PML SERIES

Instruction Manual

BEFORE USING THE POWER SUPPLY UNIT

Be sure to read this instruction manual thoroughly before using this product. Pay attention to all cautions and warnings before using this product. Incorrect usage could lead to an electrical shock, damage to the unit or a fire hazard.

⚠ DANGER

- Never use this product in locations where flammable gas or ignitable substances are present.

⚠ WARNING

- Do not make unauthorised changes to this product, otherwise you may receive an electric shock and void your warranty.
- Do not touch this product or its internal components while it is in operation or shortly after shut down. There may be high voltage or high temperature present and you may receive an electric shock or burn.
- When the product is operating, keep your hands and face away from it as you may be injured by flying debris in the event of a fault.
- Do not use this product in the event of the emission of smoke or abnormal smell and sound etc. It might lead to fire and electric shock. In such cases, please contact us. Do not attempt repair by yourself, as it is dangerous for the user.
- Do not drop or insert anything into the product. It might lead to failure, fire and electric shock.
- Do not operate these products in the presence of condensation. It might lead to fire and electric shock.

⚠ CAUTION

- This power supply is designed for use within an end product such that it is accessible to SERVICE ENGINEERS only.
- As a component part, compliance with the standard will be based upon installation in the final application. This product must be installed in a restricted access location, accessible to authorized competent personnel only.
- The input power source to this product must have reinforced or double insulation between it and the mains.
- Confirm connections to input/output terminals and signal terminals are correct as indicated in the instruction manual before switching on.
- Use an external fuse to each module to ensure safe operation and compliance with the Safety Standards to which it is approved. The recommended input fuse rating within the instructions. The breaking capacity and voltage rating of this fuse may be subject to the end use application.
- Input voltage, Output current, Output power, ambient temperature and ambient humidity should be kept within specifications, otherwise the product will be damaged.
- For applications which require very high reliability (Nuclear related equipment, traffic control equipment, medical equipment etc.), it is necessary to provide a fail safe mechanism in the end equipment.
- Do not use this product in environment with a strong electromagnetic field, corrosive gas or conductive substances.
- Do not operate and store this product in an environment where condensation might occur. In such case, waterproof treatment is necessary.
- Never operate the product under over current or short circuit conditions, or outside its specified Input Voltage Range. Insulation failure, smoking, burning or other damage may occur.
- It must not be made accessible to users. Protection must be provided for Service Engineers against indirect contact with the output terminals and to prevent tools being dropped across them. While working on this product, the input power must be switched off and the input and output voltage should be safe level.
- The application circuits and their parameters are for reference only. Be sure to verify effectiveness of these circuits and their parameters before finalising the circuit design. TDK-Lambda does not assume any responsibility for any patents, utility model, etc. related to applications.
- Do not inject abnormal voltages into the output or signal of this product. The injection of reverse voltage or over voltage exceeding nominal output voltage into the output or signal terminals might cause damage to internal components.
- The information in this document is subject to change without prior notice. Please refer to the latest version of the data sheet, etc., for the most up-to date specifications of the product.
- When handling this product, hold the board edge and take care not to touch the component. When installing this product in apparatus or equipment, mount it on spacers.
- This product contains a printed circuit board utilising surface mounted devices. PCB stress such as bending, twisting etc could cause damage. Therefore, please handle with care.
-

DWG. No. : C261-04-11		
APPD	CHK	DWG
T. Ueno 22. Jan. '14	T. Masuda 22, Jan. '14	R.S.E.E 22. Jan. '14

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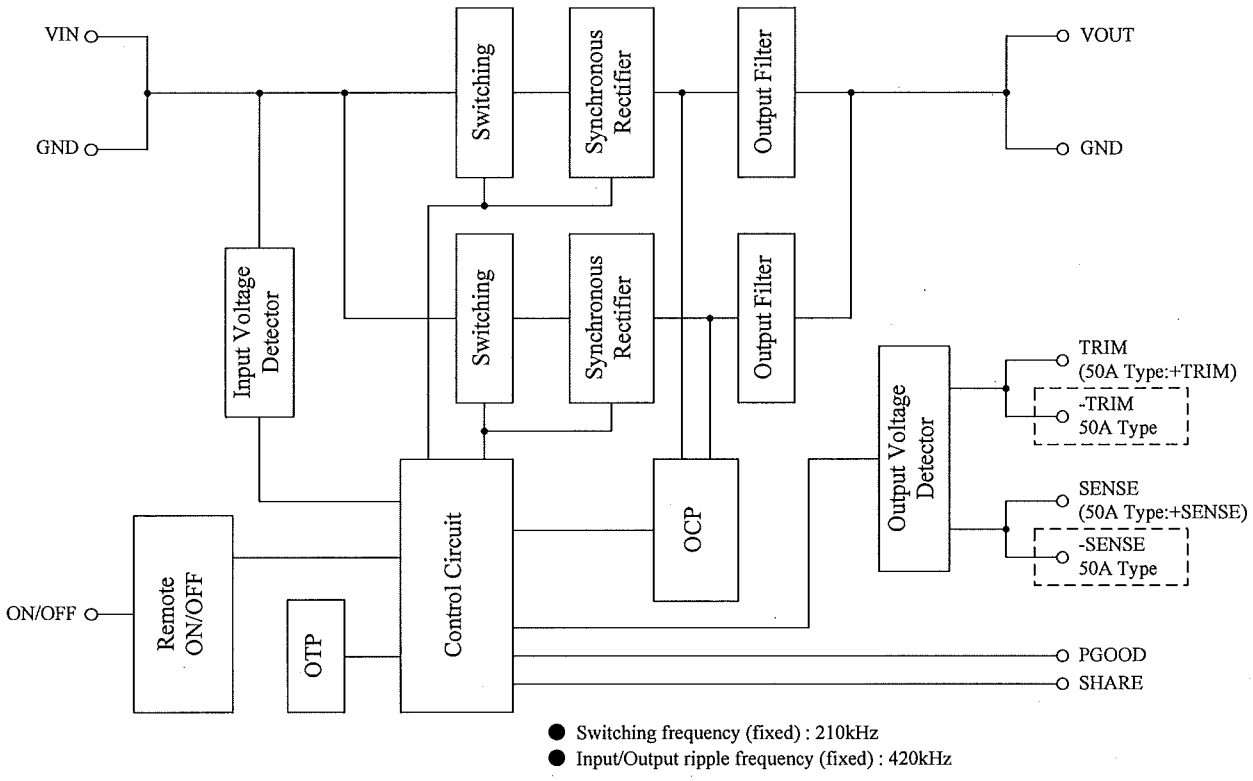
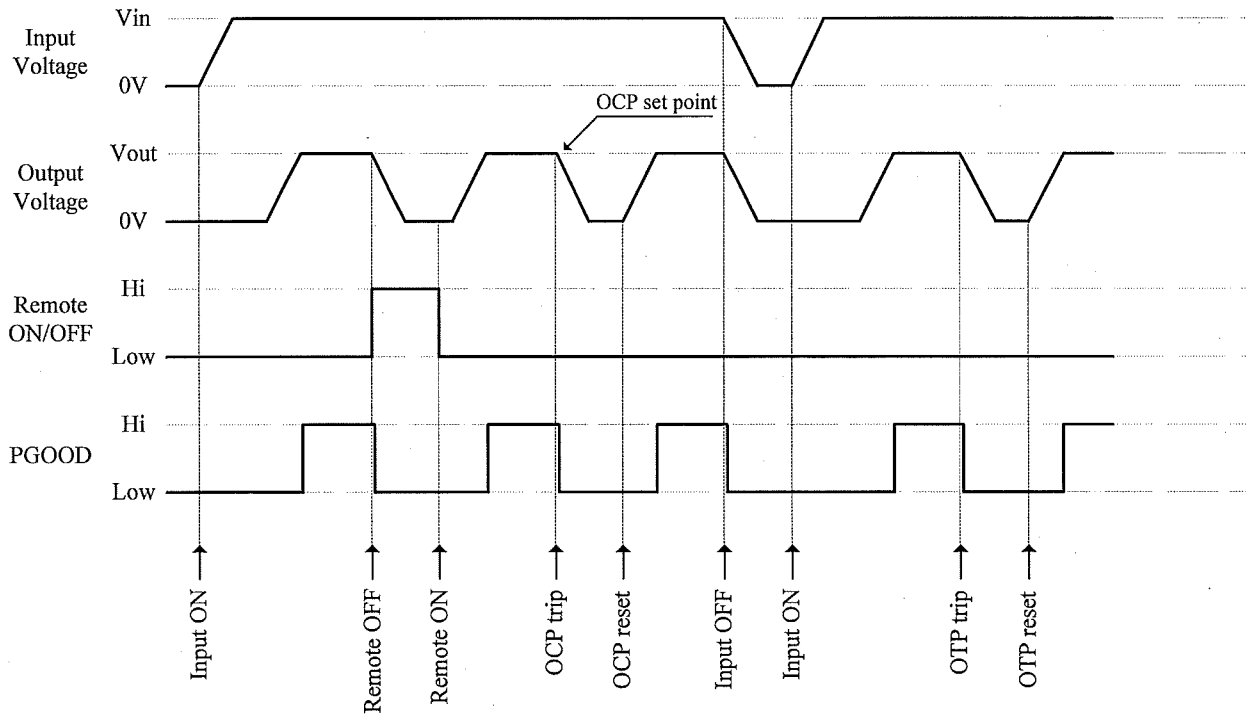
Block Diagram



