HA16107P/FP, HA16108P/FP

PWM Switching Regulator for
High-performance Voltage Mode Control

HITACHI

Description

The IC products in this series are primary control switching regulator control IC's appropriate for obtaining stabilized DC voltages from commercial AC power.

These IC's can directly drive power MOS FET's, they have a timer function built in to the secondary overcurrent protection, and they can perform intermittent operation or delayed latched shutdown as protection operations in unusual conditions. They can be used to implement switching power supplies with a high level of safety due to the wide range of built-in functionality.

Functions

- 6.45 V reference voltage
- Triangle wave generator
- Error amplifier
- Under voltage lockout protector
- PWM comparator
- Pulse-by-pulse current limitting
- Timer-latch current limitting (HA16107)
- ON/OFF timer function (HA16108)
- Soft start and quick shutdown
- Output circuit for power MOS FET driving

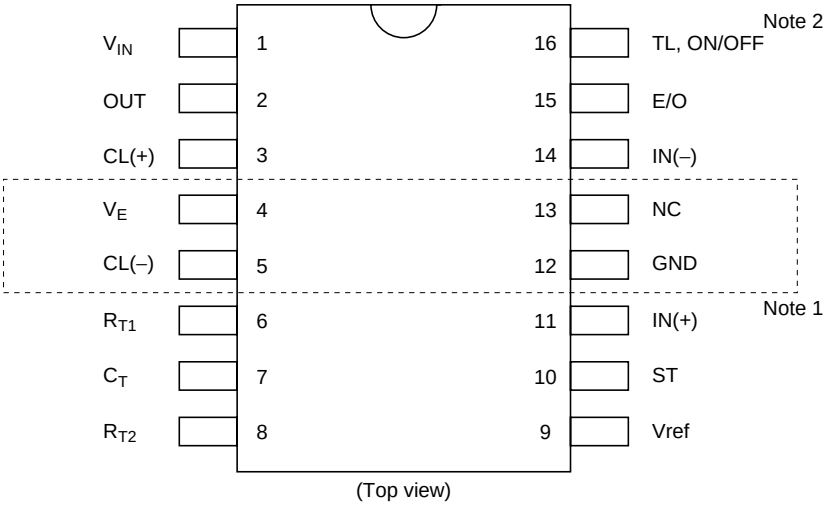
Features

- Operating frequencies up to a high 600 kHz
- Built-in pre-driver circuit for driving power MOS FET
- Built-in timer latch over-current protection function (HA16107)
- The OCL enables intermittent operation by an ON/OFF timer for prevention of secondary overcurrent. (HA16108)
- The UVL function (under voltage lockout) is applied to both Vin and Vref.
- ON/OFF reset: an auto-reset function which is based on the time constant of an external capacitor and observation of drops in Vin.
- Since the over-voltage protection function OVP (the TL pin) only observes voltage drops in Vin, it is possible to use the OVP and ON/OFF pin for independent purposes.
- Built-in 34 V Zener diode between Vin and ground.

Ordering Information

	Typical Threshold Voltage			
Product	**UVL1**	**OVP**	**Notes**	**Package**
HA16107P	Hi: 16.2 V	7.0 V	Timer latch protection	DP-16
HA16107FP	Lo: 9.5 V			FP-16DA
HA16108P	Hi: 16.2 V	Hi: 7.0 V	On-off timer protection	DP-16
HA16108FP	Lo: 9.5 V	Lo: 1.3 V	(intermittent operation possible)	FP-16DA

Pin Arrangement



(Top view)

Notes: 1. In the SOP package models (HA16107FP and HA16108FP) pins 4, 5, and 13 are connected inside the IC. However, all must be connected to the system ground.
2. Pin 16 is TL (HA16107), ON/OFF (HA16108).

