DUAL CHANNEL SMD TRANSCEIVER 868 MHz BAND

Product Code: **32001399**

PRODUCT SUMMARY:

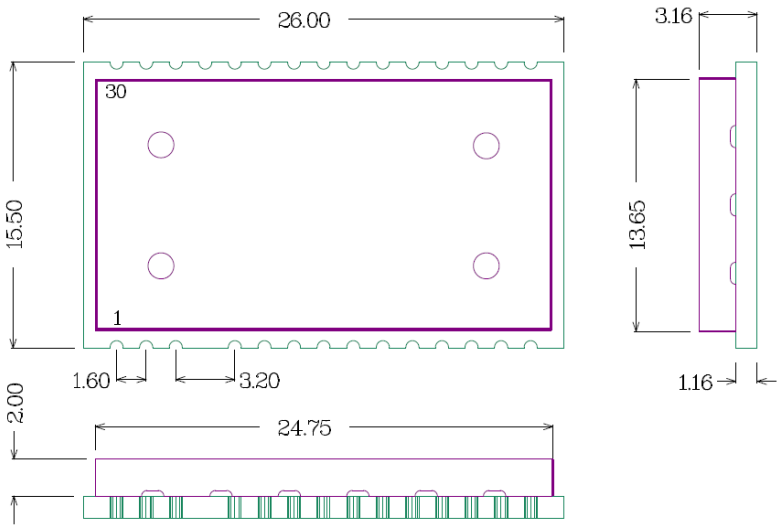
Dual-channel transceiver operating in the 868 MHz SRD band with compact dimensions and surface mounting. The device operates as an independent device that can be controlled through external control lines.
The module meets all the requirements in the industrial temperature range -40 / 85 °C.
Developed according to **ETSI EN 300 220** European Standard.
The module meets with the Radio Equipment Directive **(RED) 2014/53/EU.**
Compliant with **REACH** and **RoHS** directives.

Two different operating modes are possible:

- **Normal mode (default):** The TRX module operates as a dual channel (868.15 - 868.45 MHz) transceiver in **FSK**. Through the external pins, the user can control the operation mode (Tx, Rx, stand-by) and the channel frequency. Supports data rates up to 4800 baud.
- **Extended Mode (User-programmable):** Through a predefined sequence of serial commands, the user can customize the module behavior.

It is possible to set the output power, the frequency of the channel (selectable for each channel between 868.1, 868.15, 868.2, 868.3, 868.4, 868.45, 868.5, 868.825, 868.95, 869.075, 869.85 MHz MHz), the modulation (OOK, FSK), the baud rate up to 38400 baud, etc.

MECHANICAL CHARACTERISTICS



ALL DIMENSIONS ARE IN MILLIMETERS
GENERAL TOLERANCE +/-0.1MM

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PIN DESCRIPTION

Pin	Name	Pin Type	Description	Notes
1	GND	Power Supply	Ground (0 V)	
2	RF I/O	Antenna IN/OUT	Tx: output RF / Rx: input RF	3
3	GND	Power Supply	Ground (0 V)	
5	DATA IN	Data IN	Data Input in transmission mode	
6	NC	NC	Reserved Pin – do not connect	
7	NC	NC	Reserved Pin – do not connect	
8	NU	NC	Not Used Pin – do not connect	
9	NU	NC	Not Used Pin – do not connect	
10	NU	NC	Not Used Pin – do not connect	
11	NC	NC	Reserved Pin – do not connect	
12	NC	NC	Reserved Pin – do not connect	
13	NU	NC	Not Used Pin – do not connect	
14	NU	NC	Not Used Pin – do not connect	
15	GND	Power Supply	Ground (0 V)	
16	GND	Power Supply	Ground (0 V)	
17	Vcc	Power Supply	Power supply	
18	NC	NC	Reserved Pin – do not connect	
19	NU	NC	Not Used Pin – do not connect	
20	NU	NC	Not Used Pin – do not connect	
21	NRST	Data IN	Reset. Input Pull-Up	
22	Tx/Rx	Data IN	0 = Reception, 1 = Transmission	
23	Data Out	Data OUT	Data Output in reception mode	
24	EN	Data IN	0 = Power down, 1 = Active; ready to TX or RX	
25	CH_SEL / Serial input	Data IN	Normal Mode : 0 = 868.15 MHz “ “ : 1 = 868.45 MHz Extended Mode : Sequence of commands	
26	NC	NC	Reserved Pin – do not connect	
27	NU	NC	Not Used Pin – do not connect	
28	NU	NC	Not Used Pin – do not connect	
29	TXRamp	Analog OUT	Ramping signal for external PA. Leave unconnected if not used.	
30	GND	Power Supply	Ground (0 V)	

