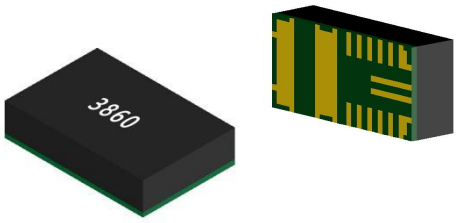
DC DC POWER MODULES

2.3~5.5V Input, 6A Output DC/DC Integrated plastic package adjustable voltage reduction module



1 Features

- **6A continuous output current**
- **Input voltage range: 2.3V-5.5V**
- **Output voltage: 0.5V-3.3V**
- **Switching frequency: 3MHz**
- **Light duty PFM mode**
- **Power Good Indicator (PG)**
- **Internal fixed soft start time**
- **Small size LGA package (4mm x 6mm x 1.6mm)**

2 Applications

- **Optical Modules**
- **Telecommunications and Network Systems**
- **Industrial equipment**
- **Embedded power supplies**

3 Description

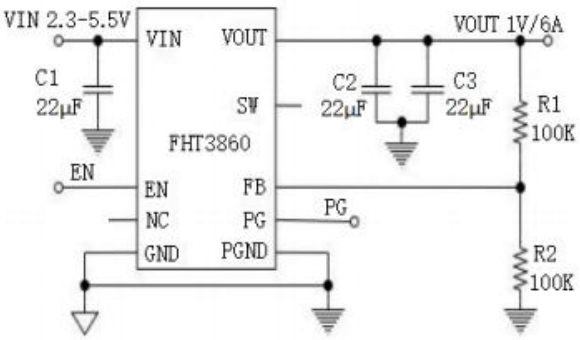
The FHT3860 is a high-frequency, high-efficiency DC/DC step-down converter that provides a complete power supply solution, simplifies the design, and requires few external resistors to achieve a 2.3~5.5V input voltage, 6A rated output current, adjustable output voltage, and excellent load and linearity regulation.

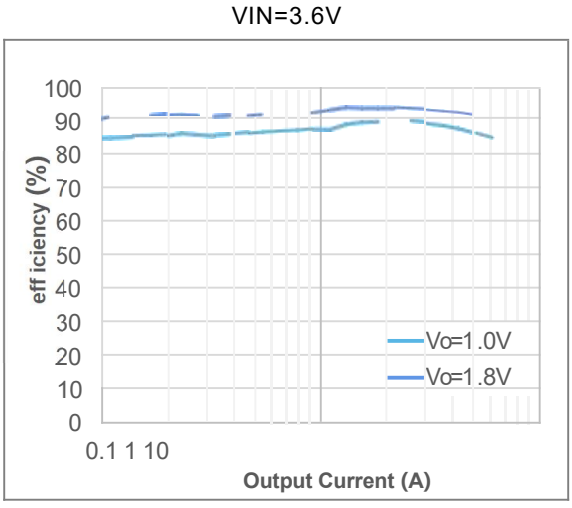
The FHT3860 has a full range of protection features, including overcurrent protection (OCP), input undervoltage lockout protection (UVLO), and thermal protection.

Ordering Information

Product model	Input		Output	Dimensions and Packaging	Packing
	Input Range	Nominal Input			
FHT3860	2.3V~5.5V	--	0.5V~3.3V/6A	4mm × 6mm × 1.6mm (LGA)	Tray

