BBI-14.4 Industrial Modem

Installation, Operation and Diagnostics

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1. PRODUCT OVERVIEW

The BBI-14.4 is an industrial modem for direct connection to public switched telephone lines. Though similar to commercial modems, the BBI-14.4 contains special features that make it particularly well suited for industrial applications. These capabilities include:

Environment The BBI-14.4 has been designed explicitly for use in industrial environments. In addition to an extended temperature range (-40 to +85^{o} C), the BBI-14.4 includes surge, shock, vibration, and safety parameters superior to those of conventional commercial modems.

Low Power The BBI-14.4 implements a "low power" standby mode. This mode allows the BBI-14.4 to consume a small fraction of its active power while waiting for either controller or telephone activity.

Industrial The BBI-14.4 uses standard industrial connectors for both data and telephone interfaces. These connectors allow reliable interconnect to other industrial components. Furthermore, the BBI-14.4 data lines are provided at either RS-232 or TTL signal levels for both stand-alone and embedded applications.

2. PRODUCT DESCRIPTION

The BBI-14.4 provides dial-up telephone communication capabilities for the industrial environment. It can be operated stand-alone or as a component of a larger industrial system.

2.1 Telephone Interface

The BBI-14.4 telephone interface operates over two wire loop start lines available in North America. The telephone line interface is environmentally benign, allowing use in Class I, Division 2 applications.

2.2 Data Interface

The BBI-14.4 data interface provides RS-232 compatible serial signaling. The data interface interconnects to industrial controllers at either RS-232E or TTL signal levels. Selectable RS-232 only or TTL with RS-232 override

2.3 Power

The BBI-14.4B accepts either regulated 4.75 to 5.25 volts DC, unregulated 5.5 to 7.0 volts DC (battery) or unregulated 9.5 to 18.0 volt power inputs. The unregulated power inputs are also suitable for use with 6.0 volt and 12.0 volt solar power systems.

2.4 Mechanical

The BBI-14.4 consists of two printed circuit boards: A single two sided baseboard and a four layer modem board (Telenetics PE14.4)

3. MODEM SPECIFICATIONS

The BBI-14.4 modem capabilities are based upon the Rockwell RC144ACL modem chipset. Modem control is through the industry standard 'AT' command set. The BBI-14.4 provides all popular error correction and data compression capabilities.

The BBI-14.4 provides the following modem features.

Dialing and Data Command Set

RC144ACL (Rockwell) AT command set.

Data Modulations and Speeds

V.32bis	14400, 12000, 14400, 9600, 7200, 4800 bps.
V.32	9600, 4800 bps.
V.22bis	2400, 1200 bps
V.22	1200 bps.
V.21	0-300 bps.
Bell 212A	1200 bps.
Bell 103J	0-300 bps.

Data Modulation Connectivity

Connectivity:	95% or better

Error Correction and Data Compression Specifications

Error Correction	MNP Class 2-4, MNP 10, V.42.
Data Compression	MNP 5, V.42bis.

Serial Formats and Flow Control

Serial Speeds:	57600, 38400, 19200, 9600, 4800, 2400, 1200, 300bps
Serial Formats:	8N1, 7E1, 7O1, 7N2
Flow Control:	RTS/CTS, XON/XOFF, None

4. SERIAL CONNECTOR SPECIFICATIONS

The BBI-14.4 communicates with industrial controllers through RS-232 compatible serial signaling. Both RS-232E and TTL signal levels are provided. The RS-232E signal levels are used to interconnect with RS-232E compatible embedded controllers; the TTL signal levels are used to interconnect with TTL compatible embedded controllers. The RS-232E signal levels are also used to configure the BBI-14.4.

The RS-232E and TTL signals are present on several connectors. The RS-232 signal levels are present on three (3) connectors: the TTL levels are present on two (2) connectors;

The BBI-14.4 RS-232E and TTL signals interfaces are independent. All RS-232E signals are internally connected together; likewise, all TTL signals are internally connected together. The RS-232E signals, though, are not internally connected to the TTL signals.

