

TypeABR AWS FreeRTOS SDK Getting Started Guide

Version :	0.2.0
Author :	SyChip Engineering
Document ID :	S10204
Release Date :	August 11, 2020

Notice

Murata reserves the right to make changes in specifications at anytime and without notice. The information furnished in this data sheet is believed to be accurate and reliable. However, no responsibility is assumed by Murata for its use, no any infringements of patents or other rights of third parties resulting from its use. No license is generated under any rights of Murata or its supporters unless specifically agreed.

CONTENTS

1	Introduction	2
1.1	Scope	2
1.2	Audience.....	2
1.3	Contact Information and Support	2
1.4	Text Conventions	2
1.5	Acronyms	3
1.6	Related Documents.....	3
2	Overview	4
2.1	System Diagram	4
2.2	Preparation	5
2.2.1	Hardware Preparation	5
2.2.2	Software Preparation	5
2.3	AWS IoT Settings	5
2.3.1	AWS account and permissions.....	5
2.3.2	Register with AWS IoT.....	5
3	Build The AWS FreeRTOS SDK	6
3.1	Set up development environment.....	6
3.2	Get the AWS FreeRTOS SDK	6
3.3	AWS FreeRTOS SDK Modifications	7
3.4	Build the AWS demos firmware	8
4	Run the Firmware	9
4.1	Download the firmwares.....	9
4.2	Run the FreeRTOS demo project.....	9
4.3	Monitoring MQTT messages on the cloud	10
5	LastWillAndTestament	11
5.1	Reference Solution	11
5.2	Reference Patches.....	13
5.3	Reference Running Logs	13
6	PRECONDITION TO USE OUR PRODUCTS	14

Revision History

Revision	Date	Description
V0.1.0	2020-06-17	<ul style="list-style-type: none">• Initial version.
V0.2.0	2020-08-11	<ul style="list-style-type: none">• Add the section for LastWillAndTestament test case.• Revise for public release.

INTRODUCTION

1.1 Scope

This document provides instructions about how to use AWS FreeRTOS SDK to build the AWS Demo and Run the AWS Demo on Murata TypeABR module.

1.2 Audience

This document is intended for software/firmware engineers to evaluate AWS IOT with Murata TypeABR module.

1.3 Contact Information and Support

For general contact, technical support services, technical questions and report documentation errors contact Murata Technical Support window. Please keep us informed of your comments and suggestions for improvements. Murata will take into consideration any and all feedback from the users of this information.

1.4 Text Conventions

Danger: This information MUST be followed or catastrophic equipment failure or bodily injury may occur.

Caution: Alerts the user to important points about using the product; if these points are not followed, the product and end user equipment may fail or malfunction.

Tip: Provides advice and suggestions that may be useful when using the product.

Note: Provides note admonitions that should be took into considerations when using the product.

1.5 Acronyms

Abbr.	Description
EVB	Evaluation Board

1.6 Related Documents

- [DS] TypeABR_Module_Datasheet.pdf, Murata
- [UG] CMWC1ZZABR EVB Hardware Manual.pdf, Murata
- [AN] S10093-TypeABR_Firmware_Upgrade_Guide.pdf, Murata

OVERVIEW

This tutorial contains instructions for the following getting started steps:

1. Required preparation materials.
2. Connecting your board to a host machine.
3. Installing software on the host machine for developing and debugging embedded applications.
4. Cross-compiling a FreeRTOS demo application to a binary image.
5. Loading the application binary image to your board and then running the application.
6. Interacting with the application running on your board across a serial connection for monitoring and debugging purposes.

2.1 System Diagram

The typical system diagram shown as below:

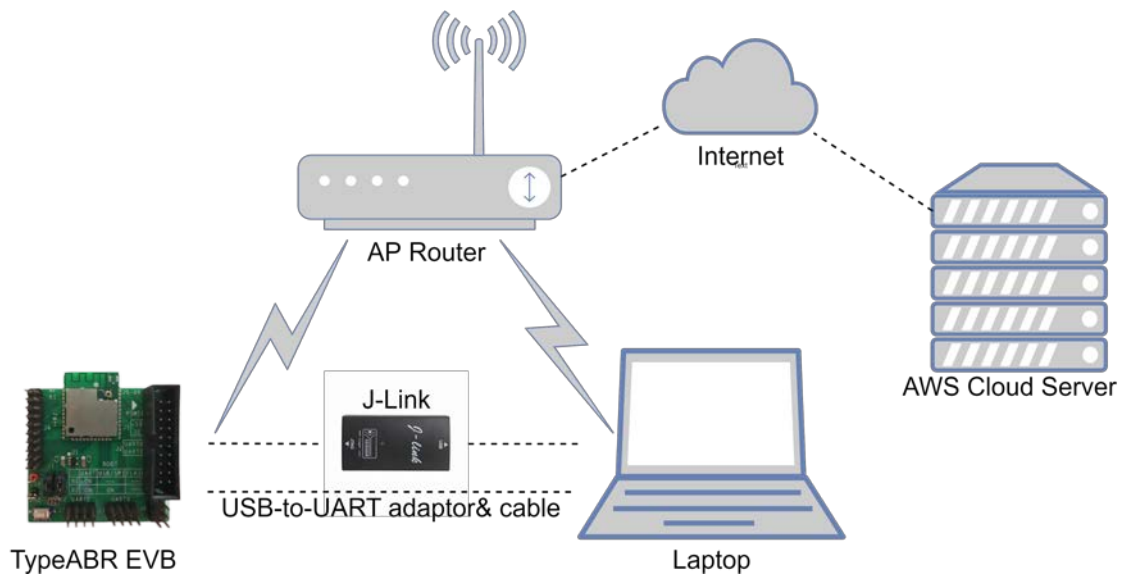


Fig. 2.1: System Diagram

2.2 Preparation

2.2.1 Hardware Preparation

Table 2.1: Hardware Preparation

Name	Quantity	Comment
TypeABR EVB	1	TypeABR Evaluation Kit
USB-to-UART adaptor& cable	1	Monitoring the log
J-Link	1	JTAG adaptor for loading image
Laptop with Ubuntu/Linux OS	1	Host machine for cross-compiling and load image
AP Router	1	Provide Internet access to AWS Cloud Server

2.2.2 Software Preparation

Table 2.2: Software Preparation

Name	Quantity	Comment
Tera Term	1	Or similar serial terminals.

2.3 AWS IoT Settings

2.3.1 AWS account and permissions

You need an AWS account, an IAM user with permission to access AWS IoT and FreeRTOS cloud services.

Please complete the instructions in [Setting up your AWS account and permissions](#) .

2.3.2 Register with AWS IoT

To register your board with AWS IoT, you need the following:

An AWS IoT policy The AWS IoT policy grants your device permissions to access AWS IoT resources. It is stored on the AWS Cloud.

An AWS IoT thing An AWS IoT thing allows you to manage your devices in AWS IoT. It is stored on the AWS Cloud.

A private key and X.509 certificate The private key and certificate allow your device to authenticate with AWS IoT.

Please follow the procedures in [Registering your MCU board with AWS IoT](#) to register your board manually.

BUILD THE AWS FREERTOS SDK

The below steps were verified on Ubuntu x86_64 GNU/Linux OS.

3.1 Set up development environment

1. Install the required packages

```
sudo apt-get install lib32ncursesw5 lib32z1 lib32ncurses5 libbz2-1.0:i386  
libncurses5-dev lib32ncurses5-dev libncursesw5-dev
```

2. Install the **gcc-arm-none-eabi** toolchain.

```
wget https://launchpad.net/gcc-arm-embedded/4.9/4.9-2015-q3-update/+download/gcc-  
arm-none-eabi-4_9-2015q3-20150921-linux.tar.bz2  
tar -vxf gcc-arm-none-eabi-4_9-2015q3-20150921-linux.tar.bz2  
# Add gcc-arm-none-eabi-gcc toolchain to System PATH  
PATH="$PATH:~/gcc-arm-none-eabi-4_9-2015_q3/bin"
```

3. make sure that the *cmake* version is after **3.15** and python version is **2.7**

```
cmake --version  
cmake version 3.15.3
```

```
python --version  
Python 2.7.17
```

Note: You can download the latest version of CMake from CMake.org . Both source and binary distributions are available.

You can download the specific release of Python from Python.org .

