RENTRY

AN ORBITAL SIMULATOR

APOLLO MISSION CONTROL

USER MANUAL

REENTRY

AN ORBITAL SIMULATOR
MOCR USER MANUAL

DRAFT

UPDATED: 06/18/2021

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I. INTRODUCTION

I. INTRODUCTION

1. ABOUT

Thank you for buying REENTRY – An Orbital Simulator!

REENTRY – An Orbital Simulator is an educational game/simulator that allows you to fly and operate spacecrafts in a realistic manner. The available spacecrafts have been programmed using the real manuals provided by NASA, with some modifications and simplifications made to allow this to be an enjoyable experience.

Please note that the game is in its early phase of development and might crash or malfunction at any time. I am working hard to fix bugs, and if you encounter an error, I highly suggest you report the bug on Steam or our Discord.

The Apollo Mission Operations and Control Room Live module is in Early Testing and comes with the base installation packages and might be removed from the game at any time.

LEGAL AND EULA

By downloading and/or using Reentry – An Orbital Simulator, you agree to the EULA located here: https://store.steampowered.com/eula/882140_eula_0

DOWNLOAD

The game can be downloaded from http://reentrygame.com/ - the game package comes with the Mercury, Gemini and Apollo spacecrafts.

JOIN THE COMMUNITY – CONTRIBUTING

Use the Community Hub to discuss the game, as well as talk with the community, get help and give feedback to the developer.
The community hub for REENTRY can be found here:
https://steamcommunity.com/app/882140/

An official Discord server can be found here:
https://discord.gg/reentrygame

The reddit subreddit can be found here:
https://www.reddit.com/r/reentrygame/

Tools and content files can be found here:
https://github.com/ReentryGame

WHAT IS THIS MANUAL?

This manual contains most of the information you need to understand how the Apollo Mission Operations Control Room module for Reentry works. This manual covers the Mission Control multiplayer module for the Apollo Control Center, how you play and general tips on how you can make a session as realistic as possible.

II. INSTALLATION

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1. DOWNLOADING

REENTRY is distributed through Steam on the following link:
https://store.steampowered.com/app/882140/Reentry__An_Orbital_Simulator/

You will need to purchase the game to start the download, and to play it.

2. SYSTEM REQUIREMENTS

The system requirements can be seen on the Steam page for Reentry and will have the latest known system requirements. It is not guaranteed that the game will run on your system, even if you meet the requirements. For the latest requirements, always check the Steam page.

MINIMUM

Requires a 64-bit processor and operating system

OS: 64-bit Windows 7, Windows 8.1, Windows 10

Processor: Intel Core i5-4430 / AMD FX-6300

Memory: 8 GB RAM

Graphics: NVIDIA GeForce GTX 960 2GB / AMD Radeon R7 370 2GB

DirectX: Version 11

Storage: 15 GB available space

RECOMMENDED

Requires a 64-bit processor and operating system

OS: 64-bit Windows 7, Windows 8.1, Windows 10

Processor: Intel Core i5-6600K / AMD Ryzen 5 1600

Memory: 32 GB RAM

Graphics: NVIDIA GeForce GTX 1060 3GB / AMD Radeon RX 580 4GB

DirectX: Version 11

Storage: 15 GB available space

III. ASTRONAUT

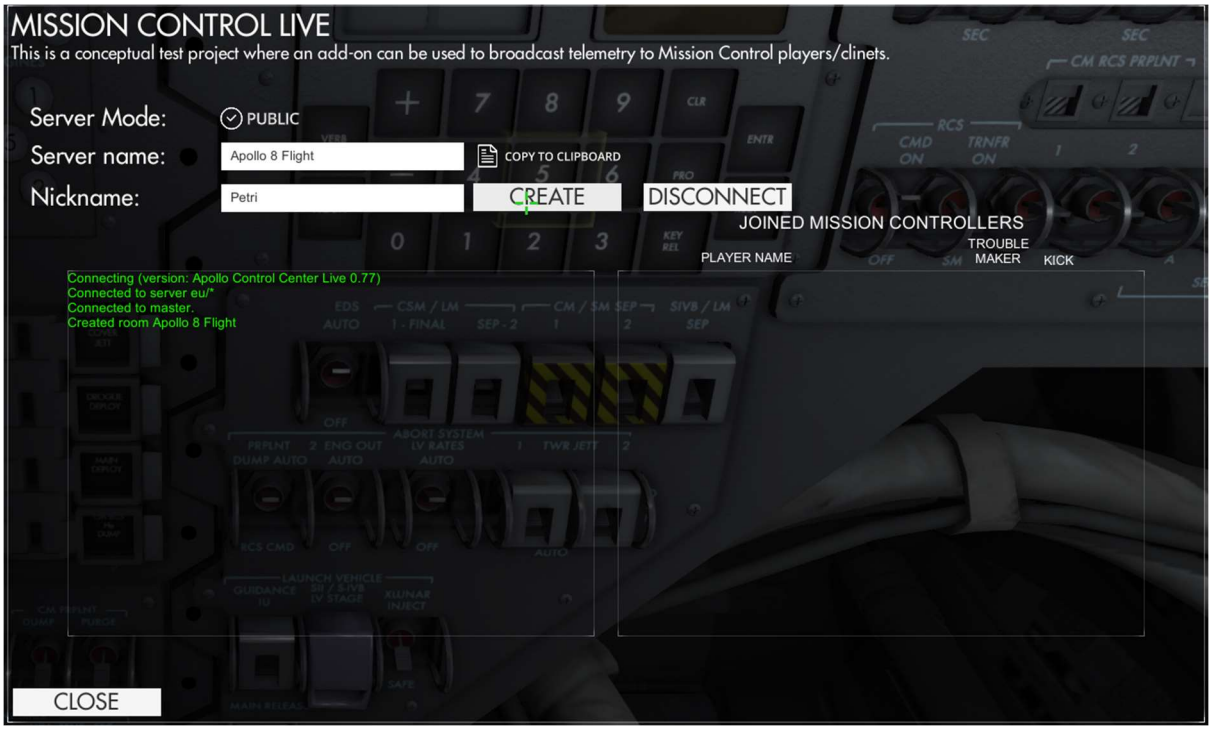
III. ASTRONAUT

1. INFORMATION FOR THE ASTRONAUT

1.1 CONNECTION

Upon entering the spacecraft, press Escape to open the in-game menu, then press Mission Control Live. This opens the server creation menu. Every Apollo Control Center live sessions needs the astronaut to be the host. If the astronaut disconnects, the session will end.

From this menu, you can set the server mode to be either public or private. Public games need a server name. Private games will generate an invite code that can be copied to the clipboard and shared with those you wish to invite to your session. You can optionally change your name. To create the server, verify the data then press CONNECT. When the log says "room created" you are good to go, and others can join your session. You can close the menu.



1.2 COMMUNICATING WITH MISSION CONTROL

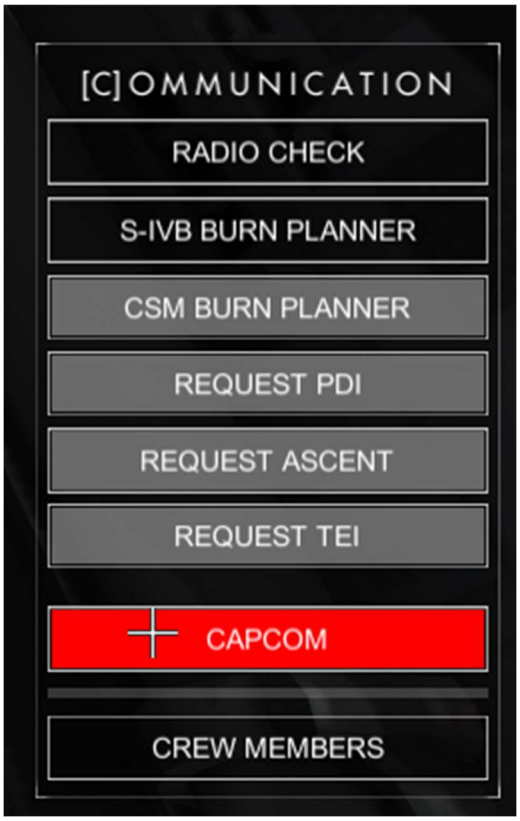
There are two ways to communicate with Mission Control. You can use the default text option where you send a text message to CapCom over the CAPSULE intercom channel, or through the integrated Voice Chat feature over the A/G intercom channel. Both modes are completely independent systems and can be used as you like.

1.2.1 COMMUNICATION USING TEXT

Not every player wants to use voice or has the equipment to do so.

Text Messages from the Mission Controllers/Capsule Communicator are received in the same manner as the normal offline AI mission control messages you are used to.

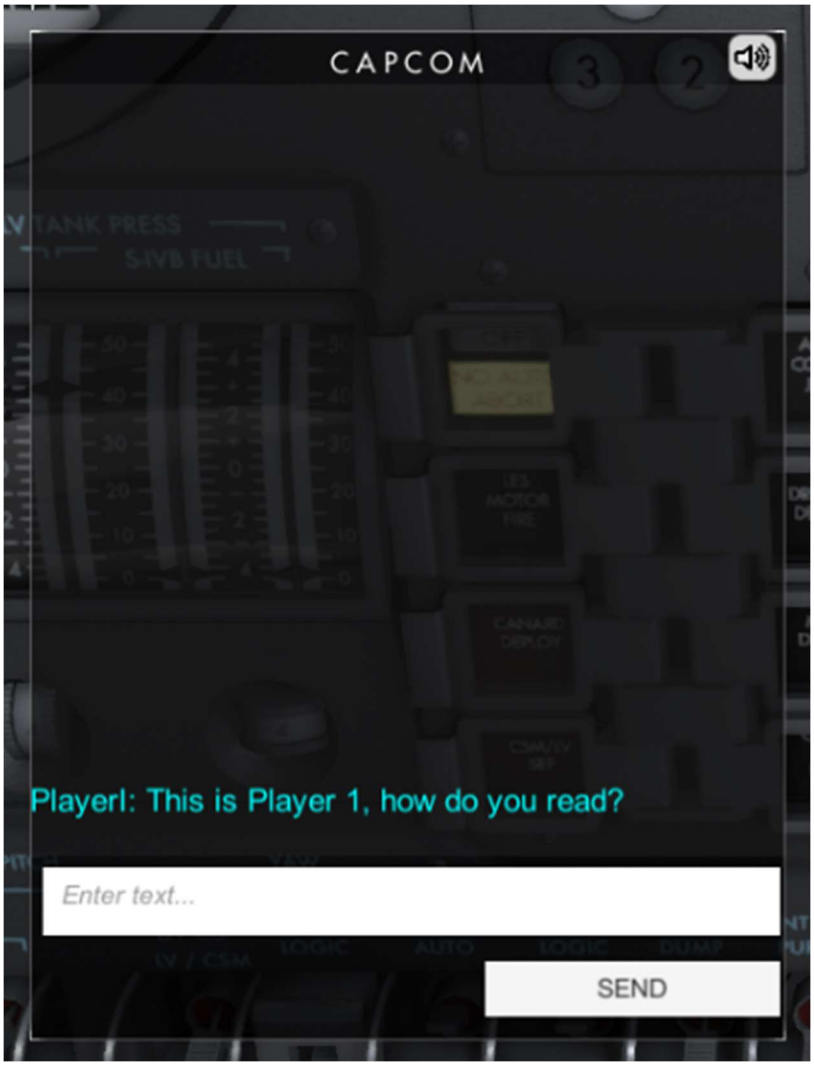
A dedicated CapCom interface exists where you can see the chat history and replay to messages from MCC using text. You can access it using the CAPCOM menu option in the COMMUNICATION window. This is only visible when you are connected to a live session.



If you click this, the CapCom interface opens in a new window that can be moved around. This view also includes the message log. If you wish to remove the normal mission message command UI (the one with ROGER) and know you won't be needing it, feel free to move it out of the screen.

To send a message to CapCom, enter the message into the textbox and press SEND. You can optionally bind the send button in the INPUT MAPPER.

When the message is sent, it will be directed through the on-board radio system, through the antennas and reach the Apollo Control Centers Capsule Intercom.



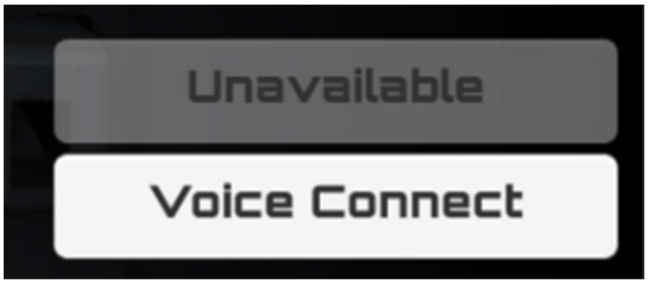
Those mission controllers who are listening to the astronaut/capsule intercom will receive you message. Because of this, you should aim to only talk directly to the CapCom mission controller and let this person deal with the teamwork down on Earth.

1.2.2 COMMUNICATION USING VOICE

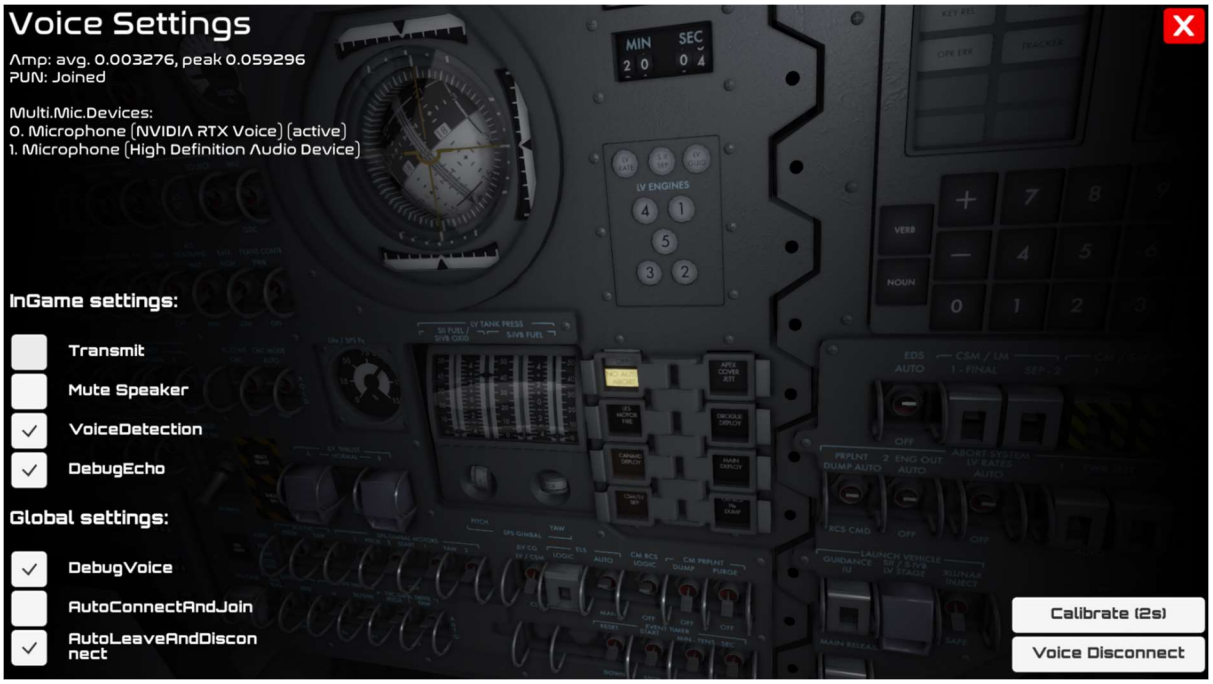
The Voice feature resembles a realistic voice experience between the astronaut and the ground. A dedicated air-to-ground (A/G) intercom exists and can be used to communicate with the mission controllers.

To connect to voice, an extra step is needed. On the CAPCOM text interface, click the VOICE icon 🔊 to open the voice settings.

To connect to the voice server, click the Voice Connect button:



The game will then spend a few seconds connecting to voice. Once connected, more buttons will be introduced on the UI.



You won't need to modify the default settings.

To speak, you will need to bind a special Push-To-Talk (PTT) button, usually bound to one of the extra buttons on your mouse.

To talk to the A/G intercom, simply hold the PTT button and talk, and release when done.

Voice Detection is enabled by panel configuration. The Commanders Radio Panel in the CSM and the Commanders Radio Panel in the LM configures this. If you set the switch to PTT or PTT/Intercom/ICS, you need to use the PTT to talk. If you set it to VOX, the voice detection logic is enabled.

The Calibrate option on the Voice Settings menu can be used to calibrate VOX. This function will try to detect the noise in your surroundings and use this to calibrate the detection. Do not talk or make any extra noise when calibrating.

When speaking into the A/G intercom, every mission controller who listens to this intercom channel will be able to hear you, and those who has the channel speak-active will be able to talk to you. This is usually CapCom, and the Mission Controller with the CapCom should be the only person to talk with the astronaut, while the other Mission Controllers should be speaking into different channels.

IV. MISSION CONTROLLER

IV. MISSION CONTROLLER

1. INFORMATION FOR THE MISSION CONTROLLER

1.1 FINDING GAMES

Some games might be public, or you might have some friends who are hosting a session. But what if none of the above is available?

The Official Reentry Discord server (http://discord.gg/reentrygame) has group channels set up for this, and lfg (looking for group) systems to aid you in setting up a session with members of the community. In addition, we host the Mission Control Academy there, where real players take you through the basics in a relaxed atmosphere.

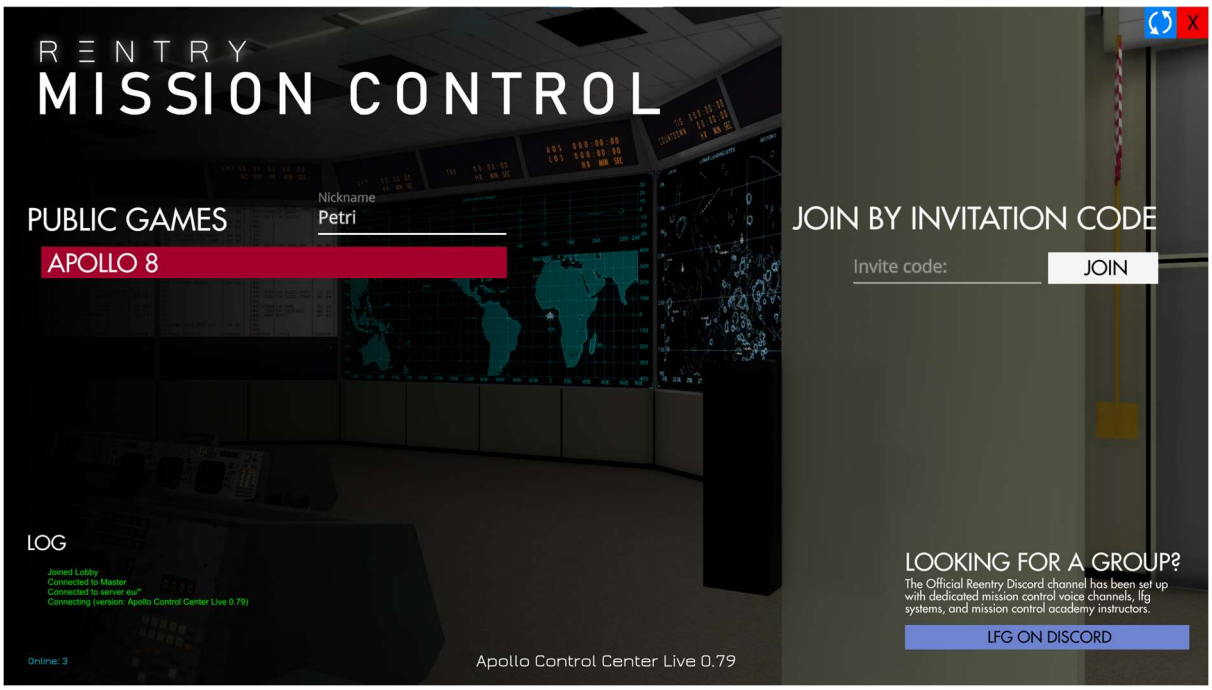
1.2 CONNECTING

To join a Mission Control session, you need to select MISSION CONTROL from the Main Menu.

Then select the APOLLO MISSION CONTROL option to find Apollo specific games:

Then hit START to load the MOCR.

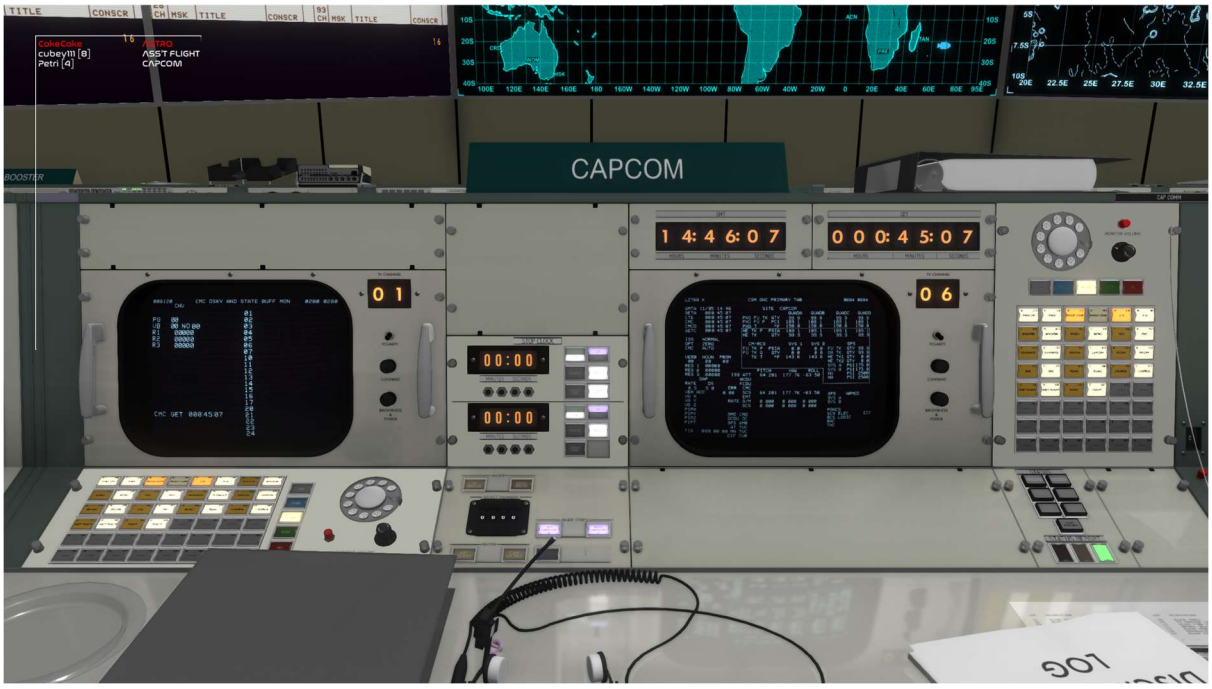
The first thing you will see is a list of public games, and a way to join private games. To join a public or private game, the astronaut will need to create the server (so the telemetry gets broadcasted). It will then appear in the list of public games if the server is set to public. If the game is private; the astronaut will need to share the invite code with you. The code is then used to join the private game.



1.3 YOUR FIRST STEPS

When you enter, you will be looking into the main room from the entrance door in "walk mode". This allows you to walk around in the room using WASD and mouse input. Use the View Selector (default bound to V) to select the CAPCOM station.

The camera should place you in front of the CAPSULE COMMUNICATOR desk, and the view should be like this:



You can look and move around using the normal virtual cockpit camera controls.

NOTE:

This is an extraordinarily complex model, and Paoli Mangili did an excellent job with it. I have spent a lot of time with him on making it possible to render it in realtime, and a lot of tricks has been done to render the model with descent fps. However, it will be slow to render if you see the entire room. If you press ESC, you can see the in-game menu. A section called ROOM SETTINGS can be used to tweak some of the rendering settings. You can hide details, switch to a simplified lighting algorithm, or set the room to a dark mode.

The difference between the light and dark mode can be seen in the two following screenshots:

On top of the desk, you can see the role you have to play. Whenever you are in a seat, the sign will tell you which seat you're in and what role you play. Additionally, a UI windows in the upper left corner of the screen (the player overview) will also show your role and it will show up in the chat when submitting a message to an intercom. Everyone in Mission Control can see your role in the player overview and in your chat messages.

The first thing you want to do is to set your status report to amber.

This is how you indicate to the flight-controller if you're ready to proceed or not. By default, none of the buttons will be lit. Pressing an unlit button changes the status of the seat. Pressing a lit button turns off the status-report, which can be used to indicate that the seat is vacant. It's recommended that a crewed station is set to amber (yellow, center) outside of GO/NOGO-calls. If you need to leave the seat , set it to none so flight can see this.

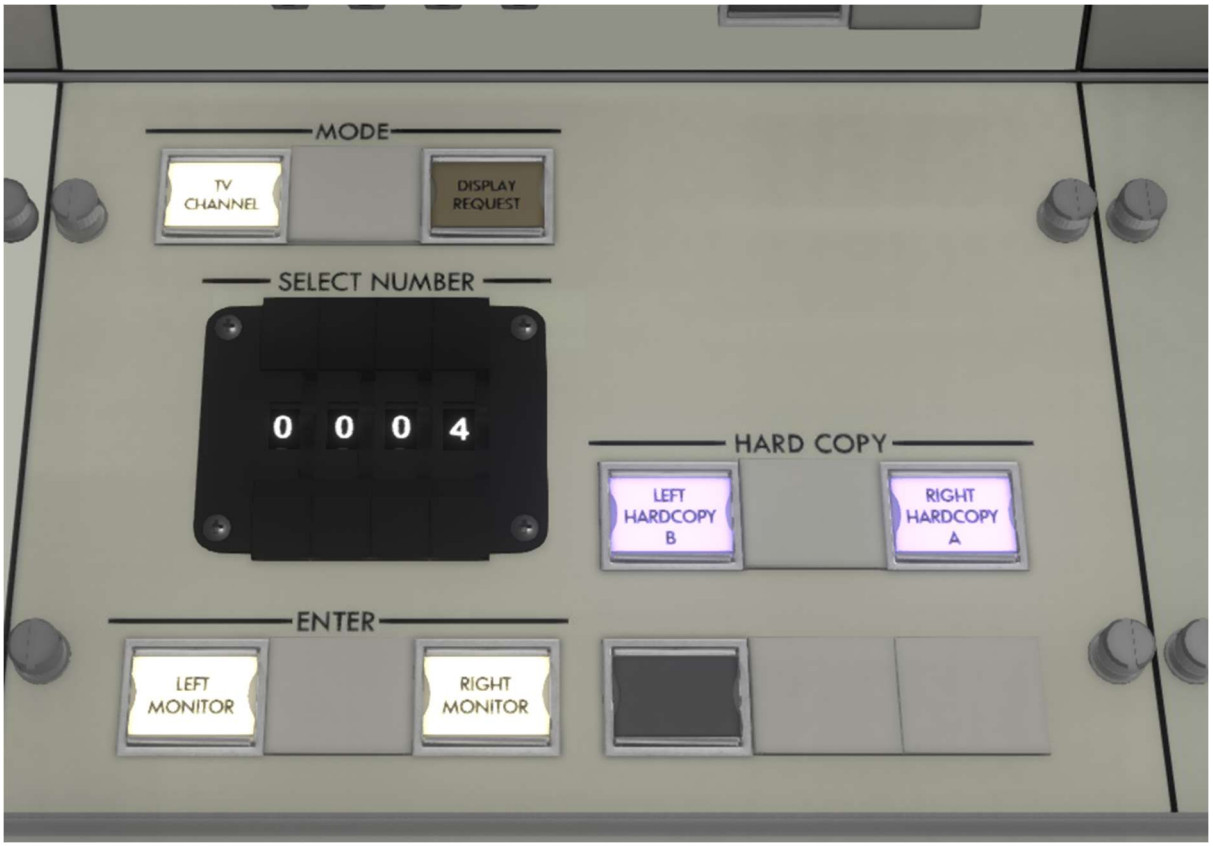
During critical maneuvers or mission phases, this is used during GO/NO-GO calls. If something isn't GO on your station, change it to red and call out reason in the intercom (more on that later). These are the recommended patterns, but the rules FLIGHT set for the mission can change from one to another.

Each station/seat is built up from various modules that specify its function. The main role of CapCom is to communicate with the astronaut (capsule communication). The 2nd thing you want to do is to either type something in the text-intercom, or to join in on the voice-intercom.

On top of the desk, you can see the Mission Elapsed Time (MET) and Greenwich Mean Time (GMT). MET shows you how long it is since the launch.

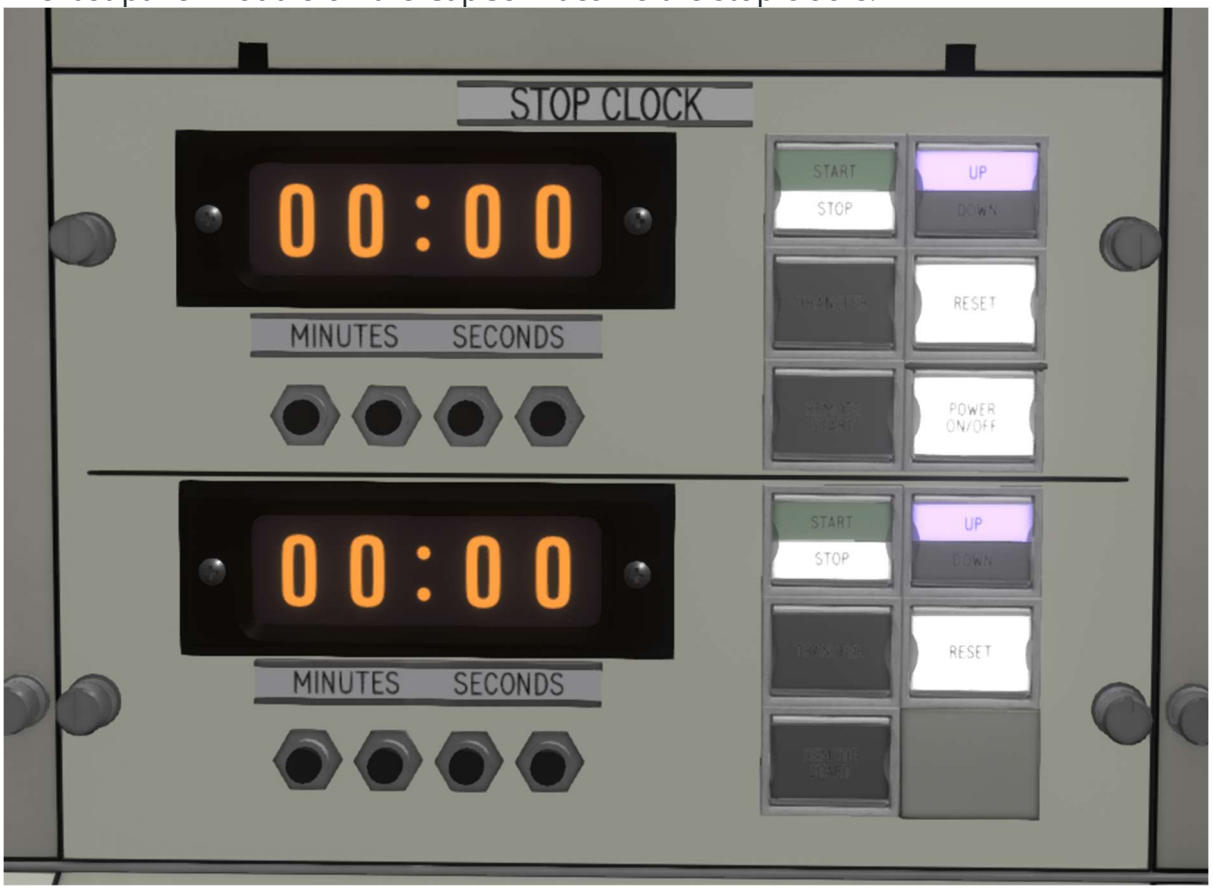
The CapCom desk has two monitors. The monitors are used to switch between different TV channels. It can be configured to show any channel you wish, and is usually chosen based on the current mission phase.

