HM2740/HM2741

High Performance Low Cost Off-line PWM Power Switch

FEATURES

- **Integrated with 650V Power MOSFET and HV Startup Circuit**
- **Multi Mode Control with Audio Noise Free Operation**
- **Supports Buck and Buck-Boost Topologies**
- **Default 12V Output with FB floated**
- **Less than 50mW Standby Power**
- **Green Mode Operation for High Efficiency**
- **Good Line and Load Regulation**
- **Built-in Soft Start**
- **Build in Protections:**
  - **Over Load Protection (OLP)**
  - **Cycle-by-Cycle Current Limiting (OCP)**
  - **Output OVP**
  - **VDD OVP, UVLO & Clamp**
- **Available with SOP-8 Package**

APPLICATIONS

- **Small Home Appliance**
- **Industry Controls**

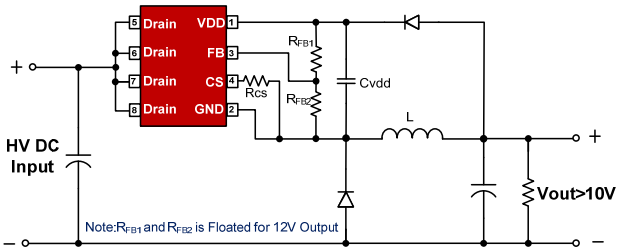
GENERAL DESCRIPTION

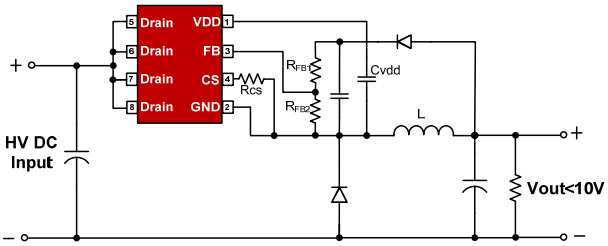
HM274X family is a high performance Switch Mode Power Supply Switcher for low power off-line application with minimum components in typical buck solution. This family has built-in high break down voltage MOSFET to withstand high surge input.

Unlike conventional PWM control, there's no fixed internal clock in HM274X family to trigger the GATE driver, the switching frequency is changed according to the load conditon. The multi mode PWM control is integrated to simplify circuit design and achieve good line and load regulation without audio noise generated. The peak current limit changes according to the real load condition for low standby power in no load.

HM274X integrates functions and protections of Under Voltage Lockout (UVLO), Cycle-by-cycle Current Limiting (OCP), Output OVP, On-chip Thermal Shutdown, Over Load Protection (OLP), VDD OVP with Auto Recovery Mode Protection, etc.

TYPICAL APPLICATION CIRCUIT

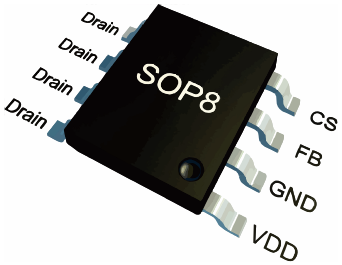




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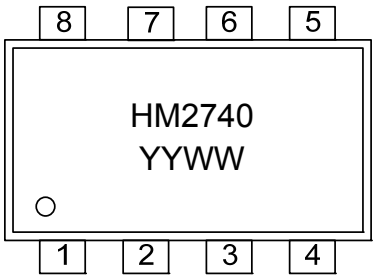
Pin Configuration



SOP-8

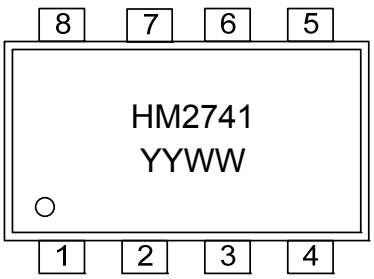
Marking Information

YY: Year
WW: Week, 01-52



SOP-8

YY: Year
WW: Week, 01-52



SOP-8

Output Power Table

Part Number	Package	R_{dson}	Vo	Load Current@85-265Vac
HM2740	SOP-8	10ohm	>2V	200mA<Io<400mA
HM2741	SOP-8	4.5ohm	>2V	350mA<Io<700mA