4.1 The following lists the BBI-14.4 serial interfaces. All connector definitions are described in Appendix A

RS-232 Configuration Connector 1 (J5)

Connector Type:	DB9, female, right angle
Signal Levels:	RS-232

RS-232 Configuration Connector 2 (J4)

Connector Type:	DB9, female, straight board mount.
Signal Levels:	RS-232

RS-232 Configuration Connector 3 (TB2)

Connector Type:	Part of Alternate Telephone Connector 2, see below.
Signal Levels:	RS-232

TTL Serial Connector 2 (P1)

Connector Type:	15 pin, 0.025" square post, gold plated, single row
Signal Levels:	TTL

TTL Serial Connector 2 (TB3)

Connector Type:	7 circuit, screw-type terminal block
Signal Levels:	TTL

4.2 Serial Interface Selection (Jumper J6)

As previously described, the BBI-14.4 has two separate serial interfaces: one for RS-232E levels and one for TTL levels. BBI-14.4 interface selection is determined either automatically or manually.

The BBI-14.4 becomes active and responds to a serial interface in response to either the interface DTR signal becoming active or in response to an incoming ring signal. In the first case, the interface DTR signal determines the active serial interface. In the second case, incoming ring, a manual jumper determines the active interface.

When configured to respond to the RS-232E interface (J6 Jumper Position 1-2), an active RS-232E DTR signal will power up the BBI-14.4 and its RS-232E line drivers. Communication to and from the BBI-14.4 will be through the RS-232 E serial interface only. The TTL serial interface signals will be clamped at inactive signal levels. Also in this configuration, when incoming ring has been detected, the RS-232E interface will become active.

When configured for the TTL interface (J6 Jumper Position 2-3), active TTL DTR signal will activate the BBI-14.4. Communication is to and from the controller through the TTL serial interface only. The BBI-14.4 RS-232E line drivers will be powered off. When an incoming ring has been detected, the TTL interface will become active.

When in the RS-232E configuration, TTL signals are always ignored. This configuration allows the BBI-14.4A to be used as a conventional modem.

When in the TTL configuration, though, RS-232E signals can be used for BBI-14.4 configuration. Regardless of the state of the TTL serial interface, an active RS-232E DTR signal will result in inactivating the TWX serial interface, activating the RS-232E serial interface. If there is an active modem connection the call is not disconnected. To disconnect the user must enter the command mode (+++) type ATH or drop DTR (to disconnect) and reinstate DTR to the active state.

The RS-232E configuration is called stand alone mode. It is intended for applications when attached to intelligent controllers which can configure the BBI-14.4 in the field. The TTL configuration is called the embedded mode. It is intended for applications when attached to older controllers that cannot configure the BBI-14.4 in the field. When in embedded mode, the RS-232E interface is used to configure the BBI-14.4.

Connector Type	3 pin header
Jumper Positions	1-2: RS232 2-3: TTL with RS232 override

NOTE: Section 6 below discusses the BBI-202T's three power supply options and indicates which serial interface (RS-232 and/or TTL) is supported by each power option.

5. TELEPHONE INTERFACE SPECIFICATIONS

The BBI-14.4 contains telephone circuitry for connection to the public switched telephone network. The circuitry is suitable for loop start telephone lines.

The BBI-14.4 has both primary and alternate telephone connectors. The primary connector is used for connecting RJ-11 terminated cabling. The alternate telephone connectors provide terminal strip wiring of telephone cabling. Internally, all connectors are wired together.

The following lists the BBI-14.4 telephone interfaces. All connector definitions are described in Appendix A.

Telephone Line Type: Two wire loop start lines.

Primary Connector (J1): RJ-11.
Only the center two signals of the RJ-11, (TIP and RING), are used by the BBI-14.4.

Alternate Connector 1 (TB1): 6 circuit, screw-type terminal block.

Alternate Connector 2 (TB2): 10 circuit, screw-type terminal block.
Both TIP and RING of the primary connector are connected to the alternate connector 2.

Telephone Polarity: None. The BBI-14.4 telephone circuitry is insensitive to the telephone line's polarity.

Telephone Functions: Dialing and answering by AT commands. Automatic answering is also programmable.

Call Progress Detection: Dial tone, busy, and silence.

Digit Dialing Types: Tone and pulse.

Additional Functions: None. The BBI-14.4 does not provide line current detection, caller ID, distinctive ringing or any other additional telephone functions.

