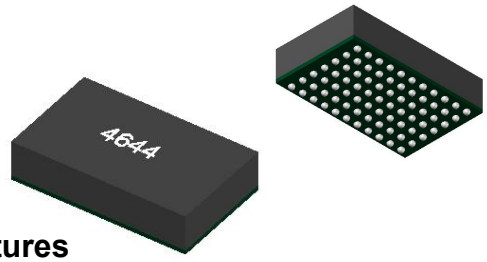
DC DC POWER MODULES

4-Channel DC/DC, With each channel outputting 4A Ultra-thin SIP package power module



1 Features

- Adopting SMT process, SIP plastic encapsulated packaging
- General specification： GJB 10164-2021
- Output current: 4A continuous full-load output current per channel, peak at 5.5A
- Operating temperature (Tc) ：-55℃ ~ +125℃
- Wide input voltage range：4.5V to 16V
- Output voltage range：0.6V to 5.5V
- Switching frequency: Select-able at 800KHZ or 1.2MHZ (factory setting)
- Operating mode: adjustable between PFM and FCCM
- Efficiency： 92%
- No-load power consumption: total of 0.01W for 4 channels (12Vin, 5V output)
- Output ripple voltage： 15mVp-p（typical）
- Voltage regulation rate： ±1.0% （typical）
- Load regulation rate： ±0.5% （typical）
- Soft start: internal 1mS soft start
- Protection: output over-current, overheat, output over-voltage, input under-voltage
- Standard dimensions:

  LGA package (9.0*15.0*4.32mm)

  LGA package (9.0*15.0*5.01mm)
- Ultra-thin Dimensions:

  LGA package(9.0*15.0*1.82mm)

  LGA package (9.0*15.0*2.42mm)

2 Applications

- Multi-rail load point regulation;
- Power supply for CPUs and GPUs;
- Power supply for ASIC chips such as CPLDs, DSPs, and FPGAs.

3 Description

The FHT4644F is a non-isolated buck DC/DC power module with a wide input voltage range of 4 to 16V and an adjustable output range of 0.6 to 5.5V. It features four output channels, each capable of delivering up to 4A. Users can choose between LGA and BGA packaging options.

The FHT4644F is an SMT surface-mount module that is welded onto the PCB board using reflow soldering. It is characterized by high power density and a small size, with an ultra-thin thickness of only 1.82mm and a power density reaching 300W/cm³. The power module circuit integrates power chips, inductors, and related components. Each output only requires a voltage-regulating resistor and a few input and output ceramic capacitors on the periphery to quickly complete the design of a multi-channel power supply system. This simplified system design maximizes space savings on the PCB layout.

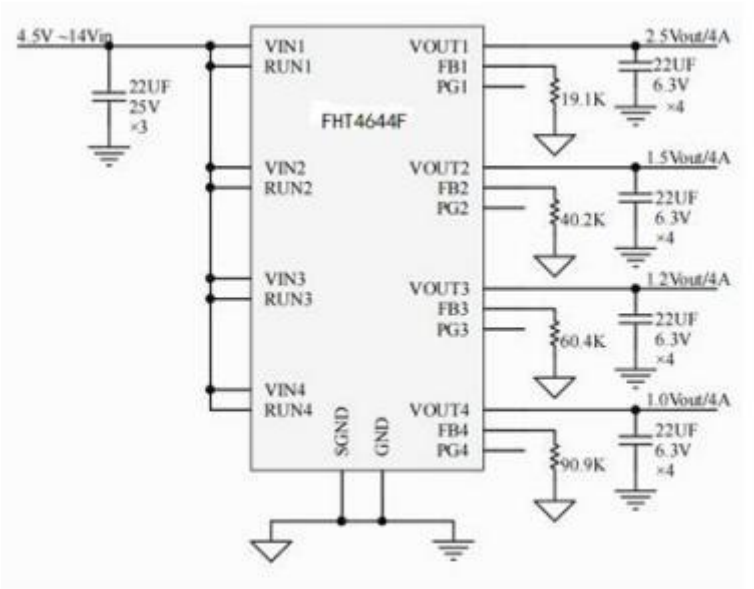
The FHT4644F, serving as a point-of-load power supply, can be directly mounted next to the FPGA to provide high-precision voltages such as 5.0V, 3.3V, 2.5V, and 1.2V for the digital circuits, FPGA control circuits, motherboard, CPU, communication modules, storage, and other components in the system. Each channel can continuously deliver a current of 4A. It is ideally suited for applications requiring low output voltages and multiple channels.

The FHT4644F has three adjustable operating modes: PFM, UFM, and FCCM. The operating frequency is 800KHZ and 1.2MHZ, which can be selected and set at the factory.

All components of FHT4644F are made in China, and can provide independent and controllable reports. In addition, the power module also has the characteristics of high reliability, high efficiency and long life. Especially in low-voltage output, its efficiency is significantly higher than that of similar products, which can provide more reliable and stable power supply for the system.

