Infrared Remote Control Transmitter **SDA 2008**

The SDA 2008 IC represents a follow-on development of the infrared transmitter IC SAB 3210. It includes a disconnectable 8-stage divider, thus enabling the oscillator to operate up to 500 kHz with a ceramic oscillator instead of an *LC* circuit.

Features

● Complete security of the keyboard against operating errors

● Instruction extension up to 60 instructions is possible by using diodes and by means of a shift key (keyboard changeover)

● Start bit programmable by external voltage

● Wide supply voltage range between 5 V and 16 V

● Low current consumption, typically 3 mA. The battery can be switched off by an external transistor

● No external column resistors necessary

Maximum ratings
all voltages referred to $V_{DD} = 0$ V

Supply voltage	V_{SS}	18	V
Input voltage	V_i	18	V
Power dissipation per output	P_q	100	mW
Total power dissipation	P_{tot}	500	mW
Storage temperature range	T_{stg}	−40 to 125	°C

Operating range
referred to $V_{DD} = 0$ V

Supply voltage	V_{SS1}	5 to 16	V
Supply voltage[1]	V_{SS1}	5.5 to 16	V
Ambient temperature	T_A	0 to 70	°C

---

1) Instruction extension with diodes

Characteristics
all voltages referred to V_{DD}

		min	typ	max	
Supply current (outputs not connected)	I_6		3	7	mA
Leakage current, total current of outputs Ca, Cb, Cc, Cd, ETA, IRA (refer to test circuit)	$I_{2,3,4,5,7,8}$			1	μA

Inputs
Oscillator input CLK I

		min	typ	max	
Operating frequency with prescaler	f_{17}	160		560	kHz
Operating frequency for external clock with disconnected prescaler	f_{17}	20		70	kHz

IRA remote control signal output

		min	typ	max	
H output voltage (refer to test circuit) $I = 4$ mA; $V_{SS} = 6$ V	V_{qH8}	$V_{SS}-5$			V
H resistor with respect to V_{SS}	R_{qH8}	100			Ω

ETA switch-on transistor output

		min	typ	max	
H output current $V_{q7} = V_{SS}-4$ V	I_{qH7}	100		10000	μA

Row input 1 to 8 (internal pull-high resistors)

Instructions can be transmitted by connecting the respective row input with the corresponding column output (refer to instruction set). Operating errors, such as connecting more than one respective row and column are recognized and transmission is interrupted. Only exception: instruction extension with row 8 (see input, keyboard).

The connection can include as max. resistance a silicon diode junction in forward direction and a 100 Ω resistance in series. Minimum resistance is zero.

ETA input

The ETA input is connected to the supply voltage via the base-emitter diode of the NPN switching transistor for normal transmitting operations.

PPIN program input

If the PPIN input is joined with the corresponding column output or with the IRA output (in this case = 33 kΩ $\leq R_{IRA} \leq$ 47 kΩ) the output mode can be changed in accordance with the table "PPIN connections".

Example
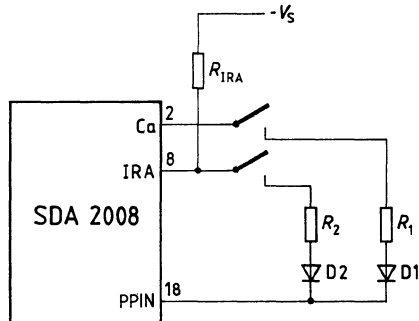
$33 \text{ k}\Omega \leq R_{IRA} \leq 47 \text{ k}\Omega$
$R_1 R_2 \leq 100 \ \Omega$
$D1, D2 = V_1 \leq 0\text{-}8 \text{ V at } I_F = 0.1 \text{ mA}$
and $T_{A\,min}$

Description of function

The SDA 2008 IC operates as a transmitter for the infrared remote control system IR 60.

The PMOS circuit contains a control output for an NPN transistor which deactivates the supply voltage if the keyboard is not activated (i.e. no row is in "low" state).