Telephone Speaker: None.

Telephone LED Indicators: None

Telephone Approvals: FCC Part 68. The BBI-14.4 is also suitable for approval within Canada.

Safety Suitable for use in Class I, Division 2 Hazardous Locations.

6. POWER SUPPLY SPECIFICATIONS

The BBI-14.4 contains a low quiescent power regulator. The BBI-14.4 also has a "low power" standby mode which minimizes overall power requirements when the BBI-14.4 is used intermittently.

6.1 Power Supply Selection ~ The power supplies are selected through the use of a multi-pin ganged header (JP1A, B & C) and power is connected to either a 2 circuit, screw-type terminal block (TB4) or a 15 pin header (P1).

The following lists the BBI-14.4 power interfaces. All connector pin definitions are described in Appendix A.

Power Connector P1

Connector Type:	15 Pin Header
Selection:	Selected by jumper between JP1B & JP1A
Regulated Power Supply Range:	**4.75 to 5.75VDC.**
Standby Supply Currents:	200uA
Active Supply Currents:	190mA
In-Rush Current:	< 250mA
Reverse Protection Method:	I.C. Internal Protection
Over-Voltage Clamp Limit:	None
Serial Data Interface Supported:	RS-232 and TTL

Power Connector TB4

Connector Type:	2 circuit, screw-type terminal block.
Selection:	Selected by jumper between JP1B and JP1C
Unregulated Power Supply Range:	**9.5 to 18VDC.**
Standby Supply Current:	150 uA
Active Supply Current:	125 mA
In-Rush Current:	<250 mA
Reverse Protection Method:	TransZorb TVS and I.C. Internal Protection
Over-Voltage Clamp limit:	Zener diode
Serial Data Interface Supported:	*RS-232 and TTL*

Battery / Solar Panel Connection TB4

Connector Type:	2 circuit, screw-type terminal block.
Selection:	Selected by jumper between JP1C Pins 1 & 2
Unregulated Power Supply Range:	**5.5 to 7VDC**
Standby Supply Current:	150 uA

Active Supply Current:	125 mA
In-Rush Current:	<250 mA
Reverse Protection Method:	TransZorb TVS and I.C. Internal Protection
Over-Voltage Clamp limit:	Zener diode
Serial Data Interface Supported:	*RS-232 only*

6.2 Standby Operation

The BBI-14.4 is configured for "low-power" standby operation. When in the standby mode, the BBI-14.4B consumes only 200uA power. Standby is controlled by the serial interface (RS-232 or TTL) DTR signal.

The BBI-14.4 will automatically enter standby mode after 30 seconds of no DTR activity.

Standby mode ends when either a ring has been detected on the telephone line or DTR becomes active. If ringing occurs, the BBI-14.4 increases its power demands only enough to determine if the ring is valid. If the BBI-14.4 determines the ring invalid, it returns to standby mode after 30 seconds. If the ring is valid, the BBI-14.4 will answer the call. (Note that the BBI-14.4B must be in the auto-answer mode, i.e.: S0=1 or greater, see Appendix B)

7. ENVIRONMENTAL SPECIFICATIONS

The BBI-14.4 meets the following environmental specifications.

Operating Temperatures	-40 to 85°C
Storage Temperature	-55 to 100°C
Relative Humidity	0 to 95% non-condensing.
Altitude	20,000 ft (operating), 40,000 ft (shipping).
Vibration Effect	Withstand 10 to 500 Hz at 1 g on any axis per SAMA PMC-31-1 without damage or impairment.
ESD susceptibility	Field connected circuits meet the requirements of IEC 801-2 for ESD withstand capability up to 10 KV.
EMI susceptibility	Withstand 27 to 1000 MHz per IEC 801-3 level 1 (1v/m) without damage or impairment.
EMI radiation	Meets FCC Rules Part J, Subpart 15, Class A for radiated emissions.

8. APPROVALS

The BBI-14.4 meets the following approvals:

Telephone	FCC Part 68
Emissions	FCC Part 15
Environment	UL listed (pending) for use in Class I, Division 2, Groups C and D hazardous locations.

