June 2007

Cost-Effective Touch Screen Demo Using E-field Sensor MC34940

AC305

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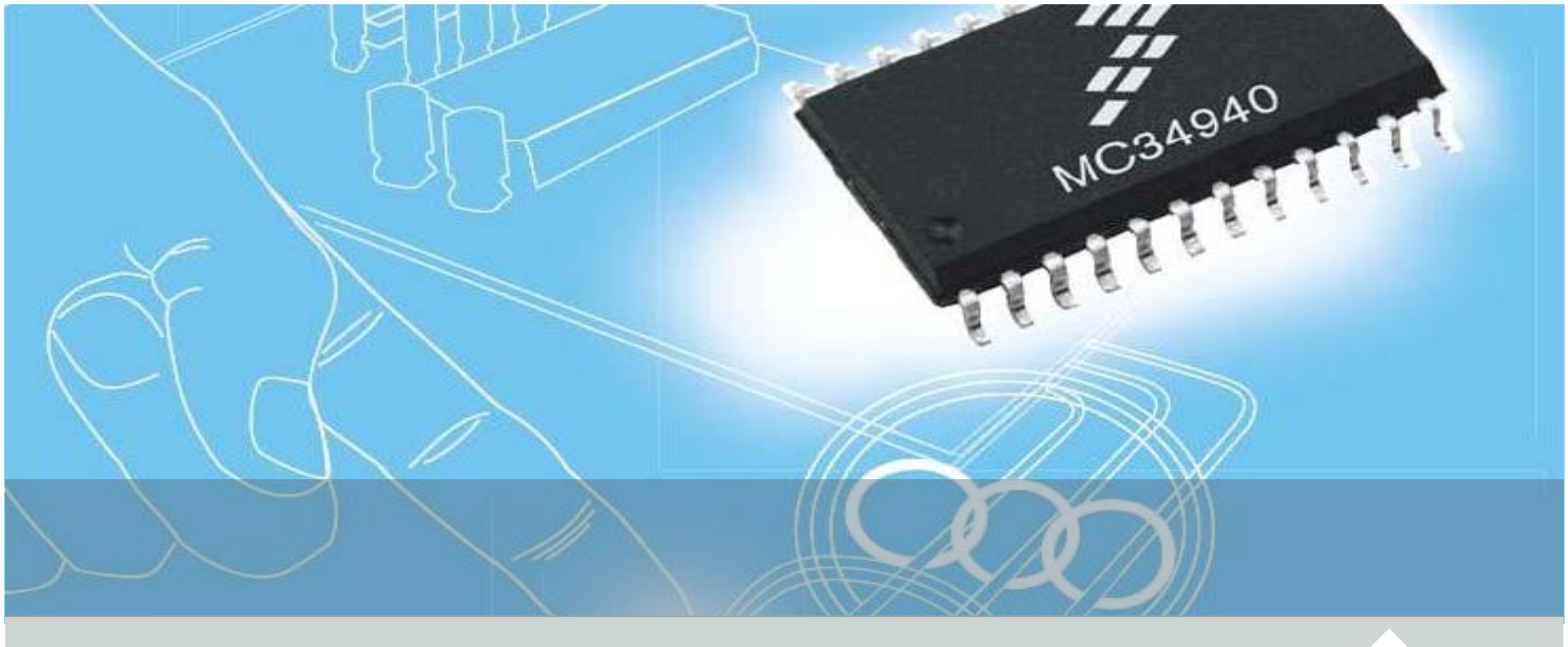

Introduction

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Scope of the Project

- Convert your old LCD panel into a Touch Screen System.
- Replace the traditional, expensive Touch Screens using our E-field Sensors.
- Eliminate the use of mechanical buttons.
- Cost Effective Solution.
- This Reference Design provides a proof of concept.

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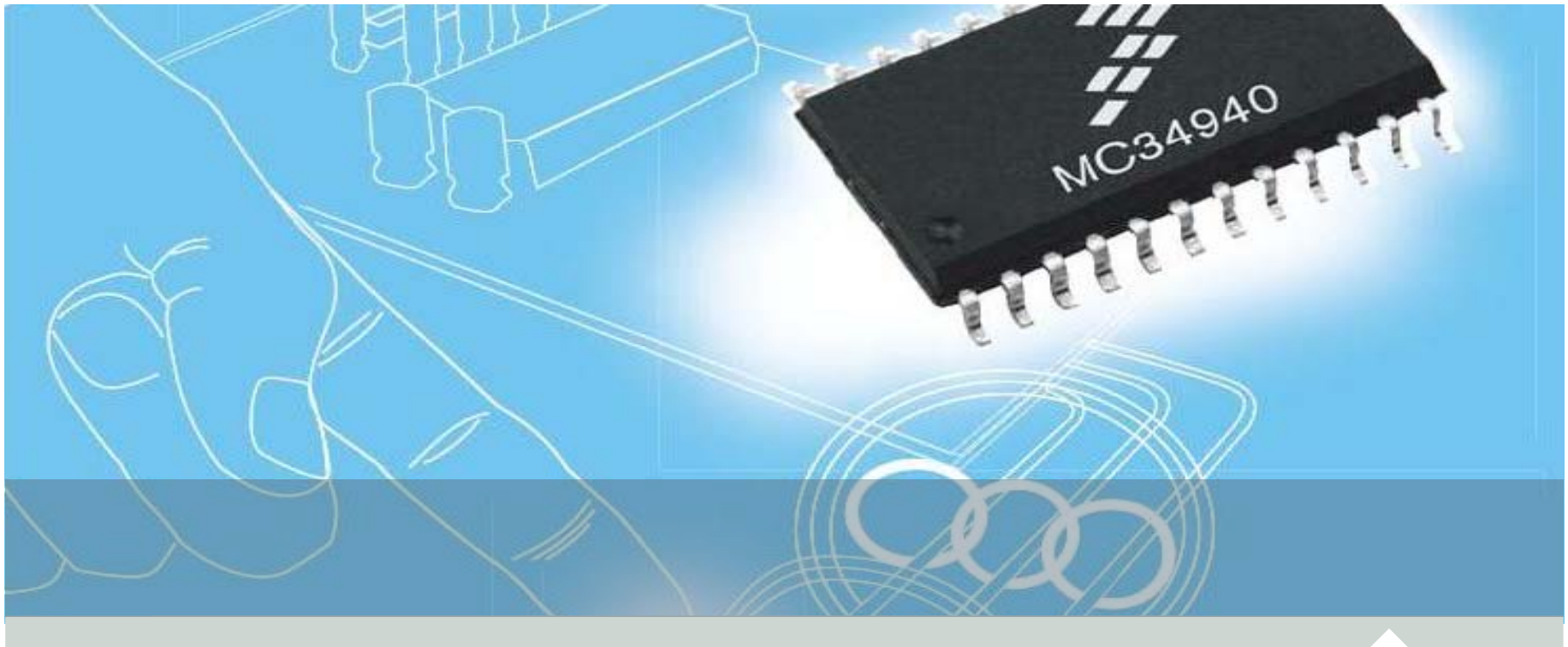

