PJ52916QW

6A, Ultra-Low On-Resistance Load Switch with Soft Start In a DFN2x2-8 Package

GENERAL DESCRIPTION

The product of PJ52916 is an ultra-low on-resistance, power-distribution switch equipped with external soft start control. It integrates a N-channel MOSFET that can each deliver 6 A continuous load current.

The device contains over-temperature protection. When the junction temperature rises above 160°C, the over-temperature protection function shuts down the N-channel MOSFET power switch and turns the power switch on automatically when temperature drops by 25°C.

The device is available in lead free DFN2x2-8 package.

FEATURES

- Wide input voltage range (V_{IN}) : 0.6 V to 5.5 V
- Supply voltage range (V_{BIAS}) : 2.5 V to 5.5 V
- R_{ON} : 13 mΩ (typ.)
- Continuous current : up to 6 A
- Soft start time programmable by external capacitor
- Integrated Quick Output Discharge
- Enable input of switch :
  - PJ52916A : Logic high turns on switch
  - PJ52916B : Logic low turns on switch
- Over-temperature protection
- Package : DFN2x2-8

APPLICATIONS

- Notebook
- Tablet PCs
- AIO PC
- Consumer electronics
- Set-top boxes
- Telecom systems
- Industrial systems

ORDERING INFORMATION

ORDER NUMBER	ENABLE	MARKING ID	PACKAGE	DESCRIPTION
PJ52916AQW_R1	Logic High	A1 W	DFN2x2-8	Halogen Free in T&R, 3000 pcs/Reel
PJ52916BQW_R1	Logic Low	A2 W	DFN2x2-8	Halogen Free in T&R, 3000 pcs/Reel

PIN CONFIGURATION

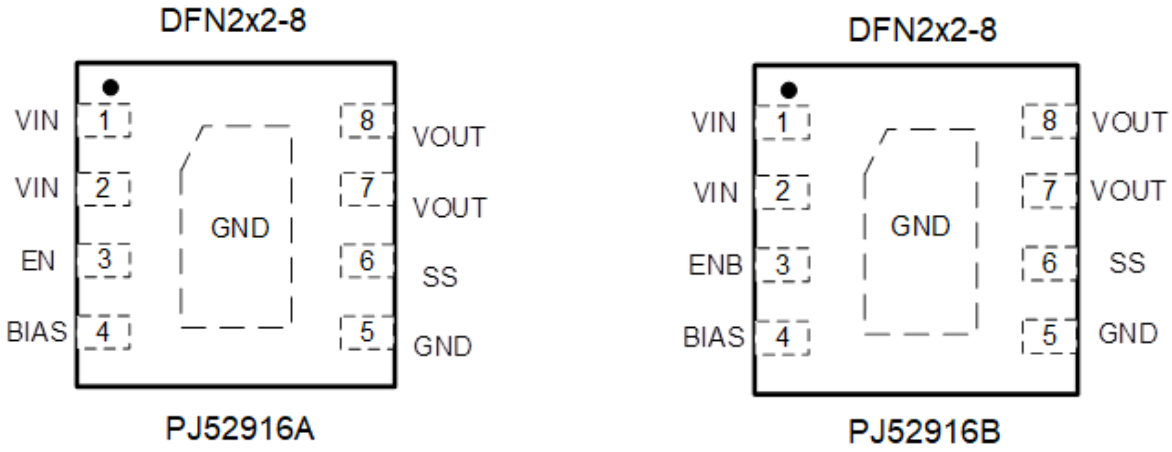


Figure-1. PIN CONFIGURATION (TOP VIEW)

FUNCTIONAL PIN DESCRIPTION

NAME	I/O(1)	DESCRIPTION
VIN	P	Power supply input of switch. Connect this pin to an external DC supply
EN / ENB	I	Enable input of switch. The pin cannot be left floating EN : logic high turns on switch ENB : logic low turns on switch
BIAS	P	Bias voltage input pin for internal control circuitry
GND	G	Ground pin of the circuitry. All voltage levels are measured with respect to this pin.
SS	-	Soft start control of switch. A capacitor (C_T) from this pin to ground sets the VOUT's rise slew rate.
VOUT	P	Switch output.
Exposed Pad	P	Connect this pad to system ground plane for good thermal conductivity.

