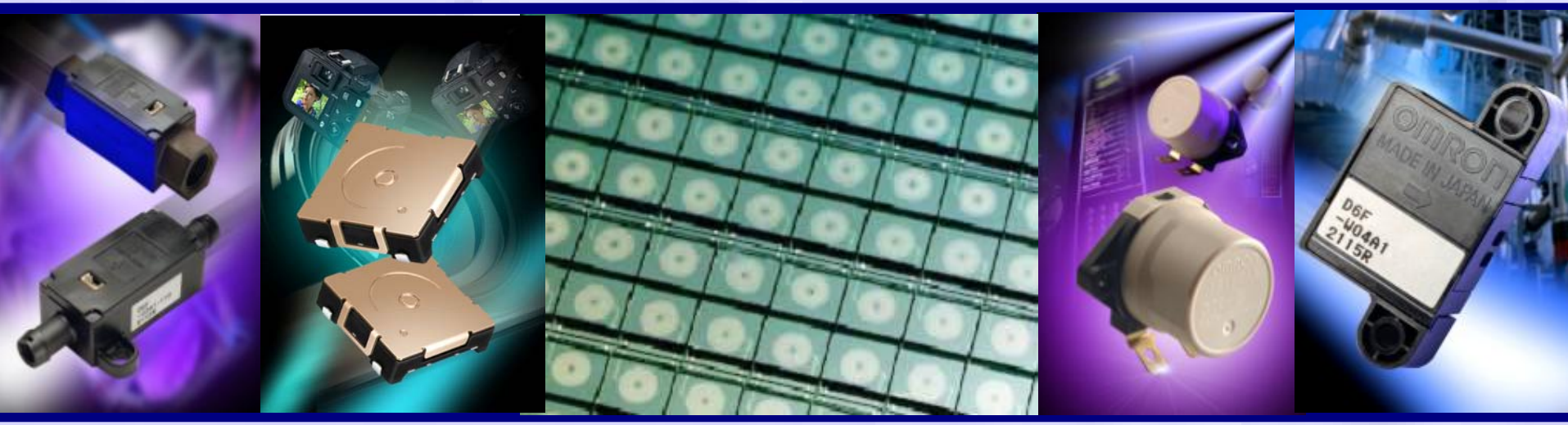
OMRON Electronic Components Europe BV

Capacitive Touch Sensors - B6T



Capacitive Touch Sensors - B6T - Content

- B6T Touch Technology - Introduction
- B6T Touch Technology – Principle
- Design Tool B6TWorkbench – B6T Hardware
- B6T Roadmap
- B6T Promotion tools

Capacitive Touch Sensors - B6T - Content

- B6T Touch Technology - Introduction
- B6T Touch Technology – Details
- Design Tool B6TWorkbench – B6T Hardware
- B6T Roadmap
- B6T Promotion tools

Capacitive Touch Sensors - B6T

- B6T Technology - Introduction: Overview

1. "Application ready" We developed B6TS to be highly tolerant of its working environment with adaptive features such as semi-self teaching, auto threshold and intelligent filtering to meet the demands of most applications today. B6TS resists EMC and compensates continuously for long term drift. A universal design tool (B6TWorkbench) offers the possibility for first evaluations of the B6T technology and later the fine tuning off the customer touch panel solution.

2. "Freedom to design" With the exception of a few rules of thumb you are limited only by your imagination. You are free to decide electrode size, shape, spacing etc. Design is quick and easy

3. "Freedom in material" You can use low cost commercial PCB materials to create your designs. Most designs can be done on low cost single sided PCB like FR-2 or CEM-1. You can make touch keys through any non-conducting panel material including plastic, rubber, glass, marble and wood.

4. "Freedom to manufacture" We don't make your final PCBs. You or your chosen CEM does that. We sell you the chips and offer support.

5. "Standard or custom?" B6TS is µController based, so we can provide off the shelf solutions as well as "quick to market" customised types. Additional features may be possible at very low development cost.

6. "Your design – not ours" You can design your own circuits; you don't need to rely on Omron to do your designs. You can count on us for help and advice.

7. "Let your product stand out" B6TS sensor chips let you create exciting solutions with various materials, graphics, and special lighting effects that will let your product stand out. Create Backlighting and even Clear Sensing solutions! B6TS works with ITO and other clear materials to enable you to create back light touch keys for special effects. Touch switches over LCD and LED backlighting are possible. Cost effective Multi-key solutions are within your grasp!

Capacitive Touch Sensors - B6T

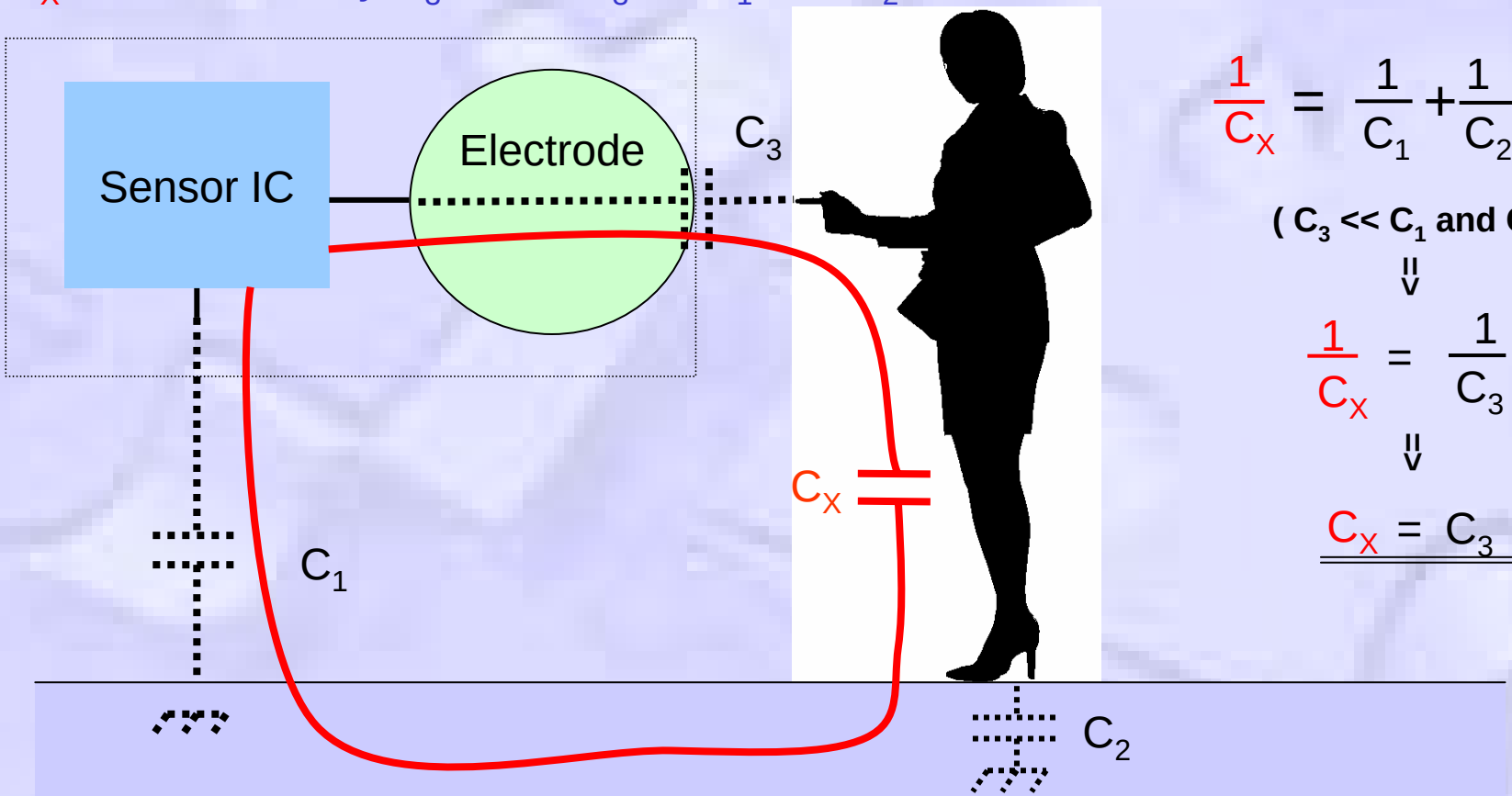
- B6T Technology - Introduction: Sensor Technologies

	Infrared	Millimeter waves	Radio waves	Dielectric constant & magnetic permeability	Resistance	Capacitance
Detection distance	Few meter	Few meter	Few centimeter	Few millimeter	Few millimeter	Few millimeter
Covering material	Line of sight	Nonconductor	Nonconductor	Nonconductor	Thin film	Nonconductor
Cost, euro	2 - 7	10 - 100	> 10	> 10	~	2 - 7
Environmental durability	Moderate	Very good	Very good	Good	Moderate	Good
Reliability	Moderate	Good	Good	Good	Moderate	Good
Noise source	External light	~	Reflection	Local magnetism	~	Stray capacity
Typical application	Toilet flush Automatic room light ATM	Security device Car distance sensor	Car door knob	Sitting sensor Syrup ran-out sensor	PDA LCD monitor	Control panels General MMI Lamps
Suitable Field	Automatic operation outdoors by detection of human body	Automatic operation outdoors by detection of human body To reduce miss-operation	In case of impossible to use infrared and detection distance is short	High accuracy detection of human body indoors	Operation panel indoors	Operation touch Proximity switch indoors
Advantage	Detect Long distance	High reliability	High reliability	High accuracy	Simple Low cost	Simple Low cost
Disadvantage	limitation of design	Expensive	Expensive	Expensive	Durability	Care and attention in pre adjustment

Capacitive Touch Sensors - B6T

- B6T Technology - Introduction: Basic Principle 1/2

Detect the capacitance of C_X = (combined capacity of C_1,C_2 and C_3)
C_X is dominated by C_3, since $C_3 << C_1$ and C_2.



$$\frac{1}{C_X} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

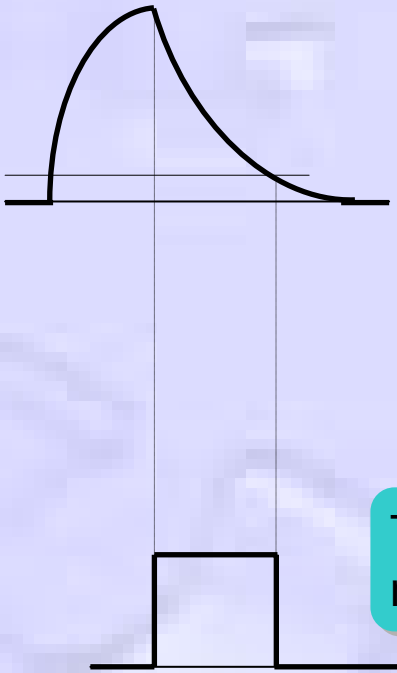
($C_3 << C_1$ and C_2)

