battery C to d-c main bus A, and disconnects BATTERY CHARGER selector switch (MDC-18). | BATTERY CHARGER-BAT B CHGE (MDC-22) | Battery bus B | None | |
| | OFF | Allows manual control of motor switch to: a. Disconnects battery bus B from d-c main bus B and battery C from d-c main bus A. b. Connect BATTERY CHARGER selector switch (MDC-18) to battery bus B and battery C. | | | | |
| | BAT CHGR switch | Provides means of selecting a-c bus No. 1 or a-c bus No. 2 for battery charger a-c power source. | BATTERY CHARGER-AC PWR (MDC-22) | A-C bus No. 1 A-C bus No. 2 | | Switch works with BATTERY CHARGER selector switch (MDC-18) to enable battery charger operation. |
| | AC 1 | Controls 3 ϕ a-c power from a-c bus No. 1 to battery charger during battery charging operation. | | | | |
| | AC 2 | Controls 3 ϕ a-c power from a-c bus No. 2 to battery charger during battery charging operation. | | | | |
| | NON ESS BUS switch | Connects nonessential bus No. 1 and No. 2 to d-c main bus A. Disconnects nonessential buses from d-c main buses Connects nonessential bus No. 1 and No. 2 to d-c main bus B. | | D-C main bus A D-C main bus B | | Equipment associated with this switch is: a. Scientific equipment bay No. 1 b. Scientific equipment bay No. 2 c. Scientific equipment hatch d. Flight qualification recorder e. Nonessential instrumentation f. Voice recorder flag |
| | MN A | | | | | |
| | OFF | | | | | |
| | MN B | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---|--|--|--|---------------------------------|--|
| MDC-22 (Cont) | G&N VIEWER switch | Provides means of selecting a-c bus No. 1 or a-c bus No. 2 for LEB panel brightness control, SCT and SXT reticle lights and signal conditioner. | VIEWER AC 1 and AC 2 (MDC-22) | A-C bus No. 1 A-C bus No. 2 | None | <p>Equipment associated with this switch is:</p> <ul style="list-style-type: none"> a. Unified S-band equipment b. Premodulation processor c. Signal conditioning equipment d. S-band power amplifier. <p>Equipment associated with this switch is:</p> <ul style="list-style-type: none"> a. PCM telemetry b. VHF/FM transmitter c. C-band transponder d. Data storage equipment e. Flight qualification recorder f. Voice recorder |
| | AC 1 | Selects 3 ϕ a-c power from a-c bus No. 1 | | | | |
| | AC 2 | Selects 3 ϕ a-c power from a-c bus No. 2 | | | | |
| | TELECOM switches | | | | | |
| | FSS switch | Provides control of 3 ϕ a-c power to the TELECOMMUNICATIONS-GROUP - 2 and SIG CONDS-BAND PA (MDC-22) telecommunications (T/C) equipment which is essential to safety of flight. | None | | | |
| | AC 1 | Controls 3 ϕ a-c power from a-c bus No. 1 to essential T/C equipment controlled by TELECOMMUNICATIONS - GROUP - 2 and SIG COND-S-BAND PA (MDC-22). | | A-C bus No. 1 | | |
| | OFF | Disconnects 3 ϕ a-c power from essential T/C equipment. | | A-C bus No. 2 | | |
| | AC 2 | Controls 3 ϕ a-c power from a-c bus No. 2 to essential T/C equipment. | | | | |
| | NONESS switch | Provides control of 3 ϕ a-c power to TELECOMMUNICATIONS-GROUP - 1 and PCM TLM (MDC-22) telecommunications (T/C) equipment which is not essential to safety of flight. | | | | |
| | AC 1 | Controls 3 ϕ a-c power from a-c bus No. 1 to nonessential T/C equipment. | | | | |
| OFF | Disconnects 3 ϕ a-c power from nonessential T/C equipment. | | | | | |
| AC 2 | Controls 3 ϕ a-c power from a-c bus No. 2 to nonessential T/C equipment. | | | A-C bus No. 2 | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---|---|-----------------|--------------------------|---------------------------------|---|
| MDC-22 (Cont) | FUEL CELL 1 circuit breaker | | N/A | 115 vac 400 cps 3Ø | None | |
| | CIR & SEP MOTORS (3 amp) | a. Applies power from a-c bus No. 1 or 2 through FUEL CELL PUMP - 1 switch to C/B, and to circulator and separator pump motors in fuel cell 1. b. Provides ØA power to pH sensor probe. | | | | |
| | H ₂ & O ₂ VALVE (10 amp) | Applies d-c power from battery relay bus to FUEL CELL 1 - REACTANTS switch (MDC-18), and to F/C VALVES-RESET switch (MDC-19). | | +28 vdc | | Opened after operation of F/C VALVES-RESET switch (MDC-19). |
| | BUS CONT (10 amp) | a. Applies d-c power from battery relay bus to F/C 1 bus disconnect control through FUEL CELL 1 - MAIN BUS A and MAIN BUS B switches (MDC-18). b. Provides power to reactants event indicator. | | | | |
| | PURGE (5 amp) | Applies power from d-c main buses A and B to F/C 1 purge valve control through FUEL CELL 1 - O ₂ PURGE - H ₂ PURGE switch (MDC-18), and to H ₂ PURGE LINE HTR switch (MDC-15). | | | | H ₂ PURGE LINE HTR switch (MDC-15) positioned to ON 30 minutes prior to an H ₂ purge operation. |
| | FUEL CELL 2 circuit breakers | | | 115 vac 400 cps 3Ø | | |
| | CIR & SEP MOTORS (3 amp) | a. Applies power from a-c bus No. 1 or 2 through FUEL CELL PUMP - 2 switch to C/B, and to circulator and separator pump motors in fuel cell 2. b. Provides ØA power to pH sensor probe. | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Quantity | Remarks |
|------------------|---|---|-----------------|--------------------------------|---------------------------------|---|
| MDC-22 (Cont) | H ₂ & O ₂ VALVE (10 amp) | Applies d-c power from battery relay bus to FUEL CELL 2 - REACTANTS switch (MDC-18), and to F/C VALVES-RESET switch (MDC-19). | N/A | +28 vdc | None | Opened after operation of F/C VALVES-RESET switch (MDC-19). |
| | BUS CONT (10 amp) | a. Applies d-c power from battery relay bus to F/C 2 bus disconnect control through FUEL CELL 2 - MAIN BUS A and MAIN BUS B switches (MDC-18). b. Provides power to reactants event indicator. | | | | |
| | PURGE (5 amp) | Applies power from d-c main buses A and B to F/C 2 purge valve control through FUEL CELL 2 - O ₂ PURGE - H ₂ PURGE switch (MDC-18), and to H ₂ PURGE LINE HTR switch (MDC-15). | | | | |
| | FUEL CELL 3 circuit breakers CIR & SEP MOTORS (3 amp) | a. Applies power from a-c bus No. 1 or 2 through FUEL CELL PUMP - 3 switch to C/B, and to circulator and separator pump motors in fuel cell 3. b. Provides ϕ A power to pH sensor probe. | | | | |
| | H ₂ & O ₂ VALVE (10 amp) | Applies d-c power from battery relay bus to FUEL CELL 3 - REACTANTS switch (MDC-18). | | 115 vac 400 cps 3 ϕ | | |
| | | | | +28 vdc | | Opened after operation of F/C VALVES-RESET switch (MDC-19). |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|---------------|--|--|-----------------|--------------|---------------------------------|---------|
| MDC-22 (Cont) | RUS CONT (10 amp) | a. Applies d-c power from battery relay bus to F/C 3 bus disconnect control through FUEL CELL 3 - MAIN BUS A and MAIN BUS B switches (MDC-18) b. Provides power to reactants event indicator. | N/A | +28 vdc | None | |
| | PURGE (5 amp) | Applies power from d-c main buses A and B to F/C purge valve control through FUEL CELL 3 - O ₂ PURGE - H ₂ PURGE switch (MDC-18). | | | | |
| | INVERTER CONTROL circuit breakers | | | | | |
| | 1 (10 amp) | Applies d-c power from battery relay bus to AC INVERTER 1 and AC INVERTER 3 switches (MDC-18). | | | | |
| | 2 (10 amp) | Applies d-c power from battery relay bus to AC INVERTER 2 and AC INVERTER 1 switches (MDC-18). | | | | |
| | 3 (10 amp) | Applies d-c power from battery relay bus to AC INVERTER 2 and AC INVERTER 3 switches (MDC-18). | | | | |
| | MASTER EVENT SEQ CONT circuit breakers | | | | | |
| | ARM group | | | | | |
| | BAT A (5 amp) | Applies d-c power from battery bus A to the following switches: a. MESC-LOGIC ARM switches 1 and 2 (MDC-25) b. MASTER EVENT SEQ CONT - PYRO ARM switches 1 and 2 (MDC-24) c. LES MOTOR FIRE switch (MDC-5) d. CANARD DEPLOY switch (MDC-5) | | | | |

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|------------------|-------------------------------|---|-----------------|--------------|---------------------------------|---------|
| MDC-22 (Cont) | BAT B (5 amp) | c. ADAPT SEP switch (MDC-5) f. REACTION CONTROL SYSTEM - C/M PRESS switch (MDC-16) g. REACTION CONTROL SYSTEM - CMD/ON/OFF switch (MDC-16) h. C/M - S/M SEP switches 1 and 2 (MDC-15). | N/A | +28 vdc | None | |
| | BAT B (5 amp) | Applies d-c power from battery bus B to the following switches: a. MESC-LOGIC ARM switches 1 and 2 (MDC-25) b. MASTER EVENT SEQ CONF - PYRO ARM switches 1 and 2 (MDC-24) c. LES MOTOR FIRE switch (MDC-5) d. CANARD DEPLOY switch (MDC-5) e. ADAPT SEP switch (MDC-5) f. REACTION CONTROL SYSTEM - C/M PRESS switch (MDC-16) g. REACTION CONTROL SYSTEM - CMD/ON/OFF switch (MDC-16) h. C/M - S/M SEP switches 1 and 2 (MDC-15). | | | | |
| | LOGIC group BAT A (15 amp) | a. Applies d-c power from battery bus A to the logic A bus in the master event sequence controller when the MESC - LOGIC ARM switches 1 and 2 (MDC-25) are in the LOGIC ARM position. The logic bus in turn provides power to the ABORT SYSTEM - MODE switches 1 and 2 and, during LES aborts, to the ABORT SYSTEM - OX DUMP switch. | | | | |

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|------------------|-------------------|--|--|--------------|----------------------------------|---------|--|
| MDC-22 (Cont) | BAT B (15 amp) | b. Arms the abort switch in commanders translation control c. Provides part of the power to the LES and SPS abort circuitry. | N/A | +28 vdc | None | | |
| | | a. Applies d-c power from battery bus B to the logic B bus in the master event sequence controller when the MESC - LOGIC ARM switches 1 and 2 (MDC-25) are in the LOGIC ARM position. The logic bus in turn provides power to the ABORT SYSTEM—MODE switches 1 and 2 and, during LES aborts provides power to the ABORT SYSTEM—OX DUMP switch. | | | | | |
| | | b. Arms the abort switch in commanders translation control. c. Provides part of the power for the LES and SPS abort circuitry. | | | | | |
| | | DC SINSR SIG circuit breakers MN A (5 amp) MN B (5 amp) | Applies power from d-c main bus A to d-c undervoltage sensing unit and DC INDICATORS switch. Applies power from d-c main bus B to d-c undervoltage sensing unit and DC INDICATORS switch. | | | | Unit receives power from battery relay bus through circuit breakers on MDC-21. |
| | | CENTRAL TIMING SYS circuit breakers MN A (5 amp) MN B (5 amp) | Applies 28-vdc power to CTE power supply No. 1 Applies 28-vdc power to CTE power supply No. 2 | None | D-C main bus A D-C main bus B | | The CTE contains two power supplies for redundancy, No. 1 and No. 2. If either one fails, the other will provide sufficient power for the CTE. |
| | | SCIEN EQUIP circuit breakers SEB-1 (20 amp) | Applies power from non-essential bus to scientific equipment outlet in component A. | | NON ESS BUS NO. 2 +28 vdc | | Compartment A scientific equipment outlet is located in the LEB. (See figure 4-13.) |

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|------------------|---|--|-----------------|---------------------------------|---------------------------------|--------------------|
| MDC-22 (Cont) | SEB-2 (20 amp) | Applies power from non-essential bus to scientific equipment outlet in compartment B. (Proposed) | None | NON ESS BUS NO. 2 +28 vdc | None | (See figure 4-13.) |
| | BAT RLY BUS circuit breakers | | | | | |
| | BAT A (20 amp) | Applies d-c power from battery bus A through an isolation diode to battery relay bus. | | | | |
| | BAT B (20 amp) | Applies d-c power from battery bus B through an isolation diode to battery relay bus. | | | | |
| | BATTERY CHARGER circuit breakers | | | | | |
| | BAT A CHGE (10 amp) | Applies d-c power from battery bus A to MAIN BUS TIE - BAT A & C switch (MDC-22) and through contacts of bus tie motor switch to position A of BATTERY CHARGER selector switch (MDC-18). | | | | |
| | BAT B CHGE (10 amp) | Applies d-c power from battery bus B to MAIN BUS TIE - BAT B & C switch (MDC-22) and through contacts of bus tie motor switch to position B of BATTERY CHARGER selector switch (MDC-18). | | | | |
| MN A (5 amp) | Applies power from d-c main bus A, through an isolation diode, to BATTERY CHARGER selector switch (MDC-18) and d-c contacts of battery charger input-power control relay. | | | | | |
| MN B (5 amp) | Applies power from d-c main bus B, through an isolation diode, to BATTERY CHARGER selector switch (MDC-18) and d-c contacts of battery charger input-power control relay. | | | | | |

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|------------------|--|---|-----------------|-------------------------------|---------------------------------|--|
| MDC-22 (Cont) | AC PWR (2 amp) | Applies power from a-c bus No. 1 or a-c bus No. 2 to contacts of battery charger input-power control relay. | None | 115 vac 400 cps 3 phase | None | |
| | TELECOMMUNICATIONS circuit breakers GROUP number 1 AC (2 amp) | Applies 115-vac 3-phase power to: a. VHF-FM transmitter via internal power control relay controlled by VHF/FM switch (MDC-20) b. C-band transponder via power control relay K3 in circuit utilization box; relay is controlled by C-BAND switch (MDC-20) c. DSE; controlled by TAPE RECORDER switches (MDC-20) and logic circuitry in DSE d. FQR; controlled by FLIGHT QUAL RCDR switch (MDC-19) and logic circuitry in FQR. e. Voice recorder power converter, controlled by RCDR/HF-T/R and POWER-VOX switches MDC-13, -23, -26. | | A-C bus No. 1 or 2 | | A-C bus supplying power to this equipment is determined by position of TELCOM—NON ESS switch (MDC-22). |
| | 2 AC (2 amp) | Applies 115-vac 3-phase power to: a. USBE power supply via power control relay K2 in circuit utilization box, relay is controlled by S-BAND-XPONDER/OFF/XPONDER PWR AMPL switch (MDC-20) b. PMP power supply via internal power control relay, controlled by PWR-FMP switch and S-BAND-EMERG switch (MDC-20). | | | | A-C bus supplying power to this equipment is determined by position of TELCOM—ESS switch (MDC-22). |

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|------------------|-------------------|---|-----------------|----------------------------|---------------------------------|---------|
| MDC-22 (Cont) | 3 (5 amp) | Applies 28-vdc power to: a. Engineer's audio center POWER switch (MDC-23) b. RECOVERY—VHF-BCN switch (MDC-20) c. Commander's left microphone amplifier d. Engineer's right microphone amplifier. | None | Flight and Postlanding Bus | None | |
| | 4 (10 amp) | Applies 28-vdc power to: a. Commander's audio center POWER switch (MDC-26) b. VHF/AM transmitter-receiver and HF transceiver keying relay coils c. RECOVERY—HF—ON/OFF switch (MDC-20) d. VHF-AM—T/R/OFF/REC switch (MDC-20) e. Navigator's left microphone amplifier f. Commander's right microphone amplifier. | | | | |
| | 5 (7.5 amp) | Applies 28-vdc power to: a. Navigator's audio center POWER switch (MDC-13) b. TAPE RECORDER—FWD/REV switch (MDC-20) c. TAPE RECORDER—RECORD/PLAY switch (MDC-20) d. POWER—SCE switch (MDC-20) e. POWER—PMP switch (MDC-20) f. S-BAND—EMERG switch (MDC-20) g. VHF-FM—ON/OFF switch (MDC-20) | | | | |

