TSC

FMA1127 TOUCH SENSOR CONTROLLER

SK-TSC-1127-SB

QUICK START GUIDE

FUJITSU
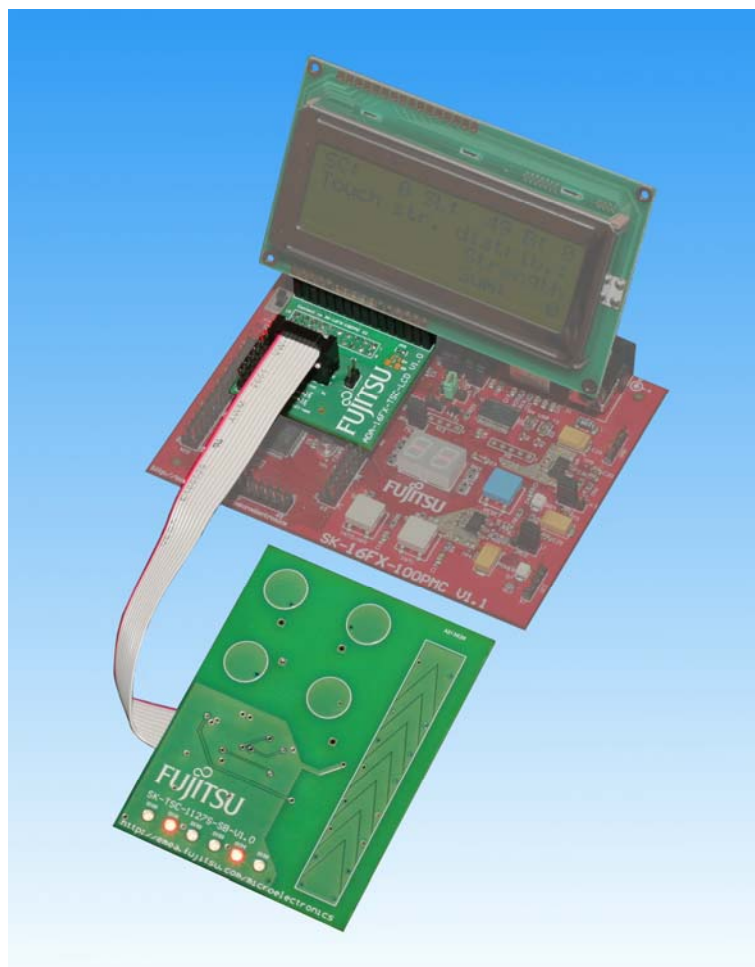
Revision History

Date	Issue
2009/05/12	V1.0, CHa, first official version
2009/07/01	V1.1, CHa, changes for Starterkit V1.1 and FMA1127DC

This document contains 22 pages

NOTE:

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This evaluation system must only be used for test applications in an evaluation laboratory environment!

0 Contents

1 Overview

1.1 Abstract

The SK-TSC-1127-SB Starter Kit allows easy evaluation of the FMA1127 Touch Sensor Controller. It consists of the following parts:

- 1x SK-TSC-1127S-SB touch board with FMA1127, 1 slider + 4 buttons, six LEDs

- 1x ADA-16FX-TSC-LCD

- 1x 10-pin ribbon cable

- 3x FMA1127DC-30S Sample

- **The Kit requires an SK-16FX-EUROSCOPE Starter Kit as host PCB which has be ordered separately. Alternatively, the Touch Board (SK-TSC-1127S-SB) can be used with the TSC Tuning Kit EVALB1127 (sold separately)**

A demo firmware allows direct evaluation of the touch sensor, and provides various commands to tune the TSC parameters using a command-line interface and a terminal program. The newest version of the demo firmware, the SK-Wizard (the recommended terminal program) and additional information can be downloaded from the TSC product page:

http://www.fujitsu.com/emea/services/microelectronics/tsc/

This manual will describe the behaviour when used with the above demo firmware where needed (e.g. tuning with command line interface). Of course the Starter Kit itself can also be used with different host software and / or hardware combinations.

This evaluation system must only be used for test applications in an evaluation laboratory environment!

1.2   Features

▸ FMA1127DC-30S Touch Sensor Controller (SOP30 package) with 12 touch input channels and 6 digital I/Os

▸ Slider (eight elements)

▸ Four buttons

▸ Six LEDs

▸ 10-pin connector for I2C and interrupt signals, pin compatible with EVALB1127 Tuning Kit

▸ Completely flat front surface for easy mounting to different front panels

▸ Adapter board (ADA-16FX-TSC-LCD) to connect to SK-16FX-EUROSCOPE (SK-16FX-EUROSCOPE not included)

▸ Connector for parallel LC Display (on ADA-16FX-TSC-LCD)

▸ 3.3-5V operation

1.3   General Description

The SK-TSC-1127-SB is a starter kit and evaluation system for the FMA1127 Touch Sensor Controller (TSC). It features a slider consisting of eight capacitive touch elements as well as four single buttons. The kit uses an SK-16FX-EUROSCOPE Starter Kit (to be ordered separately) holding the 16FX MB96F348 MCU as host platform, so that the user can easily develop TSC applications using the EUROSCOPE debugging environment. Alternatively, the touch board can be connected to the EVALB1127 TSC Tuning Kit (to be ordered separately). The TSC touch board is connected using a 10-pole ribbon cable which holds the power supply lines, the I2C connection as well as reset- and interrupt lines. It can be connected either to the Starter Kit using the included adapter board (ADA-16FX-TSC-LCD) or to the TSC Tuning Kit EVALB1127.

A demo firmware which also supports parameter tuning using a PC terminal program can be downloaded from the web. In this demo application, the raw touch data of the slider elements is read by the MCU, which then performs an interpolation algorithm to increase the absolute position resolution. The buttons are directly read using the APIS mode I of the TSC.

As soon as the slider or one of the four buttons is touched, the two 7-segment LED displays on the SK-16FX-EUROSCOPE will indicate either the slider position (from 0-99) or the number of the touched button (Display: "b.1" – "b.4").

Additionally, a standard parallel LCD (20x4) can be connected to the ADA-16FX-TSC-LCD. When the LCD is present, in addition to the slider position and the pressed buttons, the demo firmware shows the distribution of the touch strength among the slider elements on the LCD as soon as the slider is touched.

2   Installation

2.1   Setup (Starter Kit Hardware)

Carefully remove the PCBs from the shipping carton.

Please follow the steps below to assemble the Starter Kit:

1. Connect the ribbon cable end with the pull relief to X1 on the ADA-16FX-TSC-LCD. Pin1 (Marked on the cable) of the cable must be on the left side close to the pin header X3. ***Please note that for compatibility with the EVALB1127 Tuning Kit, the plug of this cable end is rotated so that the Pin1 marking of the cable is at the opposite side of the one on the plug.***

2. Mount the ADA-16FX-TSC-LCD on the SK-16FX-EUROSCOPE by pressing it on X2 of the SK-16FX-100PMC PCB. Be sure that both connectors match exactly before pressing both boards together. X2 is the pin header close to the SUB-D connectors on the SK-16FX-EUROSCOPE.

3. OPTIONAL: Connect the LCD (not included) to X5 of the ADA-16FX-TSC-LCD. Pin1 is located on the left side. The example software assumes a 20x4 LCD (e.g. DisplayTech 204B). Optionally a resistor can be mounted for the LCD backlight supply via Pins 15 and 16 of X5. Contrast can be set using RP1 on the ADA-16FX-TSC-LCD board.

4. Connect the remaining ribbon cable end to the touch board SK-TSC-1127S-SB. Pin1 of the cable must be located in direction of the four buttons printed on the PCB.

5. Connect the SK-16FX-100PMC to a PC via USB using a standard USB connection. Please proceed as explained in the SK-16FX-EUROSCOPE user guide. It can be found on the CD accompanying the SK-16FX-EUROSCOPE; this CD also contains the USB drivers, the Softune Workbench and the EUROSCOPE debugging environment. The example firmware can be programmed using the Flash programmer which can also be found on the same CD.

2.2   Setup (PC Software)

The installation of the USB driver is described in the SK-16FX-EUROSCOPE documentation. In case the USB connection is only used as power supply, the driver installation is optional. Communication with the demo firmware also is possible using the standard RS232 connector ('UART A') on the SK-16FX-EUROSCOPE.

The newest version of the demo and tuning firmware can be downloaded at

http://www.fujitsu.com/emea/services/microelectronics/tsc/

The .mhx file from the archive can directly be programmed to the host MCU using the Flash programmer on the SK-16FX-EUROSCOPE CD.

After power-up, the host MCU will start the initialization of the FMA1127 TSC. Two parameter sets can be chosen: By default, parameters are loaded which allow the usage of the SK-TSC-1127S-SB with no front plate or only a thin foil etc. The 7-segment displays will show 'P1' during initialization. If the left button (SW2) is held during reset and until the TSC initialization is finished ('P2' appears on the 7-segment display), a second parameter set is loaded which is more sensitive, allowing thicker front panels (3-4mm acryl glass). The parameters can be changed as described later.

After initialization, the LED displays on the SK-16FX-EUROSCOPE should show "--", indicating that no button is touched. After some seconds, the LEDs on the SK-TSC-1127S-SB will start showing a moving light as long as the kit is idle.

The demo firmware for the MB96340 Series MCU on the SK-16FX-EUROSCOPE offers several functions to support a quick and easy setup and tuning of the application. The tuning process is explained more in detail later in this document.

Generally, the command line can be accessed by any PC terminal program. However, not all terminal programs support the 'form feed' command to clear the screen; this is used for the real-time monitoring modes. Therefore the Fujitsu 'SK Wizard' is recommended for tuning; it can be downloaded free of charge at

http://mcu.emea.fujitsu.com/mcu_tool/software.htm

Communication settings for the serial port are 8N1 at 115200baud (8 bits, no parity, 1 stop bit).

After connection to the starter kit, type 'help' followed by the 'enter' key for a list and short description of available commands.

2.3   Pictures
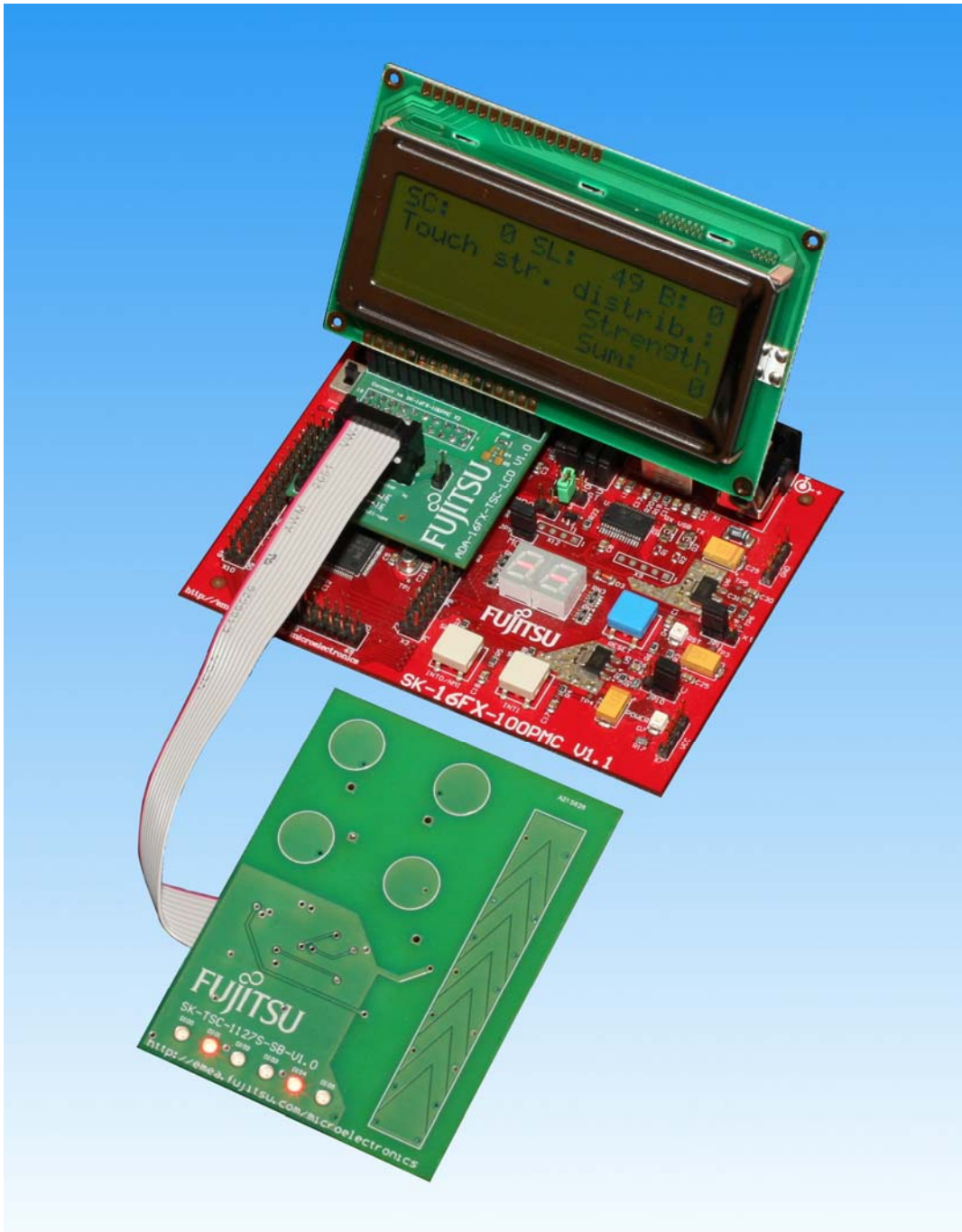

Figure 1: SK-TSC-1127S-SB (front)

Figure 2: System set-up

(LCD and SK-16FX EUROSCOPE not included!)

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2.4 Jumper settings

2.4.1 SK-TSC-1127S-SB

Jumper	Setting	Description
JP1 (LED VCC)	Open	LEDs not connected to VCC
	Closed	LEDs connected to VCC
JP2 (SCL pull-up)	Open	I2C SCL line not connected to Pull-up resistor
	Closed	I2C SCL line connected to Pull-up resistor
JP3 (SDA pull-up)	Open	I2C SDA line not connected to Pull-up resistor
	Closed	I2C SDA line connected to Pull-up resistor
JP4 (TINT)	Open	TINT not connected to X1
	Closed	TINT connected to X1
JP5 (GINT)	Open	GINT not connected to X1
	Closed	GINT connected to X1
JP6 (reserved)	Open	X1 Pin9 not connected
	1-2	X1 Pin9 connected to VCC (pull-up)
	2-3	X1 Pin9 connected to GND (pull-down)
JP7 (ID)	1-2	Chip ID = 0x58
	2-3	Chip ID = 0x5B
JP8 (reserved)	Open	X1 Pin10 not connected
	1-2	X1 Pin10 connected to VCC (pull-up)
	2-3	X1 Pin10 connected to GND (pull-down)
JP9 (LDO)	Open	Internal LDO not connected
	Closed	Internal logic supplied by internal LDO
JP14 (TP int/ext)	1-2	Use on-board touch pad S11
	2-3	Use external electrode connected to TP4

JP6 and JP8 can be used e.g. to identify different touch boards by the host SW by checking the level on X1 Pin 9 and Pin10.

In most cases, the default settings will not have to be changed.

2.4.2 ADA-16FX-TSC-LCD

Jumper	Setting	Description
JP2 (SCL pull-up)	Open	I2C SCL line not connected to Pull-up resistor
	Closed	I2C SCL line connected to Pull-up resistor
JP3 (SDA pull-up)	Open	I2C SDA line not connected to Pull-up resistor
	Closed	I2C SDA line connected to Pull-up resistor
JP3 (TSC Reset)	Open	TSC Reset Pin (X1 Pin 8) not connected
	Closed	TSC Reset Pin connected to MCU pin 17 (P04_3)
JP4 (SDA)	Open	TSC SDA (X1 Pin 2) not connected to MCU
	Closed	TSC SDA connected to MCU
JP5 (LCD Backlight)	Open	LCD Backlight not connected or via R4/R5
	Closed	LCD Backlight directly connected to VCC
JP6 (SCL)	Open	TSC SCL (X1 Pin 1) not connected to MCU
	Closed	TSC SCL connected to MCU

The contrast for the (optional) LC display can be adjusted using RP1.

A resistor suitable for the LCD backlight can be soldered on the PCB (R4 for 0805, R5 for 0805 or 1206). JP5 should only be closed if the LCD itself is equipped with a suitable series resistor for the backlight.

2.4.3 SK-16FX-EUROSCOPE

The TSC starter kit uses the default jumper settings of the SK-16FX-EUROSCOPE. Please refer to the user manual of the SK-16FX-EUROSCOPE for configuration options.

Note:

The TSC can operate at 3.3V as well as 5V (default), but most standard LC displays will only operate at 5V.

2.5 I2C header (X1) pinout

X5 Pin	Name	Connected to	Descripton
1	SCL	JP6, X3 Pin 1	I2C Serial Clock Line
2	SDA	JP4, X3 Pin 2	I2C Serial Data Line
3	GND		System Ground
4	VCC		VCC for TSC and LCD
5	TINT	X3 Pin 5	Touch interrupt from TSC to MCU
6	GINT	X3 Pin 6	General Purpose interrupt from TSC to MCU
7	TOUT	X3 Pin 7	'Beep' Signal for Piezo Buzzer (FMA1127-40N only)
8	RESET_N	X3 Pin 8	Reset Pin of TSC
9	reserved	X4 Pin 1	Can be used e.g. as ID pin for Touchboard
10	reserved	X4 Pin 2	Can be used e.g. as ID pin for Touchboard

X3 can be used to access the TSC signals, e.g. to route the Interrupts to an appropriate external interrupt pin of the MCU.

2.6 LCD header (X5) pinout

Pin	Name	Pin	Name
1	VSS	9	n/c
2	VDD	10	n/c
3	V0 (contrast)	11	D4
4	RS	12	D5
5	R/W	13	D6
6	E	14	D7
7	n/c	15	VLED (Backlight +)
8	n/c	16	VLSS (Backlight -)

The contrast for the (optional) LC display can be adjusted using RP1.

2.7 Further connection options

Using X2 (VCC), X3 (GND) and X4 (DIO0 – 5), additional connections to the FMA1127 can be made. X4 is connected to the digital input / output pins DIO0-5 of the TSC. If these are to be connected to external circuits, the on-board LEDs should be disabled by opening JP1.

3 Basic Tuning Process using the Command Line Interface and a PC Terminal Program

The SK-TSC-1127-SB kit can also be used together with a demo application running on the SK-16FX-EUROSCOPE to adapt settings like sensitivity and other parameters in the running application and to optimize performance. When tuning is done using the EVALB1127 Tuning Kit, please refer to the Tuning Manual / Application Guide enclosed with the Tuning Kit.

Here for, only a terminal program is needed on the PC, so it is platform independent. The Fujitsu Startkerkit Wizard is recommended for this, as it supports the 'Form Feed' command which is used for the monitoring modes explained later in this document.

Please note that the SK Wizard only supports UART numbers 1-4. For this reason, the UART used for terminal communication has to be COM1-4 on the PC. If this is not the case (often the SK16FX will have a higher COM port number), the assigned COM port number has to be changed in the control panel (Device Manager -> Ports (COM & LPT) -> right-click on 'FUJITSU Microcontroller Board (COMx)' -> Properties -> Port Settings -> Advanced)

Open the SK Wizard or Terminal Program and connect to the UART (8N1, 115200 baud) and type 'help<ENTER>' for a list of available commands. The most important will be also explained in the following.

'mon'	Numerically monitor current impedance values and touch status
'mon2'	Graphically monitor current impedance values and touch status
	Bars turn from '	' to ' * ' when pad is active
'moff'	Turn off monitoring
'srd nn'	Set Reference Delay to nn (0-99, decimal). A lower value moves all
	Bars (mon2 mode) to the right, a higher to the left.
'sa nn mm'	Set Alpha (sensitivity) of channel nn to value mm (0-99, decimal)
'sax mm'	Set all Alphas of the Slider (Pads 0-7) to mm (0-99, decimal)
'sv'	Show current values of Alpha and Reference Delay
'wr'	Issue a Warm Reset to the selected TSC (activate settings)
'id=0xnn'	Select Chip ID nn (hex) for tuning
'rst'	Reset all TSCs to the power-up firmware defaults used by the demo
'dump'	Print out current register settings
'set nn mm'	Set register nn (hex) to mm (decimal)
'setx nn mm'	Set register nn (hex) to mm (hex)
'rd nn'	Read register x (hex)
'fl=nn'	Set length of moving average filter used to smooth slider operation
	(0-32, decimal)
'sf p t'	Set TSC internal low pass filter to period p and threshold t (p>t)
	(touch will be signalled when more than t samples during one period p are active)
'a+nn'	Increment all Alpha values by nn
'a-nn'	Decrement all Alpha values by nn

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Typically, to start tuning a new application, first of all the Reference Delay and Alpha settings need to be set. For this, the 'mon2' monitor mode can help to directly show the effect of changed settings.

The Reference Delay is set by the 'srd nn' command, where 'nn' is the desired value from 0-99. A warm reset command is issued automatically to activate the new setting. Typical starting value will be ~50.

The Reference Delay value moves all of the bars (mon2 mode) to the left (higher RD value) or to the right (lower RD value). Using the Reference Delay, the average (idle) impedance of all touch sensors can be placed somewhere in the middle of the FMA1127 dynamic range, indicated by the bars. Incrementing the Reference Delay by one step has a similar effect as attaching an external capacitor of 0.078pF to the AREF pin of the TSC. So, in case the reference delay maximum value of 99 is not sufficient, an additional capacitor of max. 10 pF can be connected to the AREF pin to increase the reference impedance value.

If the variation of the different sensor idle impedances is too high, small tuning capacitors have to be added (from the touch pads to ground), so that the idle capacitances of the different channels are in the same range. However, a difference of 40-50 counts still is not critical as long as there is enough room left to 0 and 99. Therefore, most typical applications (including the SK-TSC-1127S-SB) will not require tuning capacitors.

After setting the Reference Delay, the Alpha of the channels can be set. Alpha is the difference between measured impedance and the reference in idle (not touched) state. A smaller value of Alpha makes the pad more sensitive, while increasing Alpha decreases sensitivity. Typical values for a directly touched (only solder stop or thin foil between electrode and finger) pad will be ~20 or higher. If some mm of plastic is used as front cover, typical Alpha values will be in the range of 4-10.

The Alpha values are preset by the application in order to fit to the used PCB. Two settings can be chosen by holding SW2 during reset and initialization; 'P1' can be used for the PCB without front panel, while 'P2' is more sensitive in order to be used with a front plate, e.g. plastic or glass.

NOTE:

When a front panel with high dielectric constant, such as glass, is pressed against the SK-TSC-1127S-SB PCB during operation (no front panel present at power-up or reset), the sudden increase in capacitance might be detected as touch. As the Automatic Impedance Calibration is suspended as long as a touch is detected, a calibration should be forced (e.g. by using the 'wr' command to issue a warm reset) after the front panel was added during operation and when this was detected as touch. If the front panel is already present during power-up or reset, the initial calibration will automatically adjust sensitivity.

Based on these Settings, the Alpha values can be set for the entire slider ('sax'), for one channel only ('sa'), or it can be incremented / decremented for all channels (a+nn / a-nn).

The current values of Alpha and Reference Delay can be checked with the 'sv' command.

All remaining registers can be accessed by the 'set' and 'setx' commands using their addresses. Please note that after writing to certain registers, a 'warm reset' has to be performed e.g. using the 'wr' command.

Please refer to the application note 'FMA1127_Init_Reg_Description' for further register description.

Note:

When the SK-TSC-1127S-SB is used without any front cover, the resulting very strong capacitance change by a finger touch can saturate the corresponding input channel (the corresponding bar in the 'mon2' mode reaches 99). Therefore, the slider will not operate smoothly, but rather snap to the single pad electrodes. This behaviour is reduced or eliminated already by using a thin front plate as it will usually be the case in most applications.
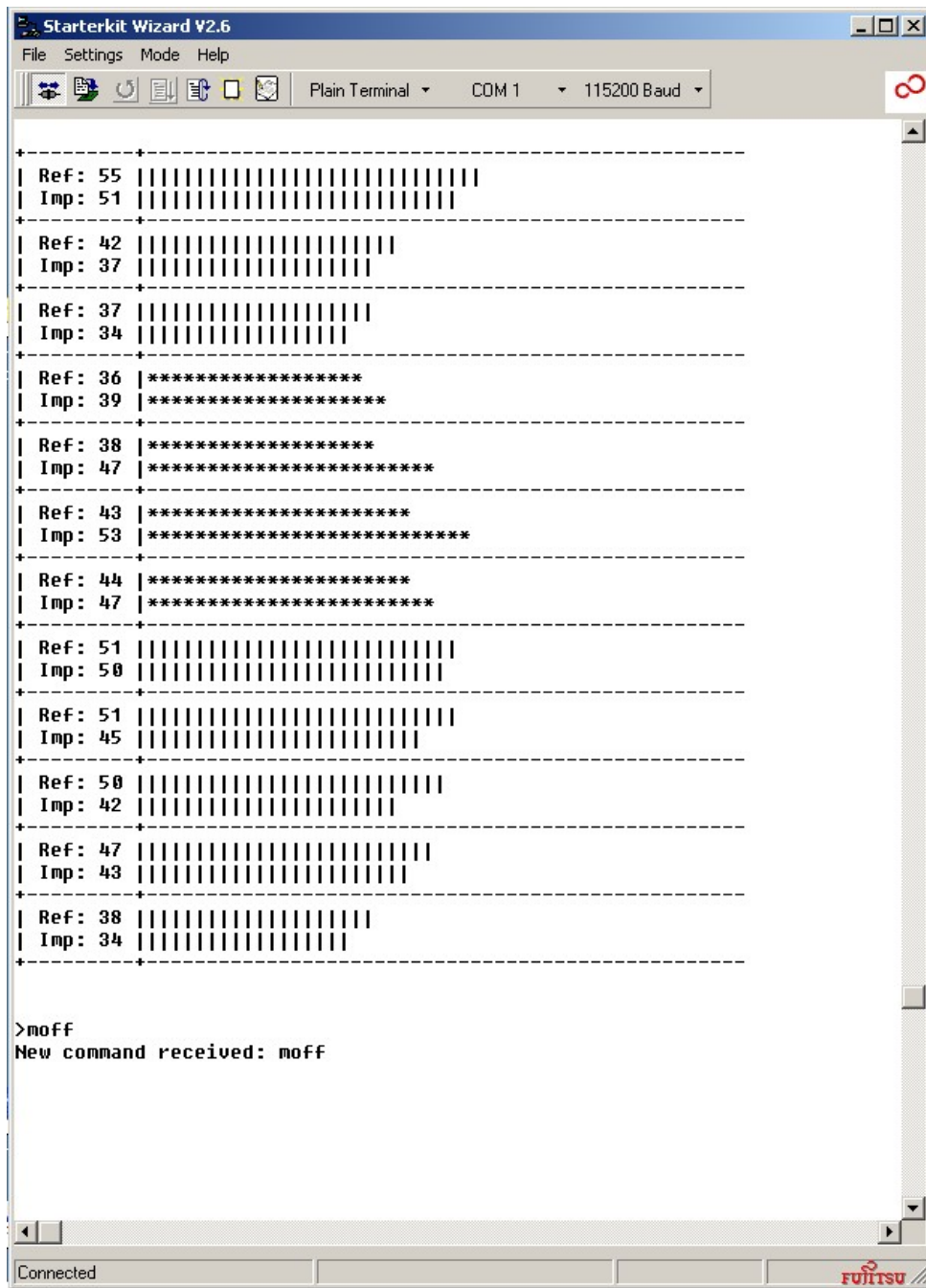
Figure 3: Monitor Mode (‚mon2')

In mon2 mode, channels with active touch status will be shown with stars '*', those in inactive state are shown with lines '|'.

Note:

While using the mon2 monitor mode, the position of the slider might not be updated regularly, because the UART output takes some time.

4 Related Products

- ▸ SK-16FX-EUROSCOPE   Evaluation board for the 16FX Family MB96340 Series MCU
- ▸ EVALB1127   Tuning Kit for the FMA1127 TSC (can also be connected to all SK-TSC-1127xxx touch boards)

5 Information in the WWW

Information about FUJITSU MICROELECTRONICS Products
can be found on the following Internet pages:

Touch sensor controllers:

http://www.fujitsu.com/emea/services/microelectronics/tsc/

Microcontrollers (8-, 16- and 32bit), Graphics Controllers
Datasheets and Hardware Manuals, Support Tools (Hard- and Software)

http://mcu.emea.fujitsu.com/

Linear Products: Power Management, A/D and D/A Converters

http://www.fme.fujitsu.com/products/linear/start.html

Media Products: SAW filters, acoustic resonators and VCOs

http://www.fme.fujitsu.com/products/saw/index.html

For more information about FUJITUS MICROELECTRONICS

http://www.fme.fujitsu.com/products/start.html

6 China-RoHS regulation

Evaluation Board评估板

Emulation Board 仿真板

根据SJ/T11364-2006

《电子信息产品污染控制标识要求》特提供如下有关污染控制方面的信息。

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In order to maintain the declared EFUP, the product shall be operated normally according to the instructions and environmental conditions as defined in the product manual, and periodic maintenance schedules specified in Product Maintenance Procedures shall be followed strictly.

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Table of hazardous substances name and concentration

部件名称 Component Name	有毒有害物质或元素 Hazardous substances name					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
SK-TSC-1127S-SB	x	o	o	o	o	o
ADA-16FX-TSC-LCD	x	o	o	o	o	o

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下

X: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006 标准规定的限量要求

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