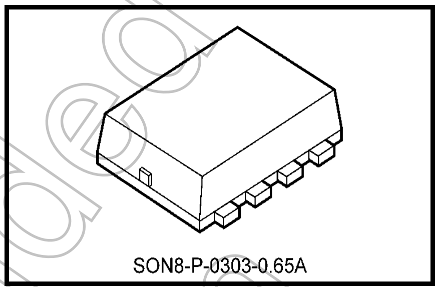
TOSHIBA CMOS Integrated Circuit Silicon Monolithic

TCV7104FN

Buck DC-DC Converter IC

The TCV7104FN is a single-chip buck DC-DC converter IC.
The TCV7104FN contains high-speed and low-on-resistance power MOSFETs for the main switch and synchronous rectifier to achieve high efficiency.

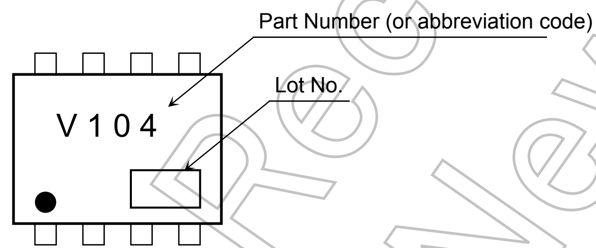


Weight: 0.017 g (typ.)

Features

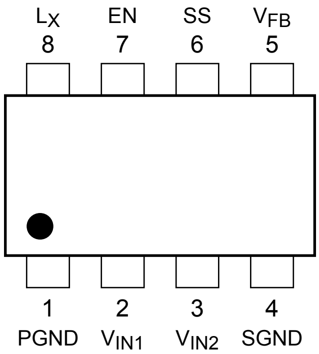
- Enables up to 2 A of load current (I_{OUT}) with a minimum of external components.
- High efficiency: η = 95% (typ.)
  (@V_{IN} = 5 V, V_{OUT} = 3.3 V, I_{OUT} = 0.7 A)
- Operating voltage range: V_{IN} = 2.7 to 5.5 V
- Low ON-resistance: $R_{DS\ (ON)}$ = 0.18 Ω (high-side) / 0.12 Ω (low-side) typical (@V_{IN} = 5 V, T_j = 25°C)
- High oscillation frequency: f_{OSC} = 1500 kHz (typ.)
- Feedback voltage: V_{FB} = 0.8 V ± 1% (@T_j = 25°C)
- Uses internal phase compensation to achieve high efficiency with a minimum of external components.
- Allows the use of a small surface-mount ceramic capacitor as an output filter capacitor.
- Housed in a small surface-mount package (PS-8) with a low thermal resistance.
- Soft-start time adjustable by an external capacitor

Part Marking

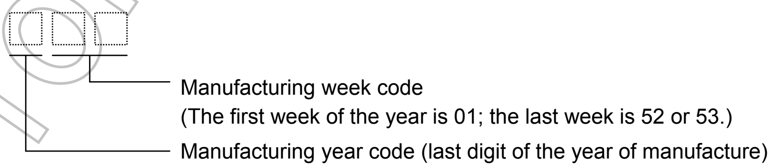


The dot (•) on the top surface indicates pin 1.

Pin Assignment



*: The lot number consists of three digits. The first digit represents the last digit of the year of manufacture, and the following two digits indicates the week of manufacture between 01 and either 52 or 53.



This product has a MOS structure and is sensitive to electrostatic discharge. Handle with care.

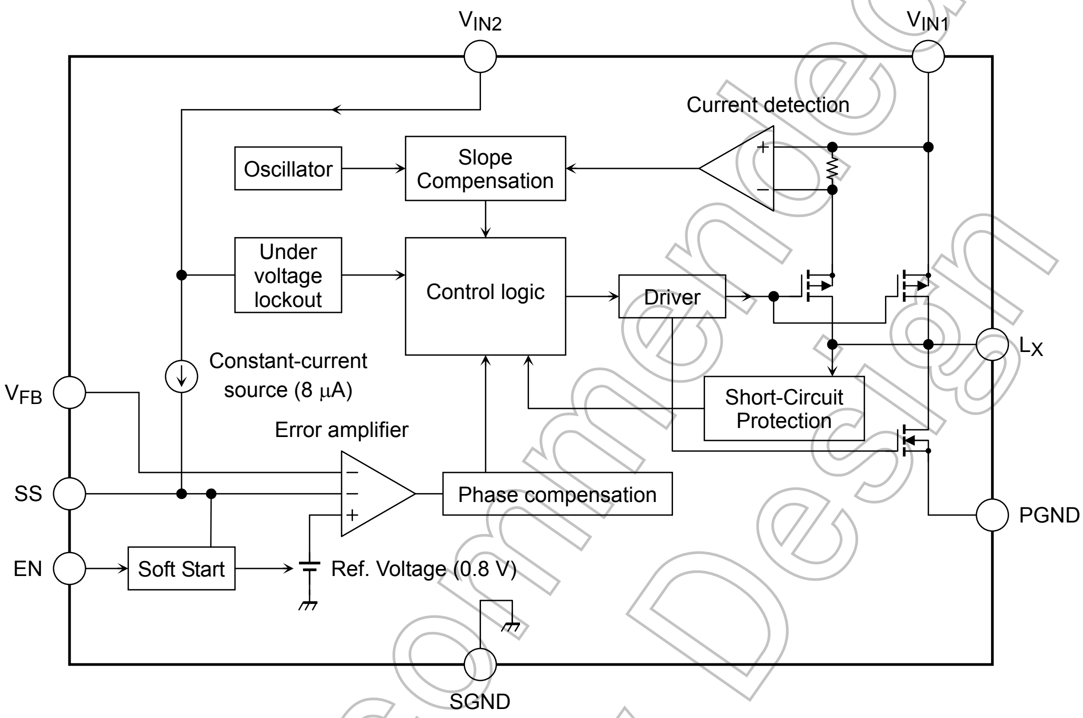
The product(s) in this document ("Product") contain functions intended to protect the Product from temporary small overloads such as minor short-term overcurrent, or overheating. The protective functions do not necessarily protect Product under all circumstances. When incorporating Product into your system, please design the system (1) to avoid such overloads upon the Product, and (2) to shut down or otherwise relieve the Product of such overload conditions immediately upon occurrence. For details, please refer to the notes appearing below in this document and other documents referenced in this document.

Start of commercial production
2009-10

Ordering Information

Part Number	Shipping
TCV7104FN (TE85L, F)	Embossed tape (3000 units per reel)

Block Diagram



Pin Description

Pin No.	Symbol	Description
1	PGND	Ground pin for the output section
2	V_{IN1}	Input pin for the output section This pin is placed in the standby state if V_{EN} = low. Standby current is 10 μA or less.
3	V_{IN2}	Input pin for the control section This pin is placed in the standby state if V_{EN} = low. Standby current is 10 μA or less.
4	SGND	Ground pin for the control section
5	V_{FB}	Feedback pin This input is fed into an internal error amplifier with a reference voltage of 0.8 V (typ.).
6	SS	Soft-start pin When the SS input is left open, the soft-start time is 1 ms (typ.). The soft-start time can be adjusted with an external capacitor. The external capacitor is charged from a 8 μA (typ.) constant-current source, and the reference voltage of the error amplifier is regulated between 0 V and 0.8 V. The external capacitor is discharged when EN = low and in case of undervoltage lockout or thermal shutdown.
7	EN	Enable pin When EN ≥ 1.5 V (@ V_{IN} = 5 V), the internal circuitry is allowed to operate and thus enable the switching operation of the output section. When EN ≤ 0.5 V (@ V_{IN} = 5 V), the internal circuitry is disabled, putting the TCV7104FN in Standby mode. This pin has an internal pull-down resistor of approx. 500 kΩ.
8	L_X	Switch pin This pin is connected to high-side P-channel MOSFET and low-side N-channel MOSFET.