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|------------------|--|--|-----------------|------------------------------|---------------------------------|--|
| MDC-22 (Cont) | | <p>h. S-BAND — PWR AMPL switch (MDC-20)</p> <p>i. C-BAND — 1 PULSE/2 PULSE switch (MDC-20)</p> <p>j. S-BAND PA equipment</p> <p>k. TV equipment</p> <p>l. DSE</p> <p>m. USBE power control relays</p> <p>n. UP-DATA switch (MDC-20) and up-data link equipment</p> <p>o. VHF ANTENNA switch (MDC-20)</p> <p>p. S-BAND ANTENNA switch through S-BAND-XPONDER/OFF/XPONDER PWR AMPL switch (MDC-20)</p> <p>q. Engineer's left microphone amplifier</p> <p>r. Navigator's right microphone amplifier</p> <p>s. BIO-MED PCM/TLM</p> | None | Flight and Postlanding Bus | None | |
| | PCM TLM (2 amp) | Applies 115 vac 3-phase power to PCM/telemetry equipment. | | AC NON ESS BUS 1 or 2 | | A-C bus supplying power to this equipment is determined by position of TELCOM — NON ESS switch (MDC-22). |
| | SIG COND S-BAND PA AC (2 amp) | Applies 115 vac 3-phase power to: | | | | A-C bus supplying power to this equipment is determined by position of TELCOM — ESS switch (MDC-22). |
| | SCIEN EQUIP HATCH circuit breaker (20 amp) | <p>a. SCE power supply via internal latching relay controlled by PWR-SCE switch (MDC-20)</p> <p>b. S-band PA power supplies via power control relay K1 in circuit utilization box; relay is controlled by S-BAND-XPONDER/OFF/XPONDER PWR AMPL switch (MDC-20).</p> <p>Applies power from nonessential bus to No. 2 to scientific equipment receptacle below RH and LH observation windows.</p> | | DC NON ESS BUS NO. 2 +28 vdc | | (See figures 5-3 and 5-4) |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | |
|------------------|---|---|-----------------|-----------------------|---------------------------------|---------|--|
| MDC-22 (Cont) | ECS circuit breakers H ₂ O ACCUM group MIN A (5 amp) | Applies power from d-c main bus A to the following: | None | +28 vdc | None | | |
| | | a. H ₂ O ACCUM-AUTO 1/MAN/AUTO 2 switch (MDC-13) b. H ₂ O accumulator pump failure detection unit. | | | | | |
| | MIN B (5 amp) | Applies power from d-c main bus B to the following: | None | | | | |
| | | a. H ₂ O ACCUM-AUTO 1/MAN/AUTO 2 switch (MDC-13) b. H ₂ O accumulator pump failure detection unit. | | | | | |
| | GAS ANAL circuit breaker AC 1 (2 amp) | Applies 6A a-c power to gas chromatograph package (GFE) located in scientific equipment compartment of LEB. | None | 115 vac 400 cps 3ø | | | |
| | INSTRUMENTS circuit breakers ESS group MIN A (15 amp) | Applies 28-vdc power to ESSENTIAL - 1, -2, -3, & -4 circuit breakers on INST PWR CONT panel (RHEB-204). | None | D-C main bus A | | | |
| | | Applies 26-vdc power to ESSENTIAL - 1, -2, -3, & -4 circuit breakers on INST PWR CONT panel (RHEB-204). | | | | | |
| | MIN B (15 amp) | None | D-C main bus B | | | | |
| | NON ESS BUS (5 amp) NON ESS (15 amp) | Applies 28-vdc power to NON ESSENTIAL-5 through -10 circuit breakers on INST PWR CONT panel (RHEB-204). | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | | | |
|------------------|--|---|--|---------------------|---------------------------------|---|---------|--|-----------------------|
| MDC-22 (Cont) | RCDR NON ESS (5.0 amp) | Applies 28-vdc power to FQR. Applies 28-vdc power to VOICE RECORD event indicator (MDC-19) | None | D-C main bus A or B | None | The nonessential buses No. 1 and No. 2 obtain 28 vdc power from D-C main bus A or B, depending on position of NON ESS BUS switch (MDC-22) | | | |
| | SCIEN (7.5 amp) | Applies power from nonessential bus No. 1 for scientific instruments. (Not used.) | | | | | | | |
| | GUIDANCE & NAVIGATION circuit breakers | IMU HTR group | | | | | | | |
| | | MN A (7.5 amp) | Applies power from d-c main bus A to IMU heaters. | N/A | | | +28 vdc | | |
| | MN B (7.5 amp) | Applies power from d-c main bus B to IMU heaters. | | | | | | | |
| | IMU group | MN A (25 amp) | Applies power from d-c main bus A to IMU. | | | | | | |
| | | MN B (25 amp) | Applies power from d-c main bus B to IMU. | | | | | | |
| | COMPUTER group | MN A (10 amp) | Applies power from d-c main bus A to AGC. | | | | | | |
| | | MN B (10 amp) | Applies power from d-c main bus B to AGC. | | | | | | |
| | OPTICS group | MN A (10 amp) | Applies power from d-c main bus A to optics. | | | | | | |
| | | MN B (10 amp) | Applies power from d-c main bus B to optics. | | | | | | |
| | VIEWER group | AC 1 (1 amp) | Applies power from a-c bus No. 1 to C2N VIEWER switch. | | | | | | 115 vac 400 cps ØB |
| | | AC 2 (1 amp) | Applies power from a-c bus No. 2 G&N VIEWER switch. | | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identify | Remarks |
|------------------|--|--|-----------------|-----------------------|---------------------------------|---------|
| MDC-22 (Cont) | ENVIRONMENTAL CONTROL SYSTEM circuit breakers CABIN AIR FAN - 1 group AC 1 | Applies 3Ø power from a-c bus No. 1 to the following: a. CABIN AIR FAN - 1 switch (MDC-21) b. Waste management blower switch (RHEB-201). | N/A | 115 vac 400 cps 3Ø | None | |
| | CABIN AIR FAN - 2 group AC 2 | Applies power from a-c bus No. 2 to the following: a. 3Ø to CABIN AIR FAN-2 switch (MDC-21) b. ØC to CABIN TEMP - AUTO/MAN switch (MDC-13). | | | | |
| | GLYCOL PUMPS group AC 1 | Applies power from a-c bus No. 1 to the following: a. 3Ø to ECS GLYCOL pump switch (MDC-21) b. ØA to GLYCOL EVAP - TEMP IN switch (MDC-13) c. ØB to SUIT EVAP switch (MDC-13) d. ØC to GLYCOL EVAP - STEAM PRESS - AUTO/MAN switch (MDC-13) e. ØC to GLYCOL EVAP - H ₂ O FLOW switch (MDC-13). | | | | |
| | AC 2 | Applies 3Ø power from a-c bus No. 2 to ECS GLYCOL pump switch (MDC-21). | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|--|---|-----------------|--------------|---------------------------------|---------|
| MDC-22 (Cont) | TRANSDUCER group WASTE & POT H ₂ O MN A (5 amp) | Applies power from d-c main bus A to the following pressure transducers: a. Waste water tank b. Potable water tank. | N/A | +28 vdc | None | |
| | | Applies power from d-c main bus B to the following pressure transducer: a. Waste water tank b. Potable water tank. | | | | |
| | PRESS GROUPS-1 MN A (5 amp) | Applies power from d-c main bus A to the following pressure transducers: a. Suit b. Compressor ΔP c. Water-glycol pump discharge d. Water-glycol accumulator (quantity) e. Water-gly evap steam. | | | | |
| | | Applies power from d-c main bus B to the following pressure transducers: a. Suit b. Compressor ΔP c. Water-glycol pump discharge (quantity) d. Water-glycol accumulator e. Water-gly evap steam. | | | | |
| | PRESS GROUPS-2 MN A (5 amp) | Applies power from d-c main bus A to the following pressure transducers: a. O ₂ flow rate b. O ₂ supply regulator outlet (telemetered only) | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---|---|-----------------|-----------------------|---------------------------------|---------|
| MDC-22 (Cont) | MN B (5 amp) | c. Cabin d. CO ₂ partial pressure. Applies power from d-c main bus B to the following pressure transducers: a. O ₂ flow rate b. O ₂ supply regulator outlet (telemetered only) c. Cabin d. CO ₂ partial pressure. | N/A | +28 vdc | None | |
| | TEMP group | Applies power from d-c main bus A to the temperature transducer power supply, and in turn to the following transducer amplifiers: a. Water-gly evap liquid outlet b. Cabin c. Suit d. Steam duct (telemetered only) e. Space radiator outlet. | | | | |
| | MN A (5 amp) | Applies power from d-c main bus B to the temperature transducer power supply, and in turn to the following transducer amplifiers: a. Water-gly evap liquid outlet b. Cabin c. Suit d. Steam duct (telemetered only) e. Space radiator outlet. | | | | |
| | MN B (5 amp) | Applies power from d-c main bus B to the temperature transducer power supply, and in turn to the following transducer amplifiers: a. Water-gly evap liquid outlet b. Cabin c. Suit d. Steam duct (telemetered only) e. Space radiator outlet. | | | | |
| | SUIT COMPRESSORS Group AC 1 #A (2 amp) #B (2 amp) #C (2 amp) | Applies power from a-c bus No. 1 to SUIT COMPRESSOR switch (MDC-21). | | 115 vac 400 cps 3φ | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|--------------------------------|---|-----------------|-----------------------|---------------------------------|---------|
| MDC-2: (Cont) | AC 2 | Applies power from a-c bus No. 2 to SUIT COMPRESSOR switch (MDC-21). | N/A | 115 vac 400 cps 3Ø | None | |
| | RAD VALVE group | | | | | |
| | AC 1 | Applies ØA power from a-c bus No. 1 to ECS - RADIATOR-1-A switch (MDC-21). | | | | |
| | 1A (2 amp) | Applies ØB power from a-c bus No. 1 to ECS - RADIATOR-2-B switch (MDC-21). | | | | |
| | 2B (2 amp) | Applies ØA power from a-c bus No. 2 to ECS - RADIATOR-1-B switch (MDC-21). | | | | |
| | AC 2 | Applies ØC power from a-c bus No. 2 to ECS - RADIATOR-2-A switch (MDC-21). | | | | |
| | 1B (2 amp) | Applies power from d-c main bus A to the following: a. POT H ₂ O HEATER switch (MDC-21) b. GLYCOL EVAP - H ₂ O FLOW switch (MDC-13). | | | | |
| | 2A (2 amp) | Applies power from d-c main bus B to the following: a. POT H ₂ O HEATER switch (MDC-21) b. GLYCOL EVAP - H ₂ O FLOW switch (MDC-13) c. WASTE H ₂ O TK REFILL switch (MDC-13). | | +28 vdc | | |
| | POT H ₂ O HTR group | | | | | |
| | MN A (5 amp) | | | | | |
| MN B (5 amp) | | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | | |
|------------------|---|---|---|--------------|---------------------------------|------------|------|--|
| MDC-22 (Cont) | CRYOGENIC TANK FAN MOTORS circuit breakers AC 1 group | Applies a-c θ A power from a-c bus No. 1 θ A to: a. H ₂ FANS - 1 switch (MDC-13) b. O ₂ FANS - 1 switch (MDC-13). | N/A | θ A | None | | | |
| | | | | θ B | | | | |
| | | | | θ C | | | | |
| | | | | θ A | | | | |
| | | | | θ B | | | | |
| | | | | θ C | | | | |
| | | AC 2 group | Applies a-c θ B power from a-c bus No. 2 θ B to: a. H ₂ FANS - 2 switch (MDC-13) b. O ₂ FANS - 2 switch (MDC-13). | N/A | N/A | θ A | None | |
| | | | | | | θ B | | |
| | | | | | | θ C | | |
| | | | | | | θ A | | |
| | | | | | | θ B | | |
| | | | | | | θ C | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---|---|--|------------------------------|---------------------------------|---|
| MDC-22 (Cont) | CRYOGENIC SYSTEM circuit breakers | | N/A | +28 vdc | None | |
| | TANK HEATERS group | | | | | |
| | H ₂ circuit breakers | Applies power from d-c main bus A to H ₂ HEATERS switch (MDC-13). | | | | |
| | MN A (5 amp) | Applies power from d-c main bus B to H ₂ HEATERS switch (MDC-13). | | | | |
| | MN B (5 amp) | Applies power from d-c main bus A to O ₂ HEATERS switch (MDC-13). | | | | |
| | O ₂ circuit breakers | Applies power from d-c main bus B to O ₂ HEATERS switch (MDC-13). | | | | |
| | MN A (15 amp) | Applies power from d-c main bus A to H ₂ HEATERS switch (MDC-13). | | | | |
| | MN B (15 amp) | Applies power from d-c main bus B to O ₂ HEATERS switch (MDC-13). | | | | |
| | QTY AMPL group | | | | | |
| | AC1-ϕC (2 amp) | Applies power from a-c bus No. 1 (ϕC) to H ₂ and O ₂ No. 1 tanks signal conditioning boxes. | | | | |
| AC2-ϕC (2 amp) | Applies power from a-c bus No. 2 (ϕC) to H ₂ and O ₂ No. 2 tanks signal conditioning boxes. | | | | | |
| MDC-23 | FLOODLIGHTS control | | COUCH ATTEN MN A MN B FLOOD- LIGHTS (MDC-25) | D-C main buses A and B | None | FLOODLIGHTS controls on MDC-23, -26, and LEB-100 are functionally identical and each controls the floodlights in its respective area. The rheostat control may be adjusted for desired brightness of primary |
| | PRIMARY rheostat | Removes power from C/M primary floodlights. | | | | |
| | OFF | Indicates maximum floodlight brightness has been reached. | | | | |
| | BRIGHT | | | | | |
| | SECONDARY switch | | | | | |
| | ON | Illuminates secondary floodlights. | | | | |
| | OFF | Removes power from secondary floodlights. | | | | |

MAIN DISPLAY CONSOLE - PANELS 22 AND 23

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|----------------------|---|--|----------------------------|---------------------------------|---|
| MDC-23 (Cont) | C/W LAMP TEST switch | | CAUT/ WARN- MN A MN B (MDC-25) | D-C main buses A and B | None | Lamp check of G&N condition lights and the MASTER ALARM light on LEB-103 is accomplished by pressing CHECK CONDITION LAMPS switch (LEB-105). Master alarm tone is not activated by test illumination of lights. |
| | 1 | Completes d-c ground return path for test illumination of system status lights on MDC-10 and the MASTER ALARM switch-lights on MDC-3 and -18. | | | | |
| | OFF | Opens d-c ground return path of lamp test circuit, extinguishing system status lights on MDC-10 and -11. | | | | |
| | 2 | Completes d-c ground return path for test illumination of system status lights on MDC-11. | | | | |
| | POWER switch | Controls power to pilots module in audio center equipment. | T/C- CROUP 3 (MDC-22) | Flight and postlanding bus | | The audio center will not be activated unless the POWER switch is in PTT or VOX position. |
| | PTT | Applies d-c power to audio and control circuits. | | | | Intercom capability when cobra cable PTT/CW switch is in CW and transmit when switch is in PTT. |
| | OFF | Removes power from pilots audio center equipment module and controls. | | | | |
| | VOX | a. Applies d-c power to audio and control circuits b. Enables VOX control of mike amplifier by supplying ground to VOX circuitry. | | | | VOX operation permits voice transmission and transmitter keying of intercom, HF recovery transceiver and voice recorder when cobra cable PTT/CW switch is at PTT. |
| | S-BAND switch | | N/A | Audio center equipment | | The S-BAND, HF, VHF-AM, and INTERCOM switches all control ground return paths for appropriate diode switching and isolation circuitry in the pilots module of the audio center equipment to allow transmission and reception, or reception alone, of voice signals over selected equipment. The HF and VHF-AM switches also provide ground return paths for the HF and VHF-AM transmitter keying circuits when in the T/R position. |
| | T/R | No effect. S-band T/R function supplied by cobra cable PTT key. | | | | |
| | OFF | Prevents pilot from transmitting or receiving voice over USBE. | | | | |
| | RCV | Enables pilot to receive voice from USBE. | | | | |

MAIN DISPLAY CONSOLE-PANEL 23

CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|------------------------|--|-----------------|------------------------|---------------------------------|--|
| MDC-23 (Cont) | RCDR HF switch T/R | a. Enables pilot to transmit and receive voice over HF transmitter when operating in AM or SSB mode. b. Enables voice recorder through VOX circuit. Prevents pilot from transmitting or receiving voice over HF transmitter. | N/A | Audio center equipment | None | Provides power ground through audio center VOX circuit for HF transmitter transmit-receive relay and voice recorder power relay. |
| | OFF | | | | | |
| | RCV | Enables pilot to receive voice from HF transmitter when operating in AM or SSB mode. | | | | VHF-AM transmits, in addition to S-band voice, when cobra cable PTT key is closed. Cobra cable PTT/CW switches must be at PTT, and audio center POWER switch must be at PTT. |
| | VHF AM switch T/R | Enables pilot to transmit and receive voice over VHF/AM transmitter-receiver when operating in T/R mode. | | | | |
| | OFF | Prevents pilot from transmitting or receiving voice over VHF-AM transmitter-receiver. | | | | |
| | RCV | Enables pilot to receive voice from VHF-AM transmitter-receiver. | | | | Audio center POWER switch must be at VOX to enable make amplifier when cobra cable PTT/CW switches at PTT. |
| | INTERCOM switch T/R | Enables pilot to transmit and receive voice over the intercom system. | | | | |
| | OFF | Prevents pilot from transmitting or receiving voice over intercom system. | | | | |
| | RCV | Enables pilot to receive voice from intercom system. | | | | |

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|--|---|---|---|--|--|
| MDC-23 (Cont) | VOX SENS control | Increase or decreases sensitivity of voice-operated relay circuitry in pilots audio center module. | N/A | Audio center equipment | None | These three controls are thumbwheel-type potentiometers which may be rotated upward or downward, as required. |
| | INTERCOM BALANCE control | Increases or decreases level of audio signal received by pilot from RF equipment relative to that received from intercom bus. | | | | Position 9 most sensitive |
| | VOLUME control | Increases or decreases level of audio signal from pilot's ear-phone amplifier to earphone. | | | | |
| MDC-24 | EDS POWER switch ON OFF | Supplies entry battery A, B, and C power to the EDS buses 1, 2, and 3. Removes power from EDS buses 1, 2, and 3. | EDS-1, 2, 3 BAT A BAT C and BAT B (MDC-25) | Battery buses A, B, and entry battery C | None | Closing of the EDS POWER switch provides power to the EDS display circuitry and also supplies power for the EDS auto abort initiating circuitry. |
| | MASTER EVENT SEQ CONT - PYRO ARM switches Switches 1 and 2 PYRO ARM | Energizes relays in the MESC which perform the following: a. Connects pyro battery A to the MESC pyro bus A b. Connects pyro battery B to the MESC pyro bus B c. Connects pyro battery A to the C/M RCSC pyro bus A d. Connects pyro battery B to the C/M RCSC pyro bus B. Removes pyro battery power from the MESC pyro buses A and B, and RCS controllers. | MASTER EVENT SEQ CONT - A ARM B BAT A and BAT B (MDC-22) | Battery buses A and B | CD0005V DC voltage pyro bus A CD0006V DC voltage pyro bus B | Lever lock-type switches are locked in the SAFE position and must be unlocked before they can be set to PYRO ARM position. The lock and guard assembly must be unlocked with a key prior to hatch closeout. The range safety officer will have possession of the key. |
| | SAFE | | | | | |
| | SCS GROUP 2 controls TVC 2 POWER switch AC 1 | Applies a-c power to the gimbal positioning portion of the following: a. Yaw ECA b. Pitch ECA c. Redundant gimbal trim pot. | SCS - GROUP 2 AC 1 (MDC-25) | A-C bus No. 1 | | TVC 2 POWER switch supplies power to the redundant TVC electronics. Switch must be set to AC 1 or AC 2 position during any ΔV maneuver. It will provide the backup TVC capability required for automatic maneuver from TVC 1 in the event of a malfunction. MTVC can only be accomplished using TVC 2 electronics. The TVC 2 power switch also provides power to the MTVC electronics. |