3.2 Get the AWS FreeRTOS SDK

Clone the **amazon-freertos** from gitub

```
git clone git@github.com:aws/amazon-freertos.git  
cd amazon-freertos  
git checkout origin/202002.00 -b 202002.00  
git submodule update --init --recursive  
cd ..
```


3.3 AWS FreeRTOS SDK Modifications

1. Modify board file for TypeABR module

Modify below settings in `mw300_rd.c` located in `aws_freertos/vendors/marvell/WMSDK/mw320/sdk/src/boards`

```
51 int board_32k_osc()
52 {
53     return false;
54 }
```

```
68 void board_uart_pin_config(int id)
69 {
70     switch (id)
71     {
72         case UART0_ID:
73             GPIO_PinMuxFun(GPIO_2, GPIO2_UART0_TXD);
74             GPIO_PinMuxFun(GPIO_3, GPIO3_UART0_RXD);
75             GPIO_PinMuxFun(GPIO_0, GPIO0_UART0_CTSn);
76             GPIO_PinMuxFun(GPIO_1, GPIO1_UART0_RTSn);
77             break;
78         case UART1_ID:
79             /* Not implemented yet */
80             break;
81         case UART2_ID:
82             GPIO_PinMuxFun(GPIO_48, GPIO48_UART2_TXD);
83             GPIO_PinMuxFun(GPIO_49, GPIO49_UART2_RXD);
84             break;
85     }
86 }
```

2. Modify the WiFi AP SSID and PASSWORD in SDK

Modify below settings in `amazon-freertos/demos/include/aws_clientcredential.h`

```
58 #define clientcredentialWIFI_SSID          "TestAP"
64 #define clientcredentialWIFI_PASSWORD     "12345678"
```

Modify the security if needed.

```
74 #define clientcredentialWIFI_SECURITY      eWiFiSecurityWPA2
```

3. Modify the AWS Ting Name and endpoint in SDK

Modify below settings in `amazon-freertos/demos/include/aws_clientcredential.h`

```
34 #define clientcredentialMQTT_BROKER_ENDPOINT      "xxxxxxxxxxxxxxxx-ats.iot.
    ↪ap-northeast-1.amazonaws.com"
```

```
41 #define clientcredentialIOT_THING_NAME           "aws_demo_led"
```

4. Modify AWS Thing cert and private key

modify below setting in `amazon-freertos/demos/include/aws_clientcredential_keys.h` with the cert and private key download from AWS-IoT.

```
39 #define keyCLIENT_CERTIFICATE_PEM             "-----BEGIN CERTIFICATE-----\n\
40                                             "...base64 data...\n\
41                                             "-----END CERTIFICATE-----\n"
```

```
60 #define keyCLIENT_PRIVATE_KEY_PEM          "-----BEGIN CERTIFICATE-----\n" \  
61                                           " ..base64 data...\n" \  
62                                           "-----END CERTIFICATE-----\n"
```

3.4 Build the AWS demos firmware

The firmware file **aws_demos.bin** is located in **build** after below commands.

```
cd amazon-freertos  
cmake -DVENDOR=marvell -DBOARD=mw320 -DCOMPILER=arm-gcc -S . -B build -DAFR_ENABLE_  
-TESTS=0  
cd build  
make all -j4
```

RUN THE FIRMWARE

4.1 Download the firmwares

Using below commands to download the firmwares into TypeABR module.

```
export DEBUG_INTERFACE=jlink
./vendors/marvell/WMSDK/mw320/sdk/tools/OpenOCD/flashprog.py -l ./vendors/marvell/
WMSDK/mw320/sdk/tools/OpenOCD/mw300/layout.txt --boot2 ./vendors/marvell/WMSDK/
mw320/boot2/bin/boot2.bin
./vendors/marvell/WMSDK/mw320/sdk/tools/OpenOCD/flashprog.py --wififw ./vendors/
marvell/WMSDK/mw320/wifi-firmware/mw30x/mw30x_uapsta_W14.88.36.pl35.bin
./vendors/marvell/WMSDK/mw320/sdk/tools/OpenOCD/flashprog.py --mcufw ./build/
marvell/mw320/aws_demos.bin -r
```

4.2 Run the FreeRTOS demo project

Press the RST button to reset the device and start booting the application. Some logs will output on **UART0**.