Understanding the Electric Field (E-Field)

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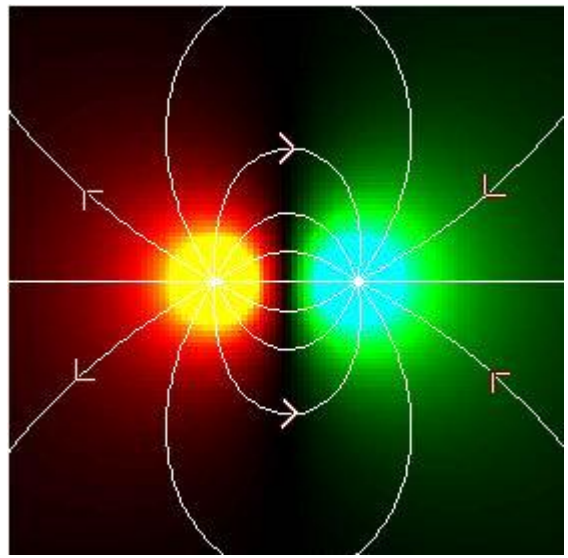
What is an Electric Field?

- A field of force surrounding a charged particle.
- Determines the electric force exerted by a charged particle on all other charged objects in its vicinity.
- Represented by invisible lines between objects at different potentials.

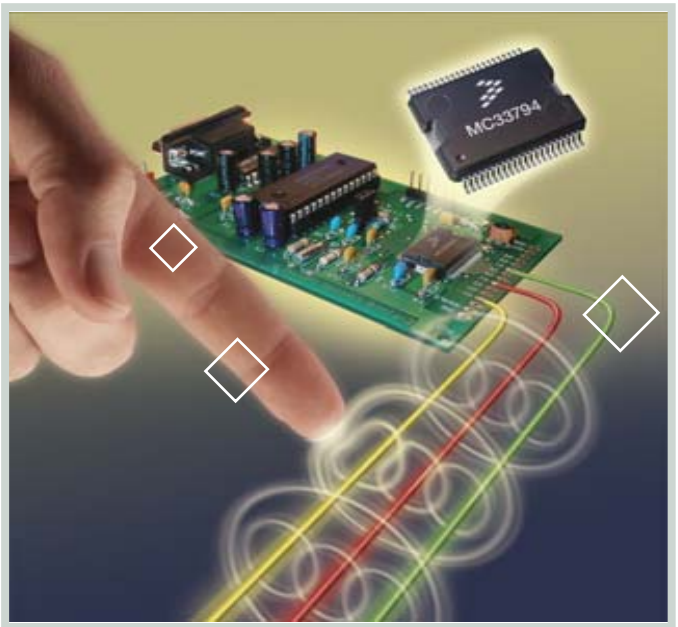


The strength of an E-Field is:

- **Proportional to the area of the electrode**
- **Proportional to the dielectric constant of the material between the electrodes**
- **Inversely proportional to the distance between the objects**

How Freescale's E-field Sensor Works?

- When connected to external Electrodes, an Electric Field is created.
- As the object approaches to the electrode, the E-field is intercepted by the object.
- What kind of materials can be sensed with an E-field Sensor?
  - Any object which is somewhat conductive and/or has a different dielectric constant than its surroundings



