INSTALLATION MANUAL

T60M665

Bluetooth Modem Combo Module

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Section One: Introduction

The Bluetooth Modem Combo Module is a cost-effective wireless access. The Bluetooth circuit of this module is compliant to Bluetooth 1.1 standard. With V.92 technology, the modem part can achieve internet connection rates up to 56 kbits/s with backward compatibility. The V.92 Feature include PCM Upstream, Modem On Hold, Quick Connection and V.44 Data compression. The Audio CODEC will be placed on the notebook and contact with Modem Codec by AC-Link Interface. The combo card complies with MDC Domestic form factor.

1.1 Features

1.1.1 Bluetooth Function

- Bluetooth radio firmware is upgradeable for bug fixes, initial version compatible with Bluetooth specification version 1.1.
- Fully compliant to Bluetooth SIG (BQB) compatibility testing.
- USB Pin assignment is to use MDC reserve pin to communicate with Host.interface
- Bluetooth Profile Support
  - General Access Profile
  - Service Discovery Application Profile
  - Serial Port Profile
  - Dial-up Networking Profile
  - LAN Access Profile
  - Generic Object Exchange Profile
  - File Transfer Profile
  - Object Push Profile
  - Synchronization Profile
- Drivers support Windows 98, 98SE, ME, 2000, XP.
- Supports Power Management ACPI 1.94 (or later)
- Bluetooth performance must exceed 500 kbps, using OBEX.

1.1.2 Modem Function

- AC' 97/MC' 97 2.2 compliant
- Support Modem Digital Line Guard: The product shall incorporate circuitry to sense whenever the

current on the line exceeds approximately 130mA, and should immediately go back on hook.

- The call progress signal shall be scaled digitally according to the speaker level setting (ATL1, L2, L3)
- ITU-T V.92 PCM Upstream and V.90 data rates with auto-fallback to V.34, V.32terbo, V.32bis and fallbacks
- TIA/EIA 602 standard for AT Command set
- Supports V.42 error correction and V.44, V.42bis/MNP5 data compression
- FAX capabilities: ITU-T V.17, V.29, V.27ter, V.21 Ch2 and TIA/EIA 578 Class1 FAX
- Support Wake up on Ring and meet WHQL test requirement..

1.2 Hardware Requirements

Supply Voltage	3.3V & 1.8V
Frequency Range	2.400-2.4835 GHz
Antenna Load	50 Ohm
Receive Sensitivity	–80 dBm@0.1% BER
Maximum Receiver Signal	-20 dBm
TX Power	4 dBm maximum (class 2)
RF Power Control Step Size	2 dB
Range	10 meters at 0 dBm TX power (class 2)
Radio	Compliant with Bluetooth standard version 1.1
Pico Net	1 master to 7 slaves
Operating Channels	79 channels of 1 MHz BW
Security	Full support of Bluetooth security provisions including hardware support for full length 128 bit encryption keys.
Host Interface (USB)	USB specification 1.1 compliant and using MDC reserve pin to communicate with Host
Software Requirements	Windows 98SE, ME, 2000, XP.
Mechanical Requirements	27mm x 45mm x 4.7mm(1.2/0.8/2.7mm)

Section Two: Bluetooth Installation

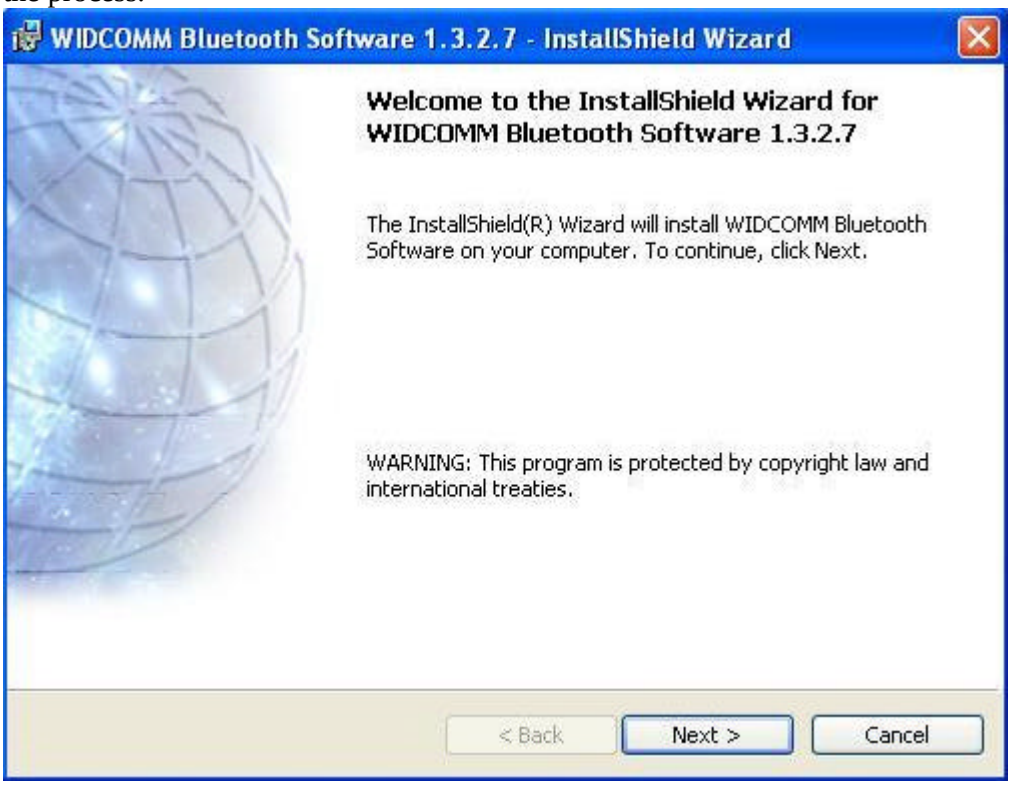
The following steps provide instructions for installing Bluetooth.

