SUPLET®

Technical Specification

DC-DC Converter Non-isolated

DAC10P12P0V59E

3.0Vdc to 13.8Vdc Input；0.59～5.1Vdc/10A Output

RoHS Complaint

Applications

- Distributed Power Architectures
- Wireless Networks
- Access and Optical Network Equipment
- Enterprise Networks
- Latest generation IC's (DSP, FPGA, ASIC) and Microprocessor powered applications

Features

- Compliant to RoHS6 EU Directive 2002/95/EC
- Compliant to Lead free reflow environment
- Delivers up to 10A output current
- High efficiency: up to 91.7% at 5V full load (Vin= 12Vdc)
- Small size and profile: 0.64×0.64×0.13(inch)
- SMT version
- Low output ripple and noise
- Wide operating temperature range
- Adjustable output voltage
- Margin control
- Constant switching frequency
- Exceptional thermal performance
- High reliability: MTBF > 2,000,000h at 25 °C
- Remote On/Off positive logic
- Input undervoltage protection
- Output overcurrent protection
- Short circuit protection
- Meets the voltage and current requirements for ETSI 300-132-2 and complies with and licensed for Basic Insulation rating per IEC60950 3rd edition
- ISO 9001:2000 Certificate HK03/0436
- ISO 14001:2004 Certificate HK06/01652

Description

DAC10P12P0V59E is a non-isolated DC/DC converter that provides a high efficiency single output. It can operate from 3.0Vdc to 13.8Vdc input and 0.59Vdc～5.1Vdc/10A output. The remote control logic is positive. The converter turns off when the REM pin is at logic low (0Vdc～0.2Vdc) and turns on when it is left open or at logic high (that should be ensured above 0.7Vdc). The output voltage is 0.59V when the "TRIM" pin is left open and will increase when an external resistor is connected between "TRIM" and "-Sense". The Power Good indicator output will be logic low when the output voltage in excess of ±10% of the set point. For each set-point of the output voltage, the Margin Control function is available. The output voltage will be adjusted upward when the "Margin" pin is at logic high and downward when it is at logic low. If the "Margin" pin is left open, this function will be disabled.

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only, functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect the device reliability.

Parameter	Units	Specifications		Notes & conditions
		Min.	Max.	
Input Voltage	Vdc	-0.3	13.8	Continuous
		-0.3	13.8	Transient（100ms）
Operating Ambient Temperature	℃	-40	85	Ambient Temperature
Storage Temperature	℃	-40	125	
Solder Temperature	℃	-	260	<10S
Humidity	RH(%)	0	80	

Electrical Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions.

Input Characteristics

Parameter		Units	Specifications			Notes & conditions
			Min.	Typ.	Max.	
Operating Input Voltage	Vo≤2.5V	Vdc	3.0	-	13.8	Add a 25V/22uF Tantalum external capacitor at input when Vin≥ 9V,dv/dt≤100mv/ms
	V_O=3.3V		4.3		13.8	
	V_O=5.0V		6.0	-	13.8	
Maximum Input Current		A	-	-	10	
Input No load Current		mA	-	100	-	Vin=Vin(min) to Vin(max),Iout=0A,
Input Reflected Ripple Current (Peak-to-Peak)		%	-	0.5	-	
Inrush Transient		A^2S	-	0.01	-	

Remote Control Characteristics

Parameter	Units	Specifications			Notes & conditions
		Min.	Typ.	Max.	
Turn on voltage	Vdc	0.7	-	Vin	Vin≤5V
				5	Vin＞5V
Turn off voltage	Vdc	0	-	0.2	

Output Characteristics

Parameter		Units	Specifications			Notes & conditions
			Min.	Typ.	Max.	
Output Voltage		Vdc	0.59	0.6/0.9/1.2/ 1.5/1.8/2.5/ 3.3/5.0	5.1	Io=0 to Io(max)
Output Current		A	-	-	10	25℃,Forced air cooling
Line Regulation		%Vo	-	0.2	-	Vin=Vin(min) to Vin(max),Io=Io(nom)
Load Regulation		%Vo	-	0.5	-	Vin=Vin(nom),Io=0 to Io(max)，25℃
Output Voltage Accuracy		%Vo	-	-	1	Vin=Vin(min) to Vin(max),Io=0 to Io(max)
Output Current Limit Inception		A	-	20	-	
Temperature Coefficient		ppm	-	200	-	Ambient Temperature,-40℃～70℃
External Capacitive Load	V_O=0.6V, 0.9V	µF	10	-	7500	Vin=12V
	V_O=1.2V		10	-	6000	
	V_O=1.5V		10	-	4500	
	V_O=1.8V		10	-	3000	
	V_O=2.5V		10	-	2400	
	V_O=3.3V, 5.0V		10	-	1200	
Ripple and Noise	V_O=0.6V	mV	-	20	-	Measured with a 10uF ceramic external capacitor; 20MHz
	V_O=0.9V		-	30	-	
	V_O=1.2V		-	30	-	
	V_O=1.8V		-	35	-	
	V_O=2.5V		-	40	-	
	V_O=5.0V		-	45	-	
Dynamic Response	V_O=0.6V	mV/µS	-	90/8	-	50%~100%Io(nom), di/dt=2.5A/µS. measured with 25V/22uF Tantalum, 10uF ceramic external capacitor
	Vin=12V, V_O=0.9V		-	90/8	-	
	V_O=1.2V		-	100/8	-	
	V_O=1.8V		-	120/8	-	
	Vin=12V, V_O=2.5V		-	135/8	-	
	V_O=5.0V		-	160/10	-	
Turn-on Delay Time	V_O=0.6V	ms	-	0.7	-	Delay from instant at which Vin=Vin(min) until Vo=10% of Vo(nom)
	V_O=0.9V		-	0.6	-	
	V_O=1.2V		-	0.5	-	
	V_O=1.8V		-	0.5	-	
	V_O=2.5V		-	0.4	-	
	V_O=5.0V		-	0.3	-	
Turn-on Rise Time	V_O=0.6V	ms	-	1.2	-	Time for Vo to rise from 10% of Vo(nom) to 90% of Vo(nom)
	V_O=0.9V		-	1.2	-	
	V_O=1.2V		-	1.3	-	
	V_O=1.8V		-	1.3	-	
	V_O=2.5V		-	1.3	-	
	V_O=5.0V		-	1.4	-	
Switching Frequency		kHz	-	1000	-	
Weight		g	2.25			
MSL Rating		-	3			

Protection Characteristics

Parameter		Units	Specifications			Notes & conditions
			Min.	Typ.	Max.	
Input Undervoltage Lockout	Turn-on Threshold	Vdc	-	3.0	-	
	Turn-off Threshold	Vdc	-	2.7	-	
Output Overcurrent Protection		A	-	20	-	
Short Circuit Protection			-	Y	-	Hiccup mode Automatic recovery

General Specifications

Parameter		Units	Specifications			Notes & conditions
			Min.	Typ.	Max.	
Efficiency	Vin=12V, V_O=0.9V	%	-	76.6	-	Ambient Temperature 25℃, 100%load
	Vin=12V, V_O=2.5V		-	85.9	-	
	Vin=12V, V_O=5.0V		-	91.7	-	
MTBF		Hours	-	2,000,000		Bellcore TR332, 25℃
Safety Design		Compliant to IEC60950-1，UL60950-1,EN60950-1 and GB4943				
Vibration		IEC68－2－6				
Transportation		ETS300019－1－2				

Characteristic Curves

The following figures provide typical characteristics for the DAC10P12P0V59E module at ambient temperature 25℃

Characteristic Curves (Efficiency)

