Data Sheet

Keyboard encoder IC 9600-PRO

RS stock number 633-161

The 9600 is a keyboard encoder that contains all the logic necessary to debounce and encode the SPST key switches used in a keyboard matrix and provide a fully decoded data output consisting of a nine bit simple binary code which can be converted to the required information code by a PROM or microprocessor etc. This permits maximum user flexibility for key layout and coding.

Contact bounce elimination circuitry with an externally controllable delay is included and data outputs are TTL compatible.

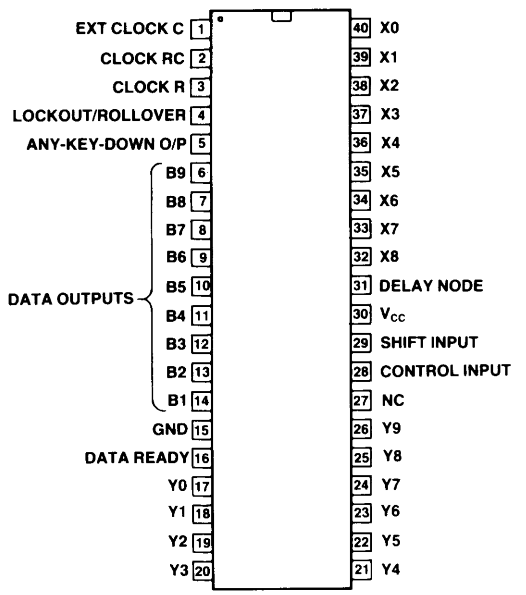
Absolute maximum ratings

Positive voltage any pin with respect to Gnd ____+8.0V
Negative voltage any pin with respect to Gnd ____0.3V
Operating temperature range __________0°C to +70°C
Storage temperature range _________–55°C to +150°C
Lead temperature soldering 10s ____________+325°C

Features

- On-chip contact bounce elimination
- N-Key rollover or lockout operation
- TTL compatible data outputs
- Normal, shift, control and shift-control modes
- Simple binary code output for user conversion
- Single + 5V supply.

