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Gravity Probe B Relativity Mission

## GP-B Space Vehicle EMC Test Report

S0943 Rev. -  
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ITAR Control Required? ☐ Yes ☒ No

**Purpose:**

This document describes electromagnetic compatibility (EMC) tests run on the space vehicle in building 1610 at Vandenberg Air Force Base on 18-22 August 2003 and the overall effects of this test on the space vehicle electronics systems.

**Reference Documents:**

1. O/O EMC-001 EMC Test Operations Order (procedure)
2. S0942 VFAB GPS EMI Testing Report

**Test Description:**

The tests performed on the space vehicle were designed to test for self-compatibility between the following subsystems:

1. Transponder-to-payload susceptibility
2. Transponder-to-GPS receiver susceptibility.

The antenna hats on the transponder omni directional antennas were backed off by 12 inches and the hats on GPS antennas were backed off 6 inches to both reduce the coupling coefficients between the hats and the antennas and permit transponder radiation to impinge on the space vehicle.

The space vehicle was brought up into a nominal on-orbit operating configuration (MISNOMOSP-A) and vehicle telemetry was recorded for the duration of the test.

The transponders and forward and aft antennas were activated alternately during the test to generate potentially interfering EMI signals

The GPS subsystem's response to the transponder S0942 "VFAB GPS EMI Testing Report" and found that the GPS receivers were not affected by the operation of the transponders.

**Payload Analysis**

Overall, the payload electronics systems showed no observable sensitivity to transponder operation during the intervals where the transponders were active. All payload and spacecraft computers (SRE, GSS, CCCA) and computer-like equipment (ECU, GPS) continued to function and provide data via the telemetry system.

To look for more subtle effects, the telemetry traces 164 individual payload and spacecraft monitors have been examined to look for data corruption during intervals of transponder operation. Specifically, the data was examined for spikes which correspond to transponder turn on and turn off times as well as changes in noise levels during transponder operation.

A list of these monitors is presented in Table 1; the set of plots examined for indications of sensitivity is given in the appendix. Though the entire duration test (data cycle -2455, VT 2001/249-11:45:00 +2 hours) was examined for sensitivity, only a two-hour slice is presented for clarity. In this time period, the A and B transponders are cycled on and off twice.

In summary, no sensitivity was seen in any of the payload or spacecraft data to transponder operation

#### Notes on the data plots:

1. Appendix page 1 shows the correlation between the analog monitor depicting RF output power (TX\_AAnIRFOutPwr and TX\_BAnIRFOutPwr) and the corresponding transponder temperatures (TX\_AAnIPA and TX\_BAnIPA). This clearly shows when the two transponders are active. Note, however, the power scaling is wrong for both of the RF power graphs. This is a ground database issue, not an issue with the space vehicle (the “raw” measurements are consistent). To minimize confusion, notes have been made on each plot showing when each transponder is active.
2. Appendix page 1 shows the transponder active periods along with a plot of the power bus voltage. Note that between  $t = 0.83$  hours and  $t=0.92$  hours, the power bus dips significantly as the vehicle goes into a simulated eclipse. This is a normal occurrence for the bus as the SPRU stops providing regulated power from the solar arrays and the vehicle switches to batteries. This bus change shows up in a few monitors – primarily the payload magnetometers – and should not be confused with coupling from the transponders.
3. A number of the temperature monitors are read by the spacecraft as 8-bit values, and thus are quite coarse in their measurements. Look carefully at the vertical scale; some seemingly erratic measurement are simply a measurement bouncing back and forth across a AD converter bin boundary.

## **Conclusion**

A detailed examination of 164 analog monitors that were active during the space vehicle EMC test show that the payload and spacecraft has no measurable sensitivity to transponder operation in our test configuration. The vehicle operated as expected and no disruption to the test plan was noted. In addition the GPS system operated cleanly throughout and showed no correlation in measured SNR on its antenna channels and transponder operation.

This test indicates the Gravity Probe B space vehicle is insensitive to the operation of the communications transponders.

**Table 1 - Monitors examined for EMC sensitivity to Transponder Operation**

| <b>Subsystem</b> | <b>Monitor</b>  | <b>Description</b>                                                   | <b>Sensitivity Seen</b> |
|------------------|-----------------|----------------------------------------------------------------------|-------------------------|
| ACS              | TW_ACE_1A_Temp  | Attitude Control Electronics 5V Power Supply #1 Temperature - A-side | No                      |
| ACS              | TW_ACE_1B_Temp  | Attitude Control Electronics 5V Power Supply #1 Temperature - B-side | No                      |
| ACS              | TW_ACE_2A_Temp  | Attitude Control Electronics 5V Power Supply #2 Temperature - A-side | No                      |
| ACS              | TW_ACE_2B_Temp  | Attitude Control Electronics 5V Power Supply #2 Temperature - B-side | No                      |
| CCS              | TW_SSR_A_Temp   | Solid State Recorder DC-DC Converter Case Temperature - A-side       | No                      |
| CCS              | TW_SSR_B_Temp   | Solid State Recorder DC-DC Converter Case Temperature - B-side       | No                      |
| CTU              | DC_A_15V_Mon    | CTU A +15V Monitor                                                   | No                      |
| CTU              | DC_A_5V_Mon     | CTU A + 5V Monitor                                                   | No                      |
| CTU              | DC_B_15V_Mon    | CTU B + 15V Monitor                                                  | No                      |
| CTU              | DC_B_5V_Mon     | CTU B + 5V Monitor                                                   | No                      |
| EPS              | TW_Batt_1A      | Battery #1 Internal Temperature Pri                                  | No                      |
| EPS              | TW_Batt_1B      | Battery #1 Internal Temperature B/U                                  | No                      |
| EPS              | TW_Batt_2A      | Battery #2 Internal Temperature Pri                                  | No                      |
| EPS              | TW_Batt_2B      | Battery #2 Internal Temperature B/U                                  | No                      |
| EPS              | TW_SPRU_Temp    | SPRU Baseplate Temperature No. 2 Thermistor                          | No                      |
| PMS              | TW_PressSensor1 | Helium Pressure Sensor #1 Temperature                                | No                      |
| PMS              | TW_PressSensor2 | Helium Pressure Sensor #2 Temperature                                | No                      |
| SCE              | TW_SACE_Temp_1A | SACE A Temperature Monitor 1 Hi                                      | No                      |
| SCE              | TW_SACE_Temp_1B | SACE B Temperature Monitor 1 Hi                                      | No                      |
| SCE              | TW_SACE_Temp_2A | SACE A Temperature Monitor 2 Hi                                      | No                      |
| SCE              | TW_SACE_Temp_2B | SACE B Temperature Monitor 2 Hi                                      | No                      |
| TCS              | TL_FEE_skin_mX  | FEE skin temperature, -X                                             | No                      |
| TCS              | TL_FEE_skin_pX  | FEE skin temperature, +X                                             | No                      |

| Subsystem | Monitor         | Description                                 | Sensitivity Seen |
|-----------|-----------------|---------------------------------------------|------------------|
| TCS       | TL_FEEfwdplt_mX | FEE fwd plate temperature -X                | No               |
| TCS       | TL_FEEfwdplt_pX | FEE fwd plate temperature +X                | No               |
| TCS       | TL_crossFIng_mX | Cross flange temperature -X                 | No               |
| TCS       | TL_crossFIng_pX | Cross flange temperature +X                 | No               |
| TCS       | TL_dewarCone_mX | Dewar cone temperature -X (-X magnetometer) | No               |
| TCS       | TL_dewarCone_pX | Dewar cone temperature +X (+X magnetometer) | No               |
| ECU       | CE_FIMHI_ah05ad | Flow meter heater current/a: (H-05AD)       | No               |
| ECU       | CE_FIMHI_bh05bd | Flow meter heater current/b: (H-05BD)       | No               |
| ECU       | DE_MAG1_X_OUT   | Magnetometer-1 X-out                        | No               |
| ECU       | DE_MAG1_Y_OUT   | Magnetometer-1 Y-out                        | No               |
| ECU       | DE_MAG1_Z_OUT   | Magnetometer-1 Z-out                        | No               |
| ECU       | DE_MAG2_X_OUT   | Magnetometer-2 X-out                        | No               |
| ECU       | DE_MAG2_Y_OUT   | Magnetometer-2 Y-out                        | No               |
| ECU       | DE_MAG2_Z_OUT   | Magnetometer-2 Z-out                        | No               |
| ECU       | DE_MAG3_X_OUT   | Magnetometer-3 X-out                        | No               |
| ECU       | DE_MAG3_Y_OUT   | Magnetometer-3 Y-out                        | No               |
| ECU       | DE_MAG3_Z_OUT   | Magnetometer-3 Z-out                        | No               |
| ECU       | DE_MAG4_X_OUT   | Magnetometer-4 X-out                        | No               |
| ECU       | DE_MAG4_Y_OUT   | Magnetometer-4 Y-out                        | No               |
| ECU       | DE_MAG4_Z_OUT   | Magnetometer-4 Z-out                        | No               |
| ECU       | TE_Fi1_2_aGT06P | Final filter 1&2 GRT/a: T-06P               | No               |
| ECU       | TE_Fi1_2_bGT07P | Final filter 1&2 GRT/b: T-07P               | No               |
| ECU       | TE_Fi3_4_aGT08P | Final filter 3&4 GRT/a: T-08P               | No               |
| ECU       | TE_Fi3_4_bGT09P | Final filter 3&4 GRT/b: T-09P               | No               |
| ECU       | TE_FIM_a__GT18D | Flow meter vent line GRT/a: T-18D           | No               |

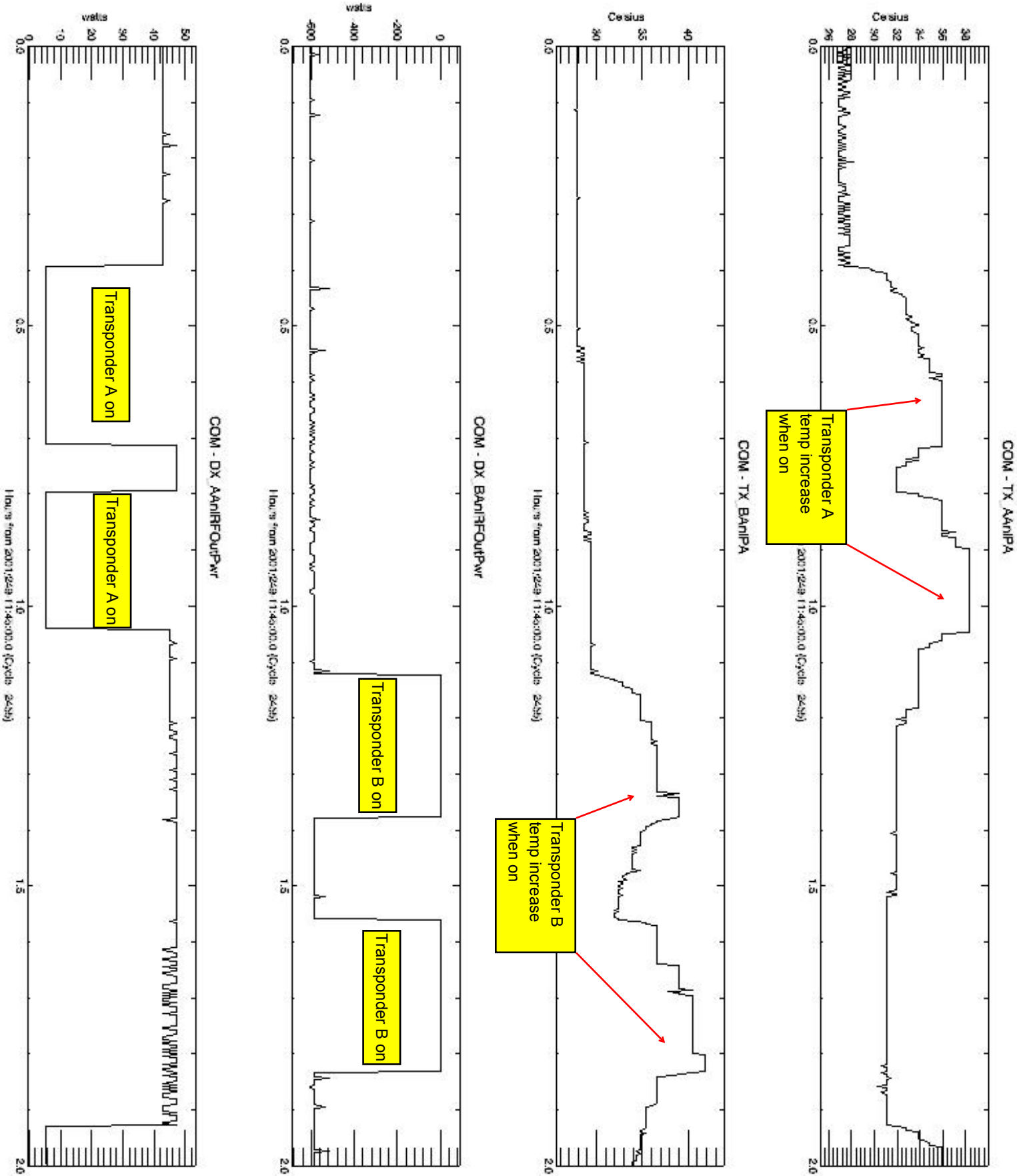
| Subsystem | Monitor         | Description                         | Sensitivity Seen |
|-----------|-----------------|-------------------------------------|------------------|
| ECU       | TE_FIMtr_bGT19D | Flow meter vent line GRT/b: T-19D   | No               |
| ECU       | TE_GMA_SDT_1A   | GMA #1A SDT/a                       | No               |
| ECU       | TE_GMA_SDT_1B   | GMA #1B SDT/b                       | No               |
| ECU       | TE_GMA_SDT_2A   | GMA #2A SDT/a                       | No               |
| ECU       | TE_GMA_SDT_2B   | GMA #2B SDT/b                       | No               |
| ECU       | TE_Gyro_1_GT01Q | Gyroscope #1 GRT: T-01Q             | No               |
| ECU       | TE_Gyro_2_GT02Q | Gyroscope #2 GRT: T-02Q             | No               |
| ECU       | TE_Gyro_3_GT03Q | Gyroscope #3 GRT: T-03Q             | No               |
| ECU       | TE_Gyro_4_GT04Q | Gyroscope #4 GRT: T-04Q             | No               |
| ECU       | TE_HEX1Dw_ST03D | HEX-1 dewar SDT: T-03D              | No               |
| ECU       | TE_HEX1Pr_ST01P | HEX-1 probe SDT: T-01P              | No               |
| ECU       | TE_HEX2Dw_ST06D | HEX-2 dewar SDT: T-06D              | No               |
| ECU       | TE_HEX2Pr_ST02P | HEX-2 probe SDT: T-02P              | No               |
| ECU       | TE_HEX3Dw_ST07D | HEX-3 dewar SDT: T-07D              | No               |
| ECU       | TE_HEX3Pr_ST03P | HEX-3 probe SDT: T-03P              | No               |
| ECU       | TE_HEX4Dw_ST08D | HEX-4 dewar SDT: T-08D              | No               |
| ECU       | TE_HEX4Pr_ST04P | HEX-4 probe SDT: T-04P              | No               |
| ECU       | TE_Q_Aft__GT05Q | Quartz block aft end GRT: T-05Q     | No               |
| ECU       | TE_Q_ForEGGT17Q | Quartz block forward end GRT: T-17Q | No               |
| ECU       | TE_St2Dw_aGT01D | Station 200 dewar GRT/a: T-01D      | No               |
| ECU       | TE_St2Dw_bGT02D | Station 200 dewar GRT/b: T-02D      | No               |
| ECU       | TE_St2Pr_aGT05P | Station 200 probe GRT: T-05P        | No               |
| ECU       | TE_TelD_1_GT12Q | Telescope detector #1 GRT: T-12Q    | No               |
| ECU       | TE_TelD_2_GT13Q | Telescope detector #2 GRT: T-13Q    | No               |
| ECU       | TE_UVLampA_T2   | UV Lamp-A bulb temperature          | No               |

