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NETWORK SERVICES

Code Operated Matrix Switch and 4-Port Expansion Board

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This equipment generates, uses, and can radiate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Caution:

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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NOTE

Shielded interface cables must be used with this product. Call Technical Support at 724-746-5500 for guidance in choosing cables.
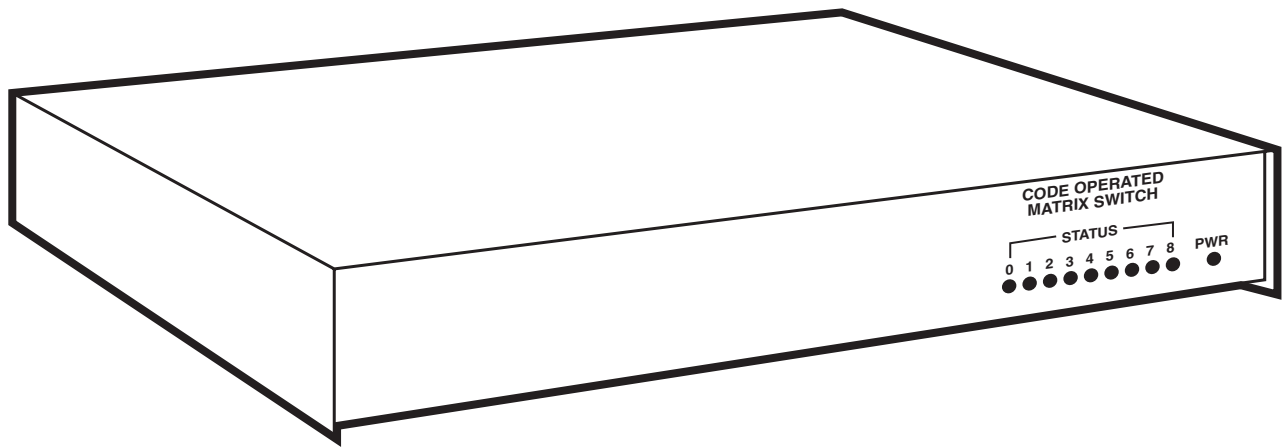
Contents

Hardware Section

CODE OPERATED
MATRIX SWITCH

STATUS

0 1 2 3 4 5 6 7 8 PWR

1. Specifications

Leads Supported — 1-8, 20, 22

Connectors — Base Unit: (5) DB25S 25-pin sub-D female; Unit with 4-Port Expansion Board: (9) DB25S 25-pin sub-D female

Indicators — 10 LEDs: (1) Power, (9) Port Activity showing Receive activity

Interface — Asynchronous RS-232C/V.24 DTE/DCE (each port individually selectable)

Speeds — 110 to 19,200 bps (each port individually selectable)

Memory — 31K buffer

Enclosure — Steel

Operating Temperature — 32 to 113°F (0 to 45°C)

Storage Temperature — -4 to 158°F (-20 to 70°C)

Humidity — 0 to 95% relative, noncondensing

Mean Time Between Failures — 20,000 hours for standard Switch (Ground Benign Environment), 16,000 hours for standard Switch with 4-Port Expansion Board

Power — 115-VAC, 60 Hz, at 175 mA (230-VAC, 50-Hz version available)

Size — 2.3"H x 11.2"W x 12.1"D (5.8 x 28.4 x 30.7 cm)

Weight — 9.6 lb. (4.3 kg) for standard Switch, 10.2 lb. (4.6 kg) for standard Switch with 4-Port Expansion Board

The Code Operated Matrix Switch (COMS for short) is a versatile microprocessor-

2. Introduction

controlled electronic switch. It allows any of its ports to communicate with any other connected port, or any pair of ports to communicate simultaneously.

For example, a number of terminals or computers can share several peripheral devices, such as printers or modems. A simple code from any terminal or computer links it to the desired peripheral.

Here's another application: one computer is connected to a laser printer, while another computer is simultaneously connected to a dot-matrix printer. Later, the printers could be swapped (as in an X-switch configuration) without the need to change or move any cables.

The standard Code Operated Matrix Switch has five ports that support any combination of input, output, or bidirectional devices. The Switch has 32K of RAM with approximately 31K devoted to buffering. The 4-Port Expansion Board (Model SW541-C) provides four additional input/output ports (see **Appendix B** for instructions on setting it up).

This manual includes a quick-reference section, **Appendix C**. If you're familiar with the operation of the COMS, use the charts in that section to set up the Switch. If not, proceed through Sections 3, 4, and 5.

NOTE: **This manual will take you through installation, operation, and troubleshooting for the Code Operated Matrix Switch in both the five-port and nine-port versions. See Appendix B for instructions on setting up the 4-Port Expansion Board.**

You'll need an edged or pointed object small enough to set DIP switches to install the Switch. These are the steps to follow for installation:

1. Set the internal option DIP switches.

2. Configure shunt jumpers for DTE or DCE.

3. Connect devices to the switch ports.

4. Supply power to the Code Operated Matrix Switch.

3. Installation

3.1 Setting the Internal DIP Switches

Remove the cover of the Switch's enclosure to expose the PC board.

Figure 1 shows the location of the Code Operated Matrix Switch's internal DIP switches. There are two types:

1. Individual Port Switches (see **Section 3.1.1**)

2. System Switches (these apply to all ports; see **Section 3.1.2**)

NOTE: **DIP Switches may have different designators to indicate the "ON" and "OFF" settings. In this manual, "ON" is equivalent to "Closed" and "OFF" is equivalent to "Open."**

3.1.1   INDIVIDUAL PORT CONFIGURATIONS

A number of options can be configured for each port individually. You can select:

- Baud rate: 110, 300, 600, 1200, 2400, 4800, 9600, or 19,200 bps

- Parity: Even, odd, or none

- Data bits per word: 7 or 8

- Flow Control: Hardware (DTR/CTS) or software (X-ON/X-OFF)

- Break detection: Break to disconnect or ignore breaks
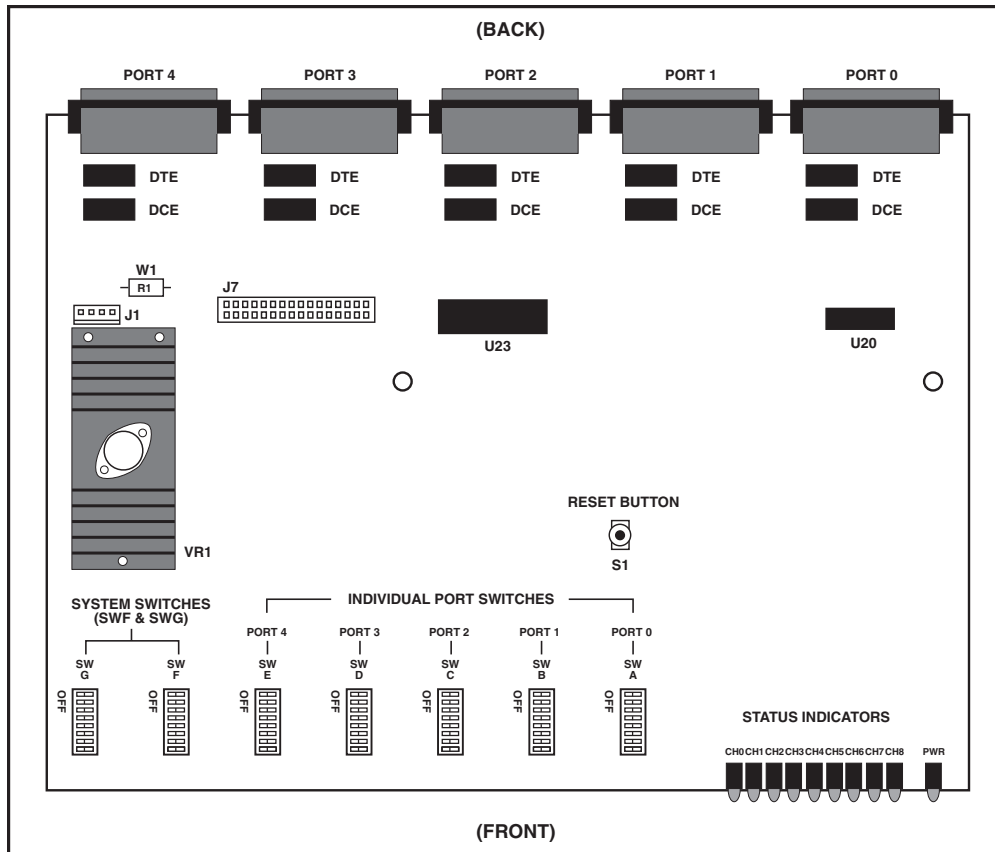
Fig. 1. Internal Switch Locations for the Standard Code Operated Matrix Switch

