

Application Note

5/Sep./2016

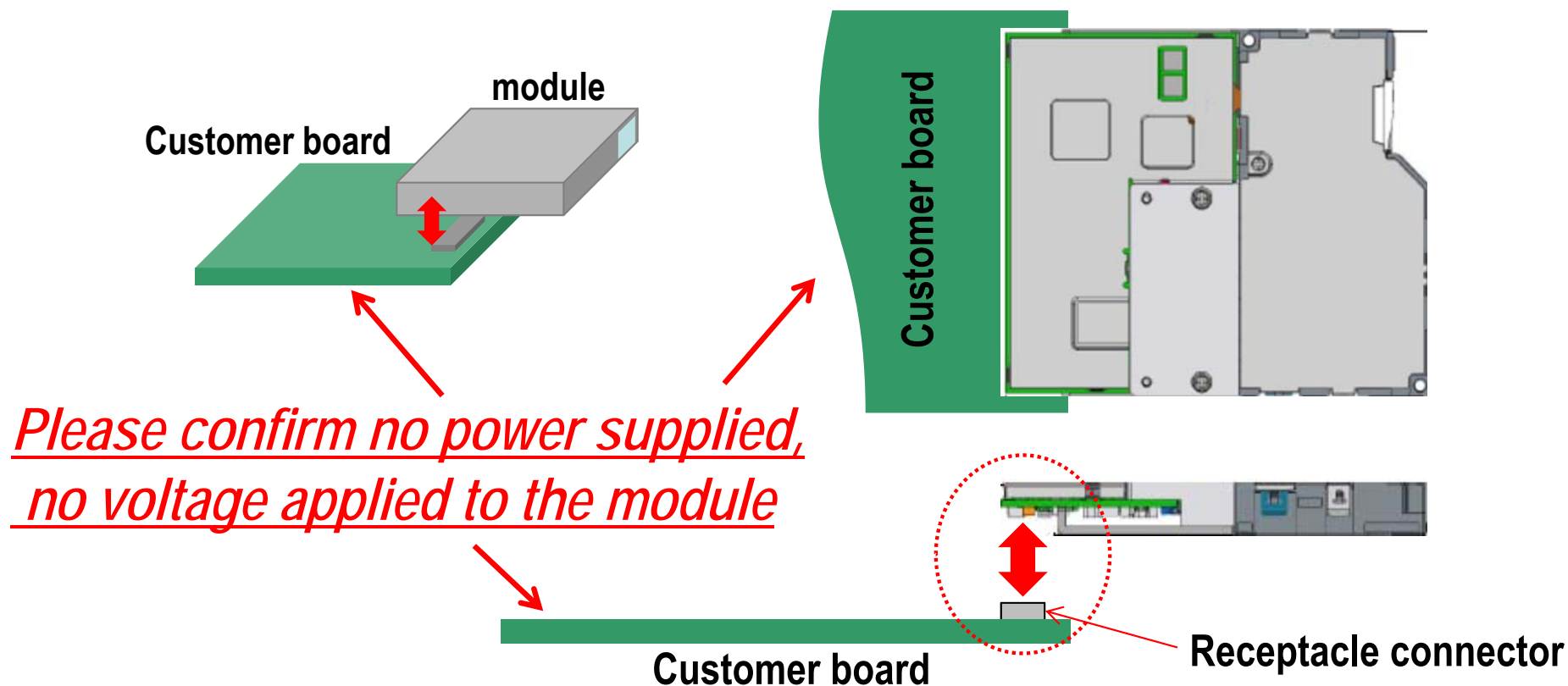
Sony Corporation

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Module handling

When the module is mounted on and un-mounted off the board, power supply of the board must be shut down.

It may cause malfunction of the module accidentally, if the module is connected to powered board and voltages are applied to power pins in illegal sequence.



Picking up module

Please do not touch lens part.

It may cause image quality problem.



