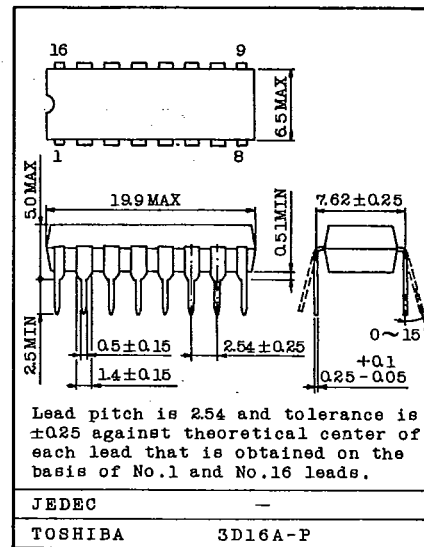


TC9138AP**TC9138AP AUTOMATIC PROGRAM SEARCH IC FOR TAPE RECORDER**

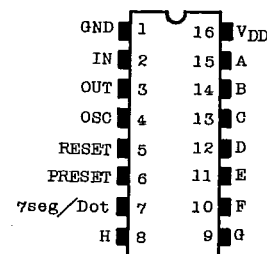
TC9138AP is an automatic music selector IC for searching programs on the tape of a cassette tape recorder, etc., being capable of automatically selecting music up to 15 programs at maximum.

- Low power dissipation by C²MOS construction.
- Operating voltage 4.0V ~ 6.0V
- Capable of searching and selecting up to 15 programs at maximum.
- Preset programs can be indicated in the two ways, such as character display by 7-segment LED and dot display by LED lamps.
- Built-in interprogram sensing circuit enables head amplifier output to be directly input
Input sensitivity 500mV_{p-p} (Typical)
- Built-in LED driver for output saves use of external parts
- Sensing time of blank spaces between selections can be arbitrarily set by external CR.
- Capable of performing direct preset of 1~15 programs by combining step-up set by up-key, direct set of 1~5 programs, and +5, +10 keys.

Unit in mm

**MAXIMUM RATINGS (Ta = 25°C)**

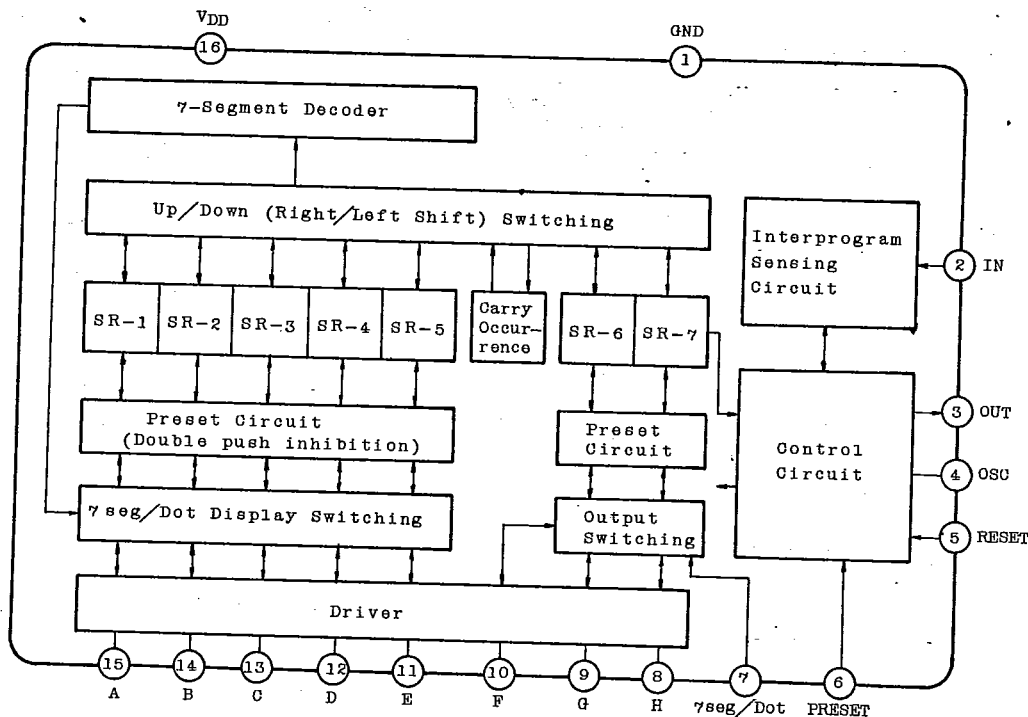
CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V _{DD}	-0.3 ~ 7.0	V
Input Voltage	V _{IN}	-0.3 ~ V _{DD} +0.3	V
Output Current	I _{OH}	+30	mA
Output Current	I _{OL}	-30	mA
Power Dissipation	P _d	300	mW
Operating Temperature	T _{opr}	-30 ~ 75	°C
Storage Temperature	T _{stg}	-55 ~ 125	°C

PIN CONNECTIONS**TOSHIBA**

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BLOCK DIAGRAM



FUNCTIONAL EXPLANATION OF EACH TERMINAL

PIN NO.	SYMBOL	FUNCTIONAL EXPLANATIONS	I/O FORM
1, 16	GND, VDD	Supply voltage applying terminals	
2	IN	Audio signal input. Built-in interprogram signal sensing circuit enables rectifying circuit to be eliminated. In this case, input is effected by combining capacitors.	
3	OUT	Plunger control signal output for program search. Usually it is hold "L" level, the pulse at "H" level is output after completion of selecting up to the desired program.	
4	OSC	Oscillator terminal for setting interprogram sensing time and output pulse width. C and R are externally connected.	

