

Appendix B MASCS Telemetry Handbook

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1 List of telemetry items

1.1 MESSENGER Critical Housekeeping Data

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Mission-Required Critical Status						
Executed	8	0	7	0	unsigned integer	Commands executed
Opcode	8	8	15	1	unsigned integer	Command opcode
Macro?	1	16	16	2	0=uplink 1=macro	Set if executed in a macro
Result	7	17	23	2	See section 1.2.1	Command result code
Alarm	8	24	31	3	See section 1.2.2	Latest alarm id
Alarm type	1	32	32	4	0=persistent 1=transient	Latest alarm type
Alarms	7	33	39	4	unsigned integer	Count of alarms
MASCS-Specific Critical Status						
Major version	4	0	3	0	1-15	Software major version
Minor version	4	4	7	0	0-15	Software minor version
VIRS Scanning	1	8	8	1	0 = false 1 = true	VIRS scan on going?
UVVS Scanning	1	9	9	1	0 = false 1 = true	UVVS scan on going ?
Grating drive ON	1	10	10	1	0 = off 1 = on	Indicates whether grating drive is on or off
UVVS GD Moving	1	11	11	1	1 = moving 0 = not moving	Indicates if the UVVS grating drive is making any movement
SBOS enabled	1	12	12	1	0 = false 1 = true	Indicates whether SBOS is commanded to be active
SBOS triggered	1	13	13	1	0 = false 1 = true	Indicates whether the SBOS has been triggered. This bit is cleared when the VIS tube is turned on again.
Spare	3	14	16	2	0	
NIR power	1	17	17	2	0 = off 1 = on	See FPGA document section 7.1

VIS power	1	18	18	2	0 = off 1 = on	See FPGA document section 7.1
VIS PMT HV	1	19	19	2	0 = off 1 = on	See FPGA document section 7.1
MUV PMT HV	1	20	20	2	0 = off 1 = on	See FPGA document section 7.1
FUV PMT HV	1	21	21	2	0 = off 1 = on	See FPGA document section 7.1
HVPS HV	1	22	22	2	0 = off 1 = on	See FPGA document section 7.1
NIR Flat Field Lamp	1	23	23	2	0 = off 1 = on	See FPGA document section 7.1
VIS Flat Field Lamp	1	24	24	3	0 = off 1 = on	See FPGA document section 7.1
NIR gain	1	25	25	3	0 = low 1 = high	See FPGA document section 7.1
NIR LP	1	26	26	3	0 = false 1 = true	See FPGA document section 7.2
VIS LP	1	27	27	3	0 = false 1 = true	See FPGA document section 7.2
Spare	4	28	31	3	0	

1.2 MESSENGER Common Instrument Telemetry

All of the telemetry items required in the GIIS are actually implemented in the Common Code. For a detailed description of the packets listed in this section, see document titled “MESSENGER Instrument Common Software”. Each type of telemetry packet has been named below with any necessary MASCS instrument specific details included.

1.2.1 Command Echo

ApID is 0x341.

Command echo packets can contain any of the following result codes. Note that values 0x00 to 0x0f are all determined by the common code while values 0x0f to 0x7f are MASCS-specific.

Value	Code Description
0x00	No error, command executed
0x01	No error, command appended to macro
0x02	Unknown opcode
0x03	Bad argument
0x04	Cannot run macro; no contexts
0x05	Cannot be used outside of a macro
0x06	Macro compilation error
0x07	Macro not killed (not running ?)
0x08	Bad EEPROM program
0x09	Cannot restore macros; bad checksum
0x0a	Cannot load memory; write disabled
0x0b ... 0x0f	Reserved for common code
0x10	Out of range command
0x11	Configuration error; scan cancelled
0x12	Process busy; configuration or scan command rejected
0x13	HVPS command error
0x14	VIRS power off; cannot power on stim lamps
0x15	Software enable not set
0x16	Table not initialized
0x17 ... 0x7f	Not used

1.2.2 Alarm

ApID is 0x342

No alarm monitoring is used by the MASCS-specific application. The common code does use some alarms, however and defines the following Id's:

ID	Description	Information
0	Unused	
1	Bad transfer frame	
2	Out of macro contents	Macro ID
3	Bad command destination	Incorrect destination; wrong instrument
4 ... 15	Reserved for common code	
16 ... 255	Reserved for MASCS	Not used

1.2.3 Memory Checksum

ApID is 0x343

Same as described in document titled "MESSENGER Instrument Common Software".

1.2.4 Memory Dump

ApID is 0x344

Same as described in document titled "MESSENGER Instrument Common Software".

1.2.5 Status

ApIDs are 0x345 and 0x356

The status packet is required by the GIIS to contain many common telemetry data items. It also contains instrument-specific engineering data needed to monitor the health of the MASCS instrument. There will be a nominal short status packet and a diagnostic long packet that contains full resolution on all engineering monitors. The status packets are fully defined below in section 1.2.

1.2.6 Monitor Limits

ApId is 0x346

MASCS does not use the monitor limits feature of the common code, and so this packet consists of only a header and 10 place holder limits.

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Primary and Secondary Headers						
Version	3	0	2	0	0	Designates a source packet
Type	1	3	3	0	0	Designates a telemetry packet
Secondary?	1	4	4	0	1	Secondary header is present
App ID	11	5	15	1	346h	Application identifier
Grouping	2	16	17	2	11 = None	Grouping flags
Sequence count	14	18	31	3	unsigned integer	Continuous sequence count for each Application Process ID
Length	16	32	47	5	23	Packet length (bytes) - 1
Secondary header	32	48	79	9	unsigned integer	Time tag (MET)
Monitors						
Limits 1	16	80	95	11	unsigned integer	not defined
Limits 2	16	96	111	13	unsigned integer	not defined
Limits 3	16	112	127	15	unsigned integer	not defined
Limits 4	16	128	143	17	unsigned integer	not defined
Limits 5	16	144	159	19	unsigned integer	not defined
Limits 6	16	160	175	21	unsigned integer	not defined

Limits 7	16	176	191	23	unsigned integer	not defined
Limits 8	16	192	207	25	unsigned integer	not defined
Limits 9	16	208	223	27	unsigned integer	not defined
Limits 10	16	224	239	29	unsigned integer	not defined

