TC9190N, TC9191P

T-52-13-09
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VFL/LED DYNAMIC DRIVERS

The TC9190N and TC9191P are VFL(Fluorescent display) and LED dynamic drivers for output extension of NEW-DTS series.

TC9190N

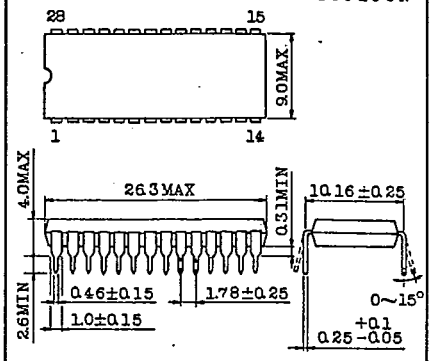
- Connected with a controller by 4 serial lines.
- 8-segment output and 7-digit output allows indication of maximum 8 × 7=56 segments.
- Built-in high breakdown-voltage driver allows VFL to directly drive. (P-ch open drain type where output pull-down resistance is built-in)
- 4 built-in input ports.
- Package with shrink DIP-28 pins.

TC9191P

- Connected with a controller by 3 serial lines.
- 8-segment output and 5-digit output allows indication of maximum 8 × 5=40 segments.
- Built-in large-current driver allows LED to directly drive.
- Package with DIP-20pins.
- C^2MOS construction and low power dissipation.

Unit in mm

TC9190N



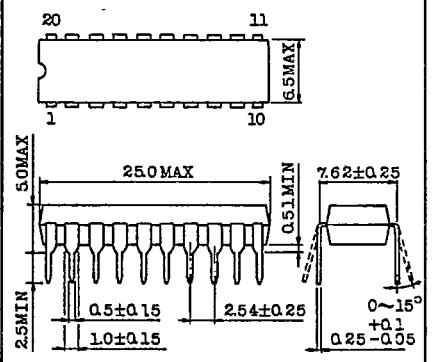
Lead pitch is 1.78 and tolerance is ±0.25 against theoretical center of each lead that is obtained on the basis of No. 1 and No. 28 leads.

JEDEC	—
TOSHIBA	4D28A-P

Weight : 2.2g

Unit in mm

TC9191P



Lead pitch is 2.54 and tolerance is ±0.25 against theoretical center of each lead that is obtained on the basis of No. 1 and No. 20 leads.

JEDEC	—
TOSHIBA	3D20A-P

Weight : 1.2g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{DD}	-0.3~7.0	V
Input Voltage	V_{IN}	-0.3~V_{DD}+0.3	V
Output Voltage	V_{OL}	V_{DD}-35 (Note 1)	V
Output Current	I_{OH}	50 (Note 2)	mA
Power Dissipation	P_D	350	mW
Operating Temperature	Topr	-30~75	°C
Storage Temperature	Tstg	-55~125	°C

Note 1. TC9190N only is assured.

Note 2. TC9191P only is assured.

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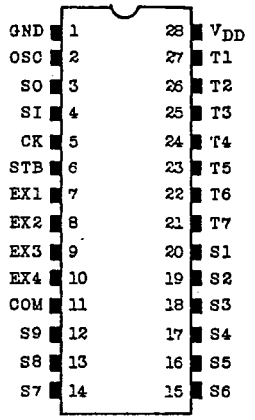
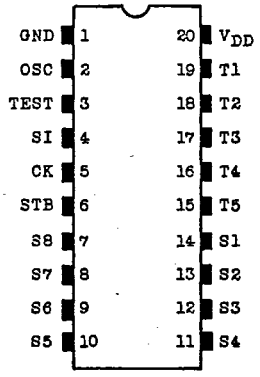
TERMINAL CONNECTION DIAGRAM