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PIN NO.	SYMBOL	FUNCTIONAL EXPLANATIONS	I/O FORM
5	RESET	Resetting input of preset data. Preset data is reset when the level is set to "L" level at time of presetting the desired programs or at time of misoperation.	
6	PRESET	Preset input of desired program. Desired programs are shifted up by 1 step/1 push. Usually they are at "L" level, and are shifted up at "H" level.	
7	7 seg/ Dot	Input for shifting desired program display to 7-segment LED and LED lamp. 7-segment LED display at "H" level, and dot display by LED lamp at "L" level.	
8 ~ 15	H ~ A	Direct preset inputs for desired programs and driver outputs for display. I/O type of combined use of input and output.	

ELECTRICAL CHARACTERISTICS (Unless otherwise specified, $V_{DD}=5V$, $T_a=25^\circ C$)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Operating Supply Voltage		V_{DD}	-		4.0	-	6.0	V
Operating Supply Current		I_{DD}	-	No load $V_{DD}=6.0V$	-	-	1.0	mA
Input Voltage	"L" Level	V_{IL}	-	RESET, PRESET, 7 seg/Dot, A ~ H	-	-	1.0	V
	"H" Level	V_{IH}	-	RESET, PRESET, 7 seg/Dot, A ~ H	4.0	-	-	V
Output Current	"L" Level	I_{OL}	-	Nch FET drain output $V_{OL}=15V$	-	-20	-15	mA
	"H" Level	I_{OH}	-	NPN transistor emitter output $V_{OH}=3.8V$	15	25	-	mA
Output Voltage	"L" Level	V_{OL}	-	A ~ H	-	-	0.2	V
	"H" Level	V_{OH}	-	F ~ H	4.8	-	-	V
Pull-up Resistance		R_{UP}	-		6	-	20	k Ω
Pull-down Resistance		R_{DOWN}	-	Terminals other than RESET, V_{DD} GND	6	-	20	k Ω
		R_{DOWN}	-	RESET	30	-	100	k Ω
Max. Operating Frequency		$f_{MAX.}$	-		-	100	-	kHz
Operating Input Oscillation		V_{IN}	-	$f = 10kHz$	-	500	-	mV _{p-p}
Input Amplifier Gain		G_v	-	$f = 10kHz$	-	20	-	dB

TOSHIBA

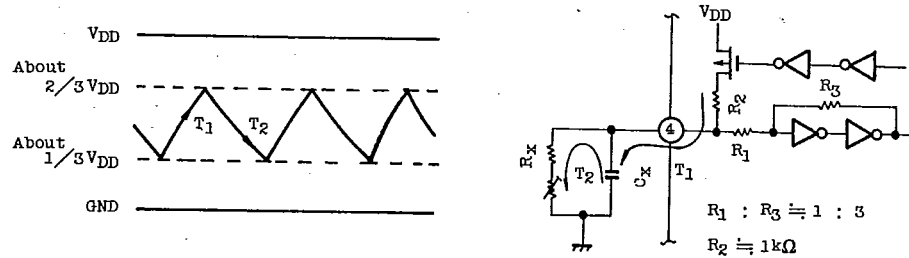
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OPERATIONAL DESCRIPTION

1. OSCILLATOR CIRCUIT

The oscillator circuit is of a single-terminal type, and is made up by connecting C and R to the OSC terminal.



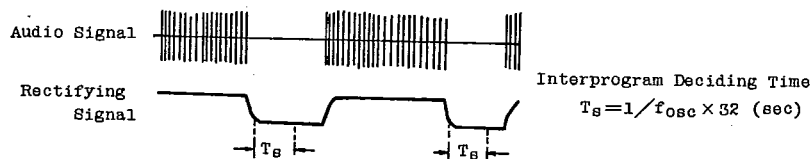
Repeatedly this oscillator circuit charges electricity by the time constants of the resistor R_2 in IC and external C_X , and discharges by the external resistor R_X .

Since the hysteresis voltage of schmidt trigger considerably fluctuates by variations between the supply voltage and IC, it is recommended that a semi-fixed resistor be used as R_X .

Oscillation Frequency (Refer to Graph 1.)

2. INTERPROGRAM SENSING TIME

The interprogram non-signal time is decided by the oscillation frequency mentioned above; therefore, such time can be arbitrarily set up by changing the oscillation frequency.



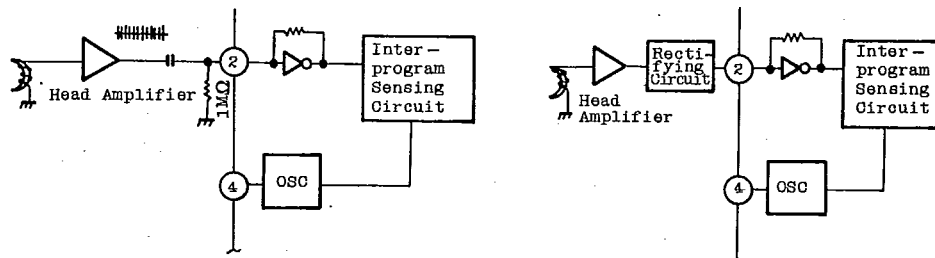
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3. INPUT CIRCUIT

Since the audio signal input circuit contains an interprogram signal sensing circuit, the head-amplifier output can be also directly input by combining capacitors.

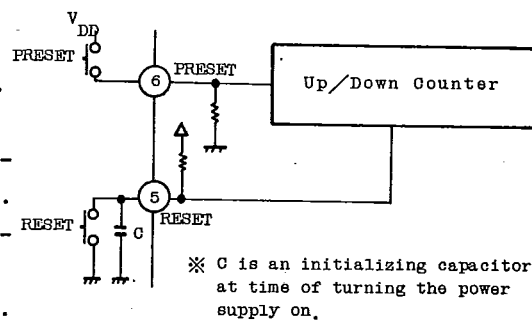


4. PRESET AND RELEASE OF DESIRED PROGRAMS

4.1 PRESET, RESET Terminals

The preset of desired programs can be stepped up by PRESET input.

