



SANYO Semiconductors

DATA SHEET

An ON Semiconductor Company

ExPD (Excellent-Performance Power & RF Device)

TN5D01A — Separately-Excited Step-Down Switching Regulator (Variable Output Type)

Features

- High efficiency (ON resistance 100mΩ, Vertical-type P-ch Power MOSFET).
- Over current protection function (Self recovery type).
- Under voltage protection function.
- Over temperature protection function (Self recovery type).
- Soft start function (Variable subject to externally-connected capacitor).
- Stand-by mode function (Compatible with soft start terminal).

Specifications

Absolute Maximum Ratings at Ta=25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum Input Voltage	V _{IN} max		57	V
Maximum Output Current	I _O max		5	A
Drain-to-Source Voltage of built-in MOSFET	V _{DSS}		-60	V
Drain Current of built-in MOSFET (DC)	I _D		-9	A
Drain Current of built-in MOSFET (Pulse)	I _{DP}	PW≤10μs, duty cycle≤1%	-36	A
FB Pin Maximum Input Voltage	V _{fb}		5	V
SS Pin Maximum Input Voltage	V _{SS}		7	V
Allowable Power Dissipation	P _D		2.0	W
		T _c =25°C	15	W
Operating Temperature	T _{opr}		-25 to +125	°C
Junction Temperature	T _j		150	°C
Storage Temperature	T _{stg}		-55 to +150	°C

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TN5D01A

Recommended Operating Conditions

Parameter	Symbol	Conditions	Ratings	Unit
Input Voltage	V_{IN}	$T_a=25^{\circ}\text{C}$	10 to 30	V
Output Voltage	V_{OUT}	$T_a=25^{\circ}\text{C}$, $V_{OUT} / V_{IN} \geq 0.1$	2.7 to 4.9	V
Output Current	I_{OUT}	$T_a=25^{\circ}\text{C}$	0 to 5	A
Operating Temperature Range	Topr rec		-10 to + 85	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$, See Specified Test Circuit ($V_{OUT}=3.3\text{V}$)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Reference Voltage	V_{FB}	$V_{IN}=20\text{V}$, $I_{OUT}=3\text{A}$	1.12	1.15	1.18	V
Efficiency	η	$V_{IN}=20\text{V}$, $I_{OUT}=3\text{A}$		82		%
Drain-to-Source Breakdown Voltage of built-in MOSFET	$V_{(BR)DSS}$	$I_D=-1\text{mA}$, V_{IN} , GND, V_{fb} , $V_{SS}=0\text{V}$	-60			V
Drain-to-Source On Resistance of built-in MOSFET	$R_{DS(on)}$	$I_{SW}=5\text{A}$		100		$\text{m}\Omega$
Switching Frequency	Freq	$V_{IN}=20\text{V}$, $I_{OUT}=3\text{A}$	120	150	180	kHz
Maximum Duty	Duty max	$V_{IN}=20\text{V}$, $V_{fb}=0\text{V}$	88	92	96	%
Line Regulation	ΔV_{line}	$V_{IN}=10$ to 30V, $I_{OUT}=3\text{A}$		30	60	mV
Load Regulation	ΔV_{load}	$V_{IN}=20\text{V}$, $I_{OUT}=0.5$ to 5A		35	60	mV
Output Voltage Temperature Coefficient *1	$\Delta V_O/\Delta T_a$	$V_{IN}=20\text{V}$, $I_{OUT}=3\text{A}$, $T_a=-25$ to 125°C		± 0.33		$\text{mV} / ^{\circ}\text{C}$
Over-Current-Protection-Operation -Threshold Current	I_{ocp}	$V_{IN}=20\text{V}$	5.1	7.5	10	A
Under-Voltage-Protection-Operation -Threshold Voltage	$V_{uvlo\ on}$		7.2	8.0	8.8	V
Under-Voltage-Protection-Operation -Release Voltage	$V_{uvlo\ off}$		8.1	9.0	9.9	V
Under-Voltage-Protection Hysteresis Voltage	$V_{uvlo\ hys}$			1.0		V
Over-Temperature-Protection-Operation -Threshold-Temperature *1	$T_{tsd\ on}$			165		$^{\circ}\text{C}$
Over-Temperature-Protection-Operation -Release Temperature *1	$T_{tsd\ off}$			140		$^{\circ}\text{C}$
Over-Temperature-Protection-Operation -Hysteresis Temperature *1	$T_{tsd\ hys}$			25		$^{\circ}\text{C}$
SS Terminal Current	I_{SS}	$V_{IN}=20\text{V}$		10		μA
Standby Operating Voltage	$V_{stb\ on}$	$V_{IN}=20\text{V}$		0.3		V
Standby Current	I_{stb}	$V_{IN}=20\text{V}$, $V_{SS}=0\text{V}$			500	μA

