

# JW ACDC 方案介绍

Kun Zhang  
2022.03.29

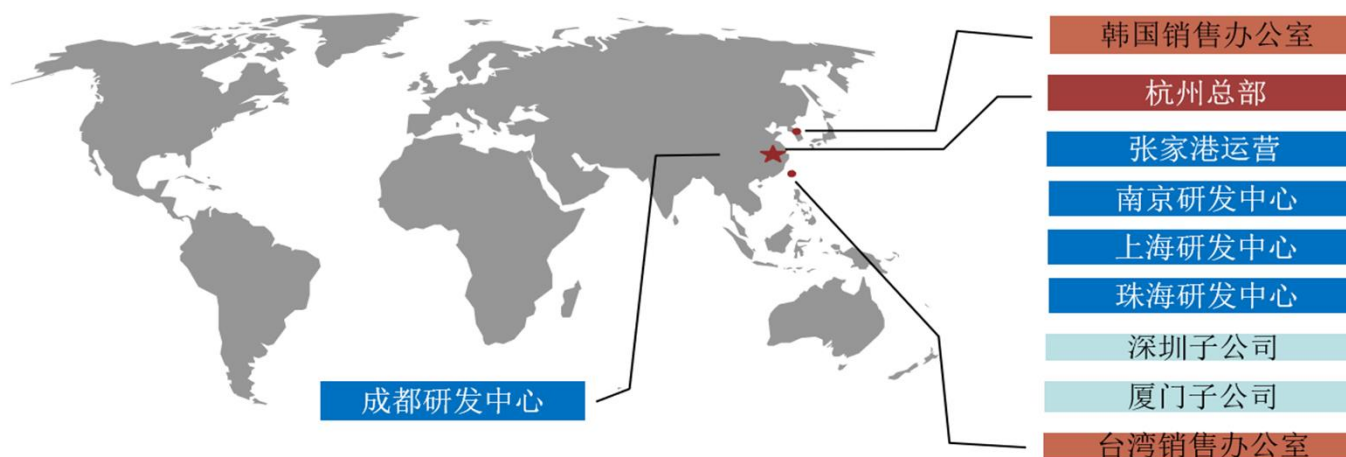
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## Agenda

- **JW Company Introduction**
- JW ACDC Product Overview
- PD GAN Adapter
  - ACF, QR, AHB
- PD Si Adapter
  - QR, PWM, ZVS
- 135W AHB DEMO

- 2013年成立于杭州
- 高性能模拟和数模混合，电源管理为主
- 自主BCD工艺，虚拟IDM
- 总员工490余人，近半数有硕博学历
- 主要成员来自LT, Maxim, TI, MPS, etc
- 800专利
- 1000可售产品
- 400M+ pcs月发货量



## 广泛的产品布局

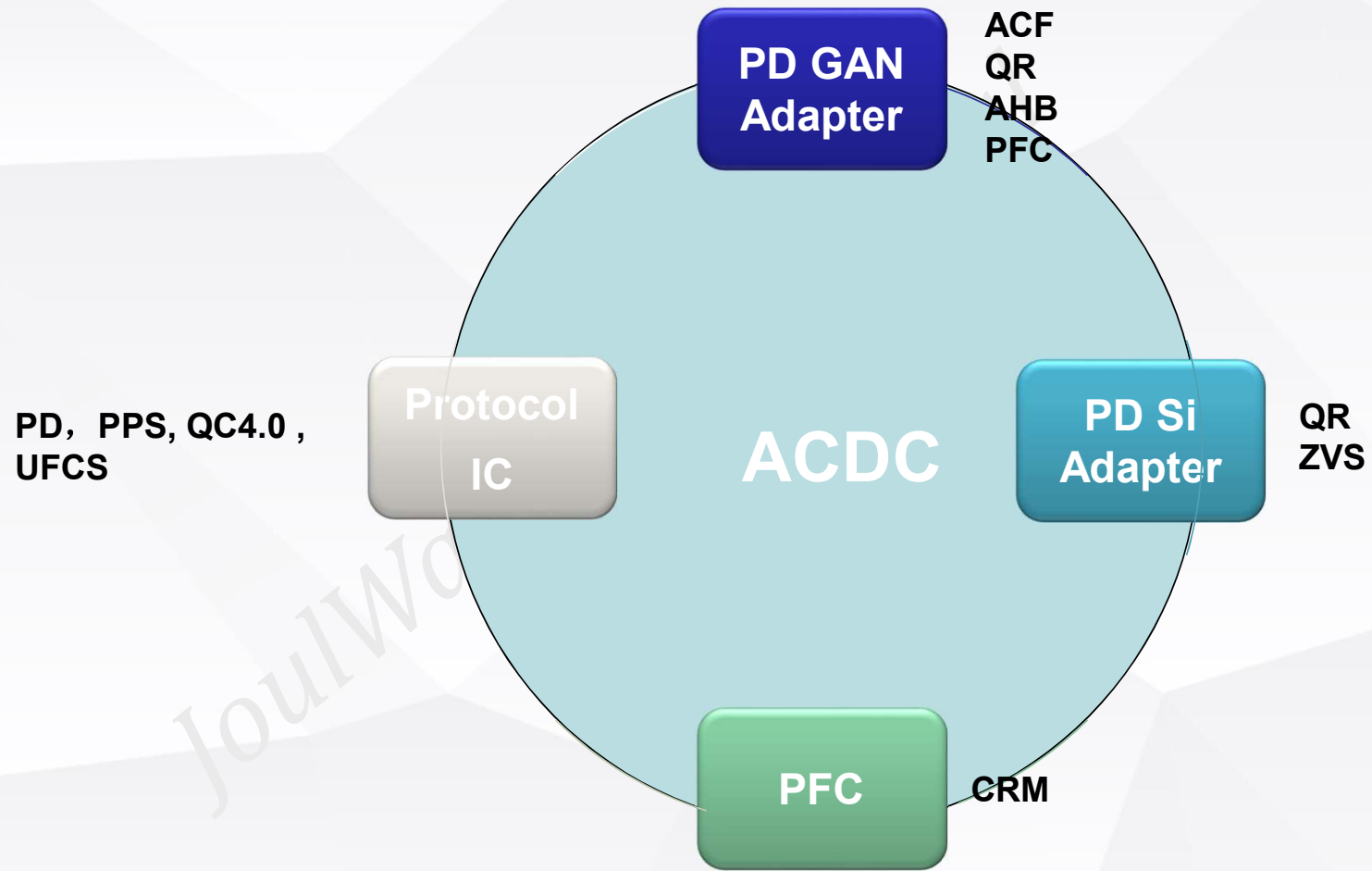
- 世界级的设计团队，丰富的IP和专利组合，确保产品的广度，可以满足各种应用场景的电源需求。
- 产品类型覆盖了绝大部分业界主流电源管理品类。

DC/DC	AC/DC	Lighting
Buck	Flyback controller	Linear driver
High current buck	Synchronous Rectifier Controller	Primary-side control
Buck-boost	PFC and LLC controller	Traic dimming
Boost	USB PD controller	High PF and low THD
	GAN driver	Offline buck led driver
	Low IQ HV Buck	
Charger/BMS	Automotive	Linear Power
Linear Charger	DCDC	Load switch
Switching charger	Load switch	ORing
AFE	LED driver	Hotswap&Fuse&Protection
Battery protection	USB charger	Motor driver
Active balancing		Gate driver
		PoE

