Introduction

This document provides information and recommendations related to the UMS evaluation board (EVB) and its use to evaluate the performance of a given product.

General description

A representative photograph of the evaluation board is shown in Figure 1. The exact description of different options are given below.

Equipment needed

- RF cables with appropriate connectors (SSMA, K, V)
- Appropriate 8mm torque wrench
- Wire to BNC adaptor
- M2 allen wrench

Figure 1 : Evaluation Board (EVB) Photograph
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Revision history

4/2023: Revision 1: Initial Version

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1. Evaluation Board (EVB) description

1.1. RF line layout

The input and output RF line stackup is described in Figure 2. It is a microstrip structure with 310µm line width.

![RF line stack-up diagram](image)

Figure 2: Evaluation Board (EVB) RF line stack-up

Lines are designed to be 50Ω matched with a return loss better than -15dB (Figure 3).

![Thru line return loss graph](image)

Figure 3: Thru line return loss
1.2. **Power supply and RF input and output**

The DC connectors are double row 2.54mm pitch terminal strips. The lower row is connected to the ground and the upper row is used to route the DC or pulsed signal to the die. To avoid any oscillation, we recommend to connect the terminal strips by brazing with an adapter to coaxial connectors (example shown in Figure 4).

![Figure 4: Wire to BNC interconnector](image)

The RF access (RF\textsubscript{in} and RF\textsubscript{out}) are marked on the base of the evaluation board (EVB).

The evaluation board can be delivered with SMA, K or V RF connectors depending on the product frequency range. The appropriate connector must be used, otherwise it could damage the demonstrator.

The board can be configured for both CW or pulsed measurements (wire loop compatible with Hall Effect, current probe and appropriate decoupling).

Figure 5 gives an example for a CW measurement configuration and Figure 6 for a pulsed measurement configuration.

1.3. **Measurement considerations**

The evaluation board is suitable for characterization in a temperature range from -60°C up to 125°C. For measurements below the dew point, we recommend to use dry air to prevent the formation of dew or frost on the surface of the die or the PCB.
1.4. Preparation of the test

The evaluation board is delivered with a lid for mechanical protection. We recommend to remove the lid with a 2mm Allen wrench for the measurement to avoid any influence on the results.
1.5. Thermal information

The temperature can be measured close to the die by using a thermocouple placed in the mechanical base shown in Figure 7. We recommend to use a thermocouple with a diameter between 1mm and 1.5mm.

The information about the correspondence of the thermocouple temperature in the evaluation board and the backside of the die is given in the product datasheet. We recommend to use a cooling plate to regulate the temperature and to improve the thermal contact between the base of the evaluation board and the cooling plate by a thermal paste.

Figure 7: Evaluation board (EVB) base drawing
1.6. **Calibration and de-embedding**

Figure 8 shows the environment close to the die. When measuring the evaluation board, the input and output line loss have to be removed. The distance between the input and output is 28mm.

![Figure 8: RF lines, distance between input and output is 28mm](image)

We recommend to perform a calibration in the connector plane with an appropriate calibration kit (SOLT or TRL).

The example below explains how to evaluate the correction to be applied on raw measurement data at room temperature by using the curves of Figure 9 and Figure 10.

**Example**

If the die is 4 mm long, the input line length will be approximately 
\[
\frac{28\text{mm}-4\text{mm}}{2} = 12\text{mm}.
\]

Figure 9 gives the insertion loss for a 27mm long line equipped with 2 RF connectors. At 50GHz for example, the loss is \(L=2.4\text{dB}\).

![Figure 9: Insertion loss for a 1mm long die (RF lines 27mm) at room temperature](image)

Half of the loss is \(HL=1.2\text{dB}\) and represent one connector and a 13.5mm long line.
Figure 10 gives the line loss per millimetre. At 50GHz, the loss is $LL = 0.08 \text{ dB/mm}$.

![Figure 10: Line loss/mm](image)

The extra length to be removed on both the input and output line is 1.5mm. The corresponding loss is $LC = 1.5 \times LL = 0.12 \text{ dB}$.

The correction to be applied is $\text{Corr} = HL - LC = 1.2 \text{ dB} - 0.12 \text{ dB} = 1.08 \text{ dB}$.

Hence, at 50GHz the de-embedding to be applied on both the input and output is $1.08 \text{ dB}$.

### 1.7. Biasing sequence

The detailed biasing sequence of the product is given in its datasheet.

### 1.8. Expected results

See the product datasheet for the expected results.
2. Notes
Recommended ESD management
Refer to the application note AN0020 available at https://www.ums-rf.com for ESD sensitivity and handling recommendations for the UMS products.

Recommended environmental management
UMS products are compliant with the regulation in particular with the directives RoHS N°2011/65 and REACh N°1907/2006. More environmental data are available in the application note AN0019 also available at https://www.ums-rf.com.

3. Ordering information

Product commercial reference:
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- EVB-XXXXXXXX-98F

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