# AFEM-7780
## UMTS2100 4x7 Front-end Module (FEM)

# Data Sheet

## Description

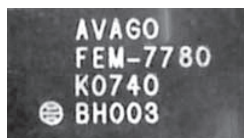
The AFEM-7780 is a fully matched WCDMA Band1 Frond-End Module (FEM) featuring the integration of Avago Technologies' power amplifier and FBAR.

The AFEM-7780 offers extended talk time and excellent linearity by using CoolPAM technology, which enhances efficiencies in low and medium power mode. Idle current is as low as 11mA.

The FBAR (Film Bulk Acoustic Resonator) based duplexer provides low insertion loss and outstanding isolation, which improves efficiency and RX sensitivity.

By using CoolPAM and FBAR technologies, AFEM-7780 shows best performance with smaller footprint.

## Component Image




## Feature

- Excellent linearity
- Operating Frequency:
  - Tx: 1920~1980 MHz
  - Rx: 2110~2170 MHz
- 24.5 dBm Linear Output Power (HSDPA)
- Very low quiescence current in low power mode
- High isolation (Low Tx leakage at Rx port)
- HSDPA capable
- 50 ohm input and output matching
- 20-pin surface mounting package
- 4. 0 x 7.0 x 1.1(typ) mm SMT Package

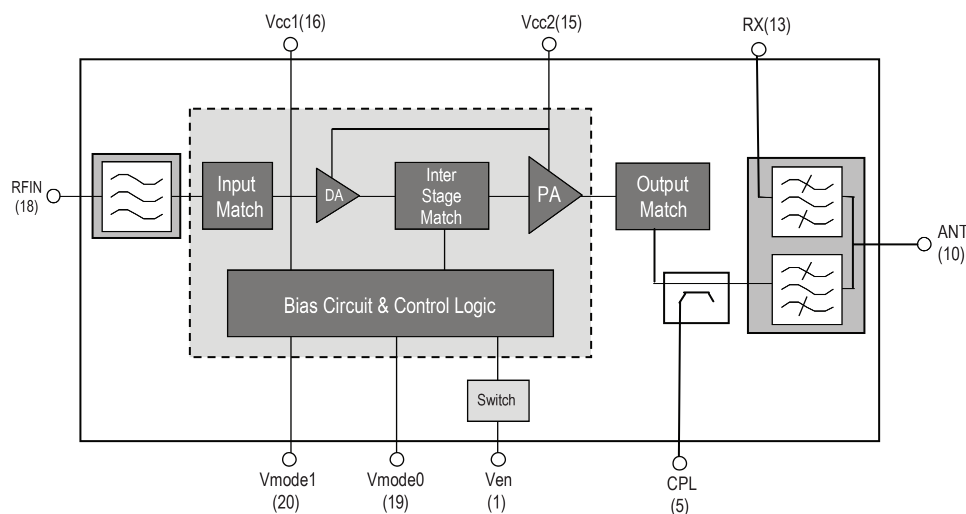
## Applications

- WCDMA handset (HSDPA)

## Ordering Information

| Part Number | Number of Devices | Container |
|---|---|---|
| AFEM-7780-TR1 | 1000 | 178mm (7") Tape/Reel |
| AFEM-7780-BLK | 100 | Bulk |

## Block Diagram



### Absolute Maximum Rating

No damage assuming only one parameter is set at limit at a time with all other parameters set at or below typical value

Operation of any single parameter outside these conditions with the remaining parameters set at or below typical values may result in permanent damage

| Description | Min | Typ | Max | Unit | Associated Pins |
|---|---|---|---|---|---|
| Tx Input Power | | 0 | 10 | dBm | $RF_{IN}$ |
| DC Supply Voltage | | 3.4 | 5.0 | V | Vcc |
| Enable Voltage | | 2.6 | 3.3 | V | Ven |
| Control Voltages | | 2.6 | 3.3 | V | Vmode0, Vmode1 |
| Storage Temperature | -55 | 25 | 125 | °C | |

### Recommended Operating Conditions

| Description | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Tx Frequency | | 1920 | | 1980 | MHz |
| Rx Frequency | | 2110 | | 2170 | MHz |
| DC Supply Voltage (Vcc1, Vcc2) | | 3.2 | 3.4 | 4.2 | V |
| Enable Voltage (Ven) | LOW | 0 | 0 | 0.5 | V |
| | HIGH | 2.15 | 2.6 | 2.9 | V |
| Mode Control Voltage (Vmode0, Vmode1) | LOW | 0 | 0 | 0.5 | V |
| | HIGH | 2.15 | 2.6 | 2.9 | V |
| Case Operating Temperature | | -20 | 25 | +90 | °C |

### Operation Logic Table

| Power Mode | Recommended Pout Range | Ven | Vmode0 | Vmode1 |
|---|---|---|---|---|
| High Power Mode | ~ 24.5 dBm | HIGH | LOW | LOW |
| Mid Power Mode | ~ 13.5 dBm | HIGH | HIGH | LOW |
| Low Power Mode | ~ 4 dBm | HIGH | HIGH | HIGH |
| Shunt Down Mode | | LOW | - | - |