(1) I – Input; P – Power; G – Ground

ABSOLUTE MAXIMUM RATINGS

Over operating free-air temperature range (unless otherwise noted) (1)

PARAMETER		MIN	MAX	Unit
V_{IN}	VIN input voltage	-0.3	6	V
V_{BIAS}	BIAS input voltage	-0.3	6	V
V_{OUT}	VOUT output voltage	-0.3	6	V
V_{EN}, V_{ENB}	EN or ENB to GND voltage	-0.3	6	V
$I_{OUT(MAX)}$	Maximum pulsed switch current, pulse < 300 µs, 1% duty cycle		8	A
T_J(2)	Operating junction temperature range	-40	150	°C
T_{STG}	Storage temperature range	-65	150	°C
T_{SDR}	Maximum lead soldering temperature (10s)		260	°C
ESD	Human Body Model (HBM) ESD stress voltage	-7000	7000	kV

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) Operating at junction temperatures greater than 125°C, although possible, degrades the lifetime of the device.

THERMAL INFORMATION

THERMAL RESISTANCE		DFN2x2-8	UNIT
θ_{JA}	Junction to ambient thermal resistance	TBD	°C/W
θ_{JC}	Junction to case resistance	TBD	°C/W

RECOMMENDED OPERATING CONDITIONS

PARAMETER		MIN	TYP	MAX	UNIT
V_{IN}	Input voltage range	0.6	-	5.5	V
V_{BIAS}	BIAS input voltage	2.5		5.5	V
I_{OUT}	Output DC current range	0	-	6	A
V_{EN}, V_{ENB}	Input logic high	1		5.5	V
	Input logic low	0		0.4	V
T_A	Operating Ambient temperature	-40	-	85	°C
T_J	Operating Junction temperature	-40	-	125	°C

ELECTRICAL CHARACTERISTICS

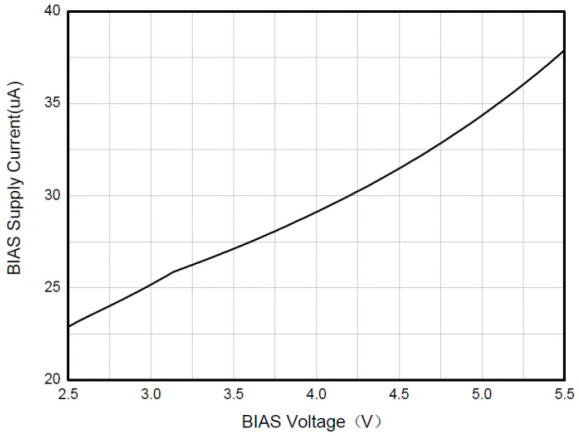
V_{IN} = 0.6 V to 5 V, V_{BIAS} = 5 V, V_{EN} = High or V_{ENB} = Low. T_J = -40°C to 150°C. Typical value is tested at T_A = 25°C, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply current						
I_Q	BIAS supply current	No load		28	50	μA
$I_{SD,VBIAS}$	BIAS supply current at shut-down	No load, V_{EN} = 0 V		2.5	5	μA
		No load, V_{ENB} = 5 V		3.5	5	μA
$I_{SD,VIN}$	VIN off-state supply current	No load, V_{BIAS} = 5 V, V_{EN} = 0 V or V_{ENB} = 5 V, V_{IN} = 5 V		0.01	8	μA
		No load, V_{BIAS} = 5 V, V_{EN} = 0 V or V_{ENB} = 5 V, V_{IN} = 3.3 V		0.01	3	μA
		No load, V_{BIAS} = 5 V, V_{EN} = 0 V or V_{ENB} = 5 V, V_{IN} = 1.8 V		0.01	2	μA
		No load, V_{BIAS} = 5 V, V_{EN} = 0 V or V_{ENB} = 5 V, V_{IN} = 0.8 V		0.01	1	μA
Under-voltage lockout (UVLO)						
V_{UVLO}	Rising BIAS UVLO threshold	V_{BIAS} rising	1.9	2.1	2.3	V
$V_{UVLO, Hys}$	BIAS UVLO hysteresis			0.1		V
Power switch						
$R_{DS(ON)}$	Power switch on resistance	V_{BIAS} = 5 V, V_{IN} = 0.6 to 5 V, I_{OUT} = 1 A, T_J = 25ºC		13	18	mΩ
		V_{BIAS} = 2.5 V, V_{IN} = 0.6 to 2.5 V, I_{OUT} = 1 A, T_J = 25ºC		13	18	mΩ
	VOUT discharge resistance	V_{EN} = 0 V or V_{ENB} = 5 V, VOUT force 1 V		100		Ω
Soft-start control pin						
I_{SS}	SS discharge current	V_{SS} = 6 V, V_{EN} = 0 V or V_{ENB} = 5 V, measured at SS		1.5		mA
EN or ENB input pin						
V_{EN}, V_{ENB}	Input logic high		1			V
	Input logic low				0.4	V
I_{EN}	EN Input current				1	μA
Overt-temperature protection (OTP)						
	Over-temperature threshold	T_J rising		160		ºC
	Over-temperature threshold hysteresis	T_J falling		25		ºC

