AN8092, AN8092S

Overvoltage Protection Circuit Incorporated Switching Power Supply

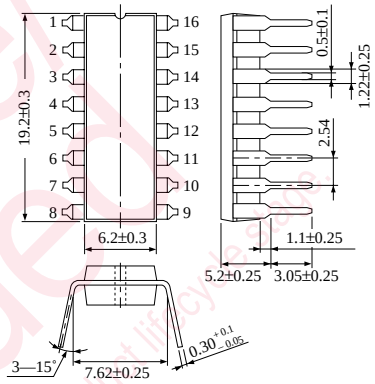
■ Overview

The AN8092 and AN8092S are equipped with various protection functions such as from overcurrent and overvoltage, which can raise the reliability of the power supply, realizing the high-speed control up to 500 kHz.

■ Features

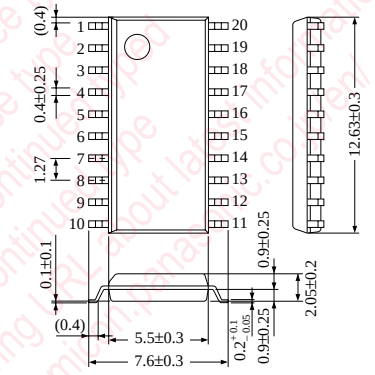
- The PWM control frequency of up to 500 kHz and miniaturization realized.
- The power MOS FET of large capacitance directly controllable
- Built-in overcurrent protection function for two systems of positive side detection and negative one, and intermittent operation function for protection when overcurrent condition proceeds further
- ON/OFF function allowing the power supply to be started or stopped by the external signal, and current control function required for the secondary side control incorporated
- Package : 16-pin DIP for the AN8092, 20-pin SOP for the AN8092S
- Able to be released by the external signal after OVP operation

AN8092 Unit : mm



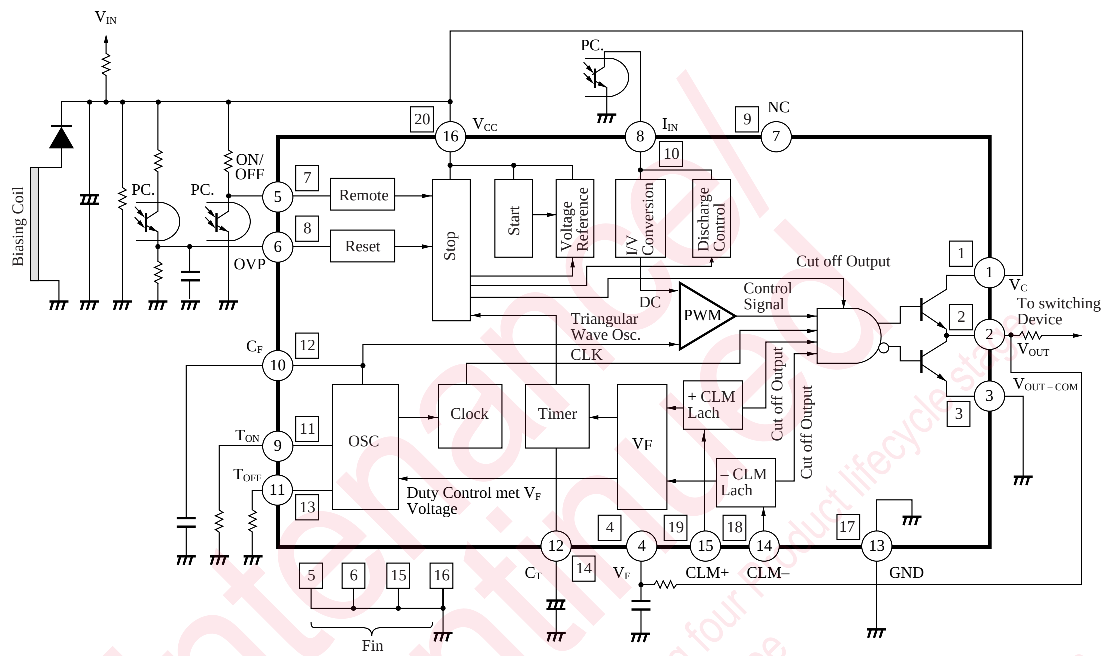
16-pin DIP Package (DIP016-P-0300D)

AN8092S Unit : mm



20-pin SOP Package (SOP020-P-0300C)