Pin connections

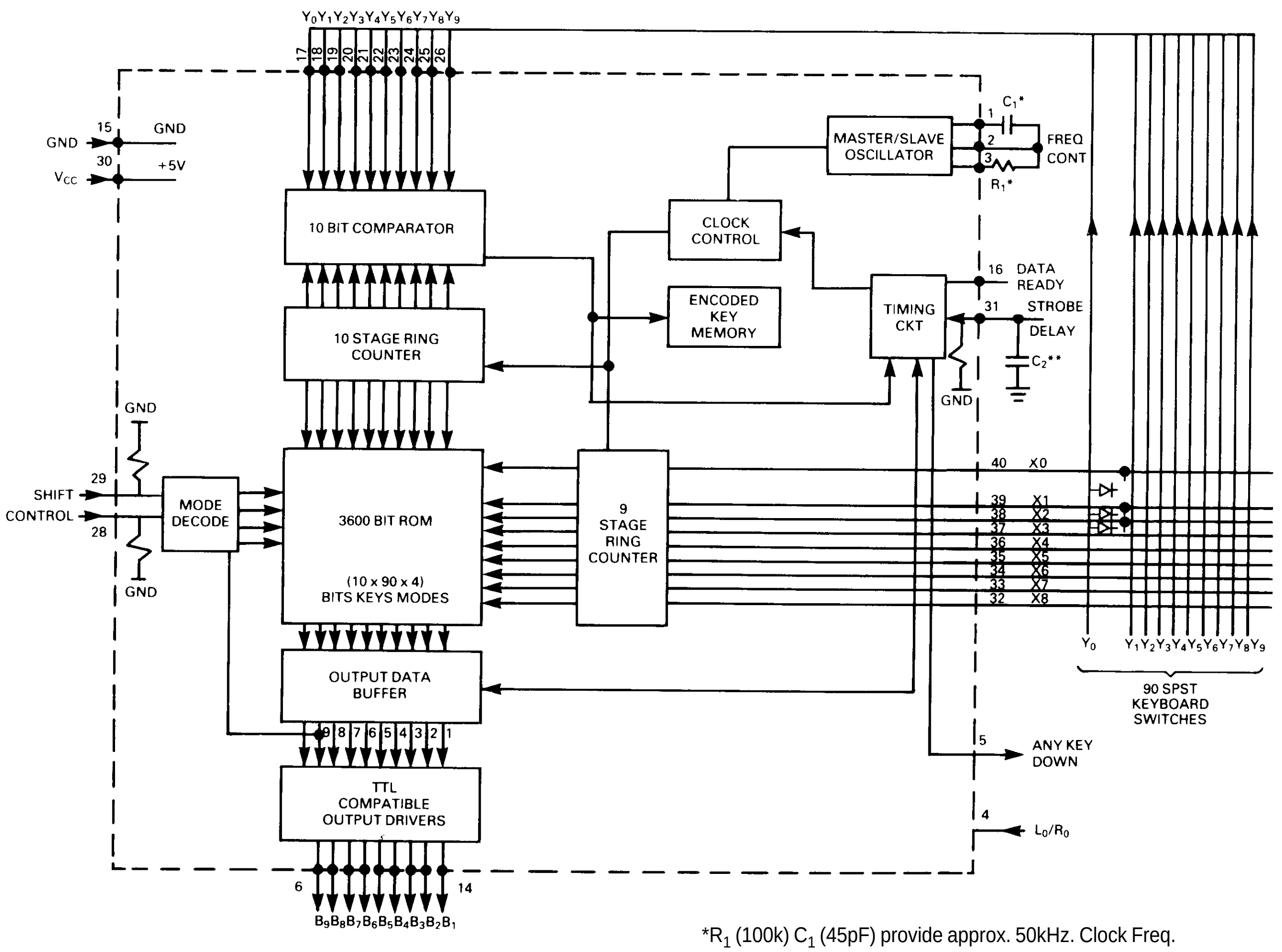


Top view

Electrical characteristics TA = 0°C to 70°C, V_{CC} = 5V ±5%

Parameter	Conditions	Min.	Typ.	Max.	Units
dc characteristics					
Low level input voltage				0.8	V
High level input voltage	Except Y inputs	2.0			V
Y input high level		2.8			V
Y input low level				0.8	V
Input leakage current	Except Y V_{IN} = 5V			10.0	µA
Input with pull down R	V_{IN} = 5V	75		220	µA
Y inputs	V_{YIL} = 1V	–100	–400	–500	µA
Output voltage levels					
Low level	I_{OL}= 1.6mA			0.4	V
High level	I_{OH}= 100µA	2.4			V
X output voltage					
Low level	600µA clock high		0.4		V
High level	I_{OH} = 10µA	2.0	4.0		V
Input capacitance	All inputs			10	pF
Power supply current			20	40	mA
ac characteristics					
Clock frequency		0.01		0.1	MHz
Chip enable access time				250	ns
Switch characteristics					
Contact resistance					
closed				300	Ω
open		10			MΩ

Figure 1 **KR9600 - PRO Block diagram**



*R_1 (100k) C_1 (45pF) provide approx. 50kHz. Clock Freq.
**C_2 (300 ns Delay/(C_{pF}) R_2 supplied internally
***Diodes necessary for complete n Key Rollover operation.

Operation

The keys are scanned in a nine output by ten input matrix, each key having a unique input-output combination connected to it. The inputs all go selectively to a level detector which has logically variable (1's and 0's) levels and hysteresis. The outputs are enabled one at a time from output X0 towards X8, at a rate of 10-100kHz, through a 9 stage counter. The 10 inputs are searched one at a time from Y0 to Y9, through a 10 stage ring counter, each time one of the outputs is enabled. The output and input pins all have pullups to V_{cc} and are precharged each clock even if the scan is stopped at one key. When a level on the selected path to the comparator matches a level on the corresponding comparator input from the 10 stage ring counter and the key has not been encoded, the switch bounce delay network is enabled. The key down stroke is examined without advance to the next key location, until the key has been stable for the length of the DELAY CAP pin to discharge. The code for the depressed key is transferred to the output data buffer and the data ready signal appears.