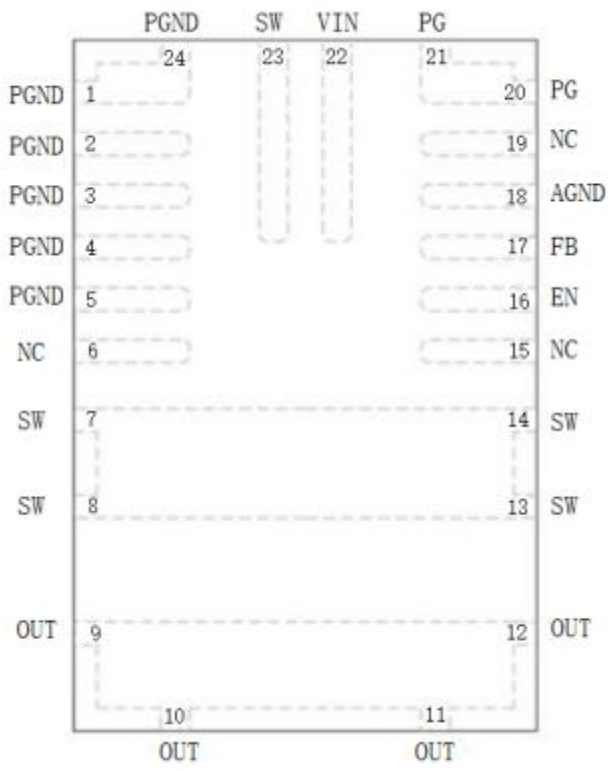
Typical Applications





FHT3860

Pin Configuration



Top View

Pin	Symbol	Description
16	EN	**Enable pin,** EN connects high to turn on the module and low to turn off the module. When left open, this pin has an internal 2MΩ resistor connected to ground and the module is turned off.
20,21	PG	**Power Supply Normal Output Indicator Pin.**
17	FB	**Voltage feedback pin.** This pin connects to an external divider resistor to regulate the output voltage.
9,10,11,12	VOUT	**Output voltage pin.**
18	AGND	**Signal ground.** This pin is not internally connected to system ground; ensure that AGND is connected to system ground during PCB layout.
1,2,3,4,5,24	PGND	**System ground.** This pin is the reference ground for regulating the output voltage.
7,8,13,14,23	SW	**Switch output pin.** Connect using wide PCB traces.
22	VIN	**Voltage input pin.** Connect VIN to the input power supply to power the module.
6,15,19	NC	Suspended.

Electrical Characteristics

Absolute Maximum Ratings	Condition	Minimum value	Nominal value	Maximum value	Unit
V_{IN}		-0.3		7	V
pg, sw, fb, en		-0.3		VIN+0.3	V
Storage Temperature		-40		+150	℃
Input Characteristics	**Condition**	**Minimum value**	**Nominal value**	**Maximum value**	**Unit**
Input voltage range		2.3		5.5	V

Input current

Input current at full load	V_{IN} =5.5V , V_{OUT} =1.8V , I_{OUT}=6A		2.18		A
Low voltage full load input current	V_{IN} =3V , V_{OUT} =1.8V , I_{OUT}=6A		4.02		A
Static Current	VIN = 3.6V, VOUT = 1.8V , I_{OUT}=0A		40		μA
Input current at shutdown	V_{IN} =3.6V , EN=GND		3		μA
General Requirements	**Condition**	**Minimum Value**	**Nominal Value**	**Maximum Value**	**Unit**
Switching frequency			3		MHz
Soft start time			3		ms
FB voltage		495	500	505 mV	mV
Functionality	**Condition**	**Minimum value**	**Nominal value**	**Maximum value**	**Unit**
EN High level		1.2			V
EN Low				0.5 V	V
PGOOD indication threshold	V_{OUT} Rising		96.5%		V
	V_{OUT} Falling		92.5%		V
Output Characteristics	**Condition**	**Minimum value**	**Nominal value**	**Maximum value**	**Unit**
Output Voltage	Adjusted by RFB resistor	0.5		3.3	V
Linear Regulation	V_{OUT}= 1.8V , 3.3V < V_{IN}< 5.5V , I_{LOAD} = 6A			±1	%
Load Regulation	V_{IN}=3.3V , V_{OUT}=1.8V, 0A < I_{LOAD} ≤ 6A			±1	%
Ripple and Noise	V_{IN}=3.3V , V_{OUT}=1.8V , I_{OUT}=6A, C_{out}=22uF×3, 20MHz bandwidth		10		mV
Dynamic Load Response	50-100% ILOAD , di/dt=3A/μS; V_{IN} =3.3V , V_{OUT}=1.8V, C_{out}=22uF×3		50		mV

Electrical Characteristics(continued)

Protection Characteristics	Conditions	Minimum Value	Nominal value	Maximum value	Unit
Undervoltage Blocking Threshold	$_{IN}$V rise		2.0	2.2	
Thermal shutdown			150		℃
Thermal shutdown hysteresis			20 ℃		℃
Structural Characteristics	**Condition**	**Minimum value**	**Nominal value**	**Maximum value**	**Unit**
Dimension	Length	5.9	6	6.1	mm
	Wide	3.9	4	4.1	mm
	Height	1.496	1.546	1.596	mm
Environmental Adaptability	**Condition**	**Minimum value**	**Nominal value**	**Maximum value**	**Unit**
Operating Temperature (Operating Junction Temperature)		-40		125	℃
High temperature storage (ambient temperature)	+125℃ , 48h			125	℃
High temperature working (ambient temperature)	+85℃ , 24h; Input low pressure, standard pressure, high pressure each 8h;			85	℃
Low temperature storage (ambient temperature)	-55℃ , 24h	-55			℃
Low temperature working (ambient temperature)	-40℃ , 24h; Input low pressure, standard pressure, high pressure each 8h	-40			℃
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	℃
Temperature shock	High temperature 125 ℃, low temperature -55 ℃, high and low temperature for an hour for a cycle, a total of 32 test cycles	-55		125	℃

