# 1 Features

An Active stylus communicates with the device like tablet, smartphone etc. using the projected capacitive touch screen as the physical layer. The CSAA2001 Rev2.3 IC integrates the key analog and power functions for active capacitive stylus. In addition, it integrates the digital controller and state machines for the Universal Stylus Protocol thus making it a single chip solution for USI stylus.The IC can be used to implement active stylus solutions for other one-way or two-way communication protocols when used with an external low cost microcontroller.

**Stylus Transmitters**

- Low power capacitive line driver capable of driving signals of 15kHz to 500kHz to pen tip
- Programmable Transmit level from 10V-28V in steps of 0.5V.
- Three independent tip drivers (TIP_OP1, TIP_OP2, TIP_OP3) can be used for main tip, parallax reduction and tilt or eraser by the stylus developer
- Dynamic Voltage Change on transmit boost voltage possible to save power of the stylus depending on the stylus state (hover/tip) through vendor extension commands.

**Receiver**

- Analog interface to amplify signal received by the pen
- Receiver amp can take the signal from any electrode connected to TIP1, TIP2 or TIP3
- Low power detection algorithm detects received signal even under noisy conditions. Device GND may have noise as per IEC61000-4-6 Level 2 and pen can receive beacons successfully without need for high voltage excitation from Touch Panel.

**Tip Pressure sense Analog Front End (AFE)**

- Operates from a 1.8V power supply
- Interfaces to a capacitive sensor or a Wheatstone bridge Piezo-resistive force sensor.
- Sensor bias : voltage or current to bias the sensor
- Sensor Readout: Pressure readout through on chip ADC for calibration.
- Internal algorithm to map raw pressure characteristics to user desired stylus pressure curve.
- 4096 pressure levels

**Stylus Power Sources**

- AAAA 1.5V Alkaline Battery, Lithium batteries or Super Capacitor
- Linear Charger configurable to charge Lithium batteries or Super Capacitors with maximum charging current up to 500mA.

**Interfaces**

- The IC features a I2C interface
- A special interface through Touch Panel allows the Touch Panel to read/write to all IC registers of the encapsulated stylus wirelessly.

**System support Functions**

- Reverse battery protection for dry cell
- Battery monitor for reading state of charge for all sources
- Low Power Ship Mode for minimal discharge of battery when shipped to customer.
- Calibration of pressure curve

**Other Functions**

- 32kHz XTAL Oscillator
- On chip silicon oscillator.
- OTP memory for programmability and stylus calibration

**Package Pins**

- 2mm x 3.64 mm, 30 ball, 0.4mm pitch WCSP

**Variants**

- CSAA2001B is a variant of the IC identical in all respects except that it does not include the “ship mode”.