TC9190N



TC9191P

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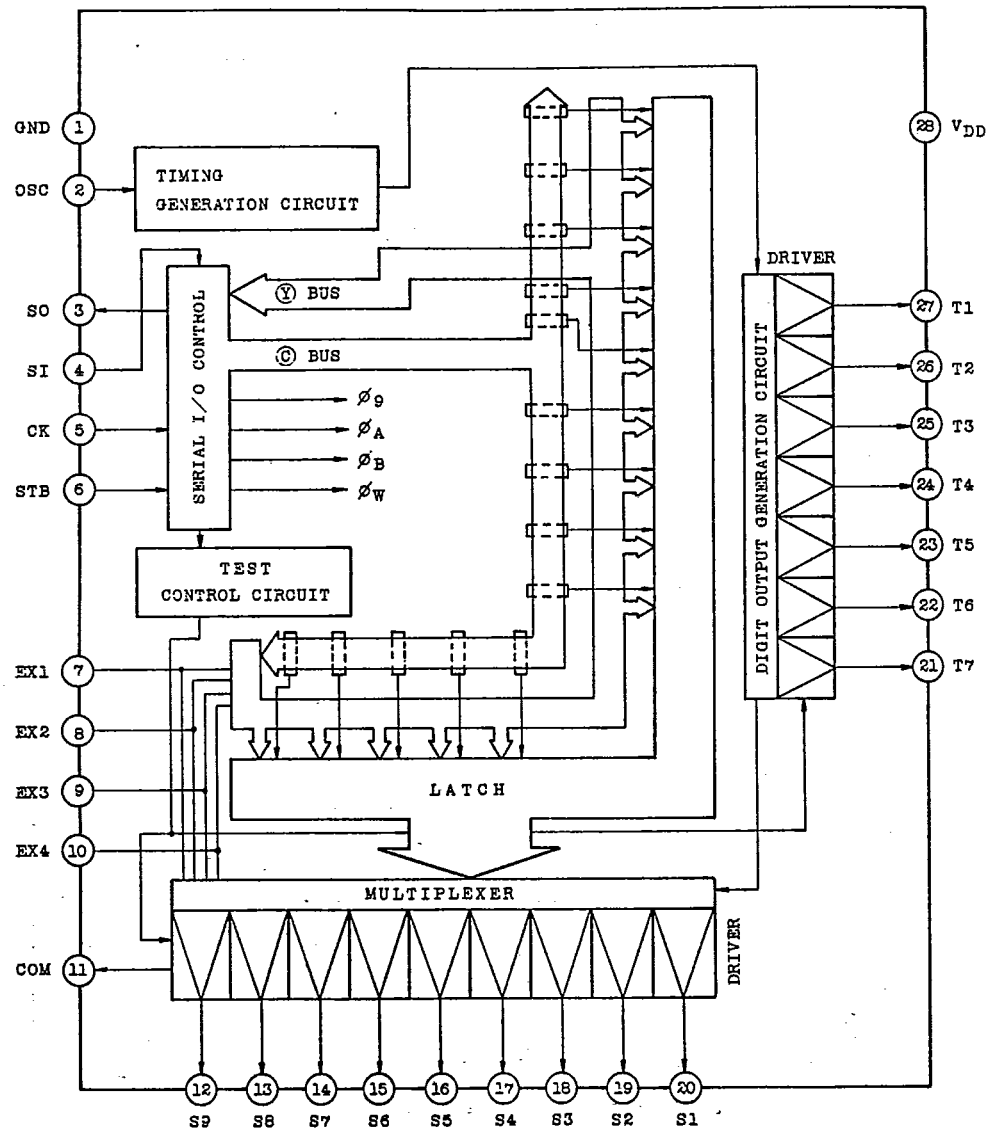
BLOCK DIAGRAM

TC9190N



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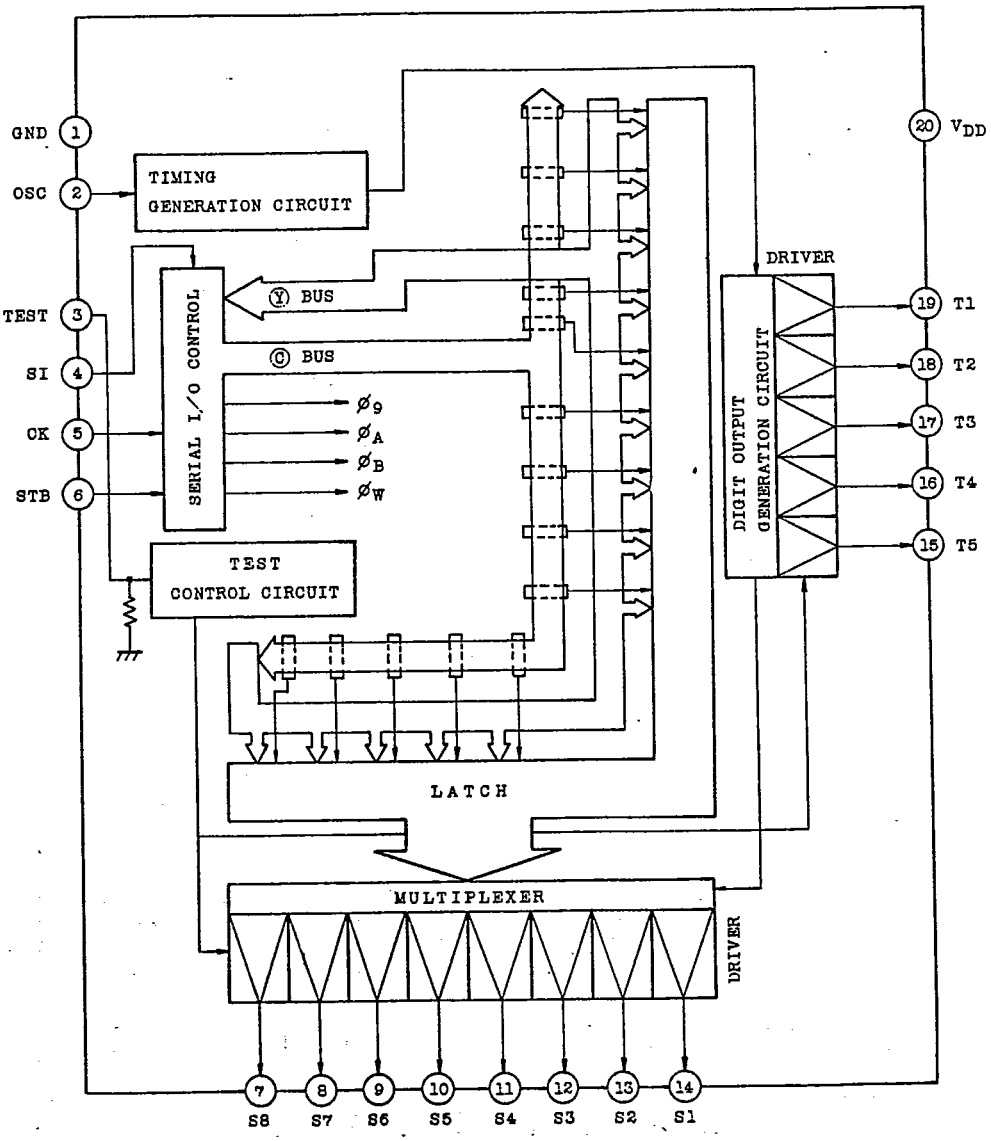
TC9191P



