STPM32, STPM33, STPM34

ASSP for metering application with up to 4 independent 24-bit 2nd order sigma-delta ADC and 2 embedded PGLNA

Data brief

QFN24   QFN32

Features

- Active power accuracy:
  - < 0.1% error over 5000:1 dynamic range
  - < 0.5% error over 10000:1 dynamic range
- Reactive power accuracy:
  - < 0.1% error over 2000:1 dynamic range
- Exceeds 50 - 60 Hz EN 50470-x, IEC 62053-2x, ANSI12.2x standards requirements for AC watt meters
- Fundamental and wide band energy
- Dual mode apparent energy
- Instantaneous and average power
- RMS and instantaneous voltage and current
- Overvoltage and undervoltage detection
- Overcurrent detection with programmable threshold
- Alternate UART and SPI serial interface with programmable CRC polynomial verification
- Programmable LED and interrupt outputs
- Four independent 24-bit 2nd order $\Delta\Sigma$ ADC
- Two programmable gain chopper stabilized low-noise and low offset amplifiers
- 3.6 kHz at -3 dB bandwidth
- 3.3 V ± 10% V_{CC} supply voltage
- 4 mA typ. I_{CC} supply current (STPM33)
- 16 MHz input clock frequency, Xtal or external source
- 1.23 V Twin precision voltage reference with independent programmable TC, 30 ppm/°C typ.

- 3 V and 1.2 V (typ.) internal low drop regulators
- STPM32 package: QFN24
- STPM33/34 package: QFN32
- Operating temperature: -40 °C up to +85 °C

Description

The STPM3x is an ASSP family designed for high accuracy measurement of power and energies in power line systems using the Rogowski coil, current transformer or shunt current sensors.

It is a mixed signal IC family with an analog and a digital section. The analog section consists of up to two programmable gain low-noise low offset amplifiers and up to four 2nd order 24-bit $\Delta\Sigma$ ADC, two independent BandGap voltage references with temperature compensation, a low drop voltage regulator and DC buffers. The digital section consists of a digital filtering stage, a hardwired DSP, a DFE to the input modulators, and a serial communication interface (UART or SPI).
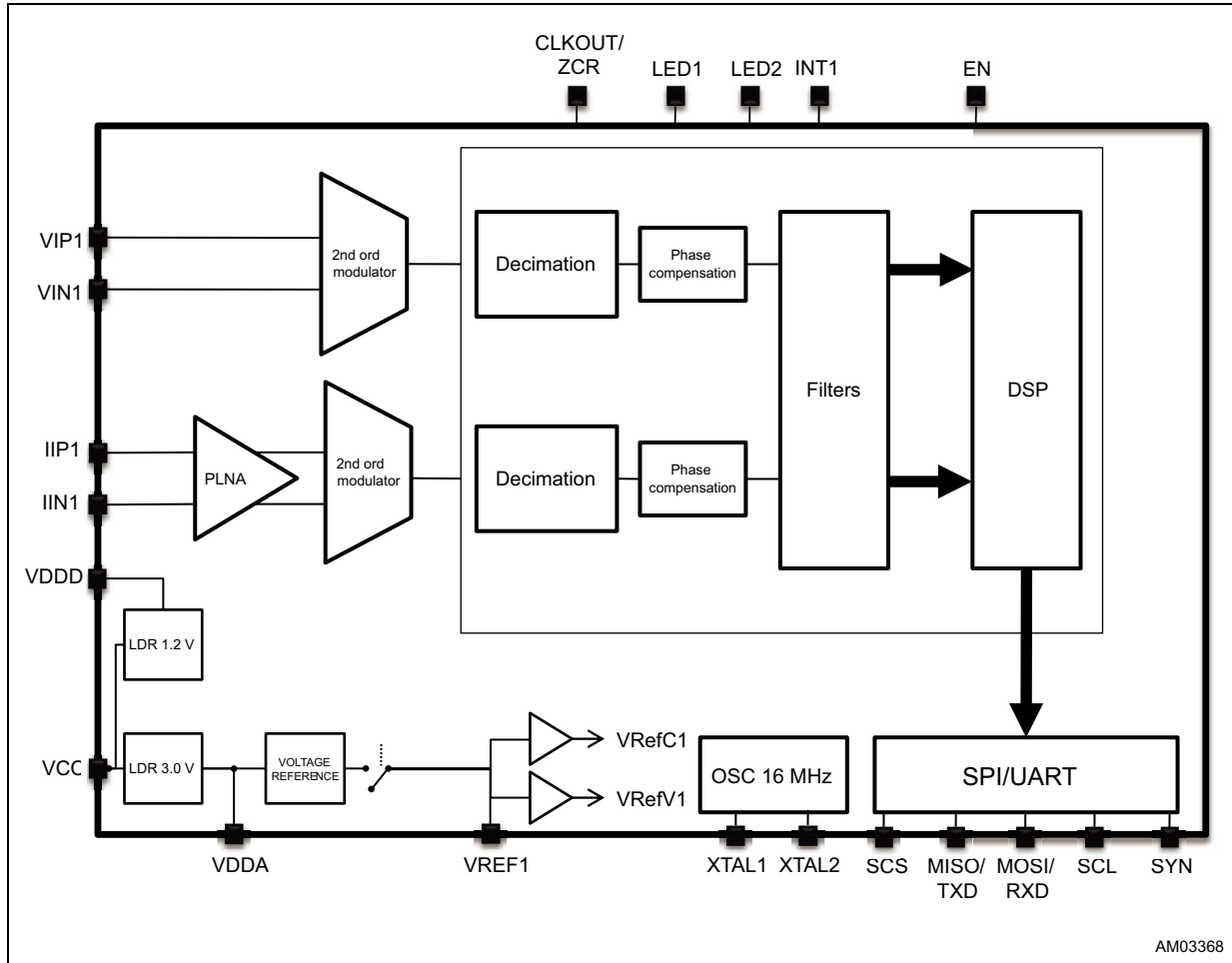
The devices are able to calculate instantaneous and RMS voltage and currents, active, reactive and apparent power and energies. They are fully configurable and allow a fast digital calibration in a single point over the entire current dynamic range.

