TOSHIBA BiCD Integrated Circuit Silicon Monolithic

TB62D701FNG/FTG

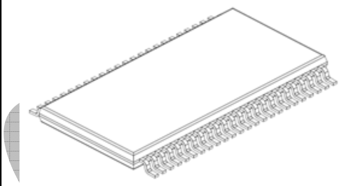
Step up type DC/DC controller built in 8 channel sink driver for White LED

TB62D701FNG/FTG 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 8 lines.

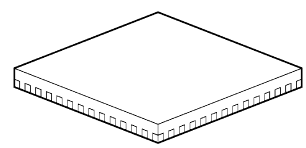
This IC is especially for driving back light white LEDs in large LCD.

HTSSOP48



Weight: TBD g (TYP)

QFN48

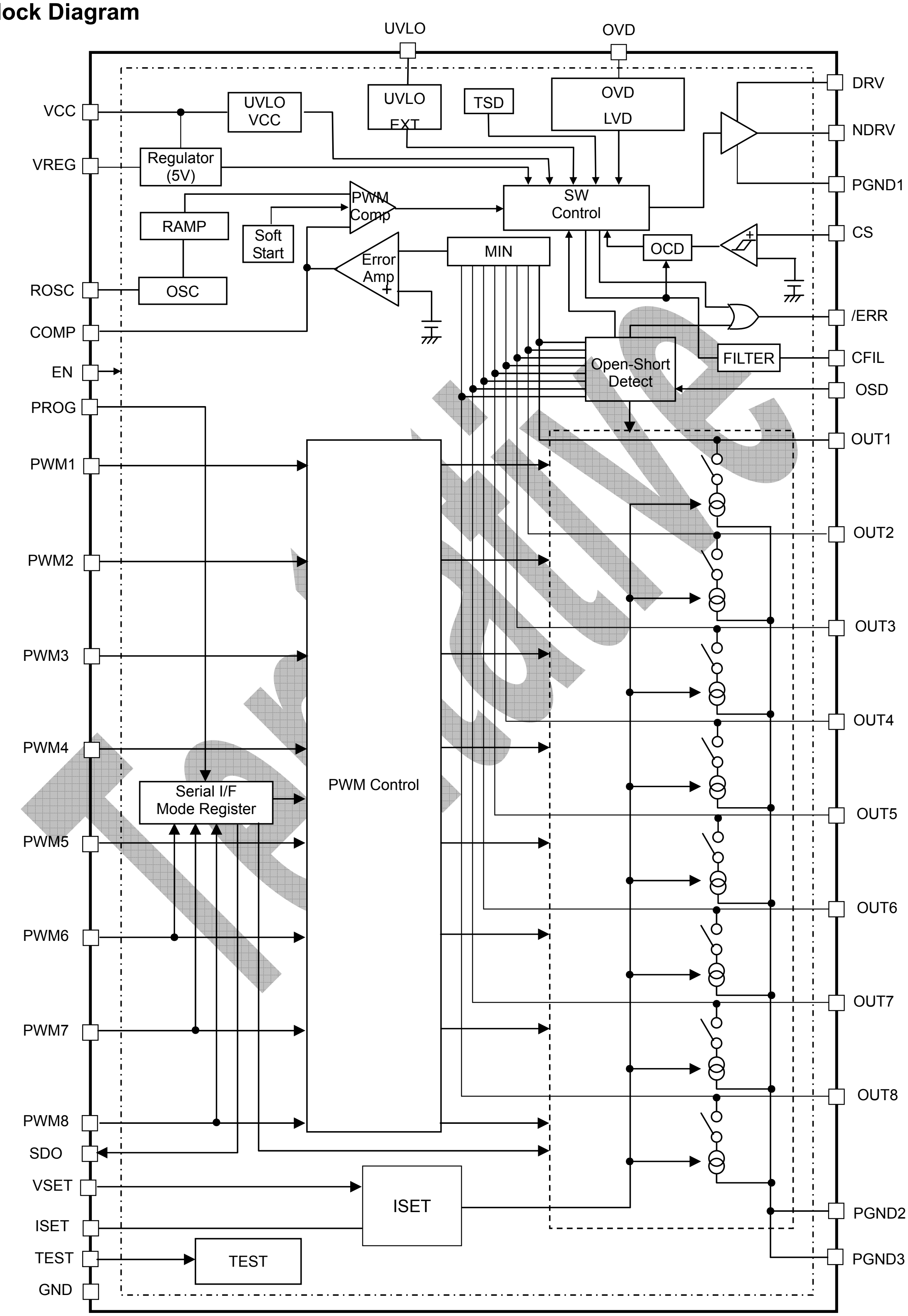


Weight: TBD g (TYP)