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# JW ACDC Product Overview

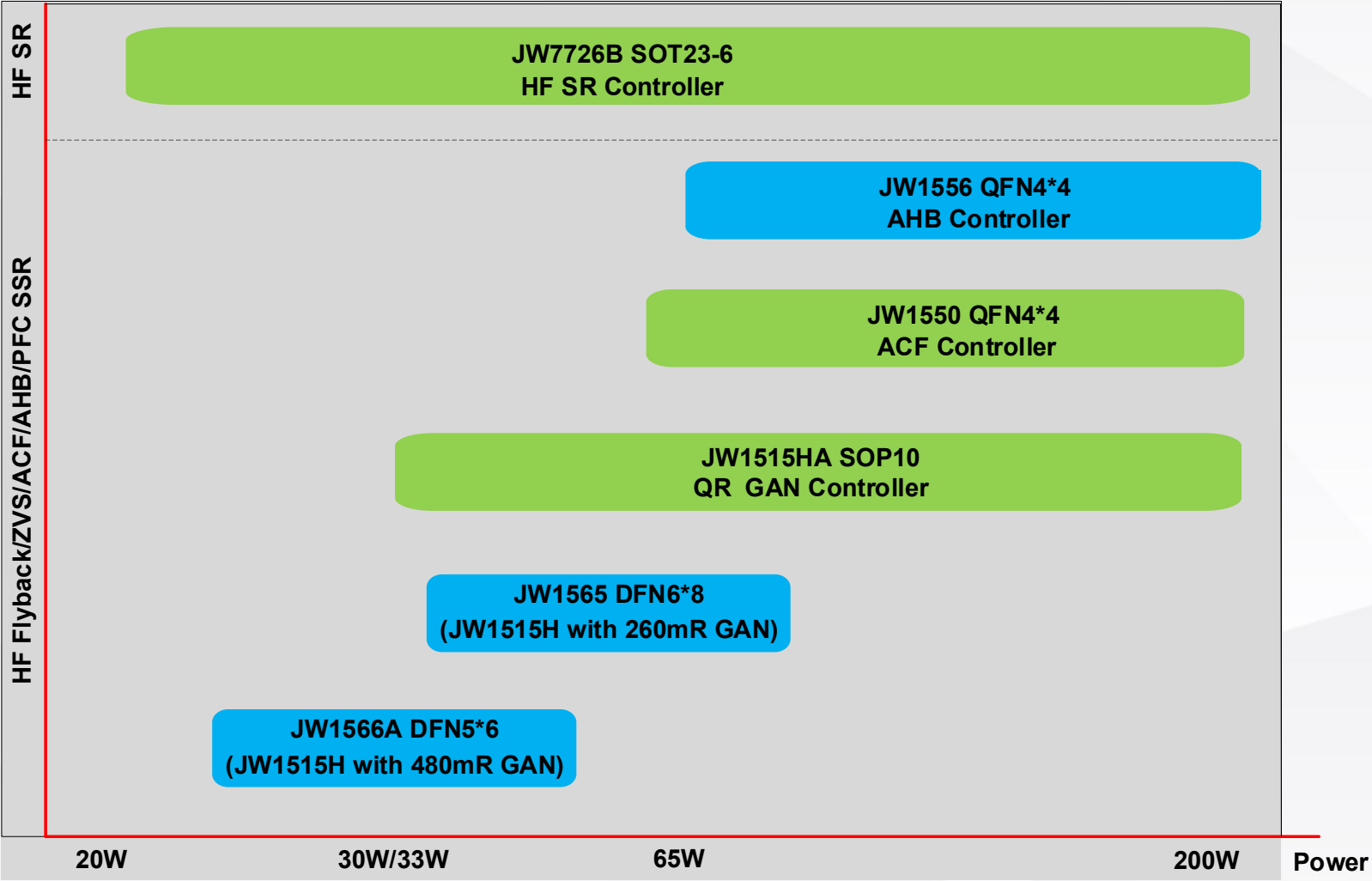


JoulWatt

## Agenda

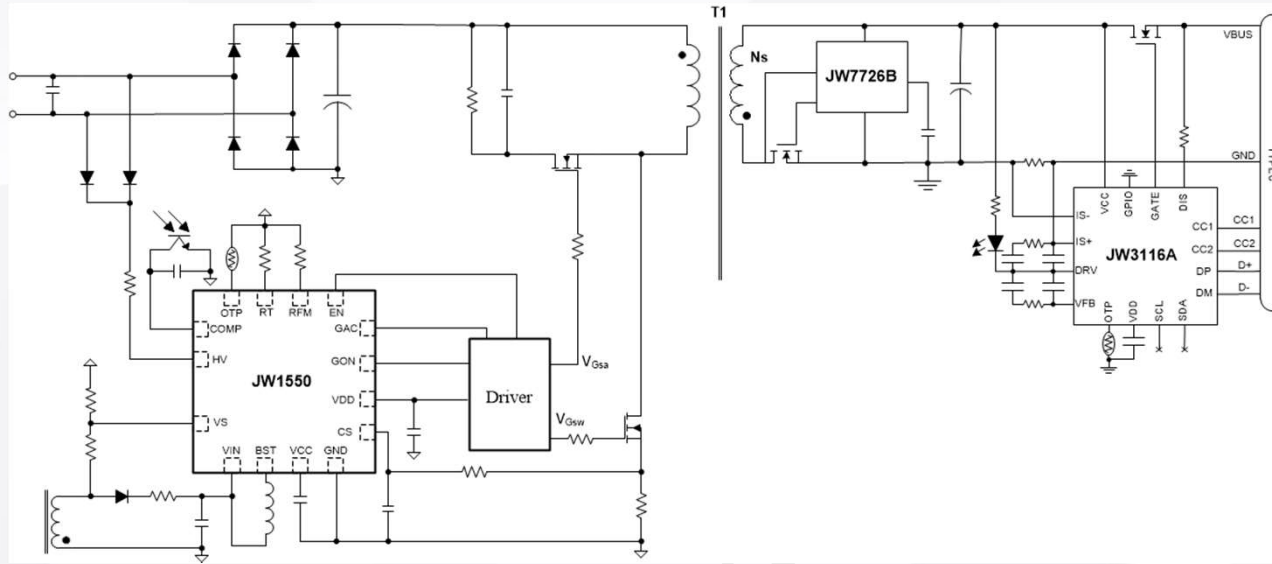
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# PD GAN Adapter Solution



- Released
- Sample
- Under development
- Planned

# ACF (Active-Clamp Flyback) Controller: JW1550



QFN4\*4

## Key Features

- Boundary Mode Operation with ZVS at Heavy Load
- QR Operation at Light Load
- HV startup (700V)
- X-cap discharge
- Low standby loss
- Protections: OVP, OCP, SCP, OTP, VS open/short, CS open/short, brown in & out
- Internal boost for IC power supply

## Application

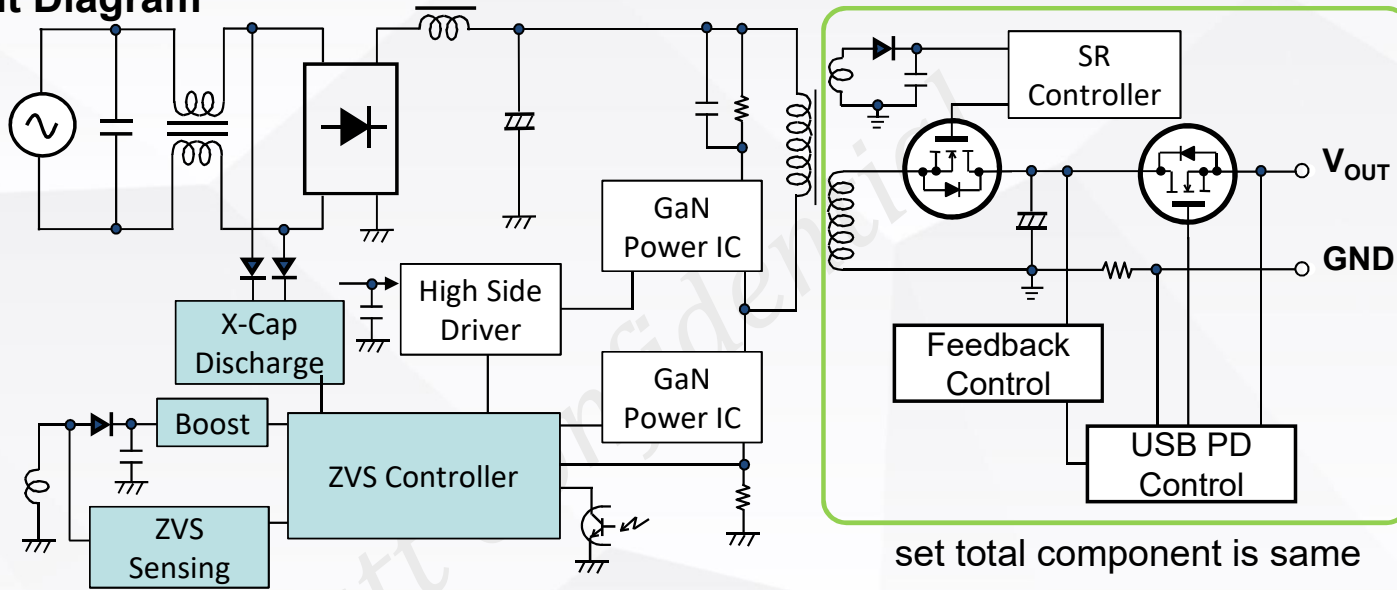
- 65W~200W PD adapter

## Benefits

- High Efficiency
- High Power Density

# Part Count Comparison Between JW1550 and Competitor

Circuit Diagram



Estimate Part Count

	EMI & Rectifier	FET Driver	GaN Related	ZVS Sensing	X-Cap Discharge	VCC & BST circuit	Control Circuit
UXX287xx	9	13	12	4	5	10	18
JW1550	9	13	12	1	4	8	9

Total Reduce Part Count is around 15 pcs

## 135W Demo Board Pictures



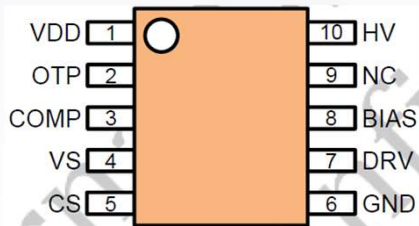
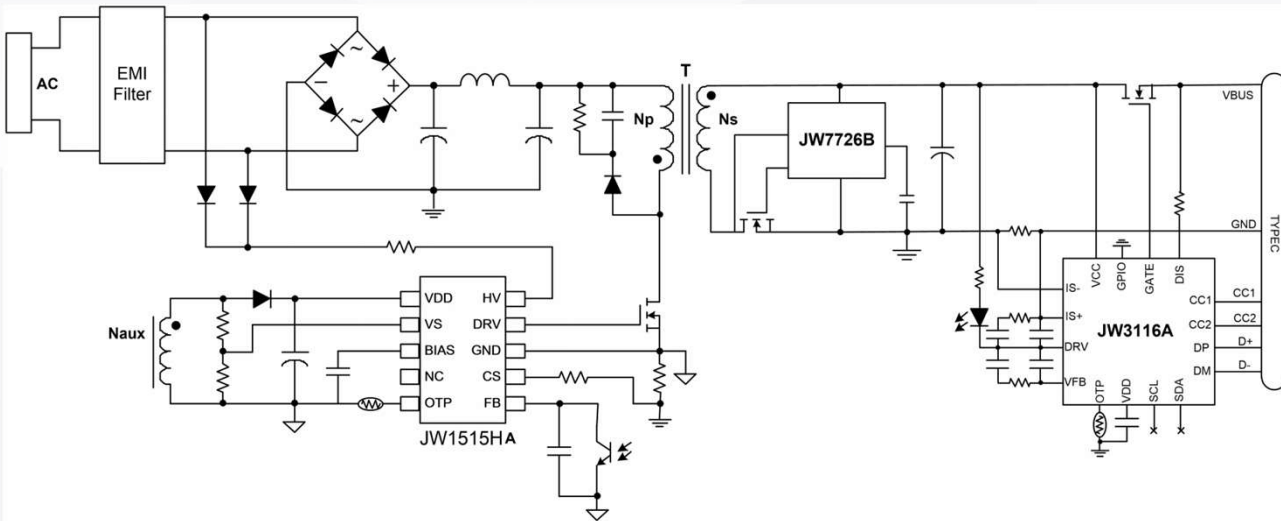
## 135W Type-C PD with PPS(PFC + ACF)

### • 主要器件:

PFC controller	JW1571;
ACF controller	JW1550;
SR controller	JW7726BH;

规格	
输入电压	90Vac-264Vac
输出电压/电流	5V5A/9V5A/12V5A/15V5A/20V6.75A
输出功率	135W
PCBA尺寸	66.5mm*58.7mm*25mm
PCBA功率密度	1.38W/cc
效率	92.2%@90Vac; 94.5%@230Vac

# High Frequency QR GAN Controller: JW1515HA



SSOP10

## Key Features

- QR with Fmax limit:260kHz
- GAN application: 6V Precise Drive Voltage
- Negative current sense for better drive loop
- Optional OCP and OPP function for different output application
- HV startup (700V) and X-cap discharge
- Frequency jitter for better EMI
- Protections: OVP, OCP, SCP, Internal and external OTP, VS open/short, CS open/short, Brown in/out
- Wide VDD range for PD/QC (90V)

## Application

- 30W~200W PD Charger

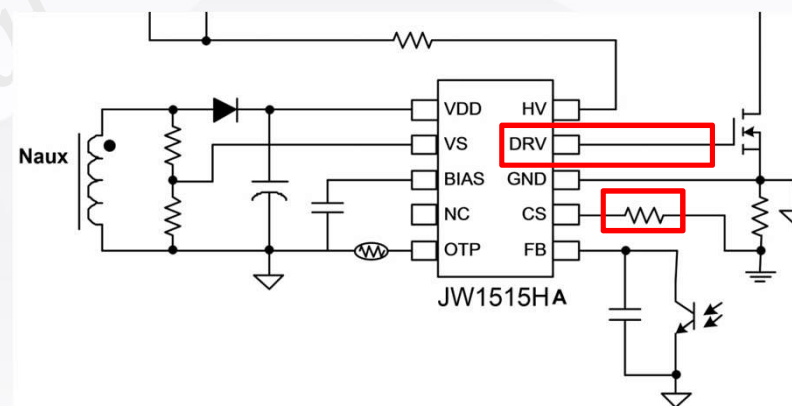
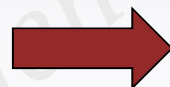
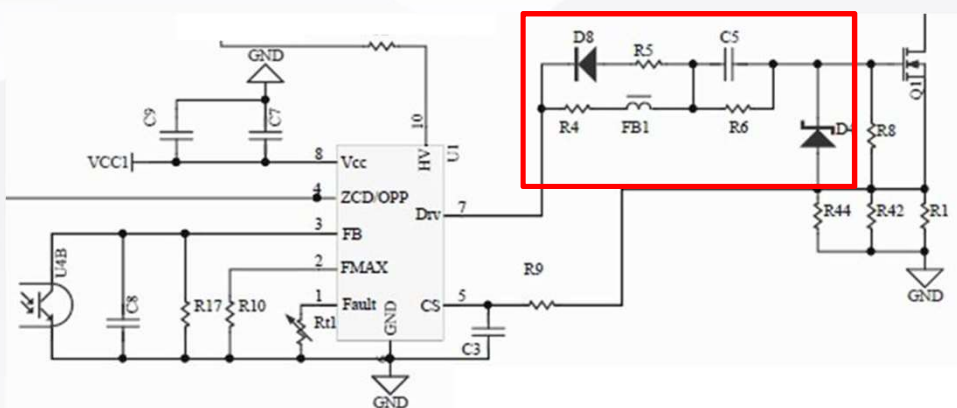
## Benefits

