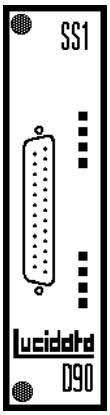
D90-IB7 MODULE

For synchronous connection of IBM 2780/3780 BSC stations



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Introduction

Like all Lucidata Diplomat data communications products, the D90-IB7 module has been designed to be easy to use in most normal applications whilst retaining a large degree of flexibility.

It is Lucidata's policy to try and find out as much about the intended application of its products before shipment so that the unit can be pre-configured at the factory for easy installation. In this case you may skip many sections of this manual. If the application changes with time then you will need to refer to those sections to reconfigure the unit.

In the event of difficulty, please contact Lucidata's technical support staff who will be able to guide you through the process.

The configuration switches are not normally changed once a unit is installed and it is outside the scope of this manual to describe the behaviour of the module for every combination of switches in all circumstances.

Description

The D90-IB7 module runs on an SS1 hardware module which is fitted with a single synchronous port. The SS1 module provides a synchronous interface into the D90 system for all frame transmission protocols. This module would normally be connected directly to a synchronous modem, line driver or Terminal Interface.

Within the module there is an EPROM which contains the program (Firmware) for emulating a Host computer operating the IBM 2780 BSC communications protocol.The firmware also contains the various communication parameter defaults (speed, parity etc) which are set when the module is powered up. These defaults can only be changed by installing new firmware or by means of a Diplomat Network Monitor (DNM) if one is present in the same rack. The defaults for these parameters will be found in the *Customer System Summary* section of this manual which is specific to each customer.

The functional characteristics are controlled by certain parameters which can be changed by means of the Configuration Bytes described later in this section.

A D90-IB7 behaves as a Local Client on the D90 rack and will always be associated with a Local Server, such as a D90-TCP module, on the same rack.

Data Communications

Each D90-IB7 module is fitted with a single synchronous port. This port is fitted with a D25 male connector, configured as DTE. The signalling levels are RS232. The use of screened cable with the outer conductor grounded to the connector shell is recommended when making connections to the SS1 module in order to guarantee immunity to external electromagnetic interference. Ensure that the cables are securely fixed to the screwlock pillars.

The port is normally connected to a synchronous modem or line driver. If it is connected directly to the cluster controller, it will require the use of a cross-over cable or null modem. The following table gives the pinouts.

PIN NO.		
1		Protective Ground
2	TXD	Transmitted Data - SS1 transmits data on this pin
3	RXD	Received Data - SS1 receives data on this pin
4	RTS	Request to Send - controlled by SS1
5	CTS	Clear to Send - enables SS1 transmitter
6	DSR	Data Set Ready
7	SG	Signal Ground
8	DCD	Data Carrier Detect - sensed by SS1
9		Internally connected to +12V via 1KΩ
10		Internally connected to -12V via 10Ω
11		Not Used
12		Not Used
13		Protective Ground
14		Not Used
15		Transmit Clock In
16		Not Used
17		Received Clock In
18		Not Used
19		Internally connected to -12V via 10KΩ
20	DTR	Data Terminal Ready - set high or low by configuration setting
21		Not Used
22	RI	Ring Indicator
23		Not Used
24		External Transmit Clock, speed obtained from selected TX clock*
25		Not Used

**Note:* *If it is required that the D90-IB7 provide the clock signal, a jumper should be fitted to the DTE side of link L4 on the PCB. The D90-IB7 should also be configured for an internal Transmit Clock at the required speed and have Pin 24 clock enabled.*

LED Indicators

There are 8 LEDs on the front panel of the D90-IB7 module. The indicators are Red(R), Yellow(Y) and Green(G) and have the following meanings when illuminated.

- O (R) RTS Request To Send asserted (SS1)
- O (R) CTS Clear To Send asserted (Modem)
- O (R) DCD Data Carrier Detect (Modem)
- O (Y) Remote connection established

- O (R) Error on last I/O
- O (R) External Clock Enabled (SS1)
- O (R) DTR Enabled (SS1)
- O (G) Dialogue with another module

Configuration

The D90-IB7 firmware contains Configuration Bytes of "silicon switches". These are used to control the low level behaviour of the module. The switches are listed in the following tables, together with a description of their function.

Initialisation

On power-up the D90-IB7 firmware delays for about ten seconds to allow time for any Diplomat Network Monitor (DNM) module to finish configuring the rack. If no DNM is present then the D90-IB7 module will use its own EPROM based configuration values. By this means it is possible to have simple operation with automatic defaults and no DNM.

