

**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.

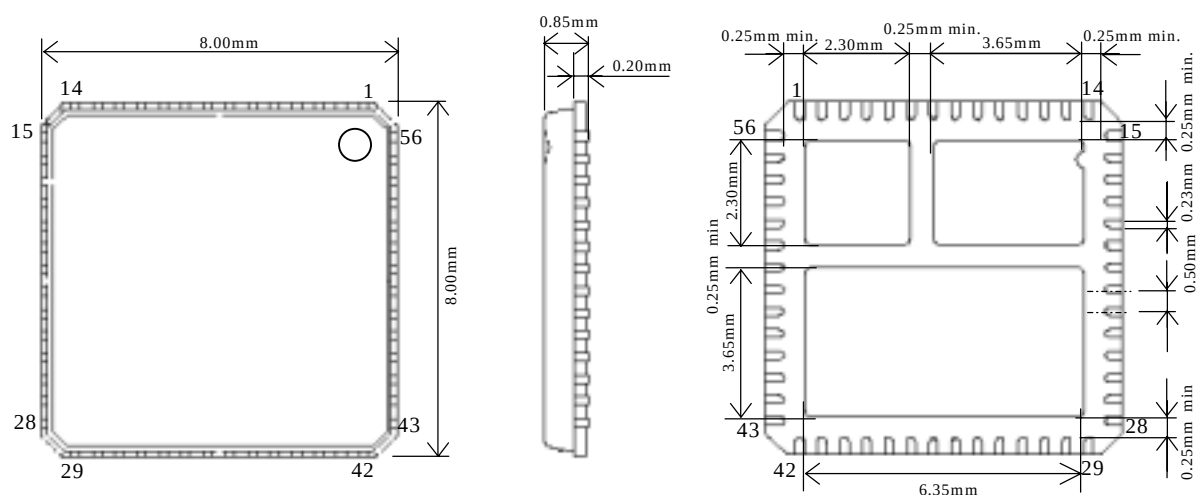
**Features**

- 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

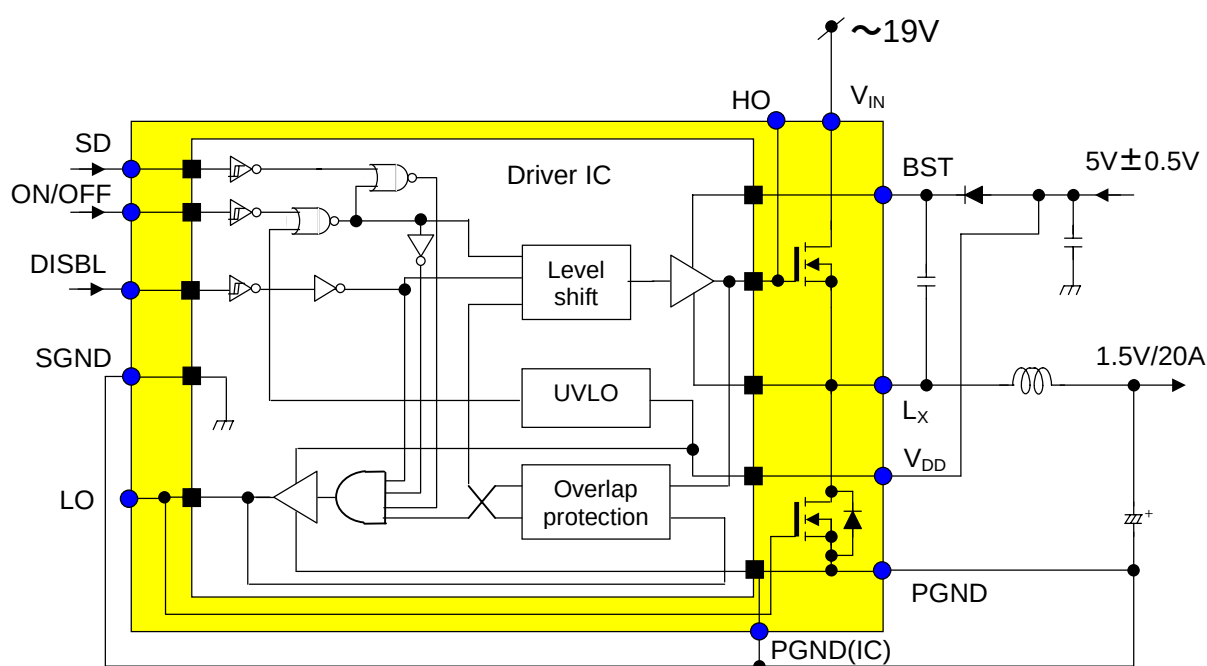


Top view

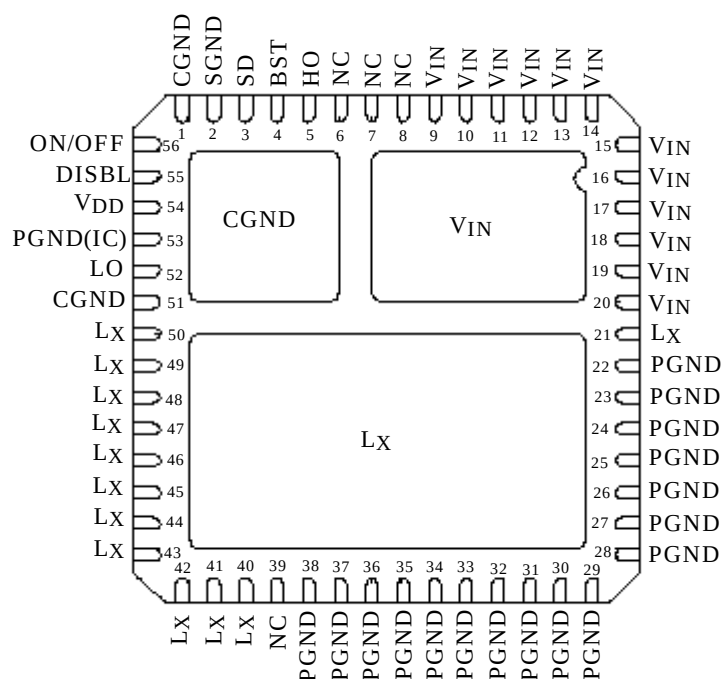
Side view

Bottom view

## Block diagram



## Terminal configurations

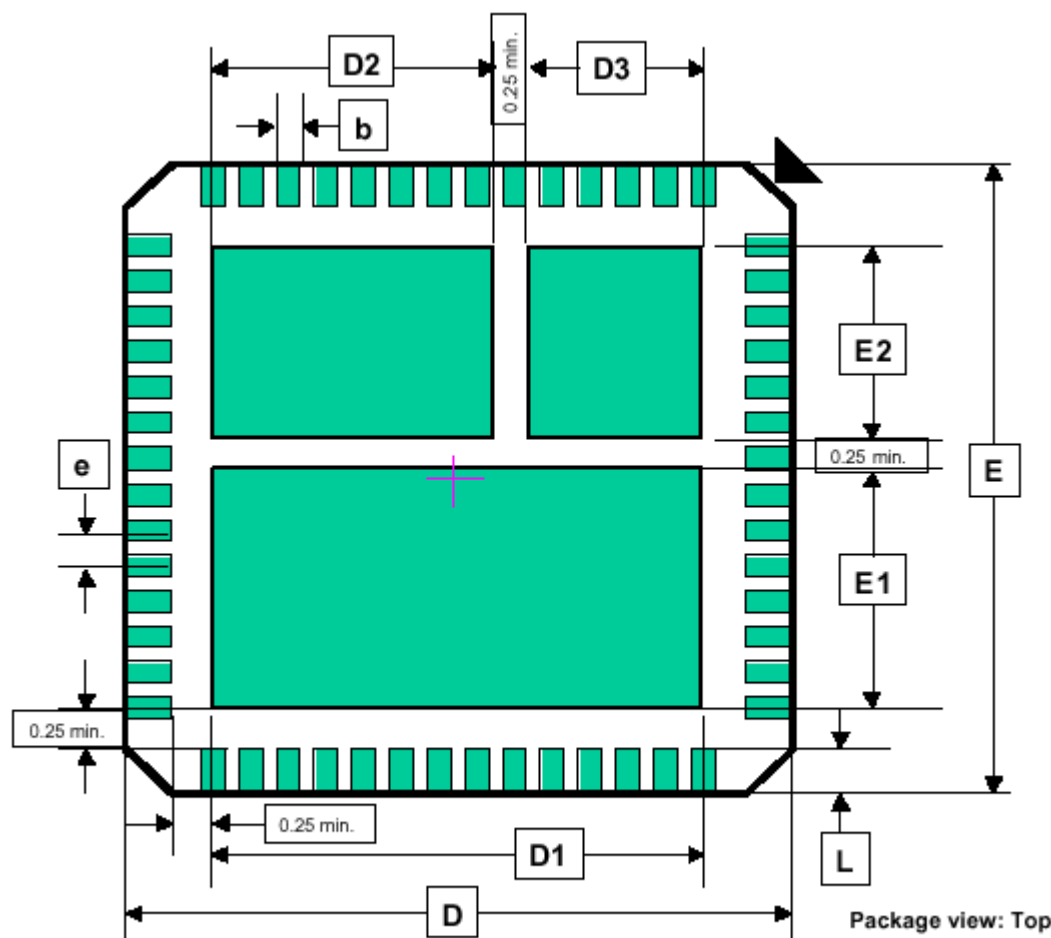


Bottom view

