

TMX320-P28027 development board

Users Manual



All boards produced by Olimex are RoHS compliant

Rev.A, October 2009

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INTRODUCTION

TMX320-P28027 is development board with TMS320F28027 microcontroller from Texas Instruments. The board have everything necessary to build simple applications: Reset circuit, trimmer potentiometer, clock circuit, USB, JTAG, user button, most of the GPIOs are on prototype area and extension headers, where you can connect your additional circuits. The board have very competitive pricing and is very good for people who want to learn DSPs.

BOARD FEATURES

- MCU: TMS320F28027 32KB Flash, 6 KB SARAM, 4.6 MSPS 12Bit ADC, SPI, RS232, I2C;
- JTAG connector;
- USB-to-RS232 convertor allow easy to power board and to connect to notebooks and decent computers without RS232 port;
- UEXT connector for connection to other Olimex modules as MOD-NRF24Lx, MOD-MP3, etc.;
- MOTOR control connector (for add on modules with ADC, PWM, Interrupt signals available);
- User button;
- Trimmer potentiometer connected to Analog input;
- power supply LED;
- user status LED;
- RST button;
- external power supply jack for AC or DC power supply;
- Voltage regulator + power supply filtering capacitor;
- prototype area with 0.1" step, Vcc + GND bus;
- PCB: FR-4, 1.5 mm (0,062"), green soldermask, white silkscreen component print;
- Dimensions: 140x100 mm (5.5x3.9").

ELECTROSTATIC WARNING

The TMX320-P28027 development board is shipped in protective anti-static packaging. The board must not be subject to high electrostatic potentials. General practice for working with static sensitive devices should be applied when working with this board.

BOARD USE REQUIREMENTS

Cables: Depends on the Programmers/Debuggers you use. If you use TMS320-JTAG, you will need LPT cable, if you use TMS320-JTAG-USB, you will need 1.8 meter USB A-B cable.

Hardware: Power supply adapter 4.5-6VAC or 6-9VDC (if the board is not powered from USB host).
[TMS320-JTAG](#), or [TMS320-JTAG-USB](#) for programming and debugging or similar tool.

NOTE: When you use TMS320-JTAG-USB, switch off USB cable from TMX320-P28027 and power supply the board from PWR Jack connector (6-9VDC).

Software: Texas Instruments Code Composer Studio 3.30 and drivers- available on the www.ti.com