APPENDIX A. CONNECTOR PIN DEFINITIONS

CONNECTOR P1: TTL Serial Connector 1

	1	not used		
GND	2	ground		
+5VDC	3	regulated 5 volts (4.7 to 5.2VDC)		
	4	not used		
	5	not used		
TD	6	transmit data	to	BBI-14.4
RTS	7	request to send	to	BBI-14.4
DTR	8	data terminal ready	to	BBI-14.4
RD	9	receive data	from	BBI-14.4
CTS	10	clear to send	from	BBI-14.4
DSR	11	data set ready	from	BBI-14.4
CD	12	data carrier detect	from	BBI-14.4
	13	not used		
	14	not used		
	15	not used		

CONNECTOR TB3: TTL Serial Connector 2

+5VDC	1	regulated 5 volts		
TD	2	transmit data	to	BBI-14.4
RTS	3	request to send	to	BBI-14.4
DTR	4	data terminal ready	to	BBI-14.4
RD	5	receive data	from	BBI-14.4
CTS	6	clear to send	from	BBI-14.4
CD	7	data carrier detect	from	BBI-14.4

CONNECTOR J5: RS-232 Configuration Connector 1

DCD	1	data carrier detect	from	BBI-14.4
RD	2	receive data	from	BBI-14.4
TD	3	transmit data	to	BBI-14.4
DTR	4	data terminal ready	to	BBI-14.4
GND	5	ground		
DSR	6	data set ready	from	BBI-14.4
RTS	7	request to send	to	BBI-14.4
CTS	8	clear to send	from	BBI-14.4
RI	9	ring indication	from	BBI-14.4
PGND	shield	protective ground		

CONNECTOR J4: RS-232 Configuration Connector 2

DCD	1	data carrier detect	from	BBI-14.4
RD	2	receive data	from	BBI-14.4
TD	3	transmit data	to	BBI-14.4
DTR	4	data terminal ready	to	BBI-14.4
GND	5	ground		
DSR	6	data set ready	from	BBI-14.4
RTS	7	request to send	to	BBI-14.4
CTS	8	clear to send	from	BBI-14.4
RI	9	ring indication	from	BBI-14.4
PGND	shield	protective ground		

CONNECTOR J1: Primary Telephone Connector

Dial Pin	*Leased Line*		
	2	2-Wire: Not Used	4-Wire: Rx
T/R	3	2-Wire: Tx/Rx	4-Wire: Tx
T/R	4	2-Wire: Tx/Rx	4-Wire: Tx
	5	2-Wire: Not Used	4-Wire: Rx

CONNECTOR TB1: Alternate Telephone Connector 1

Definition	*Pin*	*Dial*	*Leased Line*
T/R	1	Tip or Ring	2-Wire: Tx/Rx 4-Wire:Tx
T/R	2	Tip or Ring	2-Wire: Tx/Rx 4-Wire:Tx
R	3		2-Wire: Not Used 4-Wire:Rx
R	4		2-Wire: Not Used 4-Wire:Rx
K-GND	5	key ground (not used)	
KEY	6	key output (not used)	

CONNECTOR TB2: Alternate Telephone Connector 2

Definition	*Pin*	*Dial*	*Leased Line*
T/R	1	Tip or Ring	2-Wire: Tx/Rx 4-Wire:Tx
T/R	2	Tip or Ring	2-Wire: Tx/Rx 4-Wire:Tx
R	3		2-Wire: Not Used 4-Wire:Rx
R	4		2-Wire: Not Used 4-Wire:Rx
K-GND	5	key ground (not used)	
KEY	6	key output (not used)	
DTR	8	data terminal ready	to BBI-14.4
RD	9	receive data	from BBI-14.4
TD	10	transmit data	to BBI-14.4

CONNECTOR TB4: Unregulated (9.5-18VDC) or Battery/Solar Power (5.5-7VDC) Connector

GND	1	ground
EXTVDC	2	power input

JUMPERS JP1A, B & C: Regulated / Unregulated / Battery Power Selector

Jumper Position JP1A to JP1B	Regulated 4.75 - 5.25VDC
Jumper Position JP1B to JP1C	Unregulated 9.5 - 18VDC
Jumper Position JP1C, Pins 1-2	Battery/Solar Power (5.5 to 7VDC)

JUMPER J6: RS-232 / TTL Data Interface Selector

Jumper Position 1-2	RS-232 only
Jumper Position 2-3	TTL with RS232 override

APPENDIX B. AT COMMAND SET

The BBI-14.4 modem is based upon the Rockwell RC144ACL chipset. This chipset contains Rockwell's "AT" command set.

