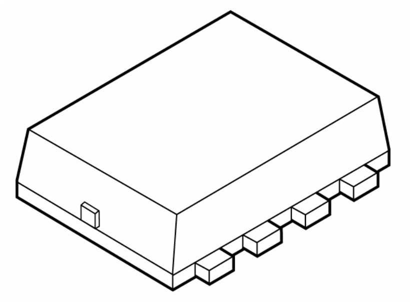
Toshiba BiCD Integrated Circuit Silicon Monolithic

TB7101F(T5L1.2,F) , TB7101F(T5L1.5,F) TB7101F(T5L1.8,F) , TB7101F(T5L2.5,F) TB7101F(T5L3.3,F)

Step-down DC-DC Converter IC

The TB7101F is a single-chip step-down DC-DC converter IC. Equipped with a built-in high-speed and low on-resistance power MOSFET, and utilizing a synchronous rectifier circuit, this IC can achieve high efficiency.



SON8-P-0303-0.65A

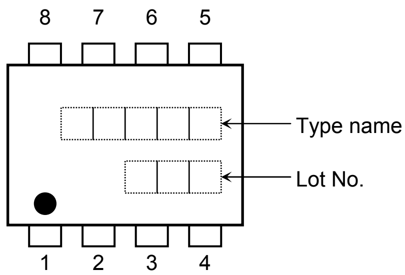
Weight : 0.017 g (typ.)

Features

- Capable of high current drive (I_{OUT} = maximum of 1 A), using only a few external components.
- Operating voltage (V_{IN}) range: 2.7 to 5.5 V.
- Fixed output voltage : V_{OUT} = 1.2V / 1.5V / 1.8V / 2.5V / 3.3V(typ.)
- High oscillation frequency of 1 MHz (typ.), making it possible to use small external components.
- Uses internal phase compensation, achieving high efficiency using only an inductor and two capacitors.
- Built-in current mode architecture with excellent fast load response.
- A small surface-mount type ceramic capacitor can be used as an output smoothing capacitor.
- Housed in a small surface-mount package (PS-8) with a low thermal resistance.
- Built-in undervoltage lock out (U.V.L.O), heatprotection, and overcurrent protection.

Marking (Note 1)/Pin Assignment

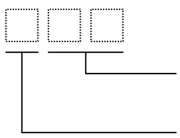
Type	Output voltage(V)	Type name
TB7101F(T5L1.2,F)	1.2	7101A
TB7101F(T5L1.5,F)	1.5	7101B
TB7101F(T5L1.8,F)	1.8	7101C
TB7101F(T5L2.5,F)	2.5	7101D
TB7101F(T5L3.3,F)	3.3	7101E



1 : PGND
2 : V_{IN}
3 : EN
4 : SGND
5 : N.C.
6 : N.C.
7 : V_{OUT}
8 : L_X

Note 1: ● on the lower left of the marking indicates Pin 1.

* The Lot number comprises three numerals. The first numeral represents the last digit of the year of manufacture, and the following two digits indicate the week of manufacture, beginning with 01 and continuing to either 52 or 53.



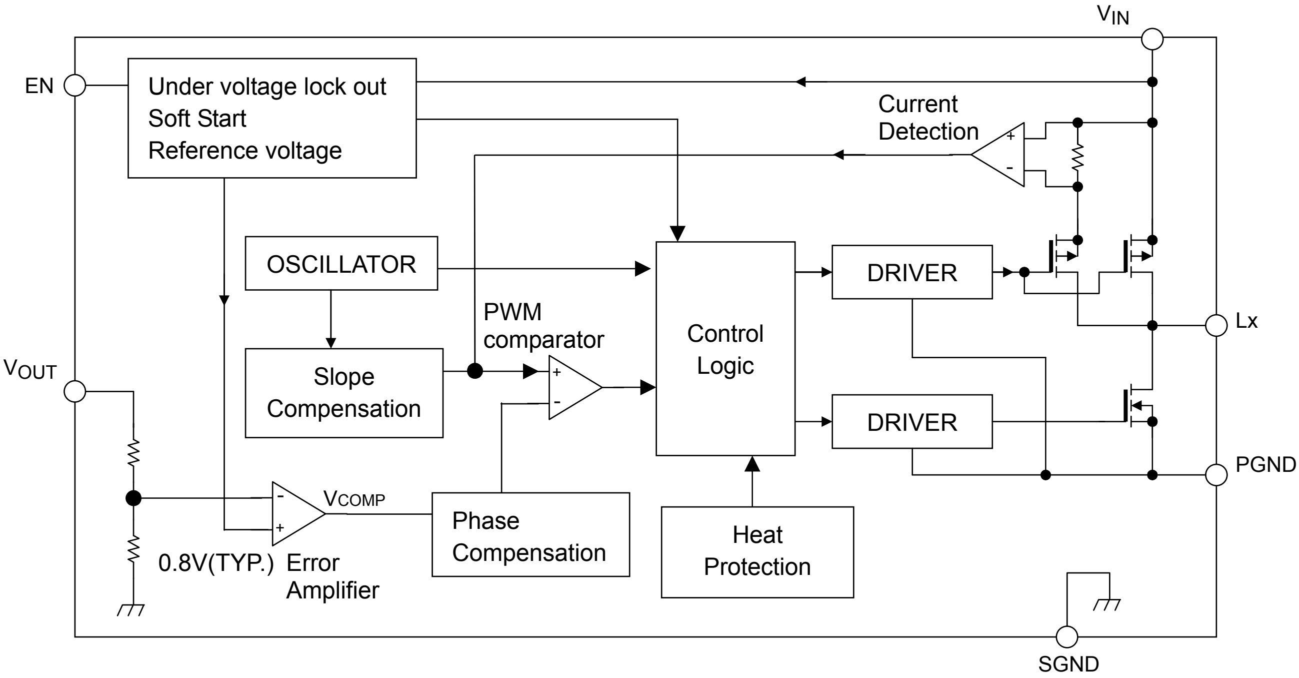
Manufacturing week Code
(The first week of the year is 01, continuing up to 52 or 53)
Manufacturing year Code
(Last digit of the year of manufacture)

Due to its MOS structure, this product is sensitive to electrostatic discharge. Handle with care.

How to Order

Product No.	Package Type and Capacity
TB7101F(T5L*.*,F)	Emboss Taping (3000pcs / reel)

