

Application Note

Diagnostics Channel Protocol MHX-920/921/2420/2421

Revision:

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1 Overview

This application note describes how to use Diagnostics Protocol supported by MHX920/921/2420/2421.

2 Diagnostics Protocol

2.1 Frame Structure

All basic commands that the diagnostic channel protocol supports, have the following structure (Figure 1).

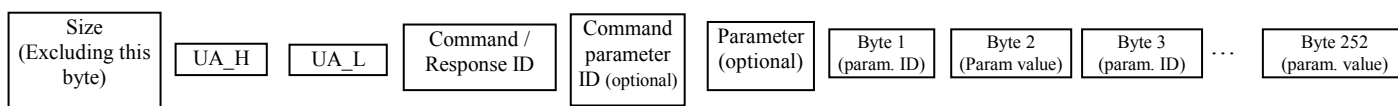


Figure 1. The frame structure for the diagnostic channel communication (direct addressing).

The first byte is always a packet size (this byte is not included in the number of sending or receiving bytes). The next two bytes represent the selected modem's unit address (UA_H, UA_L). The low byte always follows the high byte. Unit address 0 is reserved for the local modem request (the modem's address is unknown), and unit address 255 is reserved for the broadcast request (not implemented yet). Command or response ID determines the type of the data packet. Data bytes are optional and represent parameters' data: two bytes for every parameter (parameter ID and parameter value). All parameters are grouped in 5 Groups (Group 0, Group 1, Group 2, Group 3 and Diagnostic Group). For multi-byte parameters, the high byte is sent first. The parameters, such as the Serial number, the Encryption key, the Version of firmware, are strings.

Example of the simplest command (command ID=0) for the modem with UA=5: 3, 0, 5, 0.

2.2 Special Rules Using Diagnostics Protocol

Using diagnostics channel user must follow special rules:

- 1) Diagnostics channel has a 20ms character time-out timer. If you have inter-command delay shorter than 20 ms, commands could be overlapped.
- 2) If modem returns a response on user's diagnostics command, user must wait for this response before sending next diagnostics command.
- 3) If response on a diagnostics command is not required, user must give the modem some time to process last command. For example, the command that updates modem's parameters saves them in the EEPROM (processing time up to 100 ms).
- 4) Multi-byte parameters must be updated at once.
- 5) Modem resets itself after updating some fundamental parameter (parameters' IDs are marked by stars in the Appendix A).
- 6) The command 255 resets modem (all made changes should be saved).

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2.3 Using RadioNetwork software for the on-line Diagnostics

The biggest advantage of using dedicated diagnostics channel is an on-line diagnostics and update parameters. On-line diagnostics doesn't affect your system in contrast to AT-command menu. User can get diagnostics information either locally or remotely.

The Windows-based software "RadioNetwork" designed by Microhard Systems implements Diagnostics Protocol. The "RadioNetwork" allows users of our modems:

- to build wireless network topology
- to get diagnostics information on-line
- to get modem settings on-line
- to update modem's settings on-line
- to do spectrum analysis
- hard firmware local upgrade
- soft firmware local upgrade
- remote firmware upgrade

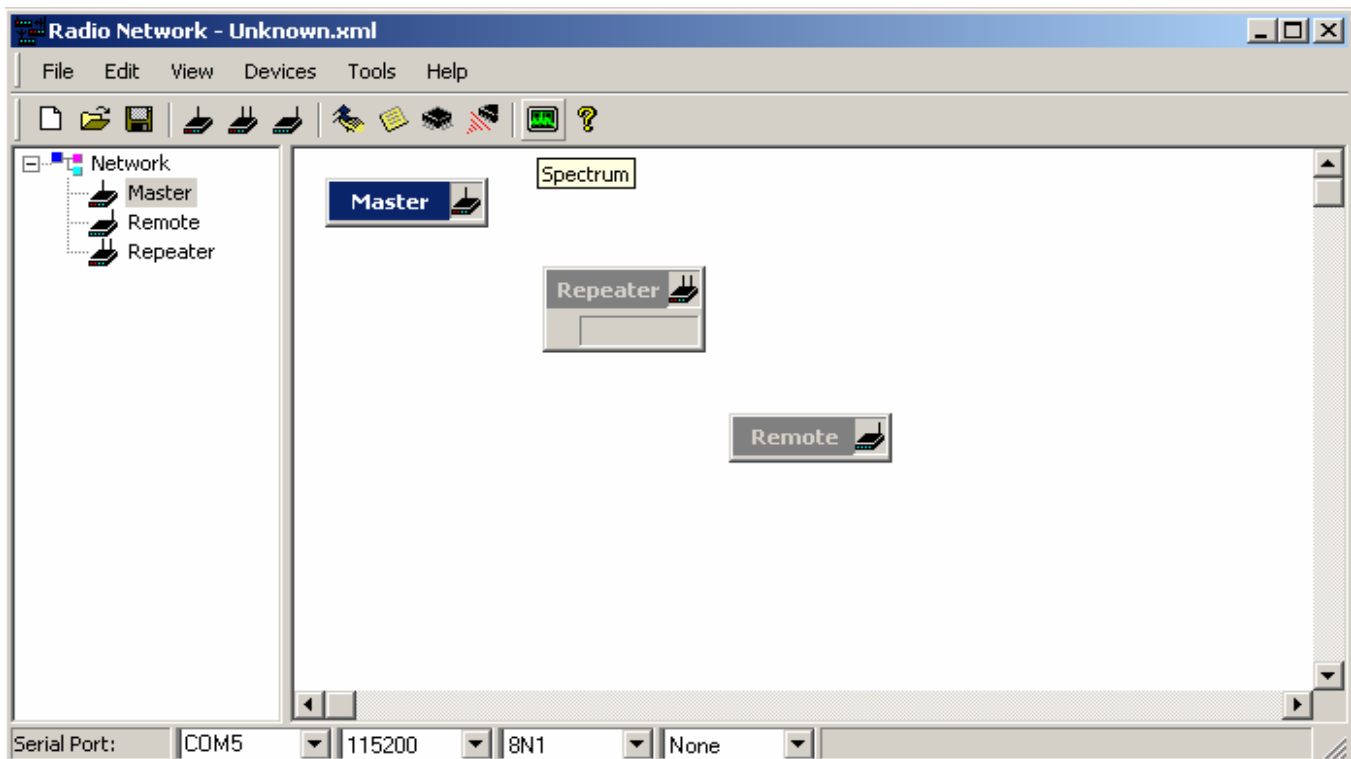


Figure 2. The wireless network topology.

