TAIWAN SEMICONDUCTOR

RoHS COMPLIANCE

TS2576

3A / 52KHz Buck Switching Regulator

TO-220-5L



TO-263-5L (D²PAK)



Pin Definition:
1. Input
2. SW Output
3. Ground
4. Feedback
5. Enable

General Description

TS2576 Series are step-down switching regulators with all required active functions. It is capable of driving 3A load with excellent line and load regulations. These devices are available in fixed output voltages of 3.3V, 5V and adjustable output version.

TS2576 series operates at a switching frequency of 52kHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. It substantially not only reduces the area of board size but also the size of heat sink, and in some cases no heat sink is required. The ±4% tolerance on output voltage within specified input voltages and output load conditions is guaranteed. Also, the oscillator frequency accuracy is within ±10%. External shutdown is included. Featuring 70μA (typical) standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

Features

- Output Voltage: 3.3V, 5V & Adjustable version
- Adjustable Output Voltage Range 1.23V~37V ±4%
- 52kHz fixed switching frequency
- Voltage Mode Non-synchronous PWM control
- Thermal Shutdown and Current Limit Protection
- ON/OFF Shutdown Control Input
- High Efficiency
- Short Circuit Protect (SCP)
- Operating Voltage Can be up to 40V
- Output Load Current 3A
- Low Power Standby Mode
- P+ Product Enhancement Tested

Ordering Information

Part No.	Package	Packing
TS2576CZ5**xx** C0	TO-220-5L	50pcs / Tube
TS2576CM5**xx** RN	TO-263-5L	800pcs / 13” Reel

Note: Where **xx** denotes voltage option, available are
50= 5.0V
33= 3.3V
Leave blank for adjustable version

Application

- Simple High-efficiency Step down Regulator
- On-Card Switching Regulators
- Positive to Negative Converter

Absolute Maximum Rating

Parameter	Symbol	Limit	Unit
Maximum Supply Voltage	V_{CC}	+45	V
Recommend Operating Supply Voltage	V_{OP}	4.5 to 40	V
SW, EN Pin Input Voltage	V_{SW}, V_{EN}	-0.3 to +25	V
Feedback Pin Voltage	V_{FB}	-0.3 to +25	V
Power Dissipation	P_D	Internally Limited	W
Output Voltage to Ground	V_{OUT}	-1	V
Storage Temperature Range	T_{ST}	-65 to +150	°C
Operating Temperature Range	T_{OP}	-40 to +125	°C
ESD Susceptibility (HBM)		2	kV

Thermal Information

Parameter		Symbol	Maximum	Unit
Thermal Resistance (Junction to Case)	TO-220-5L	Θ_{JC}	2	°C/W
	TO-263-5L		2	
Thermal Resistance (Junction to Ambient)	TO-220-5L	Θ_{JA}	65 (note 1)	°C/W
	TO-263-5L		50 (note 2)	