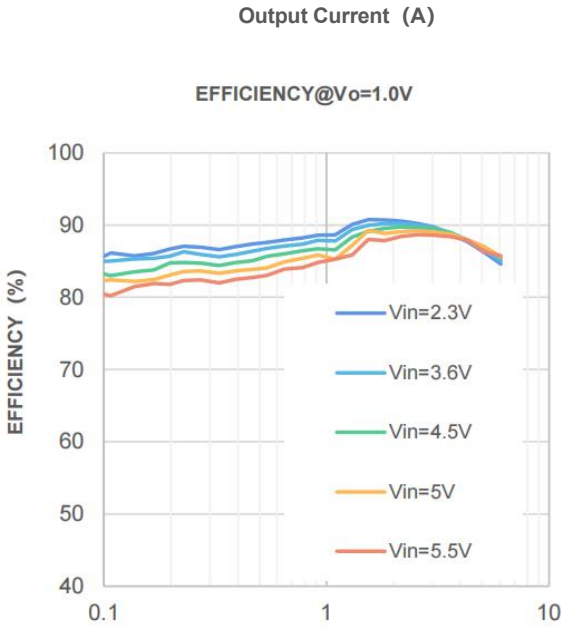
Note 1: Stresses above the values listed in the "Limit Values" section may cause permanent damage to the device. Prolonged exposure to any of the absolute maximum ratings may affect the reliability and service life of the device.

Note 2: The maximum continuous output current may be derated due to the junction temperature of the FHT3860.

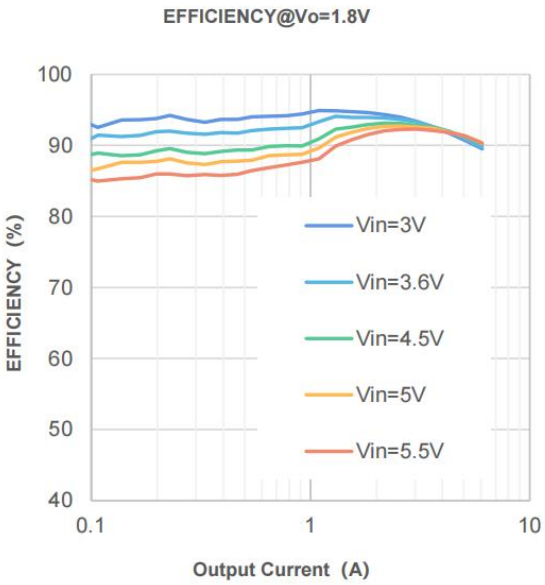
Note 3: The performance specifications of the FHT3860 are guaranteed over the full -40°C to 125°C internal operating stability range. Note that the maximum internal temperature is determined by specific operating conditions in conjunction with the board layout, rated thermal resistance of the package, and other environmental factors.

Test conditions are V_{IN} = 3.3V , V_{OUT} = 1.8V, external C_{IN}=2x10μF , C_{OUT} = 3x22μF , TA = 25。C , unless otherwise noted.

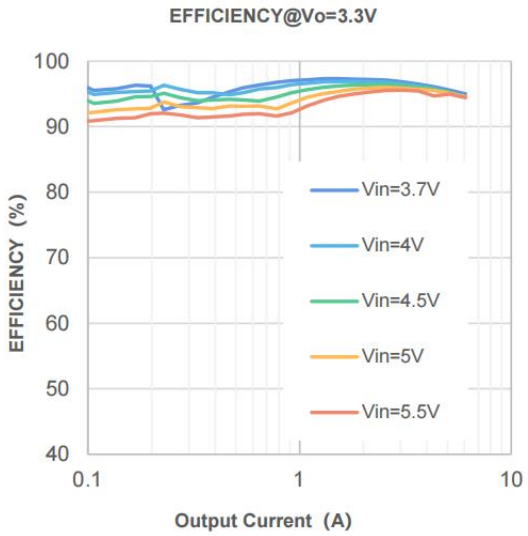
Output Current vs Efficiency (V_{OUT} = 1.0V)



Output Current vs Efficiency (V_{OUT} = 1.8V)



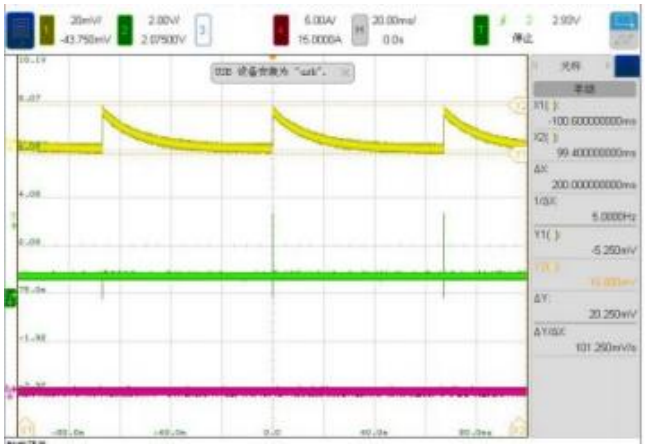
Output Current vs. Efficiency (V_{OUT}=3.3V)