Special cables are required to connect a modem to user's computer (Appendix D).

If user wants to be connected to a modem (master, slave or repeater) locally, he needs to connect his computer to a modem's diagnostics connector using diagnostics cable. User can be connected to a modem remotely only through master. In this case,



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user needs to connect his computer to the master's diagnostics channel. User should select the proper COM port using controls located on the bottom status bar with the following settings: baud rate 155.2 Kbps, data format 8N1, no hardware handshaking.

By clicking on an icon of desired modem, the new window "Properties" will be opened. It has three tabs:

- Settings;
- Restrictions 'N Repeaters;
- Diagnostics.

First of all, user has to select a type of access to a modem: local or remote by selecting "Local" or "Remote". This radio buttons are present on every "Properties"-related sub-window.

The main window "Settings" allows user to read and update modem's parameters. User can read all parameters by pressing the button "Read All" or read selected parameters by pressing the button "read". Every modem's parameter has four fields: a check box, description, S-register number and value. Check boxes are used for the parameters' selection. A parameter's value can be changed using special edit boxes or combo boxes.

The buttons "Serial No." and "Version" are used for reading modem's serial number and firmware version.

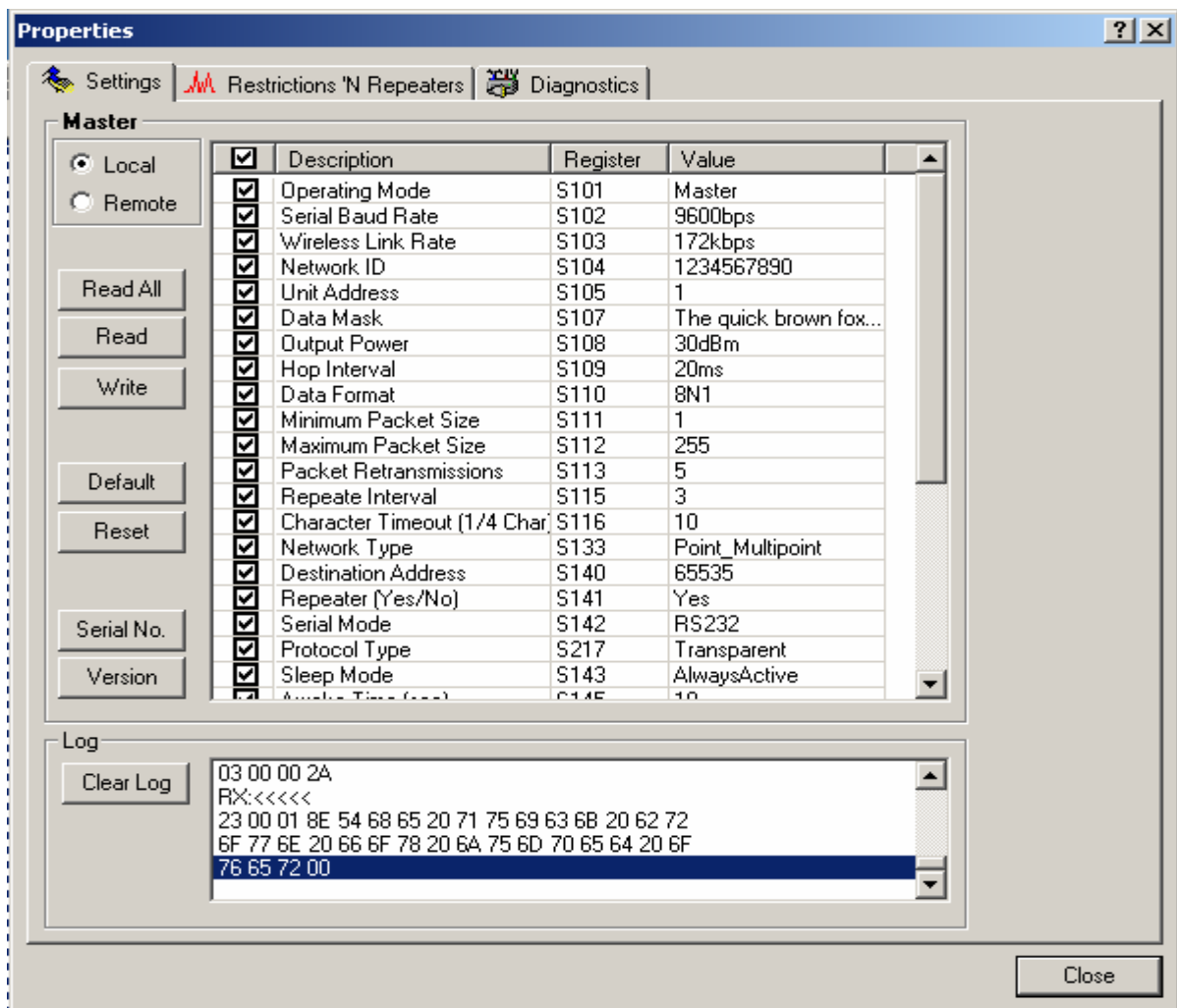


Figure 3. Modem's settings.



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The button “Default” is used to load the default factory configuration. If user wants to take in affect changed parameters and save them in the EEPROM, user should use the button “Write”. The button “Reset” is used to reset a modem.

Note:

Modem could reset itself after updating some parameters.

The next sub-window allows user to read and update frequency restrictions and the list of registered repeaters.