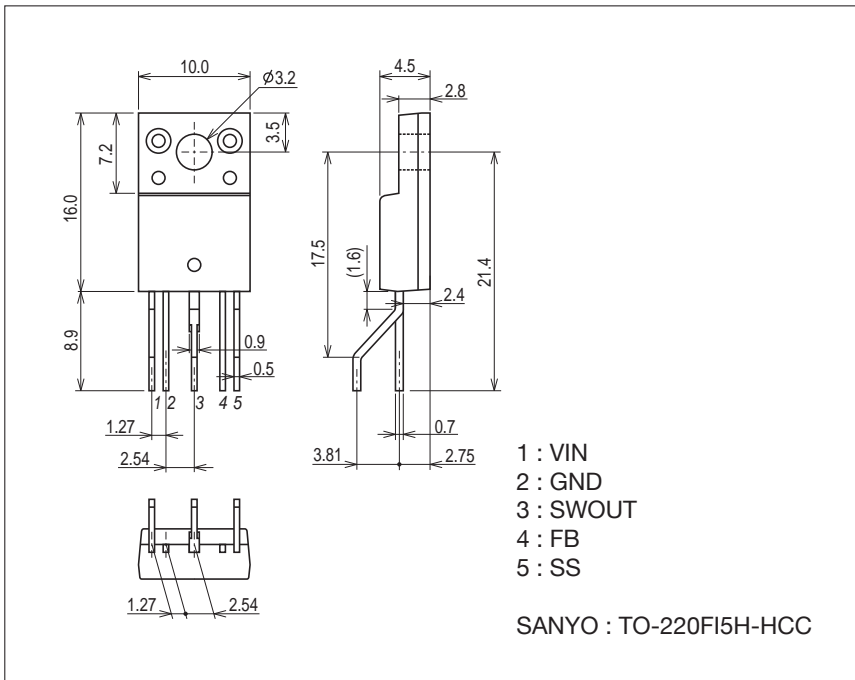
Note: the values with “*1” are our targeted values, but not guaranteed.

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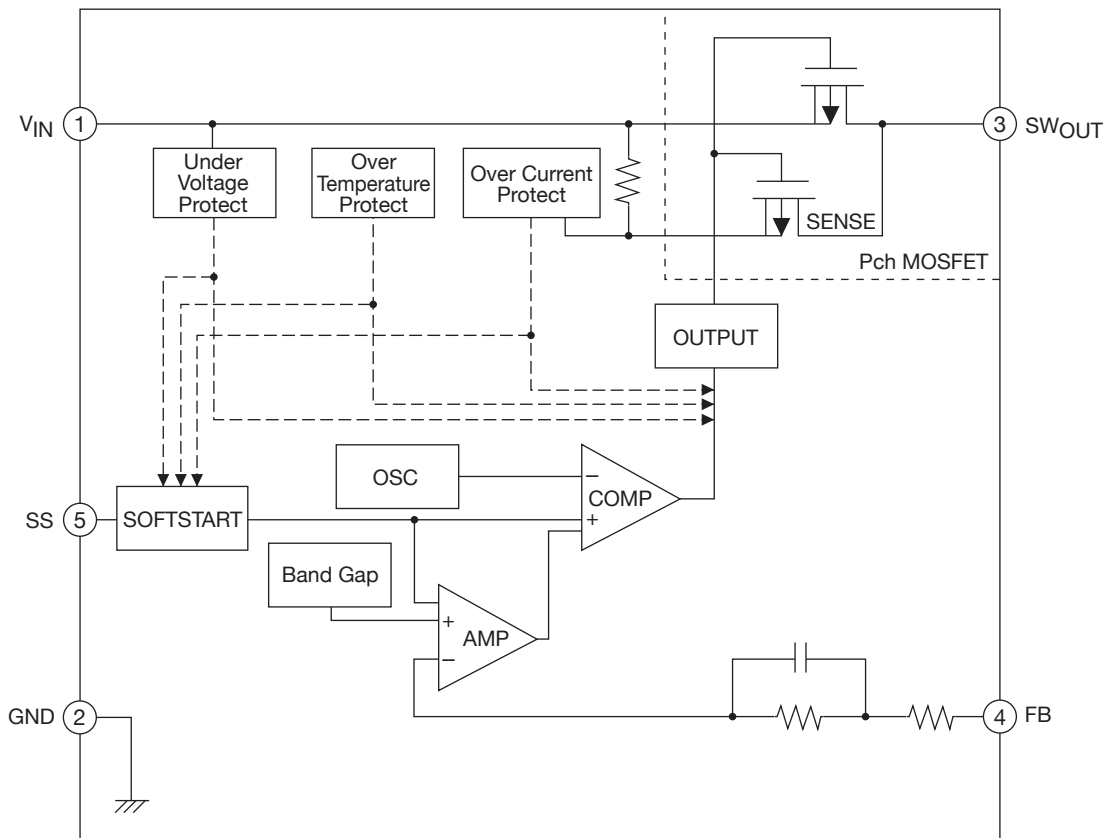
Package Dimensions

unit : mm (typ)

