BROADCOM®

Application Note

AFBR-S4N Series

NUV-MT Handling and Soldering

Introduction

Broadcom® NUV-MT silicon photomultipliers (AFBR-S4N series) are ultra-sensitive low-light detectors. The NUV-MT SiPMs are offered in an overmold package with a land grid array for electrical connections on the backside. Detailed information, such as the mechanical outlines and specifications, can be found in the data sheets of the respective components.

Related Part Numbers

The handling and solder guidelines in this application note are valid for Broadcom's NUV-MT SiPM series (AFBR-S4N series). As of November 2026, the AFBR-S4N series includes the following part numbers:

- AFBR-S4N22P014M
- AFBR-S4N44P014M
- AFBR-S4N44P044M
- AFBR-S4N44P164M
- AFBR-S4N66P014M
- AFBR-S4N66P024M
- AFBR-S4N33P012M

All SiPMs in the AFBR-S4N series have the same package type and are shipped by Broadcom in a similar type of packaging. Therefore, the handling guidelines apply to all parts in this SiPM series.

Related Documents

The following end-customer documents are related to the handling guidelines for the AFBR-S4N series:

- *AFBR-S4NxxPyy4M: NUV-MT Soldering Precautions*
- Data sheets

Solder Precautions

The Broadcom AFBR-S4Nxx is an SiPM series that is used for ultra-sensitive precision measurements of single photons. SiPMs from this series are qualified according to moisture/reflow sensitivity classification MSL 5. Refer to the shipment label for the MSL classification of your devices. Also refer to the Joint Industry Standard (IPC/JEDEC J-STD-020) for details on the moisture sensitivity classification. Precautions must be taken to reduce thermo-mechanical stress during the solder process of the SiPMs.

During the solder process, the most critical zone is where temperatures exceed 125°C. Broadcom recommends following the solder profile parameters as close as possible for temperatures above 125°C (during heat-up and cool-down). Temperatures below 125°C are less critical for the solder process.

Table 1 shows the details of the solder profile.

1. **Preheat** – A temperature gradient below 125°C must not exceed 3 K/s. Our reference profile uses a temperature gradient of 1 K/s.
2. **Preheat/Soak** – A temperature gradient above 125°C must not exceed 1 K/s. Our reference profile uses a temperature gradient of 0.4 K/s until 200 seconds and 1 K/s until 240°C.
3. **Above Liquidus** – The recommended time above liquidus is between 60 seconds and 120 seconds. Our reference profile is above liquidus for 60 seconds.
4. **Cool-Down** – The maximum cool-down rate is 3 K/s and is also determined by the requirement of being above the liquidus temperature for 60 seconds and being above 240°C for 30 seconds.

The solder profile shown in Figure 1 represents one profile that follows the aforementioned guidelines. The solder profile reflects maximum temperature rates during the reflow solder process, which must not be exceeded. Exceeding the specified maximum temperature ramps can lead to issues affecting reliability and performance. It is recommended to verify the profile on all new PCB materials and designs with thermocouple measurements. Thermo-mechanical stress can occur at all steps during the solder process. Therefore, not only must the heat-up phase follow the recommended solder profile, but the peak temperature and the cool-down rate must also be obeyed.

Prior Soldering

- Baking at 125°C (+5°C/–0°C) for 16 hours is mandatory before soldering if the floor life is exceeded (48 hours according to MSL 5).
- A maximum of three baking cycles is allowed.
- For MSL 5, the *maximum* floor life is 48 hours at 30°C and 60% relative humidity. No baking by the customer is required if the floor life time is obeyed.
- If the floor life is not exceeded, baking is optional.

The floor life is reset by proper baking. If the baking is interrupted for more than 15 minutes, it should be extended by the time elapsed during the interruption. For baking, no special heat-up and cool-down rate is necessary.

Silicon Photomultipliers in Trays (Maximum 125°C)

Broadcom NUV-MT SiPMs and the SiPM trays are specified to be bakeable at 125°C. The SiPMs can be baked within the trays.

NUV-MT HDR SiPMs are specified to be bakeable at up to 90°C.

Silicon Photomultipliers in Tape and Reel (Maximum 40°C)

Refer to JEDEC J-STD-033D for details on baking for devices shipped in low-temperature carriers (such as the tape and reel used by Broadcom for SiPM products).

SiPMs shipped in tape and reel may not be baked at temperatures higher than 40°C within the reel.

Table 1: Recommended Baking Times for Broadcom SiPM Products in Tape and Reel

Recommended baking time	Exceeding the floor life by < 72 hours	Exceeding the floor life by > 72 hours
	7 days	11 days

If shorter baking times are required, the SiPMs must be removed from the tape and reel. See the following table for recommended baking times in a suitable high-temperature carrier (such as trays).