Sequence Time Chart

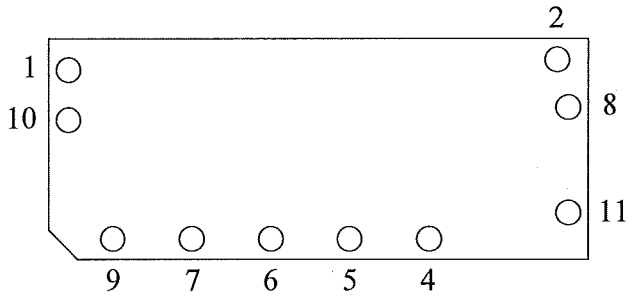


For details on Remote ON/OFF, PGOOD H / L level, please refer to "9. Remote ON/OFF", "11.Power Good signal".

■ Terminal Explanation

PML12030A007V

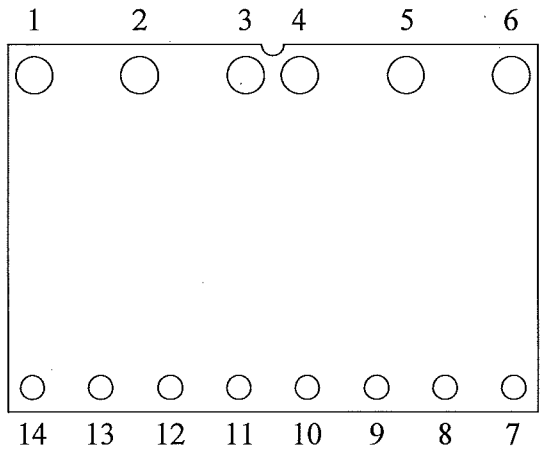
Bottom view



Pin No.	Function
1	ON/OFF
2	VIN
4	GND
5	VOUT
6	TRIM
7	SENSE
8	GND
9	SHARE
10	GND
11	PGOOD

PML12050A007V

Bottom view



Pin No.	Function
1	VIN
2	GND
3	VOUT
4	VOUT
5	GND
6	VIN
7	NC
8	PGOOD
9	ON/OFF
10	-SENSE
11	+SENSE
12	+TRIM
13	-TRIM
14	SHARE

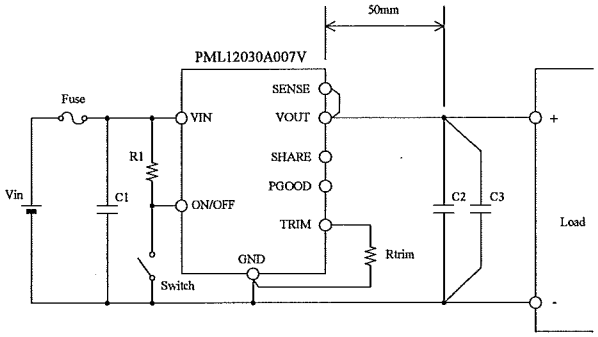
■ Explanation on Specifications

1. Input Voltage Range

Input voltage range for PML Series is indicated below.

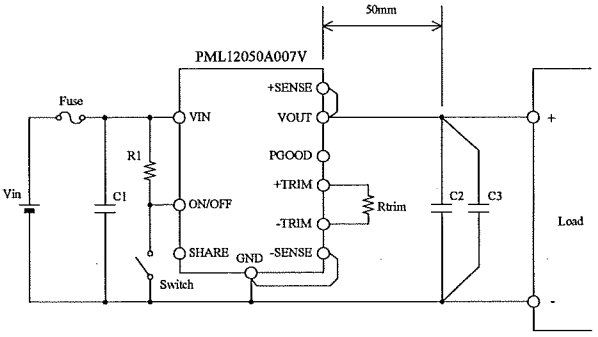
Input Voltage Range : 8VDC~14VDC

● **Basic Connection**



*The GND side of input and output should wire at GND plane.

Fig.1-1 PML12030A007V Basic Connection



* The GND side of input and output should wire at GND plane.

Fig.1-2 PML12050A007V Basic Connection

Input Fuse:

Use external fuse to improve safety. Also, use normal-blow type for every module.

Furthermore in-rush surge current flows during line throw-in. Be sure to check I^2t capability of external switch and fuse.

Model	Input Fuse Recommended current rating
PML12030A007V	20A
PML12050A007V	30A

Table.1-1 Input Fuse Recommended current rating

Input Capacitor C1

To prevent the effect of input line inductance to the power module, connect ceramic capacitor between VIN and GND terminals.

Recommended capacitor value :
22μF x 7 parallel and above
(Rated voltage 25V and above)

Take note that when input line inductance becomes excessively high, operation of the power module could become unstable.