The RC144ACL is part of the family of RC96ACXXX/RC144XXX modem device set family. The low power version is used in the BBI-14.4B and will support both facsimile and data operation at 14400 bits per second (bps).

The full Rockwell command set specification is available from Rockwell and is contained within their document:

AT Command Reference Manual
for the RC144ACi,RC144ACL and
RC144ACG Modem Families.

Order No.883
Rev. 3, May 5, 1995

A summary of the Rockwell command set is provided on the following pages B-3 through B-6.

The revision of the Rockwell firmware within the BBI-14.4 is Telenetics Version 1.4T.

1. BBI-14.4 Command Set Modifications

The BBI-14.4 contains a modified version of the standard Rockwell AT command set. These modifications are as follows:

(a) &DN Modification

The &Dn command is configure in active profile 0 during Final System test, for &D0 so that DTR is ignored (assumed ON)

(b) &Cn Modification

The &Cn command is set for &C1 in Final System test (Carrier Detect will follow the state of the carrier.

(c) RTS/CTS Modification

The &Rn command has been modified (Code Version 1.4T) to the following:

&R0 is set so that CTS will follow RTS. There is a CTS/RTS delay of 5ms to 100ms with an RS232 interface and no delay with a TTL interface.

&R1 has not been changed; CTS is controlled by the flow control functions.

2. AUTO DIAL

Command \D1 will enable Auto Dial: When DTR goes from an OFF to ON condition, and \D1 is set, the modem will auto dial the phone number stored in location &Z0 (up to 45 digits).

Command \D0 (default) will disable the Auto Dial feature.

3. IDENTIFICATION PARAMETER

Command I3 will report the firmware version V2.41_T1442.

SUMMARY OF THE ROCKWELL "AT" COMMAND SET

To communicate using the modem, use an asynchronous communication program. The command set for the Telenetics modems is compatible with the Hayes command set.

The modem is controlled and configured by the AT (attention command). Each command consists of the following elements (with exception of the A/and the +++ command which will be discussed later).

1. The two character sequence AT
2. A command
3. A command parameter
4. A carriage return

A command is not entered until a carriage return <ENTER> is entered. Spaces entered are ignored. For example, to enter the command `Answer', type ATA and <ENTER>.

Some commands do not have parameters. Any missing parameters in a command are assigned the value zero, which may be a valid parameter for the command. The sequence followed by AT command causes the modem to enter a command state. That is, AT without a command serves as a wake up code and an "OK" appears on the screen.

The modem queues commands in a 40-character command line. The command line begins with AT and can have several commands. A separator is not required between the commands.

The command line format is the "AT" prefix, followed the required commands from the attached list and terminated with a Carriage Return.

When a carriage return is received, the commands are performed in the order in which they are sent to the modem. If more than 40 characters are sent to the modem, an error occurs and all commands must be re-entered.

BASIC AT COMMANDS...

A/	Execute Previous Command, without Striking <CR> Key
AT	Attention
A	Answer Immediate
BO	CCITT V.22 Mode
B1	Bell 212A Mode -**DEFAULT**
DP	Dial Using Pulse Dial
D	Dial Command
DT	Dial Using DTMF Tone Dial Default
DL	Dial Using Last Number, Regardless of Last Command
DW	Wait for Dial Tone For Period Set by S7 register
AD@	Quiet Answer: Wait for 5 seconds of Silence Before Dialing
AD!	Hookflash: Commonly Used PBX Systems
DR	Reverse Answer Mode
DSn	Dial Stored Number n=0 - 3