Table 2: Recommended Baking Times

Part Number	SiPM Series	Bake at 40°C (<5% RH)	Bake at 90°C (<5% RH)	Bake at 125°C (<5% RH)
AFBR-S4N22P014M	NUV-MT	11 days	24 hours	16 hours
AFBR-S4N44Pxx4M	NUV-MT	11 days	24 hours	16 hours
AFBR-S4N66Pxx4M	NUV-MT	11 days	24 hours	16 hours
AFBR-S4N33P012M	NUV-MT HDR	11 days	24 hours	Not allowed

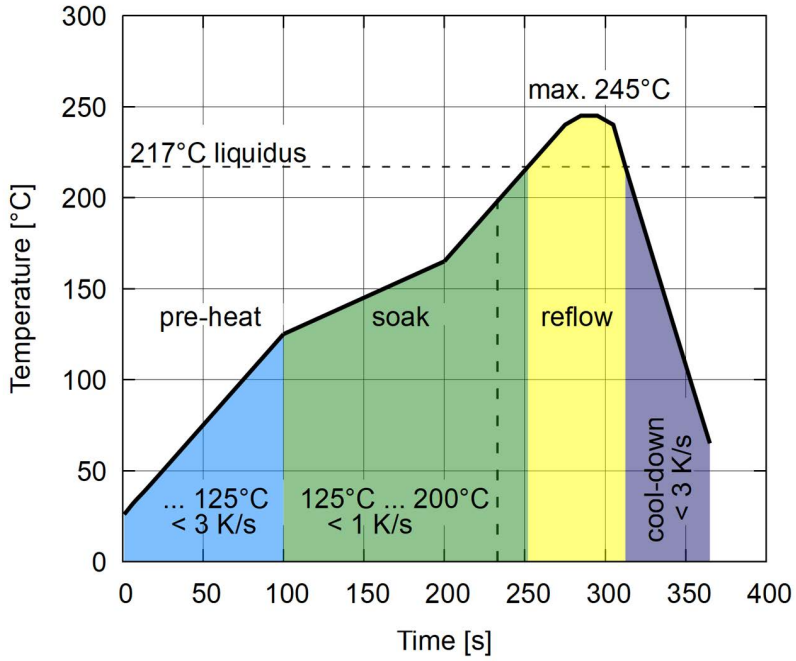
Solder Procedure Critical Phases

- Preheat/soak (from 125°C to 200°C)
- Peak temperature (245°C)
- Cool-down rate (< 3 K/s)

Table 3: Recommended Solder Profile Features

Profile Feature	Recommendation	As Displayed in Reference Profile
Preheat Rate (< 125°C)	< 3 K/s	1 K/s
Preheat/Soak (125°C to 200°C)	≤ 1 K/s	■ 0.4 K/s until 200s ■ 1 K/s until 200°C (200s to 287s)
Liquidus Temperature	217°C	217°C
Time above Liquidus Temperature	60s to 120s	60s with: ■ 1 K/s until 240°C ■ 3-K/s cool-down from 240°C until 217°C
Peak Temperature	245°C	245°C
Time within 5°C of the Peak Temperature (240°C to 245°C)	30s	30s with: ■ 0.5 K/s until peak temperature ■ 10s at peak temperature ■ 3-K/s cool-down from 245°C until 217°C
Ramp-Down Rate	≤ 3 K/s	3 K/s

Figure 1: Recommended Reflow Soldering Profile



NOTE:

- When assembling a two-sided PCB, the floor life, baking, and solder profile must be considered each time the SiPM is placed in a reflow oven.
- If the SiPMs (arrays) must be stored, N_2 storage is recommended.

Storage

- N_2 storage is recommended directly after baking. N_2 storage extends the floor life. Resealing is not recommended for parts stored in N_2.
- If you are unsure about the floor life or if the parts are close to the end of the specified floor life, new baking is recommended.
- For parts that have not yet been baked, the specified storage temperatures are according to the data sheet from 20°C to 60°C.

Rework

- When parts are removed from PCBs, it is recommended that localized heating be used and that the maximum temperature comply with Broadcom's solder profile recommendations.
- Before devices are removed, the assembly must first be baked for 16 hours at 125°C.

ESD Precautions

Silicon photomultipliers are sensitive electrical devices, and ESD precaution measures must be taken when handling the devices. These measures include the following:

- Work on an ESD-specified and grounded workstation (the floor and a desk fulfill ESD specifications).
- Wear an ESD coat when handling the devices.
- Wear ESD shoes when handling the devices.
- Use ESD-specified equipment (for example, tweezers).

The ESD specifications were tested according to JESD22-A114 (human-body model [HBM]) and JESD22-C101F (charged-device model [CDM]) with a maximum voltage capability of ESD_{HBM} = 2 kV and ESD_{CDM} = 500V.

Cleaning

If surface cleaning is necessary, the SiPM can be carefully cleaned using isopropanol and a microfiber wipe. Special care must be taken to avoid scratching the surface by applying too much pressure when cleaning.

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