



B900ss-20
Radio Modem Card
Spread Spectrum
(FCC Approved
Part 15.247)

Technical Manual



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Chapter 1. Objective

The objective of this document is to present the features and the application of the B900ss-20 radio module.

The operation of this module is divided into two chapters:

- The 'Basic Operation' chapter describes the Module operating modes and allows the user to learn the WinB900 Software in walking through it.
- The 'Advanced Operation' is especially for users that want to program the module directly. It presents all the available commands.

FCC Compliance and Warning

Thank you for choosing Adcon Telemetry's B900ss-20 Smart Spread Spectrum RF Module, which has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules.

In accordance with FCC rules and regulations, Part 15, this is to advise you that if the FCC ID number of the Smart Spread Spectrum is not visible when installed inside your device, then the outside of your device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains FCC ID: MQXB900ss-20." Any similar wording that expresses the same meaning may be used.

In addition the following statement should also be included on an exterior label (or in your documentation, if the unit is too small to accommodate the label) "This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference that may cause undesired operation. "

Adcon's Smart Spread Spectrum Modules are designed as component devices, which require external components to function. The B900ss-20 modules are intended to allow for full Part 15 compliance and are approved by the FCC. The purchaser understands that further approvals may be required prior to the sale or operation of the device, and agrees to utilize the component in keeping with all laws governing its operation in the country of operation. "

In order to comply with the FCC rules and regulations, the B900ss-20 RF Module may only be used with approved antennas that have been tested with this radio. At this writing the only approved antenna is the quarter-wave rubber duck antenna by MAT. If the OEM integrates the MQXB900ss-20 into their final product, where the product utilizes a non-approved antenna, the OEM is responsible for obtaining a separate authorization on the final product.



This wireless transmitter contains a low power transmitter. When in transmit it sends out radio frequency (RF) energy. In August 1996 the Federal Communications Commission (FCC) adopted RF exposure safety guidelines. To maintain compliance with the FCC's RF safety exposure guidelines it is recommended that you remain 2 inches (5 centimeters) away from the antenna while the unit is transmitting. The D900ss-20 Demo Kit comes supplied with a permanently attached antenna. Modifications or attachments could damage the transmitter, alter the RF exposure, and may violate FCC regulations.

Chapter 2. Module introduction

2.1. Description

The B900ss-20 is an FM radio transceiver with frequency hopping using an F.S.K modulation. The receiver is of a super beat oscillator type with heterodyning. It operates on the 902-928 MHz band and, therefore, is within U.S. FCC part 15.247 standard.

Using the frequency synthesis, it has a maximum of 50 channels spaced by 150 kHz and can communicate with equipment via a serial interface with RS-232 standard and TTL levels.

The serial link is completely programmable from 2400 up to 38400 Baud. The radio rate is established at 40 KBits/s.

The B900ss-20 uses the most recent technology of flash memory micro controller, which allows the user to update or to load new features through the serial link.

Many parameters are programmable through the serial link and the default configuration is memorized in an EEPROM (ROM).

At each activation, the radio modem component is programmed with its configuration parameters (Channel, Speed, Protocol, etc.).

The default data are: RS-232 connection at 19,200 Baud, 8 bits, 1 stop bit, no parity, Frequency Table 1, slave modem.

All these parameters are accessible and modifiable with HAYES or AT commands.

2.2. Specifications

2.2.1. General

The B900ss-20 is a radio card component that receives and transmits data according to a frequency table selected by the user.

2.2.2. Specifications of the B900ss-20

Dimensions

Weight:	<2 ozs. (< 50 grams)
Dimensions:	1.57" x 1.69" x .29" (without antenna).
Connectors:	1 14FMS-1.0SP-TF 14 pin connector from JST.

Electronics

• Radio part	
Frequency:	902 to 928 MHz (FCC part 15-247).
Number of channels:	50, channel 0 to 49.
Channel selection:	Frequency hopping, according to a random table of 50 channels. 8 tables are stored in EEPROM memory.
Radio rate:	40KBits/s.
Modulation/Demodulation:	FSK (Frequency Shift Keying).
Bit encoding:	Quad Frequential encoding.
RF sensitivity:	-90 dBm (± 2 dB) at 50 Ohms.
RF power:	+13 dBm (20 mW) (± 2 dB) over 50 Ohms.
Error rate:	10^{-4} to -88 dBm.
Saturation:	Two modules communicate at 0 dBm.
Operating Temp.:	Standard Operation: +32°F to +122°F. (0° to +50° Centigrade)
Storage Temp.:	-40°F to +176°F (-40°C to +80° C)
Relative humidity:	from 20% to 90% RH (without condensation).

- Digital Part

Processor:	FLASH Atmel Micro controller		
Programming:	Upload and download with a PC through the RS232 serial link and a specific interface (Demo Kit D900).		
Program Mem.:	8 Ko of FLASH		
Data Memory:	512 bytes of RAM for stack and data		
EEPROM Memory:	512 bytes for the HAYES parameters (registers S).		
Serial Link:	2400 to 38400 Baud, NRZ format, 5 volts TTL level.		

- Power Supply

Supply voltage:	5V monitored ($\pm 5\%$).		
Consumption:	Receive <40mA	Transmit <80mA	Sleep <5mA

- HAYES Commands:

The user can program all the parameters. A Windows programming software is supplied "on-line" with documentation support. (See AT commands).

Examples of Hayes commands:

Serial:	Serial link rate, parity, bit count, stop bit count, Serial Time-out, ...
Radio:	Channels table selection, retry count, ...
Mode:	Point to Point, Network, Stand-by, etc.

- Performance range

Length of com.:	164 to 328 Feet (50 to 100 meters) in difficult environment (buildings, reinforced concrete) 984 to 1,312 Feet (300-400 meters) in open environment (Ground level). 3,281 Feet (1 Km) in view and in height (example: between buildings)
Obstacles Impact:	Walls, trees, obstacles can strongly reduce the range

2.2.3. Schematic

See Appendix 1 for the principle schematics and the physical description of the card.

2.3. Available Configuration

2.3.1. Software Configuration

The B900ss-20 has 3 operating modes managed by the WinB900 Software (See Chapter 3):

- "Hayes".
- Point-to-Point.
- Network (future)

2.3.2. Hardware Configuration

All the B900SS product radio modules are delivered with the necessary software for operation. An evaluation Demo Kit (D900SS-20) is available at Adcon and allows the user to evaluate the radio module's performance. For more information, refer to Appendix 4.

With each radio module, the following is available:

- Series of programming ASCII messages to integrate the radio modems with a serial link.
- A Windows configuration and test software programming the radio modules and testing the links (quality, distance, shadow area, etc.).
- A set of reference material available in CD-ROM.

Chapter 3. *Basic Operation*

3.1. *General*

The B900ss-20 can operate with three data communication modes:

- "Hayes": inspired from the standard Hayes for voice modems, it is used to program the modem's parameters.
- "Point-to-Point": Two B900ss-20 replace a cable (the Half-duplex operation copies the function of an RS-485 cable). This mode automatically handles the data security (encapsulation, iterations, etc.)
- "Network": Several B900ss-20 can work together, in accordance with a Client/Server structure. A Server will then be able to handle up to 16 clients simultaneously.

3.2. *"Hayes" Mode*

The Hayes commands used by the radio module are in conformity with the Hayes protocol standard used for the voice modems. This protocol is based on the following principle: A data frame always starts with the two ASCII characters "AT" for "ATtention". The commands follow and are coded on one or several characters eventually with additional data.

Since the B900ss-20 does not operate exactly like a voice modem, it includes additional "AT" codes.

These commands are principally used to read and write the data in the configuration registers stored in EEPROM.

3.3. *"Point-to-Point" Mode*

In this mode, two B900ss-20 Modems can communicate together without getting any interference with other Modems.

For this purpose, their work is synchronized and constantly jumping frequency, avoiding interference with another transmitter: if one or more channels are busy, the data will be transmitted through another channel.

On the other hand, a "Personal Network" owns each set of modem. The data used for a "Personal Network" cannot be intercepted by another "Personal Network". Each "Personal Network" owns a Master, which handles the communication (synchronization, priority, etc.) and a Slave that obeys its Master.