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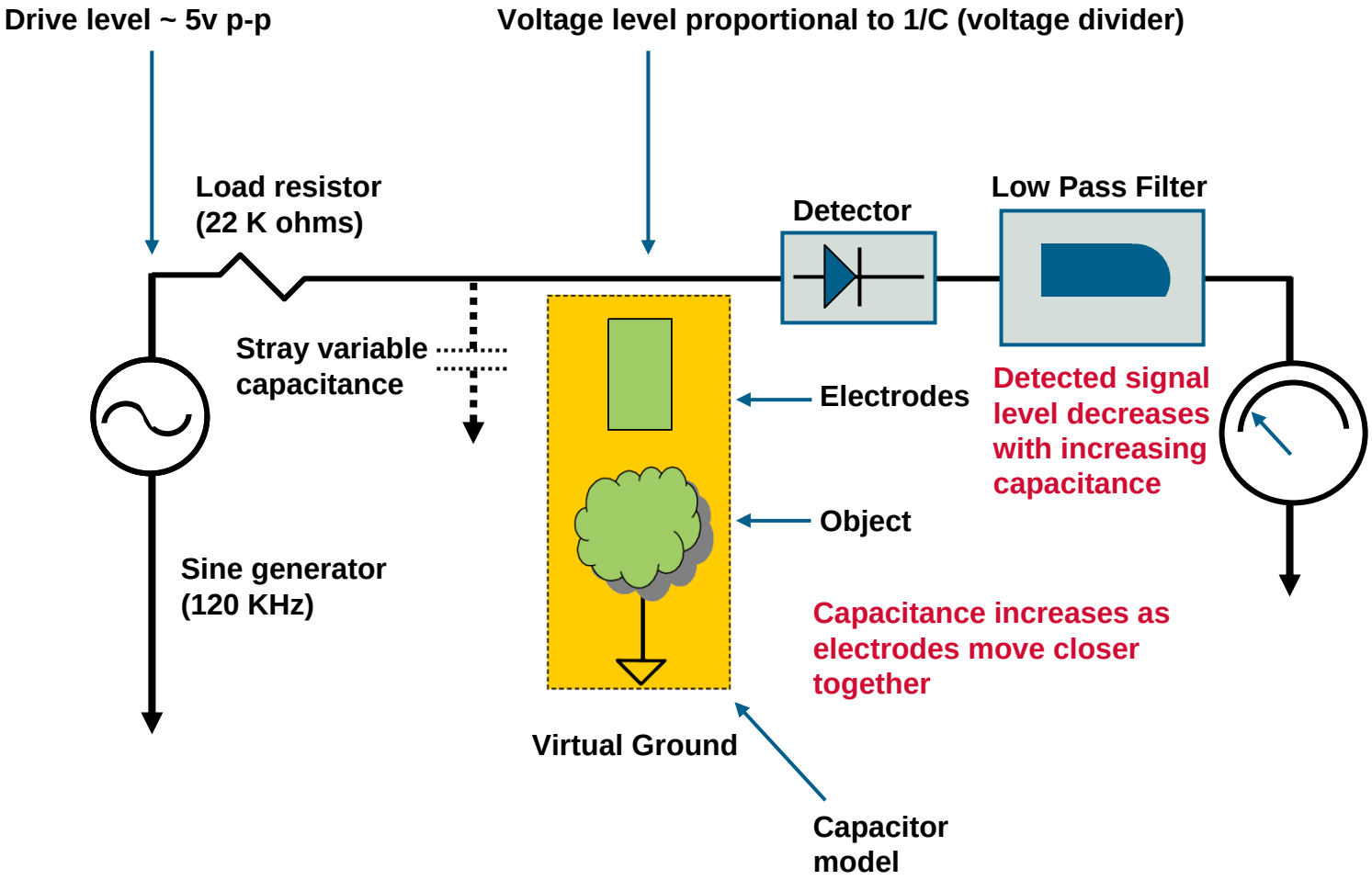
How Freescale's E-field Sensor Works? (cont.)



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Capacitor Model

C = the capacitance in farads (F)

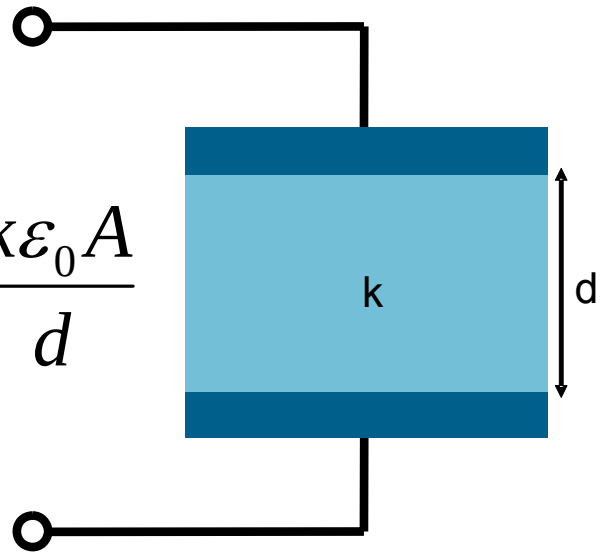
A = the area of the plates in square meters (m2)

d = the distance between the plates in meters (m)

k = the dielectric constant of the material separating the plates

ε_0 = is the permittivity of free space (8.85 x 10-12 F/m)

$$C = \frac{k\varepsilon_0 A}{d}$$



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Using Freescale's Capacitive Technology for Touch Screens

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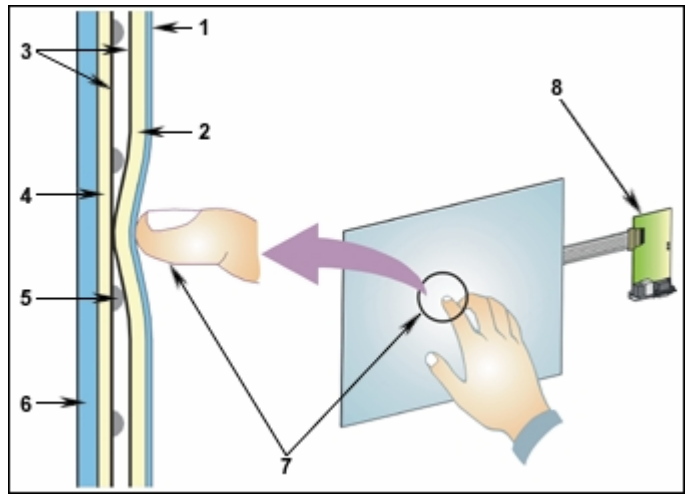
The Most Commonly Technology used for Touch Screens

How does the resistive touch screens work?



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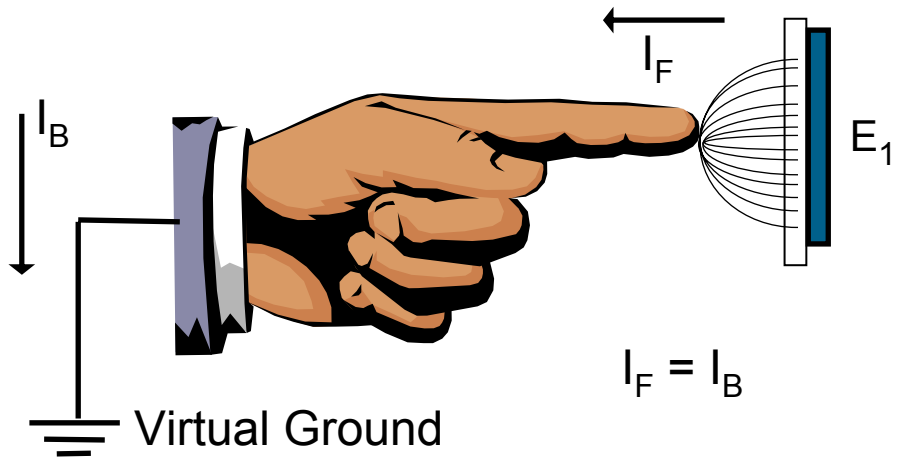
Capacitive Touch Sensing Theory

How does it work?