Input, keyboard

The transmitter contains an input matrix of 8 rows and 4 columns. In order to input an instruction, a row must be connected to a column. Thus, the transmitter is switched on and the appropriate instruction is sent. Without further measures it is possible to issue up to 32 instructions. The instruction set can be extended up to 60 either with the aid of additional diodes (for this purpose 2 diodes are required for each 4 additional instructions) or up to 62 instructions with a shift key. In both cases the additional connection (diodes to row 8 or shift key) is necessary prior to issuing the first instruction — after that the originally allocated instruction is sent independent of the additional connection.

As a fifth matrix column, $- V_S$ can be used to input the instructions 40 to 47 (without external diode connection using only one key, each).

Operating error

The circuit includes a security lock against multi-operations (several keys are depressed simultaneously). An exception is the double operation inside a column with one of the rows 1 to 7 and row 8, since this combination is used in order to extend the instruction set with the aid of diodes. After transmission of the first infrared instruction after the startbit, this double operation is locked as well.

Start instruction, end instruction

After the switch-on, the instruction No. 62 is issued as start instruction thus indicating to the receiver the start of the instruction transmission.

In case of an operating error, this instruction is generated by the security lock. If the key or keys are released, the selected instruction is sent once more (depending upon the exact instant of release) while the instruction No. 62 is sent once as stop before the supply voltage is switched off. Safety measures prevent to change an instruction to any other than instruction No. 62.

Output

The transmitter encodes the input in bi-phase code (refer to timing diagram). Prior to the 6 information bits, a presignal and a startbit which can be selected via PPIN, are sent. The presignal enables proper control of the preamplifier on the receiver side, whereas the startbit is used for receiver discrimination. Thus it is possible to control a TV set and a radio in one room independently of each other with the same remote control system.

The output signal is carried at 1/16 of the clock frequency ($f_{CLKi}/16$) and a pulse duty factor of 1:4. With the help of corresponding wiring of the program input PPIN, the carrier can be switched off. Thus any other external carrier can be used.

Instruction interval

The interval between two given instructions (except the start instruction) is approximately 12 times the instruction length (incl. presignal) or 35536 CLKI clocks, respectively. This interval can be reduced to 30976 CLKI clocks in order to obtain diminished instruction intervals at lower clock frequencies.

Operation at low clock frequency

The prescaler (divide by 8) can be switched off. Thus, operation is possible at a clock frequency of approx. 500 kHz or 62.5 kHz, as required. The prescaler can only be switched off if — at low resistance — the IRA output is not forced to low (by means of a base-emitter space), e.g. in the case of wiring for front-end control.

Operation without switching transistor

During operations with a fixed supply voltage (ETA = low), the columns a to d are periodically interrogated (H pulse) in the normal sequence (as if an instruction is emitted) in order to permit an external synchronization.

After the supply voltage began to rise at 0 V, the flow of control is brought into a definite state and starts column interrogation. After having recognized a row in the "low" state, the flow of control is reset – then the flow corresponds until disconnection to the flow present during battery operations. After transmission has ended, the flow of control continues column interrogation, however, without any further output to IRA.

Multitransmitter operation

Without great increase in external circuitry, it is possible to cascade two SDA 2008 ICs so that they can be multiplexed to give out the instructions. For this purpose, the automatic resetting of the flow control and the instruction register are utilized which become effective as soon as both columns a and b are on high.

PPIN connections

Connect with:	Function
Column a	Shift into second instruction group (bit F = "1")
Column b	Shortened instruction interval
Column c	Startbit = "0"
Column d	No carrier of the IRA signal
IRA	Bridging the prescaler

(In the case of combinations of these functions, decoupling with diodes according to figure PPIN connection is necessary).

ETA connection

ETA = V_{DD}	Operation at constant supply voltage. If no row is set to "low", IRA is without output, however permanent column interrogation.
ETA to base of the voltage commutation transistor	Normal battery operation including disconnection of the supply voltage after the end instruction at open row combination.