Pin Functions

- HA16107P, HA16108P

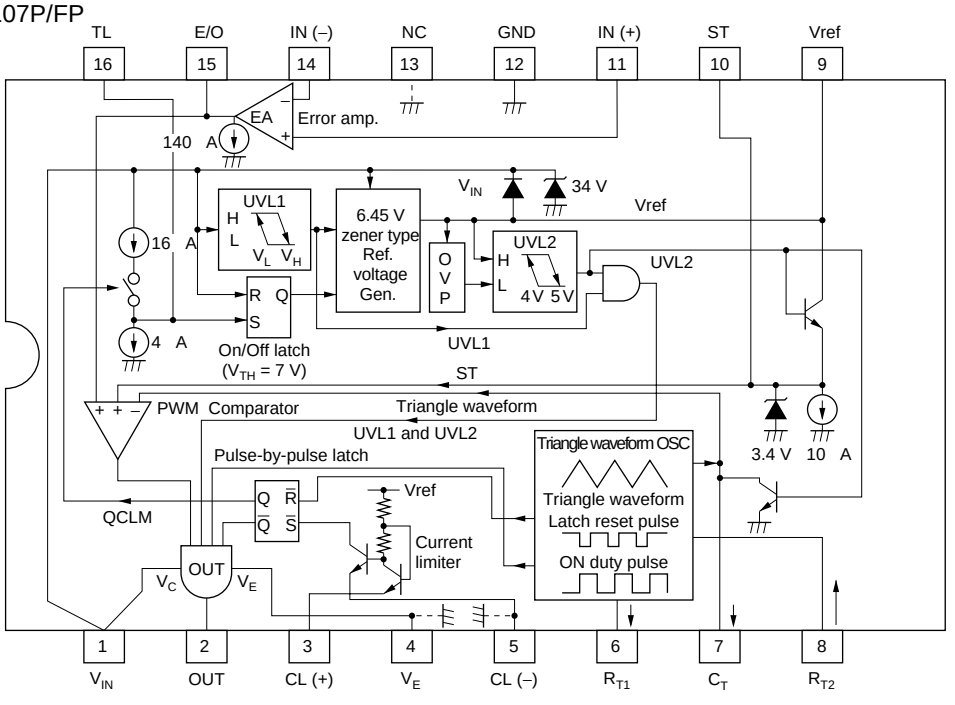
Pin No.	Symbol	Pin Functions
1	V_{IN}	Input voltage
2	OUT	Pulse output
3	CL (+)	Current limiter
4	V_E	Output ground
5	CL (–)	Current limiter
6	R_{T1}	Timing resistor (rising time)
7	C_T	Timing capacitor
8	R_{T2}	Timing resistor (falling time)
9	Vref	Reference voltage output
10	ST	Soft start
11	IN (+)	Error amp (+) input
12	GND	Ground
13	NC	NC
14	IN (–)	Error amp (–) input
15	E/O	Error output
16	TL, ON/OFF	Timer latch (HA16107), ON/OFF (HA16108)

- HA16107FP, HA16108FP

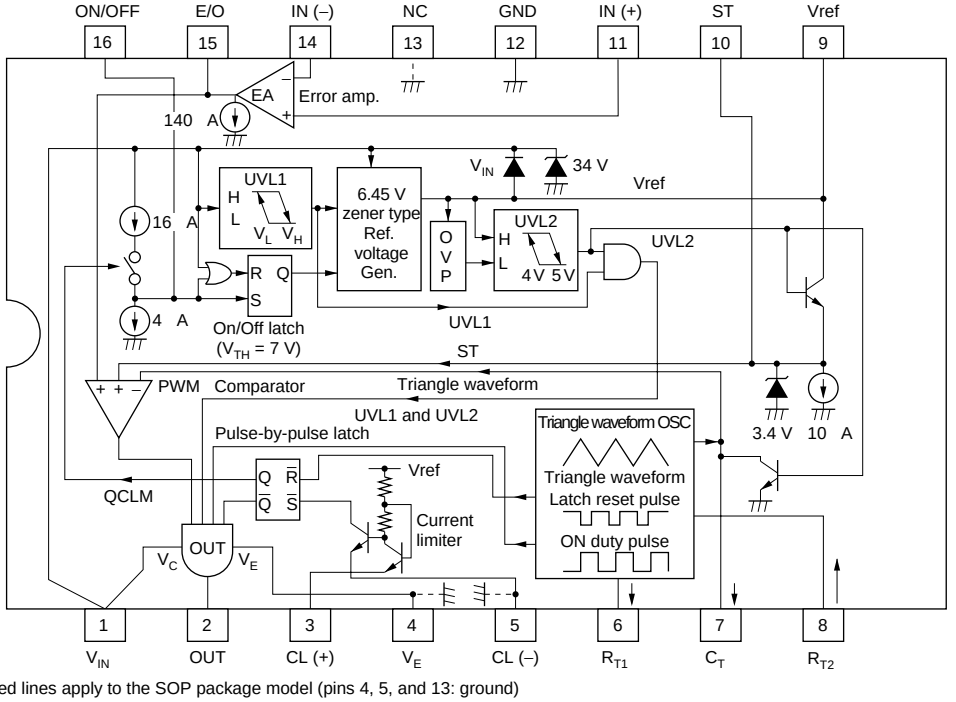
Pin No.	Symbol	Pin Functions
1	V_{IN}	Input voltage
2	OUT	Pulse output
3	CL (+)	Current limiter
4	GND	Ground
5	GND	Ground
6	R_{T1}	Timing resistor (rising time)
7	C_T	Timing capacitor
8	R_{T2}	Timing resistor (falling time)
9	Vref	Reference voltage output
10	ST	Soft start
11	IN (+)	Error amp (+) input
12	GND	Ground
13	GND	Ground
14	IN (–)	Error amp (–) input
15	E/O	Error output
16	TL, ON/OFF	Timer latch (HA16107), ON/OFF (HA16108)

