PS/2 Keyboard Communication & Scan Code Sets For USAR's PS/2 KeyCoders™

Overview

The PS/2 protocol was developed by IBM. In 1987, IBM ceased to support the standard. Nonetheless, the protocol is still widely used today. Relatively simple and inexpensive, the PS/2 standard's main drawback is its limited scope. A few things have changed in the input device subsystem since 1987. For this reason, many keyboard manufacturers have been forced to add their own extensions to the protocol. This has resulted in an occasional compatibility problem, most notably in implementations of an external PS/2 mouse and keyboard port.

USAR has also developed proprietary extensions to the PS/2 protocol for both its MouseCoder™ and KeyCoder™ products. However, these extensions do not conflict with the original specification and therefore do not cause any compatibility problems.

This document provides some cursory data on the PS/2 protocol in regards to the keyboard subsystem. For more detailed information, please refer to the IBM Technical Reference Manuals.

PC Communication

USAR's PS/2-compatible KeyCoders™ implement all the standard functions of communication with a BIOS-compatible AT/PS/2 host system. The following table shows the commands that the system may send and their values in hex.

Command	Hex Value
Set/Reset Status Indicators	ED
Echo	EE
Invalid Command	EF
Select Alternate Scan Codes	F0
Invalid Command	F1
Read ID	F2
Set Typematic Rate/Delay	F3
Enable	F4
Default Disable	F5
Set Default	F6
Set Default	F6
Set All Keys	
■ Typematic	F7
■ Make/Break	F8
■ Make	F9
■ Typematic/Make/Break	FA
Set Key Type	
■ Typematic	FB
■ Make/Break	FC
■ Make	FD
Reset	FF
Resend	FE

Table 1: **Keyboard Commands from the System (AT/PS/2 protocol)**

These commands are supported in the AT/PS/2 protocol and can be sent to the keyboard at any time. Two lines, KC and KD, provide bi-directional clock and data signals according to the protocol (PC or AT) selected.

The following table shows the commands that the keyboard may send to the system.

Command	Hex Value
Key Detection Error/Overrun	00*
Keyboard ID	83AB
BAT Completion Code	AA
BAT Failure Code	FC
Echo	EE
Acknowledge (Ack)	FA
Resend	FE
Key Detection Error/Overrun	FF**

*Code Sets 2 and 3
**Code Set 1

Table 2: **Keyboard Commands to the System (AT/PS/2 protocol)**

USAR's KeyCoders™ support all commands from and to the system, as described in the IBM Technical Reference Manuals.

Scan Codes

The following tables list the scan codes associated with each key for each scan code set. To determine the character that corresponds to each key number, refer to the Keyboard Layouts A–D on the following pages. Scan Code Set 2 is the default when the KeyCoder™ is set in AT/PS/2 mode.

Scan Code Set 1 (Part 1 of 5)

The following keys send the assigned scan codes independently of the state of any Shift Keys (Ctrl, Alt and Shift) or the Num Lock State (On or Off).

Key#	Make Code	Break Code	Key#	Make Code	Break Code	Key#	Make Code	Break Code
1	29	A9	31	1E	9E	90	45	C5
2	02	82	32	1F	9F	91	47	C7
3	03	83	33	20	A0	92	4B	CB
4	04	84	34	21	A1	93	4F	CF
5	05	85	35	22	A2	96	48	C8
6	06	86	36	23	A3	97	4C	CC
7	07	87	37	24	A4	98	50	D0
8	08	88	38	25	A5	99	52	D2
9	09	89	39	26	A6	100	37	B7
10	0A	8A	40	27	A7	101	49	C9
11	0B	8B	41	28	A8	102	4D	CD
12	0C	8C	43	1C	9C	103	51	D1
13	0D	8D	44	2A	AA	104	53	D3
15	0E	8E	46	2C	AC	105	4A	CA
16	0F	8F	47	2D	AD	106	4E	CE
17	10	90	48	2E	AE	110	01	81
18	11	91	49	2F	AF	112	3B	BB
19	12	92	50	30	B0	113	3C	BC
20	13	93	51	31	B1	114	3D	BD
21	14	94	52	32	B2	115	3E	BE
22	15	95	53	33	B3	116	3F	BF
23	16	96	54	34	B4	117	40	C0
24	17	97	55	35	B5	118	41	C1
25	18	98	57	36	B6	119	42	C2
26	19	99	58	1D	9D	120	43	C3
27	1A	9A	60	38	B8	121	44	C4
28	1B	9B	61	39	B9	122	57	D7
29	2B	AB	62	E0 38	E0 B8	123	58	D8
30	3A	BA	64	E0 1D	E0 9D	125	46	C6

Scan Codes, Cnt.