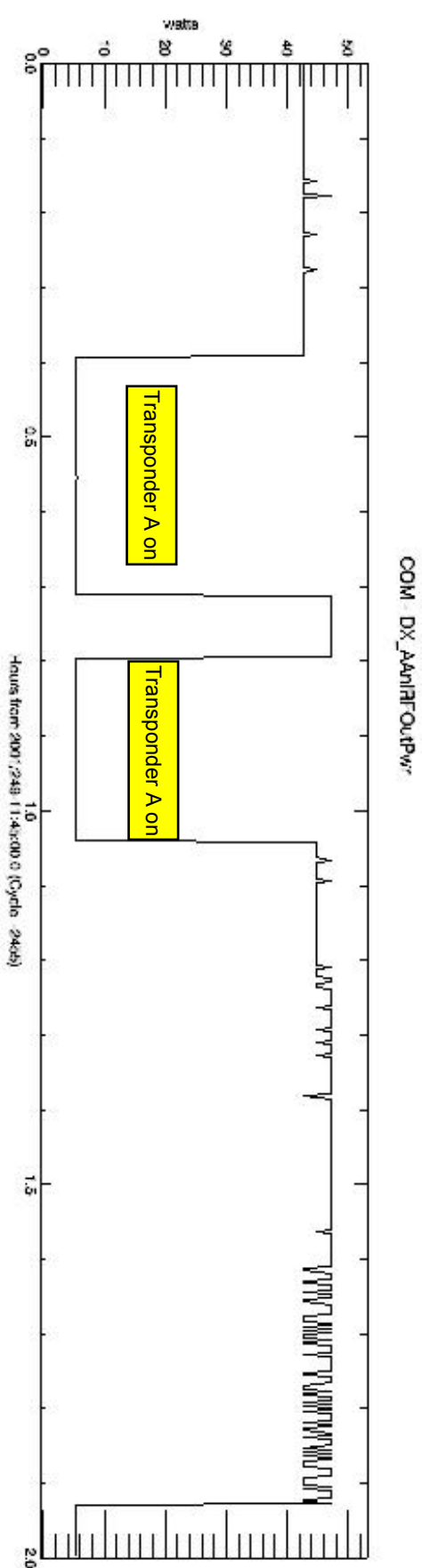
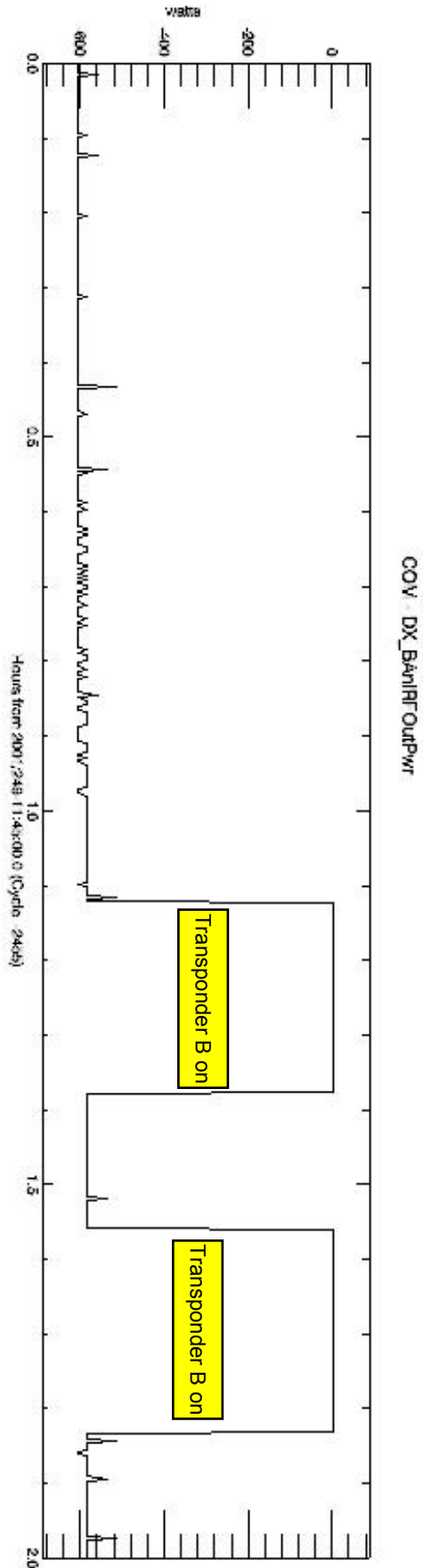
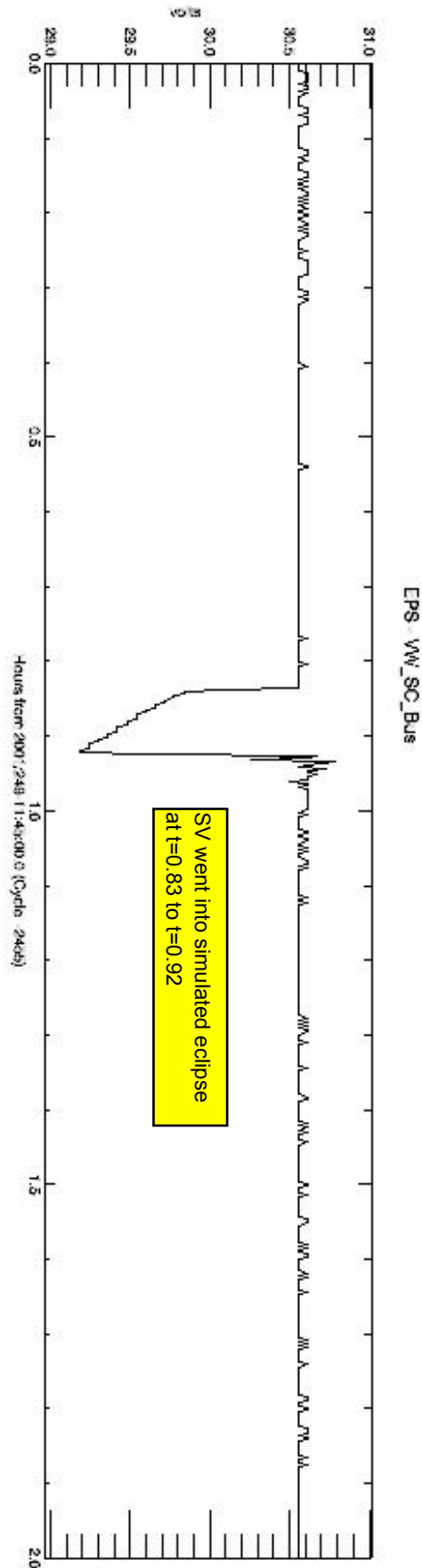
| Subsystem | Monitor         | Description                         | Sensitivity Seen |
|-----------|-----------------|-------------------------------------|------------------|
| ECU       | TE_UVLampB_T2   | UV Lamp-B bulb temperature          | No               |
| ECU       | TE_VAT_EV1_SDTa | Exhaust Valve 1 SDT/a               | No               |
| ECU       | TE_VAT_EV1_SDTb | Exhaust valve 1 SDT/b               | No               |
| ECU       | TE_VAT_EV2_SDTa | Exhaust Valve 2 SDT/a               | No               |
| ECU       | TE_VAT_EV2_SDTb | Exhaust valve 2 SDT/b               | No               |
| ECU       | TE_VAT_LV1_SDTa | Leakage valve 1 SDT/a               | No               |
| ECU       | TE_VAT_LV1_SDTb | Leakage valve 1 SDT/b               | No               |
| ECU       | TE_VAT_LV2_SDTa | Leakage valve 2 SDT/a               | No               |
| ECU       | TE_VAT_LV2_SDTb | Leakage valve 2 SDT/b               | No               |
| ECU       | VE_FIMH_a_H05AD | Flow meter heater voltage/a: H-05AD | No               |
| ECU       | VE_FIMH_b_H05BD | Flow meter heater voltage/b: H-05BD | No               |
| ECU       | VE_Mux11A_VCAL  | +5V Monitor/a                       | No               |
| ECU       | VE_Mux11B_VCAL  | +5V Monitor/b                       | No               |
| GPS       | SP_SNR0         | SNR                                 | No               |
| GPS       | SP_SNR1         | SNR                                 | No               |
| GPS       | SP_SNR2         | SNR                                 | No               |
| GPS       | SP_SNR3         | SNR                                 | No               |
| GPS       | SP_SNR4         | SNR                                 | No               |
| GPS       | SP_SNR5         | SNR                                 | No               |
| GSS       | IY_ABP_P5V_I_1  | ACU +5V Hi voltage monitor          | No               |
| GSS       | IY_ABP_P5V_I_2  | ACU +5V Hi voltage monitor          | No               |
| GSS       | IY_ABP_P5V_I_3  | ACU +5V Hi voltage monitor          | No               |
| GSS       | IY_ABP_P5V_I_4  | ACU +5V Hi voltage monitor          | No               |
| GSS       | RY_ATCposX1     | GSS X ATC position, LSB=1nm, GSS1   | No               |
| GSS       | RY_ATCposX2     | GSS X ATC position, LSB=1nm, GSS2   | No               |

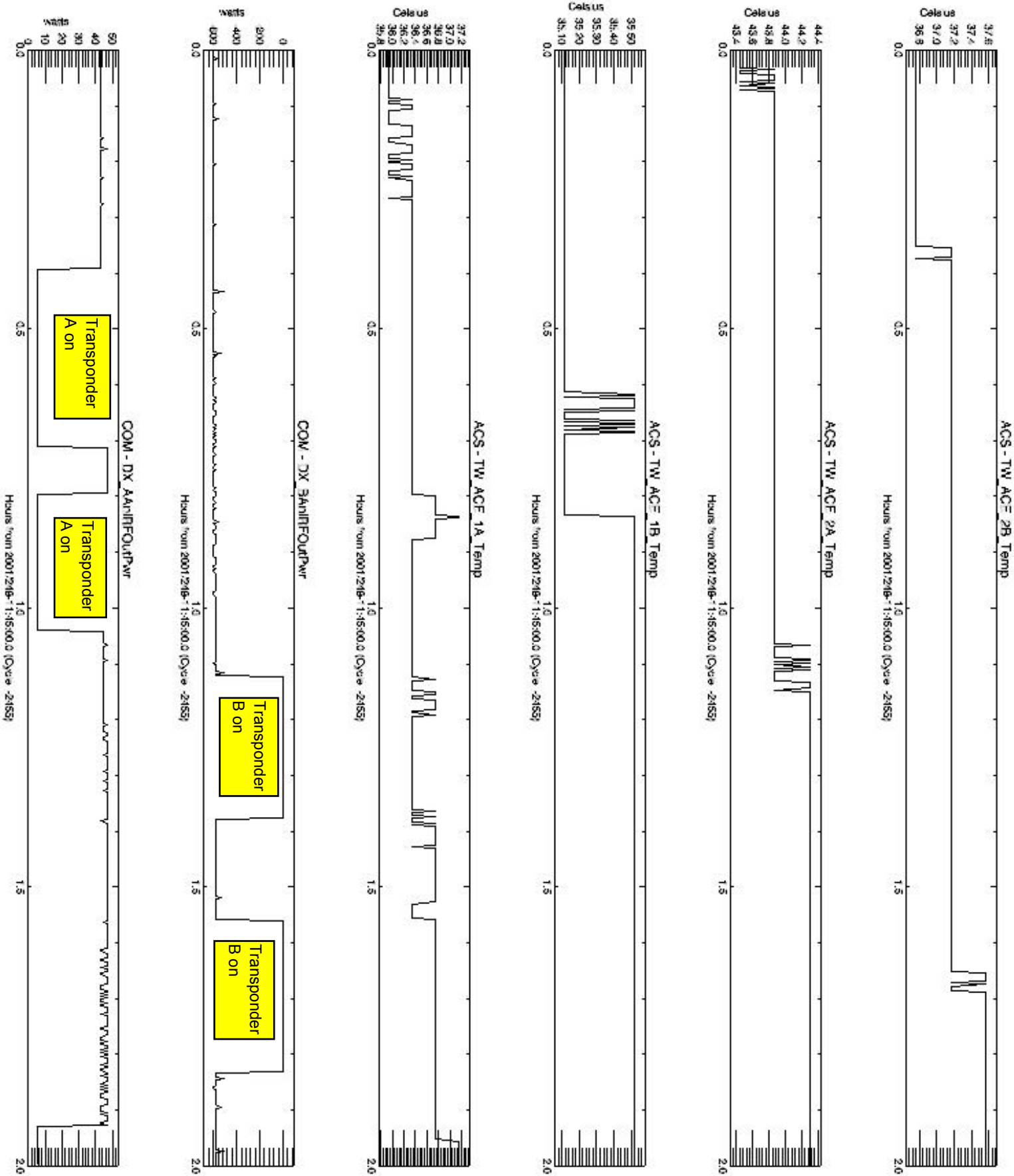
| Subsystem | Monitor         | Description                       | Sensitivity Seen |
|-----------|-----------------|-----------------------------------|------------------|
| GSS       | RY_ATCposX3     | GSS X ATC position, LSB=1nm, GSS3 | No               |
| GSS       | RY_ATCposX4     | GSS X ATC position, LSB=1nm, GSS4 | No               |
| GSS       | RY_ATCposY1     | GSS Y ATC position, LSB=1nm, GSS1 | No               |
| GSS       | RY_ATCposY2     | GSS Y ATC position, LSB=1nm, GSS2 | No               |
| GSS       | RY_ATCposY3     | GSS Y ATC position, LSB=1nm, GSS3 | No               |
| GSS       | RY_ATCposY4     | GSS Y ATC position, LSB=1nm, GSS4 | No               |
| GSS       | RY_ATCposZ1     | GSS Z ATC position, LSB=1nm, GSS1 | No               |
| GSS       | RY_ATCposZ2     | GSS Z ATC position, LSB=1nm, GSS2 | No               |
| GSS       | RY_ATCposZ3     | GSS Z ATC position, LSB=1nm, GSS3 | No               |
| GSS       | RY_ATCposZ4     | GSS Z ATC position, LSB=1nm, GSS4 | No               |
| GSS       | SY_ACS_Pll_Ctl1 | ACS PLL control monitor           | No               |
| GSS       | SY_ACS_Pll_Ctl2 | ACS PLL control monitor           | No               |
| GSS       | SY_ACS_Pll_Ctl3 | ACS PLL control monitor           | No               |
| GSS       | SY_ACS_Pll_Ctl4 | ACS PLL control monitor           | No               |
| GSS       | TY_AMT_Temp1    | AMT temperature monitor           | No               |
| GSS       | TY_AMT_Temp2    | AMT temperature monitor           | No               |
| GSS       | TY_AMT_Temp3    | AMT temperature monitor           | No               |
| GSS       | TY_AMT_Temp4    | AMT temperature monitor           | No               |
| GSS       | TY_FRM_Temp1    | FRM temperature monitor           | No               |
| GSS       | TY_FRM_Temp2    | FRM temperature monitor           | No               |
| GSS       | TY_FRM_Temp3    | FRM temperature monitor           | No               |
| GSS       | TY_FRM_Temp4    | FRM temperature monitor           | No               |
| GSS       | TY_fX_Brg_Temp1 | X Brg temperature monitor         | No               |
| GSS       | TY_fX_Brg_Temp2 | X Brg temperature monitor         | No               |
| GSS       | TY_fX_Brg_Temp3 | X Brg temperature monitor         | No               |

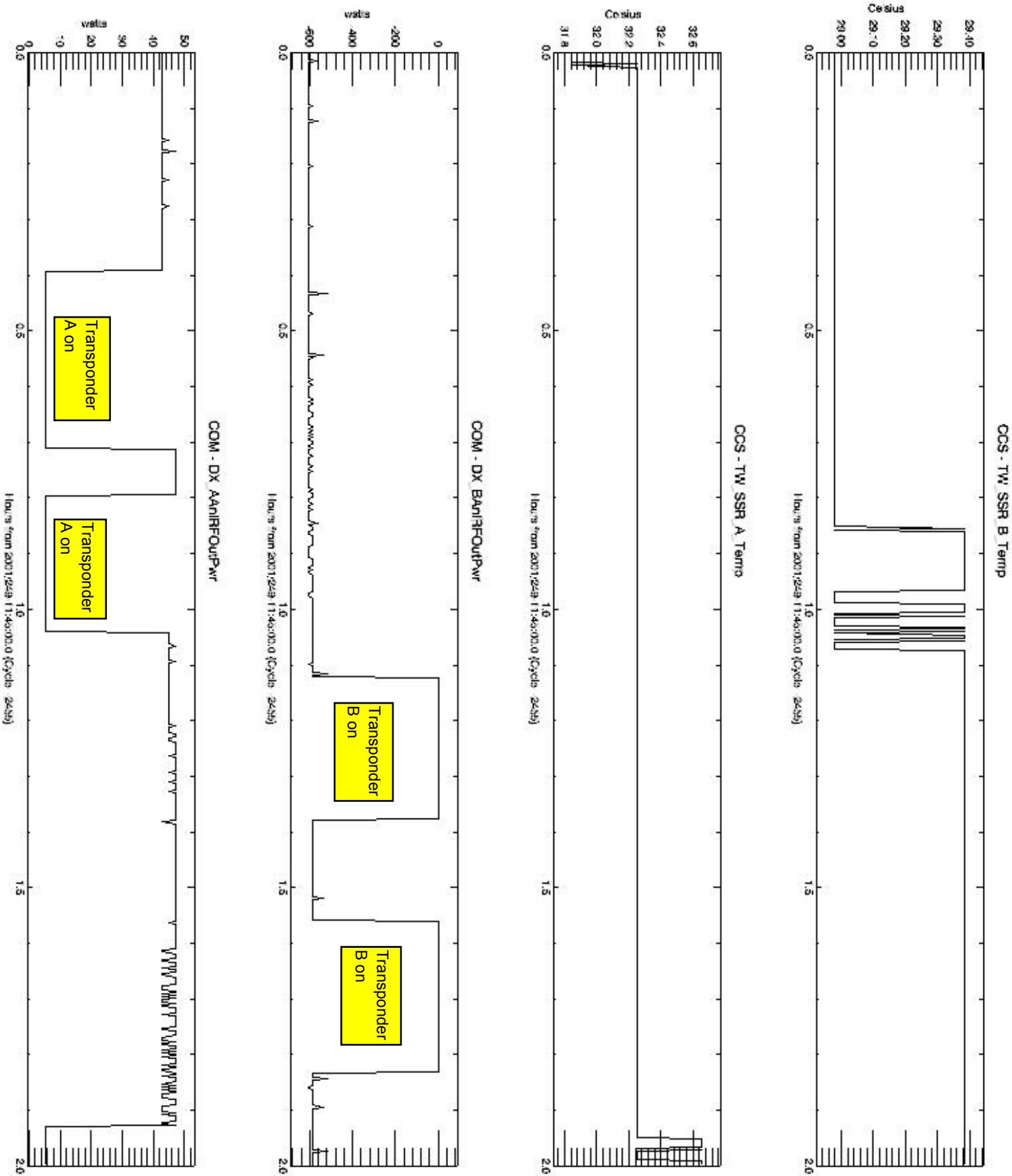
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|-----------|-----------------|----------------------------------------------------------|------------------|
| GSS       | TY_fx_Brg_Temp4 | X Brg temperature monitor                                | No               |
| GSS       | VY_Plus5_V_aPS1 | P5V voltage monitor                                      | No               |
| GSS       | VY_Plus5_V_aPS2 | P5V voltage monitor                                      | No               |
| GSS       | VY_Plus5_V_aPS3 | P5V voltage monitor                                      | No               |
| GSS       | VY_Plus5_V_aPS4 | P5V voltage monitor                                      | No               |
| GSS       | VY_Pos_50V_FRM1 | FSU +50V voltage monitor                                 | No               |
| GSS       | VY_Pos_50V_FRM2 | FSU +50V voltage monitor                                 | No               |
| GSS       | VY_Pos_50V_FRM3 | FSU +50V voltage monitor                                 | No               |
| GSS       | VY_Pos_50V_FRM4 | FSU +50V voltage monitor                                 | No               |
| SRE       | SQ_20HzSignal_1 | Last sample of SQUID 1 20Hz signal at a 10Hz cycle       | No               |
| SRE       | SQ_20HzSignal_2 | Last sample of SQUID 2 20Hz signal at a 10Hz cycle       | No               |
| SRE       | SQ_20HzSignal_3 | Last sample of SQUID 3 20Hz signal at a 10Hz cycle       | No               |
| SRE       | SQ_20HzSignal_4 | Last sample of SQUID 4 20Hz signal at a 10Hz cycle       | No               |
| SRE       | SQ_DAC_ETmp_1   | SQUID 1 DAC Electronic Temperature data                  | No               |
| SRE       | SQ_DAC_ETmp_2   | SQUID 2 DAC Electronic Temperature data                  | No               |
| SRE       | SQ_DAC_ETmp_3   | SQUID 3 DAC Electronic Temperature data                  | No               |
| SRE       | SQ_DAC_ETmp_4   | SQUID 4 DAC Electronic Temperature data                  | No               |
| SRE       | RQ_DAS2P5Ref1_A | The first reference 2.5V analog data from DAS for SRE-A  | No               |
| SRE       | RQ_DAS2P5Ref1_B | The first reference 2.5V analog data from DAS for SRE-B  | No               |
| SRE       | RQ_DAS2P5Ref2_A | The second reference 2.5V analog data from DAS for SRE-A | No               |
| SRE       | RQ_DAS2P5Ref2_B | The second reference 2.5V analog data from DAS for SRE-B | No               |
| SRE       | SQ_Bkt_ETmp_A   | SQUID bracket electronic temperature for SRE-A           | No               |
| SRE       | SQ_Bkt_ETmp_B   | SQUID bracket electronic temperature for SRE-B           | No               |
| SRE       | SQ_PwrBrdTmp_A  | Temperature from the power board for SRE-A               | No               |
| SRE       | SQ_PwrBrdTmp_B  | Temperature from the power board for SRE-B               | No               |

