THE DATASHEET OF

TN5D61A-HB11-E

Ordering number : ENA1240

SANYO Semiconductors

DATA SHEET

An ON Semiconductor Company

ExPD (Excellent-Performance Power & RF Device)

TN5D61A — Separately-Excited Step-Down Switching Regulator (24V 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}		30	V
SS Pin Maximum Input Voltage	V_{SS}		7	V
Allowable Power Dissipation	P_D		2.0	W
		Tc=25°C	15	W
Operating Temperature	Topr		−25 to +125	°C
Junction Temperature	Tj		150	°C
Storage Temperature	Tstg		−55 to +150	°C

Recommend Operating Conditions

Parameter	Symbol	Conditions	Ratings	Unit
Input Voltage	V_{IN}	Ta=25°C	30 to 48	V
Output Current	I_{OUT}	Ta=25°C	0 to 5	A
Operating Temperature Range	Topr rec		−10 to +85	°C

Electrical Characteristics at Ta=25°C, See Specified Test Circuit

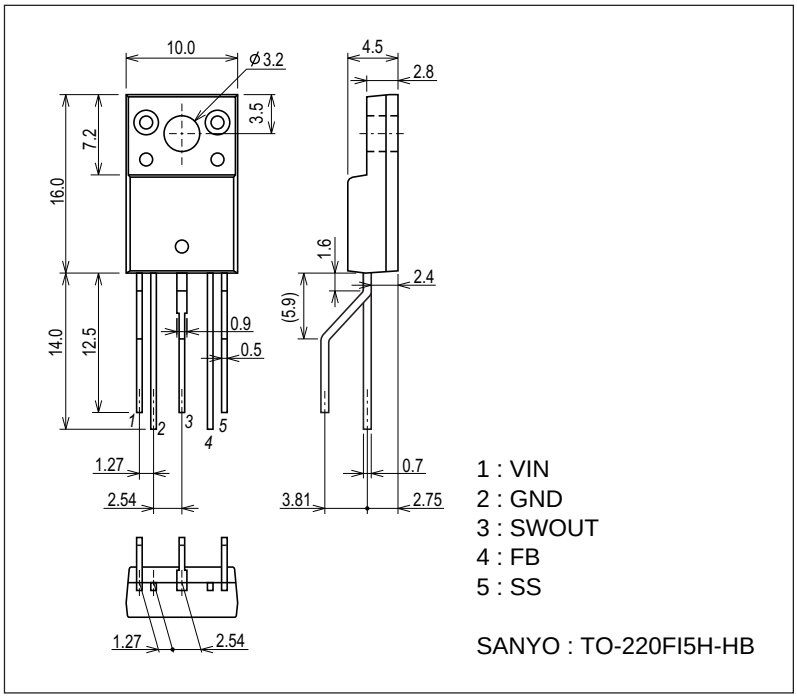
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output Voltage	V_{OUT}	V_{IN}=40V, I_{OUT}=3A	23.3	24.0	24.7	V
Efficiency	η	V_{IN}=40V, I_{OUT}=3A		94		%
Drain-to-Source Breakdown Voltage of built-in MOSFET	$V_{(BR)DSS}$	I_D=−1mA, V_{IN}, GND, V_{fb}, V_{SS}=0V	−60			V
Drain-to-Source On Resistance of built-in MOSFET	R_{DS}(on)	I_{SW}=5A		100		mΩ
Switching Frequency	Freq	V_{IN}=40V, I_{OUT}=3A	120	150	180	kHz
Maximum Duty	Duty max	V_{IN}=40V, V_{fb}=0V	88	92	96	%
Line Regulation	ΔVline	V_{IN}=30 to 48V, I_{OUT}=3A		260	400	mV
Load Regulation	ΔVload	V_{IN}=40V, I_{OUT}=0.5 to 5A		140	200	mV
Output Voltage Temperature Coefficient *1	ΔV_O / ΔTa	V_{IN}=40V, I_{OUT}=3A, Ta= −25 to +125°C		±2.4		mV / °C
Over-Current-Protection-Operation -Threshold Current	I_{ocp}	V_{IN}=40V	5.1	7.5	10	A
Under-Voltage-Protection-Operation -Threshold Voltage	Vuvlo on		7.2	8.0	8.8	V
Under-Voltage-Protection-Operation -Release Voltage	Vuvlo off		8.1	9.0	9.9	V
Under-Voltage-Protection Hysteresis Voltage	Vuvlo hys			1.0		V
Over-Temperature-Protection-Operation -Threshold-Current *1	Ttsd on			165		°C
Over-Temperature-Protection-Operation -Release Temperature *1	Ttsd off			140		°C
Over-Temperature-Protection -Hysteresis Temperature *1	Ttsd hys			25		°C
SS Terminal Current	I_{SS}	V_{IN}=40V		10		μA
Standby Operating Voltage	Vstb on	V_{IN}=40V		0.3		V
Standby Current	Istb	V_{IN}=40V, V_{SS}=0V			500	μA

