TOSHIBA BiCD Integrated Circuit Silicon Monolithic

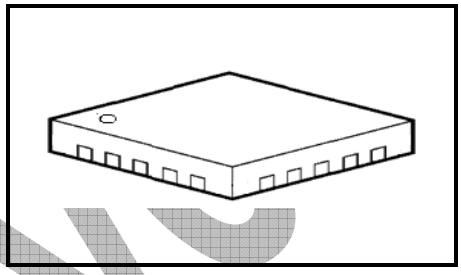
TB62771FTG/FNG

Step up type DC/DC controller built in 4 channel sink driver for White LED

TB62771FTG/FNG is a high efficient step-up type DC/DC controller specially designed for constant current drive of High power white LED.

This IC can drive white LEDs with constant current by dividing white Led's, which are serial connected with lots of LEDs, into 4 lines.

This IC is especially for driving back light white LEDs in large LCD.

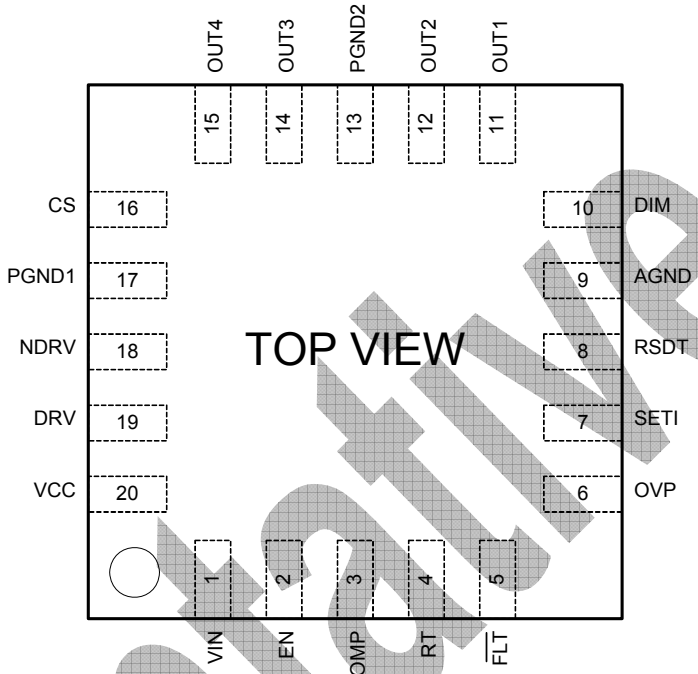


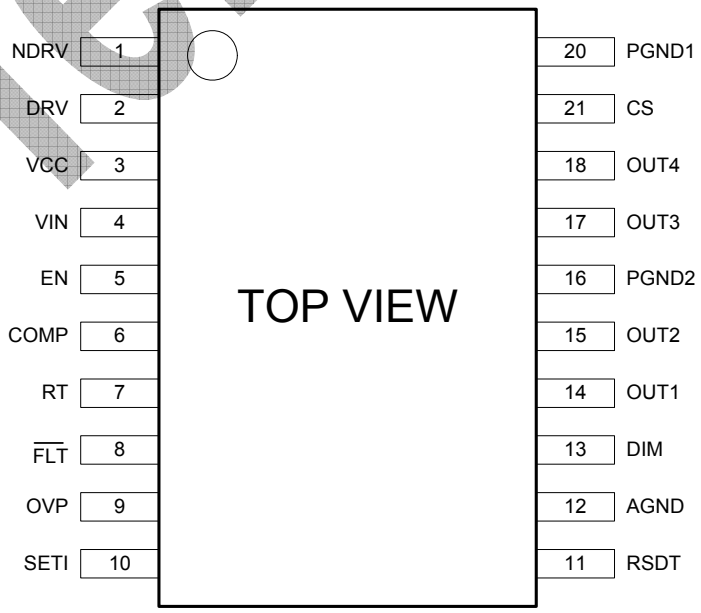
Weight : TBD g (TYP)

