SATELLINE-1AS and SATELLINE-2AS
Radio Data Modem

USER GUIDE

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**** Due to continuous product development SATEL OY reserves the right to change specifications without notice ****

1 SATELLINE-1AS and SATELLINE-2AS Radio Data Modems

This user guide is meant for SATELLINE-1AS, SATELLINE-1ASm2, SATELLINE-2AS and SATELLINE-2ASm2 radio modems. Since their electrical function is identical and only their housing is different, the brand names SATELLINE-1AS and SATELLINE-2AS refer to every model mentioned above.

1.1 Radio Data Modem

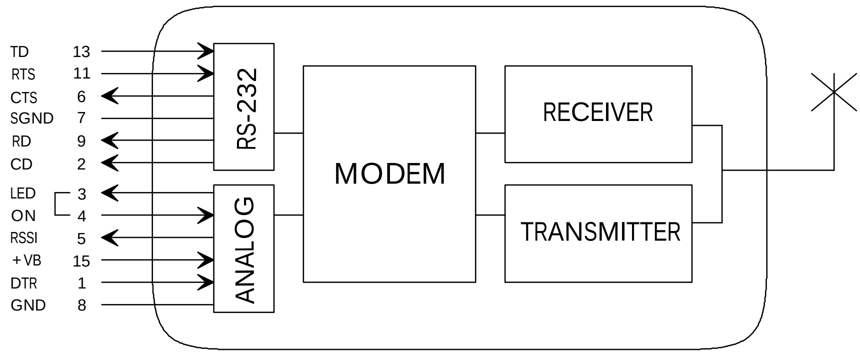


Fig. 1. SATELLINE-1AS radio modem

The SATELLINE-1AS radio data modem is comprised of a 450 MHz transmitter, receiver and a modem board, housed in a compact resistant aluminium casing. It has an RS-232 interface that allows easy connection to a variety of data networks.

The SATELLINE-1ASl radio data modem has a maximum data speed of 1200 bps. It is especially suitable for longer distances because of its better sensitivity.

The SATELLINE-2AS differs from SATELLINE-1AS by the radio part. Both the transmitter and the receiver parts are on the same board (transceiver) and their function is based on the synthesized radio technique. The frequency stability is better and it is possible to change the radio channel.

The data transmission formed by radio modems resembles a cable. Unlike in cables the data transmission is half-duplex. The delays in transmission due to the half-duplex transmission and possible interferences must be considered when planning a system.

Should Simplex operation be required, it can be achieved by installing a SATELLINE-1T transmitting modem and a SATELLINE-1R receiving modem.

Typical applications of radio modems are :

- Replacing a cable in situations where installation of such a cable is difficult, expensive or even impossible.
- Data transmissions between mobile or portable terminals
- Wireless alarm transmission
- Telemetry
- Remote control

- Transferring text to displays
- For use with Global Positioning System (GPS)

With two SATELLINE-1AS/-2AS radio data modems it is easy to make up point to point connections. The power level of the transmitter is 0,5 W. It is possible to reach distances from 2 to 30 km depending on topographical conditions and antenna locations. On special request it is possible to manfacture transmitters with the maximum output power of 1,0 W. Country specific laws of radio communication must always be followed.

The radio data modem operates well in data networks where the same channel is used by several mobile terminals. In such systems the protocol can be either polling mode, in which the data communication is controlled through one of the radio modems or multimaster mode, in which any one of the radio modems can initiate the data transmission when the radio channel is free.

When the radio data modem is in the receiving mode, a data squelch facility is incorporated into the modem board to effectively ignore reception of error characters to the RD line which may have been caused by radio interference.

1.2 RS232 Pin Connections

D-connector Pin	Line	SD *)	Operation
1	DTR	IN	Data Terminal Ready
2	CD	OUT	Carrier Detect
3	LED ON	-	LED on switching
4	LED ON	-	LED on switching
5	RSSI	OUT	Receiving signal strength indicator
6	CTS	OUT	Clear to send
7	SGND	-	Signal Ground
8	GND	-	Ground
9	RD	OUT	Receive Data
10	DSR	OUT	Data Set Ready
11	TD	IN	Transmit Data
12	-	-	-
13	RTS	IN	Request to Send
14			
15	VB	-	Supply Voltage positive pole

SD = Signal direction from radio data modem
IN = Input OUT= Output

Operation description of the lines pin by pin:

1	DTR operates as an ON/OFF switch of the modem	"0" (0 V...-12 V) "1" (+5 V...+12V)

2 CD indicates a signal on the radio channel exceeding the level of sensitivity of the modem (it can record radio interferece signal).

3 and 4 Will be connected together in models with LEDs, where the most important lines are indicated by leds.

5 RSSI measures the received signal strength of the field of the transmitting radio (starts approximately from 0.5 V and goes up to 5 V). The strength of the field increases with the voltage. See appendix 4

6 CTS indicates when the radio data modem is clear to receive data via the RS-interface

7 SGND is the signal ground

8 GND is the ground of supplying voltage

9 RD received data

11 TD input of transmitted data

13 RTS gives radio modem a request to send, starts the transmitter (answer by CTS line)

15 Supply voltage

The RSSI (Received Signal Strength Indicator) is available on the radio data modem. This feature indicates the level of field strength of an incoming transmission and is particularly useful in systems that have several receivers as it is possible to select the receiving device that has the optimum incoming signal.

The radio modem also incorporates a CD (Carrier Detect) line output which is activated 5...10 ms after the activation of the RTS line of the transmitting modem. The CD line also indicates the presence of either a signal on the radio channel or an interference signal above the sensitivity limit of the radio modem.

