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## Specification for Production

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Software Version

SN55 R3\_1\_1 from 08.01.2008

Contents

Approval for Mass Production

Customer

By signing this document, Customer accepts the validity of the below-mentioned contents and declares his full notice to it. Some passages may be changed if required; the validity shall not be affected thereby.

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PRELIMINARY

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## 1. KEY FEATURES

### Schlüsseigenschaften

- Short range 2,4GHz ISM band transceiver with microcontroller and reference oscillator
- Provides complete hardware for a wireless node using IEEE802.15.4 packet structure
- Very small size (12.2mm x 16.4mm x 2.2mm)
- 2 antenna options: Single port 50Ω or ceramic antenna
- 16 selectable Channels with 250 kbps in the 2.4 GHz band
- Low power modes for increased battery life
- High sensitivity of -92 dBm typ. at 1% Packet Error Rate
- 0 dBm typ. output power programmable over a 30 dB range
- Low supply voltage (2.0 V to 3.4 V, 2.7 V typ.)
- Operating temperature range -40°C to +85°C
- Link Quality and Clear Channel Assessment capability
- 60k Flash and 4k RAM memory
- 4 channel A/D converter with 10 Bit for fast and easy conversion from analog inputs -such as temperature, pressure and fluid levels- to digital values.
- 3 channel 16 Bit timer/pulse width modulation (TPM) outputs
- BDM port for direct download programming
- In total 20 digital I/O lines with programmable pull-ups and few with high-current driver.
- Low power modes for increased battery life
- Low battery warning
- Low voltage detect/reset
- Complies with ETSI EN300328 and FCC Part 15C

## 2. APPLICATIONS FOR THE MODULE

### Anwendungen für das Modul

- ZigBee™ FFD (full functional) and RFD (reduced functional) devices working in star and mesh networks
- Wireless sensor and actuator networks
- Remote control and wire replacement in industrial systems
- Factory and home automation and control
- Inventory and logistics management
- HID (Human Interface Devices)
- Toys
- Home gateways
- proprietary networking solutions using IEEE802.15.4

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### 3. DESCRIPTION OF THE MODULE

#### Beschreibung des Moduls

The PAN4555 module is a short range, low power, 2.4 GHz ISM band transceiver which includes a complete 802.15.4 physical layer (PHY) modem, designed for the IEEE 802.15.4 wireless standard and a appropriate microcontroller (MCU) with reference oscillator which provides a cost effective solution for short-range data links and networks.

The main purpose of PAN4555 are ZigBee™ ([www.zigbee.org](http://www.zigbee.org)) applications based on "BeeStack" of Freescale Inc.. For details on ZigBee™ application software see chapter 21.

Proprietary networking solutions on top of the IEEE802.15.4 MAC/PHY software package (available at [www.freescale.com/zigbee](http://www.freescale.com/zigbee)) could be implemented instead of ZigBee™ as well.

As Integrated Development Environment (IDE) the Metrowerks™ CodeWarrior IDE from [www.metrowerks.com](http://www.metrowerks.com) is required. For device flash programming via the BDM port of PAN4555 the USB HCS08/HCS12 Multilink from [www.pemicro.com](http://www.pemicro.com) is recommended.

### 4. SCOPE OF THIS DOCUMENT

#### Umfang dieses Dokumentes

This product specification applies to the ZigBee ready modem ENWC9A0xxxE. The xxx is the indicator for different versions (refer to chapter 25 Ordering Information). The used ZigBee chip is the MC13213 from the US company freescale [www.freescale.com/zigbee](http://www.freescale.com/zigbee).

Diese Produktionsunterlagen beziehen sich auf das ZigBee ready Modem ENWC9A0xxxE Die Zeichen xxx bezeichnen verschiedene Versionen (Erklärung im Kapitel 25 Ordering Information).

Der verwendete ZigBee Chip ist der MC13213 der US Firma Freescale.

### 5. HISTORY FOR THIS DOCUMENT

#### Versionsverwaltung dieses Dokumentes

| Revision<br>Version | Date<br>Datum | Modification / Remarks<br>Änderungen / Bemerkungen  |
|---------------------|---------------|---|
| A                   | 26.04.2007    | Initial draft version   |
| B                   | 08.06.2007    | Corrected pin14 in chapter Terminal Layout and revised chapter Block Diagram.   |
| C                   | 28.06.2007    | Change IC name from MC13214 to MC13213 in chapter 21.   |
| D                   | 11.07.2007    | Support fee reduced to \$500 in chapter 21. Change MOQ from 1500pcs to 500pcs. Add special note (2) for the ripple on supply voltage. |
| E                   | 20.08.2007    | Add chapter Regulatory Information and add [9] in chapter 29.   |
| F                   | 16.01.2008    | Updated software supplier on the front page and add E-Senza Manual as a link under [9] in chapter 29.                                 |
| G                   | 14.02.2008    | Corrected current consumption values and added state-info in chapter 12   |

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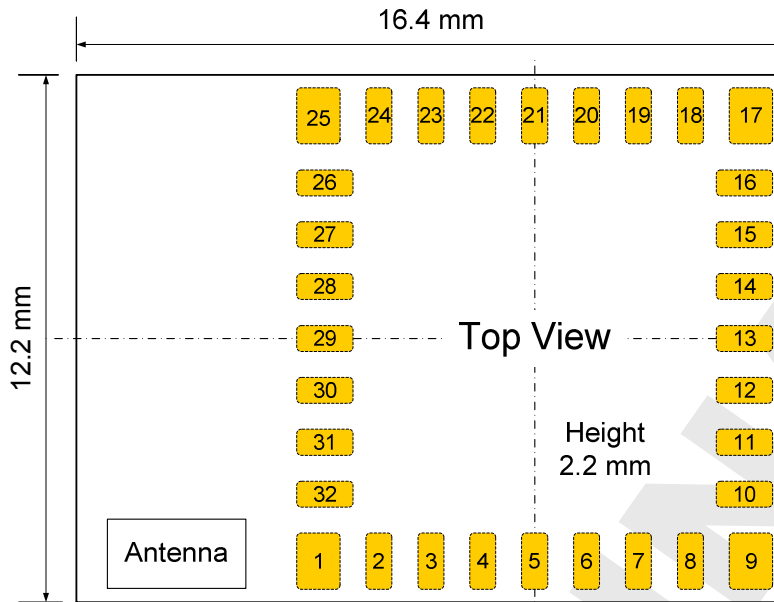
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## 6. TERMINAL LAYOUT Anschlußbelegung



Please refer also to the MC1321x technical data sheet and reference manual, which is given in [2] and [3] in chapter Related Documents.

| Pin No. | Pin Name          | Pin Type     | Description   |
|---------|-------------------|--------------|---|
| 1       | GND               | I/O          | Ground  |
| 2       | PTB0 / AD1P0      | I/O          | MCU Port B Bit 0 / ATD analog Channel 0                                   |
| 3       | PTB1 / AD1P1      | I/O          | MCU Port B Bit 1 / ATD analog Channel 1                                   |
| 4       | PTB2 / AD1P2      | I/O          | MCU Port B Bit 2 / ATD analog Channel 2                                   |
| 5       | PTB7/AD1P7        | I/O          | MCU Port B Bit 7 / ATD analog Channel 7                                   |
| 6       | VREFH             | I            | MCU high reference voltage for ATD  |
| 7       | PTA7 / KBI1P7     | Dig. I/O     | MCU Port A Bit 7 / Keyboard Input Bit 7                                   |
| 8       | PTA5 / KBI1P5     | Dig. I/O     | MCU Port A Bit 5 / Keyboard Input Bit 5                                   |
| 9       | GND               | I/O          | Ground  |
| 10      | PTA6 / KBI1P6     | Dig. I/O     | MCU Port A Bit 6 / Keyboard Input Bit 6                                   |
| 11      | PTG0 / BKGND / MS | Dig. I/O     | MCU Port G Bit 0 / Background / Mode Select <sup>(1)</sup>                |
| 12      | PTG1 / XTAL       | Dig. I/O / O | MCU Port G Bit 1 / Crystal oscillator output <sup>(2)</sup>               |
| 13      | PTG2 / EXTAL      | Dig. I/O / I | MCU Port G Bit 2 / Crystal oscillator input <sup>(2)</sup> <sup>(3)</sup> |
| 14      | CLKO              | O            | Programmable Clock Output (default: 32,768 kHz) <sup>(3)</sup>            |