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Input pin voltage for the output section	V_{IN1}	−0.3 to 6	V
Input pin voltage for the control section	V_{IN2}	−0.3 to 6	V
Feedback pin voltage	V_{FB}	−0.3 to 6	V
Soft-start pin voltage	V_{SS}	−0.3 to 6	V
Enable pin voltage	V_{EN}	−0.3 to 6	V
V_{EN} – V_{IN2} voltage difference	V_{EN}-V_{IN2}	$V_{EN} - V_{IN2} < 0.3$	V
Switch pin voltage (Note 1)	V_{LX}	−0.3 to 6	V
Switch pin current	I_{LX}	±2.4	A
Power dissipation (Note 2)	P_D	0.9	W
Operating junction temperature	T_{jopr}	−40 to125	°C
Junction temperature (Note 3)	T_j	150	°C
Storage temperature	T_{stg}	−55 to150	°C

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc)

Note 1: The switch pin voltage (V_{LX}) doesn't include the peak voltage generated by TCV7104FN's switching.
A negative voltage generated in dead time is permitted among the switch pin current (I_{LX}).

Thermal Resistance Characteristics

Characteristics	Symbol	Max	Unit
Thermal resistance, junction to ambient	$R_{th\ (j\text{-}a)}$	110.2 (Note 2)	°C/W

Note 2:

Single-sided glass epoxy board

FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

Note 3: The TCV7104FN may into thermal shutdown at the rated maximum junction temperature. Thermal design is required to ensure that the rated maximum operating junction temperature, T_{jopr}, will not be exceeded.

Electrical Characteristics (T_j = 25°C, V_{IN1} = V_{IN2} = 2.7 to 5.5 V, unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Operating input voltage	$V_{IN\ (OPR)}$	—	2.7	—	5.5	V
Operating current	I_{IN}	$V_{IN1} = V_{IN2} = V_{EN} = V_{FB}$ = 5 V	—	450	680	μA
Output voltage range	$V_{OUT\ (OPR)}$	$V_{EN} = V_{IN1} = V_{IN2}$	0.8	—	—	V
Standby current	$I_{IN\ (STBY)\ 1}$	$V_{IN1} = V_{IN2}$ = 5 V, V_{EN} = 0 V V_{FB} = 0.8 V	—	—	10	μA
Standby current	$I_{IN\ (STBY)\ 2}$	$V_{IN1} = V_{IN2}$ = 3.3 V, V_{EN} = 0 V V_{FB} = 0.8 V	—	—	10	μA
High-side switch leakage current	$I_{LEAK\ (H)}$	$V_{IN1} = V_{IN2}$ = 5 V, V_{EN} = 0 V V_{FB} = 0.8 V, V_{LX} = 0 V	—	—	10	μA
EN threshold voltage	$V_{IH\ (EN)\ 1}$	$V_{IN1} = V_{IN2}$ = 5 V	1.5	—	—	V
	$V_{IH\ (EN)\ 2}$	$V_{IN1} = V_{IN2}$ = 3.3 V	1.5	—	—	
	$V_{IL\ (EN)\ 1}$	$V_{IN1} = V_{IN2}$ = 5 V	—	—	0.5	
	$V_{IL\ (EN)\ 2}$	$V_{IN1} = V_{IN2}$ = 3.3 V	—	—	0.5	
EN input current	$I_{IH\ (EN)\ 1}$	$V_{IN1} = V_{IN2}$ = 5 V, V_{EN} = 5 V	6	—	13	μA
	$I_{IH\ (EN)\ 2}$	$V_{IN1} = V_{IN2}$ = 3.3 V, V_{EN} = 3.3 V	4	—	9	
V_{FB} input voltage	V_{FB1}	V_{IN} = 5 V, V_{EN} = 5 V Tj = 0 to 85°C	0.792	0.8	0.808	V
	V_{FB2}	V_{IN} = 3.3 V, V_{EN} = 3.3 V Tj = 0 to 85°C	0.792	0.8	0.808	
V_{FB} input current	I_{FB}	$V_{IN1} = V_{IN2}$ = 2.7 to 5.5 V $V_{FB} = V_{IN2}$	–1	—	1	μA
High-side switch on-state resistance	$R_{DS\ (ON)\ (H)\ 1}$	$V_{IN1} = V_{IN2}$ = 5 V, V_{EN} = 5 V I_{LX} = –1 A	—	0.18	—	Ω
	$R_{DS\ (ON)\ (H)\ 2}$	$V_{IN1} = V_{IN2}$ = 3.3 V, V_{EN} = 3.3 V I_{LX} = –1 A	—	0.21	—	
	$R_{DS\ (ON)\ (H)\ 3}$	$V_{IN1} = V_{IN2}$ = 5 V , V_{EN} = 5V I_{LX} = - 0.1 A , Tj=-40～85°C	—	—	0.25	
	$R_{DS\ (ON)\ (H)\ 4}$	$V_{IN1} = V_{IN2}$ = 3.3 V , V_{EN} = 3.3V I_{LX} = - 0.1 A , Tj=-40～85°C	—	—	0.3	
Low-side switch on-state resistance	$R_{DS\ (ON)\ (L)\ 1}$	$V_{IN1} = V_{IN2}$ = 5 V, V_{EN} = 5 V I_{LX} = 1 A	—	0.12	—	Ω
	$R_{DS\ (ON)\ (L)\ 2}$	$V_{IN1} = V_{IN2}$ = 3.3 V, V_{EN} = 3.3 V I_{LX} = 1 A	—	0.14	—	
	$R_{DS\ (ON)\ (L)\ 3}$	$V_{IN1} = V_{IN2}$ = 5 V , V_{EN} = 5V I_{LX} = 0.1 A , Tj=-40 to 85°C	—	—	0.18	
	$R_{DS\ (ON)\ (L)\ 4}$	$V_{IN1} = V_{IN2}$ = 3.3 V , V_{EN} = 3.3V I_{LX} = 0.1 A , Tj=-40 to 85°C	—	—	0.2	
Oscillation frequency	f_{OSC}	$V_{IN1} = V_{IN2} = V_{EN}$ = 5 V	1200	1500	1800	kHz
Internal soft-start time	t_{SS}	$V_{IN1} = V_{IN2}$ = 5 V, I_{OUT} = 0 A, Measured between 0% and 90% points at V_{OUT}.	0.5	1	1.5	ms
External soft-start charge current	I_{SS}	$V_{IN1} = V_{IN2}$ = 5 V, V_{EN} = 5 V	–5	–8	–13	μA
High-side switch duty cycle	Dmax	$V_{IN1} = V_{IN2}$ = 2.7 to 5.5 V	—	—	100	%
Thermal shutdown (TSD) — Detection temperature	T_{SD}	$V_{IN1} = V_{IN2}$ = 5 V	—	150	—	°C
Thermal shutdown (TSD) — Hysteresis	ΔT_{SD}	$V_{IN1} = V_{IN2}$ = 5 V	—	15	—	
Undervoltage lockout (UVLO) — Detection voltage	V_{UV}	$V_{EN} = V_{IN1} = V_{IN2}$	2.3	2.45	2.6	V
Undervoltage lockout (UVLO) — Recovery voltage	V_{UVR}	$V_{EN} = V_{IN1} = V_{IN2}$	2.4	2.55	2.7	
Undervoltage lockout (UVLO) — Hysteresis	ΔV_{UV}	$V_{EN} = V_{IN1} = V_{IN2}$	—	0.1	—	
L_X current limit	I_{LIM}	$V_{IN1} = V_{IN2}$ = 5 V, V_{OUT} = 2 V	2.3	3.2	—	A

Note on Electrical Characteristics

The test condition T_j = 25°C means a state where any drifts in electrical characteristics incurred by an increase in the chip's junction temperature can be ignored during pulse testing.

