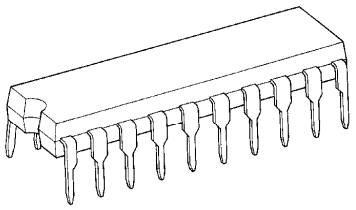
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC9244P

LSI FOR REMOTE CONTROL RECEIVING

The TC9244P is an LSI for infrared Remote Control receiving. It is used for remote control of devices such as audio system, TVs, VTRs, CD players.
Remote control systems are easily constructed using TC9244P in combination with transmitting LSIs TC9243P and TC9243F.



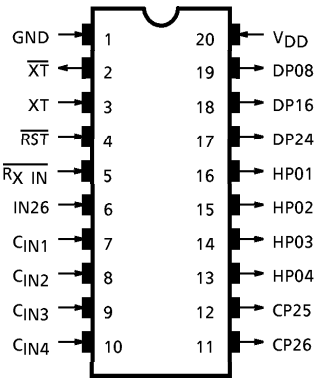
DIP20-P-300-2.54A

Weight : 1.4g (Typ.)

FEATURES

- Basic function : 9
  Hold pulse function : 7
  Cyclic pulse function : 2
- 3 functions out of 7 hold pulse functions are shift key outputs and can be output in parallel with other outputs corresponding to double-pushed signals sent from sending side.
- 1 function out of 2 cyclic pulse functions can be control outputs using an external key in addition to control by remote control signal.
- 8bit system codes are detected. System codes permitting signal receiving can be set up to 4 bits. Interference with other equipment can be thus prevented.

PIN CONNECTION (TOP VIEW)



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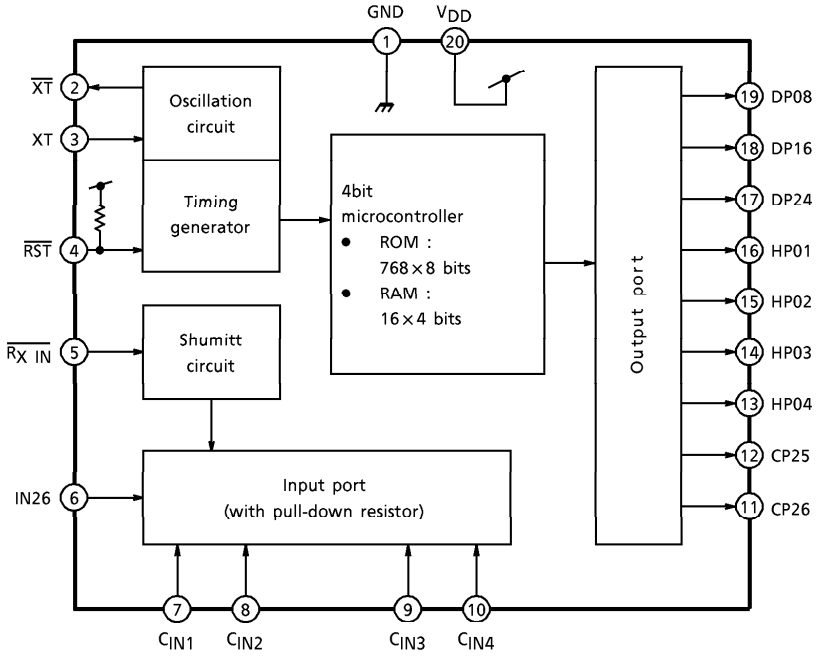
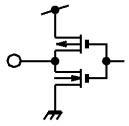
BLOCK DIAGRAM