**Applications**

Active Stylus, USI Protocol

# 2 Block Diagram

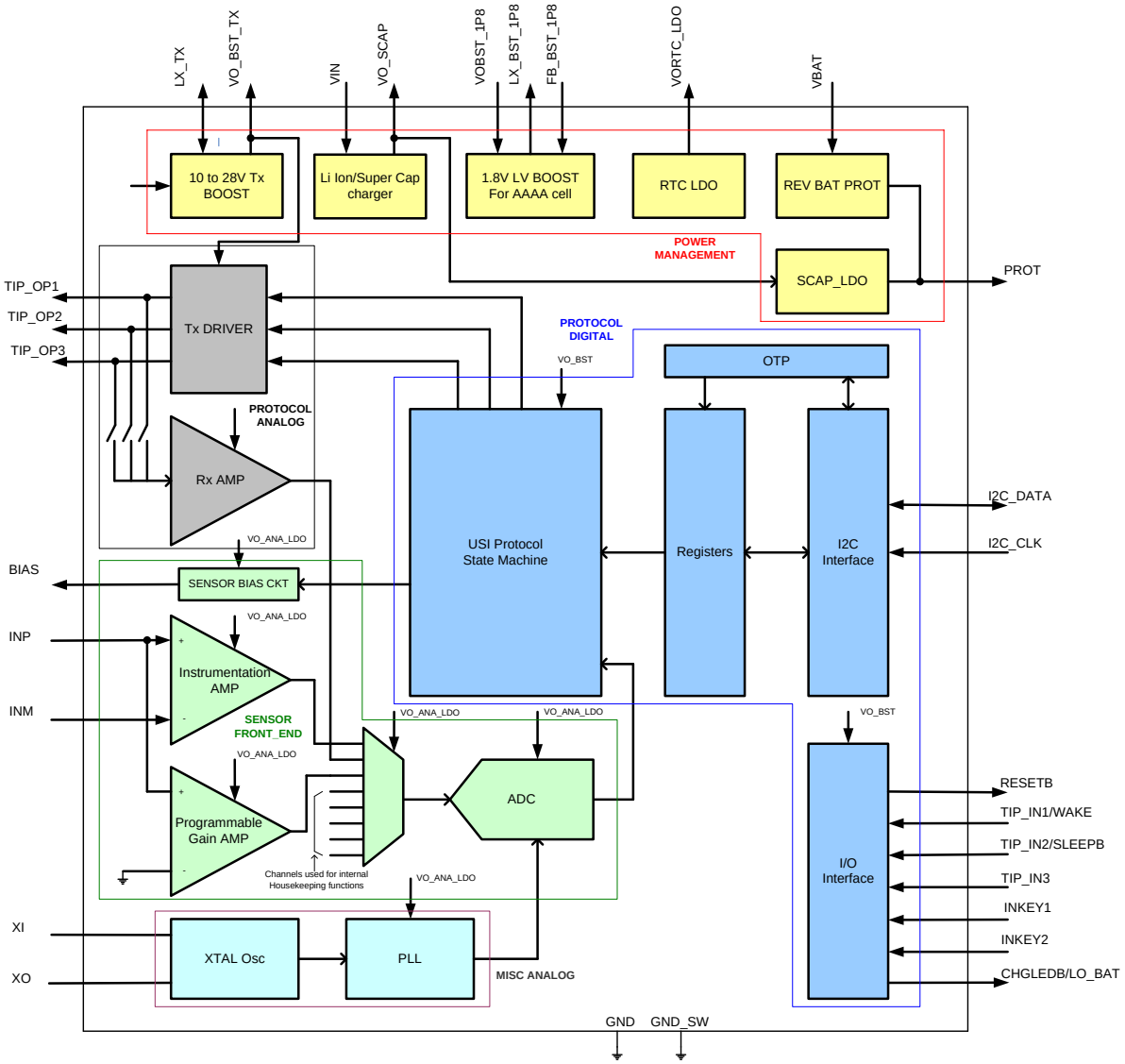



*Figure 2-1 : CSAA2001-Rev 23 Block Diagram*

# 3 Pin List CSAA2001-Rev23

| Pad Count | Bump Location | Label | Type | Description |
|---|---|---|---|---|
| 1. | D1 | VIN | Power Input | Input of Super Cap/ Li-Ion battery Charger. |
| 2. | C1 | VO_SCAP | Power Input/Output | Super Cap/Li-Ion battery charger output. Super Capacitor/Li-Ion battery is connected to this pin and GND. This pin is also the input of the SCAP LDO. Li-Ion Battery or Super Capacitor should be placed close and shorted to this pin. |
| 3. | A1 | PROT | Power Input/Output | Output of the reverse battery protection device. An external supply can also be applied at this point. This is also the power supply input of the 1.8V Low Voltage (LV) Boost Regulator. It is the regulated LDO output of the SCAP LDO when it is enabled to regulate the Li-Ion/Super cap output voltage. |
| 4. | B1 | VBAT | Power Input | Input pin to connect a AAAA battery voltage range of 1V to 1.8V. The battery should be placed close and shorted to this pin. |
| 5. | E2 | CHGLEDB/LOBAT | Digital Output | Open drain output- A red LED is connected between VO_BST and this pin. Slow Flash represents that charging is in progress. Constant glow represents that the charging is completed. When charger is disconnected and the battery is fully charged, the LED is off. When the battery is discharged and reaches the Low battery threshold, the LED flashes fast. |
| 6. | A3 | VOBST_1P8 | Power Output | Output of the LV Boost Converter. The load which is an external micro-controller can be connected to this pin. The LV boost also powers the internal circuits of the CCAA2001. |
| 7. | A2 | LX_BST_1P8 | SMPS pin | One end of the external inductor of the LV boost converter is connected to this point. The other end of the inductor is connected to VBAT. |
| 8. | A4 | FB_BST_1P8 | Analog Input | LV boost converter feedback pin for voltage regulation. |
| 9. | D6 | RESETB | Digital Output | Open drain output – Active low reset signal. This needs an external 10k pull up resistor to the supply to which it is referred to. |