1.2.7 Macro Dump

ApID is 0x348

1.2.8 Macro Checksum

ApID is 0x349

1.3 MASCS Housekeeping Packet Description

1.3.1 Status Packet Short housekeeping packet description

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Primary and Secondary Headers						
Version	3	0	2	0	0	Designates a source packet
Type	1	3	3	0	0	Designates a telemetry packet
Secondary?	1	4	4	0	1	Secondary header is present
App ID	11	5	15	1	345h	Application identifier
Grouping	2	16	17	2	11 = None	Grouping flags
Sequence count	14	18	31	3	unsigned integer	Continuous sequence count for each Application Process ID
Length	16	32	47	5	71	Packet length (bytes) - 1
Secondary header	32	48	79	9	unsigned integer	Time tag (MET)
Software Status						
Status Int.	16	80	95	11	1 – 65535 (0 = Off)	Status interval (seconds)
Macro Blocks	16	96	111	13	unsigned integer	Number of macro blocks free
TLM Vol.	16	112	127	15	unsigned integer	Telemetry volume produced (KB)
Watch Addr.	16	128	143	17	unsigned integer	Memory watch address
Watch Mem	8	144	151	18	unsigned integer	Memory watch id (page no.)
Watch Data	16	152	167	20	unsigned integer	Watched memory
SW Version	8	168	175	21	unsigned integer	Software version number
Alarm Id	8	176	183	22	unsigned integer	Latest alarm Id- see Alarm ID table
Alarm Type	1	184	184	23	0 = persistent 1 = transient	Latest alarm type
Alarm Count	7	185	191	23	unsigned integer	Count of alarms
Cmd Exec	8	192	199	24	unsigned integer	Commands executed
Cmd Reject	8	200	207	25	unsigned integer	Commands rejected
Mac Exec	8	208	215	26	unsigned integer	Macro commands executed
Mac Reject	8	216	223	27	unsigned integer	Macro commands rejected
Macro Id	8	224	231	28	unsigned integer	Id of most recent macro executed
Macro Learn	1	232	232	29	0 = not learning 1 = learning	Macro learn mode
Monitor Response	1	233	233	29	0 = disabled 1 = enabled	Monitor response
Write Enb	1	234	234	29	0 = disabled 1 = enabled	Memory write enable
Shutter Position Valid	1	235	235	29	0 = false 1 = true	Tells whether the shutter position was monitored in this status interval

Slit Position Valid	1	236	236	29	0 = false 1 = true	Tells whether the slit position was monitored in this status interval
VIRS Scanning	1	237	237	29	0 = false 1 = true	VIRS scan on going?
UVVS Scanning	1	238	238	29	0 = false 1 = true	UVVS scan on going ?
Grating drive table generating	1	239	239	29	0 = false 1 = true	Flag indicates whether grating drive table is being generated
FPGA and SBOS Status						
Grating pass-thru mode	1	240	240	30	0 = false 1 = true	See FPGA document section 7.1
NIR power	1	241	241	30	0 = off 1 = on	See FPGA document section 7.1
VIS power	1	242	242	30	0 = off 1 = on	See FPGA document section 7.1
VIS PMT HV	1	243	243	30	0 = off 1 = on	See FPGA document section 7.1
MUV PMT HV	1	244	244	30	0 = off 1 = on	See FPGA document section 7.1
FUV PMT HV	1	245	245	30	0 = off 1 = on	See FPGA document section 7.1
HVPS HV	1	246	246	30	0 = off 1 = on	See FPGA document section 7.1
NIR Flat Field Lamp	1	247	247	30	0 = off 1 = on	See FPGA document section 7.1
VIS Flat Field Lamp	1	248	248	31	0 = off 1 = on	See FPGA document section 7.1
NIR gain	1	249	249	31	0 = low 1 = high	See FPGA document section 7.1
Grating drive ON	1	250	250	31	0 = off 1 = on	Indicates whether grating drive is on and ready to control to position or off
Spare	1	251	251	31	0	0
VIRS shutter	1	252	252	31	1 = closed 0 = open	See FPGA document section 7.1
UVVS slit position	1	253	253	31	0 = surface 1 = atmospheric	See FPGA document section 7.1
UVVS grating at index	1	254	254	31	0 = false 1 = true	See FPGA document section 7.1
VIRS busy	1	255	255	31	0 = false 1 = true	See FPGA document section 7.1
CC cmd error	1	256	256	32	0 = no error 1 = error	See FPGA document section 7.2
VIRS shutter command error	1	257	257	32	0 = no error 1 = error	See FPGA document section 7.2
UVVS slit command error	1	258	258	32	0 = no error 1 = error	See FPGA document section 7.2

HVPS command sequence error	1	259	259	32	0 = no error 1 = error	See FPGA document section 7.2
NIR LP	1	260	260	32	0 = false 1 = true	See FPGA document section 7.2
VIS LP	1	261	261	32	0 = false 1 = true	See FPGA document section 7.2
Reset command error	1	262	262	32	0 = no error 1 = error	See FPGA document section 7.2
UVVS GD Moving	1	263	263	32	1 = moving 0 = not moving	Indicates if the UVVS grating drive is making any movement
Spare	2	264	265	33	0	0
UVVS EOI	1	266	266	33	0 = false 1 = true	See FPGA document section 7.2
Step grating now	1	267	267	33	0 = false 1 = true	See FPGA document section 7.2
Table generated?	1	268	268	33	0 = false 1 = true	Indicates if lookup table has been generated yet.
Grating drive direction	1	269	269	33	0 = CCW 1 = CW	Direction grating drive is set to rotate to first upon a find index command
VIRS irq	1	270	270	33	0 = false 1 = true	See FPGA document section 7.2
GDLCI irq	1	271	271	33	0 = false 1 = true	See FPGA document section 7.2
UVVS grating drive position	12	272	283	35	0 - 2700 arc minutes	Grating drive position reported from software
CC software enable	1	284	284	35	0 = disabled 1 = enabled	Software enable set to open contamination cover
FPGA reset software enable	1	285	285	35	0 = disabled 1 = enabled	Software enable set to reset FPGA
SBOS enabled	1	286	286	35	0 = false 1 = true	Indicates whether SBOS is commanded to be active
SBOS triggered	1	287	287	35	0 = false 1 = true	Indicates whether the SBOS has been triggered. This bit is cleared when the VIS tube is turned on again.
SBOS level (read)	8	288	295	36	unsigned integer	Software bright object sensor level (upper 8 bits of MUV PMT counts)