$$\frac{1}{C_X} = \frac{1}{C_3}$$

$$C_X = C_3$$

Capacitive Touch Sensors - B6T

- B6T Technology - Introduction: Basic Principle 2/2



Charge
Discharge

Filtering

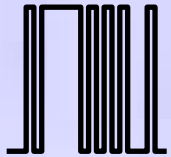
Time constant
measurement

Calculation
Comparison

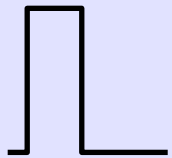
Operation
parameter

Output
circuit

Output
circuit



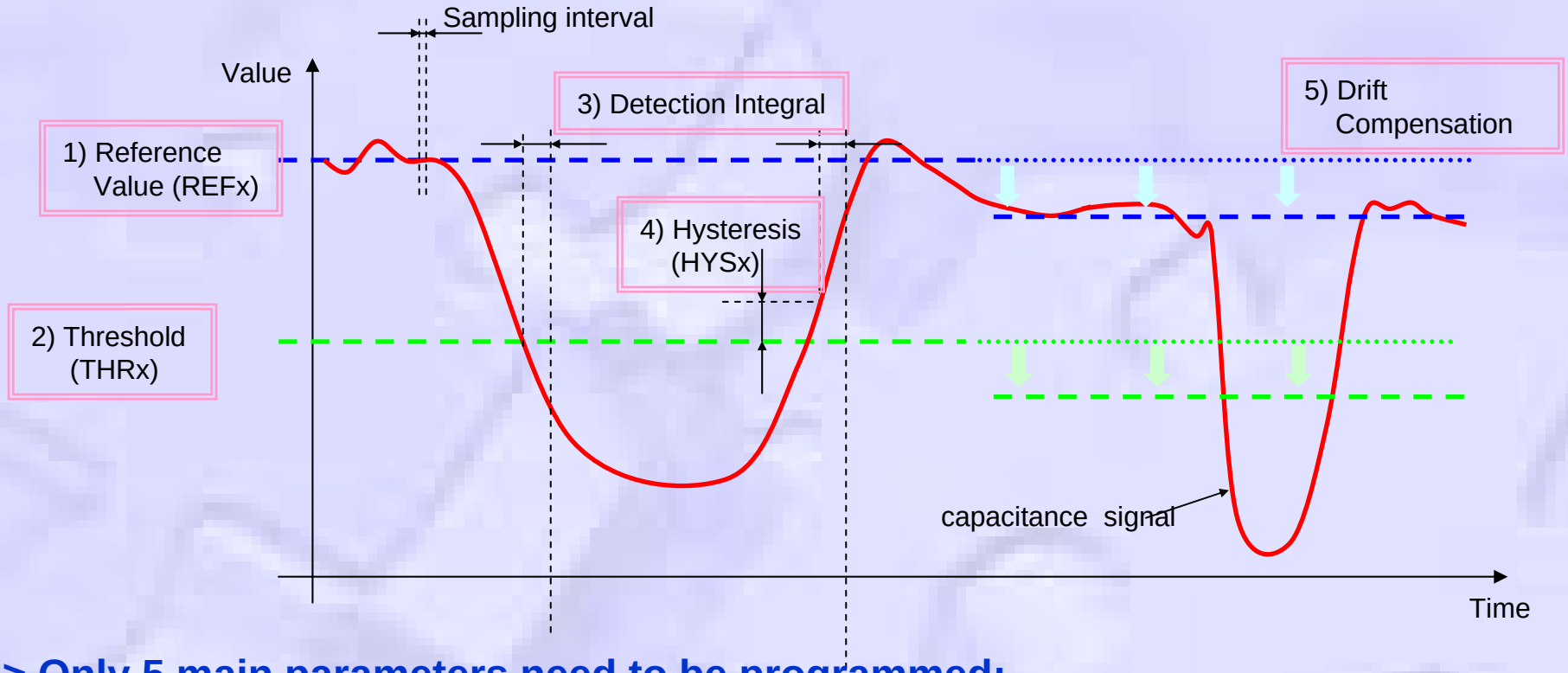
Serial output



ON/OFF output

Capacitive Touch Sensors - B6T

- B6T Technology – Introduction: Adjustment 1/2

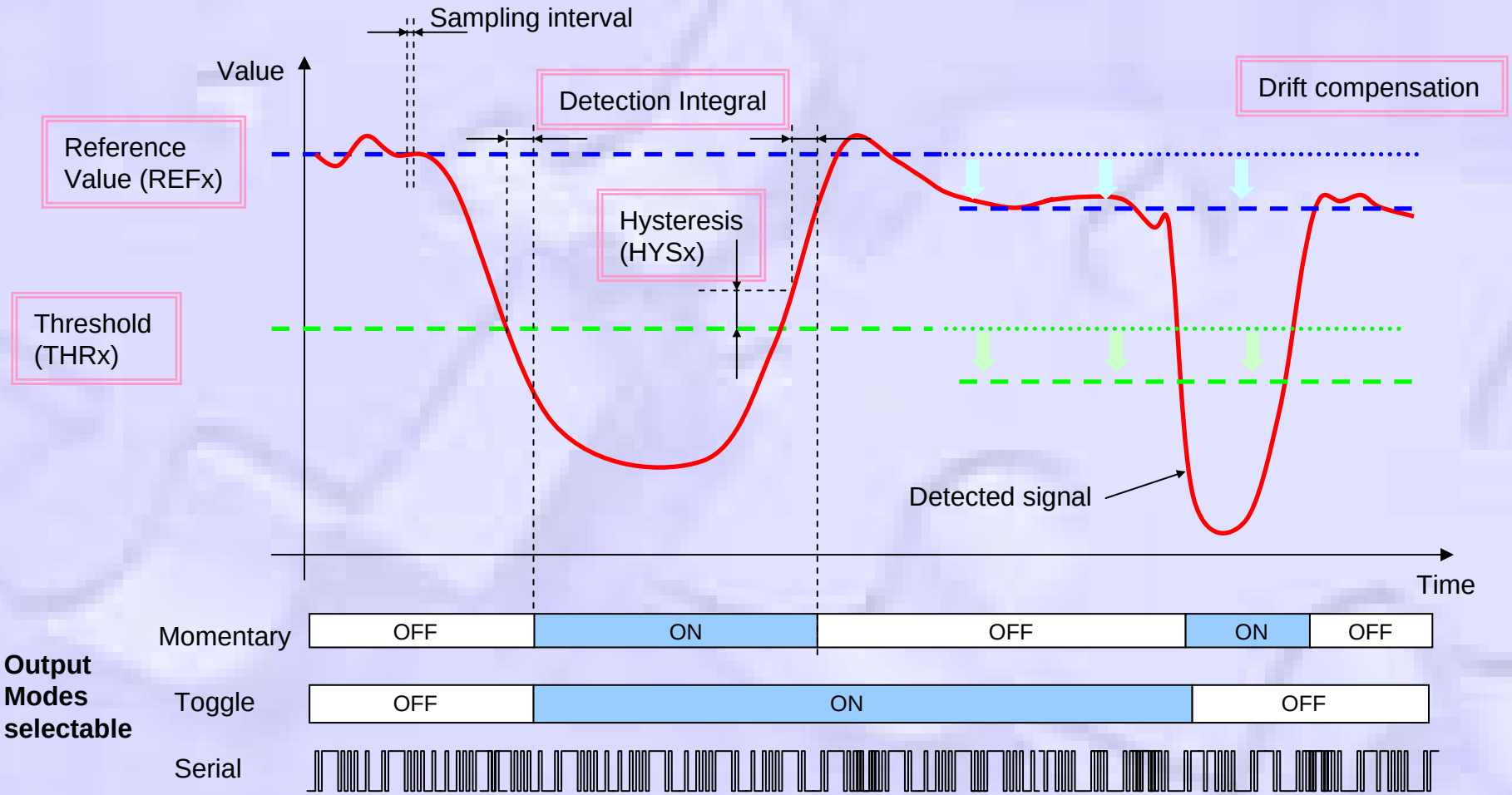


-> Only 5 main parameters need to be programmed:

1. Reference Value: Capacitance value for non-touch condition
2. Threshold: 1 requirement to judge a touch event: Capacitance change (amplitude)
3. Detection integral: 2 requirement to judge a touch event: time (delay)
4. Hysteresis: Amplitude change to judge non-touch condition
5. Drift compensation: To ensure long operation life reliability

Capacitive Touch Sensors - B6T

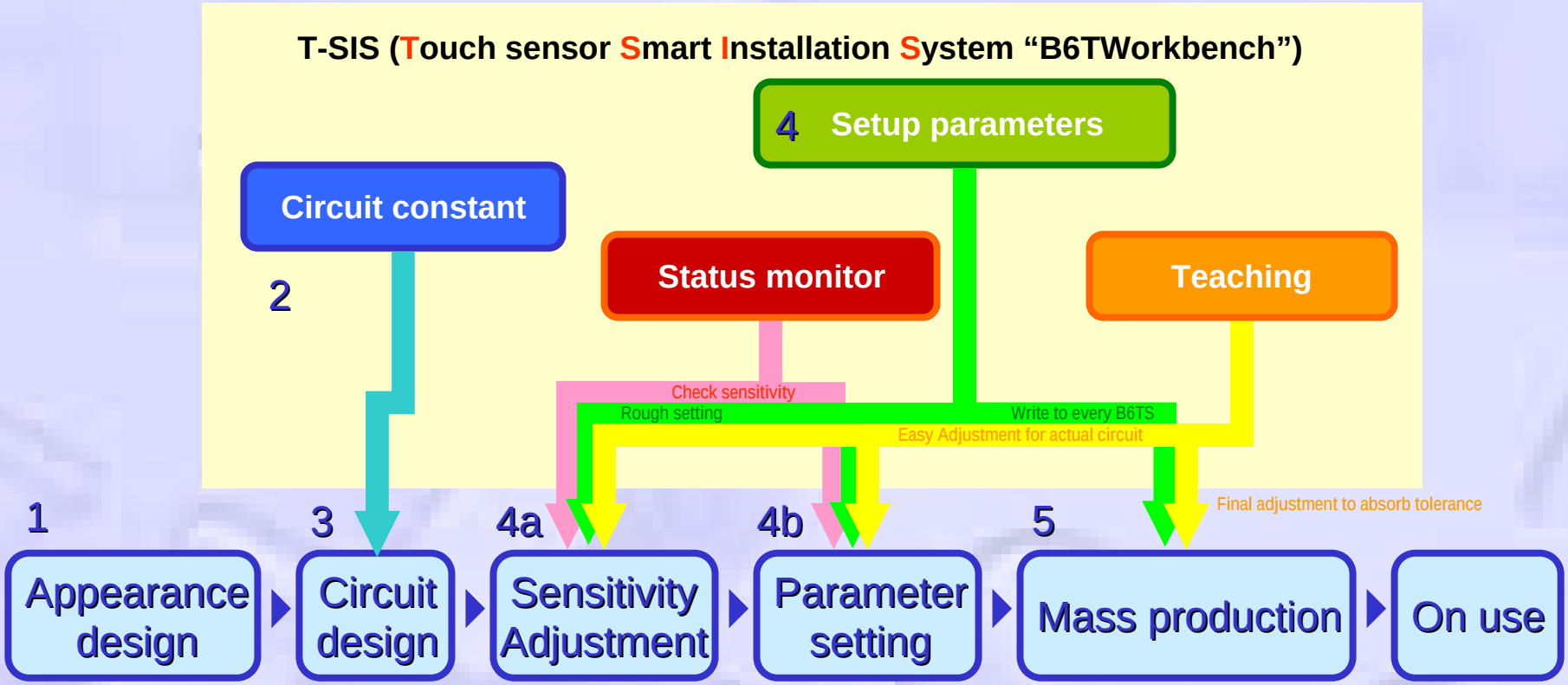
- B6T Technology - Introduction: Adjustment 2/2



-> Output modes selectable: Momentary, Latching or serial (SPI)

Capacitive Touch Sensors - B6T

- B6T Technology - Introduction: Development Process



--> In hours (days) to the touch panel prototype!

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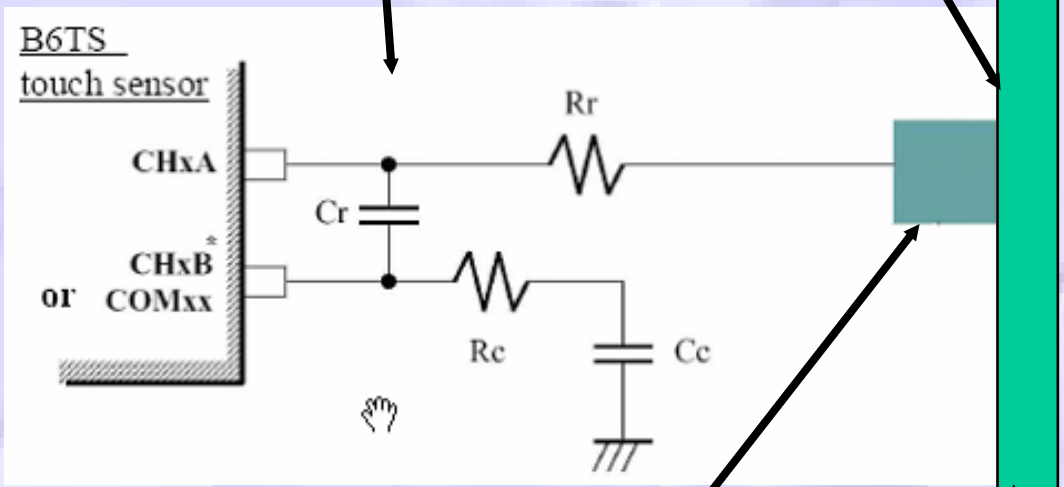
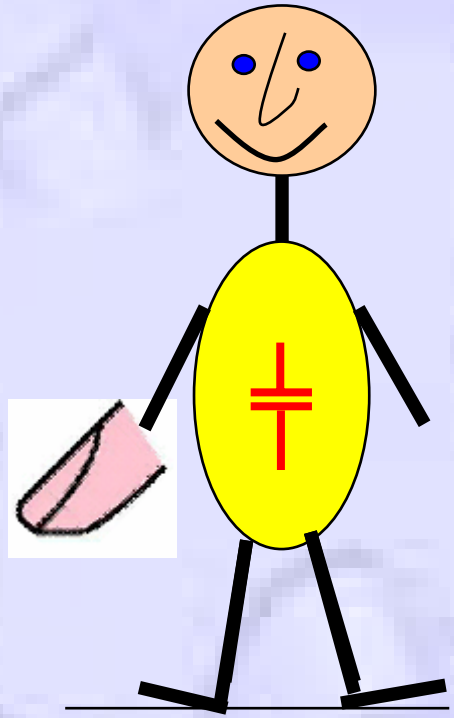
Capacitive Touch Sensors - B6T

