

Driver circuit for MPPC

C12332

INSTRUCTION MANUAL

- Read this instruction manual carefully before using this product.
- Attempting to operate this product by methods different from those described in this instruction manual may cause serious accidents.
- This product generates high voltage, so use caution when handling.
- Keep this instruction manual near the product for easy reference when needed.
- This product is provided solely for the purpose of performing the functional evaluation of MPPC. Do not incorporate this product into your products or system.

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Form KXX-3512 A

HAMAMATSU

Safety precautions

The following warning symbols and signal words are used in this manual to call your attention to important items. Be sure to comply with these instructions.



"WARNING" indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



"CAUTION" indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury or damage to the equipment or software.

Package contents

After unpacking, make sure the following items are included. If any item is missing or damaged, please contact us without using this product.

	Item	Qty	Description
1	C12332	1	Sensor board / Power supply board (mounting C11204-01)
2	Power cable (3pin)	1	
3	Operating voltage monitoring Cable (2pin)	1	For evaluation of C11204-01
4	flexible flat cable (FFC)	1	For connecting the sensor board and the power supply board (length: 50mm)
5	USB cable	1	USB cable A to Mini-B
6	CD-ROM	1	Instruction manual and sample software, etc.
7	Quick start guide	1	Gives the basics to use this product.

*Instruction manual is in the 'Manual' folder in attached CD-ROM.

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1. Product overview

The C12332 is a driver circuit for the Hamamatsu MPPC (Multi Pixel Photon Counters). The C12332 consists of a sensor board and a power supply board. The sensor board includes a socket for inserting various types of MPPC (non-cooled type) and an analog temperature sensor. The power supply board includes a C11204-01 power supply module for MPPC, a high-speed amplifier, and a USB serial converter unit.

The two boards are connected by a flexible flat cable (FFC) to allow you to easily lay out the boards when evaluating a MPPC.

The MPPC gain can be set to the desired level using the sample application software that also comes supplied with the C12332. Handling the C12332 is easy since it operates by supplying DC voltage (± 5 V) from an external power source.

■ Block diagram

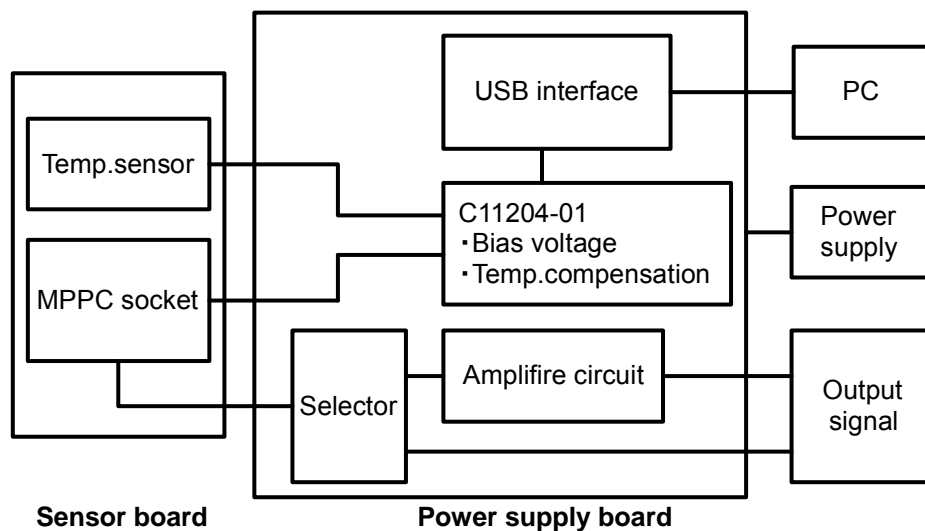


Figure 1: Block diagram

2. Precautions for use (Be sure to read !)



- ⦿ Do not touch the circuit board during operation. (High voltage hazard!)

High voltage (about 100 V) is present in some sections of this product but they are not covered with protective coating. Touching such high voltage sections will cause electrical shock or injury. Also, improper short circuit may cause malfunction or failure.

If you have to touch any part of this product, always first turn off the power to this product and wait at least 10 seconds before touching.



- ⦿ Never disassemble or modify any part of this product. Doing so may cause malfunction or failure.
- ⦿ Handle carefully so as not to drop this product and protect it from bump. Rough handling may damage the circuit or components.
- ⦿ Always use this product within the maximum ratings.
- ⦿ Never connect this product incorrectly.
If connected incorrectly, excessive current may flow, possibly causing the internal components to burn out or catch fire.

3. How to use

Use the following procedure to use this product.

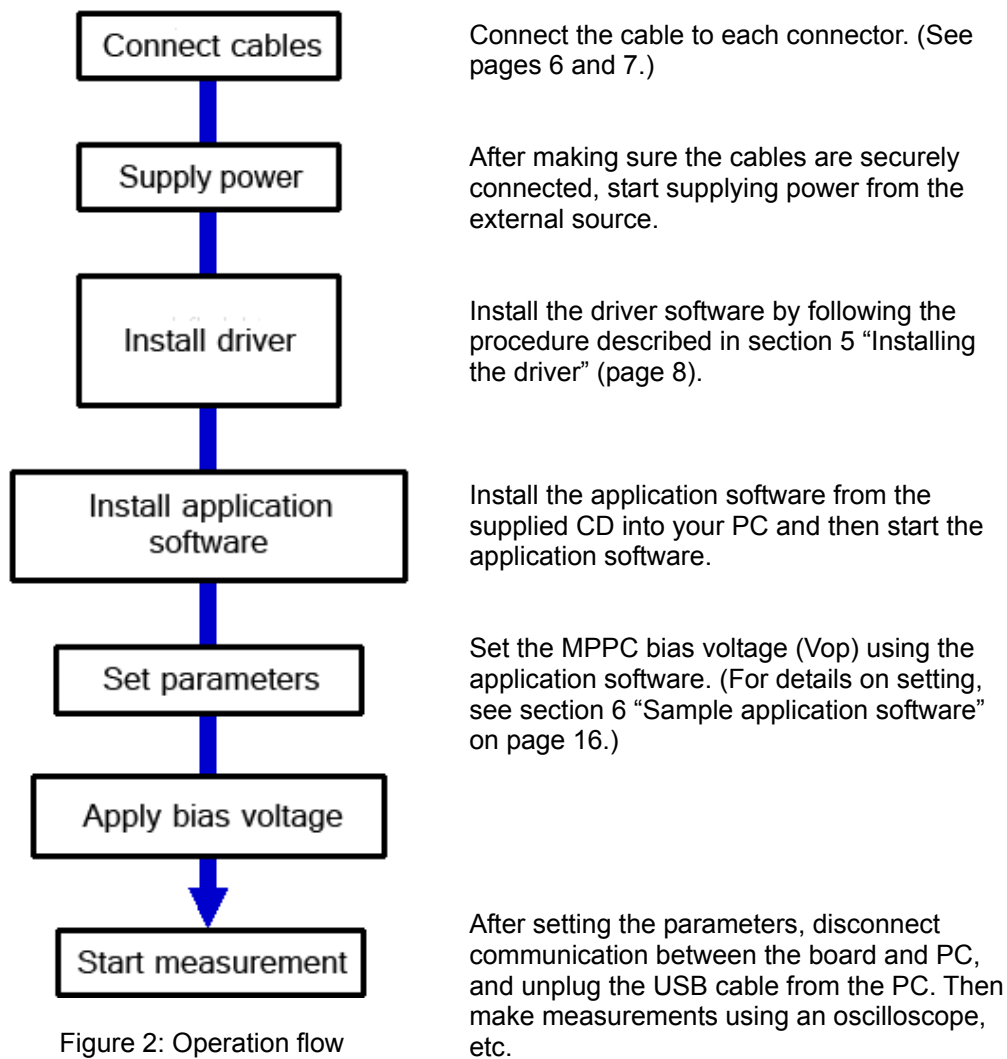


Figure 2: Operation flow

4. Making connections

1. Connecting the cables

(1) Power cable and signal cable

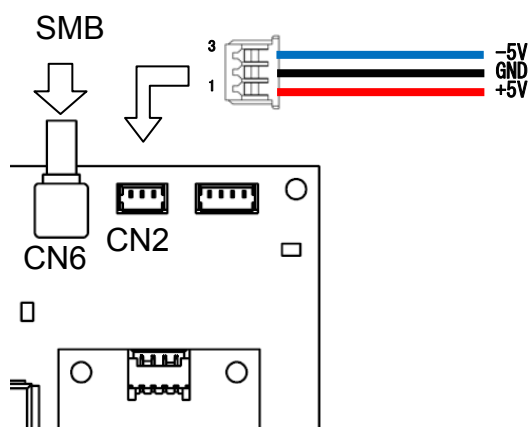


Figure 3: Power cable connection

Connect the supplied power cable to the CN2 connector on the power supply board.
(Connector: Molex 53047-0310, Housing: Molex 51021-0300)

Pin No.	Signal name	Wire color
1	+5V	Red
2	GND	Black
3	-5 V	Blue

Next connect a signal cable (SMB) to the CN6 connector.

NOTE: Signal cable (SMB) is not supplied with the C12332 and should be prepared by the user.

To connect : The connector has a polarity. Align the connector and push it in until it stops.

