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Power supply for MPPC

C11204-03

Operation Manual

Be sure to read the operation manual carefully before this board is used.
If operated differently from the standard procedure in the manual,
a serious accident may occur.
Keep this manual for future reference.

Doc. No. K29-B61800e

Revision A Jul.26, 2016

FormKXX-3513 B

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1. OVERVIEW

This module is a high-voltage power supply that is optimized for driving HAMAMATSU MPPC (multi-pixel photon counter) series. This module is available under the magnetic field environment, because it does not have a built-in inductor inside.
It can output up to 80V by applying external hight voltage. It contains a temperature compensation function that constantly optimizes the MPPC operation even in environments with varying temperatures. It also has built-in output voltage monitor and output current monitor. All function can be controlled from a PC via its serial interface (UART). This module is available in a 16-lead hybrid board.

■ Features

- Available under the magnetic field environment
- Wide output voltage range: 0 V to 80 V
- Superb temperatures stability: ±10ppm/°C typ.
- Finely adjustable resolution (in 1.8 mV steps)
- Serial interface
- Over current protection

2. PRECAUTIONS FOR USE

WARNING

■ High voltage hazard!

This module includes a high-voltage parts needed to operate the MPPC. Touching the high voltage parts may cause electrical shock, numbness or tingling. Also, improper short circuit may cause malfunction or failure. If you have to touch this module, always first turn off the power and wait at least 10 seconds before touching.

■ Do not disassemble.

Do not disassemble any part of this module. Changing the adjustment or modifying this module may cause malfunctions and lead to fire or electrical shock.

■ Keep away from water or any liquid.

Electrical shock or damage may occur if this module becomes wet.

■ Be sure to connect the wiring correctly.

Incorrect wiring may cause excessive current flow, resulting in damage to components and connected devices, or fire.

■ Always observe the absolute maximum ratings.

Do not use this module under conditions that exceed the absolute maximum ratings. Damage to this module or fire may result if used in excess of the absolute maximum ratings.

■ Be careful to avoid short-circuits.

During operation do not bring any conductive objects such as metal close to the PC board. These may cause short-circuits that damage the module or cause fire.

■ Take adequate care to make sure that the soldering iron tip temperature and the soldering time are correct. Do not attempt soldering at high temperatures or long periods.

Soldering of this product should be made by using a soldering iron. Recommended solder temperature is 260 degree or less, the soldering time should be done within 10 seconds.