1. Make sure your MDC BT/Modem Combo card already insert into your notebook.
2. Make sure your notebook operating system support Windows 98SE or ME or 2000 or XP.

2.1 Bluetooth Installation

Proceed to the following section.

1. Execute the program ‘Setup.exe’ in the CD. Windows displays the dialog as below. Click ‘**Next**’ to begin the process.



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2.The “License Agreement” windows will pop up, please read it carefully. If you agree it, and choose ‘**I agree the terms in the license agreement**’ and click on ‘**Next**’.

3. “Destination Folder” appears, specify the location of the driver and software to be installed then press ‘**Next**’ bottom.

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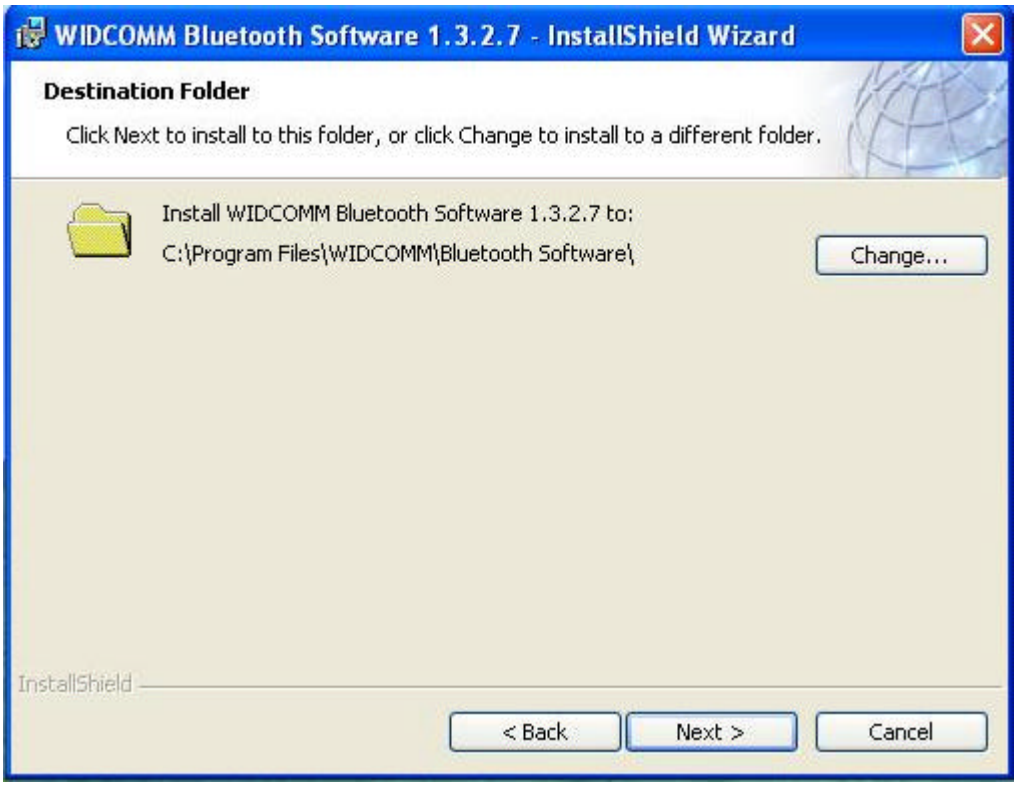
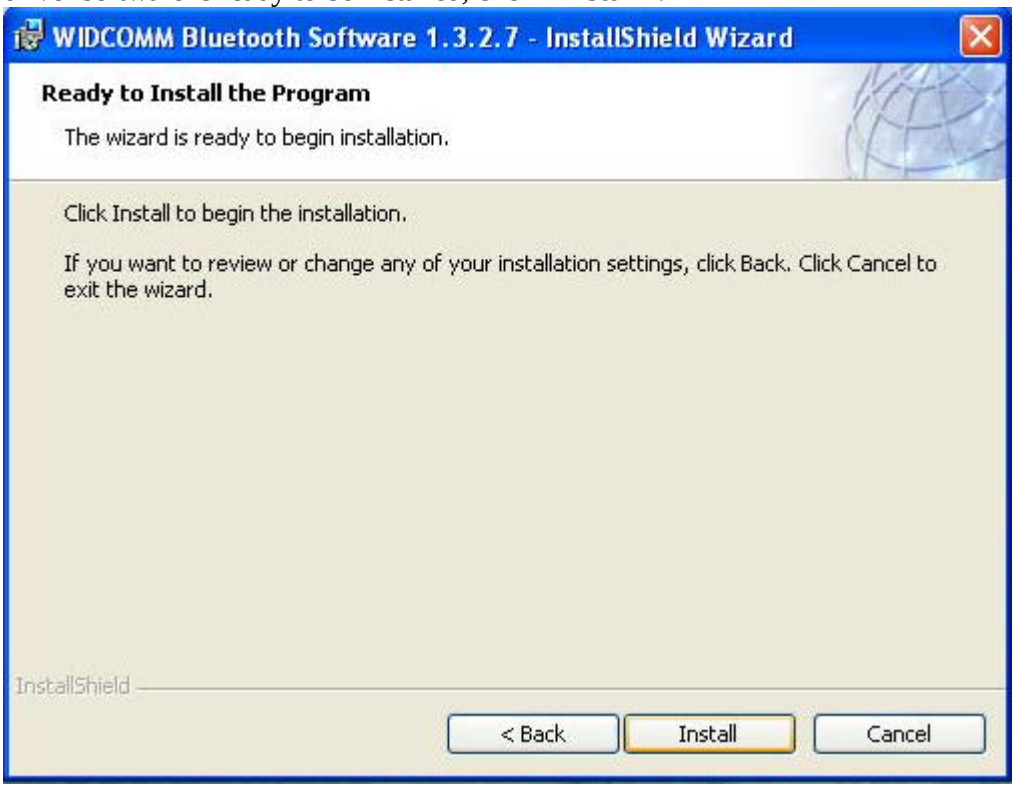