7531-001



Block Diagram

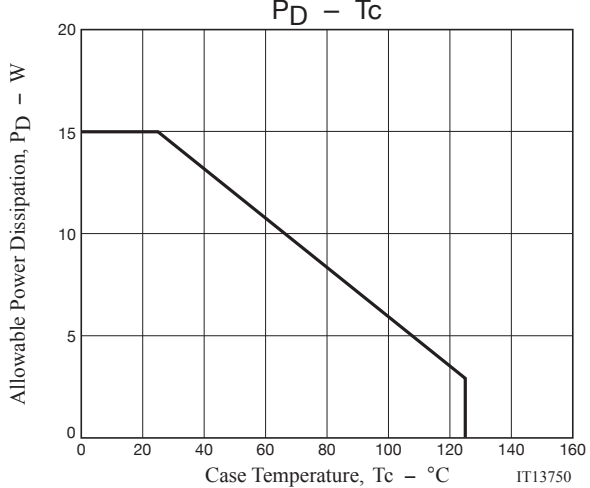
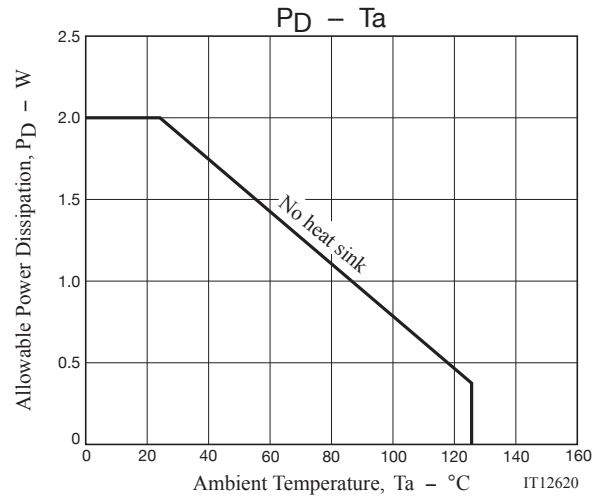
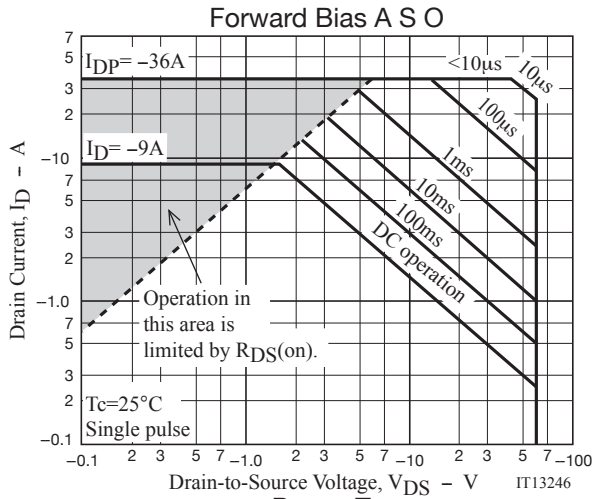
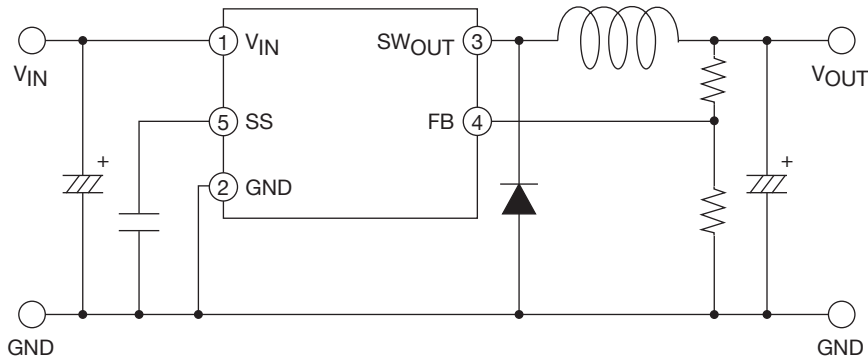


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Pin Functions

Pin No.	Symbol	Function
1	V _{IN}	Power Supply Input (Maximum 57V)
2	GND	GND
3	SW _{OUT}	Pulse Voltage Output
4	FB	Feedback from Output Voltage
5	SS	For Soft Start Capacitor Connection and Standby Mode Switching

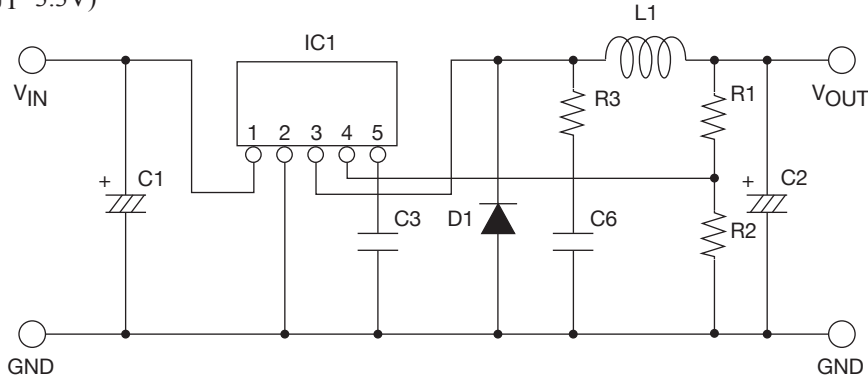
Application Circuit Example



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Specified Circuit for Electrical Characteristics

[Circuit] ($V_{OUT}=3.3V$)