Application Circuit Example

Figure 1 shows a typical application circuit using a low-ESR electrolytic or ceramic capacitor for C_{OUT}.

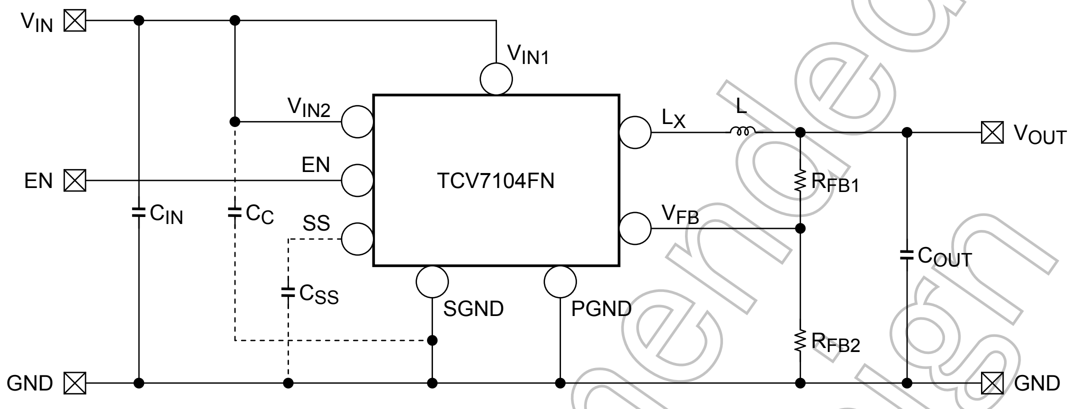


Figure 1 TCV7104FN Application Circuit Example

Component values (reference value@ V_{IN} = 5 V, V_{OUT} = 3.3 V, Ta = 25°C)

C_{IN}: Input filter capacitor = 10 μF
(ceramic capacitor: GRM21BB30J106K manufactured by Murata Manufacturing Co., Ltd.)

C_{OUT}: Output filter capacitor = 10 μF
(ceramic capacitor: GRM21BB30J106K manufactured by Murata Manufacturing Co., Ltd.)

R_{FB1}: Output voltage setting resistor = 7.5 kΩ

R_{FB2}: Output voltage setting resistor = 2.4 kΩ

L: Inductor = 1.5 μH
(LTF5022T-1R5N3R6-LC or SLF6045T-1R5N4R0-3PF manufactured by TDK-EPC Corporation)

C_{SS} is a capacitor for adjusting the soft-start time.
C_C is a decoupling capacitor of Input pin for the control section.
(Connect it when the circuit operation is unstable due to the board layout or a feature of the C_{IN}.)

Examples of Component Values (For Reference Only)

Output Voltage Setting V_{OUT}	Inductance L	Input Capacitance C_{IN}	Output Capacitance C_{OUT}	Feedback Resistor R_{FB1}	Feedback Resistor R_{FB2}
1.2 V	1.5 μH	10 μF	10 μF	7.5 kΩ	15 kΩ
1.51 V	1.5 μH	10 μF	10 μF	16 kΩ	18 kΩ
1.8 V	1.5 μH	10 μF	10 μF	15 kΩ	12 kΩ
2.5 V	1.5 μH	10 μF	10 μF	5.1 kΩ	2.4 kΩ
3.3 V	1.5 μH	10 μF	10 μF	7.5 kΩ	2.4 kΩ

Component values need to be adjusted, depending on the TCV7104FN's I/O conditions and the board layout.

Application Notes

Inductor Selection

The inductance required for inductor L can be calculated as follows:

$$L = \frac{V_{IN} - V_{OUT}}{f_{OSC} \cdot \Delta I_L} \cdot \frac{V_{OUT}}{V_{IN}} \quad \cdots\cdots\cdots\cdots(1)$$

V_{IN}: Input voltage (V)
V_{OUT}: Output voltage (V)
f_{OSC}: Oscillation frequency = 1500 kHz (typ.)
ΔI_L: Inductor ripple current (A)

*: Generally, ΔI_L should be set to approximately 30% of the maximum output current. Since the maximum output current of the TCV7104FN is 2.0 A, ΔI_L should be 0.6 A or so. The inductor should have a current rating greater than the peak output current of 2.3 A. If the inductor current rating is exceeded, the inductor becomes saturated, leading to an unstable DC-DC converter operation.

When V_{IN} = 5 V and V_{OUT} = 3.3 V, the required inductance can be calculated as follows. Be sure to select an appropriate inductor, taking the input voltage range into account.

$$\begin{aligned} L &= \frac{V_{IN} - V_{OUT}}{f_{OSC} \cdot \Delta I_L} \cdot \frac{V_{OUT}}{V_{IN}} \\ &= \frac{5\ \text{V} - 3.3\ \text{V}}{1500\text{kHz} \cdot 0.6\text{A}} \cdot \frac{3.3\ \text{V}}{5\ \text{V}} \quad (2) \\ &= 1.25\mu\text{H} \end{aligned}$$

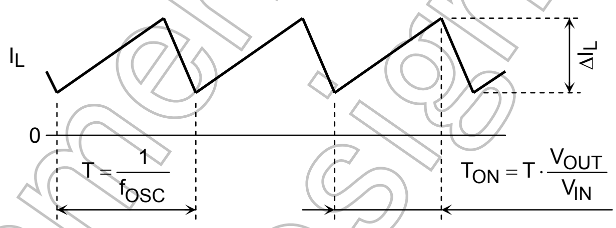


Figure 2 Inductor Current Waveform

Setting the Output Voltage

A resistive voltage divider is connected as shown in Figure 3 to set the output voltage; it is given by Equation 3 based on the reference voltage of the error amplifier (0.8 V typ.), which is connected to the Feedback pin, V_{FB}. R_{FB1} should be up to 30 kΩ or so, because an extremely large-value R_{FB1} incurs a delay due to parasitic capacitance at the V_{FB} pin. It is recommended that resistors with a precision of ±1% or higher be used for R_{FB1} and R_{FB2}.

$$\begin{aligned} V_{OUT} &= V_{FB} \cdot \left(1 + \frac{R_{FB1}}{R_{FB2}}\right) \\ &= 0.8\ \text{V} \cdot \left(1 + \frac{R_{FB1}}{R_{FB2}}\right) \quad \cdots\cdots\cdots(3) \end{aligned}$$

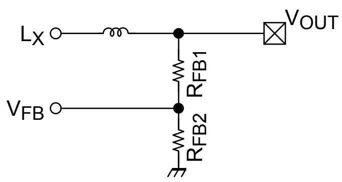


Figure 3 Output Voltage Setting Resistors

Output Filter Capacitor Selection

Use a low-ESR electrolytic or ceramic capacitor as the output filter capacitor. Since a capacitor is generally sensitive to temperature, choose one with excellent temperature characteristics. As a rule of thumb, its capacitance should be 10 μF or greater for applications. The capacitance should be set to an optimal value that meets the system's ripple voltage requirement and transient load response characteristics. The phase margin tends to decrease as the output voltage is getting low. Enlarge a capacitance for output flatness when phase margin is insufficient, or the transient load response characteristics cannot be satisfied. Since the ceramic capacitor has a very low ESR value, it helps reduce the output ripple voltage; however, because the ceramic capacitor provides less phase margin, it should be thoroughly evaluated.

Soft-Start Feature

The TCV7104FN has a soft-start feature.

If the SS pin is left open, the soft-start time, t_{SS}, for V_{OUT} defaults to 1 ms (typ.) internally.