■ Block Diagram



Number in ☐ is for Pin No. of AN8092S

■ Absolute Maximum Ratings (Ta=25˚C)

Parameter	Symbol	Rating		Unit
Supply voltage	V_{CC}	31		V
Collector terminal allowable applied voltage	V_C	31		V
Peak output current	I_{Opeak}	±2		A
Maximum continuous output current	I_{Omax}	±150		mA
V_F terminal allowable applied voltage	V_F	V_{CC}		V
ON/OFF terminal allowable applied voltage	$V_{ON/OFF}$	V_{CC}		V
CLM^- terminal allowable applied voltage	V_{CLM^-}	±4		V
CLM^+ terminal allowable applied voltage	V_{CLM^+}	– 0.3, 4		V
OVP terminal allowable applied voltage	V_{OVP}	V_{CC}		V
FB terminal allowable applied voltage	V_{FB}	0, 10		V
T_{ON} terminal allowable applied voltage	I_{TON}	–1		mA
T_{OFF} terminal allowable applied voltage	I_{TOFF}	–1		mA
Allowable joint temperature	T_j	150		˚C
Power dissipation Ta ≦ 25˚C	P_D	AN8092	1736	mW
		AN8092S	1500	
Operating ambient temperature	T_{opr}	–30 to +85		˚C
Storage temperature	T_{stg}	–55 to +150		˚C

Note) For surface mounting on the glass epoxy board (50 × 50 × 0.45mm)

■ Recommended Operating Range (Ta=25˚C)

Parameter	Symbol	Range
Operating supply voltage	V_{CC}	Stop voltage to 30 V

■ Electrical Characteristics (Ta=25˚C)

Parameter	Symbol	Condition	min	typ	max	Unit
Operation start voltage	$V_{CC\ (start)}$		15.2	16	17.2	V
Operation stop voltage	$V_{CC\ (stop)}$		9	10	10.9	V
Voltage difference between operation start and stop	DV_{CC}	$DV_{CC}=V_{CC\ (start)}-V_{CC\ (stop)}$	5	6	7	V
Pre-start circuit current (1)	I_{CCL1}	V_{CC}=14.5V	50	100	120	µA
Circuit currentt (1)	I_{CC01}	V_{CC}=11V (Start Condition)	10	15	21	mA
Circuit current (2)	I_{CC02}	V_{CC}=30V	10	15	21	mA
OFF-time circuit currentt (1)	$I_{CC1\ OFF}$	V_{CC}=14V	50	100	120	µA
OFF-time circuit current (2)	$I_{CC2\ OFF}$	V_{CC}=25V	0.95	1.5	1.9	mA
Timer off operation circuit currentt (1)	$I_{CC1\ CT}$	V_{CC}=14V	—	190	270	µA
Timer off operation circuit current (2)	$I_{CC2\ CT}$	V_{CC}=25V	0.95	1.55	2	mA
OVP operation circuit currentt (1)	$I_{CC1\ OVP}$	V_{CC}=9.5V	215	280	380	µA
OVP operation circuit current (2)	$I_{CC2\ OVP}$	V_{CC}=25V	1.3	2	3	mA
ON/OFF terminal H threshold voltage	$V_{THH\ ON/OFF}$		2.1	2.6	3.1	V
ON/OFF terminal L threshold voltage	$V_{THL\ ON/OFF}$		1.9	2.4	2.9	V
ON/OFF terminal hysteresis voltage	$DV_{TH\ ON/OFF}$		0.1	0.2	0.3	V
Output 0 % duty FB current	$I_{FB\ MIND}$	V_{CC}=18V	–2	–1.5	–1.1	mA
Output maximum duty FB current	$I_{FB\ MAXD}$	V_{CC}=18V	– 0.9	– 0.55	– 0.4	mA
FB current difference between output 0% and maximum duty	DI_{FB}	$DI_{FB}=I_{FB\ MIND}-I_{FB\ MAXD}$	–1.35	– 0.95	– 0.7	V
FB terminal voltage	V_{FB}	I_{FB}= – 0.95mA	4.6	5.6	6.8	V
FB terminal discharging current	$I_{FB\ Res}$		1	3	—	mA
OVP terminal threshold voltage	$V_{TH\ OVP}$		1.2	1.4	1.6	V
OVP terminal input current	$I_{IN\ OVP}$	V_{OVP}=5V	– 0.5	0	0.5	µA
OVP release supply voltage	$V_{CC\ OVP}$		6	7	8	V
OVP terminal reset threshold voltage	$V_{RES\ OVP}$		0.4	0.6	0.8	V
Power supply stop voltage - OVP release supply voltage	$DV_{CC\ OVP}$	$DV_{CC\ OVP}=V_{CC\ STOP}-V_{CC\ OVP}$	0.65	1.3	—	V
Timer frequency	f_{TIM}		0.27	0.44	0.6	Hz
Timer charging currentt (1)	$I_{CH1\ TM}$		–180	–125	– 80	µA
Timer Off/On time ratio	G_{TIM}		7	8.3	11	—
CLM^- erminal threshold voltaget (1)	$V_{TH1\ CLM-}$		–215	–200	–185	mV
CLM^- terminal out-current	$I_{OUT\ CLM-}$		–170	–125	–90	µA
CLM^+ terminal threshold voltaget (1)	$V_{TH1\ CLM+}$		185	200	215	mV
CLM^+ terminal out-current	$I_{OUT\ CLM+}$		–270	–200	–140	µA
Oscillation frequencyt (1)	f_{OSC1}	R_1=17kΩ, R_2=20kΩ, C_F=220pF	185	200	215	kHz
Duty ratiot (1)	G_{DUTY1}	R_1=17kΩ, R_2=20kΩ, C_F=220pF	47	49	51	%
Oscillation waveform upper limit voltage	V_{OSCH}		4	4.4	4.8	V
Oscillation waveform lower limit voltage	V_{OSCL}		1.8	2	2.2	V
Oscillation waveform voltage difference between upper and lower limit	DV_{OSC}		2.2	2.4	2.6	V
CLM operation oscillation frequencyt (1)	$f_{OSC1\ VF}$	R_1=17kΩ, R_2=20kΩ, C_F=220pF, V_F=5V	185	200	215	kHz
CLM operation oscillation frequency (2)	$f_{OSC2\ VF}$	R_1=17kΩ, R_2=20kΩ, C_F=220pF, V_F=2V	110	124	141	kHz
CLM operation oscillation frequency (3)	$f_{OSC3\ VF}$	R_1=17kΩ, R_2=20kΩ, C_F=220pF, V_F=0.2V	20	25	32	kHz
Timer operation start V_F voltage	$V_{TH\ TIM}$		2.7	3	3.3	V
Pre-start circuit currentt (2) Note 1)	I_{CCL2}	V_{CC}=14.5V, –30˚C≦Ta≦85˚C	40	100	160	µA

