National Semiconductor

MM53226 Infrared Remote Control Transmitter

General Description

The MM53226 is an infrared remote control transmitter circuit using low threshold N-channel enhancement and depletion devices. This versatile circuit is ideal for sophisticated TV/HiFi consumer applications. The transmission of information is achieved using bursts of pulse code modulated infrared light, each burst consists of a fixed number of constant amplitude pulses with binary coded spaces. This system allows high pulse current drive to the transmitter diodes, and also high data integrity with noise immunity. The circuit features very low quiescent current drain guaranteeing long battery life.

Features

- 64 commands to 4 addresses
- Simple interface to Standby 9V battery
- Very low standby current — 10μA typical
- Pin compatible with ITT 1050/1250
- 0.1% IR drive ensures long battery life
- 6-bit data word, 2-bit address word
- Simple RC oscillator only requires 3 external components
- Keyswitch requirements allow use of low cost keyboard
- Simple interface to high current IR diodes
- Double key depression detection

Applications

- Remote control of TV
- Remote control of HiFi
- Remote machine control
- Remote ASCII keyboard
- Serial keyboard encoder

Block Diagram

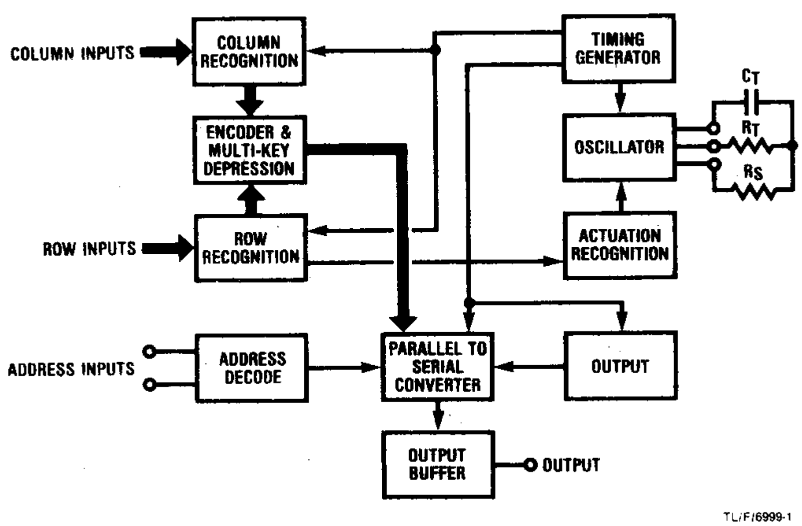


Figure 1

Absolute Maximum Ratings

Voltage at Any Pin	−0.5 to 12V
Storage Temperature	−65°C to 150°C
Lead Temperature (Soldering, 10 seconds)	300°C

Electrical Characteristics $T_A = 0°C$, $V_{SS} = 0V$, $V_{DD} = 6V$ to 10V unless otherwise specified.

Sym	Parameter	Conditions	Min	Typ	Max	Units
V_{DD}	Supply Voltage		6		10	V
I_{DD}	Supply Current	$V_{DD} = 9V$ No key depressed		10	20	μA
		$V_{DD} = 7V$ Valid key depressed (See Figure 5)			10	mA
	Oscillator Frequency	$C_T = 47pF$ 2% $R_T = 33k$ 1% $R_S = 33k$ 5% (See Figure 5)	160		220	kHz
	Output Logic Levels					
	Serial Out Logic "0"	1 Sink = 0.2mA			0.2	V
	Logic "1"	1 Source = 0.2mA	1.0			V

Functional Description

The block diagram of the MM53226 is shown in Figure 1. A connection diagram is shown in Figure 2.

The MM53226 operates using a simple 8 × 8 keyboard giving 64 different commands. The two inputs FA and FB are address inputs which allow a total of 256 messages to be transmitted. These commands are transmitted using pulse position modulation. See Figure 4.

The row and column circuitry recognizes when a single row is connected to a single column and removes the reset from the circuit. This activates the oscillator whose frequency is determined by the external components C_T, R_T and R_S. If a row input is connected to a column input for greater than 40k clocks the message is transmitted using 14 pulses of data. For the period that the row is connected to the column the message is transmitted every 40k clocks.

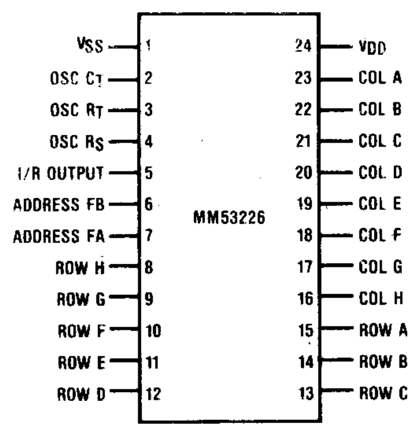
Releasing the row-column connection powers down the circuit to a standby condition of very low current consumption to conserve battery power. If the key contact is released during the transmission of a message the circuit will complete the transmission before powering down.