ABSOLUTE MAXIMUN RATINGS

Supply voltage, Vcc, pin 15:	4 V
Radio Frequency Input, pin 2:	10 dBm
Max pins voltage:	Vcc + 0.3 V
Storage Temperature (excl. package):	-40 ÷ 85 °C
Storage Temperature (incl. package):	-10 ÷ 65 °C
Operating Temperature:	-40 ÷ 85 °C

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ELECTRICAL CHARACTERISTICS AT 25°C TEMPERATURE

Parameter	Min.	Typ.	Max.	Unit	Notes
Supply Voltage (Vcc)	2.1	3.0	3.6	V	
Current drain Power Down	-	0.5	-	µA	1
Current drain Tx mode	-	25	-	mA	1
Current drain Rx mode	-	15	-	mA	1
V_{low} on I/O pins	0	-	0.2 * Vcc	V	
V_{high} on I/O pins	0.8 * Vcc	-	+Vcc	V	
Output load on pin 4	2000	-	-	Ω	

RECEIVER CHARACTERISTICS AT 25°C TEMPERATURE

Parameter	Min.	Typ.	Max.	Unit	Notes
FSK Sensitivity	-	-104	-	dBm	2
OOK Sensitivity (extended mode only)	-	-110	-	dBm	2
Operating Frequency Ch.1	-	868.15	-	MHz	4
Operating Frequency Ch.2		868.45		MHz	4
-3 dB BW in FSK	-	100	-	kHz	4
-3 dB BW in OOK (extended mode only)	-	200	-	kHz	4
FSK deviation	-	±25	-	kHz	4
Baud Rate	1200	-	4800	Baud	4

TRANSMITTER CHARACTERISTICS AT 25°C TEMPERATURE

Parameter	Min.	Typ.	Max.	Unit	Notes
Output power (50-Ω load)	-	11.0	-	dBm	3
Operating frequency Ch.1	-	868.15	-	MHz	
Operating frequency Ch.2	-	868.45	-	MHz	
FSK deviation	-	±25	-	kHz	
Frequency accuracy	-	±10	-	kHz	
Baud-Rate RF	1200	-	4800	Baud	

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TIMINGS

Parameter	Min.	Typ.	Max.	Unit	Notes
Time between power on and valid data reception in OOK	-	40	-	ms	
Time between power on and valid data reception in FSK	-	40	-	ms	
Time between power on and valid data transmission in OOK	-	40	-	ms	
Time between power on and valid data transmission in FSK	-	40	-	ms	
Time by power down to RX in OOK	-	1.5	-	ms	
Time by power down to RX in FSK	-	1	-	ms	
Time by power down to TX in OOK	-	1	-	ms	
Time by power down to TX in FSK	-	1	-	ms	
Time by TX to RX in OOK	-	400	-	µs	
Time by TX to RX in FSK	-	400	-	µs	
Time by RX to TX in OOK	-	400	-	µs	
Time by RX to TX in FSK	-	400	-	µs	
Time by Ch1 to Ch2 in RX in OOK	-	1	-	ms	
Time by Ch1 to Ch2 in RX in FSK	-	700	-	µs	
Time by Ch2 to Ch1 in RX in OOK	-	700	-	µs	
Time by Ch2 to Ch1 in RX in FSK	-	600	-	µs	
Time by Ch1 to Ch2 in TX in OOK	-	500	-	µs	
Time by Ch1 to Ch2 in TX in FSK	-	600	-	µs	
Time by Ch2 to Ch1 in TX in OOK	-	500	-	µs	
Time by Ch2 to Ch1 in TX in FSK	-	500	-	µs	
Time by no RF at input port to valid data reception (settling) in OOK	-	150		µs	
Time by no RF at input port to valid data reception (settling) in FSK	-	150		µs	