## 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                                                                                                                                                         |                     |

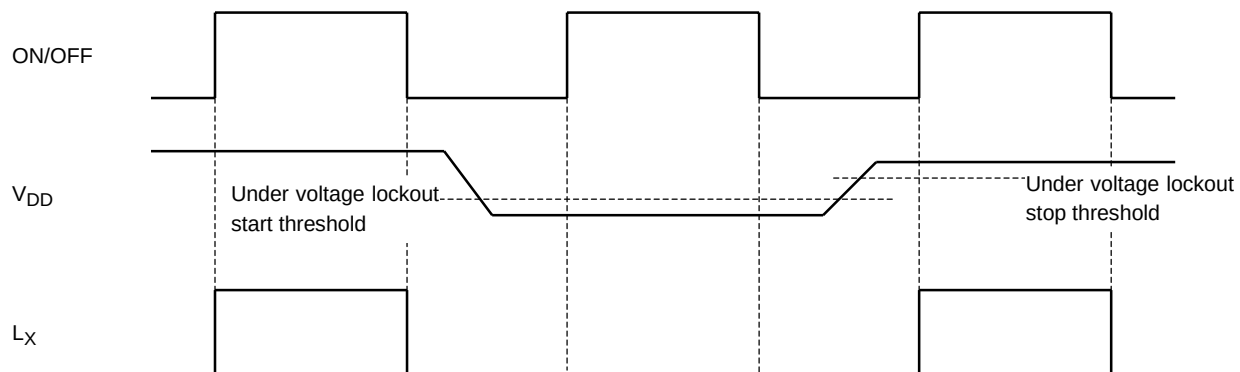
Recommended PCB footprint



| S<br>Y<br>M | DIMENSION |      |      | N<br>o<br>t<br>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 ( $V_{DD}=5V$  ,  $T_a=25^{\circ}C$  , 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     |      | $m\Omega$ |
|                                        | $R_{DS(ON)(H)}$   | $V_{IN}$ - $L_X$ | $I_{LX} = -10A$ , $V_{BST-LX} = 5V$ | —                                    | 10    |      | $m\Omega$ |
| 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          | $t_{off}$        | $L_X$                               | $V_{BST-LX} = 5V$<br>$I_{LX} = -20A$ | —     | 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         |

