

# ***T/X-XTSI***

External Telephone Station Interface  
for Speech/Fax/Modem and Audio Daughter-card Modules for  
*TORNADO* DSP Systems, Controllers and Coprocessors

## ***User's Guide***

covers:  
*T/X-XTSI* rev.1A

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## About this Document

This user's guide contains description for *T/X-XTSI* external telephone station interface for speech/fax/modem/audio SIOX daughter-card modules (DCM) for *TORNADO* DSP systems/controllers/coprocessors from MicroLAB Systems Ltd.

This document does not include detail description neither for for speech/fax/modem/audio SIOX daughter-card modules (DCM), nor for *TORNADO* systems. To get the corresponding information please refer to the following documentation:

1. ***T/SDAS-SCOM1 Single-channel Speech/Fax/Modem SIOX Daughter-card Module User's Guide.*** MicroLAB Systems, 1998.
2. ***T/SDAS-SCOM2 Dual-channel Speech/Fax/Modem SIOX Daughter-card Module User's Guide.*** MicroLAB Systems, 1997.
3. ***Audio SIOX Daughter-card Modules User's Guide.*** MicroLAB Systems, 2000.

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# Chapter 1. Introduction

This chapter contains general description for *T/X-XTSI* external telephone station interface.

## 1.1 General Information

*T/X-XTSI* option (fig.1-1) is a single-channel external telephone station interface (also known as SLIC (subscriber line interface circuit)) for speech/fax/modem and audio AD/DA SIOX (serial I/O expansion) daughter-card modules (DCM) for *TORNADO* DSP systems for ISA and PCI-bus, *TORNADO-E* stand-alone DSP controllers and *TORNADO-PX/SX* DSP coprocessors from MicroLAB Systems Ltd.



Fig. 1-1. *T/X-XTSI* external telephone station Interface.

### overview

*T/X-XTSI* external telephone line interface must be used in order to interface speech/fax/modem/audio AD/DA SIOX DCM for *TORNADO* DSP systems/controllers/coprocessors to the PSTN (public switched telephone network) compliant devices (phone, fax machine, answering machine, computer modem, etc), which is required for speech/fax/modem, telecommunication, VoIP and many other similar applications.

*T/X-XTSI* external telephone line interface simulates the PSTN subscriber line output and operates under host *TORNADO* DSP software control.

### Installation

At the external I/O side, the subscriber line output of *T/X-XTSI* external telephone station interface connects directly to the PSTN compliant devices (phone, fax machine, modem, etc) and is similar to the PSTN subscriber line output. External PSTN compliant device can plug directly to the RJ-11 subscriber line outlet of *T/X-XTSI* external telephone station interface.

**CAUTION**

It is strongly prohibited to connect the RJ-11 subscriber line output connector of *T/X-XTSI* external telephone station interface to the PSTN phone line wall-outlet, since this can damage either *T/X-XTSI* external telephone station interface or the PSTN station equipment.

Instead, the RJ-11 subscriber line output connector of *T/X-XTSI* external telephone station interface is functionally similar to the PSTN line and allows direct connection to the phone, fax, answering machine and other PSTN compliant devices.

At the host interface side, host interface of *T/X-XTSI* connects to speech/fax/modem and audio SIOX DCM for *TORNADO* DSP systems/controllers/coprocessors from MicroLAB Systems:

- connects directly to the *T/SDAS-SCOM1* single-channel speech/fax/modem DCM (fig.1-2)
- connects to any channel of *T/SDAS-SCOM2* dual-channel speech/fax/modem DCM via *T/X-X2C* dual-channel splitter (fig.1-3)
- connects to any channel of *T/SDAS-ATEL2* dual-channel audio DCM via *T/X-X2C* dual-channel splitter (fig.1-4).



Fig. 1-2. *T/X-SCOM1* DCM with external *T/X-XTSI* external telephone station interface.



Fig. 1-3. T/SDAS-SCOM2 DCM with external dual-channel splitter (T/X-X2C) and one external T/X-XTSI external telephone station interface.



Fig. 1-4. T/SDAS-ATEL2 DCM with external dual-channel splitter (T/X-X2C) and one external T/X-XTSI external telephone station interface.