- B6T Touch Technology – Details: Standard Panel

-> Electronics + Mechanics = **MechaTronics**





Electrode on PCB

Cover Material

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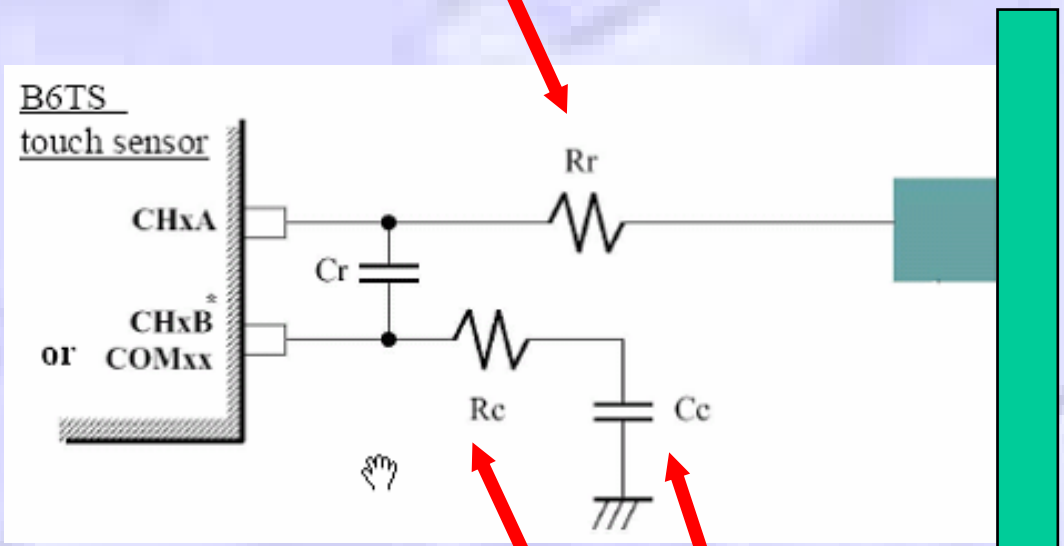
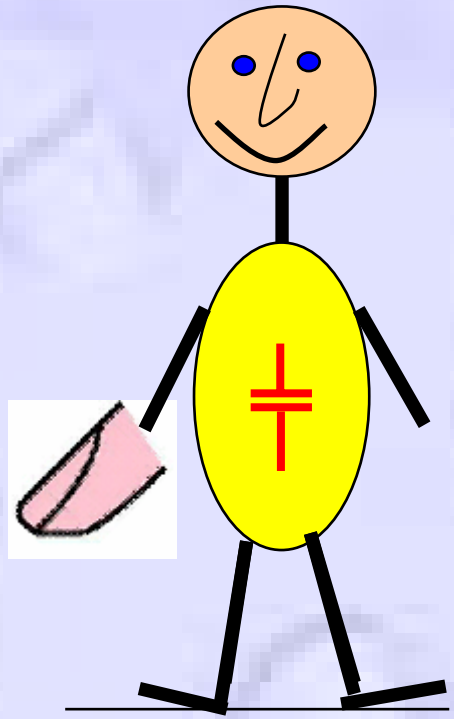
- B6T Touch Technology – Details: Standard Panel

ESD protection resistor, recommended 10kR





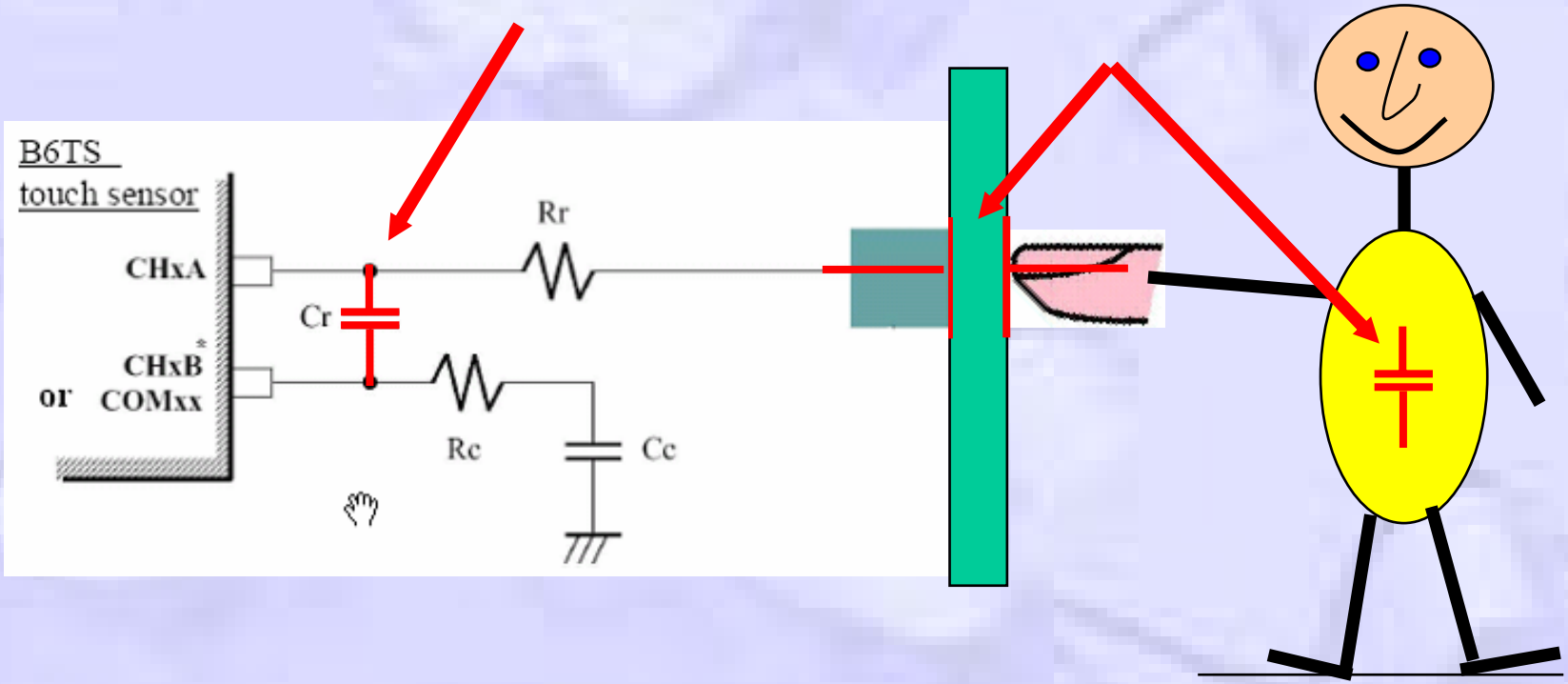
Energy buffer for charge/discharge: Rc + Cc

Capacitive Touch Sensors - B6T

- B6T Touch Technology – Details: Standard Panel

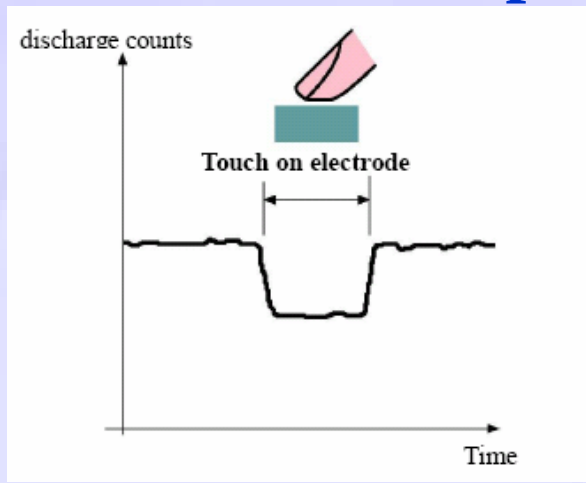
Reference Capacitor Cr

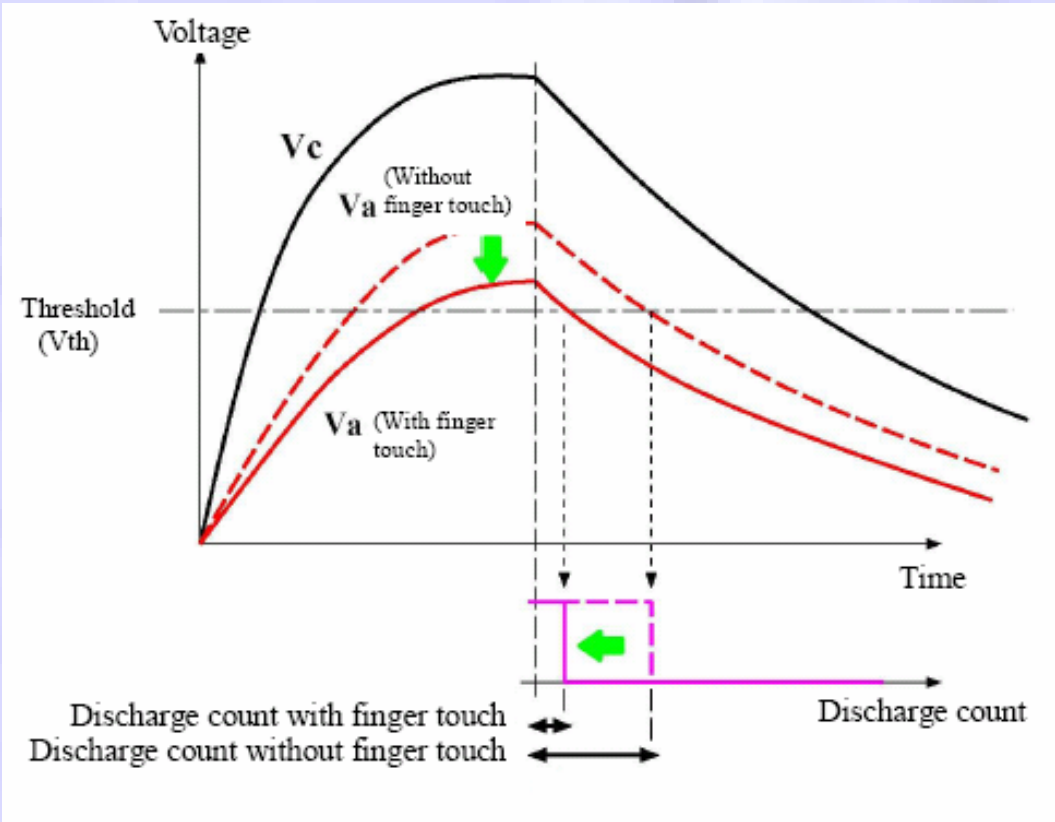
Capacitor Cx
= $C_{electrode}$ + $C_{HumanBody}$

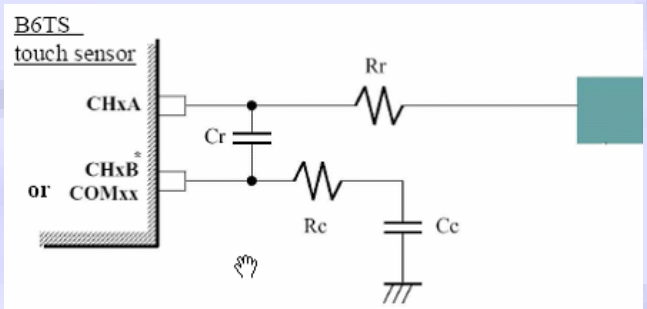


Capacitive Touch Sensors - B6T

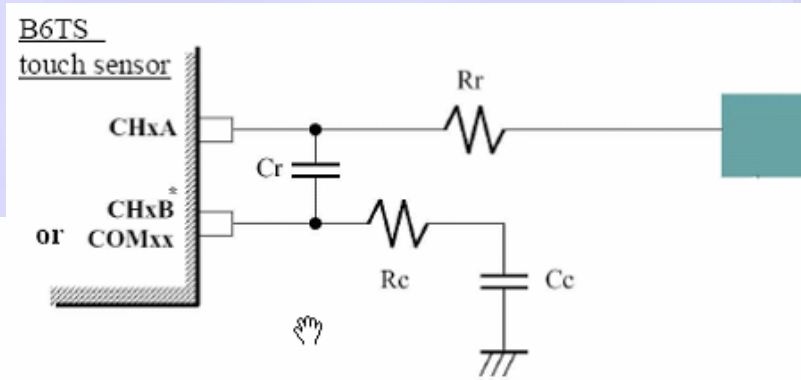
- B6T Touch Technology – Details: Patented Principle