Feature

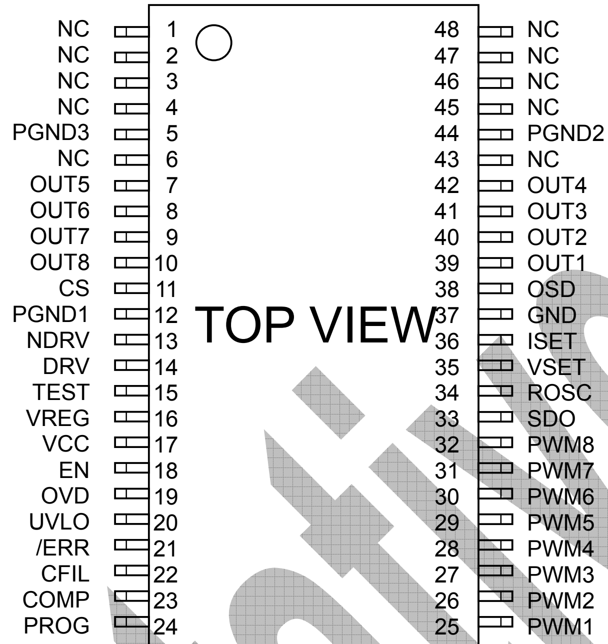
- Input Voltage range : 7V to 36V
- Built in Current mode DC/DC controller
- Switching frequency :
  - Set by the resistance connected to RT terminal (100 kHz to 2.0 MHz)
  - External Switching Frequency Synchronization
- 8ch Constant current driver :
  - Sink current 20mA to 150mA
  - Current accuracy +/- 2% (ILED = 120mA)
  - Control voltage 0.5V
- Dimming control :
  - Input PWM range 100Hz to 30kHz
  - Minimum input PWM width 330ns
  - Individual inputting PWM signal for every channels (For Back lighting scanning function and Local Dimming)
  - Analog Dimming
- Detection circuit:
  - Under voltage lock out (For VCC and External power)
  - LED open detection
  - LED short detection
  - Built in thermal shutdown circuit 165°C(typ.)
  - Output voltage over detection (OVD)
  - Output voltage under detection (LVD)
  - Over current detection (OCD)
  - Non-use channel detection
- Soft Start Function
- IC package : HTSSOP48, QFN48

Block Diagram

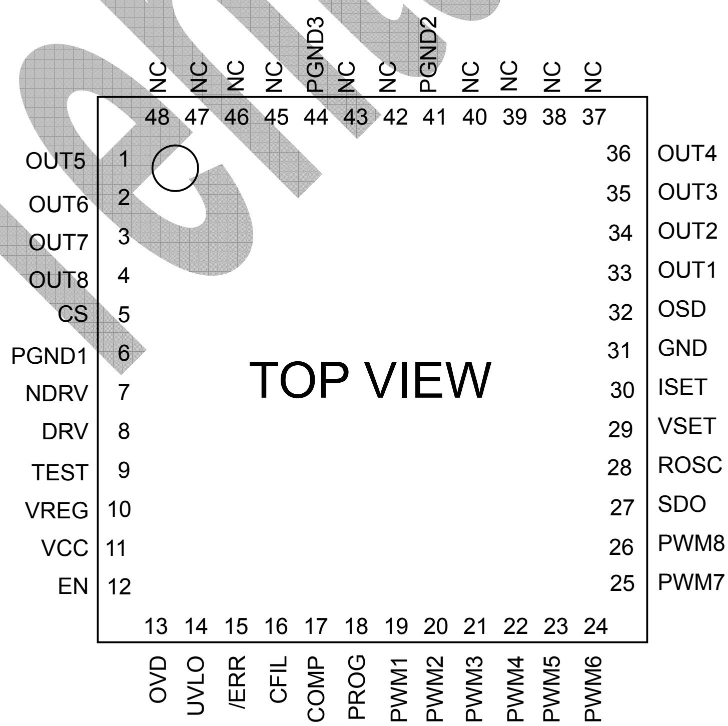


Pin Assignment (Top View)