On the standard 5-port model, the DIP switches that correspond to each port are:

- Port 0: SWA
- Port 1: SWB
- Port 2: SWC
- Port 3: SWD
- Port 4: SWE

For the 4-Port Expansion Board:

- Port 5: SWH
- Port 6: SWI
- Port 7: SWJ
- Port 8: SWK

Table 1 lists the individual options and settings for each port switch.

3.1.2   SYSTEM CONFIGURATIONS

In the lower left corner of the printed circuit board are two DIP switch banks, SWF and SWG, for configuring the system. Switch SWG is reserved for future use. Switch SWF uses the first four positions, with Positions 5 through 8 reserved for future use. The settings and functions of the first four positions of SWF are given in Table 2. Check the chart, and then use a pointed object, such as a small screwdriver, to set the bank.

Table 1. Switch Port Options (Individual Port Switch Banks)

Option	Switch Position Settings							
	1	2	3	4	5	6	7	8
Baud Rate								
110	ON	ON	ON					
300	OFF	ON	ON					
600	ON	OFF	ON					
1200	OFF	OFF	ON					
2400	ON	ON	OFF					
4800	OFF	ON	OFF					
9600	ON	OFF	OFF					
19,200	OFF	OFF	OFF					
Parity								
No Parity				ON	ON			
Even Parity				OFF	ON			
Odd Parity				ON	OFF			
No Parity				OFF	OFF			
Data Bits/Word								
7						OFF		
8						ON		
Flow Control								
Hardware (DTR/CTS)							ON	
Software (X-ON/X-OFF)							OFF	
Break Detection								
Break to Disconnect								ON
Ignore Breaks								OFF

Lead Pass-Through

This function allows the COS II either to pass hardware-handshake leads to connected devices or to block them. If they are blocked, the leads will still be used to regulate the internal buffer of the Switch. The following table shows the behavior of the COS II for different combinations of devices.

Table 2. Leads Passed Through.

Port 1	Port 2	Leads Passed
DTE	DTE	Port 1 DCD to Port 2 RTS Port 2 DCD to Port 1 RTS
DTE	DCE	Port 1 DCD to Port 2 DCD Port 2 RTS to Port 1 RTS
DCE	DTE	Port 1 RTS to Port 2 RTS Port 2 RTS to Port 1 DCD
DCE	DCE	Port 1 RTS to Port 2 DCD Port 2 RTS to Port 1 DCD

Table 3. Settings and Functions for Switch SWF

Switch Position	Switch Setting	Function
1	ON	Reverts to attention string of @ and switches to factory defaults when reset or re-powered.
	OFF	Maintains user-set attention upon reset.
2	ON	Limits port name changes and attention-character changes to Port 0 only.
	OFF	All ports can change port names and attention characters.
3	ON	Perform self-test (see **Section 5**)
	OFF	Normal operation.
4	ON	DCD (RTS) passed through.
	OFF	DCD (RTS) blocked.
5-8		Reserved for future use.

NOTE

To use the saving function of the SW540A-R3, DIP switch F position 1 must be OFF.

3.2 Configuring Shunt Jumpers for DTE or DCE

Each of the five (or nine) ports has a bank of shunt jumpers located next to its port connector on the rear of the internal board or boards. (See Fig. 1 for their location.) These jumpers allow each port to be configured as either Data Terminal Equipment (DTE) or Data Communications Equipment (DCE). You don't need a crossover cable to connect your equipment to the Code Operated Matrix Switch—just standard straight-through cabling.

Shunt jumpers are fragile. When removing them, use a small flathead screwdriver or IC remover. With a screwdriver, use a gentle motion, prying from one end of the shunt. When installing, press down gently only after you have made sure all pins are above holes.

Table 3. Input and Output Signals

Signal	Pin	Direction as DTE	Direction as DCE
TXD	2	Output	Input
RXD	3	Input	Output
RTS	4	Output	Input
CTS	5	Input	Output
DSR	6	N/A	Output
DCD	8	Input	Output
DTR	20	Output	Input
RI	22	Input	N/A

Table 4. DIP Shunt Settings

Connecting straight cable to:	Set DIP Shunt to:
PC w/25-pin connector	DCE
DEC™ computer	DCE
Data General computer	DCE
Most printers (ex: HP® LaserJet®)	DCE
DTE devices	DCE
Modem	DTE
HP minicomputer	DTE
DCE devices	DTE

NOTE: **If you use a cross-pinned cable, set the DIP shunt setting to the opposite of the one recommended above.**

3.3 Connecting Devices to the Ports

After you configure the internal switches and jumpers, connect the Code Operated Matrix Switch to the input/output devices:

1. Replace the Switch's cover.

2. Connect the input/output device cables to Ports 0-4 (or 0-8 if you have the 4-Port Expansion Board) of the COMS.

3. Plug the wall-mounted power supply into a suitable outlet.

The Switch is now ready. Go on to **Chapter 4** to learn about the Switch's controls and indicators.

You'll control your switch mostly through ASCII codes you send from the devices connected to it. There are, however, mechanical controls and indicators on the Code Operated Matrix Switch. This chapter begins with the mechanical controls, **Sections 4.1** and **4.2**, and then treats the character codes in the sections that follow.

4. Operation

4.1 Front-Panel Indicators

There are a total of ten LEDs, located on the Switch's right front panel: nine port status LEDs and one power LED.

Power LED: This indicator lights when the power is on.

Port Status LEDs: The nine status LEDs accommodate the 4-Port Expansion Board as well as the standard 5-port Switch. A port's LED flickers momentarily, indicating activity, whenever that port receives data. The LED will flash only if a link is established and actual data (not commands) is being received.

4.2 Reset Button

Figure 1 shows the location of the reset button. Use this button to reset the Code Operated Matrix Switch. Any time you change the internal switch settings, press the reset button to activate the changes. While the Code Operated Matrix Switch is resetting, it does not process data.

Disconnecting power from the Code Operated Matrix Switch also resets it.

A third way to reset the switch is to use the Remote Reset command. See **RR** in **Section 4.3.2.**

4.3 ASCII Control Codes

The Code Operated Matrix Switch accepts commands from any port. (No one port is designated as a master port.) A single command consists of the attention string, followed by a command sequence that may be from one to three characters long. The Help screen, shown in Fig. 2., presents all the command sequences for the Switch.

4.3.1 THE ATTENTION STRING

The ATTENTION string is a character string, 0 to 8 characters in length, that must precede all commands. Enter the character string via the SET ATTENTION command. The factory default is the character **@**. To change the attention string, see the **A** (*Set Attention String*) command in the next section.