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

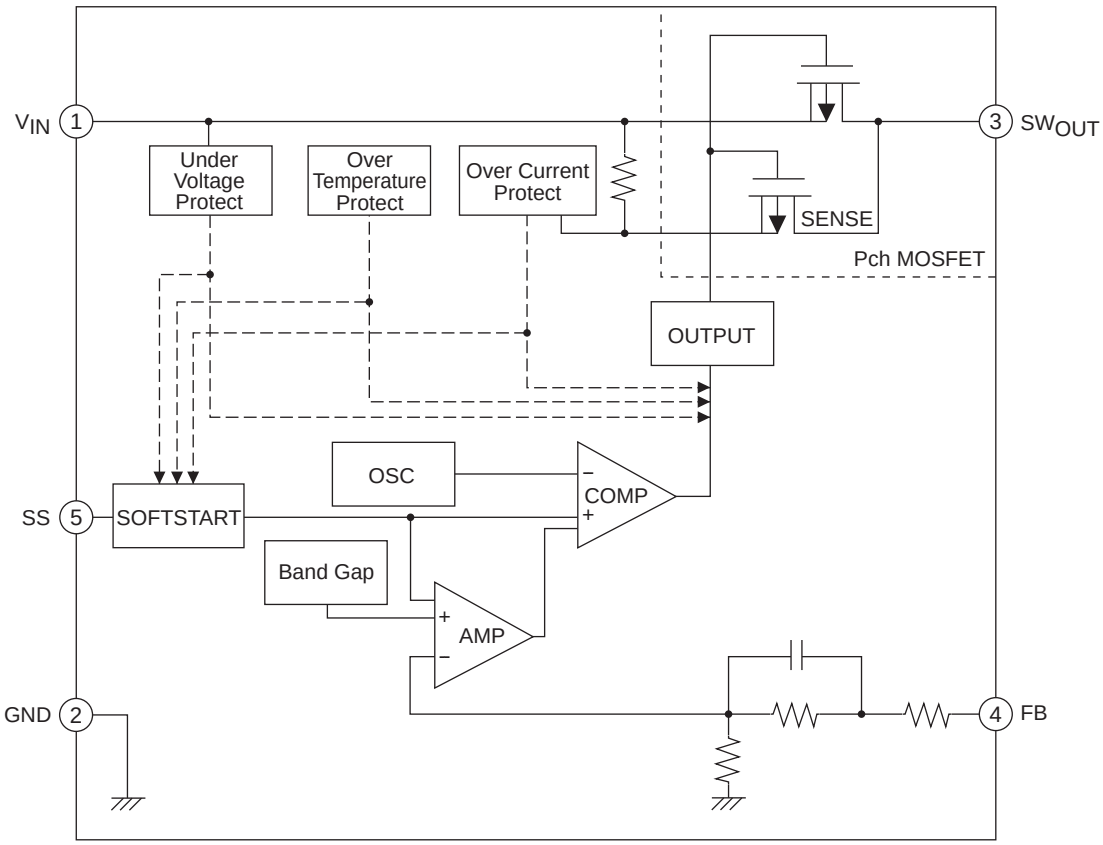
Package Dimensions

unit : mm (typ)