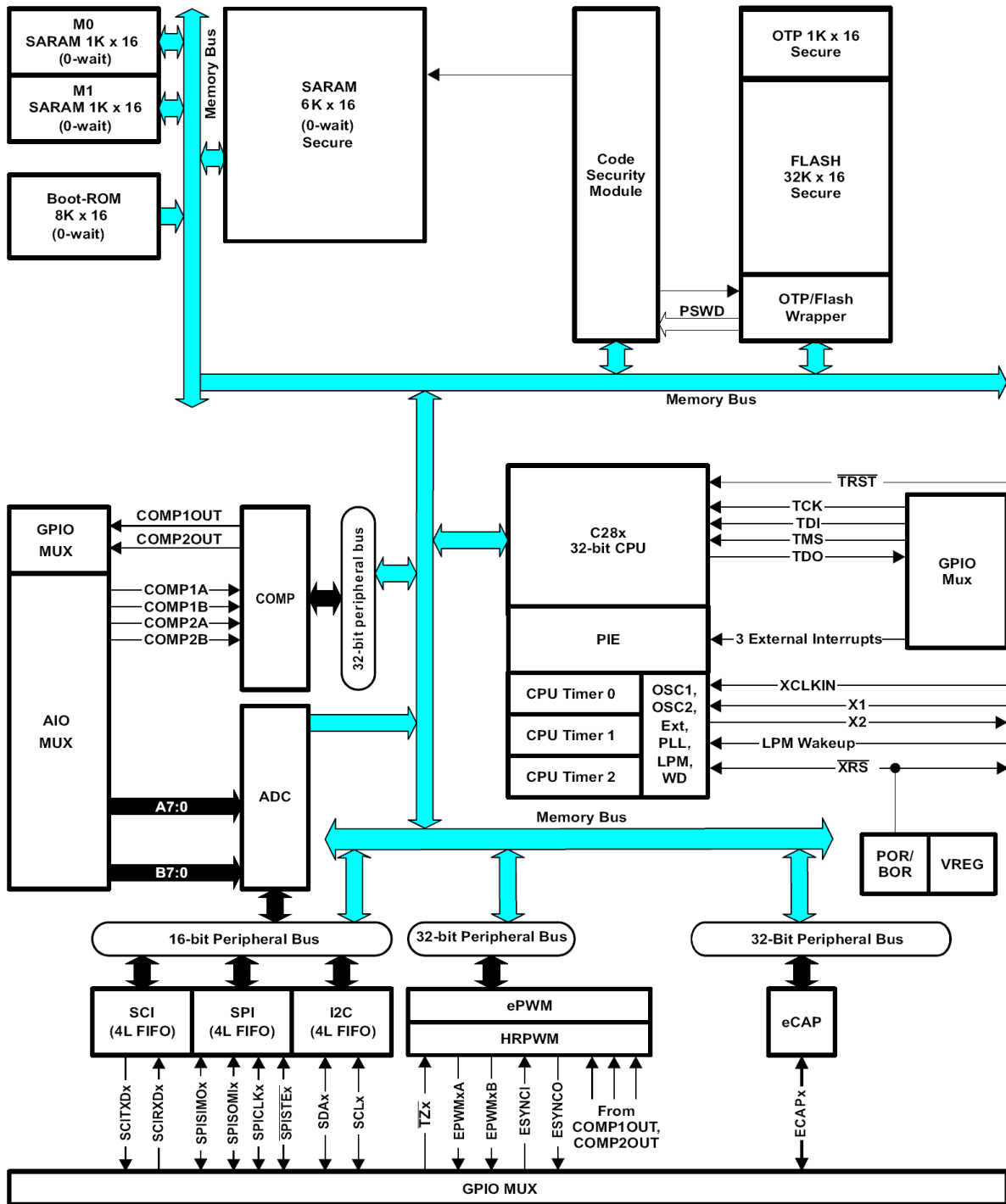
PROCESSOR FEATURES

The TMS320F28027 processor has the following features:

- High-Efficiency 32-Bit CPU (TMS320C28x™)
 - 60 MHz (16.67-ns Cycle Time)
 - 40 MHz (25-ns Cycle Time)
 - 16 x 16 and 32 x 32 MAC Operations
 - 16 x 16 Dual MAC
 - Harvard Bus Architecture
 - Atomic Operations
 - Fast Interrupt Response and Processing
 - Unified Memory Programming Model
 - Code-Efficient (in C/C++ and Assembly)
- Low Device and System Cost:
 - Single 3.3-V Supply
 - No Power Sequencing Requirement
 - Integrated Power-on Reset and Brown-out Reset
 - Small Packaging, as Low as 38-Pin Available
 - Low Power
 - No Analog Support Pins
- Clocking:
 - 2 Internal Zero-pin Oscillators
 - On-chip Crystal Oscillator/External Clock Input
 - Dynamic PLL Ratio Changes Supported
 - Watchdog Timer Module
 - Missing Clock Detection Circuitry
- Up to 22 Individually Programmable Multiplexed GPIO Pins With Input Filtering

- Peripheral Interrupt Expansion (PIE) Block That Supports All Peripheral Interrupts
- Three 32-Bit CPU Timers
- Independent 16-bit Timer in Each ePWM Module
- On-Chip Memory
 - On-chip FLASH (16-bit word) - 32K
 - On-Chip SARAM (16-bit word) - 6K
 - OTP, Boot ROM Available
- 128-Bit Security Key/Lock
 - Protects Secure Memory Blocks
 - Prevents Firmware Reverse Engineering
- Serial Port Peripherals
 - One SCI (UART) Module
 - One SPI Module
 - One Inter-Integrated-Circuit (I2C) Bus
- Advanced Emulation Features
 - Analysis and Breakpoint Functions
 - Real-Time Debug via Hardware
- Enhanced Control Peripherals
 - Enhanced Pulse Width Modulator (ePWM)
 - High-resolution PWM (HRPWM)
 - Enhanced Capture (eCAP)
 - Analog-to-Digital Converter (ADC)
 - On-Chip Temperature Sensor
 - Comparator
- Package
 - 48-Pin PT Plastic Quad Flatpack (PQFP)

