Code Operated Switch II
4-Port Expansion Board
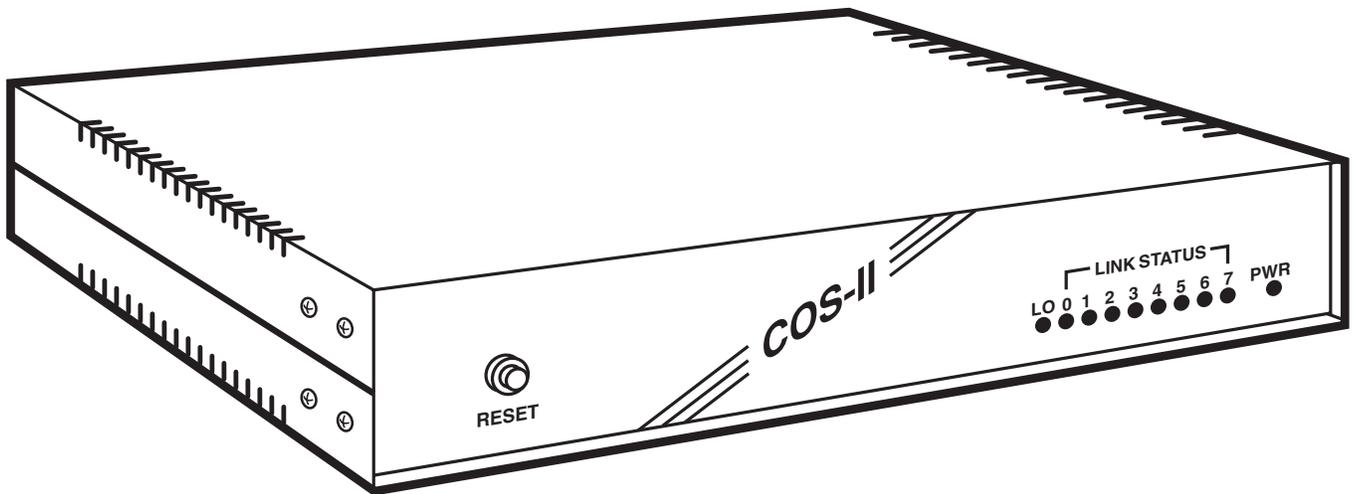
FEDERAL COMMUNICATIONS COMMISSION
AND
INDUSTRY CANADA
RADIO FREQUENCY INTERFERENCE STATEMENTS

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.

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

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canadian.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

INSTRUCCIONES DE SEGURIDAD (Normas Oficiales Mexicanas Electrical Safety Statement)

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.

2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.

3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.

4. Todas las instrucciones de operación y uso deben ser seguidas.

5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..

6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.

7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.

8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.

9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.

10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.

11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra fisica y la polarización del equipo no sea eliminada.

13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.

14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.

15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.

16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.

17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.

18. Servicio por personal calificado deberá ser provisto cuando:

    A: El cable de poder o el contacto ha sido dañado; u

    B: Objectos han caído o líquido ha sido derramado dentro del aparato; o

    C: El aparato ha sido expuesto a la lluvia; o

    D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o

    E: El aparato ha sido tirado o su cubierta ha sido dañada.

Contents

If you're already familiar with the Code Operated Switch II, and you just need to know how to configure the DIP switches, you can turn to the Quick Reference Guide on page 21.

CE

        This product is CE certified. This certificate indicates that the product is suitable for use in commercial and light industrial environments as defined in EN 50081-1:1992.

NOTE

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

1. Specifications

Interface — RS-232 asynchronous (each port individually selectable for DTE or DCE)

Connectors — Switch: (5) DB25S female; Switch with Expansion Board: (9) DB25S female

Pins Supported — 1-8, 20, 22

Speed — 110 to 19,200 bps (selectable by port)

Memory — 8K buffer

Enclosure — Steel

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

Humidity — 0 to 95% relative humidity

Mean Time Between Failures — Standard Switch**:** 20,000 hours; Switch with Expansion Board: 16,000 hours

Indicators —LEDs: 1 Power, 1 Lockout, 8 Port-Connected

Power — 115 VAC (230-VAC version available)

Size — 2.3"H x 12.2"W x 11"D (5.8 x 31 x 27.9 cm)

Weight — Switch: 7.5 lb. (3.4 kg); Expansion Board: 0.6 lb. (0.3 kg); Wallmount power supply: 2.1 lb. (1 kg)

2. Introduction

The Code Operated Switch II (COS II) makes code-operated switching possible for diverse combinations of serial devices. As it switches, the COS II also reconciles differences in word size, speed, flow control, and parity for up to four devices. An Expansion Board, available separately, doubles the maximum number of devices, to eight.

Configuration is port-independent: You may set different speeds, word sizes, parities, and flow-control requirements for each port. The 8K buffer handles speed conversions from 110 bps to 19,200 bps. DTE and DCE are also independently determined for every port.

A control sequence manages the switching for the COS II. The COS II will accept the sequence from any port—the master port, which will ordinarily have a PC or terminal connected to it, or any of the four (or eight) slave ports.

A special graphics timeout lets you send graphics files through the Switch without the chance of accidental switching. In graphics mode, the COS II recognizes the appearance of the control code only when the code characters are preceded by a pause of a specified length. The COS II treats all other occurrences of the control code as data—they are passed along to the slave device with the rest of the characters in the file.

Any office, lab, or shop with a variety of serial devices will benefit from a COS II. Use it in a typical multiprinter office, or to transfer files between computers. You could also set up the COS II as the link between a single PC and a mixture of high- and low-speed remote data lines. The COS II will pass your high-speed—9600-bps—data without interference, while the internal buffer of the COS will downshift PC data for the slower modems.

3. Installation

3.1. Introduction

In addition to this manual, your Switch package should contain one standard switch unit and a wallmounted power supply. After you've unpacked the Switch, take a few minutes to look through this manual. You will need a screwdriver large enough to remove the case screws, and a small screwdriver or other edged tool for setting DIP switches. Also, you might want to refer to the manuals of the devices you plan to connect to the COS-II.

Installing the COS-II is a simple, three-step task that should take no more than an hour to complete. First, you'll configure all of the DIP switches for the internal options of the COS II. Then, you'll specify DTE or DCE for each port by setting shunt jumpers. Finally, you'll cable the Switch to your devices and connect power to the COS II.