○ HTSSOP48



○ QFN48

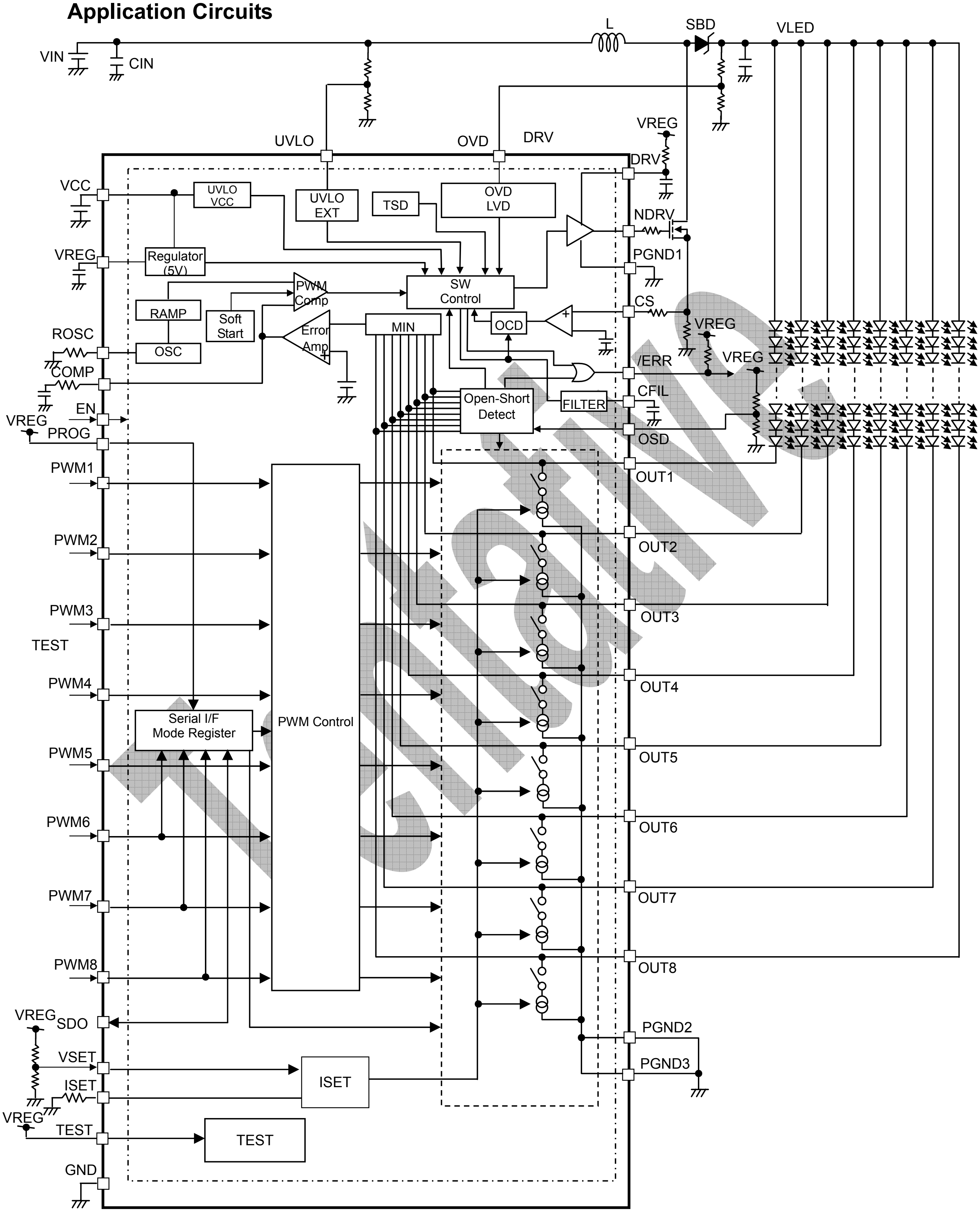


Pin Description

Pin No		Name	I/O	Function
HTSSOP	QFN			
1	43	NC	-	No connect. No connect or connect to ground.
2	45	NC	-	No connect. No connect or connect to ground.
3	46	NC	-	No connect. No connect or connect to ground.
4	47	NC	-	No connect. No connect or connect to ground.
5	44	PGND3	P	Ground for constant current
6	48	NC	-	No connect. No connect or connect to ground.
7	1	OUT5	O	Constant current SINK terminal to drive LED (Channel 5)
8	2	OUT6	O	Constant current SINK terminal to drive LED (Channel 6)
9	3	OUT7	O	Constant current SINK terminal to drive LED (Channel 7)
10	4	OUT8	O	Constant current SINK terminal to drive LED (Channel 8)
11	5	CS	I	Current sense input to monitor MOSFET current.
12	6	PGND1	P	Power ground
13	7	NDRV	O	Switching n-MOSFET Gate-Driver Output.
14	8	DRV	P	MOSFET Gate-driver Supply input. Connect a resistor between VREG and DRV to power the MOSFET driver with the internal 5V regulator. Bypass DRV to GND with a minimum of 0.1μF ceramic capacitor.
15	9	TEST	-	TEST terminal. Connect to VREG.
16	10	VREG	O	5V Regulator Output for internal circuits. Connect to GND with minimum of 1.0μF capacitor as close to the device.
17	11	VCC	P	Power Supply input. Connect a 7 to 36V supply to VCC. Bypass VCC to GND with a ceramic capacitor.
18	12	EN	I	Input chip enable signal, EN=high : operation-mode or standby-mode EN=Low : shut down mode
19	13	OVD	I	Monitor for Over voltage detection and Under voltage detection. Over voltage detection threshold : 3.5V (TYP) Under voltage detection threshold : 0.2V (TYP)
20	14	UVLO	I	Under voltage lockout input terminal for external Power Supply. Lockout voltage is 1.15V(TYP) at VUVLO rising
21	15	/ERR	O	Error signal output by fault protection control.
22	16	CFIL	O	Terminal which Setting latch up time for fault detection (OVD,LVD,OCD). Connect Capacitor between CFIL and GND depend on setting time.
23	17	COMP	O	Terminal for controlling compensation point of AMP which controls output voltage. Connect RC between COMP and GND.
24	18	PROG	I	Serial I/F Setting input All PWM individual control mode: Connect to VREG.

