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

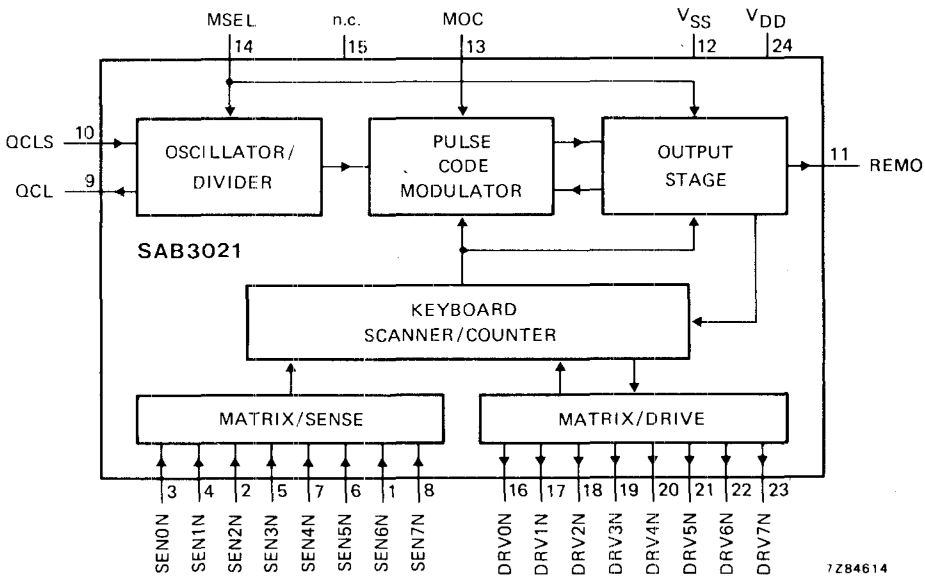

Fig. 1 Block diagram.

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

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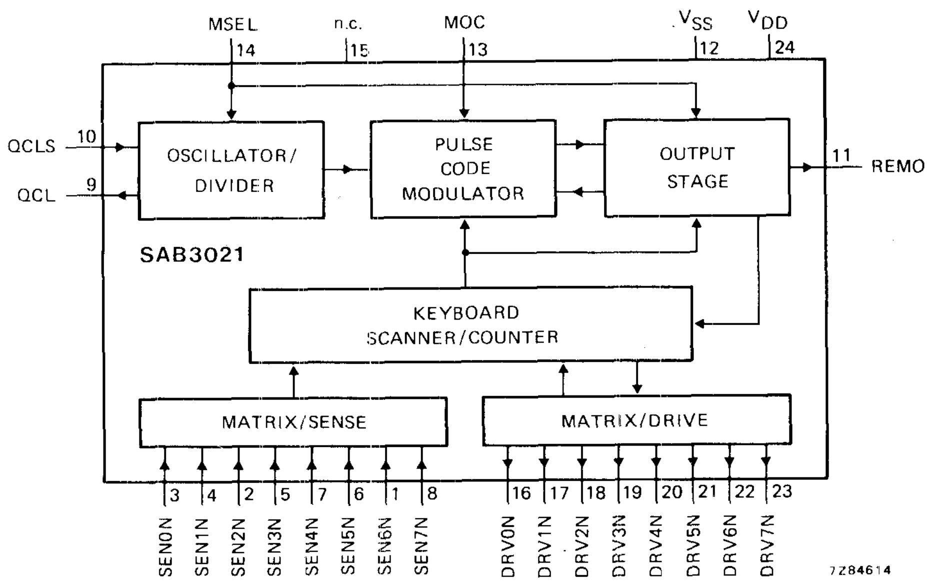
Operating ambient temperature range	T_{amb}		−20 to + 70 °C
Nominal oscillator input frequency (remote mode)	f_{QCLS}		4 MHz
Quiescent current V_{DD} = 10,5 V; remote mode	I_{DD}	typ.	10 μA