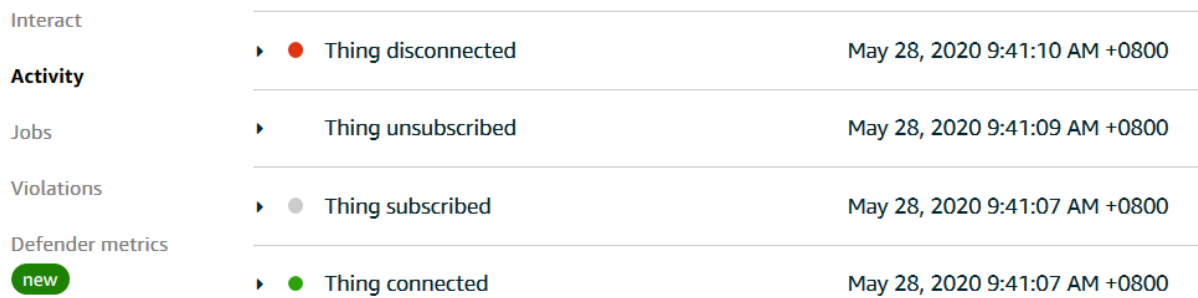
```
1 FreeRTOS Started
2
3 Application Daemon Startup
4
5 Will attempt to start wlan
6
7 Wi-Fi module initialized. Connecting to AP...
8 Registered seed_handler
9 0 21045 [IP-task] vDHCPPProcess: offer c0a8328cip
10 1 30045 [IP-task] vDHCPPProcess: offer c0a8328cip
11
12 Network connection successful.
13
14 Wi-Fi Connected to AP. Creating tasks which use network...
15 2 30107 [Startup Hook] Write certificate...
16 3 30113 [iot_thread] [INFO ][DEMO][30113] -----STARTING DEMO-----
17 4 30113 [iot_thread] [INFO ][INIT][30113] SDK successfully initialized.
18 5 38303 [IP-task] vDHCPPProcess: offer c0a8328cip
19 6 38313 [IP-task] vDHCPPProcess: offer c0a8328cip
20
21 Network connection successful.
22 .....
23 163 42458 [iot_thread] [INFO ][DEMO][42458] Demo completed successfully.
24 164 42508 [iot_thread] [INFO ][INIT][42508] SDK cleanup done.
25 165 42508 [iot_thread] [INFO ][DEMO][42508] -----DEMO FINISHED-----
```

4.3 Monitoring MQTT messages on the cloud

You can use the MQTT client in the AWS IoT console to monitor the messages that your device sends to the AWS Cloud.

To subscribe to the MQTT topic with the AWS IoT MQTT client

1. Sign in to the [AWS IoT console](#).
2. In the navigation pane, choose **Test** to open the MQTT client.
3. In **Subscription topic**, enter `iotdemo/#`, and then choose **Subscribe to topic**.



The screenshot shows the AWS IoT console interface with a list of device connection events. The interface includes a left-hand navigation menu with sections: Interact, Activity, Jobs, Violations, and Defender metrics. The Activity section is expanded, showing a list of events. The events are: 'Thing disconnected' (red dot), 'Thing unsubscribed' (grey dot), 'Thing subscribed' (grey dot), and 'Thing connected' (green dot). The 'Thing connected' event has a green 'new' badge. All events are timestamped as 'May 28, 2020 9:41:07 AM +0800'.

Category	Event	Timestamp
Activity	▶ ● Thing disconnected	May 28, 2020 9:41:10 AM +0800
Jobs	▶ ● Thing unsubscribed	May 28, 2020 9:41:09 AM +0800
Violations	▶ ● Thing subscribed	May 28, 2020 9:41:07 AM +0800
Defender metrics	▶ ● Thing connected	May 28, 2020 9:41:07 AM +0800

Fig. 4.1: AWS-IoT Cloud Device connection status

LASTWILLANDTESTAMENT

TypeABR module have passed all of the required FreeRTOS qualification tests. However, some modifications are required to pass the **LastWillAndTestament** test case.

```
TEST(MQTT_System, LastWillAndTestament) /libraries/c_sdk/standard/mqtt/test/system/
↪io
```

This test case requires plenty of heap memory for two MQTT connection, so the default configuration needs to be modified to reduce the firmware size and release more memory.

5.1 Reference Solution

Here is a solution for reference.

Note: This LastWillAndTestament should be tested alone.