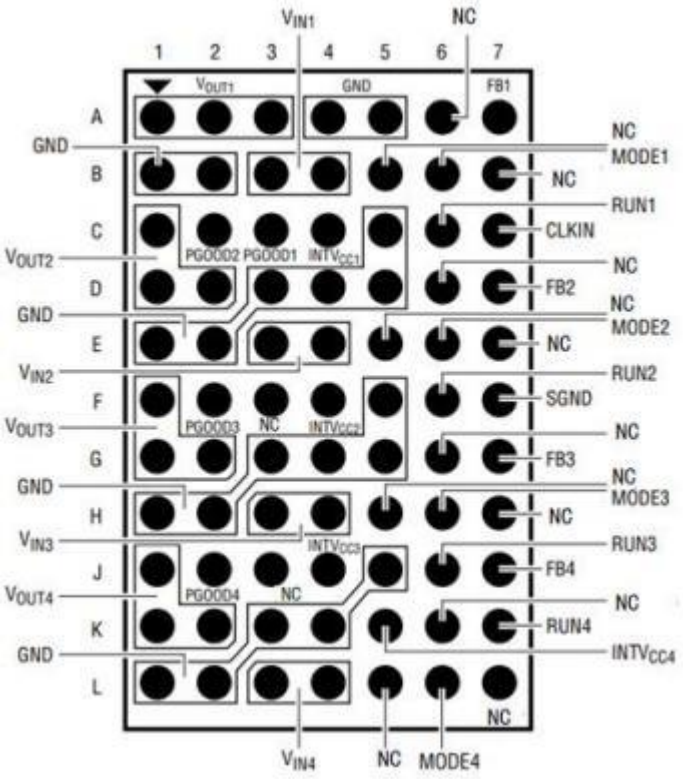
Typical Applications

Circuit Application Diagram



Pin Configuration

TOP VIEW



Pin Configuration

Pin	Description
V_{OUT1} (A1,A2,A3) ,V_{OUT2} (C1,D1,D2) , V_{OUT3} (F1,G1,G2) ,V_{OUT4} (J1,K1,K2)	Power Module Four-Channel Output Pins
V_{IN1} (B3,B4) ,V_{IN2} (E3,E4) , V_{IN3} (H3,H4) ,V_{IN4} (L3,L4)	Power Module Four-Channel Input Pins
GND (A4,A5, B1,B2, C5, D3,D4,D5, E1,E2, F5, G3,G4,G5, H1,H2, J5,K3, K4,L1,L2)	Ground Pin
FB1 (A7) , FB2 (D7) ,FB3 (G7) , FB4 (J7)	Four-channel output voltage adjustment pins, which can be connected to a voltage-regulating resistor with 0.5% precision to GND.
RUN1 (C6) , RUN2 (F6) , RUN3,(J6) , RUN4 (K7)	The four enable pins can either be directly connected to the input voltage or to an external power supply to control the power module. The minimum enable startup voltage is 1.1V. When the enable voltage is below 1.0V, the power is turned off. It is recommended that the enable voltage be greater than 1.3V. This pin should not be left floating. To turn off the power, this pin can be connected to ground.
PGOOD1 (C3) ,PGOOD2 (C2) , PGOOD3 (F2) ,PGOOD4 (J2)	The fault indication pin, PG, serves as an indicator of VOUT's voltage status: PG high signifies that VOUT is within the specified voltage range, whereas PG low indicates that VOUT has fallen below the prescribed value. This PGOOD pin can be connected to the VO pin via a 100K resistor (note: it is crucial to assess whether the actual voltage at the VO pin meets the voltage requirements of the subsequent FPGA or other chip I/O ports). Alternatively, an external power supply can be connected to the PGOOD pin. When PGOOD is set to low, it signifies that an abnormality has occurred in the power module, which may include under-voltage (UV), over-voltage (OV), over-current (OC), over-temperature (OT), and other issues. If the fault indication function is not required, this resistor can be omitted, and the PGOOD pin can be left floating.
INTVCC1 (C4) , INTVCC2 (F4) , INTVCC3 (J4) , INTVCC4 (K5)	The internal power driver and control circuitry are powered by this pin, and each pin internally uses a 1μF low ESR (Equivalent Series Resistance) ceramic capacitor for decoupling to GND.
MODE1(B6), MODE2(E6), MODE3(H6), MODE4(L6)	The operating mode pin allows for the selection of different operation modes for each channel, with two options available: PFM (Pulse Frequency Modulation) and FCCM (Forced Continuous Conduction Mode). By connecting the MODE pin to VCC, the device operates in Forced Continuous Current Modulation (FCCM) mode. Conversely, grounding the pin will put the device in Pulse Frequency Modulation (PFM) mode.
SGND (F7)	It is recommended to route the signal ground (SGND) separately from the power ground (GND), and ultimately connect them using a 0-ohm resistor.
SS1 (A6), SS2(D6), SS3(G6), SS4(K6)	External soft-start pin: An external 3.3nF ceramic capacitor can be connected to the signal ground. If the external soft-start function is not required, this capacitor can be omitted, and the SS pin can be left floating.
NC (A6, D6, G6, K6,E7,H7,L7,C7,L5,H5,E5,B5,J3,F3)	NC (No Connect) Pin: This is a pin that serves no electrical function.

Electrical Characteristics

Absolute Maximum Ratings	Condition	Minimum value	Nominal value	Maximum value	Unit
V_{IN} (per channel)		-0.3		19	V
FB、V_{OUT} (per channel)		-0.3		6	V
PGOOD (per channel)		-0.3		6	V
PGOOD Current (per channel)				10	mA
$INTV_{CC}$ (per channel)		-0.3		6	V
RUN (per channel)		-0.3		19	V
Storage temperature		-55		150	℃
Reflow Soldering Temperature				245	℃
Input Characteristics	**Condition**	**Minimum value**	**Nominal value**	**Maximum value**	**Unit**
Input Voltage Range		4.5		16	V
Power-on Voltage Threshold		4	4.25	4.45	V
Power-off Voltage Threshold		3.6	3.7		V
Input Current at Full Load	V_{IN} =12V, V_{OUT} =1.5V, I_{OUT} =4A		0.6		A
Input Current at Low Voltage and Full Load	V_{IN} =5V, V_{OUT} =1.5V, I_{OUT} =4A		1.5		A
Input Current at No Load	V_{IN} =12V, V_{OUT} =1.5V, I_{OUT} =0A		650		μA
Static Input Current	ON/OFF=OFF		15		μA
General Requirements	**Condition**	**Minimum Value**	**Nominal Value**	**Maximum Value**	**Unit**
Switching Frequency	Automatic adjustment		1200		KHz
Efficiency	Vin=5V, Vout=3.3V			92	%
Soft Start Time	SS pin plus 3.3nF ceramic capacitor		1		ms

Functionality	Condition	Minimum value	Nominal value	Maximum value	Unit
RUN Enable Voltage		1.2	-	15	V

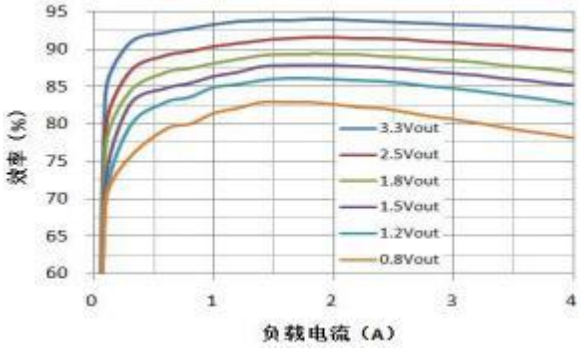
Output Characteristics	Condition	Minimum value	Nominal value	Maximum value	Unit
$INTV_{CC}$		4.75	5	5.25	V
Output Voltage Range	Adjusted by the resistor at the FB pin	0.6		5.5	V
Output Voltage	CIN = 22μF, COUT = 22uF×4,VIN = 4V to 16V, IOUT = 0A to 4A	1.47	1.5	1.53	V
Linear Regulation	V_{OUT}= 1.5V, 4V < V_{IN}< 16V, I_{LOAD} = 4A		±0.5	±1	%
Load Regulation	V_{IN}=12V, V_{OUT}=1.5V,1A < I_{LOAD} ≤ 4A		±1	±2	%
Ripple and Noise	V_{IN} =12V, V_{OUT} =1.5V, I_{OUT}=4A, C_{out}=22uF×4, 20MHz bandwidth		10	50	mV
Dynamic Load Response	75-100% full load, di/dt=1A/μS C_{out}=22uF×4		50, 40		mV, μs

