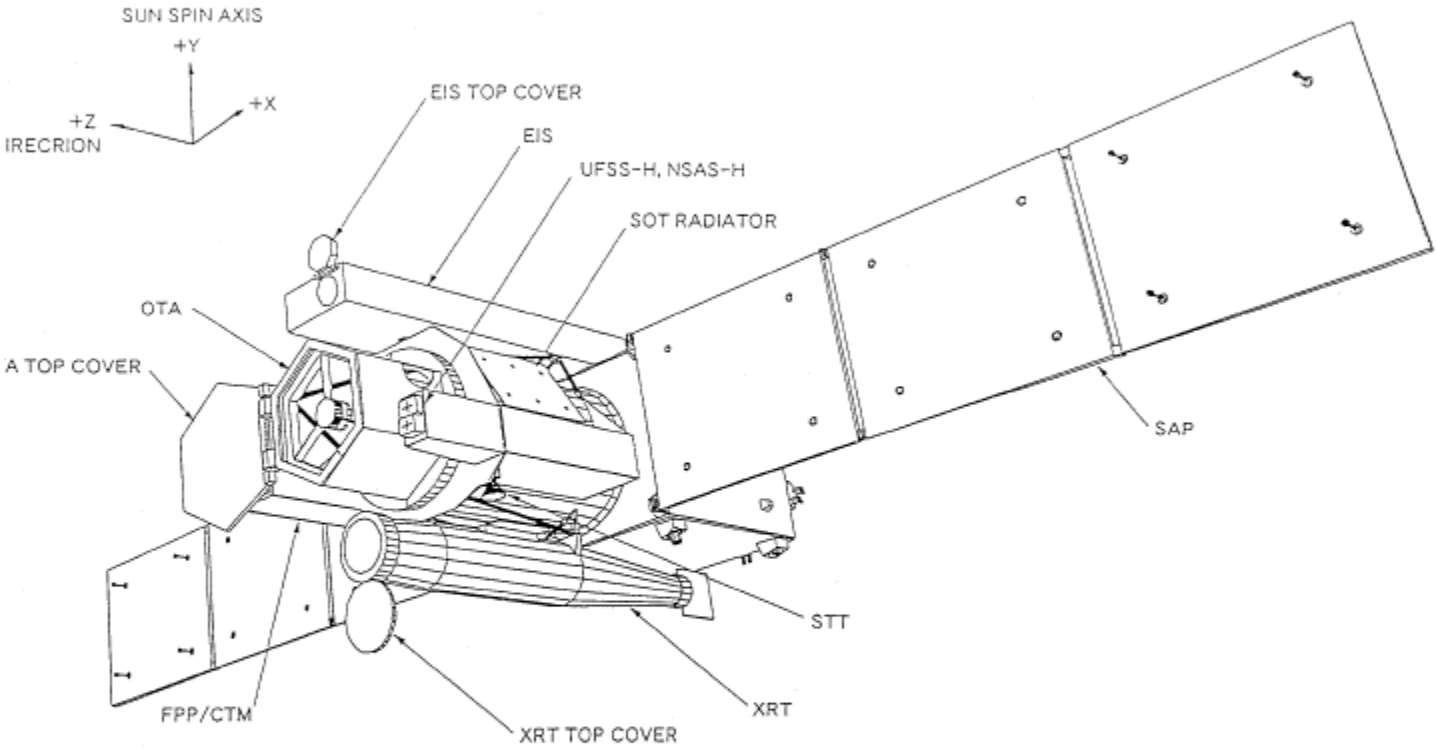


Solar-B EIS Engineering Meeting a
July 27 - 29, 1999

H. Hara (NAOJ)

;/Solar-B	Documents for Subsystem Design

Document Name		Date	Lang
rmal Design Standard for Solar-B	(DRAFT)	Feb 12,1999	J
uirements for Structural Mathematical Models		Mar 8,1999	E
:hanical Design Standard	(DRAFT)	Mar 8, 1999	J+E
ironmental Conditions for Solar-B	(DRAFT)	Mar 8, 1999	J+E
tamination Control Program Plan for Solar-B	(DRAFT)	Mar 8, 1999	E
ır-B Electrical Design Standard	(DRAFT)	Apr 24,1999	J
	(DRAFT)	July 27,1999	E
ır-B/Telescope Thermal Interface Condition	(DRAFT)	June 30, 1999	J+E
uirements for Interface Thermal Math Model of Solar-B Telescope	(DRAFT)	June 30, 1999	J+E
:metry & Command Design Standard	(DRAFT)	not yet made	

y report of satellite design meeting on June 30, 1999

Solar-B	Requests from System side to EIS

Position of Mounting I/F points. There is inconsistent with the I/F legs. Chang
the drawing to meet the I/F points before making structure math model.

Electrical relationship among ICU, MHC, and FPA. How these are connected
electrical lines ?

Ranges of temperature is too narrow. Widen the ranges (relatively urgent).

Show disturbance torque of each moving component (urgent issue).

32 W solar power is input in EIS at entrance filter. Is this OK ? How is this
energy to be treated ?

Number and location of survival heaters when EIS primary power is off.
Temperatures for switch-on and switch-off controls should be reported.
The survival heaters are controlled by HCE. At present three survival
heaters are allocated to EIS by the request of Japanese side, though the
usage is uncertain. This issue must be reported to the system side by July 15.

Solar-B	Solar-B system issues

netry & Command system: ASTRO-F system was adopted.

nary of electrical interface related to EIS was shown (see Fig. 1).

lite structure almost meet the size of fairing envelope.
eption: XRT & EIS. In case of EIS, interface points should be shifted to -Z dir

is put at low part of +Y side panel of bus structure (Fig.2).

ht of EIS: EIS-STR 50.3 kg, EIS-ICU 6.0 kg, EIS-HAR 4.0 kg. Margin
is managed by system side in a different level of system issue.

r: ICU: Wmax = 60 W, Imax = 2.3 A
Heater power of 10 W is tentatively allocated to EIS because of no input.

nal analysis of optical bench + mounting legs + bus structure was almost finis
ge of optical axes of SOT, XRT, and EIS is only 0.2-0.3 arcsec during the sun
ronous orbit in the worst case. The infinite rigid body for telescopes is assum
s analysis.

Solar-B	Solar-B system issues

ss: If there is an electrical harness whose length should be less than 4 m by so reason, we must report it to the system side.

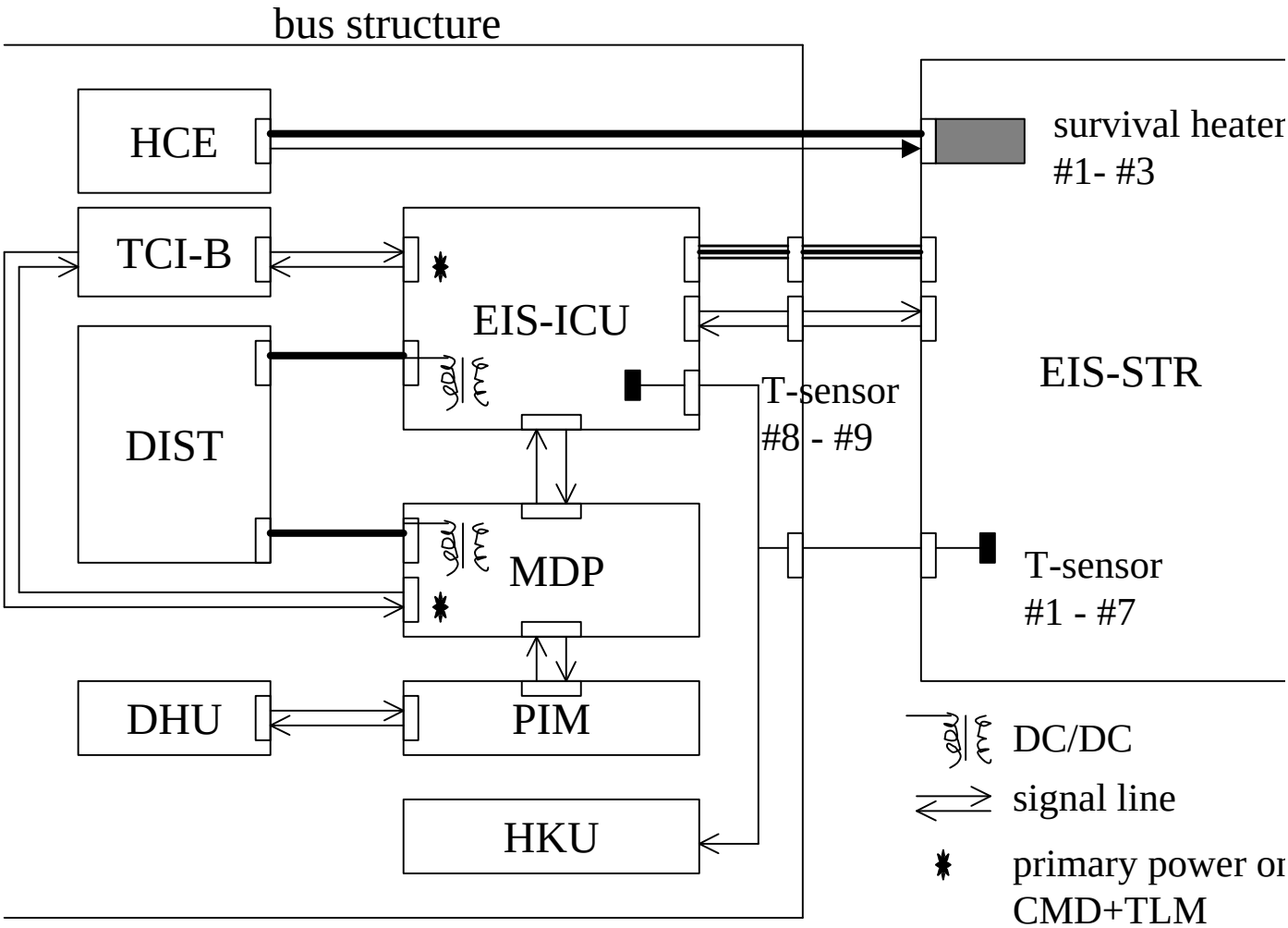
: savings: Even in the case of sun-synchronous orbit, satellite night comes in s period. System asked all telescope teams if the power saving can be during the night period or not for power saving.

oltage for SOT, XRT, and EIS is 28 +/- (A) V. (A) will be less than 2.

ure math model: The schedule of structure analysis was updated (see Fig. 3).

