

# ***T/X-XTLI***

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

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

covers:  
*T/X-XTLI* rev.1B

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## About this Document

This user's guide contains description for *T/X-XTLI* external telephone line 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-XTLI* external telephone line interface.

## 1.1 General Information

*T/X-XTLI* option (fig.1-1) is a single-channel external telephone line interface (also known as DAA (digital access arrangement)) 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-XTLI* External Telephone Line Interface.

*T/X-XTLI* connects directly to speech/fax/modem and audio AD/DA SIOX DCM for *TORNADO* DSP systems/controllers/coprocessors and operates under host *TORNADO* DSP software control. In case appropriate DSP software is supplied, then this converts *TORNADO* DSP system or controller with installed speech/fax/modem or audio AD/DA SIOX DCM with connected external *T/X-XTLI* telephone line interface into automatic answering machine, fax machine, modem, or any other functional device with data transmission over PSTN telephone lines.

*T/X-XTLI* external telephone line interface is V.34bis compatible device and features internal galvanic isolation and surge protection between PSTN line and interface analog and digital I/O signals, which connect to host speech/fax/modem/audio SIOX DCM..

*T/X-XTLI* external telephone line interface allows to detect incoming line calls/rings, to picks up the phone and perform dialing either using either DTMF or pulse dialing.

### Installation

On one side, *T/X-XTLI* external telephone line interface connects directly to the PSTN (public switched telephone network) equipment and offers direct access to available PSTN subscriber lines and is similar to the telephone line interface of automatic answering machine, fax machines and computer modems. Line outlet of *T/X-XTLI* external telephone line interface plugs directly to the phone line wall-outlet.

On the other hand, *T/X-XTLI* connects to the following speech/fax/modem and audio SIOX DCM for *TORNADO* DSP systems/controllers/coprocessors:

- 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).

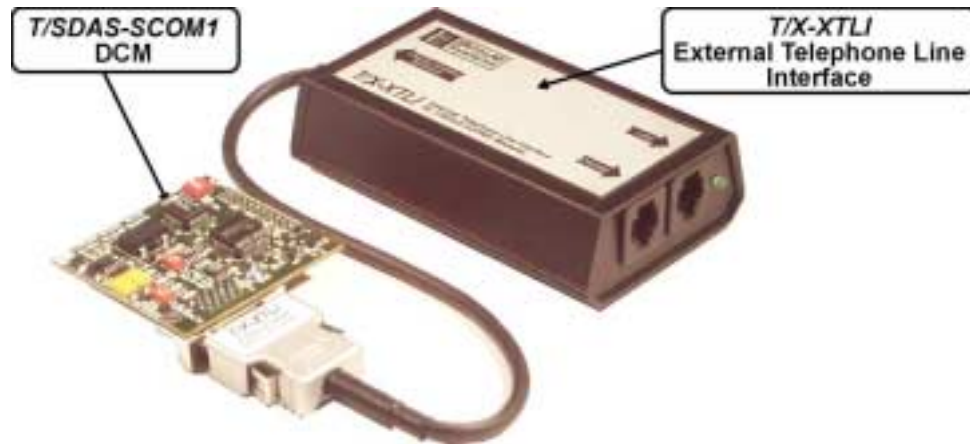


Fig. 1-2. *T/X-SCOM1* DCM with external *T/X-XTLI* external telephone line interface.



