



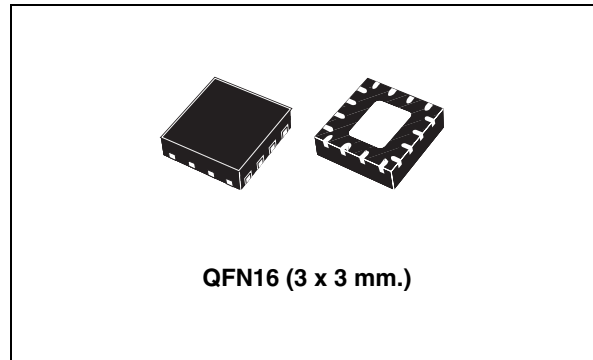
STPMS1

Smart sensor dual-channel first-order sigma-delta modulator with embedded PGA

Data brief

Features

- V_{CC} supply range: 3.2 V - 5.5 V
- Two first-order sigma-delta ($\Sigma\Delta$) modulators
- Programmable chopper-stabilized low noise and low offset amplifier
- Supports 50-60 Hz, IEC 687/1036 spec for class1 AC watt meters
- Less than 0.1% error over 1:1000 range
- Internal low drop regulator at 3 V (typ.)
- Precision voltage reference: 1.23 V and 30 ppm/ $^{\circ}$ C max.



Applications

- Power metering
- ADC converters

Description

The STPMS1, also called a “smart sensor” device, is an ASSP designed for effective measurement in power line systems utilizing the Rogowski coil, current transformer or shunt principle. It is used in combination with the STPMC1 programmable poly-phase energy calculator IC, as a building block for single-phase or multi-phase energy meters.

The STPMS1 is a mixed signal IC consisting of an analog and a digital section. The analog section consists of one preamplifier and two first-order $\Sigma\Delta$ modulator blocks, band-gap voltage reference, a low-drop voltage regulator and DC buffers, while the digital section consists of a clock generator and output multiplexer.

Table 1. Device summary

| Order code | Package | Packaging |
|------------|------------------|---------------------|
| STPMS1BPQR | QFN16 (3 x 3 mm) | 2500 parts per reel |

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1 General operation description

The STPMS1 performs A/D conversions of analog signals on two independent channels in parallel. There is a current channel for measuring line current and a voltage channel for measuring line voltage. The converted $\Sigma\Delta$ signals are multiplexed in time to reduce the number of external connections. The conversion and the multiplex are driven by an external clock signal which has twice the frequency, as it is used to strobe the analog inputs.

