SGS-THOMSON MICROELECTRONICS

M3005LAB1

MONOLITHIC MICROSYSTEMS DIVISION

ADVANCE DATA

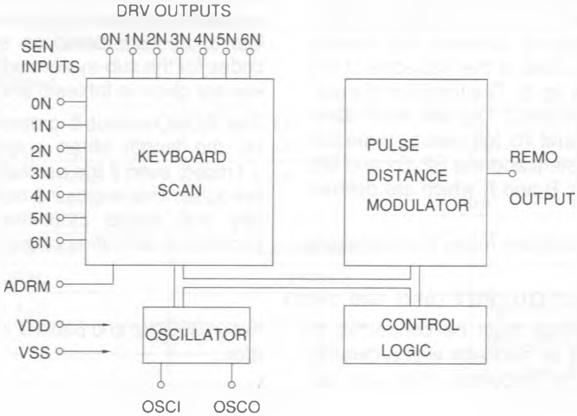
- FLASHED OR MODULATED TRANSMISSION
- 7 SUB-SYSTEM ADDRESSES
- UP TO 64 COMMANDS PER SUB-SYSTEM ADDRESS
- HIGH-CURRENT REMOTE OUTPUT AT VDD = 6V ($-I_{OH}$ = 40mA)
- LOW NUMBER OF ADDITIONAL COMPONENTS
- KEY RELEASE DETECTION BY TOGGLE BITS
- VERY LOW STAND-BY CURRENT (< 2μA)
- OPERATIONAL CURRENT < 1mA AT 6V SUPPLY
- SUPPLY VOLTAGE RANGE 2 TO 6.5V
- CERAMIC RESONATOR CONTROLLED FREQUENCY (typ. 450kHz)
- ENCAPSULATION : 20-LEAD PLASTIC DIL

REMOTE CONTROL TRANSMITTER

The M3005LAB1 transmitter IC is designed for infrared remote control systems. It has a total of 448 commands which are divided into 7 sub-system groups with 64 commands each. The sub-system code may be selected by a press button, a slider switch or hard wired.

The M3005LAB1 generates the pattern for driving the output stage. These patterns are pulse distance coded. The pulses are infrared flashes or modulated. The transmission mode is defined in conjunction with the sub-system address. Modulated pulses allow receivers with narrow-band preamplifiers for improved noise rejection to be used. Flashed pulses require a wide-band preamplifier within the receiver.

BLOCK DIAGRAM



INPUTS AND OUTPUTS

Key matrix inputs and outputs (DRV0N to DRV6N and SEN0N to SEN6N).

The transmitter keyboard is arranged as a scanned matrix. The matrix consists of 7 driver outputs and 7 sense inputs as shown in fig. 1. The driver outputs DRV0N to DRV6N are open drain N-channel transistors and they are conductive in the stand-by mode. The 7 sense inputs (SEN0N to SEN6N) enable the generation of 56 command codes. With 2 external diodes all 64 commands are addressable. The sense inputs have P-channel pull-up transistors so that they are HIGH until they are pulled LOW by connecting them to an output via a key depression to initiate a code transmission.

ADDRESS MODE INPUT (ADRM)

The sub-system address and the transmission mode are defined by connecting the ADRM input to one or more driver outputs (DRV0N to DRV6N) of the key matrix. If more than one driver is connected to ADRM, they must be decoupled by diodes. This allows the definition of seven sub-system addresses as shown in table 3. If driver DRV6N is connected to ADRM, the data output format of REMO is modulated or if not connected, flashed.

The ADRM input has switched pull-up and pull-down loads. In the stand-by mode only the pull-down device is active. Whether ADRM is open (sub-system address 0, flashed mode) or connected to the driver outputs, this input is LOW and will not cause unwanted dissipation. When the transmitter becomes active by pressing a key, the pull-down device is switched off and the pull-up device is switched on, so that the applied driver signals are sensed for the decoding of the sub-system address and the mode of transmission.

The arrangement of the sub-system address coding is such that only the driver DRVnM with the highest number (n) defines the sub-system address, e.g. if drivers DRV2N and DRV4N are connected to ADRM, only DRV4N will define the sub-system address. This option can be used in systems requiring more than one sub-system address. The transmitter may be hard-wired for sub-system address 2 by connecting DRV1N to ADRM. If now DRV3N is added to ADRM by a key or a switch, the transmitted sub-system address changes to 4. A change of the sub-system address will not start a transmission.