1.3 Technical Specifications

SATELLINE-1AS

Satelline-1AS complies with the following international standards:
CEPT T/R 20-04 (radio standard) and the model m2 also with prETS 300 683 (EMC standard)

TRANSMITTER

Frequency Range	400...470 MHz
Channel Separation	25 kHz
Frequency Stability	< ± 2.5 kHz (± 5 ppm)
No. of Channels	1 (Crystal)
Carrier Power	400 mW/ 50 ohm (+ 26 dBm)
Carrier Power Stability	- 2 dB / + 1 dB
Frequency Deviation	± 2.5 kHz...± 3.0 kHz
Adjacent Channel Power	< 200 nW
Spurious Radiations	< 250 nW
Method of Modulation	FSK

RECEIVER

Frequency Range	400...470 MHz		
Channel Separation	25 kHz		
Frequency Stability	< ± 2.5 kHz (± 5 ppm)		
No. of Channels	1 (Crystal)		
Maximum usable sensitivity	BER < 10 E-4	1AS	1ASI
	300 bit/s	-114 dBm	-116 dBm
	600 bit/s	-114 dBm	-116 dBm
	1200 bit/s	-112 dBm	-116 dBm
	2400 bit/s	-110 dBm	
	4800 bit/s	-110 dBm	
Co-Channel Rejection	> -8 dB		
Adjacent Channel Selectiv.	> 60 dB		
Intermodulation attenuation	> 60 dB		
Spurious radiations	< 2 nW		

MODEM

Interface	RS-232
Interface Connector	D15 connector, female
Data Speed	300 - 4800 bit/s (1AS), 300 - 1200 bit/s (1ASI)
Modulating Signal	Manchester-coded NRZ
Data Formats	Asynchronous data character length 10 or 11 bits
Data Squelch	On the modem board: prevents interference from appearing to the RD line in receiving mode

GENERAL

Operating Voltage	+ 10...+ 13 Vdc	
Current Consumption	When DTR is "0":	0.4 mA
	When DTR is "1":	Receiving: 55 mA
		Transmitting: 330 mA
Antenna Connector	TNC, 50 ohm, female	
Size H x W x D	137 x 67 x 29 mm	
Installation plate	130 x 63 x 1 mm	
Weight	230 g	
Temperature Range	- 25 C...+ 55 C	

SATELLINE-2AS

Satelline-2AS complies with the following international standards:
I-ETS 300 220, CEPT T/R 20-04 (radio standard) and the model m2 also with prETS 300 683 (EMC standard)

TRANSCEIVER

Frequency Range	400...470 MHz / base band 2 MHz
Channel Spacing	25 kHz
Number of Channels	16 (selectable by a Hex switch)
Frequency Stability	< ± 1.5 kHz
Method of Modulation	FSK

Transmitter

Carrier Power	500 mW/ 50 ohm (+ 27 dBm)
Adjustment range	20mW... 1 W / 50 ohm (factory set)
Carrier Power Stability	+ 1 dB / - 2 dB
Frequency Deviation	± 2.5 kHz
Adjacent Channel Power	< 200 nW
Spurious Radiations	I-ETSI 300 220

Receiver

Sensitivity	< -108 dBm (BER < 10 E-4)
Co-channel rejection	> 8 dB
Adjacent channel selectivity	> 65 dB
Intermodulation attenuation	> 65 dB
Spurious radiations	< 2 nW

MODEM

Interface	RS-232
Interface Connector	D15 connector, female
Data Speed	300 - 4800 bit/s
Modulating Signal	Manchester-coded NRZ
Data Formats	Asynchronous data: 10 or 11 bits
Data Squelch	On the modem board: prevents interference from appearing to the RD line in receiving mode

GENERAL

Operating Voltage	+ 10...+ 14 Vdc	
Current Consumption	When DTR is "0":	2,8 mA
	When DTR is "1":	Receiving: 90 mA
		Transmitting: 600 mA
Antenna Connector	TNC, 50 ohm, female	
Size H x W x D	137 x 67 x 29 mm	
Installation plate	130 x 63 x 1 mm	
Weight	250 g	
Temperature Range	- 25 °C...+ 55 °C	

Labelling information:

Ser.no. 96052938 Freq. Ch F 468.200 MHz
SATEL OY
Tel: +358-24-7331033, Fax: +358-24-7331034

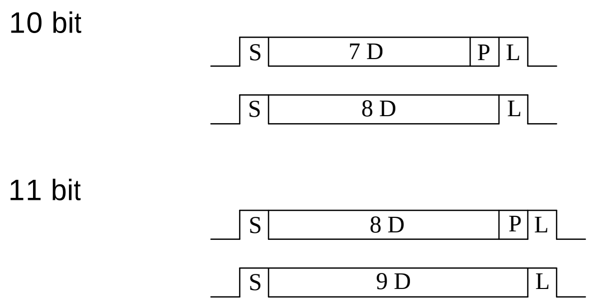
- Serial number (year+ week + manufacture number)
- Frequency, set by the manufacturer. F = position of the channel switch and the frequency corresponding 468.200 MHz
- Manufacturer's contact information

2 Asynchronous Data Transmission

2.1 Asynchronous Characters

Data characters can be transmitted either in 10 or 11 bits and either in 8 or 9 bit data characters between the start and stop bits respectively. These options are factory set. Thus, they have to be decided in advance.

Characters are formatted in accordance with the ANSI standard asynchronous characters. See diagram below.



S = start bit

P = parity bit

L = stop bit

D = data bit

Data transmission between the radio data modems is synchronous. The radio data modem corrects the time difference between a clock signal from the data transmitting equipment

(DTE) and its own clock signal by adding one stop bit if required. The radio data modem transfers parity bits as they are received.