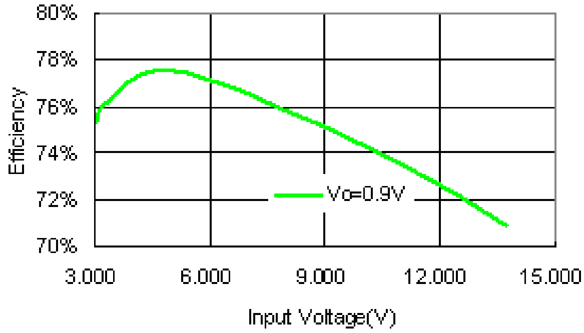


Figure1 Efficiency vs. input voltage (Vo=0.9V，100%load)

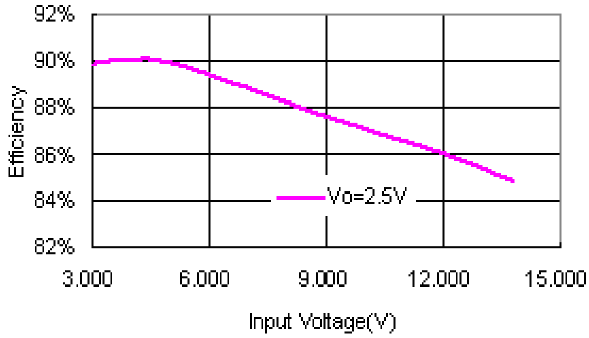


Figure2 Efficiency vs. input voltage (Vo=2.5V，100%load)

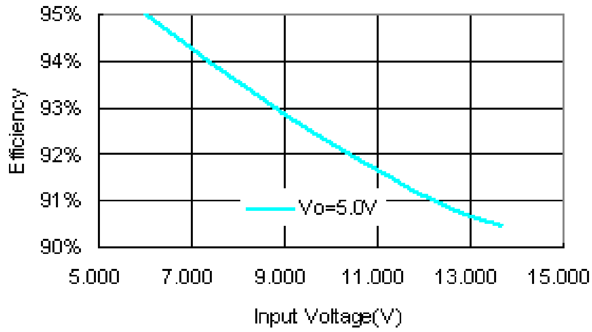


Figure3 Efficiency vs. input voltage (Vo=5.0V，100%load)

Characteristic Curves (Derating)

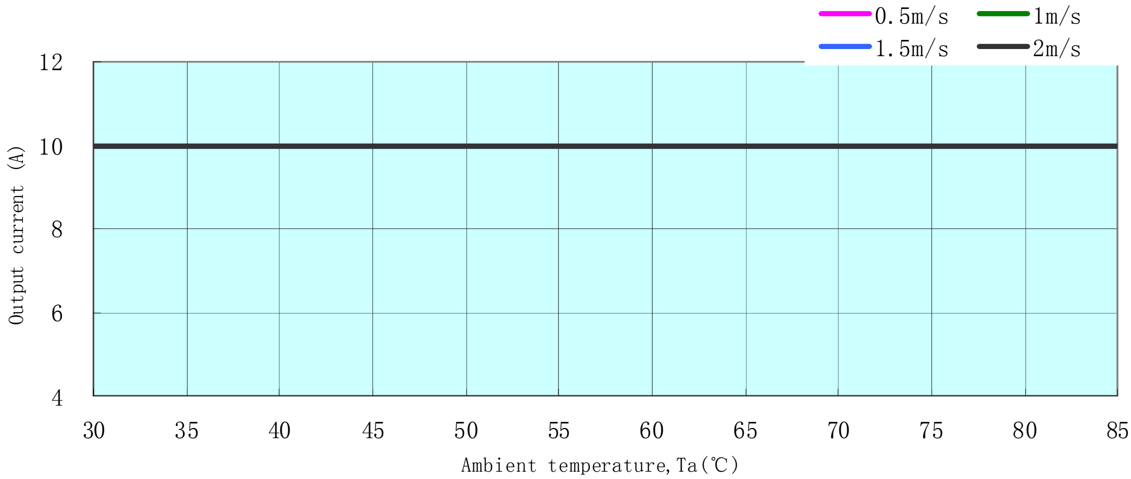


Figure4 Derating Output Current versus Ambient Temperature and Airflow(Vin=12.0V/Vo=5.0V).

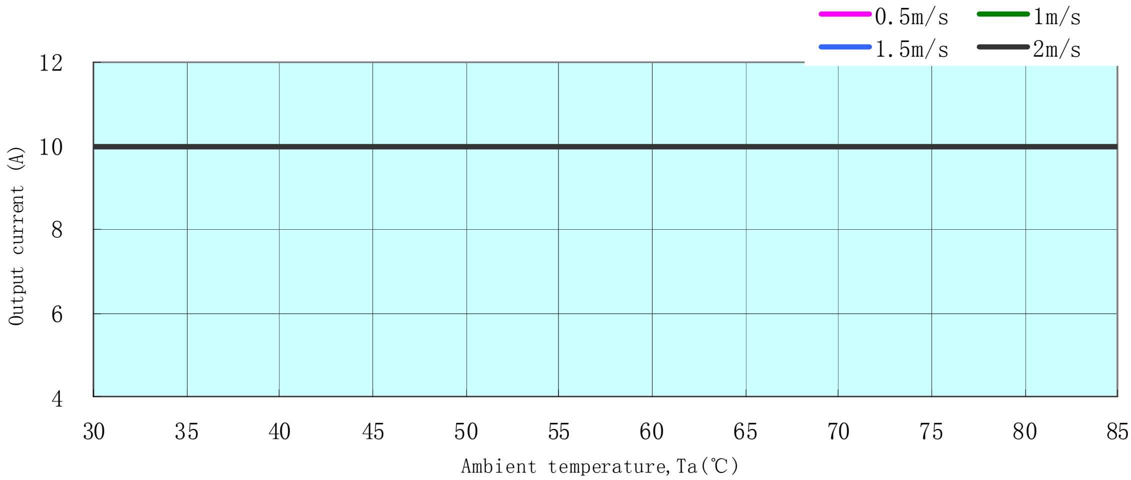


Figure5 Derating Output Current versus Ambient Temperature and Airflow(Vin=12.0V/Vo=2.5V).

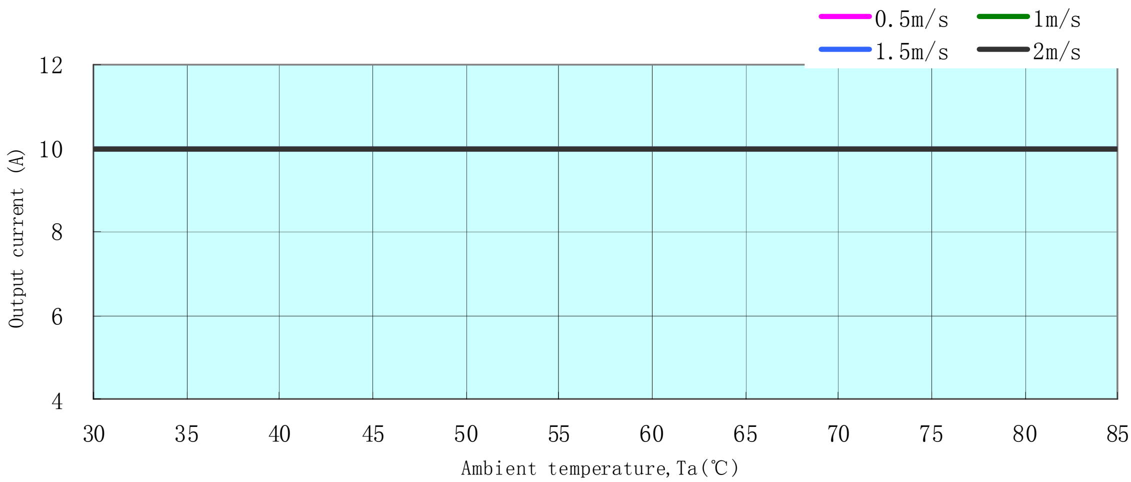


Figure6 Derating Output Current versus Ambient Temperature and Airflow(Vin=12.0V/Vo=0.9V).