Electrical Characteristics

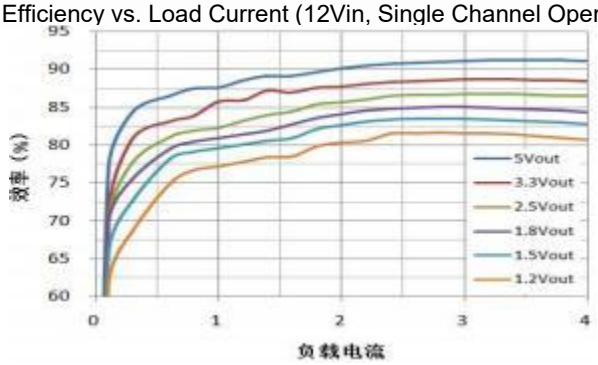
Output Characteristics	Condition	Minimum value	Nominal value	Maximum value	Unit
Output Over current Protection	Iout%	115	120	125	%
Output Over voltage Protection	Vout%	115	115	130	%
Over-Temperature Protection	Case temperature (Tc)	-	-	135	℃
Structural Characteristics	**Conditions**	**Minimum Value**	**Nominal value**	**Maximum value**	**Unit**
Packaging	LGA、BGA	-	-	-	-
Standard Size	LGA: 9*15*4.32; BGA: 9*15*5.01	-	-	-	mm
Ultra-thin Size	LGA: 9*15*1.82; BGA: 9*15*2.42	-	-	-	mm
Weight			1.6		g
Environmental Adaptability	**Condition**	**Minimum value**	**Nominal value**	**Maximum value**	**Unit**
Operating temperature (Case temperature)		-55		125	℃
High temperature storage (ambient temperature)	+125℃, 48h			125	℃
High temperature operation (ambient temperature)	+85℃, 24h; Input low pressure, standard pressure, high pressure each 8h			85	℃
Low temperature storage (ambient temperature)	-55℃, 24h	-55			℃
Low temperature operation (ambient temperature)	-55℃, 24h; Input low pressure, standard pressure, high pressure each 8h	-55			℃
Damp heat	High temperature and high humidity stage: 60℃, 95%; Low temperature and high humidity stage: 30℃, 95%; 10 cycles, each cycle is 24h.	30		60	℃
Thermal shock	High temperature 125 ℃, low temperature -55 ℃, high and low temperature of an hour for a cycle, a total of 32 cycles of the test	-55		125	℃

NOTE : Stresses above the values listed in the "Limit Values" section may cause permanent damage to the device. Prolonged exposure to any of the absolute maximum ratings may affect the reliability and life of the device.

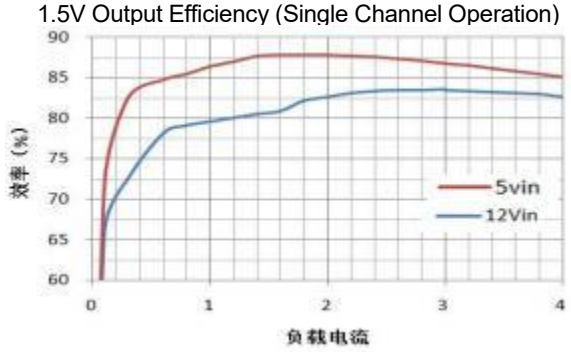
Efficiency vs. Load Current (5Vin, Single Channel Operation)



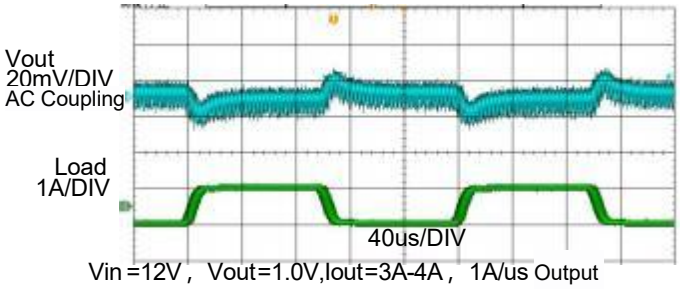
Efficiency vs. Load Current (12Vin, Single Channel Operation)



1.5V Output Efficiency (Single Channel Operation)

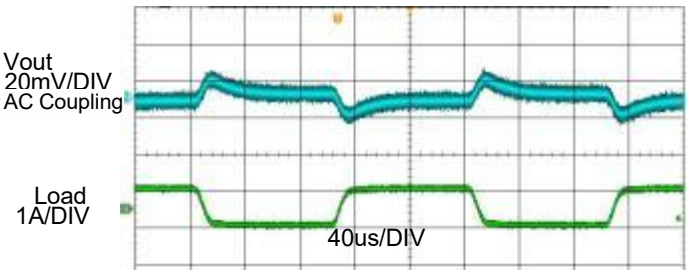


Dynamic Load Response at 1.0V



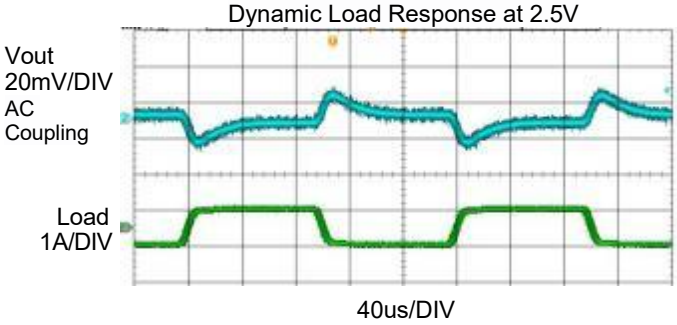
Vin =12V， Vout=1.0V,Iout=3A-4A， 1A/us Output
Capacitance=4*22uF+0.1uFCeramic Capacitor

Dynamic Load Response at 1.5V



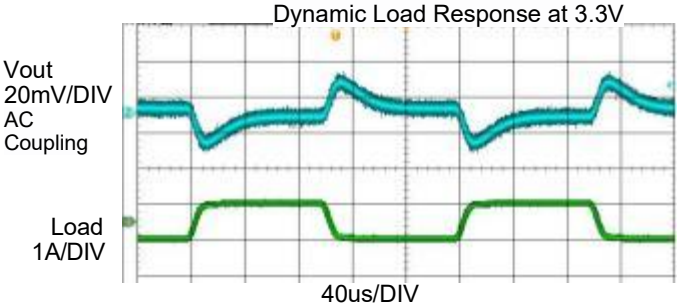
Vin =12V， Vout=1.5V,Iout=3A-4A， 1A/us Output
Capacitance=4*22uF+0.1uFCeramic Capacitor