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| Pin No. | Pin Name                  | Pin Type | Description                             |
|---------|---------------------------|----------|---|
| 15      | PTC0 / TXD2               | Dig. I/O | MCU Port C Bit 0 / SCI2 TX data out     |
| 16      | PTC1 / RXD2               | Dig. I/O | MCU Port C Bit 1/ SCI2 RX data in       |
| 17      | GND                       | I/O      | Ground                                  |
| 18      | PTC5                      | Dig. I/O | MCU Port C Bit 5                        |
| 19      | PTC3 / SCL1               | Dig. I/O | MCU Port C Bit 1/ IIC bus clock         |
| 20      | PTC2 / SDA1               | Dig. I/O | MCU Port C Bit 1/ IIC bus clock         |
| 21      | PTE0 / TXD1               | Dig. I/O | MCU Port E Bit 0 / SCI1 TX data out     |
| 22      | PTE1 / RXD1               | Dig. I/O | MCU Port E Bit 1/ SCI1 RX data in       |
| 23      | VDDA                      | Power O  | Modem analog regulated supply output    |
| 24      | Vcc                       | Power I  | Modem voltage regulators' input         |
| 25      | GND                       | I/O      | Ground                                  |
| 26      | Vcc                       | Power I  | Modem voltage regulators' input         |
| 27      | $\overline{\text{RESET}}$ | Dig. I/O | MCU reset. Active low                   |
| 28      | PTD6 / TPM2CH3            | Dig. I/O | MCU Port D Bit 6 / TPM2 Channel 3       |
| 29      | PTD4 / TPM2CH1            | Dig. I/O | MCU Port D Bit 4 / TPM2 Channel 1       |
| 30      | PTD2 / TPM1CH2            | Dig. I/O | MCU Port D Bit 2 / TPM1 Channel 2       |
| 31      | GND                       | I/O      | Ground                                  |
| 32      | EXANT                     | I/O      | Pin for external antenna (50 $\Omega$ ) |

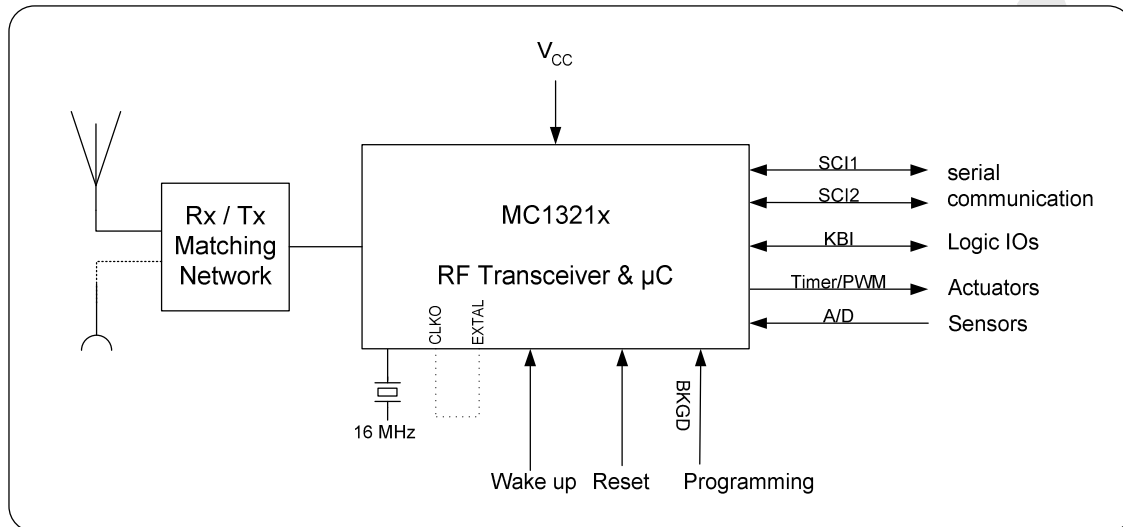
Note:

- (1) PTG0 is output only. Pin is I/O when used as BDM function.
- (2) Full I/O when not used as clock source. Please refer also to [2].
- (3) CLK0 (Pin 14) and PTG2/EXTAL (Pin 13) must be connected externally if the microcontroller should use the programmable clock derived from the internal 16 MHz crystal.

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## 7. BLOCK DIAGRAM Blockdiagramm



## 8. KEY PARTS LIST Liste der Schlüsselkomponenten

| Part Name<br>Teilenummer  | Material<br>Material   |
|---------------------------|--|
| P.W.Board<br>Leiterplatte | Glass cloth epoxide resin with gold plating<br>FR4 mit Goldauflage   |
| Casing<br>Deckel          | Material: BZn15-20, thickness 0.15mm<br>Material: Weißblech 0,15mm Dicke   |
| IC part name<br>IC Name   | MC13213 (freescale <a href="http://www.freescale.com/zigbee">www.freescale.com/zigbee</a> )<br>All information are based on [2] chapter 28 |

## 9. TEST CONDITIONS Meßbedingungen

Measurements shall be made under room temperature and humidity unless otherwise specified.  
Messungen unter normalen Bedingungen, Abweichungen sind gesondert notiert.

|             |            |                  |             |
|-------------|------------|------------------|-------------|
| Temperature | 25 ± 10 °C | Humidity         | 40 to 85%RH |
| Temperatur  | 25 ± 10 °C | Luftfeuchtigkeit | 40 to 85%RH |

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## 10. ABSOLUTE MAXIMUM RATINGS

### Absolute Grenzwerte

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

| No. | Item<br>Punkt   | Symbol<br>Zeichen | Absolute Maximum Ratings<br>Absolute Grenzwerte      | Unit<br>Einheit |
|-----|---|-------------------|--|-----------------|
| 1   | Supply voltage  | $V_{CC}$          | -0.3 to +3.6   | Vdc             |
| 2   | Ripple on $V_{CC}$  | $V_{CCrip}$       | tbd <sup>(2)</sup> (ripple frequency $\geq 200kHz$ ) | mVpp            |
| 3   | Digital input voltages  | $V_{in}$          | -0.3 to $V_{CC}+0.3$                                 | Vdc             |
| 4   | Instantaneous maximum current<br>Single pin limit for all digital I/O pins <sup>(1)</sup> | $I_{DB}$          | $\pm 25$   | mAdc            |
| 5   | Storage temperature range   | $T_{stg}$         | -40 to +105  | °C              |
| 6   | Operating temperature range   | $T_{op}$          | -40 to +85   | °C              |
| 7   | RF Input Power  | $P_{max}$         | 10   | dBm             |
| 8   | ESD on any pin except for pin 32 EXANT.<br>Human Body Model (HBM)                         | $V_{THHBM}$       | $\pm 2$  | kV              |
| 9   | Lead temperature<br>Löttemperatur   | $T_{Death}$       | Please refer to chapter 15.2.                        | °C              |
| 10  | Moisture Sensitivity Level  | MSL               | 3 (168 hours)  |                 |

Notes:

- (1) Input must be current limited to the value specified
- (2) The supply voltage has to be free of ac ripple voltage, as for example from a battery or a low noise regulator output. For noisy supply voltages provide a decoupling circuit as for example a ferrite in series connection and a blocking capacitor to ground of at least 47uF directly at the module. The exact allowed ripple will be published at a later revision.

