REMOTE OR LOCAL TRANSMITTER/ENCODER

The SAB3021 is a MOS N-channel integrated circuit which provides the encoding and modulation functions for the remote or local control of, for example, television and radio receivers.

Features

- Transmitter for 2 x 64 commands.
- One transmitter for two types of equipment, e.g. radio and television.
- Very low current consumption.
- Designed for remote infrared or local operation.
- Transmission by means of a pulse code modulation.
- Short interval between operation and re-operation of the same key, due to automatic double word spacing.

QUICK REFERENCE DATA

Supply voltage range (remote)	V_{DD}		6 to 10,5	V
Supply voltage range (local)	V_{DD}		4,75 to 6	V
Operating ambient temperature range	T_{amb}		-20 to +70	°C
Nominal oscillator input frequency (remote mode)	f_{QCLS}		4	MHz
Quiescent current $V_{DD} = 10,5$ V; remote mode	I_{DD}	typ.	10	µA

SAB3021 block: OSCILLATOR/DIVIDER (QCLS 10, QCL 9), KEYBOARD SCANNER/COUNTER, PULSE CODE MODULATOR, OUTPUT STAGE (REMO 11), MATRIX/SENSE, MATRIX/DRIVE.

MSEL 14, n.c. 15, MOC 13, V_{SS} 12, V_{DD} 24

SEN0N 3, SEN1N 4, SEN2N 2, SEN3N 5, SEN4N 7, SEN5N 6, SEN6N, SEN7N 8

DRV0N 16, DRV1N 17, DRV2N 18, DRV3N 19, DRV4N 20, DRV5N 21, DRV6N 22, DRV7N 23
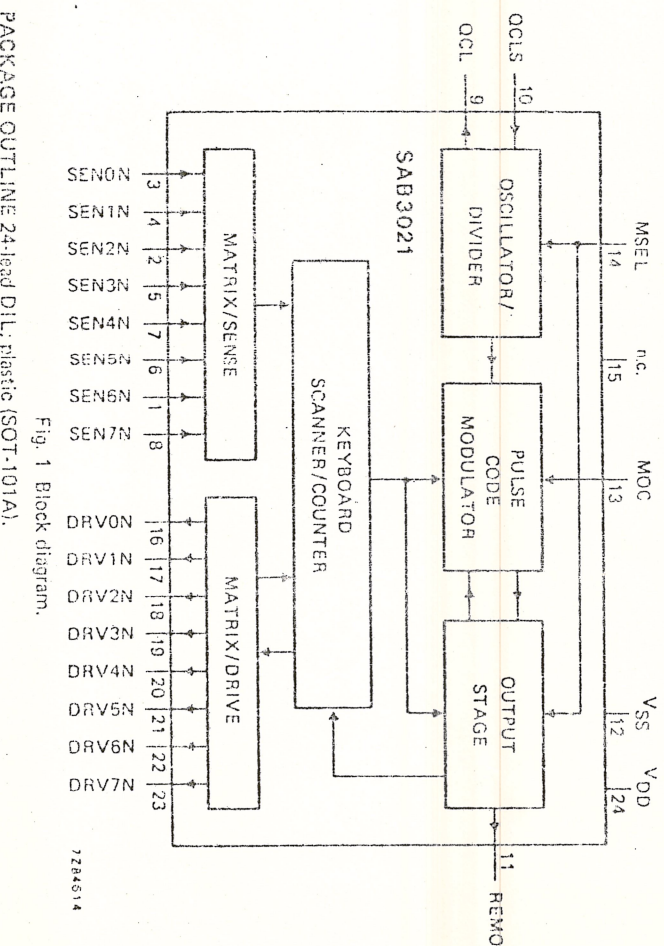
Fig. 1 Block diagram.

PACKAGE OUTLINE 24-lead DIL; plastic (SOT-101A).

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CHARACTERISTICS (continued)

	V_{DD} V	symbol	min.	typ.	max.		conditions
Input MOC							
Switching threshold voltage		V_I	0,8	–	3,5	V	$V_I = V_{DD}$
Input leakage current		I_{IR}	–	–	1	µA	
Oscillator QCL and QCLS							$T_{amb} = 0$ to +70 °C
Oscillator frequency	6 to 10,5	f_{QCLS}	–	4	4,5	MHz	MSEL = LOW
External frequency	4,75 to 6	f_{QCLS}	45	62,5	80	kHz	MSEL = HIGH
Output REMO							
Output voltage LOW	4,75 to 10,5	V_{OL}	–	–	0,5	V	$I_O = 1$ mA
Output voltage HIGH for remote control	6 to 10,5	V_{OH}	3	–	–	V	$-I_O = 1$ mA, MSEL = LOW
Output voltage HIGH for local control	4,75 to 6	V_{OH}	3,5	–	–	V	$-I_O = 20$ µA, MSEL = V_{DD}

OPERATION DESCRIPTION

When a key is depressed the device starts and the circuit completes a reset cycle. The keyboard is scanned until the activated key is located. This process takes about 64 µs to 512 µs. The generated, pulse width modulated, data words are produced at output REMO.
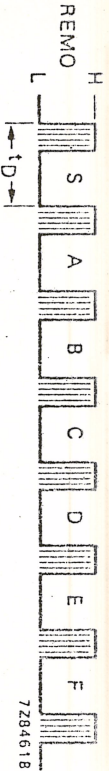

Fig. 3 7-bit data word at output REMO.