Changing TV channels can be done with the TV CHANNEL panel.



This will be covered in the Monitor chapter of this manual.

The last panel module on the CapCom desk is the stop clocks.



The stop clocks can be used as your own tool and is not synchronized over the network. The only stop clock that is synchronized is the Assistant Flight Directors stop clock. These are usually used as your own tool and must not be confused with the countdowns used towards ignitions and so on. Uses these however you like, or as a backup.

If you look around, you may see the avatars of others. Above the avatars, you'll see their usernames and what Apollo Mission Control level they are (an indicator of how much experience they have as a mission controller for Apollo). You can customize your avatar in the profile-part of the game settings-menu.

The player overview shows everyone in the session, their role and their level. The astronaut is highlighted in red, while your team members on ground are in white.

2. INTERCOM AND RADIO-MESSAGES

If you do not have the text-intercom and radio-messages open, press C. The buttons in the red rectangle allow you to select which intercom you receive messages from,

and you can "listen" to both intercoms at the same time if you want. In this example, the user is receiving messages from the mission control room only.

Radio-messages are color-coded so you know which intercom they're from, with blue for messages in the mission-control intercom. You'll also notice that the messages also indicate the current position of the person. The buttons in the green rectangle allows you to select which intercom you're sending a message to. Historically, you'd listen to multiple intercoms but only speak to capsule if you're CAPCOM, but in MCL that's up to you, or rather the rules FLIGHT set for the mission.

On the other hand, if "radio messages" is setup like this, with both "ROOM" and "CAPSULE" colored, you'll receive messages for both the MCC and capsule.

The Voice-intercom works like it did in real life. You can select what channel you want to talk to, and what channel(s) you want to listen to. The voice-intercom is operated through that large array of white and yellow buttons:

On the top-left you will see a button named PABX ON. It should be dark if not connected to voice, and illuminated if connected. If it is flashing, it is connecting to the voice server. To join, press it once and wait for it to connect (flashing stops).

To select the intercom you wish to speak to, press a white button. Your main intercom will be the A/G (Air/Ground). This is the intercom the astronaut speaks into. Everyone that has the yellow A/G button enabled can listen into this communication.

MOCR CONF is the main room conference intercom, however, each desk also has a dedicated intercom that can be used as you like.

You might have noticed that there are two intercom panels on some of the desks. Feel free to use any. Your intercom settings will not be synchronized, so nobody will be able to mess with your setup. All desks will have your configuration, so you don't need to reconfigure when joining another seat.

3. CONTROLS

(Assuming default controls) Arrow-keys are used to walk around without changing seat (designed to look closer at instruments and around the table, pan around). This only works when you are seated and assigned a role. Holding the middle mouse button lets you pitch and yaw the view, scroll wheel zooms.

The view selector is available if you press V, and a chat-window is viewable if you press C.

To trigger the failure-menu, press CTRL+T.

It's advised that you bind chat send to ENTER or something similar if needed.

4. VIEWS

STATION VIEWS

Each desk is a station with a dedicated role. One player can oversee and operate them all, or multiple players can share the roles among each other. It's usual to have the responsibility of one or two desks in larger games.

ORBIT VIEW

This view is mostly used by mission planners, guidance and retro to plan the orbit and reentry procedures. Markers can be placed and time to these points will be given.It\s not yet active in MOCR.

HANG AROUND VIEW

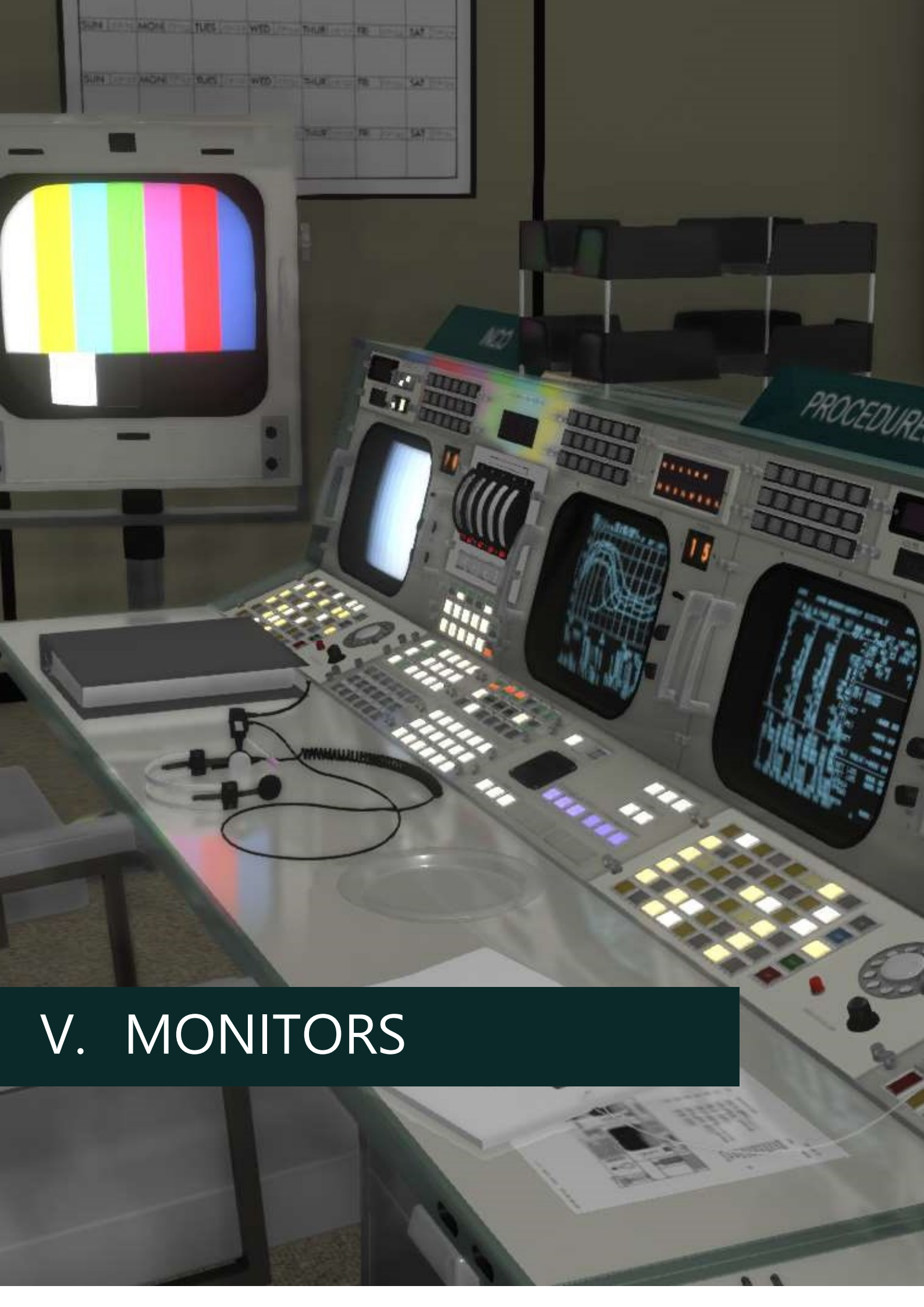
The "FPS" view aka. Hang Around is a way to walk around in the room using a traditional FPS controller. You can use this to oversee the room, join other mission controllers next to their desk, check out the simulator and the map.

THE SIMULATOR

The simulator is just a non-functional mockup of the CSM and LM panels. This is used to have a realistic reference to the capsule panels for verifying switch locations, procedures, and checklists.

5. MISSION PAD

You will have access to the same checklists as the astronauts has onboard. It is a good practice to walk through each checklist with the astronaut and verify the procedures.

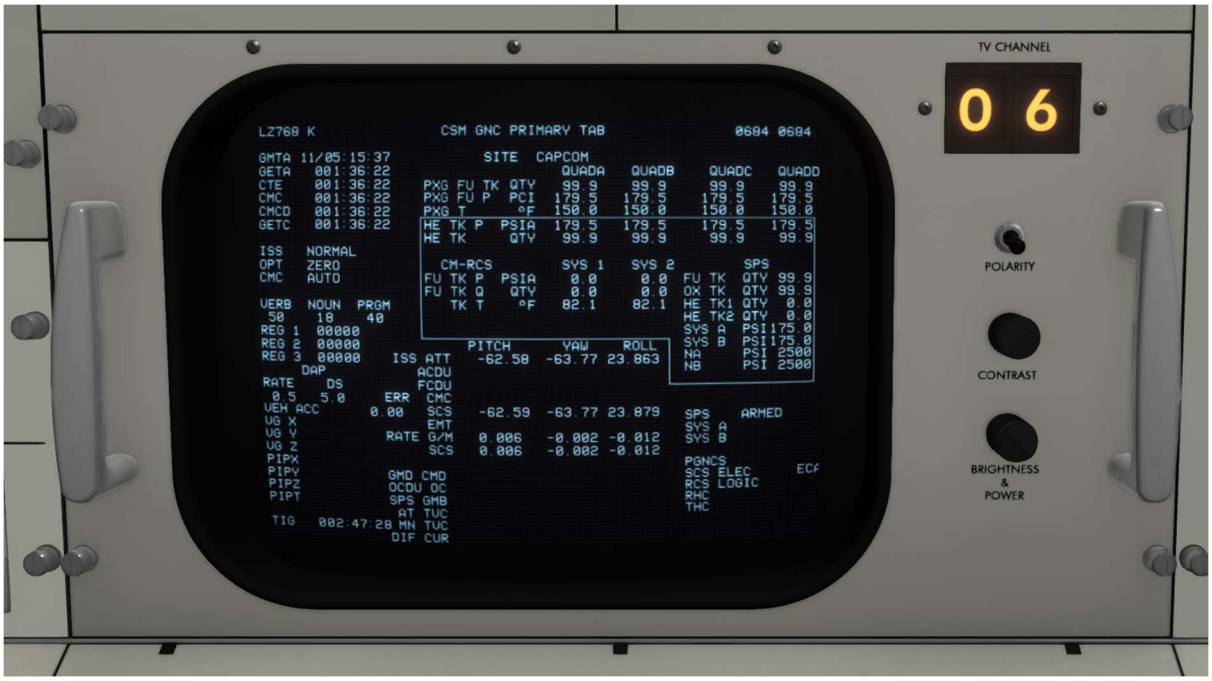


V. MONITORS

V. MONITORS

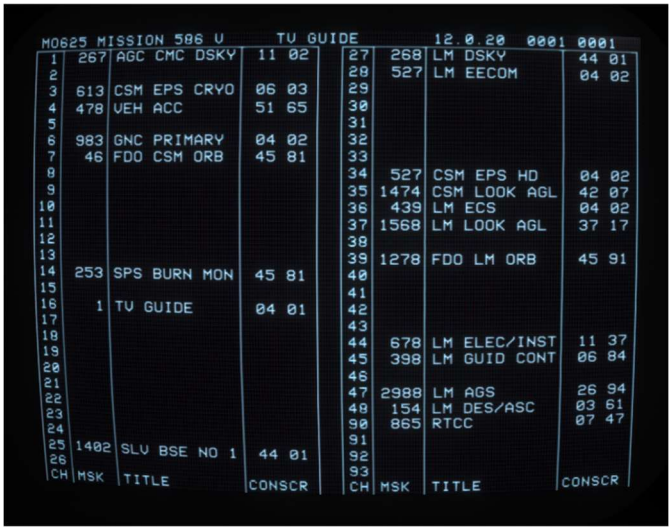
1. GENERAL

Each desk are equipped with monitors used to read data from the spacecrafts. The Saturn V, the CSM and the LM sends telemetry that can be monitored on the screens. A dedicated TV channel system lets you control what monitor should display what channel.



1.1 SWITCHING TV CHANNELS

The TV GUIDE can be used to find the channel you wish to tune into. Some monitors shows the TV channel overview, as well as the projectors in front of the room (unless someone changed them). If you need to bring it up, the TV GUIDE can always be found on channel 16.



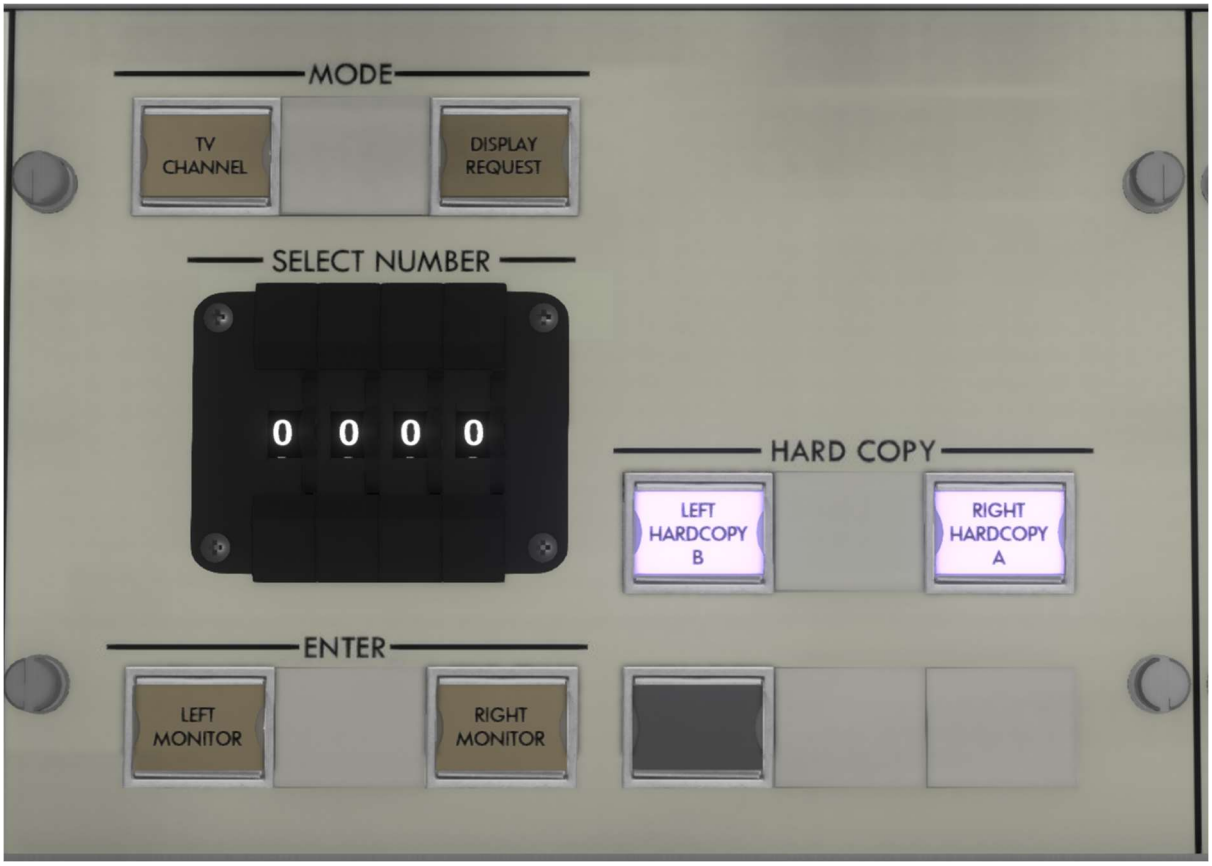
The TV GUIDE is split into two sections (left and right), both equal in how the display the channels. The left column shows the channel (starts from 1 and goes up to 50 and 93). Channel 1 is the AGC CMC DSKY channel for example.

The first thing you should do is to find the channel you are interested in seeing and then finding the channel index of it.

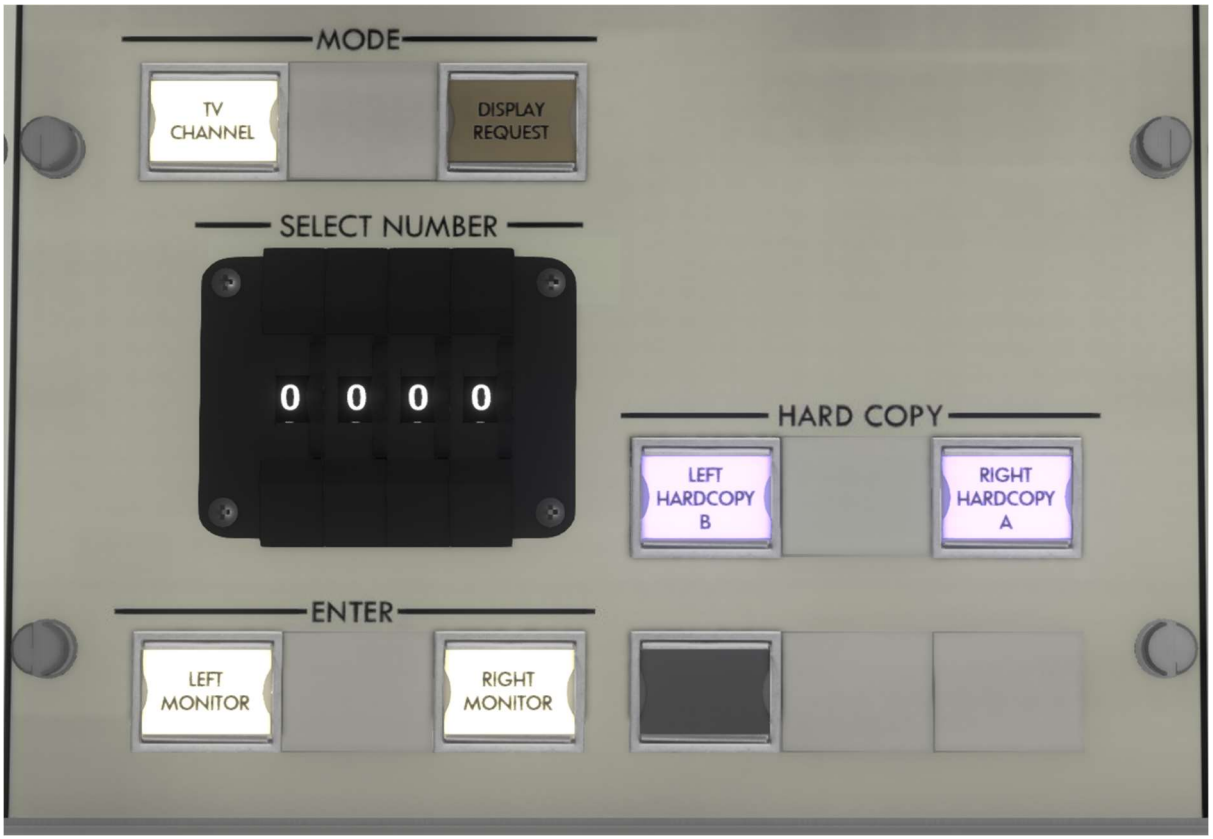
Let's say we wish to see channel 25, the Saturn V Boost Systems Engineer 1 channel: SLV BSE NO 1.

Knowing the index, you can use the TV CHANNEL panel to reconfigure your setup.

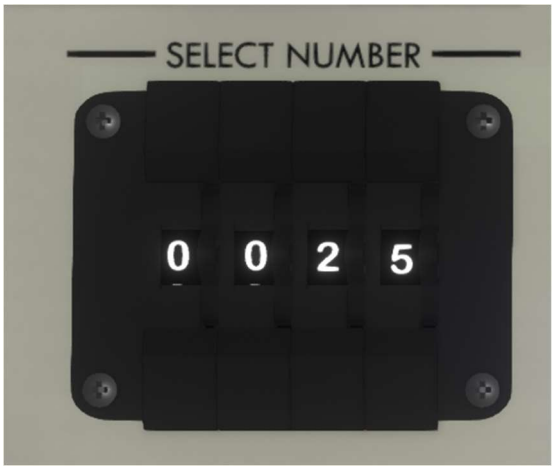
On the CapCom desk, there are two monitors. Some desks has three, and even multiple TV CHANNEL panels. Use the one that changes the monitor you wish to change.



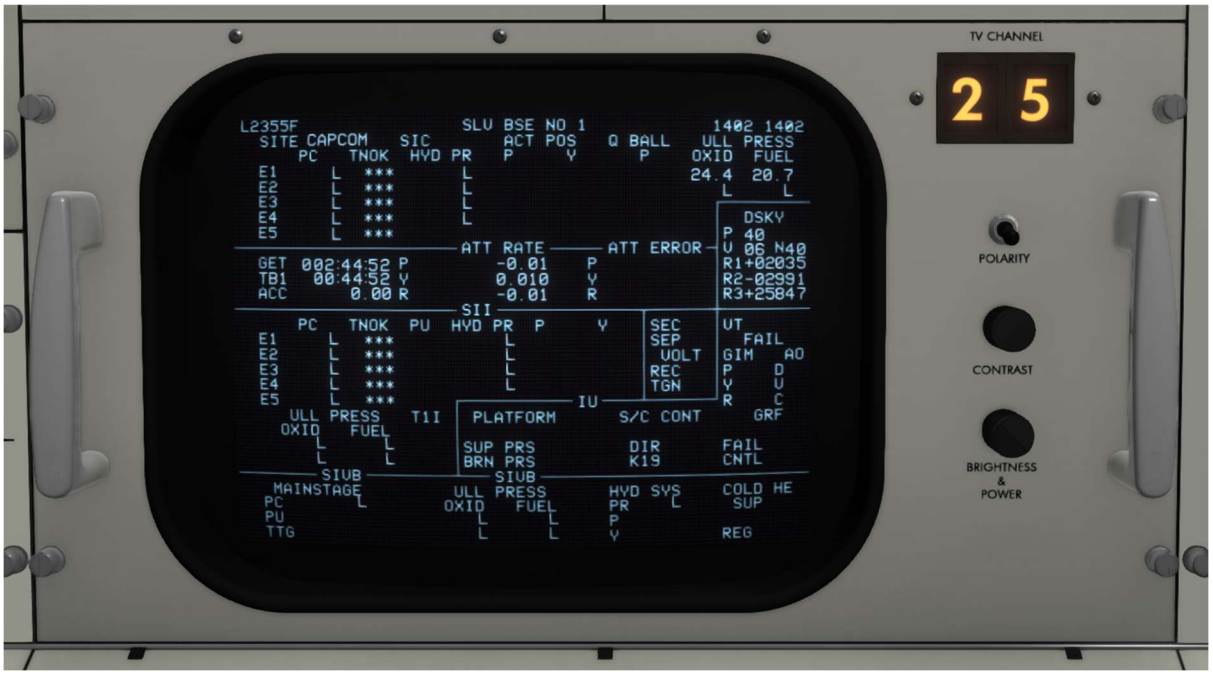
The panel has a MODE section, ENTER section and a HARD COPY section. Mode is used to start a channel change operation where SELECT NUMBER is the channel index you wish to change to. The ENTER section is used to select what monitor that should be changed. For the channel 25 example, first press TV CHANNEL. It should illuminate, along with the ENTER switches.



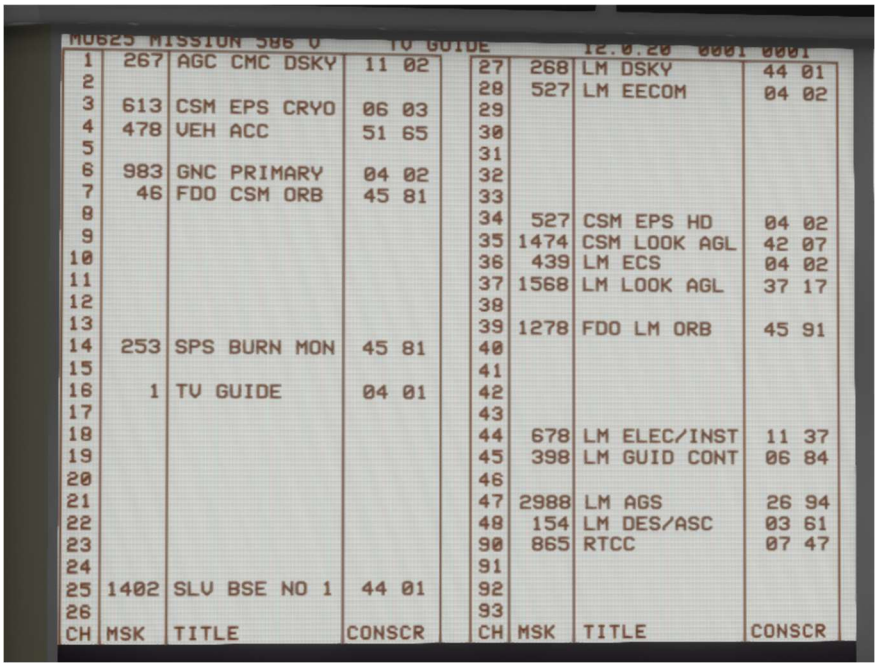
Then press above the 3rd digit so move it up, or below to move it down. Set it to 2, and set the 4th digit to 5.



With the channel set, press either LEFT MONITOR or RIGHT MONITOR to execute the change. The results can be seen on the monitor you then selected.



As mentioned earlier, the TV guide can also be seen on the projectors, just like any other TV channel.



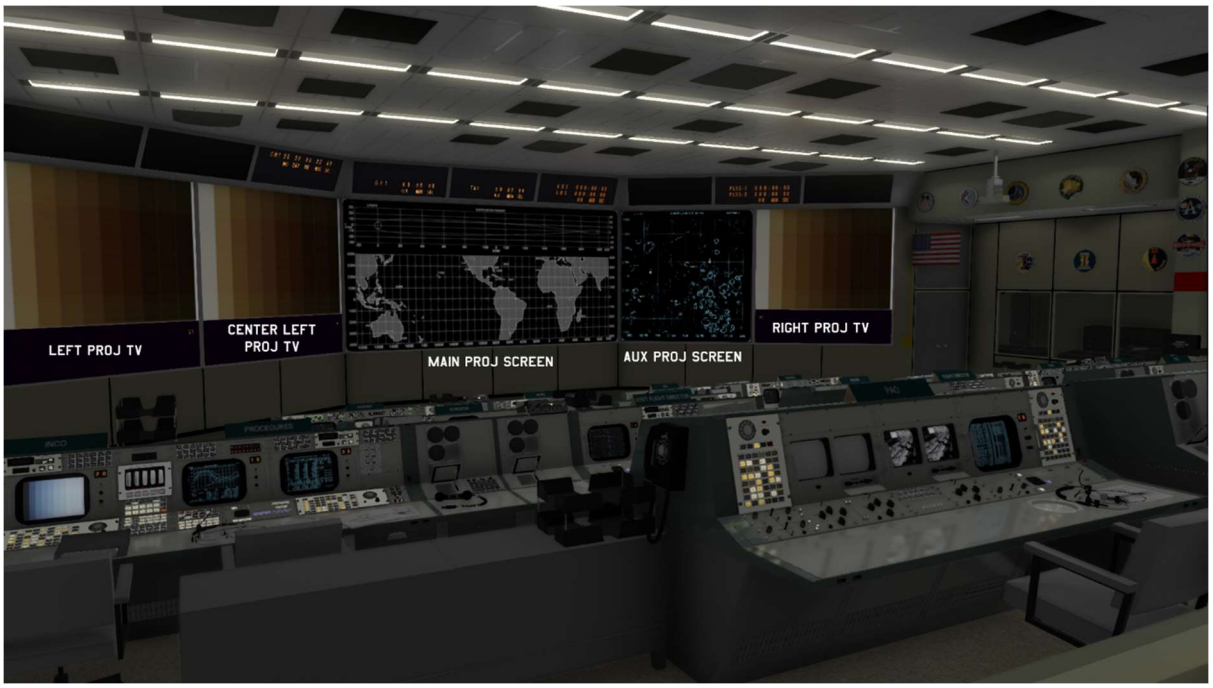
1.2 SWITCHING PROJECTORS

The projectors can only be changed from the ASSISTANT FLIGHT DIRECTORs desk (and Procedures once this is implemented). It works exactly the same as changing the TV CHANNEL on a monitor, but instead of selecting a monitor to reconfigure, you select the

projector.

You can see on the right side that each projector can be changed. The TV projectors works the same as a monitor, and can display the same channels that a monitor can display. The AUX and MAIN PROJECTION are special and only some channels can be change here.

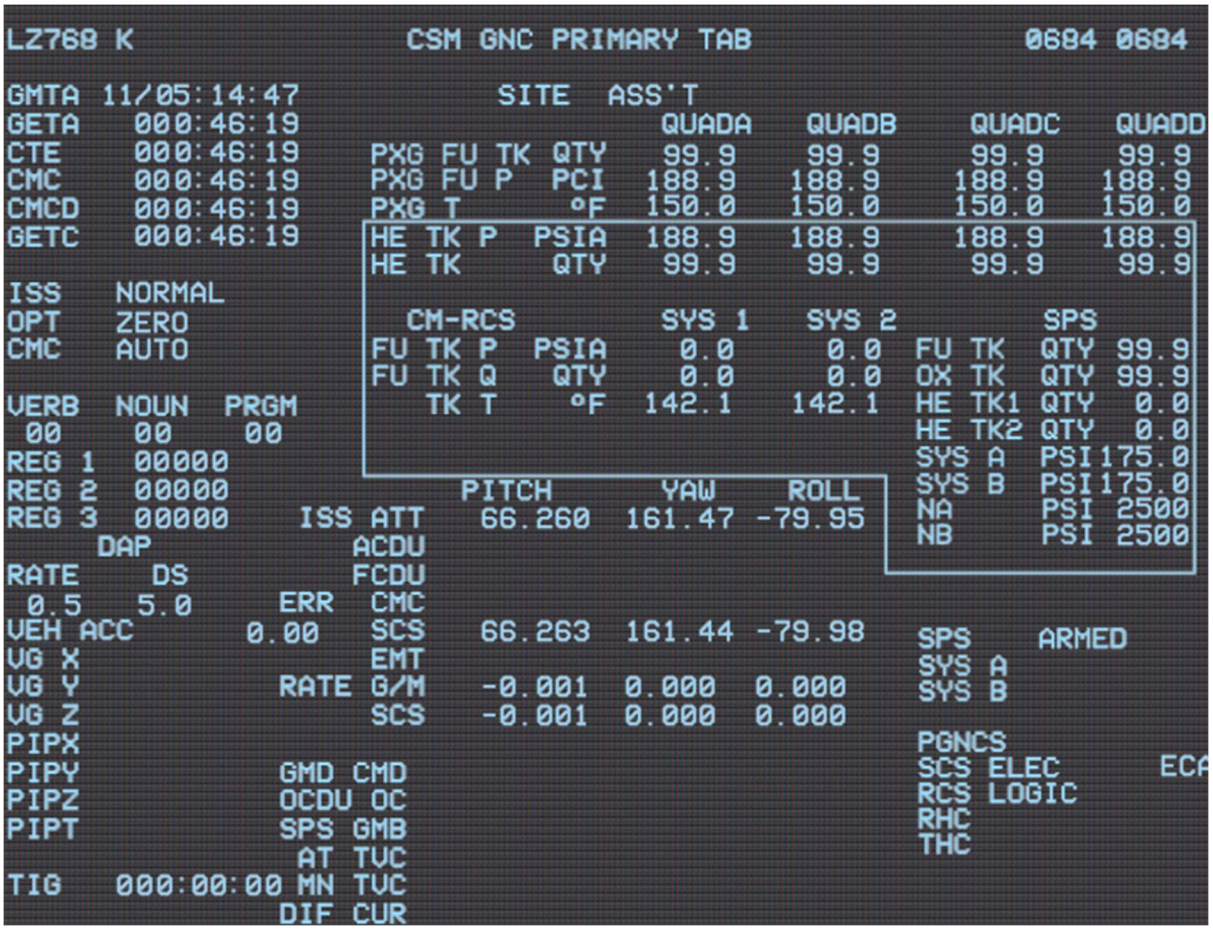
The MAIN PROJECTOR can be reconfigured to show EARTH or the MOON map.