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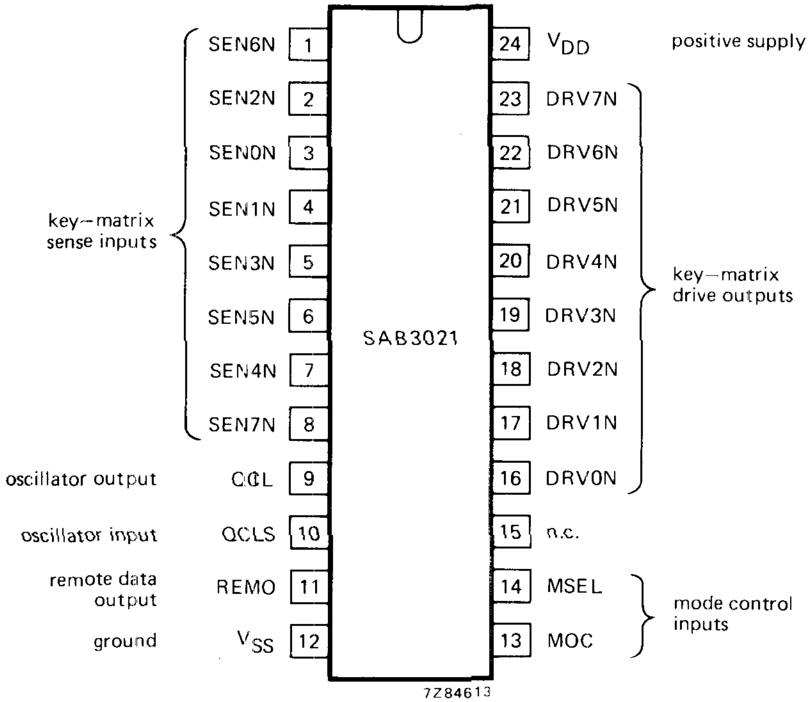


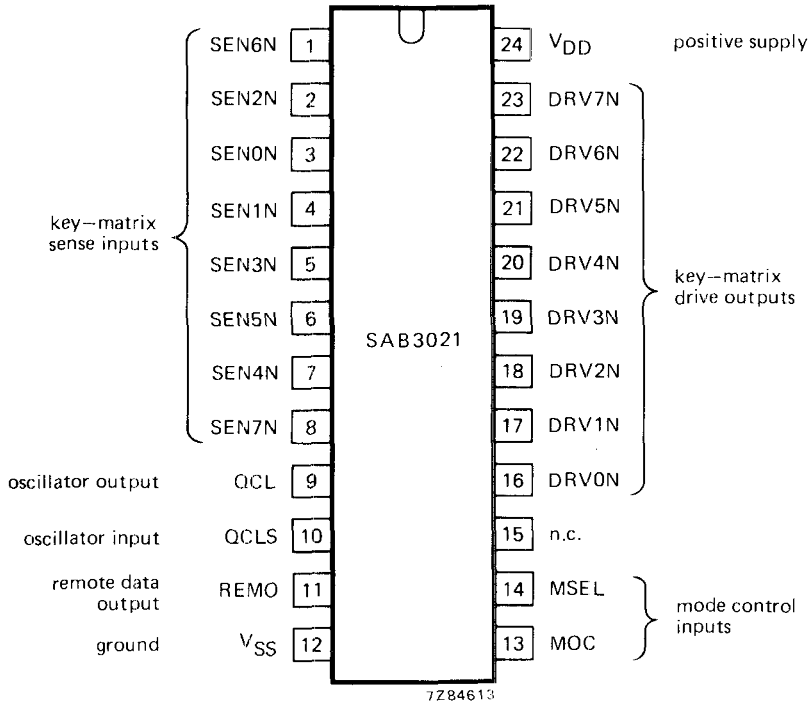
Fig. 2 Pinning diagram.

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 system clock is generated 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").