## Electrical Characteristics

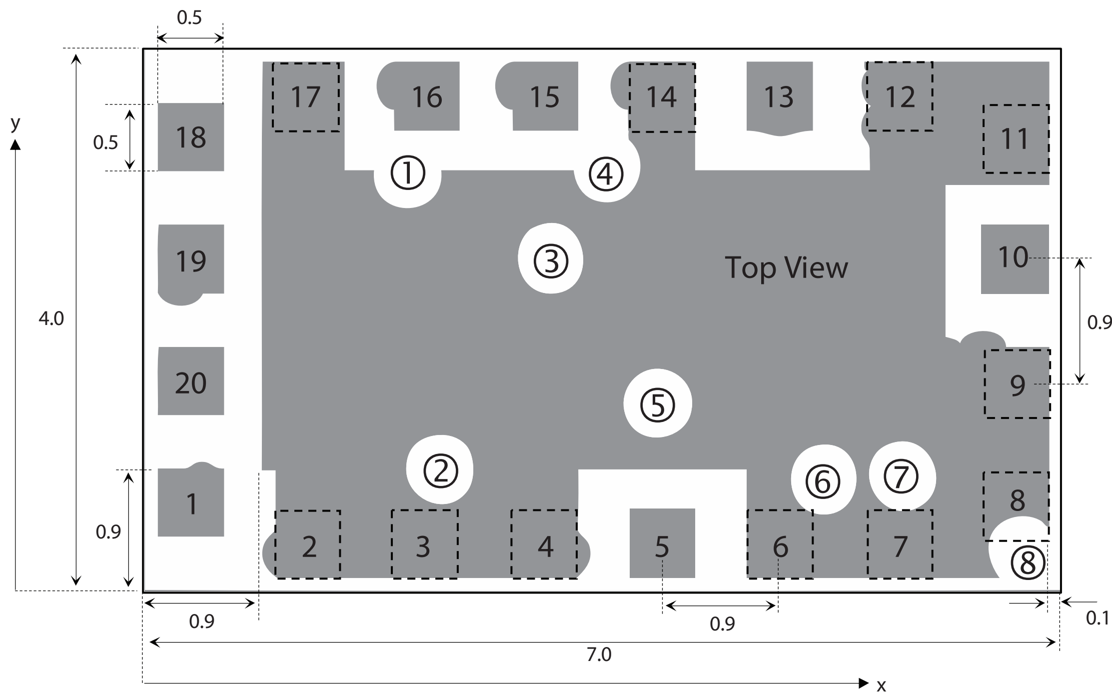
- Conditions: Vcc1=Vcc2=3.4, Ven=2.6V, Temp=25°C
- Signal configuration: HSDPA modulated uplink (DPCCH/DPDCH=12/15, HS-DPCCH/DPDCH=15/15)

| Parameter | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **TX to Antenna Port** | | | | | |
| Tx Operating Frequency Range | TX | 1920 | | 1980 | MHz |
| Maximum Output Power | High Power Mode | 24.5 | | | dBm |
| Gain | High Power Mode, Po=24.5dBm | 18 | 23.5 | | dB |
| | Mid Power Mode, Po=13.5dBm | 8 | 13.5 | | dB |
| | Low Power Mode, Po=4dBm | 5 | 11 | | dB |
| Power Added Efficiency | High Power Mode, Po=24.5dBm | 20.6 | 23.9 | | % |
| | Mid Power Mode, Po=13.5dBm | 7.9 | 9.5 | | % |
| | Low Power Mode, Po=4dBm | 1.9 | 2.7 | | % |
| Current Consumption | High Power Mode, Po=24.5dBm | | 345 | 400 | mA |
| | Mid Power Mode, Po=13.5dBm | | 66 | 80 | mA |
| | Low Power Mode, Po=4dBm | | 25 | 35 | mA |
| Quiescent Current | High Power mode | | 98 | 110 | mA |
| | Mid Power mode | | 17 | 25 | mA |
| | Low Power Mode | | 12 | 20 | mA |
| Adjacent Channel Power | ±5MHz offset, High Power Mode, Po=24.5dBm | | -39 | -36 | dBc |
| | ±10MHz offset, High Power Mode, Po=24.5dBm | | -52 | -46 | dBc |
| | ±5MHz offset, Mid Power Mode, Po=13.5dBm | | -40 | -36 | dBc |
| | ±10MHz offset, Mid Power Mode, Po=13.5dBm | | -60 | -46 | dBc |
| | ±5MHz offset, Low Power Mode, Po=4dBm | | -43 | -36 | dBc |
| | ±10MHz offset, Low Power Mode, Po=4dBm | | -60 | -46 | dBc |
| Harmonics | 2nd Harmonics | | -40 | -33 | dBm/MHz |
| | 3rd Harmonics | | -55 | -33 | dBm/MHz |
| Input VSWR at Tx port | | | 2.5:1 | | |
| Stability, spurious level | TX source VSWR < 5:1<br>FEM Antenna load VSWR < 5:1, all angles | | | -70 | dBc |
| Leakage current at shut-down | Ven=0V, without RF | | | 5 | uA |
| Change in TX insertion phase | MPM ↔ HPM | | 20 | | degree |
| | LMP ↔ MPM | | 2 | | degree |
| Intermodulation | CW interface -40dBc<br>@ 5MHz: Intermod products<br>@10MHz: Intermod products | | <br>-43<br>-52 | <br>-35<br>-45 | <br>dBc<br>dBc |

