MOSES Housekeeping Link Protocol (HLP) Document

Charles Kankelborg, Lewis Fox, Ehson Mosleh, Reginald Mead,
Jacob Plovanic, Nicholas Bonham
Montana State University

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Contents

1 Revision History

Revision	Date	History	Initial
0.1	10-11-2004	Created	
0.2	4-9-2013	Ported to LaTeX. Revisions and updates	JTP
0.3	4-11-2013	Correctly documented Checksum calculation	JTP
0.4	4-23-2013	Packet ring out updates	JTP
0.5	5-15-2017	Updated changes to Start/Stop Delimiters formatting	NPB

2 HLP Format

Data will be transferred between the MOSES Flight Computer (F/C) and the Ground Support Computer (GSC) via two different satellite streams. One is a 9600 baud downlink from the F/C to the GSC and another is a 1200 baud uplink from the GSC to the F/C. The data streams will be organized into "packets" which will enable us to decode information and keep it well organized. The following table is the format in which packets will be sent and received by both the F/C and the GSC in ascending order.

Field Number	Field Name	Data Format	Required
1	Start Delimiter	10 ASCII characters	YES
2	Time Stamp	6 ASCII characters	YES
3	Type	1 ASCII character	YES
4	Sub Type	3 ASCII characters	YES
5	Length	2 character ASCII coded Hex	YES
6	Data	ASCII or Hex	NO
7	Checksum	1 ASCII character	YES
8	Stop Delimiter	10 ASCII characters	YES

Start Delimeter: Packets will begin with a string of the ASCII percent character "%%%%%%%%%", ASCII 037.

Time Stamp: 6 ASCII numerals denoting the time in 24-hour format, HHMMSS.

Type: Denotes the main type of the packet.

Sub Type: Denotes the subtype of the packet.

Length: The number of characters in the following Data field in Hex format. The smallest Length value is 00. The largest Length value is FF (255 in decimal). If the Length is 00, then the Data field is not present. There can also be packets with Length 01 and a Data field of one NUL character.

Data: Data content and format (either ASCII or Hex) depends on the Type and Sub Type.

Checksum: An ASCII character computed for use in error detection. See Section 5.

Stop Delimeter: Packets will end with a string of ASCII carets and an ASCII tilde "^^^^^^^^^~", ASCII 094 and ASCII 126.

3 Main Types

Type	Name	Description
T	Timer	Confirmation that timer signals have been received from the timer deck.
U	Uplink	Acknowledgment of uplink command by the F/C.
G	Good Acknowledge	Acknowledgment of readable packet.
B	Bad Acknowledge	Acknowledgment of unreadable packet.
S	Shell	Shell input and output packets.
P	Power	Power system queries and commands.
M	Mission Data Acquistion (MDAQ) Uplink	Uplink packets from GSC to F/C. (These are not ROE housekeeping packets.)
Q	MDAQ Downlink	Downlink packets from F/C to GSC.
H	Housekeeping (HK) Uplink	HK uplink packets from GSC to F/C.
K	HK Downlink	HK downlink packets from F/C to GSC.

3.1 Timer

Note: An asterisk (*) denotes that the definition is not part of the packet.

Sub Type	**DK2**
Length	00
Data	None
Sent By*	F/C
Received By*	Ground Station Software server (GSS Server)
Full Name*	Dark Sequence 2 (TDK2)

Sub Type	**DK4**
Length	00
Data	None
Sent By*	F/C
Received By*	GSS Server
Full Name*	Dark Sequence 4 (TDK4)

Sub Type	**DST**
Length	00
Data	None
Sent By*	F/C
Received By*	GSS Server
Full Name*	Data Start (TDST)

Sub Type	**DSP**
Length	00
Data	None
Sent By*	F/C
Received By*	GSS Server
Full Name*	Data Stop (TDSP)

Sub Type	**SLP**
Length	00
Data	None
Sent By*	F/C
Received By*	GSS Server
Full Name*	Sleep (TSLP)

3.2 Uplink

The Flight Computer responds to each uplink command by sending a Good Acknowledge and a copy of the uplink packet without a Data field. This copied packet is sent in response to both an Uplink packet and the momentary-close hard uplink on the ground station Uplink & Timer deck.