Instruction set

No diodes at row 8 unshifted		
Instr. No.	Code FED CBA	Key
0	000 000	1a
1	000 001	1b
2	000 010	1c
3	000 011	1d
4	000 100	2a
5	000 101	2b
6	000 110	2c
7	000 111	2d
8	001 000	3a
9	001 001	3b
10	001 010	3c
11	001 011	3d
12	001 100	4a
13	001 101	4b
14	001 110	4c
15	001 111	4d
16	010 000	5a
17	010 001	5b
18	010 010	5c
19	010 011	5d
20	010 100	6a
21	010 101	6b
22	010 110	6c
23	010 111	6d
24	011 000	7a
25	011 001	7b
26	011 010	7c
27	011 011	7d
28	011 100	8a
29	011 101	8b
30	011 110	8c
31	011 111	8d

No diodes at row 8 shifted		
Instr. No.	Code FED CBA	
32	100 000	
33	100 001	
34	100 010	
35	100 011	
36	100 100	
37	100 101	
38	100 110	
39	100 111	
40	101 000	
41	101 001	
42	101 010	
43	101 011	
44	101 100	
45	101 101	
46	101 110	
47	101 111	
48	110 000	
49	110 001	
50	110 010	
51	110 011	
52	110 100	
53	110 101	
54	110 110	
55	110 111	
56	111 000	
57	111 001	
58	111 010	
59	111 011	
60	111 100	
61	111 101	
62	111 110 } end instructions	
62	111 110	

With diodes at row 8 unshifted/shifted		
Instr. No.	Code FED CBA	Key
32	100 000	81a
33	100 001	81b
34	100 010	81c
35	100 011	81d
36	100 100	82a
37	100 101	82b
38	100 110	82c
39	100 111	82d
40	101 000	83a
41	101 001	83b
42	101 010	83c
43	101 011	83d
44	101 100	84a
45	101 101	84b
46	101 110	84c
47	101 111	84d
48	110 000	85a
49	110 001	85b
50	110 010	85c
51	110 011	85d
52	110 100	86a
53	110 101	86b
54	110 110	86c
55	110 111	86d
56	111 000	87a
57	111 001	87b
58	111 010	87c
59	111 011	87d

Special group unshifted/shifted		
Instr. No.	Code FED CBA	Key
40	101 000	1L
41	101 001	2L
42	101 010	3L
43	101 011	4L
44	101 100	5L
45	101 101	6L
46	101 110	7L
47	101 111	8L

Instruction interval (prescaler switched on)

Interval	Interval in CLKI clocks	Interval in ms $f_{CLKI} = 500$ kHz	PPIN connected to column b
Normal	65536	approx. 131	————————
Reduced	30976	approx. 62	X

Definition of the instruction interval

Instruction Interval
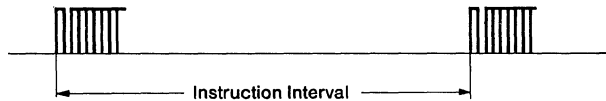
Hints for special functions

	IR remote control TV/radio sets	Front-end operation TV/radio sets	Transmission via AF cable	Remote control for model rail way	Typewriter keyboard	Time programmable remote control	TV games	Light switch remote control
Start bit changeover	X	X	X	X	X	X	X	
Shift into second group	X	X	X	X		X	X	
Diode matrix	X	X	X	X	X	X	X	
Special instruction group	X	X	X	X	X	X	X	
No carrier		X	X		X			
Bridged prescaler		X						
Shortened instruction interval			X	X				
No debounce delay								X
Special connection			X		X	X		

110

Pin description

Pin	Function
1	V_{SS}, +supply voltage
2	Column a
3	Column b
4	Column c
5	Column d
6	V_{DD}, −supply voltage
7	ETA (switch-on transistor output)
8	IRA (infrared output)
9	Row 1
10	Row 2
11	Row 3
12	Row 4
13	Row 5
14	Row 6
15	Row 7
16	Row 8
17	CLKI (oscillator input)
18	PPIN (programming input)