| Pad Count | Bump Location | Label | Type | Description |
|---|---|---|---|---|
| 10. | C4 | TIP_IN3 | Digital Input | 1.8V Logic input is transmitted out to TIP_OP_3 when configured through OTP. |
| 11. | B4 | TIP_IN2/SLEEPB | Digital Input | Input can be configured as transmitter input pin TIP_IN2 or SLEEPB pin. When configured as TIP_IN2, a 1.8V Logic input is transmitted out to TIP_OP_2. When configured as SLEEPB pin, the sleep signal is active low. Logic "0" – Device in sleep state. Logic "1" – Device in wake state. |
| 12. | B6 | TIP_IN1/WAKE | Digital Input | Input can be configured as transmitter input pin TIP_IN1 or WAKE pin. When configured as TIP_IN1, a 1.8V Logic input is transmitted out to TIP_OP_1. When configured as WAKE pin, the wake signal is active high. Logic "0" – Device in sleep state. Logic "1" – Device in wake state. |
| 13. | A5 | I2C_DATA | Digital I/O | I2C Interface Data |
| 14. | A6 | I2C_CLK | Digital I/O | I2C Interface Clock |
| 15. | E8 | BIAS | Analog Output | Bias Current/Voltage pin for external sensor network |
| 16. | D9 | INP | Analog Input | Non-inverting input of Instrumentation Amplifier |
| 17. | E9 | INM | Analog Input | Inverting input of Instrumentation Amplifier |
| 18. | E3 | VORTC_LDO | Power Output | Regulated 1.8V output of VO_BST_1P8 for ADC and other sensitive analog blocks. |
| 19. | E5 | GND | Ground | Ground Pin – Pad |
| 20. | C6 | INKEY1 | Digital I/O | The CCAA2001 recognizes a INKEY1 key press and the digital state machine transmits the INKEY1 assigned word through one the TIP outputs. |
| 21. | D4 | INKEY2 | Digital Input/ Analog Output | CCAA2001 recognizes a INKEY2 key press and the digital state machine transmits the INKEY2 assigned word through one the TIP outputs. |
| 22. | E4 | XO | Analog Output | XTAL Output. 32768Hz Crystal is connected to this terminal. |
| 23. | E6 | XI | Analog Input | XTAL Input. 32768Hz Crystal is connected to this terminal. |
| 24. | E1 | TIP_OP3 | Analog Output | Pen Tip Transmitter output |
| 25. | C9 | TIP_OP2 | Analog Output | Pen Tip Transmitter output |
| 26. | B9 | TIP_OP1 | Analog Output | Pen Tip Transmitter output |
| 27. | A8 | LX_TX | SMPS pin | One end of the external inductor for the |

| Pad Count | Bump Location | Label | Type | Description |
|---|---|---|---|---|
| | | | | transmitter boost is connected to this pin. The other end of the inductor is connected to either VBAT or to PROT depending on the configuration that it is used in. |
| 28. | A7 | VO_BST_TX | Power Output | Output of the Transmitter Boost Converter. This pin is connected to VDD_TX |
| 29. | A9 | GND_SW | Power Input | Ground of Transmitter Boost Switcher |
| 30. | E7 | **NC** | Unused | No Connect |

