Ground Station Kit

Ground Station Kit Datasheet

ISIS-GSKIT-DSH-0001, version 1.1draft

Building Block for your Space Mission

Applications

The ISISPACE small Ground Station kit (GSkit) is a low cost, turnkey solution, designed to communicate with satellites in Low Earth Orbit (LEO) in VHF, UHF and S-band, in either Amateur or commercial frequency bands. The GSkit consists of an antenna and a 19" rack which houses the transceiver, rotor control and computer which make the system very compact and allows the ground station to fit in almost any location. The transceiver makes use of a software defined radio (SDR), providing flexibility to swiftly reconfigure modulation/coding/data-rate on the run, with most of the commonly used modulation schemes and coding methods are already implemented. Our GSkit has to possibility to configure and control the ground station remotely through the internet, and allows for autonomous tracking with scheduler.

Product Features

Instrumentation Rack containing:

- SDR based ISISPACE VHF/UHF transceiver and S-band receiver (in case of complete station)
- Software compatible to be used as Data Distribution Center (DDC) in ground station networks.
- Rotator Controller housed in a 19" industrial standard rack

Steerable Antenna System:

- Azimuth and elevation rotators with speed up to 6°/sec.
- Hot-dip galvanized steel mounting mast
- UHF and VHF Yagi antennas (Amateur/commercial bands)
- Weatherized rotors
- Lightning protection system
- 20m of cable between 19"rack and antenna

Standard Software

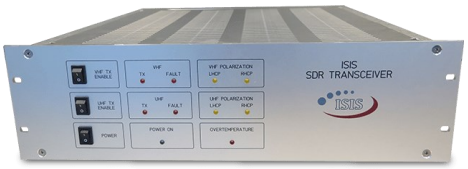
- Satellite tracking software pre-installed
- Autonomous tracking with scheduler
- Debian/GNU LINUX operating system pre-installed
- GUI to configure the SDR transceivers.
- LGS (Local Ground Station) software, including control interface to control the rotor

Heritage & Quality Assurance

- Already delivered more then 50 Groundstaions in different combinations
- Supporting CubeSat missions and platforms since 2014
- Compatible with a large range of operational temperatures: -10 to +50 ºC

Optional Features & Services

- High Data rate S-band receiver
- Stand-alone VHF/UHF Transceiver and ISISPACE S-band receiver
- Onsite installation
- Onsite training of personnel or students
- Onsite servicing and maintenance



Ordering information

Please contact sales@isispace.nl for ordering information

Specification

Parameter			VHF	UHF	S-Band	S-band (high rate)
Radio Characteristics						
Frequency Range	TX	Amateur	145.8 – 146 MHz	435 – 438 MHz	-	
		Commercial	148 – 149.9 MHz	-	-	
	RX	Amateur	144 – 146 MHz	435 – 438 MHz	2400 – 2450 MHz	
		Commercial	-	400.15 – 402 MHz	2200 – 2290 MHz	
Frequency Stability (at 25°C)			±2 ppm	±2 ppm	±0.02 ppm	±0.01 ppm
Modulation scheme	TX		AFSK @ 1.2 kbps FSK-G3RUH @ 2.4, 4.8, 9.6 kbps		-	
	RX		AFSK @ 1.2 kbps BPSK(-G3RUH) @ 1.2, 2.4, 4.8, 9.6 kbps FSK @ 1.2, 2.4, 4.8 kbps FSK-G3RUH @ 2.4, 4.8, 9.6 kbps		BPSK, AFSK, BPSK-G3RUH, FSK-G3RUH, FSK	BPSK, OQPSK
Data rate	TX		1.2 - 9.6 kbps		-	-
	RX		1.2 - 9.6 kbps		9.6, 14.4, 28.8, 57.6, 115.2 kbps	625 – 5000 ksymbols/s
Output Power			Switchable 40 dBm and 50dBm		-	-
External Ref. Input (Optional)			10 MHz		10MHz	-
Data link layer protocol			AX.25		AX.25	CCSDS
Data interfaces			IQ data output, Raw bytes output, KISS input & output, Binary input & output		IQ data output, Raw bytes output, KISS output, Binary output	Binary output
Rotor characteristics						
Rotational Range	Azimuth		360 deg			
	Elevation		180 deg			
Rotational Speed			0 – 6 deg/s			
Rotor Pointing Accuracy			≤ 0.2 deg			
Antenna Characteristics						
Antenna Gain	Amateur		12.3 dBic	15.5 dBic	31.4 dBic	
	Commercial		11.5 dBic	15.0 dBic	31.4 dBic	
Front-to-Back Ratio	Amateur		20 dB	18 dB	-	
	Commercial		20 dB	20 dB	-	