AD/	Wait 0.125 Seconds
AD;	Returns to Command Mode After Dialing
AD,	Pause fo Time Set by S8 Register
E0	Command Echo Disabled
E1	Command Mode Echo Enabled -**DEFAULT**
F0	No Echo when Connected
F1	Echo Transmitted Characters when Connected -**DEFAULT**
H0	Go On Hook (Open Relay)
H1	Go Off Hook (Close Relay)
10	Identification Code
I1	Identification Code
I2	"OK" Response if Checksum Verifies
I3	Revision Number
L0	Lowest Volume setting
L1	Same as L0
L2	Medium Volume Setting -**DEFAULT**
L3	Maximum Volume
M0	Speaker Always Off
M1	Speaker On Until Carrier is Detected -**DEFAULT**
M2	Speaker Always On
M3	DTMF Tones are Not Heard, but Speaker is On Until Carrier Detected
0	Originate Immediate or eturn to Data Mode
Q0	Enable Result Code -**DEFAULT**
Q1	Disable Result Code
Sn?	Provide S Register Value (n = 0 - 27)
Sn=	Set Register Value (n = 0 - 27)
V1	Verbose Response -**DEFAULT**. See V0 for Response
W0	Negotiation Process Result Codes Not Required -DEFAULT
W1	Negotiation Process Result Codes Returned
X0	Enable Result Codes 0-4
X1	Enable Result Codes 0-5
X2	Enable Result Codes 0-6
X3	Enable Result Codes 0-5 and 7 and 10
X4	Enable Result Codes 0-10 **-DEFAULT**
Y0	Disable Long Space Disconnect -**DEFAULT**
Y1	Enable Long Space Disconnect
Z0	Software Reset, Restore S Register from Profile Location 0
Z1	Restore S Register from Profile Location 1 in NVRAM
&C0	EIA Carrier Line Always Forced on -**DEFAULT**
&D0	DTR Always on **-DEFAULT**
&D1	Modem Goes to Command Mode When DTR Goes OFF
&D2	Modem Goes on HOOK and Return to Command Mode when DTR Goes OFF
&D3	Modem Initializes when DTR Goes OFF
&F	Fetch S Register from EPROM for Factory Default
&G0	No Guard Tone **-DEFAULT**

&G1	500 Hz Guard Tone Enable
&G2	1800 Hz Guard Tone Enabled
&J0	RJ-11 Select **-DEFAULT**
&J1	No Function
&L0	Switched Line Select -**DEFAULT**
&L1	Leased Line Select (Not Supported)
&M0	Asynchronous Mode -**DEFAULT**
&P0	US Make/Break Ratio for Pulse Dialing **-DEFAULT**
&P1	UK Make/Break Ratio for Pulse Dialing
&Q0	Same as &M0
&R0	Clear to Send (CTS) Follows RTS -**DEFAULT**
&R1	CTS Always On
&S0	Data Set Ready (DSR) Always on -**DEFAULT**
&S1	DSR Normal
&T0	Terminate Test in Progress -**DEFAULT**
&T1	Initiate Local Analog Loopback for time Set by Register S18
&T2	Not Defined
&T3	Initiate Digital Loopback for time Set by Register
&T4	Enable Remote Digital Loopback (RDLB) Response
&T5	Disable Remote Digital Loopback (RDLB) Response
&T6	Initiate RDLB
&T7	Initiate RDLB with Self Test
&T8	Initiate ALB with Self Test
&W0	Write S Register Into User Profile Number 0
&W1	Write S Register Into User Profile Number 1
&X0	Modem Provides Transmit Clock
&X1	DTE Supplies Transmit Clock
&X2	Slave Clock Mode (Not Supported)
&Y0	Power Up recall user Profile 0
&V	List Configuration Both Active and Stored
&Zm=An	Store Telephone Numbers into NVRAM (XL93C46) where:

m	is the Number Location (0-3)
A	is P or T (pulse or Tone)
n	is the Telephone Number

%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.
%L	Return received line signal level.
%Q	Report the line signal quality.
\D0	Selects AutoDial mode DTR is switched from OFF to ON the number in Z0 location will be dial
\D1	Auto Dial disable (default)
\G0	Disable modem to modem flow control.

\G1 Enable modem to modem flow control.

\H0 Dial Mode (Default)

\H1 Lease Line Mode

\Kn Controls break handling during three states:

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.

\M0 Lease Line Modem in Answer Mode

\M1 Lease Line Modem in Originate Mode

\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.

ECC COMMANDS...

%C0 Disable data compression.

