

MD1810/11/12/15 Datasheet

High performance primary side regulator (PSR) offline switch power supply (SMPS) controller



PRODUCT DESCRIPTION

MD181X is high performance primary sensing regulator (PSR) and monolithic switch power controller which is designed for small-power supply equipment with current mode control. Built-in accurate CV/CC control circuit, eliminates optocoupler, TL431 and its related loop devices. High integration design, a high performance power BJT and PFM controller and all kinds of protection circuits in one chip, to minimize the peripheral components to save the cost greatly.

MD181X can be simply designed a typical flyback switch converter, the unique driving technology promotes the characteristics of withstand voltage and achieves excellent converting efficiency.

FEATURES

- ◆ Built-in 710V power BJT.
- ◆ PSR control, eliminates optocoupler and TL431
- ◆ Accurate CV/CC control
- ◆ Hysteresis over-temperature protection (OTP) circuit
- ◆ Higher efficiency and meet Level 6 efficiency standards
- ◆ Output voltage protection (OVP/UVP)
- ◆ < 100 mW no-load consumption @264Vac (5* rating)
- ◆ Auto-Restart function
- ◆ Ultra-low start-up current
- ◆ Quasi-resonant operation
- ◆ Line under voltage protection(LUVP)
- ◆ Good EMC characteristic allows the simple EMC circuit

APPLICATIONS

- ◆ Intelligent mobile phone/small size tablet computer
- ◆ Digital cameras and other small digital products
- ◆ Power adapters for network products etc.