4. When all the above process are done, it will show ‘ Ready to Install the Program” window. Make sure the driver software is ready to be installed, click ‘ **Install**’ .



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5.Choose ‘ **Install the software automatically [Recommened]**’ , then Click ‘ **Next**’ to continue.

6. Congratulations! Bluetooth has been installed successfully.

Please click ‘ **Finish**’ to confirm the completion of installation.

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7. Then click '**Finish**' to exit the InstallShield Wizard.

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Section Three: Modem Installation

The following steps provide instructions for installing your 56K Internal modem.

1. Check the BT/modem Module already inserted into the slot.
2. Insert the connector of RJ-11 cable into the female connector of modem. The connector is keyed and will no allow incorrect insertion. Plug the other end of the RJ-11 cable into an available phone jack.

3.1 Driver Installation

Your modem is using the Plug and Play (PnP) capabilities of you computer. PnP is a set of specifications that define the ability for the computer hardware and operating system to automatically configure all compliant devices that are installed, relieving the user of the need to determine which addresses and interrupts to user for each device.
Proceed to the following section.

1. Start Windows 98, an "PCI Card" dialog with drive selected will appear. Click "**Next**"

2. Search for the best driver for Modem card and click **Next** to continue.

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3 Please release your driver to “c:\driver” or any specific location you want.

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4. After Windows finishes loading, select My Computer\Control Panel\System\Device Manager. If you can see the modem device on this Device Manager, then you already complete the Modem Driver installation.

