MOS INTEGRATED CIRCUIT

M 1025

30-CHANNEL REMOTE CONTROL RECEIVER

- 3 ANALOG OUTPUT SIGNALS
- 5 BINARY-CODED INPUT/OUTPUT LINES
- MAINS SWITCH OUTPUT
- MUTING FUNCTION
- NORMALIZATION OF ANALOG SIGNALS
- STORAGE AVAILABILITY OF ANALOG SIGNALS

The M 1025 is a monolithic integrated circuit intended for a remote-controlled system in which 30 different ultrasonic frequencies are used to transmit 30 control commands. The recommended transmitters are the M 1024 or the M 1124. The M 1025 measures the frequency of the arriving signal by counting the cycles during a fixed measuring time determined by a 4.433 MHz quartz crystal. All ultrasonic commands are converted into a coded 5-bit output signal and issued in pulsed form on 5 parallel lines. Nine of the thirty commands are memorized and used inside the M 1025; they can also be selected directly by a 5-bit word applied to the input/output binary lines (A to E). The further 21 commands are for free application; different TV channels are selectable if a decoder is connected to the outputs. Six of the nine memorized commands give output signals for controlling three analog values, e.g. volume, brightness and colour saturation. These signals are continuously delivered in square waveform; the duty cycle can be varied so determining the level of the analog value. Even when the mains voltage is not available, the latest analog value may be stored with a minimum of power by means of a battery or accumulator. The M 1025 is constructed in low-threshold P-channel silicon gate technology and is supplied in a 16-lead dual in-line plastic package with copper insert. Three different types are available, CA, CB, CAZ, which differ as specified in the table below.

Type	MAINS ON by commands (see truth table for the definition of N)
CA	N = 1 and N = 15 to 30 (program selection)
CB	N = 15 to 30 (program selection)
CAZ	N = 1

ABSOLUTE MAXIMUM RATINGS*

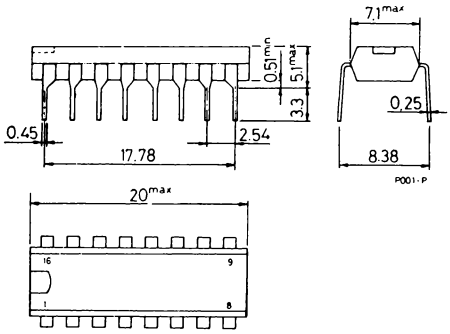
V_{DD}, V_{DDI}**	Supply voltages	-20 to 0.3	V
V_I	Input voltage	-20 to 0.3	V
I_O	Output current (pins 2, 3, 4, 6, 7, 8, 9, 11, 12)	$\|5\|$	mA
P_{tot}	Total package power dissipation	1	W
T_{stg}	Storage temperature	-65 to 150	°C
T_{op}	Operating temperature	-25 to 70	°C

* Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other condition above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

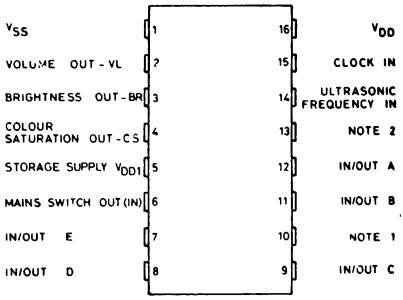
** All voltages values are refered to V_{SS} pin voltage.

ORDERING NUMBERS: M 1025 B5 CA
M 1025 B5 CB
M 1025 B5 CAZ

MECHANICAL DATA (dimensions in mm)