During this delay the D90-IB7 module will have received details of all other modules on the rack and also sent its own particulars to anyone who asked.

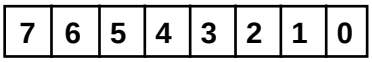
After the initial delay the D90-IB7 will decide the Slot Address of the nearest Server Module on the rack that offers the service it requires (eg. TCP) In this regard a Server Module to the left of the D90-IB7 module is always nearer than any Server Module to the right even if it is physically closer.

Configuration Bytes

The current generation of D90 equipment grew from a generation that had lots of configuration switches on the PCB to set up options. This required taking the lid off the box to make changes and in addition the switches occupied valuable PCB space that could be better utilised for extra functionality. For simplicity we have introduced the concept of 'Silicon Switches' to select low level options. They are directly analogous to ordinary switches but only exist in the D90 module's memory.

In the D90-IB7 there are four sets of Silicon Switches associated with four Configuration Bytes. Configuration Byte A controls the major characteristics of Port A and Configuration Byte B controls the major characteristics of the D90 BUS interface. More detailed characteristics of the way the Synchronous Data Stream is processed are determined by Configuration Byte I and rules for controlling the data flow between Port A and other D90 modules are selected with Configuration Byte T.

By convention the switches or bits of a configuration byte are numbered as follows



Configuration Byte A Specifies Protocol on Port A

Bit	Name of Switch	Description
0	BPRIMA	[0] - Act as Secondary BSC station [1] - Act as Primary BSC station
1	BTURBO	[0] - Use extra SYN characters on first line bid and 40mS turnaround delay therafter [1] - Only use six SYN characters, turnaround controlled only by CTS
2	BPADIT	[0] - Strip trailing space characters [1] - Pad output data to record length with space characters
3	BRECLN	[0] - Record length is 80 [1] - Record length is 132
4	BBLOCK	[0] - Block output stream by buffer content [1] - Block output stream according to 2780 or 3780 protocol
5	BEBCHC	[0] - Host character code is ASCII [1] - Host character code is EBCDIC
6	B3780	[0] - Protocol is 2780 [1] - Protocol is 3780
7	BEXREP	[0] - Do not report locally detected exception conditions [1] - Report locally detected conditions to remote

Note (i) A Primary BSC station will not try to bid for the line again for at least 1.2 seconds after it has given up the line. A secondary BSC station will not try to bid for at least 3 seconds after it has given up the line.

Configuration Byte B defines additional properties of Port A

Bit	Name of Switch	Description
2,1,0	MPADS	[111] - Mark to extract count of trailing pad characters [000] - [111] - 0 to 7 trailing pad characters added to every block
3	BEXTCK	[0] - Disable Pin 24 of Port A [1] - Allow internally generated TX clock to appear on Pin 24 of Port A
4	BRTSF	[0] - Pin 4 (RTS) always stays high [1] - Pin 4 only goes high when data is to be sent
5	BDROP	[0] - Take no action on session drop [1] - Drop Pin 20 (DTR) for 1 second on session drop
6	BDCDF	[0] - DCD is constant (dropping will close TCP session) [1] - DCD is controlled
7	BTXTIO	[0] - Ignore TX Timeout on Port A [1] - Force session drop on Timeout of Port A

Note (i) If BTXTIO=1 a timeout will be recorded if any of the following occur
a) Port A has been unable to start sending within 1 second
b) Port A has exceeded the retry count (3) for a valid response

Configuration Byte I qualifies Port A behaviour

Bit	Name of Switch	Description
0	BDLESD	[0] - Do not send DLE EOT on session drop (TCP CLOSE or RST) [1] - Send DLE EOT on session drop (TCP CLOSE or RST)
1	BEOTSD	[0] - Do not send EOT on session drop (TCP CLOSE or RST) [1] - Send EOT on session drop (TCP CLOSE or RST)
2	BAUTET	[0] - Do not automatically send EOT after ETX frame sent [1] - Automatically send an EOT after an ETX frame sent
4,3	BMSKEF	[11] - Mask to extract EOF action bits [00] - No EOF characters sent to Local Server module [01] - Forward ETB, ETX, EOT and RVI characters to Local Server module [10] - Convert ETX to SUB and forward to Local Server module [11] - Convert ETX to EOF text message and forward to Local Server module
5	BCRLF	[0] - Leave CR as CR [1] - Expand CR to CR LF if filtering
6	BFILTR	[0] - Do not filter data [1] - Apply filters to translated data
7	BTRANS	[0] - Do not perform ASCII/EBCDIC translation [1] - Perform ASCII/EBCDIC translation of data

Note (i) The unit will always filter out characters that would cause the BSC protocol to fail, unless Transparent Text Mode has been selected.

