

『MMS101 SDK for Raspberry Pi』 User's Guide:

Instruction Manual

OUTLINE

This document is the instruction manual of "MMS101 SDK for Raspberry Pi".

"MMS101 SDK for Raspberry Pi" is a System Design Kit(SDK) consisting of an Add-on Board(connected to Raspberry Pi), a conversion board, and sample code. You can easily check the operation of the sensor by using the sample code. This kit is an expanded part of Raspberry Pi and not operable alone.

For more information on the MMS101, please refer to the data sheet.

CAUTION

This kit is a design / sales promotion tool specifically for our products.

Therefore, we do not provide any guarantees for the performance, reliability, management of contained substances, export management, and others regarding this kit.

Please let us know that we will replace it if it is defective in its initial state.

Table of Contents

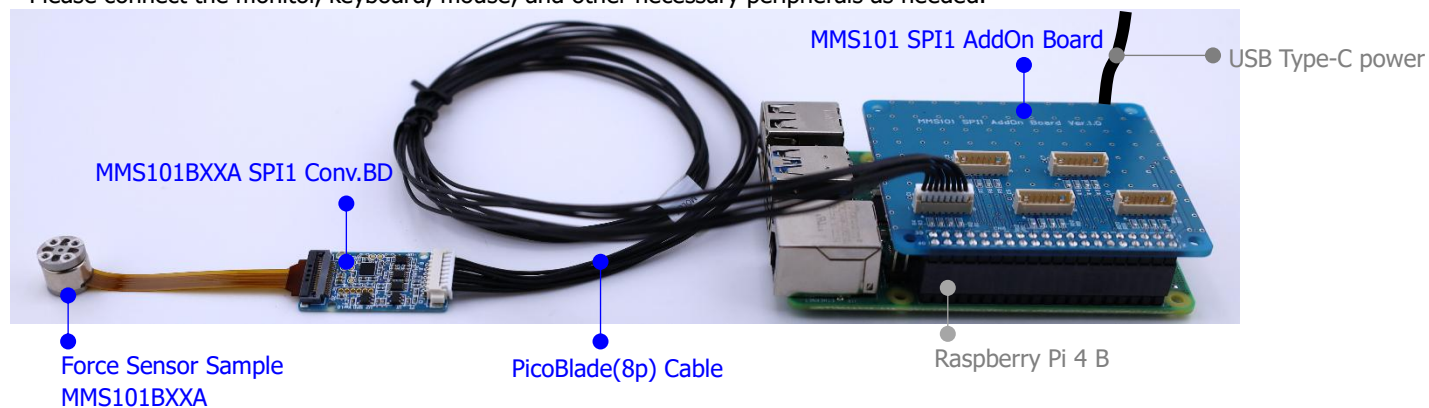
1	Configuration	3
1-1	Kit Configuration	3
2	Usage form	4
3	Supported models	4
4	Sample Code	5
4-1	File configuration	5
4-2	Evaluation procedure	5
5	Evaluation application	6
6	Board configuration	7
6-1	Expansion Board: MMS101 SPI1 AddOn Board Ver.1.0	7
6-2	Conversion Board: MMS101B SPI1 Conv.BD Ver.1.0	7
6-3	Conversion Board: MMS101C SPI1 Conv.BD Ver.1.0	7
7	Schematic circuit diagram	8
7-1	Expansion Board: MMS101 SPI1 AddOn Board Ver.1.0	8
7-2	Conversion Board: MMS101B SPI1 Conv.BD Ver.1.0	9
7-3	Conversion Board: MMS101C SPI1 Conv.BD Ver.1.0	10
8	Layout diagram	11
8-1	Expansion Board: MMS101 SPI1 AddOn Board Ver.1.0	11
8-2	Conversion Board: MMS101B SPI1 Conv.BD Ver.1.0	12
8-3	Conversion Board: MMS101C SPI1 Conv.BD Ver.1.0	13
9	BOM list	14
9-1	Expansion Board: MMS101 SPI1 AddOn Board Ver.1.0	14
9-2	Conversion Board: MMS101B SPI1 Conv.BD Ver.1.0	14
9-3	Conversion Board: MMS101C SPI1 Conv.BD Ver.1.0	15
10	MMS101B SPI1 Conv.BD Ver.1.0 Communication Specification	16
10-1	Description	16
10-2	SPI communication settings	16
10-3	Communication data format	16
10-4	Command list	17
10-5	Status Code list	21
10-6	Measure Status list	21
10-7	State ID list	21
10-8	State transition diagram	22
10-9	State transition table	22
10-10	Outline of measurement operation	23
11	Ordering Information	24
11-1	PO No. Description	24
11-2	Lineup	24
11-3	Evaluation Kit List	25

2 Usage form

Connect the evaluation kit as shown below.

You can connect up to 5 sensors, compatible with all connectors from CN1 to CN5.

Please connect the monitor, keyboard, mouse, and other necessary peripherals as needed.



3 Supported models

This kit has been confirmed to operate with Raspberry Pi 4 B.

4 Sample Code

The sample code is written in C language. GCC (GNU Compiler Collection) is required to compile the sample code.

4-1 File configuration

[MMS101_SDK_for_RaspberryPi_Sample_Code_ver.1.0.0.x]
 └ mms101_sample: Original executable file of sample code
 └ mms101.c/h: Main processing
 └ spidrv.c/h: SPI driver
 └ Makefile: make file
 └ ReadMe.txt:

4-2 Evaluation procedure

(1) How to run the sample code

Set the sensor connector number and the number of measurements in command line arguments.

- First argument to the one before the last argument : the sensor connector number
- Last argument: the number of measurements

(ex.1) connect the sensor to CN1 and measure 10 times

```
./mms101_sample 1 10
```

(ex.2) connect two sensors to CN2 and CN4 and measure 100000 times

```
./mms101_sample 2 4 100000
```

(2) Initialize the SPI driver : CSB Terminal

When the sample code is executed, the CSB terminal will be initialized as shown below.

```
/sys/class/gpio/export
/sys/class/gpio/gpio26/direction
/sys/class/gpio/gpio26/value
/sys/class/gpio/export
/sys/class/gpio/gpio19/direction
/sys/class/gpio/gpio19/value
/sys/class/gpio/export
/sys/class/gpio/gpio13/direction
/sys/class/gpio/gpio13/value
/sys/class/gpio/export
/sys/class/gpio/gpio6/direction
/sys/class/gpio/gpio6/value
/sys/class/gpio/export
/sys/class/gpio/gpio5/direction
/sys/class/gpio/gpio5/value
```

The CSB terminal of each connector and Raspberry Pi are connected shown below.

CSB	Rasp Pi GPIO	Rasp Pi Pin No.
CN1	26	37
CN2	19	35
CN3	13	33
CN4	6	31
CN5	5	29

(3) Initialize the SPI driver: SCLK Terminal

When the sample code is executed, the SCLK terminal will be initialize as shown below.

```

/ sys/class/gpio/gpio07/value
Send dummy clock
devNo,time[s],Fx,Fy,Fz,Mx,My,Mz

```

Raspberry Pi's initial state is SCLK=L. When SCLK is idle, it remains SCLK=L until a clock is sent. Therefore, after turning on power, please send a dummy clock before the first SPI communication.

(4) Measurement

When the sample code is executed, the measurement values will be output separated by commas as shown below.

```

devNo,time[s],Fx,Fy,Fz,Mx,My,Mz
CN1,0.010452,-218.089,152.382,3061.305,-1.83326,-2.05003,-2.96966
CN1,0.011477,-218.080,152.553,3061.330,-1.83320,-2.04994,-2.96904
CN1,0.012520,-218.073,152.758,3061.452,-1.83326,-2.04980,-2.96856
CN1,0.013560,-218.068,152.662,3061.423,-1.83328,-2.04976,-2.96832
CN1,0.014603,-218.072,152.783,3061.447,-1.83326,-2.04969,-2.96876
CN1,0.015641,-218.048,152.978,3061.540,-1.83335,-2.04952,-2.96954
CN1,0.016679,-218.030,152.797,3061.593,-1.83345,-2.04942,-2.96933
CN1,0.017716,-218.048,152.792,3061.609,-1.83346,-2.04953,-2.96857
CN1,0.018756,-218.064,152.397,3061.672,-1.83369,-2.04948,-2.96896
CN1,0.019793,-218.032,152.366,3061.707,-1.83386,-2.04913,-2.96880

```

(5) How to build the sample code

We have prepared a Makefile. Please build it with the make command as shown below. The mms101 file is generated.

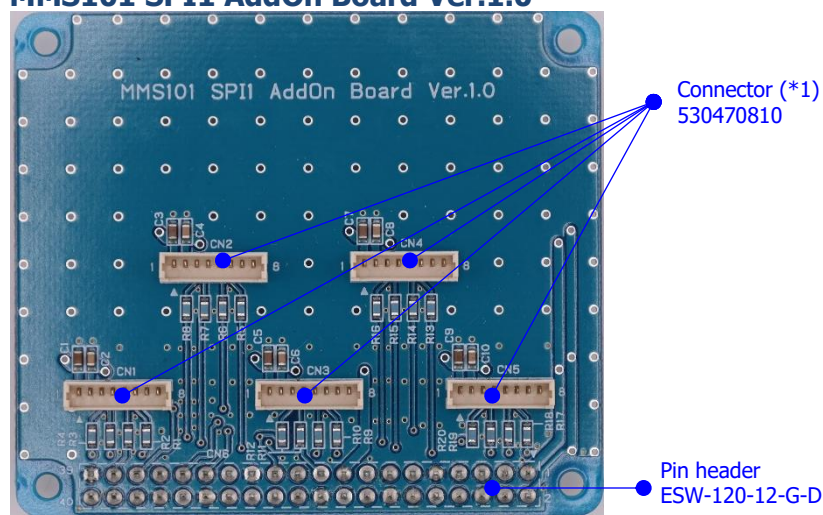
```
make
```

5 Evaluation application

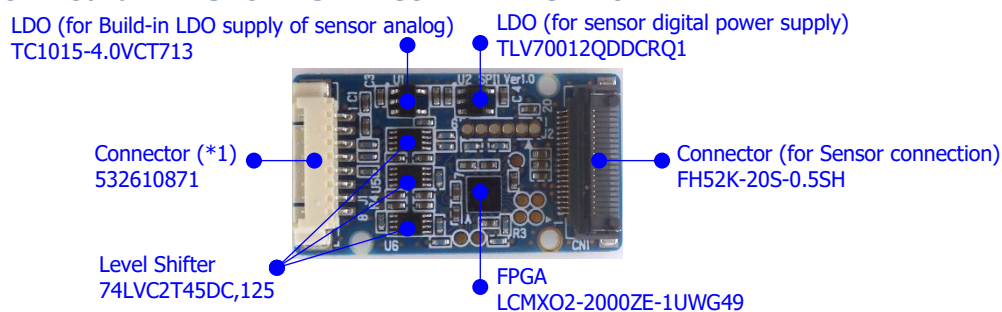
This kit does not have an evaluation app that can display graphs.

