

|                                         |  |                                                 |  |                       |             |
|-----------------------------------------|--|-------------------------------------------------|--|-----------------------|-------------|
| CLASSIFICATION                          |  | PRODUCT SPECIFICATION                           |  | No.<br>DS-PAN4580-102 | REV.<br>1.0 |
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# Product Specification

|                                              |                                                                                                       |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------|
| <p>Applicant / Manufacturer<br/>Hardware</p> | <p>Panasonic Industrial Devices Europe GmbH<br/>Zeppelinstrasse 19<br/>21337 Lüneburg<br/>Germany</p> |
| <p>Applicant / Manufacturer<br/>Software</p> | <p>Please refer to chapter 24 Ordering Information</p>                                                |
| <p>Software Version</p>                      | <p>Please refer to chapter 24 Ordering Information</p>                                                |

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|                                                                                                      |          |         |          |
|------------------------------------------------------------------------------------------------------|----------|---------|----------|
| POWER ELECTRONICS R&D CENTER<br>WIRELESS CONNECTIVITY<br>PANASONIC INDUSTRIAL DEVICES<br>EUROPE GmbH | APPROVED | CHECKED | DESIGNED |
|------------------------------------------------------------------------------------------------------|----------|---------|----------|

|                                         |                                                 |                       |             |
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| CLASSIFICATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                | PRODUCT SPECIFICATION                           | No.<br>DS-PAN4580-102                                              | REV.<br>1.0 |
| SUBJECT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 802.15.4-MODEM |                                                 | PAGE                                                               | 3 of 34     |
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| PANASONIC INDUSTRIAL DEVICES EUROPE GMBH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |                                                 | <a href="http://www.pideu.panasonic.de">www.pideu.panasonic.de</a> |             |

|                                         |                                                 |                       |             |
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## 1. KEY FEATURES

- Available as small size SMD device (29.8mm x 19.0mm x 2.7mm) or ETU (Easy to use) with pin header (33.9 x 33.9 x 7.3mm)
- 2.4GHz RF Frequency
- 3 antenna options: Single port 50Ω, ceramic antenna or plug
- 16 selectable Channels with up to 2Mbps RF data rate
- Low power modes for increased battery life
- High sensitivity: -99dBm typ. @ 250kbps & 1% Packet Error Rate
- +3.0 dBm @ 2.4GHz P<sub>out</sub> programmable over a 20 dB range
- Low supply voltage (1.9 V to 3.6 V, 3.0 V typ.)
- Operating temperature range -40°C to +85°C
- 128k total Flash, when using SNAP: 58.5k free for uploadad user SNAPpy scripts.
- 2 UART ports for control or transparent data
- 38 GPIOs and up to 7 A/D inputs with 10 Bit ADC for fast and easy conversion from analog inputs -such as temperature, pressure and fluid levels- to digital values.
- Spread Spectrum (DSSS) technology surmounts noisy environments when using SNAP®
- Low power mode: 1.5µA with internal timer running
- Mesh (SNAP®) Mesh networking Topology with 16 Channels
- Manufactured in conformance with RoHS

## 2. APPLICATIONS FOR THE MODULE

- Automatic Meter Reading
- Inventory management, Factory- and home automation
- Wireless Sensor Networks, e.g. Lighting Control
- Monitoring (environmental, patient or fitness)

## 3. DESCRIPTION FOR THE MODULE

The PAN4580 module is a short range, low power, 2.4GHz ISM band transceiver which includes a complete 802.15.4 physical layer (PHY). It is designed for the IEEE 802.15.4 wireless standard. Using an appropriate microcontroller (MCU) with reference oscillator provides a cost effective solution for short range data links and networks.

The PAN4580 and PAN4580ETU comes optionally pre-loaded with the Synapse SNAP® mesh network operating system.

This module is CE and FCC / IC certified.

The PAN4580 use the MCU with integrated Transceiver ATmega128RFA1 from Atmel.

Please contact your local sales office for further details on additional options and services, by visiting [www.panasonic.com/rfmodules](http://www.panasonic.com/rfmodules) or write an e-mail to [wireless@eu.panasonic.com](mailto:wireless@eu.panasonic.com).

|                                         |                                                 |                       |             |
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#### 4. SCOPE OF THIS DOCUMENT

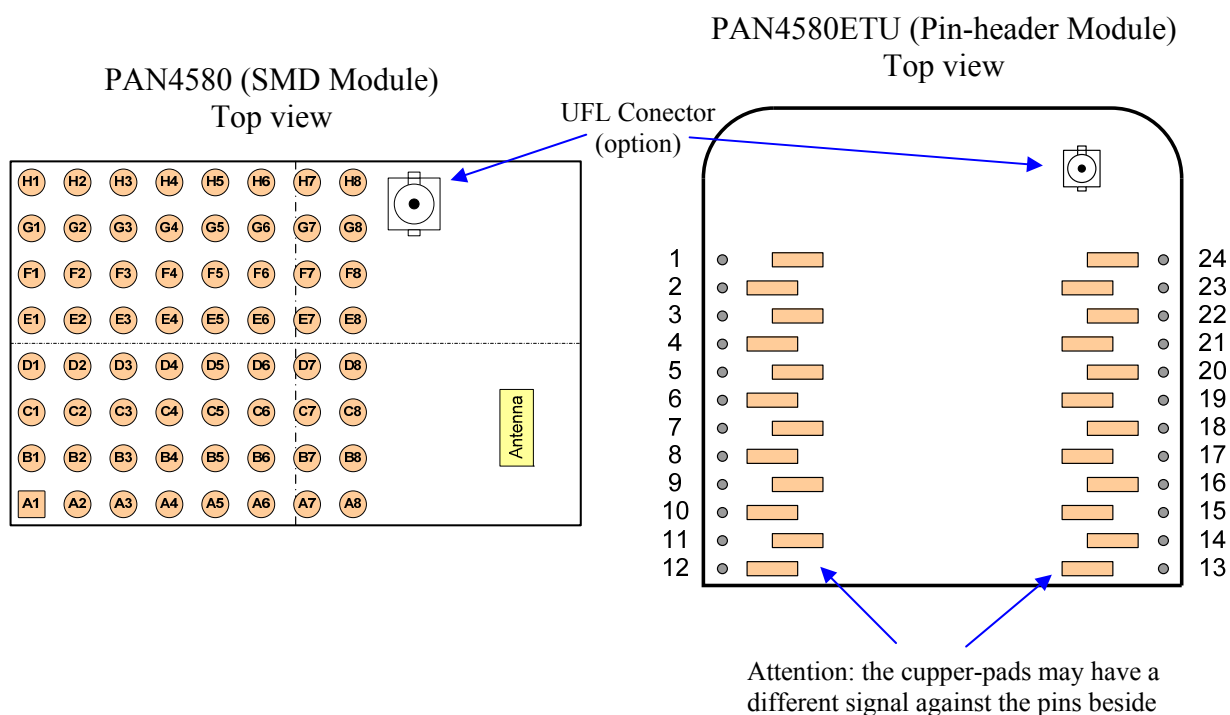
This product specification applies to Panasonic's 802.15.4 Modem PAN4580 // ENWC9A31xxEF and PAN4580ETU // ENWC9A33xxEF.  
Different versions of the PAN4580 are available (refer to chapter 24).

#### 5. HISTORY FOR THIS DOCUMENT

| Revision | Date       | Modification / Remarks                   |
|----------|------------|------------------------------------------|
| 0.1      | 20.03.2012 | Initial draft version                    |
| 1.0      | 19.10.2012 | Add ETU-module, add FCC/IC certification |
|          |            |                                          |
|          |            |                                          |
|          |            |                                          |

|                                         |                                                 |                       |             |
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## 6. TERMINAL LAYOUT



| Pin No.<br>PAN4580                       | Pin No.<br>PAN4580ETU | Pin Name      | SNAPpy<br>IO <sup>1</sup> | Description                                                                                  |
|------------------------------------------|-----------------------|---------------|---------------------------|----------------------------------------------------------------------------------------------|
| A1, A8, B8,<br>C8, D8, F8,<br>G8, H1, H8 | 1, 24                 | GND           |                           | DC Power supply, 0V                                                                          |
| A2, A3                                   | 21                    | VDD           |                           | DC Power supply, typical 3V (1.8 ~ 3.6V)                                                     |
| A4                                       | 13                    | PF0_ADC0      | 24                        | IO or ADC input channel 0                                                                    |
| A5                                       | 15                    | PF2_ADC2_DIG2 | 26                        | IO or ADC input channel 2 or Radio Transceiver Antenna Diversity Control Output              |
| A6                                       | 17                    | PF4_ADC4_TCK  | 28                        | IO or ADC input channel 4 or JTAG Test Clock                                                 |
| A7                                       | 19                    | PF6_ADC6_TDO  | 30                        | IO or ADC input channel 6 or JTAG Test Data Output or I <sup>2</sup> C SDA                   |
| B1                                       | 16                    | PE2_XCK0_AIN0 | 18                        | IO or Analog Comparator Positive Input or USART0 external clock input/output                 |
| B2                                       | 22                    | PE3_OC3A_AIN1 | 19                        | IO or Analog Comparator Negative Input or Output Compare and PWM Output A for Timer/Counter3 |
| B3                                       | 8                     | PE5_OC3C_INT5 | 21                        | IO or External Interrupt5 Input or Output Compare and PWM Output C for Timer/Counter3        |

