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Full Tuning for QMatrix

including Touchscreens QT5xxx/QT4xxx, but not for maXTouch
QMatrix_Tuning_v01.pdf, 2009-08-18, Paul, Atmel QRG FAE Japan

Tuning:

1. Preset:
- Set for estimated BL (~32 for keys, 80~100 for Touchscreens)
- Set for Longest Dwell Time (Tlib and some QT ICs)
  QT IC setting, or link appropriate Touch library (i.e. Dwell _D50_)
- Set Rx and Ry to minimum ~100ohm (For Touchscreens Rx=100R never change)
- Set Cs to typical shown in datasheet (4.7~22nF)

2. Cs Tuning for best sensing
- As you Increase BL then the Reference level should increase Linearly.
  If Reference level doesn't increase linearly, then design has extra
  Gnd loading, so may need to increase Cs or reduce BL.
- If Reference level doesn't increase linearly,
  then Bigger BL gives smaller Delta (Good is Bigger BL give Bigger Delta)
- You can put scope on X, and between Cs/Rsmp
  You will be able to see Y charging during X Pulses
  Y charging is very low negative signal 0.05~0.2V
  Each step of Vcs will form a line (ignore spikes) as charges negative at Cs-Rsmp,
  and it should be linear, else increase Cs:
- Please refer to figures in QMatrix IC datasheet, such as
  http://www.atmel.com/dyn/resources/prod_documents/AT42QT2160_DS.pdf
  AT42QT2160 figure 4-3 (good, linear charging) and figures 4-1/4-2 (Bad, curved)
- It's easier to see shape with a long BL,
  but only need linear for portion of BL really used

3. Dwell Tuning to remove temperature sensitivity: (TLib and some QT ICs)
- Set BL (maybe BL=64~100)
- Check Reference Level (This is Ref Max)
- Decrease Dwell (QT IC setting, or Link library with smaller _Dxx_)
- TLib: Compile and restart, QT IC: Calibrate or reset
- Check reference several times, take average
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- Repeat for shorter Dwell times until Reference level decreases to <90% of Max
- Select Shortest Dwell time where: Ref >=99% of Dwell Max

4. Rx and Ry Tuning for best EMC without degrading sensitivity
- For QMatrix Buttons, Sliders/Wheels typically Rx=Ry
  For Touchscreens change only Ry (Rx=100R, Don't change Rx)
- First set Rx=Ry=100ohm (Minimum)
- Check Reference Level (This is Ref Max)
- Increase Rx/Ry (Try 1k, 2K, 4.7K … max 22K)
- TLib: Compile and restart, QT IC: Calibrate or reset

5. Rsmp Tuning for best Touch delta and least signal jitter:
- Rsmp should be between 200K~1.5Mohm
- Look at signal jitter
- If signal jitter < +/- 1, then increase Rsmp
- If signal jitter > +/- 3, then decrease Rsmp
- Too much jitter is just wasted time processing noise
- Too small jitter may mean lost resolution (Lost Delta)

6. BL Tuning for balance of sensitivity versus power and response time:
- Keys:Adjust BL so Touch Delta is 20~30 (10~20 may be OK for Quiet designs)
- Touchscreen: Adjust BL so Touch Delta is 30~40 (20~30 maybe for Quiet Designs)
- If you changed BL you should recheck steps 1~4.

7. NTHR Tuning for Sensitivity
- Set NTHR = 50%~75% of the Touch Delta (Proximity Delta)
- NTHR should be > [5 x Signal Noise]
  For special cases maybe NTHR > [2 x Signal Noise] is OK.
  But recommend a larger DI if NTHR near noise Level.

8. Test, EMC Test