8

Ham radio image operations

SSTV and radiofax broadcasting has their own rules, as well as other communication modes. If you already have a station equipped with some SSTV device and you are familiar with your SSTV software and have TRX interfaced with computer, you can start your image operations.

The ideal beginning is to ask experienced operator for a first test QSO. During this first QSO you or your partner can reveal some problems like bad settings of synchronization rates or noise affecting your computer signal or another problem you cannot reveal yourself. You can also contact your local SSTV party for help.

International Amateur Radio Union (IARU) recommends usage of amateur bands and recommends specified frequencies for voice, digital and image operations. Latest band plans dates of March 2009. For I.T.U. region I (Europe, Africa and Middle East and Northern Asia) there are recommended frequencies **8.1**in table.

The usage of side band is same like for voice operations, on bands below 10 MHz it is LSB and for above bands it is USB.

Before you start calling CQ make sure that chosen frequency and its neighborhood are free. SSTV operations are recommended in same sections of bands as voice communication and other modes so it is very unpleasant to interference each other. So before you start transmission ask on chosen frequency: “Is this frequency free for SSTV?” and again listen if the frequency is really free. There is unpleasant feature of some bands, e. g. 20 meters (14 MHz), that closer stations we can’t detect, although only a noise sounds from speakers doesn’t mean that no connection is make on the frequency.

There are centre of activities recommended on all bands, so for stations we should look around these frequencies. They are also can be used as calling frequency and after the station calling CQ on the frequency makes contact, the both station should tune to another free frequency (QSY) within the SSB segment.

Frequency	Recommendation
3,735 kHz	center of activity
7,165 kHz	center of activity (previously 7 030 –7 040 kHz)
14,230 kHz	center of activity
21,340 kHz	center of activity
28,680 kHz	center of activity
144,500 kHz	calling frequency for SSTV
432,500 kHz	narrowband SSTV
433,400 kHz	SSTV (FM/AFSK)

Table 8.1: Band plan recommendations for image communication.

Unfortunately, reality does not comply with this, so situation on very crowded band 20 meters is such, that stations are glued to each other around 14,230 kHz, they are interfering each other and weaker long distance stations are noised by undisciplined nearer stations. If you find that there is activity tune to another frequency at least ±3 kHz. Good practice is chose frequency near centra of activity in 3kHz steps, e.g. on 15 meters:

... 21,334 21,337 **21,340** 21,343 21,346 ...

There is great probability to find stations calling CQ or your own CQ will be heard by the other side. You can call CQ by sending the image in the desired SSTV mode. The image must contain code CQ. It is good practice to place CQ test to the bottom of a picture, so a station that tunes to the frequency later finds what is going on. If you call CQ on calling frequencu add code QSY (Change to transmission on another frequency [(or on_ kHz]) and specify frequency where you can continue the QSO.

An answering to CQ call is possible in two ways. The first one is that you answer by sending the image always in the same mode as called station. Of course, listen first that they are not another answering station. Add the call signs, e. g. OK1AAA de OK2BBB and report RSV into your picture. The second method, which is less used, you can contact the station by voice and than send your image.

Beyond that it depends on your choice what style you will prefer when you make the SSTV connection. It is possible to communicate only in SSTV, when all informations are transmitted in pictures or use SSTV as addition for voice operations, when both stations during QSO change few images. First way prefers mainly European stations, but in northern America is preferred second one for making QSOs.

SSTV operation is closely linked with voice operation and although "one picture can say thousand words", it is sometimes more effective to use the microphone for communication. In particular, if we enter into an ongoing QSO or calling party of more stations it is preferred to call firstly by voice before you send an image.

In earlier times operators before sending image said the mode they are use, but now the SSTV software can automatically detect modes during transmission and the announcing mode is obsolete.

Figure 8.1: Sample received SSTV images for your inspiration.

Broadcast images can contain almost everything, do not forget to send your own image or photograph of hamshack, your equipment and QTH. You can also add descriptive texts. It is suitable to get a video digitizer or small webcam and broadcast live images.

I do not recommend send images which may be distorted during transmission like fractals, stereograms and contain a lot of details, which is lost due to analog transmission. Keep in mind that some picture topics might embarrass your QSO partner.