Dynamic Load Response at 2.5V



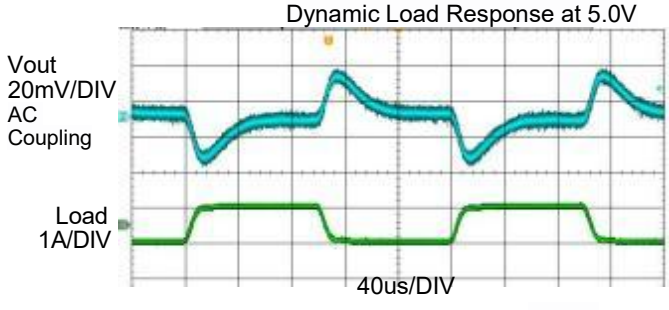
Vin=12V， Vout=2.5V,Iout=3A-4A， 1A/us Output
Capacitance=4*22uF+0.1uFCeramic Capacitor

Dynamic Load Response at 3.3V



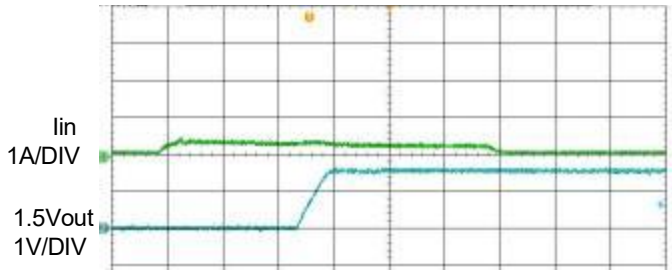
Vin=12V， Vout=3.3V,Iout=3A-4A， 1A/us Output
Capacitance=4*22uF+0.1uFCeramic Capacitor

Dynamic Load Response at 5.0V



Vin=12V， Vout=5V,Iout=3A-4A， 1A/us Output
Capacitance=4*22uF+0.1uFCeramic Capacitor

Output Startup - No Load



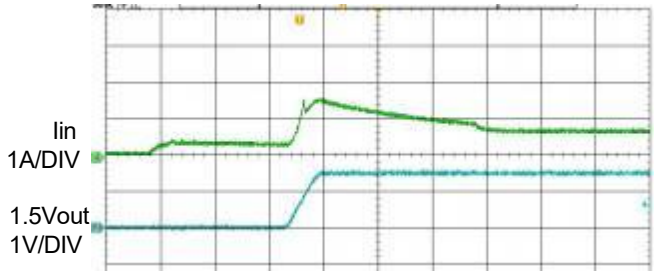
2ms/DIV

Vin=12V， Vout=1.5V,Iout=0A

Input Capacitance = 150uF electrolytic capacitor + 4 * 22uF + 0.1uF ceramic capacitor

Output Capacitance = 4 * 22uF + 0.1uF ceramic capacitor

Output Startup with 4A Load



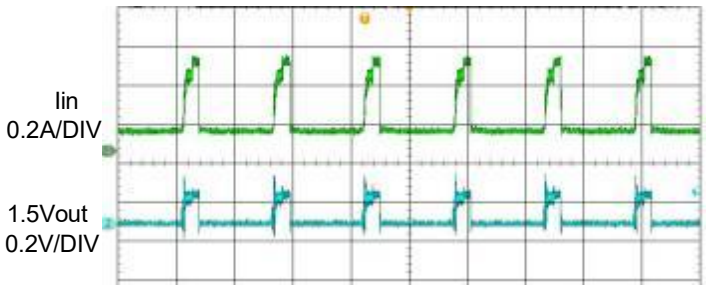
2ms/DIV

Vin=12V， Vout=1.5V,Iout=4.0A

Input Capacitance = 150uF electrolytic capacitor + 4 * 22uF + 0.1uF ceramic capacitor

Output Capacitance = 4 * 22uF + 0.1uF ceramic capacitor

Normal State and Hiccup Mode under Output Short-Circuit and No-Load Condition



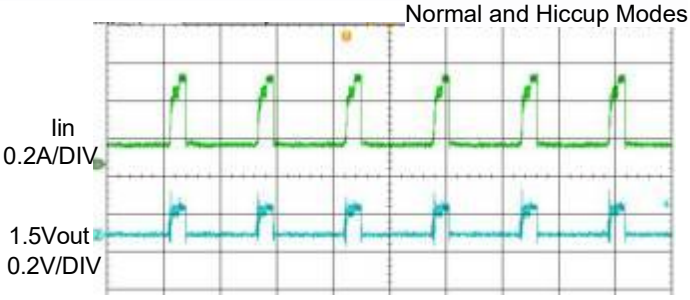
4ms/DIV

Vin=12V， Vout=1.5V,Iout=0A

Input Capacitance = 150uF electrolytic capacitor + 4 * 22uF + 0.1uF ceramic capacitor

Output Capacitance = 4 * 22uF + 0.1uF ceramic capacitor

Output Short-Circuit with 4A Load in Normal and Hiccup Modes

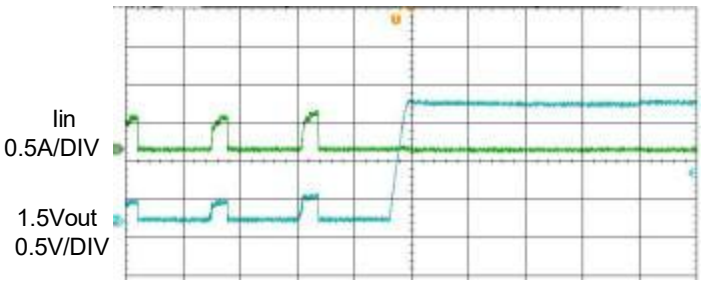


4ms/DIV

Input Capacitance = 150uF electrolytic capacitor + 4 * 22uF + 0.1uF ceramic capacitor

Output Capacitance = 4 * 22uF + 0.1uF ceramic capacitor

Output Short-Circuit Removal - No-Load (Transient, Hiccup Mode)