- Compact System Design
- High Efficiency

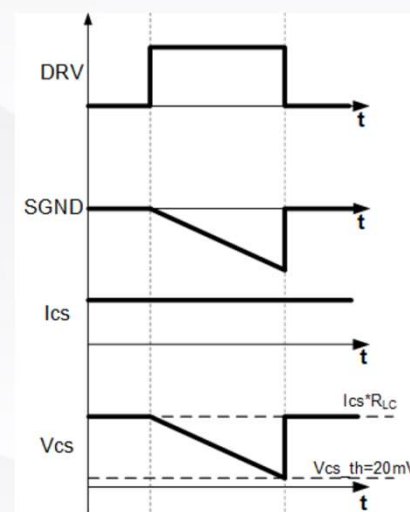


# JW1515HA Feature and Benefit

## 稳定高可靠性氮化镓直驱技术

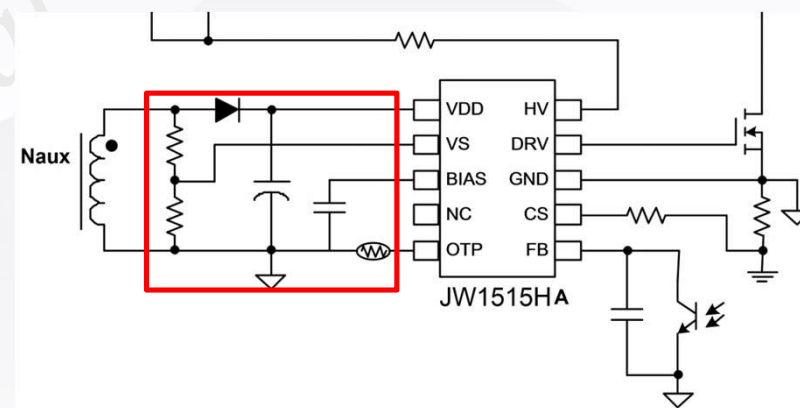
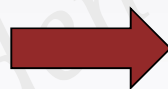
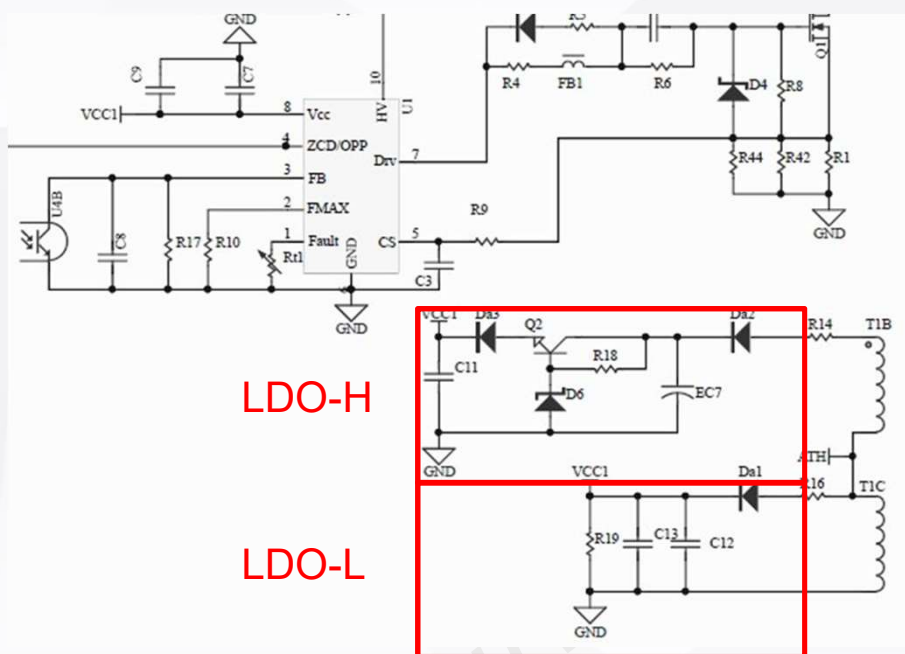


- 不需要增加复杂的 Clamp 驱动线路，增加可靠性
- 采用负压采样，减小驱动 Loop，提供稳定高可靠性驱动电压



# JW1515HA Feature and Benefit

## 宽范围的 VCC 电压



- VCC 范围 7.5V-90V，不需要增加 VCC LDO 线路，降低功耗
- 不需要双绕组供电，节省空间

# JW1515HA Feature and Benefit

## BIAS PIN 调节 EMI

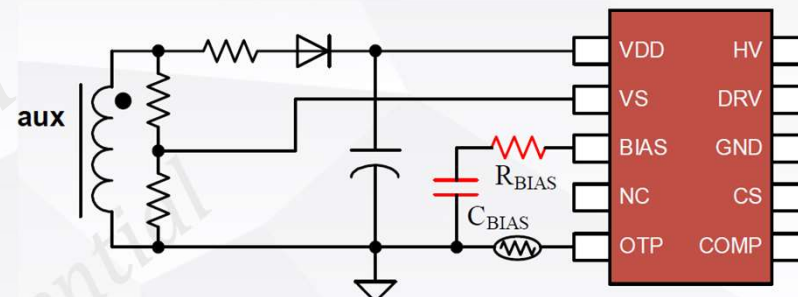
### BIAS PIN 参数设置:

#### ➤ CBIAS 选型

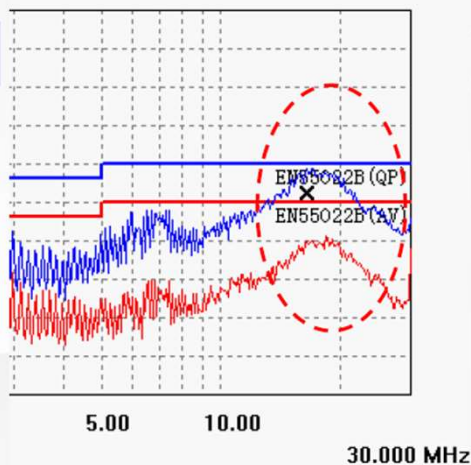
为驱动信号 DRV 提供能量，推荐 10nF

#### ➤ RBIAS 选型

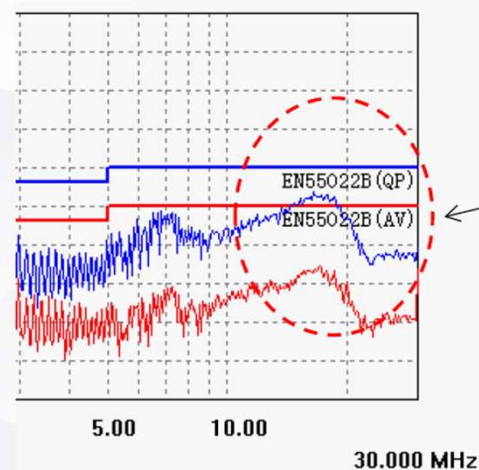
通过串联 RBIAS 可以限制 CBIAS 提供给 DRV 的电流，实现降低 GaN 的开关速度，优化 EMI



$R_{BIAS}=0\Omega$



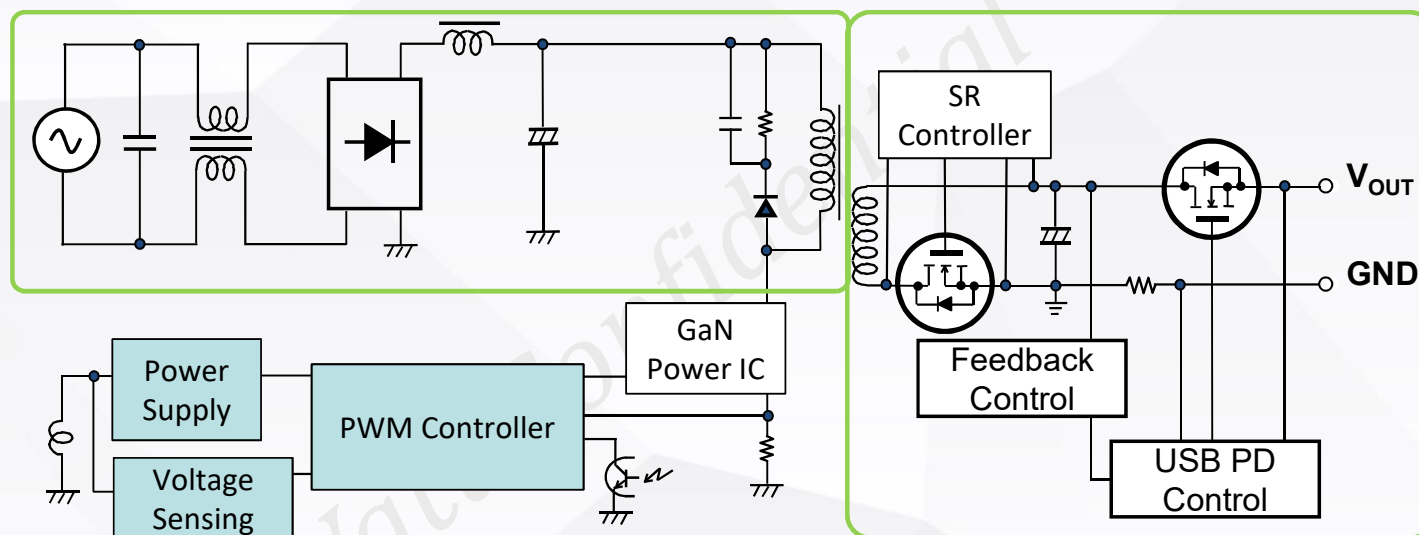
$R_{BIAS}=200\Omega$



通过串联  $R_{BIAS}$  电阻后，EMI 高频部分下降明显！

# JW1515HA, GaN Direct Drive , QR Flyback Controller

## 外围零件数比较



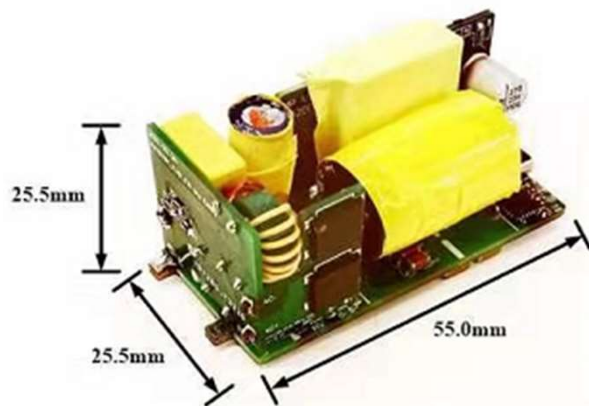
set total component is same

### Estimate Part Count

	OPP	Power Supply	Control Circuit	GaN Related
NXX134X	2	8	10	7
JW1515HA	0	4	10	3

Total Reduce Part Count is around 10 pcs

## 65W Demo Board Pictures



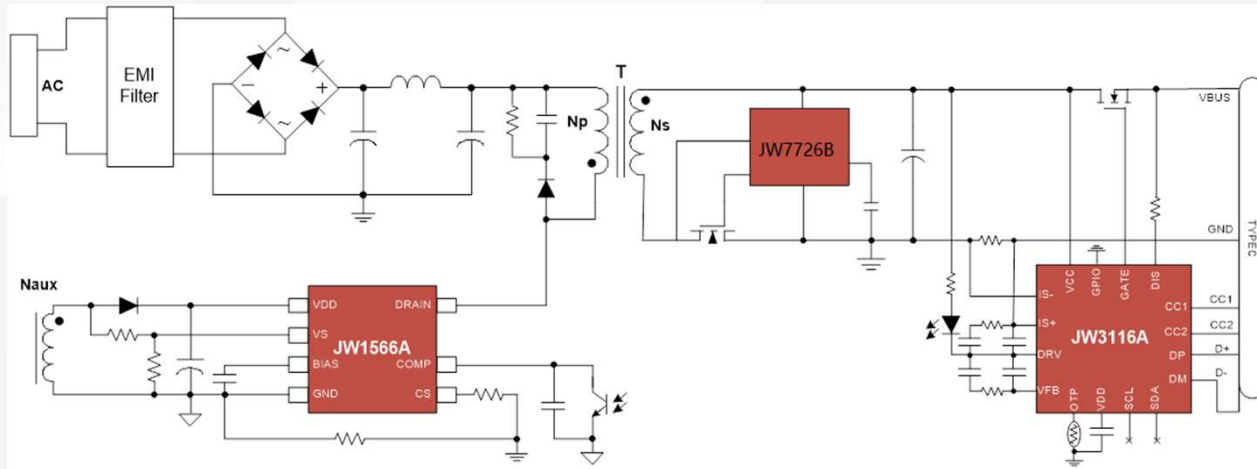
### 65W Type-C PD (High Frequency QR)