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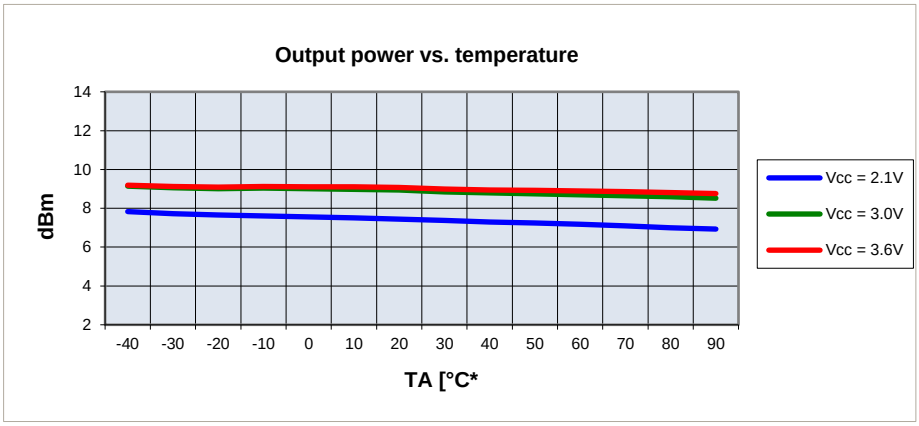
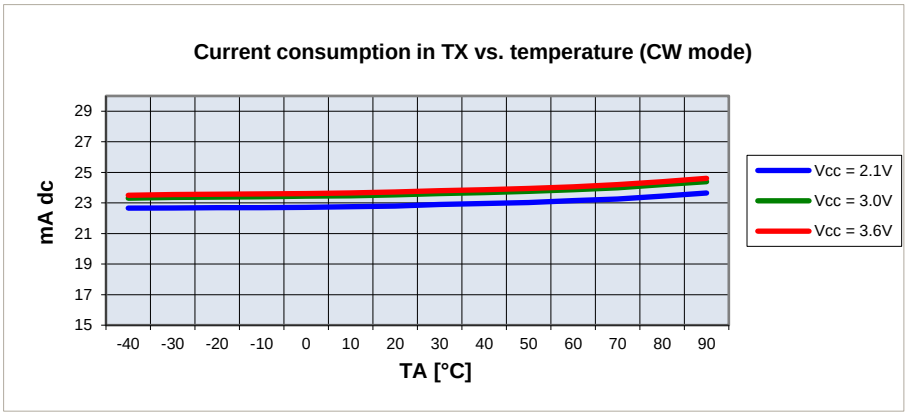
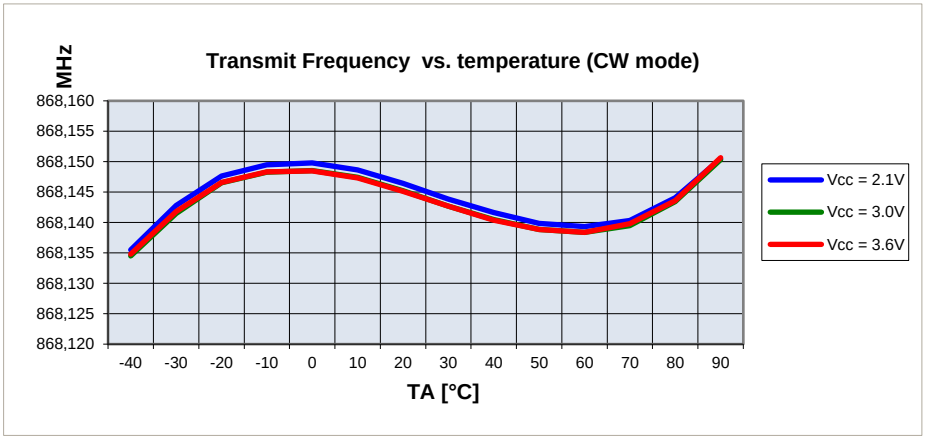
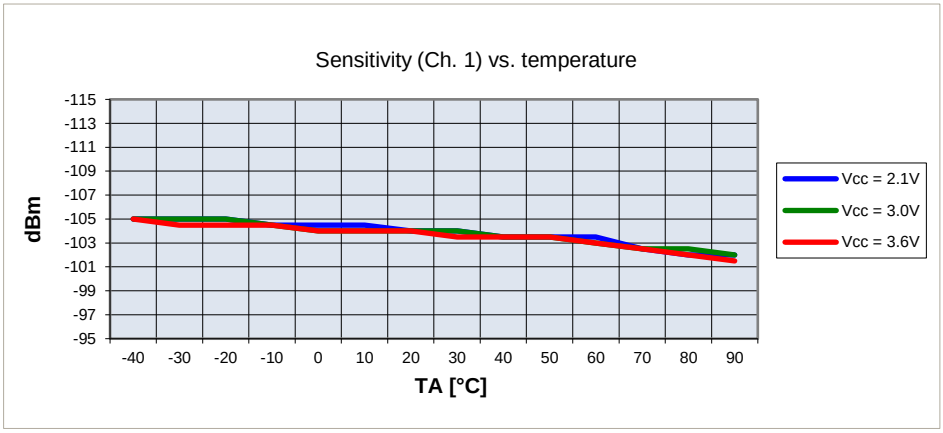
TYPICAL CHARACTERISTICS (*)