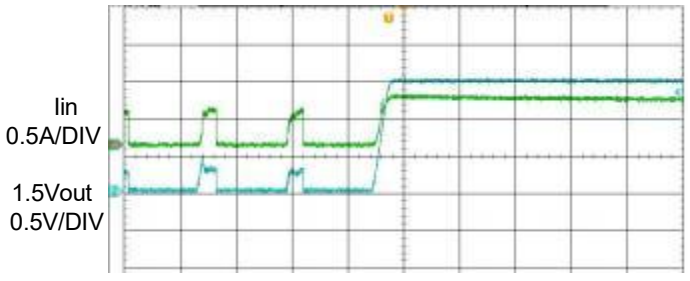
4ms/DIV

Vin=12V， Vout=1.5V,Iout=0A

Input Capacitance = 150uF electrolytic capacitor + 4 * 22uF + 0.1uF ceramic capacitor

Output Capacitance = 4 * 22uF + 0.1uF ceramic capacitor

Output Short-Circuit Removal - 4A Load (Transient, Hiccup Mode)



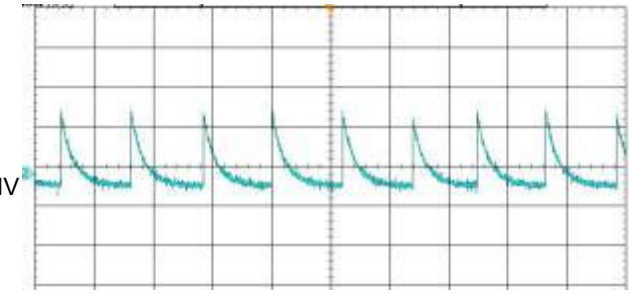
4ms/DIV

Vin=12V， Vout=1.5V,Iout=4.0A

Input Capacitance = 150uF electrolytic capacitor + 4 * 22uF + 0.1uF ceramic capacitor

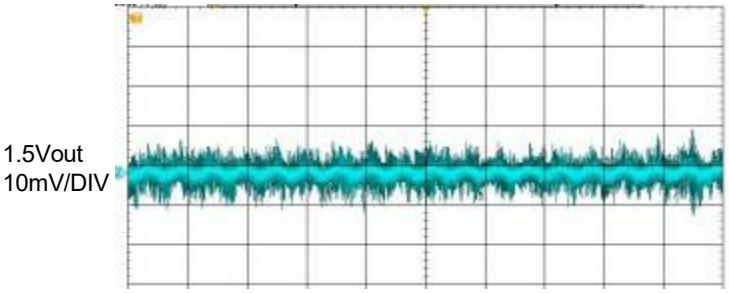
Output Capacitance = 4 * 22uF + 0.1uF ceramic capacitor

1.5V Output Ripple - No-Load Condition



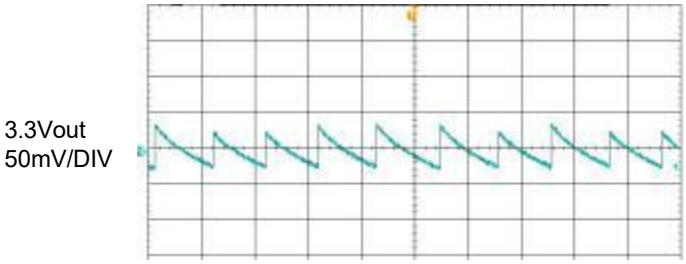
Vin=12V， Vout=1.5V,Iout=0A
Input Capacitance = 150uF electrolytic capacitor + 4 * 22uF + 0.1uF ceramic capacitor
Output Capacitance = 4 * 22uF + 0.1uF ceramic capacitor
20MHz Bandwidth Limitation

1.5V Output Ripple under 4A Load



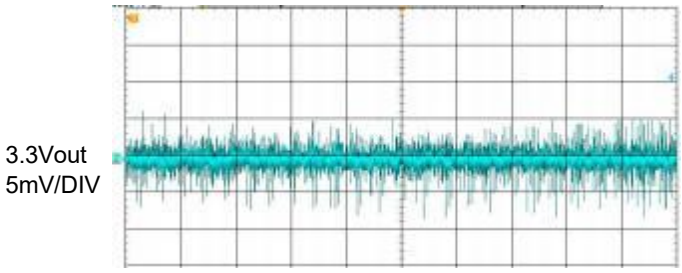
Vin=12V， Vout=1.5V,Iout=4.0A
Input Capacitance = 150uF electrolytic capacitor + 4 * 22uF + 0.1uF ceramic capacitor
Output Capacitance = 4 * 22uF + 0.1uF ceramic capacitor
20MHz Bandwidth Limitation

3.3V Output Ripple - No-Load Condition



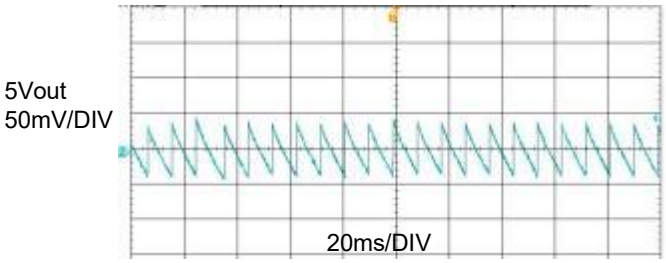
Vin=12V， Vout=3.3V,Iout=0A
Input Capacitance = 150uF electrolytic capacitor + 4 * 22uF + 0.1uF ceramic capacitor
Output Capacitance = 4 * 22uF + 0.1uF ceramic capacitor
20MHz Bandwidth Limitation

3.3V Output Ripple under 4A Load



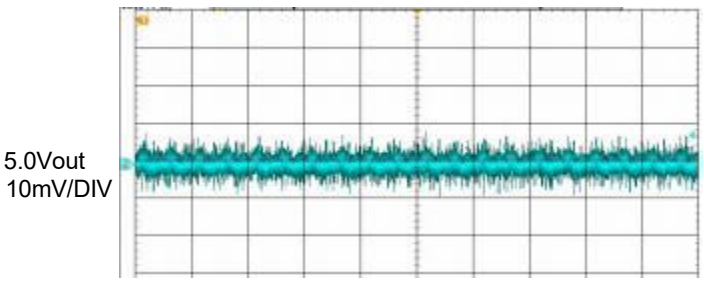
Vin=12V， Vout=3.3V,Iout=4.0A Input Capacitance = 150uF electrolytic capacitor + 4 * 22uF + 0.1uF ceramic capacitor
Output Capacitance = 4 * 22uF + 0.1uF ceramic capacitor
20MHz Bandwidth Limitation

5V Output Ripple - No-Load Condition



Vin=12V， Vout=5.0V,Iout=0A
Input Capacitance = 150uF electrolytic capacitor + 4 * 22uF + 0.1uF ceramic capacitor
Output Capacitance = 4 * 22uF + 0.1uF ceramic capacitor
20MHz Bandwidth Limitation

5V Output Ripple under 4A Load



Vin=12V， Vout=5.0V,Iout=4.0A
Input Capacitance = 150uF electrolytic capacitor + 4 * 22uF + 0.1uF ceramic capacitor
Output Capacitance = 4 * 22uF + 0.1uF ceramic capacitor
20MHz Bandwidth Limitation

Operation

The FHT4644F is a four-channel, independently outputting, non-isolated DC/DC switching voltage regulator. It boasts four separate regulator channels, each capable of delivering up to 4A of continuous output current, requiring only minimal external input and output capacitors. Across an input voltage range of 4.5V to 16V, each regulator channel can provide a precisely adjustable output voltage, ranging from 0.6V to 5.5V, via an external resistor.