1.3 HARD COPY

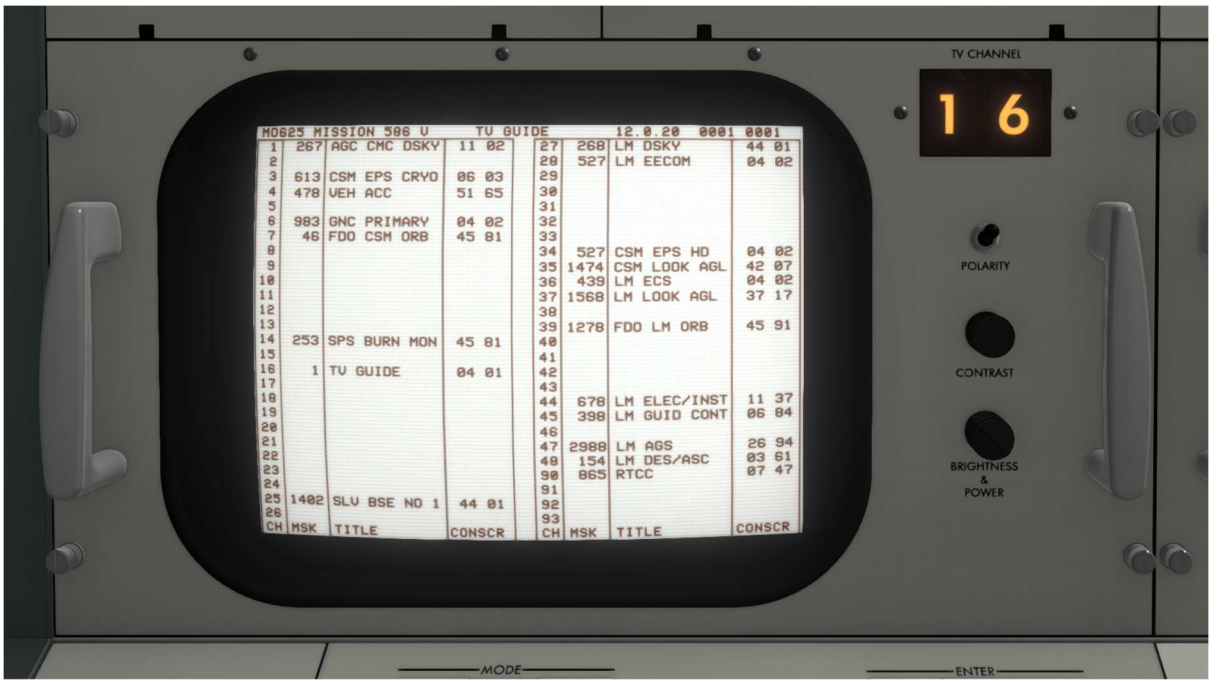
Each monitor has a hard copy feature. It will take a screen dump of the current data. If you press the purple button associated to the screen you wish to save, it will copy the screen to a file in the AppData export folder. You can then send this file to others through Discord etc.

The file will look something like this:



2. HARDWARE

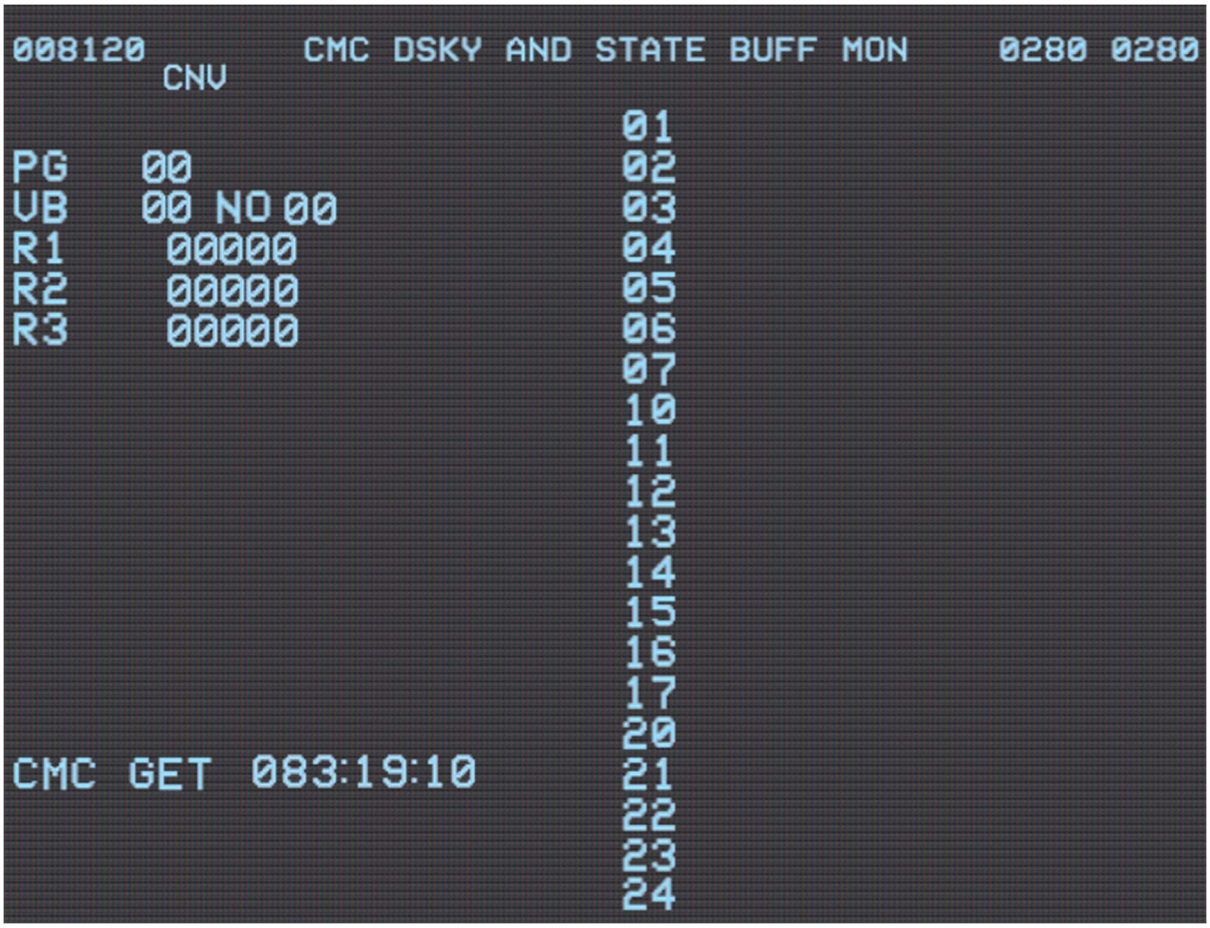
Each monitor is equal and consist of the monitor itself, and some buttons used to interact with it. I plan on implementing all of them, but currently, only the polarity switch is enabled. It can be used to invert the color of the screen.



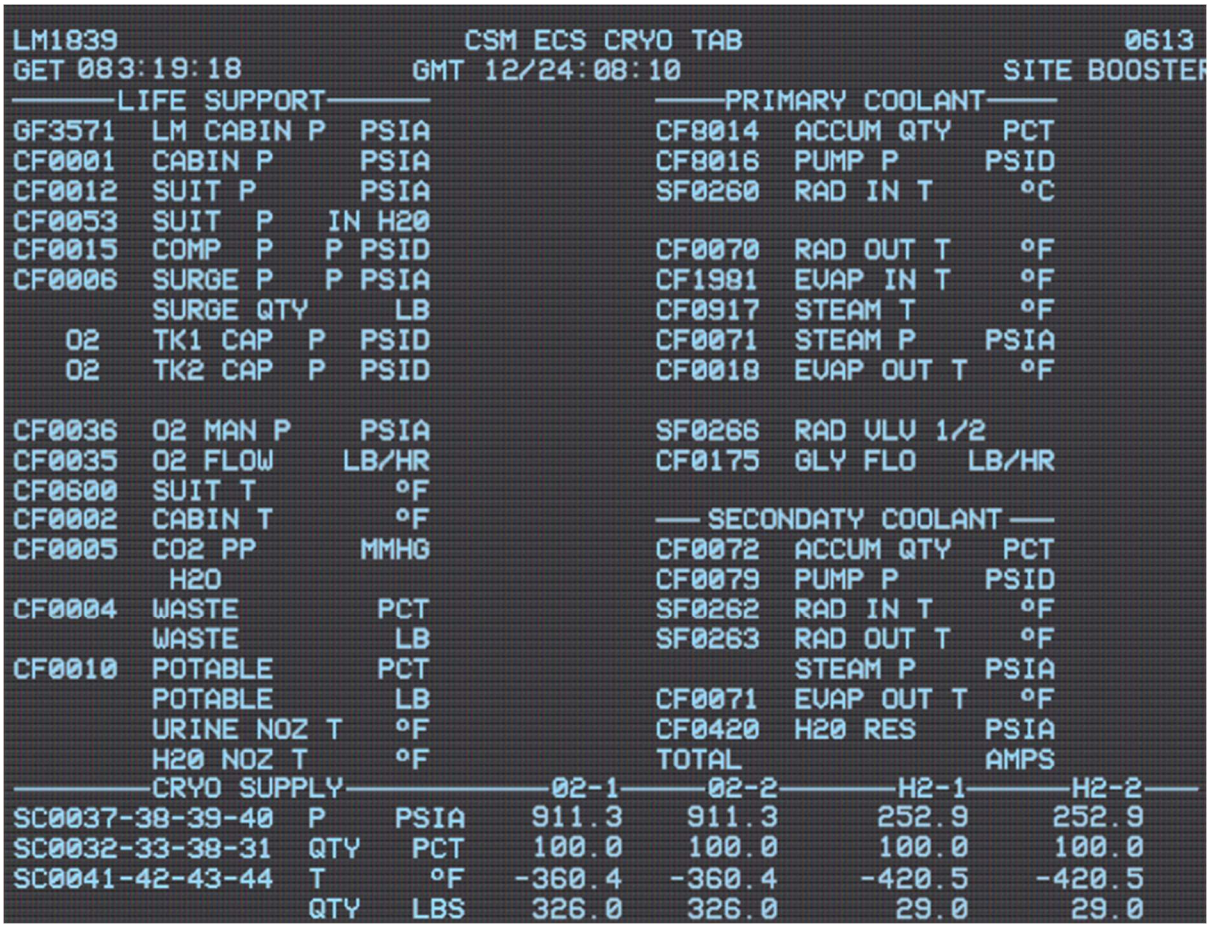
3. TV CHANNEL DICTIONARY

This section will describe each TV CHANNEL supported by Reentry MOCR Live.

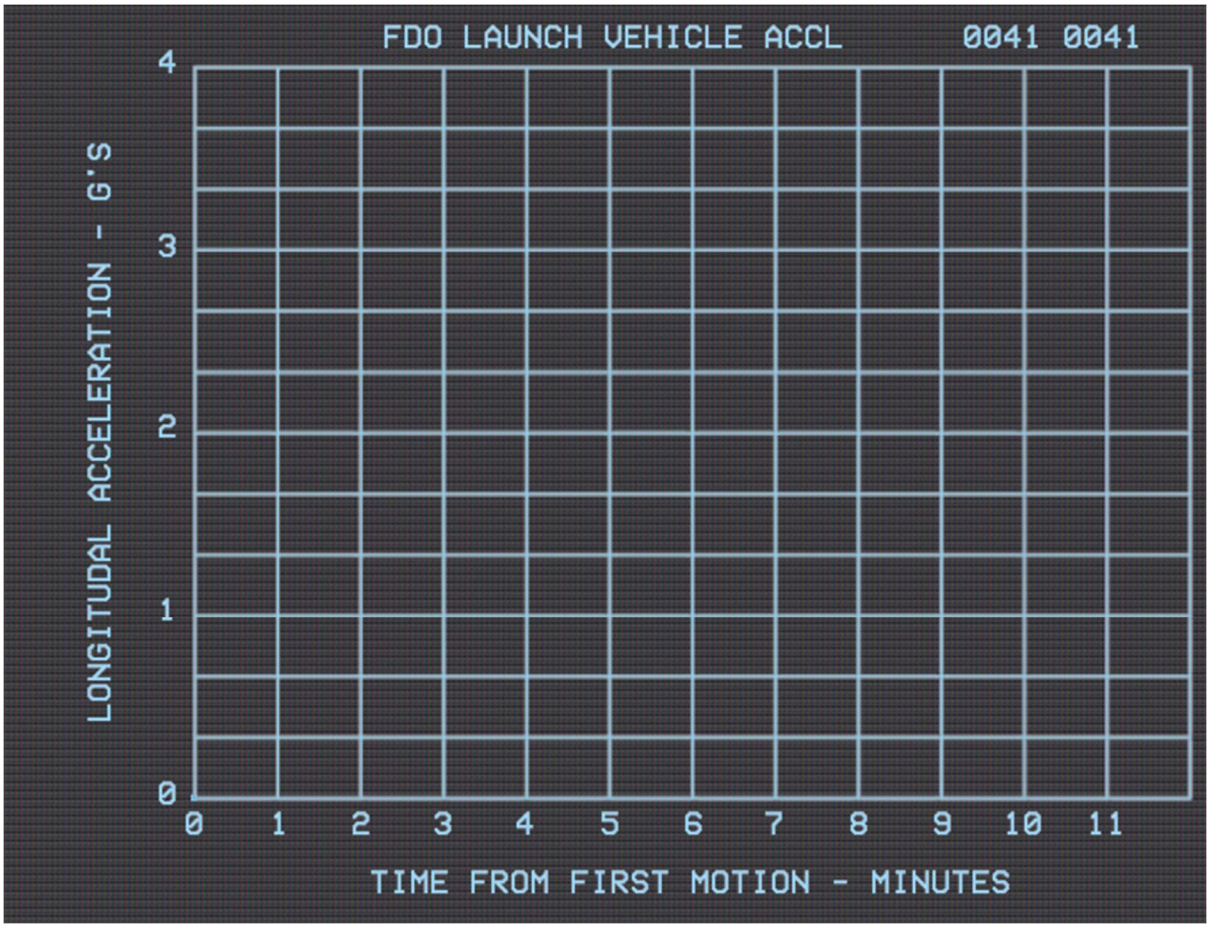
CHANNEL 01: CMC DSKY



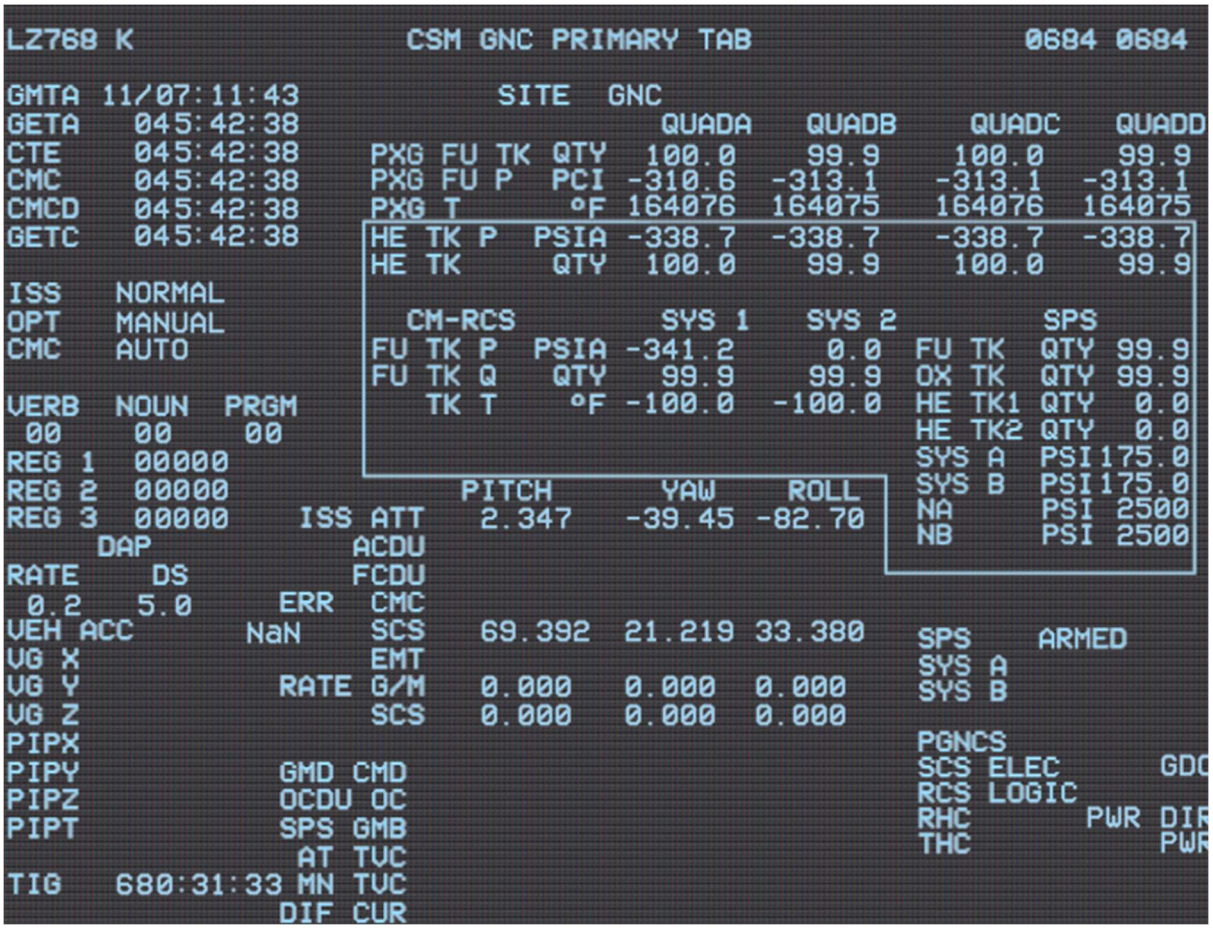
CHANNEL 03: CSM ECS CRYOGENIC TAB



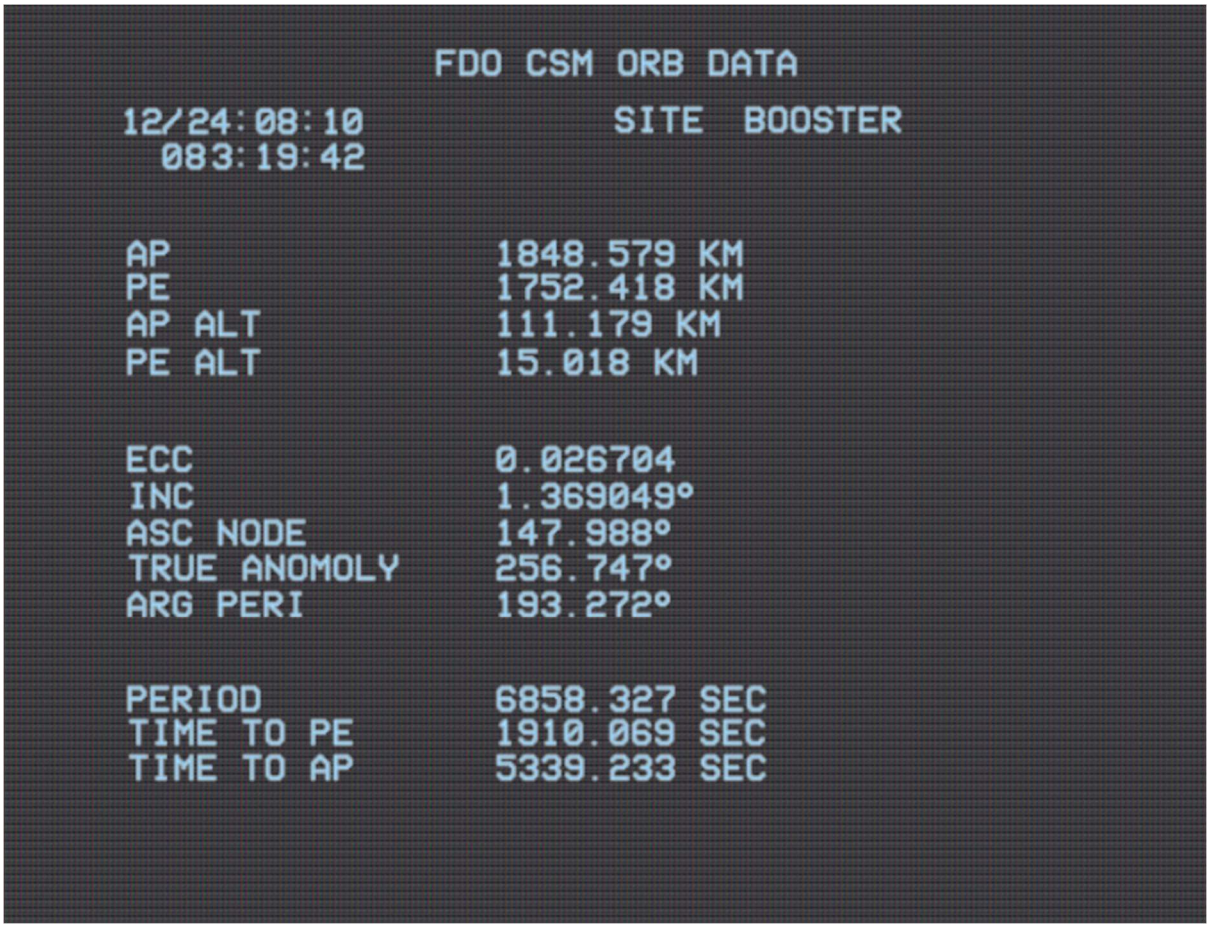
CHANNEL 04: FDO LAUNCH VEHICLE ACCELERATION