REMOTE CONTROL SIGNAL OUTPUT (REMO)

The REMO signal output stage is a push-pull type. In the HIGH state, a bipolar emitter-follower allows a high output current. The timing of the data output format is listed in tables 1 and 2. The information is defined by the distance tb between the leading edges of the flashed pulses or the first edge of the modulated pulses (see fig. 3). The format of the output data is given in fig. 2 and 3. The data word starts with two toggle bits T1 and T0, followed by three bits for defining the sub-system address S2, S1 and S0, and six bits F, E, D, C, B and A which are defined by the selected key.

In the modulated transmission mode the first toggle bit is replaced by a constant reference time bit (REF). This can be used as a reference time for the decoding sequence. The toggle bits function as an indication for the decoder that the next instruction has to be considered as a new command. The codes for the sub-system address and the selected key are given in tables 3 and 4.

The REMO-output is protected against "Lock-up", i.e. the length of an output pulse is limited to < 1msec, even if the oscillator stops during an output pulse. This avoids the rapid discharge of the battery that would otherwise be caused by the continuous activation of the LED.

OSCILLATOR INPUT/OUTPUT (osci and osco)

The external components must be connected to these pins when using an oscillator with a ceramic resonator. The oscillator frequency may vary between 350kHz and 600kHz as defined by the resonator.

FUNCTIONAL DESCRIPTION

KEYBOARD OPERATION

In the stand-by mode all drivers (DRV0N to DRV6N) are on (low impedance to VSS). Whenever a key is pressed, one or more of the sense inputs (SENnN) are tied to ground. This will start the power-up sequence. First the oscillator is activated and after the debounce time t_{DB} (see fig. 4) the output drivers (DRV0N to DRV6N) become active successively).

Within the first scan cycle the transmission mode, the applied sub-system address and the selected command code are sensed and loaded into an internal data latch.

In contrast to the command code, the sub-system is sensed only within the first scan cycle. If the applied sub-system address is changed while the command key is pressed, the transmitted sub-system address is not altered.

In a multiple key stroke sequence (see fig. 5) the command code is always altered in accordance with the sensed key.

MULTIPLE KEY-STROKE PROTECTION

The keyboard is protected against multiple keystrokes. If more than one key is pressed at the same time, the circuit will not generate a new output at REMO (see fig. 5). In case of a multiple key-stroke, the scan repetition rate is increased to detect the release of a key as soon as possible.

There are two restrictions caused by the special structure of the keyboard matrix :

- The keys switching to ground (code numbers 7, 15, 23, 31, 39, 47, 55 and 63) and the keys connected to SEN5N and SEN6N are not covered completely by the multiple key protection. If one sense input is switched to ground, further keys on the same sense line are ignored, i.e. the command code corresponding to "key to ground" is transmitted.
- SEN5N and SEN6N are not protected against multiple keystroke on the same driver line, because this condition has been used for the definition of additional codes (code number 56 to 63).

OUTPUT SEQUENCE (data format)

The output operation will start when the selected code is found. A burst of pulses, including the latched address and command codes, is generated at the output REMO as long as a key is pressed. The format of the output pulse train is given in fig. 2 and 3. The operation is terminated by releasing the key or if more than one key is pressed at the same time. Once a sequence is started, the transmitted data words will always be completed after the key is released.

The toggle bits T0 and T1 are incremented if the key is released for a minimum time t_{REL} (see fig. 4). The toggle bits remain unchanged within a multiple keystroke sequence.

Table 1: Pulse Train Timing.

Mode	T_O ms	t_P µs	t_M µs	t_W ms
Flashed	2.53	8.8	–	121
Modulated	2.53	–	tosc	121

	Flash Mode	Carrier Mode	
t_{OSC}	455kHz	600kHz	
t_P	4 x t_{OSC}	–	Flashed Pulse Width
t_M	–	t_{OSC}	Modulation Period
N	–	8*	Number od Modulation Pulses
To	1152 x t_{OSC}	1536 x t_{OSC}	Basic Unit of Pulse Distance
t_W	55296 x t_{OSC}	73728 x t_{OSC}	Word Distance

* The following number of pulses may be selected by metal option : N = 8, 12, 16.