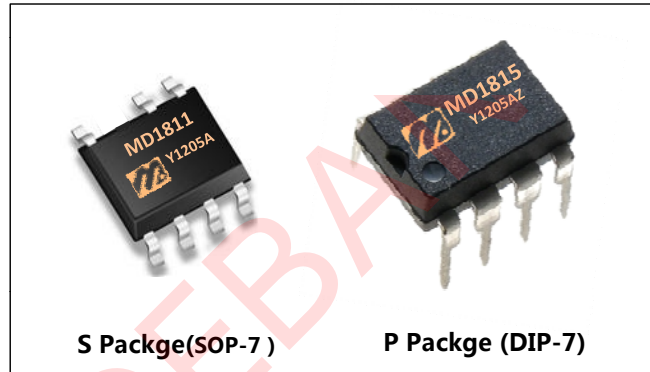


Figure 1 Package diagram

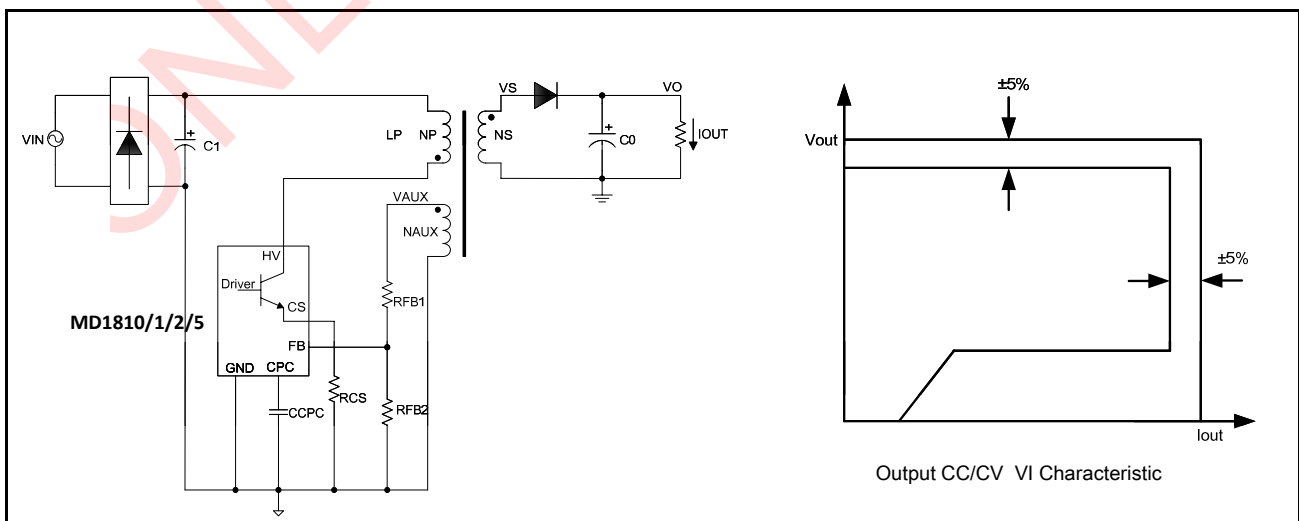
Output Power Table

P/N	Package	90Vac-265Vac	
		Adapter	Open Frame
MD1810	S	5W	6W
MD1811	S	8W	10W
MD1812	S	11W	12W
MD1815	P	15W	18W

Notes:

1. Continuous maximum output power is tested in typical non-ventilated closed adapter measured at environment temperature + 40 °C.
 2. The biggest actual continuous output power is tested in the condition of that peripheral circuit is designed properly and enough space for heat dissipation.
- ◆ Package: S: SOP - 7; P: DIP-8

APPLICATION DIAGRAM



MD1810/11/12/15 Datasheet

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PINOUT CONFIGURATION

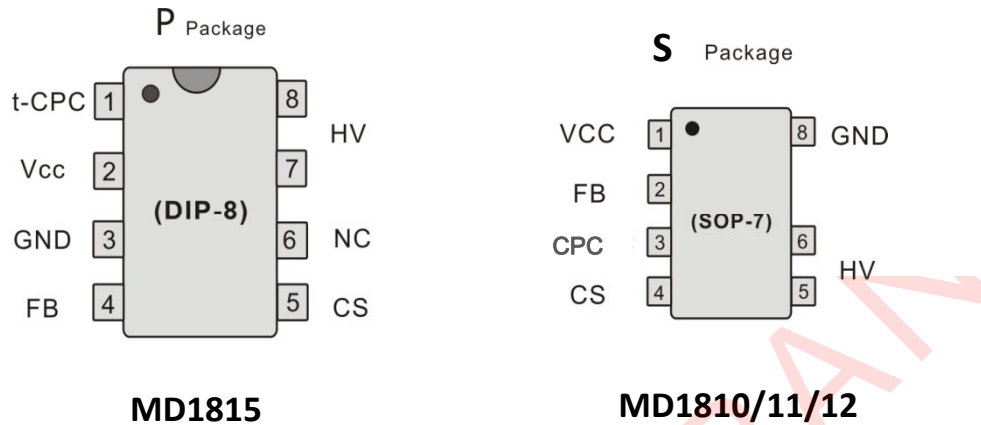


Figure 2. Pin Configuration of MD1810/11/12/15 (Top view)

PIN Function Description

Pin #	Name	Function Description
5, 4	CS	Connect external primary current sensing resistor RCS, the controller can detect the primary current through the external sense resistor. When the voltage on the resistor achieves the maximum value, the internal power BJT will be turned off immediately.
1, 3	CPC	To connect with a 100+nF capacitor, the pin will become output cable drop compensation pin.
2, 1	VCC	Power supplying pin of the controller, In order to let the controller gain more stable supply voltage, the external filter capacitor must use low equivalent impedance (Low ESR) of the electrolytic capacitor.
4, 2	FB	Output feedback pin, to detect the output condition through the auxiliary winding voltage of the transformer.
7-8, 5-6	HV	To connect the collector of internal power BJT
6,-	NC	Not connected (Only for D Package)
3, 8	GND	The referring grounding pin of the controller

