Touch Control Technology (TCT) Fixed Matrix Microcontrollers

1. SCOPE

1.1. Content

This document specifies performance, test, and quality requirements for the Tyco Electronics Touch Control Technology (TCT) Fixed Matrix Microcontrollers. Part numbers for various quantities of keys and output formats are listed in Table 1 below. Table 2 identifies the basic microcontroller operating parameters. TCT microcontrollers use a patented touch recognition technology as the basis for switching. Patent number US 5,760,715 (June 2, 1998) applies to TCT products.

Part Number	Package	Maximum Number of Keys	Output Format	Notes
1710400-1	TQFP-32	10	2x5 Matrix	See dwg.1710400
1710400-2	TQFP-32	10	2x5 Matrix	Rated for 105°C See note C.
1710401-1	TQFP-32	15	3x5 Matrix	See dwg.1710401
1710401-2	TQFP-32	15	3x5 Matrix	Rated for 105°C See note C.
1710402-1	TQFP-32	24	4x6 Matrix	See dwg.1710402
1710402-2	TQFP-32	24	4x6 Matrix	Rated for 105°C See note C.
1710403-1	TQFP-32	36	6x6 Matrix	See dwg.1710403
1710403-2	TQFP-32	36	6x6 Matrix	Rated for 105°C See note C.
1710404-1	TQFP-32	56	7x8 Matrix	See dwg.1710404 See note B.
1710404-2	TQFP-32	56	7x8 Matrix	Rated for 105°C See notes B & C.

Table 1: TCT Microcontroller Part Numbers

Note A: *All parts are JEDEC standard compliant.*
Note B: *In analog mode, these operate as 48 key controllers with a 6 x 8 matrix.*
Note C: *Rated for 3000 cumulative hours at the higher temperature.*

1.2. Qualification

Procedures specified in Table 3 shall be used when tests are performed on the subject product line. All inspections shall be performed using the applicable inspection plan(s) and product drawing(s).

2. APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the latest edition of the document applies. In the event of conflict between the requirements of this specification and the product drawing, the product drawing shall take precedence. In the event of conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.

2.1. Tyco Electronics Documents

A. 109 Series: Test Specifications
B. 114-47014: Application Specification: Touch Control Technology (TCT) Fixed Matrix Microcontrollers
C. 501-47021 Qualification Test Report

2.2. Non-Tyco Electronics Documents

A. Federal Communications Commission (FCC) CFR47, Part 15, Subpart B, Class B Computing Devices
B. IEC 61000-4-3: Radiated RF Immunity

3. REQUIREMENTS

3.1. Design and Construction

Product shall be of the design, construction and physical dimensions specified on the applicable product drawing.

3.2. Materials

Materials used in the construction of this product shall be as specified on the applicable product drawing. All materials are RoHS compliant.

3.3. Electrical Characteristics

Symbol	Parameter	Min	Typ	Max
V_{CC}	Supply Voltage	4.75V	5.0V	5.5V
V_{IH}	Output High Voltage (VCC = 5V, IOL = 5 mA)	4.0V	-	5.0V
V_{IL}	Output Low Voltage (VCC = 5V, IOL = 5 mA)	-	-	1.0V
T_{op}	Operating Temperature	-20°C	-	85 °C (105 °C for high temperature version)

Table 2 : Operating Ratings

3.4 Operating modes

The microprocessor can be operated in 2 modes:

- Analog mode uses two resistors in the external circuit to set the sensitivity of all keys.
- Digital Mode provides a more even key sensitivity across the keyboard. It requires that sensitivity be set using a calibration fixture.

3.5 Output signals

The TCT output signals represent the following key touch states: no-touch, touch. If more than one key is activated in the same time, a no-touch signal is returned. In the case of touch, the TCT microcontroller generates the matrix code of the key number being touched. Refer to output tables in Tyco Electronics Application Specification 114-47014.

3.6 Test Requirements and Procedures Summary

TCT microcontrollers are designed to meet the electrical, mechanical and environmental performance requirements specified in Table 3. Unless otherwise specified, all tests shall be performed at ambient environmental conditions. The temperature and humidity values are to be noted in the test report.