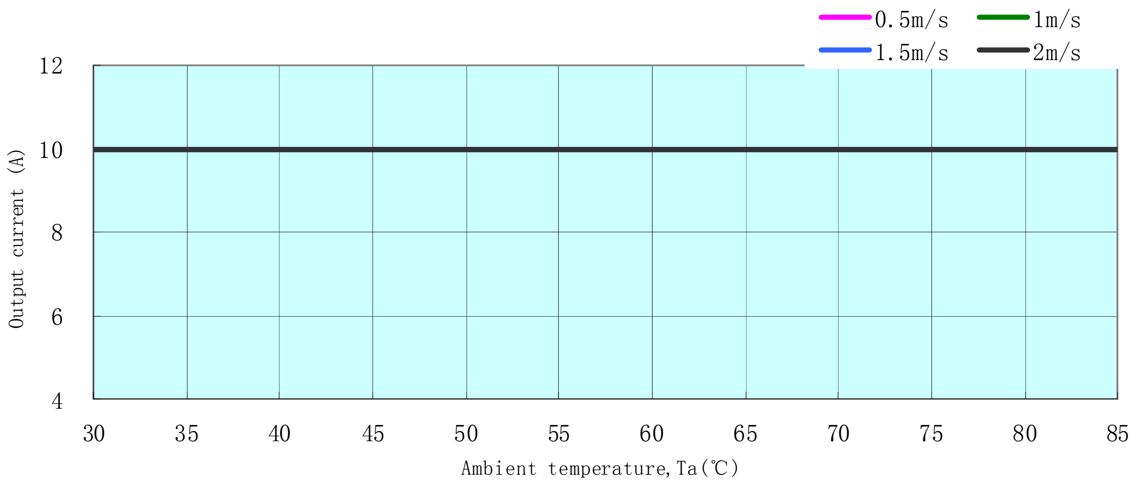


Figure7 Derating Output Current versus Ambient Temperature and Airflow(Vin=5.0V/Vo=2.5V).

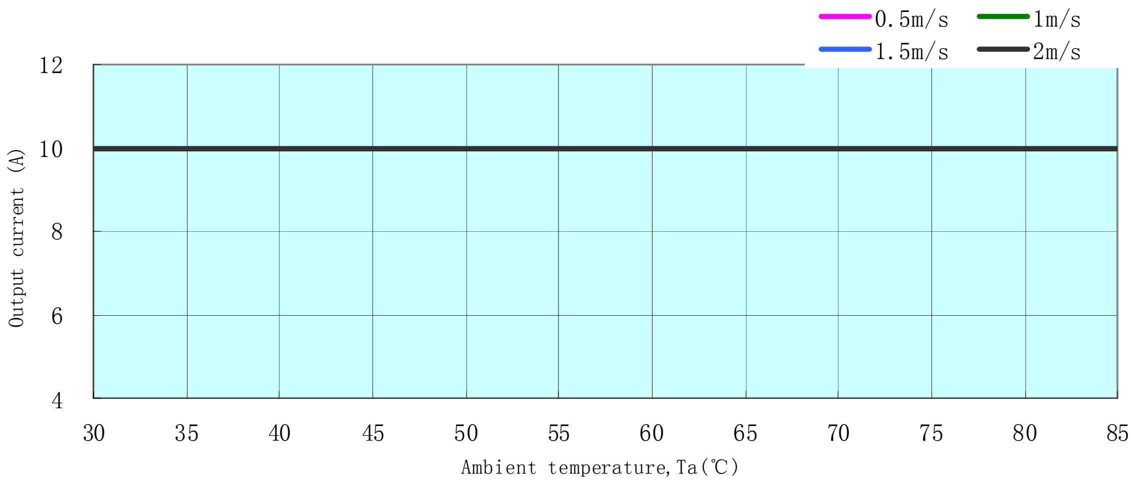


Figure8 Derating Output Current versus Ambient Temperature and Airflow(Vin=5.0V/Vo=0.9V).

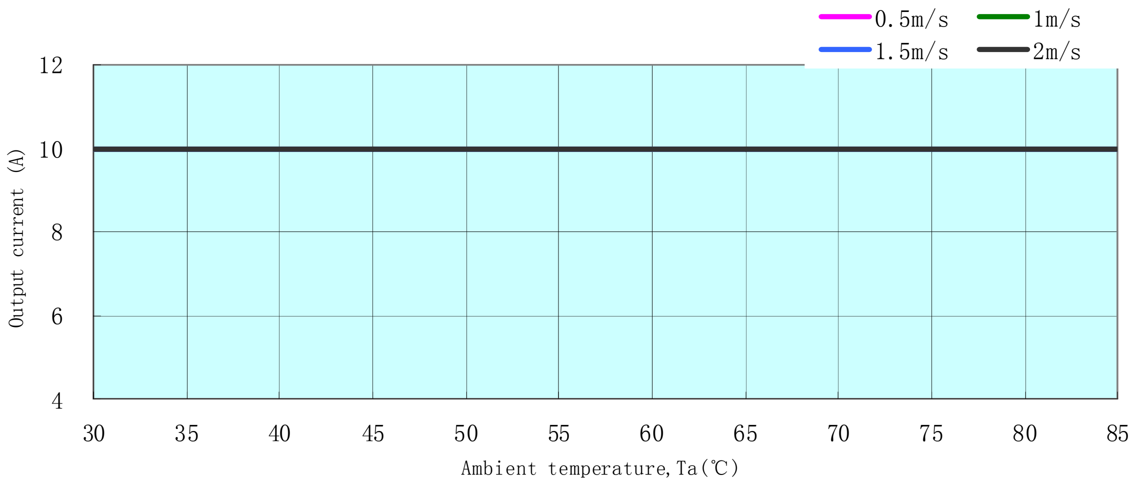


Figure9 Derating Output Current versus Ambient Temperature and Airflow(Vin=3.3V/Vo=2.5V).

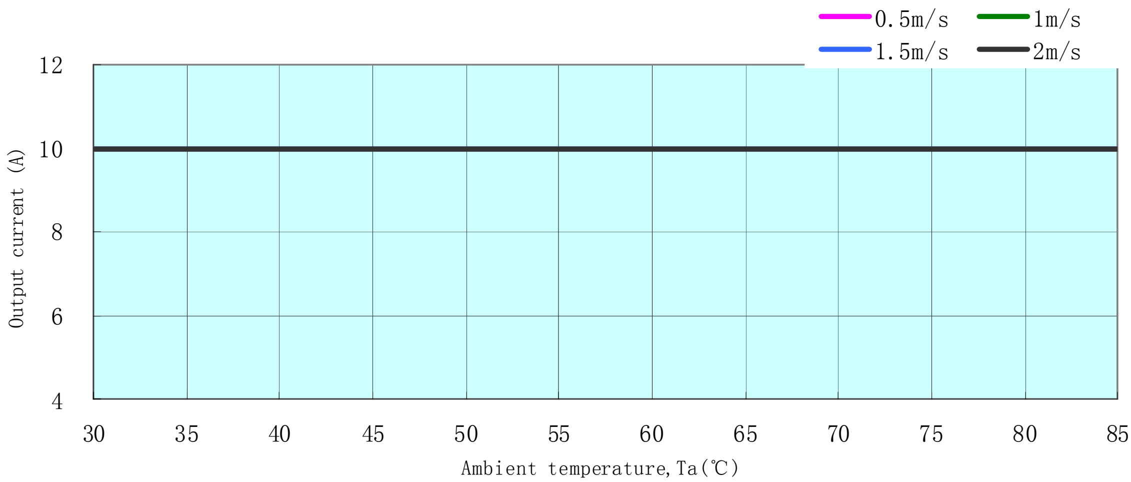


Figure10 Derating Output Current versus Ambient Temperature and Airflow(Vin=3.3V/Vo=0.9V).