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Using ITO Glass for Touch Screens

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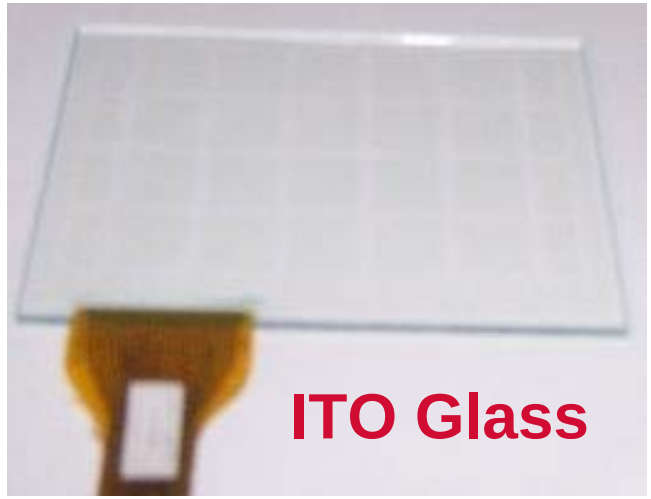
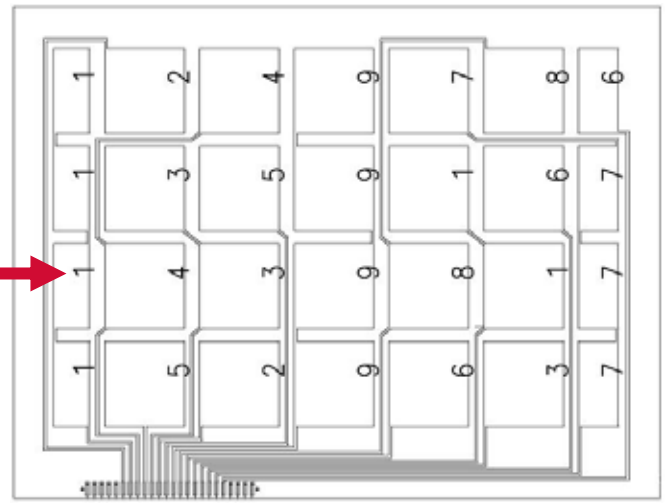
Getting familiar with the ITO Glass

- What is an ITO Glass?
- **Is a glass coated with a transparent & conductive material named Indium Tin Oxide**



ELECTRODES PATTERN



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ITO Glass features

Things to keep in mind!

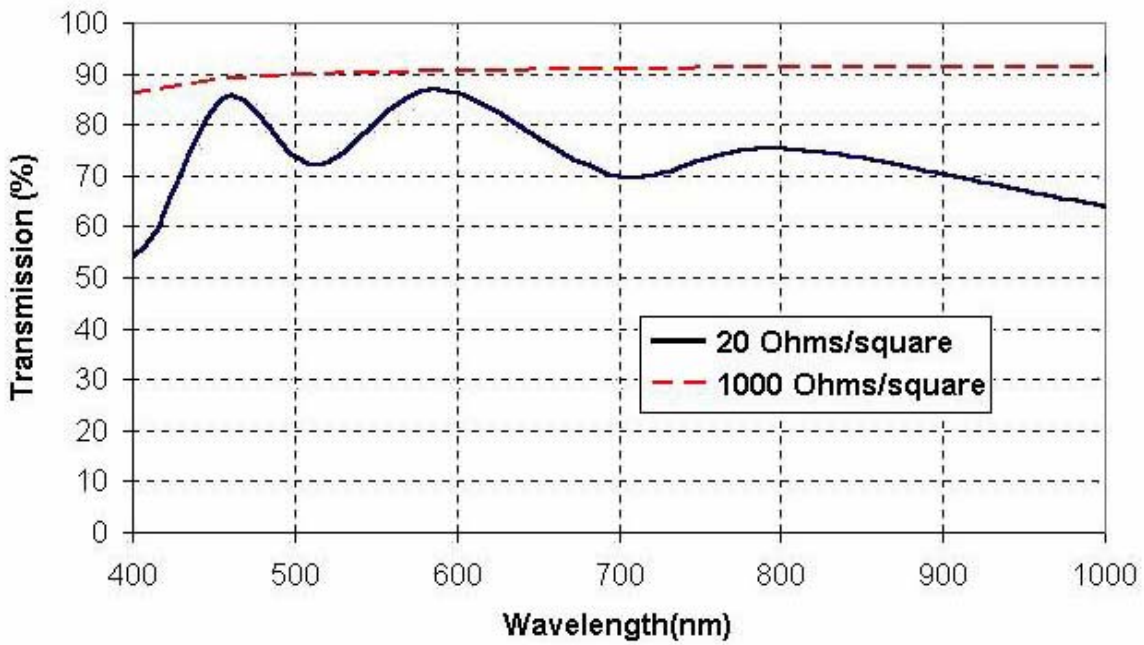
- As the thickness of the ITO coating is increased:
  - The coating becomes more conducting
  - The transmission falls
  - The cost rises
  - The flexibility of the coating reduces.

For efficient use of ITO and optimum performance the thinnest possible coatings should be used commensurate with the required resistivity.

Transmission Index

Lower Sheet Resistance (Ohms/Square) means Lower Transparency!