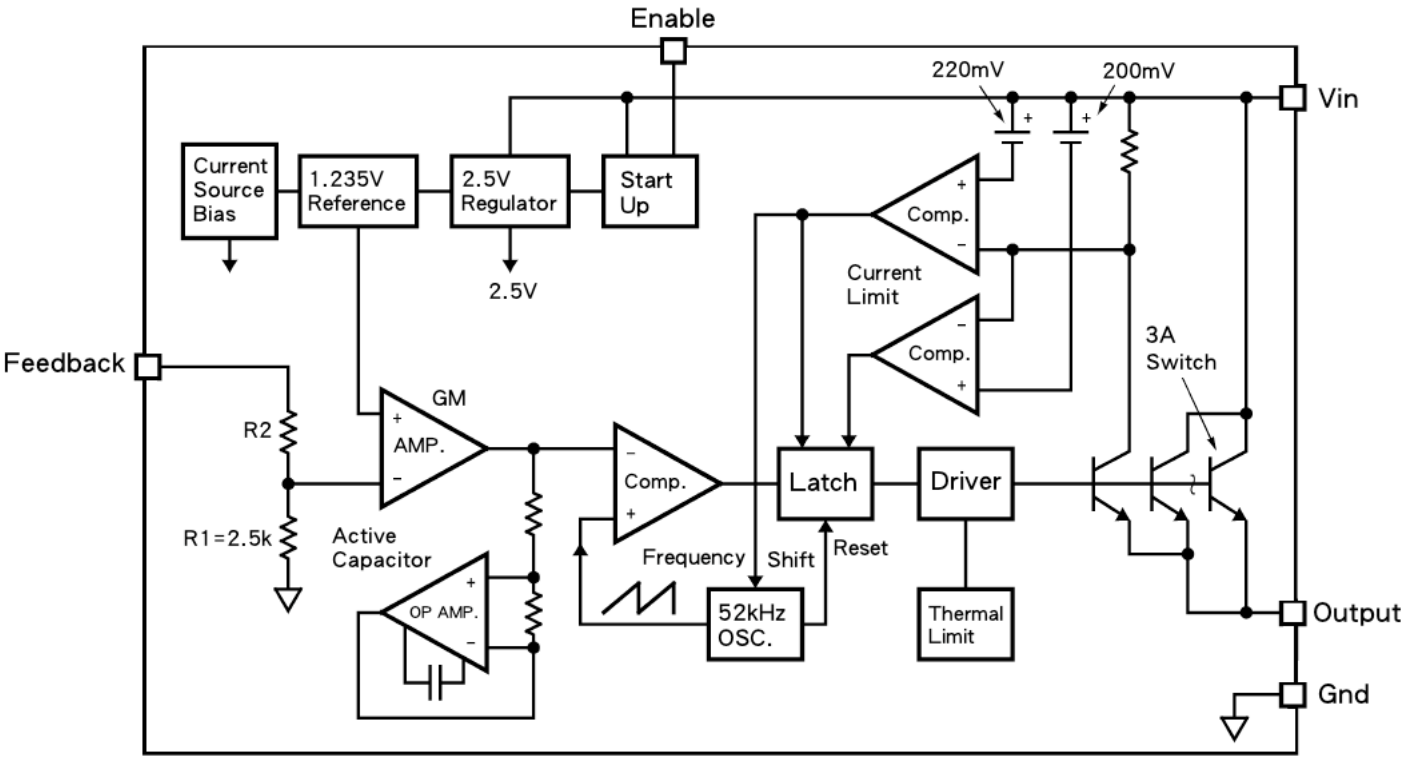
Note1: Θ_{JA} is measured on the PCB with minimum copper area.
Note2: Θ_{JA} is measured with the PCB copper area (need connect to GROUND pins) of approximately 0.5 in^2

Electrical Specifications (All Output Voltage Version)

(Ta = 25°C unless otherwise noted, V_{IN}=12V for 3.3V, 5V, Adjustable version. I_{LOAD} =0.5A)