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RATINGS (V_{SS} = 0)

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

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

V_{SS} = 0 V; V_{DD} = 9 V for remote and 5 V for local; T_{amb} = 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; T_{amb} = 0 to + 70 °C
Supply voltage (local)	–	V_{DD}	4,75	5	6	V	MSEL = HIGH; T_{amb} = 0 to + 70 °C
Supply current	10,5	I_{DD}	–	–	10	mA	T_{amb} = 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		$-I_I$	25	–	150	μA	V_I = 0,3 V
Outputs DRV...N							
Open drain outputs							max. external load 100 pF per output
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		V_I	0,8	–	3,5	V	
Input current	10,5	$-I_I$	–	–	0,5	mA	V_I = 0 V; REMO = V_{DD}
Input current	6	I_I	–	–	1	mA	V_I = 6 V; REMO = V_{SS}

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

RATINGS (V_{SS} = 0)

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

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

V_{SS} = 0 V; V_{DD} = 9 V for remote and 5 V for local; T_{amb} = 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; T_{amb} = 0 to + 70 °C
Supply voltage (local)	–	V_{DD}	4,75	5	6	V	MSEL = HIGH; T_{amb} = 0 to + 70 °C
Supply current	10,5	I_{DD}	–	–	10	mA	T_{amb} = 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		$-I_I$	25	–	150	μA	V_I = 0,3 V
Outputs DRV...N							
Open drain outputs							max. external load 100 pF per output
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		V_I	0,8	–	3,5	V	
Input current	10,5	$-I_I$	–	–	0,5	mA	V_I = 0 V; REMO = V_{DD}
Input current	6	I_I	–	–	1	mA	V_I = 6 V; REMO = V_{SS}

DEVELOPMENT SAMPLE DATA

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

CHARACTERISTICS (continued)

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

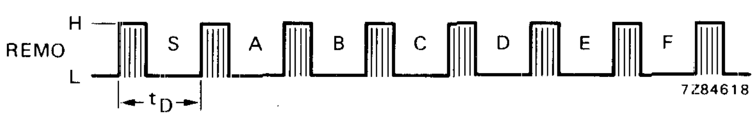

Fig. 3 7-bit data word at output REMO.

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 words 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).

CHARACTERISTICS (continued)

	V_{DD} V	symbol	min.	typ.	max.		conditions
Input MOC							
Switching threshold voltage		V_I	0,8	–	3,5	V	
Input leakage current		I_{IR}	–	–	1	μA	$V_I = V_{DD}$
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							T_{amb} = 0 to + 70 °C
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}

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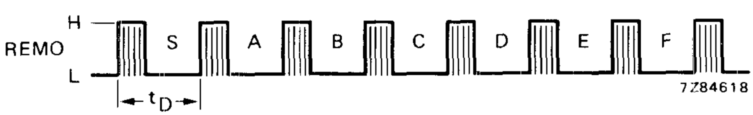

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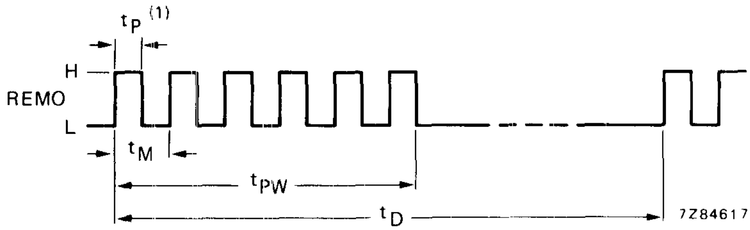


(1) 6 pulses (as shown) for the remote mode; 5 pulses for local mode.

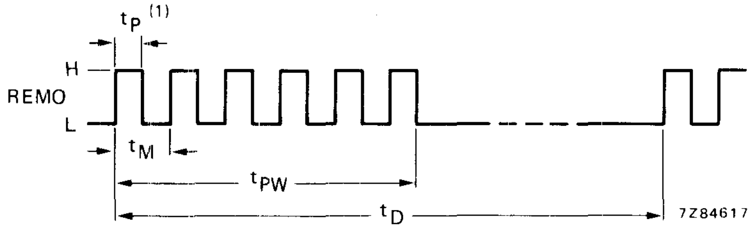
Fig. 4 Output signal of the SAB3021 at output REMO.