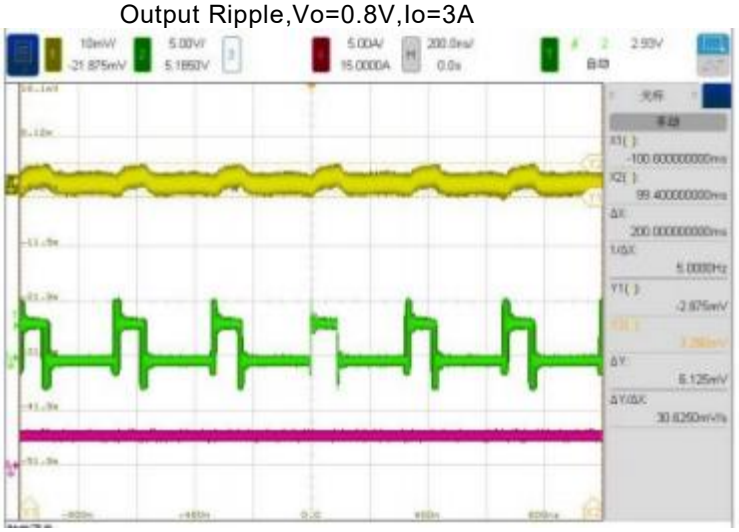
HT3860

Test conditions are V_{IN} = 3.3V , V_{OUT} = 1.8V, external C_{IN}=2x10μF , C_{OUT} = 3x22μF , TA = 25。C, unless otherwise noted. CH1: Vo, CH2: SW, CH4: Io