## 11. OPERATING CONDITIONS

### Betriebsbedingungen

| No. | Item                                | Condition / Remark                          | Symbol    | Value               |     |                     | Unit |
|-----|-------------------------------------|---|-----------|---------------------|-----|---------------------|------|
|     |                                     |   |           | Min                 | Typ | Max                 |      |
| 1   | Supply voltage                      | The typical value is recommended            | $V_{CC}$  | 2.0                 | 2.7 | 3.4                 | Vdc  |
| 2   | RF Input Frequency                  |   | $f_{in}$  | 2405                |     | 2480                | MHz  |
| 3   | Return loss of load at pin 32 EXANT | Receive/Transmit Mode to 50Ω reference load | a         | -10                 |     |                     | dB   |
| 4   | Logic Input Voltage Low             |   | $V_{IL}$  | 0                   |     | $0.3 \times V_{CC}$ | V    |
| 5   | Logic Input Voltage High            |   | $V_{IH}$  | $0.7 \times V_{CC}$ |     | $V_{CC}$            | V    |
| 6   | SPI clock rate                      | The typical value is recommended            | $f_{SPI}$ | -                   | 8.0 | 8.0                 | MHz  |
| 7   | Operating temperature range         |   | $T_{op}$  | -40                 |     | +85                 | °C   |

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## 12. DC ELECTRICAL CHARACTERISTICS

$V_{CC} = 2.7V$ ,  $T_{amb} = 25^{\circ}C$  if nothing else stated

| No. | Item   | Condition / Remark                               | Symbol        | Value <sup>(12)</sup> |      |      | Unit    |
|-----|--|--|---------------|-----------------------|------|------|---------|
|     |  |  |               | Min                   | Typ  | Max  |         |
| 1   | Transmit current consumption                                   | Transmit Mode <sup>(1)(9)</sup>                  | $I_{CCT}$     |                       | 36.5 | 42.5 | mA      |
| 2   | Receive current consumption                                    | Receive Mode <sup>(9)</sup>                      | $I_{CCR}$     |                       | 37   | 42   | mA      |
| 3   | Low power current consumption                                  | Off <sup>(2)(5)</sup>                            | $I_{leakage}$ |                       | 0.25 | 5    | $\mu A$ |
|     |  | Sleep <sup>(2)(6)(10)</sup>                      | $I_{CCH}$     |                       | 1.9  | 17   | $\mu A$ |
|     |  | Standby <sup>(2)(3)(7)(10)</sup>                 | $I_{CCD}$     |                       | 36   | 120  | $\mu A$ |
|     |  | Idle <sup>(8)</sup>                              | $I_{CCI}$     |                       | 1.6  | 2.7  | mA      |
| 4   | digital I/O pin characteristics                                | Please refer to [2] 6.3.1 MCU DC Characteristics |               |                       |      |      |         |
| 5   | digital I/O pin input capacitance                              | all non-supply pins <sup>(4)</sup>               | $C_{In}$      |                       |      | 7    | pF      |
| 6   | Low voltage warning/detection<br>Power on reset re-arm voltage | Please refer to [2] 6.3.1 MCU DC Characteristics |               |                       |      |      |         |

Notes:

- (1) SPI Register 12 is default value of 0x00BC which sets output power to nominal value
- (2) To attain specified low power current, all GPIO and other digital IO must be handled properly. Detailed description could be found at [2] at section 7.2 Low Power Considerations.
- (3) CLK0 frequency at default value of 32.786 kHz.
- (4) This parameter is characterized and not tested on each device.
- (5) Off mode: Stop1 on  $\mu C$ , Modem off [3]. Wakeup by IRQ or Reset
- (6) Sleep mode: Stop2 + RTC on  $\mu C$ , Modem Hibernate [3]. Wakeup by IRQ, Reset or Real-Time-Interrupt
- (7) Standby mode: Stop3 + RTC on  $\mu C$ , Modem Doze [3]. Wakeup by IRQ, Reset, RTI or Keyboard Interrupt
- (8) Idle mode:  $\mu C$  runs at reduced 2 MHz clock, Modem is in Idle state [3]
- (9)  $\mu C$  runs in full speed mode (16 MHz clock)
- (10) RTC requires external 32 kHz crystal. Without RTC 300nA less current
- (11)  $\mu C$  must run on internal RC oscillator or external 32 kHz crystal, as internal crystal oscillator is off
- (12) Max values at  $+85^{\circ}C$

## 13. A/D CONVERTER CHARACTERISTICS

| No | Item                                   | Remark  |
|----|--|---|
| 1  | ATD characteristics                    | Please refer to [2] 6.3.3 MCU ATD Characteristics |
| 2  | ATD timing/performance characteristics | Please refer to [2] 6.3.3 MCU ATD Characteristics |

The A/D high reference voltage VREFH is connected to pin 6 (VREFH)  
The A/D low reference voltage VREFL is internally connected to GND.

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#### 14. AC ELECTRICAL CHARACTERISTICS

$V_{CC} = 2.7V$ ,  $T_{amb} = 25^{\circ}C$ ,  $50\Omega$  load at EXANT, for all channels number 11,12,..., 26 according to [1]

| No<br>Nr | Receiver<br>Empfänger   | Limit |     |     | Unit<br>Einheit |
|----------|---|-------|-----|-----|-----------------|
|          |   | Min   | Typ | Max |                 |
| 1        | Sensitivity for 1% Packet Error Rate (PER),<br>-85dBm required by [1]               | -     | -92 | -87 | dBm             |
| 2        | Saturation (maximum input level)  | 0     | 10  | -   | dBm             |
| 3        | Adjacent Channel Interference for 1% PER<br>( $\pm 5MHz$ ; desired signal -82dBm)   | 0     | 29  | -   | dB              |
| 4        | Alternate Channel Interference for 1% PER<br>( $\pm 10MHz$ ; desired signal -82dBm) | 0     | 40  | -   | dB              |
| 5        | Frequency Error Tolerance   | -     | -   | 200 | kHz             |
| 6        | Symbol Rate Error Tolerance   | -     | -   | 80  | ppm             |
| 7        | In-band Spurious Emission   | -     | tbd | -   | dBm             |
| 8        | Spurious Emissions <1GHz  | -     | tbd | -57 | dBm             |
| 9        | Spurious Emissions >1GHz  | -     | tbd | -47 | dBm             |

| No<br>Nr | Transmitter<br>Sender                           | Limit |       |     | Unit<br>Einheit |
|----------|---|-------|-------|-----|-----------------|
|          |   | Min   | Typ   | Max |                 |
| 1        | Maximum Output Power <sup>(1)</sup>             | -3.0  | 0.0   | -   | dBm             |
| 2        | Nominal Output Power <sup>(2)</sup>             | -     | -4.0  | -   | dBm             |
| 3        | Minimum Output Power                            | -     | tbd   | -   | dBm             |
| 4        | Error Vector Magnitude (EVM)                    | -     | 25    | 35  | %               |
| 5        | Power Control Range                             | -     | 30    | -   | dB              |
| 6        | Over the Air Data Rate                          | -     | 250   | -   | kbps            |
| 7        | 2 <sup>nd</sup> harmonic @ maximum output power | -     | -50   | -30 | dBm             |
| 8        | 3 <sup>rd</sup> harmonic @ maximum output power | -     | -60   | -30 | dBm             |
| 9        | Spurious Emissions <1GHz                        | -     | < -40 | -36 | dBm             |
| 10       | Spurious Emissions >1GHz                        | -     | < -40 | -30 | dBm             |

| No<br>Nr | Stand By<br>In Bereitschaft | Limit |       |     | Unit<br>Einheit |
|----------|-----------------------------|-------|-------|-----|-----------------|
|          |                             | Min   | Typ   | Max |                 |
| 1        | Spurious Emissions <1GHz    | -     | < -60 | -57 | dBm             |
| 2        | Spurious Emissions >1GHz    | -     | < -50 | -47 | dBm             |

Notes:

- (1) SPI Register 12 programmed to 0xFF which sets output power to maximum.  
Measured at pin EXANT for the SMD pad version.
- (2) SPI Register 12 programmed to 0xBC which sets output power to nominal.  
Measured at pin EXANT for the SMD pad version.

