

# **KB232E**

PS/2 Keyboard  
RS-232 Adapter  
Part # SA0018  
(Version 3.0)



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**L3 Systems, Inc.**  
**Redmond**

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# Quick Reference

Command	Notes
<b>C</b>  Displays Configuration String	Field 1 = Terminal emulation: Simple, <u>I</u> TY, <u>P</u> C, <u>A</u> NSI, or <u>V</u> T  Field 2 = Baud Rate <u>9</u> 600, <u>4</u> 800, <u>2</u> 400, or <u>1</u> 200. <u>9</u> 600 is default  Field 3 = Parity <u>E</u> ven, <u>E</u> 8, <u>O</u> dd. <u>O</u> 8 or <u>N</u> o Par (default)  Field 4 = Keyboard LED Settings 1 <sup>st</sup> : " <u>D</u> " = OFF/enabled, " <u>N</u> " = ON/enabled " <u>D</u> " = Disabled. " <u>E</u> " = ON/disabled " <u>A</u> " = NL on, LED on " <u>a</u> " = NL on, LED off 2 <sup>nd</sup> : " <u>C</u> " = OFF/enabled, " <u>C</u> " = ON/enabled " <u>D</u> " = Disabled. " <u>E</u> " = ON/disabled  Field 5 = Repeat Delay <u>0</u> = 250 Milliseconds, <u>1</u> =500, <u>2</u> =750, <u>3</u> =1000 Default = <u>2</u> (750 milliseconds)  Field 6 = Repeat rate (00 to31) <u>0</u> = 2/sec <u>31</u> =30/sec, Default is <u>20</u> (15/sec)
<b>CW=&lt;string&gt;</b>	Write Configuration String
<b>D</b>	Set Configuration string to default: "Simple,9600,No Par,Leds,2,20"
<b>Lkk=aa,bb...</b>	Loads custom key code for "aa" as ASCII hex values aa,bb...
<b>P</b>	Print Custom Key Codes
<b>E</b>	Erase Custom Scan Codes
<b>H</b>	Displays Help Message
<b>V</b>	Displays Version
<b>T</b>	Test Keyboard Interface

# **Introduction**

The KB232E PS/2 Keyboard RS-232 adapter allows a PS/2 style keyboard to be connected to an RS-232 port of a computer or other equipment using RS-232 communications. This allows the use of a standard "PC" type keyboard for embedded applications that only have RS-232 interfaces.

## **Power considerations**

The KB232E receives power from the RS-232 inputs "DTR" on pin 4 and "CTS" on pin 7 of the DB9-S RS-232 connector. Typically there is enough power from the RS-232 signals to allow the keyboard to operate. However, the Caps Lock and Num Lock LED's may require more power than the RS-232 port can provide. If this is the case there are three possible solutions:

The first solution is to use the "CW=" command to change the KB232E configuration to not turn on LED's and thus saving power. (See pages 5 and 6 for more information on setting configuration values.) Some keyboards can

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operate if one LED is active, but not two. The "CW=" command allows you to disable both the Caps Lock and Num Lock LED's or just one of them. Note that if you disable a Caps Lock or Num Lock LED, the key still will operate to modify the characters sent.

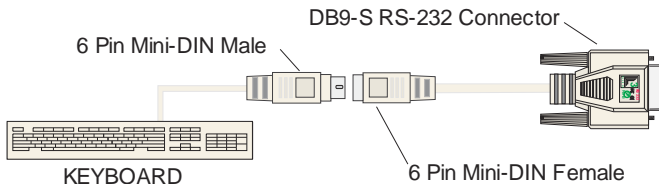
The second solution is to use a 9 Volt or 12 Volt DC power supply to power the keyboard and adapter. You can attach +9V or +12V power supply by connecting the plus voltage to pin 7, and ground (or Return) to pin 5 of the RS-232 connector. ***(Caution: make sure that the DC positive voltage (pin 7) is not connected to pin 7 of the RS-232 port of the equipment to which you are connecting.)***

The third solution is to use a keyboard that uses less power. L3 Systems sells a keyboard which will work on many RS-232 connections. This is available with the KB232E RS-232 Keyboard kit.

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### Connections



### **KB232E RS-232 Serial Port Connector**

The KB232E adapter uses a standard RS-232 9-Pin female “D” connector that can connect directly to a “PC” computer’s serial port. The KB232E can power itself and the attached keyboard using active DTR and CTS signals on pins 4 and 7 of the connector. However, those signals may not provide adequate power, in which case +9VDC or +12VDC power may have to be provided on one of those pins in place of the DTR or CTS signals.