The scan has two modes as determined by the LOckout/Rollover option. Once a key is determined to be down the scan will not advance if in the LOckout mode. Consequently a new key closure is not detected until the previously depressed key is released. The scan sequence will resume upon key release and the output data buffer stores the code of the last key encoded. In the Rollover mode a "1" is stored in the encoded key memory and the scan sequence is resumed and the code for the last encoded key remains in the data output buffer. Each depressed key is encoded regardless of the state of the previously depressed keys. The internal keyboard ROM is 10 bits wide. Bits 1-8 are output via outputs B1-B8.

Description of pin functions

Name	Symbol	Pin	Function
X outputs	X0-X8	40-32	External outputs from the 9-stage ring counter to the keyboard to form X-Y matrix with the keyboard switches as the crosspoints.
Y inputs	Y0-Y9	17-26	External inputs from the keyboard X-Y matrix
Clock		CK	1-3 Oscillator connection pins
Any key down	AKO	5	Output indicator of key closure
Data outputs	B9-B1	6-14	Data outputs B1-B9 parallel outputs
Data ready	DR	16	This output is a pulse which signals that a key closure has been detected and that data is available at the output port.
Delay node input	Delay	31	Externally controllable delay network for eliminating the effect of switch contact bounce.
Shift input	Shift	29	This input is used to select the shift mode data
Control input	CNTRL	28	This input is used to select the control mode data. Simultaneous assertion of shift and control inputs will place the encoder into the shift-control mode.
Lockout/rollover	LO/RO	4	Selects the mode of operation for key scan
Power supply	V_{cc}	30	+5V power supply
Ground	Gnd	15	Ground

Oscillator:

The main clocks are derived from the Internal oscillator, three pins (pins #1,2,3) for frequency selection via an external resistor and capacitor are used.

Lockout/Rollover: LO/RO

This option selects the operation of the key scan when a new key is detected. In Lockout the scan stops as long as the key is down. In Rollover the scan stops till the new key is debounced by the DELAY CAP and the key code is output. Then the key position is marked as down and the scan continues until another new key is seen. The option is selected by an external pin. Lockout is active high and an on chip pulldown resistor is included.

Data ready:

The data ready pin gives a pulse upon an output state ready to transfer. This transfer occurs when a new key is encoded or when the current key is repeated.

Any key down: AKO output

The AKO output is an indicator to tell there is at least one key determined to be depressed. The output is logic high (true).

Shift control: SC

These two pins determine the output in response to a new key being detected. See coding sheet for specific outputs.

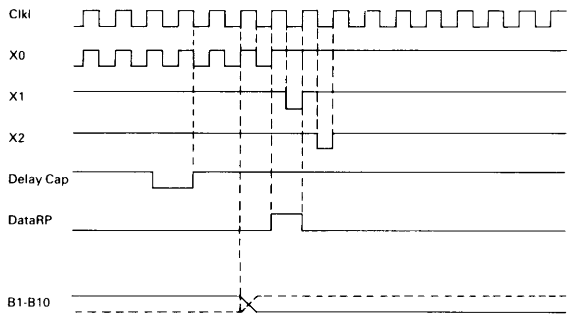
Minimum switch closure

T = Switch bounce + (90 × 1/f) + Strobe delay + Strobe width

Switch bounce	(90 × 1/f)	Strobe delay	Strobe width
maximum expected	determined by frequency of operation	determined by external capacitance	minimum time required by external circuitry

Figure 3 **Timing diagram**

CONDITIONS:
A key is pressed down at X0Y0 but the delay cap has not time out.
Data Ready is high true and we have already had another key.
DataRP = Data Ready as a Pulse.



The output of the 9600 PRO is a simple binary code which may be converted to a standard information code by a PROM or directly by a microprocessor. This permits a user maximum flexibility of key layout with simple field programming.

The code in the 9600 is shown in Table 1. The format is simple: output bits, 9,8,7,6,5,4 and 1 are a binary sequence. The count starts at X0, Y0 and increments through X0Y1, X0Y2...X8Y9; bit 9 is the LSB; bit 1 is the MSB.