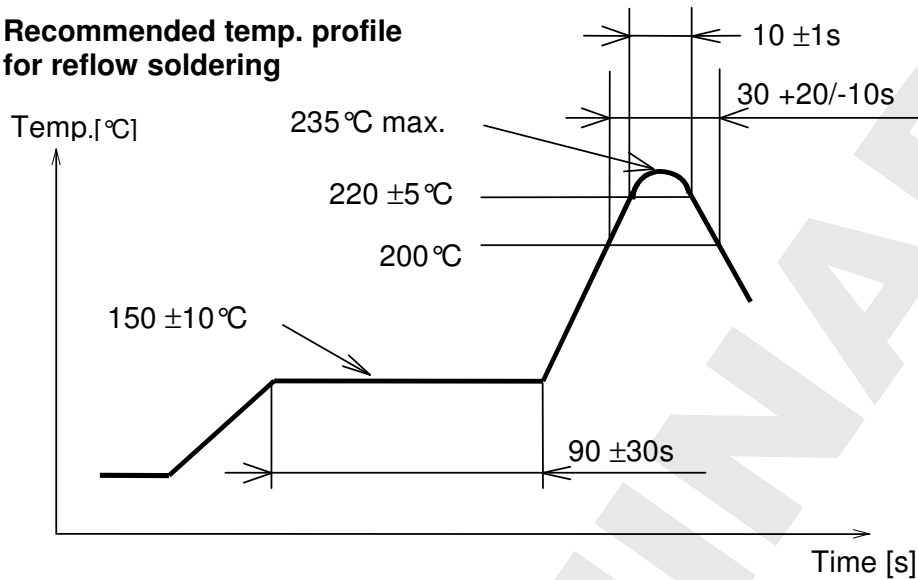
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15. SOLDERING TEMPERATURE-TIME PROFILE (FOR REFLOW SOLDERING)  
Temperatur-Zeit Profil für die Reflowlötung

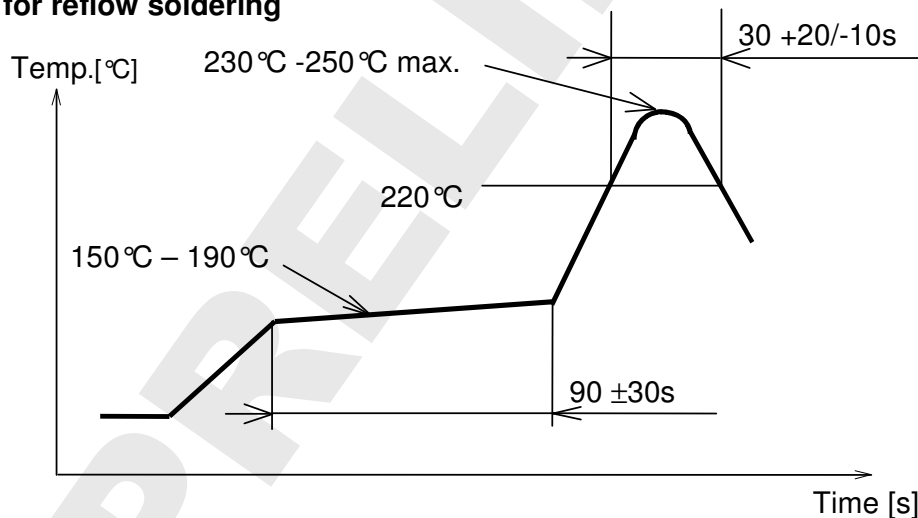
15.1. FOR LEAD SOLDER

**Recommended temp. profile  
for reflow soldering**



15.2. FOR LEADFREE SOLDER

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



Reflow permissible cycle: 2  
Opposite side reflow is prohibited due to module weight.

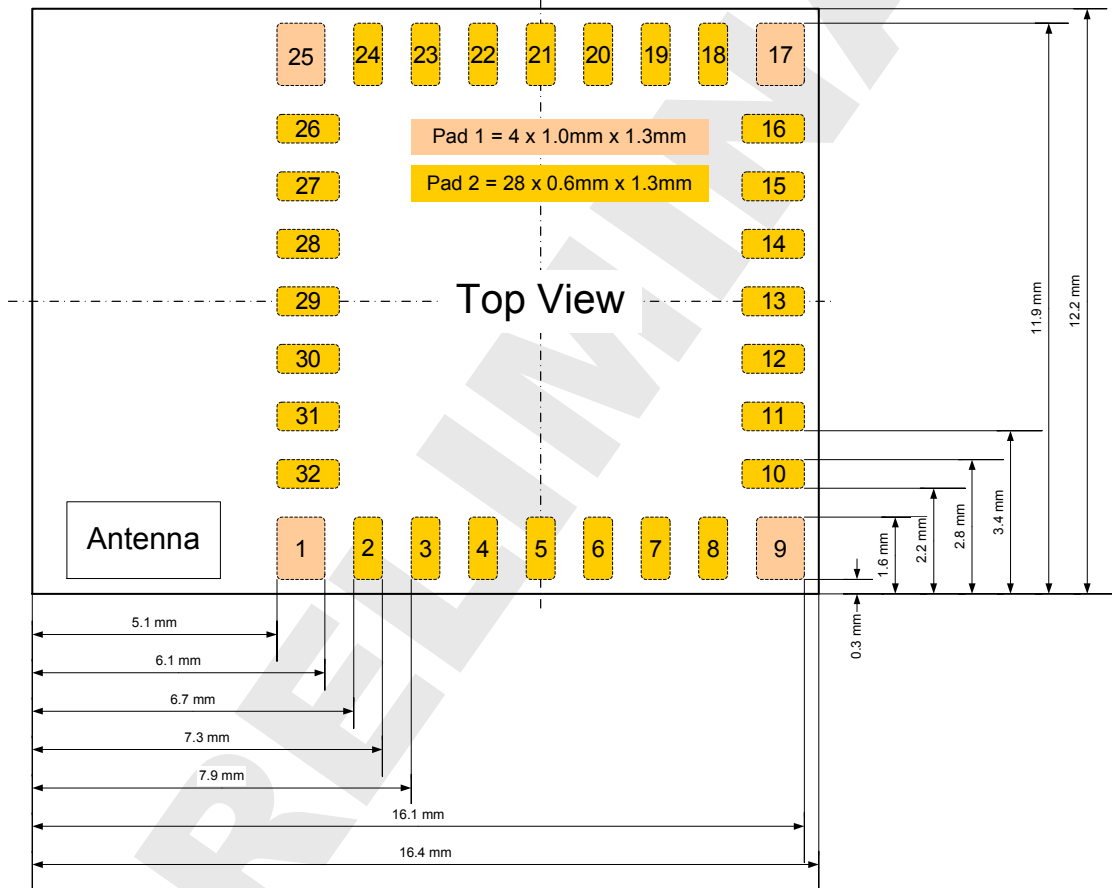
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## 16. MODULE DIMENSION Modulabmessungen

| No. | Item<br>Punkt | Dimension<br>Abmessung | Tolerance<br>Toleranz | Remark<br>Bemerkung |
|-----|---------------|------------------------|-----------------------|---------------------|
| 1   | Width         | 12.20                  | ± 0.20                |                     |
| 2   | Lenght        | 16.40                  | ± 0.20                |                     |
| 3   | Height        | 2.20                   | ± 0.20                | With case           |