3. PIN ASSIGN

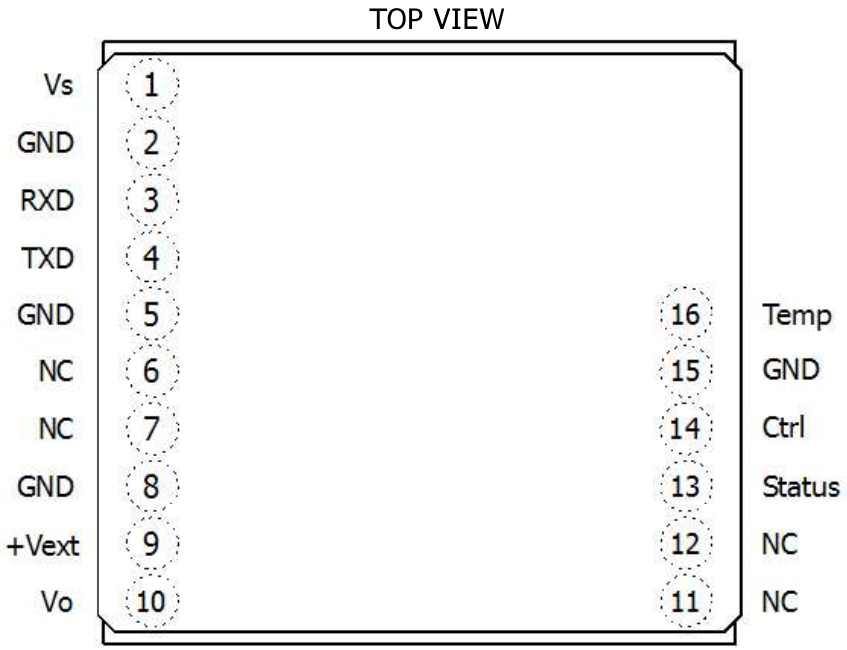


Fig.1 Pin assign

Table.1 Description of pin function

Pin no.	Symbol	Function
1	Vs	Positive supply voltage Furnish a bypass capacitor to ground as close to this pin as possible.*1
2,5,8,15	GND	GND Connect directly to the ground plane using the shortest wire possible.
3	RXD	Serial data input
4	TXD	Serial data output
6,7,11,12	NC	NC
9	+Vext	High voltage input Do not apply a voltage higher than 85 V.
10	Vo	High voltage output
13	Status	Status monitor*2
14	Ctrl	Output voltage ON/OFF control*3
16	Temp	Analog temperature sensor connection Connect to an analog temperature sensor.

*1: Refer to [5.OPERATION MANUAL]
*2: Refer to [6.FUNCTIONS], [C11204-03 Command Reference]
*3: Refer to [6.FUNCTIONS]

4. CONNECTION CIRCUIT EXAMPLE

4-1.Power Supply Pin (Vs) connection

Connect the power supply voltage to this pin (Pin 1). In this case, please connect a bypass capacitor between the GND. The bypass capacitor should be connected near the pin as possible.

4-2.External high voltage Pin (+Vext) connection

Connect the external supply voltage pin (9 pin) to power supply that can be output up to +80V about. In this case, please connect a bypass capacitor between the GND. The bypass capacitor should be connected near the pin as possible.
It is recommended to use a power supply with lower ripple noise.
Use the external power supply with a capacity of at least 3mA per one of the power supply module.

4-3.High Voltage Output Pin (Vo) connect

Connect HAMAMATSU MPPC Series to this pin (Pin 10). This pin must be connected to low pass filter to suppress the ripple noise (See Fig. 2). Low ESR capacitors should be used at the output to minimize the output voltage ripple.

4-4.RXD Pin and TXD Pin (RXD, TXD) connect

These are used for serial communication. The RXD (Pin 3) should be connected to a TXD of host. Similarly, the TXD (pin 4) should be connected to a RXD of host. Refer to Command Reference for the communication specification.
The details of the communication are described for "C11204-03 Command Reference".

4-5.Temperature sensor Pin (Temp) connect

Connect analog temperature sensor (Texas Instruments; LM94021) to this pin (Pin 16) (See Fig. 2). Put a low-pass filter near this pin to remove a noise from C11204-03 (See Fig. 2). The pin 1 and pin 5 of the temperature sensor must be connected to GND. If you don't use a temperature sensor, this pin must be connected to GND. When it is not connected, there is the case that the temperature compensation function will be malfunction.

4-6.Output voltage ON/OFF control Pin (Ctrl) connect

To turn OFF the output voltage, connect the output voltage ON/OFF control pin (14 pin) to Vih (High level). To ON the output voltage is connected to Vil (Low level).
If you do not want to use the output voltage ON / OFF control, please unconnected.
ON/OFF control function of control voltage input is not the default function. Please enable this function by the "Power supply function setting" command if you want to use it.

4-7.Sutatus monitor Pin (Status) connect

If the status is of the error state, the output is the High, will be the case of the normal output is Low. If you want to use the status monitor, should be connected status monitor pin (13 pin) microcontroller and testers, to an oscilloscope or the like.
If you do not want to use the Status Monitor, please unconnected.

*If you do not want to use the Ctrl terminal, after the power is turned on it will be output immediately high voltage.