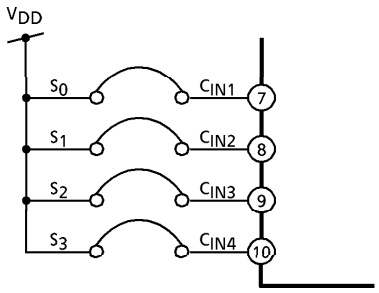
PIN FUNCTION

PIN No.	SYMBOL	PIN NAME	FUNCTION AND OPERATION		
1 20	GND V_{DD}	Power supply terminal	Applies power supply voltage. (V_{DD} = 5.0V, Typ.)		
2 3	$\overline{XT}$ XT	Oscillator terminal	Ceramic oscillator output and input amplifier circuit and feedback resistor are built in.		
4	$\overline{RST}$	Reset input	When set to "L" level, initializes internal states. pull-up resistor are built in.		
5	$\overline{R_{X\ IN}}$	Remote control signal input	Input remote control signal whose sub-carrier signal is removed.		
6	IN26	Cyclic input	Inverts corresponding output (CP26) each time "H" level is input. Pull-down resistors are built in.		
7~10	C_{IN1}~C_{IN4}	Code input	Inputs system code which enables receiving. Pull-down resistors are built in.		
11, 12	CP26, CP25	Cyclic output	Inverted by corresponding remote control signal and key input. "L" level when power is turned on. (reset)	OUTPUT FORMAT	
13~16 17~19	HP04~HP01 DP24, 16, 08	Hold output	Remains at "H" level during remote control signal input.		

OPERATIONS

1. Setting receive-enable system code

Transmitting LSIs TC9243P and TC9243F support an 8bit system code transmitting format to prevent interference with other machines.
This code makes each machine unique and thus prevents interference.
With TC9244P, the lower 4 bits of the 8bit system code used to enable receive can be set.
The upper 4 bits are fixed to "1000". (Setting value range : "80"~"8F" HEX.)
Once this receive-enabling system code is set, a match between the system code of the remote control input signal and the set system code enables reception of the subsequent key data code.



To set the receive-enabling system code, connect pins $C_{IN1\sim4}$ to V_{DD} using jumpers.
The jumpers correspond to system code bits 0~3 (S_0~S_3).
Connecting the pins to V_{DD} using jumpers sets the corresponding bits to 1.