Note: All RF parameters measured with input (pin 3) connected to a 50-Ω impedance signal source or load.









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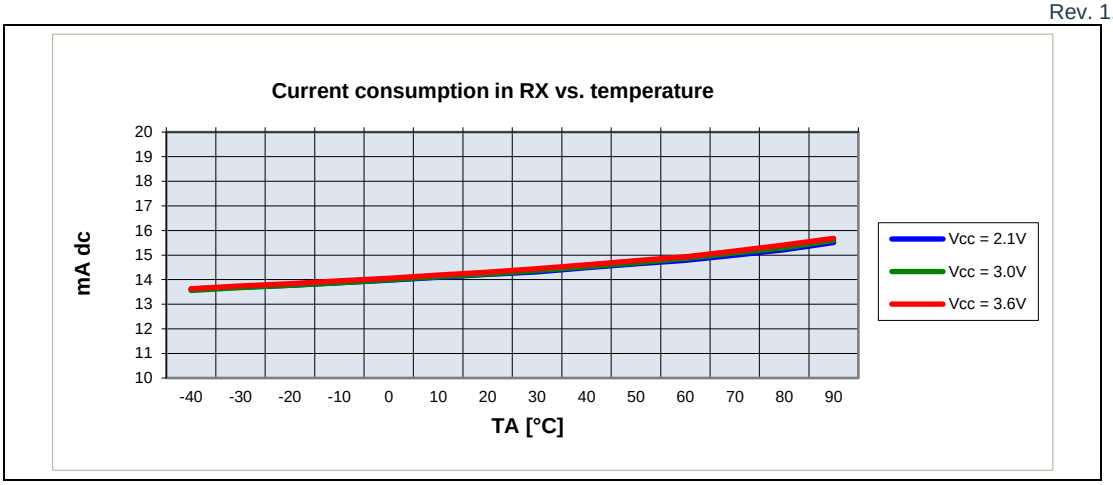

(*): All graphs must be considered as indicative typical results in accordance with temperature variation.