1. Modify the AWS Iot Test configuration files

- *tests/common/aws_test_runner.c* updated/*tests/common/aws_test_runner.c*

```
103 #if ( testrunnerFULL_MQTTv4_ENABLED == 1 )
104
105
106
107
108
109 RUN_TEST_GROUP( MQTT_System );
110 #endif /* if ( testrunnerFULL_MQTTv4_ENABLED == 1 ) */
```

- *libraries/c_sdk/standard/mqtt/test/system/iot_tests_mqtt_system.c*

```
716 TEST_GROUP_RUNNER( MQTT_System )
717 {
718
719
720
721 RUN_TEST_CASE( MQTT_System, LastWillAndTestament );
722
723
724
725
726 }
```

- *vendors/marvell/boards/mw300_rd/aws_tests/config_files/aws_test_runner_config.h*

TypeABR AWS FreeRTOS SDK Getting Started Guide

```

35 #define testrunnerFULL_OTA_CBOR_ENABLED          0
36 #define testrunnerFULL_OTA_AGENT_ENABLED        0
37 #define testrunnerFULL_OTA_PAL_ENABLED          0
38 #define testrunnerFULL_MQTT_ALPN_ENABLED        0
39 #define testrunnerFULL_PKCS11_ENABLED          0
40 #define testrunnerFULL_CRYPT0_ENABLED          0
41 #define testrunnerFULL_MQTT_STRESS_TEST_ENABLED 0
42 #define testrunnerFULL_MQTT_AGENT_ENABLED       0
43 #define testrunnerFULL_TCP_ENABLED              0
44 #define testrunnerFULL_GGD_ENABLED              0
45 #define testrunnerFULL_GGD_HELPER_ENABLED       0
46 #define testrunnerFULL_SHADOW_ENABLED           0
47 #define testrunnerFULL_MQTTv4_ENABLED           1
48 #define testrunnerFULL_WIFI_ENABLED             0
49 #define testrunnerFULL_MEMORYLEAK_ENABLED       0
50 #define testrunnerFULL_TLS_ENABLED              0
51 #define testrunnerFULL_HTTPS_CLIENT_ENABLED     0

```

2. Modify the MbedTLS Configuration in *libraries/3rdparty/mbedtls/include/mbedtls/config.h*.

```
579 // #define MBEDTLS_CIPHER_MODE_CBC
```

```
586 // #define MBEDTLS_CIPHER_MODE_CFB
```

```
593 // #define MBEDTLS_CIPHER_MODE_CTR
```

```
687 // #define MBEDTLS_REMOVE_ARC4_CIPHERSUITES
```

```
720 // #define MBEDTLS_ECP_NIST_OPTIM
```

```
966 // #define MBEDTLS_KEY_EXCHANGE_ECDHE_ECDSA_ENABLED
```

```
1180 // #define MBEDTLS_PK_RSA_ALT_SUPPORT
```

```
1250 // #define MBEDTLS_SSL_ALL_ALERT_MESSAGES
```

```
1570 // #define MBEDTLS_SSL_SERVER_NAME_INDICATION
```

3. Modify FreeRTOS Configurations in *vendors/marvell/boards/mw300_rd/aws_tests/config_files/FreeRTOSConfig.h*.

```
54 #define configMAX_PRIORITIES          ( 5 )
```

```
115 #define configTIMER_QUEUE_LENGTH      3
```

3. Modify IoT Configurations in *vendors/marvell/boards/mw300_rd/aws_tests/config_files/iot_config.h*.

```
28 #define IOT_THREAD_DEFAULT_STACK_SIZE 2840
```

5.2 Reference Patches

The provided patch files can also be used to complete the above reference solution for code changes.

- `murata_typeabr_module_board_for_amazon-freertos.patch`: This patch file is used for modifying the board file for murata TypeABR module.
- `murata_typeabr_fixs_LastWillAndTestament_for_amazon-freertos.patch`: This patch file is used for modifying the SDK files to pass the LastWillAndTestament test.

Note: The above patch files were generated based on *amazon-freertos* released tag **202002.00**.

To apply the patch, follow these steps:

```
~# cd /path/to/amazon-freertos-202002.00
~# cat /path/to/murata_typeabr_xxx.patch | patch -p1
```

Apply the first patch to run all the Amazon Freertos certification test. Then all the test results will be shown **PASS except LastWillAndTestament**.

Apply the second patch, and this **LastWillAndTestament** will be tested alone, then test result for **LastWillAndTestament** will be **PASS** .

