REMOTE CONTROL TRANSMITTER ENCODER

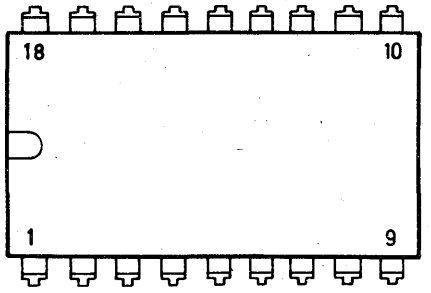
The SAA5000 is a MOS N-channel integrated circuit which provides the encoding and modulation functions for the remote control of television receivers, including those equipped with teletext and viewdata facilities.
It is intended for use with the SAA5010 remote control receiver decoder device. 32 commands are provided which can be activated by either touch or switch controls.
Modulation may be selected for either infra-red or ultrasonic transmission systems.

QUICK REFERENCE DATA

Supply voltage	V_{DD}	nom.	6	V
Supply current (Inactive, $I_{DD} + I_{16}$)		<	20	μA
(Active, I_{DD})		typ.	25	mA
Number of commands			32	
Power-up			Automatic	
Operating temperature range	T_{amb}		−20 to +70	°C

PACKAGE OUTLINE

18-lead DIL; plastic (SOT-102A)



Viewed from top

PINNING

1. V_{SS}
2. Oscillator (C and R common connection)
3. Oscillator (R connection)
4. Keyboard (Matrix inputs)
5. Keyboard (Matrix inputs)
6. Keyboard (Matrix inputs)
7. Keyboard (Matrix inputs)
8. Keyboard (Matrix inputs)
9. Keyboard (Matrix inputs)
10. Keyboard (Matrix outputs)
11. Keyboard (Matrix outputs)
12. Keyboard (Matrix outputs)
13. Keyboard (Matrix outputs)
14. Keyboard (Matrix outputs)
15. Keyboard (Matrix outputs)
16. $\overline{\text{Data}}$ output (Modulator drive)
17. Ultrasonic/Infra-red select
18. V_{DD}

DESCRIPTION

The method of data encoding provides a 24-bit code which incorporates protection against false responses at the decoder under adverse transmission path conditions.
The device automatically "powers up" when the first command is selected and reverts to the standby mode when the operation has been completed. No adjustments or critical components are required in the peripheral circuitry.

HANDLING

Inputs and outputs are protected against electrostatic charge in normal handling. However, to be totally safe, it is desirable to take normal precautions appropriate to handling MOS devices. (See MOS Handling Notes).

RATINGS Limiting values in accordance with the Absolute Maximum System.

Voltages		min.	max.	
Supply voltage (pin 18)	V_{DD}	−0.3	7.5	V
$\overline{\text{Data}}$ output (Modulator drive) (pin 16)		−0.3	11.0	V
Input voltage — all inputs (pins 2 to 9 and 17)		−0.3	7.5	V
Output voltage — all outputs except pin 16 (pins 10 to 15)		−0.3	7.5	V
Temperatures				
Storage temperature	T_{stg}	−20 to +125		°C
Operating ambient temperature	T_{amb}	−20 to +70		°C
$\overline{\text{Data}}$ output				
Safe duration for short circuit to V_{DD}			1	s

CHARACTERISTICS

		min.	typ.	max.	
Supply voltage (pin 18)	V_{DD}	4.5	—	7.0	V

The following characteristics apply at T_{amb} = 25 °C, V_{DD} = 6 V unless otherwise stated.

Supply current					
Inactive, $I_{DD} + I_{16}$		—	—	20	μA
Active, I_{DD}		—	25	35	mA
Oscillator (pins 2 and 3)					
Operating bit period (V_{DD} = 4.5 to 7 V, C = 1.0 nF, R = 220 kΩ)		6.5	8.2	10	ms
Keyboard. Matrix inputs (pins 4 to 9)					
Switching threshold voltage		0.95	—	1.45	V
Keyboard. Matrix outputs (pins 10 to 15)					
Output voltage. HIGH state					
V_{DD} = 4.5 V	I_{out} = −10 μA	4.3	—	—	V
V_{DD} = 4.5 V	I_{out} = −125 μA	2.25	—	—	V

	min.	typ.	max.	
Output voltage. LOW state				
V_{DD} = 7.5 V	–	–	0.48	V
Short circuit current	–	–	0.95	mA
$\overline{\text{Data}}$ output (Modulator drive) (pin 16)				
Low-state voltage (I_{16} = 15 mA)	–	–	0.5	V
Pull-down transition time	–	–	2	μs
Infra-red operation				
Low-state duration				
(Expressed as a ratio of bit period)	–	1:24	–	
Ultrasonic operation				
'0' bit low state duration				
(Expressed as a ratio of bit period)	–	1:6	–	
'1' bit low state duration				
(Expressed as a ratio of bit period)	–	4:6	–	