### applications

T/X-XTSI external telephone station interface with speech/fax/modem/audio AD/DA SIOX DCM and host *TORNADO* DSP system/controller/coprocessor can be used for fax/modem, VoIP, and many other signal processing applications, which requires connection to the PSTN compliant devices.

## 1.2 Technical Specifications

The following are technical specifications for T/X-XTSI external telephone station interface for temperature of external environment +25°C.

<i><u>parameter description</u></i>	<i><u>parameter value</u></i>
<i>Electrical:</i>	
Ringing voltage	40 Vrms typ
Ringing frequency	18 Hz typ
Line battery voltage	48 V typ
Ring trip detect time	200 mS typ
Loop current	20 mA typ
Transmitter frequency response over 300 Hz..3.4 kHz	± 0.25 dB
Receiver frequency response over 300 Hz..3.4 kHz	± 0.25 dB
Receiver THD	0.2% @ 0 dBm 5 % @ +3 dBm
Maximum ground over-current (TIP or RING to GROUND)	45 mA
Ringer equivalence (1 RE = 7000 Ohm @ 20Hz)	5
Surge protection between long line PSTN TIP and RING signals	210 Vpeak
Supply current	During ringing @ 5 RE: +12V @ 390mA max -5V @ 5 mA  during line pick up: +12V @ 100mA max -5V @ mA
Logical I/O levels for logical interface signals for connection to speech/fax/modem/audio SIOX DCM	5V TTL I/O
<i>physical and other:</i>	
dimensions	5.31" x 3.35" x 1.5"
operation temperature	0..70°C

## Chapter 2. Construction

This chapter contains description of architecture and construction for *T/X-XTSI* external telephone station interface for speech/fax/modem and audio SIOX DCM for *TORNADO* DSP system/controller/coprocessor.

### 2.1 Block Diagram

Basic configuration and connectivity of *T/X-XTSI* external telephone station interface is presented at fig.2-1.

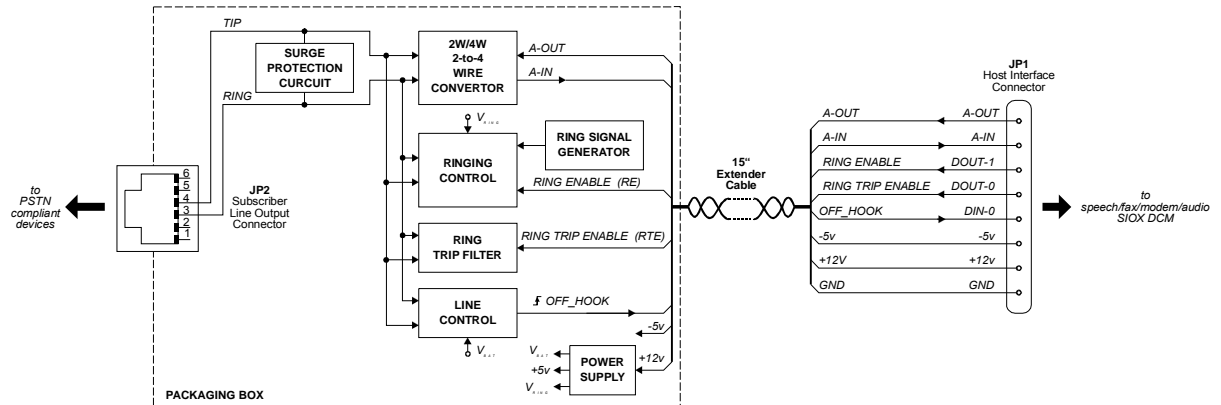


Fig. 2-1. Block diagram of *T/X-XTSI* external telephone station interface.

*T/X-XTSI* external telephone station interface comprises of the following components:

- 2W/4W (2-to-4 wire) balanced converter circuit
- line surge protection circuit
- ring control circuit and ring signal generator
- ring trip filter
- line status/control circuit
- local power supply circuit
- JP2 industry-standard RJ-11 receptacles at subscriber line output for connection to PSTN compliant devices
- JP1 interface connector at extender cable for connection to host speech/fax/modem/audio SIOX DCM on *TORNADO* DSP system/controller/coprocessor.

