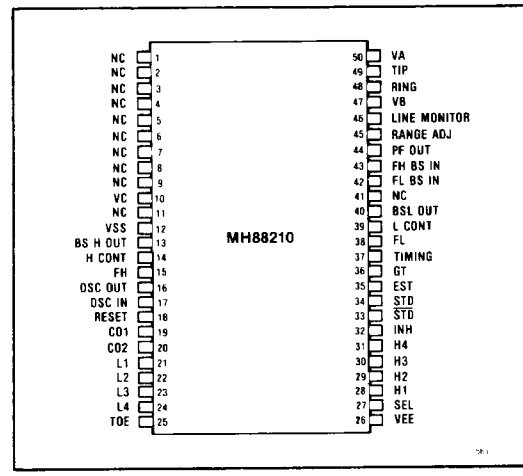
Hybrid DTMF Receiver System

OCT. 1981

Features

- Up to 40dB Dynamic Range
- Single Power Supply
- No External Components Needed
- Direct Connection To Telephone Line
- Exceptional Talk Off
- 14dB Signal to Noise Ratio
- Acquisition Time Adjustable Down to 10ms
- Major Parameters Externally Adjustable



Applications

- Control Systems
- Mobile Radio
- Central Office
- PABX
- Key Systems

Description

The Mitel MH88210 Hybrid Receiver is a high performance high quality TOUCH-TONE® receiver packaged as a dual in line hybrid measuring only 2.5″ × 1.5″ × 0.25″ which requires no external components for normal operation. The unit features exceptional dynamic range to meet the exacting requirements of end to end signaling applications as well as providing a unit of excellent central office quality. The MH88210 utilizes a digital detection algorithm incorporated in the MITEL CMOS/LSI MT8820 Digital Tone Decoder, which provides the unit with excellent talk-off immunity and signal to noise performance.

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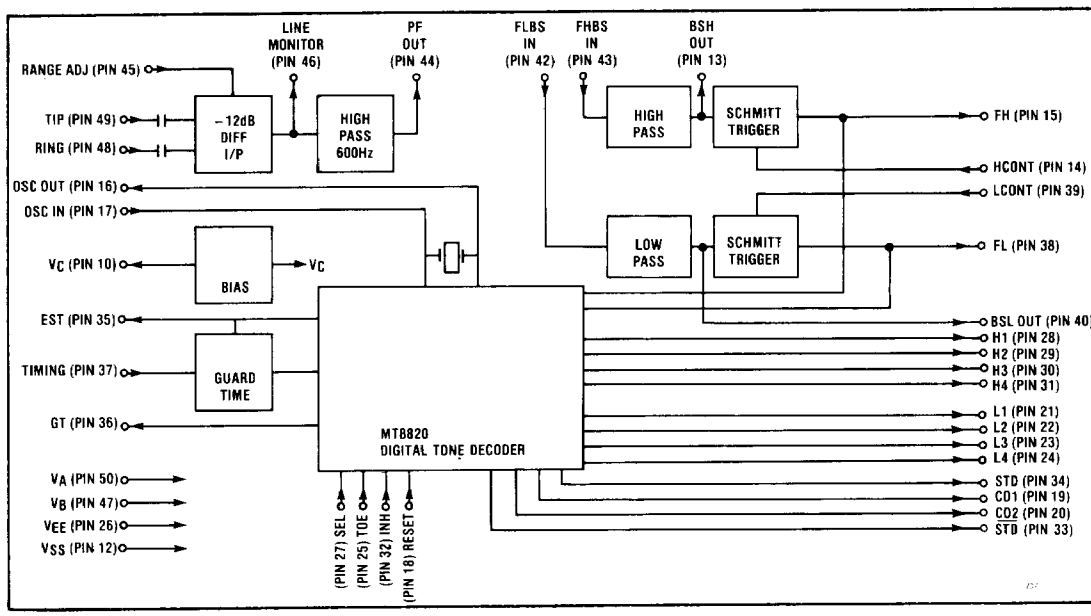