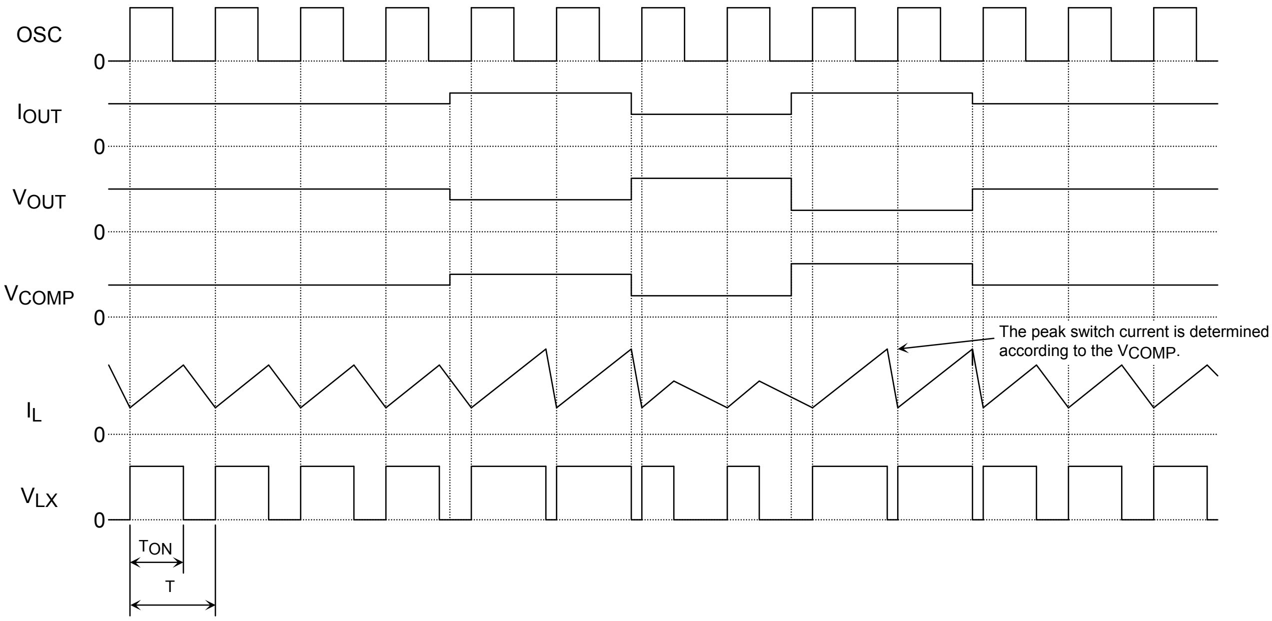
Block Diagram



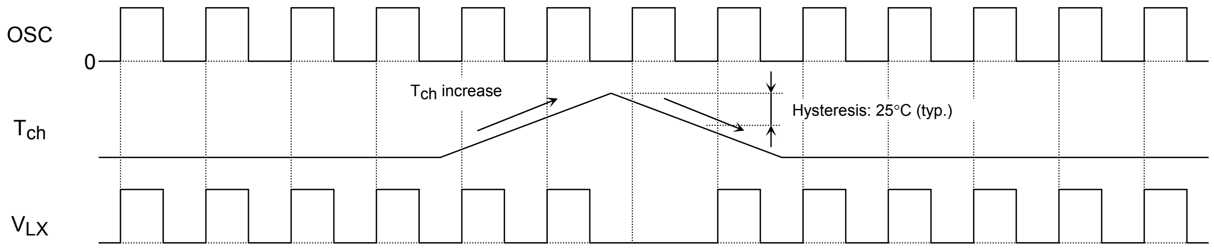
Pin Descriptions

Pin No.	Pin Symbol	Pin Description
1	PGND	Power ground.
2	V_{IN}	Input pin. This pin is placed in the standby state if V_{ENB} = low. 1 μA or lower operating current.
3	EN	Enable pin. This pin is connected to the CMOS inverter. Applying 3.5 V or higher (@ V_{IN} = 5 V) to this pin causes the internal circuit to start switching control.
4	SGND	Signal ground.
5	N.C.	No connection.
6	N.C.	No connection.
7	V_{OUT}	Output voltage pin. Output voltage is set to 1.2V / 1.5V / 1.8V / 2.5V / 3.3V(typ.) internally.
8	L_X	Switching pin. This pin is connected to high-side pch MOS FET and low-side nch MOS FET.

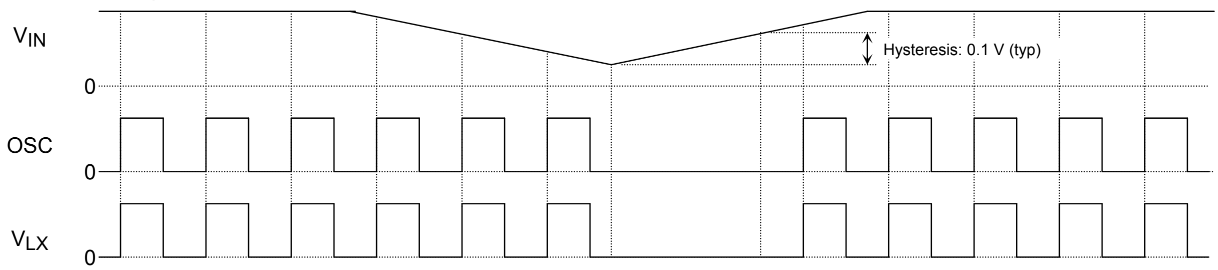
Timing Chart



Overheat state operation



Low Voltage operation



OSC : Internal oscillator output voltage
I_{OUT} : Load current
V_{OUT}: Output voltage
V_{COMP}: Output voltage of error amplifier
I_L : Inductor current
V_{LX} : L_X pin voltage
V_{IN} : Input pin voltage
T_{ch} : Channel temperature

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Input voltage	V_{IN}	-0.3～6	V
Switch pin voltage	V_{LX}	-0.3～6	V
Feedback pin voltage	V_{OUT}	-0.3～6	V
Enable pin voltage	V_{EN}	-0.3～6	V
Input-enable pin voltage	V_{EN}-V_{IN}	V_{EN}-V_{IN}<0.3	V
Power dissipation (Note 1)	P_D	0.7	W
Operating temperature	T_{opr}	-40～85	°C
Operating junction temperature	T_{jopr}	-40～125	°C
Channel temperature	T_{ch}	150	°C
Storage temperature	T_{stg}	-55～150	°C

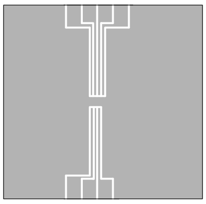
Note 1: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage a significant change in temperature, etc.) may significantly reduce the reliability of this product even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.
Please consult 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) when designing in order to ensure the appropriate reliability.

Thermal Resistance Characteristic

Characteristics	Symbol	Max	Unit
Thermal resistance, channel and ambient	$R_{th\ (ch-a)}$	178.6 (Note 2)	°C /W

(Note 2)

Glass epoxy board



Material: FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

Electrical Characteristics (unless otherwise specified: Tj = 25°C and V_{IN} = 2.7 to 5.5 V)

●TB7101F(T5L1.2,F)