• 主要器件:

QR controller            JW1515H;  
SR controller            JW7726B;  
Protocol IC                JW3119;

规格	
输入电压	90Vac-264Vac 47-64Hz
输出电压/电流	5V3A/9V3A/12V3A/15V3A/20V3.25A
输出功率	65W
PCBA尺寸	55mm*25.5mm*25.5mm
PCBA功率密度	1.82W/cc
效率	92.1%@90Vac; 93.3%@230Vac

# High Frequency QR GAN Converter: JW1566A



## Key Features

- QR with fmax limit:260kHz
- 480mR/650V
- GAN application: 6V Precise Drive Voltage
- Negative current sense for better drive loop
- Optional OCP and OPP function for different output application
- HV startup (650V)
- Frequency jitter for better EMI
- Protections: OVP, OCP, SCP, Internal OTP, VS open/short, CS open/short
- Wide VDD range for PD/QC (90V)



DFN5\*6

## Application

- 30W~45W PD Charger

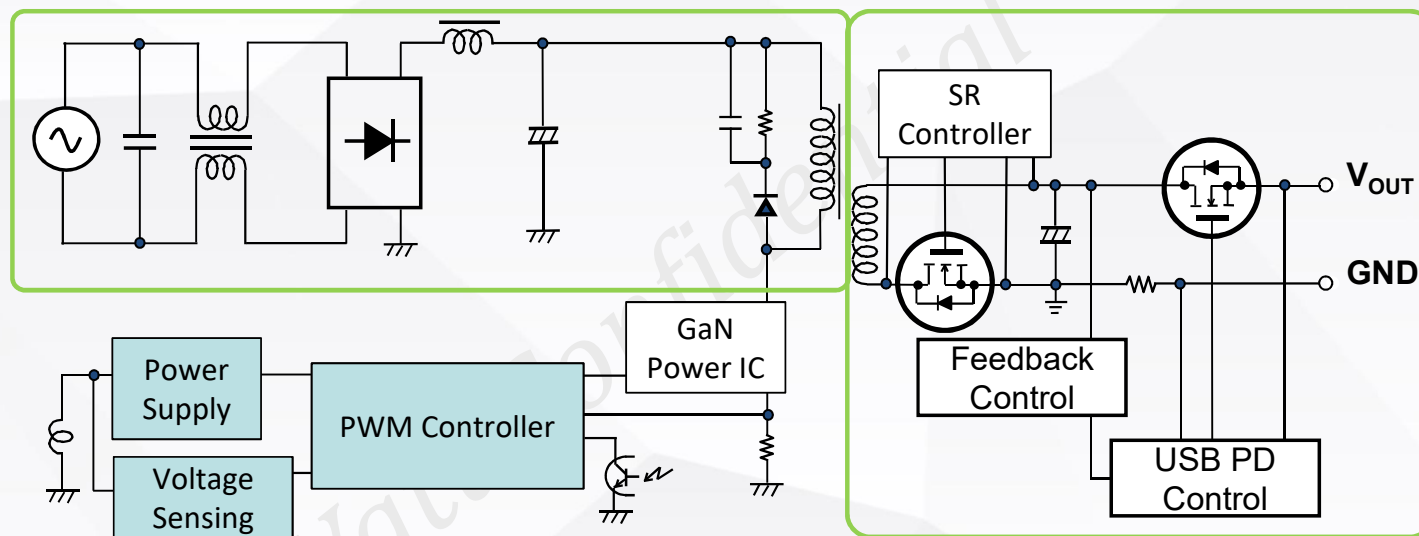
## Benefits

- Compact System Design
- High Power Density



# JW1566A, 650V/480mΩ GaN Integrated, QR Flyback Converter

## 外围零件数比较



set total component is same

## Estimate Part Count

	Voltage Sensing	Power Supply	Control Circuit	GaN Related
NXX134X+GaN	5	7	4	7
JW1566A	3	4	4	/

Total Reduce Part Count is around 12 pcs

## 33W Demo Board Pictures



### 33W Type-C PD (HF QR Integrated with GaN)

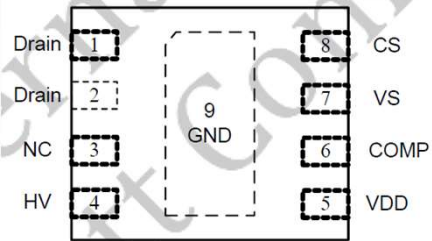
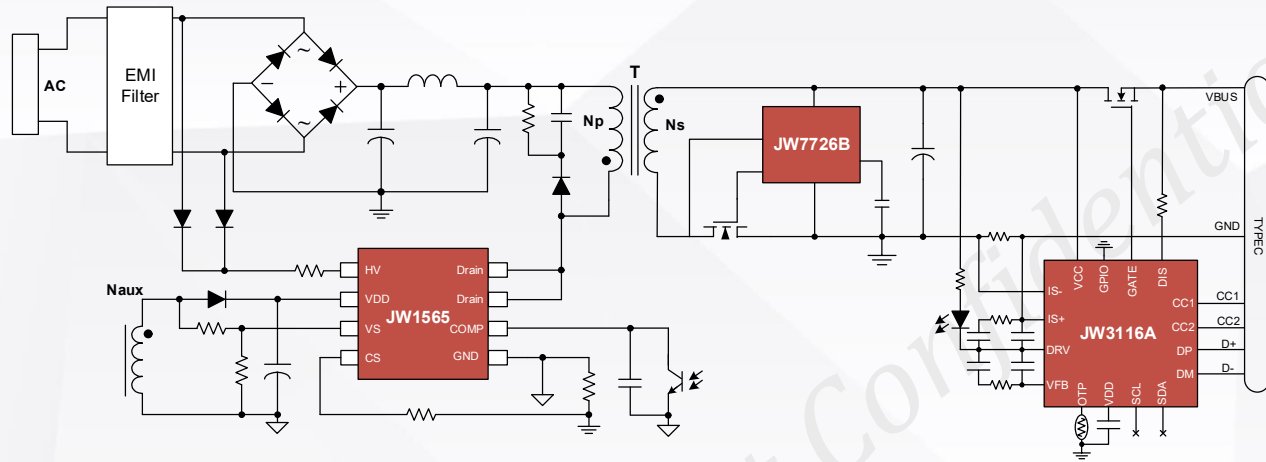
- 主要器件:

QR Regulator            JW1566A;  
SR controller            JW7726B;  
Protocol IC                JW3119;

#### 技术参数

输入电压	90Vac-264Vac 47-64Hz
输出电压电流	5V3A / 9V3A / 11V3A / 15V2.0A / 20V1.5A
输出功率	33W
PCB尺寸	25mm*29mm*21.5mm
功率密度	1.92W/cc
效率	92%@90Vac; 93.5%@230Vac

# High Frequency QR GAN Converter: JW1565



DFN6\*8-8

## Key Features

- QR with fmax limit:260kHz
- 260mR/650V
- GAN application: 6V Precise Drive Voltage
- Negative current sense for better drive loop
- Optional OCP and OPP function for different output application
- HV startup (650V)
- X-Cap Discharger
- Frequency jitter for better EMI
- Protections: OVP, OCP, SCP, Internal OTP, VS open/short, CS open/short
- Wide VDD range for PD/QC (90V)

## Application

- 45W~65W PD Charger

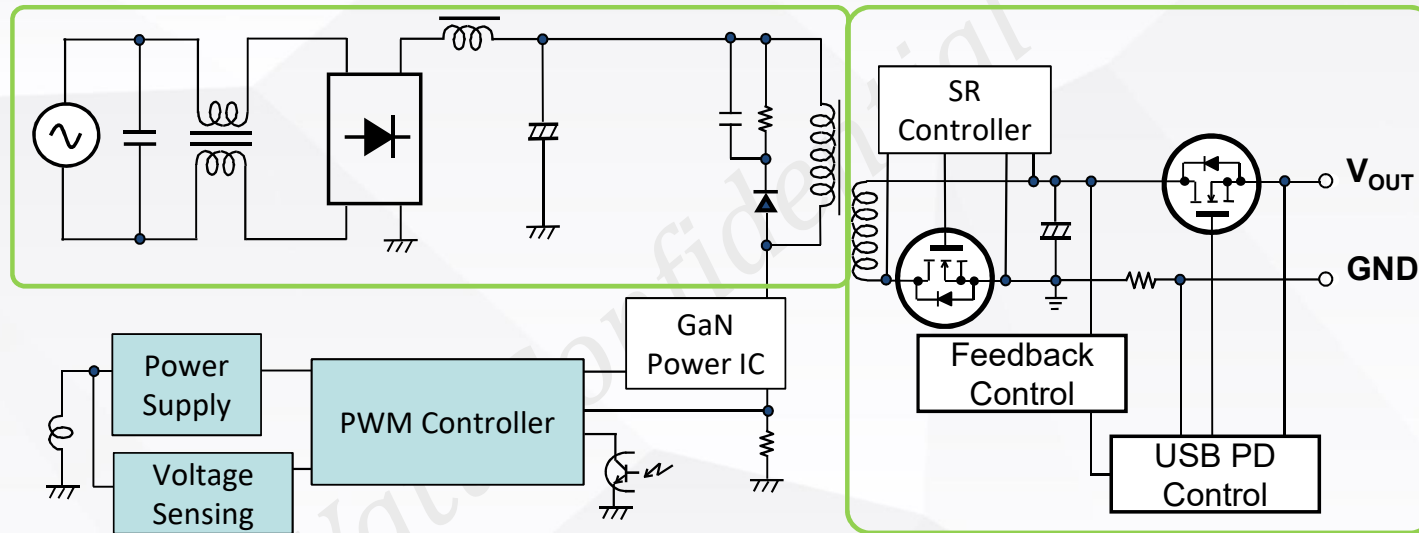
## Benefits

- Compact System Design
- High Power Density



# JW1565, 650V/260mΩ GaN Integrated, QR Flyback Converter

## 外围零件数比较



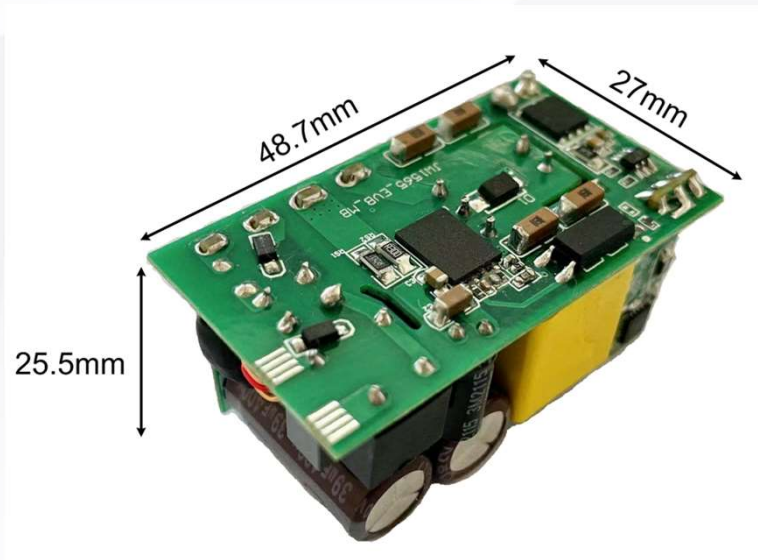
set total component is same

### Estimate Part Count

	Voltage Sensing	Power Supply	Control Circuit	GaN Related
NXX134X+GaN	5	7	4	7
JW1566A	3	4	4	/

Total Reduce Part Count is around 12 pcs

## 65W Demo Board Pictures



## 65W Type-C PD (HF QR Integrated with GaN)

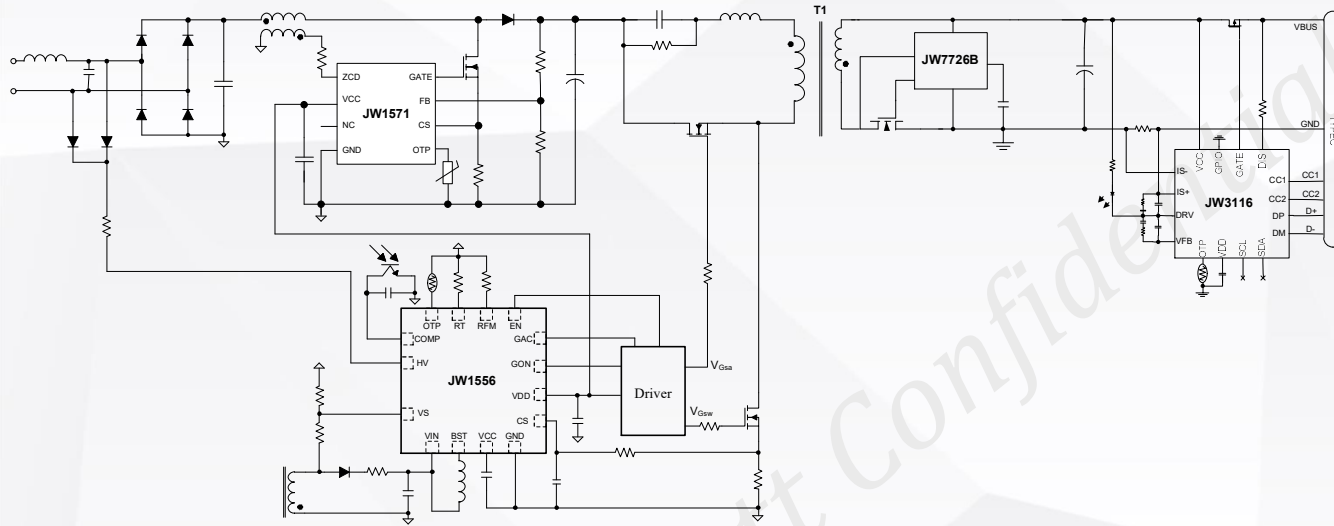
### 主要器件:

QR Regulator	JW1565;
SR controller	JW7727H;
Protocol IC	JW3119;

### 技术参数

输入电压	90Vac-264Vac 47-64Hz
输出电压电流	5V3A / 9V3A / 12V3A / 15V3A / 20V3.25A
输出功率	65W
PCB尺寸	48.7mm*27mm*25.5mm
功率密度	1.92W/cc
效率	92.5%@90Vac; 94.3%@230Vac

# AHB Controller: JW1556



QFN4\*4

## Key Features

- Boundary Mode Operation with ZVS at Heavy Load
- HV startup and Built-in Soft-start Function
- X-cap Discharge Function
- Include a Boost Converter
- Adjustable Line Compensation
- High Switching Frequency up to 1.5MHz
- Protections: VIN OVP, VS OVP, SCP, Brown-In/Out, OTP, CS Open and Short

## Application:

- >65W~240W PD adapter

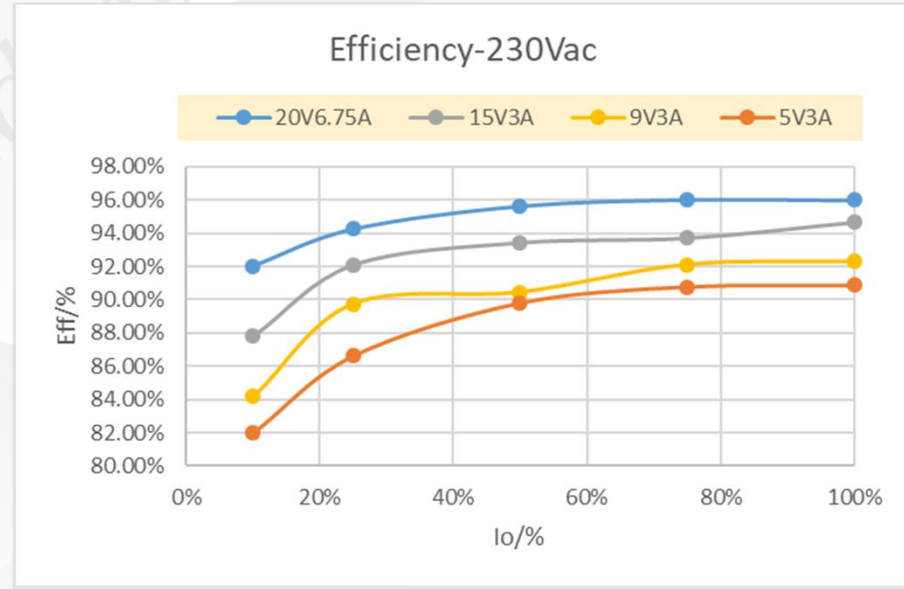
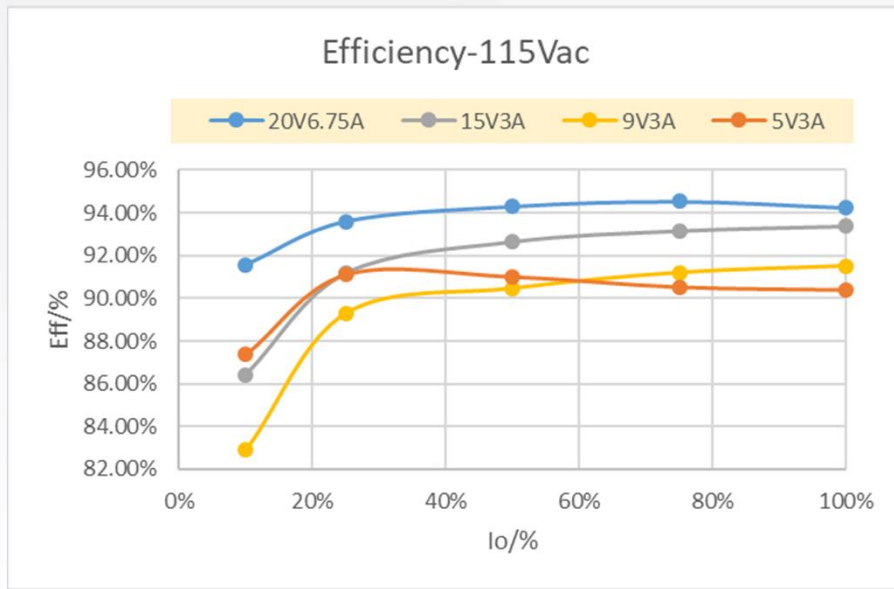
## Benefits

- Low Voltage Stress for both GaN and SR
- Best Efficiency
- High Power Density



# AHB Efficiency

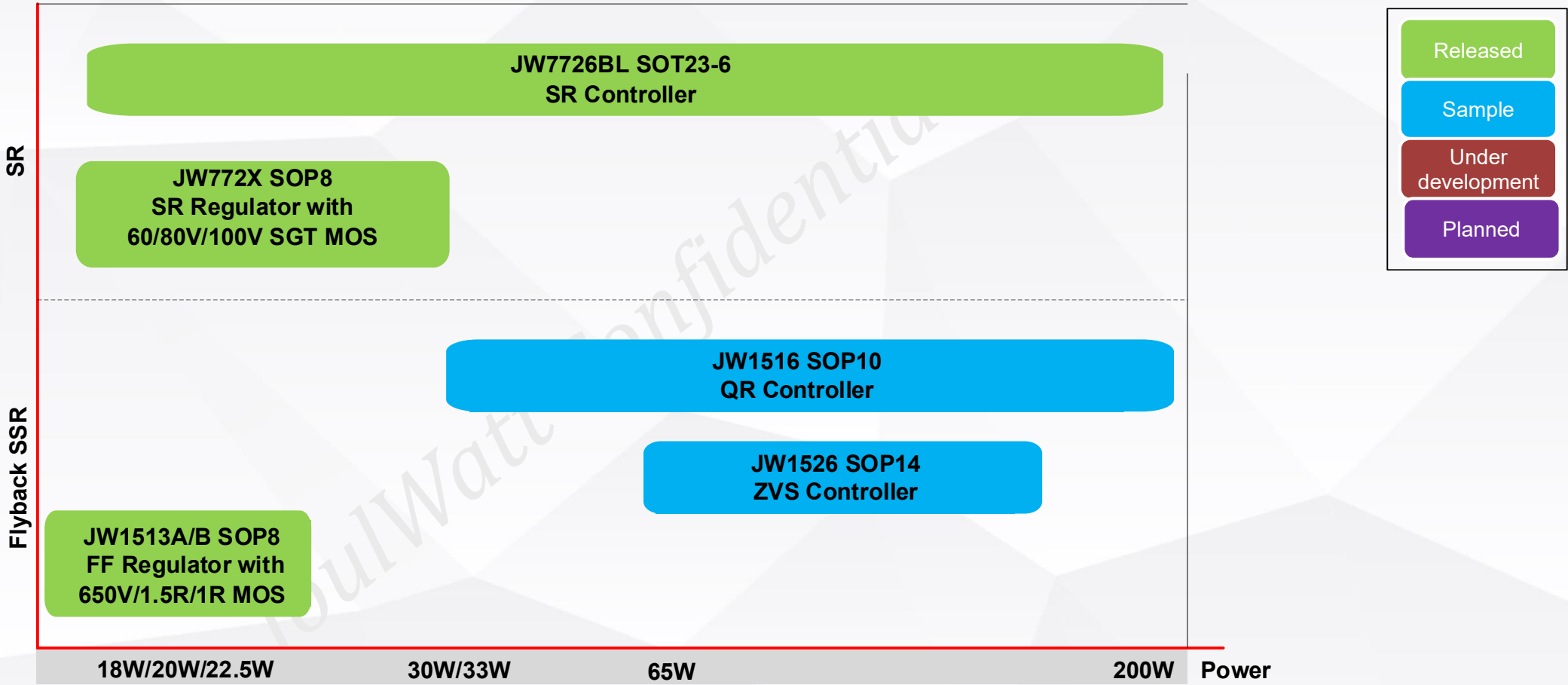
Test condition: Comparison test at 135W Demo Board.