Note : The different dividing ratio for T_O and t_W between flash mode and carrier mode is obtained by changing the modulo of a particular divider from divide by 3 during flash mode to divide by 4 during carrier mode. This allows the use of 600kHz ceramic resonator during carrier mode to obtain a better noise immunity for the receiver without a significant change in T_O and t_W. For first samples, the correct divider ratio is obtained by a metal mask option. For final parts, this is automatically done together with selection of flash-/carrier mode.

Table 2 : Pulse Train Separation (t_b).

Code	t_b
Logic "0"	$2 \times T_0$
Logic "1"	$3 \times T_0$
Toggle Bit Time	$2 \times T_0$ or $3 \times T_0$

Table 3 : Transmission Mode and Sub-system Address Selection.

The sub-system address and the transmission mode are defined by connecting the ADRM input to one or more driver outputs (DRV0N to DRV6N) of the key matrix. If more than one driver is connected to ADRM, they must be decoupled by diodes.

Mode	Sub–system Address				Driver DRVnN for n =						
	#	S2	S1	S0	0	1	2	3	4	5	6
FLASHED	0	1	1	1							
	1	0	0	0	O						
	2	0	0	1	X	O					
	3	0	1	0	X	X	O				
	4	0	1	1	X	X	X	O			
	5	1	0	0	X	X	X	X	O		
	6	1	0	1	X	X	X	X	X	O	
MODULATED	0	1	1	1							O
	1	0	0	0	O						O
	2	0	0	1	X	O					O
	3	0	1	0	X	X	O				O
	4	0	1	1	X	X	X	O			O
	5	1	0	0	X	X	X	X	O		O
	6	1	0	1	X	X	X	X	X	O	O

O = connected to ADRM.
blank = not connected to ADRM.
X = don't care.

Table 4 : Key Codes.

Matrix Drive	Matrix Sense	Code						Matrix Position
		F	E	D	C	B	A	
DRV0N	SEN0N	0	0	0	0	0	0	0
DRV1N	SEN0N	0	0	0	0	0	1	1
DRV2N	SEN0N	0	0	0	0	1	0	2
DRV3N	SEN0N	0	0	0	0	1	1	3
DRV4N	SEN0N	0	0	0	1	0	0	4
DRV5N	SEN0N	0	0	0	1	0	1	5
DRV6N	SEN0N	0	0	0	1	1	0	6
VSS	SEN0N	0	0	0	1	1	1	7
VSS	SEN1N	0	0	1	1	1	1	8 to 15
VSS	SEN2N	0	1	0	1	1	1	16 to 23
VSS	SEN3N	0	1	1	1	1	1	24 to 31
VSS	SEN4N	1	0	0	1	1	1	32 to 39
VSS	SEN5N	1	0	1	1	1	1	40 to 47
VSS	SEN6N	1	1	0	1	1	1	48 to 55
VSS	SEN5N and SEN6N	1	1	1	1	1	1	56 to 63

ABSOLUTE MAXIMUM RATINGS

Limiting values in accordance with the absolute maximum system (IEC 134).

Symbol	Parameter		Value	Unit
V_{DD}	Supply Voltage Range		– 0.3 to + 7	V
V_I	Input Voltage Range		– 0.3 to (V_{DD} + 0.3)	V
V_O	Output Voltage Range		– 0.3 to (V_{DD} + 0.3)	V
± I	D.C. Current into Any Input or Output	Max.	10	mA
– I(REMO)M	Peak REMO Output Current during 10µs ; Duty Factor = 1%	Max.	300	mA
P_{tot}	Power Dissipation per Package for T_{amb} = – 20 to + 70°C	Max.	200	mW
T_{stg}	Storage Temperature Range		– 55 to + 125	°C
T_{amb}	Operating Ambient Temperature Range		– 20 to + 70	°C

ELECTRICAL CHARACTERISTICS V_{SS} = 0V ; T_{amb} = 25°C ; unless otherwise specified