The soft-start time can be extended by adding an external capacitor (C_{SS}) between the SS and SGND pins. The soft-start time can be calculated as follows:

$$t_{SS2} = 0.1 \cdot C_{SS} \quad \cdots\cdots\cdots\cdots (4)$$

t_{SS2}: Soft-start time (in seconds) when an external capacitor is connected between SS and SGND.

C_{SS}: Capacitor value (μF)

The soft-start feature is activated when the TCV7104FN exits the undervoltage lockout (UVLO) state after power-up and when the voltage at the EN pin has changed from logic low to logic high.

Overcurrent Protection（OCP）

The TCV7104FN has maximum current limiting. The TCV7104FN limits the ON time of high side switching transistor and decreases output voltage when the peak value of the L_X terminal current exceeds switching terminal peak current limitation I_{LIM}=3.2A(typ.).

Undervoltage Lockout (UVLO)

The TCV7104FN has undervoltage lockout (UVLO) protection circuitry. The TCV7104FN does not provide output voltage (V_{OUT}) until the input voltage (V_{IN2}) has reached V_{UVR} (2.55 V typ.). UVLO has hysteresis of 0.1 V (typ.). After the switch turns on, if V_{IN2} drops below V_{UV} (2.45 V typ.), UVLO shuts off the switch at V_{OUT}.

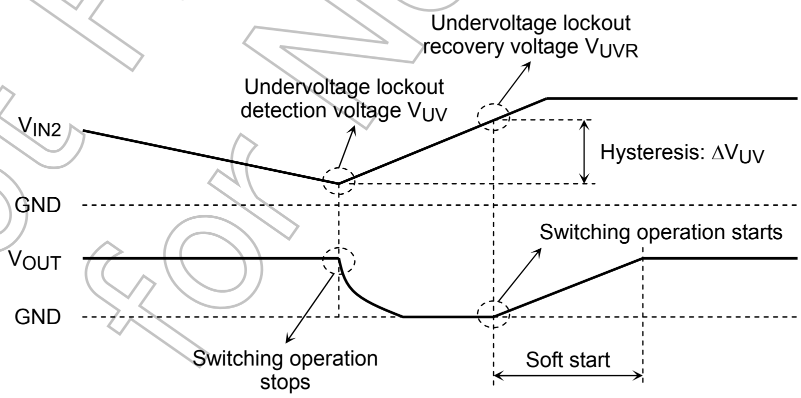


Figure 4 Undervoltage Lockout Operation

Thermal Shutdown (TSD)

The TCV7104FN provides thermal shutdown. When the junction temperature continues to rise and reaches T_{SD} (150°C typ.), the TCV7104FN goes into thermal shutdown and shuts off the power supply. TSD has a hysteresis of about 15°C (typ.). The device is enabled again when the junction temperature has dropped by approximately 15°C from the TSD trip point. The device resumes the power supply when the soft-start circuit is activated upon recovery from TSD state.

Thermal shutdown is intended to protect the device against abnormal system conditions. It should be ensured that the TSD circuit will not be activated during normal operation of the system.

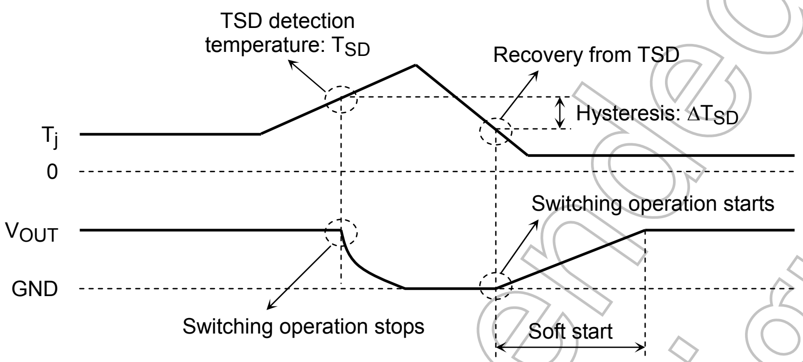
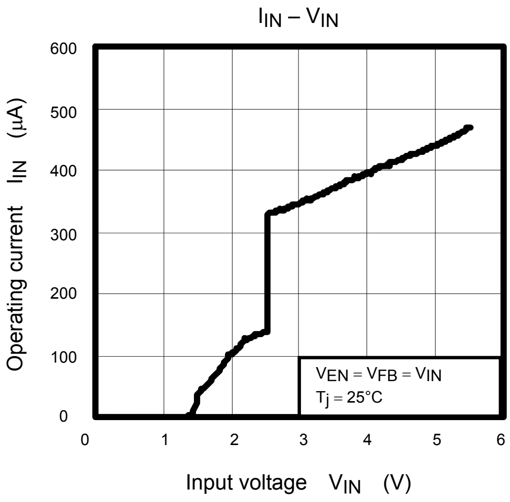