Configuration Byte T controls transfer of data from Local Server module to Port A

Bit	Name of Switch	Description
0	Reserved	[0] - Required value
1	BTTEXT	[0] - Use Text Mode - STX, ETB/ETX framing [1] - Use Transparent Text Mode - DLE STX, DLE ETB/ETX framing
2	BDRDLE	[0] - Ignore DLE EOT from Port A [1] - Drop TCP session on detected DLE EOT from Port A
3	BDREOT	[0] - Ignore EOT from Port A [1] - Drop TCP session on detected EOT from Port A
4	BRXTIO	[0] - Ignore no response (RX Timeout) from Port A [1] - Drop TCP session on continued no response from Port A
5	BEFLEN	[0] - Data stream starts on first data byte of first TCP/UDP packet [1] - Length of packet is given in first two bytes of TCP/UDP packet
6	BEFETX	[0] - EOF is determined by the TCP session closing [1] - EOF is determined by SB or ETX character at end of a packet
7	BFILEP	[0] - Each packet is part of a data stream [1] - Each packet contains a complete file

Note (i) In general BEFLEN=1 should only be used in conjunction with BTTEXT=1 to avoid generation of invalid BSC characters.

Note (ii) BEFETX=1 only has effect if Bits 3 and 4 of Byte I=00, otherwise Bits 3 and 4 determine the signalling criteria.

Note (iii) BFILEP=1 is usually used in conjunction with BAUTET=1 in Byte I. Each data block to arrive from the local server module causes the IB7 to bid for the BSC line, send an ETX terminated block containing all the received data, and then drop the line with an EOT.

Normal BSC Operation

In IBM terminology the *D90-IB7*can act as a Primary station or a Secondary station using either the IBM 2780 or IBM 3780 Binary Synchronous Protocol (BSC) operating in Point to Point Data Link Mode.

Idle State

Assuming a direct connection of Port A to a 2780/3780 Host, the system will remain idle with no traffic flowing over the interface. There are two states that can be entered.

Master State

Characters arrive over the D90 backplane from a local Server cause the *D90-IB7* to bid to become link master. It will bid 3 times before logically dropping the line with an EOT frame and then freshly discover that it has data to send and start bidding again. This process will repeat for ever or until some control action is taken. When it receives an acknowledgement from the remote system the *D90-IB7* enters the Master or Sending state. All characters that are not interpreted as commands by the *D90-IB7* are processed and packaged up in a BSC envelope for transmission over the link.

Slave State

The system on the other end of the BSC link bids to become Link Master and the *D90-IB7*, being idle, acknowledges the bid and enters the Slave or Receiving state. As each data block is extracted from a correctly received BSC envelope the characters are processed and sent to the Local Server on the D90 rack.

IBM 2780 and IBM 3780

In the following sections it can be assumed that any description applies equally to 2780 or 3780 unless indicated to the contrary.

ASCII and EBCDIC

The BSC protocol is defined for both EBCDIC and ASCII code sets although the most usual one found in practise is EBCDIC. The data transported by the protocol can be either printable characters and selected control codes taken from the same code as the BSC envelope, or encoded as Transparent (Binary) Data. Thus ASCII coded data may be transported within an EBCDIC envelope by sending it in Transparent mode and vice versa. The Network side always works in units of 8 bits.

Transparent Text Mode

If switch BTTEXT=1 the *D90-IB7* operates in Transparent Text mode. All data characters enclosed within the BSC envelope are delivered unchanged with nothing added and nothing taken away.

If switch BTTEXT=0, data will be examined and filtered, translated or interpretted according to the settings of other switches.

In normal Text mode the *D90-IB7* will react to control codes that have meaning to its operation such as CR and SUB and consume them from the data stream coming from the Local Server. If it is required to include a character value in the data stream which could be confused with an ASCII control code (ie less than 32) then Transparent Text Mode should be used.

Control Codes

There are certain characters that can be used to control the behaviour of the *D90-IB7*. There are also a limited set of control codes that may be transported within the BSC envelope when operating in plain Text mode. These are shown in *Table 1* for both protocols. This does not prevent the sending of other codes across the link but they have to be sent in Transparent Text mode.