3.2. Setting the DIP switches

In order to set the DIP switches, you'll need to open the case of the COS-II. There are several screws on each side. Remove them, and lift the case lid from the body of the COS-II. The board layout of your unit should match the diagram shown below (Fig.1).
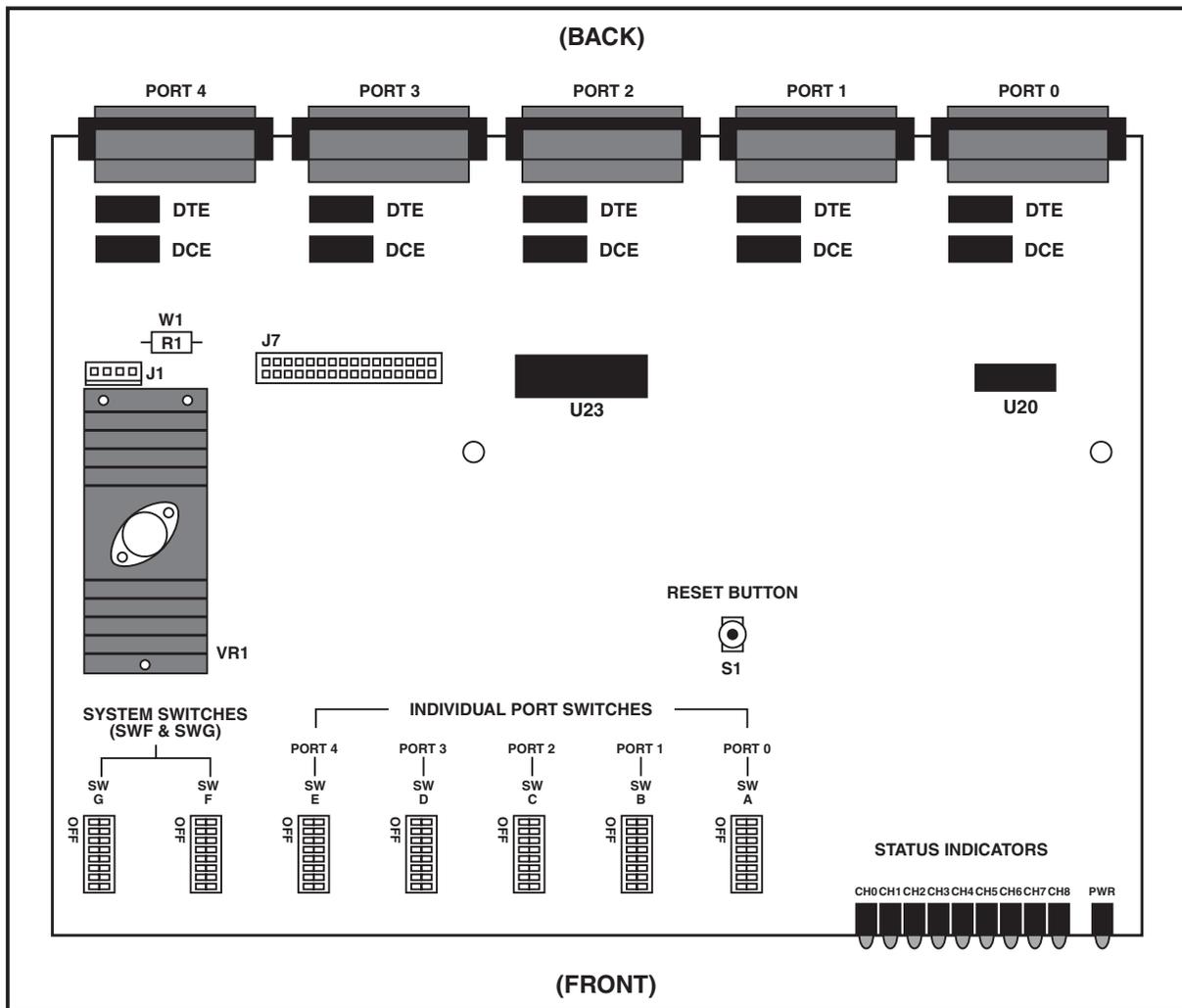
Fig. 3-1. Board Layout for the COS-II.

The board layout for the Four-Port Expansion Board is shown on this page (Fig. 2). If you have ordered one, check your Board to make sure it matches.

NOTE: **Every time you change the DIP switch settings, you must press the reset button located on the front panel of the switch, or unplug the power supply. The COS-II will not process any data during a reset.**

A note on charts: you'll find all the charts printed in this chapter duplicated either in the **Appendix** or in the **Quick Reference Guide**.

3.3 Functions and Arrangement of the Switch Banks

On the standard board there are seven banks of DIP switches, of which five control the characteristics of the individual ports (SWA through SWE). The remaining two banks (SWF, SWG) control options that affect the entire system. The Four-Port Expansion Board adds individual port banks SWH through SWK.

A note on terminology: This manual will use the following system to designate individual switches within each switch bank. The bank label will be given first, followed by a hyphen and then the number of the DIP switch. "SWA-6" refers to the sixth DIP switch of Switch Bank A. Also, the words "ON" and "OFF" are used in the switch charts, but your banks may have the words "CLOSED" and "OPEN" printed instead. "CLOSED" is equivalent to "ON," and "OPEN" is equivalent to "OFF."

You'll set the following options with Switch Banks SWA through SWE (the individual port banks):
• Data rates, from 110 to 19,200 bps
• Parity—even, odd, or no parity
• Word sizes —7 or 8 bits
• Flow control by hardware (DTR/CTS) or software (X-ON/X-OFF).
Section 3.4 covers these banks in more detail.

The two banks SWF and SWG (system banks) regulate:
• Responsibility for the Link Command (from master or slave port)
• Automatic timeout period
• Length of pause in Graphics Mode
• Lead Pass-Through
• Arming character
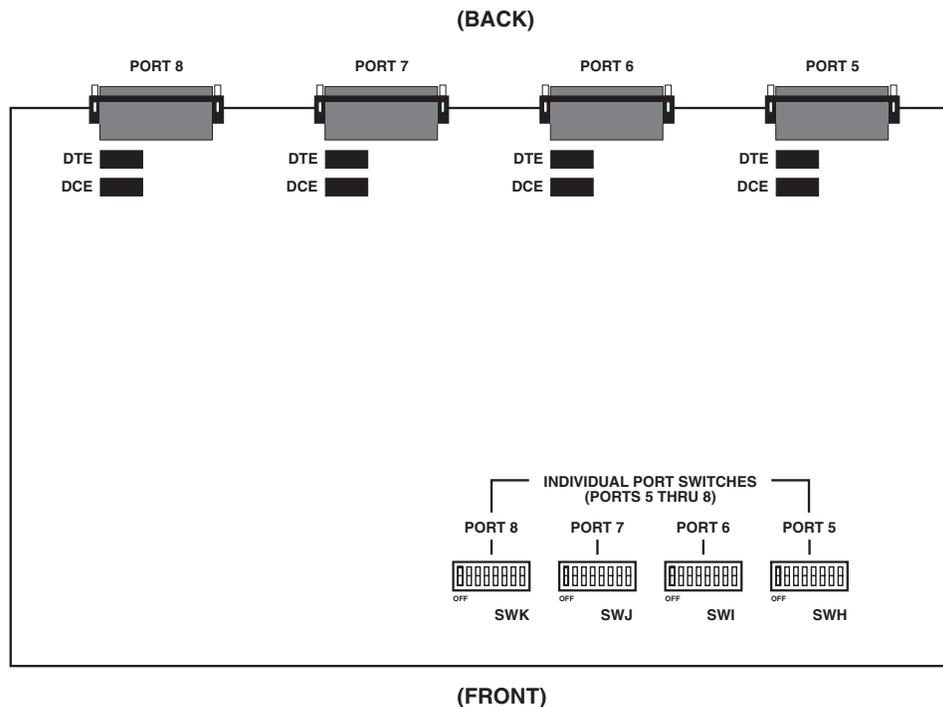
Fig. 3-2. Layout of the 4-Port Expansion Board.