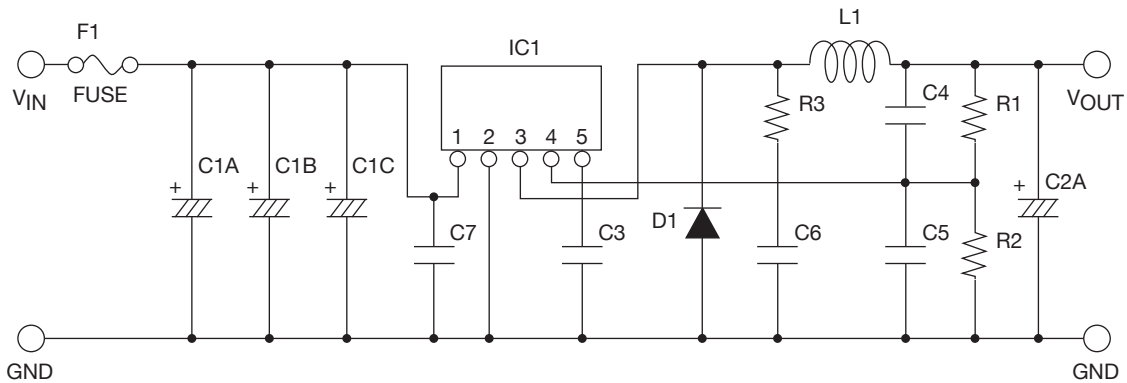
[Components] ($V_{OUT}=3.3V$)

Symbol	Component	Specification
C1	Electrolytic Capacitor	3000 to 3600 μ F
C2	Electrolytic Capacitor	2000 to 2200 μ F
C3	Capacitor	0.1 μ F
C6	Ceramic Capacitor	1000pF
R1	Carbon Resistor	1.8k Ω /1/2W
R2	Carbon Resistor	1k Ω /1/2W
R3	Metal Oxide Film Resistor	47 Ω /2W
L1	Choke Coil	100 μ H
D1	Schottky Barrier Diode	SBT250-06J

* When measuring ripple noise voltage, put 47 μ F (electrolytic capacitor) and 0.1 μ F (ceramic or film capacitor) into measuring point.

Evaluation Board

[Circuit] ($V_{OUT}=3.3V$)

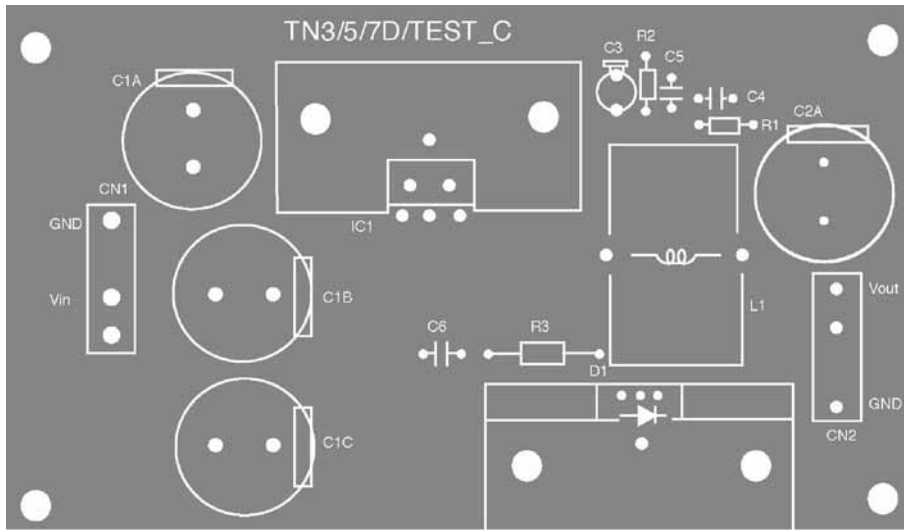


[Components]

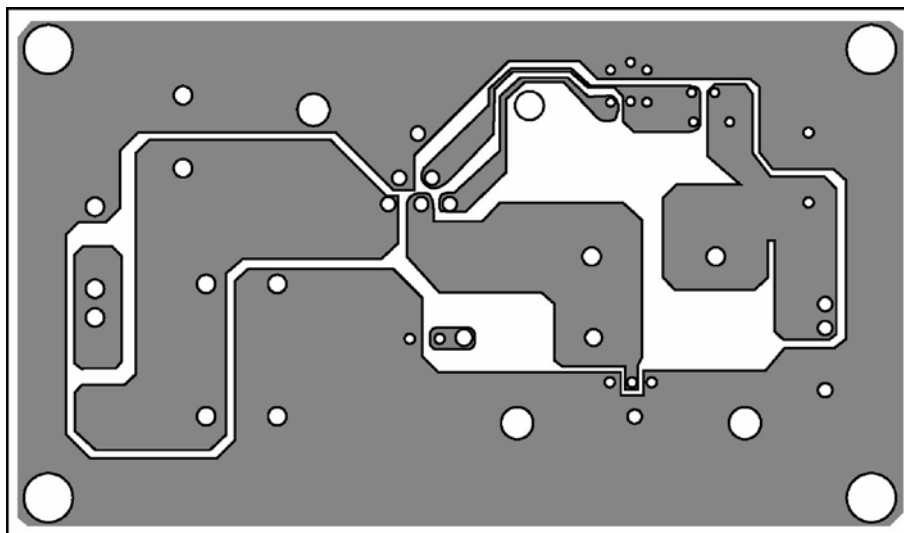
Symbol	Component	Specification	Maker	Remark
F1	Fuse	4A	Littelfuse	452 004
C1A	Electrolytic Capacitor	1200 μ F/80V	Nippon Chemi-Con Corp.	KZE
C1B	Electrolytic Capacitor	1200 μ F/80V	Nippon Chemi-Con Corp.	KZE
C1C	Electrolytic Capacitor	1200 μ F/80V	Nippon Chemi-Con Corp.	KZE
C2A	Electrolytic Capacitor	2200 μ F/80V	SANYO Electronic Co., Ltd.	MV
C3	Film Capacitor	0.1 μ F/100V	Matsushita Electronic Components Corp.	ECQ-B
C4	N.C.			
C5	N.C.			
C6	Ceramic Capacitor	1000pF	Murata Manufacturing Co., Ltd.	
C7	Ceramic Capacitor	47000pF	Murata Manufacturing Co., Ltd.	
R1	Carbon Resistor	1.8k Ω /1/2W	Matsushita Electronic Components Corp.	
R2	Carbon Resistor	1k Ω /1/2W	Matsushita Electronic Components Corp.	
R3	Metal Oxide Film Resistor	22 Ω /2W	Matsushita Electronic Components Corp.	
L1	Choke Coil	HK-10S100-1010	TOHO ZINC CO.,LTD.	100 μ H
D1	Schottky Barrier Diode	SBT250-06J	SANYO Semiconductor Co., Ltd.	