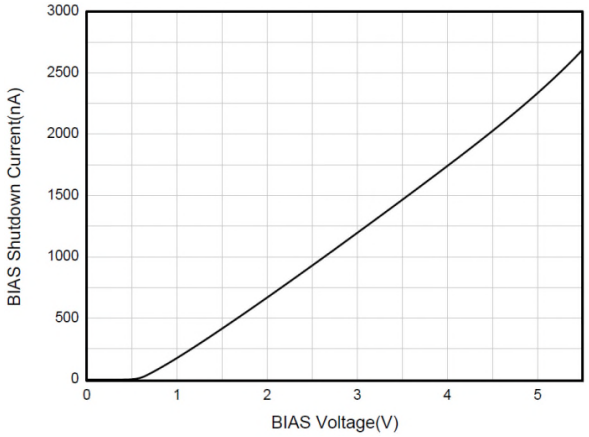
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IN} = V_{BIAS} = 5 V, T_A = 25ºC (unless otherwise noted)						
t_{ON}	Turn on time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		1200		µS
t_{OFF}	Turn off time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		1		
t_R	VOUT rise time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		1800		
t_F	VOUT fall time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		2		
t_D	ON delay time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		390		
V_{IN} = 0.8 V, V_{BIAS} = 5 V, T_A = 25ºC (unless otherwise noted)						
t_{ON}	Turn on time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		430		µS
t_{OFF}	Turn off time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		1		
t_R	VOUT rise time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		320		
t_F	VOUT fall time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		1.9		
t_D	ON delay time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		290		
V_{IN} = 0.6 V, V_{BIAS} = 5 V, T_A = 25ºC (unless otherwise noted)						
t_{ON}	Turn on time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		450		µS
t_{OFF}	Turn off time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		1		
t_R	VOUT rise time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		260		
t_F	VOUT fall time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		1.4		
t_D	ON delay time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		330		
V_{IN} = V_{BIAS} = 2.5 V, T_A = 25ºC (unless otherwise noted)						
t_{ON}	Turn on time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		1000		µS
t_{OFF}	Turn off time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		1.3		
t_R	VOUT rise time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		1450		
t_F	VOUT fall time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		2.2		
t_D	ON delay time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		440		

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IN} = 0.8 V, V_{BIAS} = 2.5 V, T_A = 25ºC (unless otherwise noted)						
t_{ON}	Turn on time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		600		µS
t_{OFF}	Turn off time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		1.3		
t_R	V_{OUT} rise time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		480		
t_F	V_{OUT} fall time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		2.3		
t_D	ON delay time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		380		
V_{IN} = 0.6 V, V_{BIAS} = 2.5 V, T_A = 25ºC (unless otherwise noted)						
t_{ON}	Turn on time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		620		µS
t_{OFF}	Turn off time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		1.2		
t_R	V_{OUT} rise time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		380		
t_F	V_{OUT} fall time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		1.5		
t_D	ON delay time	R_L = 10 Ω, C_L = 0.1 µF, C_{IN} = 1 µF, C_T = 1 nF, V_{ON} = 5 V		430		

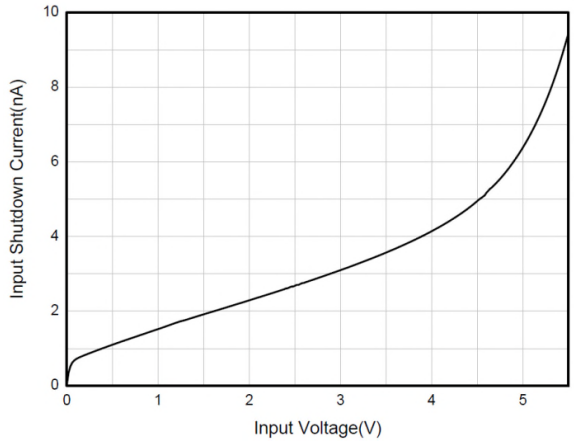
Typical Operating Characteristics



V_{IN} = V_{BIAS}, V_{ON} = 5 V, V_{OUT} = 0 V
Figure-2. BIAS supply current vs. BIAS voltage



V_{IN} = V_{BIAS}, V_{ON} = 0 V, V_{OUT} = 0 V
Figure-3. BIAS shutdown current vs. BIAS voltage



V_{BIAS} = 5.5 V, V_{ON} = 0 V, V_{OUT} = 0 V
Figure-4. Input shutdown current vs. Input voltage