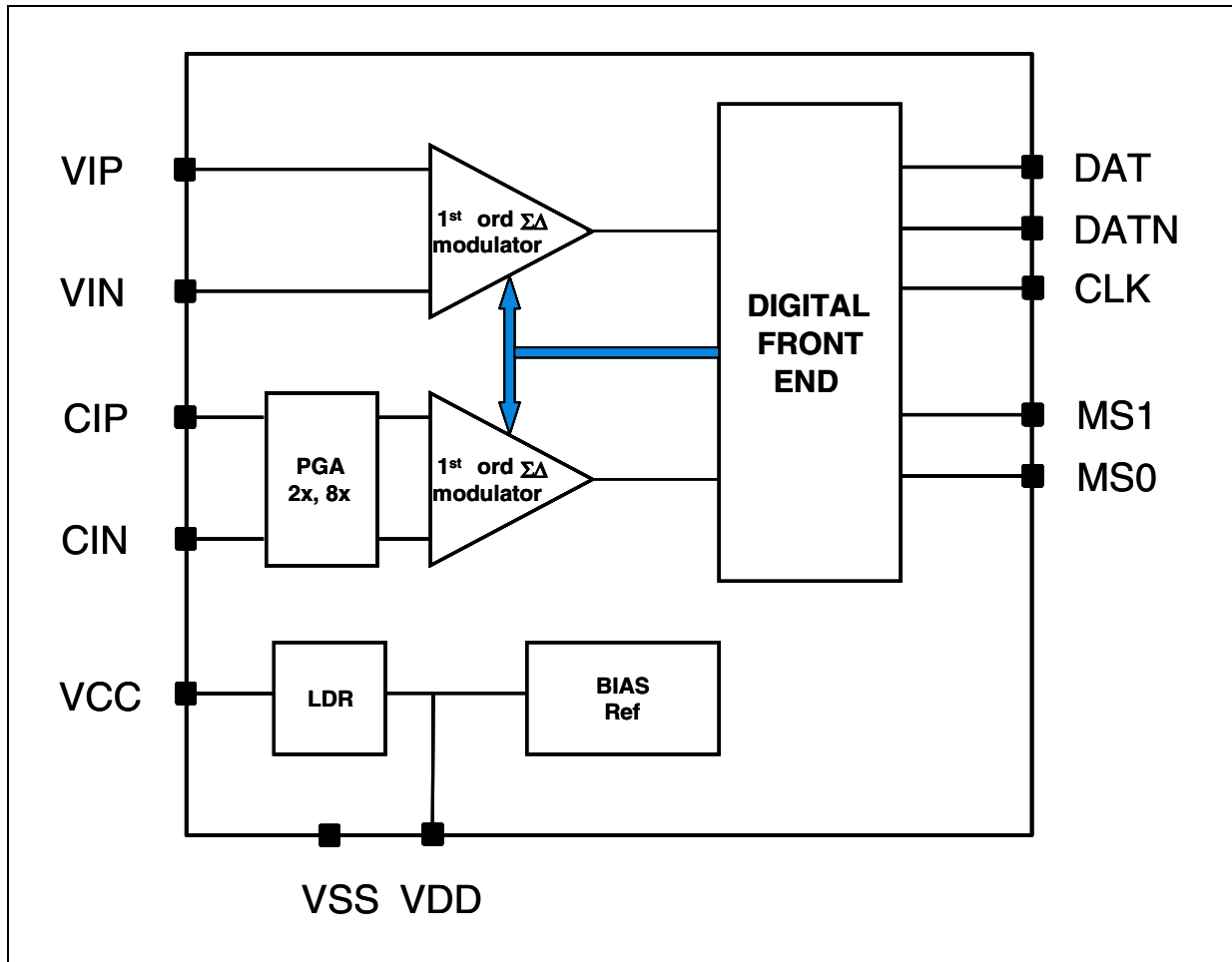
The voltage channel is connected externally and differentially to a line voltage divider which provides an analog signal proportional to the voltage v . The current channel is connected to a Rogowski coil, or to a current transformer (CT) or shunt, which are used to interface the line current. The coil provides an analog signal proportional to di/dt , while the shunt or CT provides an analog signal proportional to the current i . There should be an anti-aliasing LP filter of $f_C = 5$ kHz inserted between the sensors and the inputs of both channels of the STPMS1. A CT differs from shunt in sensitivity and phase error.

Internally, the differential voltage of the voltage channel is connected directly to the A/D converter, which implies a preamplification of x4 and uses a 0.6152 V reference voltage. On the other hand, the differential voltage of the current channel is connected to a x4 preamplifier first and the output of this preamplifier to the similar A/D converter, which implies selectable preamplification of x2 or x8 and uses the same reference voltage.

A pair of digital inputs (MS0 and MS1) is used to select the configuration of device.