4.3.2 THE COMMANDS

?—*Help*

When the Code Operated Matrix Switch receives an ATTENTION string followed by a **?** (question mark), it sends the HELP screen out to the port that issued the command. See Fig. 2 on the next page.

Q—*Query*

When the Code Operated Matrix Switch receives an ATTENTION string followed by a **Q**, it sends the STATUS screen out to the port that issued the command. (See Fig. 3.)

```
 HELP SCREEN

 COMMAND NAME                     DESCRIPTION

 Attention Character must precede all commands

 L<x><y>      LINK                Make regular link from port <x> to port <y>
 U<x><y>      UNLINK              Remove regular or transparent link port <x> to port
<y>
 DA           DISCONNECT ALL          Disconnects all regular and transparent links
 T<x><y>      TRANSPARENT LINK    Make transparent link from port <x> to port <y>
 B<x>         SEND BREAK          Send break out port <x>
 A<x><z>      SET ATTENTION       Set port <x> attention to <z> (up to 8 characters,
CR)
 N<x><z>      SET PORT NAME       Set port <x> name to <z> (up to 8 chars, CR)
 Q            QUERY               Query box for status
 S            SAVE                Save Connection Matrix
 RL           RELOAD              Reload factory default settings
 RR           REMOTE RESET        Return unit to power up configuration
 ?            HELP                Displays help screen
 <BREAK>      BREAK CONDITION     Remove a regular or transparent link
```

Fig. 2. The Help Screen

The STATUS screen shows PORT NAMES, which ports are LINKED to other ports, which links are TRANSPARENT, (a transparent link does not honor the Attention command), ACTIVITY (the presence of buffered characters), and the ATTENTION strings for each port.

L — *Link*

When the Code Operated Matrix Switch receives an ATTENTION string followed by an **L** and two PORT NUMBERS, it attempts to set up a bi-directional link between these two ports. If either of these ports is already linked, the Code Operated Matrix Switch sends a message to the port that issued the command, indicating that the link was not made. Otherwise, the two ports link and the Code Operated Matrix Switch sends a message to the port that issued the command, indicating that it made the link.

NOTE: Any port can issue the Link command, even if that port is not one of the two ports being linked. For example, Port 1 could issue a command to link Port 2 and Port 5.

U — *Unlink*

When the Code Operated Matrix Switch receives an ATTENTlON string followed by a **U** and two PORT NUMBERS, it attempts to break a bi-directional link between these two ports ("unlink"). If these two ports are not linked to each other, the Code Operated Matrix Switch sends a message to the port that issued the command, indicating that the unlink was not made. Otherwise, the two ports will be unlinked and the Code Operated Matrix Switch sends a message to the port that issued the command, indicating that the unlink was successful.

Port	Name	Linked To	Transparent	Activity	Attention String
0		....	N	N	@
1		....	N	N	@
2		....	N	N	@
3		....	N	N	@
4		....	N	N	@
5		....	N	N	@
6		....	N	N	@
7		....	N	N	@
8		....	N	N	@

Fig. 3. The Status Screen

NOTE: Any port can issue the Unlink command, even if that port is not one of the two ports that will be unlinked. For example, Port 5 could command Port 2 and Port 3 to unlink.

DA — *Disconnect All*

When the Code Operated Matrix Switch receives an ATTENTION string followed by **DA**, it will break every link currently defined. The buffers are purged, and any data in them is lost.

T — *Transparent Link*

A TRANSPARENT LINK is similar to a REGULAR LINK, with only this exception: When a port is transparently linked, the Switch will no longer honor an ATTENTION string from that port. The ATTENTION string is treated as data, to allow all data to pass between two ports. If you want to break a Transparent Link, you must enable break detection (see **Section 4.4**), then send a break to the switch from either of the devices attached to the transparently linked ports (see **B**—*Send Break*). You can also send the **U**—*Unlink* command from one of the unattached ports.

When the Code Operated Matrix Switch receives an ATTENTION string followed by a **T** and two PORT NUMBERS, it attempts to set up a bi-directional TRANSPARENT link between these two ports. If either of these ports is already linked, the Code Operated Matrix Switch sends a message to the port that issued the command, indicating that the link was not made. Otherwise, the two ports link and the Code Operated Matrix Switch sends a message to the port that issued the command indicating that the link was successful.

NOTE: Any port can issue the Transparent Link command, even if that port is not one of the two ports being transparently linked. For example, Port 1 could issue a command to transparently link Port 2 to Port 5.

B — *Send Break*

The Switch uses a break condition to unlink a pair of ports. When it receives an ATTENTION string followed by a **B** and a PORT NUMBER, it sends a 250-millisecond break condition out the indicated port. Then it sends a message to the port that issued the command, indicating that the break was sent.

NOTE: Any port can issue the Send Break command. For example, Port 3 could issue a command to send a break out Port 4.

A — *Set Attention*

When the Code Operated Matrix Switch receives an ATTENTION string followed by an **A** and a Port number, it echoes the **A** and the port number to the indicated port. The Code Operated Matrix Switch then waits for a 0- to 8-character ATTENTION string followed by **Return**. If control characters are entered, they will appear on the screen as ^<letter>, where <letter> is the key you pressed while holding down the control key. If a zero-length ATTENTION string is entered for a port, you will no longer be able to send commands from that port.

NOTE: Any port can issue the Set Attention command. For example, Port 5 could issue a command to set the attention string for Port 6. If you need more security, you can designate Port 0 as the only port capable of changing an attention string, by setting Switch F's Position 2 to ON.

N — *Set Port Name*

When the Code Operated Matrix Switch receives an ATTENTION string followed by an **N** and a PORT NUMBER, it echoes the **N** and the PORT NUMBER to the indicated port. The Code Operated Matrix Switch then waits for a 1 to 8 character PORT NAME followed by **Return**.

NOTE: Any port can issue the Set Port Name command. For example, Port 7 could issue a command to set the port name for Port 8. You can designate Port 0 as the only port capable of changing a Port Name, by setting Switch F's Position 2 to ON.

S — *Save*

When the Code Operated Matrix Switch receives an ATTENTION string followed by an **S**, it will save the current connection matrix in nonvolatile memory. This will preserve any combination of regular and transparent links. After this Save operation is completed, the links you saved will be restored any time the Switch is reset.

RL — *Reload*

When the Code Operated Matrix Switch receives an ATTENTION string followed by **RL**, it returns to its factory-default settings. All port names are replaced with spaces, and all attention strings revert to the default **@**. Any data that may be in the buffers is purged.

RR — *Remote Reset*

When the Code Operated Matrix Switch receives an ATTENTION string followed by **RR**, it resets itself, as though you had pushed the reset button or turned the power off and back on. Any links you've saved with the Save command will be restored.

4.4 Break Detection

When the Code Operated Matrix Switch detects an incoming break condition, it will either act on it or ignore it, depending on how DIP Switch Position 8 is set on each port. If Position 8 is ON, then when any port on the Code Operated Matrix Switch is linked to another port and receives a break condition, the two ports will be unlinked. The Code Operated Matrix Switch sends a message to the port that requested the break condition, to indicate that the unlink was successful. Otherwise, the Code Operated Matrix Switch sends a message to the requesting port to indicate that the unlink was unsuccessful, since that port was not linked initially.

Sometimes cable noise can be perceived as a break, so unless you want a break to be a port's normal method of disconnection, you should configure that port to ignore breaks. Set DIP Switch Position 8 to ON.