**Electrical Characteristics** (continued)

| | | | | | |
|---|---|---|---|---|---|
| Noise Power from TX | GPS Band (1570-1580MHz) | | -166 | -164 | dBm/Hz |
| | DCS Band (1805-1880Mhz) | | -135 | -132 | dBm/Hz |
| | ISM Band (2400-2480MHz) | | -166 | -164 | dBm/Hz |
| | Noise folding at DCS Band<br>Tx port noise input power=-134dBm/Hz | | -85 | -78 | dBm/<br>100kHz |
| Attenuation | 0-925 MHz | 25 | 60.8 | | dB |
| | 925-960 MHz | 42 | 60.4 | | dB |
| | 960-1570 MHz | 25 | 50.2 | | dB |
| | 1570-1580 MHz | 33 | 51.6 | | dB |
| | 1580-1805 MHz | 20 | 52.2 | | dB |
| | 1805-1880 MHz | 12 | 46.7 | | dB |
| | 2110-2170 MHz | 50 | 63.9 | | dB |
| | 2300-2400 MHz | 32 | 47.5 | | dB |
| | 2400-2500 MHz | 35 | 47 | | dB |
| | 3840-3960 MHz | 27 | 63.9 | | dB |
| | 5760-5940 MHz | 27 | 57.9 | | dB |
| **Antenna to Rx port** | | | | | |
| Rx Operating Frequency Range | RX | 2110 | | 2170 | MHz |
| Rx Insertion Loss | | | 1.5 | 2.5 | dB |
| Input VSWR at RX port | | | 2:1 | | |
| Attenuation | 0-175 MHz | 23 | 66.6 | | dB |
| | 175-205 MHz | 30 | 65.4 | | dB |
| | 205-1730 MHz | 23 | 38.4 | | dB |
| | 1730-1805 MHz | 30 | 45.1 | | dB |
| | 1805-1920 MHz | 23 | 50.8 | | dB |
| | 1920-1980 MHz | 35 | 56.1 | | dB |
| | 1980-2025 MHz | 15 | 39.3 | | dB |
| | 2255-2400 MHz | 15 | 56.9 | | dB |
| | 2400-2484 MHz | 30 | 55.2 | | dB |
| | 2500-4150 MHz | 10 | 19.7 | | dB |
| | 4220-4340 MHz | 10 | 26.7 | | dB |
| | 5940-6140 MHz | 15 | 15.6 | | dB |
| **Noise Power from TX to Rx port** | | | | | |
| Noise Power | 2110-2170 MHz | | -185 | -181 | dBm/Hz |
| | 1920-1980MHz | | -27 | -24 | dBm/<br>3.84MHz |
| **Coupling port** | | | | | |
| Coupled power | Measured after 6dB attenuator | | | 0 | dBm |

## Footprint




| | x | y | | x | y |
|---|---|---|---|---|---|
| ① | 2.01 | 3.08 | ⑤ | 3.92 | 1.39 |
| ② | 2.26 | 0.90 | ⑥ | 5.19 | 0.83 |
| ③ | 3.10 | 2.46 | ⑦ | 5.79 | 0.85 |
| ④ | 3.53 | 3.13 | ⑧ | 6.70 | 0.30 |

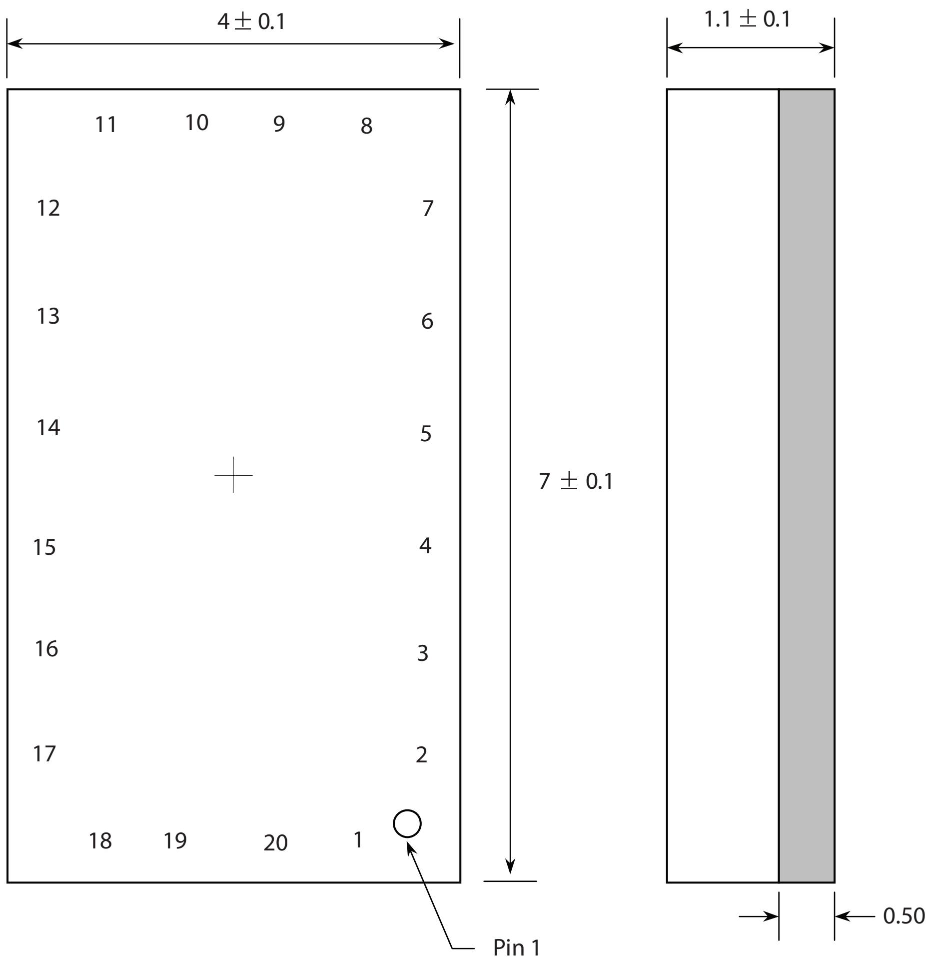
Notes :