One push of switches enables programs to be stepped up one by one. In case of misoperation, the preset can be released by setting the PRESET terminal to "L" level.



4.2 Direct Set of 1 ~ 15 programs (1)

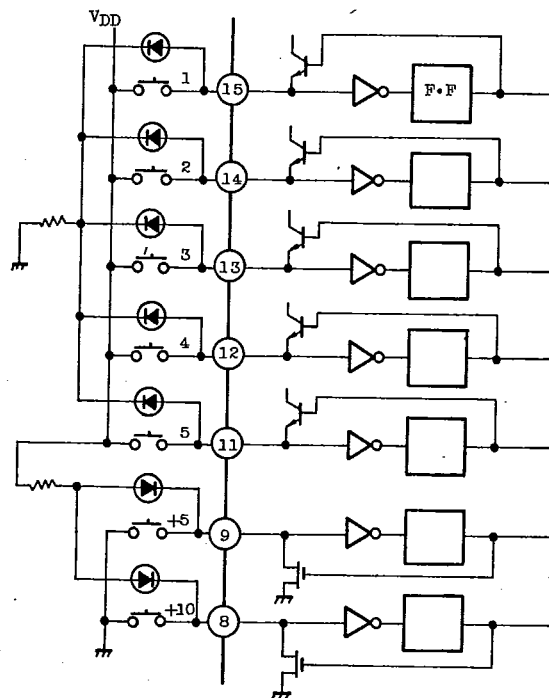
Programs can be directly preset by combining (1) ~ (5) inputs with (+15), (+10) inputs. The (+5), (+10) inputs cannot be operated individually.

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For example, in case where the 8th program is preset, +5 input is set with (3) input only set.

When +5 and (3) inputs are set, the program is considered to be the 3rd program.



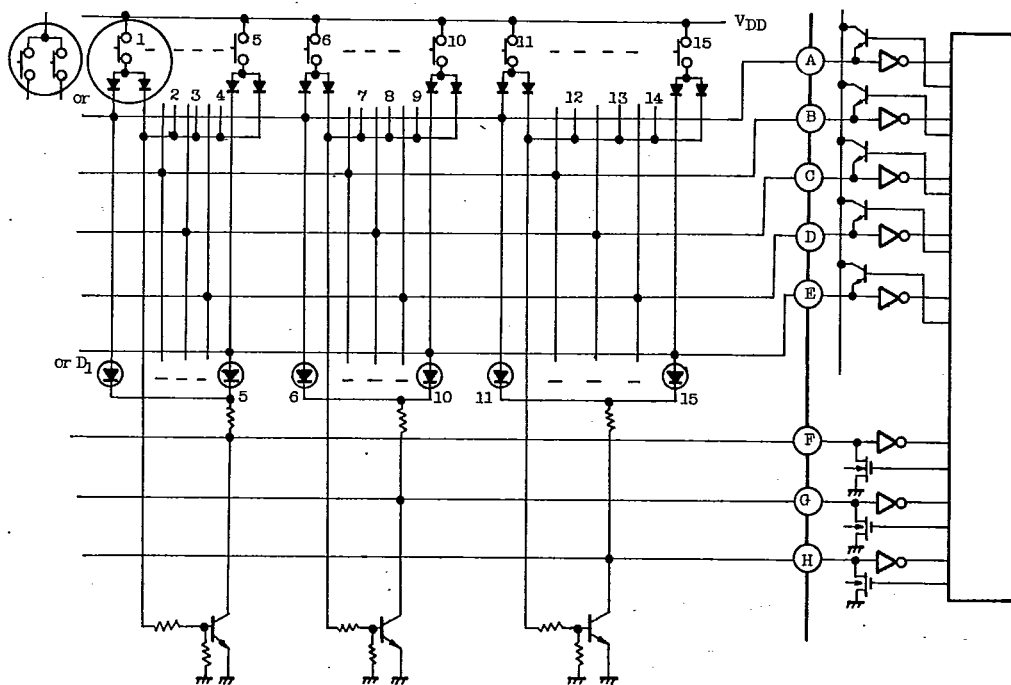
4.3 Direct Set of 1 ~ 15 programs

Para. 4.2 is the description of semi-direct setting by use of 7 switches. Entirely direct set can be also made by use of 15 switches.

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Direct preset is made by use of 15 switches in total (5×3) after matrixing 5 lines of $A \sim E$ with 3 lines of $F \sim H$.

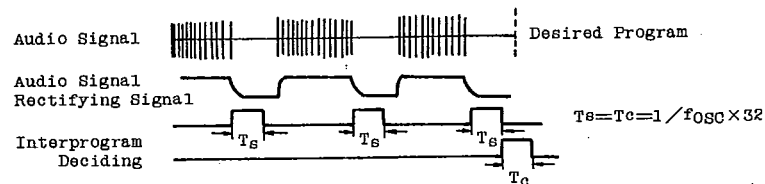


5. PLUNGER CONTROL OUTPUT

When the decision of interprogram time prior to any desired program has been completed by fast-forward (or rewind) operation up to the desired program, a pulse is output for a specified period of time. This pulse width is the same as the interprogram deciding time.