5. Troubleshooting

5.1 Self-Tests

The Code Operated Matrix Switch has a number of self-tests to ensure that its circuitry is fully operational. These tests check the RAM, LEDs, DIP Switches, and Serial Ports. An Interrupt Test can also be performed.

• The RAM Test checks the internal memory of the Switch by writing an internal test pattern, and then reads it for accuracy. This test checks the integrity of the RAM.

• The LED Test checks the LEDs by turning them all OFF, then ON one at a time, then all ON, then OFF one at a time. This test tells you whether the LEDs are working normally or whether any are shorted. The test runs continuously until you press any key to exit.

• The DIP Switch Test reads the DIP switches and displays their settings on the screen. This test tells you whether the DIP switches and associated circuitry are operating normally and are set up the way you want them. The settings will be displayed on the screen continuously until you press any key. Then the test checks whether an Expansion Board is installed. (If an Expansion Board is not installed, readings will be displayed but can be disregarded.)

• The Serial Port Test is a simple loopback test that checks whether data is being correctly transmitted and received on any particular port. This test also checks, using DTR/CTS/RI or RTS/DCD, whether the box can loop control leads back properly.

• The Interrupt Test checks the interrupt circuitry of the Switch. During this test, the letter **A** will appear on the screen. A message will indicate whether the test passed or failed.

NOTE: **To perform a data test, jumper Pins 2 and 3 together on the port you want to test. To test DTR/CTS/RI, jumper Pins 20, 5, and 22 together. To test RTS/DCD, jumper Pins 4 and 8 together.**

To run a self-test, follow these steps:

1. Using the shunt, configure Port 0 as DCE.

2. Set the terminal to 9600 baud, 1 stop bit, no parity.

3. Connect the terminal to Port 0, using only Pins 2, 3, and 7.

4. Set DIP Switch 3 on Switch F to the ON position (the switch is OFF for normal operation).

5. Power the switch on.

6. When a self-test is run, this message will appear:

Type in your reply: capital **R** or capital **O**.

```
**CODE OPERATED MATRIX SWITCH SELF TEST V 1.0**
  RUN TESTS (R)EPEATEDLY OR (O)NCE?
```

If you select **R**, the tests you select from the next menu will repeat until you press the BREAK key. **O** will run tests only once.

After you've picked **R** or **O**, this menu appears:

If you select **A**, you get the following tests:

```
WHICH TESTS SHOULD BE RUN?
(R)AM TEST
(L)ED TEST
(D)IP SWITCH TEST
(S)ERIAL PORT TEST
(I)NTERRUPT TEST
(A)LL TESTS
```

```
  RAM TEST 64K RAM IS GOOD
  LED TEST IN PROGRESS, ALL LEDS SHOULD TURN ON
  AND OFF. PRESS ANY KEY TO EXIT
```

```
DIP SWITCH TEST (MAIN BOARD) HIT ANY KEY TO GO
     TO NEXT TEST
 SWITCHES ARE DISPLAYED IN BINARY (0 = OFF, 1 =
ON)

 SWG     SWF      SWE     SWD     SWC     SWB     SWA
 00000010         00100000        1000010110000101
10000101 10000100 10000100
```

```
  EXPANSION BOARD IS INSTALLED
  DIP SWITCH TEST (EXPANSION BOARD) HIT ANY KEY
TO          GO TO NEXT TEST
  SWITCHES ARE DISPLAYED IN BINARY (0 = OFF, 1 =
ON)

  SWK       SWJ        SWI       SWH
  11111101  11101101   11110101  11100101
```

```
 SERIAL PORT TEST (EXPANSION BOARD IS
INSTALLED)

 PORT#             DATA    DTR/CTS/RI   RTS/DCD

 PORT 0              *       FAILED      FAILED
 PORT 1            FAILED    FAILED      FAILED
 PORT 2            FAILED    FAILED      FAILED
 PORT 3            FAILED    FAILED      FAILED
 PORT 4            FAILED    FAILED      FAILED
 PORT 5            FAILED    FAILED      FAILED
 PORT 6            FAILED    FAILED      FAILED
 PORT 7            FAILED    FAILED      FAILED
 PORT 8            FAILED    FAILED      FAILED


 SERIAL PORT TEST FAILED


 INTERRUPT TEST IN PROGRESS
 A
 INTERRUPT TEST PASSED
```

The tests are performed at 9600 bps, no parity, and 1 stop bit. The serial-port test will return a "*" for every section that passes the test, and a "FAILED" message otherwise. To perform a proper serial-port test, you must tie together Pins 2 and 3 for the data portion, Pins 20, 5, and 22 for the DTR/CTS/RI portion, and Pins 4 and 8 for the RTS/DCD portion for each port you wish to test.

5.2 Sample Test Program

Here is a sample test program written in BASIC for the Code Operated Matrix Switch. When run, this program will output a test message on each port. To run this program, connect the PC to Port 0. REM statements ("Remarks") are optional, and the attention character is the default **@**.

```
100REM**CODE OPERATED MATRIX SWITCH TEST**
110OPEN "COM1:9600,N,8,1,CS,DS"AS1              :REM** SET UP COM 1 PC PORT**
120P=49                                         :REM** SET PORT # TO 1 (DECIMAL 49)**
130PRINT #1,CHR$(64);                           :REM** SEND ATTENTION CHAR (@) **
140PRINT #1,"L0";                               :REM** SEND LINK COMMAND**
150PRINT #1,CHR$(P)                             :REM** SEND PORT # OUT COM 1**
160T=P-48                                       :REM** CONVERT DEC. TO ACTUAL PORT #**
170PRINT #1,"THIS IS A TEST OF PORT #"T         :REM** SENDS MESSAGE OUT COM 1**
180FOR I=1 TO 250                               :REM** DELAY**
190NEXT I                                       :REM** LOOP**
200PRINT #1,CHR$(64);                           :REM** SEND ATTENTION CHAR (@)**
210PRINT #1,"U0";                               :REM** SEND UNLINK COMMAND**
220PRINT #1,CHR$(P)                             :REM** SEND PORT # OUT COM 1**
230P=P+1                                         :REM** INCREMENT PORT #**
240FOR I=1 TO 250                               :REM** DELAY**
250NEXT I                                        :REM** LOOP**
260IF P=57 THEN GOTO 120 ELSE GOTO 130          :REM** LOOPBACK FOR NEXT PORT**
```

Appendix A: ASCII Codes

CONTROL CHARACTERS

OCTAL	HEX	DECIMAL	
0	0	0	NUL
1	1	1	SOH
2	2	2	STX
3	3	3	ETX
4	4	4	EOT
5	5	5	ENQ
6	6	6	ACK
7	7	7	BEL
10	8	8	BS
11	9	9	HT
12	A	10	LF
13	B	11	VT
14	C	12	FF
15	D	13	CR
16	E	14	SO
17	F	15	SI
20	10	16	DLE
21	11	17	DC1
22	12	18	DC2
23	13	19	DC3
24	14	20	DC4
25	15	21	NAK
26	16	22	SYN
27	17	23	ETB
30	18	24	CAN
31	19	25	EM
32	1A	26	SUB
33	1B	27	ESC
34	1C	28	FS
35	1D	29	GS
36	1E	30	RS
37	1F	31	US

NUMBERS AND SYMBOLS

OCTAL	HEX	DECIMAL	
40	20	32	SP
41	21	33	!
42	22	34	"
43	23	35	#
44	24	36	$
45	25	37	%
46	26	38	&
47	27	39	'
50	28	40	(
51	29	41	)
52	2A	42	*
53	2B	43	+
54	2C	44	,
55	2D	45	-
56	2E	46	.
57	2F	47	/
60	30	48	0
61	31	49	1
62	32	50	2
63	33	51	3
64	34	52	4
65	35	53	5
66	36	54	6
67	37	55	7
70	38	56	8
71	39	57	9
72	3A	58	:
73	3B	59	;
74	3C	60	<
75	3D	61	=
76	3E	62	>
77	3F	63	?