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The binary code elements are represented by pulse separations t_D, which follow one another as a series in time. As well as the two pulse separations t_{D0} and t_{D1} used to represent '0' and '1', there are also two further time separations t_{DW} and t_{DS} involved by varying t_D. t_{DW} serves to separate transmitted directly after each other, whilst t_{DS} separates double words when the same key-command is given. The four time separations t_{D0}, t_{D1}, t_{DW} and t_{DS} are in the ratio 5 : 7 : 14 : 19 for infrared and local mode. The times given in Table 1, which depend on the clock frequency, show the operation of the SAB3021 (see also Fig. 4).
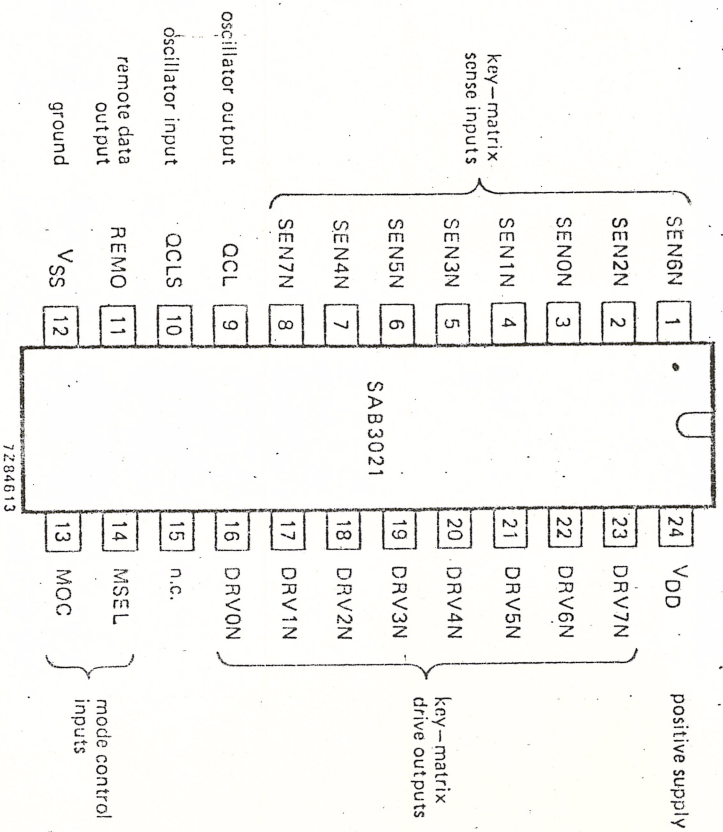
GENERAL DESCRIPTION

The SAB3021 is a MOS N-channel integrated circuit which provides the encoding and modulation functions for the control of, for example, television and radio receivers. It is designed to be used with the receiving circuits SAB3023 and SAB3042 or with a suitably programmed microcomputer. The device is designed for use in an infrared remote control link or as a local keyboard circuit.

128 commands can be generated by using a 64 key matrix with one additional toggle switch. The device automatically 'powers-up' when the first command is selected and reverts to the stand-by mode when the operation has been completed. In remote mode, the device is clocked directly by a 4 MHz crystal oscillator. In local mode, the device is clocked directly by the 62,5 kHz VTS (Video Tuning System) system clock. The SAB3021 generates a sequence of 8 short-duration bursts of pulses, representing a 7-bit word. The bit element is represented by different distances between the pulses. The 7-bit word (or command) is continuously repeated while a key is depressed and, after the first complete command (double word) the transmission stops as soon as the key is released.

During stand-by, with no key operated, the oscillator and logic are switched off, so only leakage and power-on reset latch currents determine the current consumption, thus minimizing battery load.

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 "Handling MOS Devices").

Fig. 2 Pinning diagram.