Block Diagram

• HA16107P/FP



• HA16108P/FP



Note: Dotted lines apply to the SOP package model (pins 4, 5, and 13: ground)

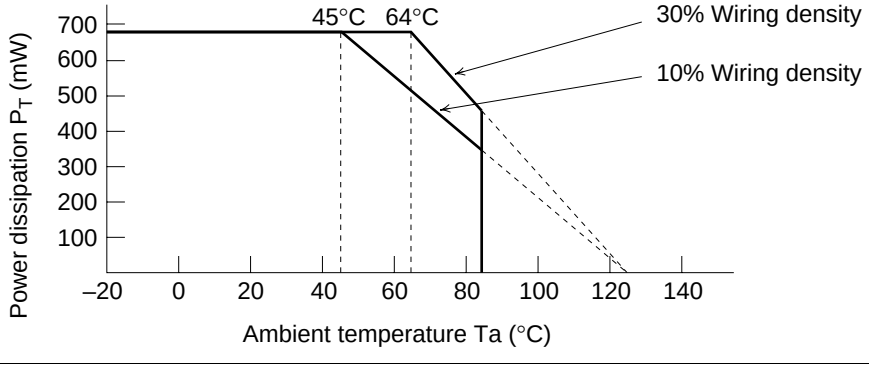
Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rating Value	Units	Notes
Supply voltage	V_{IN}	30	V	
Output current (DC)	I_O	±0.2	A	
Output current (peak)	Iopeak	±2	A	
Current limiter voltage	V_{CL}	+4, –1	V	
Error amp input voltage	V_{IEA}	Vref	V	
E/O output voltage	$V_{IE/O}$	Vref	V	
R_{T1} pin current	I_{RT1}	500	µA	
R_{T2} pin current	I_{RT2}	5	mA	
Power dissipation	P_T	680	mW	1, 2
Operating temperature range	Topr	–20 to +85	°C	
Storage temperature range	Tstg	–55 to +125	°C	

Notes: 1. For the “FP” products (SOP package), this value is when mounted on a 40 by 40 by 1.6 mm glass epoxy substrate. However, this value must be derated by 8.3 mW/°C from Ta = 45°C. When the wiring density is 10%, and 11.1 mW/°C from Ta = 64°C when the wiring density is 30%.

2. For the “P” products (DIP package), this value is valid up to 45°C, and must be derated by 8.3 mW/°C above 45°C.

3. In the case of SOP, use center 4 pins, (4), (5), (12), (13) for solder-mounting and connect the wide ground pattern, because these pins are available for heat sink of this IC.