2 Schematic diagram

Figure 1. Block diagram



3 Pin configuration

Figure 2. Pin connections

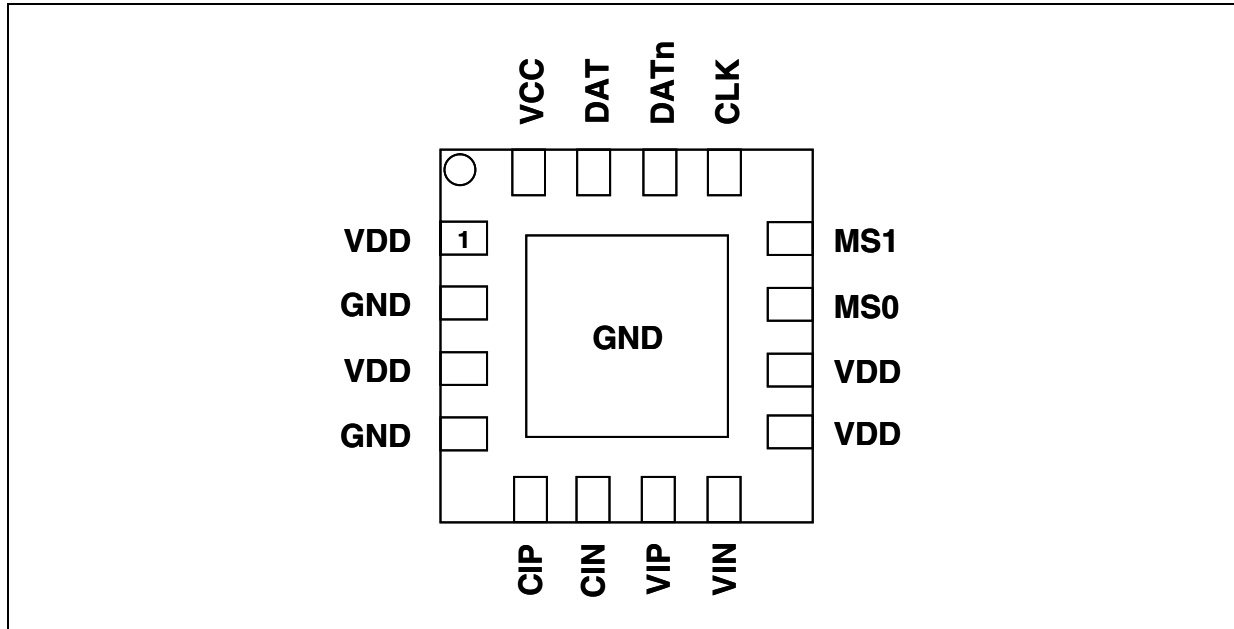


Table 2. Pin description

| Pin | Symbol | Description |
|---------|--------|---|
| 1 | VDD | Output of internal +3.0 V low drop regulated power supply |
| 2 | GND | Ground level for signals and pin protection |
| 3 | VDD | Output of internal +3.0 V low drop regulated power supply |
| 4 | GND | Ground level for signals and pin protection |
| 5 | CIP | Current channel + |
| 6 | CIN | Current channel - |
| 7 | VIP | Voltage channel + |
| 8 | VIN | Voltage channel - |
| 9 | VDD | Output of internal +3.0 V low drop regulated power supply |
| 10 | VDD | Output of internal +3.0 V low drop regulated power supply |
| 11 | MS0 | Input for configurator 0 |
| 12 | MS1 | Input for configurator 1 |
| 13 | CLK | Input for external measurement clock |
| 14 | DAT | Output of multiplexed $\Sigma\Delta$ signal |
| 15 | DATn | Output of multiplexed $\Sigma\Delta$ signal negated |
| 16 | VCC | Unregulated supply voltage for padding, band gap, low drop and level shifters |
| Exp PAD | GND | Ground level for signals and pin protection |