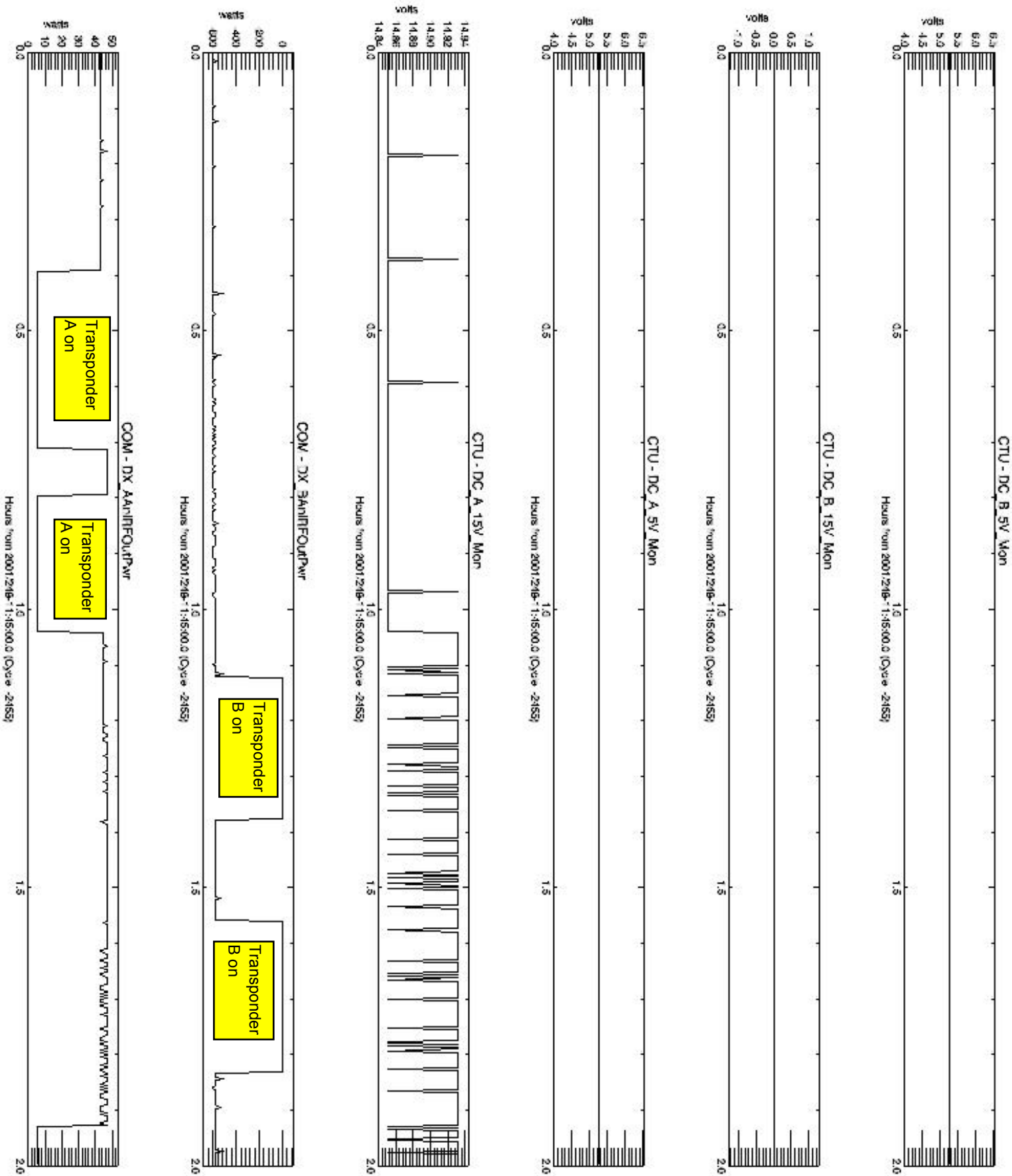
| Subsystem | Monitor         | Description                                                          | Sensitivity Seen |
|-----------|-----------------|----------------------------------------------------------------------|------------------|
| SRE       | SQ_ST_Ref_A     | Science Telescope +10V Reference data for SRE-A                      | No               |
| SRE       | SQ_ST_Ref_B     | Science Telescope +10V Reference data for SRE-B                      | No               |
| SRE       | SQ_SysMnus_V_A  | System -V analog data for SRE-A                                      | No               |
| SRE       | SQ_SysMnus_V_B  | System -V analog data for SRE-B                                      | No               |
| SRE       | SQ_SysPlus_V_A  | System +V analog data for SRE-A                                      | No               |
| SRE       | SQ_SysPlus_V_B  | System +V analog data for SRE-B                                      | No               |
| TRE       | ST_M12VSuplPX_A | -12V supply voltage of the X axis for TRE A side                     | No               |
| TRE       | ST_M12VSuplPX_B | -12V supply voltage of the X axis for TRE B side                     | No               |
| TRE       | ST_M12VSuplPY_A | -12V supply voltage of the Y axis for TRE A side                     | No               |
| TRE       | ST_M12VSuplPY_B | -12V supply voltage of the Y axis for TRE B side                     | No               |
| TRE       | ST_P12VSuplPX_A | +12V supply voltage of the X axis for TRE A side                     | No               |
| TRE       | ST_P12VSuplPX_B | +12V supply voltage of the X axis for TRE B side                     | No               |
| TRE       | ST_P12VSuplPY_A | +12V supply voltage of the Y axis for TRE A side                     | No               |
| TRE       | ST_P12VSuplPY_B | +12V supply voltage of the Y axis for TRE B side                     | No               |
| COM       | TX_AAnlPA       | Transponder A power amplifier temperature digitized analog telemetry | No               |
| COM       | TX_BAnlPA       | Transponder B power amplifier temperature digitized analog telemetry | No               |

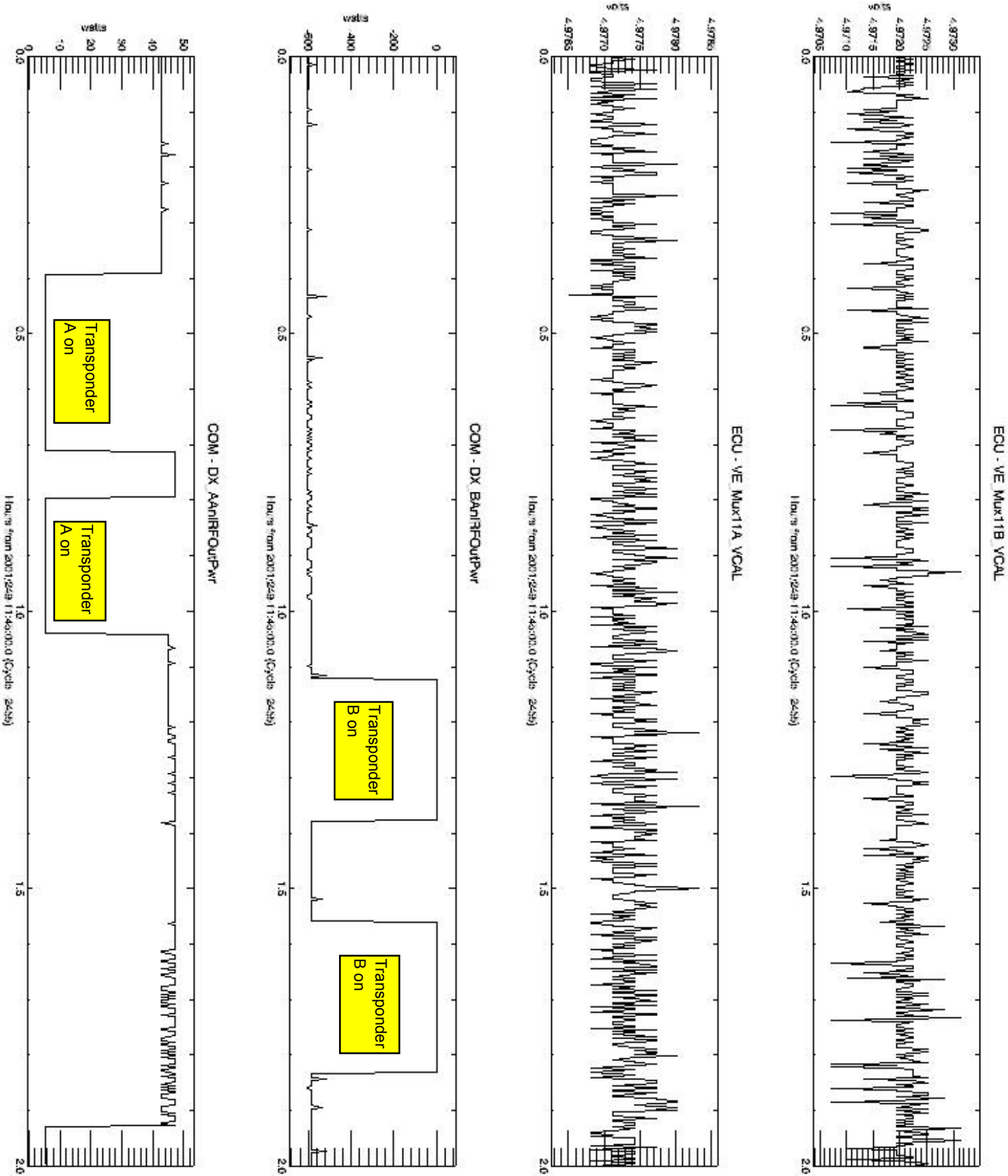


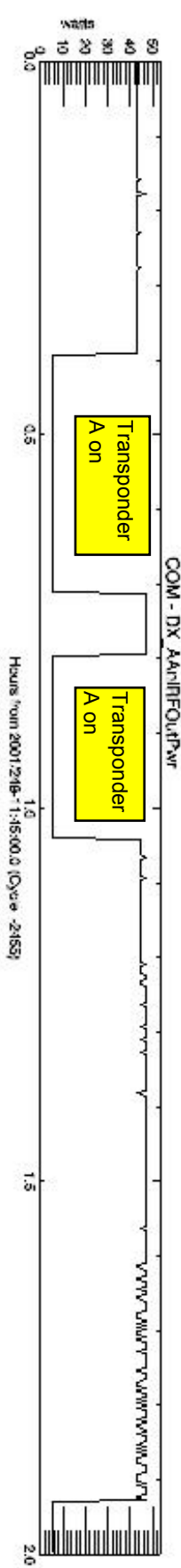
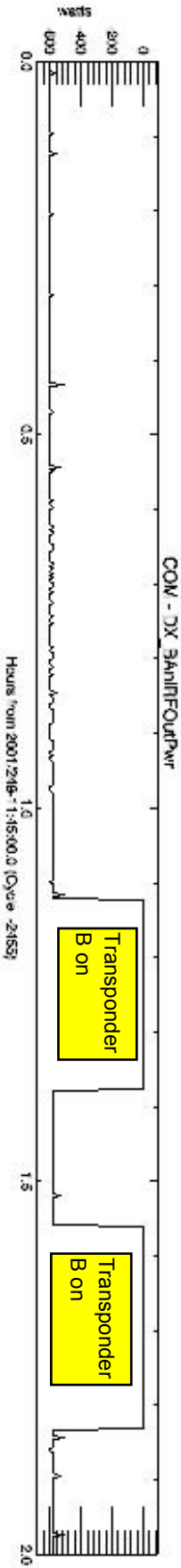
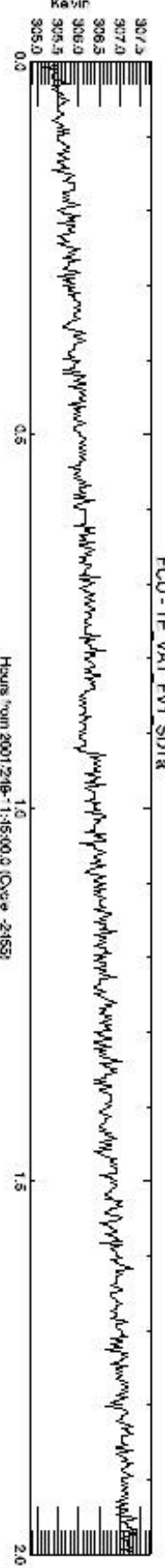
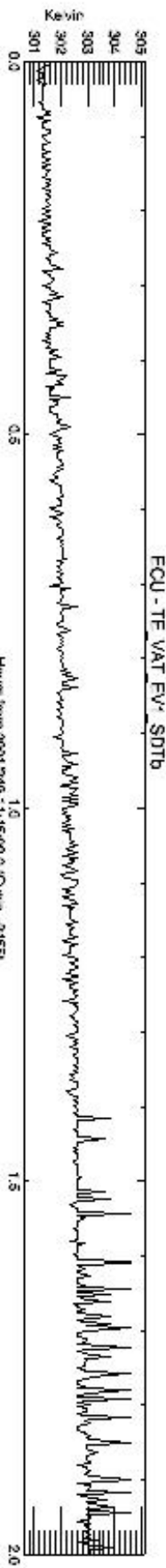
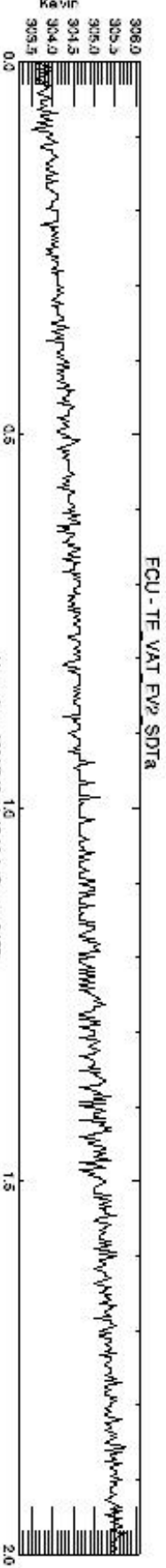
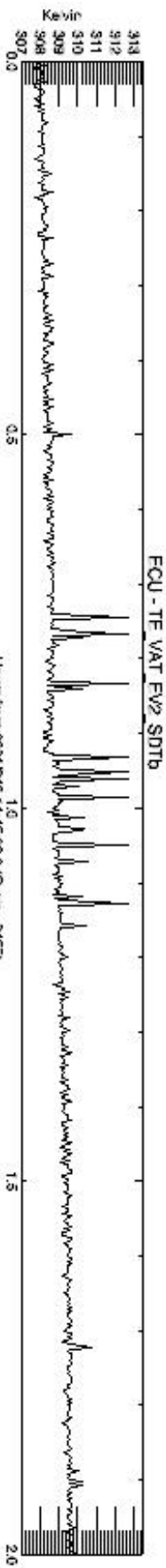