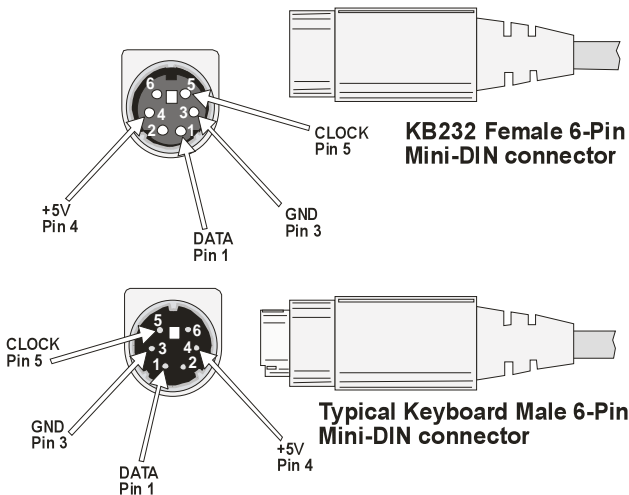
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Pin	Signal	KB232E Function
1	Chassis Gnd	
2	RX (Receive) from KB232E	RS-232 Output
3	TX (Transmit) to KB232E	RS-232 Input
4	DTR or 9-12V DC Power	RS-232 Input (Used to power the KB232E Adapter)
5	Signal Ground	Ground
7	CTS or 9-12V DC Power	RS-232 Input (Used to power the KB232E Adapter)

## KB232E Mini-DIN Connector

The following connector shows the pin definitions for the KB232E Female 6-Pin Mini-DIN connector and the mating keyboard Male 6-Pin Mini-DIN Connector.



### Testing the RS-232 Communications

The KB232E RS-232 Keyboard Adapter comes setup with RS-232 communications of 9600 baud, 8 data bits, 1 stop bit and no parity. This can be changed, but the first time you talk to the KB232E you must use this setting.

To verify the KB232E interface, we suggest using a serial terminal program such a Tera Term, Kermit, Hyperterm, Procomm, etc. After setting the appropriate baud rate and bit frame, each time you type an **<ENTER>** key should elicit a ":" response:

```
:<ENTER>  
:
```

### Testing Keyboard Operation

If you have verified the RS-232 communications, you should be able to type on the attached keyboard and see characters. Type the keys "A" "B:" and "C" on keyboard and you should see the corresponding lower-case letters echoed:

```
:abc
```



### Commands

The KB232E Adapter comes with a small set of commands that can be sent through the RS-232 port to configure operation. Typing "H<Enter>" on the RS-232 terminal will list the commands that can be entered:

```
:h<Enter>  
Commands  
-----  
C-Show Config String  
C<string>-Load Config <String>  
D-Set Default Config  
E-Erase Custom Scan Codes  
H-Help Screen  
Lkk=aa,bb... Load scan code  
P-Print Custom Scan Codes  
T-Keyboard Test  
V-Version  
:
```

### “C” Configuration Command

The “C” configuration command allows you to display configuration settings. Just typing “C<Enter>” on the RS-232 terminal will display the configuration string. Below is the “C” command showing the configuration string as shipped with a new KB232E adapter:

```
:C<Enter>  
Simple,9600,No Par,nc,2,20  
:
```

The configuration string is in the following format:

<Emulation><Baud><Parity><LEDs><Repeat Delay><Repeat Rate>

**Emulation** – Terminal emulation setting:

“**Simple**” – Simple keyboard, no arrows, function or special keys, ie. Home, PgUp, PgDn. (default)

“**TTY**” – ASCII keyboard, ASCII arrows, but no function keys or special keys such as Home, End, PgUp, PgDn.

“**PC**” – PC Terminal with arrows, function & special keys

“**ANSI**” – ANSI Terminal, with arrows, function & special keys

“**VT**” – VT220/320 Terminal, w/ arrows, function & special keys. *Note: Only first character (underlined) needed*

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**Baud Rate** – Values are “9600” (default), “4800”, “2400” & “1200”. (Only 2 digits needed).