1. Dimensions in millimeters
2. All GND pins are merged into center ground
3. Radius of non-ground circle is 0.52mm
4. Center position of non-ground circle

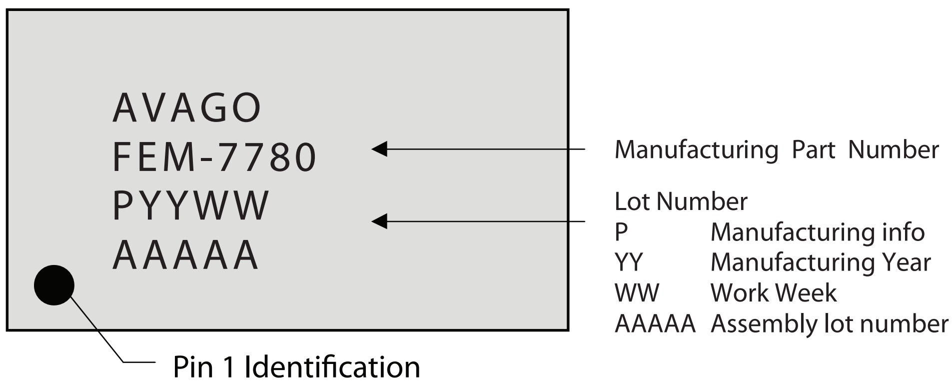
## Pin Description

| Pin # | Name | Description | Pin # | Name | Description |
|---|---|---|---|---|---|
| 1 | Ven | Module on/off control | 11 | GND | Ground |
| 2 | GND | Ground | 12 | GND | Ground |
| 3 | GND | Ground | 13 | RX | DPX RX output |
| 4 | GND | Ground | 14 | GND | Ground |
| 5 | CPL | TX Power Coupling Output | 15 | VCC2 | DC Supply Voltage |
| 6 | GND | Ground | 16 | VCC1 | DC Supply Voltage |
| 7 | GND | Ground | 17 | GND | Ground |
| 8 | GND | Ground | 18 | RFIN | TX RF Input |
| 9 | GND | Ground | 19 | Vmode0 | Mode Control Voltage |
| 10 | ANT | Antenna | 20 | Vmode1 | Mode Control Voltage |