Bit 2 and 3 indicate the mode as follows:

Bit 2	Bit 3	
0	0	Normal
0	1	Shift
1	0	Control
1	1	Shift Control

For maximum ease of use and flexibility, an internal scanning oscillator is used, with pin selection of N-key lockout (also known as 2-key rollover) and N-key rollover. An 'any-key-down' output is provided for such uses as repeat oscillator keying.

Figure 2 **Oscillator and strobe selection graphs**

Oscillator frequency vs C1 for 9600

Strobe delay vs C2 for 9600

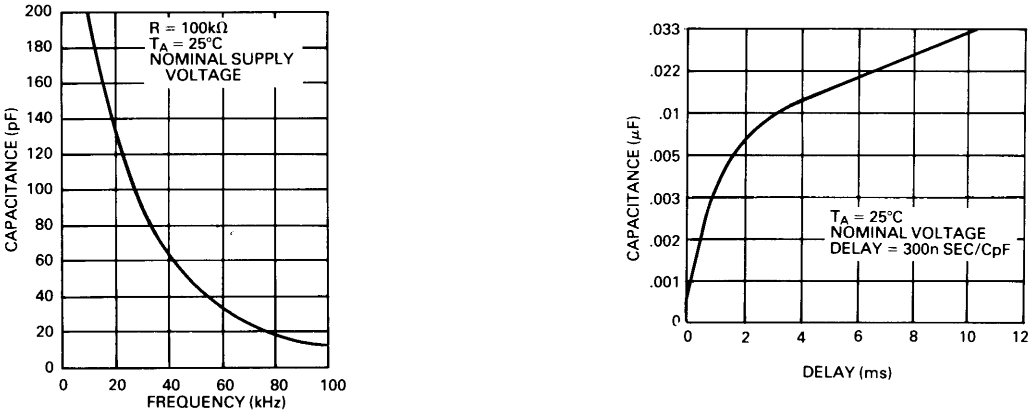


Table 1 9600-Pro coding sheet

XY	Normal B-12345678910	Shift B-12345678910	Control B-12345678910	Shift/Control B-12345678910
00	000000000	001000000	010000000	011000000
01	000000001	001000001	010000001	011000001
02	000000010	001000010	010000010	011000010
03	000000011	001000011	010000011	011000011
04	000000100	001000100	010000100	011000100
05	000000101	001000101	010000101	011000101
06	000000110	001000110	010000110	011000110
07	000000111	001000111	010000111	011000111
08	000001000	001001000	010001000	011001000
09	000001001	001001001	010001001	011001001
10	000001010	001001010	010001010	011001010
11	000001011	001001011	010001011	011001011
12	000001100	001001100	010001100	011001100
13	000001101	001001101	010001101	011001101
14	000001110	001001110	010001110	011001110
15	000001111	001001111	010001111	011001111
16	000010000	001010000	010010000	011010000
17	000010001	001010001	010010001	011010001
18	000010010	001010010	010010010	011010010
19	000010011	001010011	010010011	011010011
20	000010100	001010100	010010100	011010100
21	000010101	001010101	010010101	011010101
22	000010110	001010110	010010110	011010110
22	000010110	001010110	010010110	011010110
23	000010111	001010111	010010111	011010111
24	000011000	001011000	010011000	011011000
25	000011001	001011001	010011001	011011001
26	000011010	001011010	010011010	011011010
27	000011011	001011011	010011011	011011011
28	000011100	001011100	010011100	011011100
29	000011101	001011101	010011101	011011101
30	000011110	001011110	010011110	011011110
31	000011111	001011111	010100000	011100000
32	000100000	001100000	010100000	011100000
33	001000001	001100001	010100001	011100001
34	000100010	001100010	010100010	011100010
35	000100011	001100011	010100011	011100011
36	000100100	001100100	010100100	011100100
37	000100101	001100101	010100101	011100101
38	000100110	001100110	010100110	011100110
39	000100111	001100111	010100111	011100111
40	000101000	001101000	010101000	011101000
41	000101001	001101001	010101001	011101001
42	000101010	001101010	010101010	011101010
43	000101011	001101011	010101011	011101011
44	000101100	001101100	010101100	011101100
45	000101101	001101101	010101101	011101101
46	000101110	001101110	010101110	011101110
47	000101111	001101111	010101111	011101111
48	000110000	001110000	010110000	011110000
49	000110001	001110000	010110001	011110001
50	000110010	001110010	010110010	011110010
51	000110011	001110011	010110011	011110011
52	000110100	001110100	010110100	011110100
53	000110101	001110101	010110101	011110101
54	000110110	001110110	010110110	011110110
55	000110111	001110111	010110111	011110111
56	000111000	001111000	010111000	011111000
57	000111001	001111001	010111001	011111001
58	000111010	001111010	010111010	011111010
59	000111011	001111011	010111011	011111011
60	000111100	001111100	010111100	011111100
61	000111101	001111101	010111101	011111101
62	000111110	001111110	010111110	011111110
63	000111111	001111111	010111111	011111111
64	100000000	101000000	110000000	111000000
65	100000001	101000001	110000001	111000001
66	100000010	101000010	110000010	111000010
67	100000011	101000011	110000011	111000011
68	100000100	101000100	110000100	111000100
69	100000101	101000101	110000101	111000101
70	100000110	101000110	110000110	111000110
71	100000111	101000111	110000111	111000111
72	100001000	101001000	110001000	111001000
73	10000101	101001001	110001001	111001001
74	100001010	101001010	110001010	111001010
75	100001011	101001011	110001011	111001011
76	100001100	101001100	110001100	111001100
77	100001101	101001101	110001101	111001101
78	100001110	101001110	110001110	111001110
79	100001111	101001111	110001111	111001111
80	100010000	101010000	110010000	111010000
81	100010001	101010001	110010001	111010001
82	100010010	101010010	110010010	111010010
83	100010011	101010011	110010011	111010011
84	100010100	101010100	110010100	111010100
85	100010101	101010101	110010101	111010101
86	100010110	101010110	110010110	111010110
87	100010111	101010111	110010111	111010111
88	100011000	101011000	110011000	111011000
89	100011001	101011001	110011001	111011001