MAIN DISPLAY CONSOLE - PANELS 23 AND 24

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | | | |
|------------------|----------------------------------|---|--|---|---------------------------------|--|---|---|--|
| MDC-24 (Cont) | OFF | Removes a-c power from units supplied by AC 1 and AC 2 positions. | SCS— GROUP 2 AC 1 (MDC-25) | A-C bus No. 1 | None | Switch is a three-position toggle and must be in either the 1 or 2 position for normal rotation control operation. | | | |
| | AC 2 | Applies a-c power to the following: a. Yaw ECA b. Pitch ECA c. Redundant gimbal trim pot. | SCS— GROUP 2 AC 2 (MDC-25) | A-C bus No. 2 | | | | | |
| | ROTATION CONTROL POWER switch | | | | | | | | |
| | AC 1 | Applies a-c power to the following: a. Command pilot's rotation control b. Senior pilot's rotation control c. Pitch ECA d. Yaw ECA e. Roll ECA | SCS— GROUP 2 AC 1 (MDC-25) | A-C bus No. 1 ØA | | | This switch has no effect on the rotation control direct mode function. | | |
| | OFF | Removes a-c power from units supplied by positions 1 and 2. | | | | | | Power for the two rotation controls is provided through the yaw, pitch, and roll ECAs. The power applied to yaw, pitch, and roll ECAs is demodulator reference voltage for rotation control output signals. | |
| | AC 2 | Applies a-c power to the following: a. Command pilot's rotation control b. Senior pilot's rotation control c. Pitch ECA d. Yaw ECA e. Roll ECA | SCS— GROUP 2 AC 2 (MDC-25) | A-C bus No. 2 ØA | | | | | |
| | BMAG POWER switch | | | | | | | | |
| | | AC 1 | Applies a-c and d-c power to the following: a. DISPLAY/AGAA ECA b. Pitch ECA c. Yaw ECA d. Roll ECA e. Attitude gyros spin motor power through DISPLAY/AGAA ECA | SCS— GROUP 2 AC 1 MN A (MDC-25) | | | A-C bus No. 1 D-C main bus A | | The power applied to DISPLAY/AGAA ECS is used to operate the BMAGs, torquing amplifiers, and preamplifiers in the AGAA. The power applied to pitch, yaw, and roll ECAs is demodulator reference voltage for BMAG error signal. |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---|---|---|---------------------------------------|---------------------------------|--|
| MDC-24 (Cont) | CFF | Removes a-c and d-c power from units supplied by position AC 1 and AC 2. | SCS— GROUP 2 AC 1 MN A (MDC-25) | A-C bus No. 1 D-C main bus A | None | Provides power for backup rate function. |
| | AC 2 | Applies a-c and d-c power to the following: a. DISPLAY/AGAA ECS b. Pitch ECA c. Yaw ECA d. Roll ECA e. Attitude gyros spin motor power through DISPLAY/AGAA ECA. | SCS— GROUP 2 AC 2 MN B (MDC-25) | A-C bus No. 2 D-C main bus B | | Switches are three-position rotary type. Refer to section 6, Normal/Backup Procedures, for the various switch positions required for the flight control modes. D-C voltage is provided to AS/GPI and the FDAI ALIGN switch. Three-phase a-c voltage is provided for the following: a. Aux ECA demodulator reference voltages and AGCU power supplies b. FDAI total attitude display motor, and associated electronics. Phase A a-c voltage is provided for the following: a. FDAI error needles b. FDAI ball drive servo amplifier c. FDAI rate needles for backup rate d. FDAI self-test circuit e. AS/GPI gimbal position excitation voltage f. Square wave generator reference voltage g. AGCU amplifier demodulator reference voltage. |
| | SCS GROUP 1 controls PARTIAL SCS POWER switch AC 1 | Applies a-c and d-c power to the following: a. DISPLAY/AGAA ECA b. Pitch ECA c. Roll ECA d. Auxiliary ECA e. Yaw ECA f. Velocity change indicator g. Attitude set/gimbal position indicator. Removes a-c and d-c power from units supplied by AC 1 and AC 2 positions. Applies a-c and d-c power to the following: a. DISPLAY/AGAA ECA b. Pitch ECA c. Roll ECA d. Auxiliary ECA e. Yaw ECA f. Velocity change indicator g. Attitude set/gimbal position indicator. | SCS— GROUP 1 AC 1 MN A (MDC-25) | A-C bus No. 1 D-C main bus A | | |
| | OFF | | | | | |
| | AC 2 | | SCS— GROUP 1 AC 2 MN B (MDC-25) | A-C bus No. 2 D-C main bus B | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|--------------------------------|--|---|---|---------------------------------------|---|
| MDC-24 (Cont) | RATE GYRO POWER switch AC 1 | Applies a-c power to the following: a. Rate gyro assembly. b. Yaw ECA c. Pitch ECA d. Roll ECA e. Display/AGAA ECA. Removes a-c power from units supplied by AC 1 and AC 2 positions. Applies a-c power to the following: a. Rate gyro assembly b. Yaw ECA c. Pitch ECA d. Roll ECA e. Display/AGAA ECA. | SCS— GROUP 1 AC 1 (MDC-25) | A-C bus No. 1 | None | The RATE GYRO POWER switch applies three-phase, 115-vac power to the rate gyro assembly. Phase A, 115-vac power is provided for the following: a. Roll, pitch, yaw ECA rate demodulator reference voltage. b. Roll, pitch, and yaw rate demodulators reference in display/AGAA ECA. |
| | OFF | | | | | |
| | AC 2 | | | SCS— GROUP 1 AC 2 (MDC-25) | A-C bus No. 2 | |
| | TVC 1 POWER switch AC 1 | a. Applies a-c power to the pitch and yaw ECAs. b. Applies d-c power to the DISPLAY/AGAA ECA c. X-axis accelerometer. Removes a-c and d-c power from units supplied by AC 1 and AC 2 positions. | SCS— GROUP 1 AC 1 MN A (MDC-25) | A-C bus No. 1 D-C main bus A | | The TVC 1 POWER switch applies 115 vac and 28 vdc to the pitch and yaw TVC power supplies in the TVC electronics. Provide necessary power for operating the ΔV REMAINING electronics. After completion of a burn, the switch must be placed to OFF then on to reactivate the ΔV inhibit circuit. |
| | OFF | | | | | |
| | AC 2 | | | SCS— GROUP 1 AC 2 MN B (MDC-25) | A-C bus No. 2 D-C main bus B | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|--|---|---|----------------------------|---------------------------------|---|
| MDC-24 (Cont) | DIRECT O ₂ metering valve | Permits controlled flow of oxygen directly into suit circuit. | N/A | N/A | None | Valve has a shaft rotation of 1-3/4 turns from OPEN to close, and is manually controlled by a T-handle tool. This tool is stowed in DIRECT O ₂ valve socket for use in positioning other valves accessible to crewman in LH couch. A second T-handle tool is stowed in LHEB-314 for operating valves in that area. |
| | OPEN (ccw) | | | | | |
| MDC-25 | Close (cw) | Shuts off flow of oxygen directly into suit circuit. | N/A | +28 vdc | None | Valve is opened in event of contamination or inability of demand pressure regulator to maintain minimum pressure. It may also be opened for cooling during descent, if necessary. In full open position flow rate is 0.66 pound/minute for approximately 5 minutes. Normal position of valve is closed. |
| | POSTLANDING controls | Applies d-c power from the flight and postlanding bus to the POST-LANDING-FLOAT BAG switch No. 1 (MDC-25). | | | | |
| | VENT FAN group PL BUS-FLOAT BAG 2 circuit breaker (5 amp) | Applies d-c power from flight and postlanding bus to the following: a. FLOAT BAG switch 2 b. VENT FAN-HIGH/LOW/OFF switch (MDC-25). | | | | |
| | HIGH/LOW/OFF switch HIGH | Applies d-c power to the following: a. Inlet and outlet vent valve motors, placing valves in open position. b. Vent fan motor for high flow output. | POST-LANDING-VENT FAN-PL BUS-FLOAT BAG 2 (MDC-25) | Flight and postlanding bus | | Prior to switch actuation, lockpins installed in both vent valves must be pulled. Output of cabin vent fan in HIGH is 150 cfm. Cabin vent valve full travel requires 1.5 seconds (max). |

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | |
|------------------|-----------------------------|---|--|-----------------------------|---------------------------------|---|--|
| MDC-25 (Cont) | LOW | Applies d-c power to the following: a. Inlet and outlet vent valve motors, placing valve in open position. b. Vent fan motor for low flow output. | POST-LANDING— VENT FAN— PL BUS— FLOAT BAG 2 (MDC-25) | Flight and poststanding bus | None | Output of cabin vent fan in LOW is 100 cfm. Cabin vent valve full travel requires 1.5 seconds (max). Both vent valves will be immediately closed by activation of the PLV attitude switch when the C/M becomes inverted or rolls beyond a specified limit. Switch must be set to OFF position before reactivating the PLV. | |
| | OFF | Removes d-c power from motor of cabin vent fan, and applies power to motors of inlet and outlet cabin vent valves, placing valves in closed position. | POST-LANDING— FLOAT BAG 1 PL BUS (MDC-25) | | | Lever lock-type switch. Flotation bag No. 1 is located on the +Y axis in the forward compartment of the C/M. Solenoid valve in "seal" mode. The switch must remain in the VENT position during launch and throughout flight. | |
| | FLOAT BAG group Switch 1 | Starts two compressors which inflate flotation bag No. 1 | POST-LANDING— FAN-PL BUS— FLOAT BAG 2 (MDC-25) | | | Lever lock-type switch. Flotation bag No. 2 is located on the +Z axis in the forward compartment of the C/M. Solenoid valve in "seal" mode. The switch must remain in the VENT position during launch and throughout flight. | |
| | Center | Neutral (off) position. | | | | | |
| | VENT | Disconnects 28 vdc from the two compressors and opens vent line to flotation bag No. 1 | | | | | |
| | Switch 2 | Starts two compressors which inflate flotation bag No. 2. | POST-LANDING— FAN-PL BUS— FLOAT BAG 2 (MDC-25) | | | Lever lock-type switch. Flotation bag No. 2 is located on the +Z axis in the forward compartment of the C/M. Solenoid valve in "seal" mode. The switch must remain in the VENT position during launch and throughout flight. | |
| | Center | Neutral (off) position. | | | | | |
| | VENT | Disconnects 28 vdc from the two compressors and opens vent line to flotation bag No. 2. | | | | | |
| | Switch 3 | Starts two compressors which inflate flotation bag No. 3. | ELS-A BAT A— FLOAT BAG 3 (MDC-25) | | | Battery bus A | Lever lock-type switch Flotation bag No. 3 is located on the +Z axis in the forward compartment of the C/M. Solenoid valve in "seal" mode. The switch must remain in the VENT position during launch and throughout flight. |
| | Center | Neutral (off) position. | | | | | |
| | VENT | Disconnects 28 vdc from the two compressors and opens vent line to flotation bag No. 3. | | | | | |

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---|---|--|---|--|--|
| MDC-25 (Cont) | ANTENNA DEPLOY switches | Connects 28 vdc to the postlanding antenna deploy circuitry. Normal position, no function. | PYRO A GROUP— SEQ A and PYRO B group - SEQ B (LEB-150) | Pyro bus A and pyro bus B in the MESC when the MASTER EVENT SEQ CONT— PYRO switches A and B are in the ARM position | None | Two-position toggle switch that is set to A after landing when C/M is in upright position. |
| | DEPLOY | | | | | |
| | A | Connects 28 vdc to the postlanding antenna deploy circuitry. Backup switch for DEPLOY switch A. Normal position, no function. | MASTER EVENT SEQ CONT - A ARM B BAT A (MDC-22) | Battery buses A and B | CD0200V D-C voltage logic bus A CD0201V D-C voltage logic bus B | Two-position toggle switch that is set to B after landing when C/M is in upright position. |
| | OFF | | | | | |
| | B | Normal position, no function. | N/A | +28 vdc | None | Lever lock-type switches. |
| | OFF | | | | | |
| | MESC—LOGIC ARM switches Switches 1 and 2 | Energizes relays in both MESC which perform the following: a. Connects battery bus A to the MESC A logic bus A. b. Connects battery bus B to the MESC B logic bus B. Removes 28 vdc from MESC logic buses A and B. | | | | |
| | LOGIC ARM | | | | | |
| | OFF | | | | | |
| | EVENT TIMER circuit breakers | Applies d-c power from d-c main bus A to event timer switches (MDC-8). Applies d-c power from d-c main bus B to event timer switches (MDC-8). | | | | |
| | MN A (5 amp) | | | | | |
| | MN B (5 amp) | | | | | |
| | COUCH ATTEN - FLOOD-LIGHTS circuit breakers | Applies d-c power from d-c main bus A to the following controls: a. FLOODLIGHTS- PRIMARY rheostat (MDC-26). | | | | |
| | MN A (15 amp) | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---|---|-----------------|--------------|---------------------------------|---------|
| MDC-25 (Cont) | MN B (15 amp) | b. LIGHTING-FLOODS-PRIMARY rheostat (LEB-100) c. FLOODLIGHTS-SECONDARY switch (MDC-23) d. COUCH UNLOCK switch (MDC-8) e. LIGHTING-FLOODS-CLOCKS switch (LEB-100) | N/A | +28 vdc | None | |
| | MN B (15 amp) | Applies d-c power from d-c main bus B to the following controls: a. FLOODLIGHTS-PRIMARY rheostat (MDC-23) b. LIGHTING-FLOODS-SEC switch (LEB-100) c. FLOODLIGHTS-SECONDARY switch (MDC-26) d. COUCH UNLOCK switch (MDC-8). | | | | |
| | STABILIZATION & CONTROL SYSTEM circuit breakers (top row) DIRECT CONT group MN A (30 amp) | Applies power from d-c main bus A to the following: a. DIRECT RCS switch on MDC-8 b. DIRECT ULLAGE switch on MDC-7 c. NORMAL/OFF/DIRECT ON switch on MDC-7 d. Arms command pilot's rotation control for direct commands through direct RCS switch | | | | |
| | MN B (30 amp) | Applies power from d-c main bus B to the following: a. DIRECT RCS switch on MDC-8 b. DIRECT ULLAGE switch on MDC-7 | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | | | | |
|----------------------------|---|--|-----------------|--------------|---------------------------------|---------|---------------------------------------|---------------|----------------|----------------|
| | | | | | | | Maneuver function - engine activation | | | |
| MDC-25 (Cont) | A & C ROLL group MN A (20 amp) | c. NORMAL/OFF/DIRECT ON switch on MDC-7 d. Arms sensor pilot's rotation control for direct commands, through direct RCS switch. | N/A | +28 vdc | None | | | | | |
| | | | | | | | Maneuver function - engine activation | | | |
| | MN B (20 amp) | Applies power from d-c main bus A to A & C ROLL channel switch on MDC-8. | | | | | | SCS CB | Function | S/M RCS Engine |
| | B & D ROLL group MN A (20 amp) | Applies power from d-c main bus B to A & C ROLL channel switch on MDC-8. | | | | | | A&C ROLL MN A | roll right | A13 |
| | | | | | | | | A&C ROLL MN B | roll right | C15 |
| | MN B (20 amp) | Applies power from d-c main bus A to B & D ROLL channel switch on MDC-8. | | | | | | A&C ROLL MN A | roll left | A16 |
| | | | | | | | | A&C ROLL MN B | roll left | C14 |
| | MN A (20 amp) | Applies power from d-c main bus A to B & D ROLL channel switch on MDC-8. | | | | | | B&D ROLL MN A | roll right | B9 |
| | | | | | | | | B&D ROLL MN B | roll right | D11 |
| | MN B (20 amp) | Applies power from d-c main bus B to B & D ROLL channel switch on MDC-8. | | | | | | B&D ROLL MN A | roll left | B12 |
| | | | | | | | | B&D ROLL MN B | roll left | D10 |
| | PITCH group MN A (20 amp) | Applies power from d-c main bus B to B & D ROLL channel switch on MDC-8. | | | | | | PITCH MN B | pitch up | A3 |
| | | | | | | | | PITCH MN A | pitch up | C1 |
| | MN B (20 amp) | Applies power from d-c main bus A to PITCH channel switch on MDC-8. | | | | | | PITCH MN A | pitch down | A2 |
| | | | | | | | | PITCH MN B | pitch down | C4 |
| | MN A (20 amp) | Applies power from d-c main bus A to PITCH channel switch on MDC-8. | | | | | | YAW MN A | yaw right | B7 |
| YAW MN B | | | | | | | | yaw right | D5 | |
| MN B (20 amp) | Applies power from d-c main bus B to PITCH channel switch on MDC-8. | | | | | | YAW MN B | yaw left | B6 | |
| | | | | | | | YAW MN A | yaw left | D8 | |
| YAW group MN A (20 amp) | Applies power from d-c main bus A to YAW channel switch on MDC-8. | | | | | | SCS CB | Function | C/M RCS Engine | |
| | | | | | | | Maneuver function - engine activation | | | |
| MN B (20 amp) | Applies power from d-c main bus B to YAW channel switch on MDC-8. | | | | | | B&D ROLL MN A | roll right | A9 | |
| | | | | | | | B&D ROLL MN B | roll right | B11 | |
| MN A (20 amp) | Applies power from d-c main bus A to YAW channel switch on MDC-8. | | | | | | B&D ROLL MN A | roll left | A12 | |
| | | | | | | | B&D ROLL MN B | roll left | B10 | |
| MN B (20 amp) | Applies power from d-c main bus B to YAW channel switch on MDC-8. | | | | | | PITCH MN A | pitch up | A1 | |
| | | | | | | | PITCH MN B | pitch up | B3 | |
| MN A (20 amp) | Applies power from d-c main bus A to YAW channel switch on MDC-8. | | | | | | PITCH MN A | pitch down | A2 | |
| | | | | | | | PITCH MN B | pitch down | B4 | |
| MN B (20 amp) | Applies power from d-c main bus B to YAW channel switch on MDC-8. | | | | | | YAW MN A | yaw right | A5 | |
| | | | | | | | YAW MN B | yaw right | B7 | |
| | | | | | | | YAW MN A | yaw left | A8 | |
| | | | | | | | YAW MN B | yaw left | B6 | |

