

XRT Data Verification Guide V10

M. Weber & K. Korreck;
Revised Fana Mulu-Moore (2010 March 4),
Revised K. Reeves (2010 September 20)
Revised P. McCauley (2012 July 10, November 29);
Revised P. R. Jibben (2013 October 7, 2014 May 7)

2014 May 7

1 Introduction

The purpose of this document is to explain and support the job of XRT Data Verification.

2 Job of XRT-DV

2.1 Duty cycle

The job of XRT-DV is usually assigned to the XRT-CO for their observing week. As such, the XRT-CO/DV is responsible for the data starting from the end of the last DV e-mail (from the previous CO/DV) to the available data at the end of your last day of CO/DV work. The shift for DV runs concurrently with the XRT-CO shift. No tasks are required over the weekend, except monitoring the Housekeeping and Health & Safety information.

The tasks can be separated into broad categories: monitoring latest data, organizing support for the XRT-CO, validating recent data against the observing plans and annotating that data, and reporting and archiving. These tasks are described in more detail in later sections.

Over the weekend, the Housekeeping temperatures and Health & Safety information need to be monitored several times per day. The weekend data will also have to be validated, eventually, but it is acceptable to catch up on this task during the regular work-week.

Data verification tasks should not be passed off to the following person just because some of those tasks are not urgent. You are responsible for your week's data, even if you have to complete your tasks after your week. It is not fair to put off your work onto someone else, in the absence of other arrangements.

2.2 Description of tasks

This section merely details the tasks that comprise the XRT-DV job. Schedule and frequency of tasks is discussed in a separate section.

1. *Check Housekeeping and Health & Safety (H&S) information.* (This is a high-priority task which needs to be performed more often than once per day.) The H&S system automatically checks vital instrument parameters and will send notification to XRT-CO management personnel in the event that a safety threshold is passed. The XRT-CO who is usually the XRT-DV is responsible for always being in contact during their tour of duty, which runs 7 days per week, and for organizing any immediate response.

The Housekeeping webpage has lots of information. The temperatures, currents, and voltages should be monitored several times per day. Other values should be checked occasionally, to watch for strange developments. The HK webpage is currently here:

<http://xrt.cfa.harvard.edu/missionops/hks.php>.

Nominal values for the currents and voltages are found in Section 3.

Be sure to monitor the C_C0_STAT value during the housekeeping checks. This can be found in the first column of the housekeeping page. C_C0_STAT indicates the status of the most recently received command and should always be 0, otherwise there may be a problem (such as a rejected focus command resulting from a particle hit, for example). *Please send an email separate from the DV report if the C_C0_STAT is anything other than 0.* A table showing what the other values mean can be found in Section 3.

These values should be checked again just before sending the daily report. The results and timestamp of this check should be noted in the report.

In case the HK data needs to be recovered as it is not updating on the SAO site, please see the website:

http://xrt.cfa.harvard.edu/missionops/howtos/howto.restart_hk.php. Follow the instructions found here to restart the HK data. You will need to send an email to xrt_co@solar.isas.jaxa.jp and xrt_manager@head.cfa.harvard.edu informing them of the restart.

An additional website at:

http://www.isas.jaxa.jp/home/solar/hinode_xrt/status has older (about 32 hours behind) housekeeping data and can be used if the latest data is not available at the housekeeping website.

2. *Check recent data.* (This is a high-priority task which needs to be performed more often than once per day.) This amounts to running `browser` for the very most recent few hours of data which have appeared in the archive. You only need to view a few hours, but you should view *all* of it. In other words, view every frame, of every FOV, and do not bin or over-process the image. (Viewing as a slow movie is alright.) The danger is that binning or processing may hide something.

The purpose of this check is to discover current dangerous situations in the state of the XRT or the CCD. At this point, you need not evaluate the scientific value of the data— you’re just looking for technical problems that require an immediate response. This task should be performed at least 2x per day...first thing in the morning, and again just before sending the daily report. The results and timestamps of the most recently reviewed data should be noted in the daily report.

The XRT data archive at SAO can be found here:

`/archive/hinode/xrt/QLraw/YYYY/MM/DD/`

The default path in **browser** may need to be edited to reflect this.