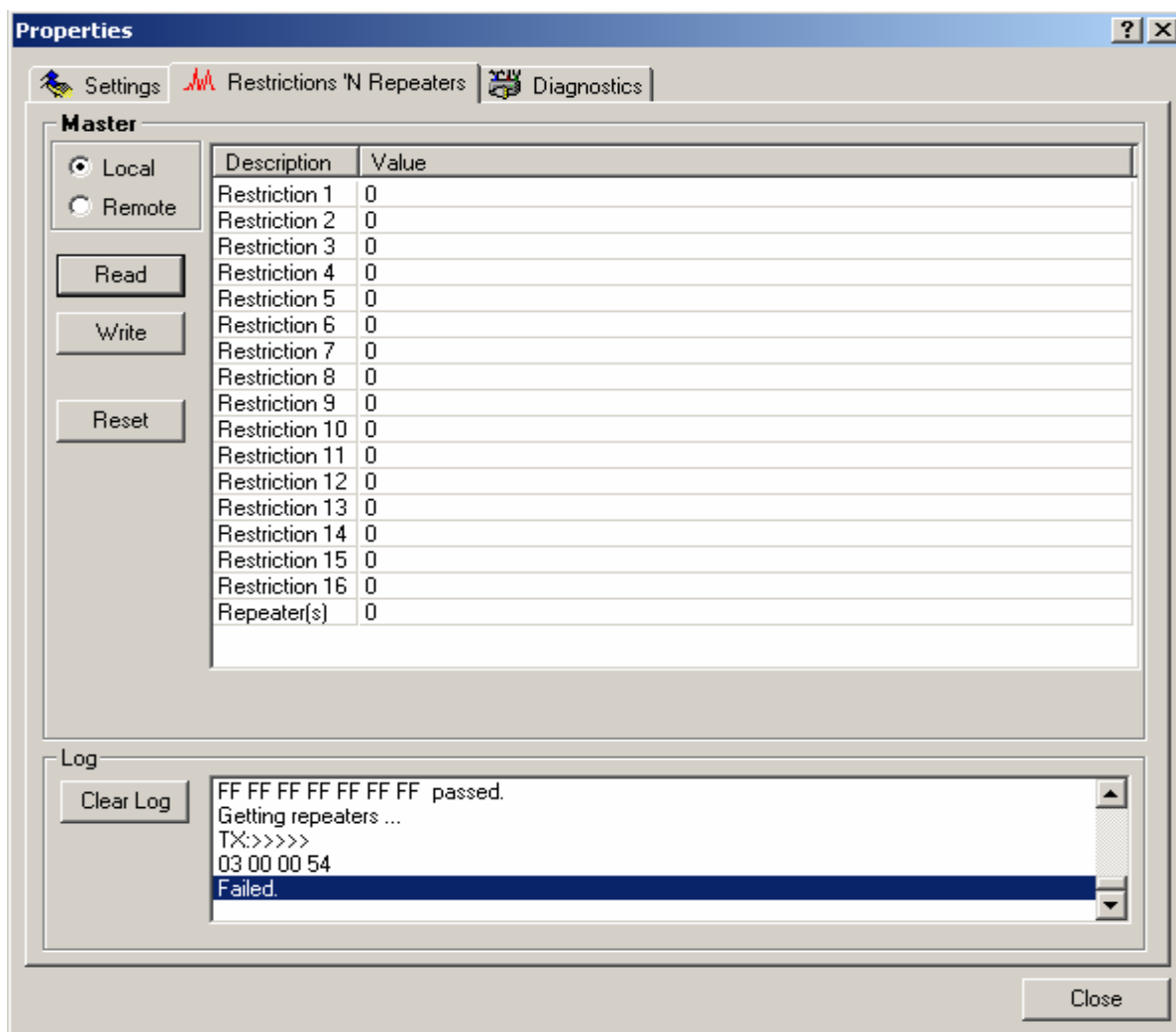


Figure 4. Modem’s Restrictions and Repeaters.

If user wants to update the table of restricted frequencies, he needs to enter the following string:

UA:Fstart1 Fstop1, Fstart2 Fstop2, Fstart8 Fstop8,

where

UA - Unit Address of a modem that will have restricted frequencies;

Fstart i, Fstop i - Restricted sub bands, represented by start and stop frequencies in Hz (up to 8 sub bands).



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If user wants to update the list of registered repeaters, he should enter the following string:

UA1, UA2, UA3,...UA16

where

UAi – Unit Address of registered in a system repeaters (up to 16 repeaters).

The last sub-window allows user to read some modem's parameters, such as Temperature (°C), Supply Voltage (V), RSSI Reading (dBm), VSWR reading. All these parameters could be read once or could be polled continuously (the "Poll" feature should be checked in the last case).

