

TouchChip Principle of Operation

TouchChip is an active capacitive fingerprint-sensing technology. Each sensor cell (pixel) contains an active capacitive feedback circuit whose effective feedback capacitance is modulated by the presence of live skin close to the surface of the sensor as shown in Figure 3.

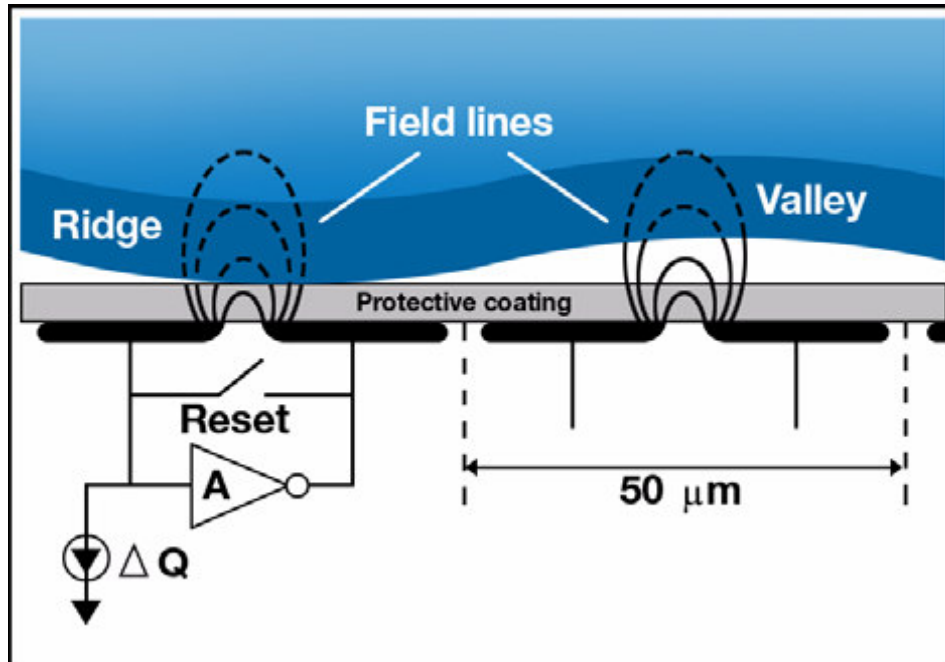


Figure 3. Principle of Operation

The surface of each pixel is composed of two adjacent metal plates, which are separated from the skin and the environment by an ultra-hard protective coating. These sensor plates create a fringing capacitance between them whose field lines extend beyond the surface of the silicon. When live skin is brought in close proximity to the sensor plates, the skin interferes with field lines between the two plates and reduces the effective capacitance between them. When the skin is on the sensor surface (fingerprint ridge) the feedback capacitance is minimized. When the skin is far from the sensor surface (fingerprint valley) the feedback capacitance is maximized.

The sensor plates are connected in an active feedback circuit with an inverter (inverting amplifier) creating a charge integrator. One plate is connected to the inverter input and the other plate is connected to the inverter output. This charge integrator circuit can convert the feedback capacitance of the sensor cell to an output voltage corresponding to the distance of sensor plates from the fingerprint skin.

The sensor cell works in two phases. In the reset phase, the input and output of the inverter are shorted together through a reset switch, causing the charge integrator output to settle to the logical threshold of the inverter. During the sensing phase the reset switch is opened and a calibrated charge is input into the input plate of the sensor cell, causing the charge integrator

output to change by an amount proportional to the feedback capacitance between the two sensor cells. Because the feedback capacitance of a fingerprint ridge is smaller than the feedback capacitance of a fingerprint valley, the output swing of a sensor cell under a ridge is greater than the output swing of a sensor cell underneath a fingerprint valley.

A two dimensional array of sensor cells captures the entire fingerprint image. The array is addressed in a random access mode through row and column decoders, enabling advanced functions such as windowing and sub-sampling. The output of the sensor array is passed through an analog signal-conditioning block providing the capability to adjust sensor gain and offset before the signal is converted through an on-chip A/D converter into an 8-bit digital signal for output off chip.

The TouchChip fingerprint sensor is controlled through a set of on-chip control registers, controlled through PerfectPrint fingerprint optimization technology. PerfectPrint controls the TouchChip to optimize fingerprint image sharpness, brightness and contrast, resulting in the best possible fingerprint image being quickly selected from the sensor. PerfectPrint guarantees that the TouchChip always provides the best possible fingerprint image under any operating conditions and for all types of skin quality.