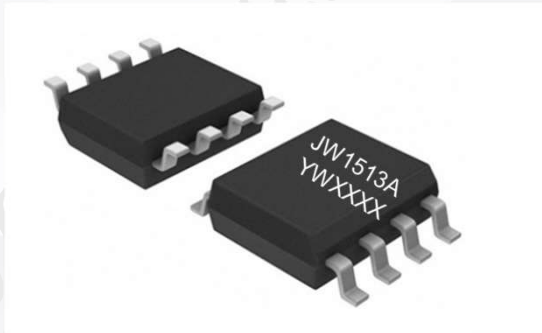
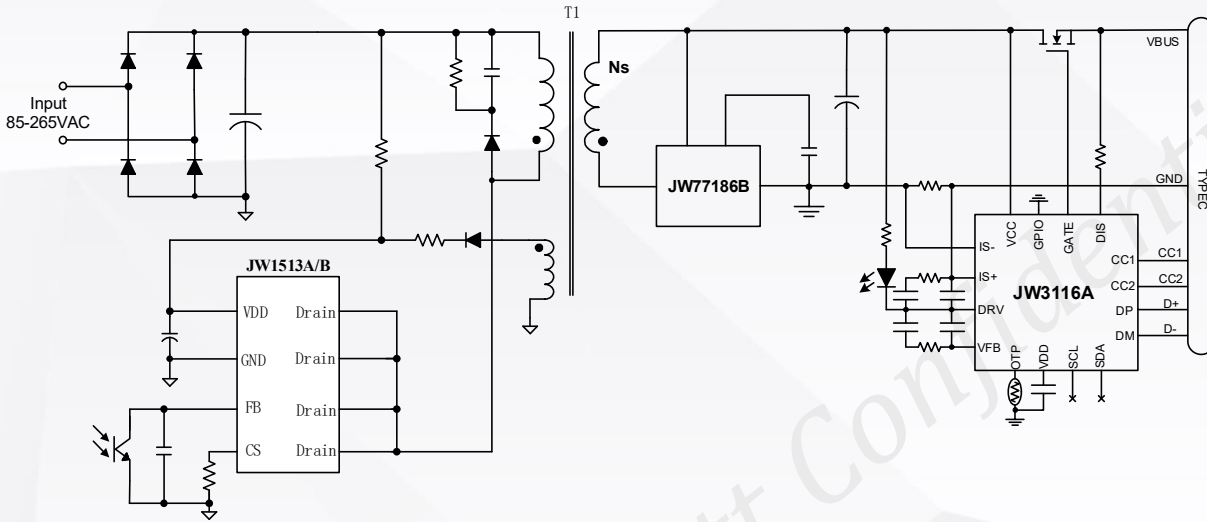
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# PD Si Adapter Solution



# Multi-mode PWM Regulator: JW1513A



SOP8

## Key Features

- 65kHz PWM Regulator
- Internal 650V/1.2ohm MOSFET
- Frequency jitter for better EMI
- Protections: OVP, OLP, SCP, OTP, CS open/short
- Wide VDD range for PD/QC

## Application:

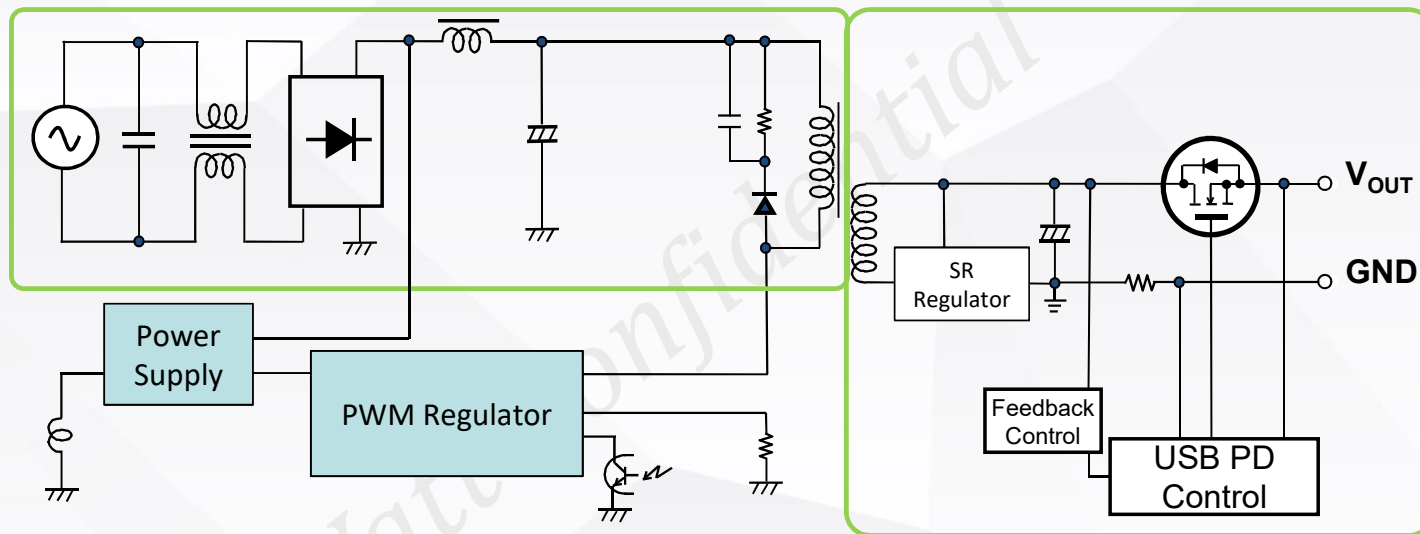
- 20W PD adapter

## Benefits:

- Compact System Design
- Cost Effective

# JW1513A, 650V/1.2Ω MOS Integrated, Multi-mode PWM Regulator

## Few Part Count



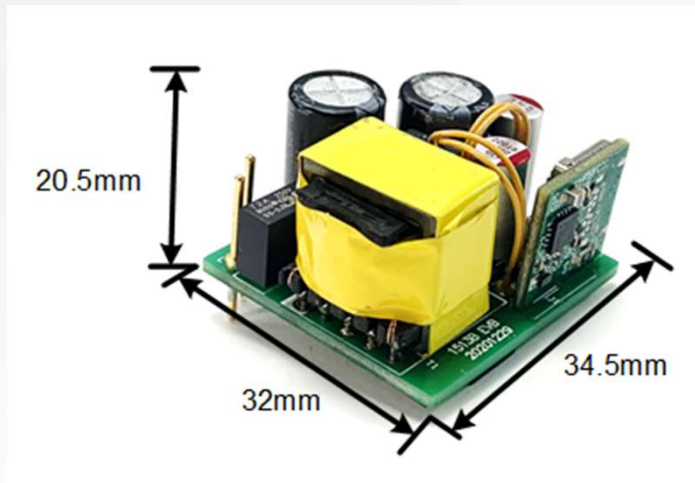
set total component is same

## Estimate Part Count

	Power Supply	PWM Regulator	SR Regulator
JW1513A	4	2	2

JW1513A combined SR Regulator JW77216, the total part count will be **8** pcs

## 20W Demo Board Pictures



### 20W Type-C PD

#### 主要器件:

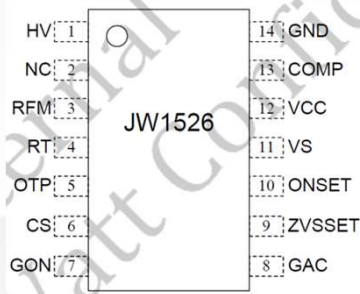
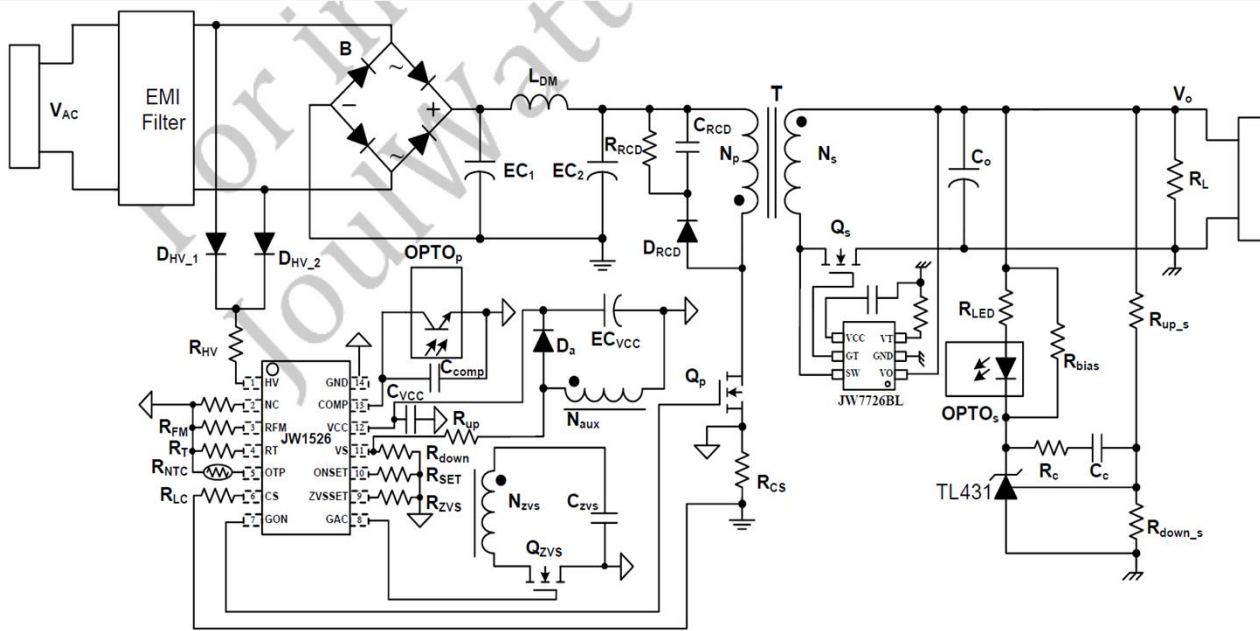
PWM Regulator	JW1513A;
SR	JW77216;
Protocol IC	JW3116A

#### 技术参数

输入电压	90Vac-264Vac 47-64Hz
输出电压电流	5V3A / 9V2.22A / 12V1.67A
输出功率	20W
PCB尺寸	34.5mm*32mm*20.5mm
功率密度	0.88W/cc
效率	89.1%@90Vac; 90.8%@230Vac



# High Frequency ZVS Controller: JW1526



SOP-14

## Key Features

- Multi-mode PWM/PFM Control
- X-cap Discharge Function
- ZVS for the Main Switch with an Auxiliary Switch in the Primary Side
- Programmable ZVS-ON Voltage by a single External Resistor
- Programmable Frequency by a Single External Resistor, up to 270kHz
- Adjustable Output Compensation for OCP
- Reliable Fault Protections
- Frequency Jitter for Easy EMI Compliance
- Negative-voltage Current Sensing