Pinning (SAB3021):

Pin	Name	Function
1	SEN6N	key-matrix sense inputs
2	SEN2N	
3	SEN0N	
4	SEN1N	
5	SEN3N	
6	SEN5N	
7	SEN4N	
8	SEN7N	
9	QCL	oscillator output
10	QCLS	oscillator input
11	REMO	remote data output
12	VSS	ground
13	MOC	mode control inputs
14	MSEL	
15	n.c.	
16	DRV0N	key-matrix drive outputs
17	DRV1N	
18	DRV2N	
19	DRV3N	
20	DRV4N	
21	DRV5N	
22	DRV6N	
23	DRV7N	
24	VDD	positive supply

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RATINGS (VSS = 0)

Limiting values in accordance with the Absolute Maximum System (IEC 134)

	symbol		conditions
Supply voltage range	V_{DD}	$-0,3$ to $+12$ V	
Input voltage range	V_I	$-0,3$ to $+12$ V	
Output voltage	V_O	$-0,3$ to $+12$ V	
Output current	$\pm I_O$	max. 10 mA	
Power dissipation per output DRV...N	P_O	max. 20 mW	
Power dissipation for output REMO	P_O	max. 100 mW	
Operating ambient temperature range	T_{amb}	-20 to $+70$ °C	
Storage temperature range	T_{stg}	-20 to $+125$ °C	

CHARACTERISTICS

VSS = 0 V; VDD = 9 V for remote and 5 V for local; Tamb = 25 °C; unless otherwise specified

	V_{DD} V	symbol	min.	typ.	max.	conditions
Supply voltage (remote)	—	V_{DD}	6	9	10,5 V	MSEL = LOW; Tamb = 0 to +70 °C
Supply voltage (local)	—	V_{DD}	4,75	5	6 V	MSEL = HIGH; Tamb = 0 to +70 °C
Supply current	10,5	I_{DD}	—	—	10 mA	Tamb = 0 to +70 °C
Quiescent supply current	10,5	I_{DD}	—	—	10 µA	MSEL = LOW
Inputs SEN...N						
Switching threshold voltage	—	V_{iL}	0,8	—	3,5 V	
Input current	—	$-I_I$	—	—	150 µA	$V_I = 0,3$ V
Outputs DRV...N Open drain outputs						
Output voltage LOW	—	V_{OL}	—	—	0,5 V	$I_O = 0,5$ mA
Output leakage current HIGH	—	I_{RH}	—	—	1 µA	$V_O = 10,5$ V
Input MSEL*						
Switching threshold voltage	10,5	V_i	0,8	—	3,5 V	
Input current	10,5	$-I_I$	—	—	0,5 mA	{ $V_I = 0$ V; REMO = VDD }
Input current	6	I_I	—	—	1 mA	{ $V_I = 6$ V; REMO = VSS }

* For local mode MSEL = V_{DD}; for remote mode MSEL = V_{SS}.

(conditions: max. external load 100 pF per output)

REMO

H
L

t_p t_M t_{PW} t_D

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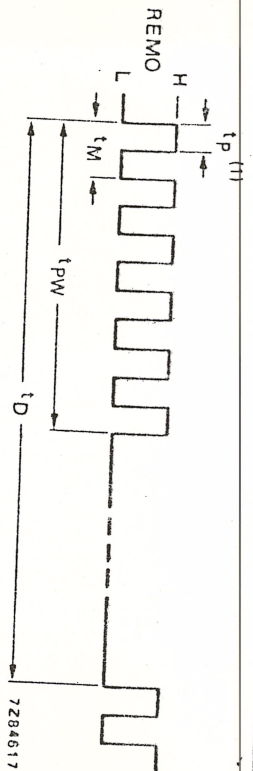
(1) 5 pulses (as shown) for the remote mode; 5 pulses for local mode.

Fig. 4 Output signal of the SAB3021 at output REMO.

Table 1

		remote control MSEL = LOW	local control MSEL = HIGH	(handwritten)
Clock frequency	f_Q	4 MHz	62,5 kHz	3MHz/64
Unity delay	t_{UD}	$4096/f_Q = 1024$ μs	$64/f_Q = 1024$ μs	
Pulse separation	t_p	$48/f_Q = 12$ μs	$1/f_Q = 16$ μs	
	t_M	$112/f_Q = 28$ μs	$2/f_Q = 32$ μs	
Carrier frequency	f_M	35,71 kHz	31,25 kHz	46,875 kHz / 23,4137,5 kHz
Pulse separation for '0'	t_{pW}	$5 \times t_M + t_p = 152$ μs	$4,5 \times t_M = 144$ μs	
Pulse separation for '1'	t_{D0}	$5 \times t_{UD} = 5,12$ ms		
Word separation	t_{D1}	$7 \times t_{UD} = 7,14$ ms		
Double word separation	t_{DW}	$14 \times t_{UD} = 14,34$ ms		
	t_{DS}	$19 \times t_{UD} = 19,46$ ms		

From the times of Table 1, one will see that, if a key is depressed continuously a data word will be generated every 50176 μs (e.g.: $7 \times 5 \times t_{UD} + t_{DW}$) for code 0 and S = 0 and every 64512 μs (e.g.: $7 \times 7 \times t_{UD} + t_{DW}$) for code 63 and S = 1 (see also Fig. 3).