6 Board configuration

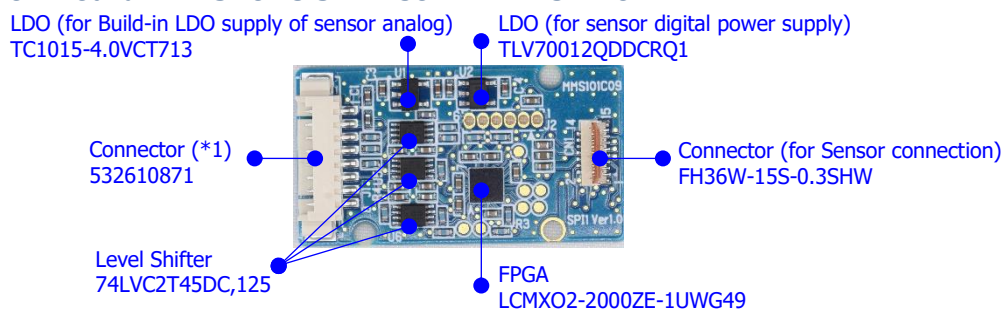
6-1 Expansion Board: MMS101 SPI1 AddOn Board Ver.1.0



6-2 Conversion Board: MMS101B SPI1 Conv.BD Ver.1.0



6-3 Conversion Board: MMS101C SPI1 Conv.BD Ver.1.0

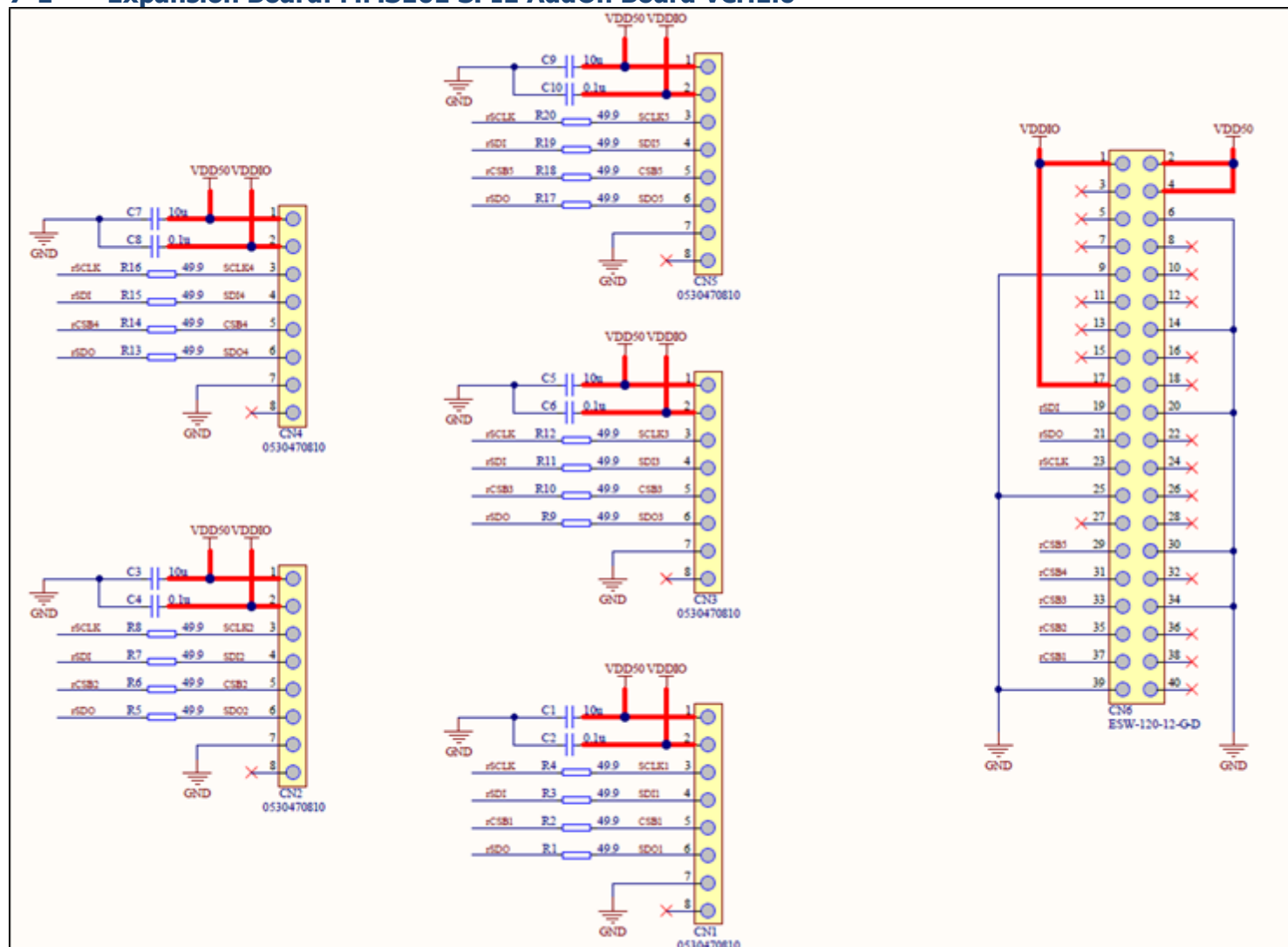


Pin assign: Connector(*1)

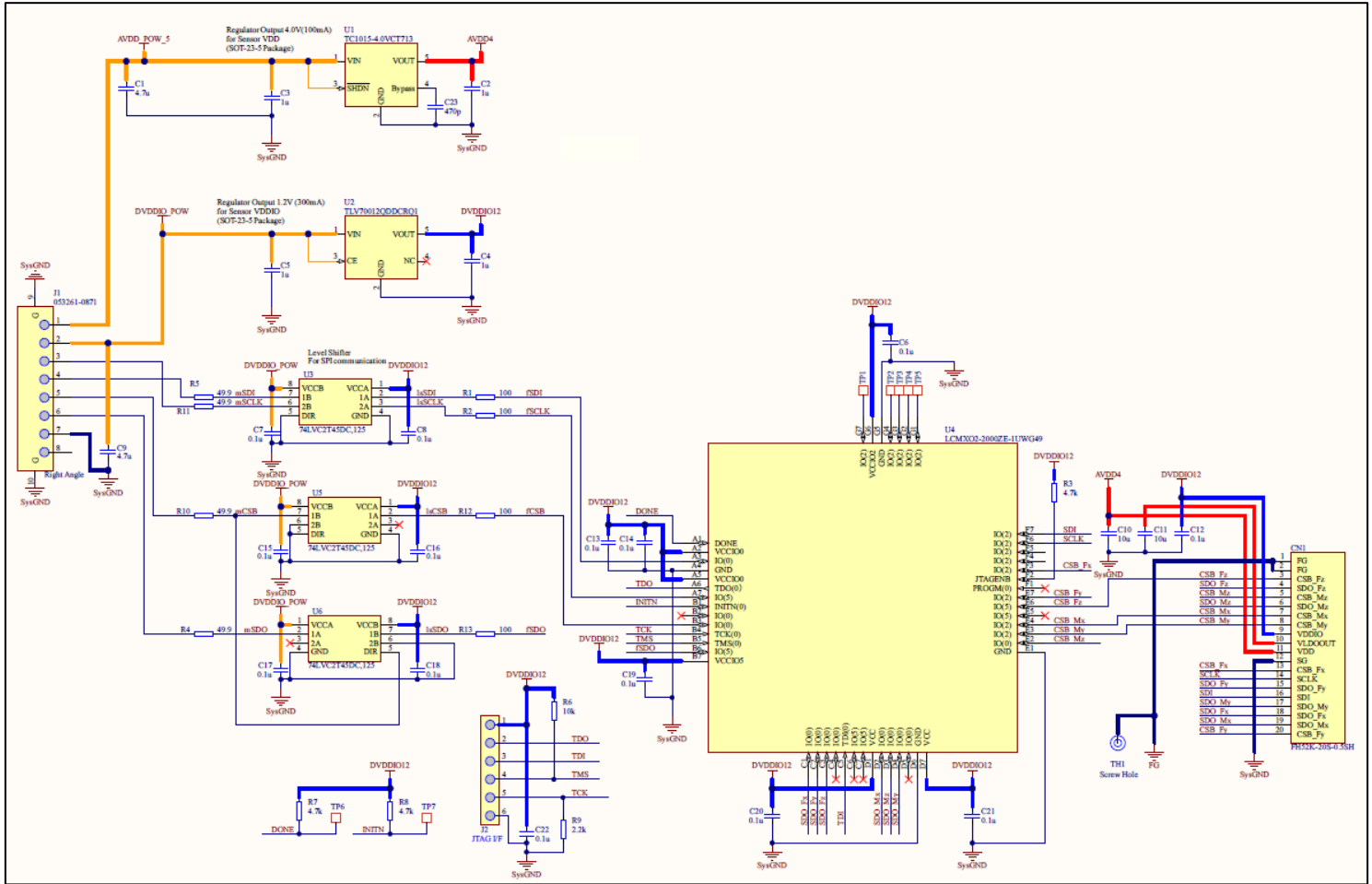
No.	Pin Name	Function
1	VDD	Analog power supply (4.5 ~ 6.0V)
2	VDDIO	Digital I/O power supply (2.0 ~ 5.5V)
3	SCLK	Serial clock for SPI
4	SDI	Serial Data Input for SPI (MOSI)
5	CSB	Chip select for SPI (negative logic)
6	SDO	Serial Data Output for SPI (MISO)
7	GND	Ground
8	NC	-