- Optical Transmission of ITO coatings:



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Designing an ITO Glass

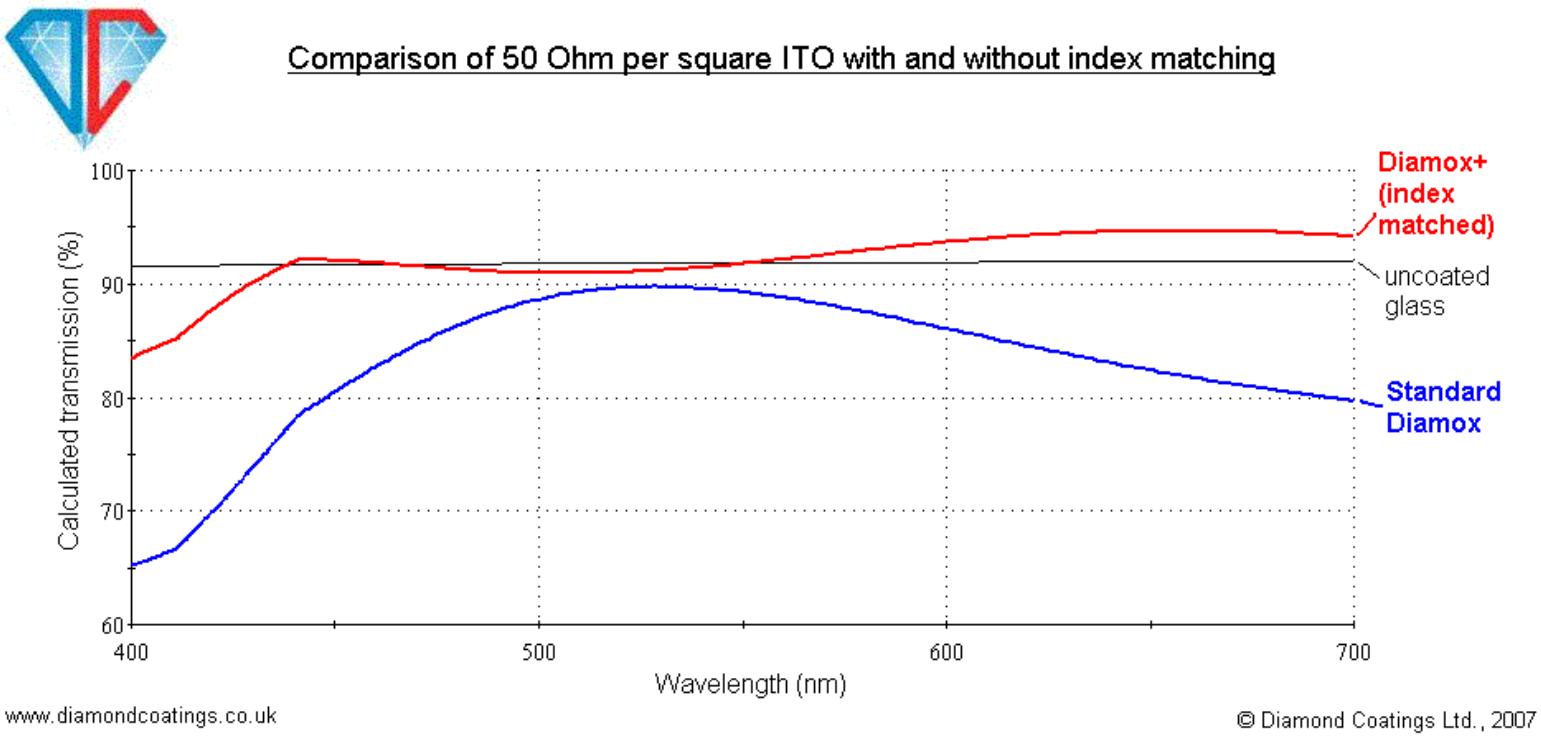
General Rules & Trade-offs!

- 1. ITO shall be transparent, choose appropriate XXX ohm/sq thickness.
- 2. Total resistance in each electrode has to be less than 30kohm!
- 3. Trace width shall be as thin as possible
- 4. Maximize the separation between traces. Trace width shall be equal at all points.
- 5. Minimize the trace length between pads and connectors.
- 6. Separation between traces shall be equal.
- 7. The connection point of a trace to pad does not matter. Connect at a point that suits trace rules 2 - 6.
- **NOTE: Rules are listed in order of priority**

TIP…Send the Pattern to the ITO glass manufacturer and ask if they can do the trace routing for you. Remember, the manufacturer has the tools & the experience to comply with your requirements.

How can be improved the Transmission Index?

A Matching Layer is the answer!



- Ask for this feature to your ITO manufacturer

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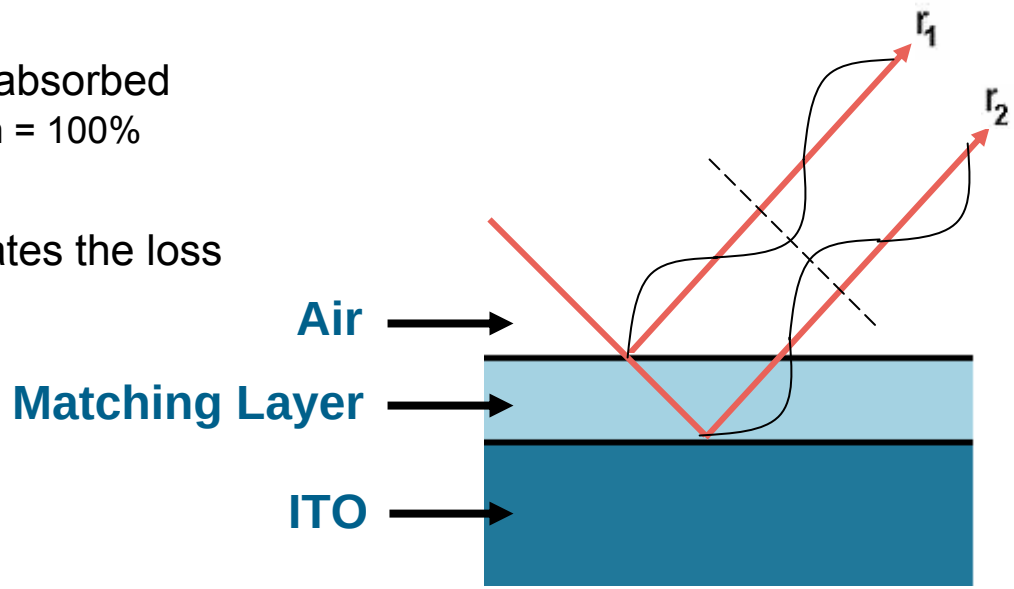
What is a matching Layer?