UPPER CASE

OCTAL	HEX	DECIMAL	
100	40	64	@
101	41	65	A
102	42	66	B
103	43	67	C
104	44	68	D
105	45	69	E
106	46	70	F
107	47	71	G
110	48	72	H
111	49	73	I
112	4A	74	J
113	4B	75	K
114	4C	76	L
115	4D	77	M
116	4E	78	N
117	4F	79	O
120	50	80	P
121	51	81	Q
122	52	82	R
123	53	83	S
124	54	84	T
125	55	85	U
126	56	86	V
127	57	87	W
130	58	88	X
131	59	89	Y
132	5A	90	Z
133	5B	91	[
134	5C	92	\
135	5D	93	]
136	5E	94	^
137	5F	95	-

LOWER CASE

OCTAL	HEX	DECIMAL	
140	60	96	`
141	61	97	a
142	62	98	b
143	63	99	c
144	64	100	d
145	65	101	e
146	66	102	f
147	67	103	g
150	68	104	h
151	69	105	i
152	6A	106	j
153	6B	107	k
154	6C	108	l
155	6D	109	m
156	6E	110	n
157	6F	111	o
160	70	112	p
161	71	113	q
162	72	114	r
163	73	115	s
164	74	116	t
165	75	117	u
166	76	118	v
167	77	119	w
170	78	120	x
171	79	121	y
172	7A	122	z
173	7B	123	{
174	7C	124	l
175	7D	125	}
176	7E	126	~
177	7F	127	del

Appendix B: Installing the 4-Port Expansion Card

Before you begin, follow standard procedures for grounding any accumulated static electricity, to prevent damage to the circuits of the main and expansion boards. Also, shut off the Switch's power by unplugging the wall-mounted transformer.

1. Remove the cover of the Switch.

2. Make sure you have set Ports 0 through 5 properly for DTE or DCE operation. Refer to **Section 3.2** of the manual for details.

3. Install the standoffs in the two holes that run along the midline of the main board.

4. Insert the Expansion Board's row of RS-232 connectors into the row of holes at the rear of the Switch. Make sure the connector that projects from the bottom of the Expansion Board is seated firmly in the socket of the main board.

5. Screw the 8 screwlocks into the holes along the row of expansion ports. Also set screws into the standoffs.

6. Set the baud rate, parity, word size, flow control, and break-detection capacity with DIP Switch Banks SWH through SWK. Use the chart on the next page.

7. Set each expansion port for DTE or DCE operation with the DIP shunts. For precautions and more information on shunts, see **Section 3.2** (page 8).

8. Replace the cover of the Switch.

9. Connect your additional devices to the Switch.

10. Plug the wall-mounted transformer into its AC socket.

(BACK)
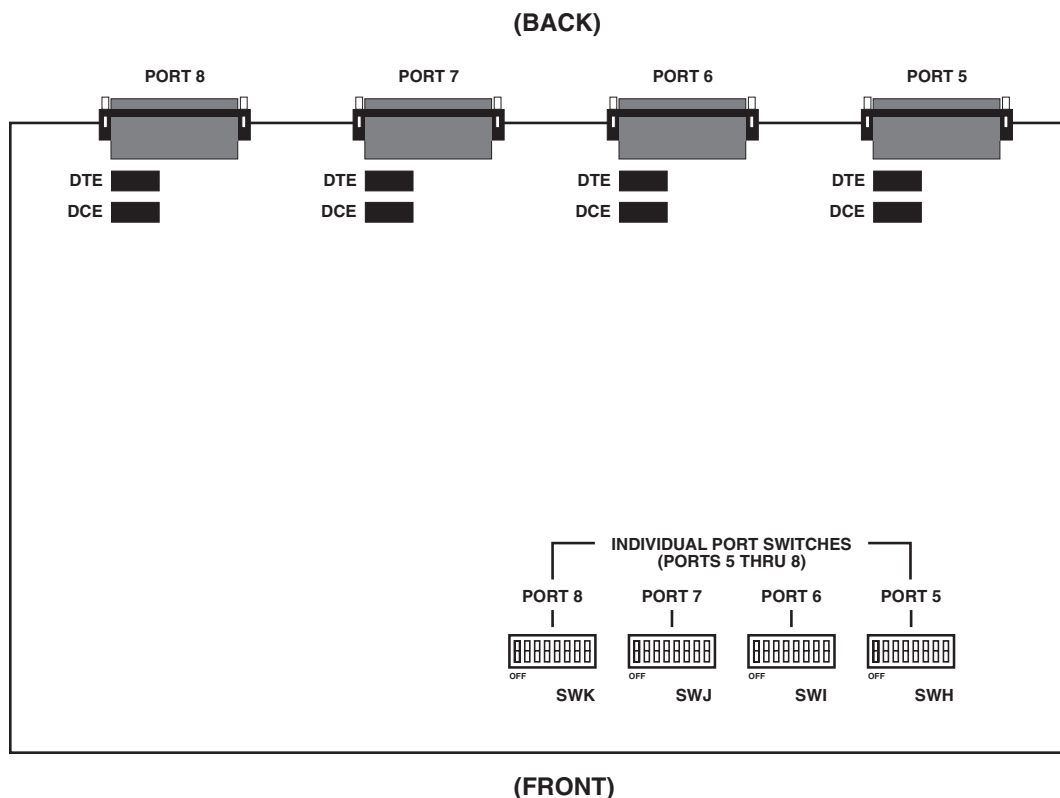
The 4-Port Expansion Board

Appendix C: Quick Setup Guide

Option	Switch Position Settings							
	1	2	3	4	5	6	7	8
Baud Rate								
110	ON	ON	ON					
300	OFF	ON	ON					
600	ON	OFF	ON					
1200	OFF	OFF	ON					
2400	ON	ON	OFF					
4800	OFF	ON	OFF					
9600	ON	OFF	OFF					
19,200	OFF	OFF	OFF					
Parity								
No Parity				ON	ON			
Even Parity				OFF	ON			
Odd Parity				ON	OFF			
No Parity				OFF	OFF			
Data Bits/Word								
7						OFF		
8						ON		
Flow Control								
Hardware (DTR/CTS)							ON	
Software (X-ON/X-OFF)							OFF	
Break Detection								
Break to Disconnect								ON
Ignore Breaks								OFF

Individual Port Switch Banks

Switch Position	Switch Setting	Function
1	ON	Reverts to factory-set attention string of @ when reset
	OFF	Maintains user-set attention string when reset
2	ON	Limits port name changes and attention-character changes to Port 0 only
	OFF	All ports can change port names and attention characters
3	ON	Perform self-test (see **Section 5**)
	OFF	Normal operation
4	ON	DCD (RTS) passed through
	OFF	DCD (RTS) blocked
5-8		Reserved for future use