In addition, there are some system characteristics that are set with the eighth DIP switch of the individual port switch banks. **Sections 3.6** and **3.7** explain these functions in depth.

3.4 Bank Assignments

The individual port switch banks are assigned as follows:

Bank Label	Port
SWA	Master Device Port
SWB	0
SWC	1
SWD	2
SWE	3

The Four-Port Expansion Board provides these additional banks:

Bank Label	Port
SWH	4
SWI	5
SWJ	6
SWK	7

3.5 Configuring Ports with the Individual Port Switch Banks

To set the switch banks, use a small screwdriver or other small object with a clean edge or point. The individual port switch banks are identical in function, and the set of charts provided on the following pages applies to all of them.

3.5.1 PORT SPEED (SWITCHES 1, 2, AND 3)

Speed	Set Switches		
	1	2	3
110 bps	ON	ON	ON
300 bps	OFF	ON	ON
600 bps	ON	OFF	ON
1200 bps	OFF	OFF	ON
2400 bps	ON	ON	OFF
4800 bps	OFF	ON	OFF
9600 bps	ON	OFF	OFF
19200 bps	OFF	OFF	OFF

3.5.2 PARITY (SWITCHES 4 AND 5)

Parity	Set Switch	
	4	5
Even	OFF	ON
Odd	ON	OFF
None	OFF	OFF

3.5.3 WORD SIZE (SWITCH 6)

Size	Set Switch 6
7 bits per word	OFF
8 bits per word	ON

3.5.4 FLOW CONTROL (SWITCH 7)

Flow Control	Set Switch 7
Hardware (DTR/CTS)	ON
Software (X-ON/X-OFF)	OFF

3.6 Setting Global Characteristics with the System Switch Banks

Refer to the explanations and the charts below to set the system switch banks SWF and SWG.

3.6.1 FUNCTIONS OF SWITCH BANK SWF

Responsibility for the Link Command

When the COS II receives a control code sequence from the proper device, it will establish a communications link between the master port and one of the slave ports. If it then receives the lockout character—a character with a value of 38 in hexadecimal—it will ignore the remaining unlinked subordinate ports. For more information on links and lockouts, see **Sections 4.2** and **4.3**.

You can set the Switch to accept the command to link from only the master port, only a slave port, or from either the master or a slave port. Switches SWF 1 and SWF 2 designate the origin of the link.

Origin of Command	Set SWF	
	1	2
master	ON	ON
slave	OFF	ON
either master or slave	ON or OFF	OFF

NOTE: **If the slave ports are set up for hardware flow control, or if DTR/CTS pass-through is enabled, you should set the Switch to accept a link command from the master port only.**

Automatic Timeout

The COS II times the intervals between the reception of each character and the next. You may instruct it to return to an unlinked state after intervals of 2.5, 5, or 10 minutes, or you may disable this automatic timeout feature. SWF 5 and SWF 6 control this feature.

Timeout Setting	Set SWF-	
	5	6
2.5 minutes	ON	ON
5 minutes	OFF	ON
10 minutes	ON	OFF
Disabled	OFF	OFF

Graphics Pause

These switch settings are followed only when the COS II has been set previously for Graphics Mode (for an explanation, see **Section 4.5**). They determine the amount of time that must pass before the COS II recognizes a control code sequence.

By providing for this pause, it is possible to send graphics files through the unit with no risk that it will switch accidentally when it encounters a control code sequence, or its binary equivalent. SWF 7 and SWF 8 determine the length of the pause.

CTS-to-DTR Pass-Through Mode

To Set A Pause of	Set SWF	
	7	8
50 milliseconds	ON	ON
100 milliseconds	OFF	ON
500 milliseconds	ON	OFF
1.5 seconds	OFF	OFF

If you choose CTS-to-DTR Pass-Through, CTS (Pin 5) and DTR (Pin 20) are passed straight through the Switch. The next table shows how the DTE or DCE setting of the port affects the pass-through option:

NOTE: If the internal buffer fills, the appropriate

Master	Slave	Leads Passed
DTE	DTE	Master CTS to slave DTR
		Slave CTS to master DTR
DTE	DCE	Master CTS to slave CTS
		Slave DTR to master DTR
DCE	DTE	Master DTR to slave DTR
		Slave CTS to master CTS
DCE	DCE	Master DTR to slave CTS
		Slave DTR to master CTS

control lead (DTR or CTS) will be dropped to prevent data loss.

If you select Normal Operation, DTR (Pin 20) and CTS (Pin 5) are used strictly for buffer control. They are *not* passed straight through the Switch.

DCD-to-RTS Pass-Through Mode

To Set This Mode	Set SWC 8
CTS-to-DTR Pass-Through	ON
Normal Operation	OFF

If you select DCD-to-RTS Pass-Through, DCD (Pin 8) and RTS (Pin 4) are passed straight through the Switch. The next table shows how the DTE or DCE setting of the port affects the pass-through option:

If you select Normal Operation, DCD and RTS are

Master	Slave	Leads Passed
DTE	DTE	Master DCD to slave RTS
		Slave DCD to master RTS
DTE	DCE	Master DCD to slave DCD
		Slave RTS to master RTS
DCE	DTE	Master RTS to slave RTS
		Slave DCD to master DCD
DCE	DCE	Master RTS to slave DCD
		Slave RTS to master DCD

always asserted. They are *not* passed through the Switch.