Test Description	Requirement	Procedure
Initial/ Final Examination of Product	Meets visual requirements.	Visual and dimensional inspection per product drawing.
ELECTRICAL		
Power up response	Less than 200 ms	Use a dual channel oscilloscope. Calculate the response time as the time difference between application of power to the board and output signal.
Sensitivity adjustment, Analog mode	For the given qualification jig (see Note A) all keys shall be functional at two dielectric	Adjust the sensitivity potentiometer to achieve a solid touch signal for each of the two material thickness

Test Description	Requirement	Procedure
	thickness extremes of 1.5 mm and 19 mm.	extremes. See 3.7 Keys must sense using the Go gauge and not the No-Go gauge (See Note D) for touch simulation.
Key equalization and sensitivity adjustment, Digital mode	For the given qualification jig, keys shall be adjusted to have the correct sensitivities at dielectric thickness extremes of 1.5 mm and 12 mm.	Equalize with the calibration fixture. See 3.7. Keys must sense the Go gauge and not the transitional gauge (See Note D) for touch simulation.
Multiple key press	When two or more keys are activated simultaneously, output will be the code for a no key touch condition	Activate two keys on the qualification jig simultaneously and read the output signal. Observe that there is no output signal. Test in both analog and digital modes.
Key ON Response Time	Less than 100 ms	Use a dual channel oscilloscope. Calculate the response time as the time difference between input signal and output signal.
Key OFF Response Time	Less than 100 ms	Use a dual channel oscilloscope. Calculate the response time as the time difference between input signal and output signal.
Latching time	Equal to or greater than 50 ms	Use a dual channel oscilloscope. Measure the latching time in response to an input signal less than 50 ms duration. Test in both analog and digital modes.
Flicker test	When the Go gauge approaches from the side of a key, once sensed, the signal shall be maintained without interruption.	Use the Go gauge to approach the side of several representative keys on the qualification jig and observe output.
Output code signals	The output signals must match those stated in Tyco Electronics Application Specification 114-47014.	Activate all functional keys on the qualification jig and read the output signal. Observe the output signals. Test in both analog and digital modes.
ENVIRONMENTAL		
Operating Temperature	Functional over -20°C to + 85°C range (-20°C to + 105°C for -2 parts)	. Test using the Go gauge on all keys for each of the two material thickness extremes.
EMI (FCC) Test	Certified to FCC CFR47, Part 15, Subpart B, Class B Computing Devices	Per FCC CFR47, Part 15, Subpart B, Class B Computing Devices
Radiated RF Immunity	Pass the requirements of IEC specification IEC 61000-4-3	Test at 20V/m from 26 –1000 MHz and 20 V/m, 900 MHz with 200 Hz pulse modulation.

Table 3: Test Summary

Note D: *The dimensions of the test fixture key used for testing are shown in figure 1. A touch condition is simulated with a Go gauge consisting of a metal cylinder of 0.40" diameter. The No-Go gauge consists of a metal cylinder of 0.15" diameter. The transitional gauge consists of a metal cylinder of 0.25" diameter.*

3.7 Test Procedures

Sensitivity adjustment, Analog mode:

1. Turn off the microcontroller power supply.
2. Set the microcontroller to analog mode by connecting pin 4 to Vcc through a 10k ohm resistor.
3. Connect pin 6 to Vcc through a 10k ohm resistor.
4. Connect pin 31 to a potentiometer to adjust voltage between 0 and 5V. Set pin voltage to 5V.
5. Place the thin (Lexan 1.5 mm) dielectric on the test keypad. You may repeat the process with 12mm dielectric.
6. Place the Go gauge on any key.
7. Decrease the voltage on pin 31 until the output signal for the selected key represents the ON state.
8. Repeat the procedure from step 5 using the thick (19 mm) dielectric.

Sensitivity adjustment, Digital mode:

1. Turn off the microcontroller power supply.
2. Set the microcontroller to digital mode by connecting pin 4 to circuit ground.
3. Connect pin 6 to Vcc through a 10k ohm resistor.
4. Place the calibration fixture over the test board (without the dielectric layer).
5. Connect the calibration fixture to the output of the pulse transistor per the schematic shown in Application Specification 114-47014.
6. Connect pin 6 to circuit ground.
7. Turn on the microcontroller power.
8. Wait until all key are turned on and off in sequence and disconnect circuit ground from pin 6. This process should not take more than two seconds.
9. Cycle the microcontroller power supply off and on.
10. Remove the calibration fixture, apply the dielectric layer, and check each key for sensitivity using the Go and No-Go gauges.
11. Adjust the sensitivity of any key that does not meet the Go / No-Go criteria by adjusting the height of the calibration fixture screws.
12. Repeat the procedure from step 4 until all keys meet the Go / No-Go criteria.

