TSC
FMA1125 TOUCH SENSOR CONTROLLER
SK-TSC-1125S

QUICK START GUIDE
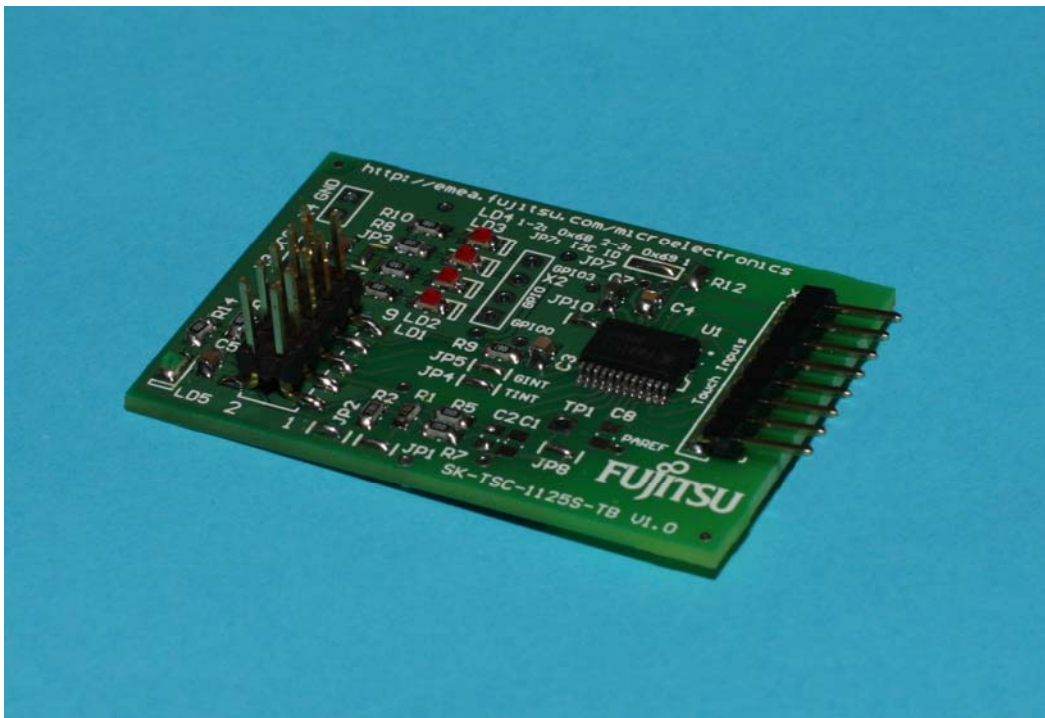
Revision History

Date	Issue
2009-11-11	V1.0, CHa, first official version
2009-12-15	V1.1, CHa, disclaimer updated, some corrections

This document contains 19 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-1125S Starter Kit allows easy evaluation of the FMA1125 Touch Sensor Controller. It consists of the following parts:

- 1x SK-TSC-1125S-TB touch board with FMA1125 TSC
- 1x ADA-16FX-TSC-LCD
- 1x 10-pin ribbon cable
- 3x FMA1125DC-24S Sample

- **In order to use the free example software, an SK-16FX-EUROSCOPE Starter Kit is required as host system, which has to be ordered separately. In this case, the included ADA-16FX-TSC-LCD and ribbon cable can be used to connect both PCBs.**
- **The SK-TSC-1125S-SB itself can alternatively be connected to any suitable host PCB using appropriate connections.**

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

▸ FMA1125DC-24S Touch Sensor Controller (SSOP24 package) with 4-8 touch input channels and 4-8 digital I/Os (4 pins can be I/O or touch input)

▸ Connector for up to eight touch input channels, with 'mini-slider' on PCB

▸ Four LEDs connected to TSC GPIO pins

▸ 10-pin connector for I2C and interrupt signals

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

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

▸ 3.3-5V operation

1.3 General Description

The SK-TSC-1125S is a starter kit and evaluation system for the FMA1125 Touch Sensor Controller (TSC). 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. 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.

Different demo firmware variants, also supporting parameter tuning using a PC terminal program, can be downloaded from the web to demonstrate different applications of the TSC.