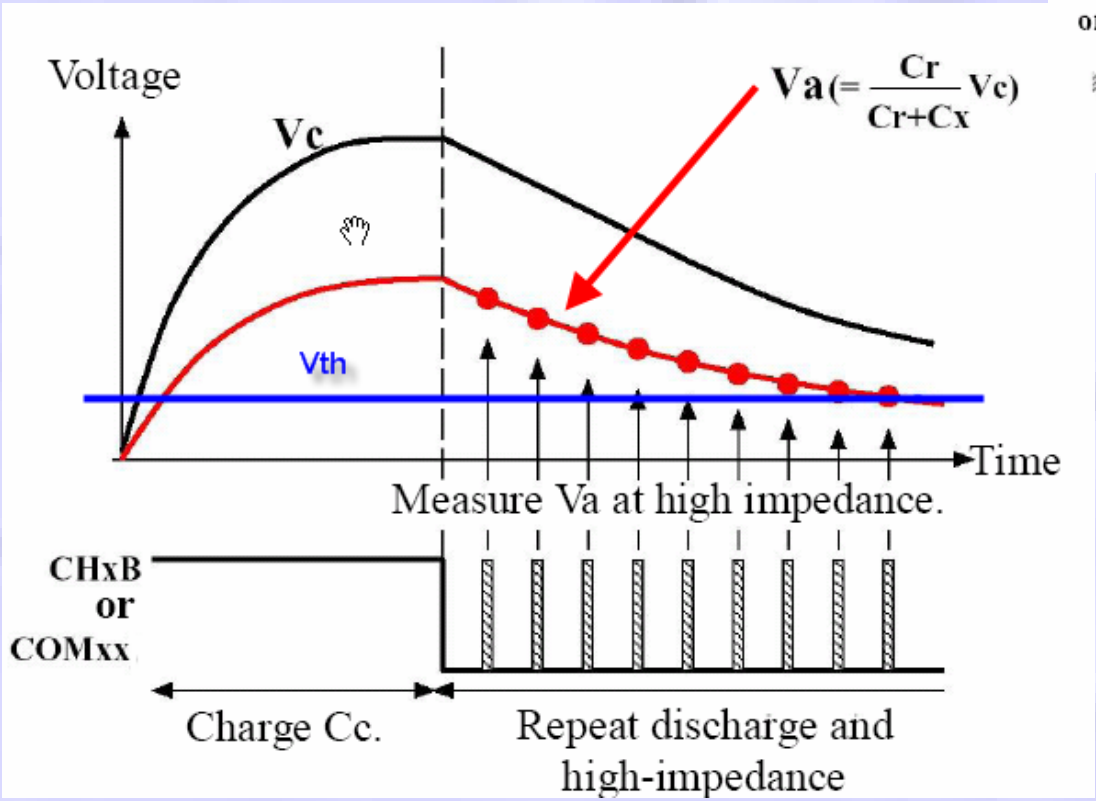






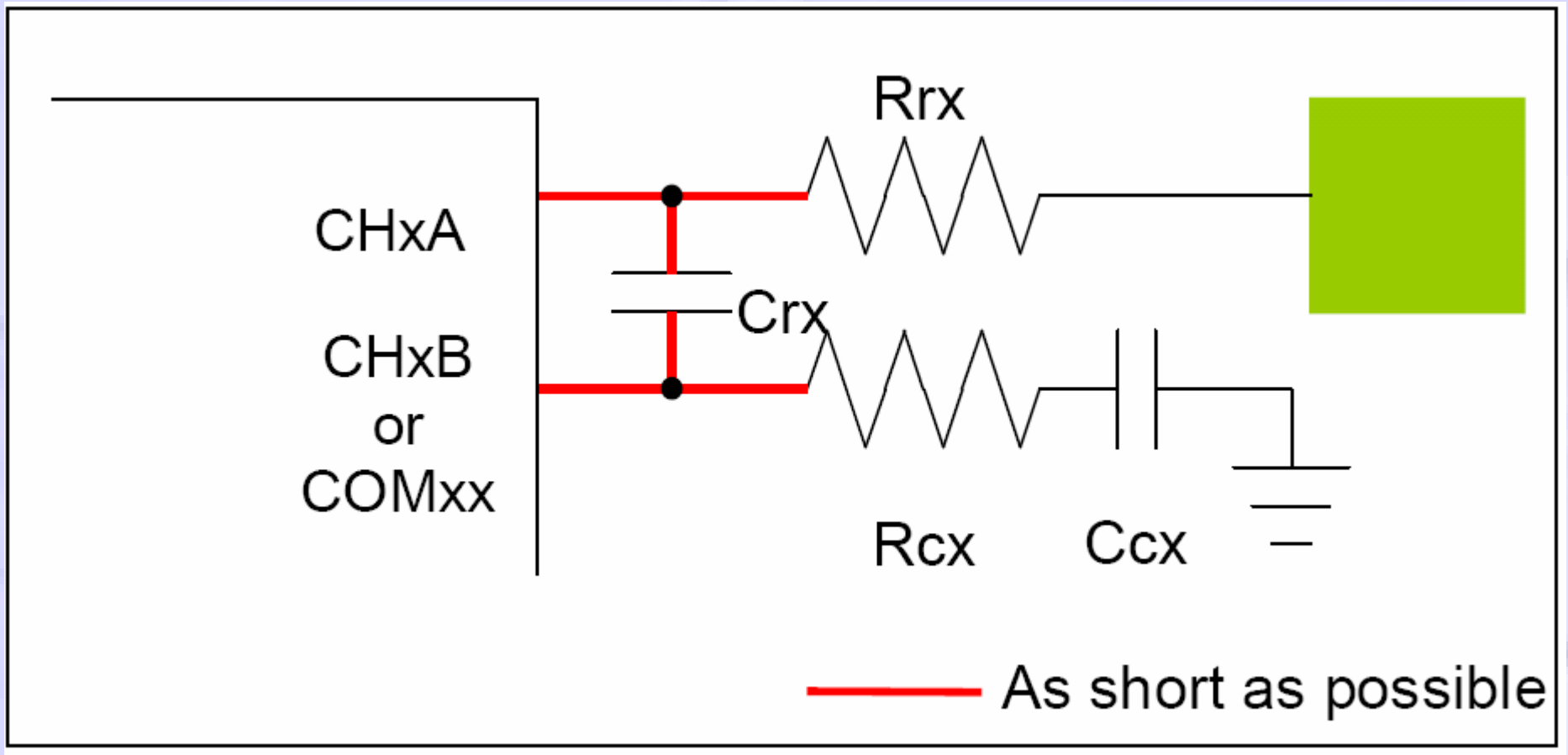
Capacitive Touch Sensors - B6T
- B6T Touch Technology – Details: Patented Principle





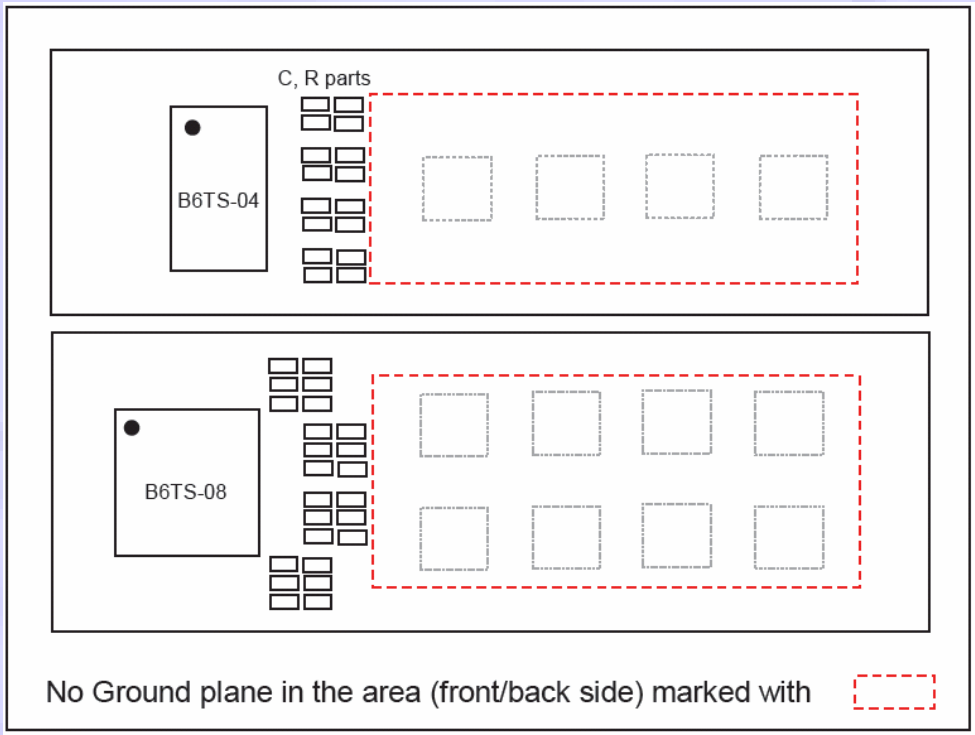
Capacitive Touch Sensors - B6T

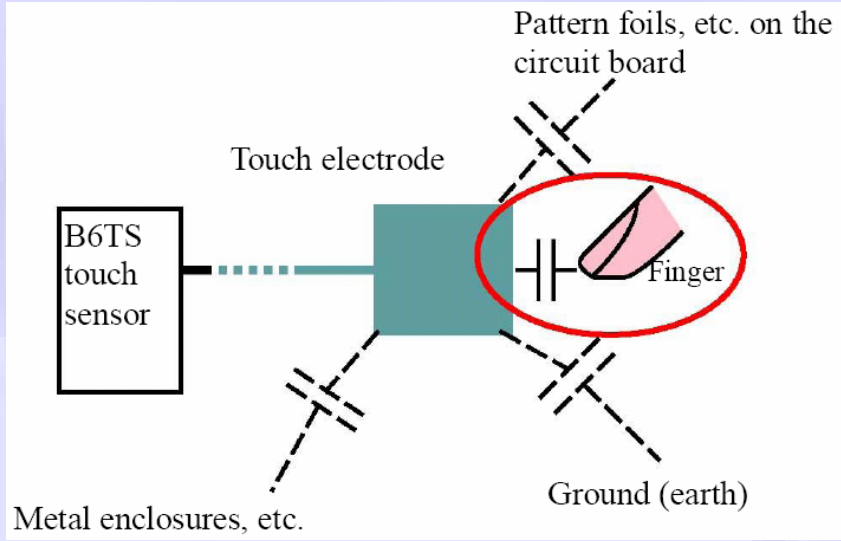
- B6T Touch Technology – Details: Design Rules 1/4



Capacitive Touch Sensors - B6T

- B6T Touch Technology – Details: Design Rules 2/4

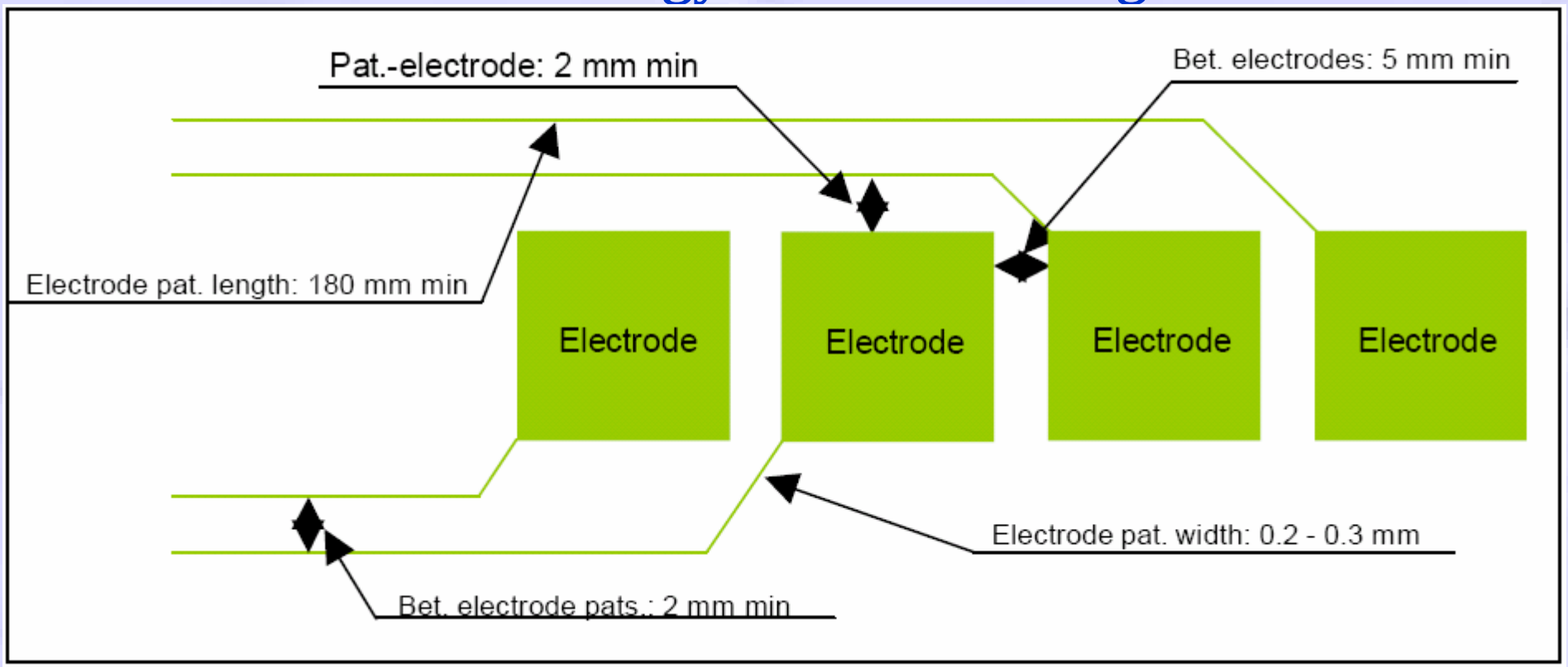




- Ground planes close to the electrodes reduce the usable signal (-> signal to noise is reduced - SNR)