7 Schematic circuit diagram

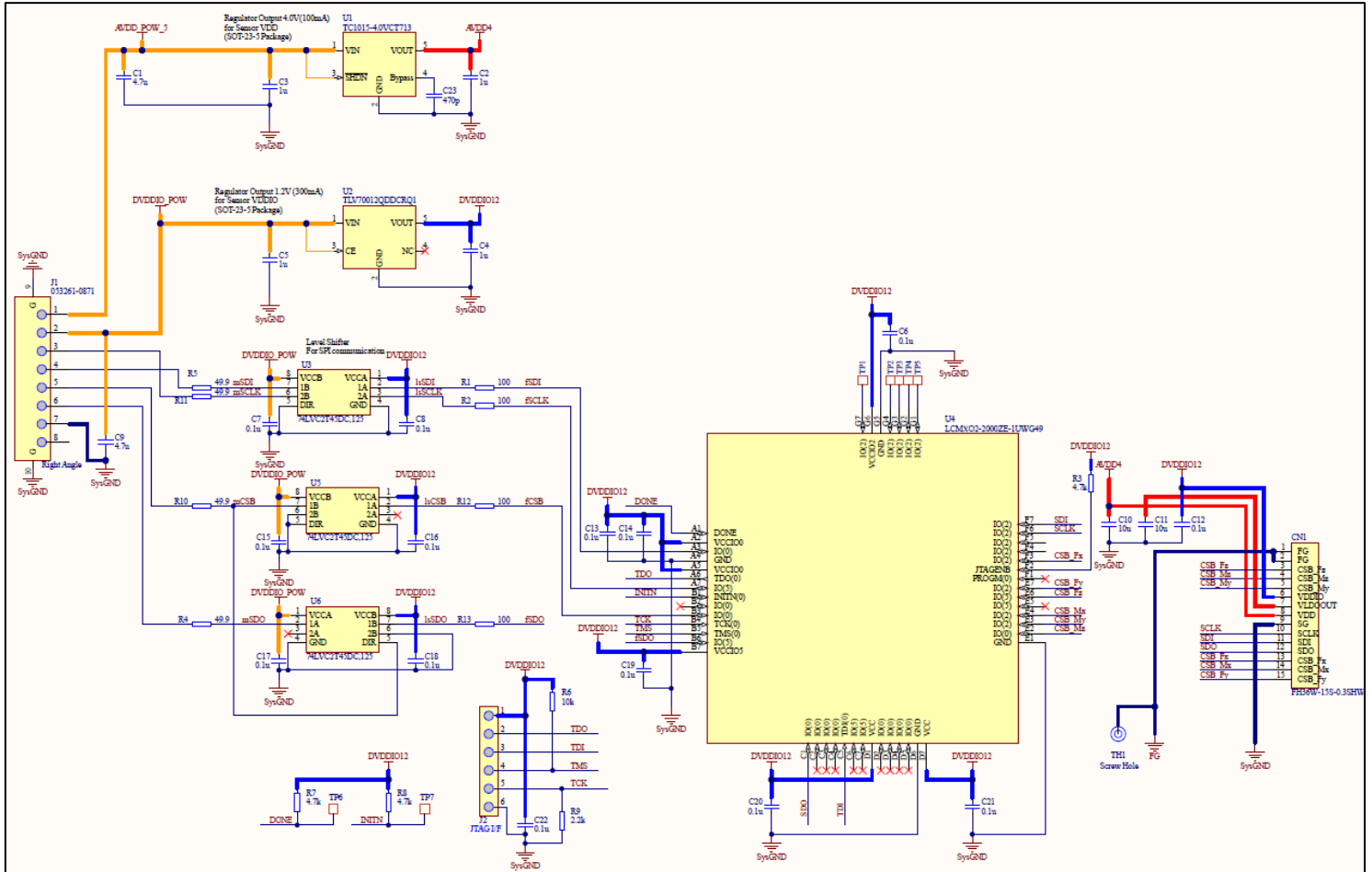
7-1 Expansion Board: MMS101 SPI1 AddOn Board Ver.1.0



7-2 Conversion Board: MMS101B SPI1 Conv.BD Ver.1.0



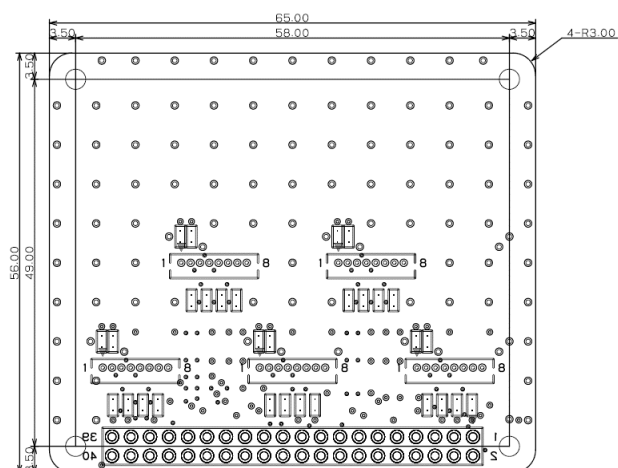
7-3 Conversion Board: MMS101C SPI1 Conv.BD Ver.1.0



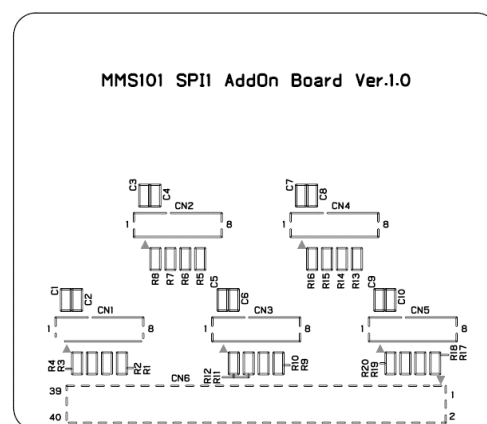
8 Layout diagram

8-1 Expansion Board: MMS101 SPI1 AddOn Board Ver.1.0

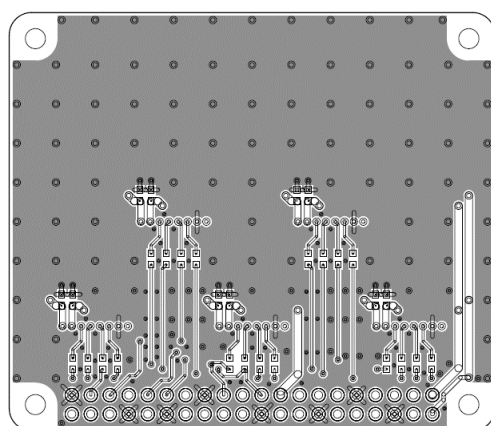
Mouting hole: $\Phi 2.7$



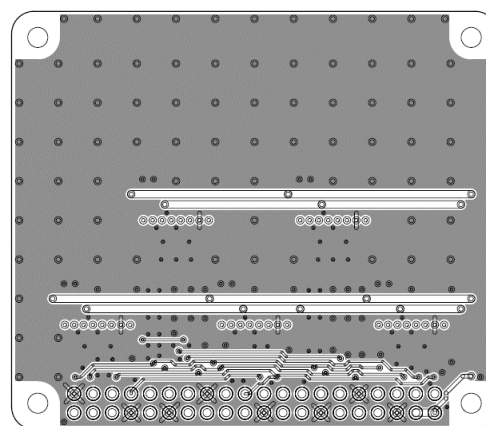
Dimansions (Unit: mm)



Component placement



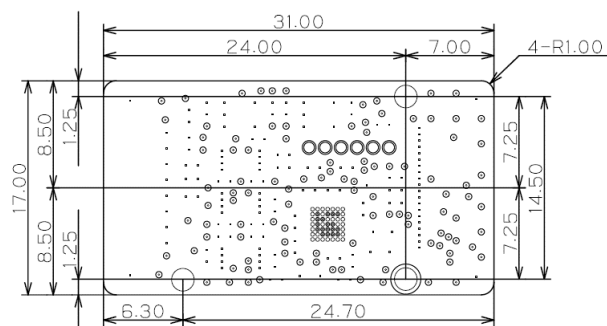
Pattern (Component side)



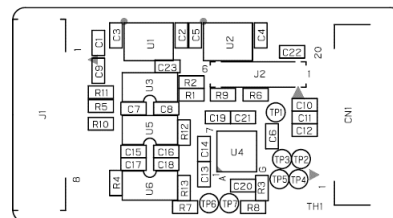
Pattern (Solder side)

8-2 Conversion Board: MMS101B SPI1 Conv.BD Ver.1.0

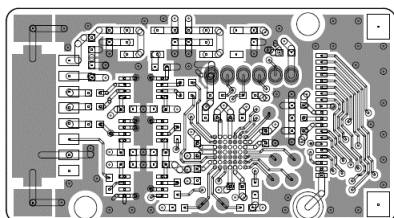
Mounting hole: $\Phi 1.8$



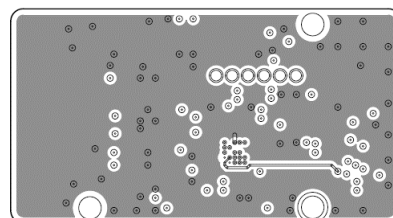
Dimensions (Unit: mm)