## Application

- 40W~120W PD Charger

## Benefits

- High Efficiency
- High Power Density



# Efficiency (65W DEMO)

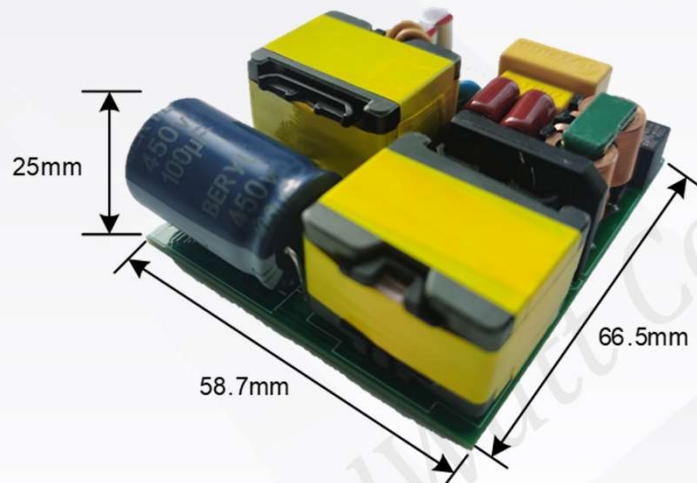
90Vac							115Vac							230Vac							264Vac							
	Load	Pin	Vo	Io	Po	Eff		Load	Pin	Vo	Io	Po	Eff		Load	Pin	Vo	Io	Po	Eff		Load	Pin	Vo	Io	Po	Eff	
20V	100%	70.236	19.76	3.25	64.22	91.43%	20V	100%	69.92	19.8	3.25	64.35	92.03%	20V	100%	68.732	19.79	3.249	64.29771	93.55%	20V	100%	68.943	19.8	3.25	64.35	93.34%	
	75%	52.764	19.8	2.437	48.2526	91.45%		75%	52.325	19.8	2.437	48.2526	92.22%		75%	52.131	19.8	2.437	48.2526	92.56%		75%	52.053	19.8	2.437	48.2526	92.70%	
	50%	35.223	19.8	1.625	32.175	91.35%		50%	35.087	19.8	1.625	32.175	91.70%		50%	34.986	19.8	1.625	32.175	91.97%		50%	34.94	19.8	1.625	32.175	92.09%	
	25%	17.734	19.81	0.814	16.12534	90.93%		25%	17.695	19.81	0.813	16.10553	91.02%		25%	17.758	19.8	0.813	16.0974	90.65%		25%	17.795	19.81	0.813	16.10553	90.51%	
	10%	7.273	19.81	0.325	6.43825	88.52%		10%	7.282	19.81	0.325	6.43825	88.41%		10%	7.42	19.81	0.325	6.43825	86.77%		10%	7.45	19.81	0.325	6.43825	86.42%	
	AVG							91.29%	AVG							91.74%	AVG											
12V	100%	38.617	11.9	3	35.7	92.45%	12V	100%	38.347	11.89	2.999	35.65811	92.99%	12V	100%	38.09	11.9	2.999	35.6881	93.69%	12V	100%	38.26	11.89	3	35.67	93.23%	
	75%	28.963	11.9	2.25	26.775	92.45%		75%	28.778	11.9	2.25	26.775	93.04%		75%	28.65	11.9	2.251	26.7869	93.50%		75%	28.752	11.9	2.25	26.775	93.12%	
	50%	19.29	11.9	1.5	17.85	92.53%		50%	19.163	11.9	1.499	17.8381	93.09%		50%	19.197	11.9	1.499	17.8381	92.92%		50%	19.272	11.9	1.499	17.8381	92.56%	
	25%	9.688	11.9	0.75	8.925	92.12%		25%	9.653	11.9	0.749	8.9131	92.34%		25%	9.683	11.9	0.75	8.925	92.17%		25%	9.76	11.9	0.75	8.925	91.44%	
	10%	3.99	11.9	0.3	3.57	89.47%		10%	3.988	11.9	0.3	3.57	89.52%		10%	4.06	11.9	0.3	3.57	87.93%		10%	4.102	11.9	0.3	3.57	87.03%	
	AVG							92.39%	AVG							92.86%	AVG											
9V	100%	29.105	8.96	3	26.88	92.36%	9V	100%	28.838	8.96	2.999	26.87104	93.18%	9V	100%	28.873	8.96	2.999	26.87104	93.07%	9V	100%	28.997	8.96	2.999	26.87104	92.67%	
	75%	21.747	8.96	2.251	20.16896	92.74%		75%	21.588	8.96	2.251	20.16896	93.43%		75%	21.655	8.96	2.25	20.16	93.10%		75%	21.75	8.96	2.251	20.16896	92.73%	
	50%	14.463	8.96	1.499	13.43104	92.86%		50%	14.386	8.96	1.499	13.43104	93.36%		50%	14.481	8.96	1.499	13.43104	92.75%		50%	14.57	8.96	1.5	13.44	92.24%	
	25%	7.268	8.96	0.75	6.72	92.46%		25%	7.247	8.96	0.749	6.71104	92.60%		25%	7.314	8.96	0.749	6.71104	91.76%		25%	7.394	8.96	0.749	6.71104	90.76%	
	10%	2.982	8.96	0.299	2.67904	89.84%		10%	2.991	8.96	0.3	2.688	89.87%		10%	3.096	8.96	0.3	2.688	86.82%		10%	3.148	8.96	0.3	2.688	85.39%	
	AVG							92.61%	AVG							93.14%	AVG											
5V	100%	16.514	5.088	2.999	15.25891	92.40%	5V	100%	16.405	5.088	2.999	15.25891	93.01%	5V	100%	16.561	5.088	2.999	15.25891	92.14%	5V	100%	16.597	5.088	2.998	15.25382	91.91%	
	75%	12.361	5.088	2.25	11.448	92.61%		75%	12.317	5.088	2.251	11.45309	92.99%		75%	12.448	5.088	2.25	11.448	91.97%		75%	12.5	5.088	2.25	11.448	91.58%	
	50%	8.244	5.089	1.5	7.6335	92.59%		50%	8.211	5.088	1.499	7.626912	92.89%		50%	8.344	5.088	1.499	7.626912	91.41%		50%	8.366	5.089	1.499	7.628411	91.18%	
	25%	4.139	5.089	0.749	3.811661	92.09%		25%	4.132	5.089	0.749	3.811661	92.25%		25%	4.252	5.088	0.749	3.810912	89.63%		25%	4.322	5.089	0.749	3.811661	88.19%	
	10%	1.698	5.089	0.3	1.5267	89.91%		10%	1.716	5.09	0.3	1.527	88.99%		10%	1.854	5.089	0.299	1.521611	82.07%		10%	1.905	5.089	0.3	1.5267	80.14%	
	AVG							92.42%	AVG							92.78%	AVG											

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## Agenda

- JW Company Introduction
- JW ACDC Product Overview
- PD GAN Adapter
  - ACF, QR, AHB
- PD Si Adapter
  - QR, PWM, ZVS
- **135W AHB DEMO**

## Demo Board Pictures



### 135W Type-C PD (PFC + AHB)

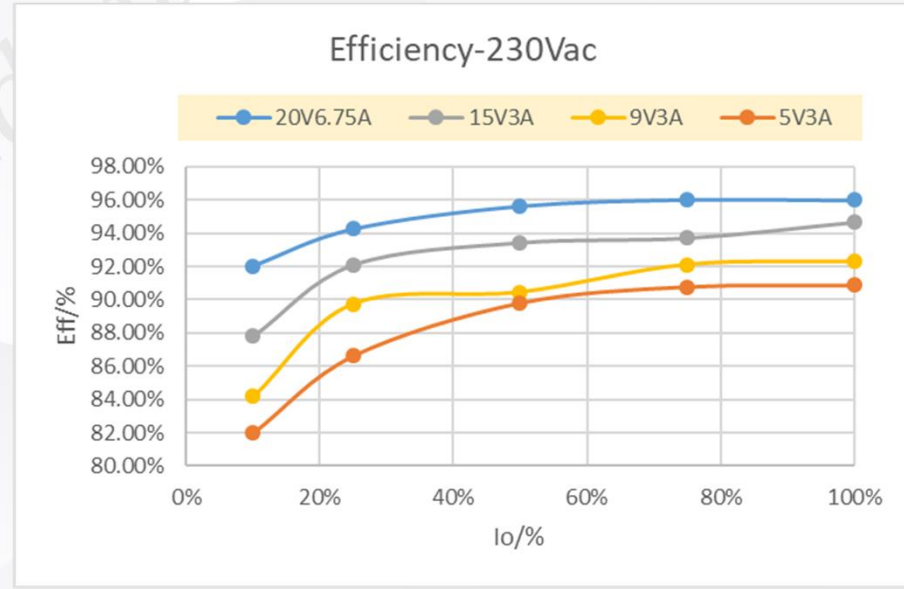
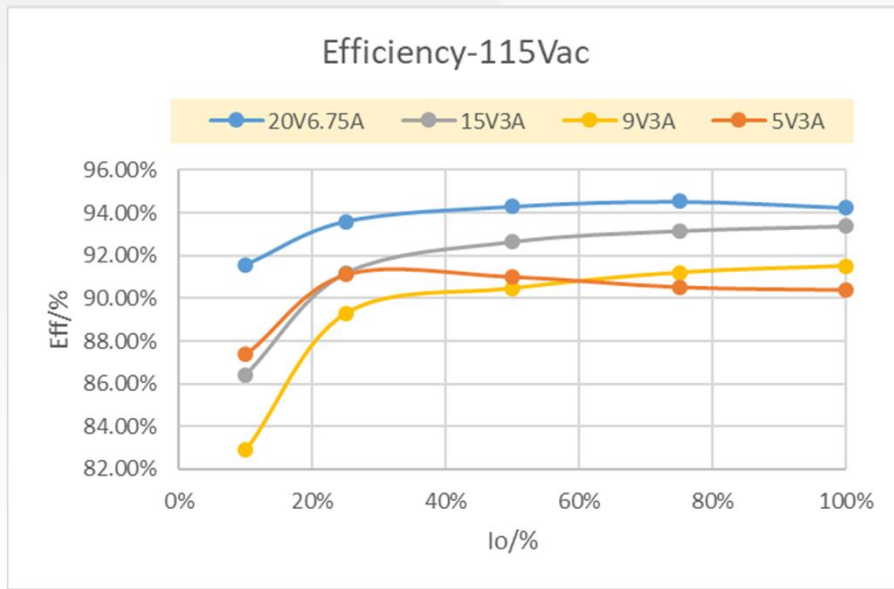
- 主要器件:

PFC controller	JW1571;
AHB controller	JW1556;
SR controller	JW7726B;

规格	
输入电压	90Vac-264Vac
输出电压/电流	5V5A/9V5A/12V5A/15V5A/20V6.75A
输出功率	135W
PCBA尺寸	66.5mm*58.7mm*25mm
PCBA功率密度	1.38W/cc
效率	93.3%@90Vac

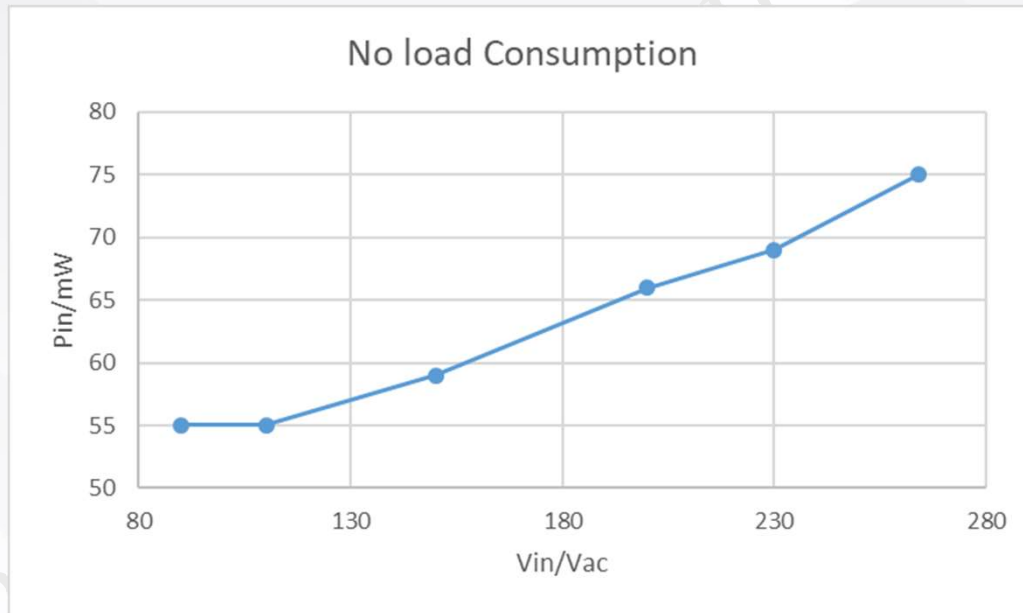
# AHB Efficiency

Test condition: Comparison test at 135W Demo Board.