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|------------------|--|--|----------------------------|------------------------|---------------------------------|---------|
| MDC-25 (Cont) | STABILIZATION & CONTROL SYSTEM controls (bottom row) | | | | | |
| | FDAL LTG switch | Controls application of a-c power to the FDAL brightness control on MDC-2 for FDAL lighting and for illumination of the lamp in the THRUST ON switch on MDC-7. | SCS - GROUP 2 AC 1 or AC 2 | A-C bus 1 or a-c bus 2 | | |
| | AC 1 | Applies a-c bus 1 phase B power to FDAL brightness control. | | | | |
| | OFF | Removes all a-c power from FDAL brightness control. | | | | |
| | AC 2 | Applies a-c bus 2 phase B power to FDAL brightness control. | | | | |
| | GROUP 1 circuit breakers | | N/A | | | |
| | AC 1 (2 amp) | Applies power from a-c bus No. 1 to the following switches on MDC-24: a. SCS POWER b. RATE GYRO POWER c. TVC 1 POWER. | | | 115 vac 400 cps 3 phase | |
| | AC 2 (2 amp) | Applies power from a-c bus No. 2 to the following switches on MDC-24: a. SCS POWER b. RATE GYRO POWER c. TVC 1 POWER. | | | | |
| | GROUP 2 circuit breakers | | | | | |
| | AC 1 (2 amp) | Applies power from a-c bus No. 1 to the following switches on MDC-24: a. BMAG POWER b. ROTATION CONTROL POWER c. TVC 2 POWER | | | | |

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identify | Remarks |
|------------------|---|--|-----------------|-------------------------------|---------------------------------|---------|
| MDC-25 (Cont) | AC 4 (2 amp) | Applies power from a-c bus No. 2 to the following switches on MDC-24: a. BMAG POWER b. ROTATION CONTROL POWER c. TVC 2 POWER. | N/A | 115 vac 400 cps 3 phase | None | |
| | GROUP 1 circuit breakers MN A (15 amp) | Applies power from d-c main bus A to the following: a. SCS POWER switch on MDC-24 b. TVC 1 POWER switch on MDC-24 c. SCS switches on MDC-8 d. Translation control prior to CM-SM separation. | | +28 vdc | | |
| | MN B (15 amp) | Applies power from d-c main bus B to the following: a. SCS POWER switch on MDC-24 b. TVC 1 POWER switch on MDC-24 c. SCS switches on MDC-8 d. Translation control prior to CM-SM separation. | | | | |
| | GROUP 2 circuit breakers MNA (15 amp) | Applies power from d-c main bus A to the following: a. BMAG POWER switch on MDC-24 b. Command pilot's rotation control c. Command pilot's translation control. | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | |
|------------------|--|--|--|----------------|---------------------------------|---------|--------------------------|
| MDC-25 (Cont) | MN B (15 amp) | Applies power from d-c main bus B to the following: a. TVC 2 POWER switch on MDC-24 b. Senior pilot's rotation control c. Senior pilot's translation control. | N/A | +28 vdc | None | | |
| | BIO MED COMM circuit breakers | Used on unmanned mission only. | | | | | |
| | MN A (5 amp) | Applies power from d-c main bus B to TLM INPUTS—BIO MED switch (MDC-20). | | D-C main bus B | | | |
| | SERVICE PROPULSION SYSTEM circuit breakers | GAUGING group | Applies power from d-c main bus A to the following propellant utilization and gauging subsystem control unit circuits: a. Self-test b. Primary power supply only when SPS engine ignition driver relay is energized. | | | | +28 vdc |
| | | MN A (5 amp) | Applies power from d-c main bus B to propellant utilization and gauging subsystem control unit auxiliary power supply only when SPS engine ignition driver relay is energized. | | | | |
| | MN B (5 amp) | Applies power from a-c bus No. 1 to AC 1 contacts of SPS GAUGING switch on MDC-25. | | | | | 115 vac 400 cps 9C |
| | AC 1 (2 amp) | Applies power from a-c bus No. 2 to AC 2 contacts of SPS GAUGING switch on MDC-25. | | | | | |
| | AC 2 (2 amp) | | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|--|--|-----------------|--------------|---------------------------------|---------|
| MDC-25 (Cont) | He VALVE group MN A (7.5 amp) | Applies power from d-c main bus A to the following: | N/A | +28 vdc | None | |
| | | a. Left-hand SPS HELIUM switch (MDC-20) | | | | |
| | | b. INJECT PRE-VALVES A switch (MDC-3) | | | | |
| | | c. FCSM-G&N switch (MDC-2) | | | | |
| | MN B (7.5 amp) | d. FCSM-SCS switch (MDC-2) | N/A | +28 vdc | None | |
| | | Applies power from d-c main bus B to the following: | | | | |
| | GIMBAL MOTOR CONTROL group 1 - PITCH - 2 | a. Right-hand SPS HELIUM switch (MDC-20) | N/A | +28 vdc | None | |
| | | b. INJECT PRE-VALVES B switch (MDC-3) | | | | |
| | | c. FCSM-G&N switch (MDC-2) | | | | |
| | | d. FCSM-SCS switch (MDC-2). | | | | |
| BAT A (15 amp) | | Applies power from battery bus A to SPS GIMBAL MOTORS PITCH 1 switch on MDC-3. | | | | |
| BAT B (15 amp) | | Applies power from battery bus B to SPS GIMBAL MOTORS PITCH 2 switch on MDC-3. | | | | |
| 1 - YAW - 2 | BAT A (15 amp) | Applies power from battery bus A to SPS GIMBAL MOTORS YAW 1 switch on MDC-3. | | | | |
| BAT B (15 amp) | Applies power from battery bus B to SPS GIMBAL MOTORS YAW 2 switch on MDC-3. | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|-----------------------------|--|---|--|---------------------------------|--|
| MDC-25 (Cont) | G&N SYNC switch | Provides manual maneuver capability in G&N attitude control mode. Permits detent switch in rotational control to place CDUs in a follow mode. Does not affect G&N attitude control mode. | SCS GROUP 2 MN A | D-C main bus A | None | When the G&N SYNC switch is returned to OFF and the rotation control is returned to detent, the G&N system will maintain S/C attitude within the selected deadband limits. This switch will not be used per procedural constraint. |
| | On (up) OFF | | | | | |
| | SPS GAUGING switch | Applies a-c power to the following: a. Quantity gauging system control unit self-test circuitry. b. Normally open contacts of SPS engine ignition driver relay. Removes all a-c power. Applies a-c power to the following: a. Quantity gauging system control unit self-test circuitry. b. Normally open contacts of SPS engine ignition driver relay. | SPS— GAUGING AC 1 AC 2 (MDC-25) | A-C bus No. 1 A-C bus No. 2 | | Three-position toggle switch which controls application of a-c power to propellant quantity utilization and gauging system control unit. Power for control unit self-test circuitry is applied directly by switch. Power for propellant quantity measuring circuitry is applied only when engine ignition driver relay is energized by engine firing signal. |
| | OFF AC 2 | | | | | |
| | AC 1 | | | | | |
| | AC SNR SIG circuit breakers | Applies power from a-c bus No. 1 to a-c over-undervoltage and overload sensing unit to AC INDICATORS switch (MDC-18). Applies power from a-c bus No. 2 to a-c over-undervoltage and overload sensing unit and to AC INDICATORS switch (MDC-18). | N/A | 115 vac 400 cps 3 phase | | |
| | AC 1 (2 amp) | | | | | |
| | AC 2 (2 amp) | | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|---------------|--|---|-----------------|--------------|---------------------------------|---------|
| MDC-25 (Cont) | REACTION CONTROL SYSTEM circuit breakers PROP ISOL group MN A (10 amp) | <p>Applies power from d-c main bus A to the following:</p> <ol style="list-style-type: none"> a. SM RCS quads B and D HELIUM 1, HELIUM 2, and PROPELLANT switches. b. CM RCS system A PROPELLANT switch. c. Microswitch in each isolation valve controlled by switches listed in steps a and b. Microswitch controls event indicator operation. d. RCS control box relay contacts which cause automatic closure of system A fuel and oxidizer isolation valves in the event of an abort initiation prior to T + 61 seconds. | N/A | | None | |
| | MN B (10 amp) | <p>Applies power from d-c main bus B to the following:</p> <ol style="list-style-type: none"> a. SM RCS quads A and C HELIUM 1, HELIUM 2, and PROPELLANT switches. b. CM RCS system B PROPELLANT switch. c. Microswitch in each isolation valve controlled by switches listed in steps a and b. Microswitch controls event indicator operation. | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|---|---|-----------------|--------------|---------------------------------|---------|
| MDC-25 (Cont) | C/M - S/M TRANSFER group MN A (15 amp) | d. RCS control box relay contacts which cause automatic closure of system B fuel and oxidizer isolation valves in the event of an abort initiated prior to T + 61 seconds. | N/A | ±28 vdc | None | |
| | MN B (15 amp) | Applies power from d-c main bus A to the following: a. RCS TRANSFER switch (MDC-16) b. C/M PROPELLANT JETT group LOGIC switch (MDC-8) c. C/M RCS HTRS switch RHFEB-200 d. C/M RCS He DUMP switch (MDC-26) | | | | |
| | CAUT/WARN circuit breakers MN A (10 amp) | Applies power from d-c main bus A to caution and warning system. | | | | |
| | MN B (10 amp) | Applies power from d-c main bus B to caution and warning system. | | | | |
| | EDS-1, 2, 3 circuit breakers BAT A (5 amp) | Applies d-c power from battery bus A to the EDS POWER switch (MDC-24). | | | | |

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| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|--|--|--|------------------------|---------------------------------|--|
| MDC-25 (Cont) | BAT C (5 amp) | Applies d-c power from entry battery C to the EDS POWER switch (MDC-24). | N/A | +28 vdc | None | |
| | BAT B (5 amp) | Applies d-c power from battery bus B to the EDS POWER switch (MDC-24). | | | | |
| | ELS-A, B circuit breakers | Applies d-c power from battery bus A to the following: a. ELS LOGIC switch (MDC-8) b. APEX COVER JETT switch (MDC-5) c. MAINDEPLOY switch (MDC-5) d. MAINDEPLOY switch (MDC-5) e. POST LANDING-FLOAT BAG - switch 3 (MDC-25). | | | | |
| | BAT A - FLOAT BAG 3 (10 amp) | Applies d-c power from battery bus B to the following: a. ELS LOGIC switch (MDC-8) b. APEX COVER JETT switch (MDC-5) c. DRCCUE DEPLOY switch (MDC-5) d. MAIN DEPLOY switch (MDC-5) | | | | |
| MDC-26 | FLOODLIGHTS controls PRIMARY rheostat Off Bright SECONDARY switch ON OFF | Removes power from C/M primary floodlights. Indicates maximum floodlight brightness has been reached. Illuminates secondary floodlights. Removes power from secondary floodlights. | COUCH ATTEN MN A MN B FLOOD- LIGHTS (MDC-25) | D-C main buses A and B | None | FLOODLIGHTS controls on MDC-23, -26, and LEB-100 are functionally identical and each controls the floodlights in its respective area. The rheostat control may be adjusted for desired brightness of primary floodlights. |

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| | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | |
|------------------|---|---|------------------------|-----------------------------|---------------------------------|---|---|
| MDC-26 (Cont) | POST 1.DG BEACON switch | Applies power to the beacon lights. | N/A | Beacon light battery | None | The audio center will not be activated unless the POWER switch is in PTT or VOX position. Intercom capability when cobra cable PTT/CW switch is in C/W and transmit when switch is at PTT. | |
| | LIGHT | Removes power from the beacon lights. | | | | | |
| | POWER switch | Controls power to command pilot's module in audio center equipment | T/C - GROUP 4 (MDC-22) | Flight and post-landing bus | | | |
| | PTT | Applies d-c power to audio and control circuits. | | | | | |
| | OFF | Removes power from command pilot's audio center equipment module and controls. | | | | | |
| | VOX | a. Applies d-c power to a.i.o and control circuits. b. Enables VOX control of mike amplifier by supplying ground to VOX circuitry. | | | | | |
| | S-BAND switch | No effect. S-band T/R function supplied by cobra cable PTT key. | N/A | Audio center equipment | | | VOX operation permits voice transmission and transmitter keying of intercom; HF recovery transceivers and voice recorder when cobra cable PTT/CW switch is at PTT. |
| | T/R | Prevents command pilot from transmitting or receiving voice over USBE. | | | | | The S-BAND, HF, VHF-AM, and INTERCOM switches all control ground return paths for appropriate diode switching and isolation circuitry in the command pilot's module of the audio center equipment, to allow transmission and reception, or reception alone, of voice signals over selected equipment. The HF and VHF-AM switches also provide ground return paths for the HF and VHF-AM transmitter keying circuits when in the T/R position. |
| | OFF | Enables command pilot to receive voice from USBE. | | | | | Provides power ground through audio center VOX circuit for HF transmitter transmit-receive relay and voice recorder power relay. |
| | RCV | Prevents command pilot from transmitting or receiving voice over H-F transceiver. | | | | | |
| RCDR/HF switch | a. Enables command pilot to transmit and receive voice over H-F transceiver when operating in AM or SSB mode. b. Enables voice recorder through VOX circuit. | | | | | | |
| T/R | Prevents command pilot from transmitting or receiving voice over H-F transceiver. | | | | | | |
| OFF | | | | | | | |

MAIN DISPLAY CONSOLE - PANEL 26

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------|--------------------------|--|-----------------|------------------------|---|---|
| MDC-26 (Cont) | RCV | Enables command pilot to receive voice from H-F transceiver when operating in AM or SSB mode. | N/A | Audio center equipment | None | VHF-AM transmits, in addition to S-band voice, when cobra cable PTT key is closed. Cobra cable PTT/CW switch must be at PTT and audio center POWER switch must be at PTT. |
| | VHF AM switch | Enables command pilot to transmit and receive voice over VHF-AM transmitter-receiver when operating in T/R mode. | | | | |
| | T/R | Prevents command pilot from transmitting or receiving voice over VHF-AM transmitter-receiver. | | | | |
| | OFF | Enables command pilot to receive voice from VHF-AM transmitter-receiver. | | | | |
| | RCV | Enables command pilot to transmit and receive voice over the intercom system. | | | | |
| | T/R | Prevents command pilot from transmitting or receiving voice over intercom system. | | | | |
| | OFF | Enables command pilot to receive voice from intercom system. | | | | |
| | RCV | Increases or decreases sensitivity of voice-operated relay circuitry in-command pilot audio center module. | | | | |
| | VOX SENS control | Increases or decreases level of audio signal received by command pilot from R-F equipment relative to that received from intercom bus. | | | | |
| | INTERCOM BALANCE control | Increases or decreases level of audio signal from command pilot earphone amplifier to earphone. | | | | |
| VOLUME control | | | | | These three control are thumb-wheel-type potentiometers which may be rotated upward or downward, as required. Position 9 most sensitive. | |

MAIN DISPLAY CONSOLE - PANEL 26

APOLLO OPERATIONS HANDBOOK

CONTROLS AND DISPLAYS

| Item No. | Control Name | Function | Control Breaker | Electrical System | Location | Remarks |
|----------|--|--|--|-------------------|----------|--|
| 113-100 | Emergency (up) | Emergency relays required to activate C/2, C/3 helium purge operation. | PCSM C/2-3 M/A M/B M/DG-25 | DC main bus | None | Emergency relays are controlled toggle switches which provide on-up capability for shuttling back in power operation in the event of C/2 or C/3 helium purge switch failure (C/2-C/3). The switch receives power directly from the circuit breakers. |
| 113-101 | Lighting controls of C/2 group FFMAP, Boost OFF OFF DIM | Removes power from C/2 primary floodlights. Indicates maximum floodlight brightness has been reached. | C/2 M/A M/B M/DG-25 | DC main bus | None | C/2 floodlights controls on M/DG-25, -26, and 113-109 are functionally identical and each controls the floodlights in its respective area. It is also that control may be adjusted for desired brightness of primary floodlight. |
| | of C/3 group FFMAP, Boost OFF OFF DIM | Illuminates secondary floodlights. Removes power from secondary floodlights. Brightly illuminates the integral lighting for the mechanical clocks on 113-306. Disconnects power from the lighting circuit to the clocks. Dimly illuminates the integral lighting for the mechanical clocks on 113-306. | | | | |

MAIN DISPLAY CONSOLE - PANEL 2
LOWER INSTRUMENT RAY - PANEL 100

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CONTROLS AND DISPLAYS

| Part No. | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|----------|------------------------------|--|-------------------------------------|------------------------|---------------------------------|--|
| 1FB-101 | IMU-CDU DIFFERENCE indicator | Displays the difference between the IMU gimbal angles and the CDU shaft angles in degrees. | GEN-IMU MN A MN B (MDC-22) | D-C main buses A and B | None | A three-dial panel meter. The signals applied to the meter are the demodulated outputs of the CDU single speed receivers. Depending upon the IMU mode, the differences shown can represent the following: a. Misalignment of the IMU b. Error in the orientation of the spacecraft c. Error in the CDU display of actual gimbal angles. |
| | TRANSFER switch | Controls selection of ISS operating modes. | | | | SFST toggle switch |
| | MANUAL | Enables manual selection of ISS operating modes through the use of MODE switches. | | | | |
| | COMPUTER | Enables AGC selection of ISS operating modes by setting mode relays directly. | | | | |
| | MANUAL ALIGN switch | Causes the IMU gimbals to align CDU angles. | | | | SFST momentary contact pushbutton. Used in conjunction with CDU MAN mode pushbutton to coarse align the IMU gimbals. |
| | MODE switches | Allow selection and display of ISS operating modes. | | | | SFST illuminates pushbutton switches. Computer controlled when TRANSFER switch is in COMPUTER position. Manually controlled when TRANSFER switch is in MANUAL position. |

LOWER EQUIPMENT COMPARTMENT 101

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-------------------|-------------------|--|--|------------------------|---------------------------------|--|
| LEB-101 (Cont) | ZERO ENC | Selects zero encoder mode of ISS operation. This mode sets the shafts and encoders of the CDUs and CDU registers in the computer to zero. | G&N—IMU MN A MN B (MDC-22) | D-C main buses A and B | None | CDUs must be zeroed whenever the G&N system is turned on. |
| | COARS ALIGN | Selects coarse align mode of IMU operation. This mode positions the stable member of the IMU. Selects coarse align mode of ISS operation. This mode positions the stable member to within 1.5° of desired inertial reference attitude. | | | | In this mode, the CDUs are driven to angles commanded by the AGC. These angles define an inertial reference. |
| | FINE ALIGN | Selects fine align mode of ISS operation. This mode completes stable member alignment to desired inertial reference attitude. | | | | Upon completion of the fine align mode, the stable member is fine aligned to an inertial reference and the CDU readouts indicate gimbal angles relative to that reference. |
| | CDU MAN | Selects manual CDU mode of ISS operation. This mode provides for backup-manual alignment of the stable member. Stable member drives to CDU angles when MANUAL ALIGN switch is depressed. | | | | Actuation of CDU MAN switch energizes a relay which removes the excitation to the CDU motors to lock the CDUs in position. |
| | ATT CONT | Selects attitude control mode of IMU operation. Selects attitude control mode of ISS operation. This mode provides attitude and velocity change sensing with respect to the space stabilized stable member. | | | | The attitude error signals generated in this mode represent the difference between IMU gimbal angles and CDU angles. |
| | ENTRY | Selects entry mode of T/J operation. This mode is similar to attitude control mode; however, the gain of the roll control loop is increased by a factor of 16 to increase roll rate and decrease response time. | | | | This mode is used during spacecraft entry into the earth atmosphere. |
| | LEB-102 | CDU angle display readouts 2X TRUNNION, SHAFT ANGLE, OUTER GIMBAL (ROLL), INNER GIMBAL (PITCH), MIDDLE GIMBAL (YAW) | Provide visual representation of ICPU and OCPU angles. | | | None |