Typical Operating Characteristics (Continue)

Condition : R_L = 10 Ω, C_L = 0.1 μF, C_{IN} = 1 μF, C_T = 1 nF, V_{BIAS} = V_{IN} = 5 V

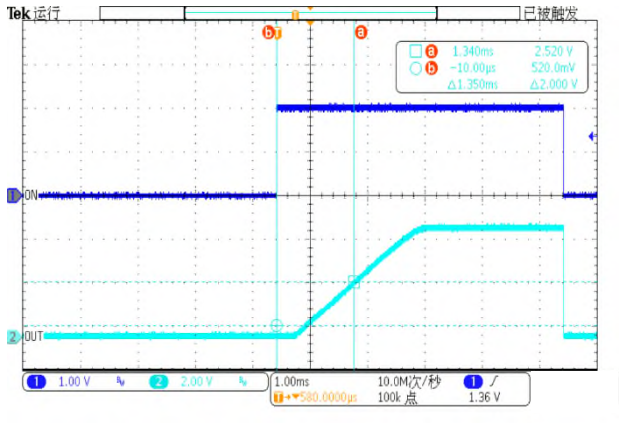


Figure-5. Turn on response time

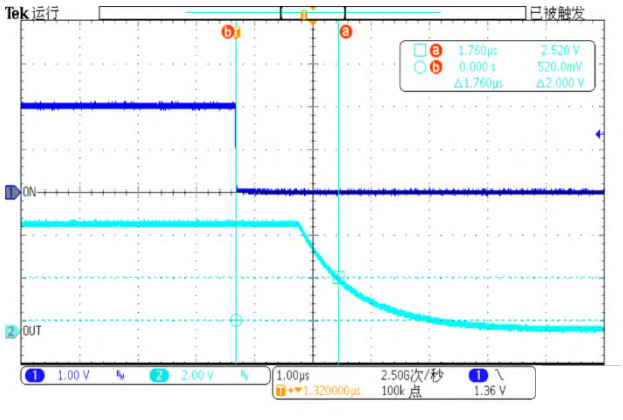


Figure-6. Turn off response time

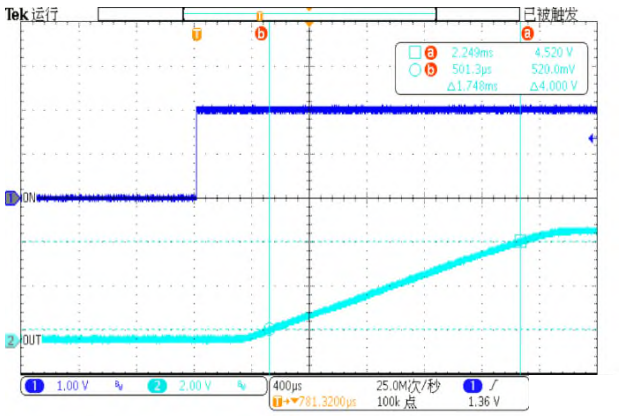


Figure-7. Rise time vs. Input voltage

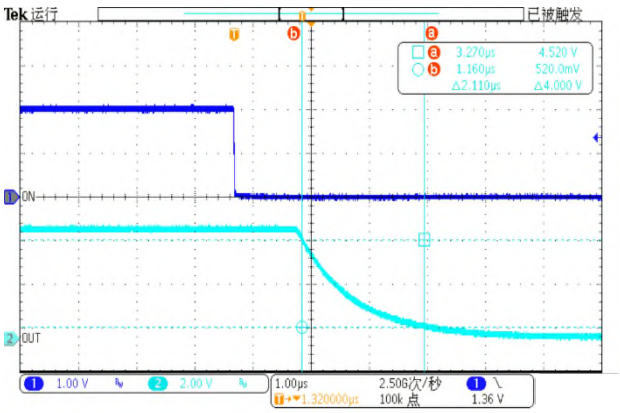


Figure-8. Fall time vs. Input voltage

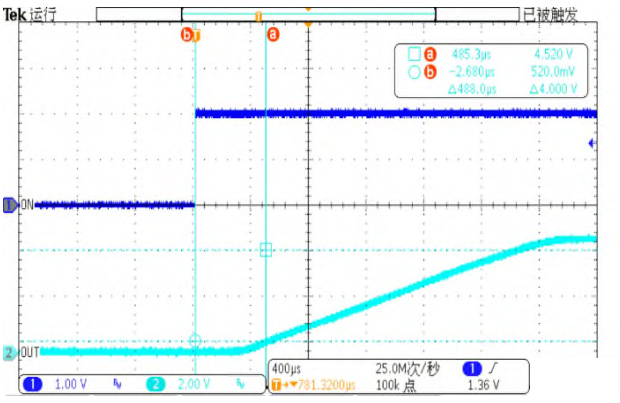


Figure-9. Delay time vs. Input voltage

Typical Operating Characteristics (Continue)