Scan Code Set 1 (Part 2 of 5)

The following keys send a series of codes dependent on the state of the Shift Keys and the state of the Num Lock.

Key	Base Case, or Shift + Num Lk		Shift Case*		Num Lock on	
Number	Make	Break	Make	Break	Make	Break
75	E0 52	E0 D2	E0 AA E0 52	E0 D2 E0 2A	E0 2A E0 52	E0 D2 E0 AA
76	E0 53	E0 D3	E0 AA E0 53	E0 D3 E0 2A	E0 2A E0 53	E0 D3 E0 AA
79	E0 4B	E0 CB	E0 AA E0 4B	E0 CB E0 2A	E0 2A E0 4B	E0 CB E0 AA
80	E0 47	E0 C7	E0 AA E0 47	E0 C7 E0 2A	E0 2A E0 47	E0 C7 E0 AA
81	E0 4F	E0 CF	E0 AA E0 4F	E0 CF E0 2A	E0 2A E0 4F	E0 CF E0 AA
83	E0 48	E0 C8	E0 AA E0 48	E0 C8 E0 2A	E0 2A E0 48	E0 C8 E0 AA
84	E0 50	E0 D0	E0 AA E0 50	E0 D0 E0 2A	E0 2A E0 50	E0 D0 E0 AA
85	E0 49	E0 C9	E0 AA E0 49	E0 C9 E0 2A	E0 2A E0 49	E0 C9 E0 AA
86	E0 51	E0 D1	E0 AA E0 51	E0 D1 E0 2A	E0 2A E0 51	E0 D1 E0 AA
89	E0 4D	E0 CD	E0 AA E0 4D	E0 CD E0 2A	E0 2A E0 4D	E0 CD E0 AA

* If the left Shift Key is held down, the AA/2A, shift make and break is sent with the other scan codes. If the right Shift Key is held down, B6/36 is sent. If both Shift Keys are down, both sets of codes are sent with the other scan codes.

Scan Code Set 1 (Part 3 of 5)

Key	Scan Code		Shift Case	
Number	Make	Brake	Make	Brake
95	E0 35	E0 B5	E0 AA E0 35	E0 B5 E0 2A

*If the left Shift Key is held down, the AA/2A shift make and break is sent with the other scan codes. If the right Shift Key is held down, B6/36 is sent. If both Shift Keys are down, both sets of codes are sent with the other scan codes

Scan Code Set 1 (Part 4 of 5)

Key	Scan Code		Ctrl Case, Shift Case		Alt Case	
Number	Make	Brake	Make	Brake	Make	Brake
124	E0 2AE0 37	E0 B7 E0 AA	E0 37	E0 B7	54	D4

Scan Code Set 1 (Part 5 of 5)

Key Number	Make Code	Ctrl Key Pressed
126*	E1 1D 45 E1 9D C5	E0 46 E0 C6

*This key is not Typematic. All associated scan codes occur on the make of the key.

Scan Codes, Cnt.

Scan Code Set 2 (Part 1 of 5)

The following keys send the codes shown regardless of any Shift States in the keyboard or the system.