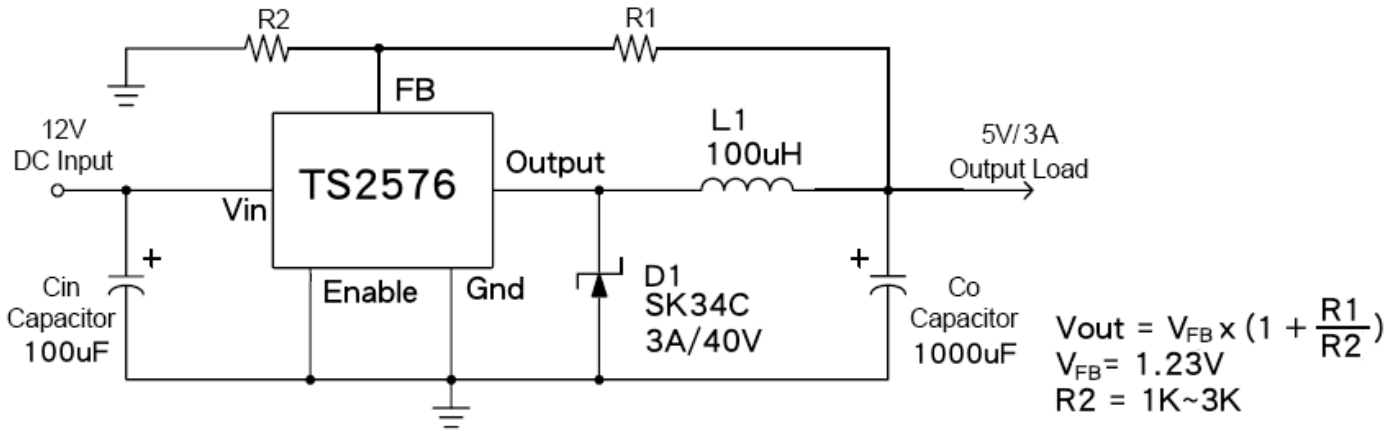
Parameter		Symbol	Test Condition	Min	Typ	Max	Unit
Output Feedback	ADJ	V_{FB}	4.5V≤ V_{IN} ≤40V 0.2A≤ I_{LOAD} ≤3A	1.180	1.23	1.280	V
Efficiency		η	V_{IN} =12V, I_{LOAD} =3A	--	75	--	%
Output Feedback	3.3V	V_{FB}	4.75V≤ V_{IN} ≤40V 0.2A≤ I_{LOAD} ≤3A	3.135	3.3V	3.465	V
Efficiency		η	V_{IN} =12V, I_{LOAD} =3A	--	75	--	%
Output Feedback	5V	V_{FB}	7V≤ V_{IN} ≤40V 0.2A≤ I_{LOAD} ≤3A	4.75	5	5.25	V
Efficiency		η	V_{IN} =12V, I_{LOAD} =3A	--	77	--	%
Feedback Bias Current		I_{FB}	V_{OUT} = 5V (Adjustable Version)	--	50	100	nA
Oscillator Frequency		F_{OSC}		47	52	58	KHz
Soft-Start Time		T_{SS}	Rising edge of EN on to I_{CL}	--	3	--	mS
Current Limit		I_{CL}	Pear Current, no outside circuit V_{FB} =0V force driver on	5.9	--	--	A
Saturation Voltage		V_{SAT}	I_{OUT}=3A, No outside circuit V_{FB} =0V force driver on	--	1.4	1.8	V
ON/OFF Pin Logic Input Threshold Voltage		V_{IL}	Low (regulator ON)	--	1.2	1.0	V
		V_{IH}	High (regulator OFF)	2.2	1.4	--	
ON/OFF Pin Logic Input Current		I_L	V_{LOGIC} =5V (OFF)	--	12	30	μA
		I_H	V_{LOGIC} =0V (ON)	--	0	10	
Maximum Duty Cycle (ON)		DC	V_{FB} =0V force driver on	93	98	--	%
Maximum Duty Cycle (OFF)			V_{FB} =12V force driver off	--	0	--	
Quiescent Current		I_Q	V_{FB} =12V force driver off	--	5	10	mA
Standby Quiescent Current		I_{STBY}	ON/OFF pin=5V	--	70	200	μA
			V_{IN} =40V	--		250	
SW Pin Leakage Current	SW pin = 0	I_{SWL}	No outside circuit, V_{FB} =12V force driver off	--	0.3	2	mA
	SW pin = -1		V_{IN} =12V	--	7.5	30	mA