<sup>1</sup> When using SNAP Software by Synapse Wireless, Inc.

|                                         |                                                 |                       |             |
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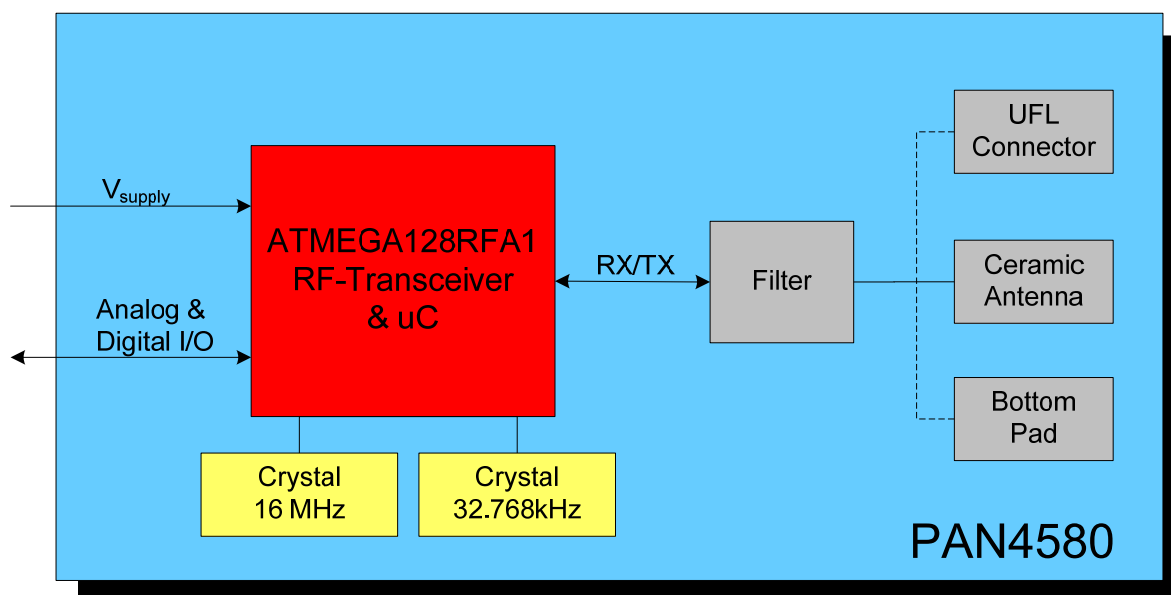
| Pin No.<br>PAN4580 | Pin No.<br>PAN4580ETU | Pin Name             | SNAPpy<br>IO <sup>1</sup> | Description                                                                                                                            |
|--------------------|-----------------------|----------------------|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| B4                 | 14                    | PF1_ADC1             | 25                        | IO or ADC input channel 1                                                                                                              |
| B5                 |                       | PG1_DIG1             | 33                        | IO or Radio Transceiver Antenna Diversity Control Output                                                                               |
| B6                 | 18                    | PF5_ADC5_TMS         | 29                        | IO or ADC input channel 5 or JTAG Test Mode Select                                                                                     |
| B7                 | 20                    | PF7_ADC7_TDI         | 31                        | IO or ADC input channel 7 or JTAG Test Data Input or I <sup>2</sup> C SCL                                                              |
| C1                 | 5                     | PE0_RXD0_PCINT8      | 16                        | IO or USART0 Receive Pin or Pin Change Interrupt8                                                                                      |
| C2                 | 6                     | PE1_TXD0             | 17                        | IO or USART0 Transmit Pin                                                                                                              |
| C3                 | 7                     | PE4_OC3B_INT4        | 20                        | IO or External Interrupt4 Input or Output Compare and PWM Output B for Timer/Counter3                                                  |
| C4                 |                       | PE6_T3_INT6          | 22                        | IO or External Interrupt6 Input or Timer/Counter3 Clock Input                                                                          |
| C5                 | 12                    | PE7_ICP3_INT7_CLK0   | 23                        | IO or UART1 RTS or External Interrupt7 Input, Timer/Counter3 Input Capture Trigger or Divided System Clock                             |
| C6                 |                       | PF3_ADC3_DIG4        |                           | IO or ADC input channel 3 or Radio Transceiver RX/TX Indicator Output                                                                  |
| D1                 | 4                     | PB5_OC1A_PCINT5      | 5                         | IO or Output Compare and PWM Output A for Timer/Counter1 or Pin Change Interrupt 5                                                     |
| D2                 | 3                     | PB6_OC1B_PCINT6      | 6                         | IO or Output Compare and PWM Output B for Timer/Counter1 or Pin Change Interrupt 6                                                     |
| D3                 | 2                     | PB7_OC0A_OC1C_PCINT7 | 7                         | IO or Output Compare and PWM Output A for Timer/Counter0, Output Compare and PWM Output C for Timer/Counter1 or Pin Change Interrupt 7 |
| E1                 |                       | PB2_MOSI_PCINT2      | 2                         | IO or SPI Bus Master Output/Slave Input , Programming Data Input or Pin Change Interrupt 2                                             |
| E2                 |                       | PB3_MISO_PCINT3      | 3                         | IO or SPI Bus Master Input/Slave Output, Programming Data Output or Pin Change Interrupt 3                                             |
| E3                 |                       | PB4_OC2A_PCINT4      | 4                         | IO or Output Compare and PWM Output A for Timer/Counter2 or Pin Change Interrupt 4                                                     |
| E8                 |                       | RF IN/OUT            |                           | Peripheral transmit 50 Ohm RF output / input pin (only ENWC9A31CxEF, other modules NC)                                                 |
| F1                 |                       | PB0_SSN_PCINT0       | 0                         | IO or SPI Slave Select input or Pin Change Interrupt 0                                                                                 |
| F2                 |                       | PB1_SCK_PCINT1       | 1                         | IO or SPI Bus Serial Clock or Pin Change Interrupt 1                                                                                   |
| F3                 |                       | PD1_SDA_INT1         | 9                         | IO or External Interrupt1 Input or I <sup>2</sup> C                                                                                    |

|                                         |                                                 |                       |             |
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| Pin No.<br>PAN4580                                             | Pin No.<br>PAN4580ETU | Pin Name      | SNAPpy<br>IO <sup>1</sup> | Description                                                      |
|----------------------------------------------------------------|-----------------------|---------------|---------------------------|------------------------------------------------------------------|
| F4                                                             |                       | PD0_SCL_INT0  | 8                         | IO or External Interrupt0 Input or I <sup>2</sup> C              |
| F5                                                             |                       | PG0_DIG3      |                           | IO or Radio Transceiver RX/TX Indicator Output                   |
| F6                                                             |                       | PG2_AMR       |                           | IO or Automated Meter Reading - Counter Input for Timer/Counter2 |
| G1                                                             |                       | CLKI          |                           | Must be pulled low during normal operation                       |
| G2                                                             |                       | PD7_T0        | 15                        | IO or Timer/Counter0 Clock Input                                 |
| G3                                                             | 11                    | PD4_ICP1      | 12                        | IO or UART1 CTS output or Timer/Counter1 Input Capture Trigger   |
| G4                                                             | 9                     | PD2_RXD1_INT2 | 10                        | IO or UART1 Receive Pin or External Interrupt2 Input             |
| G5                                                             |                       | PG5_OC0B      | 37                        | IO or Output Compare and PWM Output B for Timer/Counter0         |
| H2                                                             |                       | PD6_T1        | 14                        | IO or Timer/Counter1 Clock Input                                 |
| H3                                                             |                       | PD5_XCK1      | 13                        | IO or USART1 External Clock Input/Output                         |
| H4                                                             | 10                    | PD3_TXD1_INT3 | 11                        | IO or External Interrupt3 Input or UART1 Transmit Pin            |
| H5                                                             | 23                    | RESET#        |                           | Module Reset, Active Low                                         |
| H6                                                             |                       | TST           |                           | Must be pulled low during normal operation                       |
| C7, D4, D5,<br>D6, D7, E4,<br>E5, E6, E7,<br>F7, G6, G7,<br>H7 |                       | NC            |                           | -                                                                |

|                                         |                                                 |                       |             |
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## 7. BLOCK DIAGRAM



## 8. KEY PARTS LIST

| Part Name    | Material                                                                 |
|--------------|--------------------------------------------------------------------------|
| P.W.Board    | Glass cloth epoxide resin with gold plating                              |
| Casing       | Material: C7521, thickness 0.15mm                                        |
| IC part name | ATmega128RFA1 (Atmel, <a href="http://www.atmel.com">www.atmel.com</a> ) |

## 9. TEST CONDITIONS

Measurements are made under room temperature and humidity unless otherwise specified.

|                |             |
|----------------|-------------|
| Temperature    | 25 ± 10°C   |
| Humidity       | 40 to 85%RH |
| Supply voltage | 3.0V        |

|                                         |                                                 |                       |             |
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## 10. ABSOLUTE MAXIMUM RATINGS

The maximum ratings may not be exceeded under any circumstances, not even momentarily and individually, as permanent damage to the module will result.