FIG. 1 FUNCTIONAL BLOCK DIAGRAM

Absolute Maximum Ratings

RATING	SYMBOL	MIN	MAX	UNIT
Supply Voltage	$V_A - V_{EE}$ $V_A - V_B$ $V_A - V_{SS}$		18 18 7	V V V
Input Current on any logic pin	I_{IN}		10	mA
Voltage on any logic pin	V_{IN}	$V_{EE} - 0.3$	$V_A + 0.3$	V
Operating Temperature Range	T_A	−40	+85	°C
Storage Temperature Range	T_{STG}	−55	+125	°C

DC Electrical Characteristics

		CHARACTERISTIC	V_A = 5, V_{EE} = V_B = OV			V_A = 15V, V_B = V_{EE} = OV			
			Min	Typ	Max	Min	Typ	Max	UNITS
1.	SUPPLY	Operating Voltage	4.75					16	V
2.	SUPPLY	I_A Supply Current		10	15		15	20	mA
3.	SUPPLY	V_C		2.7			8.1		V
4.	SUPPLY	I_C Load Current on V_C			4			4	mA
5.	LOGIC INPUTS	V_{IH} (All inputs)	3.5			13.0			V
6.	LOGIC INPUTS	V_{IL} (All inputs)			1.5			3.0	V
7.	LOGIC INPUTS	I_{IH} SEL, INH, RST		50			200		μA
8.	LOGIC INPUTS	I_{IH} Others		10			20		μA
9.	LOGIC INPUTS	I_{IL} TOE		10			50		μA
10.	LOGIC INPUTS	I_{IL} Others		10			20		μA
11.	LOGIC OUTPUTS	I_{OL} (V_O = 0.4V)	0.4			1			mA
12.	LOGIC OUTPUTS	I_{OH} (V_O = V_A − 0.4V)	0.4			1			mA
13.	LOGIC OUTPUTS	I_{OZ} (HI Z)			0.5			10	μA
14.	LOGIC OUTPUTS	I_{OL}STD (V_O = 0.5V)	5			10			mA
15.	LOGIC OUTPUTS	I_{OL} STD (V_D = 0.5V)		25			25		μA
16.	LOGIC OUTPUTS	I_{OH} STD (V_D = V_A − 0.5V)	1			1			mA

AC Electrical Characteristics

		CHARACTERISTIC	V_A = 5, V_{EE} = V_B = OV			V_A = 15V, V_B = V_{EE} = OV			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
1	TONE INPUTS	Common Mode Voltage dc			200			200	Vdc
2		60Hz			160			160	Vrms
3		1kHz			10			30	Vrms
4		Gain to RANGE ADJUST 1		−6			−6		dB
5		Impedance at 1kHz to V_A		200			200		kΩ
6		Differential Impedance		400			400		kΩ
		Valid Signal Levels (Dual Tone)	−26						
7		-Normal			10	−16		10	dBm 600Ω
8		-Extended Range	−38		0	−30		10	dBm600Ω
9		Tone Level Difference (V_H V_L or V_L V_H)			10			10	dB
10		Tone Freq deviation accepted			2.0			2.0	%
11		Tone Freq Deviation Rejected	2.8			2.8			%
		3rd Tone Level wrt Lowest Tone Note 1							
12		DC to 480Hz		20			20		dB
13		480Hz to 1.1kHz		−22			−22		dB
14		1.1kHz to 2.0kHz		−16			−16		dB
15		S/N Ratio Note 2	14			14			dB
16		t_{REC} (adjustable) = (t_{DO} + t_{GT})	26		38				ms
17		t_{DO} (fixed)	6		18				ms
18		t_{DSTD}		5					µs
19		t_{DO}			10				ms
20		t_{IDP}	20						ms
21		t_{GT} (adjustable)		20					ms

Notes 1. Maximum level of third interfering tone to cause valid tone pair recognition error.

