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# HA1835P/HA1848P

Watchdog Timer

# HITACHI

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## Description

The HA1835P and HA1848P is a monolithic voltage regulator control designed for microcomputer systems. In addition to the voltage regulator, it include watchdog timer function and power-on reset function.

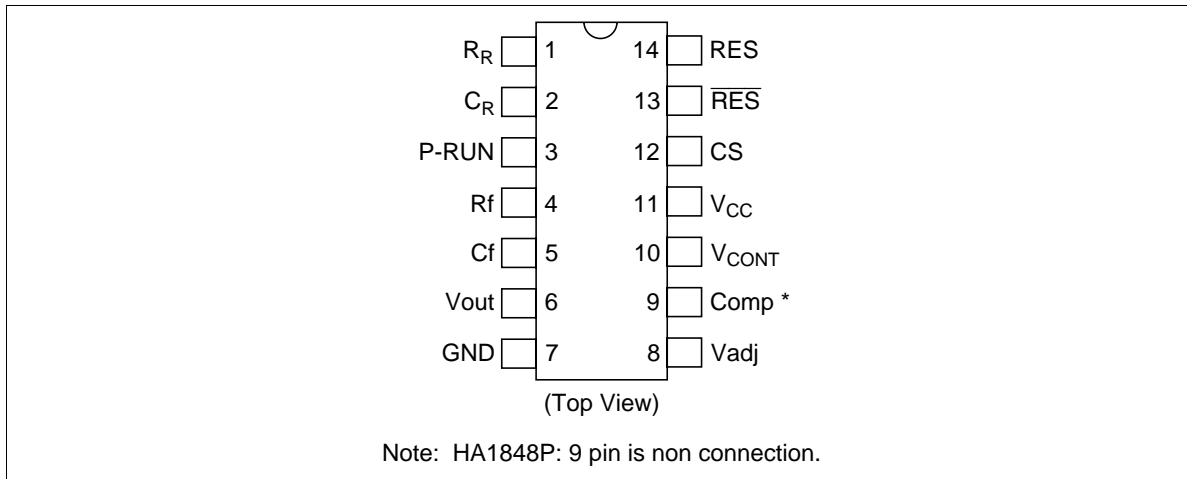
These ICs can perform many function in various microcomputer systems with few external parts.

## Features

- Regulated power supply control function
  - Wide area of operational voltage;  $V_{CC} = 6\text{ V to }30\text{ V}$
  - Available external PNP-type transistor, suited to any system power supply
  - Built-in overcurrent limiter for external PNP-type transistor
  - Output voltage can be adjusted exactry in the range from 4 V to 6 V
- Watchdog timer
  - Internal bandpass filter control circuit (pulse width detect type) and reset signal oscillator
  - Fail-safe utility
  - Bandpass filter characteristics can be set by external resistor ( $R_f$ ) and capacitance ( $C_f$ )
- Automatic reset
  - Automatic power-on reset
  - Pulse generator characteristics can be set by external resistor ( $R_R$ ) and capacitance ( $C_R$ )
  - Alternative between  $\overline{\text{RES}}$  and RES output