PIN CONNECTIONS

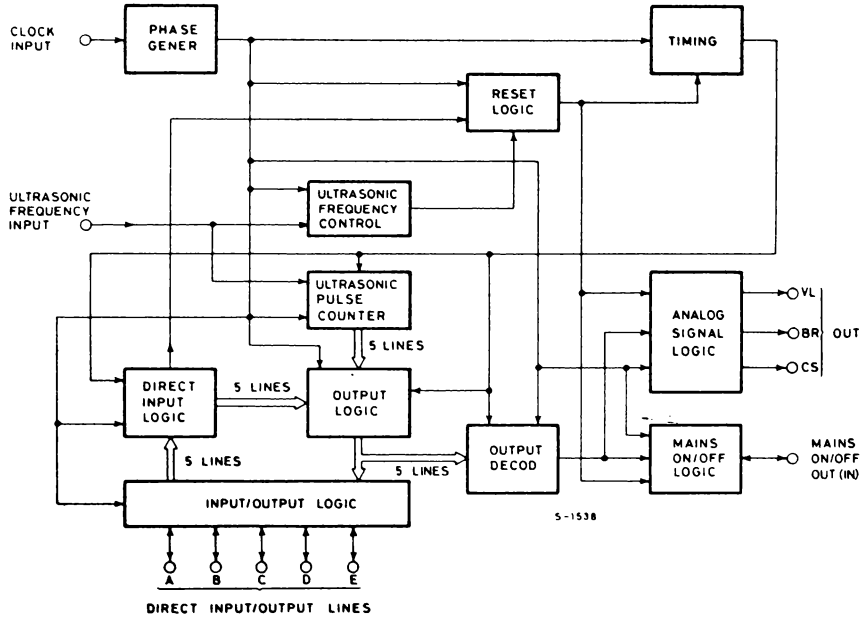


NOTE 1: THIS PIN MUST BE LEFT OPEN OR CONNECTED TO V_{SS}

NOTE 2: THIS PIN MUST BE LEFT OPEN

S-1537

BLOCK DIAGRAM



TRUTH TABLE (Clock frequency, f = 4.4336 MHz)

N	Ultrasonic Frequency	Command	Code				
			E	A	B	C	D
1	33 945 Hz	CA, CAZ types: MAINS ON/OFF** / CB type: MAINS OFF**	H	L	H	H	H
2	34 291 Hz	MUTING ON/OFF	L	L	H	H	H
3	34 638 Hz	Colour saturation (CS)+	H	H	L	H	H
4	34 984 Hz	Normalisation (*)	L	H	L	H	H
5	35 330 Hz	Colour saturation (CS) –	H	L	L	H	H
6	35 677 Hz	S1	L	L	L	H	H
7	36 023 Hz	Brightness (BR)+	H	H	H	L	H
8	36 370 Hz	S2	L	H	H	L	H
9	36 716 Hz	Brightness (BR) –	H	L	H	L	H
10	37 062 Hz	S3	L	L	H	L	H
11	37 409 Hz	Volume (VL) +; MUTING OFF	H	H	L	L	H
12	37 755 Hz	S4	L	H	L	L	H
13	38 101 Hz	Volume (VL) –	H	L	L	L	H
14	38 448 Hz	S5	L	L	L	L	H
15	38 794 Hz	Program 1	H	H	H	H	L
16	39 141 Hz	Program 2	L	H	H	H	L
17	39 487 Hz	Program 3	H	L	H	H	L
18	39 833 Hz	Program 4	L	L	H	H	L
19	40 180 Hz	Program 5	H	H	L	H	L
20	40 526 Hz	Program 6	L	H	L	H	L
21	40 872 Hz	Program 7	H	L	L	H	L
22	41 219 Hz	Program 8	L	L	L	H	L
23	41 565 Hz	Program 9	H	H	H	L	L
24	41 912 Hz	Program 10	L	H	H	L	L
25	42 258 Hz	Program 11	H	L	H	L	L
26	42 604 Hz	Program 12	L	L	H	L	L
27	42 951 Hz	Program 13	H	H	L	L	L
28	43 297 Hz	Program 14	L	H	L	L	L
29	43 643 Hz	Program 15	H	L	L	L	L
30	43 990 Hz	Program 16	L	L	L	L	L

CA, CB types: all these commands act also as MAINS ON**

S1 to S5 are additional commands.

* The Normalisation command sets the colour saturation to a pulse duty cycle of 16/31 and the brightness to a pulse duty cycle of 18/31; this command has no effect on volume, unless MUTING has been inserted: in this case the volume is restored, without changing the duty cycle.

** If MUTING has been commanded, each MAINS OFF or MAINS ON command also acts on MUTING to restore the previous volume level.