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I/O MAP

	I/O CODE	SEG 1				SEG 2				SEG 3			
		Y1	Y2	Y4	Y8	Y1	Y2	Y4	Y8	Y1	Y2	Y4	Y8
INPUT PORT	0	OPTION OUTPUT* (ø900)											
		EX1	EX2	EX3	EX4								
	1												
	2												
	3												
	4												
	5												
	6												
	7												
OUTPUT PORT	8												
	9	T1 (ø99 Ⓨ)				T4 (øA9 Ⓨ)				* T7 (øB9 Ⓨ)			
		S1	S2	S3	S4	S1	S2	S3	S4	S1	S2	S3	S4
	A	T1 (ø9A Ⓨ)				T4 (øAA Ⓨ)				* T7 (øBA Ⓨ)			
		S5	S6	S7	S8	S5	S6	S7	S8	S5	S6	S7	S8
	B	T2 (ø9B Ⓨ)				T5 (øAB Ⓨ)							
		S1	S2	S3	S4	S1	S2	S3	S4				
	C	T2 (ø9C Ⓨ)				T5 (øAC Ⓨ)							
		S5	S6	S7	S8	S5	S6	S7	S8				
	D	T3 (ø9D Ⓨ)				* T6 (øAD Ⓨ)				INDICATION CONTROL (øBD Ⓨ)			
		S1	S2	S3	S4	S1	S2	S3	S4	EN	DIS	DIM ON	DIM OFF
	E	T3 (ø9E Ⓨ)				* T6 (øAE Ⓨ)				TM (øBE Ⓨ)			
		S5	S6	S7	S8	S5	S6	S7	S8	TEST1	TEST2		
	F	CHIP SELECT CODE DATA"9"				CHIP SELECT CODE DATA"A"				CHIP SELECT CODE DATA"B"			
		1	0	0	1	0	1	0	1	1	1	0	1

* Option outputs T6 and T7 are built in TC9190N only.

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ELECTRICAL CHARACTERISTICS (Unless otherwise specified, Ta=25°C, V_{DD}=5.0V)

	CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
	Power Supply Voltage		V_{DD}		*	4.0	5.0	6.0	V
	Power Supply Current		I_{DD}		Non-load f_{OSC}=50kHz	-	0.2	1.0	mA
	Input Voltage	"H" Level	V_{IH1}		SI, CK, STB	V_{DD} × 0.7	-	V_{DD}	V
		"L" Level	V_{IL1}		SI, CK, STB	0	-	V_{DD}×0.3	
	Input Current	"H" Level	I_{IH1}		SI, CK, STB V_{IH}=5.0V	-	-	±1.0	μA
		"L" Level	I_{IL1}		SI, CK, STB V_{IL}=0.0V	-	-	±1.0	
	Timing Input Frequency		f_{opr}		SI, CK, STB *	-	300	500	kHz
	Oscillation Frequency		f_{OSC}		R_X=22kΩ C_X=1500pF *	-	50	500	kHz
	Auto-Initialize Voltage		V_{AI}			-	2.4	2.6	V
Note 1	Input Voltage	"H" Level	V_{IH2}		EX1~EX4	V_{DD} × 0.7	-	V_{DD}	V
		"L" Level	V_{IL2}		EX1~EX4	0	-	V_{DD}×0.3	
	Input Current	"H" Level	I_{IH2}		EX1~EX4 V_{IH}=5.0V	-	-	±1.0	μA
		"L" Level	I_{IL2}		EX1~EX4 V_{IL}=0.0V	-	-	±1.0	
	Output Current		I_{OH1}		SO V_{OH}=4.0V	-	-2.0	-1.0	mA
			I_{OH2}		T1~T7 V_{OH}=3.0V	-	-15.0	-10.0	
			I_{OH3}		S1~S9 V_{OH}=3.0V	-	-5.0	-3.0	
	Output Off-Leak Current		I_{OFF}		T1~T7, S1~S9 V_{OL}=-27.0V	-	-	±10.0	μA
			I_{OFF1}		SO V_{OL}=0.0V	-	-	±1.0	
	Load Resistance		R_L		Com=-27.0V	50	100	200	kΩ
Note 2	Output Current		I_{OH}		T1~T5, S1~S8 V_{OH}=4.0V	-	-30	-20	mA
			I_{OL}		T1~T5, S1~S8 V_{OL}=1.0V	0.5	1.0	-	
	Pull-Down Resistance		R_{Down}		TEST	22	47	68	kΩ

Note: Items marked with * are assured when V_{DD}=4.0~6.0V, Ta=-30~75°C.