Note 1) These are design reference values, not guaranteed values.

■ Electrical Characteristics (cont.) (Ta=25˚C)

Parameter	Symbol	Condition	min	typ	max	Unit
Timer charging current (2) Note 1)	$I_{CH2\ TIM}$	V_{CT}=3.3V, Ta=–5˚C	95	130	185	µA
Timer charging current (3) Note 1)	$I_{CH3\ TIM}$	V_{CT}=3.3V, Ta=85˚C	75	100	145	µA
CLM^- terminal threshold voltage (2) Note 1)	$V_{TH2\ CLM-}$	–30˚C ≦ Ta ≦ 85˚C	–215	–200	–185	mV
CLM^- terminal delay time Note 1)	$T_{PD\ CLM-}$		—	190	—	ns
CLM^+ terminal threshold voltage (2) Note 1)	$V_{TH2\ CLM+}$	–30˚C ≦ Ta ≦ 85˚C	185	200	215	mV
CLM^+ terminal delay time Note 1)	$T_{PD\ CLM+}$		—	190	—	ns
Oscillation frequency (2) Note 1)	f_{OSC2}	R_1=17kΩ, R_2=20kΩ, C_F=220pF, –30˚C ≦ Ta ≦ 85˚C	185	200	215	kHz
Oscillation frequency (3) Note 1)	f_{OSC3}	R_1=17kΩ, R_2=20kΩ, C_F=68pF, –30˚C ≦ Ta ≦ 85˚C	462	500	538	kHz
Duty ratio (2) Note 1)	G_{DUTY2}	R_1=17kΩ, R_2=20kΩ, C_F=220pF, –30˚C ≦ Ta ≦ 85˚C	46	49	52	%
Duty ratio (3) Note 1)	G_{DUTY3}	R_1=17kΩ, R_2=20kΩ, C_F=68pF, –30˚C ≦ Ta ≦ 85˚C	44	49	54	%
FB terminal voltage Note 1)	R_{FB}		—	500	—	Ω
T_{ON} terminal voltage Note 1)	V_{TON}	R_1=17kΩ	—	4.4	—	V
T_{OFF} terminal voltage Note 1)	V_{TOFF}	R_2=20kΩ	—	3.6	—	V
Output voltage rise time Note 1)	G_{rise}	Under no load	—	50	—	ns
Output voltage fall time Note 1)	G_{fall}	Under no load	—	40	—	ns