Lens

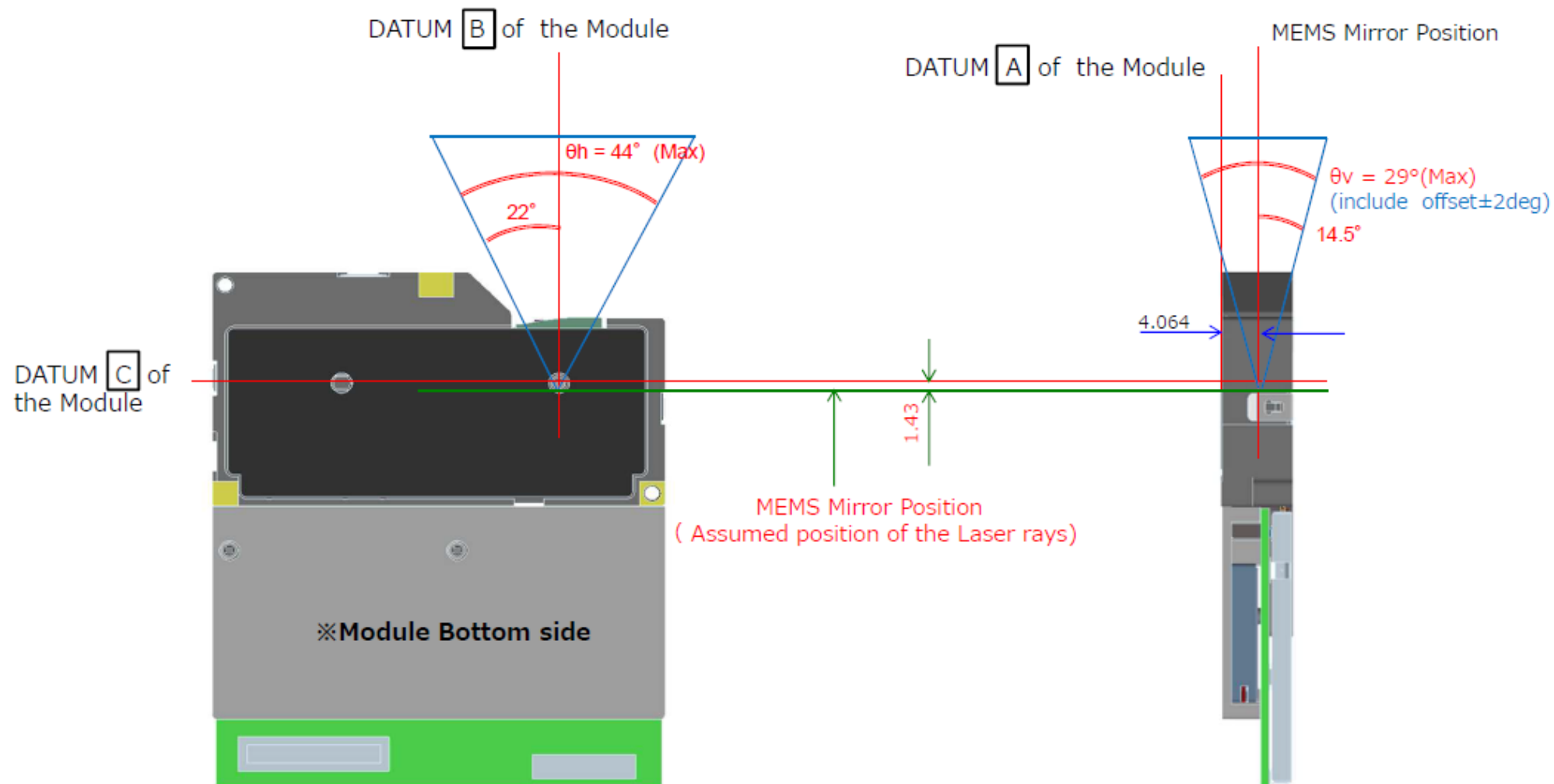
Good

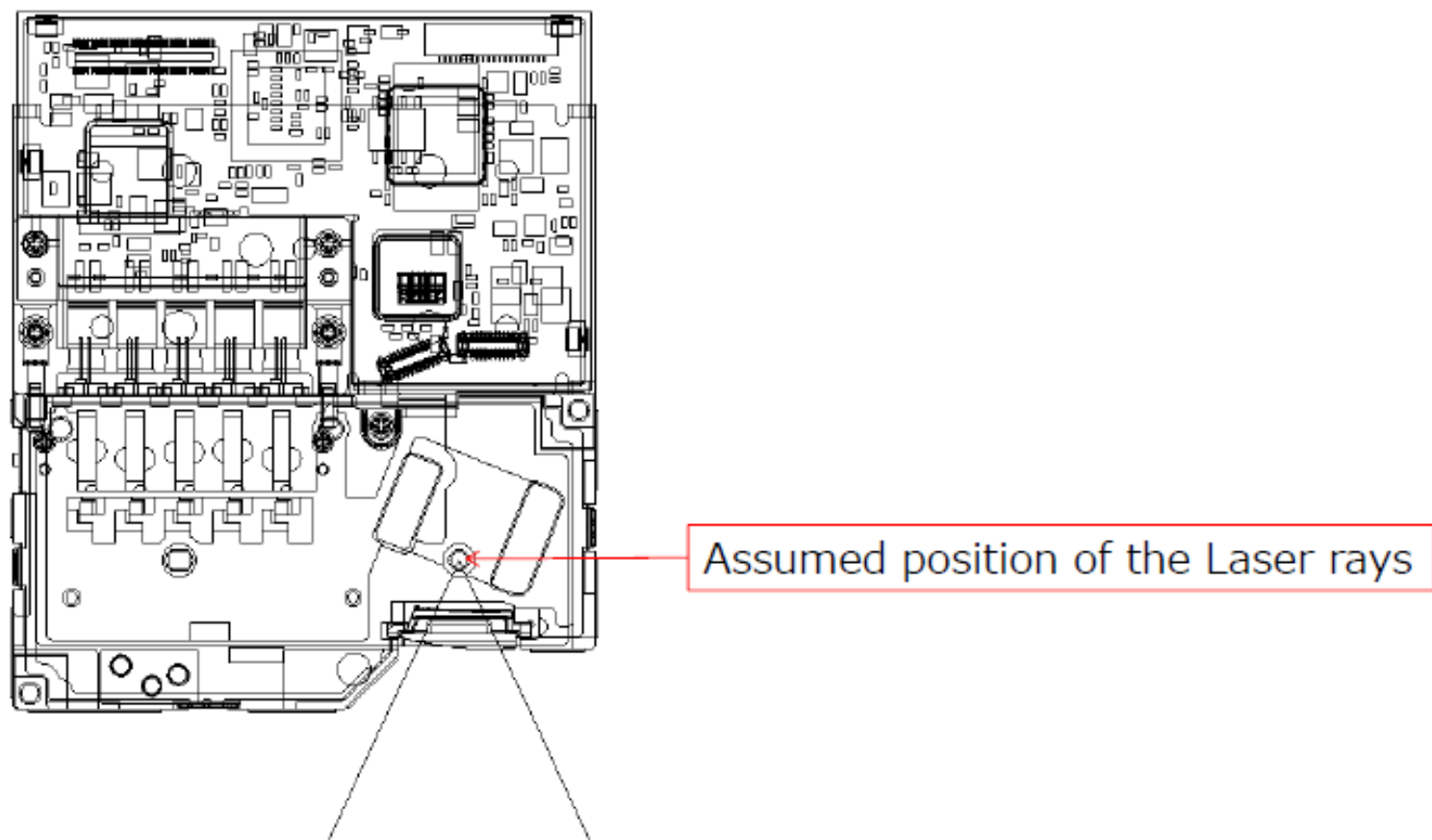


Bad

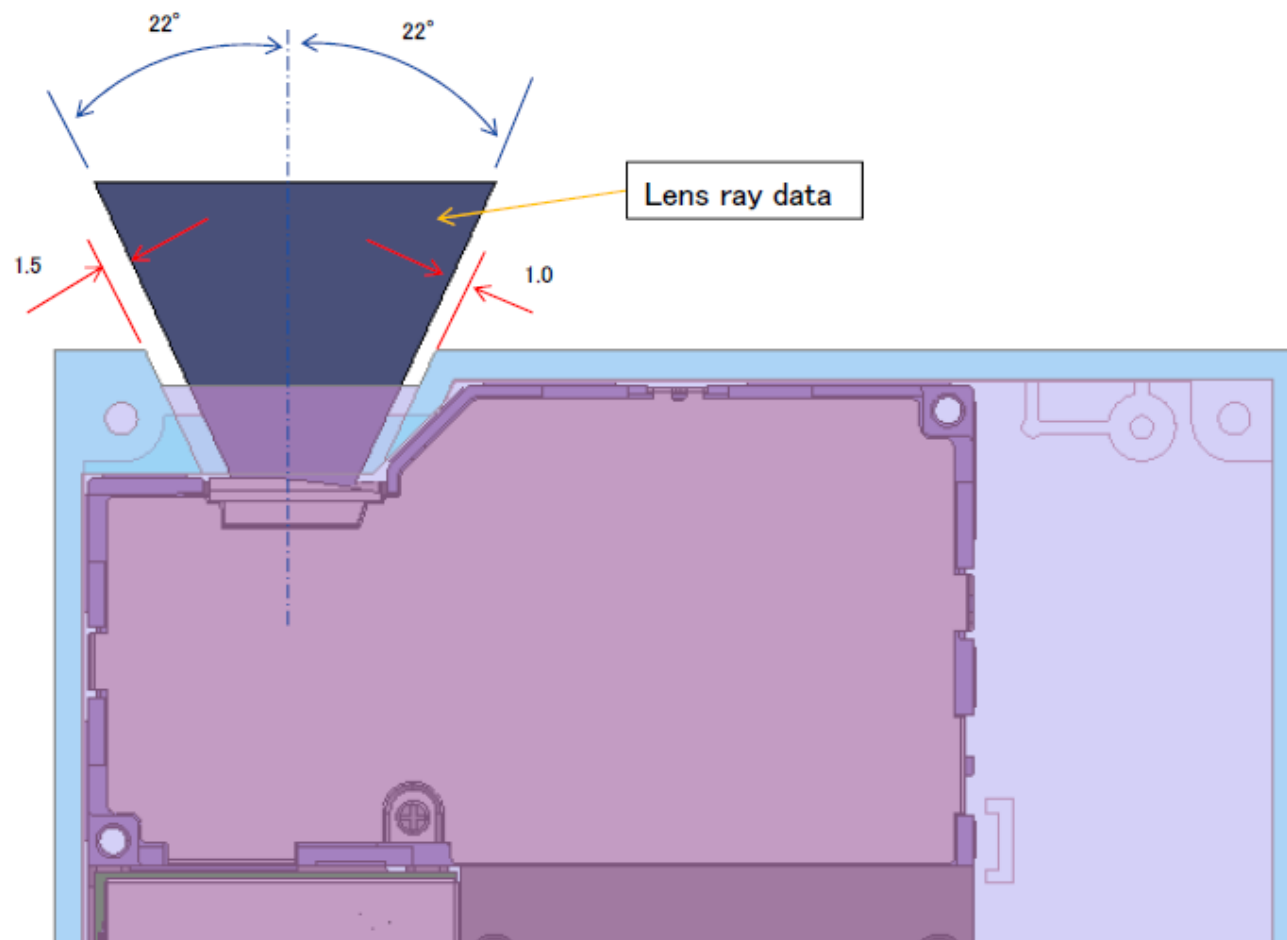
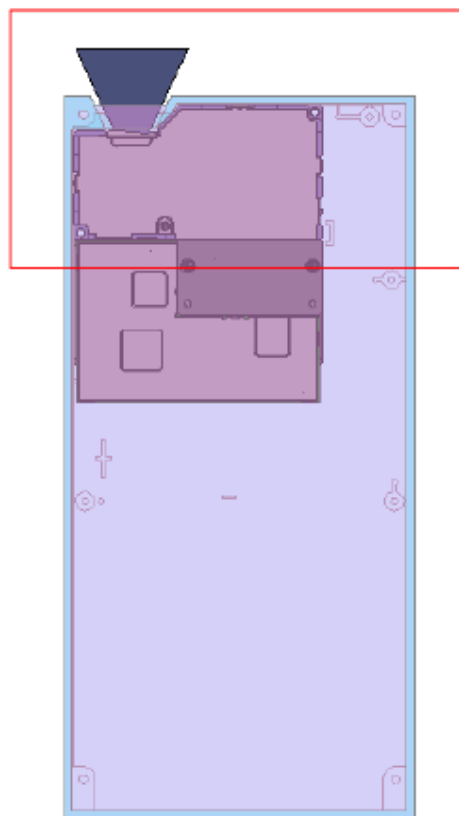
Scanning angle

