Atmel Touch Layout Guidelines Quick Reference Ongoing...

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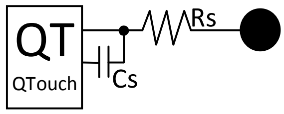
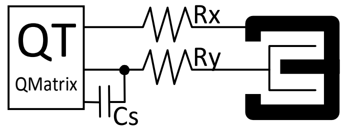
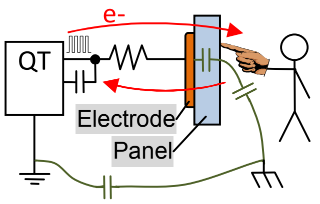
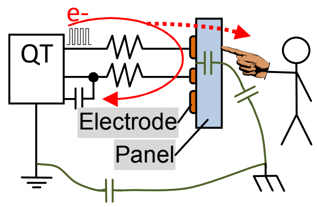
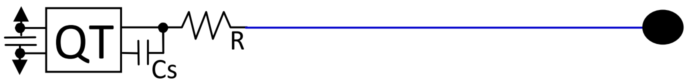
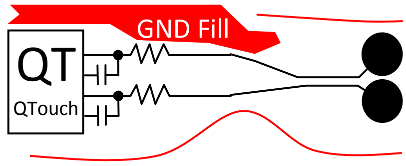
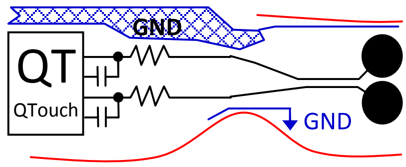
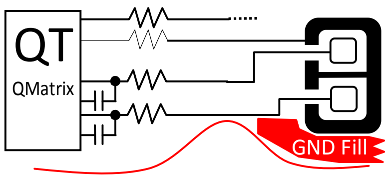
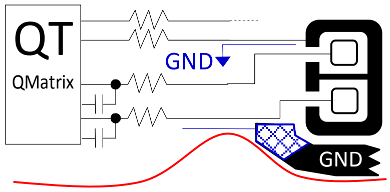