Texts in picture should by written by some nice readable font. Choose a color that has enough contrast with the image background. It is good practice to add contrast edge to letters. Note, that conditions on the opposite side is not always perfect and it should be hard to decipher small letters in noisy image.

8.1 The reporting system

The message about report contains info about – readability, signal strength and picture quality report. The report message is transerred as a three-letter code RSV (Readability, Strength, Video), see **table 8.2**.

Readability – shows quality of signal reception in 5 degrees.

Signal strength – describes strength of received signal in 9 degrees. Tool to determine the strength is measuring instrument called S-meter, which is part of most receivers. Absolute deviation of his pointer is not very good indication, because by the S-meter we can only compare the signal with anothers in current conditions on a band.

Video – the quality of received image you can consider visually in 5 degrees, see **fig. 8.2**. The same method is used in ATV picture quality reporting system.

	R – Readability	S – Sig. strength	V – Video
1	Unreadable	Faint signal, barely perceptible	Barely perceptible
2	Barely readable, occasional words distinguishable	Very weak	Poor
3	Readable with considerable difficulty	Weak	Fair
4	Readable with practically no difficulty	Fair	Good
5	Perfectly readable	Fairly good	Excellent
6		Good	
7		Moderately strong	
8		Strong	
9		Very strong signals	

Table 8.2: Signal reporting with RSV code.

The report can expand information on interference (QRM, QRN) or if the image is slanted add entry `SLANT`. The example report is `RSV 595` when the reception is awesome.

8.2 SSTV not only for hams

The SSTV found application in other sectors in the past, mainly due to commercial production equipment destined for amateurs, and image transfer by phone.

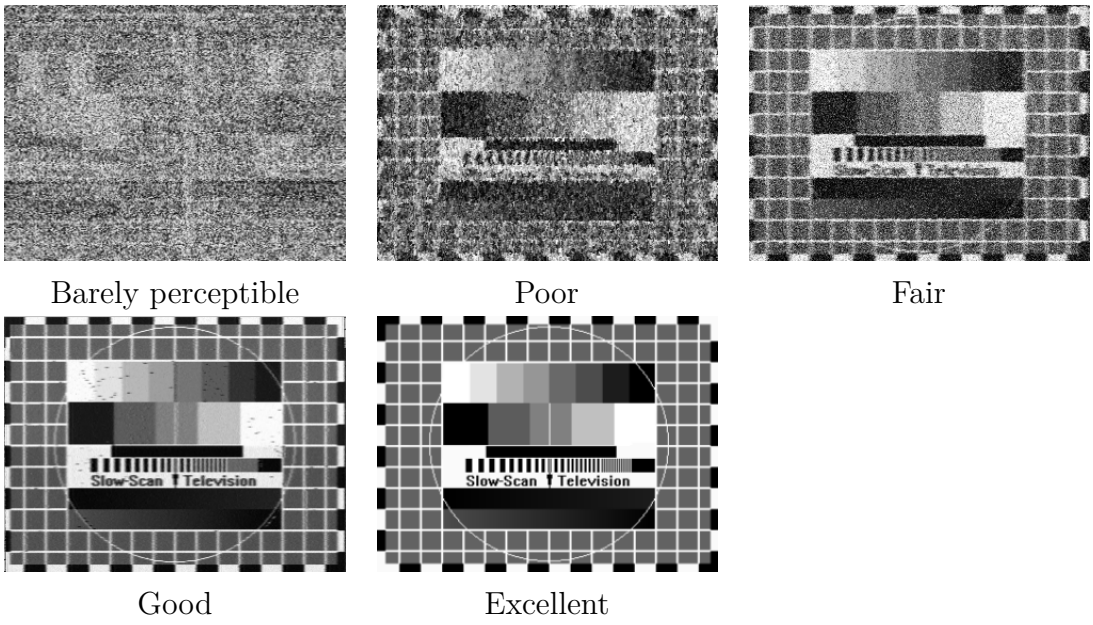

Figure 8.2: Picture quality reporting system.

Perhaps the most notable applications is the use of SSTV to monitor active Volcano [[error 2]]. U.S. Geological Survey installed in September 1987 sensing camera and FM radio transceiver for observation of volcanic activity on Mount St. Helena.