## HA1835P/HA1848P

### Pin Arrangement

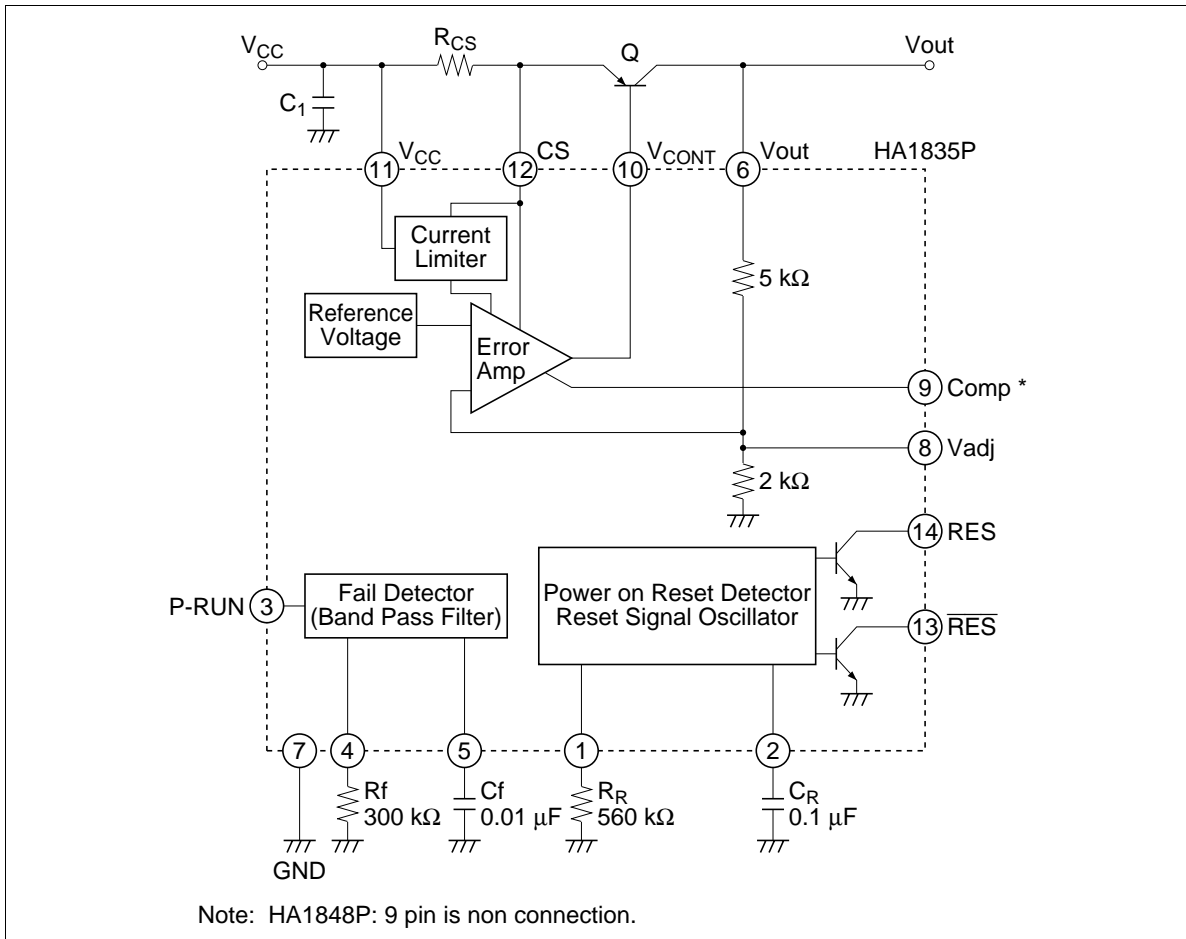


### Pin Functions

Pin No.	Symbol	Functions
1	$R_R$	Reset pulse width depends on resistance connected to $R_R$ Recommended range: 100 k $\Omega$ to 1 M $\Omega$
2	$C_R$	Reset pulse width depends on capacitance connected to $C_R$
3	P-RUN	Clock pulse input terminal for watchdog timer
4	$R_f$	Frequency band width of filter circuit depends on resistance connected to $R_f$ Recommended range: 100 k $\Omega$ to 500 k $\Omega$
5	$C_f$	Frequency band width of filter circuit depends on capacitance connected to $C_f$
6	Vout	Connect to external PNP transistor's collector: This pin supplies 5 V regulated voltage for internal circuit
7	GND	Ground
8	Vadj	Output voltage fine tuning terminal
9	Comp	Phase compensation terminal: Connect less than 100 pF capacitor between $V_{CC}$ and Comp. HA1848P is non connection
10	$V_{CONT}$	External PNP transistor's base control terminal
11	$V_{CC}$	Supply voltage terminal: Operating supply voltage range is 6 V to 30 V
12	CS	Connect current sense resistor, which protects the external PNP transistor, between $V_{CC}$ and CS
13	$\overline{RES}$ *	Reset pulse output terminal for low level reset type microcomputer
14	RES *	Reset pulse output terminal for high level reset type microcomputer

Note:  $\overline{RES}$  and RES are open-collector output terminals, so connect a pull-up resistor of about 5 k $\Omega$ .