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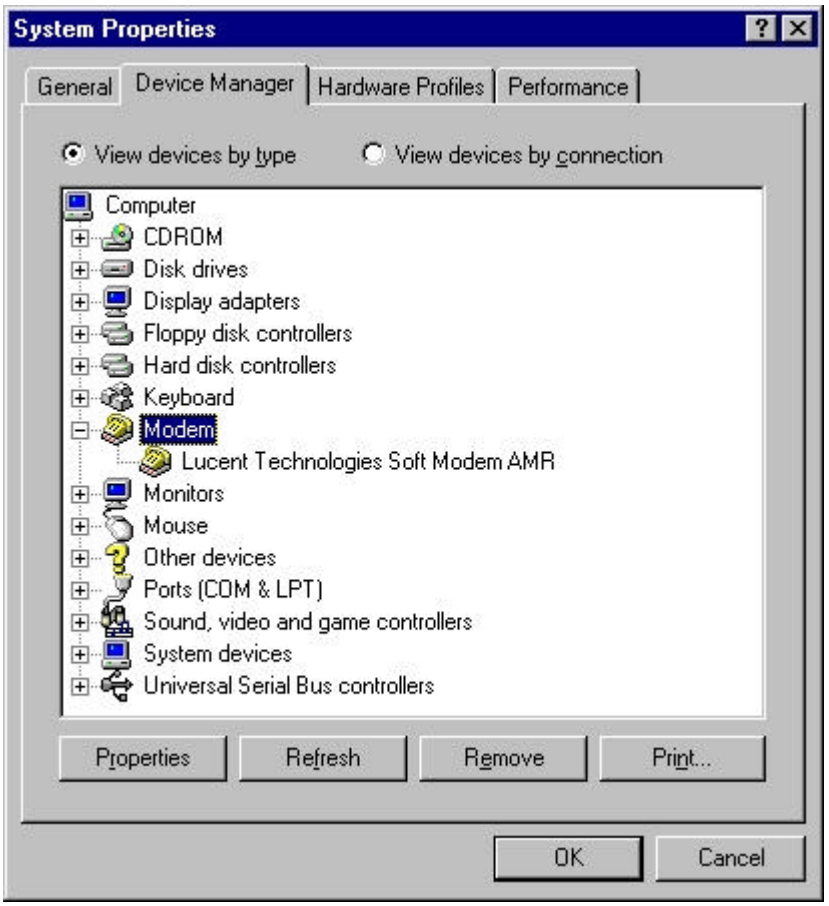

3.2 AT Commands

Basic AT Commands

A summary of the commands implemented by the modem are shown in Table1. Commands may be executed when the modem is in COMMAND mode. COMMAND mode is entered upon one of the following conditions:

After power up.
At the termination of a connection.
After the execution of a command other than dial or answer commands (ATO or AT&T).
Upon the receipt of the ESCAPE SEQUENCE (three consecutive characters matching the contents of S register 2) while online mode.
Upon the on-to-off transition of DTR if D1, &D2, or &D3 has been set.

AT Commands

Basic AT Commands

Command	Function	Command	Function
A/	Re-execute command	A	Go off-hook and attempt to answer a call
B0	Select V.22 connect @1200 bps	B1	Select Bell 212A connect @1200 bps
C1	Return OK message	Dn	Dial modifier

E0	Turn off command echo	E1	Turn on command echo
H0	Initiate a hang-up sequence	H1	If on-hook, go off-hook and enter command mode
I0	Report product code		
I1	Report pre-computed checksum	I2	Report “OK” if the calculated checksum equals the prestored checksum or if the prestored checksum value is FFh
I3	Report firmware revision, model, and interface type		
I4	Report response programmed by OEM	I5	Report the country code parameter
I6	Report modem data pump model and code revision	I7	Report the DAA code
		L0	Set low speaker volume
L1	Set low speaker volume	L2	Set medium speaker volume
L3	Set high speaker volume	M0	Turn speaker off
M1	Turn speaker on during handshaking and turn speaker off while receiving carrier	M2	Turn speaker on during handshaking and while receiving carrier
		M3	Turn speaker off during dialing and receiving carrier and turn speaker on during answering
N0	Turn off auto mode detection		
N1	Turn on auto mode detection		
P	Force pulse dialing	Q0	Allow result codes to DTE
Q1	Inhibit result codes to DTE	Sn	Select S-Register n as default
Sn?	Return the value of S-Register n	Sn=v	Set default S-Register n to value v
T	Force DTMF dialing		
V0	Report short form result codes	V1	Report long form result codes
W0	Report DTE speed only	W1	Report line speed, EC protocol and DTE speed
W2	Report DCE speed only		
X0	Report basic call progress result codes, i.e., Ok, Connect, Ring, No Carrier (also, for busy, if enabled, and dial tone not detected), No Answer and Error	X1	Report basic call progress result codes and connections speeds (Ok, Connect, Ring, No Carrier (also, for busy, if enabled, and dial tone not detected), No Answer, Connect XXXX, and Error
X2	Report basic call progress result codes and connections speeds, i.e., Ok, Connect, Ring, No Carrier (also, for busy, if enabled, and dial tone not detected), No Answer, Connect XXXX, and Error	X3	Report basic call progress result codes and connections rate, i.e., Ok, Connect, Ring, No Carrier, No Answer, Connect XXXX, Busy, and Error
		Y0	Disable long space disconnect before on-hook
X4	Report all call progress result codes and connections rate, i.e., Ok, Connect, Ring, No Carrier, No Answer, Connect XXXX, Busy, No Dial Tone and Error	Z0	Restore stored profile 0 after warm reset
Z1	Soft reset and restore stored profile 1 after warm reset	&C0	Soft reset and force RLSD active regardless of the carrier state
&C1	Allow RLSD to follow the carrier state		
&D0	Interpret DTR On-to-OFF transition per &Qn &Q0, &Q5, &Q6 The modem ignores DTR &Q1, &Q4 The modem hangs up &Q2, &Q3 The modem hangs up	&D1	Interpret DTR On-to-OFF transition per &Qn &Q0, &Q1, &Q4, &Q5, &Q6 Asynchronous escape &Q2, &Q3 The modem hangs up
&D2	Interpret DTR On-to-OFF transition per &Qn &Q0 through &Q6 The modem hangs up	&D1	Interpret DTR On-to-OFF transition per &Qn &Q0, &Q1, &Q4, &Q5, &Q6 Soft reset &Q2, &Q3 The modem hangs up
&F0	Restore factory configuration 0		
&G0	Disable guard tone	&G1	Disable guard tone
&G2	Enable 1800 Hz guard tone	&J0	Set S-Register response only for compatibility
&K0	Disable DTE/DCE flow control		