2. Band limited white noise referred to lowest single tone.
Tone burst 40ms on - 40ms off. Error rate 1 in 10,000.

Parameter Definitions

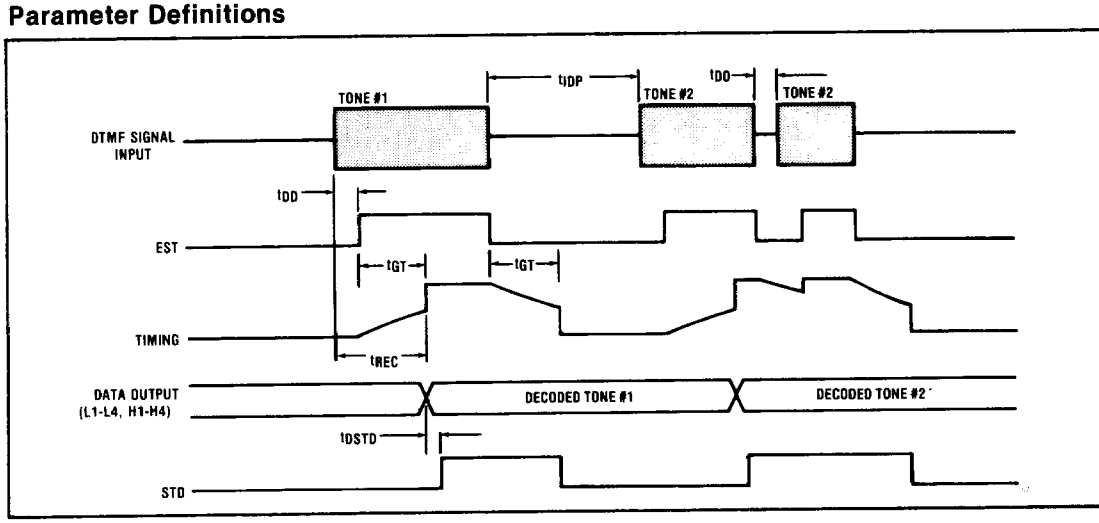

Fig. 2 Signal Waveforms

Pin Description

Pin No.	Pin Name	Function
10	V_C	V_{ref} output
12	V_{SS}	Internal Supply Normally Open, See instructions for 5 Volt operation
13	BSH Out	High Group Band Split Filter Output Normally Open
14	H Cont.	High Group Schmitt Trigger Feedback Control Normally Open
15	FH	High Group Schmitt Trigger Output Normally Open
16	OSC Out	Oscillator Output 3.579545 MHz, Internal Osc Amp and Crystal
17	OSC In	Oscillator Input
18	RESET	Test point (normally open) Auto reset on power up and tone input
19	CO1	18.266 kHz clock, Non-overlapping
20	CO2	Low Going
21	L1	LOW GROUP LOGIC OUTPUTS 697
22	L2	770
23	L3	See Truth Table (Table 1) 852
24	L4	941
25	TOE	Threestate Output Enable (normally open or high)
26	V_{EE}	Negative Supply to Logic
27	SEL	Code Select Input (normally low or open for hexcode)
28	H1	HIGH GROUP LOGIC OUTPUTS 1209
29	H2	1336
30	H3	See Truth Table (Table 1) 1477
31	H4	1633
32	INH	Inhibit Non-numeric Tones (normally low or open)
33	STD	Tone Valid Output - active low
34	STD	Tone Valid Output - active high collector NPN
35	EST	Tone presence output (early steering)
36	GT	Guard time adjust (normally connected to pin 37)
37	TIMING	Guard Time adjust pins (normally connected to pin 36)
38	FL	Low Group Schmitt Trigger Output Normally Open
39	L Cont	Low Group Schmitt Trigger Feedback Control Normally Open
40	BSL Out	Low Group Band Split Filter Output Normally Open
42	FL BS In	Low Group Band Split Filter Input Normally Shorted to 44
43	FH BS In	Hi Group Band Split Filter Input Normally Shorted to 44
44	PF Out	Pre Filter Output Normally Shorted to 43 and 42
45	RANGE ADJUST	Sensitivity adjustment node (normally open)
46	LINE MONITOR	Line buffer output and sensitivity adj node
47	V_R	Negative Supply to Analog Circuits
48	RING	Tone inputs, differential
49	TIP	
50	V_A	Positive Supply to Logic and Analog