Current and Voltage Monitors

DEB FPGA +2.5 V	8	296	303	37	signed integer	See TBD document
HVPS Test Monitor Sum	8	304	311	38	signed integer	See TBD document
+5 V	8	312	319	39	signed integer	See TBD document
-5 V	8	320	327	40	signed integer	See TBD document
+12 V	8	328	335	41	signed integer	See TBD document
-12 V	8	336	343	42	signed integer	See TBD document
+5 V Current	8	344	351	43	signed integer	See TBD document

-5 V Current	8	352	359	44	signed integer	See TBD document
+ 12 V Current	8	360	367	45	signed integer	See TBD document
-12 V Current	8	368	375	46	signed integer	See TBD document
+28 V Current	8	376	383	47	signed integer	See TBD document
Switched +28V current monitor	8	384	391	48	signed integer	See TBD document
Unregulated HV Monitor	12	392	403	50	signed integer	See TBD document
VIS HV Monitor	12	404	415	51	signed integer	See TBD document
MUV HV Monitor	12	416	427	53	signed integer	See TBD document
FUV HV Monitor	12	428	439	54	signed integer	See TBD document
Temperature Monitors						
DEB Temp	12	440	451	56	signed integer	See TBD document
VIS PMT Temp	12	452	463	57	signed integer	See TBD document
MUV PMT Temp	12	464	475	59	signed integer	See TBD document
FUV PMT Temp	12	476	487	60	signed integer	See TBD document
HVPS LV Temp	12	488	499	62	signed integer	See TBD document
HVPS HV Temp	12	500	511	63	signed integer	See TBD document
UVVS Grating Temp	12	512	523	65	signed integer	See TBD document
VIS Array Temp #1	12	524	535	66	signed integer	See TBD document
VIS Array Temp #2	12	536	547	68	signed integer	See TBD document
NIR External Temp	12	548	559	69	signed integer	See TBD document
NIR Internal Temp	12	560	571	71	signed integer	See TBD document
BOB Temp	12	572	583	72	signed integer	See TBD document
VIRS Grating Temp	12	584	595	74	signed integer	See TBD document
Contamination Cover Temp	12	596	607	75	signed integer	See TBD document
LVPS Temp	12	608	619	77	signed integer	See TBD document
Spare	4	620	623	77	0	Pad to 8-bit boundary

1.3.2 Status Packet Long housekeeping packet description

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Primary and Secondary Headers						
Version	3	0	2	0	0	Designates a source packet
Type	1	3	3	0	0	Designates a telemetry packet
Secondary?	1	4	4	0	1	Secondary header is present
App ID	11	5	15	1	356h	Application identifier
Grouping	2	16	17	2	11 = None	Grouping flags
Sequence count	14	18	31	3	unsigned integer	Continuous sequence count for each Application Process ID
Length	16	32	47	5	85	Packet length (bytes) - 1
Secondary header	32	48	79	9	unsigned integer	Time tag (MET)
Software Status						
Status Int.	16	80	95	11	1 – 65535 (0 = Off)	Status interval (seconds)
Macro Blocks	16	96	111	13	unsigned integer	Number of macro blocks free
TLM Vol.	16	112	127	15	unsigned integer	Telemetry volume produced (KB)
Watch Addr.	16	128	143	17	unsigned integer	Memory watch address
Watch Mem	8	144	151	18	unsigned integer	Memory watch id (page no.)
Watch Data	16	152	167	20	unsigned integer	Watched memory
SW Version	8	168	175	21	unsigned integer	Software version number
Alarm Id	8	176	183	22	unsigned integer	Latest alarm Id- see Alarm ID table
Alarm Type	1	184	184	23	0 = persistent 1 = transient	Latest alarm type
Alarm Count	7	185	191	23	unsigned integer	Count of alarms
Cmd Exec	8	192	199	24	unsigned integer	Commands executed
Cmd Reject	8	200	207	25	unsigned integer	Commands rejected
Mac Exec	8	208	215	26	unsigned integer	Macro commands executed
Mac Reject	8	216	223	27	unsigned integer	Macro commands rejected
Macro Id	8	224	231	28	unsigned integer	Id of most recent macro executed
Macro Learn	1	232	232	29	0 = not learning 1 = learning	Macro learn mode
Monitor Response	1	233	233	29	0 = disabled 1 = enabled	Monitor response
Write Enb	1	234	234	29	0 = disabled 1 = enabled	Memory write enable
Shutter Position Valid	1	235	235	29	0 = false 1 = true	Tells whether the shutter position was monitored in this status interval
Slit Position Valid	1	236	236	29	0 = false 1 = true	Tells whether the slit position was monitored in this status interval

VIRS Scanning	1	237	237	29	0 = false 1 = true	VIRS scan on going?
UVVS Scanning	1	238	238	29	0 = false 1 = true	UVVS scan on going ?
Grating drive table generating	1	239	239	29	0 = false 1 = true	Flag indicates whether grating drive table is being generated
FPGA and SBOS Status						
Grating pass-thru mode	1	240	240	30	0 = false 1 = true	See FPGA document section 7.1
NIR power	1	241	241	30	0 = off 1 = on	See FPGA document section 7.1
VIS power	1	242	242	30	0 = off 1 = on	See FPGA document section 7.1
VIS PMT HV	1	243	243	30	0 = off 1 = on	See FPGA document section 7.1
MUV PMT HV	1	244	244	30	0 = off 1 = on	See FPGA document section 7.1
FUV PMT HV	1	245	245	30	0 = off 1 = on	See FPGA document section 7.1
HVPS HV	1	246	246	30	0 = off 1 = on	See FPGA document section 7.1
NIR Flat Field Lamp	1	247	247	30	0 = off 1 = on	See FPGA document section 7.1
VIS Flat Field Lamp	1	248	248	31	0 = off 1 = on	See FPGA document section 7.1
NIR gain	1	249	249	31	0 = low 1 = high	See FPGA document section 7.1
Grating drive ON	1	250	250	31	0 = off 1 = on	Indicates whether grating drive is on and ready to control to position or off
Spare	1	251	251	31	0	0
VIRS shutter	1	252	252	31	1 = closed 0 = open	See FPGA document section 7.1
UVVS slit position	1	253	253	31	0 = surface 1 = atmospheric	See FPGA document section 7.1
UVVS grating at index	1	254	254	31	0 = false 1 = true	See FPGA document section 7.1
VIRS busy	1	255	255	31	0 = false 1 = true	See FPGA document section 7.1
CC cmd error	1	256	256	32	0 = no error 1 = error	See FPGA document section 7.2
VIRS shutter command error	1	257	257	32	0 = no error 1 = error	See FPGA document section 7.2
UVVS slit command error	1	258	258	32	0 = no error 1 = error	See FPGA document section 7.2
HVPS command sequence error	1	259	259	32	0 = no error 1 = error	See FPGA document section 7.2