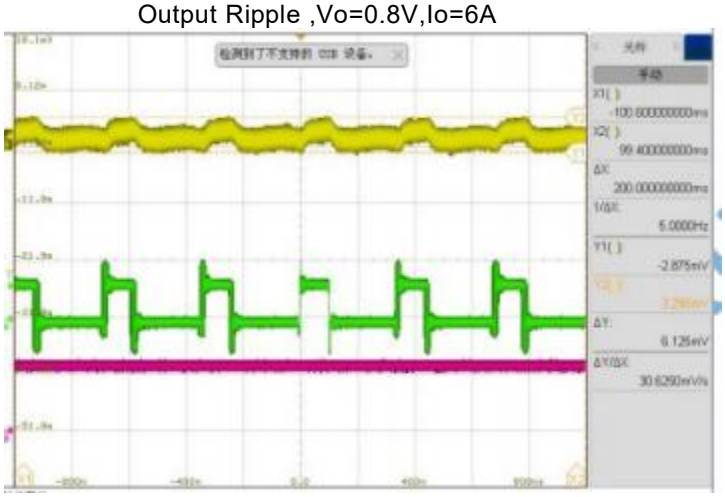
Output Ripple ,Vo=0.8V,Io=0A



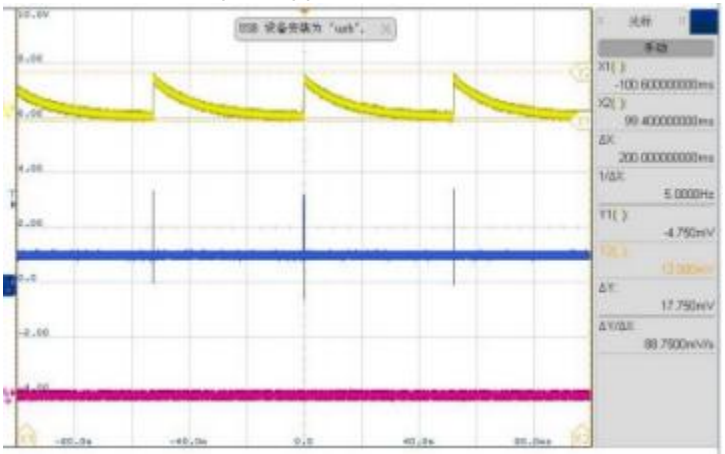
Output Ripple,Vo=0.8V,Io=3A



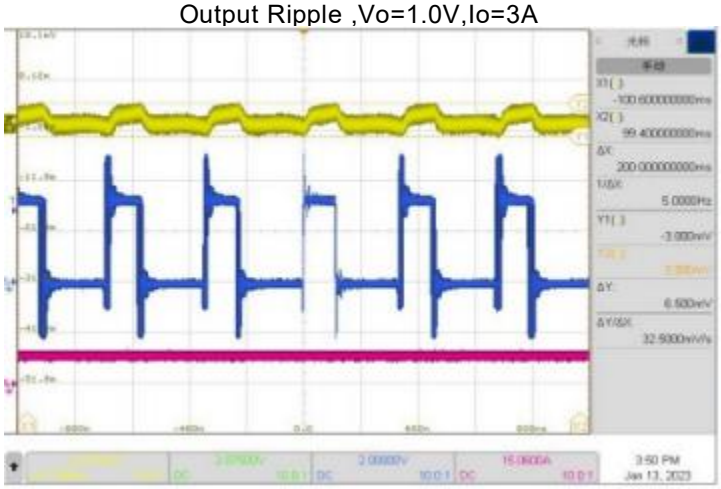
Output Ripple ,Vo=0.8V,Io=6A



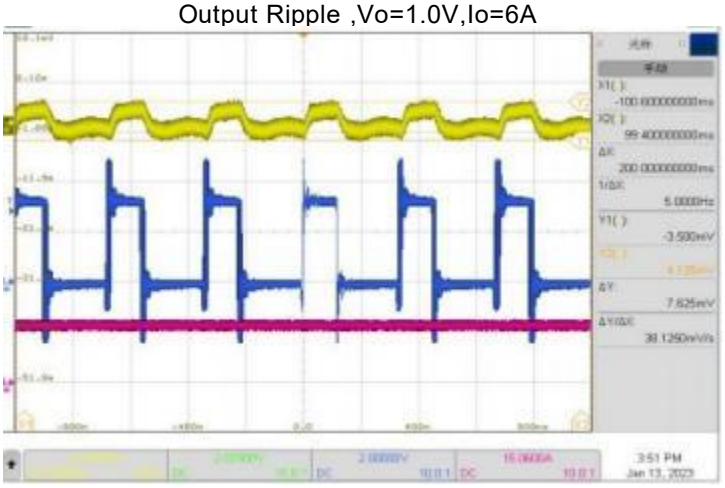
Output Ripple ,Vo=1.0V,Io=0A



Output Ripple ,Vo=1.0V,Io=3A

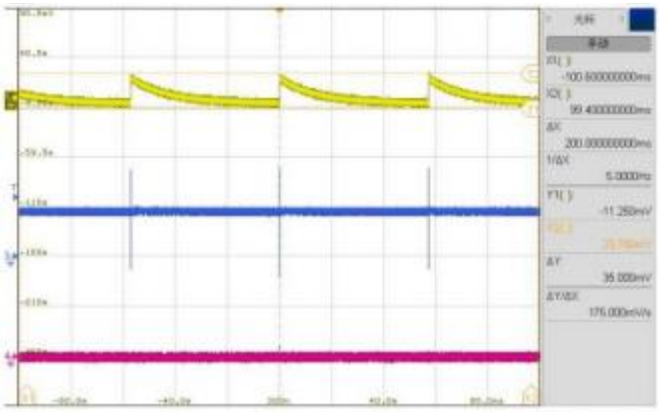


Output Ripple ,Vo=1.0V,Io=6A

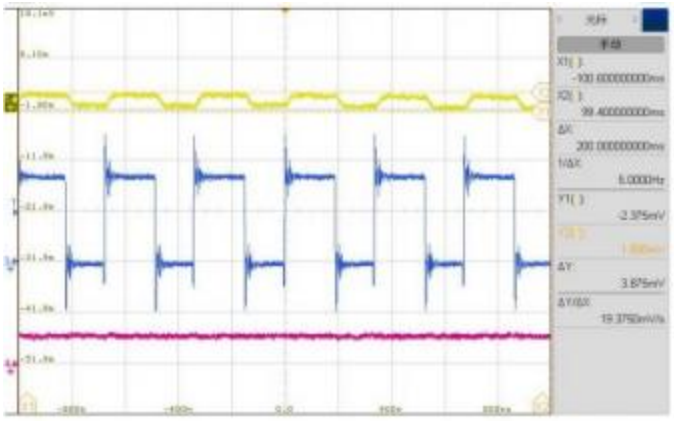


V_{IN} V_{OUT} I_{NOUT} Test conditions are V = 3.3V, V = 1.8V, external C = 2x10μF, C = 3x22μF, TA = 25.C, unless otherwise noted.