Sub Type	**DK1**
Length	01
Data	NUL
Sent By*	GSS Server
Received By*	F/C
Full Name*	Dark Sequence 1 (UDK1)

Sub Type	**DK1**
Length	00
Data	None
Sent By*	F/C
Received By*	GSS Server
Full Name*	Dark Sequence 2 (UDK1)

Sub Type	**DK2**
Length	01
Data	NUL
Sent By*	GSS Server
Received By*	F/C
Full Name*	Dark Sequence 2 (UDK2)

Sub Type	**DK2**
Length	00
Data	None
Sent By*	F/C
Received By*	GSS Server
Full Name*	Dark Sequence 2 (UDK2)

Sub Type	**DK3**
Length	01
Data	NUL
Sent By*	GSS Server
Received By*	F/C
Full Name*	Dark Sequence 3 (UDK3)

Sub Type	**DK3**
Length	00
Data	None
Sent By*	F/C
Received By*	GSS Server
Full Name*	Dark Sequence 3 (UDK3)

Sub Type	**DK4**
Length	01
Data	NUL
Sent By*	GSS Server
Received By*	F/C
Full Name*	Dark Sequence 4 (UDK4)

Sub Type	**DK4**
Length	00
Data	None
Sent By*	F/C
Received By*	GSS Server
Full Name*	Dark Sequence 4 (UDK4)

Sub Type	**SLP**
Length	01
Data	NUL
Sent By*	GSS Server
Received By*	F/C
Full Name*	Sleep (USLP)

Sub Type	**SLP**
Length	00
Data	None
Sent By*	F/C
Received By*	GSS Server
Full Name*	Sleep (USLP)

Sub Type	**WAK**
Length	01
Data	NUL
Sent By*	GSS Server
Received By*	F/C
Full Name*	Wake (UWAK)

Sub Type	**WAK**
Length	00
Data	None
Sent By*	F/C
Received By*	GSS Server
Full Name*	Wake (UWAK)

Sub Type	**DST**
Length	01
Data	NUL
Sent By*	GSS Server
Received By*	F/C
Full Name*	Data Start (UDST)

Sub Type	**DSP**
Length	01
Data	NUL
Sent By*	GSS Server
Received By*	F/C
Full Name*	Data Stop (UDSP)

Sub Type	**TST**
Length	01
Data	NUL
Sent By*	GSS Server
Received By*	F/C
Full Name*	Testing Routine (UTST)

Sub Type	**TST**
Length	00
Data	None
Sent By*	F/C
Received By*	GSS Server
Full Name*	Testing Routine (UTST)

3.3 Good Acknowledge

Sub Type	**ACK**
Length	05
Data	The first character is the Main Type of the received packet. The next three characters are the Sub Type of the received packet. The final character is a NUL.
Description*	This packet is sent to indicate that a good (i.e. readable) packet as been received. The data of a GACK packet are the Main Type and Sub Type of the received packet.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Good Acknowledge (GACK)

3.4 Bad Acknowledge

Sub Type	**ACK**
Length	05
Data	The first character is the Main Type of the received packet. The next three characters are the Sub Type of the received packet. The final character is a NUL.
Description*	This packet is sent to indicate that a bad (i.e. unreadable) packet as been received. The data of a BACK packet are the Main Type and Sub Type of the received packet.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Bad Acknowledge (BACK)

3.5 Shell

Sub Type	**ACK**
Length	0-255
Data	A string of up to 255 characters. It is an exact copy of the SINP Data field sent from the GSS Server to the F/C.
Description*	This packet is used by the F/C to indicate that it has received a terminal
Sent By*	F/C
Received By*	GSS Server
Full Name*	Shell Acknowledge (SACK)

Sub Type	**INP**
Length	0-255
Data	A string of up to 255 characters.
Description*	Terminal command sent from the GSS Server to the F/C.
Sent By*	GSS Server
Received By*	F/C
Full Name*	Shell Input (SINP)

Sub Type	**OUT**
Length	0-255
Data	A string of up to 255 characters. Contains the output of the shell on the F/C. (Check whether this was properly implemented)
Description*	Not sure if this was implemented correctly. Previous HLP document is unclear.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Shell Output (SOUT)