Note 1. TC9190N only is assured.

Note 2. TC9191P only is assured.

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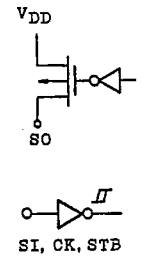
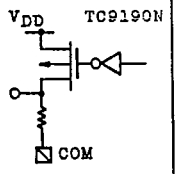
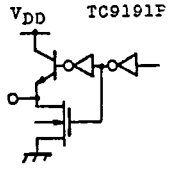
FUNCTIONAL DESCRIPTION OF EACH TERMINAL

PIN No. 20 PIN	PIN No. 28 PIN	SYMBOL	TERMINAL NAME	FUNCTIONAL & OPERATIONAL DESCRIPTION	REMARKS
1	1	GND	Power Supply Application Terminal		
20	28	V_{DD}			
2	2	OSC	1 Terminal Oscillation Terminal	1 terminal type oscillation circuit oscillating a clock necessary for the system by an external C·R.	
3	-	TEST		Pull-down resistance is built-in.	
-	3	SO	Serial Output	Serial I/O port Sending and receiving of segment output data are performed between controllers. SO is Pch open drain output and SI,CK,STG are Schmitt trigger inputs.	
4	4	SI	Serial Input		
5	5	CK	Clock Signal		
6	6	STB	Strobe Signal		
-	7 ~ 10	EX1~EX2	Option Input Terminal	Option input terminal.	C-MOS input
-	11	COM	VFL Power Supply Terminal	VFL driving minus power supply is applied. $V_{DD}-V_{FL} \leqq 33V$	
-	12	S9	Segment Output Terminal	Segment output is generated in synchronism with digit output. . TC9190N .... Pch open drain output . TC9191P .... Bipolar output	
7 ~ 14	13 ~ 20	S8 ~ S1			
-	21	T7	Digit Output Terminal	Dynamic indication is performed together with segment output. . TC9190N ... Pch open drain output . TC9191P ... Bipolar output	
	22	T6			
15 ~ 19	23 ~ 27	T5 ~ T1			

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DESCRIPTION OF OPERATION

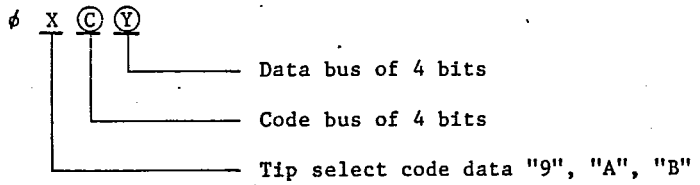
As shown in the block diagram, the TC9190N and the TC9191P are controlled by accessing port groups connected with the data bus Y and the code bus C having 4-bit function. Each data on the data bus and the code bus is sent to and recevied from the controller side by 4 terminals of SI, SO, CK, and STB (in TC9191P, 3 terminals of SI, CK, and STB) through the serial port.

As described above, all is controlled on a port basis, and description is made with the function of each port below.

These ports are constituted on 4-bit basis and each of them is selected by a code data of 4 bits. A list of code assignment to each port is desceibed as an I/O map before. As a whole, codes "0H~7H" are assigned to the input ports and codes "8H~FH" to the output ports.

(Note 1) The meaning of "input port" and "output port" is always used with the controller side as reference. Therefore, a port to be accessed at outputting data from the controller side to the driver side is called an output port and a port to be accessed at taking in data from the driver side to the controller side is called an input port.

(Note 2) In the sentence and the drawing, code assignment to each port is expressed with it coded as follows.



(Example) ϕ9A9 : Set S5, S8 of digit T1.
ϕACF : Set S5, S6, S7, S8 of digit T2.