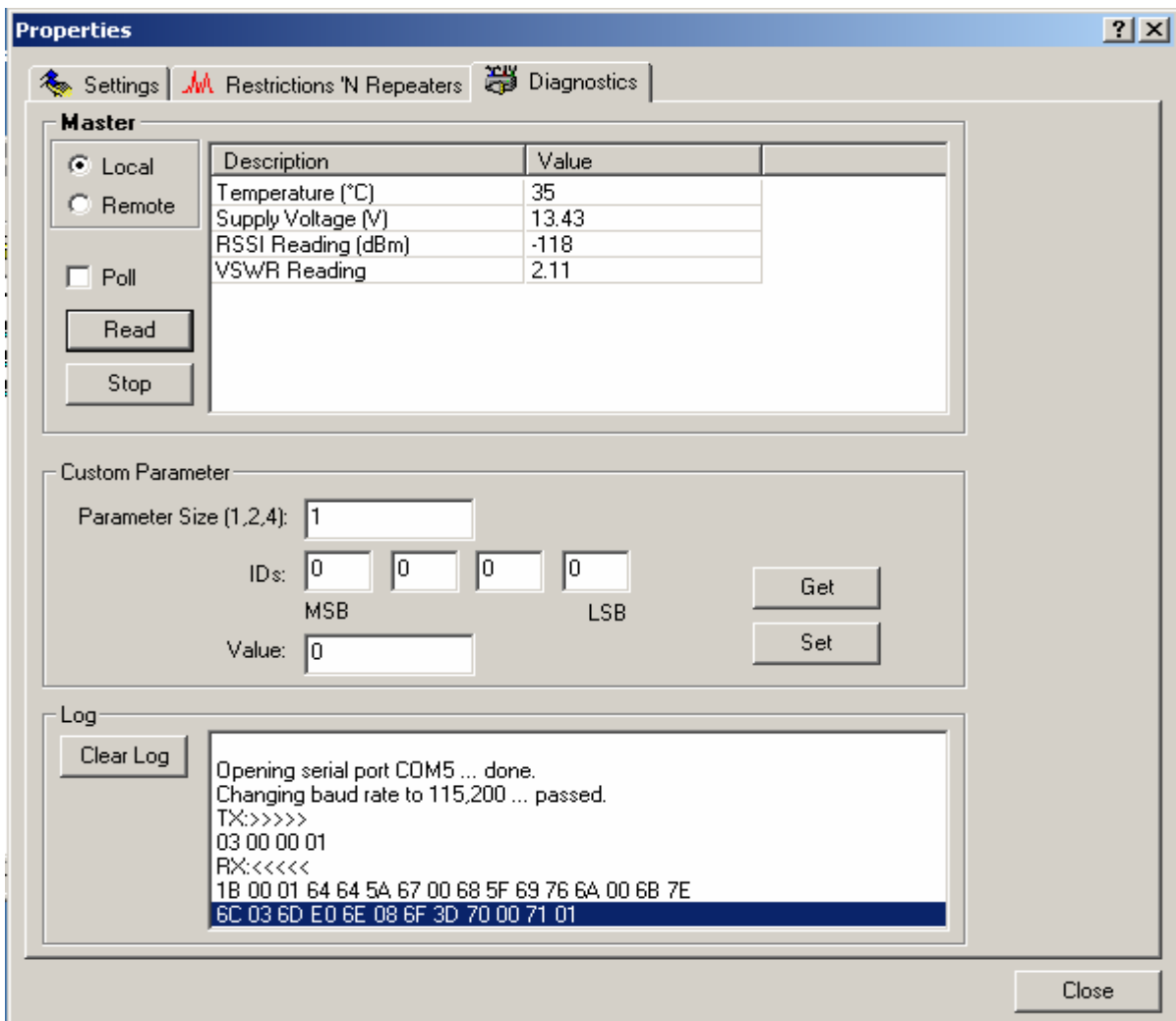


Figure 5. Modem's settings.



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Appendixes

Commands and Responses Set

Appendix A

Group	Subgroup	Command ID	Function	Response ID	Response
Request	Group parameters	0	Request of modem's group parameters (Group 0) <u>Command format:</u> Size, UA_H, UA_L, Command ID. <u>Example for modem UA=5:</u> 3, 0, 5, 0	100	Modem's parameters (Group 0) <u>Command format:</u> Size, UA_H, UA_L, Command ID, (ParamID, ParamData)n. <u>Example for all parameters of Group 0 that are set to 0:</u> 43, 0, 5, 100, 1,0, 2,0, 3,0, 4,0, 5,0, 6,0, 7,0, 8,0, 9,0, 10,0, 11,0, 12,0, 13,0, 14,0, 15,0, 16,0, 17,0, 18,0, 19,0, 20,0
		1	Request of modem's diagnostic group parameters (Diagnostic Group) <u>Command format:</u> Size, UA_H, UA_L, Command ID. <u>Example for modem UA=5:</u> 3, 0, 5, 1	100	Modem's parameters (Diagnostic Group) <u>Command format:</u> Size, UA_H, UA_L, Command ID, (ParamID, ParamData)n. <u>Example for all parameters of Diagnostic Group that are set to 0:</u> 27, 0, 5, 100, 100,0, 103,0, 104,0, 105,0, 106,0, 107,0, 108,0, 109,0, 110,0, 111,0, 112, 0, 113,0
		2	Request of modem's group parameters (Group 1) <u>Command format:</u> Size, UA_H, UA_L, Command ID. <u>Example for modem UA=5:</u> 3, 0, 5, 2	100	Modem's parameters (Group 1) <u>Command format:</u> Size, UA_H, UA_L, Command ID, (ParamID, ParamData)n. <u>Example for all parameters of Group 1, that are set to 0:</u> 35, 0, 5, 100, 21,0, 22,0, 23,0, 24,0, 25,0, 26,0, 27,0, 28,0, 29,0, 30, 0, 31, 0, 32, 0, 33, 0, 34, 0, 35, 0, 36, 0
		3	Request of modem's group parameters (Group 2) <u>Command format:</u> Size, UA_H, UA_L, Command ID. <u>Example:</u> 3, 0, 5, 3	100	Modem's parameters (Group 2) <u>Command format:</u> Size, UA_H, UA_L, Command ID, (ParamID, ParamData)n. <u>Example for all parameters of Group 1, that are set to 0:</u> 35, 0, 5, 100, 50,0, 51,0, 52,0, 53,0, 54,0, 55,0, 56,0, 57,0, 58,0, 59, 0, 60, 0, 61, 0, 62, 0, 63, 0, 64, 0, 65, 0
		4	Request of modem's group parameters (Group 3) <u>Command format:</u>	100	Modem's parameters (Group 3) <u>Command format:</u> Size, UA_H, UA_L, Command ID,