Table 1. Device summary

Order codes	Package	Packaging
STPM32	QFN24	Tube
STPM32TR	QFN24	Tape and reel
STPM33	QFN32	Tube
STPM33TR	QFN32	Tape and reel
STPM34	QFN32	Tube
STPM34TR	QFN32	Tape and reel

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1 Block diagrams

Figure 1. STPM32 block diagram
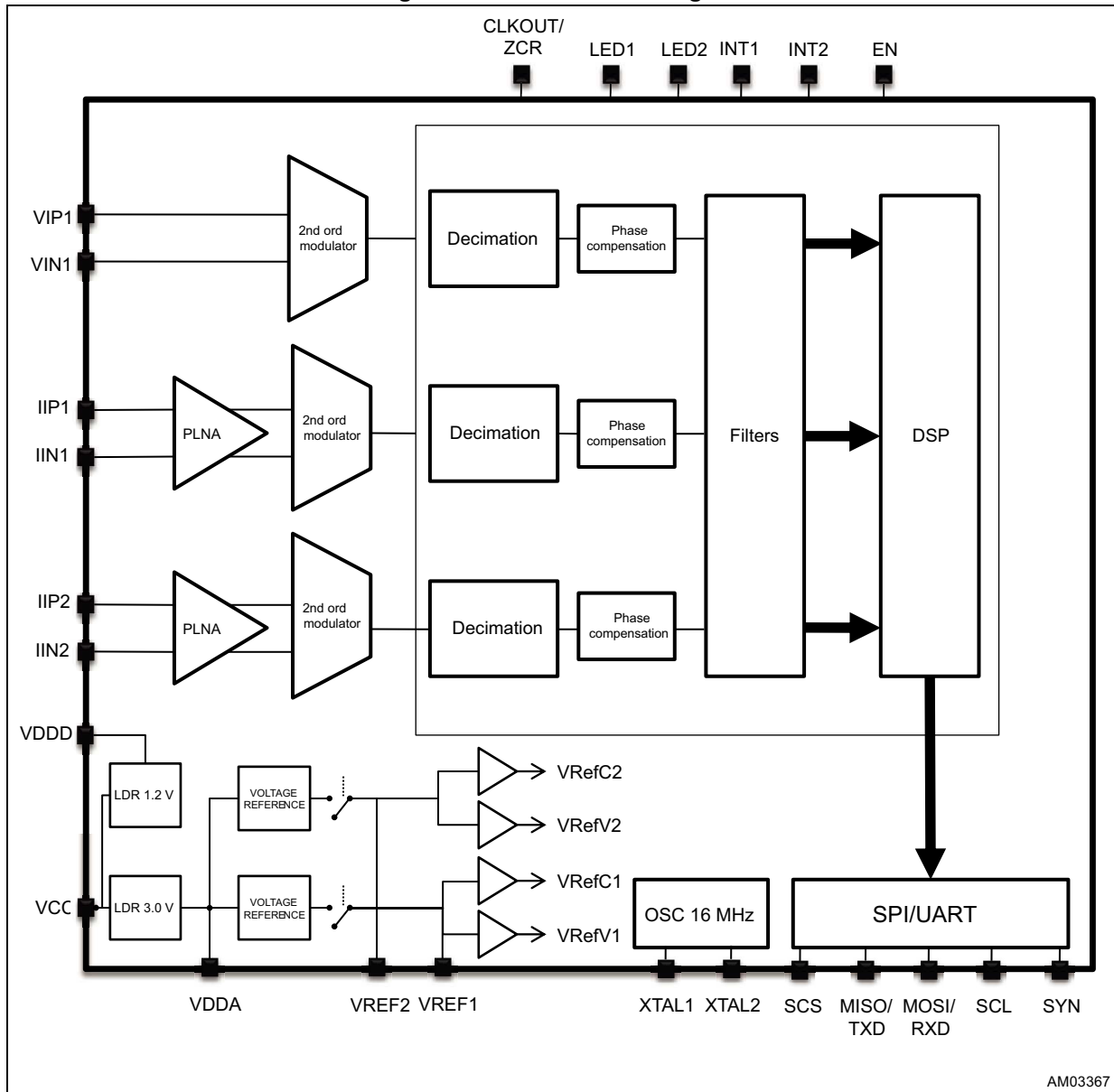
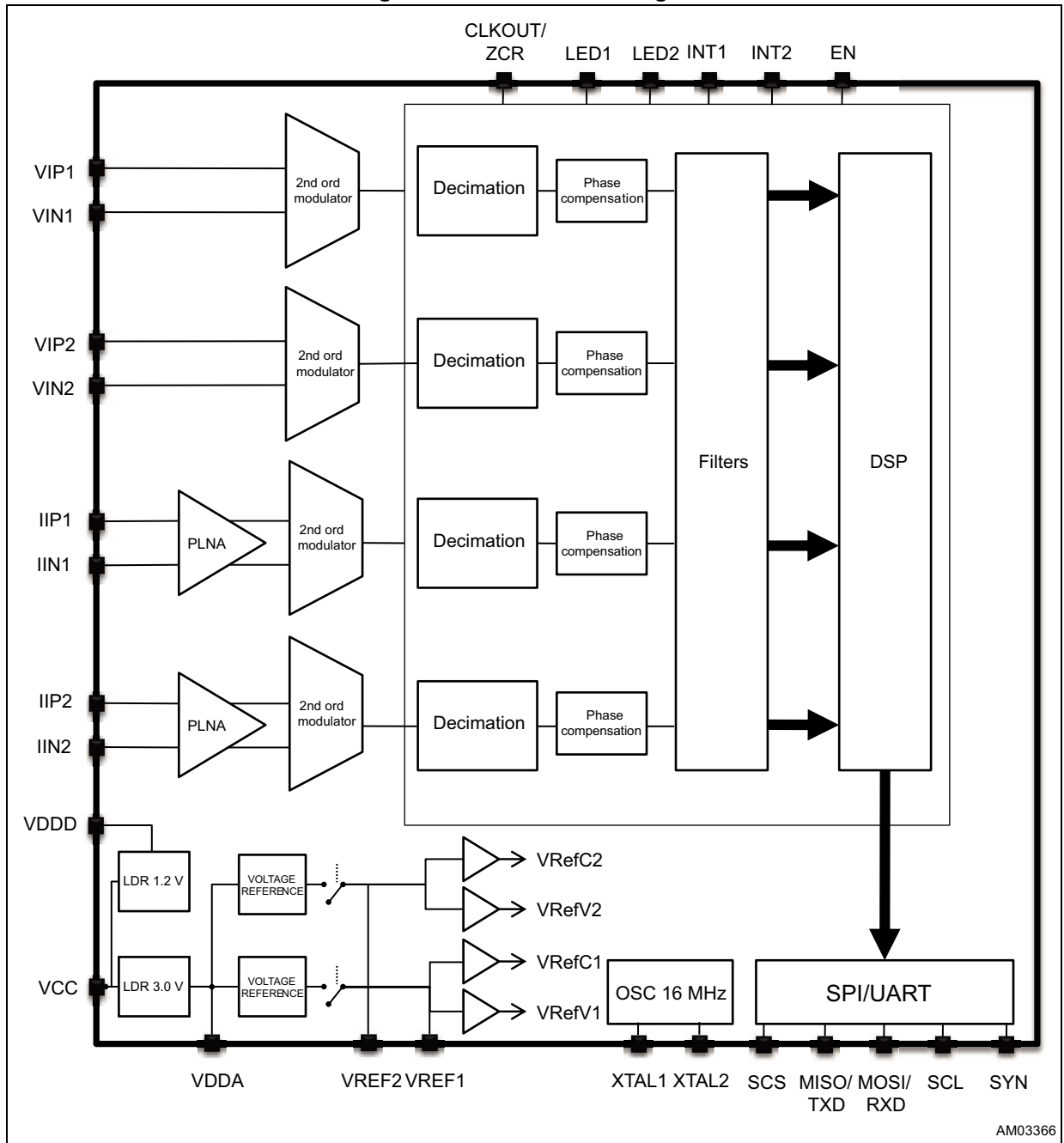## Figure 2. STPM33 block diagram