Output Truth Table

	SEL=H (2-of-8 Code)								SEL=L (L1-L4 Hexadecimal Code. H1-H4 format)							
	L1	L2	L3	L4	H1	H2	H3	H4	L1	L2	L3	L4	H1	H2	H3	H4
1	H	L	L	L	H	L	L	L	H	L	L	L	L	L	L	L
2	H	L	L	L	L	H	L	L	L	H	L	L	L	H	L	L
3	H	L	L	L	L	L	H	L	H	H	L	L	L	L	H	L
4	L	H	L	L	H	L	L	L	L	L	H	L	L	L	L	H
5	L	H	L	L	L	H	L	L	H	L	H	L	L	H	L	H
6	L	H	L	L	L	L	H	L	L	H	H	L	L	L	H	H
7	L	L	H	L	H	L	L	L	H	H	H	L	H	L	L	L
8	L	L	H	L	L	H	L	L	L	L	L	H	H	H	L	L
9	L	L	H	L	L	L	H	L	H	L	L	H	H	L	H	L
0	L	L	L	H	L	H	L	L	L	H	L	H	L	H	H	L
*	L	L	L	H	H	L	L	L	H	H	L	H	H	L	H	H
#	L	L	L	H	L	L	H	L	L	L	H	H	H	L	L	H
A	H	L	L	L	L	L	L	H	H	L	H	H	H	H	H	L
B	L	H	L	L	L	L	L	H	L	H	H	H	H	H	L	H
C	L	L	H	L	L	L	L	H	H	H	H	H	L	H	H	H
D	L	L	L	H	L	L	L	H	L	L	L	L	H	H	H	H

Functional Description

The Mitel MH88210 Tone Receiver is designed to accept standard DTMF tones as recommended by CCITT. A telephone line can be directly connected to Tip and Ring inputs which are high impedance ac coupled and balanced. The differential input impedance is approximately 200kohms. The input signal is passed through a high pass filter to provide dial tone rejection. High and low frequencies of the input signal are separated by band splitting filters, and squared off using a Schmitt trigger for each high and low tone group. These square waves which are the frequencies of the high and low input tones are presented as inputs to the MITEL MT8820 Digital Tone Decoder where a proprietary averaging algorithm and all further signal processing takes place. On valid detection of both the high and low tone, the early steering output EST, goes HIGH. (Refer to Fig. 2) This activates a simple analog guard time circuit which operates on tone acquisition and release, preventing multiple digit recognition in the presence of impulse noise, or tone interruption less than the allowable tone drop-out time t_{DO}. If a tone drop-out or frequency error occurs prior to elapse of the guard time t_{GT}, EST goes low resetting the analog timer. The digital detection algorithm is then repeated.

At the positive transition of TIMING after t_{GT} has elapsed, the output latches (L1-L4, H1-H4) of the MT8820 are updated. Three output formats are selectable via SEL, Pin 27. These formats are 2 of 8 active high, hexadecimal, or an alternate 4 BIT code. The Truth Table is listed in Table 1. The data in the output latches will remain stable until the valid recognition of the subsequent tone pair. The end of a tone is not recognized until t_{GT} has timed out on the trailing edge of the detected tone pair. A delayed strobe signal, STD, is available on Pin 34. This signal remains HIGH for the duration of the detected tone pair and goes low after the release guard time has elapsed. Signal $\overline{STD}$ on Pin 33 provides the inverse of this signal. Additionally, a 3-state output enable TOE, Pin 25, is provided to enable bussing of the data outputs. Two non-overlapping, active low clocks are provided at CO1 and CO2 for optional use with digital logic that may be used to process the decoded digital outputs.