| Symbol               | Parameter                               | Condition                                                              | Min. | Typ. | Max.               | Units |
|----------------------|-----------------------------------------|------------------------------------------------------------------------|------|------|--------------------|-------|
| T <sub>STOR</sub>    | Storage temperature                     |                                                                        | -40  |      | +85                | °C    |
| V <sub>ESD</sub>     | ESD robustness                          | Human Body Model (HBM)                                                 |      |      | ±2                 | kV    |
| P <sub>RF</sub>      | Input RF level                          |                                                                        |      |      | +14                | dBm   |
| V <sub>DDMAX</sub>   | Maximum voltage                         | Maximum voltage from any pin to ground                                 | -0.3 |      | 3.6                | V     |
| V <sub>DIG</sub>     | Voltage on all pins                     | except pins B3,C4,F3,F4                                                | -0.3 |      | V <sub>DDMAX</sub> | V     |
| V <sub>ANA</sub>     | Voltage on pins B3,C4,F3,F4             |                                                                        | -0.3 |      | 2.0                | V     |
| V <sub>COMP_IN</sub> | Comparator input voltage                | Pins with Comparator input connected by the analog multiplexer         | -0.3 |      | V <sub>DDMAX</sub> | V     |
| V <sub>PGA_IN</sub>  | PGA input voltage                       | Pins with PGA input connected by the analog multiplexer                | -0.3 |      | V <sub>DDMAX</sub> | V     |
| V <sub>ADC_IN</sub>  | ADC input voltage                       | Pins with ADC input connected by the analog multiplexer (PGA bypassed) | -0.3 |      | 2.0                | V     |
| T <sub>Death</sub>   | Surface Mount Solder Reflow Temperature | Refer to chapter 16                                                    |      |      |                    |       |

## 11. OPERATING CONDITIONS

| Symbol              | Parameter                   | Condition                                          | Min. | Typ. | Max. | Units |
|---------------------|-----------------------------|----------------------------------------------------|------|------|------|-------|
| T <sub>OP</sub>     | Operating temperature range |                                                    | -40  |      | +85  | °C    |
| V <sub>DD</sub>     | Supply voltage              | Voltage on pins A2,A3                              | 1.9  | 3.0  | 3.6  | V     |
| V <sub>OVRDRV</sub> | Pin Overdrive voltage       | Pin Voltage exceeding supply voltage except pin E8 |      |      | +0.3 | V     |

## 12. DIGITAL PIN CHARACTERISTICS

| Symbol          | Parameter                               | Condition              | Min.               | Typ. | Max.               | Units |
|-----------------|-----------------------------------------|------------------------|--------------------|------|--------------------|-------|
| V <sub>IH</sub> | High level input voltage <sup>(1)</sup> | Except pin RSTN pin H5 | 0.7V <sub>DD</sub> |      |                    | V     |
| V <sub>IL</sub> | Low level input                         | Except pin RSTN pin H5 |                    |      | 0.3V <sub>DD</sub> | V     |

|                                         |                                                 |                       |             |
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| Symbol              | Parameter                                | Condition                                                                                                                            | Min.                  | Typ. | Max.               | Units |
|---------------------|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------|--------------------|-------|
|                     | voltage <sup>(1)</sup>                   |                                                                                                                                      |                       |      |                    |       |
| V <sub>IHRSTN</sub> | High level input voltage <sup>(1)</sup>  | Pin H5                                                                                                                               | 0.9V <sub>DD</sub>    |      |                    | V     |
| V <sub>ILRSTN</sub> | Low level input voltage <sup>(1)</sup>   | Pin H5                                                                                                                               |                       |      | 0.1V <sub>DD</sub> | V     |
| V <sub>OH</sub>     | High level output voltage <sup>(1)</sup> | I <sub>OH</sub> = -12mA, V <sub>DD</sub> = 3.6V<br>I <sub>OH</sub> = -6mA, V <sub>DD</sub> = 1.8V<br>Max. drive strength by DPDS0/1  | V <sub>DD</sub> - 0.4 |      |                    | V     |
| V <sub>OL</sub>     | Low level output voltage <sup>(1)</sup>  | I <sub>OL</sub> = 16mA, V <sub>DD</sub> = 3.6V<br>I <sub>OL</sub> = 10mA, V <sub>DD</sub> = 1.8V<br>Max. drive strength by DPDS0/1   |                       |      | 0.4                | V     |
| V <sub>OHMIN</sub>  | High level output voltage <sup>(1)</sup> | I <sub>OH</sub> = -3mA, V <sub>DD</sub> = 3.6V<br>I <sub>OH</sub> = -1.5mA, V <sub>DD</sub> = 1.8V<br>Min. drive strength by DPDS0/1 | V <sub>DD</sub> - 0.4 |      |                    | V     |
| V <sub>OLMIN</sub>  | Low level output voltage <sup>(1)</sup>  | I <sub>OL</sub> = 4mA, V <sub>DD</sub> = 3.6V<br>I <sub>OL</sub> = 2.5mA, V <sub>DD</sub> = 1.8V<br>Min. drive strength by DPDS0/1   |                       |      | 0.4                | V     |
| R <sub>GPIO</sub>   | GPIO pull-up resistor                    | If pull-up resistor is enabled                                                                                                       | 120                   |      | 360                | kΩ    |

**Notes:**

- (1) The capacitive load should not be larger than 50 pF for all I/Os when using the default driver strength settings. Generally, large capacitance loads increase the overall current consumption.

### 13. DC ELECTRICAL CHARACTERISTICS

Assume V<sub>CC</sub> = 3.0V, T<sub>amb</sub> = 25°C if nothing else stated

| Symbol             | Parameter                                    | Condition     | Min. | Typ. | Max. | Units |
|--------------------|----------------------------------------------|---------------|------|------|------|-------|
| I <sub>TX</sub>    | Supply current transmit state <sup>(2)</sup> | PTX = 3.5 dBm |      | 20   | 27   | mA    |
| I <sub>RX</sub>    | Supply current receive state <sup>(2)</sup>  | RX_ON state   |      | 17   | 23   | mA    |
| I <sub>SLEEP</sub> | Supply current SLEEP state <sup>(2)(3)</sup> | SLEEP state   |      | 1.5  |      | μA    |

**Notes:**

- (2) When using the SNAP-core  
(3) For sleep-mode settings refer to the SNAP Reference Manual [3]

|                                         |                                                 |                       |             |
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## 14. A/D CONVERTER CHARACTERISTICS

| Symbol           | Parameter                                | Condition                          | Min. | Typ. | Max. | Units      |
|------------------|------------------------------------------|------------------------------------|------|------|------|------------|
| $V_{REFH}^{(4)}$ | Voltage Reference, High                  | Programmable                       | 1.5  | 1.6  | 1.8  | V          |
| $V_{INDC}$       | Analog input voltage                     | Single Ended                       | 0    |      | 1.8  | V          |
|                  |                                          | Differential <sup>(5)</sup>        | 0    |      | 3.3  | V          |
| $R_{AS}$         | Source impedance at input <sup>(6)</sup> |                                    |      |      | 3    | k $\Omega$ |
| RES              | Conversion Resolution                    | Single Ended<br>CLKADC $\leq$ 4MHz |      | 10   |      | Bits       |
|                  |                                          | Single Ended<br>CLKADC = 8MHz      |      | 8    |      |            |
| DNL              | Differential non-linearity               | $V_{REFH} = 1.6V$ , CLKADC=4MHz    | -0.5 |      |      | LSB        |
| INL              | Integral non-linearity                   | $V_{REFH} = 1.6V$ , CLKADC=4MHz    |      | 0.8  |      | LSB        |
| $E_{ZS}$         | Zero-scale error                         |                                    |      | 1.5  |      | LSB        |
| $E_G$            | Gain error                               |                                    |      | 1    |      | LSB        |

(4)  $V_{REFH}$  is programmable to three fixed values; 1.5V, 1.6V, and 1.8V. The default is 1.6V

(5) Each differential analogue input may be as high as 3.3V but the differential voltage is still limited

(6) Any analog source with a source impedance greater the 3k $\Omega$  will increase the sampling time