Note 1: Current consumption measured at power supply level of 3 V. Current consumption in TX measured in CW.
Note 2: Sensitivity measured with OOK modulated signal, PRBS code, 4800 baud, result at BER equal or less than 10^{-2}.
Note 3: Transmitter is compliant with ETSI 300 220.
Note 4: All RF parameters measured with Input/output (pin 1) connected to 50-Ω impedance signal source or load.

APPLICATION NOTE

I/O PINS STATUS:

- **Data Out (pin 23):**

Normal mode operation: ACTIVE (High or Low)
Power Down: **ACTIVE LOW** – MUST **NOT** be driven externally

- **EN (pin 24):**

Normal mode operation and Power Down: **HIGH IMPEDANCE** – **MUST** be driven externally (High or Low)

- **Tx/Rx (pin 22):**

Normal mode operation and Power Down: **HIGH IMPEDANCE** – **MUST** be driven externally (High or Low)

- **CH_SEL/Serial input (pin 25):**

Normal mode operation and Power Down: **HIGH IMPEDANCE** – **MUST** be driven externally (High or Low)

- **Data In (pin 5):**

Normal mode operation and Power Down: **HIGH IMPEDANCE** – **MUST** be driven externally (High or Low)

NORMAL MODE OPERATION:

It is the standard use. The module behaves as a transparent device with respect to the data stream, and can be controlled via external control lines.

The data flow is carried out along the following lines:
- **Data out (pin 23)**: data output in reception mode.
- **Data in (pin 5)**: data input in transmission mode.

The maximum data rate is 4800 baud. Control lines are:

EN (pin 24): enable pin. Allows to activate or set in stand-by the module, according to the following logic:
- **0: powerdown** (module in stand-by)
- **1: enable** (module operative)

TX/RX (pin 22): operating mode selection pin.
- **0: module in reception**
- **1: module in trasmission**

CH_SEL (pin 25): channel selection pin.
- **0: module operating on channel 1** (868.15 MHz)
- **1: module operating on channel 2** (868.45 MHz)

Important: *These command pins are high impedance inputs, therefore they must NOT be left floating (ie: if the "Power-Down" function is not used, connect the EN pin to +Vcc; if it is used only the channel 1, then*

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connect CH_SEL to GND, etc).

EXTENDED MODE OPERATION

User programmable: see Application Note **AN003**

OPERATION BELOW MINIMUM OPERATING VOLTAGE

In order to ensure compliance with the EMC and radio spectrum regulations, set the module in Power-Down mode before the power supply falls below the minimum operating voltage (2.1 V).

FRAME STRUCTURE FOR RADIO SYSTEMS

See Application Note **AN001**

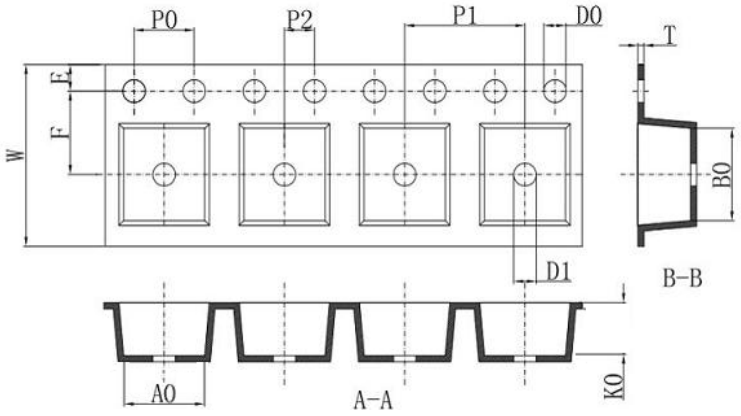
PCB LAYOUT GUIDELINES

See Application Note **AN002**

PROCESS INFORMATION

DELIVERY

The modules are delivered in tape/reel packaging of 250 units.