Additionally, a standard parallel LCD (20x4) can be connected to the ADA-16FX-TSC-LCD. When the LCD is present, depending on the application, some information will be displayed, such as the distribution of the touch strength among the input channels. The same information can also be obtained by the terminal program interface.

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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 earlier products, 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-1125S-TB. Pin1 of the cable must be located in direction of the lower PCB edge.

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 FMA1125 TSC.

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.
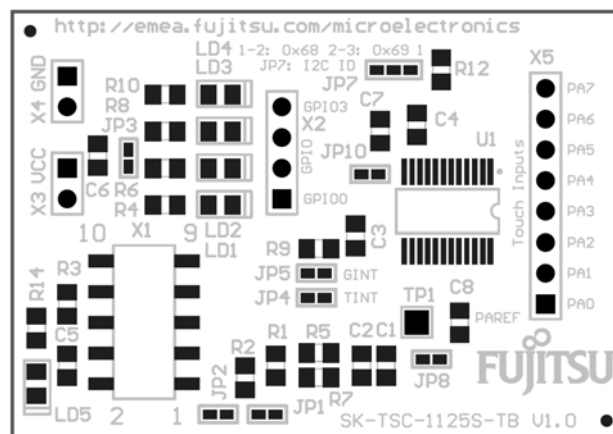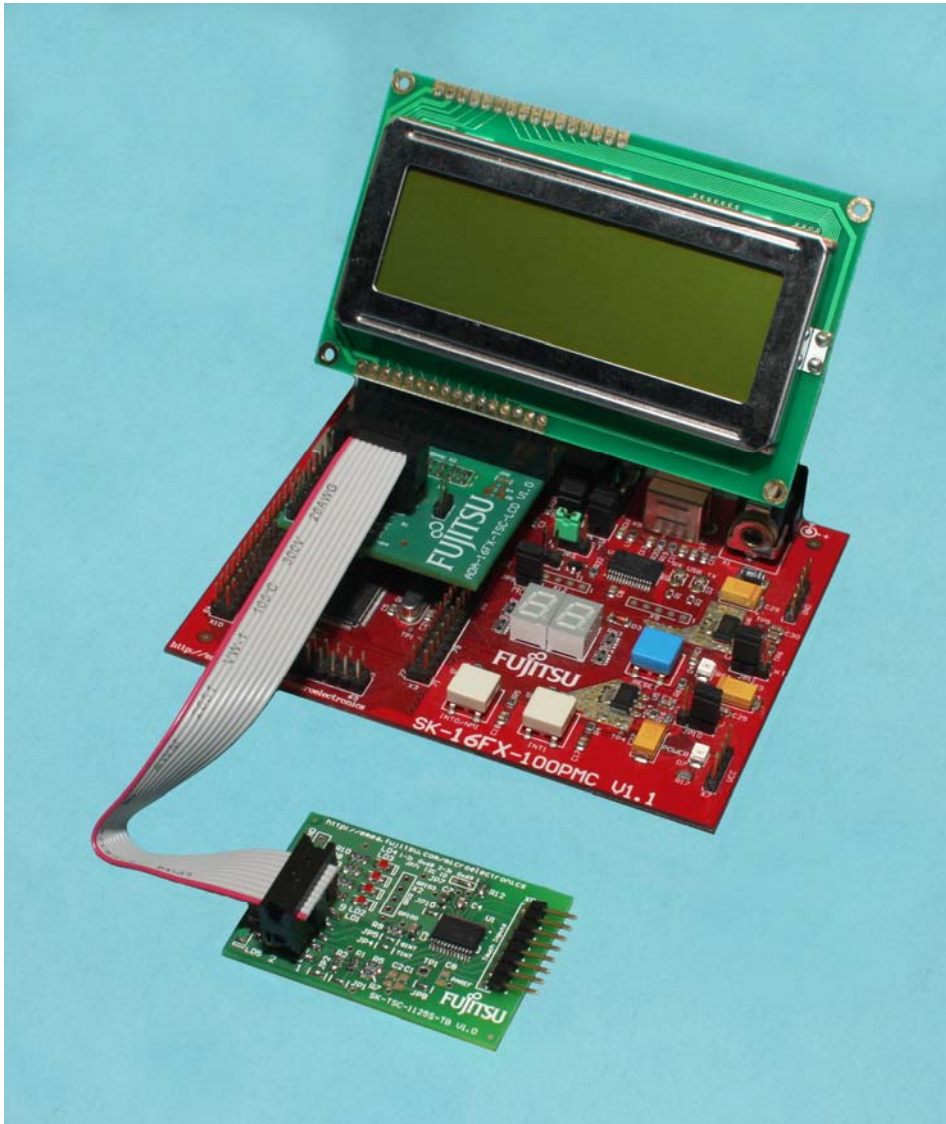
2.3 Pictures