Characteristics

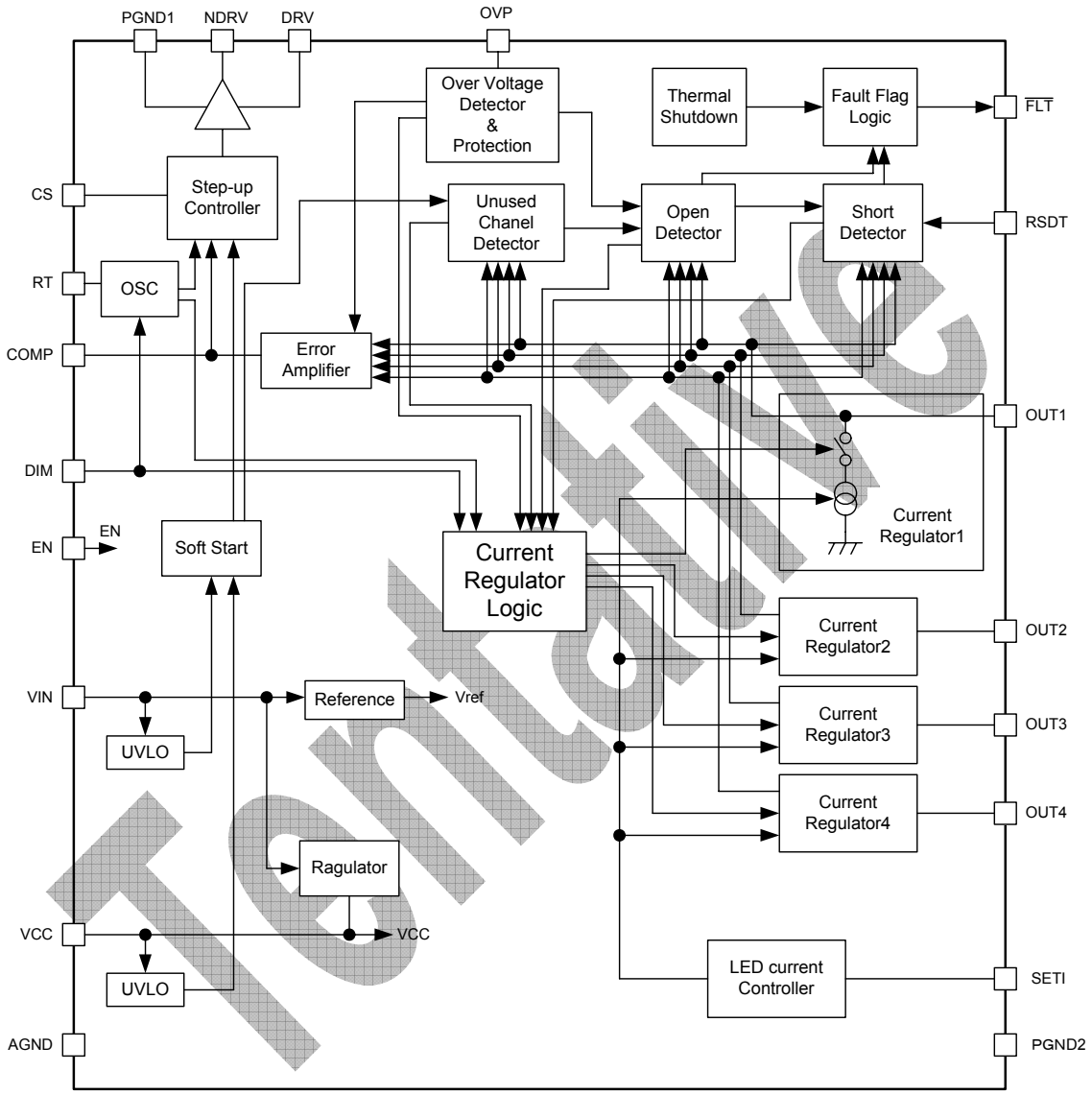
- Input Voltage range : 4.75V to 40V Built in Current mode DC/DC controller
- Switching frequency :
  Set by the resistance connected to RT terminal (200kHz to 2.0 MHz)
- 4ch Constant current driver :
  Sink current 20mA to 200mA
  Current accuracy +/- 2% (ILED = 100mA)
  Control voltage 0.5V (ILED = 150mA)
- Dimming control : Input PWM range 100Hz to 30kHz
  Minimum input PWM width 330ns
- Protection circuit:
  VIN under voltage lockout (UVLO(VIN))
  VCC under voltage lock out (UVLO(VCC))
  LED open detection
  LED short detection (Set by the resistance connected to RSDT terminal)
  Built in thermal shutdown circuit 165°C(typ.)
  Output voltage over detection
  Output voltage under detection
- Soft start function
- Output delay function
- Standby Supply Current 40μA(MAX)
- IC package : QFN20, HTSSOP20(Under planning)