Figure 3. STPM34 block diagram

2 Pin configuration

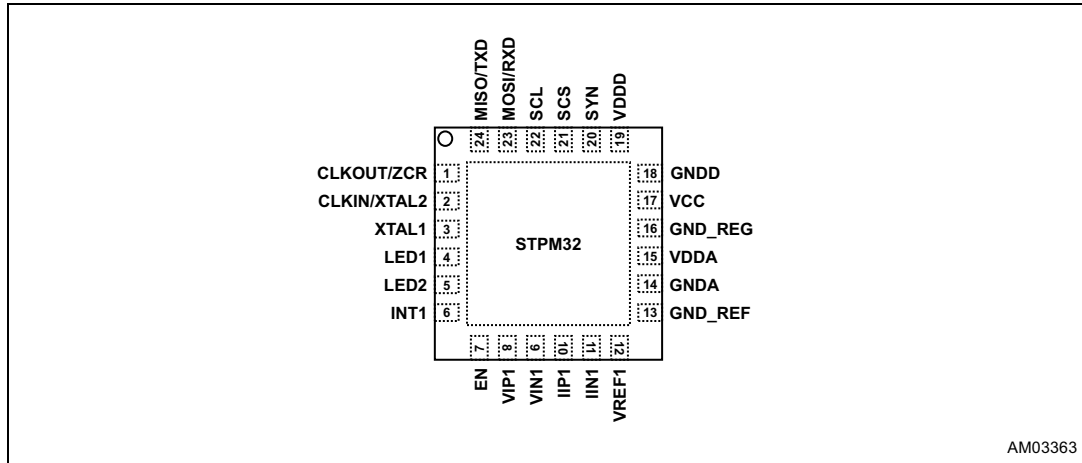**Figure 4. Package pinout STPM32 (top view), 4 x 4 QFN24L 0.5 pitch**

