



**TS-COMBOX
Manual**



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1 OVERVIEW

TS-COMBOX Application Kit includes a complete software and hardware solution for embedded systems and applications requiring high level of control through multiple serial communication ports. The TS-COMBOX features 25 integrated RS-232 serial ports implemented on the FPGA of the TS-7300 ARM9 Single Board Computer. In addition, this design comes with a rugged metal enclosure that brings out 9 DB9 connectors and provides internal room for 3 extra PC/104 peripherals connected on the TS-7300.

On the software side, the TS-COMBOX is powered with the Linux OS running from an SD card with all of the tools and drivers necessary to make the TS-COMBOX work out-of-the-box. TS-COMBOX features include:

- ✓ Powered by TS-7300 SBC
- ✓ 200MHz ARM9 CPU with MMU
- ✓ 25 RS-232 Serial Ports in FPGA
- ✓ 32MB SDRAM (128MB opt)
- ✓ 2 10/100 Ethernets
- ✓ 800x600 Video
- ✓ 2 USB 2.0 (12 Mbit/s max)
- ✓ 2 SD sockets, up to 4GB SD
- ✓ 8-30V switching power supply
- ✓ Rugged Metal Enclosure w/ 9 DB9
- ✓ Internal room for 3 peripherals
- ✓ Industrial quality design
- ✓ Boots Linux in 1.69 seconds
- ✓ Linux drivers for all 25 COM ports
- ✓ Optional Battery-Backed RTC
- ✓ Optional On-Board Temperature Sensor



Notes

The TS-COMBOX makes use of a TS-7300 computer module. Please, refer to the TS-7300 documentation for further information

2 GETTING STARTED

2.1 Handling the Board Safely

Before performing any set up or placement procedures, take precautions outlines in this section.

- ✓ Be sure to take appropriate Electrostatic Discharge (ESD) precautions.
- ✓ Disconnect the power cable at the rear panel of the enclosure before moving, cabling, or performing any set up procedures.



Warning

Inappropriate handling may cause damage to the board inside

2.2 Setup and Installation Instructions

Follow these guidelines for safety and maximum product performance:

- ✓ Observe local health and safety requirements and guidelines for manual material handling.
- ✓ Set the enclosure on a level surface with adequate ventilation.
- ✓ Ensure the rubber feet are used for protection and stability on level surfaces.
- ✓ Wall-mount the unit if placement on a level surface is not available, or desired.

2.3 Setup Tools

Depending on placement and cabling of the enclosure, you may need the following tools:

- ✓ Small flat-blade screwdriver
- ✓ Small Phillips screwdriver

2.4 Setup Procedures

After locating, setting up, grounding, and cabling the enclosure:

- ✓ Apply power to the unit (refer to some other section)
- ✓ Monitor COM1 using a terminal emulator to verify that the enclosure is operating properly