MD1810/11/12/15 Datasheet

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FUNCTIONAL BLOCK DIAGRAM

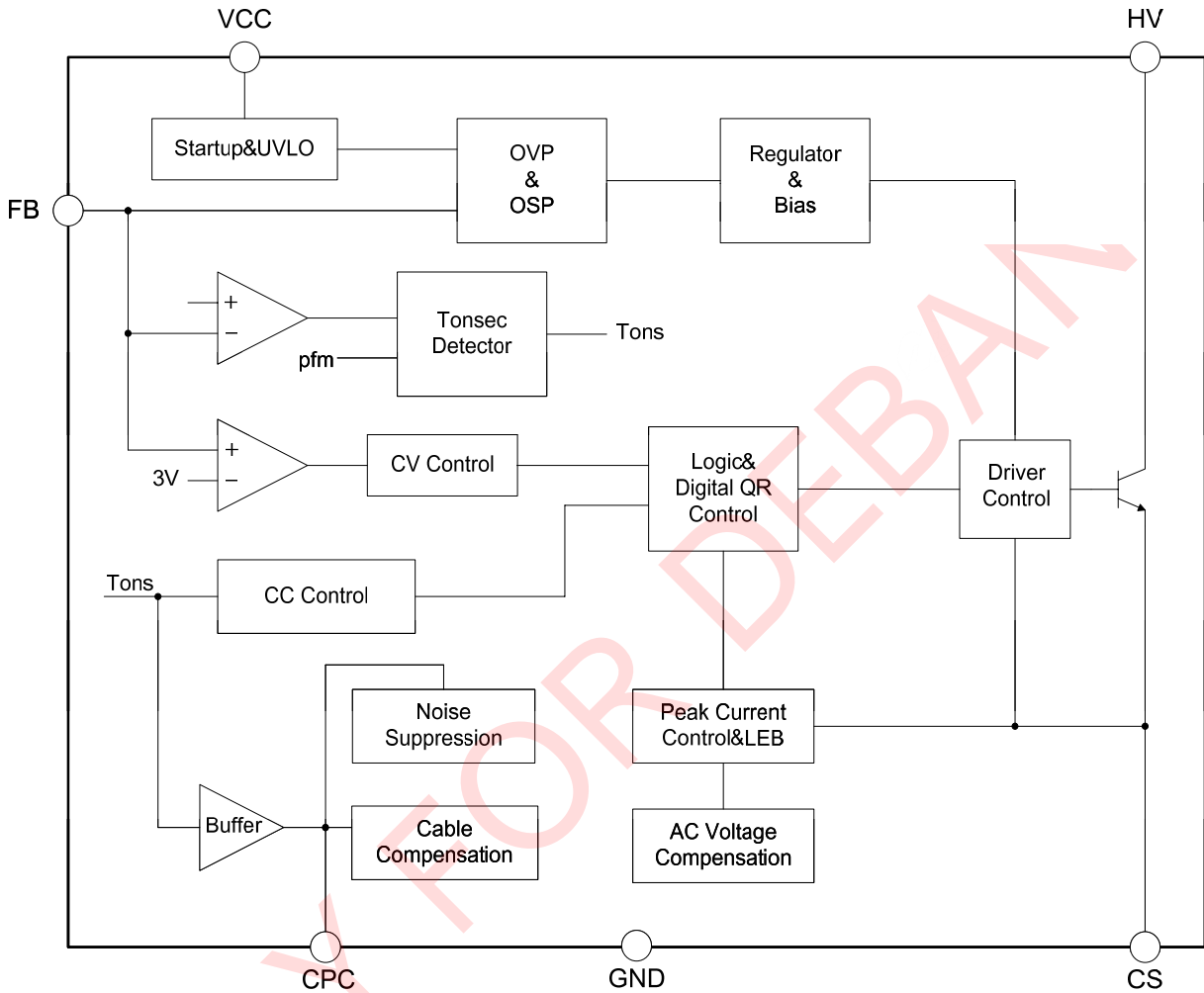


Figure 3. Functional block diagram of MD1810/11/12/15

MD1810/11/12/15 Datasheet

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ABSOLUTE MAXIMUM RATINGS

HV PIN Maximum Voltage		-0.3~700V	Storage Temperature	-55~+150°C
IC Peak Current:	MD1810	600mA	Lead Temperature	+260°C/10S
	MD1811	800mA	ESD(Human Body Model)	2000V
	MD1812	1200mA		
	MD1815	1500mA		
VCC Pin Voltage		9V	Notes: 1.All voltages referred to IC GND (TA=25°C) , 2. Duration not exceed 2 msec. 3.Instant maximum ratings specified will not cause permanent damage to the product, while long maximum ratings specified applied will do and may affect product reliability.	
FB Pin Voltage		7.5V		
Others Pin Voltage		Vcc + 0.3V		
Operating Temperature (Tj)		0~ +150°C		

ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Conditions	Min	Type	Max	Unit
VDD UVLO						
Star-up Voltage	V _{DD-ON}	-	7.5	8.0	8.5	V
Shut down	V _{DD-OFF}	-	3.0	3.3	3.5	
Star-up Current	I _{Star}	-	-	0.2	1	uA
Operating Current	I _{DD}	Static current	-	400	500	
Max. Operating Voltage	V _{DD-MAX}	-	-	-	8.2V	V
CURRENT SENSE SECTION						
FB Reference Voltage	I _{CS}	-	3.4	4	5	uA
Current Sense Threshold Voltage	V _{CS}				500	mV
Leading Edge Blanking	T _{LEB}	I _c = 1mA		500	-	nS
FEEDBACK INPUT SECTION						
FB Reference Voltage	V _{REF-FB}		2.85	2.9	2.95	V
Input Resistance of FB Pin	R _{FB}		1.2	1.5	2	MΩ
Feedback Threshold Voltage	V _{FB-MAX}				5	V
POWER BJT SECTION						
Collector-emitter Saturation Voltage	V _{CE(SAT)}	I _o = 1.0mA			0.3	V
Collector-emitter Voltage	V _{CEO}		450			V
Collector-Base Voltage	V _{CBO}		700			V
OVER TEMPERATURE PROTECTION(OTP)						
Shutdown Temperature	T _{SHDN}		130	135	140	°C

MD1810/11/12/15 Datasheet

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FUNCTION DESCRIPTION

MD181X is specially designed for the charger/adaptor of small power digital products. To use PSR control technology to provide accurate (CV/CC) characteristics. The controller works in PFM mode and the switching frequency can be automatically adjusted as per the load. Optimized driving circuit greatly promotes withstand voltage of the power BJT and minimizes the switching loss, so as to make the circuit have excellent converting efficiency.

CONSTANT VOLTAGE(CV) OPERATION

When the circuit is operates in CV area, FB will detect the output voltage when the power BJT turn-off through the sensing voltage by auxiliary winding of the transformer, to make the output voltage stablized in the fixed value. In the turn-on period of the output rectifier diode D,it's given the output winding voltage and auxiliary winding voltage as follows:

$$V_{AUX} = \frac{N_{AUX}}{N_S} \cdot (V_O + V_d) \dots\dots\dots(5)$$

V_{AUX} : auxiliary winding voltage ; **N_b** : subsidiary winding turns ; **NS**: output winding turns ; **V_d** : forward voltage drop of output rectifier diode

FB will test the auxiliary winding voltage while the power BJT off-time to regulate the output voltage. In order to avoid the peak influence happens in power BJT turn-off resulting from the leakage inductance of the transformer, and considering the accuracy of sampling voltage, FB captures the auxiliary winding detection sampling points as below:

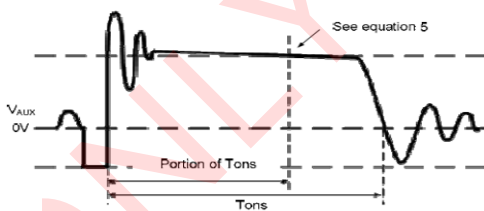


Figure 4.Auxiliary Voltage Wavaform

CONSTANT CURRENT(CC) OPETATION

MD181X CC control circuit is requested the converter oprating in DCM . In CC operation mode , the CC control circuit will fix the proportion between the Tons and Toffs produced by diode rectifier D. When Tons time, the primary energy of the transformer will be converted to the secondary winding, via the rectifier diode then charge the output capacitor and supply load simultaneously.

When Toffs, the primary coil stores the energy, the output filter capacitor makes load discharge. In CC operation area, MD181X switch frequency will follow the output load direct ratio control detected by FB Voltage.