Output Capacitor

C2 : 0.1μF (Rated voltage 4V and above)

To reduce spike noise voltage at the output, connect a ceramic capacitor between VOUT and GND terminals within 50mm distance from the output terminals.

For details on measurement of Output ripple noise, please refer to "3. Maximum Ripple and Noise".

C3

For stable operation, connect an electrolytic capacitor between VOUT and GND terminals within 50mm distance from the output terminals.

Recommended capacitor value :
PML12030A007V : 100μF x 3 parallel and above
PML12050A007V : 100μF x 5 parallel and above
(Rated voltage 4V and above)

Take note that output ripple and output rise could be affected by ceramic capacitor, equivalent series resistance and inductance characteristics of ceramic capacitor and wiring. So, design equivalent series resistance and inductance to become small as much as possible.

For cases of dynamic changes in load current or input voltage, increasing capacitance value of the external capacitors could reduce the voltage fluctuation.

When output voltage is low and the external output capacitor is small, reverse current might flow during output rise and overshoot. Please conduct thorough evaluation before using. These phenomena can be improved by increasing capacitance value of the external capacitors.

Maximum capacitance (ceramic capacitor) that can be connected between VIN and GND terminals is shown below.

Maximum capacitance of external output capacitor:
1,000μF

When output capacitor more than the above is required, please contact us.

2. Output Voltage Adjustment Range

(TRIM terminal or +TRIM, –TRIM terminal)

Output voltage could be adjusted within the range described below by Rtrim of external resister between TRIM terminal and GND terminal at PML12030A007V or between +TRIM terminal and –TRIM terminal at PML12050A007V.

Output Voltage Adjustment Range : 0.7V – 2.0V

Take care that noise does not enter into TRIM terminal.

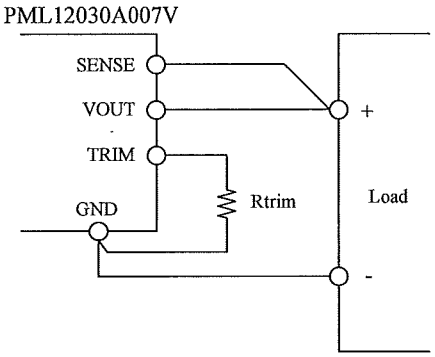


Fig.2-1 PML12030A007V
Connection for output voltage adjustment

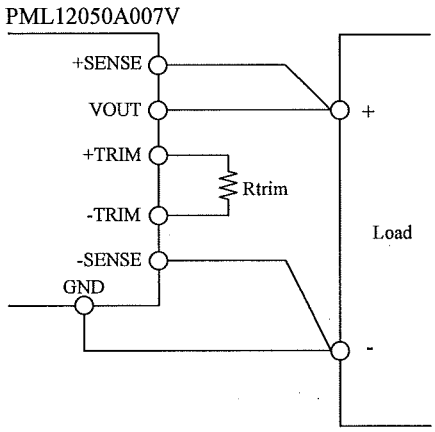


Fig.2-2 PML12050A007V
Connection for output voltage adjustment

Equation of external resistor and output voltage is shown in below.

$$\text{Rtrim} = \left(\frac{7}{\text{Vout} - 0.7} \right) \quad [\text{k}\Omega]$$

Rtrim : External resistor
Vout : Output voltage set-point

The value of Rtrim for typical output voltage is shown in Table 2-1.

Vout (V)	Rtrim (kΩ)
0.7	Open
1.0	23.33
1.2	14.00
1.5	8.75
1.8	6.36
2.0	5.38

Table.2-1

The value of Rtrim for typical output voltage

3. Maximum Ripple and Noise

Measured value according to the specified methods based on JEITA-9141 (Clause 7.12 and clause 7.13) which is described in the following.

Connect according to Fig.3-1 and measure. Connect ceramic capacitors (C2, C3) at 50mm distance from the output terminals. Measure at ceramic capacitor (C3) terminals as shown in Fig. 3-1 using coaxial cable with JEITA attachment. Use oscilloscope with 100MHz frequency bandwidth or equivalent.

Take note that PCB wiring design might influence output spike noise voltage.

Generally, increasing capacitance value of external capacitor can reduce output ripple voltage and output spike noise.

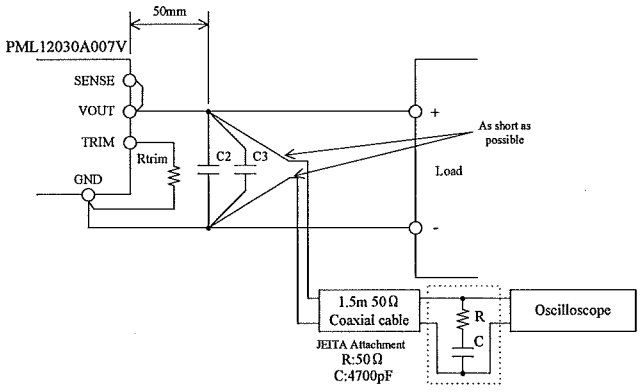


Fig.3-1 PML12030A007V
Measurement of Maximum Output Ripple & Noise

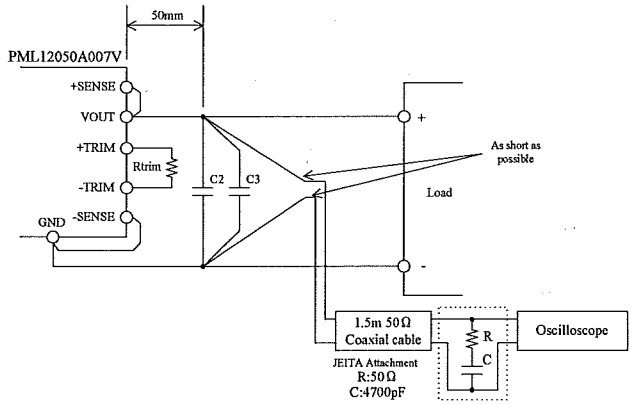


Fig.3-2 PML12050A007V
Measurement of Maximum Output Ripple & Noise

4. Maximum Line Regulation

Maximum value of output voltage change when input voltage is gradually varied (steady state) within specified input voltage range.

5. Maximum Load Regulation

Maximum value of output voltage change when output current is gradually varied (steady state) within specified output current range.

When using at dynamic load mode, output voltage fluctuation might increase. A thorough pre-evaluation must be performed before using this power module.

6. Over Current Protection (OCP)

This power module has built-in OCP function.

In the state of short circuit or overload, it becomes intermittent operation. Output will restart automatically when short circuit or overload conditions are released. OCP setting value is fixed and therefore, cannot be externally adjusted.

Also, take note that power module might be damaged continuing output short circuit or over load conditions depending on thermal conditions.

7. Over Temperature Protection (OTP)

This power module has built-in OTP function.

This function operates and shuts down the output when ambient temperature or internal temperature of power module abnormally rises. OTP operates at 140℃ (Typ.) by components temperature(Tc) OTP can be released when component temperature drops down approximately to 100℃(typ.) or less. However, take note that OTP will operate again unless the cause of abnormal heat of the power module is eliminated.