5.3 Reference Running Logs

```

1  FreeRTOS Started
2  Application Daemon Startup
3  Registered seed_handler
4  0 328 [Startup Hook] Write certificate...
5  Will attempt to start wlan
6  Wi-Fi module initialized. Connecting to AP...
7  1 2400 [IP-task] vDHCPPProcess: offer c0a8328cip
8  2 33004 [IP-task] vDHCPPProcess: offer c0a8328cip
9  Network connection successful.
10 Wi-Fi Connected to AP. Creating tasks which use network...
11 -----STARTING TESTS-----
12 3 36022 [IP-task] vDHCPPProcess: offer c0a8328cip
13 4 36031 [IP-task] vDHCPPProcess: offer c0a8328cip
14 Network connection successful.
15 5 41102 [RunTests_task] DNS[0x1525B8]: The answer to Node (36f92182ip) will be _
    ↪stored
16 6 41102 [RunTests_task] DNS[0x1525B8]: The answer to Node (34c40b9cip) will be _
    ↪stored
17 TEST(MQTT_System, LastWillAndTestament) PASS
18 -----
19
20 OK
21 -----ALL TESTS FINISHED-----

```

PRECONDITION TO USE OUR PRODUCTS

PLEASE READ THIS NOTICE BEFORE USING OUR PRODUCTS.

Please make sure that your product has been evaluated and confirmed from the aspect of the fitness for the specifications of our product when our product is mounted to your product.

All the items and parameters in this product specification/datasheet/catalog have been prescribed on the premise that our product is used for the purpose, under the condition and in the environment specified in this specification. You are requested not to use our product deviating from the condition and the environment specified in this specification. Please note that the only warranty that we provide regarding the products is its conformance to the specifications provided herein. Accordingly, we shall not be responsible for any defects in products or equipment incorporating such products, which are caused under the conditions other than those specified in this specification.

WE HEREBY DISCLAIMS ALL OTHER WARRANTIES REGARDING THE PRODUCTS, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, THAT THEY ARE DEFECT-FREE, OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS.

The product shall not be used in any application listed below which requires especially high reliability for the prevention of such defect as may directly cause damage to the third party's life, body or property. You acknowledge and agree that, if you use our products in such applications, we will not be responsible for any failure to meet such requirements. Furthermore, YOU AGREE TO INDEMNIFY AND DEFEND US AND OUR AFFILIATES AGAINST ALL CLAIMS, DAMAGES, COSTS, AND EXPENSES THAT MAY BE INCURRED, INCLUDING WITHOUT LIMITATION, ATTORNEY FEES AND COSTS, DUE TO THE USE OF OUR PRODUCTS IN SUCH APPLICATIONS.

- Aircraft equipment.
- Aerospace equipment
- Undersea equipment.
- Power plant control equipment
- Medical equipment.
- Transportation equipment (vehicles, trains, ships, elevator, etc.).
- Traffic signal equipment.
- Disaster prevention / crime prevention equipment.
- Burning / explosion control equipment
- Application of similar complexity and/ or reliability requirements to the applications listed in the above.

We expressly prohibit you from analyzing, breaking, reverse-engineering, remodeling altering, and reproducing our product. Our product cannot be used for the product which is prohibited from being manufactured, used, and sold by the regulations and laws in the world. We do not warrant or represent that any license, either express or implied, is granted under any our patent right, copyright, mask work right, or our other intellectual property right relating to any combination, machine, or process in which our products or services are used. Information provided by us regarding third-party products or services does not constitute a license from us to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from us under our patents or other

intellectual property. Please do not use our products, our technical information and other data provided by us for the purpose of developing of mass-destruction weapons and the purpose of military use. Moreover, you must comply with foreign exchange and foreign trade law, the U.S. export administration regulations, etc. Please note that we may discontinue the manufacture of our products, due to reasons such as end of supply of materials and/or components from our suppliers. By signing on specification sheet or approval sheet, you acknowledge that you are the legal representative for your company and that you understand and accept the validity of the contents herein. When you are not able to return the signed version of specification sheet or approval sheet within 30 days from receiving date of specification sheet or approval sheet, it shall be deemed to be your consent on the content of specification sheet or approval sheet. Customer acknowledges that engineering samples may deviate from specifications and may contain defects due to their development status. We reject any liability or product warranty for engineering samples. In particular we disclaim liability for damages caused by

- the use of the engineering sample other than for evaluation purposes, particularly the installation or integration in the product to be sold by you,
- deviation or lapse in function of engineering sample,
- improper use of engineering samples.

We disclaim any liability for consequential and incidental damages. If you cant agree the above contents, you should inquire our sales.

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Murata:](#)

[CMWC1ZZABR-107](#)