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



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

**applications**

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

**1.2 Technical Specifications**

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

<u>parameter description</u>	<u>parameter value</u>
<i>electrical:</i>	
Transmission insertion loss (flat within 300Hz..4kHz)	± 0.8 dB
Transmit frequency response (transmit ref 1800 Hz, bandwidth 0.2kHz..4kHz)	± 0.3 dBm
Transmit noise distortion (10 dBm transmit power, 600 Hz)	-82 dBm
Transmit input impedance (1800 Hz)	150 kOhm typ
Receive gain (1800 Hz, 600 Ohm receive terminator, flat within 300Hz..4KHz)	± 0.5 dBm

receive frequency response (receive ref 1800 Hz, bandwidth 0.2kHz..4kHz)	± 0.3 dBm
Receive 2 <sup>nd</sup> , 3 <sup>rd</sup> , 4 <sup>th</sup> harmonic distortion (-10dB at TIP/RING)	-82 dBm
Receive noise distortion (400Hz..4kHz)	-82 dBm
receive output impedance (1800 Hz)	10 Ohm typ
'Off-hook' state PSTN line input impedance (at 1800Hz)	600 Ohm typ
'On-hook' state PSTN line input impedance	10 MOhm min
Loop current between TIP and RING	20..100mA
Return loss (Zref=600 Ohm, C=2.16uF, F=1kHz)	25 dBm
Ring select sensitivity (AC voltage between TIP and RING)	38 Vrms min
Ringer equivalence (type A)	0.2A REN
Isolation protection between PSTN TIP/RING and interface signals for connection to speech/fax/modem/audio SIOX DCM	1500 VAC RMS
Surge protection between PSTN TIP/RING and interface signals for connection to speech/fax/modem/audio SIOX DCM	2212 Vpeak
Surge protection between long line PSTN TIP and RING signals	210 Vpeak
Supply current	+12V @ 20mA max
Logical I/O levels for logical interface signals for connection to speech/fax/modem/audio SIOX DCM	5V TTL I/O

*physical and other:*

dimensions	4.25" x 2.60" x 1.12"
operation temperature	0..70°C
standards compliance/approval	UL1950 ed.3 CSA C22.2 950 FCC part 68 DOT CSA CS-03 Part 1

## Chapter 2. Construction

This chapter contains description of architecture and construction for *T/X-XTL* external telephone line 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-XTL* external telephone line interface is presented at fig.2-1.

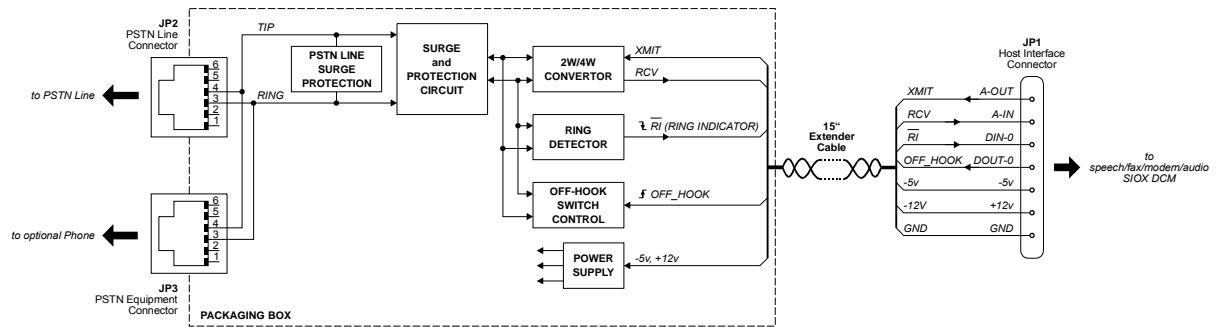


Fig. 2-1. Block diagram of *T/X-XTL* external telephone line interface.

*T/X-XTL* external telephone line interface comprises of the following components:

- 2W/4W (2-to-4 wire) balanced converter circuit
- PSTN line surge protection circuit
- ring detection circuit
- off-hook switch control circuit
- isolation and surge protection circuitry
- local power supply circuit
- JP2 and JP3 industry-standard RJ-11 receptacles for connection to PSTN and external optional phone
- 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-XTL* external telephone line 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 signals.

**CAUTION**

PSTN TIP and RING signals are available via JP2 and JP3 industry standard RJ-11 receptacles for connection to PSTN and optional phone device.

**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 PSTN line surge protection circuit provides protection of *T/X-XTLI* external telephone line interface from possible long line light and surge spikes.