[Unit: mm, deg]



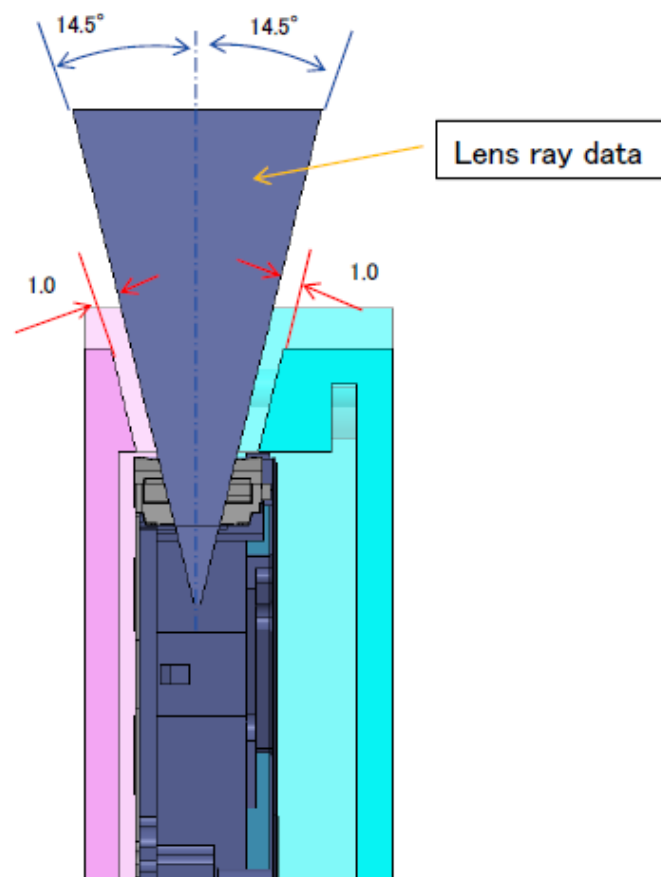
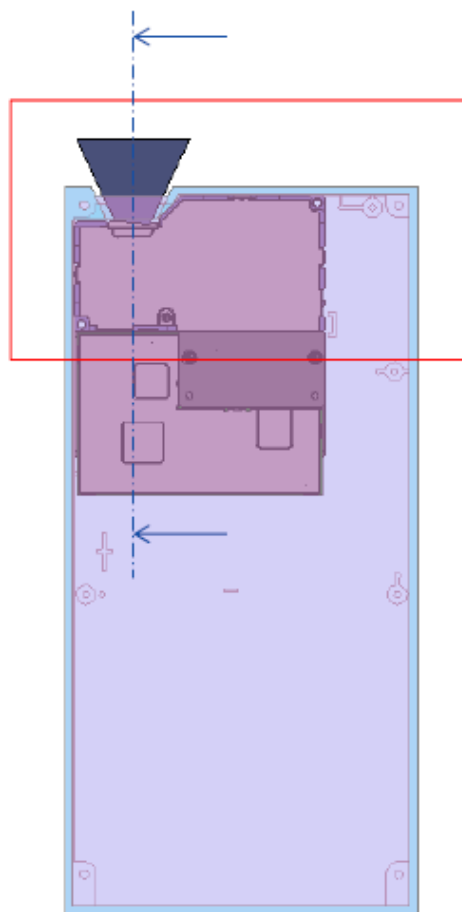


■ About lens open aperture - Top View -



Opening of cavity is offset from the lens ray data.
Left 1.5mm、Right 1.0mm from Top view

■ About lens open aperture - Side View -



Opening of cavity is offset from the lens ray data.
Top and Bottom same 1.0[mm] from Top view

Audio vibration issue

Vibration from speaker may be conducted to module and cause image disturbance.
It is recommended to consider followings:

- Higher strength of case is preferable to avoid vibration propagation.
 - ✓ thickness, material, etc
- Vibration conductance from speaker to case should be reduced.
- It is better to place speaker at a distance from module.
- Resonance frequency of case especially around 800Hz should be avoided.
- Frequencies related to MEMS are 60/50Hz, around 800Hz, 27KHz. And around 800Hz causes more affect.

Adjustment function

Laser Scanning Beam projector needs to implement two adjustment functions as maintenance mode due to drift with time or stress during set product manufacturing.

- 1) Laser beam alignment
- 2) Bi-phase adjustment

*Details are described in following pages.

This function is needed for two cases,

- (1) End customer may execute adjustment of them when realizing image drift.
- (2) Manufacturer needs to inspect image quality in set product manufacturing line and adjust them if necessary.

➤ **Laser beam alignment:**

Laser beam spots may shift in manufacturing and time depending effect. Though beam spots have been corrected in manufacturing process, alignment adjustment function is required to be implemented in HOST firmware due to time depending issue in use and stress in set manufacturing process. To adjust this alignment, [please refer to followings in “FW Specification document”](#).