The first synchronization is named "Acquisition", and lets a Slave get acquainted with its Master (No. of Personal Network, Frequency Table used, etc.). Eventually, at each powered reset, the Slave will synchronize, then later be able to communicate with its Master. A "Lock" signal shows if a Slave has been synchronized with its Master or not.

Eventually, this synchronization is maintained all along the Master/Slave Dialogue.

A hardware flow control (RTS/CTS) is present on the Modems serial link in order to let the user know that the buffer (130 characters) starts to saturate. The alarm level is by default 130 characters and can be programmed through the S215 Register.

Finally, an Ack_Tx signal, synchronized on the RTS signal, allows the transmitter user to know if the receiver user has received a data frame or not.

For more specific information and to get the Time Series Charts, see the following chapter ("Advanced Part") and the Appendix 5.

3.4. *"Network" Mode*

In this mode, several B900ss-20 Modems are able to communicate with each other. Therefore, they constitute a Network handled by a Server Modem that can hold up to 16 Client Modems (6 in the actual V0.2 version).

The acquisition procedures, the modems synchronization and the RTS/CTS and Ack_Tx signals handling are the same as for the "Point-to-Point" Mode.

On the other hand, when a frame is sent, it is necessary that a character indicating the receiver modem number precedes the data frame. Also, in receiving the frame, a character preceding this frame indicates the transmitter modem.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference that may cause undesired operation.

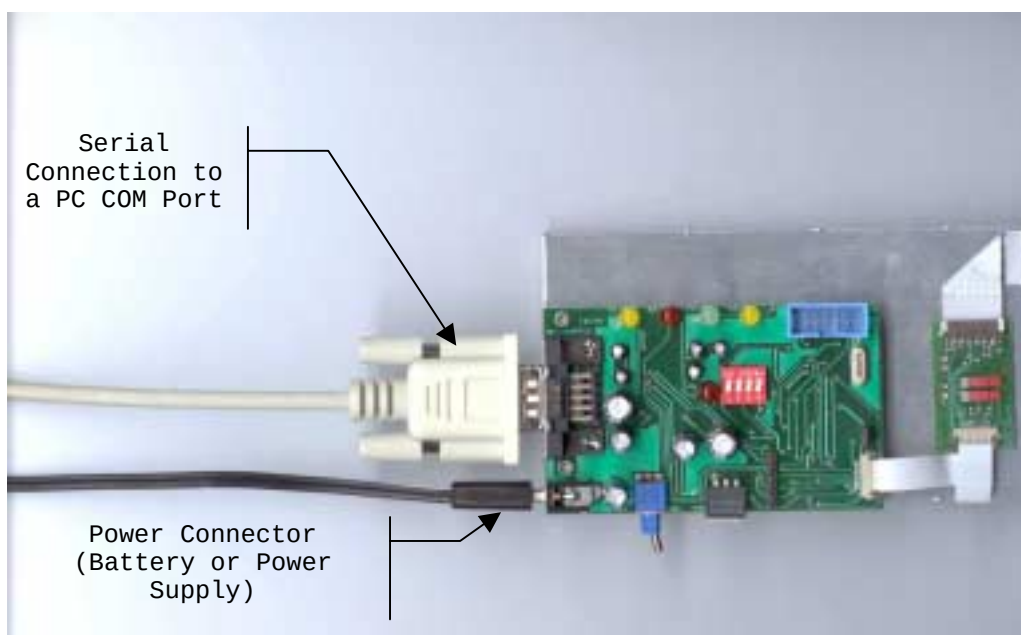
3.5. Demo Kit Utilization

3.5.1. Installation and Connection

A D900SS-20 Demo Kit includes a plate that holds the B900ss-20 radio module, the antenna and the RS232 interface card.

In order to use it, connect the plate to a PC's COM Port through the supplied serial cable and connect the power supply (see picture).

On the interface card, ALL the switches have to be set to 'Off' and, of course, the On/Off switch has to be on the 'On' position.

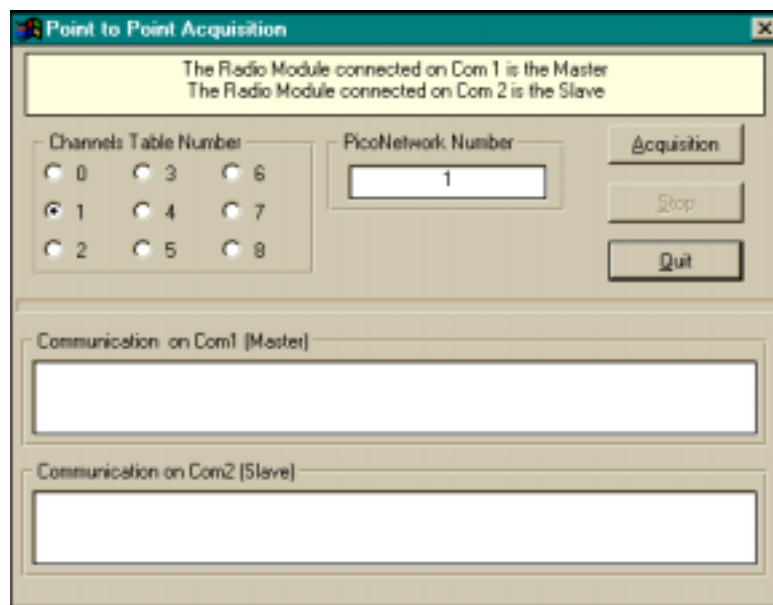


A Windows Software, 'WinB900' parameterizes and tests the B900ss-20 radio module. In order to install it on your PC, launch 'Setup.exe' located on the CD-ROM supplied in the Demo Kit, in the WinB900ss directory.

3.5.2. WinB900 Software Utilization in Point-to-Point Mode

The WinB900 Software can have two radio modules communicate between the COM1 and COM2 Port of a PC.

In a first phase, the two modems have to recognize each other ("Acquisition"). Go in the "Quick Configuration" Menu, to the "Acquisition" Option. When this option is selected, the software displays the following screen:



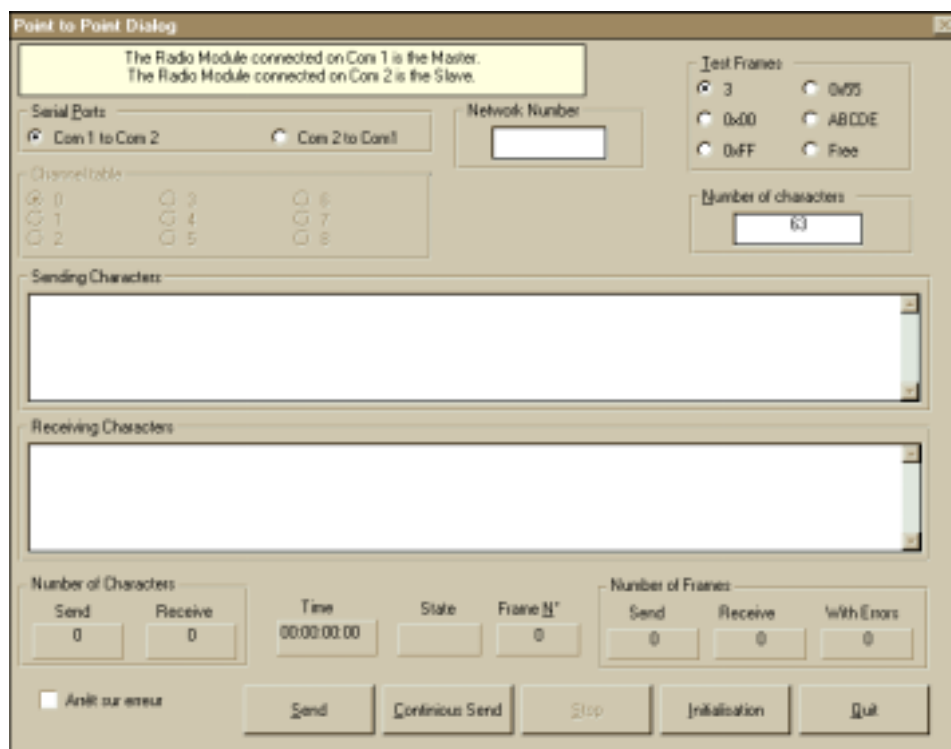
Select the table of the chosen channels as well as the No. of Personal network (between 1 and 65535), and then launch the Acquisition clicking on the "Point-to-Point Acquisition" button.