The INH pin, Pin 32, taken HIGH, allows the user to inhibit decoding of tone pairs corresponding to the keypad designations A,B,C,D,*,# to further reduce susceptibility to "talk-off".

Typical Applications

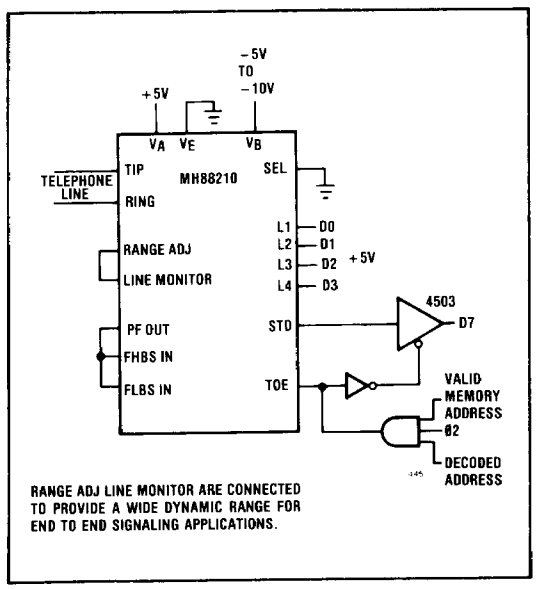

Fig. 3 Telephone Line Signal Interfacing to 6800 Type Microprocessor

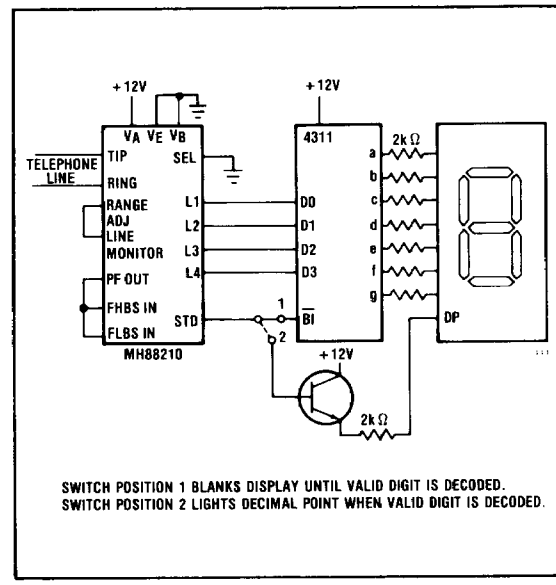

Fig. 4 A Simple TOUCH-TONE Telephone Digit Decoder