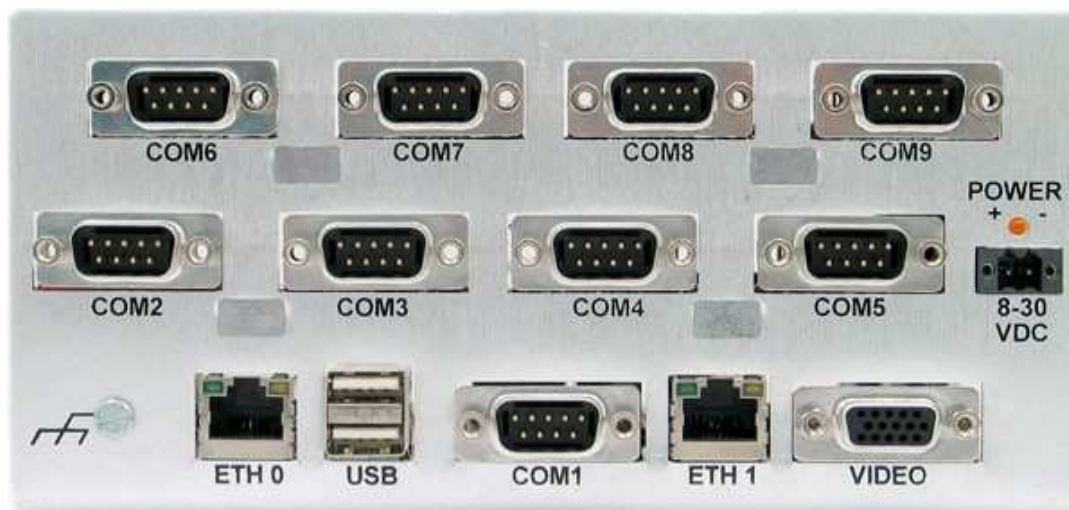
2.5 Disconnecting AC Power

- ✓ Unplug the cord from the power source
- ✓ Disconnect the power cord from the rear panel of the enclosure

3 COMPONENTS

3.1 Front and Rear Panels

The TS-COMBOX front panel is shown on the first page of this manual.



The rear panel of the TS-COMBOX enclosure (shown above) has all of the input/output connectors, including one COM port directly connected to the ARM processor, eight additional COM ports using FPGA implemented logic, two USB 2.0 ports, two ethernet ports (one implemented in FPGA logic the other ethernet MAC is in the ARM processor), VGA video out connector implemented in FPGA logic, two pin power connector, and a power indicator LED.

3.2 Standard Headers and Connectors

COM1: Console RS-232 Serial Port

The COM1 RS-232 port uses a standard DB-9 male connector on the TS-COMBOX.

Table: COM1 DB9 Pinouts

| DB9 Pin | Signal | Description |
|---------|--------|---------------------|
| 1 | DCD | Data Carrier Detect |
| 2 | RXD | Receive Data |
| 3 | TXD | Transmit Data |
| 4 | DTR | Data Terminal Ready |
| 5 | GND | Ground |
| 6 | DSR | Data Set Ready |
| 7 | RTS | Request to Send |
| 8 | CTS | Clear to Send |
| 9 | - | - |


Note

The COM1 port on the TS-COMBOX is the default port used for system console. The RC-DB9 cable must be connected to COM1 in order to have a Linux console via any terminal emulator.

USB

The USB Connector on the TS-COMBOX provide two USB interfaces for the user. These are directly connected to the EP9302 processor, which integrates an USB dual-port Open Host Controller Interface (OHCI), providing full-speed serial communications ports at a baud rate of 12 Mbits/sec. Up to 127 USB devices (printer, mouse, camera, keyboard, etc.) and USB hubs can be connected to the USB host in the USB “tiered-star” topology.

ETH0 and ETH1

The ethernet connectors ETH0 and ETH1 makes use of a standard RJ-45 socket. They can be used to connect a standard 10/100 Ethernet cable into the enclosed SBC.

The ETH0 port is controlled by the ARM9 CPU, while the ETH1 port is controlled by the TS-7300 onboard FPGA.


Note

The right side LED above the Ethernet port indicates a 100-Mbit link, while the left side LED indicates network activity.

VGA

A standard DB15 VGA connector is available on the TS-COMBOX for video interface. For further information on the VGA Video function, refer to the TS-7300 manual.

COM2 through COM9

These eight COM ports are implemented on the TS-7300 by a proprietary FPGA IP core. Each of the eight extra DB9 connectors can support up to three COM ports, therefore providing 24 (3x8) COM ports total. That is accomplished by changing the function of some standard RS-232 signals, meaning that the RTS signal becomes TX2, the CTS signal becomes RX2, the DTR signal becomes TX3 and the DCD signal becomes RX3. The TS-COMBOX includes a FPGA bitstream with 24 COM ports, the TS-736 peripheral board with RS-232 drivers/interface and Linux drivers for all the 25 COM ports.

Table: COM2 Through COM9

| DB-9 Pin | Signal | Description |
|----------|---------|-------------------------------------|
| 1 | DCD/RX3 | Data Carrier Detect/Receive Data 3 |
| 2 | RXD | Receive Data 1 |
| 3 | TXD | Transmit Data 1 |
| 4 | DTR/TX3 | Data Terminal Ready/Transmit Data 3 |
| 5 | GND | Ground |
| 6 | DSR | Data Set Ready |
| 7 | RTS/TX2 | Request to Send/Transmit Data 2 |
| 8 | CTS/RX2 | Clear to Send/Receive Data 2 |
| 9 | -- | -- |

3.3 TS-736 FPGA Daughter Board

The TS-736 FPGA daughter board should be connected to the TS-7300 40-pin header in order to interface with the TS-7300 FPGA. The TS-736 implements a switching power supply in order to provide regulated power to the TS-7300 from a 8-28VDC external power source connected to the TS-COMBOX enclosure. In addition, the TS-736 includes level shifters necessary to convert signals from the FPGA to RS-232 voltage levels and vice versa.