Table 1		remote control MSEL = LOW	local control MSEL = HIGH
Clock frequency	f_Q	4 MHz	62,5 kHz
Unity delay	t_{UD}	$4096/f_Q = 1024\ \mu s$	$64/f_Q = 1024\ \mu s$
	t_P	$48/f_Q = 12\ \mu s$	$1/f_Q = 16\ \mu s$
	t_M	$112/f_Q = 28\ \mu s$	$2/f_Q = 32\ \mu s$
Carrier frequency	f_M	35,71 kHz	31,25 kHz
	t_{PW}	$5 \times t_M + t_P = 152\ \mu s$	$4{,}5 \times t_M = 144\ \mu s$
Pulse separation for '0'	t_{D0}	$5 \times t_{UD} = 5{,}12$ ms	
Pulse separation for '1'	t_{D1}	$7 \times t_{UD} = 7{,}14$ ms	
Word separation	t_{DW}	$14 \times t_{UD} = 14{,}34$ ms	
Double word separation	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 V_{DD} (HIGH) for local operation. This causes the internal pull-up of a depletion type transistor between output REMO and V_{DD}.



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	t_M	$112/f_Q$ = 28 μs	$2/f_Q$ = 32 μs
Carrier frequency	f_M	35,71 kHz	31,25 kHz
	t_{PW}	$5 \times t_M + t_P$ = 152 μs	$4,5 \times t_M$ = 144 μs
Pulse separation for '0'	t_{D0}	$5 \times t_{UD}$ = 5,12 ms	
Pulse separation for '1'	t_{D1}	$7 \times t_{UD}$ = 7,14 ms	
Word separation	t_{DW}	$14 \times t_{UD}$ = 14,34 ms	
Double word separation	t_{DS}	$19 \times t_{UD}$ = 19,46 ms	

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DEVELOPMENT SAMPLE DATA

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 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 (V_{SS}).
During scanning only one driver at a time is conductive to V_{SS} (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 (OCLS/OCL)

OCLS is the input and OCL 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 OCLS.

Table 2. Arrangement of IBUS code

SEN . N	DRV . N	IBUS code						IBUS code no.	
		F	E	D	C	B	A	MOC = LOW	MOC = HIGH
0	0	0	0	0	0	0	0	0	64
1	0	0	0	0	0	0	1	1	65
2	0	0	0	0	0	1	0	2	66
3	0	0	0	0	0	1	1	3	67
4	0	0	0	0	1	0	0	4	68
5	0	0	0	0	1	0	1	5	69
6	0	0	0	0	1	1	0	6	70
7	0	0	0	0	1	1	1	7	71
0 to 7	1	0	0	1	000	to	111	8 to 15	72 to 79
0 to 7	2	0	1	0	000	to	111	16 to 23	80 to 87
0 to 7	3	0	1	1	000	to	111	24 to 31	88 to 95
0 to 7	4	1	0	0	000	to	111	32 to 39	96 to 103
0 to 7	5	1	0	1	000	to	111	40 to 47	104 to 111
0 to 7	6	1	1	0	000	to	111	48 to 55	112 to 119
0 to 7	7	1	1	1	000	to	111	56 to 63	120 to 127

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 clock frequency, the allowable supply voltage range and the output current at REMO depend on the mode of operation.
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During scanning only one driver at a time is conductive to V_{SS} (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.

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		F	E	D	C	B	A	MOC = LOW	MOC = HIGH
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1	0	0	0	0	0	0	1	1	65
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3	0	0	0	0	0	1	1	3	67
4	0	0	0	0	1	0	0	4	68
5	0	0	0	0	1	0	1	5	69
6	0	0	0	0	1	1	0	6	70
7	0	0	0	0	1	1	1	7	71
0 to 7	1	0	0	1	000	to	111	8 to 15	72 to 79
0 to 7	2	0	1	0	000	to	111	16 to 23	80 to 87
0 to 7	3	0	1	1	000	to	111	24 to 31	88 to 95
0 to 7	4	1	0	0	000	to	111	32 to 39	96 to 103
0 to 7	5	1	0	1	000	to	111	40 to 47	104 to 111
0 to 7	6	1	1	0	000	to	111	48 to 55	112 to 119
0 to 7	7	1	1	1	000	to	111	56 to 63	120 to 127

APPLICATION INFORMATION

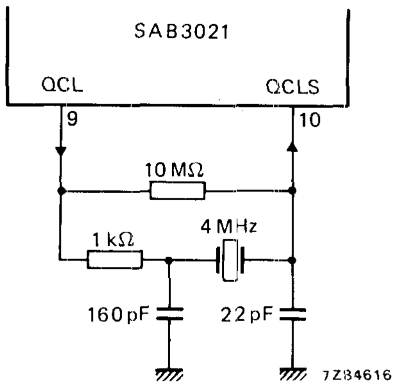


Fig. 5 Example of a 4 MHz quartz oscillator.