3. *Check for Saturation in G-Band Synoptics.* (To be performed once per day.) Because saturation is not readily apparent when viewing G-band images in **browser** (unlike the x-ray images), it is important to explicitly check for saturated pixels in the G-band synoptics using the **threshold** tool. This can be found in the lower-left of the main **browser** window under **single window tools**. With the G-band image already opened, enter a threshold value of 2500 and select “GE” under “make mask”. (It may be necessary to first click the “link” button followed by the opened G-band image.) Any white pixels in the window that appears are saturated. Note any saturation in the DV report and suggest a shorter exposure time if any more than a few isolated pixels are saturated.
4. *Compare, validate, and annotate observations with its respective timeline plan.* (This is a medium-priority task. It may wait for a few days, but should be finished before the end of your week.) This task is one of the core purposes of the XRT-DV job, and is comprised of several elements which are usefully performed at roughly the same time.

The idea is to evaluate the data for a timeline plan. Since new timelines will typically start running in the early morning of the Eastern time zone, the most recently completed timeline will typically have “yesterday’s” date. (For example, it is 9:00 am EST on Wed, Jan-10. The 20070110 timeline probably just started a few hours ago, and the 20070109 timeline is the most recently completed timeline.) For multiple day timelines, the first day of data should be reviewed if the timeline is still running.

There is a cron job that runs at SAO to move all appropriate timeline files to the website in order to make viewing and validating easier. This cron job will place the appropriate timeline on the web timeline archive

`http://xrt.cfa.harvard.edu/missionops/timelines/`.

If the appropriate files are not present, please contact:

`xrt_manager@head.cfa.harvard.edu`.

The html file of the timeline will be copied there as well as a pdf version of the XOBs used in the daily timeline.

The following files will appear on the above website:

- Data rate file: `dr_XRT_yyyymmddpppp.txt`

- Data rate plot: `dr_plot_yyyymmdd.png`.
- Data rate sim file: `dr_XRT_yyyymmddpppp.sim`.
- Pointing file: `re-point_yyyymmddpppp.txt`.
- ORL file: `XRT_yyyymmddpppp.orl`.
- Timeline HTML file: `yyymmdd_exported.htm`.
- XOB explanation file: `xrt_plan_yyyymmdd.pdf`.

Here are the tasks for which this information will be useful:

- Verify that the actual sequences of data match observation plan sequences (aka “XOBs”). This is easy in **browser**. View the image list for the time period of each XOB in the timeline. The browser list will show the FOV, filter, and exposure duration, which should be sufficient to make sure the images are there. You should check the entire run of the XOB, not just one cycle, because you may find weird stuff that doesn’t happen right away. In addition, the `dr_XRT_yyyymmddpppp.sim` file is used to make the XOB pdf file. In the current version of COT, there might be times when an XOB is edited after this but before upload. Please check to see if this may have been a cause for any discrepancy you find in the XOBs.

- Check the data again for technical problems, as was done for Task #2. Again, you should actually view every image for the timeline. Do not bin, as this could hide something. It is OK to view as a movie, but be ready to slow down or stop to investigate. Any strange things should be investigated further and/or forwarded to someone appropriate. Also, all such items need to be mentioned in the daily report

- Note any missing blocks of images, and images with missing data. IDL programs are available to check for these things. Documentation is in the headers of these files. The syntax is:

```
IDL>dir='/archive/hinode/xrt/QLraw';change it to your XRT QL path
IDL>xrt_dv_find_missing_pixels,'03-OCT-2008 10:00','04-OCT-2008 10:00',
xrtfiledir=dir
IDL>xrt_dv_find_missing_imgs,'03-OCT-2008 10:00','04-OCT-2008
10:00',xrtfiledir=dir
```

- Validate the XOBs. Review whether they worked as intended. Annotate as appropriate. Things to check here are... Did the XOB do what was intended? Was the estimated data rate correct?

- Review data for interesting scientific discoveries and events. Note events for the XRT Picture of the Week (XPOW).

A note of warning: Two consecutive timelines will overlap in the period between 8-11UT (as determined by the real-time pass and OP PERIOD), and there may be Real-Time pass commands which further perturb the earlier timeline. The details

of the hand-off can cause the data list to look strange around that time, so be prepared to compare the image list to both timelines around the overlap.

6. *Prepare and send the daily XRT-DV report.* The daily report is an email sent to xrt_co@solar.isas.jaxa.jp after the day's tasks have been finished. It should list all the tasks which were completed, including day- and time-stamps. It should also note any strange items which were discovered during any of the checks. It is a good idea to check the Housekeeping, Health & Safety, and most recent data (Tasks #1 and #2) one last time just before sending the report. look at recent reports for examples of the format of this email.

The email Subject line should be of the form: xrt_co: XRT DV report: yyyy/mm/dd, where the date is today's date. Typically, you will be reporting on more than one timeline in your daily report, so it would be confusing to name the report according to a particular timeline. Just give the date of the day you did this work.