RECOMMENDED OPERATING CONDITIONS

V_{DD}	Supply voltage	-18 ± 1	V
V_{DD1}	Storage supply voltage: - D/A signal storing	-10 to V_{DD}	V
	- No storing	0	V
V_I	Input voltage	0 to V_{DD}	V
f_i	Input clock frequency	4.4336	MHz
T_{op}	Operating temperature	-25 to 70	°C
t_r	Supply voltage rise time	max 100	ms
I_o	Output current (pins 2-3-4-6-7-8-9-11-12)	max |2.5|	mA

STATIC ELECTRICAL CHARACTERISTICS (Over recommended operating conditions)
(Typical values are at T_{amb} = 25°C)

Parameter		Test conditions and notes	Values			Unit
			Min.	Typ.	Max.	
I_{DD}	Supply current	V_{DD} = -19V		22	35	mA
I_{DD1}	Storage supply current	V_{DD1} = -19V		0.2		mA
r_{on}	Output resistance (on state) pins 2, 3, 4, 6	V_{DD} = -18V, R_L = 2 kΩ			1	kΩ
r_{on}	Output resistance (on state) pins 7, 8, 9, 11, 12	V_{DD} = -18V, R_L = 3.9 kΩ			5	kΩ

DIRECT INPUTS (7, 8, 9, 11, 12, 6)

V_{IH}	High level input voltage		-1		V_{SS}	V
V_{IL}	Low level input voltage		V_{DD}		-4	V

CLOCK INPUT (pin 15)

V_{IPP}	Input peak to peak voltage swing (sinusoidal)	Signal applied without DC voltage	4		8	v

ULTRASONIC FREQUENCY INPUT (pin 14)

V_{IPP}	Input peak to peak voltage swing	Signal applied without DC voltage	500		V_{DD}	mV

DYNAMIC ELECTRICAL CHARACTERISTICS (Clock frequency f = 4.4336 MHz)

Parameter		Min.	Typ.	Max.	Unit
t_1	Ultrasonic input acceptance time (except MAINS and MUTING commands)		115.5		ms
t_2	Ultrasonic input acceptance time (for MAINS and MUTING commands)		669.8		ms
t_3	Direct inputs acceptance time (except MAINS and MUTING commands)		69.3		ms
t_4	Direct inputs acceptance time (for MAINS and MUTING commands)		600.6		ms
t_5	Output activation delay (including acceptance time) for all commands except MAINS and MUTING		115.5		ms
t_6	Output activation delay (including acceptance time) for MAINS and MUTING commands		669.8		ms
t_7	Analog-output step to step response time		184.8		ms
t_8	MAINS OFF to ON acceptance time plus activation time from MAINS input-output	10			µs
f	Analog-output frequency		8.9		kHz
D	Analog-output frequency duty-cycle	1/31		30/31	–

DESCRIPTION

The function of the M 1025 is explained by reference to the various pins as follows:

Pin 1 - V_{SS}

The substrate of the integrated circuit is connected to this pin. It is the reference point for all voltage parameters of the device, and is to be connected to the highest potential of the supply voltage.
Examples: V_{SS}= 0V V_{DD}= -18V or V_{SS}= +18V V_{DD}= 0V

Pin 5 - V_{DD1} storage supply voltage

If the last-stored D/A information is to be preserved when the mains plug has been disconnected, -10V at least should be fed to pin 5. The current consumption of the memory is typically 0.2 mA. The voltage V_{DD1} should be applied before $|V_{DD}|$ falls below 16V. If the storing function is not required, V_{DD1} has to be connected to V_{SS}: in this case, when V_{DD} is applied, the analog control signals are set at the normalized position.

Pin 14 - Ultrasonic frequency input

The amplified ultrasonic signals of 500 mV peak to peak at minimum are applied to this pin via a capacitor to remove DC voltage. The input waveform must be present for more then 115.5 ms to allow the command to be accepted. Exceptions are the MAINS and MUTING commands which have a 669.8 ms acceptance time. Internal control logic suppresses input frequencies greater than 55.4 kHz and lower than 27.7 kHz. Due to the recognition system, the ultrasonic transmission frequency of 33.9 kHz may fluctuate by ± 0.51% and the frequency of 44.0 kHz by ± 0.39% without causing errors.

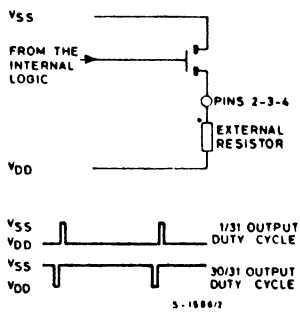
Pin 15 - Clock input

The clock input has to be connected via a capacitor to a 4.4336 MHz quartz controlled oscillator, whose output peak to peak voltage has to be comprised between 4 and 8V.

