WS3206D

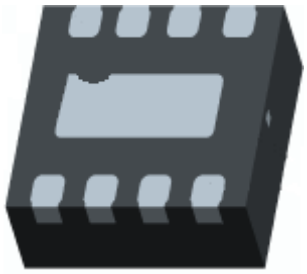
Over-Voltage-Protection IC with P-channel power MOSFET for Li-ion battery charging

Descriptions

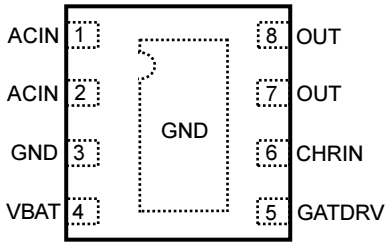
The WS3206D is an Over-Voltage-Protection (OVP) device with P-channel power MOSFET for Li-ion battery charging circuit. The device will switch off internal MOSFET to protect charging system when any of input voltage, input current and battery voltage over the threshold. The Over-Temperature-Protection (OTP) function monitors chip temperature to protect the device.

The WS3206D integrated a P-channel power MOSFET with the body diode reverse protection and can replace external P-MOSFET and schottky diode in the charging system of mobile phone.

The WS3206D is available in DFN2x2-8L package. Standard product is Pb-Free.



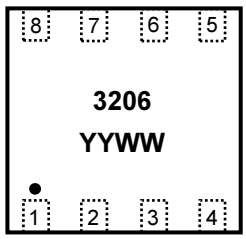
DFN2x2-8L



Pin configuration (Top view)

Features

- High voltage technology
- Maximum input voltage : 30V
- Input Over Voltage Protection (OVP)
- Input OVP threshold: 6.8V
- Ultra fast response of input OVP: <1us
- Input Over Current Protection (OCP)
- Input OCP threshold: 1A Min.
- Battery Over Voltage Protection
- Battery OVP threshold: 4.35V
- Integrated Charging P-MOSFET
- P-MOSFET body diode reverse protection
- Small package: DFN2x2-8L