< Detailed Description of Functions >

Adjustment function (Optical axis offset)

Adjustment function (Easy optical axis offset adjustment)

< Command list>

Get Optical Alignment

Set Optical Alignment

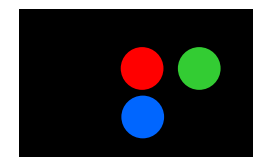
Set EasyOpticalAdjustmentControl

Set EasyOpticalAdjustmentPlus

Set EasyOpticalAdjustmentMinus

Set EasyOpticalAdjustmentExit

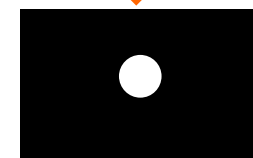
[example image]



Beam spots miss-aligned



Adjusted with correction command



Beam spots aligned

➤ **Bi-phase adjustment:**

Laser beam scanning is swept right to left and left to right, this is called “Bi-phase”.

Scanning phase between them is adjusted in manufacturing process, however it may shift with time depending effect. So phase adjustment function is required to be implemented in HOST firmware due to time depending issue in use. To adjust this phase, [please refer to followings in “FW Specification document”](#).

< Detailed Description of Functions >

Adjustment function (Biphase)

Adjustment function (Easy biphase adjustment)

< Command list>

Get Biphase

Set Biphase

Set EasyBiphaseAdjustmentControl

Set EasyBiphaseAdjustmentPlus

Set EasyBiphaseAdjustmentMinus

Set EasyBiphaseAdjustmentExit

[example image]



Scanning phase shifted

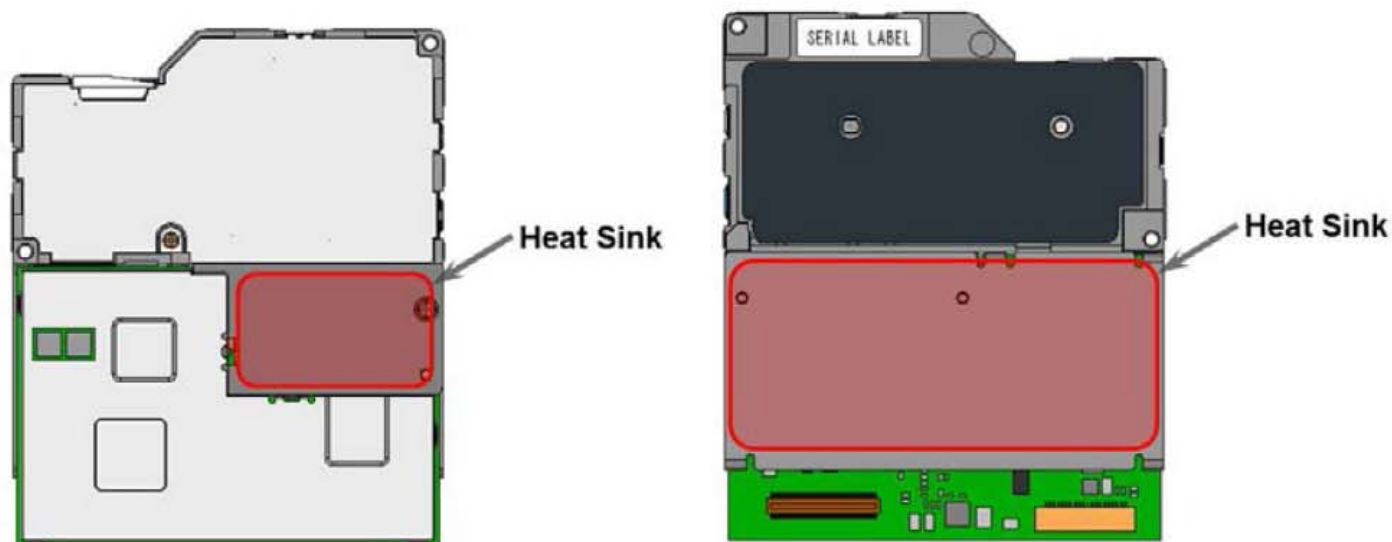


Adjusted with correction command



Scanning phase adjusted

Thermal design



The thermal design is expected to make the temperatures of the specified heat sink never exceed 60 °C.

In the default setting, the module is in Mute (black) mode at 60 °C internal temperature and system is stopped at 65 °C internal temperature. This monitored temperature differs from heat sink temperature. Thermal design must be based on the specified heat sink temperature.

Please make sure that the thermal design must be based on the specified heat sink temperature.

This is an example of thermal conduction material that can be used between heat sink and thermal spreader part.

Gap Pad® 1500

Thermally Conductive, Un-Reinforced Gap Filling Material

BERGQUIST COMPANY

Features and Benefits

- Thermal conductivity: 1.5 W/m-K
- Un-reinforced construction for additional compliancy
- Conformable, low hardness
- Electrically isolating

Gap Pad 1500 has an ideal filler blend that gives it a low-modulus characteristic that maintains optimal thermal performance yet still allows for easy handling. The natural tack on both sides of the material allows for good compliance to adjacent surfaces of components, minimizing interfacial resistance.

TYPICAL PROPERTIES OF GAP PAD 1500

PROPERTY	IMPERIAL VALUE	METRIC VALUE	TEST METHOD
Color	Black	Black	Visual
Reinforcement Carrier	—	—	—
Thickness (inch) / (mm)	0.020 to 0.200	0.508 to 5.080	ASTM D374
Inherent Surface Tack (1- or 2-sided)	2	2	—
Density (g/cc)	2.1	2.1	ASTM D792
Heat Capacity (J/g-K)	1.0	1.0	ASTM E1269
Hardness, Bulk Rubber (Shore 00) (1)	40	40	ASTM D2240
Young's Modulus (psi) / (kPa) (2)	45	310	ASTM D575
Continuous Use Temp (°F) / (°C)	-76 to 392	-60 to 200	—
ELECTRICAL			
Dielectric Breakdown Voltage (Vac)	>6000	>6000	ASTM D149
Dielectric Constant (1000 Hz)	5.5	5.5	ASTM D150
Volume Resistivity (Ohm-meter)	10 ¹¹	10 ¹¹	ASTM D257
Flame Rating	V-O	V-O	U.L. 94
THERMAL			
Thermal Conductivity (W/m-K)	1.5	1.5	ASTM D5470

1) Thirty second delay value Shore 00 hardness scale.
 2) Young's Modulus, calculated using 0.01 in/min. step rate of strain with a sample size of 0.79 inch². For more information on Gap Pad modulus, refer to Bergquist Application Note #116.

Procedure example for Temperature Stop state

When monitored internal temperature reaches 60°C, the module gets in to the Mute (black screen) mode. And when the temperature becomes under 60°C, the state is back to previous state (it resumes automatically). However this may cause oscillation between Mute and previous state. Following procedure is an example to avoid unexpected oscillation.

Monitored internal temperature reaches 60°C



in to the Mute (black screen) mode automatically



“Temperature Emergency Notify” returns



Send “Mute” command explicitly



Monitor the temperature using “Get Temperature” command and if temperature becomes low enough for example 50 °C(*), then



Send “UnMute” command to resume

(): Monitored temperature differs from heat sink, usually it is lower than heat sink by several degrees, depending on thermal design. Please check heat sink temperature correlation. Temperature must be maintained based on heat sink temperature.*

Update of FW / Start-up screen picture

There are two ways for FW and start-up screen picture update.