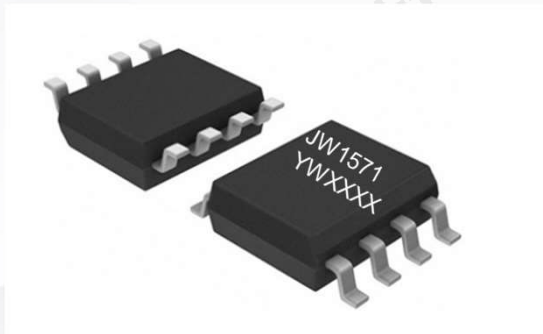
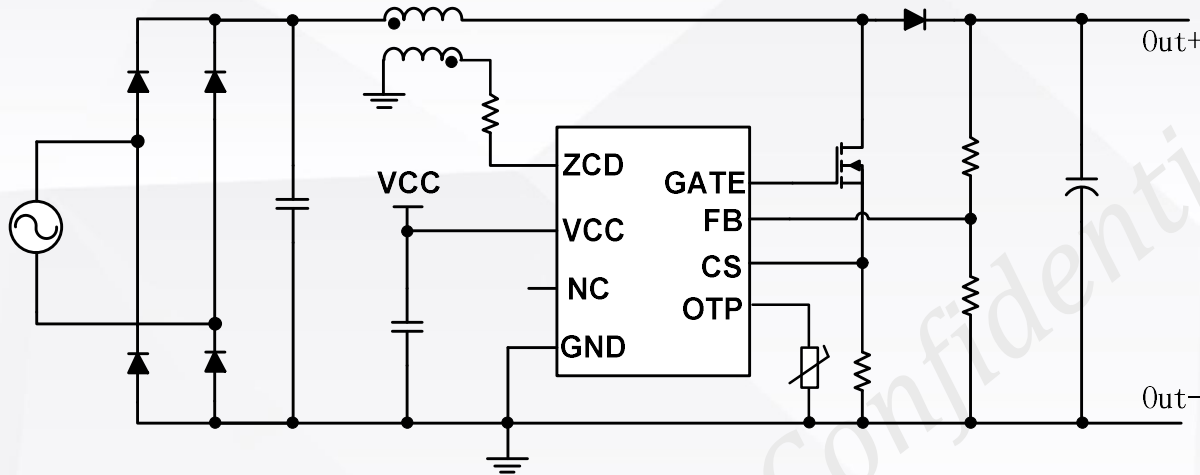


# AHB Efficiency

Test condition: Comparison test at 135W Demo Board.



# PFC Controller: JW1571



SOP8

## Key Features

- High power factor and low THD
- Critical conduction mode
- High efficiency over wide operating range
- Reduce frequency at light load
- Open Feedback protection
- Disable Function
- Internal loop compensation
- External OTP
- **2ND OVP**

## Application:

- **Adapter;TV; High Power Charger**

## Benefits:

- **Internal Loop Compensation**

# High Frequency SR Controller: JW7726B

## Key Features

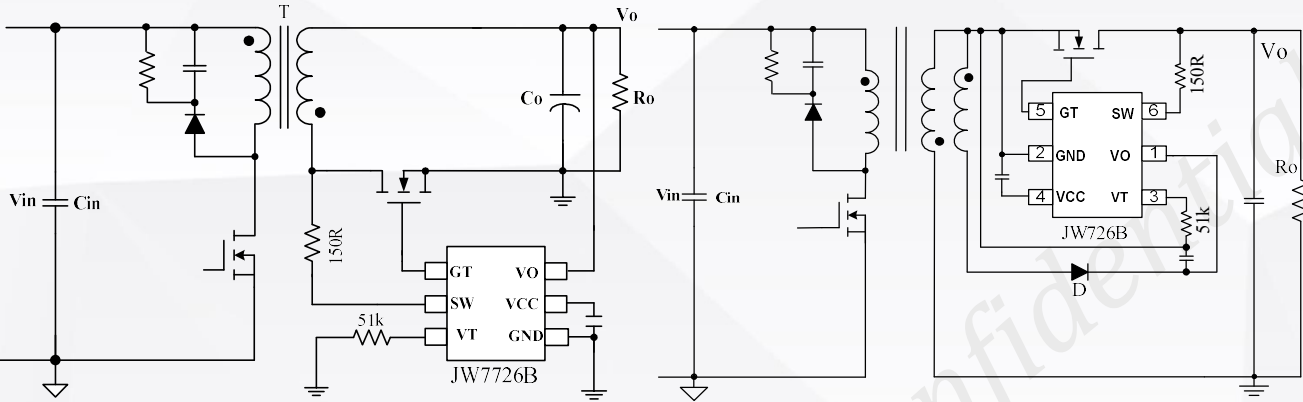
- Support DCM , CrM & CCM Flyback, Active Clamp Flyback
- High Driver Sink Capability for CCM operation
- Low Turn on and Turn off Delay
- Low Quiescent Current
- Support High Side & Low side rectification
- SOT-23-6 package

## Application:

- 30W~200W Adapter, Power Supply

## Benefits:

- Best Efficiency
- Best Performance at transient condition



Low side application

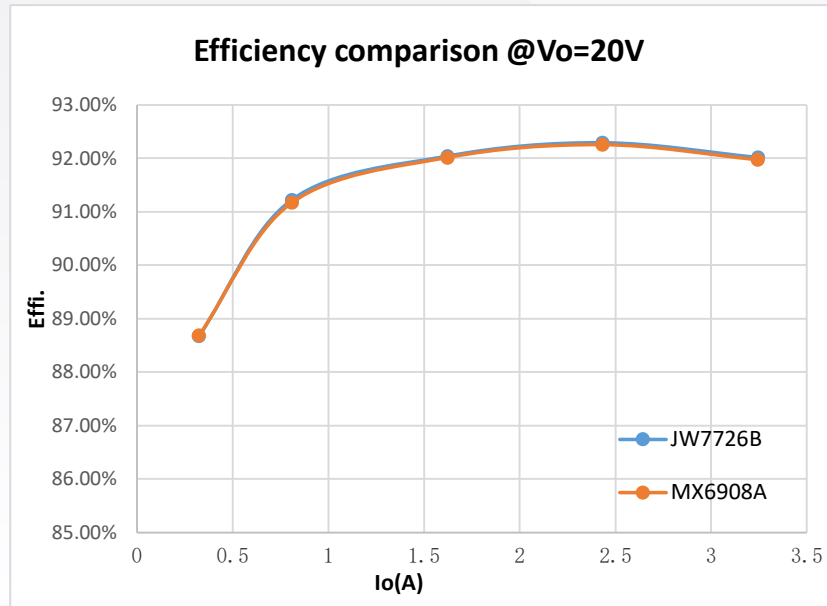
High side application



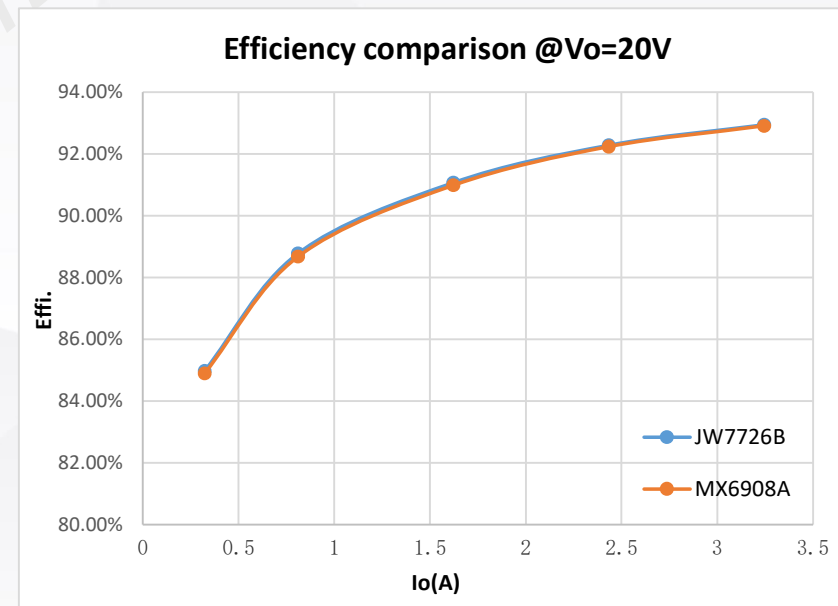
# Efficiency Comparison between JW7726B and Competitor

Test condition:  $V_{in}=120/230V_{ac}$ ,  $V_o=20V$ ,  $I_o=0.325A\sim 3.25A$ , at  $25^{\circ}C$  ambient temperature.  
Efficiency test after 15 minutes' burn in. Comparison test at 65W PD GaN adapter(**High frequency**).

115Vac input



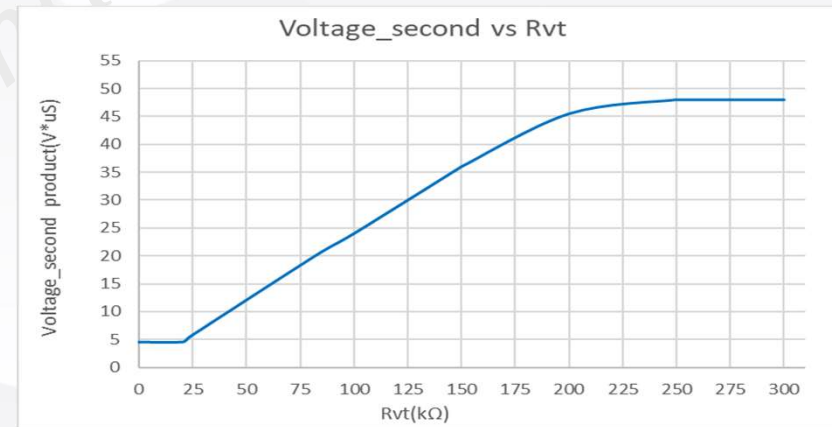
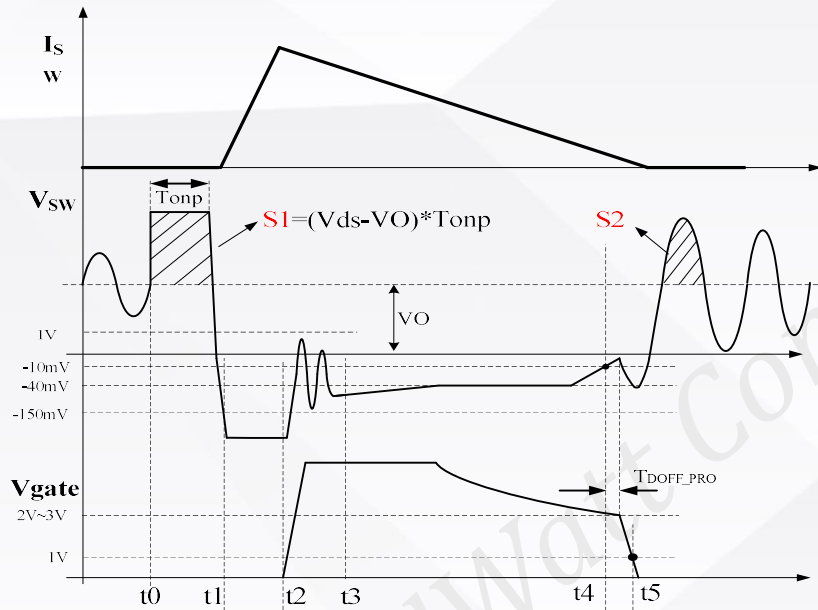
230Vac input



The system efficiency with JW7726B is the same as MX690XA.

# JW7726B Application note

## ➤A. Voltage-second threshold set



JW7726B可通过VT脚设置伏秒阈值（右上图）来避免gate误开通：

即只有当阴影面积S1大于设定的伏秒阈值后才使能开通信号、在VDS小于-140mV后开通gate；

同时阴影面积S2会小于设定的伏秒阈值，这样在振铃期间即使触碰到开通阈值-140mV也不会开通SR MOS，从而防止误开通。

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# Thanks