Pins 2 - 3 - 4 - D/A outputs

The outputs CS (colour saturation), BR (brightness) and VL (volume) are the drain of the output transistors. A square wave output voltage is produced when resistors are inserted between the outputs and V_{DD}. The frequency of these square waves is 8.93 kHz. The pulse duty cycle is variable in 30 steps between 1/31 and 30/31 (see fig. 1). 115.5 ms after the onset of an ultrasonic or direct binary command, the pulse duty cycle is advanced by one step. In the case of a continuous command, further advances follow at intervals of 184.8 ms until the final value is reached. The time needed to make the entire variation is 5.543 seconds. When the supply voltage is applied, with V_{DD1}= 0, the D/A outputs are normalized with the following pulse duty cycles: output colour saturation = 16/31; output brightness = 18/31; output volume = 10/31; if V_{DD1} pin has been maintained at its correct voltage, the last stored information is preserved. The command N = 2 switches on or off, the VL output transistor, with a delay time of 669.8 ms acting as a sound ON/OFF-switch. The command N = 4 (normalisation) sets outputs CS and BR to a pulse duty cycle of 16/31 and 18/31, but this command has no effect on the output VL, unless MUTING has been previously commanded. In this case the command N=4 restores the volume. If the MUTING has been commanded, the volume can also be restored with the command VL+, provided that the circuit is not in the stand-by position. In any case the MUTING command is cancelled by a MAINS ON or OFF command.

Fig. 1

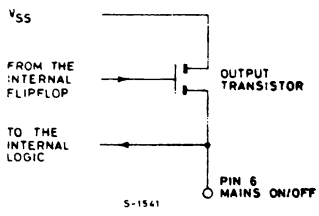


DESCRIPTION (continued)

Pin 6 - MAINS ON/OFF output/input

For the purpose of switching the TV set ON or OFF ultrasonically, the input signal must be present at least for 669.8 ms. Thereafter the mains flip flop toggles, controlling an open drain transistor (see fig. 2). After power supply is applied, the mains flip flop is set independently of V_{DD1} so that the output transistor is off. When the output transistor is off, the D/A-converters are locked, i.e. the output signals at pins 2,3 and 4 cannot be varied. With M 1025 CA type, switching ON can be obtained either by selecting one of the 16 stations or by the power ON/OFF command. With M 1025 CB type, switching ON can be achieved only by using one of the 16 station control commands; with M 1025 CAZ type, only by the Power ON/OFF command. In all types, switching ON can also be obtained connecting pin 6 to V_{SS} for at least 10 μs and switching OFF is obtained only by the command N = 1 (see truth table).

Fig. 2



Pins 7 - 8 - 9 - 11 - 12 - Direct input/output lines

These pins serve as inputs for commands on the TV set and, also as outputs for ultrasonic transmitted commands. Fig. 3 shows the input/output stage of one line of the circuit. The commands may be introduced directly in the form of a 5-bit word applied to the Input/Output lines A, B, C, D and E. An input signal is only recognized as valid if it exceeds the threshold voltage at least once in each of three successive 23.1 ms periods, for at least 10 μs. When this happens, an output pulse of 23.1 ms duration is generated after a processing time of 46.2 ms. (Total delay time 115.5 ms). In the case of MAINS ON/OFF and MUTING input commands the acceptance time is 600.6 ms; the output pulse will appear with a delay of 69.3 ms after the acceptance time (total delay time 669.8 ms). Evidently the output signals act on the inputs again, but this does not cause interferences because the inputs are locked while an output signal is available. If commands are issued either from the remote control or locally to the television set, the local command will always override the remote command.

Fig. 3

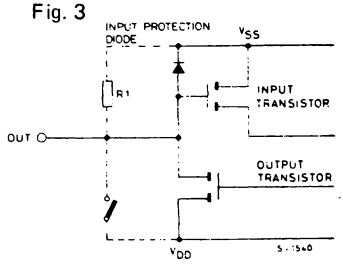


Fig. 4 - Typical output characteristics of the open source transistor at pins 7,8,9,11,12