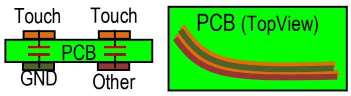
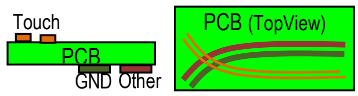
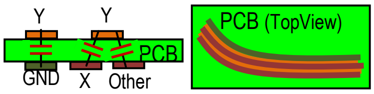
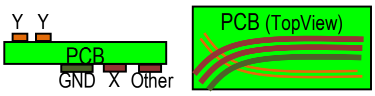
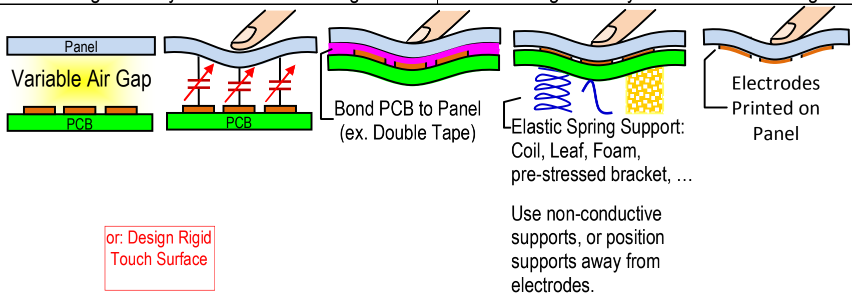
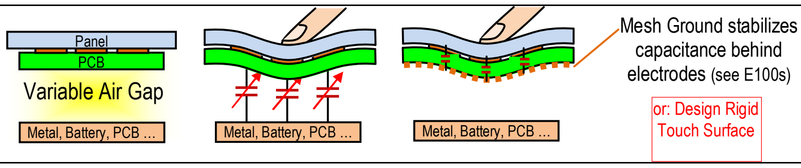
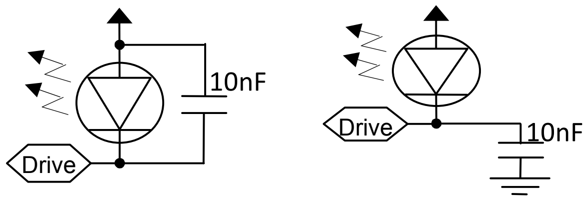
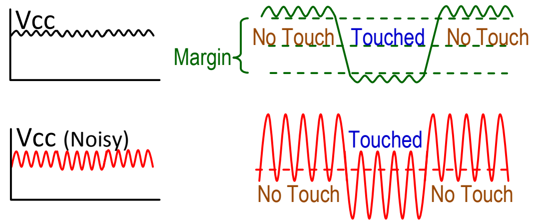
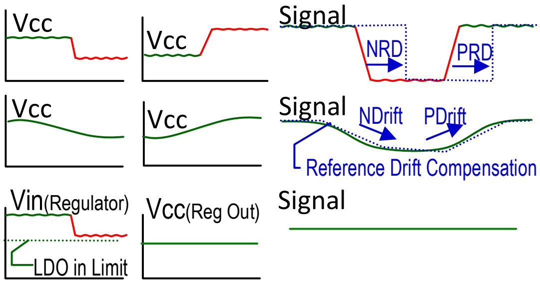
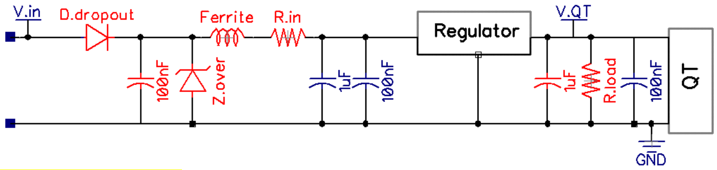
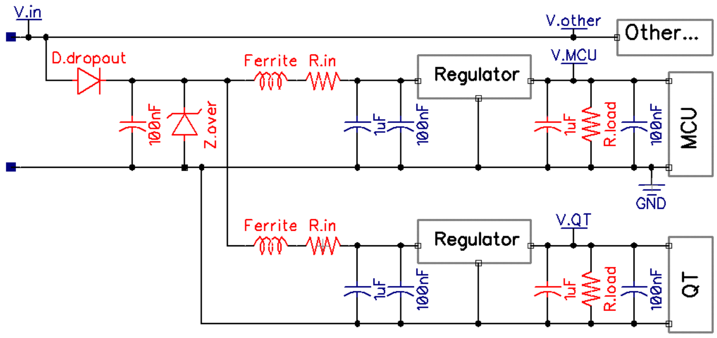
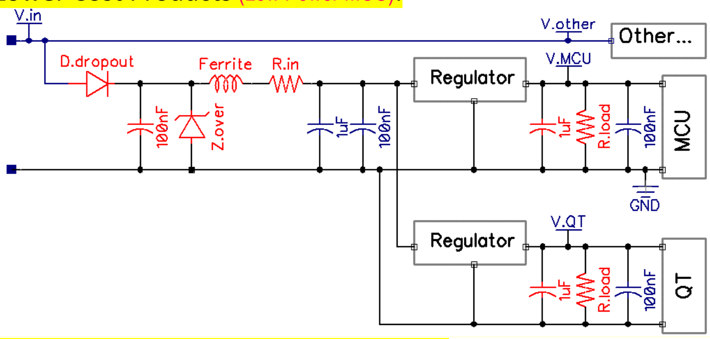
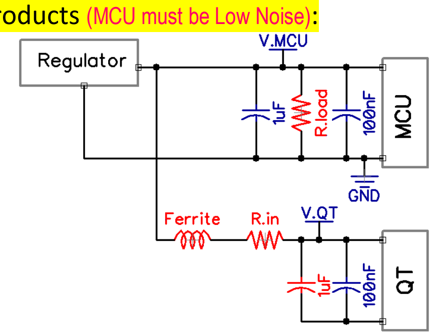