APPLICATION DATA

Data bit period and response time

The data bit period is controlled by choice of the two oscillator timing components connected to pins 2 and 3. Table 1 shows oscillator timing component values against data bit period.

Ultrasonic operation (Fig.2)

The system response time is approximately 27 x bit period. The minimum bit period is limited by ultrasonic echo decay time encountered under operational conditions and for reliable operation a nominal bit period of 8.2 ms is recommended. Transmitter supply current for the recommended circuit shown in Fig. 2 is approximately 3 mA r.m.s., and is independent of the data bit period.

Infra-red operation (Fig.3)

The system response time is approximately 51.5 x bit period. The transmitter stage (recommended circuit shown in Fig. 3) supply current varies with the bit period as shown in Table 1.

Table 1

Oscillator resistor = 220 kΩ

Oscillator capacitor (pF)		100	120	150	180	220	270	330	390	470	560	680	820	1000	1200
Bit period	(ms)	0.82	1.0	1.2	1.5	1.8	2.2	2.7	3.3	3.9	4.7	5.6	6.8	8.2	10
Transmitter stage average current	Infra-red (mA)	23	19	16	13	11	8.7	7.0	5.8	4.9	4.1	3.4	2.8	2.3	1.9
	Ultrasonic (mA)	3	3	3	3	3	3	3	3	3	3	3	3	3	3

APPLICATION DATA (continued)

The function is quoted against the corresponding pin number

Pin No.

1. V_{SS} Ground – 0 V

2, 3 **Oscillator timing components**

A resistor and capacitor are required to time the oscillator, the frequency of which determines the output data bit rate. The capacitor is connected between pins 1 and 2 and the resistor between pins 2 and 3.

4, 5, 6, 7, 8, 9 **Keyboard Inputs** (From keyboard matrix)

10, 11, 12, 13, 14, 15 **Keyboard Outputs** (To keyboard matrix)

In the 'powered down' state these outputs assume approximately the battery +ve potential. The required data code sequence (see Table 2) is selected by connecting a chosen input to one of the outputs via the keyboard matrix. The application of the high level from the output to the input causes the circuit to 'power-up', the oscillator starts and a sequence of pulses appear on the output pins. As a result of the connection between the selected input and output the chosen message code appears at the data output (pin 16). When the connection is removed the circuit returns to the 'powered-down' state at the end of the message sequence.
Input sensitivity is controlled by the choice of the input pull-down resistors. For maximum sensitivity (i.e. for touch sensitive keyboards) 6.8 MΩ resistors are recommended. Lower values can be used (18 kΩ minimum) with low impedance keyboard switches.

16. $\overline{\text{Data}}$ **output** (Modulator drive)

This is an open-drain output capable of sinking current to V_{SS}. In the 'powered down' state the output is high impedance. When the circuit is active the 24 bit data sequence appears at this output to control an ultrasonic or infra-red transmitter. (See Fig. 5 for details of the data pulse train). When infra-red mode is selected the 24 bit sequence is transmitted twice with an extra pulse at the end of each sequence. This is to ensure the correct reception of the code by the receiver.

17. **Ultrasonic/Infra-red** select

By connecting this pin to V_{SS} the data output pulses are suitable for ultrasonic transmission. By connecting this pin to V_{DD} the output pulses are suitable for infra-red transmission. (See Fig. 4 for details of data pulses).

18. V_{DD} Positive Supply

A 6 V dry cell battery may be used for operation in a portable unit. Four HP7 cells, or equivalent, are recommended.