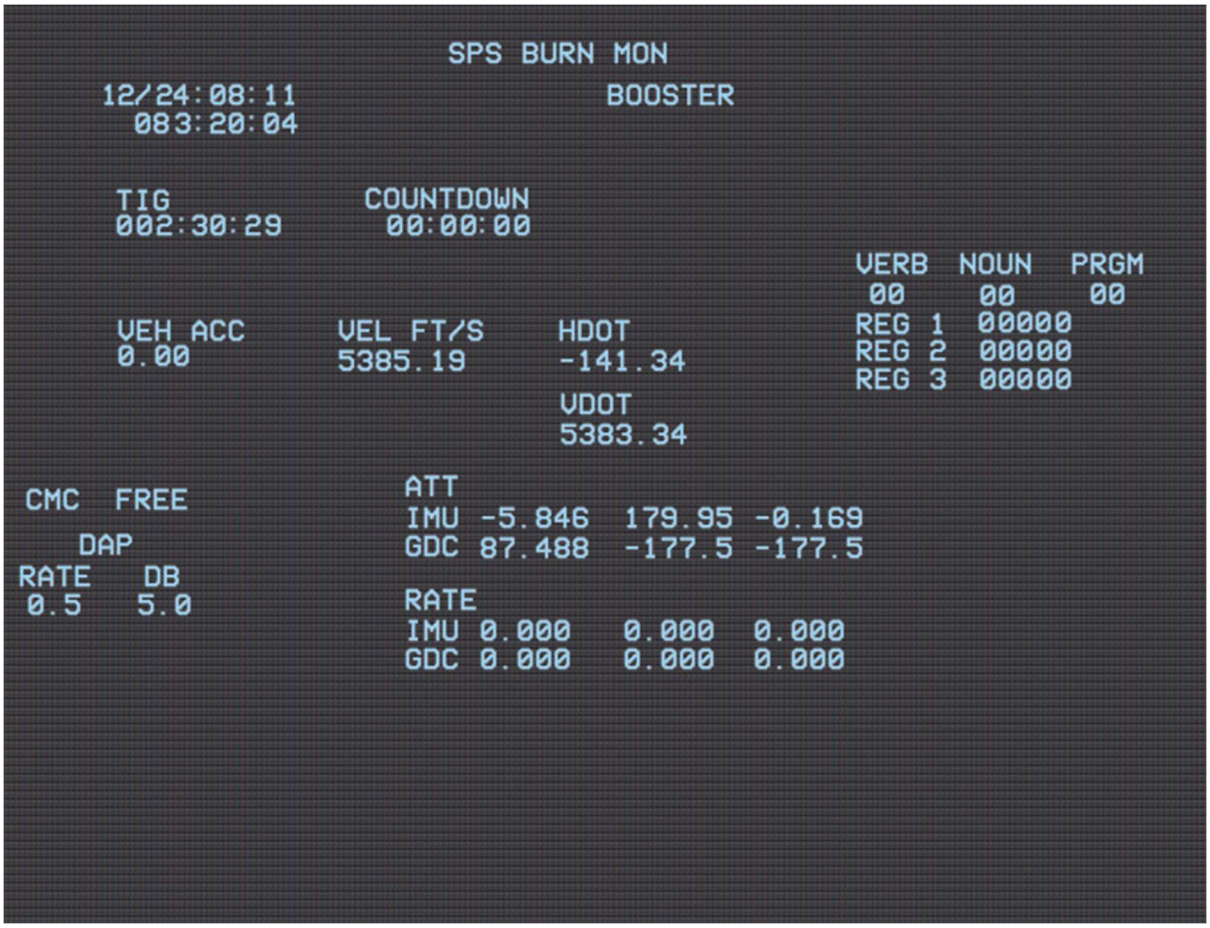
CHANNEL 06: CSM GNC PRIMARY TAB



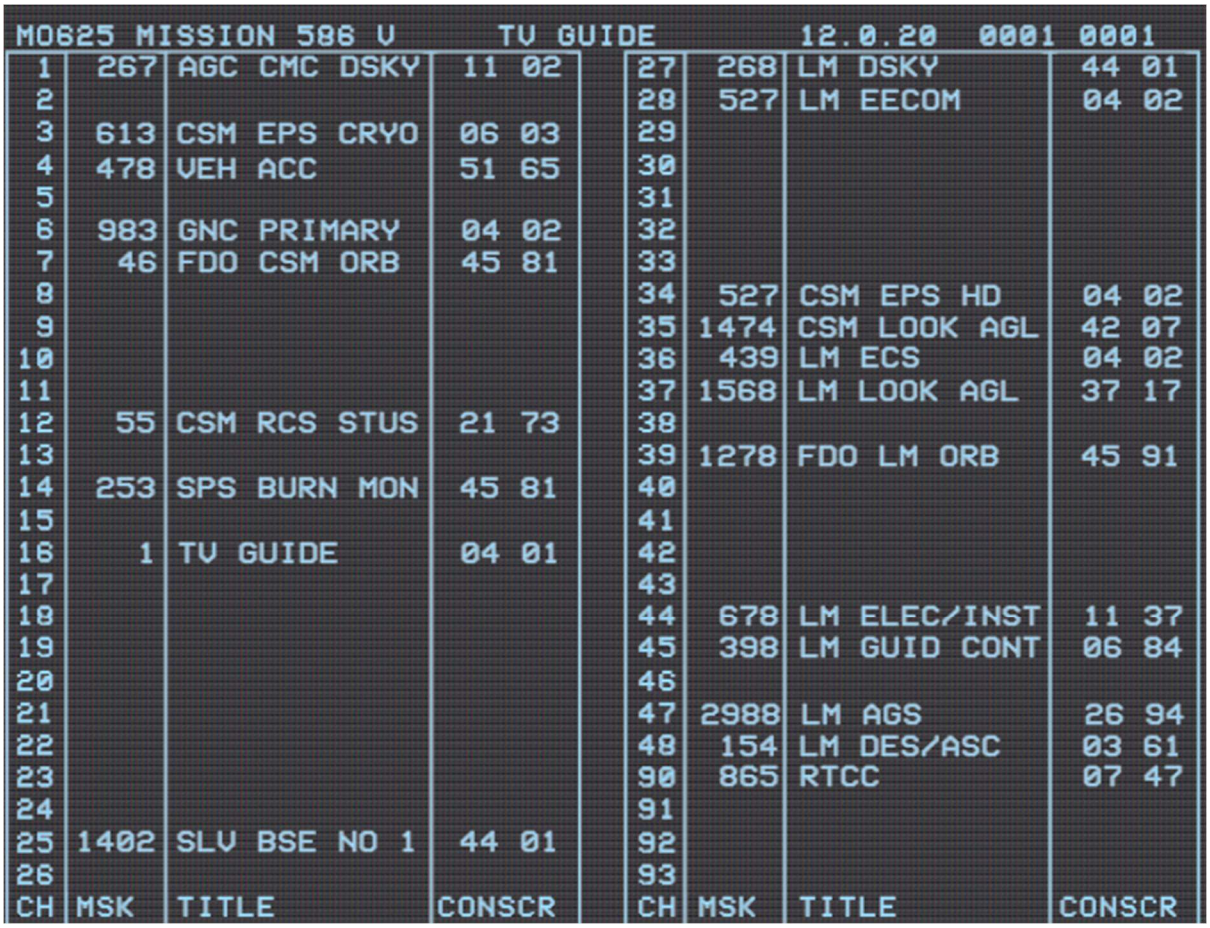
CHANNEL 07: FDO CSM ORB DATA



CHANNEL 14: SPS BURN MON



CHANNEL 16: TV GUIDE

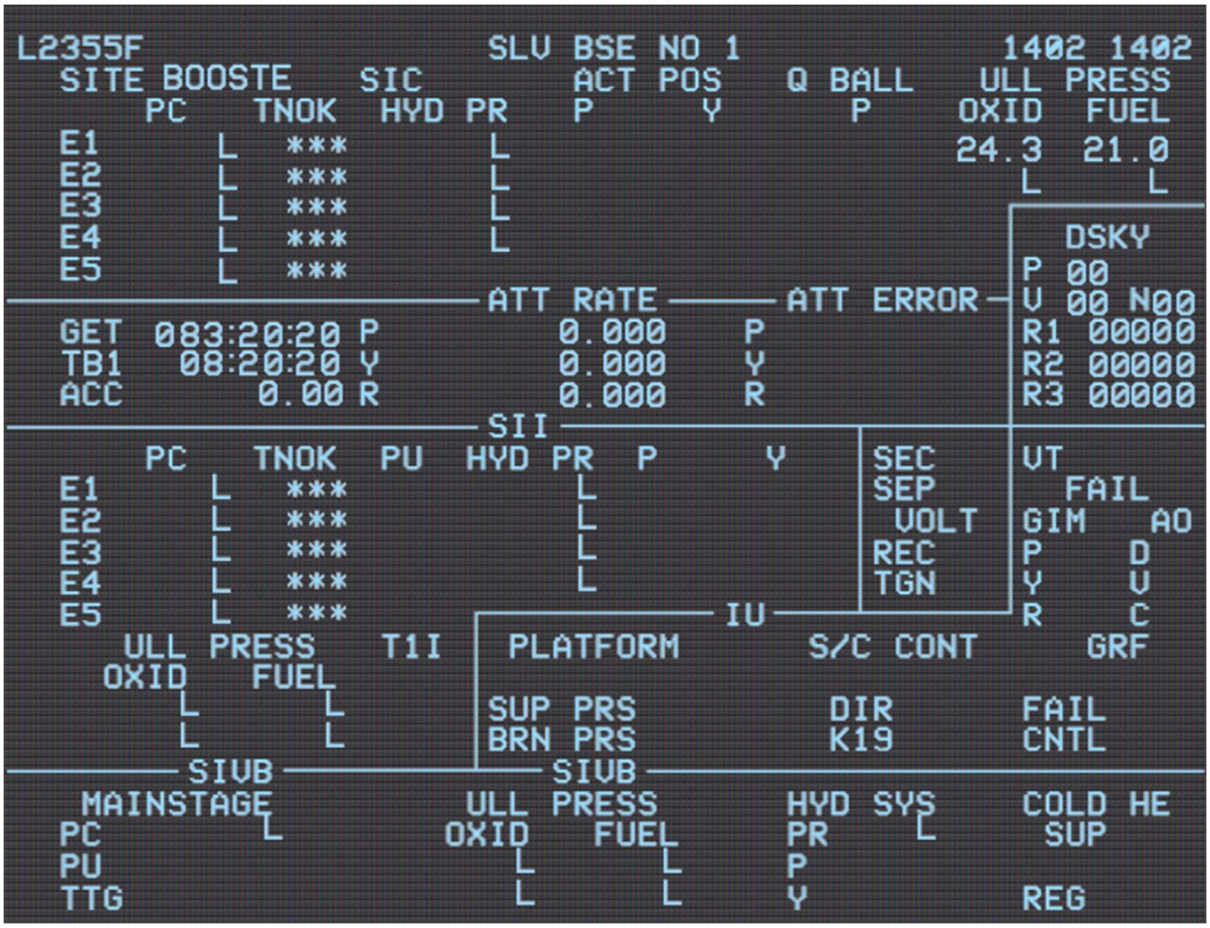


MO625 MISSION 586 V TV GUIDE 12.0.20 0001 0001

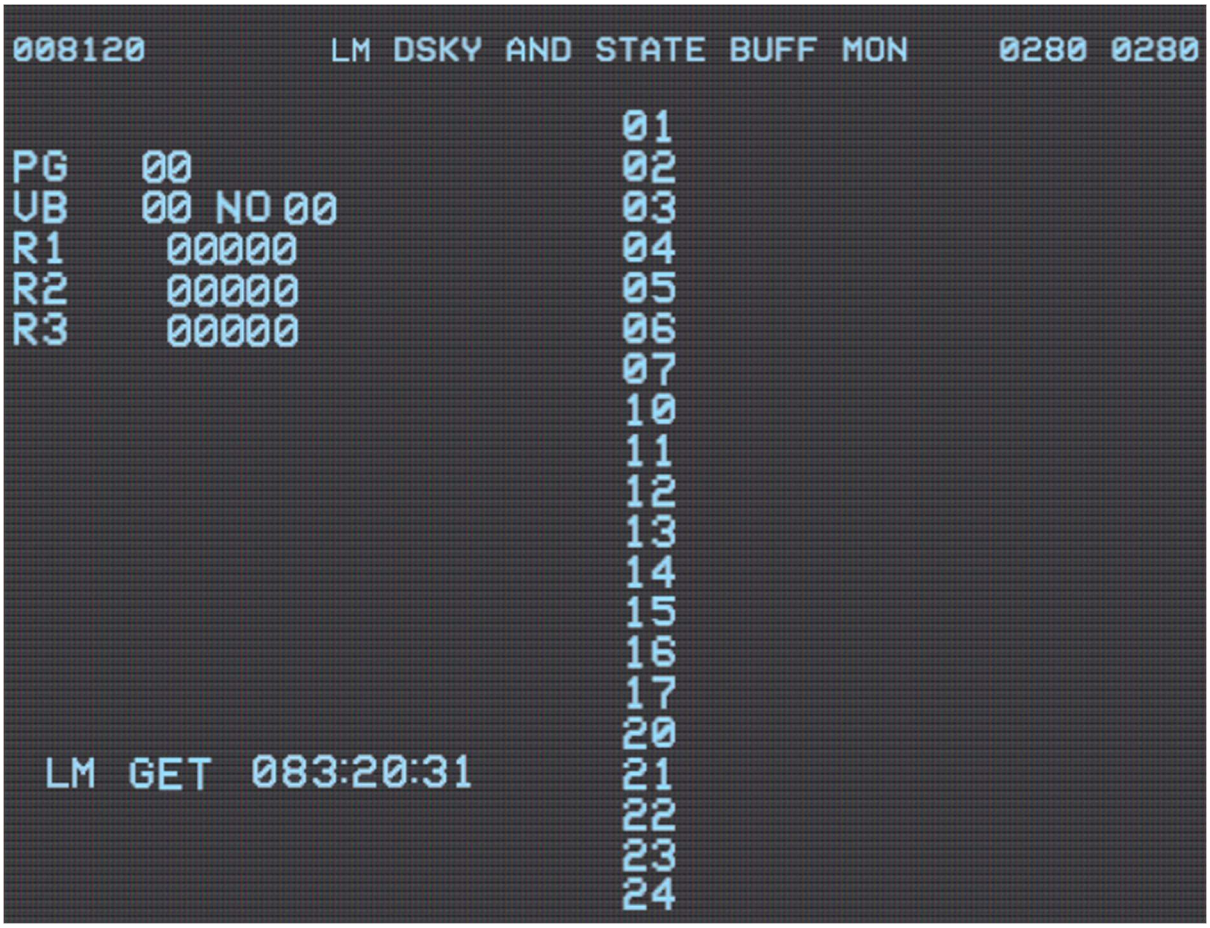
CH	MSK	TITLE	CONSCR
1	267	AGC CMC DSKY	11 02
2			
3	613	CSM EPS CRYO	06 03
4	478	VEH ACC	51 65
5			
6	983	GNC PRIMARY	04 02
7	46	FDO CSM ORB	45 81
8			
9			
10			
11			
12	55	CSM RCS STUS	21 73
13			
14	253	SPS BURN MON	45 81
15			
16	1	TV GUIDE	04 01
17			
18			
19			
20			
21			
22			
23			
24			
25	1402	SLV BSE NO 1	44 01
26			
CH	MSK	TITLE	CONSCR

CH	MSK	TITLE	CONSCR
27	268	LM DSKY	44 01
28	527	LM EECOM	04 02
29			
30			
31			
32			
33			
34	527	CSM EPS HD	04 02
35	1474	CSM LOOK AGL	42 07
36	439	LM ECS	04 02
37	1568	LM LOOK AGL	37 17
38			
39	1278	FDO LM ORB	45 91
40			
41			
42			
43			
44	678	LM ELEC/INST	11 37
45	398	LM GUID CONT	06 84
46			
47	2988	LM AGS	26 94
48	154	LM DES/ASC	03 61
90	865	RTCC	07 47
91			
92			
93			