Functions and Settings, Switch Bank SWF
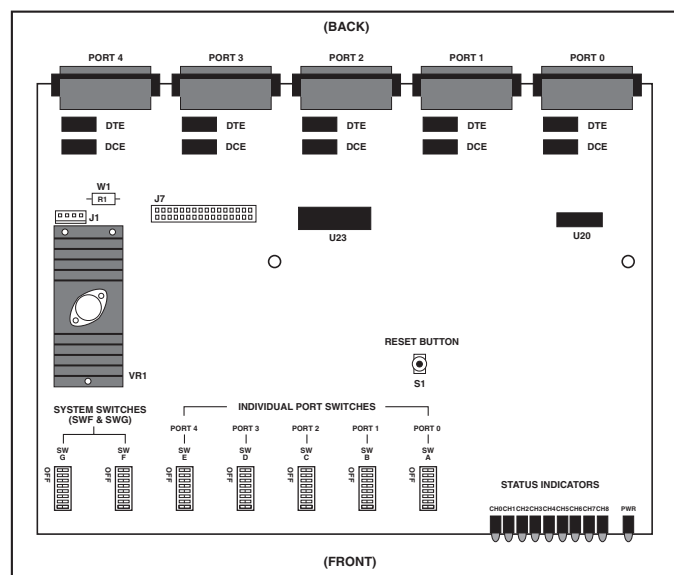
Internal Board Locations

LINKUP Software
for the Code Operated Matrix Switch

LINKUP
PC SUPPORT PROGRAM
Version 2.0
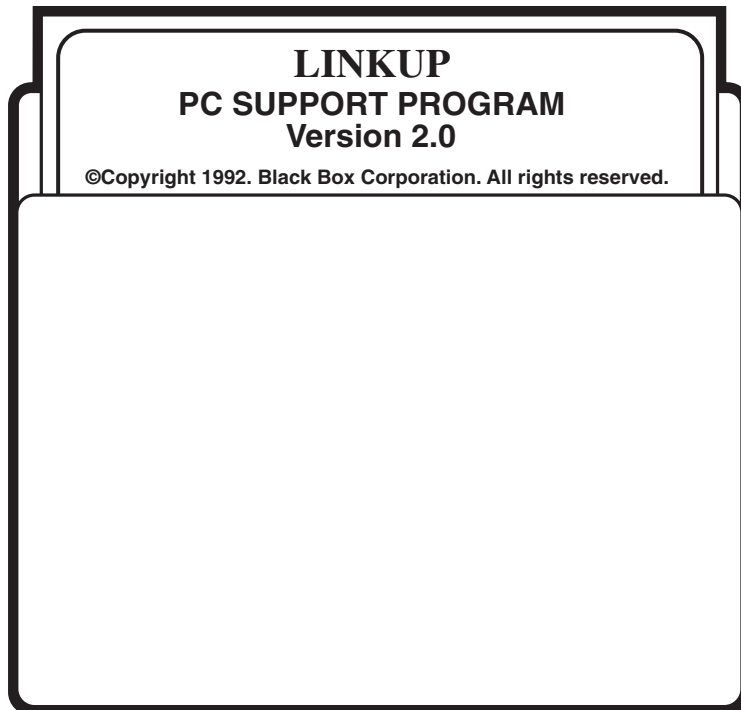
1. Introduction

1.1 What Is LINKUP?

LINKUP is a support program included with the Code Operated Matrix Switch (COMS). It works with either the older versions of the COMS (SW540 and SW540A-R2) or the current version (SW540A-R3).

You don't need LINKUP to operate the COMS. However, it can be very useful when you need to execute a COMS command (for example, to make or break a link between two COMS ports). It's especially useful when you don't have a terminal-emulation program to perform these functions.
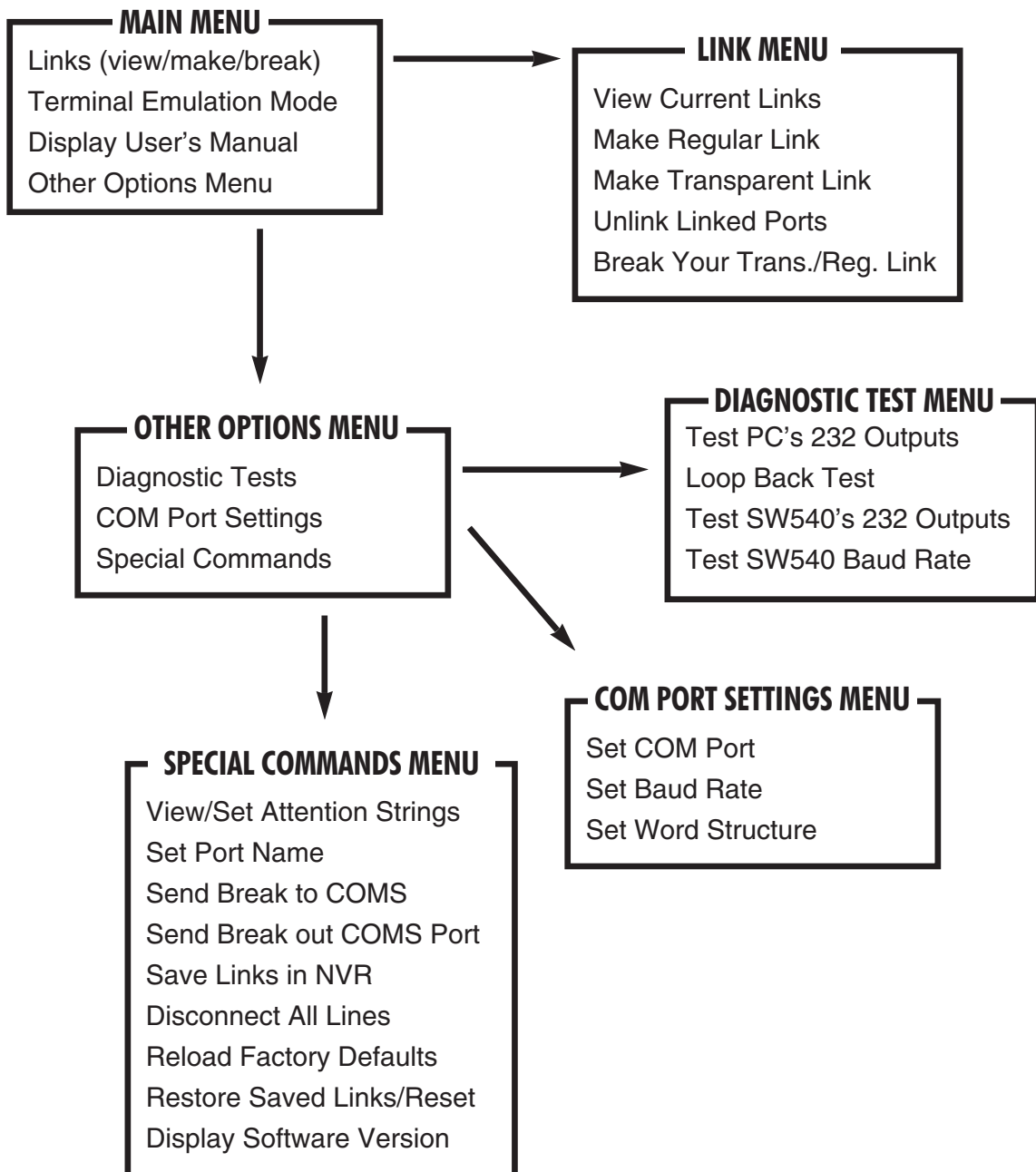
LINKUP is a user-friendly, menu-driven program with a quick-help window and an on-line user's manual for the COMS. The program lets you execute every COMS command, run diagnostic tests, or enter a dumb-terminal emulation program (so you can communicate directly with the COMS if you wish).

With LINKUP, you can check to see whether a shared device is in use by someone else. If it's free, LINKUP will help you create a link from your computer to the device. Once you are linked through the COMS, you can exit from LINKUP. Your regular application programs can now use the shared device as if it were connected directly to your computer—for example, you can print to a shared printer from your word-processing program.