To disconnect : Hold the cable near the connector and pull it out to unplug the connector.

(2) USB cable

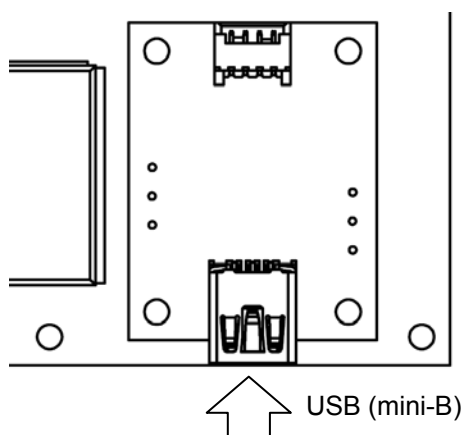
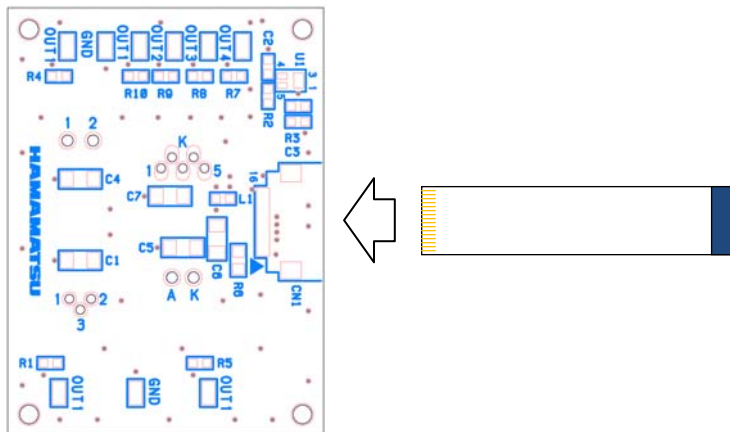


Figure 4: USB cable connection

Connect the supplied USB cable to the USB connector on the power supply board.

(3) FFC (flexible flat cable)

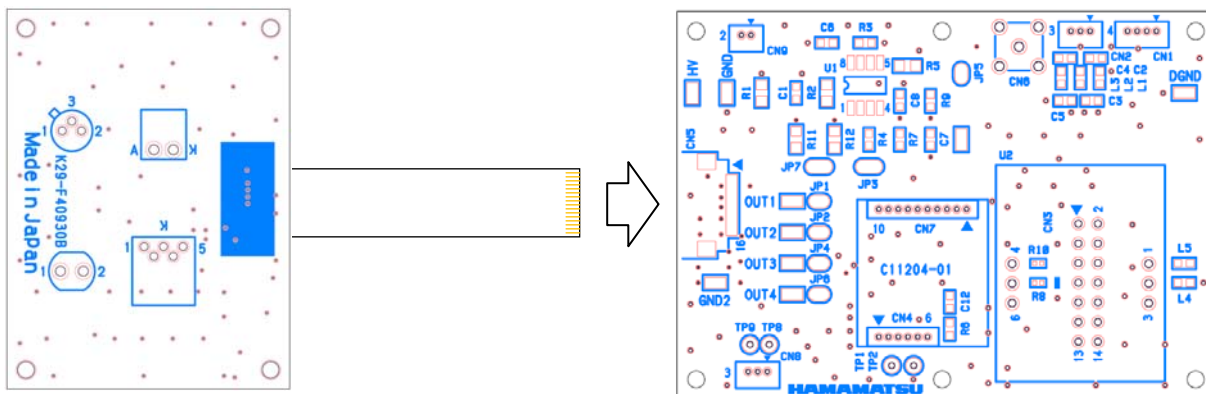
1) Connecting to the sensor board



Sensor board (front side)

Figure 5-1: Connecting the FCC to the sensor board

2) Connecting to the power supply board



Power supply board (front side)

Figure 5-2: Connecting the FFC to the power supply board

Connect one end of the supplied FFC to the power supply board and the other end to the sensor board.

NOTE: When plugging the FFC into the connector, make sure the electrode side faces up.

NOTE: The connector for the FFC may easily be damaged, so handle carefully when plugging or unplugging the FFC.

5. Installing the driver software

1) Windows 7

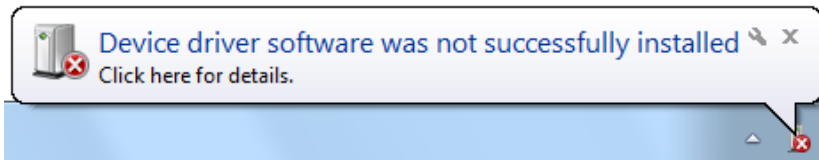
1. Check that the power cable and USB cable are securely connected to the power supply board.
2. Supply power to the power supply board.
After supplying power, make sure that no excessive current is flowing and no smoke is emitted from this product.
If any abnormal condition is found, immediately turn off the power.

NOTE: The default settings for the power supply board and sensor board are as follows:

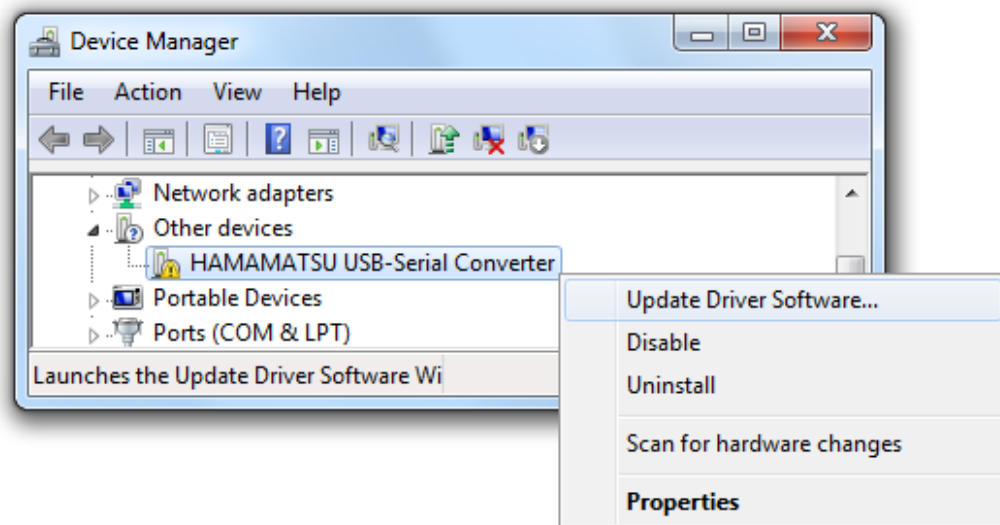
Power supply board	Load resistance is set to 50 ohms.
	Amplifier circuit is set not to be used.
Sensor board	Load resistance is set not to be used

To change the default settings, see the supplemental information and circuit diagrams shown on page 22 onward.

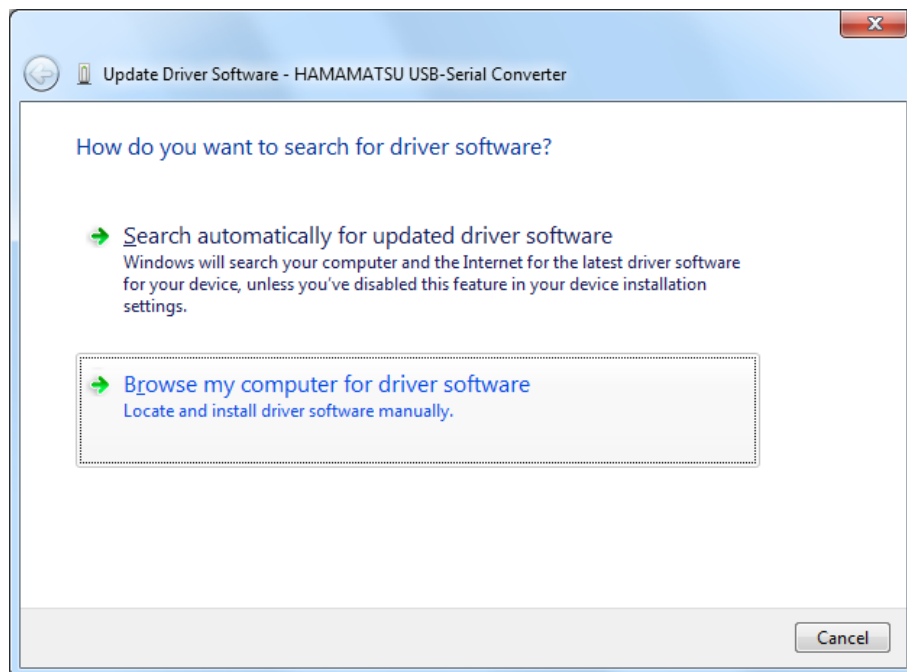
3. When the following message appears, click the [×] button in the upper right corner.