2. Receive signal check

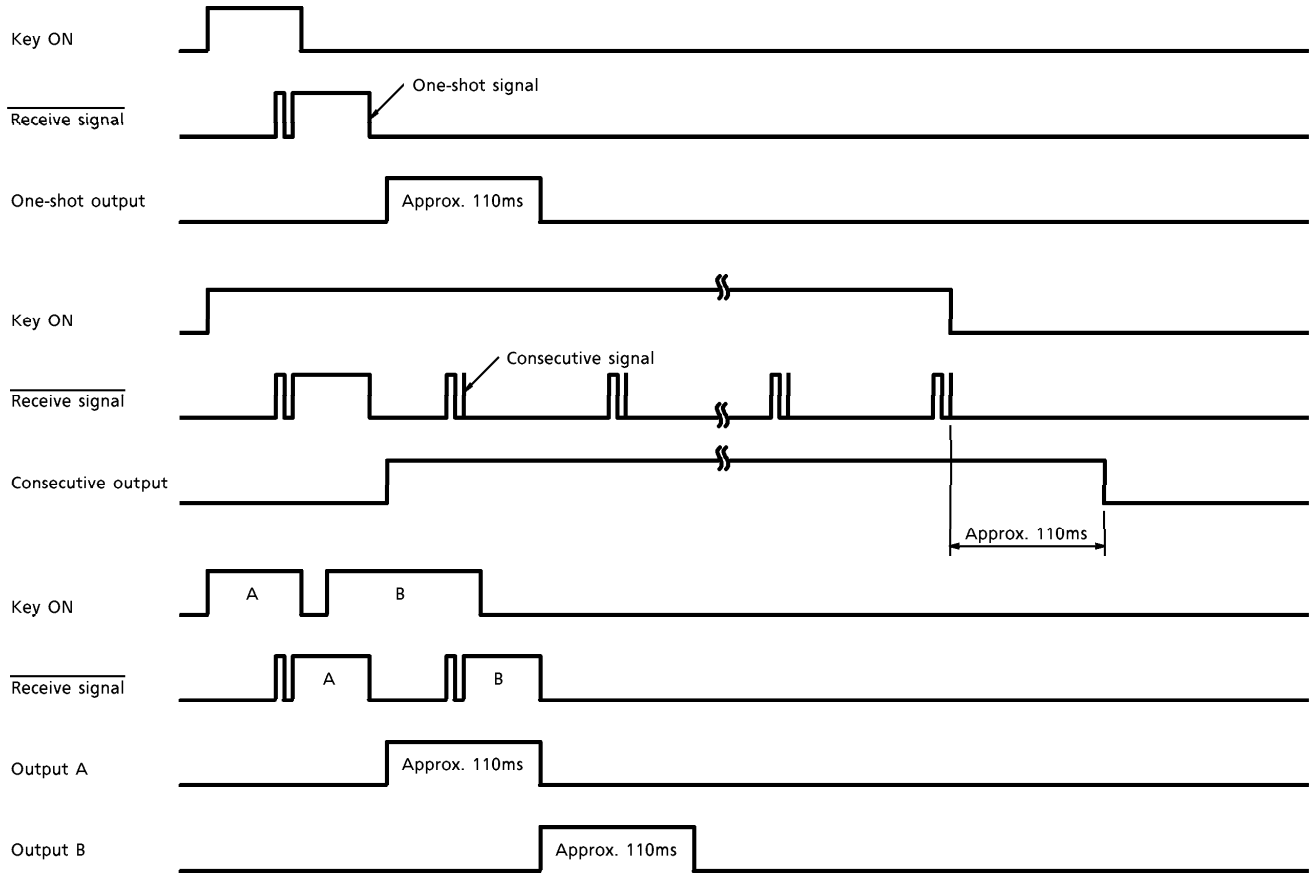
The transmitting LSIs TC9243P and TC9243F support transmission of a check code in one-shot waveforms in order to prevent malfunctioning due to data read errors.
As the check code, the same system code is sent again ; after the key data code, the inverted key data code is sent.

Leader pulse	System code								System code								Key data code								$\overline{\text{Key data code}}$							
	S_0	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_0	S_1	S_2	S_3	S_4	S_5	S_6	S_7	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	$\overline{D_0}$	$\overline{D_1}$	$\overline{D_2}$	$\overline{D_3}$	$\overline{D_4}$	$\overline{D_5}$	$\overline{D_6}$	$\overline{D_7}$

TC9244P decodes all data. The code is sent twice. TC9244P determines that the data are valid only when codes in both transmissions match.

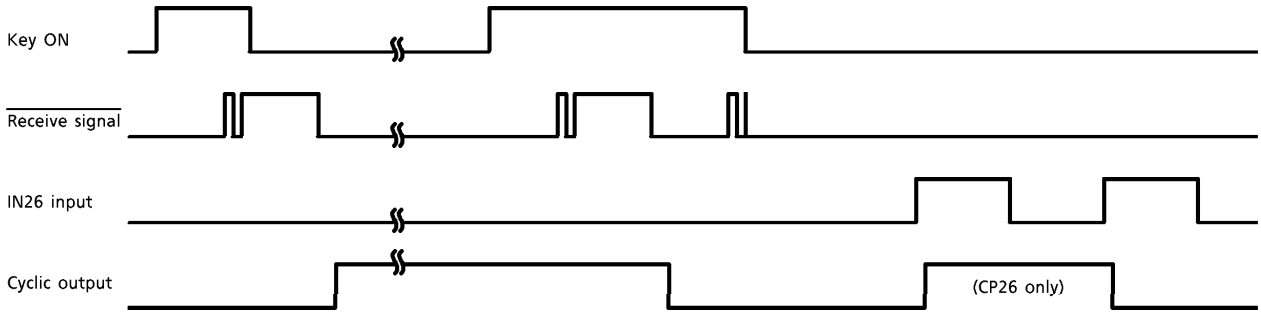
3. HP, DP and CP output pulses

3-1. HP01~HP04, DP08, DP16, DP24 (Hold pulse)