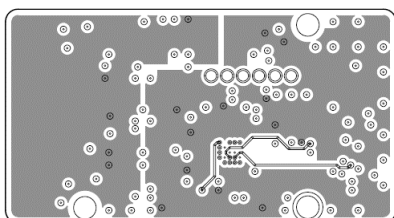
Component placement



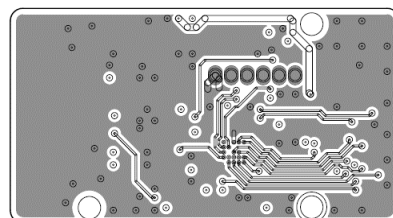
Pattern (Component side)



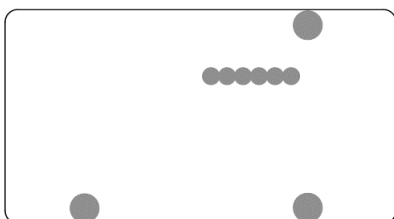
Pattern (L2)



Pattern (L3)



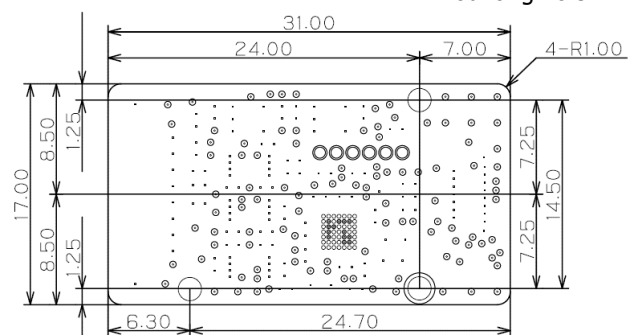
Pattern (L4)



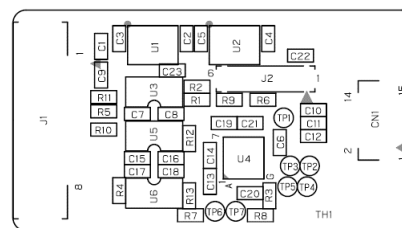
Pattern (Solder side)

8-3 Conversion Board: MMS101C SPI1 Conv.BD Ver.1.0

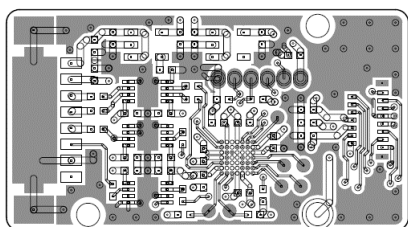
Mounting hole: $\Phi 1.8$



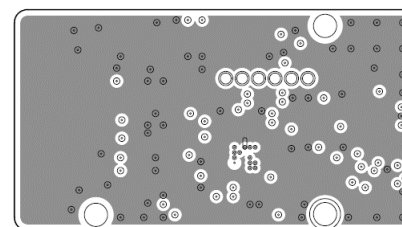
Dimensions (Unit: mm)



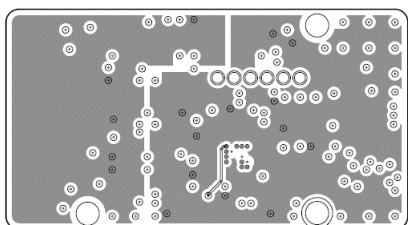
Component placement



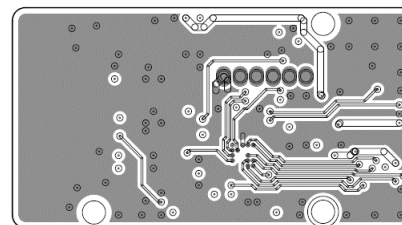
Pattern (Component side)



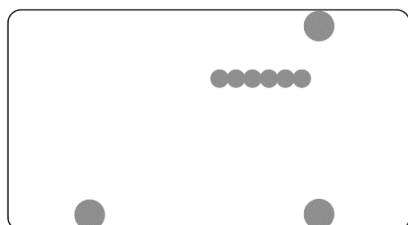
Pattern (L2)



Pattern (L3)



Pattern (L4)



Pattern (Solder side)

9 BOM list

9-1 Expansion Board: MMS101 SPI1 AddOn Board Ver.1.0

Designator	Model	Maker	Parts name	Value	Q'ty
C1, C3, C5, C7, C9	GRM188R61E106KA73D	muRata	Capacitor	10u	5
C2, C4, C6, C8, C10	CGA3E2X7R1H104K080AA	TDK	Capacitor	0.1u	5
CN1, CN2, CN3, CN4, CN5	530470810	Molex	Connector	8pin	5
CN6	ESW-120-12-G-D	Samtec Inc.	Pin header	40pin	1
R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19, R20	RK73H1JTDD49R9F	KOA	Resistor	49.9	20

9-2 Conversion Board: MMS101B SPI1 Conv.BD Ver.1.0

Designator	Model	Maker	Parts name	Value	Q'ty
C1, C9	GRM155R61A474KE15D	muRata	Capacitor	4.7u	2
C2, C3, C4, C5	GRM155R61E105KA12D	muRata	Capacitor	1u	4
C6, C7, C8, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22	GCM155R71C104KA55D	muRata	Capacitor	0.1u	14
C10, C11	GRM155R61A106ME11D	muRata	Capacitor	10u	2
C23	GCM1555C1H471JA16D	muRata	Capacitor	470p	1
CN1	FH52K-20S-0.5SH	Hirose Electric	Connector	20pin	1
J1	532610871	Molex	Connector	8pin	1
J2	XB-1-3 6pin	Mac8	Pin header	OPEN	1
R1, R2, R12, R13	RK73H1ETTP1000	KOA	Resistor	100	4
R3, R7, R8	RMC1/16SK472FTH	KAMAYA	Resistor	4.7k	3
R4, R5, R10, R11	RK73H1ETTP49R9F	KOA	Resistor	49.9	4
R6	RMC1/16SK103FTH	KAMAYA	Resistor	10k	1
R9	RK73H1ETTP2201F	KOA	Resistor	2.2k	1
TH1	-	-	Through hole	Φ1.8	1
TH2	-	-	None TH	Φ1.8	1
TP1, TP2, TP3, TP4, TP5, TP6, TP7	-	-	Test land	Φ1.0	7
U1	TC1015-4.0VCT713	Microchip Technology	LDO	4.0V,100mA	1
U2	TLV70012QDDCRQ1	Texas Instruments	LDO	1.2V,300mA	1
U3, U5, U6	74LVC2T45DC,125	Nexperia USA Inc.	Level shifter	-	3
U4	LCMX02-2000ZE-1UWG49	Lattice Semiconductor	FPGA	-	1

9-3 Conversion Board: MMS101C SPI1 Conv.BD Ver.1.0

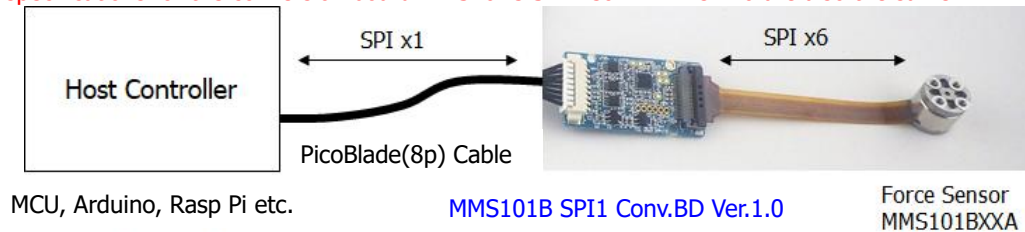
Designator	Model	Maker	Parts name	Value	Q'ty
C1, C9	GRM155R61A474KE15D	muRata	Capacitor	4.7u	2
C2, C3, C4, C5	GRM155R61E105KA12D	muRata	Capacitor	1u	4
C6, C7, C8, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22	GCM155R71C104KA55D	muRata	Capacitor	0.1u	14
C10, C11	GRM155R61A106ME11D	muRata	Capacitor	10u	2
C23	GCM1555C1H471JA16D	muRata	Capacitor	470p	1
CN1	FH36W-15S-0.3SHW	Hirose Electric	Connector	15pin	1
J1	532610871	Molex	Connector	8pin	1
J2	XB-1-3 6pin	Mac8	Pin header	OPEN	1
R1, R2, R12, R13	RK73H1ETTP1000	KOA	Resistor	100	4
R3, R7, R8	RMC1/16SK472FTH	KAMAYA	Resistor	4.7k	3
R4, R5, R10, R11	RK73H1ETTP49R9F	KOA	Resistor	49.9	4
R6	RMC1/16SK103FTH	KAMAYA	Resistor	10k	1
R9	RK73H1ETTP2201F	KOA	Resistor	2.2k	1
TH1	-	-	Through hole	Φ1.8	1
TH2	-	-	None TH	Φ1.8	1
TP1, TP2, TP3, TP4, TP5, TP6, TP7	-	-	Test land	Φ1.0	7
U1	TC1015-4.0VCT713	Microchip Technology	LDO	4.0V,100mA	1
U2	TLV70012QDDCRQ1	Texas Instruments	LDO	1.2V,300mA	1
U3, U5, U6	74LVC2T45DC,125	Nexperia USA Inc.	Level shifter	-	3
U4	LCMXO2-2000ZE-1UWG49	Lattice Semiconductor	FPGA	-	1

10 MMS101B SPI1 Conv.BD Ver.1.0 Communication Specification

10-1 Description

The conversion board MMS101 SPI1 Conv.BD Ver.1.0 (hereafter referred to as SPI1 Conv.BD) consolidates the six SPI wires of the force sensor MMS101BXXA into one SPI wire to communicate with the host controller.