Key#	Make Code	Break Code	Key#	Make Code	Break Code	Key#	Make Code	Break Code
1	0E	F0 0E	31	1C	F0 1C	90	77	F0 77
2	16	F0 16	32	1B	F0 1B	91	6C	F0 6C
3	1E	F0 1E	33	23	F0 23	92	6B	F0 6B
4	26	F0 26	34	2B	F0 2B	93	69	F0 69
5	25	F0 25	35	34	F0 34	96	75	F0 75
6	2E	F0 2E	36	33	F0 33	97	73	F0 73
7	36	F0 36	37	3B	F0 3B	98	72	F0 72
8	3D	F0 3D	38	42	F0 42	99	70	F0 70
9	3E	F0 3E	39	4B	F0 4B	100	7C	F0 7C
10	46	F0 46	40	4C	F0 4C	101	7D	F0 7D
11	45	F0 45	41	52	F0 52	102	74	F0 74
12	4E	F0 4E	43	5A	F0 5A	103	7A	F0 7A
13	55	F0 55	44	12	F0 12	104	71	F0 71
15	66	F0 66	46	1A	F0 1A	105	7B	F0 7B
16	0D	F0 0D	47	22	F0 22	106	79	F0 79
17	15	F0 15	48	21	F0 21	110	76	F0 76
18	1D	F0 1D	49	2A	F0 2A	112	05	F0 05
19	24	F0 24	50	32	F0 32	113	06	F0 06
20	2D	F0 2D	51	31	F0 31	114	04	F0 04
21	2C	F0 2C	52	3A	F0 3A	115	0C	F0 0C
22	35	F0 35	53	41	F0 41	116	03	F0 03
23	3C	F0 3C	54	49	F0 49	117	0B	F0 0B
24	43	F0 43	55	4A	F0 4A	118	83	F0 83
25	44	F0 44	57	59	F0 59	119	0A	F0 0A
26	4D	F0 4D	58	14	F0 14	120	01	F0 01
27	54	F0 54	60	11	F0 11	121	09	F0 09
28	5B	F0 5B	61	29	F0 29	122	78	F0 78
29	5D	F0 5D	62	E0 11	E0 F0 11	123	07	F0 07
30	58	F0 58	64	E0 14	E0 F0 14	125	7E	F0 7E

Scan Codes, Cnt.

Scan Code Set 2 (Part 2 of 5)

The following keys send a series of codes dependent on the state of the Shift Keys and the state of the Num Lock.

Key	Base Case, or Shift + Num Lk		Shift Case*		Num Lock on	
Number	Make	Break	Make	Break	Make	Break
75	E0 70	E0 F0 70	E0 F0 12 E0 70	E0 F0 70 E0 12	E0 12 E0 70	E0 F0 70 E0 F0 12
76	E071	E0 F0 71	E0 F0 12 E0 71	E0 F0 71 E0 12	E0 12 E0 71	E0 F0 71 E0 F0 12
79	E0 6B	E0 F0 6B	E0 F0 12 E0 6B	E0 F0 6B E0 12	E0 12 E0 6B	E0 F0 6B E0 F0 12
80	E0 6C	E0 F0 6C	E0 F0 12 E0 6C	E0 F0 6C E0 12	E0 12 E0 6C	E0 F0 6C E0 F0 12
81	E0 69	E0 F0 69	E0 F0 12 E0 69	E0 F0 69 E0 12	E0 12 E0 69	EO F0 69 E0 F0 12
83	E0 75	E0 F0 75	E0 F0 12 E0 75	E0 F0 75 E0 12	E0 12 E0 75	E0 F0 75 E0 F0 12
84	E0 72	E0 F0 72	E0 F0 12 E0 72	E0 F0 72 E0 12	E0 12 E0 72	E0 F0 72 E0 F0 12
85	E0 7D	E0 F0 7D	E0 F0 12 E0 7D	E0 F0 7D E0 12	E0 12 E0 7D	E0 F0 7D E0 F0 12
86	E0 7A	E0 F0 7A	E0 F0 12 E0 7A	E0 F0 7A E0 12	E0 12 E0 7A	E0 F0 7A E0 F0 12
89	E0 74	E0 F0 74	E0 F0 12 E0 74	E0 F0 74 E0 12	E0 12 E0 74	E0 F0 74 E0 F0 12

* If the left Shift Key is held down, the F0 12/12 shift make and break is sent with the other scan codes. If the right Shift Key is held down, F0/59/59 is sent. If both Shift Keys are down, both sets of codes are sent with the other scan codes.

Scan Code Set 2 (Part 3 of 5)

Key	Scan Code		Shift Case *	
Number	Make	Brake	Make	Brake
95	E0 4A	E0 FO 4A	E0 F0 12 E0 4A	E0 12 F0 4A

*If the left Shift Key is held down, the F0 12/12 shift make and break is sent with the other scan codes. If the right Shift Key is held down, F0 59/59 is sent. If both Shift Keys are down, both sets of codes are sent with the other scan codes.

Scan Code Set 2 (Part 4 of 5)

Key	Scan Code		Ctrl Case, Shift Case		Alt Case	
Number	Make	Brake	Make	Brake	Make	Brake
124	E0 12 E0 7C	E0 F0 7C E0 F012	E0 7C	E0 F0 7C	84	F0 84

Scan Code Set 2 (Part 5 of 5)

Key Number	Make Code	Ctrl Key Pressed
126*	E1 14 77 E1 F0 14 F0 77	E0 7E E0 F0 7E

*This key is not Typematic. All associated scan codes occur on the make of the key.