Symbol	V_{DD}(V)	Parameter	Min.	Typ.	Max.	Unit
V_{DD}		Supply Voltage T_{amb} = 0 to + 70°C	2		6.5	V
 I_{DD} I_{DD}	 3 6	Supply Current ; Act. f_{OSC} = 455kHz ; REMO Outp. Unload.		 0.25 1.0		 mA mA
 I_{DD}	 6	Supply Current ; Inactive (stand-by mode) T_{amb} = 25°C			 4	 µA
f_{osc}	2 to 6.5	Oscill. Frequency (cer. resonator)	350		600	kHz
  V_{IL} V_{IH} $-I_I$ $-I_I$ I_I	 2 to 6.5 2 to 6.5 2 6.5 6.5	Keyboard Matrix Inputs SEN0N to SEN6N Input Voltage LOW Input Voltage HIGH Input Current V_I = 0V Input Leakage Current V_I = V_{DD}	 0.7 x V_{DD} 10 100		 0.3 x V_{DD} 100 600 1	 V V µA µA µA
  V_{OL} V_{OL} I_O	 2 6.5 6.5	Outputs DRV0N to DRV6N Output Volt. "ON" I_O = 0.25mA I_O = 2.5mA Outp. Current "OFF" V_O = 11V			 0.3 0.6 10	 V V µA
 V_{IL} V_{IH} I_{IL} I_{IL}	 2 6.5	Control Input ADRM Input Voltage LOW Input Volt. HIGH Input Current (switched P-and N-channel pull-up/pull-down) Pull-up Act., Oper. Condition ; V_{IN} = V_{SS}	 0.7 x V_{DD} 10 100		 0.3 x V_{DD} 100 600	 V V µA µA
I_{IH} I_{IH}	2 6.5	Pull-down Active Standby Cond. ; V_{IN} = V_{DD}	10 100		100 600	µA µA

ELECTRICAL CHARACTERISTICS (continued)

Symbol	V_{DD}(V)	Parameter	Min.	Typ.	Max.	Unit
		Data Output REMO				
V_{OH}	2	Output Volt. HIGH	0.8			V
V_{OH}	6.5	$-I_{OH}$ = 40mA	5.0			V
V_{OL}	2	Output Volt. LOW			0.4	V
V_{OL}	6.5	I_{OL} = 0.5 mA			0.4	V
t_{MH}/t_{OSC}	6	Pulse Duty Cycle During Carrier Mode	0.4	0.5	0.6	
t_{OH}	6.5	Pulse Length, Oscill. Stopped			1	msec
		Oscillator				
I_I	2	Input Current			5.0	µA
I_I	6.5	OSC1 at V_{DD}	5.0		70	µA
		Output Volt. HIGH				
V_{OH}	6.5	$-I_{OL}$ = 0.1mA	V_{DD} – 0.8			V
		Output Volt. LOW				
V_{OL}	6.5	I_{OH} = 0.1mA			0.7	V

Figure 1 : Typical Application.

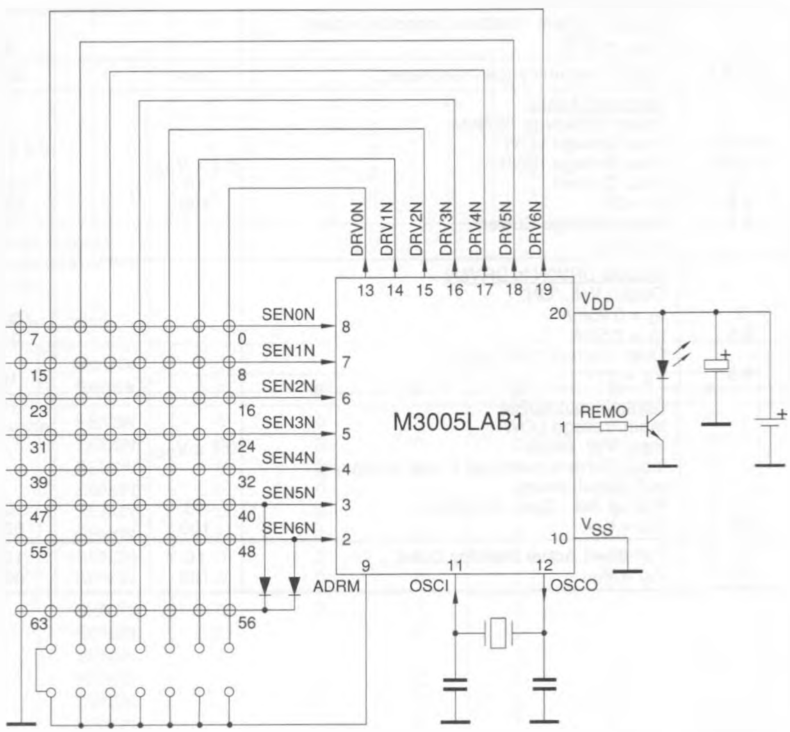


Figure 2 : Data Format of REMO Output.