1. Use I2C from HOST CPU
2. Use UART from outside PC control
 - ✓ This might be used in product manufacturing line using PC connected with wire to board and terminal software like TeraTerm.
 - ✓ Strongly recommended to place terminals or something connector on board in order to be wired from outside.

This is helpful and important for manufacturer, when start-up screen is installed in set manufacturing line. Therefore update scheme should be considered properly.

Test procedure example for using I2C update and also instruction for using UART update are described in following pages.

Test procedure example of update using I2C

Use “Update FW Image” or “Division Transmission Update FW Image” command.

* For many application processor system, it limits data transfer size at one time for I2C, in that case , please use “Division Transmission Update FW Image” with chunked data transfer.

1. Check current FW version with “Get Version” command (0xA2 0x00)
“0xA2 0x0d 0x00 0x-- 0x-- 0x-- 0x-- , , , ,” should be sent back as Notify.
 2. Update FW with “Division Transmission Update FW Image” using “flash(date)_====_**_DCL.img” as test FW data.
 3. Reboot once.
 4. Then check FW was updated with “Get Version” command.
“0xA2 0x0d 0x00 0x== 0x== 0x== 0x== , , , ,” should be sent back as Notify.
 5. Re-update back to current FW with “Division Transmission Update FW Image” using “flash(date)_----_**_DCL.img”
 6. Check current FW version resumed with “Get Version” command.
“0xA2 0x0d 0x00 0x-- 0x-- 0x-- 0x-- , , , ,” should be sent back as Notify.
- ✓ Sony will provide test FW data “flash(date)_====_**_DCL.img” and current FW data “flash(date)_----_**_DCL.img” to resume.

Use “Update Picture Data” or “Division Transmission Update Picture Data” command.

* For many application processor system, it limits data transfer size at one time for I2C, in that case , please use “Division Transmission Update Picture Data” with chunked data transfer.

1. Update picture data with “Division Transmission Update Picture Data” using “(test).bin” as test picture data.
2. Reboot once.
3. Check the picture image as start-up screen was changed.
4. Re-update back to real picture with “Division Transmission Update picture Data” using “xx.bin” to resume.
5. Check the picture image as start-up screen was resumed correctly to real picture.

Update instruction using UART

■ Description

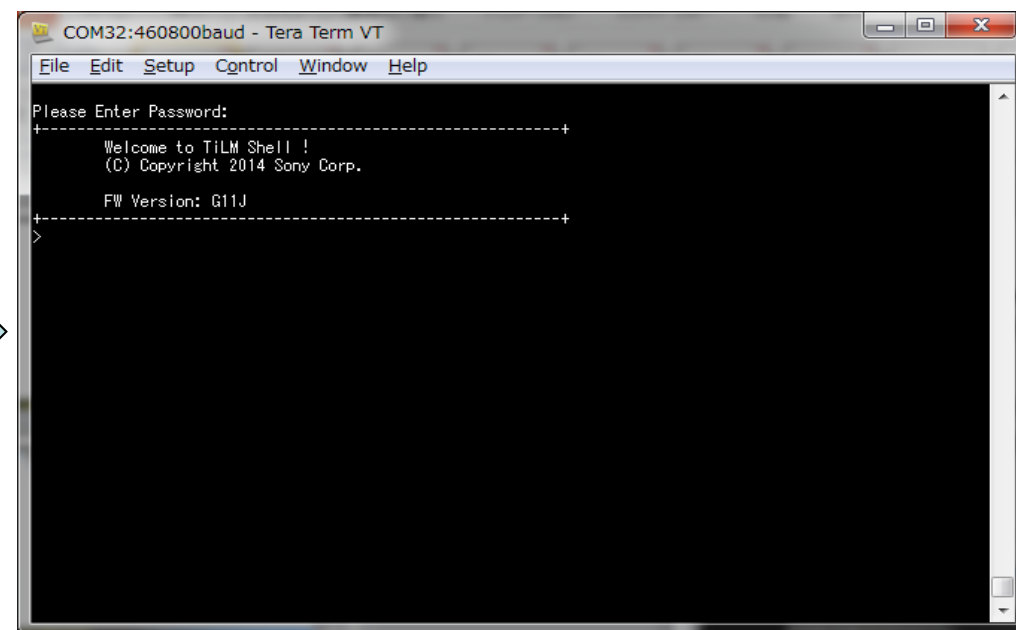
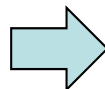
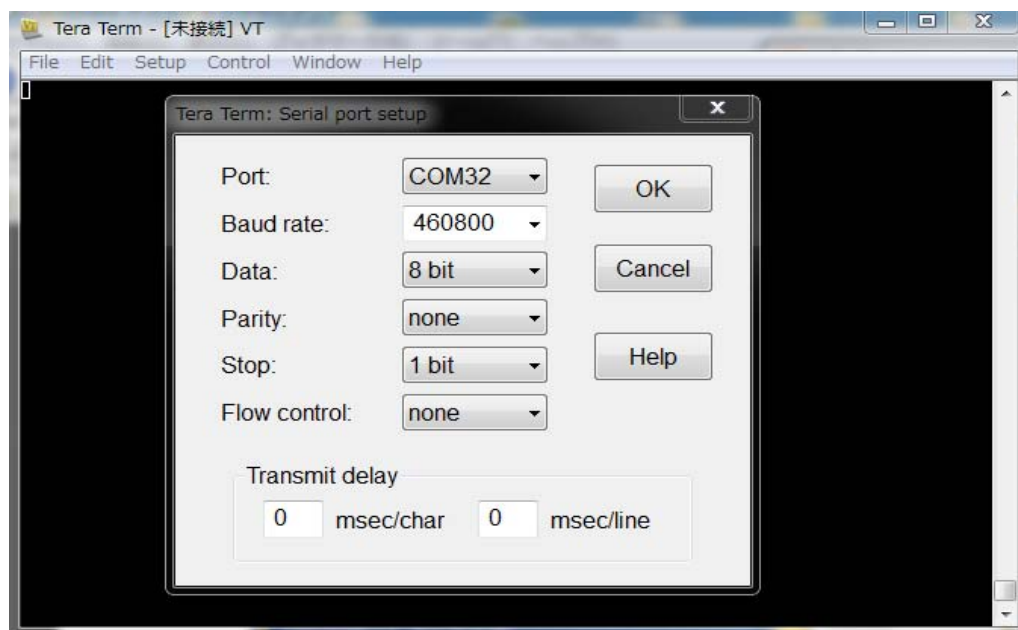
- ◆ The module has a UART (Universal Asynchronous Receiver/Transmitter) interface. This interface can be used for logo updates and firmware updates.

This describes the start-up screen picture and firmware updating method using the UART interface.