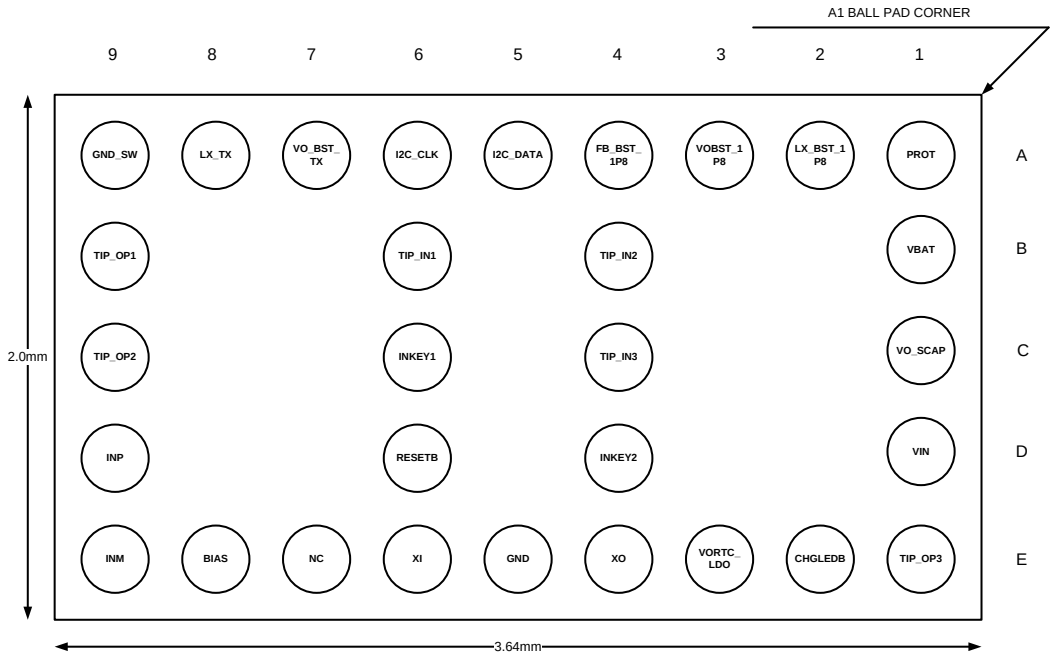



**Figure 3-1 CSAA2001-Rev23 WCSP Package Ball Map Bottom view**

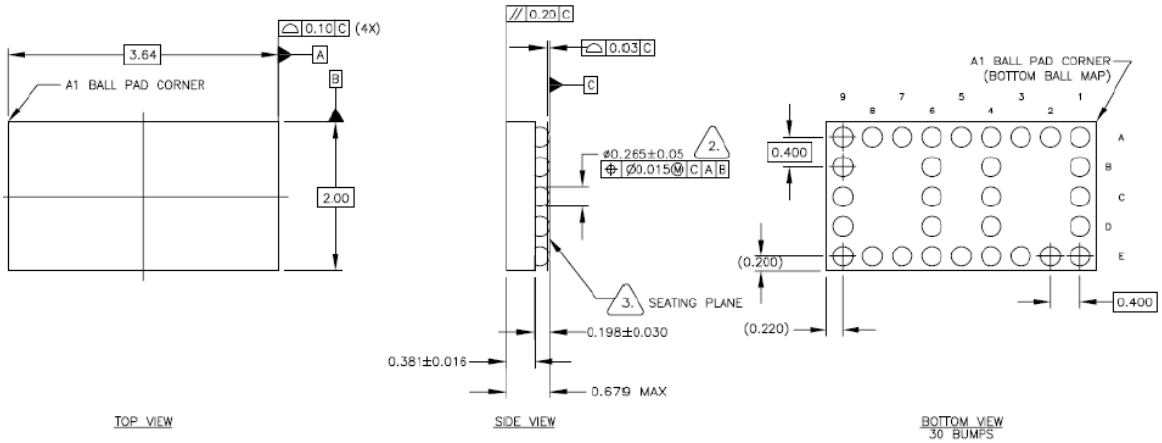
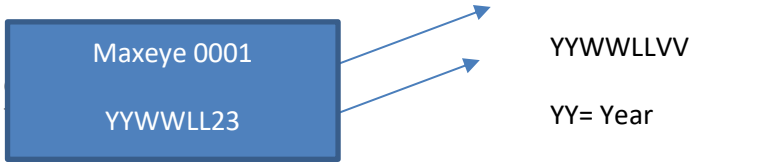