7527-001



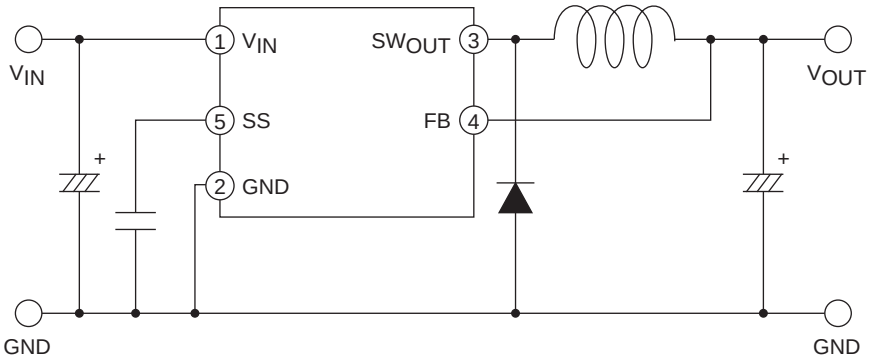
Block Diagram

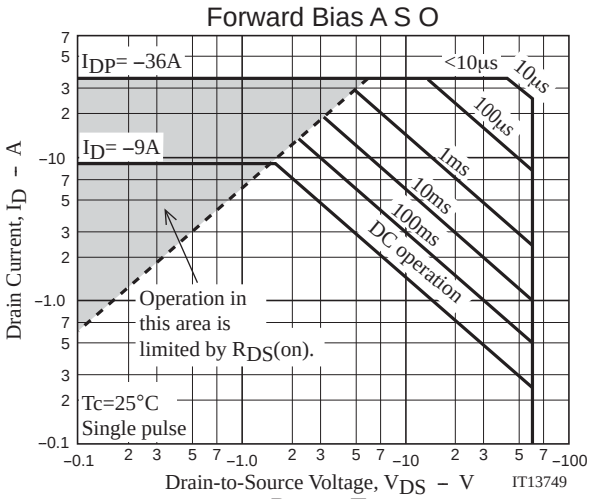


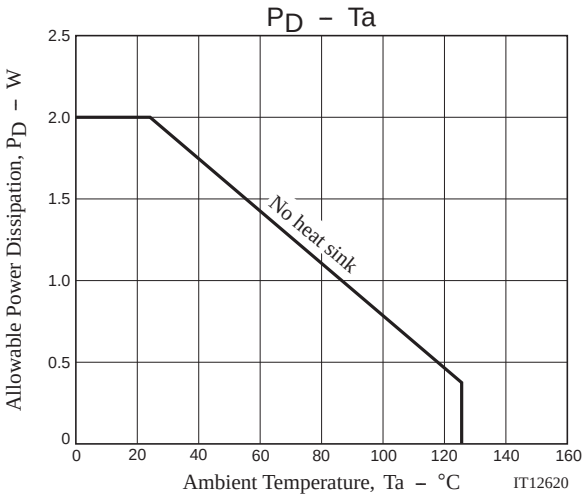
Pin Functions

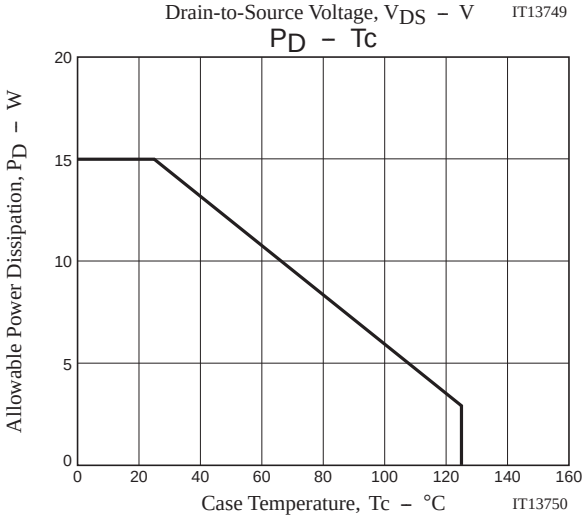
Pin No.	Symbol	Function
1	V_{IN}	Power Supply Input (Maximum 57V)
2	GND	GND
3	SW_{OUT}	Pulse Voltage Output
4	FB	Feedback from Output Voltage
5	SS	For Soft Start Capacitor Connection and Standby Mode Switching

Application Circuit Example



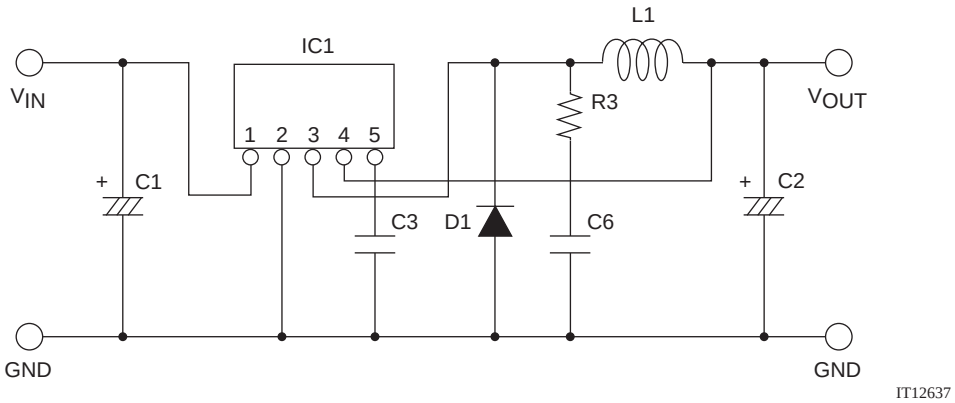






Specified Circuit for Electrical Characteristics

[Circuit]



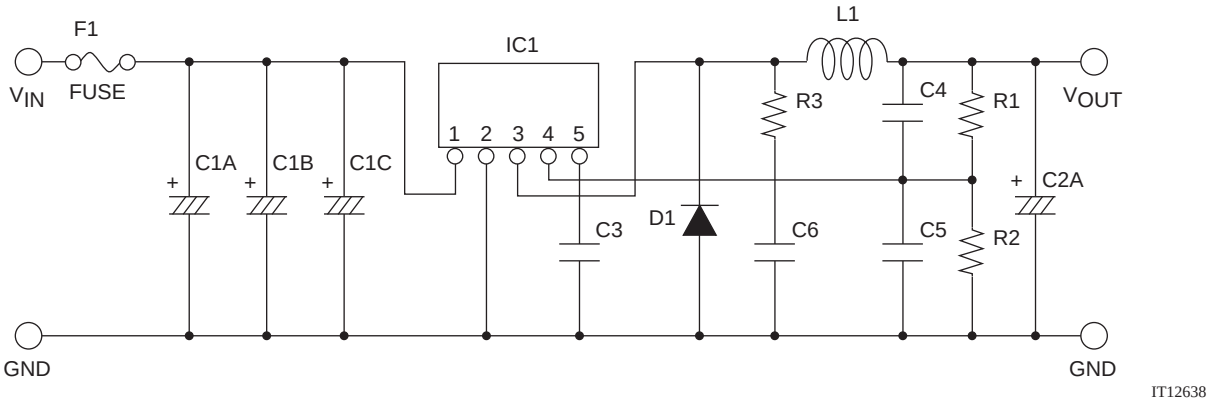
[Components]