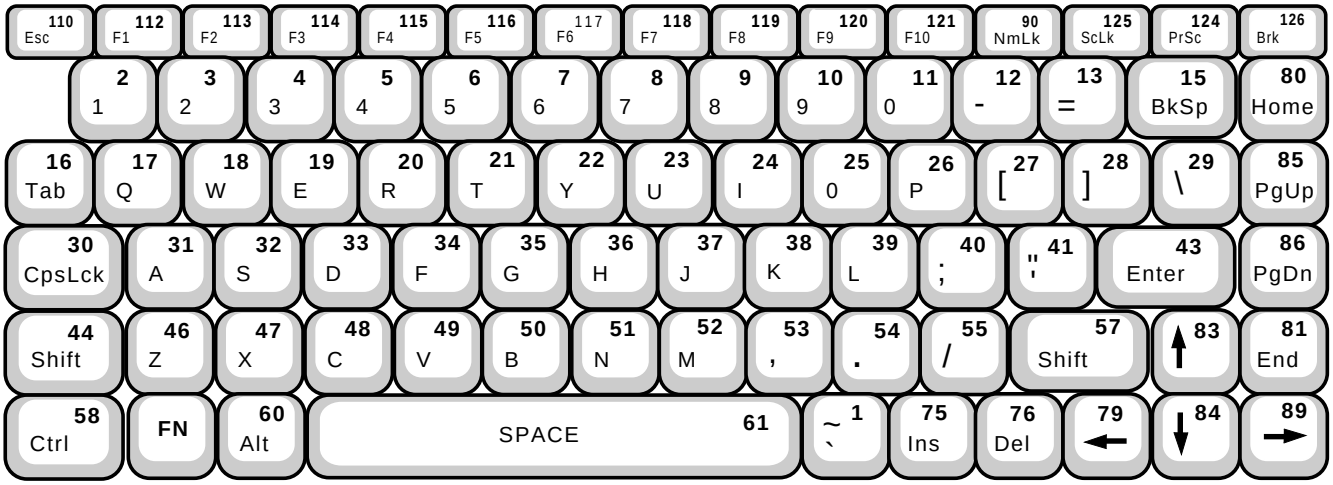
Scan Codes, Cnt.

Key Number	Make Code	Break Code	Default Key State
1	0E	F0 0E	Typematic
2	16	F0 16	Typematic
3	1E	F0 1E	Typematic
4	26	F0 26	Typematic
5	25	F0 25	Typematic
6	2E	F0 2E	Typematic
7	36	F0 36	Typematic
8	3D	F0 3D	Typematic
9	3E	F0 3E	Typematic
10	46	F0 46	Typematic
11	45	F0 45	Typematic
12	4E	F0 4E	Typematic
13	55	F0 55	Typematic
15	66	F0 66	Typematic
16	0D	F0 0D	Typematic
17	15	F0 15	Typematic
18	1D	F0 1D	Typematic
19	24	F0 24	Typematic
20	2D	F0 2D	Typematic
21	2C	F0 2C	Typematic
22	35	F0 35	Typematic
23	3C	F0 3C	Typematic
24	43	F0 43	Typematic
25	44	F0 44	Typematic
26	4D	F0 4D	Typematic
27	54	F0 54	Typematic
28	5B	F0 5B	Typematic
29	5C	F0 5C	Typematic
30	14	F0 14	Make/Break
31	1C	F0 1C	Typematic
32	1B	F0 1B	Typematic
33	23	F0 23	Typematic
34	2B	F0 2B	Typematic
35	34	F0 34	Typematic
36	33	F0 33	Typematic
37	3B	F0 3B	Typematic
38	42	F0 42	Typematic
39	4B	F0 4B	Typematic
40	4C	F0 4C	Typematic
41	52	F0 52	Typematic
43	5A	F0 5A	Typematic
44	12	F0 12	Make/Break
46	1A	F0 1A	Typematic
47	22	F0 22	Typematic
48	21	F0 21	Typematic
49	2A	F0 2A	Typematic
50	32	F0 32	Typematic
51	31	F0 31	Typematic
52	3A	F0 3A	Typematic
53	41	F0 41	Typematic
54	49	F0 49	Typematic
55	4A	F0 4A	Typematic
57	59	F059	Make/Break
58	11	F0 11	Make/Break
60	19	F0 19	Make/Break
61	29	F0 29	Typematic
62	39	F0 39	Make only
64	58	F0 58	Make only
75	67	F0 67	Make only
76	64	F0 64	Typematic
79	61	F0 61	Typematic
80	6E	F0 6E	Make only
81	65	F0 65	Make only
83	63	F0 63	Typematic
84	60	F0 60	Typematic
85	6F	F0 6F	Make only
86	6D	F0 6D	Make only
89	6A	F0 6A	Typematic
90	76	F0 76	Make only
91	6C	F0 6C	Make only
92	6B	F0 6B	Make only
93	69	F0 69	Make only
95	77	F0 77	Make only
96	75	F0 75	Make only
97	73	F0 73	Make only
98	72	F0 72	Make only
99	70	F0 70	Make only
100	7E	F0 7E	Make only
101	7D	F0 7D	Make only
102	74	F0 74	Make only
103	7A	F0 7A	Make only
104	71	F0 71	Make only
105	84	F0 84	Make only
106	7C	F0 7C	Typematic
110	08	F0 08	Make only
112	07	F0 07	Make only
113	0F	F0 0F	Make only
114	17	F0 17	Make only
115	1F	F0 1F	Make only
116	27	F0 27	Make only
117	2F	F0 2F	Make only
118	37	F0 37	Make only
119	3F	F0 3F	Make only
120	47	F0 47	Make only
121	4F	F0 4F	Make only
122	56	F0 56	Make only
123	5E	F0 5E	Make only
124	57	F0 57	Make only
125	5F	F0 5F	Make only
126	62	F0 62	Make only