Peripheral circuitry

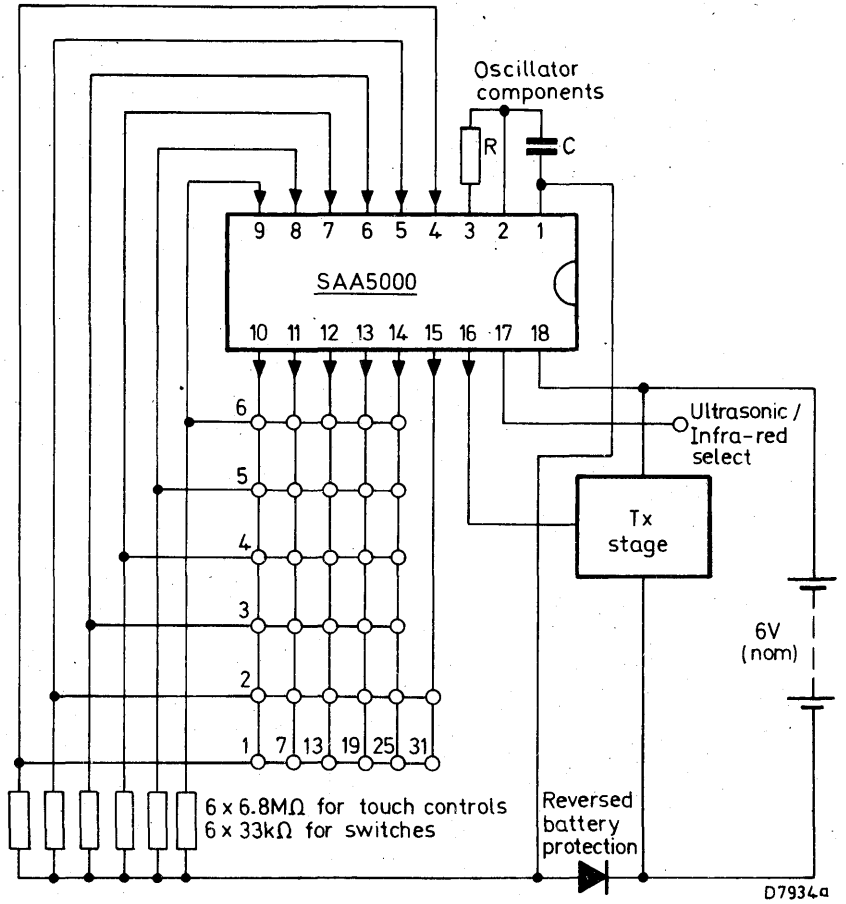


Fig.1

APPLICATION CIRCUITS

Ultrasonic Transmitter

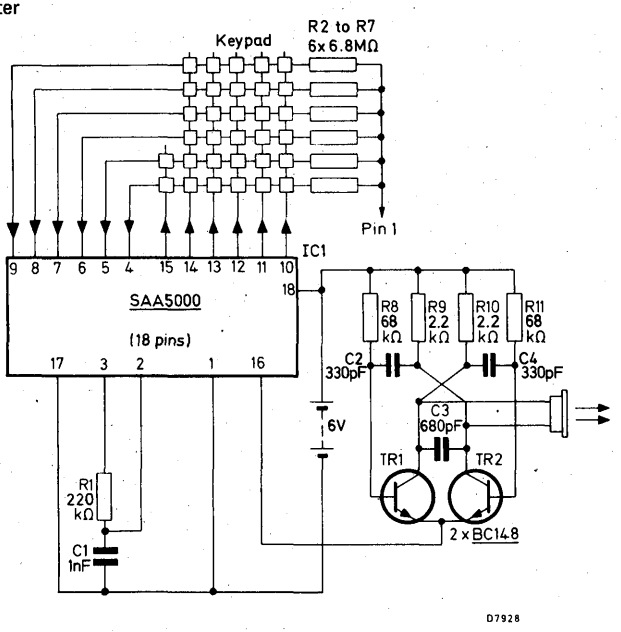


Fig.2

Infra-red Transmitter

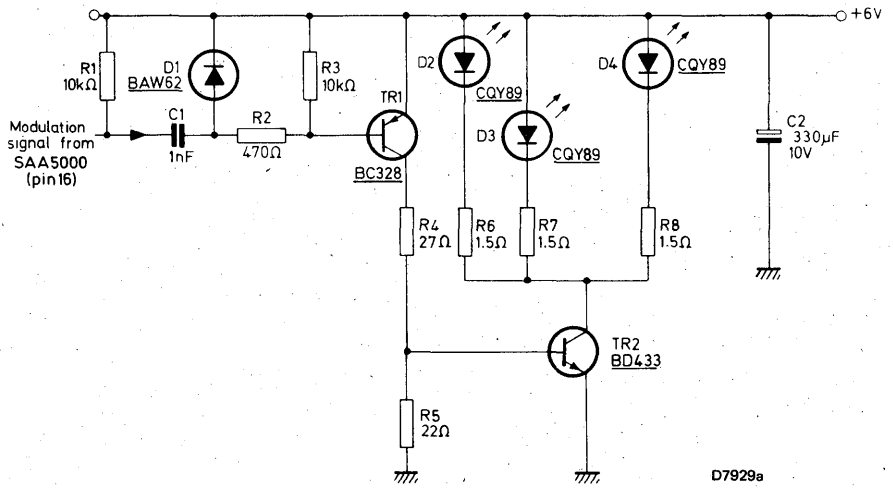


Fig.3

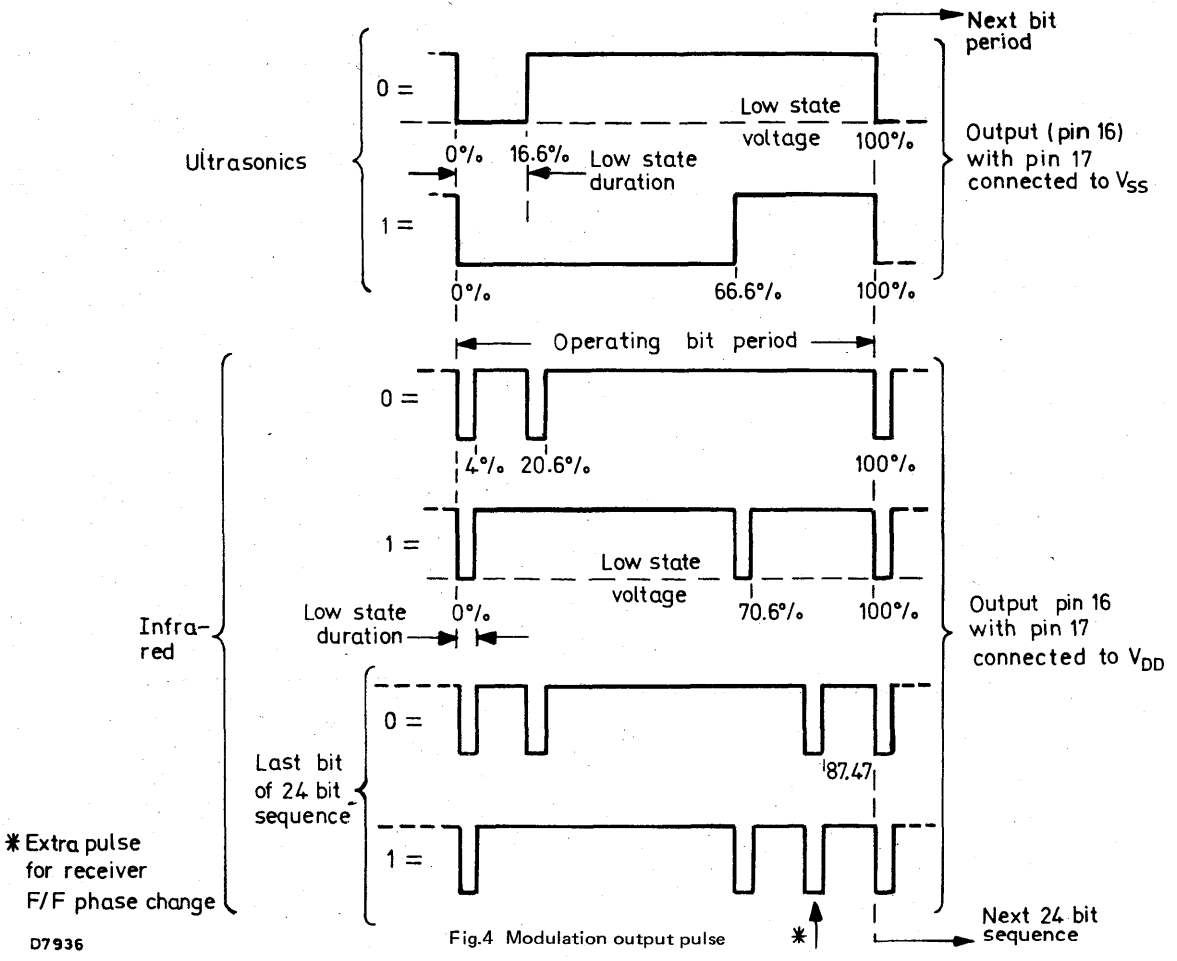


Fig.4 Modulation output pulse