2.3 Schedule of tasks

Previous week. The new XRT-DV should start paying attention to current operations, and should attend all operations meetings and telecons.

Friday, Monday-Thursday (JST). Monitor Housekeeping and Health & Safety (Task #1). Check recent data (Task #2). Check for saturation in G-band synoptics (Task #3). Compare, validate, and annotate the most recently completed day of observations with its respective timeline plan, and prepare report (Tasks #4-6).

Saturday, Sunday Monitor Housekeeping and Health & Safety (Task #1).

Wednesday (US) or Thursday (JST) Attend XRT telecon and deliver DV report, summarizing DV results thus far, particularly highlighting any anomalies, outstanding questions, unusual events.

The following points also apply:

- The XRT-DV responsibility runs Friday to Thursday to coincide with your CO shift.
- The completed timelines should be verified for the Friday timeline *before* the duty week, through to the Thursday timeline.
- Daily reports should be filed on Friday, Monday, Tuesday, Wednesday and Thursday.
- For the weekend monitoring of HK and H&S, it is assumed that no news is good news.

Here is an example of the task order for the middle of the week. Assume it is Wednesday.

1. Check Housekeeping and Health & Safety (H&S) information. (Task # 1)

2. Check recent data (from the Tuesday and Wednesday timelines, in this example). (Task # 2)
3. Check for saturation in G-band synoptics. (Task # 3)
4. Validate the most recently completed timeline (from the Tuesday timeline, in this example). (Task # 4)
5. Check recent data (from the Tuesday and Wednesday timelines, in this example). (Task # 2)
6. Check Housekeeping and Health & Safety (H&S) information. (Task # 1)
7. Prepare and send the Daily Email Report. (Task # 5)
8. In the evening, check Housekeeping and Health & Safety (H&S) information. (Task # 1)

End example.

3 Voltages and Temperatures for Housekeeping Data

3.1 Voltage levels for Housekeeping Data

This section should serve as a reference for housekeeping values.

1. P_GND - System ground. Should be very close to 0.
2. P_M15BV - Main line that handles bus current. The nominal range is -16.5 to -13.5 Volts.
3. P_P15BV - Main line that handles bus current. The nominal range is 13.5 - 16.5 Volts.
4. P_P28OH - Operational heater. This graph is normally populated with nonsensical negative values when the operational heater is not in use. The thing to note is that: (1) If the operational heater is in use, these values should be positive and not exceed 1.6 amps; (2) If the operational heater is not in use and the values are positive, this means a circuit has been shorted and there is a problem. The nominal range, for when the operational heater is off, is any range of negative values. When viewing the housekeeping plots keep in mind that the units the long-term plots are in Amps while the 3hr, 12hr, and 24hr plots have units of miliAmps. The data in the long-term plots are also averaged over a day so their values may differ slightly.
5. P_P28IC - This is the main power line to all mechanisms and the MCU. The small spikes are caused by the filter wheel shutter movements. The large spikes correspond to MDP_XRT_CTRL_MANU commands. The nominal range is 142-162 with the larger spikes occasionally peaking at around 280. All values should

be between 100 and 520 milliamps. When viewing the housekeeping plots keep in mind that the units the long-term plots are in Amps while the 3hr, 12hr, and 24hr plots have units of miliAmps. The data in the long-term plots are also averaged over a day so their values may differ slightly.

6. P_P28IV - This is the main power line to all mechanisms and the MCU. The nominal range is 23.4 - 33 Volts.
7. P_P5AV - Power supply to XRT-D. The nominal range is 4.6 - 5.6 Volts.
8. P_P5BV - This value changes as discrete commands are issued (such as XOBs, synoptics, repoints and stops). The median value of this graph should not change by more than 0.2 volts and should stay within the range 4.5 - 5.5 Volts.

3.2 Housekeeping Temperature and C_C0_STAT Reference

This is the reference for housekeeping data. The table below was updated to reflect the temperature limits as of October 7, 2013. These values may need to be updated in the future. The temperature values should stay within these ranges even during a CCD bakeout.