3206 = Device code
YY = Year
WW = Week

Marking

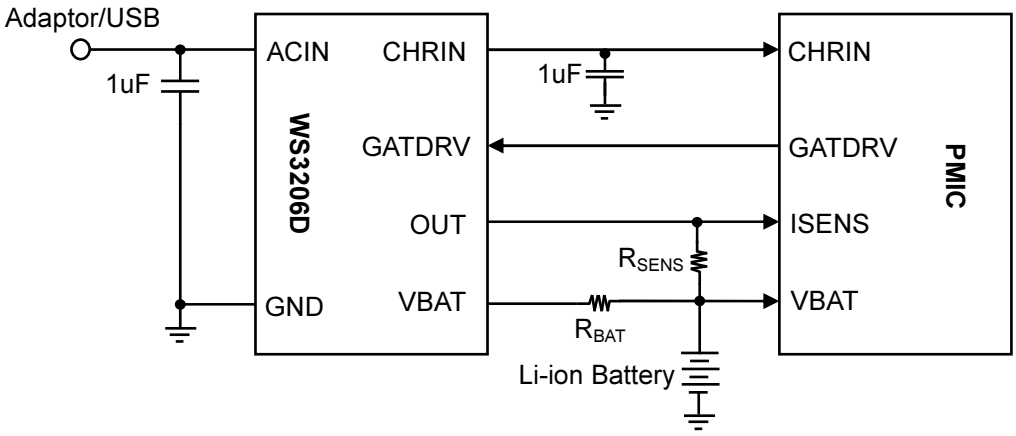
Applications

- Mobile phone
- PDA
- Other portable electronic equipment

Order information

Device	Package	Shipping
WS3206D-8/TR	DFN2x2-8L	3000/Reel&Tape

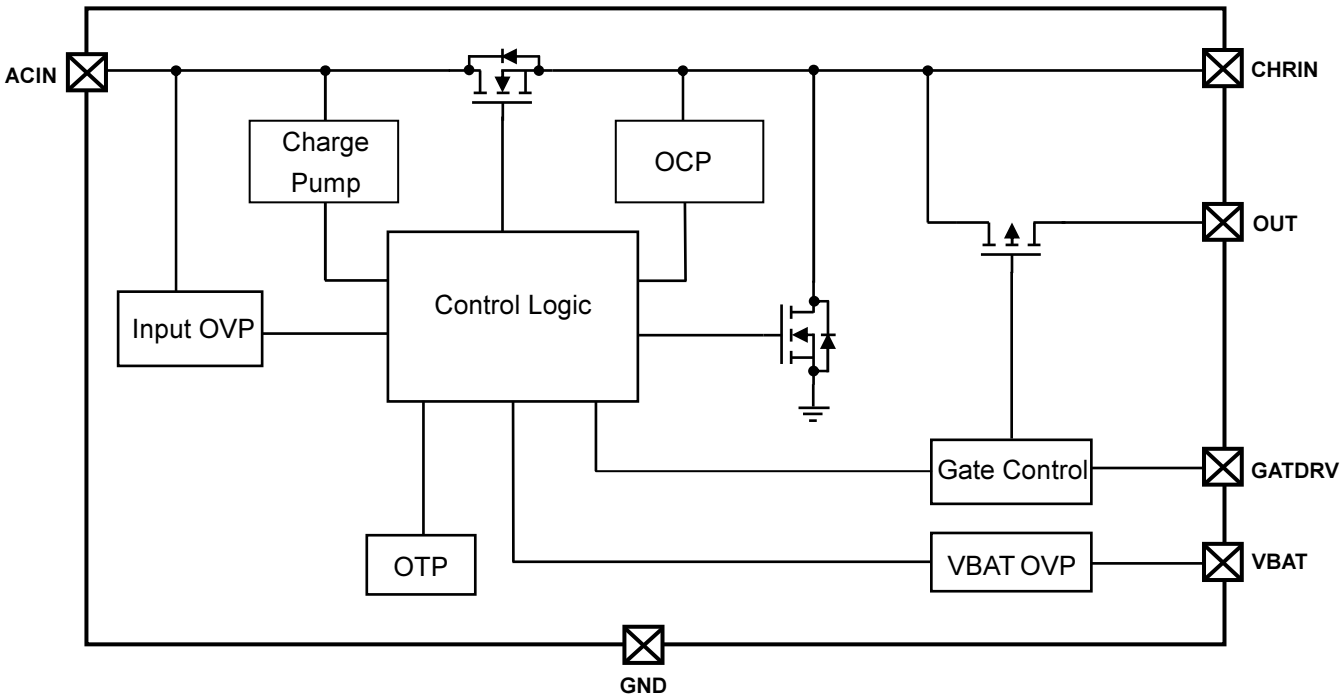
Typical applications



Pin descriptions

Pin Number	Symbol	Description
1	ACIN	Power supply input. Connect to adaptor or USB power supply
2	ACIN	
3	GND	Ground
4	VBAT	Battery voltage sense input. Must connect to Li-ion through 200KΩ resistor
5	GATDRV	P-Channel MOSFET gate input
6	CHRIN	Power supply output. This pin provide power supply to PMIC input
7	OUT	Output pin. This pin provide supply source current to Li-ion battery
8	OUT	

Block diagram



Absolute maximum ratings

Parameter	Symbol	Value	Unit
ACIN pin input voltage	V_{ACIN}	-0.3 ~ 30	V
CHRIN pin output voltage	V_{CHRIN}	-0.3 ~ 7.0	V
OUT pin output voltage	V_{OUT}	-0.3 ~ 7.0	V
OUT pin output current	Iout	1.5	A
Power dissipation [a]	P_D	1.6	W
Power dissipation [b]		1.0	W
Junction temperature	T_J	150	°C
Lead soldering temperature, 10s	T_L	260	°C
Storage temperature	T_{SG}	-55 ~ 150	°C
ESD rating	HBM	±8000	V
	MM	±400	V

Recommend operating conditions (Ta=25°C, unless otherwise noted)