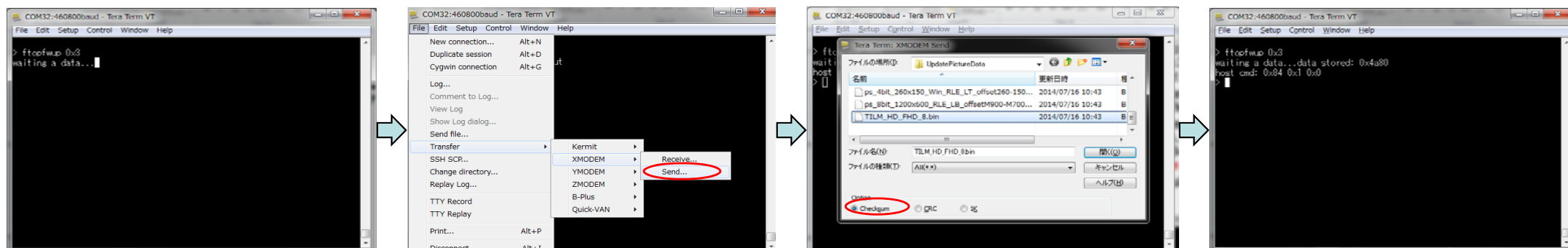
■ Contents

- ◆ Terminal Setup
- ◆ Start-up screen picture Update
- ◆ Firmware Update

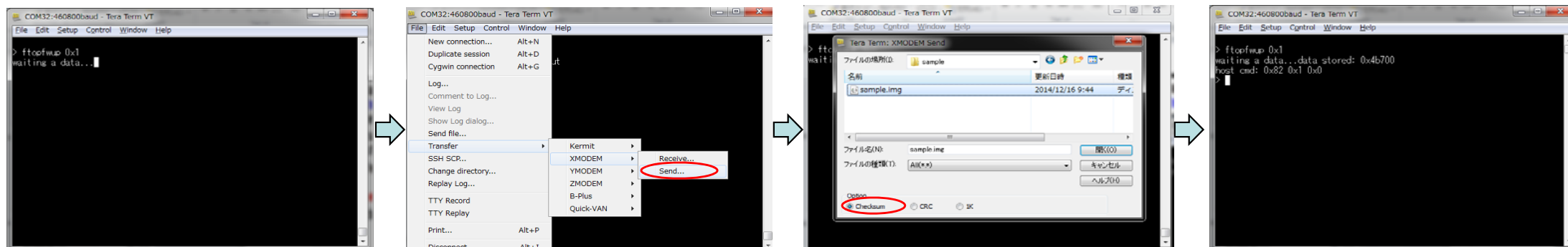
1. Turn on power to the module
2. Start TeraTerm(A free software terminal emulator for MS-Windows)
 - ◆ Select your Com Port
 - ◆ Set the baud rate to 460800
3. Enter the password
 - ◆ Password is 'sonytilm'

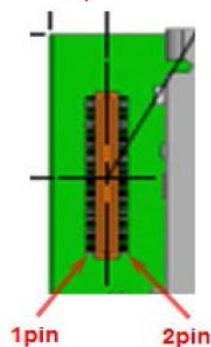
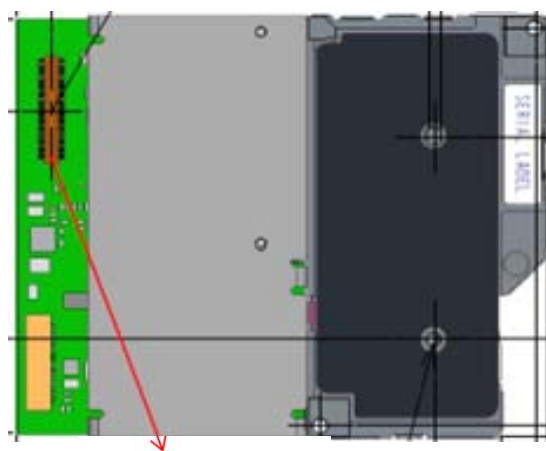


1. Enter the screen picture update command below:
`> ftopfwup 0x3`
Then you will get a message 'waiting a data...'
2. Send a picture binary file using the XMODEM/SUM protocol:
`File -> Transfer -> XMODEM -> Send...` (Select the checksum option)
3. Once the transfer and update have finished you will get a message like:
`data stored: 0x4a80`
`host cmd: 0x84 0x1 0x0`
*** Don't turn the power off before update is completely finished.**
4. Reboot the module



1. Enter the firmware update command below:
`> ftopfwup 0x1`
Then you will get a message 'waiting a data...'
2. Send a firmware binary file using the XMODEM/SUM protocol:
`File -> Transfer -> XMODEM -> Send...` (Select the checksum option)
3. Once the transfer and update have finished you will get a message like:
`data stored: 0x4b700`
`host cmd: 0x82 0x1 0x0`
*** Don't turn the power off before update is completely finished.**
4. Reboot the module

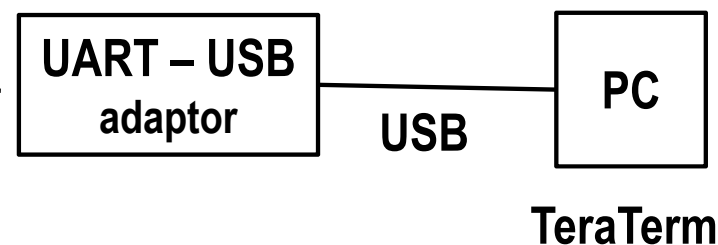




Module B to B connector

Pin Name	Pin #	Pin #	Pin Name
UART_RX	38	37	UART_TX

UART 3.3V
+ GND



Attention for flash memory write

**When commands with writing flash memory are used,
power supply of module must not be off until completion.**

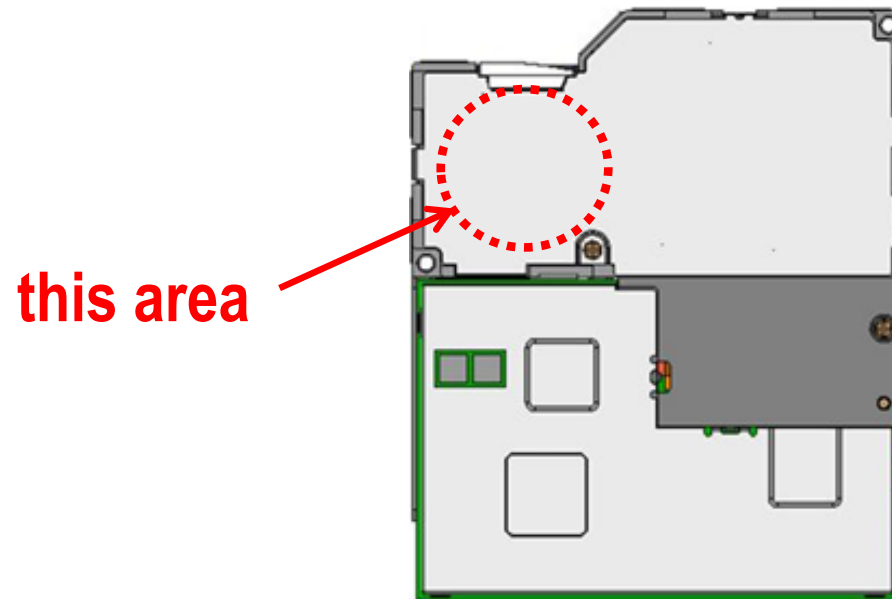
It may destroy flash memory data. In this case, the module can not be booted-up permanently. Also “EN” pin must be kept high during that, lowering EN causes internal power down. Completion can be recognized by Notify with normal completion result.