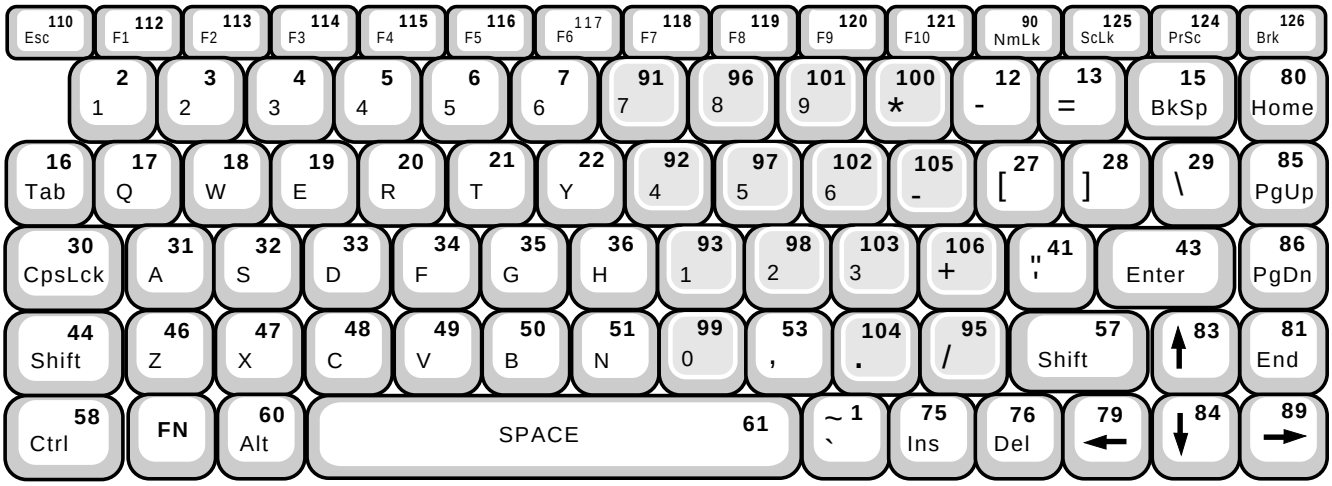
Keyboard Layouts (US English)

Depending on the status of the Num Lock and the FN Key, the KeyCoder™ can implements one of four keyboard layouts. (Key numbering of a standard 101/102 keyboard is shown.)

