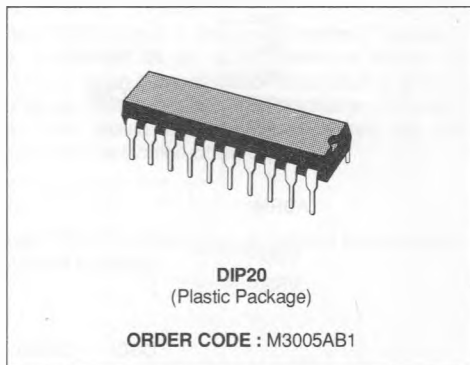


## REMOTE CONTROL TRANSMITTER

**ADVANCE DATA**

- FLASHED OR MODULATED TRANSMISSION
- 7 SUB-SYSTEM ADDRESSES
- UP TO 64 COMMANDS PER SUB-SYSTEM ADDRESS
- HIGH-CURRENT REMOTE OUTPUT AT  $V_{DD} = 6V$  ( $-I_{OH} = 100mA$ )
- LOW NUMBER OF ADDITIONAL COMPONENTS
- KEY RELEASE DETECTION BY TOGGLE BITS
- VERY LOW STAND-BY CURRENT ( $< 2\mu A$ )
- OPERATIONAL CURRENT  $< 1mA$  AT 6V SUPPLY
- SUPPLY VOLTAGE RANGE 4 TO 12V
- CERAMIC RESONATOR CONTROLLED FREQUENCY (typ. 450kHz)
- ENCAPSULATION : 20-LEAD PLASTIC DIL

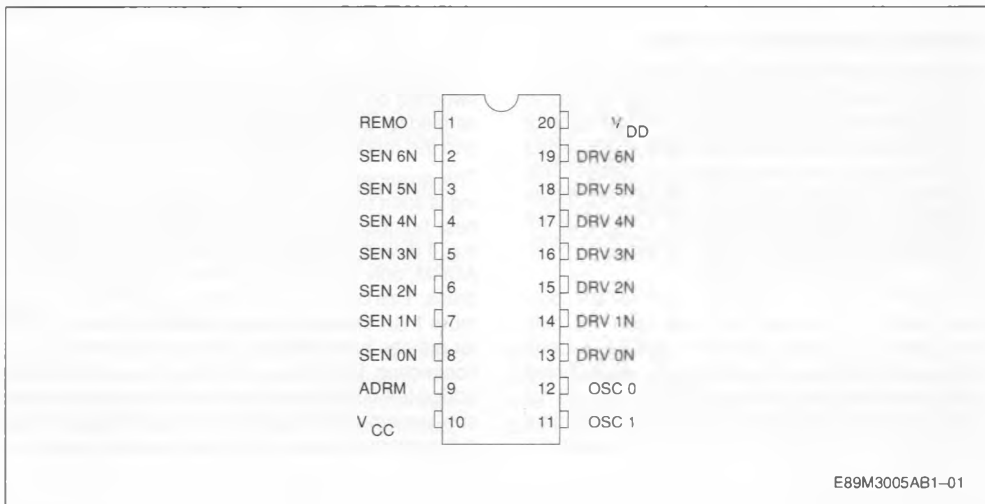


The M3005 AB1 generates the pattern for driving the output stage. These patterns are pulse distance coded. The pulses are infrared flashes or modulated. The transmission mode is defined in conjunction with the sub-system address. Modulated pulses allow receivers with narrow-band preamplifiers for improved noise rejection to be used. Flashed pulses require a wide-band preamplifier within the receiver.