ıal math model: The schedule of thermal analysis was updated (see Fig. 4).

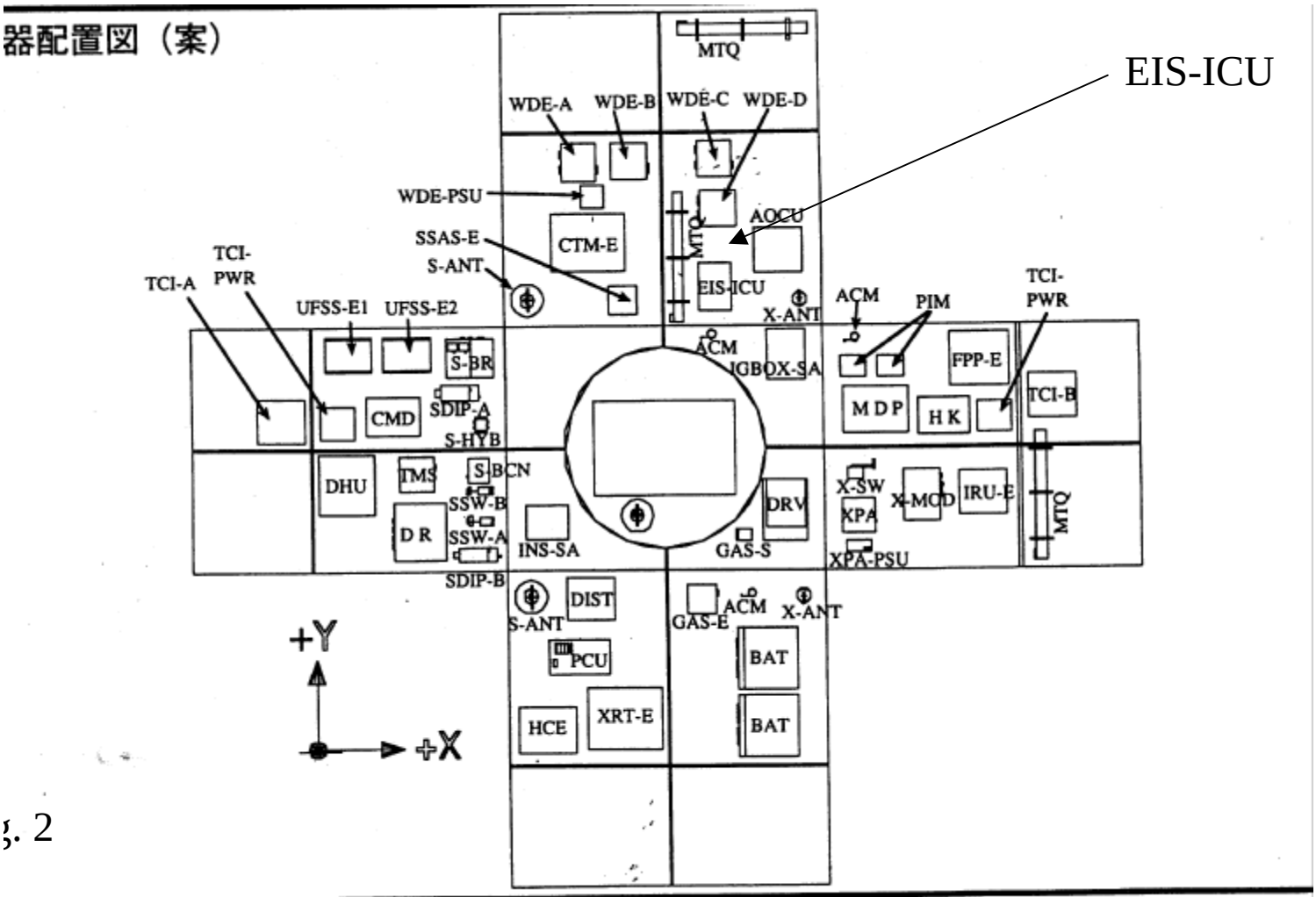
Solar-B | Electrical Interface of EIS



28V primary power line
secondary power line

Fig. 1

Solar-B	Location of EIS-ICU in Bus Structure



g. 2

Solar-B | Schedule of Structure Analysis

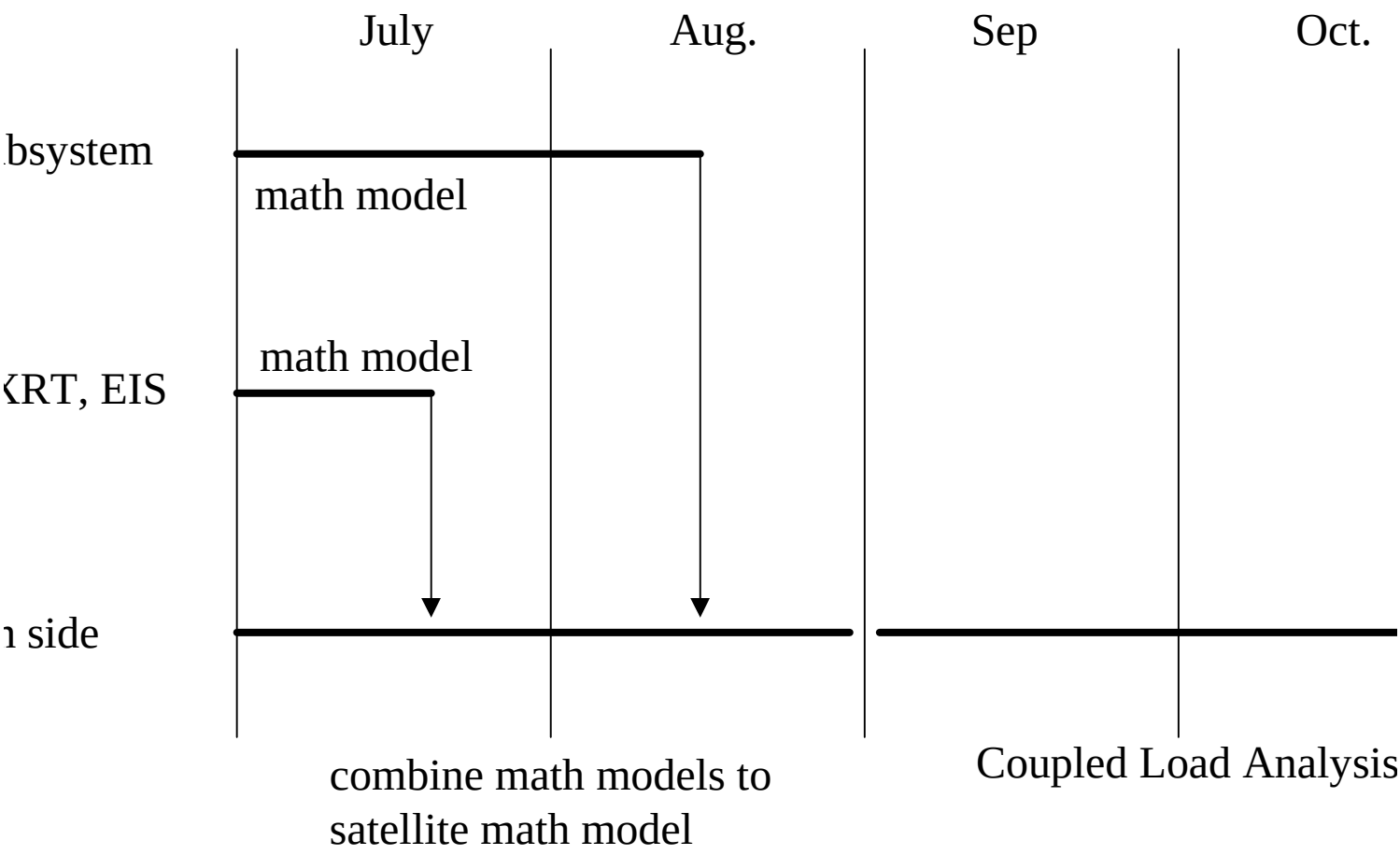
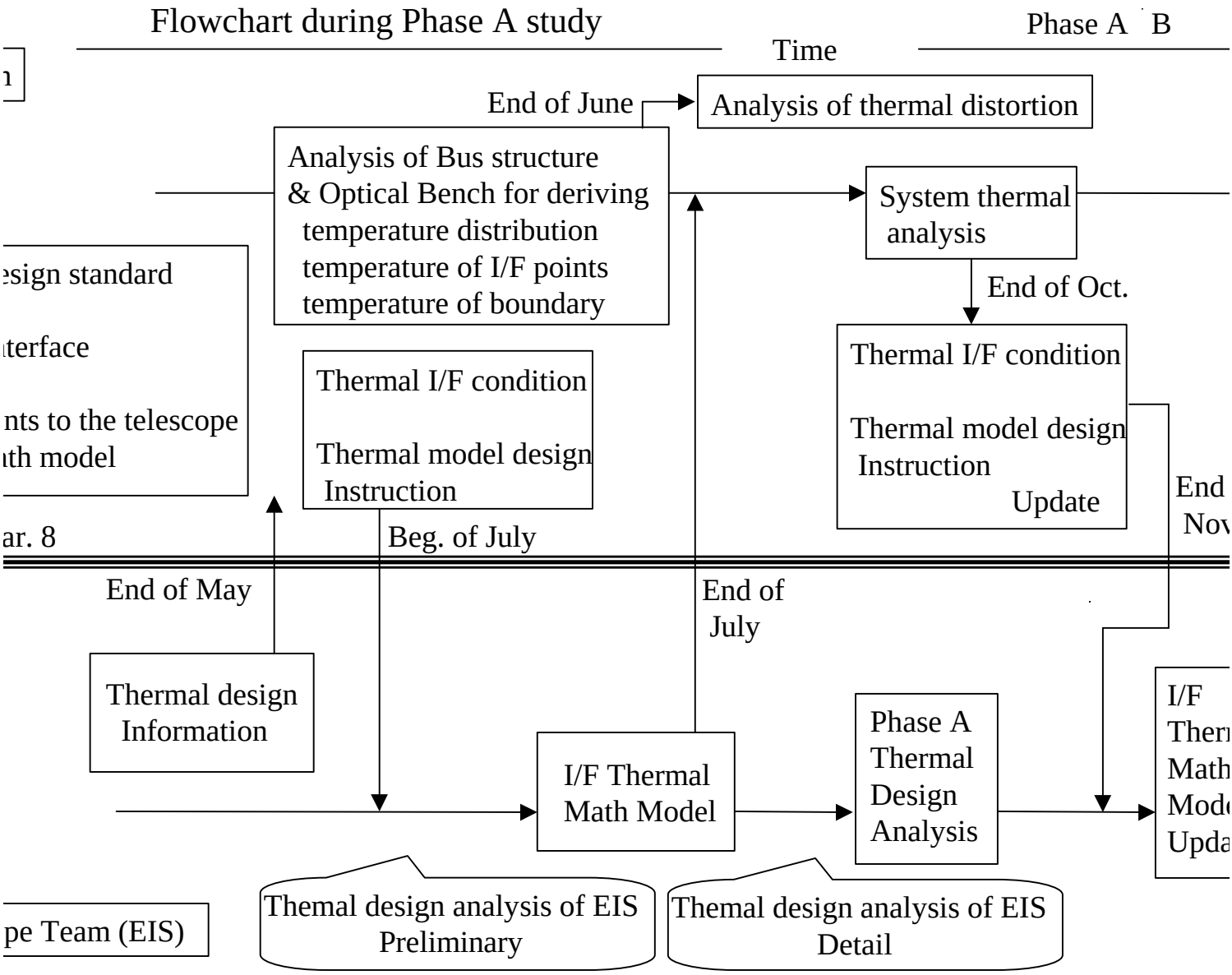


