



Golf-TEE and FoxPlusA Telemetry

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Radio Amateur Satellite Corporation



Review: Flight Software Changes Little

Radio Amateur Satellite Corp.

- ❖ **Basic Flight Software Unchanged Since Fox-1a (AO-85, 2015)**
- ❖ **Largest changes came with Fox-1e/RadFxSat2 (AO-109, 2021) and HuskySat (HO-107)**
 - ❖ **Switched from FM repeater to Linear Transponder**
 - ❖ **Switched from 100bps DUV telemetry to 1200bps BPSK**
 - ❖ **Add support for CAN bus**
 - ❖ **Added secure commanding**
- ❖ **Faster telemetry allows whole orbit data (more later/next talk)**

Review: FoxPlus/Golf-TEE BPSK Telemetry

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- **BPSK = Binary Phase Shift Keying**
 - Essentially a sine wave whose phase is shifted
 - Each shift represents a 1 or 0
 - Sits just below the transponder passband



Downlink

Golf-TEE/FoxPlus Frames

Radio Amateur Satellite Corp.

- ❖ **Contains 669 8-bit data bytes**
- ❖ **Each frame starts with header**
 - ❖ **Indicates which satellite**
 - ❖ **Frame Type number**
 - ❖ **Satellite mode and other data**
- ❖ **Each frame ends with FEC check blocks**
- ❖ **Each frame has a CRC**
- ❖ **Each frame is a fixed size**



Frames and Payloads

Radio Amateur Satellite Corp.

- ❖ **Frame is Fixed Length**
 - ❖ Frame transmits in a bit over 5 seconds
 - ❖ Contains 6-ish variable-size sets of data called payloads
 - ❖ Frame type number tells which payloads are within it
- ❖ **Payloads**
 - ❖ Examples: Current health data, min health data, max health data, infrequent or diagnostic data
 - ❖ Whole Orbit Data (more later/next talk)



Payload vs Frame Size

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**Payload Sizes: Header=12,RTHealth=100 (common=64,common2=32,specific=4),
min=80,max=72,WODHealth=104,Diag=148, RadiationRT=60,RadiationWod=68**

```
Frame sizes:
      Payload Only,   Current Filler
Current Size
RT1          604      065 SafeData1  660      009
669
RT2          596      073 SafeData2  648      021
669
AllWOD1      648      021 SafeWOD   604      065
669
AllWOD2      612      057 Diagnostic 660      009
669
AllWOD3      636      033
669
AllFrames = 669
```

FoxPlus/Golf-TEE Frames

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Header <i>Satellite Number</i> <i>Satellite Time</i> <i>Frame Type</i>
Payload 1
Payload 2
Payload 3
Payload 4
Payload 5
FEC Check Blocks
CRC Check

Examples of Payload Within Frames

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1=realtime, 2=min,3=max,4=science,5=WOD,6=Diag

❖ Frame type 0 (All WOD):

❖ Payloads 5 5 5 5 5 5

❖ Frame type 1 (Real Time)

❖ Payloads 1 5 5 5 5 5

❖ Frame type 2 (Min-Max)

❖ Payloads 2 3 5 5 5 6

❖ Frame type 3 (Safe 1)

❖ Payloads 1 2 3 5 5 5

❖ Frame type 4 (Safe 2)

❖ Payloads 5 5 5 5 6

Frame Frequency

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- ❖ **Some frames can be sent less frequently or in different satellite modes**

Normal Health Mode

Realtime
All WOD
Min
Max
All WOD
All WOD

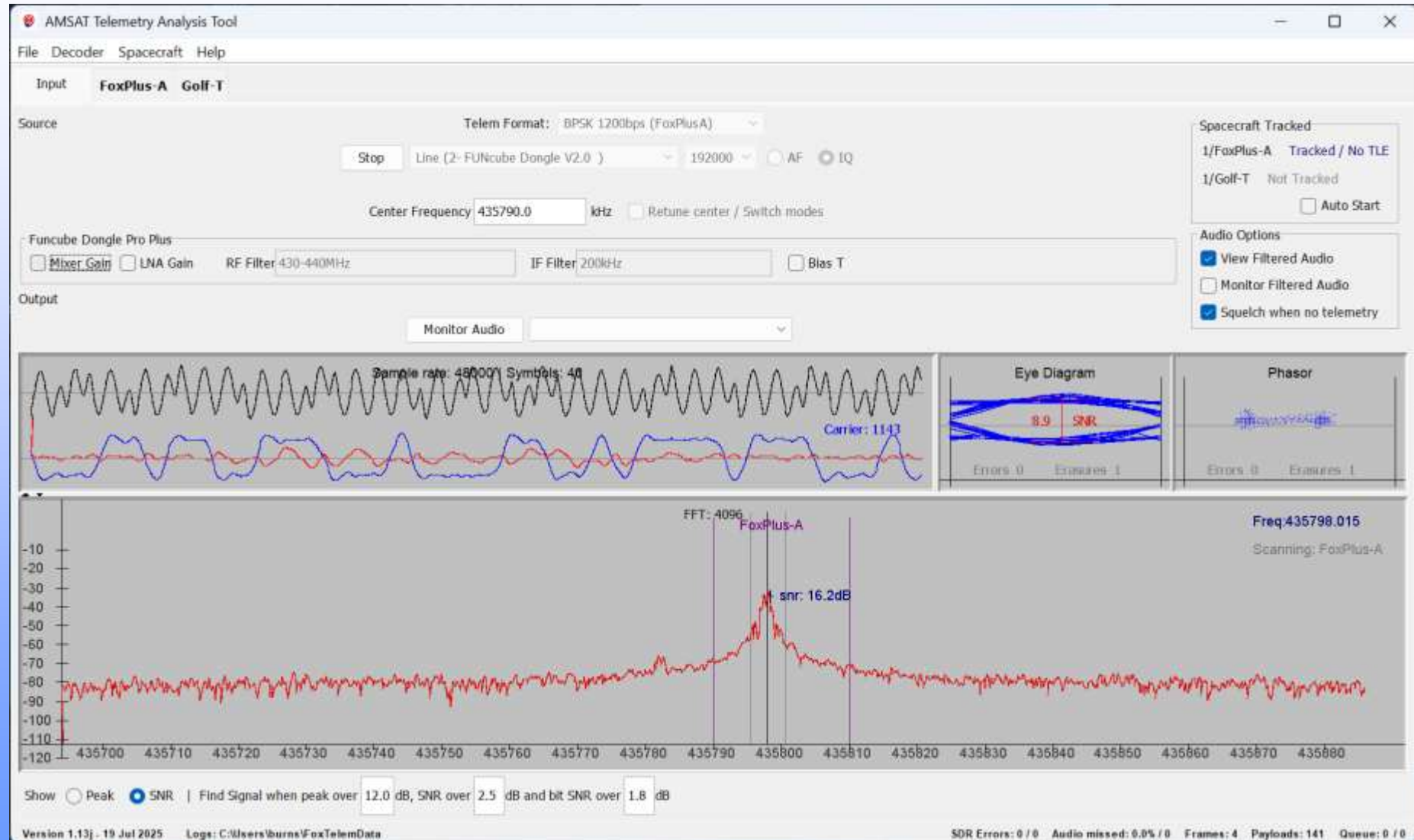
Safe Mode

Safe1
Safe2

FoxTelem Displays

Radio Amateur Satellite Corp.

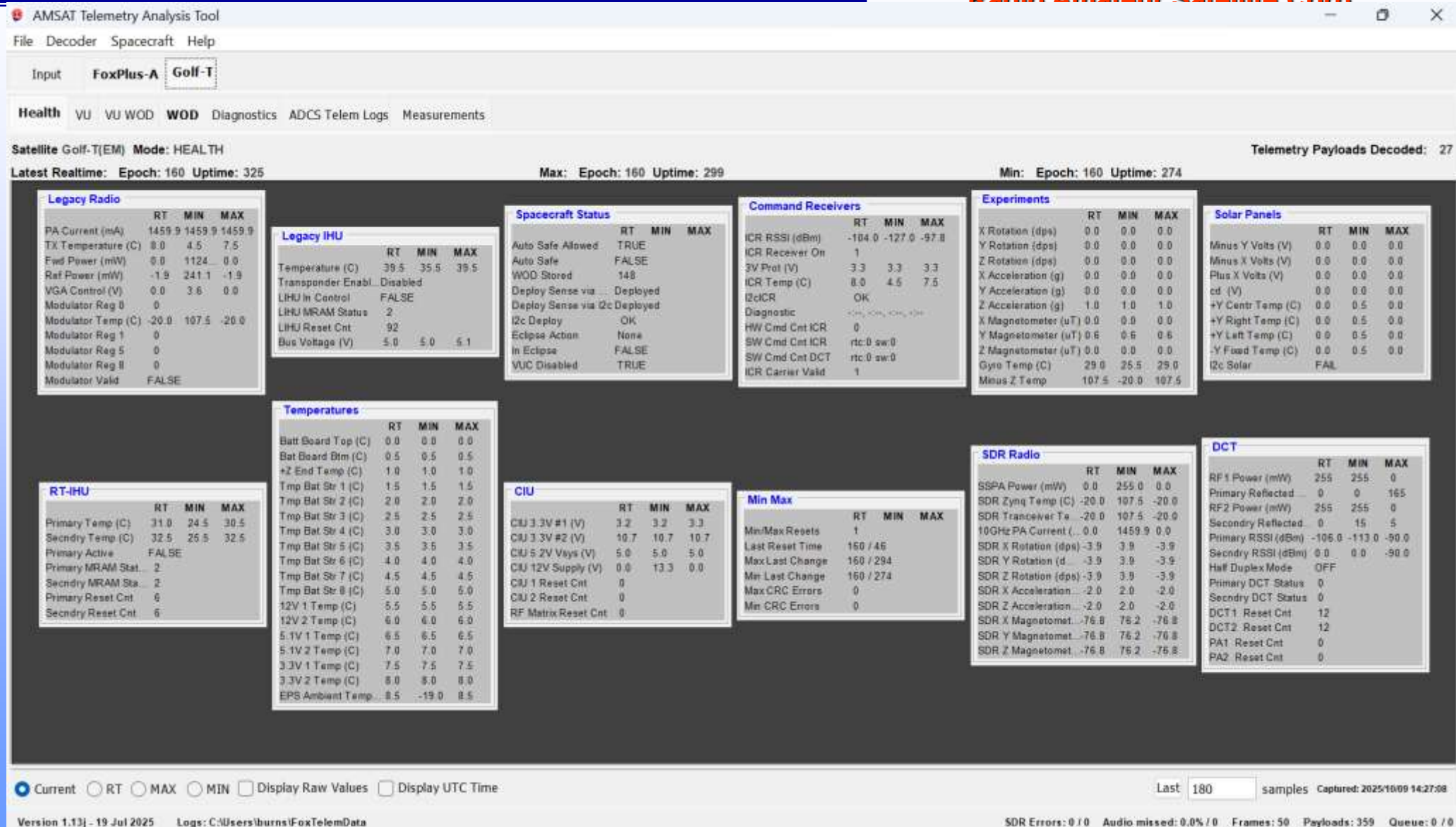
RF Input Screen



FoxTelem Displays

Radio Amateur Satellite Corp