Note:

1. Default for Buck Converter Application
2. The practical output power is determined by the output voltage and thermal condition

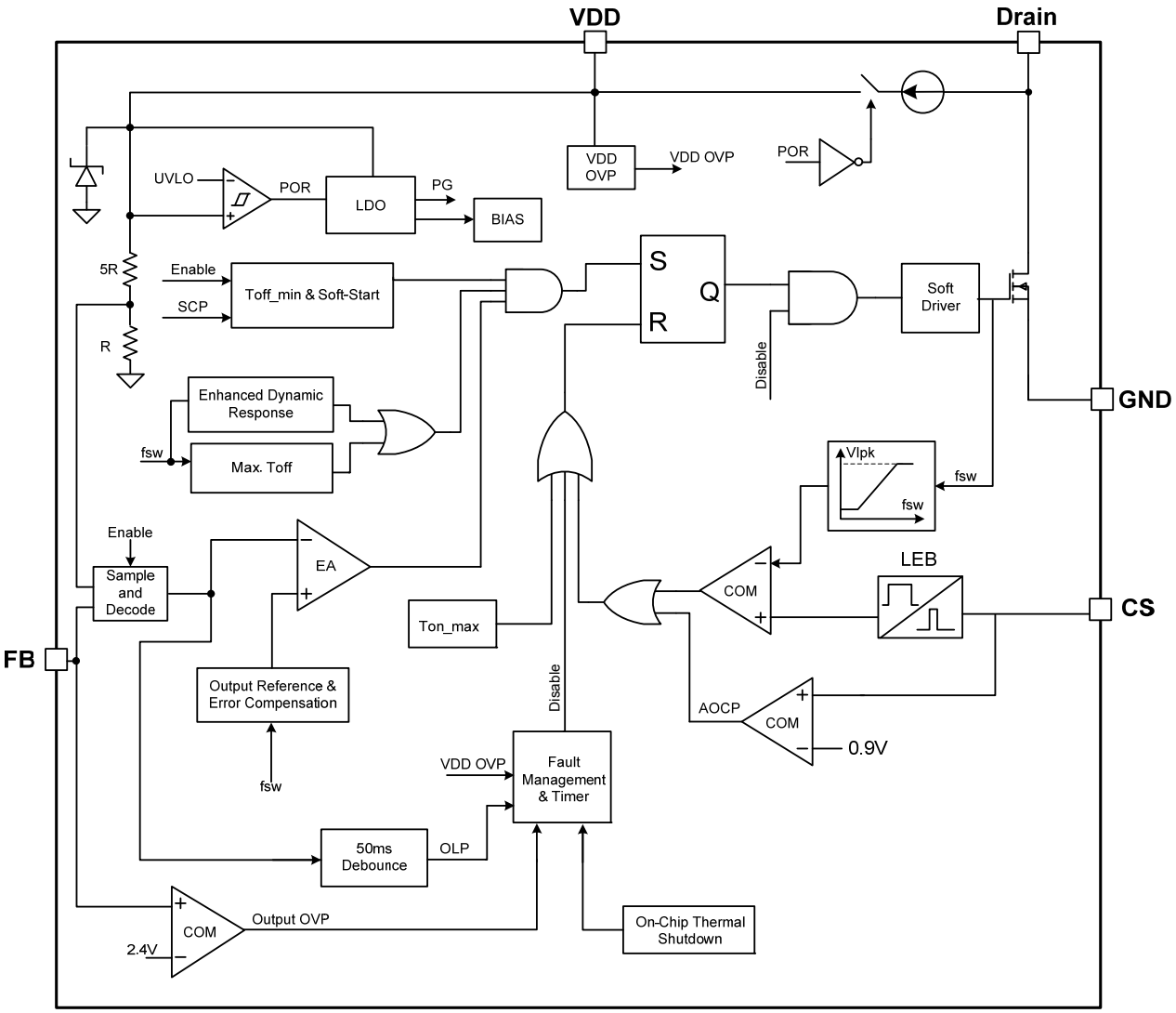
Pin Description

Pin Number	Pin Name	I/O	Description
1	VDD	P	The power supply and the output voltage feedback pin. For the normal operation, a capacitor with 1uF is recommended to connect to this pin
2	GND	P	The ground reference for the IC
3	FB	I	Feedback Input. Left open for default 12V output
4	CS	O	Current Sensing Input
5,6,7,8	Drain	P	The Power MOSFET Drain