Block Diagram



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## HA1835P/HA1848P

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### Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rating	Unit
Supply voltage	V <sub>CC</sub>	30	V
P-RUN input voltage	V <sub>P-RUN</sub>	-0.3 to V <sub>out</sub>	V
Output voltage	V <sub>RES</sub>	17.5	V
	V <sub>RES</sub>	17.5	V
Output current	I <sub>RES</sub>	2	mA
	I <sub>RES</sub>	2	mA
Control terminal voltage	V <sub>CONT</sub>	V <sub>CC</sub>	V
Control terminal current	I <sub>CONT</sub>	20	mA
Power dissipation (Note)	P <sub>T</sub> *	400	mW
Operating temperature range	Topr	-40 to +85	°C
Storage temperature range	Tstg	-50 to +125	°C
Soldering temperature	Tsol	+260 (< 10 sec)	°C

Note: Ta ≤ 77°C. If Ta > 77°C, derate by 8.3 mW/°C.

**Electrical Characteristics** ( $V_{CC} = 12\text{ V}$ ,  $V_{out} = 5\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )

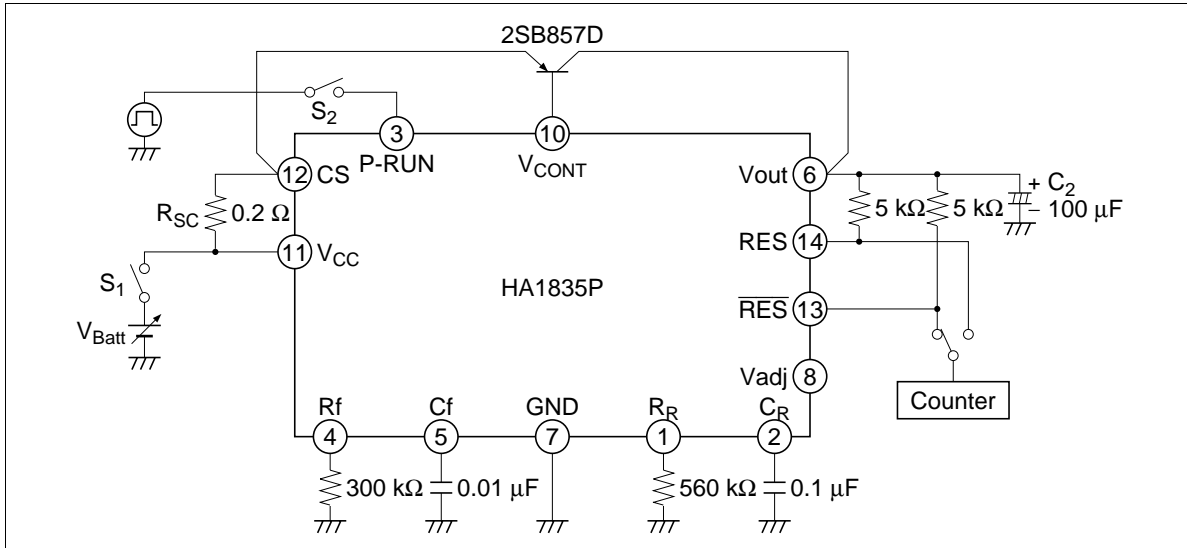
Item		Symbol	Min	Typ	Max	Unit	Test Conditions
Power supply terminal current		$I_{CC}$	—	6.3	12	mA	$V_{CC} = 17.5\text{ V}$ (No load), with PNP transistor
Regulator section	Output voltage	$V_{out1}$	4.75	5.00	5.25	V	$V_{CC} = 6\text{ to }17.5\text{ V}$ , $I_{out} = 0.5\text{ A}$
		$V_{out2}$	4.70	5.00	5.30	V	$V_{CC} = 6\text{ to }17.5\text{ V}$ , $I_{out} = 1\text{ A}$
	Line regulation	$\delta V_{Oline}$	-50	—	+50	mV	$V_{CC} = 6\text{ to }17.5\text{ V}$ , $I_{out} = 1\text{ A}$
	Load regulation	$\delta V_{Oload}$	-100	—	+100	mV	$I_{out} = 10\text{ mA to }0.5\text{ A}$
	Ripple rejection	$R_{REJ}$	40	75	—	dB	$e_i = 0.5\text{ Vrms}$ , $f_i = 1\text{ kHz}$
	Limiter operating current	$I_{CS}$	1.0	—	2.0	A	$R_{SC} = 0.2\ \Omega$
	Output voltage temperature coefficient	$\delta V_{out}/\delta T$	—	-0.6	—	mV/ $^\circ\text{C}$	
P-RUN input section	Low-level input voltage	$V_{IL}$	—	—	0.8	V	
	High-level input voltage	$V_{IH}$	2.0	—	—	V	
	Low-level input current	$I_{IL}$	-120	-60	—	$\mu\text{A}$	$V_{IL} = 0\text{ V}$
	High-level input current	$I_{IH}$	—	1.8	3.0	mA	$V_{out} = 5\text{ V}$ , $V_{IH} = 5\text{ V}$