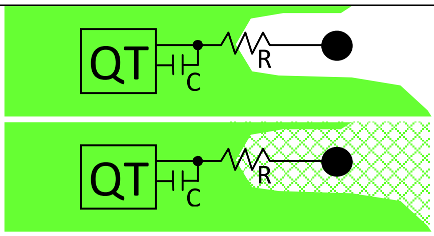
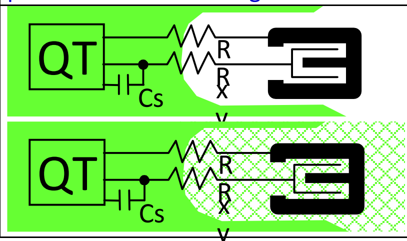
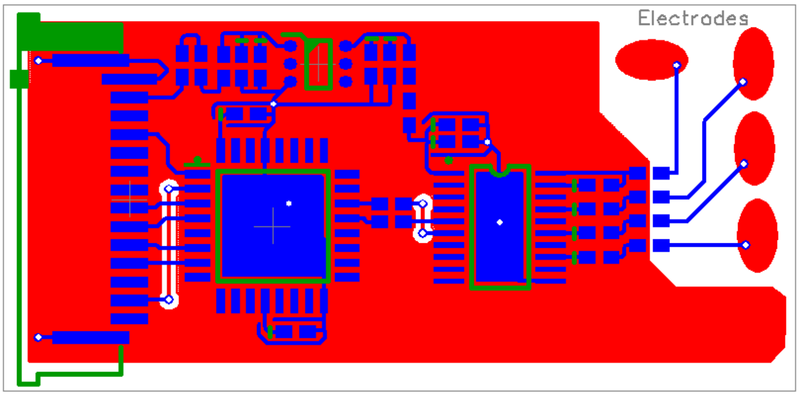
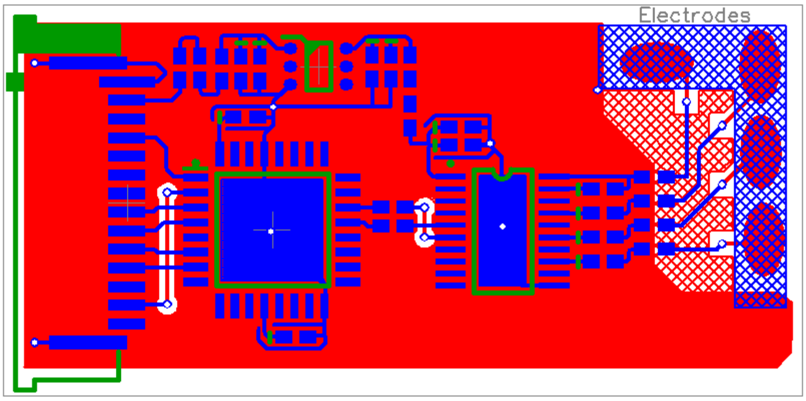
*** These are guidelines only. Actual requirements and performance may vary depending on panel construction, items behind panel, connection length, noise sources, etc.

For more details on the ideas presented in this document, please refer to the QT IC's datasheet, and the official Atmel Touch Sensor Design Guide.