Symbol	Component	Specification
C1	Electrolytic Capacitor	3000 to 3600μF
C2	Electrolytic Capacitor	2000 to 2200μF
C3	Capacitor	0.1μF
C6	Ceramic Capacitor	1000pF
R3	Metal Oxide Film Resistor	47Ω / 2W
L1	Choke Coil	100μH
D1	Schottky Barrier Diode	SBT250-06J

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

Evaluation Board

[Circuit]

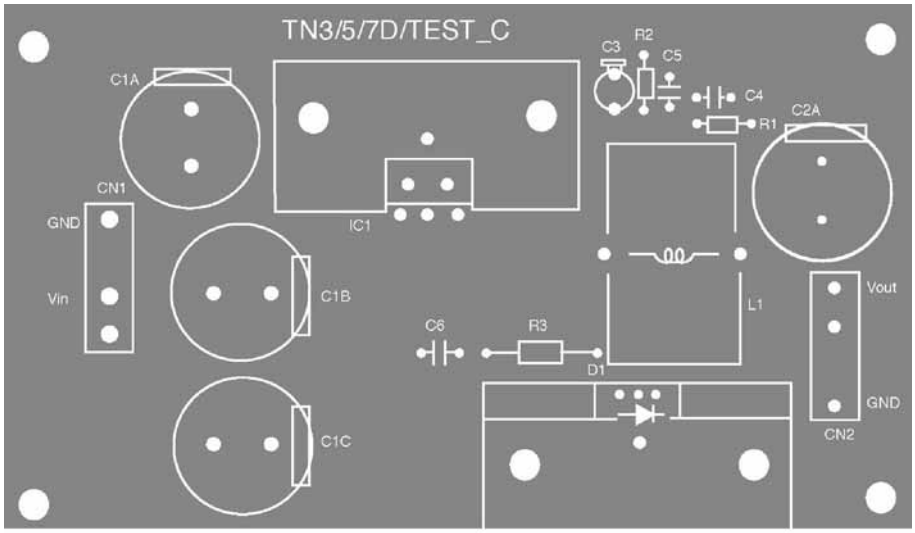


[Components]

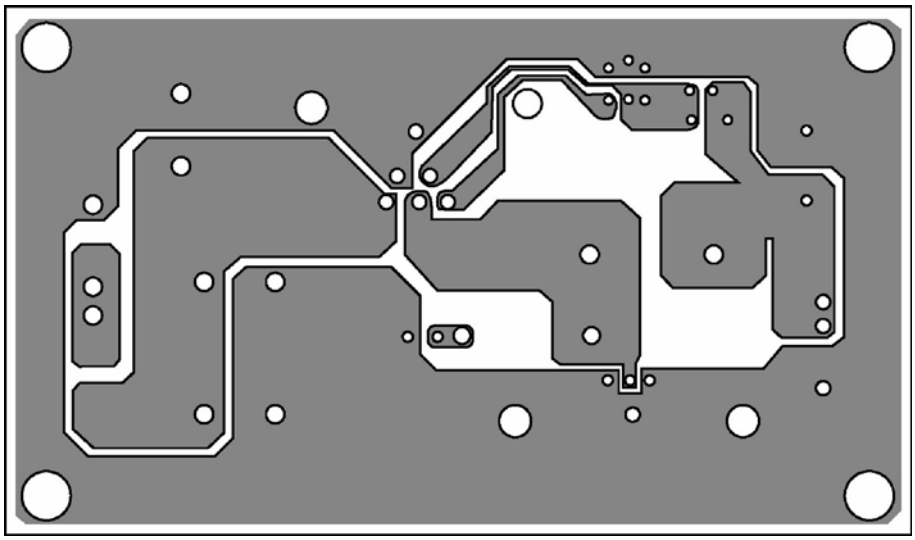
Symbol	Component	Specification	Maker	Remark
F1	Fuse	4A	Littelfuse	452 004
C1A	Electrolytic Capacitor	1200μF / 80V	Nippon Chemi-Con Corp.	KZE
C1B	Electrolytic Capacitor	1200μF / 80V	Nippon Chemi-Con Corp.	KZE
C1C	Electrolytic Capacitor	1200μF / 80V	Nippon Chemi-Con Corp.	KZE
C2A	Electrolytic Capacitor	2200μF / 35V	SANYO Electronic Co., Ltd.	MV
C3	Film Capacitor	0.1μF / 100V	Matsushita Electronic Components Corp.	ECQ-B
C4	N.C.			
C5	N.C.			
C6	Ceramic Capacitor	1000pF	Murata Manufacturing Co., Ltd.	
R1	Jumper Line			
R2	N.C.			
R3	Metal Oxide Film Resistor	47Ω / 2W	Matsushita Electronic Components Corp.	
L1	Choke Coil	HK-10S100-1010	TOHO ZINC CO.,LTD.	100μH
D1	Schottky Barrier Diode	SBT250-06J	SANYO Semiconductor Co., Ltd.	