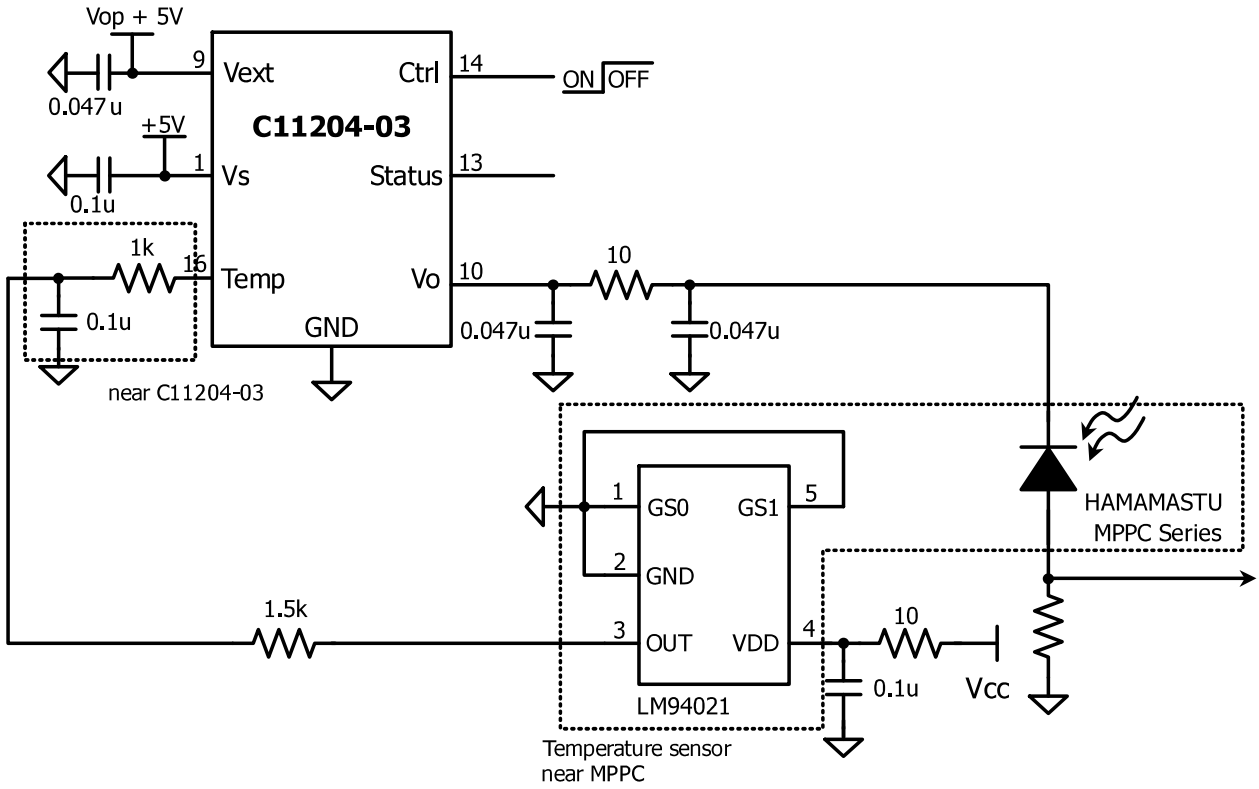


Fig.2 Connection circuit example

5. OPERATION METHOD

5-1.Installation method

■Mounting to socket

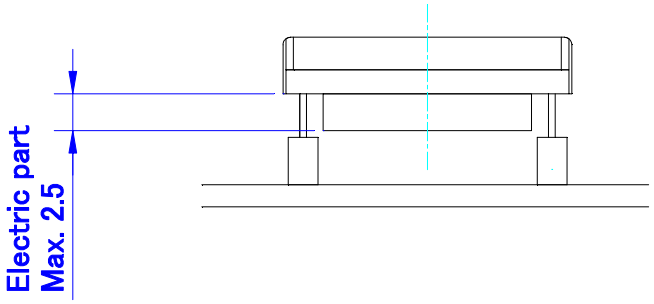


Fig.3 Mounting to the socket

*Recommendation socket: ME-10-10(MAC8)

■Soldering to PCB

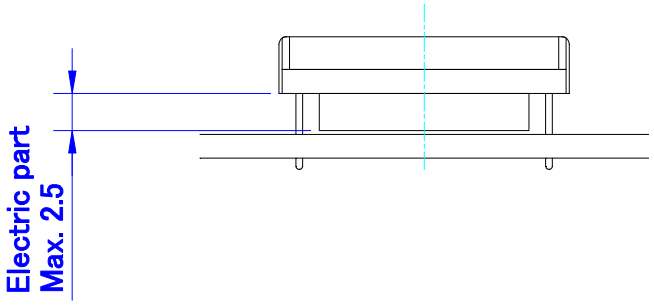


Fig.4 Soldering to PCB

If the tall parts are located at the under of the power supply, there is a possibility to contact with the electronic components of the power supply module. Do not locate the tall parts under the power supply as possible.