Fig. 3

y report of satellite design meeting on June 30, 1999

Solar-B Schedule of Thermal Analysis



Solar-B	MDP development schedule

Specifications of MDP shall be fixed by the following dates:

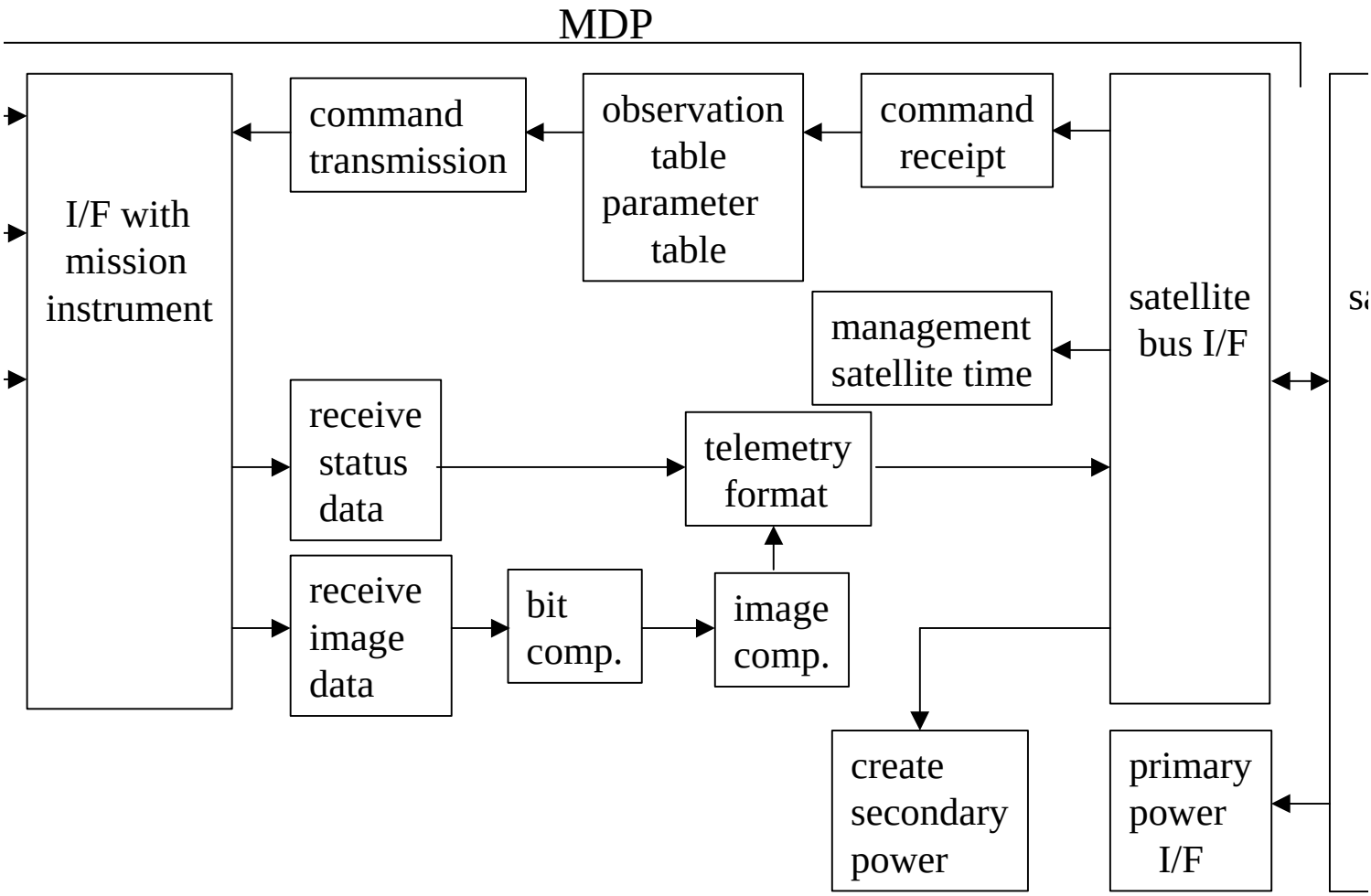
hardware related issues: August 31, 1999

software related issues: November 30, 1999

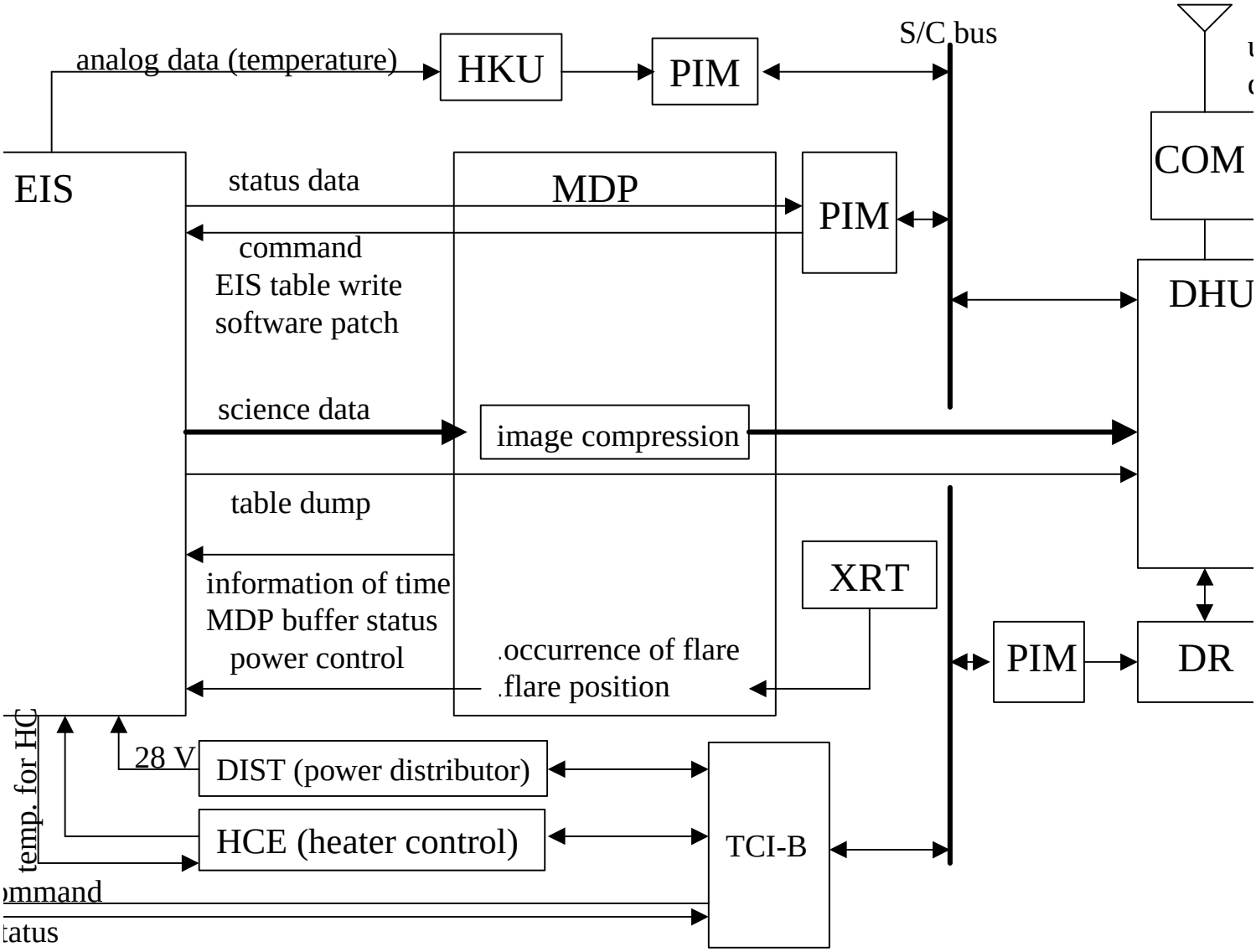
Purpose of PM tests (Feb 1 - Mar 31, 2001)