Reset circuit section	Reset terminal low-level voltage	$V_{OL1}$	—	—	0.4	V	$I_{OL} = 2\text{ mA}$
	Reset terminal leakage current	$I_{OH1}$	—	—	5.0	$\mu\text{A}$	$V_{OH} = 5\text{ V}$
		$I_{OH3}$	—	—	30	$\mu\text{A}$	$V_{OH} = 17.5\text{ V}$
Reset time	Power on time	$t_{on}$	80	130	200	ms	$R_f = 300\text{ k}\Omega$ , $R_R = 560\text{ k}\Omega$ ,
	Clock off reset time	$t_{off}$	60	130	220	ms	$C_f = 0.01\ \mu\text{F}$ , $C_R = 0.1\ \mu\text{F}$
	Reset pulse low-level time	$t_{RL}$	40	80	160	ms	
	Reset pulse high-level time	$t_{RH}$	50	100	200	ms	

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# HA1835P/HA1848P

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## Test Circuit



## Functional Description

### Voltage Regulator

The HA1835P, and HA1848P supplies 5 V regulated output from a wide  $V_{CC}$  input range ( $V_{CC} = 6$  V to 17.5 V). The external PNP transistor should be selected according to the supply current demand of the system. Connect a more than 100  $\mu$ F capacitor between  $V_{out}$  and GND to realize the 5 V regulated output.

The resistor connected from the  $V_{adj}$  terminal to the  $V_{out}$  or GND terminal fine tunes the output voltage. A resistor between  $V_{adj}$  and the  $V_{out}$  decreases the output voltage, and a resistor between  $V_{adj}$  and GND increases the output voltage.

$$R (V_{out} - V_{adj}) \approx \frac{5 \cdot V_{out} - 7.14}{5 - V_{out}} \quad (\text{k}\Omega)$$

$$R (V_{adj} - \text{GND}) \approx \frac{7.14}{V_{out} - 5} \quad (\text{k}\Omega)$$

### Current Limiter

To protect the external transistor from overcurrent, connect a current-sense resistor between the CS terminal and the  $V_{CC}$  terminal. The value of this resistor should be:

$$R_{SC} \approx \frac{0.3 \text{ V}}{I_{out} (\text{Limit})} \quad (\text{at } T_a = 25^\circ\text{C})$$

### Power-On Reset

The HA1835P, and HA1848P can output a reset pulse to start the microcomputer at power on (figure 6). The external resistor  $R_R$  and capacitor  $C_R$  determine the power-on reset timing.