Figure 1: SK-TSC-1125S-TB (front)

Figure 2: System set-up

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

2.4 Jumper settings

2.4.1 SK-TSC-1125S-TB

Jumper	Setting	Description
JP1 (SCL pull-up)	Open	I2C SCL line not connected to Pull-up resistor
	Closed	I2C SCL line connected to Pull-up resistor
JP2 (SDA pull-up)	Open	I2C SDA line not connected to Pull-up resistor
	Closed	I2C SDA line connected to Pull-up resistor
JP3 (LED VCC)	Open	LEDs not connected to VCC
	Closed	LEDs connected to VCC
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
JP7 (ID)	1-2	Chip ID = 0x68
	2-3	Chip ID = 0x69
JP8 (TCLK)	Open	Clock can be provided by test pin TP1
	Closed	TCLK pin connected to GND
JP10 (LDO)	Open	Internal LDO not connected
	Closed	Internal logic supplied by internal LDO

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 only 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 (ADA-16FX-TSC-LCD)

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	
10	reserved	X4 Pin 2	

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 (ADA-16FX-TSC-LCD)

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 X3 (VCC), X4 (GND) and X2 (GPIO0 – 3), additional connections to the FMA1125 can be made. X2 is connected to the digital input / output pins GPIO0-3 of the TSC. If these are to be connected to external circuits, the on-board LEDs can be disabled by opening JP3.

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

The SK-TSC-1125S 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.

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.

Command	Description
'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 (0-127, 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 (0-127, decimal)
'sax mm'	Set all Alphas (PA0-7) to mm (0-127, decimal)
'sv'	Show current values of Alpha and Reference Delay
'wr'	Issue a Warm Reset to the TSC (activate settings + force calibration)
'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)
'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, p and t <= 15)
'a+nn'	Increment all Alpha values by nn
'a-nn'	Decrement all Alpha values by nn
'stp n'	Store current parameters to Flash preset n (n = 0…9)
'ldp n'	Load preset n from Flash and write to TSC registers

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 0-127. A warm reset command is issued automatically to activate the new setting. Typical starting value will be ~50-80, depending on the touch electrodes connected.

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 FMA1125 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 PAREF pin of the TSC (depending on the R_SEL settings of the TSC, please refer to the FMA1125 register description for details). So, in case the reference delay maximum value of 127 is not sufficient, an additional capacitor of max. ~10 pF can be connected to the PAREF pin to increase the reference impedance value.

If the difference between the sensor idle impedances of the channel is too high (e.g. some channels smaller ~30, others bigger ~100), small tuning capacitors (some few pf; 1 count step = 0.078pF depending on R_SEL settings) should 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 127. Therefore, most typical applications 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 5-15.

NOTE:

When a front panel with high dielectric constant, such as glass, is pressed against the touch electrodes 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 all input channels ('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. This also will trigger a calibration.

Up to 10 register settings (all read/writable registers) can be stored to and loaded from the internal Flash memory of the Microcontroller using the 'stp' and 'ldp' commands.