3.6 Power

Sub Type	**TON**
Length	A string of 0-255 characters or 4 characters of ASCII coded Hex.
Data	Number of payload subsystem. See Section 6.
Description*	Command the payload subsystem to power on.
Sent By*	GSS Server
Received By*	F/C
Full Name*	Power Turn ON (PTON)

Sub Type	**TOF**
Length	A string of 0-255 characters or 4 characters of ASCII coded Hex.
Data	Number of payload subsystem.
Description*	Command the payload subsystem to power off.
Sent By*	GSS Server
Received By*	F/C
Full Name*	Power Turn OFF (PTOF)

Sub Type	**QRY**
Length	A string of 0-255 characters or 4 characters of ASCII coded Hex.
Data	Number of payload subsystem.
Description*	Query the power status of the payload subsystem.
Sent By*	GSS Server
Received By*	F/C
Full Name*	Power Query (PQRY)

Sub Type	**SON**
Length	A string of 0-255 characters or 4 characters of ASCII coded Hex.
Data	Number of payload subsystem.
Description*	Reports that the subsystem is ON.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Power Status ON (PSON)

Sub Type	**SOF**
Length	A string of 0-255 characters or 4 characters of ASCII coded Hex.
Data	Number of payload subsystem.
Description*	Reports that the subsystem is OFF.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Power Status OFF (PSOF)

3.7 MDAQ Uplink

Sub Type	**GSN**
Length	2 digit ASCII coded Hex.
Data	Signal number.
Description*	Get sequence name that corresponds to the signal number in the data field.
Sent By*	GSS Server
Received By*	F/C
Output*	Corresponding MDAQ downlink packet is QGSN, containing the sequence name as a string.
Full Name*	Get Sequence Name (MGSN)

Sub Type	**SSQ**
Length	0-255 character ASCII.
Data	The first two characters are the signal number as ASCII coded Hex. The remaining characters are the sequence name as a string.
Description*	Associates a sequence name with a signal number.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Set Sequence (MSSQ)

Sub Type	**SOF**
Length	0-255 character ASCII.
Data	String representing the filename for the output file.
Description*	Uses stem for an output file. (What does this even mean? Who wrote this?)
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Set Output Filename (MSOF)

Sub Type	**GSI**
Length	2 digit ASCII coded Hex.
Data	Signal number
Description*	Generates a string representation of the sequence file.
Sent By*	GSS Server
Received By*	F/C
Output*	Corresponding MDAQ downlink packet is QGSI, containing a string of current sequence information.
Full Name*	Get Sequence Information (MGSI)

Sub Type	**GCS**
Length	00
Data	None
Description*	Commands the flight software to return the currently running sequence.
Sent By*	GSS Server
Received By*	F/C
Output*	Corresponding MDAQ downlink packet is QGCS, containing a string of the current sequence name. If no sequence is running, the return packet has NULL data.
Full Name*	Get Current Sequence (MGCS)

Sub Type	**GFL**
Length	00
Data	None
Description*	Commands the flight software to return the current frame's exposure length.
Sent By*	GSS Server
Received By*	F/C
Output*	Corresponding MDAQ downlink packet is QGFL, containing a decimal value of the current exposure length. If no sequence is running, the return packet has NULL data.
Full Name*	Get Frame Length (MGFL)

Sub Type	**GFI**
Length	00
Data	None
Description*	Commands the flight software to return the current frame's index number.
Sent By*	GSS Server
Received By*	F/C
Output*	Corresponding MDAQ downlink packet is QGFI, containing a decimal value of the current frame index.
Full Name*	Get Frame Index (MGFI)

Sub Type	**GOF**
Length	00
Data	None
Description*	Commands the flight software to return the filename of the output file.
Sent By*	GSS Server
Received By*	F/C
Output*	Corresponding MDAQ downlink packet is QGOF, containing a string of the output filename.
Full Name*	Get Output Filename (MGOF)