Capacitive Touch Sensors - B6T

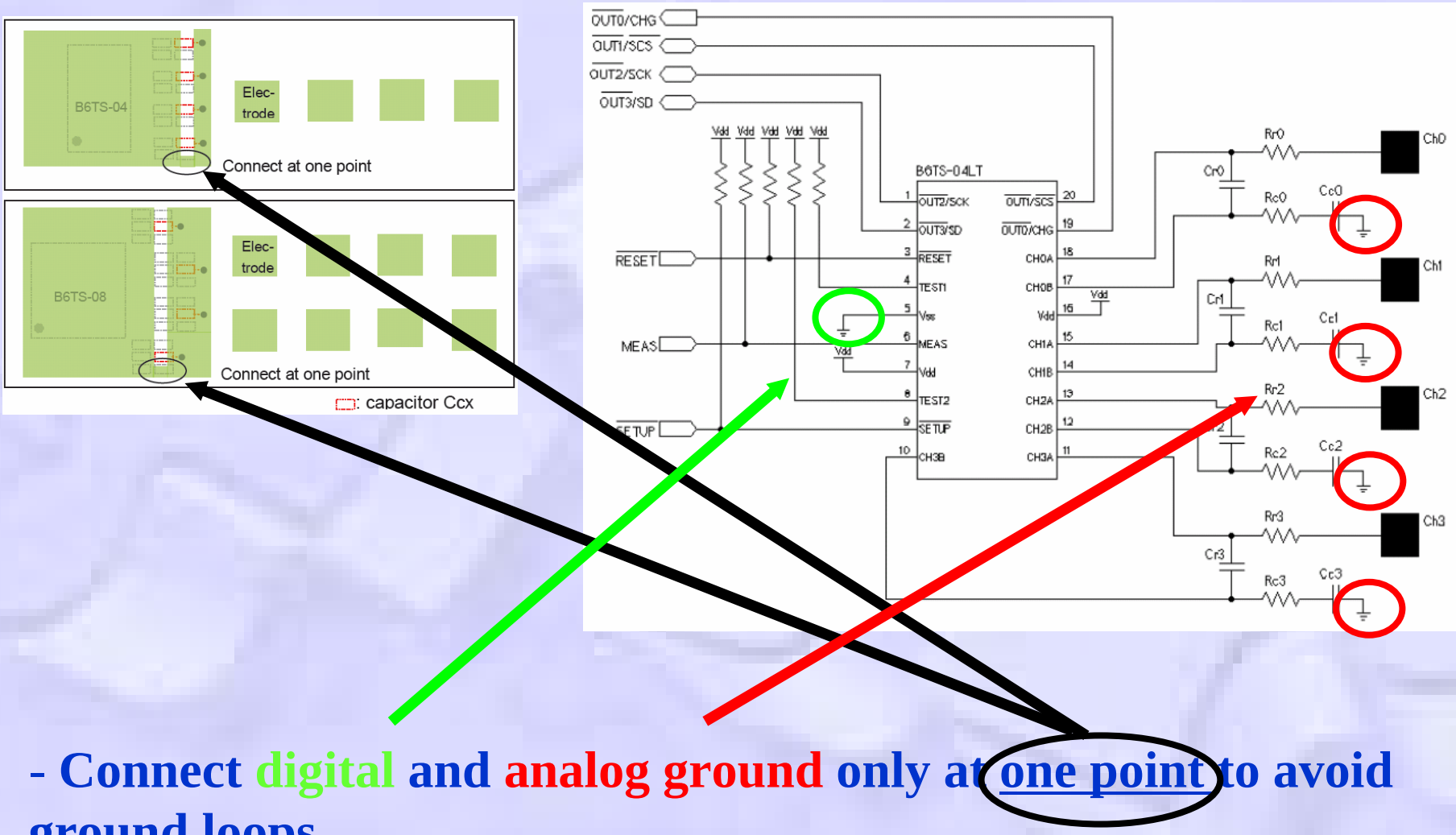
- B6T Touch Technology – Details: Design Rules 3/4



- Distances between the channels must be considered to minimize the effects of cross talk
- Track length as short as possible to minimize antenna effects

Capacitive Touch Sensors - B6T

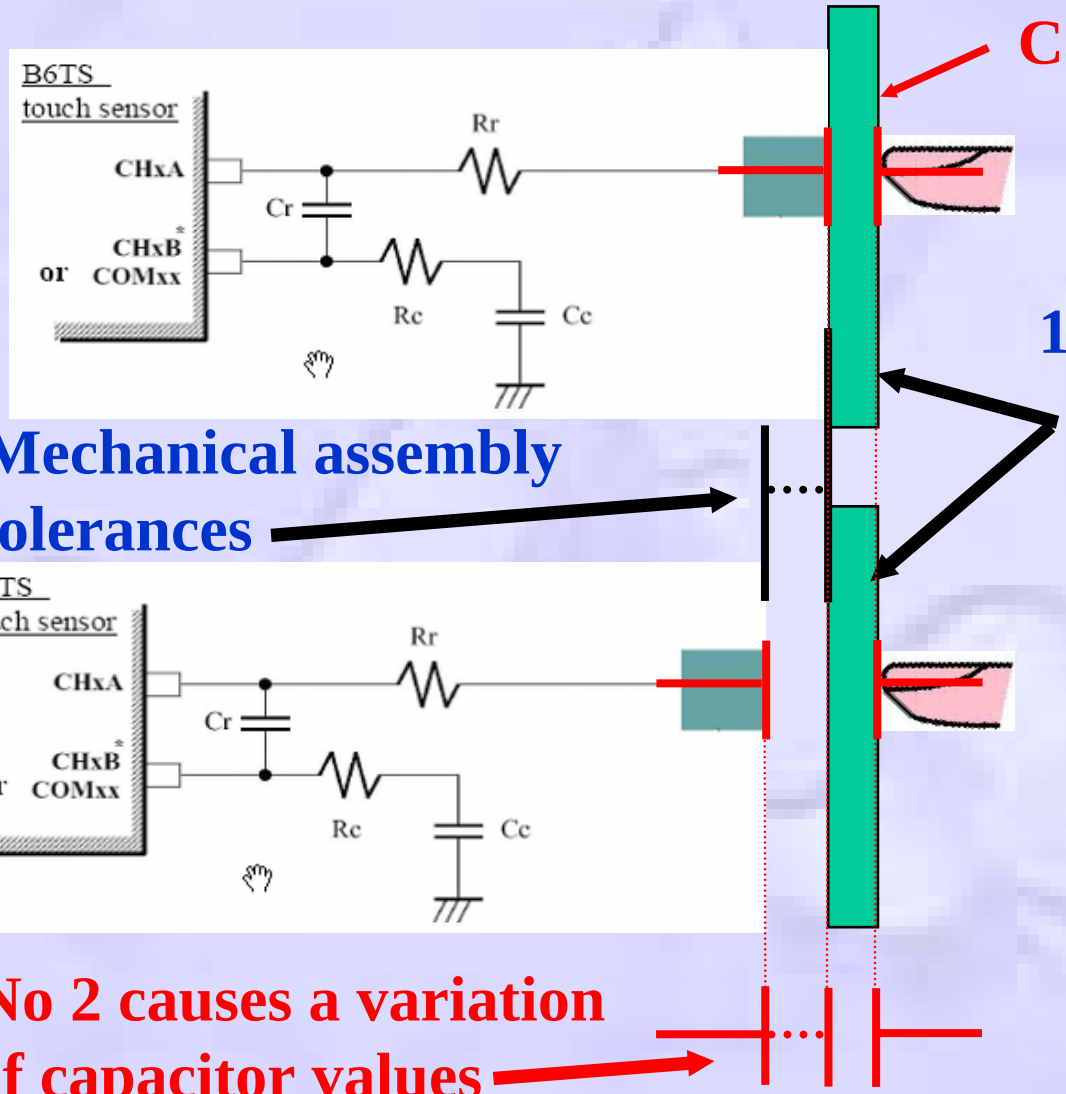
- B6T Touch Technology – Details: Design Rules 4/4



- Connect digital and analog ground only at one point to avoid ground loops

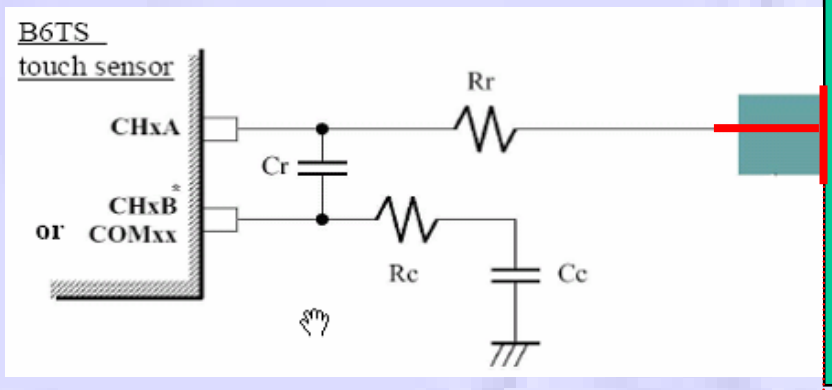
Capacitive Touch Sensors - B6T

- B6T Touch Technology – Details: Assembly 1/3

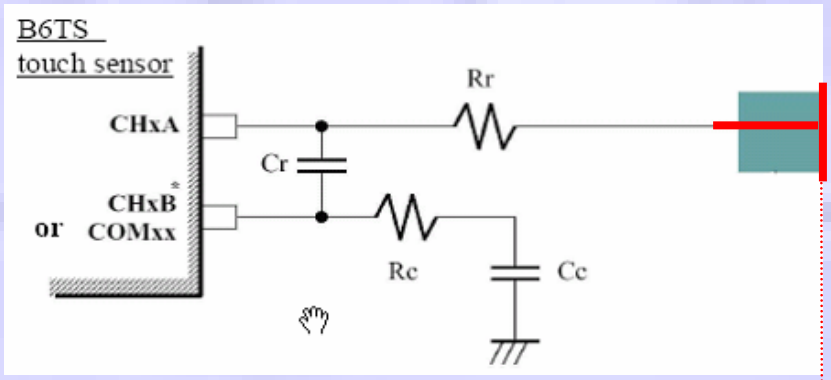


Capacitive Touch Sensors - B6T

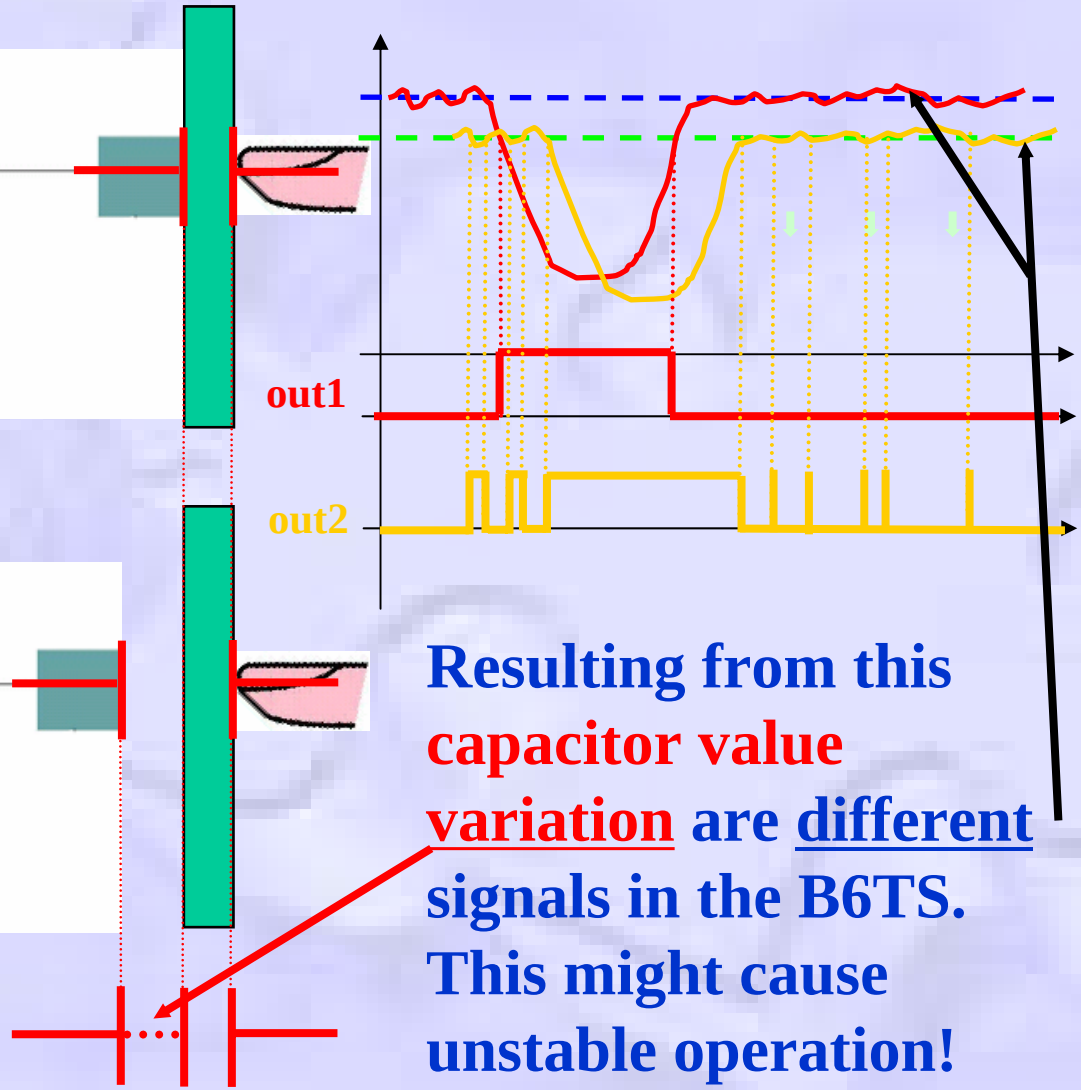
- B6T Touch Technology – Details: Assembly 2/3



Device no1

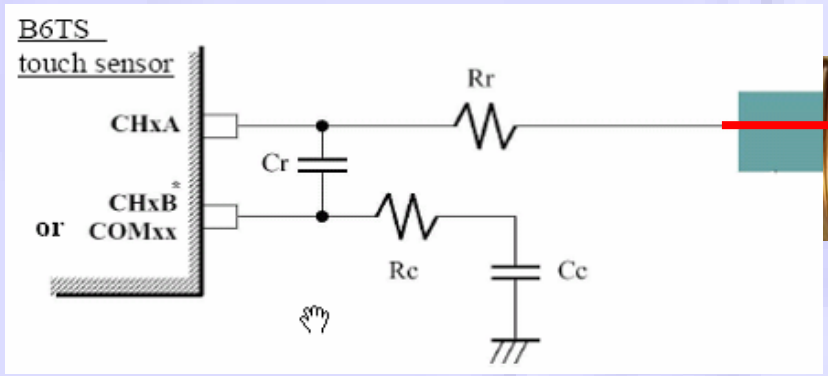


Device no2

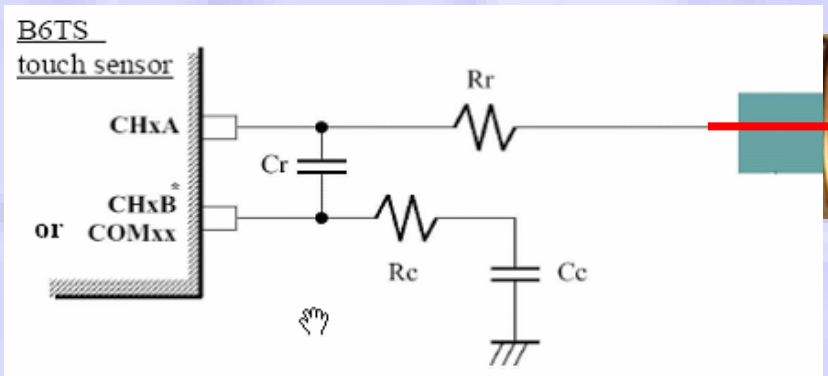


Resulting from this capacitor value variation are different signals in the B6TS. This might cause unstable operation!