Oscillator connection

1)
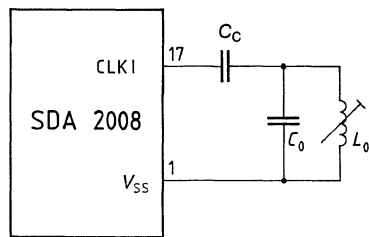
2)
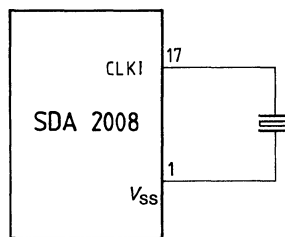
$$C_c \geq 10\,nF \qquad f_{CLKI} \approx \frac{1}{2\pi\sqrt{L_0\,C_0}}$$

Leakage current, total current (test circuit)

$I \geq -1\mu A$

$V_q = -10 V$

$T_A = 25°C$
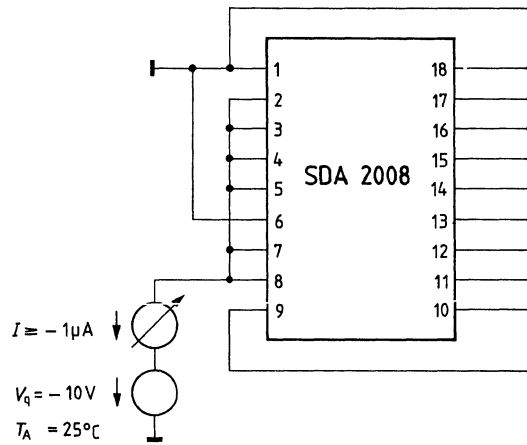
IRA remote control signal output (test circuit)

$\geq 6V$

1

V_{SS}

SDA 2008

8

IRA

V_{DD}

6

0 V

$V < 5V$

$I = 4 mA$
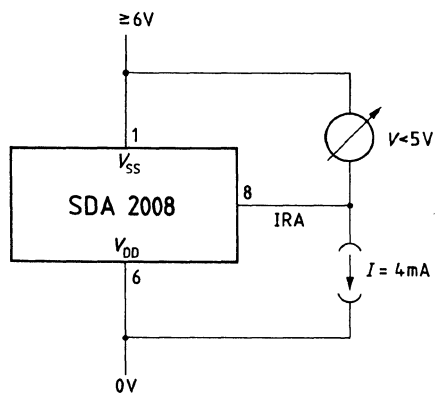
Biphase coding from instruction 011001

Def: for "0" and "1"

1) with Carrier
2) without Carrier
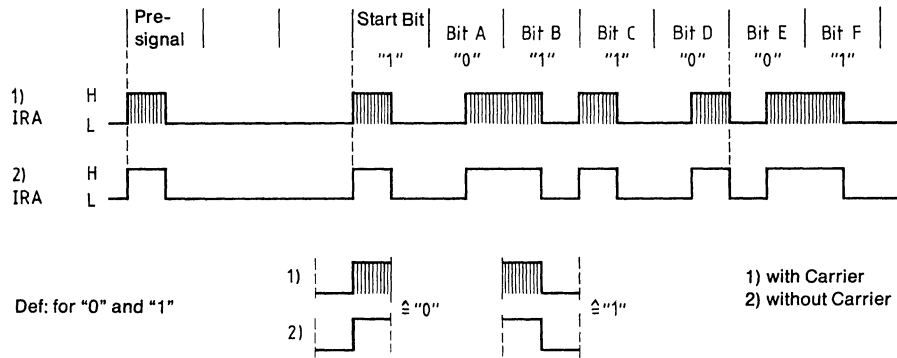
Exact Pulse Train of a Burst for 1):