Corresponding commands including flash writing operation are:

- “Save User Param”
- “Update FW Image”
- “Update Picture Data”
- “Division Transmission Update Data”
- “Set EasyOpticalAdjustmentControl”
- “Set EasyOpticalAdjustmentExit”
- “Set EasyBiphaseAdjustmentControl”
- “Set EasyBiphaseAdjustmentExit”

Attention for magnetic field

The module generates “magnetic field” from MEMS device in the module.



Save Factory Param

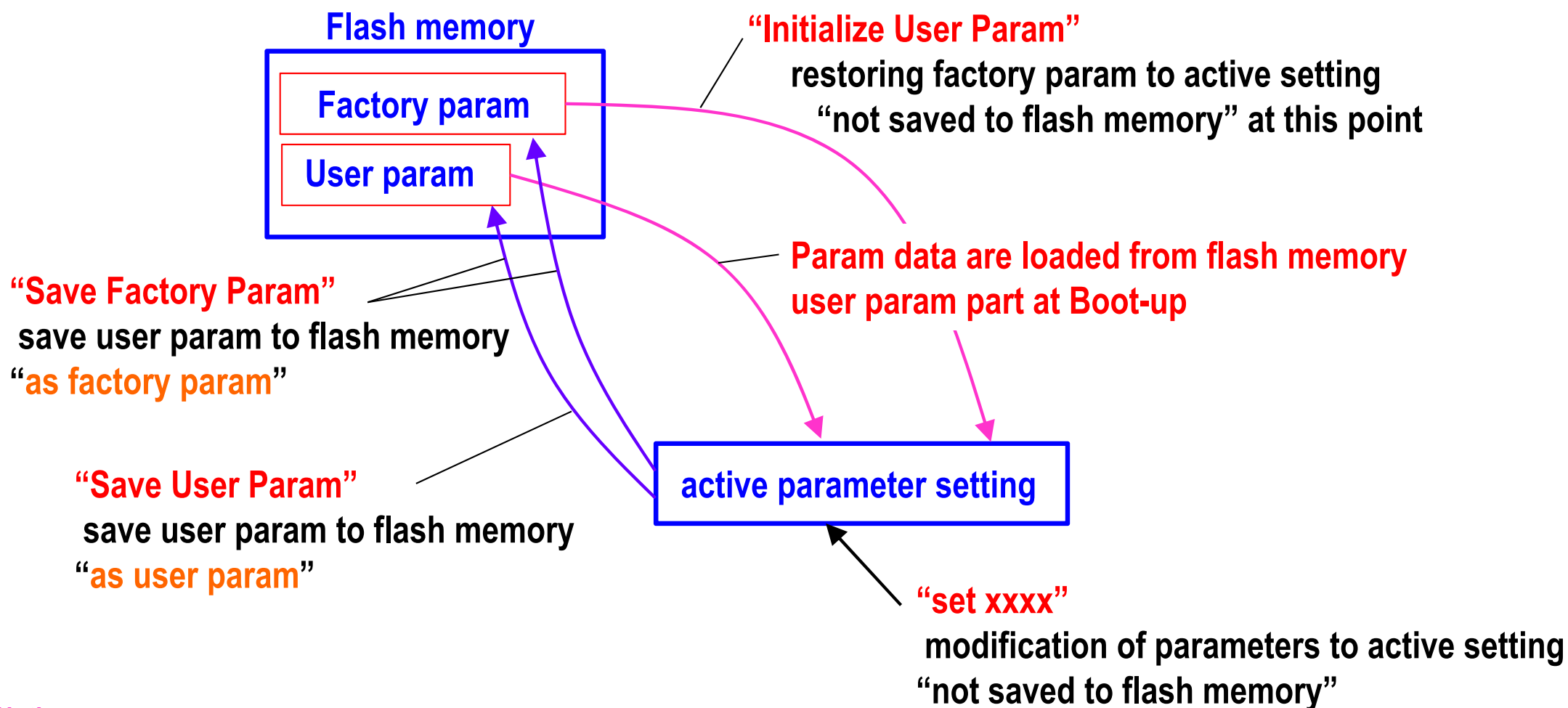
“Initialize User Param” can reset parameters (Param) to factory values, however this factory values are not able to be changed in default command set.

Special command, “Save Factory Param” is available to rewrite factory param values.

“Save Factory Param” makes HOST-system possible to set the reset values which can restore using “Initialize User Param” command.

Please use this command carefully because it overwrite original factory parameter which can not be recovered. It is not recommended to use unless really required.

Relation and behavior of Param-commands are explained at the next page.

**Notice:**

When commands with writing flash memory are used,
power supply of module must not be off until completion.

It may destroy flash memory data. In this case, the module can not be booted-up permanently.
Also “EN” pin must be kept high during that, lowering EN causes internal power down.
Completion can be recognized by Notify with normal completion result.

Save Factory Param

[Description]

This command saves the all parameters as factory setting values.

[Attributes]

Attribute	Information
Type	Request • Notify type
CMD	0x09
Request OP0 [Size information]	0x08
Notify OP0 [Size information]	0x01

[Detailed Description of Request]

Issue this command to execute a save all parameters request. This makes it possible to save the parameters as factory setting. These saved parameters are used as default parameters for Initialized User Param command to reset as factory setting.

When the Request communication of this command stalls partway and a Time Out occurs, or when processing cannot be performed due to internal circumstances, Command Emergency Notify is notified by Module→HOST communication.

This command can be issued in the Ready and Active state.

The OP information sent by the Request is shown below.

OP	Description
OP1	1 byte of the 4-byte parameter version information. This is the version [0] value. Fixed value
OP2	1 byte of the 4-byte parameter version information. This is the version [1] value.
OP3	1 byte of the 4-byte parameter version information. This is the version [2] value.
OP4	1 byte of the 4-byte parameter version information. This is the version [3] value.
OP5	1 byte of the 4-byte parameter date information. This is the date [0] value.
OP6	1 byte of the 4-byte parameter date information. This is the date [1] value.
OP7	1 byte of the 4-byte parameter date information. This is the date [2] value.
OP8	1 byte of the 4-byte parameter date information. This is the date [3] value.

OP1:

This indicates 1 byte of the 4-byte parameter version information. When the version information is expressed as version[4] = {"G", "0", "1", "2"}, this is the ASCII data for version[0]="G".

This is a fixed value, so it can not be changed.

OP2:

This indicates 1 byte of the 4-byte parameter version information. When the version information is expressed as version[4] = {"G", "0", "1", "2"}, this is the ASCII data for version[1]="0".

This value is an arbitrarily determined value, so there is no value information.

OP3:

This indicates 1 byte of the 4-byte parameter version information. When the version information is expressed as version[4] = {"G", "0", "1", "2"}, this is the ASCII data for version[2]="1".

This value is an arbitrarily determined value, so there is no value information.

OP4:

This indicates 1 byte of the 4-byte parameter version information. When the version information is expressed as version[4] = {"G", "0", "1", "2"}, this is the ASCII data for version[3]="2".

This value is an arbitrarily determined value, so there is no value information.

OP5:

This indicates 1 byte of the 4-byte parameter date information. When the date information is expressed as version[4] = {0x20, 0x14, 0x02, 0x10}, this is the ASCII data for date[0]=0x20.

This value is an arbitrarily determined value, so there is no value information.