Pin No		Name	I/O	Function
HTSSOP	QFN			
25	19	PWM1	I	Digital PWM dimming input for OUT1.
26	20	PWM2	I	Digital PWM dimming input for OUT2.
27	21	PWM3	I	Digital PWM dimming input for OUT3.
28	22	PWM4	I	Digital PWM dimming input for OUT4.
29	23	PWM5	I	Digital PWM dimming input for OUT5.
30	24	PWM6(SDA)	I	Digital PWM dimming input for OUT6. (Serial I/F: DATA input.)
31	25	PWM7(SCK)	I	Digital PWM dimming input for OUT7. (Serial I/F: CLOCK input.)
32	26	PWM8(STB)	I	Digital PWM dimming input for OUT8. (Serial I/F: STROBE input.)
33	27	SDO	O	Serial I/F DATA output terminal
34	28	ROSC	I	Internal Oscillator setting terminal. Connect to Ground with resistor. $fOSC(Hz)=7.35\times10^{9}$ / $ROSC(\Omega)$ Apply an AC-coupled external clock at ROSC to synchronize the switching frequency with external clock.
35	29	VSET	I	Analog dimming DC input.
36	30	ISET	I	Constant current (IOUT) adjust input. Connect a resister to GND. IOUT(mA) = (VSET(V) / RISET(kΩ))×1500
37	31	GND	P	Ground for Analog and Logic circuits.
38	32	OSD	I	LED Short Detection Threshold Adjust input. Connect a resistive divider from VREG to OSD and GND. Threshold level = VOSD × 3.5(TYP)
39	33	OUT1	O	Constant current SINK terminal to drive LED (Channel 1)
40	34	OUT2	O	Constant current SINK terminal to drive LED (Channel 2)
41	35	OUT3	O	Constant current SINK terminal to drive LED (Channel 3)
42	36	OUT4	O	Constant current SINK terminal to drive LED (Channel 4)
43	37	NC	-	No connect. No connect or connect to ground.
44	41	PGND2	P	Ground for constant current
45	38	NC	-	No connect. No connect or connect to ground.
46	39	NC	-	No connect. No connect or connect to ground.
47	40	NC	-	No connect. No connect or connect to ground.
48	42	NC	-	No connect. No connect or connect to ground.

Application Circuits



Absolute Maximum Ratings (Ta = 25°C if without notice)

Characteristics	Symbol	condition	Rating	Unit
Power supply voltage	VCC		–0.3 ~ +38	V
Input voltage 1	VIN1	EN	–0.3 ~ +38	V
Input voltage 2	VIN2	PWM1~8, VREF, RS1~8, CS1~8, ROSC, /ERR, OVD, DRV	–0.3 ~ +6	
Input voltage 3	VOUT	OUT1~8	–0.3 ~ +58	V
Thermal resistance	T_{opr}		–40~+85	°C
Storage temperature range	T_{stg}		–55~+150	°C
Maximum junction temperature	T_j		150	°C

Recommended Operating Condition (Ta = -40～85°C if without notice)

Characteristics	Symbol	Condition	Min	Typ.	Max	Unit
Power Supply Voltage	VCC		6	-	36	V
Signal Frequency of PWM input	fPWM		0.1	-	30	kHz
Oscillating setup range	fOSC		0.1	-	2.0	MHz
PWM : Minimum ON/OFF time	tON(tOFF)		330	-	-	ns