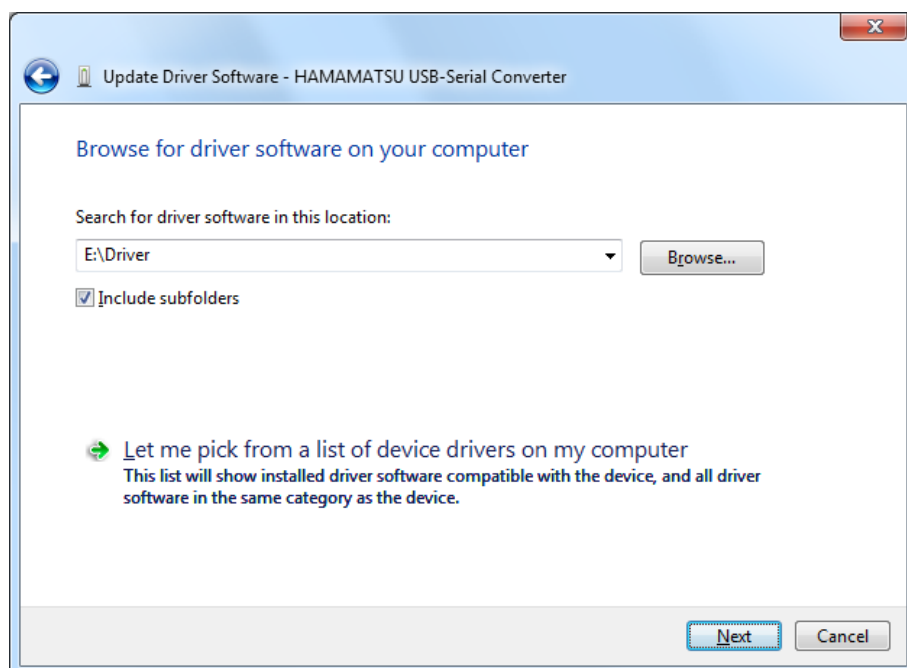
4. Open the Device Manager. In the Device Manager window, right-click “HAMAMATSU USB-Serial Converter” under “Other devices” and then select “Update Driver Software...”



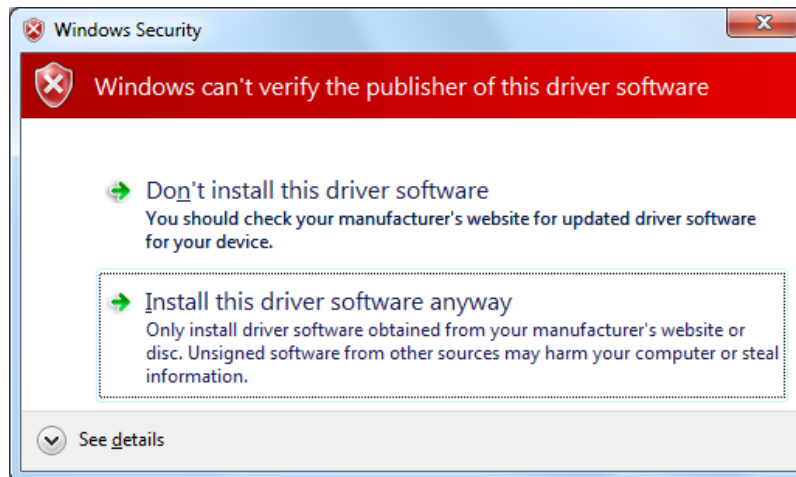
5. When the following dialog appears, click “Browse my computer for driver software.”



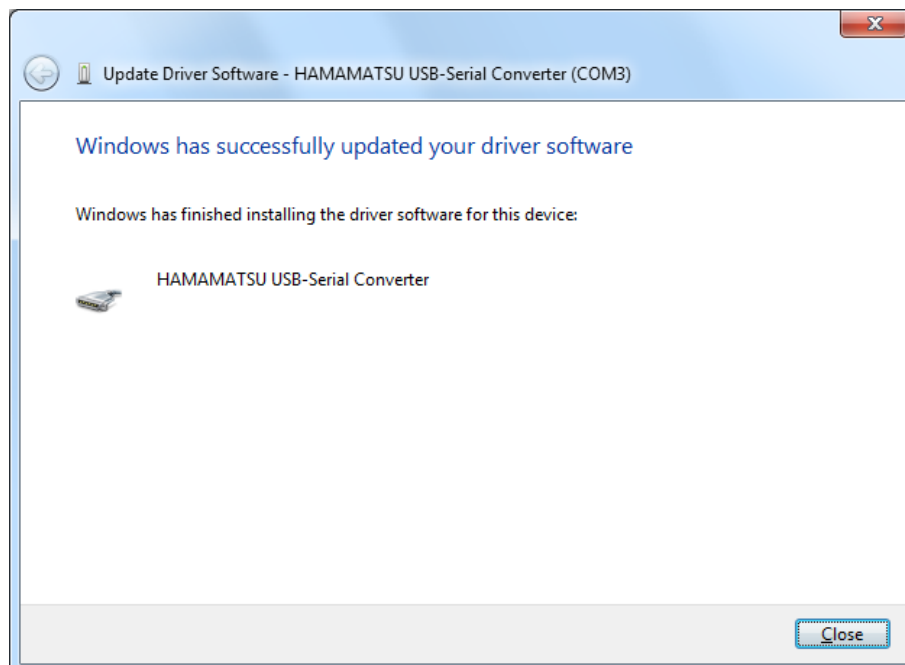
6. In the “Search for driver software in this location” box, specify the “Driver” folder in the drive (drive E in this example) where you inserted the supplied CD-ROM and then click [Next] to continue.



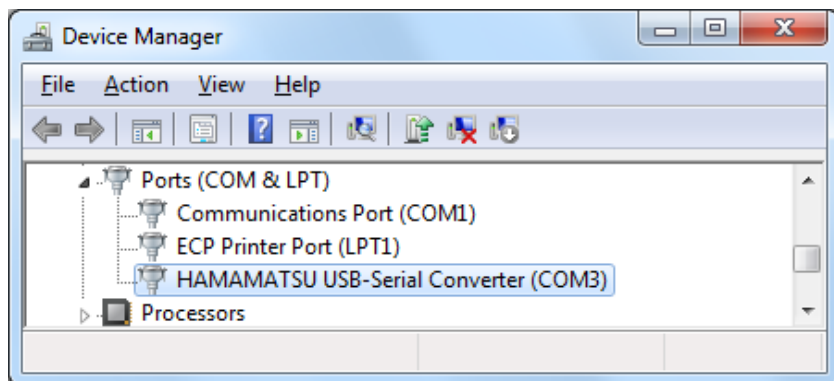
7. When the following message appears, click “Install this driver software anyway.”



8. When finished installing the driver software, the following window appears. Click the [Close] button.



9. The COM port number for the “HAMAMATSU USB-Serial Converter” is displayed in the Device Manager as shown below (COM3 in this example).



■ Setting the output voltage

Set the output voltage V_{op} to operate an MPPC from the sample application software.

For details on how to use the sample application software, see “Starting the application software” in section 6.

After setting the V_{op} , click the [Close] button on the application software screen and then unplug the USB cable connected to the PC.

NOTE: The V_{op} differs depending on each MPPC. Set the V_{op} that matches the MPPC mounted on the sensor board.

■ Setting the light level

Adjust the light level incident on the MPPC so that the MPPC output does not become saturated.

2) Windows XP

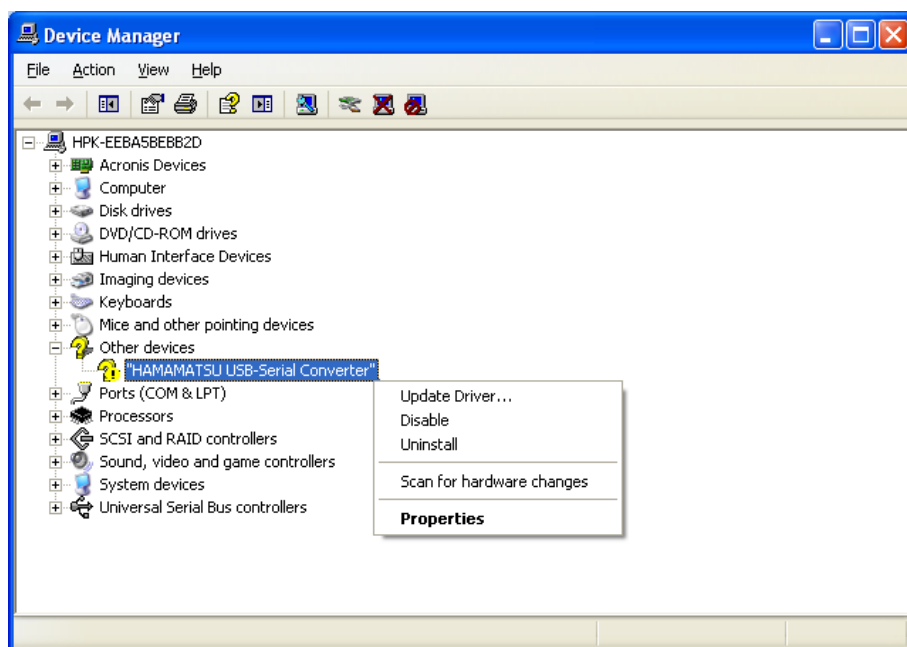
1. Check that the power cable and USB cable are securely connected to the power supply board.
2. Supply power to the power supply board.
After supplying power, make sure that no excessive current is flowing and no smoke is emitted from this product.
If any abnormal condition is found, immediately turn off the power.

NOTE: The default settings for the power supply board and sensor board are as follows:

Power supply board	Load resistance is set to 50 ohms.
	Amplifier circuit is set not to be used.
Sensor board	Load resistance is set not to be used

To change the default settings, see the supplemental information and circuit diagrams shown on page 22 onward.