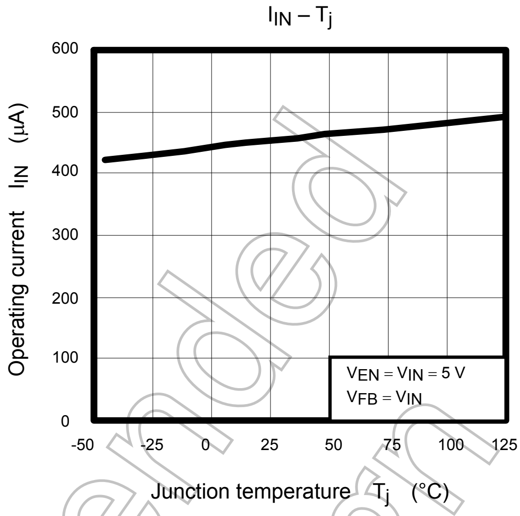
Figure 5 Thermal Shutdown Operation

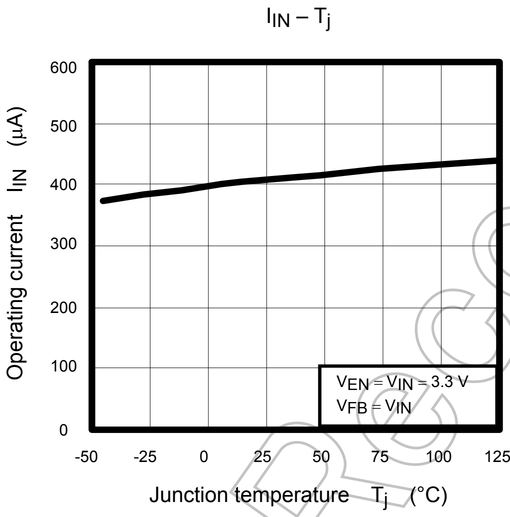
Usage Precautions

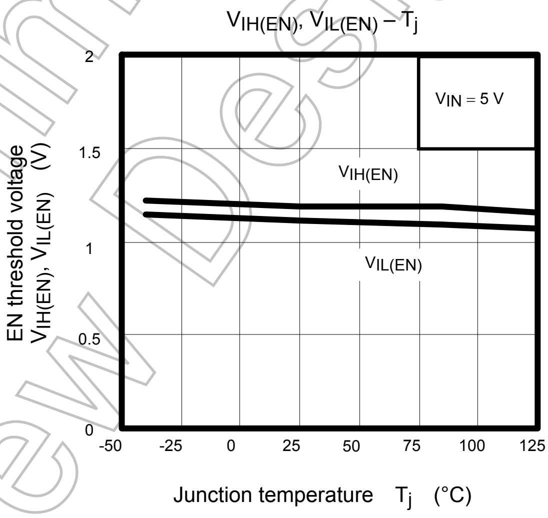
- The input voltage, output voltage, output current and temperature conditions should be considered when selecting capacitors, inductors and resistors. These components should be evaluated on an actual system prototype for best selection.
- External components such as capacitors, inductors and resistors should be placed as close to the TCV7104FN as possible.
- The TCV7104FN has an ESD diode between the EN and V_{IN2} pins. The voltage between these pins should satisfy $V_{EN} - V_{IN2} < 0.3$ V.
- C_{IN} should be connected as close to the PGND and V_{IN1} pins as possible. Operation might become unstable due to board layout. In that case, add a decoupling capacitor (C_C) of 0.1 μF to 1 μF between the SGND and V_{IN2} pins.
- The minimum programmable output voltage is 0.8 V (typ.). If the difference between the input and output voltages is small, the output voltage might not be regulated accurately and fluctuate significantly.
- When TCV7104FN is in operation, a negative voltage is generated since regeneration current flows through the switch pin (L_X). Even if the current flows through the low side parasitic diode during the dead time of switching transistor, operation is undisturbed so an external flywheel diode is unnecessary. If there is the possibility of an external negative voltage generation, add a diode for protection.
- SGND pin is connected with the back of IC chip and serves as the heat radiation pin. Secure the area of a GND pattern as large as possible for greater of heat radiation.
- The overcurrent protection circuits in the Product are designed to temporarily protect Product from minor overcurrent of brief duration. When the overcurrent protective function in the Product activates, immediately cease application of overcurrent to Product. Improper usage of Product, such as application of current to Product exceeding the absolute maximum ratings, could cause the overcurrent protection circuit not to operate properly and/or damage Product permanently even before the protection circuit starts to operate.
- The thermal shutdown circuits in the Product are designed to temporarily protect Product from minor overheating of brief duration. When the overheating protective function in the Product activates, immediately correct the overheating situation. Improper usage of Product, such as the application of heat to Product exceeding the absolute maximum ratings, could cause the overheating protection circuit not to operate properly and/or damage Product permanently even before the protection circuit starts to operate.