Interface with SOT, XRT, EIS, DHU, TCI-B, HCE, DIST
- – establishment of hardware interface
- – establishment of software protocol
- – establishment of exposure sequence

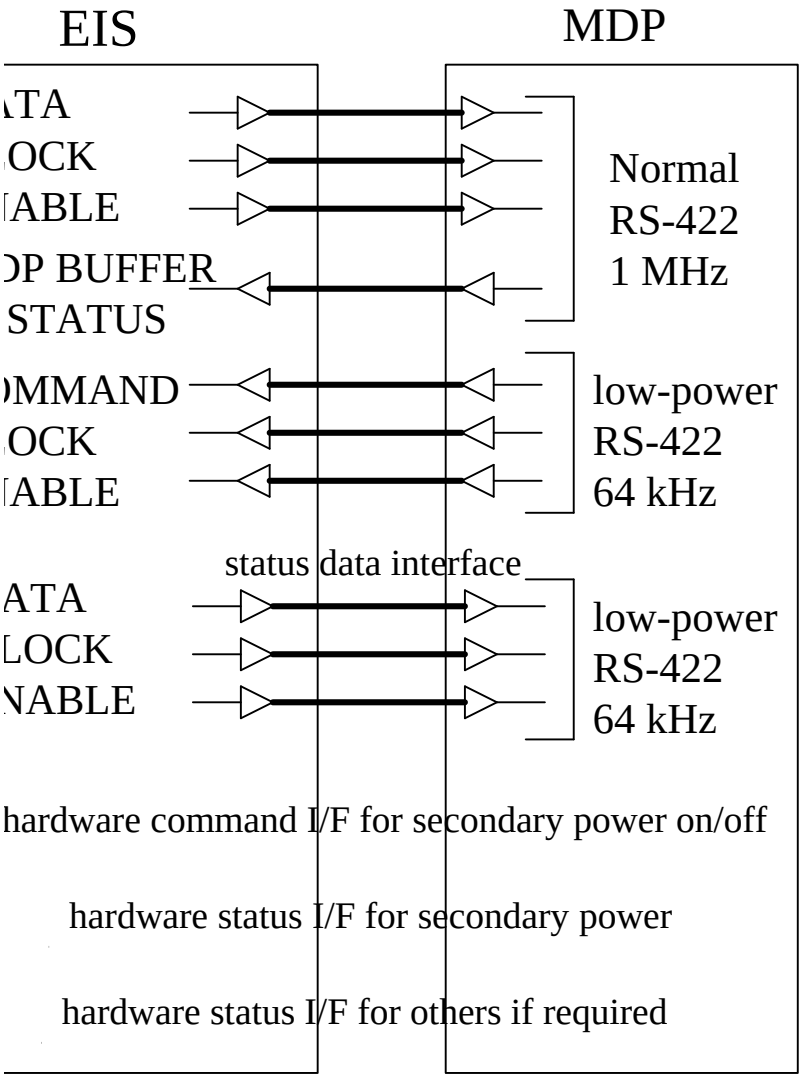
Confirmation of main processing functions
- – confirmation of processing command/telemetry
- – confirmation of processing science data including compressio


MDP
I/F with mission instrument
command transmission
observation table parameter table
command receipt
satellite bus I/F
sa
management satellite time
receive status data
telemetry format
receive image data
bit comp.
image comp.
create secondary power
primary power I/F

/Solar-B | Electrical Interface with MDP



/Solar-B | Interface lines



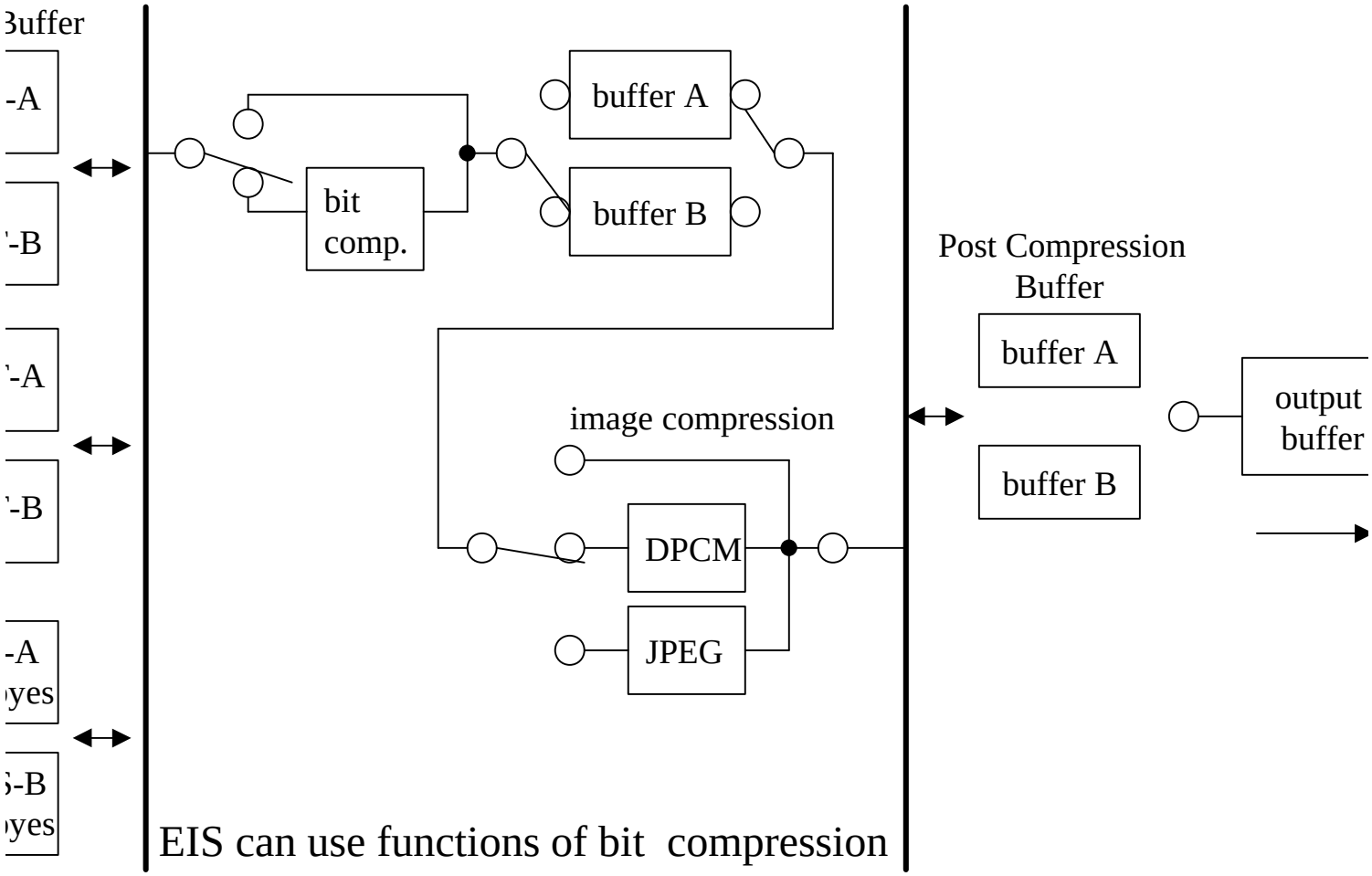
All electrical interface lines betw
EIS and MDP are digital interfac

differential RS-422 line interfac

HS-26C31 HS-26C32

‘MDP Buffer Status line is use
1: for safe exchange of ‘input
buffer’ in MDP.
2: when post compression buf
become almost full.

Flow of image data processing in MDP



EIS can use functions of bit compression & image compression in MDP.

/Solar-B | Data lines

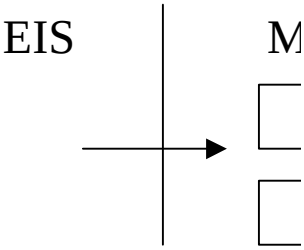
. line: normal differential RS-422 line, 1Mbps

. Science data (spectrum or image)

. Status data (~1 sec interval; Report of shutter & scan mirror motions will be required.)