Sub Type	**GST**
Length	00
Data	None
Description*	Commands the flight software to determine if the ROE is in self-test mode.
Sent By*	GSS Server
Received By*	F/C
Output*	Corresponding MDAQ downlink packet is QGST, containing a string of either ON or OFF.
Full Name*	Self Test Status (MGST)

Sub Type	**GSM**
Length	00
Data	None
Description*	Commands the flight software to determine if the ROE is in Stims (WTF?) mode.
Sent By*	GSS Server
Received By*	F/C
Output*	Corresponding MDAQ downlink packet is QGSM, containing a string of either ON or OFF.
Full Name*	Get Stims Status (MGSM)

Sub Type	**GSH**
Length	00
Data	None
Description*	DEPRECATED. Retained here until I decide to delete it, which is likely.
Sent By*	GSS Server
Received By*	F/C
Output*	Corresponding MDAQ downlink packet is QGSH, containing a string of either ON or OFF.
Full Name*	Get Shutter Status (MGSH)

Sub Type	**GTM**
Length	00
Data	None
Description*	Determines if Telemetry is enabled.
Sent By*	GSS Server
Received By*	F/C
Output*	Corresponding MDAQ downlink packet is QGTM, containing a string of either OPEN or CLOSED.
Full Name*	Get Telemetry Status (MGTM)

Sub Type	**GC0**
Length	00
Data	None
Description*	Determines if Channel 0 data will be recorded.
Sent By*	GSS Server
Received By*	F/C
Output*	Corresponding MDAQ downlink packet is QGC0, containing a string of either ON or OFF.
Full Name*	Get Channel 0 Status (MGC0)

Sub Type	**GPO**
Length	00
Data	None
Description*	Determines if Pos channel data will be recorded.
Sent By*	GSS Server
Received By*	F/C
Output*	Corresponding MDAQ downlink packet is QGPO, containing a string of either ON or OFF.
Full Name*	Get Pos Only Status (MGPO)

Sub Type	**SCL**
Length	0-255 character ASCII
Data	Floating point number as a string.
Description*	Commands the flight software to scale the current sequence, multiplying each frame by the floating point value contained within the Data field.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Scale Sequence (MSCL)

Sub Type	**TRN**
Length	0-255 character ASCII
Data	Floating point number as a string.
Description*	Commands the flight software to translate the current sequence, adding the floating point value in the Data field to each frame in the sequence.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Translate Sequence (MTRN)

Sub Type	**FNJ**
Length	0-255 character ASCII
Data	Floating point number as a string.
Description*	Commands the flight software to INTERRUPT the current exposure, FIND an exposure of the length given in the Data field, and JUMP to the first exposure matching this criterion.
Sent By*	GSS Server
Received By*	F/C
Output*	The corresponding MDAQ downlink is QFNJ, containing the index value of the exposure to which the sequence jumped, or -1 if no exposure matched the given parameter.
Full Name*	Find and Jump (MFNJ)

Sub Type	**JMP**
Length	0-255 character ASCII
Data	Floating point number as a string.
Description*	Commands the flight software to JUMP to the exposure with index number given in the Data field.
Sent By*	GSS Server
Received By*	F/C
Output*	The corresponding MDAQ downlink is QJMP, containing the index value of the exposure to which the sequence jumped, or -1 if no exposure matched the given parameter.
Full Name*	Jump (MJMP)

Sub Type	**FNR**
Length	0-255 character ASCII
Data	2 floating point numbers as a strings separated by a comma. <FIND>,<REPLACE>
Description*	Commands the flight software to FIND exposures with lengths given by the first floating point value in the Data field and REPLACE them with the second value in the Data field.
Sent By*	GSS Server
Received By*	F/C
Output*	The corresponding MDAQ downlink is QFNR, containing the index numbers of the exposures that were replaced, or -1 if no exposure matched the given parameter.
Full Name*	Find and Replace (MFNR)

Sub Type	**SAV**
Length	0-255 character ASCII
Data	Filename as a string.
Description*	Commands the flight software to save the current sequence to the filename defined in the Data field.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Save Sequence (MSAV)

Sub Type	**BSQ**
Length	00
Data	None
Description*	Commands the flight software to start the currently loaded sequence.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Begin Sequence (MBSQ)