### DESCRIPTION

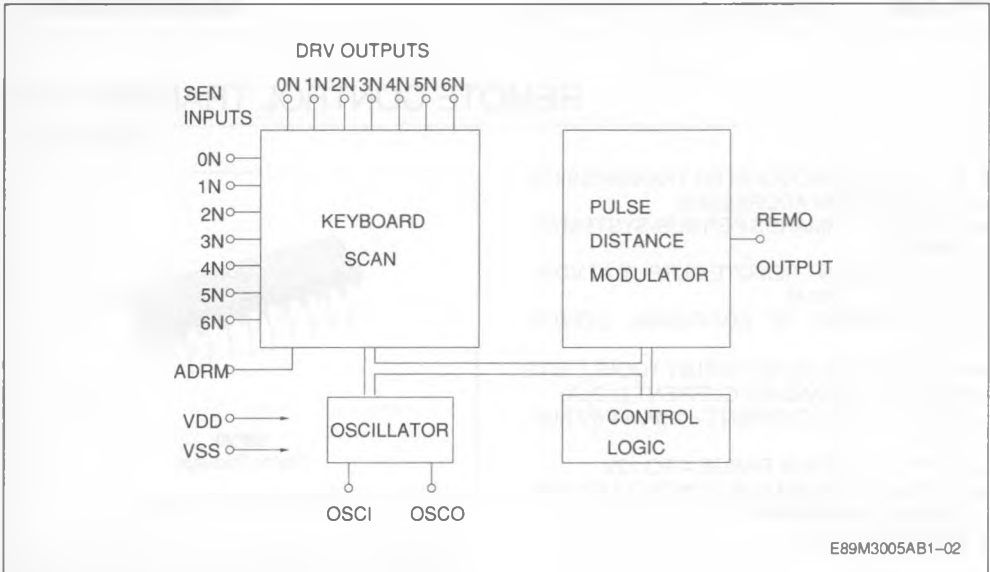
The M3005 AB1 transmitter IC is designed for infrared remote control systems. It has a total of 448 commands which are divided into 7 sub-system groups with 64 commands each. The sub-system code may be selected by a press button, a slider switch or hard wired.

### PIN CONNECTIONS



E89M3005AB1-01

## BLOCK DIAGRAM



## INPUTS AND OUTPUTS

Key matrix inputs and outputs (DRVON to DRV6N and SENON 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 DRVON to DRV6N are open drain N-channel transistors and they are conductive in the stand-by

## ADDRESS MODE INPUT (ADRMP)

The sub-system address and the transmission mode are defined by connecting the ADRMP input to one or more driver outputs (DRVON to DRV6N) of the key matrix. If more than one driver is connected to ADRMP, 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 ADRMP, the data output format of REMO is modulated or if not connected, flashed.

The ADRMP input has switched pull-up and pull-down loads. In the stand-by mode only the pull-down device is active. Whether ADRMP 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 de-

vice 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.

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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 ADRMP, 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 ADRMP. If now DRV3N is added to ADRMP 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  $t_b$  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 < 1 msec, 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 bet-

ween 350kHz and 600kHz as defined by the resonator.

## FUNCTIONAL DESCRIPTION

Keyboard operation.

In the stand-by mode all drivers (DRVON 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 (DRVON 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 key-strokes. 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 con-

nected 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 tREL (see fig. 4). The

toggle bits remain unchanged within a multiple key-stroke sequence.

**Table 1:** Pulse Train Timing.

Mode	T <sub>O</sub> ms	t <sub>P</sub> μs	t <sub>M</sub> μs	t <sub>w</sub> ms
Flashed	2.53	8.8	–	121
Modulated	2.53	–	t <sub>osc</sub>	121

	Flash Mode	Carrier Mode	
t <sub>osc</sub>	455kHz	600kHz	
t <sub>P</sub>	4 x t <sub>osc</sub>	–	Flashed Pulse Width
t <sub>M</sub>	–	t <sub>osc</sub>	Modulation Period
N	–	8*	Number of Modulation Pulses
T <sub>O</sub>	1152 x t <sub>osc</sub>	1536 x t <sub>osc</sub>	Basic Unit of Pulse Distance
t <sub>w</sub>	55296 x t <sub>osc</sub>	73728 x t <sub>osc</sub>	Word Distance

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

**Note :** The different dividing ratio for T<sub>o</sub> and t<sub>w</sub> 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 a 600kHz ceramic resonator during carrier mode to obtain a better noise immunity for the receiver without a significant change in T<sub>o</sub> and t<sub>w</sub>. For first samples, the correct divider ratio is obtained by a metal mask option. For final parts, this is automatically done together with the selection of flash-/carrier mode