Electrical Characteristics

(Unless otherwise noted, VCC=EN=24V, OSD=PWM*=VREG, OVD=CS=GND=PGND1=PGND2=0V, ROSC=12.25kΩ, NDRV=COMP=OUT*=unconnected, ISET=VSET/RSET=80μA, CVREG=1μF, Ta=25°C)

Characteristics	Symbol	Condition	Min	Typ.	Max	Unit
<CONSUMPTION CURRENT>						
Operation consumption Current	ICC(On)	VCC=24V , EN=H PWM1~8=H	―	8.7	15.0	mA
Static consumption Current	ICC(Off)	VCC=24V,EN=L	―	TBD	TBD	μA
<5V REGULATOR>						
Output Voltage of VREG	VREG	IREG=0A	4.95	5.0	5.05	V
Output Maximum Current of VREG	IREG				20	mA
<OSCILLATOR>						
Switching Frequency Accuracy (*1)	fOSC1	fsw=200kHz~2000kHz vs. actual typical frequency	-7		7	%
Maximum Duty Cycle	Dmax1	fsw=200kHz~600kHz	90	94	98	%
	Dmax2	fsw=600kHz~2000kHz	86	90	94	%
Sync Threshold voltage	VOSC		4			V
Minimum Sync Frequency	fOSC(EX)		1.1fsw			Hz
<MOSFET DRIVER>						
NDRV Source Resistance	RNDRVH	INDRV=-100mA		0.9		Ω
NDRV Sink Resistance	RNDRVL	INDRV=100mA		1.1		Ω
NDRV Rise Time	trNDRV	CL=1nF		6		ns
NDRV Fall Time	tfNDRV	CL=1nF		6		ns
<LOGIC INPUT / OUTPUT>						
EN Input High Voltage	VIH_EN		2.1	-	VCC	V
EN Input Low Voltage	VIL_EN		0	-	0.8	V
PWM Input High Voltage	VIH_PWM		2.1	-	VREG	V
PWM Input Low voltage	VIL_PWM		0	-	0.8	V
PROG Input High Voltage	VIH_PROG		2.1	-	VREG	V
PROG Input Low voltage	VIL_PROG		0	-	0.8	V
EN Input Current	IIH_EN	VEN=36V			1.0	μA
	IIL_EN	VEN=0V	-1.0	-	-	μA
PWM Input Current	IIH_PWM	VPWM=5.0V	-	-	1.0	μA
	IIL_PWM	VPWM=0V	-1.0	-	-	μA
PROG Input Current	IIH_PROG	VPROG=5.0V	-	-	1.0	μA
	IIL_PROG	VPROG=0V	-1.0	-	-	μA
SDO Output Voltage	VOH_SDO	IOH=-1mA, VREG=5.0V	4.6	-	-	V
	VOL_SDO	IIOL=1mA	-	-	0.4	V