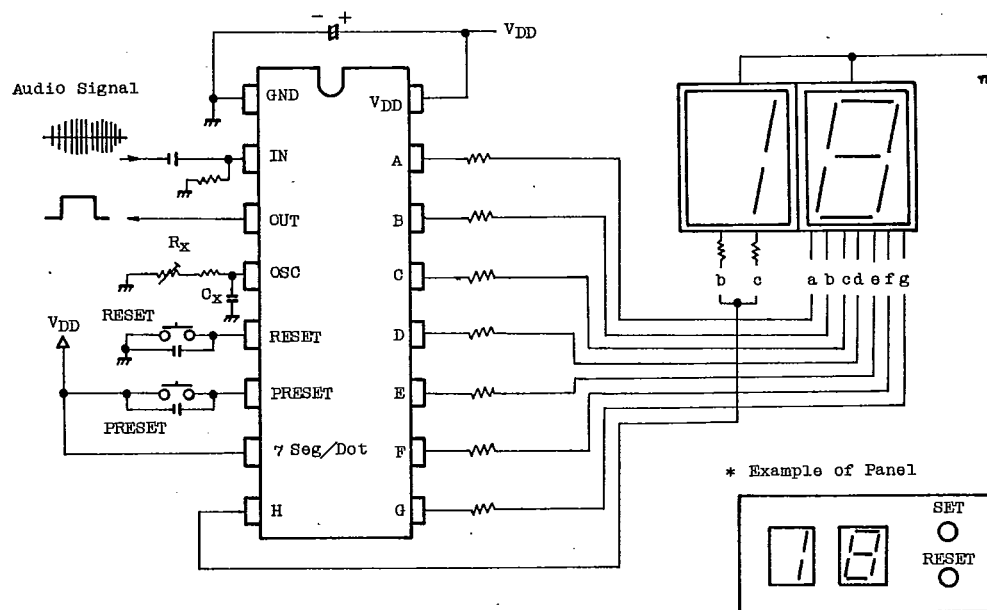
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APPLICATION CIRCUIT EXAMPLE (1)

7-Segment Display



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o DISPLAY

The display of a desired program is indicated in terms of 2-digit, 7-segment LED. The outputs A ~ G drive the segments a ~ g of 1st digit ($\times 1$) LED, and the output H drives the segments b and c of 2nd digit ($\times 10$) LED.

All of the outputs A ~ H serve as open emitters (NPN transistors) by setting the 7 seg/Dot terminal to "H" level.

o METHOD OF SETTING DESIRED PROGRAMS

Desired programs are set making them step up by adding "H" level to the preset input. Programs are set by one program per one pulse.

The procedures for selecting the 12th program are as follows:

1. Make one push of preset switch to clear the internal state.
2. Push the preset switch 12 times and ascertain that the display shows "12".
3. Set the tape recorder to the starting state of specific program.

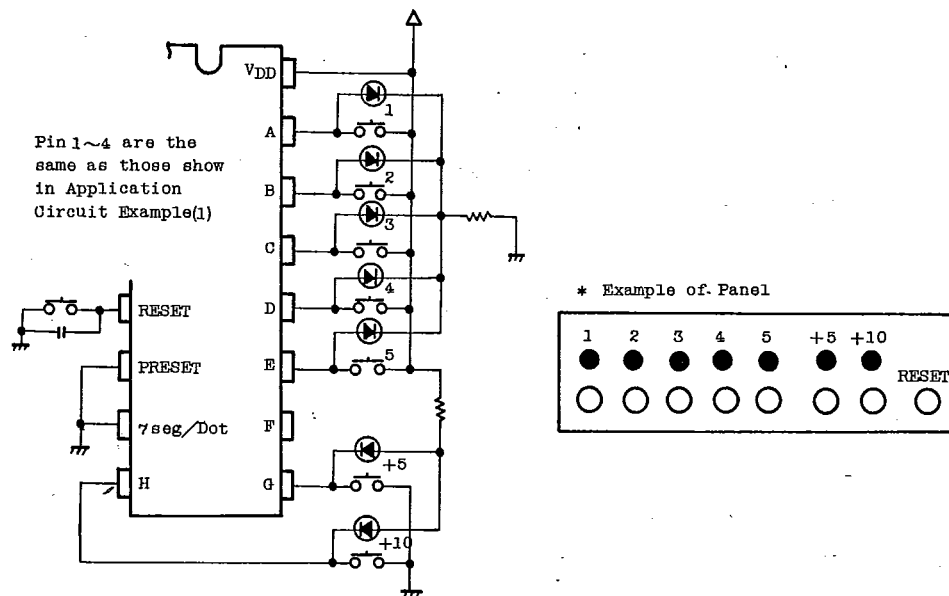
* When the switch is pushed 15 times or more, the display shows 15 \rightarrow 1, 2, 3, repeatedly.

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APPLICATION CIRCUIT EXAMPLE (2)

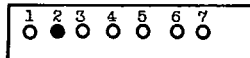


o DISPLAY

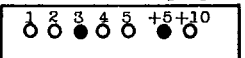
For displaying 1st ~ 5th desired programs LEDs light up one by one,
for displaying 6th ~ 10th desired programs LEDs (1 ~ 5 and +5)
light up, and for displaying 11th ~ 15th desired programs LEDs
(1 ~ 5 and +10) light up.

(Example)