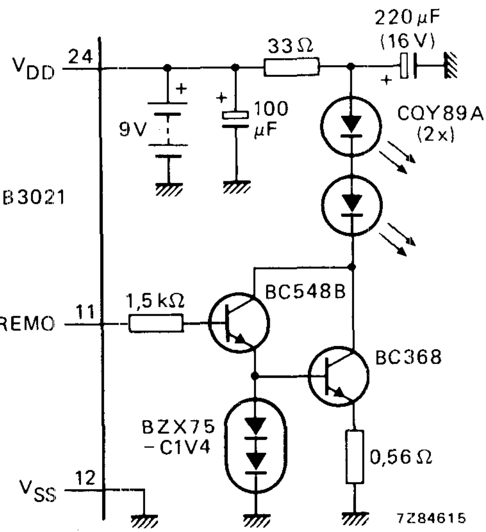
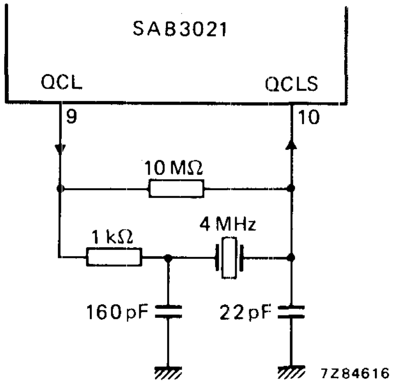


Fig. 6 Infrared transmitter circuit.

DEVELOPMENT SAMPLE DATA

APPLICATION INFORMATION



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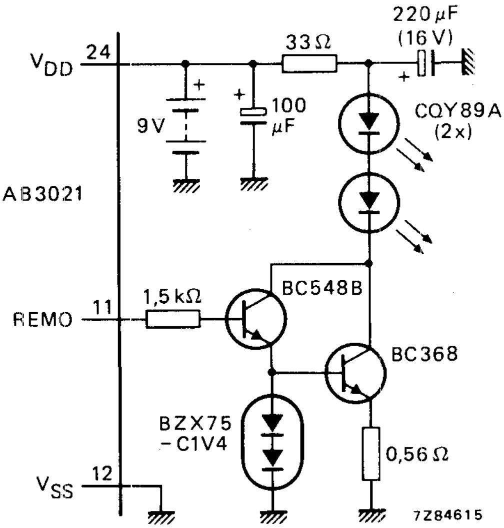


Fig. 6 Infrared transmitter circuit.

DEVELOPMENT SAMPLE DATA

APPLICATION INFORMATION (continued)