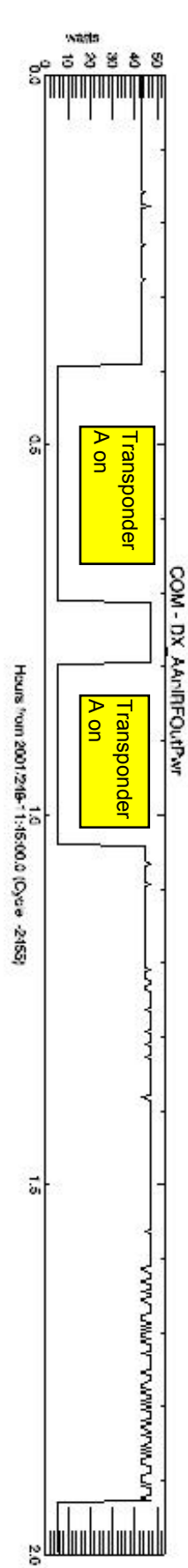
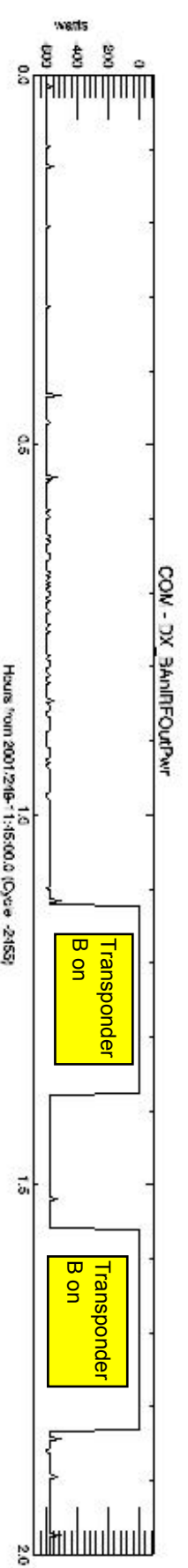
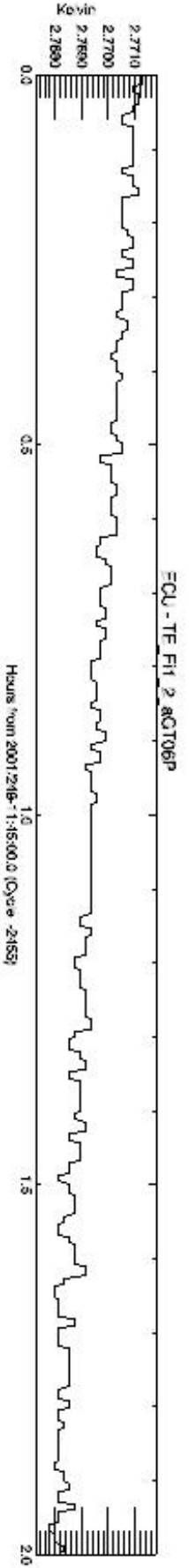
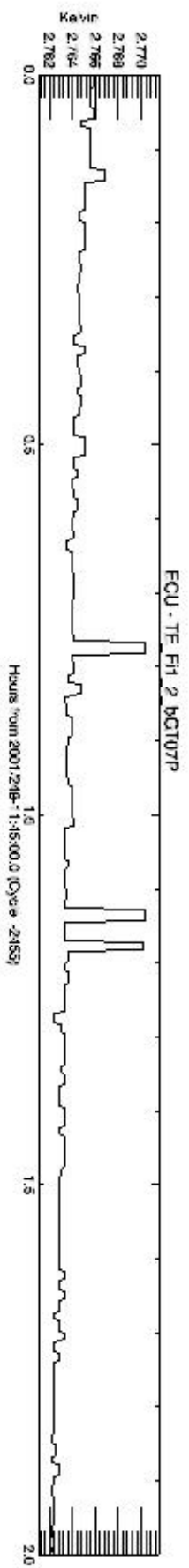
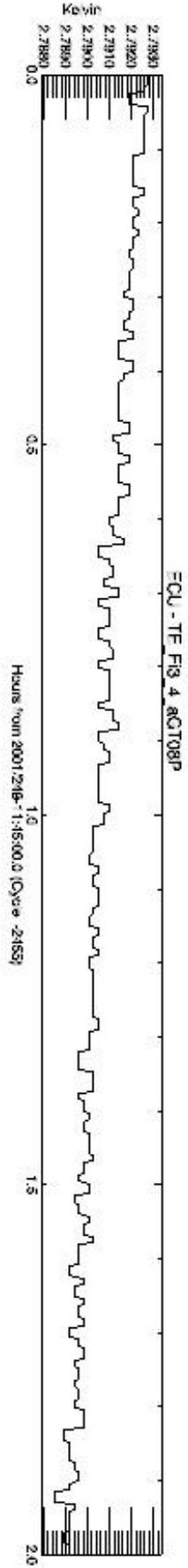
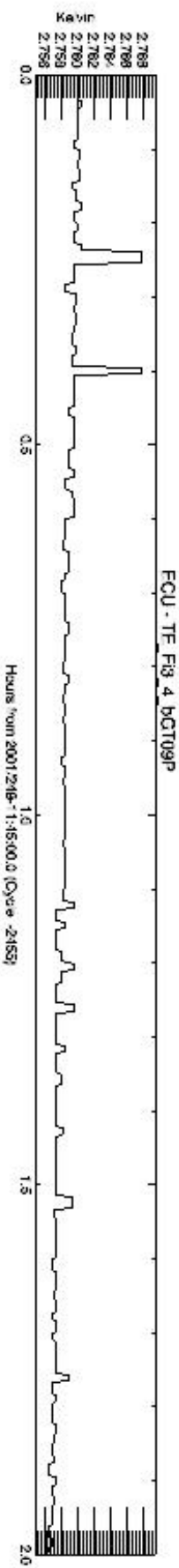


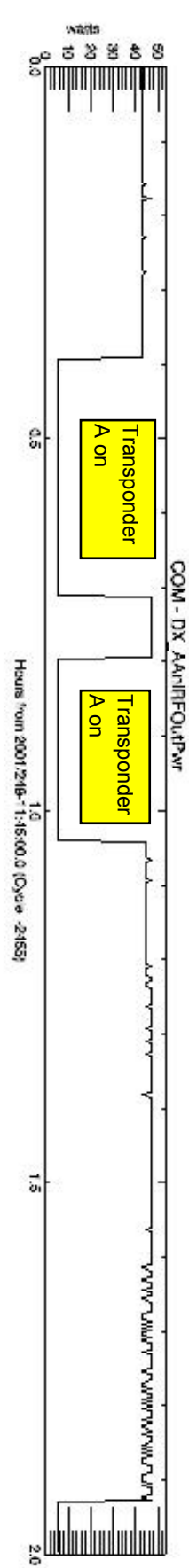
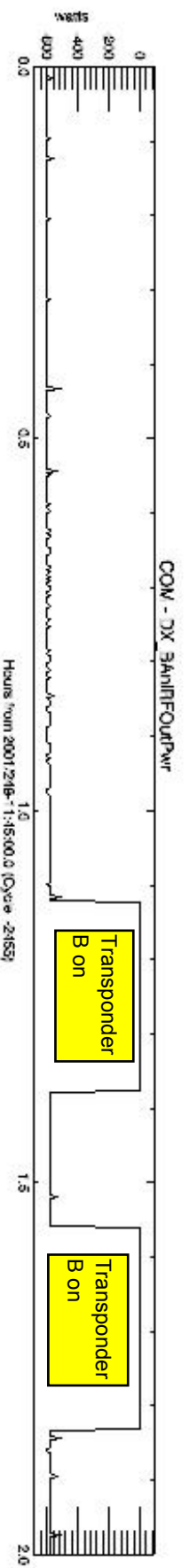
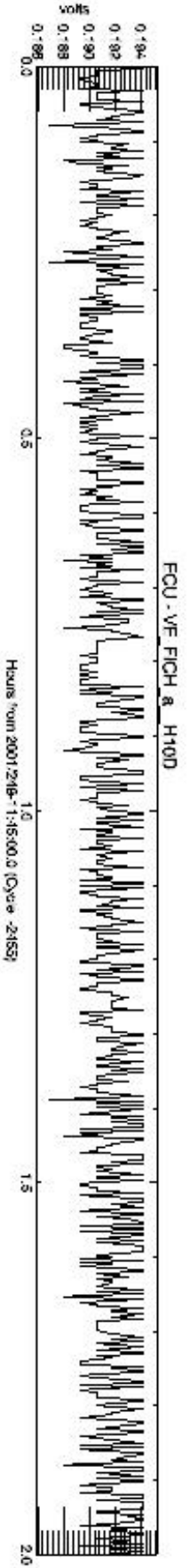
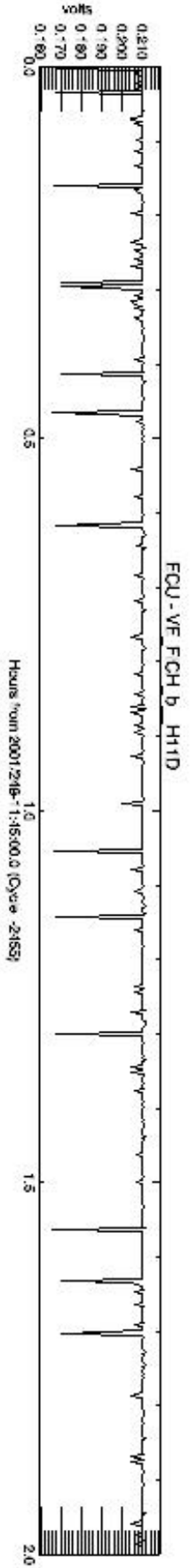
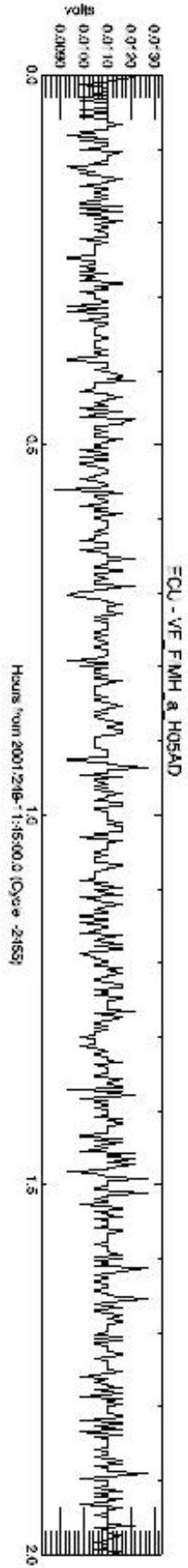
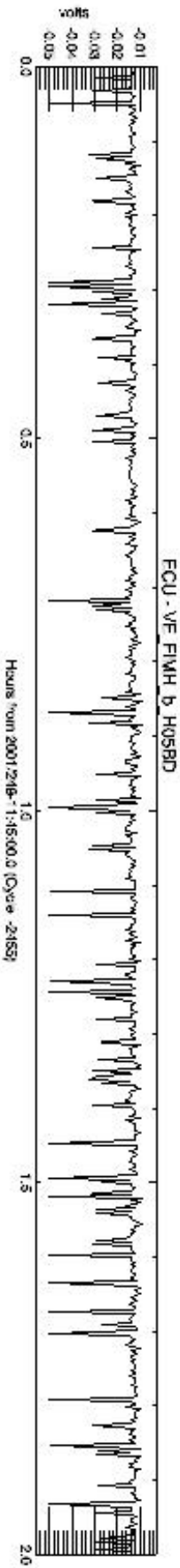