5-2.Power ON method

1. External supply voltage is applied
External supply voltage should be applied prior to turning on the power module.
Recommended supply voltage is Vop + 5V of MPPC to be used.
When the external supply voltage is applied in a state in which the power is turned on the power supply module, high voltage of up to about external supply voltage will be output.

2. Turn the power on
The power supply module and turn on the power supply (+5V).
By default, the high voltage +40V is output.
After the power is turned on, check whether excessive current is flow the device and whether the device is operating abnormally, for example if smoke is coming out.
If any abnormal operation occurs, immediately power off.

3. Setting of the output voltage
Set the parameters of the power supply module so that the output voltage to match the MPPC you want to use. About the information about how to set the output voltage, refer to the temperature compensation function of 6.FUNCTIONS.

5-3.Power OFF method

After turning off the external supply voltage, turn off the power of the power supply module.
If you want to turn ON the power again, please be performed according to the procedure of 5-2. Power ON method.

6. FUNCTIONS

6-1.Temperature compensation function

When the ambient temperature of the MPPC is changed, is a function of outputting the calculated voltage value based on a correction coefficient set in the power module. The output voltage is decided by setting the reference voltage Vb[V], the reference temperature Tb[°C], the primary temperature coefficient ΔT[mV/°C], and the secondly temperature coefficient ΔT'[mV/°C]. It can be done a "temperature compensation" and "output voltage setting", by setting each parameter.
All setting of the C11204-03 uses serial communication (UART).

1.Output voltage setup
This function can set the output voltage to any value. The output voltage is decided by setting the reference voltage Vb[V]. Please use command of "Temperature correction factor setting" to set it (See C11204-03 Command Reference).
For how to calculate the output voltage, refer to the "Temperature compensation" in the next.

2.Temperature compensation
This function performs temperature compensation of the output voltage using the temperature T[°C] of the external temperature sensor.
The output voltage Vo[V] is determined by the following formula.

$$Vo = (\Delta T' * (T - Tb)^2 + \Delta T * (T - Tb)) / 1000 + Vb$$

Where ΔT[mV/°C] is temperature coefficient, T[°C] is temperature of the external temperature sensor. Temperature coefficient・・・ΔT[mV/°C] can set to four parameters of high temperature side coefficient ΔT'1[mV/°C^2], ΔT1[mV/°C] and primary low temperature side coefficient ΔT'2[mV/°C^2], ΔT2[mV/°C] (See Fig. 1). If you don't use this function, please input 0 into ΔT'1 and ΔT.
When the temperature of the temperature sensor deviates significantly, the temperature compensation function becomes OFF forcibly. In this case, the output voltage will be set to the reference voltage Vb[V].

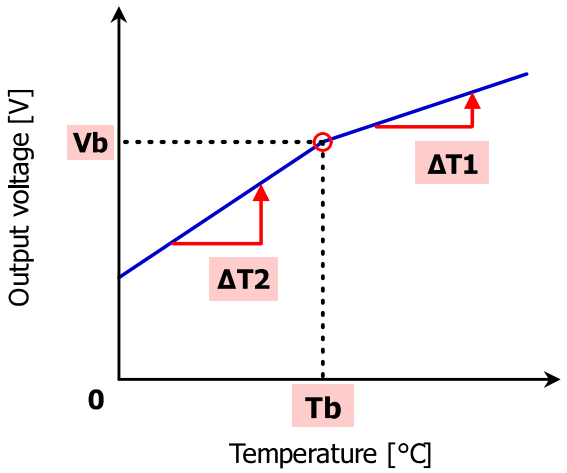


Fig.5 Temperature compensation function

6-2.Monitor function

It can be measured the output voltage Vo[V], output current Id[mV], and external temperature sensor value T[°C]. If you want to get the monitor value, "Get the monitor information and status", "Get output voltage", "Get output current", use the "Get MPPC temperature" command (See C11204-03 Command Reference).

