

# ***T/SDAS-4215***

# ***T/SDAS-ATEL2***

# ***T/SDAS-AU/8L***

Audio AD/DA SIOX rev.B Daughter-card Modules  
for *TORNADO* DSP Systems, Controllers and Coprocessors

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

covers:  
*T/SDAS-4215* rev.2A  
*T/SDAS-ATEL2* rev.1A  
*T/SDAS-AU/8L* rev.1B

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## About this Document

This user's guide contains description for *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* audio AD/DA SIOX daughter-card modules for *TORNADO* DSP systems/controllers/coprocessors from MicroLAB Systems Ltd.

This document does not include detail description neither for *TORNADO* systems/controllers/coprocessors, nor for the corresponding hardware and software. To get the corresponding information please refer to the following documentation:

1. ***TORNADO-3x. User's Guide.*** MicroLAB Systems, 1999.
2. ***TORNADO-54x. User's Guide.*** MicroLAB Systems, 1998.
3. ***TORNADO-6x. User's Guide.*** MicroLAB Systems, 1998.
4. ***TORNADO-P6x. User's Guide.*** MicroLAB Systems, 2000.
5. ***TORNADO-P3x. User's Guide.*** MicroLAB Systems, 2000.
6. ***TORNADO-PX31DP. User's Guide.*** MicroLAB Systems, 1996.
7. ***TORNADO-SX30. User's Guide.*** MicroLAB Systems, 1996.
8. ***TORNADO-E3x. User's Guide.*** MicroLAB Systems, 1999.
9. ***TORNADO-E54x. User's Guide.*** MicroLAB Systems, 1998.
10. ***TORNADO-E6x. User's Guide.*** MicroLAB Systems, 1999.
11. ***T/X-XTLI External Telephone Line Interface. User's Guide.*** MicroLAB Systems, 1998.
12. ***T/X-XTSI External Telephone Station Interface. User's Guide.*** MicroLAB Systems, 1998.
13. ***CS4215 Multimedia Audio Codec.*** Crystal Semiconductor Corp, 1993
14. ***AD1849K Sound-port Stereo Codec.*** Analog Devices Inc, 2000.

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# Chapter 1. Introduction

This chapter contains general description for *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* audio AD/DA SIOX daughter-card modules (DCM).

## 1.1 General Information

*T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* are audio AD/DA SIOX (serial I/O expansion) DCM for *TORNADO* PC plug-in DSP systems (*TORNADO-3x/54x/6x/P3xP6x/etc*), *TORNADO-E* stand-alone DSP controllers (*TORNADO-E3x/E54x/E6x/etc*) and *TORNADO-PX/SX* DSP coprocessors (*TORNADO-PX31DP/SX30/etc*) from MicroLAB Systems Ltd.

*T/SDAS-4215* DCM (fig.1-1a) has been designed for stereo audio signal processing applications, which require interfacing to both professional (+22dBu) and consumer (2Vrms) audio analog equipment.

*T/SDAS-ATEL2* DCM (fig.1-1b) has been designed for stereo audio signal processing applications, which may require interfacing to either public telephone network (PSTN) or to standard telephone-line compatible equipment via external telephone line interface (*T/X-XTLI*) or external telephone station interface (*T/X-XTSI*) options. When connecting to external audio analog equipment, *T/SDAS-ATEL2* DCM features consumer (2Vrms) audio I/O signal levels.

*T/SDAS-AU/8L* DCM (fig.1-1c) has been designed for either 2-channel stereo, or 4-channel or 8-channel audio signal processing applications, and features consumer (2Vrms) audio I/O signal levels when connecting to external audio analog equipment.



Fig. 1-1a. *T/SDAS-4215* Stereo Audio SIOX DCM with Professional/Consumer I/O.

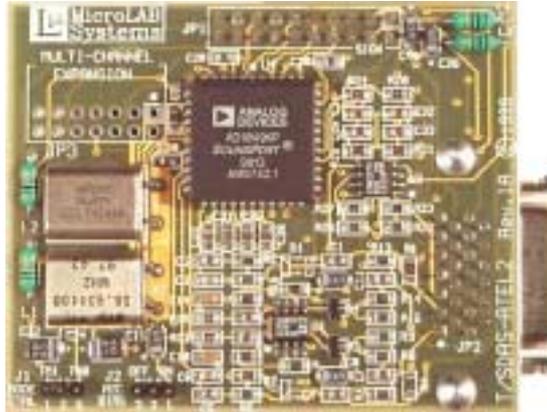


Fig. 1-1b. T/SDAS-ATEL2 Stereo Audio SIOX DCM with External Telephone Interface Capability.