Recommended PCB Pattern

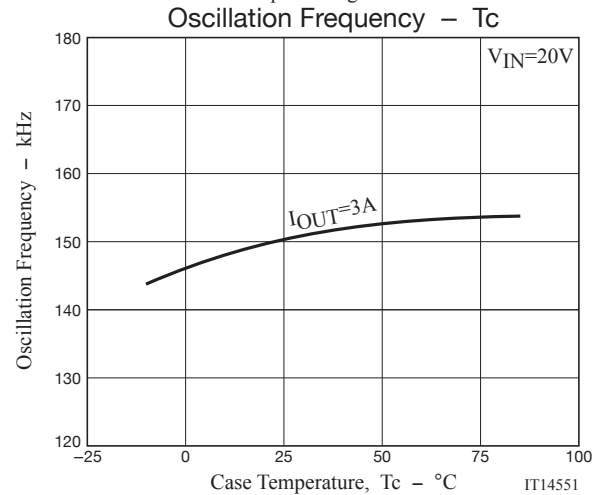
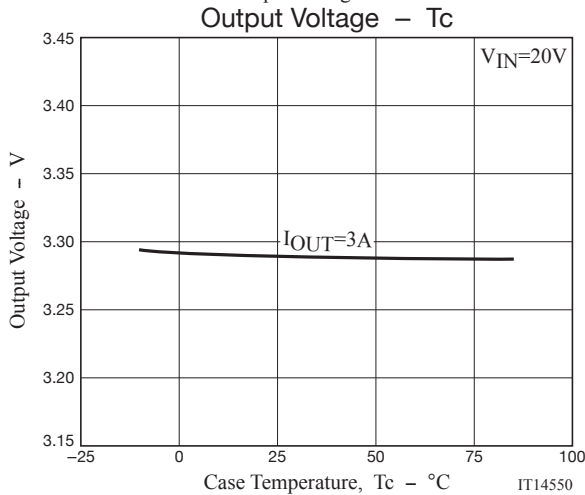
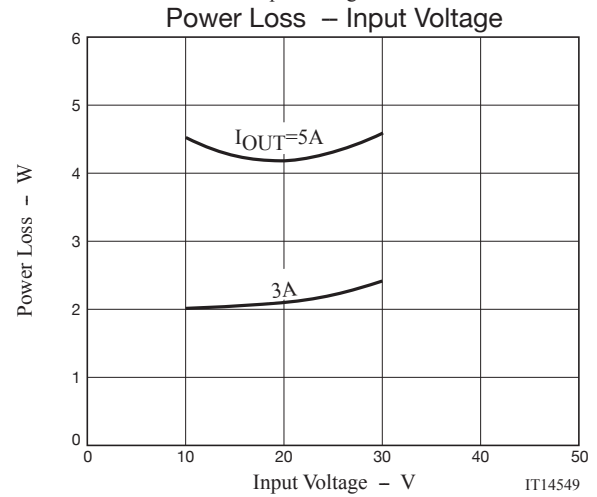
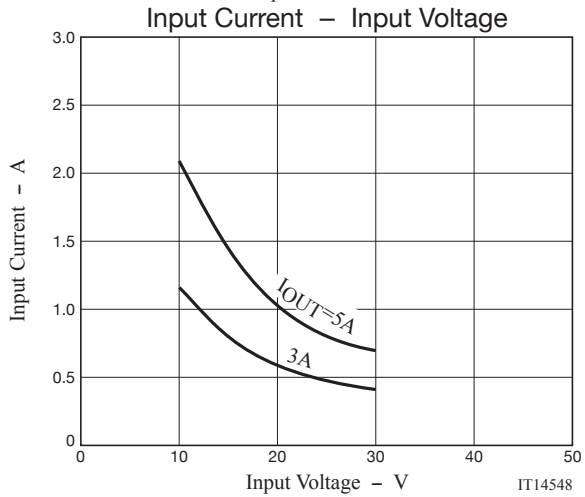
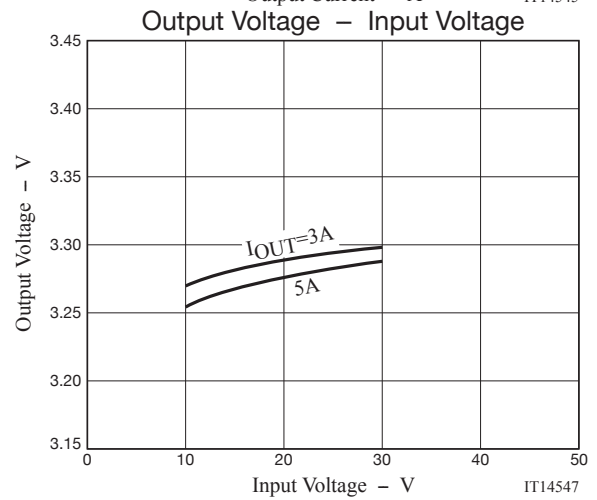
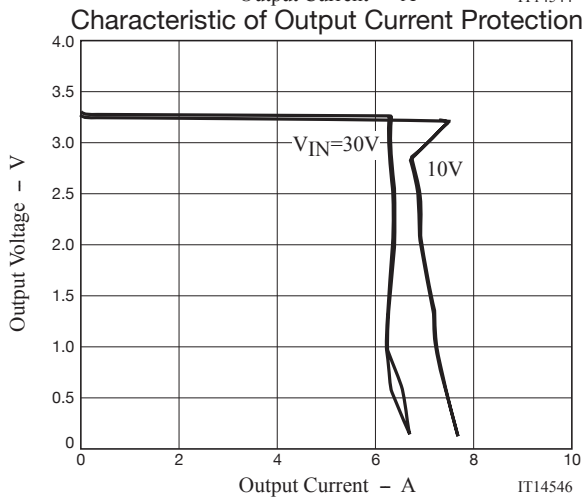
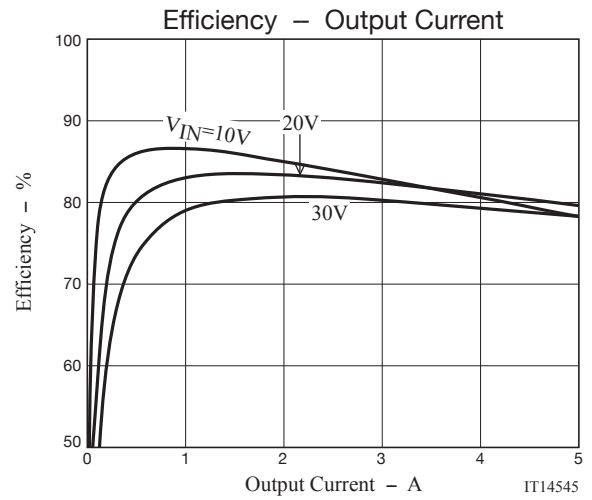
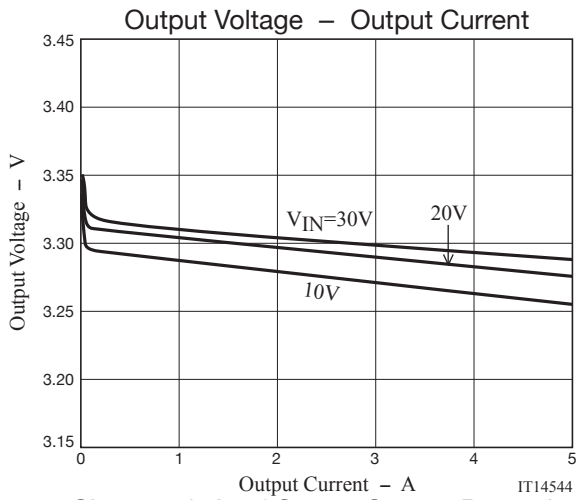
Silk Printing (Top View)