## 15. AC ELECTRICAL CHARACTERISTICS

### 15.1. TRANSMITTER CHARACTERISTICS

| Symbol      | Parameter                                            | Condition                                  | Min. | Typ. | Max.       | Units |
|-------------|------------------------------------------------------|--------------------------------------------|------|------|------------|-------|
| $P_{TX}$    | TX Output power                                      | Maximum configurable TX output power value | 0    | 3    | 6          | dBm   |
| $P_{RANGE}$ | Output power range                                   | 16 steps                                   |      | 20   |            | dB    |
| $P_{ACC}$   | Output power tolerance                               |                                            |      |      | $\pm 3$    | dB    |
| $P_{HARM}$  | Harmonics                                            |                                            |      |      |            |       |
|             | 2 <sup>nd</sup> harmonic<br>3 <sup>rd</sup> harmonic |                                            |      |      | -35<br>-35 | dBm   |

|                                         |                                                 |                       |             |
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## 15.2. RECEIVER CHARACTERISTICS

| Symbol                | Parameter                                                              | Condition                               | Min.                | Typ. | Max.       | Units             |
|-----------------------|------------------------------------------------------------------------|-----------------------------------------|---------------------|------|------------|-------------------|
| P <sub>SENS</sub>     | Receiver sensitivity                                                   | 250kb/s, PER ≤ 1%                       |                     | -98  |            | dBm               |
| P <sub>RXMAX</sub>    | Maximum RX input level                                                 | PER ≤ 1%                                |                     | 10   |            | dBm               |
| P <sub>ACRN</sub>     | Adjacent channel rejection: -5 MHz                                     | PER ≤ 1%, PRF = -82 dBm                 |                     | 34   |            |                   |
| P <sub>ACRP</sub>     | Adjacent channel rejection: +5 MHz                                     | PER ≤ 1%, PRF = -82 dBm                 |                     | 38   |            |                   |
| P <sub>AACRN</sub>    | Alternate channel rejection: -10 MHz                                   | PER ≤ 1%, PRF = -82 dBm                 |                     | 54   |            |                   |
| P <sub>AACRP</sub>    | Alternate channel rejection: +10 MHz                                   | PER ≤ 1%, PRF = -82 dBm                 |                     | 54   |            |                   |
| P <sub>SPUR</sub>     | Spurious emissions:<br>LO leakage<br>30 – ≤ 1000 MHz<br>>1 – 12.75 GHz |                                         |                     | -71  | -57<br>-47 | dBm<br>dBm<br>dBm |
| f <sub>RXTXOFFS</sub> | TX/RX carrier frequency offset                                         | Sensitivity loss < 2 dB                 | -300 <sup>(7)</sup> |      | +300       | kHz               |
|                       | RSSI tolerance                                                         | Tolerance within gain step              |                     |      | ±5         | dB                |
|                       | RSSI dynamic range                                                     |                                         |                     | 81   |            | dB                |
|                       | RSSI resolution                                                        |                                         |                     | 3    |            | dB                |
|                       | RSSI sensitivity                                                       | Defined as RSSI_BASE_VAL                |                     | -90  |            | dBm               |
|                       | Minimum RSSI value                                                     | P <sub>RF</sub> ≤ RSSI_BASE_VAL         |                     | 0    |            |                   |
|                       | Maximum RSSI value                                                     | P <sub>RF</sub> > RSSI_BASE_VAL + 81 dB |                     | 28   |            |                   |

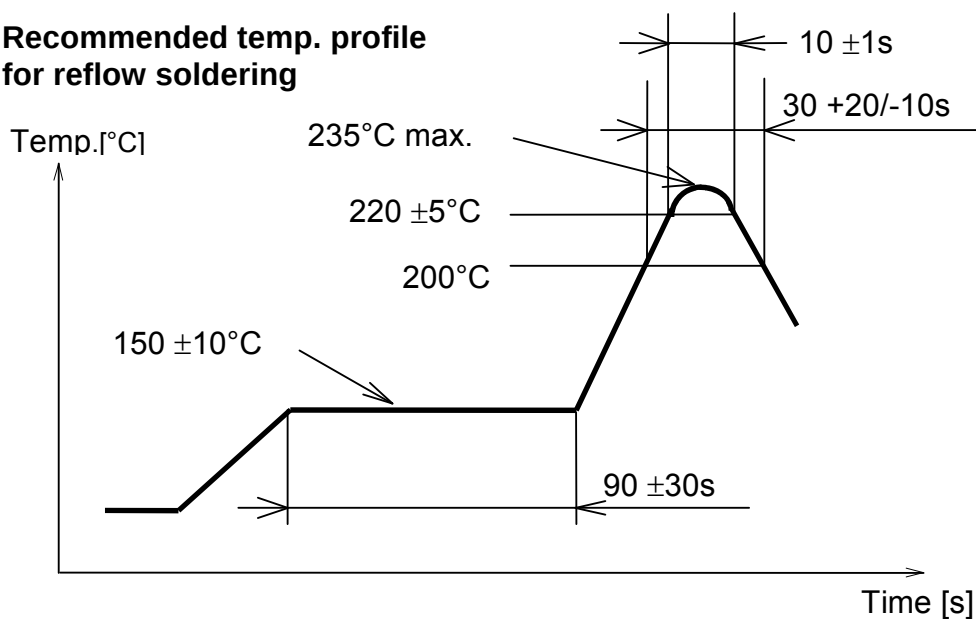
(7) Offset equals ±120 ppm

|                                         |                                                 |                       |             |
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## 16. SOLDERING TEMPERATURE - TIME PROFILE FOR REFLOW SOLDERING (only SMD Module PAN4580 / ENWC9A31xxEF)

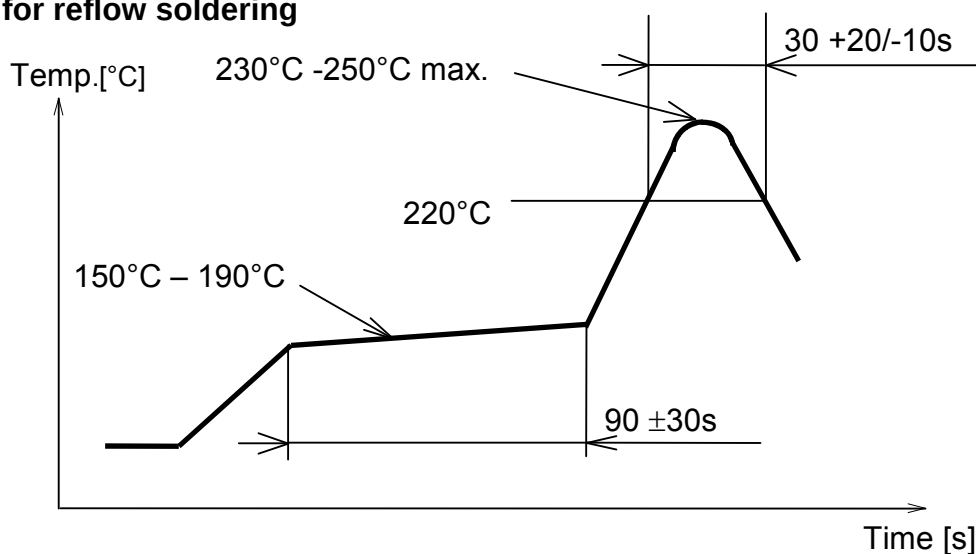
### 16.1. FOR LEAD SOLDER

#### Recommended temp. profile for reflow soldering



### 16.2. FOR LEAD FREE SOLDER

#### Our used temp. profile for reflow soldering



Reflow permissible cycles: 2

Opposite side reflow is prohibited due to the module weight.

|                                         |                                                 |                       |             |
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## 17. MODULE DIMENSIONS

### 17.1. SMD MODULE PAN4580 / ENWC9A31XXEF

| Item   | Dimension | Tolerance  | Remark    |
|--------|-----------|------------|-----------|
| Width  | 19.00     | $\pm 0.25$ |           |
| Lenght | 29.80     | $\pm 0.25$ |           |
| Height | 2.55      | $\pm 0.25$ | With case |

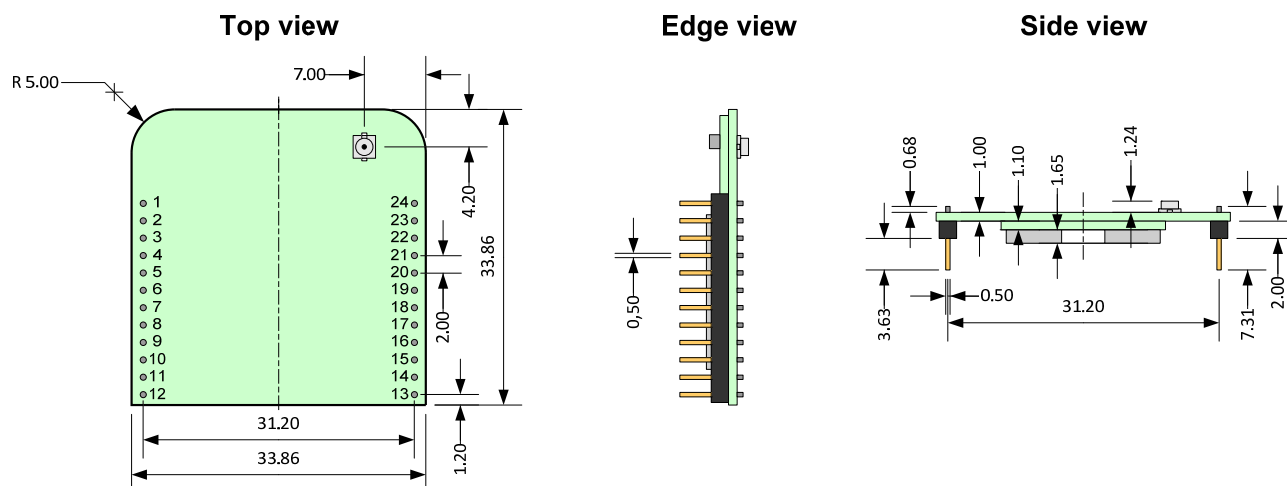
### 17.2. PIN HEADER MODULE PAN4580ETU / ENWC9A33XXEF

| Item   | Dimension | Tolerance  | Remark          |
|--------|-----------|------------|-----------------|
| Width  | 33.86     | $\pm 0.25$ |                 |
| Lenght | 33.86     | $\pm 0.25$ |                 |
| Height | 7.31      | $\pm 0.25$ | With pin-header |



|                                         |                                                 |                       |             |
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## 18.2. PIN HEADER MODULE PAN4580ETU / ENWC9A33XXEF