#### analog I/O circuit

Analog I/O circuit of *T/X-XTSI* external telephone station interface performs 2-to-4 balanced wire conversion of interface A-IN and A-OUT analog I/O signals to the balanced TIP and RING bi-directional PSTN compliant signals.

**CAUTION**

TIP and RING signals are available via JP2 RJ-11 subscriber line output connector for connection to PSTN compliant devices (phone, fax machine, answering machine, computer modem, etc).

**CAUTION**

It is strongly prohibited to connect the JP2 RJ-11 subscriber line output connector of *T/X-XTSI* external telephone station interface to the PSTN phone line wall-outlet, since this can damage either *T/X-XTSI* external telephone station interface or the PSTN station equipment.

**CAUTION**

A-IN and A-OUT analog I/O signals are available via JP1 connector and connect directly to host speech/fax/modem/audio SIOX DCM.

Provided line surge protection circuit provides protection of the subscriber line output of *T/X-XTSI* external telephone station interface from possible long line light and surge spikes.

**ring control**

*T/X-XTSI* external telephone station interface can generate ring signal to the subscriber line output via ring signal generator and ring control circuit. Ring signal generator generates source ring signal with the frequency about 18 Hz, whereas ring control circuit amplifies source ring signal and induces it into the subscriber line output of *T/X-XTSI* external telephone station interface.

Generation of ring signal into the subscriber line output of *T/X-XTSI* external telephone station interface is controlled by host DSP software via the ring enable (RE) active high logical input.

**CAUTION**

Input active high logical ring enable signal (RE) connects directly to host speech/fax/modem/audio SIOX DCM and appears as DOUT-1 output signal at JP1 interface connector.

Logical '0' at the RE input disables the ring circuit, whereas logical '1' enables generation of ring signal to the subscriber line output.

**off-hook status detection and subscriber line control**

Off-hook status detection for subscriber line output of *T/X-XTSI* external telephone station interface is performed by means of line status/control circuit.

Once *T/X-XTSI* external telephone station interface detects the 'off-hook' state at the subscriber line output, then active high OFF-HOOK logical output signal is generated to host speech/fax/modem/audio SIOX DCM.

**CAUTION**

Active high logical OFF-HOOK output signal connects directly to host speech/fax/modem/audio SIOX DCM and appears as the DIN-0 input signal at JP1 interface connector.

Logical '0' output at the OFF-HOOK output signal corresponds to the 'on-hook' condition of subscriber line output of *T/X-XTSI* external telephone station interface, i.e. the subscriber line output is not loaded with active phone device ( $R_L > 1.4 \text{ k}\Omega$ ) and the analog I/O circuit of *T/X-XTSI* external telephone station interface is disconnected from the subscriber line output. In case the subscriber line output of *T/X-XTSI* external telephone station interface is in the 'on-hook' state, then *T/X-XTSI* external telephone station interface generates the 48 V battery line shift voltage to the subscriber line and is also ready to generate the outgoing rings.

Logical '1' output at the OFF-HOOK output signal corresponds to the 'off-hook' condition of subscriber line output of *T/X-XTSI* external telephone station interface, i.e. the subscriber line output is loaded with active phone device ( $R_L = 600 \text{ }\Omega$ ) and analog I/O circuit of *T/X-XTSI* external telephone station interface is connected to the subscriber line output. In case the subscriber line output of *T/X-XTSI* external telephone station interface is in the 'off-hook' state, then *T/X-XTSI* external telephone station interface and host speech/fax/modem/audio SIOX DCM can perform analog I/O via subscriber line output and detect input dialing events. When the subscriber line output of *T/X-XTSI* external telephone station interface is in the 'off-hook' state, then it generates current loop about 20 mA to the subscriber line output via TIP and RING pins.

**CAUTION**

It is strongly prohibited to generate outgoing rings to the subscriber line output of *T/X-XTSI* external telephone station interface in case the subscriber line output is in the 'off-hook' state, since this can damage internal hardware of *T/X-XTSI* external telephone station interface.

**ring trip filter**

Line status/control circuit detects 'off-hook' condition for subscriber line output of *T/X-XTSI* external telephone station interface by means of monitoring the DC load current across the TIP and RING outputs. Once the DC load current overcomes the predefined threshold, then this event is interpreted as the 'off-hook' status.