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&K3	Enable RTS/CTS DTE/DCE flow control	&K4	Enable XON/XOFF DTE/DCE flow control
&K6	Enable both RTS/CTS and XON/XOFF flow control	&M0	Select direct asynchronous mode
		&P0	Set 10 pps pulse dial with 39%/61% make/break
&P1	Set 10 pps pulse dial with 33%/67% make/break	&P2	Set 20 pps pulse dial with 39%/61% make/break
&Q0	Select direct asynchronous mode		
&Q5	Modem negotiates an error corrected link	&Q6	Select asynchronous operation in normal mode
&R0	CTS tracks RTS (sync) or CTS is normally ON and will turn OFF only if required by flow control (async)	&R1	CTS is always active (sync) or CTS is normally ON and will turn OFF only if required by flow control (async)
&S0	DSR is always active	&S1	DSR will become active after answer tone has been detected and inactive after the carrier has been lost
&T0	Terminate any test in progress		
&T1	Initiate local analog loop back		
&T2	Returns ERROR result code	&T3	Initiate local digital loop back
&V	Display current configuration and stored profiles	&W0	Store the current configuration as profile 0
&Y0	Recall stored profile 0 upon power up		
&Zn=x	Store dial string x (up to 34 digits) to location n (0 to 3)	%E0	Disable line quality monitor and auto retrain
%E1	Enable line quality monitor and auto retrain	%E2	Enable line quality monitor and fallback/ fall forward

When modem receives a break from the DTE:

\K0,2,4	Enter on-line command mode, no break sent to the remote modem	\K1	Clear buffers and send break to remote modem
\K3	Send break to remote modem immediately	\K5	Send break to remote modem in sequence with transmitted data

When modem receives \B in on-line command state:

\K0,1	Clear buffers and send break to remote modem	\K2,3	Send break to remote modem immediately
\K4,5	Send break to remote modem in sequence with transmitted data		

When modem receives break from the remote modem:

\K0,1	Clear data buffers and send break to DTE	\K2,3	Send a break immediately to DTE
		\K4,5	Send a break with received data to the DTE
\N0	Select normal speed buffered mode	\N1	Select direct mode
\N2	Select reliable link mode	\N3	Select auto reliable mode
\N4	Force LAPM mode	\N5	Force MNP mode
\V0	Connect messages are controlled by the command settings X, W, and S95	\V1	Connect messages are displayed in the single line format
+MS	Select modulation	+H0	Disable Rockwell Protocol Interface (RPI) /Video ready mode
+H1	Enable RPI and set DTE speed to 19200 bps	+H2	Enable RPI and set DTE speed to 38400 bps
+H3	Enable RPI and set DTE speed to 57600 bps	+H11	Enable RPI+ mode
		+H16	Enable Video Ready mode
**0	Download to flash memory at last sensed speed	**1	Download to flash memory at 38.4 kbps
		**2	Download to flash memory at 57.6 kbps
-SDR=0	Disable distinctive ring	-SDR=1	Enable distinctive ring type 1