$$\left(\text{with } T = \frac{16}{f_{CLKI}}, \text{ or } T = \frac{2}{f_{CLKI}}\right)$$
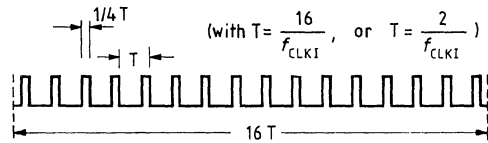
Actuating a key (e.g. 1a), $f_{CLKI} = 500$ kHz
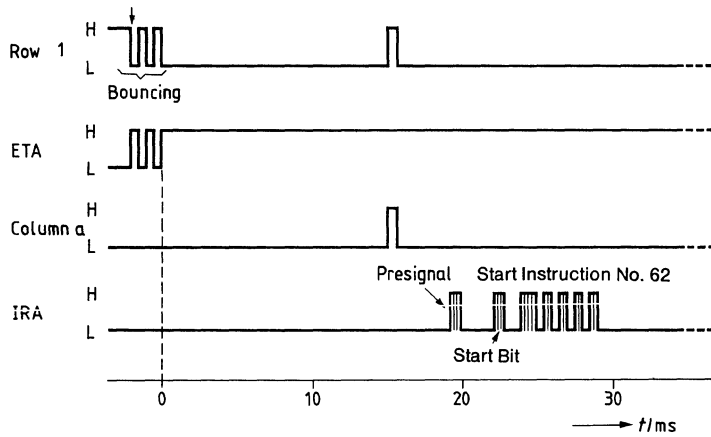
Releasing a key (1a), $f_{CLKI} = 500$ kHz
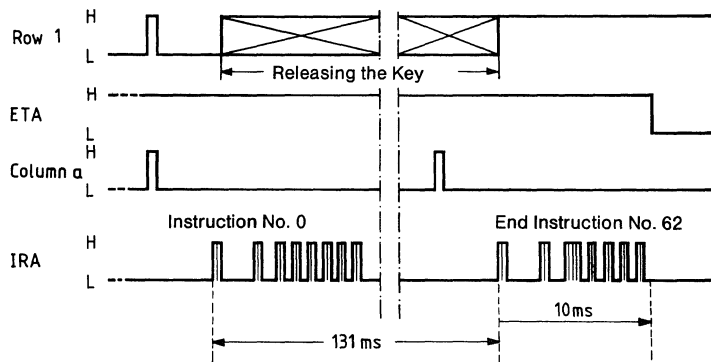
Instruction interval, f_{CLKI} = 500 kHz
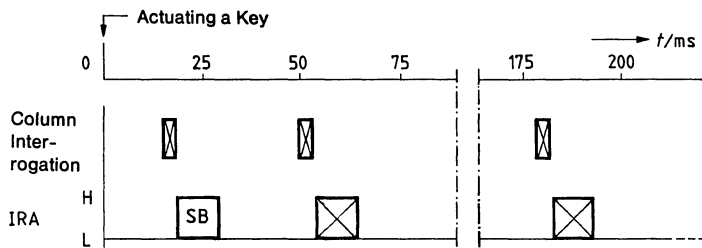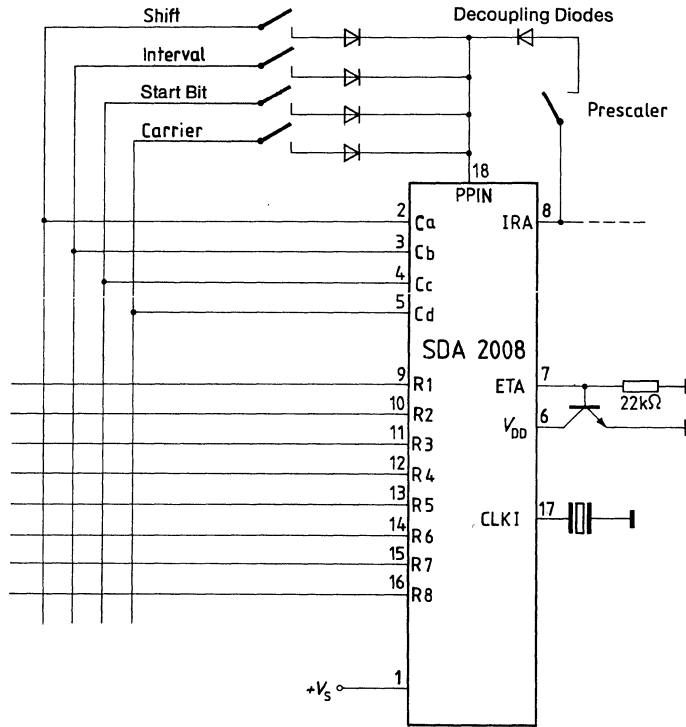