Housekeeping Temperature Reference

TMP No. as per SLRB-1299	Location Description	Normal Operating	RED Limits
		Min/Max C°	Min/Max C°
TMP00	Telescope Tube +X/-Y, +Z end	-35.0 / +55.0	-50.0 / +60.0
TMP01	Telescope Tube +Y, +Z end	-35.0 / +55.0	-50.0 / +60.0
TMP02	Telescope Tube -X/-Y, +Z end	-35.0 / +55.0	-50.0 / +60.0
TMP03	Telescope Tube -X, -Z end	-35.0 / +55.0	-50.0 / +60.0
TMP04	Telescope Tube +X, -Z end	-35.0 / +55.0	-50.0 / +60.0
TMP05	E-Box PWB	-55.0 / + 65.0	-60.0 / +70.0
TMP06	Telescope Tube -Y, Mid +Z end	-35.0 / +55.0	-50.0 / +60.0
TMP07	Telescope Tube +Y, Mid +Z end	-35.0 / +55.0	-50.0 / +60.0
TMP08	Telescope Tube -Y, Mid -Z end	-35.0 / +55.0	-50.0 / +60.0
TMP09	Telescope Tube +Y, Mid -Z end	-35.0 / +55.0	-50.0 / +60.0
TMP10	Sun Shield	-65.0 / +100.0	-70.0 / +110.0
TMP11	Mirror Support -X	-35.0 / +49.5	-50.0 / +59.2
TMP12	Mirror Support +X	-35.0 / +49.5	-50.0 / +59.2
TMP13	VLI Housing	-45.0 / +55.0	-60.0 / +60.0
TMP14	VLS Motor Casing	-45.0 / +55.0	-60.0 / +60.0
TMP15	Mounting Foot -X	-45.0 / +55.0	-55.0 / +60.0
TMP16	Mounting Foot +X	-45.0 / +55.0	-55.0 / +60.0
TMP17	Mounting Foot +Z	-45.0 / +55.0	-55.0 / +60.0
TMP18	E-Box XRT-D	-55.0 / +65.0	-60.0 / +70.0
TMP19	Telescope Tube -X, -Z end	-35.0 / +55.0	-50.0 / +60.0
TMP20	Telescope Tube +X, -Z end	-35.0 / +55.0	-50.0 / +60.0
TMP21	Focus Motor	-35.0 / +55.0	-50.0 / +60.0
TMP22	Shutter Motor	-35.0 / +55.0	-50.0 / +60.0
TMP23*	Wax Actuator	-110.0 / +55.0	-150.0 / +80.0

* TMP23 is not on any group plot at housekeeping webpage.

Status values that can be returned in the C_C0_STAT or C_C1_STAT fields.

Error	Code		Description
	Dec	Hex	
eSuccess	0	0	Normal successful operation
eInvalidCommandIDErr	1	1	Command ID is invalid
eInvalidLengthErr	2	2	Length of command packet is invalid for this command
eBadCommandInThisModeErr	3	3	Valid command ID is not accepted in this software mode
eCommandNotEnabledErr	4	4	This XRT_DOOR_OPERATE_A/B, XRT_JAM_OPERATE, XRT_FOCUS_STEPS, or XRT_VLS_STEPS command was not first enabled
eRangeErr	5	5	An argument is out of range
eFSAErr	6	6	Filter wheel/shutter assembly error
eExposeBusyErr	7	7	An exposure is already in progress
eXmitBusyErr	8	8	A status packet is currently being transmitted
eMemoryDumpBusyErr	9	9	A memory dump is in progress
eMechBusyErr	10	A	A mechanism is currently busy
eTimeoutErr	11	B	A timeout occurred (not used)
eBadExposureTableErr	12	C	The exposure table contains invalid entries
eFPSTimeoutErr	13	D	The focal plane shutter timed out
eFPSWrongPositionErr	14	E	The FPS is in the wrong position
eFPSUnknownPositionErr	15	F	The FPS position is unknown
eCommandAbortedErr	16	10	Command aborted by XRT_OPERATION_ABORT
eFilterWheelMovingErr	17	11	A filter wheel is currently in motion
eFWInvalidPositionErr	18	12	A filter wheel is between two filters
eFWWrongFilterErr	19	13	A non-existent filter was requested
eFocusMechanismTimeoutErr	20	14	The focus mechanism timed out
eVLSTimeoutErr	21	15	The visible light shutter timed out
eVLSJamTimeoutErr	22	16	A VLS jam clear timed out
eDoorOpenTimeoutErr	23	17	The door timed out
eAbortInProgressErr	24	18	An abort operation is in progress
eFocusNotCalibratedErr	25	19	Focus is not yet calibrated. Use XRT_FOCUS_RECALIBRATE
eBadCriticalOpsChecksumErr	26	1A	Check byte is incorrect for a critical operations command
eBadTableErr	27	1B	A table contained invalid values
Reserved	28	1C	
Reserved	29	1D	
Reserved	30	1E	
Reserved	31	1F	