■ Electrical Characteristics

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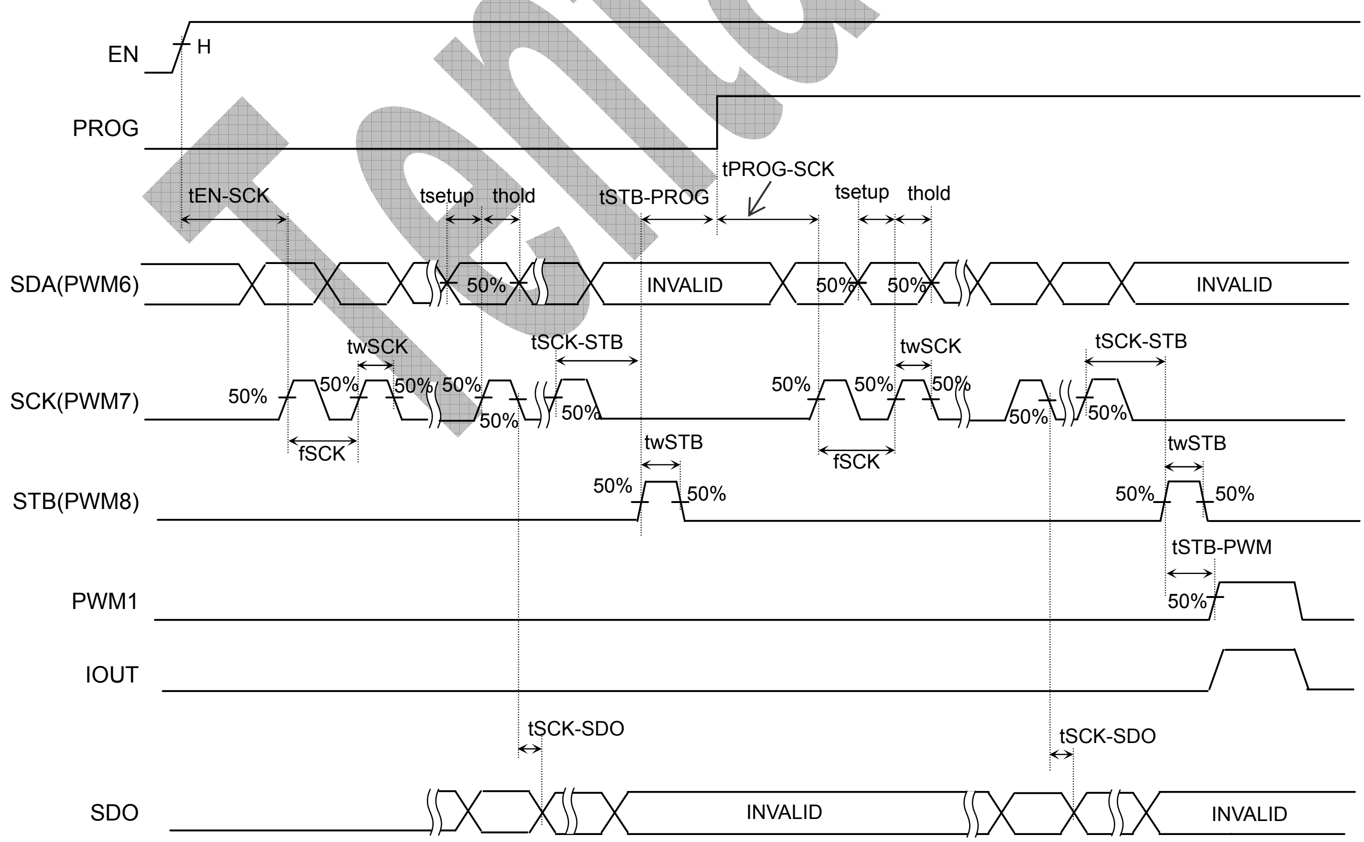
Characteristics	Symbol	Condition	Min	Typ.	Max	Unit
<UNDER VOLTAGE LOCKOUT>						
UVLO(VCC) Threshold Voltage	UVLO_VCC	VCC SWEEP UP	5.5	6.0	6.5	V
UVLO(VCC) Hysteresis	VHYS_VCC		200	300		mV
UVLO(EXT) Threshold Voltage	UVLO_EXT	VUVLO SWEEP UP		1.15		V
UVLO(EXT) Hysteresis	VHYS_EXT		50	100		mV
<DETECTION CIRCUITS>						
OVD Threshold Voltage	VOVD	VOVD SWEEP UP		3.5		V
OVD Hysteresis	VHYS_OVD			300		mV
LVD Threshold Voltage	VLVD			0.2		V
CS Control Voltage	VCS			0.4		V
<LED CURRENT SOURCES>						
LED Current Sink Range	IOUT		20		150	mA
LED Current Setting	IOUT	ISET=VSET/RSET=80μA, Gain=1500		120		mA
LED Current Accuracy	ΔILED	Channel to chanel IOUT=120mA	-2.0		2.0	%
LED Open Detection Threshold	VOPEN		0	0.2	0.35	V
LED Short Detection Threshold1 (OSD=GND)	VSHORT1	OSD=GND		6.9		V
LED Short Detection Threshold2	VSHORT2	VOSD=0.5V～VREG-1.5V		VOSD ×6		V
PWM-IOUT Turn Delay	tON	PWM rising(50%) to IOUT rising(10%)		100		ns
PWM-IOUT Turn Off Delay	tOFF	PWM falling(50%) to IOUT falling(90%)		100		ns
IOUT Rise Time	trout	10% to 90%		200		ns
IOUT Fall Time	tfOUT	90% to 10%		200		ns
<**ERROR AMPLIFIER** >						
OUT Regulation Voltage	VOUTmin			0.5		V
COMP Source Current	ISO_COMP	VOUT=0V, VCOMP=2.5V	-160	-375	-800	μA
COMP Sink Current	ISI_COMP	VOUT=5V, VCOMP=2.5V	160	375	800	μA
< **SLOPE COMPENSATION**>						
Peak Slope Compensation	ISLOPE	Current ramp added to the CS input.	45	50	55	μA× fsw
</ERR NCH OPEN DRAIN>						
/ERR output Low Voltage	VOL_ERR	IOL=1mA		0.1		V
<CP FILTER>						
CFIL Detection Voltage	VCFIL	VCFIL SWEEP UP		2.0		V
CFIL Source Current	ISO_CFIL			-1.0		μA