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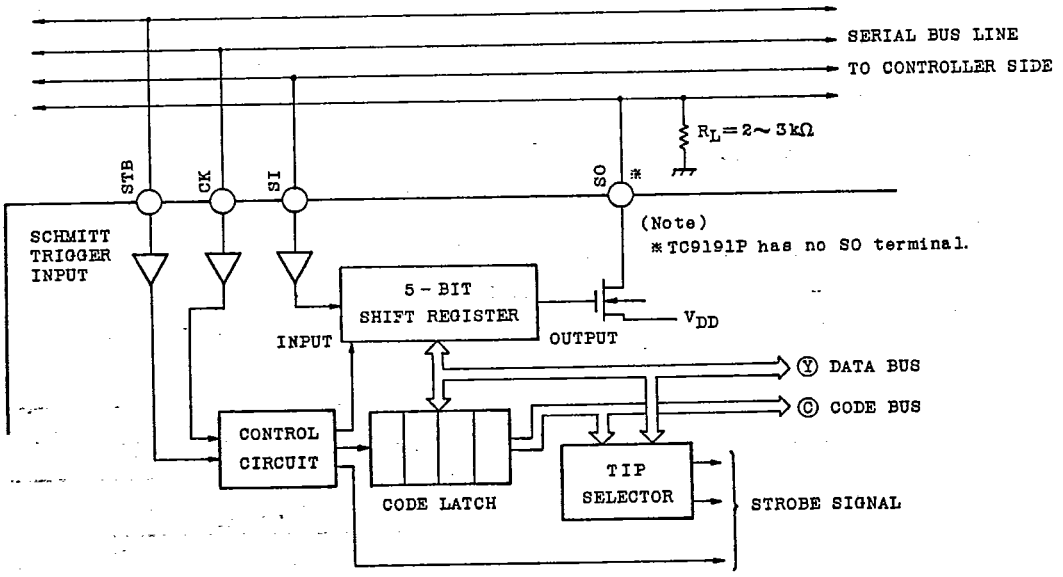
○ SERIAL I/O PORT

As described above, control of each port is pergormed by serial bus lines through the serial port. The serial port controls sending and receiving of data on the serial bus line and the code bus and the data bus line inside the IC.
The I/O terminals of the serial port are 4 terminals of SO, SI, CK, and STB in TC9190N since it has an input port and 3 terminals of SI, CK, and STB in TC9191F since it has no input port.
In the SI, CK, and STB terminals, schmitt trigger input is built and the SO terminal is of Pch FET open drain output construction.

(Note) For the SO terminal, an external load resistance is required. (R_L=2~3kΩ)



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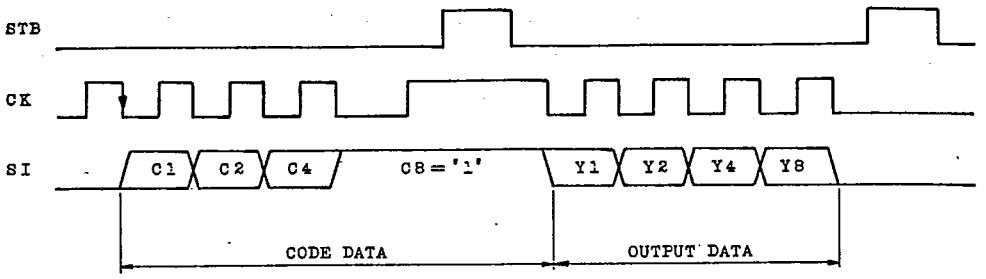
1. DATA TRANSFER FORMAT

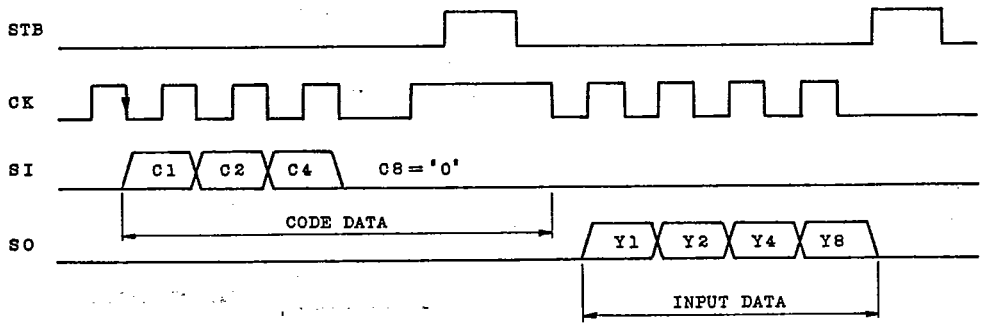
1) At outputting data (access of output port)



At the timing shown in the above drawing, input the 4-bit code data (C_1~C_8) of the output port and the 4-bit data (Y_1~Y_8) to be output are serially input in the SI terminal. The SI data is read in at rising of CK.

(Note) At specifying the output port, the code data "C8" becomes always "1".

2) At inputting data (access of input data)



At the timing shown in the above drawing, input the 4-bit code data (C_1~C_8) of the input port in the SI terminal, and the data of the specified port is output to the SO terminal with 4-bit Y_1~Y_8 serial. The SI data is read in at rising of CK and the SO data is swept away at rising of CK.

(Note) At specifying the input port, the code data "C8" becomes always "0".

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2. SPECIFICATION OF CHIP SELECT

Various peripheral option IC other than a driver can be connected to serial bus lines. Therefore, it is necessary to specify as to whether a data is sent and received between the controller side and any of the ICs connected by the bus lines. For specifying the IC which is the object of control on the bus lines, a chip select code is provided.