Block Diagram

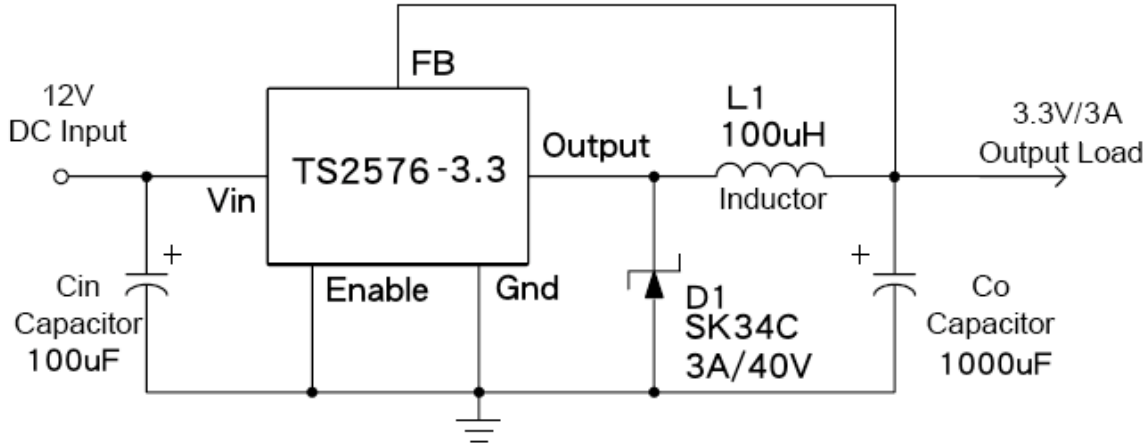


Typical Application Circuit

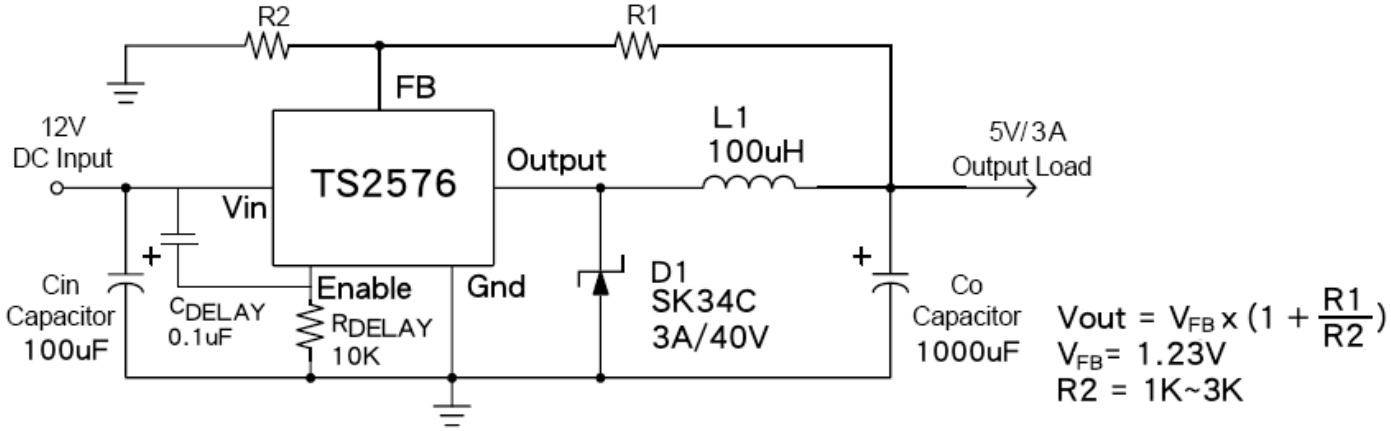
1. Adjustable Output Voltage Version



2. Fixed Output Voltage Version



3. Adjustable Output Voltage Version with Delayed Startup



Pin Function Description

Vcc
This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be presented at this pin to minimize voltage transients and to supply the switching currents needed by the regulator.

Ground
Circuit ground

SW Output
Internal switch. The voltage at this pin switches between (+Vcc – Vsat) and approximately – 0.5V, with a duty cycle of approximately Vout / Vcc. To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be minimized.

Feedback
Sense the regulated output voltage to complete the feedback loop.