%C1 Enable MNP 5 data compression.

%C2 Enable V.42 bis data compression.

%C3 Enable both V.42 bis and MNP 5 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.

APPENDIX C: FACTORY CONFIGURATION

The BBI-14.4B is factory configured with the following changes to the standard Rockwell AT default settings...

B1
&C1
&G0
&K0
&Q6
&R1
&T5
S0=1
S11=95
%C0
F8
&W0 (Stores the above in Profile 0)

APPENDIX D: DIAGNOSTICS

The following AT&Tn commands form part of the CCITT V.54 protocol and can be used for diagnostic testing.

Note: &Tn commands can only be used when the modem is configured for &Q0 <CR> (unbuffered/direct asynchronous mode).

&TO TERMINATE TEST IN PROGRESS

If a V.54 loopback test is in progress as a result of executing an &Tn command, then the &TO command will cause that test to be terminated provided that the modem is in the command state, or a V.54 state that accepts commands from the DTE. See specific &Tn command descriptions for termination actions.

&T1 INITIATE LOCAL ANALOG LOOPBACK (See Figure D.2)

When the AT&T1 command is entered, the modem goes on hook and configures itself for analog loopback. DSR is turned off (if &S1 is in effect), the analog loopback state is entered, and the test timer is set to the value in S18. A connect result code is sent to the DTE, and the test timer then begins its count down. The test terminates when the test timer expires. If S18 equals 0, then the test must be terminated by an &T0, H0, or Z command. While any command may be entered while the modem is in this test state, the modem response is not specified except for H0, &T0 and Z, any of which will terminate the test. Upon termination of the test, the modem enters the command state.

RESULT CODE	DESCRIPTION
CONNECT	When local analog loopback state is entered.
ERROR	If any other &Tn test is active (except &T0) or if in the on-line command state.
OK	After test is stopped by test timer, the H0 command, or the &T0 command.

&T2 NO FUNCTION

&T3 PERFORM LOCAL DIGITAL LOOPBACK (See Figure D.3)

The modem must be in the command state with connection established when this command is issued, otherwise an ERROR result code occurs.

The AT&T3 command establishes a loopback of received data, after demodulation, and sends it back to the distant end. The modem is configured for local digital loopback, DSR is turned off (if &S1 is in effect), the test timer is started with the value in S18, and an OK result code is

sent to the DTE. If S18 contains a 0, the test must be terminated by a &T0, H0, or Z command. The latter two result in the modem going on hook. If S18 does not contain 0, the test is terminated after the number of seconds stored in S18.

RESULT CODE	DESCRIPTION
OK	After 2 second delay
ERROR	If any other self test is active (&T1, &T6, &T7 or &T8) or if in idle state.
OK	When test is terminated.

&T4 GRANT REMOTE DIGITAL LOOPBACK (RDL) REQUESTS

When in the on-line state, the modem will honor a remote digital loopback request from a distant modem if it occurs. This will result in an ERROR if the command is given while any V.54 test is active (&T1, &T3, &T6, &T7 or &T8).

NOTE: There are data patterns that may cause a Remote Digital Loopback conditions. Care should be given to the type of data being received so that no RDL modes will be initiated.

&T5 DENY RDL REQUESTS

The modem will not respond to a remote digital loopback request from a distant modem. This will result in an error if the command is given while any V.54 test is active (&T1, &T3, &T6, &T7 or &T8).

&T6 INITIATE REMOTE DIGITAL LOOPBACK (See Figure D.4)

The command is valid only if the modem is in the command state with a connection established.

Configure the modem under test with an AT&T4 command so that it will honor a remote digital loopback request.

Enter AT&T6 at the local modem and it will send a remote digital loopback request to the remote modem. After the RDL acknowledgement signal is received from the remote modem, DSR is turned off (if &S1 is in effect), the on-line state is entered, a CONNECT result code is sent to the DTE, and the test timer is set to the value in S18.

If the local modem does not receive the RDL acknowledgement signal from the remote end in three seconds, it sends an ERROR result code to the DTE and returns to the command state. The local modem sends the signal to release the remote digital loopback when the test is terminated.