***ring detection circuit***

Ring detection circuit is used to detect incoming ring event and to generate output active low logical ring indicator signal (RI).

**CAUTION**

Output active low logical ring indicator signal (RI) connects directly to host speech/fax/modem/audio SIOX DCM and appears as DIN-0 input signal at JP1 interface connector.

Output RI ring indicator signal will stay in active low while incoming ring signal with the frequency about 20 Hz is being received over PSTN TIP and RING signals.

**CAUTION**

Output RI ring indicator signal will stay in active low state for about 50 ms after incoming ring signal over PSTN TIP and RING signals is removed.

***off-hook switch control circuit***

Off-hook switch control circuit is controlled by the logical input OFF-HOOK signal and is used to set either the 'on-hook' or 'off-hook' state of *T/X-XTLI* external telephone line interface.

**CAUTION**

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

Active low state of input OFF-HOOK signal corresponds to the ‘on-hook’ condition of *T/X-XTL* external telephone line interface, i.e. analog I/O circuit of *T/X-XTL* external telephone line interface is disconnected from the PSTN line and is ready to accept the incoming rings.

Active high state of input OFF-HOOK signal corresponds to the ‘off-hook’ condition of *T/X-XTL* external telephone line interface, i.e. analog I/O circuit of *T/X-XTL* external telephone line interface is connected to the PSTN line and host speech/fax/modem/audio SIOX DCM can perform analog I/O via PSTN line and dialing operation. When *T/X-XTL* external telephone line interface is in the ‘off-hook’ state, then it induces 600 Ohm resistance between PSTN TIP and RING pins, which indicates to the PSTN station that the PSTN line is in the ‘off-hook’ state.

***DTMF dialing***

While in the ‘off-hook’ state, the *T/X-XTL* external telephone line interface can perform DTMF dialing under the control of host DSP software. Host DSP software of *TORNADO* DSP system/controller/coprocessor must generate DTMF tones over A-OUT analog output of speech/fax/modem/audio SIOX DCM, which is installed onto *TORNADO* DSP system/controller/coprocessor. Generated DTMF tones are transmitted directly to the PSTN TIP and RING signals.

***pulse dialing***

After the ‘off-hook’ state of *T/X-XTL* external telephone line interface has been set, then host DSP software can perform pulse dialing via *T/X-XTL* external telephone line interface.

Pulse dialing via *T/X-XTL* external telephone line interface can be performed by means of control of the OFF-HOOK signal using short-time PSTN line disconnection technique.

In order to perform pulse dialing of one digit N (N=0..9) after *T/X-XTL* external telephone line interface has been set to the ‘off-hook’ state, host DSP software must provide an uninterrupted series of N pulse dialing cycles (N=0 corresponds to 10 pulse dialing cycles).

**CAUTION**

Duration of each pulse dialing cycle must be 100 mS and must comprise 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. Consult your PSTN provider for particular specification.

Dialing cycle pulse is generated 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 is generated 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 performing a pulse dialing of a particular phone number, which comprises of several dialed digits (0..9), then host DSP software must insert an inter-cycle dialing pause between dialing of succeeding digits in order PSTN station equipment can recognize end of dialing cycle for each digit.

**CAUTION**

Duration of each inter-cycle pause between succeeding pulse dialing cycles must be at least 100..250 mS depending upon the particular country standard (consult your PSTN provider for particular specification).

***isolation and surge protection circuit***

Isolation and surge protection circuitry perform isolation and surge spike protection between PSTN TIP and RING signals and host interface analog and digital I/O signals. This is required for safe operation and connection to the PSTN. Isolation and surge protection specifications meets that of FCC Part 68 and DOT CSA CS-03 Part I standards.

***internal power supply***

T/X-XTLI external telephone line interface uses only +12 V power line from JP1 host interface connector in order to supply internal analog I/O and digital I/O circuits. T/X-XTLI external telephone line interface is a low power consumption device.