Characteristics		Symbol	Test circuit	Test condition	Min	Typ.	Max	Unit
Operating supply voltage		$V_{IN(OPR)}$	-	-	2.7	-	5.5	V
Operating current		$I_{IN(1)}$	-	V_{IN}= 5V, V_{EN}= 5V, V_{OUT}= 5V	-	0.68	0.9	mA
		$I_{IN(2)}$	-	V_{IN}= 2.7V, V_{EN}= 2.7V, V_{OUT} =2.7V	-	0.55	0.69	mA
Standby current		$I_{IN(STBY)}$	-	V_{IN}= 5V, V_{EN}= 0V,V_{OUT}= 0V	-	-	1	μA
Enable pin threshold voltage		$V_{IH(EN)(1)}$	-	V_{IN}= 5V	3.5	-	-	V
		$V_{IH(EN)(2)}$	-	V_{IN}= 2.7V	1.89	-	-	V
		$V_{IL(EN)(1)}$	-	V_{IN}= 5V	-	-	1.5	V
		$V_{IL(EN)(2)}$	-	V_{IN}= 2.7V	-	-	0.81	V
Enable pin input current		$I_{IH(EN)(1)}$	-	V_{IN}= 5V, V_{EN}= 5V	7.6	-	12.4	μA
		$I_{IH(EN)(2)}$	-	V_{IN}= 2.7V, V_{EN}= 2.7V	4.1	-	6.7	μA
Output voltage		$V_{OUT(1)}$	-	V_{IN}= 5V, V_{EN}= 5V I_{OUT}=100mA	1.164	1.2	1.236	V
		$V_{OUT(2)}$	-	V_{IN}=2.7V, V_{EN}= 2.7V, I_{OUT}=100mA	1.164	1.2	1.236	V
Line regulation		LINE REG	-	V_{IN}= V_{EN}= 2.7V～5.5V I_{OUT}=100mA	-	-	14.5	mV
Load regulation		LOAD REG	-	V_{IN}=5V I_{OUT}= 100mA～500mA	-	-	14.5	mV
High-side on-state resistance		$R_{DS(ON)(H)}$	-	V_{IN}= 5V, V_{EN}= 5V, I_{LX}= 0.5A	-	0.27	-	Ω
Low-side on-state resistance		$R_{DS(ON)(L)}$	-	V_{IN}= 5V, V_{EN}= 5V, I_{LX}= 0.5A	-	0.27	-	Ω
High-side leakage current		$I_{LEAK(H)}$	-	V_{IN}= 5V, V_{EN}= 0V, V_{LX}= 0V	-	-	1	μA
Low-side leakage current		$I_{LEAK(L)}$	-	V_{IN}= 5V, V_{EN}= 0V, V_{LX}= 5V	-	-	1	μA
Oscillation frequency		$f_{OSC(1)}$	-	V_{IN}= 5V, V_{EN}= 5V	0.85	1	1.15	MHz
		$f_{OSC(2)}$	-	V_{IN}= 2.7V, V_{EN}= 2.7V	0.85	1	1.15	MHz
Soft start time		$tss_{(1)}$	-	V_{IN}=5V , V_{EN}=5V, (no load)	1	2	-	ms
		$tss_{(2)}$	-	V_{IN}= 2.7V, V_{EN}= 2.7V, (no load)	1.4	2.4	-	ms
Undervoltage protection	Detection	V_{UV}	-	-	2.2	2.5	2.7	V
	Hysteresis	ΔV_{UV}	-	-	-	0.1	-	V

Protection function (reference data)

●TB7101F(T5L1.2,F)

Overheat protection	Detection	T_{SD}	-	-	-	160	-	°C
	Hysteresis	ΔT_{SD}		-	-	20	-	°C

Electrical Characteristics (unless otherwise specified: Tj = 25°C and V_{IN} = 2.7 to 5.5 V)

●**TB7101F(T5L1.5,F)**

Characteristics		Symbol	Test circuit	Test condition	Min	Typ.	Max	Unit
Operating supply voltage		$V_{IN(OPR)}$	-	-	2.7	-	5.5	V
Operating current		$I_{IN(1)}$	-	V_{IN}= 5V, V_{EN}= 5V, V_{OUT}= 5V	-	0.68	0.9	mA
		$I_{IN(2)}$	-	V_{IN}= 2.7V, V_{EN}= 2.7V, V_{OUT} =2.7V	-	0.55	0.69	mA
Standby current		$I_{IN(STBY)}$	-	V_{IN}= 5V, V_{EN}= 0V,V_{OUT}= 0V	-	-	1	μA
Enable pin threshold voltage		$V_{IH(EN)(1)}$	-	V_{IN}= 5V	3.5	-	-	V
		$V_{IH(EN)(2)}$	-	V_{IN}= 2.7V	1.89	-	-	V
		$V_{IL(EN)(1)}$	-	V_{IN}= 5V	-	-	1.5	V
		$V_{IL(EN)(2)}$	-	V_{IN}= 2.7V	-	-	0.81	V
Enable pin input current		$I_{IH(EN)(1)}$	-	V_{IN}= 5V, V_{EN}= 5V	7.6	-	12.4	μA
		$I_{IH(EN)(2)}$	-	V_{IN}= 2.7V, V_{EN}= 2.7V	4.1	-	6.7	μA
Output voltage		$V_{OUT(1)}$	-	V_{IN}= 5V, V_{EN}= 5V I_{OUT}=100mA	1.455	1.5	1.545	V
		$V_{OUT(2)}$	-	V_{IN}=2.7V, V_{EN}= 2.7V, I_{OUT}=100mA	1.455	1.5	1.545	V
Line regulation		LINE REG	-	V_{IN}= V_{EN}= 2.7V～5.5V I_{OUT}=100mA	-	-	18	mV
Load regulation		LOAD REG	-	V_{IN}=5V I_{OUT}= 100mA～500mA	-	-	18	mV
High-side on-state resistance		$R_{DS(ON)(H)}$	-	V_{IN}= 5V, V_{EN}= 5V, I_{LX}= 0.5A	-	0.27	-	Ω
Low-side on-state resistance		$R_{DS(ON)(L)}$	-	V_{IN}= 5V, V_{EN}= 5V, I_{LX}= 0.5A	-	0.27	-	Ω
High-side leakage current		$I_{LEAK(H)}$	-	V_{IN}= 5V, V_{EN}= 0V, V_{LX}= 0V	-	-	1	μA
Low-side leakage current		$I_{LEAK(L)}$	-	V_{IN}= 5V, V_{EN}= 0V, V_{LX}= 5V	-	-	1	μA
Oscillation frequency		$f_{OSC(1)}$	-	V_{IN}= 5V, V_{EN}= 5V	0.85	1	1.15	MHz
		$f_{OSC(2)}$	-	V_{IN}= 2.7V, V_{EN}= 2.7V	0.85	1	1.15	MHz
Soft start time		$tss_{(1)}$	-	V_{IN}=5V , V_{EN}=5V, (no load)	1	2	-	ms
		$tss_{(2)}$	-	V_{IN}= 2.7V, V_{EN}= 2.7V, (no load)	1.4	2.4	-	ms
Undervoltage protection	Detection	V_{UV}	-	-	2.2	2.5	2.7	V
	Hysteresis	ΔV_{UV}	-	-	-	0.1	-	V

Protection function (reference data)

●**TB7101F(T5L1.5,F)**

Overheat protection	Detection	T_{SD}	-	-	-	160	-	°C
	Hysteresis	ΔT_{SD}		-	-	20	-	°C

Electrical Characteristics (unless otherwise specified: Tj = 25°C and V_{IN} = 2.8 to 5.5 V)

●TB7101F(T5L1.8,F)