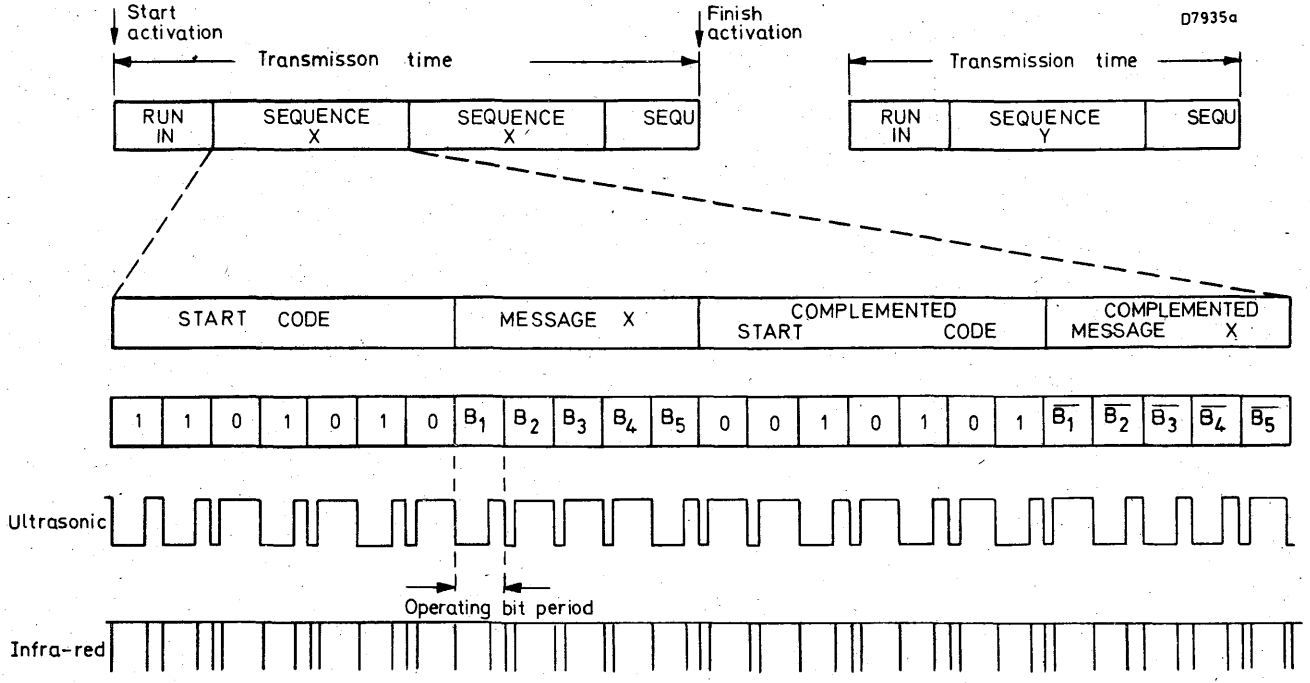


Fig.5 Encoded data format (example: code 18)

See Fig. 4 for details of output pulses.

Transmitter message code

Table 2

Key No.	Binary code				
	B_1	B_2	B_3	B_4	B_5
1	0	0	0	0	0
2	1	0	0	0	0
3	0	1	0	0	0
4	1	1	0	0	0
5	0	0	1	0	0
6	1	0	1	0	0
7	0	1	1	0	0
8	1	1	1	0	0
9	0	0	0	1	0
10	1	0	0	1	0
11	0	1	0	1	0
12	1	1	0	1	0
131	0	0	1	1	0
14	1	0	1	1	0
15	0	1	1	1	0
16	1	1	1	1	0

Key No.	Binary code				
	B_1	B_2	B_3	B_4	B_5
17	0	0	0	0	1
18	1	0	0	0	1
19	0	1	0	0	1
20	1	1	0	0	1
21	0	0	1	0	1
22	1	0	1	0	1
23	0	1	1	0	1
24	1	1	1	0	1
25	0	0	0	1	1
26	1	0	0	1	1
27	0	1	0	1	1
28	1	1	0	1	1
29	0	0	1	1	1
30	1	0	1	1	1
31	0	1	1	1	1
32	1	1	1	1	1