Power Supply Connections

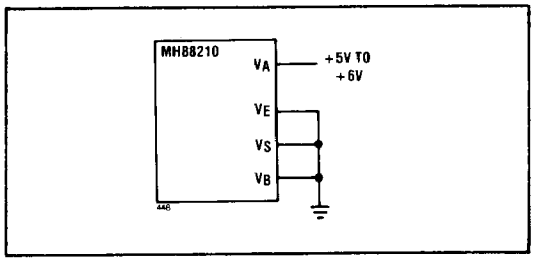

Fig. 5 5V to 6V Logic

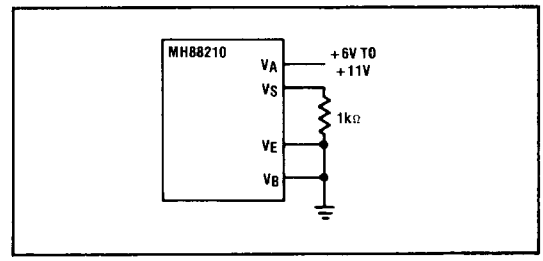

Fig. 6 6V to 11V Logic

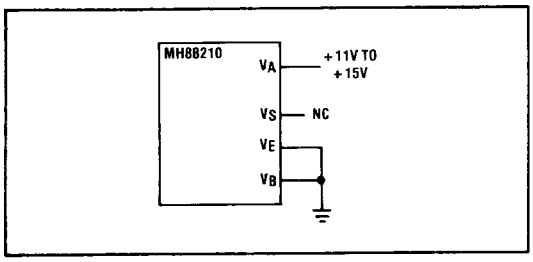

Fig. 7 11V to 15V Logic

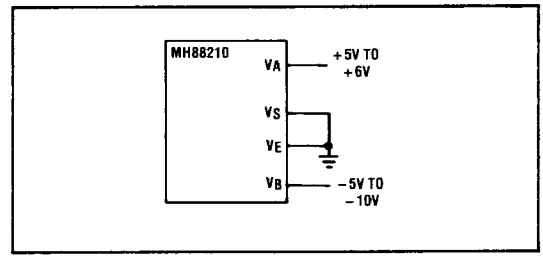

Fig. 8 +5V to +6V

Parameter Adjustment - Sensitivity, Range and Guard Time

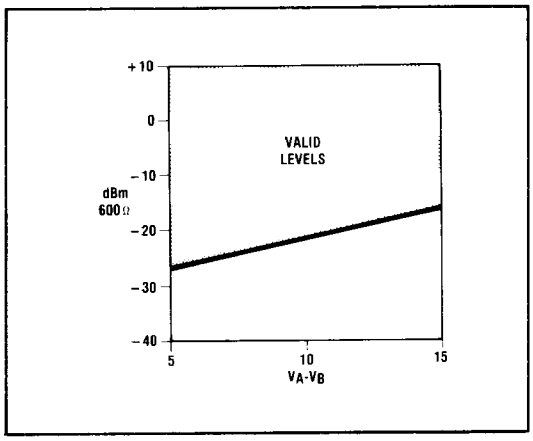