BLOCK DIAGRAM

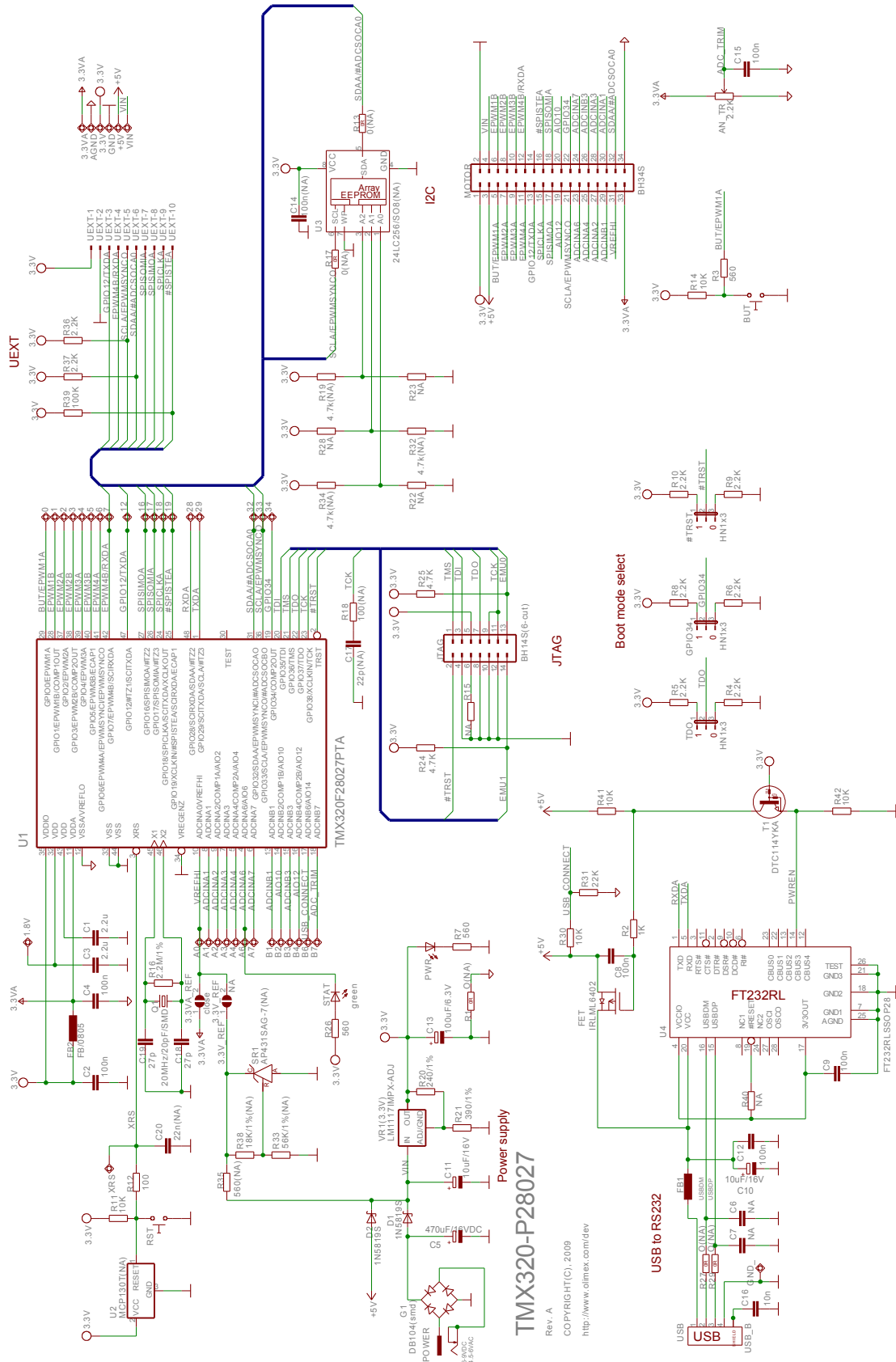


A. Not all peripheral pins are available at the same time due to multiplexing.

MEMORY MAP

| | | Data Space | Prog Space |
|---|-----------|--|------------|
| Low 64K (24x/240x Equivalent Data Space) | 0x00 0000 | <i>M0 Vector RAM (Enabled if VMAP = 0)</i> | |
| | 0x00 0040 | M0 SARAM (1K x 16, 0-Wait) | |
| | 0x00 0400 | M1 SARAM (1K x 16, 0-Wait) | |
| | 0x00 0800 | Peripheral Frame 0 | Reserved |
| | 0x00 0D00 | PIE Vector - RAM (256 x 16) (Enabled if VMAP = 1, ENPIE = 1) | |
| | 0x00 0E00 | Peripheral Frame 0 | Reserved |
| | 0x00 2000 | Reserved | |
| | 0x00 6000 | Peripheral Frame 1 (4K x 16, Protected) | Reserved |
| | 0x00 7000 | Peripheral Frame 2 (4K x 16, Protected) | |
| | 0x00 8000 | L0 SARAM (4K x 16) (0-Wait, Secure Zone + ECSL, Dual Mapped) | |
| | 0x00 9000 | Reserved | |
| | 0x3D 7800 | User OTP (1K x 16, Secure Zone + ECSL) | |
| | 0x3D 7C00 | Reserved | |
| | 0x3D 7C80 | Calibration Data | |
| 0x3D 7CC0 | Reserved | | |
| 0x3D 8000 | Reserved | | |
| High 64K (24x/240x Equivalent Program Space) | 0x3F 0000 | FLASH (32K x 16, 4 Sectors, Secure Zone + ECSL) | |
| | 0x3F 7FF8 | 128-Bit Password | |
| | 0x3F 8000 | L0 SARAM (4K x 16) (0-Wait, Secure Zone + ECSL, Dual Mapped) | |
| | 0x3F 9000 | Reserved | |
| | 0x3F E000 | Boot ROM (8K x 16, 0-Wait) | |
| | 0x3F FFC0 | Vector (32 Vectors, Enabled if VMAP = 1) | |