SSTV was used for remote medical applications during eighties, e. g. transfer of radiologic pictures over phone lines and over satellite narrow band communication channels.

Often repeated mistake is that NASA has used the same system as amateurs for the SSTV transmissions from space in Apollo mission and that the first images from the Moon were transmitted in same way as amateur slow-scan TV. An NASA system for video transmission is different, but their engineers also named it *slow-scan TV*, but it transmitted images at rate 10 frames per second with 320 lines. The conversion to a normal television broadcast was made by optical path, the television camera panned SSTV monitor for broadcast to millions of households.

The Amateur SSTV fly to space later, when SSTV images were sent from space shuttle in SAREX missions or from orbital stations Mir and ISS. These broadcasts were received by many hams over the World.

8.3 Diplomas and QSL cards

A tangible confirmation of ham radio contact is a QSL card, although after finished QSO you may have few saved pictures on your hard drive as a memory of the contact. But QSL cards still remains as traditional contact confirmation. Also, list

of confirmed QSOs (those you've obtained QSL cards) must be also accompanied for obtaining a number of ham radio diplomas. So the picture of QSL has not same value as real QSL card.

In addition to diplomas issued directly only for SSTV contacts, the diplomas like WAS, WAC, ADXA, CQ DX Award and many more can be obtained with indication of used communication mode and some additional variants like QRP.

There are few diplomas for exclusive two-way QSO using slow-scan television listed bellow.

8.3.1 IVCA DX Achievement Award DXAA

The award is issued to amateurs and listeners for two-way SSTV contact/reception with 50 countries from DXCC list. Additional stickers are for every more 25 countries.

8.3.2 DANISH DX SSTV AWARD

The award can be obtained by radio amateurs and listeners for confirmed contacts with 50 different ARRL's DXCC countries. A QSL list must contain: call, time , date, band, mode (SSTV) and country and confimed by two licensed amauteurs and signed by applicant. All bands legally used in applicant's country are accepted, but no contacts via repeaters. It is possible to get additional stickers for contacts with 100 countries and 1 OZ station (silver), 150+2 (gold) and 200 (diamant).

The fee for basic award is $8 or €10.

Award manager: *S.K.Mogensen OZ6SM, Rundhøjvej 8, DK 7970 Redsted, Danmark*, email: `oz6sm@nypost.dk`.

`http://www.ddxg.dk/awards/sstvaward.htm`

8.3.3 Russian SSTV Award

This award is sponsored by the CRC of Krenkelya and the Moscow section SSTV to popularize the use of SSTV in Russia and other countries of the CIS. Earn 75 points by contacting Russian and CIS stations on the SSTV mode on or after 1st March 1998. Contacts with members of the Moscow SSTV is valuated by 3 points and one point for contacts with CIS countries or stations not members of the Moscow SSTV 1.

Send GCR list and fee of $5, 10 IRC or equivalent to: *Verigin Dmitriy Andreevich, Lyubertsy, Moscovskaya oblast, Novaya street, 10-48, 140002, Russia*, email: ra3ahq@online.ru

http://olympia.fortunecity.com/bruno/544/award/msstvs/rusaward.html

8.4 Contests

Contest	Date
DARC SSTV Contest	3rd weekend in March
Russian SSTV Contest	2nd Saturday in April
NVCG SSTV Contest	2nd week of July
Danish SSTV Contest	1st weekend in May
DARC HF–FAX–Contest	3rd weekend in August
JASTA SSTV Activity	from 1st to 31st August
Ukrainian SSTV Contest	1st Saturday in December

Table 8.3: none

8.4.1 DARC SSTV Contest

It takes place the 3rd weekend in March, begins at 12:00 UTC on Saturday and ends at 12:00 UTC on Sunday. Competing has categories operator and SWL, on the bands 3.5 to 28 MHz. Transmit RSV and the number of QSOs beginning with 001, each QSO is valued by a point. Multipliers are WAE/DXCC countries, W, VE and JA districts. Logs should be sent within 4 weeks after the contest at: *Werner Ludwig DF5BX, Post Box 1270, D-49110 Georgsmarienshuette, Germany*, email: df5bx@darc.de.