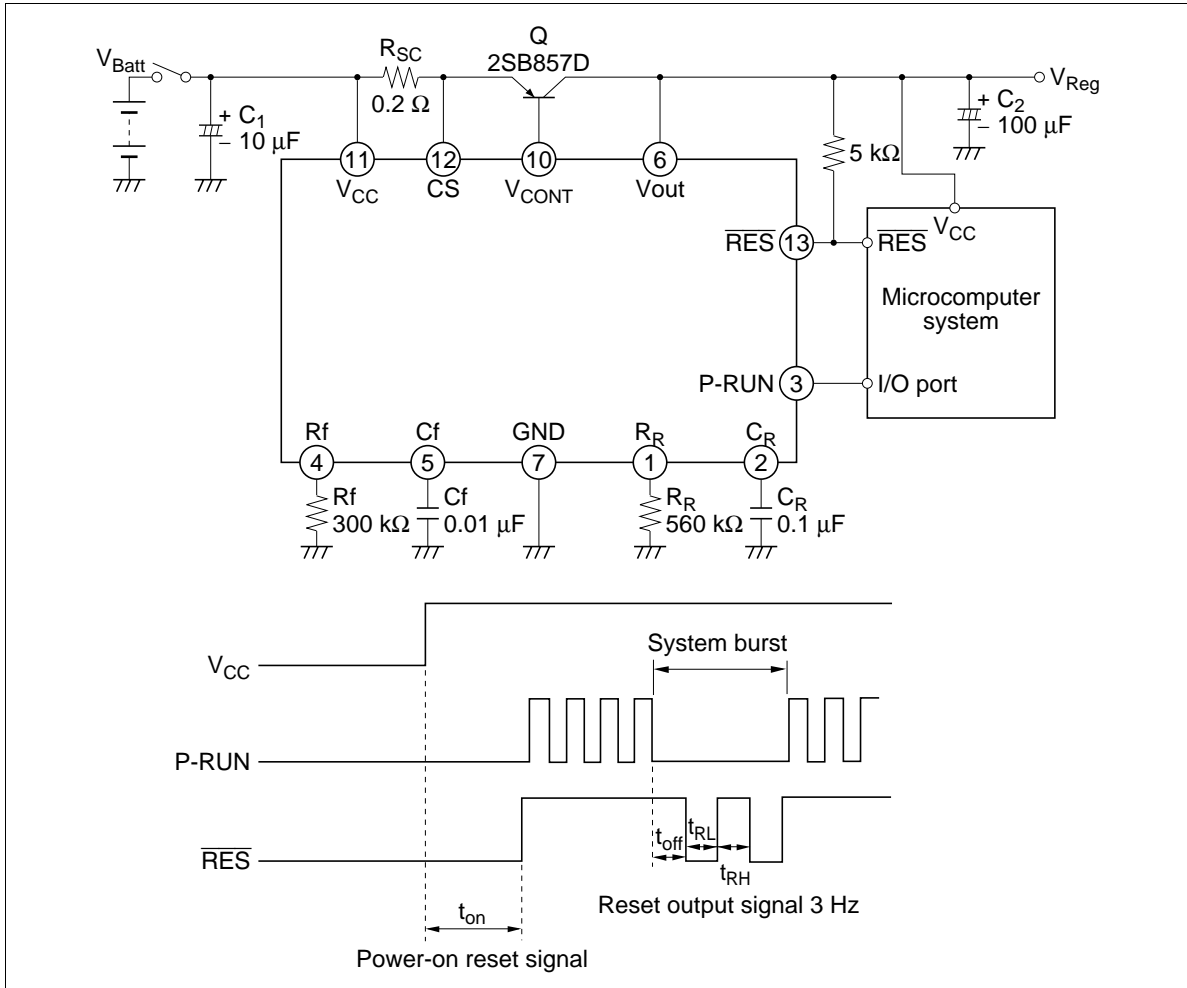
Note that  $\overline{\text{RES}}$  and RES are open-collector terminals. They should therefore be connected to a pull-up resistor of about 5 k $\Omega$ .