TS-736 Internal Power Cable

The internal power cable of the TS-736 must be connected to the power input of the enclosed SBC in order to provide regulated 5VDC power supply to the SBC.



Warning

The indicated polarity must be used when connecting this cable

TS-736 Routing/Connectors

The TS-737T/B boards are each connected via a 26-pin ribbon cable to the TS-736 and the TS-737B board has a 10-pin connection to provide input power to the TS-736 to be regulated to 5VDC.

4 OPERATION OF COMBOX PORTS

The TS-COMBOX ships with the necessary FPGA bitstream and drivers to access the 24 RS-232 ports created by the TS-736.

4.1 Bitstream

The bitstream that is loaded in to the FPGA by default is called "ts736.rbf", while this is normally loaded at bootup, it can be loaded by the user from a fully booted state with the command:

```
$ load_ts7300 /boot/ts736.rbf
```

4.2 Driver

Once the FPGA bitstream is loaded, a Linux kernel module must be loaded in order for the system to recognize the created serial devices. The driver is loaded in to the kernel at bootup by default, but can also be loaded from a fully booted state with the following command:

```
$ modprobe tsuart-736
```

4.3 Devices

When both the bitstream and module are loaded there are multiple devices created in the "/dev" directory. These are devices are:

```
/dev/ttyT8Sy0 through /dev/ttyT8Sy23  
/dev/ttyT9Sy0 through /dev/ttyT9Sy23  
/dev/cuaT8Sy0 through /dev/cuaT8Sy23  
/dev/cuaT9Sy0 through /dev/cuaT9Sy23
```


“/dev/ttyT8Sy*” devices are 8-bit serial devices, while “/dev/ttyT9Sy*” devices are 9-bit. The “/dev/cua*” devices are for legacy support, following the same 8 and 9-bit number scheme.

The naming scheme is as follows: TX/RX are accessible via the devices “/dev/*Sy0 through 7”; when these are the only ports are in use the RTS, CTS, DTR, and DCD lines are be used normally. TX2/RX2 are accessed via the devices “/dev/*Sy8 through 15”, when these lines are used, RTS/CTS functionality for each COM port is lost in order to provide TX2/RX2 lines. TX3/RX3 are accessed via the devices “/dev/*Sy16 through 23”, when these lines are use, DTR/DCD functionality for each COM port is lost in order to provide the TX3/RX3 lines. This same naming scheme is used for the “/dev/cua*” devices.

5 PRODUCT SPECIFICATIONS

5.1 Dimensions

The TS-ENC730 enclosure dimensions are **7.25” x 5.5” x 3.5”**

5.2 Cabling

The enclosure includes the following cables for use with the TS-7300 SBC:

- ✓ A 10-pin ribbon cable to connect the TS-737B to the TS-736
- ✓ Two 26-pin ribbon cables to connect the TS-737T/B boards to the TS-736
- ✓ 5VDC cable to power the enclosed TS-7300 from the TS-736

5.3 Environmental

To ensure optimum product operation you must maintain the operational environmental specifications listed in the table below.

Table: Environmental Specification for TS-COMBOX

| Environmental Specification | Standard Temp Products | Extended Temp Products |
|-----------------------------|--|--|
| Ambient Temperature | -20° to +70° C The internal temperature must not exceed +70° C. | -40° to +85° C Extended temperature range is also standard lower CPU clock speeds. Note: At high temperature operations, CPU clock speed should be set to <=166MHz Note: Refer to your product manual, or contact Technologic Systems if the environmental temperature of the location is in doubt. |
| Relative Humidity | 0 to 90% relative humidity. Not to exceed 90% non-condensing. | Not to exceed 90% non-condensing. |