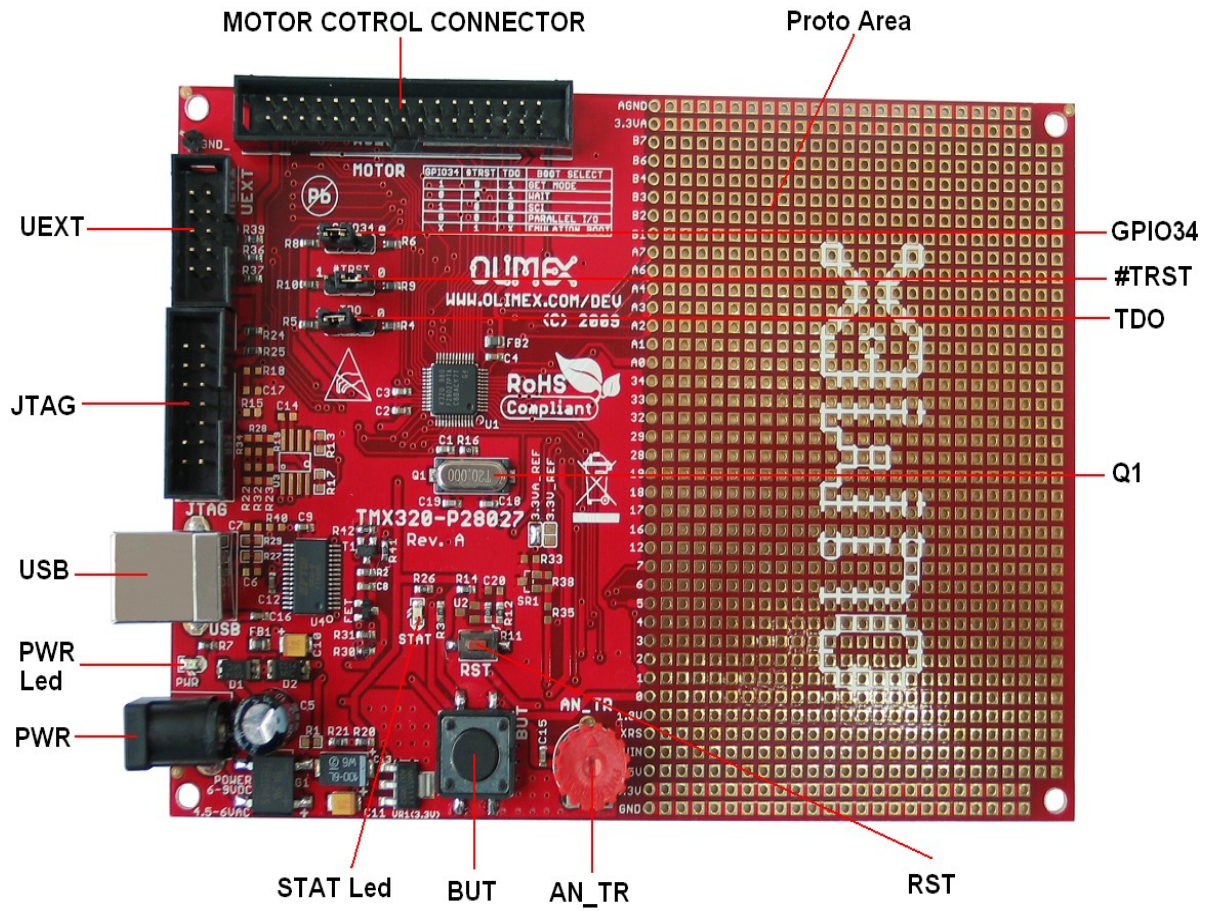
SCHEMATIC



TMX320-P28027

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BOARD LAYOUT



POWER SUPPLY CIRCUIT

TMX320-P28027 board can take power from POWER connector (4.5-6VAC or 6-9VDC), from VIN on the prototype area (5-9VDC), from MOTOR connector pin 4 (5-9VDC) and from USB connector.

The board power consumption is around 90mA with all peripherals and MCU running at full speed.

RESET CIRCUIT

Reset circuit includes R11 (10k), R12 (100 Ohm) and TMS320F28027 pin 3 (XRS). Although on the schematic is made provision for external reset by the RST button.

CLOCK CIRCUIT

Quartz crystal 20Mhz is connected to TMS320F28027 pin 45 (X1) and pin 46 (X2).

JUMPER DESCRIPTION

The jumpers TDO, GPIO34 and #TRST selects boot mode source. The table bellow shows boot mode variants.

| BOOT SELECT | TDO | GPIO34 | #TRST |
|----------------|-----|--------|-------|
| GET MODE | 1 | 1 | 0 |
| WAIT | 1 | 0 | 0 |
| SCI | 0 | 1 | 0 |
| I2C | 1 | 0 | 0 |
| PARALLEL I/O | 0 | 0 | 0 |
| EMULATION BOOT | X | X | 1 |

GPIO34



1 0

#TRST



1 0

TDO



1 0

Default state: GET MODE

3.3VA_REF



Connects VREFHI to analog 3.3 V.