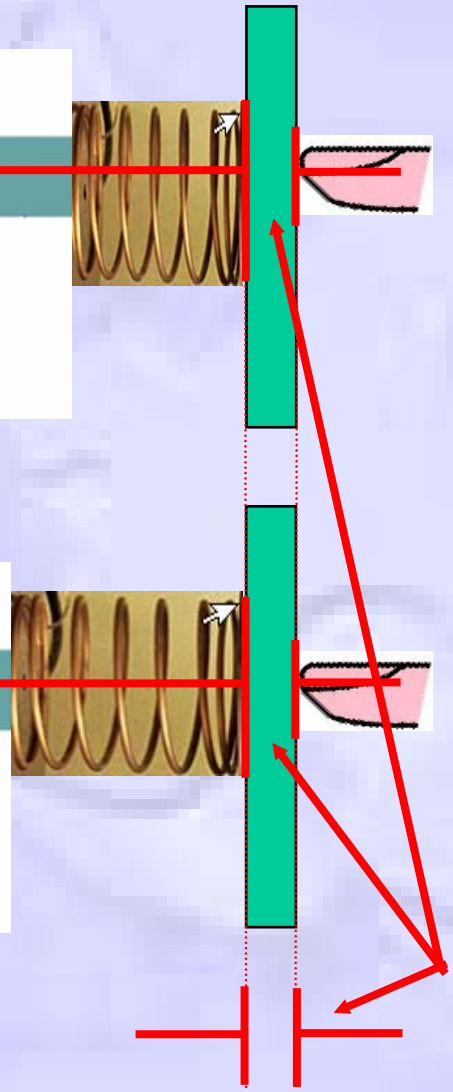
Capacitive Touch Sensors - B6T
- B6T Touch Technology – Details: Assembly 3/3



Device no1



Device no2



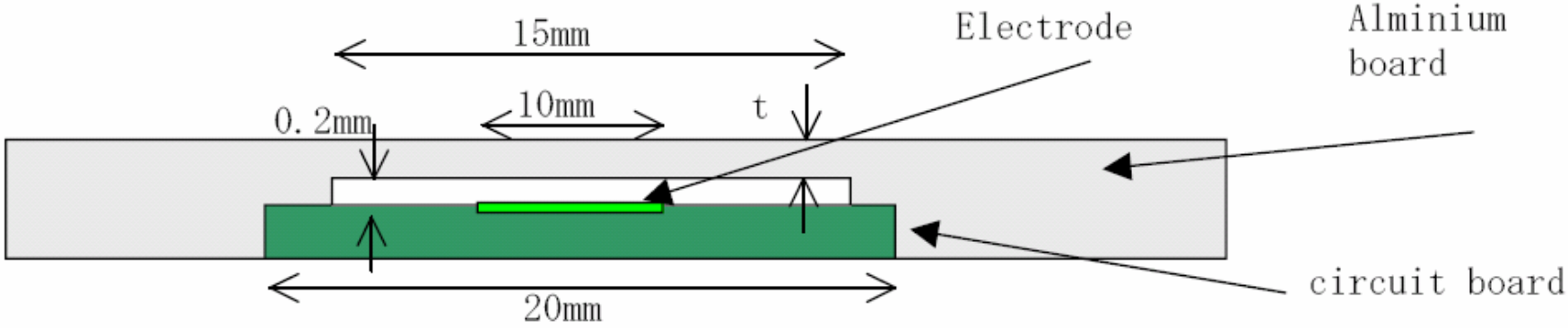
To compensate the mechanical tolerances, a flexible conductor is used: “A Spring”

The capacitor value stays constant!

Capacitive Touch Sensors - B6T

- B6T Touch Technology – Details: Metal Covers 1/2

(3) Example of structure



【Result in the case of structure 3】

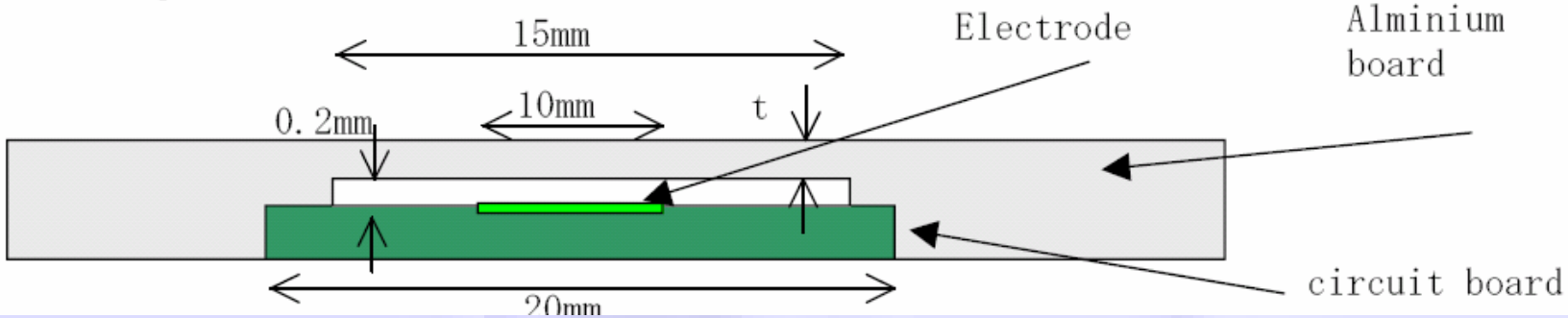
1. Parts setting

	ch0(t=0.2)	ch1(t=0.25)	ch2(t=0.3)	ch3(t=0.35)
Cc	0.1μF			
Rc	6.8kΩ			
Cr	18pF			
Rr	10kΩ			

( ) = thickness of Aluminium cover

Capacitive Touch Sensors - B6T
- B6T Touch Technology – Details: Metal Covers 2/2

(3) Example of structure



2. Mesured result

・pressing force = 150g

	ch0 (0.2)	ch1 (0.25)	ch2 (0.3)	ch3 (0.35)
esurements (non touch)	322	358	314	247
mesurements (touch)	253	323	290	233
⊿	69	35	24	14

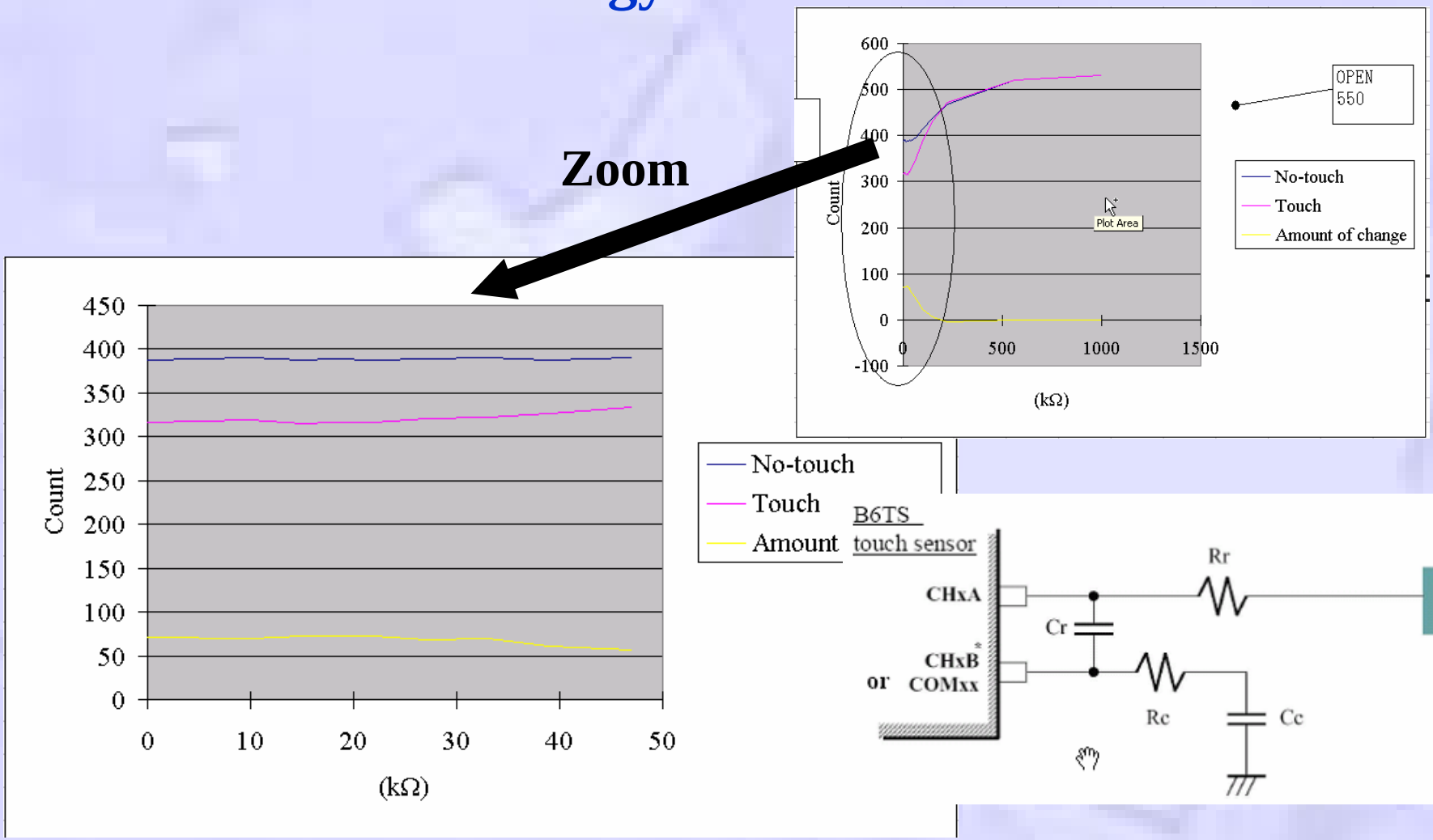
・pressing force =300g

	ch0 (0.2)	ch1 (0.25)	ch2 (0.3)	ch3 (0.35)
esurements (non touch)	315	347	305	245
mesurements (touch)	190	280	250	210
⊿	125	67	55	35

・pressing force =500g

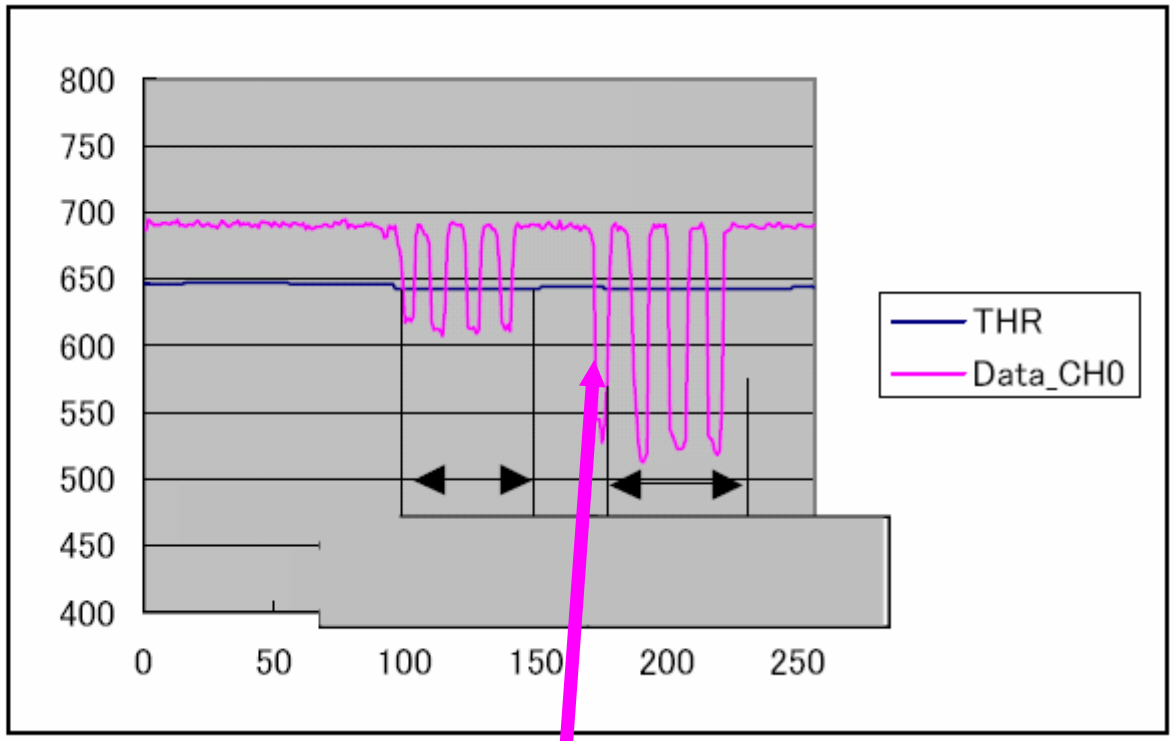
	ch0 (0.2)	ch1 (0.25)	ch2 (0.3)	ch3 (0.35)
esurements (non touch)	315	347	305	245
mesurements (touch)	4	210	226	190
⊿	311	137	79	55