Please refer to "Output Derating" for Tc measurement point.

8. Remote Sensing

(SENSE terminal or +SENSE, -SENSE terminal)

Remote sensing terminal is provided to compensate for voltage drop across the wirings from the power module output terminal to the load input terminal.

When remote sensing function is not used (local sensing), short SENSE terminal to VOUT terminal at PML12030A007V, short +SENSE terminal to VOUT terminal and –SENSE terminal to GND terminal at PML12050A007V.

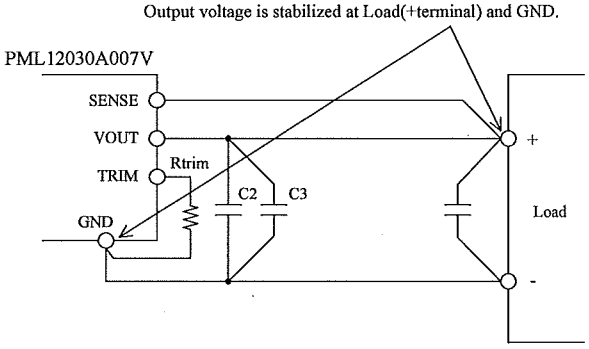


Fig.8-1 PML12030A007V Remote Sensing is in Use

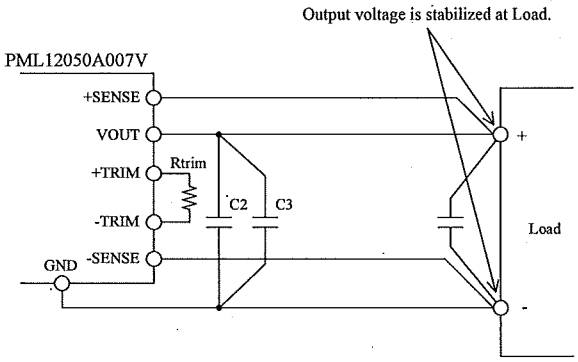


Fig.8-2 PML12050A007V Remote Sensing is in Use

Line drop between VOUT terminal and sensing point (for PML12050A007V, line drop between sensing point and GND terminal shall be included) should be less than 0.5V. When using remote sensing, voltage at the VOUT terminal should not exceeded maximum allowable adjust voltage rating.

Furthermore, reduce noise effect by using shield wire, twist pair, or parallel pattern.

For remote sensing, when voltage becomes unstable at the load terminal, attach additional capacitor at the load terminal. However, load capacitance should not exceed maximum allowable output capacitance.

9. Remote ON/OFF (ON/OFF terminal)

Output also can be turned ON or OFF by using the Remote ON/OFF terminal when input line is active.

There are two types of logic available for this function namely, Negative and Positive Logic.

When ON/OFF function is not used, leave the ON/OFF terminal open.

To use ON/OFF function, attach a pull-up resistor R1 between the VIN terminal and the ON/OFF terminal, and a switch between the ON/OFF terminal and GND terminal, as shown in Fig. 9-1.

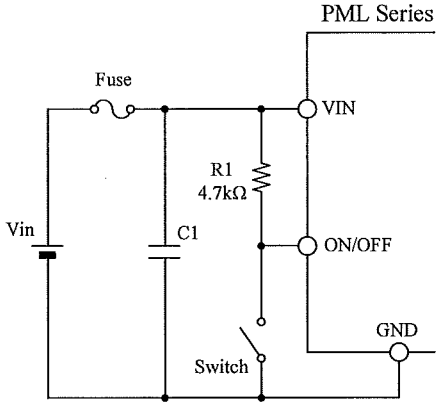


Fig.9-1 ON/OFF Terminal Connection

Logic	Switch	Output Status
Negative Logic	Short (0V≦ON/OFF≦0.8V)	ON
	Open (4V≦ON/OFF≦14V)	OFF
Positive Logic	Short (0V≦ON/OFF≦0.8V)	OFF
	Open (4V≦ON/OFF≦14V)	ON

Table 9-1. ON/OFF Terminal Connection

10. Parallel Operation (SHARE Terminal)

By connecting the SHARE Terminal of each POL connected in parallel, total output current can be shared among the connected POLs. Parallel operation can only be done for similar output models. Maximum allowable connection in parallel is two units.

However, allowable maximum output current is limited in parallel operation as shown below. Exceeding this limit, will cause the Over Current or Over Temperature Protection to activate.

Model	Maximum Allowable Units	Maximum Allowable Total Output Current
PML12030A007V	2 units	80% of the total rated output current
PML12050A007V	2 units	85% of the total rated output current

Table 10-1 Allowable Range in Parallel Operation

For other operating conditions aside from the above, consult our Customer Support Group.

If output voltage need to be adjusted, attach Rtrim across each TRIM terminal of the POL.

Note)

1. Impedance of each output wire from each POL output to the load should be equal. If the impedance is different, current imbalance might occur which might cause the Over Current or Over Temperature Protection to activate.
2. Take into consideration line drop when using Remote Sensing. Refer to "1.8 Remote Sensing" section for details.
3. At output rise up, initially set the load to within maximum output current of one unit only. If initial load current is exceed the maximum output current rating of one unit, Over Current Protection might activate.