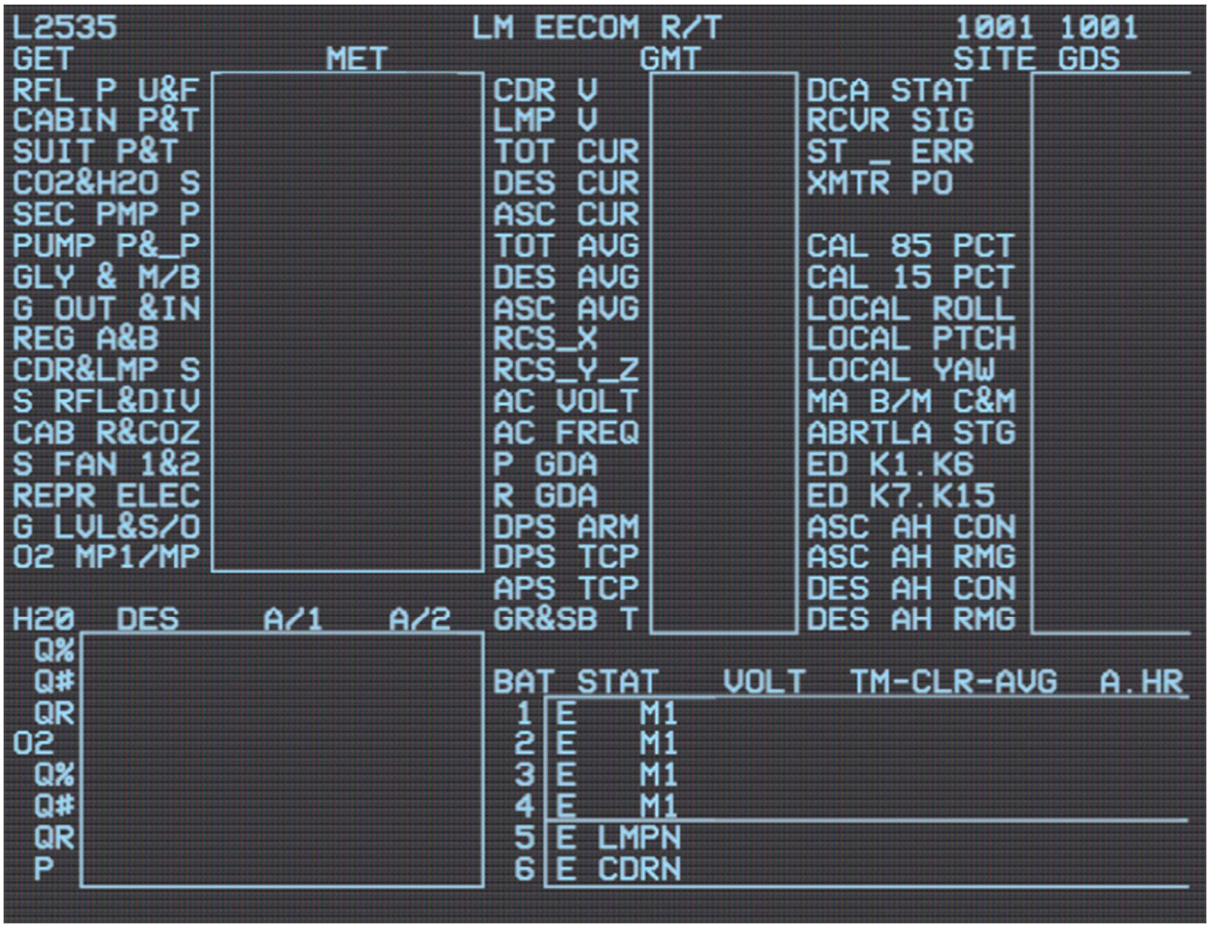
CHANNEL 25: SLV BSE NO 1



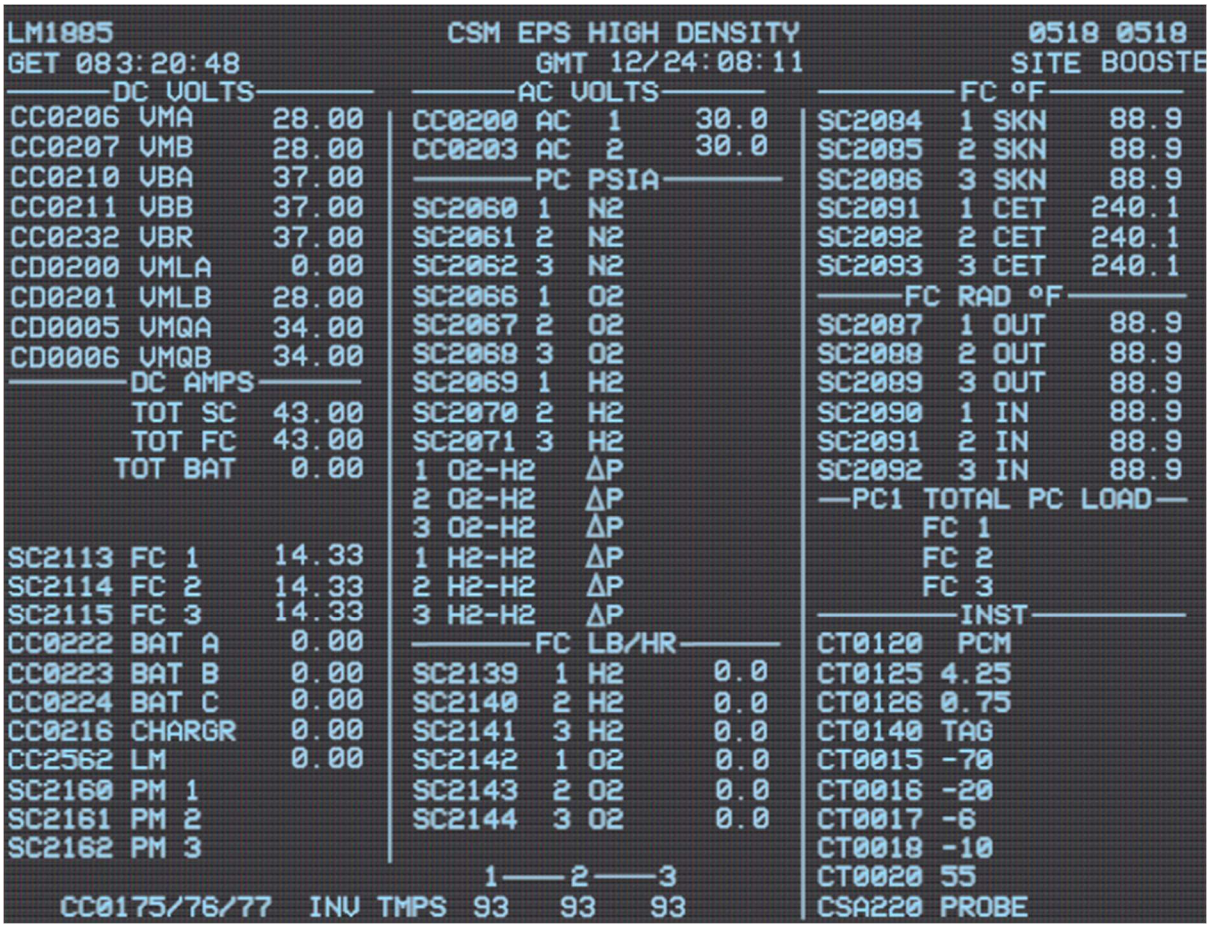
CHANNEL 27: LM DSKY



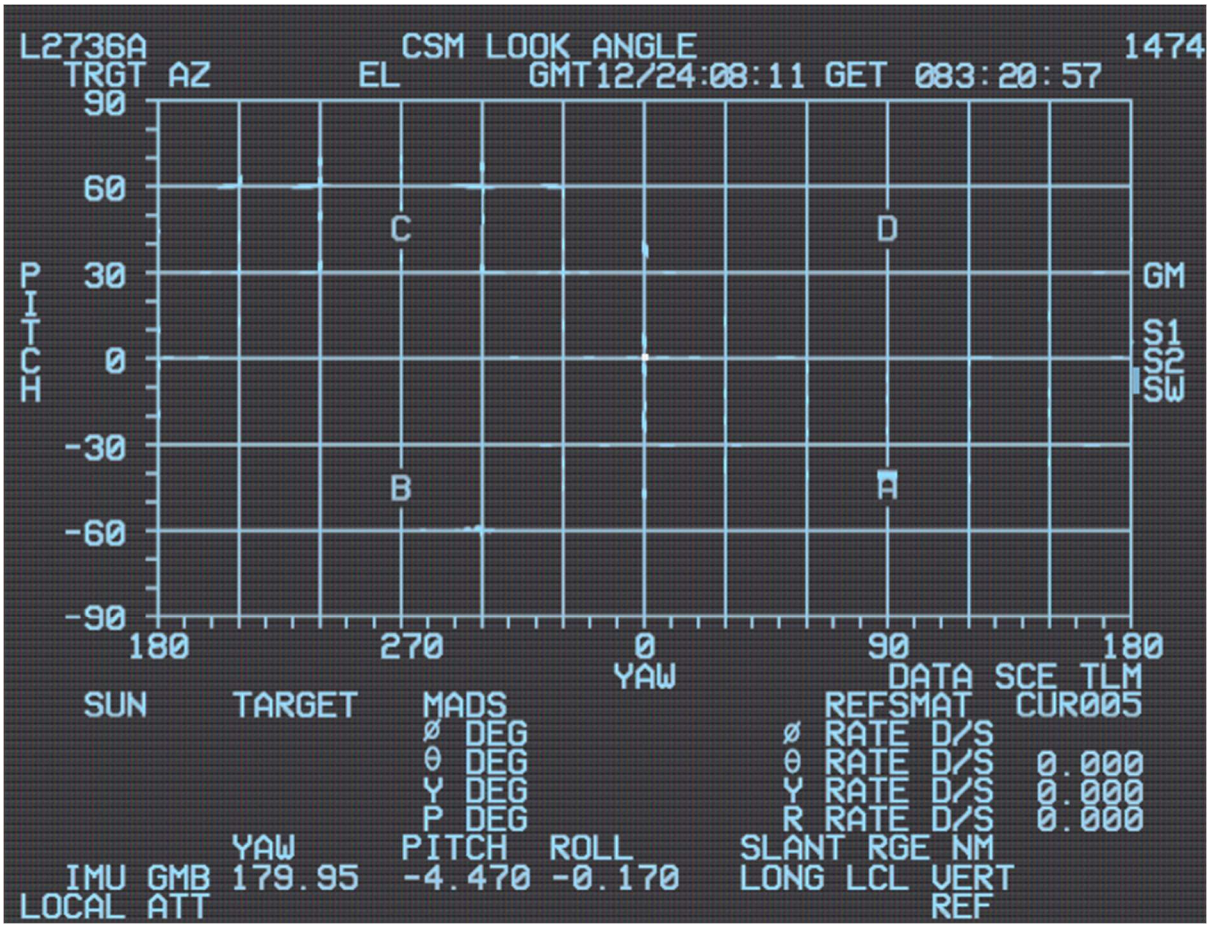
CHANNEL 28: LM EECOM



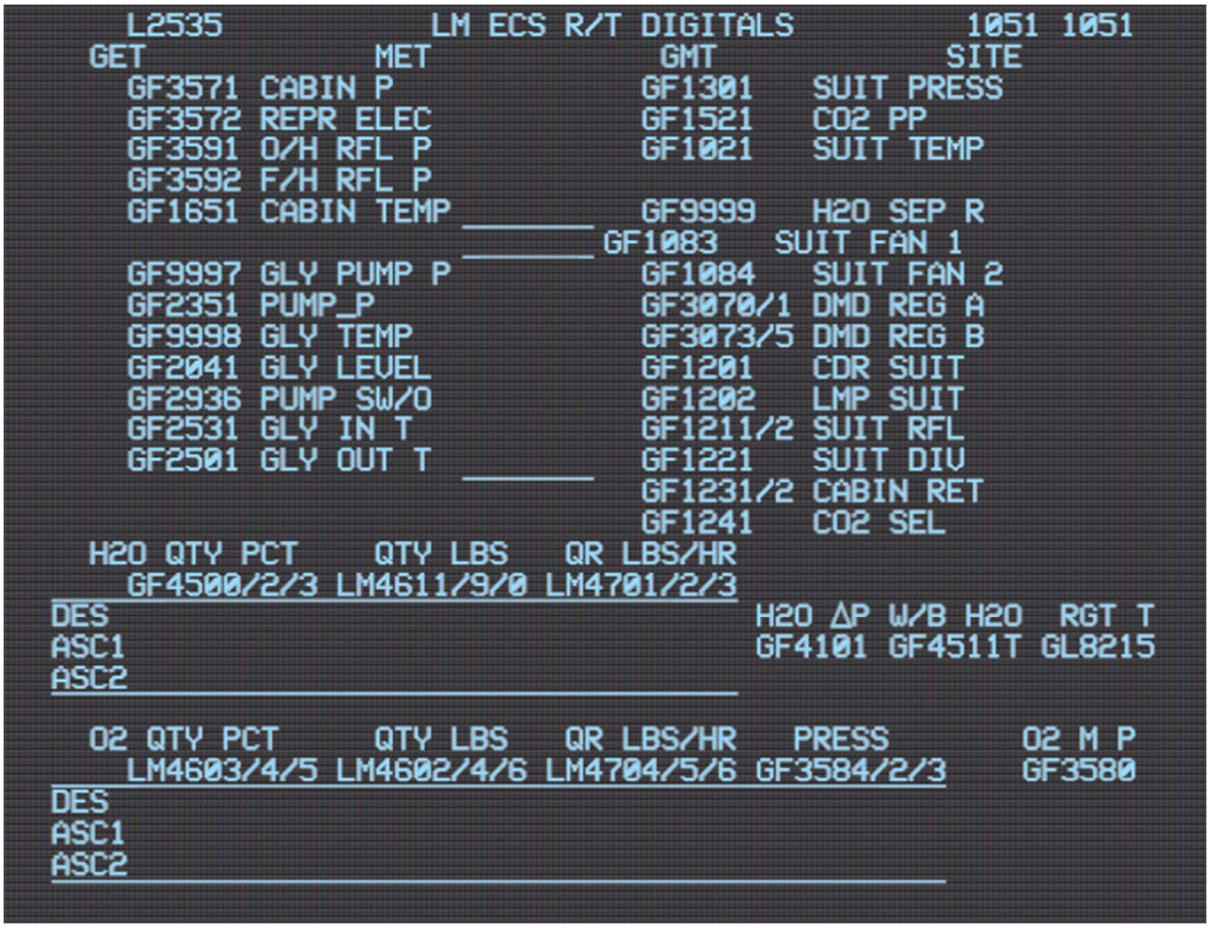
CHANNEL 34: CSM EPS HIGH DENSITY



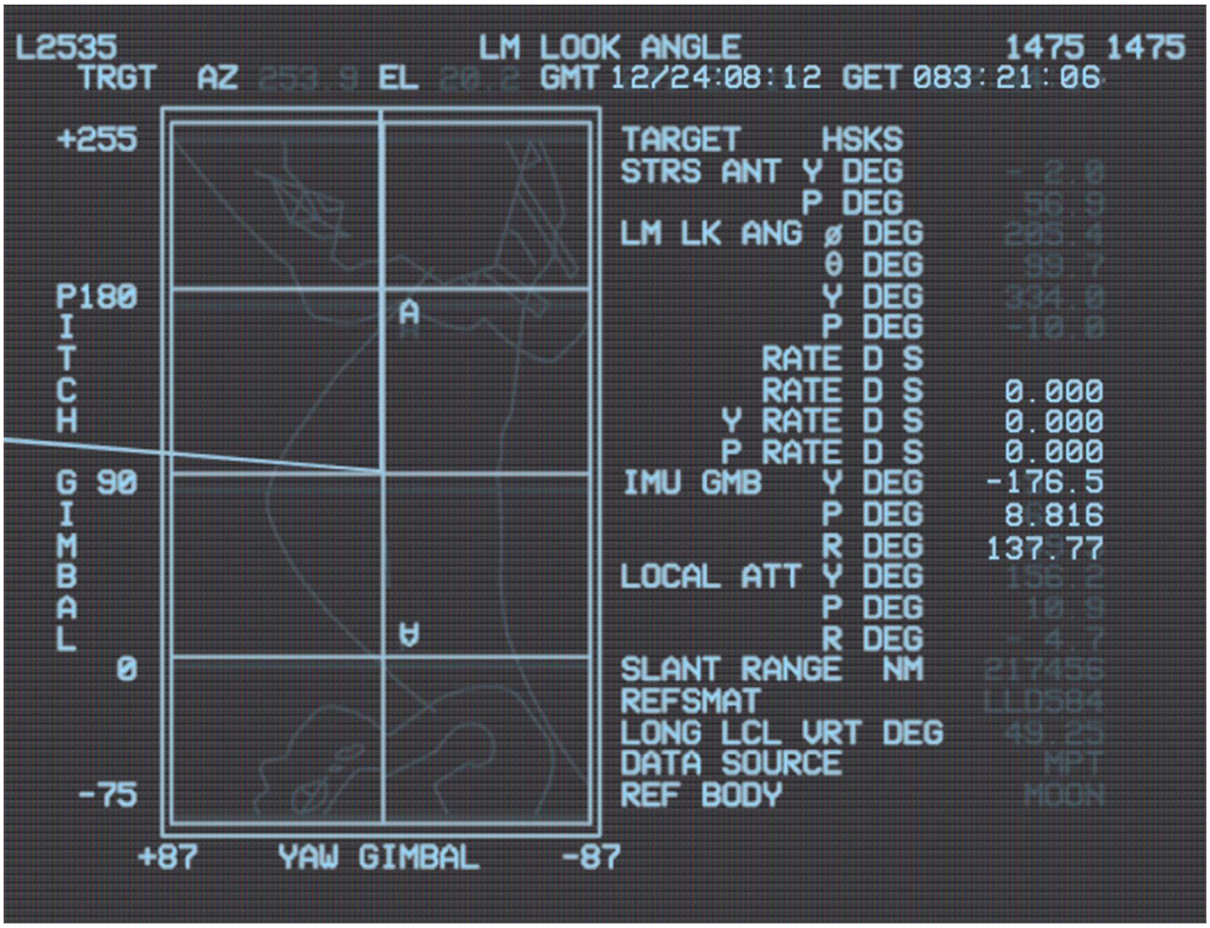
CHANNEL 35: CSM LOOK ANGLE



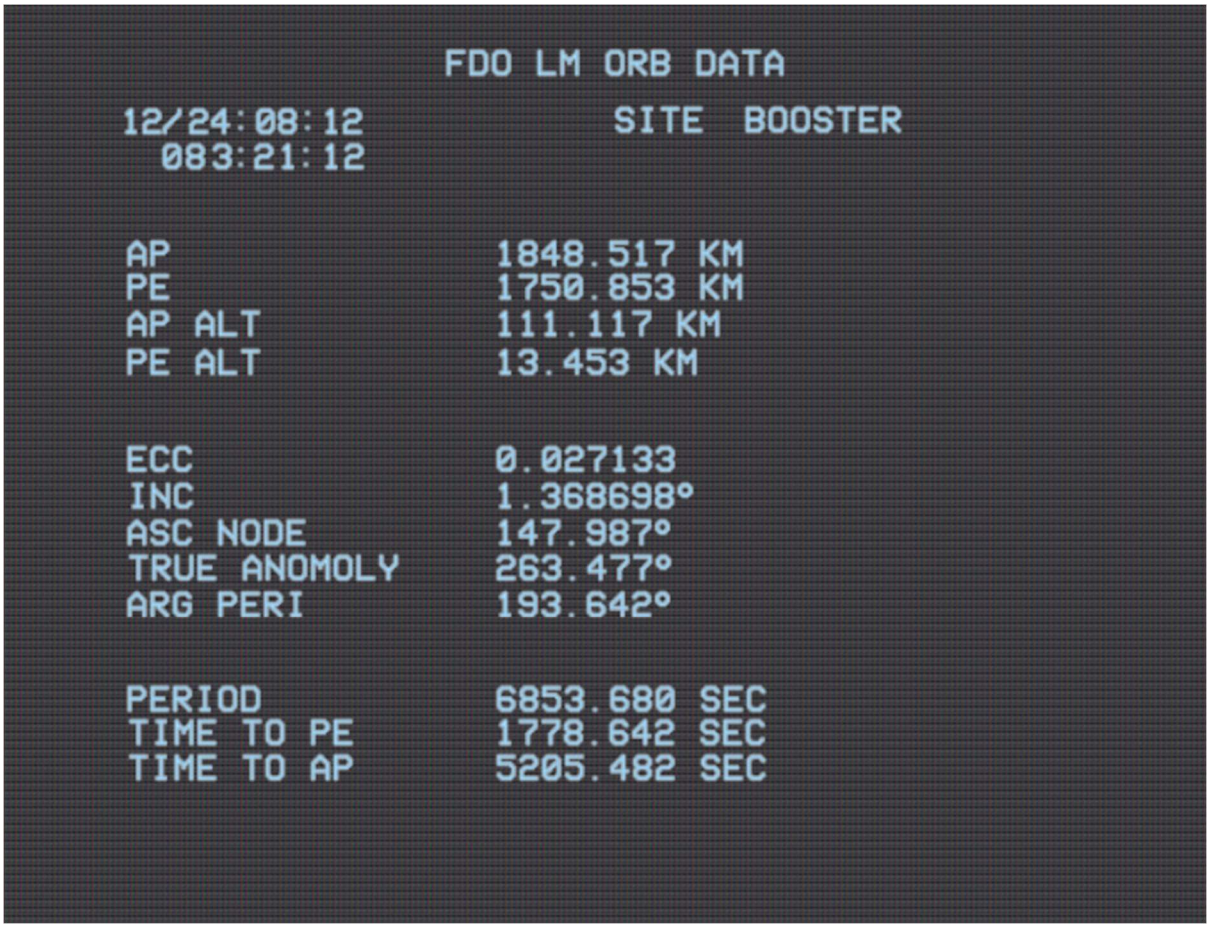
CHANNEL 36: LM ECS



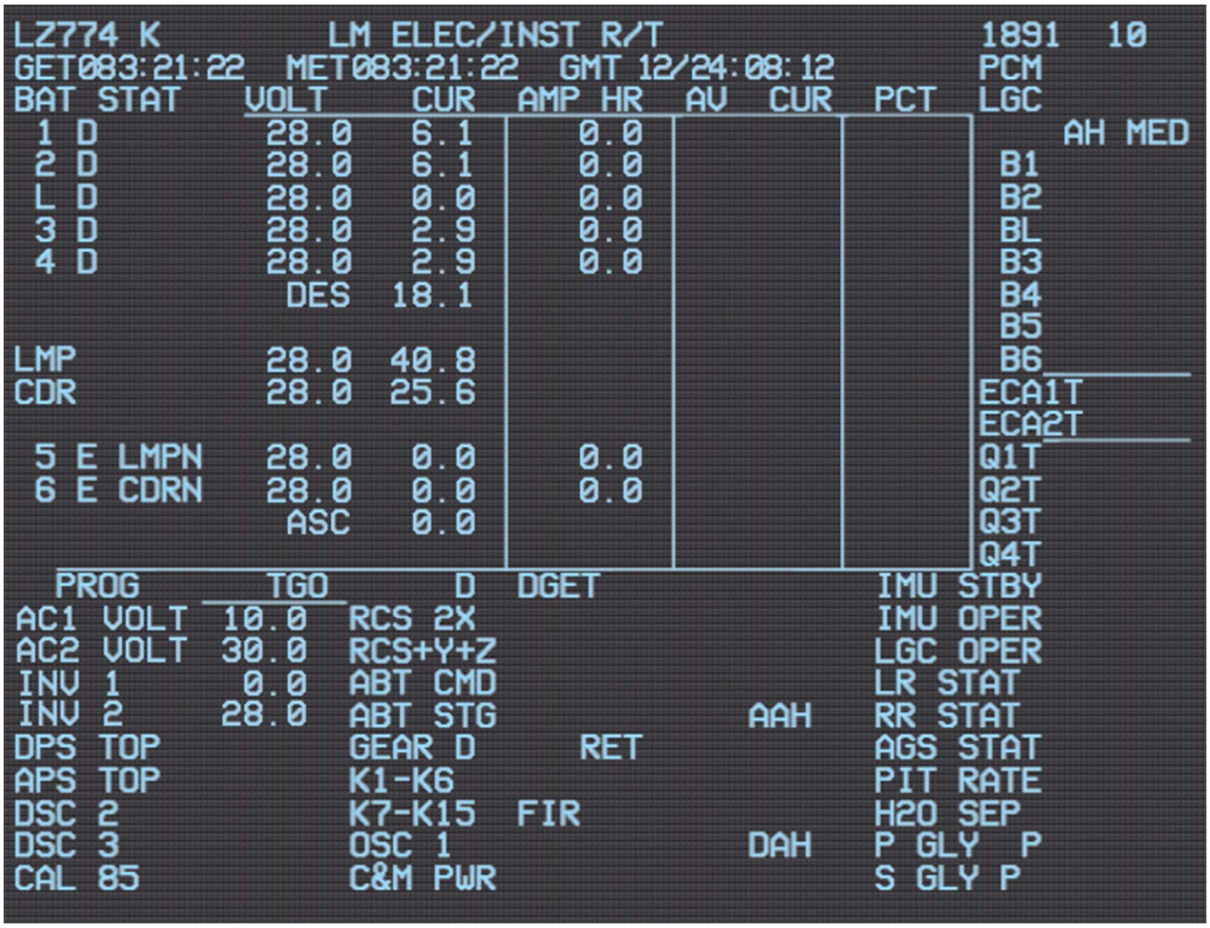
CHANNEL 37: LM LOOK ANGLE



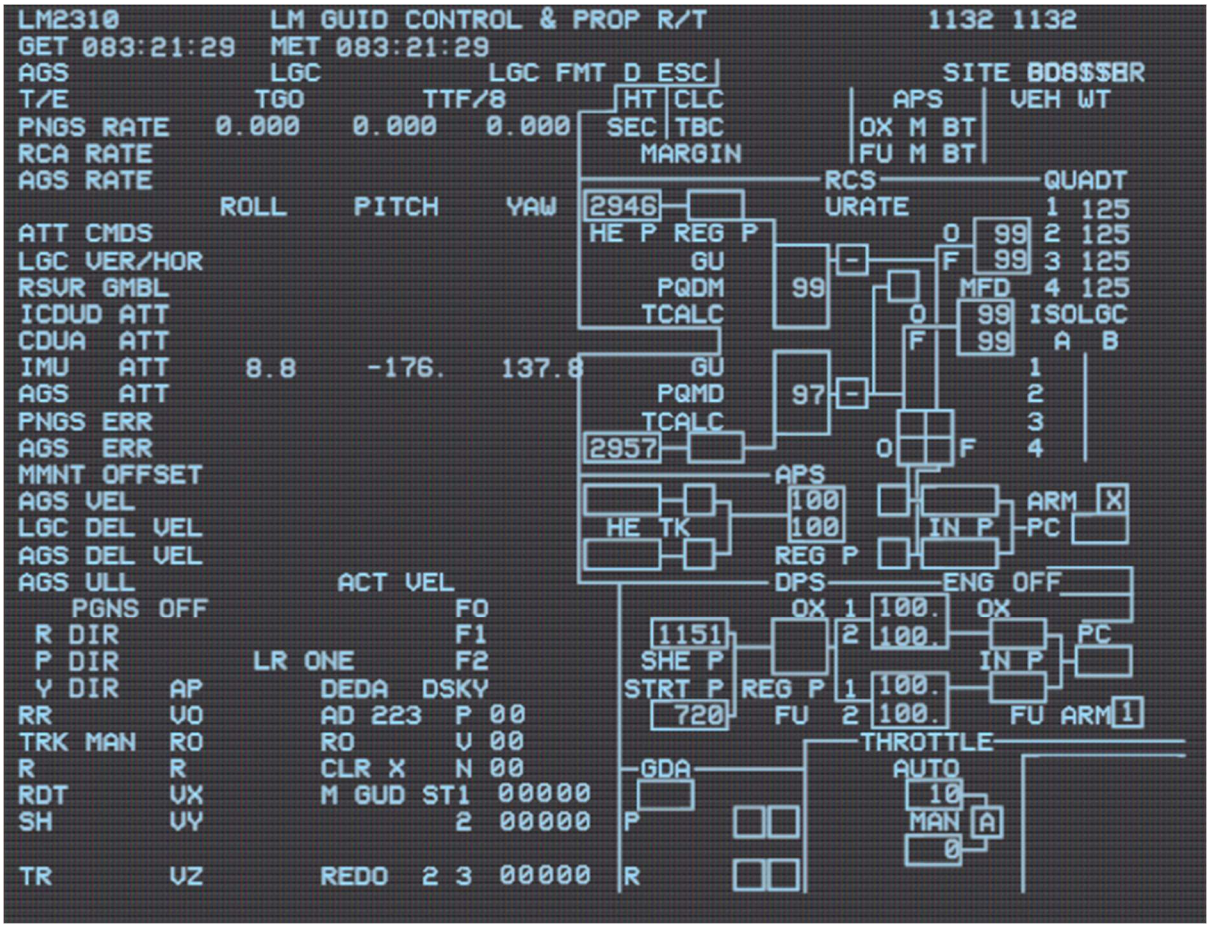
CHANNEL 39: FDO LM ORB DATA



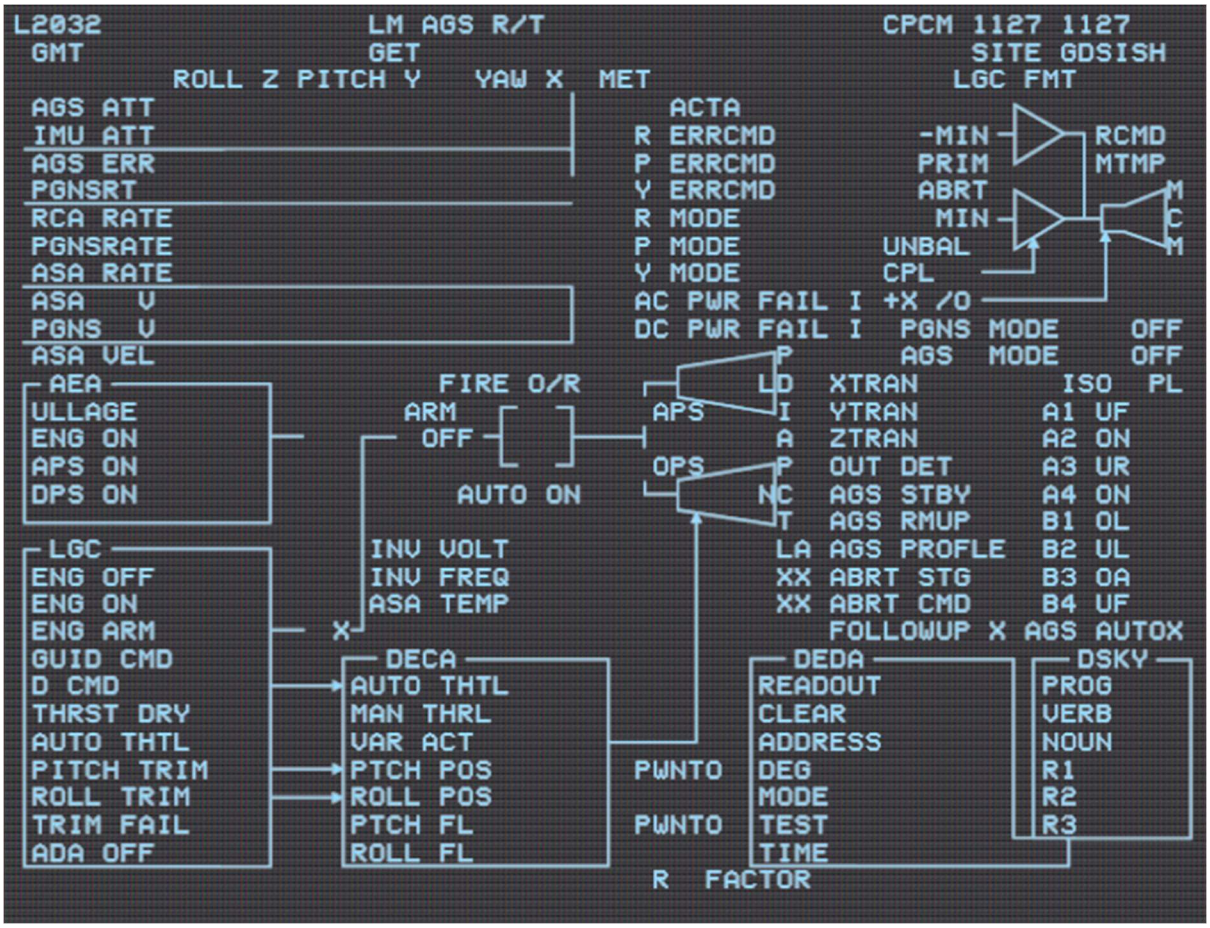
CHANNEL 44: LM ELECT/INST



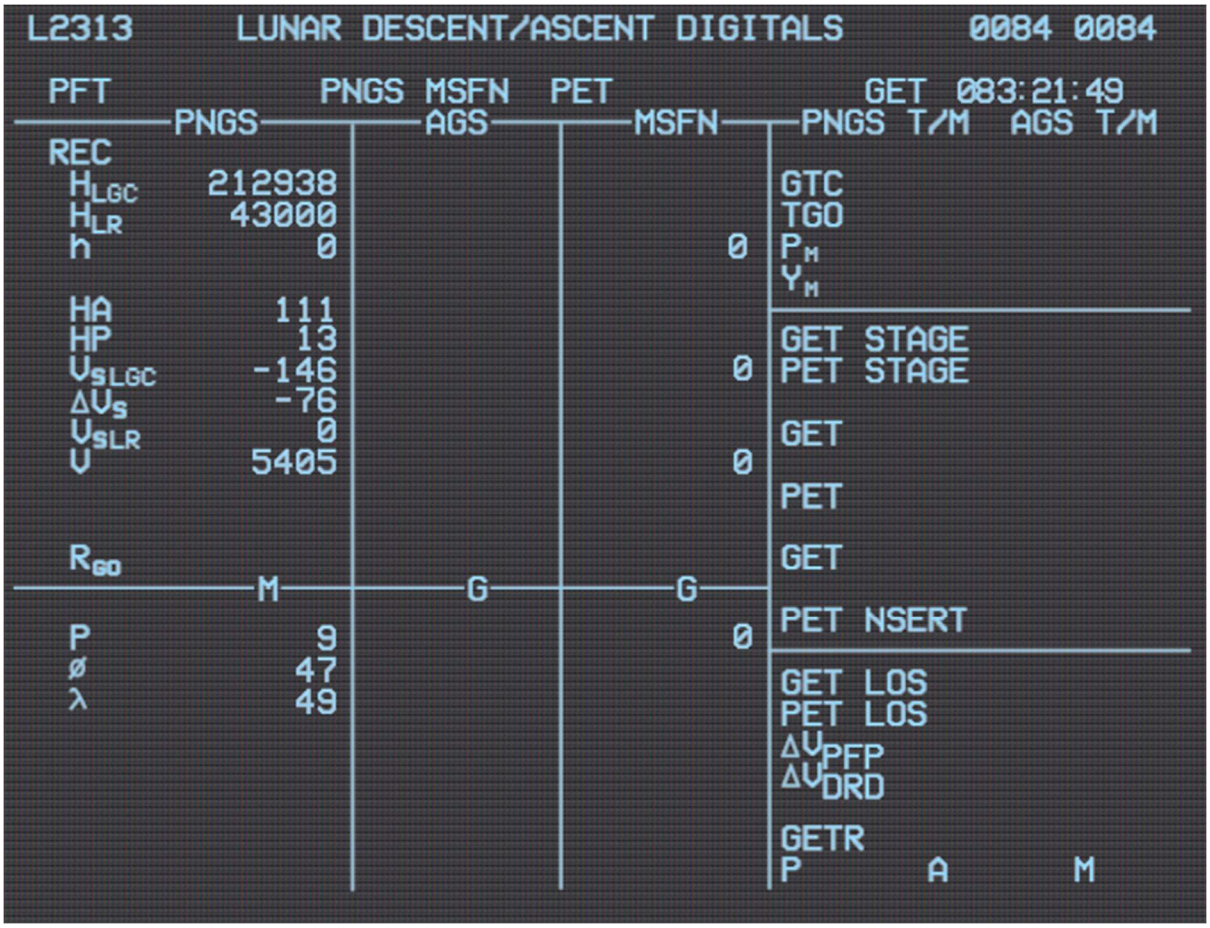
CHANNEL 45: LM GUIDANCE, CONTROL & PROPULSION



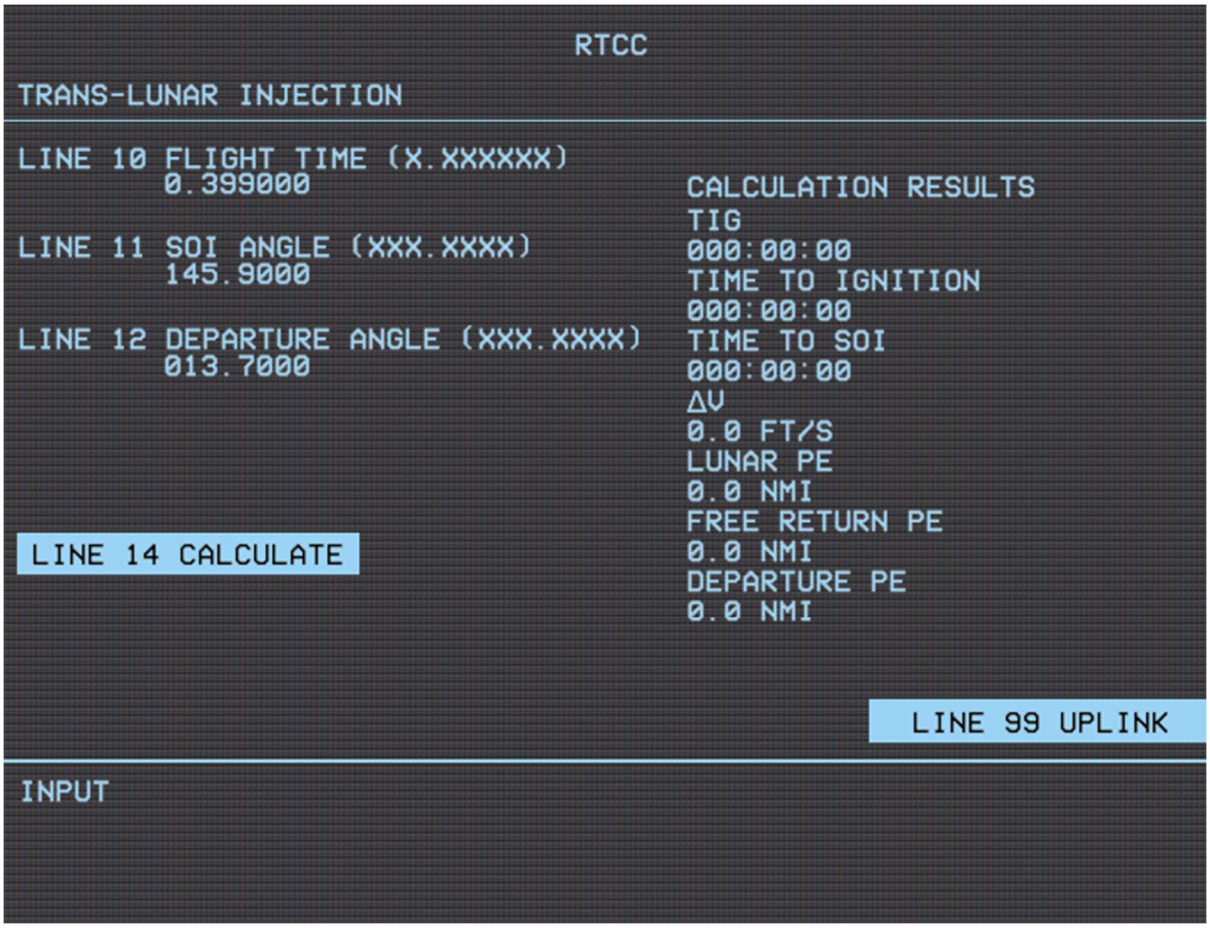
CHANNEL 47: LM AGS



CHANNEL 49: LUNAR DESCENT/ASCENT DIGITALS



CHANNEL 90: RTCC



VI. REAL-TIME COMPUTER

VI. REAL-TIME COMPUTER

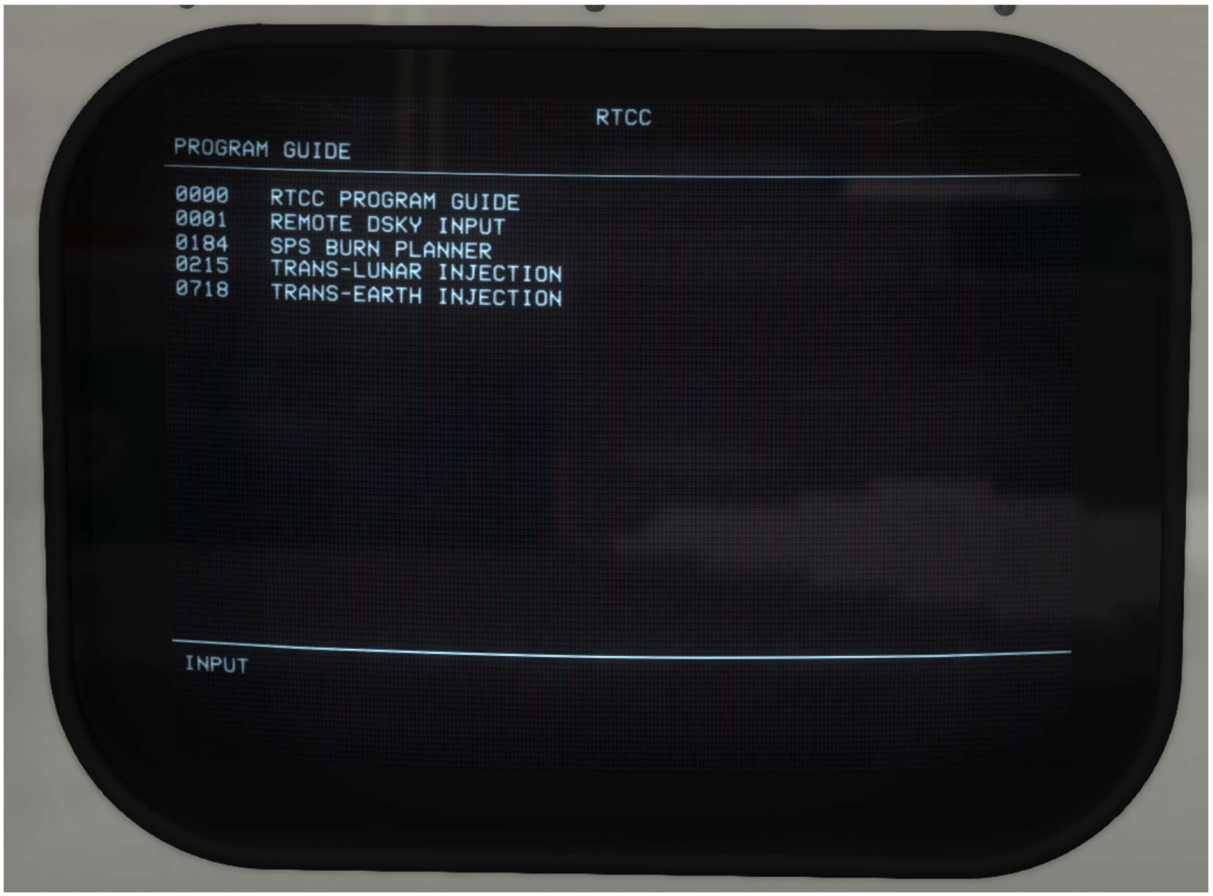
1. GENERAL

NASAs Real-Time Computing Complex, which resides at the first floor of building 30, the same building that houses MOCR 1 and 2, houses 5 IBM 360/75 computers, of which at any time 2 are used redundantly (1 active, 1 hotswap) to support the flight, while the others are used for sims, experiments, etc, and can be swapped in to replace one of the two flight support computers. Data from the RTCC is primarily fed into the display control system, including the television slide display, which is responsible for controlling the overlays used in the above-mentioned TV-system.

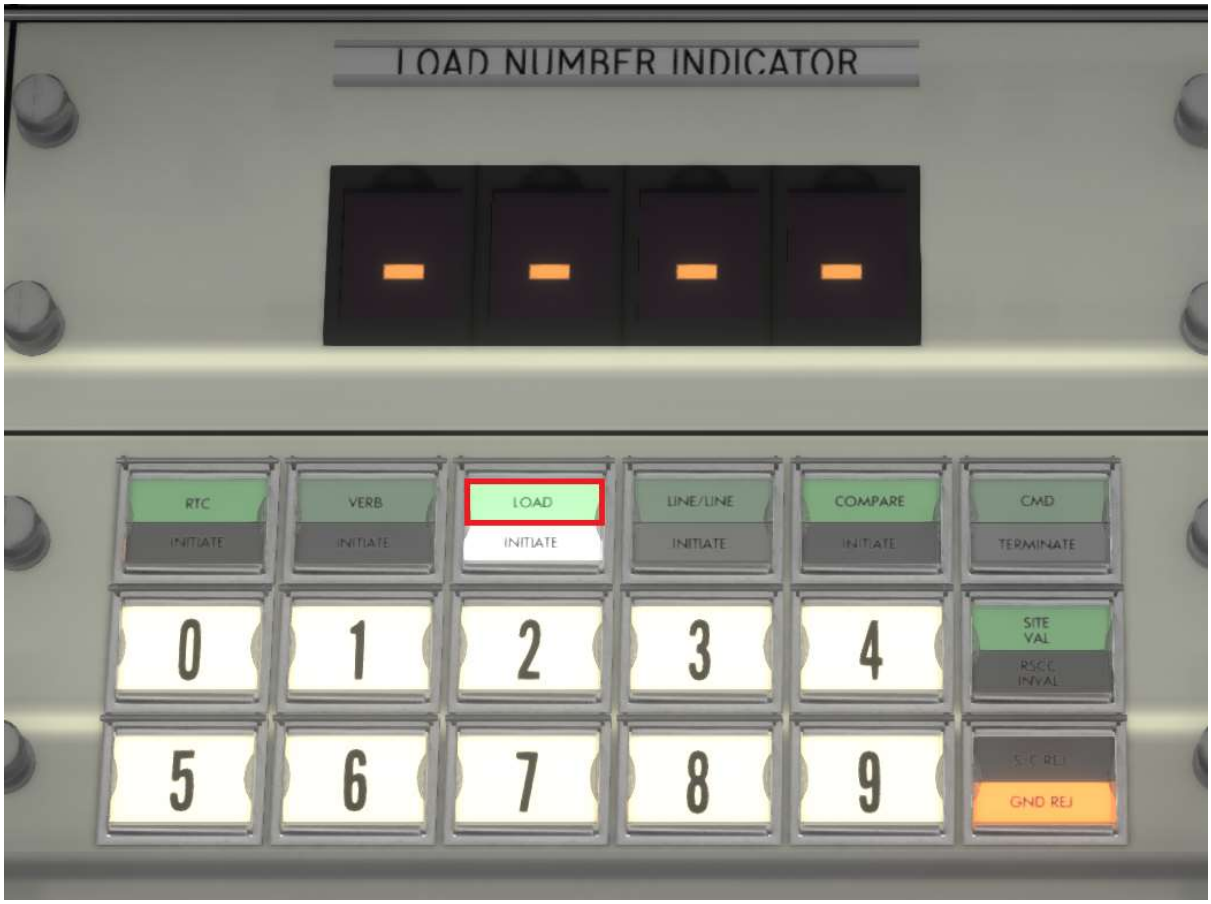
2. OPERATION

The RTCC is operated through the Program Request and keyboard module located on the GUIDANCE and BOOSTER desks.

The RTCC has a dedicated TV CHANNEL. Tune in to Channel 90 on a monitor to view it. The default program is 0000 – The Program Guide.

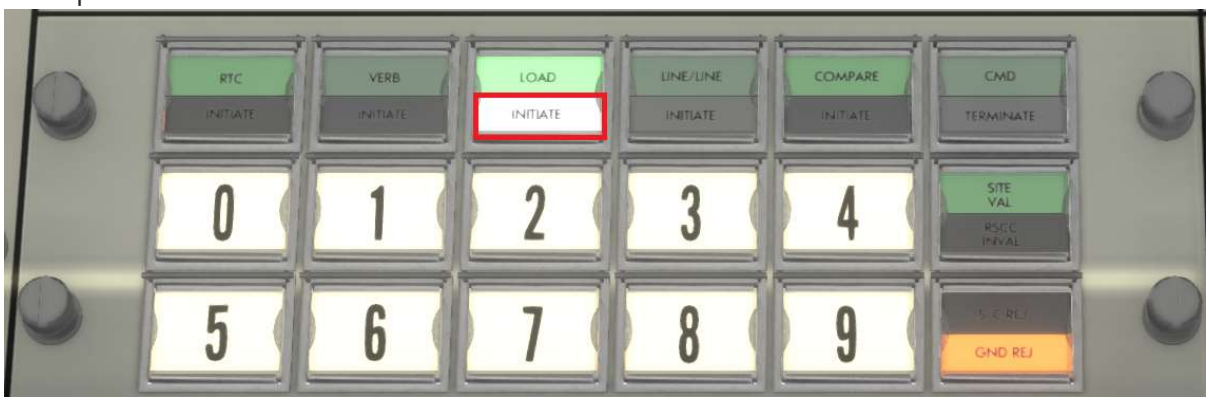


To select a program to run on the RTCC, you will need to perform a Program Request using the LOAD NUMBER INDICATOR. This requires you to enter 4 digits, including leading and trailing zeros. To let the module know you wish to enter data, press the green LOAD button:



The four digits on the LOAD NUMBER INDICATOR blanks. You will then need to enter 4 digits. Press 0 0 0 1 as indicated in the screenshot below.

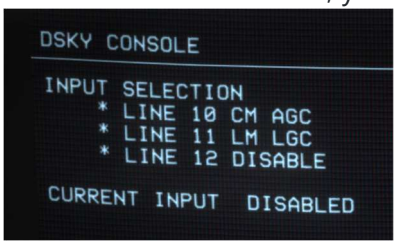
Then press the white illuminated INITIATE button below LOAD:



This will start program 0001 – DSKY CONSOLE.

This will let you send DSKY commands to the AGC and the LGC. It is currently disabled, and the astronaut will need to set UPL TLM to ACCEPT for it to work.

On the screenshot above, you can see that the program has an INPUT SELECTION.

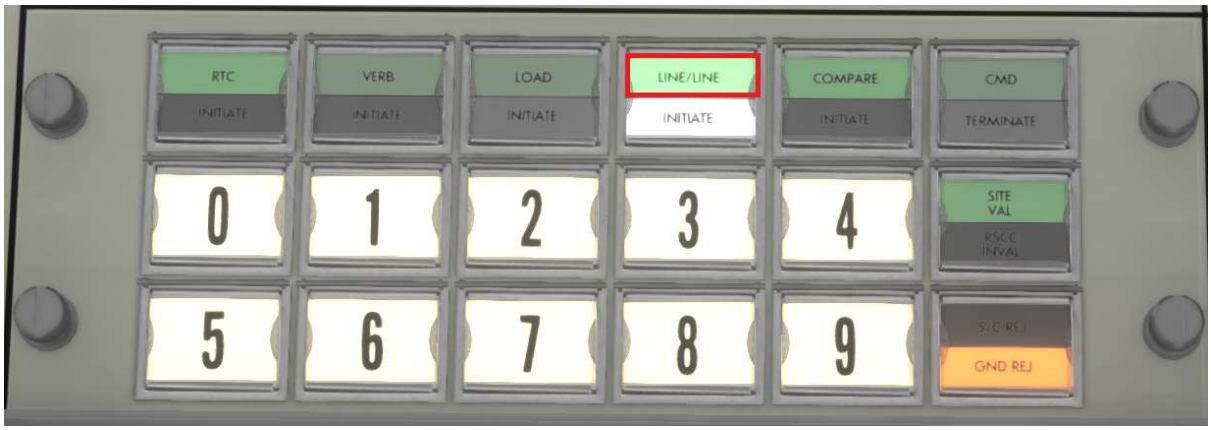


This is a toggle. Notice the LINE indicator, and the ID behind it.

The way you interact with the RTCC is by selecting the LINE you wish to modify by using the ID behind it. Toggles only have an ID, but some can have numbers as well.

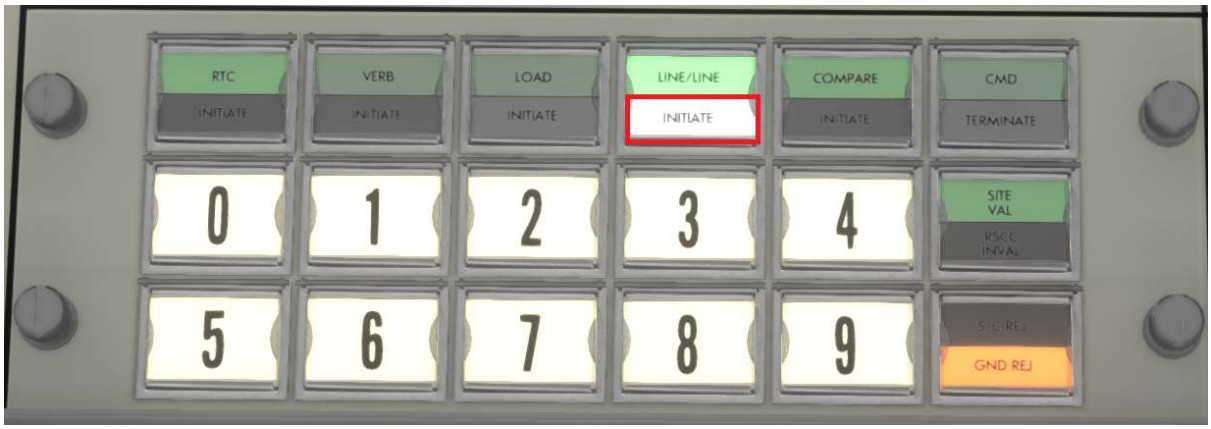
Let's try to set LINE 10, CM AGC.