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Group	Subgroup	Command ID	Function	Response ID	Response
			Size, UA_H, UA_L, Command ID. <i>Example:</i> 3, 0, 5, 4		(ParamID, ParamData)n. <i>Example for all parameters of Group 3 that are set to 0:</i> 35, 0, 5, 100, 66,0, 67,0, 68,0, 69,0, 70,0, 71,0, 72,0, 73,0, 74,0, 75, 0, 76, 0, 77, 0, 78, 0, 79, 0, 80, 0, 81, 0
		5	Request of modem's group parameters (Group 4) <i>Command format:</i> Size, UA_H, UA_L, Command ID. <i>Example:</i> 3, 0, 5, 5	100	Modem's parameters (Group 4) <i>Command format:</i> Size, UA_H, UA_L, Command ID, (ParamID, ParamData)n. <i>Example for all parameters of Group 3 that are set to 0:</i> 37, 0, 5, 100, 82,0, 83,0, 84,0, 85,0, 86,0, 87,0, 88,0, 89,0, 90,0, 91, 0, 92, 0, 93, 0, 94, 0, 95, 0, 96, 0, 97, 0, 98,0
		6	Request of modem's group parameters (Group 5) <i>Command format:</i> Size, UA_H, UA_L, Command ID. <i>Example:</i> 3, 0, 5, 6	100	Modem's parameters (Group 5) <i>Command format:</i> Size, UA_H, UA_L, Command ID, (ParamID, ParamData)n. <i>Example for all parameters of Group 3 that are set to 0:</i> 15, 0, 5, 100, 27,0, 38,0, 39,0, 40,0, 41,0, 42,0
		7	Request of modem's group parameters (Statistics 1) <i>Command format:</i> Size, UA_H, UA_L, Command ID. <i>Example:</i> 3, 0, 5, 7	100	Modem's parameters (Statistics 1) <i>Command format:</i> Size, UA_H, UA_L, Command ID, (ParamID, ParamData)n. <i>Example for all parameters of Group 3 that are set to 0:</i> 7, 0, 5, 100, 65,0, 70,0
	Selected parameters	20/21	Request of selected parameters <i>Command format:</i> Size, UA_H, UA_L, Command ID, (ParamID)n. <i>Example for Power, Hop time, Protocol:</i> 6, 0, 5, 20, 3, 4, 11	100/121	Modem's selected parameters <i>Command format:</i> Size, UA_H, UA_L, Command ID, (ParamID, ParamData)n. <i>Example for Power=0, Hop time=2, Protocol=1:</i> 9, 0, 5, 100, 3, 0, 4, 2, 11, 1
	String parameters	40	Request of Firmware version <i>Command format:</i> Size, UA_H, UA_L, Command ID. <i>Example:</i> 3, 0, 5, 40	140	Version of firmware (maximum 11 characters) <i>Command format:</i> Size, UA_H, UA_L, Command ID, String <i>Example for the version of firmware Ver.1.01-15:</i> 14, 0, 5, 140, 'V', 'e', 'r', '.', '1', '.', '0', '1', '-', '1', '5'
		41	Request of Serial number	141	Serial number (maximum 11



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Group	Subgroup	Command ID	Function	Response ID	Response
			<u>Command format:</u> Size, UA_H, UA_L, Command ID. <u>Example:</u> 3, 0, 5, 41		characters) <u>Command format:</u> Size, UA_H, UA_L, Command ID, String <u>Example of response from the modem with UA=5 and Serial number : 12345- ABC</u> 12, 0, 5, 141, '1', '2', '3', '4', '5', '-', 'A', 'B', 'C'
		42	Request of Encryption key <u>Command format:</u> Size, UA_H, UA_L, Command ID. <u>Example:</u> 3, 0, 5, 42	142	Encryption key (32 characters) <u>Command format:</u> Size, UA_H, UA_L, Command ID, String <u>Example of response from modem with UA=5 for the key: Calgary</u> 10, 0, 5, 142, 'C', 'a', 'l', 'g', 'a', 'r', 'y'
		43	Request of unit address <u>Command format:</u> Size, MUA_H, MUA_L, Command ID. <u>Example:</u> 3, 0, 5, 42	143	Unit address <u>Command format:</u> Size, MUA_H, MUA_L, Response ID, UA1_H,UA1 <u>Example of response from modem with UA=5</u> 5, 0, 5, 143, 0, 5
		44	Request of selected table of restricted frequencies <u>Command format:</u> Size, MUA_H, MUA_L, COM_ID, TABLE_INDEX, <u>Example:</u> 4 1 1 44 7	144	Table of restricted frequencies <u>Example of response from modem with UA=257 and restricted table with the Index=5</u> 36 1 1 144 7 0 0 1 144 7 208 9 96 15 160 17 48 23 112 25 00 31 64 32 208 39 16 40 160 46 224 48 112 255 255 255 255
		45	Request of Network configuration <u>Command format:</u> Size, MUA_H, MUA_L, Command ID. <u>Example:</u> 3, 0, 5, 45	145	Network configuration (up to 32 unit addresses belong to the detected slaves) <u>Command format:</u> Size, MUA_H, MUA_L, Response ID, UA1_H,UA1_L,UA2_H, UA2_L.... <u>Example of response from modem with UA=5 for the slaves' UA=6,7,8,9</u> 11, 0, 5, 145, 0, 6, 0, 7, 0, 8, 0, 9
		46	Request of Network discovery <u>Command format:</u> Size, MUA_H, MUA_L, Command ID.	146	Network discovery <u>Command format:</u> Size, MUA_H, MUA_L, Response ID, DISCOVERY_SIZE, DISCOVERY STRUCTURE



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Group	Subgroup	Command ID	Function	Response ID	Response
			<i>Example:</i> 3, 0, 5, 46		<i>Example of response from modem with UA=5</i> 11, 0, 5, 146,
		47	User default settings AT&Fx (this command saves user parameters in EEPROM and resets modem) <i>Command format:</i> Size, MUA_H, MUA_L, Command ID, PARAM. <i>Example:</i> 4, 0, 5, 47, 1		No response, modem is reset
		60	Block write into the EEPROM <i>Command format:</i> Size, MUA_H, MUA_L, Command ID, Block#, data bytes <i>Example:</i> 36, 0, 5, 60, 125, 32 data bytes		
		65	Flash memory upgrade commands Clear the RAM (Parameter ID=0) <i>Command format:</i> Size, MUA_H, MUA_L, COM_ID, PARAM, <i>Example:</i> 4 1 1 65 0 Download of the firmware image into the RAM (Parameter ID=1) <i>Command format:</i> Size, MUA_H, MUA_L, COM_ID, PARAM, SEG_SEQ_N_H, SEG_SEQ_N_L, DATA0,...DATA127 <i>Example:</i> 134 1 1 65 1 0 0 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 ...127 Arm the firmware upgrade procedure (PARAMETR ID=2) <i>Command format:</i> Size, MUA_H, MUA_L, COM_ID, PARAM, MARKER1(23),	165	Acknowledgement for Clear the RAM (Parameter ID=0) <i>Command format:</i> Size, MUA_H, MUA_L, RESP_ID, PARAM, <i>Example:</i> 4 1 1 165 0 Acknowledgement for the download of the firmware image into the RAM (Parameter ID=1) <i>Command format:</i> Size, MUA_H, MUA_L, RESP_ID, PARAM, SEG_SEQ_N_H, SEG_SEQ_N_L <i>Example:</i> 4 1 1 165 1 Acknowledgement for the arm the firmware upgrade procedure (PARAMETR ID=2) <i>Command format:</i> Size, MUA_H, MUA_L, RESP_ID,