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-SDR=2	Enable distinctive ring type 2	-SDR=3	Enable distinctive ring type 1 and 2
-SDR=4	Enable distinctive ring type 3	-SDR=5	Enable distinctive ring type 1 and 3
-SDR=6	Enable distinctive ring type 2 and 3	-SDR=7	Enable distinctive ring type 1, 2 and 3

ECC Commands

%C0	Disable data compression	%C1	Enable MNP 5 data compression
\A0	Set maximum block size in MNP to 64	\A1	Set maximum block size in MNP to 128
\A2	Set maximum block size in MNP to 192	\A3	Set maximum block size in MNP to 256
\Bn	Send break of n x 100 ms		

MNP 10 Commands

-K0	Disable MNP 10 extended services	-K1	Enable MNP 10 extended services
-K2	Disable MNP 10 extended services detection only	-SEC=0	Disable MNP 10-EC

-SEC=1, [<tx level>] Enable MNP 10-EC and set transmit level<tx level> 0 to 30 (0 dBm to -30 dBm)

FAX Class 1

+Fclass=1	Service class	+FAE=0	Disable data/fax auto answer
+FAE=1	Enable data/fax auto answer	+FRH=n	Receive data with HDLC framing
+FRM=n	Receive data	+FRS=n	Receive silence, nx10 ms
+FTH=n	Transmit data with HDLC framing	+FTM=n	Transmit data
+FTS=n	Stop transmission and wait, nx10 ms		

V.92 Command set

1.AT%TT61 V.92 generate V.92 PCM upstream signal for PTT testing.
2.AT+PQC=255 to clear all stored fast connect profiles.

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AT Commands for Homologation Testing and Debugging

Table 1. Homologation Testing and Debugging Commands

Command	Description	Comments
ATSxxx	Modify homologation parameter.	xxx represents the S-register that controls the associated homologation parameter.
ATSxxx?	Read homologation parameter.	xxx represents the S-register to be read.
AT%TT00—AT%TT09	Generate DTMF 0—9.	—
AT%TT0A	Generate DTMF *.	—
AT%TT0B	Generate DTMF #.	—
AT%TT0C—AT%TT0F	Generate DTMF A—D.	—
AT%TT10	V.21 channel 1 mark signal.	—
AT%TT11	V.21 channel 2 mark signal.	—
AT%TT12	V.23 backward channel mark signal.	—
AT%TT13	V.23 forward channel mark signal.	—
AT%TT15	V.22 originate signaling at 1200 bits/s.	—
AT%TT16	V.22bis originate signaling at 2400 bits/s.	—
AT%TT17	V.22 answer signaling at 1200 bits/s.	—
AT%TT18	V.22bis answer signaling at 2400 bits/s.	—
AT%TT19	V.21 channel 1 space signal.	—
AT%TT1A	V.21 channel 2 space signal.	—
AT%TT1B	V.23 backward channel space signal.	—
AT%TT1C	V.23 forward channel space signal.	—
AT%TT20	V.32 9600 bits/s.	—
AT%TT21	V.32bis 14400 bits/s.	—
AT%TT22	V.32ter 19200 bits/s.	—
AT%TT30	Off-hook.	Puts the modem in the off-hook state.
AT%TT31	V.25 answer tone (2100 Hz).	—
AT%TT32	1800 Hz guard tone.	—
AT%TT33	V.25 data calling tone (1300 Hz).	—
AT%TT34	FAX calling tone (1100 Hz).	—
AT%TT35	Send tones of variable levels and frequencies.	Ln—level for the n-th tone (in dBm). Fn—frequency for the n-th tone (in Hz).
AT%TT40	V.21 channel 2.	—
AT%TT41	V.27 2400 bits/s.	—
AT%TT42	V.27 4800 bits/s.	—
AT%TT43	V.29 7200 bits/s.	—
AT%TT44	V.29 9600 bits/s.	—
AT%TT45	V.17 7200 bits/s (long train).	—
AT%TT46	V.17 7200 bits/s (short train).	—
AT%TT47	V.17 9600 bits/s (long train).	—