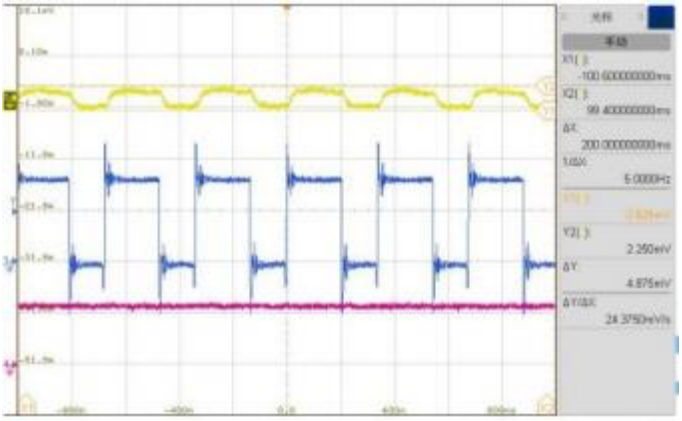
Output Ripple ,Vo=1.8V,Io=0A



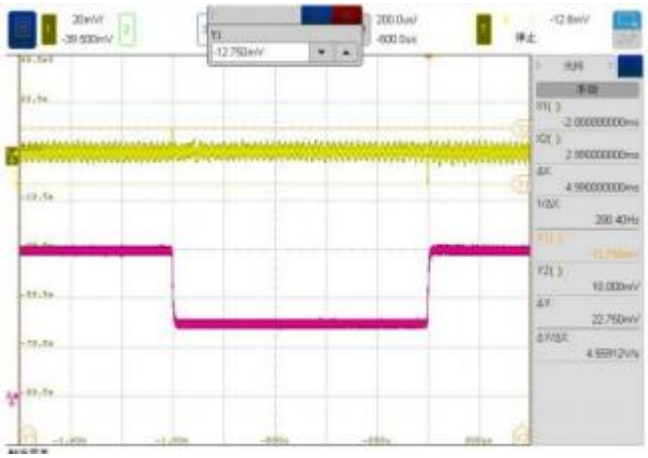
Output Ripple ,Vo=1.8V,Io=3A



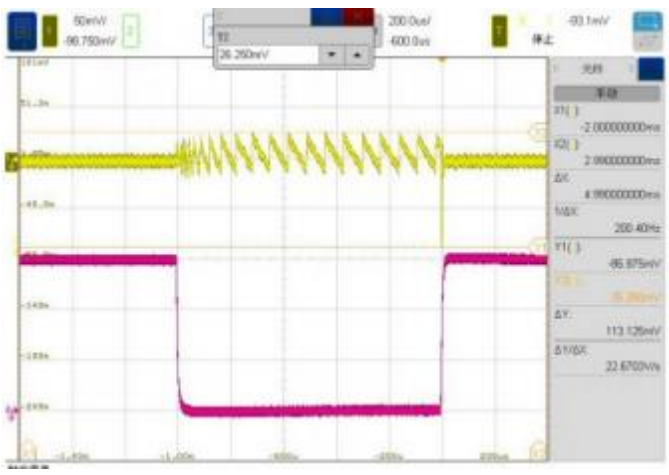
Output Ripple ,Vo=1.8V,Io=6A



Load Dynamic Response , VOUT = 0.8V,IOUT = 3A -> 6A

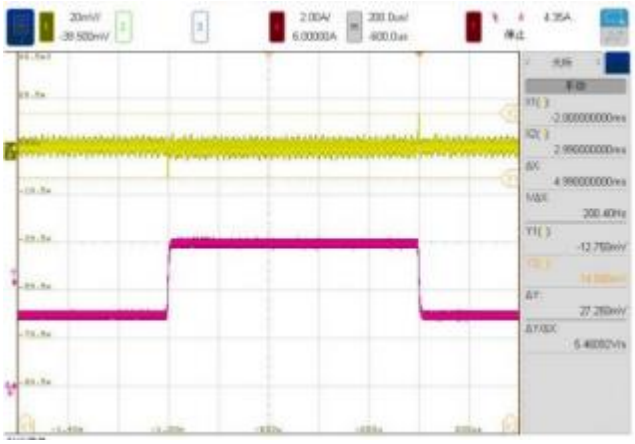


Load Dynamic Response , VOUT = 0.8V,IOUT = 0A -> 6A

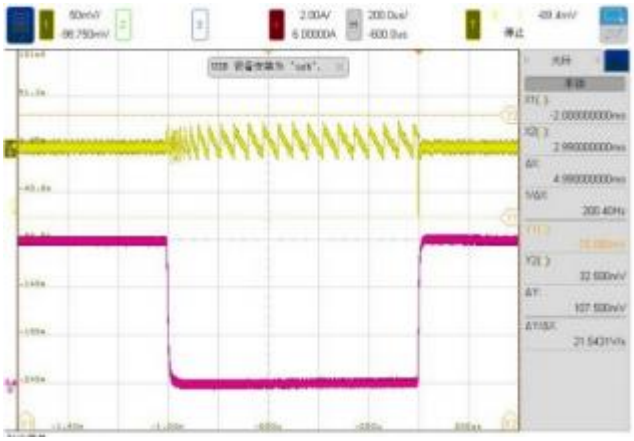


Test conditions are V_{IN} = 3.3V , V_{OUT} = 1.8V, external C_{IN}=2x10μF , C_{OUT} = 3x22μF , TA = 25。C , unless otherwise noted.