Pin Assignment (Top view)





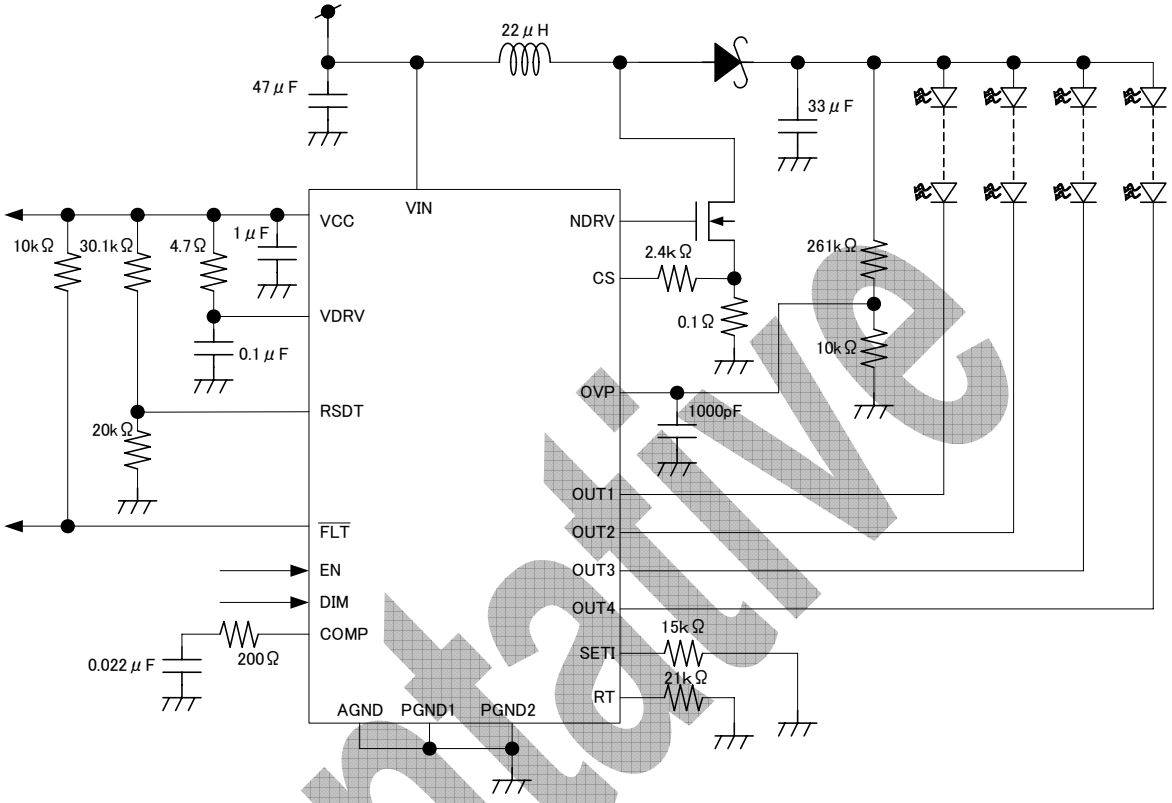
Block Diagram



Pin Function

No		Name	I/O	Function
QFN20	HTSSOP20			
1	4	VIN	P	Power supply input. The input voltage range is 4.75V to 40V.
2	5	EN	I	Input chip enable signal, EN=High: operation mode or standby mode, EN=Low: shut down mode. The Input logic threshold is 1.23V (typ) as internally.
3	6	COMP	O	Terminal for controlling compensation point of AMP which controls output voltage. Connect RC between COMP and GND.
4	7	RT	O	Internal Oscillator setting terminal. Connect to AGND with resistance (RT). Switching Frequency are set by the formula RT = 7.350 x 10E9 / fsw
5	8	$\overline{FLT}$	O	Error signal output by fault protection control (Nch open drain) , This terminal is set Low when detecting LED Open, LED Short, and thermal shut down. Connect a 10kΩ pull up resister from FLT to VCC.
6	9	OVP	I	Overvoltage threshold adjust input. Connect Resistance from the switching converter output to OVP and AGND. The OVP comparator reference is set 1.23V internally.
7	10	SETI	O	LED current adjust input. Connect a resister (RSETI) to AGND.ILED are set by the formula ILED = 1.23/RSETI × 1500
8	11	RSDT	I	LED short detection adjusting input. Connect Resistance from VCC to AGND. LED short detection comparator in internally reference to 2V.Connect RSDT directly to VCC to disable LED short detection.
9	12	AGND	P	Ground for logic signal. Connect to PGND1, PGND2.
10	13	DIM	I	Digital PWM dimming input. DIM = High: Operation mode DIM = Low: Standby mode. Connect to VCC if dimming control is not used that like as constant current sink.
11	14	OUT1	O	Constant current sink terminals to drive LED for channel 1. This terminal is open drain output which sinks up to 150mA.
12	15	OUT2	O	Constant current sink terminals to drive LED for channel 2. This terminal is open drain output which sinks up to 150mA.
13	16	PGND2	P	Power Ground. Connect GND, PGND1.
14	17	OUT3	O	Constant current sink terminals to drive LED for channel 3. This terminal is open drain output which sinks up to 150mA.