Recommended PCB Pattern

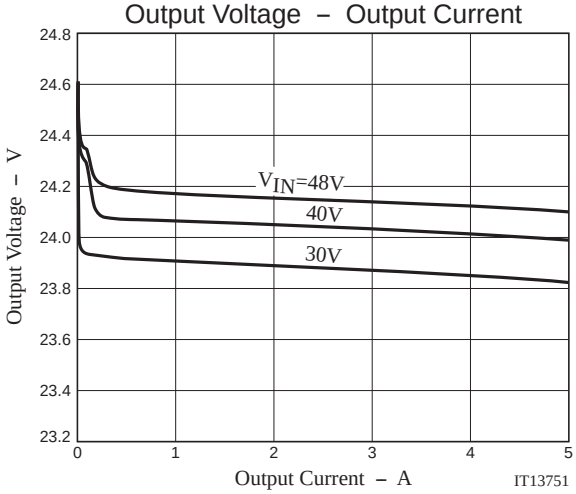
TO-220FI5H-HB Specification Silk Printing (Top View)



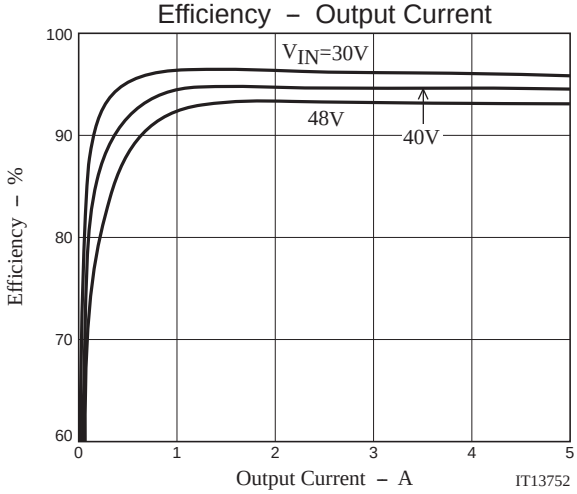
TO-220FI5H-HB Specification Pattern (Perspective View)