LOWER EQUIPMENT BAY—PANELS 101 AND 102

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CONTROLS AND DISPLAYS

| Low Alt. L. | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | | |
|-------------|----------------------|---|-------------------------------------|------------------------|---------------------------------|------------------------|-------------------------------------|---|
| LEB-103 | G&N condition lights | Warning lights denote detected malfunction. | G&N-IMU MN A MN B (MDC-22) | D-C main buses A and B | | Yellow caution lights. | | |
| | | PGNS | | | | | CG5005X (Error detect) | |
| | | ACC PWR FAIL | | | | | CC5030X (Computer power fail light) | |
| | | IMU FAIL | | | | | CG5001X (IMU fail) | |
| | | CDU FAIL | | | | | CG5002X (CDU fail) | |
| | | ACCEL FAIL | | | | | CG5000X (PIPA fail) | |
| | | GIMBAL LOCK | | | | | CG5003X (Gimbal lock warning) | |
| | | IMU TEMP | | | | | CG5006X (IMU temp light) | |
| | | ZERO ENCODER | | | | | CG5007X (Zero encoder light) | |
| | | IMU DELAY | | | | | CG5008X (IMU delay light) | |
| | | | | | | | | White light. |
| | | | | | | | | White light. Illuminates only at initial IMU turn-on or immediately after switching from standby operation. |

LOWER EQUIPMENT BAY - PANEL 103

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CONTROLS AND DISPLAYS

| Item No. | Symbol | Name | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|----------------|---------|------------------------|--|---|------------------------|-------------------------------------|---|
| 31B-114 (cont) | | MASTER ALARM light | Red light illuminates to alert crewmembers at lower equipment bay of malfunction or out-of-tolerance condition. This is indicated by illumination of applicable system status lights on MDC-10 or -11. | CAUT/ WARN MN A MN B (MDC-25) | D-C main buses A and B | CS0150X (Master caution-warning on) | Upon illumination of MASTER ALARM light, the MASTER ALARM switch-lights on MDC-3 and -18 are simultaneously illuminated and an audio tone is sent to each headset. The MASTER ALARM light does not contain an integral switch. Light may be extinguished only by pressing the MASTER ALARM switch-light on MDC-3 or -18. |
| 31B-114 | SEXTANT | | Optical instrument for measuring the angle between two objects. | None | None | None | The SXT is a dual line-of-sight instrument used to determine the following: a. The angle between a landmark and a star. b. The angle between a star line of sight and the navigation base. c. Tracking an unknown landmark. This information is used by the AGC for the following: a. Determine spacecraft position. b. Calculate required ΔV corrections. c. To fine align the IMU. The SXT has a 1.8° field of view with a magnification of 28. The scanning telescope has a 60° field of view and a 1X magnification (long relief eyepiece = 0.2X). |
| | | Scanning telescope | Optical instrument used for the following: a. Tracking a landmark in earth orbit. b. Identifying and centering a star within the sextant field of view. | | | | |
| | | TRUNNION control | Enables manual positioning of the trunnion angles. | | | | These controls are manually operated by means of a universal tool. They are used in the event of optics electronic failure. |
| | | SHAFT control | Enables manual positioning of the shaft angles. | | | | |
| | | TRUNNION ANGLE display | Provides a mechanical readout of the SCT trunnion angle that is commanded manually or by the computer. | | | | Drum-type readouts in degrees, mechanically connected to the scanning telescope (SCT) trunnion and shaft drives, respectively. (SXT angles are identical.) |
| | | SHAFT ANGLE display | Provides a mechanical readout of the SCT shaft angle that is commanded manually or by the computer. | | | | |

LOWER EQUIPMENT BAY - PANELS 403 AND 404

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|----------|--------------------------------------|--|--|------------------------|---------------------------------|--|
| LEB-105 | Optics hand controller | Provides electrical commands to the optics shaft and trunnion drive motors. | G&N-OPTICS MN A MN B (MDC-22) | D-C main buses A and B | None | SP4T, five-position switch, spring-loaded to center OFF position. direction of target movement with respect to controller movement depends upon mode selected by CONTROLLER MODE switch. Rate of image movement is proportional to amount of hand controller movement. |
| | CHECK COOLANT switch | When pressed, applies power to floodlamps behind the display and control panel. Enables the crew to view the IMU quick-disconnect couplings through CHECK COOLANT windows. | | | | Pushbutton switch, momentary contact. |
| | CHECK COOLANT windows (two) | Permit observation of IMU coolant supply system quick-disconnect couplings for detecting leaks. | None | None | | |
| | AGC code numbers display (not shown) | Provides the crew with a quick reference for computer code numbers. | | | | Panel inscribed, nonreplaceable. |
| | MARK switch | Supplies an interrupt signal to the AGC which commands it to read the optical IMU angles, the time, and the IMU gimbal angles (if the IMU is operating). | G&N-OPTICS MN A MN B (MDC-22) | D-C main buses A and B | | Pushbutton, SPST, momentary-contact switch. If MARK is satisfactory, computer proceeds normally. If MARK is unsatisfactory, flight crew inhibits computer processing of data by making DSKY entry of V52E. |
| | PANEL BRIGHTNESS control | Provides adjustment of the illumination level of all integrally lighted G&N system controls and displays. In addition, the control provides power to the lamp in the THRUST ON switch. | | | | Thumbwheel potentiometer. |
| | CHECK MODE LAMPS switch | Applies power to all MODE indicators on the IMU control panel LEB-101. | | | | Pushbutton, SPST, momentary-contact switch. Used to check operation of the MODE lamps. |
| | CHECK CONDITION LAMPS switch | Applies power to all condition (caution and warning) lamps on panel LEB-103. | | | | Pushbutton, SPST, momentary-contact switch. Used to check the operation condition of the condition lamps. |

LOWER EQUIPMENT BAY - PANEL 105

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-------------------|--|--|--|------------------------|---------------------------------|---|
| LFR-105 (Cont) | CONDITION LAMPS switch ON | Applies d-c power to G&N condition lamps. | G&N- IMU MN A MN B (MDC-22) | D-C main buses A and B | None | SPST toggle switch. |
| | OFF | Removes d-c power from lamps. | | | | SP(T, seven-position switch, spring-loaded to center off. The control is used to apply one or any combination of pitch, roll, or yaw minimum thrust impulses to the S/C providing rate damping impulses of 2.4 arc-minutes/second/pulse or less. One pulse is produced each time the control is moved from the center position. |
| | ATTITUDE IMPULSE GROUP Attitude impulse control | A control stick used to apply small rotational thrust impulses to the spacecraft by means of the service module reaction jets. | SCS - GROUP 1 AC 1 AC 2 (MDC-25) | Essential bus | | Toggle-type, solenoid-held-to-on microswitch. The SCS must be in the G&N or SCS attitude control mode to enable solenoid holding. Attitude impulse is not enabled in the SCS local vertical mode. To enable the attitude impulse control circuit, the LIMIT CYCLE switch must also be ON. |
| | ENABLE switch ON | Enables the attitude impulse control. Supplies a signal to the G&N and SCS systems which disables the active S/C attitude control mode, allowing the S/C to drift freely, and enables the attitude impulse control. | | | | |
| | OFF | Disables the attitude impulse control. | | | | |
| | IMU TEMP MODE GROUP Mode switch | Enables the crew to select any one of the four modes of IMU temperature controls. | G&N IMU HTR MN A MN B (N-DC-22) | D-C main buses A and B | | Rotary, four-position, three-wafer switch. PROPORTIONAL mode is used if a malfunction occurs in the temperature indicating circuit, causing cycling to the EMERGENCY mode. |
| | PROPORTIONAL | Temperature control is furnished by same control circuit used in AUTO/OVERRIDE mode. | | | | BACKUP mode is used if a malfunction occurs in the normal control circuit. In this mode, the IMU TEMP light will illuminate when the heaters are off and will extinguish when the heaters are on. MSFN must monitor |
| | BACKUP | Temperature control is furnished by temperature sensing circuits. | | | | |

LOWER EQUIPMENT BAY - PANEL 105

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | |
|-------------------|---------------------------|---|--|--|---------------------------------|---|---|
| LEB-105 (Cont) | AUTO OVERRIDE | Normal mode of temperature control. If IMU temperature exceeds normal tolerances by ±4°F, system automatically switches to emergency mode and IMU TEMP light illuminates. | G&N IMU HTR MN A MN B (MDC-22) | D-c main buses A and B | None | the IMU temperature. Manual switching to emergency mode is necessary if the temperature becomes excessive. When a malfunction occurs, the temperature alarm relays turn off the control heaters. Emergency heaters continue to operate under the control of an emergency mercury thermostat. When the temperature returns to within 1°F of normal, the IMU TEMP light extinguishes and the system switches back to the normal control mode. A thermostat provides overheat protection for the IMU by opening the emergency heater circuit when the temperature exceeds 130°F. When this temperature drops below 128°F, the thermostat closes the circuit to reactivate the heaters. | |
| | EMERGENCY | IMU temperature is controlled to approximately 130°F by means of mercury thermostat and emergency heaters. | | | | Pushbutton, DPST, momentary-contact switch. | |
| | ZERO switch | Used to check calibration of IRIG and PIPA temperature monitoring devices. | | | | | |
| | GAIN switches | Used to check temperature alarm circuit. | | | | | |
| | IRIG | Simulates low temperature error (-5°F) to check IRIG temperature sensors and also tests alarm circuit | | | | | Pushbutton, momentary-contact switch. When it is pressed, the IMU TEMP indicator (LEB-103) should be illuminated. If not, a malfunction exists in the system. |
| | PIPA | Simulates high temperature error (+5°F) to check PIPA temperature sensors and also test alarm circuits. | | | | | |
| | MAP AND DATA VIEWER group | None | | None | | None | Function deleted as a result of map and data viewer deactivation. |
| | OPTICS group | | | G&N OPTICS MN A MN B (MDC-22) | | D-C main buses A and B | |
| | SLAVE TELESCOPE switch | | | | | | |
| | STAR LOS | Slaves SCT trunnion axis to SXT trunnion. | | | | | Single pole, three-position toggle switch |

LOWER EQUIPMENT BAY - PANEL 105

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | | | | | | | | | | | | | | | | | |
|-----------------------------------|--------------------------------------|--|---|------------------------|---------------------------------|---|--|--|--|---|--|--|--|----------------------|--|--|--|--|---|--|--|--|---|
| LFB-105 (Cont) | LANDMARK LOS 0° OFFSET 25° | Drives SCT trunnion to zero independently of CDU trunnion. | G&N OPTICS MN A MN B (MDC-22) | D-C main buses A and B | None | Zero position is parallel to SXT shaft axis. | | | | | | | | | | | | | | | | | |
| | | Drives telescope trunnion to 25° offset from shaft axis. | | | | | | | | | | | | | | | | | | | | | |
| | OPTICS HOLD Mode switch | Opens input to motors to prevent CDU creep | | | | | | | | This will bring the star and landmark within the 60° field-of-view of the SCT, while rotating about the shaft axis. | | | | | | | | | | | | | |
| | | Selects optics mode of operation. | | | | | | | | | | | | | | | | | | | | | |
| | ZERO OPTICS | Optics and CDU resolvers are driven to zero. AGC register is set to all zeros. | | | | | | | | | | | | SFST, toggle switch. | | | | | | | | | |
| | | MANUAL | | | | | | | | | | | | | Normal operating position enabling crew to position optics by means of optics hand controller. | | | | | | | | |
| | COMPUTER | Optics are automatically positioned by the AGC. Panel-mounted controls are disabled. | | | | | | | | | | | | | | | | Rotary, three-position switch. Completed in approximately 60 seconds. | | | | | |
| | | CONTROLLER SPEED switch | | | | | | | | | | | | | | | | | Provides attenuation of shaft and trunnion slew commands from optics hand controller. | | | | |
| | HI MED LOW | Direct Mode Maximum Drive Rates | | | | | | | | | | | | | | | | | Controls control stick output configuration. | | | | In this position, the crew may select either the DIRECT or RESOLVED controller mode of operation. |
| | | Trunnion | | | | | | | | | | | | | | | | | | | | | |
| 8.8°/sec | | 17.3°/sec | | | | | | | | | | | | | | | | | | | | | |
| 1.05°/sec | | 2.06°/sec | | | | | | | | | | | | | | | | | | | | | |
| 0.105°/sec | | 0.206°/sec | | | | | | | | | | | | | | | | | | | | | |
| Resolved Mode Maximum Drive Rates | | Shaft | | | | | | | | | | | | | | | | | | | | | |
| Trunnion | Shaft | | | | | | | | | | | | | | | | | | | | | | |
| 8.8°/sec | 8.8°/sec | | | | | | | | | | | | | | | | | | | | | | |
| 1.05°/sec | 1.05°/sec | | | | | | | | | | | | | | | | | | | | | | |
| 0.105°/sec | 0.105°/sec | | | | | | | | | | | | | | | | | | | | | | |
| CONTROLLER MODE switch | | | | | | Single-pole, three-position toggle switch. Attenuated output is applied to the MODE switch. | | | | | | | | | | | | | | | | | |
| | | | | | | SPDT, two-position, toggle switch. | | | | | | | | | | | | | | | | | |

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-------------------|----------------------------|--|---------------------------------|------------------------|---------------------------------|--|
| LEB-105 (Cont) | DIRECT | Applies control movements directly to CDUs. Right/left movement commands shaft rotation. Up/down movement commands trunnion angle increase/decrease. | G&N - OPTICS MN A MN B (MDC-22) | D-C main buses A and B | None | Target moves about arcs with speed of target movement varying with magnitude of angle. |
| | RESOLVED | Applies control stick movements to angular resolving circuits before applying commands to the CDUs. | | | | Target moves horizontally and vertically at a linear rate. |
| LEB-106 | Alarm condition indicators | Indicate abnormal conditions of computer operation. | G&N COMPUTER MN A MN B (MDC-22) | D-C main buses A and B | | Observe REGISTER displays for numerical flag denoting malfunction. |
| | PROG ALM | AGC program error detected. | | | CG5020X (AGC alarm 1) | |
| | COUNTER FAIL | Counter increment instruction not executed or not completed within 10 msec of initiation. | | | CG5026X (AGC alarm 7) | If malfunction is counter-increment not completed within 10 msec, the TC TRAP indicator will illuminate. |
| | RUPT LOCK | No interrupt within 80 msec or interrupt not completed within 10 msec. | | | CG5028X (AGC alarm 9) | |
| | TC TRAP | Transfer control not executed within 10 msec or not completed within 10 msec. | | | CG5029X (AGC alarm 10) | |
| | SCALEK FAIL | 100-pps signal from scaler A of computer timing section failed. | | | CG5024X (AGC alarm 5) | |
| | PARITY FAIL | Parity error exists in data word from memory. | | | CG5025X (AGC alarm 6) | |
| | TM FAIL | Telemetry data rate incorrect or transmission incorrect. | | | CG5022X (AGC alarm 3) | |
| LEB-106 | CHECK FAIL | Incorrect DSKY operation attempted. | | | CG5023X (AGC alarm 4) | |
| | KEY RLSE | Computer program cannot proceed until operator releases DSKY control. | | | CG5027X (AGC alarm 8) | Not a failure. Operator will press KEY RELEASE pushbutton. Computer will resume computation. |

LOWER EQUIPMENT BAY - PANELS 105 AND 106

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------------|--|---|---|------------------------|---|--|
| LEB-106 (Cont) | ACTIVITY lights | Indicates activity the computer is presently engaged in. | G&N COMPUTER MN A MN B (MDC-22) | D-C main buses A and B | CG5021X (AGC alarm 2) | On-board data provides definition of PROGRAM, NOUN, and VERB digits. |
| | UPTL | Computer is receiving information from telemetry up-data link. | | | | |
| | COMP | Computer is engaged in computation. | | | | |
| | PROGRAM indicator | A two-digit display, indicating the number of the program (major mode) presently in progress. | | | | |
| | VERB indicator | A two-digit display, indicating verb code selected. | | | | |
| | NOUN indicator | A two-digit display, indicating noun code selected. | | | | |
| | REGISTER 1 indicator | Displays contents of selected register or memory location. First component of extended data word, if applicable. | | | | |
| | REGISTER 2 indicator | Displays contents of selected register or memory location. Second component of extended data word, if applicable. | | | | |
| | REGISTER 3 indicator | Displays contents of selected register or memory location. Third component of extended data word, if applicable. | | | | |
| | BRIGHTNESS control | Varies brightness of electro-luminescent data displays: REGISTER 1, REGISTER 2, and REGISTER 3. | | | | |
| KEY RELEASE pushbutton | Enables program control of DSKY. Releases operator control of DSKY circuits. | | | | | |
| TEST ALARM pushbutton | Illuminates the alarm displays for bulb test. | | | | Displays may be commanded manually or by AGC. | |

LOWER EQUIPMENT BAY - PANEL 106

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-------------------|----------------------------|--|---|------------------------------|---------------------------------|--|
| LEB-106 (Cont) | ERROR RESET pushbutton | Resets alarm light relays. AGC recycles to start of current operation. | G&N COMPUTER MN A MN B (MDC-22) | D-C main buses A and B | None | Verifies alarms. Alarms triggered by transients should not repeat. Pushbutton-type switches (selectors). Each key generates a specific 5-bit keycode denoting the instruction or number being selected. |
| | Keyboard switches | Provide for entering data into or commanding operations of the AGC. | | | | |
| | CLEAR | Places all zeros (logic 0s) in register being loaded. | | | | |
| | VERB | Prepares computer to accept next two digits as verb code. | | | | |
| | NOUN | Prepares computer to accept next two digits as noun code. | | | | |
| | ENTER | Transfers contents of input register to central processor and initiates execution of instructions. | | | | |
| | + | Denotes data to follow has positive decimal value. | | | | |
| | - | Denotes data to follow has negative decimal value. | | | | |
| | 0 to 9 | Enters binary equivalent of key pressed. | | | | |
| LEB-107 | ACC MODE switch | Applies normal power to AGC. | G&N COMPUTER MN A MN B (MDC-22) | D-C main buses A and B | None | SPDT, toggle switch In STANDBY, AGC maintains timing signals and other circuits necessary to restart. STANDBY operation is used to conserve electrical power. |
| | ON STANDBY | Applies power timing section of AGC. | | | | |
| LEB-120 | Gas chromatograph controls | | GAS ANAL- AC 1 (MDC-22) | A-C bus No. 1 (ØA) | | The gas chromatograph (GFE) is serviced and installed by ground support personnel prior to flight crew ingress. The unit operates on 80-minute cycles, during which it identifies 28 gas components. |

LOWER EQUIPMENT BAY—PANELS 106, 107, AND 120.