### Watchdog Timer

The watchdog timer is a fail-safe function. It can reset the microcomputer system if the system runs out of control. It does this by monitoring a pulse output by the system's software. It uses a bandpass filter to determine whether the pulse frequency is within the system's normal frequency band (figure 7, 8). External resistor and capacitor  $R_f$  and  $C_f$  determine the frequency range of the bandpass filter. If the pulse frequency is not within the frequency band, the HA1835P, and HA1848P outputs a reset pulse.

# HA1835P/HA1848P

## Application Circuit Example





Characteristic Curves

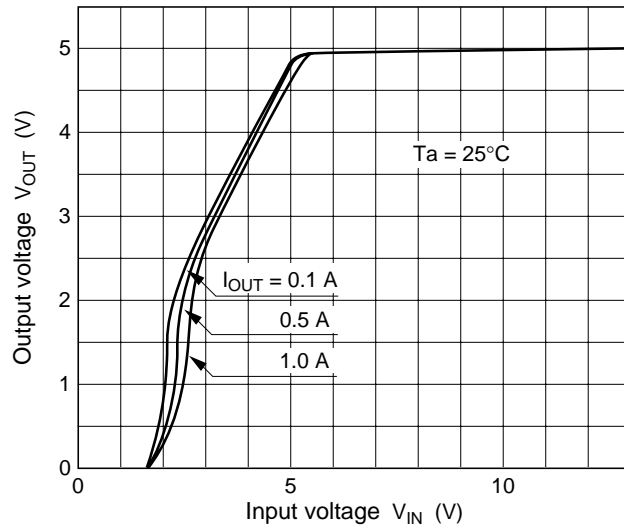


Figure 1 Output Voltage vs. Input Voltage

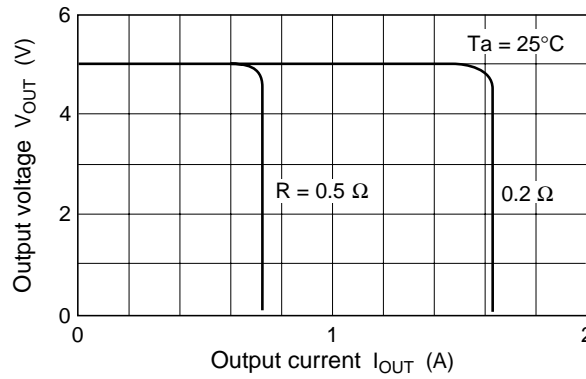


Figure 2 Output Voltage vs. Output Current

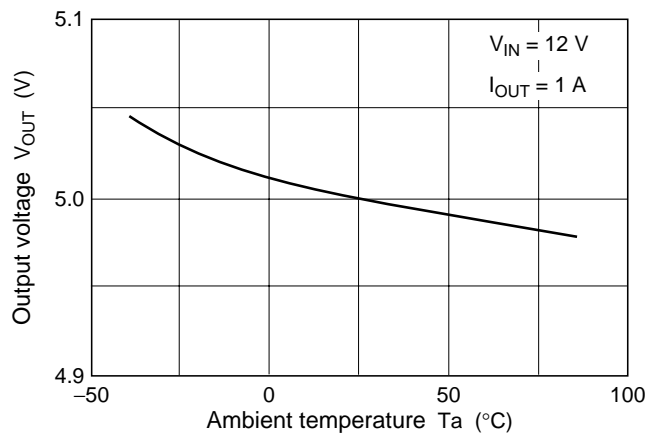


Figure 3 Output Voltage vs. Ambient Temperature

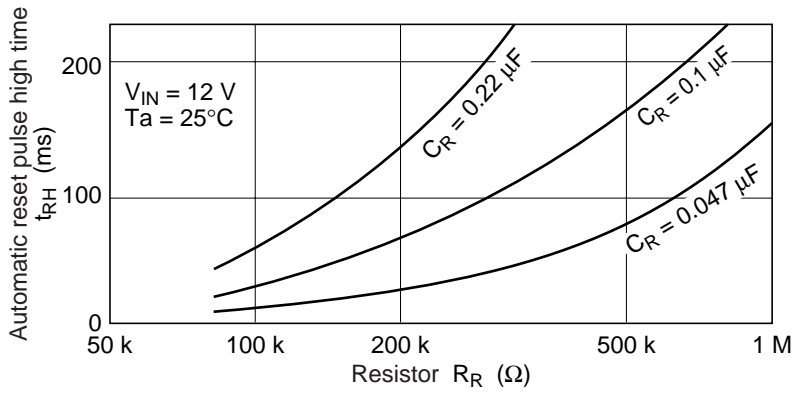


Figure 4 Automatic Reset Pulse High Time vs. Resistor

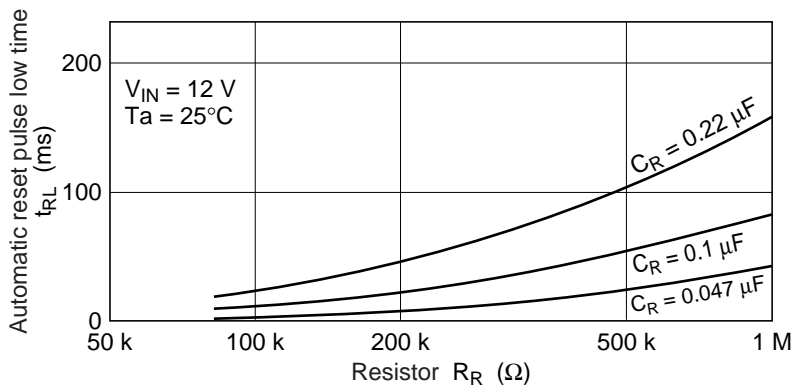


Figure 5 Automatic Reset Pulse Low Time vs. Resistor