NIR LP	1	260	260	32	0 = false 1 = true	See FPGA document section 7.2
VIS LP	1	261	261	32	0 = false 1 = true	See FPGA document section 7.2
Reset command error	1	262	262	32	0 = no error 1 = error	See FPGA document section 7.2
UVVS GD Moving	1	263	263	32	1 = moving 0 = not moving	Indicates if the UVVS grating drive is making any movement
Spare	2	264	265	33	0	0
UVVS EOI	1	266	266	33	0 = false 1 = true	See FPGA document section 7.2
Step grating now	1	267	267	33	0 = false 1 = true	See FPGA document section 7.2
Table generated?	1	268	268	33	0 = false 1 = true	Indicates if lookup table has been generated yet.
Grating drive direction	1	269	269	33	0 = CCW 1 = CW	Direction grating drive is set to rotate to first upon a find index command
VIRS irq	1	270	270	33	0 = false 1 = true	See FPGA document section 7.2
GDLCI irq	1	271	271	33	0 = false 1 = true	See FPGA document section 7.2
UVVS grating drive position	12	272	283	35	0 - 2700 arc minutes	Grating drive position reported from software
CC software enable	1	284	284	35	0 = disabled 1 = enabled	Software enable set to open contamination cover
FPGA reset software enable	1	285	285	35	0 = disabled 1 = enabled	Software enable set to reset FPGA
SBOS enabled	1	286	286	35	0 = false 1 = true	Indicates whether SBOS is commanded to be active
SBOS triggered	1	287	287	35	0 = false 1 = true	Indicates whether the SBOS has been triggered. This bit is cleared when the VIS tube is turned on again.
SBOS level (read)	8	288	295	36	unsigned integer	Software bright object sensor level (upper 8 bits of MUV PMT counts)

Current and Voltage Monitors

DEB FPGA +2.5 V	14	296	309	38	signed integer	See TBD document
HVPS Test Monitor Sum	14	310	323	40	signed integer	See TBD document
+5 V	14	324	337	42	signed integer	See TBD document
-5 V	14	338	351	43	signed integer	See TBD document
+12 V	14	352	365	45	signed integer	See TBD document
-12 V	14	366	379	47	signed integer	See TBD document
+5 V Current	14	380	393	49	signed integer	See TBD document
-5 V Current	14	394	407	50	signed integer	See TBD document
+ 12 V Current	14	408	421	52	signed integer	See TBD document

-12 V Current	14	422	435	54	signed integer	See TBD document
+28 V Current	14	436	449	56	signed integer	See TBD document
Switched +28V current monitor	14	450	463	57	signed integer	See TBD document
Unregulated HV Monitor	14	464	477	59	signed integer	See TBD document
VIS HV Monitor	14	478	491	61	signed integer	See TBD document
MUV HV Monitor	14	492	505	63	signed integer	See TBD document
FUV HV Monitor	14	506	519	64	signed integer	See TBD document
Temperature Monitors						
DEB Temp	14	520	533	66	signed integer	See TBD document
VIS PMT Temp	14	534	547	68	signed integer	See TBD document
MUV PMT Temp	14	548	561	70	signed integer	See TBD document
FUV PMT Temp	14	562	575	71	signed integer	See TBD document
HVPS LV Temp	14	576	589	73	signed integer	See TBD document
HVPS HV Temp	14	590	603	75	signed integer	See TBD document
UVVS Grating Temp	14	604	617	77	signed integer	See TBD document
VIS Array Temp #1	14	618	631	78	signed integer	See TBD document
VIS Array Temp #2	14	632	645	80	signed integer	See TBD document
NIR External Temp	14	646	659	82	signed integer	See TBD document
NIR Internal Temp	14	660	673	84	signed integer	See TBD document
BOB Temp	14	674	687	85	signed integer	See TBD document
VIRS Grating Temp	14	688	701	87	signed integer	See TBD document
Contamination Cover Temp	14	702	715	89	signed integer	See TBD document
LVPS Temp	14	716	729	91	signed integer	See TBD document
Spare	6	730	735	91	0	Pad to 8-bit boundary

1.4 MASCS Diagnostic Telemetry Packets

1.4.1 Index Found diagnostic packet description

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Primary and Secondary Headers						
Version	3	0	2	0	0	Designates a source packet
Type	1	3	3	0	0	Designates a telemetry packet
Secondary?	1	4	4	0	1	Secondary header is present
App ID	11	5	15	1	355h	Application identifier
Grouping	2	16	17	2	11 = None	Grouping flags
Sequence count	14	18	31	3	unsigned integer	Continuous sequence count for each Application Process ID
Length	16	32	47	17	14	Packet length (bytes) - 1
Secondary header	32	48	79	9	unsigned integer	Time tag (MET)
Index Found Header						
Offset	16	80	95	11	0 - 27000	Offset from index/hardstop in fine position count units
Index found	1	96	96	12	0 = false 1 = true	Indicates whether find index command was successful or not
Direction	1	97	97	12	0 = CCW 1 = CW	Direction grating drive moves first to find initial hardstop
Index algorithm used	1	98	98	12	0 = find index 1 = hardstop offset	Selectable index algorithm can search for an index pulse on encoder disk or use a position offset from a hardstop
Lookup table saturated	1	99	99	12	0 = false 1 = true	Indicates whether LED intensity was too high to optimize lookup table
Spare	4	100	103	12	0	Pad to 8 bit boundary
UVVS Grating Temperature	12	104	115	14	unsigned integer	Temperature of UVVS grating
LED Intensity Output	4	116	119	14	unsigned integer	Value written to LED ADC
Min A	8	120	127	15	unsigned integer	Minimum value of grating drive encoder

						sine signal
Max A	8	128	135	16	unsigned integer	Maximum value of grating drive encoder sine signal
Min B	8	136	143	17	unsigned integer	Minimum value of grating drive encoder cosine signal
Max B	8	144	151	18	unsigned integer	Maximum value of grating drive encoder cosine signal
Grating Clear Track Intensity Min	8	152	159	19	unsigned integer	Minimum value of grating drive encoder clear track signal sampled
Grating Clear Track Intensity Max	8	160	167	20	unsigned integer	Maximum value of grating drive encoder clear track signal sampled