Characteristic Curves (Start-up)

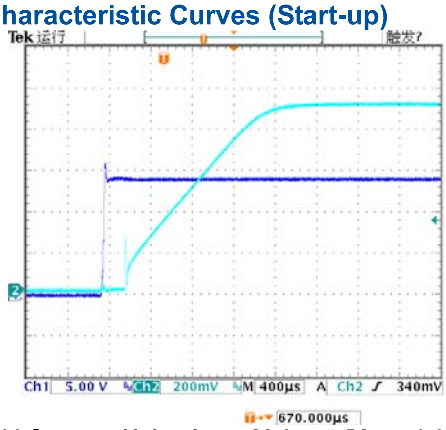


Figure11 Start-up Using Input Voltage (Vout=0.9V,Io=10A)

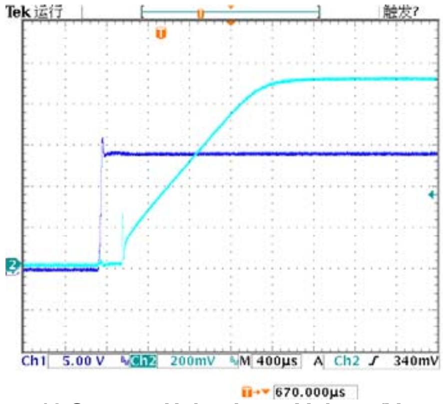


Figure12 Start-up Using Input Voltage(Vout=0.9V,Io=10A)

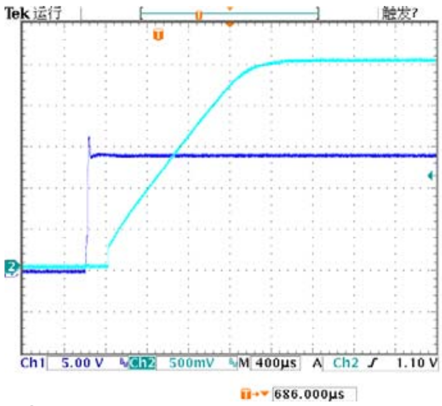


Figure13 Start-up Using Input Voltage (Vout=2.5V,I o=10A)

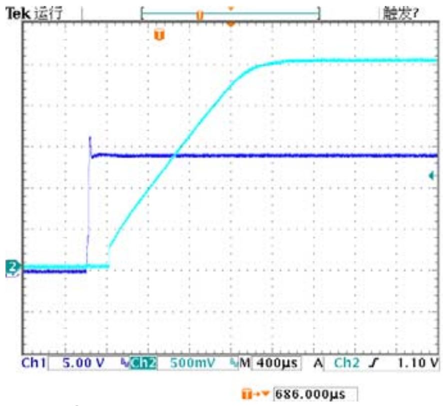


Figure14 Start-up Using Input Voltage(Vout=2.5V,Io=10A)

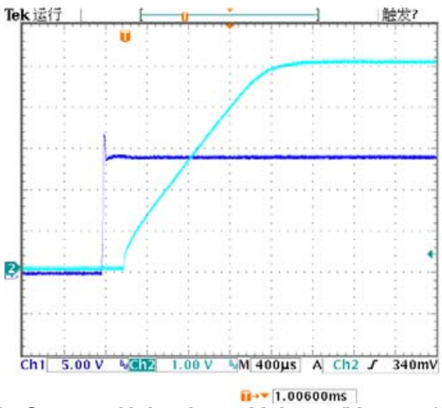


Figure15 Start-up Using Input Voltage (Vout=5.0V, Io=10A)

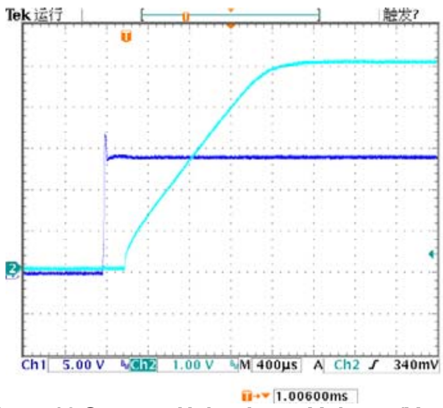


Figure16 Start-up Using Input Voltage (Vout=5.0V,Io=10A)

Characteristic Curves (Dynamic Response)

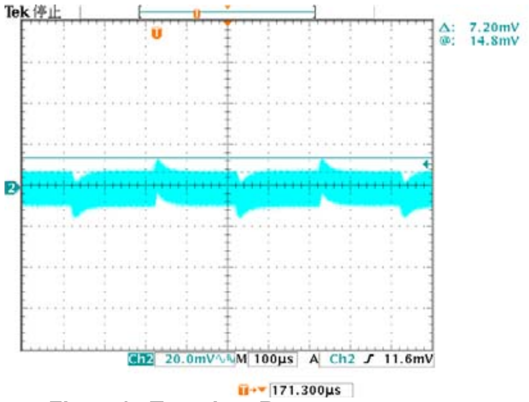


Figure17 Transient Response
(Vout=0.9V 25%~50% 2.5A/µS)

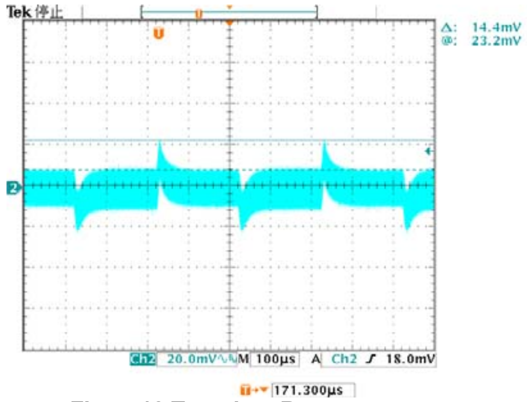


Figure18 Transient Response
(Vout=0.9V 50%~100% 2.5A/µS)

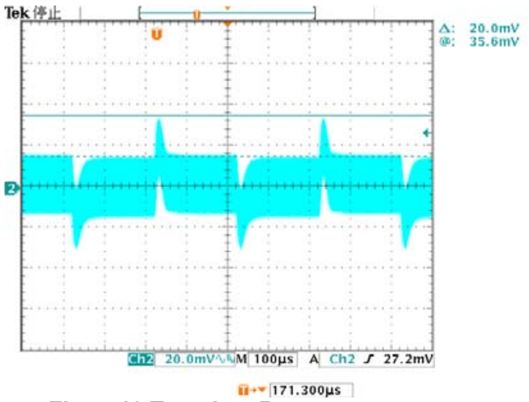


Figure19 Transient Response
(Vout=2.5V 25%~50% 2.5A/µS)

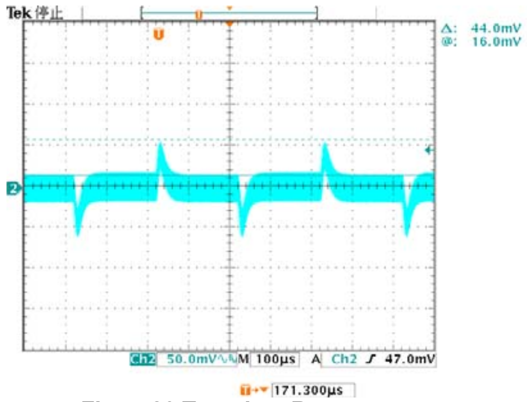


Figure20 Transient Response
(Vout=2.5V 50%~100% 2.5A/µS)

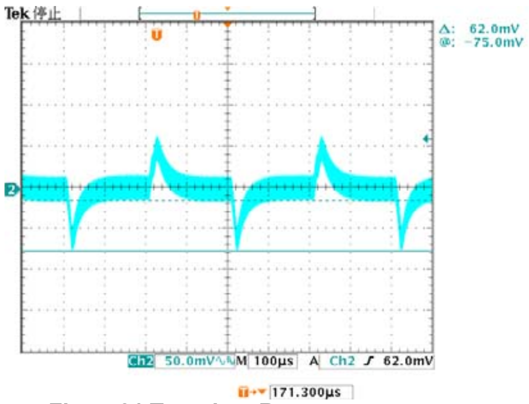


Figure21 Transient Response
(Vout=5V 25%~50% 2.5A/µS)