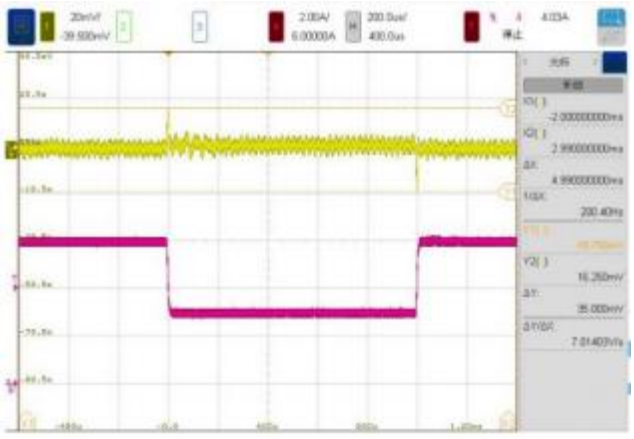
Load Dynamic Response , V_{OUT} = 1.0V,I_{OUT} = 3A -> 6A



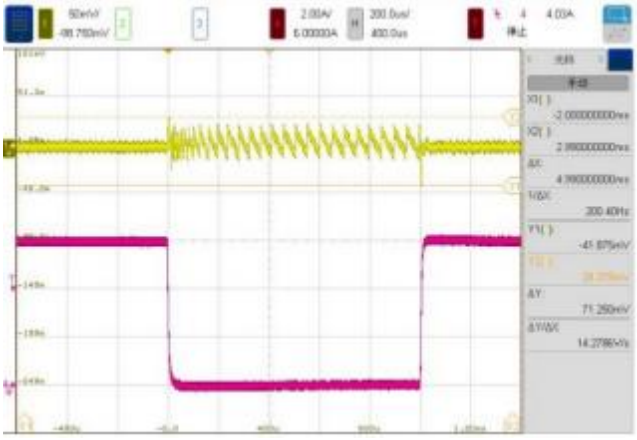
Load Dynamic Response , V_{OUT} = 1.0V,I_{OUT} = 0A -> 6A



Dynamic Load Response , V_{OUT} = 1.8V, I_{OUT} = 3A -> 6A



Load Dynamic Response , V_{OUT} = 1.8V, I_{OUT} = 0A -> 6A



Operation

The FHT3860 is a synchronous step-down DC-DC voltage converter with a switching frequency of 3MHz. The FHT3860 achieves a continuous output current of 3A over the 2.3V to 5.5V input voltage range.

Enable Control (EN)

The FHT3860 can be enabled or disabled by setting the EN pin; when EN is high, the module is enabled. When EN is low, the module is disabled. In this mode, the output current is less than 3μA and the output is connected to ground through a resistive load. When the EN pin is left open, the output is connected to ground through an internal 2 MΩ resistor.

Soft Start (SS)

The soft-start function controls the ramp of the output voltage within 3ms during startup, which suppresses inrush current.

Input Under Voltage Lockout (UVLO) Protection

The FHT3860 maintains UVLO in shutdown mode when the input voltage falls below 2.0V. If enabled during a UVLO condition, the module remains in shutdown mode until the input voltage is above a set threshold. When the input falls below 1.8V, the module shuts down with a 200mV hysteresis.

Operating Modes

The FHT3860 uses a constant on-time control, and at heavy load currents, the switching frequency is almost constant at 3MHz.

At light load currents, the FHT3860 automatically enters PFM mode to maintain high efficiency at light loads.

As the load current changes, the FHT3860 switches between PFM and PWM modes to optimize performance. If the input voltage is too close to the output voltage, the FHT3860 enters 100% duty cycle mode, where the high-side switch is always on, providing a low input-to-output voltage differential.

Over Temperature Protection (OTP)

When the junction temperature of the FHT3860 exceeds the threshold of 150 °C, thermal shutdown protection is activated. This protection is non-latching. Once the junction temperature drops to approximately 130 °C, the module resumes operation through a soft start.

Overcurrent protection (OCP)

The FHT3860 is overcurrent protected to avoid damage under overcurrent conditions. The overcurrent protection is triggered when the valley current reaches 9A. After 16 consecutive cycles of reaching the valley current limit, the output will be disabled. After 1.5ms of disabling, the module will reboot and start a new soft start cycle.

Power GOOD Output Indication (PGOOD)

The PGOOD pin is an open drain output. When the FB voltage is less than 92% of the nominal internal reference voltage, the PG pin will be driven low; when the FB voltage is greater than 96% of the nominal internal reference voltage, the PG pin will be restored.