## 17. FOOT PRINT OF THE MODULE Löt pads vom Modul



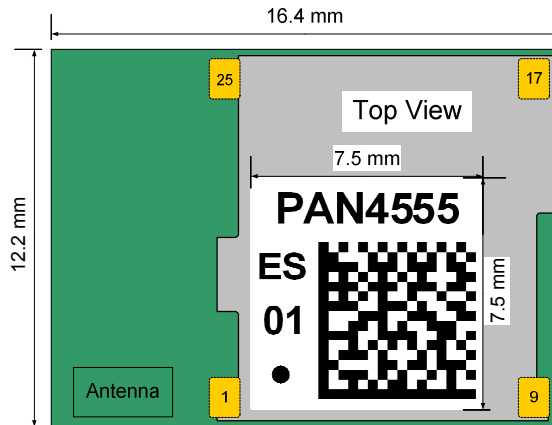
All dimensions in mm.  
The outer dimensions has a tolerance of ± 0.2mm.

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## 18. LABELING DRAWING

Kennzeichnung des Moduls durch Label



This label is suitable for reflow soldering and designed for the engineering sample status.

Information in the 2D-Barcode are the date code in the format Year-Month-Day [6 signs], serial number [6 signs], ordering number [8 signs; without ENW and F], the identifier for the hardware release [2 signs, now 01] and the ES, separated by a semicolon.

ES stands for Engineering Samples, please refer to chapter General Information.

In mass production status, the ES will be eliminated and replaced by a software identifier. And will be also implemented at the last information in the 2D-Barcode.

The point on the label is the identifier for pin 1 of the module.

01 is the hardware revision.

## 19. MECHANICAL REQUIREMENTS

Mechanische Anforderungen

| No. | Item Punkt                    | Limit Grenzwerte  | Condition Bedingung                                     |
|-----|-------------------------------|---|---|
| 1   | Solderability<br>Lötfähigkeit | More than 75% of the soldering area shall be coated by solder<br>Mehr als 75% der Lötfläche soll mit Lötpaste bedeckt sein. | Reflow soldering with recommendable temperature profile |
| 2   | Resistance to soldering heat  | It shall be satisfied electrical requirements and not be mechanical damage  | Please refer to chapter 15.2.                           |

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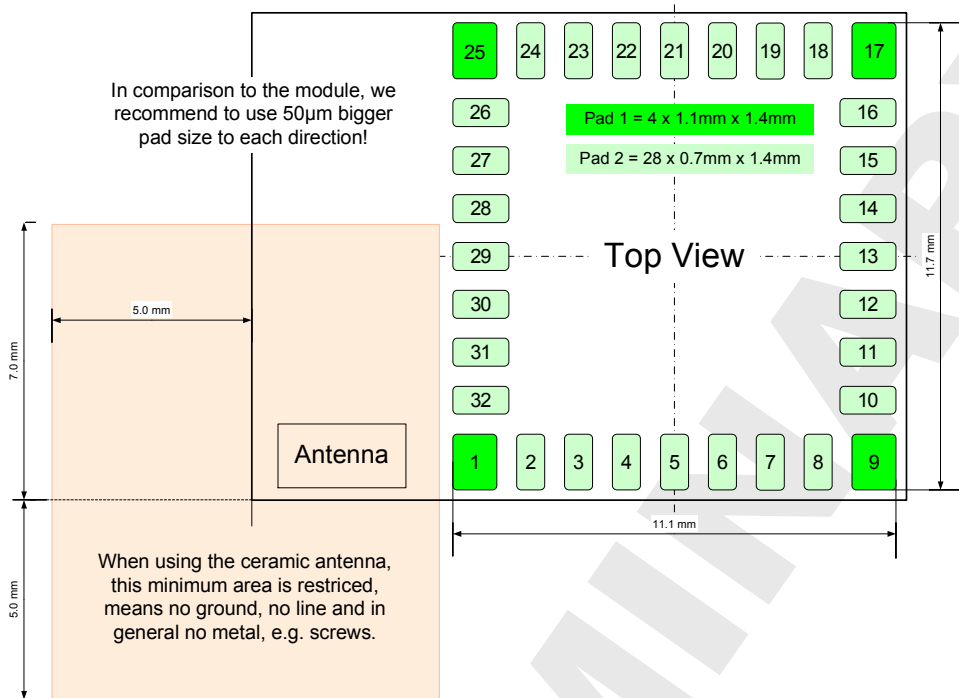
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DESIGNED  
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## 20. RECOMMENDED LAND PATTERN Empfohlenes Land Pattern



Dimensions in mm.

The land pattern dimensions above can serve as a guidance, but this information is given without any legal responsibility.

For your footprint, we recommend to use 50µm bigger size for the pads at each direction in comparison to the module footprint, please refer to chapter 17. Foot Print of the Module.

For the solder paste screen please use the same as for the module, but slight different measures and shapes of the solder paste screen cutouts might be optimum depending on your soldering process, for example on the chosen solder paste screen thickness. The solder screen thickness depends on your production standard, we recommend 120µm to 150µm.

### IMPORTANT:

The bottom side of PAN4555 is fully coated, nevertheless no copper, such as through hole vias, planes or tracks on your board component layer should be located below PAN4555 in order to avoid short cuts. In cases where a track or through hole via has to be located under the module it has to be kept away from PAN4555 bottom pads. The PN4555 multilayer pcb contains an inner RF shielding plane, therefore no pcb shielding plane below the module is needed.

When using the antenna pad version and if your application allows, please place the antenna on the edge of your carrier board.

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If you have any questions on these points, we are open to discuss your individual situation.

PRELIMINARY

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## 21. DEVELOPMENT OF APPLICATIONS WITH FREESCALE BEESTACK™

Entwicklung von Applikationen mit Hilfe des BeeStacks von freescale

This chapter are copied from [8], please refer to this document to get more information.

PAN4555 is built around the MC13213 single package from Freescale Inc. which includes the freescale ZigBee codebase BeeStack™ (downscaled versions of PAN4555 with MC1321x suited for IEEE802.15.4 or SMAC only are available on demand as well).

The access to BeeStack™ is provided after registration and login at <http://www.freescale.com/zigbee>. After login the BEEKITDOWNLOADPACKAGE.zip can be downloaded. This package contains BeeStack™, IEEE802.15.4 MAC and SMAC codebases. For PAN4555 PHY testing using TestTool™ the download of the latest 1321xEVK package is recommended.

After successful installation of Beekit on a PC open BeeKit. A ZigBee sample solution \*.bksln can be created in a few steps.

**Important:** Before a solution may be exported for PAN4555 the MC1321x target settings have to be changed via the "User defined target editor". The required changes are:

- Uncheck the "Use external Antenna Switch"
- Adjust the port settings depending on your application, the PAN4555 datasheet and for use of the PAN4555 carrier board the pin list in chapter PAN4555 PINLIST at [8].

For importing, compiling and debugging of the BeeKit™ solution the Integrated Development Environment (IDE) Metrowerks™ CodeWarrior from [www.metrowerks.com](http://www.metrowerks.com) is required.

As device flash programmer the USB HCS08/HCS12 Multilink from [www.pemicro.com](http://www.pemicro.com) is recommended.

**Important:** PAN4555 is a single RF port design with MC13213, refer also to AN3248. The Freescale reference boards 13213-NCB and 13213-SRB are dual port designs, software for these boards will not run.

The shipping of products which use ZigBee™ technology requires a membership of the ZigBee™ Alliance ([www.zigbee.org](http://www.zigbee.org)), at least as an adopter member, and is mandatory for the ZigBee™ product certification procedure and use of the ZigBee™ Logo.