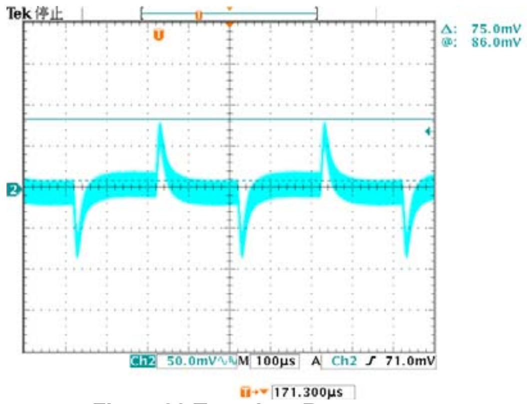


Figure22 Transient Response
(Vout=5V 50%~100% 2.5A/µS)

Characteristic Curves (Ripple, Peak to Peak)

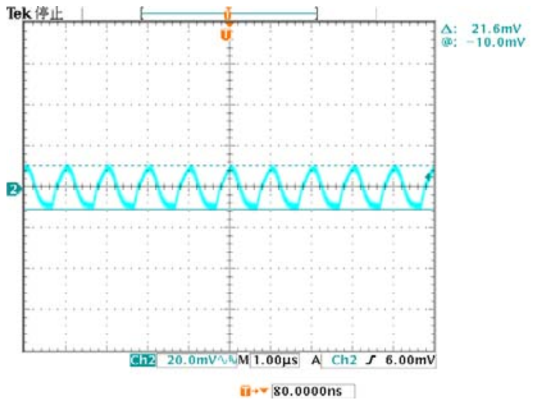


Figure23 Output ripple and noise(Vout=0.9V，Io=10A)

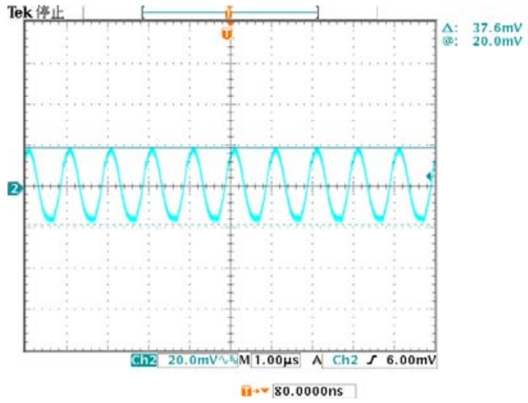


Figure24 Output ripple and noise(Vout=2.5V，Io=10A)

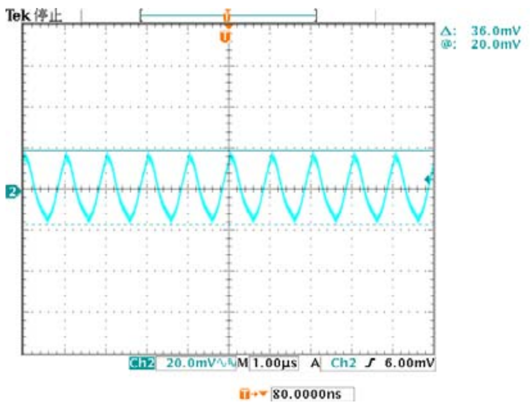


Figure25 Output ripple and noise(Vout=5.0V，Io=10A)

Typical Application

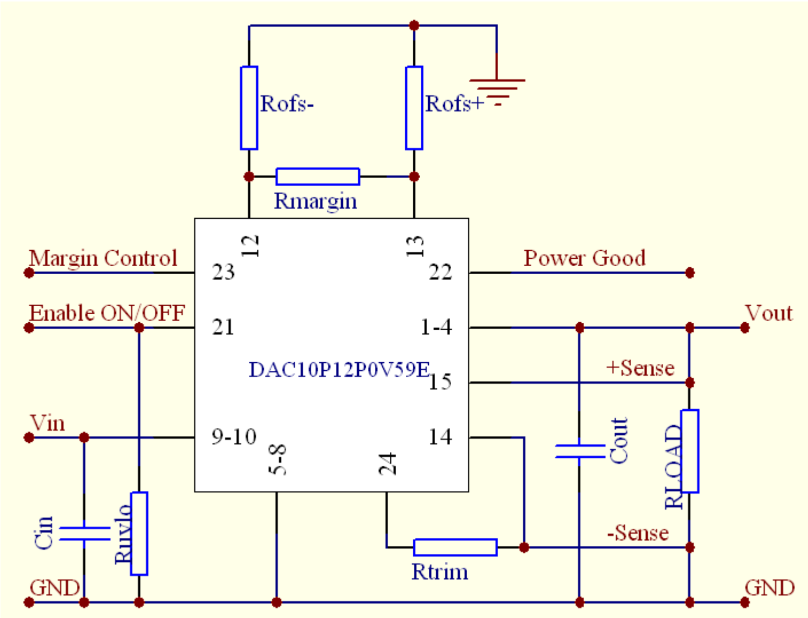
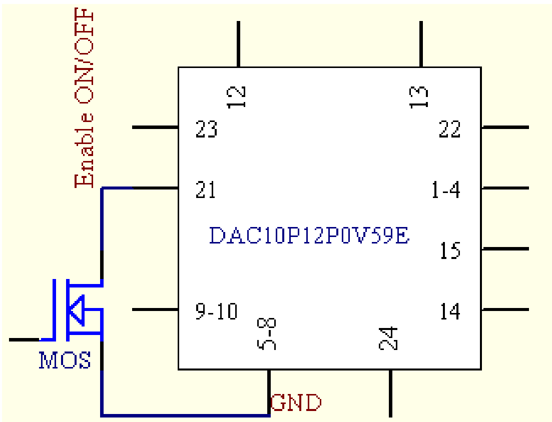


Figure26 Typical Application Circuit

Recommended Value

Part	Recommended Value
Cin	1μF ceramic capacitor
Cout	10μF ceramic capacitor

Remote Control



Note: The remote on/off control is available by connecting a MOSFET between the "Enable" and the "GND". "Enable" left open = module on; "Enable" at 0~0.2Vdc = module off.

Figure 27 Remote Control Application Circuit

Output Adjustment

The output voltage can be adjusted by setting the value of the "R_{trim}"(external regulation resistance) connected between the "TRIM" and the "-Sense" as follows:

$$Rtrim = \frac{1.182}{Vout - 0.591} K\Omega$$

Table1. Output Voltage Vs. Regulation Resistance

Vout (V)	0.9	1.2	1.5	1.8	2.0	2.5	3.3	5.0
R_{trim} (KΩ)	3.83	1.94	1.30	0.976	0.839	0.619	0.432	0.267

Margin Control

The output voltage will be adjusted upward when the "Margin" pin is at logic high and downward when it is at logic low. If the "Margin" pin is left open, this function will be disabled. At the default setting of the output voltage, the maximum margin range is ±200mV. When this input is asserted to GND, the output voltage is decreased by 5% from the nominal. The input requires an open-collector (open-drain) interface. It is not TTL compatible. A lower percent change can be accommodated with a series resistor. If unused, this input may be left unconnected.

The upward margin adjustment：

$$Vmargin\_up = 0.1182 \times \frac{Rmargin}{Rofs+} \times \frac{Rtrim + 2k}{Rtrim},$$

The downward margin adjustment：

$$Vmargin\_down = 0.1182 \times \frac{Rmargin}{Rofs-} \times \frac{Rtrim + 2k}{Rtrim}$$

When Vin≤5V, Vmargin(max)=Vin; When Vin＞5V, Vmargin(max)=5V.