Characteristics		Symbol	Test circuit	Test condition	Min	Typ.	Max	Unit
Operating supply voltage		$V_{IN(OPR)}$	-	-	2.8	-	5.5	V
Operating current		$I_{IN(1)}$	-	V_{IN}= 5V, V_{EN}= 5V, V_{OUT}= 5V	-	0.68	0.9	mA
		$I_{IN(2)}$	-	V_{IN}= 2.8V, V_{EN}= 2.8V, V_{OUT} =2.8V	-	0.55	0.69	mA
Standby current		$I_{IN(STBY)}$	-	V_{IN}= 5V, V_{EN}= 0V,V_{OUT}= 0V	-	-	1	μA
Enable pin threshold voltage		$V_{IH(EN)(1)}$	-	V_{IN}= 5V	3.5	-	-	V
		$V_{IH(EN)(2)}$	-	V_{IN}= 2.8V	1.89	-	-	V
		$V_{IL(EN)(1)}$	-	V_{IN}= 5V	-	-	1.5	V
		$V_{IL(EN)(2)}$	-	V_{IN}= 2.8V	-	-	0.81	V
Enable pin input current		$I_{IH(EN)(1)}$	-	V_{IN}= 5V, V_{EN}= 5V	7.6	-	12.4	μA
		$I_{IH(EN)(2)}$	-	V_{IN}= 2.8V, V_{EN}= 2.8V	4.26	-	6.94	μA
Output voltage		$V_{OUT(1)}$	-	V_{IN}= 5V, V_{EN}= 5V I_{OUT}=100mA	1.746	1.8	1.854	V
		$V_{OUT(2)}$	-	V_{IN}=2.8V, V_{EN}= 2.8V, I_{OUT}=100mA	1.746	1.8	1.854	V
Line regulation		LINE REG	-	V_{IN}= V_{EN}= 2.8V～5.5V I_{OUT}=100mA	-	-	14.5	mV
Load regulation		LOAD REG	-	V_{IN}=5V I_{OUT}= 100mA～500mA	-	-	14.5	mV
High-side on-state resistance		$R_{DS(ON)(H)}$	-	V_{IN}= 5V, V_{EN}= 5V, I_{LX}= 0.5A	-	0.27	-	Ω
Low-side on-state resistance		$R_{DS(ON)(L)}$	-	V_{IN}= 5V, V_{EN}= 5V, I_{LX}= 0.5A	-	0.27	-	Ω
High-side leakage current		$I_{LEAK(H)}$	-	V_{IN}= 5V, V_{EN}= 0V, V_{LX}= 0V	-	-	1	μA
Low-side leakage current		$I_{LEAK(L)}$	-	V_{IN}= 5V, V_{EN}= 0V, V_{LX}= 5V	-	-	1	μA
Oscillation frequency		$f_{OSC(1)}$	-	V_{IN}= 5V, V_{EN}= 5V	0.85	1	1.15	MHz
		$f_{OSC(2)}$	-	V_{IN}= 2.8V, V_{EN}= 2.8V	0.85	1	1.15	MHz
Soft start time		$tss_{(1)}$	-	V_{IN}=5V , V_{EN}=5V, (no load)	1	2	-	ms
		$tss_{(2)}$	-	V_{IN}= 2.8V, V_{EN}= 2.8V, (no load)	1.4	2.4	-	ms
Undervoltage protection	Detection	V_{UV}	-	-	2.2	2.5	2.7	V
	Hysteresis	ΔV_{UV}	-	-	-	0.1	-	V

Protection function (reference data)

●TB7101F(T5L1.8,F)

Overheat protection	Detection	T_{SD}	-	-	-	160	-	°C
	Hysteresis	ΔT_{SD}		-	-	20	-	°C

Electrical Characteristics (unless otherwise specified: Tj = 25°C and V_{IN} = 3.5 to 5.5 V)

●TB7101F(T5L2.5,F)

Characteristics		Symbol	Test circuit	Test condition	Min	Typ.	Max	Unit
Operating supply voltage		$V_{IN(OPR)}$	-	-	3.5	-	5.5	V
Operating current		$I_{IN(1)}$	-	V_{IN}= 5V, V_{EN}= 5V, V_{OUT}= 5V	-	0.68	0.9	mA
		$I_{IN(2)}$	-	V_{IN}= 3.5V, V_{EN}= 3.5V, V_{OUT} =3.5V	-	0.55	0.705	mA
Standby current		$I_{IN(STBY)}$	-	V_{IN}= 5V, V_{EN}= 0V,V_{OUT}= 0V	-	-	1	μA
Enable pin threshold voltage		$V_{IH(EN)(1)}$	-	V_{IN}= 5V	3.5	-	-	V
		$V_{IH(EN)(2)}$	-	V_{IN}= 3.5V	2.45	-	-	V
		$V_{IL(EN)(1)}$	-	V_{IN}= 5V	-	-	1.5	V
		$V_{IL(EN)(2)}$	-	V_{IN}= 3.5V	-	-	1.05	V
Enable pin input current		$I_{IH(EN)(1)}$	-	V_{IN}= 5V, V_{EN}= 5V	7.6	-	12.4	μA
		$I_{IH(EN)(2)}$	-	V_{IN}= 2.7V, V_{EN}= 2.7V	5.32	-	8.68	μA
Output voltage		$V_{OUT(1)}$	-	V_{IN}= 5V, V_{EN}= 5V I_{OUT}=100mA	2.425	2.5	2.575	V
		$V_{OUT(2)}$	-	V_{IN}=3.5V, V_{EN}= 3.5V, I_{OUT}=100mA	2.425	2.5	2.575	V
Line regulation		LINE REG	-	V_{IN}= V_{EN}= 3.5V～5.5V I_{OUT}=100mA	-	-	30	mV
Load regulation		LOAD REG	-	V_{IN}=5V I_{OUT}= 100mA～500mA	-	-	30	mV
High-side on-state resistance		$R_{DS(ON)(H)}$	-	V_{IN}= 5V, V_{EN}= 5V, I_{LX}= 0.5A	-	0.27	-	Ω
Low-side on-state resistance		$R_{DS(ON)(L)}$	-	V_{IN}= 5V, V_{EN}= 5V, I_{LX}= 0.5A	-	0.27	-	Ω
High-side leakage current		$I_{LEAK(H)}$	-	V_{IN}= 5V, V_{EN}= 0V, V_{LX}= 0V	-	-	1	μA
Low-side leakage current		$I_{LEAK(L)}$	-	V_{IN}= 5V, V_{EN}= 0V, V_{LX}= 5V	-	-	1	μA
Oscillation frequency		$f_{OSC(1)}$	-	V_{IN}= 5V, V_{EN}= 5V	0.85	1	1.15	MHz
		$f_{OSC(2)}$	-	V_{IN}= 3.5V, V_{EN}= 3.5V	0.85	1	1.15	MHz
Soft start time		$tss_{(1)}$	-	V_{IN}=5V , V_{EN}=5V, (no load)	1	2	-	ms
		$tss_{(2)}$	-	V_{IN}=3.5V , V_{EN}=3.5V, (no load)	1.3	2.4	-	ms
Undervoltage protection	Detection	V_{UV}	-	-	2.2	2.5	2.7	V
	Hysteresis	ΔV_{UV}	-	-	-	0.1	-	V

Protection function (reference data)

●TB7101F(T5L2.5F)

Overheat protection	Detection	T_{SD}	-	-	-	160	-	°C
	Hysteresis	ΔT_{SD}		-	-	20	-	°C

Electrical Characteristics (unless otherwise specified: Tj = 25°C and V_{IN} = 4.3 to 5.5 V)

●**TB7101F(T5L3.3,F)**

Characteristics		Symbol	Test circuit	Test condition	Min	Typ.	Max	Unit
Operating supply voltage		$V_{IN(OPR)}$	-	-	4.3	-	5.5	V
Operating current		$I_{IN(1)}$	-	V_{IN}= 5V, V_{EN}= 5V, V_{OUT}= 5V	-	0.68	0.9	mA
		$I_{IN(2)}$	-	V_{IN}= 4.3V, V_{EN}= 4.3V, V_{OUT} =4.3V	-	-	0.775	mA
Standby current		$I_{IN(STBY)}$	-	V_{IN}= 5V, V_{EN}= 0V,V_{OUT}= 0V	-	-	1	μA
Enable pin threshold voltage		$V_{IH(EN)(1)}$	-	V_{IN}= 5V	3.5	-	-	V
		$V_{IH(EN)(2)}$	-	V_{IN}= 4.3V	3.01	-	-	V
		$V_{IL(EN)(1)}$	-	V_{IN}= 5V	-	-	1.5	V
		$V_{IL(EN)(2)}$	-	V_{IN}=4.3V	-	-	1.29	V
Enable pin input current		$I_{IH(EN)(1)}$	-	V_{IN}= 5V, V_{EN}= 5V	7.6	-	12.4	μA
		$I_{IH(EN)(2)}$	-	V_{IN}= 2.7V, V_{EN}= 2.7V	6.54	-	10.66	μA
Output voltage		$V_{OUT(1)}$	-	V_{IN}= 5V, V_{EN}= 5V I_{OUT}=100mA	1.164	1.2	1.236	V
		$V_{OUT(2)}$	-	V_{IN}=4.3V, V_{EN}= 4.3V, I_{OUT}=100mA	1.164	1.2	1.236	V
Line regulation		LINE REG	-	V_{IN}= V_{EN}= 4.3V～5.5V I_{OUT}=100mA	-	-	40	mV
Load regulation		LOAD REG	-	V_{IN}=5V I_{OUT}= 100mA～500mA	-	-	40	mV
High-side on-state resistance		$R_{DS(ON)(H)}$	-	V_{IN}= 5V, V_{EN}= 5V, I_{LX}= 0.5A	-	0.27	-	Ω
Low-side on-state resistance		$R_{DS(ON)(L)}$	-	V_{IN}= 5V, V_{EN}= 5V, I_{LX}= 0.5A	-	0.27	-	Ω
High-side leakage current		$I_{LEAK(H)}$	-	V_{IN}= 5V, V_{EN}= 0V, V_{LX}= 0V	-	-	1	μA
Low-side leakage current		$I_{LEAK(L)}$	-	V_{IN}= 5V, V_{EN}= 0V, V_{LX}= 5V	-	-	1	μA
Oscillation frequency		$f_{OSC(1)}$	-	V_{IN}= 5V, V_{EN}= 5V	0.85	1	1.15	MHz
		$f_{OSC(2)}$	-	V_{IN}= 4.3V, V_{EN}= 4.3V	0.85	1	1.15	MHz
Soft start time		$t_{ss(1)}$	-	V_{IN}=5V , V_{EN}=5V, (no load)	1	2	-	ms
		$t_{ss(2)}$	-	V_{IN}=4.3V , V_{EN}=4.3V, (no load)	1.2	2.4	-	ms
Undervoltage protection	Detection	V_{UV}	-	-	2.2	2.5	2.7	V
	Hysteresis	ΔV_{UV}	-	-	-	0.1	-	V

Protection function (reference data)

●**TB7101F(T5L3.3,F)**

Overheat protection	Detection	T_{SD}	-	-	-	160	-	°C
	Hysteresis	ΔT_{SD}		-	-	20	-	°C

Electrical Characteristics Common to All Products

When a pulse test is carried out, Tj = 25°C is the standard condition in the measurements for each item.
Any drift in the electrical characteristic due to a rise in the junction temperature of the chip may be disregarded.

Application Circuit Example

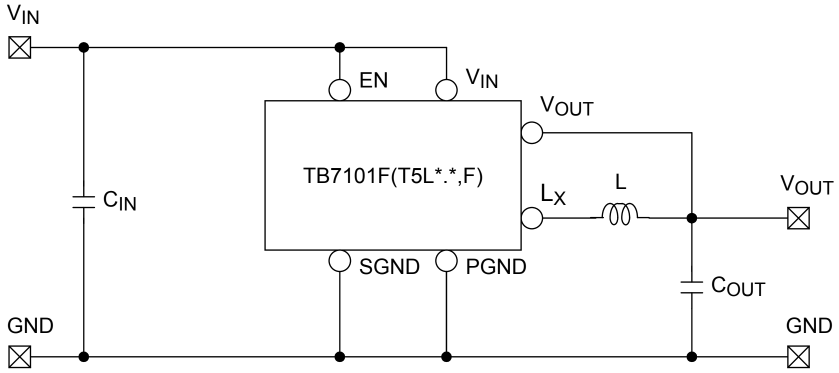


Figure 1: TB7101F application circuit example

Component constants
The following values are given only for your reference and may need tuning depending on your input/output conditions and board layout.

C_{IN}: Input smoothing capacitance of 10 μF
(multilayer ceramic capacitor JMK212BJ106KG, manufactured by Taiyo Yuden Co., Ltd.)
C_{OUT}: Output smoothing capacitance of 10 μF
(multilayer ceramic capacitor JMK212BJ106KG manufactured by Taiyo Yuden Co., Ltd.)
L: Inductor3.3 μH (@ V_{IN} = 5 V, V_{OUT} = 3.3 V); CDRH4D28C/LD series, manufactured by Sumida Corporation

How to use

Setting the Inductance

The required inductance can be calculated by using the following equation:

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

V_{IN}: Input voltage (V) f_{OSC}: Oscillation frequency (Hz)
V_{OUT}: Output voltage (V) ΔI_L: Inductor ripple current (A)

* Generally, ΔI_L should be set to 30% to 40% of the maximum output current. For the TB7101F, set ΔI_L to 0.3 A, as its maximum current [$I_{LX(MAX)}$] is 1 A (min). Therefore select an inductor whose current rating is no lower than the peak switch current [1.15 A (min)] of the TB7101F. If the current rating is exceeded, the inductor becomes saturated, leading to an unstable DC-DC converter operation.

If V_{IN} = 5 V and V_{OUT} = 3.3 V, the required inductance can be calculated as below. Be sure to select an inductor with an optimum constant by taking V_{IN} variations into consideration.

$$L = \frac{V_{IN} - V_{OUT}}{f_{OSC} \cdot \Delta I_L} \cdot \frac{V_{OUT}}{V_{IN}}$$
$$= \frac{5V - 3.3V}{1MHz \cdot 300mA} \cdot \frac{3.3V}{5V}$$
$$= 3.7\,\mu H$$

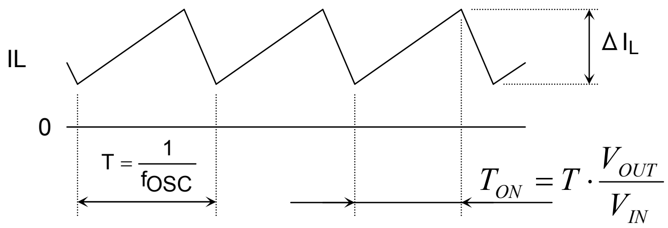


Figure 2: Inductor current waveform

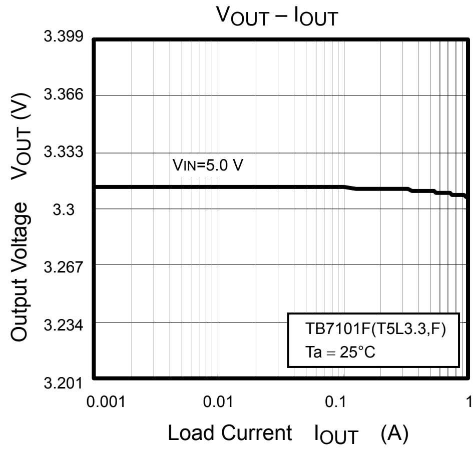
Output capacitor

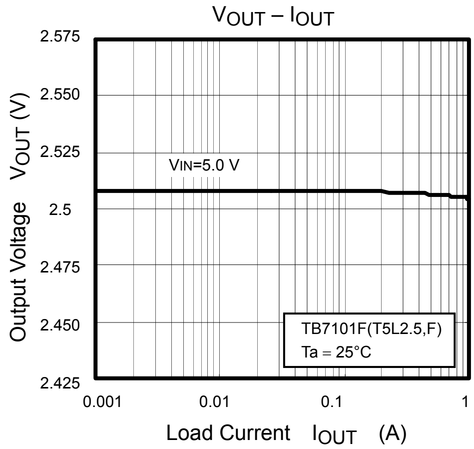
The capacitance of the output ceramic capacitor is greatly affected by temperature. Select a product whose temperature characteristics (such as B-characteristic) are excellent. The capacitance value should be to more than 10μF, and set to an optimum value by, for example, enlarging the output capacitor when there is instability under use conditions ,or when there is a large ripple voltage or drop in output voltage under heavy loads. Ceramic capacitors can be used to achieve low output ripple, though it is more difficult to achieve phase compensation with ceramic capacitors because the equivalent series resistance (ESR) of ceramic capacitors is lower. For this reason, perform a careful evaluation when using ceramic capacitors.

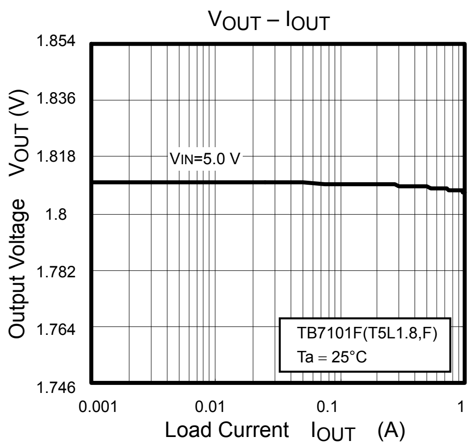
Precautions

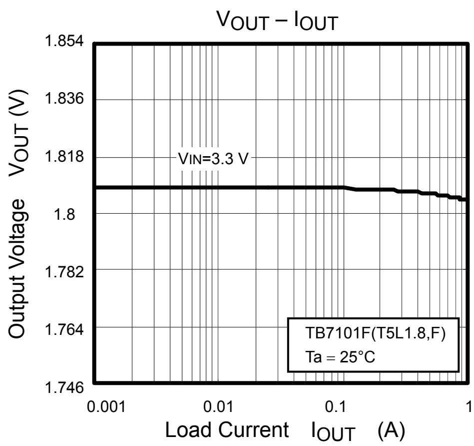
- Please select parts after confirming the actual operation in the customer set and considering the input voltage the output voltage, the output current, the temperature, the characteristics or the kind of capacitor, and the inductor.
- If the voltage between the input and output is low, the influence of the on-state voltage of the switch power MOSFET is greater, causing the voltage across the inductor to decrease. For this reason, it may become impossible for the required inductor current to flow, resulting in lower performance or unstable operation of the DC-DC converter. As a rough standard, keep the input-output voltage potential difference at or above 1 V, taking the on-state voltage of the power MOSFET into consideration.
- The lowest output voltage that can be set is 0.8 V (typ.).
- There is an antistatic diode between the ENB and V_{IN} pins. The voltage between the ENB and V_{IN} pins should satisfy the rating $V_{ENB} - V_{IN} < 0.3$ V
- If operation becomes unstable due to switching noise under a heavy load, please mount a by-pass capacitor C_{CC} between the SGND pin and the VIN pin.

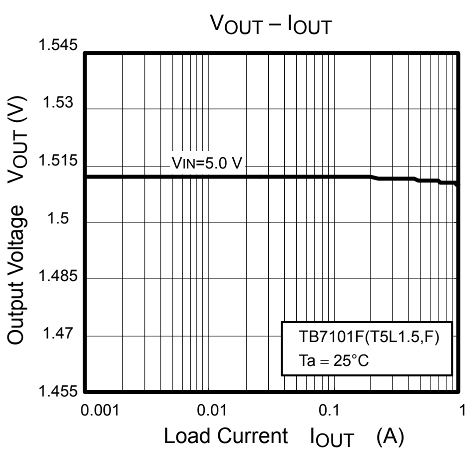
Characteristic data

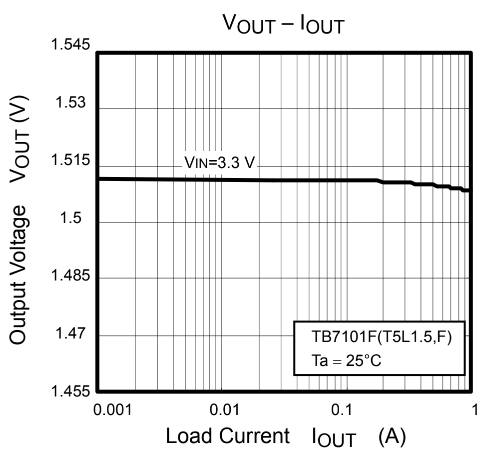


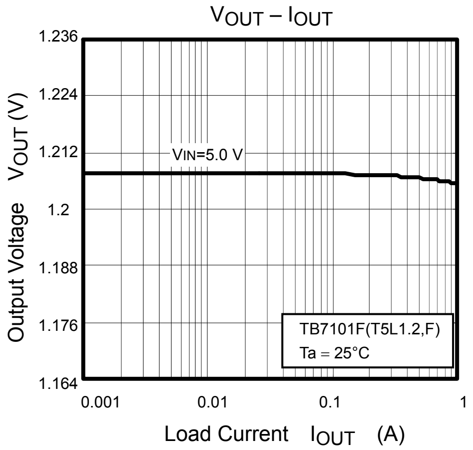


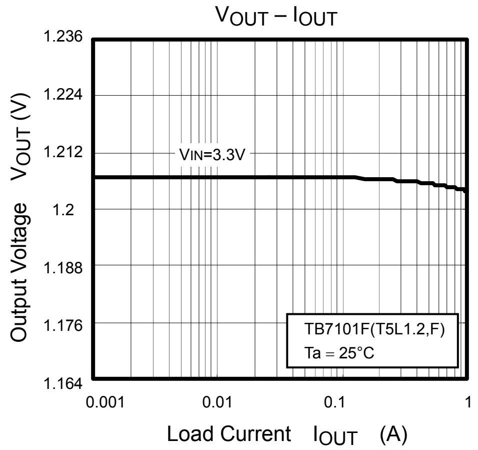


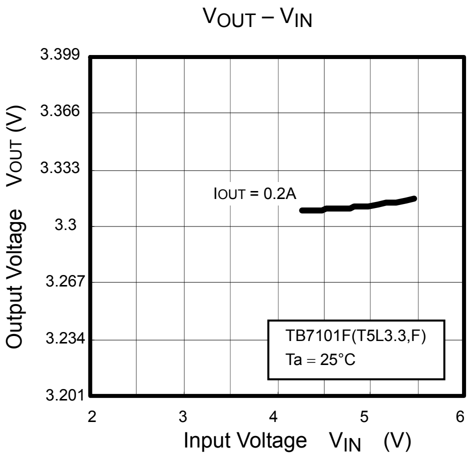


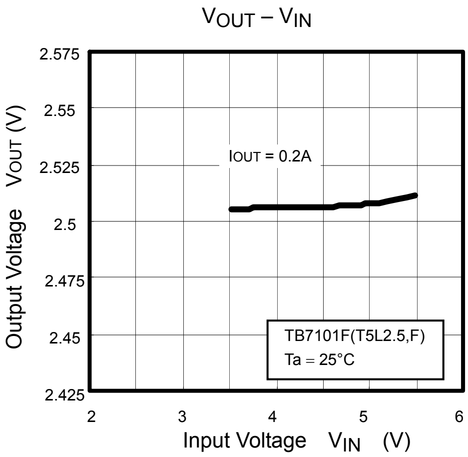


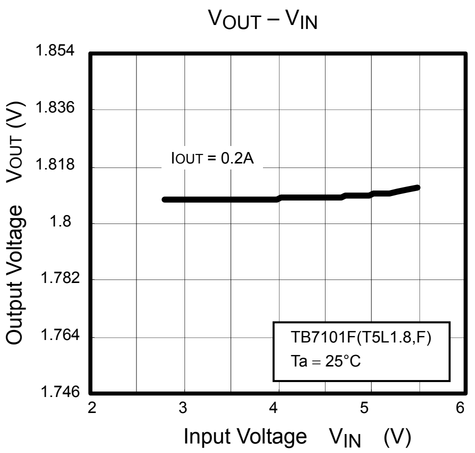


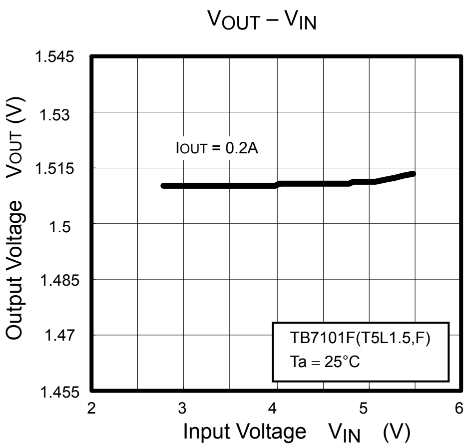

VOUT – IOUT
1.236
1.224
1.212
1.2
1.188
1.176
1.164
VIN=5.0 V
TB7101F(T5L1.2,F)
Ta = 25°C
0.001
0.01
0.1
1
Output Voltage VOUT (V)
Load Current IOUT (A)

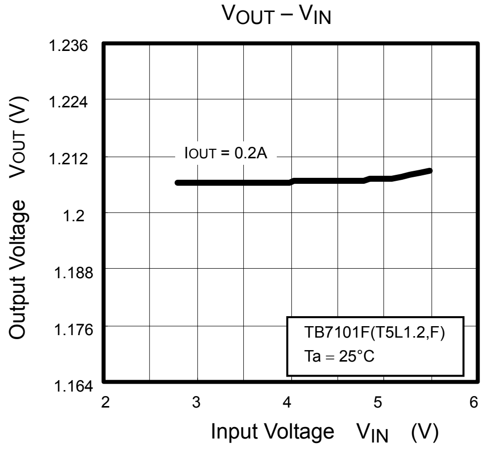

VOUT – IOUT
1.236
1.224
1.212
1.2
1.188
1.176
1.164
VIN=3.3V
TB7101F(T5L1.2,F)
Ta = 25°C
0.001
0.01
0.1
1
Output Voltage VOUT (V)
Load Current IOUT (A)

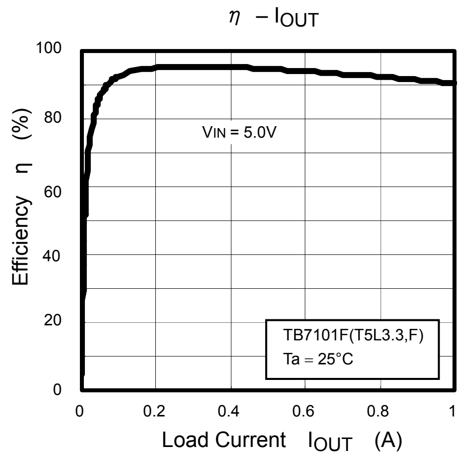

VOUT – VIN
3.399
3.366
3.333
3.3
3.267
3.234
3.201
IOUT = 0.2A
TB7101F(T5L3.3,F)
Ta = 25°C
2
3
4
5
6
Output Voltage VOUT (V)
Input Voltage VIN (V)

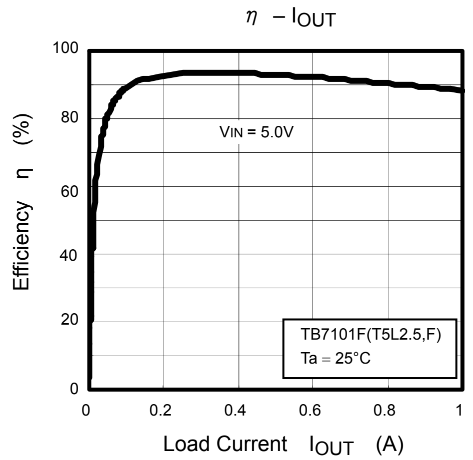

VOUT – VIN
2.575
2.55
2.525
2.5
2.475
2.45
2.425
IOUT = 0.2A
TB7101F(T5L2.5,F)
Ta = 25°C
2
3
4
5
6
Output Voltage VOUT (V)
Input Voltage VIN (V)

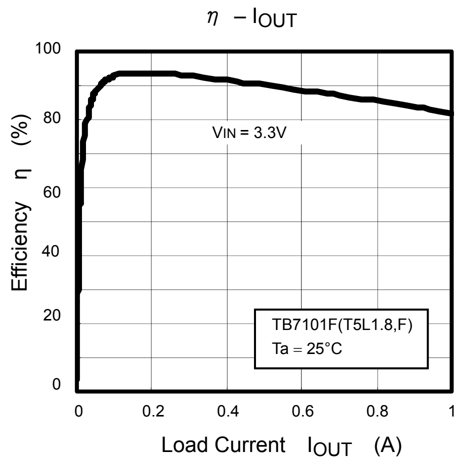

VOUT – VIN
1.854
1.836
1.818
1.8
1.782
1.764
1.746
IOUT = 0.2A
TB7101F(T5L1.8,F)
Ta = 25°C
2
3
4
5
6
Output Voltage VOUT (V)
Input Voltage VIN (V)

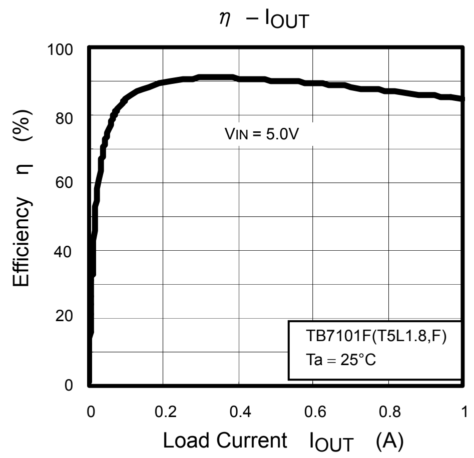

VOUT – VIN
1.545
1.53
1.515
1.5
1.485
1.47
1.455
IOUT = 0.2A
TB7101F(T5L1.5,F)
Ta = 25°C
2
3
4
5
6
Output Voltage VOUT (V)
Input Voltage VIN (V)

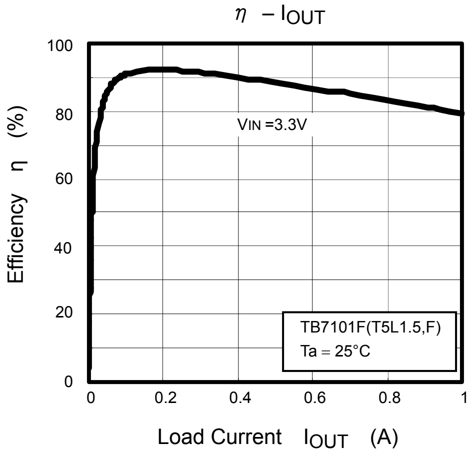

VOUT – VIN
Output Voltage VOUT (V)
1.236
1.224
1.212
1.2
1.188
1.176
1.164
IOUT = 0.2A
TB7101F(T5L1.2,F)
Ta = 25°C
2
3
4
5
6
Input Voltage VIN (V)

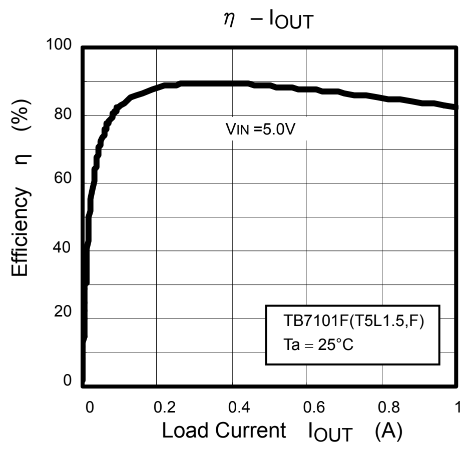

η – IOUT
Efficiency η (%)
100
80
60
40
20
0
VIN = 5.0V
TB7101F(T5L3.3,F)
Ta = 25°C
0
0.2
0.4
0.6
0.8
1
Load Current IOUT (A)

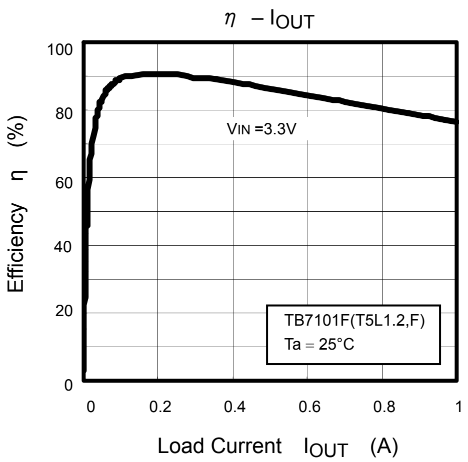

η – IOUT
Efficiency η (%)
100
80
60
40
20
0
VIN = 5.0V
TB7101F(T5L2.5,F)
Ta = 25°C
0
0.2
0.4
0.6
0.8
1
Load Current IOUT (A)

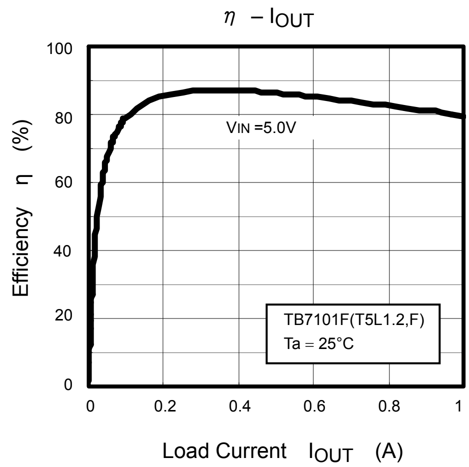

η – IOUT
Efficiency η (%)
100
80
60
40
20
0
VIN = 3.3V
TB7101F(T5L1.8,F)
Ta = 25°C
0
0.2
0.4
0.6
0.8
1
Load Current IOUT (A)


η – IOUT
Efficiency η (%)
100
80
60
40
20
0
VIN = 5.0V
TB7101F(T5L1.8,F)
Ta = 25°C
0
0.2
0.4
0.6
0.8
1
Load Current IOUT (A)


η – IOUT
VIN =3.3V
TB7101F(T5L1.5,F)
Ta = 25°C
Efficiency η (%)
Load Current IOUT (A)
0
20
40
60
80
100
0
0.2
0.4
0.6
0.8
1


η – IOUT
VIN =5.0V
TB7101F(T5L1.5,F)
Ta = 25°C
Efficiency η (%)
Load Current IOUT (A)
0
20
40
60
80
100
0
0.2
0.4
0.6
0.8
1

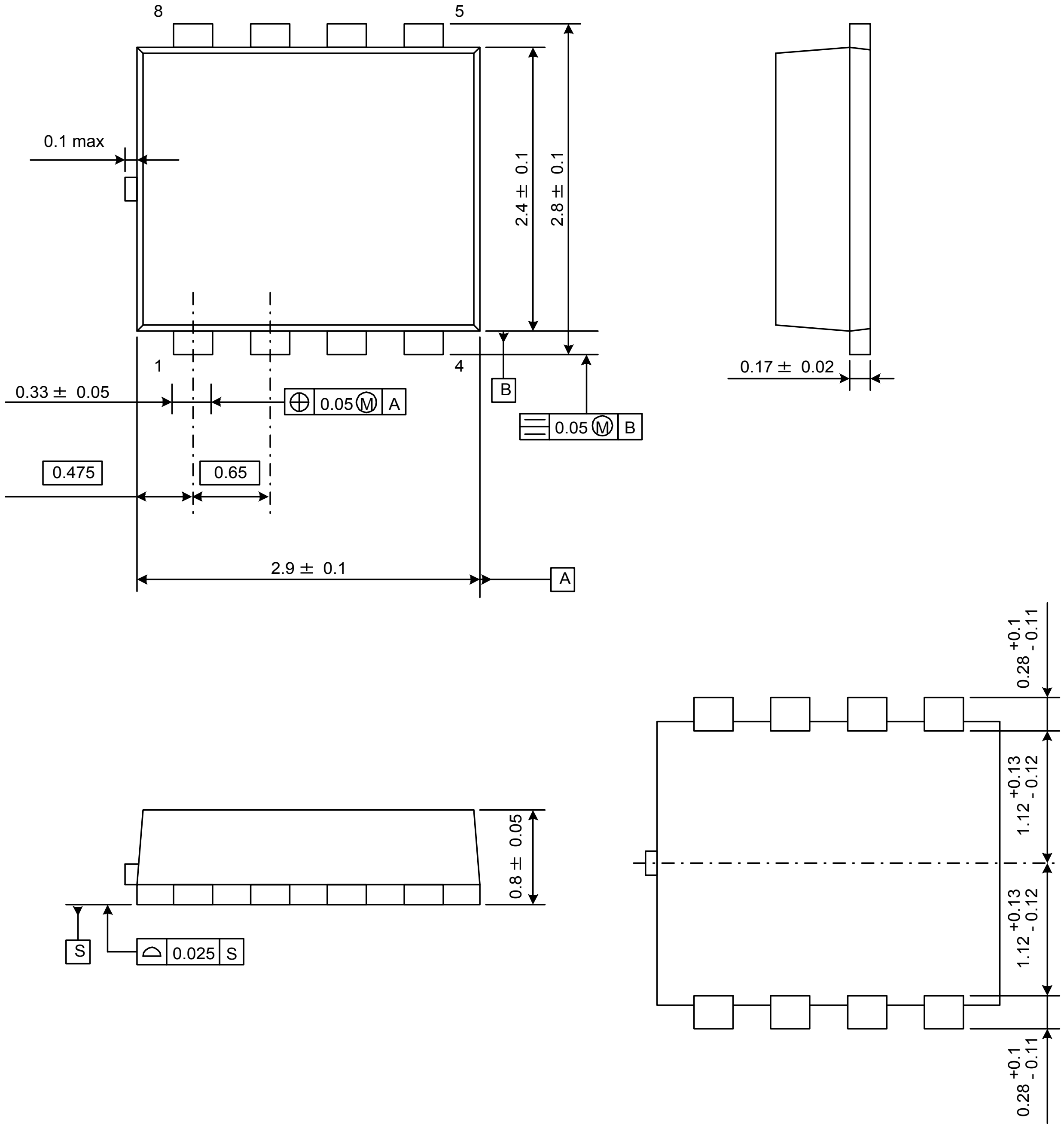

η – IOUT
VIN =3.3V
TB7101F(T5L1.2,F)
Ta = 25°C
Efficiency η (%)
Load Current IOUT (A)
0
20
40
60
80
100
0
0.2
0.4
0.6
0.8
1


η – IOUT
VIN =5.0V
TB7101F(T5L1.2,F)
Ta = 25°C
Efficiency η (%)
Load Current IOUT (A)
0
20
40
60
80
100
0
0.2
0.4
0.6
0.8
1

Package dimensions

SON8-P-0303-0.65A

Unit: mm



Weight: 0.017 g (Typ.)

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20070701-EN

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