After clicking the button, the following message appears:



You can then quit the window. The Modems are synchronized (Green Led on).

Consequently, you can communicate between the two Modems with the 'Point-to-Point Dialogue' Option from the "Quick Configuration" menu. When this option is selected, the software displays the following screen:



The different fields and buttons are described below:

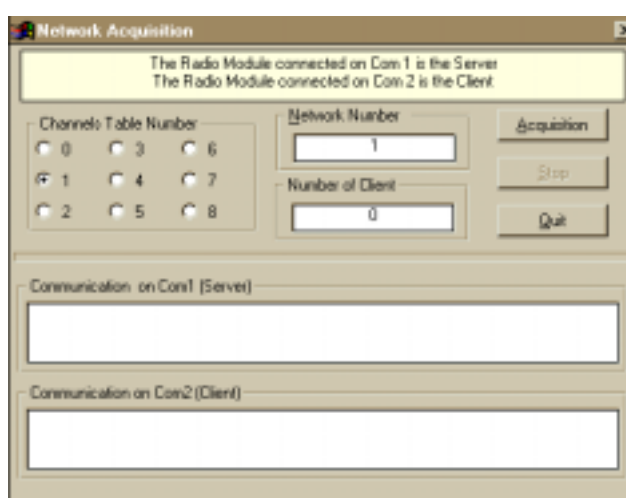
- "Sent Characters" Field
This side of the window sends the data entry.
- "Received Characters" Field
This side of the window shows the received data.
- "Test Frames" Selection
This selection allows the selection for the type of character sent. For example, 0x00 sends a character frame only made of a 0x00 binary character. If the "Free" frame type is selected, the frame can be typed by the user in the "Sent Character" field. This frame will then be sent.

- "Characters Count" Field
This field allows the selection of the character count to be sent if the selected test frame type is any other than "free".
- Button: "Send"
This button sends the frame entered previously to the Characters section to be sent.
- Button: "Continuous"
This button sends continuously the frame entered previously to the Data section to be sent.
- Button: "Initialization"
This button reinitializes all the counter fields (Elapse Time, Character Count, Frame Count, etc.)
- Button: "Stop"
This button stops a continuous upload.
- Button: "Quit"
This button leaves this window and returns to the main menu.
- "Character Count Sent/Received" Fields
These fields show the sizes of the sent and received frames.
- "Elapsed time" Field
This field shows how long it takes the modem to upload the same frame during a continuous upload.
- "Sent/Received/Corrupted Count" Fields
These fields show the amount of frames correctly uploaded, downloaded or corrupted (or not received) since the start of a continuous upload.
- "Stop on Error" Selection
This selection stops automatically the continuous upload if a frame is corrupted.

3.5.3. Use of the WinB900 Software in Network Mode

The operating principle is similar to the Point-to-Point Mode.

In a first phase, the two modems have to recognize each other ("Acquisition"). Go in the "Quick Configuration" Menu, to the "Network Acquisition" option. When this option is selected, the software displays the following screen:



It should be noticed that if the Modem already holds a Network Number and Clients, these two pieces of information will display in the "Network No." and "Clients Count". If the Network No. is modified, the Server will then lose all the Clients already acquired.

Acquisition can be launched by clicking on the "Acquisition" button. After this, the following message is displayed:



You can then quit the window. The Modems are synchronized (Green Led (On)).

You can then communicate between the two Modems with the 'Network Dialogue' Option from the "Quick Configuration" Menu. When you pick this option, the software displays the following:

The different fields and buttons are similar to the ones described in the previous paragraph at the "Point-to-Point Dialogue" window. Only two new fields appear:

- "Network Number"
This field indicates the Network No. in the Server (COM1).
- "Client Number"
This field indicates the Modem No. in the Client (COM2).

3.5.4. Use of the "Terminal" or "HyperTerminal" Software

The Demo Kit or the B900ss-20 radio modules can also be handled from a Windows "HyperTerminal" or "Terminal" type communication software.

The software has to be configured, in order to communicate at 19200 Baud, 8 bits, no parity, 1 stop bit through a Serial link. To start with a correct configuration for HyperTerminal and Terminal, the following directories are provided:

- "B900-CM1.ht" for "HyperTerminal" on COM1.
- "B900-CM2.ht" for "HyperTerminal" on COM2.
- "B900-CM1.trm" for "Terminal" on COM1.
- "B900-CM2.trm" for "Terminal" on COM2.

In this case, if your modems have already been configured and already been "Acquired", you can send data frames with these software immediately. Otherwise, refer to Chapter 4 (Advanced Operation) to know how to use the Registers.

Chapter 4. Advanced Operation

4.1. General

The section "Basic Operation" showed us how to operate the B900ss-20 Radio Module and its D900SS-20 Demo Kit.

This section's objective is to know the module more completely; particularly the Hayes commands necessary to handle the modem.

4.2. "Hayes" Protocol Commands

4.2.1. General

These commands configure the Modem assigning different values in the registers (S200 and next). They also enable the user to know the state of the registers and the version of the modem software. These frames can only be sent if the CTS signal is active except when in Acquisition Mode.

These commands support the 'Hayes' protocol used by the voice Modems. **When a command is sent, it always has to be preceded by the 'AT' characters (ATtention). When a command has been sent, it always has to be followed by the <CR> character (carriage return, Hexadecimal 0x13 code).**

NOTE: The time slot between two characters of the command has to be inferior to Time-Out (S214). As a result, the commands have to be sent by block:

A	T	Command	Additive command	...	<CR>
---	---	---------	------------------	-----	------

The sole exception is the passing command from the Operation Mode in progress to the Hayes Mode: In this case, the escape code ('+++') has to be followed and preceded by a silence period that lasts at least the same as time out. In this case only, the command will neither be preceded by AT, nor followed by <CR>

These commands are described in detail in the next chapter.

4.2.2. Description of the standard commands

Here is a description of possible commands:

- '+++': Running in Hayes Mode.**
 This command allows the user to return to Hayes Mode when the Modem is in "Point-to-Point" Mode. It cannot be preceded by AT, only by an idle time (blank) that can be set through the S214 register for the duration.
- NOTE: When the Modem runs in "AT" Mode, it is no longer in radio receiver.
- 'ATO': Running in "Point-to-Point" Mode.**
 This command allows the user to run the Modem in "Point-to-Point" Mode. To retrieve the "Hayes" Mode, send out the sequence '+++'.
 These parameters are saved in EEPROM Memory and automatically reloaded during a reset or when powered up.
- 'ATSn?': Display of the S Number n Register content.**
 The content of the B900ss-20 operating parameters are found in named 'S' registers, and are numbered as described in Chapter VII- 3. Some parameters are standard for all the Hayes Modems; others are specific to B900ss-20.
 (See Table in Appendix 6).
- If the requested register is correct, the modem responds: "Sxxx=yyy" with xxx: register number and yyy: register content.
 If the requested register is incorrect, the modem responds with the error character 'E' (0x45).
- 'ATSn=m': Assignment to the m Value at the S Register n Number.**
 Loading of a parameter in a register. This parameter is automatically saved in EEPROM Memory.
 The n and m values are given in ASCII coded decimals. If the assigned register is correct, the modem responds with the OK character 'O' (0x4F).
 If the assigned register is incorrect or if the value goes over the limits of this register, the modem responds with the error character 'E' (0x45).
- 'AT/S': Content Uncoded Display of all Significant Records.**

All the Modem significant registers (radio configuration, serial configuration, operating mode...) are sent on the serial link uncoded, ready to be displayed using a software such as "Terminal" for Windows. The response is a list of all the used registers with their value, each register being separated from the other with the "Carriage Return" character (CR): "S200=xx<CR>S201=yy<CR>...."

'AT/V': Uncoded Display of the Modem Software Version.

The information on the version number, conception date and the program CRC are sent to the uncoded serial link, ready to be displayed using a software such as "Terminal" for Windows.