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S-Registers

Register	Function	Range/units	Default
S0	Rings to auto-answer	0-255/rings	0
S1	Ring counter	0-255/rings	0
S2	Escape character	0-255/ASCII	43
S3	Carriage return character	0-127/ASCII	13
S4	Line feed character	0-127/ASCII	10
S5	Backspace character	0-255/ASCII	8
S6	Wait time for dial tone	2-255/s	2
S7	Wait time for carrier	1-255/s	50
S8	Pause time for dial delay modifier	0-255/s	2
S9	Carrier detect response time	1-255/.1 s	0
S10	Carrier loss disconnect time	1-255/.1 s	20
S11	DTMF tone duration	50-255/.001 s	95
S12	Escape prompt delay	0-255/.02 s	50
S14	General bit mapped options status		8 (8h)
S16	Test mode bit mapped options status (&T)		7
S18	Test timer	0-255/s	0
S19	Auto Sync options		0
S20	Auto Sync HDLC address or BSC Sync character	0-255	0
S21	V.24/general bit mapped options status		48 (30h)
S22	Speaker/results bit mapped options status		112 (70h)
S23	General bit mapped options status		0
S24	Sleep inactivity timer	0-255/s	10
S25	Delay to DTR off	0-255/s or .01s	0
S26	RTS-to-CTS delay	0-255/.01 s	0
S27	General bit mapped options status		0
S28	General bit mapped options status		0
S29	Flash dial modifier time	0-255/10 ms	0
S30	Disconnect inactivity timer	0-255/10 s	0
S31	General bit mapped options status		0
S32	XON character	0-255/ASCII	10 (Ah)
S33	XOFF character	0-255/ASCII	0
S36	LAPM failure control		7
S37	Line connection speed		0
S38	Delay before forced hang-up	0-255/s	0
S39	Flow control bit mapped options status		0
S40	General bit mapped options status		0
S41	General bit mapped options status		0
S46	Data compression control		0
S48	V.42 negotiation control		7
S82	LAPM break control		0
S86	Call failure reason code	0-255	0
S91	PSTN transmit attenuation level	0-15/dBm	10 (country dependent)
S92	Fax transmit attenuation level	0-15/dBm	10 (country dependent)
S95	Result code messages control		150

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Result Code Summary

OK	0		CONNECT		1
RING	2		NO CARRIER	3	
ERROR	4		CONNECT 1200		5
NO DIAL TONE	6		BUSY		7
NO ANSWER	8		CONNECT 0600		9
CONNECT 2400	10		CONNECT 4800		11
CONNECT 9600	12		CONNECT 7200		13
CONNECT 12000	14		CONNECT 14400	15	
CONNECT 19200	16		CONNECT 38400	17	
CONNECT 57600	18		CONNECT 115200	19	
CONNECT 230400	20		CONNECT 75TX/1200RX		22
CONNECT 1200TX/75RX	23		DELAYED		24
BLACKLISTED	32		FAX		33
DATA	35		CARRIER 300		40
CARRIER 1200/75	44		CARRIER 75/1200		45
CARRIER 1200	46		CARRIER 2400		47
CARRIER 4800	48		CARRIER 7200		49
CARRIER 9600	50		CARRIER 12000		51
CARRIER 14400	52		CARRIER 16800		53
CARRIER 19200	54		CARRIER 21600		55
CARRIER 24000	56		CARRIER 26400		57
CARRIER 28800	58		CONNECT 16800	59	
CONNECT 21600	61		CONNECT 24000	62	
CONNECT 26400	63		CONNECT 28800	64	
COMPRESSION: CLASS 5	66		COMPRESSION: V.42 bis		67
COMPRESSION: NONE	69		PROTOCOL: NONE		70
PROTOCOL: LAPM	77		CARRIER 31200		78
CARRIER 33600	79		CONNECT 33600	84	
CONNECT 31200	91		CARRIER 32000	150	
CARRIER 34000	151		CARRIER 36000		152
CARRIER 38000	153		CARRIER 40000		154
CARRIER 42000	155		CARRIER 44000		156
CARRIER 46000	157		CARRIER 48000		158
CARRIER 50000	159		CARRIER 52000		160
CARRIER 54000	161		CARRIER 56000		162
CONNECT 32000	165		CONNECT 34000	166	
CONNECT 36000	167		CONNECT 38000	168	
CONNECT 40000	169		CONNECT 42000	170	
CONNECT 44000	171		CONNECT 46000	172	
CONNECT 48000	173		CONNECT 50000	174	
CONNECT 52000	175		CONNECT 54000	176	
CONNECT 56000	177		+FCERROR	+F4	

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Section Four: FCC Notice

4.1 FCC Compliance

This Equipment complies with Part 68 of the FCC Rules. On this equipment is a label that contains, among other information, the FCC registration number and Ringer Equivalence Number (REN) for this equipment. You must, upon request, provide this information to your telephone company.
If your telephone equipment causes harm to the telephone network, the Telephone Company may discontinue your service temporarily. If posible, they will be notify in advience. But if advance notice isn't practical, you will notified as soon as possible. You will be informed of your right to file a complaint with the FCC.
Your telephone company may make changes in its facilities, equipment, operations or procedures that could affect proper operation of your equipment. If they do, you will be notified in advance to give you an opportunity you maintain uninterrupted telephone service.
The FCC prohibits this equipment's should fail to operate properly, disconnect the equipment from the phone line to determine if it is causing the problem. If the problem is with the equipment, discontinue use and contact your dealer or vendor.