Parameter		VHF	UHF	S-Band	S-band (high rate)
Beamwidth	Amateur	52 deg	30 deg	5.1 deg	
	Commercial	53 deg	35 deg	5.1 deg	
Polarization		Switchable LHCP and RHCP		Fixed RHCP or LHCP	
RF Characteristics					
Overall System Noise Figure (typical)[1]	Amateur	2.2 dB	2.6 dB		
	Commercial	-	3.3 dB		
Receive G/T (at 45° elevation)	Amateur	-16.8 dB/K[2]			
	Commercial	-15.5 dB/K[3]			
Receive G/T (at 30° elevation)	Amateur		-12.7 dB/K[2]		
	Commercial		-10.2 dB/K[3]		
Receive G/T (at 5° elevation)				7.5 dB/K [4]	
Receiver Noise Figure		1.6 dBi	2.0 dBi	0.9 dBI	

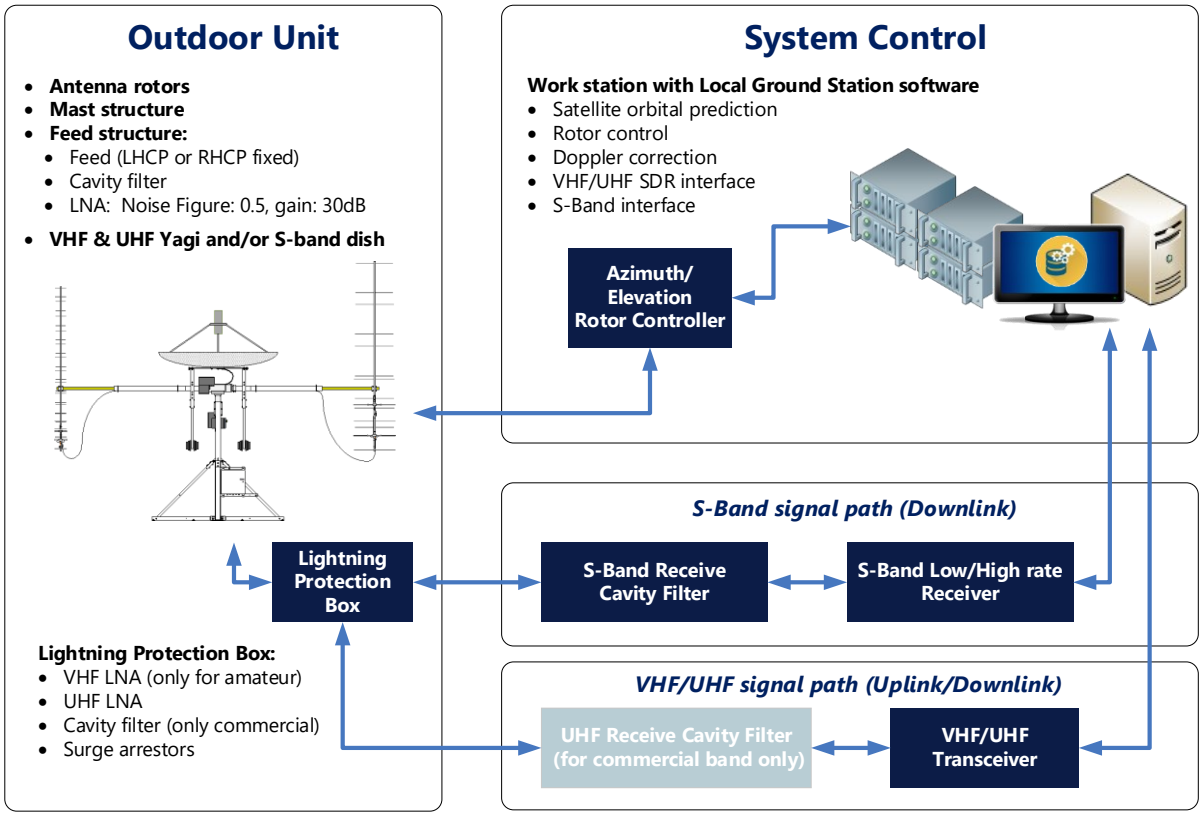
1) As measured relative to the RF connection plane between antenna and Lightning Protection Box (LPB); 20 m RF cable between LPB and indoor rack unit.