Capacitive Touch Sensors - B6T
- B6T Touch Technology – Details: ITO



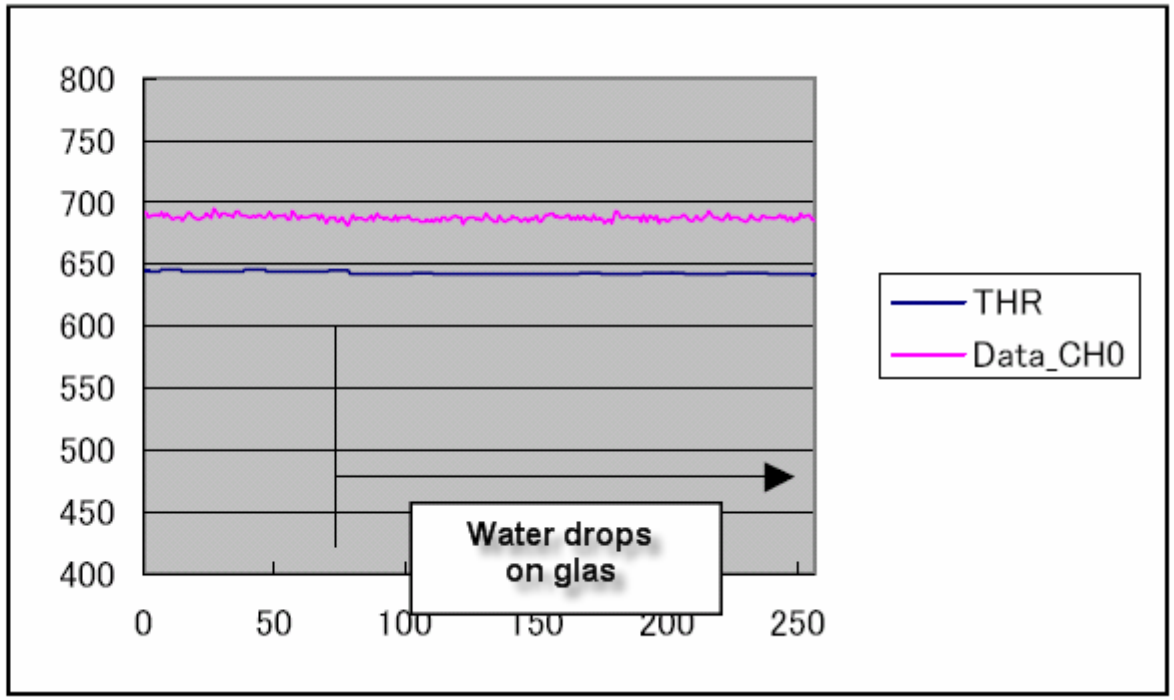
Effect of series resistance when using ITO technology

Capacitive Touch Sensors - B6T
- B6T Touch Technology – Details: Effect of Water 1/4



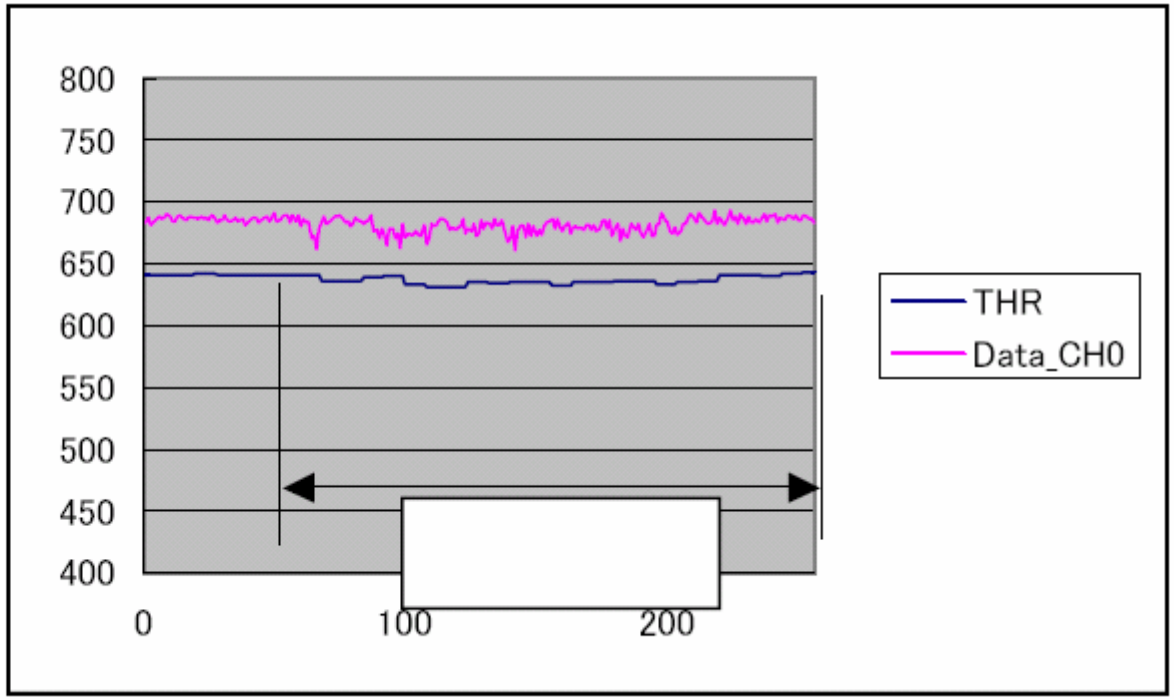
The signal without water -> Signal changes for touch events

Capacitive Touch Sensors - B6T
- B6T Touch Technology – Details: Effect of Water 2/4



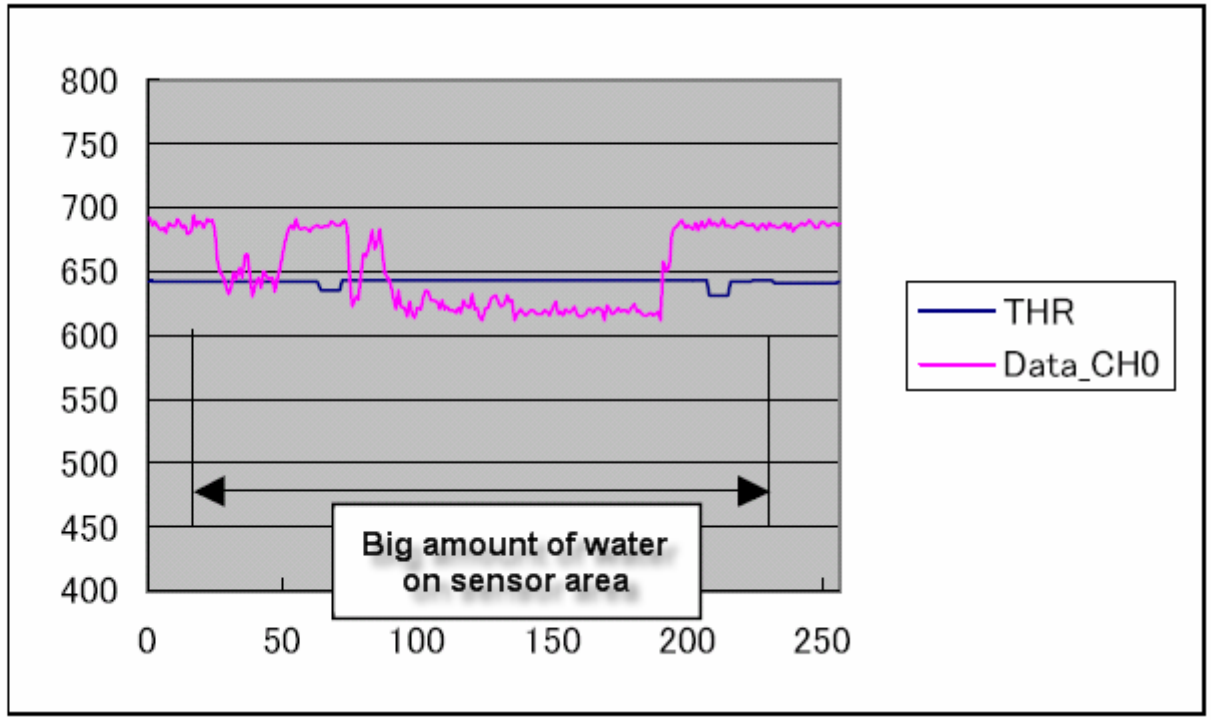
The signal with small amount of water, just some water drops

Capacitive Touch Sensors - B6T
- B6T Touch Technology – Details: Effect of Water 3/4



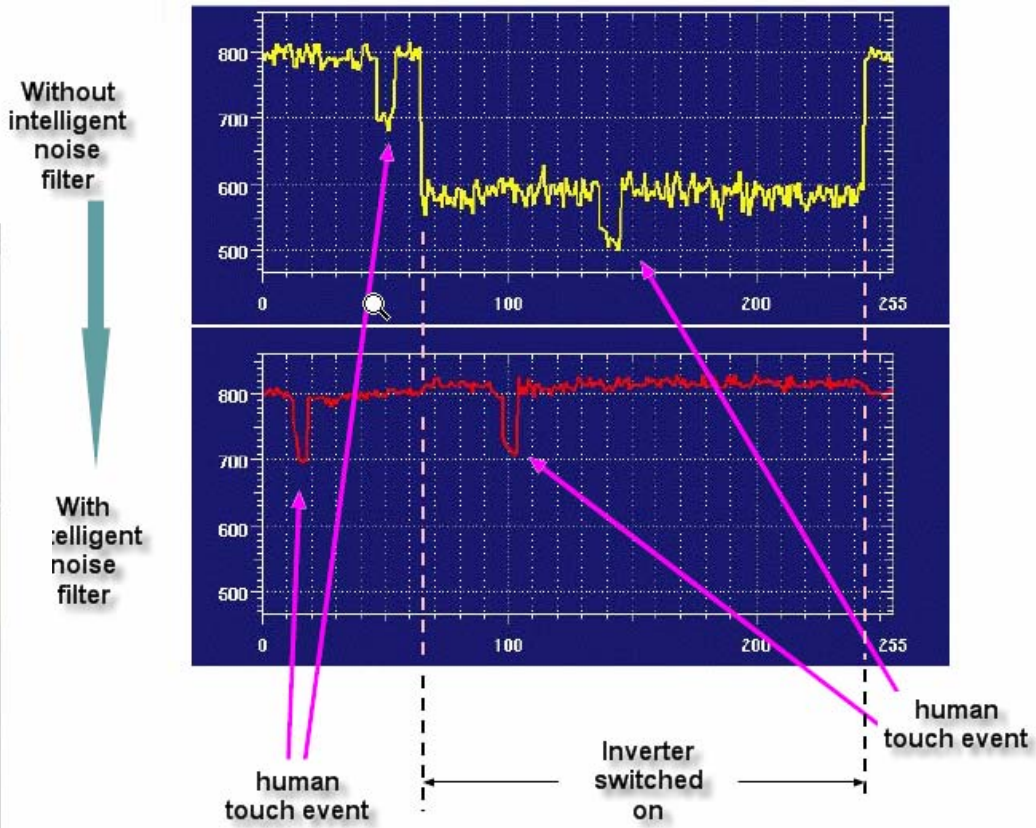
The signal with more water running down the glass panel
–>The drift compensation adjusts the switching thresholds

Capacitive Touch Sensors - B6T
- B6T Touch Technology – Details: Effect of Water 4/4



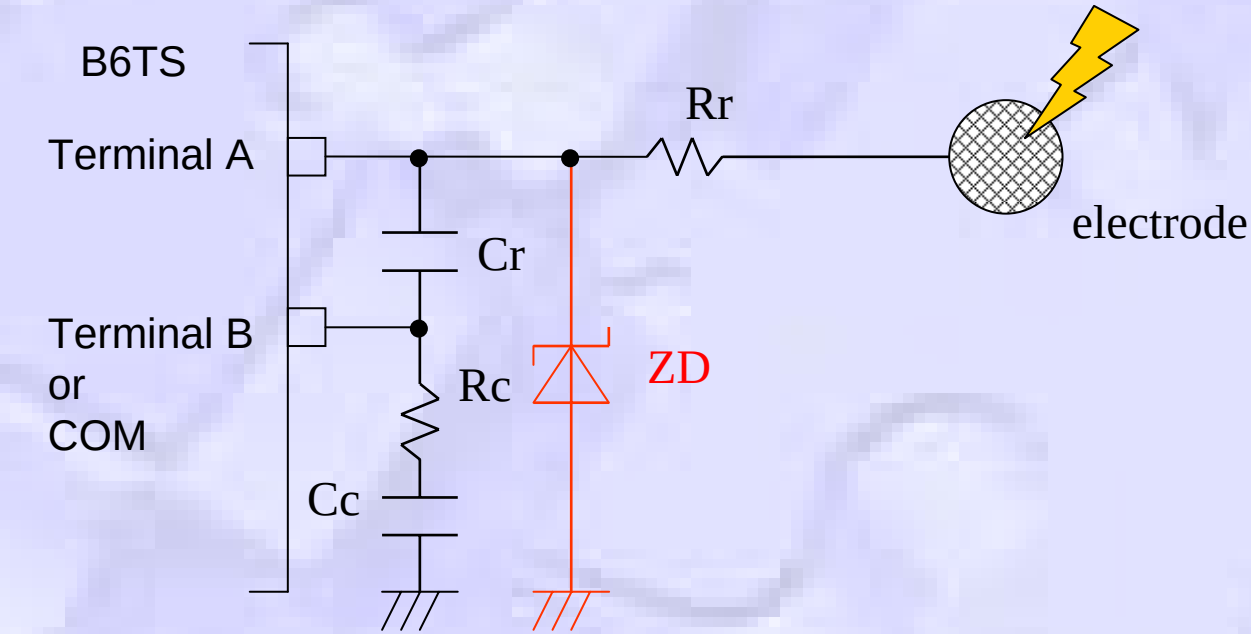
The signal with big amount of water could make the B6TS switch unwanted