## 2.2 Construction

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



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The front edge side of the box features mounted JP2 and JP3 industry-standard RJ-11 connectors for connection to PSTN and optional phone.

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-XTLI* external telephone line interface.

### 3.1 Installation

*T/X-XTLI* external telephone line 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-XTLI* external telephone line interface is considered to be connected to the *T/SDAS-SCOM1* single-channel speech/fax/modem DCM, then connect JP1 connector of *T/X-XTLI* external telephone line interface directly to the JP2 external analog I/O of *T/SDAS-SCOM1* single-channel speech/fax/modem DCM.
3. In case *T/X-XTLI* external telephone line 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-XTLI* external telephone line interface. Connect JP1 connector of *T/X-XTLI* external telephone line 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 of *T/X-XTLI* external telephone line interface to the PSTN line wall outlet.
5. Use standard telephone extension cable with two RJ-11 plugs in order to connect JP3 connector of *T/X-XTLI* external telephone line interface to optional phone, fax machine, computer modem, or other PSTN compliant device.
6. Switch on power of host PC or of *TORNADO-E* stand-alone DSP controller.

### 3.2 Connection to PSTN equipment

Connection of *T/X-XTLI* external telephone line interface to PSTN line and optional external PSTN compliant equipment is performed by means of JP2 and JP3 industry-standard RJ-11 connector (fig.1-1 and A-1) and the corresponding telephone extension cables with two RJ-11 plugs.



## Appendix A. Connectors

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

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



Fig. A-1. Connectors layout for *T/X-XTLI* external telephone line interface.

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

Table A-1. Connectors of *T/X-XTLI* external telephone line 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-XTLI</i> external telephone line interface.
JP2	RJ-11 connector for connection to PSTN line.
JP3	RJ-11 connector for connection to optional phone, fax machine, computer modem, or other PSTN compatible device.

### 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-XTLI* external telephone line interface, then compatible plug-in connectors for JP1 are available from MicroLAB Systems upon request.

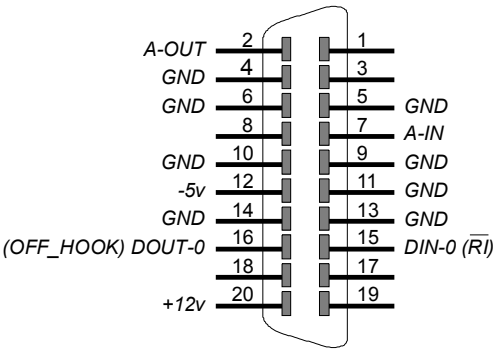


Fig. A-2. Pinout for JP1 host interface connector of *T/X-XTLI* external telephone line interface.

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

Signal name	Type	Description
A-IN	AO	A-IN analog input, which is analog output from <i>T/X-XTLI</i> external telephone line interface..
A-OUT	AI	A-OUT analog output, which is analog input for <i>T/X-XTLI</i> external telephone line interface.
DIN-0	TTL/OUT	Active low RI ring indicator output from <i>T/X-XTLI</i> external telephone line interface.
DOUT-0	TTL/IN	Active high OFF-HOOK input for <i>T/X-XTLI</i> external telephone line interface.
GND	-	Ground.
+12V	-	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 and JP3 PSTN line/device connectors**

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

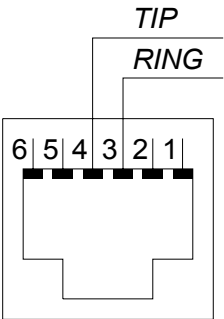


Fig. A-3. Pinout for JP2 and JP3 PSTN line/equipment connectors of *T/X-XTL* external telephone line interface.

Table A-3. Signal description for JP2 and JP3 PSTN line/equipment connectors of *T/X-XTL* external telephone line interface.

Signal name	Type	Description
<i>TIP</i> <i>RING</i>	PSTN	Direct PSTN line interface signals.

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