RUN Enable

Pulling the RUN pin of each regulator channel to ground forces the regulator into a shutdown state, turning off the power MOSFET and most internal control circuits. Placing the RUN pin above 0.7V only turns on the internal reference while still keeping the power MOSFET off. Further increasing the voltage on the RUN pin to above 1.3V will turn on the entire regulator channel.

Output Voltage Setting

Within the FHT4644F, the FB pin is connected to the VOUT terminal of each channel through a 60.4kΩ precision resistor. The output voltage of this module can be controlled by programming the resistance between the FB and GND pins. The calculation is shown below:

Note: It is recommended to reserve two resistor positions with a precision of 0.5% for fine-tuning the output voltage. The following formula is used to calculate the output voltage adjustment resistor:

$$R_{FB}(K) = \frac{60.4K}{\frac{V_{OUT}}{0.6} - 1}$$

Table 1: Relationship Between R_{FB} Resistance and Various Output Voltages

Vout (V)	0.6	1.0	1.2	1.5	1.8	2.5	3.3	5.0

Soft-Start Feature

The module is equipped with a built-in 1.0 millisecond (mS) soft-start function.

Working Mode Adjustment (MODE)

There are two mode options: PFM and FCCM. By connecting the MODE pin to VCC, the device operates in the Forced Continuous Conduction Mode (FCCM). By grounding the pin, the device will run in Pulse Frequency Modulation (PFM) mode.

Units are in mS. For example, when the additional soft-start time is 1ms, the required soft-start capacitor is 4nF.

Input Under-Voltage Protection

When VIN drops below 3.7V, under-voltage lockout (UVLO) occurs.

Note: If the input cable is relatively long, due to the voltage drop across the cable, it is necessary to ensure that the voltage at the input pins of the module is greater than 4.5V to guarantee normal output. This is to compensate for the voltage loss in the cable and ensure that the module receives sufficient input voltage to operate correctly.

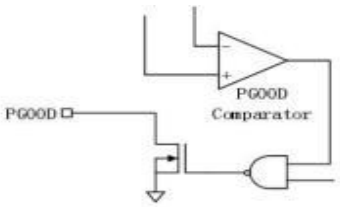
Output Over-Current Protection

If the output current goes above the limit, the FHT4644F protects itself by entering a safe mode.When the output current returns to a safe level, the converter starts working normally again.

Power Good

The PGOOD pin is an open-drain output that indicates the status of the output voltage. If the output voltage drops below a certain threshold, the PGOOD pin signals this by going high. This pin can also be used to detect when protective features like UVLO or OTP are activated. By attaching a resistor, you can pull the PGOOD pin up to a specific voltage level for monitoring purposes.

Below is a schematic diagram of the PG (Power Good) circuit, followed by List 2 which presents the logic table for the PGOOD pin:



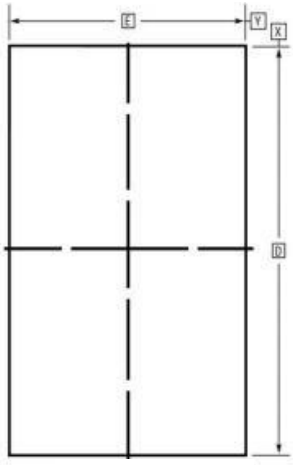
Monitoring Item	Conditions	PG Status
VLO	0.7V < VIN < VUVLO	Low Level

Notes: VFB represents the voltage at the voltage feedback pin, VTH_PG is the threshold voltage for the PGOOD pin, TJ stands for junction temperature, and TSD refers to the temperature at which the power supply protection shutdown occurs.

Package Description (77-pin)

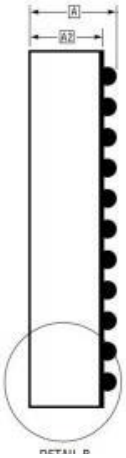
LGA（9mm×15mm×4.32/1.82mm）

BGA（9mm×15mm×5.01/2.42mm）

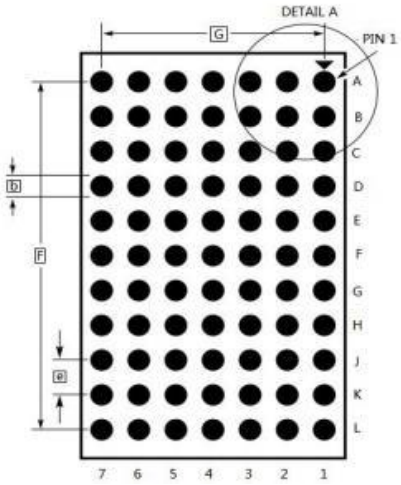


TOP VIEW

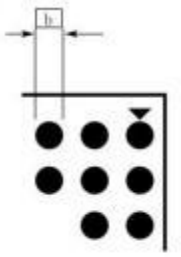
LGA SIDE VIEW



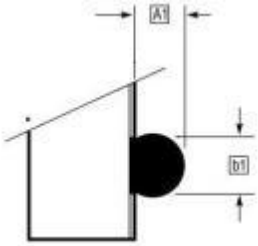
BGA SIDE VIEW



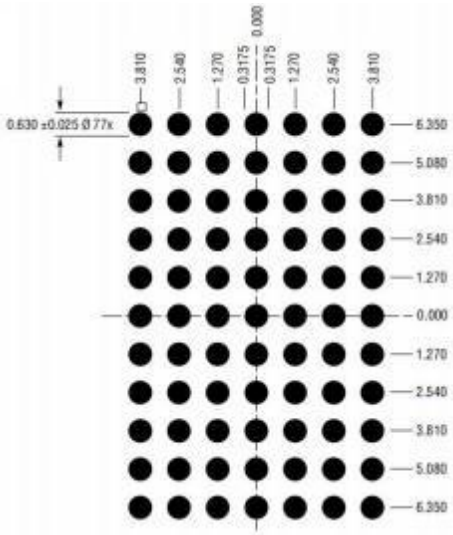
BOTTOM VIEW



DETAIL A



DETAIL B



TOP VIEW(PCB LAYOUT (RECOMMENDED SIZE)