2.2 Effects of character lenght on transmission

The transmitted data character can be either 10 or 11 bits, the length of these characters is determined by hard wiring on the modem board.

It is important that the transmission from the data terminal equipment to the radio data modem matches the selected character length. In the event of a mismatch transmission errors will be shown at the receiving end as "error characters" and the data transmission will be discontinued.

NOTE! The length of the character from the data terminal equipment must correspond to that of the modem.

2.3 Data Speed

The data speed of the radio modem can be 300, 600, 1200, 2400 or 4800 bits/s. The data speed is carried out by changes on the modem card.

2.4 Transmission

There are <u>two</u> different methods of initiating data transmission.

1 RTS/CTS handshaking
2 Data connected directly to TD line

The first method using RTS/CTS handshaking has to be used for data speeds of 2400 and 4800 bit/s. This method is initiated from the radio data modem requesting permission to send. This is achieved by switching the RTS line from an OFF to an ON state. The subsequent reception of data will cause the CTS line to be raised and the data transmission will be sent on the TD line. If there is an active radio transmitter on the system with the same radio channel the CTS line will not be raised.

The second method of transmission operates within the range of 300 to 1200 bit/s. In this case the transmitter is switched directly to the TD line.

Should a break in transmission occur e.g. caused by a weak radio field, transmission can only be restarted by switching off the transmission for a period of at least 20 ms before re-sending.

2.5 Reception

The radio modem is ready to receive data when the supply voltage is switched on and the DTR line is in the "ON" state.

Equipment connected to the radio data modem receives information about the incoming data by detecting the change in state of the RD line. In addition, the change in state of the CD line also allows the equipment to detect the start of a transmission.

2.6 Delays during data transmission

Delays may occur when transmitting or receiving data using the radio data modem.

These delays are:

Wake-up time DTR OFF/ON	30 ms (1AS) / 400 ms (2AS)	
RTS/CTS delay	8...10 ms	
Rx/Tx turn round delay	2 x 40 DBP + 20...25 m	(40ms @4800 bit/s) (50ms @2400 bit/s)
Rx ON connecting time	10 ms	
Synchronization sequence	10 DBP (DBP=Data Bit Period) (e.g. 2ms @ 4800 bit/s)	

3 Multi Modem Data Systems

3.1 Required sequence of data characters

The data should be transferred in continuous sequences or in sequences divided into blocks. Sequences that are too short (e.g. 1 character) should not be sent because "overhead-information" (synchronization plus terminal address) takes a great deal of processing time and thus slows down the data transmission. The recommended length of a data packet is 50 - 500 characters.

The size of a system using one radio channel can be increased when the timeframe of transmission of one terminal is short. This must be taken into account when planning the system. The operating range of the system can be extended by increasing both the number of base stations and the number of radio channels.

It is important that only one transmitter can be active on the same channel at the same time.

3.2 Polling

The system can be configured as a "Master-Slave" network which allows one radio modem to control the others in the system. Slave units can communicate to the Master during the time allocated to that Slave by the Master unit.
The advantage of the polling mode is that collisions (i.e. simultaneous transmissions) do not occur. The disadvantage of this method is that the transmitter of the Master is switched on half of the time in situations where there is no data transmission from mobile to Master.

A polling protocol is not included in the transparent radio modem. It is a protocol of higher hierarchy and supplied by the system.

3.3 Multi Master

The system can also be configured as a "Multi-Master" network. In this situation any radio data modem can start transmission after first testing either by the CTS line or the CD line that the radio channel is free.

The advantage of this system is that the transmitter is ON only during data transmission. The disadvantage is that if all the mobile stations do not "hear" each another collisions may occur.

A multi master protocol is not included in the transparent radio modem. It is a protocol of higher hierarchy and supplied by the system.

4 Planning a Radio Modem Network

4.1 Factors affecting quality and distance of the radio connection

- power of radio transmitter
- sensitivity of radio receiver
- tolerance of spurious radiations of the radio modulating signal
- amplification of transmitting and receiving antennas
- antenna cable rejection
- height
- natural obstacles
- interferences caused by radio frequencies

The transmitter power of the base model of SATELLINE-1AS/2AS is 0.5 W and sensitivity of receiver more than -108 dBm. Thus in a flat area and in free space with a 1/4 wave antenna (antenna amplifcation 1dBi) and an antenna height of 1 m communications from 3 km to 4 km can be achieved. Distances may be considerably shorter in situations where there are metallic walls or other material inhibiting the propagation of radio waves.

Over long distances, problems caused by natural obstacles can often be solved by raising the height of antennas. A ten fold increase in distance can be achieved with the use of amplifying antennas. Frequent topographical variations over long distances may require that at least one of the antennas needs to be raised to a height of 10 to 20 m.

As the placement of the antenna at the base station is more than 10 m from the modem it is necessary to use a low loss cable (< 0.7 dB /10m) in order not to waste the antenna amplification.

If the antenna at the base station must be placed near other radio transmitter antennas (eg. NMT, GSM etc.), an antenna filter should be added between the modem and the antenna.

Problematical connections can also be solved by adding another intermediate station for relay. In systems with many base stations an RSSI-signal would assist in choosing the best receiving base station. A communications network can also be built with a combination of cables and radio data modems.

The SATELLINE-1AS/2AS radio data modem operates in the 450 MHz band where interference caused by human beings is insignificant. Long distance interferences need not to be taken into account even in special weather conditions.

The SATELLINE-1AS/2AS eradicates normal levels of interference that occur. However, exceptionally high levels of interference can break through the safeguards and thus cause errors on transmssion. In mobile vehicle applications the range of operation can be increased by dividing the transmitted data into e.g. 50...500 bits blocks and by retransmitting defected blocks.