. Dump data of EIS observation table

. Dump data of EIS compression table



MDP knows kind of data by looking at the header part after the data are transfe

2 bits data flow in this data line.

maximum transfer speed: 1 Mbps (TBD)

Input Buffer in MDP: 1. double buffer system 2. buffer size: 8 Mbytes/buffe

cept of Data Format: fixed-length header + variable-length data

maximum image size in a single packet = 256 kpixel

science data: header + 12 bits CCD image data

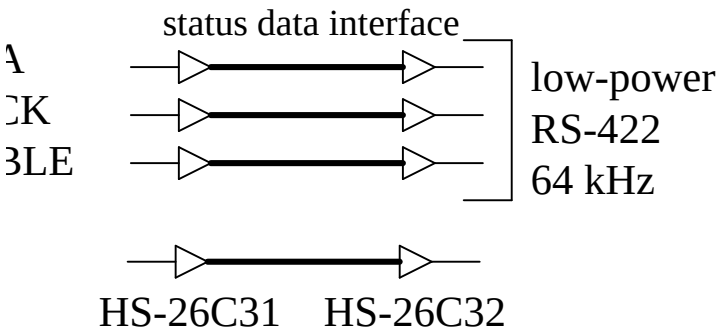
The number of pixels in the image data is a multiple of 8.

Is this OK ?

other data : header + 12 bit data (Upper 4 bits are all 0. Is this OK ?)

can send data to MDP at any time when a status of MDP buffer status line is R

/Solar-B	Recommended status line interface



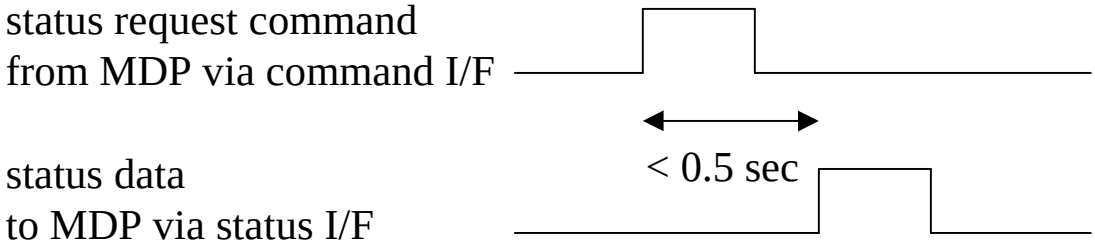
format

A1	DATA2	DATA3	DATA4	·	DATA N
ts	8 bits	8 bits	8bits		8bits

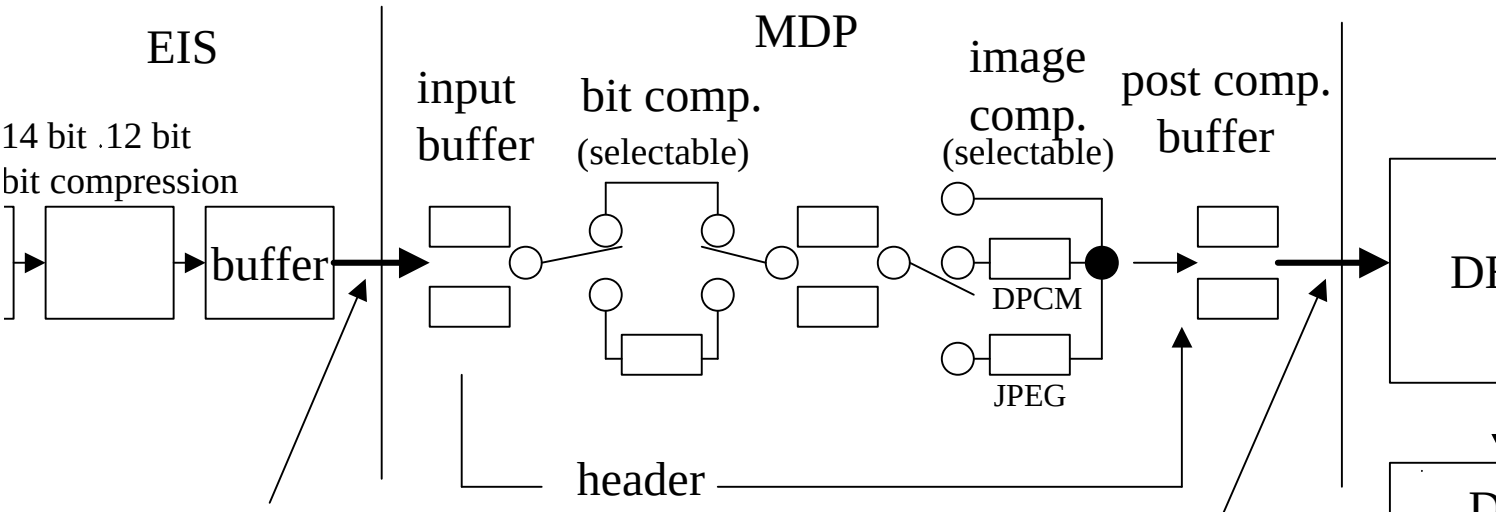
← Data format is cons
with requirement of

UIREMENTS

quest of sending status data is informed from MDP via command line, and EIS
ll send status data to MDP within 0.5 sec.



Data Compression



bps line 12 bits data
ler includes information of
compression in MDP.

2 Mbps (TBD) line for SOT, XRT & EIS

EIS can use 2 Mbps line nominally
for 0.5 s every 6 seconds.

→ max. 167 kbps, but DR for EIS will
become full in a short time.

D
2.4
fo

y of DR will be ~3 Gbits, but only downlink 2.4 Gbits during the KSC/DSN c

/Solar-B	Command Lines

ımand line: low-power differential RS-422 line, 64 kbps

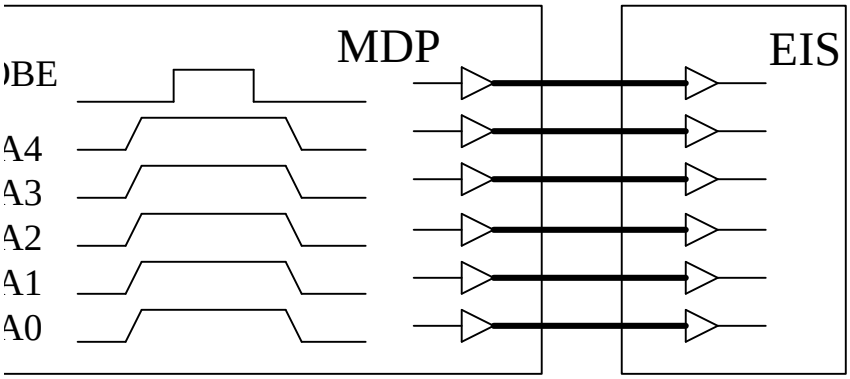
P contractors would like to know:

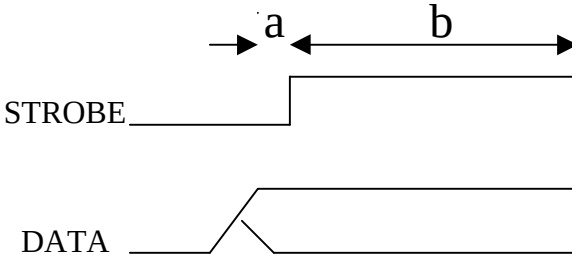
1. list of commands required for EIS operation
2. how ICU reads commands from MDP (Please explain it.)
3. response time for a command
4. size of buffer ?
5. whether there is some restriction for the data format or not.

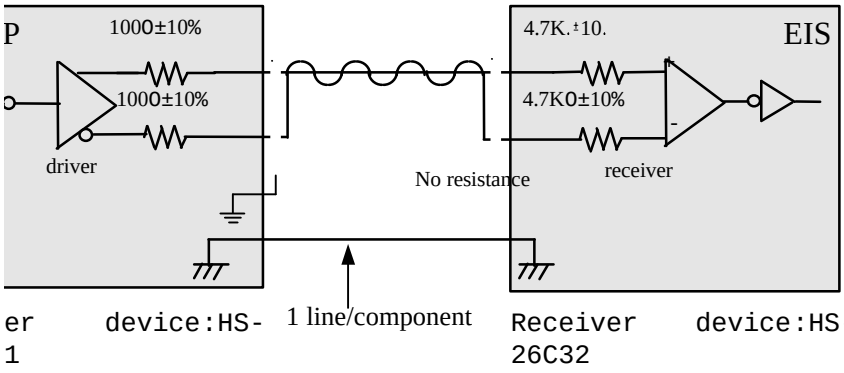
ımand answer back: receipt of command ⟶ put the command data into statu
for confirmation.

/Solar-B | Hardware command interface

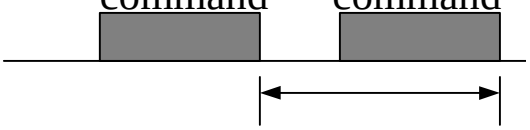
)urpose: Irrespective of MDP CPU status, the secondary power on/off comma
and others are sent via hardware command interface.







minimum interval of
command transmiss

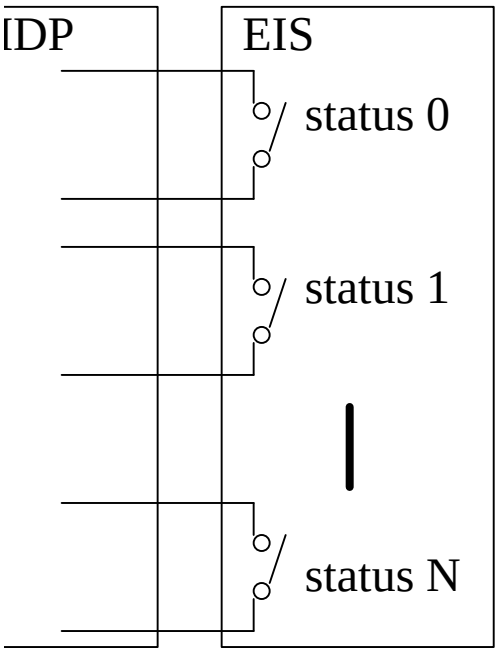


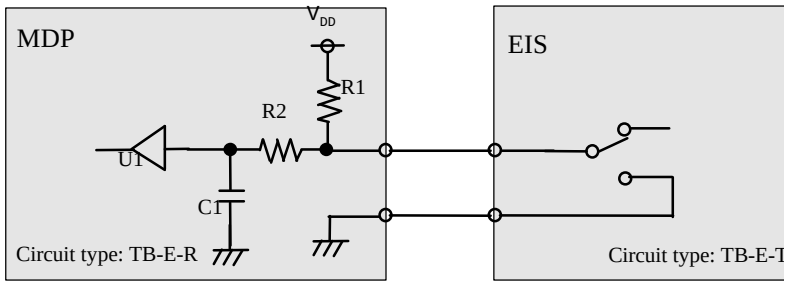
31.25 msec (min)

nce: Solar-B Electrical Design Standards §8-(8)

/Solar-B	Hardware status interface for secondary power

pose: ON/OFF status of EIS secondary power relay is periodically monitored
a hardware logic circuits.

