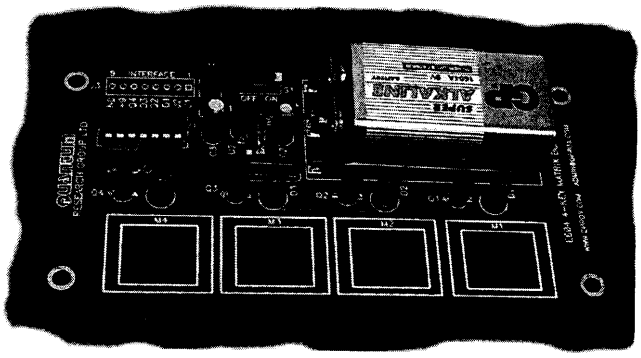
362-6040 Manual + Tech Datasheet are the same

E604 USER GUIDE

Overview

The E604 board is designed for rapid evaluation of the QT60040 4-key QMatrix™ IC. The board includes a piano-style keyboard with 4 corresponding LEDs that indicate touch.



Connections are provided for external interfacing.

The board is powered by a single 9V alkaline battery.

Using the E604

To use the board right away:

1. Insert a 9V alkaline battery into the clips on the board. Make sure the power switch is Off.
2. Install four rubber feet (supplied) to the four corners of the rear of the board.
3. Place the board on a desk, or hold the board on the battery side so your fingers do not come near the keys or the IC, or the traces on the bottom. (If they do, a key may calibrate against your finger, making it less sensitive to touch for a while).
4. Turn on the power slide switch. The IC requires less than a second to calibrate all keys; after this time you can touch the keys *from the top of the board only*.

The keys are slightly more sensitive if you hold the board with one hand around the battery, due to increased coupling from the board's signal ground and your body. In an actual system where the IC is powered from and connected to other circuitry, this effect will not come into play and the board will always be at its maximum sensitivity.

How it Works

The E604 works by scanning the four keys using 4 'X' drive lines and a 'Y' receive line.

The QT60040 scans each key by placing a burst of pulses on the 'X' lines, while detecting charge that is forced across the XY interleaved key pattern through to the Y line. Immediately after power-up, the amount of charge received from each key is noted and recorded as a set of reference levels. Thereafter, the signals are monitored for changes. If a key is touched on the top surface of the pcb, the charge flowing from X to Y across the gap is disturbed, resulting in a *decrease* in signal received on the Y line. The signal decreases because a finger absorbs some of the charge flowing from X to Y across the interleave gaps; the charge flows back into the local environment and eventually makes its way back to the E604 via capacitive coupling.

If the decrease in signal on a Y line is sufficient, the QT60040 confirms a detection in progress and sets the corresponding output line high.

All keys are scanned in time-sequence within 100ms.

A schematic of the E604 is found at the end of this guide.

Board Details

Interface Connector
The main interface connector is located above the IC. Available on this connector are pads for remoting the jumpers, external power, and the 4 sense outputs from each key.

External voltages from 8 to 12 volts regulated DC are suitable for use with the E604.

Remove the battery if using external power! Failure to remove it will cause unintended charging of the battery which will lead to electrolyte leakage and a serious explosion hazard!

Although the power is regulated onboard via a 78L05 device, raw power should be free from switching noise and short-term fluctuations for best performance.

Keys
The four keys on the board are made of interleaved traces of copper on the rear. The sense field projects through the composite material of the PCB to create touch areas on the top.

Interleaved electrodes require a dielectric layer (like the PCB in the case of the E604) to propagate the capacitive field in a manner that can be absorbed by human touch. Touching the key electrodes themselves will cause false operation.

The four keys are arranged electrically as a 4 x 1 matrix, having four 'X' drive lines and one Y receive line common to the four keys.

Key sensitivity is governed by the value of C1 (see section below on C1) and is the same for all four keys. The only way keys can be made to have differing gains is to make the key geometries different (i.e. by altering the track sizes, interleaving ratio, etc.).

Option Jumpers
There are two option jumpers on the board:

J1 Rollover control. If the jumper is -

Installed	1 key can only be detected at a time
Not installed	2 keys can be detected simultaneously

J2 Recalibration timeout. If the jumper is -

Installed	10 second recalibration timeout
Not installed	60 second recalibration timeout

Further details on these features are noted below.

The jumpers are sensed by the IC continuously and thus power to the board does not have to be cycled in order for jumper settings to take effect.

Key Rollover
The QT60040 IC allows up to 2 keys at a time to be contacted ('2-key rollover'). Jumper J1, if installed, allows this to be reduced to only one key at a time. If additional keys are touched beyond the selected maximum, the IC will ignore the additional keys.

Recalibration Timeout
Each key has an individual timeout function that allows recovery from 'stuck key' conditions that may be caused by foreign objects or mechanical problems. The timeout can be set to either 10s or 60s according to the option jumper noted above.

After 10s or 60s of *continuous* detection, the key will automatically recalibrate itself to the signal present at the moment of recalibration. This can be demonstrated by touching a key for the duration of the timeout setting.

Drift Compensation
Each key will compensate for signal drift due to humidity, temperature effects, dielectric changes, etc. and will do so continuously over the life of the sensor.

The drift compensation mechanism only occurs at times when a valid touch is not being sensed.

If a key is touched for a duration longer than the recalibration timeout interval (see above) and the key is released thereafter, the key logic will then drift compensate automatically to return to its normal calibration point. The logic of the IC is always self-healing.

Remoting the Keys
It is possible to remote the keys by converting them to 'single electrode' operation. By placing a square piece of adhesive metal foil on the touch surface of a single key area, covering the entire key area within the inner white key border, then soldering a wire to the foil, the wire can be led to a different location (within 25cm or so) and connected to a secondary metal foil adhered to the rear of a thin plastic or glass panel of up to 2.5mm thickness. Touching this secondary key on the panel side (opposite the metal foil) will activate the key.

It is important to reduce stray capacitance of the wiring as much as possible to allow the key to retain as much sensitivity as possible. It may be necessary to adjust the value of C1 to achieve the desired level of sensitivity on the secondary key.

Connecting the supply ground of the PCB to a local ground is essential in this mode to allow the fields to work properly, to make it sensitive enough.

C1 Sample Capacitor
The primary sample capacitor is C1. This capacitor controls the sensitivity of all 4 keys; it is socketed to allow for easy experimentation with different values. Only relatively stable capacitors should be used such as PPS and polyester film types. Most ceramic capacitors have serious problems in this circuit and should be avoided.

Increasing C1 increases key sensitivity. Typical values are from 27nF to 100nf (0.1uF). The E604 is supplied with a 47nF capacitor.

Output Lines
The four out lines, Q1..Q4, are all active-high. They remain high for the duration of a touch or until the calibration timeout interval has expired for a particular key.

LEDs
The four LEDs reflect the state of each of the four output lines. If an LED is 'On', the corresponding 'Q' output line is high.

Only one or two keys can be active at a time, depending on the setting of jumper J1 (see Option Jumper notes above).