Parameter	Symbol	Value	Unit
ACIN pin input voltage	V_{ACIN}	4.5 ~ 5.5	V
Output current	I_{OUT}	0 ~ 700	mA
Operating temperature	T_{OP}	-45 ~ 85	°C

Thermal resistance characteristics (Ta=25°C, unless otherwise noted)

Parameter	Symbol	Value	Unit
Junction to ambient thermal resistance [a]	$R_{\theta JA}$	75	°C/W
Junction to ambient thermal resistance [b]		125	

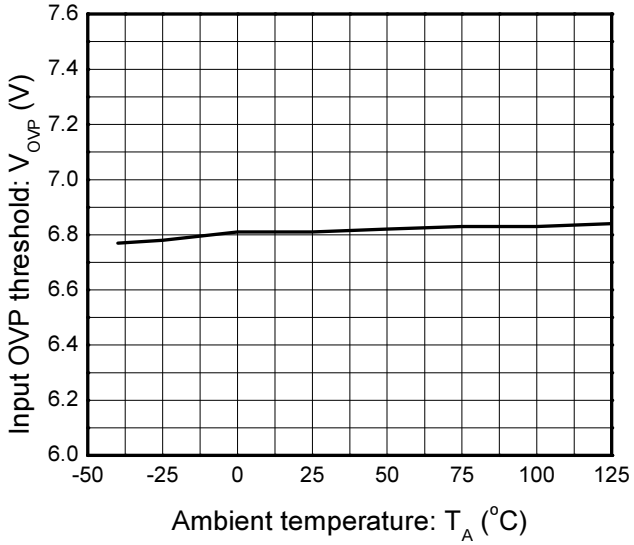
a Surface mounted on FR-4 Board using 1 square inch pad size, double side, 1oz copper

b Surface mounted on FR-4 board using minimum pad size, 1oz copper

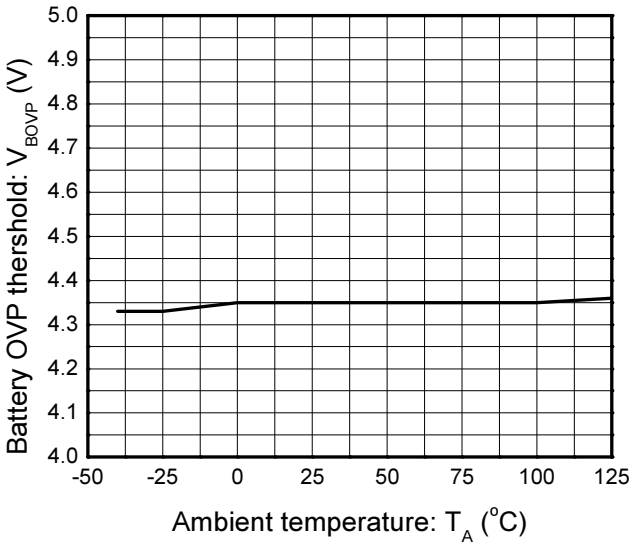
Electronics Characteristics (Ta=25°C, unless otherwise noted)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Static Characteristics						
ACIN quiescent current	I_Q	V_{ACIN}=5V, I_{OUT}=0A, I_{CHRIN}=0A		250	300	uA
VBAT pin leakage current	I_{VBAT}	V_{BAT}=4.2V		10	15	nA
OUT pin input current	I_{OUTOFF}	V_{CHRIN}= V_{GATDRV}=0V, V_{OUT}=4.2V,			1	uA
OUT pin leakage current	I_{OUTLKG}	V_{ACIN}=V_{CHRIN}=V_{GATDRV}=5V, V_{OUT}=0V			1	uA
GATDRV pin input current	I_{GATDRV}	V_{ACIN}=V_{CHRIN}=V_{GATDRV}=5V			1	uA
CHRIN discharge resistance	$R_{DISCHRGE}$			500		Ω
ACIN-to-OUT on-resistance	R_{ON}	V_{ACIN}=5V, I_{OUT}=0.7A, V_{GATDRV}=0V		0.6		Ω
ACIN UVLO voltage	V_{UVLO}	V_{ACIN} falling		2.35		V
UVLO Hysteresis				250		mV
CHRIN output power-on time	T_{ON}	V_{ACIN}=0 to 5V, V_{GATDRV}= V_{CHRIN}		8		ms
Input Over-Voltage-Protection (Input OVP)						
Input OVP threshold	V_{OVP}	ACIN rising	6.6	6.8	7.0	V
Input OVP active time	T_{OVP}				1	us
Input OVP hysteresis				300		mV
CHRIN output power-on recovery time	$T_{ON(OVP)}$	V_{ACIN}=12 to 5V, V_{GATDRV}= V_{CHRIN}		8		ms
VBAT Over-Voltage-Protection (Battery OVP)						
VBAT OVP threshold	V_{BOVP}	VBAT rising	4.32	4.35	4.38	V
VBAT OVP active time	T_{BOVP}			176		us
VBAT OVP hysteresis				290		mV
Input Over-Current-Protection (Input OCP)						
Input OCP threshold	I_{OCP}		1.0		1.5	A
Input OCP active time	T_{OCP}			176		us
Input OCP recovery time	$T_{ON(OCP)}$			64		ms
Over-Temperature-Protection (OTP)						
OTP threshold	T_{OTP}			160		°C
OTP hysteresis				40		°C
P-Channel power MOSFET characteristics						
Gate threshold voltage	V_{th}	V_{ACIN}=5V, I_{OUT}=250uA		0.8		V
Drain-to-Source on resistance	R_{ON}	V_{ACIN}=5V, I_{OUT}=0.7A, V_{GATDRV}=0V		300		mΩ
Input Capacitance	C_{IN}			280		pF