2) Residential Environment per ITU-R P.372-14 Chapter 6.

3) City Environment per ITU-R P.372-14 Chapter 6.

4) Based on a median background noise factor Fam = 2.2 below 0° elevation

Ground Station Architecture



Mechanical/Environmental Specifications

Parameter		VHF/UHF	S-Band	VHF/UHF/S-band
Outdoor System				
Height (from ground to cross-boom)		2.3 m	2.3 m	2.3 m
Dynamic Envelope (Clearance)	Diameter	6.2 m	3.5 m	6.3 m
	Height	4.4 m	4.0	4.0 m
Weight		208 kg	230 kg	247 kg
Operating Temperature		-10 °C to 50 °C		
Lightning Protection		< 10kA		
Survival Wind Speed		120 km/h		
Indoor System				
Size (w x h x d)		9U 19" rack: 56x46x80 cm 6U 19" rack: 56x32x80 cm (for S-band only sytems)		
Weight		< 46 kg		
Operating Temperature		10 °C to 35°C		
Humidity		95%, non-condensing		
Supply Voltage		100 to 240 VAC, 50 to 60 Hz		
Supply Current		max 3.5 A @220V, max 7.0 A @110V		

Dynamic envelope

The dynamic envelope defines the mechanical clearance area required for free movement of our antennas, as shown below for our VHF/UHF/S-band antenna, as an example. The values for the VHF/UHF and S-band antenna are provided in the previous table. On the right, the footprint of our antennas is shown.