**Table 2 :** Pulse Train Separation (t<sub>b</sub>).

Code	t <sub>b</sub>
Logic "0"	2 x T <sub>o</sub>
Logic "1"	3 x T <sub>o</sub>
Toggle Bit Time	2 x T <sub>o</sub> or 3 x T <sub>o</sub>

**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
F	0	1	1	1							
L	1	0	0	0	O						
A	2	0	0	1	X	O					
S	3	0	1	0	X	X	O				
H	4	0	1	1	X	X	X	O			
E	5	1	0	0	X	X	X	X	O		
D	6	1	0	1	X	X	X	X	X	O	
M	0	1	1	1							O
O	1	0	0	0	O						O
U	2	0	0	1	X	O					O
L	3	0	1	0	X	X	O				O
A	4	0	1	1	X	X	X	O			O
T	5	1	0	0	X	X	X	X	O		O
E	6	1	0	1	X	X	X	X	X	O	O

0 = 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

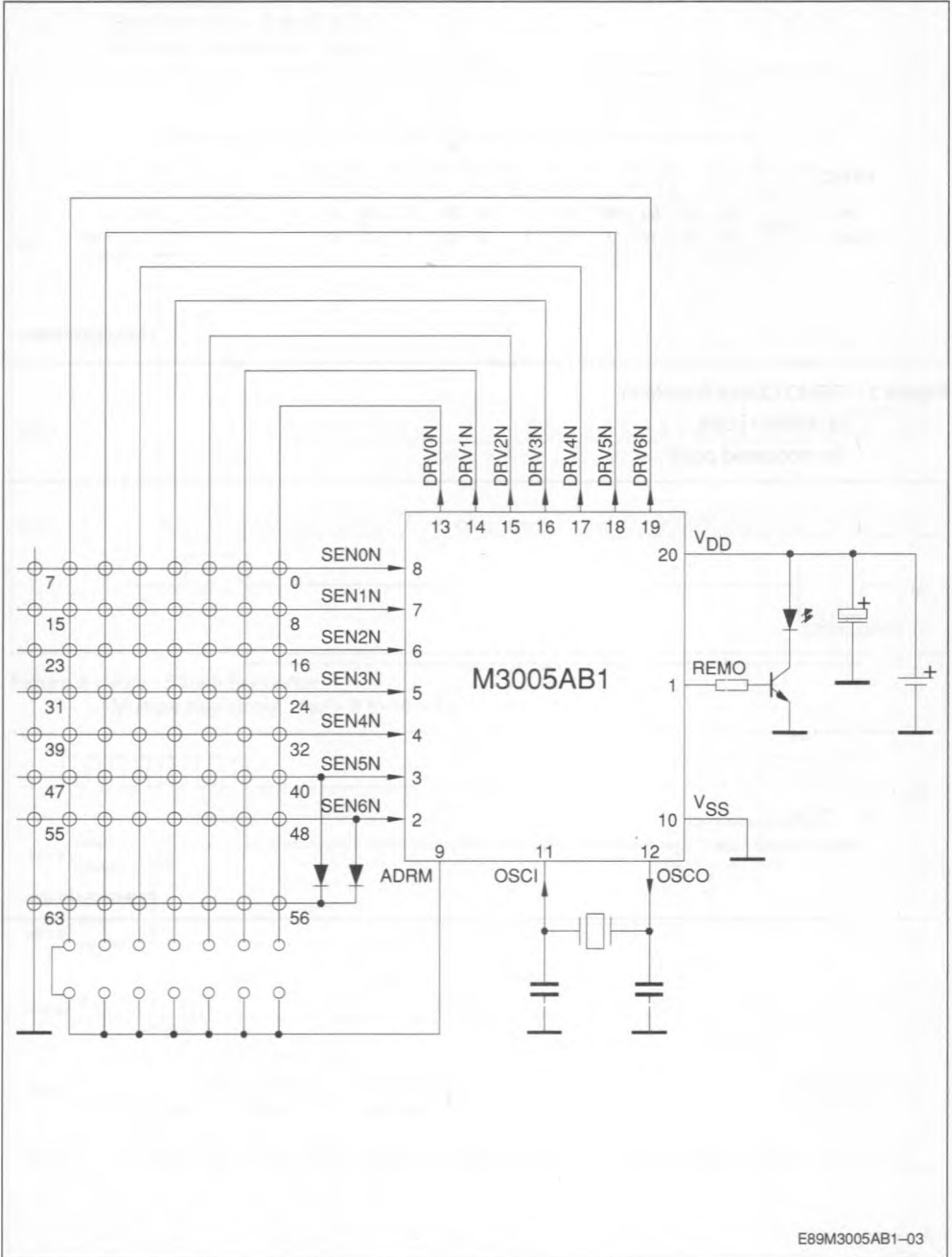
## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
VDD	Supply Voltage Range	- 0.3 to + 13	V
V <sub>I</sub>	Input Voltage Range	- 0.3 to VDD + 0.3	V
V <sub>O</sub>	Output Voltage Range	- 0.3 to VDD + 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 <sub>tot</sub>	Power Dissipation per Package for T <sub>amb</sub> = - 20 to + 70°C	Max. 200	mW
T <sub>stg</sub>	Storage Temperature Range	- 55 to + 150	°C
T <sub>amb</sub>	Operating Ambient Temperature Range	- 20 to + 70	°C