15	18	OUT4	O	Constant current sink terminals to drive LED for channel 4. This terminal is open drain output which sinks up to 150mA.
16	19	CS	I	Current sense input .To Monitor the current of external power MOSFET source.
17	20	PGND1	O	Power Ground. Connect AGND, PGND2.
18	1	NDRV	O	Switching n-MOSFET gate driver output.
19	2	DRV	P	Power Supply input for the control circuits of switching MOSFET gate. Connect Resistance between DRV and 5V regulator output VCC. And connect DRV to PGND with minimum of 0.1μF Bypass capacitor.
20	3	VCC	O	5V Regulator Output. Connect to GND with minimum of 1.0μF capacitor as close to the device.
-	-	EP	-	Exposed Pad. Connect to AGND.

Application Circuits



■ Absolute Maximum Ratings (Ta = 25°C Unless otherwise noted)

Characteristics	Symbol	condition	Rating	Unit
Power supply voltage	V_{IN}		−0.3 ~ +45	V
Input voltage1	V_{IN1}	EN	−0.3 ~ V_{IN} +0.3	V
Input voltage2	V_{IN2}	DRV, $\overline{FLT}$, DIM, RSDT, OVP	−0.3 ~ +6	V
Input voltage3	V_{IN3}	CS, RT, COMP, SETI	−0.3 ~ V_{CC} +0.3	V
Input voltage4	V_{IN4}	NDRV	−0.3 ~ V_{DRV} +0.3	V
Output voltage	V_{out}	OUT1, OUT2, OUT3, OUT4	−0.3 ~ +45	V
Power dissipation	P_D		TBD	W
Thermal resistance	$R_{th\ (j-a)}$		TBD	°C/W
Operation temperature range	Topr		−40 ~ +85	°C
Storage temperature range	Tstg		−65 ~ +150	°C
Maximum junction temperature	Tj		150	°C

Electrical Characteristics

(Unless otherwise noted, VIN = VEN = 12V, RSETI = 15kΩ, CVCC = 1μF, VCC = VDRV, NDRV = COMP =OUT_= Open, VRSDT = VDIM = VCC, VOVP = VCS =PGND1 = PGND2 = AGND = 0V, Ta = -40~85°C, Typical value Ta = 25°C condition.)

Characteristics	Symbol	Condition	Min	Typ.	Max	Unit
Power supply voltage	V_{IN}		4.75	-	40	V
Operating consumption current	I_{IN}		-	2.5	TBD	mA
Standby consumption current		V_{EN} = 0V	-	15	40	μA
VIN under lock out voltage		V_{IN} rising	3.975	4.3	4.625	V
VIN under lock out voltage hysteresis			-	170	-	mV

Electrical Characteristics

(Unless otherwise noted, VIN = VEN = 12V, RSETI = 15kΩ, CVCC = 1μF, VCC = VDRV, NDRV = COMP =OUT_= Open, VRSDT = VDIM = VCC, VOVP = VCS =PGND1 = PGND2 = AGND = 0V, Ta = -40~85°C, Typical value Ta = 25°C condition.)