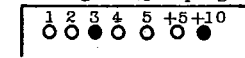
Setting of 2nd program



Setting of 8th program



Setting of 13th program



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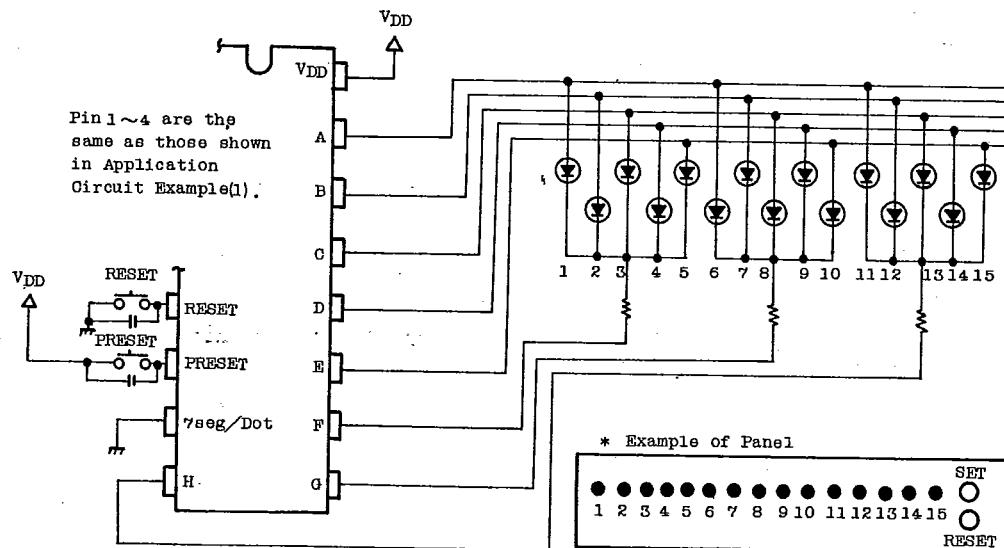
0 METHOD OF SETTING DESIRED PROGRAM

In case of 1st ~ 5th desired programs, they are set by switches (1 ~ 5). In case of 6th ~ 15th desired programs, they are set by combining the switches (+5 and +10) and the switches (1 ~ 5); the switches (+5 and +10) can work only when any of the switches (1 ~ 5) was previously set. For example, when the switch (+5) is pushed and the switch (3) is pushed, the 3rd program can be set; that is, the switch of +5 or +10 cannot individually set any program.

The procedures for setting the 13rd program are as follows:

1. Make one push of the reset switch to clear the internal state.
2. Then, push the switch of 3, and then push the switch of +10.
3. Set the tape recorder to the starting state of program search.

APPLICATION CIRCUIT EXAMPLE (3)



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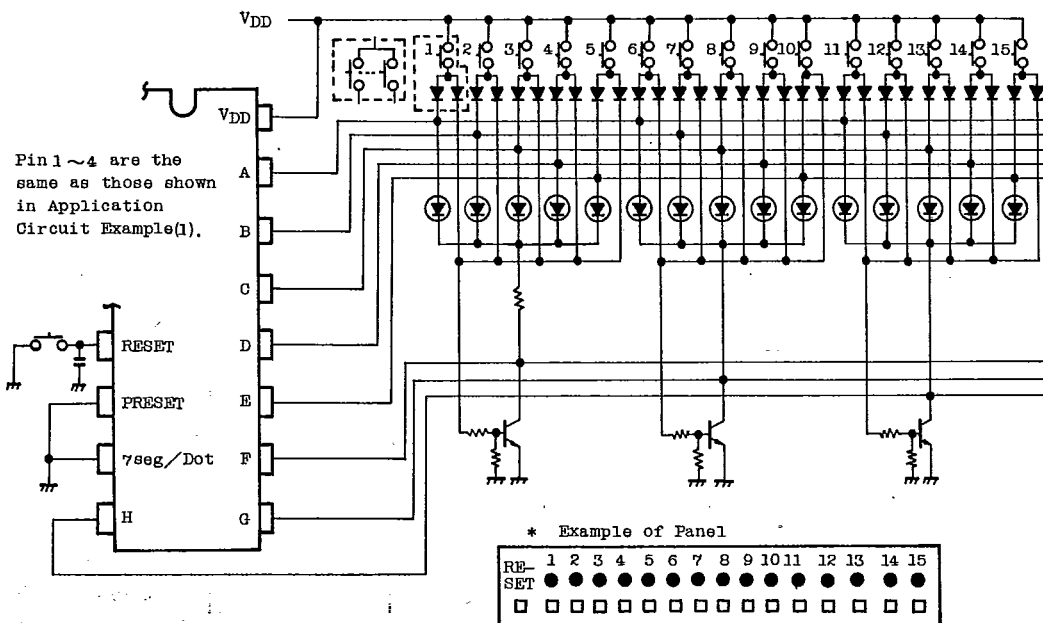
o DISPLAY

On the basis of one LED to one program, 15 LEDs at max. are displayed.
LEDs are matrix-wired between the outputs A ~ E and F ~ H of IC.

o METHOD OF SETTING DESIRED PROGRAM

Like the application circuit example (1), the setting method is a step-up system by the preset switch. For example, if the 14th program is desired to be set, it can be set by pushing the preset switch 14 times.

APPLICATION CIRCUIT EXAMPLE (4)



o DISPLAY

On the basis of one LED to one program, 15 LEDs at max. can be displayed.

o METHOD OF SETTING DESIRED PROGRAMS

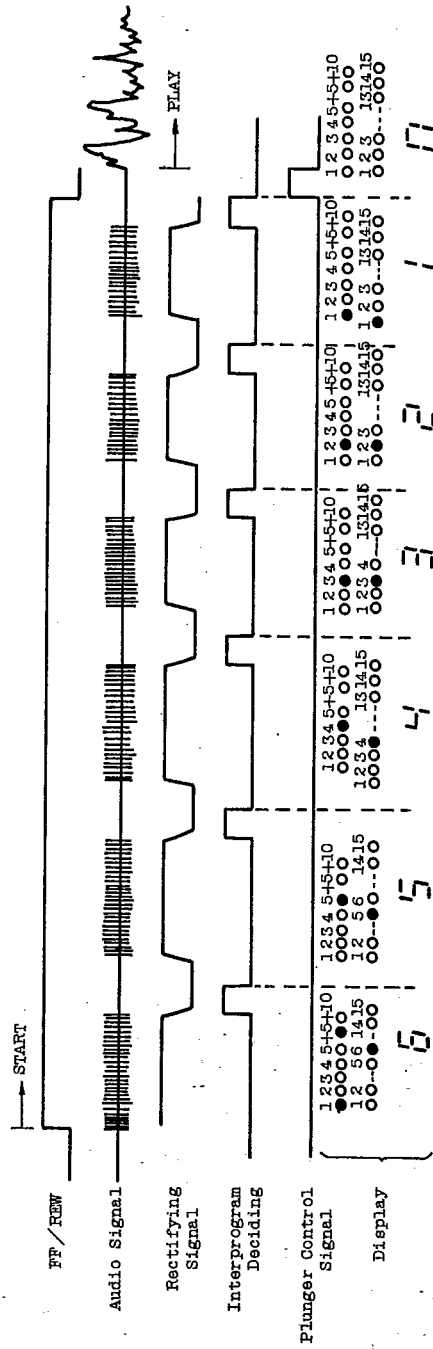
This is a direct preset method of 15 programs by pushing one switch per one program. The switches are different each other as mentioned above according to one circuit, two circuits.