Table 2. Recommended Parameter for Margin Function

Function	**Vout_nom (V)**	**Rtrim (kΩ)**	**Rmargin (kΩ)**	**Rofs- (kΩ)**	**Rofs+ (kΩ)**	**Vmargin_down (V)**	**Vout _down (V)**	**Vmargin_up (V)**	**Vout_up (V)**
Margin up/down 5%	0.9	3.83	2.49	10.0	10.0	0.045	0.855	0.045	0.945
	1.2	1.96	2.49	10.0	10.0	0.059	1.141	0.059	1.259
	1.8	0.976	2.49	10.0	10.0	0.090	1.710	0.090	1.809
	2.5	0.619	2.49	10.0	10.0	0.125	2.375	0.125	2.625
	3.3	0.432	2.49	10.0	10.0	0.166	3.134	0.166	3.455
	5.0	0.267	2.49	10.0	10.0	0.250	4.750	0.250	5.250
Margin up/down 10%	0.9	3.83	4.99	10.0	10.0	0.09	0.810	0.09	0.990
	1.2	1.96	4.99	10.0	10.0	0.119	1.081	0.119	1.319
	1.8	0.976	4.99	10.0	10.0	0.180	1.620	0.180	1.980
	2.5	0.619	4.99	10.0	10.0	0.250	2.250	0.250	2.750
	3.3	0.432	4.99	10.0	10.0	0.332	2.968	0.332	3.632
	5.0	0.267	4.99	10.0	10.0	0.501	4.499	0.501	5.501

Protection Features

Input Under voltage Lockout

At input voltages below the input under-voltage lockout limit, the module operation is disabled. The module will begin to operate at an input voltage above the under-voltage lockout turn-on threshold.

Output Over current Protection

To provide protection in an output overload fault condition, the module is equipped with internal current-limiting circuitry and can endure current limiting for an unlimited duration. At the instance of current-limit inception, the module enters a "hiccup" mode of operation, whereby it shuts down and automatically attempts to restart. While the fault condition exists, the module will remain in this mode until the fault is cleared. The unit operates normally once the output current is reduced back into its specified range.

Over temperature Protection

These modules feature an over temperature protection circuit to safeguard against thermal damage. The circuit shuts down and latches off the module when the maximum device reference temperature is exceeded. The module can be restarted by cycling the dc input power for at least one second or by toggling the remote on/off signal for at least one second.

Thermal Considerations

Thermal management is an important part of the system design. To ensure proper, reliable operation, sufficient cooling of the power module is needed over the entire temperature range of the module. Convection cooling is usually the dominant mode of heat transfer.
Hence, the choice of equipment to characterize the thermal performance of the power module is a wind tunnel.

Thermal Testing Setup

The following figure shows the wind tunnel characterization setup. The hottest temperature of the module is identified(less than 120℃). Thermocouple temperature sensors are placed on the case of the module. The ambient temperature sensor and a heater element are also put inside the sealed box, equaling heatsink in size. Test done in a thermal chamber, run the thermal chamber at constant 55℃, airflow 2m/s over the heat sink (size like an A4 paper). Derating curves showing current / still air temperature inside the box, heater the temperature up to 85℃, the thermal probe is measuring air temperature inside the box.

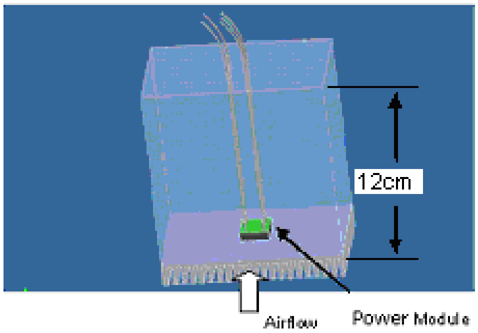


Figure 28. Thermal Testing Setup

Reflow Soldering Information

The modules are lead-free and RoHS compliant and both compatible in a Pb-free soldering process. It is recommended that the customer review data sheets in order to customize the solder reflow profile for each application board assembly. Failure to observe these information and instructions may result in the failure of or cause damage to the modules, and can adversely affect long-term reliability.

Typically, the solder paste melts at 217℃, wets the land, and subsequently wicks the device connection. Sufficient time must be allowed to fuse the plating on the connection to ensure a reliable solder joint. There are several types of SMT reflow technologies currently used in the industry. Modules can be reliably soldered using natural forced convection, IR(radiant infrared), or a combination of convection/IR. For reliable soldering the solder, reflow profile should be established by accurately measuring the modules pin temperatures