**Figure 3-2 WCSP Package Dimensions**

## 3.1 Part Marking

Part making maybe Maxeye0001 or CSAA2001v23 for the part.

| Parameter | Specification |
|---|---|
| Marking spec on IC for Maxeye0001 |  |

## 3.2 Absolute Maximum Ratings

Over operating junction temperature range (unless otherwise noted)[1]

| PARAMETER | PINS | CONDITION | VALUE | | UNIT |
|---|---|---|---|---|---|
| | | | MIN | MAX | |
| Input Voltage | VIN, I2C_CLK, I2C_DATA, VO_SCAP | Wrt GND | -0.3 | 5.5 | V |
| | VBAT, INP, INN, XI, TIP_IN1, TIP_IN2, TIP_IN3, FB_BST_1P8, INKEY1, INKEY2 | | -0.3 | 2.2 | V |
| Output Voltage | I2C_DATA | | -0.7 | 5.5 | V |
| | PROT, VO_BST1P8, BIAS, VORTC_LDO, XO, CHGLEDB, RESETB | | | 2.2 | V |
| | LX_BST1P8 | | | 2.8 | V |
| | LX_TX, TIP_OP1, TIP_OP2, TIP_OP3, VO_BST_TX | | -0.7 | 30 | V |
| Sink Current | RESETB, CHGLEDB | | | 4 | mA |
| | VORTC_LDO | | | 10 | mA |
| | VO_BST_1P8 | | | 100 | mA |
| | I2C_DATA | | | 4 | mA |
| | BIAS | | | 100 | uA |
| | TIP_OP1, TIP_OP2, TIP_OP3 | | | 100 | uA |
| | VO_BST_TX | | | 200 | uA |
| | VO_SCAP (Charging Mode) | | | 500 | mA |

[1] Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

| | | | | | |
|---|---|---|---|---|---|
| Temperature | Operating Junction Temperature | -40 | | 85 | ºC |

## 3.3 Operating Range

Over operating junction temperature range (unless otherwise noted)[2]

| PARAMETER | PINS | CONDITION | VALUE | | UNIT |
|---|---|---|---|---|---|
| | | | MIN | MAX | |
| Input Voltage | VIN | Wrt GND | 4.5 | 5.5 | V |
| | VO_SCAP | Wrt GND | 1.2 | 4.65 | V |
| | VBAT | Wrt GND | 1 | 1.8 | V |

## 3.4 Design Considerations

Stylus coupling to touchscreen should follow the Sensor to Stylus coupling guidelines as mentioned in the "USI-Stylus and Device Technical Specification 1.0" in the "Section 5.4 Stylus Tip".

Care should be taken on material selection of the pen tip in case the transmitter output as well as the receive input are sharing the same tip. Certain material that pen tips have been made of, when rubbed against the touchscreen, causes electrostatic buildup on the pen tip due to triboelectric effect, which would then affect the receiver's performance.

AAAA battery should be connected as close as possible to the VBAT pin. Thick PCB trace should be employed for the connection. Similarly the Li-Ion battery or Super Capacitor voltage sources should be connected as close as possible to the VOSCAP pin. Thick PCB trace should be employed.

External chargers when used for these voltage sources should be connected through thick PCB traces so as to not cause ringing on the voltage sources. Plugging in and out the charger would cause transients to appear on the voltage sources which would exceed the absolute maximum ratings of the device if the recommended guidelines are not adhered.

If the user so desires to connect other than the recommended voltage sources or so desires to add circuitry between the voltage sources and the device, it is highly recommended that these be reviewed with Cirel Systems Pvt. Ltd. before making the PCB.

[2] Operating beyond the ranges suggested would result in improper operation of the device. These inputs should has proper decoupling capacitors as suggested in the application notes. Please contact and review your board design with Cirel Systems for use cases other than that suggested.

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