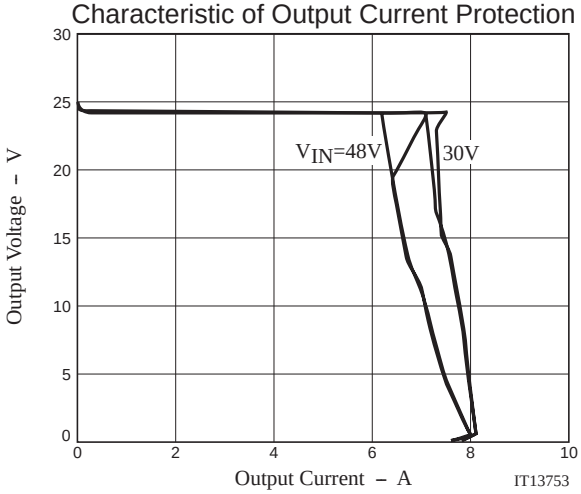
Output Voltage – Output Current



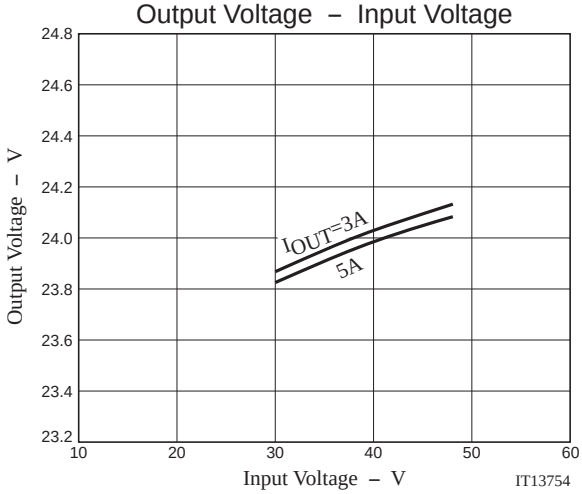
Efficiency – Output Current



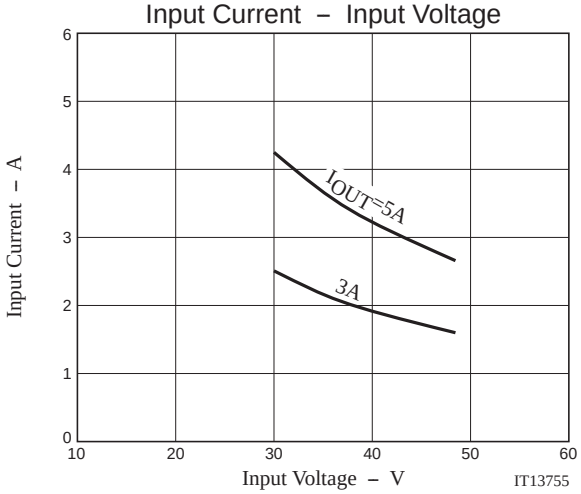
Characteristic of Output Current Protection



