

High performance synchronous rectifier power switch

KEY FEATURES

- Integrated 40V synchronous rectifier MOS
- Supports output voltage as low as 3V in CC mode (self-powered)
- Placed on the positive or negative end of the output, without auxiliary winding power supply
- DCM and QR modes are supported
- Precise 0mV voltage off
- Support switching power supply frequency up to 200kHz
- <1mW standby power consumption
- Supports up to 4kVHBM human mode ESD protection

PRODUCT OVERVIEW

The DP40XXD is a high performance synchronous rectification power switch with integrated N-channel power MOS for isolated synchronous rectification applications. Especially suitable for high-efficiency applications in chargers, and compatible with both DCM and QR modes.

DP40XXD adopts the patented self-power supply mode, which can be flexibly placed in the positive or negative output end. When placed in the positive end, no extra auxiliary winding is required.

The DP40XXD uses patented technology in DCM and QR mode to avoid mis-opening the MOS.

The DP40XXD uses precise zero voltage turn-off to greatly improve the turn-on efficiency of the synchronous rectifier.

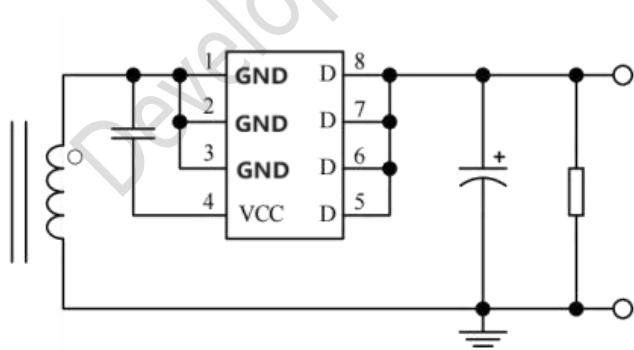
TYPICAL APPLICATION

- Charger or adapter
- Standby power or flyback auxiliary power or switching power

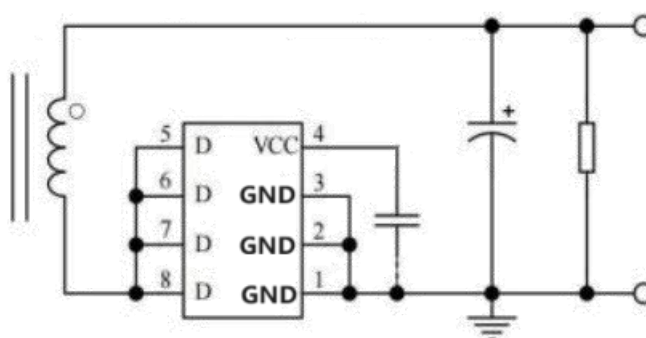
PACKAGING INFORMATION

Product name	Description	MSL level
DP40XXD	SOP8, halogen-free, braided tray pack, 4,000 pills/roll	MSL=3

SCHEMATIC DIAGRAM OF TYPICAL APPLICATION



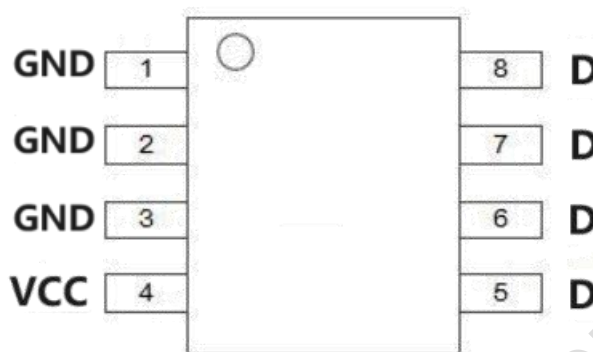
SR is placed on the positive end circuit



SR is placed on the negative end circuit

PRODUCT DESCRIPTION

➤ Pin arrangement



➤ Pin function description

Pin Number	Name	Pin description
1, 2, 3	GND	Chip ground, built-in synchronous rectifier source
4	VCC	Chip power supply
5,6,7,8	D	Built-in synchronous rectifier drain with built-in LDO input

➤ Product markings



DP40XXD is the product name:

XXXXXX the first X represents the last digit of the year, e.g. 2014 is 4; The second X represents the month, which is represented by 12 letters A-L; The third and fourth X represent the day, 01-31; And the last two X's represent the wafer lot number tracking code.