**Package Dimensions** (all dimensions are in millimeter)




**Marking Specification**



## Metallization



## Solder Mask Opening



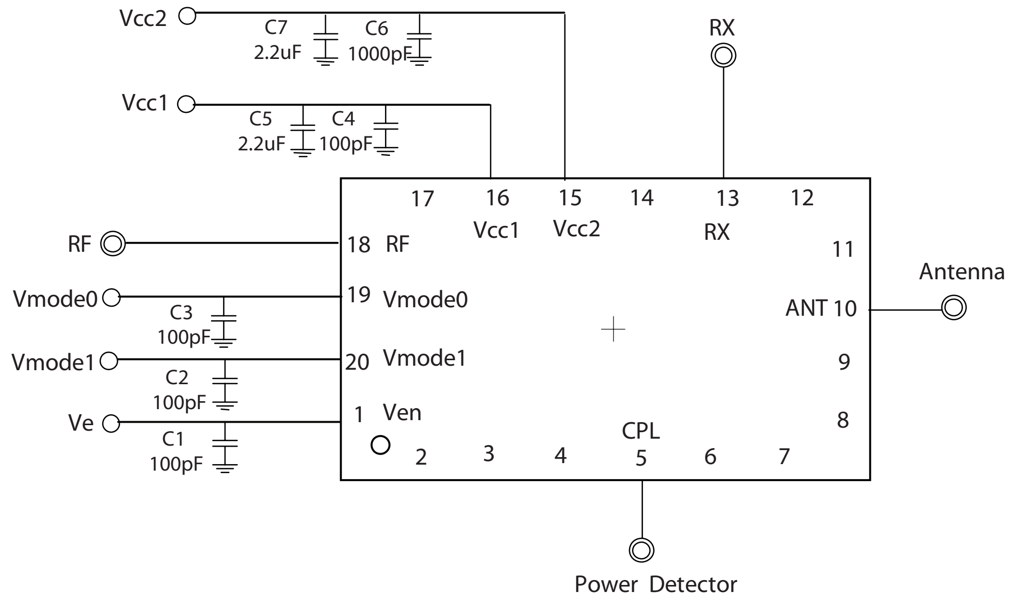
## Solder Plate Stencil Aperture



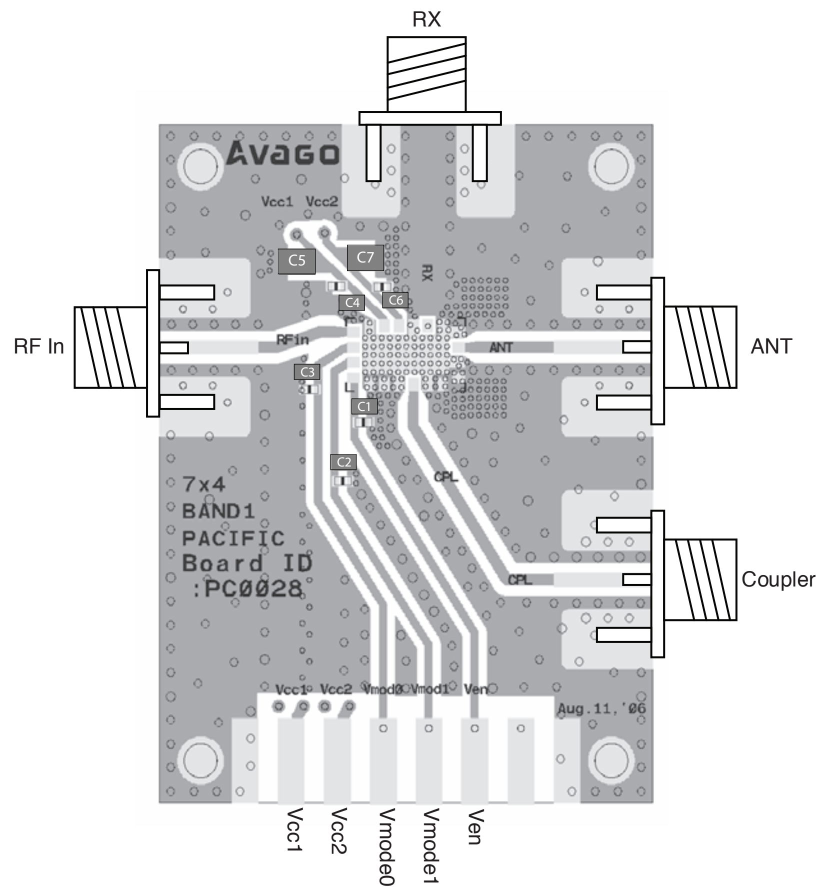
Notes :

1. Dimensions in millimeters
2. W and G adjusted for Zo=50Ω (CPW type is preferable)
3. Extended Ground area and VIAs are required for better Tx/Rx isolation
4. Rx signal line and Ant signal line should be at the different layer with proper isolation by GND for better Tx/Rx isolation

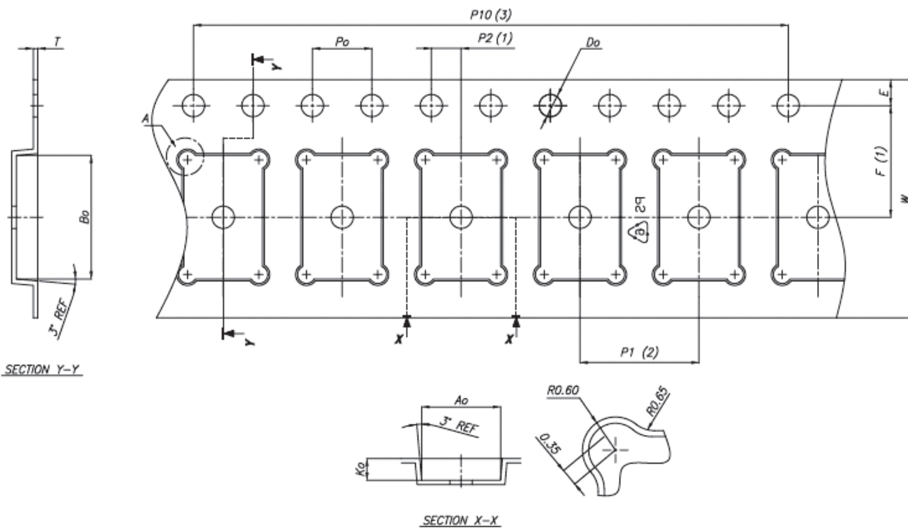
## Evaluation Board Schematic




## Evaluation Board Description

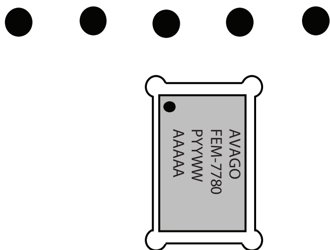


## Tape Drawing

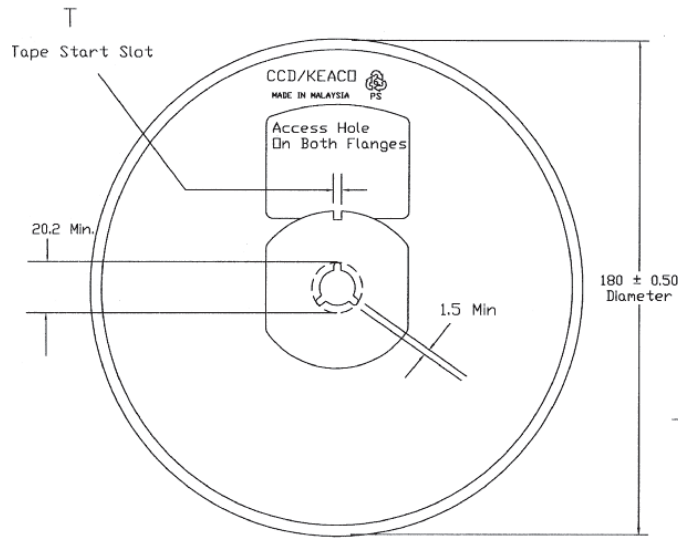



| Dimension List | | | |
|---|---|---|---|
| Annote | Milimeter | Annote | Milimeter |
| Ao | 4.30±0.10 | E | 1.75±0.10 |
| Bo | 7.30±0.10 | F | 7.50±0.10 |
| Ko | 1.55±0.10 | W | 16.00±0.30 |
| Do | 1.55±0.05 | T | 0.30±0.10 |
| D1 | 1.50±0.10 | | |
| Po | 4.00±0.10 | | |
| P1 | 8.00±0.10 | | |
| P2 | 2.00±0.10 | | |
| P10 | 40.00±0.20 | | |