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Group	Subgroup	Command ID	Function	Response ID	Response
			MARKER2(113) <u>Example:</u> 6 1 1 65 2 Download the firmware image into the FLASH memory (Parameter ID=3) <u>Command format:</u> Size, MUA_H, MUA_L, COM_ID, PARAM, <u>Example:</u> 4 1 1 65 3 Calculation of the firmware image's CRC-16 (Parameter ID=4) <u>Command format:</u> Size, MUA_H, MUA_L, COM_ID, PARAM, <u>Example:</u> 4 1 1 65 4		PARAM, MARKER1(23), MARKER2(113) <u>Example:</u> 6 1 1 165 2 Acknowledgement for the download the firmware image into the FLASH memory (Parameter ID=3) <u>Command format:</u> Size, MUA_H, MUA_L, RESP_ID, PARAM, <u>Example:</u> 4 1 1 65 3 Response – calculated the firmware image's CRC-16 (Parameter ID=4) <u>Command format:</u> Size, MUA_H, MUA_L, RESP_ID, PARAM, CRC_H, CRC_L <u>Example:</u> 6 1 1 165 4 47 89
Settings	Selected parameters	70	Sending modem's selected settings. <u>Command format:</u> Size, UA_H, UA_L, Command ID, (ParamIDs, ParamData)n. <u>Example for Retransmission=5, Unit address=149:</u> 9, 0, 5, 70, 9, 5, 26, 0, 27, 149		
		74	Lock awake mode <u>Command format:</u> Size, MUA_H, MUA_L, Command ID <u>Example for Unit address=5:</u> 3, 0, 5, 74	174	Acknowledgement for the lock awake mode <u>Command format:</u> Size, MUA_H, MUA_L, Command ID <u>Example for Unit address=5:</u> 3, 0, 5, 74
		75	Saving all user's parameters in the EEPROM. <u>Command format:</u> Size, MUA_H, MUA_L, Command ID <u>Example for Unit address=5</u>		



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Group	Subgroup	Command ID	Function	Response ID	Response
			3, 0, 5, 75		
	String parameters	81	<p>Sending Encryption key (maximum 32 character string)</p> <p><u>Command format:</u> Size, UA_H, UA_L, Command ID, String.</p> <p><u>Example for the key: "Calgary Flames":</u> 17, 0, 5, 81, 'C', 'a', 'l', 'g', 'a', 'r', 'y', ' ', 'F', 'l', 'a', 'm', 'e', 's'</p>		
		82	<p>Set up the selected table of restricted frequencies</p> <p><u>Command format:</u> Size, MUA_H, MUA_L, COM_ID, TABLE_INDEX, UA_H, UA_L, START0_H, START0_L, STOP0_H, STOP0_L,START7_H, START7_L, STOP7_H, STOP7_L,</p> <p><u>Example for the Unit Address 257:</u> 36 1 1 82 0 0 0 1 144 7 208 9 96 15 160 17 48 23 112 25 00 31 64 32 208 39 16 40 160 46 224 48 112 255 255 255 255</p>	182	<p>Acknowledgement of the table of restricted frequencies set up</p> <p><u>Command format:</u> Size, RESP_ID, MUA_H, MUA_L,</p> <p><u>Example for the Unit Address 257</u> 3 182 0 5</p>
		83	<p>Save all tables of restricted frequencies</p> <p><u>Command format:</u> Size, MUA_H, MUA_L, COM_ID,</p> <p><u>Example for the Unit Address 257:</u> 3 1 1 83</p>	183	<p>Acknowledgement of the table of restricted frequencies saving</p> <p><u>Command format:</u> Size, RESP_ID, MUA_H, MUA_L,</p> <p><u>Example for the Unit Address 257:</u> 3 1 1 183</p>
Data transfer	Formatted data/text message	90, 91	<p>Sending formatted data/text messages (up to 250 characters) to modem</p> <p><u>Command format:</u> Size, UA_H, UA_L, Command ID, String.</p> <p><u>Example for the message: "Hello world":</u> 14, 0, 5, 90, 'H', 'e', 'l', 'l', 'o', ' ', 'w', 'o', 'r', 'l', 'd'</p>		
				90, 91	Received formatted data/text message (up to 250 characters) is



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Group	Subgroup	Command ID	Function	Response ID	Response
					sent back to user <u>Command format:</u> Size, UA_H, UA_L, Command ID, String <u>Example for the message: "Hello world":</u> 14, 0, 5, 90, 'H', 'e', 'l', 'l', 'o', ' ', 'w', 'o', 'r', 'l', 'd'
Modem control instructions		255	Sending RESET command <u>Command format:</u> Size, UA_H, UA_L, Command ID. <u>Example:</u> 3, 0, 5, 255		



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Parameters IDs and Groups

Appendix B

Parameter ID	Parameter	Parameters Group	S-Register
Group 0			
1	Serial channel mode	Group 0	S142
2*	Baud rate	Group 0	S102
3*	Power	Group 0	S108
4*	Hop time	Group 0	S109
5	Packet size minimum (H)	Group 0	S111
6	Packet size minimum (L)		
7	Packet size maximum (H)	Group 0	S112
8	Packet size maximum (L)		
9	Retransmission	Group 0	S113
10*	Repeaters in system	Group 0	S141
11*	Protocol type	Group 0	S217
12	Handshake	Group 0	&K
13*	Operating mode	Group 0	S101
14*	Wireless link rate	Group 0	S103
15	Esc. Character	Group 0	S2
16*	Destination Address (H)	Group 0	S140
17*	Destination Address (L)		
18	Power up mode	Group 0	S0
19	Data format	Group 0	S110
20	Quick enter to command	Group 0	S119
Group 1			
21	Bandwidth, %	Group 1	S250
22*	Network ID (H)	Group 1	S104
23*	Network ID (M2)		
24*	Network ID (M1)		
25*	Network ID (L)		
26*	Unit address (H)	Group 1	S105
27*	Unit address (L)		
28	Repeat interval	Group 1	S115
29	Character time-out	Group 1	S116
30*	Roaming (H)	Group 1	S118
31*	Roaming (L)		
32*	Sleep mode	Group 1	S143
33	Sleep time (H)	Group 1	S144
34	Sleep time (L)		
35	Wake time (H)	Group 1	S145
36	Wake time (L)		
Group 2			
50	Slave's tuning time	Group 2	S230
51	Slave ACK overhead	Group 2	S231
52	Max buffers IN storage (H)	Group 2	S232
53	Max buffers IN storage (L)		
54	Slow sync time-out (H)	Group 2	S248
55	Slow sync time-out (L)		