➤ Typical power meter

Product model number	85-265VAC
	Adapters
DP4008D	17W
DP4020D	11W
DP4025D	10W

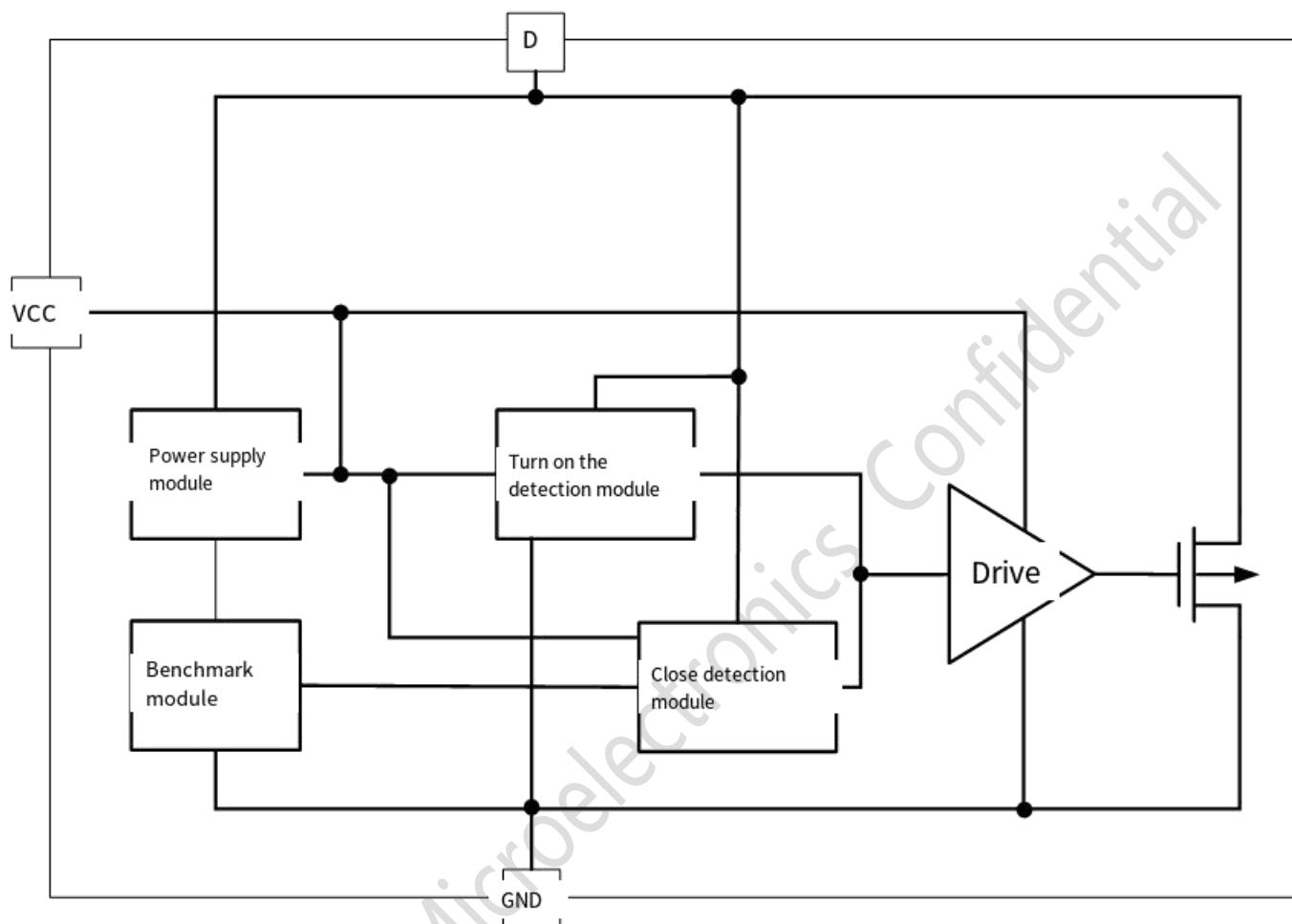
➤ ESD performance

ESD parameters	Numerical values	Units
Mannequin (HBM) with all pins tested according to ANSI/ESDA/JEDEC JS-001 test standard	4000	V
Component Charging Model (CDM), with all pins tested according to JEDEC and JESD22-C101 standards	1750	V

(1) According to the requirements of the JEDEC JEP155 standard, the ESD level of the human model (HBM) required for standard safe production is 500V

(2) According to the requirements of the JEDEC JEP157 standard, the ESD level of the component charging model (CDM) required by the standard safety production is 250V electrical parameters (unless specifically specified, $T_{amp}=25^{\circ}\text{C}$)