VCC REGULATOR

Characteristics	Symbol	Condition	Min	Typ.	Max	Unit
VCC output voltage	V_{CC}	6.5V < VIN < 10V, 1mA < ILOAD < 50mA 10V < VIN < 40V, 1mA < ILOAD < 10mA	4.75	5.0	5.25	V
VCC drop voltage		VIN - VCC, VIN = 4.75V, ILOAD = 50mA	-	200	500	mV
VCC current limit		VCC connects to AGND	-	100	-	mA
VCC under lock out voltage		VCC rising	-	4	-	V
VCC under lock out voltage hysteresis			-	100	-	mV

RT OSCILLATOR

Characteristics	Symbol	Condition	Min	Typ.	Max	Unit
Switching Frequency	f_{SW}		200	-	2000	kHz
Maximum Duty Cycle		f_{SW} = 200kHz ~ 600kHz	90	94	98	%
		f_{SW} = 600kHz ~ 2000kHz	86	90	94	
Frequency Accuracy		f_{SW} = 200kHz ~ 2000kHz vs. actual typical frequency	-7	-	7	%
Synchronized Signal Threshold			4	-	-	V
Minimum Synchronized Frequency			$1.1f_{SW}$	-	-	Hz

PWM COMPARATOR

Characteristics	Symbol	Condition	Min	Typ.	Max	Unit
PWM Comparator Leading-Edge Blanking time			-	60	-	ns
PWM-NDRV Propagation Delay			-	90	-	V

SLOPE COMPENSATION

Characteristics	Symbol	Condition	Min	Typ.	Max	Unit
Peak Slope Compensation Current		Peak slope for CS Input	45	50	55	μA × fsw

Electrical Characteristics

(Unless otherwise noted, VIN = VEN = 12V, RSETI = 15kΩ, CVCC = 1μF, VCC = VDRV, NDRV = COMP =OUT_= Open, VRSDT = VDIM = VCC, VOVP = VCS =PGND1 = PGND2 = AGND = 0V, Ta = -40~85°C, Typical value Ta = 25°C condition.)

CURRENT LIMIT COMPARATOR

Characteristics	Symbol	Condition	Min	Typ.	Max	Unit
Current Limit Threshold			413	433	454	mV
CS Limit Comparator to NDRV propagation Delay		10mV Over Drive Not included Leading-Edge Blanking time	-	10	-	ns

ERROR AMPLIFIER

Characteristics	Symbol	Condition	Min	Typ.	Max	Unit
OUT Regulation Voltage		20mA < ILED < 150mA	-	0.5	-	V
		150mA < ILED < 200mA	-	0.7	-	V
No Load Gain			-	75	-	
COMP Sink current		VOUT=5V, VCOMP=2.5V	160	375	800	nA
COMP Source Current		VOUT=5V, VCOMP=2.5V	160	375	800	nA

MOSFET DRIVER

Characteristics	Symbol	Condition	Min	Typ.	Max	Unit
NDRV On Resistance		ISINK = 100mA (nMOS)	-	0.9	-	Ω
		ISOURCE = 100mA (pMOS)	-	1.1	-	
Peak sink Current		VNDRV = 5V	-	2.0	-	A
Peak Source Current		VNDRV = 0V	-	2.0	-	A
Rise Time		CLOAD = 1nF	-	6	-	ns
Fall Time		CLOAD = 1nF	-	6	-	ns

LED CURRENT

Characteristics	Symbol	Condition	Min	Typ.	Max	Unit
LED Current Sink Range		VOUT = VREF	20	-	150	mA
Channel to Channel Accuracy		IOUT = 100mA	-	-	±2	%
Output Leakage		VDIM = 0V, VOUT = 40V	-	-	1	μA