The multi-key depression detection circuit inhibits the output if more than one key is depressed.

The encoder provides at the output, via the parallel to serial converter, one of 64 codes (see Table 1). One of four addresses may be selected (see Table 2) giving a total of 256 commands that may be transmitted.

Connection Diagram

Dual-In-Line Package



Top View

Figure 2

Order Number MM53226N
See NS Package N24A

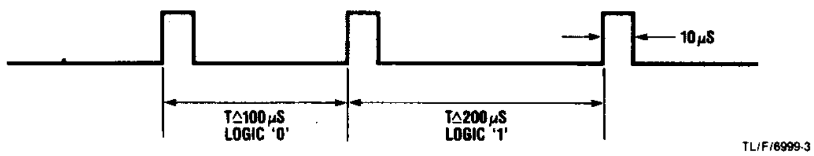
Typical Keyboard Specifications

R_{ON}	5 kΩ max
R_{OFF}	300 kΩ min

Format of Transmitted Signal:

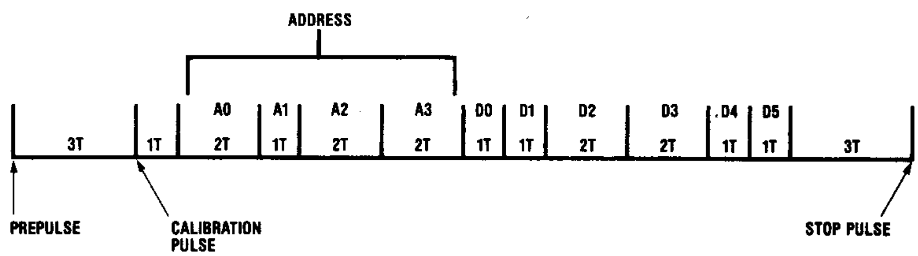
The information is transmitted in coded groups of infrared light pulses. The binary value of a single bit is represented by the time space between leading edges of two consecutive pulses. With an input oscillator frequency of 200kHz a time T△ 100μs is defined as the unit space (1T) representing a binary zero, a double space (2T) represents a binary one. See Figure 3.

Eleven pulses are required for each word consisting of 4 bits for address and 6 bits for data. Each word is preceded by a calibration and start pulse at intervals of 1T and 3T respectively. A stop pulse is transmitted 3T after the last data pulse.



All times are related to an input oscillator frequency of approximately 200kHz.

Figure 3



Format of message 001100 to address 1101

Figure 4

Table 1. Instruction Table

	Row Input								Column Input								Binary Code 6 Bit Data MSB					LSB	International REF 6 Bit ASCII Code
	a	b	c	d	e	f	g	h	A	B	C	D	E	F	G	H							
1.	x								x								0	0	0	0	0	0	@
2.	x									x							0	0	0	0	0	1	A
3.	x										x						0	0	0	0	1	0	B
4.	x											x					0	0	0	0	1	1	C
5.	x												x				0	0	0	1	0	0	D
6.	x													x			0	0	0	1	0	1	E
7.	x														x		0	0	0	1	1	0	F
8.	x															x	0	0	0	1	1	1	G
9.		x							x								0	0	1	0	0	0	H
10.		x								x							0	0	1	0	0	1	I
11.		x									x						0	0	1	0	1	0	J
12.		x										x					0	0	1	0	1	1	K
13.		x											x				0	0	1	1	0	0	L
14.		x												x			0	0	1	1	0	1	M
15.		x													x		0	0	1	1	1	0	N
16.		x														x	0	0	1	1	1	1	O
17.			x						x								0	1	0	0	0	0	P
18.			x							x							0	1	0	0	0	1	Q
19.			x								x						0	1	0	0	1	0	R
20.			x									x					0	1	0	0	1	1	S
21.			x										x				0	1	0	1	0	0	T
22.			x											x			0	1	0	1	0	1	U
23.			x												x		0	1	0	1	1	0	V
24.			x													x	0	1	0	1	1	1	W
25.				x					x								0	1	1	0	0	0	X
26.				x						x							0	1	1	0	0	1	Y
27.				x							x						0	1	1	0	1	0	Z
28.				x								x					0	1	1	0	1	1	[
29.				x									x				0	1	1	1	0	0	\
30.				x										x			0	1	1	1	0	1	]
31.				x											x		0	1	1	1	1	0	∧
32.				x												x	0	1	1	1	1	1	—
33.					x				x								1	0	0	0	0	0	SP
34.					x					x							1	0	0	0	0	1	!
35.					x						x						1	0	0	0	1	0	"
36.					x							x					1	0	0	0	1	1	#
37.					x								x				1	0	0	1	0	0	$
38.					x									x			1	0	0	1	0	1	%
39.					x										x		1	0	0	1	1	0	&
40.					x											x	1	0	0	1	1	1	'
41.						x			x								1	0	1	0	0	0	(
42.						x				x							1	0	1	0	0	1	)
43.						x					x						1	0	1	0	1	0	*
44.						x						x					1	0	1	0	1	1	+
45.						x							x				1	0	1	1	0	0	,
46.						x								x			1	0	1	1	0	1	—
47.						x									x		1	0	1	1	1	0	.
48.						x										x	1	0	1	1	1	1	/
49.							x		x								1	1	0	0	0	0	0
50.							x			x							1	1	0	0	0	1	1
51.							x				x						1	1	0	0	1	0	2
52.							x					x					1	1	0	0	1	1	3
53.							x						x				1	1	0	1	0	0	4
54.							x							x			1	1	0	1	0	1	5
55.							x								x		1	1	0	1	1	0	6
56.							x									x	1	1	0	1	1	1	7
57.								x	x								1	1	1	0	0	0	8
58.								x		x							1	1	1	0	0	1	9
59.								x			x						1	1	1	0	1	0	:
60.								x				x					1	1	1	0	1	1	;
61.								x					x				1	1	1	1	0	0	<
62.								x						x			1	1	1	1	0	1	=
63.								x							x		1	1	1	1	1	0	>
64.								x								x	1	1	1	1	1	1	?