Condition : R_L = 10 Ω, C_L = 0.1 μF, C_{IN} = 1 μF, C_T = 1 nF, V_{BIAS} = 2.5 V, V_{IN} = 0.6 V

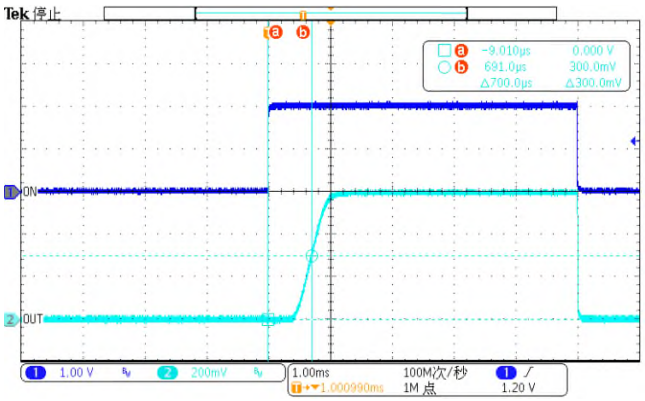


Figure-10. Turn on response time

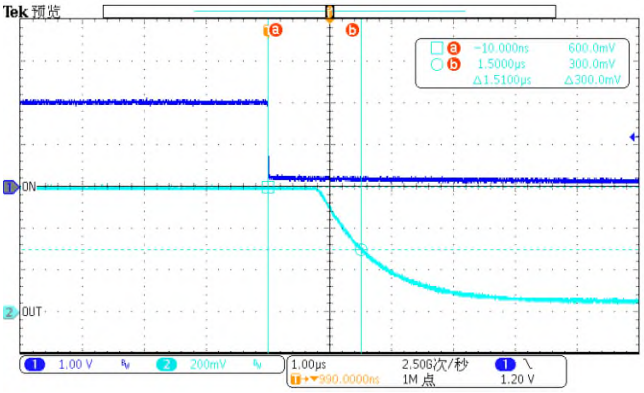


Figure-11. Turn off response time

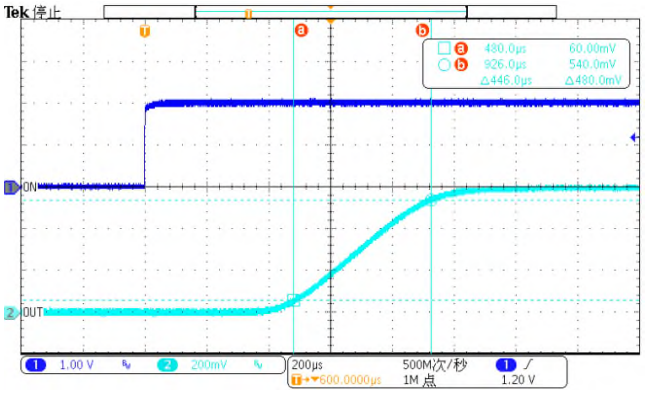


Figure-12. Rise time vs. Input voltage

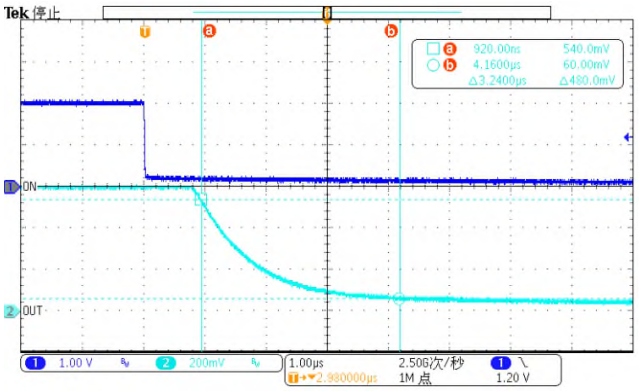


Figure-13. Fall time vs. Input voltage

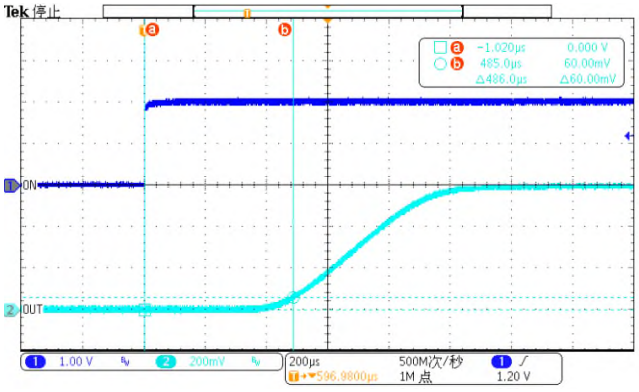


Figure-14. Delay time vs. Input voltage