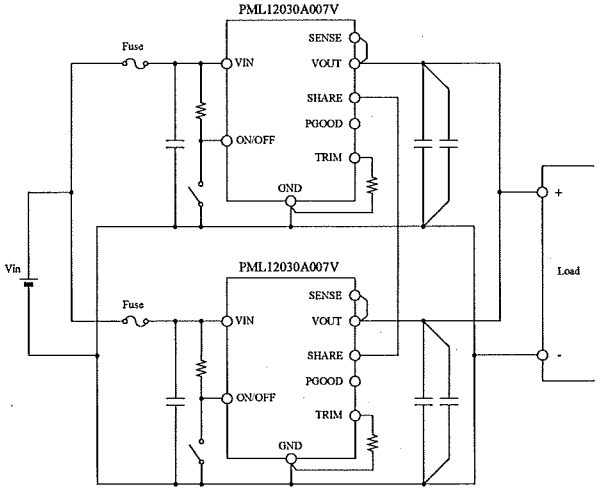


Fig. 10-1. PML12030A007V Parallel Operation Connection

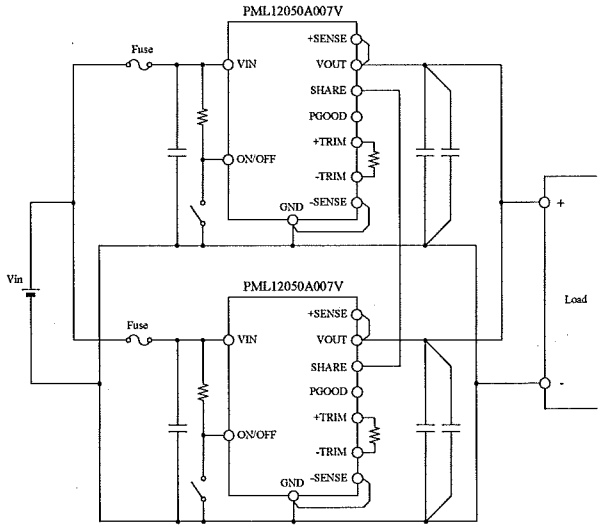


Fig. 10-2. PML12050A007V Parallel Operation Connection

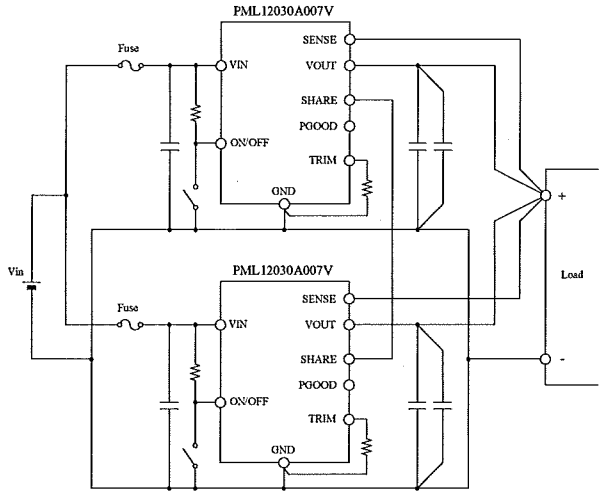


Fig. 10-3. PML12030A007V Parallel Operation Connection when using Remote Sensing function

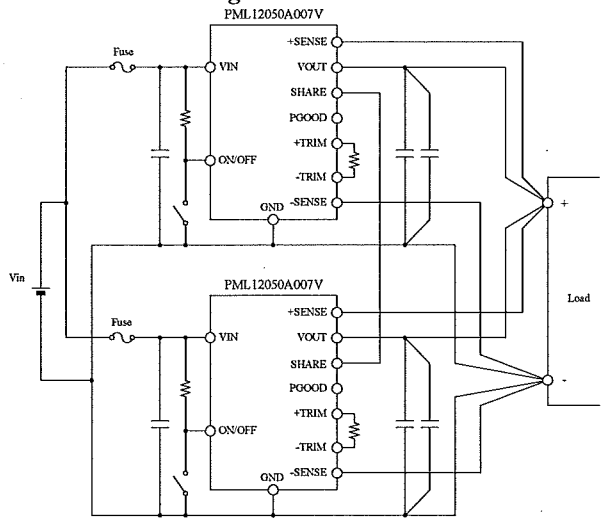


Fig. 10-4. PML12050A007V Parallel Operation Connection when using Remote Sensing function

11. Power Good Signal (PGOOD Terminal)

By connecting PGOOD terminal, normal or abnormal operation of this POL can be monitored.

This monitor signal output is pulled-up to 5V internally. If output voltage is normal, PGOOD is High, if abnormal or not operating, PGOOD is Low.

PGOOD terminal ground is the GND Terminal.

Output Voltage	PGOOD Voltage
Normal Operation	4V ≦ PGOOD
Abnormal or Not Operating	1V ≧ PGOOD

Table 11-1 PGOOD Terminal Voltage

12. Operating Ambient Temperature

This is the allowable operating range.

Output Load needs to be derated depending on the ambient temperature. There is no restriction on mounting direction but there should be enough consideration for airflow so that heat does not accumulate around the POL vicinity.

Determine external components configuration and mounting direction on PCB such that air could flow around the POL at forced cooling and conventional cooling.

For better improvement of POL reliability, derating of ambient temperature is recommended.

For details, refer to "Output Derating" section.

13. Operating Ambient Humidity

Take note that condensation could lead to POL abnormal operation or damage.

14. Storage Ambient Temperature

Abrupt temperature change would cause condensation that leads to poor solderabilty of each terminal of the POL.

15. Storage Ambient Humidity

Take enough care when storing the POL because rust which causes poor solderability would form in each terminal when stored in high temperature, high humidity environment.

■Output Derating

There is no restriction on mounting direction but there should be enough consideration for airflow so that heat does not accumulate around the POL vicinity. Determine external components configuration and mounting direction on PCB such that air could flow around the POL at forced cooling and conventional cooling.

Output Current derating vs Ambient Temperature of PML30 and PML50 is measured according to Fig.1 and Fig.2. When mounting on actual device, do actual measurement based on measurement points shown in Fig. 1 and Fig. 2. For this measurement, in order not to exceed the maximum Tc of the critical component, refer to the temperature measurement point shown on Fig.3 and Fig. 4.

(1) Output Current Derating vs. Ambient Temperature Measurement Method

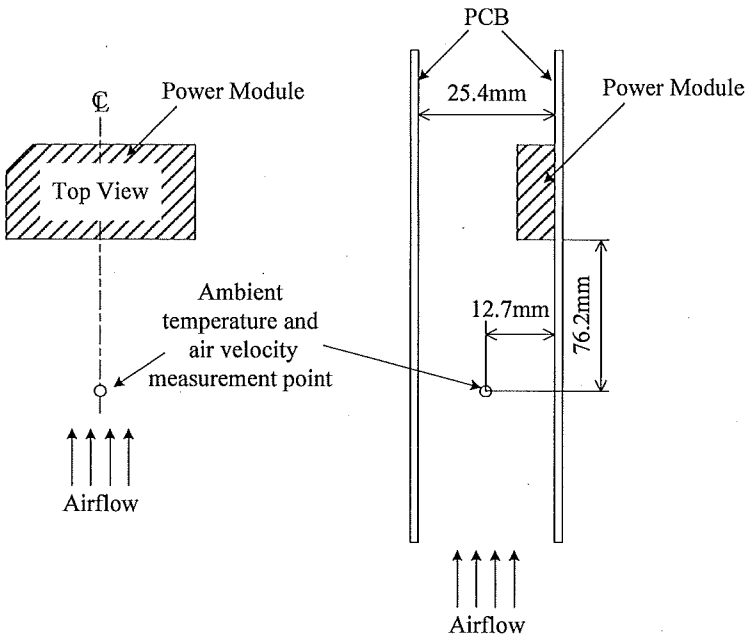


Fig. 1. PML12030A007V Output Current Derating vs. Ambient Temperature Measurement Method