The test may be terminated by the H0, Z, or &T0 command. The test will also terminate when the test timer expires (sending the modem to the command state) or carrier is lost (causing a NO CARRIER result code and the modem to go on hook in the command state).

RESULT CODE	DESCRIPTION
CONNECT	When on-line state is entered.
ERROR	If any V.54 test is active (&T1, &T3, &T6-&T8).
ERROR	If not in on-line command state
ERROR	If the RDL signal is not acknowledged.

&T7 INITIATE RDL WITH LOCALSELF TEST (See Figure D.5)

This is a system test, end to end.

The command is valid only if the modems are in the command state with a connection established.

Configure the remote modem with an AT&T4 command so that it will honor a remote digital loopback request.

Enter AT&T7 at the local modem and it will send a digital loopback request to the remote modem. After the RDL acknowledgement signal is received from the remote modem, DSR is turned off (if &S1 is in effect), the on-line sate is entered, an OK result code is sent to the DTE, and the test timer is set to the value in S18. While the test is active, the local modem sends a test message to the remote modem and counts the errors in the received (looped back) signal. The modems stay in the command state during the test. When the test is terminated (except by a loss of carrier), the local modem sends the release signal to the remote modem, as in &T6, and reports the three-digit error count to the DTE.

The information text is followed by an OK result code. The test is terminated by loss of carrier, or an H0, &T0, or Z command, and by the S18 timer running out.

RESULT CODES	DESCRIPTION
OK	When command executed is started.
OK	After error count is sent to DTE (&T1, &T3, &T6, &T7 or &T8).
ERROR	If not in on-line command state.
ERROR	If the RDL signal is not acknowledged.

&T8 LOCAL LOOPBACK WITH SELF TEST (See Figure D.6)

The modem should be on hook. Enter AT&T8 to configure the modem for analog loopback and self test. The test timer is started at the time indicated by S18, DSR is turned off (if &S1 is in effect). A self test condition is entered, and an OK result code is sent to the DTE. During the test the modem sends a test message and counts errors in the looped back signal. The test is terminated when the timer times out (S18) or the &T0, H0, or Z command is issued. When the test is terminated, the three digit error count is sent to the DTE. An OK result code follows the error count.

RESULT CODE	DESCRIPTION
OK	If a test state is entered.
OK	After error count is sent to DTE
ERROR	If any other V.54 test is active (&T1, &T3, &T6, &T7), or if on-line.

ADDITIONAL TEST / DIAGNOSTICS COMMANDS...

%L RECEIVED SIGNAL LEVEL

Returns a value (-dBm) which indicates the received signal level at modem DATA PUMP interface. This value is determined by the loss/gain of modem Telco Interface circuit ±dB at the Tip/Ring input to the modem. Typical value should be -25dBm to -35dBm for most Telco connections.

%Q RECEIVED LINE SIGNAL QUALITY

Reports the line signal quality at the modem DATA PUMP interface. This signal is also dependent on the DAA circuit (Teleco Interface). Returns the higher order byte of the EQM (Eye Quality Monitor is the filter squared magnitude of the error vector). Typical value should be below 10. The lower the number, the better the performance from the modem.

ERROR response if NO connection to remote modem.

In &T1, modem %Q will be 0.

S86 CONNECTION FAILURE CAUSE

S86 can help determine the cause of a connection failure. When the modem issues a NO CARRIER result code, a value is written to this register. To read this register, following the connection failure, issue ATS86? <CR>. The modem will report one of the following values...

0	Normal hang up; no error occurred.
4	Physical carrier loss. (Loss Of Carrier)
5	Feature negotiation failed to detect presence of another V.42 error-control modem at other end.
6	Other error-control modem did not respond to feature negotiation message sent by this modem.
7	Other modem is synchronous-only; this modem is asynchronous-only.
8	Modems could not find a common framing technique.
9	Modems could not find a protocol in common.
10	Feature negotiation message sent by other modem incorrect.
11	Synchronous information (data of flags) not received from other modem.
12	Normal disconnect initiated by other modem.
13	Other modem did not respond after many transmissions of the same message. Modem made 10 attempts then hung up.
14	Protocol violation occurred.
15	Compression failure.

Note: Multiple occurrences may contribute to a NO CARRIER message; S86 records the first event that occurred.