Chip select codes for specifying TC9190N and TC9191P are the following three kinds:

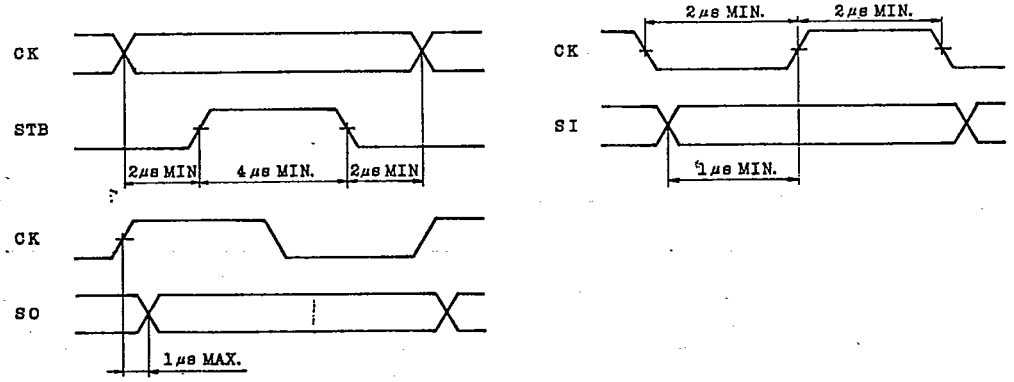
* Digit Chip select code for specifying the output ports T1~T3 and the input ports (TC9190N) :9
* Digit Chip select code for specifying the output ports T4~T6 (in TC9191P, T4~T5) :A
* Digit Chip select code for specifying the output port T7 (in TC9191P, no) and modes :B

1) The select code is set at the data output port of the chip select code(code "FH").

2) The select code must be set first at inputting or outputting data.

3) The select code once set is held unless specified again, and it is unnecessary to specify the select code everytime the data is input or output.

3. SERIAL TIMING PULSE WIDTH



4. SETTING OF MODE

In the TC9190N and the TC9191P, an auto-blanking circuit is built and the output indication at time of power on is in blanking state.

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In usual operation, it is necessary to set as follows.

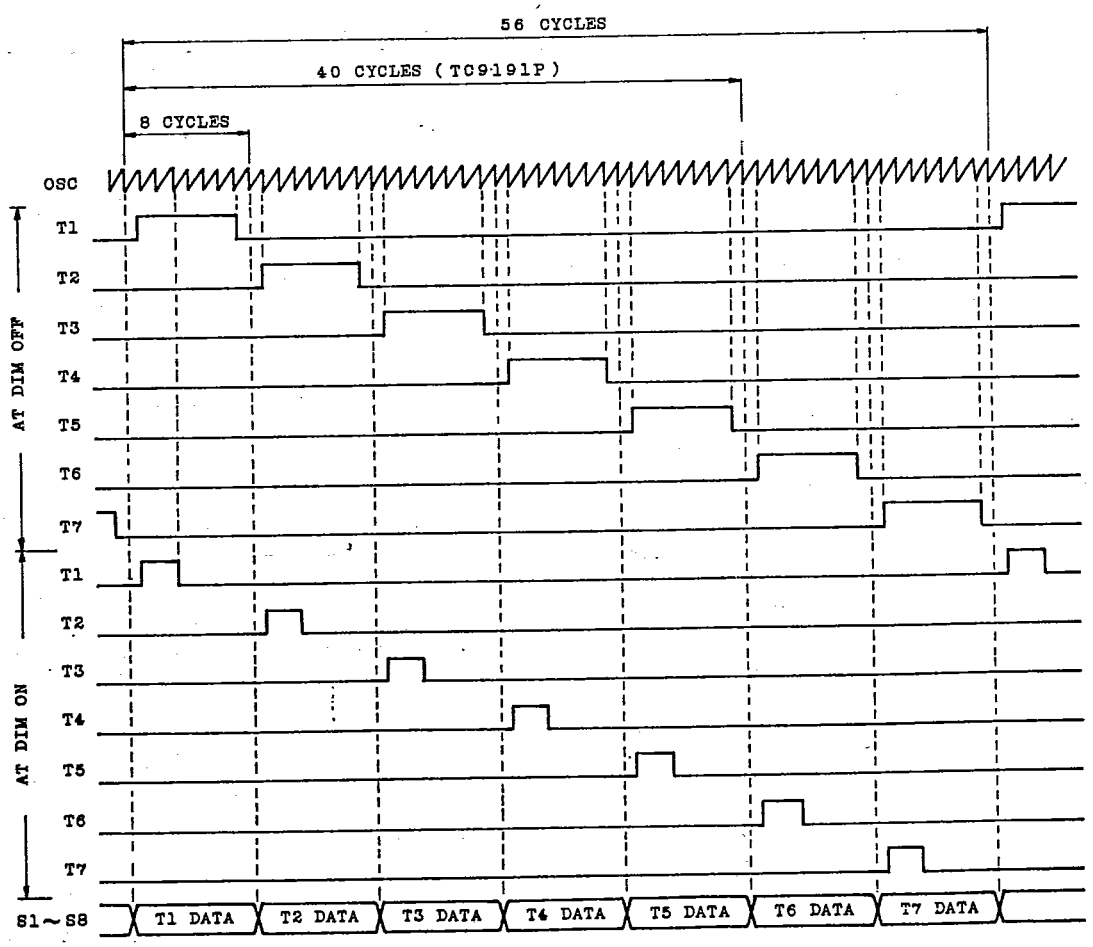
EN="1", DIS="0", TEST1="0", and TEST2="0"

When set to others, the circuits become in blanking state.