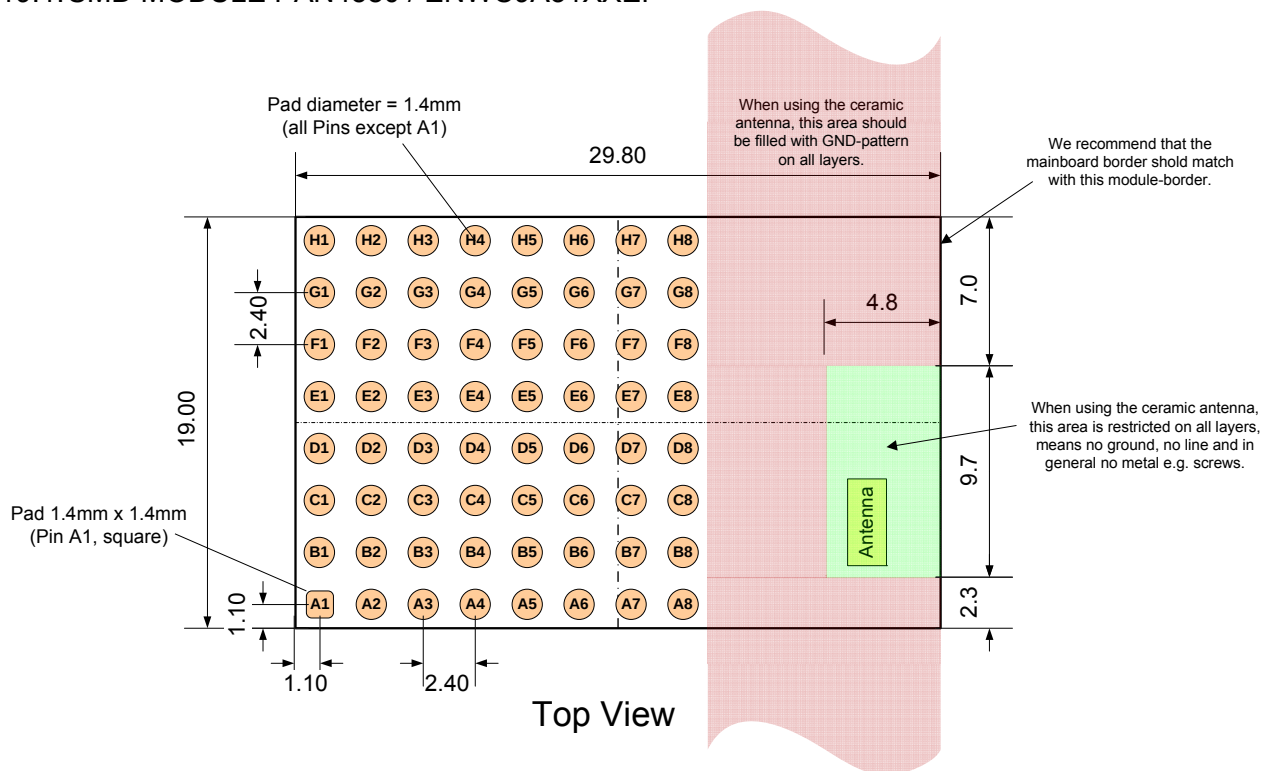


All dimensions are in millimeters.  
The outer dimensions have a tolerance of  $\pm 0.25\text{mm}$ .

|                                         |                                                 |                       |             |
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## 19. RECOMMENDED LAND PATTERN

### 19.1. SMD MODULE PAN4580 / ENWC9A31XXEF



Dimensions in millimeters.

The land pattern dimensions above are meant to serve only as a guid. This information is provided without any legal liability.

It is recommended that the application PCB use the same pad-size as the module footprint.

For the solder paste screen, use as a first guideline the same foot print as shown in the figure above. Solder paste screen cutouts (with slightly different dimensions) might be optimum depending on your soldering process. For example, the solder paste screen thickness chosen might have an effect. The solder screen thickness depends on your production standard - 100µm to 120µm is recommended.

When using a module with an embedded antenna, for optimum RF performance, place the antenna on the edge of your application PCB

If you have any questions on these points, please contact your local Panasonic representative.

Schematics and layouts may be sent to [wireless@eu.panasonic.com](mailto:wireless@eu.panasonic.com) for final review.



|                                         |                                                 |                       |             |
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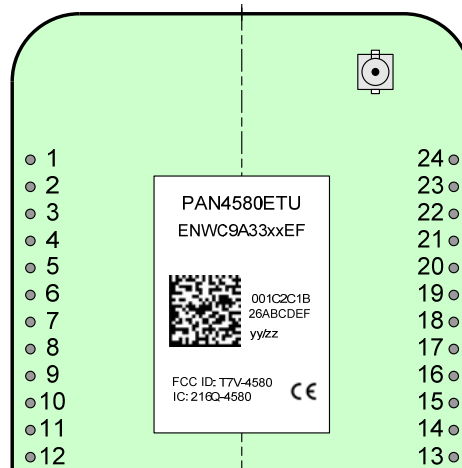
## 20. LASER/LABEL MARKING

SMD Module  
PAN4580 / ENWC9A31XXEF



Top View

Pin header Module  
PAN4580ETU / ENWC9A33xxEF



Top View

The 2D-Barcode contains the following information separated by a semicolon:

| Value                            | Description                                                                                                                              |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Date-code                        | Date code in the format Year - Calender Week - Day of Week – Line - Lot [YYWDDL]                                                         |
| MAC-adress/<br>Serial-number     | ENWC9A31x5EF (SNAP-software): Last 8 digits of the MAC-adress<br>ENWC9A31x1EF (without software): Sequential serial-number               |
| C9A31xxx (SMD)<br>C9A33xxx (ETU) | Ordering number [8 signs; without the first 3 digits (ENW) and the last digit (F), refer also to chapter 0.<br><br>Ordering Information] |
| yyzz                             | The identifier for the hardware release [2 signs, here yy]<br>and the software release [2 signs, here zz]                                |

The point on the marking (below left) is the identifier for pin 1 of the module.

|                                         |                                                 |                       |             |
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## 21. RELIABILITY TESTS

Measurements should be completed after the module has been exposed to room temperature and humidity for 1 hour.

| No. | Item                       | Limit                                           | Condition                                                                                                                           |
|-----|----------------------------|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Heat-shock-resistance test | Electrical parameter should be in specification | Temperature: 125°C to -50°C<br>Voltage: off<br>Period: 500cycles<br>Temp. Cycle: -50°C and +125°C each 7min.                        |
| 2   | Humidity load life test    | the same as above                               | Temperature: +85°C<br>Humidity: 85%<br>Period: 500hrs<br>Voltage: on                                                                |
| 3   | Vibration test             | the same as above                               | Vibration Ampl.: 1.5mm<br>Vibr. Freq.: 10~55~10Hz (total 1min.)<br>Directions: X; Y; Z each 1hrs                                    |
| 4   | ESD test                   | the same as above                               | Regarding JEDEC JESD-22a114D each contact with 100pF, 1.5kOhm min. 2kV (Human Body Model HBM)                                       |
| 5   | MSL test                   | the same as above                               | Pre conditioning:<br>Temperature: +85°C<br>Humidity: 85°C<br>Period: 96hrs<br>Soldering condition:<br>Peak: 260°C for ~10s, 2 times |

## 22. CAUTIONS

Failure to do so may result in degrading of the product's functions and damage to the product.

### 22.1. DESIGN NOTES

- (1) Follow the conditions written in this specification, especially the control signals of this module.
- (2) The supply voltage has to be free of AC ripple voltage (for example from a battery or a low noise regulator output). For noisy supply voltages, provide a decoupling circuit (for example a ferrite in series connection and a blocking capacitor to ground of at least 47uF directly at the module).
- (3) This product should not be mechanically stressed when installed.
- (4) Heat is the major cause of shortening the life of these products. Keep this product away from heat.  
Avoid assembly and use of the target equipment in conditions where the products' temperature may exceed the maximum tolerance.
- (5) The supply voltage should not be exceedingly high or reversed. It should not carry noise and/or spikes.
- (6) Keep this product away from other high frequency circuits.

|                                         |                                                 |                       |             |
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## 22.2. INSTALLATION NOTES

- (1) Reflow soldering is possible twice based on the conditions in chapter 16. Set up the temperature at the soldering portion of this product according to this reflow profile.
- (2) Carefully position the products so that their heat will not burn into printed circuit boards or affect the other components that are susceptible to heat.
- (3) Carefully locate these products so that their temperatures will not increase due to the effects of heat generated by neighboring components.
- (4) If a vinyl-covered wire comes into contact with the products, then the cover will melt and generate toxic gas, damaging the insulation. Never allow contact between the cover and these products to occur.
- (5) This product should not be mechanically stressed or vibrated when reflowed.
- (6) (6) If you want to repair your board by hand soldering, follow the conditions detailed in this chapter.
- (7) Do not wash this product.
- (8) Refer to the recommended pattern when designing a board.
- (9) Pressing parts on the metal cover or fastening objects to the cover will cause damage to the module.