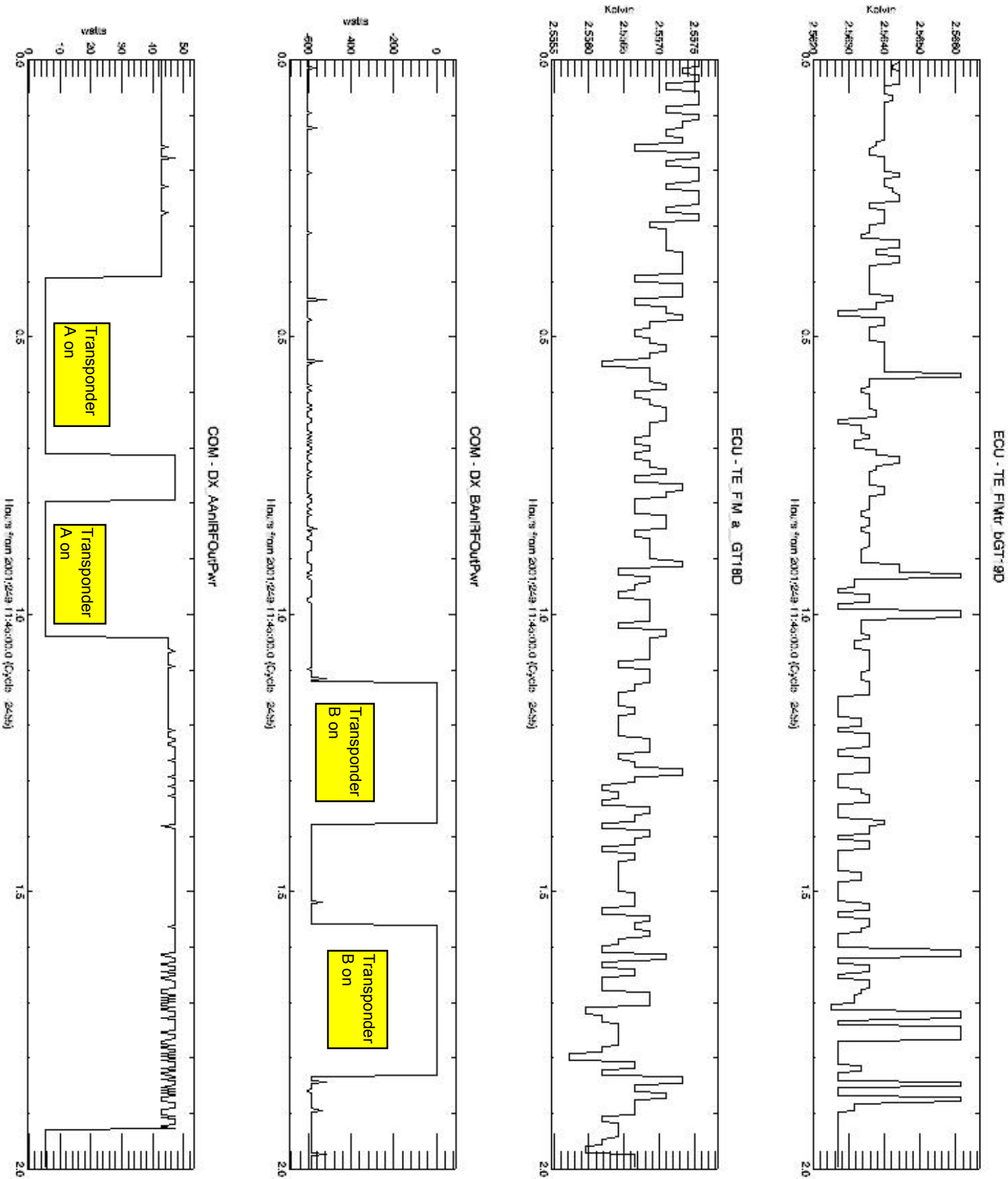


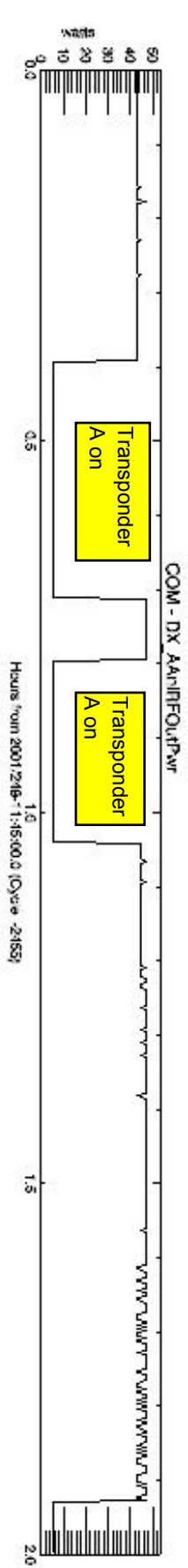
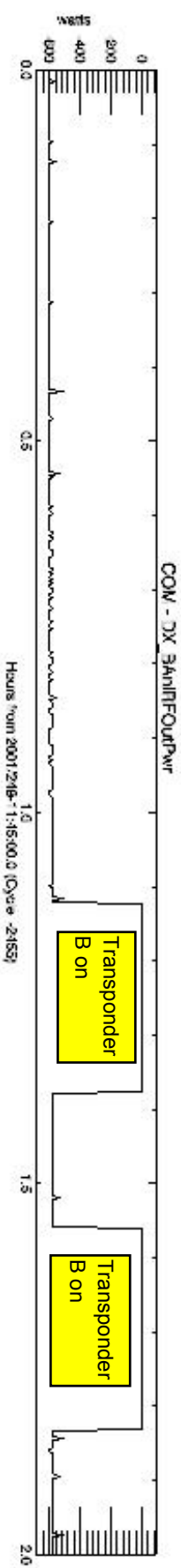
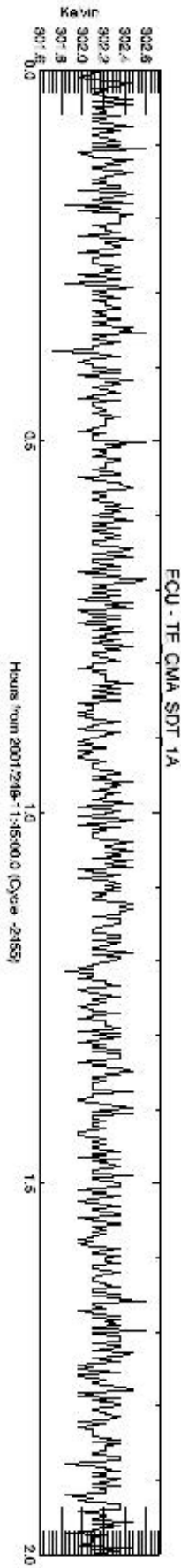
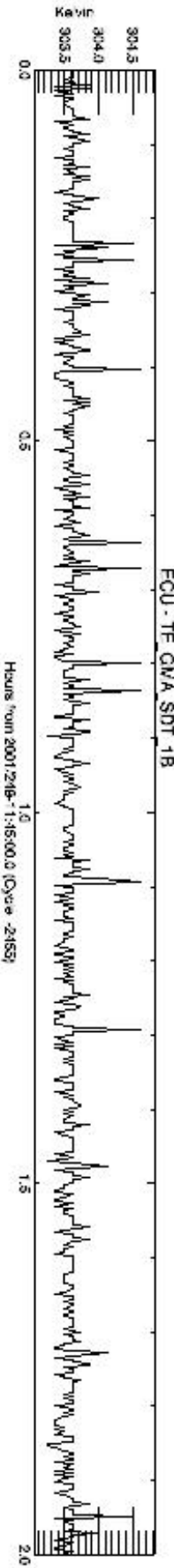
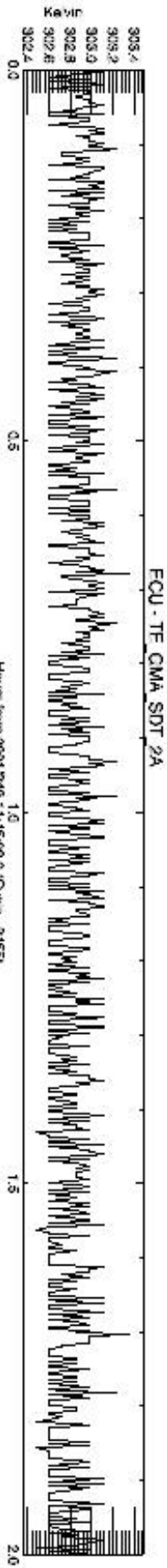
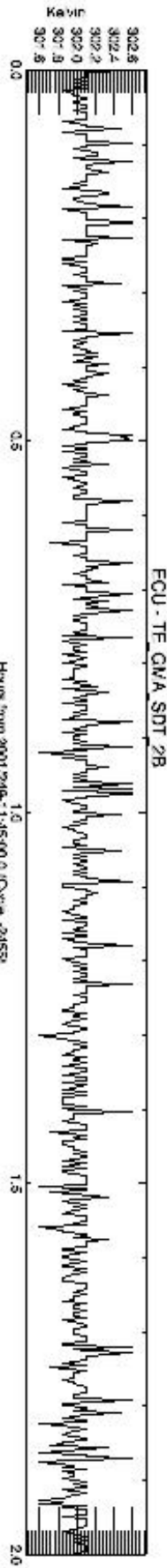


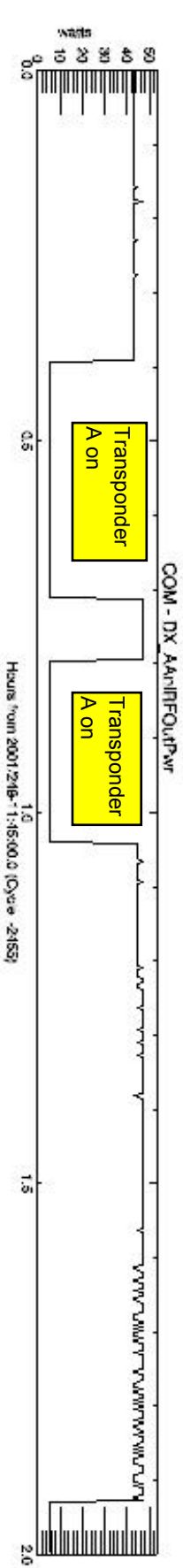
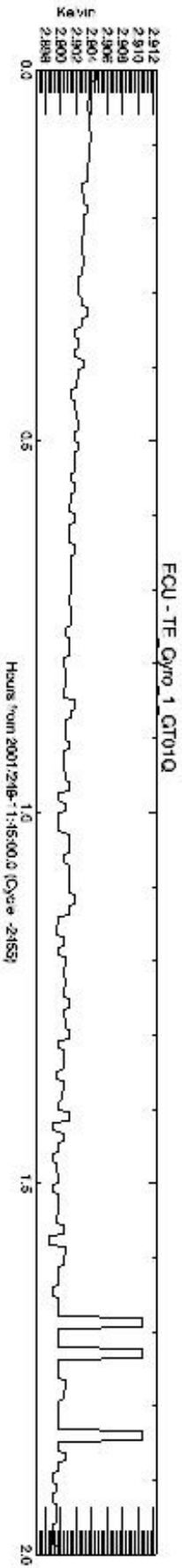
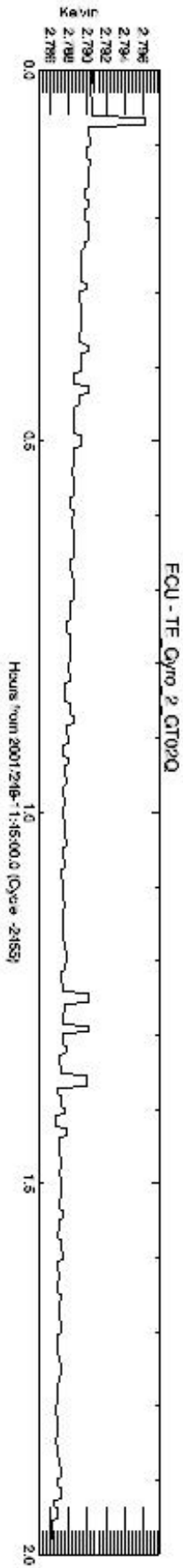
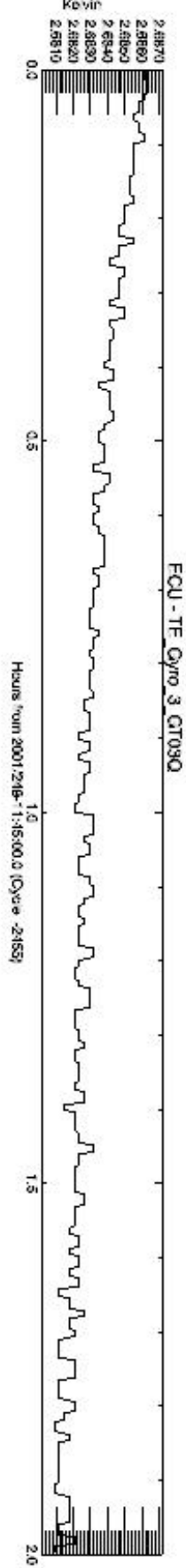
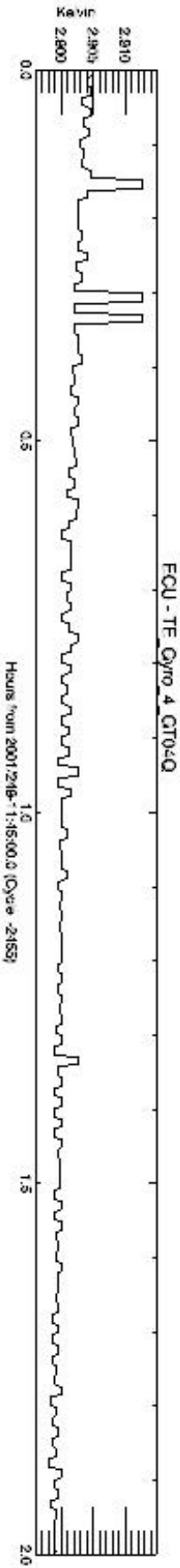


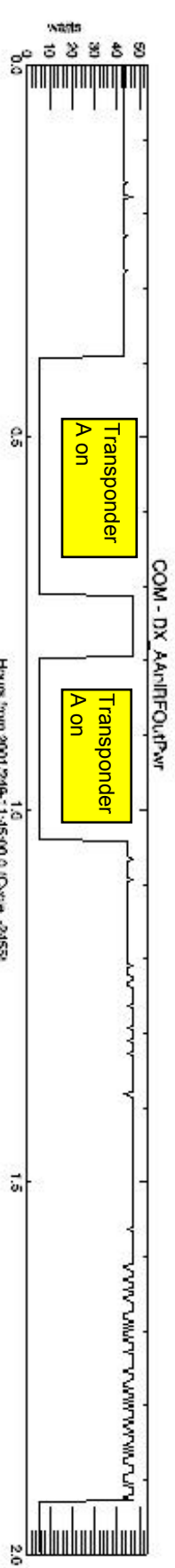
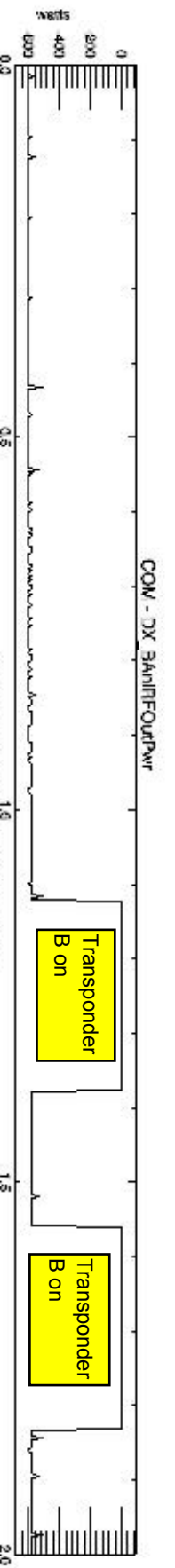
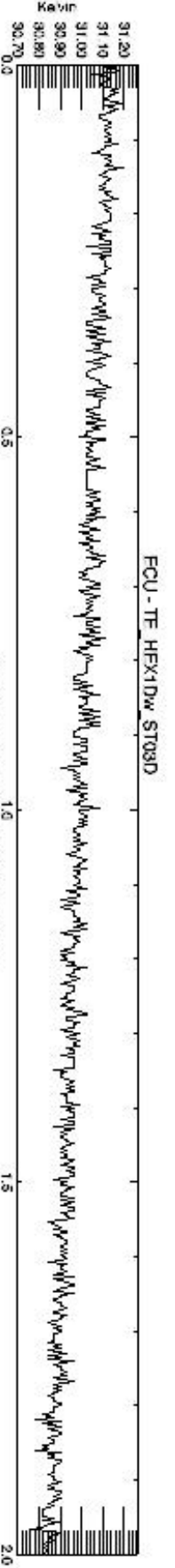
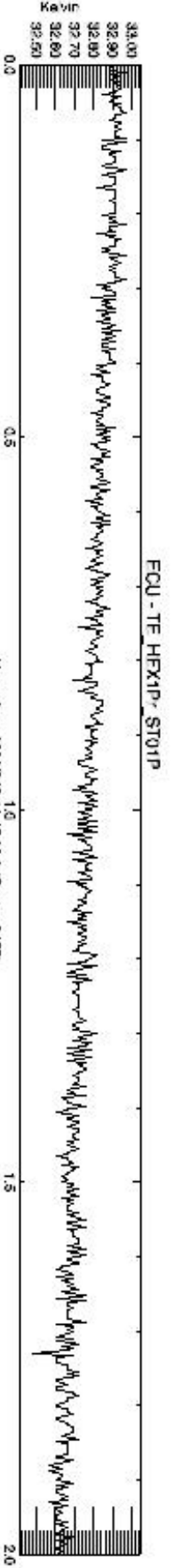
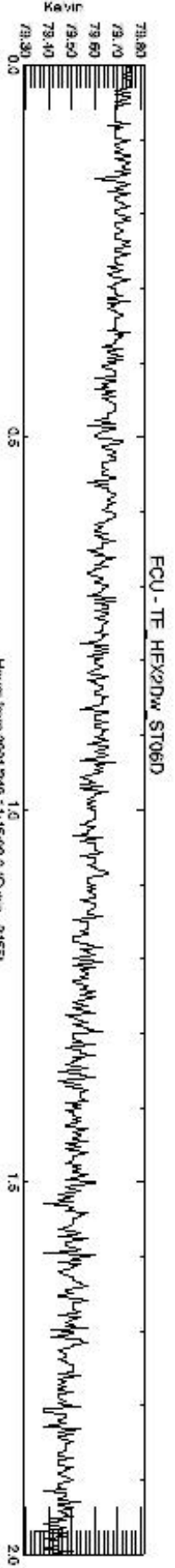


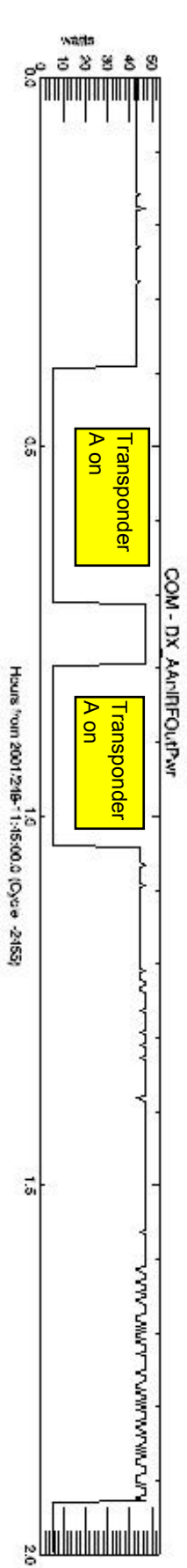
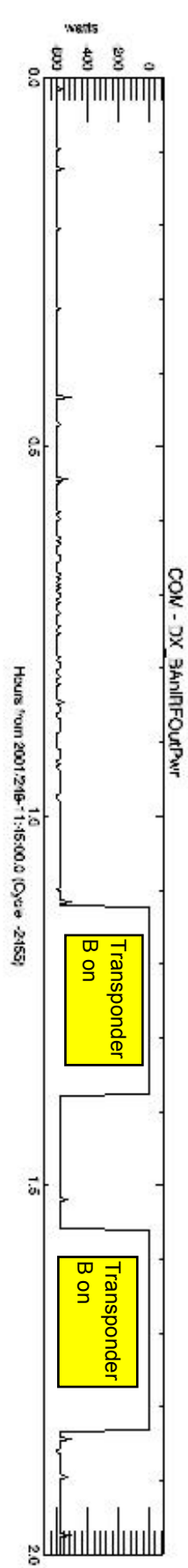
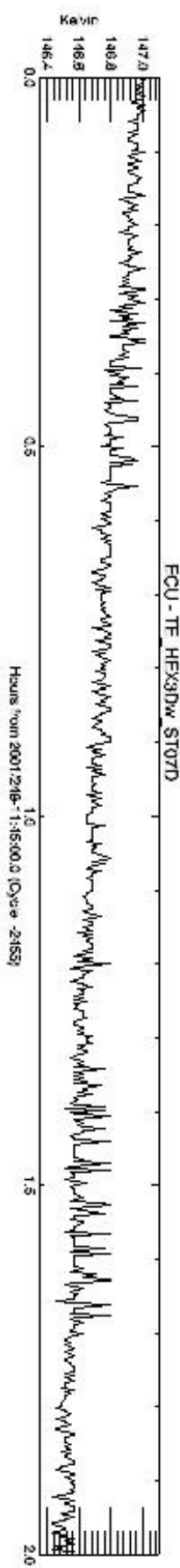
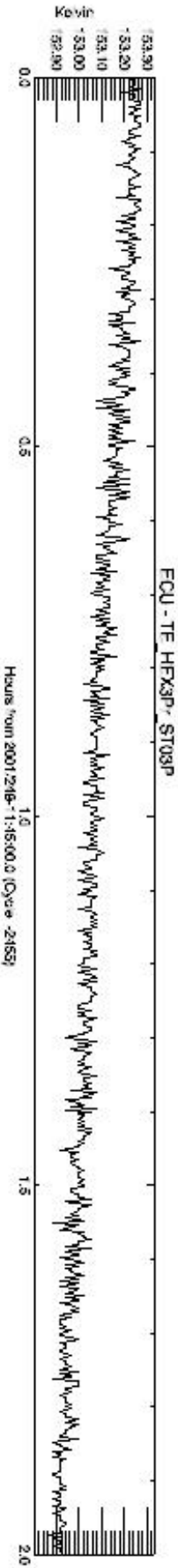
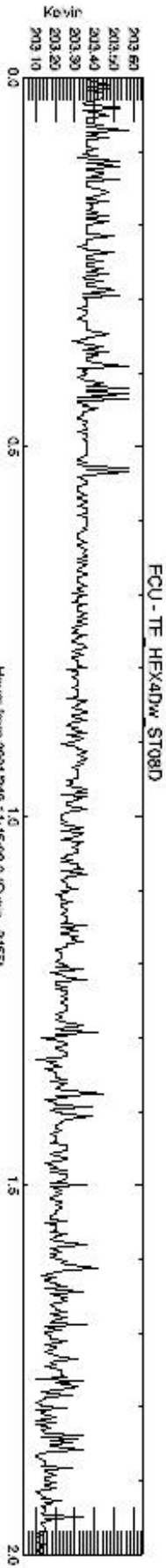
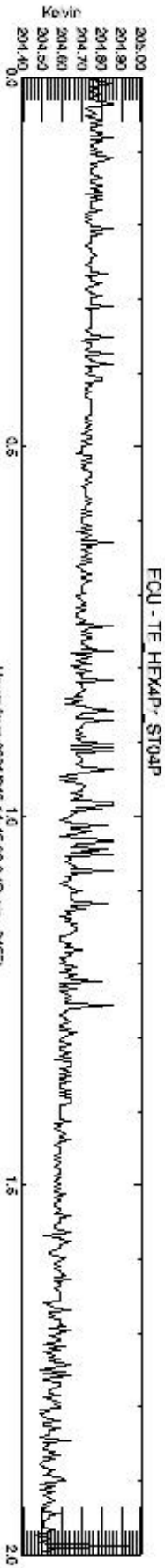