The response is as follows: "Version: x.xx<CR> Date: MM/JJ/AAA<CR> CheckSum: 0xhhhh<CR>"

'ATM1': Running in Acquisition Mode.

This command allows to toggle from Normal Mode to Acquisition Mode. The Modem is in Normal Mode by default.

If the command is given correctly, the modem responds with the OK character 'O' (0x4F), otherwise with the error character 'E' (0x45).

'ATPx': Running in Standby or Normal mode.

This command allows the user to toggle from Normal Mode to Standby Mode and vice versa, according to the 'x' value. The Modem is in Normal Mode by default.

Then there is: x = '0' → Normal,

x = '1' → Standby.

If the command is correctly given, the modem responds with the OK character 'O' (0x4F), otherwise with the Error character 'E' (0x45).

'ATR': Parameters Reset.

This command allows the user to reprogram ALL the stored EEPROM registers and give them their value by default.

If the command is correctly given, the modem responds with the OK character, 'O' (0x4F), otherwise with the Error character 'E' (0x45).

4.2.3. Registers Description

This section is available in Appendix 6.

4.3. Utilization Example

4.3.1. Acquisition of two Point-to-Point Modems

To send the following commands to the Modem, it is necessary to use software such as HyperTerminal for Windows.

- Parameterization of the "Master" Modem" :

```
User:          +++                      /* run in Hayes Mode. */
Modem response: O<CR>

User:          ATS200=3<CR>            /* Choice of Frequency table 3. */
Modem response: O<CR>

User:          ATS201=0<CR>            /* Choice of No. 1 Synchronization
Modem response: O<CR>                    Frequency. */

User:          ATS202=10<CR>           /* Choice of No. 2 Synchronization Frequency. */
Modem response: O<CR>

User:          ATS203=20<CR>           /* Choice of No. 3 Synchronization Frequency. */
Modem response: O<CR>

User:          ATS204=30<CR>           /* Choice of No. 4 Synchronization Frequency. */
Modem response: O<CR>

User:          ATS220=2<CR>            /* Choice of Master Mode. */
Modem response: O<CR>

User:          ATS250=1<CR>            /* Choice of Personal Network No. */
Modem response: O<CR>

User:          ATM1<CR>                /* Run in Acquisition Mode */
Modem response: O<CR>
```

The user now must configure the Slave Modem (see next page). Once this configuration has been done and the "ATM1" command activated, they acquire themselves and the Master Modem returns: S252=1<CR> /* Indicates Acquisition done */

```
User:          AT0<CR>          /* Run in Point-to-Point Mode */
Modem response: O<CR>
```

- Parameterization of the "Slave" Modem:

Before parameterizing the Slave Modem, the Server must have been configured and must be in Acquisition Mode.

```

User:          +++                /* Run in Hayes Mode. */
Modem response: O<CR>

User:          ATS200=3<CR>       /* Choice of the Frequency Table 3. */
Modem response: O<CR>

User:          ATS201=0<CR>       /* Choice of No. 1 Synchronization Frequency. */
Modem response: O<CR>

User:          ATS202=10<CR>      /* Choice of No. 2 Synchronization Frequency. */
Modem response: O<CR>

User:          ATS203=20<CR>      /* Choice of No. 3 Synchronization Frequency. */
Modem response: O<CR>

User:          ATS204=30<CR>      /* Choice of No. 4 Synchronization Frequency. */
Modem response: O<CR>

User:          ATS220=3<CR>       /* Choice of Slave Mode. */
Modem response: O<CR>

User:          ATS250=0<CR>       /* Indicates Uncoded Slave (No Personal Network No.).
*/
Modem response: O<CR>

User:          ATM1<CR>          /* Runs in Acquisition Mode */
Modem response: O<CR>

```

At this time, the two Modems have to acquire themselves, and the Slave Modem sends:

```

Modem response: S250=1<CR>S252=1<CR> /* Indicates Acquisition
done */

User:          AT0<CR>          /* Runs in Security Transparent Mode */
Modem response: O<CR>

```

4.4. Radio Test Commands

These Special AT commands are integrated in the B900ss-20 in order to measure in continuous emission, and are primarily used during radio tests (radiated power, line width, etc.) to respect the Part15-247 FCC standard.
It stops when any character is sent:

- ATT0: Transfer of a pure carrier with the frequency chosen by the channel command.
- ATT1: Transfer of a modulated carrier '00'.
- ATT2: Transfer of a modulated carrier '01'.
- ATT3: Transfer of a modulated carrier '10'.
- ATT4: Transfer of a modulated carrier '11'.

NOTE: the character <CR> follows each command.

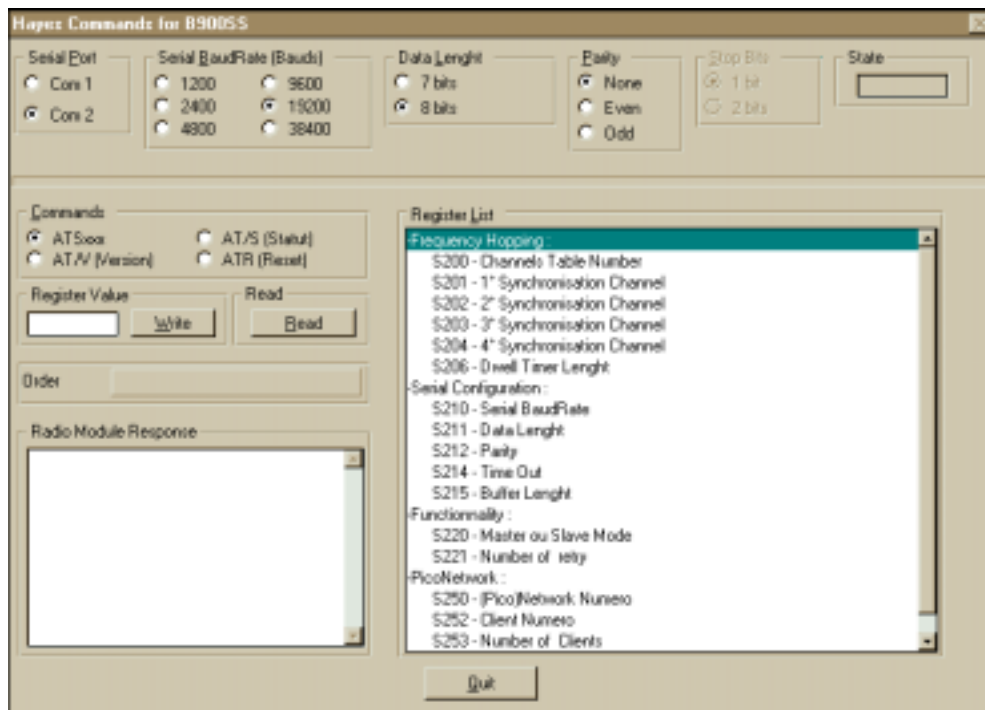
4.5. Utilization of WinB900

4.5.1. Hayes commands

The parameterization with the Hayes commands can be simply done with the WinB900 software.

The option "Hayes Commands" of the "Advanced Configuration" allows to perform all of the Hayes Commands on the modems connected to the PC.

When this option is selected, the software displays the following window:



The top section allows the user to select the port to work on and describes the state of the serial link (speed, parity, etc.). The serial link state is not directly modifiable: It will follow the evolution of the values in S210 to S213 registers.

The bottom end sends Hayes commands. All the Registers are present with the content explanation for each of them.