1.4.2 Grating Drive Step Response diagnostic packet description

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Primary and Secondary Headers						
Version	3	0	2	0	0	Designates a source packet
Type	1	3	3	0	0	Designates a telemetry packet
Secondary?	1	4	4	0	1	Secondary header is present
App ID	11	5	15	1	357h	Application identifier
Grouping	2	16	17	2	11 = None	Grouping flags
Sequence count	14	18	31	3	unsigned integer	Continuous sequence count for each Application Process ID
Length	16	32	47	5	4096	Packet length (bytes) - 1
Secondary header	32	48	79	9	unsigned integer	Time tag (MET)
Step Response Header						
Start position	12	80	91	11	0 to 2700 steps	Start position where grating drive begins a scan
Step count	12	92	103	12	0 to 2700 steps	Number of steps the grating drive will take in a scan
Step size	8	104	111	13	0 - 15 arcmin	Step size in arcminute units
Integration period	16	112	127	15	3 – 4095 GDLCI periods (1ms – 1.3 s)	Integration time in grating drive loop control interrupt periods (nominally 3000 Hz)
Step time	8	128	135	16	0 - 31 GDLCI (0 – 10.3 ms) periods	Step time in grating drive control loop interrupt periods (nominally 3000 Hz)
LED Intensity Output	4	136	139	17	unsigned integer	Value written to LED ADC
Phase offset	3	140	142	17	0 to 7 GDLCI periods	Phase offset in grating drive control loop interrupt periods
Spare	1	143	143	17	0	Pad to 8 bit boundary
Kp	16	144	159	19	unsigned integer	Proportional gain
Kd	16	160	175	21	unsigned integer	Derivative gain
Kf	16	176	191	23	unsigned	Feed forward gain

					integer	
Ki	16	192	207	25	unsigned integer	Integral gain
Min A	8	208	215	26	signed integer	Minimum value of grating drive encoder sine signal
Max A	8	216	223	27	signed integer	Maximum value of grating drive encoder sine signal
Min B	8	224	231	28	signed integer	Minimum value of grating drive encoder cosine signal
Max B	8	232	239	29	signed integer	Maximum value of grating drive encoder cosine signal
Target position select	1	240	240	30	0 = not selected 1 = selected	Specifies whether target position has been included in G20data field
Current position select	1	241	241	30	0 = not selected 1 = selected	Specifies whether current position has been included in data field
Error select	1	245	245	30	0 = not selected 1 = selected	Specifies whether position error has been included in data field
D term select	1	246	246	30	0 = not selected 1 = selected	Specifies whether derivative term has been included in data field
I term select	1	247	247	30	0 = not selected 1 = selected	Specifies whether integral term has been included in data field
P term select	1	248	248	31	0 = not selected 1 = selected	Specifies whether proportional term has been included in data field
F term select	1	249	249	31	0 = not selected 1 = selected	Specifies whether feed forward term has been included in data field
Loop sum select	1	250	250	31	0 = not selected 1 = selected	Specifies whether loop sum term has been included in data field
Motor output select	1	251	251	31	0 = not selected 1 = selected	Specifies whether the motor output value has been included in data field

Channel A and B raw counts	1	252	252	31	0 = not selected 1 = selected	Specifies whether encoder channels A and B raw values have been included in data field
Spare	6	252	257	32	0	Pad to 8 bit boundary
Step Response Data						
Data set 1	(Only selected items are included)					
Channels A and B raw (8 bit values paired together)	16					
Target position	16					
Current position	16					
Error	16					
D term	32					
I term	32					
P term	32					
F term	32					
Loop sum	32					
Motor output	16					
Data set 2						
.....						
Data set N	Until packet is full					

1.5 MASCS science packets

1.5.1 UVVS FUV PMT science packet description

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Primary and Secondary Headers						
Version	3	0	2	0	0	Designates a source packet
Type	1	3	3	0	0	Designates a telemetry packet
Secondary?	1	4	4	0	1	Secondary header is present
App ID	11	5	15	1	0x351	Application identifier
Grouping	2	16	17	2	11 = None	Grouping flags
Sequence count	14	18	31	3	Unsigned integer	Continuous sequence count for each Application Process ID
Length	16	32	47	5	19-4099	Packet length (bytes) - 1
Secondary header	32	48	79	9	Unsigned integer	Start time of observation in MET (seconds)
UVVS FUV Data Header						
Sync bytes	16	80	95	11	0xAA55	Sync bytes to align message
Subsecond timer	8	96	103	12	0-199 (5 ms units)	Indicates subsecond start time of observation in 5 ms increments
Start position	12	104	115	14	0 to 2700 steps	Start position where grating drive begins a scan
Step count	12	116	127	15	0 to 2700 steps	Number of steps the grating drive will take in a scan
Integration period	16	128	143	17	3 – 4095 GDLCI periods (1ms – 1.3 s)	Integration time in grating drive loop control interrupt periods (nominally 3000 Hz)
Step time	5	144	148	18	0 - 31 GDLCI (0 – 10.3 ms) periods	Step time in grating drive control loop interrupt periods (nominally 3000 Hz)
Phase offset	3	149	151	18	0 to 7 GDLCI periods	Phase offset in grating drive control loop interrupt periods
Scan cycles	8	152	159	19	1 to 255	Number of times to repeat scan
Zigzag mode	1	160	160	20	0 = disable 1 = enable	Bit indicates whether grating drive moves in a triangle motion or not
Data compressed?	1	161	161	20	0 = 16 bit data, 1 = 9 bit	Selectable data size
Slit mask position	1	162	162	20	0 = atmospheric 1 = surface	Bit indicates whether slit mask is in atmospheric (open) or surface (closed)