Electrical Characteristics (Ta = 25°C, V_{IN} = 18 V, f_{OSC} = 100 kHz)

Section	Item	Symbol	Min	Typ	Max	Unit	Test Conditions	Note
Reference voltage	Output voltage	Vref	6.10	6.45	6.80	V		
	Line regulation	Line	—	30	60	mV	12 V ≤ V_{IN} ≤ 30 V	
	Load regulation	Load	—	30	60	mV	0 mA ≤ I_O ≤ 10 mA	
	Temperature stability	ΔVref/ ΔTa	—	40	—	ppm/ °C		
	Short circuit current	I_{OS}	30	50	—	mA	Vref = 0 V	
	Over voltage protection (Vref OVP voltage)	Vrovp	7.4	8.0	9.0	V		
Triangle wave generator	Maximum frequency	fmax	600	—	—	kHz		
	Minimum frequency	fmin	—	—	1	kHz		
	Voltage stability	$\Delta f/fo_1$	—	±1	±3	%	12 V ≤ V_{IN} ≤ 30 V fo_1 = (fmax + fmin)/2	
	Temperature stability	$\Delta f/fo_2$	—	±1	—	%	–20°C ≤ Ta ≤ +85°C fo_2 = (fmax + fmin)/2	
	Frequency accuracy	f_{OSC}	270	300	330	kHz	R_{T1} = R_{T2} = 27 kΩ C_T = 120 pF	
PWM comparator	Minimum deadband pulse width	t_{DB}	—	—	1.0	µs		
	Low level threshold voltage	V_{TL}	1.9	2.2	2.5	V		
	High level threshold	V_{TH}	3.8	4.2	4.6	V		
	Differential threshold	ΔV_{TH}	1.7	2.0	2.3	V		
	Deadband width initial accuracy	ΔDB1	—	±1	±3	%	R_{T1} = R_{T2} = 27 kΩ C_T = 470 pF	
	Deadband width voltage stability	ΔDB2	—	±0.2	±2.0	%	12 V ≤ V_{IN} ≤ 30 V (Dmax – Dmin)/2	
	Deadband width temperature stability	ΔDB3	—	±1	—	%	–20°C ≤ Ta ≤ +85°C (Dmax – Dmin)/2	
Error amp	Input offset voltage	V_{IO}	—	2	10	mV		
	Input bias current	I_{IB}	—	0.8	2.0	µA		
	Input sink current	Iosink	80	140	—	µA	V_O = 2 V	
	Output source current	Iosource	80	140	—	µA	V_O = 5 V	

Electrical Characteristics (Ta = 25°C, V_{IN} = 18 V, f_{OSC} = 100 kHz) (cont.)

Section	Item	Symbol	Min	Typ	Max	Unit	Test Conditions	Note
Error amp (cont.)	High level output voltage	V_{OH}	Vref – 1.5	—	—	V	I_O = 10 µA	
	Low level output voltage	V_{OL}	—	—	0.5	V	I_O = 10 µA	
	Voltage gain	G_V	—	55	—	dB	f = 10 kHz	
	Band width	BW	—	15	—	MHz		
	(–) Common mode voltage	V_{CM}–	1.2	—	—	V		
	(+) Common mode voltage	V_{CM}+	—	—	Vref – 1.5	V		
Over-current detector	(+) Threshold voltage	V_{TH}+	0.216	0.240	0.264	V		
	(+) Bias current	I_B+	—	180	250	µA	V_{CL}+ = 0 V	
	(–) Threshold voltage	V_{TH}–	–0.264	–0.240	–0.216	V		1, 2
	(–) Bias current	I_B–	—	950	1350	µA	V_{CL} = –0.3 V	1, 2
	Response time	t_{off}	—	100	—	ns	CL; open V_{CL} = +0.35 V	
Soft start	High level voltage	V_{STH}	3.2	3.8	4.4	V	Isink = 1 mA	
	Sink current	Isink	7	10	13	µA	V_{ST} = 2.0 V	
Under voltage lockout 1	V_{IN} high level threshold voltage	V_{INTH}	14.7	16.2	17.7	V		
	V_{IN} low level threshold voltage	V_{INTL}	8.5	9.5	10.5	V		
	Threshold differential voltage	ΔV_{TH}	5.2	6.2	7.2	V	(V_{INTH} – V_{INTL})	
Under voltage lockout 2	Vref high level threshold voltage	V_{rTH}	4.5	5.0	5.5	V		
	Vref low level threshold voltage	V_{rTL}	3.5	4.0	4.5	V		

Notes: 1. Only applies to the HA16107P, HA16108P
2. The terminal should not be applied under –1.0 V.