**Parity** – Valid values are:

- “**NoPar**” – No parity, 8 bit data (default)
- “**Even**” – Even parity, 7 bit data
- “**E8**” – Even parity, 8 bit data
- “**Odd**” – Odd parity, 7 bit data
- “**O8**” – Odd parity, 8 bit data (1<sup>st</sup> character is the letter O)

**LEDs** – Keyboard LED indicator operation.

**1st character:**

- “**n**” – Num Lock LED toggles, initially off (default)
- “**N**” – Num Lock LED toggles, initially on
- “**D**” – Num Lock LED disabled
- “**E**” – Num Lock LED disabled, but Num Lock Keys ON
- “**A**” – Num Lock LED always on, Number pad always on
- “**a**” – Num Lock LED always off, Number pad always on

**2nd character:**

- “**c**” – Caps Lock LED enabled, initially off (default)
- “**C**” – Caps Lock LED enabled, initially on
- “**D**” – Caps Lock LED disabled
- “**E**” – Caps Lock LED disabled, but Caps Lock Keys ON

**Repeat Delay** – Delay before a key repeats

“0” – 250ms, “1” – 500ms, “2” – 750ms, “3” – 1000ms.

**Repeat Rate** – Keyboard key repeat rate. Values are from “00” (slowest, 2/second) to “31” (fastest, 30/second). “D” disables repeating keys.

### “CW” Configuration Write Command

You can use the “C” configuration command to set options described on the previous page. To do this you type the C command with a string that has parameters in the same order as displayed:

CW=<Emulation><Baud><Parity><LEDs><Repeat  
Delay><Repeat Rate>

Below is an example loading the same values as the default settings with the minimum characters:

```
:CW=S,96,n,nc,2,20<Enter>
```

You can then display the string loaded:

```
:C<Enter>  
S,96,n,nc,2,20  
:
```

### “D” Set Default Configuration values

The “D” command sets the configuration values to the default settings:

```
:D<Enter>
```

You can display the default configuration string:

```
:C<Enter>  
Simple,9600,No Par,Leds,2,20  
:
```

### “V” Display Version

The “V” command displays the version information of the KB232E program.

```
:V<ENTER>  
KB232E, Version 3.0x0, [C] L3 Systems, Inc.  
2003  
:
```

### “L” Load Key Code Table

The “L” command allows you to specify what ASCII characters are sent when a key is struck. The format of the command is:

Lkk=aa,bb,cc...

The easiest way to explain this command is by an example. For this example we'll make the F1 key send “Hello”. First you need to find the key code for the keyboard key you want to load in the ASCII key table on pages 15-19. The F1 key is “05”. Then you need to find the ASCII codes for “Hello” in the ASCII hexadecimal chart on page 20. The ASCII codes for “Hello” are 48, 65, 6C, 6C and 6F. The following command would add a look-up for the F1 key to the key code table:

```
:L05=48,65,6C,6C,6F<Enter>  
:
```

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If the first byte of the ASCII bytes is between 81 and 86, this signifies that modifier key(s) SHIFT, CTRL and/or ALT are required:

81=SHIFT 82=CTRL 84=ALT 83=SHIFT & CTRL  
85=SHIFT & ALT 86=CTRL & ALT

To load the ALT-F2 key to send "Bye":

```
:L06=84,42,79,65<Enter>  
:
```

You can also use the LW command to make a key not send anything. To do this, just don't put any bytes after the equal sign. The following example prevents the Esc key from sending any characters:

```
:L01=<Enter>  
:
```

### "P" Print Key Code Table

The "P" command outputs the custom key code table loaded with the "L" command. This example shows the key codes loaded above:

```
:P<Enter>  
KC Bytes  
--  
05 48 65 6C 6C 6F          ← F1 key sends "Hello"  
06 84 42 79 65            ← ALT-F2 key sends "Bye"  
01 00                      ← Esc key sends nothing  
:
```

### “E” Erase Key Code Table

“E” Erases the Key Code Table. The following shows the “E” command followed by “P” command showing the empty table.

```
:E<ENTER>
:P<Enter>
KC Bytes
-- -----
:
```

### “T” Test Keyboard

The “T” command runs a test on the keyboard interface which cycles the LED indicators in a pattern. It outputs a “.” each it changes the indicator pattern, and when done says “OK” indicating success, or “No Keyboard?” if it has a problem.

```
:T<ENTER>
.....
OK   or   No Keyboard?
:
```

### Emulation settings

The "CW" (Configuration Write) command allows you to specify an emulation setting. Available selections are commonly used ASCII terminal emulations which support the non-ASCII keys on the keyboard. The ASCII key table on the next page shows the ASCII characters sent for each emulation type: "Simple", "TTY", "PC", "ANSI" and "VT". If these emulations don't exactly match your needs, pick the one that comes closest and then use the LW command to map or re-map the keys to be what you need.