8.4.2 Russian SSTV Contest

Takes place in 2nd Saturday in April from 00:00 MSK to 24:00 MSK (UTC = MSK – 3). Bands: 80, 40, 20, 15, 10, 6, 2 m. There are several categories: A. Multi-operators, all bands; B. One operator, all bands (legal in Russia); C. One operator, all bands; D. One operator, one band; E. listener. A CQ image should contains CQ RUSTEST.

Transmit RSV and the number of QSOs beginning with 001, Russian stations transmit RSV, zone and number of QSOs. Scoring: 6 points for each QSO, plus 2 points for QSO with MsstvS member, additional points for QSO with station from MsstvS scoring list. Final score: total sum of points plus additional points. Send log separately for each band, must include band, date, time in UTC, call sign messages sent and received. Stations with multiple operators must deliver list of names and signatures for all operators. The log send to 24th April. Organizer: *Russian SSTV Contest Manager Krenkel of CRC Russia, P.O. Box 88, Moscow, Russia.*

8.4.3 NVCG SSTV Contest

The contest is organize Nishi Nippon Visual Communication Group and takes up 9 days in July. Score is 2 points for two-way SSTV QSO with NVCG member (they used "M" letter in report, e. g. 595M), and 1 point for another QSO. Only one QSO with same station is counted regardless of band. The multiplier is the total number of different prefixes. Send log to *Susumu Tokuyasu JA6GN, 3-1-6 Jyousei Sawaraku, Fukuoka 814-0003, Japan* or email: `sstv-contest-nvcg@wak.bbiq.jp`.

8.4.4 Danish SSTV Contest

The contest is organized by Danish SSTV Group. Takes place first weekend in May, from Saturday 00:00 UTC to Sunday 24:00 UTC. Bands: 80, 40, 20, 15, 10, 6, 2 m. Score: 2 points for every DXCC country, 1 point for contact and bonus 1 point for contact with Danish station. It is possible to make QSO with same station on different band. The stations on 1st to 5th place will receive certificates. Mail logs to: *Carl Emkjer, Soborghus Park 8, DK 2860 Soborg, Denmark.*

8.4.5 JASTA SSTV Activity

Takes place in August from 1st 00:00 UTC to 31st 24:00 UTC on 3.5MHz band and all upper bands. There are two categories: "J" – Japanese stations; "S" – all stations operating outside of Japan. Exchange the usual RSV and number of QSO starting with 001. Regardless of bands used a station may only be contacted only once each UTC day. The points for QSOs depend on band: 1 point 3.5–28 MHz, 2 points 50–430 MHz and 3 point for 1200 MHz and upper bands. Multipliers are districts JA1 to JA0, DXCC countries and working days (max. 10). Prefixes 7K to 7N are all JA1 districts. Contest manager: *Yoshikazu Tanabe JA3WZT/1, 905-8, Shimotaniganuki, IRUMA, SAITAMA, 358 Japan*, send logs in TXT format to `ja3wzt@mue.biglobe.ne.jp`.

http://homepage3.nifty.com/jasta/

8.4.6 Ukrainian SSTV Contest

Takes place in first Saturday in December, from 12:00 UTC to Sunday 12:00 UTC. Bands: 80, 40, 20, 15 and 10 m. There are contest categories: A. One operator; B. One operator, one band; C. Multiple operators; F. listeners. The CQ picture should contain text CQ UKR Contest. Exchange report RSV and number from 001. Ukrainian stations send two-letter region code too. The score is 1 point for QSO with same country station, 2 points for same continent QSO, 3 points for QSO with other continent, QSO with Ukrainian station is for 10 points. Multipliers are DXCC and WAE countries and Ukrainian district for each band. The score is counted separately for Ukrainian and foreign stations. Logs send in usual form for each band to organizer: *UKR SSTV CONTEST, P. O. Box 10, Kerch, 98300 Ukraine.*

8.5 SSTV repeaters

An SSTV repeater is radio station for relaying of SSTV signals. A typical repeater is equipped with HF or VHF transceiver and computer with sound card. A software must have an option to work as repeater.

SSTV repeaters are used by amateur radio operators for exchanging pictures. If two stations can not copy each other, they can still communicate through a repeater.