Default state is closed.

3.3V_REF



Gives user opportunity to connect VREFHI to external 3.3V power source.
Default state is open.

INPUT/OUTPUT

Reset button with name **RST** – connected to TMS320F28027 pin 3 (XRS).

User button with name **BUT** – connected to TMS320F28027 pin 29 (GPIO0/EPWM1A).

Status LED (green) with name **STAT** – connected to TMS320F28027 pin 4 (ADCINA6).

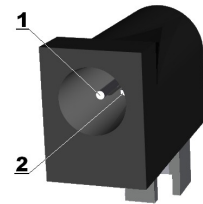
Trimmer potentiometer with name **AN_TR** – connected to TMS320F28027 pin 18 ADCINB7.

Power supply LED (red) with name **PWR** – indicates that 3.3V is present.

EXTERNAL CONNECTOR DESCRIPTION

PWR:

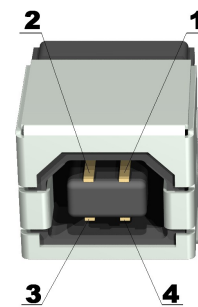
| Pin # | Signal Name |
|-------|------------------------------------|
| 1 | From 4.5 to 6VAC or from 6 to 9VDC |
| 2 | GND |



USB:

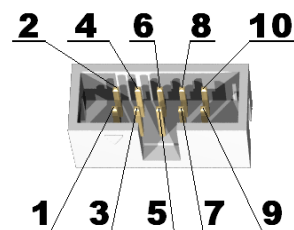
The USB is made with USB to serial converter chip FT232RL of FTDI. RXD and TXD pins of the converter is connected to SCI_A module of TMS320F28027 respective to GPIO28/SCIRXDA (pin 48) and GPIO29/SCITXDA (pin 1)

| Pin # | Signal Name |
|-------|-------------|
| 1 | +5V |
| 2 | USBDM |
| 3 | USBDP |
| 4 | GND |