LGA SIZE

SYMBOL	MIN	NOM	MAX
A2（Standard size）	4.12	4.32	4..52
A2（Ultra-thin size）	1.62	1.82	2.02
b	0.60	0.70	0.90
D	14.8	15	15.2
E	8.8	9	9.2
e	1.27		
F	12.70		
G	7.62		

BGA SIZE

SYMBOL	MIN	NOM	MAX
（Standard size）	4.81	5.01	5.21
（Ultra-thin size）	2.22	2.42	2.62
b	0.60	0.75	0.90
A1	0.50	0.60	0.70
b1	0.60	0.63	0.66
D	14.8	15	15.2
E	8.8	9	9.2
e	1.27		
F	12.70		
G	7.62		

Operating Conditions、Testing and Special Application Notes

1、Recommended Operating Conditions for This Module：

★Input Voltage Range：VIN = 4.5V ~ 16V

★Output Voltage Range：VOUT = 0.8V ~ 5.0V

★ Output Current Range：It is recommended to use with a 80% derating)

Iout= 0 ~ 4A Independent operation of a single channel

★Operating Case TemperatureTC： -55℃ ~ 125℃

2、Testing and Application Instructions

It is not recommended to use a linear power supply for functional testing of this power module (as linear power supplies tend to generate transient voltage fluctuations when adjusting the output, posing a risk of exceeding the maximum rated voltage). Instead, it is recommended to use a switching power supply or a DC/DC module power supply.

★ This power module features a high power density circuit, and it is recommended to use a PCB board with 4 layers or more for layout. Considering long-term stable operation under high temperature conditions, it is advisable to implement appropriate load derating (80% of rated load) or thermal management measures (options include: system-level air cooling, attaching a heatsink above the power module, increasing the copper-clad area on the PCB board beneath the power module, etc.).

★ For the PCB board application of this power module, it is recommended to use wider copper foil for the layout of VIN, VOUT, and GND to reduce conduction losses and thermal stress caused by high currents. It is advisable to place the input and output filtering capacitors close to the power module. To avoid interference, it is recommended to layout the input capacitors and output capacitors with a distance greater than 1 cm between them.

★ If you were previously using an LTM4644 peripheral circuit design, you will need to recalculate RFB according to the following formula.， Only the resistance value needs to be changed, and there is no need to modify the PCB layout.

$$R_{FB}(K) = \frac{60.4K}{\frac{V_{OUT}}{0.6} - 1}$$

★ This power module is a hermetically sealed product. Before soldering, check the changes on the humidity indicator card to determine if pre-baking treatment is necessary.

★Attention should be paid to electrostatic protection during product transportation.

Precautions for Reflow Soldering

1. Products that are well-packaged must undergo baking at 125°C for 24 hours before use. If the packaging bag is found to be torn or if the desiccant or indicator label has changed color, the products must undergo baking at 125°C for 48 hours before use. For more information, please refer to the IPC/JEDEC J-STD-033 standard.

2.For reflow soldering of lead-free BGA solder ball products, the peak temperature should not exceed 245°C; for lead-containing BGA solder ball products, the peak temperature should not exceed 225°C.

3.It is recommended to use a stencil thickness of 125um-160um, with stencil openings slightly smaller than the solder pads. Taking a Φ0.635mm solder pad as an example, the recommended stencil opening size is Φ0.620mm.

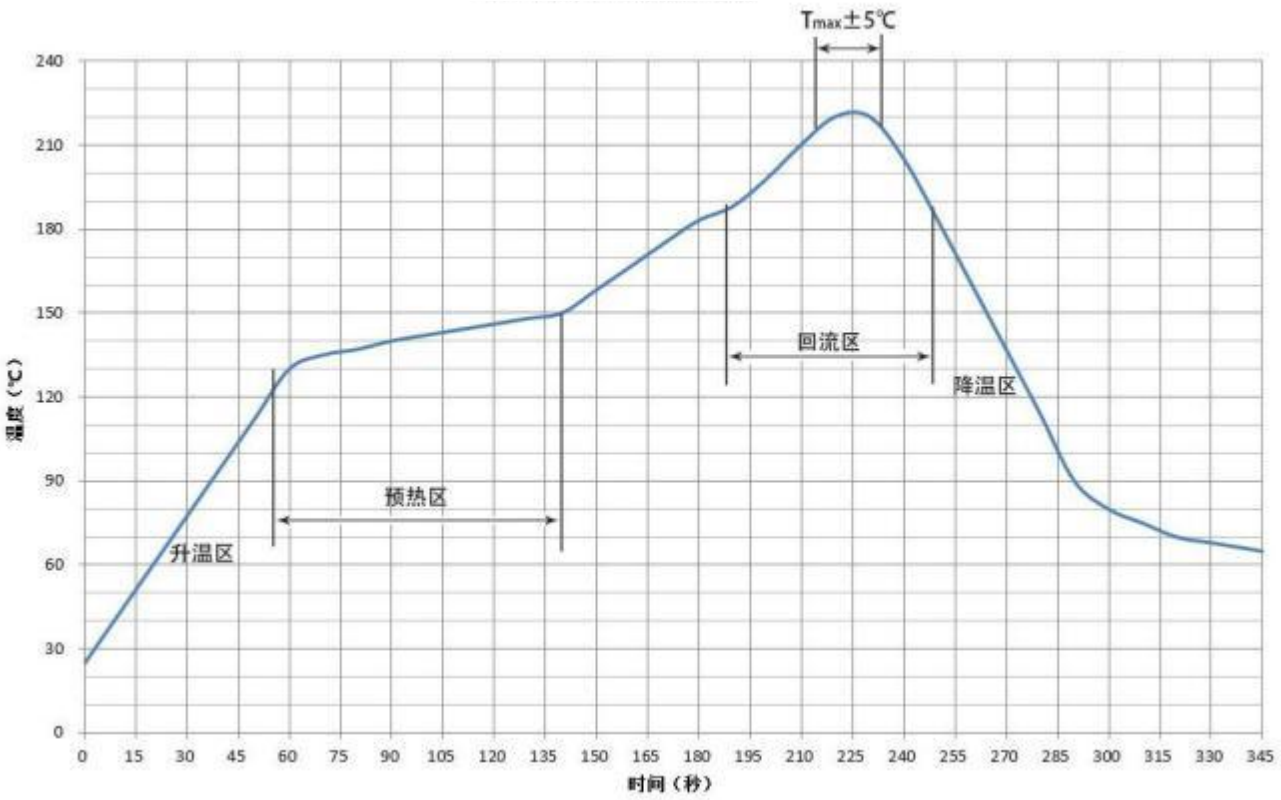
4. The solder paste can be either lead-free SAC or SnPb (with lead). Powder types 3 or 4 are recommended. Different brands of solder paste may have different welding recommendations, so please pay attention to the references. The porosity rate is recommended to not exceed 25%.