There are four types of possible manipulation:

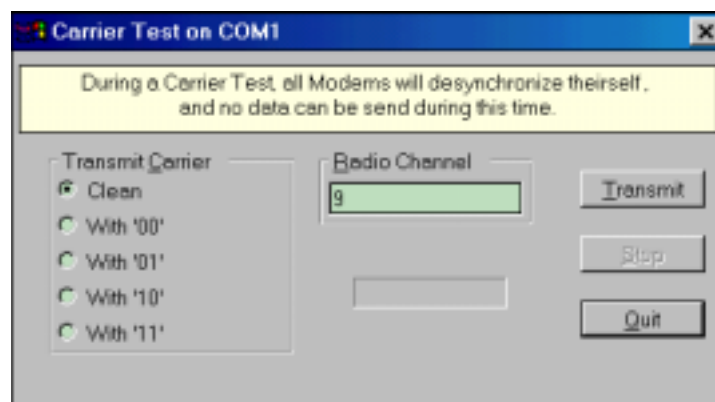
- ✎ Read/Write on the Registers: Select the "ATSxxx" option in the "Available Commands", then select the required register clicking on it in the "Registers List".
 - If you want to read a register, click now on the "Read" button. The "Syntax" window will display the sent command while the "Radio Module Response" window will display the B900SS response.
 - If you want to write in a register, indicate the value that you want to give to this register in the "Register Value" window, then click on the "Write" Button. The "Syntax" window will display the sent command while the "Radio Module Response" window will display the B900SS response.
- ✎ Read the Firmware Version: Select the "AT/V" option in the "Available Commands", then click on the "Read" button. The "Syntax" window will display the sent command while the "Radio Module Response" will display the B900SS response.
- ✎ Read the Status Information: Select the "AT/S" option in the "Available Commands", then click on the "Read" button. The "Syntax" window will display the sent command while the "Radio Module Response" window will display the B900SS response.
- ✎ Registers Reset to the default value: Select the "ATR" option in the "Available Commands", then click on the "Read" button. The "Syntax" window will display the sent command while the "Radio Module Response" will display the B900SS response.

4.5.2. Test Commands (Future software option – Not available at this time)

Carrier Transmission Tests can also be simply realized with the WinB900 Software.

The "Carrier Test" option of the "Advanced Configuration" Menu allows to test Carrier Transmission from a radio module.

When this option is selected, the software displays the following window:



- "Carrier Transmission" Selection

Through this window, it is possible to transmit several types of carrier to check the power and the signal modulation. Here are the following Carrier's choices:

- Pure
- Modulated at '00'
- Modulated at '01'
- Modulated at '10'
- Modulated at '11'

Remark:

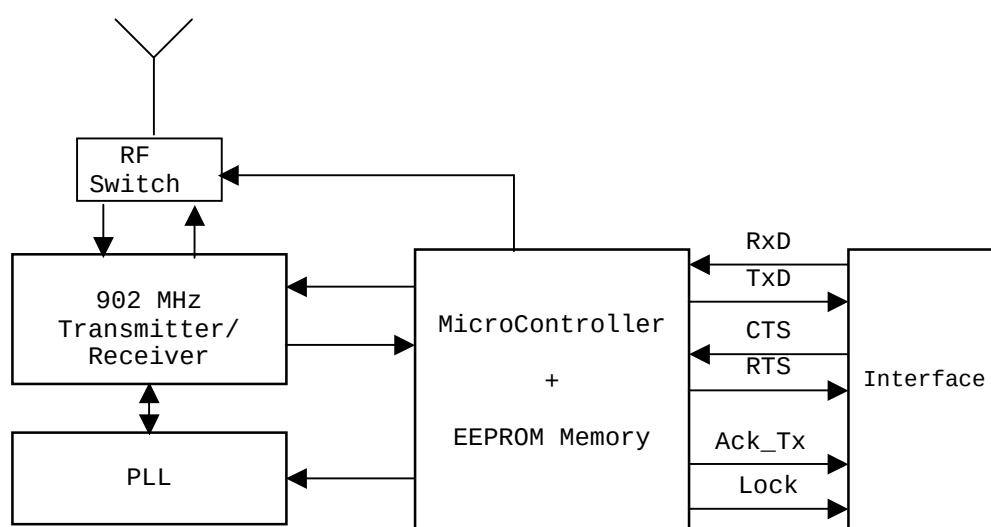
If a transmission is in progress and you want to change the carrier type, it is imperative to stop the transmission before selecting another carrier, otherwise your change will not take effect

- "Radio Channel" Field

This Field available for input specifies the radio channel where the selected carrier will be transmitted from.

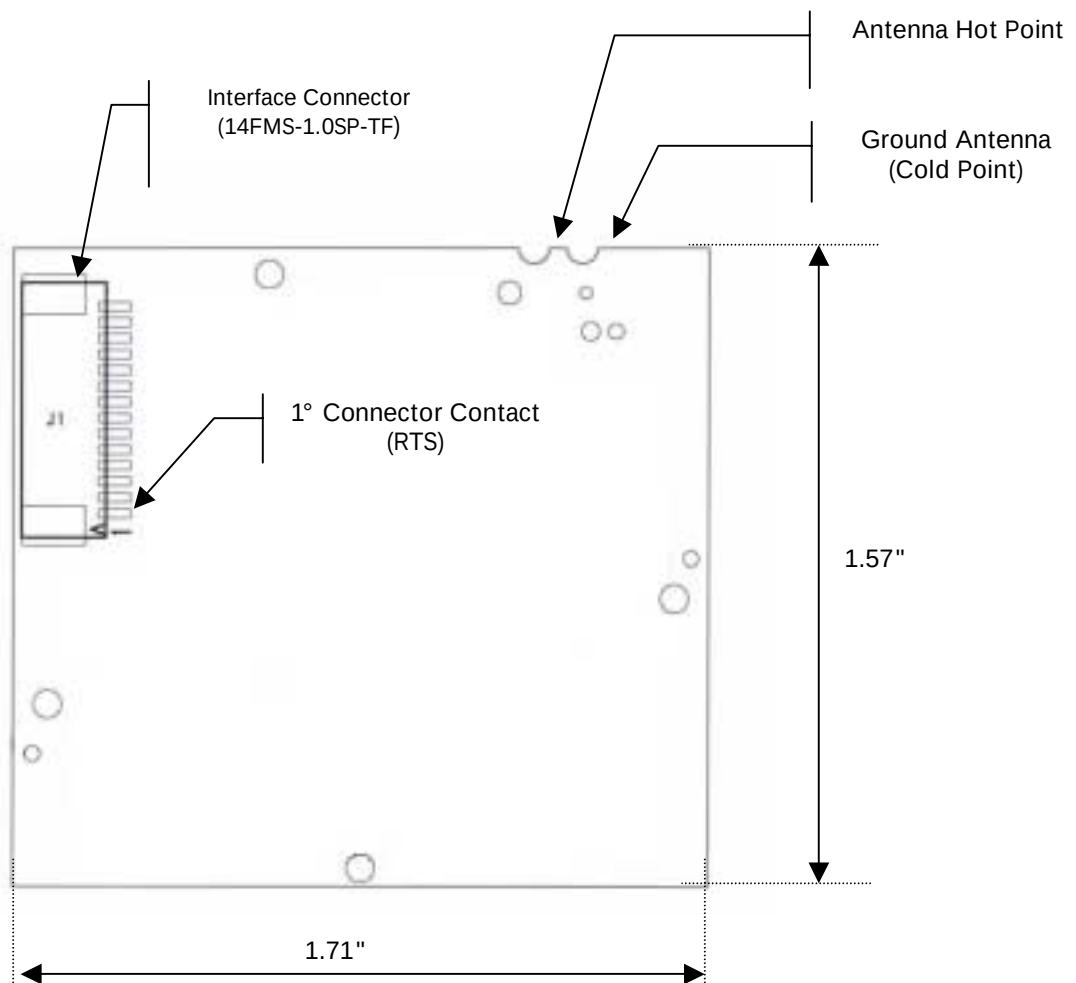
- "Transmission" Button
This button allows initiating the selected carrier transmission based on the chosen channel. When this button is selected, a red rectangle appears indicating that the modem is transmitting.
- "Stop" Button
This button stops transmitting the selected carrier.
- "Quit" Button
This button returns to the Main Window.

Appendix 1: Schematic Block Diagram



Appendix 2: Mechanical Drawings

Drawing of the B900ss-20 Card



WARNING : In the "Rev. A" version of the card, the 1° connector contact of the J1 interface (corresponding to the RTS Signal) is "below", as shown on the schematic. In future ("Rev. B, Rev C, etc." versions, the 1° connector contact of the J1 interface (corresponding to the RTS Signal) will be "above", meaning on the opposite side of its actual position.