To activate repeater send the activation tone of frequency 1750 Hz, when the repeater is activated, it's send –.– (K) in morse code. The station must start sending a picture in approximately 10 seconds. After reception the received image is transmitted on the repeater's operation frequency.

Repeaters should operate in common SSTV modes, but it depends on the software used (MMSSTV, JVComm32, MSCAN). Some repeater are not activated by audio tone, but instead by the SSTV vertical synchronization signal.

Some repeaters works also as beacon and sends periodically random images with identification and timestamp.

8.5.1 HF and 50 MHz repeater list

8.6 Ham radio satellites and space broadcast

For SSTV operations can be used a linear relay installed on some of the amateur radio satellites. Amateur satellites orbiting the Earth for elliptical orbits. *Linear*

Freq.	Call	QTH	Activation	Power	Note
3,720	F5ZFJ	Haute Saône, JN27UR	image		linked with repeater on 144,525 MHz
14,236	VK3DNH	Rochester			Active 24 hours
14,239	VK2ISP	Coogee, New South Wales			Aktive 24 hours
21,349	VK6ET	Brackenridge, approx. 20 km north from Brisbane		50–100 W	QRV 22:00-08:00 UTC
28,660	GI4GTY	Lisburn	image		
28,688	HB9AC	Eighental, Lucerne JN47CA	1750 Hz		Linked with repeater on 144,825 MHz FM.
28,690	K3ASI	North Carolina	1750 Hz	45 W	Aktive 24 hours, beacon every 15-20 minut.
28,700	ON4VRB	Heist o/d Berg	1750 Hz		Linked with repeater on 433,925 MHz.
28,750	ON0DTG	Doornik			
28,900	EA8EE				
50,500	F6IKY	Haute Savois (700 m)			USB
50,510	OZ6STV	Copenhagen, JO65ER	1750 Hz	60 W	Beacon every 30 minutes.

Table 8.4: none

relays (transponder) performs retransmission of the wider frequency range, typically 50 to 250 kHz. So the satellite then transmits all the signals (CW, SSB, ...) received on the band (not like the FM ground FM repeater to allow operations to only one user). If you have station equipped for satellite communication you can try also SSTV.

You can also monitor experimental SSTV transmission from International Space Station and receive SSTV signals with your 2m FM transceiver, see **section 8.6.3**.

Space communications provides few problems. The first of these is *Doppler effect*, named after the famous Austrian physicist, which reflects changes in wavelength of the signal between the observer and the signal source on a moving object. In practice this means that if the satellite is closer to your position the signal appears to have a shorter wavelength and the receiver must tune to higher frequencies, when the satellite is moving away it's exactly the opposite.

Other problem is variance of signal quality due to satellite rotation, that causes a leakage signal. The antenna with circular polarization should be used for these purposes.

Frequency band	Designator
21–30 MHz	H
144–146 MHz	V
435–438 MHz	U
1.26–1.27 GHz	L
2.40–2.45 GHz	S
5.6 GHz	C
10.4, GHz	X
24 GHz	K
47 GHz	R

Table 8.5: Uplink and downlink bands.

Frequency bands of linear relays are shown **in table 8.5**. These frequencies describe satellite relay operating modes. It is fixed by satellite design on chosen by control center. The designator like U/V describes uplink 435–438 MHz (U) and downlink 144–146 MHz (V). E. g. *Fuji-OSCAR 29 (FO-29)* operates in mode V/U, the uplink is in the range of 146,000 to 145,900 kHz CW/LSB and downlink 435.800 to 435.900 kHz CW/USB. Note that relay inverts signal frequency (LSB to USB). Other satellites carry on board the single-channel FM transmitter, such as the popular AO-27 with uplink 145,850 kHz FM and downlink 436,795 kHz FM.

It is required to monitor own SSTV signals on downlink, when working on linear relays. Some sound cards support full duplex operation, so the computer can also send and receive in same time. Then the operator changes the transmit frequency so that receiving frequency appears to be same, just follow the position of the syncs on spectroscope. This way compensates the Doppler effect.