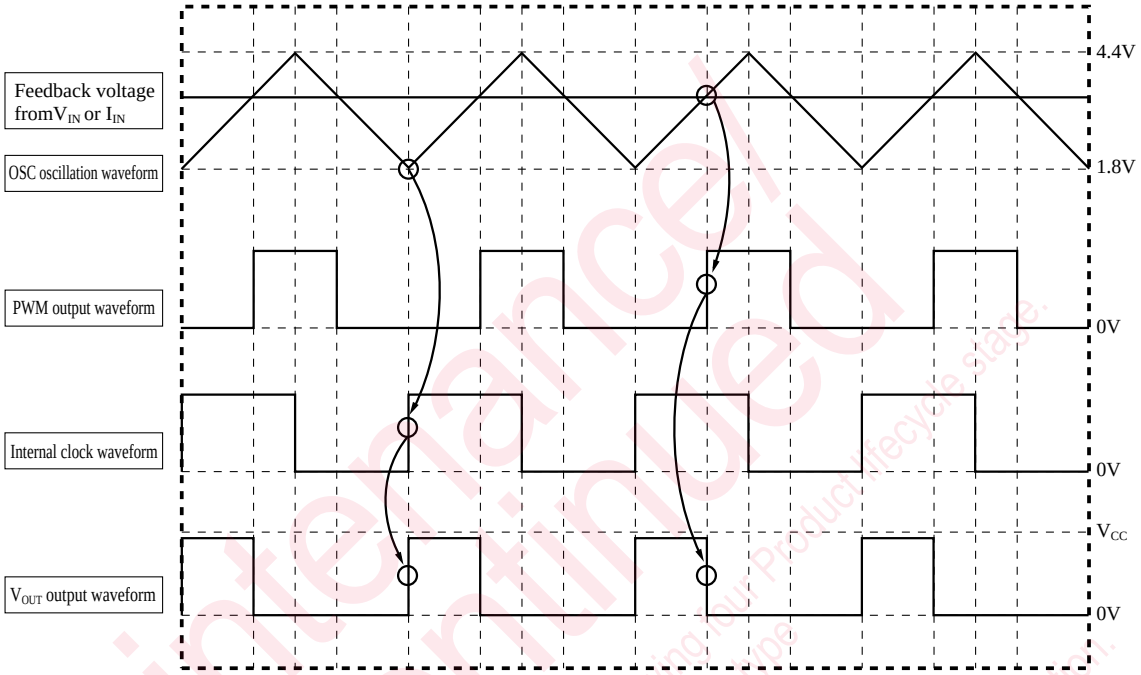
Note 1) These are design reference values, not guaranteed values.