Sub Type	**ESQ**
Length	00
Data	None
Description*	Commands the flight software to stop the currently running sequence.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	End Sequence (MESQ)

Sub Type	**XIT**
Length	00
Data	None
Description*	Terminates the flight software (Needs testing)
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Exit (MXIT)

Sub Type	**TMN**
Length	00
Data	None
Description*	Commands the flight software to turn Telemetry ON.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Telemetry ON (MTMN)

Sub Type	**TMF**
Length	00
Data	None
Description*	Commands the flight software to turn Telemetry OFF.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Telemetry OFF (MTMF)

Sub Type	**C0N**
Length	00
Data	None
Description*	Commands the flight software to turn Channel 0 ON.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Channel 0 ON (MC0N)

Sub Type	**C0F**
Length	00
Data	None
Description*	Commands the flight software to turn Channel 0 OFF.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Channel 0 OFF (MC0F)

Sub Type	**PON**
Length	00
Data	None
Description*	Commands the flight software to turn Pos Only ON.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Pos Only ON (MPON)

Sub Type	**POF**
Length	00
Data	None
Description*	Commands the flight software to turn Pos Only OFF.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Pos Only OFF (MPOF)

Sub Type	**STN**
Length	00
Data	None
Description*	Commands the flight software to turn STIMS ON.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	STIMS ON (MSTN)

Sub Type	**STF**
Length	00
Data	None
Description*	Commands the flight software to turn STIMS OFF.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	STIMS OFF (MSTF)

Sub Type	**RRR**
Length	00
Data	None
Description*	Commands the flight software to reset the ROE.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Reset ROE (MRRR)

Sub Type	**XDF**
Length	00
Data	None
Description*	Exit to Default Mode (Find out what Default Mode is).
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Exit Default (MXDF)

Sub Type	**SLF**
Length	00
Data	None
Description*	Commands the flight software to set the ROE self-test.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Set Self Test (MSLF)

Sub Type	**RST**
Length	00
Data	None
Description*	Resets the flight software.
Sent By*	GSS Server
Received By*	F/C
Output*	None
Full Name*	Reset (MRST)

3.8 MDAQ Downlink

Sub Type	**GSN**
Length	0-255 character ASCII
Data	Sequence name
Description*	F/C response to MGSN.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Get Sequence Name (QGSN)

Sub Type	**GSI**
Length	0-255 character ASCII
Data	Sequence filenames as a string.
Description*	F/C response to MGSI.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Get Sequence Info (QGSI)

Sub Type	**GCS**
Length	0-255 character ASCII
Data	Sequence name
Description*	F/C response to MGCS. Gives the current sequence name. Returns ASCII NUL if no sequence is running.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Get Current Sequence (QGCS)

Sub Type	**GFL**
Length	6 character ASCII
Data	Number as string
Description*	F/C response to MGFL. Gives the current exposure length.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Get Frame Length (QGFL)

Sub Type	**GFI**
Length	2 character ASCII
Data	Number as string
Description*	F/C response to MGFI. Gives the index number of the current frame.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Get Frame Index (QGFI)

Sub Type	**GOF**
Length	0-255 character ASCII
Data	FIlename as string
Description*	F/C response to MGOF. Gives the output filename.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Get Output Filename (QGOF)

Sub Type	**GST**
Length	2 or 3 character ASCII
Data	ON or OFF
Description*	F/C response to MGST. Gives the self test status.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Get Self Status (QGST)

Sub Type	**GSM**
Length	2 or 3 character ASCII
Data	ON or OFF
Description*	F/C response to MGSM. Gives the STIMS status.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Get STIMS Status (QGSM)

Sub Type	**GTM**
Length	2 or 3 character ASCII
Data	ON or OFF
Description*	F/C response to MGTM. Gives the Telemetry status.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Get Telemetry Status (QGTM)

Sub Type	**GC0**
Length	2 or 3 character ASCII
Data	ON or OFF
Description*	F/C response to MGC0. Gives the Channel 0 status.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Get Channel 0 Status (QGC0)

Sub Type	**GPO**
Length	2 or 3 character ASCII
Data	ON or OFF
Description*	F/C response to MGPO. Gives the Pos Only status.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Get Pos Only Status (QGPO)