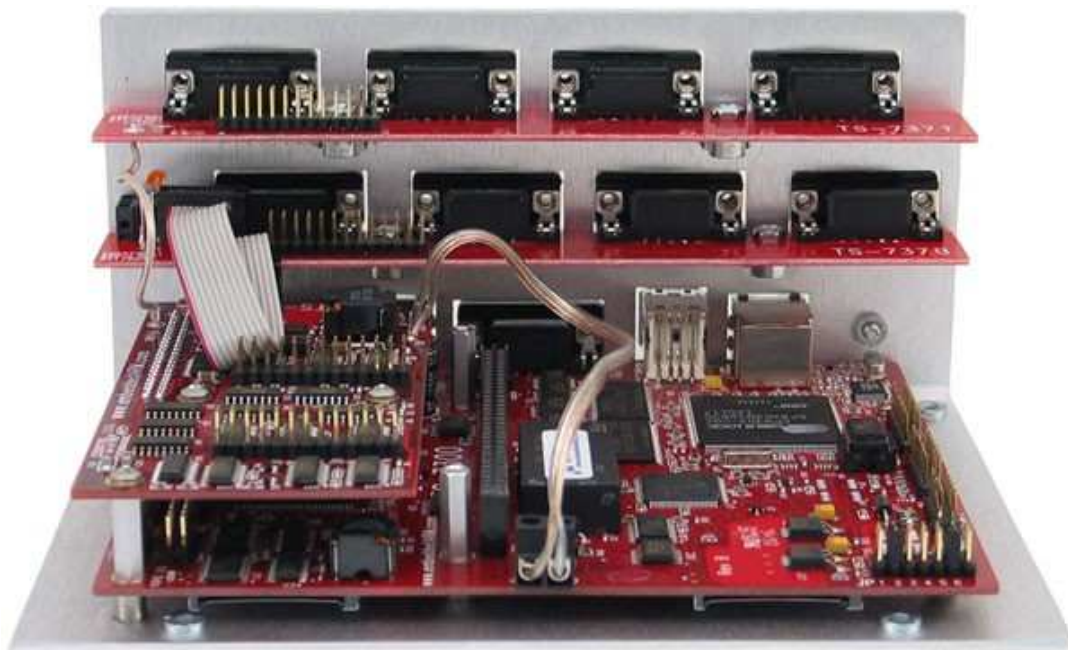
6 FURTHER REFERENCES

- ✓ **Getting Started with TS-Linux**
(<http://www.embeddedarm.com/documentation/software/arm-tslinux-ts72xx.pdf>)
- ✓ **Linux for TS-ARM User's Guide**
(<http://www.embeddedarm.com/documentation/software/arm-linux-ts72xx.pdf>)
- ✓ **TS-7300 Data Sheet**
(<http://www.embeddedarm.com/documentation/ts-7300-datasheet.pdf>)
- ✓ **TS-7300 schematic**
(<http://www.embeddedarm.com/documentation/ts-7300schematic.pdf>)
- ✓ **TS-7300 mechanical drawing**
(<http://www.embeddedarm.com/documentation/ts-7300mechanical.pdf>)
- ✓ **TS-7300's download section**
(<http://www.embeddedarm.com/epc/ts7300-spec-d.htm>)
- ✓ **EP9301 User's Guide**
(http://www.embeddedarm.com/documentation/thirdparty/ts-7000_ep9301-ug.pdf)
- ✓ **EP9301 Data Sheet**
(http://www.embeddedarm.com/documentation/thirdparty/ts-7000_ep9302-ds.pdf)
- ✓ **TS-7000 Yahoo Users' Group**
(<http://groups.yahoo.com/group/ts-7000/>)

APPENDIX A: DOCUMENT HISTORY

| <i>Date of Issue/Revision</i> | <i>Revision Number</i> | <i>Comments</i> |
|-------------------------------|------------------------|-------------------------|
| May 28 th , 2008 | 1.0 | Initial Release |
| June 1 st , 2009 | 1.1 | Updated mailing address |

APPENDIX B: ENCLOSURE VIEWS



Internal view of TS-COMBOX shown with TS-7300, TS-736, TS-737T, and TS-737B (Two 26-pin ribbon cables not shown)

APPENDIX C: CONTACT TECHNOLOGIC SYSTEMS



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