Ordering Information

Part Number	Description
HM2740	SOP-8, Halogen free in T&R, 4000Pcs/Reel
HM2741	SOP-8, Halogen free in T&R, 4000Pcs/Reel

Block Diagram



Absolute Maximum Ratings (Note 1)

Parameter	Value	Unit
Drain Pin Voltage Range	-0.3 to 650	V
VDD DC Supply Voltage	30	V
VDD DC Clamp Current	10	mA
FB, RT, CS Voltage Range	-0.3 to 7	V
Package Thermal Resistance ---Junction to Ambient (SOP-8)	165	°C/W
Maximum Junction Temperature	160	°C
Storage Temperature Range	-65 to 150	°C
Lead Temperature (Soldering, 10sec.)	260	°C
ESD Capability, HBM (Human Body Model)	3	kV
ESD Capability, MM (Machine Model)	250	V

Recommended Operation Conditions (Note 2)

Parameter	Value	Unit
Operating Ambient Temperature	-40 to 85	°C
Operation Switching Frequency	40 to 60	kHz

Electrical Characteristics (Ta = 25℃, If Not Otherwise Noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
High Voltage Startup Section (HV Pin)						
I_{HV}	HV Charging Current	Drain=650V, VDD=0V	1	2		mA
$I_{HV_leakage}$	HV Leakage Current	Drain=650V, VDD=12V			10	uA
Supply Voltage Section(VDD Pin)						
V_{DD_ON}	VDD Under Voltage Lockout Exit			7.5		V
V_{DD_OFF}	VDD Under Voltage Lockout Enter			7.0		V
V_{DD_Reg1}	VDD Regulation Voltage	FB is floating	11.8	12	12.2	V
I_{VDD_st}	Start-up Current	No switching		100	300	uA
I_{VDD_Op}	Operation Current	Fsw=60kHz		800		uA
I_{VDD_Q}	Quiescent Current			200		uA
V_{DD_OVP}	VDD OVP Threshold			28		V

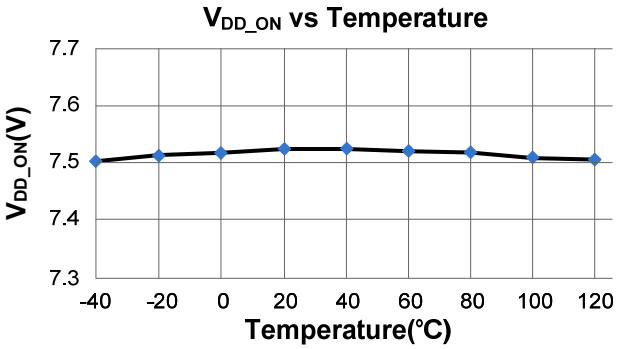
V_{DD_Clamp}	VDD Clamp Votage	IVDD=10mA		30		V
Feedback Section (FB Pin)						
V_{FB_REF}	Internal Error Amplifier (EA) Reference Input		1.97	2.0	2.03	V
V_{FB_OVP}	Output Over Voltage Protection (Output OVP) Threshold			2.4		V
V_{FB_OLP}	Output Over Load Protection (Output OLP) Threshold			1.87		V
T_{D_OLP}	Over Loading Debounce Time			50		ms
Current Sense Input Section (CS Pin)						
T_{LEB}	Leading Edge Blanking Time			350		ns
T_{D_OCP}	Over Current Detection and Control Delay			100		ns
V_{IPK}	Normal Peak Current Limit		0.50	0.55	0.60	V
V_{AOCP}	Abnormal Over Current Protection Threshold			0.9		V
Timer Section						
$T_{OFF_min_norm}$	Normal Minimum OFF time		14.5	16	17.5	us
$T_{OFF_max_nom}$	Nominal Maximum OFF Time			1.4		ms
$T_{OFF_max_FDR}$	Maximum OFF Time in Fast Dynamic Response Mode			420		us
T_{ON_max}	Maximum ON Time			12		us
T_{ss}	Internal Soft Start Time			3		ms
$T_{Auto_Recovery}$	Protection Auto Recovery Debounce Time			500		ms
On-Chip Thermal Shutdown						
T_{SD}	Thermal Shutdown Trigger Point	(Note 3)		150		°C
Power MOSFET Section (Drain Pin)						
V_{BR}	Power MOSFET Drain Source Breakdown Voltage		650			V
R_{dson}	Static Drain-Source On Resistance	HM2740		10		ohm
		HM2741		5		ohm