Is an *Anti Reflection Layer* on Top of the ITO

- Reflections r1 and r2 are equal and opposite
- Then, it greatly reduces the reflection from the ITO
- As background, most of the transmission loss is due to reflection
- The light is either transmitted, reflected or absorbed
  - Transmission + Reflection + Absorption = 100%
- Absorption is very small , reflection dominates the loss
  - Transmission = 100% - Reflection

If the *reflection is reduced*,
Then the *transmission goes up*



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Challenges & Limitations

- Supplier's Capabilities
- Resolution
- Electrodes Pattern (Single Layer)
- Connector Attachment
(What's the best option?)

You can replace resistive touch as long as the application does not require fine resolution such as signature capture.

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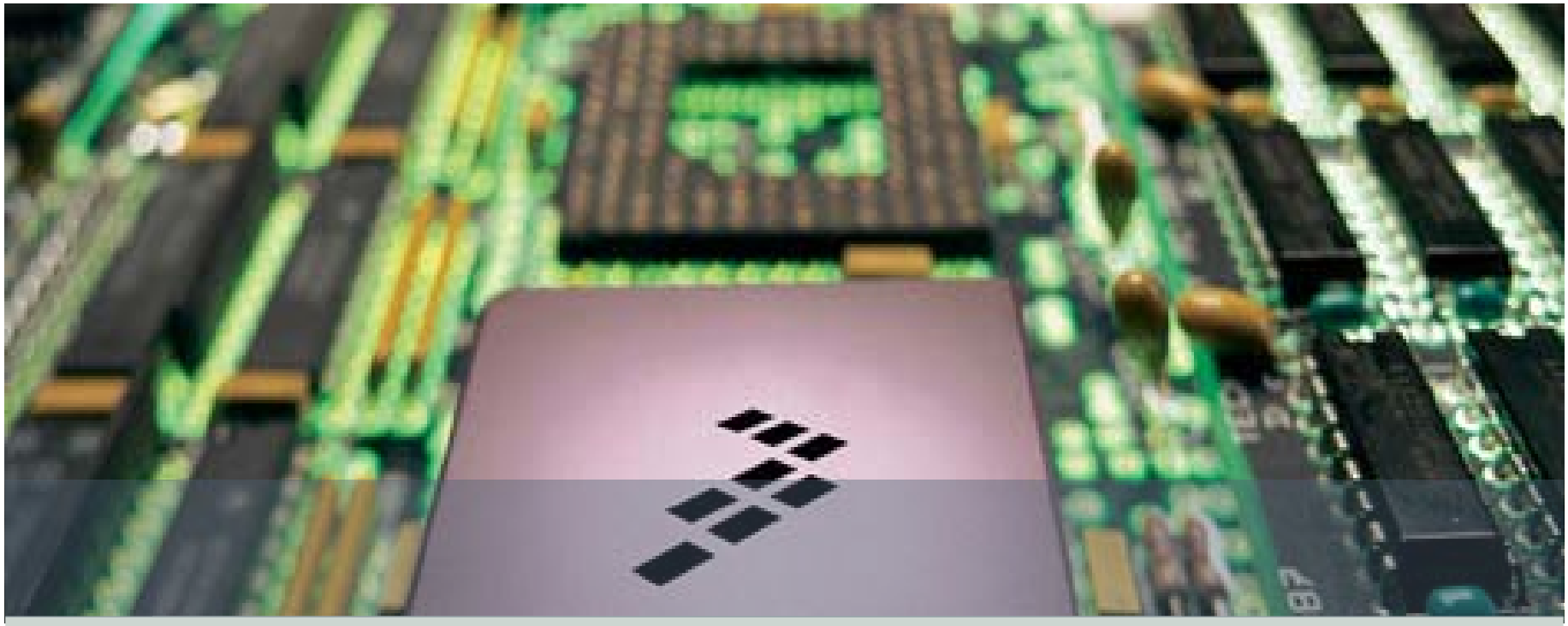

Cost-Effective Touch Screen System Design

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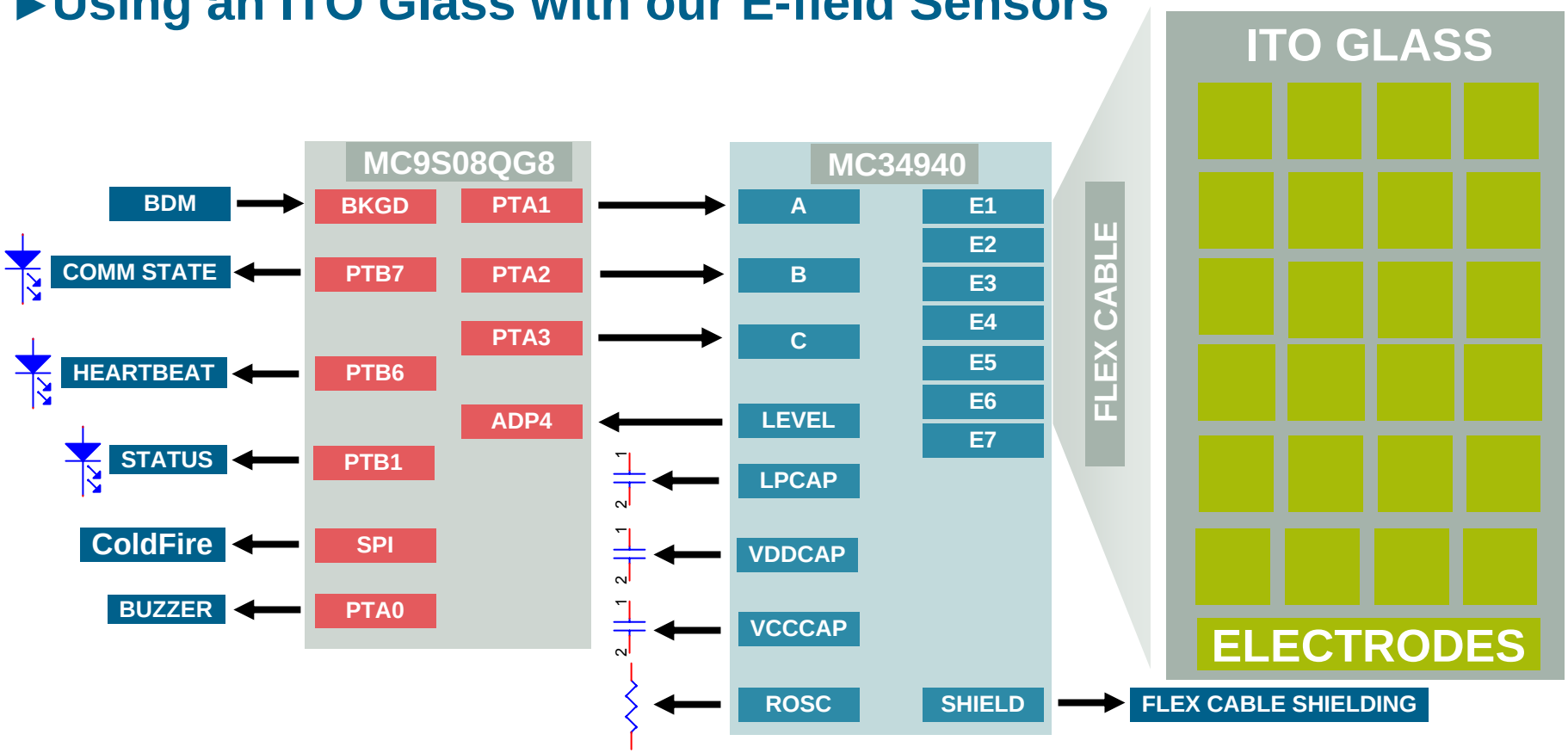
MC34940 E-field sensor for Touch Screen Apps

