latest version of this document, https://docs.google.com/document/d/1CX4qpPEJk3kTOv5EntLFR_ThwAURezeROti3s7yNzug

SYSTEM DESCRIPTION

PLATFORM

* mass 400g, size 50x50x85 mm
* standard PocketQube 1P5
* 4 solar panels, 750mWpeak per panel, 500Mw average orbit power
* 4Wh energy accumulator
* passive orientation control, based on a permanent magnet

ORBIT

* h=500km, i=97º
* LTAN=6,12,18H typical
* LTAN=12h (47 minutes sun, 47 minutes eclipse) in GENESIS-V **object 58567**

SERVICE

* voice transponder, switchable between 25 and 250mW
* telemetry, switchable between 25 and 250mW
* cw beacon, 250mW/20wpm
* frequencies
  input: 145.925 kHz, output: 436.666 kHz, or
  input: 145.875 kHz, output: 436.888 kHz

ARCHITECTURE

* Antenna
  dipole for VHF-RX 2.2dB and monopole for UHF-TX 4dB
  linear polarization: linear
  orientation: follows to the Earth's magnetic field
* Receiving chain
  superhetereodyne with 12kHz IF at 45MHz and 455kHz
  digital signal processor decodes FSK commands and manages the squelch
* Transponder does not add/remove emphasis.
* Transmission chain
  Modulated 13M65 crystal oscillator with a varactor and
  PLL multiplying the frequency by 32 and
  25mW/250mW class C amplifier

GROUND SEGMENT OPERATION

DO NOT CALL IF NO SIGNALS ARE RECEIVED IN THE SATELLITE DOWNLINK CHANNEL
TX and RX antenna footprints could not be equal.

RECOMMENDED STATION

For a comfortable and reliable operation..

* use separate transmitter and receiver
* VHF TX yagi 3 elements 5W
* UHF RX yagi 7 elements
* Use SDR receiver with narrow IF (10kHz) and audio (2700Hz) filters
* use full duplex ground station configuration:
  you can hear your own transmissions
* Use SDR receiver to monitor if your transmissions are
  centered on frequency by observing the transponder output spectrum

PROCEDURE IN MANUAL OPERATION

* find a maximum changing the polarization of the receiver's antenna
* without touching the receiver's antenna
* start transmissions and listen your own signal in the satellite
* find a maximum changing the polarization of the transmitter's antenna
* repeat often when the satellite arrives at bigger elevations

MODULATIONS

* **NFM/AnalogVoice**
* Operator-to-Operator digital modes are also encouraged all Fridays

    * USB/DigitalVoice **FREEDV-2400A** (4FSK 1300bps 6kHz)
    * USB/DigitalVoice **FREEDV-800XA** (4FSK 700bps 2kHz)
    * **USB/MSK144** T/R=5s SH=YES (use abbreviations, five seconds transmissions)
    * USB/SSTV-ROBOT8-slow-video
    * USB/FSK-RTTY-45bps-170Hz
    * USB/FSK-AX25-1200bps-bell202 packet-radio

* Transponder accepts constant amplitude (angular) modulations
* Transmitting VOICE in Single-Side Band does not work

NOTES ON FREQUENCY DEVIATION

* Modern FM transceivers have adjustable WIDE/NARROW frequency deviation
* Satellite frequency deviation output is proportional to the input
  if TX enters with dF=2.5khz, exits with dF=2.5kHz, occupying 11kHz of bandwidth
  if TX enters with dF=5.0khz, exits with dF=5.0kHz, occupying 16kHz of bandwidth
* a TX with dF=2.5khz produces a lower audible signal in a RX with F=5.0khz
* wide deviation dF=5kHz is recommended because matches with the satellite IFBW

SQUELCH

* the satellite does NOT have subtones
* squelch it is activated by noise silencing
* activate the satellite through a two second transmission with no voice
* It is important to be centered on the frequency to activate the squelch
* squelch level is set to 75 (variable in a range of 75-100)

To activate the SQUELCH, we use this procedure:

* every 30 or 180 seconds, not aligned with UTC clock
* there are a telemetry transmission
* in the spaces between, the satellite is "available"
* a transmission from a ground station silences the receiver
* then transponder is activated until the end of the current minute
* when minute finishes, the cycle starts again

TELEMETRIES

The description of the telemetries waveforms and decoding software can be found here:

https://www.amsat-ea.org/app/download/13595777/AMSAT+EA+-+HADES-D+Transmissions+description.pdf
https://www.amsat-ea.org/app/download/13648532/HADES-D_telemetry_decoder_Linux_X86_ARM_v1.21.zip
https://www.amsat-ea.org/app/download/13570585/UZ7HO_URESAT_HADES_D_demodulator_decoder_Windows.zip

TEST SIGNALS

If you can transmit 4kHz and/or 24kHz wide signals and record IQ signals, we have prepared a test recordings to check the performance of the satellite in a variety of operation conditions. Send your IQ recordings to genesis@amsat-ea.org

https://drive.google.com/drive/folders/1hrgYBwGD-hkaVs9rCYe6-TrDLe2xf_nr

SATNOGS DATABASE

Collection of telemetry frames and their storage in the SATNOGS database allows to observe the evolution of the satellite health on the dashboard.
WINDOWS: Use a combination of SoundModem from UZ7HO, GetKissPlus from DK3WN, to demodulate-and-decode and Pedro EA4HCF database tools.
LINUX: Use EA4GPZ GR_SATELLITE application to perform the tasks of decoding and uploading frames to the database.