4 Application information

Figure 3. Application schematic

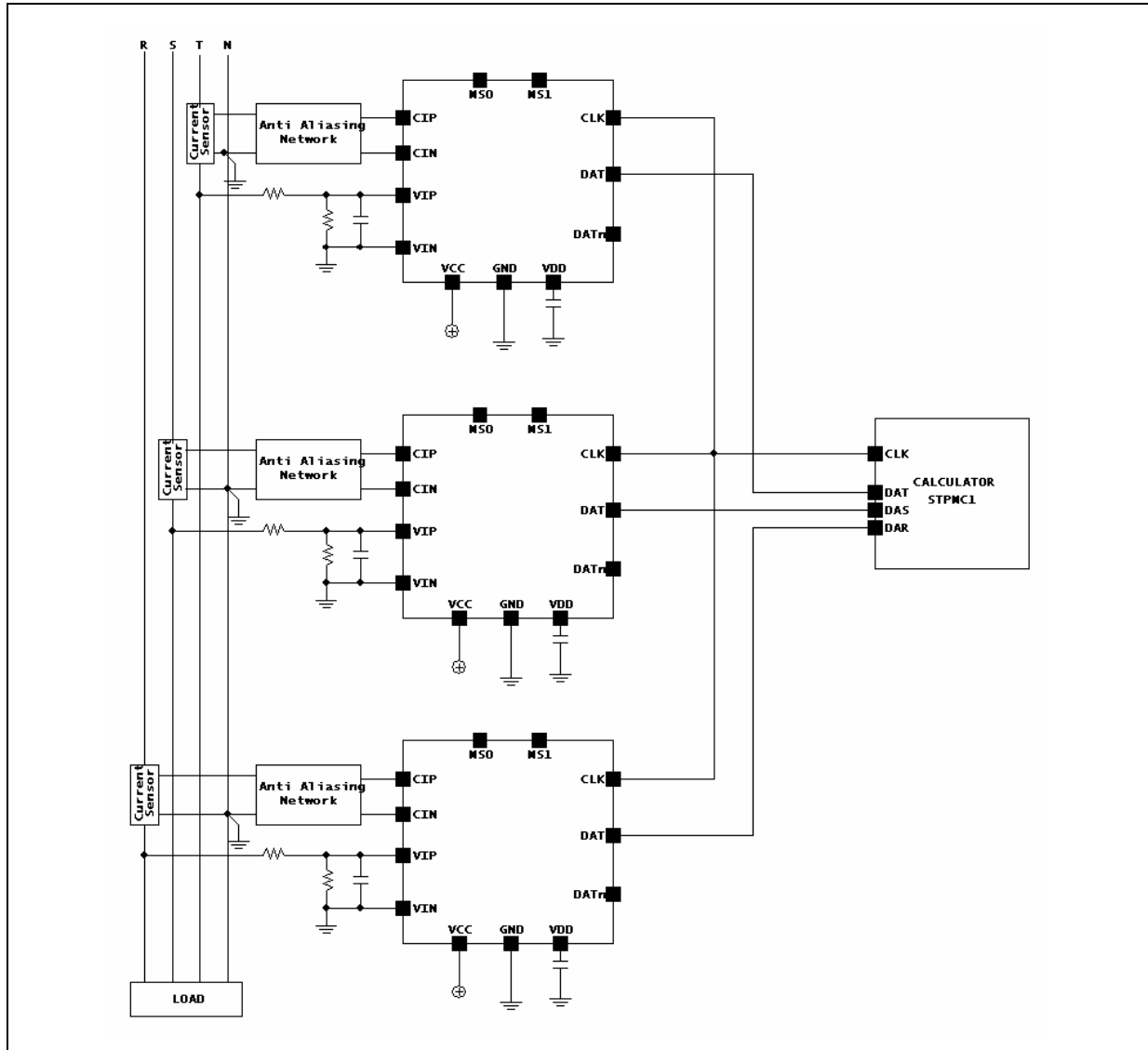


Table 3. List of external components

| Component | Description | Value | Tolerance | | Unit |
|---------------|-----------------------------|-------|-----------|--------|------|
| Calculator | STPMC1 | - | - | - | - |
| Divider | Interfaces the line voltage | 1:780 | ± 1% | 50 ppm | V/V |
| Rogowski coil | Interfaces the line current | 3 | ± 12% | - | mV/A |
| CT | Interfaces the line current | 30 | ± 12% | - | mV/A |
| Shunt | Interfaces the line current | 0.2 | ± 5% | - | mV/A |