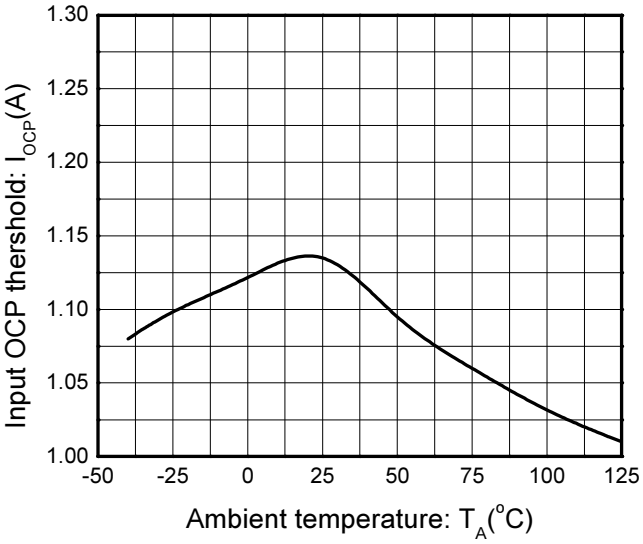
Typical Characteristics (Ta=25°C, unless otherwise noted)



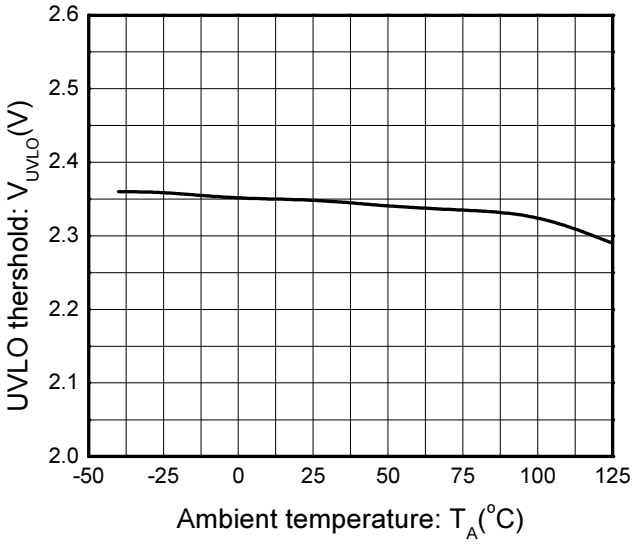
Input OVP threshold vs. Ambient temperature