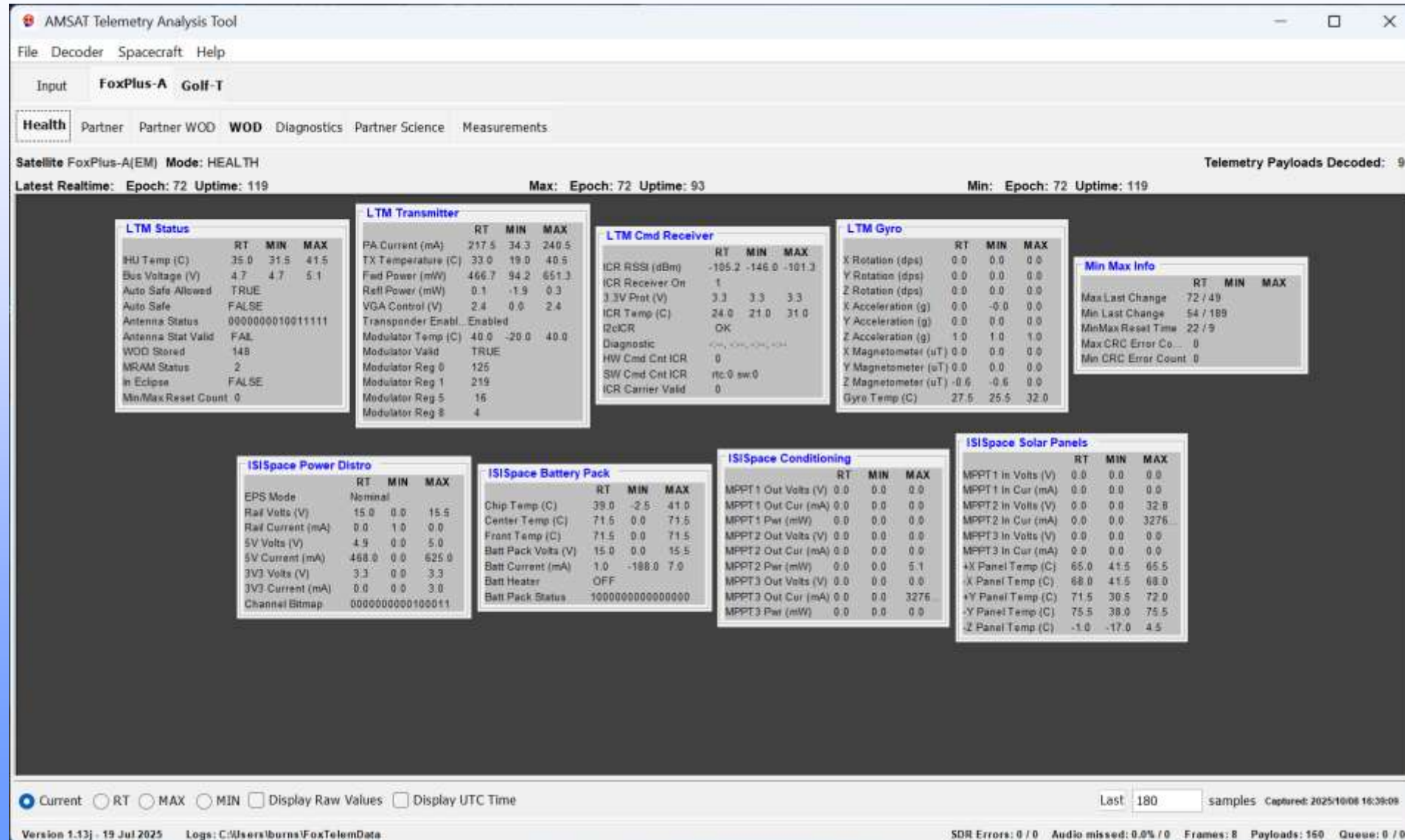
GOLF-TEE Health Display



FoxTelem Displays

Radio Amateur Satellite Corp.