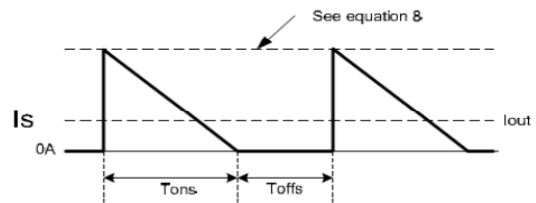


Figure 5. Secondary Current Wavaform

The secondary rectifier diode peak current is determined by the peak current of primary-side inductance which also affects the output current. The corresponding relation between the primary peak current and the secondary peak current is as follows.

$$I_{pks} = \frac{N_P}{N_S} \cdot I_{pk} \dots\dots\dots(8)$$

I_{pk}: primary peak current ; **NP**: primary winding turns ; **NS**: secondary winding turns ; **I_{pks}**:secondary peak current

And primary inductance peak current is determined by Pin 4 to RCS resistance, the primary inductance peak current and RCS resistance are in inverse proportion, so only need to adjust CS resistance to achieve different output currents. Output current Iout and primary current are given by:

$$I_{out} = \frac{1}{2} \cdot I_{pks} \cdot \frac{Tons}{Tons + Toffs} \dots\dots\dots$$

I_{out}: Output current ; **Tons**: secondary rectifier diode on-time ; **Toffs**: secondary rectifier diode off-time

OUTPUT CABLE COMPENSATION

MD181X built-in output cable drop compensation circuit. When it outputs different loads, the cable drop compensation circuit provides cable drop voltage compensation which is in fixed proportion with output voltage. The internal circuit will generate one cable drop compensation signal once have one 100nF capacitor connected with external Pin CPC.

PROTECTIVE FUNCTIONS

In order to guarantee a safe and reliable circuit to all occasions, MD181X built-in rich protection circuits, such as OCP ,OVP, FB open-loop protection etc as intergration. Once abnormality, it will come into protection mode.

MD1810/11/12/15 Datasheet

High performance primary side regulator (PSR) offline switch power supply (SMPS) controller



TYPICAL APPLICATION CIRCUIT

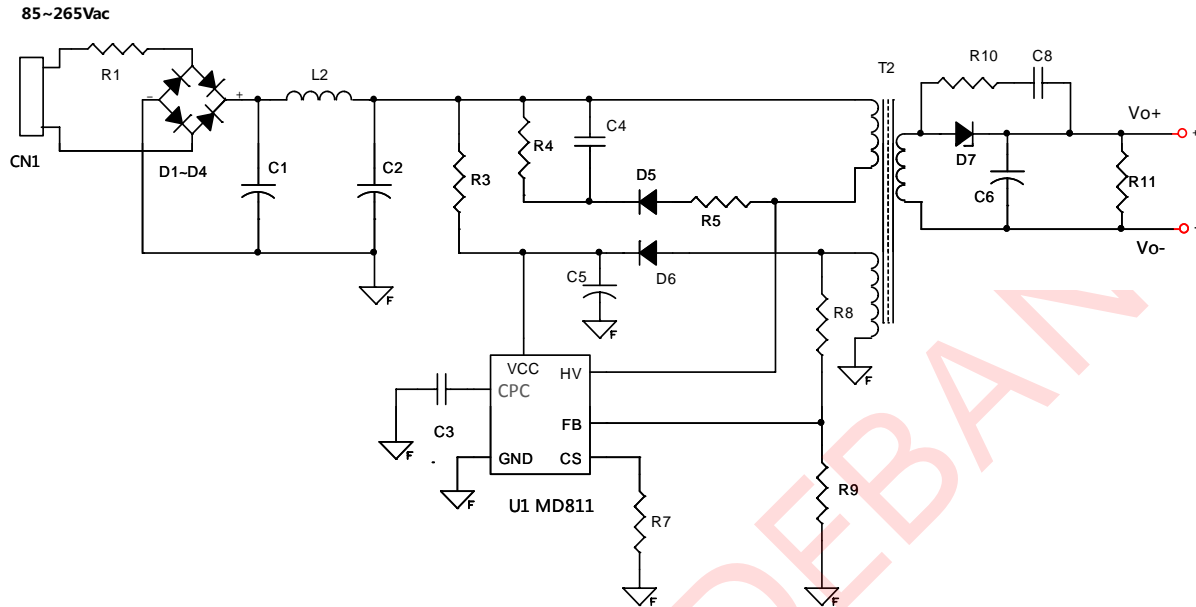


Figure 6. Typical application of MD1810 (Output : 5V1A)