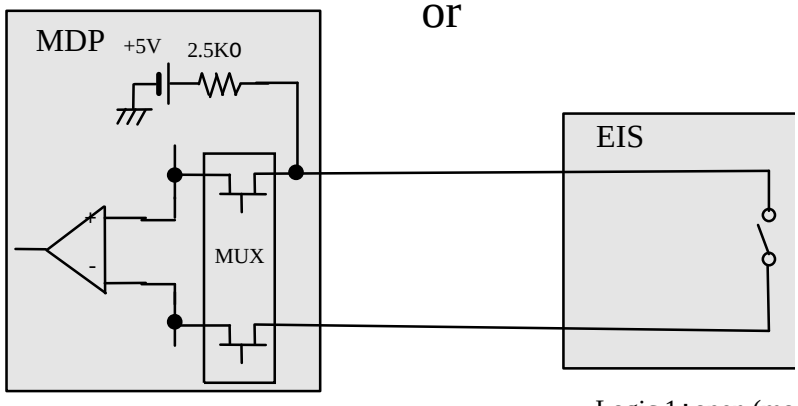




VDD : +5V ± TBD V
U1 : CMOS 4049/4050

C1 : 220pF ± TBD %
R1 : 27KΩ± TBD %
R2 : 10KΩ± TBD %

or



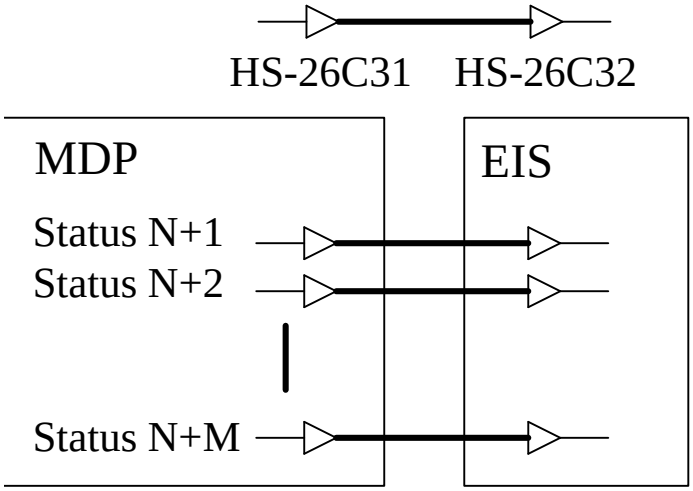
Input impedance : more than 1MΩ

Logic 1 : open (mo
Logic 0 : close (10

reference: Solar-B Electrical Design Standards §8-(6) or (7)

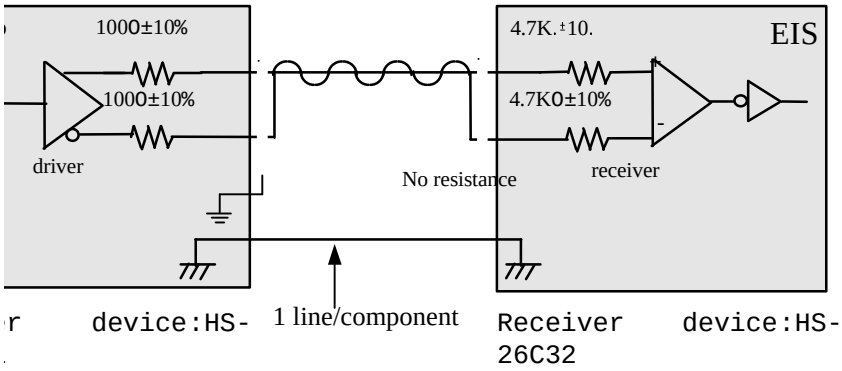
/Solar-B | Hardware status interface for important bi-level s

Purpose: Important bi-level status data are periodically monitored by a hardwa
logic circuit.



N: Number of “secondary power

M: Number of “H/W status”



erence: Solar-B Electrical Design Standards §8-(8)

/Solar-B	Counter-plan for Errors

hen some error happens in EIS-CPU due to SEU,

does EIS side request anything to MDP ?
or
does EIS side deal with the error by itself ?

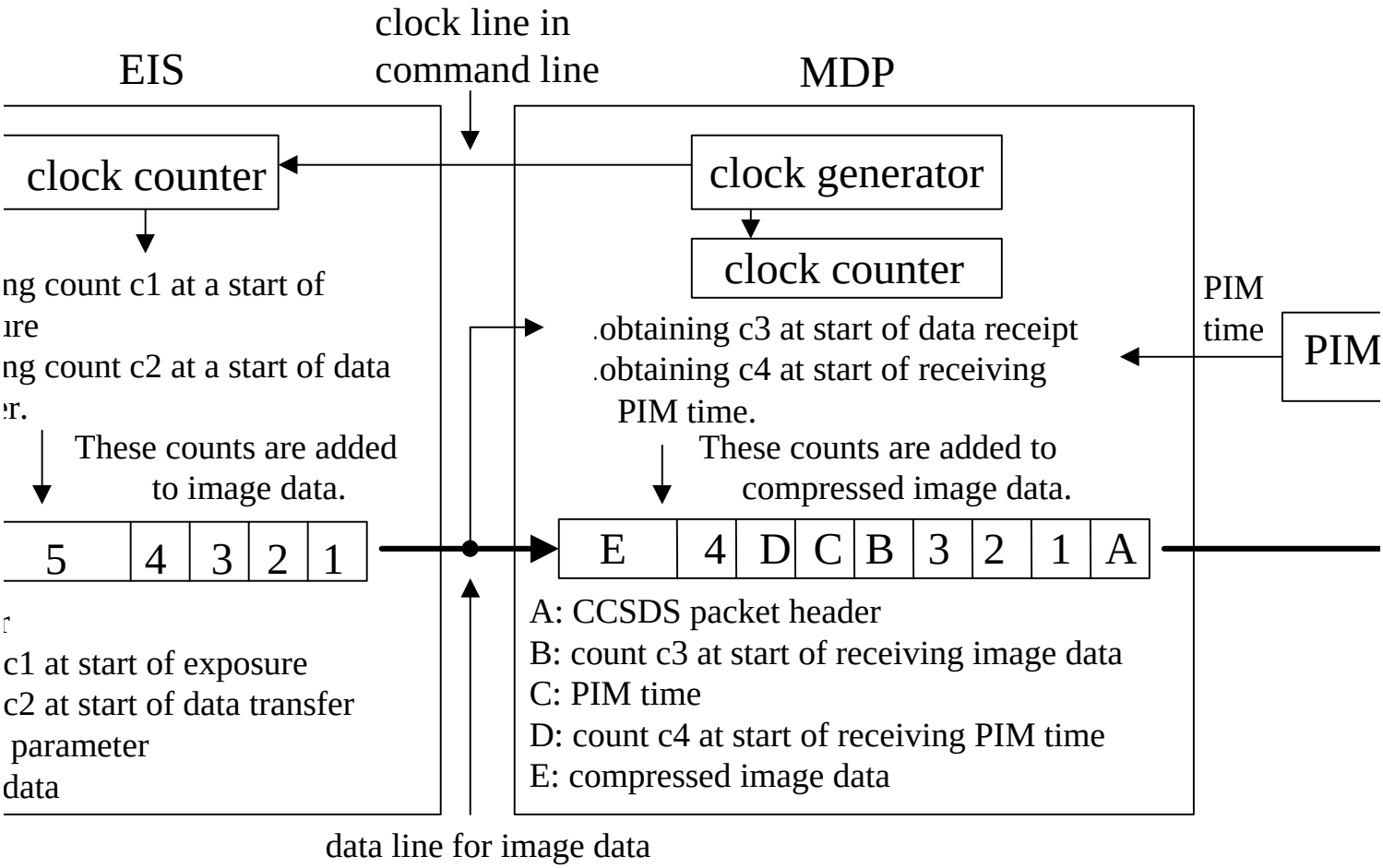
hen some error happens in MDP due to SEU,

does EIS side request anything to MDP backup system for safety ?
or
does EIS side deal with the error by itself ?

DP realizes stop of EIS CPU by the following procedure.

MDP sends a status request command and waits for 0.5 sec.
When the same procedure is done three times in a condition that status data do not come to MDP, MDP judges that EIS CPU is down.

his is effective only when the status line is independent of science data line.>



f data except for science data, EIS only put counter value at start of data transfer.