Interface Signals

The Modem will communicate with the host through an interface with the following signals:

Bus Pin	Interface Function	Signal direction μC*	μC Function
1	RTS Or Data Out SPI ⁽¹⁾	O	RTS → Request To Send Data Out SPI → Data out during the programming of the Flash Program.
2	Ack_Tx Or Clock In SPI ⁽¹⁾	I/O	Ack_Tx → Transmission Ok Clock In SPI → Clock In during the programming of the Flash Program.
3	N.U.	-	-
4	RXD	I	RxD UART - Serial Data Reception
5	CTS Or Data In SPI ⁽¹⁾	I	CTS → Clear To Send Data In SPI → Data In during the programming of the Flash Program.
6	TXD	O	TxD UART - Serial Data Transmission
7	VDD	-	5 volts power for digital ("noisy").
8	LOCK	O	Network Synchronization Ok.
9	RESET	I	External Reset. Also used during the programming of the Flash Program.
10	GND	-	Ground
11	N.U.	I	-
12	N.U.	I	-
13	N.U.	I	-
14	N.U.	I	-

⁽¹⁾: SPI hardware only in slave. The user is connected to this bus only in Flash/EEPROM Programming: In this case, the RESET signal has to be on.

*I = Input O = Output

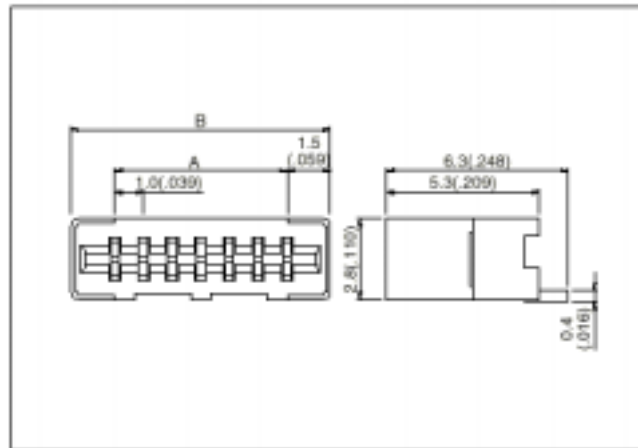
NOTE: The connector used is the 14FMS-1.0SP-TF 14-pin manufactured and distributed by JST.

Signals Description

N.U.:	Not used. By default, these signals are linked to the micro-controller, configured at input but are not actually used.
LOCK:	Solely used on the Portable: Indicates that the synchronization with the Base is valid. Latter indicates if the Server is at radio range. Active on high.
RESET:	Reset hardware of the modem card. Maximum Duration: 200 ms. Active on low.
ACK_TX:	Indicates that the buffer transmission has been executed correctly. This signal is valid at the end of the transmission of a radio message (Active RTS Signal) and is kept until RTS returns to inactive. Active (buffer transmitted) on low.
xx SPI:	Signals for the Flash or the EEPROM programming of the Modem from the host. There are three signals: Data In, Data Out and Clock. When the host wants to read and/or modify the EEPROM, the modem must absolutely be in reset by activating the RESET Signal.
CTS:	Clear To Send: signal into the Modem. Indicates if the Modem can send serial data to the User (Active on low) or not (Inactive on high).
RTS:	Request To Send: signal going out of the Modem. Indicates that the user can transmit serial data (Active on low) or not (Inactive on high). This signal switches when the serial reception buffer's filling rate reaches a programmable threshold (S215) or when the user finished to transmit serial data (out on Time-Out).
TxD, RxD:	Serial link signals in NRZ/TTL format. TxD is for the data <u>going out</u> of the Modem while RxD is for the data <u>coming into</u> the Modem. Le logic '1' is represented by high.

Connector Drawing

The selected connector is the 14FMS-1.0SP-TF from the JST Manufacturer. It is a CMS and non-ZIF (Zero Insertion Force) 14-pin angled connector with a spacing of .039".

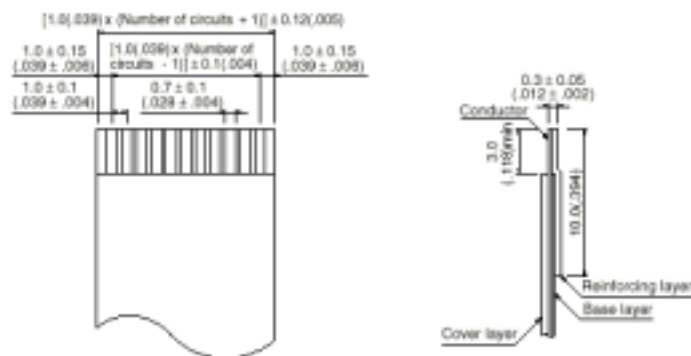


With:

Connector	A (inch)	B (inch)
14FMS-1.0SP-TF (14-pin)	.511	.630

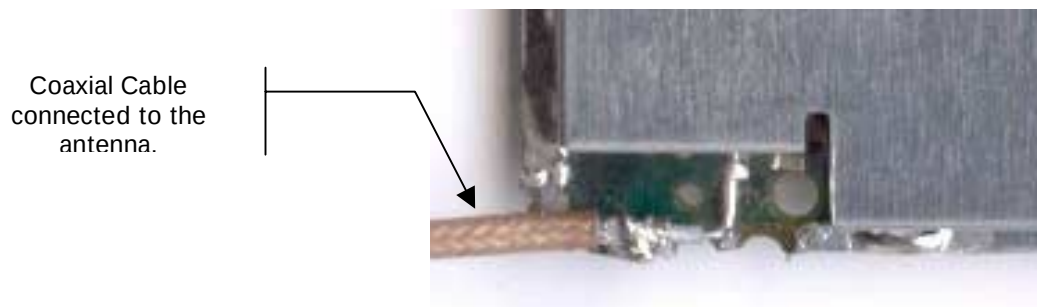
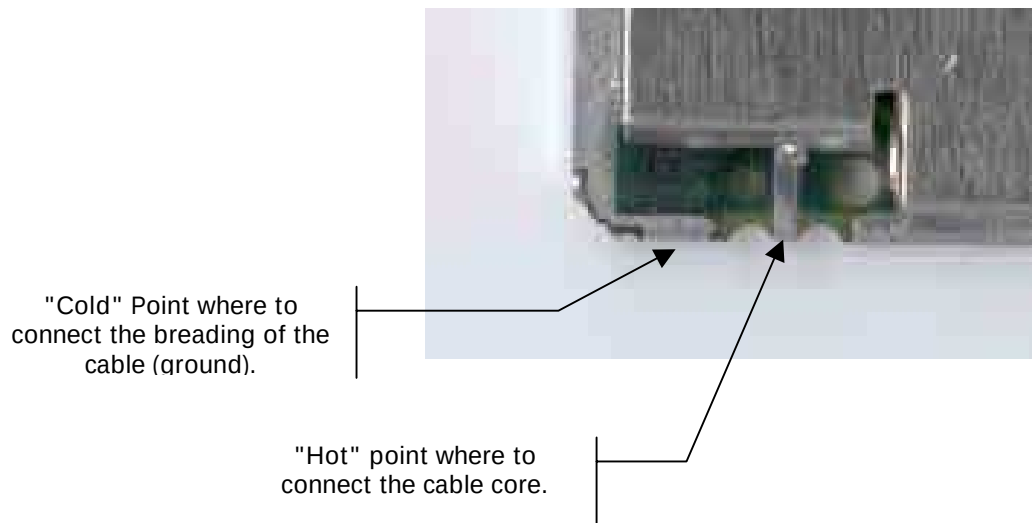
Connecting Cable Drawing

The associated cable should have the following dimensions:



Appendix 3: Antenna Connection

Here is an example of the coaxial cable connection of the 900MHz antenna provided with the Demo Kit. The hot and cold point can easily be seen before and after soldering the cable.