The communication specifications for the conversion board MMS101C SPI1 Conv.BD Ver.1.0 are also the same.



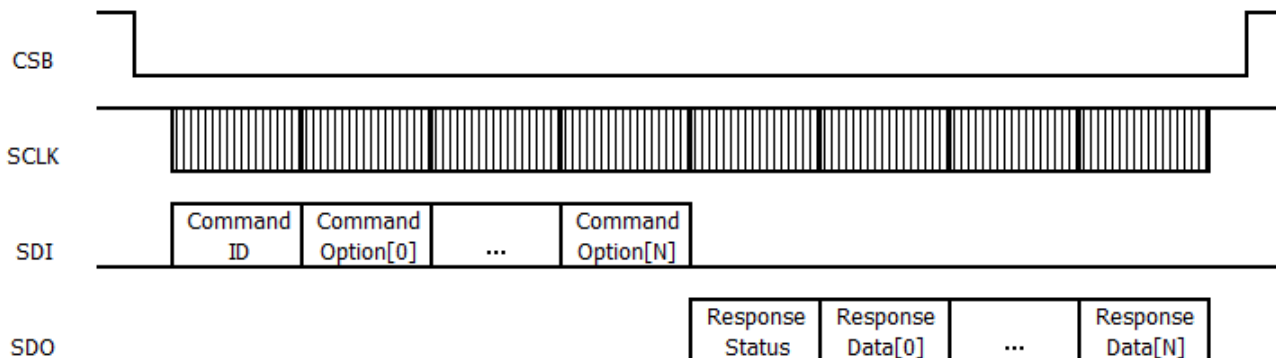
10-2 SPI communication settings

Host controller and SPI1 Conv.BD communicate using SPI. SPI communication settings are as follows.

Item	Settings
Mode	Mode3(CPOL=1,CPHA=1)
Baud rate	~ 2MHz
Data length	8 bit
Data transmission direction	MSB First
Byte order	Big Endian

10-3 Communication data format

SPI1 Conv.BD always returns a response to the received command. The basic communication format is as follows.



Command format

Byte	Name	Details
0	Command ID	Indication code of the command instructed to SPI1 Conv.BD. Refer to " Command list ".
1	Command Option[0]	If there is a parameter associated with Command ID, it is appended. For multiple byte data, the byte order is big-endian.
:	:	
N+2	Command Option[N]	

Response format

Byte	Name	Details
0	Response Status	This is the result of executing the command. Refer to " Status Code list ".
1	Response Data[0]	If there is anything order than the response status, it is appended. For multiple byte data, the byte order is big-endian.
:	:	
N+2	Response Data[N]	

10-4 Command list

The command to instruct SPI Conv.BD is as follows.

Name	Command ID	Operation
START	0xF0	Command to start measurement for SPI1 Conv.BD
DATA2(*1)	0xE2	Command to read ADC data from SPI1 Conv.BD
RESTART	0xC0	Command to update temperature sensor value for offset temperature correction of MMS101
BOOT	0xB0	Command to read and hold the matrix correction coefficient from MMS101 by SPI1 Conv.BD
STOP	0xB2	Command to stop measurement for SPI1 Conv.BD
RESET	0xB4	Command to reset SPI1 Conv.BD and MMS101
STATUS	0x80	Command to read status of SPI1 Conv.BD
VERSION	0xA2	Command to read version of SPI1 Conv.BD
COEFF	0x30(*2)	Command to read the matrix correction coefficient held by SPI1 Conv.BD
INTERVAL	0x44	Command to update temperature sensor value for offset temperature correction of MMS101 at set cycle

(*1) Please execute the matrix operation by user's system.

(*2) Command ID is different for each axis. (Fx=0x30, Fy=0x32, Fz=0x34, Mx=0x36, My=0x38, Mz=0x3A)

10-4-1 START command

Command to start measurement for SPI1 Conv.BD. SPI1 Conv.BD acquires ADC data from MMS101 at 1msec intervals and holds the latest data. Please execute this command when in READY state.

Command format

Byte	Data	Details
0	Command ID=0xF0	

Response format

Byte	Data	Details
0	Status Code	Refer to " Status Code list "

10-4-2 DATA2 command

Command to read ADC data (before the matrix operation) from SPI1 Conv.BD. To obtain force data, perform matrix operation on the ADC data. Obtain the matrix correction coefficients in advance with COEFF command. Please execute this command when in MEASURE state.

Command format

Byte	Data	Details
0	Command ID=0xE2	

Response format

Byte	Data	Details
0	Status Code	Refer to " Status Code list ".
1-2	Measure Status	Refer to " Measure Status list ".
3-5	FxADC	ADC data for each axis.
6-8	FyADC	
9-11	FzADC	
12-14	MxADC	
15-17	MyADC	
18-20	MzADC	

Matrix operation formula:

$$FxMD = A1 * FxADC + A2 * FyADC + A3 * FzADC + A4 * MxADC + A5 * MyADC + A6 * MzADC$$

...

$$MzMD = F1 * FxADC + F2 * FyADC + F3 * FzADC + F4 * MxADC + F5 * MyADC + F6 * MzADC$$

Unit conversion formula:

$$Fx = FxMD / 2^{11} [*0.001 \text{ N}]$$

...

$$Mz = MzMD / 2^{11} [*0.00001 \text{ Nm}]$$

For details, please refer to "Matrix operation" in the data sheet.

10-4-3 RESTART command

Command to update temperature sensor value for offset temperature correction of MMS101. Please execute this command when in MEASURE state.

It is also possible to set the automatic update cycle of temperature sensor value using INTERVAL command.

Command format

Byte	Data	Details
0	Command ID=0xC0	

Response format

Byte	Data	Details
0	Status Code	Refer to " Status Code list "

10-4-4 BOOT command

Command to read and hold the matrix correction coefficients from MMS101. Please execute this command when in STANDBY state.

Command format

Byte	Data	Details
0	Command ID=0xB0	

Response format

Byte	Data	Details
0	Status Code	Refer to " Status Code list "

10-4-5 STOP command

Command to stop measurement for SPI1 Conv.BD. Please execute this command when in MEASURE state.

Command format

Byte	Data	Details
0	Command ID=0xB2	

Response format

Byte	Data	Details
0	Status Code	Refer to " Status Code list "

10-4-6 RESET command

Command to reset the internal information and the matrix correction coefficients in SPI1 Conv.BD. Execute reset on MMS101. After executing this command, it changes to STANDBY state.

Command format

Byte	Data	Details
0	Command ID=0xB4	

Response format

Byte	Data	Details
0	Status Code	Refer to " Status Code list "

10-4-7 STATUS command

Command to read status of SPI1 Conv.BD. This command can be executed in any state.

Command format

Byte	Data	Details
0	Command ID=0x80	

Response format

Byte	Data	Details
0	Status Code	Refer to " Status Code list "
1-2	Measure Status	Refer to " Measure Status list "
3	State ID	Refer to " State ID list "

10-4-8 VERSION command

Command to read the hardware version and firmware version of SPI1 Conv.BD. This command can be executed in any state.

Command format

Byte	Data	Details
0	Command ID=0xA2	

Response format

Byte	Data	Details
0	Status Code	Refer to " Status Code list "
1-2	Hardware version	Indicates the two-digit hardware version
3	Firmware version	Indicates the four-digit firmware version

10-4-9 COEFF command

Command to read the matrix correction coefficients held by SPI1 Conv.BD. It is necessary to obtain the matrix correction coefficients from MMS101 in advance using the BOOT command. Command ID is different for each axis. Please execute this command when in READY state.

Command format

Byte	Data	Details
0	Command ID=0x30	0x30 = Fx, 0x32 = Fy, 0x34 = Fz, 0x36 = Mx, 0x38 = My, 0x3A = Mz

Response format

Byte	Data	Details
0	Status Code	Refer to " Status Code list "
1-3	Coefficient Data1	matrix correction coefficient 1 (A1 ~ F1)
4-6	Coefficient Data2	matrix correction coefficient 2 (A2 ~ F2)
7-9	Coefficient Data3	matrix correction coefficient 3 (A3 ~ F3)
10-12	Coefficient Data4	matrix correction coefficient 4 (A4 ~ F4)
13-15	Coefficient Data5	matrix correction coefficient 5 (A5 ~ F5)
16-18	Coefficient Data6	matrix correction coefficient 6 (A6 ~ F6)

10-4-10 INTERVAL command

Command to update temperature sensor value for offset temperature correction of MMS101. When the number of data acquisitions reaches the Interval value, the temperature sensor value for offset temperature correction is updated and the number of data acquisitions is reset. The temperature sensor value is automatically updated at the interval of the Interval value. This command can be executed in any state.

The number of data acquisitions will also be reset when RESTART command is executed.

Command format

Byte	Data	Details
0	Command ID=0x44	
1-3	Interval = 0~10,000,000	0: Temperature updates are not performed automatically. N(>0): The temperature sensor value is updated after data is acquired N times.

Response format

Byte	Data	Details
0	Status Code	Refer to " Status Code list "

10-5 Status Code list

The execution result of the received command is shown below.

Status Code	Details	
0x00	OK	No error
0x01	Busy	Access denied (Respond to on illegal state)
0x81	Not Support	Respond to an illegal Command ID
0x82	Illegal Command	Respond to an illegal command format
0x83	Illegal Parameter	Respond to an illegal parameter (out of range)

10-6 Measure Status list

When an error occurs in SPI1 Conv.BD, the corresponding bit becomes 1. If there are no errors, all bits are 0.

(Example) If a communication error with the Fx axis occurs during BOOT processing, b0 and b6 will be 1.