OP6:

This indicates 1 byte of the 4-byte parameter date information. When the date information is expressed as version[4] = {0x20, 0x14, 0x02, 0x10}, this is the ASCII data for date[1]=0x14.

This value is an arbitrarily determined value, so there is no value information.

OP7:

This indicates 1 byte of the 4-byte parameter date information. When the date information is expressed as version[4] = {0x20, 0x14, 0x02, 0x10}, this is the ASCII data for date[2]=0x02. This value is an arbitrarily determined value, so there is no value information.

OP8:

This indicates 1 byte of the 4-byte parameter date information. When the date information is expressed as version[4] = {0x20, 0x14, 0x02, 0x10}, this is the ASCII data for date[3]=0x10. This value is an arbitrarily determined value, so there is no value information.

[Detailed Description of Notify]

Notify is always sent back as the response of this command.

The OP information sent by Notify is shown below.

OP	Description
OP1	Command result

OP1:

This indicates the command result. The possible value information is shown below.

Value	Description
0x00	Normal
0x8X	Internal failure, X is 1 to 4.

Resume from lock-state of failure mode

The module has a function to lock in order to avoid boot again as “Failure Mode” in case of physical malfunction causing abnormal laser emission before regular “Laser Safety Function” is activated.

The way (command) to resume the module from this locked state by set product side is provided. However in use, it must be confirmed the module works properly.
The module must not be used in the real failure case.

The module might detect the failure mode and be lock accidentally under following cases. Please handle and design the module carefully.

1. In case the module is put on/off the board which power is supplied, or in case of contact failure of connector.
2. In case the module is booted at VBAT under 3.0V of specification.
(For example, Battery characteristic and/or power supply design is weak or not proper.)

The locked state can be released with following commands.

Please confirm the module works properly after resuming the module.

For example, if the module is locked again even at full charged battery condition, it may be real malfunction and please do not use the module.

If “Boot Completed Notify” result is “0x80” in the boot sequence, the module is in the failure mode and locked state. In this situation, “Get TroubleInfo” and “Clear TroubleInfo” commands can be used for getting failure information and clearing the failure state to resume, respectively.

Get TroubleInfo

[Description]

This command gets the failure information stored internally.

[Attributions]

Attribute	Information
Type	Request・Notify type
CMD	0xCA
Request OP0 [Size information]	0x05
Notify OP0 [Size information]	0x03

[Detailed Description of Request]

Issue this command to execute a get stored failure information request. This makes it possible to get the stored failure information by Notify communication.

When the Request communication of this command stalls partway and a Time Out occurs, or when processing cannot be performed due to internal circumstances, Command Emergency Notify is notified by Module→HOST communication.

This command can be issued in the Ready, Active and failure states.

The OP information sent by Request is shown below.

OP	Description
OP1	0x01 (Fixed value)
OP2	0x24 (Fixed value)
OP3	0x10 (Fixed value)
OP4	0x06 (Fixed value)
OP5	0x00 (Fixed value)

OP1 to OP5:

Each OP is fixed value and other value is not guaranteed.

[Detailed Description of Notify]

Notify is always sent back as the stored failure information response of this command.
The OP information sent by Notify is shown below.

OP	Description
OP1	Command result
OP2	0x01 (Fixed value)
OP3	Stored failure information

OP1:

This indicates the command result. The possible value information is shown below.

Value	Description
0x00	Normal
0x8X	Internal failure, X is 1 to 4.

OP2:

Fixed value

Value	Description
0x01	Fixed value

OP3:

This indicates the stored failure information. The possible value information is shown below.

Value	Description
0x00	No failure information stored, not failure state
0x01	Failure information stored, in failure state

Clear TroubleInfo

[Description]

Issue this command to clear the stored failure information. This makes it possible to resume the module if the failure occurred accidentally.

[Attributions]

Attribute	Information
Type	Request・Notify type
CMD	0xCB
Request OP0 [Size information]	0x06
Notify OP0 [Size information]	0x01

[Detailed Description of Request]

Issue this command to execute a clear stored failure information request. This makes it possible to clear the stored failure information.

When the Request communication of this command stalls partway and a Time Out occurs, or when processing cannot be performed due to internal circumstances, Command Emergency Notify is notified by Module→HOST communication.

This command can be issued in the Ready, Active and failure states.

The OP information sent by Request is shown below.

OP	Description
OP1	0x01 (Fixed value)
OP2	0x24 (Fixed value)
OP3	0x10 (Fixed value)
OP4	0x06 (Fixed value)
OP5	0x00 (Fixed value)
OP6	0x00 (Fixed value)

OP1 to OP6:

Each OP is fixed value and other value is not guaranteed.

[Detailed Description of Notify]

Notify is always sent back as the stored failure information response of this command.

The OP information sent by Notify is shown below.

OP	Description
OP1	Command result

OP1:

This indicates the command result. The possible value information is shown below.

Value	Description
0x00	Normal
0x8X	Internal failure, X is 1 to 4.

Notification form of customer evaluation completion and FW revision

“Nortification_Comp_Eva.pdf”

CONFIDENTIAL

Device Solutions Business Group
Sony Corporation

Analogue LSI Business Division
Laser and MEMS Products Department

P
M Takashi Kobayashi → Attention : No. _____

Notification of Completed Evaluation

This is to inform you of the following result.

Product Name : CXN010x-xxx
Device Function : Pico Projector
Evaluation Result : Pass

Please check the box of applicable number below.

Accepted
☒ 1. I have completed all planned evaluation and investigation of all functions and characteristics of this product, and declare that there is no problem on practical use of this product.

Not Accepted
☐ 2. This product has a problem(s) on design.
☐ 3. This product has other reason(s).

When you indicating 2. or 3. above, please note specific contents and processing below.

Signature _____ Date of Approval _____
Name : _____

Ver. 141125

To start mass-production or in case of certain major firmware change, Sony request customer to evaluate and return notification document of customer's evaluation completion.

Sony will provide this form “Nortification_Comp_Eva.pdf”, then **please fill it up and send back scanned data by e-mail.**

Please check after evaluation completed.

Please sign, print name and date.

***Sony may revise firmware without notice and/or customer evaluation for module manufacturing or other improvement purpose.**

Others

Purpose of Use of the Products:

Customer shall use the Products with the utmost concern for safety, and shall not use the Products for any purpose that may endanger life or physical wellbeing, or cause serious damage to property or the environment, either through normal use or malfunction.

Use of the Products for purposes other than those stipulated in this specification is strictly prohibited.

Furthermore, usage of the Products for military purposes is strictly prohibited at all times.

Safe Design:

Customer is responsible for taking due care to ensure the product safety design of its products in which the Products are incorporated, such as by incorporating redundancy, anti-conflagration features, and features to prevent mis-operation, in order to prevent accidents resulting in injury, death, fire, or other social damage as a result of failure.

Product Information:

The product specifications, circuit examples, and any and all other technical information and content contained in this specification, as well as any other information and materials provided to Customer in connection with the Products (collectively, "Product Information") have been provided to Customer for reference purpose only, and the availability and disclosure of such Product Information and its usage by Customer shall not be construed as giving any indication that Sony, its subsidiaries and/or its licensors will license any right, including intellectual property rights in such Product Information by any implication or otherwise.

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