The repeated data words are separated by the time t_{DW}.

After releasing a depressed key for a short time followed by directly depressing the same key or another, a double word separation will be generated after the first double word. A remote controlled receiver can now distinguish if the input signal is a continuously or a repeated same command.

Output (REMO)

REMO is the output for the pulse separation coded signal. Output REMO is LOW during standby.

An amplifier circuit for infrared operation is shown in the section APPLICATION INFORMATION.

Input MSEL must be connected to VDD (HIGH) for local operation. This causes the internal pull-up of a depletion type transistor between output REMO and VDD.

OPERATION DESCRIPTION (continued)

Mode programming inputs (MSEL and MOC)

The logic level at MSEL determines the operation mode; MSEL = LOW: remote control; MSEL = HIGH: local control.

The logic level at MOC determines the clock frequency, the allowable supply voltage range and the output current at REMO depend on the mode of operation.

The logic level at MOC determines the logic state of start bit S for data transmission:

MOC = LOW : S = 0 (e.g. for television applications),
MOC = HIGH: S = 1 (e.g. for radio applications).

Keyboard matrix sense inputs/driver outputs (SEN0N to SEN7N and DRV0N to DRV7N)

The keyboard matrix is connected between the driver outputs (DRV.N) and the sense inputs (SEN.N).

If no key is operated, all sense inputs are HIGH due to internal depletion type pull-up transistors.

The driver outputs are open drain N-channel transistors and in the standby mode these are all active; i.e. conductive to ground (VSS).

During scanning only one driver at a time is conductive to VSS (low-ohmic), while all the other drivers are high-ohmic. During the output process, a driver remains conductive, if its line locates an operated key.

Oscillator input/output (QCLS/QCL)

QCLS is the input and QCL the output of the oscillator. For a typical oscillator circuit see Fig. 5. The circuit operates as a quartz crystal oscillator in the remote control mode; for local control a clock signal of 62,5 kHz is applied to QCLS.

Table 2. Arrangement of IBUS code

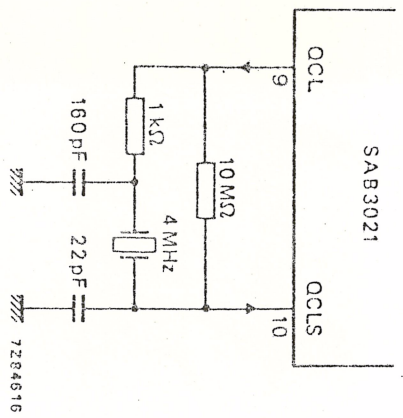| SEN.N	DRV.N	F	E	D	C	B	A	IBUS code no. MOC = LOW	IBUS code no. MOC = HIGH
0	1	0	0	0	0	0	0 to 111	64	8 to 15
1	0	0	0	0	0	1	0 to 111	65	16 to 23
2	0	0	0	0	1	0	0 to 111	66	24 to 31
3	0	0	0	0	1	1	0 to 111	67	32 to 39
4	0	0	0	1	0	0	0 to 111	68	40 to 47
5	0	0	0	1	0	1	0 to 111	69	48 to 55
6	0	0	0	1	1	0	0 to 111	70	56 to 63
7	0	0	0	1	1	1	0 to 111	71	72 to 79
0 to 7	1								80 to 87
0 to 7	2								88 to 95
0 to 7	3								96 to 103
0 to 7	4								104 to 111
0 to 7	5								112 to 119
0 to 7	6								120 to 127
0 to 7	7								

APPLICATION INFORMATION

Fig. 5 Example of a 4 MHz quartz oscillator.
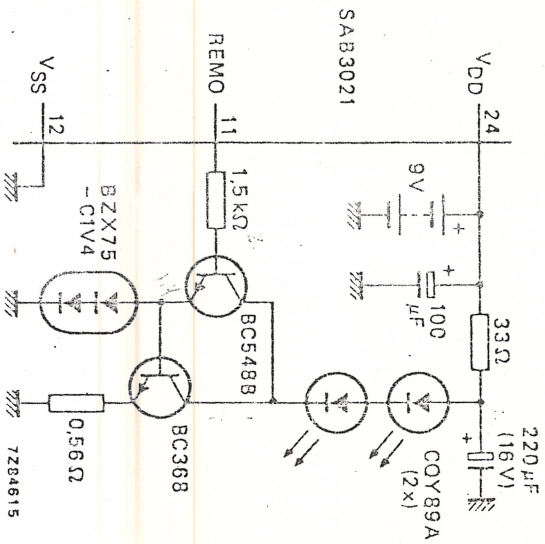
Fig. 6 Infrared transmitter circuit.