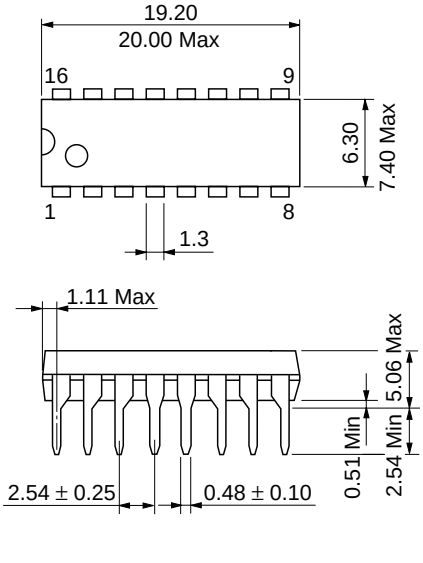
Electrical Characteristics (Ta = 25°C, V_{IN} = 18 V, f_{OSC} = 100 kHz) (cont.)

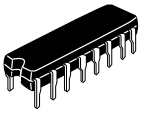
Section	Item	Symbol	Min	Typ	Max	Unit	Test Conditions	Note
Timer latch, ON/OFF timer*2	Latch threshold voltage	V_{THH}	6.5	7.0	7.5	V		
	V_{IN} reset voltage	V_{INR2}	6.0	6.5	7.0	V		
	Reset voltage	V_{THL2}	1.0	1.3	1.6	V		1
	Differential threshold to UVL low voltage	ΔV	2.0	3.0	—	V	(V_{INTL} – V_{INR2})	
	Source current (OCL mode)	Isource	8	12	16	μA	Over current detection mode	
	Sink current (latch mode)	Isink	2.5	4	5.5	μA	TL(ON/OFF) terminal = 4 V	
Output	Low voltage	V_{OL1}	—	1.7	2.2	V	Iosink = 0.2 A	
	High voltage	V_{OH}	V_{IN} – 2.2	—	—	V	Iosource = 0.2 A	
	Low voltage (standby mode)	V_{OL2}	—	—	0.5	V	Iosink = 1 mA	
	Rising time	t_r	—	40	—	ns	C_L = 1000 pF	
	Falling time	t_f	—	60	—	ns	C_L = 1000 pF	
Total	Standby current	Ist	—	160	250	μA	V_{IN} = 14 V	
	Operation current	I_{IN1}	—	16	20	mA	V_{IN} = 30 V, C_L = 1000 pF, f = 100 kHz	
	Operation current	I_{IN2}	—	12	16	mA	V_{IN} = 30 V, f = 100 kHz, Output open	
	ON/OFF latch current	I_{IN3}	—	350	460	μA	V_{IN} = 14 V	
	V_{IN} – GND Zener voltage	V_Z	30	34	—	V		

Notes: 1. Only applies to the HA16108P/FP.
2. Timer latch: HA16107P/FP.
ON/OFF timer: HA16108P/FP.

Package Dimensions

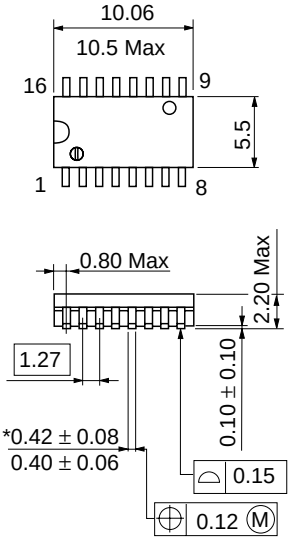
Unit: mm

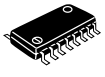




Hitachi Code	DP-16
JEDEC	Conforms
EIAJ	Conforms
Mass (reference value)	1.07 g

Unit: mm





Hitachi Code	FP-16DA
JEDEC	—
EIAJ	Conforms
Mass (reference value)	0.24 g

*Dimension including the plating thickness
Base material dimension