Diagnostics Protocol supported by MHX-920/921/2420/2421

Parameter ID	Parameter	Parameters Group	S-Register
56	Packets per hop Tx limit	Group 2	S249
57	Master hop allocation time out	Group 2	S251
58	Slave channel allocation limit	Group 2	S252
59	FEC mode	Group 2	S158
60	No sync data intake	Group 2	S130
61	Primary channel (H)	Group 2	S131
62	Primary channel (L)		
63	Secondary channel (H)	Group 2	S132
64	Secondary channel (L)		
65	Network type	Group 2	S133
Group 3			
66	Time to live for routing table	Group 3	S235
67	Master channel request time-out	Group 3	S234
68	Max buffers OUT storage (H)	Group 3	S236
69	Max buffers OUT storage (L)		
70	DSR	Group 3	&S
71	DTR	Group 3	&D
72	Tx done time-out (H)	Group 3	S146
73	Tx done time-out (L)		
74	Rx done time-out (H)	Group 3	S147
75	Rx done time-out (L)		
76	Restriction enable	Group 3	S148
77	LEDs brightness, %	Group 3	S149
78	Fast sync time-out (H)	Group 3	S151
79	Fast sync time-out (L)		
80	Sync mode	Group 3	S150
81	Fast sync hold on ACK	Group 3	S152
Group 4			
82	Sniff time-out	Group 4	S237
83	Address tag	Group 4	S153
84	Current save mode	Group 4	S239
85	Pattern size	Group 4	S165
86	RF emission control	Group 4	
87	Filtering Address (H)	Group 4	
88	Filtering Address (L)		
89	Country code	Group 4	
90	Sniff sleep time (H)	Group 4	S169
91	Sniff sleep time (L)		
92	Sniff wake time (H)	Group 4	S170
93	Sniff wake time (L)		
94	Filter	Group 4	S168
95	Rate Change TMO	Group 4	S162
96	QOS report request	Group 4	S163
97	Restriction zone	Group 4	S178



Diagnostics Channel Protocol supported by MHX-920/921/2420/2421

Parameter ID	Parameter	Parameters Group	S-Register
98	Header type	Group 4	S176
Group 5			
37	Bad QOS (H)	Group 5	S171
38	Bad QOS (L)		
39	Good QOS (H)	Group 5	S172
40	Good QOS (L)		
41	IP sleep	Group 5	S179
42	State pin 12 enable	Group 5	
Diagnostic Group			
100	Temperature	Diagnostic Group	
103	Battery Voltage (H)	Diagnostic Group	
104	Battery Voltage (L)		
105	RSSI	Diagnostic Group	S123
106	Reflected power (H)	Diagnostic Group	
107	Reflected power (L)		
108	Forward power (H)	Diagnostic Group	
109	Forward power (L)		
110	VSWR (H)	Diagnostic Group	
111	VSWR (L)		
112	Status of the packet bad/good	Diagnostic Group	
113	Sync parameter	Diagnostic Group	
Statistics 1			
120	Rx data, Kbytes (H)	Statistics 1	
121	Rx data, Kbytes (M2)		
122	Rx data, Kbytes (M1)		
123	Rx data, Kbytes (L)		
124	Tx data, Kbytes (H)	Statistics 1	
125	Tx data, Kbytes (M2)		
126	Tx data, Kbytes (M1)		
127	Tx data, Kbytes (L)		
128	Rx data, packets (H)	Statistics 1	
129	Rx data, packets (M2)		
130	Rx data, packets (M1)		
131	Rx data, packets (L)		
132	Tx data, packets (H)	Statistics 1	
133	Tx data, packets (M2)		
134	Tx data, packets (M1)		
135	Tx data, packets (L)		
136	Corrected errors (H)	Statistics 1	
137	Corrected errors (M2)		
138	Corrected errors (M1)		
139	Corrected errors (L)		
140	CRC errors (H)	Statistics 1	



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Parameter ID	Parameter	Parameters Group	S-Register
141	CRC errors (M2)		
142	CRC errors (M1)	Statistics 1	
143	CRC errors (L)		
144	Lost sync (H)	Statistics 1	
145	Lost sync (M2)		
146	Lost sync (M1)		
147	Lost sync (L)		

Notes:

Display Diagnostics Information:

Temperature = temperature reading – 55 (°C)

Voltage = (voltage reading * 36194.0/256/1000) (volts)

RSSI = -1 * (rssi reading)