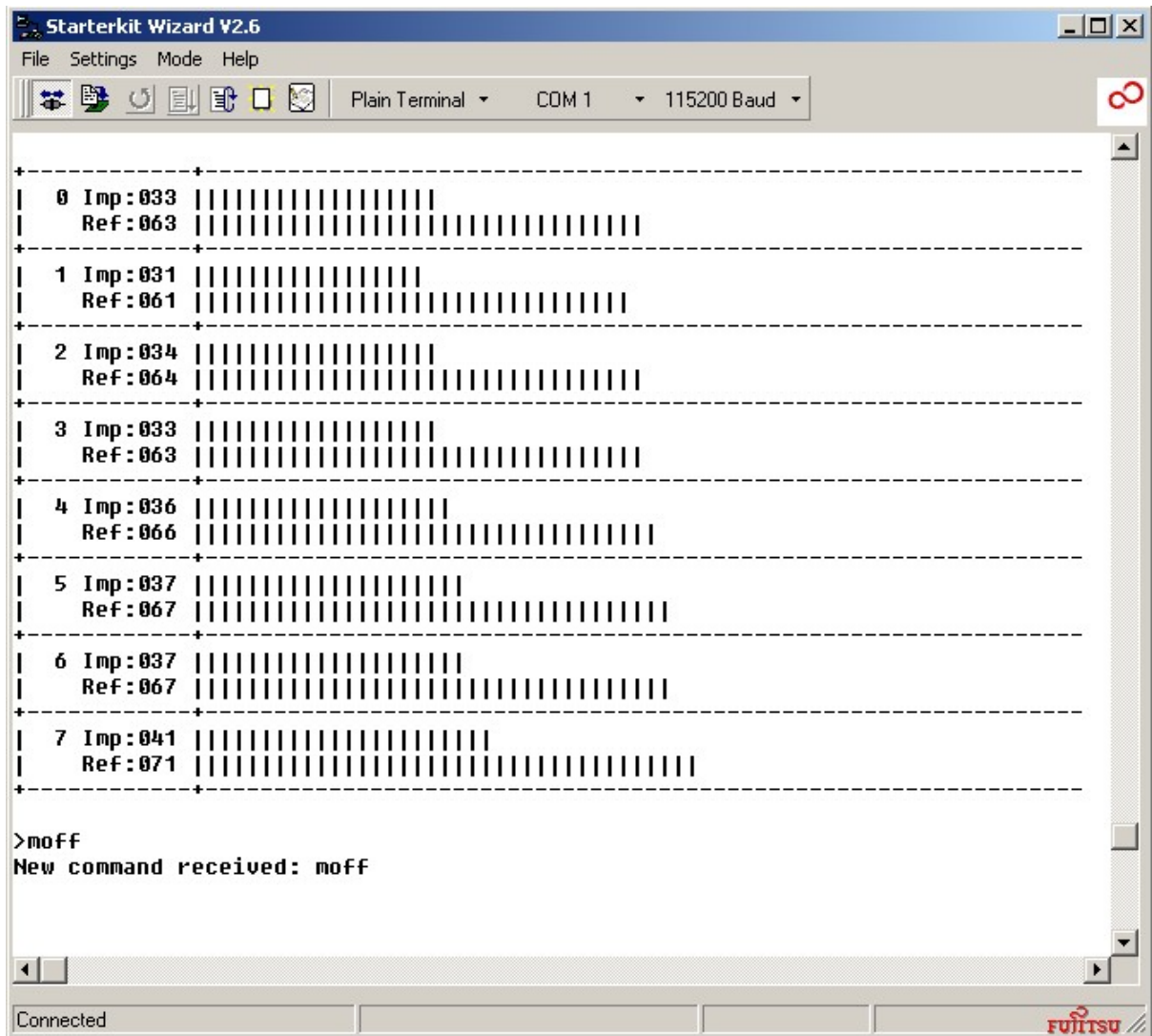Please refer to the application note 'FMA1125_Init_Reg_Description' for further register description.

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 '|'.

4 Related Products

- ▶ SK-16FX-EUROSCOPE   Evaluation board for the 16FX Family MB96340 Series MCU
- ▶ SK-TSC-1127-SB   Starter Kit for the FMA1127 Touch Sensor Controller with 12 channels

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

This starter kit is compliant with China RoHS

7 Recycling

Gültig für EU-Länder:

Gemäß der Europäischen WEEE-Richtlinie und deren Umsetzung in landesspezifische Gesetze nehmen wir dieses Gerät wieder zurück.

Zur Entsorgung schicken Sie das Gerät bitte an die folgende Adresse:

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Warehouse/Disposal

Monzastraße 4a

D-63225 Langen

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For disposal please send the device to the following address:

Fujitsu Microelectronics Europe GmbH

Warehouse/Disposal

Monzastraße 4a

D-63225 Langen

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-- END --