Internal Oscillator (Pins 1, 2, 3)
Lockout/Rollover (Pin 4)
Internal Resistor to GND
Lockout is Logic 1

Pulse Data Ready
Any Key Down (Pin 5) Positive Output
Internal Resistor to GND on Shift
and Control Pins

Applications

Figure 4 shows a PROM-encoded 64 key, 4 mode application, using a 256 × 8 PROM, and Figure 5 a full 90 key, 4 mode application utilising a 512 × 8 PROM.

If N-key rollover operation is desired, it is recommended that a diode be inserted in series with each switch as shown. This prevents 'phantom' key closures from resulting if three or more keys are depressed simultaneously.

Figure 4 **9600-PRO typical application 64 key, 4 mode**

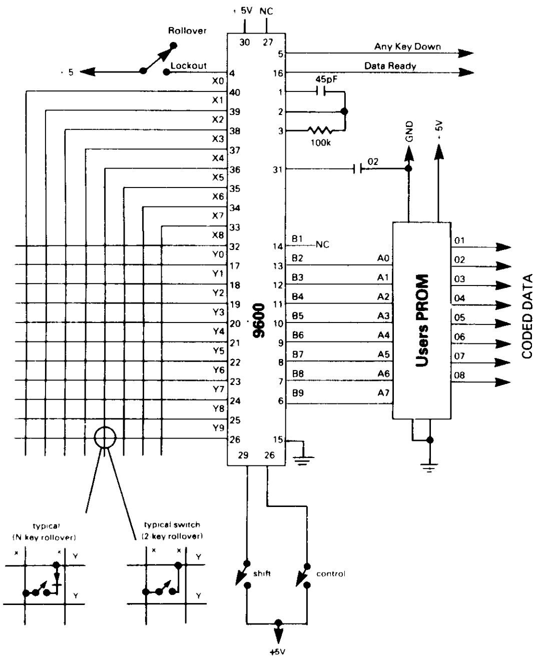


Figure 5 **9600-PRO typical application 90 key, 4 mode**