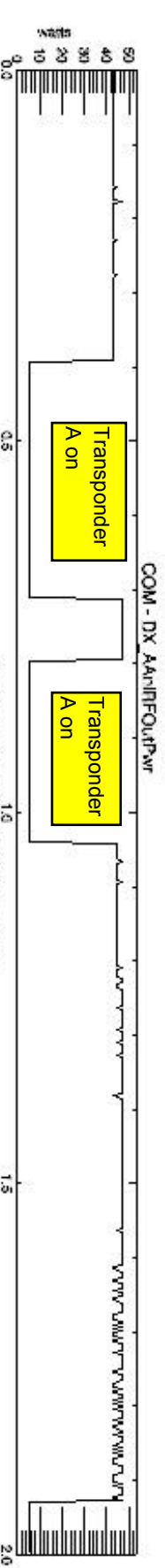
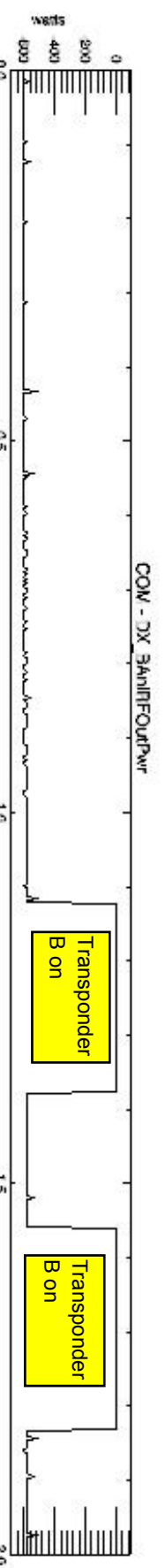
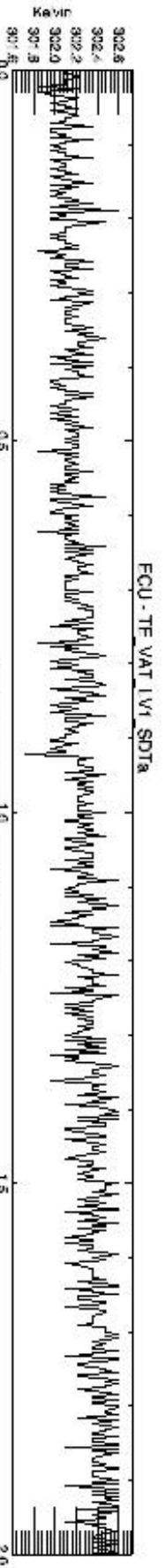
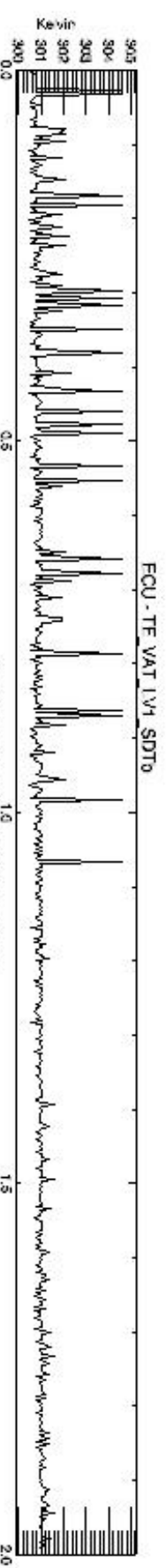
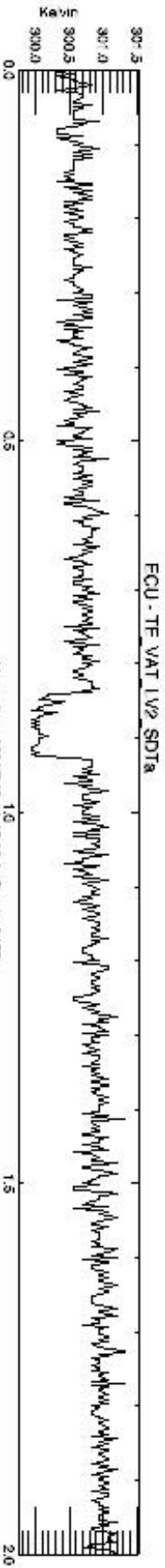
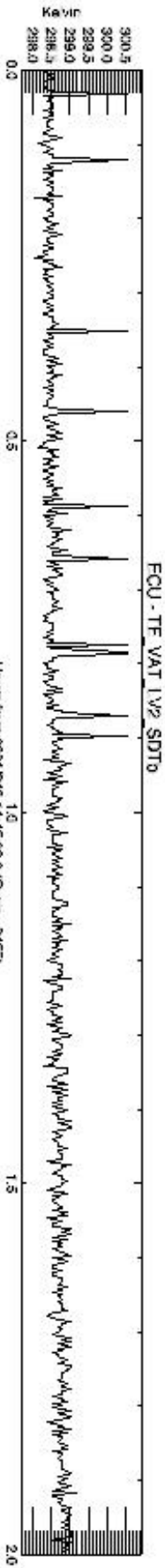


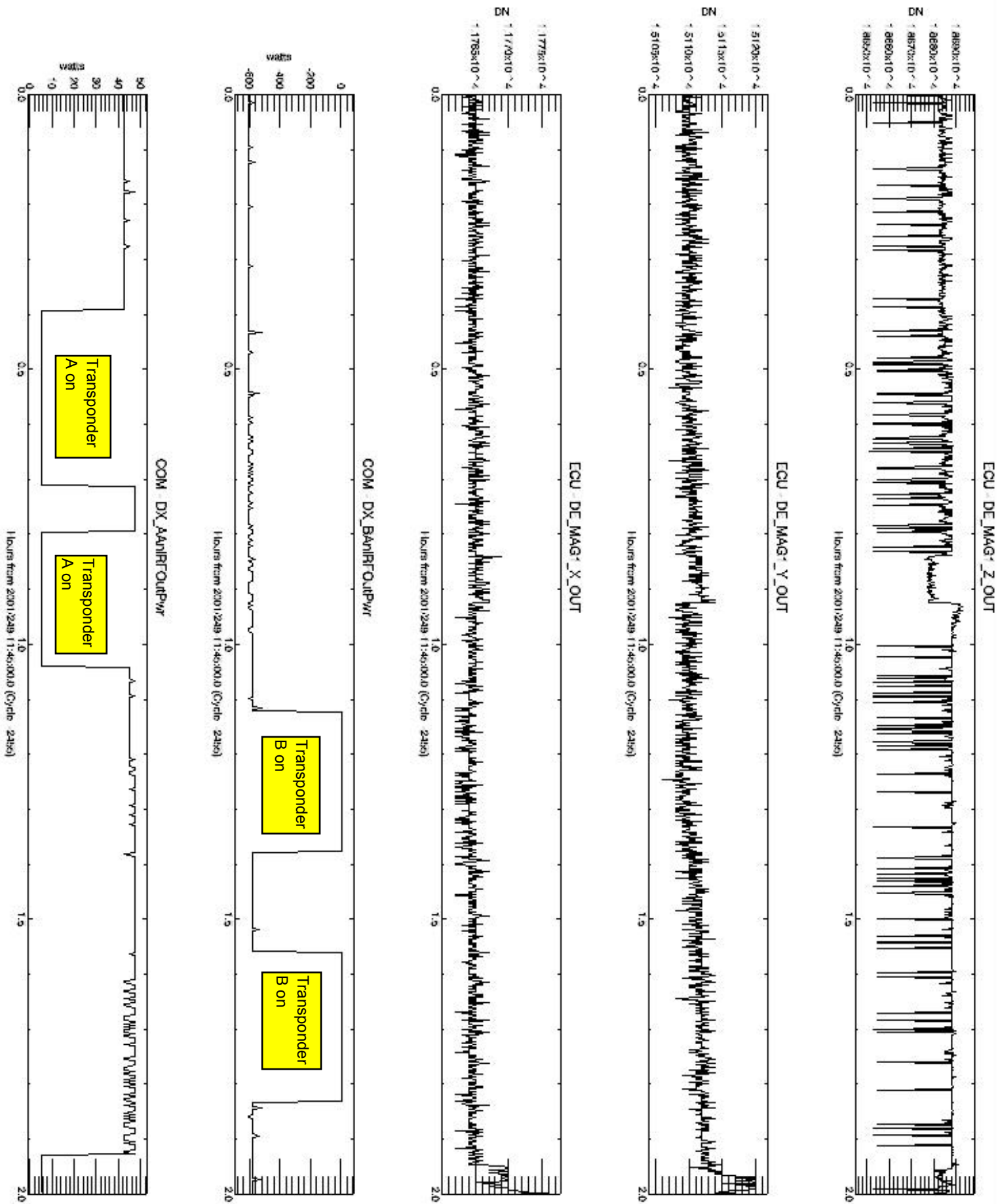


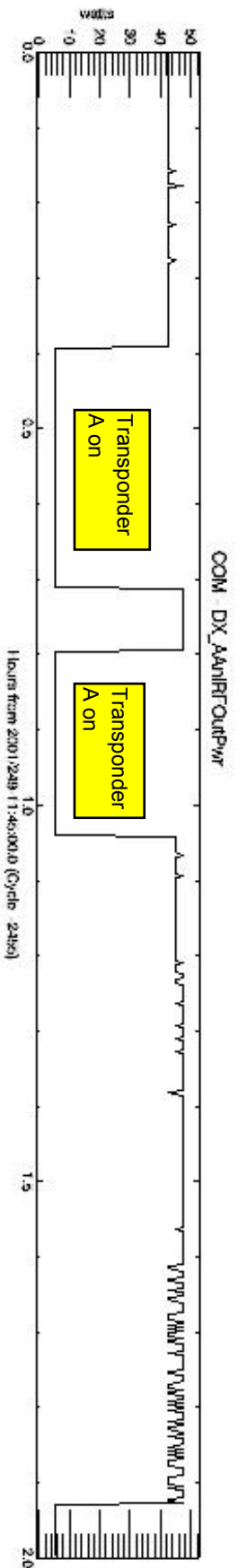
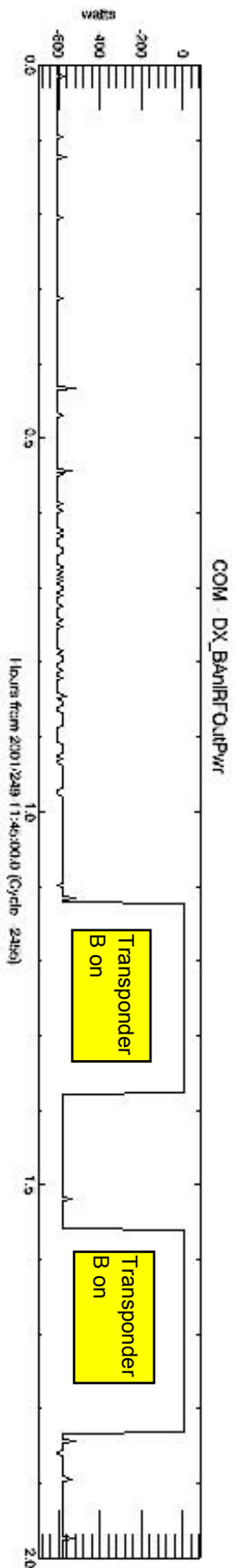
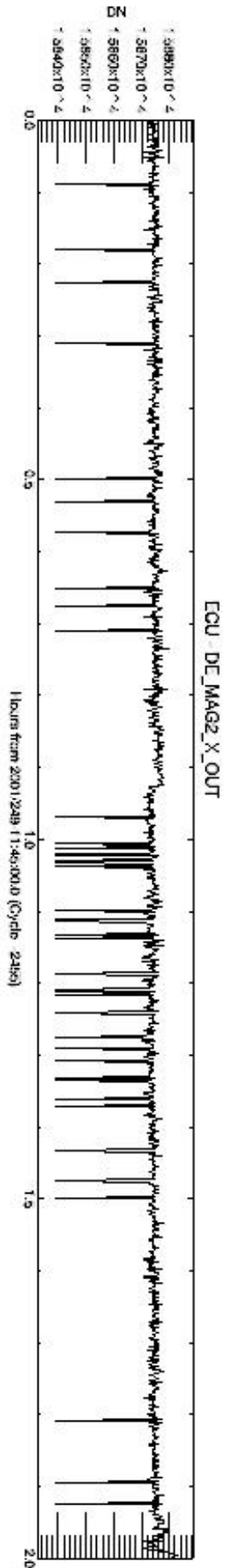
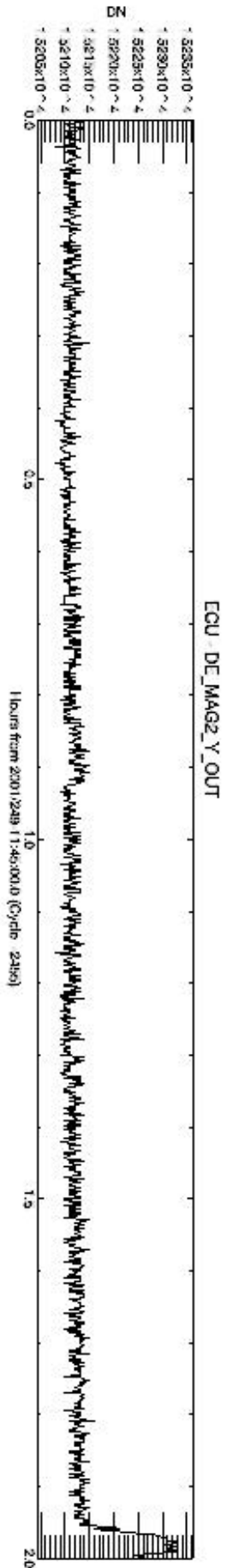
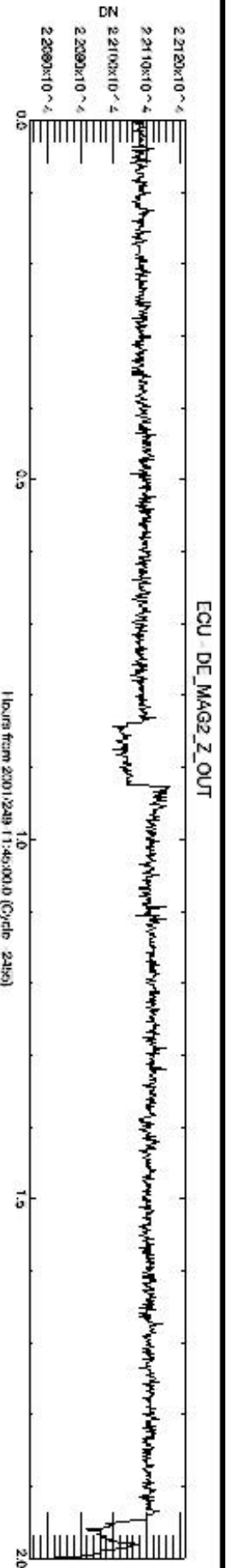