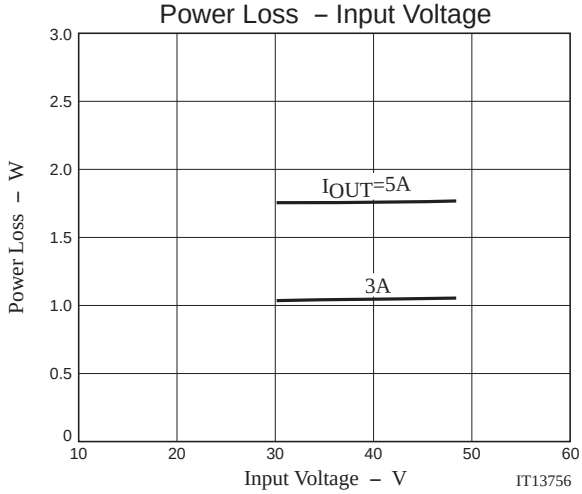
Output Voltage – Input Voltage



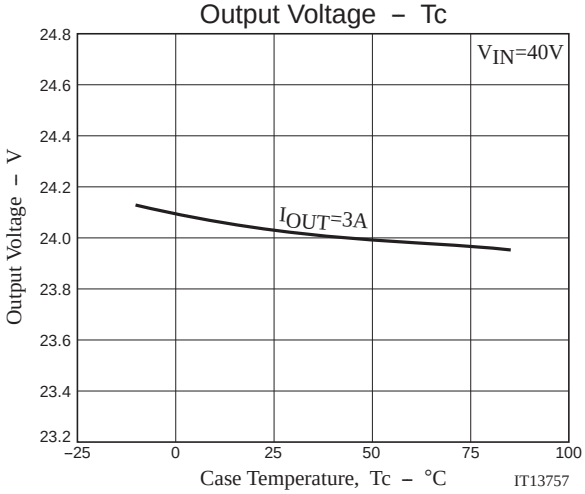
Input Current – Input Voltage



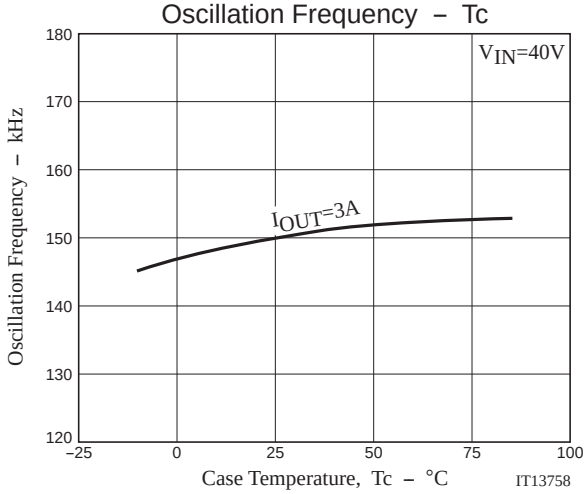
Power Loss – Input Voltage



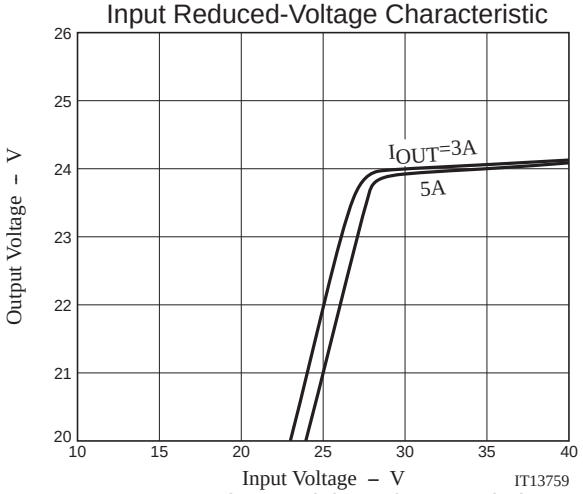
Output Voltage – Tc



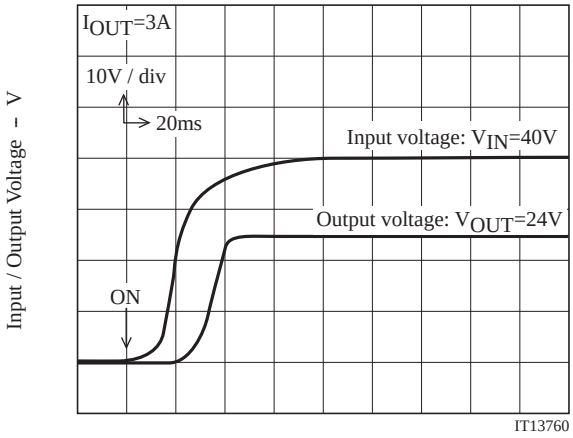
Oscillation Frequency – Tc



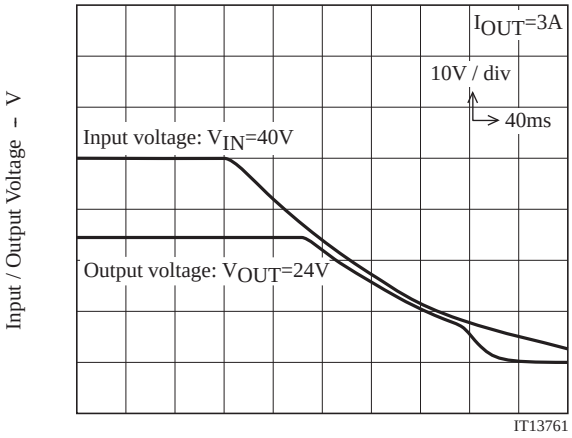
Input Reduced-Voltage Characteristic



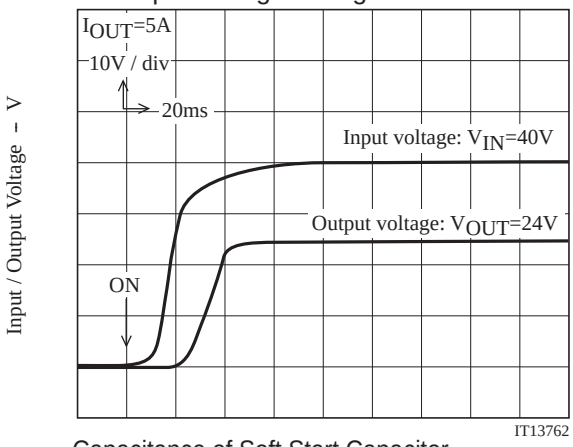
Output Voltage Rising Characteristic



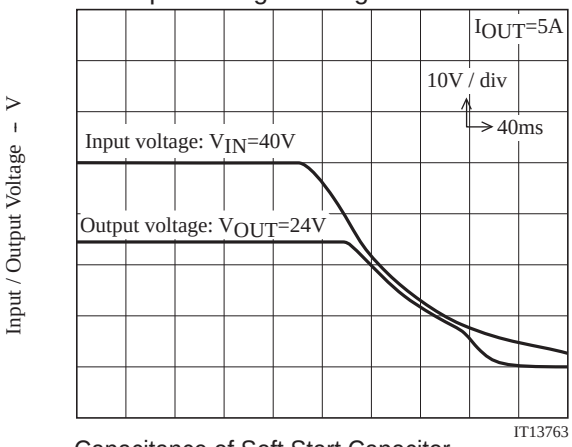
Output Voltage Falling Characteristic



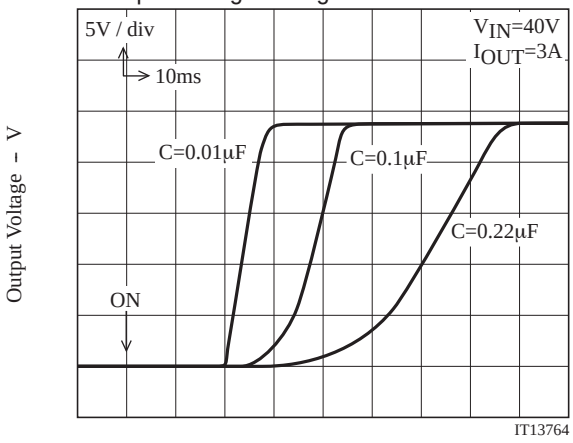
Output Voltage Rising Characteristic



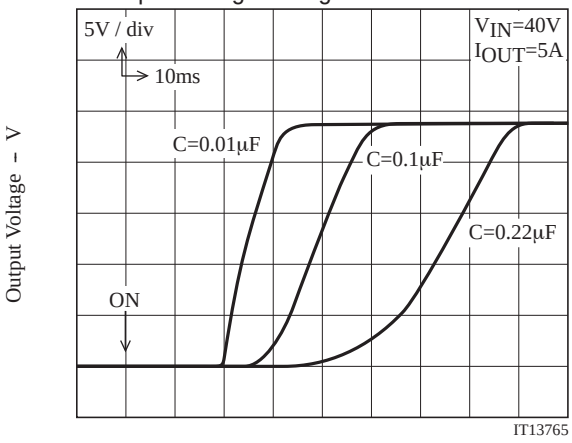
Output Voltage Falling Characteristic



Capacitance of Soft Start Capacitor – Output Voltage Rising Characteristic



Capacitance of Soft Start Capacitor – Output Voltage Rising Characteristic