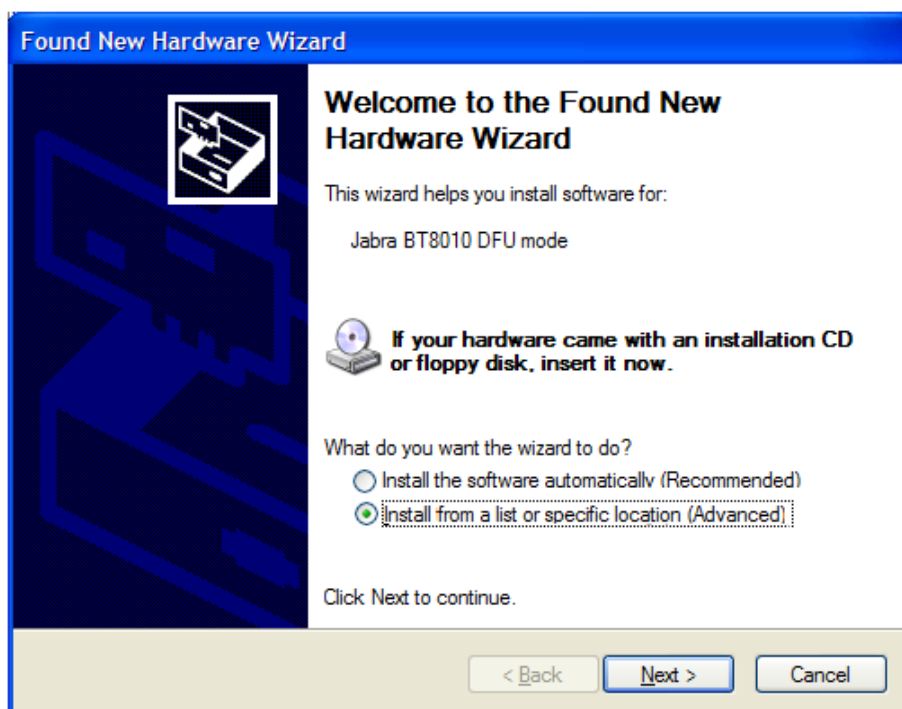
3. Open the Device Manager. In the Device Manager window, right-click "HAMAMATSU USB-Serial Converter" under "Other devices" and then select "Update Driver Software."



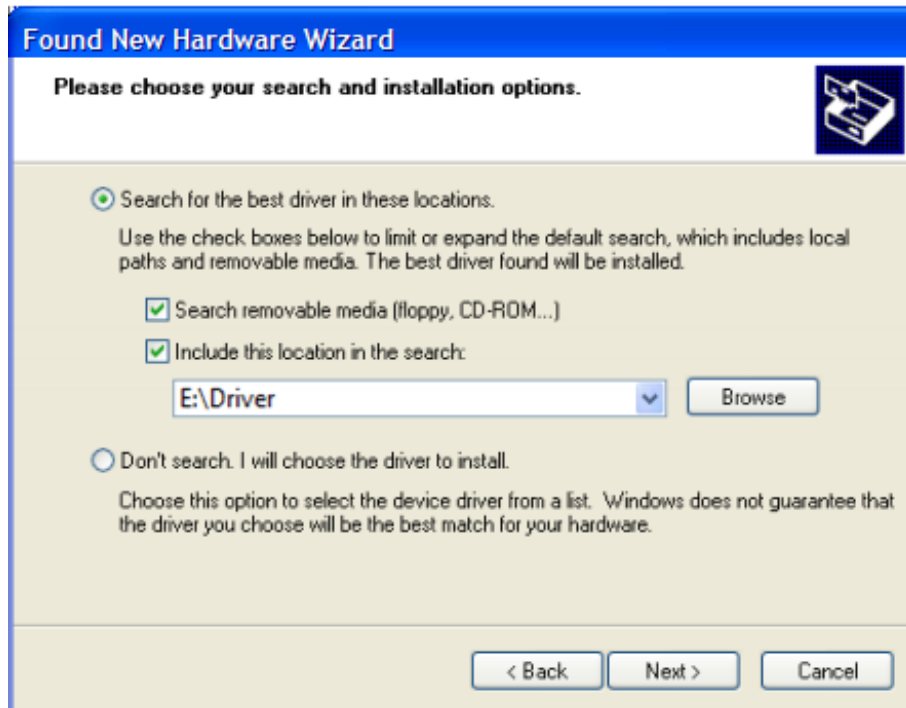
4. When the following dialog appears, click “No, not this time.”



5. When the following dialog appears, select “install from a list or specific location (Advanced).”



6. When the following dialog appears, select “Search for the best driver in these locations” and, in the “box under “Include this location in the search”, specify the “Driver” folder in the drive (drive E in this example) where you inserted the supplied CD-ROM and then click [Next] to continue.



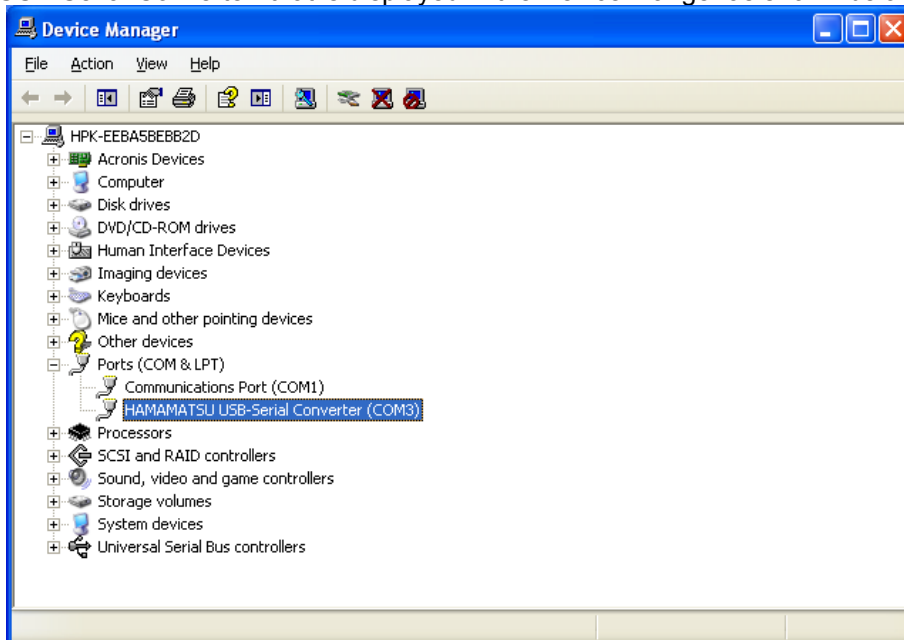
7. When the following dialog appears, click [Continue Anyway].



8. When finished installing the driver software, the following dialog appears. Click [Finish].



9. After installing the driver software, check the COM port number assigned to the “HAMAMATSU USB-Serial Converter” that is displayed in the Device Manager as shown below (COM3 in this example)..



Setting the output power

Set the output power V_{op} to operate an MPPC from the sample application software.

For details on how to use the sample application software, see “Starting the application software” in section 6.

After setting the V_{op} , click the [Close] button on the application software screen and then unplug the USB cable connected to the PC.

NOTE: The V_{op} differs depending on each MPPC. Set the V_{op} that matches the MPPC mounted on the sensor board.

Setting the light level

Adjust the light level incident on the MPPC so that the MPPC output does not become saturated.

6. Sample application software

This application software is created by Microsoft Visual Basic 2008 Express Edition SP1. The system requirements for running this application software are as follows:

Supported OS

Microsoft Windows XP (32-bit version), Windows Vista (32-bit version), Windows 7 (32-bit/64-bit version)