Dimensions are:

W	= 44 mm	P	= 20 mm
T	= 0.35 mm	Ao	= 16 mm
Bo	= 26.5 mm	Ko	= 3.6 mm
D0	= 1.5 mm	D1	= 1.5 mm

STORAGE AND HANDLING

Moisture Sensitivity Level (MSL)

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions for devices that are sensitive to moisture-induced stress. The MSL standard is IPC/JEDEC J-STD-020 and can be downloaded from www.jedec.org.
Following table summarizes the dry pack requirements for different MSL levels in the IPC/JEDEC specification.

Dry Pack Requirement

MSL LEVEL	Dry Pack Requirement
1	Optional
2	Required

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3	Required
4	Required

According to IPC/JEDEC specification J-STD-020, if a device passes MSL level 1, it is classified as not moisture sensitive and does not require dry pack. If a device fails level 1 but passes a higher level, it is classified as moisture sensitive and must be dry packed in accordance with J-STD-033.

The **32001399 is qualified for MSL level = 3.**

Dry Bag

Products with an MSL level of 2 or above are shipped dry packed in a Moisture Barrier Bag (MBB). Carrier materials such as trays, tubes, reels, etc., that are placed in the MBB can affect the moisture level within the dry bag. The effect of these materials is compensated by adding additional desiccant in the MBB to ensure the shelf life of the SMT packages.
IPC/JEDEC specifications require that MSD sensitive devices be packaged together with a Humidity Indicator Card (HIC) and desiccant to absorb humidity. If no moisture has been absorbed, the three fields in the HIC indicate blue color.

Storage and floor life

The calculated shelf life for dry packed SMT packages is a minimum of 12 months from the bag seal date, when stored in a non-condensing atmospheric environment of <40°C/90% RH.
Following table lists floor life for different MSL levels in the IPC/JDEC specification.

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

The parts must be processed and soldered within the time specified for the MSL level. If this time is exceeded, or the humidity indicator card in the sealed package indicates that they have been exposed to moisture, the devices need to be pre-baked before the reflow solder process.

Drying

Both encapsulate and substrate materials absorb moisture. IPC/JEDEC specification J-STD-020 must be observed to prevent cracking and delamination associated with the “popcorn” effect during reflow soldering. The popcorn effect can be described as miniature explosions of evaporating moisture. Baking before processing is required in the following cases:

- Humidity indicator card: At least one circular indicator is no longer blue
- Floor life or environmental requirements after opening the seal have been exceeded, e.g. exposure to excessive seasonal humidity.
-

Refer to Section 4 of IPC/JEDEC J-STD-033 for recommended baking procedures. Table 4-1 of the specification lists the required bake times and conditions for drying.

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Following table provides a summary of specified recommendations:

Bake Time							
		Bake @ 125 °C		Bake @ 90 °C and ≤ 5% RH		Bake @ 40 °C and ≤ 5% RH	
Package Body	**MSL Level**	**Exceeding Floor Life by > 72 h**	**Exceeding Floor Life by ≤ 72 h**	**Exceeding Floor Life by >72 h**	**Exceeding Floor Life by ≤ 72 h**	**Exceeding Floor Life by > 72 h**	**Exceeding Floor Life by ≤ 72 h**
Thickness ≤ 1.4 mm	2	5 hours	3 hours	17 hours	11 hours	8 days	5 days
	2a	7 hours	5 hours	23 hours	13 hours	9 days	7 days
	3	**9 hours**	**7 hours**	**33 hours**	**23 hours**	**13 days**	**9 days**
	4	11 hours	7 hours	37 hours	23 hours	15 days	9 days
	5	12 hours	7 hours	41 hours	24 hours	17 days	10 days
	5a	16 hours	10 hours	54 hours	24 hours	22 days	10 days
Thickness >1.4 mm ≤ 2.0 mm	2	18 hours	15 hours	63 hours	2 days	25 days	20 days
	2a	21 hours	16 hours	3 days	2 days	29 days	22 days
	3	27 hours	17 hours	4 days	2 days	37 days	23 days
	4	34 hours	20 hours	5 days	3 days	47 days	28 days
	5	40 hours	25 hours	6 days	4 days	57 days	35 days
	5a	48 hours	40 hours	8 days	6 days	79 days	56 days
Thickness >2.0 mm ≤ 4.5 mm	2	48 hours	48 hours	10 days	7 days	79 days	67 days
	2a	48 hours	48 hours	10 days	7 days	79 days	67 days
	3	48 hours	48 hours	10 days	8 days	79 days	67 days
	4	48 hours	48 hours	10 days	10 days	79 days	67 days
	5	48 hours	48 hours	10 days	10 days	79 days	67 days
	5a	48 hours	48 hours	10 days	10 days	79 days	67 days