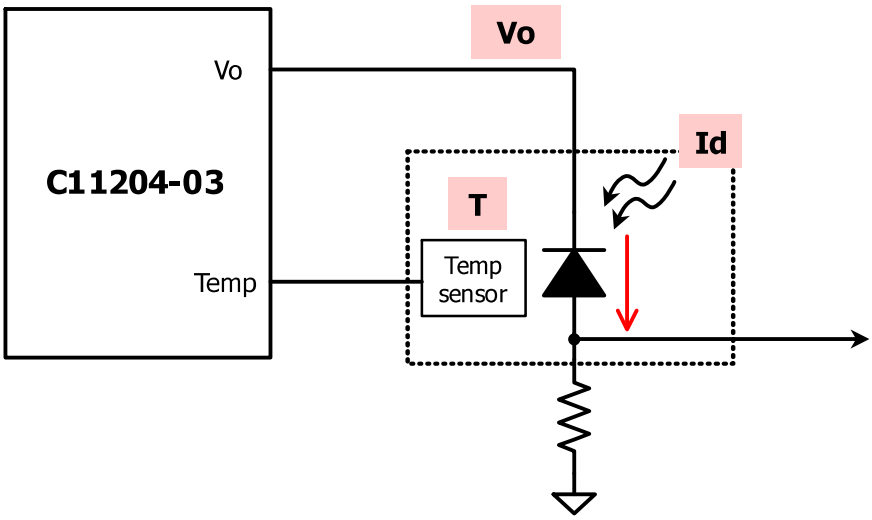


Fig.6 Monitor function

6-3.Output voltage ON/OFF control function

This function is to switch the ON / OFF of the output voltage from the outside. There are two switching method of command and control voltage input.
In the case of state [ON], the setting voltage will be output. In the case of state [OFF], the output voltage becomes 0V. If you do not want to use the Ctrl terminal, after the power is turned on it will be output immediately high voltage.

1.Command
If you want to [OFF] state use the "High voltage output OFF" command. If you want to [ON] state use the "High voltage output ON" command (See C11204-03 Command Reference).

2.Control voltage input
If you use the ON / OFF control function of the control voltage input, it must be so that a High/Low voltage can be applied to the output voltage ON/OFF control pin (14 pin).
When you enter the Vil (Low level) to the output voltage ON / OFF control pin, the output voltage turns ON. When you enter the Vih (High level), the output voltage is turned OFF.
Please enable this function by the "Power supply function setting" command if you want to use it.

6-4.Overcurrent protection function

When an overcurrent flows through the MPPC, overcurrent protection function operates in order to protect the MPPC.
One is automatic restoration mode, one is a mode which stops the output of the high voltage. At the default, the automatic restoration mode is selected.
However, it is possible to change to the mode of stopping the output by the command. (See C11204-03 Command Reference)

1.Automatic restoration mode

When current load exceeded a threshold level more than 4 seconds, the applied voltage to MPPC will be lower to about half. And while monitoring the consumption current to the MPPC, the voltage applied to the MPPC will be gradually increased. It will return to the original setting voltage at the time when the normal current value has been confirmed.