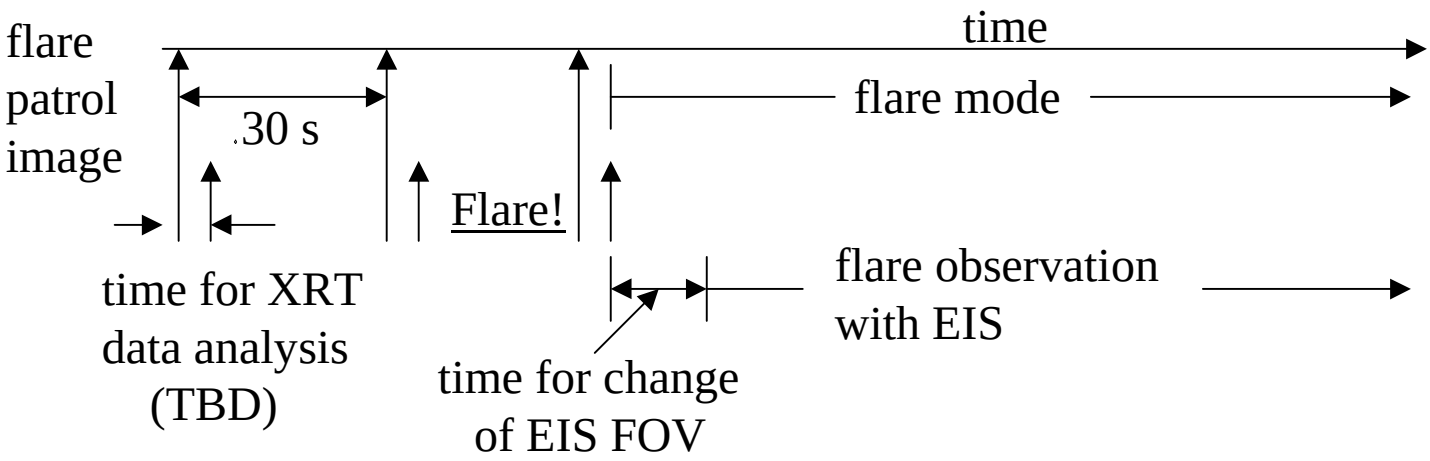
/Solar-B	Flare Detection

e following is a baseline of flare detection.

etection of flares is done by XRT.
8 on-chip summation image covering the whole XRT field of view will be use
or flare patrol.
ne flare patrol image will be taken every .30 sec (TBD).
formation on flare detection is sent to EIS by MDP.

1. Flare detection
2. Flare location in XRT CCD coordinate; X=0-255, Y=0-255 (TBI

uration of flare mode TBD



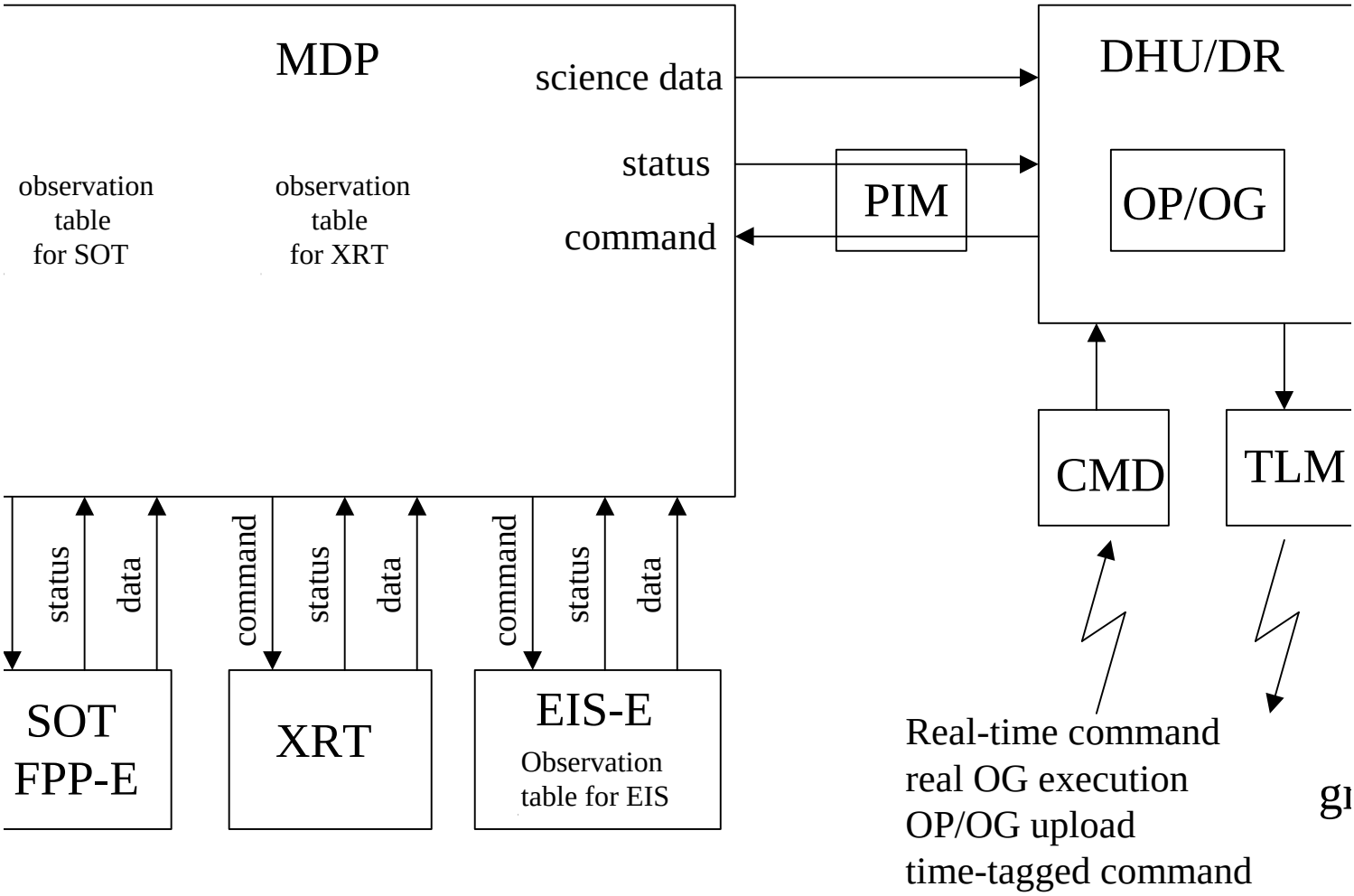
olar-B	Command to MDP

ASTRO-F type command system (similar to *Yohkoh* system) >

Type Classification	Command Types
Command Block Type	Discrete Command (DC) Block Command (DC+BC+...+ BC)
Command Grouping	Individual Command Organized Command (OG)
Operation Type	Real-time command Time-tagged command Operation Program (OP) Onboard-triggered command

OP and Onboard-triggered command support only OG to execute.

Solar-B | Command System Block Diagram



Solar-B	Data length of Command

Command Block Type		Maximum data length (bytes)
DC		1
DC+BC+…..+BC	real time OP/OG time-tagged	1 + 252 1 + 13 1 + 8

DC is used for single task such as ON/OFF, START/STOP and ENA/DIS.

BC is used for data transmission such as program load, table upload, and so o

Real-time commands are sent from the ground and are immediately executed.

Time-tagged commands are stored in DHU and executed at a specified time ir
a resolution of about 1 sec. 32 commands can be stored in DHU.

peration Program; a group of time-line commands consisting of OG. 512 (TBD) time slots are prepared for OP. Each time line is executed at a time defi time interval between consecutive two time lines. The unit of time is TBD sec. OP is started at a Kagoshima contact pass.

rGanized command; One OG has 16 (TBD) command slots. Discrete command or bloc command data is included in each slot. 256 (TBD) OG can be store in DHU. Time interval between two slots in an OG is 62.5 msec.

Example of OP:

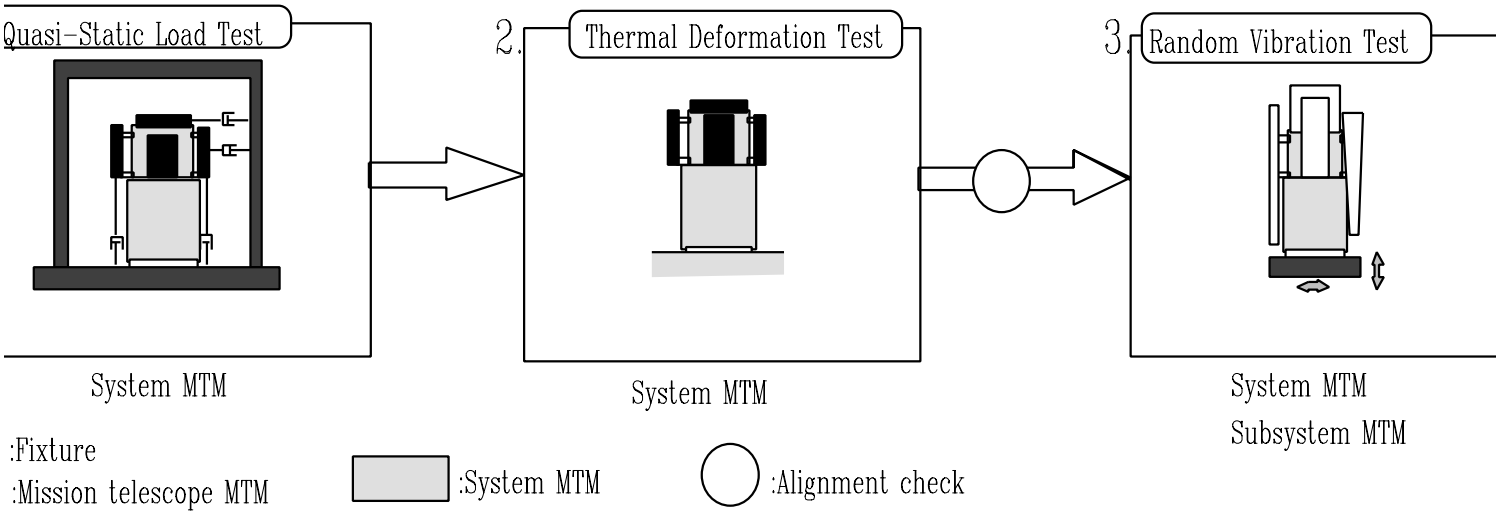
CE	#OG	Interval	
00	0	121	NOP
01	3	32	KSC LOS
02	22	85	DSN AOS
……			
129	255		OP STOP