CR and SUB

The two most important codes in Text mode are CR (ASCII value 13) and SUB (ASCII value 26) as these cause the *D90-IB7* to try to transmit a data frame over the link. The CR is used to terminate each line or block of characters input from the Local Server and results in a BSC envelope terminated with an ETB character. The SUB is used to terminate the last data block and causes a BSC envelope terminated with an ETX character to be sent. The *D90-IB7* will then give up the link by issuing an EOT frame, if so configured.

Table 1. Legal Control Codes

Symbol	ASCII value	EBCDIC value	2780 mode	3780 mode
BEL	7	47	✓	✓
HT	9	5	✓	✓
VT	11	11	✓	✓
FF	12	12	✓	✓
EM	25	25	✓	
ESC	27	39	✓	✓
FS Newline	28	21	✓	✓
GS	29	29		✓
RS	30	30		✓
US	31	31	✓	✓

Filtering the Data Stream

If switch BFILTR=1, then the translated data stream is modified by various filters. The process is asymetric and is designed to simplify the processing of the data stream by the recipient of the data.

When the *D90-IB7* is sending from the Local Server, the data stream is filtered to pass only the printing characters and the control characters listed in Table 1. Some special ones are processed in the following manner.

Newline — An FS (ASCII value 28) character is translated to the EBCDIC Newline (NL) character.

ITB in 2780 Mode — In 2780 mode an ITB (ASCII value 31) character is translated to EBCDIC but then causes the *D90-IB7* to follow it with the currently computed CRC value prior to resetting the CRC and placing further characters onto the link.

GS in 3780 Mode — In 3780 mode the Space Compression (GS) code (ASCII value 29) is translated to EBCDIC and the following space count character recomputed before being sent as its EBCDIC equivalent.

Note: In the following descriptions, the symbol CRLF means the CR (ASCII value 13) character by itself if switch BCRLF=0, or followed by the LF (ASCII value 10) character if BRCLF=1.

When the *D90-IB7* is receiving, the data removed from the BSC envelope is examined for control characters. The characters listed in the first part of Table 1 are passed on directly but the rest are processed in the following manner.

Newline — The EBCDIC Newline character (EBCDIC value 21) is converted to CRLF.

Escape sequences — ESC followed by '/','S', or 'T' are converted into 1, 2, or 3 CRLF characters and ESC followed by 'A' is converted to the Form Feed (FF) character (ASCII value 12)

Device control — Codes DC1, DC2, DC3 and DC4 (EBCDIC values 17, 18, 19, 60) are removed from the data stream as is the NUL (value 0) character.

2780 Mode — In 2780 mode the ITB (EBCIDIC value 31) character is converted to CRLF as are all other unrecognized codes.

The frame terminating character ETB (EBCDIC value 23) is also converted to a CRLF to delineate transmission blocks.

3780 Mode — In 3780 mode the RS (EBCDIC value 30) character is converted to CRLF as are ITB (EBCDIC value 31) and EM (EBCDIC value 25) characters. If switch BPADIT=1, then the Space Compression sequence GS (EBCDIC value 29) 'count' is expanded to spaces. If switch BPADIT=0, then the Space Compression (GS) code (EBCDIC value 29) is translated to ASCII and the following space count character recomputed and output as its ASCII equivalent.

EOF Text Message — When the last data frame arrives with its terminating ETX (EBCDIC value 3) character it is followed by a SUB (ASCII value 26, CTRL/Z) character or the text string - "*** END OF DATA ***", dependant on the setting of switch BMSKEF. The master station will then logically drop the line by sending an EOT or DLE EOT frame.

Reverse Interrupt (RVI) — If the link slave has an urgent message to send, the link master may be temporarily forced to give up its control of the link by sending it an RVI message. This is treated as a positive acknowledgement of the last block received and the link master is expected to issue an EOT frame to show its compliance. The sender of the RVI then bids for link mastership, sends its urgent message (usually an error message) and gives up the line by sending an EOT frame. The original link master then bids to re-establish its mastership and continues its transfer from where it left off. The *D90-IB7* responds to a received RVI in this way.

Signalling over the Network

If Bits 4 and 3 of Configuration Byte I are set to 01, a special character is added to the end of the data block sent to the local server. The special character notifies the remote application what the BSC frame type was that held the data in the current packet. Similarly, when a data packet is received from the local server, the last character is stripped off the data and used to determine one of the following:how to terminate the BSC frame that will surround the data or drop the line if in Master Mode or request an RVI if in Slave Mode.

The following four characters and their interpretation are shown below. The coding is always ASCII for signalling, but determined by BEBCHC for Port A.