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### ASCII Key Table

NN/SS NN=non-shifted, SS=Shifted

Key Code	KEY	Emulation: Hex ASCII Characters sent				
		Simple	TTY	PC	ANSI	VT
66	<b>BS</b>	08	08	08	08	08
0D	<b>Tab</b>	09	09	09	09	09
5A	<b>Enter</b>	0D	0D	0D	0D	0D
76	<b>ESC</b>	1B	1B	1B	1B	1B
29	<b>Space</b>	20	20	20	20	20
52	<b>' / "</b>	27/22	27/22	27/22	27/22	27/22
41	<b>, / &lt;</b>	2C/3C	2C/3C	2C/3C	2C/3C	2C/3C
4E	<b>- / _</b>	2D/5F	2D/5F	2D/5F	2D/5F	2D/5F
49	<b>. / &gt;</b>	2E/3E	2E/3E	2E/3E	2E/3E	2E/3E
4A	<b>// ?</b>	2F/3F	2F/3F	2F/3F	2F/3F	2F/3F
45	<b>0 / )</b>	30/29	30/29	30/29	30/29	30/29
16	<b>1 / !</b>	31/21	31/21	31/21	31/21	31/21
	<b>2 /</b>					
1E	<b>@</b>	32/40	32/40	32/40	32/40	32/40
26	<b>3 / #</b>	33/23	33/23	33/23	33/23	33/23
25	<b>4 / \$</b>	34/24	34/24	34/24	34/24	34/24
2E	<b>5 / %</b>	35/25	35/25	35/25	35/25	35/25
36	<b>6 / ^</b>	36/5E	36/5E	36/5E	36/5E	36/5E
3D	<b>7 / &amp;</b>	37/26	37/26	37/26	37/26	37/26
3E	<b>8 / *</b>	38/2A	38/2A	38/2A	38/2A	38/2A
46	<b>9 / (</b>	39/28	39/28	39/28	39/28	39/28
4C	<b>; / :</b>	3B/3A	3B/3A	3B/3A	3B/3A	3B/3A
55	<b>= / +</b>	3D/2B	3D/2B	3D/2B	3D/2B	3D/2B

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### ASCII Key Table (cont) **NN**/**SS** **NN**=non-shifted, **SS**=Shifted

Key Code	KEY	Emulation: Hex ASCII Characters sent				
		Simple	TTY	PC	ANSI	VT
1C	<b>A</b>	61/41	61/41	61/41	61/41	61/41
32	<b>B</b>	62/42	62/42	62/42	62/42	62/42
21	<b>C</b>	63/43	63/43	63/43	63/43	63/43
23	<b>D</b>	64/44	64/44	64/44	64/44	64/44
24	<b>E</b>	65/45	65/45	65/45	65/45	65/45
2B	<b>F</b>	66/46	66/46	66/46	66/46	66/46
34	<b>G</b>	67/47	67/47	67/47	67/47	67/47
33	<b>H</b>	68/58	68/58	68/58	68/58	68/58
43	<b>I</b>	69/49	69/49	69/49	69/49	69/49
3B	<b>J</b>	6A/4A	6A/4A	6A/4A	6A/4A	6A/4A
42	<b>K</b>	6B/4B	6B/4B	6B/4B	6B/4B	6B/4B
4B	<b>L</b>	6C/4C	6C/4C	6C/4C	6C/4C	6C/4C
3A	<b>M</b>	6D/4D	6D/4D	6D/4D	6D/4D	6D/4D
31	<b>N</b>	6E/4E	6E/4E	6E/4E	6E/4E	6E/4E
44	<b>O</b>	6F/4F	6F/4F	6F/4F	6F/4F	6F/4F
4D	<b>P</b>	70/50	70/50	70/50	70/50	70/50
15	<b>Q</b>	71/51	71/51	71/51	71/51	71/51
2D	<b>R</b>	72/52	72/52	72/52	72/52	72/52
1B	<b>S</b>	73/53	73/53	73/53	73/53	73/53
2C	<b>T</b>	74/54	74/54	74/54	74/54	74/54
3C	<b>U</b>	75/55	75/55	75/55	75/55	75/55
2A	<b>V</b>	76/56	76/56	76/56	76/56	76/56
1D	<b>W</b>	77/57	77/57	77/57	77/57	77/57
22	<b>X</b>	78/58	78/58	78/58	78/58	78/58