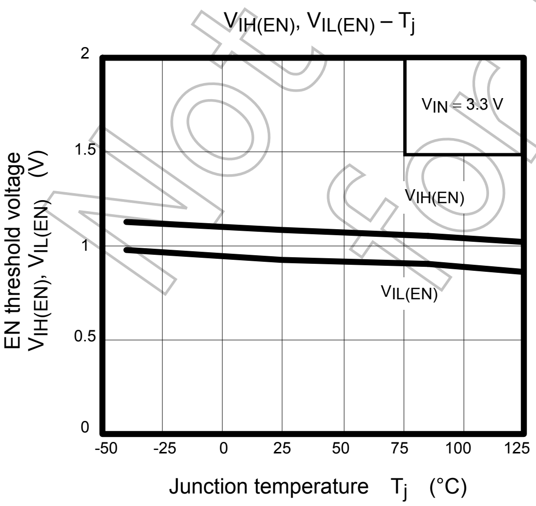
Typical Performance Characteristics

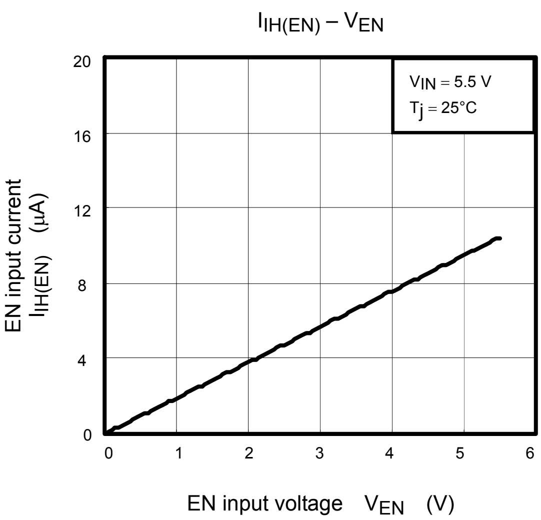




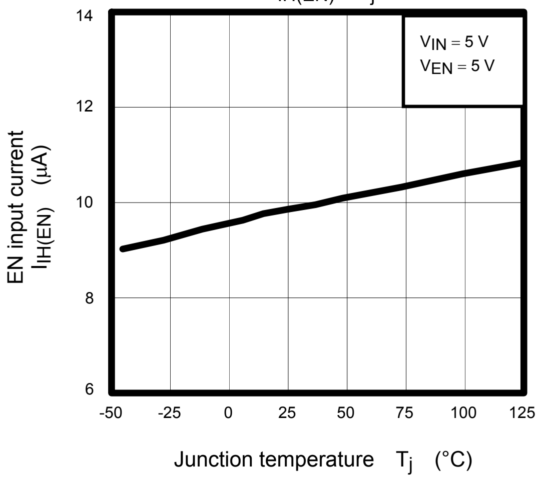




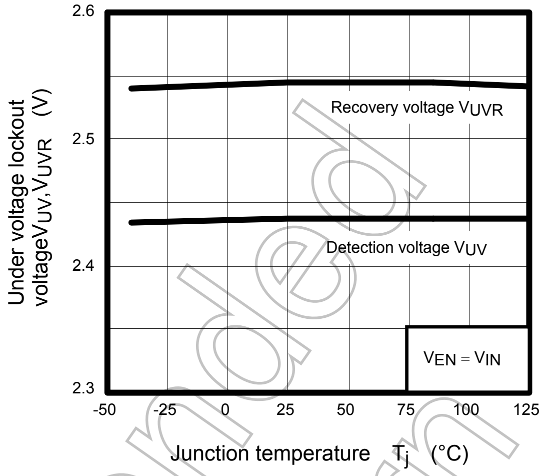




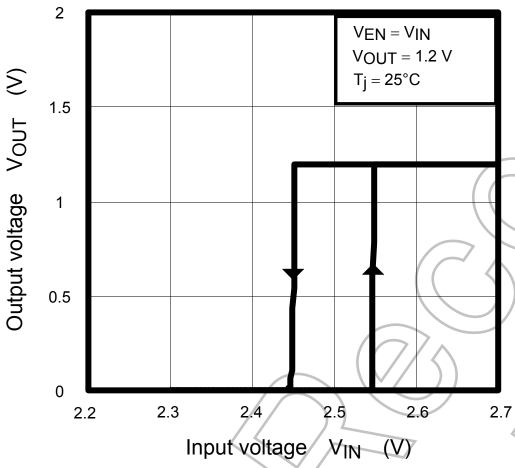
$I_{IH(EN)}$ – T_j



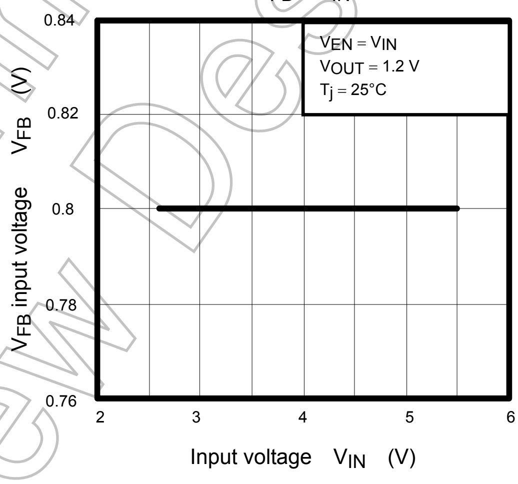
V_{UV}, V_{UVR} – T_j



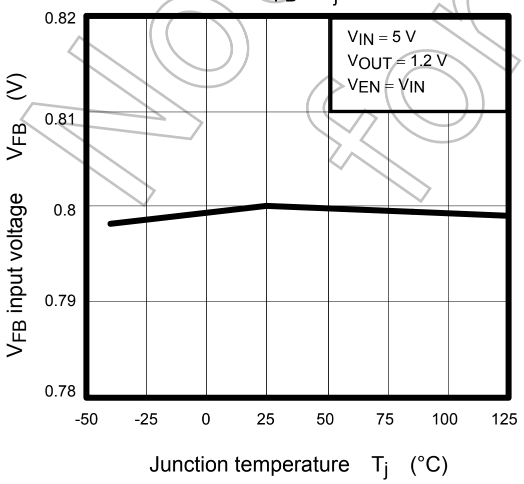
V_{OUT} – V_{IN}



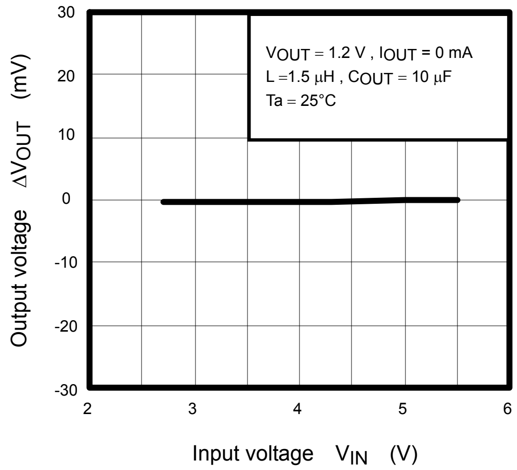
V_{FB} – V_{IN}

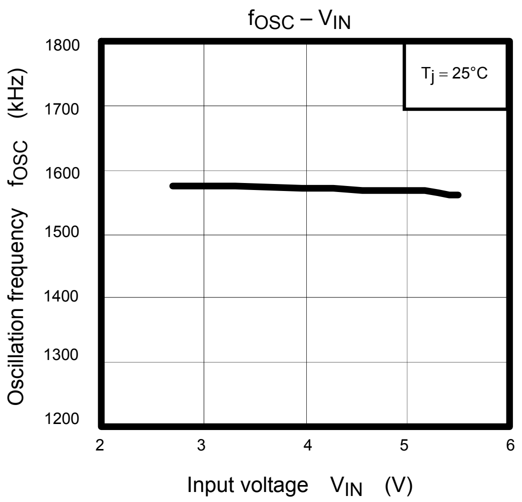


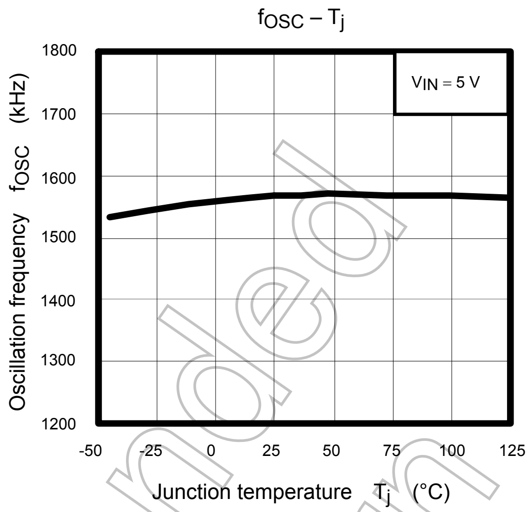
V_{FB} – T_j

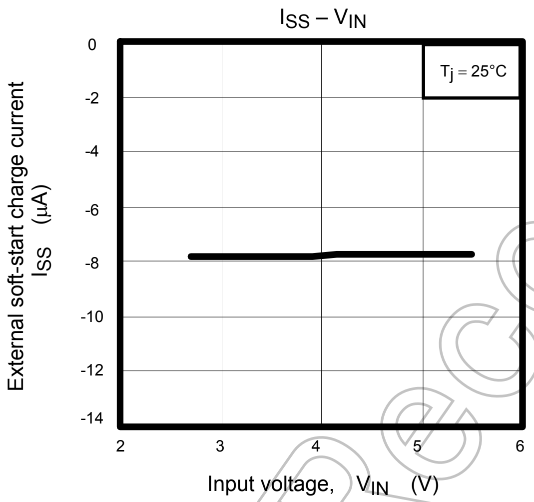


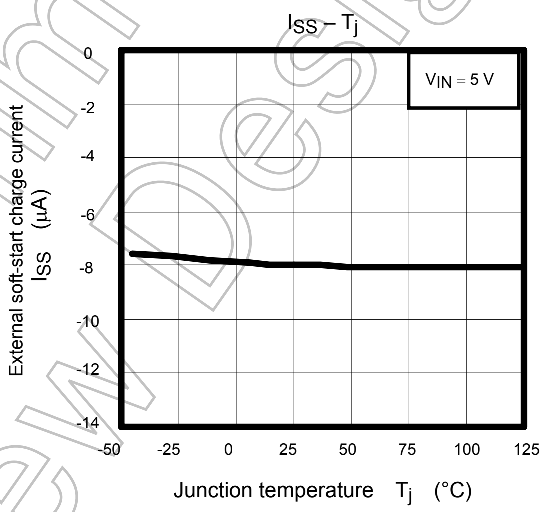
ΔV_{OUT} – V_{IN}

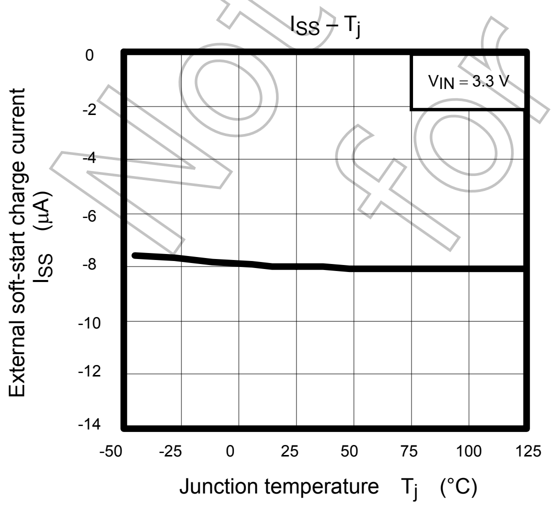


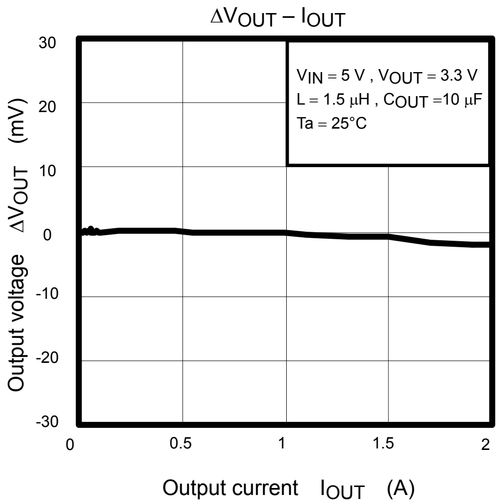

fOSC – VIN
Tj = 25°C
Oscillation frequency fOSC (kHz)
1800
1700
1600
1500
1400
1300
1200
2
3
4
5
6
Input voltage VIN (V)

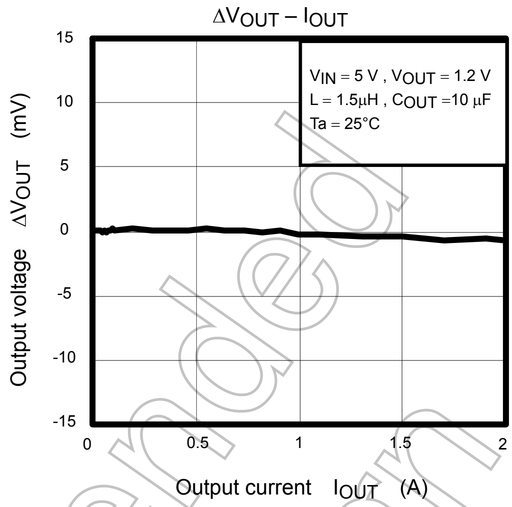

fOSC – Tj
VIN = 5 V
Oscillation frequency fOSC (kHz)
1800
1700
1600
1500
1400
1300
1200
-50
-25
0
25
50
75
100
125
Junction temperature Tj (°C)