ELECTRICAL CHARACTERISTICS VSS = 0V ; T<sub>amb</sub> = 25°C ; unless otherwise specified

Symbol	VDD(V)	Parameter	Min.	Typ.	Max.	Unit
VDD		Supply Voltage T <sub>amb</sub> = 0 to + 70°C	4		12	V
IDD	6	Supply Current ; Act. f <sub>OSC</sub> = 455kHz ;		0.4	1	mA
IDD	9	REMO Outp. Unload.		0.8	2	mA
IDD	6	Supply Current ; Inactive (stand-by mode)			2	μA
IDD	9	T <sub>amb</sub> = 25°C			2	μA
fosc	4 to 11	Oscill. Frequency (cer. resonator)	350		600	kHz
V <sub>IL</sub>	4 to 11	<u>Keyboard Matrix</u> Inputs SENON to SEN6N Input Voltage LOW	0.8 x VDD		0.2 x VDD	V
V <sub>IH</sub>	4 to 11	Input Voltage HIGH		V		
- I <sub>I</sub>	4	Input Current		250		μA
- I <sub>I</sub>	11	V <sub>I</sub> = 0V		750		μA
I <sub>I</sub>	11	Input Leakage Current V <sub>I</sub> = VDD		1		μA
V <sub>OL</sub>	4	<u>Outputs DRVON to DRV6N</u> Output Volt. "ON" I <sub>O</sub> = 0.25mA			0.3	V
V <sub>OL</sub>	11	I <sub>O</sub> = 22.5mA			0.5	V
I <sub>O</sub>	11	Outp. Current "OFF" V <sub>O</sub> = 11V			10	μA
V <sub>IL</sub>		<u>Control Input ADRM</u> Input Voltage LOW	0.8 x VDD		0.2 x VDD	V
V <sub>IH</sub>		Input Volt. HIGH		V		
		Input Current (switched P-and N-channel pull-up/pull-down)				
I <sub>IL</sub>	4	Pull-up Act., Oper. Condition ;		250		μA
I <sub>IL</sub>	11	V <sub>IN</sub> = VSS		750		μA
I <sub>IH</sub>	4	Pull-down Active Standby Cond. ;	250	μA		
I <sub>IH</sub>	11	V <sub>IN</sub> = VDD	750	μA		
V <sub>OH</sub>	6	<u>Data Output REMO</u> Output Volt. HIGH	3			V
V <sub>OH</sub>	9	- I <sub>O</sub> H = 100mA	6			V
V <sub>OL</sub>	6	Output Volt. LOW			0.2	V
V <sub>OL</sub>	9	I <sub>O</sub> L = 0.6 mA			0.1	V
t <sub>MH</sub> /t <sub>OSC</sub>	6	Pulse Duty Cycle During Carrier Mode	0.4	0.5	0.6	
t <sub>OH</sub>	6	Pulse Length, Oscill. Stopped			1	ms
I <sub>I</sub>	6	<u>Oscillator</u> Input Current OSC1 at VDD	0.8		2.7	μA
V <sub>OH</sub>	6	Output Volt. HIGH - I <sub>O</sub> L = 0.1mA			VDD - 0.6	V
V <sub>OL</sub>	6	Output Volt. LOW I <sub>O</sub> H = 0.1mA			0.6	V