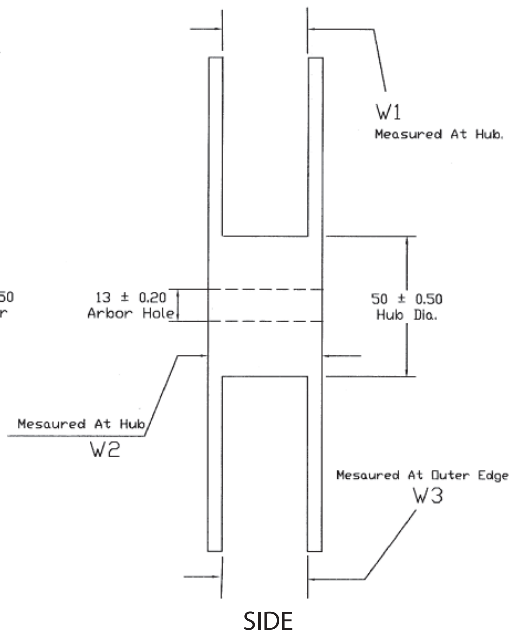
## Part Orientation in Tape



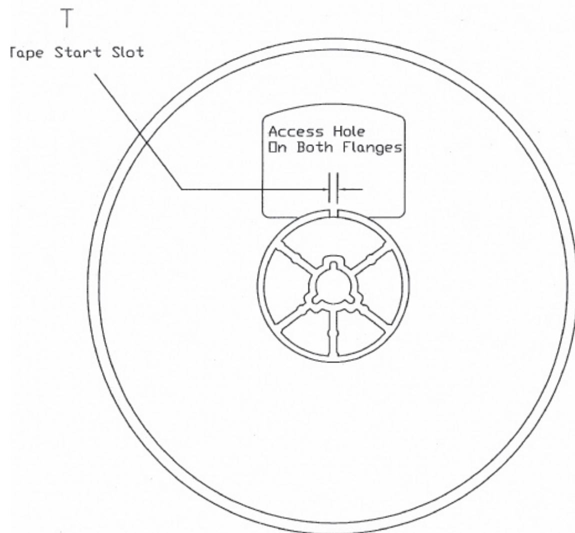
## **Reel Drawing** (all dimensions are in millimeters)




FRONT




SIDE




BACK

Notes:

1. Material: : Polystrene
2. Surface Resistivity : < 10E12 OHMS/SQ
   Method : ASTM D-257 at 50% RH
3. Static Decay : < 2 Secs at 50% RH

| **Tape Width** | **T** | **W1** | **W2** | **W3** |
|---|---|---|---|---|
| 16 mm | 4.4 ± 0.50 | 16.40 +1.5<br>- 0.0 | 22.0 MAX | 16.40 +2.0<br>- 0.0 |

## Handling and Storage

### ESD (Electrostatic Discharge)

Electrostatic discharge occurs naturally in the environment. With the increase in voltage potential, the outlet of neutralization or discharge will be sought. If the acquired discharge route is through a semiconductor device, destructive damage will result.

ESD countermeasure methods should be developed and used to control potential ESD damage during handling in a factory environment at each manufacturing site.

### MSL (Moisture Sensitivity Level)

Plastic encapsulated surface mount package is sensitive to damage induced by absorbed moisture and temperature.

Avago Technologies follows JEDEC Standard J-STD 020B. Each component and package type is classified for moisture sensitivity by soaking a known dry package at various temperatures and relative humidity, and times. After soak, the components are subjected to three consecutive simulated reflows.

The out of bag exposure time maximum limits are determined by the classification test describe below which corresponds to a MSL classification level 6 to 1 according to the JEDEC standard IPC/JEDEC J-STD-020B and J-STD-033.

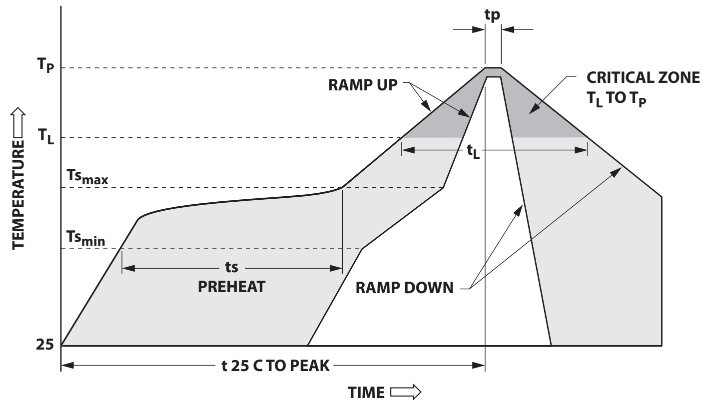
AFEM-7780 is MSL3. Thus, according to the J-STD-033 p.11 the maximum Manufacturers Exposure Time (MET) for this part is 168 hours. After this time period, the part would need to be removed from the reel, de-taped and then re-baked. MSL classification reflow temperature for the AFEM-7780 is targeted at 260°C +0/-5°C. Figure and table on following page shows typical SMT profile for maximum temperature of 260 +0/-5°C.