Electrical Characteristics

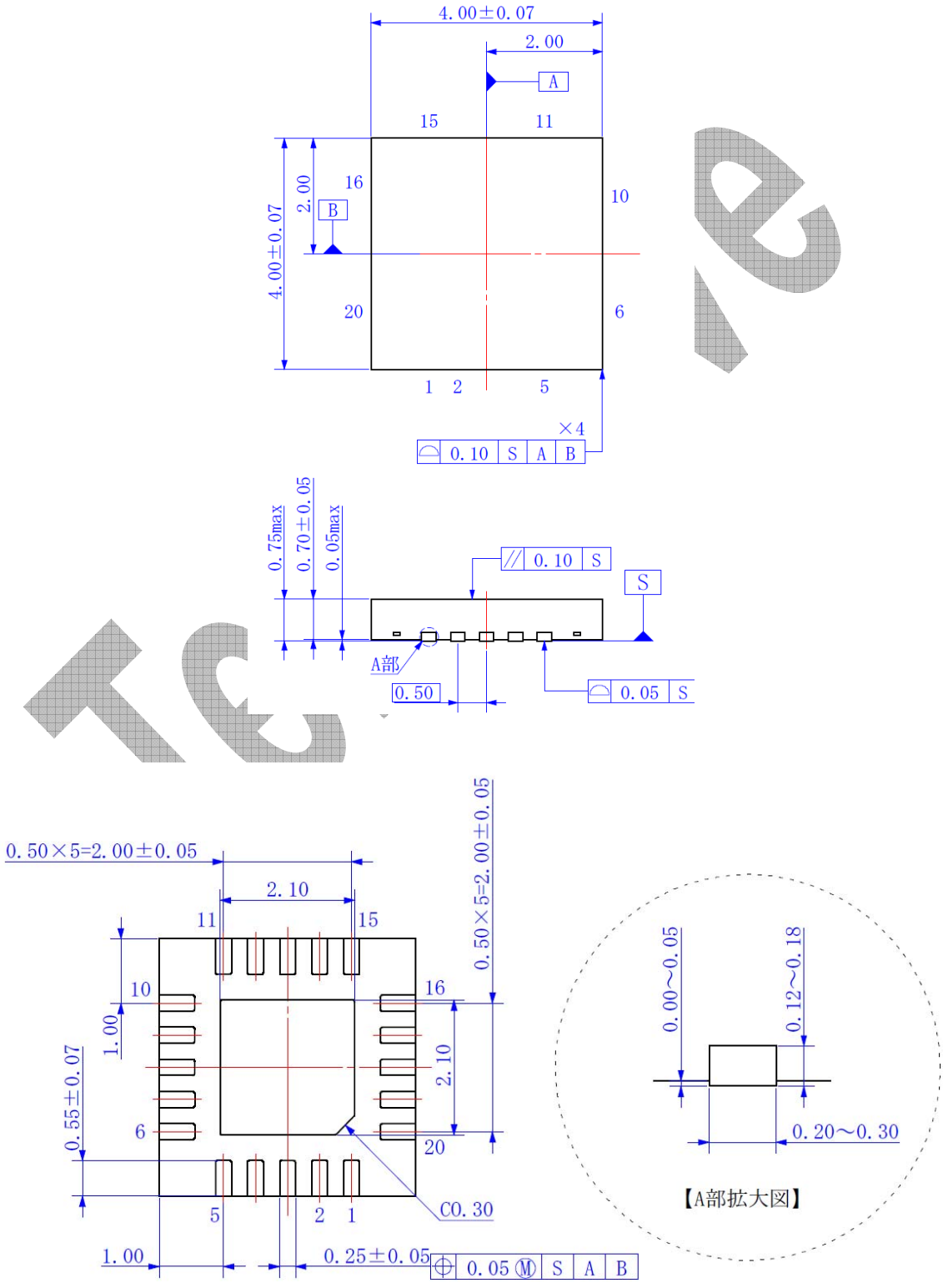
(Unless otherwise noted, VIN = VEN = 12V, RSETI = 15kΩ, CVCC = 1μF, VCC = VDRV, NDRV = COMP =OUT_= Open, VRSDT = VDIM = VCC, VOVP = VCS =PGND1 = PGND2 = AGND = 0V, Ta = -40~85°C, Typical value Ta = 25°C condition.)