APOLLO OPERATIONS HANDBOOK

CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-------------------|---|--|-------------------------------|---------------------------|--|---|
| LEB-120 (Cont) | CABIN AIR/AUTO/ SUIT AIR switch | Selects C/M cabin atmosphere for gas component sampling. | GAS ANAL- AC 1 (MDC-22) | A-C bus No. 1 (9A) | CTO 108K (Gas analysis suit and cabin) | Switch set to CABIN AIR position on command from MSFN. |
| | CABIN AIR | Permits suit circuit and C/M cabin atmospheres to be alternately sampled for gas components. | | | | Normal position of switch. |
| | AUTO | Selects suit circuit atmosphere for gas component sampling. | | | | Switch set to SUIT AIR position on command from MSFN. |
| LEB-150 | SUIT AIR | Applies a-c power to operational portion of gas chromatograph. | N/A | Pyro battery A +23 vdc | None | Oven requires 7 watts for preheat period and 5 watts during operation. |
| | START/OFF/ PREHEAT switch | Removes a-c power from warmup oven and operational portion of gas chromatograph. | | | | Normal position of switch after completion of preheat operation. |
| | START | Applies a-c power to oven for required preheating prior to unit being placed in operation. | | | | A minimum of 30 minutes warmup is required before switch is set to START position. |
| | OFF | Push-type switch for use during bench calibration only. | | | | Thermal, push-pull, manual reset type circuit breakers with the amperage rating of each denoted by a white placard. |
| | PREHEAT | Applies d-c power from pyro battery A to the MESC pyro bus when the MASTER EVENT SEQ CONT—switch A or B (MDC-24) is in the PYRO ARM position, and to the open contacts of the C/M RCSC pyro arm relay in the MESC. The relay is energized when the MASTER EVENT SEQ CONT—switch A or B (MDC-24) is in the PYRO ARM position to arm the pyro bus in the C/M RCSC. Applies pyro battery A voltage to DC INDICATORS switch. | | | | Normally closed in flight. Opened if pyro battery A fails. |
| AMP-L-CAL switch | Applies d-c power from entry battery A to above sequencer circuits, and entry battery A voltage to PYRO BAT A position of DC INDICATORS switch. | N/A | Entry battery A +28 vdc | None | Normally open in flight. Closed if pyro battery A fails. | |

LOWER EQUIPMENT BAY - PANEL 120 AND 150

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CONTROLS AND DISPLAYS

| Part No. | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-----------|---|---|---|-------------------------------------|--|--|
| RHFEB-200 | C/M RCS HTRS switch On (up) | Activates relays which apply +28 vdc to the direct coils of all C/M RCS engine solenoid valves. | RCS - HEATERS A MN B B MN A (MDC-21) | +28 vdc | None | Two-position toggle switch, used to pre-heat all C/M RCS engine valves in order to preclude propellant freezing when system is pressurized prior to entry. |
| | OFF | Deactivates relays which remove +28 vdc from the direct coils of all C/M RCS engine solenoid valves. | | | | Switch is enabled by CM PROP JETT-LOGIC switch (MDC-8) in the ON (up) position. |
| | DC VOLTS meter (auxiliary) | Indicates d-c voltage of selected measurement points. | N/A | Instrumentation signal conditioners | Refer to TEST SELECT switch (RHFEB-97) | Meter functions in conjunction with FUNCTION SELECT and TEST SELECT switches located directly below meter. Meter range is 0 to 5 vdc. |
| | FUNCTION SELECT switch A OFF B | Selects A or B wafer of TEST SELECT switch. Connects Aux DC VOLTS meter to wafer A of TEST SELECT switch. Disconnects Aux DC VOLTS meter from circuit. Connects Aux DC VOLTS meter to wafer B of TEST SELECT switch. | | | | FUNCTION SELECT switch in conjunction with the TEST SELECT switch makes possible 24 measurement points for the Aux DC VOLTS meter. |
| | TEST SELECT switch 1 (A) 1 (B) | Selects two groups of 12 measurements, depending on position of FUNCTION SELECT switch, A or B. Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates output pressure of fuel cell No. 1 nitrogen regulator. Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates temperature of C/M oxidizer valve, -P engine (No. 2) system A. | | | SC2060P (N ₂ pressure F/C 1 regulated) CR2205T (Temp ox. valve -P engine system A) | TEST SELECT switch has two independent wafers, each containing 12 contacts. N ₂ pressure range is 0 to 75 psia. Temperature range is -50° to +250° F. |

RH FORWARD EQUIPMENT BAY - PANEL 200

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|--------------------------|-------------------|--|-----------------|-------------------------------------|--|--|
| RHF EB. 200 (Cont) | 2 (A) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates output pressure of fuel cell No. 2 nitrogen regulator. | N/A | Instrumentation signal conditioners | SC2061P (N ₂ pressure F/C 2 regulated) | N ₂ pressure range is 0 to 75 psia. |
| | 2 (B) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates temperature of C/M oxidizer valve, +Y engine (No. 7) system B. | | | CR2203T (Temp ox. valve +Y engine system B.) | Temperature range is -50° to +250°F. |
| | 3 (A) | Applies a d-c measurement to Aux DC VOLTS meter which indicates output pressure of fuel cell No. 3 nitrogen regulator. | | | SC2062P (N ₂ pressure F/C 3 regulated) | N ₂ pressure range is 0 to 75 psia. |
| | 3 (B) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates temperature of C/M oxidizer valve, -P engine (No. 4) system B. | | | CR2204T (Temp ox. valve -P engine system B.) | Temperature range is -50° to +250°F. |
| | 4 (A) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates output pressure of fuel cell No. 1 oxygen regulator. | | | SC2066P (O ₂ pressure F/C 1 regulated) | O ₂ pressure range is 0 to 75 psia. |
| | 4 (B) | Applies a d-c measurement voltage to DC VOLTS meter which indicates temperature of C/M oxidizer valve cw engine (No. 11) system B. | | | CR2206T (Temp ox. valve cw engine system B.) | Temperature range is -50° to +250°F. |
| | 5 (A) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates output pressure of fuel cell No. 2 oxygen regulator. | | | SC2067P (O ₂ pressure F/C 2 regulated) | O ₂ pressure range is 0 to 75 psia. |
| | 5 (B) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates PIPA temperature. | | | CG2300T (PIPA temperature) | Temperature range TBD. |
| | 6 (A) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates output pressure of fuel cell No. 3 oxidizer regulator. | | | SC2068P (O ₂ pressure F/C 3 regulated) | O ₂ pressure range is 0 to 75 psia. |

RH FORWARD EQUIPMENT BAY - PANEL 200

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CONTROLS AND DISPLAYS

| Location | View and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|--------------------------|-------------------|--|-----------------|--|--|--|
| RHF EB. 200 (Cont) | 6 (B) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates IRIG temperature. | N/A | Instruments - tion signal conditioners | CG2301T (IRIG temperature) | Temperature range TBD. |
| | 7 (A) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates output pressure of fuel cell No. 1 hydrogen regulator. | | | SC2069P (H ₂ pressure F/C 1 regulated) | H ₂ pressure range is 0 to 75 psia. |
| | 7 (B) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates IMU heater current. | | | CG2302C (IMU heater current) | IMU heater current range is from 0 to 5 amperes. |
| | 8 (A) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates output pressure of fuel cell No. 2 hydrogen regulator. | | | SC2070P (H ₂ pressure F/C 2 regulated) | H ₂ pressure range is 0 to 75 psia. |
| | 8 (B) | Applies a d-c measurement to Aux DC VOLTS meter which indicates IMU blower current. | | | CG2303C (IMU blower current) | IMU blower current range is from 0 to 5 amperes. |
| | 9 (A) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates output pressure of fuel cell No. 3 hydrogen regulator. | | | SC2071P (H ₂ pressure F/C 3 regulated) | H ₂ pressure range is 0 to 75 psia. |
| | 9 (B) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates pressure of battery compartment manifold. | | | CC0188P (Press. bat. compartment manifold) | Battery compartment manifold pressure range is 0 to 18 psia. |
| | 10 (A) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates temperature of F/C No. 1 radiator outlet. | | | SC2087T (Temp F/C 1 radiator outlet) | F/C 1 radiator outlet temperature range is -50° to +300°F. |
| | 10 (B) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates temperature of ECS radiator inlet. | | | SF0665T (ECS radiator inlet temp) | ECS radiator inlet temperature sensor range is +60° to +150°F. Minimum inlet temperature is 75°F. |
| | 11 (A) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates temperature of F/C No. 2 radiator outlet. | | | SC2088T (Temp F/C 2 radiator outlet) | F/C 2 radiator outlet temperature range is -50° to +300°F. |

RH FORWARD EQUIPMENT BAY - PANEL 200

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-----------------|---|--|----------------------------------|-------------------------------------|--|---|
| RHEB-200 (Cont) | 11 (B) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates temperature of C/M oxidizer valve, ccw engine (No. 12) system A. | N/A | Instrumentation signal conditioner) | CR2201T (Temp ox. valve ccw engine system A) | Temperature range is -50 to +250°F. |
| | 12 (A) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates temperature of F/C No. 3 radiator outlet. | | | SC2209T (Temp F/C 3 radiator outlet) | F/C 3 radiator outlet temperature range is -50° to +300°F. |
| | 12 (B) | Applies a d-c measurement voltage to Aux DC VOLTS meter which indicates temperature of C/M oxidizer valve, -Y engine (No. 8) system A. | | | CR2202T (Temp ox. valve -Y engine system A) | Temperature range is -50° to +250°F. |
| RHEB-207 | SCIENTIFIC EQUIPMENT receptacle switch ON OFF | Applies d-c power from nonessential bus No. 2 to SCIENTIFIC EQUIPMENT receptacle for M09A experiment 15 mm sequence camera. Removes d-c power from SCIENTIFIC EQUIPMENT receptacle. | SCIENTIFIC EQUIP. HATCH (MDC-22) | +28 vdc | None | |
| RHEB-201 | WASTE MANAGEMENT panel OVBD DRAIN valve DUMP OFF SELECTOR valve | Connects WMS overboard dump line from selector valve to outside atmosphere, permitting dumping urine and fecal odors overboard. Closes WMS overboard dump line to outside atmosphere. | N/A | N/A | None | This shutoff valve is manually controlled by bar knob. The valve is operated in conjunction with the SELECTOR valve. Valve is set to DUMP position after setting SELECTOR valve to URINE FECEES position. Upon completion of dumping or venting operation, OVBD DRAIN valve is set to OFF position before SELECTOR valve is set to OFF position. This valve is manually controlled by bar knob. |

RHE FORWARD EQUIPMENT BAY-PANELS 200 AND 207
 RHE EQUIPMENT BAY-PANEL 201

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|--------------------|--|---|--|---------------|---------------------------------|---|
| RHEP-201 (Cont) | URINE FECEES | a. Connects waste management dump line to overboard dump line. b. Closes switch that applies a-c power to WMS blower. | ECS-CABIN AIR FAN-1-AC 1 0A 0B 0C (MDC-22) | A-C bus No. 1 | None | Blower operation in this valve position is not functional due to WMS modifications. Valve is placed to URINE FECEES position for dumping urine collected in the Urine Sample Volume Measurement System (USVMS), or for venting odors originating during fecal canister usage. This valve position is selected in conjunction with the OVBD DRAIN valve. Valve is set to URINE FECEES position before setting OVBD DRAIN valve to DUMP position. Upon completion of dumping or venting operation, SELECTOR valve is set to OFF position after OVBD DRAIN valve is set to OFF position. |
| | VACUUM | a. Connects vacuum cleaner line to WMS blower. b. Closes switch that applies a-c power to WMS blower. | None | None | | With valve to VACUUM position, WMS blower is activated and blower exhaust is directed into C/M cabin. |
| | OFF | a. Closes all valve ports, deactivating waste management system. b. Removes a-c power from WMS blower. | None | None | | |
| RHEP-202 | WASTE MANAGEMENT ACCESS panel BATTERY VENT valve VENT CLOSE | Permits gases generated by C/M batteries to be vented into the urine/water dump line. Shuts off the venting of C/M batteries into the urine/water dump line. | N/A | N/A | None | This valve is manually controlled by a bar knob. Normal position of valve is VENT to dump overboard gases generated by C/M batteries. Valve is closed in event of battery vent system leakage, which would permit C/M atmosphere leakage to space. |
| RHEP-203 | MAIN A circuit breakers BAT BUS A (80 amp) | Applies d-c power from battery bus A to d-c main bus A through contacts of main bus tie bat A motor switch. | N/A | -28 vdc | None | |

RHE EQUIPMENT BAY-PANELS 201, 202, AND 203

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | |
|-------------------------|--|---|-----------------|--------------|---------------------------------|--|--|
| RHEB-203 (Cont) | BAT C (20 amp) | Applies d-c power from battery C to d-c main bus A through contacts of main bus tie bat B motor switch. | N/A | +28 vdc | None | These circuit breakers remain dis-engaged during flight and are engaged (pushed in) prior to CSM separation. | |
| | MAIN B circuit breakers | | | | | | |
| | BAT C (80 amp) | Applies d-c power from battery C to d-c main bus B through contacts of main bus tie bat A motor switch. | | | | | |
| | BAT BUS B (80 amp) | Applies d-c power from battery bus B to d-c main bus B through contacts of main bus tie bat B motor switch. | | | | | |
| | POST LDG circuit breakers | | | | | | |
| | BAT BUS A (25 amp) | Applies d-c power from battery bus A to flight and postlanding bus. | | | | | |
| | BAT BUS B (25 amp) | Applies d-c power from battery bus B to flight and postlanding bus. | | | | | |
| | BAT C (25 amp) | Applies d-c power from 100-amp BAT C PWR circuit breaker to flight and postlanding bus. | | | | | |
| | MAIN A (10 amp) | Applies power from d-c main bus A to flight and postlanding bus. | | | | | |
| | MAIN B (10 amp) | Applies power from d-c main bus B to flight and postlanding bus. | | | | | |
| | INVERTER PWR circuit breakers | | | | | | |
| | No. 1 MIN A (75 amp) | Applies power from d-c main bus A to inverter No. 1. | | | | | |
| No. 2 MIN B (75 amp) | Applies power from d-c main bus B to inverter No. 2. | | | | | | |

RH EQUIPMENT BAY - PANEL 203

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-----------------|--|--|--|--|---------------------------------|--|
| RHEB-203 (Cont) | NO. 3 group MN A (70 amp) MN B (70 amp) | Applies power from d-c main bus A to inverter No. 3. Applies power from d-c main bus B to inverter No. 3. | N/A | +28-vdc | None | |
| RHEB-204 | INST PWR CONT circuit breaker ESSENTIAL group 1 (7.5 amp) 2 (7.5 amp) 3 (7.5 amps) 4 (5 amp) NON ESSENTIAL group 5 (5 amp) 6 (5 amp) 7 (5 amp) 8 (10 amp) 9 (10 amp) 10 (10 amp) | Applies +28-vdc power to RCS and structural operational instrumentation. Applies +28-vdc power to ELS, EPS, and ECS surge tank operational instrumentation. Applies +28-vdc power to operational instrumentation in S/M. (Spare) (Spare) (Spare) (Spare) Applies 28-vdc power to flight qualification instrumentation. Applies 28-vdc power to flight qualification instrumentation and to ECS radiator outlet temperature sensors. (Spare) | INSTRUMENTS-ESS MN A and/or MN B (MDC-22) INSTRUMENTS-NONESS (MDC-22) INSTRUMENTS-NONESS (MDC-22) | D-C main bus A or d-c main bus B Non-essential bus No. 1 Non-essential bus No. 1 | None None | |
| RHEB-205 | UPRIGHTING SYSTEM circuit breakers COMPR NO. 1 (25 amp) COMPR NO. 2 (25 amp) | Applies d-c power from battery bus A to the control motor switch of compressor No. 1. Applies d-c power from battery bus B to the control motor switch of compressor No. 2. | N/A | +28-vdc | None | The compressors are turned on and off by manual actuators of the POST LANDING-FLOAT BAG switches on MDC-25. These circuit breakers remain disengaged during flight and are engaged only after landing |

RH EQUIPMENT BAY-PANELS 203, 204, AND 205

APOLLO OPERATIONS HANDBOOK

CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|----------------------|---|---|-----------------|-------------------------------|---------------------------------|--|
| RHEB-200 | U.S. STEAM DUCT HEATERS MN A (5 amp) | Applies power from d-c main bus A to the following: a. Steam duct heater b. Urine/water dump nozzle heater. | N/A | 28 vdc | None | There are no switches to control the operation of the heaters. When the circuit breakers are activated, power is applied directly to corresponding 3-watt heating elements of the steam duct heaters, and to the 5, 7-watt urine/water dump nozzle heater. |
| RHEB-200 | MN B (5 amp) | Applies power from d-c main bus B to the following: a. Steam duct heater b. Urine/water dump nozzle heater. | None | A-C phase inverter 1, 2, or 3 | None | Normally, both the steam duct and urine/water dump nozzle heaters are in operation for the total length of the mission. |
| RHEB-200 | INV PHASE LOCK | Central timing signal to inverters supplied through inverter phase synchronizer to provide in-phase a-c power to a-c bus 1 and 2 when a separate inverter is powering each a-c bus. | None | N/A | None | Normal position during flight (PSU draws power with control switch in either position). |
| RHEB-300, -301, -302 | OFF Suit flow control valve | Provides central timing signal directly to inverters. Closes valve, shutting off flow of oxygen to suit connector. | N/A | N/A | None | Position if phase synchronizer unit fails. There are three suit connector assemblies in the cabin. Although they vary slightly in appearance, their function is identical, thus suit flow control valve data is covered once. The three suit connector assemblies are located at LHFFEB-100, -301, and -302, and are controlled by sliding levers. Suit hose may be connected or disconnected only with the valve in the OFF position. The number of suit flow control valves placed to either the CABIN FLOW or the SUIT FULL FLOW positions should always equal the number of crewmen in the C/M. |