Figure 1 shows how the menus in LINKUP are arranged.

1.2 Hardware Requirements

LINKUP runs on the IBM® PC family of computers, including the PC/XT™ and AT®, and on any true IBM compatible with a disk drive capable of reading a 360K diskette. Since it's a text-based program, it runs on any 80-column monitor.

MAIN MENU

Links (view/make/break)
Terminal Emulation Mode
Display User's Manual
Other Options Menu

LINK MENU

View Current Links
Make Regular Link
Make Transparent Link
Unlink Linked Ports
Break Your Trans./Reg. Link

OTHER OPTIONS MENU

Diagnostic Tests
COM Port Settings
Special Commands

DIAGNOSTIC TEST MENU

Test PC's 232 Outputs
Loop Back Test
Test SW540's 232 Outputs
Test SW540 Baud Rate

COM PORT SETTINGS MENU

Set COM Port
Set Baud Rate
Set Word Structure

SPECIAL COMMANDS MENU

View/Set Attention Strings
Set Port Name
Send Break to COMS
Send Break out COMS Port
Save Links in NVR
Disconnect All Lines
Reload Factory Defaults
Restore Saved Links/Reset
Display Software Version

2. Setup and Configuration

2.1 Files on the LINKUP Disk

There are five files on your LINKUP disk:

1. LINKUP.EXE: The executable version of the program.

2. LINKUP.CFG: A data file that keeps your current configuration of the program (baud rate, data bits, and so on).

3. LINKUP.DOC: The on-line user's manual for the COMS.

4. README.BBC: The LINKUP user's manual (this manual you're reading).

5. INSTALL.BAT: The automatic installation program to install LINKUP on your hard drive.

2.2 Making a Backup Copy

We encourage you to share this program with all other users of the Code Operated Matrix Switch, and to make a backup copy for your protection. You may copy the disk freely, as long as:

• You make no changes to any file on this diskette.

• Each copy you make includes all files on the original diskette.

• You include the following copyright notice on all copies.

"Copyright © 1992. Black Box Corporation. All rights reserved."

DOS gives you two ways to make a backup copy. If you have only one disk drive, use the DISKCOPY command. If you have two disk drives, you'll probably find it more convenient to use COPY. (If your disk drive can't format a blank disk to match the format of the LINKUP disk, you'll have to use the COPY command.) See your DOS manual for help with any of the DOS commands used below.

2.2.1   MAKING A BACKUP WITH **DISKCOPY**

1. Format a blank 360K diskette, to match the format of the LINKUP diskette).

2. Place the LINKUP diskette in Drive A.

3. To make a backup copy, type:

   A:

   (makes Drive A: the current working directory)

   diskcopy

   When DOS prompts you to "enter target disk," place your new blank disk in Drive A.

2.2.2   MAKING A BACKUP WITH **COPY**

NOTE: You must have two disk drives to make a backup with COPY.

1. Format a blank diskette and place it in Drive B.

2. Place the LINKUP diskette in drive A.

3. To make a backup copy, type:

   A:

   (makes Drive A the current working directory)

   copy *.* B:

   (copies all files from the LINKUP disk to the blank disk in Drive B)

2.3 Installing the LINKUP Files on Your Hard Drive

The batch program INSTALL.BAT will automatically install the LINKUP files on your hard drive. If you prefer to do the installation yourself, skip to the next section.

2.3.1 INSTALLING THE LINKUP FILES AUTOMATICALLY

1. Place your backup copy of the LINKUP disk in Drive A.

2. Type the following DOS commands at the command prompt:

    A:

    (makes Drive A the current working directory)

    INSTALL

    (executes the INSTALL program)

3. The program will tell you what to do from here.

2.3.2 INSTALLING THE LINKUP FILES YOURSELF

1. If you've been using a previous version of LINKUP, make sure you delete all the old LINKUP files from your hard drive. They would probably be in a directory called "LINKUP."

2. Place your backup copy of the LINKUP disk in Drive A.

3. Type the following DOS commands at the command prompt:

    c:

    (makes Drive C the current working directory)

    md linkup

    (makes a new directory called "linkup"—or whatever name you prefer—unless a directory by that name already exists)

    copy a:*.* c:\linkup

    (copies files from Drive A: to the directory on the hard drive)

2.4 Modifying Your AUTOEXEC.BAT File

You might need to use a number of DOS commands to set up your system for LINKUP. If you add them to your AUTOEXEC.BAT file, they'll run automatically when you turn your machine on, and you won't have to type them in again every time you run LINKUP. Reboot your PC after modifying your AUTOEXEC.BAT file.

If you don't know how to create or edit the AUTOEXEC.BAT file, See your DOS manual's sections on the AUTOEXEC.BAT file and the DOS editor program EDLIN.

2.4.1 DOS PATH AND APPEND COMMANDS

You might want to add these lines to your AUTOEXEC.BAT file so you can access LINKUP files from any directory or drive on your machine. Otherwise, you can access LINKUP only if you make your working directory the directory LINKUP was installed in.

    path = c:\linkup

    (allows DOS to find the .exe file in this directory)

    append = c:\linkup

    (allows DOS to find the data files in this directory)

NOTE: The path "c:\linkup" is for example only. Use the directory name you selected when you installed LINKUP (see Section 2.3).

If the "append.com" file is not in directory "c:\" then your path statement must first include the directory of this file. Separate directories with a semicolon.

If a path or append statement already exists in your AUTOEXEC.BAT file, just add the following to the end of that existing statement:

    ;c:\linkup

2.4.2 DOS MODE COMMAND

The MODE command can be used to configure communications (COM) port parameters and to redirect parallel printer output to a COM port.

DOS MODE COM Command. You'll need to add a MODE COM command to your AUTOEXEC.BAT file if:

- You will be using the DOS print command to send data to the COMS.

- You will be using an application that does not allow you to set the baud rate and word structure of your COM port.

If you meet either of those conditions, add the following command to your AUTOEXEC.BAT file:

> **MODE COM1:9600,N,8,1**
>
> (specifies asynchronous communications parameters as 9600 baud, no parity, 8 data bits, 1 stop bit)

DOS MODE LPT Command. You'll need to add a MODE LPT command to your AUTOEXEC.BAT file if:

- You will be using the DOS print command to send data to the COMS and you do not want to enter "COM1" or "COM2" at the PRINT-command prompt ("list device [PRN]: ").

- You will be using an application program that does not allow you to select a COM port as your print/list device.

If you meet either of those conditions, add the following command to your AUTOEXEC.BAT file:

> **MODE LPT1:=COM1**
>
> (redirects printer output from Parallel Printer Port 1 to Communications Port 1)

NOTE: **You must use the MODE COM command to specify the asynchronous communications mode before you can redirect parallel printer output to the COM port with the MOD LPT command. See your DOS manual for more information on the MODE command.**

2.5 Default Settings

The COMS hardware and LINKUP support program should be shipped from the factory with the following default configuration:

Code Operated Matrix Switch:

- 19,200 baud, 7 data, no parity, X-ON/X-OFF flow control (all ports)

- attention string "@" (all ports)

- <break> sequences are ignored (for example, a port's link will not be broken on <break>)

- a user-set attention string remains if the COMS is reset

- all ports can change port names and attention strings

- the COMS is in Normal Operation (not running its internal self-test)

- DCD and RTS are not passed through between linked ports

LINKUP Program:

- 19,200 baud, 7 data, no parity, flow control N/A

- attention string "@"

- COM Port #1

DOS COM Port:

Use the DOS MODE COM command in your AUTOEXEC.BAT file to set your computer's defaults for baud rate and word structure for any communication (COM) port.