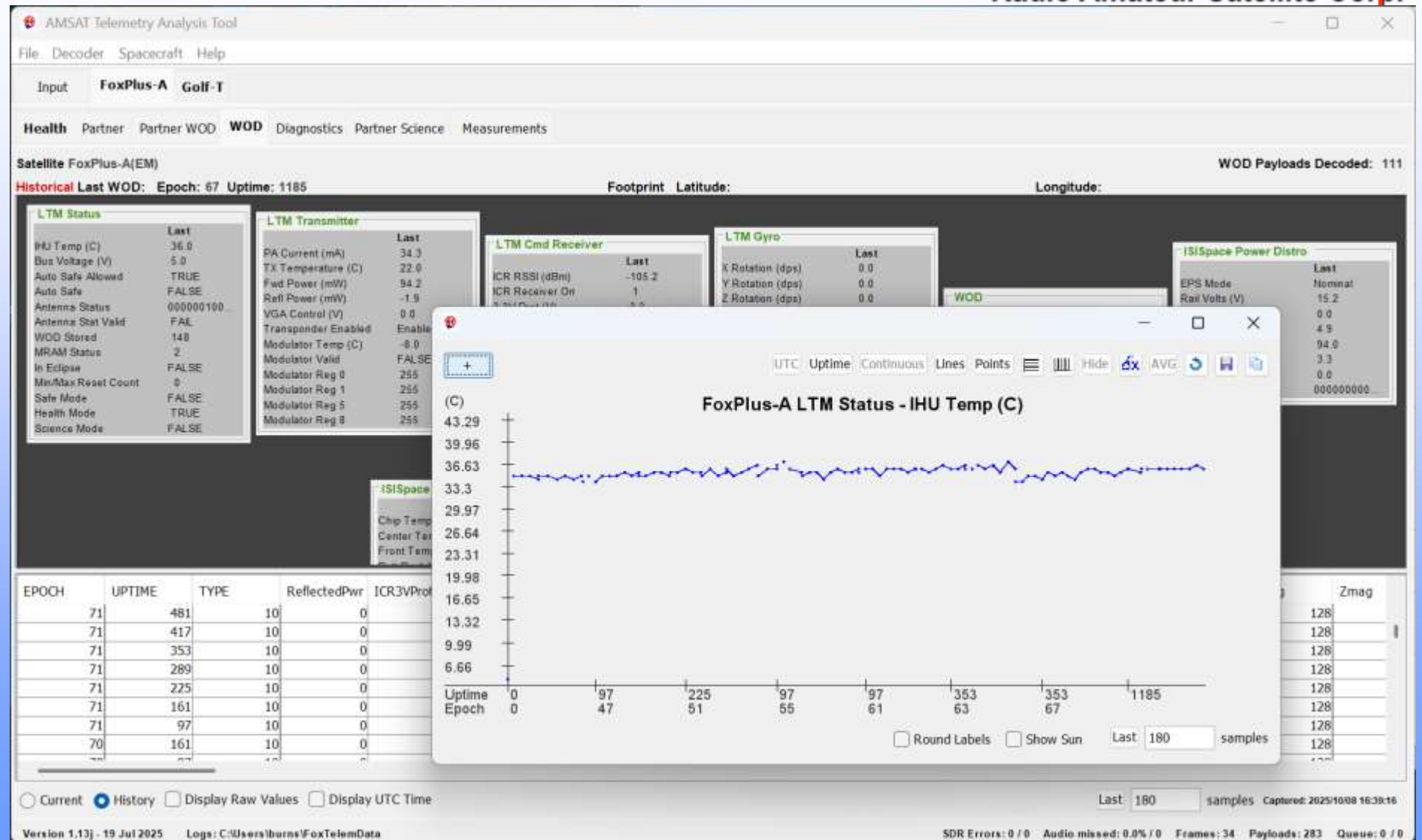
FoxPlus-A Health Display



FoxTelem Displays

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FoxPlus-A WOD Display



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AMSAT Telemetry Tool

File Decoder Spacecraft Help

Input FoxPlus-A Golf-T

Health VU VU WOD WOD Diagnostics ADCS Telem Logs Measurements

Golf-T Experiment: Diagnostics

Payloads Decoded: 3

General Info

	Last
LIHU Data Valid	TRUE
RTMH1 Data Valid	TRUE
RTMH2 Data Valid	TRUE
Time In Epoch (secs)	0
UTCHours	0
UTCMinutes	0
UTCSeconds	0
UTCDay	0
UTCMonth	0
UTCYear	0
UTCValid	FALSE
Secs Since Launch	0
EnterAutosafe	4.0
ExitAutosafe	5.1
LIHU Version Number	0
RTMH1 Version Number	30007
RTMH2 Version Number	30007