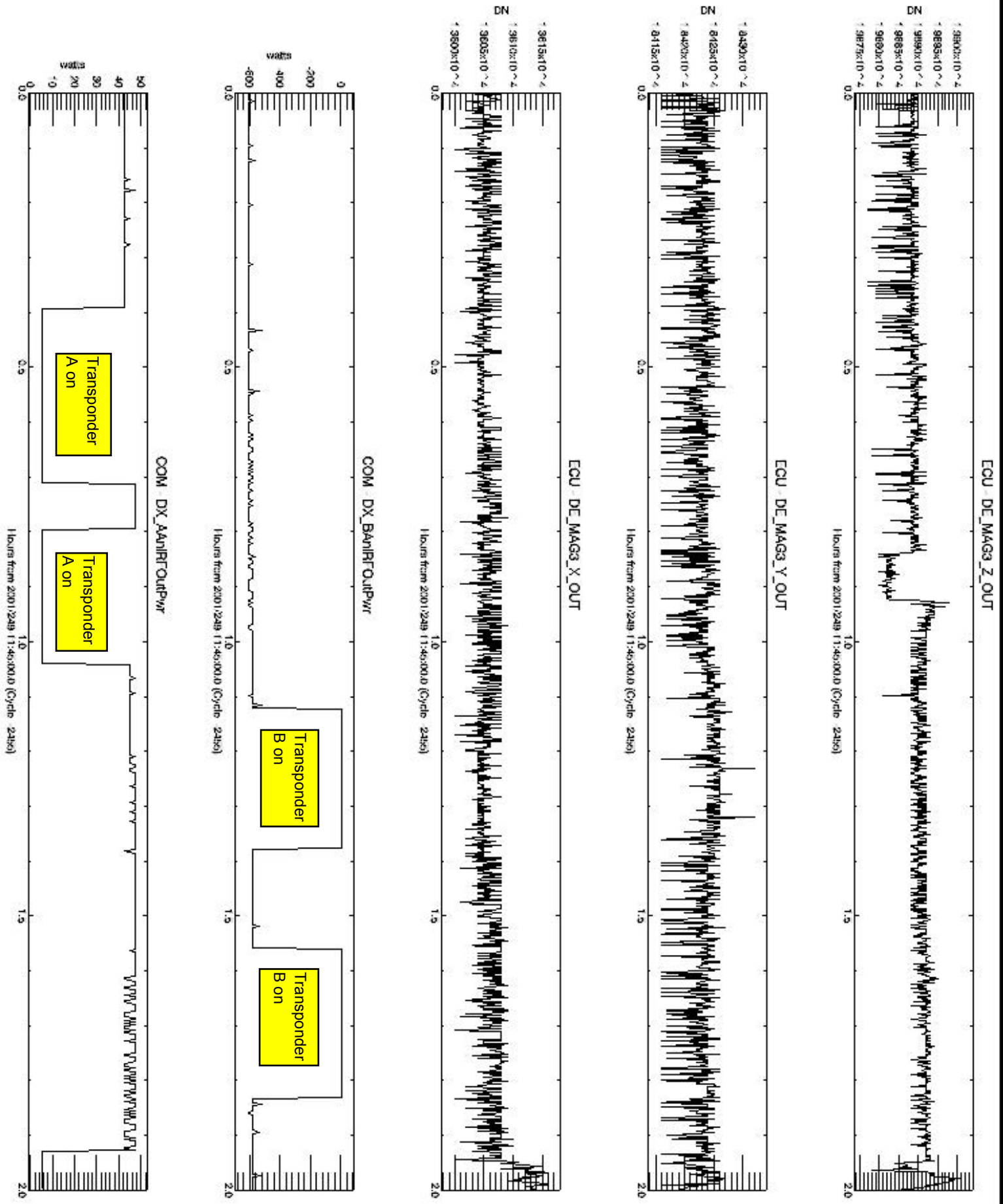


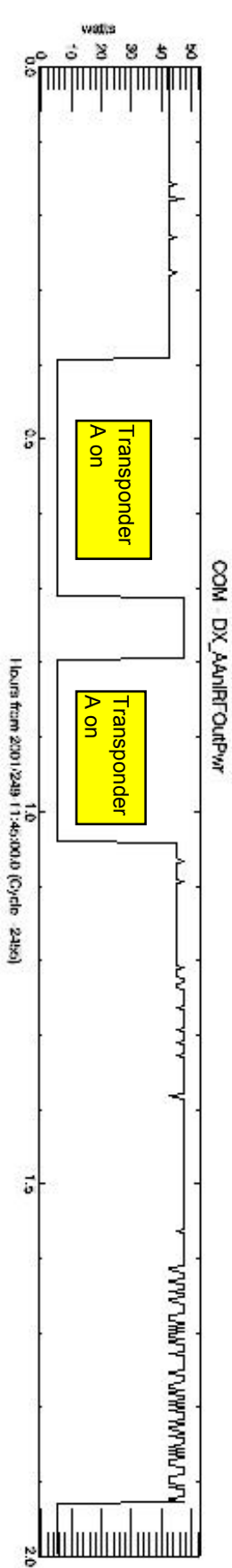
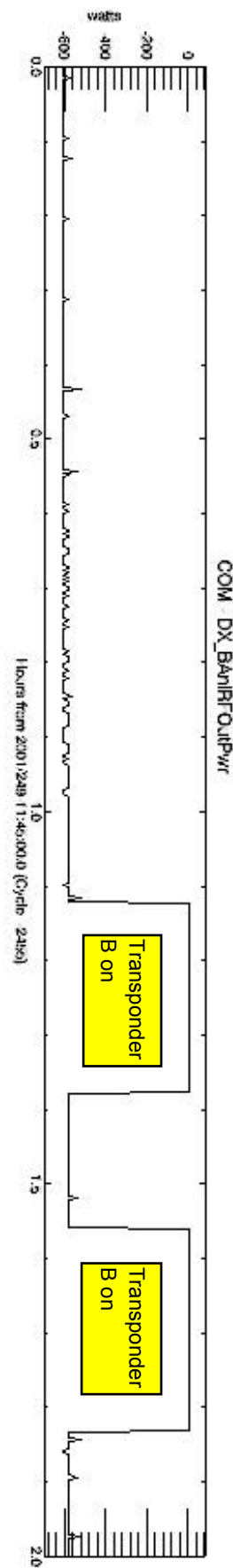
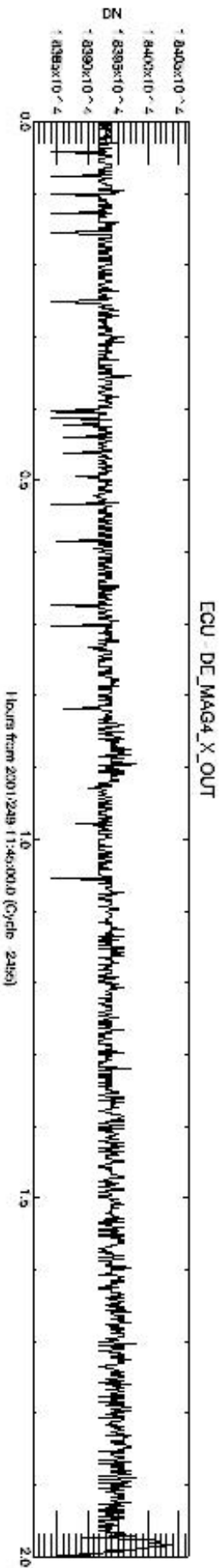
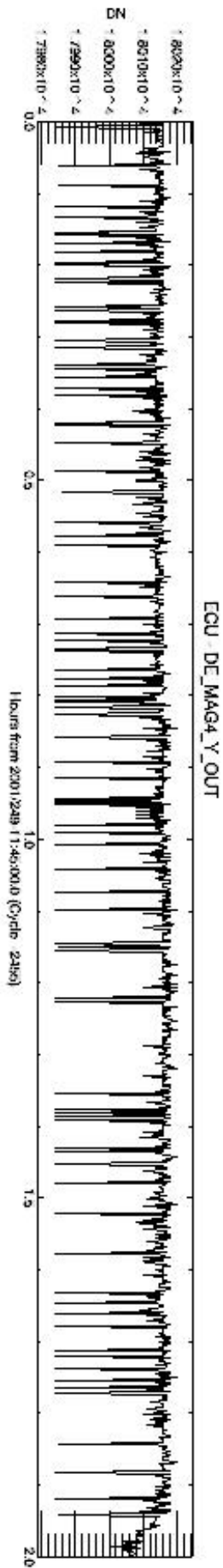
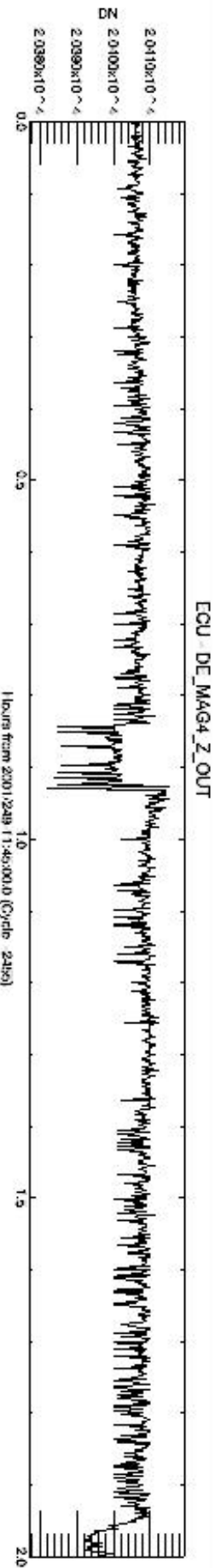


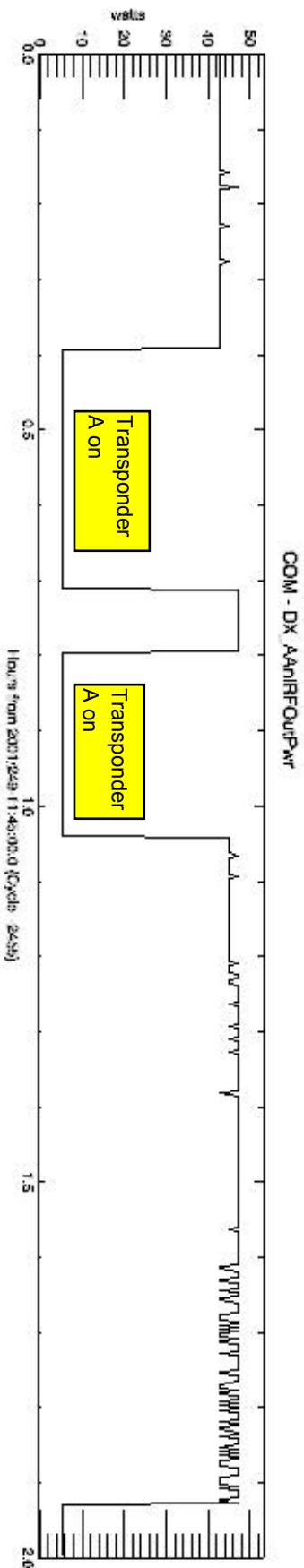
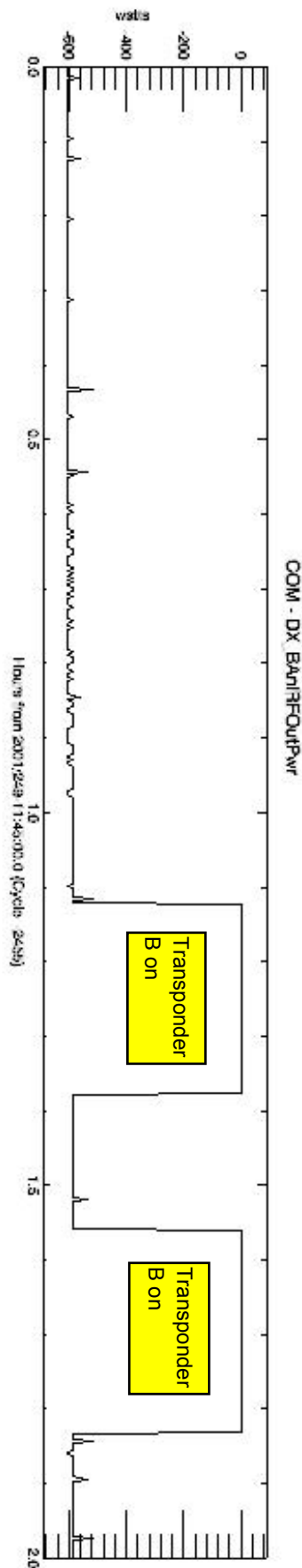
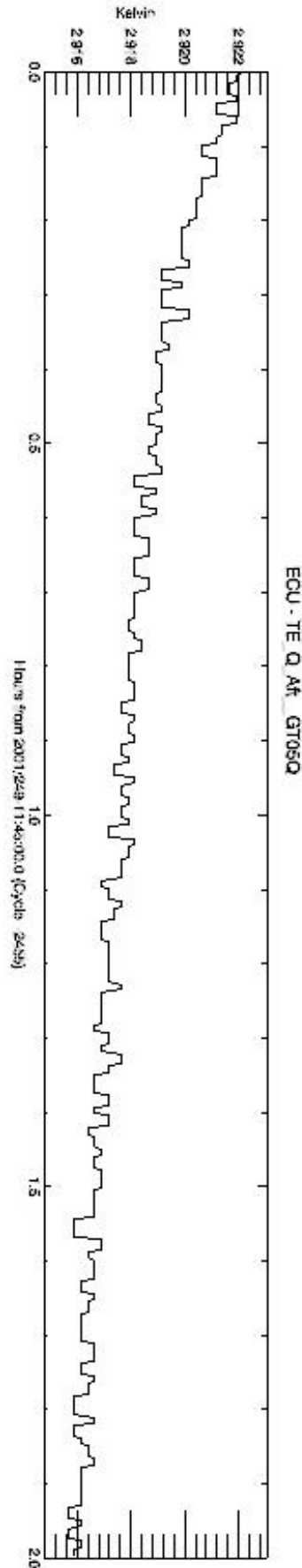
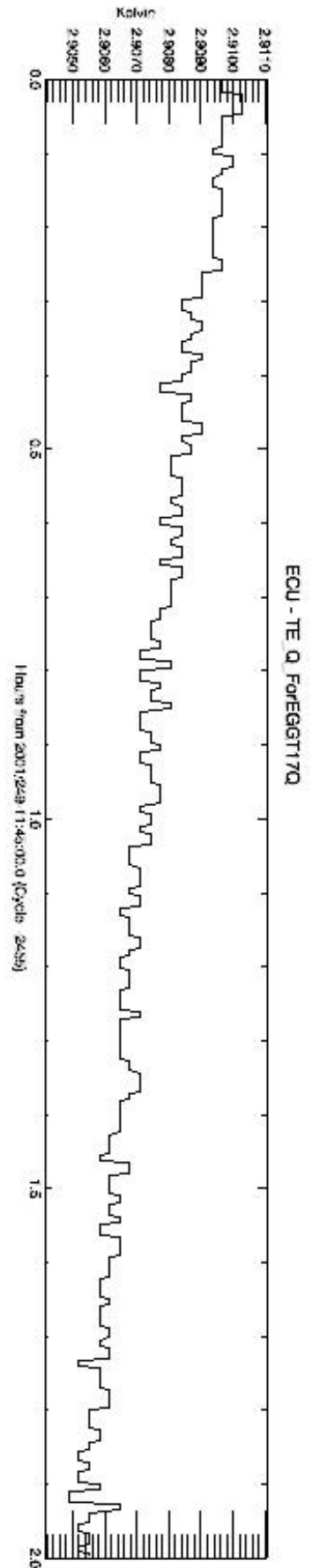