UEXT:

| Pin # | Signal Name | Pin # | Signal Name |
|-------|-------------|-------|-------------|
| 1 | 3.3V | 2 | GND |
| 3 | GPIO12/TXDA | 4 | EPWM4B/RXDA |



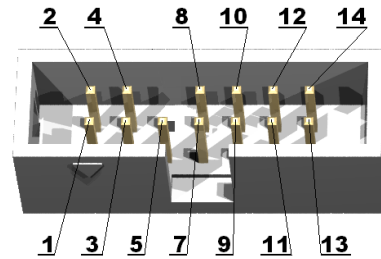
| | | | |
|---|----------------|----|----------------|
| 5 | SCLA/EPWMSYNCO | 6 | SDAA/#ADCSOCA0 |
| 7 | SPISOMIA | 8 | SPISIMOA |
| 9 | SPICLKA | 10 | #SPISTEA |

UEXT is a universal connector which Olimex uses on it's development boards to attach different "modules" on the connector there are 3.3V power supply and UART, SPI and I2C interface. Olimex have range of modules like MOD-MP3, MOD-nRF24Lx, MOD-RFID125, MOD-NOKIA6610 and many others to come.

JTAG:

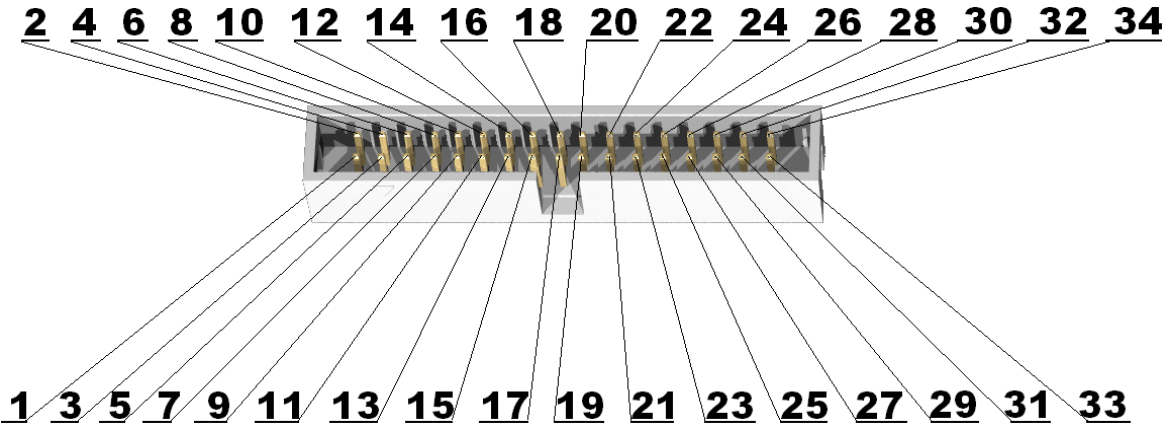
TI standard 2x7 pin JTAG connector

| Pin # | Signal Name | Pin # | Signal Name |
|-------|-------------|-------|-------------|
| 1 | TMS | 2 | #TRST |
| 3 | TDI | 4 | GND |
| 5 | 3.3V | 6 | Removed |
| 7 | TDO | 8 | GND |
| 9 | TCK | 10 | GND |
| 11 | TCK | 12 | GND |
| 13 | EMU0 | 14 | EMU1 |