To Set This Mode	Set SWF 3
DCD-to-RTS Pass-Through	ON
Normal Operation	OFF

3.6.2 SETTING THE ARMING CHARACTER WITH SWG

Switch Bank SWG supplies a portion of the control-code sequence, the sequence that activates the Switch. The arming character, the ASCII code that alerts the COS-II to an upcoming switch action, is set with SWG. The settings are given in the chart below. For a more detailed explanation of control codes, see **Section 4.2.** A note on abbreviations: LSB stands for least significant bit, MSB for most significant bit.

ARMING CHARACTER SWITCH POSITIONS

ASCII	CTRL	HEX	DECIMAL	LSB 1	2	3	4	5	6	7	MSB 8
NUL	@	00	0	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
SOH	A	01	1	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
STX	B	02	2	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
ETX	C	03	3	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
EOT	D	04	4	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
ENQ	E	05	5	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF
ACK	F	06	6	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF
BEL	G	07	7	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
BS	H	08	8	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF
HT	I	09	9	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF
LF	J	0A	10	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF
VT	K	0B	11	ON	ON	OFF	ON	OFF	OFF	OFF	OFF
FF	L	0C	12	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF
CR	M	0D	13	ON	OFF	ON	ON	OFF	OFF	OFF	OFF
SO	N	0E	14	OFF	ON	ON	ON	OFF	OFF	OFF	OFF
SI	O	0F	15	ON	ON	ON	ON	OFF	OFF	OFF	OFF
DLE	P	10	16	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
DC1	Q	11	17	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
DC2	R	12	18	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF
DC3	S	13	19	ON	ON	OFF	OFF	ON	OFF	OFF	OFF
DC4	T	14	20	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF
NAK	U	15	21	ON	OFF	ON	OFF	ON	OFF	OFF	OFF
SYN	V	16	22	OFF	ON	ON	OFF	ON	OFF	OFF	OFF
ETB	W	17	23	ON	ON	ON	OFF	ON	OFF	OFF	OFF
CAN	X	18	24	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF
EM	Y	19	25	ON	OFF	OFF	ON	ON	OFF	OFF	OFF
SUB	Z	1A	26	OFF	ON	OFF	ON	ON	OFF	OFF	OFF
ESC	[	1B	27	ON	ON	OFF	ON	ON	OFF	OFF	OFF
FS	\	1C	28	OFF	OFF	ON	ON	ON	OFF	OFF	OFF
GS	]	1D	29	ON	OFF	ON	ON	ON	OFF	OFF	OFF
RS	^	1E	30	OFF	ON	ON	ON	ON	OFF	OFF	OFF
US	_	1F	31	ON	ON	ON	ON	ON	OFF	OFF	OFF
SP		20	32	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
!		21	33	ON	OFF	OFF	OFF	OFF	ON	OFF	OFF
"		22	34	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF
#		23	35	ON	ON	OFF	OFF	OFF	ON	OFF	OFF
$		24	36	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF
%		25	37	ON	OFF	ON	OFF	OFF	ON	OFF	OFF
&		26	38	OFF	ON	ON	OFF	OFF	ON	OFF	OFF

ARMING CHARACTER SWITCH POSITIONS

ASCII	CTRL	HEX	DECIMAL	LSB 1	2	3	4	5	6	7	MSB 8
'		27	39	ON	ON	ON	OFF	OFF	ON	OFF	OFF
(		28	40	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF
)		29	41	ON	OFF	OFF	ON	OFF	ON	OFF	OFF
*		2A	42	OFF	ON	OFF	ON	OFF	ON	OFF	OFF
+		2B	43	ON	ON	OFF	ON	OFF	ON	OFF	OFF
,		2C	44	OFF	OFF	ON	ON	OFF	ON	OFF	OFF
-		2D	45	ON	OFF	ON	ON	OFF	ON	OFF	OFF
.		2E	46	OFF	ON	ON	ON	OFF	ON	OFF	OFF
/		2F	47	ON	ON	ON	ON	OFF	ON	OFF	OFF
0		30	48	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF
1		31	49	ON	OFF	OFF	OFF	ON	ON	OFF	OFF
2		32	50	OFF	ON	OFF	OFF	ON	ON	OFF	OFF
3		33	51	ON	ON	OFF	OFF	ON	ON	OFF	OFF
4		34	52	OFF	OFF	ON	OFF	ON	ON	OFF	OFF
5		35	53	ON	OFF	ON	OFF	ON	ON	OFF	OFF
6		36	54	OFF	ON	ON	OFF	ON	ON	OFF	OFF
7		37	55	ON	ON	ON	OFF	ON	ON	OFF	OFF
8		38	56	OFF	OFF	OFF	ON	ON	ON	OFF	OFF
9		39	57	ON	OFF	OFF	ON	ON	ON	OFF	OFF
:		3A	58	OFF	ON	OFF	ON	ON	ON	OFF	OFF
;		3B	59	ON	ON	OFF	ON	ON	ON	OFF	OFF
<		3C	60	OFF	OFF	ON	ON	ON	ON	OFF	OFF
=		3D	61	ON	OFF	ON	ON	ON	ON	OFF	OFF
>		3E	62	OFF	ON	ON	ON	ON	ON	OFF	OFF
?		3F	63	ON	ON	ON	ON	ON	ON	OFF	OFF
@		40	64	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF
A		41	65	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF
B		42	66	OFF	ON	OFF	OFF	OFF	OFF	ON	OFF
C		43	67	ON	ON	OFF	OFF	OFF	OFF	ON	OFF
D		44	68	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF
E		45	69	ON	OFF	ON	OFF	OFF	OFF	ON	OFF
F		46	70	OFF	ON	ON	OFF	OFF	OFF	ON	OFF
G		47	71	ON	ON	ON	OFF	OFF	OFF	ON	OFF
H		48	72	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF
I		49	73	ON	OFF	OFF	ON	OFF	OFF	ON	OFF
J		4A	74	OFF	ON	OFF	ON	OFF	OFF	ON	OFF
K		4B	75	ON	ON	OFF	ON	OFF	OFF	ON	OFF
L		4C	76	OFF	OFF	ON	ON	OFF	OFF	ON	OFF
M		4D	77	ON	OFF	ON	ON	OFF	OFF	ON	OFF
N		4E	78	OFF	ON	ON	ON	OFF	OFF	ON	OFF
O		4F	79	ON	ON	ON	ON	OFF	OFF	ON	OFF
P		50	80	OFF	OFF	OFF	OFF	ON	OFF	ON	OFF
Q		51	81	ON	OFF	OFF	OFF	ON	OFF	ON	OFF
R		52	82	OFF	ON	OFF	OFF	ON	OFF	ON	OFF