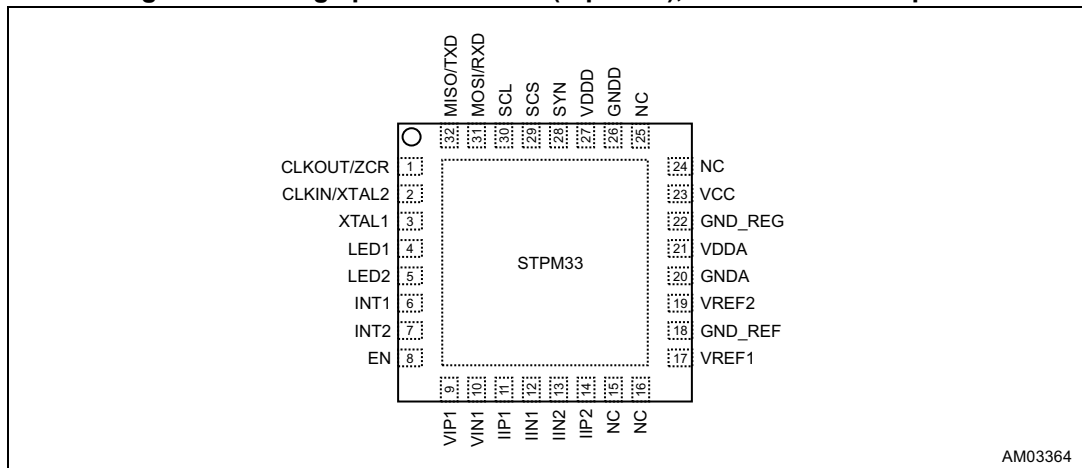**Figure 5. Package pinout STPM33 (top view), 5 x 5 QFN32L 0.5 pitch**

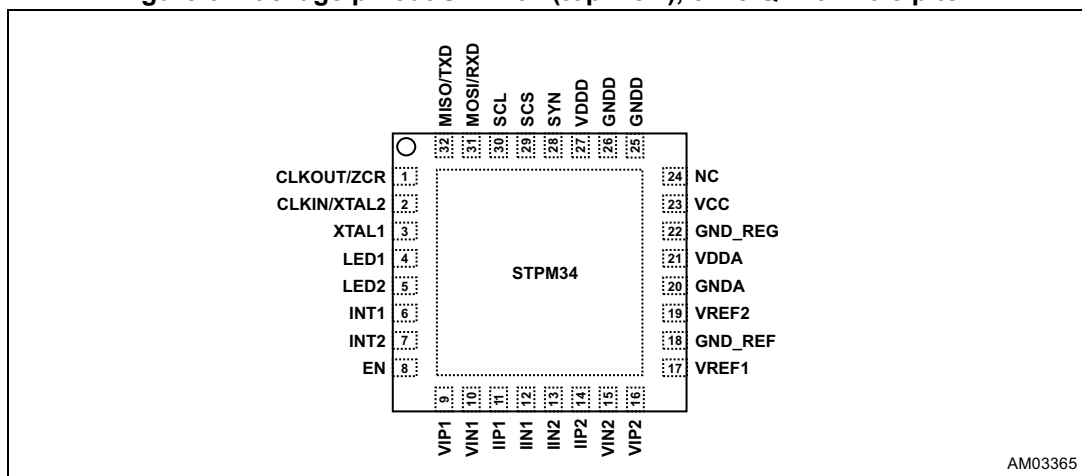**Figure 6. Package pinout STPM34 (top view), 5 x 5 QFN32L 0.5 pitch**