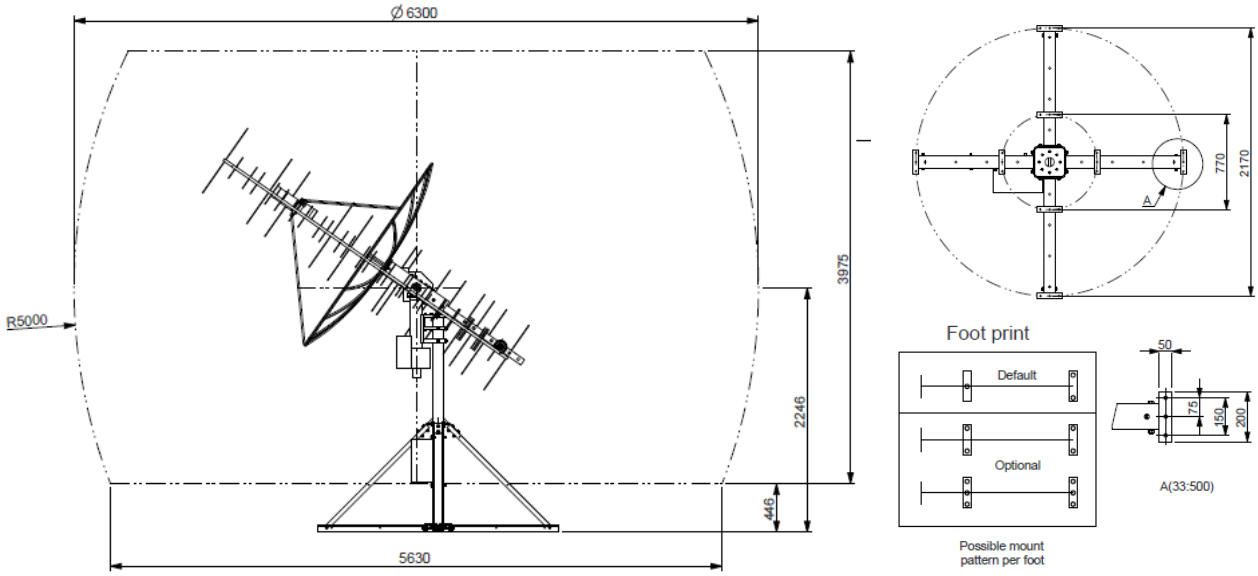


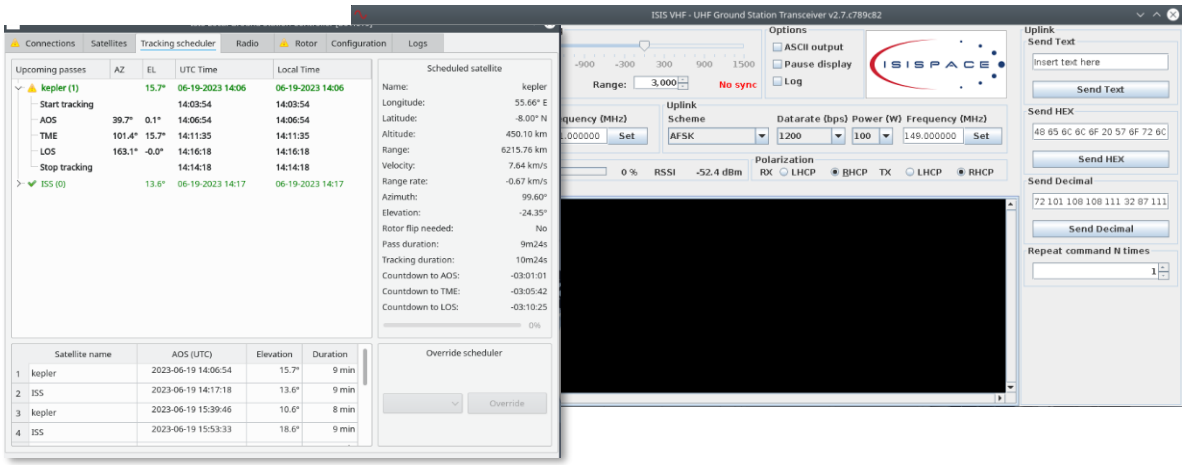
Figure 1 -Dynamic Envelope & Footprint

Software

Each ground station includes the ISISPACE GSkit software to operate the hardware and to handle the following:

- Automatic tracking information download from internet
  - Supports TLEs and OMMs
  - Configurable addresses and formats
  - Supports manual TLE and OMM input
- Automatic rotor control based on tracking information
- Automatic radio control including correction for Doppler effect, based on tracking information
- TCP interfaces that output the decoded binary packets received via VHF/UHF or S-Band
- TCP interface that receives the individual to-be-uplinked binary packets, which are then automatically modulated and transmitted.
- TCP interface that outputs updated satellite tracking schedule
- External reference input switch

Additionally, the VHF/UHF Transceiver and S-band Receiver include a network interface that can be operated remotely to control the radio. The control interface can report the radio system capabilities (supported frequencies, modulations and datarates) and its current settings (frequency, modulation, data rate, RX gain, polarization, and doppler compensation), and can receive changes to its settings, separately for uplink and downlink channels.



User Interface: Tracking Scheduler & VHF/UHF Transceiver (example)

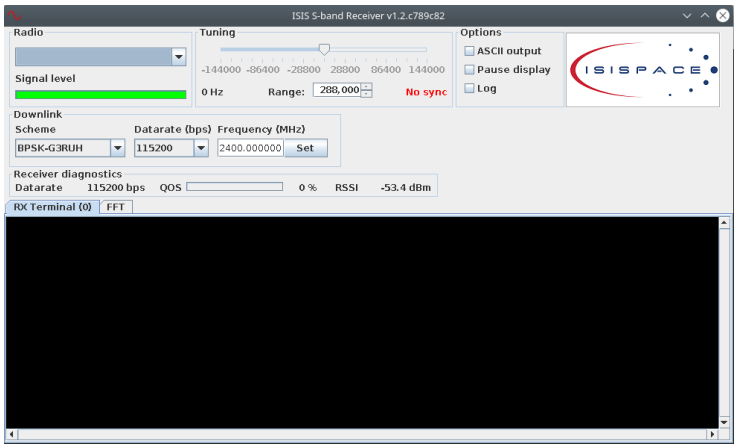


Figure 2 -User Interface: S-band Receiver (example)

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