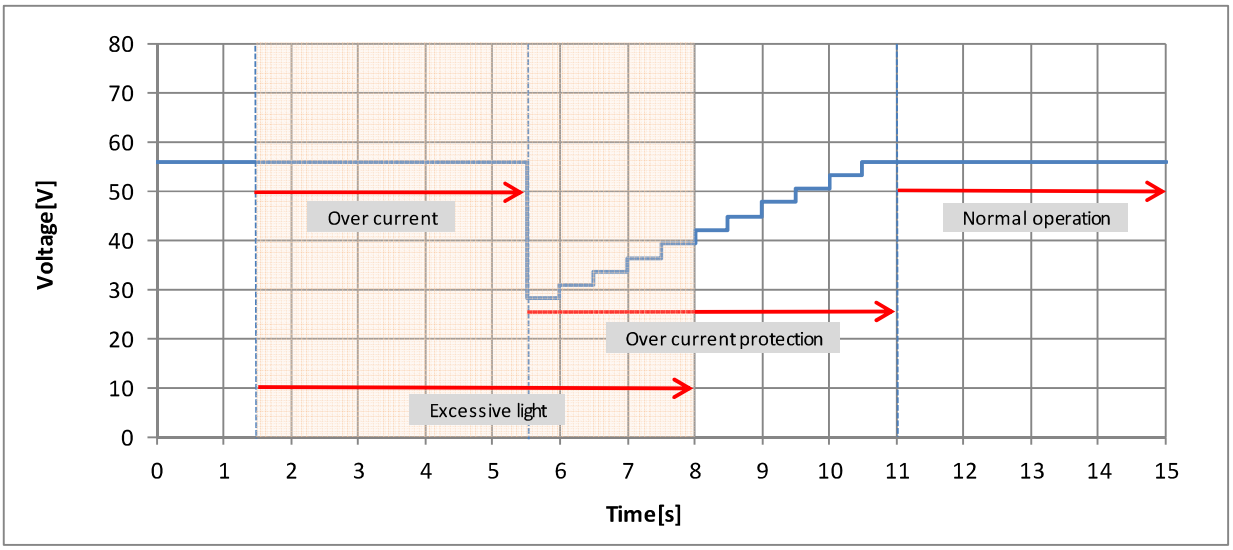


Fig.7 Automatic restoration mode normal operation Migration

In addition, this function is to stop the high-voltage and the current value of more than 3mA from migrating to the mode in which the automatic return is detected three times.
When you want to output the high voltage again, please send a reset command or reboot the C11204-03.

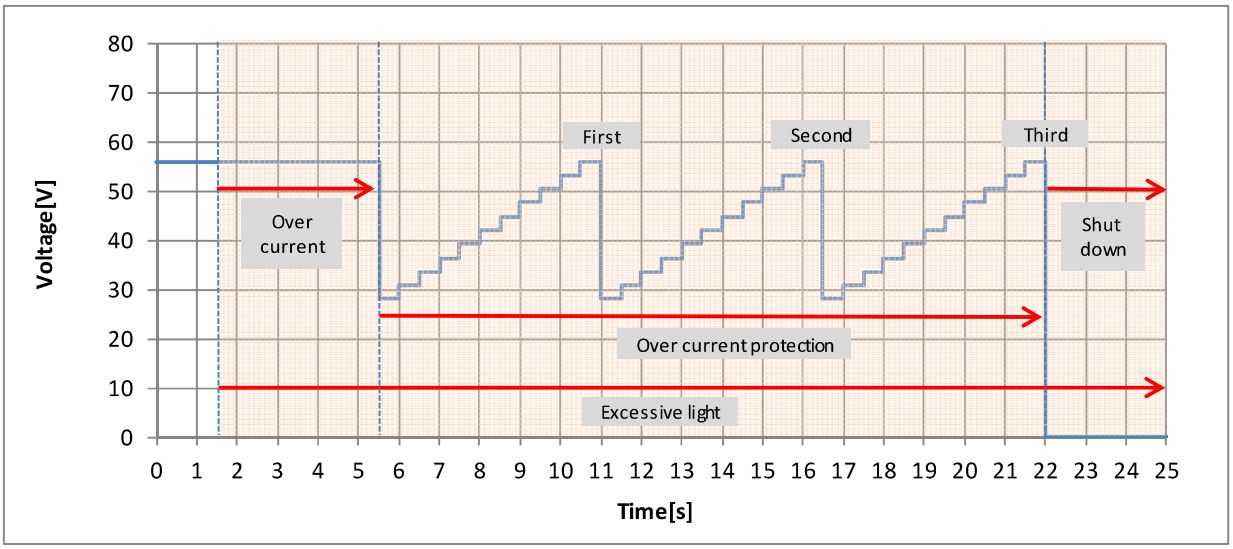


Fig.8 Automatic restoration mode

2.High voltage stop mode

When current load exceeded a threshold level more than 4 seconds, the output voltage becomes 0V. The threshold of the default is 3mA. When you want to output the high voltage again, please send a reset command or reboot the C11204-03.

6-5.Status notification function

This function is used to notify the status information of the power supply.
There are two confirmation methods: By command and by output from status monitor pin.
It can get more detailed information by using command than by output from status monitor pin.

1.Command

If you want to get the power status, use the command "Get the monitor information and status" or "Get status". (See C11204-03 Command Reference)
To get the detailed status information, please check the command reference.