CODE OPERATED SWITCH II

ARMING CHARACTER SWITCH POSITIONS

ASCII	CTRL	HEX	DECIMAL	LSB 1	2	3	4	5	6	7	MSB 8
S		53	83	ON	ON	OFF	OFF	ON	OFF	ON	OFF
T		54	84	OFF	OFF	ON	OFF	ON	OFF	ON	OFF
U		55	85	ON	OFF	ON	OFF	ON	OFF	ON	OFF
V		56	86	OFF	ON	ON	OFF	ON	OFF	ON	OFF
W		57	87	ON	ON	ON	OFF	ON	OFF	ON	OFF
X		58	88	OFF	OFF	OFF	ON	ON	OFF	ON	OFF
Y		59	89	ON	OFF	OFF	ON	ON	OFF	ON	OFF
Z		5A	90	OFF	ON	OFF	ON	ON	OFF	ON	OFF
[		5B	91	ON	ON	OFF	ON	ON	OFF	ON	OFF
\		5C	92	OFF	OFF	ON	ON	ON	OFF	ON	OFF
]		5D	93	ON	OFF	ON	ON	ON	OFF	ON	OFF
^		5E	94	OFF	ON	ON	ON	ON	OFF	ON	OFF
_		5F	95	ON	ON	ON	ON	ON	OFF	ON	OFF
`		60	96	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF
a		61	97	ON	OFF	OFF	OFF	OFF	ON	ON	OFF
b		62	98	OFF	ON	OFF	OFF	OFF	ON	ON	OFF
c		63	99	ON	ON	OFF	OFF	OFF	ON	ON	OFF
d		64	100	OFF	OFF	ON	OFF	OFF	ON	ON	OFF
e		65	101	ON	OFF	ON	OFF	OFF	ON	ON	OFF
f		66	102	OFF	ON	ON	OFF	OFF	ON	ON	OFF
g		67	103	ON	ON	ON	OFF	OFF	ON	ON	OFF
h		68	104	OFF	OFF	OFF	ON	OFF	ON	ON	OFF
i		69	105	ON	OFF	OFF	ON	OFF	ON	ON	OFF
j		6A	106	OFF	ON	OFF	ON	OFF	ON	ON	OFF
k		6B	107	ON	ON	OFF	ON	OFF	ON	ON	OFF
l		6C	108	OFF	OFF	ON	ON	OFF	ON	ON	OFF
m		6D	109	ON	OFF	ON	ON	OFF	ON	ON	OFF
n		6E	110	OFF	ON	ON	ON	OFF	ON	ON	OFF
o		6F	111	ON	ON	ON	ON	OFF	ON	ON	OFF
p		70	112	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF
q		71	113	ON	OFF	OFF	OFF	ON	ON	ON	OFF
r		72	114	OFF	ON	OFF	OFF	ON	ON	ON	OFF
s		73	115	ON	ON	OFF	OFF	ON	ON	ON	OFF
t		74	116	OFF	OFF	ON	OFF	ON	ON	ON	OFF
u		75	117	ON	OFF	ON	OFF	ON	ON	ON	OFF
v		76	118	OFF	ON	ON	OFF	ON	ON	ON	OFF
w		77	119	ON	ON	ON	OFF	ON	ON	ON	OFF
x		78	120	OFF	OFF	OFF	ON	ON	ON	ON	OFF
y		79	121	ON	OFF	OFF	ON	ON	ON	ON	OFF
z		7A	122	OFF	ON	OFF	ON	ON	ON	ON	OFF
{		7B	123	ON	ON	OFF	ON	ON	ON	ON	OFF
		7C	124	OFF	OFF	ON	ON	ON	ON	ON	OFF
}		7D	125	ON	OFF	ON	ON	ON	ON	ON	OFF
~		7E	126	OFF	ON	ON	ON	ON	ON	ON	OFF
DEL		7F	127	ON	ON	ON	ON	ON	ON	ON	OFF

ARMING CHARACTER SWITCH POSITIONS

ASCII	CTRL	HEX	DECIMAL	LSB 1	2	3	4	5	6	7	MSB 8
		80	128	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
		81	129	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON
		82	130	OFF	ON	OFF	OFF	OFF	OFF	OFF	ON
		83	131	ON	ON	OFF	OFF	OFF	OFF	OFF	ON
		84	132	OFF	OFF	ON	OFF	OFF	OFF	OFF	ON
		85	133	ON	OFF	ON	OFF	OFF	OFF	OFF	ON
		86	134	OFF	ON	ON	OFF	OFF	OFF	OFF	ON
		87	135	ON	ON	ON	OFF	OFF	OFF	OFF	ON
		88	136	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON
		89	137	ON	OFF	OFF	ON	OFF	OFF	OFF	ON
		8A	138	OFF	ON	OFF	ON	OFF	OFF	OFF	ON
		8B	139	ON	ON	OFF	ON	OFF	OFF	OFF	ON
		8C	140	OFF	OFF	ON	ON	OFF	OFF	OFF	ON
		8D	141	ON	OFF	ON	ON	OFF	OFF	OFF	ON
		8E	142	OFF	ON	ON	ON	OFF	OFF	OFF	ON
		8F	143	ON	ON	ON	ON	OFF	OFF	OFF	ON
		90	144	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON
		91	145	ON	OFF	OFF	OFF	ON	OFF	OFF	ON
		92	146	OFF	ON	OFF	OFF	ON	OFF	OFF	ON
		93	147	ON	ON	OFF	OFF	ON	OFF	OFF	ON
		94	148	OFF	OFF	ON	OFF	ON	OFF	OFF	ON
		95	149	ON	OFF	ON	OFF	ON	OFF	OFF	ON
		96	150	OFF	ON	ON	OFF	ON	OFF	OFF	ON
		97	151	ON	ON	ON	OFF	ON	OFF	OFF	ON
		98	152	OFF	OFF	OFF	ON	ON	OFF	OFF	ON
		99	153	ON	OFF	OFF	ON	ON	OFF	OFF	ON
		9A	154	OFF	ON	OFF	ON	ON	OFF	OFF	ON
		9B	155	ON	ON	OFF	ON	ON	OFF	OFF	ON
		9C	156	OFF	OFF	ON	ON	ON	OFF	OFF	ON
		9D	157	ON	OFF	ON	ON	ON	OFF	OFF	ON
		9E	158	OFF	ON	ON	ON	ON	OFF	OFF	ON
		9F	159	ON	ON	ON	ON	ON	OFF	OFF	ON
		A0	160	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON
		A1	161	ON	OFF	OFF	OFF	OFF	ON	OFF	ON
		A2	162	OFF	ON	OFF	OFF	OFF	ON	OFF	ON
		A3	163	ON	ON	OFF	OFF	OFF	ON	OFF	ON
		A4	164	OFF	OFF	ON	OFF	OFF	ON	OFF	ON
		A5	165	ON	OFF	ON	OFF	OFF	ON	OFF	ON
		A6	166	OFF	ON	ON	OFF	OFF	ON	OFF	ON
		A7	167	ON	ON	ON	OFF	OFF	ON	OFF	ON
		A8	168	OFF	OFF	OFF	ON	OFF	ON	OFF	ON
		A9	169	ON	OFF	OFF	ON	OFF	ON	OFF	ON
		AA	170	OFF	ON	OFF	ON	OFF	ON	OFF	ON
		AB	171	ON	ON	OFF	ON	OFF	ON	OFF	ON
		AC	172	OFF	OFF	ON	ON	OFF	ON	OFF	ON
		AD	173	ON	OFF	ON	ON	OFF	ON	OFF	ON