BOM LIST 5V1A Charger With MD1810

Position	Description	Q'ty	Position	Description	Q'ty
D1-D4	1N4007 1A/1KV DO-41	4	R4	330K 1206 ±5%	1
D5	FR 107 1A/1KV DO-41	1	R7	1.3R 1206 ±1%	1
D7	SB340 3A/40V DO-15	1	R5	200R 1206 ±5%	1
C1 , C2	4.7uF/400V ±20% 8*12	2	R8	30K 0805 ±1%	1
C4	102 1KV ±10%	1	R9	22K 0805 ±1%	1
C5	10uF/16V ±20% 5*11	1	R10	2K 0805 ±5%	1
C3	104 25V ±10% SMD	1	R11	202R 0805 ±5%	1
C6	470uF/10V ±20% 6*12 Low ESR	2	L1	1mH 1W Inductor	1
C8	102/100V 0805	1	T1	EE13 5+5 Transformer	1
R1	10R/1W ±5%	1	U1	MD1810SGB-TR SOP-7	1
R3	20M/1W ±5%	1			

MD1810/11/12/15 Datasheet

High performance primary side regulator (PSR) offline switch power supply (SMPS) controller



THERMAL IMPEDANCE

P (DIP-8) Package Impedance(Reference only)

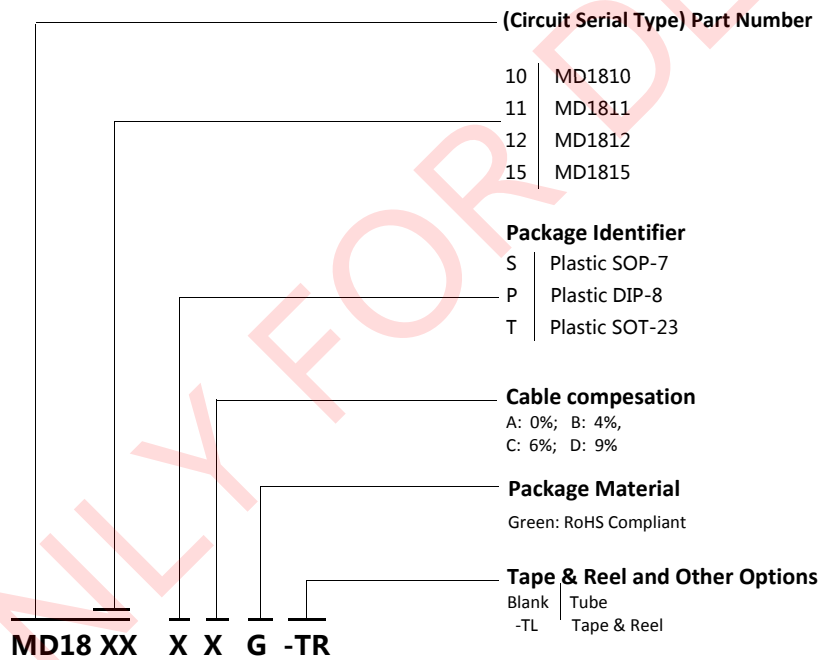
(θ_{JA})1.....70°C/W
 (θ_{JC})2.....11°C/W

S (SOC-7) Package Impedance(Reference only)

(θ_{JA})1.....100°C/W
 (θ_{JC})2.....30°C/W

Notes : 1. Pin7 (5), 8 (6) Soldered to 2 oz. (610 g/m²) copper clad,as large area as possible.
 2. Measured on pin 7,8 (5.6) close to plastic interface (Power BJT Collector)