BLOCK DIAGRAM

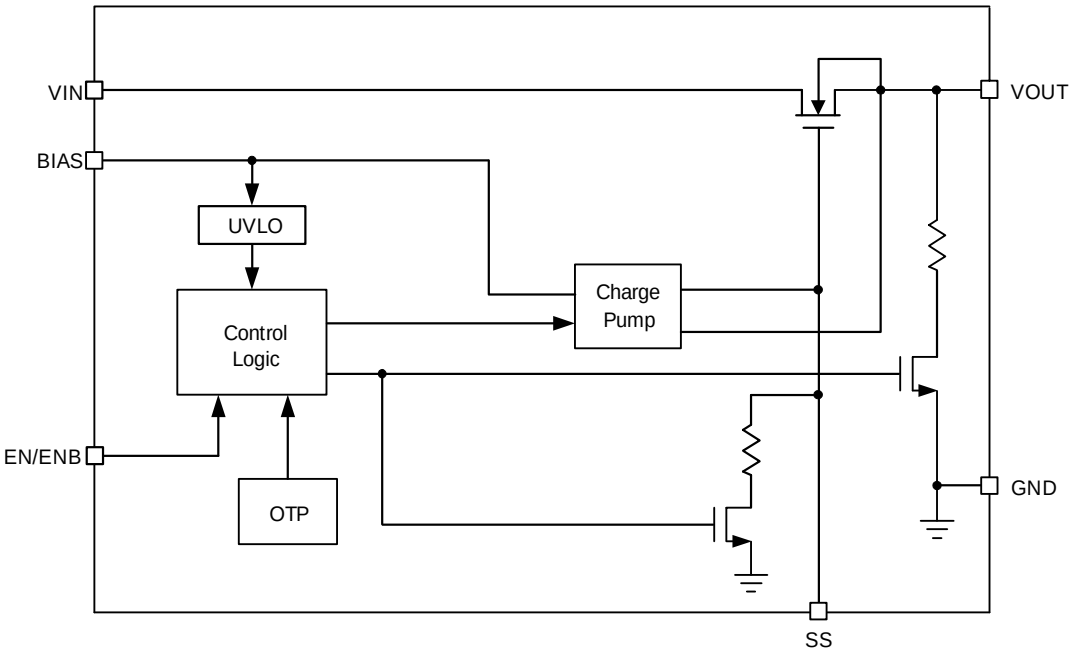


Figure-05. Block diagram

APPLICATION SCHEMATIC

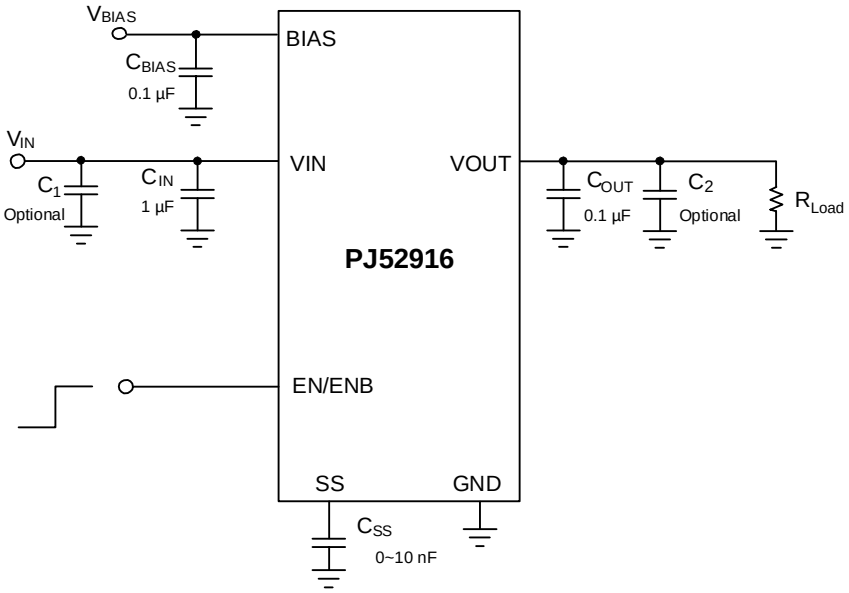


Figure-16. Typical application

FEATURE DESCRIPTION

BIAS Under-voltage Lockout (UVLO)

Wrong logic controls are prevented by an under-voltage lockout (UVLO) circuit which monitors the BIAS pin's voltage. During powering on, the UVLO function initiates a soft-start process after the BIAS supply voltages exceed the rising UVLO voltage threshold.