ARMING CHARACTER SWITCH POSITIONS

ASCII	CTRL	HEX	DECIMAL	LSB 1	2	3	4	5	6	7	MSB 8
		AE	174	OFF	ON	ON	ON	OFF	ON	OFF	ON
		AF	175	ON	ON	ON	ON	OFF	ON	OFF	ON
		B0	176	OFF	OFF	OFF	OFF	ON	ON	OFF	ON
		B1	177	ON	OFF	OFF	OFF	ON	ON	OFF	ON
		B2	178	OFF	ON	OFF	OFF	ON	ON	OFF	ON
		B3	179	ON	ON	OFF	OFF	ON	ON	OFF	ON
		B4	180	OFF	OFF	ON	OFF	ON	ON	OFF	ON
		B5	181	ON	OFF	ON	OFF	ON	ON	OFF	ON
		B6	182	OFF	ON	ON	OFF	ON	ON	OFF	ON
		B7	183	ON	ON	ON	OFF	ON	ON	OFF	ON
		B8	184	OFF	OFF	OFF	ON	ON	ON	OFF	ON
		B9	185	ON	OFF	OFF	ON	ON	ON	OFF	ON
		BA	186	OFF	ON	OFF	ON	ON	ON	OFF	ON
		BB	187	ON	ON	OFF	ON	ON	ON	OFF	ON
		BC	188	OFF	OFF	ON	ON	ON	ON	OFF	ON
		BD	189	ON	OFF	ON	ON	ON	ON	OFF	ON
		BE	190	OFF	ON	ON	ON	ON	ON	OFF	ON
		BF	191	ON	ON	ON	ON	ON	ON	OFF	ON
		C0	192	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
		C1	193	ON	OFF	OFF	OFF	OFF	OFF	ON	ON
		C2	194	OFF	ON	OFF	OFF	OFF	OFF	ON	ON
		C3	195	ON	ON	OFF	OFF	OFF	OFF	ON	ON
		C4	196	OFF	OFF	ON	OFF	OFF	OFF	ON	ON
		C5	197	ON	OFF	ON	OFF	OFF	OFF	ON	ON
		C6	198	OFF	ON	ON	OFF	OFF	OFF	ON	ON
		C7	199	ON	ON	ON	OFF	OFF	OFF	ON	ON
		C8	200	OFF	OFF	OFF	ON	OFF	OFF	ON	ON
		C9	201	ON	OFF	OFF	ON	OFF	OFF	ON	ON
		CA	202	OFF	ON	OFF	ON	OFF	OFF	ON	ON
		CB	203	ON	ON	OFF	ON	OFF	OFF	ON	ON
		CC	204	OFF	OFF	ON	ON	OFF	OFF	ON	ON
		CD	205	ON	OFF	ON	ON	OFF	OFF	ON	ON
		CE	206	OFF	ON	ON	ON	OFF	OFF	ON	ON
		CF	207	ON	ON	ON	ON	OFF	OFF	ON	ON
		D0	208	OFF	OFF	OFF	OFF	ON	OFF	ON	ON
		D1	209	ON	OFF	OFF	OFF	ON	OFF	ON	ON
		D2	210	OFF	ON	OFF	OFF	ON	OFF	ON	ON
		D3	211	ON	ON	OFF	OFF	ON	OFF	ON	ON
		D4	212	OFF	OFF	ON	OFF	ON	OFF	ON	ON
		D5	213	ON	OFF	ON	OFF	ON	OFF	ON	ON
		D6	214	OFF	ON	ON	OFF	ON	OFF	ON	ON
		D7	215	ON	ON	ON	OFF	ON	OFF	ON	ON
		D8	216	OFF	OFF	OFF	ON	ON	OFF	ON	ON
		D9	217	ON	OFF	OFF	ON	ON	OFF	ON	ON
		DA	218	OFF	ON	OFF	ON	ON	OFF	ON	ON
		DB	219	ON	ON	OFF	ON	ON	OFF	ON	ON
		DC	220	OFF	OFF	ON	ON	ON	OFF	ON	ON
		DD	221	ON	OFF	ON	ON	ON	OFF	ON	ON
		DE	222	OFF	ON	ON	ON	ON	OFF	ON	ON

ARMING CHARACTER SWITCH POSITIONS

ASCII	CTRL	HEX	DECIMAL	LSB 1	2	3	4	5	6	7	MSB 8
		DF	223	ON	ON	ON	ON	ON	OFF	ON	ON
		E0	224	OFF	OFF	OFF	OFF	OFF	ON	ON	ON
		E1	225	ON	OFF	OFF	OFF	OFF	ON	ON	ON
		E2	226	OFF	ON	OFF	OFF	OFF	ON	ON	ON
		E3	227	ON	ON	OFF	OFF	OFF	ON	ON	ON
		E4	228	OFF	OFF	ON	OFF	OFF	ON	ON	ON
		E5	229	ON	OFF	ON	OFF	OFF	ON	ON	ON
		E6	230	OFF	ON	ON	OFF	OFF	ON	ON	ON
		E7	231	ON	ON	ON	OFF	OFF	ON	ON	ON
		E8	232	OFF	OFF	OFF	ON	OFF	ON	ON	ON
		E9	233	ON	OFF	OFF	ON	OFF	ON	ON	ON
		EA	234	OFF	ON	OFF	ON	OFF	ON	ON	ON
		EB	235	ON	ON	OFF	ON	OFF	ON	ON	ON
		EC	236	OFF	OFF	ON	ON	OFF	ON	ON	ON
		ED	237	ON	OFF	ON	ON	OFF	ON	ON	ON
		EE	238	OFF	ON	ON	ON	OFF	ON	ON	ON
		EF	239	ON	ON	ON	ON	OFF	ON	ON	ON
		F0	240	OFF	OFF	OFF	OFF	ON	ON	ON	ON
		F1	241	ON	OFF	OFF	OFF	ON	ON	ON	ON
		F2	242	OFF	ON	OFF	OFF	ON	ON	ON	ON
		F3	243	ON	ON	OFF	OFF	ON	ON	ON	ON
		F4	244	OFF	OFF	ON	OFF	ON	ON	ON	ON
		F5	245	ON	OFF	ON	OFF	ON	ON	ON	ON
		F6	246	OFF	ON	ON	OFF	ON	ON	ON	ON
		F7	247	ON	ON	ON	OFF	ON	ON	ON	ON
		F8	248	OFF	OFF	OFF	ON	ON	ON	ON	ON
		F9	249	ON	OFF	OFF	ON	ON	ON	ON	ON
		FA	250	OFF	ON	OFF	ON	ON	ON	ON	ON
		FB	251	ON	ON	OFF	ON	ON	ON	ON	ON
		FC	252	OFF	OFF	ON	ON	ON	ON	ON	ON
		FD	253	ON	OFF	ON	ON	ON	ON	ON	ON
		FE	254	OFF	ON	ON	ON	ON	ON	ON	ON
		FF	255	ON	ON	ON	ON	ON	ON	ON	ON