Sub Type	**JMP**
Length	1 character ASCII
Data	-1
Description*	F/C response to MJMP. ONLY occurs if the jump index does not exist.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Jump (QJMP)

Sub Type	**FNJ**
Length	2 character ASCII
Data	Index number of exposure that was found and jumped to.
Description*	F/C response to MFNJ.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Find and Jump (QFNJ)

Sub Type	**FNR**
Length	0-255 character ASCII
Data	List of replaced index numbers.
Description*	F/C response to MFNR.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Find and Replace (QFNR)

Sub Type	**BSQ**
Length	00
Data	None
Description*	Confirmation that a sequence has started.
Sent By*	F/C
Received By*	GSS Server
Full Name*	Begin Sequence (QBSQ)

Sub Type	**ESQ**
Length	00
Data	None
Description*	Confirmation that a sequence has ended.
Sent By*	F/C
Received By*	GSS Server
Full Name*	End Sequence (QESQ)

3.9 HK Uplink

Sub Type	**2.5**
Length	2 character ASCII
Data	See Section 4 for the 2 character labels for each system.
Description*	Request for all 2.5 V voltages and currents.
Sent By*	GSS Server
Received By*	F/C
Output*	K2.5 packet from F/C
Full Name*	H2.5

Sub Type	**+5V**
Length	2 character ASCII
Data	See Section 4 for the 2 character labels for each system.
Description*	Request for all +5 V voltages and currents.
Sent By*	GSS Server
Received By*	F/C
Output*	K+5V packet from F/C
Full Name*	H+5V

Sub Type	**-5V**
Length	2 character ASCII
Data	See Section 4 for the 2 character labels for each system.
Description*	Request for all -5 V voltages and currents.
Sent By*	GSS Server
Received By*	F/C
Output*	K-5V packet from F/C
Full Name*	H-5V

Sub Type	**12V**
Length	2 character ASCII
Data	See Section 4 for the 2 character labels for each system.
Description*	Request for all 12 V voltages and currents.
Sent By*	GSS Server
Received By*	F/C
Output*	K12V packet from F/C
Full Name*	H12V

Sub Type	**36V**
Length	2 character ASCII
Data	See Section 4 for the 2 character labels for each system.
Description*	Request for all 36 V voltages and currents.
Sent By*	GSS Server
Received By*	F/C
Output*	K36V packet from F/C
Full Name*	H36V

Sub Type	**TMP**
Length	2 character ASCII
Data	See Section 4 for the 2 character labels for each system.
Description*	Request for all temperature reading.
Sent By*	GSS Server
Received By*	F/C
Output*	KTMP packet from F/C
Full Name*	HTMP

Sub Type	**2.0**
Length	00
Data	None
Description*	Request for all 2.0 V readings from the F/C.
Sent By*	GSS Server
Received By*	F/C
Output*	K2.0 packet from F/C
Full Name*	H2.0

Sub Type	**3.3**
Length	00
Data	None
Description*	Request for all 3.3 V readings from the F/C.
Sent By*	GSS Server
Received By*	F/C
Output*	K3.3 packet from F/C
Full Name*	H3.3

Sub Type	**AVO**
Length	00
Data	None
Description*	Request for CCDA_VOD current from the ROE.
Sent By*	GSS Server
Received By*	F/C
Output*	KAVO packet from F/C
Full Name*	HAVO

Sub Type	**AVR**
Length	00
Data	None
Description*	Request for CCDA_VRD current from the ROE.
Sent By*	GSS Server
Received By*	F/C
Output*	KAVR packet from F/C
Full Name*	HAVR

Sub Type	**AVS**
Length	00
Data	None
Description*	Request for CCDA_VSS current from the ROE.
Sent By*	GSS Server
Received By*	F/C
Output*	KAVS packet from F/C
Full Name*	HAVS

Sub Type	**BVO**
Length	00
Data	None
Description*	Request for CCDB_VOD current from the ROE.
Sent By*	GSS Server
Received By*	F/C
Output*	KBVO packet from F/C
Full Name*	HBVO