A sufficent safety margin can be obtained by testing communications using an extra 6 dB rejection at the antenna connection and with slightly less effective antennas than those to be used in the final system. Saterm test program can be used in the communications testing. If there is a need to measure RSSI signal during the Saterm test transmission, a message long enough must be used eg. File Logo.TXT

4.2 Radio field strength

A successful radio transmission depends essentially on the radio field. Where field strength is over a certain level the operational results are very good. Below this level, a few dB marginal areas may occur in which errors begin to be generated by noise and interference which will eventually lead to loss of connection.

Whilst in an open space, the field strength is at its optimum level although it will still be reduced by distance. It must also be remembered that one open space has different environmental and external factors to another and that the effects on transmission quality must be taken into account when planning the system.

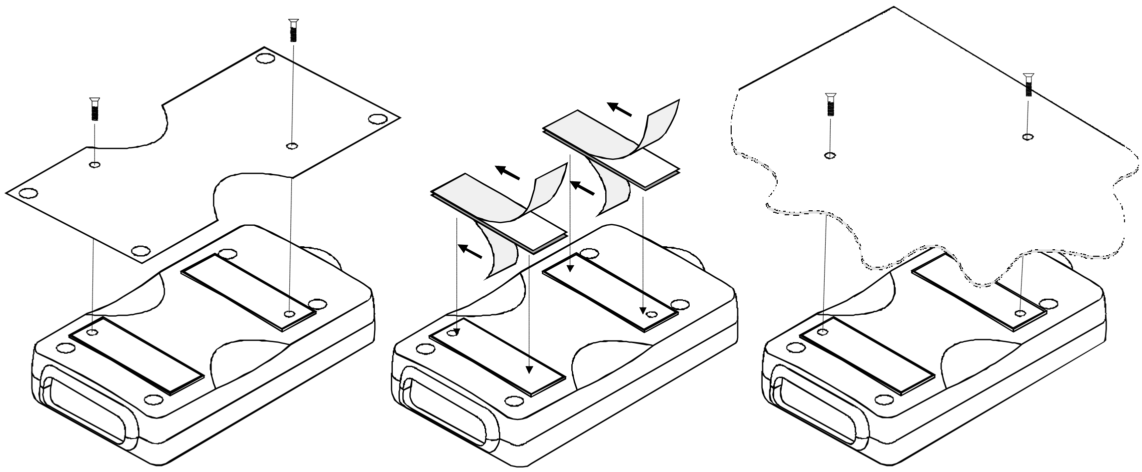
Ground, ground contours and buildings cause attenuation (loss of energy through absorbtion) and reflections of radio waves. Buildings reflect radio waves and therefore the effects of attenuation are not as acute when transmission is over a short distance.

However, the reflected waves will suffer a loss in power once they travel over a certain distance, this means that they combine with the direct radio waves and interact in either weakening or strenghtening the signal respectively. In reality attenuation can even occur at 40 dB which is very sharp and the effect on the 450 MHz frequency is about 35 cm difference.

Please note that the RSSI tolerance is ± 10 dB when using the RSSI signal of the modem to define the field strenght. See appendices

5 Installation

The radio modem is to be installed with the installation accessories supplied with the radio modem



1. By using the installation plate, that should be fastened on the back side of the radio modem. The installation plate can be mounted using the holes provided on installation plate .

2. By using the velcro-type tape supplied with the radio modem.

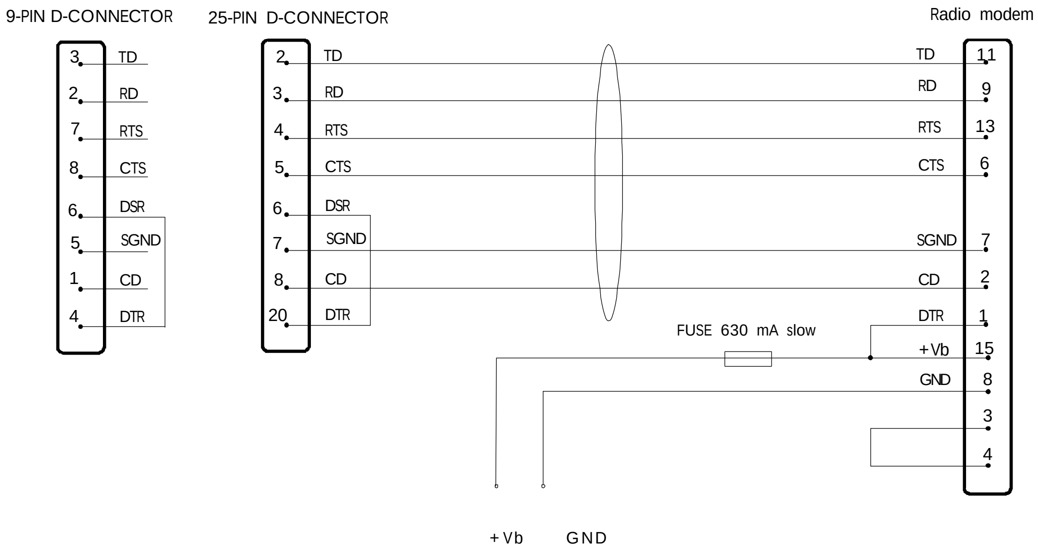
3. By mounting the radio modem directly on the customer´s equipment .

> NOTE ! When choosing the place of mounting, please check that water can not get inside the radio modem. It is not recommendable to mount the radio modem on a powerfully vibrating foundation. The attachment should be lessened with help of a resilient material.