Fig. 9 Sensitivity - No Adjustment

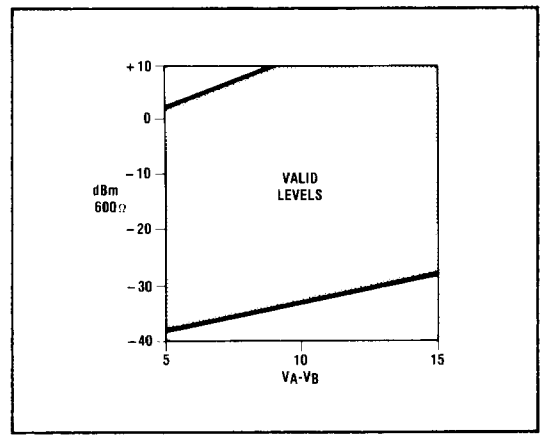

Fig. 10 Range 1 Shorted to Range 2

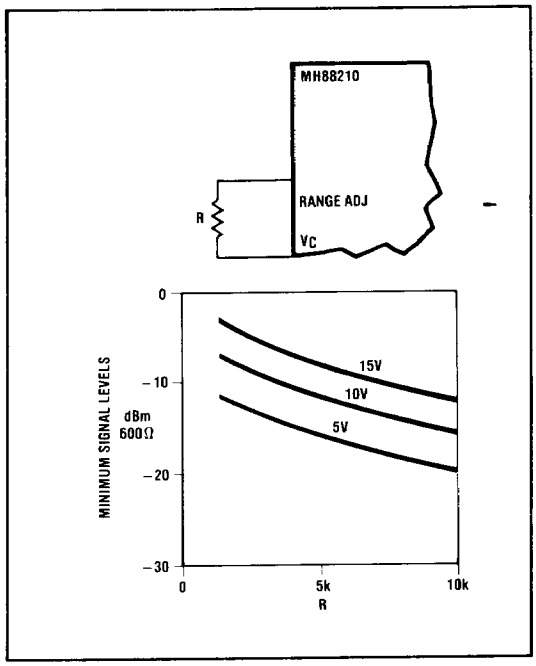

Fig. 11 Sensitivity Decrease

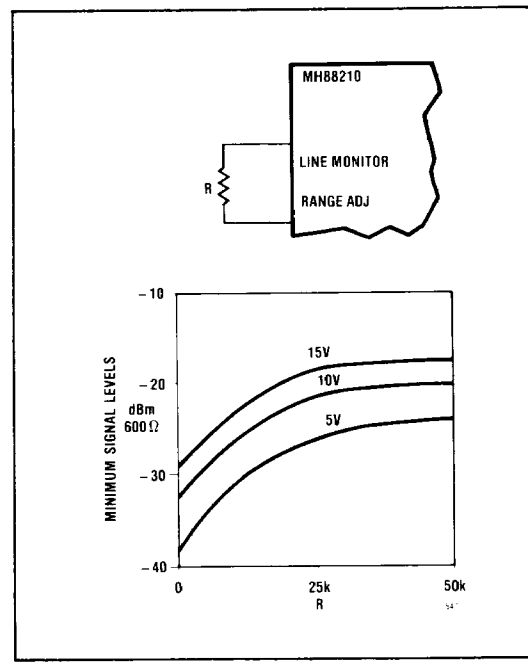

Fig. 12 Sensitivity Increase

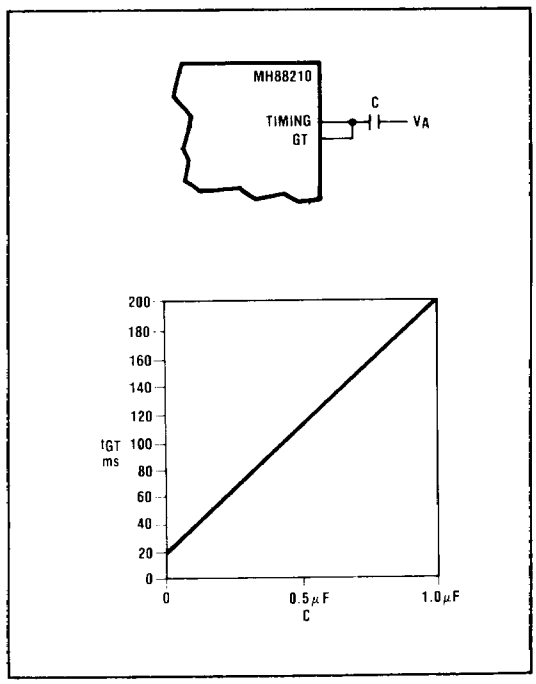

Fig. 13 Guard Time Increase

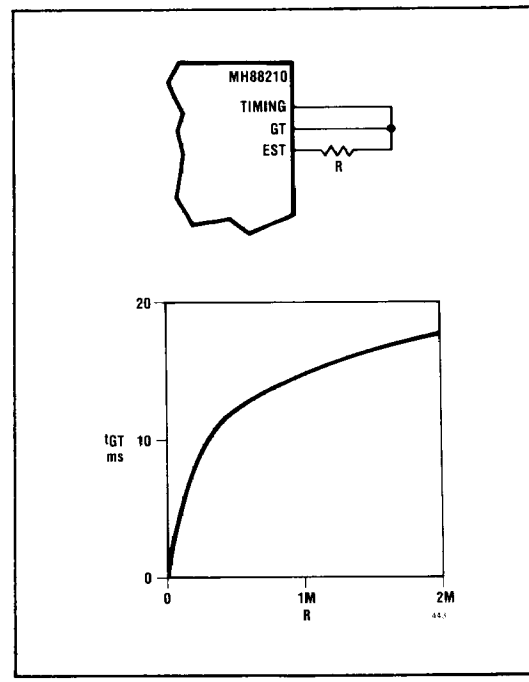

Fig. 14 Guard Time Decrease