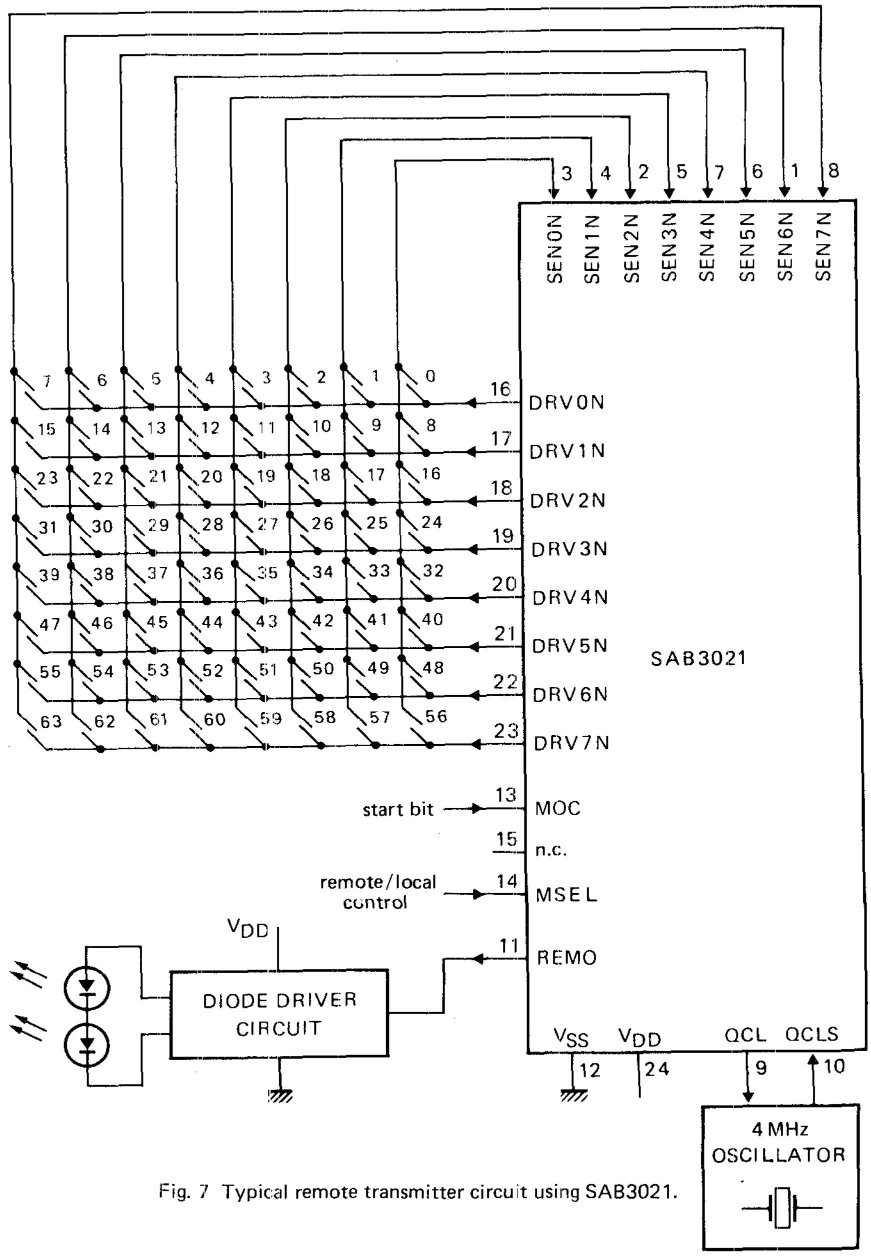


Fig. 7 Typical remote transmitter circuit using SAB3021.

APPLICATION INFORMATION (continued)