The prices and fees as known from today are as follows:

- IDE CodeWarrior order number CWS-H08-C64K-CX from [www.metrowerks.com](http://www.metrowerks.com) : US\$ 995,-.
- USB HCS08/HCS12 Multilink ([www.pemicro.com](http://www.pemicro.com)), orderable at [www.freescale.com/zigbee](http://www.freescale.com/zigbee) with the ID USBMULTILINKBDM: US\$ 99,-
- BeeStack™: The support fee after a 30 days period free of charge required by Freescale

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Inc. is US\$ 500,-.

- Companies selling products using ZigBee™ technology have to be a member of the ZigBee™ Alliance ([www.zigbee.org](http://www.zigbee.org)). The minimum fee per year for a membership as adopter is US\$ 3500,-.
- For adopter members the fee for listing the first product at ([www.zigbee.org](http://www.zigbee.org)) is US\$ 1000,-.
- The cost of a ZigBee™ product certification at a test house (TÜV Rheinland) ranges from approximately US\$ 4000,- to US\$ 8000,-, depending on the implemented software.

## 22. RELIABILITY TESTS

### Zuverlässigkeitstests

The measurement should be done after exposed to room temperature and humidity for 1 hour.

Die Messungen sollten erst nach einer Stunde Lagerung unter normalen Bedingungen erfolgen.

| No. | Item Punkt      | Limit Grenzwerte                                | Condition Bedingung  |
|-----|-----------------|---|--|
| 1   | Vibration test  | Electrical parameter should be in specification | a) Freq.:10~50Hz, Amplitude:1.5mm<br>a) 20min. / cycle, 1hrs. each of XYZ axis<br>b) Freq.:30~100Hz, 6G<br>b) 20min. / cycle, 1hrs. each of XYZ axis |
| 2   | Shock test      | the same as the above                           | Dropped onto hard wood from height of 50cm for 3 times   |
| 3   | Heat cycle test | the same as the above                           | -40 °C for 30min. and +85 °C for 30min.;<br>each temperature 300 cycles  |
| 4   | Moisture test   | the same as the above                           | +60 °C, 90% RH, 300h   |
| 5   | Low temp. test  | the same as the above                           | -40 °C, 300h   |
| 6   | High temp. test | the same as the above                           | +85 °C, 300h   |

## 23. CAUTIONS

### Warnungen

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

### 23.1. NOTES OF DESIGN

#### Designhinweise

- (1) Please follow the condition written in this specification, especially the control signals of this module.
- (2) The supply voltage has to be free of ac ripple voltage, as for example from a battery or a low noise regulator output. For noisy supply voltages provide a decoupling circuit as 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 stressed when installed.
- (4) Heat is the major cause of shortening the life of these products. Please keep this product away from heat.  
Avoid assembly and use of the target equipment in conditions where the

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- products' temperature may exceed the maximum allowable.
- (5) The supply voltage should not be exceeding or reverse, and should not carry noise and spike.
  - (6) Please keep this product away from other high frequency circuits.

### 23.2. NOTES OF INSTALLATION

#### Verarbeitungshinweise

- (1) Reflow soldering is possible for twice on the condition in chapter 15. Please 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 stressed or vibrated when reflowed.
- (6) Please keep the following conditions when you install this product for reparation by hand soldering.
- (7) Please do not wash this product.
- (8) Please refer to the recommended pattern when designing a board.
- (9) Pressing on parts of the metal cover or fastening objects to the metal cover is not allowed.

### 23.3. NOTES OF USAGE CONDITIONS

#### Benutzerhinweise

- (1) Please take measure against static electricity. If pulses or other transient loads (a large load applied in a short time) are applied to the products, then before use, check and evaluate their operation when assembled on your products.
- (2) Please do not use the fallen product.
- (3) Please do not put on damage and dirt to the pin , and don't touch the electric components.
- (4) Please follow the condition written in the ratings , about the power supply instruments 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 is not allowed.
- (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.

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#### 23.4. NOTES OF STORAGE

##### Lagerhinweise

- (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:
  - 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>
  - Storage in direct sunlight
  - 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.
  - Storage of the products for more than one year after the date of delivery at your company if all the above conditions (1) to (3) have been avoided
- (3) Storage period: Please check the adhesive strength of the embossed tape and soldering after 6 months of storage.
- (4) Please keep this product away from water, poisonous gas and corrosive gas.
- (5) This product should not be stressed or shocked when transported.
- (6) Please follow the specification when piling up the packed crate ( max. 10).

#### 23.5. CAUTIONS FOR SAFETY

##### Sicherheitshinweise

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

Before use, check and evaluate their 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 at least, 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.

#### 23.6. OTHER CAUTIONS

##### Weitere Hinweise

- (1) This specification sheet is copyrighted. Please do not open it to the third party.
- (2) Please do not use this product of our company for another purpose.
- (3) Be sure to provide an appropriate fail-safe function on your product to prevent a second damage that may be caused by the abnormal function or the failure of our 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

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conditions carefully to determine whether or not they can be used in such a manner.

- In liquid, such as water, salt water, oil, alkali, or organic solvent, or in places where liquid may splash.
  - In direct sunlight, outdoors, or in a dusty environment
  - In an environment where condensation occurs.
  - 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>)
- (6) 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.
- (7) When you have any question or uncertainty, both of you and Panasonic sincerely cope with it.

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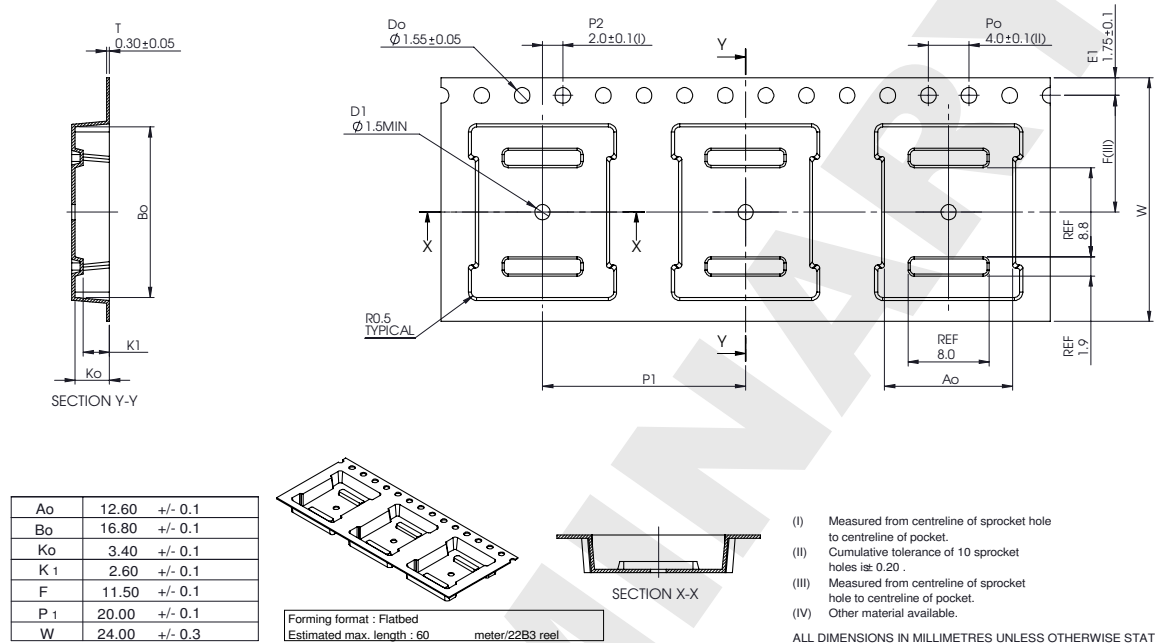
PRELIMINARY