PART ORDERING INFORMATION



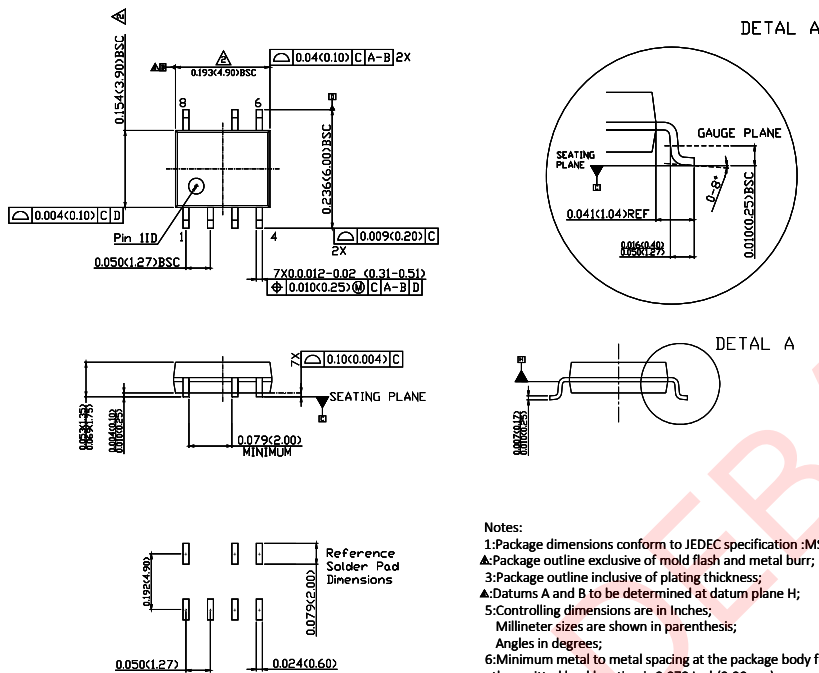
Package	Part Number	Marking ID on Body	Packing Type	Minimum Pack
S(SOP-7)	MD1810SXG-TR	MD1810	Tape & Reel	4000PCS
	MD1811SXG-TR	MD1811	Tape & Reel	4000PCS
	MD1812SXG-TR	MD1812	Tape & Reel	4000PCS
P(DIP-8)	MD1815PXG	MD1815	Tube	2000PCS/box

MD1810/11/12/15 Datasheet

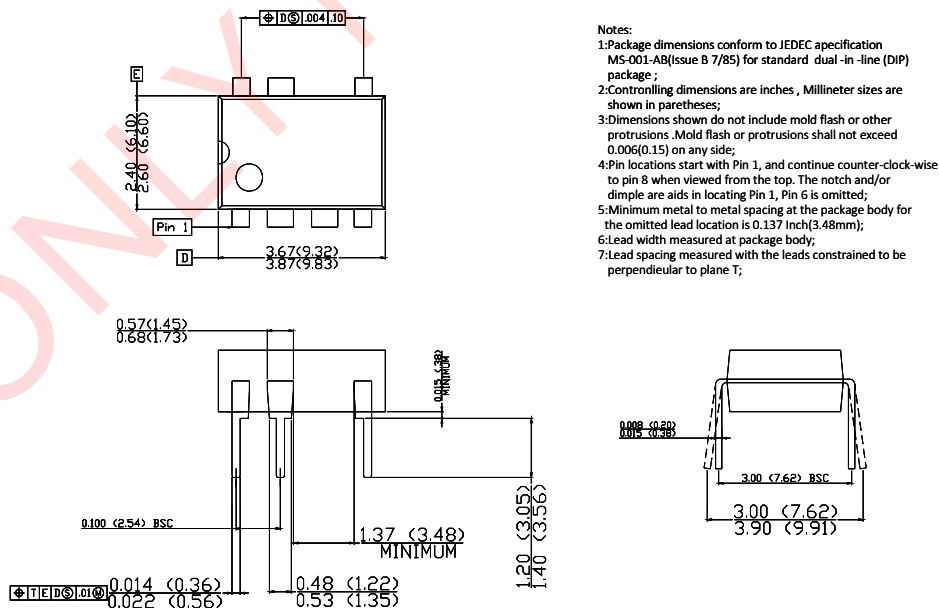
High performance primary side regulator (PSR) offline switch power supply (SMPS) controller



MECHANICAL DIMENSIONS S-SOP-7



MECHANICAL DIMENSIONS P-DIP-7



MD1810/11/12/15 Datasheet

High performance primary side regulator (PSR) offline switch power supply (SMPS) controller



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VERSION INFORMATIONS

Version	Description	Date
Rev.01	New Release	15,Oct,2012
Rev.02	Change the form , add. application informations	1,Jul,2013

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