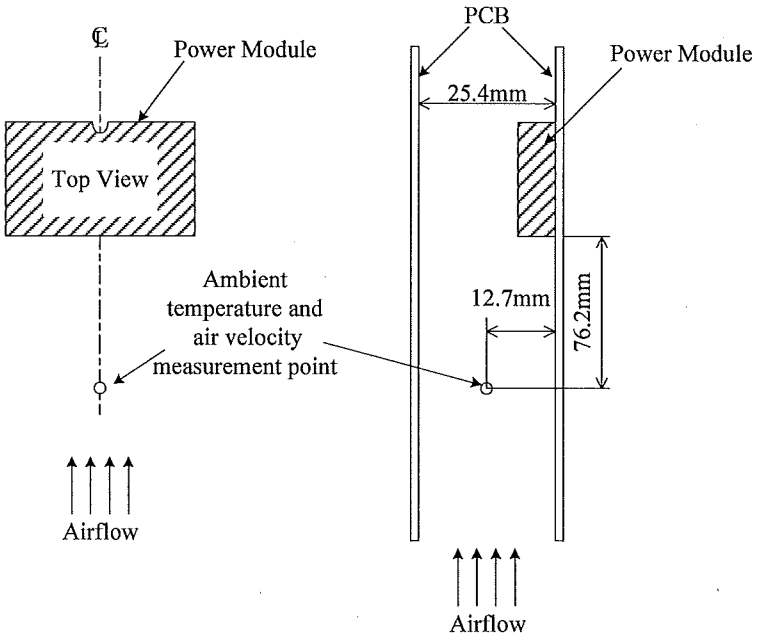
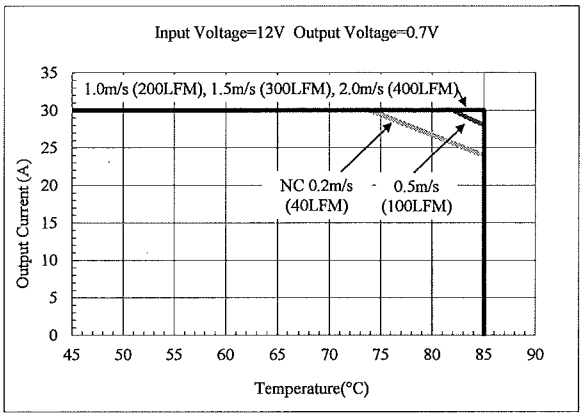
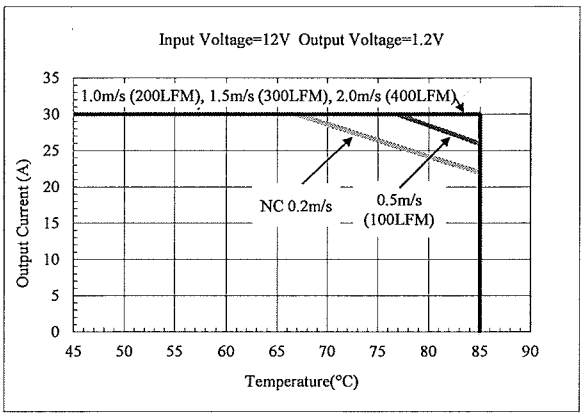
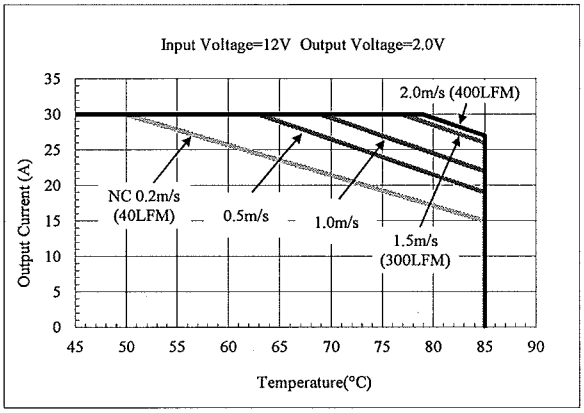


Fig.2. PML12050A007V Output Current Derating vs. Ambient Temperature Measurement Method

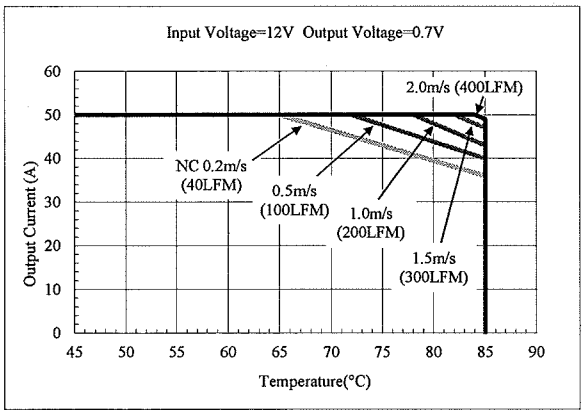
(2) PML12030A007V Output Current Derating vs. Ambient Temperature (Ref Data)

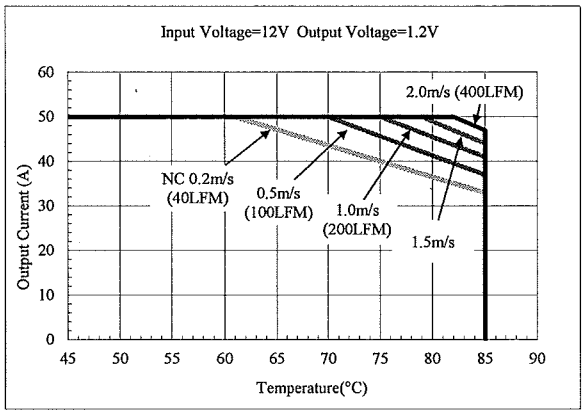


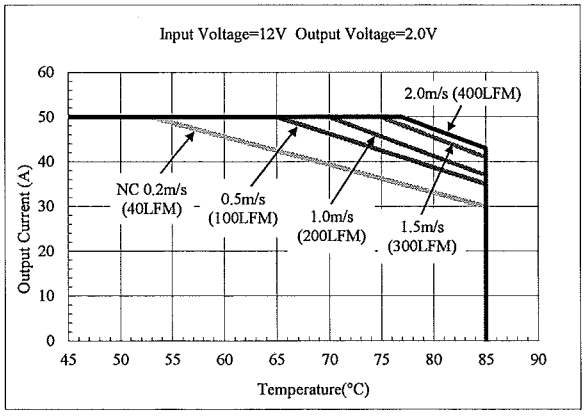




(3) PML12050A007V Output Current Derating vs. Ambient Temperature (Ref Data)