- How can you make this real?
- **Using an ITO Glass with our E-field Sensors**



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Low Cost Electric Field Sensor MC34940

▶Competitive Appliance-Industrial Market Features

- **The MC34940 is lower cost to serve the appliance and industrial markets**
- **Supports up to 7 Electrodes**
- **Supports up to 28 touch pad sensors w/ 2 way multiplexing**
- **Linear and rotational touch pad sliders**
- **Proximity detection**
- **Supports multifunctional applications**
- **Shield Driver for Driving Remote Electrodes Through Coaxial Cable**
- **High-Purity Sine Wave Generator Tunable with External Resistor**
- **Response Time Tunable with External Capacitor**
- **Versatile**
  - A wide range of objects and materials can be detected
  - People, metallic and non metallic materials
  - 3-dimensional position determination
- **Package: 24-pin SOICW**
- **Pb-Free and RoHS compliant**

Contact and Contact-less Sensing!

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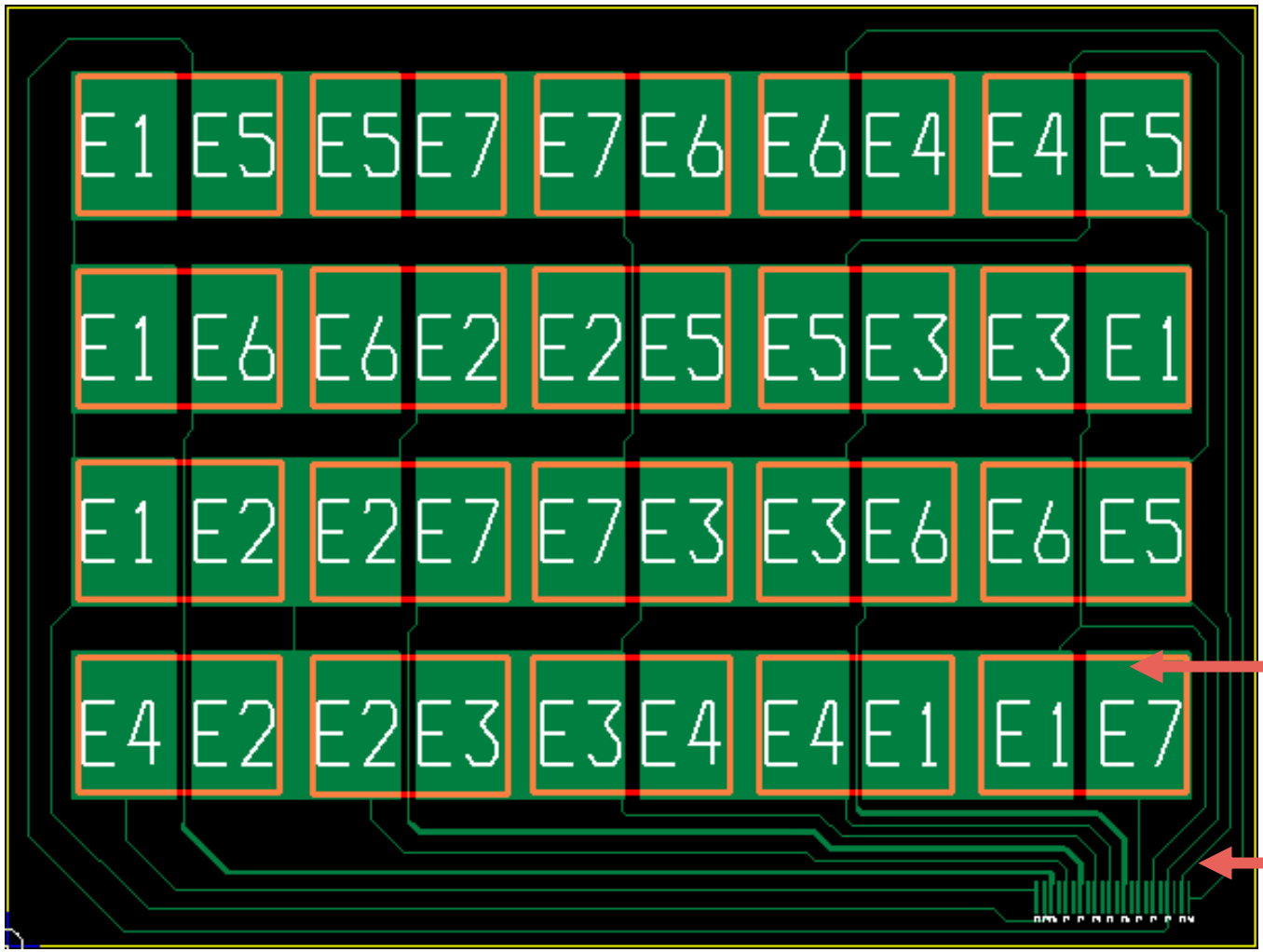
MC9S08QG8 features used in this Design