Recommended Reflow Soldering Parameters Table

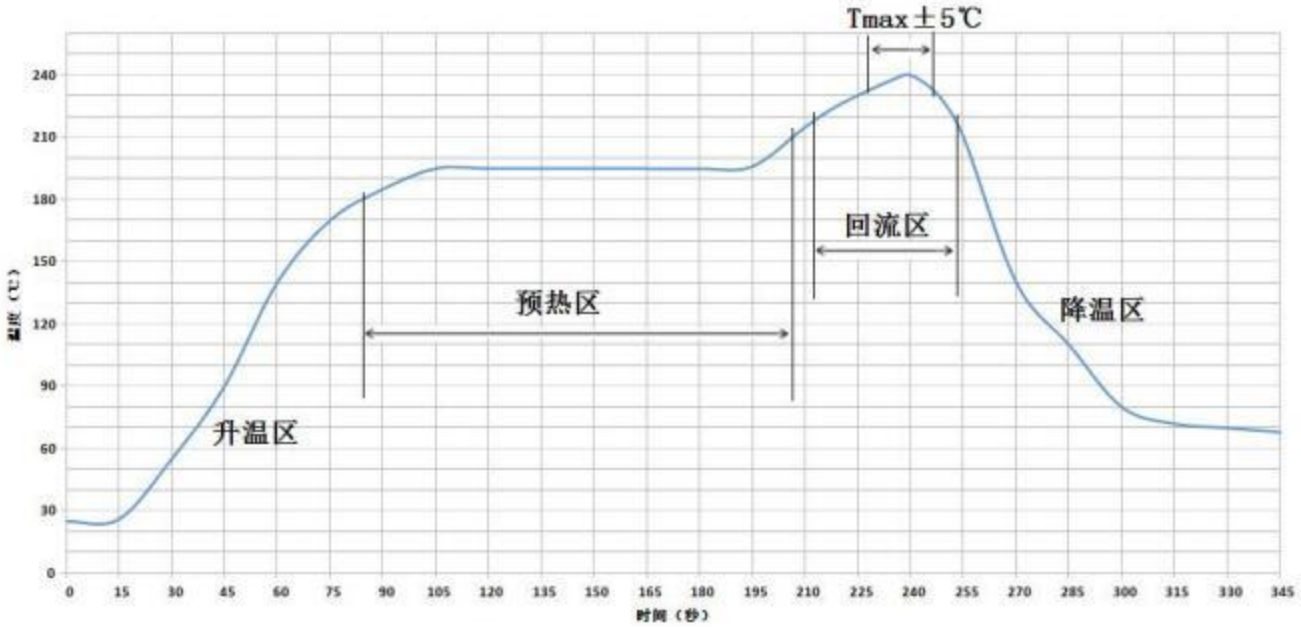
		Lead-free solder paste	SnPb (lead-containing) solder paste
Preheat	Minimum Preheat Temperature	150℃	100℃
	Maximum Preheat Temperature	200℃	150℃
	Preheat Duration	(60-120) seconds	(60-120) seconds
Reflow Soldering	Melting Point	217℃	183℃
	Duration Above Melting Point	(30-90) seconds	(30-90) seconds
Peak Temperature of the Welding Curve		245℃	225℃
Maximum Duration within ±5℃ of Peak Temperature		30 seconds	
Maximum Average Heating Rate		2.5℃/second	
Maximum Cooling Rate		2.5℃/second	
Maximum Time to Reach Peak Temperature from 25℃		8 minutes	

Recommended Reflow Soldering Profile (for reference)

Reflow soldering profile for SnPb solder paste



Reflow soldering profile for lead-free solder paste



Ordering Information

1. Product Naming Convention

FHT 4644F L M Y #PBF

① ② ③ ④ ⑤ ⑥

① Manufacturer Code

②Product Series Number

③ The presence of "L" signifies an ultra-thin size model, while its absence indicates a regular size model

④ Usage Grade: "M" stands for Military Grade (general military use), "I" for Industrial Grade, and "E" for Consumer Grade

⑤ Lead Configuration: "Y" or "V". "V" represents Land Grid Array (LGA) packaging, while "Y" represents Ball Grid Array (BGA) packaging

⑥BGA Solder Ball Characteristics: "#PBF" indicates lead-free, while the absence of this notation signifies lead-based

2. Selection Table for Regular Size Products

Product Model	Input		Output		Efficiency	Enable Voltage	Packaging	Grade	Temperature Range (Case Temperature)	Packaging
	Input Range	Nominal Input	Output range	Nominal Output						
FHT4644FMY	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	BGA (leaded)	general military grade	-55-125℃	Tray
FHT4644FMY#PBF	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	BGA (lead-free)	general military grade	-55-125℃	Tray
FHT4644FMV#PBF	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	LGA (lead-free)	general military grade	-55-125℃	Tray
FHT4644FIY	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	BGA (leaded)	industrial grade	-40-125℃	Tray
FHT4644FIY#PBF	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	BGA (lead-free)	industrial grade	-40-125℃	Tray
FHT4644FIV#PBF	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	LGA (lead-free)	industrial grade	-40-125℃	Tray
FHT4644FEY#PBF	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	BGA (lead-free)	Consumer Grade	-40-125℃	Tray

Ordering Information

3. Selection Table for Ultra-thin Size Products

Product Model	Input		Output		Efficiency	Enable Voltage	Packaging	Grade	Temperature Range (Case Temperature)	Packaging
	Input Range	Nominal Input	Output range	Nominal Output						
FHT4644FLMY	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	BGA (leaded)	general military grade	-55-125℃	Tray
FHT4644FLMY#PBF	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	BGA (lead-free)	general military grade	-55-125℃	Tray
FHT4644FLMV#PBF	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	LGA (lead-free)	general military grade	-55-125℃	Tray
FHT4644FLIY	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	BGA (leaded)	industrial grade	-40-125℃	Tray
FHT4644FLIY#PBF	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	BGA (lead-free)	industrial grade	-40-125℃	Tray
FHT4644FLIV#PBF	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	LGA (lead-free)	industrial grade	-40-125℃	Tray
FHT4644FLEY#PBF	4.5-16V	12V	0.6-5.5V	5.0，3.3，2.5,1.5V	92%	1.3-16V	BGA (lead-free)	Consumer Grade	-40-125℃	Tray