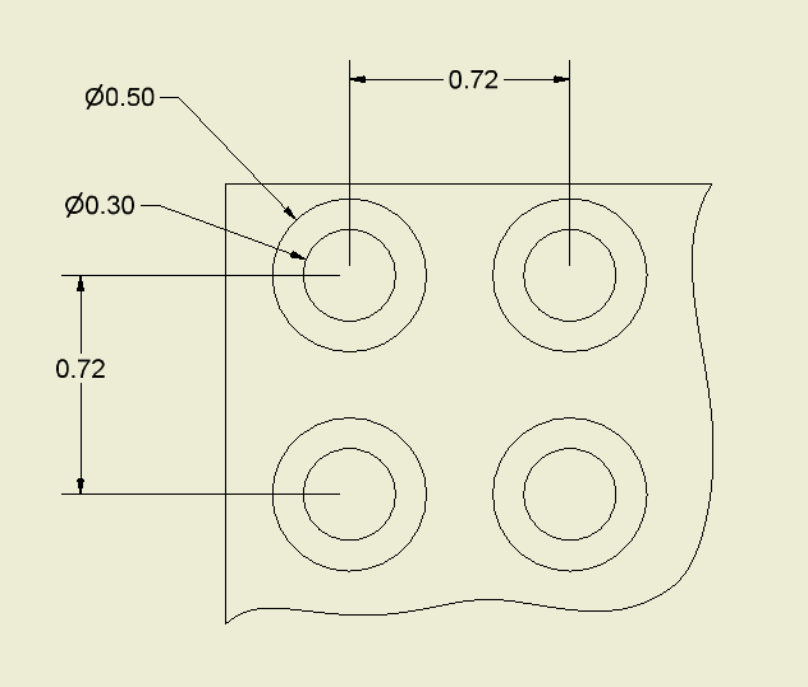

Figure 1: Typical key dimensions and spacing(inches)

NOTE: Using larger diameter key pads you can achieve solid touches through more than 12mm plastic. In you use glass as dielectric, thickness can be improved beyond 25mm.

3.8 Product Qualification and Re-qualification Test Sequence

	Test Group (a)	
TEST or EXAMINATION	1	2
	Test Sequence (b)	
Initial/Final Examination of Product	1,11	1,5
Power up response	2	
Sensitivity adjustment, Analog	3	
Multiple key press	4	
Key ON Response Time	5	
Key OFF Response Time	6	
Latching time	7	
Flicker	8	
Sensitivity adjustment, Digital	9	
Operating Temperature	10	
Output code signals		2
EMI (FCC)		3
Radiated RF Immunity		4

Table 4 Test Sequence

Note E: *(a) See paragraph 4.1.A for specimen selection.*
(b) Numbers indicate sequence in which tests are performed.

4. QUALITY ASSURANCE PROVISIONS

4.1. Qualification Testing

A. Specimen Selection

Specimens shall be prepared in accordance with applicable Instruction Sheets and shall be selected at random from current production. Group one shall consist of a minimum of three specimens. Group two consists of one specimen.

B. Test Sequence

Qualification inspection shall be verified by testing specimens as specified in Table 3.

4.2. Re-qualification Testing

If changes significantly affecting form, fit or function are made to the product or manufacturing process, product assurance shall coordinate re-qualification testing, consisting of all or part of the original testing sequence as determined by development/product, quality and reliability engineering.

4.3. Acceptance

Acceptance is based on verification that the product meets the requirements of Table 3. Failures attributed to equipment, test setup or operator deficiencies shall not disqualify the product. If product failure occurs, corrective action shall be taken and specimens resubmitted for qualification. Testing to confirm corrective action is required before re-submittal.

4.4. Quality Conformance Inspection

The applicable quality inspection plan shall specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification.