

**Preliminary**

TOSHIBA Multi Chip Module

**TB7001FL**

For high current and low voltage applications

Synchronous buck converter module

This product is a synchronous buck switching converter module. The additional components for DC-DC converter are a PWM control IC, an external inductor, and input and output capacitors.

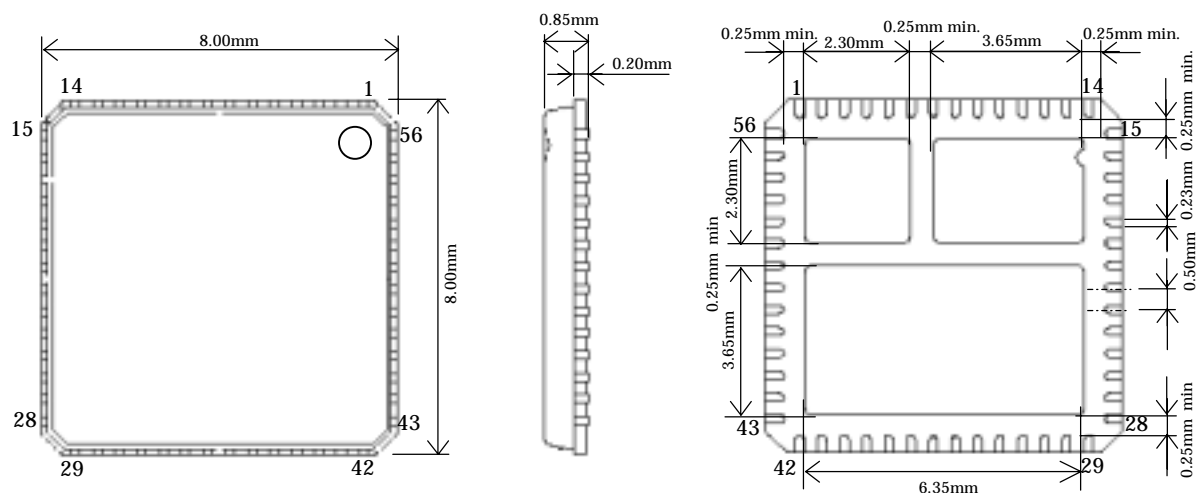
**Features**

- 3 chips (high-side MOSFET, low-side MOSFET, MOSFET gate driver- IC) are in 1 package.
- Maximum Input voltage is 19V, it is capable for note-PC applications.
- Under voltage lockout and thermal shut down
- Keeping off low-side MOSFET function. When load current is low, low-side MOSFET is able to been kept off. Consequently the efficiency increases at low load condition.
- Internal control circuit disable function. The quiescent current is less than 10  $\mu$  A.
- High operation frequency :  $f_c = 1\text{MHz}$  (Max.)
- High output current :  $I_{OUT} = 20\text{A}$  (Max.)
- High efficiency :  $\eta = 85\%$  (@  $V_{IN} = 12\text{ V}$ ,  $V_{OUT} = 1.5\text{ V}$ ,  $I_{OUT} = 20\text{A}$ ,  $f_c = 1\text{MHz}$ )

**Maximum ratings (Ta = 25°C)**

Characteristics	Symbol	Ratings	Unit
$V_{IN}$ to PGND voltage	$V_{IN}$	30	V
$L_X$ to PGND voltage	$V_{LX}$	-2 ~ 30	V
$V_{DD}$ to SGND voltage	$V_{DD}$	-0.3 ~ 6	V
BST to $L_X$ voltage	$V_{BST-LX}$	-0.3 ~ $V_{DD} + 0.3$	V
BST to SGND voltage	$V_{BST}$	-0.3 ~ 30	V
ON/OFF to SGND voltage	$V_{ON/OFF}$	-0.3 ~ $V_{DD} + 0.3$	V
SD to SGND voltage	$V_{SD}$	-0.3 ~ $V_{DD} + 0.3$	V
DISBL to SGND voltage	$V_{DISBL}$	-0.3 ~ $V_{DD} + 0.3$	V
Output RMS current	$I_{OUT}$	20	A
Power dissipation	$P_D$	TBD	W
Operating channel temperature	$T_{ch-opr}$	-40 ~ 150	°C
Storage temperature	$T_{stg}$	-55 ~ 150	°C

## Package outline

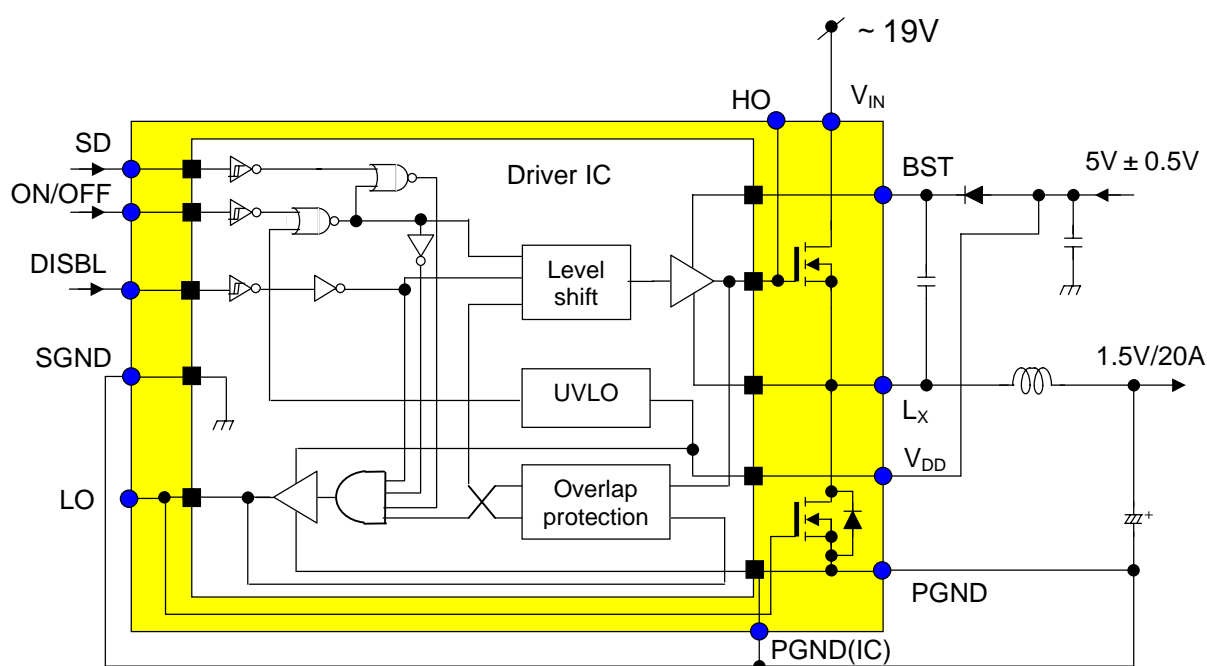


Top view

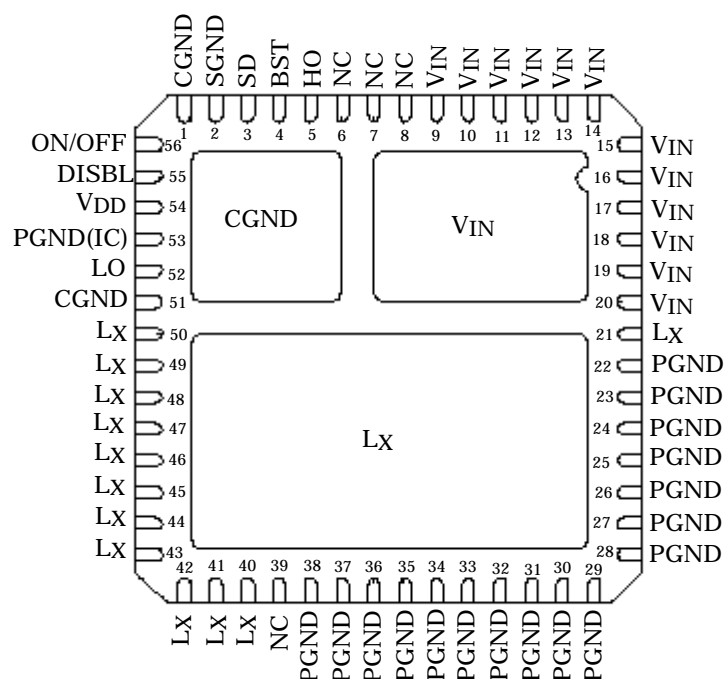
Side view

Bottom view

## Block diagram



## Terminal configurations

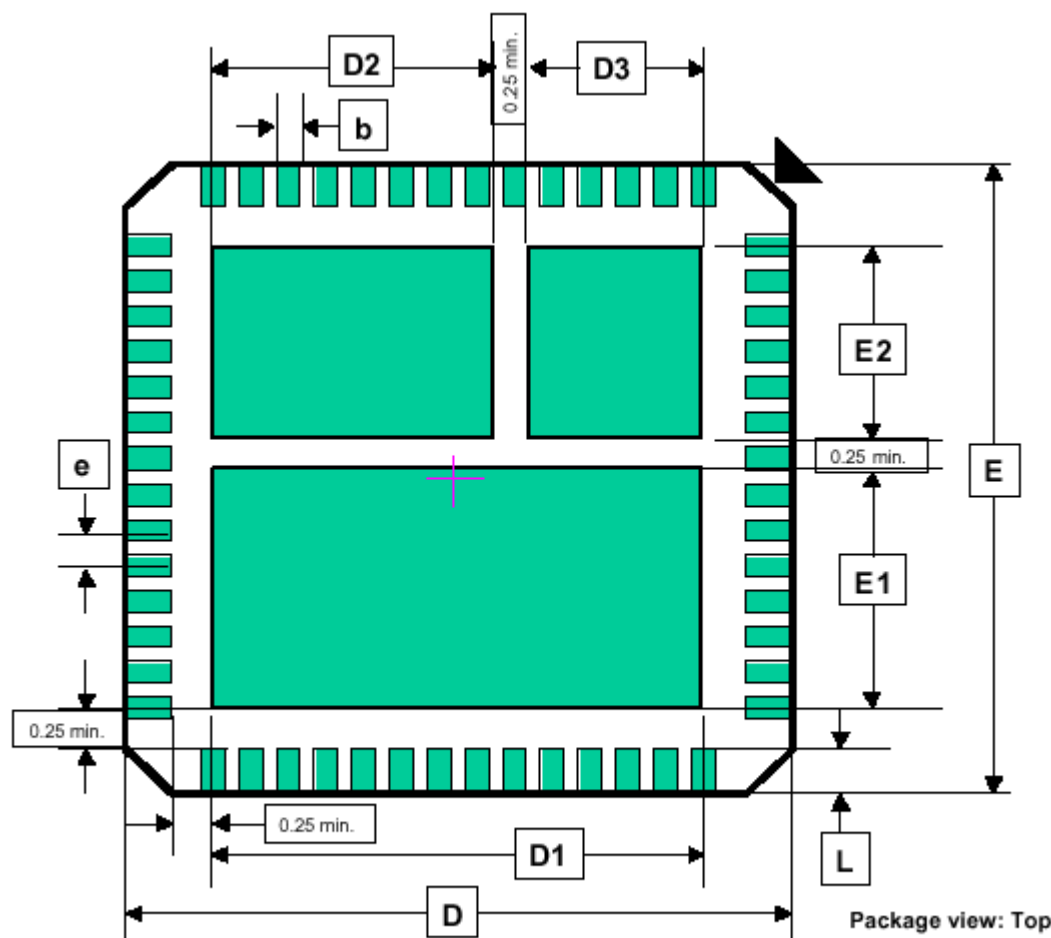


Bottom view

## Terminal functions

Name	No.	Functions	Notes
CGND	1,51,Tab	Internal driver-IC chip bed	Connect to the SGND
SGND	2	Internal driver-IC signal ground	Connect to the PGND
SD	3	Shut down signal for the low-side MOSFET. When set to low, the low-side MOSFET is turned off.	
BST	4	Connect to the external boot strap capacitor	
HO	5	High-side MOSFET gate signal	For monitoring
NC	6,7,8,39	No internal connection. Keep them open.	
V <sub>IN</sub>	9 ~ 20,Tab	Input voltage for the DC-DC converter	
L <sub>X</sub>	21,40 ~ 50,Tab	Switching node. Connect to the output inductor.	
PGND	22 ~ 38	Power ground	
LO	52	Low-side MOSFT gate signal	For monitoring
PGND(IC)	53	Internal driver-IC power ground	
V <sub>DD</sub>	54	Supply voltage for the internal driver-IC	
DISBL	55	Disable signal for the internal control circuit. When set to low, the Internal control circuit is disabled. The high-side MOSFET and low-side MOSFET are turned off.	
ON/OFF	56	Input signal	

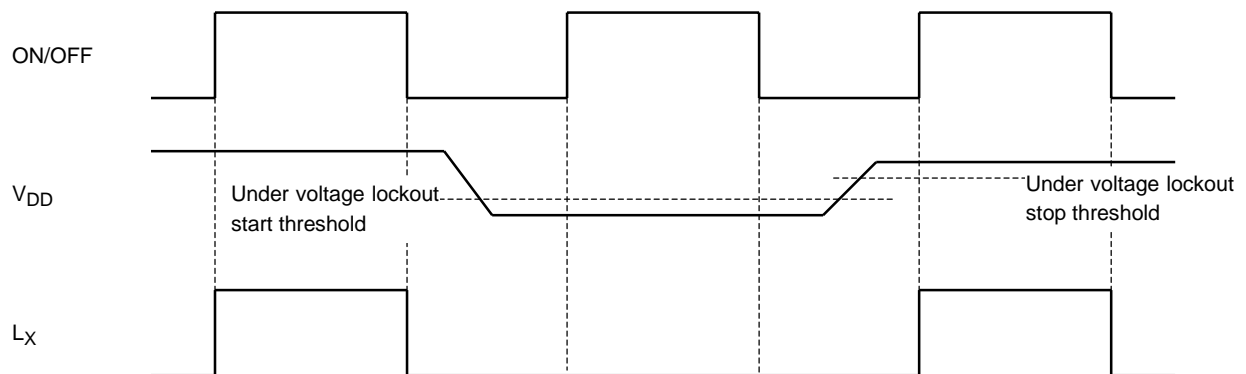
Recommended PCB footprint



S Y M	DIMENSION			N o t e
	Min	Nom	Max	
e	0.5 BSC			
L	0.30	0.40	0.50	
b	0.18	0.23	0.30	
D	8.0			
D1	6.20	6.35	6.50	
D2	3.55	3.65	3.80	
D3	2.10	2.30	2.45	
E	8.0			
E1	3.55	3.65	3.80	
E2	2.10	2.30	2.45	

(unit : mm)

## Timing chart



Under voltage lockout : When VDD is lower than Under voltage lockout start threshold, the operation is stopped.

When VDD is higher than Under voltage lockout stop threshold, it return to the normal operation.

(The hysteresis between lockout start and lockout stop is 0.7V.)

Electrical specifications ( $V_{DD}=5V$  ,  $T_a=25$  , unless otherwise noted.)

Characteristics	Symbol	Terminal	Conditions	Min.	Typ.	Max.	Unit
Operating input Voltage ( $V_{IN}$ )	$V_{IN(OPR)}$	$V_{IN}$	-	7	-	19	V
Operating input Voltage ( $V_{DD}$ )	$V_{DD(OPR)}$	$V_{DD}$	-	4.5	5	5.5	V
$V_{DD}$ quiescent current	$I_{DD(OFF)}$	$V_{DD}$	$V_{DISBL} = 0$	-	-	15	$\mu A$
ON/OFF input current H	$I_{INH(ON/OFF)}$	ON/OFF	$V_{ON/OFF} = 5V$	-	0.25	0.4	mA
ON/OFF input current L	$I_{INL(ON/OFF)}$	ON/OFF	$V_{ON/OFF} = 0$	-	0	-	mA
SD input current H	$I_{INH(SD)}$	SD	$V_{SD} = 5V$	-	0	-	mA
SD input current L	$I_{INL(SD)}$	SD	$V_{SD} = 0$	-0.4	-0.25	-	mA
ON/OFF input rising threshold	$V_{H(ON/OFF)}$	ON/OFF	-	2.0	-	-	V
ON/OFF input falling threshold	$V_{L(ON/OFF)}$	ON/OFF	-	-	-	0.8	V
SD input rising threshold	$V_{H(SD)}$	SD	-	2.0	-	-	V
SD input falling threshold	$V_{L(SD)}$	SD	-	-	-	0.8	V
DISBL input rising threshold	$V_{H(DISBL)}$	DISBL	-	2.0	-	-	V
DISBL input falling threshold	$V_{L(DISBL)}$	DISBL	-	-	-	0.8	V
Output ON resistance	$R_{DS(ON)(L)}$	$L_X$ -PGND	$I_{LX} = 10A$	-	5		m
	$R_{DS(ON)(H)}$	$V_{IN}$ - $L_X$	$I_{LX} = -10A$ , $V_{BST-LX} = 5V$	-	10		m
Output cut-OFF current	$I_{LEAK(H)}$	$V_{IN}$ - $L_X$	$V_{IN} = 24V$ , $L_X = 0$	-	-	10	$\mu A$
	$I_{LEAK(L)}$	$L_X$ -PGND	$V_{LX} = 24V$ , $PGND = 0$	-	-	100	$\mu A$
Switching time	Turn off	$t_{off}$	$L_X$	$V_{BST-LX} = 5V$ $I_{LX} = -20A$	30	-	ns
	Turn on	$t_{on}$	$L_X$		60	-	ns
Internal SBD foreword voltage	$V_F$	PGND- $L_X$	$I_{DR} = 10A$	-	0.6	0.7	V
Under voltage lock out start threshold	$V_{UVLO}$	$V_{DD}$	-	2.6	2.8	3.1	V
Under voltage lock out hysteresis	$V_{hys-UVLO}$	$V_{DD}$	-	-	0.7	-	V