AUDIO DIGITAL IC

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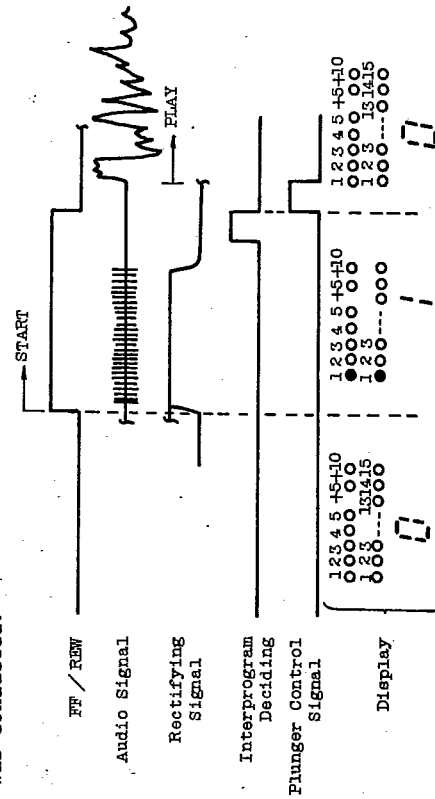
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OPERATIONAL TIMING IN 6-PROGRAM SEARCH



IN CASE WHERE THE PROGRAM SEARCH HAS BEEN CONDUCTED WITHOUT PRESETTING DESIRED PROGRAM

In this case, the application circuit operates in the same manner as the 1st program search was conducted.



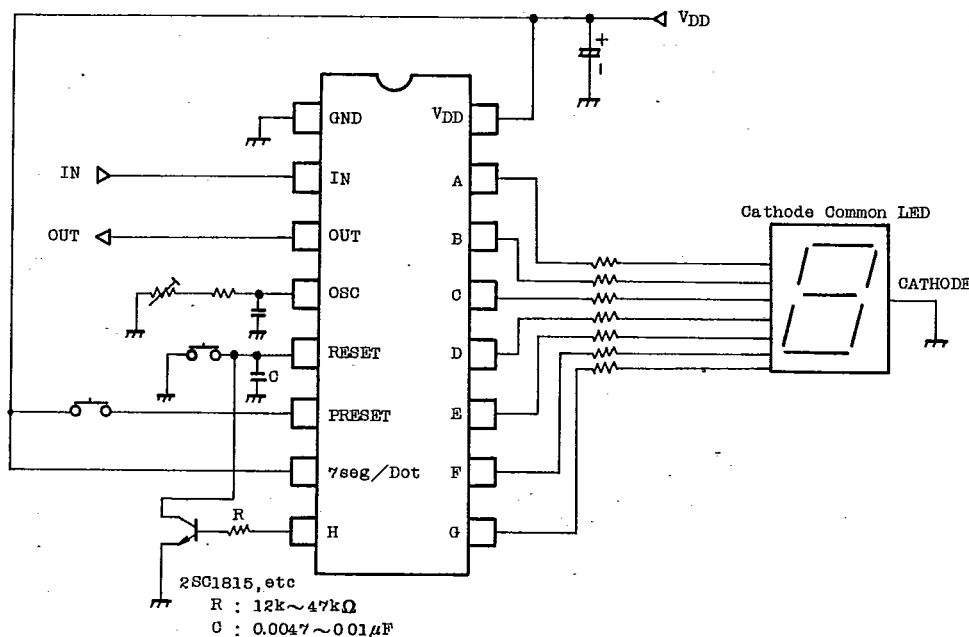
Input "1" is automatically Set.

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APPLICATION CIRCUIT EXAMPLE (5)

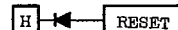
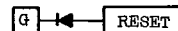
[SELECTION OF NINE PROGRAMS AT MAXIMUM BY USE OF 7-SEGMENT LED ONE DIGIT]



APPLICATION CIRCUIT EXAMPLE (6)

[SELECTION OF "N" PROGRAMS AT MAXIMUM BY USE OF DOT DISPLAY]

- o For five programs, "G" output is connected to "RESET" input by diodes.
- o For ten programs, "H" output is connected to "RESET" input by diodes.
- o For pieces of music other than five or ten programs, when "n + 1" program is selected, RESET signal generates and "0" display is made after clearing the inside state.



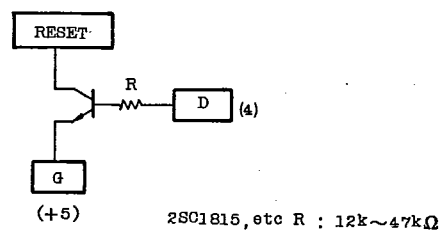
AUDIO DIGITAL IC

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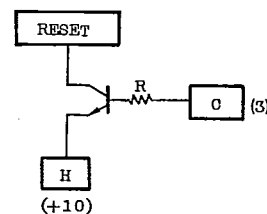
(Example - 1)

Eight programs at max.