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### ASCII Key Table (cont) NN/SS NN=non-shifted, SS=Shifted

Key Code	KEY	Emulation: Hex ASCII Characters sent				
		Simple	TTY	PC	ANSI	VT
35	Y	79/59	79/59	79/59	79/59	79/59
1A	Z	7A/5A	7A/5A	7A/5A	7A/5A	7A/5A
54	[ / {	5B7B	5B7B	5B7B	5B7B	5B7B
5B	] / }	5D7D	5D7D	5D7D	5D7D	5D7D
5D	\ /	5C7C	5C7C	5C7C	5C7C	5C7C
0E	` / ~	60/7E	60/7E	60/7E	60/7E	60/7E
05	F1			00 3B	1B 4F 50	1B 5B 31 31 7E
06	F2			00 3C	1B 4F 51	1B 5B 31 32 7E
04	F3			00 3D	1B 4F 52	1B 5B 31 33 7E
0C	F4			00 3E	1B 4F 53	1B 5B 31 34 7E
03	F5			00 3F	1B 4F 54	1B 5B 31 35 7E
0B	F6			00 40	1B 4F 55	1B 5B 31 37 7E
0F	F7			00 41	1B 4F 56	1B 5B 31 38 7E
0A	F8			00 42	1B 4F 57	1B 5B 31 39 7E
01	F9			00 43	1B 4F 58	1B 5B 32 30 7E

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### ASCII Key Table (cont) NN/SS NN=non-shifted, SS=Shifted

Key Code	KEY	Emulation: Hex ASCII Characters sent				
		Simple	TTY	PC	ANSI	VT
09	<b>F10</b>			00 44	1B 4F 59	1B 5B 32 31 7E
78	<b>F11</b>			00 85		1B 5B 32 38 7E
07	<b>F12</b>			00 86		1B 5B 32 39 7E
60	<b>Pad 0</b>	30	30	30	30	30
61	<b>Pad 1</b>	31	31	31	31	31
62	<b>Pad 2</b>	32	32	32	32	32
63	<b>Pad 3</b>	33	33	33	33	33
64	<b>Pad 4</b>	34	34	34	34	34
65	<b>Pad 5</b>	35	35	35	35	35
67	<b>Pad 6</b>	36	36	36	36	36
68	<b>Pad 7</b>	37	37	37	37	37
6A	<b>Pad 8</b>	38	38	38	38	38
6D	<b>Pad 9</b>	39	39	39	39	39
6F	<b>Pad /</b>	2F	2F	2F	2F	2F
7C	<b>Pad *</b>	2A	2A	2A	2A	2A
7B	<b>Pad -</b>	2D	2D	2D	2D	2D
79	<b>Pad +</b>	2B	2B	2B	2B	2B
6E	<b>Pad .</b>	2E	2E	2E	2E	2E

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### ASCII Key Table (cont) NN/SS NN=non-shifted, SS=Shifted

Key Code	KEY	Emulation: Hex ASCII Characters sent				
		Simple	TTY	PC	ANSI	VT
70	<b>Insert</b>			00 52	1B 5B 40	1B 5B 48
71	<b>Delete</b>	7F	7F	7F	7F	7F
6C	<b>Home</b>			00 47	1B 5B 48	1B 5B 48
69	<b>End</b>			00 4F	1B 4F 46	1B 5B 31 7E
7D	<b>PgUp</b>			00 49	1B 5B 56	1B 5B 35 7E
7A	<b>PgDn</b>			00 51	1B 5B 55	1B 5B 36 7E
75	<b>Up Arrow</b>		0B	00 48	1B 5B 41	1B 5B 41
72	<b>Dn Arrow</b>		0A	00 50	1B 5B 42	1B 5B 42
74	<b>Rt Arrow</b>		09	00 4D	1B 5B 43	1B 5B 43
6B	<b>Lt Arrow</b>		08	00 48	1B 5B 44	1B 5B 44
4F	<b>Prn Scrn</b>					
5F	<b>Pause</b>					
1F	<b>Lt Win</b>					
27	<b>Rt Win</b>					
2F	<b>Menu</b>					
37	<b>Power</b>					
3F	<b>Sleep</b>					
5E	<b>Wake Up</b>					
77	<b>Num-Lock</b>					
58	<b>Caps-Lock</b>					
	<b>Turbo</b>	This is a local function only. Hold Turbo & press F1 (slowest), F2, F3...F7 (fastest) to adjust key repeat rate.				