LOGIC INPUTS/OUTPUTS

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
EN Reference voltage		VEN rising, Ta =-40 to 85°C	1.144	1.23	1.316	V
EN Hysteresis			-	50	-	mV
EN Input Current		VEN = 40V	-	-	±200	nA
DIM Input High Voltage			2.1	-	-	
DIM Input Low Voltage			-	-	0.8	V
DIM Input Current			-	-	±2	μA
DIM ↑ to LED Turn-on Delay		DIM ↑ ~ IOUT ↑ (10%)	-	100	-	ns
DIM ↓ to LED Turn –off Delay		DIM ↓ ~ IOUT ↓ (10%)	-	100	-	ns
IOUT Rise and Fall times			-	200	-	ns
/FLT Output Low voltage		VIN = 4.75V, ISINK = 5mA	-	-	0.4	V
/FLT Output leakage Current		VFLT = 5.5V	-	-	1.0	μA
LED Short Detection Threshold		Gain = 3.5	1.75	2.0	2.25	V
Short Detection Comparator Delay			-	6.5	-	μs
RSDT Leakage Current			-	-	±600	nA
OVD detecting Threshold		Output rising	1.19	1.228	1.266	V
OVD Hysteresis			-	70	-	mV
OVD Leakage Current		VOVP = 1.25V	-	-	±600	nA
Thermal Shutdown Threshold		Temperature rising	-	165	-	°C
Thermal Shutdown Hysteresis			-	15	-	°C

Package Dimensions

QFN48



■ Notes on Contents

1. Block Diagrams
Some of the functional blocks, circuits, or constants in the block diagram may be omitted or simplified for explanatory purposes.

2. Equivalent Circuits
The equivalent circuit diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

3. Timing Charts
Timing charts may be simplified for explanatory purposes.

4. Application Circuits
The application circuits shown in this document are provided for reference purposes only. Thorough evaluation is required, especially at the mass production design stage.
Toshiba does not grant any license to any industrial property rights by providing these examples of application circuits.

5. Test Circuits
Components in the test circuits are used only to obtain and confirm the device characteristics. These components and circuits are not guaranteed to prevent malfunction or failure from occurring in the application equipment.

IC Usage Considerations

Notes on handling of ICs

[1] The absolute maximum ratings of a semiconductor device are a set of ratings that must not be exceeded, even for a moment. Do not exceed any of these ratings.
Exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.

[2] Use an appropriate power supply fuse to ensure that a large current is not continuously drawn in case of over current and/or IC failure. The IC will fully break down when used under conditions that exceed its absolute maximum ratings, when the wiring is routed improperly or when an abnormal pulse noise occurs from the wiring or load, causing a large current drawing continuously and the breakdown can lead smoke or ignition. To minimize the effects of a large current drawing in case of breakdown, appropriate settings, such as fuse capacity, fusing time and insertion circuit location, are required.

[3] If your design includes an inductive load such as a motor coil, incorporate a protection circuit into the design to prevent device malfunction or breakdown caused by the current resulting from the inrush current at power ON or the negative current resulting from the back electromotive force at power OFF. IC breakdown may cause injury, smoke or ignition.
Use a stable power supply with ICs with built-in protection functions. If the power supply is unstable, the protection function may not operate, causing IC breakdown. IC breakdown may cause injury, smoke or ignition.

[4] Do not insert devices in the wrong orientation or incorrectly.
Make sure that the positive and negative terminals of power supplies are connected properly.
Otherwise, the current or power consumption may exceed the absolute maximum rating, and exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.
In addition, do not use any device that is applied the current with inserting in the wrong orientation or incorrectly even just one time.

[5] Carefully select external components (such as inputs and negative feedback capacitors) and load components (such as speakers), for example, power amp and regulator.
If there is a large amount of leakage current such as input or negative feedback condenser, the IC output DC voltage will increase. If this output voltage is connected to a speaker with low input withstand voltage, over current or IC failure can cause smoke or ignition. (The over current can cause smoke or ignition from the IC itself.) In particular, please pay attention when using a Bridge Tied Load (BTL) connection type IC that inputs output DC voltage to a speaker directly.

About solderability, following conditions were confirmed

- Solderability

(1) Use of Sn-37Pb solder Bath
- solder bath temperature = 230°C
- dipping time = 5 seconds
- the number of times = once
- use of R-type flux

(2) Use of Sn-3.0Ag-0.5Cu solder Bath
- solder bath temperature = 245°C
- dipping time = 5 seconds
- the number of times = once
- use of R-type flux

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