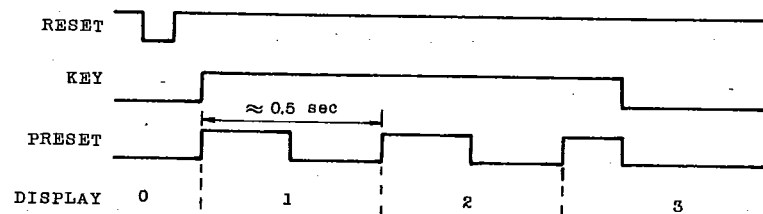
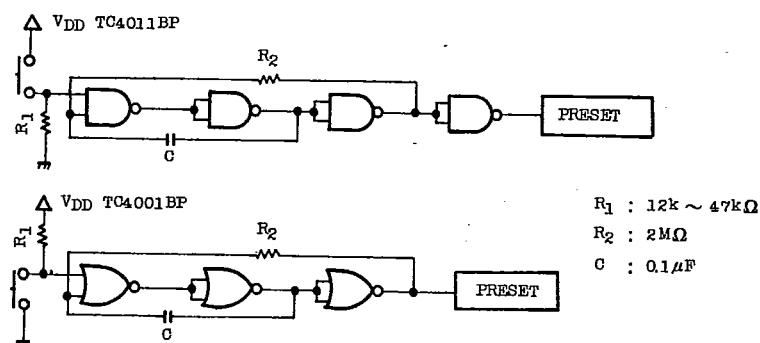
(Example - 2)

12 programs at max.



APPLICATION CIRCUIT EXAMPLE (7)

[AUTOMATIC FORWARD OF PRESET PROGRAMS]



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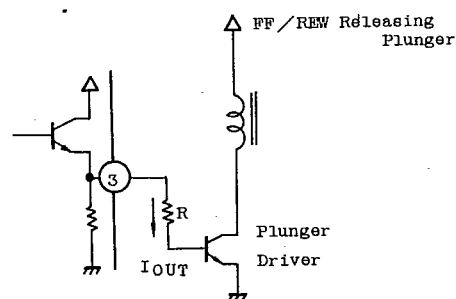
TC9138AF

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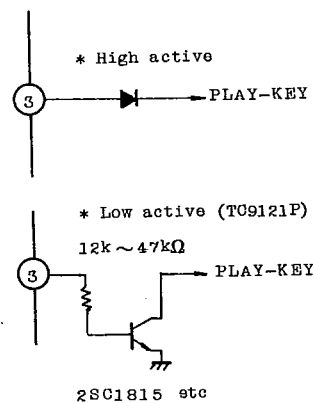
APPLICATION CIRCUIT EXAMPLE (8) [METHOD OF CONNECTING OUTPUT]

(1) Mechanical Type Deck

(2) Electronic Control Deck

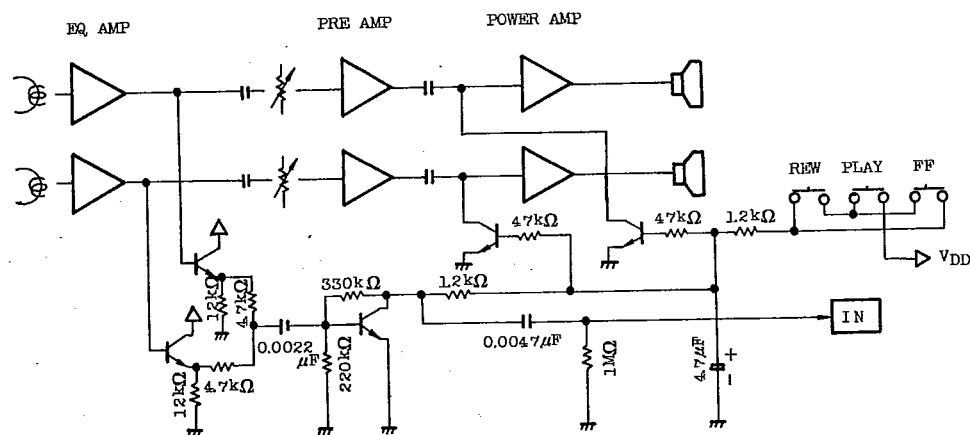


The value of R shall be preset
so as to be $I_{OUT} \leq 30\text{mA}$.

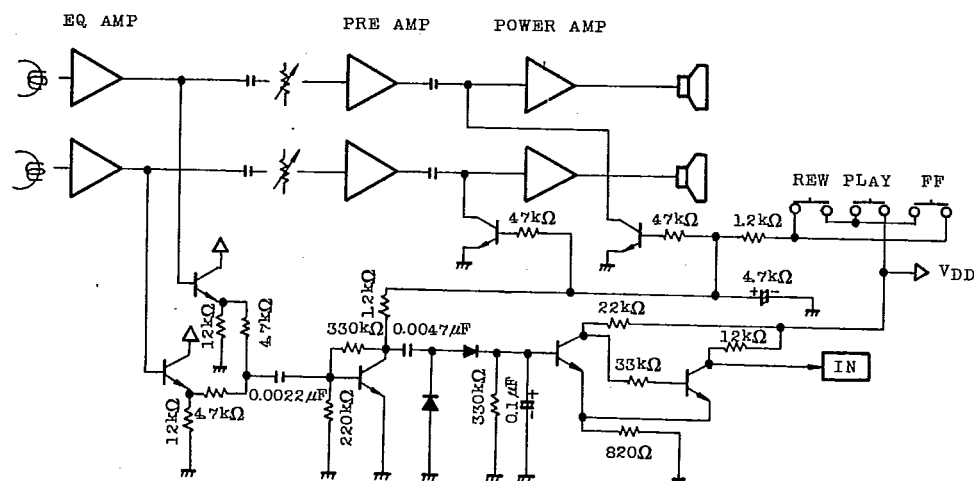


EXAMPLES OF INTERPROGRAM SENSING CIRCUIT

[DIRECT INPUT TYPE]