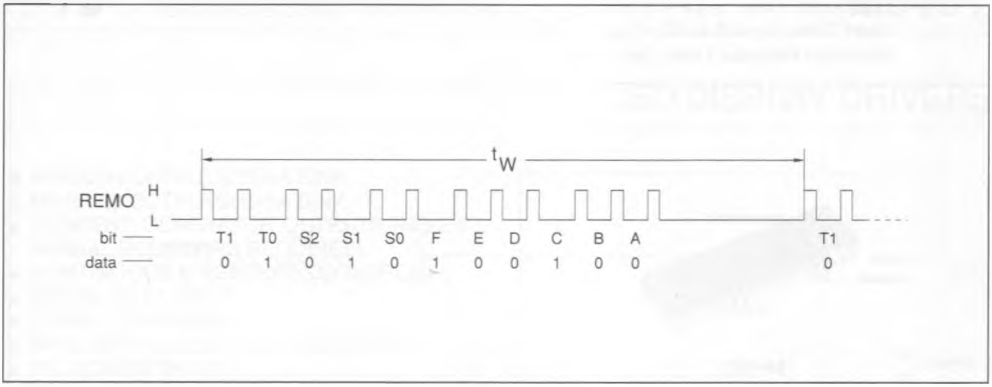


Figure 3 : REMO Output Waveform : (a) flashed pulse.
(b) modulated pulse.

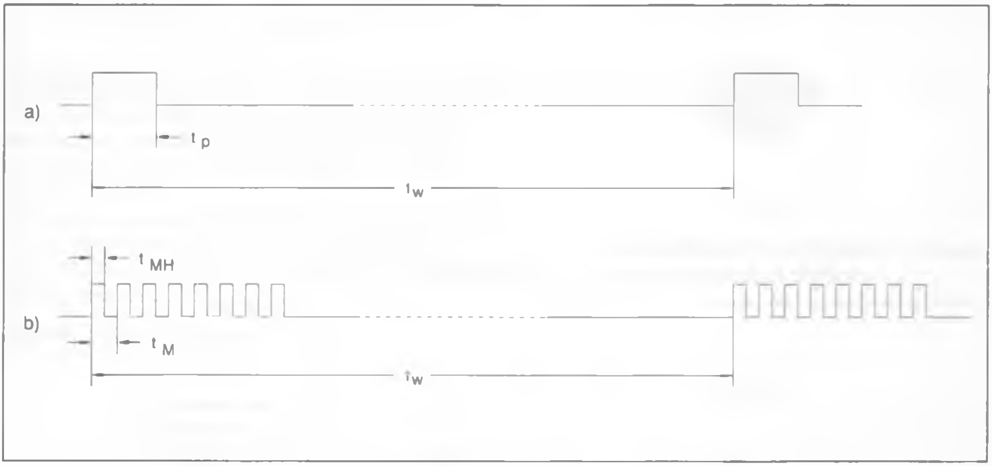


Figure 4 : Single Key - Stroke Sequence.
Debounce Time : t_{DB} = 4 to 9 x T_O
Start Time : t_{ST} = 5 to 10 x T_O
Minimum Release Time : t_{REL} = T_O.

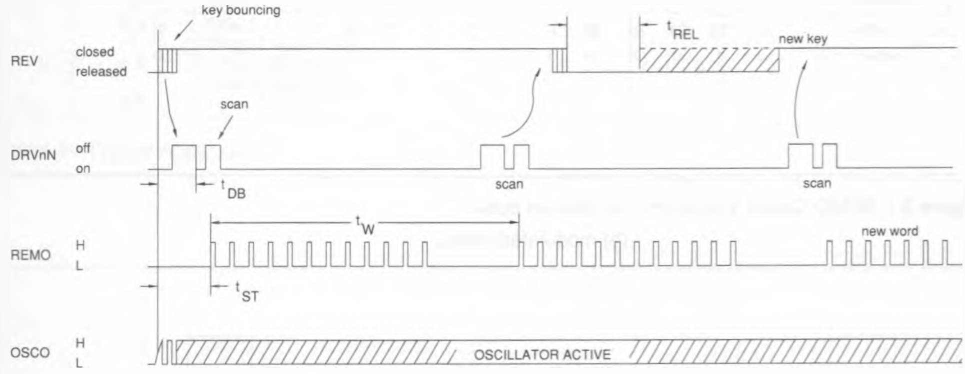


Figure 5 : Multiple Key - Stroke Sequence.
Scan Rate Multiple Key-stroke : t_{SM} = 8 to 10 x T_O.