On the RTCC, press the LINE/LINE button:

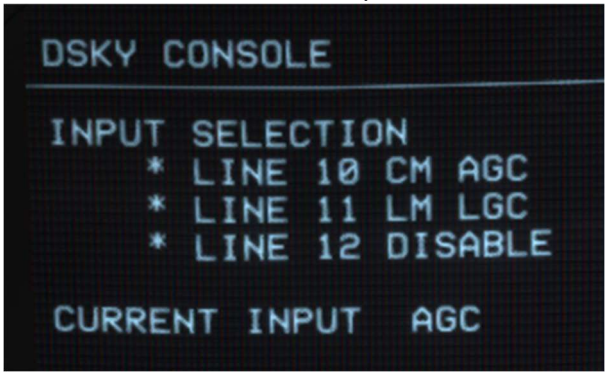


Then enter **1 0** on the keyboard. The input can be seen on the scratch pad on the monitor:

Then hit INITIATE below the LINE/LINE button to send the command to the RTCC.



You can now see that the input device selected is the AGC:



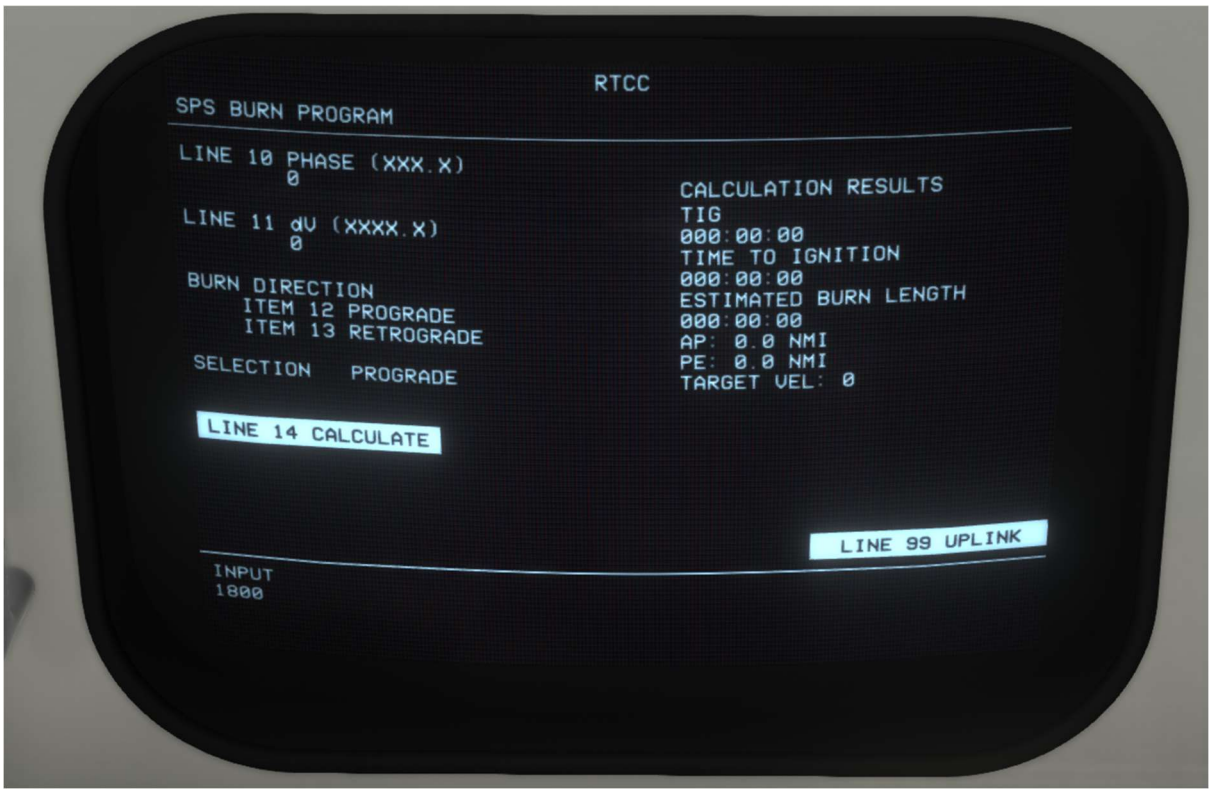
Let's take a look at a more advance program input method.

In the SPS BURN MONITOR, some of the parameters needs a number:

Line 10 in this case expects 4 digits. The (XXX.X) text indicates the expected format. There is no decimal keyboard button, so you will need to provide the input as indicated by the format. In this case, PHASE is in degrees, and can be set to a number between 000.0 and 360.0.

To input a parameter here, first press LINE/LINE and enter 1 0, then press INITIATE. The INITIATE button returns to gray, but the LINE/LINE button remains illuminated.

Insert **1 8 0 0** and verify the input on the monitor, and cross-check with the format. Format was XXX.X meaning that 1800 equals to 180.0 degrees.



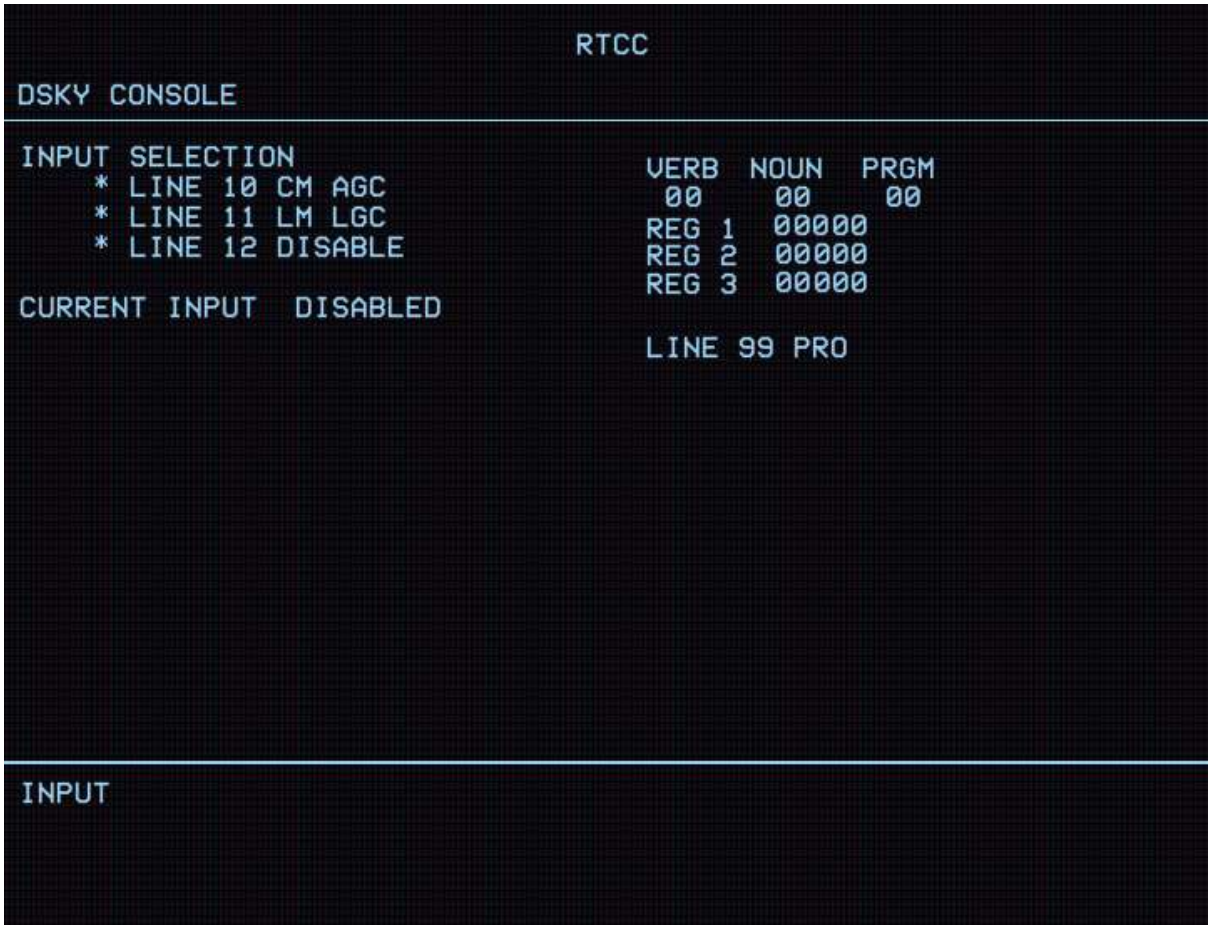
Then press INITIATE again to insert the variable. The green LINE/LINE button will extinguish and the parameter should be inserted.

3. PROGRAMS

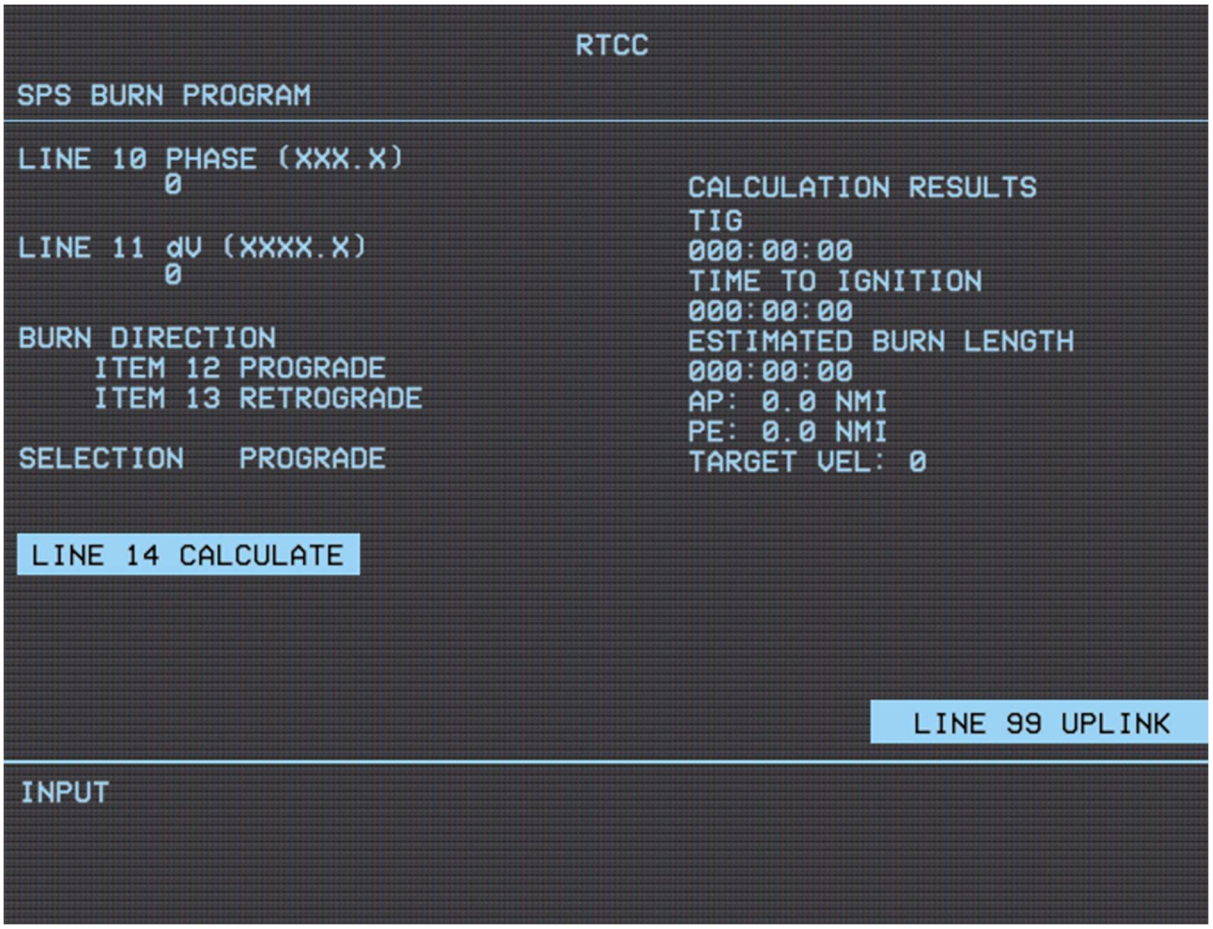
This section contains a description of all the supported programs on the RTCC.

3.1 PROGRAM GUIDE

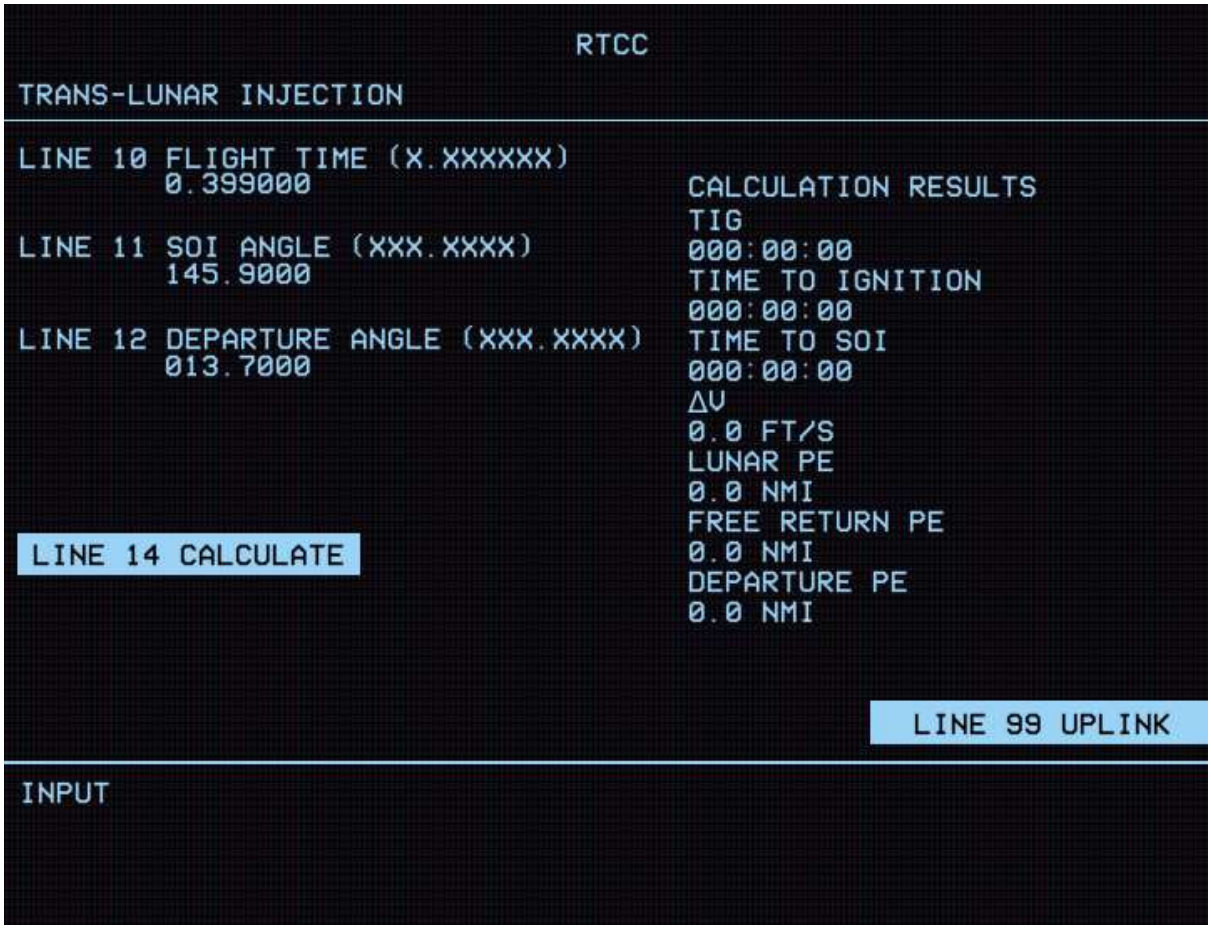
3.2 DSKY PROGRAM



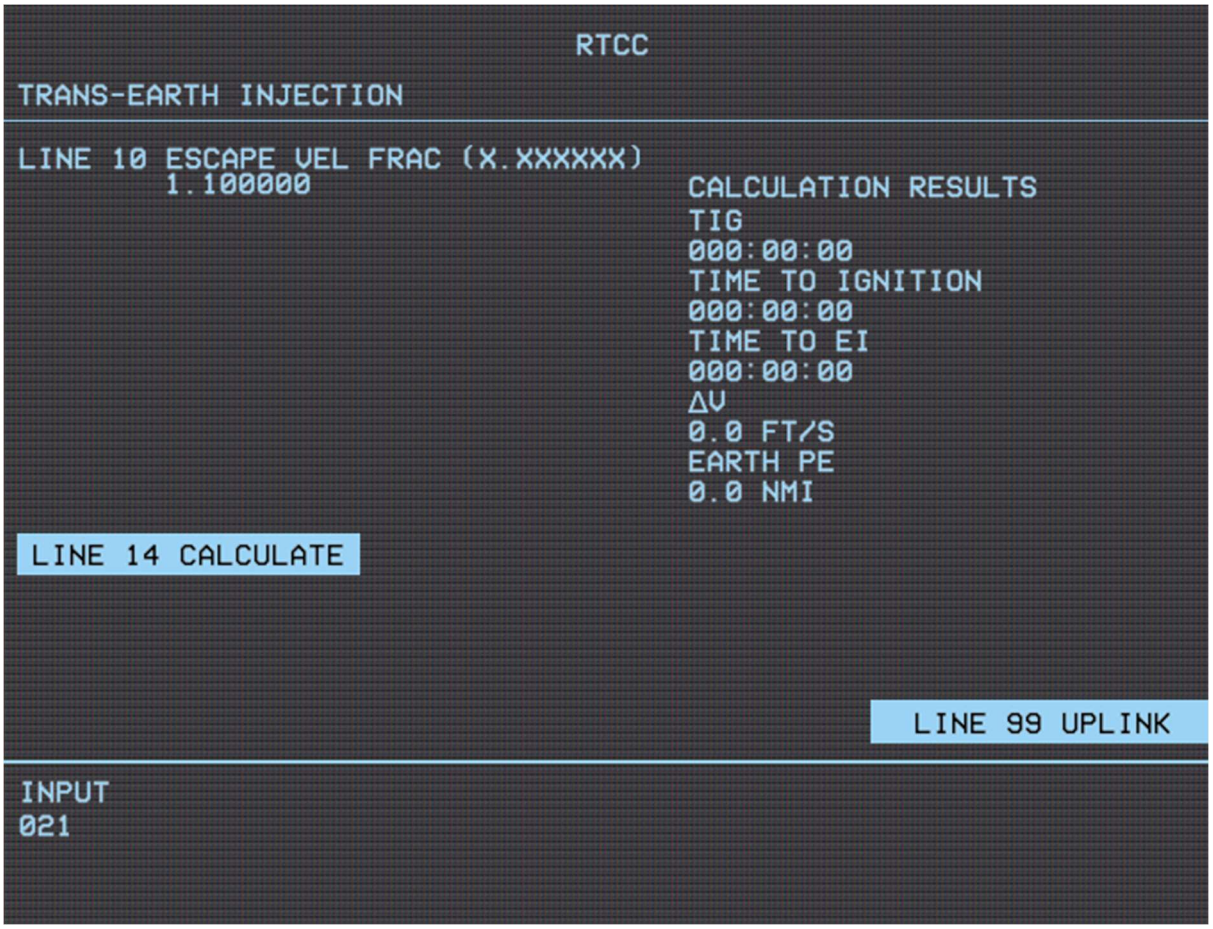
3.3 SPS BURN PROGRAM



3.4 TRANS-LUNAR INJECTION PROGRAM



3.4 TRANS-EARTH INJECTION PROGRAM



VII. FLIGHT DIRECTOR

VII. FLIGHT DIRECTOR

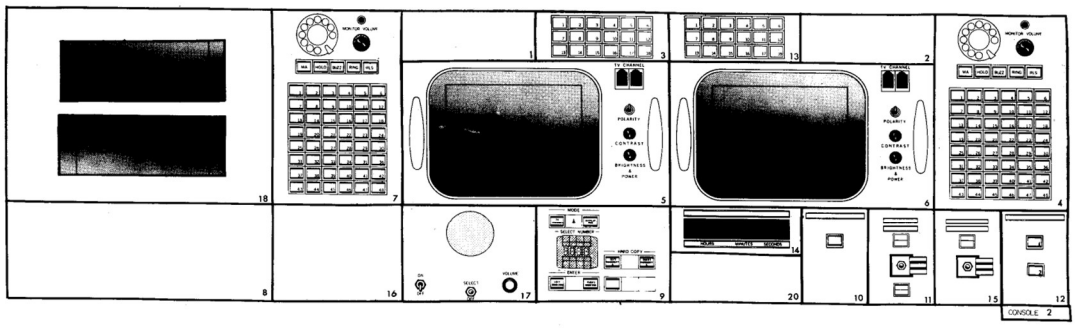
1. GENERAL

The flight director, or commonly known as FLIGHT, is the leader of the mission. FLIGHT has the responsibility of the safety of the crew and the success of the mission. FLIGHT has the ability to trigger the Abort A or B signal, as well as cancelling either the A or B signal. More on abort later.

1.1 THE DESK

03-26-71

LOC	DESCRIPTION	TYPE	NOTE	LOC	DESCRIPTION	TYPE	NOTE
01	BLANK PANEL	D11/6		11	TOGGLE SWITCH/INDICATOR/SW.	D9/9B	
02	BLANK PANEL	D11/6		12	TWO PBI SWITCH	D9/4D3	
03	EVENT INDICATOR	D9/5B		13	EVENT INDICATOR	D9/5BU2	
04	VOICE COMM POSITION-3002	V48MFD		14	7 DIGIT CLOCK	D8/3	
05	TV MONITOR 14" PRECISION	C2/1		15	TOGGLE SWITCH/INDICATOR	D9/10C	
06	TV MONITOR 14" PRECISION	C2/1		16	BLANK PANEL	D11/14	
07	VOICE COMM POSITION-3003	V48MFD		17	VOICE COMM SPEAKER	C1/1	
08	BLANK PANEL	D11/16		18	SHELF PANEL (2)	C5/1	
09	MANUAL SELECT KEYBOARD	A6A/1		20	BLANK PANEL	D11/6	
10	SINGLE PBI SWITCH	D9/4A1					



TR155 I-02-02-01

FLIGHT DIRECTOR
CONSOLE NO. 02
ROOM NO. 330

FCOB DATA PACK III.02.02.01

The layout of the desk can be seen in the drawing above. It has two monitors that can be configured to any channel as needed by the mission phase. In addition, MOCR has installed another panel that can be used to control the countdown (from the Gemini Control Room).

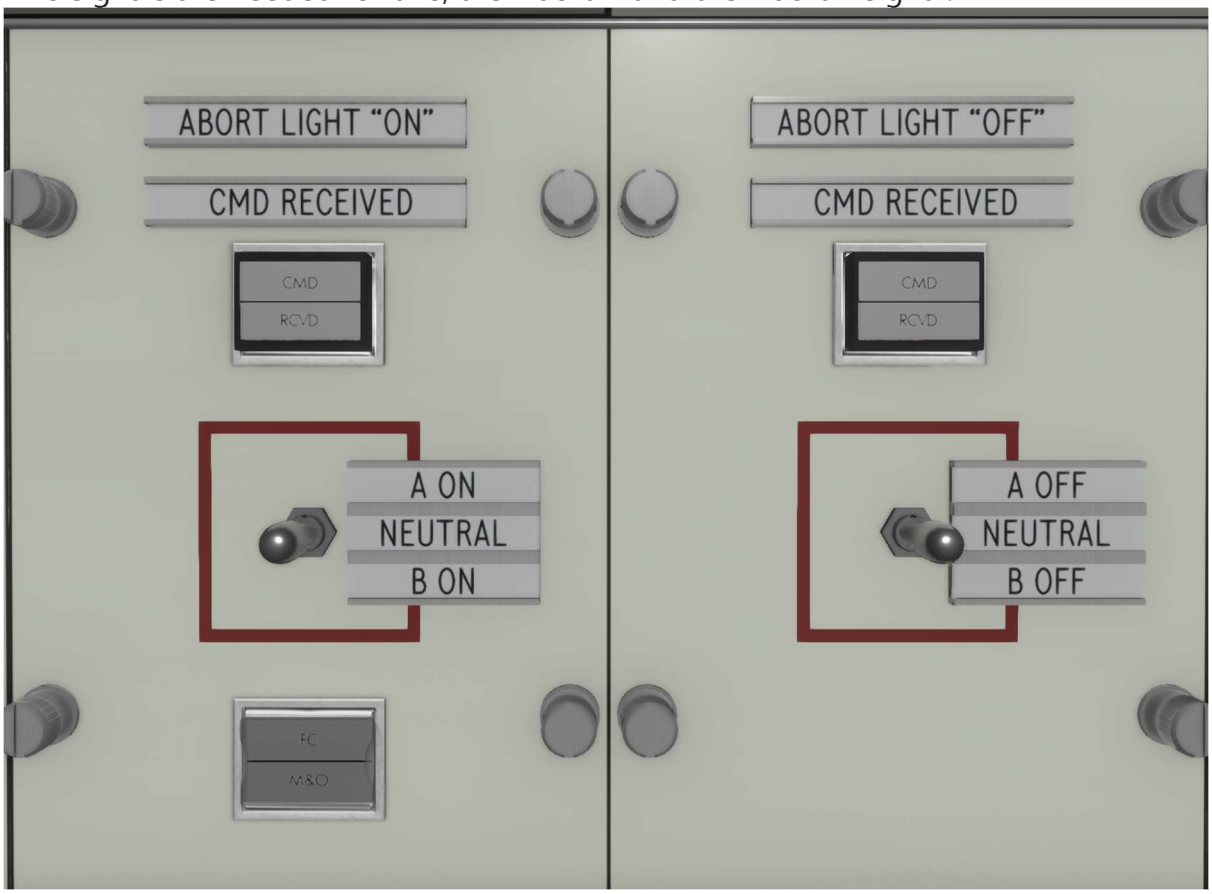
The HOLD and PROCEED indicators control the countdown timer.

This is only used during countdown. It is useful to stop the countdown when you join a mission that starts from the launch pad, as people join in and get seated.

Another important panel for FLIGHT is that status of each of the seats. In this case, most seats are set to amber, and CAPCOM is set to GREEN. Unoccupied stations are unlit. Each desk has a light in this panel. It can be Amber (seat is occupied), Red

(NOGO), or Green (GO).

In case of an abort, the flight-director presses the abort-buttons, which lights the abort-light in the capsule. This is the que for the astronaut to pull the abort handle. Two signals are needed for this, the Abort A and the Abort B signal.



FLIGHT can trigger one of the signals, A or B by setting the ABORT LIGHT ON switch to A or B. FLIGHT can also cancel a signal by using the ABORT LIGHT OFF switch.

1.2 OPERATION

The Flight Director oversees the mission. Often referred to as FLIGHT with primary role of leading the mission, the team, and have final call on decisions. The role is mainly focused on the information received over the intercom, and discussions with the other mission controllers. FLIGHTs eyes and ears are mostly focused on the room, and not in the station. Therefore, the seat is placed in the middle of the room with a good view of the map and the other stations.

Flight should have a good understanding of the flight plan (if any), knowledge of the spacecraft as a complete vehicle, and quickly be able to understand if something seems abnormal in any way. FLIGHT has to rely on information between other mission controllers, and should also lead the room when people are joining, such as roles, and how everyone should behave in the room, how the interaction between the room and the Astro should work (CapCom only?), or even set up rules such as setting desk to amber, what intercoms to use for voice (all in one, or each in their own intercom, and then be able to filter the room with the yellow buttons, etc.)

With exception of the intercom, the station has some tools that are frequently used. The map itself is in a good distance to quickly take a glance at the information available, as well as the projectors on the left and right side of it.

A good FLIGHT leads the room, keeps the order, and makes sure the mission is progressing according to plan. FLIGHT should have a clear vision for the mission, its objectives and how to get there.

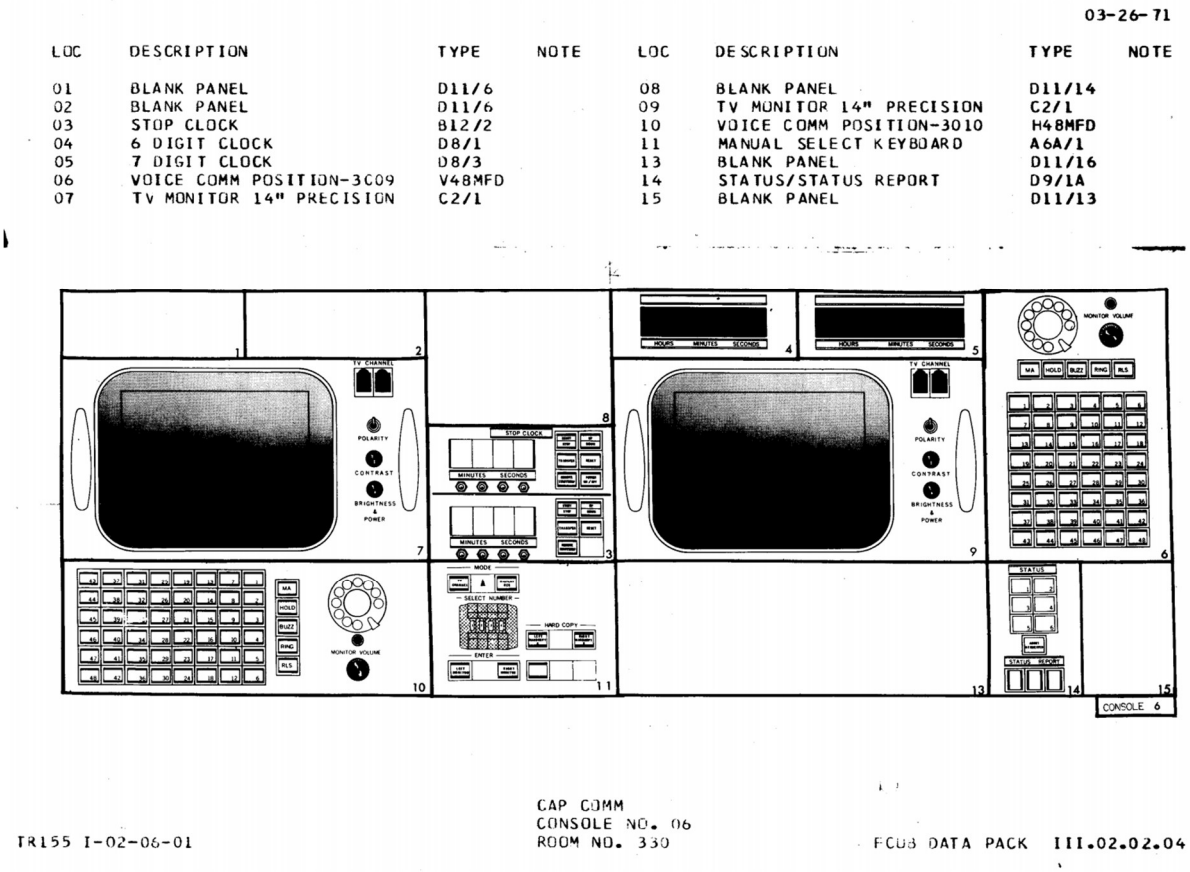
VIII. CAPSULE COMMUNICATOR

VIII. CAPSULE COMMUNICATOR

1. GENERAL

The Capsule Communicator aka. CAPCOM, is the only player who should talk directly with the astronauts. A dedicated intercom channel for the Air-to-Ground exists and is the only intercom where communication between the room and the astronaut can happen.