AUDIO DIGITAL IC



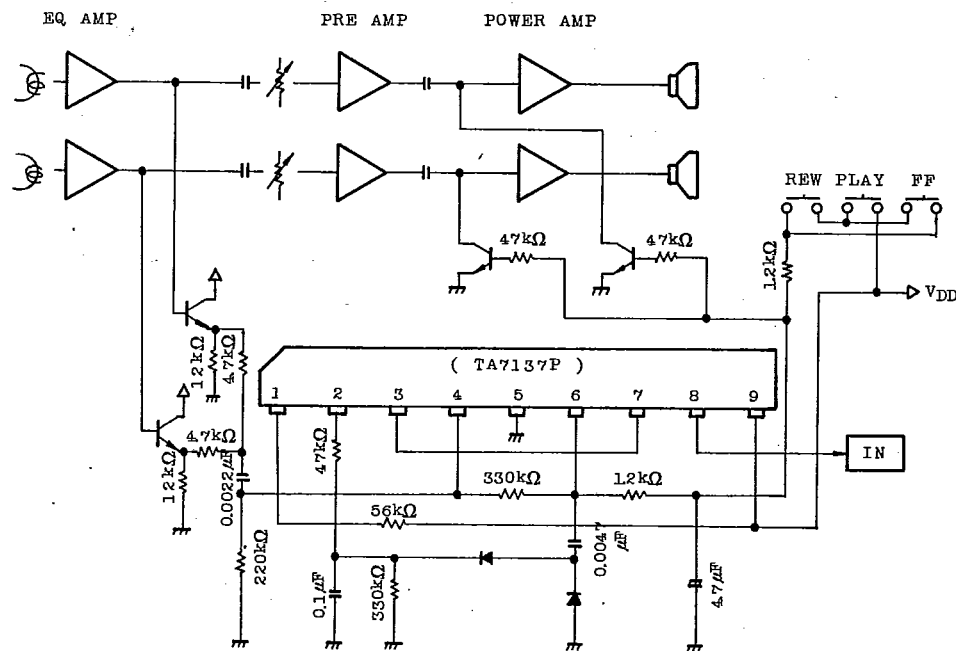
2SC1815 X 7

TC9138AP

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EXAMPLES OF INTERPROGRAM SENSING CIRCUIT

[RECTIFYING INPUT TYPE (2)]



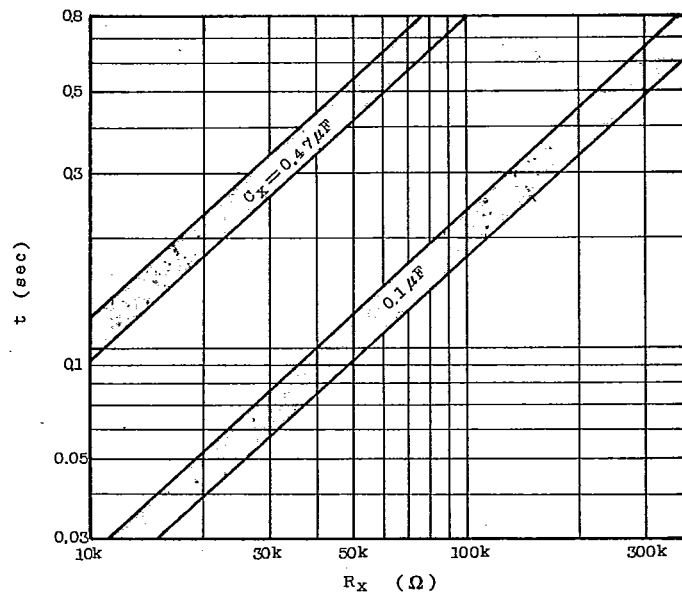
TA7137P + 2SC1815 × 4

AUDIO DIGITAL IC

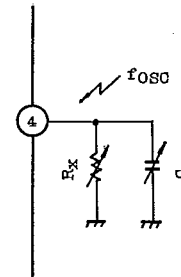
TC9138AP

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GRAPH (1) INTERPROGRAM SENSING TIME

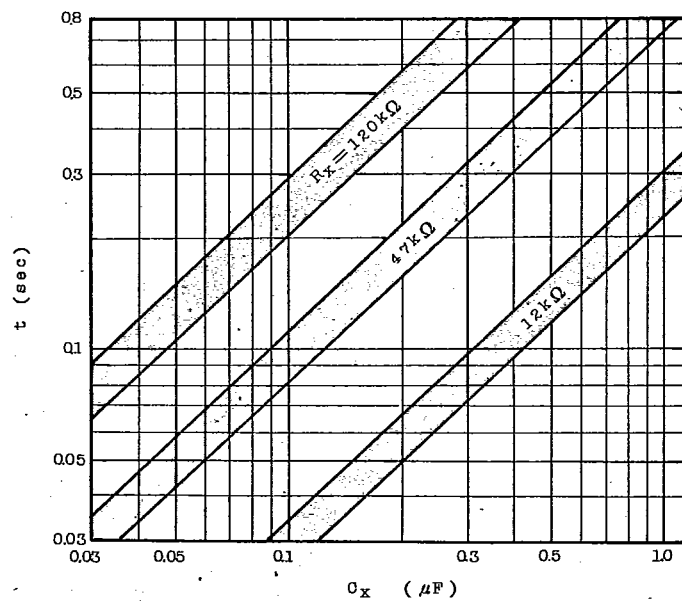


o Test Circuit



o Interprogram Sensing Time

$$t = 32/f_{osc} \text{ (sec)}$$



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