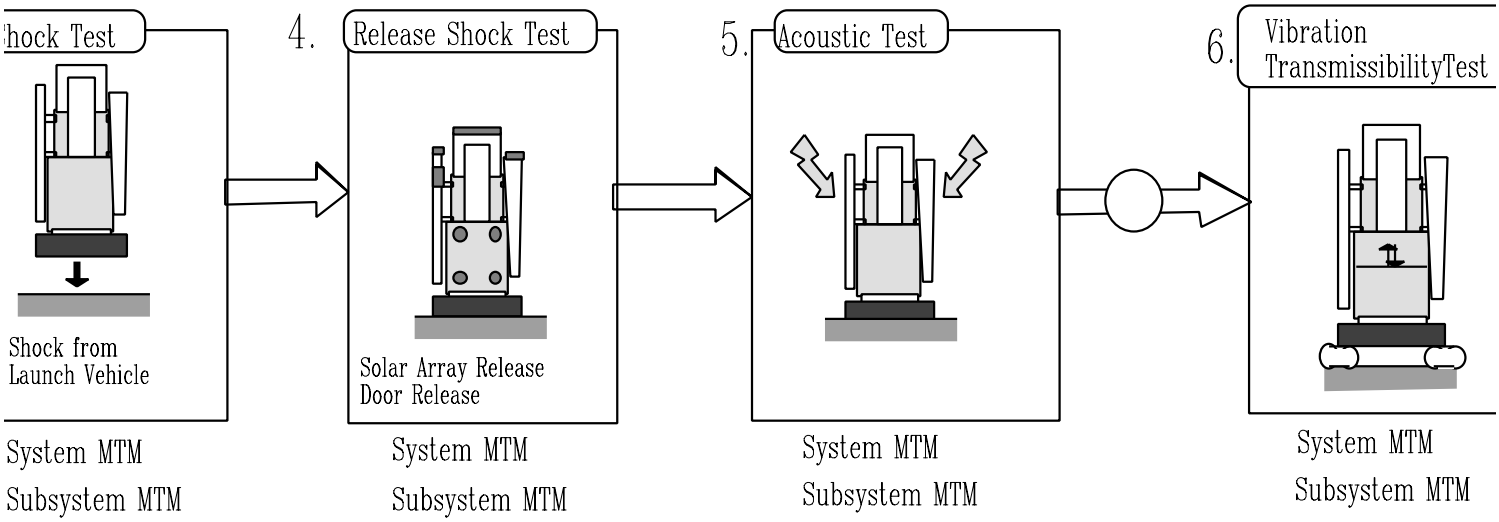
Example of OG:

00:	03-DC-11	08:	05-DC-42
01:		09:	05-BC-12
02:	03-DC-23	10:	05-BC-45
03:		11:	05-BC-32
04:		12:	
05:		13:	
06:		14:	
07:		15:	03-DC-44

S/Solar-B | MTM Test (May 15 - Aug 31, 2001)

Test Flow





ıism:	purpose	frequency	direction	angle of or sh
observation:				
protect inside from dirty environment		once/year	ar. Y-axis	180deg/
increase of stiffness		once/mission	ar. X-axis	~30 deg
focus adjustment		once/year	± Z-axis	±0.5 mm/1(
opening of vacuum enclosure		once/mission	ar. Y-axis	90 deg/
focus adjustment		once/mission?	± Z-axis	±0.5 mm/1(
change slit/slot		once/hour ?	ar. X-axis	90 deg/1
change field of view		once/day ?	± X-axis	±5arcmin/1(
ɔbservation:				
scan for raster observation		once/ 1 sec	ar. Y-axis	1 arcsec/
reset to start position		once/5-10 min	ar. Y-axis	8 arcmin
adjust exposure duration		once/ 1 sec	ar. Z-axis	~60 deg/
change slit/slot		once/ hour	ar. X-axis	90 deg/

Disturbance Torque (order of estimation)

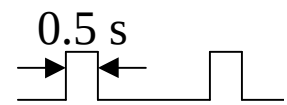
Disturbance torque during a motion: $T = d(I\,\mathbf{w})/dt \sim I\,\mathbf{q}\,(dt)^{-2}$

mentum of inertia
estimated by CMB

unit (g cm^2)

n mirror: $I_y = 4.89e4$
tter : $I_z = 36.7$
: $I_x = 44.3$

scan mirror:
[raster step]



q = 1 arcsec, dt = 0.5 sec

$T = 4.9e4 \cdot 10^{-7} \cdot 4.8e\text{-}6 \cdot 0.5^{-2} = 9.4e\text{-}8$ (N m)

[motion to home position]
q = 4 arcmin, dt = 5 sec

$T = 4.9e4 \cdot 10^{-7} \cdot 4.8e\text{-}6 \cdot 240 \cdot 5^{-2} = 2.3e\text{-}7$ (N

90 deg, dt = 10 sec

$44.3 \cdot 10^{-7} \cdot 4.8e\text{-}6 \cdot 3600 \cdot 90 \cdot 10^{-2}$

1.9e-4 (N m)
: 6.9e-8 (N m)

6.9e-6 (N m) for dt = 1 sec

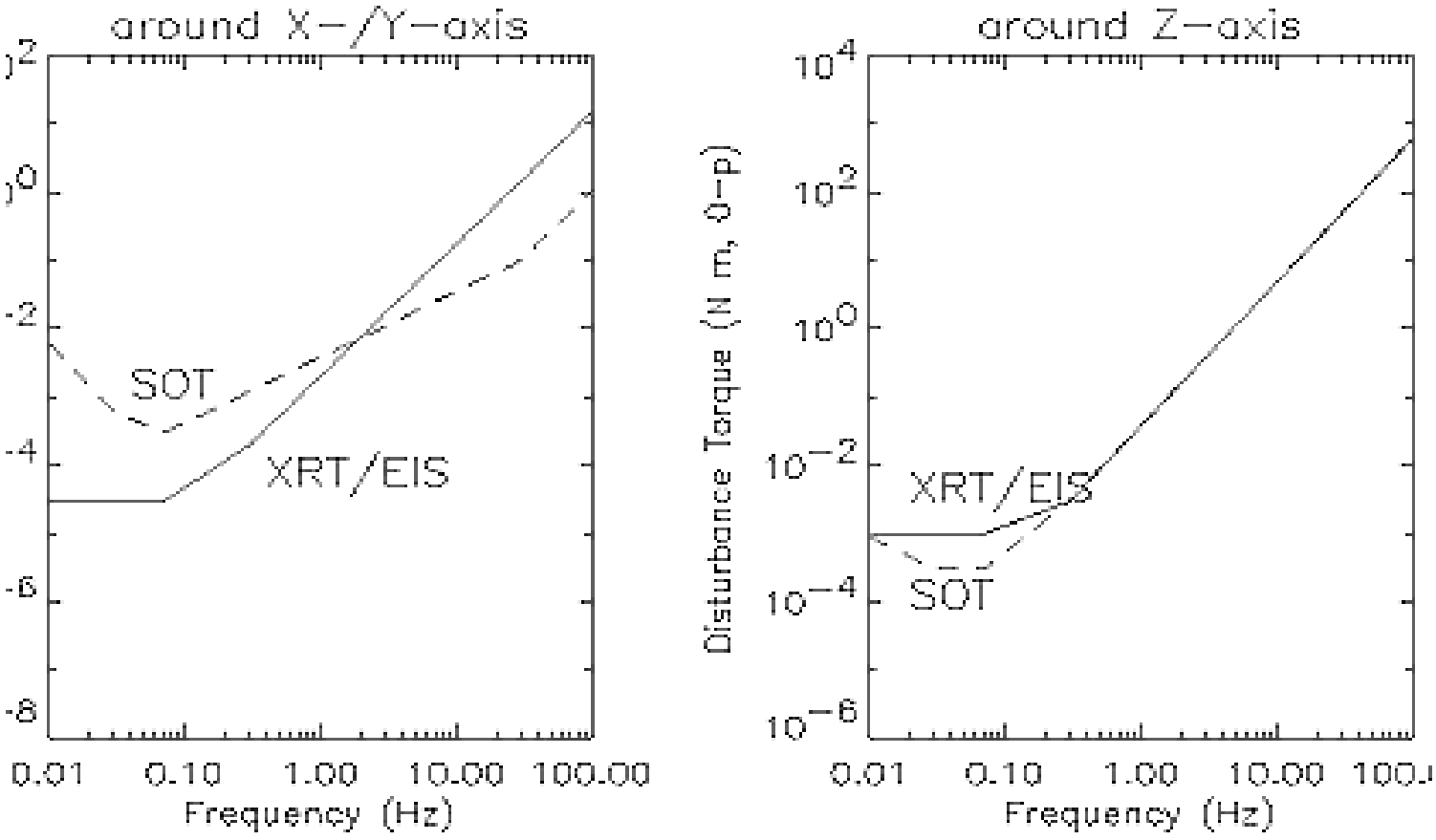
shutter:

q = 30 deg, dt = 0.1 sec

$T = 36.7 \cdot 10^{-7} \cdot 4.8e\text{-}6 \cdot 3600 \cdot 30 \cdot 0.1^{-2}$

= 1.9e-4 (N m)

S/Solar-B	Acceptable Level of Disturbance Torque



from handouts distributed in satellite design meeting held on June 30, 1999