Also, these circuits have indication dimmer function. When set to DIM ON="1" and DIM OFF="0", the circuits become in DIM ON state and the brightness of indication is reduced by half or so. When set to others, DIM OFF state is indicated.

5. TIMING CHART OF OUTPUT INDICATION

The frequency of T_1~T_7 (in TC9191P, T_1~T_5) is determined by the constant of external C and R of OSC terminal.



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Note 1. For preventing dimming of indication at DIM OFF, T_1~T_7(T_5) has the blanking period of two cycles.

Note 2. Renewal of indication data is executed during the blanking period described above.

○ EXTERNAL INPUT PORT

The TC9190N has 4 external input ports of EX_1~EX_4.

EX_1 : T1 sync
EX2 : T2 sync
EX3 : T3 sync
EX4 : T4 sync
} Controls S_9 output

Data of EX_1~EX_4 are taken in on the controller side by ϕ900.

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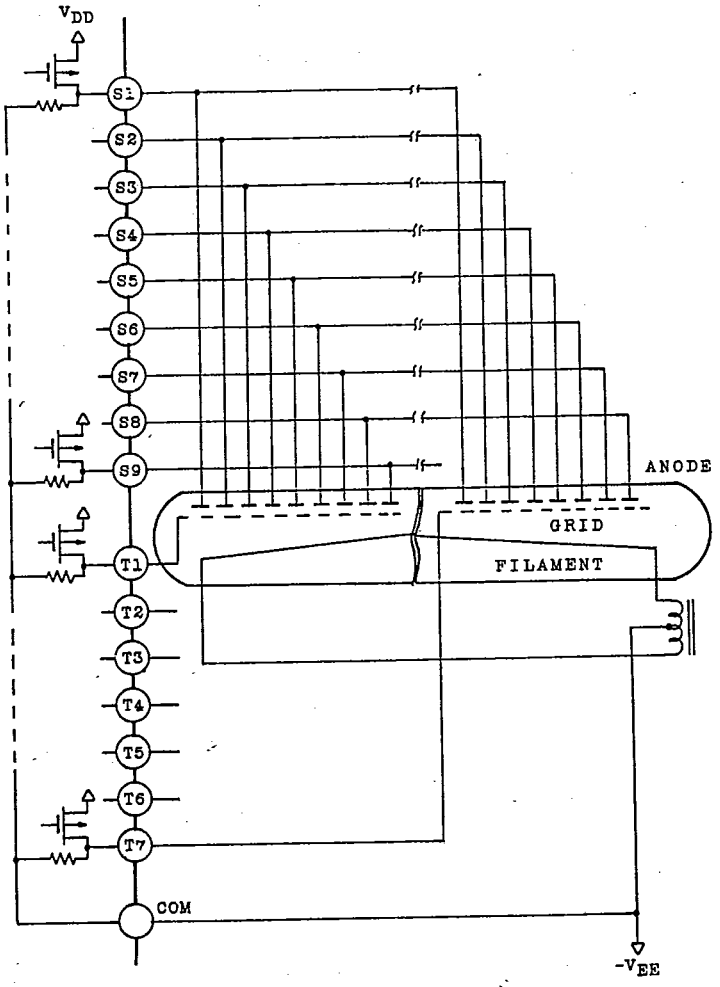
○ OUTPUT CIRCUIT

In the TC9190N, high breakdown-voltage transistor is built and VFL (fluorescent display) can be directly driven.

In the TC9191P, large-current transistor is built and LED can be directly driven.

Application of TC9190N indication (for VFL)