						position
FUV PMT state	1	163	163	20	0 = off 1 = on	Indicates whether FUV PMT power is on
MUV PMT state	1	164	164	20	0 = off 1 = on	Indicates whether MUV PMT power is on
VIS PMT state	1	165	165	20	0 = off 1 = on	Indicates whether VIS PMT power is on
Data buffer overflow	1	166	166	20	0 = false 1 = true	Indicates whether scan programmed overflowed data buffer and was therefore truncated
Spare	1	167	167	20	0	
Grating drive settle err counter	16	168	183	22	Unsigned integer	Number of times during integration that the grating drive wandered outside target range
Number of scan values	12	168	179	22	0-3620	Number of values in the entire scan observation
Step size	4	180	183	22	0 to 15 arcmin	Step size in arcmin units
Spare	8	184	191	23	0	
UVVS FUV Data Section						
Scan data	9 * N or 16 * N	192				N is number of data points. 16 or 9 bit data size is dependent on whether data compression is enabled. Scan will continue until packet is filled and terminate.

1.5.2 UVVS MUV PMT science packet description

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Primary and Secondary Headers						
Version	3	0	2	0	0	Designates a source packet
Type	1	3	3	0	0	Designates a telemetry packet
Secondary?	1	4	4	0	1	Secondary header is present
App ID	11	5	15	1	0x350	Application identifier
Grouping	2	16	17	2	11 = None	Grouping flags
Sequence count	14	18	31	3	Unsigned integer	Continuous sequence count for each Application Process ID
Length	16	32	47	5	19-4099	Packet length (bytes) - 1
Secondary header	32	48	79	9	Unsigned integer	Start time of observation in MET (seconds)
UVVS MUV Data Header						
Sync bytes	16	80	95	11	0xAA55	Sync bytes to align message
Subsecond timer	8	96	103	12	0-199 (5 ms units)	Indicates subsecond start time of observation in 5 ms increments
Start position	12	104	115	14	0 to 2700 steps	Start position where grating drive begins a scan
Step count	12	116	127	15	0 to 2700 steps	Number of steps the grating drive will take in a scan
Integration period	16	128	143	17	3 – 4095 GDLCI periods (1ms – 1.3 s)	Integration time in grating drive loop control interrupt periods (nominally 3000 Hz)
Step time	5	144	148	18	0 - 31 GDLCI (0 – 10.3 ms) periods	Step time in grating drive control loop interrupt periods (nominally 3000 Hz)
Phase offset	3	149	151	18	0 to 7 GDLCI periods	Phase offset in grating drive control loop interrupt periods
Scan cycles	8	152	159	19	1 to 255	Number of times to repeat scan
Zigzag mode	1	160	160	20	0 = disable 1 = enable	Bit indicates whether grating drive moves in a triangle motion or not
Data compressed?	1	161	161	20	0 = 16 bit data, 1 = 9 bit	Selectable data size
Slit mask position	1	162	162	20	0 = atmospheric 1 = surface	Bit indicates whether slit mask is in atmospheric (open) or surface (closed) position
FUV PMT state	1	163	163	20	0 = off 1 = on	Indicates whether FUV PMT power is on
MUV PMT state	1	164	164	20	0 = off 1 = on	Indicates whether MUV PMT power is on
VIS PMT state	1	165	165	20	0 = off 1 = on	Indicates whether VIS PMT power is on

Data buffer overflow	1	166	166	20	0 = false 1 = true	Indicates whether scan programmed overflowed data buffer and was therefore truncated
Spare	1	167	167	20	0	
Grating drive settle err counter	16	168	183	22	Unsigned integer	
Number of scan values	12	184	195	24	0-3620	Number of values in the entire scan observation
Step size	4	196	199	24	0 to 15 arcmin	Step size in arcmin units
Spare	8	200	207	25	0	
UVVS MUV Data Section						
Scan data	9 * N or 16 * N	208				N is number of data points. 16 or 9 bit data size is dependent on whether data compression is enabled. Scan will continue until packet is filled and terminate.

1.5.3 UVVS VIS PMT science packet description

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Primary and Secondary Headers						
Version	3	0	2	0		0 Designates a source packet
Type	1	3	3	0		0 Designates a telemetry packet
Secondary?	1	4	4	0		1 Secondary header is present
App ID	11	5	15	1	0x352	Application identifier
Grouping	2	16	17	2	11 = None	Grouping flags
Sequence count	14	18	31	3	Unsigned integer	Continuous sequence count for each Application Process ID
Length	16	32	47	5	19-4099	Packet length (bytes) - 1
Secondary header	32	48	79	9	Unsigned integer	Start time of observation in MET (seconds)
UVVS VIS Data Header						
Sync bytes	16	80	95	11	0xAA55	Sync bytes to align message
Subsecond timer	8	96	103	12	0-199 (5 ms units)	Indicates subsecond start time of observation in 5 ms increments
Start position	12	104	115	14	0 to 2700 steps	Start position where grating drive begins a scan
Step count	12	116	127	15	0 to 2700 steps	Number of steps the grating drive will take in a scan
Integration period	16	128	143	17	3 – 4095 GDLCI periods (1ms – 1.3 s)	Integration time in grating drive loop control interrupt periods (nominally 3000 Hz)
Step time	5	144	148	18	0 - 31 GDLCI (0 – 10.3 ms) periods	Step time in grating drive control loop interrupt periods (nominally 3000 Hz)
Phase offset	3	149	151	18	0 to 7 GDLCI periods	Phase offset in grating drive control loop interrupt periods
Scan cycles	8	152	159	19	1 to 255	Number of times to repeat scan
Zigzag mode	1	160	160	20	0 = disable 1 = enable	Bit indicates whether grating drive moves in a triangle motion or not
Data compressed?	1	161	161	20	0 = 16 bit data, 1 = 9 bit	Selectable data size

Slit mask position	1	162	162	20	0 = atmospheric 1 = surface	Bit indicates whether slit mask is in atmospheric (open) or surface (closed) position
FUV PMT state	1	163	163	20	0 = off 1 = on	Indicates whether FUV PMT power is on
MUV PMT state	1	164	164	20	0 = off 1 = on	Indicates whether MUV PMT power is on
VIS PMT state	1	165	165	20	0 = off 1 = on	Indicates whether VIS PMT power is on
Data buffer overflow	1	166	166	20	0 = false 1 = true	Indicates whether scan programmed overflowed data buffer and was therefore truncated
Spare	1	167	167	20	0	
Grating drive settle err counter	16	168	183	22	Unsigned integer	Number of times during integration that the grating drive wandered outside target range
Number of scan values	12	168	179	22	0-3620	Number of values in the entire scan observation
Step size	4	180	183	22	0 to 15 arcmin	Step size in arcmin units
Spare	8	184	191	23	0	
UVVS VIS Data Section						
Scan data	9 * N or 16 * N	192				N is number of data points. 16 or 9 bit data size is dependent on whether data compression is enabled. Scan will continue until packet is filled and terminate.