Sub Type	**BVR**
Length	00
Data	None
Description*	Request for CCDB_VRD current from the ROE.
Sent By*	GSS Server
Received By*	F/C
Output*	KBVR packet from F/C
Full Name*	HBVR

Sub Type	**BVS**
Length	00
Data	None
Description*	Request for CCDB_VSS current from the ROE.
Sent By*	GSS Server
Received By*	F/C
Output*	KBVS packet from F/C
Full Name*	HBVS

3.10 HK Downlink

Sub Type	**2.5**
Length	0-255 character ASCII
Data	2 character ASCII followed by a decimal value as a string. See Section 4 for the 2 character labels for each system.
Description*	Voltage and current values for the 2.5 V subsystems.
Sent By*	F/C
Received By*	GSS Server
Full Name*	K2.5

Sub Type	**+5V**
Length	0-255 character ASCII
Data	2 character ASCII followed by a decimal value as a string. See Section 4 for the 2 character labels for each system.
Description*	Voltage and current values for the +5 V subsystems.
Sent By*	F/C
Received By*	GSS Server
Full Name*	K+5V

Sub Type	**-5V**
Length	0-255 character ASCII
Data	2 character ASCII followed by a decimal value as a string. See Section 4 for the 2 character labels for each system.
Description*	Voltage and current values for the −5 V subsystems.
Sent By*	F/C
Received By*	GSS Server
Full Name*	K−5V

Sub Type	**12V**
Length	0-255 character ASCII
Data	2 character ASCII followed by a decimal value as a string. See Section 4 for the 2 character labels for each system.
Description*	Voltage and current values for the 12 V subsystems.
Sent By*	F/C
Received By*	GSS Server
Full Name*	K12V

Sub Type	**36V**
Length	0-255 character ASCII
Data	2 character ASCII followed by a decimal value as a string. See Section 4 for the 2 character labels for each system.
Description*	Voltage and current values for the 36 V subsystems.
Sent By*	F/C
Received By*	GSS Server
Full Name*	K36V

Sub Type	**TMP**
Length	0-255 character ASCII
Data	2 character ASCII followed by a decimal value as a string. See Section 4 for the 2 character labels for each system.
Description*	Flight computer and ROE temperatures.
Sent By*	F/C
Received By*	GSS Server
Full Name*	KTMP

Sub Type	**2.0**
Length	0-255 character ASCII
Data	ASCII decimal value
Description*	2.0 V reading from the F/C
Sent By*	F/C
Received By*	GSS Server
Full Name*	K2.0

Sub Type	**3.3**
Length	0-255 character ASCII
Data	ASCII decimal value
Description*	3.3 V reading from the F/C
Sent By*	F/C
Received By*	GSS Server
Full Name*	K3.3

Sub Type	**AVO**
Length	4
Data	ASCII coded Hex
Description*	CCDA_VOD Current from the ROE
Sent By*	F/C
Received By*	GSS Server
Full Name*	KAVO

Sub Type	**AVR**
Length	4
Data	ASCII coded Hex
Description*	CCDA_VRD Current from the ROE
Sent By*	F/C
Received By*	GSS Server
Full Name*	KAVR

Sub Type	**AVS**
Length	4
Data	ASCII coded Hex
Description*	CCDA_VSS Current from the ROE
Sent By*	F/C
Received By*	GSS Server
Full Name*	KAVS

Sub Type	**BVO**
Length	4
Data	ASCII coded Hex
Description*	CCDB_VOD Current from the ROE
Sent By*	F/C
Received By*	GSS Server
Full Name*	KBVO

Sub Type	**BVR**
Length	4
Data	ASCII coded Hex
Description*	CCDB_VRD Current from the ROE
Sent By*	F/C
Received By*	GSS Server
Full Name*	KBVR

Sub Type	**BVS**
Length	4
Data	ASCII coded Hex
Description*	CCDB_VSS Current from the ROE
Sent By*	F/C
Received By*	GSS Server
Full Name*	KBVS