When the initial one-shot system code and the receive signal are checked and the data are valid, the hold pulse is switched to "H" level.
If the receive signal is only a one-shot signal, the output switches to "L" level after approximately 110ms.
If the key is held down after the one-shot signal is output and signals are input consecutively, the output stays at "H" level.
When the key is released and the consecutive signal input stops, key release is determined after 110ms elapses after the last consecutive signal input.
The output is switched to "L" level.
DP08, DP16, DP24 are used for outputting shift pulses.
These are set to "H" level in parallel to other output in response to a signal indicating that two keys are pressed simultaneously sent by the transmitter.
This type of output is optimal for tape deck RECORD-PLAY, RECORD-PAUSE and RECORD-REVERSE output.

3-2. CP25 and CP26 (Cyclic pulses)



Cyclic pulses are inverted each time a one-shot signal is received.
Setting pin IN26 to "H" level also inverts CP26.
Unless output is stabilized within 4ms, cyclic pulse is not valid.
Thus, an external component used to prevent chatter is not required.
Cyclic pulse output is optimal for turning power on / off and for muting.

4. Code assignment (Key numbers : TC9243P and TC9243F send key numbers)

KEY NUMBER	KEY DATA CODE								OUTPUT	FUNCTION
	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7		
K_{01}	1	0	0	0	0	(*)	(*)	(*)	HP01	Hold
K_{02}	0	1	0	0	0	(*)	(*)	(*)	HP02	
K_{03}	1	1	0	0	0	(*)	(*)	(*)	HP03	
K_{04}	0	0	1	0	0	(*)	(*)	(*)	HP04	
K_{08}	(*)	(*)	(*)	(*)	(*)	1	0	0	DP08	Hold and Shift
K_{16}	(*)	(*)	(*)	(*)	(*)	1	1	0	DP16	
K_{24}	(*)	(*)	(*)	(*)	(*)	1	0	1	DP32	
K_{25}	1	0	0	1	1	(*)	(*)	(*)	CP25	Cyclic
K_{26}	0	1	0	1	1	(*)	(*)	(*)	CP26	

(*) Don't care (Corresponding output changes regardless of data)

MAXIMUM RATING (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	− 0.3~6.0	V
Input Voltage	V_{IN}	GND − 0.3~V_{DD} + 0.3	V
Power Dissipation	P_D	350	mW
Operating Temperature	T_{opr}	− 40~85	°C
Storage Temperature	T_{stg}	− 65~150	°C

ELECTRICAL CHARACTERISTICS

Recommended operating conditions (Unless otherwise specified, V_{DD} = 5.0V, Ta = 25°C)