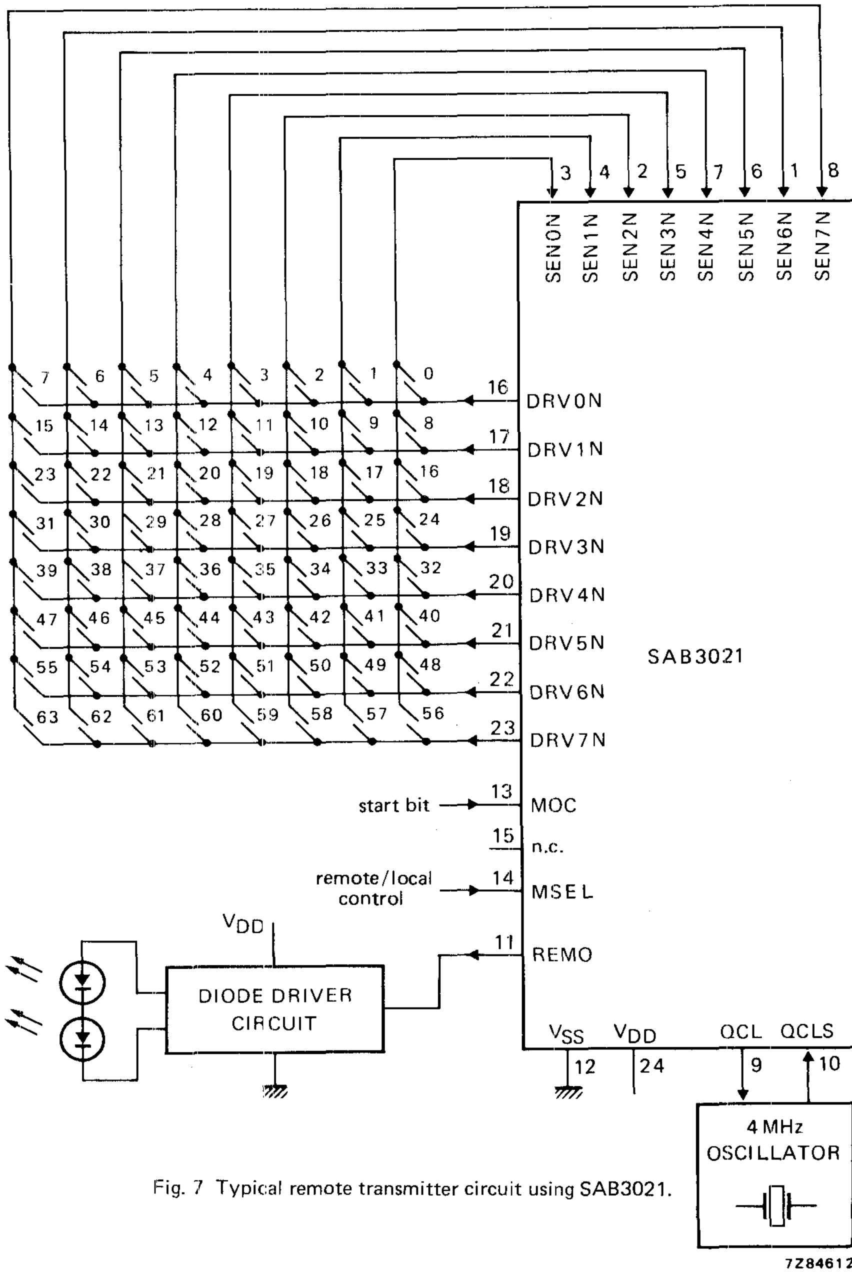
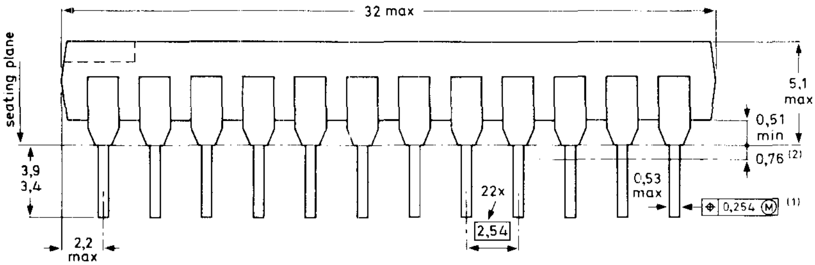
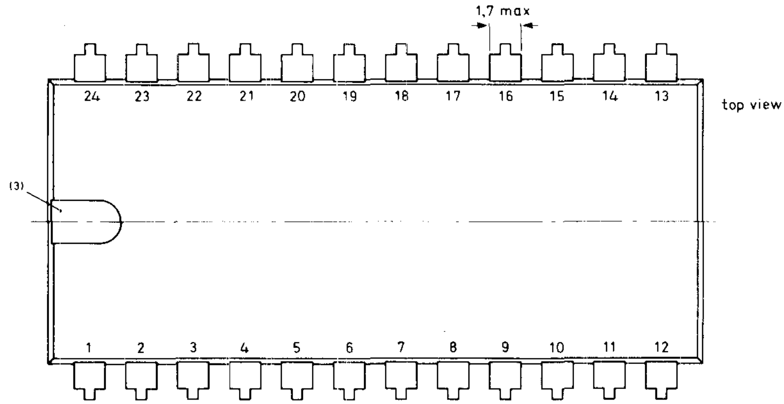
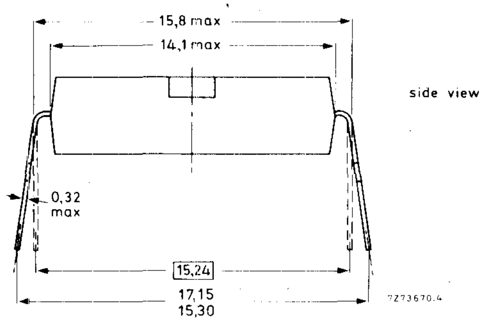


Fig. 7 Typical remote transmitter circuit using SAB3021.