4 HK Voltage and Current Data Fields

2.5		
VC	=	+2.5 V Voltage F/C
VD	=	+2.5 VD Voltage ROE
ID	=	+2.5 VD Current ROE
+5V		
VA	=	+5 VAA Voltage ROE
VB	=	+5 VAB Voltage ROE
VC	=	+5 V Voltage F/C
VD	=	+5 VD Voltage ROE
IA	=	+5 VAA Current ROE
IB	=	+5 VAB Current ROE
ID	=	+5 VD Current ROE
-5V		
VA	=	−5 VAA Voltage ROE
VB	=	−5 VAB Voltage ROE
IA	=	−5 VAA Current ROE
IB	=	−5 VAB Current ROE
12V		
VA	=	12 VAA Voltage ROE
VB	=	12 VAB Voltage ROE
VC	=	12 V Voltage F/C
IA	=	12 VA Current ROE
IB	=	12 VB Current ROE
36V		
VA	=	36 VA Voltage ROE
VB	=	36 VB Voltage ROE
IA	=	36 VA Current ROE
IB	=	36 VB Current ROE
TMP		
1	=	TEMP1 F/C
2	=	TEMP2 F/C
3	=	TEMP3 F/C
U	=	UPPER ROE
L	=	LOWER ROE

5 Error Detection

To ensure that packets are clear and not ambiguous we have decided to implement a very simple rectangle code for our error detection for the HLP. Due to the limited flight time we have decided that error correction is not necessary and might even provide data reliability issues. Both the F/C and the GCS will employ this form of error detection but will respond to them differently:

F/C — will respond with a BACK or a GACK depending on if the packet was readable.

GSS Server — will not send BACK or GACK to the F/C. This decision was made in order to alleviate the F/C from getting overwhelmed. Decisions will be made on the ground on a case-by-case basis.

Rectangle Code: The Checksum field is a one byte field that is placed at the penultimate position in the packet, just prior to the stop delimiter. It is calculated by XORing each byte in the fields preceding it (Start Delimiter, Timestamp, Type, SubType, Length, and Data); it is in effect a parity byte. The implementation of this procedure in the code is not entirely straightforward. Since all the characters used in the packets are ASCII or ASCII coded hex, they can be represented as a single byte with the most significant bit (leading digit in 8-digit binary) a 0 (we do not use the extended ASCII table with characters 128-255). To encode a parity bit, each ASCII character's parity was determined and then applied to the most significant bit. These encoded bytes were then stored in a 128 element byte array LookupTable that simplified the ability to encode or decode parity for any given ASCII character. When calculating the Checksum byte, each byte of the preceding fields was encoded using this LookupTable prior to the XOR that determines the Checksum byte, EXCEPT for the Type byte. The reason for not encoding the Type byte prior to calculating the Checksum is unclear, but since the flight software was compiled with this method any ground station software needs to take it into account in order to properly parse sent and received packets.

The following code snippets show how the parity-encoding LookupTable is created and how the Checksum byte is calculated. It comes from the C++ source code for the MOSES flight software.

```
//Builds the lookup table used to encode data
void Packet::buildLookupTable()
{
     for(int j = 0; j < 128; j++)
     {
          char sum = 0;

         for(int i = 0; i < 8; i++)
         sum += (j << i) & 1; //Calculate parity bit

         lookupTable[j] = (sum%2 == 0)?j & 0x7F:j | 0x80;
     }
}

//Calculates the checksum for checking the
//validity of this packet
```

```
char Packet::calcChecksum()
{ //the parity byte is the exclusive or of all of its aggregate parts
     char parityByte = encode(start);

     for(int i = 0; i < 6; i++)
parityByte ^= encode(timeStamp[i]);

     parityByte ^= type;

     for(int i = 0; i < 3; i++)
parityByte ^= encode(subtype[i]);

     for(int i = 0; i < 2; i++)
      parityByte ^= encode(dataLength[i]);

     for(int i = 0; i < dataSize; i++)
     {
               parityByte ^= encode(data[i]);
     }

     return parityByte;
}
```

6 Payload Subsystems

The following is a list of the payload subsystem two-digit identifiers.

01 – Shutter

02 – ROE

03 – Premod Filter

04 – Temperature Control System (TCS)-1

05 – TCS-3

06 – TCS-2

07 – TCS

08 – 5 V Regulator

09 – 12 V Regulator

10 – H_α Camera