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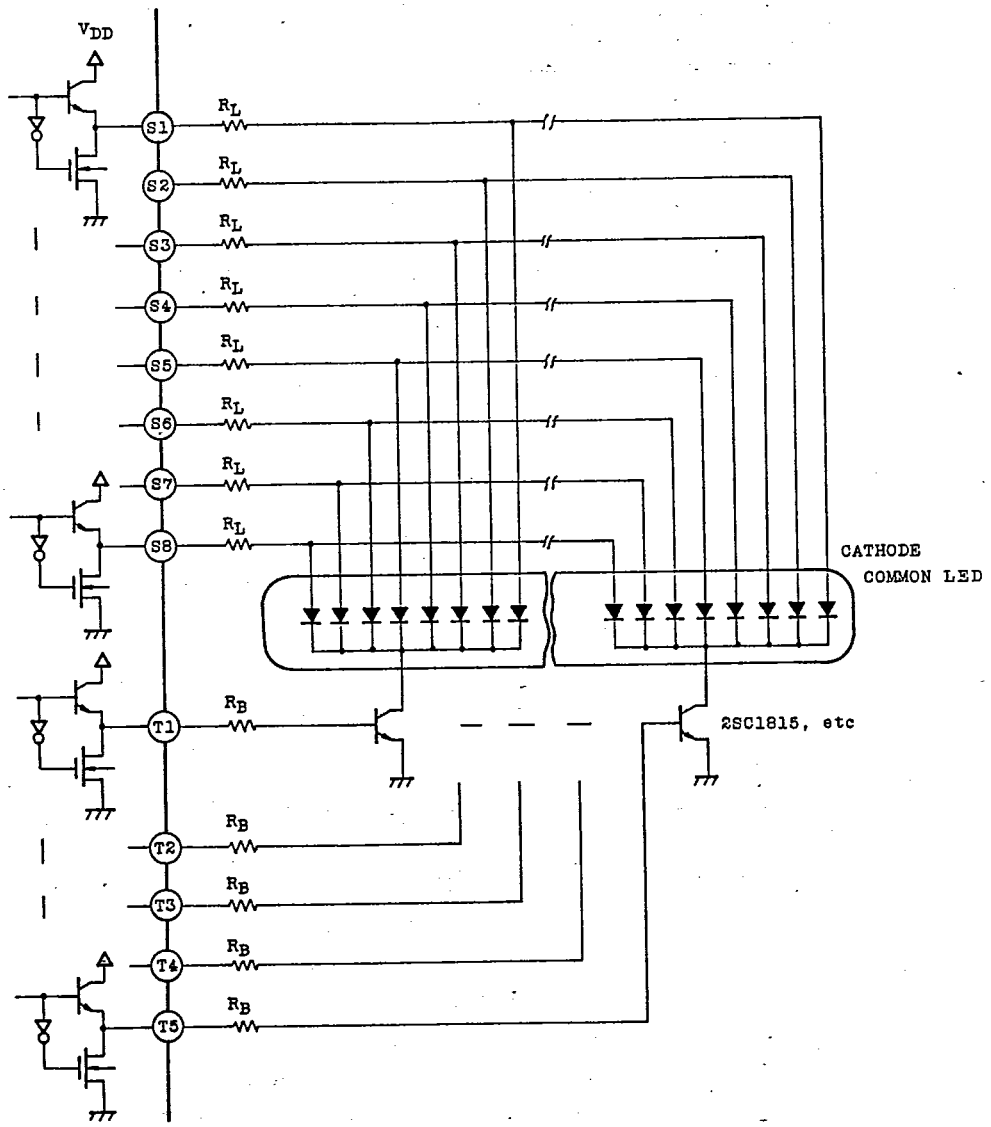
APPLICATION OF TC9191P INDICATION (For LED)

* Bipolar output



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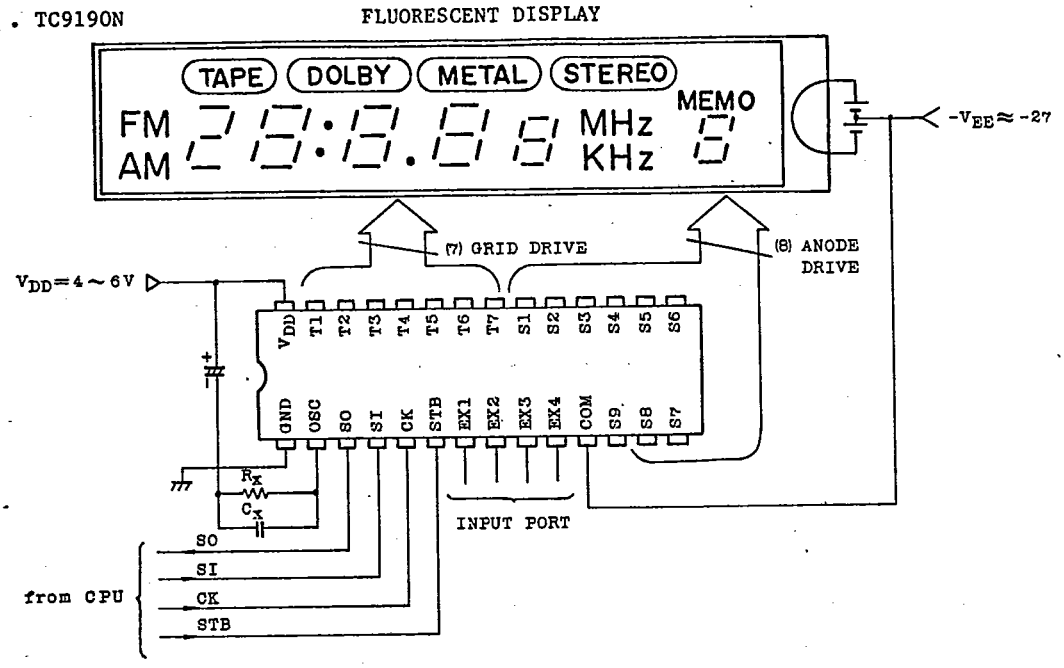
APPLICATION CIRCUIT

. TC9190N



. TC9191P