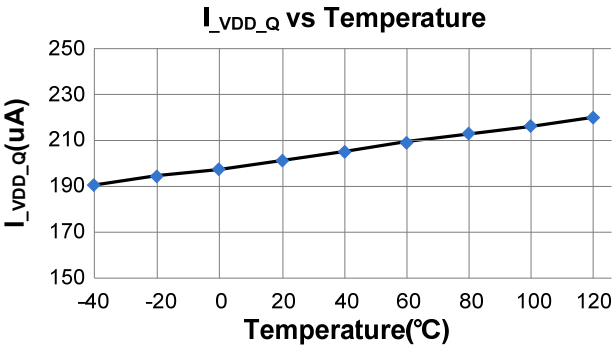
Note1. Stresses listed as the above “Maximum Ratings” may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to maximum rating conditions for extended periods may remain possibility to affect device reliability.

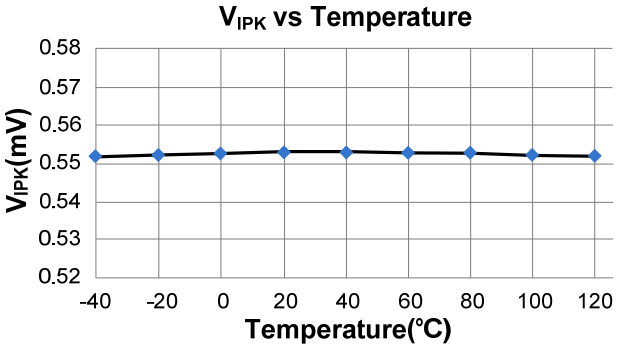
Note2. The device is not guaranteed to function outside its operating conditions.

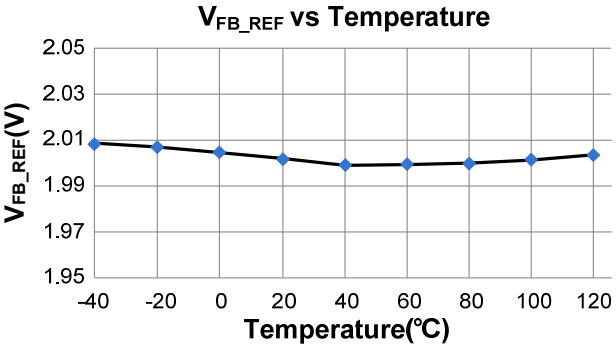
Note3. Guaranteed by design.

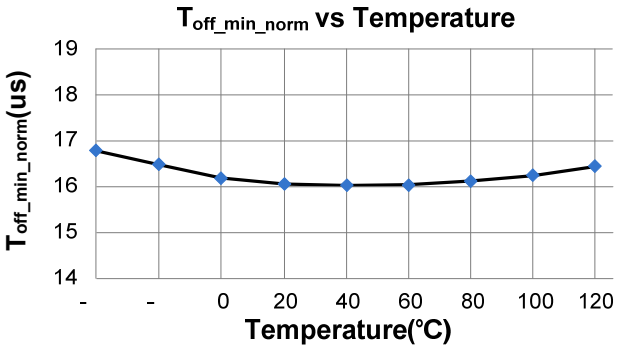
Characterization Plots











Operation Description

HM274X family integrates a high voltage power MOSFET switch and a multi mode PWM controller. It is optimized for off-line non-isolated buck or buck-boost applications in small home appliances and linear regulator replacement. The IC utilizes the multi mode PWM control to regulate output with high precision and lowest components count.

● Very Low Operation Current

The standby operating current in HM274X is as small as 200uA (typical). The small operating current results in higher efficiency and reduces the VCC hold-up capacitance requirement.

● High Voltage Start-Up Operation with Less than 50mW Standby Power

In HM274X, a 650V high voltage startup cell is integrated. During startup, the internal startup circuit is enabled and a HV current source charges the VDD hold up capacitor Cvdd through Drain pin, as shown in “Block Diagram”. When VDD reaches UVLO turn-on voltage (7.5V typical), the IC begins switching and the IC current consumed increased to 0.8mA (typical). The VDD is charged by the output through the feedback diode in steady state, which result in less than 50mW standby power with the combination of high voltage startup cell.

● Current Limit and Leading Edge Blanking

There’s a programmable current limit for current sensing voltage from CS Pin, which is changed according to the system switching frequency. When the sampled voltage exceeds the internal threshold, the power MOSFET is turned off for the remainder of that cycle. An internal leading edge blanking circuit is built in. During this blanking period (300ns, typical), the cycle-by-cycle current limiting comparator is disabled and cannot switch off the GATE driver.

● Multi Mode PWM Control

To meet the tight requirement of averaged system efficiency and no load power consumption, a hybrid of frequency modulation (FM) and amplitude modulation (AM) is adopted in HM274X which is shown in the Fig 1.

Around the full load, the system operates in FM mode. When normal to light load conditions, the IC operates in FM+AM mode to achieve excellent regulation and high efficiency. When the system is near zero loading, the IC operates in FM again for standby power reduction. In this way, the no-load consumption can be less than 50mW.

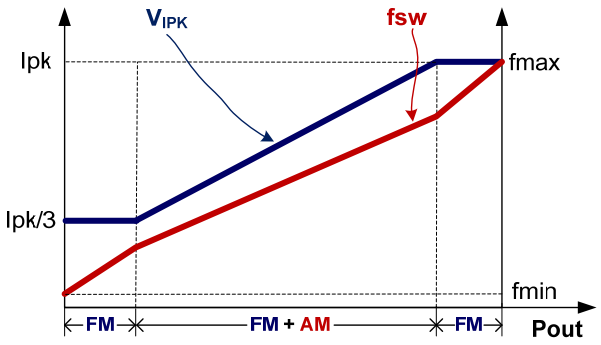


Fig.1

● Soft Start

HM274X features an internal 4ms (typical) soft start that slowly increases the switching frequency during startup sequence. Every restart attempt is followed by the soft start activation.

● Output Over Voltage Protection (OVP)

In HM274X, if the sampled FB voltage is larger than 2.4V and lasts for three continuous PWM cycles, the IC will enter into Output Over Voltage

Protection (Output OVP) mode, in which auto recovery mode will be followed.

- **Over Load Protection (OLP) / Short Load Protection (SLP)**

If over load or short load condition occurs, the output and the feedback voltage drop down to be lower than V_{FB_OLP}. If this fault is present for more than 48ms (typical), the protection will be triggered, the IC will experience an auto-restart mode (as mentioned below).

- **Abnormal Over Cu rrent Protection (AOCP)**

When in heavy load or output short condition, the inductor current may be increased too large. To avoid system components damaged, there's a abnormal over current limit (typically 0.9V) for CS Pin. When the CS voltage is larger than this threshold, the internal power MOSFET is turned off immediately and is to be turned on again after 48us.

- **On Chip Thermal Shutdown**

HM274X integrates thermal shutdown function. When the IC junction temperature is higher than 150 °C, IC shuts down and enters into auto-restart mode (as mentioned below).

- **Enhanced Dynamic Response**

In HM274X, the dynamic response performance is optimized to reduce output drop in load transient.

- **Audio Noise Free Operation**

In HM274X, the optimized combination of frequency modulation and CS peak voltage modulation algorithm can provide audio noise free operation from full loading to zero loading.

- **VDD Over Voltage Protection (OVP) and Zener Clamp**

When VDD voltage higher than V_{DD_OVP}(typically 28V), the IC will stop switching. This will cause VDD fall down to be lower than V_{DD_OFF} (typically 7V) and then the system will restart up again. An internal 30V (typical) zener clamp is integrated to prevent the IC from damage.

- **Protections with Auto-Restart**

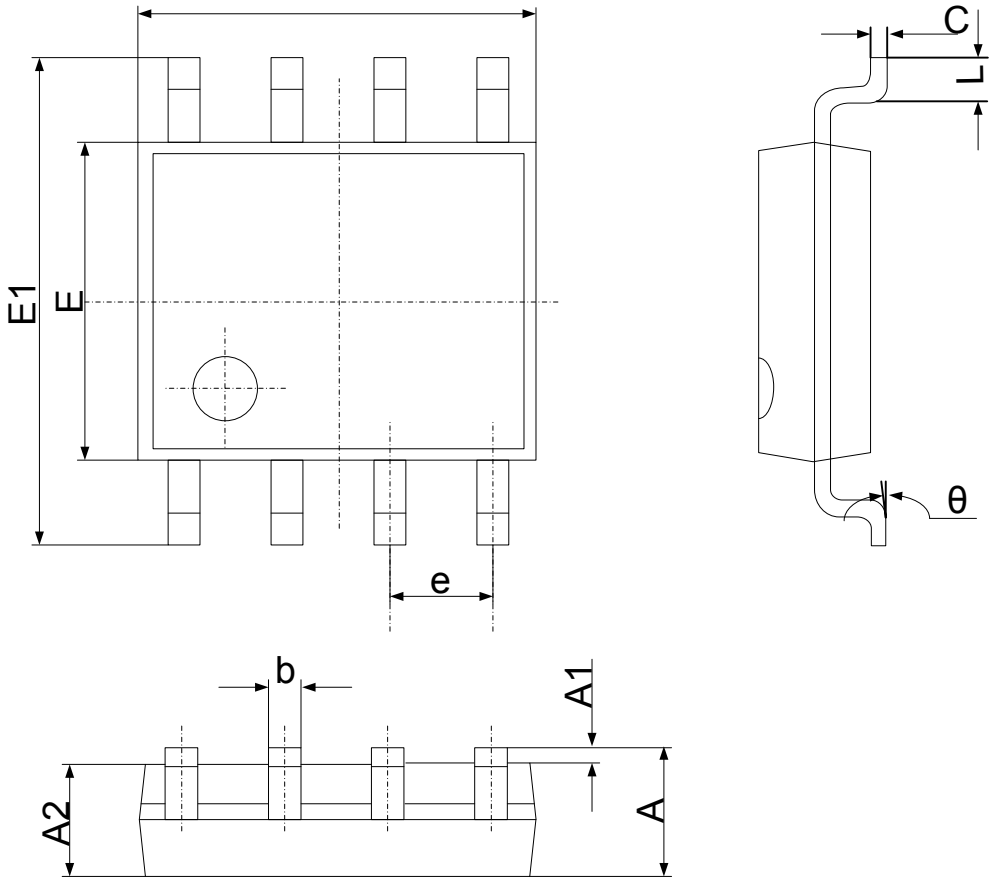
In the event of protections, the IC enters into auto-restart and an internal timer begins counting, wherein the power MOSFET is disabled. When 500ms had been counted, the IC will reset and start up the system again. However, if the fault still exists, the system will experience the above mentioned process.

- **Soft Totem-Pole Gate Driver**

HM274X has a soft totem-pole gate driver with optimized EMI performance.

Package Dimension

SOP-8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Revision History

DATE	REV.	DESCRIPTION
2017/02/08	1.0	First Release
2017/02/16	1.1	Output Voltage Range and SOP-7 Order Information Updated
2017/02/28	1.2	Package is changed to SOP-8