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|------------------------------|---|-------------------------|------------|
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## 24. PACKAGING

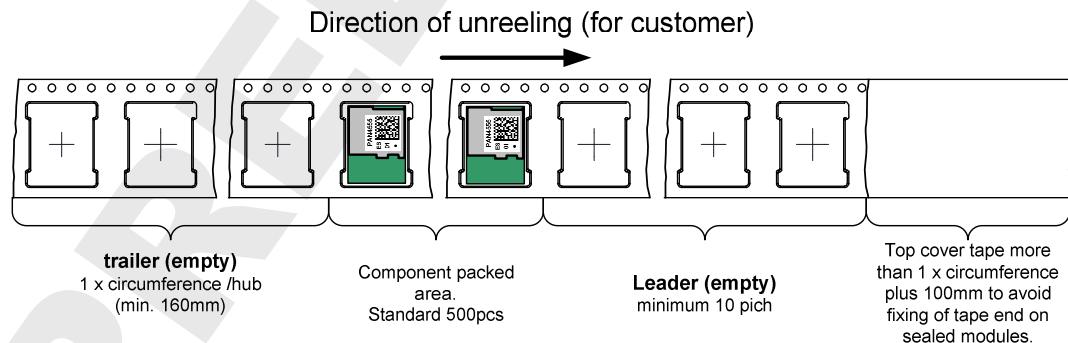
### Verpackung

#### 24.1. TAPE DIMENSION



This package will be available latest as the mass production status are confirmed.

#### 24.2. PACKING IN TAPE



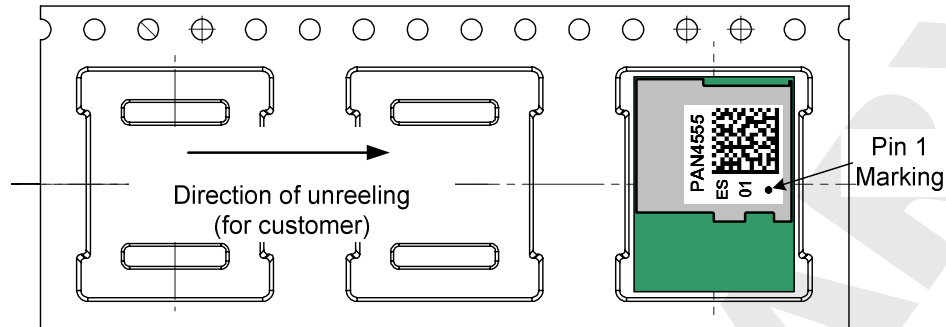
Empty hollow in component packed area shall be less than two per reel and those hollows shall not be consecutive.

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

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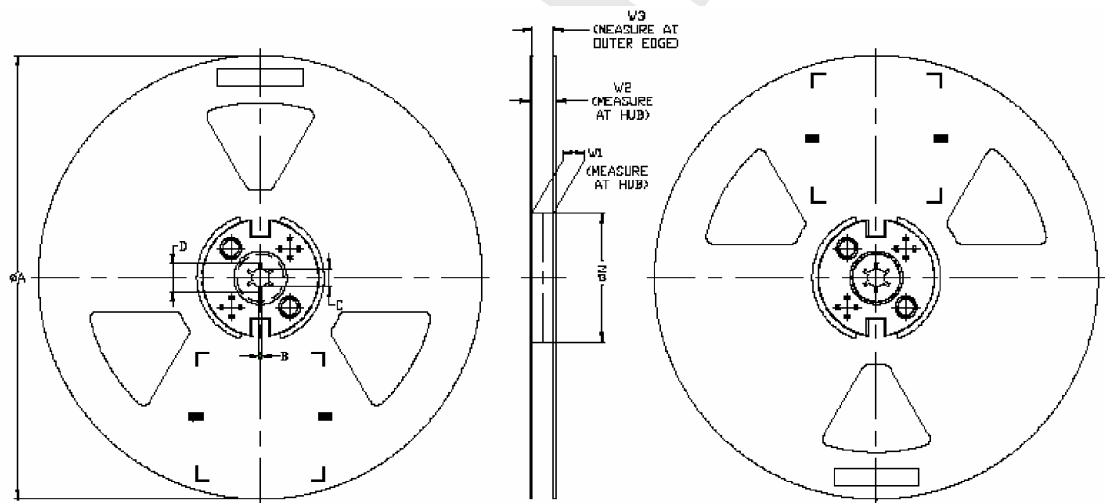
### 24.3. COMPONENT DIRECTION Komponentenanordnung



Please refer also to chapter 18. Labeling Drawing

This package will be available latest as the mass production status are confirmed.

### 24.4. REEL DIMENSION



| TAPE SIZE | A<br>MAX | B<br>MIN | C                          | D<br>MIN | N<br>±1.0 | W1                           | W2<br>MAX | W3                           | Assembly<br>Method     |
|-----------|----------|----------|----------------------------|----------|-----------|------------------------------|-----------|------------------------------|------------------------|
| 24mm      | 330.0    | 1.5      | 13 <sup>+0.5</sup><br>-0.2 | 20.2     | 100.0     | 25.0 <sup>+2.0</sup><br>-0.0 | 30.4      | 24.4 <sup>+3.0</sup><br>-0.5 | *Latch<br>*Latch (2PC) |

All dimensions in millimeters unless otherwise stated

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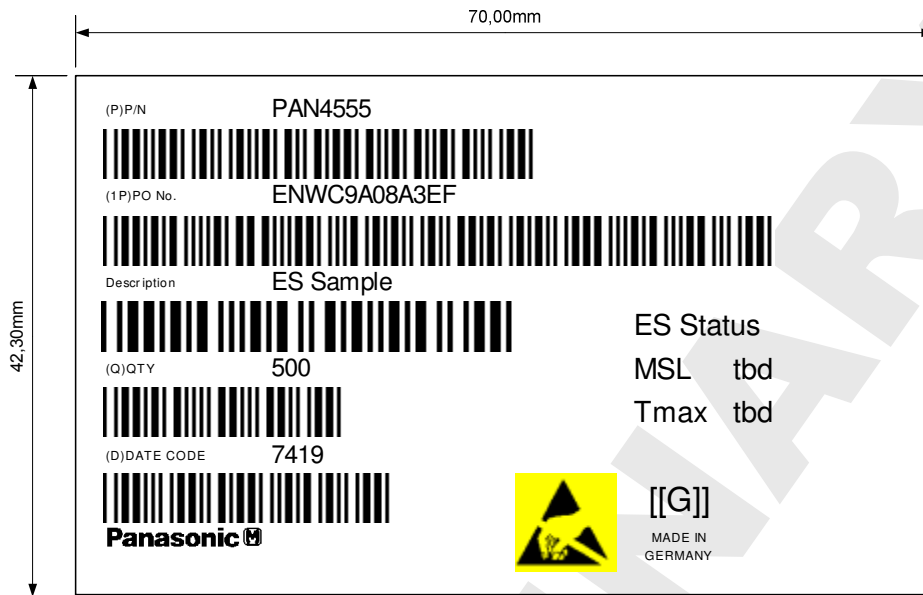
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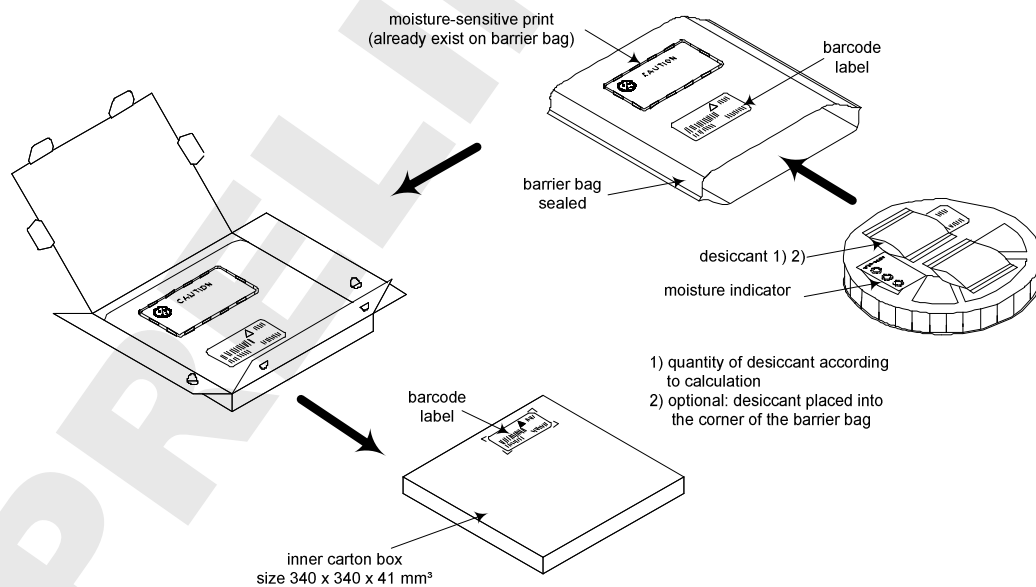
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### 24.5. LABEL FOR PACKAGE



