

## Upek Silicon Sensor

### Active capacitive pixel-sensing technology

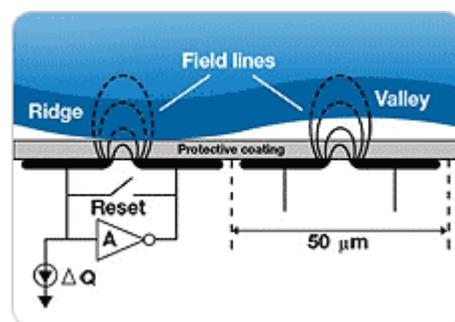
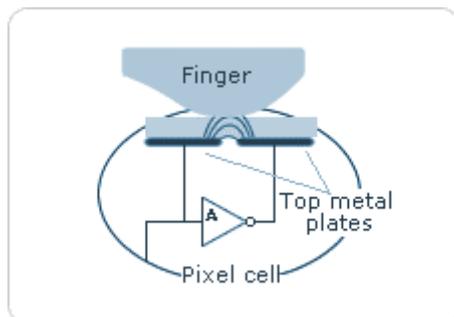
Each sensor cell (pixel) contains an active capacitive feedback circuit whose effective feedback capacitance is modulated by the presence of live skin close to the surface of the sensor. This active sensing approach provides much higher immunity to parasitic effects. This ensures a higher signal-to-noise ratio and greater capacity to capture a wider range of fingerprints than other silicon-based technologies such as passive capacitive sensing.

### How it works

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, while when the skin is far from the sensor surface (fingerprint valley) the feedback capacitance is maximized.

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 that of a fingerprint valley, the output swing of a sensor cell under a ridge will be greater than the output swing of a sensor cell underneath a fingerprint valley.

A two dimensional array of sensor cells is used to capture 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.



### Optimal fingerprints under any operating condition

PerfectPrint technology controls the fingerprint sensor to ensure that the sensor produces the best possible fingerprint image under any environmental conditions. It utilizes integrated sensor

adjustments to control image sharpness, brightness and contrast. PerfectPrint adjusts both the fixed charge input to each pixel and the analog signal conditioning of the voltages between pixel output and the input of the analog-to-digital converter. PerfectPrint automatically samples small windows of the image in real time, adjusts the sensor settings, then captures and outputs the full image - all in less than a tenth of a second.

PerfectPrint ensures that the sensor always provides the best possible fingerprint image under any operating condition and for all types of skin quality.

PerfectMatch is a set of software algorithms used to extract minutiae from fingerprint images to match a scanned fingerprint template against previously stored templates for authentication purposes.

Minutia extraction from fingerprint images takes place during the enrollment and verification processes. The PerfectMatch algorithm extracts the fingerprint's minutiae - the set of unique characteristics of a given fingerprint - and creates a fingerprint template. This template is a mathematical representation of the original fingerprint based on the analysis of the ridge patterns. It takes up significantly less space (520 bytes maximum) than the original fingerprint image, which is why biometric solutions can be embedded in a broad variety of applications.

Fingerprint templates can be used in the matching process but they cannot be used to reconstruct the original fingerprint. During enrollment, the original template is created and stored. During verification, the template derived from the scanned fingerprint image is compared with the stored original template to determine if a match is approved.

PerfectMatch is delivered in the form of a BSP (Biometric Service Provider) module with a BioAPI (link to biometrics organizations) compliant Application Programming Interface (API). This API allows customers to easily integrate the UPEK fingerprint authentication solution into their applications without the need for in-depth knowledge of biometric components. This greatly simplifies the integration into existing applications and considerably reduces development time.