Packages of sensitive components in **32001399 have a thickness ≤ 1.4 mm.**

- **Do not attempt to bake modules at temperatures higher than 60 °C while contained in tape and rolled up in reels. If baking at higher temperature is required, remove modules from packaging and place them individually onto oven tray.**

- **Oxidation Risk: Baking SMT packages may cause oxidation and/or intermetallic growth of the terminations, which if excessive can result in solderability problems during board assembly. The temperature and time for baking SMT packages are therefore limited by solderability considerations. The cumulative bake time at a temperature greater than 90 °C and up to 125 °C shall not exceed 96 hours. If the bake temperature is not greater than 90 °C, there is no limit on bake time. Bake temperatures higher than 125 °C are not allowed.**

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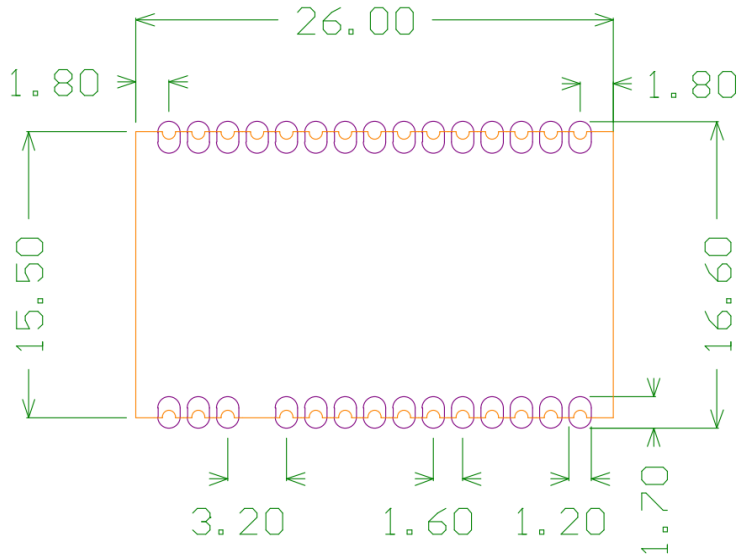
SOLDERING INFORMATION

Soldering pad pattern

The finished surface on the printed circuit board pads should be made of Nickel/Gold.
The recommended soldering pad layout on the host board for the 32001399 is shown in the diagram below (purple lines):



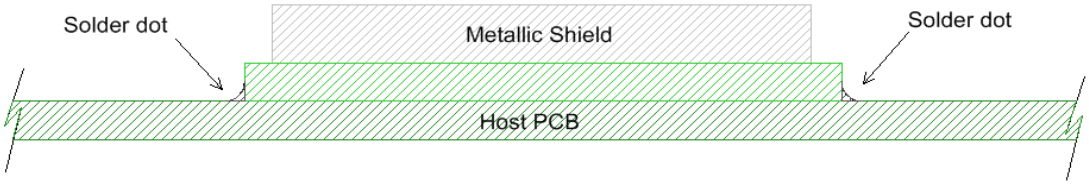
All dimensions in mm

Neither via-holes nor wires are allowed on the PCB upper layer in area occupied by the module.