■ Pin Descriptions

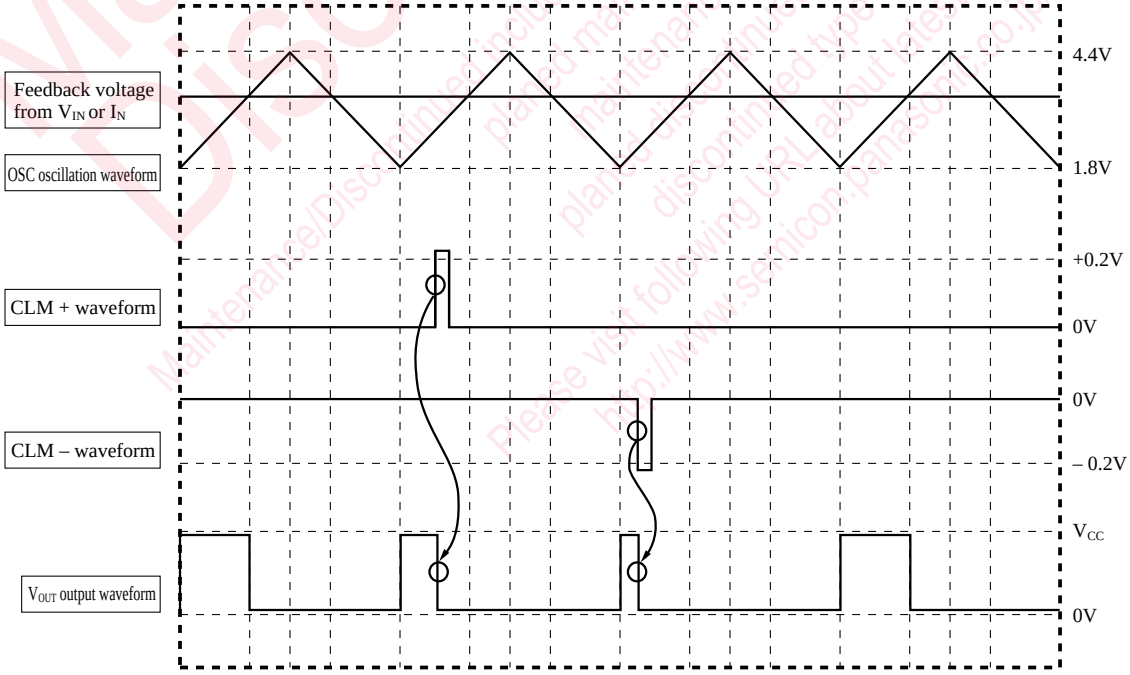
Pin No.		Symbol	Terminal description
DIL	SO		
1	1	V_C	Terminal applying the supply voltage to the output transistor.
2	2	V_{OUT}	Output terminal for IC. It drives the bipolar transistor.
3	3	$V_{OUT-COM}$	Ground terminal for the output transistor.
4	4	V_F	It detects the average level of output pulse and performs the timer control and duty control for the output.
5	7	ON/OFF	IC turning ON/OFF terminal. “H” to stop the IC (output “L”). “L” to operate the IC
6	8	OVP	It detects the overvoltage to stop the IC. The stop condition is kept. It can be released by the external signal.
7	9	N.C.	
8	10	F/B	Terminal for current-feedback of power supply output.
9	11	T_{ON}	Terminal for connecting the resistor which determines the inclination of internally oscillated triangular wave during the charging period .
10	12	C_F	Terminal for connecting the capacitor which determines the frequency of internally oscillated triangular wave.
11	13	T_{OFF}	Terminal for connecting the resistor which determines the inclination of internally oscillated triangular wave during the discharging period.
12	14	C_T	Terminal for connecting the capacitor which determines the frequency of timer control.
13	17	GND	Ground terminal for the signal system.
14	18	CLM^-	Overcurrent detection terminal for the negative potential side.
15	19	CLM^+	Overcurrent detection terminal for the positive potential side.
16	20	V_{CC}	Terminal applying the supply voltage. It detects the start voltage and stop one.
—	5	FIN (GND)	Terminal which is directly connected with the IC chip. It has double function as radiator and ground terminal.
—	6	FIN (GND)	Terminal which is directly connected with the IC chip. It has double function as radiator and ground terminal.
—	15	FIN (GND)	Terminal which is directly connected with the IC chip. It has double function as radiator and ground terminal.
—	16	FIN (GND)	Terminal which is directly connected with the IC chip. It has double function as radiator and ground terminal.