However, in case the high- voltage ring signal is active while the line is actually in the 'off-hook' condition, then this can result in missing 'off-hook' status detection by the line status/control circuit and can result in over-current condition and damage of the ring amplifier.

In order to exclude this confusion, *T/X-XTSI* external telephone station interface provides low-pass ring trip filter, which filters out the ring signal from the input of the line status/control circuit and allows reliable detection of the 'off-hook' status for subscriber line output.

Ring trip filter is enabled via the active high ring trip enable (RTE) logical input, which must be controlled by host DSP software.

**CAUTION**

Active high logical RTE input signal connects directly to host speech/fax/modem/audio SIOX DCM and appears as the DOUT-0 output signal at JP1 interface connector.

Logical '0' at the RTE input disables the ring trip filter, whereas logical '1' enables ring trip filter and allows reliable detection of the 'off-hook' status for subscriber line output.

Normally, ring trip filter must be enabled only while the ringing is active. However, different ring trip filter control must apply depending upon the particular dialing method.



**CAUTION**

In case *T/X-XTS/* external telephone station interface is being used for DTMF dialing applications, then the ring trip filter can be permanently enabled, since it does not effect the DTMF tone detection via DSP software and does not effect the analog signal distribution across the subscriber line output.

In case *T/X-XTS/* external telephone station interface is being used for pulse dialing applications, then the ring trip filter must be disabled immediately after the 'off-hook' condition for subscriber line output of *T/X-XTS/* external telephone station interface has been detected, since otherwise it will mask toggling of the OFF-HOOK output during pulse dialing and will not allow to detect pulse dialing code via DSP software.

***DTMF dialing detection***

While the subscriber line output of *T/X-XTS/* external telephone station interface is in the 'off-hook' state, detection of the DTMF dialing code must be performed by host DSP software by means of applying appropriate filtering of A-IN input analog signal from *T/X-XTS/* external telephone station interface.

***pulse dialing***

While the subscriber line output of *T/X-XTS/* external telephone station interface is in the 'off-hook' state, detection of the pulse dialing code must be performed by host DSP software by means of monitoring the status and applying appropriate logical detection procedure for the OFF-HOOK output logical signal from *T/X-XTS/* external telephone station interface.

Note, that for pulse dialing applications the ring trip filter and ring enable of *T/X-XTS/* external telephone station interface shall be disabled immediately after the 'off-hook' condition for subscriber line output of *T/X-XTS/* external telephone station interface has been detected.

When the connected phone device performs pulse dialing of one digit N (N=0..9), it provides an uninterrupted series of N pulse dialing cycles (N=0 corresponds to 10 pulse dialing cycles). As the result, the OFF-HOOK output logical signal will provide short-time toggle of its state from logical '1' to logical '0', and then back to logical '1', which is known as pulse dialing cycle. Number of such pulse dialing cycles in one uninterruptible series corresponds to the dialing digit (10 cycles corresponds to the '0' pulse dialed digit).

**CAUTION**

Duration of each pulse dialing cycle is about 100 mS and comprises of dialing cycle pulse and dialing cycle pause.

Depending of the particular country standard, either 50:50 (most typical) or 40:60 pulse dialing applies to the ratio of dialing cycle pulse and dialing cycle pause. Refer to the documentation for your connected phone device (or PSTN compliant device) for particular specification.

Dialing cycle pulse can be detected in case OFF-HOOK signal is set to the '0' state for either 50 mS (50:50 ratio) or 40 mS (40:60 ratio).

Dialing cycle pause can be detected in case in case OFF-HOOK signal is set to the '1' state for either 50 mS (50:50 ratio) or 60 mS (40:60 ratio).

When detecting a pulse dialing of a particular phone number, which comprises of several dialed digits (0..9), then host DSP software must detect an inter-cycle dialing pause between dialing of succeeding digits.

**CAUTION**

Duration of each inter-cycle pause between succeeding pulse dialing cycles is at least 100..250 mS depending upon the particular country standard.

**internal power supply**

T/X-XTSI external telephone station interface uses +12 V and -5V power lines from JP1 host interface connector in order to supply internal analog I/O and digital I/O circuits. All internal voltages for supplying the line battery and ring amplifier are generated internally from the +12V power input.