Output Voltage Setting

The output voltage of the FHT3860 is set by an external feedback resistor divider as shown in equation (1), and the voltage regulator circuit is shown in Figure 1.

$$V_{OUT} = 0.5V \times \left(1 + \frac{R1}{R2}\right) \quad (1)$$

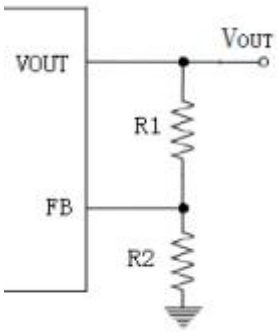
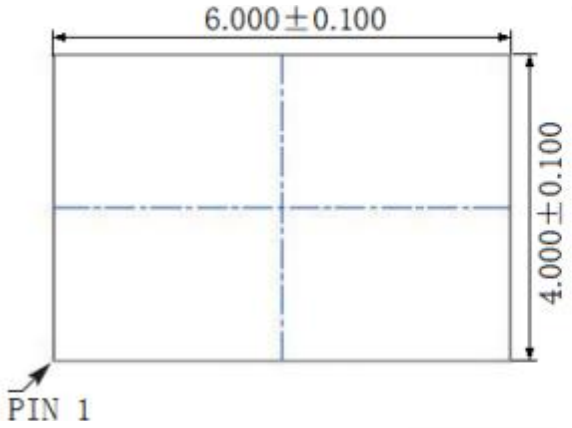


Figure 1 Voltage Divider Resistor for Output Voltage Setting

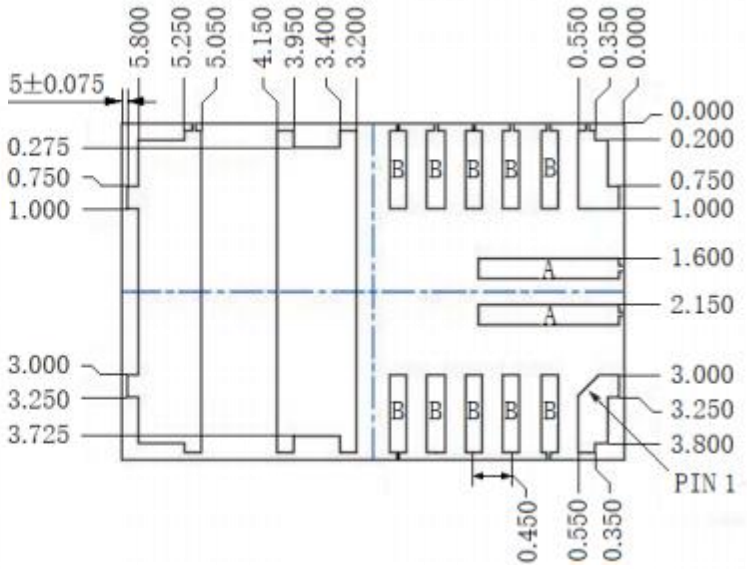
Package Description

LGA-24

(6mm x 4mm x 1.6mm)



Top View



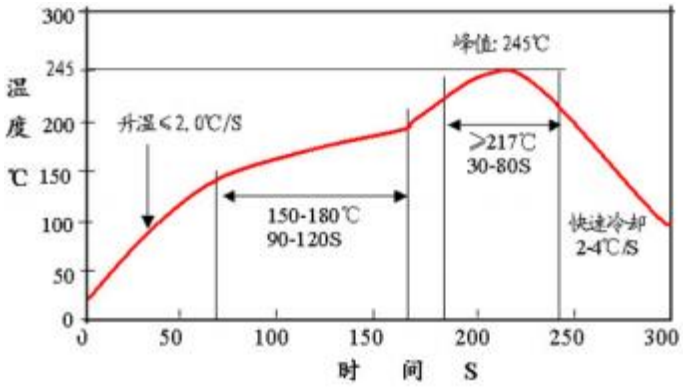
Bottom View

DIMENSIONS			
SYMBOL	MIN	NOM	MAX
A (A)		0.250×1.675	
NOM MAX		0.200×0.925	

Slide View

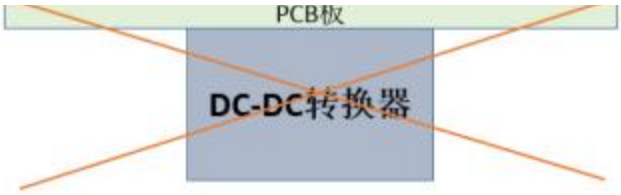
Soldering and Storage Precautions

Recommended reflow soldering profile



Caution:

1. Due to the large size of the module, please do not place the module under the board for reflow soldering to avoid falling off.



2. For bulk products and those that have been taken out of their original packaging, they should be stored in a desiccator (with a relative humidity of less than 10% inside). For products still in their original packaging, they should also be stored in a desiccator whenever possible.

3.Before mounting on the board, it is necessary to strictly follow the baking conditions to dry the samples: bake at 125°C for more than 48 hours, and control the reflow soldering temperature within 245°C.