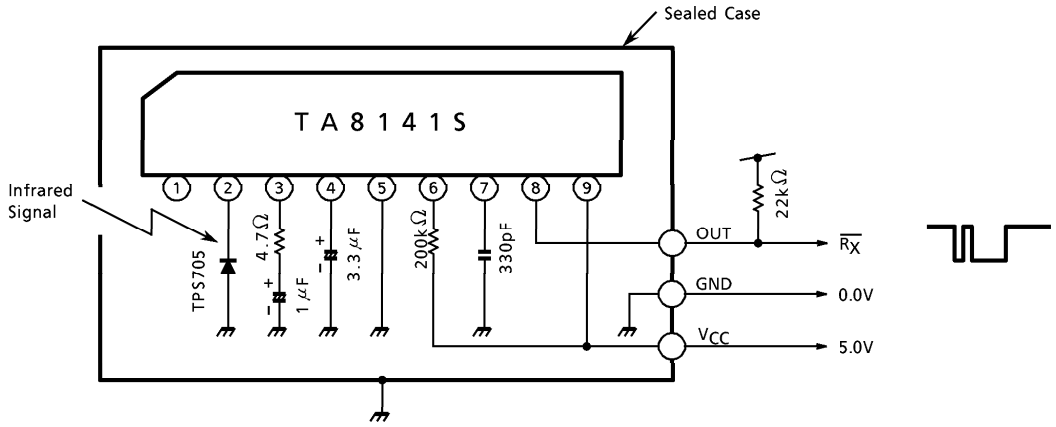
CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Supply Voltage		V_{DD}	—	Ta = − 40~85°C	4.5	—	5.5	V
Oscillation Frequency		f_{osc}	—	—	400	—	800	kHz
Input Voltage	"H" Level	V_{IH1}	—	(Except $\overline{RST}$, $\overline{R_{X\ IN}}$)	V_{DD} × 0.7	—	V_{DD}	V
	"H" Level	V_{IH2}	—	($\overline{RST}$, $\overline{R_{X\ IN}}$)	V_{DD} × 0.8	—	V_{DD}	V
	"L" Level	V_{IL1}	—	(Except $\overline{RST}$, $\overline{R_{X\ IN}}$)	0	—	V_{DD} × 0.3	V
	"L" Level	V_{IL2}	—	($\overline{RST}$, $\overline{R_{X\ IN}}$)	0	—	V_{DD} × 0.2	V

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

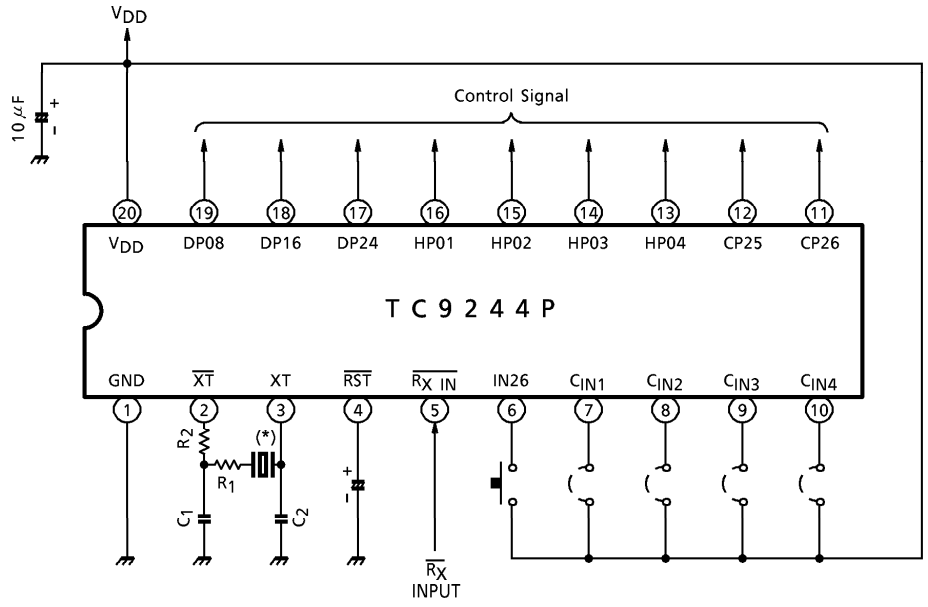
CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Supply Current		I_{DD}	—	f_{osc} = 455kHz	—	1.0	3.0	mA
Pull-down Resistor		R_D	—	(IN26, C_{IN})	100	200	400	kΩ
Pull-up Resistor		R_U	—	($\overline{RST}$)	25	50	100	kΩ
Output Current	"H" Level	I_{OH}	—	(CP, HP, DP) V_{OH} = 4V	− 1.0	− 4.0	—	mA
	"L" Level	I_{OL}	—	(CP, HP, DP) V_{OL} = 1V	1.0	8.0	—	mA
Input Leak Current		I_{LI}	—	V_{IN} = V_{DD}, GND	− 1.0	—	1.0	μA