## 2.2 Construction

T/X-XTSI external telephone station interface (fig.1-1) is designed in the plastic box with two-sides connectors layout.

The front edge side of the box features mounted JP2 industry-standard RJ-11 connector as the subscriber line output for connection to external PSTN compliant devices (phone, fax machine, answering machine, computer modem, etc).

**CAUTION**

It is strongly prohibited to connect the JP2 RJ-11 subscriber line output connector of *T/X-XTS* external telephone station interface to the PSTN phone line wall-outlet, since this can damage either *T/X-XTS* external telephone station interface or the PSTN station equipment.

The rear edge side of the box provides mounted 15” extender cable with the JP1 connector for connection to host speech/fax/modem/audio SIOX DCM, which is typically installed onto *TORNADO* DSP system/controller/coprocessor (refer to Appendix A for details).



## Chapter 3. Installation

This chapter contains information for installation of *T/X-XTSI* external telephone station interface.

### 3.1 Installation

*T/X-XTSI* external telephone station interface connects as external device to host speech/fax/modem and audio SIOX DCM from MicroLAB Systems Ltd.

Installation procedure is as easy as the following:

1. Switch off the power of host PC with *TORNADO* DSP system installed or the power of *TORNADO-E* stand-alone DSP controller with installed either *T/SDAS-SCOM1* single-channel speech/fax/modem DCM, or *T/SDAS-SCOM2* dual-channel speech/fax/modem DCM, or *T/SDAS-ATEL2* dual-channel audio DCM.
2. In case *T/X-XTSI* external telephone station interface is considered to be connected to the *T/SDAS-SCOM1* single-channel speech/fax/modem DCM, then connect JP1 connector of *T/X-XTSI* external telephone station interface directly to the JP2 external analog I/O of *T/SDAS-SCOM1* single-channel speech/fax/modem DCM.
3. In case *T/X-XTSI* external telephone station interface is considered to be connected either to the *T/SDAS-SCOM2* dual-channel speech/fax/modem DCM or to the *T/SDAS-ATEL2* dual-channel audio DCM, then the *T/X-X2C* dual-channel splitter must be used in order to convert dual-channel JP2 external analog I/O connector of *T/SDAS-SCOM2* and *T/SDAS-ATEL2* DCM to two single-channel connectors compatible with the JP1 connector of *T/X-XTSI* external telephone station interface. Connect JP1 connector of *T/X-XTSI* external telephone station interface to any of two output connectors of *T/X-X2C* dual-channel splitter, which must be connected to either *T/SDAS-SCOM2* or *T/SDAS-ATEL2* DCM. For more details about *T/X-X2C* dual-channel splitter, refer to original documentation for either *T/SDAS-SCOM2* dual-channel speech/fax/modem DCM or *T/SDAS-ATEL2* dual-channel audio DCM.
4. Use standard telephone extension cable with two RJ-11 plugs in order to connect JP2 connector (subscriber line output) of *T/X-XTSI* external telephone station interface to the PSTN compliant devices (phone, fax machine, answering machine, computer modem, etc).
5. Switch on power of host PC or of *TORNADO-E* stand-alone DSP controller.

### 3.2 Connection to the PSTN compliant devices

Connection of the JP2 subscriber line output of *T/X-XTSI* external telephone station interface to the PSTN compliant devices is performed by means and the corresponding telephone extension cables with two RJ-11 plugs.

**CAUTION**

It is strongly prohibited to connect the JP2 RJ-11 subscriber line output connector of *T/X-XTSI* external telephone station interface to the PSTN phone line wall-outlet, since this can damage either *T/X-XTSI* external telephone station interface or the PSTN station equipment.

**CAUTION**

*T/X-XTSI* external telephone station interface does not provide galvanic isolation of TIP and RING output signals at JP2 RJ-11 subscriber line output connector from the ground signal of host speech/fax/modem/audio SIOX DCM and host *TORNADO* DSP system/controller/coprocessor.

**CAUTION**

It is strongly prohibited to connect both TRIP and RING output signals at JP2 RJ-11 subscriber line output of *T/X-XTSI* external telephone station interface to the ground signal of host speech/fax/modem/audio SIOX DCM and host *TORNADO* DSP system/controller/coprocessor, since it can result in damage of internal hardware of *T/X-XTSI* external telephone station interface.