Soft-start

An adjustable soft-start circuitry is provided by the family of PJ52916 to control the rising rate of the output voltage and limit the current surge during start-up. A capacitor connected from the SS pin to the ground controls the soft-start duration.

Precise Enable Control

Pulling the ENB pin above 1 V or the EN pin below 0.4 V will deactivate the device, while pulling the EN pin above 1 V or the ENB pin below 0.4 V will enable the device. It is not possible to let the EN/ENB pins float.

Quick Output Discharge (QOD)

There is a QOD feature included in the family of PJ52916. An internal discharge resistance is connected between VOUT and GND to remove the remaining charge from the output when the switch is disabled. This resistance has a typical value of 100 Ω and prevents the output from floating while the switch is disabled. It is recommended that the device gets disabled before VBIAS falls below the minimum recommended voltage.

Over-temperature protection (OTP)

The internal thermal sense circuit turns off the power FET when the junction temperature exceeds 160°C to allow the device to cool down. The internal thermal sense circuit will enable the device when the device's junction temperature cools by 25°C, resulting in a pulsed output during continuous thermal protection. For normal operation, the junction temperature cannot exceed TJ = 135°C, and thermal protection is designed to protect the IC in the event of over temperature conditions.

Soft-Start Time

C_{SS}(nF)	Soft-start time (µs) 10% to 90%, V_{BIAS} = 5 V, C_L = 0.1 µF, C_{IN} = 1 µF, R_L = 10 Ω, Typical values are at T_A = 25°C.							
	V_{IN} = 5 V	V_{IN} = 3.3 V	V_{IN} = 1.8 V	V_{IN} = 1.5 V	V_{IN} = 1.2 V	V_{IN} = 1.05 V	V_{IN} = 0.8 V	V_{IN} = 0.6 V
0	220	170	130	110	95	85	70	65
1	1800	1200	680	570	460	410	320	260
10	16000	10500	5500	4550	3650	3200	2560	2350

APPLICATION INFORMATION

Power Sequencing

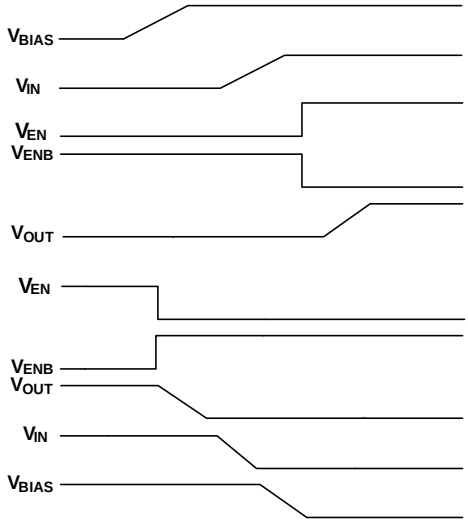


Figure-17. Power sequencing diagram

The internal parasitic diodes of the power switch connected from V_{OUT} to V_{IN} will be forward biased while IC is in the UVLO state. The internal parasitic diodes connected from V_{OUT} to V_{BIAS} will be forward biased if V_{OUT} is higher than V_{BIAS}, and V_{BIAS} must be higher than the voltage of any other input pin.

Timing Chart

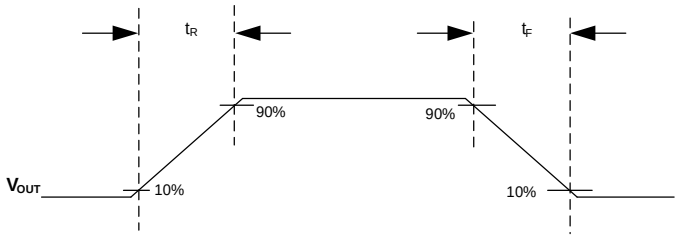


Figure-18. t_R/t_F wave forms

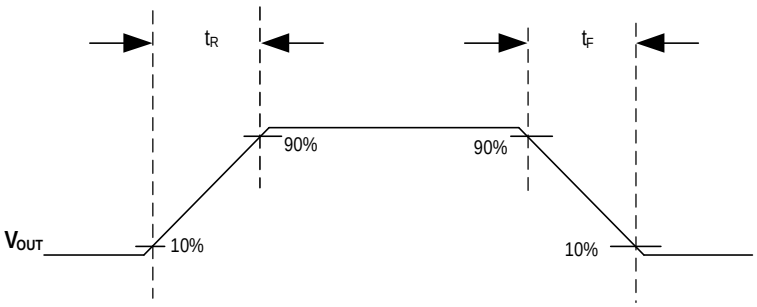


Figure-19. t_{ON}/t_{OFF} wave forms

Soft Start Capacitor

A capacitor that is connected from the SS pin to the ground and used to control the soft-start period might lessen output voltage overshoot and inrush current.