INTERNAL FUNCTIONAL BLOCK DIAGRAM



ELECTRICAL PARAMETERS

Parameters	Symbols	Conditions	Min	Typ	Max	Units
Synchronous rectifier power tube						
On-resistor	R_{dson}	DP4025D (VGS=10V, ID=1A)		20	30	mΩ
		DP4020D (VGS=10V, ID=6A)		15.5	19.5	mΩ
		DP4008D (VGS=10V, ID=20A)		5.8	7.3	mΩ
Breakdown voltage	$V_{DSS(BR)}$		40			V
Power supply voltage						
Starting voltage	V_{CC_ON}		3.1	3.3	3.5	V
Undervoltage protection threshold	V_{CC_OFF}		2.8	3	3.2	V
Undervoltage protection hysteresis	V_{CC_HYST}		0.2	0.3	0.4	V
Regulating voltage	V_{CC_REG}			5		V
Working current	I_{CC}	VCC=5V,Fsw=100KHz,	1.8	2.3	2.8	mA
		VCC=5V,Fsw=1KHz	0.1	0.15	0.2	mA
Static current	$I_{q(VCC)}$	VCC=5V,Fsw=0Hz		70	110	μA
Overvoltage protection voltage	V_{CC_dis}			6.3	6.5	V
Overvoltage protection discharge current	I_{VCC_dis}			30		mA
Control part						
Opening threshold	V_{ON_th}			-80		mV
Turn off the threshold	V_{OFF_th}			0		mV
Opening delay	T_{D_on}			20		ns
Turn-off delay	T_{D_off}			20		ns
Enable the blanking time	T_{B_ON}	NF CLOAD = 2.2		1.3		μs
Drive section						
Drive output low	V_{G_LOW}		0		0.2	V
Drive output high	V_{G_HIGH}				5.5	V

PRODUCT APPLICATION INFORMATION

The DP40XXD is a high-performance synchronous rectifier switch used to replace flyback secondary side Schottky diode rectification, with a built-in low-on-impedance power tube to improve system efficiency. Self-powered with patented technology, it can be flexibly and adaptively placed on the positive or negative side of the output. When it is placed at the positive end of the output, no extra auxiliary winding is required.

● VCC power supply

The DP40XXD uses self-powered, by supplying power from the D pin to the LDO inside.

● Synchronize the rectifier turn-on phase

DP40XXD uses patented technology to decide whether to turn on the built-in power MOSFET, can judge whether the Vds through the opening threshold is caused by the shock generated by DCM, to avoid the wrong opening of the power tube. The turn-on delay of 20ns and the turn-on threshold of -80mV also reduce the MOSFET's body diode turn-on time and improve efficiency.

In the opening detection stage, after the primary MOS is turned off, the secondary winding begins to degauss. Before the secondary MOS is turned on, the output depends on the body diode of the secondary MOS to turn on, and the VDS voltage drops. When the VDS voltage drops to -80mV, the secondary power MOS is turned on, and the opening delay is 20nS.

● BLANKINGTIME (turning on)

After the synchronous rectifier is turned on, the DP40XXD uses the internal ~1.3us blankingtime to avoid false shutdown caused by oscillation on the Vds after the synchronous rectifier is turned on. After the rectifier tube is opened, the internal time is 1.3us, and the secondary MOS is forced to perform the shutdown detection after 1.3us, so as to avoid the oscillation caused by the MOS conduction, so as to avoid false shutdown.

● Power tube turn-off stage

When the Vg voltage of synchronous rectification is raised, the on-resistance of the internal power tube MOS will become small. The gradual decrease of Isd

current of synchronous rectification will cause the Vds voltage to rise gradually close to 0V. Finally, when the Vds voltage reaches $V_{OFF_th}=0V$, DP will turn off the internal synchronous rectifier tube.

Our turn-off detection is achieved by comparing the VDS voltage with the $V_{OFF_th}=0V$ voltage. To achieve an accurate 0V off, we use the offset elimination technology to achieve an accurate 0V off.

● Typical Application

As shown in Figure 1, the DP40XXD can be placed on the positive end of the output to replace the Schottky diode, and no extra auxiliary winding is required. In this case, the VCC is powered by the D pin and adjusted to about 5.4V. In CC mode, the output voltage Vout is lower than 5V or in the case of a short circuit, the VCC will still be maintained at around 5.4V.