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## ASCII Hexadecimal Chart

Char	Hex	Char	Hex	Char	Hex	Char	Hex	Char	Hex
NUL ^@	00	SUB ^Z	1A	4	34	N	4E	h	68
SOH ^A	01	ESC ^[	1B	5	35	O	4F	i	69
STX ^B	02	FS ^\	1C	6	36	P	50	j	6A
ETX ^C	03	GS ^]	1D	7	37	Q	51	k	6B
EOT ^D	04	RS ^^	1E	8	38	R	52	l	6C
ENQ ^E	05	US ^_	1F	9	39	S	53	m	6D
ACK ^F	06	SP	20	:	3A	T	54	n	6E
BEL ^G	07	!	21	;	3B	U	55	o	6F
BS ^H	08	"	22	<	3C	V	56	p	70
TAB ^I	09	#	23	=	3D	W	57	q	71
LF ^J	0A	\$	24	>	3E	X	58	r	72
VT ^K	0B	%	25	?	3F	Y	59	s	73
FF ^L	0C	&	26	@	40	Z	5A	t	74
CR ^M	0D	'	27	A	41	[	5B	u	75
SO ^N	0E	(	28	B	42	\	5C	v	76
SI ^O	0F	)	29	C	43	]	5D	w	77
DLE ^P	10	*	2A	D	44	^	5E	x	78
DC1 ^Q	11	+	2B	E	45	_	5F	y	79
DC2 ^R	12	,	2C	F	46	`	60	z	7A
DC3 ^S	13	-	2D	G	47	a	61	{	7B
DC4 ^T	14	.	2E	H	48	b	62		7C
NAK ^U	15	/	2F	I	49	c	63	}	7D
SYN ^V	16	0	30	J	4A	d	64	~	7E
ETB ^W	17	1	31	K	4B	e	65	Del	7F
EM ^X	18	2	32	L	4C	f	66		
SUB ^Y	19	3	33	M	4D	g	67		

## SPECIFICATIONS

<b>Connector: RS-232</b>	DB9-S
<b>Connector: PS/2 Keyboard</b>	6-Pin Mini-DIN, Female
<b>Cable Length</b>	5 inches
<b>Power: w/o Keyboard</b>	10ma Max, .7-12VDC
<b>FCC Approval</b>	Class B
<b>Hazardous Material Rating</b>	RoHS, Lead Free
<b>Temperature</b>	0-50°C (32-120°F)

***Warranty:*** L3 Systems guarantees this product to be free of defects in material and workmanship for 180 days from date of shipment to the end user. L3 Systems will repair or replace (at our option) products within the warranty period at no charge for parts and labor. All returns must obtain a Return of Merchandise Authorization number (RMA) available on request from L3 Systems. Shipping costs (plus customs and duty, if any) to and from L3 Systems must be paid by the user. Damage or defect caused by accident, misuse or neglect is not covered. Damage or defect caused by shipping is excluded. L3 Systems shall not be liable for any consequential damage or losses from the use of, or inability to use its products. Any unauthorized repair or modification of the product voids the warranty. L3 Systems makes no other warranty, express or implied, nor have we authorized anyone to make representations to the contrary.

# KB232E RS-232 Keyboard Adapter



The KB232E RS-232 Keyboard Adapter allows you to attach a PS/2 style keyboard to an RS-232 port.

- ❖ **Translates PS/2 Keyboard Keys to ASCII** – Keys translated to ASCII characters.
- ❖ **Repeat/Delay Configurable** - Keyboard repeat delay and repeat rate can be configured.
- ❖ **Caps Lock and Num Lock Keys** - Caps Lock and Num Lock keys operate as expected.
- ❖ **Five Emulation Modes** – These allow emulation of common ASCII terminal equipment.
- ❖ **Flexible RS-232 settings** - Baud rates of 9600 (default), 4800, 2400 and 1200 baud.
- ❖ **Custom keyboard mappings** - Custom keyboard mappings can be loaded to change the ASCII characters assigned to keyboard keys. These are stored in non-volatile flash memory.
- ❖ **Draws power from RS-232** - The KB232E can be powered from RS-232 control signals to work without any other power source.

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