24-LEAD DUAL IN-LINE; PLASTIC (SOT-101A)







⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ±0,127 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by ±0,254 mm.

(2) Lead spacing tolerances apply from seating plane to the line indicated.

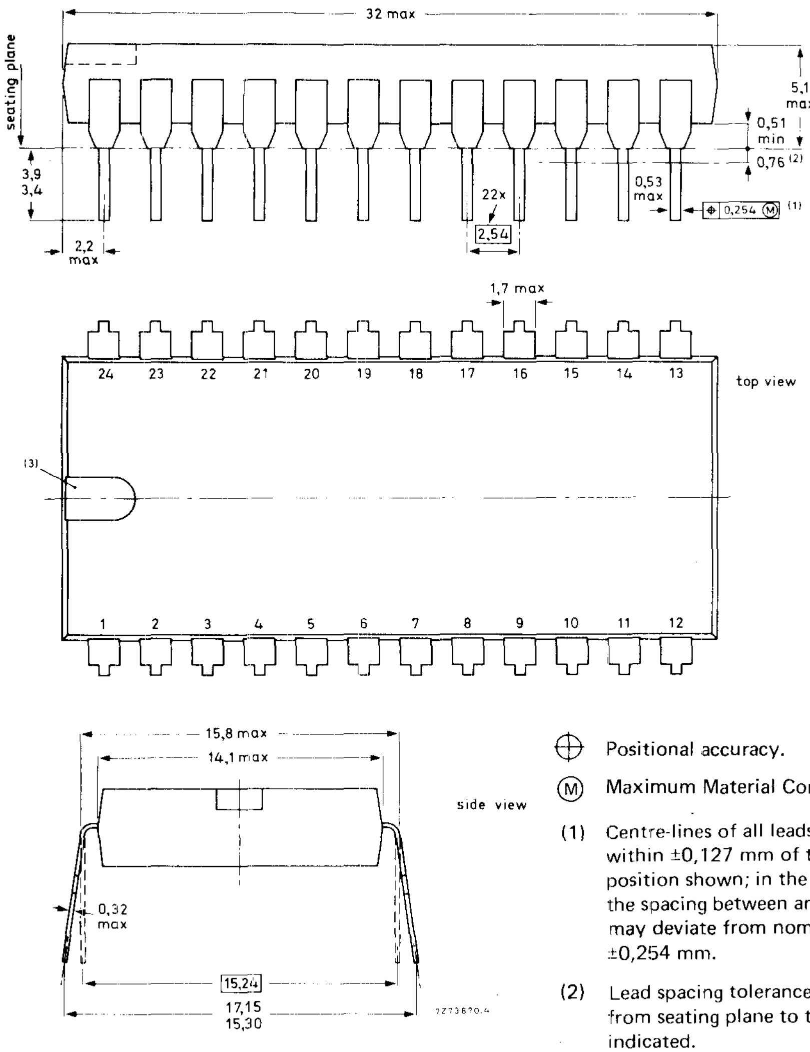
(3) Index may be horizontal as shown, or vertical.

Dimensions in mm

SOLDERING

See next page.

24-LEAD DUAL IN-LINE; PLASTIC (SOT-101A)



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(3) Index may be horizontal as shown, or vertical.

SOLDERING

See next page.

SOLDERING

1. By hand

Apply the soldering iron below the seating plane (or not more than 2 mm above it).
If its temperature is below 300 °C it must not be in contact for more than 10 seconds; if between 300 °C and 400 °C, for not more than 5 seconds.

2. By dip or wave

The maximum permissible temperature of the solder is 260 °C; this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.
The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified storage maximum. If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

3. Repairing soldered joints

The same precautions and limits apply as in (1) above.

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