Layout A (Default layout)



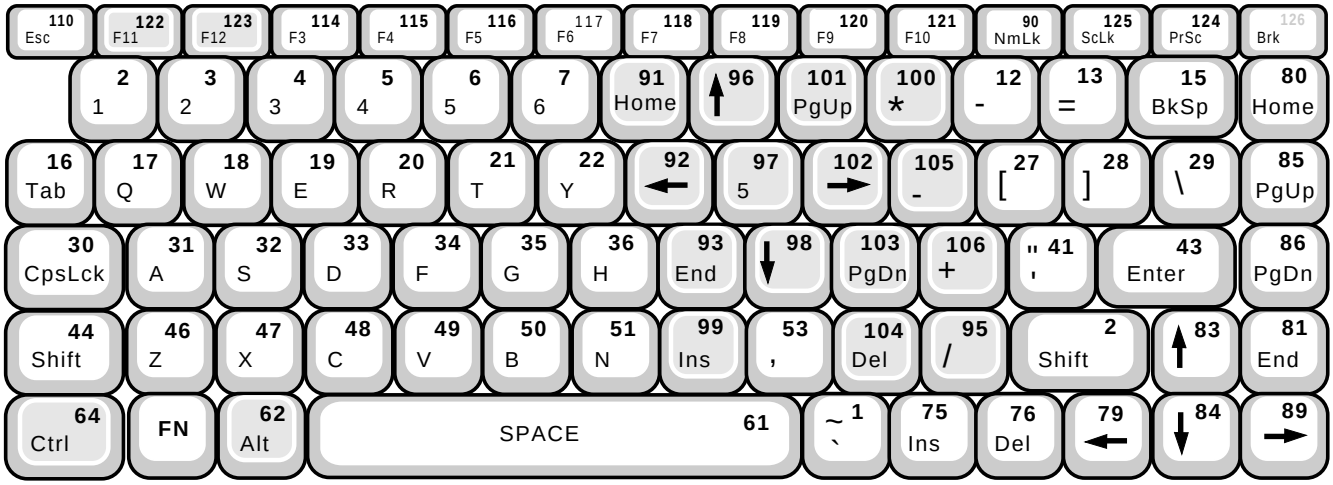
Layout B (Num Lock is set)



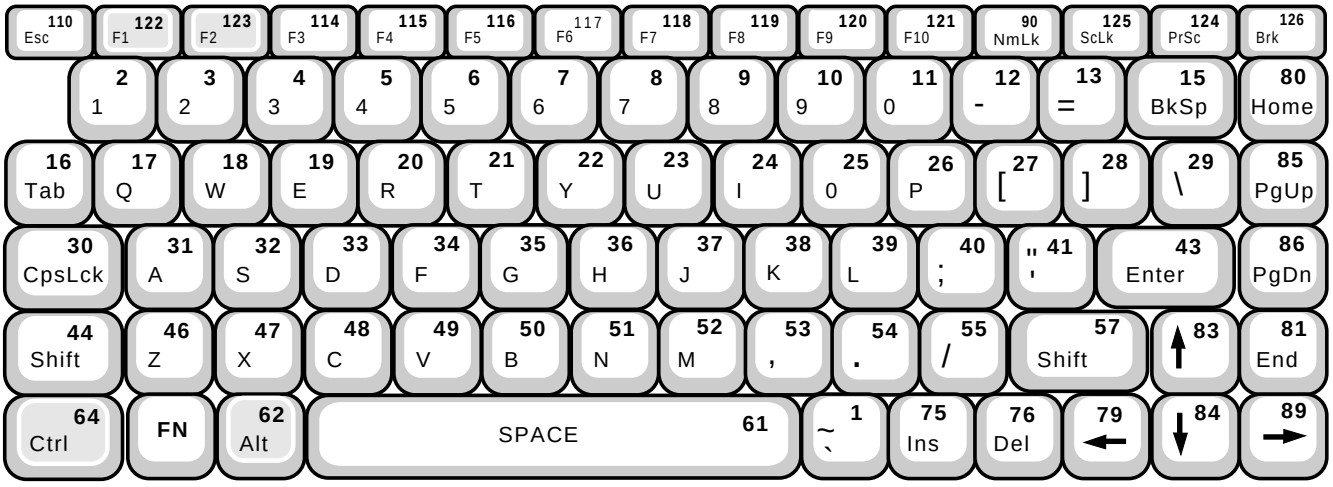
Keyboard Layouts (US English)

Depending on the status of the Num Lock and the FN Key, the KeyCoder™ can implement one of four keyboard layouts.
(Key numbering of a standard 101/102 keyboard is shown.)

Layout C (FN key pressed)



Layout D (Num Lock set and FN key pressed)



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