Character	*Value*	*Meaning*
		Master Mode (Data going from Network to Port A)
ETB	23	Send data packet with ETB or DLE ETB
ETX	3	Send data packet with ETX or DLE/ETX termination
EOT	4	Drop line with EOT frame
NAK	21	Send EOT back to sender as we are already master
		Slave Mode (Data going from Port A to Network)
ETB	23	Preceding data block was terminated with ETB or DLE ETB
ETX	3	Preceding data block was terminated with ETX or DLE ETX
EOT	4	An EOT or DLE EOT frame was received
NAK	21	Issue an RVI request and send back an EOT frame when line relinquished

ASCII	EBCDIC
0	0
1	1
2	2
3	3
4	55
5	45
6	46
7	47
8	22
9	5
10	37
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	60
21	61
22	50
23	38
24	24
25	25
26	63
27	39
28	21
29	29
30	30
31	31
32	64
33	90
34	127
35	123
36	91
37	108
38	80
39	125
40	77
41	93
42	92
43	78
44	107
45	96
46	75
47	97
48	240
49	241

ASCII	EBCDIC
50	242
51	243
52	244
53	245
54	246
55	247
56	248
57	249
58	122
59	94
60	76
61	126
62	110
63	111
64	124
65	193
66	194
67	195
68	196
69	197
70	198
71	199
72	200
73	201
74	209
75	210
76	211
77	212
78	213
79	214
80	215
81	216
82	217
83	226
84	227
85	228
86	229
87	230
88	231
89	232
90	233
91	77
92	224
93	93
94	95
95	109
96	121
97	129
98	130
99	131

ASCII	EBCDIC
100	132
101	133
102	134
103	135
104	136
105	137
106	145
107	146
108	147
109	148
110	149
111	150
112	151
113	152
114	153
115	162
116	163
117	164
118	165
119	166
120	167
121	168
122	169
123	192
124	106
125	208
126	161
127	7

EBCDIC	ASCII
0	0
1	1
2	2
3	3
4	0
5	9
6	0
7	127
8	0
9	0
10	0
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	0
21	6
22	8
23	0
24	24
25	25
26	0
27	0
28	0
29	29
30	30
31	31
32	0
33	0
34	28
35	0
36	0
37	10
38	23
39	27
40	0
41	0
42	0
43	0
44	0
45	5
46	6
47	7
48	0
49	0

EBCDIC	ASCII
50	22
51	0
52	0
53	30
54	0
55	4
56	0
57	0
58	0
59	0
60	20
61	21
62	0
63	26
64	32
65	163
66	164
67	165
68	166
69	167
70	168
71	248
72	170
73	171
74	163
75	46
76	60
77	40
78	43
79	124
80	38
81	186
82	187
83	192
84	193
85	189
86	188
87	196
88	197
89	198
90	33
91	36
92	42
93	41
94	59
95	152
96	45
97	47
98	199
99	200

EBCDIC	ASCII
100	201
101	208
102	209
103	210
104	211
105	212
106	153
107	44
108	37
109	95
110	62
111	63
112	213
113	154
114	155
115	156
116	157
117	224
118	226
119	227
120	228
121	96
122	58
123	35
124	64
125	39
126	61
127	34
128	181
129	97
130	98
131	99
132	100
133	101
134	102
135	103
136	104
137	105
138	161
139	230
140	231
141	232
142	233
143	240
144	241
145	106
146	107
147	108
148	109
149	110

EBCDIC	ASCII
150	111
151	112
152	113
153	114
154	242
155	243
156	244
157	245
158	246
159	247
160	160
161	126
162	115
163	116
164	117
165	118
166	119
167	120
168	121
169	122
170	173
171	194
172	172
173	235
174	174
175	175
176	176
177	177
178	178
179	179
180	180
181	94
182	182
183	183
184	184
185	185
186	249
187	195
188	169
189	93
190	190
191	191
192	123
193	65
194	66
195	67
196	68
197	69
198	70
199	71

EBCDIC	ASCII
200	72
201	73
202	202
203	203
204	204
205	205
206	206
207	207
208	125
209	74
210	75
211	76
212	77
213	78
214	79
215	80
216	81
217	82
218	158
219	159
220	220
221	221
222	222
223	223
224	92
225	225
226	83
227	84
228	85
229	86
230	87
231	88
232	89
233	90
234	234
235	235
236	236
237	237
238	238
239	239
240	48
241	49
242	50
243	51
244	52
245	53
246	54
247	55
248	56
249	57

EBCDIC	ASCII
250	250
251	251
252	252
253	253
254	254
255	255