Capacitor Selection

Proper input capacitors are necessary for the family of PJ52916 to supply current surge during stepping load transients to prevent the input voltage rail from dropping. More input capacitance is required for higher parasitic inductance in order to reduce the slew rate of the surge currents coming from voltage sources or other bulk capacitors to the VIN pin.

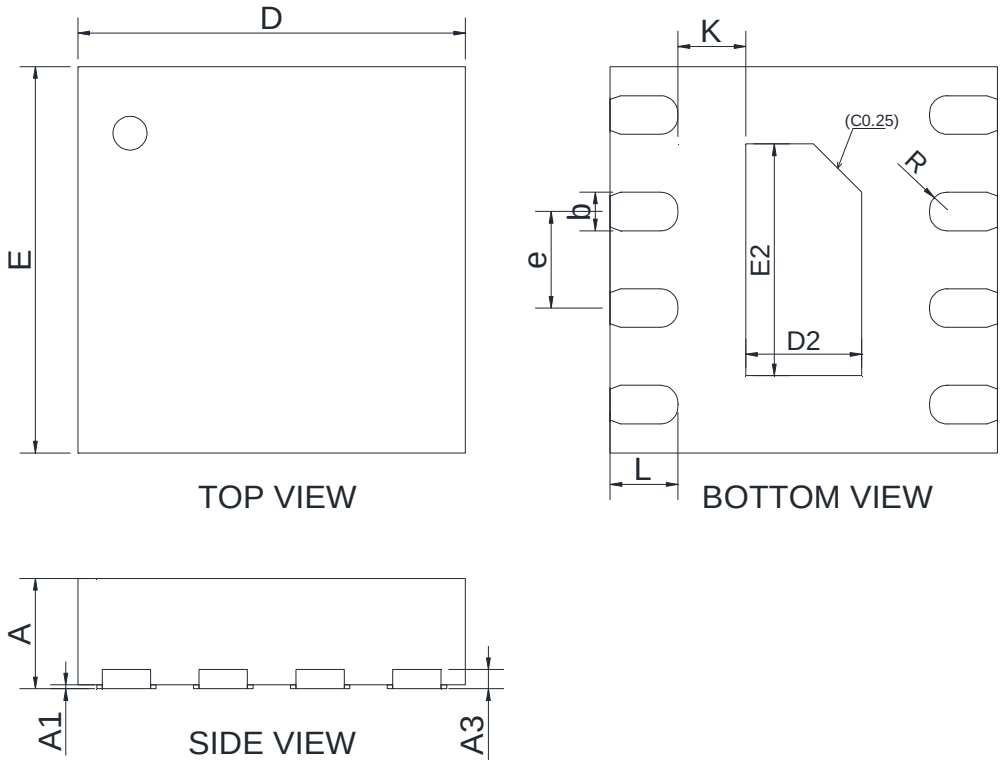
Input capacitance of 1 µF is advised for VIN in all applications except OTP or output short circuits. To prevent voltage overshoot from exceeding the device's absolute maximum voltage during load transient situations, more input capacitance may be required.

It is advised that VOUT's output capacitance be no less than 0.1 µF. Please put the capacitors as close to the PJ52916 as possible. To sustain load transient current, it is advised to place a bulk output capacitor close to the load.

PCB Layout Guidelines

In order to reduce EMI and increase heat dissipation, the PCB layout needs to be properly executed. Locate the PJ52916 and output capacitors close to the load to reduce parasitic resistance and inductance for excellent load transient performance. The input capacitors must be placed as close to the VIN pin as possible, the output decoupling capacitors for the load must be placed as close to the load as possible for decoupling high-frequency ripples.

PACKAGE DIMENSION – DFN2x2-8



Symbol	Dimensions In Millimeters	
	Min	Max
A	0.70	0.80
A1	0.00	0.05
A3	0.20 REF	
b	0.15	0.25
D	1.90	2.10
E	1.90	2.10
D2	0.50	0.70
E2	1.10	1.30
e	0.40	0.60
K	0.20	-
L	0.30	0.40
R	0.09	-

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