■ Timing Chart

• Under normal operation

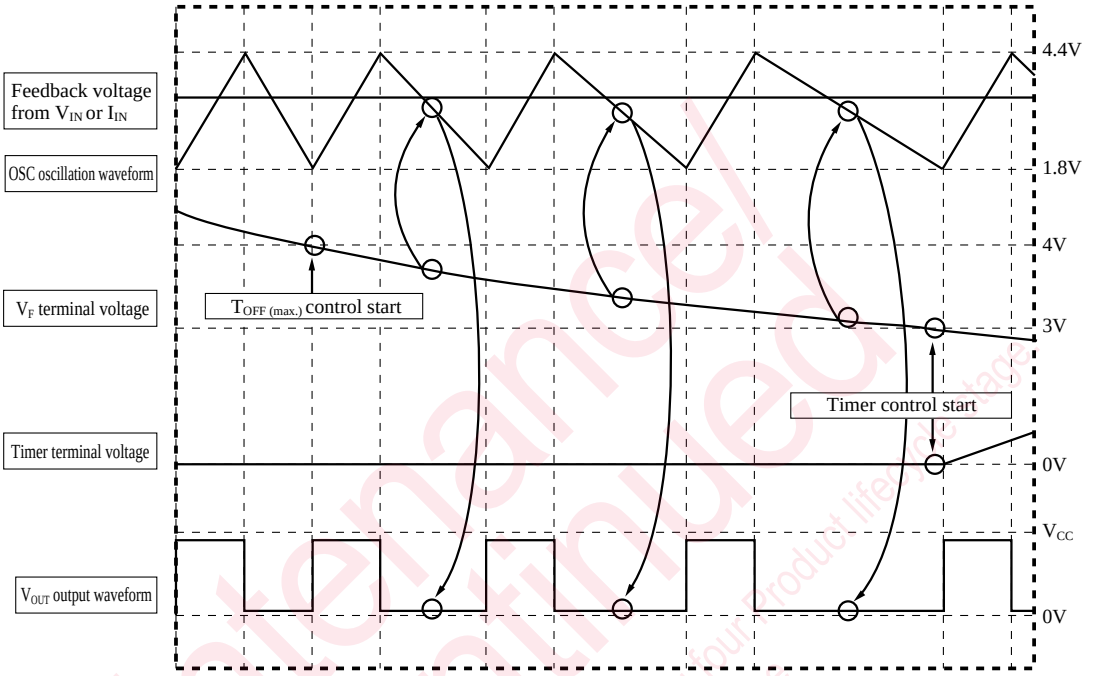


• Under current-limited operation Note 1)

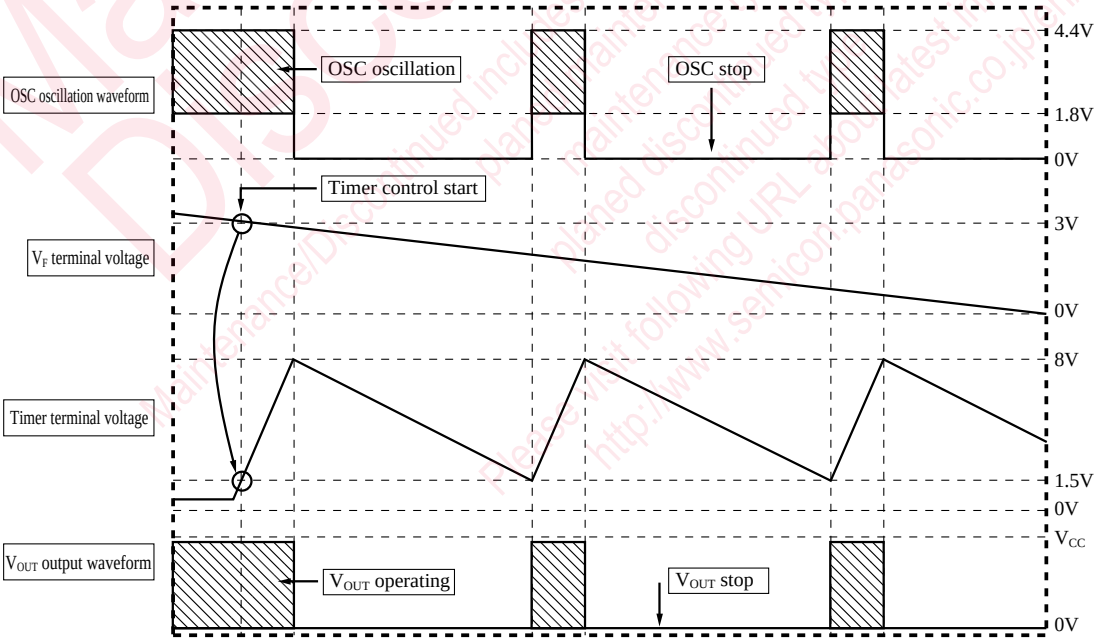


Note 1) V_F terminal voltage < $T_{OFF\ (max.)}$ control voltage (< 4V)

• Under $T_{OFF\ (max.)}$ Control Operation Note 2)



• Under Timer-Controlled Operation Note 3)



Note 2) The $T_{OFF\ (max.)}$ control and timer control work under current-limited operation (CLM+ ≧ 0.2V, CLM– ≦ – 0.2V)
Note 3) Even under the timer-controlled operation, the OFFtime of OSC (V_{OUT}) is controlled by the $T_{OFF\ (max.)}$ control.

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