Table 2. Pin description STPM34, STPM33, STPM32

STPM34	STPM33	STPM32	Name	Voltage range	Functional section
1	1	1	CLKOUT/ZCR	From 0 to V_{CC}	Multifunctional
2	2	2	CLKIN/XTAL2	From 0 to V_{CC}	Oscillator
3	3	3	XTAL1	From 0 to V_{CC}	Oscillator
4	4	4	LED1	From 0 to V_{CC}	Multifunctional
5	5	-	LED2	From 0 to V_{CC}	Multifunctional
6	6	5	INT1	From 0 to V_{CC}	Multifunctional
7	7	-	INT2	From 0 to V_{CC}	Multifunctional
8	8	6	EN	From 0 to V_{CC}	Signal
9	9	7	VIP1	From -0.3 V to 0.3 V	Signal
10	10	8	VIN1	From -0.3 V to 0.3 V	Signal
11	11	9	IIP1	From -0.3 V to 0.3 V	Signal
12	12	10	IIN1	From -0.3 V to 0.3 V	Signal
13	13	-	IIN2	From -0.3 V to 0.3 V	Signal
14	14	-	IIP2	From -0.3 V to 0.3 V	Signal
15	-	-	VIN2	From -0.3 V to 0.3 V	Signal
16	-	-	VIP2	From -0.3 V to 0.3 V	Signal
17	17	12	VREF1	About 1.2 V	Power
18	18	13	GND_REF		Power
19	19	-	VREF2	About 1.2 V	Power
20	20	14	GNDA		Power
21	21	15	VDDA	3.0 V	Power
22	22	16	GND_REG		Power
23	23	17	VCC	From 3.0 V to 3.6 V	Power
24	15, 16, 24, 25	11	N.C.		
25, 26	26	18	GNDD		Power
27	27	19	VDDD	1.2 V	
28	28	20	SYN	From 0 to V_{CC}	SPI
29	29	21	SCS	From 0 to V_{CC}	SPI/UART
30	30	22	SCL	From 0 to V_{CC}	SPI
31	31	23	MOSI/RXD	From 0 to V_{CC}	SPI/UART
32	32	24	MISO/TXD	From 0 to V_{CC}	SPI/UART

3 Electrical characteristics

Absolute maximum ratings

Table 3. Absolute maximum ratings[1]

Symbol	Parameter	Value	Unit
V_{CC}	DC input voltage	-0.3 to 4.2	V
I_{PIN}	Current on any pin (sink/source)	±150	mA
V_{ID}	Input voltage at any pin	-0.3 to V_{CC} + 0.3	V
V_{IA}	Input voltage at analog pins (VIP, VIN, IIP, IIN)	-0.7 to 0.7	V
ESD	Human body model (all pins)	±2	kV
TOP	Operating ambient temperature	-40 to 85	°C
T_J	Junction temperature	-40 to 150	°C
T_{STG}	Storage temperature range	-55 to 150	°C

1. Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

Table 4. Thermal data

Symbol	Parameter	Package	Value	Unit
R_{thJA}	Thermal resistance junction-ambient	QFN24	TBD	°C/W
R_{thJA}	Thermal resistance junction-ambient	QFN32	TBD	°C/W

4   Functions

Pin programmability

Table 5. Programmable pin functions

Name	Multiplexed function	Functional description
CLKOUT/ZCR	System clock out signals	Output CLK pin (DClock, CIC clock, modulator clock, main clock)
	Zero crossing	Line voltage/current zero crossing
LED1	Programmable pulse out 1	Primary channel energies (A, AF, R, S)
		Secondary channel energies (A, AF, R, S)
		Primary ± secondary channels energies (A, AF, R, S)
	SD out current (DATI1)	Sigma-delta bitstream of primary current channel
LED2	Programmable pulse out 2	Primary channel energies (A, AF, R, S)
		Secondary channel energies (A, AF, R, S)
		Primary ± secondary channels energies (A, AF, R, S)
	SD out current (DATI2)	Sigma-delta bitstream of secondary current channel
INT1	Interrupt	Programmable interrupt 1
	SD out voltage (DATV1)	Sigma-delta bitstream of primary voltage
INT2	Interrupt	Programmable interrupt 2
	SD out voltage (DATV2)	Sigma-delta bitstream of secondary voltage
SCS	SPI/UART select	Serial port selection at power-up
	Chip select	SPI/UART chip select
MOSI/RXD	SPI master OUT slave IN	SPI
	UART Rx	UART
MISO/TXD	SPI master IN slave OUT	SPI
	UART Tx	UART