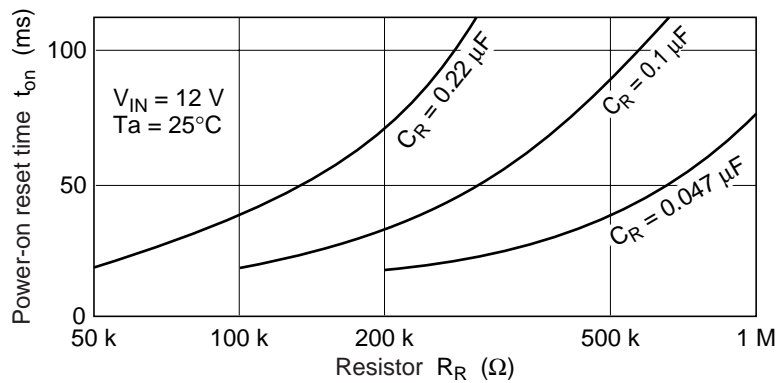


Figure 6 Power-on Reset Time vs. Resistor

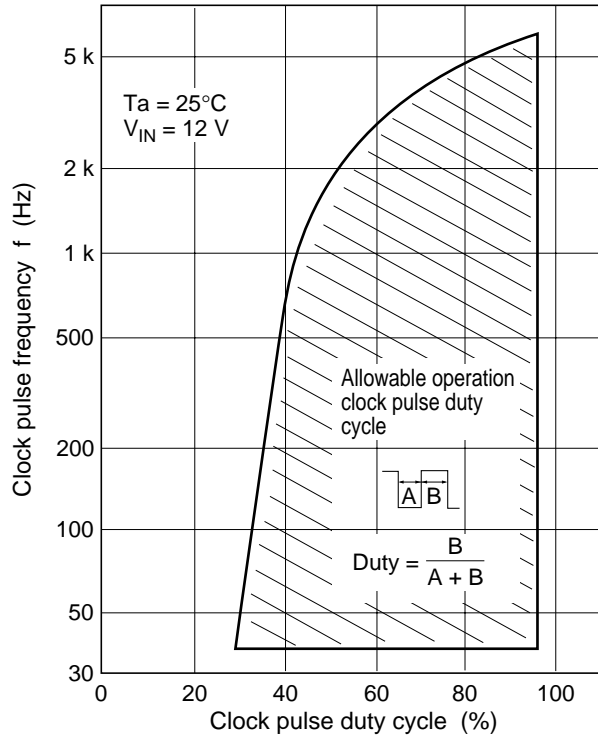


Figure 7 Clock Pulse Frequency vs. Clock Pulse Duty Cycle

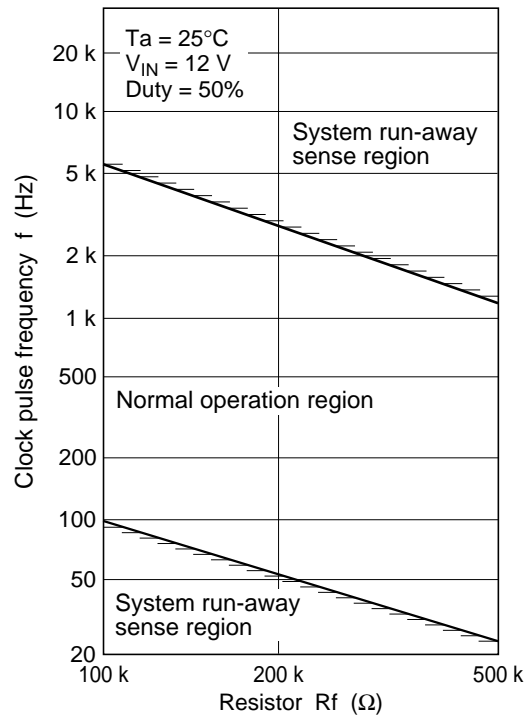
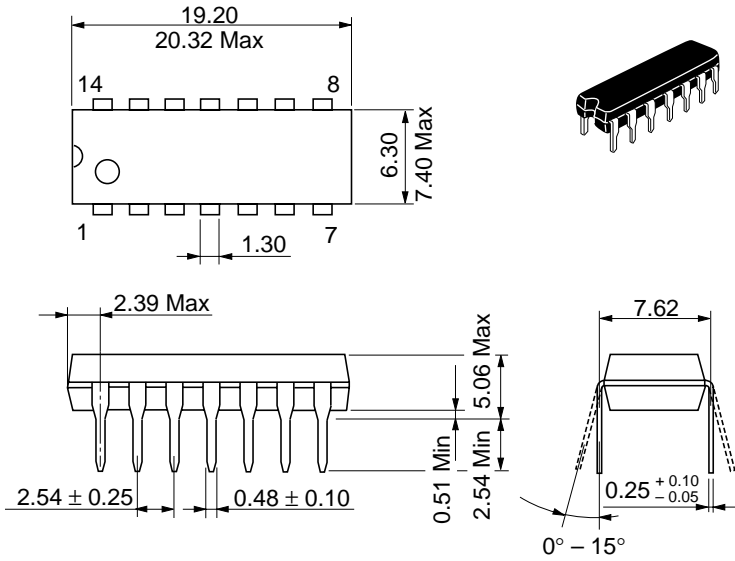


Figure 8 Clock Pulse Frequency vs. Resistor

# HA1835P/HA1848P

## Package Dimensions

Unit: mm



Hitachi Code	DP-14
JEDEC	Conforms
EIAJ	Conforms
Mass (reference value)	0.97 g

## Cautions

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