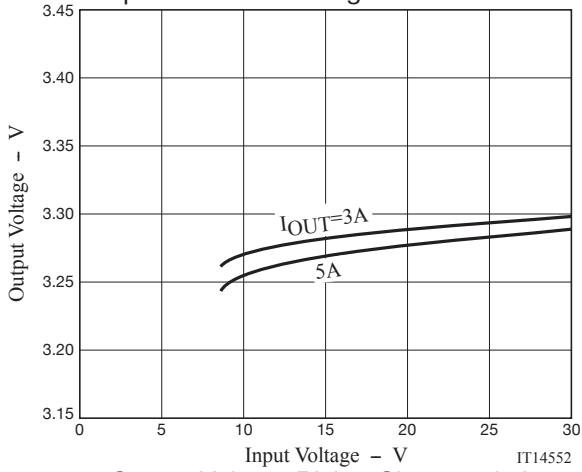
Pattern (Perspective View)



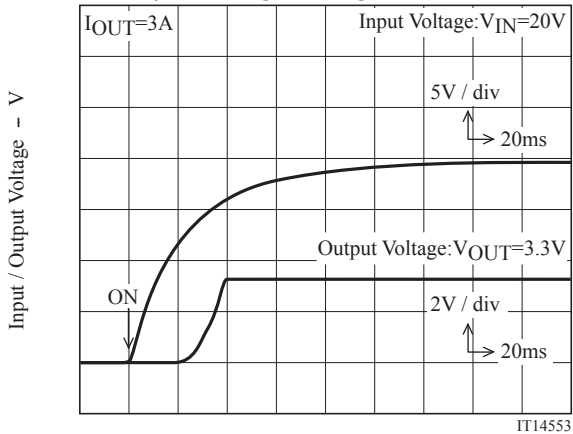
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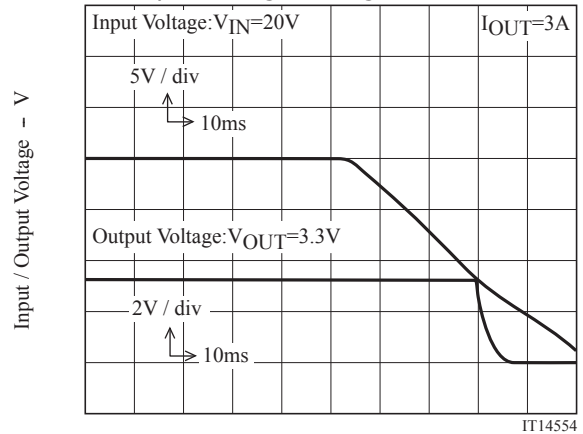
Input Reduced-Voltage Characteristic