## 22.3. USAGE CONDITIONS NOTES

- (1) Take measures to protect the unit against static electricity. If pulses or other transient loads (a large load applied in a short time) are applied to the products, check and evaluate their operation before assembly on the final products.
- (2) Do not use dropped products.
- (3) Do not touch, damage or place dirt on the pins.
- (4) Follow the recommended condition ratings about the power supply applied to this product.
- (5) Electrode peeling strength: Do not add pressure of more than 4.9N when soldered on PCB.
- (6) Pressing on parts of the metal cover or fastening objects to the metal cover will cause damage.
- (7) These products are intended for general purpose and standard use in general electronic equipment, such as home appliances, office equipment, information and communication equipment.

## 22.4. STORAGE NOTES

- (1) The module may not be stressed mechanically during storage.
- (2) Do not store these products in the following conditions or the performance characteristics of the product, such as RF performance will be adversely affected:
- (3) Storage in salty air or in an environment with a high concentration of corrosive gas, such as Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, or NO<sub>x</sub>
- (4) Storage in direct sunlight
- (5) Storage in an environment where the temperature may be outside the range of 5°C to 35°C range, or where the humidity may be outside the 45 to 85% range.
- (6) Storage of the products for more than one year after the date of delivery at your

|                                         |                                                 |                       |             |
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- company if the avoidance all the above conditions (1) to (3) have been met.
- (7) Storage period: Check the adhesive strength of the embossed tape and soldering after 6 months of storage.
  - (8) Keep this product away from water, poisonous gas and corrosive gas.
  - (9) This product should not be stressed or shocked when transported.
  - (10) Follow the specification when stacking packed crates (max. 10).

## 22.5. SAFETY CAUTIONS

These specifications are intended to preserve the quality assurance of products and individual components.

Before use, check and evaluate the operation when mounted on your products. Abide by these specifications, without deviation when using the products. These products may short-circuit. If electrical shocks, smoke, fire, and/or accidents involving human life are anticipated when a short circuit occurs, then provide the following failsafe functions, as a minimum.

- (1) Ensure the safety of the whole system by installing a protection circuit and a protection device.
- (2) Ensure the safety of the whole system by installing a redundant circuit or another system to prevent a single fault causing an unsafe status.

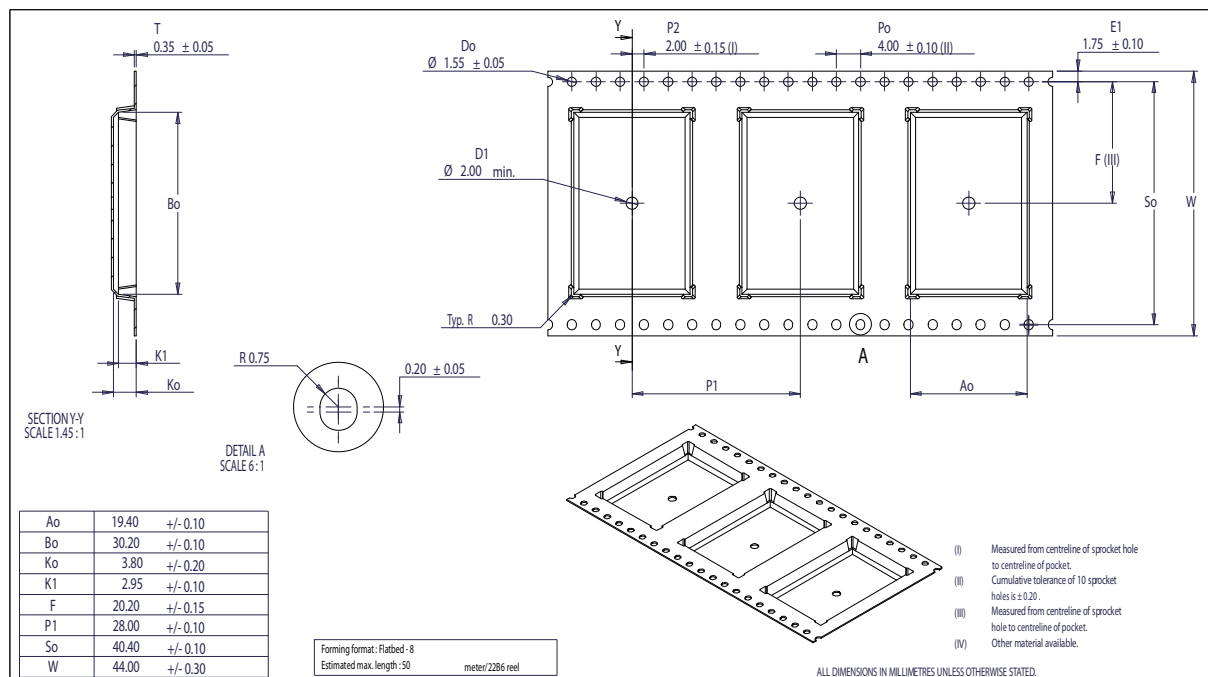
## 22.6. OTHER CAUTIONS

- (1) This specification sheet is copyrighted. Do not disclose it to a third party.
- (2) Do not use the products for other purposes than those listed.
- (3) Be sure to provide an appropriate fail-safe function on your product to prevent an additional damage that may be caused by the abnormal function or the failure of the product.
- (4) This product has not been manufactured with any ozone chemical controlled under the Montreal Protocol.
- (5) These products are not intended for other uses, other than under the special conditions shown below. Before using these products under such special conditions, check their performance and reliability under the said special conditions carefully to determine whether or not they can be used in such a manner.
- (6) In liquid, such as water, salt water, oil, alkali, or organic solvent, or in places where liquid may splash.
- (7) In direct sunlight, outdoors, or in a dusty environment
- (8) In an environment where condensation occurs.
- (9) In an environment with a high concentration of harmful gas (e.g. salty air, HCl, Cl<sub>2</sub>, SO<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, and NO<sub>x</sub>)
- (10) If an abnormal voltage is applied due to a problem occurring in other components or circuits, replace these products with new products because they may not be able to provide normal performance even if their electronic characteristics and appearances appear satisfactory.
- (11) When you have any question or uncertainty, both of you and Panasonic sincerely cope with it.

|                                         |                                                 |                       |             |
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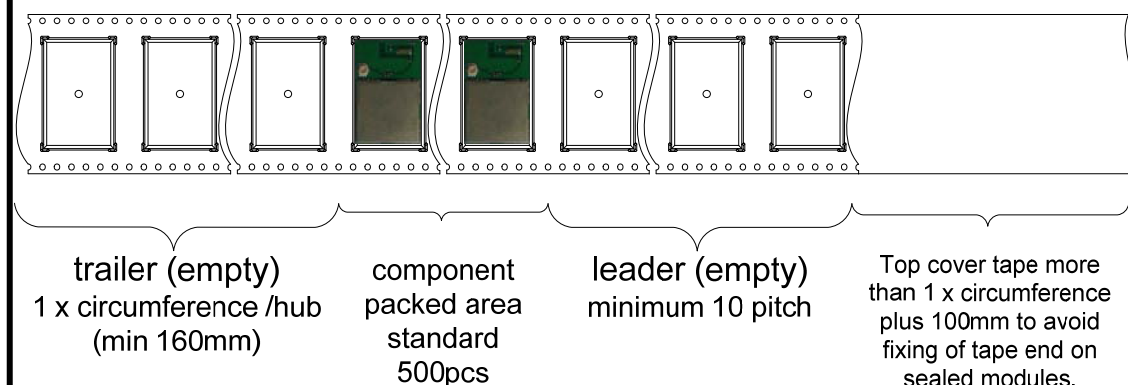
## 23. PACKAGING OF SMD MODULE PAN4580 / ENWC9A31XXEF

### 23.1. TAPE DIMENSION



### 23.2. PACKING IN TAPE

Direction of unreeling (for customer) →

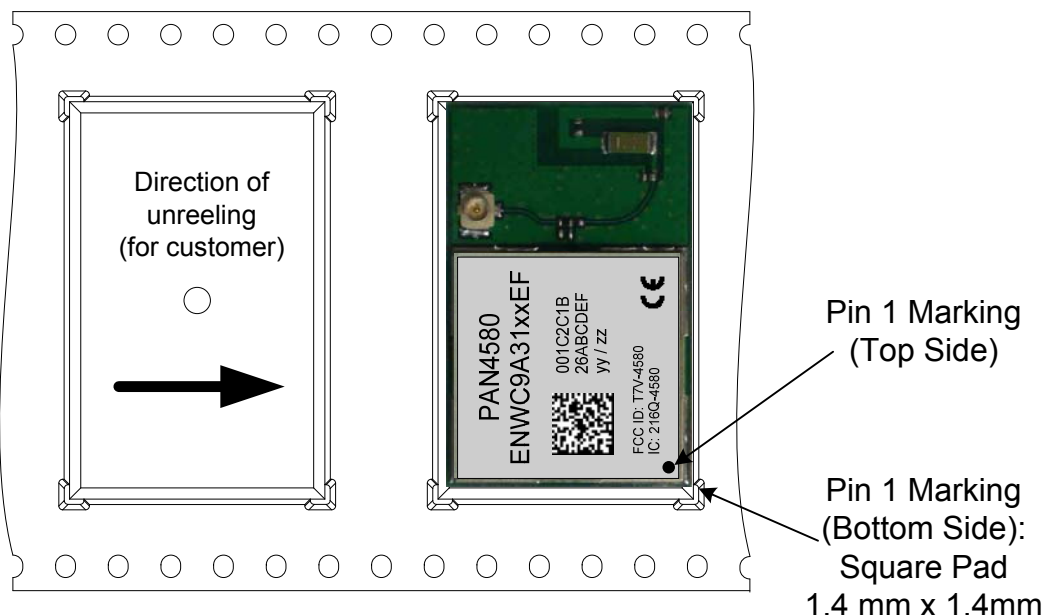


Empty spaces in component packed area shall be less than two per reel and those spaces shall not be consecutive.