Usage environment

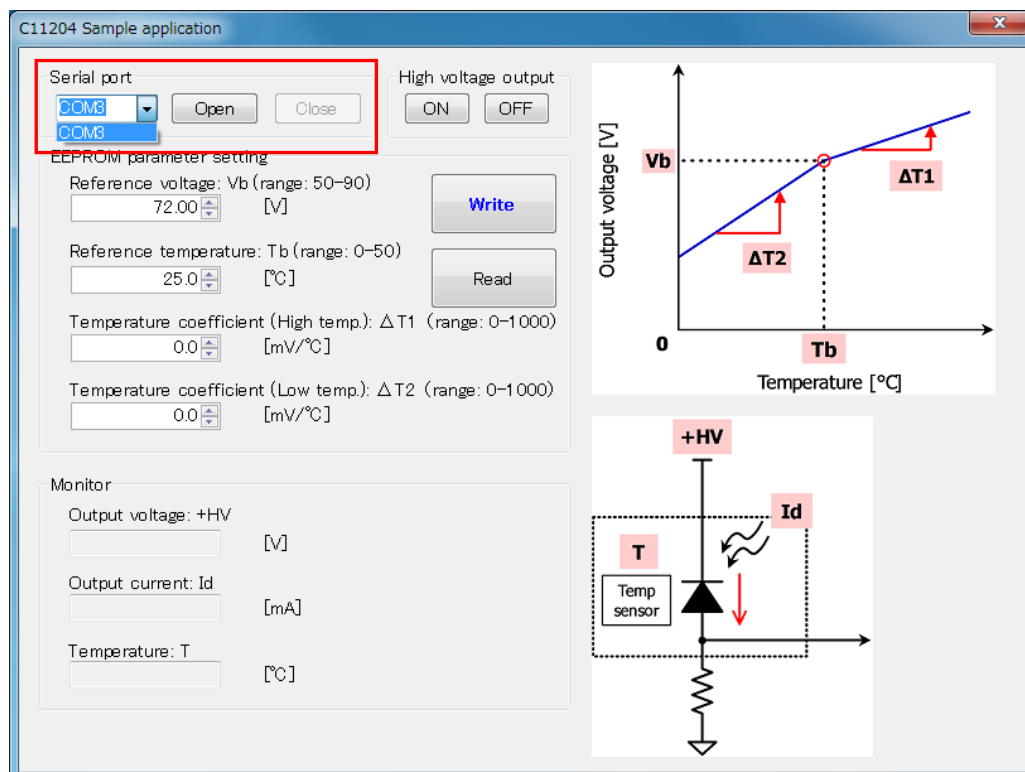
Microsoft .Netframework 2.0 or later

■ Starting the application software

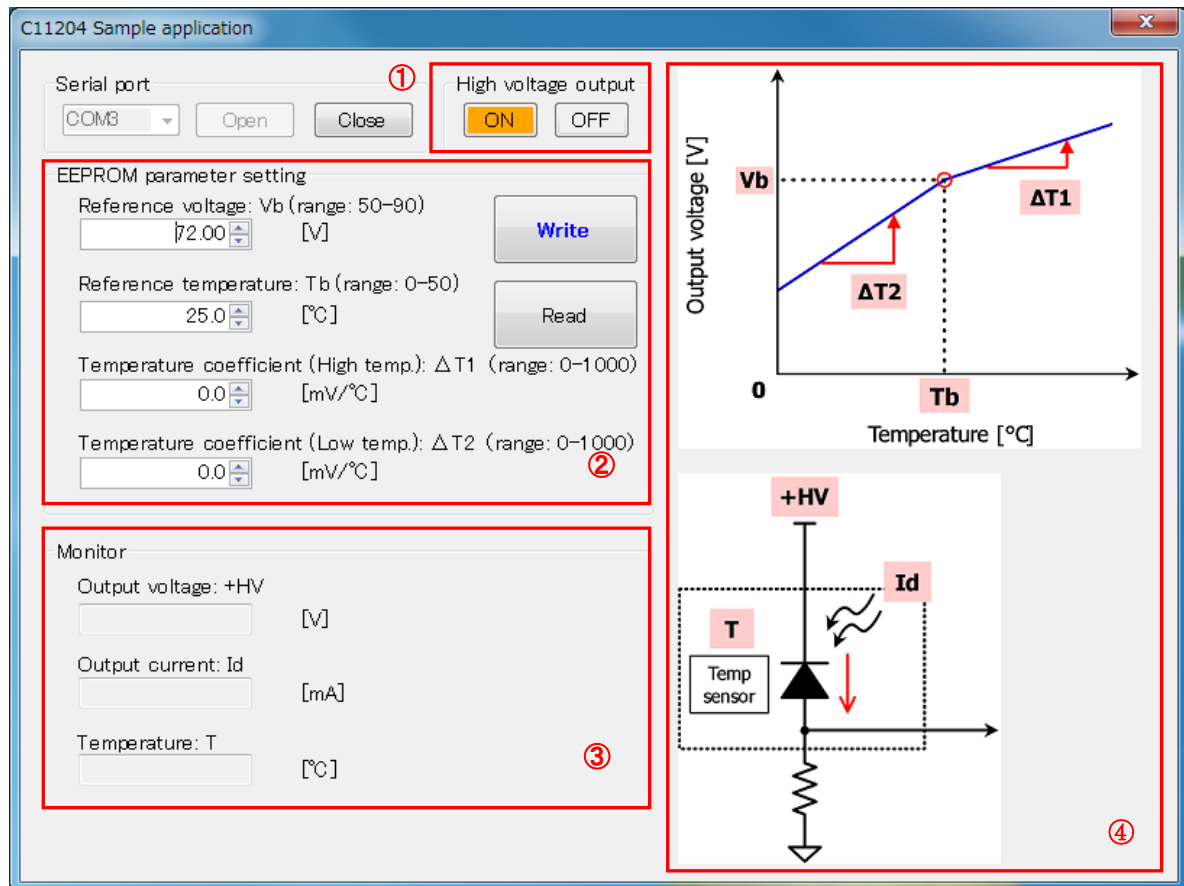
1. Copy the sample application software (C11204-01.exe) contained in the supplied CD-ROM and install it in your PC.
2. Connect the power supply board to a regulated power supply using the supplied power cable. Also connect the power supply board to the PC using the supplied USB cable (USB(A) - mini(B)).

NOTE: Do not disconnect the USB cable while the application software is running.

3. Turn on the regulated power supply.
4. Double-click the sample application software to start it.
5. Select the COM port assigned when you installed the driver software.
6. Click the [Open] button in the application software window. When successfully connected to the C11204-01, the settings last used will be loaded to allow operation (when using for the first time, the reference voltage V_b : 72.00 [V] and reference temperature T_b : 25.0 [°C] will be loaded).



■ Functions



① High voltage output <ON/OFF buttons>

Use these buttons to turn the output voltage ON or OFF. Clicking the [ON] button outputs the set voltage. Clicking the [OFF] button turns off the output voltage (sets it to 0 V). When the power supply is turned on, the output voltage is always set to ON.

② EEPROM parameter setting

Set the parameters for voltage output and temperature compensation. After setting the parameters, click the [Write] button to enable the settings. To load the current settings, click the [Read] button.

●Output voltage setting

Set the reference voltage V_b [V] and reference temperature T_b [°C] to control the output voltage to the desired value (See ④).

For the output voltage range and setting accuracy, see section 8 “Specifications” in this manual.

●Temperature compensation

The temperature dependence of output voltage can be compensated by using the temperature T [°C] detected by the externally connected temperature sensor.

The output voltage +HV [V] is determined by the following equation:

$$+HV = 1/1000 * \Delta T * (T - T_b) + V_b$$

Two temperature coefficients ΔT_1 [mV/°C] and ΔT_2 [mV/°C] can be specified (see ④). ΔT_1 is for the region higher than the reference temperature T_b [°C], and ΔT_2 is for the region lower than the reference temperature T_b [°C]. If not using the temperature compensation, set both ΔT_1 [mV/°C] and ΔT_2 [mV/°C] to 0 (zero).

③ Monitor

The following parameters can be monitored (see ④).

- High voltage +HV [V] output from the C11204-01
- Current I_d [mA] flowing in the MPPC
- Temperature T [°C] detected by the externally connected temperature sensor

For the monitor accuracy, see section 8 “Specifications” in this manual.

Excessive current protection

If excessive current flows in the output of the C11204-01, the protection function will stop the high voltage output. Specifically, when an output current load higher than 3 mA is applied for more than 4 seconds, the high voltage output will be stopped. To output the high voltage again, exit the application software and turn off the power, then restart the C11204-01.

■ Exiting the application software

1. Click the [Close] button to terminate the communication.
2. Exit the application software.
3. Turn off the power supply and then disconnect the cables.

7. Measurement example

The graph below shows a waveform measured under the following conditions:

- MPPC connected to sensor board: S12571-050C)
- Load resistance of power supply board: 50 ohms
- Amplifier circuit gain of power supply board: approximately 21 times

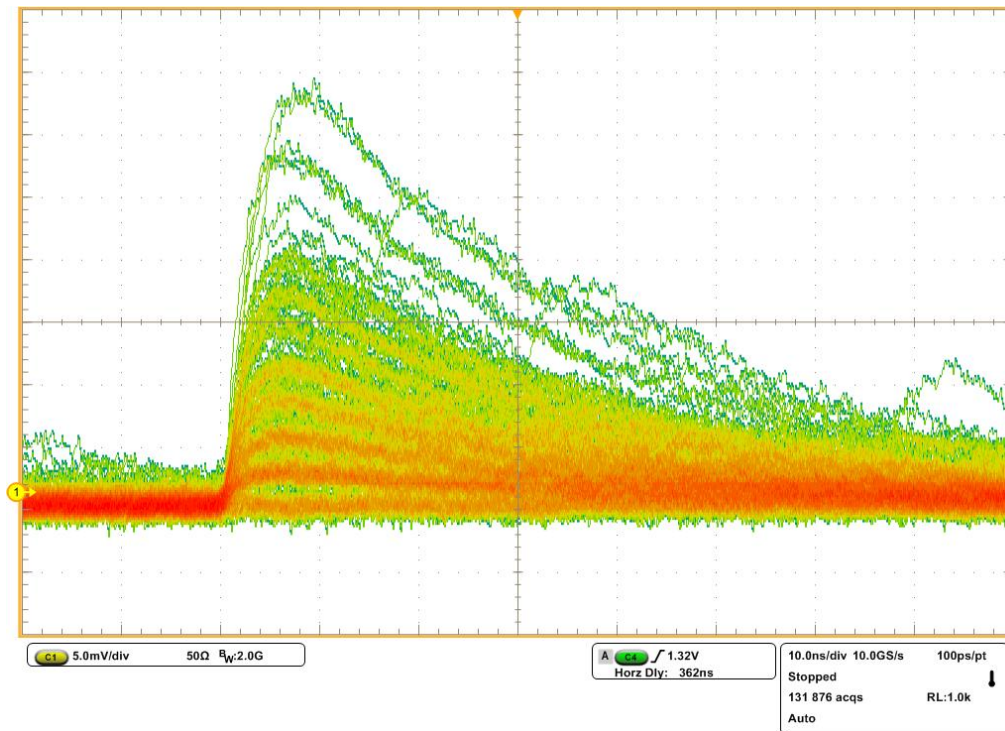


Figure 6-1: Output waveform example (Impulse light response)

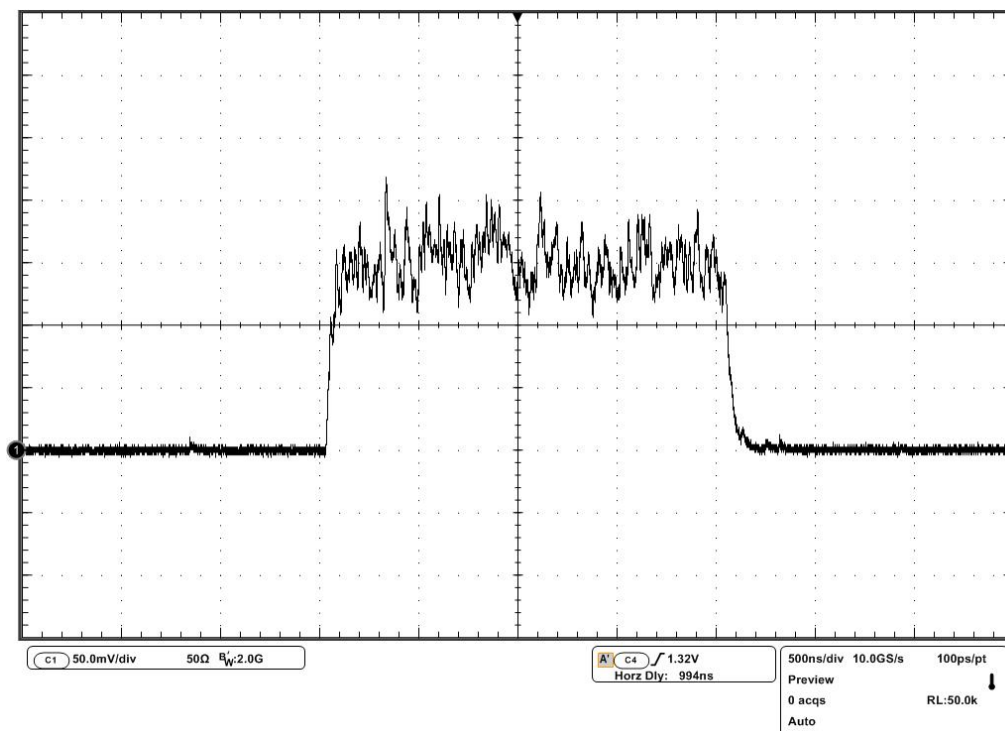


Figure 6-2: Output waveform example (Pulse light response)

<Input light condition>

- wavelength: 470nm
- pulse width: 2 μ s

8. Specifications

Parameter	Symbol	Condition	Value	Unit
Supply voltage	Vs		± 5.8	V
Operating temperature	Topr	No condensation	+10~+40	°C
Storage temperature	Tstg	No condensation	-10~+50	°C

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

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	Vs		± 4.75	± 5	± 5.25	V
Supply voltage range ^{*1}	Vo	No load	-	50~90	-	V
Setting voltage resolution ^{*2}	-		-	10	-	mV
Setting voltage error	-	Vo=72V, no load	-	± 10	± 40	mV
Voltage monitor error	-	Vo=72V, no load	-	± 10	-	mV
Current monitor error	-	Vo=72V, Io=1mA	-	± 0.05	-	mA
Load resistance ^{*3}	RL	When amplifier is not used	-	50 or 1k	-	Ω
Cutoff frequency	High	When amplifier is used (gain:20), -3dB	-	40	-	MHz
	Low		-	DC	-	
Integrated temperature sensor	-	-	LM94021BIMG (Texas Instruments)			-
Interface ^{*4}	-	-	USB 2.0(full-speed)			-

*1: The recommended operating voltage for MPPC varies depending on the product. Set an appropriate voltage by referring to the value provided with the product.

*2: When the sample software is used

*3: When using an amplifier, set the load resistance to 50 Ω .

*4: After you set the operating voltage, remove the USB cable from the C12332 to eliminate any noise effects from the PC.

2. Dimensional outlines

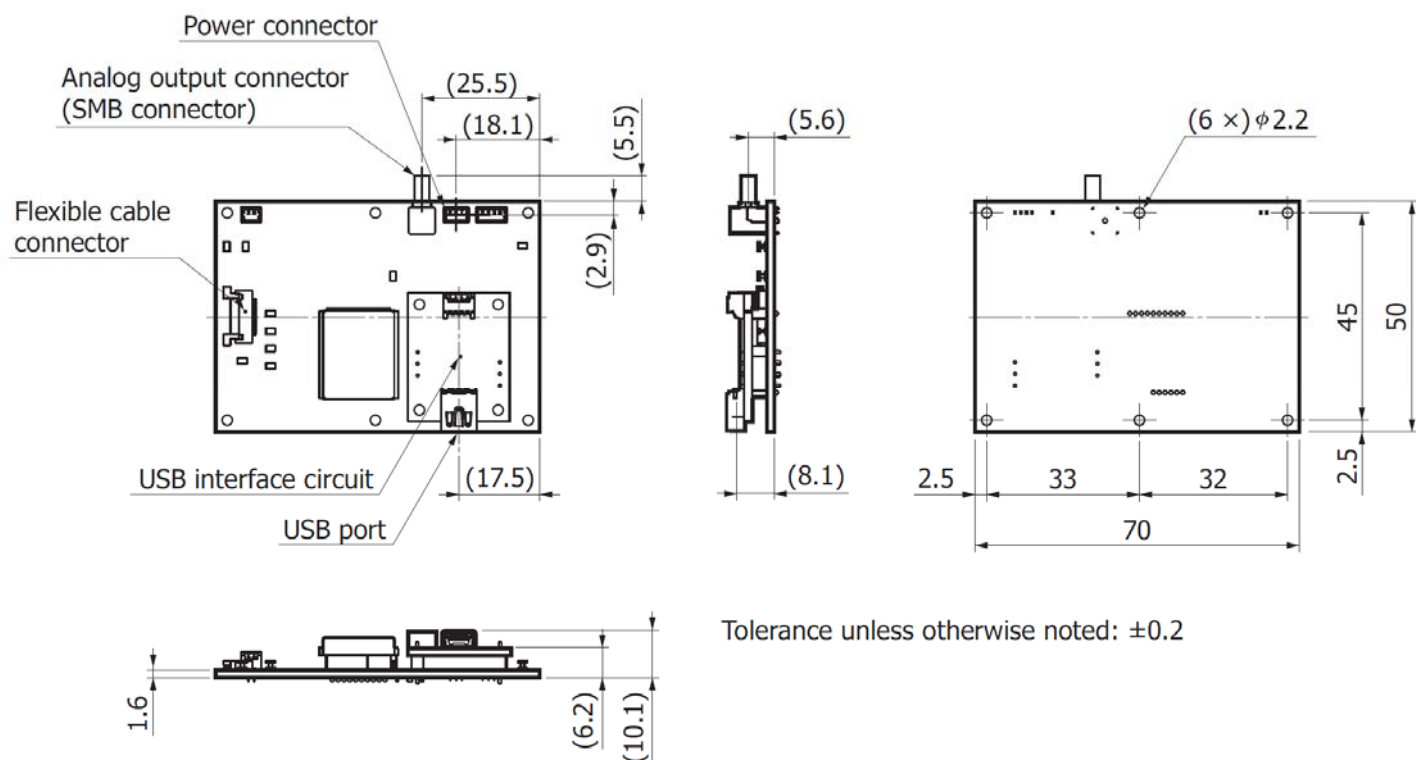


Figure 7-1: Power supply board dimensional outline (Unit: mm)

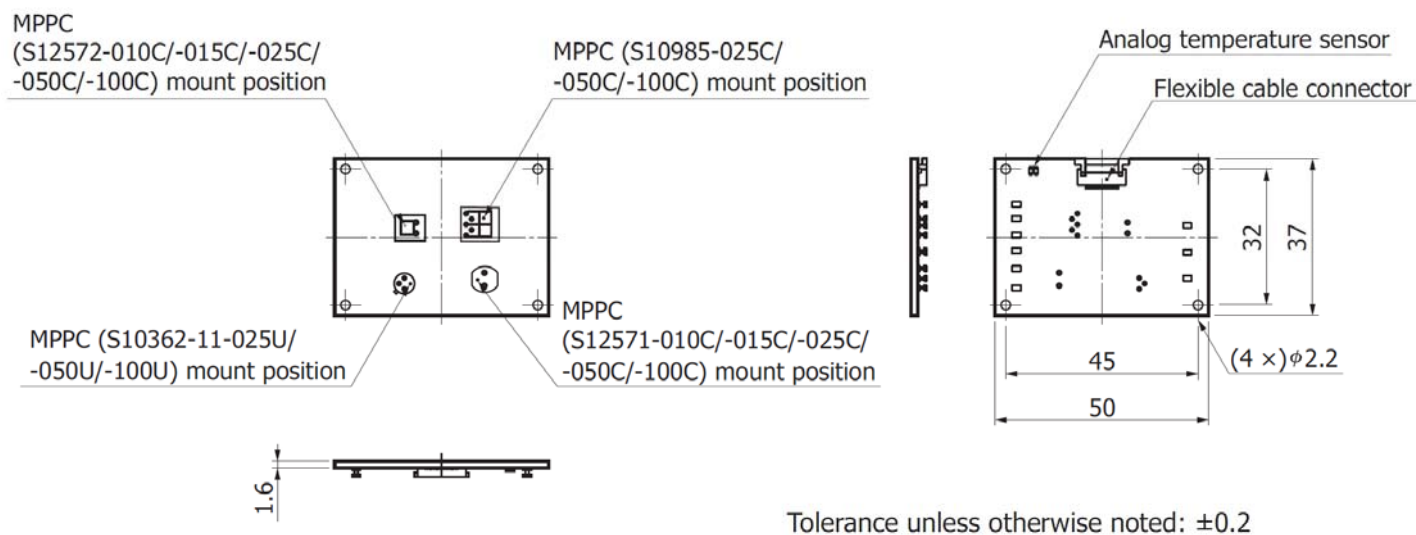


Figure 7-2: Sensor board dimensional outline (Unit: mm)

Selecting the load resistance by solder jumper on the power supply board

Solder jumper JP1 on the power supply board are connected already.

NOTE: Please use JP2, JP4 and JP6 depending on the type of MPPC.

		Connection point
Load resistance	50 Ω	JP7 left
	1 k Ω	JP7 right

Load resistor is connected to the 50 Ω side in the initial state. But if necessary, please use it to switch.

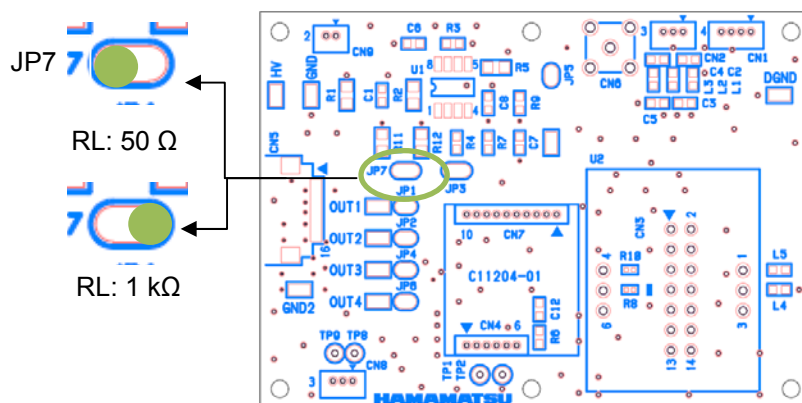


Figure 8-1: Power supply board (terminating resistance selection)

Selecting whether to use the amplifier circuit by solder jumper on the power supply board

Amplifier circuit		Connection point		Figure No.
		JP3 left	JP5	8-2
	Not used	JP3 right	JP5 not connected	8-3

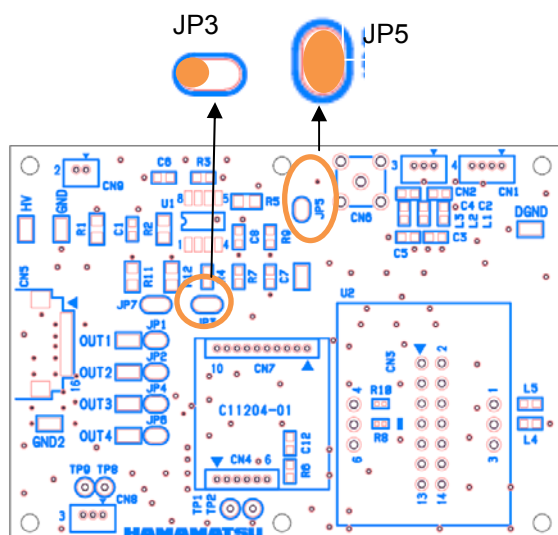


Figure 8-2: Power supply board
(with OP amp connected)

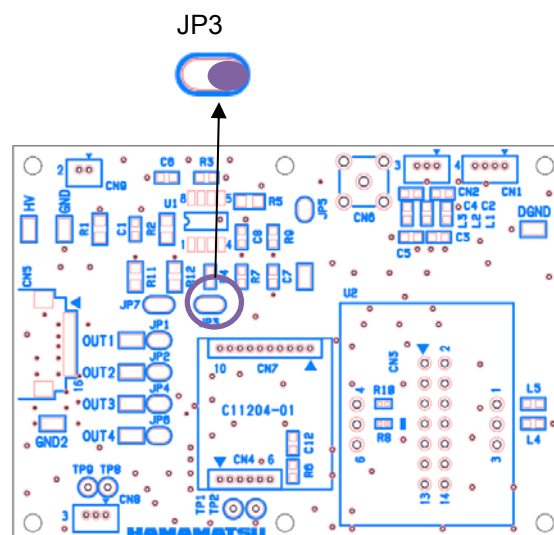


Figure 8-3: Power supply board
(with OP amp not connected)

3. Circuit diagrams

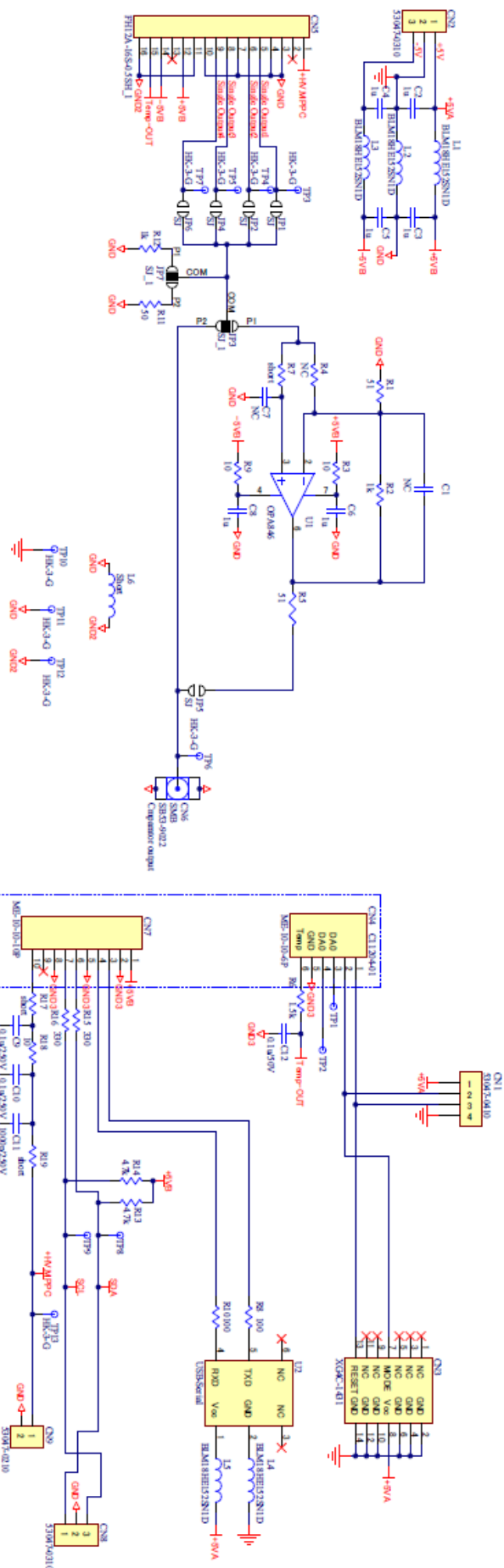
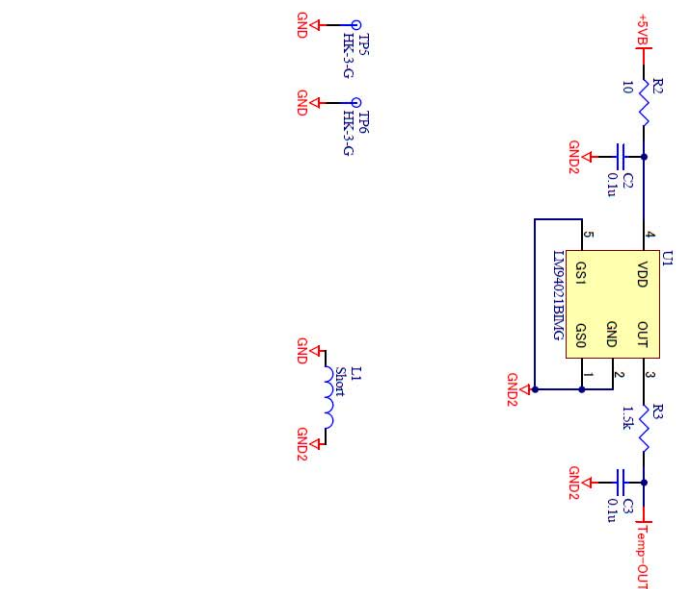


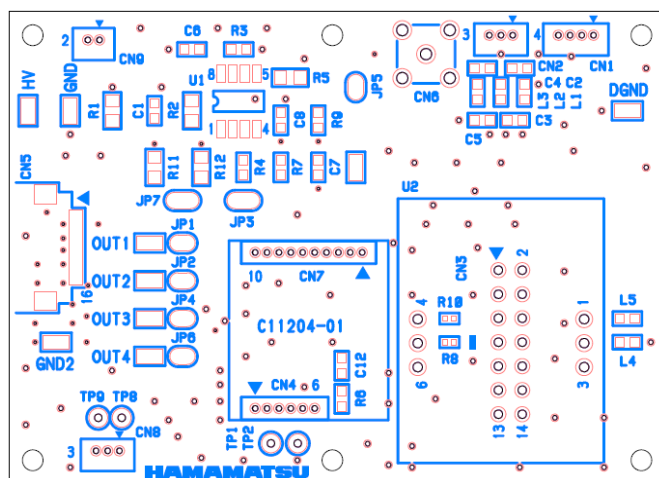
Figure 9-1: High-voltage power supply board circuit diagram



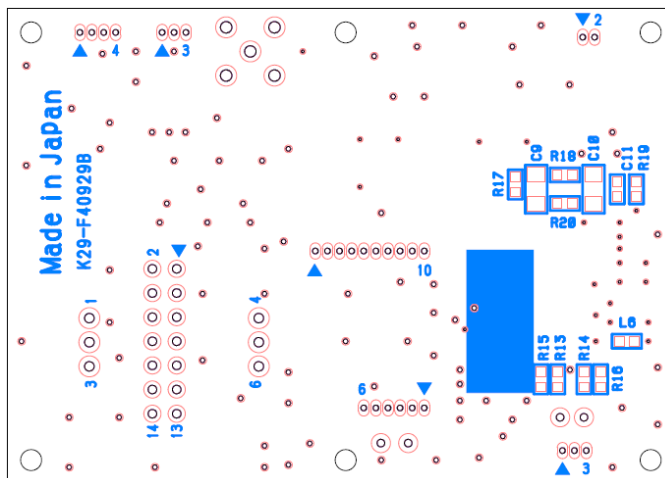
24
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4. Circuit board component layouts

Power supply board



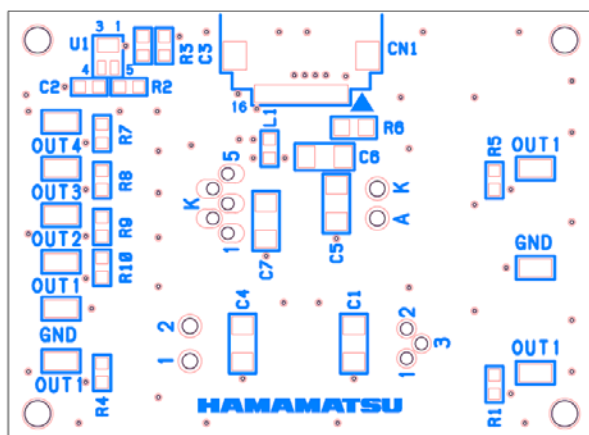
Front side



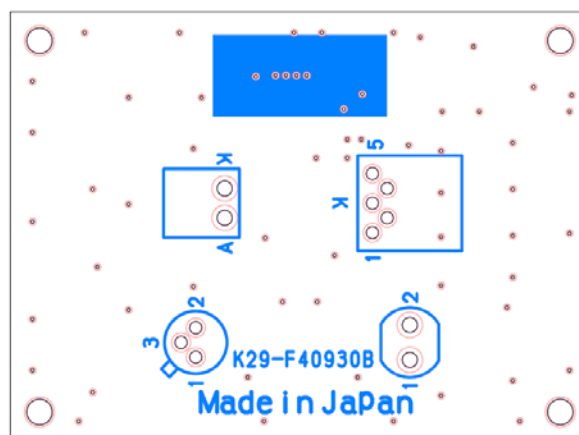
Back side

Figure 10-1: Power supply board

Sensor board



Front side



Back side

Figure 10-2: Sensor board

5. Component tables

<Power supply board>

Name	Component No.	Constant	Unit	Size	Name	Component No.	Constant	Unit	Size
Camacitor	C1	NC	F	1608	Filter	L1	BLM18HE152		1608
Camacitor	C2	1u/10V		1608	Filter	L2	BLM18HE152		1608
Camacitor	C3	1u/10V		1608	Filter	L3	BLM18HE152		1608
Camacitor	C4	1u/10V		1608	Filter	L4	BLM18HE152		1608
Camacitor	C5	1u/10V		1608	Filter	L5	BLM18HE152		1608
Camacitor	C6	1u/10V		1608	Filter	L6	Short		1608
Camacitor	C7	NC		1608	Test pin	TP1	NC		
Camacitor	C8	1u/10V		1608	Test pin	TP2	NC		
Camacitor	C9	0.1u/250V		3216	Test pin	TP3	HK-3-G		
Camacitor	C10	0.1u/250V		3216	Test pin	TP4	HK-3-G		
Camacitor	C11	1000p/250V		1608	Test pin	TP5	HK-3-G		
Camacitor	C12	0.1u/50V		1608	Test pin	TP6	HK-3-G		
Connector	CN1	53047-0410	Ω		Test pin	TP7	HK-3-G		
Connector	CN2	53047-0310			Test pin	TP8	NC		
Connector	CN3	NC			Test pin	TP9	NC		
Connector	CN4	ME-10-10-6P			Test pin	TP10	HK-3-G		
Connector	CN5	FH12A-16S-0.5SH			Test pin	TP11	HK-3-G		
Connector	CN6	SB53-9022			Test pin	TP12	HK-3-G		
Connector	CN7	ME-10-10-10P			Test pin	TP13	HK-3-G		
Connector	CN8	NC			Solder jumper	JP1			
Connector	CN9	53047-0210			Solder jumper	JP2			
Resistor	R1	51		2012	Solder jumper	JP3			
Resistor	R2	1k		2012	Solder jumper	JP4			
Resistor	R3	10		1608	Solder jumper	JP5			
Resistor	R4	NC		1608	Solder jumper	JP6			
Resistor	R5	51	Ω	2012	Solder jumper	JP7			
Resistor	R6	1.5k		1608	Operational Amplifier	U1	OPA846		
Resistor	R7	Short		1608	USB-Serial	U2			
Resistor	R8	100		1005					
Resistor	R9	10		1608					
Resistor	R10	100		1005					
Resistor	R11	51		2012					
Resistor	R12	1k		2012					
Resistor	R13	4.7k		1608					
Resistor	R14	4.7k		1608					
Resistor	R15	330		1608					
Resistor	R16	330		1608					
Resistor	R17	Short		1608					
Resistor	R18	10		1608					
Resistor	R19	Short		1608					
Resistor	R20	BLM18HE152		1608					

<Sensor board>

Name	Component No.	Constant	Unit	Size
Camacitor	C1	0.047u/250V	F	3216
Camacitor	C2	0.1u/25V		1608
Camacitor	C3	0.1u/25V		1608
Camacitor	C4	0.047u/250V		3216
Camacitor	C5	0.047u/250V		3216
Camacitor	C6	0.047u/250V		3216
Camacitor	C7	0.047u/250V		3216
Connector	CN1	FH12A-16S-0.5SH		
Filter	L1	Short		1608
Resistor	R1	Nothing	Ω	1608
Resistor	R2	10		1608
Resistor	R3	1.5k		1608
Resistor	R4	Nothing		1608
Resistor	R5	Nothing		1608
Resistor	R6	1k		2012
Resistor	R7	Nothing		1608
Resistor	R8	Nothing		1608
Resistor	R9	Nothing		1608
Resistor	R10	Nothing		1608
Test pin	TP1	HK-3-G		
Test pin	TP2	HK-3-G		
Test pin	TP3	HK-3-G		
Test pin	TP4	HK-3-G		
Test pin	TP5	HK-3-G		
Test pin	TP6	HK-3-G		
Test pin	TP7	HK-3-G		
Test pin	TP8	HK-3-G		
Test pin	TP9	HK-3-G		
Temperature Sensor	U1	LM94021BIMG		
Socket	For MPPC1 (CAN package)			
Socket	For MPPC2 (S12571-xxxG)			
Socket	For MPPC3 (S12572-xxxG)			
Socket	For MPPC4 (2x2ch)			

9. Note to user



Be sure to read !

Hamamatsu Photonics K.K.(HPK) has made every effort to enhance the reliability of its semiconductor devices; however ,the possibility of defects cannot be entirely eliminated. In order to minimize risk of damage or injury arising from a defect in an HPK semiconductor device, the customer must be familiar with the property of such devices, and utilize appropriate safety measures in the design of equipment incorporating the devices. These measures may include, but are not limited to, redundancy, fire-containment, and anti-failure design features.

This product is warranted to the original purchaser for a period of 12 months following the date of shipment. The warranty is limited to replacement or repair of any defective material due to defects in workmanship or materials used in manufacture. It does not cover loss or damage of the product due to natural calamity or misuse, even within the warranty period

In no circumstances, should these semiconductor devices be used by persons unfamiliar with their properties and limitations, or who lack proper knowledge of safe, electronic design.