	Technology:	QTouch	QMatrix
G1.	Electrode Circuit:		 • Rule: In Electrodes use Thin Y (~0.15mm) Thick Y gathers noise without helping signal. • Option: Thin Y (Touch Side) over solid X (back)
G2.	Guidelines:	QSlide QWheel …	Slider Wheel QNav QField QTwo …
G3.	Available interfaces: (See each Datasheet)	I2C SPI PPK (Pin Per Key)	I2C SPI UART
G4.	Sensitivity:	Cs	Set Parameters via Serial Interface
G5.	Configuration (Parameter Setting):	Option Pins, Resistors, and/or Serial	Set Parameters via Serial Interface
G6.	Charge Transfer Operation: An output Pulse Transfers Charge e- to the panel, then the Charge is pulled back to Cs. The amount of Charge transferred to Cs per pulse depends upon the amount of Touch. A series of Pulses is a **Burst**, The number of pulses is the **Burst Length (BL)**.	 Signal Level: The number of Burst Pulses till Cs voltage crosses a threshold. More Touch = Less Pulses Required	 Signal Level: the number of cycles to discharge Cs after a fixed Burst (BL). More Touch = Less Discharge Time
G7	Sensors	Do not add ANY circuitry to sensor signals other than shown in Datasheet, as any additional components will affect capacitance sensing, destroying sensitivity and possibly introducing noise.	
G8.	To prevent false detect over electrode traces keep them thin, and if possible on the layer farthest from touch. The Electrodes drive very small loads so minimum metal trace widths may be used.	X Bad:  O Better: 	
G9.	Sensor Component Location: Sensor Components (Cs, Rs, Rx, Ry) and Vcc Decoupling Capacitors <u>**must**</u> be located next to QT IC to minimize noise and to prevent crosstalk between signals.	X Bad:  O Better: 	
G10	Component Location:	• The QT circuit should be located as close as possible to the electrodes, with careful design the electrodes may be a few hundred mm from QT. • The QT circuit may even be located on the opposite side of the PCB from the Electrodes, but no other ICs or components should be located so close to the electrodes. • The interface circuitry near the QT IC and Electrodes should be minimal so as to reduce communications noise effects on the Touch Detection.	

	Technology:	QTouch	QMatrix
G11	Keep other signals and solid ground fills away. • If necessary a thin ground trace may be used to separate them. • QTouch signals and QMatrix Y signals are very sensitive, and may be affected by capacitive coupling to nearby solid ground fills, thick ground signals, power signals, or noisy signals. • If a nearby ground fill is necessary, change it to a low density mesh pattern (<40%, Using Thin traces).	X Bad:  O Better:  QTouch signals may be close together.	X Bad:  O Better:  QMatrix Y signals may be close together.
G12	PCB Layers: Don't locate sensitive QTouch Electrode signals or QMatrix Y signals on opposite side from other traces or solid ground fills. Crossovers are OK, but long parallel traces over each other will act as capacitors.	X Bad:  O Better:  QTouch signals may be thin and close together.	X Bad:  O Better:  QMatrix Y signals may be thin and close together.
G13	Electrode to Panel: Ensure stable layer spacing between Electrodes and Panel Surface (to avoid unstable touch detection due to Variable Capacitance at Variable Air Gaps). Options include Bonding the Electrodes to the Panel, using an Elastic or Spring mechanical support, Printing the electrodes on the inside of the Panel, etc.		
G14	Behind Electrode: A mesh ground pattern may be used (to avoid unstable touch detection due to Variable Capacitance at Variable Air Gaps).		
G15	LEDs (or any device that varies in capacitance) LEDs near Electrode Signals may require Decoupling Capacitors. Recommend always providing footprint and then determining if population needed by testing.		

	Technology:	QTouch	QMatrix
G16	Minimize QT IC Power Supply Ripple for best Touch SNR. See QT IC datasheet for recommended limit. If power supply ripple is over spec then circuit may become unreliable, or may require excessive Cs or BL to get margin for Threshold, resulting in delayed response times and higher power consumption.		Touch Signal with small noise has margin either side of Threshold. Touch Signal with Noisy Power supply has no margin for Touch Detect Threshold.
G17	Avoid Step Changes in QT IC Power as they can cause False Detection, **But** protect against the unexpected, such as in qualification testing.		Enable Recalibration timeouts for recovery (NRD, PRD, PTHR). Smooth the Vcc changes so Drift can compensate (R.in + Caps). An LDO Regulator (Low Drop Out) may protect QT from Step Changes.