3.7 Setting Global Characteristics with the Individual Banks

Several other system-wide options are specified not by the system switch banks, but rather by the eighth switch position of the individual port switch banks. Explanations and tables are given below.

Self-Test Function

NOTE

We recommend that you run software flow control from your application during self-test.

The COS II can perform a number of self-tests that check the memory, the LEDS, the DIP switches, the ports, and the interrupt circuitry of the Switch. More information about the self-tests is given in **Section 4.8**.

For	Set SWA 8
Normal operation	OFF
Self-test	ON

Sending or Suppressing Breaks

You can set the COS II either to pass break characters along or to block them from reaching your devices. SWB 8 controls this function.

To	Set SWB 8
Pass breaks	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 8K internal buffer of the Switch. The following table shows the behavior of the COS II for different combinations of devices.

Master	Slave	Leads passed
DTE	DTE	Master CTS to slave DTR
		Slave CTS to master DTR
DTE	DCE	Master CTS to slave CTS
		Slave DTR to master DTR
DCE	DTE	Master DTR to slave DTR
		Slave CTS to master CTS
DCE	DCE	Master DTR to slave CTS
		Slave DTR to master CTS

To pass or block leads, use SWC 8.

To	Set SWC 8
Pass leads	ON
To block leads	OFF

Text or Graphics Mode

SWD 8 and SWE 8 determine whether the COS II is in Graphics Mode or Text Mode. These same switches also govern the device that will signal the pause when the Switch is in Graphics Mode. (For more information on Text and Graphics Modes, see **Sections 4.4** and **4.5**).

When set for graphics, the COS II can register (1) only pauses in data coming from the master port, (2) only pauses in data coming from a slave port, (3) or pauses in data from all ports, either master or slave. Use ththis chart to configure the switch properly:

For	Set SWD 8	Set SWE 8
Text Mode	OFF	OFF
Graphics Mode, pause from master	ON	ON
Graphics Mode, pause from slave	OFF	ON
Graphics Mode, pause from either	ON	OFF

3.8. Configuring Ports for DTE or DCE

A pair of DIP shunts lies behind each DB25 connector on both the main board and the Expansion Unit. The pair eliminates the need for crossover cable to connect devices to the Switch. You can use standard straight-through cable may be used instead, with the DIP shunts acting as crossovers.

A shunt jumper lies in each shunt marked DCE. To change the port configuration to DTE, just pry the jumper gently from its current shunt, and insert it in the DTE DIP shunt.

The chart below provides the signal direction for the main RS-232 lines.

Configured as DTE Port	Signal direction	Configured as DCE Port
TXD (2)	Output from unit	RXD(3)
RXD (3)	Input to unit	TXD (2)
RTS (4)	Output from unit	DCD (8)
CTS (5)	Input to unit	DTR (20)
N/A	Output from unit	DSR (6)
DCD (8)	Input to unit	RTS (4)
DTR (20)	Output from unit	CTS (5)
RI (22)	Input to unit	N/A

3.9. Connecting and Powering Up the COS-II

Once you have configured the internal switches and jumpers, you can connect your devices and the wallmounted power jack to the COS-II. Before you begin, you might wish to check the settings of all the DIP switches again, to make sure you have set them correctly.

To prepare the COS-II:

1. Make sure that SWA 8 is set to OFF, that is, to normal operation.

2. Insert the 4-pin power-supply plug in the power-supply socket (at J1) on the COS-II circuit board.

3. Slide the cover back onto the base of the COS-II, and secure it with the screws.

4. Connect the device cables to the ports.

5. Plug the wallmounted power supply into a standard AC line.

Before you use the COS-II, you might wish to familiarize yourself with the indicators, reset button, and self-tests available. **Chapter 4** explains these features.

4. Operation

4.1. Introduction

The primary action of the Switch consists of detecting and responding to control-code sequences. As it switches to a particular port, the COS-II establishes a link between the master and the slave device. After the COS-II has switched, it can lock the link out, that is, it can ignore all requests by other ports until the link is broken.

The linking and locking capabilities of the COS-II have been covered briefly in **Chapter 3**. If you are familiar with them, you can go on to **Sections 4.4** through **4.8**, which cover the modes, indicators, the front-panel button, and the self-test feature. If, however, you need information on linking and locking, read **Sections 4.2** and **4.3**.

4.2. Creating a Link

The COS-II creates a link between the master port and a slave port when it receives a sequence of characters called a control-code sequence. It may receive these characters from the master port, a slave port, or both types of ports.

The control-code sequence consists of two characters: an arming character, and a port-select character. The arming character warns the Switch of an impending switch action, and the port-select character specifies the port. ASCII values 0 through 3 (0 through 7 when the Expansion Board is added) are used for the port-select character, while any character within the extended ASCII character set may be used for arming.

After a link has been established, the COS-II begins a timeout countdown. If the COS-II is idle for 2.5, 5, or 10 minutes (you set the timing), it will return to an unlinked state and disconnect from the current port. The timeout can be disabled, and the COS-II will then remain connected to the last linked port indefinitely.

The origin of the link command (from master or slave ports), the arming character, and the length of the timeout are all determined with DIP switches. To set them, turn to **Section 3.6**.

4.3 Signaling a Lock

After a link has been established, all other ports can be blocked from accessing the master port with a lock command. Only the master port and the linked subordinate port can put the COS-II in lockout, or bring it out of lockout.