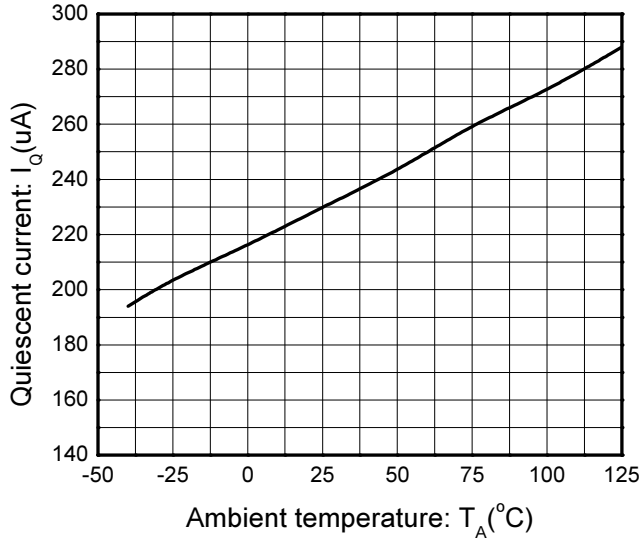
Battery OVP threshold vs. Ambient temperature



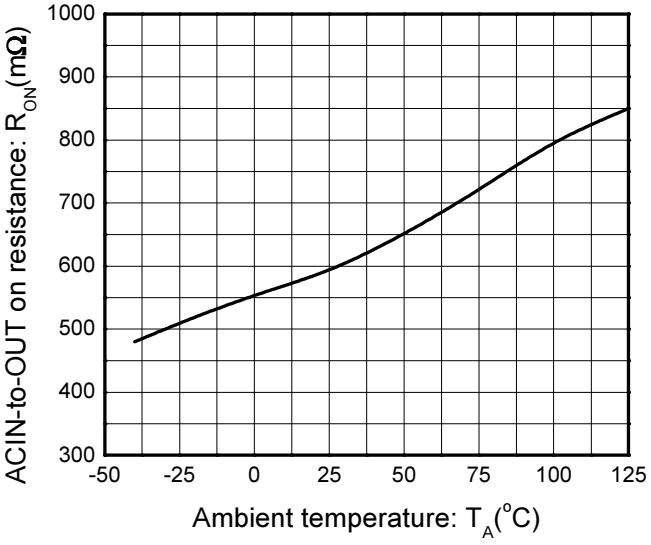
Input OCP threshold vs. Ambient temperature



UVLO threshold vs. Ambient temperature



Quiescent current vs. Ambient temperature



ON resistance vs. Ambient temperature

Application informations

Input Over-Voltage-Protection (OVP)

The WS3206D monitors input voltage continued by the input OVP circuit. When the input voltage rises above the input OVP threshold, the internal main power N-MOSFET and P-MOSFET will be turned off within T_{OVP} time and the CHRIN discharge FET will be turned on for CHRIN voltage discharge. Input OVP functions protect connected system on CHRIN pin and OUT pin. When the input voltage returns below the input OVP threshold hysteresis, the internal main FET will be turned on again after $T_{ON(OVP)}$ time. The input OVP circuit has a 300mV hysteresis and a $T_{ON(OVP)}$ recovery time to provide noise immunity against transient event.

Input Over-Current-Protection (OCP)

The WS3206D monitors input current continued by the input OCP circuit. When the input current reaches the OCP threshold, the internal main FET will be turned off after a T_{OCP} time. After a $T_{ON(OCP)}$ recovery time, the main FET will be turned on again. The WS3206D has a built-in counter. When the total count of OCP fault reaches 16, the FET is turned off permanently, requiring an ACIN power on again to restart.

Battery Over-Voltage-Protection (Battery OVP)

The WS3206D monitors the VBAT pin voltage continued by the Battery OVP circuit for battery over-voltage protection. When the battery voltage reaches the battery OVP threshold, the internal main FET will be turned off after a $T_{B(OVP)}$ time. When the battery voltage returns below the battery OVP hysteresis, the main FET is turned on again. The WS3206D has a built-in counter. When the total count of battery OVP fault reaches 16, the main FET is turned off permanently, requiring an ACIN power on again to restart.