Fig. 1-1c. T/SDAS-AU/8L 8-channel Audio SIOX DCM.

### **installation**

All T/SDAS-4215, T/SDAS-ATEL2 and T/SDAS-AU/8L DCM install as standard SIOX rev.B DCM into the corresponding SIOX rev.B site onto host TORNADO DSP system/controller mainboard (fig.1-2). If required, T/SU-X SIOX extender kit can be used for remote connection to SIOX interface of TORNADO DSP mainboard.

Connection of T/SDAS-4215, T/SDAS-ATEL2 and T/SDAS-AU/8L DCM to the corresponding SIOX site of TORNADO DSP coprocessors is performed by means of the SIOX extender kit only.



Fig. 1-2. *T/SDAS-ATEL2* DCM installed onto *TORNADO-54x* mainboard.

### overview

All *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM are based around either CS4215 16-bit multimedia stereo-audio codec chip(s) from Crystal Semiconductor Corp., or compatible AD1849K 16-bit stereo sound-port codec chip(s) from Analog Devices Inc. This makes all *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM to be software and hardware compatible products, which differ in analog I/O interfacing details only.

*T/SDAS-4215* and *T/SDAS-ATEL2* DCM also provide on-board expansion connectors in order to extend number of AD/DA channels up to totally eight channels using optional *T/SDAS-X4215* and *T/SDAS-XATEL2* multichannel expansion boards correspondingly.

All *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM assume real-time serial data communication with host TMS320 DSP of *TORNADO* DSP system/controller mainboard via DSP on-chip serial port. Data is transmitted/received by means of 64-bit data frames for *T/SDAS-4215* and *T/SDAS-ATEL2* DCM and via either 64-bit, or 128-bit, or 256-bit data frames for *T/SDAS-ATEL2* DCM.

Connection of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM to external audio analog equipment is performed via on-board I/O connector via rear panel of host PC (in case *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM is installed onto *TORNADO* DSP system for PC).

### external cable options for *T/SDAS-4215* DCM

*T/SDAS-4215* DCM can interface either to professional audio equipment with differential I/O and audio signal levels +22dBu via *T/X-XCSMP/P* external I/O cable set (fig.1-3), or to consumer audio equipment with single-ended analog signal level 2V<sub>rms</sub> via *T/X-XCSMP/C* external I/O cable set (fig.1-4). Each cable set comprises of stereo line-in, microphone –in, line-out and phones-out connectors.

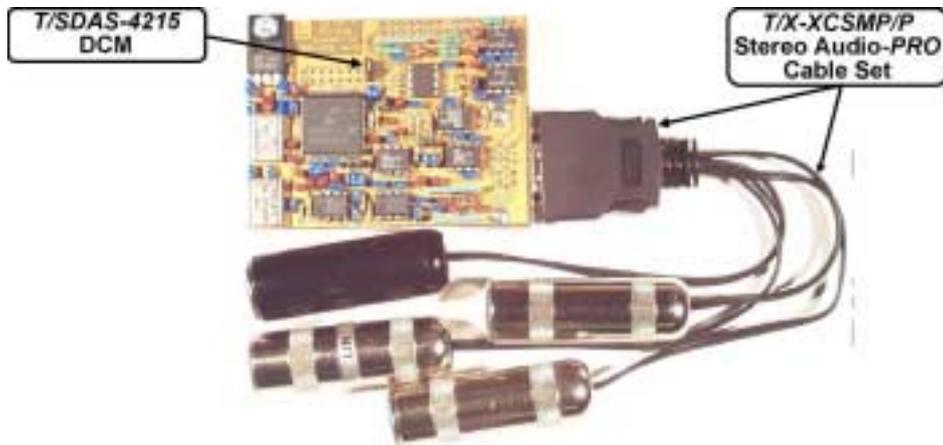


Fig. 1-3. T/SDAS-4215 DCM with T/X-XCSMP/P stereo audio-PRO cable set.

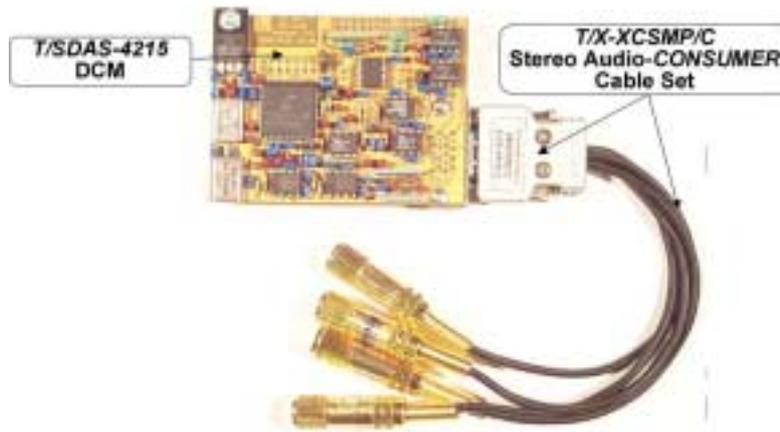


Fig. 1-4. T/SDAS-4215 DCM with T/X-XCSMP/C stereo audio-CONSUMER cable set.