G18	QT IC Power Input Clean power is required for proper Touch Detection. See QT IC and Regulator Datasheets for requirements. Components Values (C, R, D, Z, Ferrite, Regulator …) should be appropriate for the QT IC used and the product design. For improved noise performance components in Red may be useful: • D.dropout Blocks drops in V.in (from draining Caps) • Z.over Limits Over Voltage Spikes Ensure Vz(min) > V.in(max) • Ferrite Limits HF Noise (High Freq) Example Spec: DC <2Ω, HF >1KΩ, 25mA • Regulator An LDO Regulator (Low Drop Out) may be used for low V.in • R.load Some Regulators require a minimum load for best noise performance. R.load should be appropriate with the QT power modes used by product. • R.in Smoothes Input, Forms an LPF with the Capacitors (Low Pass Filter) With appropriate capacitors: R.in = (Vmin – Vrequired)/PeakCurrent Example (A): V.in(min)=11V Vregulator(min)=7V Current=5mA (Total Peak) R.in = (11V-7V)/0.005A= 800Ω Try R.in=620Ω (safety margin 20%) Example (C): V.in(min)=11V Vregulator(min)=7V Current=25mA (Total Peak) R.in = (11V-7V)/0.025A= 160Ω Try R.in=120Ω (safety margin 20%) Example (D): V.in(min)=5V Vregulator(min)=4.75V Current=5mA (Peak) R.in = (5V-4.75V)/0.005A= 50Ω Try R.in=40Ω (safety margin 20%) See also AppNote: QAN0011 Power Supply Considerations	**A. QT Power:** Standard Circuit Optional Components  **B. With other devices:**  **C. For Lower Cost Products (Low Power MCU):**  **D. For Low Cost Products (MCU must be Low Noise):** 	

	Technology:	QTouch	QMatrix
G19	Ground Shield behind Electrodes	Usually an Air Gap is provided behind QTouch electrodes, although an appropriately designed Mesh ground shield is possible (see E100s Demo)	Resistive and Mesh ground shields may be placed close behind the electrodes, sometimes only separated by a thin film. Option: Thin Y (Touch Side) over solid X provides some shielding towards back.
G20	Ground Plane: Keep solid Ground Plane or Fill away from the Sensor Signals. • Each QT IC's Datasheet may have specific recommendations. • If necessary a thin mesh Ground may be used behind electrodes (<40% copper)		
G21	Example Layouts: C = Component Side, T = Touch Side • T_Copper (Electrodes, Jumpers) • C_Copper (Components) • C_Silk • PCB Options: • Reduce RFI from IC Power: add Ground around Decoupling Capacitors. • Reduce RFI from ICs: add GND under IC. • Improve EMS (EMI, RFI …): Add Ground fill in all unused areas (but keep away from Sensors and sensor Traces). Gaps in the Ground fill allow for trace crossovers.	L1) With Ground Plane (Touch opposite side from QT IC):  L2) With Ground Shield Behind Electrodes and Ground Plane: 	

Other:

- $C = \varepsilon\,(A \times B/D)$, Maximize C_{Finger}, Minimize C_{Other}, Remove $C_{variable}$
- QMatrix Single Sided – put Jumper on Y for FMEA
- G13/G14: Testing for Variable Airgap issues: Use Wooden Chopstick or Plastic Knife and check Signal level: QTouch monitor: Signal level, or monitor Burst Length using Coin+Scope (Try ScopePad technique). QMatrix monitor: Signal Level
- Rs/Rx/Ry:
  1. Check Maximum Reference level with Rs/Rx/Ry=1K and Dwell=Max/ChargeTime=Max
  2. Adjust Rs or Dwell, Calibrate, then Check Reference.
  3. If new Reference level is <99% Max Reference then reduce Rs/Rx/Rx or Increase Dwell.
  4. Target: Min R for best Sensitivity, Max R for best Noise, Min Dwell for best Water Tolerance.