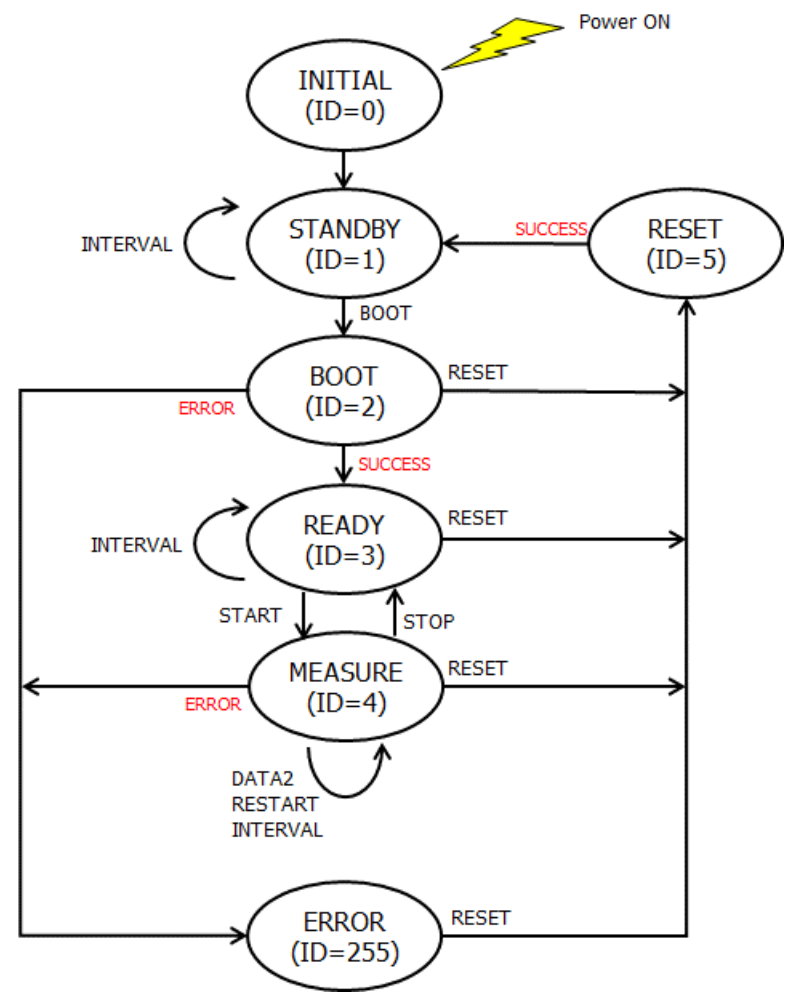
Bit	Details	
b0	Fx NACK	Communication error when accessing the corresponding axis of MMS101 (MMS101 responded NACK)
b1	Fy NACK	
b2	Fz NACK	
b3	Mx NACK	
b4	My NACK	
b5	Mz NACK	
b6	BOOT Error	Communication error during BOOT processing
b7	START Error	Communication error during START processing
b8	MEASURE Error	Communication error during MEASURE processing
b9	Not Update	New data is not ready
b10	RESTART Error	Communication error during RESTART processing
b11	STOP Error	Communication error during STOP processing
b12	RESET Error	Communication error during RESET processing
b13-b15	Reserved	-

10-7 State ID list

The state of SPI1 Conv.BD is shown below.

Name	ID	Operation
INITIAL	0	Internal initialization after power-on
STANDBY	1	Waiting state for BOOT command after internal initialization is completed
BOOT	2	Acquisition operation of the matrix correction coefficients from MMS101
READY	3	Holds the matrix correction coefficients and waits for START command
MEASURE	4	Updated sensor data at 1msec intervals Output the latest data held by DATA2 command
RESET	5	Execute reset command to MMS101 Initialize the internal information and the matrix correction coefficients of SPI1 Conv.BD
ERROR	255	Transitions when an Error occurs Wait until the RESET command is executed from host

10-8 State transition diagram

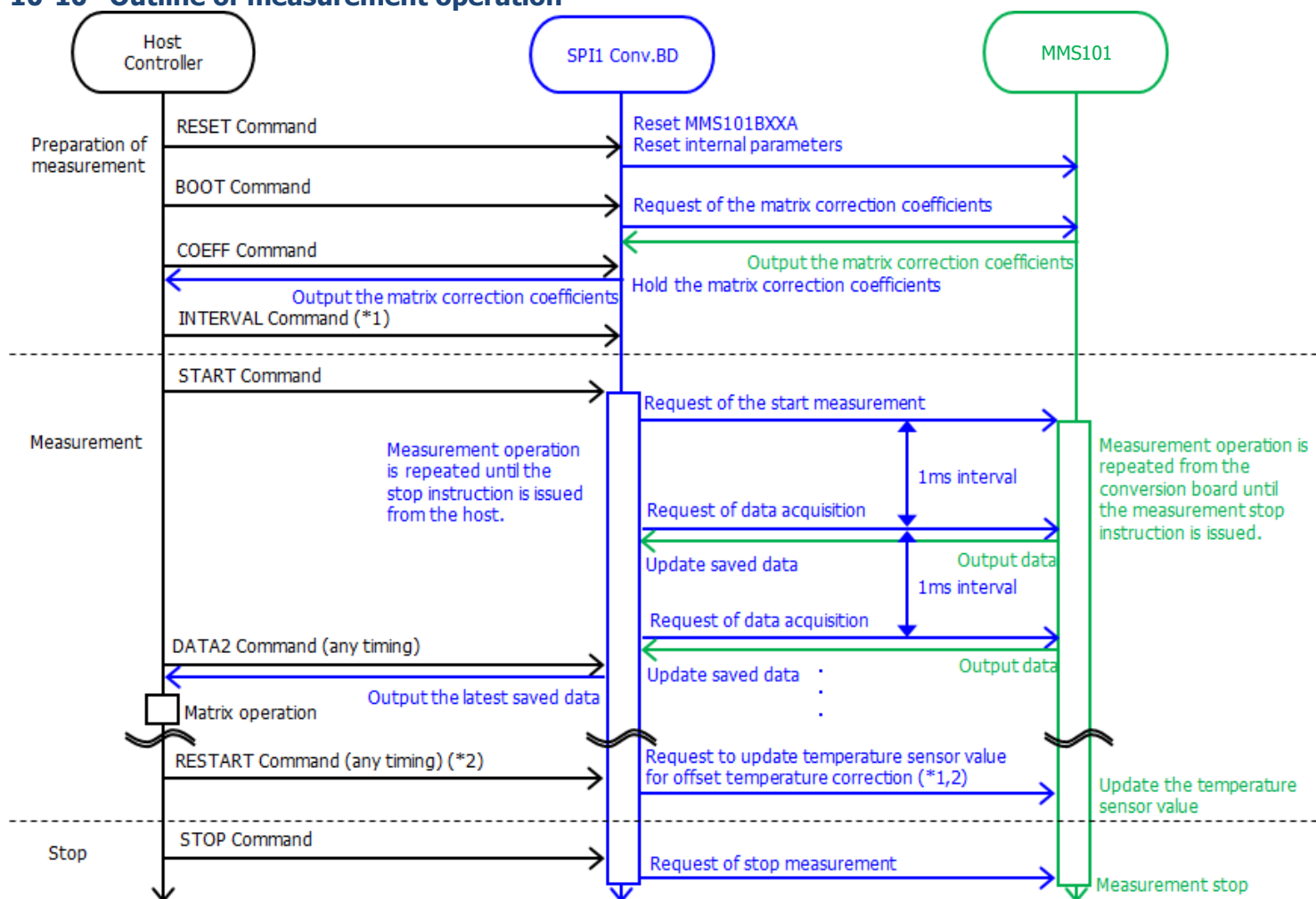


10-9 State transition table

		State						
		INITIAL	STANDBY	BOOT	READY	MEASURE	RESET	ERROR
Command	START	/	/	/	->MEASURE	/	/	/
	DATA2	/	=	=	=	=	=	=
	RESTART	/	/	/	/	=	/	/
	BOOT	/	->BOOT	/	/	/	/	/
	STOP	/	/	/	/	->READY	/	/
	RESET	/	->RESET	->RESET	->RESET	->RESET	/	->RESET
	STATUS	/	=	=	=	=	=	=
	VERSION	/	=	=	=	=	=	=
	COEFF	/	=	=	=	=	/	/
	INTERVAL	/	=	=	=	=	/	/

[>-] Transmission state [=] Keep state [/] Ignore (Return Busy)