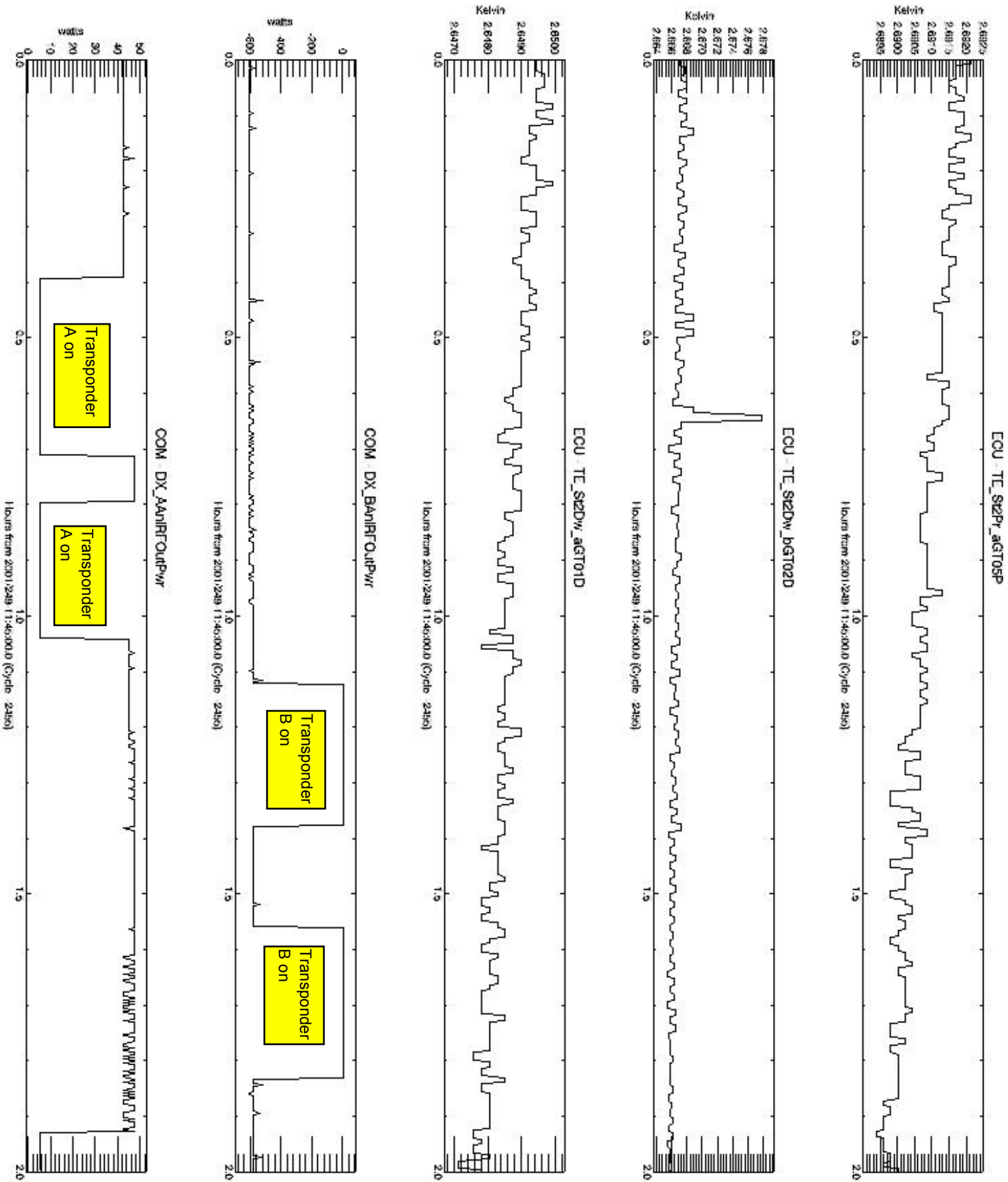


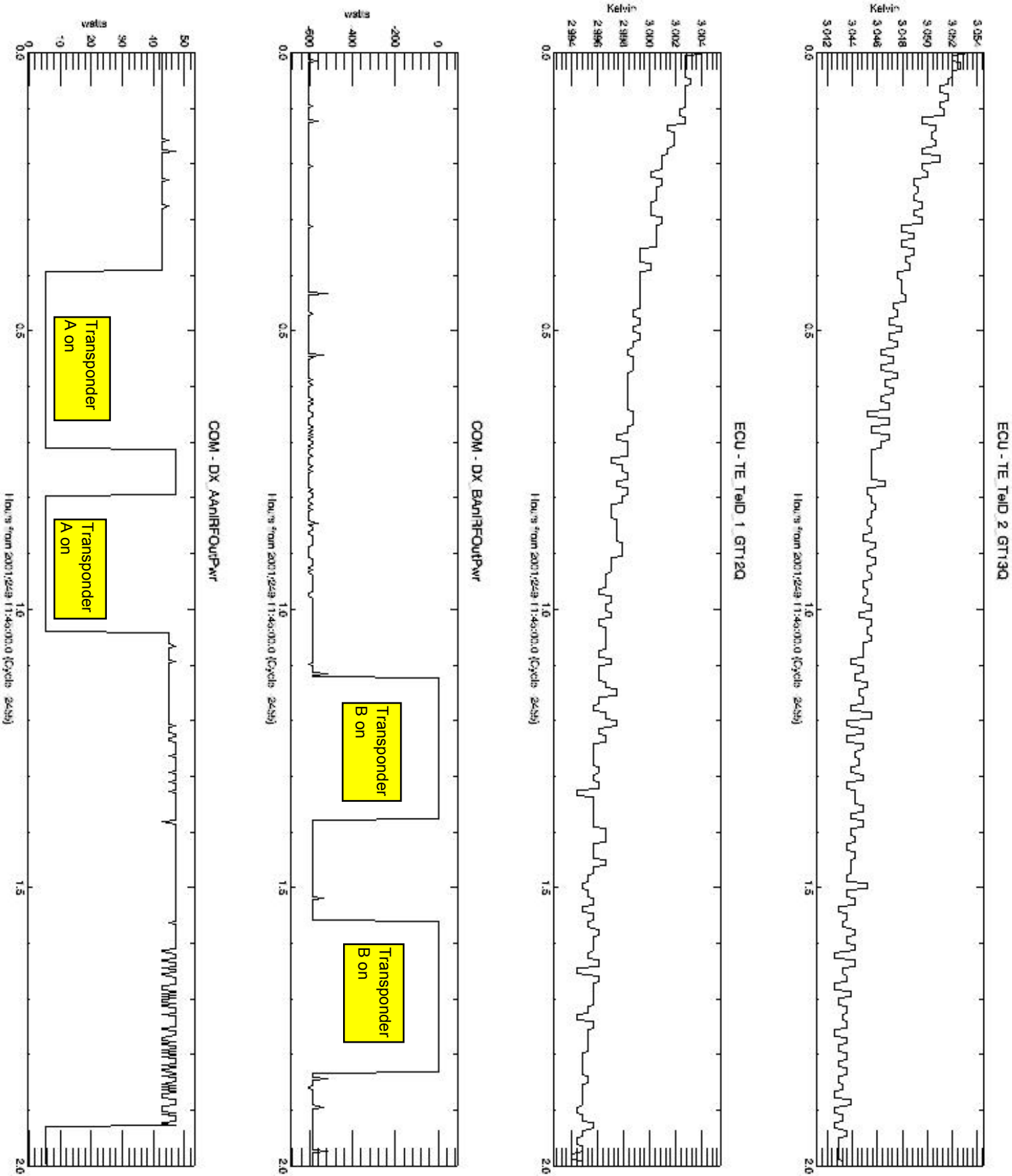


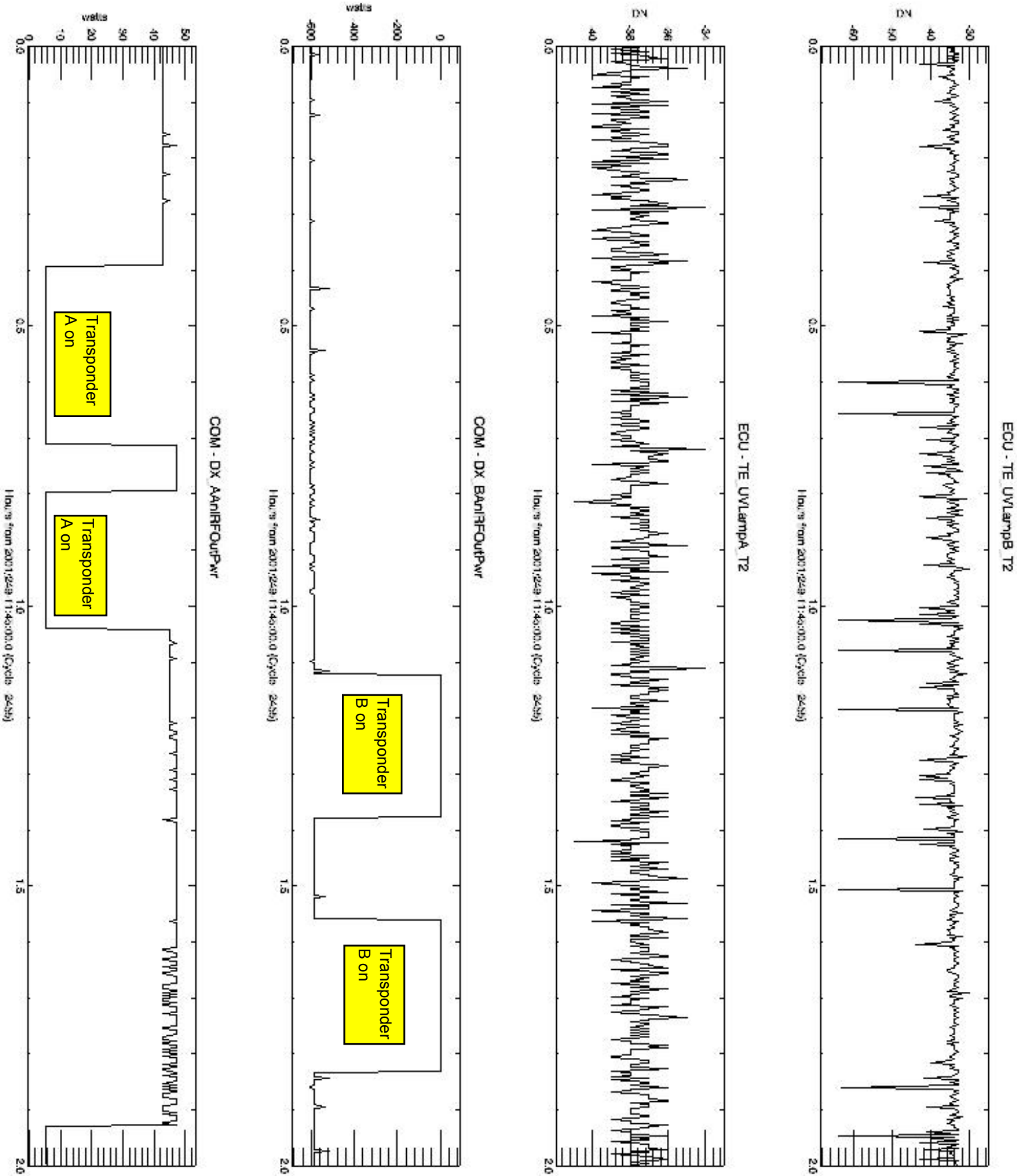


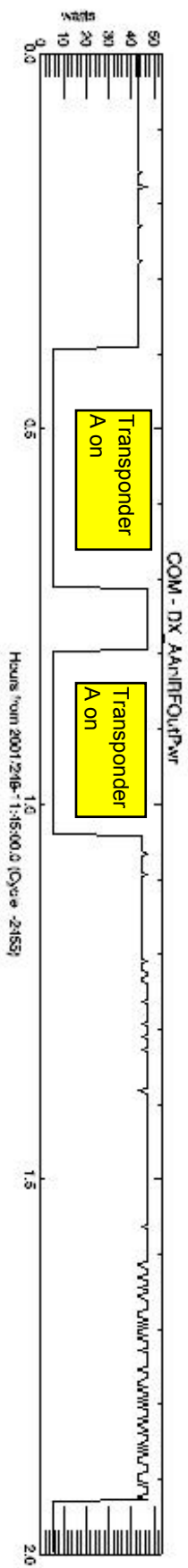
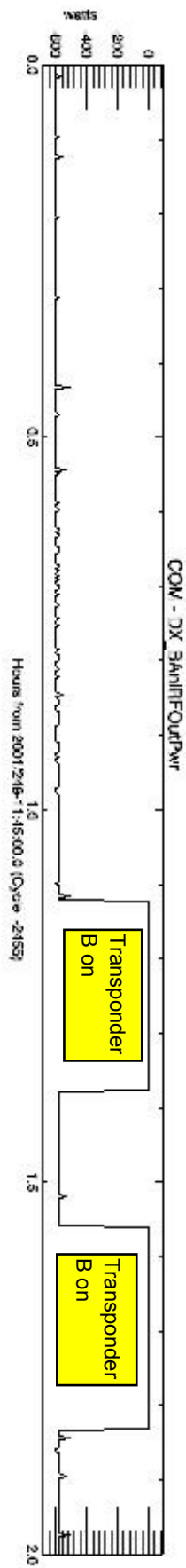
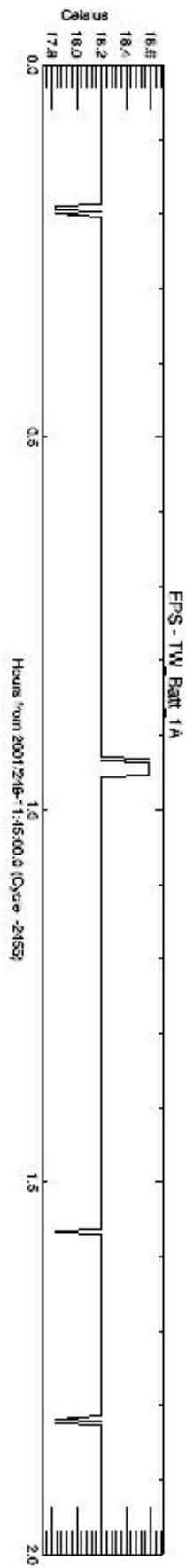
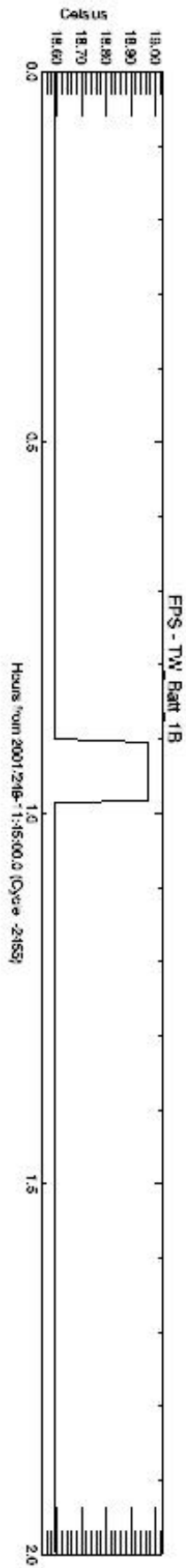
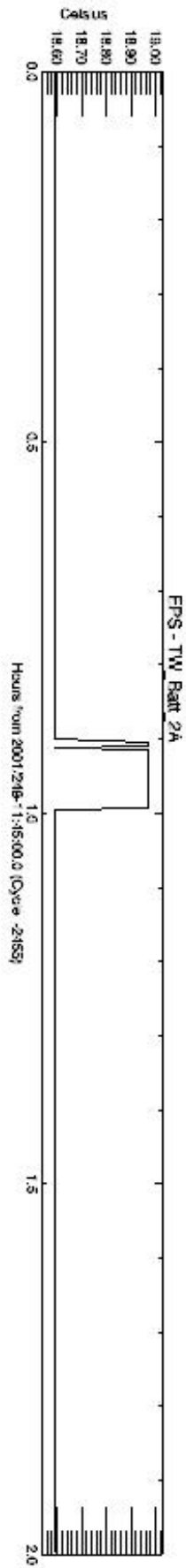




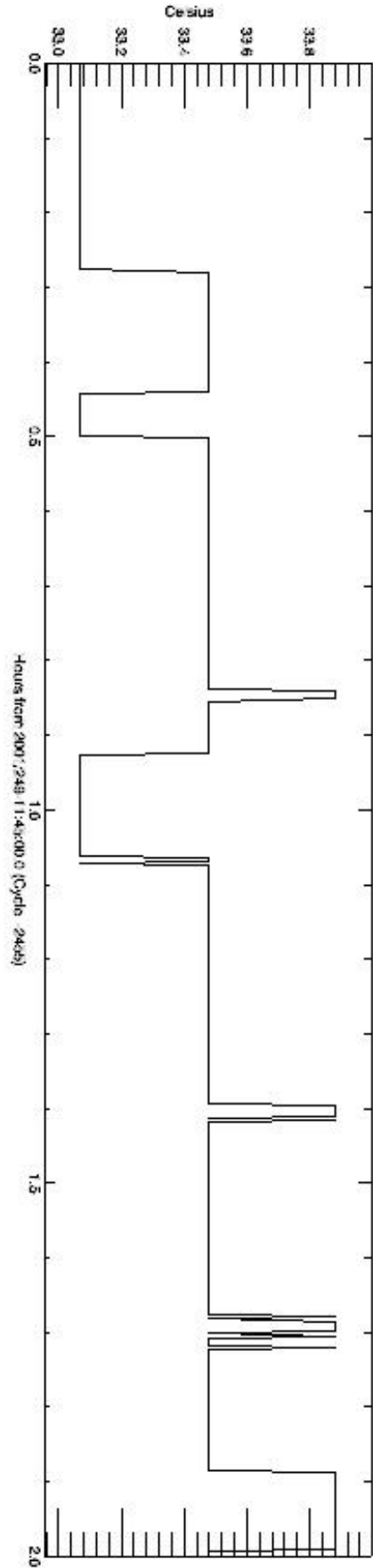




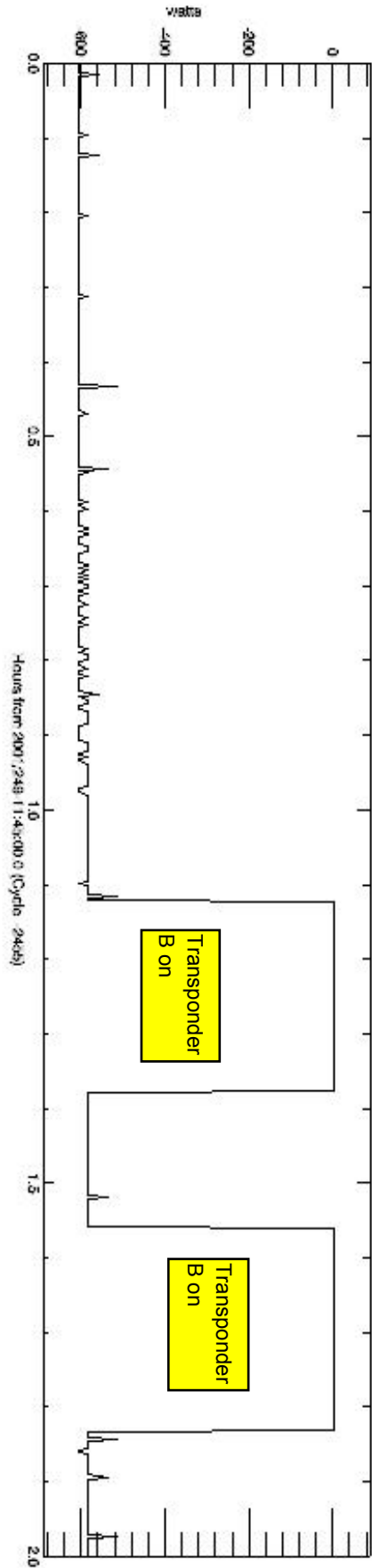




EPS\_TW\_SPRU\_Temp



COV\_DX\_BanIROutPwr



COM\_DX\_AanIROutPwr