#### **external cable option for T/SDAS-AU/8L DCM**

T/SDAS-AU/8L DCM can interface to external 8-channel consumer audio equipment with single-ended analog signal level  $2V_{rms}$  by means of T/X-XCSMP/C8 external I/O cable set (fig.1-5). T/X-XCSMP/C8 8-channel audio cable set comprises of four groups of stereo line-in, microphone -in and line-out connectors.

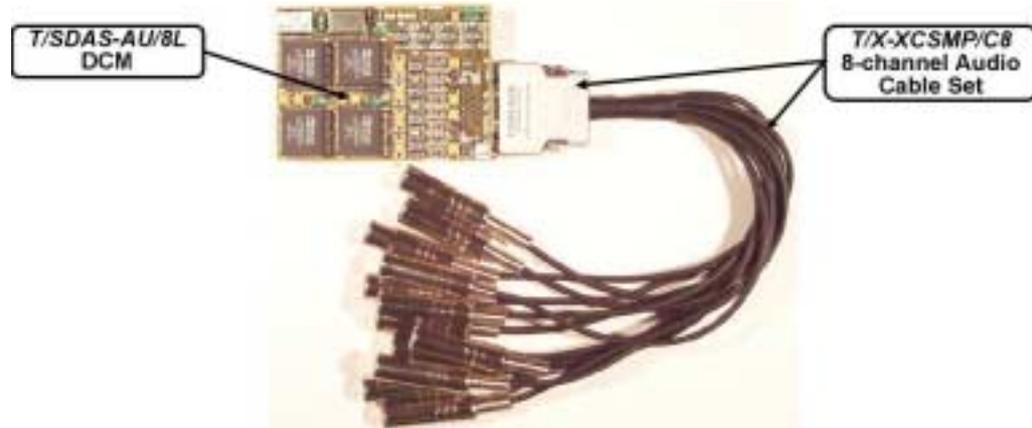


Fig. 1-5. *T/SDAS-AU/8L* DCM with *T/X-XCSMP/C8* 8-channel audio cable set.

#### **external I/O options for *T/SDAS-ATEL2* DCM**

Connection of *T/SDAS-ATEL2* DCM to external analog I/O world is performed via the on-board I/O connector, which is available via rear panel of host PC (if *T/SDAS-ATEL2* is installed onto *TORNADO* DSP system for PC).

The ultimate feature of *T/SDAS-ATEL2* DCM is modular design of external I/O facilities in order to meet multiple application configurations. Below is a list of available external I/O options:

- *T/X-XCSMP* stereo analog I/O cable set (fig.1-6) for connection of stereo MIC/Line-in/Line-out/Phone set
- *T/X-XCMP/2* dual-channel analog I/O cable set (fig.1-7) for connection of two MIC/Line-in/Line-out/Phone sets
- *T/X-X2C* dual-channel splitter (see Appendix B and fig.1-8) in order to convert dual-channel I/O connector to two single-channel I/O connectors, which are compatible with that for *T/SDAS-SCOM1* single-channel speech/fax/modem DCM and for *T/SDAS-SCOM2* dual-channel speech/fax/modem DCM
- up to two *T/X-XCMP* single-channel analog signal I/O cable sets, which connect to *T/X-X2C* dual-channel splitter (fig.1-9), and allow connection of MIC/Line-in/Line-out/Phone sets to any channel
- up to two *T/X-XTLI* external telephone line interface options, which connect to *T/X-X2C* dual-channel splitter (see subsection below and fig.1-10), and allow direct connection to PSTN (public switch telephone network) subscriber lines
- up to two *T/X-XTSI* external telephone station interface options, which connect to *T/X-X2C* dual-channel splitter (see subsection below and fig.1-11), and provides emulation of PSTN (public switch telephone network) subscriber lines and direct connection to external telephones, fax machines and computer modems.