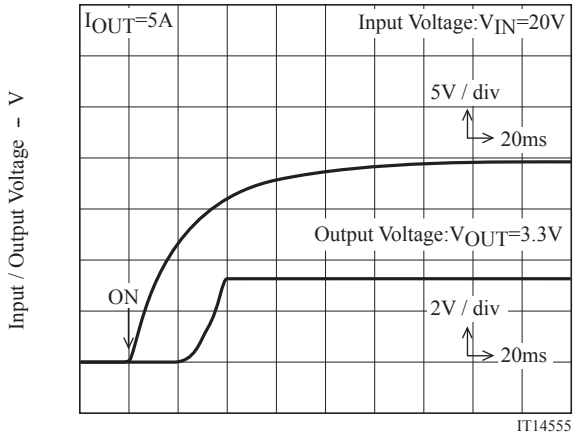
Output Voltage Rising Characteristic



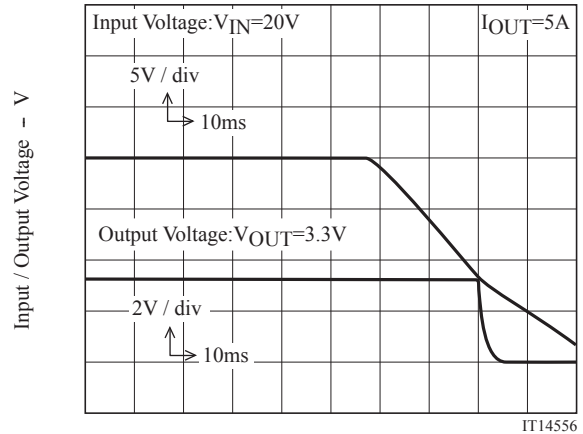
Output Voltage Falling Characteristic



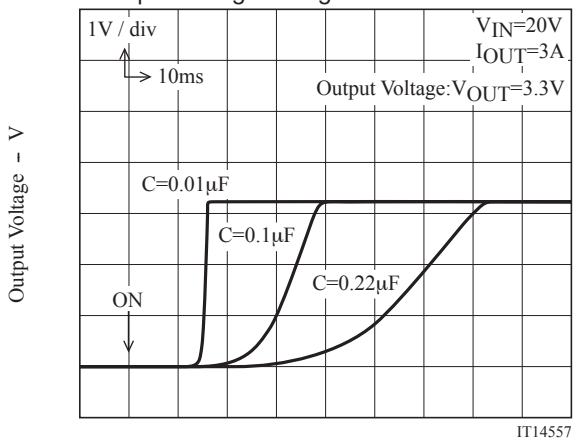
Output Voltage Rising Characteristic



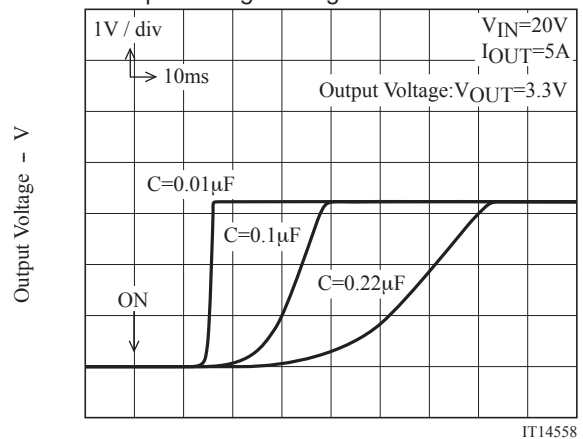
Output Voltage Falling Characteristic



Capacitance of Soft Start Capacitor - Output Voltage Rising Characteristic



Capacitance of Soft Start Capacitor - Output Voltage Rising Characteristic



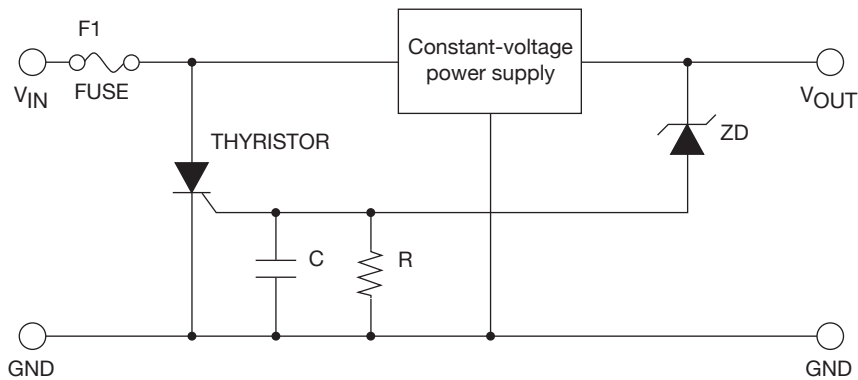
Example of Over-voltage Protection Circuit.