The label must be stick 3 times, reel, barrier bag and inner carton box.

### 24.6. TOTAL PACKING HANDLING



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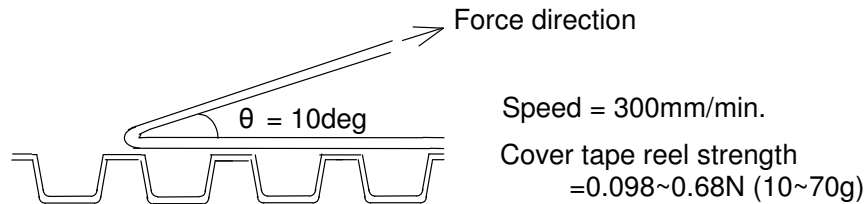
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## 24.7. COVER TAPE REEL STRENGTH



## 25. ORDERING INFORMATION

### Bestellinformationen

| Ordering part number        | Description   | MOQ <sup>(1)</sup> |
|-----------------------------|---|--------------------|
| ENWCZA08A3EF <sup>(2)</sup> | Engineering Sample ZigBee ready<br>PAN4555, 2.4GHz ZigBee ready with Ceramic Antenna<br>60kBit Flash Memory         | 1                  |
| ENWCZA09N4EF <sup>(2)</sup> | Engineering Sample ZigBee ready<br>PAN4555, 2.4GHz ZigBee ready with RF out on a SMD pad<br>60kBit Flash Memory     | 1                  |
| ENWC9A08A3EF <sup>(3)</sup> | Mass Production Sample ZigBee ready<br>PAN4555, 2.4GHz ZigBee ready with Ceramic Antenna<br>60kBit Flash Memory     | 500 <sup>(4)</sup> |
| ENWC9A09N4EF <sup>(3)</sup> | Mass Production Sample ZigBee ready<br>PAN4555, 2.4GHz ZigBee ready with RF out on a SMD pad<br>60kBit Flash Memory | 500 <sup>(4)</sup> |

#### Note:

- (1) Minimum order quantity.
- (2) The "Z" in the ordering part number, refers to the engineering sample status. After mass production the "Z" will be changed to the "9".
- (3) Could only be ordered, if we released the mass production status.  
If we finishing, this document will change from PRELIMINARY to RELEASE also the revision status will move from alphabetic numbering to 1.0.
- (4) On special agreement we can also deliver in lower quantity!

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## 26. ROHS DECLARATION

### RoHS-Erklärung

Declaration of environmental compatibility for supplied products:

Hereby we declare to our best present knowledge based on declaration of our suppliers that this product do not contain by now the following substances which are banned by Directive 2002/95/EC (RoHS) or if contain 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

## 27. DATA SHEET STATUS

### Datenblatt 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.

Please consult the most recently issued data sheet before initiating or completing a design. If there is an update, please download under: [PAN4555 Latest Data Sheet!](#)

## 28. REGULATORY INFORMATION

### 28.1. FCC NOTICE



The device PAN4555, including the ceramic antenna (ENWC9A08A3EF) and also the SMD type (ENWC9A09N4EF), including with the antennas, which are listed in 28.5, 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.

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## 28.2. 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 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

## 28.3. LABELING REQUIREMENTS



The Original Equipment Manufacturer (OEM) must ensure that FCC labeling requirements are met. This includes a clearly visible label 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 are **FCC ID: T7VPAN4555**. This FCC identifier is valid for both versions, for details, please see the chapter 25. Ordering Information.

Due to the size limitation, the EUT could not be labelled with the FCC ID: T7VPAN4555. However the FCC ID can be read from the UART of the device with the AT command "FCC ID ?" and the module will answer with FCC ID: T7VPAN4555.

In any case end product must be labelled exterior with "Contains FCC ID: T7VPAN4555"

## 28.4. ANTENNA WARNING



The related part number for this device is ENWC9A09N4EF (PAN4555 with SMD pad). For details, please see the chapter 25. Ordering Information. This device are 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: T7VPAN4555).

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## 28.5. 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    | BKR2400     | Embedded Antenna Design Ltd. | 2.4GHz         | ½ Wave Dipole | +2         |
| 2    |             |                              |                |               |            |

## 28.6. RF EXPOSURE PAN4555



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 PAN4555 with mounted ceramic antenna (FCC ID: T7VPAN4555) is far below the FCC radio frequency exposure limits.

Nevertheless, the PAN4555 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.

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## 29. RELATED DOCUMENTS

### Mitgeltende Dokumente

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 Data MC1321x Document Number: MC1321x  
Rev. 1.1, 03/2007 Freescale Semiconductor
- [3] MC1321x Reference Manual Document Number: MC1321xRM  
Rev. 1.1, 10/2006 Freescale Semiconductor
- [4] Handling MAC Address erasure, AN2825, Rev. 0.0 10/2004, Freescale Semiconductor
- [5] 802154MPSUG 802.15.4 MAC/PHY Software User's Guide, Rev 1.1, Freescale Semiconductor
- [6] 802154EBRM.pdf 802.15.4 / ZigBee Embedded Bootloader Reference Manual Rev. 0.0 09/2004
- [7] AN2771 ZigBee/802.15.4 PHY Protocol Test Client (PTC) Rev. 0.0 Freescale Semiconductor
- [8] Manual to the Evaluation Kit from Panasonic  
Downloadable under: [www.pedeu.panasonic.de](http://www.pedeu.panasonic.de).
- [9] Manual to the E-Senza SN55 Programmer Interface Manual  
Downloadable under: [www.pedeu.panasonic.de](http://www.pedeu.panasonic.de).

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### 30. GENERAL INFORMATION

#### Allgemeine Informationen

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

Please contact the related product manager in every case.

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

Panasonic Electronic Devices Europe GmbH rejects any liability or product warranty for Engineering Samples. In particular, Panasonic Electronic Devices Europe GmbH disclaims liability for damages caused by

- the use of the Engineering Sample other than for Evaluation Purposes, particularly the installation or integration in an other product to be sold by Customer,
- deviation or lapse in function of Engineering Sample,
- improper use of Engineering Samples.

Panasonic Electronic Devices Europe GmbH disclaims any liability for consequential and incidental damages. In case of any questions, please contact your local sales partner or the related product manager.

### 31. LIFE SUPPORT POLICY

#### Politik für Lebenserhaltungssysteme

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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