Top cover tape shall not be found on reel holes and shall not stick out from reel.

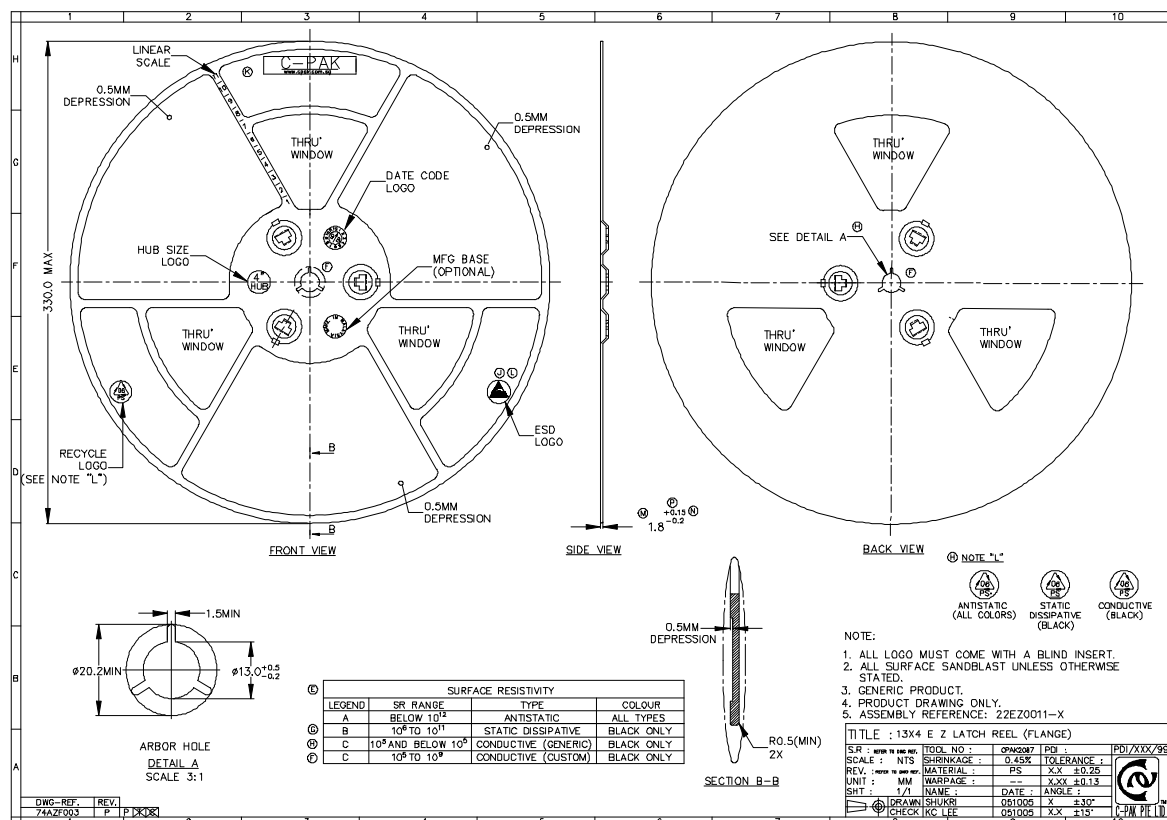
|                                         |                                                 |                       |             |
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### 23.3.COMPOONENT DIRECTION



Refer also to chapter 20. Laser/Label marking

### 23.4.REEL DIMENSION



|                                         |                                                 |                       |             |
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### 23.5.LABEL FOR PACKAGE

The label below shows only an example.



|       |                                   |                  |
|-------|-----------------------------------|------------------|
| (1T): | Lotcode [YYWWDLL]                 |                  |
|       | YY year                           | above 08         |
|       | WW normal calendar week           | above 01         |
|       | D day                             | above 5 (Friday) |
|       | L line identifier, if more as one | actual 1         |
|       | L lot identifier per day          | e.g. 1, 2, 3     |

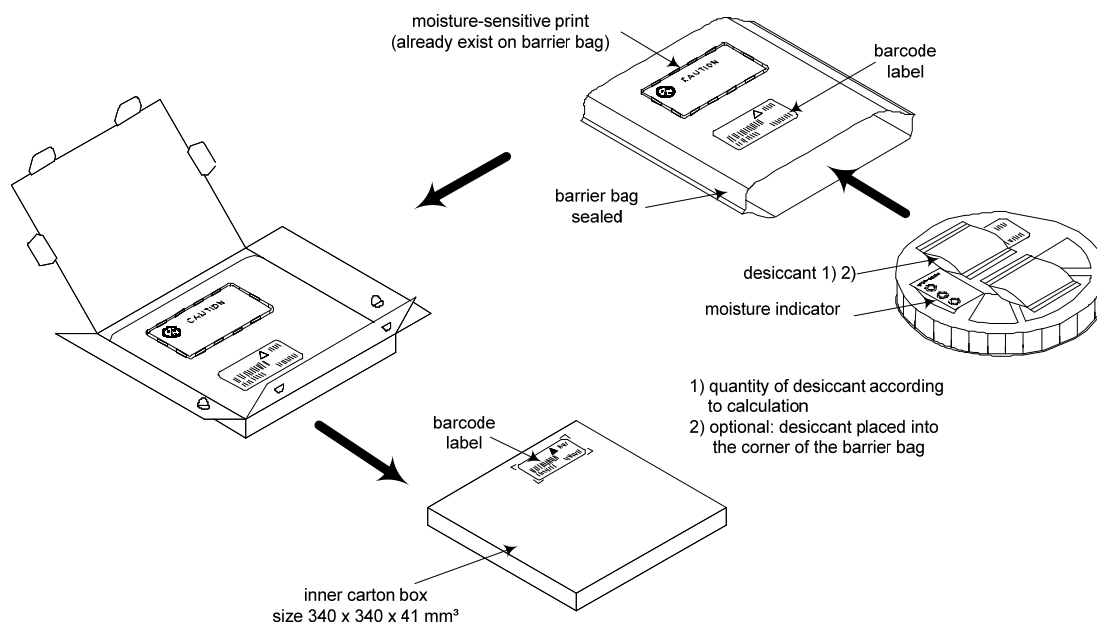
(1P) Customers Order Code.

(2P) Panasonic Part Number, refer to chapter 0

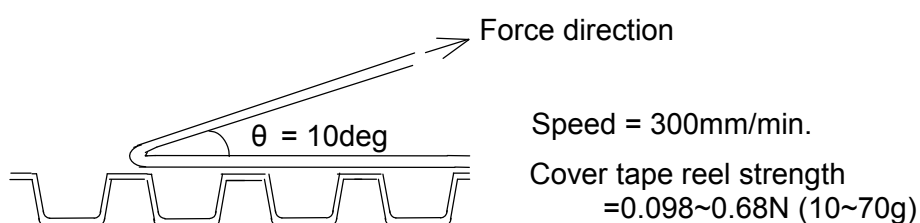
|                                                                                                                                                                                                                                                                                                                                      |                |                                                 |                       |             |
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| <p>Ordering Information</p> <p>(9D)                      Datecode as [2xYear, 2xMonth, 2xDay]</p> <p>(Q)                        Quantity [XXXX], variable</p> <p>(HW/SW)                Hardware /Software Release identifier</p> <p>[[G]]                     Identifier that the product is RoHS conform, refer to chapter 25.</p> |                |                                                 |                       |             |
| <div>PANASONIC INDUSTRIAL DEVICES EUROPE GMBH</div> <div><a href="http://www.pideu.panasonic.de">www.pideu.panasonic.de</a></div>                                                                                                                                                                                                    |                |                                                 |                       |             |

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### 23.6.TOTAL PACKING HANDLING