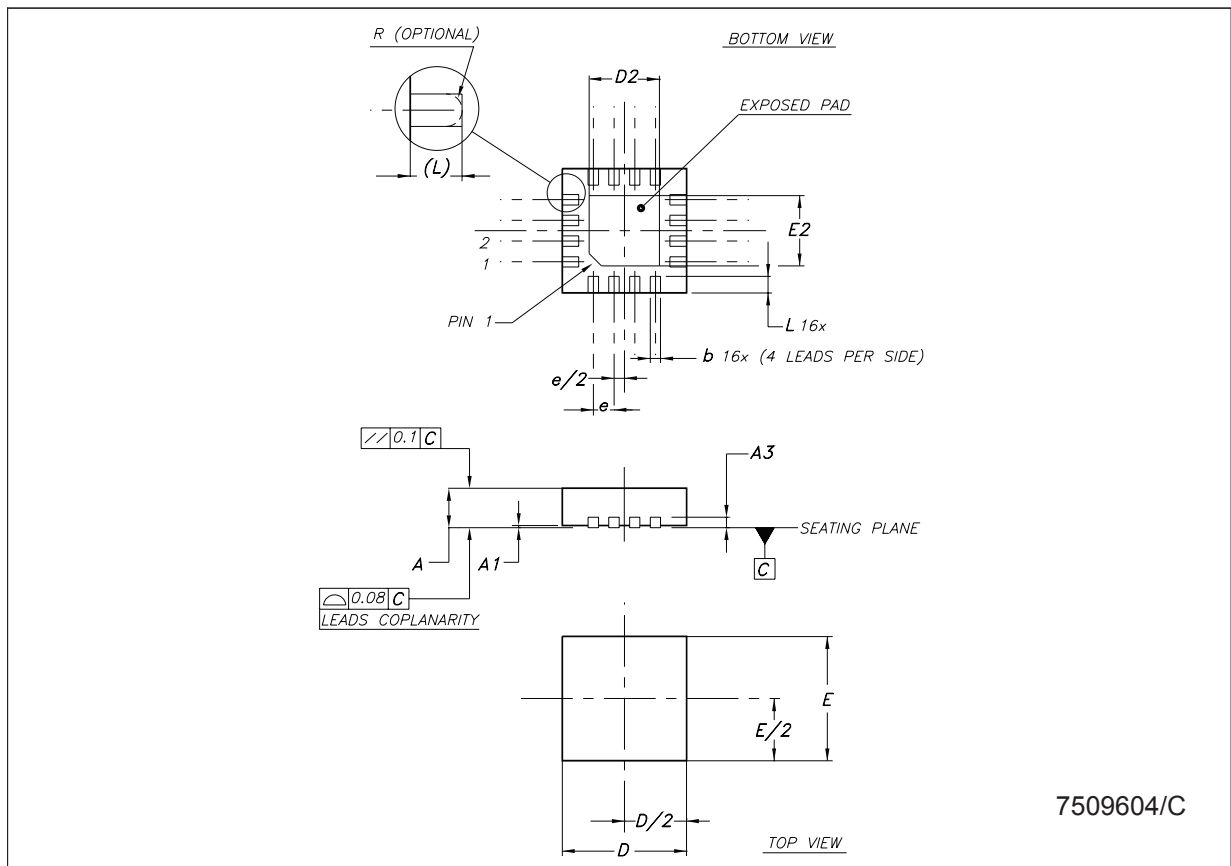
Note: The above-listed components refer to a typical metering application. Operation of the STPMS1 is not limited to the choice of these external components.

5 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] packages, depending on their level of environmental compliance. ECOPACK[®] specifications, grade definitions and product status are available at: www.st.com. ECOPACK[®] is an ST trademark.