PPIN at IRA (bridged prescaler) f_{CLKI} = 62.5 kHz
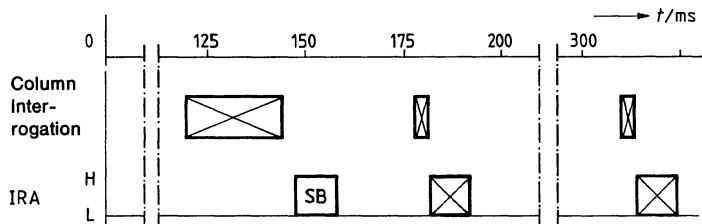
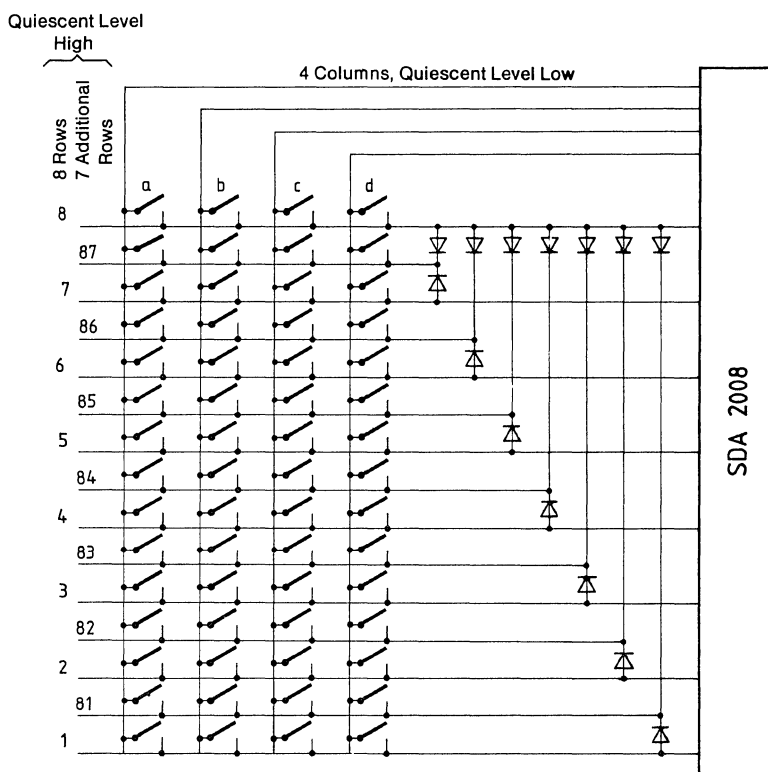**PPIN at column b (shortened instruction interval) f_{CLKI} = 500 kHz**
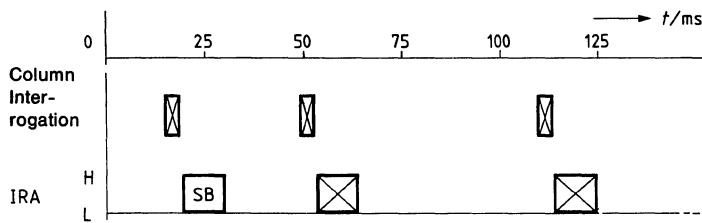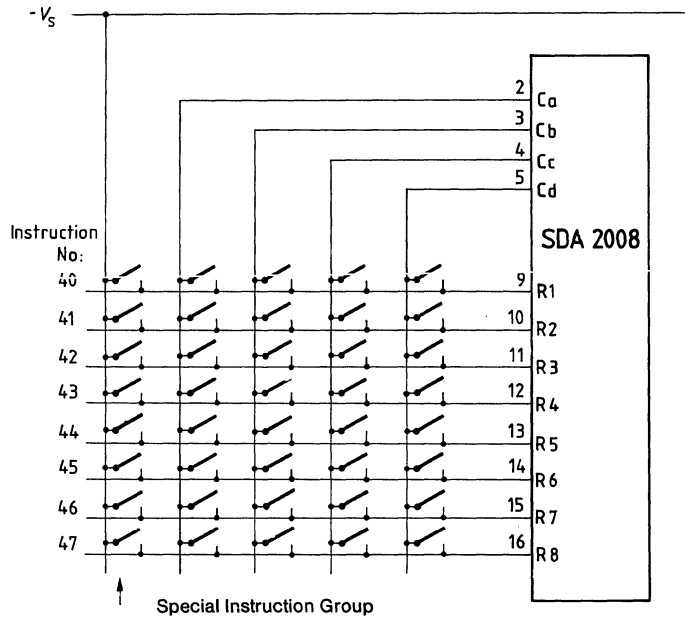