APPLICATION CIRCUIT

1. Receiver circuit



2. TC9244P circuit

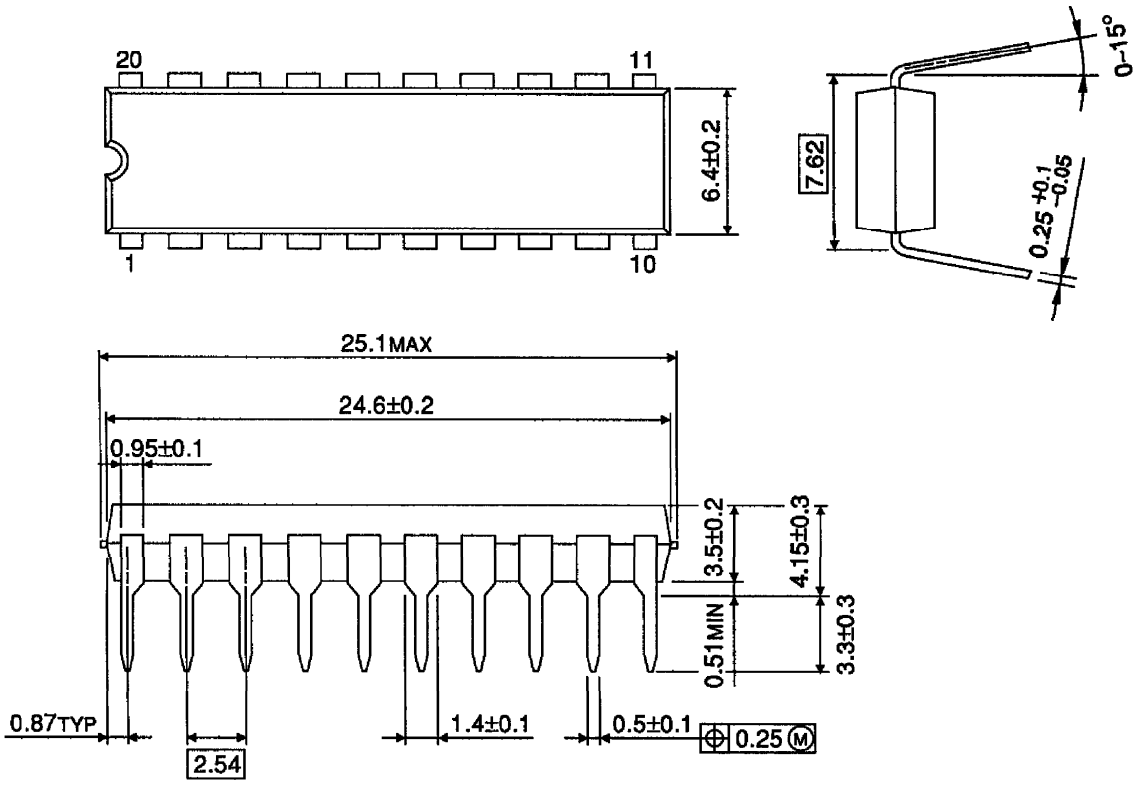


(*) Ceramic oscillator
CSB455E (Murata Seisakusyo) $C_1 = C_2 = 100pF$, R_2 = unnecessary
In case of influenced by oscillation noise, add resistor R_1 to 10kΩ MAX.
FCR455K3 (TDK) $C_1 = C_2 = 220pF$, $R_2 = 4.7k\Omega$, R_1 = unnecessary
In case of influenced by oscillation noise, add resistor R_2 to large (>4.7kΩ).
or equivalent

OUTLINE DRAWING

DIP20-P-300-2.54A

Unit : mm



Weight : 1.4g (Typ.)