To put the COS-II in lockout, send the arming character and the ASCII character with a value of 38 in hexadecimal—ASCII Numeral 8. To take the unit out of lockout, send the arming character followed by an ASCII character with a value of 39 in hexadecimal—ASCII Numeral 9. When the COS-II exits lockout, it will break the current link.

4.4. Text Mode

In this mode, the COS-II is activated as soon as it receives a control-code sequence. If auto-timeout has been selected, it will start its internal timer. The text that follows will pass through until another arming character appears within. Depending on the character that appears next, the COS-II will either place itself in lockout, or switch to another port.

The DIP switch setting for Text Mode is given in **Section 3.7**.

4.5. Graphics Mode

In this mode the COS-II will ignore appearances of the control-code sequence unless they are preceded by a pause of a certain length. Any arming character that appears without the pause will be treated as data.

The pause may be measured from:
   •the time the last character was sent from the master port to the slave port;
   •the time the last character was sent from the slave port to the master port;
   • or the time the last character was sent in either direction.

Settings for graphics are given in **Section 3.7**.

4.6. Indicators

The front panel of the Switch contains 10 LEDs. The Power LED, at the extreme right, will glow steadily when power is on. The Lockout LED, a green LED at the extreme left, will light when the unit is in lockout.

Each of the eight port LEDs, numbered 0 through 7, will respond to the action of the COS II. When the master port is switched to one of the slaves, the corresponding LED will glow continuously.

4.7. Front-Panel Button

The reset button is located on the front panel of the COS-II. After you change one of the DIP switches, you must reset the COS-II either by pressing the button or by disconnecting power from the unit.

4.8. Self-Tests

The COS-II can diagnose a variety of conditions with an array of self-tests. To configure the switch for a self-test, set the eighth switch of DIP Switch A to ON.

To run a test, follow these steps:

1. Set SWA 8 (the eighth DIP switch of Bank A) to ON.   2. Set the master port to DCE with a shunt jumper.
3. Set your terminal for 9600-bps operation, with 1 stop bit and no parity.
4. Power the unit.

This message will appear on your screen:

If you select R, the COS II will run any of the tests

```
CODE OPERATED SWITCH II SELF TEST

RUN TESTS (R)EPEATEDLY OR (O)NCE
```

you request again and again, until you press the reset button.

If you select "O," you get the message:

Explanations and screens for all of these tests are

```
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
```

given below.

RAM Test

```
RAM TEST 8K RAM IS GOOD
```

The RAM test checks the internal memory of the Switch by writing an internal test pattern, and then reading it for accuracy.

LED Test

```
LED TEST IN PROGRESS, ALL LEDS SHOULD TURN ON AND
OFF. PRESS ANY KEY TO EXIT.
```

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 if the LEDs are working normally or whether any are shorted.

DIP Switch Test

```
DIP SWITCH TEST (MAIN BOARD) HIT ANY KEY TO GO TO
NEXT TEST
SWITCHES ARE DISPLAYED IN BINARY (0=OFF, 1=ON)
SWD          SWE          SWF              SWG
00010001     00100100     10001000         01010101
```

The DIP Switch Test reads the switches and displays their settings on the screen. This test tells you whether the switches and associated circuitry are operating normally and are set up to your specifications. The settings will be displayed on screen continuously until a key is pressed. When you press any key, the box will check the settings of the Expansion Board switches. If you haven't installed a Board, disregard the reading.

```
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)
SWH          SWI          SWJ              SWK
00010001     00100100     10001000         01010101
```

After you have hit a key, the screen will change to:

Serial Port Test

```
SERIAL PORT TEST (EXPANSION BOARD IS NOT INSTALLED)


PORT#          DATA          DTR/CTS/RI          RTS/DCD
MASTER         *             FAILED              FAILED
PORT 0         FAILED        FAILED              FAILED
PORT 1         FAILED        FAILED              FAILED
PORT 2         FAILED        FAILED              FAILED
PORT 3         FAILED        FAILED              FAILED
SERIAL PORT TEST FAILED
```

The Serial Port Test is a loopback test that checks whether data is being correctly transmitted and received on any port. The test also checks, using DTR/CTS/RI or RTS/DCD, whether the box can loop back control leads correctly. To use this test, you will need to jumper Pins 2 and 3. To test DTR/CTS/RI and RTS/DCD, you'll need to jumper Pins 20, 5, and 22 together, and jumper Pins 4 and 8 together.

Interrupt Test

```
INTERRUPT TEST IN PROGRESS
A
INTERRUPT TEST PASSED
```

The Interrupt Test checks the interrupt circuitry of the unit. During this test, the letter "A" will appear on screen. A message will indicate whether the test was successful.

All Tests

If you request All Tests, the COS-II will run all the listed tests in sequence.

Quick Reference Guide

Individual Port Switch Bank Settings

Option	Switch Position Setting						
	1	2	3	4	5	6	7
Speed							
110 bps	ON	ON	ON				
300 bps	OFF	ON	ON				
600 bps	ON	OFF	ON				
1200 bps	OFF	OFF	ON				
2400 bps	ON	ON	OFF				
4800 bps	OFF	ON	OFF				
9600 bps	ON	OFF	OFF				
19200 bps	OFF	OFF	OFF				
Parity							
none				OFF	OFF		
even				OFF	ON		
odd				ON	OFF		
Word Size							
7 bits per word						OFF	
8 bits per word						ON	
Flow Control							
Hardware (DTR/CTS)							ON
Software (X-ON/X-OFF)							OFF

Settings for Switch Option F

Option	Switch Position Setting							
	1	2	3	4	5	6	7	8
Link from master	ON	ON						
" " from slave	OFF	ON						
" " from either	ON or OFF	OFF						
Time Out								
2.5 minutes					ON	ON		
5 minutes					OFF	ON		
10 minutes					ON	OFF		
Disabled					OFF	OFF		
Graphics Pause								
50 milliseconds							ON	ON
100 milliseconds							OFF	ON
500 milliseconds							ON	OFF
1.5 second							OFF	OFF

System Switch Options Available through Position 8

Option	Switch				
	SWA 8	SWB 8	SWC 8	SWD 8	SWE 8
Self-test	ON				
Normal operation	OFF				
Pass breaks		ON			
Ignore breaks		OFF			
Lead pass-through			ON		
Normal operation			OFF		
Graphics Mode					
Pause In					
Master Data				ON	ON
Slave Data			OFF	ON	
Master or slave data				ON	OFF
Text Mode				OFF	OFF

BLACK BOX®

NETWORK SERVICES