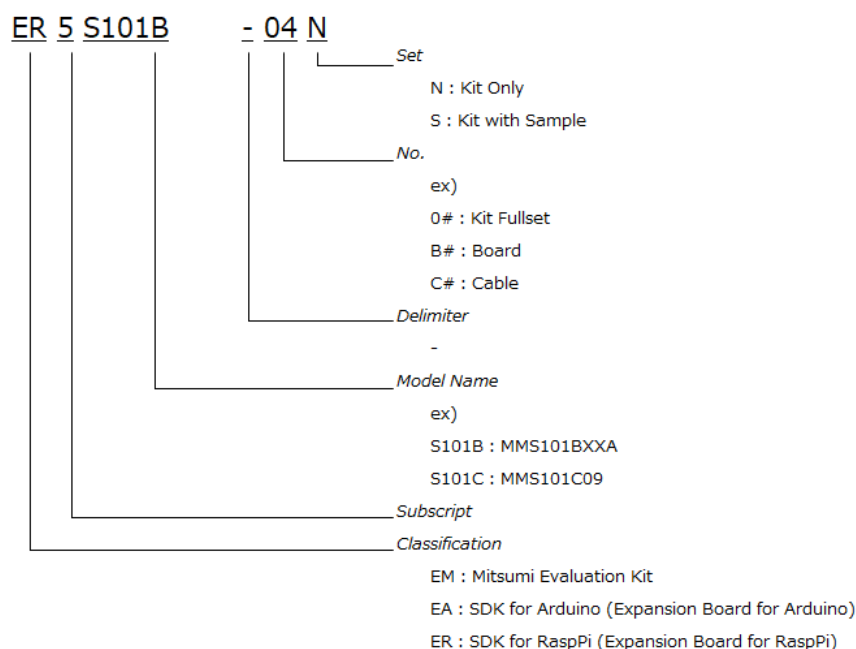
10-10 Outline of measurement operation



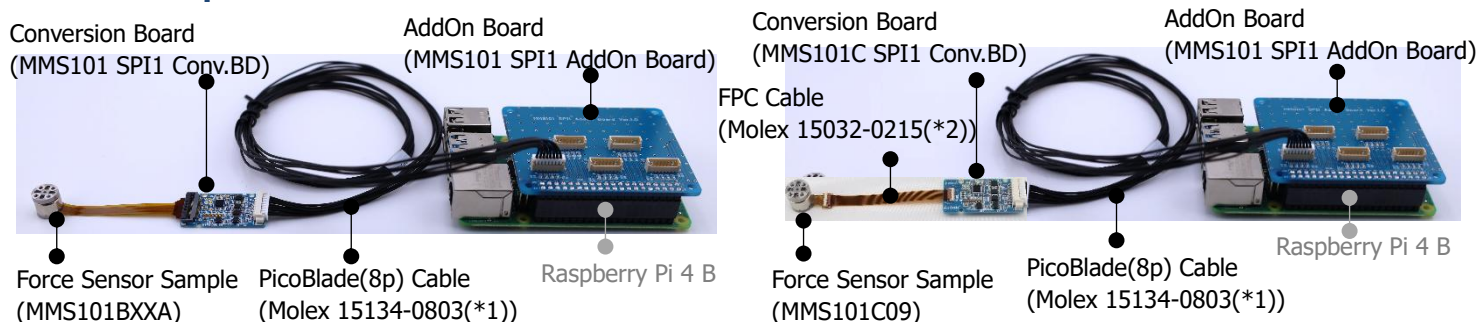
(*1)(*2) The temperature sensor value for offset temperature correction is updated according to the INTERVAL Command and RESTART Command.

11 Ordering Information

11-1 PO No. Description



11-2 Lineup



PO No.	Details			Contents			
	Product Name	Kit Name	Set	Main Contents	Sample	Accessory1	Accessory2
MMS101B							
ER5S101B-04N	MMS101BXXA	MMS101B SDK for Rasp Pi	Kit Only	MMS101 SPI1 AddOn Board	no	MMS101B SPI1 Conv.BD	PicoBlade(8p) Cable 300mm(*1)
ER5S101B-04S	MMS101BXXA	MMS101B SDK for Rasp Pi	Kit with Sample	MMS101 SPI1 AddOn Board	MMS101BXXA	MMS101B SPI1 Conv.BD	PicoBlade(8p) Cable 300mm(*1)
EA1S101B-B1	MMS101BXXA	MMS101B SPI1 Conv.BD	Accessory	MMS101B SPI1 Conv.BD	-	-	-
MMS101C							
ER5S101C-04N	MMS101C09	MMS101C SDK for Rasp Pi	Kit Only	MMS101 SPI1 AddOn Board	No	MMS101C SPI1 Conv.BD	PicoBlade(8p) Cable 300mm(*1)
ER5S101C-04S	MMS101C09	MMS101C SDK for Rasp Pi	Kit with Sample	MMS101 SPI1 AddOn Board	MMS101C09	MMS101C SPI1 Conv.BD	PicoBlade(8p) Cable 300mm(*1)
EA1S101C-B1	MMS101C09	MMS101C SPI1 Conv.BD	Accessory	MMS101C SPI1 Conv.BD	-	-	-

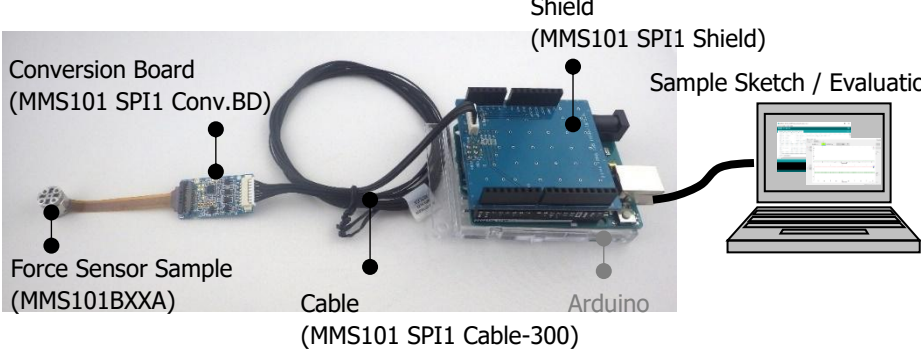
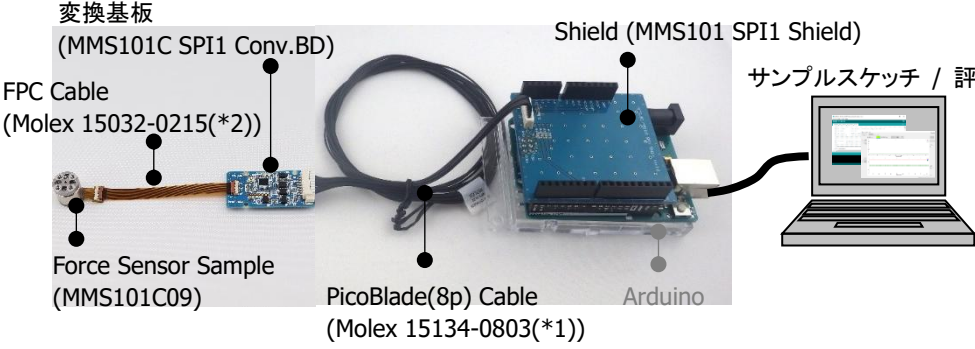
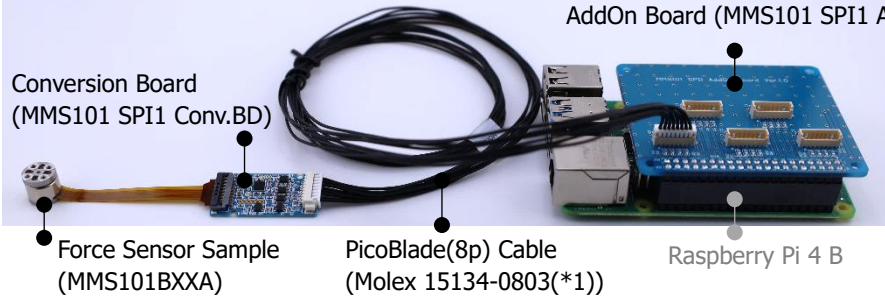
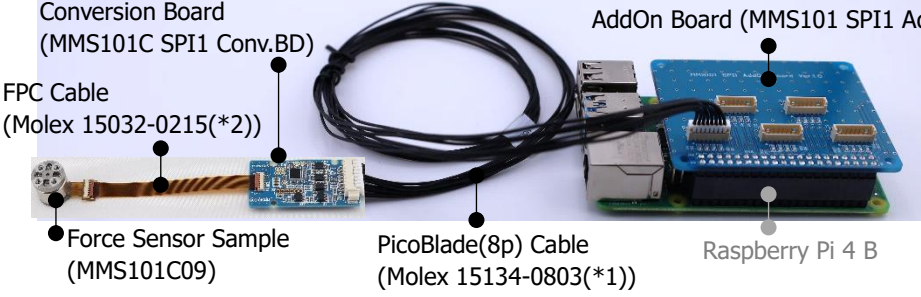
(*1) The equivalent product is the Molex PicoBlade(8p) cable (Model No. 15134-0803).

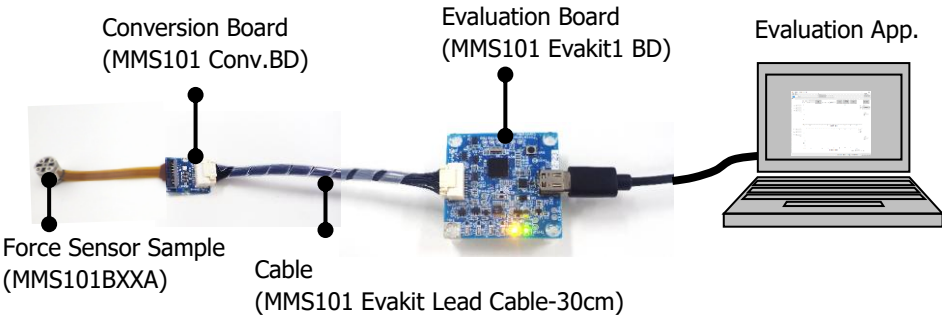
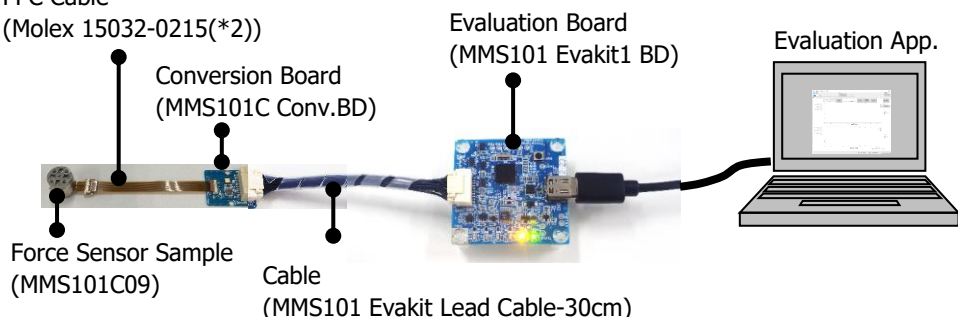
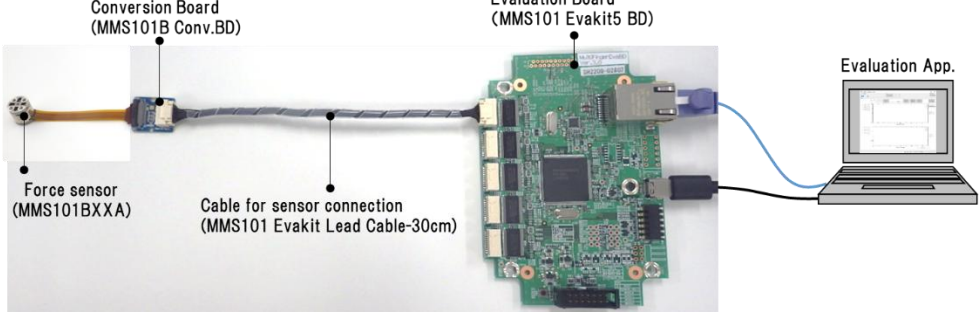
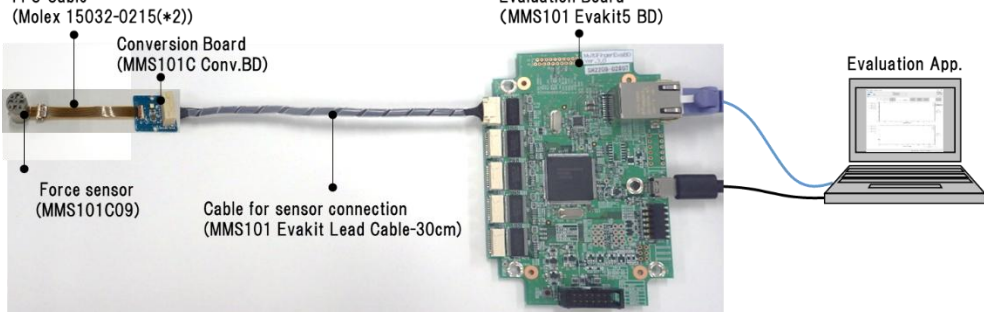
If you need additional purchases of different lengths, please use commercially available FPC cable.