1.5.4 VIRS VIS science packet description

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Primary and Secondary Headers						
Version	3	0	2	0	0	Designates a source packet
Type	1	3	3	0	0	Designates a telemetry packet
Secondary?	1	4	4	0	1	Secondary header is present
App ID	11	5	15	1	0x353	Application identifier
Grouping	2	16	17	2	01 = first 00 = continuation 10 = last 11 = none	Grouping flags
Sequence count	14	18	31	3	Unsigned integer	Continuous sequence count for each Application Process ID
Length	16	32	47	5	22-4099	Packet length (bytes) - 1
Secondary header	32	48	79	9	Unsigned integer	Start time of first spectral observation in packet. Unit is MET (seconds)
VIRS VIS Data Header						
Sync bytes	16	80	95	11	0xAA55	Sync bytes to align message
Subsecond timer	8	96	103	12	0 to 199	Subsecond time at which first spectra in observation was observed. Unit is 5 ms.
Integration time	8	104	111	13	0 to 255 in 0.05 s units	Amount of time array detectors will integrate photon counts
Integration count	16	112	127	15	0 to 65535	Number of integrations that will be taken total
Period	8	128	135	16	0-255 in 0.05 s units	Integrations will be started at the top of every period. Time between integrations equals period - integration time
Dark count frequency	8	136	143	17	0 = never 1 = all 2-255	Collect dark counts every X integrations
VIS array temp #1	12	144	155	19	Unsigned integer	
VIS array temp #2	12	156	167	20	Unsigned integer	
Spare	1	168	168	21	0	
NIR array power on	1	169	169	21	0 = off 1 = on	

NIR lamp	1	170	170	21	0 = off 1 = on	Power to NIR lamp
VIS lamp	1	171	171	21	0 = off 1 = on	Power to VIS lamp
Pixel binning	4	172	175	21	1-15	Number of pixels that are binned together in data
Start pixel	12	176	187	23	0 – 511	Start pixel of data
End pixel	12	188	199	24	0 - 511	End pixel of data
VIRS VIS Data Section						
Spectral header- bit size	8	200	207	25	15	Number of bits required to hold each spectral value minus 1. (First spectrum is full resolution 16 bits)
Spectral header- threshold	16	208	223	27	0	Value subtracted from differenced spectrum
Spectrum	n * bit size (up to 16384)					Full 16 bit pixel data
Spectral header- bit size	8				0 - 15	Number of bits required to hold each spectral value minus 1
Spectral header- threshold	16				0 - 65535	Value subtracted from differenced spectrum
Spectrum				Up to 4096		Fill rest of packet with as many differenced spectra as is possible
.....						

1.5.5 VIRS NIR science packet description

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Primary and Secondary Headers						
Version	3	0	2	0	0	Designates a source packet
Type	1	3	3	0	0	Designates a telemetry packet
Secondary?	1	4	4	0	1	Secondary header is present
App ID	11	5	15	1	0x354	Application identifier
Grouping	2	16	17	2	01 = first 00 = continuation 10 = last 11 = none	Grouping flags
Sequence count	14	18	31	3	Unsigned integer	Continuous sequence count for each Application Process ID
Length	16	32	47	5	22-4099	Packet length (bytes) - 1
Secondary header	32	48	79	9	Unsigned integer	Start time of first spectral observation in packet. Unit is MET (seconds)
VIRS NIR Data Header						
Sync bytes	16	80	95	11	0xAA55	Sync bytes to align message
Subsecond timer	8	96	103	12	0 to 199	Subsecond time at which first spectra in observation was observed. Unit is 5 ms.
Integration time	8	104	111	13	0 to 255 in 0.05 s units	Amount of time array detectors will integrate photon counts
Integration count	16	112	127	15	0 to 65535	Number of integrations that will be taken total
Period	8	128	135	16	0-255 in 0.1 s units	Integrations will be started at the top of every period. Time between integrations equals period - integration time
Dark count frequency	8	136	143	17	0 = never 1 = all 2-255	Collect dark counts every X integrations
NIR external temp	12	144	155	19	Unsigned integer	
NIR internal temp	12	156	167	20	Unsigned integer	
NIR gain	1	168	168	21	0 = low, 1 = hi	Nir array gain set high or low
VIS power on	1	169	169	21	0 = off 1 = on	VIS array power on

NIR lamp	1	170	170	21	0 = off 1 = on	Power to NIR lamp
VIS lamp	1	171	171	21	0 = off 1 = on	Power to VIS lamp
Pixel binning	4	172	175	21	1-15	Number of pixels that are binned together in data
Start pixel	12	176	187	23	0 – 511	Start pixel of data
End pixel	12	188	199	24	0 - 511	End pixel of data
VIRS NIR Data Section						
Spectral header- bit size	8	200	207	25	15	Number of bits required to hold each spectral value minus 1. (First spectrum is full resolution 16 bits)
Spectral header- threshold	16	208	223	27	0	Value subtracted from differenced spectrum
Spectrum	n * bit size (up to 16384)					Pixel data
Spectral header- bit size	8				0 - 15	Number of bits required to hold each spectral value minus 1
Spectral header- threshold	16				0 - 65535	Value subtracted from differenced spectrum
Spectrum				Up to 4096		Fill packet with as many full, differenced spectra as is possible
•••••						