(4) Tc Measurement Point

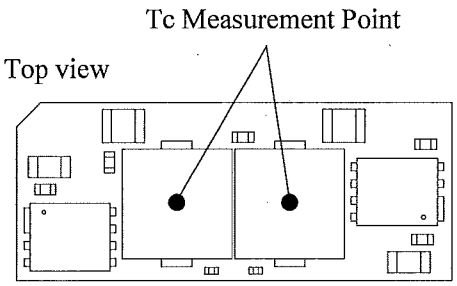


Fig 3 PML12030A007V
Tc Measurement Point

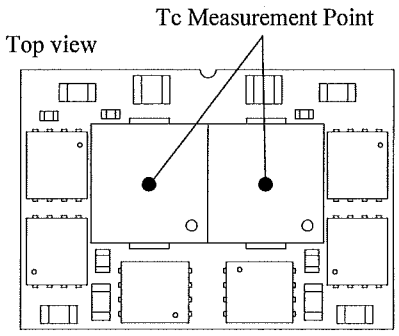
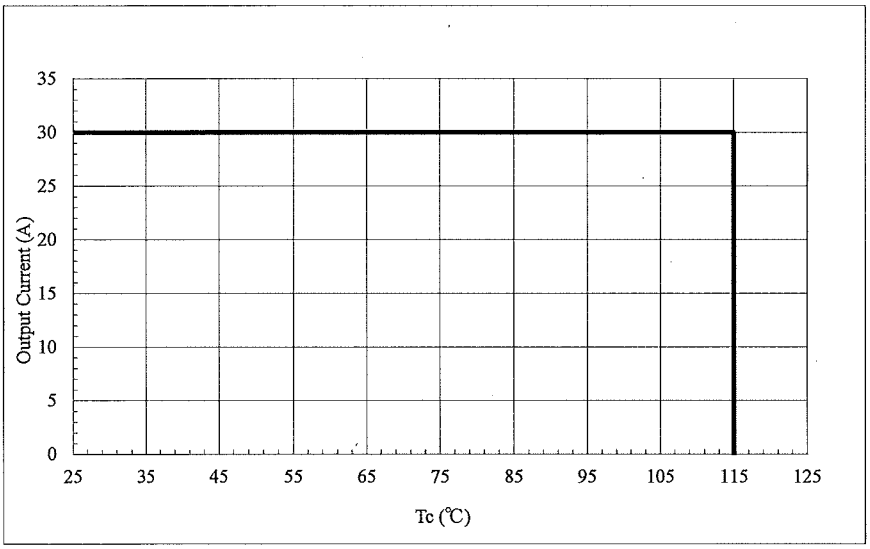
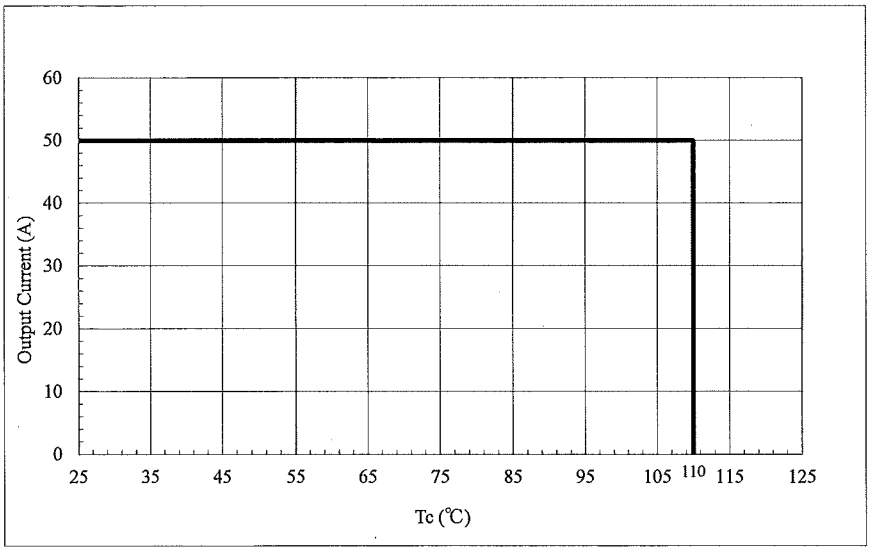


Fig 4 PML12050A007V
Tc Measurement Point

(5) PML12030A007V Derating Curve vs.Tc



(6) PML12050A007V Derating Curve vs. Tc



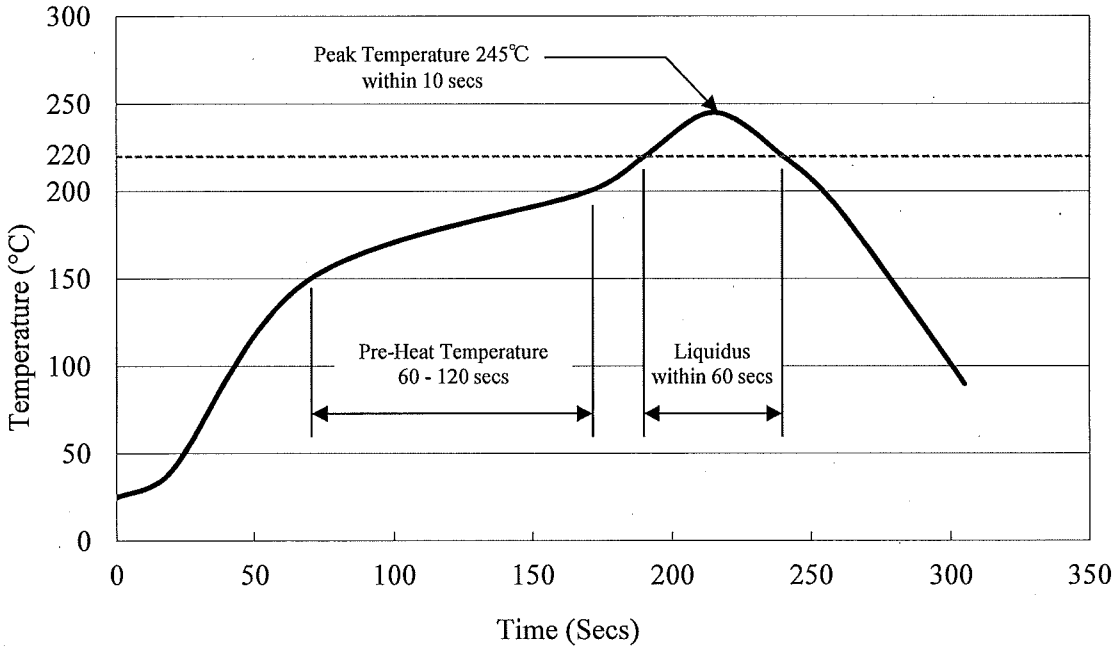
■Mounting Method

1. About Automatic Mounting

Automatic Mounting is possible for this POL. When mounting, ensure that polarity is correct.

2. Reflow Soldering Method

Recommended Reflow Profile



Allowable no. of Reflows	: 1 time
Pre-Heat Temperature	: 150℃ ～ 200℃, 60 ～ 120 secs
Liquidus	: 220℃ or more within 60 secs
Peak Temperature	: 245℃ within 10 secs

Surface Temperature of each Model

Monitor Surface Temperature at the Measurement Point for each model shown in the table below.

Model	Surface Temperature Measurement Point
PML12030A007V	Pin 1 and Pin 5
PML12050A007V	Pin 3 and Pin 7

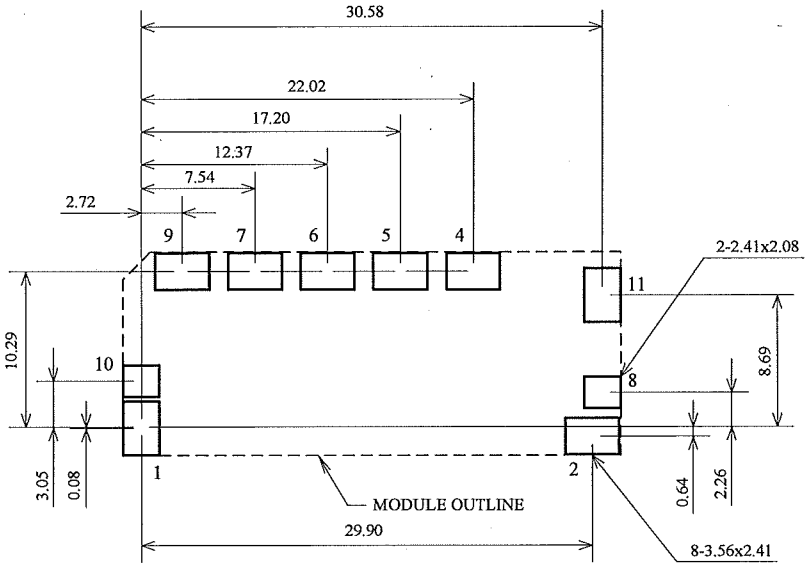
3.About Cleaning

This POL uses non-cleaning flux solder. Therefore, cleaning is not recommended.