■ Electrical Characteristics

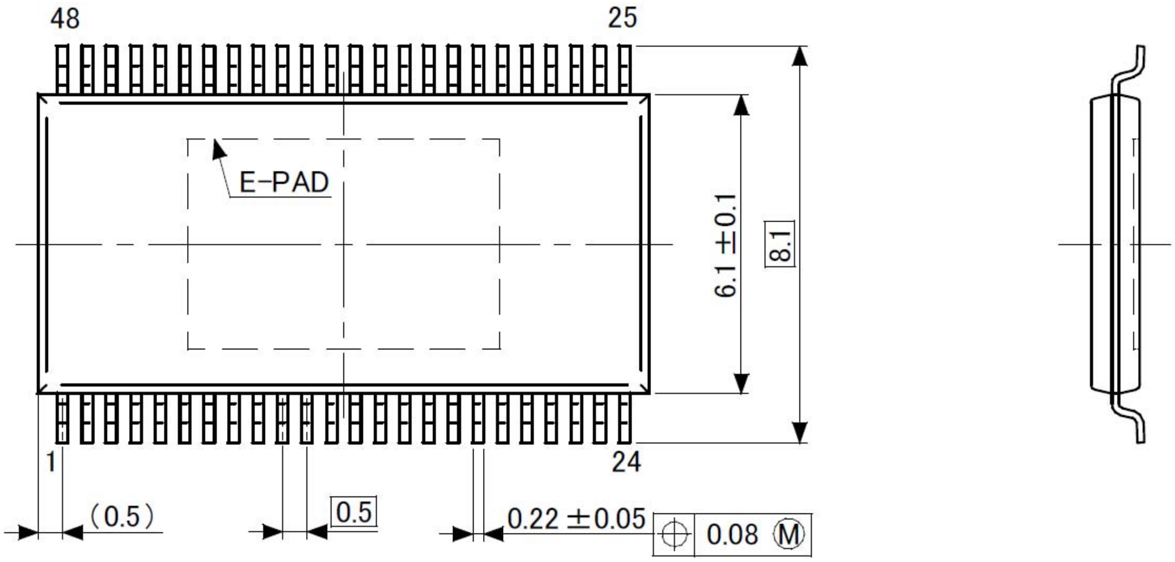
(Unless otherwise noted, VCC=EN=24V, OSD=PWM*=VREG, OVD=CS=GND=PGND1=PGND2=0V, ROSC=12.25kΩ, NDRV=COMP=OUT*=unconnected, ISET=VSET/RSET=80μA, CVREG=1μF, Ta=25°C)

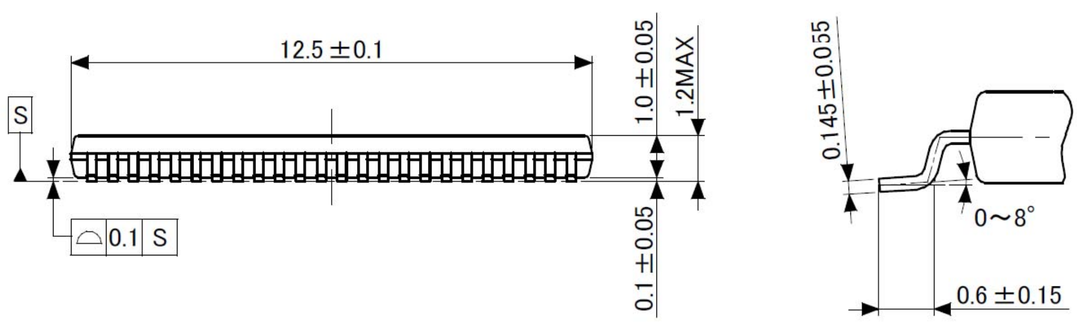
Characteristics	Symbol	Condition	Min	Typ.	Max	Unit
<SERIAL INTERFACE>						
EN-SCK Input Time	tEN-SCK	EN rising to SCK falling	TBD			μs
SCK Input Frequency	fSCK	SCK input frequency			10	MHz
SCK Input Pulse Width	twSCK	SCK H pulse	10			ns
Serial Data Input Setup Time	tsetup	SDA rising to SCK rising SDA falling to SCK rising	5			ns
Serial Data Input Hold Time	thold	SCK rising to SDA rising SCK rising to SDA falling	5			ns
STB Input Pulse Width	twSTB	STB H pulse	10			ns
SCK-STB Input Time	tSCK-STB	SCK rising to STB rising	10			ns
STB-PROG Input Time	tSTB-PROG	STB rising to PROG rising	10			ns
PROG-SCK Input Time	tPROG-SCK	PROG rising to SCK rising	10			ns
STB-PWM Input Time	tSTB-PWM	STB rising to PWM rising	10			ns
SCK-SDO Delay Time	tSCK-SDO	SCK falling(input) to SDO rising(output) SCK falling(input) to SDO falling(output)			20	ns