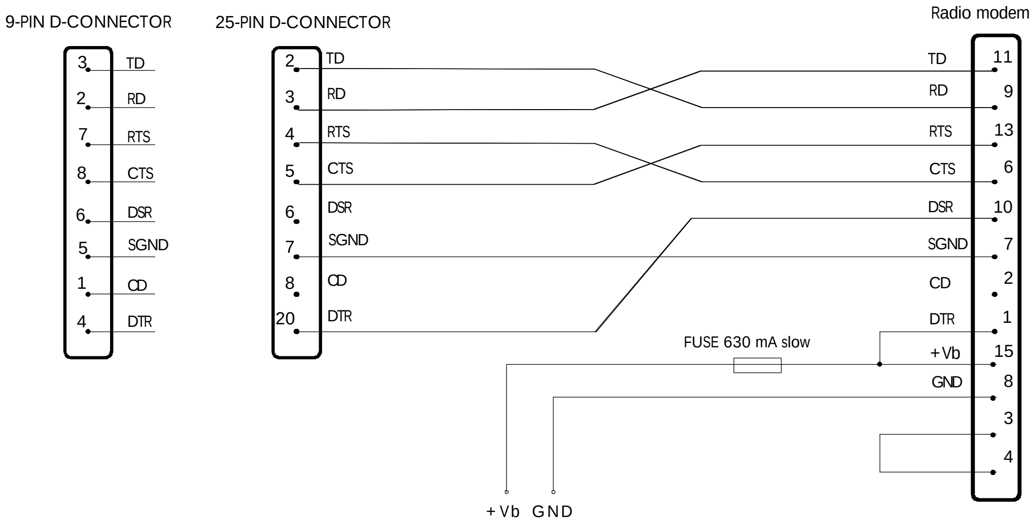
The radio modem fulfils the technical specifications regarding temperature range -25 °C...+55 °C. The radio modem operates also outside this temperature range but does not necessarily fulfil all specified requirements.

5.1 RS-232 Interface

The radio modem is connected to terminal via RS-232 interface. A typical connection where all handshaking lines are used is according to the figure below.



In some systems the radio modem is connected to another data transmission equipment (modem). The lines should in this case be connected across according to the picture below.



5.2 Supply of current

The nominal voltage of SATELLINE radio modems is 12 V. The range of voltage is 10 - 14 V. Variations in the voltage below 1V are allowed as the radio modem is changing from one mode to another. The operating voltage of the positive pole of the D 15 connector is connected to the pins of the D connector and to the negative poles 7 and 8. The DTR line in position "1" can be used as an ON/OFF switch. In this case the logical state "1" (+5...+12 V) corresponds to ON and "0" (0 V...-12 V) to OFF.

The current consumption of SATELLINE-1ASl ja -1AS varies between 50 ... 250 mA and of SATELLINE-2AS and -2ASx between 100 ... 600 mA. In systems where models SATELLINE-1ASl or -1AS have been changed to models SATELLINE-2AS tai -2ASx , current supply has to be checked. Especially in portable applications the DTR line of the radio modem should be switched to position "0" when possible. In this case the current consumption is approx. 0.2 mA (SATELLINE-1AS and -1ASl) or 3 mA (SATELLINE-2AS and -2ASx). In mobile use the radio modem is required to have a direct connection to the main vehicle battery in order to avoid additional interference.

NOTE POWER SUPPLY !

Even if the nominal output current of the power supply does not exceed it might temporarily be unstable as the current consumption changes e.g. at starting the power amplifier. The outputs of power supplies are often supplied with sufficient output capacitance. The output capacitance of self built power supplies with regulators or switched-mode power supplies might be insufficient or totally lacking.
Even if the nominal output current is considerably higher than the current consumption of the radio modem, the voltage varies several voltages according to the changes of the current consumption of the radio modem. This kind of function of the power supply weakens the function of the radio modem or prohibits it totally.
Supply current should be controlled in situations where the distance is short or the radio field strength is sufficient but the connection does not work or the number of faulty packets is big. Quick changes in voltage can not be measured with a multimeter as they often last for only approx. 0.5 ms. Therefore possible situations with undervoltage should be surveyed with an oscilloscope. To ensure a reliable operation of the radio modem the acceptable variation is below 1 V from the stable level and continuous oscillation below 50 mV.

NOTE! Whenever connecting RS-232 interface cables to equipment, the equipment MUST FIRST BE SWITCHED OFF.

5.3 Mounting the antenna

In great distances or in otherwise severe conditions the operation of radio communication is dependent on antennas and their mounting. In antennas, antenna cables and terminal adaptors there should always be a gold plated connector. Since connectors of poor quality oxidate and increase the attenuation in the course of time appropriate connectors and proper tools must always be used in mounting. One should also check that both the antenna and possible fitting elements resist well weather and environmental contamination.

The metal-free zone around small antennas should be at least 1/2 m and big antennas >5 m. The metal-free zone should be > 10 m around a relay antenna combination. This means that, if a large network of radio modems is to be installed the best place for the antenna is at the highest point of the building or even the use a radio mast. If a mast is used, the antenna can be installed using a side-installation up to 2 ...3 m away from the mast itself.

When mounting the antenna pay also attention to possible sources of interference such as:

mobile phone network base stations
local telephone network base stations
television transmitters
radio links
other radio modem networks
PC equipment (about a radius of 5 m from the antenna)

When ordering antennas please note that the antennas have been tuned to a certain frequency range. Simple antennas and those made of stacked yagis are relatively wide band. The frequency range of the antenna becomes narrower the more elements there are in a yagi.

Keeping in mind the testing and service of the system it is generally useful to use rather a long antenna cable in order to avoid the installation of radio modems near the antenna into a place possibly difficult to access.