Figure 1 : Typical Application.



E89M3005AB1-03

Figure 2 : Data Format of REMO Output.

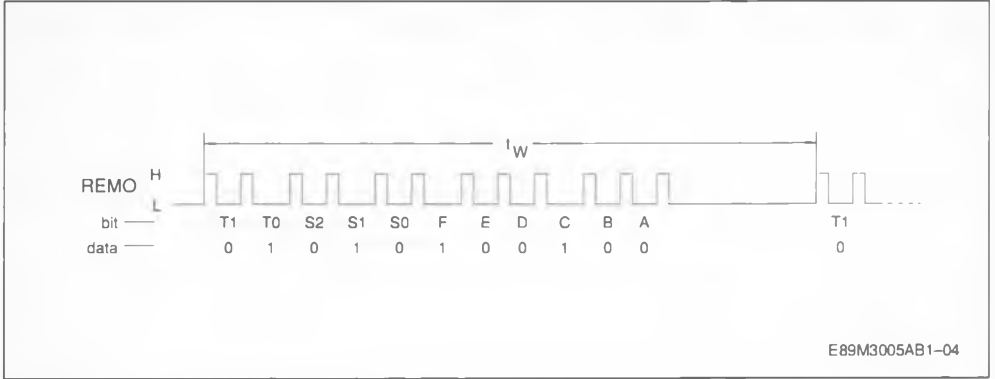
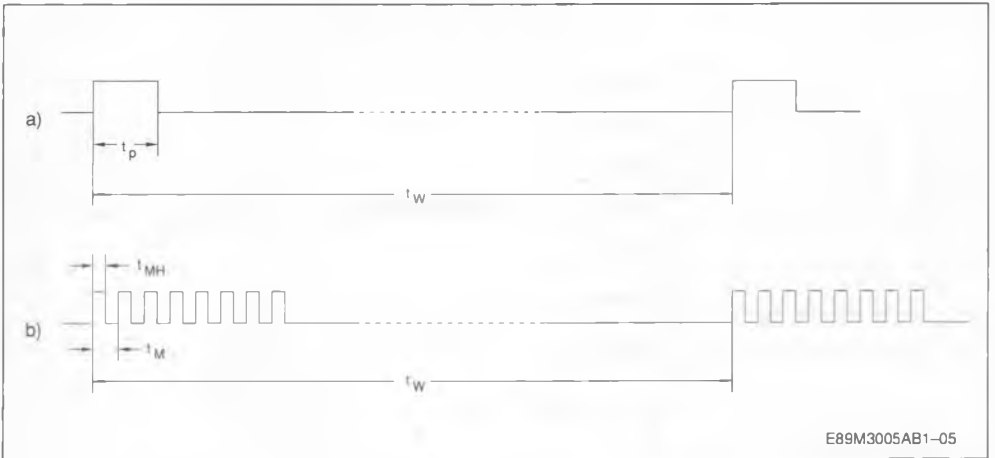