### 23.7.COVER TAPE REEL STRENGTH



|                                         |                                                 |                       |             |
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## 24. ORDERING INFORMATION

| No. | Ordering part number | Description                                                                                                                                                                                                                                                                   |
|-----|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | ENWC9A31A1EF         | PAN4580 – 2.4GHz<br>802.15.4 Mesh Network SMD-Module, which includes <i>Ceramic Antenna</i> and 128kbyte Flash Memory.<br>No software included.                                                                                                                               |
| 2   | ENWC9A31B1EF         | PAN4580 – 2.4GHz<br>802.15.4 Mesh Network SMD-Module, which includes <i>UFL connector</i> and 128kbyte Flash Memory.<br>No software included.                                                                                                                                 |
| 3   | ENWC9A31C1EF         | PAN4580 – 2.4GHz<br>802.15.4 Mesh Network SMD-Module, with <i>RF out on SMD pad</i> and 128kbyte Flash Memory.<br>No software included.                                                                                                                                       |
| 4   | ENWC9A31A5EF         | PAN4580 – 2.4GHz<br>802.15.4 Mesh Network SMD-Module, which includes <i>Ceramic Antenna</i> and 128kbyte Flash Memory, with 69.5kbyte used by SNAP core, 58.5kbyte free for uploadable SNAPpy scripts.<br><i>Synapse SNAP software</i> included, refer also to [3].           |
| 5   | ENWC9A31B5EF         | PAN4580 – 2.4GHz<br>802.15.4 Mesh Network SMD-Module, which includes <i>UFL connector</i> and 128kbyte Flash Memory, with 69.5kbyte used by SNAP core, 58.5kbyte free for uploadable SNAPpy scripts.<br><i>Synapse SNAP software</i> included, refer also to [3].             |
| 6   | ENWC9A31C5EF         | PAN4580 – 2.4GHz<br>802.15.4 Mesh Network SMD-Module, with <i>RF out on SMD pad</i> and 128kbyte Flash Memory, with 69.5kbyte used by SNAP core, 58.5kbyte free for uploadable SNAPpy scripts.<br><i>Synapse SNAP software</i> included, refer also to [3].                   |
| 7   | ENWC9A33A1EF         | PAN4580ETU – 2.4GHz<br>802.15.4 Mesh Network Pin-Header-Module, which includes <i>Ceramic Antenna</i> and 128kbyte Flash Memory.<br>No software included.                                                                                                                     |
| 8   | ENWC9A33B1EF         | PAN4580ETU – 2.4GHz<br>802.15.4 Mesh Network Pin-Header-Module, which includes <i>UFL connector</i> and 128kbyte Flash Memory.<br>No software included.                                                                                                                       |
| 9   | ENWC9A33A5EF         | PAN4580ETU – 2.4GHz<br>802.15.4 Mesh Network Pin-Header-Module, which includes <i>Ceramic Antenna</i> and 128kbyte Flash Memory, with 69.5kbyte used by SNAP core, 58.5kbyte free for uploadable SNAPpy scripts.<br><i>Synapse SNAP software</i> included, refer also to [3]. |
| 10  | ENWC9A33B5EF         | PAN4580ETU – 2.4GHz<br>802.15.4 Mesh Network Pin-Header-Module, which includes <i>UFL connector</i> and 128kbyte Flash Memory, with 69.5kbyte used by SNAP core, 58.5kbyte free for uploadable SNAPpy scripts.<br><i>Synapse SNAP software</i> included, refer also to [3].   |

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## 25. ROHS DECLARATION

Declaration of environmental compatibility for supplied products:

Hereby we declare to our best present knowledge based on declaration of our suppliers that this product does not contain the following substances which are banned by Directive 2002/95/EC (RoHS) or contains a maximum concentration of 0.1% by weight in homogeneous materials for

- Lead and lead compounds
- Mercury and mercury compounds
- Chromium (VI)
- PBB (polybrominated biphenyl) category
- PBDE (polybrominated biphenyl ether) category

And a maximum concentration of 0.01% by weight in homogeneous materials for

- Cadmium and cadmium compounds

## 26. DATA SHEET STATUS

This data sheet contains data from the PRELIMINARY specification. Supplementary data will be published at a later date. Panasonic Electronic Devices Europe GmbH reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.

Consult the most recently issued data sheet before initiating or completing a design. Use this link to check for updates: [PAN4580 Latest Data Sheet!](#)

## 27. REGULATORY INFORMATION

### 27.1. FCC NOTICE



The device PAN4580, including the ceramic antenna (ENWC9A31AxEF) and also the UFL type (ENWC9A31BxEF) and SMD type (ENWC9A31CxEF), including with the antennas, which are listed in 27.5, complies with Part 15 of the FCC Rules.

The device meets the requirements for modular transmitter approval as detailed in FCC public Notice DA00-1407. transmitter Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

The FCC identifier is **FCC ID: T7V-4580**.

### 27.2. CAUTION



The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Panasonic Electronic Devices Europe GmbH may void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide

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reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help

### 27.3. LABELING REQUIREMENTS



The Original Equipment Manufacturer (OEM) must ensure that FCC labeling requirements are met. This includes a clearly visible label (laser marking) on the outside of the OEM enclosure specifying the appropriate Panasonic FCC identifier for this product as well as the FCC Notice above. The FCC identifier is **FCC ID: T7V-4580**.

In any case end product must be labelled exterior with "Contains FCC ID: T7V-4580"

### 27.4. ANTENNA WARNING



The related part number for this device are ENWC9A31BxEF (PAN4580 with U.FL connector) and ENWC9A31CxEF (PAN4580 with SMD pad). For details, see the chapter 24. Ordering Information. This device is tested with a standard SMA connector and with the antennas listed below. When integrated in the OEMs product, these fixed antennas require installation preventing end-users from replacing them with non-approved antennas. Any antenna not in the following table must be tested to comply with FCC Section 15.203 for unique antenna connectors and Section 15.247 for emissions. The FCC identifier for this device with the antenna listed in item 1 are the same (FCC ID: T7V-2580).

### 27.5. APPROVED ANTENNA LIST

Note: We are able to qualify your antenna and will add to this list as that process is completed.

| Item | Part Number      | Manufacturer | Frequency Band | Type | Gain (dBi) |
|------|------------------|--------------|----------------|------|------------|
| 1    | LDA312G4413H-280 | Murata       | 2.4GHz         | Chip | -2.3       |
| 2    |                  |              |                |      |            |

|                                         |                                                 |                       |             |
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#### 27.6. RF EXPOSURE PAN4580



To comply with FCC RF Exposure requirements, the Original Equipment Manufacturer (OEM) must ensure that the approved antenna in the previous table must be installed.

The preceding statement must be included as a CAUTION statement in manuals for products operating with the approved antennas in the previous table to alert users on FCC RF Exposure compliance.

Any notification to the end user of installation or removal instructions about the integrated radio module is not allowed.

The radiated output power of PAN4580 with mounted ceramic antenna (FCC ID: T7V-4580) is below the FCC radio frequency exposure limits. Nevertheless, the PAN4580 shall be used in such a manner that the potential for human contact during normal operation is minimized.

End users may not be provided with the module installation instructions. OEM integrators and end users must be provided with transmitter operating conditions for satisfying RF exposure compliance.

#### 28. INDUSTRY CANADA CERTIFICATION

PAN4580 is licensed to meet the regulatory requirements of Industry Canada (IC), license: IC: 216Q-4580

Manufacturers of mobile, fixed or portable devices incorporating this module are advised to clarify any regulatory questions and ensure compliance for SAR and/or RF exposure limits. Users can obtain Canadian information on RF exposure and compliance from [www.ic.gc.ca](http://www.ic.gc.ca).

This device has been designed to operate with the antennas listed in Table 27.5 above. Antennas not included in this list are strictly prohibited for use with this device. The required antenna impedance is 50 ohms. The antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

#### 29. EUROPEAN R&TTE DECLARATION OF CONFORMITY

Hereby, Panasonic Electronic Devices Europe GmbH, declares that the module PAN4580 and their versions is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. As a result of the conformity assessment procedure described in Annex III of the Directive 1999/5/EC, the end-customer equipment should be labelled as follows:



PAN4580 and their versions in the specified reference design can be used in the following countries: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, The Netherlands, the United Kingdom, Switzerland, and Norway.

|                                         |                                                 |                       |             |
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### 30. RELATED DOCUMENTS

For an update, please search in the suitable homepage.

- [1] IEEE Standard 802.15.4 –2003 Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks (LR-WPANS)
- [2] Technical Datasheet ATmega128RFA1  
You can download the latest datasheet from the Atmel homepage [here](#).
- [3] Manual to the Evaluation Kit from Synapse, which fits to module hardware from Panasonic [Downloads: SNAP® [Reference Guide](#); SNAP® [Hardware Technical Manual](#)]  
Each new release from Synapse, will be posted [here](#). Be sure to be registered free under <http://forums.synapse-wireless.com>.

### 31. GENERAL INFORMATION

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This product description does not claim to be complete and free of mistakes.

Please contact the related product manager with any errata inquiries.

If we deliver samples to the customer, these samples have the status Engineering Samples. This means, the design of this product is not yet completed. Engineering Samples may be partially or fully functional, and there may be differences published in the Data Sheet.

Engineering Samples are not qualified and are not to be used for reliability testing or series production.

#### **Disclaimer:**

Customer acknowledges that samples may deviate from the Data Sheet and may bear defects due to their status of development and the lack of qualification mentioned above.

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- deviation or lapse in function of Engineering Sample,
- improper use of Engineering Samples.

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## 32. LIFE SUPPORT POLICY

This Panasonic Electronic Devices Europe GmbH product is not designed for use in life support appliances, devices, or systems where malfunction can reasonably be expected to result in a significant personal injury to the user, or as a critical component in any life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Panasonic Electronic Devices Europe GmbH for any damages resulting.

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