## Moisture Classification Level and Floor Life

| MSL Level | Floor Life (out of bag) at factory ambient =< 30°C/60% RH or as stated |
|---|---|
| 1 | Unlimited at =< 30°C/85% RH |
| 2 | 1 year |
| 2a | 4 weeks |
| 3 | 168 hours |
| 4 | 72 hours |
| 5 | 48 hours |
| 5a | 24 hours |
| 6 | Mandatory bake before use. After bake, must be reflowed within the time limit specified on the label |

Note :
1. The MSL Level is marked on the MSL Label on each shipping bag.

## Reflow Profile Recommendations




## Typical SMT Reflow Profile for Maximum Temperature = 260 +0/-5°C

| Profile Feature | Sn-Pb Solder | Pb-Free Solder |
|---|---|---|
| Average ramp-up rate (TL to TP) | 3°C/sec max | 3°C /sec max |
| Preheat<br>- Temperature Min (Tsmin)<br>- Temperature Max (Tsmax)<br>- Time (min to max) (ts) | <br>100°C<br>150°C<br>60-120 sec | <br>150°C<br>200°C<br>60-180 sec |
| Tsmax to TL<br>- Ramp-up Rate | | <br>3°C /sec max |
| Time maintained above:<br>- Temperature (TL)<br>- Time (TL) | <br>183°C<br>60-150 sec | <br>217°C<br>60-150 sec |
| Peak temperature (Tp) | 240 +0/-5°C | 260 +0/-5°C |
| Time within 5°C of actual Peak Temperature (tp) | 10-30 sec | 20-40 sec |
| Ramp-down Rate | 6°C /sec max | 6°C /sec max |
| Time 25°C to Peak Temperature | 6 min max. | 8 min max. |

## Storage Condition

Packages described in this document must be stored in sealed moisture barrier, antistatic bags. Shelf life in a sealed moisture barrier bag is 12 months at <40°C and 90% relative humidity (RH) J-STD-033 p.7.

### Out-of-Bag Time Duration

After unpacking the device must be soldered to the PCB within 168 hours as listed in the J-STD-020B p.11 with factory conditions <30°C and 60% RH.

### Baking

It is not necessary to re-bake the part if both conditions (storage conditions and out-of bag conditions) have been satisfied. Baking must be done if at least one of the conditions above have not been satisfied. The baking conditions are 125°C for 12 hours J-STD-033 p.8.

## CAUTION

Tape and reel materials typically cannot be baked at the temperature described above. If out-of-bag exposure time is exceeded, parts must be baked for a longer time at low temperatures, or the parts must be de-reeled, de-taped, re-baked and then put back on tape and reel. (See moisture sensitive warning label on each shipping bag for information of baking).

## Board Rework

### Component Removal, Rework and Remount

If a component is to be removed from the board, it is recommended that localized heating be used and the maximum body temperatures of any surface mount component on the board not exceed 200°C. This method will minimize moisture related component damage. If any component temperature exceeds 200°C, the board must be baked dry per 4-2 prior to rework and/or component removal. Component temperatures shall be measured at the top center of the package body. Any SMD packages that have not exceeded their floor life can be exposed to a maximum body temperature as high as their specified maximum reflow temperature.

### Removal for Failure Analysis

Not following the above requirements may cause moisture/reflow damage that could hinder or completely prevent the determination of the original failure mechanism.

### Baking of Populated Boards

Some SMD packages and board materials are not able to withstand long duration bakes at 125°C. Examples of this are some FR-4 materials, which cannot withstand a 24 hr bake at 125°C. Batteries and electrolytic capacitors are also temperature sensitive. With component and board temperature restrictions in mind, choose a bake temperature from Table 4-1 in J-STD 033; then determine the appropriate bake duration based on the component to be removed. For additional considerations see IPC-7711 and IPC-7721.

### Derating due to Factory Environmental Conditions

Factory floor life exposures for SMD packages removed from the dry bags will be a function of the ambient environmental conditions. A safe, yet conservative, handling approach is to expose the SMD packages only up to the maximum time limits for each moisture sensitivity level as shown in next table. This approach, however, does not work if the factory humidity or temperature is greater than the testing conditions of 30°C/60% RH. A solution for addressing this problem is to derate the exposure times based on the knowledge of moisture diffusion in the component package materials ref. JESD22-A120). Recommended equivalent total floor life exposures can be estimated for a range of humidities and temperatures based on the nominal plastic thickness for each device.

Table on following page lists equivalent derated floor lives for humidities ranging from 20-90% RH for three temperature, 20°C, 25°C, and 30°C.

This table is applicable to SMDs molded with novolac, biphenyl or multifunctional epoxy mold compounds. The following assumptions were used in calculating this table:

1. Activation Energy for diffusion = 0.35eV (smallest known value).
2. For ≤60% RH, use Diffusivity = 0.121exp ( -0.35eV/kT) mm2/s

   (this used smallest known Diffusivity @ 30°C).
3. For >60% RH, use Diffusivity = 1.320exp ( -0.35eV/kT) mm2/s

   (this used largest known Diffusivity @ 30°C).