Once the *T/X-X2C* dual-channel splitter is connected to *T/SDAS-ATEL2* DCM, then any of *T/X-XCMP* single-channel analog signal I/O cable set, *T/X-XTLI* external telephone line interface option or *T/X-XTSI* external telephone station interface option can connect to any channel of *T/X-X2C* dual-channel splitter, thus delivering

multiple dual-channel external signal I/O interface configurations in order to meet virtually any application requirements.

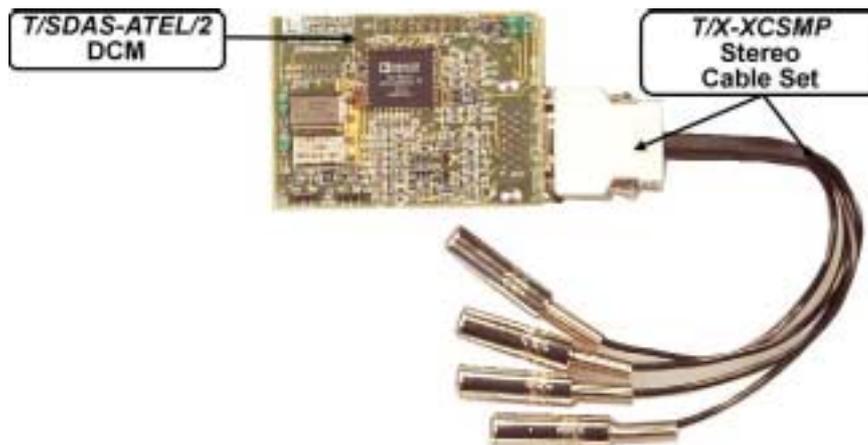


Fig. 1-6. T/SDAS-ATEL2 DCM with T/X-XCSMP stereo cable set.

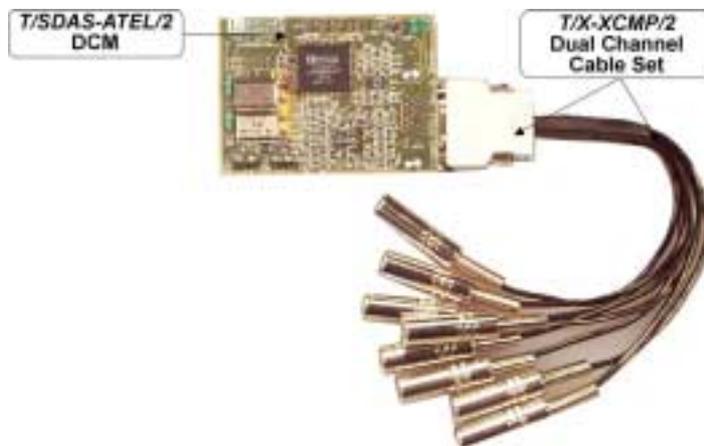


Fig. 1-7. T/SDAS-ATEL2 DCM with T/X-XCMP/2 dual-channel cable set.

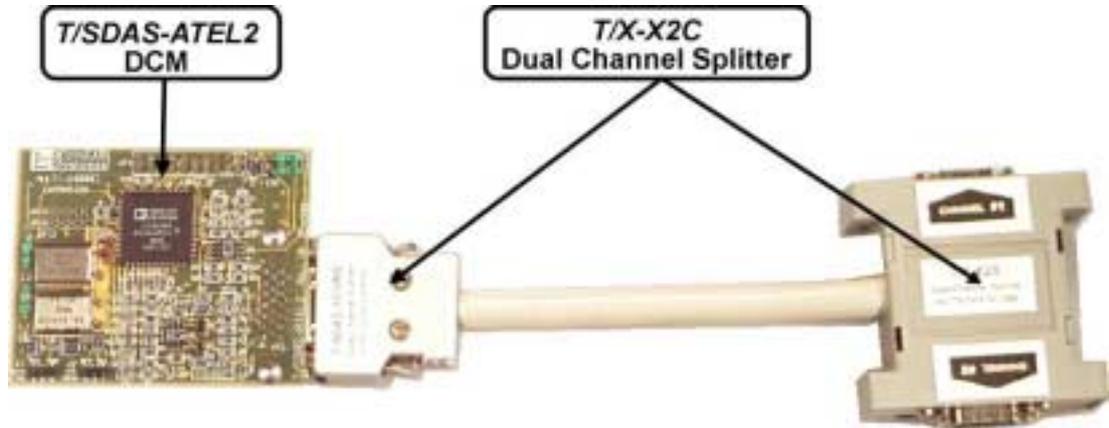


Fig. 1-8. T/SDAS-ATEL2 DCM with T/X-X2C dual-channel splitter.