During years there were many satellites used for SSTV operations, like FO-29, VUSat OSCAR 52 (beacon 145,936 kHz), AO-51, SO-50, etc. But satellite lifetime is limited, in time board batteries getting weaker and ground control center switching off transponder and waits for their recharge from solar panels. You can find actual informations and satellite statuses on website of Amateur Satellite Corporation, i. e. AMSAT.

http://www.amsat.org

8.6.1 SSTV from Mir station

Days of the orbital station Mir are already numbered, but as a reminder there is description of the experiences with SSTV transmission, which took place in Manned Amateur Radio Experiment (MAREX) in late 1998 and 1999.

The project anticipated broadcast on the frequency 437.975 MHz, but due to some problems with antenna systems we have to make do with only the occasional broadcast on the two meters band.

Transmit frequency was 145,985 MHz FM ± Dopplers's frequency shift. The packet radio AX.25 BBS R0MIR-1 was normally operating on this channel.

Station at low orbit passed 5 times a day over Europe at approximately 1.5 hours intervals.

The Robot 36 Color mode was chosen for SSTV transmission. The pictures were sent in 2 minutes interval, so during one orbit you could copy transmission for 10 minutes and receive about 5 pictures. Each picture was introduced by morse code –.././/.–./–––––/––/../.–. `DE R0MIR` and then transmitted.

Figure 8.3: SSTV picture form station R0MIR.

I found, that there was about ±5 kHz frequency change caused by Doppler's effect. So during orbit it is good to tune receiver, it's ideal to use transceiver with continuous

FM tuning (I use FT-767). When Mir approached the horizont and it was coming near the tunning frequency was 145,990 MHz and when it was fly away the frequency is lower, i.ė. 145,980 MHz. Some transceivers measure discrimination of FM signal, so it is very easy to tune on carrier frequency.

Designers of SSTV station chose Robot 36 Color mode, it's not resistant to noise, so when there is great shift from center carrier frequency the signal used to be noisy and picture quality is distorted. The frequency of AFSK signal transmitted throught FM channel doesn't change, so the color distortion, known from SSB transmission, doesn't appear.

The antenna of my station for Mir monitoring was 3 element yagi with vertical polarization (normally used for ground repeaters). I directed it to azimuth, where Mir was nearest to my site. Later I tried to direct rotator during orbit, the azimuth and time I had computed and it was possible also to direct yagi by signal strength displayed on transceiver S-metr.

8.6.2 SuitSat

In early 2006 (originally planned to release about 3 months earlier) were from the International Space Station (ISS) launched the satellite in an unusual project *ARISS (Amateur Radio on the International Space Station)*. The satellite was named *SuitSat* (the code name is the AMSAT-OSCAR-54 [AO-54]). And its name describes the full implementation of the satellite, because on-board equipment was built into expired Russian space suit (type Orlan).

The transnsceiver Kenwood TH-K2 was tuned to frequency 145,990 MHz and its power source was realized from the batteries, so its lifetime was limited to a few weeks.

The satellite was programmed to broadcast a voice message, prepared SSTV image (in Robot 36 Color) and telemetry data that contained information such as measured temperature and radiation. The entire broadcast session lasts approximately 9 minutes.

After few hours after SuitSat's release, ham radio operators reported only weak signals and was monitored only couple of days. Probably due to low temperature the on-board batteries lost capacity.

The SuitSat AO-54 should starts the series of similar experiments, like project Arissat-1.

8.6.3 Amateur Radio on the International Space Station

The successor of popular ham radio projects on Mir is the project *ARISS*. The targets are to build SSTV beacon/repeater, packet radio BBS and world-wide propagation of ham radio hobby.