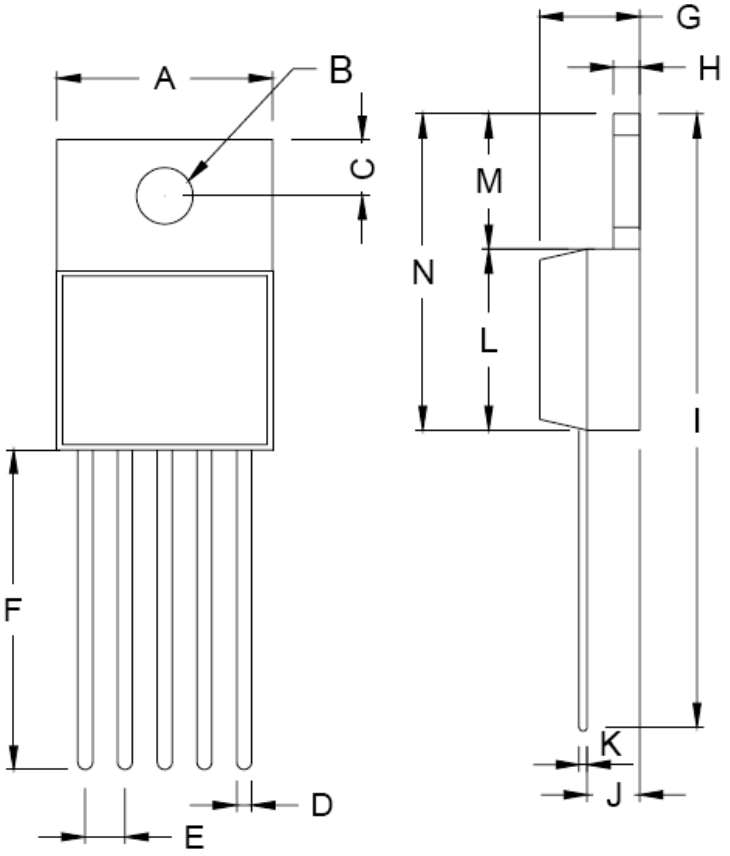
Enable
Allows the switching regulator circuit to be shutdown using logic level signals thus dropping the total input supply current to approximately 100uA. Pulling this pin below a threshold voltage of approximately 1.3V turns the regulator on, and pulling this pin above 1.3V (up to a maximum of Vcc) shuts the regulator down. If this shutdown feature is not needed, the EN pin can be wired to the ground pin.

Thermal Considerations
The TS2576 is available in two packages, a TO-220-5L and TO-263-5L.
The TO-220-5L package needs a heat sink under most conditions. The size of the heat sink depends on the input voltage, the output voltage, the load current and the ambient temperature. The TS2576 junction temperature rises above ambient temperature for a 3A load and different input and output voltages. The data for these curves was taken with the TS2576CZ5 (TO-220-5L package) operating as a buck switching regulator in an ambient temperature of 25 ^{0}C (still air). These temperature rise numbers are all approximate and there are many factors that can affect these temperatures. Higher ambient temperatures require more heat sinking.
The TO-263-5L surface mount package tab is designed to be soldered to the copper on a printed circuit board. The copper and the board are the heat sink for this package and the other heat producing components, such as the catch diode and inductor. The PC board copper area that the package is soldered to should be at least 0.8 in^{2}, and ideally should have 2 or more square inches of 2oz. Additional copper area improves the thermal characteristics, but with copper areas greater than approximately 6 in^{2}, only small improvements in heat dissipation are realized. If further thermal improvements are needed, double sided, multilayer PC board with large copper areas and/or airflow are recommended.
The TS2576 (TO-263-5L package) junction temperature rise above ambient temperature with a 3A load for various input and output voltages. This data was taken with the circuit operating as a buck switching regulator with all components mounted on a PC board to simulate the junction temperature under actual operating conditions. This curve can be used for a quick check for the approximate junction temperature for various conditions, but be aware that there are many factors that can affect the junction temperature. When load currents higher than 3A are used, double sided or multilayer PC boards with large copper areas and/or airflow might be needed, especially for high ambient temperatures and high output voltages.
For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. (Once exception to this is the output (switch) pin, which should not have large areas of copper.) Large areas of copper provide the best transfer of heat (lower thermal resistance) to the surrounding air, and moving air lowers the thermal resistance even further.