Generally, in constant-voltage power supply circuit, output voltage will become higher than the specified value (over-voltage state) in case of any failures or PC board solderability defects. To minimize the damage caused by this over-voltage, we recommend setting an over-voltage protection circuit.

In designing, the following confirmations are necessary in actual circuit.

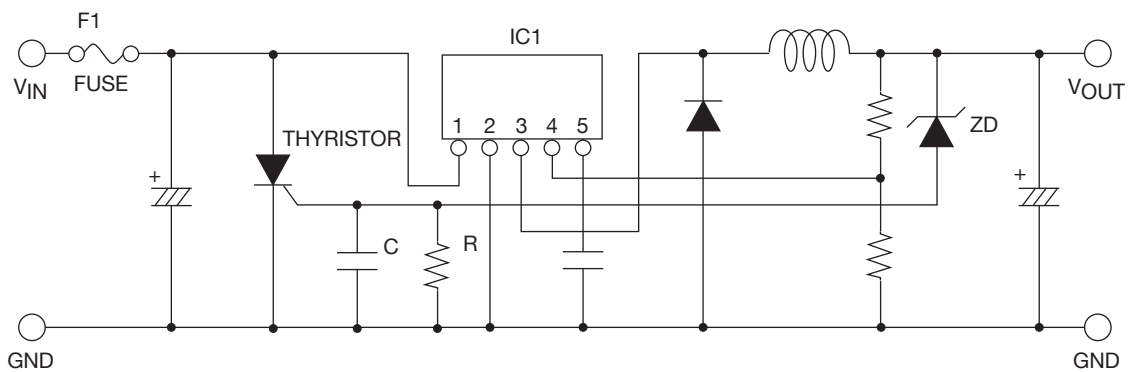
- 1) How the over-voltage protection circuit operates and its effects.
- 2) Is there any malfunction due to ambient temperature change of each device or exogenous noises?

Over-voltage Protection Circuit Example



Example of Over-voltage Protection Circuit.

The thyristor will operate when it accept an over-voltage (V_{OUT}) signal, then the fuse is melted and the input power is cut off, then the operation of IC1 is stopped.

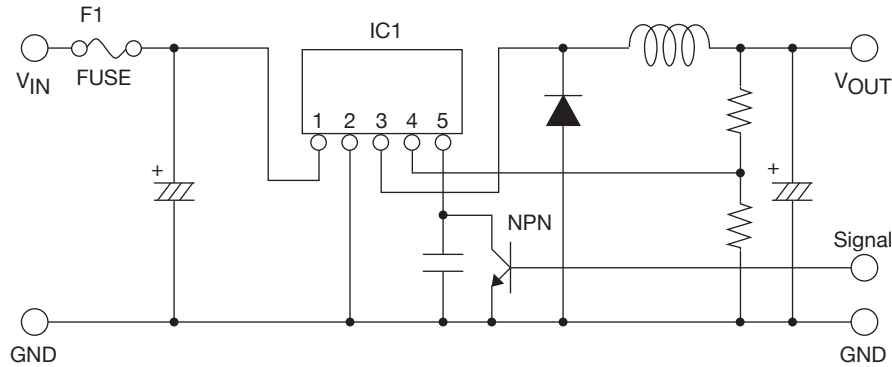


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SS terminal (5 pin) also acts as standby mode switch. By setting SS terminal (5 pin) voltage to be equal or less than $0.3V_{typ}$, the output ON/OFF is able to be controlled by external signals.

ON/OFF Control Circuit Example



In addition, confirmation of the following points is necessary in actual circuit.

- 1) How the output ON/OFF control operates and its effects.
- 2) Is there any malfunction due to the ambient temperature change of each device or exogenous noises?

Points to Remember in Pattern Designing

- 1) Transient large current flows to V_{IN} terminal (1 pin), so we recommend the input capacitor should be $3000\mu F$ and above. In addition, (+) (-) terminals of the input capacitor should be set near to V_{IN} terminal (1 pin) and GND terminal (2 pin).
 - 2) Large current flows to C1A to C, V_{IN} terminal (1 pin) of IC1, SWOUT terminal (3 pin), D1, L1, and C2A. So, the wiring should be thick and short.
 - 3) FB terminal (4 pin) of IC1 is the feedback terminal from output voltage. It should be near to the output capacitor C2A.
- For the purpose of ensuring the stability of oscillation, a capacitor should be inserted between SS terminal (5 pin) and GND terminal (2 pin).
 - The absolute maximum rated voltage of SS terminal (5 pin) is 7V. The absolute maximum rated voltage of FB terminal (4 pin) is within the range of 5 to 30V according to the output voltage type. When a voltage equal or higher than the rated value is applied to SS terminal (5 pin) or FB terminal (4 pin) in some cases such a abnormal test, protection measures like inserting fuses should be taken.
 - The built-in over-heat protection is a function to prevent the circuit from overheat state caused by transient temperature rise, but not a function to prevent from abnormal caused by a sudden heat generation. In addition, the reliability of over-heat protection function is not guarantee.

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