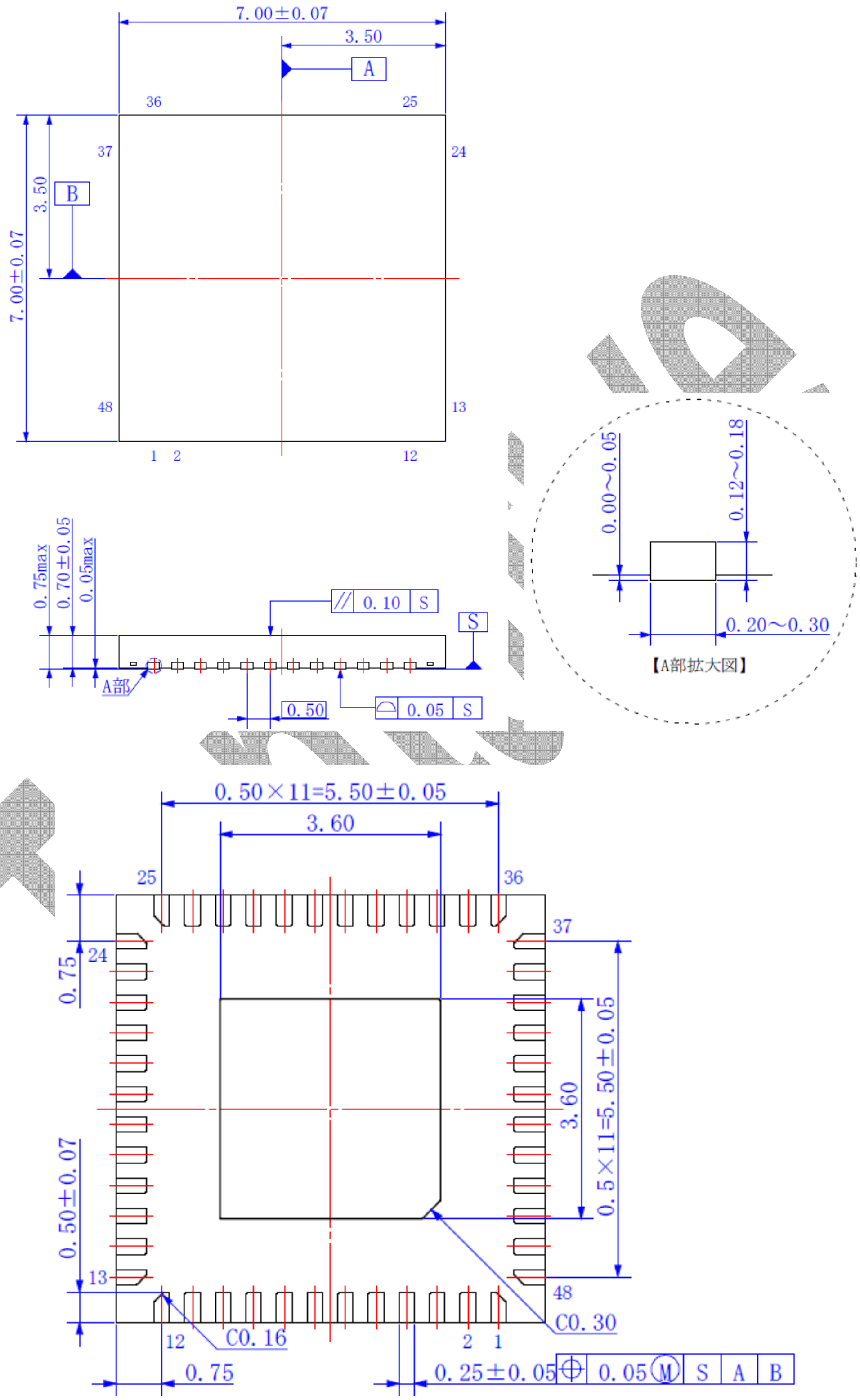
Package Dimensions

HTSSOP48





QFN48


7.00±0.07
3.50
A
B
7.00±0.07
3.50
0.75max
0.70±0.05
0.05max
0.10 S
S
A部
0.50
0.05 S
0.00~0.05
0.12~0.18
0.20~0.30
【A部拡大図】
0.50×11=5.50±0.05
3.60
0.75
0.50±0.07
3.60
0.5×11=5.50±0.05
C0.30
C0.16
0.75
0.25±0.05
0.05 M S A B

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.

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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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