TS2576

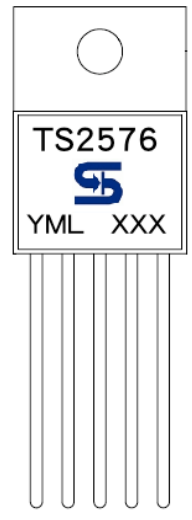
3A / 52KHz Buck Switching Regulator

TO-220-5L Mechanical Drawing



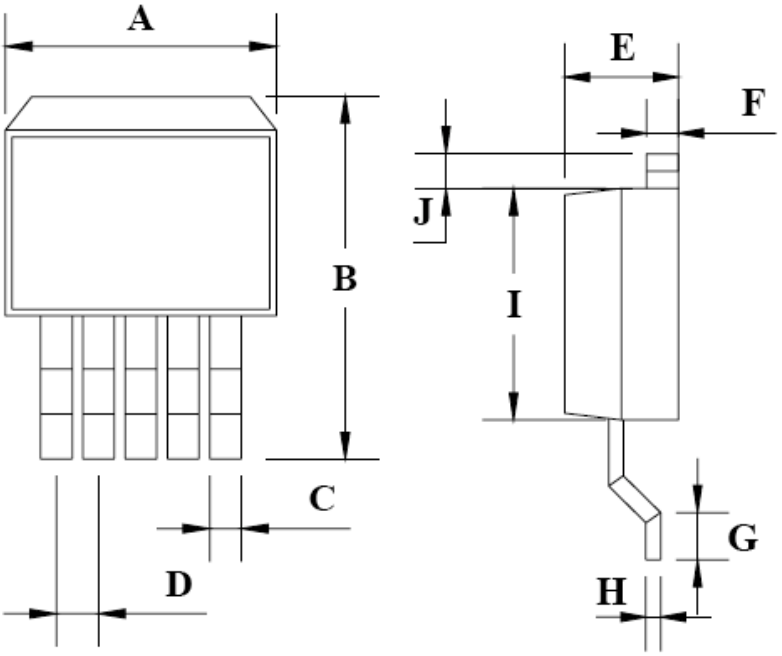
TO-220-5L DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.00	10.50	0.394	0.413
B	3.240	4.440	0.128	0.175
C	2.440	2.940	0.096	0.116
D	0.260	1.020	0.010	0.040
E	1.570	1.830	0.062	0.072
F	13.31	14.13	0.524	0.556
G	4.475	5.225	0.176	0.206
H	1.170	1.370	0.046	0.054
I	27.60	29.44	1.087	1.159
J	2.175	2.925	0.086	0.115
K	0.297	0.477	0.012	0.019
L	8.280	8.800	0.326	0.346
M	6.010	6.510	0.237	0.256
N	14.29	15.31	0.563	0.603

Marking Diagram



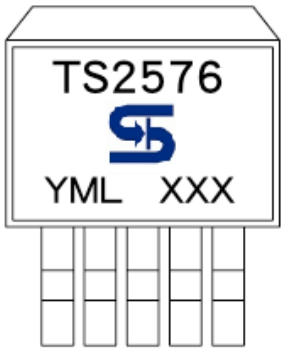
Y = Year Code
M = Month Code
(**A**=Jan, **B**=Feb, **C**=Mar, **D**=Apl, **E**=May, **F**=Jun, **G**=Jul, **H**=Aug, **I**=Sep, **J**=Oct, **K**=Nov, **L**=Dec)
L = Lot Code
XXX = Voltage Code
(3.3=3.3V, 5.0=5V)
= Package Code for Adjustable type
(CZ5 = TO-220-5L)

TO-263-5L Mechanical Drawing



TO-263-5L DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.70	10.54	0.382	0.415
B	14.60	15.87	0.575	0.625
C	0.69	0.94	0.027	0.037
D	1.524	2.032	0.060	0.080
E	4.30	4.70	0.169	0.185
F	1.22	1.40	0.048	0.055
G	2.24	2.82	0.088	0.111
H	0.36	0.56	0.014	0.022
I	8.50	9.20	0.330	0.362
J	1.40 MAX		0.055 MAX	

Marking Diagram



Y = Year Code
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(**A**=Jan, **B**=Feb, **C**=Mar, **D**=Apl, **E**=May, **F**=Jun, **G**=Jul, **H**=Aug, **I**=Sep, **J**=Oct, **K**=Nov, **L**=Dec)
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(CM5 = TO-263-5L)

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