Solder Paste

32001399 module is designed for surface mounting using half-moon solder joints (see diagram below). For proper module assembly, solder paste must be printed on the target surface of the host board. The suggested solder paste height should be within 150 µm and 180 µm.

The following diagram shows mounting characteristics for Module integration on host PCB:



Placement

The 32001399 module can be automatically placed on host boards by pick&place machines like any integrated circuit.

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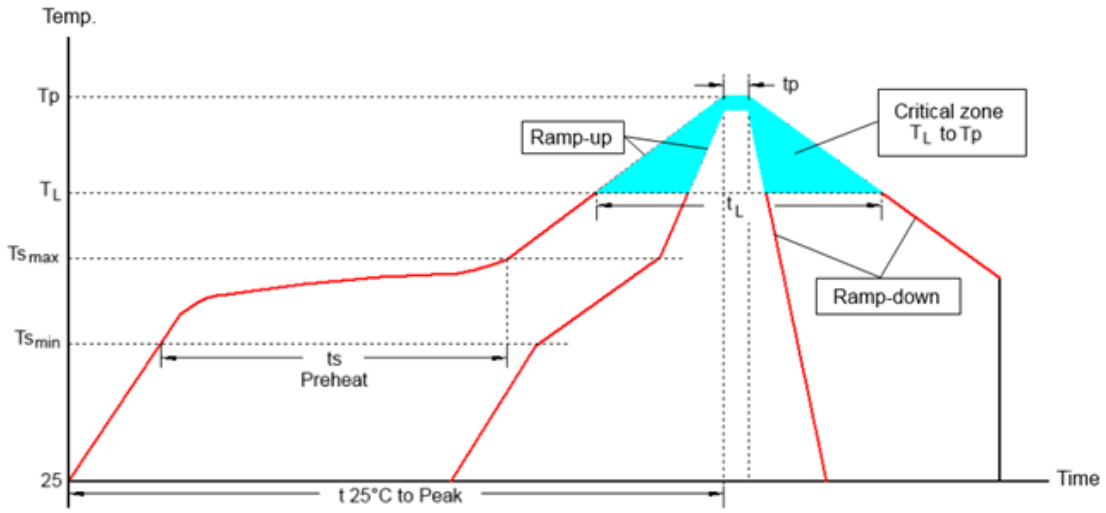
Soldering Profile (RoHS Process)

It must be noted that 32001399 module should not be allowed to be hanging upside down during the reflow operation. This means that the module has to be assembled on the side of the printed circuit board that is soldered last.
The recommendation for lead-free solder reflow in IPC/JEDEC J-STD-020D Standard should be followed.

Profile Feature	Sn-Pb Assembly	Pb-Free Assembly
Average Ramp-UP Rate (Ts max to Tp)	3 °C/s max	3 °C/s max
Preheat -Temperature Min (Ts min) -Temperature Max (Ts max) -Time (ts min to ts max)	100 °C 179 °C 80-135 s	130 °C 217 °C 80-135 s
Time maintained above: -Temperature (TL) -Time (tL)	183 °C 30-90 s	220 °C 30-90 s
Peak/Classification Temperature (Tp)	Max. Peak Temp. 220 °C	Max. Peak Temp. 250 °C
Time within 5 °C of actual Peak Temperature (tp)	10-15 s	10-15 s
Ramp-Down Rate	4 °C/s max	4 °C/s max
Time 25 °C to Peak Temperature	6 minutes max	8 minutes max

Note: All temperatures refer to topside of the package, measured on the package body surface



CAUTION – Please note that if the host board is submitted to a wave soldering after the reflow operation, a solder mask must be used in order to protect the 32001399 module's metal shield from being in contact with the solder wave.

REVISION HISTORY

Revision	Date	Description
1.3	27-08-2019	Final release

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