SB: = Instruction No. 62

PPIN connection

Extension for 60 instructions with additional diodes

−V_S as fifth matrix column

Special Instruction Group

Application circuit
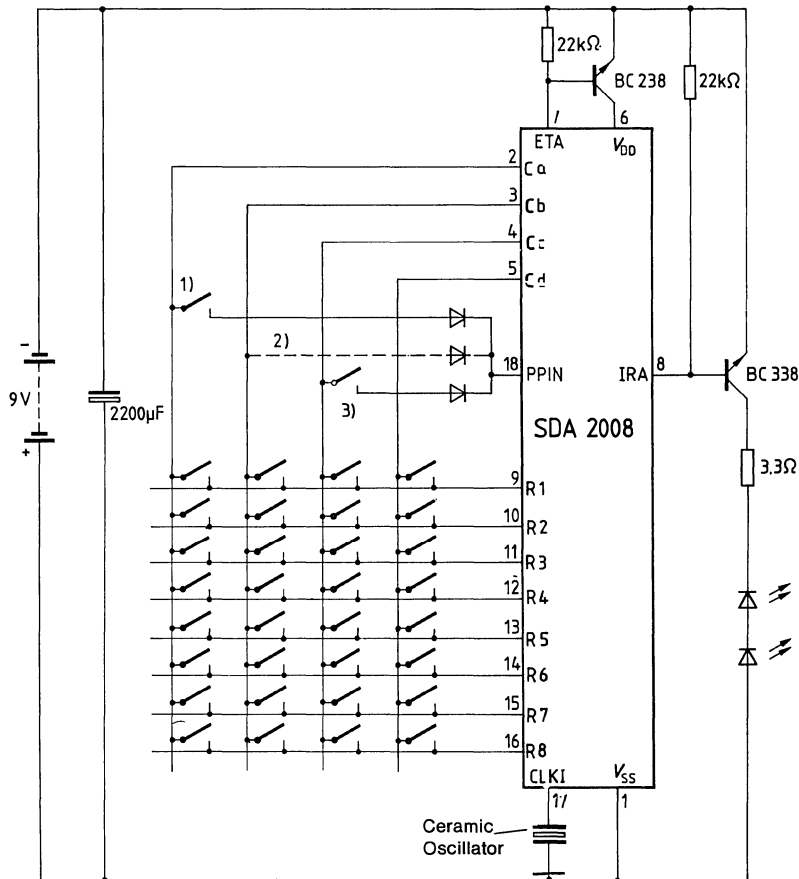
1) Shift key
2) Connection for shortened instruction interval
3) Start bit changeover

If only one of these three possibilities is used, no diode is required.