7

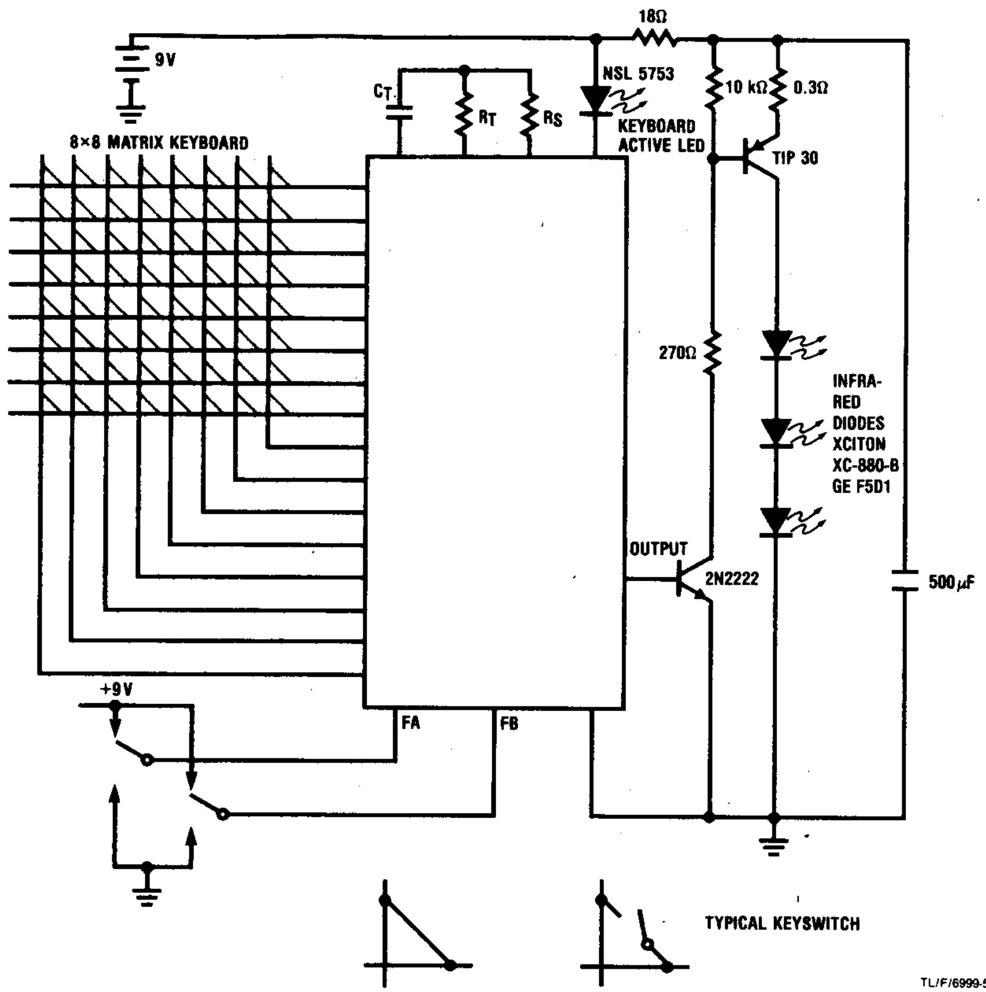
Address Decoding

FA	FB	Address MSB			LSB	
1	1	0	0	0	0	Note 1
1	0	1	1	1	0	
0	1	1	0	0	1	
0	0	0	0	0	0	

Note 1: When a key is depressed with FA = FB = 1 the first message is transmitted with address 0000, all following messages are transmitted with address 1111 for as long as the key is depressed.

Table 2

Typical Application Diagram (256 code transmitter with visual *feedback)



*If not required Keyboard Active LED can be replaced by three 1N914 diodes

Oscillator Typical Values

C_T 47 pF 2% polystyrene or silver mica
R_T 1% metal oxide
R_S 5%

Figure 5