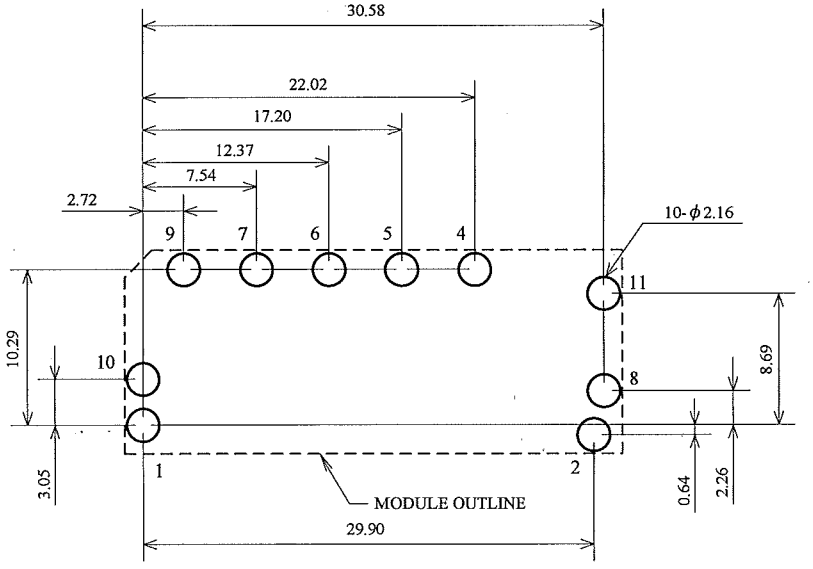
4. Recommended Pad Dimension

1) PML12030A007V Recommended Pad Dimension

STANDARD PAD SIZE



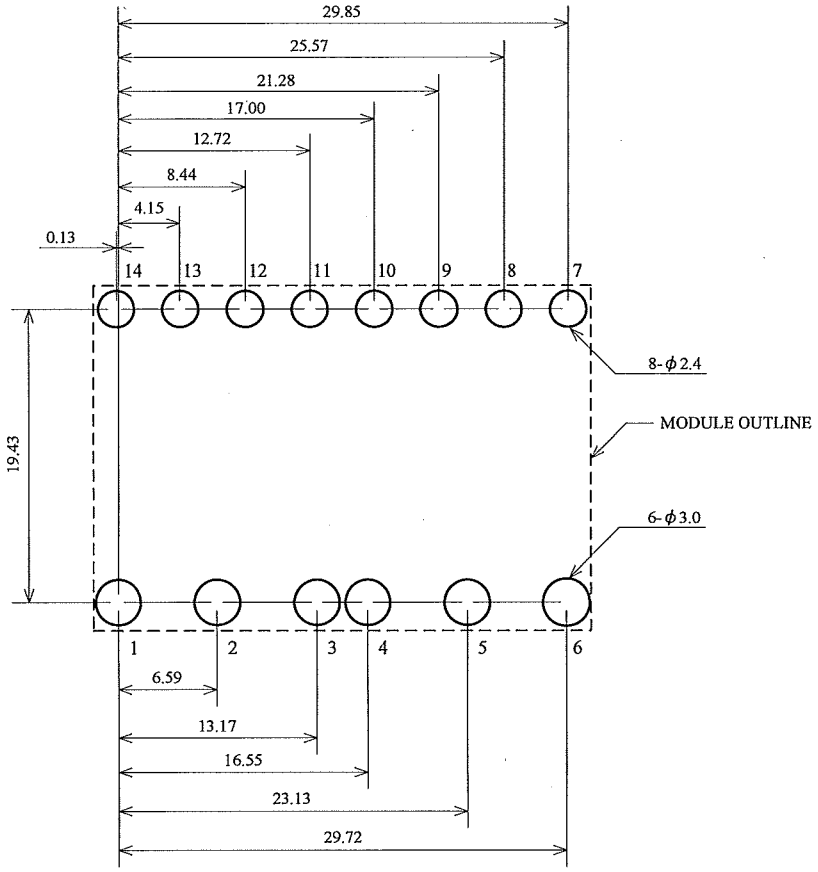
ALTERNATIVE PAD SIZE



Unit is mm
Unless otherwise, specified tolerance is ±0.25.

2) PML12050A007V Recommended Pad Dimension

STANDARD PAD SIZE



Unit is mm
Unless otherwise, specified tolerance is ±0.25.

5. Storage Conditions

This POL is composed of multi-layer PWB. Depending on storing method, failure such as pattern cut might occur during reflow. Store POL at MSL(Moisture Sensitivity Level) 2 environmental condition or equivalent.

Storage Temperature : 30℃ or below
Storage Humidity : 60%RH or below

Also, when POL has been stored for more than a year, or when the indicator indicates humidity more than 60%, perform baking.

Recommended Baking Condition : 125℃ 24 hours

Note that Taping Reel is not designed to withstand high temperature. Be sure to remove the POLs from the Taping Reel when baking.

Before concluding Power Module damage

Verify following items before concluding power module damage.

1) No output voltage
- Is specified input voltage applied?
- Are the Remote ON/OFF Terminal (ON/OFF), remote sensing terminal (SENSE, or +SENSE,-SENSE), output voltage trimming terminal (TRIM, or +TRIM, -TRIM) correctly connected?
- For cases where output voltage adjustment is used, is the resistor or variable resistor setting, connections correctly done?
- Are there no abnormalities in the output load used?
- Is the Ta, Tc within the specified temperature range?

2) Output voltage is high
- Are the remote sensing terminals (SENSE, and +SENSE, -SENSE) correctly connected?
- Is the measurement done at the sensing points?
- For cases where output voltage adjustment is used, is the resistor or variable resistor setting, connections correctly done?

3) Output voltage is low
- Is the input voltage within specification range?
- Are the remote sensing terminals (SENSE, and +SENSE, -SENSE) correctly connected?
- Is the measurement done at the sensing points?
- For cases where output voltage adjustment is used, is the resistor or variable resistor setting, connections correctly done?
- Are there no abnormalities in the load used?

4) Load regulation and line regulation is large
- Is the input voltage within specification range?
- Are the input terminals and the output terminals firmly connected?
- Is the measurement done at the sensing points?
- Is the input or output wire too thin?
- Is the input or output wire too long?

5) Output ripple voltage is large
- Is the measuring method used the same or equivalent with the specified method in the Application Notes?