JHU Reset Info

	Last
LIHU: WD Tasks OK	0
Cause of Reset	PowerCycle
Error Data	0
Task executing at reset	None/Unknown
Previous task before reset	None/Unknown
Resets in a row that hav...	0
Was this reset still early i...	FALSE
RTMH1: WD Tasks OK	0
Cause of Reset	External Reset
Error Data	0
Task executing at reset	None/Unknown
Previous task before reset	None/Unknown
Resets in a row that hav...	0
Was this reset still early i...	FALSE
RTMH2: Watchdog Task...	0
Cause of Reset	External Reset
Error Data	0
Task executing at reset	None/Unknown
Previous task before reset	None/Unknown
Resets in a row that hav...	0
Was this reset still early i...	FALSE

Legacy Errors

	Last
QC1 Errors	0
QC2 Errors	0
QC1 Resets	2
QC2 Resets	2
SPI Retries	0
MRAM CRC Errors	0
RT1SPRetries	0
MRAM Read Error	0
MRAM Write Error	0
ICRCmdFailCRC	0
ICRCmdFailTime	0
ICRCmdFailAuthenticate	0
ICRCmdFailCommand	0
ICRCmdFailNamespace	0

Primary RT Errors

	Last
Primary SRAM Corrected	0
Primary SRAM Correc...	0
Primary Flash Corrected	0
Primary Flash Correc...	0
DCT1CmdFailCRC	0
DCT1CmdFailTime	0
DCT1CmdFailAuthenticate	0
DCT1CmdFailCommand	0
DCT1CmdFailNamespace	0
RT1QC1Error	0
RT1QC2Error	0
RT1QC1Reset	0
RT1QC2Reset	0
RT1QC1 Retry Count	0
RT1QC2 Retry Count	0
RT1SPRetries	0
RT1MRAM CRC Fail co...	0
RT1MRAM Read Error C...	0
RT1MRAM Write Error C...	0
RT1FlashCorrectable Co...	0
RT1Ram Even Bank Cor...	0
RT1Ram Odd Bank Cor...	0
RT1PLLStp	0
RT1ClockMonitorFail	0
RT1VMRamParity	0
RT1CAN1RamParity	0
RT1CAN2RamParity	0
RT1DCC1Error	0
RT1DCC2Error	0
RT1NDHET2RamParity	0
RT1IOMMAccv...	0
Non-fatal error count	0

Secondary RT Errors

	Last
Secondary SRAM Correc...	0
Secondary SRAM Correc...	0
Secondary Flash Corrected	0
Secondary Flash Correc...	0
DCT2CmdFailCRC	0
DCT2CmdFailTime	0
DCT2CmdFailAuthenticate	0
DCT2CmdFailCommand	0
DCT2CmdFailNamespace	0
RT2QC1Error	0
RT2QC2Error	0
RT2QC1Reset	0
RT2QC2Reset	0
RT2QC1 Retry Count	0
RT2QC2 Retry Count	0
RT2SPRetries	0
RT2MRAMCRC	0
RT2MRAM Read Error C...	0
RT2MRAM Write Error C...	0
RT2FlashCorrectable Co...	0
RT2Ram Even Bank Cor...	0
RT2Ram Odd Bank Cor...	0
RT2PLLStp	0
RT2ClockMonitorFail	0
RT2VMRamParity	0
RT2CAN1RamParity	0
RT2CAN2RamParity	0
RT2DCC1Error	0
RT2DCC2Error	0
RT2NDHET2RamParity	0
RT2IOMMAccv...	0
Non-fatal error count	0

EPOCH UPTI... missionUptime secsInEpoch UTCValid UTCYear UTCMonth UTCDay UTCSeconds UTCMinutes UTCHours EnterAutosafe ExitAutosafe pad266 LegFiller1 LegValid LegWasStillEarlyInBo

☐ Show Raw Bytes ☐ Display Raw Values ☐ Display UTC Time

Version 1.13j - 19 Jul 2025 Logs: C:\Users\burns\FoxTelemData

SDR Errors: 0 / 0 Audio missed: 0.0% / 0 Frames: 0 Payloads: 369 Queue: 0

Last 180 samples

Thanks for listening!



AO-91 Launch