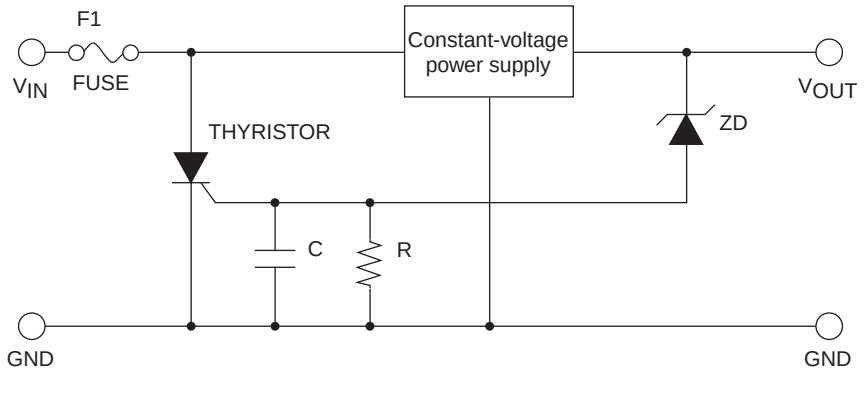


Example of Over-voltage Protection Circuit.

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.

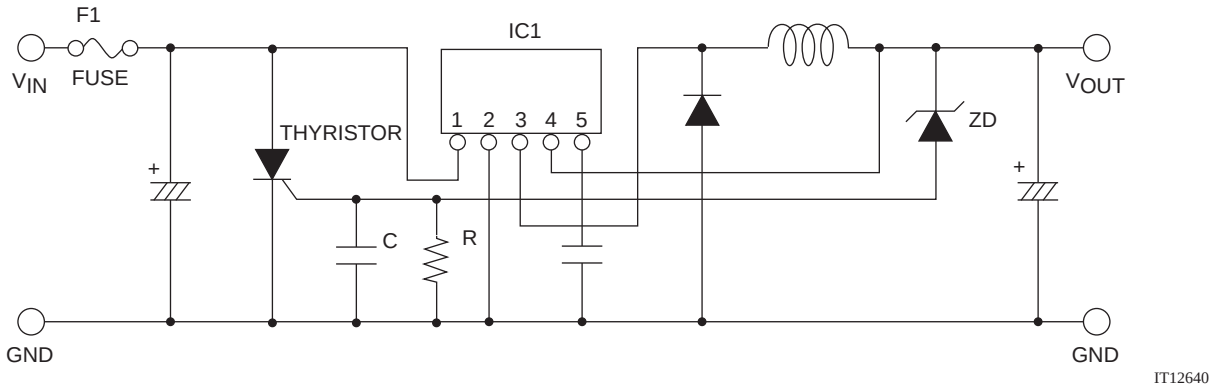
In designing, the following confirmations are necessary in actual circuit.
1) How the over-voltage protection circuit operates and its effects.
2) Is there any malfunction due to ambient temperature change of each device or exogenous noises?

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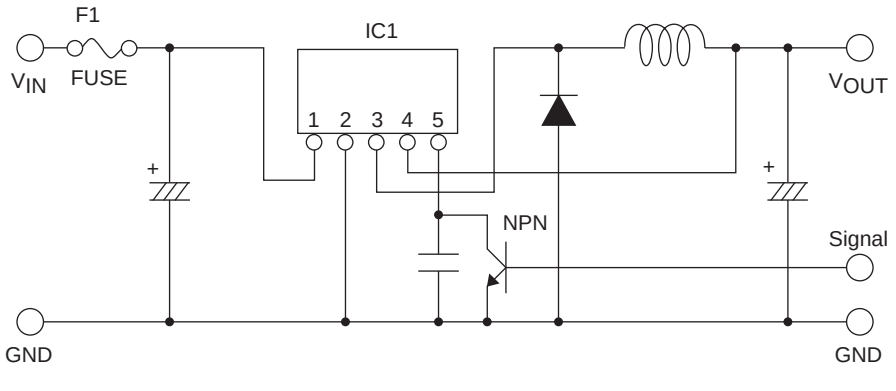
SS terminal (5 pin) also acts as standby mode switch. By setting SS terminal (5 pin) voltage to be equal or less than 0.3Vtyp, the output ON/OFF is able to be controlled by external signals.

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 3000μF 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 as 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 guarantee.

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