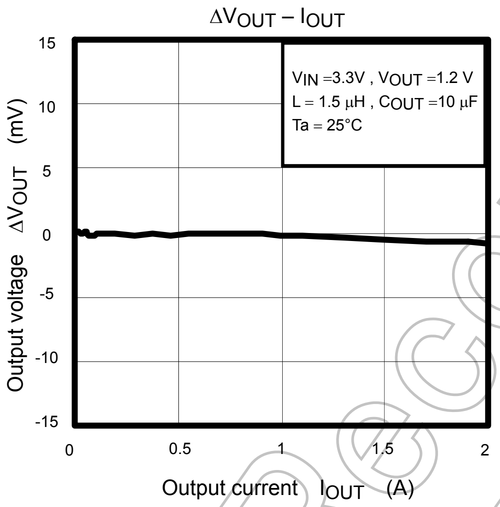

ISS – VIN
Tj = 25°C
External soft-start charge current ISS (μA)
0
-2
-4
-6
-8
-10
-12
-14
2
3
4
5
6
Input voltage, VIN (V)

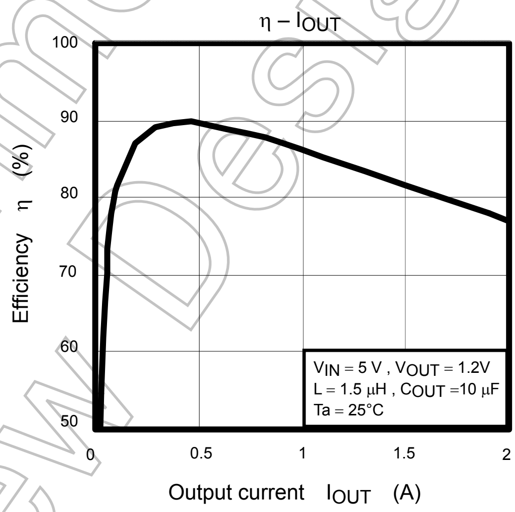

ISS – Tj
VIN = 5 V
External soft-start charge current ISS (μA)
0
-2
-4
-6
-8
-10
-12
-14
-50
-25
0
25
50
75
100
125
Junction temperature Tj (°C)

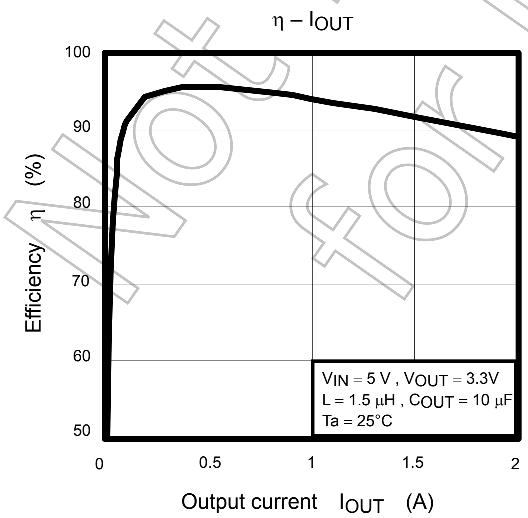

ISS – Tj
VIN = 3.3 V
External soft-start charge current ISS (μA)
0
-2
-4
-6
-8
-10
-12
-14
-50
-25
0
25
50
75
100
125
Junction temperature Tj (°C)

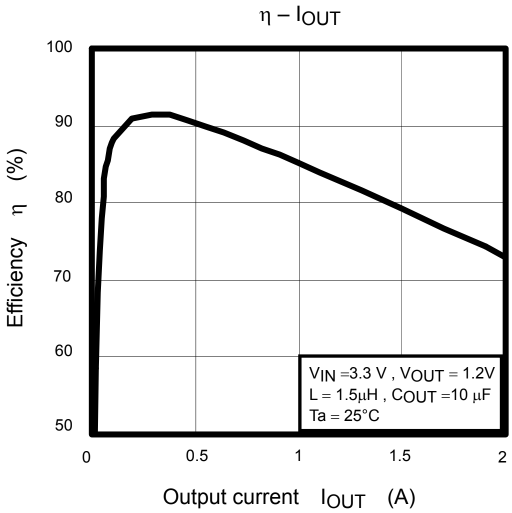

ΔVOUT – IOUT
VIN = 5 V , VOUT = 3.3 V
L = 1.5 μH , COUT =10 μF
Ta = 25°C
Output voltage ΔVOUT (mV)
30
20
10
0
-10
-20
-30
0
0.5
1
1.5
2
Output current IOUT (A)

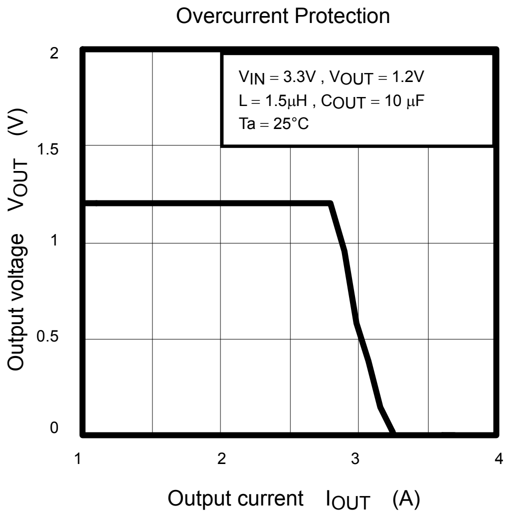

ΔVOUT – IOUT
VIN = 5 V , VOUT = 1.2 V
L = 1.5μH , COUT =10 μF
Ta = 25°C
Output voltage ΔVOUT (mV)
15
10
5
0
-5
-10
-15
0
0.5
1
1.5
2
Output current IOUT (A)

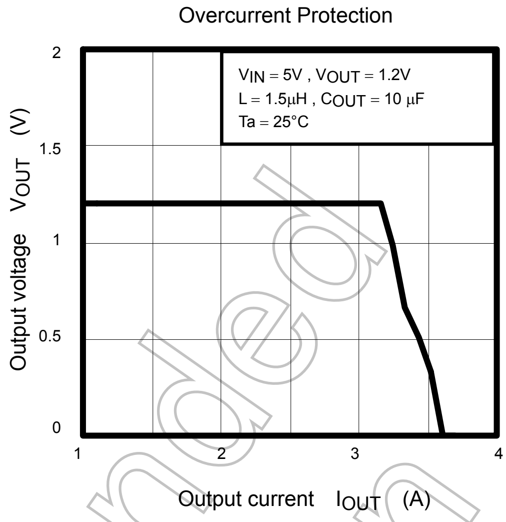

ΔVOUT – IOUT
VIN =3.3V , VOUT =1.2 V
L = 1.5 μH , COUT =10 μF
Ta = 25°C
Output voltage ΔVOUT (mV)
15
10
5
0
-5
-10
-15
0
0.5
1
1.5
2
Output current IOUT (A)

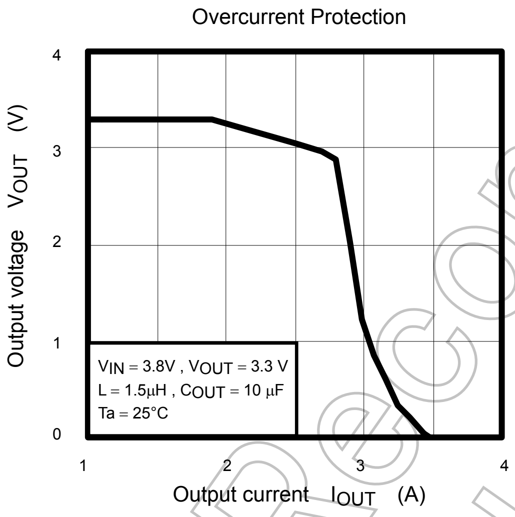

η – IOUT
VIN = 5 V , VOUT = 1.2V
L = 1.5 μH , COUT =10 μF
Ta = 25°C
Efficiency η (%)
100
90
80
70
60
50
0
0.5
1
1.5
2
Output current IOUT (A)