1.6 MASCS Memory Dump Packets

1.6.1 UVVS command structure packet description

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Primary and Secondary Headers						
Version	3	0	2	0	0	Designates a source packet
Type	1	3	3	0	0	Designates a telemetry packet
Secondary?	1	4	4	0	1	Secondary header is present
App ID	11	5	15	1	358h	Application identifier
Grouping	2	16	17	2	11 = None	Grouping flags
Sequence count	14	18	31	3	unsigned integer	Continuous sequence count for each Application Process ID
Length	16	32	47	15	51	Packet length (bytes) - 1
Secondary header	32	48	79	9	unsigned integer	Time tag (MET)
UVVS Cmd Structure Data						
start position	16	80	95	11		
step count	16	96	111	13		
step size	16	112	127	15		
integration period	16	128	143	17		
step period	16	144	159	19		
phase offset	16	160	175	21		
repeat count	16	176	191	23		
zigzag mode	16	192	207	25		
led output value	16	208	223	27		
hardstop direction	16	224	239	29		
find index offset value	16	240	255	31		
go to hardstop offset position	16	256	271	33		
PMT tubes enabled	16	272	287	35		
slit position	16	288	303	37		
step response output mask	16	304	319	39		
SBOS threshold	16	320	335	41		
SBOS enable	16	336	351	43		
compression enable	16	352	367	45		

FUV data requested	16	368	383	47		
MUV data requested	16	384	399	49		
VIS data requested	16	400	415	51		
MET	32	416	447	55		
subsecond timer	16	448	463	57		

1.6.2 VIRS command structure packet description

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Primary and Secondary Headers						
Version	3	0	2	0	0	Designates a source packet
Type	1	3	3	0	0	Designates a telemetry packet
Secondary?	1	4	4	0	1	Secondary header is present
App ID	11	5	15	1	359h	Application identifier
Grouping	2	16	17	2	11 = None	Grouping flags
Sequence count	14	18	31	3	unsigned integer	Continuous sequence count for each Application Process ID
Length	16	32	47	15	30	Packet length (bytes) - 1
Secondary header	32	48	79	9	unsigned integer	Time tag (MET)
VIRS Cmd Structure Data						
integration time	8	80	87	10	unsigned integer	
NIR pixel bin size	8	88	95	11	unsigned integer	
NIR gain	8	96	103	12	high/low	
period	8	104	111	13	unsigned integer	
VIS bin size	8	112	119	14	unsigned integer	
NIR lamp power	8	120	127	15	on/off	
VIS lamp power	8	128	135	16	on/off	
subsecond start time	8	136	143	17	unsigned integer	
differencing enabled	8	144	151	18	true/false	
VIS detector power	8	152	159	19	on/off	
NIR detector power	8	160	167	20	on/off	
dark frequency	8	168	175	21	unsigned integer	
shutter position	8	176	183	22	open/closed	
integration count	16	184	199	24	unsigned integer	
NIR start pixel	16	200	215	26	unsigned integer	
NIR end pixel	16	216	231	28	unsigned integer	

VIS start pixel	16	232	247	30	unsigned integer	
VIS end pixel	16	248	263	32	unsigned integer	
MET	32	264	295	36	unsigned integer	

1.6.3 Persistent values packet description

Name	Length (bits)	Start Bit	End Bit	End byte	Value	Description
Primary and Secondary Headers						
Version	3	0	2	0	0	Designates a source packet
Type	1	3	3	0	0	Designates a telemetry packet
Secondary?	1	4	4	0	1	Secondary header is present
App ID	11	5	15	1	35ah	Application identifier
Grouping	2	16	17	2	11 = None	Grouping flags
Sequence count	14	18	31	3	unsigned integer	Continuous sequence count for each Application Process ID
Length	16	32	47	5	183	Packet length (bytes) - 1
Secondary header	32	48	79	9	unsigned integer	Time tag (MET)
Persistent Values Data						
UVVS start position	16	80	95	11	unsigned integer	
UVVS step count	16	96	111	13	unsigned integer	
UVVS step size	16	112	127	15	unsigned integer	
UVVS integration time	16	128	143	17	unsigned integer	
UVVS step time	16	144	159	19	unsigned integer	
UVVS phase offset	16	160	175	21	unsigned integer	
UVVS repeat count	16	176	191	23	unsigned integer	
UVVS zigzag mode	16	192	207	25	unsigned integer	
UVVS LED Intensity	16	208	223	27	unsigned integer	
UVVS hardstop direction	16	224	239	29	unsigned integer	
UVVS index offset	16	240	255	31	unsigned integer	
Spare	16	256	271	33	0	
UVVS SBOS threshold	16	272	287	35	unsigned integer	

Slit active wait time	16	288	303	37	unsigned integer	
Slit inactive wait time	16	304	319	39	unsigned integer	
Slit open 0 value	16	320	335	41	unsigned integer	
Slit position 30 value	16	336	351	43	unsigned integer	
Slit position 60 value	16	352	367	45	unsigned integer	
Slit closed 90 value	16	368	383	47	unsigned integer	
VIRS integration time	16	384	399	49	unsigned integer	
VIRS NIR bin size	16	400	415	51	unsigned integer	
Spare	16	416	431	53	0	
VIRS period	16	432	447	55	unsigned integer	
VIRS VIS bin size	16	448	463	57	unsigned integer	
VIRS dark frequency	16	464	479	59	unsigned integer	
VIRS integration count	16	480	495	61	unsigned integer	
VIRS NIR start pixel	16	496	511	63	unsigned integer	
VIRS NIR end pixel	16	512	527	65	unsigned integer	
VIRS VIS start pixel	16	528	543	67	unsigned integer	
VIRS VIS end pixel	16	544	559	69	unsigned integer	
Shutter active wait	16	560	575	71	unsigned integer	
Shutter inactive wait	16	576	591	73	unsigned integer	
Shutter open 0 value	16	592	607	75	unsigned integer	
Shutter position 30 value	16	608	623	77	unsigned integer	
Shutter closed 60 value	16	624	639	79	unsigned integer	
Shutter position 90 value	16	640	655	81	unsigned integer	
Shutter open 120 value	16	656	671	83	unsigned integer	
VIRS stim lamp timeout	16	672	687	85	unsigned integer	

UVVS GD Ki constant	16	688	703	87	unsigned integer	
UVVS GD Kp constant	16	704	719	89	unsigned integer	
UVVS GD Kf constant	16	720	735	91	unsigned integer	
UVVS GD Kd constant	16	736	751	93	unsigned integer	
NIR array pixel mask	256	752	1007	125	bit mask	
VIS array pixel mask	512	1008	1519	189	bit mask	