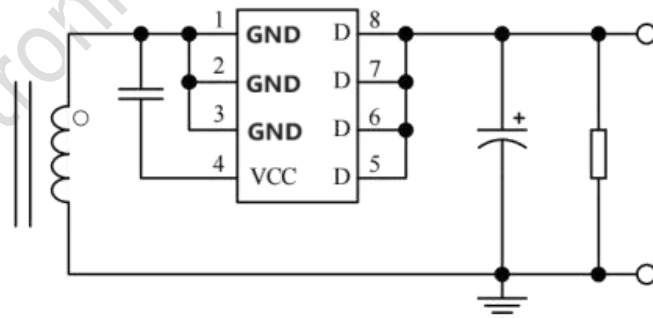


Figure 1 SR placed at the positive end circuit diagram

DP40XXD supports self-powered placement on the output negative end

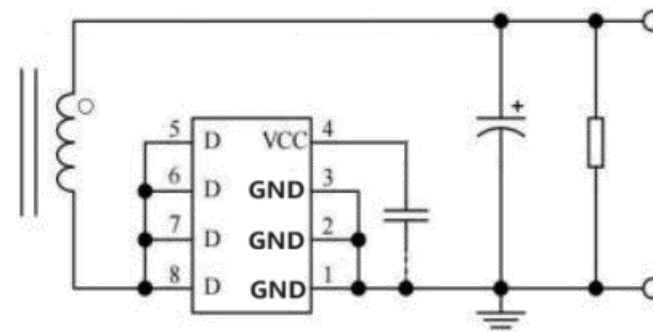
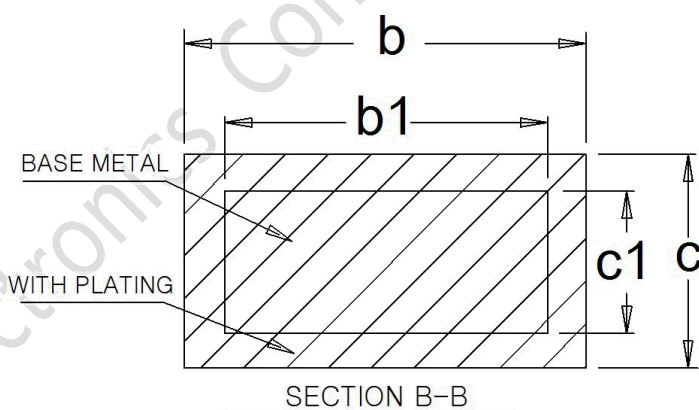
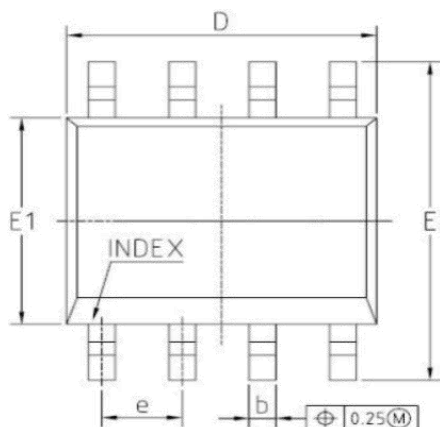
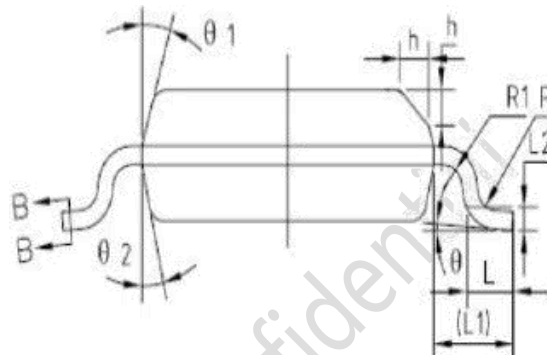
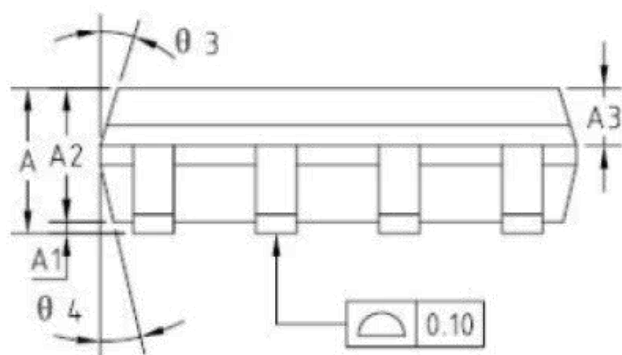


Figure 2 SR placed at the negative end of the circuit diagram

PACKAGE DIMENSIONS

SOP8



Symbol	Dimensions in Millimeters		
	Min	Nom	Max
A	1.45	1.55	1.65
A1	0.10	0.15	0.20
A2	1.353	1.40	1.453
A3	0.55	0.60	0.65
b	0.38	-	0.51
b1	0.37	0.42	0.47
c	0.17	-	0.25
c1	0.17	0.20	0.23
D	4.85	4.90	4.95
E	5.85	6.00	6.15
E1	3.85	3.90	3.95
e	1.245	1.27	1.295
L	0.45	0.60	0.75
L1	-	1.050REF	-
L2	-	0.250BSC	-
θ1-θ4	12° REF		
h	0.40REF		
R	0.15° REF		
R1	0.15° REF		

REVISION HISTORY

Editions	Revised Date	Redaction person	Revised content
REV1.0	2023.5.29	AE	First release
REV1.1	2023.9.13	AE	Internal functional block diagram updated
REV1.2	2024.3.8	AE	Function description and parameter update
REV1.3	2024.9.6	AE	Add MSL level

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