(*2) The equivalent product is the Molex FPC cable (Model No. 15032-0215).

If you need additional purchases of different lengths, please use commercially available FPC cable.

11-3 Evaluation Kit List

Evaluation Kit Name	Configuration / Features
MMS101 SDK for Arduino	 <p>Conversion Board (MMS101 SPI1 Conv.BD)</p> <p>Force Sensor Sample (MMS101BXXA)</p> <p>Cable (MMS101 SPI1 Cable-300)</p> <p>Shield (MMS101 SPI1 Shield)</p> <p>Sample Sketch / Evaluation App.</p> <p>Arduino</p> <p>◆External Communication : USB</p> <p>◆Arduino is not included.</p>
	 <p>変換基板 (MMS101C SPI1 Conv.BD)</p> <p>FPC Cable (Molex 15032-0215(*2))</p> <p>Force Sensor Sample (MMS101C09)</p> <p>PicoBlade(8p) Cable (Molex 15134-0803(*1))</p> <p>Shield (MMS101 SPI1 Shield)</p> <p>サンプルスケッチ / 評価アプリ</p> <p>Arduino</p> <p>◆External Communication : USB</p> <p>◆Arduino is not included.</p>
MMS101 SDK for Raspberry Pi	 <p>Conversion Board (MMS101 SPI1 Conv.BD)</p> <p>Force Sensor Sample (MMS101BXXA)</p> <p>PicoBlade(8p) Cable (Molex 15134-0803(*1))</p> <p>AddOn Board (MMS101 SPI1 AddOn Board)</p> <p>Raspberry Pi 4 B</p> <p>◆Up to five sensors can be connected.</p> <p>◆Raspberry Pi is not included.</p>
	 <p>Conversion Board (MMS101C SPI1 Conv.BD)</p> <p>FPC Cable (Molex 15032-0215(*2))</p> <p>Force Sensor Sample (MMS101C09)</p> <p>PicoBlade(8p) Cable (Molex 15134-0803(*1))</p> <p>AddOn Board (MMS101 SPI1 AddOn Board)</p> <p>Raspberry Pi 4 B</p> <p>◆Up to five sensors can be connected.</p> <p>◆Raspberry Pi is not included.</p>

MMS101 Evakit1	 <p>Conversion Board (MMS101 Conv.BD)</p> <p>Evaluation Board (MMS101 Evakit1 BD)</p> <p>Force Sensor Sample (MMS101BXXA)</p> <p>Cable (MMS101 Evakit Lead Cable-30cm)</p> <p>Evaluation App.</p> <p>◆External communication : USB</p>
	 <p>FPC Cable (Molex 15032-0215(*2))</p> <p>Conversion Board (MMS101C Conv.BD)</p> <p>Evaluation Board (MMS101 Evakit1 BD)</p> <p>Force Sensor Sample (MMS101C09)</p> <p>Cable (MMS101 Evakit Lead Cable-30cm)</p> <p>Evaluation App.</p> <p>◆External communication : USB</p>
MMS101 Evakit5	 <p>Conversion Board (MMS101B Conv.BD)</p> <p>Evaluation Board (MMS101 Evakit5 BD)</p> <p>Force sensor (MMS101BXXA)</p> <p>Cable for sensor connection (MMS101 Evakit Lead Cable-30cm)</p> <p>Evaluation App.</p> <p>◆External communication : Ethernet / USB</p> <p>◆Up to five sensors can be connected (Only in Ethernet).</p>
	 <p>FPC Cable (Molex 15032-0215(*2))</p> <p>Conversion Board (MMS101C Conv.BD)</p> <p>Evaluation Board (MMS101 Evakit5 BD)</p> <p>Force sensor (MMS101C09)</p> <p>Cable for sensor connection (MMS101 Evakit Lead Cable-30cm)</p> <p>Evaluation App.</p> <p>◆External communication : Ethernet / USB</p> <p>◆Up to five sensors can be connected (Only in Ethernet).</p>

(*1) The equivalent product is the Molex PicoBlade(8p) cable (Model No. 15134-0803).

If you need additional purchases of different lengths, please use commercially available PicoBlade(8p) cable.

(*2) The equivalent product is the Molex FPC cable (Model No. 15032-0215).

If you need additional purchases of different lengths, please use commercially available FPC cable.

[Contact]

Mitsumi Electric Co., Ltd.
Semiconductor Division, Design Engineering Department

1601, Sakai, Atsugi-shi, Kanagawa, 243-8533 JAPAN

TEL: 046-230-3367

URL: <https://product.minebeamitsumi.com/contact/>

Disclaimers (Handling Precautions)

1. All the information described herein (product data, specifications, figures, tables, programs, algorithms and application circuit examples, etc.) is current as of publishing date of this document and is subject to change without notice.
2. The circuit examples and the usages described herein are for reference only, and do not guarantee the success of any specific mass-production design.
MITSUMI ELECTRIC CO., LTD. is not liable for any losses, damages, claims or demands caused by the reasons other than the products described herein (hereinafter "the products") or infringement of third-party intellectual property right and any other right due to the use of the information described herein.
3. MITSUMI ELECTRIC CO., LTD. is not liable for any losses, damages, claims or demands caused by the incorrect information described herein.
4. Be careful to use the products within their ranges described herein. Pay special attention for use to the absolute maximum ratings, operation voltage range and electrical characteristics, etc.
MITSUMI ELECTRIC CO., LTD. is not liable for any losses, damages, claims or demands caused by failures and / or accidents, etc. due to the use of the products outside their specified ranges.
5. Before using the products, confirm their applications, and the laws and regulations of the region or country where they are used and verify suitability, safety and other factors for the intended use.
6. When exporting the products, comply with the Foreign Exchange and Foreign Trade Act and all other export-related laws, and follow the required procedures.
7. The products are strictly prohibited from using, providing or exporting for the purposes of the development of weapons of mass destruction or military use. MITSUMI ELECTRIC CO., LTD. is not liable for any losses, damages, claims or demands caused by any provision or export to the person or entity who intends to develop, manufacture, use or store nuclear, biological or chemical weapons or missiles, or use any other military purposes.
8. The products are not designed to be used as part of any device or equipment that may affect the human body, human life, or assets (such as medical equipment, disaster prevention systems, security systems, combustion control systems, infrastructure control systems, vehicle equipment, traffic systems, in-vehicle equipment, aviation equipment, aerospace equipment, and nuclear-related equipment), excluding when specified for in-vehicle use or other uses by MITSUMI ELECTRIC CO., LTD. Do not apply the products to the above listed devices and equipment.
MITSUMI ELECTRIC CO., LTD. is not liable for any losses, damages, claims or demands caused by unauthorized or unspecified use of the products.
9. In general, semiconductor products may fail or malfunction with some probability. The user of the products should therefore take responsibility to give thorough consideration to safety design including redundancy, fire spread prevention measures, and malfunction prevention to prevent accidents causing injury or death, fires and social damage, etc. that may ensue from the products' failure or malfunction.
The entire system in which the products are used must be sufficiently evaluated and judged whether the products are allowed to apply for the system on customer's own responsibility.
10. The products are not designed to be radiation-proof. The necessary radiation measures should be taken in the product design by the customer depending on the intended use.
11. The products do not affect human health under normal use. However, they contain chemical substances and heavy metals and should therefore not be put in the mouth. The fracture surfaces of wafers and chips may be sharp. Be careful when handling these with the bare hands to prevent injuries, etc.
12. When disposing of the products, comply with the laws and ordinances of the country or region where they are used.
13. The information described herein contains copyright information and know-how of MITSUMI ELECTRIC CO., LTD. The information described herein does not convey any license under any intellectual property rights or any other rights belonging to MITSUMI ELECTRIC CO., LTD. or a third party. Reproduction or copying of the information from this document or any part of this document described herein for the purpose of disclosing it to a third-party is strictly prohibited without the express permission of MITSUMI ELECTRIC CO., LTD.
14. For more details on the information described herein or any other questions, please contact MITSUMI ELECTRIC CO., LTD.'s sales representative.
15. This Disclaimers have been delivered in a text using the Japanese language, which text, despite any translations into the English language and the Chinese language, shall be controlling.