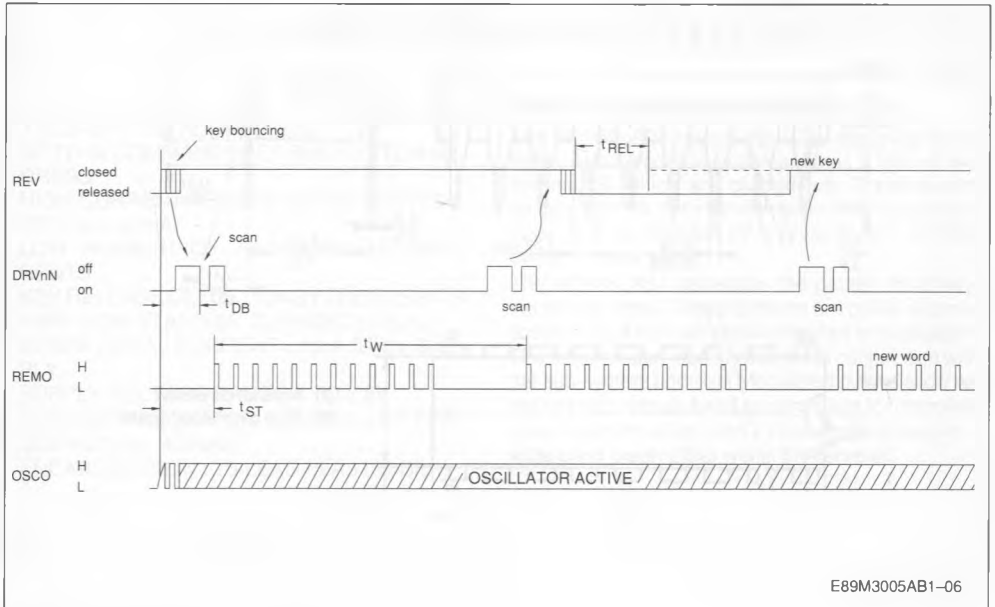
Figure 3 : REMO Output Waveform.

- (a) flashed pulse.
- (b) modulated pulse

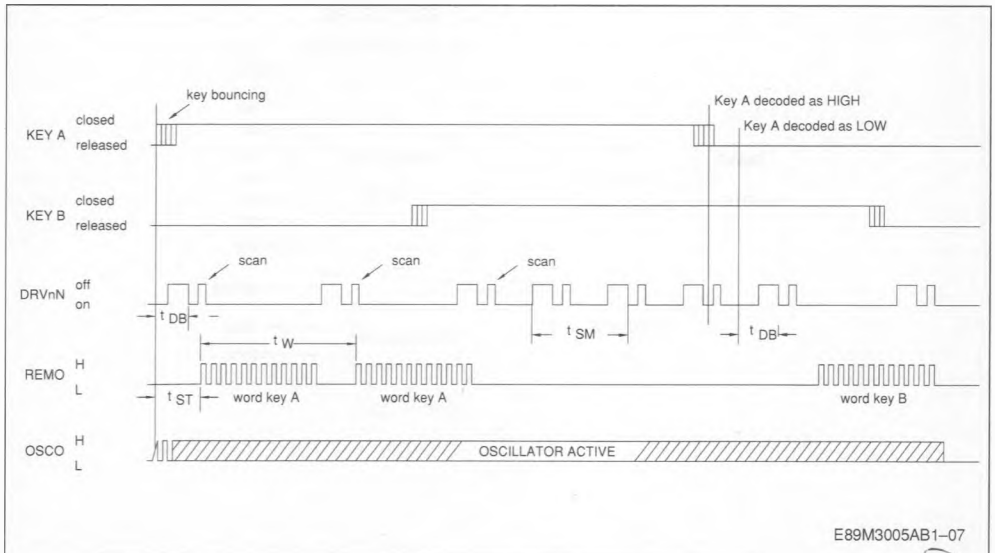




**Figure 4 : Single Key - Stroke Sequence.**  
 Debounce time :  $t_{DB} = 4$  to  $9 \times T_0$   
 Start time :  $t_{ST} = 5$  to  $10 \times T_0$   
 Minimum release time :  $t_{REL} = T_0$ .



**Figure 5 : Key - Stroke Sequence**  
 Multiple Key-stroke :  $t_{SM} = 8$  to  $10 \times T_0$ .



PACKAGE MECHANICAL DATA

20 PINS – PLASTIC DIP