- 3 General Purpose I/O for Electrode Selection
- 8KB Internal Flash and 512B RAM
- Serial Peripheral Interface for communications with the MCF5329
- 1 Analog to Digital Converter (Reads DC Level representation of Capacitive Touch)
- Internal oscillator for processor clock generation
- General Purpose I/O for direct drive of LEDs

Designed to reduce overall systems cost!

Electrodes Pattern on ITO Glass Used



Indicates area where ITO is present

Black area Indicates removal of ITO

Touch Zones

Connector Location

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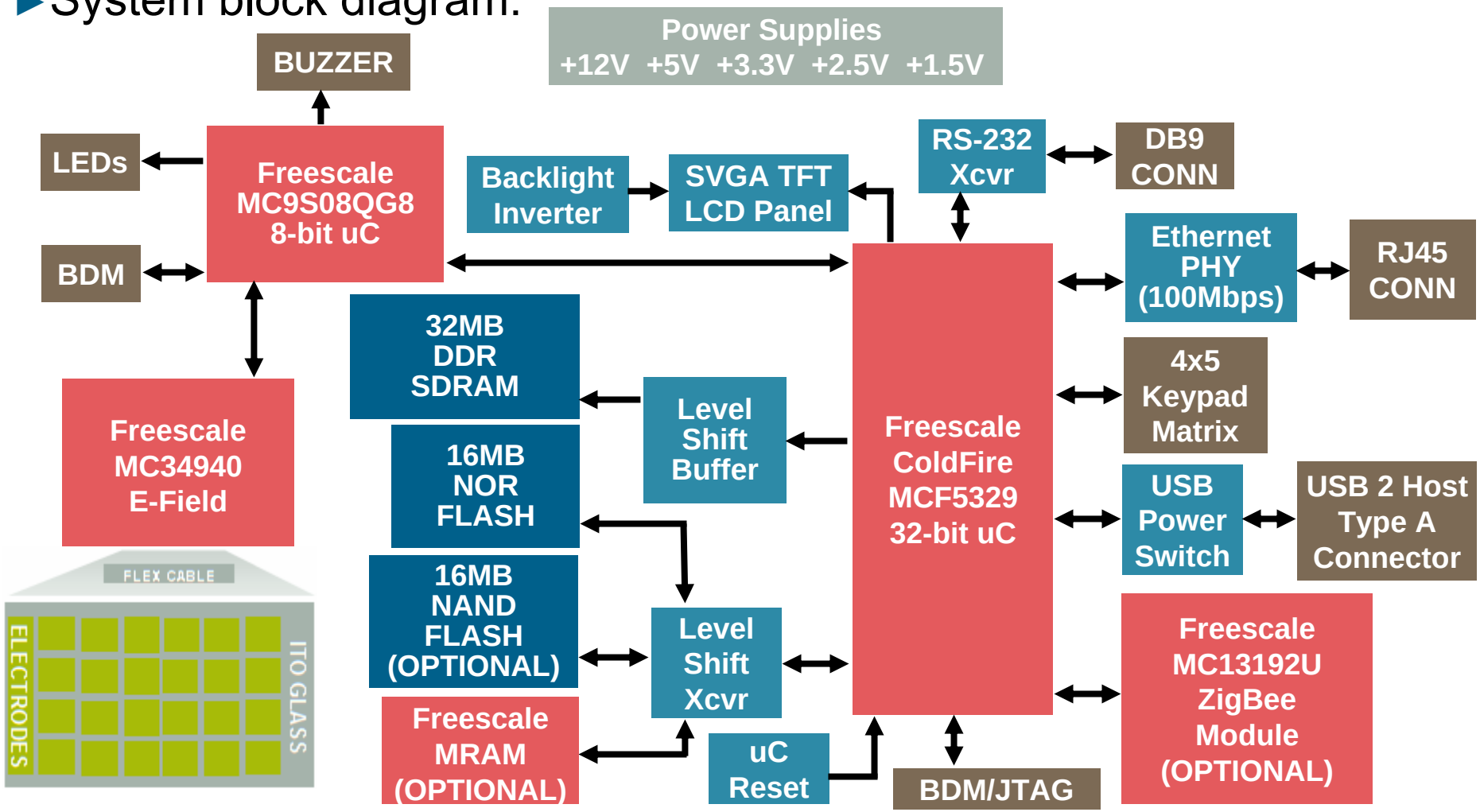
Cost-Effective Touch Screen Design

- System block diagram:



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ColdFire® MCF5329 features used in the Design

- 240 MHz core clock via internal PLL, running at up to 211 MIPS
- LCD Controller for direct interface to an 800 x 600 SVGA Color TFT Display
- Internal hardware accelerated Encryption Module for secure data transmission
- Two USB 1.1 Host interfaces for a Card Reader and Bar Code Scanner
- 10/100 Ethernet Controller driving external PHY
- Asynchronous serial interface for an RS232 transceiver
- Serial Peripheral Interface for communications with a Freescale MC9S08QG8
- DDR SDRAM memory controller interface
- Flash memory interface via the FlexBus
- General Purpose I/O for Keypad scan, LEDs, etc.
- PWM output for LCD backlight brightness control
- Freescale MC13192U ZigBee Module

It's innovation, accelerated!

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Cost-Effective Touch Screen

- Demo's Picture & video link

http://compass.freescale.net/go/170797972

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