The antenna cable should be chosen according to the lenght bearing in mind the following recommendations:

Length	Type	Attenuation
< 5 m	RG58	3.0 dB/10 m/450 MHz
5 ... 20 m	RG213	1.5 dB/10 m/450 MHz
> 20 m	Nokia RFX 1/2"-50	0.5 dB/10 m/450 MHz
> 20 m	S12272-4	0.5 dB/10 m/450 MHz
> 20 m	AirCom+	0.8 dB/10 m/450 MHz *)

*) AirCom+ cable is partly air insulated, thus an absolutely air tight connection between the cable and the connector is required.

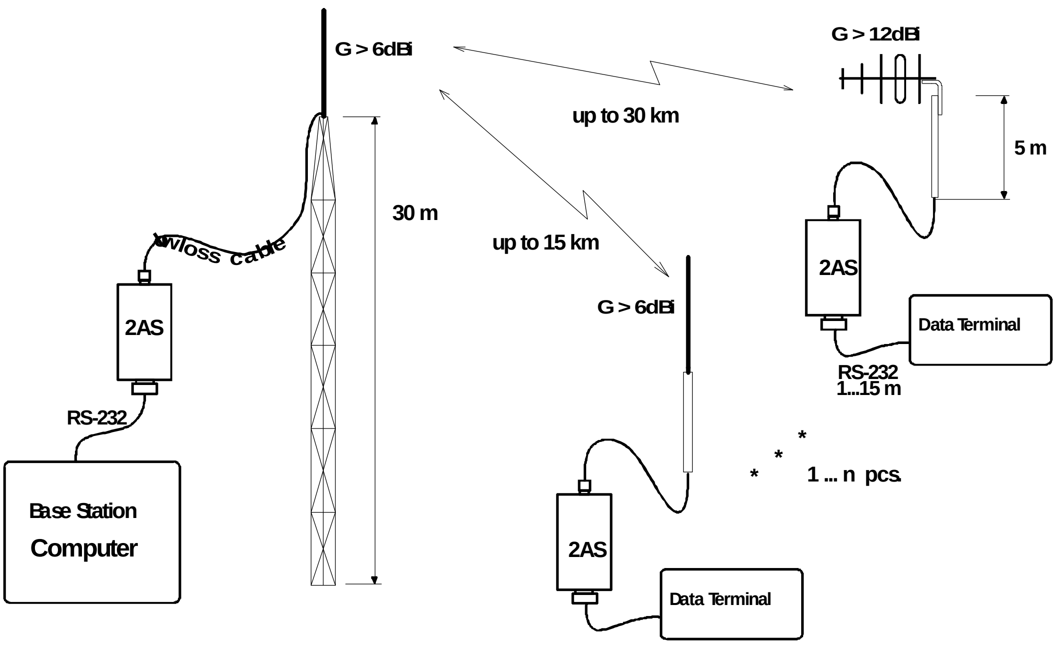
In great distances when the antennas are in optical positions a 6 dB power marginal is adequate. Since the connection is built on the reflection and/or the knife-edge diffraction the path loss can vary even 20 dB depending on the weather conditions. In this case a short test can give a too positive result of the quality of the connection. Thus the height of the antennas and topographical obstacles must be surveyed with great care. From time to time an attenuating connection can be used if the data transmission protocol is well prepared for this and the data transmission that occasionally slows down does not cause any problems to the process.

Vertical polarized systems (antenna elements are in vertical position) are often used in radio systems. In a system between a base station and sub-stations the vertical polarization is generally recommendable. The antenna of the radio modem can not be mounted on the same level with the other sub-station antennas in the same building. The best way to distinguish from the other antennas situated in the neighbourhood is by mounting the antennas as far as possible from each other on the altitude level. The best result is generally obtained when all the antennas are in the same mast. With an extra ground plane between the antennas more distinction can be obtained between the antennas in the mast.

A horizontal polarization can be used in data transmission between two points. With the polarization attenuation more distinction is obtained in the vertical polarization interference. The influence of the directional patterns of the antennas must, however, be taken into consideration. If a distinction to another interfering antenna is wanted with the horizontal polarized antennas there must be a good attenuation of the back lobe. In addition to this the interfering radiator should be situated behind the antenna.

When the system does not demand the use of an omnidirectional antenna it is recommendable to use directional antennas e.g. two-element yagis in firm external installations. As the antenna amplification increases the setting of the direction of the antenna demands for a greater care.

The base stations in high places should be supplied with 4...6 degree band-pass filters. Please note that the higher the antenna the larger the broadcast area. The disadvantages with a too high antenna installation at the base station are that interferences from a larger area affect the base station and that the base station occupies the channel of a too large area.



Example of an antenna installation: By use of amplifying antennas and by installing antennas in a high location, long distances can be reached with SATELLINE-2AS.

6 Equipment

6.1 The connection of antennas to radio modems

Recommended antenna types are as follows:

6.1.1 Hand portable equipment

1/4 wave antenna (wave length on 450 MHz is about 70 cm)
Helix antenna

The antennas are mounted directly on to the antenna connector (TNC) at the top of the radio modem.

6.1.2 Equipment installed in vehicles

1/4-wave antenna
1/2 wave antenna

Ideally the antenna should be installed vertically and it should have at least 0.5 m of open space surrounding it. In a small system 1/4 wave antenna is adequate. There should be a ground plane below the antenna (truck bonnet or roof). In weak conditions a 1/2 wave antenna is the most suitable. It can be mounted at the top of a pipe, as this provides it with as much open space as possible. In places where the antenna cannot be connected directly to the TNC a 50 ohm coaxial cable must be used to provide the link between the TNC and the antenna.