2.Status monitor pin

If any of the following occurs, the output of the status monitor pin is High. If none are confirmed it will be Low.
"Overcurrent to the MPPC"
"Non-connection of the temperature sensor"
"Abnormal temperature from the temperature sensor"
"While in voltage control Voltage"

Which symptoms has occurred, it cannot be confirmed from the status monitor pin output.

7. SPECIFICATION

7-1.Absolute maximum ratings

Parameter	Symbol	Condition	Value	Unit
Supply voltage	Vs		6	V
Low level input voltage	Vil	RXD, output voltage control	-0.3	V
High level input voltage	Vih	RXD, output voltage control	Vs + 0.3	V
External high voltage	Vext		+85	V
Operating temperature	Topr	No dew condensation	-20 to +60	°C
Storage temperature	Tstg	No dew condensation	-30 to +85	°C

7-2.General rating

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply voltage	Vs		4.75	5	5.25	V
External high voltage	Vext		-	Vop + 5	80	V

Vop=MPPC recommended operating voltage

7-3.Specification

(Typ. Ta=25°C, Vs=+5V, unless otherwise noted)

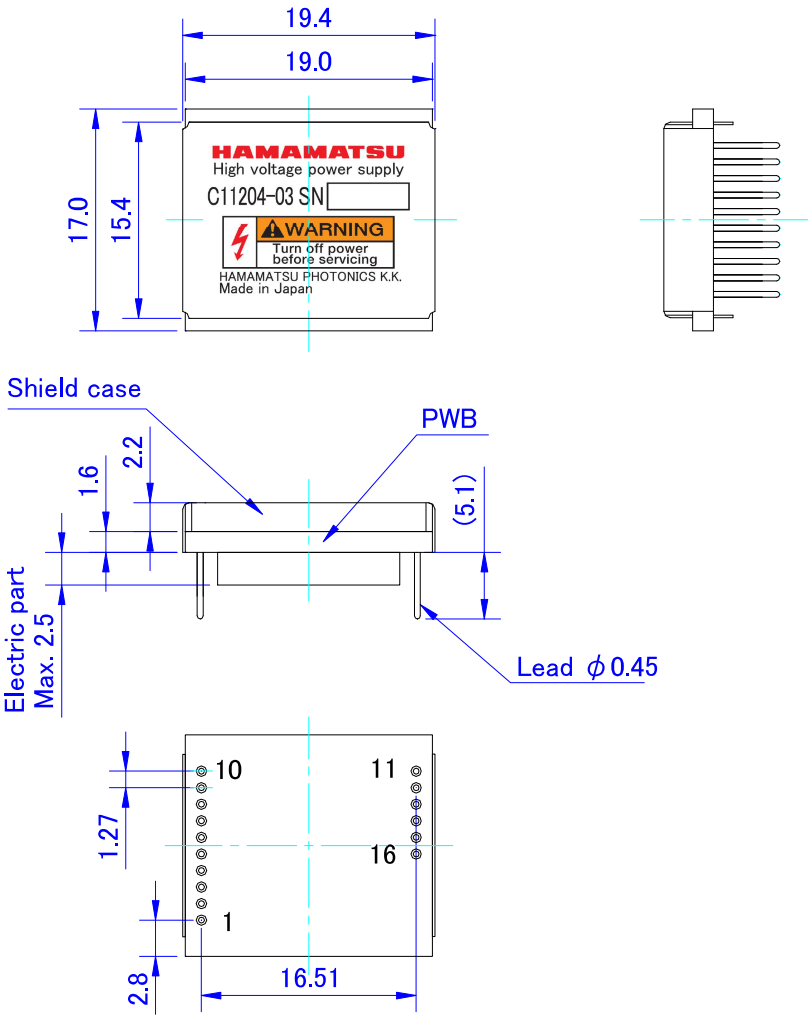
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Current consumption	Icc	Vo=56V, No load	-	5	10	mA
Output voltage	Vo	No load	-	0 to Vext	-	V
Output current	Io		0	-	2	mA
Setting precision	-	Vo=56V, No load	-	±10	-	mV
Setting resolution	-		-	1.8	-	mV
Temperature stability	-	25°C±10°C Vo=56V, No load	-	±10	-	ppm/°C
Interface	-		Serial communication (UART)			-
Low level input voltage	Vil	RXD, Output voltage control	0	-	0.4Vs	V
High level input voltage	Vih	RXD, Output voltage control	0.65Vs	-	Vs	V
Low level output voltage	Vol	TXD, Status monitor	-	-	2	V
High level output voltage	Voh	TXD, Status monitor	Vs-2.0	-	Vs	V