RH EQUIPMENT BAY - PANELS 200, 208
LH FORWARD EQUIPMENT BAY - PANELS 300, 301, AND 302

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------------------|----------------------------------|---|-----------------|--------------|---------------------------------|--|
| LHFEF-300, -301, -302 (Cont) | CABIN FLOW SUIT FULL FLOW | Partially opens valve, permitting oxygen flow into cabin (or suit) at a rate compatible to the requirements of one crewman. Fully opens valve, permitting oxygen flow to suit at a rate compatible to the requirements of one crewman. | N/A | N/A | None | This valve position may be used for reduced flow to the PGA (suit connected), or for normal flow to the cabin for shirtsleeve mode (suit not connected). Suit hose is not disconnected from suit connector panel when going to shirtsleeve mode. With the valve in SUIT FULL FLOW position (suit connected), the flow is at the rate of 17 lb/hr minimum. However, the flow rate will vary along the suit flow adjustment range from SUIT FULL FLOW to CABIN FLOW positions. |

LH FORWARD EQUIPMENT BAY - PANELS 300, 301, AND 302

APOLLO OPERATIONS HANDBOOK

CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-----------------------|----------------------------------|---|-----------------|--------------|---------------------------------|---|
| LHFEB-300, -301, -302 | CONTROL LEVER RELEASE | Permits free movement of valve control lever by releasing lever locking mechanism. | N/A | N/A | None | When release pushbutton is pressed, locking detent is removed from notch. The release pushbutton must be pressed to permit movement of the control lever in and out of the OFF position. This prevents inadvertent valve movement out of the closed position when suit hose is disconnected, and into the closed position when the suit hose is connected. |
| LHFEB-303 | CABIN TEMP valve H (heat) | Manual backup mode position of cabin temperature control valve to increase cabin temperature. | N/A | N/A | None | Motor-operated valve is manually controlled by integral knob. Rotational movement from H to C is approximately 1/2 turn. Backup mode control knob is used in event of malfunction of cabin temperature control components. This is a dual valve on a single shaft permitting water-glycol flow to heat exchanger to be regulated. Rotation toward the H (heat) position results in proportional increase in cabin temperature by directing warm water-glycol to cabin heat exchanger. There is a definite time lag in cabin temperature response following a manual adjustment; therefore, close coordination between manual adjustments and the TEMP-CABIN indicator (MDC-13) is not necessary. |
| | C (cool) | Manual backup mode position of cabin temperature control valve to decrease cabin temperature. | | | | Rotation towards the C (cool) position results in proportional decrease in cabin temperature by directing cool water-glycol to cabin heat exchanger. There is a definite time lag in cabin temperature response following a manual adjustment; therefore, close coordination between manual adjustments and the TEMP-CABIN indicator (MDC-13) is not necessary. |
| | Cabin air control louver | Manually operated louvers for adjusting direction of airflow from cabin air fans. | | | | |

LH FORWARD EQUIPMENT BAY—PANELS 300, 301, 302, AND 303

APOLLO OPERATIONS HANDBOOK

CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-----------|---|---|----------------------------------|--------------|---------------------------------|--|
| LHFEB-304 | DRINKING WATER SUPPLY shutoff valve ON OFF | Permits flow of potable water to water delivery unit. Turns off flow of potable water to water delivery unit. | N/A | N/A | None | Shutoff valve manually controlled by T-handle tool. Normal position of valve is on. Valve is closed in event of leak in water delivery unit. |
| LHFEB-305 | FOOD PREPARATION WATER supply unit COLD valve HOT valve | Upon actuation, permits metered amount of cold water (50° F) to food reconstitution nozzle. Upon activation, permits metered amount of hot water (154±4° F) to food reconstitution nozzle. | N/A | N/A | None | Cold or hot water is metered at a rate of 1.00±0.05 ounce per valve actuation. Upon release, valves return to closed position. |
| LHFEB-306 | GMT clock TO EVENT and FROM EVENT timers | Mission elapsed time indicator. Provides crew with a means of monitoring and timing events. | N/A | N/A | None | This clock has a 24-hour dial face with standard second, minutes, and hour hands. A time-set screw, at the bottom left of the dial face, is used to synchronize the clock with Greenwich mean time. Each timer has a 10-hour dial face with second, minute, hour and 10-hour hands. A knob at the bottom left of each timer is used to set the timer hands. Each timer can be reset, started, or stopped by a push-control at the top right of the timer. |
| LHFEB-318 | SCIENTIFIC EQUIPMENT receptacle switch ON OFF | Applies d-c power from nonessential bus No. 2 to SCIENTIFIC EQUIPMENT receptacle for COAS and 16 mm sequence camera. Removes d-c power from SCIENTIFIC EQUIPMENT receptacle. | SCIENTIFIC EQUIP. HATCH (MDC-22) | +28 vdc | None | |

LH FORWARD EQUIPMENT BAY - PANELS 304, 305, 306, AND 318

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|----------|------------------------------|--|-----------------|--------------|---------------------------------|--|
| L1FB-307 | CABIN PRESSURE RELIEF valves | | N/A | N/A | None | <p>There are two cabin pressure-relief valves that normally operate automatically to provide positive and negative cabin pressure relief. The upper manual control (three valve positions) and the lower manual control (four valve positions) can override their corresponding relief valves to the CLOSE and NORMAL positions, while only the lower manual control can override its corresponding relief valve to the DUMP position. Horizontal pressure must be applied to move controls out of detent.</p> <p>Both relief valves are closed for prelaunch checkout and during C/M RCS propellant dump, while either one or both relief valves are closed in flight in event of valve malfunction.</p> <p>Normal position of controls for flight period between ascent and entry. Valves are limited to the partially open position to prevent rapid cabin decompression in event valves fail open.</p> |
| | CLOSE | Manual override position to close either cabin pressure-relief valve. | | | | |
| | NORMAL | Manual override position to partially restrict travel of either cabin pressure-relief valve in the automatic mode. | | | | |

LH EQUIPMENT BAY - PANEL 307

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and identity | Remarks |
|---------------------------|---|---|-----------------|--------------|--|---|
| L.H.F.B. 107 (Cont) | BOOST ENTRY | Neutral position of override mechanism to permit both cabin pressure-relief valves full travel in the automatic mode. | N/A | N/A | None | Except for time required to dump RCS propellants during descent, both controls are normally set to the BOOST ENTRY position for the ascent and entry phases. |
| | DUMP | Manual override position of lower control to open corresponding cabin pressure-relief valve. | | | | Valve is opened to intentionally vent cabin to outside atmosphere in event of contamination or fire. Mechanical safety latch must be off to set lever in dump position. |
| | GLYCOL TO RAD valve | | | | | Shutoff valve is manually controlled by T-handle tool. |
| | OPEN | Permits flow of water-glycol from C/M to space radiators in S/M. | | | | Normal position of valve is OPEN. |
| | CLOSE | Shuts off flow of water-glycol from C/M to space radiators in S/M. | | | | Valve is closed prior to CSM separation to shut off water-glycol flow to S/M. |
| | GLYCOL RESERVOIR controls | | | | | Shutoff valve is manually controlled by T-handle tool. |
| | INLET valve | | | | | Valve is opened to direct water-glycol flow through reservoir during pre-launch and ascent phases and is operated in conjunction with GLYCOL RESERVOIR OUTLET and GLYCOL RESERVOIR BYPASS valves. |
| | OPEN | Permits flow of water-glycol from system into reservoir. | | | | Valve is closed upon completion of ascent phase to isolate reservoir from system. |
| | CLOSE | Shuts off flow of water-glycol from system into reservoir. | | | | Shutoff valve is manually controlled by T-handle tool. |
| | BYPASS valve | | | | | Valve is opened upon completion of ascent phase to bypass and isolate reservoir from system, and is operated in conjunction with GLYCOL RESERVOIR OUTLET and GLYCOL RESERVOIR INLET valves. |
| OPEN | Opens bypass line permitting flow around water-glycol reservoir. | | | | Valve is closed to direct water-glycol flow through reservoir during pre-launch and ascent phases. | |
| CLOSE | Closes bypass line that permits flow around water-glycol reservoir. | | | | | |

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|--------------------|-------------------|--|--|--------------|--|--|
| LHEB-107 (Cont) | OUTLET valve | Permits flow of water-glycol from outlet of reservoir into system. | N/A | N/A | None | Shutoff valve is manually controlled by T-handle tool. Valve is opened to direct water-glycol flow through reservoir during prelaunch and ascent phases, and is operated in conjunction with GLYCOL RESERVOIR INLET and GLYCOL RESERVOIR BYPASS valves. |
| | OPEN | | | | | |
| | | CLOSE | Shuts off flow of water-glycol from outlet of reservoir into system. | | | Valve is closed upon completion of ascent phase to isolate reservoir from system. |
| | | OXYGEN controls | | | | |
| | | ENTRY valve | | | | Shutoff valve is manually controlled by T-handle tool. |
| | | ON | Permits flow from 1-lb entry oxygen tank into C/M oxygen supply subsystem. | | | Valve furnishes 1 lb of oxygen as a redundant supply to the normal surge tank quantity of 3.7 lb. |
| | | OFF | Shuts off flow between 1-lb entry tank and C/M oxygen supply subsystem. | | | Tank filled to approximately 900 psig at a rate of 0.66 pounds/minute. |
| | | FILL | Permits flow from C/M oxygen supply subsystem to bypass the check valve and thus fill the 1-lb entry tank. | | | Shutoff valve is manually controlled by T-handle tool. |
| | | S/M SUPPLY valve | | | | Normal position of valve is ON. |
| | | ON | Permits flow of oxygen to C/M from supply in S/M. | | | Valve is closed prior to CSM separation to prevent C/M entry oxygen supply from flowing overboard in event of check valve failure. |
| | OFF | Shuts off flow of oxygen to C/M from supply in S/M. | | | Shutoff valve is manually controlled by T-handle tool. | |
| | SURGE TANK valve | | | | Normal position of valve is ON, permitting surge tank to carry out function of supplying additional oxygen | |
| | ON | Permits flow of oxygen to and from surge tank. | | | | |

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-----------------|---|--|-----------------|--------------|---------------------------------|---|
| LHEB-307 (Cont) | OFF | Shuts off flow of oxygen to and from surge tank. | N/A | N/A | None | beyond the normal maximum flow capability from the S/M, and for entry. Set O ₂ PRESS IND switch (MDC-13) to SURGE TANK to obtain indication. Valve is closed to preserve surge tank supply in event cryogenic oxygen tank pressure drops to 900 psig or below. |
| LHEB-308 | SURGE TANK PRESSURE RELIEF shutoff valve OPEN (cs) Close (ccw) | Opens line from surge tank to relief valve permitting relief function. Closes line from surge tank to relief valve eliminating relief function. | N/A | N/A | None | Shutoff valve is manually controlled by T-handle tool. Rotational movement from OPEN to close is 1/4 turn. OPEN position enables relief valve to function when surge tank pressure increases to 1045±25 psig. Valve is closed only if surge tank relief valve fails open. |
| LHEB-309 | GLYCOL PRESS RELIEF BYPASS valves Valve 1 ON OFF Valve 2 ON OFF | Permits flow of water-glycol to No. 1 water-glycol pressure-relief valve. Shuts off flow of water-glycol to No. 1 water-glycol pressure-relief valve. Permits flow of water-glycol to No. 2 water-glycol pressure-relief valve. Shuts off flow of water-glycol to No. 2 water-glycol pressure-relief valve. | N/A | N/A | None | Except for ascent and entry, one pressure-relief valve is selected for use at a time, with the second valve for standby redundancy. Shutoff valve is manually controlled by T-handle tool. Normal position of valve No. 1 when valve No. 2 is OFF. Normal position of valve No. 1 when valve No. 2 is ON, or in event of malfunction of No. 1 pressure-relief valve. Shutoff valve is manually controlled by T-handle tool. Normal position of valve No. 2 when valve No. 1 is OFF. Normal position of valve No. 2 when valve No. 1 is ON, or in event of malfunction of No. 2 pressure-relief valve. |

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|----------|---|---|-----------------|--------------|---|---|
| LH-310 | O ₂ DEMAND REGULATOR | | N/A | N/A | None | Valve is manually controlled by T-handle tool. |
| | 1 | Directs regulated oxygen (100±10 psig) to No. 1 suit demand pressure regulator. | | | | Valve set to position 1 in event of malfunction of No. 2 demand pressure regulator. |
| | 1 & 2 | Directs regulated oxygen (100±10 psig) to No. 1 and No. 2 suit demand pressure regulators. | | | | Both demand pressure regulators are selected for simultaneous use under normal conditions for redundancy in event of one regulator malfunctioning. |
| | 2 | Directs regulated oxygen (100±10 psig) to No. 2 suit demand pressure regulator. | | | | Valve set to position 2 in event of malfunction of No. 1 demand pressure regulator. |
| | OFF | Shuts off regulated oxygen (100±10 psig) to No. 1 and No. 2 suit demand pressure regulators. | | | | Valve set to OFF position only if both suit demand pressure regulators malfunction. |
| | SUIT TEST valve | | | | | Valve is operated by an integral lever. |
| | PRESS | Routes regulated oxygen flow (100±10 psig) directly into suit circuit through a pressurization orifice at a maximum buildup rate of 4 psig per minute for PCA/suit circuit tests. | | | | With valve in PRESS position, suit circuit will increase 4.25 psia above the nominal pressure of 5.0±0.3 psia. Approximately 75 seconds must be allowed for suit circuit pressure to reach maximum. This test may be performed at ground checkout or during flight. |
| DEPRESS | Shuts off O ₂ flow to suit circuit upon completion of test, permitting reduction of pressure buildup at an average bleedoff rate of 4 psig per minute. | | | | Approximately 75 seconds must be allowed for the increased suit circuit pressure to bleed back to the nominal 5.0±0.3 psia. | |
| OFF | Permits normal O ₂ flow to suit circuit through suit demand pressure regulator. | | | | Normal position of valve when not conducting a PCA/suit circuit test. Valve must not be set to off position before suit circuit has returned to nominal pressure. | |
| | SUIT HT EXCH switch | | | | | Regardless of switch position, the SUIT EVAP switch (MDC-13) must be in AUTO position for automatic control of suit circuit temperature. |

LH EQUIPMENT BAY - PANEL 310

APOLLO OPERATIONS HANDBOOK

CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-----------------|---|---|-----------------|--------------|---------------------------------|---|
| LHEB-310 (Cont) | GLY/EVAP EVAP | Places suit circuit temperature control complex in full automatic mode, whereby, cooling is accomplished either by water-glycol or water evaporation. Overrides full automatic mode of suit heat exchanger temperature control complex by positioning the water-glycol diverter valve in the bypass position, thereby, initiating the automatically controlled water evaporation cooling mode. | N/A | N/A | None | In the GLY/EVAP position, the switch is open. This prevents shorting across the circuit of the suit heat exchanger air outlet temperature sensor, and permits the sensor to automatically activate the water evaporation mode if the temperature reaches 60°F or more. In the EVAP position, the switch is closed. This shorts across the circuit of the suit exchanger air outlet temperature sensor, and creates the same effect as an over-temperature condition (above 60°F) on this sensor. This switch position is selected for cabin cold-soak operation, or if suit temperature control complex malfunctions. |
| LHEB-311 | SUIT EVAP GLYCOL valve ON OFF | Manual override position of water-glycol diverter valve, routing coolant flow to the suit heat exchanger for suit circuit cooling. Manual override position of water-glycol diverter valve, bypassing coolant flow around suit heat exchanger and activating water evaporation cooling mode. | N/A | N/A | None | Motor-operated valve is manually controlled by T-handle tool. Normal position of valve is ON to permit the automatic suit temperature control complex to select the water-glycol or water evaporation cooling mode. Valve is set to OFF position for backup cabin cold-soak operation or in event of suit temperature control malfunction. Movement of diverter valve mechanically operates switch that activates water evaporation cooling mode. |

LH EQUIPMENT BAY - PANELS 310 AND 311

APOLLO OPERATIONS HANDBOOK

CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|---------------------|--|---|-----------------|--------------|---------------------------------|--|
| E/E Bay (Panel 311) | SUI FLOW RELIEF Valve AUTO | Removes override lever from poppet valve, permitting automatic pressure-relief action to take place at a ΔP of 5 (+0.6, -0.2) inches H_2O . | N/A | N/A | None | Valve is manually controlled by T-handle tool. Normal position of valve is AUTO to maintain constant suit flow in event of suit circuit flow resistance fluctuations. |
| | OFF | Applies override lever to poppet valve holding valve in closed position. | | | | Valve is manually closed in event of its failure to close when in the automatic mode. |
| E/E Bay (Panel 311) | GLYCOL EVAP TEMP IN Valve HEAT (ccw) | Manual backup mode position of water-glycol temperature control valve to increase temperature of water-glycol entering evaporator. | | | | Motor-operated valve is manually controlled by T-handle tool. Rotational movement from HEAT to cool is just over 1/4 turn. Backup mode is used in event of malfunction of water-glycol temperature control components. Rotation toward the HEAT position results in a proportional temperature increase by changing the mixture ratio of hot-to-cold water-glycol. Close coordination between valve adjustments and GLY EVAP — OUTLET TEMP indicator (MDC-13) is necessary to obtain correct water-glycol temperature. |
| | Cool (ccw) | Manual backup mode position of water-glycol temperature control valve to decrease temperature of water-glycol entering evaporator. | | | | Rotation toward the cool position results in a proportional temperature decrease by changing the mixture ratio of cold-to-hot water-glycol. Close coordination between valve adjustments and GLY EVAP — OUTLET TEMP indicator is necessary to obtain correct water-glycol temperature. |
| E/E Bay (Panel 311) | H ₂ O ACCUMULATOR selector valves Valve 1 MAN | Routes regulated oxygen (100±10 psig) to No. 1 cyclic accumulator, bypassing solenoid shutoff valve. | | | | Valves manually controlled by T-handle tool. Valve position is selected only when No. 2 accumulator has failed and No. 1 solenoid shutoff valve cannot be operated automatically or by |