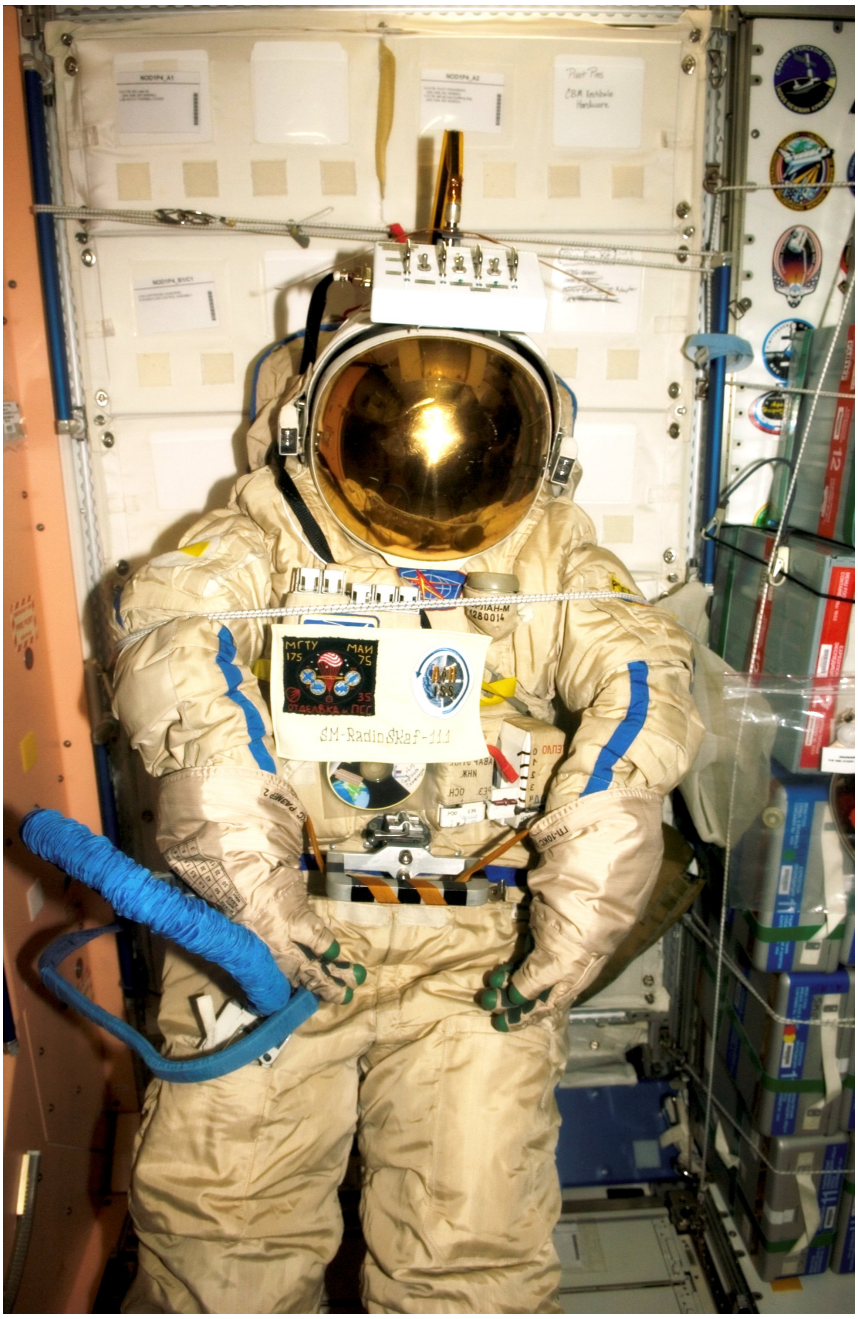

Figure 8.4: SuitSat built into the spacesuit (NASA, source cat. no. ISS012E15666).

The SSTV equipment on ISS consist of *SpaceCam 1* software (from ChromaPix authors). It runs on normal PC, support video digitizer and it can works as repeater or transmits slide-show pictures from station cameras. The SpaceCam transmit

pictures every 120 seconds in Robot Color 36 mode and every picture is started with morse identification (R0ISS, NA1SS).

The following frequencies are currently used:

- ▷ **Voice and Packet Downlink:** 145.800 MHz (Worldwide)
- ▷ **Voice Uplink:** 144.490 MHz for Regions 2 and 3 (The Americas, and the Pacific)
- ▷ **Voice Uplink:** 145.200 MHz for Region 1 (Europe, Central Asia and Africa)
- ▷ **Packet Uplink:** 145.990 MHz (Worldwide)
- ▷ **Crossband FM repeater downlink:** 145.800 MHz (Worldwide)
- ▷ **Crossband FM repeater uplink:** 437.800 MHz (Worldwide)
- ▷ **Worldwide SSTV downlink:** 145.800 MHz

For latest ARISS news and status check the website:

http://www.ariss.org