Applicable standards

EMC	EN61326-1:2013 Group 1 Class B
SAFETY	EN61010-1:2010
RoHS	EN50581

7-4.Dimensional outlines

(Unit: mm)



Tolerance unless otherwise noted: ±0.2mm

Fig.9 Dimensional outlines

8. NOTICE

Hamamatsu products should not be used in excess of their absolute maximum ratings. Attention must be paid to all documented precautions.

Hamamatsu continually makes efforts to improve the quality and reliability of its products; however these efforts cannot ensure 100% compliance with the manufacturing specifications. Sufficient safety design (such as redundant safety, fire preventative, and malfunction preventative features) are to be implemented in the development of equipment manufactured with the Hamamatsu product so that personal injury, fire, or damage to public property or welfare does not occur in the unlikely event of a malfunction of the Hamamatsu product. A dangerous condition could be created if sufficient consideration is not given to safety design that addresses potential problems, especially in the design of equipment where the failure or malfunction of the Hamamatsu product within the equipment could result in bodily harm, life-threatening injury, or serious property damage during the use of the equipment.

Appropriate descriptions of the functions, performance, and methods of operation of the Hamamatsu product and the equipment within which the Hamamatsu product is incorporated are to be provided to end-users of the equipment. All accompanying warnings and cautionary labeling are also to be provided to the end-user.

Warranty of the Hamamatsu product is limited to the repair or replacement of a product in which a defect is discovered within 1 year of delivery of the product and notification is made to Hamamatsu within that period, otherwise certain warranty is specified. However, even within the warranty period Hamamatsu shall not be responsible for damages caused by either natural disaster or improper use of the product (such as modification of the product or any use that contravenes the operating conditions, intended applications, operating instructions, storage method, disposal method, or any other term or condition described in our products' documents).

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型　号	C11204-03

环保使用期限

本标志中的年数，是根据 2016 年 1 月 21 日公布的「电器电子产品有害物质限制使用管理办法」和 SJ / T 11364—2014 「电子电气产品有害物质限制使用标识要求」，适用于在中华人民共和国生产或进口的电器电子产品的「环保使用期限」。在遵守有关本产品安全和使用上的注意事项的情况下，在从生产日开始的上述年限内，使用该产品不会对环境造成严重污染或对使用者人身、财产造成严重损害。此年限是「环保使用期限」，而不是「产品质量保证期限」。

产品在适当地使用后予以废弃时，希望依照有关电器电子产品的回收・再利用的法律・规定进行处理。

产品中有害物质的名称及含量

部件名称	有害物质					
	铅（Pb）	汞（Hg）	镉（Cd）	六价铬（Cr(VI)）	多溴联苯（PBB）	多溴二苯醚（PBDE）
C11204-01	×	○	○	○	○	○

本表格依据SJ/T 11364 的规定编制。
○：表示该有害物质在该部件所有均质材料中的含量均在GB/T 26572 规定的限量要求以下。
×：表示该有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572 规定的限量要求。

Type Number	C11204-03

Environment-friendly Use Period

The number of year in the marking is “Environment-friendly Use Period” applying to electrical and electronic products that are manufactured in or imported into People’s Republic of China, based on “Management methods for the restriction of the use of hazardous substances in electrical and electronic products (issued on January 21th, 2016)” and “Marking for the restriction of the use of hazardous substances in electronic and electrical products (SJ/T11364-2014)”. It does not cause serious environmental contamination and injuries to body or property of the user during the year from the date of manufacture ONLY if under normal use following with operation and safety precautions of this product. It is the number of years for "Environment-friendly Use Period", NOT quality assurance period.

When disposing of this product, please follow applicable local rules and regulations for collection and recycling of electrical and electronic products.

Names and Contents of the Hazardous Substances in product

Part Name	Hazardous Substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr (VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
C11204-01	X	O	O	O	O	O

This table is prepared in accordance with the provisions of SJ/T 11364.
O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.
X: Indicates that said hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.