Over-Temperature-Protection (OTP)

The WS3206D has an over-temperature protection circuit. When the junction temperature exceeds 160°C the internal thermal sense circuit turns off the main FET. When the junction temperature returns below the OTP hysteresis, the internal thermal sense circuit will enable the device, resulting in a pulsed output during continuous thermal protection. Thermal protection is designed to protect the IC in the event of over temperature conditions. For normal operation, the junction temperature cannot exceed 125°C

R_{BAT} resistor selection

The WS3206D Battery OVP circuit sense battery voltage by VBAT pin. In order to limit the leakage current in the worse case, VBAT pin should be connect to battery through a resistor. Recommend resistance of R_{BAT} is 200KΩ, the leakage current is calculated by :

$$(VACIN-VBAT)/R_{BAT}$$

In applications, VBAT pin is not allowed floating and also can not be shorted to ground for normal function.

Input and output capacitor selection

The input capacitor is for decoupling to prevent input voltage transient spike. Recommend capacitance is 1uF.

The output capacitor of CHRIN is for decoupling of CHRIN voltage. This capacitor can also be as the input capacitor of charging circuit. Recommend capacitance is 1uF.

In applications, the voltage of that capacitor must be selected properly due to the high voltage system. In 5V system, 10V capacitor is recommended strongly.

Thermal considerations

The WS3206D is a high power device in the charging system. The maximum power dissipation depends on PCB layout, package, and maximum junction temperature. The maximum power dissipation can be calculated by:

$$P_D=(T_J-T_A)/ R_{\theta JA}$$

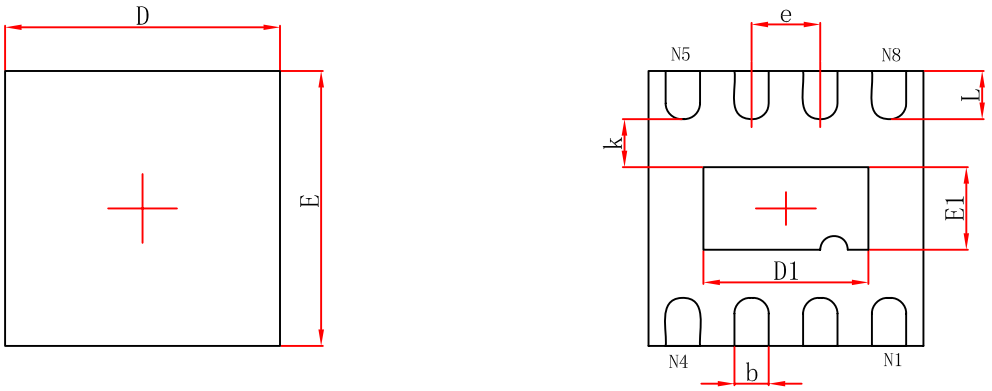
Where, P_D is maximum power dissipation; T_J is maximum junction temperature (Limited 150°C by design); T_A is ambient temperature; $R_{\theta JA}$ is thermal resistance of package (Junction-to-Ambient).

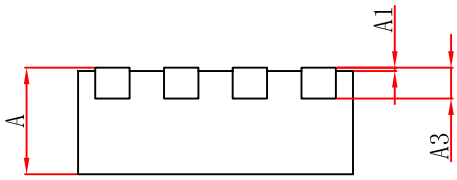
PCB layout guide

The capacitor should be placed close to the WS3206D. It is recommended that connect the expose pad to a large ground plane through via for good thermal away in the high power applications.

Package outline dimensions

DFN2x2-8L





Symbol	Dimensions in millimeter		
	Min.	Typ.	Max.
A	0.700		0.800
A1	0.000		0.050
A3	0.203 Ref.		
D	1.924	2.000	2.076
E	1.924	2.000	2.076
D1	1.100	1.200	1.300
E1	0.500	0.600	0.700
k	0.200 Min.		
b	0.200	0.250	0.300
e	0.500 Typ.		
L	0.264	0.350	0.426