2.6 Configuring the COMS, LINKUP, and DOS

The Code Operated Matrix Switch (COMS), LINKUP Support Program, and DOS must all be initially configured to use the same:

- PC COM port (for example, COM1)

- baud rate (for example, 9600)

- word structure:

- data bits (for example, 8)

- parity (for example, none)

- stop bits (for example, 1)

Configure the COMS with internal DIP switches and shunt jumpers (see the hardware section in the front of this manual for more detail).

To configure LINKUP, install the program. Then use the built-in menu commands to configure the support software (see Fig. 1, "Menus in the Linkup Software," for more details).

For DOS, use the MODE COM command to configure COM port parameters (see Section 2.4.2, "DOS MODE Command," for more details).

3. Running LINKUP

To run the program, just type "LINKUP" at the DOS command prompt.

NOTE: **If you haven't told DOS where the LINKUP files are (via the path and append statements in your AUTOEXEC.BAT file), first make the directory that holds the LINKUP files your working directory.**

3.1 Hints for Using LINKUP and the Code Operated Matrix Switch

When you're using the COMS and LINKUP, it helps to keep these recommendations in mind:

- Give each port on the COMS a unique, descriptive name.

- Select the default attention string ("@") on all COMS ports and LINKUP programs. It'll be easier to keep track of.

- Before making a link, check to make sure the desired port is not already in use

- Before breaking someone else's link, make sure that user has finished.

- When you can, make a Transparent Link instead of a Regular Link. Making a Transparent Link will often eliminate problems related to the content of the data.

- After your link is made, exit LINKUP and use your regular application program or the DOS PRINT command to send or receive data through the COMS unit.

- After all your data has passed through the COMS unit, reenter LINKUP and break your Transparent Link with the BREAK YOUR LINK menu option in the Link Menu.

3.2 Sending Data with DOS

You can use the DOS PRINT command to send data through the COMS unit. The PRINT command will let you send a file out your PC's COM port using the baud rate and word structure defined by the last MODE COM command (see Section 2.4.2, "DOS MODE Command"). The PRINT command configures the COM port for hardware flow control.

Example:

PRINT <filename.ext>

NOTE: **We do not recommend using the DOS COPY command (for example, "COPY filename.ext COM1") because it does not support flow control.**

If you used a MODE LPT command to redirect parallel-printer output to a COM port, then just use the default ("PRN") value at the next DOS prompt for list device. Otherwise, enter "COM1" as the list device the first time you execute the print command.

3.3 Sending Data with Your Application Programs

You can also send data through the COMS unit with commands in your application programs.

For some applications, like communications packages, you can configure the COM port parameters (including flow control) and use a transmit/send or receive/ capture command to transfer data through the COM port. These programs usually have options to use standard protocols (like the XMODEM protocol) to transfer files between two PCs' COM ports.

Most other application programs are designed to send data to an attached parallel printer. With these programs, you need to redirect the parallel printer output to a communications (COM) port and configure the COM ports parameters. There are two ways to redirect the output:

1. Many programs will prompt you for a print/list device. If yours does, you may be able to enter "COM1" or "COM2" and have the program itself redirect the print data out the communications port.

2. You can redirect parallel printer output out the COM port of your choice with the DOS MODE LPT command (see Section 2.4.2, "DOS Mode Command"). Then, when your application tries to send data to the printer port, DOS will redirect the data to the COM port.

In most cases, application programs like these will use the communications parameters for baud rate and word structure set up in the last DOS MODE COM command. (See Section 2.4.2.) Most of these programs will also use hardware flow control.

4. Troubleshooting

Diagnostic tests are available as menu options in the LINKUP program to assist you in testing your COM port, your cable connecting to the COMS, and the COMS port, and to determine the baud rate (but not the parity setting) of the COMS port.

You can diagnose and solve many software problems yourself. For information on hardware problems, refer to the troubleshooting section in the COMS user's manual.

PROBLEM: None of the LINKUP commands that communicate with the COMS unit are working.

Make sure that your computer is cabled correctly to the COMS unit.

Make sure that both the COMS unit and the LINKUP program are configured for the same baud rate and word structure.

Check out the attention strings:

- Make sure the COMS port's attention string matches the attention string used by the LINKUP support program.

- You might try having a user at another station change your COMS port's attention string to the default of "@" with the "View/Set Attention Strings" command.

- Or you can set Switch Bank SWF Position 1 on the COMS to "ON" (so that all attention strings will default to "@" when the COMS is reset) and reset the unit. After this, your COMS port should be using the attention string "@."

- Now change your LINKUP program's attention string to "@" with the "View/Set Attention Strings" command (make sure you change only the LINKUP program's attention string).

- If you want users to be able to save their attention-string changes, remember to turn SWF Position 1 to "OFF" and reset the COMS again.

PROBLEM: Just a few of the LINKUP commands don't work correctly (like the "Break Your Trans./Reg. Link" command).

Make sure the COMS unit's BREAK DETECTION option is set to "Break to Disconnect" for your port. See the COMS user's manual to find out which Switch Bank is assigned to your port, then make sure position 8 is ON.

PROBLEM: The SAVE LINKS IN NVR menu option in LINKUP isn't working.

COMS units with product codes earlier than SW540-R2 don't have this feature, so they simply ignore this command.

PROBLEM: These commands aren't working:

- *DISCONNECT ALL LINES*

- *RELOAD FACTORY DEFAULTS*

- *RESTORE SAVED LINKS/RESET*

COMS units with product codes earlier than SW540A-R3 don't have these features, so they simply ignore these commands.

PROBLEM: The SET NAME and SET ATTENTION menu options in LINKUP aren't working.

If your COMS is configured to allow only the user attached to Port 0 to change names, no other users will be able to use these commands. (Switch Bank SWF Position 2 should be OFF to allow any port to change port names and attention strings)

PROBLEM: I successfully made the link to my printer with LINKUP, but when I send my file it is not received correctly or it is not received at all.

Make sure the DOS MODE COM command in your AUTOEXEC.BAT file is configuring the correct COM port for the same baud rate and word structure that the COMS unit is using. Also check whether you need to configure the COMS unit, LINKUP, and DOS to use 8-bit data (for graphics data).

PROBLEM: I'm still having problems.

If you still need help, check these sources:

- Your COMS user's manual for information on hardware problems.

- LINKUP's on-line help information.

- Your DOS manual for help on any of the DOS commands, and also on EDLIN (the editing program you can use to create or change your AUTOEXEC.BAT file).

NOTE: You have to configure the COMS, LINKUP, and DOS only once, not every time you run LINKUP.

The COM port on your computer is connected to the COMS with a serial communications cable. In order for the LINKUP and DOS to successfully communicate with the COMS, make sure you follow these recommendations:

- Set the COMS DTE/DCE shunt jumper in the DCE position.

- Connect the PC COM port to the COMS port with a straight-through cable (not a null-modem cable).

- Make sure your cable supports these signals: TXD, RXD, CTS, DSR, GND, DCD, and DTR.

Important Configuration Notes:

- Your COMS port, LINKUP, and DOS must be configured exactly the same way (see the instructions above for more details).

- The fastest data speed possible with DOS MODE COM commands is 9600 bps.

- If you're sending graphics data, you'll probably need to configure everything for an "8-bit" (data bits) word length.

- DOS and many application programs use hardware flow control (CTS input Pin 5). See the COMS manual for how to configure the COMS unit for hardware flow control.

- The attention string configured in LINKUP must match the attention string for your COMS port.

- The COMS unit's BREAK DETECTION option for your port must be set to "BREAK TO DIS-CONNECT" in order for the LINKUP support program to execute all of its menu options.