**Recommended Equivalent Total Floor Life (days) @ 20°C, 25 °C & 30 °C**

For ICs with Novolac, Biphenyl and Multifunctional Epoxies (Reflow at same temperature at which the component was classified)

| Maximum Percent Relative Humidity | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Package Type and Body Thickness** | **Moisture Sensitivity Level** | **5%** | **10%** | **20%** | **30%** | **40%** | **50%** | **60%** | **70%** | **80%** | **90%** | |
| Body Thickness ≥3.1 mm Including PQFPs >84 pin, PLCCs (square) All MQFPs or All BGAs ≥1 mm | Level 2a | ∞ | ∞ | ∞ | 60 | 41 | 33 | 28 | 10 | 7 | 6 | 30°C |
| | | ∞ | ∞ | ∞ | 78 | 53 | 42 | 36 | 14 | 10 | 8 | 25°C |
| | | ∞ | ∞ | ∞ | 103 | 69 | 57 | 47 | 19 | 13 | 10 | 20°C |
| | Level 3 | ∞ | ∞ | 10 | 9 | 8 | 7 | 7 | 5 | 4 | 4 | 30°C |
| | | ∞ | ∞ | 13 | 11 | 10 | 9 | 9 | 7 | 6 | 5 | 25°C |
| | | ∞ | ∞ | 17 | 14 | 13 | 12 | 12 | 10 | 8 | 7 | 20°C |
| | Level 4 | ∞ | 5 | 4 | 4 | 4 | 3 | 3 | 3 | 2 | 2 | 30°C |
| | | ∞ | 6 | 5 | 5 | 5 | 5 | 4 | 3 | 3 | 3 | 25°C |
| | | ∞ | 8 | 7 | 7 | 7 | 7 | 6 | 5 | 4 | 4 | 20°C |
| | Level 5 | ∞ | 4 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 30°C |
| | | ∞ | 5 | 5 | 4 | 4 | 3 | 3 | 2 | 2 | 2 | 25°C |
| | | ∞ | 7 | 7 | 6 | 5 | 5 | 4 | 3 | 2 | 3 | 20°C |
| | Level 5a | ∞ | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 30°C |
| | | ∞ | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 25°C |
| | | ∞ | 5 | 4 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 20°C |
| Body 2.1 mm ≤ Thickness <3.1 mm including PLCCs (rectangular) 18-32 pin SOICs (wide body) SOICs ≥20 pins, PQFPs ≤80 pins | Level 2a | ∞ | ∞ | ∞ | ∞ | 86 | 39 | 28 | 4 | 3 | 2 | 30°C |
| | | ∞ | ∞ | ∞ | ∞ | 148 | 51 | 37 | 6 | 4 | 3 | 25°C |
| | | ∞ | ∞ | ∞ | ∞ | ∞ | 69 | 49 | 8 | 5 | 4 | 20°C |
| | Level 3 | ∞ | ∞ | 19 | 12 | 9 | 8 | 7 | 3 | 2 | 2 | 30°C |
| | | ∞ | ∞ | 25 | 15 | 12 | 10 | 9 | 5 | 3 | 3 | 25°C |
| | | ∞ | ∞ | 32 | 19 | 15 | 13 | 12 | 7 | 5 | 4 | 20°C |
| | Level 4 | ∞ | 7 | 5 | 4 | 4 | 3 | 3 | 2 | 2 | 1 | 30°C |
| | | ∞ | 9 | 7 | 5 | 5 | 4 | 4 | 3 | 2 | 2 | 25°C |
| | | ∞ | 11 | 9 | 7 | 6 | 6 | 5 | 4 | 3 | 3 | 20°C |
| | Level 5 | ∞ | 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 30°C |
| | | ∞ | 5 | 4 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 25°C |
| | | ∞ | 6 | 5 | 5 | 4 | 4 | 4 | 3 | 3 | 2 | 20°C |
| | Level 5a | ∞ | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0.5 | 0.5 | 30°C |
| | | ∞ | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 25°C |
| | | ∞ | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 20°C |
| Body Thickness <2.1 mm including SOICs <18 pin All TQFPs, TSOPs or All BGAs <1 mm body thickness | Level 2a | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ | 28 | 1 | 1 | 1 | 30°C |
| | | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ | 2 | 1 | 1 | 25°C |
| | | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ | 2 | 2 | 1 | 20°C |
| | Level 3 | ∞ | ∞ | ∞ | ∞ | ∞ | 11 | 7 | 1 | 1 | 1 | 30°C |
| | | ∞ | ∞ | ∞ | ∞ | ∞ | 14 | 10 | 2 | 1 | 1 | 25°C |
| | | ∞ | ∞ | ∞ | ∞ | ∞ | 20 | 13 | 2 | 2 | 1 | 20°C |
| | Level 4 | ∞ | ∞ | ∞ | 9 | 5 | 4 | 3 | 1 | 1 | 1 | 30°C |
| | | ∞ | ∞ | ∞ | 12 | 7 | 5 | 4 | 2 | 1 | 1 | 25°C |
| | | ∞ | ∞ | ∞ | 17 | 9 | 7 | 6 | 2 | 2 | 1 | 20°C |
| | Level 5 | ∞ | ∞ | 13 | 5 | 3 | 2 | 2 | 1 | 1 | 1 | 30°C |
| | | ∞ | ∞ | 18 | 6 | 4 | 3 | 3 | 2 | 1 | 1 | 25°C |
| | | ∞ | ∞ | 26 | 8 | 6 | 5 | 4 | 2 | 2 | 1 | 20°C |
| | Level 5a | ∞ | 10 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 0.5 | 30°C |
| | | ∞ | 13 | 5 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 25°C |
| | | ∞ | 18 | 6 | 4 | 3 | 2 | 2 | 2 | 2 | 1 | 20°C |

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