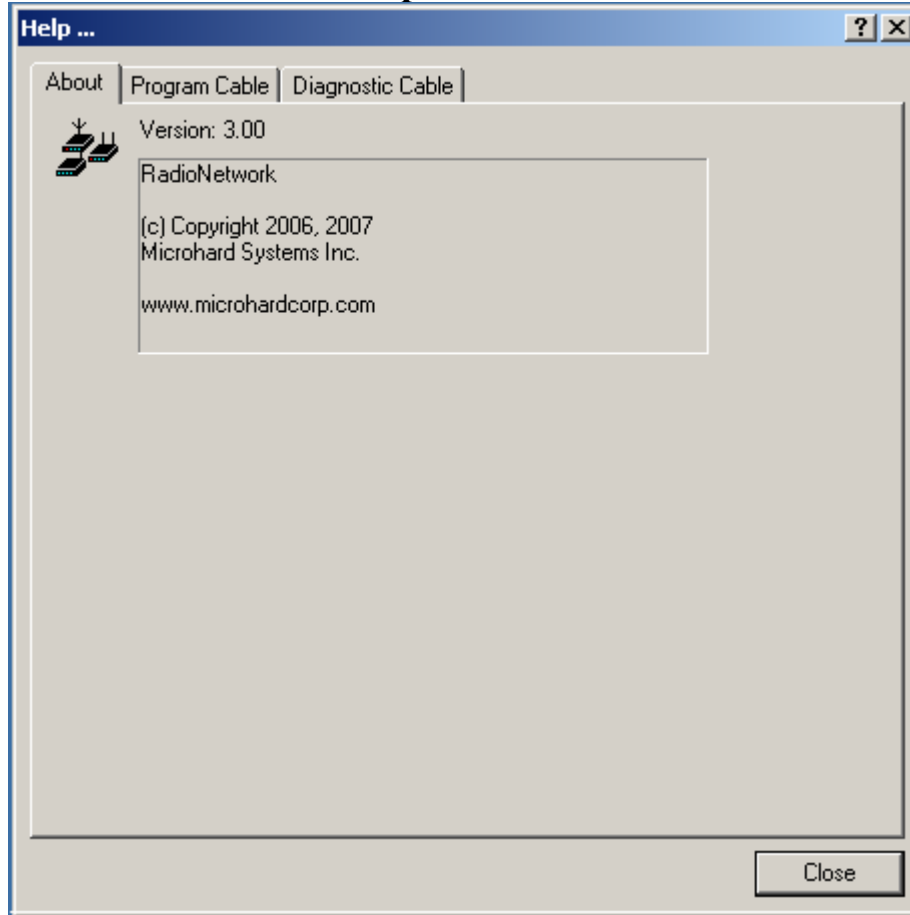
VSWR = (vswr reading /1000)



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Help Window

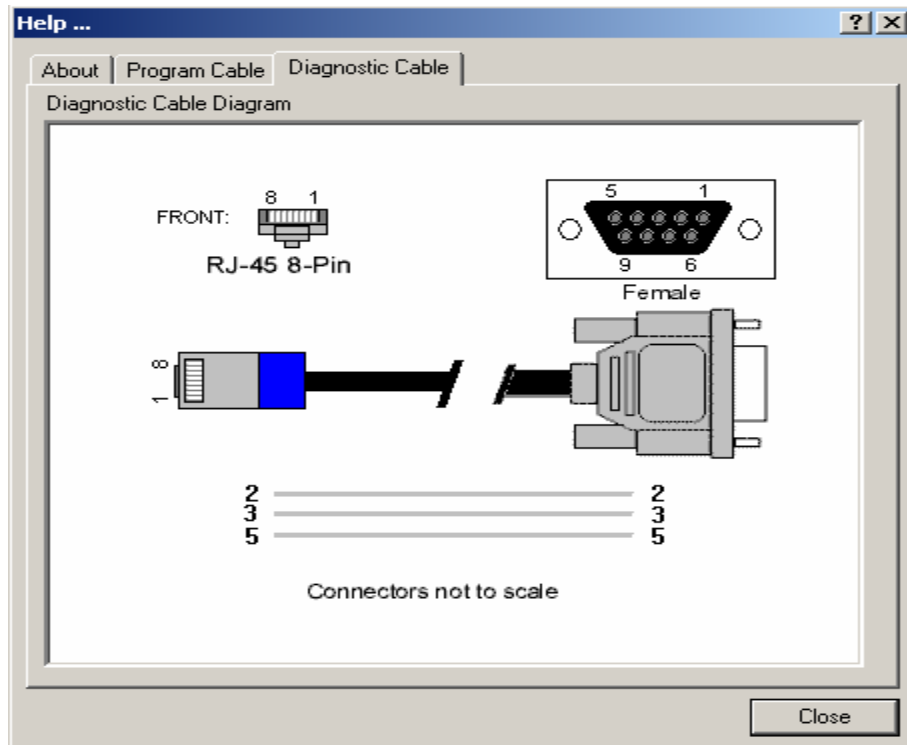
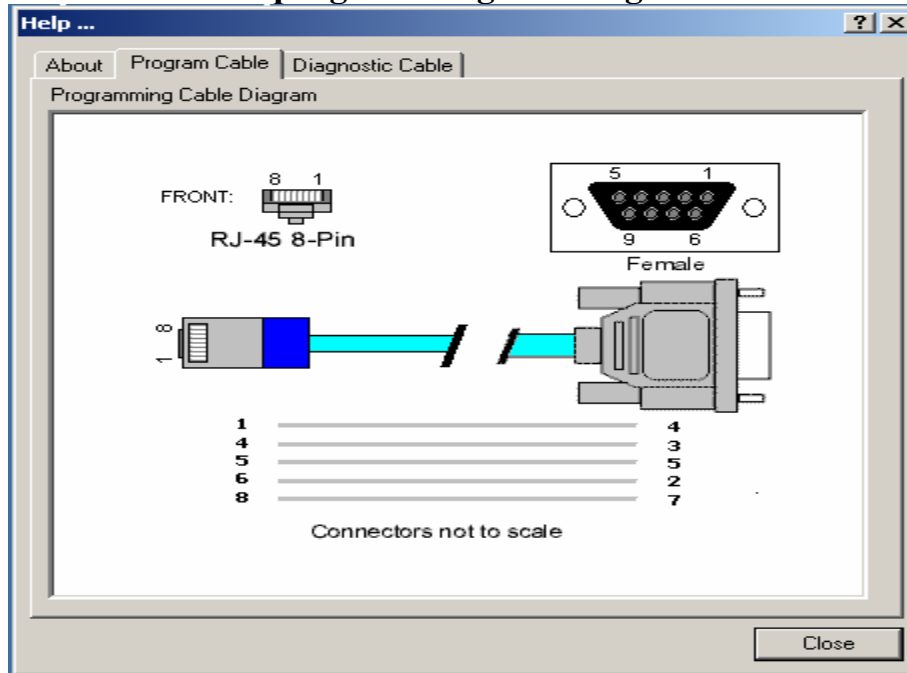
Appendix C



Diagnostics Protocol supported by MHX-920/921/2420/2421

Cables for programming and diagnostics

Appendix D





Diagnostics Channel Protocol supported by MHX-920/921/2420/2421

Hard and Soft Firmware Upgrade

Appendix E