5   Theory of operation

General operation description

The STPM3x product family is able to measure up to two line voltages and up to two line currents to perform active, reactive and apparent power and energy, RMS and instantaneous values, and line frequency information measurement of a single, split or poly-phase metering system.

The STPM3x platform generates up to two independent train pulse output signals proportional to the active, reactive, apparent or cumulative power. It also generates up to two programmable interrupts output signals.

The internal register map and the configuration registers can be accessed by means of an SPI or UART interface.

Up to four independent input channels can be converted in parallel via the delta-sigma ($\Delta\Sigma$) analog-to-digital converters into a binary stream with appropriate non-overlap control signal generator.

This technique is specifically suitable to measure electrical line parameters (voltage and current) starting from analog signals transduced by voltage and current sensors (inductive Rogowski coil, current transformer or shunt resistors). The current channel inputs are connected, through external anti-aliasing RC filter, to a Rogowski coil or a current transformer (CT) or a shunt current sensor, which converts line current into a voltage signal. Each current channel includes a low-noise voltage preamplifier with a programmable gain and has a fully differential input. The converted $\Delta\Sigma$ signals are fed to the internal decimation filter stages which decimate the 4 MHz bit-streams by a 512 factor, allowing a 3.6 kHz bandwidth at -3 dB. The 24-bit format voltages and currents data are then fed to the internal configurable filtering blocks and then to the hardwired DSP which performs the final computation of metrology quantities.

The product family embeds also two programmable temperature compensated BandGap reference voltage generators and a low drop supply voltage regulator. All reference voltages are properly designed to eliminate channels cross talking.

The operation mode and all the configuration parameters can be setup through dedicated configuration registers.

6 Package information

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.

Figure 7. QFN24L 4 x 4 x 1 mm, 0.5 mm pitch package outline

Table 6. QFN24L 4 x 4 x 1 mm, 0.5 mm pitch package mechanical data

Symbol	Dimensions (mm)		
	Min.	**Typ.**	**Max.**
A	0.80	0.90	1.00
A1	0.00	0.02	0.05
b	0.18	0.25	0.30
D	3.90	4.00	4.10
D2	2.55	2.70	2.80
E	3.90	4.00	4.10
E2	2.55	2.70	2.80
e	0.45	0.50	0.55
K	0.20	-	-
L	0.25	0.35	0.45