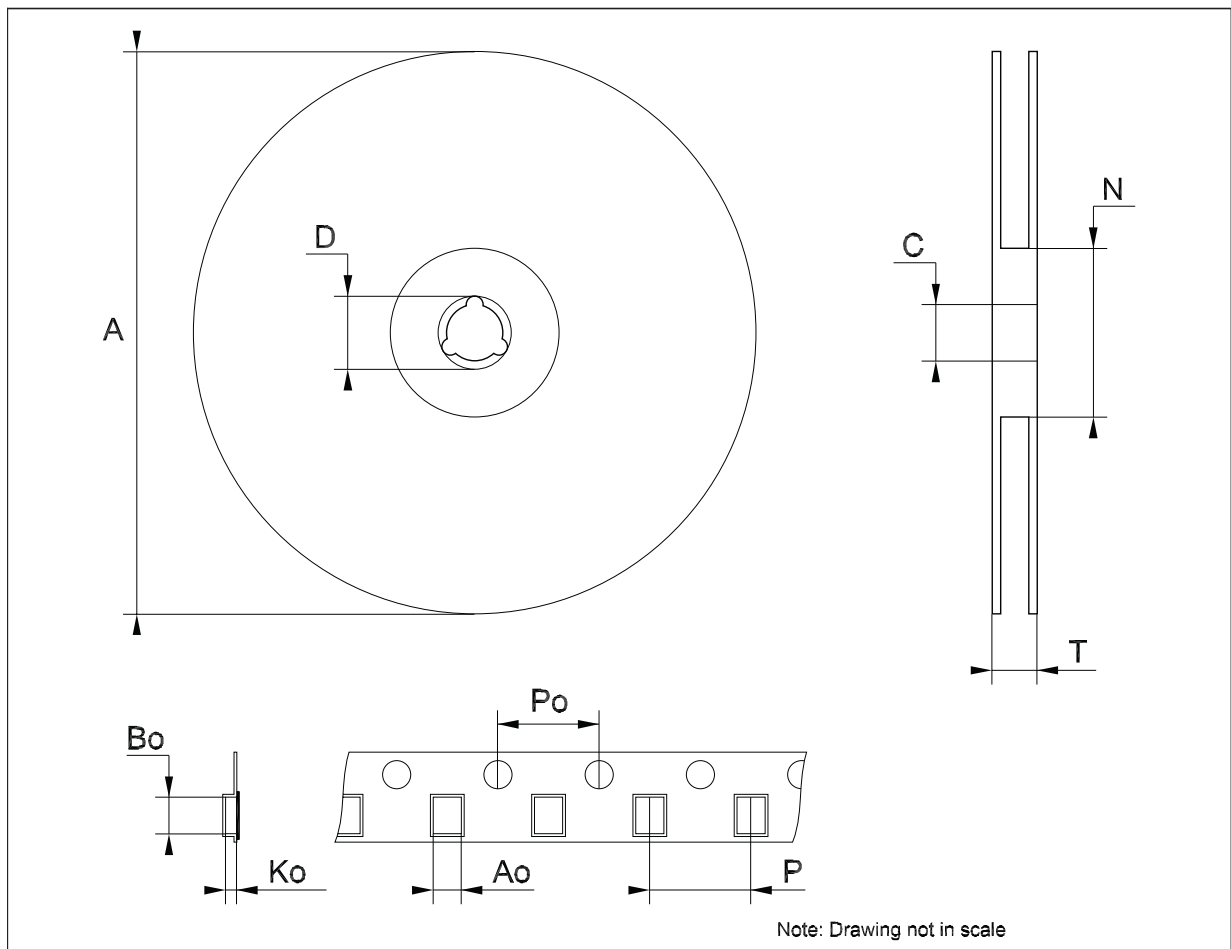
QFN16 (3 x 3 mm.) mechanical data

| Dim. | mm. | | | inch. | | |
|------|------|------|------|-------|-------|-------|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 0.80 | 0.90 | 1.00 | 0.031 | 0.035 | 0.039 |
| A1 | 0 | | 0.05 | | | 0.002 |
| A3 | | 0.20 | | | 0.008 | |
| b | 0.18 | | 0.30 | 0.007 | | 0.012 |
| D | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| D2 | 1.50 | | 1.80 | 0.059 | | 0.071 |
| E | | 3.00 | | | 0.118 | |
| E2 | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| e | | 0.50 | | | 0.020 | |
| L | 0.30 | | 0.50 | 0.012 | | 0.020 |



Tape & reel QFNxx/DFNxx (3 x 3 mm.) mechanical data

| Dim. | mm. | | | inch. | | |
|------|------|------|------|-------|-------|-------|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 180 | | | 7.087 |
| C | 12.8 | | 13.2 | 0.504 | | 0.519 |
| D | 20.2 | | | 0.795 | | |
| N | 60 | | | 2.362 | | |
| T | | | 14.4 | | | 0.567 |
| Ao | | 3.3 | | | 0.130 | |
| Bo | | 3.3 | | | 0.130 | |
| Ko | | 1.1 | | | 0.043 | |
| Po | | 4 | | | 0.157 | |
| P | | 8 | | | 0.315 | |



6 Revision history

Table 4. Document revision history

| Date | Revision | Changes |
|-------------|----------|------------------|
| 23-Oct-2009 | 1 | Initial release. |

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