Capacitive Touch Sensors - B6T
- B6T Touch Technology – Details: EMC behaviour



Capacitive Touch Sensors - B6T
- B6T Touch Technology – Details: ESD 1/2

Direct contact to electrode



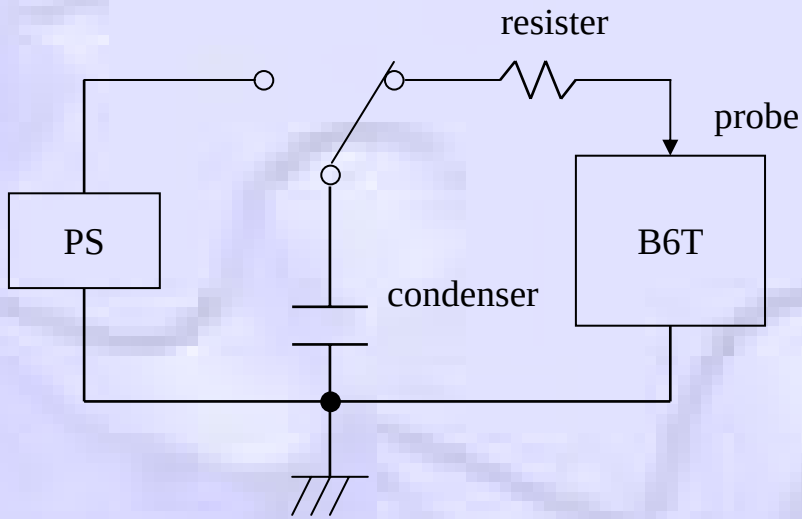
(1) Please use zener diode as a protection circuit
(2) Please set Judging count (ADC) value more than 1.

Capacitive Touch Sensors - B6T
- B6T Touch Technology – Details: ESD 2/2

At HBM (Human Body Model) method
2000V min.

condition
capacitor : 100pF
resistor : 1.5kΩ

test circuit



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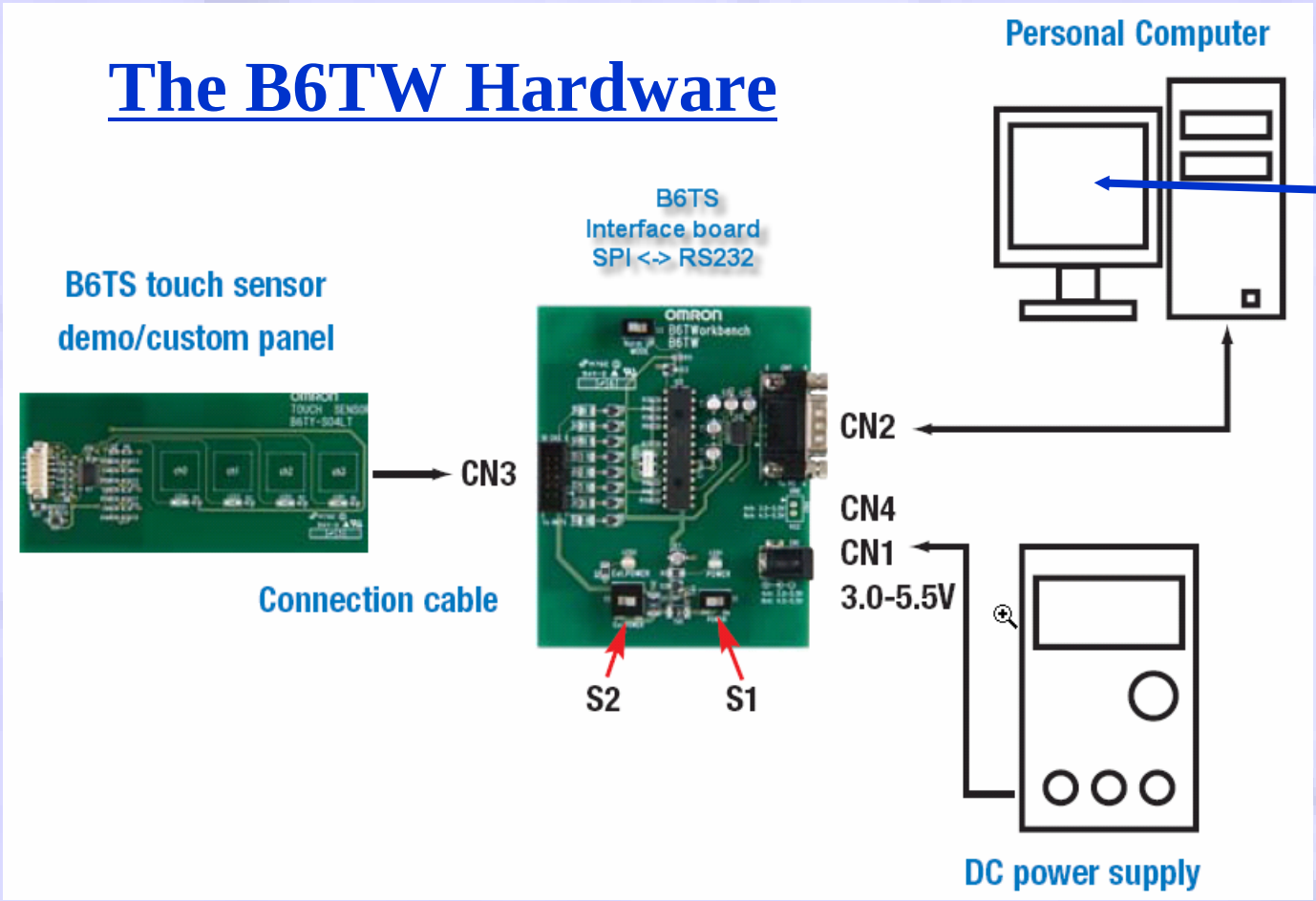
Capacitive Touch Sensors - B6T
- B6T Touch Technology – Design Tool B6TWorkbench



Capacitive Touch Sensors - B6T
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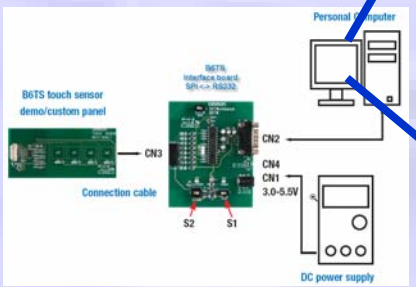
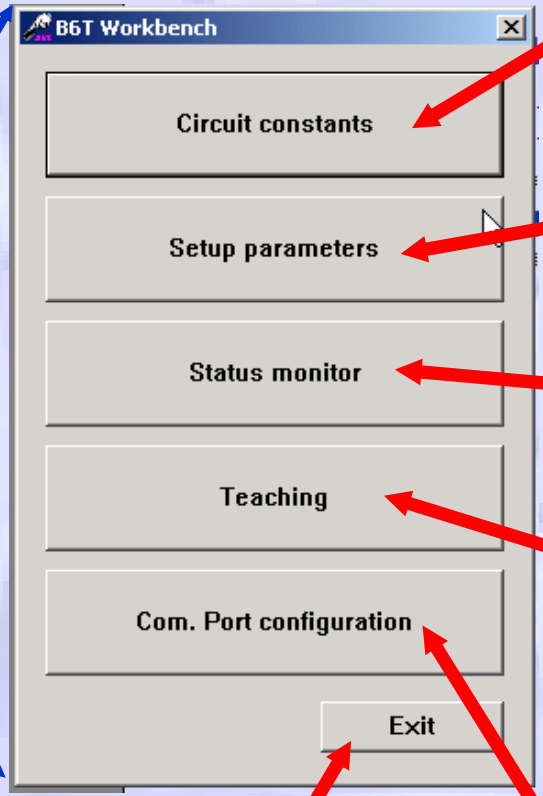
The B6TW Software





Circuit Constants simulator

Read/write access to all B6TS parameters

Real time capacitance monitor

Teachinig function for first rough parameter setup

COM port selection or virtual COM via USB

Exit

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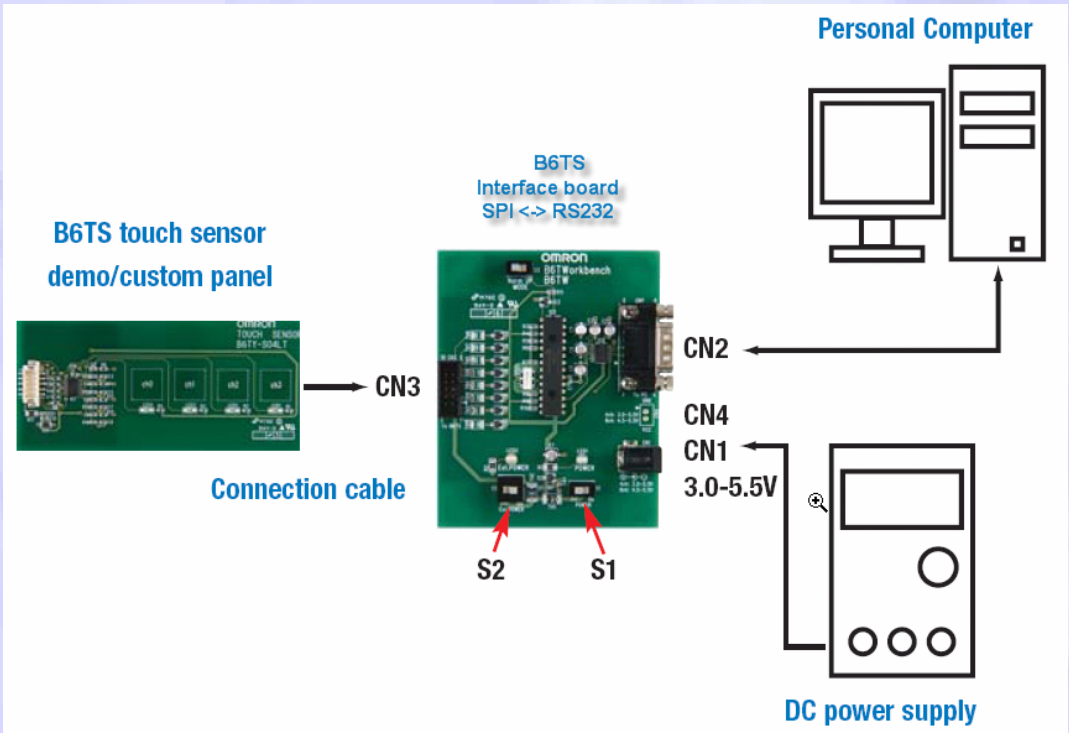
The B6TW



-> Presentation of the Design tool B6TW

Capacitive Touch Sensors - B6T - Content

- B6T Touch Technology - Introduction
- B6T Touch Technology – Details
- Design Tool B6TWorkbench – B6T Hardware
- B6T Roadmap
- B6T Promotion tools

Capacitive Touch Sensors - B6T
- B6T Roadmap

- **Available products:**
  - B6TS-04LT 4 channel
  - B6TS-08NF 8 channel (will be discontinued approx.: July 2008)

- **Under development**
  - B6TS-08LF 8 channel -> ES June, SOP July 2007 (planned)
  - B6TS-16LF 16 channel -> ES June, SOP July 2007 (planned)

- **New developments (planned)**
  - New design tool B6TWorkbench with USB interface -> date t.b.d.
  - B6TS with slider function -> date t.b.d.

- **Custom specific types possible**

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Capacitive Touch Sensors - B6T
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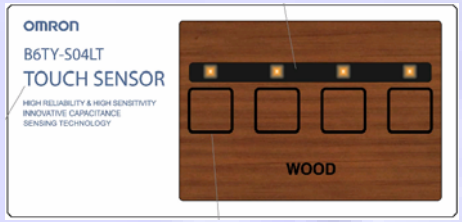
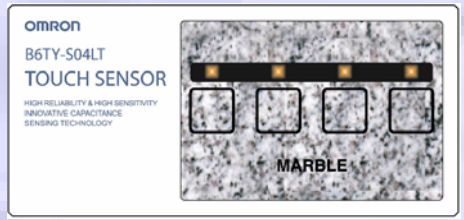
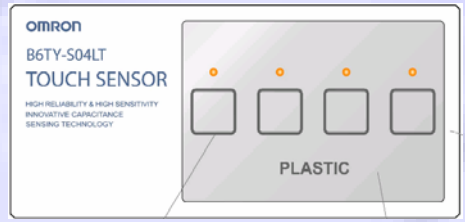


- Demonstrators ---------->





- Product brochure ---------->

- Data Sheets
- Application Notes ---------->
- On side support/training