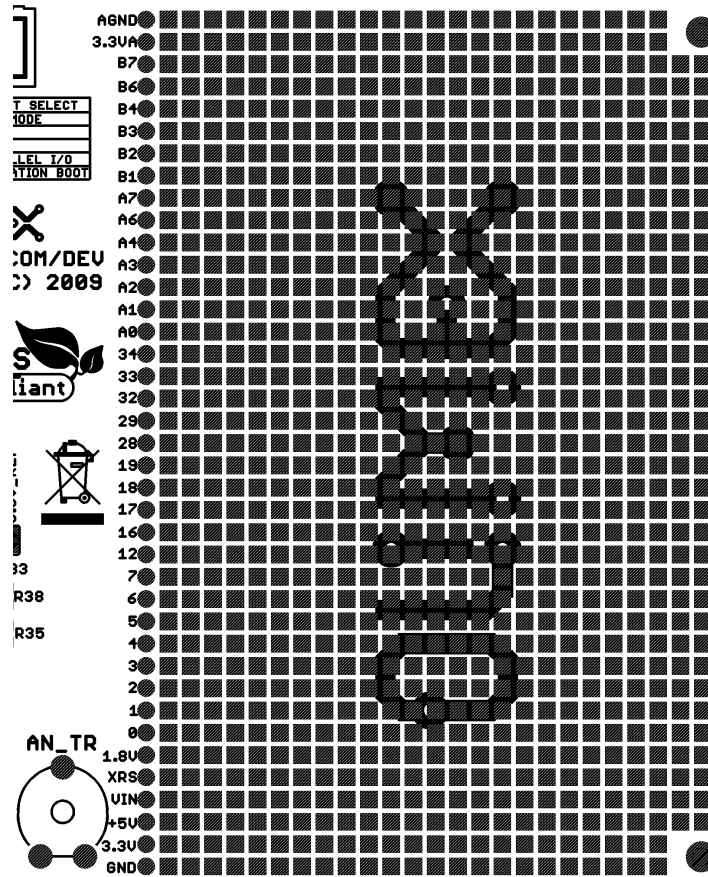
MOTOR CONTROL CONNECTOR:

MOTOR control connector provides signals for add on modules with ADC, PWM, Interrupt signals available on it.



| Pin # | Signal Name | Pin # | Signal Name |
|-------|----------------|-------|----------------|
| 1 | 3.3V | 2 | GND |
| 3 | +5V | 4 | VIN |
| 5 | BUT/EPWM1A | 6 | EPWM1B |
| 7 | EPWM2A | 8 | EPWM1B |
| 9 | EPWM3A | 10 | EPWM3B |
| 11 | EPWM4A | 12 | EPWM4B/RXDA |
| 13 | GPIO12/TXDA | 14 | NC |
| 15 | SPICLKA | 16 | #SPISTEA |
| 17 | SPISIMOA | 18 | SPISOMIA |
| 19 | AIO12 | 20 | AIO10 |
| 21 | SCLA/EPWMSYNCO | 22 | GPIO34 |
| 23 | ADCINA6 | 24 | ADCINA7 |
| 25 | ADCINA4 | 26 | ADCINB3 |
| 27 | ADCINA2 | 28 | ADCINA3 |
| 29 | ADCINB1 | 30 | ADCINA1 |
| 31 | VREFHI | 32 | SDAA/#ADCSOCA0 |
| 33 | 3.3VA | 34 | GND |

PROTO AREA:



| Pin # | Signal Name | Pin # | Signal Name | Pin # | Signal Name |
|-------|-------------|-------|----------------|-------|-------------|
| AGND | AGND | A1 | ADCINA1 | 6 | EPWM4A |
| 3.3VA | V+ | A0 | VREFHI | 5 | EPWM3B |
| B7 | ADC_TRIM | 34 | GPIO34 | 4 | EPWM3A |
| B6 | USB_CONNECT | 33 | SCLA/EPWMSYNCO | 3 | EPWM2B |
| B4 | AIO12 | 32 | SDAA/#ADCSOCA0 | 2 | EPWM2A |
| B3 | ADCINB3 | 29 | TXDA | 1 | EPWM1B |
| B2 | AIO10 | 28 | RXDA | 0 | BUT/EPWM1A |
| B1 | ADCINB1 | 19 | #SPISTEA | 1.8V | VDD1 |
| A7 | ADCINA7 | 18 | SPICLKA | XRS | XRS |
| A6 | ADCINA6 | 17 | SPISOMIA | VIN | VIN |
| A4 | ADCINA4 | 16 | SPISIMOA | +5V | +5V |
| A3 | ADCINA3 | 12 | GPIO12/TXDA | 3.3V | VCC |
| A2 | ADCINA2 | 7 | EPWM4B/RXDA | GND | GND |

SPI

The SPI is a high-speed, synchronous serial I/O port that allows a serial bit stream of programmed length (one to sixteen bits) to be shifted into and out of the device at a programmable bit-transfer rate. Normally, the SPI is used for communications between the MCU and external peripherals or another processor. Typical applications include external I/O or peripheral expansion through devices such as shift registers, display drivers, and ADCs. Multi-device communications are supported by the master/slave operation of the SPI. The SPI contains a 4-level receive and transmit FIFO for reducing interrupt servicing overhead.