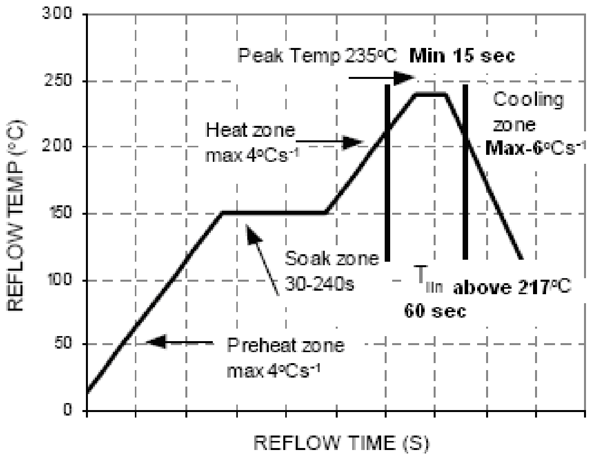


Figure29. Recommended Reflow Profile using Sn/Ag/Cu

Outline Diagram

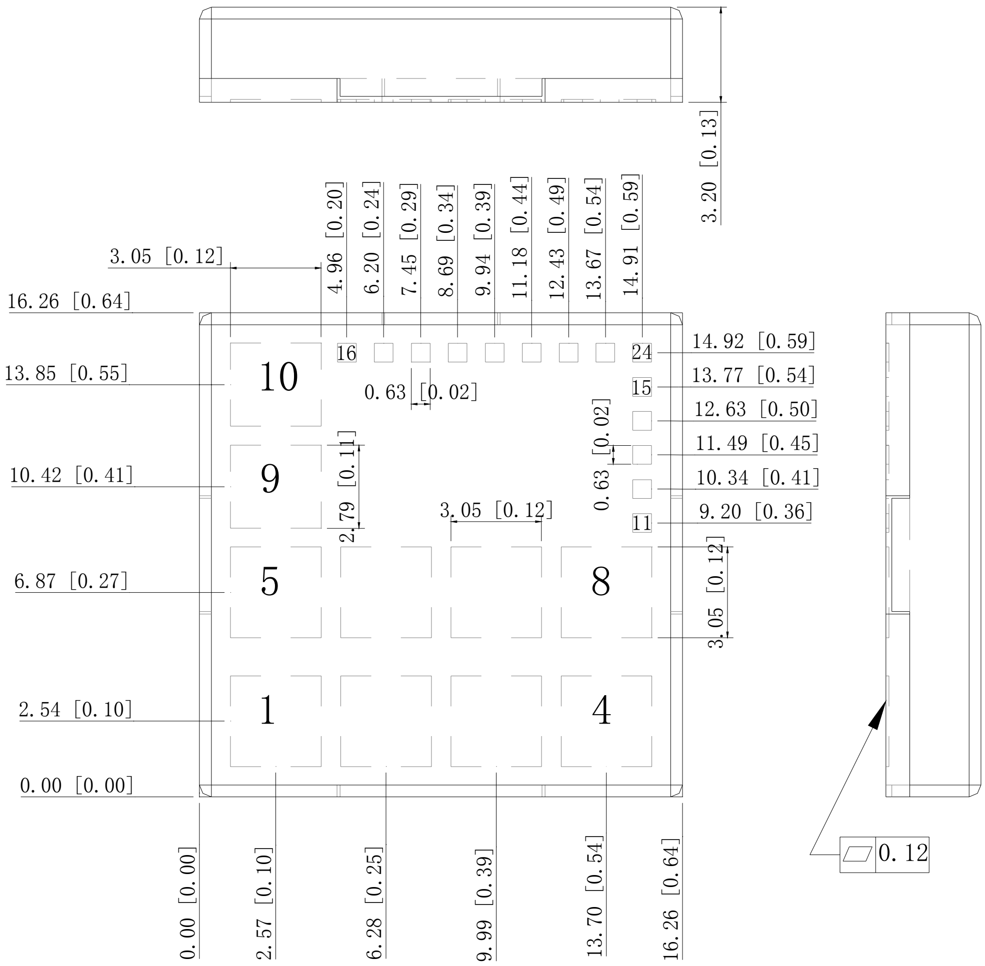


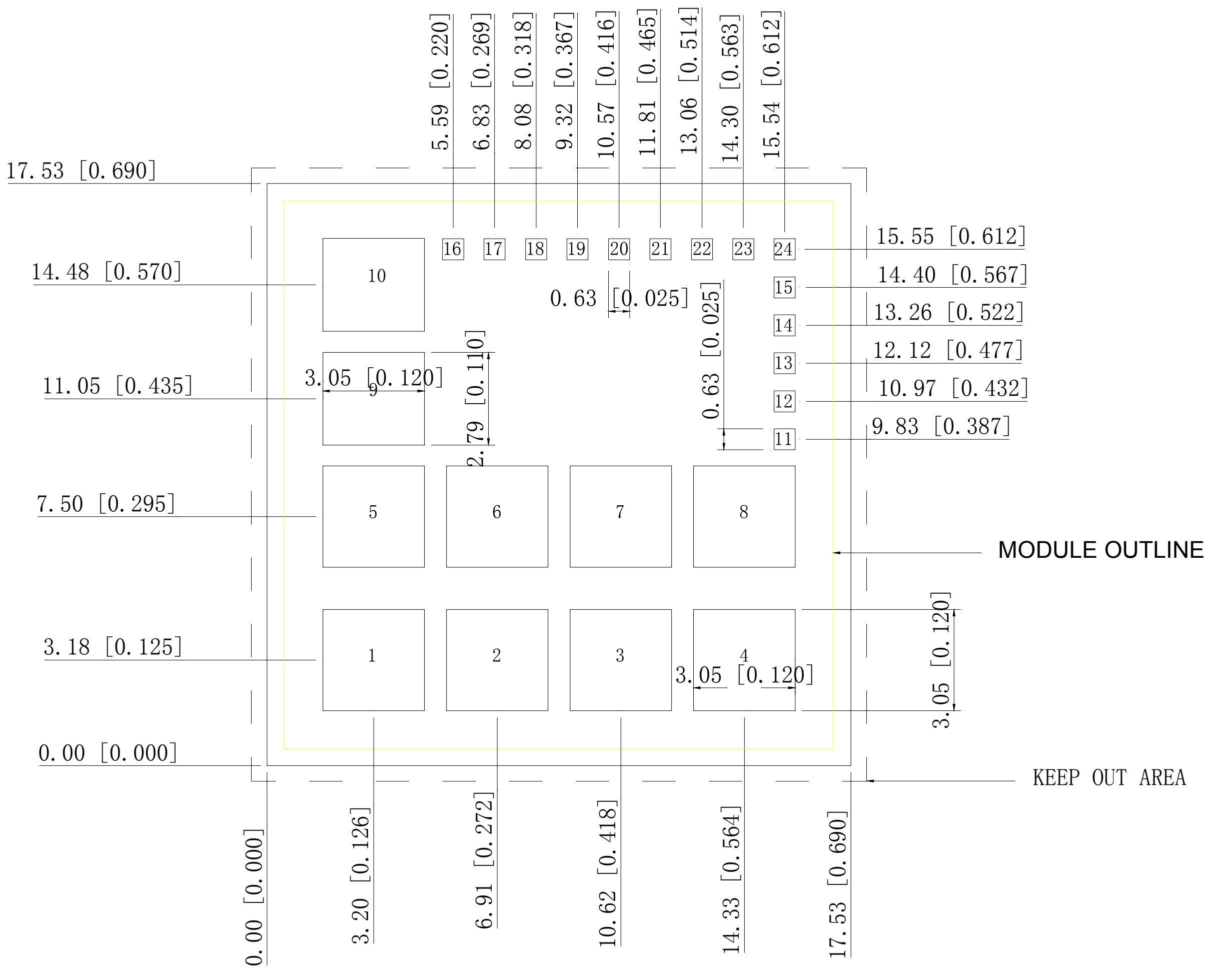
Figure30 Outline Diagram

Dimensions are in mm [inch].Tolerance: x.xx±0.20[x.xxx±0.008],x.x±0.3[x.xx±0.012]

Pin Designations

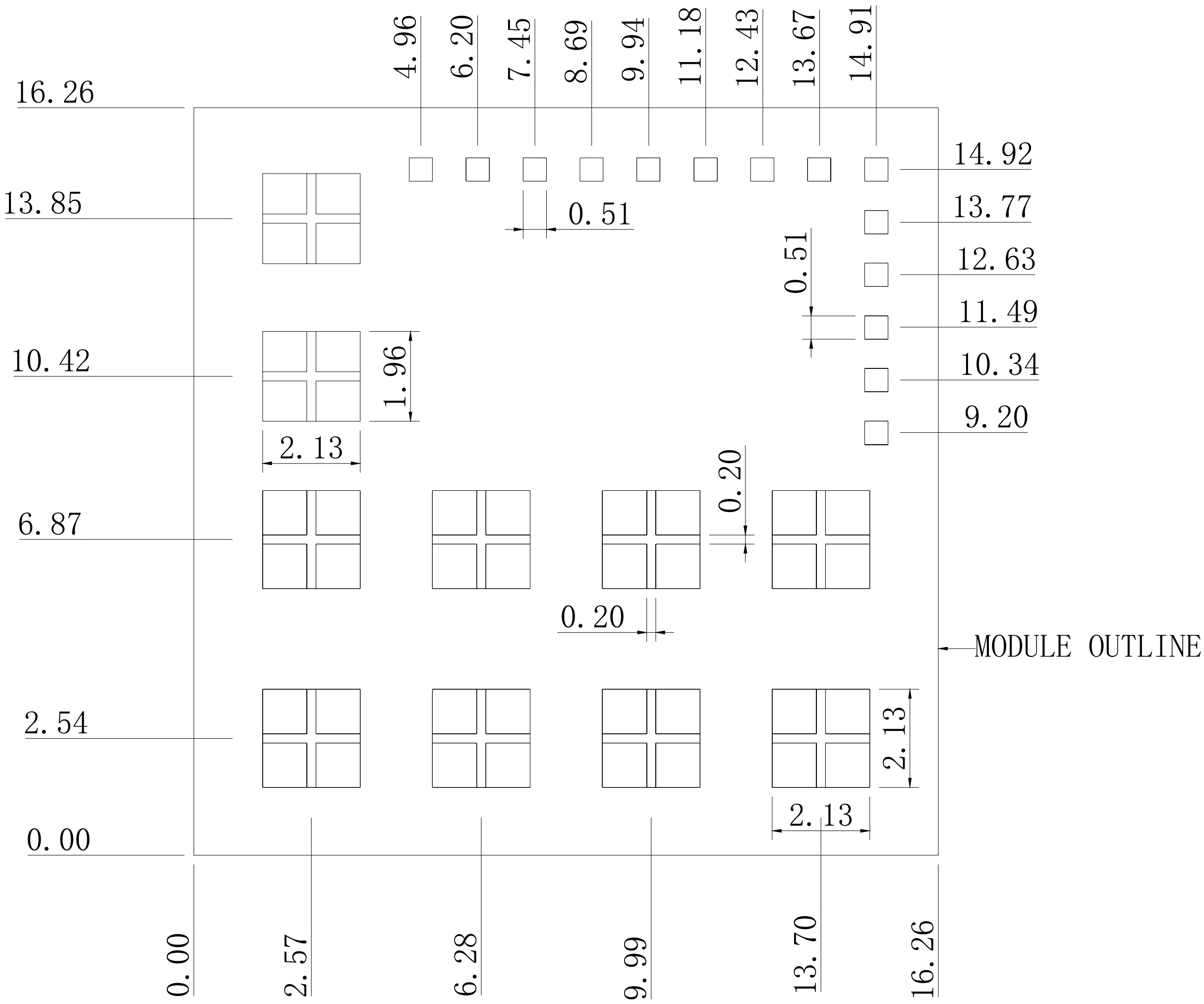
Pins No.	Symbols	Functions	Pins No.	Symbols	Functions
1,2,3,4	V_O	Positive output	14	-Sense	Negative output voltage remote sense
5,6,7,8	GND	Negative input and output	15	+Sense	Positive output voltage remote sense
9,10	Vin	Positive input	21	Enable	Remote on/off control
11,16～20	NC	No connection	22	Power Good	Power state indicator
12	-Offset	Downward margin adjustment	23	Margin Control	Output voltage subtle adjustment
13	+Offset	Upward margin adjustment	24	TRIM	Output voltage Set-point adjustment