# Appendix A. Connectors

This appendix contains a summary of connectors for *T/X-XTSI* external telephone station interface.

Connectors layout for *T/X-XTSI* external telephone station interface is presented at fig.A-1, whereas table A-1 presents a list of connectors.



Fig. A-1. Connectors layout for *T/X-XTSI* external telephone station interface.

Table A-1 contains a list of connectors for *T/X-XTSI* external telephone station interface.

Table A-1. Connectors of *T/X-XTSI* external telephone station interface.

Connector	Description
JP1	Host interface connector for connection to host speech/fax/modem/audio SIOX DCM. JP1 connector is installed at the end 15" extender cable, which is mounted onto the packaging box of <i>T/X-XTSI</i> external telephone station interface.
JP2	RJ-11 connector for subscriber line output for connection to the PSTN compliant devices (phone, fax machine, answering machine, computer modem, etc).

## Pinout for JP1 host interface connector

Pinout of JP1 host interface connector for connection to host speech/fax/modem/audio SIOX DCM is presented at fig.A-2, and description of signals is presented in table A-2.

The connector p/n for JP1 connector is DHA-PC20 female half-pitch connector from DDK Ltd manufacturer. P/n for compatible receptacle connector is DHA-RA20. In case customer needs to design his own application

specific cable for connection to *T/X-XTSI* external telephone station interface, then compatible plug-in connectors for JP1 are available from MicroLAB Systems upon request.

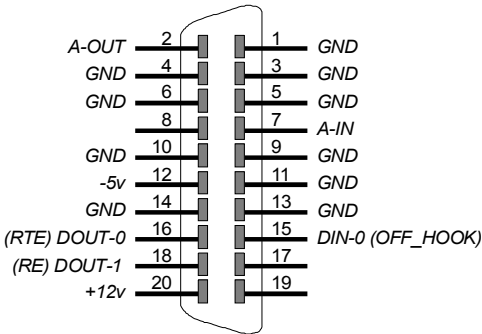


Fig. A-2. Pinout for JP1 host interface connector of *T/X-XTSI* external telephone station interface.

Table A-2. Signal description for JP1 host interface connector of *T/X-XTSI* external telephone station interface.

Signal name	Type	Description
A-IN	AO	A-IN analog input, which is analog output from <i>T/X-XTSI</i> external telephone station interface.
A-OUT	AI	A-OUT analog output, which is analog input for <i>T/X-XTSI</i> external telephone station interface.
DIN-0	TTL/OUT	Active high OFF-HOOK output from <i>T/X-XTSI</i> external telephone station interface.
DOUT-0	TTL/IN	Active high RTE ring trip filter enable input for <i>T/X-XTSI</i> external telephone station interface.
DOUT-1	TTL/IN	Active high RE ring enable input for <i>T/X-XTSI</i> external telephone station interface.
GND	-	Ground.
+12V +5V	-	Power supply outputs from speech/fax/modem/audio SIOX DCM.

Notes: 1. Signal types: AI - analog input; AO - analog output; TTL/IN - TTL compatible digital input; TTL/OUT - TTL compatible digital output.



**Pinout for JP2 subscriber line output connector**

Pinout for JP2 industry standard RJ-11 subscriber line output connector for connection to the PSTN compliant devices line and optional PSTN compliant devices (phone, fax machine, answering machine, computer modem, etc) is presented at fig.A-3, and description of signals is presented in table A-3.

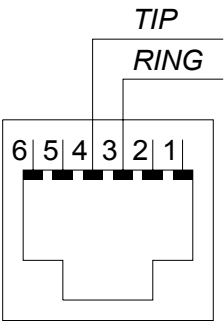


Fig. A-3. Pinout for JP2 subscriber line output connector of *T/X-XTS/* external telephone station interface.

Table A-3. Signal description for JP2 subscriber line output connector of *T/X-XTS/* external telephone station interface.

Signal name	Type	Description
<i>TIP</i> <i>RING</i>	PSTN	Subscriber line output signals.

Notes: 1. Signal types: *PSTN* – PSTN compatible signal.