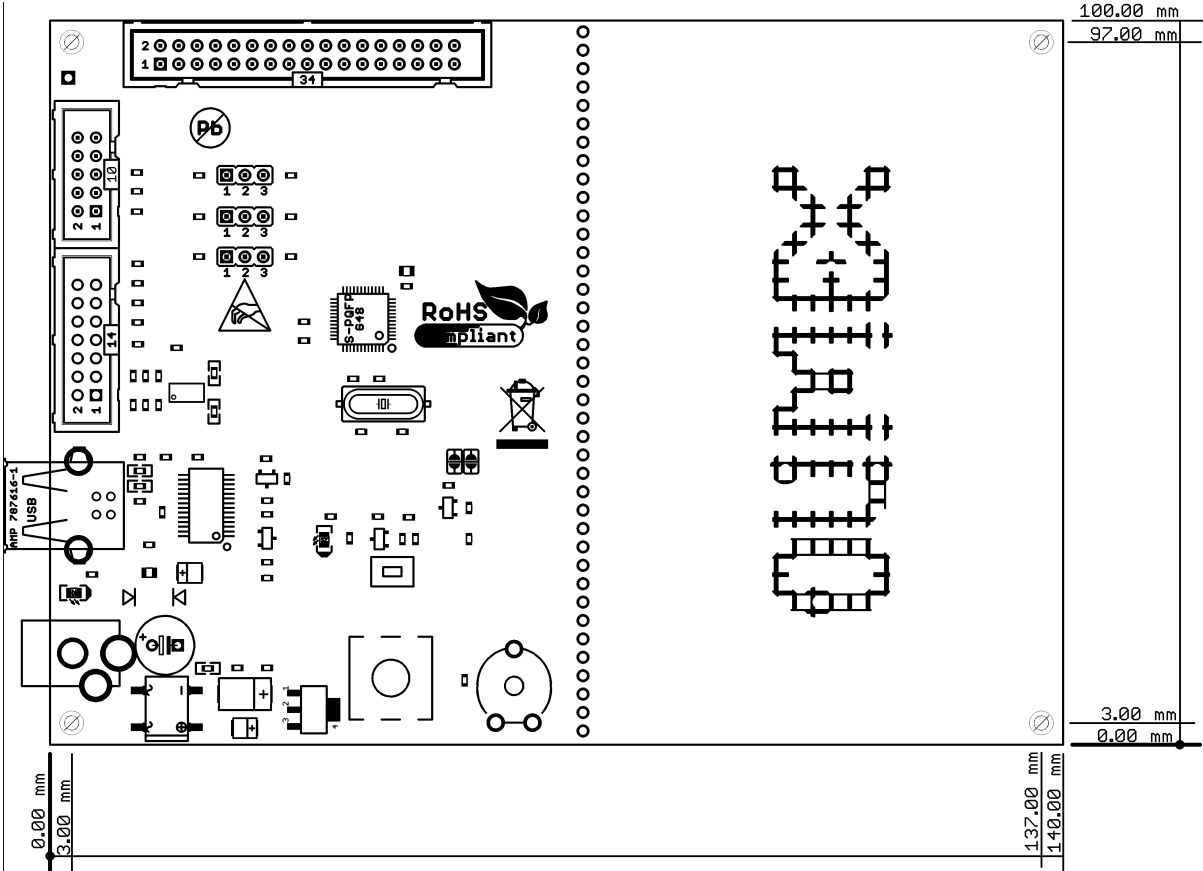
SCI

The serial communications interface is a two-wire asynchronous serial port, commonly known as UART. The SCI contains a 4-level receive and transmit FIFO for reducing interrupt servicing overhead.

I2C

The inter-integrated circuit (I2C) module provides an interface between a MCU and other devices compliant with Philips Semiconductors Inter-IC bus (I2C-bus) specification version 2.1 and connected by way of an I2C-bus. External components attached to this 2-wire serial bus can transmit/receive up to 8-bit data to/from the MCU through the I2C module. The I2C contains a 4-level receive and transmit FIFO for reducing interrupt servicing overhead.

MECHANICAL DIMENSIONS:



AVAILABLE DEMO SOFTWARE:

DEMO1. Blink LED C Source and CCS 3.3 project files
 Blinks the on-board LED.

ORDER CODE:

TMX320-P28027 - assembled and tested (no kit, no soldering required)

How to order?

You can order to us directly or by any of our distributors.

Check our web www.olimex.com/dev for more info.

Revision history:

REV.A create October 2009