Appendix 4: D900SS-20 Demo Kit

Composition

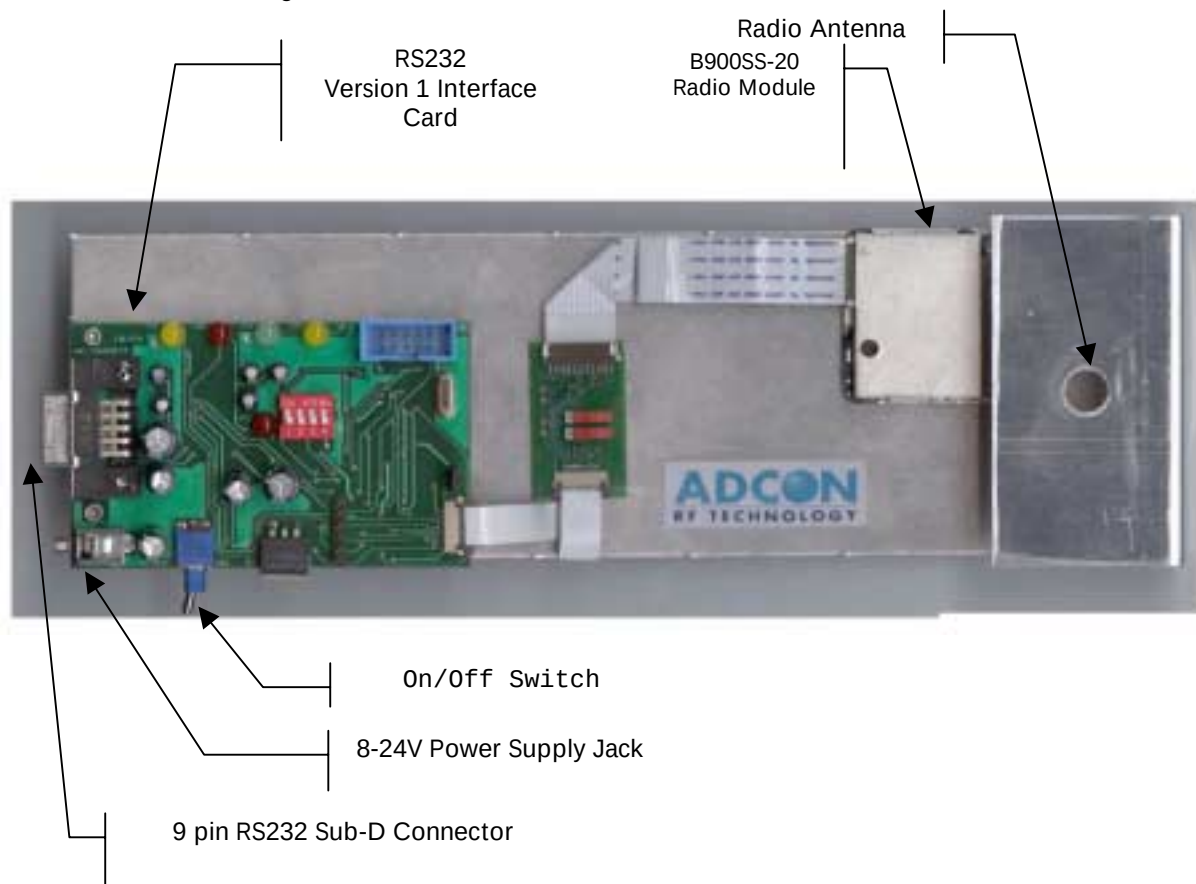
The D900SS-20 Demo Kit is used to test with ease the B900ss-20 radio module.

For this purpose, this kit connects a radio module to a serial interface in order to be able to work with the radio module without having to develop a specific interface.

In addition, Windows configuration and test software is included with the kit and allows working with the radio module immediately.

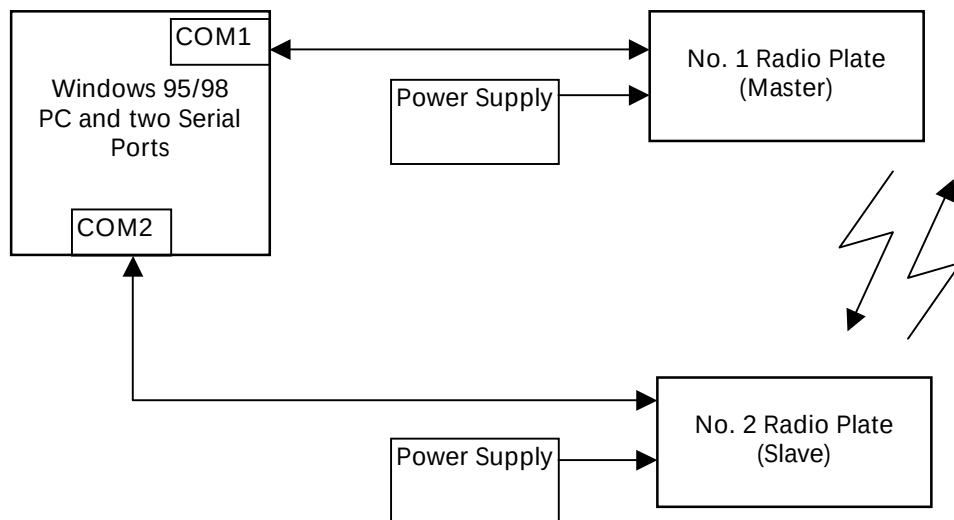
In a case, each D900SS-20 Demo Kit includes:

- Two metallic plates, with:
 - ✓ 2 900 MHz antenna,
 - ✓ 2 B900ss-20 radio module,
 - ✓ 2 interface cards connecting B900ss-20 and RS232,
- Two power supplies
- Two 9V batteries, allowing to manage without sector during field tests,
- A CD-ROM including this document in PDF Format and the "WinB900" Test and Configuration Software for Windows.

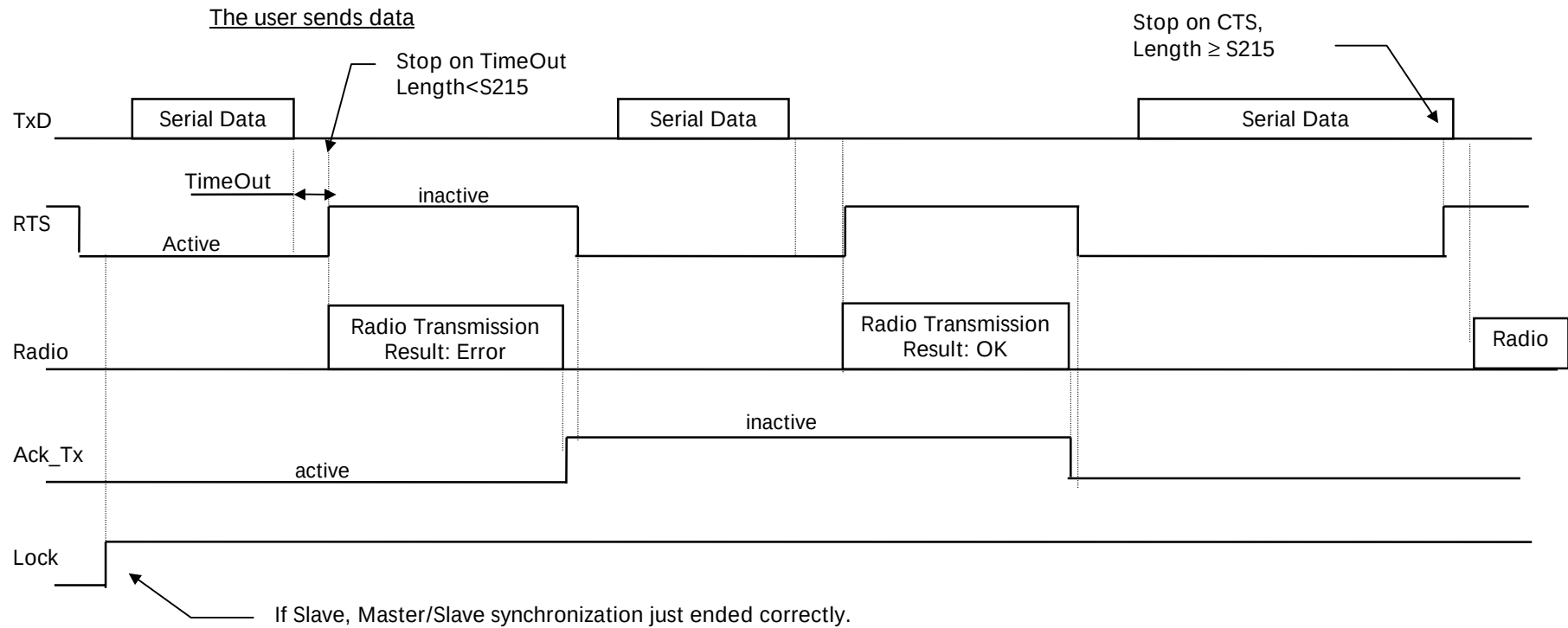


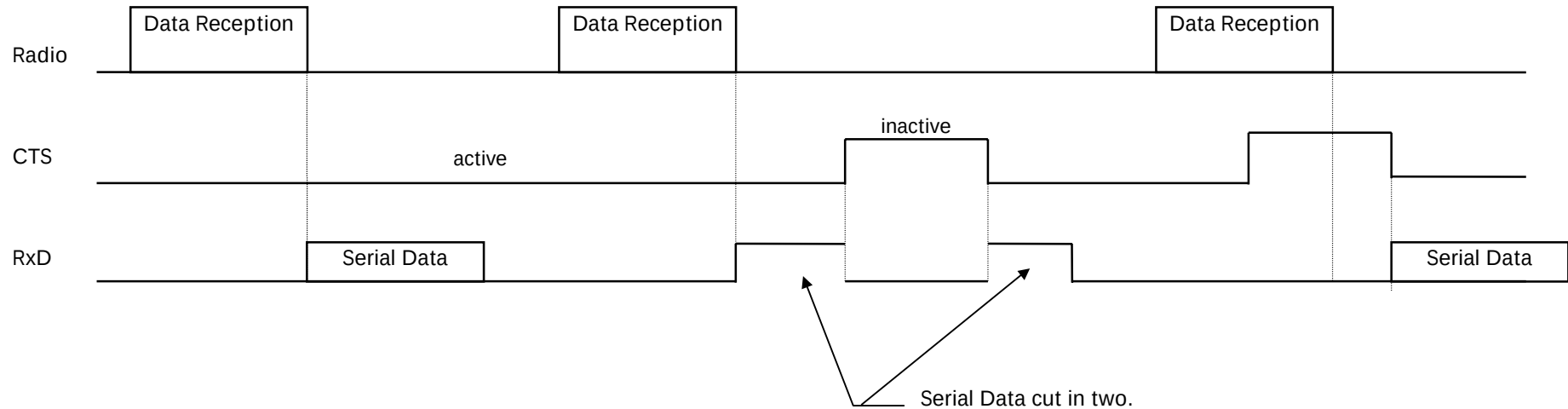
Connections

Here is how to make the connections to the Demo Kit in order to operate them with the WinB900 Software:



Appendix 5: Timing Diagrams



The user Receives data

The CTS signal indicates that the user reception buffer is full. Therefore, the modem does not send data on the serial link during that time. However, the basic radio operation (synchronization, signal lock, etc.) and the data transmission on the radio (with data reception on the serial link) continues to operate normally. On the other hand, if another modem sends a data frame on the radio, this radio frame is not handled (and then not acknowledged). The Transmitter Modem considers this radio frame as lost and indicates it to the user. (Ack_Tx signal).

It would be better to avoid making the CTS inactive as much as possible.

Appendix 6: Description of the registers

Registers used by the 'AT' protocol

This section shows a list of all the registers that configure the modems with software such as HyperTerminal for Windows.

The B900ss-20 modem will offer several facilities of possible settings.

Each parameter will be in a register and will have a default value that can be changed in sending the command 'ATSxxx=yy' (Hayes command). Also, the parameter value will be read when sending the command 'ATSxxx?'.

These parameters are stored in the EEPROM memory and will be available as soon as powered up.

NOTE: Access Type: 'R' Read and/or 'W' Write.

Access Type	Register	Name	Description
		Frequency Jump	
R/W	S200	No. of Used Frequency Table	Between 0 and 8. When Table 0 is selected, the channels remain the same and stay on the selected channel in S201 (used for the tests). Default: 1.
R/W	S201	First Frequency reserved for the synchronization.	Between 0 and 49. Has to be different from S202, S203 and S204. Default: 0.
R/W	S202	Second Frequency reserved for the synchronization.	Between 0 and 49. Has to be different from S201, S203 and S204. Default: 15.
R/W	S203	Third Frequency reserved for the synchronization.	Between 0 and 49. Has to be different from S201, S202 et S204. Default: 30.
R/W	S204	Fourth Frequency reserved for the synchronization.	Between 0 and 49. Has to be different from S201, S202 et S203. Default: 45.
R	S206	Dwell Timer Length	Calculated based on the serial connection speed (S210), the buffer size (S215) and the Client Count (S253). Given in milliseconds. Default: 110 ms (38400 Bd/130 Bytes/1 client).

Access Type	Register	Name	Description
		Serial Link	
R/W	S210	Speed.	Indicates the speed on the Serial Connection '2': 2400 Baud. '3': 4800 Baud. '4': 9600 Baud. '5': 19200 Baud (Default). '6': 38400 Baud
R/W	S211	Data Bits (*)	Serial Link Data Bits. '7': 7 bits. '8': 8 bits (Default).
R/W	S212	Parity (*)	Indicates Serial Link Parity Type: '1': None (Default). '2': Even. '3': Odd.
R/W	S214	Serial Link Time Out	Time_Out in milliseconds. Between 2 and 100 milliseconds. Default: 5 ms.
R/W	S215	Buffer Size	Indicates the maximum size of the frames that will be given to the Modem. When this size is reached, the modem resets the CTS signal. It has to be inferior to the physical size of 130 Bytes. Default: 130 Bytes.

(*): The parity control requires some constraints and the serial configuration described below can be reset:

S211	S212	Description
8	1	8 bits, no parity, 1 stop bit (8,N,1)
8	2	8 bits, even parity, 1 stop bit (8,E,1)
8	3	8 bits, odd parity, 1 stop bit (8,O,1)
7	2	7 bits, even parity, 1 stop bit (7,E,1)
7	3	7 bits, even parity, 1 stop bit (7,O,1)

Access Type	Register	Name	Description
		Operation	
R/W	S220	Server or Client Mode	Indicates the operation of the Modem. When the Modem is configured as Master (or Server), the S252 Register switches automatically to 0xFF, while it switches to 0 when configured as Slave (or Client). '0' : Server (Network), '1' : Client (Network), '2' : Master, '3': Slave (Default).
R/W	S221	Recovery Count	Maximum recovery count in case of problems (Non-Ack response to a message). If this Register is at 0, the frames are not checked and considered as still good (used for the tests). Default: 2.
		Personal Network Control	
R/W	S250	Number of Personal Network (or Network)	This register gives the Personal Network (Network) number on 2 Bytes. Only the two members of a same Personal Network can communicate with each other. Between 0 and 65535, it is at 0 when the modem is not reset. <u>NOTE:</u> To reset the register to 0 also resets the S252 Register to 0. Default: 0.
R	S252	Modem Number	Gives the Modem a unique number for a given Personal Network. Number on one Byte is 0 when the Modem is not reset, 1 if it is a Slave, between 1 and 6 if it is a Client and 255 if it is the Master. Default: 0.
R	S253	Clients Count	Gives the Client count of a Master Modem or a Server. Default: 0.
R/W	S254	Client Addition	Gives the number of a Client to be added in the already set up network. This number should be between 1 and S253. Only used on a Network Server. Default: 0.

Appendix 7: Revisions History

No. of Revision	Date	Author	Subject
0.0	01/08/00	GS	Document Creation
0.1	08/08/00	GS	Modifications after YN reading.
0.2	28/08/00	GS	Addition of Network Specifications. Serial configuration MAJ.
0.3	10/10/00	SP	English Text, Diagrams and Clarifications
0.4	1/26/01	SP	Added FCC Disclaimers (Pages 6 & 16)
0.5	1/31/01	SP	Changed Channel Spacing from 200 kHz to 150 kHz (Page 6)
0.6	4/20/01	SP	Consolidated FCC Disclaimers to Page 5 and various other miscellaneous corrections.
0.7	8/7/01	SP	Added RF safety warning and removed antenna information per FCC request