1.1 THE DESK



03-26-71

LOC	DESCRIPTION	TYPE	NOTE	LOC	DESCRIPTION	TYPE	NOTE
01	BLANK PANEL	D11/6		08	BLANK PANEL	D11/14	
02	BLANK PANEL	D11/6		09	TV MONITOR 14" PRECISION	C2/1	
03	STOP CLOCK	B12/2		10	VOICE COMM POSITION-3010	H48MFD	
04	6 DIGIT CLOCK	D8/1		11	MANUAL SELECT KEYBOARD	A6A/1	
05	7 DIGIT CLOCK	D8/3		13	BLANK PANEL	D11/16	
06	VOICE COMM POSITION-3C09	V48MFD		14	STATUS/STATUS REPORT	D9/1A	
07	TV MONITOR 14" PRECISION	C2/1		15	BLANK PANEL	D11/13	

TR155 I-02-06-01

CAP COMM
CONSOLE NO. 06
ROOM NO. 330

FCOB DATA PACK III.02.02.04

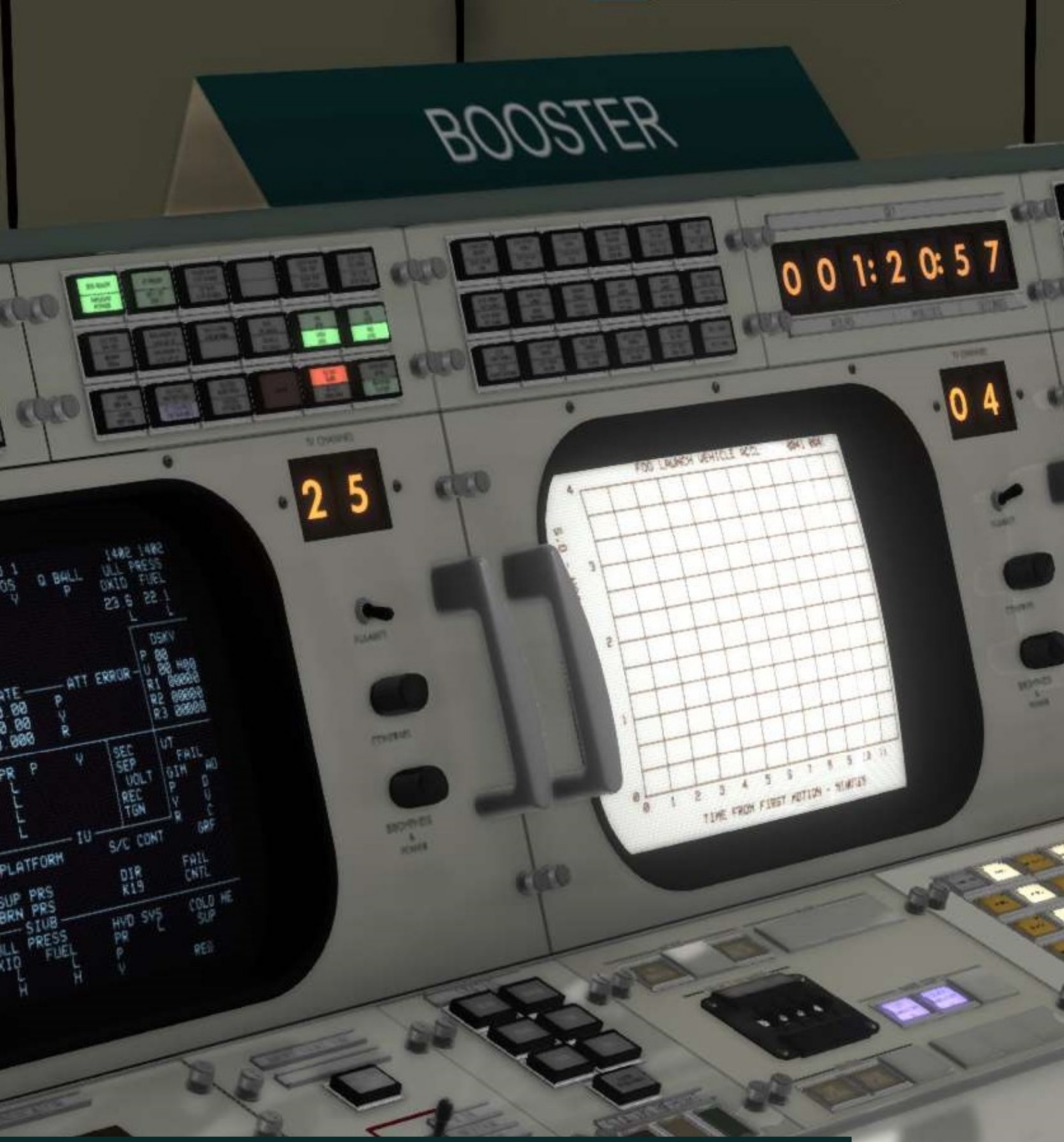
The capcom desk has two monitors that can be configured to monitor data based on the mission phase, and the descriptions being made. If the communication topic surrounds the Fuel Cells, the desk can be configured so you see the data that is being discussed. In addition, the GMT and the GET time is seen, as CapCom needs to be on top of things such as burns etc. Two stop clocks can be used for this.

1.2 OPERATION

As with FLIGHT, the CapCom role is also mainly out-of-desk. Your role is to be the main (and most likely only) communication/voice link between the astronaut and the room. You will be the one talking with the astronaut, and the only one who should submit anything on the capsule intercom. You work with the room, listening in on team discussions, talking with FLIGHT on issues, as well as the various desks needed to provide information requested by the astronaut, or report important information from the room.

Your main tool will be the intercom, and if possible, be on voice if the astronaut is on voice. However, the Text-Intercom can also be used! The communication with the crew should be clear, explicit, and singular to keep order.

If multiple players talk with the astronaut, things will likely get out of hand pretty soon and the roles will start to mix up. The CapCom role should be filled by a person who is an astronaut, so they know how the panels work, and visually be very familiar with how the cockpit and layout is set up, in order to describe things and help locating switches if needed. If you are talking with the astronaut, you should speak their language basically.



IX. BOOSTER

IX.BOOSTER

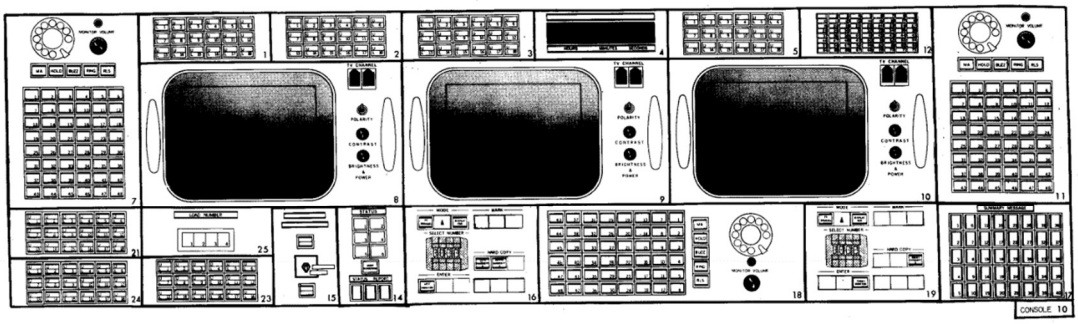
1. GENERAL

The Booster Systems Engineer (BSE) aka. BOOSTER has responsibility for the pre-launch, ignition and ascent systems for the S-IC, S-II and S-IVB stages. It's one of the largest desks and is used until the completion of a Trans-Lunar Injection burn, or when the S-IVB is staged. The BSE should be familiar with the stages of the Saturn V rocket, and monitor their performance and operation during the ascent. The BSE role has the capability of requesting an abort. The desk is not used for the reminder of the mission.

1.1 THE DESK

03-26-71

LOC	DESCRIPTION	TYPE	NOTE	LOC	DESCRIPTION	TYPE	NOTE
01	EVENT INDICATOR	D9/5B		14	STATUS/STATUS REPORT	D9/1A	
02	EVENT INDICATOR	D9/5B		15	TOGGLE SWITCH/INDICATOR	D9/9A	
03	EVENT INDICATOR	D9/5B		16	MANUAL SELECT KEYBOARD	A6B/5	
04	7 DIGIT CLOCK	D8/3		17	SUMMARY MSG ENABLE KEYBOARD	A19/A	
05	EVENT INDICATOR	D9/5B		18	VOICE COMM POSITION-3018	H48MFD	
07	VOICE COMM POSITION-3016	V48MFD		19	MANUAL SELECT KEYBOARD	A6B/6	
08	TV MONITOR 14" PRECISION	C2/1		21	SWITCH MODULE	D9/40F	
09	TV MONITOR 14" PRECISION	C2/1		23	SWITCH MODULE	D9/40E	
10	TV MONITOR 14" PRECISION	C2/1		24	SWITCH MODULE	D9/40F	
11	VOICE COMM POSITION-3017	V48MFD		25	LOAD NUMBER INDICATOR	D9/41B	
12	EVENT INDICATOR (72)	D9/28					

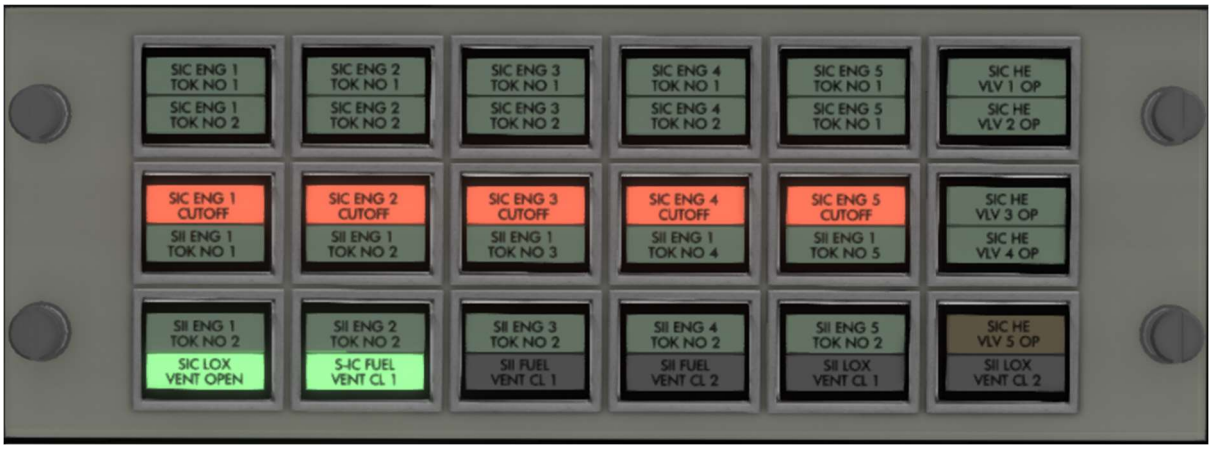


BOOSTER SYSTEMS ENGINEER
CONSOLE NO. 10
ROOM NO. 330

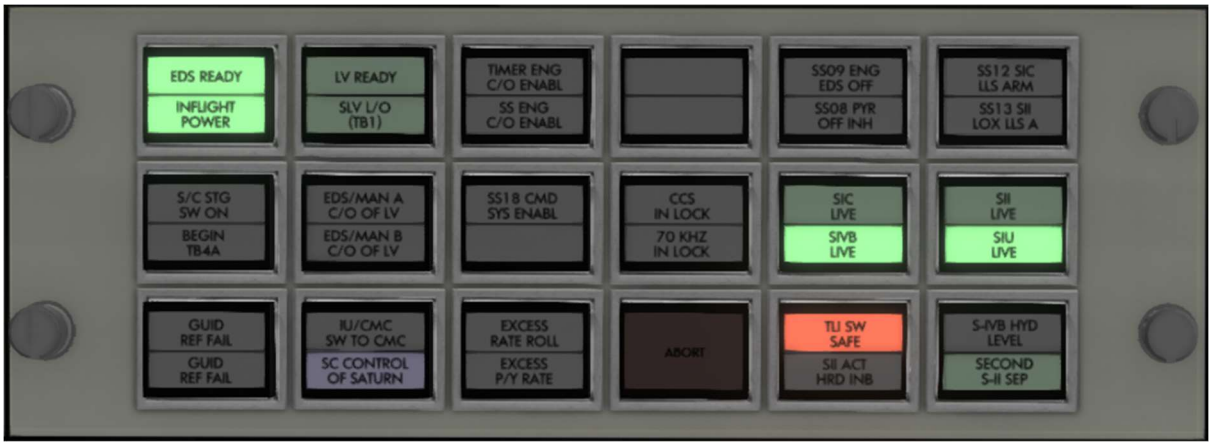
TR155 I-02-10-01 SLV DATA PACK V.02.02.01

The BOOSTER desk has three monitors that should monitor the BSE TV channels and any other based on need during the ascent. The main tools are these monitors, as well as 5 panels with arrays of telelight that shows the status of various systems and equipment.

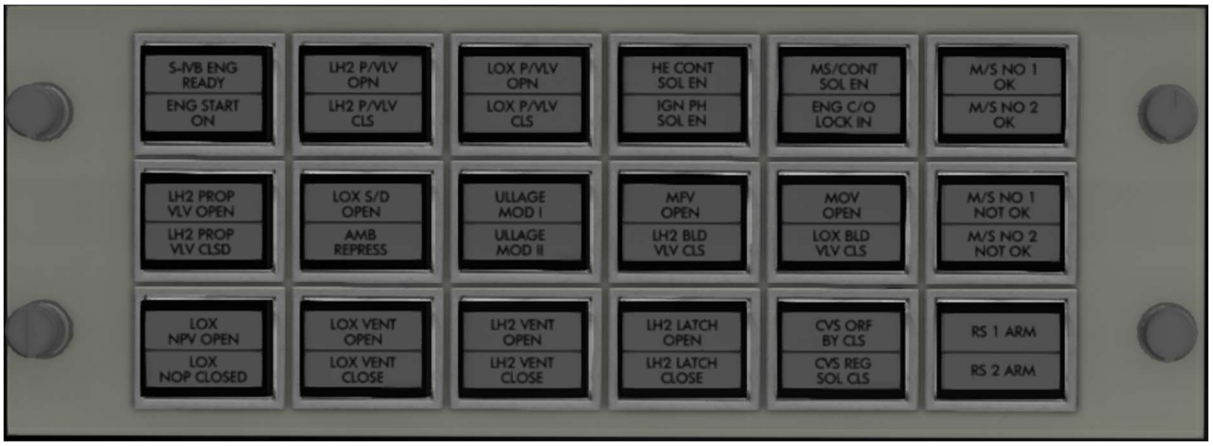
Panel 1 contains Telelights for the thrust signal (Thrsut Not OK) for S-IC and S-II, as well as some He vent valves etc.



Panel 2 contains guidance, IU and abort related telelights.

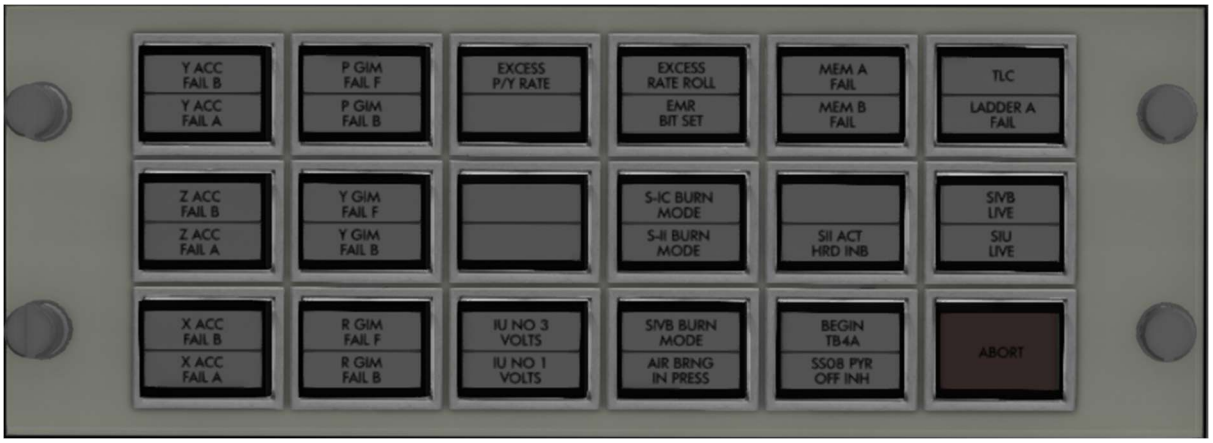


Panel 3 is mainly for the S-IVB.



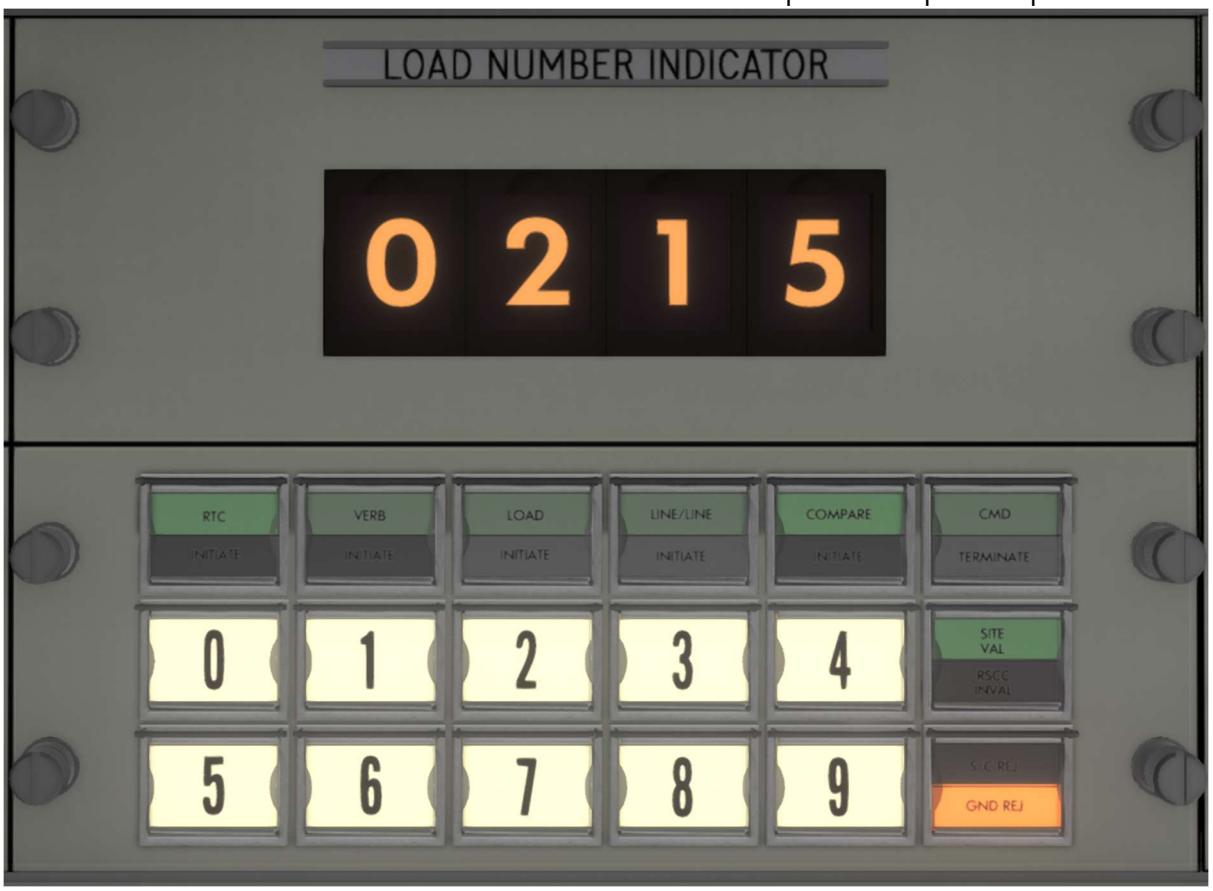
Panel 4 is the Mission Timer (GET).

Panel 5.



Panel 6.

The desk also has the RTCC interaction module and the Load Number Indicator. Both are used to control the RTCC as described in the Real-Time Computer Complex chapter.



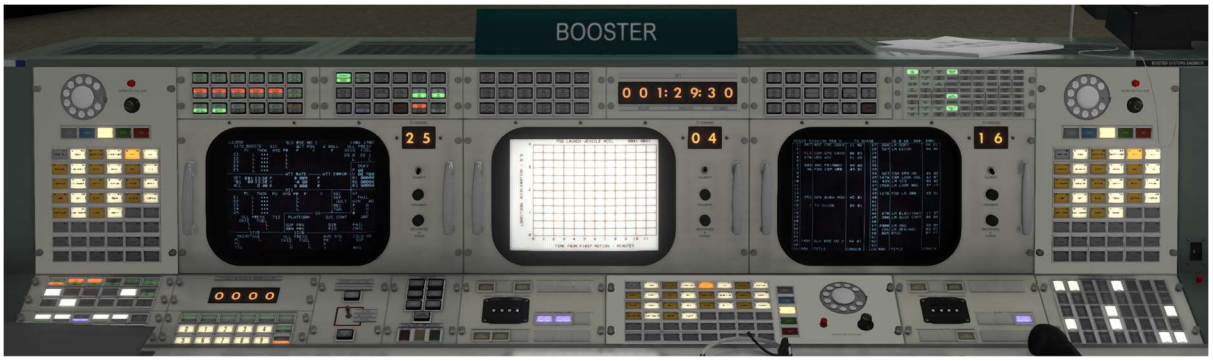
When insertion is reached and the insertion checklists are done, the RTCC will be used to calculate the TLI burn. This is the role of the BSE, while GUIDANCE makes sure that the AGC is set up correctly, can receive the data and that the AGC is set up correctly etc.

Channel 90 shows the RTCC interface for program 0215 (TRANS-LUNAR INJECTION):

BSE can trigger one of the abort mode signals using the ABORT LIGHT "ON" panel. Either signal A or B can be triggered.

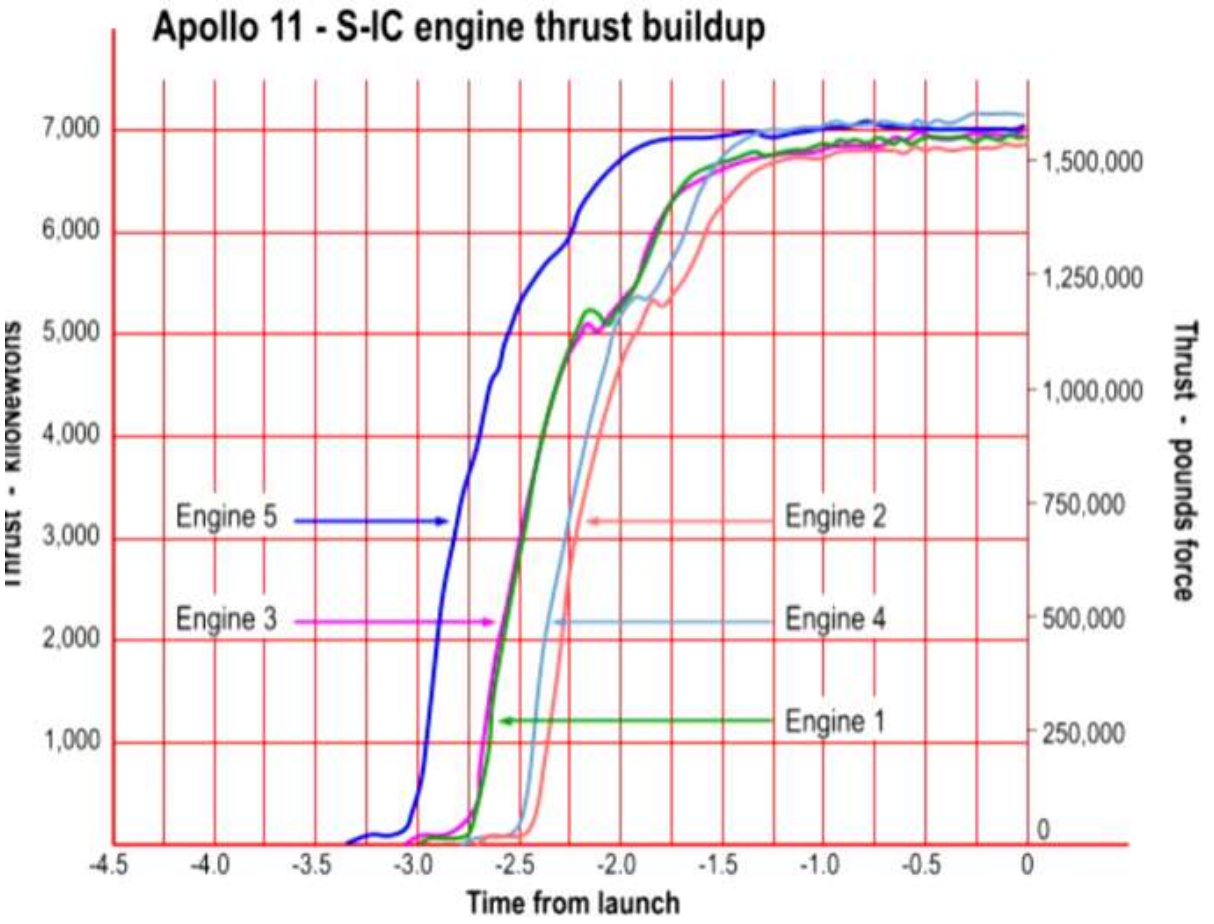
Three intercom panels exist based on where your attention is, two with the portrait layout and one with the landscape layout.

Two panels to control the monitors exist, one to change the left and center monitor, and another to change the right monitor.



1.2 OPERATION

The main responsibility for BOOSTER is the ascent and the performance of the Saturn V rocket. The BSE role basically owns the Saturn V from an engineering perspective. The BSE should call out the staging data, thrust OK data and verify proper ignition and the ignition sequence.




002344
162444
14
EL
AZ
90
60
30
0
-30
-60
-90
180
270
0
YAW
SUN
TARGET
MADS
Ø DEG
θ DEG
Ψ DEG
P DEG
YAW
PITCH
ROLL
IMU GMB
LOCAL ATT
89.107
50.217
144.24

X. RETRO

X. RETRO

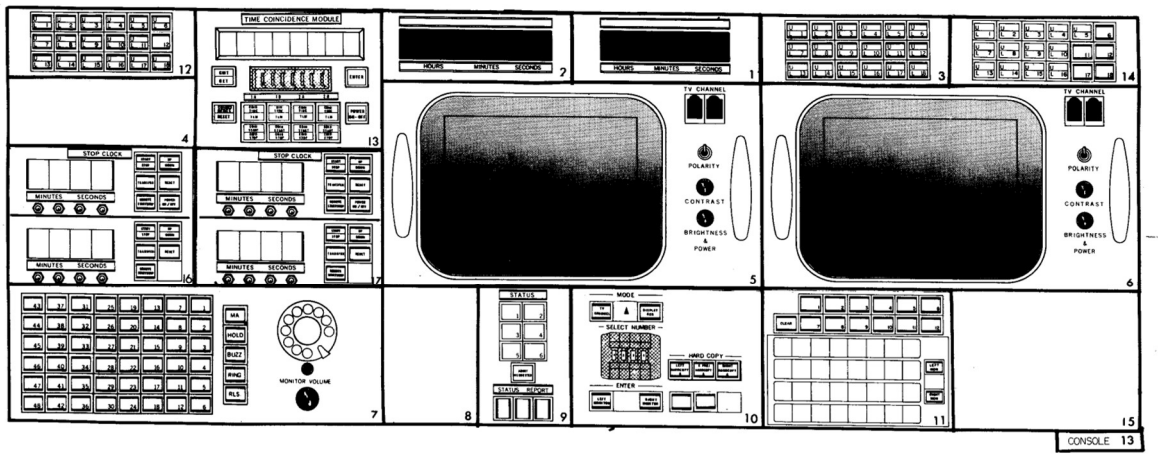
1. GENERAL

The Retrofire Officer (RFO) aka. RETRO has responsibility of getting the crew safely back to Earth with a safe landing. The main player of a return to Earth maneuver, either through a Trans-Earth Injection burn (TEI), or a direct abort, is the Service Propulsion System (SPS). The desk is also a key player in the landing phase after entry.

1.1 THE DESK

03-26-71

LOC	DESCRIPTION	TYPE	NOTE	LOC	DESCRIPTION	TYPE	NOTE
01	6 DIGIT CLOCK	D8/1		10	MANUAL SELECT KEYBOARD	A6A/4	
02	7 DIGIT CLOCK	D8/3		11	DISPLAY REQUEST KEYBOARD	A16/A	
03	SWITCH MODULE	D9/5A1		12	SWITCH MODULE	D9/5H1	
04	BLANK PANEL	D11/6		13	COINCIDENCE TIME	B13/1	
05	TV MONITOR 14" PRECISION	C2/1		14	SWITCH MODULE	D9/5G3	
06	TV MONITOR 14" PRECISION	C2/1		15	BLANK PANEL	D11/14	
07	VOICE COMM POSITION-3022	H48MFD		16	STOP CLOCK	B12/2	
08	BLANK PANEL	D11/13		17	STOP CLOCK	B12/2	
09	STATUS/STATUS REPORT	D9/1A					



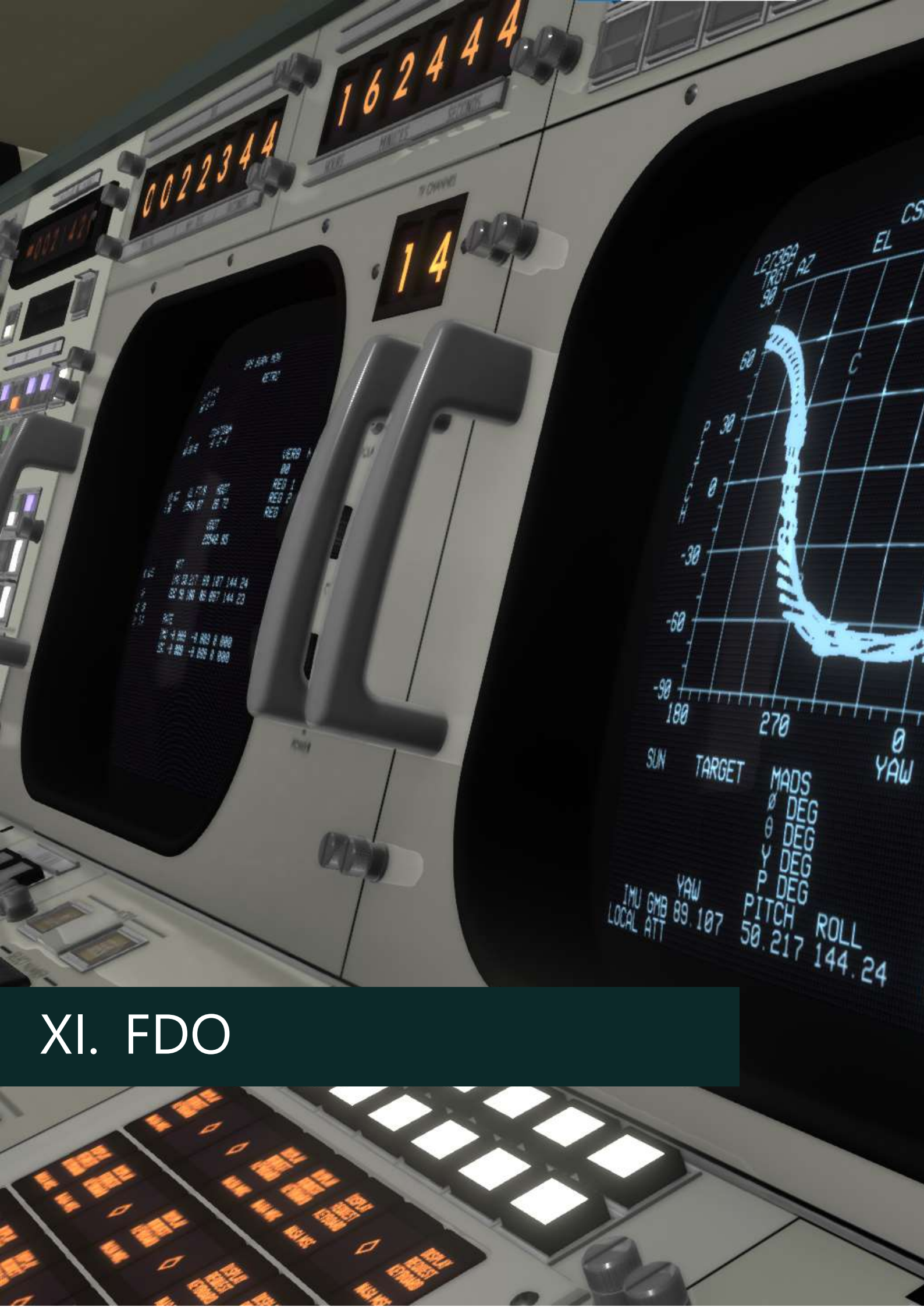
RETROFIRE OFFICER
CONSOLE NO. 13
ROOM NO. 330

TR155 I-02-13-01 FDB DATA PACK VI.02.02.03

The RETRO desk has two monitors that should monitor the trajectory and the SPS engine during the deorbit/RTE (Return-To-Earth) burn, or the recovery related channels. The panel has 4 stop clocks used during the various burns, or by planning.