6.1.3 Base station

omnidirectional (1/4, 1/2 or 5/8 wave antenna)
directional (yagi or corner reflecting antenna)

The antenna should be installed in an upright position. The exact location of the antenna depends on a number of factors from system size to physical ground countours. As a general rule, the antenna for a base station should be located at the highest point in the most central location of the system.

Alternatively the base station antenna can be situated inside the building, providing that the walls of the building do not contain metal.

6.2 Cables

NOTE ! Please check, that the contact area of cable connectors is gold plated and that the connectors used are reliable. Ageing connectors of poor quality oxidate easily and cause malfunction of the system.

6.2.1 RF cables

If the antenna cable is shorter than 5 m a good quality 50 ohm RF cable can be used (e.g. RG58). If a longer cable is required a low loss RF cable is highly recommendable. As a standard cable we supply 50 ohm RG58 cable in lengths of 1 m (CRF-1) and 5 m (CRF-5).

6.2.2 Interface cables

When planning the location of the radio modem, it must be observed that the maximum length of an RS-232 cable is 15 m. The cable must be shielded. The maximum length of the power supply cable is 2 m. As standard cables we supply cables with either a 25 pin connector CRS-1 F or CRS-1 M (F=female, M=male) or with a 9 pin connector CRS-2 F or CRS-2 M. The length of the cables are 2 m and they contain both interface and power supply cables.

There is also an interface adapter ARS-1F with a programming switch and power supply cables available for the SATELLINE-2ASx radio modem. The interface adapter matches the connector of the modem to a 9 pin (female) D connector. In addition there is a straight cable with 9 pin connector, CRS-9.

7 Check List

When installing and configuring a radio data modem following points should be considered:

1. Before connecting the RS-232 interface to equipment always check that the operating voltage is switched off.

2. Consider the exact location of the equipment for optimum results
   - Place the antenna in a free space as far as possible from any source of interference
   - Do not place the modem on a strongly vibrating surface
   - Do not place the modem in direct sun light or high humidity

3. The capacity and stability of the power supply must be secured so that the current required by the transmitter is sufficient for creating a reliable connection.

4. The antenna is installated according to given instructions.

5. The settings of the radio modem correspond those of the terminal and all radio modems of the system have the same settings and are compatible to each other.

6. The radio modems are on the same channel.

7. If the RTS/CTS handshaking is used, make sure that in the reception RTS and CTS are in the "0"-mode (-12 V). RTS will turn on the radio transmitter in the "1"-mode.

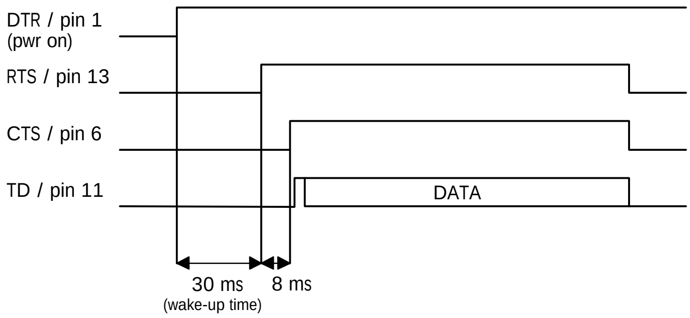
8. If a TD transmission is used check that RTS and CTS lines are unconnected.

APPENDIX 1.

The timing diagram of RS-232 interface of SATELINE-1AS and SATELLINE-2AS radio modems.

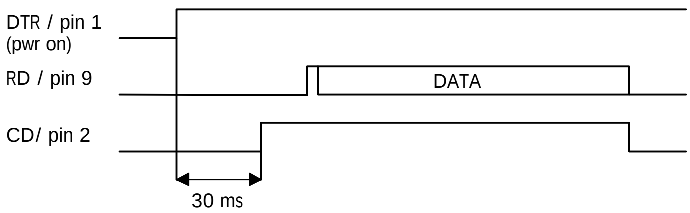
RTS/CTS handshaking must be used in data speeds 2400 bit/s and 4800 bit/s. The timing of the data transfer is the

SENDING



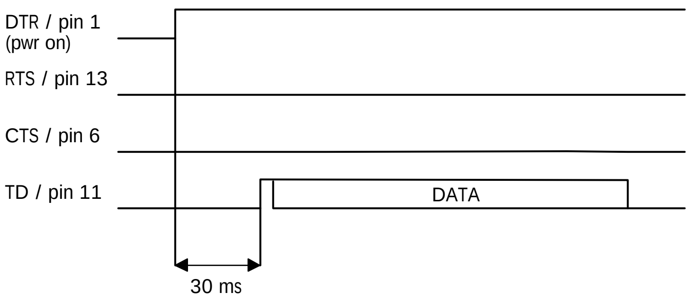
following:

RECEPTION

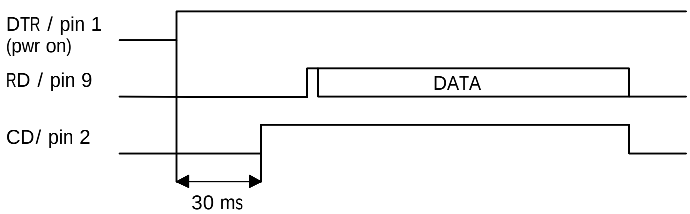


In data speeds 300 bit/s - 1200 bit/s no handshaking is needed. The timing of the data transfer is as follows:

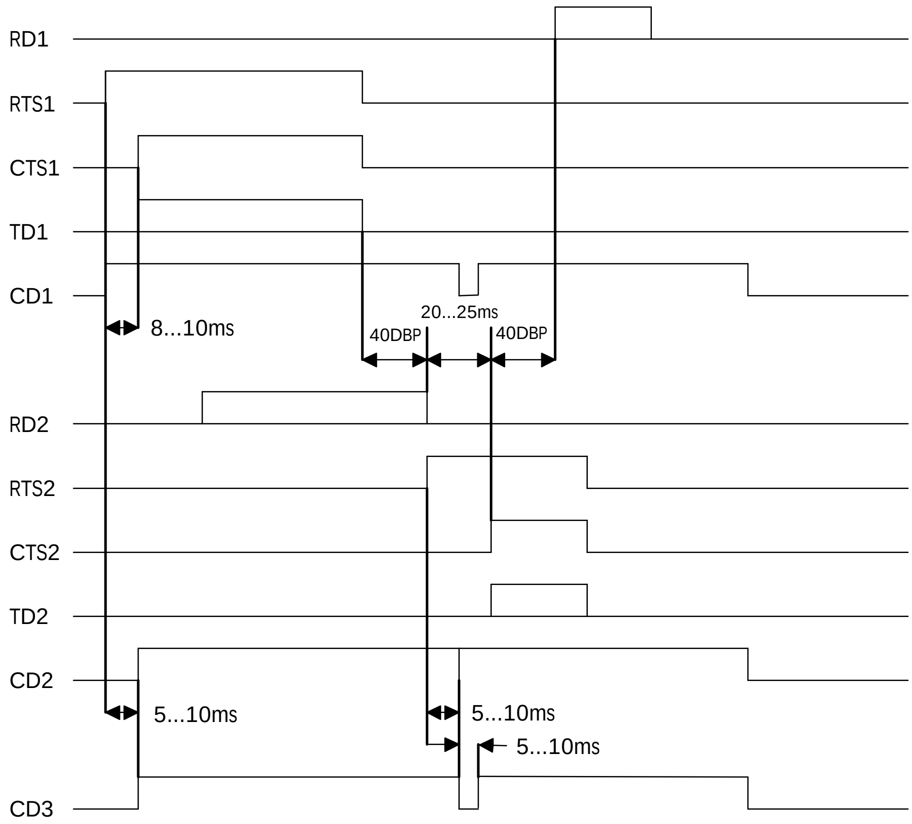
SENDING



RECEPTION



The delays in data transfer between two SATELLINE-1AS or SATELLINE-2AS radio modems will become clear in the following diagram. It also includes the CD line - in the receiving mode - of a third radio modem.



APPENDIX 2.

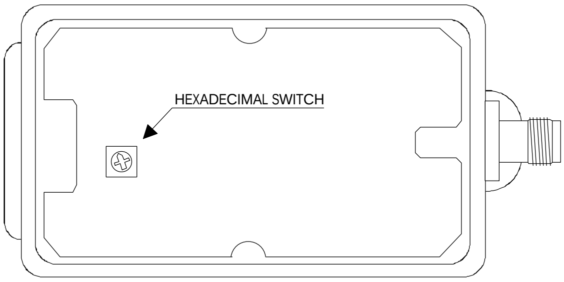
Selecting of radio channel of SATELLINE-2AS

Due to the synthesized radio there is a possibility to change the frequency of Satelline-2AS radio modem. A fixed band of sixteen adjacent channels spaced by 25 kHz has been set to the hardware of the modem at the factory. One of these channels may be selected by the user.

There is a hexadecimal switch on the radio circuit board. Operating channel is selected by turning this switch. Position F of the switch refers to the lowest frequency and 0 to the highest. Channels and respective switch positions of the particular device is found at the appendix 3.

#1 Open the back part of the housing of the modem.

#2 Turn the hexadecimal switch to the right position. The location of the switch is seen at the following diagram.



#3 Close the back cover.

Warning! The performance of the radio will be degraded if any damage is caused to the sensitive components of the radio circuit.

Table of Selectable Radio Channels

Frequency Range (harware settings)	Channel (software settings)															
	F	**E**	**D**	**C**	**B**	**A**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
**x.200 - **x.575 MHz	**x.200	**x.225	**x.250	**x.275	**x.300	**x.325	**x.350	**x.375	**x.400	**x.425	**x.450	**x.475	**x.500	**x.525	**x.550	**x.575
**x.600 - **x.975 MHz	**x.600	**x.625	**x.650	**x.675	**x.700	**x.725	**x.750	**x.775	**x.800	**x.825	**x.850	**x.875	**x.900	**x.925	**x.950	**x.975
**y.000 - **y.375 MHz	**y.000	**y.025	**y.050	**y.075	**y.100	**y.125	**y.150	**y.175	**y.200	**y.225	**y.250	**y.275	**y.300	**y.325	**y.350	**y.375
**y.400 - **y.775 MHz	**y.400	**y.425	**y.450	**y.475	**y.500	**y.525	**y.550	**y.575	**y.600	**y.625	**y.650	**y.675	**y.700	**y.725	**y.750	**y.775
**y.800 - **z.175 MHz	**y.800	**y.825	**y.850	**y.875	**y.900	**y.925	**y.950	**y.975	**z.000	**z.025	**z.050	**z.075	**z.100	**z.125	**z.150	**z.175

y = x + 1, z = x + 2

Hardware settings are made by the manufacturer. The frequency range of the equipment is marked on the label on the back of the r adio modem.

Example: The channel of the radio modem has been set on A = 433.125 MHz . The frequency range of the radio modem is 433.000 - 433.375 MHz (see the 3rd row at the table above). If the new channel should be e.g. 433.275 MHz, the channel 4 should be selected.

SATELLINE-1AS/2AS - RSSI