Figure 8. QFN32 5 x 5 x 1.0 mm, 0.5 pitch package outline

QFN5x5-32
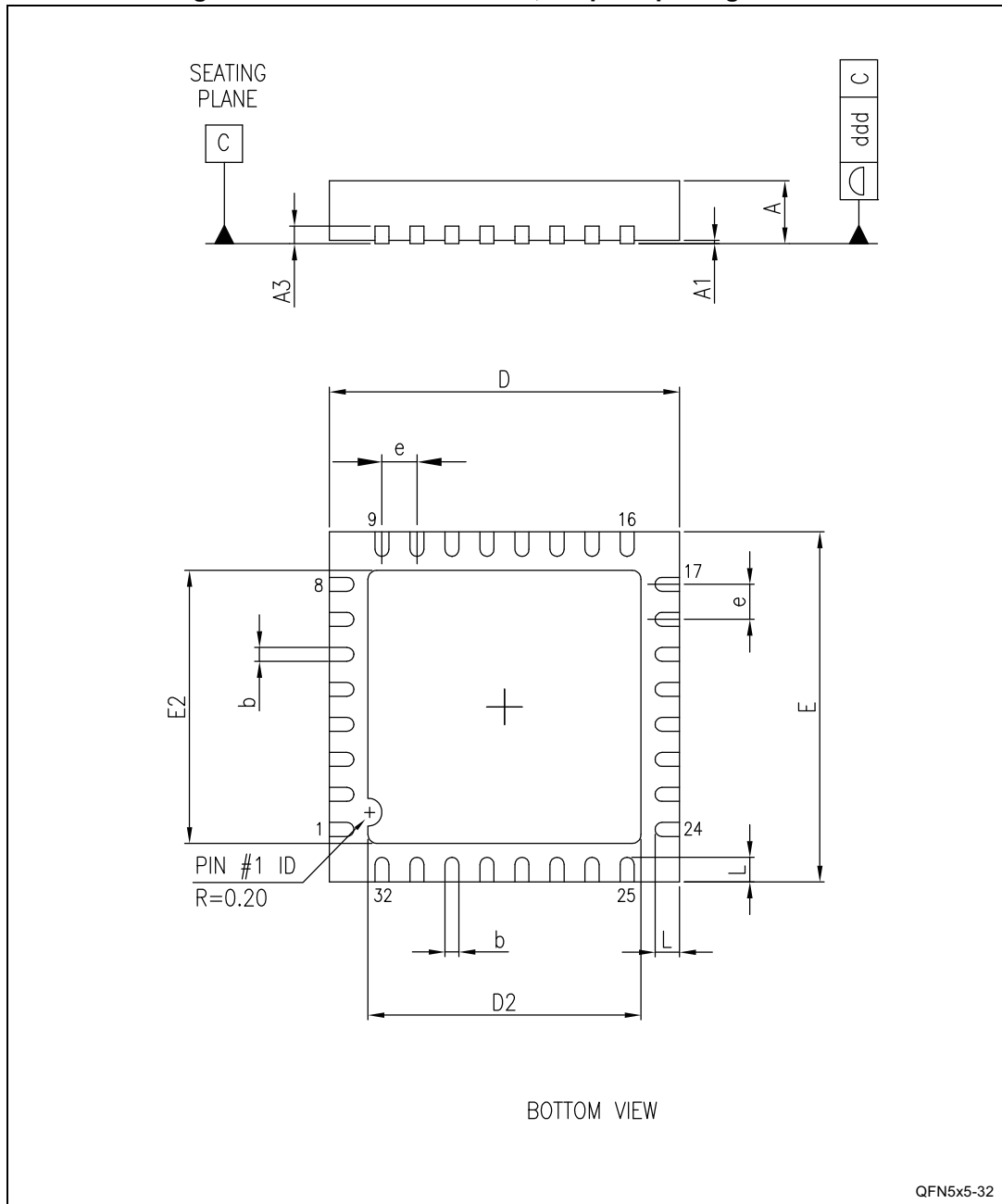
Table 7. QFN325 x 5 x 1.0 mm, 0.5 pitch package mechanical data

Symbol	Dimensions (mm)			Note
	Min.	Typ.	Max.	
A	0.80	0.90	1.00	(1)
A1	0	0.02	0.05	N/A
A3		0.20		N/A
b	0.18	0.25	0.30	
D	4.85	5.00	5.15	
D2	3.40	3.45	3.50	
E	4.85	5.00	5.15	
E2	3.40	3.45	3.50	
e	0.45	0.50	0.55	
L	0.30	0.40	0.50	
ddd			0.08	

1. VFQFPN stands for "Thermally Enhanced Very thin profile Fine pitch Quad Flat Package No lead". Very thin: 0.80 < A = 1.00 mm.

Note: *This databrief contains technical information of a device under development, thus it may be incomplete and inaccurate in some parts. Specifications are still partially defined and many data shown may be significantly modified in subsequent issues. Please contact STMicroelectronics to receive the latest updated information.*

7   Revision history

Table 8. Document revision history

Date	Revision	Changes
09-Oct-2013	1	Initial release.

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