4.2 FCC Class B Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on , the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- increase the separation between the equipment and the receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

Notice: (1)Shielded cables, if any, must be used in order to comply with the emission limits. (2) Any change or modification not expressly approved by the grantee of the equipment authorized could void the user authority to operate the equipment.

Caution: Please make sure you already disconnect the phone cable before you want to touch or remove modem module.

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Appendix

Frequency Range of a Bluetooth Device

Hereby we declare that the maximum frequency range of this device is : 2402 – 2480 MHz. This is according to the Bluetooth Core Specification V 1.1 for devices which will be operated in the USA. Other frequency ranges (e.g. for Spain, France, Japan) which are allowed according to the Core Specification are **not** supported by this device.

Co-ordination of the Hopping Sequence in Data Mode to Avoid Simultaneous Occupancy by Multiple Transmitters

Bluetooth units which want to communicate with other units must be organized in a structure called piconet. This piconet consists of maximum of 8 Bluetooth units. One unit is the master the other seven are the slaves. The master co-ordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from it's BD address which is unique for every Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.

Example of a hopping sequence in data mode

Example of a 79 hopping sequence in data mode:

40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67,
56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59,
72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75,
09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06,
01, 51, 03, 55, 05, 04.

Equally Average Use of Frequencies in Data Mode and Behaviour for Short Transmissions

The generation of the hopping sequence in connection mode depends essentially on two input values :

1. LAP/UAP of the master of the connection
2. Internal master clock

The LAP (lower address part) are the 24 LSB's of the 48 bit BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 bit BD_ADDRESS,. The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronization with other units, only offset values are added to this clock. It has no relation to the time of day. Its resolution is at least half RX/TX slot length of 312.5 µs. The clock has a cycle of a bout one day (23h30). For the deriving of the hopping sequence the entire LAP (24bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.

Regarding shorts transmissions the Bluetooth system has the following behaviours: The first connection between the two devices is established, a hopping sequence was generated. For transmitting the wanted data the complete hopping sequence was not used. The connection ended. The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value, because the period between the two transmission is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5 µs). The hopping sequence will always differ from the first one.

Receiver Input Bandwidth and Behaviour for Repeated Single or Multiple Packets

The input bandwidth of the receiver is 1 MHz.

In every connection one Bluetooth device is the master and the other one is the slave. The master determines the hopping sequence. The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master. Additionally the type of connection (e.g. single or multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings. Repeating of a packet has no influence on the hopping sequence. The hoping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be sent on the same frequency, it is sent on the next frequency of the hopping sequence.

Channel Separation in Hybrid Mode

As mentioned before, the nominal channel spacing of the Bluetooth system is 1 MHz independent of the operating mode. In other words, the channel spacing in hybrid mode (inquiry and page mode) is still 1 MHz without any change.

Derivation and Examples for a Hopping Sequence in Hybrid Mode

For the generation of the inquiry and page hop sequences the same procedures as described for the data mode are used, but this time with different input vectors:

For the inquiry hop sequence, a predefined fixed address is always used. This results in the same 32 frequencies used by all devices doing an inquiry but every time with a different start frequency and phase in this sequence.

For the page hop sequence, the device address of the paged unit is used as input vector. This results in the use of a subset of 32 frequencies which is specific for that initial state of the connection establishment between the two units. A page to different devices would result in a different subset of 32 frequencies. So it is also ensured that in hybrid mode the frequency use equally averaged.

Example of a hopping sequence in inquiry mode :

48, 50, 09, 13, 52, 54, 41, 45, 56, 58, 11, 15, 60, 62, 43, 47, 00, 02, 64, 68, 04, 06, 17, 21, 08, 10, 66, 70, 12, 14, 19, 23

Example of a hopping sequence in paging mode :

08, 57, 68, 70, 51, 02, 42, 40, 04, 61, 44, 46, 63, 14, 50, 48, 16, 65, 52, 54, 67, 18, 58, 56, 20, 53, 60, 62, 55, 06, 66, 64

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Receiver Input Bandwidth and Synchronization in Hybrid Mode :

The receiver input bandwidth is the same as in the data mode (1 MHz). When two Bluetooth devices establish contact for the first time, one device sends an inquiry access code, the other device is scanning for this inquiry access code. If two devices have been connected previously and want to start a new

transmission, a similar procedure takes place. The only difference is, instead of the inquiry access code, a special access code, derived from the BD_ADDRESS of the paged device will be sent by the master in this connection. Due to the fact that both units have been connected before (in the inquiry procedure) the paging unit has timing and frequency information about the page scan of the paged unit. For this reason the time to establish the connection is reduced considerably.

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