Recommended Application



Note: Dimensions are in mm [inch].

Figure31 Recommended Pad Layout



Note: Dimensions are in mm [inch], Recommended Stencil thickness of 7 mil

Figure32 Recommended Solder Paste Stencil

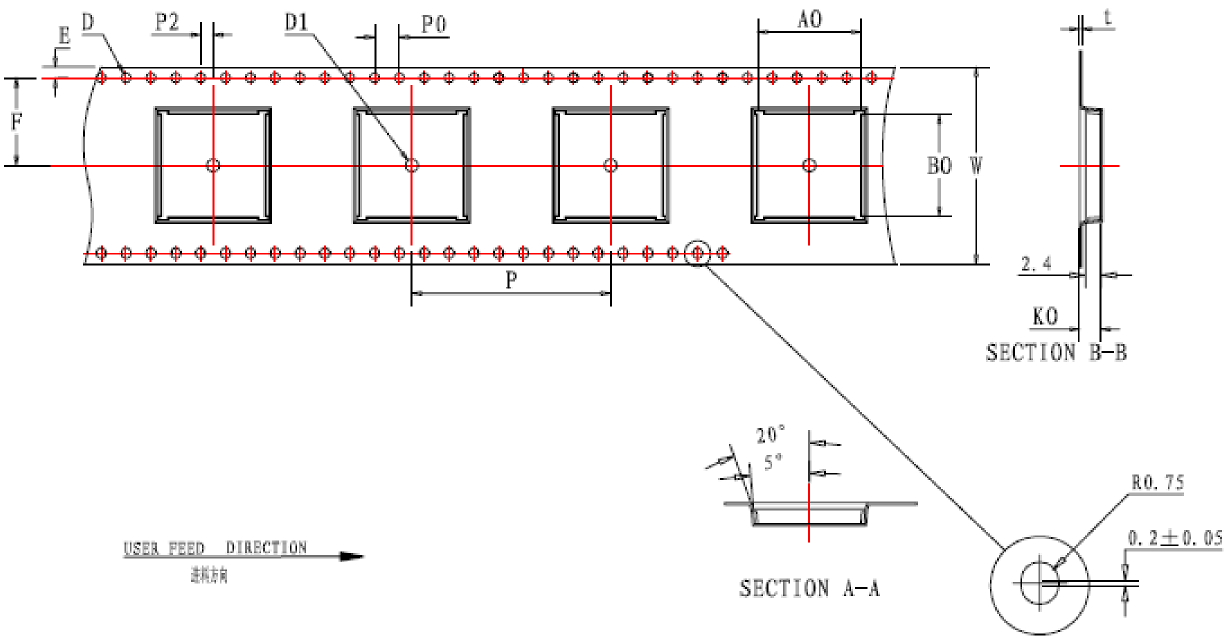
Recommended Reflow Profile: Compliant to the standard of IPC

Delivery package information

The DAC10P12P0V59E modules are supplied in tape & reel as standard. Modules are shipped in quantities of 500 pcs modules per reel.

All Dimensions are in millimeters and (in inches).

ITEM	W	Ao	Bo	Ko	P	F	E	D	D1	Po	P2	t	13"	
DIM	32.00	16.60	16.60	3.40	32.00	14.20	1.75	1.50	2.00	4.00	2.00	0.35	长度/盘	元件/盘
TOLE	+0.30 -0.30	+0.10 -0.00	+0.10 -0.00	+0.10 -0.00	+0.10 -0.10	+0.10 -0.10	+0.10 -0.10	+0.10 -0.00	+0.10 -0.00	+0.10 -0.10	+0.15 -0.15	+0.05 -0.05	16.5m	500pcs

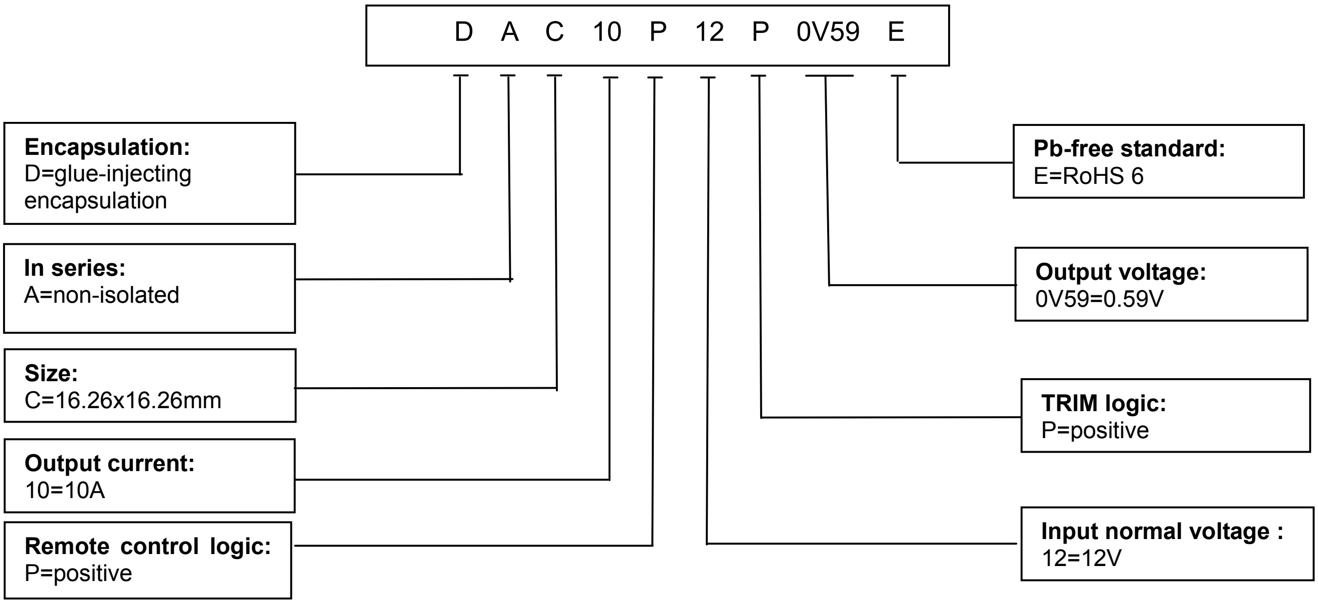


Reel Dimensions

Outside diameter: 330.2mm(13.00)
Inside diameter: 101.6mm(4.00)
Tape Width: 32.3mm(1.27)

Naming Rules On Models

For partition of output current products, our company decides to adopt the following naming rules



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