E/E EQUIPMENT BAY — PANEL 311

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-----------------|----------------------|---|-----------------|--------------|---------------------------------|--|
| LHER-311 (Cont) | OFF | Shuts off regulated oxygen (100±10 psig) to solenoid shutoff valve and bypass line to No. 1 cyclic accumulator. | N/A | N/A | None | manually selected electrical impulse. Valve will then be positioned to MAN for approximately 10 seconds every 30 minutes. |
| | RMTE | Routes regulated oxygen (100±10 psig) to solenoid shutoff valve of No. 1 cyclic accumulator. | | | | Normal position of valve is RMTE, permitting automatic (CTE) or manually selected electrical impulse to operate solenoid shutoff valve. Manually selected electrical operation is used in event of automatic control unit malfunction. |
| | Valve 2 | | | | | Valve manually controlled by T-handle tool. |
| | MAN | Routes regulated oxygen (100±10 psig) to No. 2 cyclic accumulator, bypassing solenoid shutoff valve. | | | | Valve position is selected only when No. 1 accumulator has failed and No. 2 solenoid shutoff valve cannot be operated automatically or by manually selected electrical impulse. Valve will be positioned to MAN for approximately 10 seconds every 30 minutes. |
| | OFF | Shuts off regulated oxygen (100±10 psig) to solenoid shutoff valve and bypass line to No. 2 cyclic accumulator. | | | | Normal position of valve is RMTE permitting automatic CTE or manually selected electrical impulse to operate solenoid shutoff valve. Manually selected electrical operation is used in event of automatic control unit malfunction. |
| | RMTE | Routes regulated oxygen (100±10 psig) to solenoid shutoff valve of No. 2 cyclic accumulator. | | | | Normal position of valve is RMTE permitting automatic CTE or manually selected electrical impulse to operate solenoid shutoff valve. Manually selected electrical operation is used in event of automatic control unit malfunction. |
| | GLYCOL RESERVE valve | Permits flow of water-glycol from reservoir into system. | | | | Shutoff valve is manually controlled by T-handle tool. Valve is opened to refill water-glycol system following the discovery and isolation of a leak. |

LH EQUIPMENT BAY-PANEL 311

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|----------------|----------------------------------|--|-----------------|--------------|---------------------------------|---|
| LHEB-311 (CDB) | OFF | Shuts off flow of water-glycol from reservoir into system. | N/A | N/A | None | Normal position of valve is OFF to isolate water-glycol reservoir from system. |
| | EVAP H ₂ O valve | | | | | Valve is manually controlled by T-handle tool. |
| | AUTO | Permits water flow to water-glycol evaporator solenoid-operated water inflow control valve. | | | | Normal position of valve. |
| | OFF | Shuts off water flow to water-glycol evaporator water inflow control valve. | | | | Valve is manually closed to prevent flooding water-glycol evaporator in event solenoid valve fails open. |
| | SUIT EVAP selector valve | | | | | Valve is manually controlled by T-handle tool. |
| LHEB-312 | AUTO | Routes flow of water to solenoid-operated water inflow control valve for suit circuit evaporative cooling. | | | | Valve set to AUTO position during all automatic suit temperature control operations. |
| | OFF | Shuts off flow of water to water inflow control valve and bypass line to suit evaporator. | | | | Valve set to OFF position in event water inflow control valve fails open. |
| | MAN | Bypasses flow of water around water inflow control valve, routing it directly into the suit evaporator. | | | | Valve set to MAN position for manual backup mode of evaporative cooling. This method is effective only if the steam-pressure control valve is in any position other than close. A malfunction in the temperature control components could leave the steam pressure control valve in any position. |
| | GLYCOL ACCUMULATOR shutoff valve | | N/A | N/A | None | Shutoff valve is manually controlled by torque wrench and 10-inch driver. |
| | On (ccw) | Permits flow of water-glycol from system to and from water-glycol accumulator. | | | | Normal position of valve is on, permitting accumulator to carry out function of damping surges and oscillations, and maintaining pump inlet pressure. |
| | OFF (cw) | Shuts off flow of water-glycol from system to water-glycol accumulator. | | | | Valve is closed to isolate a leaking accumulator from water-glycol system. |

LHE EQUIPMENT BAY - PANELS 311 AND 312

APOLLO OPERATIONS HANDBOOK

CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|----------|--|---|-----------------|--------------|---------------------------------|---|
| LHEB-313 | CO ₂ -odor absorber diverter valve UP Center Down | Shuts off suit circuit flow to canister B and diverts the full flow to canister A. Neutral position of valve permitting equal suit circuit flow to each canister. Shuts off suit circuit flow to canister A and diverts the full flow to canister B. | N/A | N/A | None | The diverter valve linkage includes a mechanical interlock that assures cover removal of only the canister that has been isolated from the suit flow. |
| LHEB-314 | MAIN REGULATOR selector valve NORMAL 1 OFF 2 | Directs supply of oxygen from S/M to No. 1 and No. 2 main pressure regulator and relief valves. Directs supply of oxygen from S/M to No. 1 main pressure regulator and relief valve. Shuts off supply of oxygen from S/M to No. 1 and No. 2 main pressure regulator and relief valves. Directs supply of oxygen from S/M to No. 2 main regulator and relief valve. | N/A | N/A | None | Selector valve is manually controlled by integral knob. Regulators No. 1 and No. 2 are selected for simultaneous use under normal conditions. Valve set to position 1 in event of malfunction of No. 2 main pressure regulator and relief valve. Valve set to position 2 in event of malfunction of No. 1 main pressure regulator and relief valve. Selector valve is manually controlled by T-handle tool. |
| | WATER & GLYCOL TANKS PRESSURE controls REGULATOR-SELECTOR INLET valve NORMAL | Directs regulated oxygen (100±10 psig) to No. 1 and No. 2 tank pressure regulators for reduction to 20±-psig tank pressure. | | | | Both tank pressure regulators are selected for simultaneous use under normal conditions for redundancy in event of one regulator malfunctioning. Caution If the SELECTOR INLET valve is placed to position 1 or 2, the SELECTOR OUTLET valve must be placed to the corresponding position (or NORMAL) to prevent shutting off supply of oxygen for pressurizing the water tanks and water-glycol reservoir. |

LH EQUIPMENT BAY - PANELS 313 AND 314

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-------------------------|---|--|-----------------|--------------|---------------------------------|--|
| LH EQUIPMENT BAY (Cont) | 1 | Directs regulated oxygen (100±10 psig) to No. 1 tank pressure regulator for reduction to 20±2-psig tank pressure. | N/A | N/A | None | Valve is set to position 1 in event of malfunction of No. 2 tank pressure regulator. |
| | OFF | Shuts off regulated oxygen (100±10 psig) to No. 1 and No. 2 tank pressure regulators. | | | | |
| | 2 | Directs regulated oxygen (100±10 psig) to No. 2 tank pressure regulator for reduction to 20±2-psig tank pressure. | | | | With valve in OFF position, tank pressurization system is isolated from regulated oxygen supply. Valve is set to position 2 in event of malfunction of No. 1 tank pressure regulator. |
| | RELIEF-SELECTOR OUILET valve NORMAL | Directs oxygen pressure from potable and waste water tanks to No. 1 and No. 2 tank pressure regulator relief valves. | | | | Selector valve is manually controlled by T-handle tool. Both tank pressure-relief valves are selected for simultaneous use under normal conditions for redundancy in event of one relief valve malfunctioning. There is no meter to indicate pressurization of potable and waste water tanks and glycol reservoir. Caution In the SELECTOR OUILET valve is placed to position 1 or 2, the SELECTOR INLET valve must be placed to the corresponding position (or NORMAL) to prevent shutting off supply of oxygen for pressurizing the water tanks and water-glycol reservoir. Valves set to position 1 in event of malfunction of No. 2 tank pressure regulator relief valve. |
| | 1 | Directs oxygen pressure from potable and waste water tanks to No. 1 tank pressure regulator relief valve. | | | | |
| | OFF | Shuts off oxygen pressure from potable and waste water tanks to No. 1 and No. 2 tank pressure regulator relief valves. | | | | With valve in OFF position, any increase in oxygen pressure is trapped and cannot be relieved. |
| | 2 | Directs oxygen pressure from potable and waste water tanks to No. 2 tank pressure regulator relief valve. | | | | Valve set to position 2 in event of malfunction of No. 1 tank pressure regulator relief valve. |
| | PLSS FILL valve | Manual shutoff valve controlling filling of PLSS tank with oxygen from supply in surge tank. | | | | Valve is manually controlled by integral T-handle. Rotational movement from open to CLOSE is approximately 2 turns. |

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks | | | | |
|--------------------|---|----------------------------|-----------------|--------------|---------------------------------|--|--|--|--|---|
| LHEB-314 (Cont) | EMERGENCY CABIN PRESSURE selector valve | NORMAL | N/A | N/A | None | Normal position of valve is closed. Valve is opened when used in conjunction with adjacent PLSS FILL connector. | | | | |
| | | 1 | | | | Selector valve is manually controlled by T-handle tool. | | | | |
| | | OFF | | | | Both emergency regulators are selected for simultaneous use under normal conditions, for redundancy in event of emergency decompression, as a result of cabin wall puncture. | | | | |
| | | 2 | | | | Valve set to position 1 in event of malfunction of No. 2 emergency regulator. | | | | |
| | | PRESS TO TEST pushbutton | | | | Valve is set to OFF position whenever all crewmen are suited. With valve in OFF position, both emergency regulators are isolated from regulated oxygen supply. | | | | |
| | | | | | | Valve set to position-2 in event of malfunction of No. 1 emergency regulator. | | | | |
| | | | | | | With pushbutton pressed, vents to reference pressure chambers of both regulators are closed off. This allows an artificial reference pressure to build up which results in regulator operation. This test may be accomplished at ground checkout or during flight. | | | | |
| | | CABIN REPRESS manual valve | | | | | | | | Shutoff valve is manually controlled by integral knob. Rotational movement from OPEN to close is approximately 3/4 turn. |
| | | OPEN (ccw) | | | | Directs oxygen into cabin up to the maximum flow rate of 7.2 lb per hr. Poppet-type valve is an independent unit of the cabin pressure regulator assembly. | | | | Both normal cabin pressure regulators are in use simultaneously and cannot be selected or turned off. In the event both regulators fail in the closed or fail-safe position, the manual shutoff valve is used to maintain cabin pressure. Valve is also used to repressurize cabin after decompression. |
| | | Close (ccw) | | | | Shuts off oxygen flow into cabin. | | | | |

LH EQUIPMENT BAY - PANEL 314

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CONTROLS AND DISPLAYS

| Location | Label and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|----------|-----------------------------------|--|-----------------|--------------|---------------------------------|---|
| EHEW 315 | TOOL (FOR MIE) receptacle (front) | Permits flow of water into waste water tank from ground servicing connection. | N/A | N/A | None | A second T-handle tool is stowed in socket of suit circuit DIRECT O ₂ metering valve (MDC-14) for use in positioning those valves accessible to crewman in LH couch. |
| | | Shuts off flow of water into waste water tank from ground servicing connection. | N/A | N/A | None | Shutoff valve is manually controlled by T-handle tool. Valve is opened when used in conjunction with adjacent WASTE TANK SERVICING connector. |
| EHEW 315 | WASTE TANK SERVICING valve | Permits flow of excess potable or waste water to No. 1 and No. 2 pressure relief valves. | N/A | N/A | None | Selector valve is manually controlled by integral lever. |
| | | Directs flow of excess potable or waste water to No. 1 pressure relief valve. | | | | Both pressure relief valves are selected for simultaneous use under normal conditions, for redundancy in event of one relief valve malfunctioning. |
| | | Directs flow of excess potable or waste water to No. 2 pressure relief valve. | | | | Valve set to position 1 in event No. 2 pressure relief valve malfunctions. |
| EHEW 315 | POTABLE TANK INLET valve | Permits flow of excess potable and waste water to No. 1 pressure relief valve. | N/A | N/A | None | With valve in OFF position, excess water cannot be dumped overboard. Unless both relief valves fail to open, this valve position is used for ground checkout only. |
| | | Permits flow of excess potable and waste water to No. 2 pressure relief valve. | | | | Valve set to position 2 in event No. 1 pressure relief valve malfunctions. |
| EHEW 315 | POTABLE TANK INLET valve | Permits flow of water from fuel cells into potable water tank. | N/A | N/A | None | Shutoff valve is manually controlled by T-handle tool. |
| | | Shuts off flow of water from fuel cells into potable water tank. | | | | Normal position of valve is OPEN. Valve set to CLOSE position to isolate potable water tank in event water from fuel cells becomes contaminated. |

EHEW EQUIPMENT BAY - PANELS 314 AND 315

APOLLO OPERATIONS HANDBOOK

CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|-----------------|--|---|--|----------------------------|---------------------------------|---|
| LHEB-315 (Cont) | WASTE TANK INLET valve AUTO CLOSE | Permits flow of water from fuel cells into waste water tank when relief valve differential pressure reaches 6.0±0.5 psi. Shuts off flow of water from fuel cells to differential pressure-relief valve and waste water tank. | N/A | N/A | None | Shutoff function of this relief-shutoff valve is manually controlled by T-handle tool. Normal position of valve is AUTO. If potable water tank is full or waste tank is empty, water from fuel cells will flow into waste water tank when relief valve reaches 6.0±0.5 psid. Valve set to CLOSE position in event relief valve fails open, prematurely permitting potable water flow into waste water tank. |
| LHEB-316 | PLVC switch NORMAL OPEN | Applies d-c power to pendulum-type attitude sensing switch of PLY system during normal post-landing operations. Applies d-c power directly to PLY valves, placing valves in open position in event of abnormal postlanding operations. | POSTLANDING VENT FAN - PL BUS/FLOAT BAG 2 (MDC-25) | Flight and Postlanding Bus | None | Switch set to NORMAL position to permit normal operation of attitude sensing switch (to close PLY valves) when C/M becomes inverted or tilts beyond a specified limit. Switch set to OPEN position in event of attitude sensing switch failure, or to aid crew to escape from inverted C/M. |
| LHEB-317 | GLY EVAP WATER CONTROL BYPASS valve ON OFF | Permits flow of water directly into water-glycol evaporator by bypassing solenoid-operated water inflow control valve. Shuts off flow of water bypassing water-glycol evaporator inflow control valve. | N/A | N/A | None | LHEB-317 consists of two components. A manually operated water control valve installed in the LHEB, and a plug-in unit to measure glycol evaporator wick temperature stowed in the C/M cabin. Data on plug-in unit TBD. Valve set to ON position in event of water-glycol evaporator temperature control failure. Normal position of valve is OFF. |
| LHEB-319 | SUIT CIRCUIT RETURN SHUT-OFF VALVE O (open) C (closed) | Permits flow of cabin gases to enter suit circuit for processing. Shuts off flow of cabin gases entering suit circuit. | N/A | N/A | None | Shutoff valve is manually controlled by knuzled knob. Normal position of valve is open. Valve is closed during ascent and descent, as access to valve is blocked. Valve is also closed to isolate suit circuit in event of cabin contamination. |

LH EQUIPMENT BAY - PANELS 315, 316, 317, AND 319

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CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|----------------------|---|--|---|---------------------|---------------------------------|---|
| Left Armrest LHCOUCH | Translation controls Neutral position In/out Left/right Up/down | Activates all switches located within the control to the open position. Applies +X or -X translation command signal to SCS electronics. Applies +Y or -Y translation command signal to SCS electronics. Applies +Z or -Z translation command signal to SCS electronics. | SCS - GROUP 1 MEN A MEN B (MDC-25) | D-C main bus A or B | None | Two nearly identical translation controls are installed in the S/C. The functions are identical with one exception: the CCG switch function is not available from the No. 2 control. S/C translations are accomplished by use of S/M RCS only. Physically, the No. 1 control is identified by the presence of yellow diagonal striping on the top and right hand side. A push-to-talk mike switch is located on the control handle. When pressed, the switch enables audio transmission capability in certain modes of communication system operation. The electrical cabling plugs, for the two translation controls, are connected at the LHCB. |

LEFT ARMREST, LHCOUCH

APOLLO OPERATIONS HANDBOOK

CONTROLS AND DISPLAYS

| Location | Name and Position | Function | Circuit Breaker | Power Source | Telemetry Code No. and Identity | Remarks |
|------------------------------------|--|--|--|--------------------------------|---------------------------------|--|
| Left Armrest LH Couch (Cont) | CCW (rotation) | a. Initiates manual abort command signal to the MES. C. b. Provides a backup for CSM/booster separation after all stages are expended. | MASTER EVENT SEQ CONT - A LOGIC B BAT A BAT B (MDC-22) | Battery buses A and B | None | The translation control must be in the neutral position prior to engaging MES. C logic A and B circuit breakers. Failure to confirm neutral positioning could result in an inadvertent abort or separation. Due to a positive detent the translation control must be manually returned to neutral from the CCW or CW position. This function is used when normal booster separation fails to occur. |
| | CW (rotation) | a. Engages manual thrust vector control mode during G&N or SCS ΔV . ΔV switch must be in the ΔV position prior to selecting MTVC. b. Disengages automatic attitude control during G&N or SCS attitude hold. | SCS - GROUP 2 MN A MN B (MDC-25) | D-C main bus A or B | None | This position may be used to place the S/C in free drift, and at the same time provide S/C attitude information on the FDAI depending on mode selected. |
| Crew Couches | Rotation controls | Provides manual control of C/M - S/M attitude in all axes. | SCS - GROUP 2 AC 1 AC 2 (MDC-25) | A-C bus No. 1 or A-C bus No. 2 | None | Two identical rotation controls are installed in the S/C. The function of both controls is identical. The electrical cabling plugs for the two rotation controls are connected at the RH couch junction box. |
| | Forward/back (movement) | a. Commands S/C rotation in the pitch axis. b. Provides manual control of SPS engine pitch gimbal after MTVC is engaged. | SCS - DIRECT CONT MN A MN B (MDC-25) | D-C main bus A or B | None | When using a control, S/C rotation can be commanded two ways, either by proportional rate commands or by direct on commands. Proportional rate command is obtained by utilization of the SCS electronics, and is considered the normal method. Direct on commands are available when the DIRECT RCS switch is used in conjunction with the rotation control. |
| | Left/right (movement) CW/CCW (rotation) | Commands S/C rotation in the roll axis. a. Commands S/C rotation in the yaw axis. b. Provides manual control of SPS engine yaw gimbal after MTVC is engaged. | SCS - GROUP 2 MN A MN B (MDC-25) | None | None | The indicator is located on the left sleeve between wrist and elbow, on top of arm. The indicator range is from 2 to 10 psia. |
| Pressure Garment Assembly | PGA pressure indicator | Indicates oxygen pressure (PSIA) inside pressure garment assembly. | None | None | None | |

LEFT ARMREST, LH COUCH - CREW COUCHES
PRESSURE GARMENT ASSEMBLY