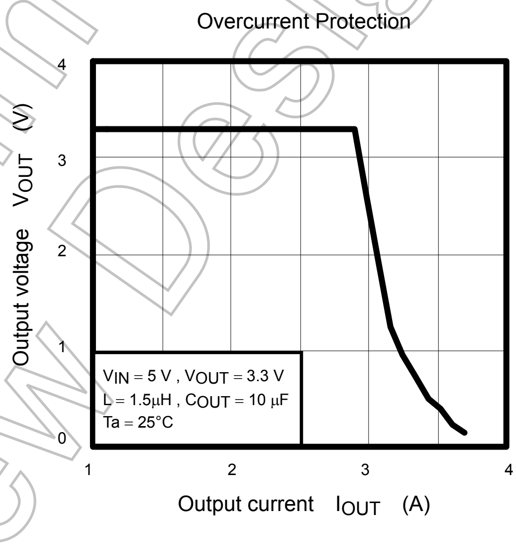

η – IOUT
VIN = 5 V , VOUT = 3.3V
L = 1.5 μH , COUT = 10 μF
Ta = 25°C
Efficiency η (%)
100
90
80
70
60
50
0
0.5
1
1.5
2
Output current IOUT (A)


η – IOUT
VIN =3.3 V , VOUT = 1.2V
L = 1.5μH , COUT =10 μF
Ta = 25°C
Efficiency η (%)
100
90
80
70
60
50
0
0.5
1
1.5
2
Output current IOUT (A)

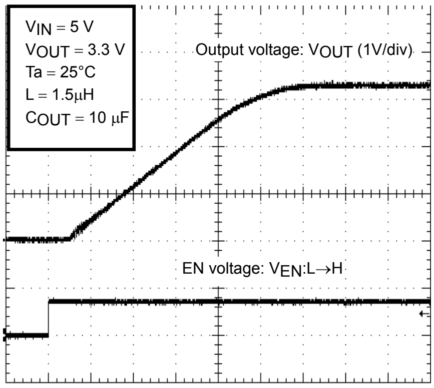

Overcurrent Protection
VIN = 3.3V , VOUT = 1.2V
L = 1.5μH , COUT = 10 μF
Ta = 25°C
Output voltage VOUT (V)
Output current IOUT (A)


Overcurrent Protection
VIN = 5V , VOUT = 1.2V
L = 1.5μH , COUT = 10 μF
Ta = 25°C
Output voltage VOUT (V)
Output current IOUT (A)


Overcurrent Protection
VIN = 3.8V , VOUT = 3.3 V
L = 1.5μH , COUT = 10 μF
Ta = 25°C
Output voltage VOUT (V)
Output current IOUT (A)

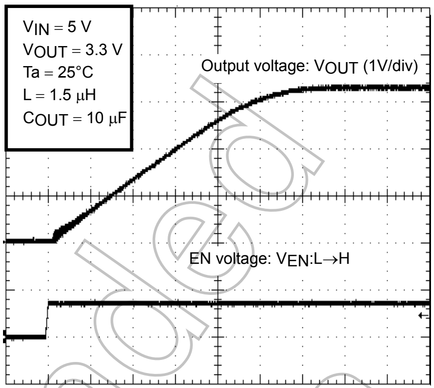

Overcurrent Protection
VIN = 5 V , VOUT = 3.3 V
L = 1.5μH , COUT = 10 μF
Ta = 25°C
Output voltage VOUT (V)
Output current IOUT (A)

Startup Characteristics
(Internal Soft-Start Time)



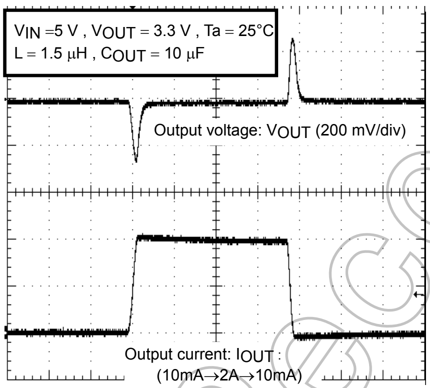
200 μs/div

Startup Characteristics
(C_{SS} = 0.1 μF)



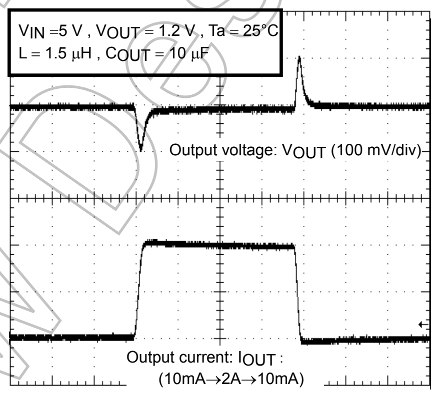
2 ms/div

Load Response Characteristics



100 μs/div

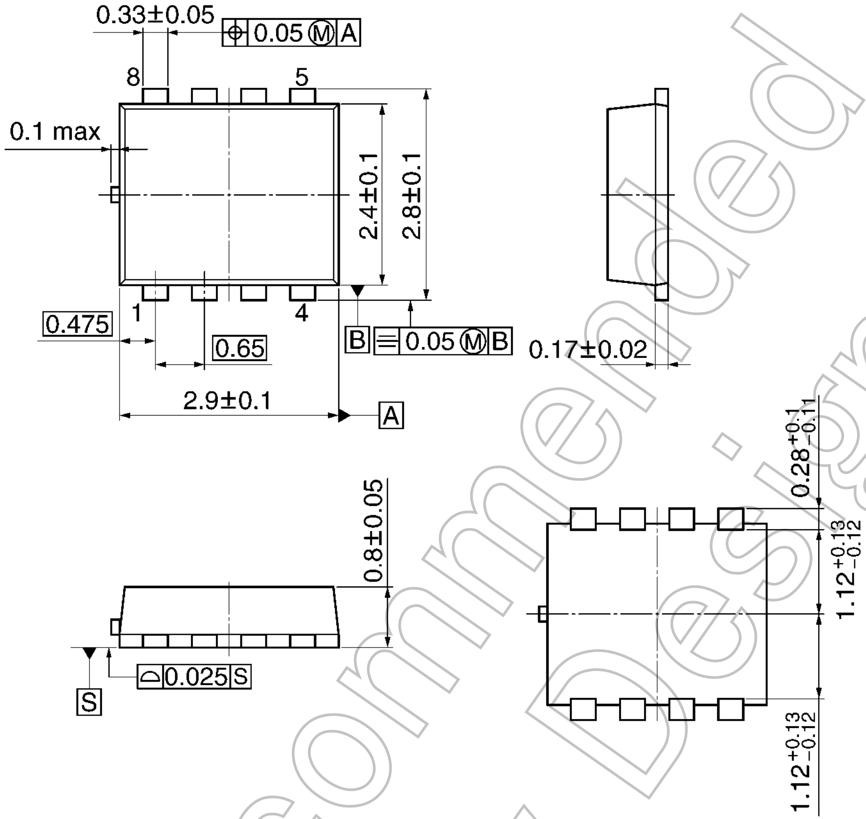
Load Response Characteristics



100 μs/div

Package Dimensions

SON8-P-0303-0.65A Unit: mm



Weight: 0.017 g (typ.)

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