1.2 OPERATION

The main responsibility for RETRO is the retrofire burn and recovery, and the condition of the SPS engine during the TEI burn.


002344
162444
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L27360
TRGT AZ
EL
90
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-30
-60
-90
180
270
0
YAW
SUN
TARGET
MADS
Ø DEG
θ DEG
Y DEG
P DEG
YAW
IMU GMB 89.107
LOCAL ATT
PITCH
ROLL
50.217 144.24

XI. FDO

XI. FDO

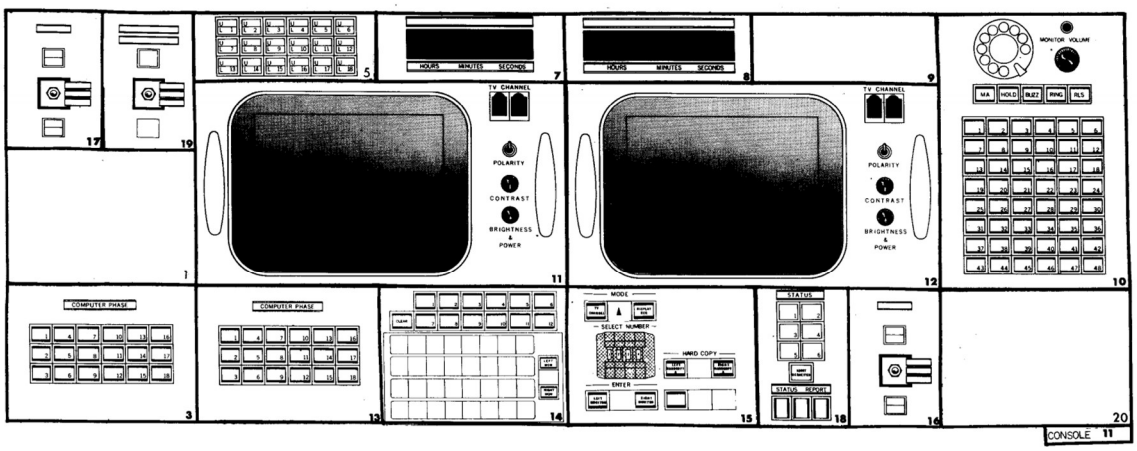
1. GENERAL

The Flight Dynamics Officer aka. FDO or FIDO monitors the trajectory of the vehicles (both CSM and the LM) during the entire mission. This includes watching orbital parameters, and the trajectories during Saturn V ascent, burns, Lunar Descents and Ascents, and entry. The FDO can request an Abort.

1.1 THE DESK

03-26-71

LOC	DESCRIPTION	TYPE	NOTE	LOC	DESCRIPTION	TYPE	NOTE
01	BLANK PANEL	D11/14		13	PHASE CONTROL KEYBOARD	A22/5	
03	PHASE CONTROL KEYBOARD	A22/4		14	DISPLAY REQUEST KEYBOARD	A16/A	
05	EVENT INDICATOR	D9/5B		15	MANUAL SELECT KEYBOARD	A6A/1	
07	6 DIGIT CLOCK	D8/1		16	TOGGLE SWITCH/INDICATOR	D9/9A	
08	7 DIGIT CLOCK	D8/3		17	TOGGLE SWITCH/INDICATOR	D9/10A	
09	BLANK PANEL	D11/6		18	STATUS/STATUS REPORT	D9/1A	
10	VOICE COMM POSITION-3019	V48MFD		19	TOGGLE SWITCH/INDICATOR	D9/9C	
11	TV MONITOR 14" PRECISION	C2/1		20	BLANK PANEL	D11/14	
12	TV MONITOR 14" PRECISION	C2/1					



FLIGHT DYNAMICS OFFICER
CONSOLE NO. 11
ROOM NO. 330

TR155 I-02-11-01

FDB DATA PACK VI.02.02.01

1.2 OPERATION

The main responsibility for FDO is to monitor the orbital parameters, be part of burn planning, or initiate correction burns, and monitor them to verify the trajectories of both the Saturn V, the CSM and the LM.

XII. GUIDANCE

XII. GUIDANCE

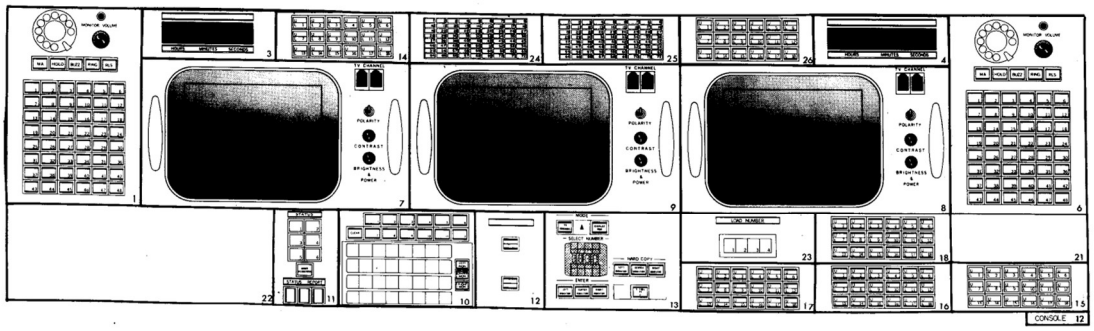
1. GENERAL

The Guidance Officer (GUIDO) aka. GUIDANCE is responsible for the guidance systems for both the CSM and the LM. This mostly involved the Apollo Guidance Computer and the Lunar Guidance Computer. Guido can use the RTCC for aid with burn planning with the person responsible for the burn (BOOSTER for TLI if needed, RETRO for TEI and FDO for the rest). GUIDANCE has the option to send DSKY commands to the CSM and the LM.

1.1 THE DESK

03-26-71

LOC	DESCRIPTION	TYPE	NOTE	LOC	DESCRIPTION	TYPE	NOTE
01	VOICE COMM POSITION-3020	V48MFD		14	EVENT INDICATOR	D9/5B	
03	6 DIGIT CLOCK	D8/1		15	EVENT INDICATOR	D9/5B	
04	7 DIGIT CLOCK	D8/3		16	SWITCH MODULE	D9/40E	
06	VOICE COMM POSITION-3021	V48MFD		17	SWITCH MODULE	D9/40E	
07	TV MONITOR 14" PRECISION	C2/1		18	SWITCH MODULE	D9/40E	
08	TV MONITOR 14" PRECISION	C2/1		21	BLANK PANEL	D11/6	
09	TV MONITOR 14" PRECISION	C2/1		22	BLANK PANEL	D11/16	
10	DISPLAY REQUEST KEYBOARD	A16/B		23	LOAD NUMBER INDICATOR	D9/41B	
11	STATUS/STATUS REPORT	D9/1A		24	EVENT INDICATOR (72)	D9/28	
12	TWO PBI SWITCH	D9/4D5		25	EVENT INDICATOR (72)	D9/28	
13	MANUAL SELECT KEYBOARD	A6A/33		26	SWITCH MODULE	D9/5A2	



TR155 I-02-12-01

GUIDANCE OFFICER
CONSOLE NO. 12
ROOM NO. 330

FDB DATA PACK VI.02.02.02

Bla bla

1.2 OPERATION

The main responsibility of guidance are the computers onboard, and the guidance systems from an execution perspective. While GNC is the engineer of the systems, guidance will focus on the actual attitude, and the usage of the computer during the various phases of the mission. Guidance can interact with the AGC and LGC, as well as the RTCC.

XIII. EECOM

XIII. EECOM

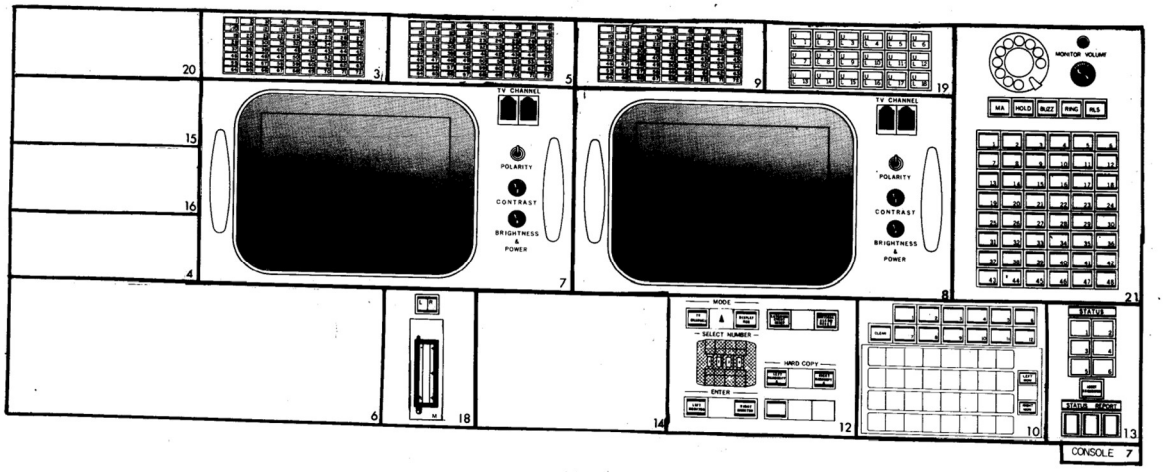
1. GENERAL

The Electrical, Environmental, and Communications controller aka. EECOM has the main responsibility for the electrical and environmental systems onboard the CSM. The main priority is to ensure the CSM is in a good state from a systems perspective to do its intended job. The EECOM should know the procedures for turning on and off the Fuel Cells, how the Main Bus is connected and what fuses and switches are used to tie it when something breaks.

1.1 THE DESK

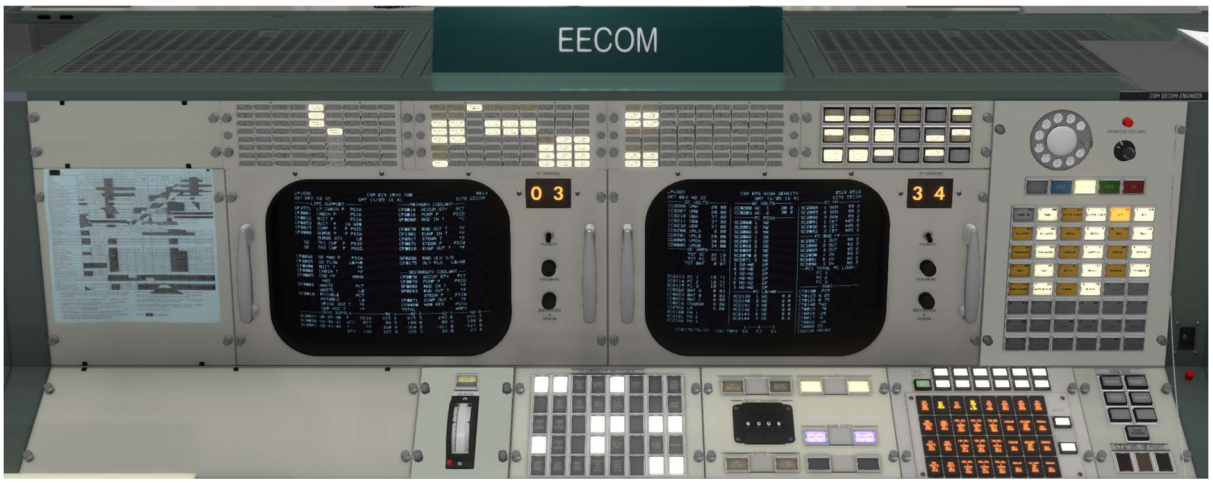
03-26-71

LOC	DESCRIPTION	TYPE	NOTE	LOC	DESCRIPTION	TYPE	NOTE
03	EVENT INDICATOR (72)	D9/28		12	MANUAL SELECT KEYBOARD	A6B/1	
04	BLANK PANEL	D11/6		13	STATUS/STATUS REPORT	D9/1A	
05	EVENT INDICATOR (72)	D9/28		14	BLANK PANEL	D11/14	
06	VOICE COMM POSITION-3011	H48MFD		15	BLANK PANEL	D11/6	
07	TV MONITOR 14" PRECISION	C2/1		16	BLANK PANEL	D11/6	
08	TV MONITOR 14" PRECISION	C2/1		18	ANALOG METER (1)	D9/29B	
09	EVENT INDICATOR (72)	D9/28		19	BLANK PANEL	D11/6	
10	DISPLAY REQUEST KEYBOARD	A16/A		20	BLANK PANEL	D11/6	
				21	VOICE COMM POSITION-3012	V48-FD	



CSM EECOM ENGINEER
CONSOLE NO. 07
ROOM NO. 330

TR155 I-02-07-01 CSB DATA PACK I.02.02.01



1.2 OPERATION

The main responsibility for EECOM is the electrical and environmental systems onboard the CSM.

XIV. GNC

XIV. GNC

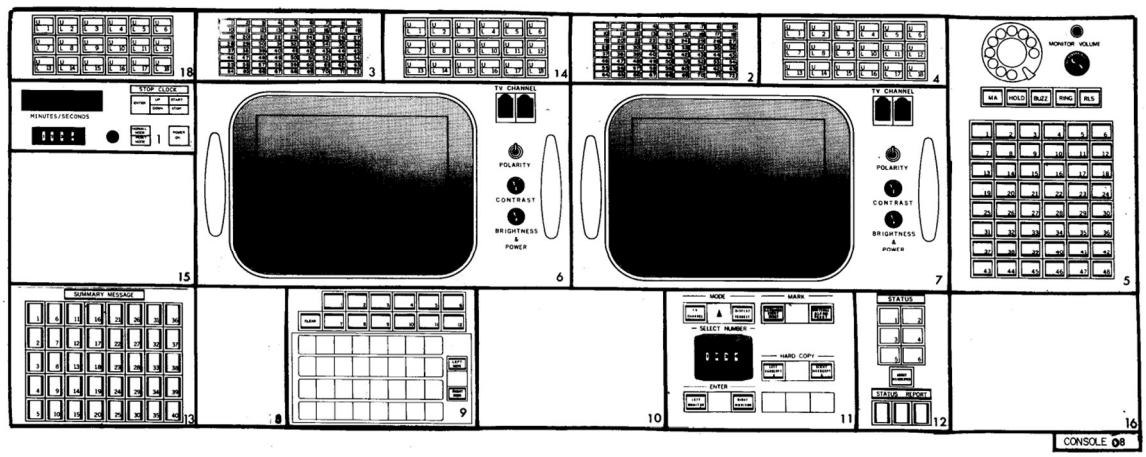
1. GENERAL

The Guidance, Navigation, and Control aka. GNC is responsible for the systems that enabled the CSM to point in a given direction, translate and function from a hardware perspective. The primary systems involved is the Reaction and Control system and the Service Propulsion System, and the hardware around the guidance systems.

1.1 THE DESK

03-26-71

LOC	DESCRIPTION	TYPE	NOTE	LOC	DESCRIPTION	TYPE	NOTE
01	STOP CLOCK (4 DIGIT)	B12/3		10	BLANK PANEL	D11/14	
02	EVENT INDICATOR (72)	D9/28		11	MANUAL SELECT KEYBOARD	A6B/1	
03	EVENT INDICATOR (72)	D9/28		12	STATUS/STATUS REPORT	D9/1A	
04	EVENT INDICATOR	D9/5B		13	SUMMARY MSG ENABLE KEYBOARD	A19/A	
05	VOICE COMM POSITION-3013	V48MFD		14	EVENT INDICATOR	D9/5B	
06	TV MONITOR 14" PRECISION	C2/1		15	BLANK PANEL	D11/14	
07	TV MONITOR 14" PRECISION	C2/1		16	BLANK PANEL	D11/14	
08	BLANK PANEL	D11/13		18	EVENT INDICATOR	D9/5B	
09	DISPLAY REQUEST KEYBOARD	A16/A					



CSM GNC ENGINEER
CONSOLE NO. 08
ROOM NO. 330

TR155 1-02-08-01 CSB DATA PACK I.02.02.02

1.2 OPERATION

The main responsibility for GNC is the engineering perspective of the guidance and control systems, the hardware used to maneuver the spacecraft.


TV CHANNEL
2 8
DCA STAT
RCVR SIG
ST_ ERR
XMTR PO
CAL 85 PCT
CAL 15 PCT
LOCAL ROLL
LOCAL PTCH
LOCAL YAW
MA B/M C&M
ABRTLA STG
ED K1.K6
ED K7.K15
ASC AH CON
ASC AH RMG
DES AH CON
DES AH RMG
BAT STAT VOLT TM-CLR-AVG
BRIGHTNESS & POWER
MODE
ENTER
LEFT MARK
LEFT MONITOR
ENTER
LEFT HARDCOPY
HARD

XV.TELMU

XV. TELMU

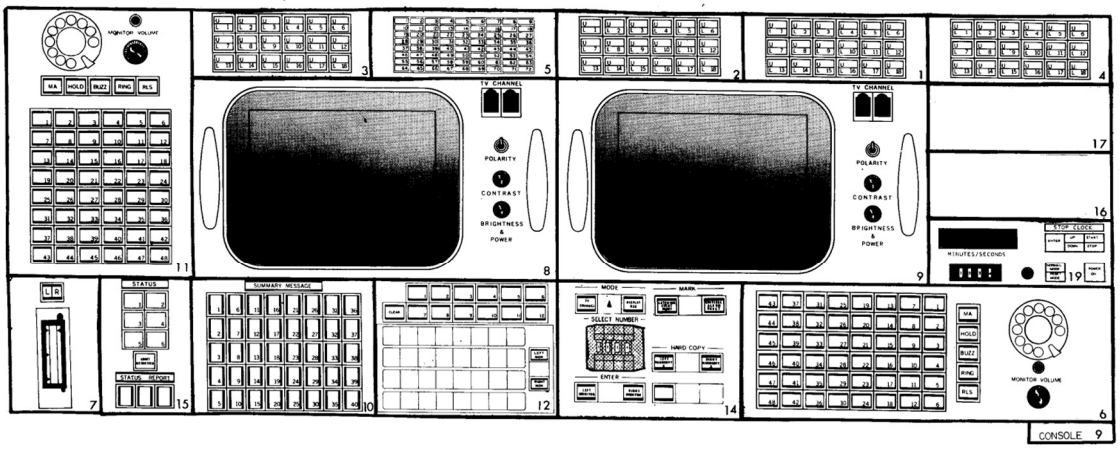
1. GENERAL

The Telemetry, Electrical, and EVA Mobility Unity console aka. TELMU is similar to the EECOM station but for the Lunar Module.

1.1 THE DESK

03-26-71

LOC	DESCRIPTION	TYPE	NOTE	LOC	DESCRIPTION	TYPE	NOTE
01	EVENT INDICATOR	D9/5B		10	SUMMARY MSG ENABLE KEYBOARD	A19/A	
02	EVENT INDICATOR	D9/5B		11	VOICE COMM POSITION-3015	V48MFD	
03	EVENT INDICATOR	D9/5B		12	DISPLAY REQUEST KEYBOARD	A16/A	
04	EVENT INDICATOR	D9/5B		14	MANUAL SELECT KEYBOARD	A6B/1	
05	EVENT INDICATOR (72)	D9/28		15	STATUS/STATUS REPORT	D9/1A	
06	VOICE COMM POSITION-3014	H48MFD		16	BLANK PANEL	D11/6	
07	ANALOG METER (1)	D9/29B		17	BLANK PANEL	D11/6	
08	TV MONITOR 14" PRECISION	C2/1		19	STOP CLOCK (4 DIGIT)	B12/3	
09	TV MONITOR 14" PRECISION	C2/1					



LM TELMU ENGINEER
CONSOLE NO. 09
ROOM NO. 33C

TR155 1-02-09-01 LSB DATA PACK IV.02.02.01

1.2 OPERATION

The main responsibility for TELMU is the electrical and environmental systems onboard the Lunar Module.


TV CHANNEL
2 8
DCA STAT
RCVR SIG
ST_ ERR
XMTR PO
CAL 85 PCT
CAL 15 PCT
LOCAL ROLL
LOCAL PTCH
LOCAL YAW
MA B/M C&M
ABRTLA STG
ED K1 K6
ED K7 K15
ASC AH CON
ASC AH RMG
DES AH CON
DES AH RMG
BAT STAT VOLT TM-CLR-AVG
BRIGHTNESS & POWER
MODE
ENTER
LEFT MARK
LEFT MONITOR
HARD

XVI. CONTROL

XVI. CONTROL

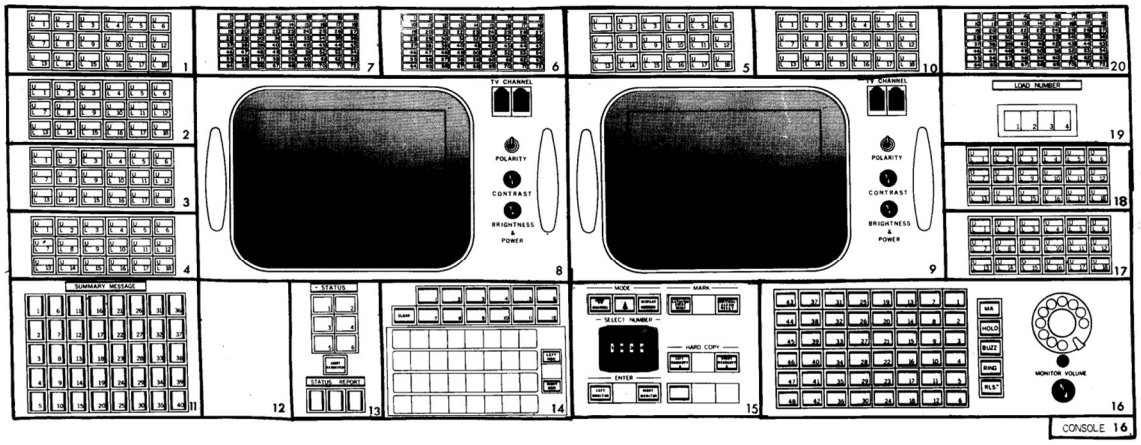
1. GENERAL

The CONTROL console is similar to the GNC console but for the CSM. It's responsible for the hardware used by guidance to point the Lunar Module where it should, and that the guidance systems get the proper data from the radars and so on.

1.1 THE DESK

03-26-71

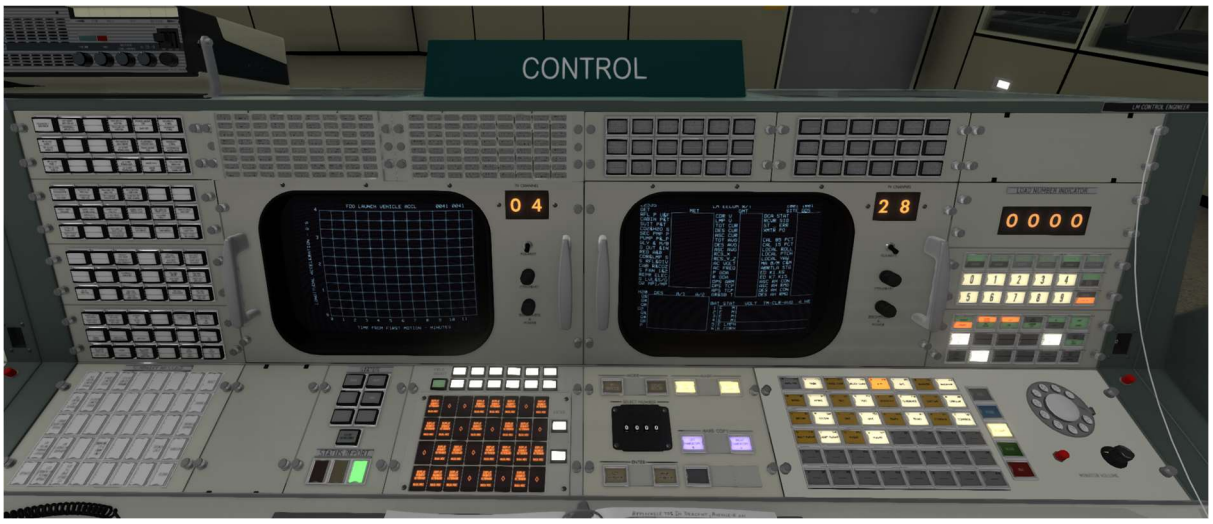
LOC	DESCRIPTION	TYPE	NOTE	LOC	DESCRIPTION	TYPE	NOTE
01	EVENT INDICATOR	D9/5B		11	SUMMARY MSG ENABLE KEYBOARD	A19/B	
02	EVENT INDICATOR	D9/5B		12	BLANK PANEL	D11/13	
03	EVENT INDICATOR	D9/5B		13	STATUS/STATUS REPORT	D9/1A	
04	EVENT INDICATOR	D9/5B		14	DISPLAY REQUEST KEYBOARD	A16/A	
05	EVENT INDICATOR	D9/5B		15	MANUAL SELECT KEYBOARD	A6A/1	
06	EVENT INDICATOR (72)	D9/28		16	VOICE COMM POSITION-3027	H48MFD	
07	EVENT INDICATOR (72)	D9/28		17	SWITCH MODULE	D9/40E	
08	TV MONITOR 14" PRECISION	C2/1		18	SWITCH MODULE	D9/40E	
09	TV MONITOR 14" PRECISION	C2/1		19	LOAD NUMBER INDICATOR	D9/41B	
10	EVENT INDICATOR	D9/5B		20	EVENT INDICATOR (72)	D9/28	23



LM CONTROL ENGINEER
CONSOLE NO. 16
ROOM NO. 330

TR155 I-02-16-01

LSB DATA PACK IV.02.02.02



1.2 OPERATION

The main responsibility for CONTROL is the engineering perspective of the guidance and control systems, such as the hardware used for attitude control and maneuvering.

XVII. ASSISTANT FLIGHT

XVII. ASSISTANT FLIGHT

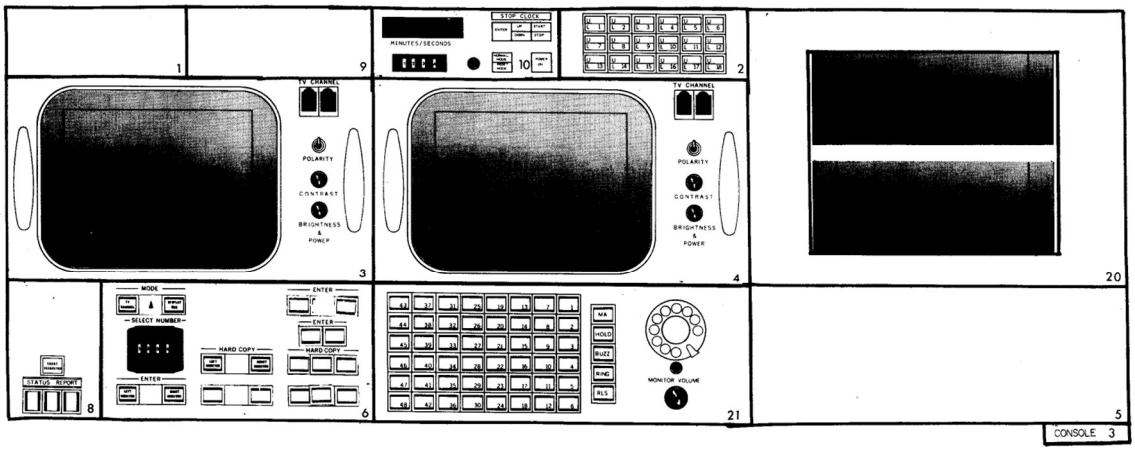
1. GENERAL

The Assistant Flight sits on the console next to FLIGHT and duplicates many of FLIGHTs roles, and monitored the mission status, and configured the projectors based on the mission status.

1.1 THE DESK

03-26-71

LOC	DESCRIPTION	TYPE	NOTE	LOC	DESCRIPTION	TYPE	NOTE
01	BLANK PANEL	D11/6		08	STATUS REPORTING	D9/1B	
02	EVENT INDICATOR	D9/5B		09	BLANK PANEL	D11/6	
03	TV MONITOR 14" PRECISION	C2/1		10	STOP CLOCK (4 DIGIT)	B12/3	
04	TV MONITOR 14" PRECISION	C2/1		20	SHELF PANEL (2)	C5/1	
05	BLANK PANEL	D11/16		21	VOICE COMM POSITION-3004	H48MFD	
06	MANUAL SELECT KEYBOARD	A6E/1					



ASST FLIGHT DIRECTOR
CONSOLE NO. 03
ROOM NO. 330

TR155 I-02-03-01

FCOB DATA PACK III.02.02.02

1.2 OPERATION

The main responsibility of the assistant flight director is to work directly with the flight director, and configure the operations room such as projectors.

XVIII. THE TROUBLEMAKER

XVIII. THE TROUBLEMAKER

1. GENERAL

1.1 GETTING THE ROLE

The troublemaker role is handed out by the Astronaut and can be given to zero or many mission controllers. If a mission controller receives the role, they will have access to the failure-menu, and can start triggering issues onboard the spacecraft.

To open the troublemaker's tools, use the hot key CTRL+T. A new window will render on top of everything.

The only tool available for now it the FAILURES menu. If you do not have access, it will look like the below.

To request access, let the astronaut know over chat, or a different channel.

1.2 TRIGGERING FAILURES

Use CTRL+T to open the menu, and simply press FAIL on the component you wish to fail.

Nobody will know who issued the failure, when, or even if a failure has been issued. This is something that must be detected, and identified by paying attention to systems, both on ground, and by the astronaut in the spacecraft.