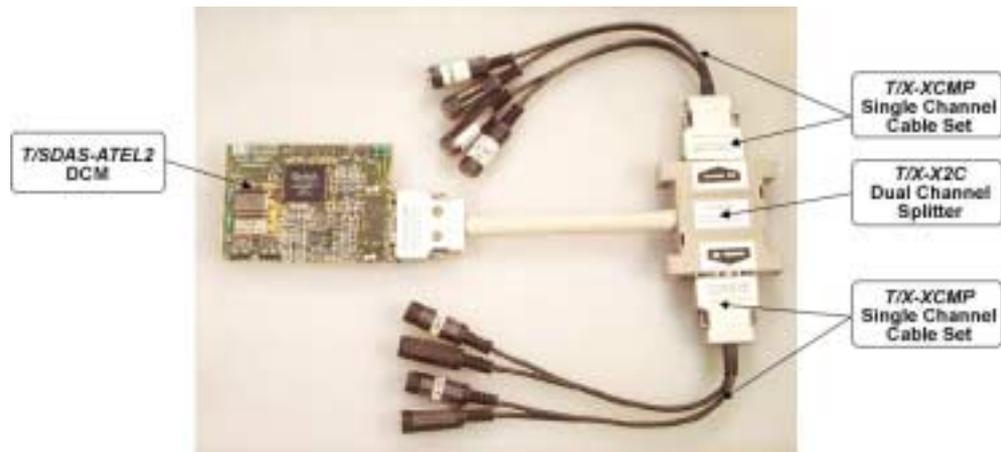


Fig. 1-9. T/SDAS-ATEL2 DCM with T/X-X2C dual-channel splitter and two T/X-XCMP single-channel cable sets.

### **external telephone line interface option for T/SDAS-ATEL2 DCM**

*T/X-XTLI* external telephone line interface option (fig.1-10) (also known as DAA (digital access arrangement) based passive telephone line interface) is designed as the end-user PSTN (public switched telephone network) equipment and offers direct access to available PSTN subscriber lines. In case appropriate DSP software is supplied, this converts *TORNADO* DSP system or controller with installed *T/SDAS-ATEL2* DCM and external *T/X-XTLI* telephone line interface into automatic answering machine, fax machine or modem with data transmission over PSTN telephone lines.

*T/X-XTLI* external telephone line interface can be also used with *T/SDAS-SCOM1* single-channel speech/fax/modem DCM and with *T/SDAS-SCOM2* dual-channel speech/fax/modem DCM.

External *T/X-XTLI* telephone line interface connects to any channel of *T/SDAS-ATEL2* DCM via *T/X-X2C* dual-channel splitter and is similar to phone line interface of automatic answering machine, fax machines and computer modems. Line outlet of *T/X-XTLI* telephone line interface plugs directly to the phone line wall-outlet.

*T/X-XTLI* option operates under the DSP software control and detects incoming line calls/rings, picks up the phone and provides dialing either using DTMF or pulse dialing.



Fig. 1-10. *T/SDAS-ATEL2* DCM with external dual-channel splitter (*T/X-X2C*) and one external *T/X-XTLI* external telephone line interface option.

### **external telephone station interface option for *T/SDAS-ATEL2* DCM**

*T/X-XTSI* external telephone station interface option (also known as SLIC (subscriber line interface circuit) based active telephone line interface) for *T/SDAS-ATEL2* DCM (and fig.1-11) is functionally opposite to *T/X-XTLI* external telephone line interface option, and is designed for emulation of subscriber line equipment of typical PSTN telephone station.

*T/X-XTLI* external telephone line interface can be also used with *T/SDAS-SCOM1* single-channel speech/fax/modem DCM and with *T/SDAS-SCOM2* dual-channel speech/fax/modem DCM.

External *T/X-XTSI* telephone station interface option connects to any channel of *T/SDAS-ATEL2* DCM via *T/X-X2C* dual-channel splitter and is similar to subscriber line equipment of typical PSTN telephone station.

Line outlet of *T/X-XTSI* option directly connects to telephone, automatic answering machine, fax machine or computer modem, but it cannot plug to the PSTN phone line wall-outlet.

*T/X-XTSI* option operates under the DSP software control and provides required voltage shift for output phone line, generates line calls/rings, detects phone pick-up and receives dialing signals either for DTMF or pulse dialing.



Fig. 1-11. T/SDAS-ATEL2 DCM with external dual-channel splitter (T/X-X2C) and one external T/X-XTSI external telephone station interface option.

### applications

All T/SDAS-4215, T/SDAS-ATEL2 and T/SDAS-AU/8L DCM are designed for multimedia audio applications with interfacing to a variety of external analog audio I/O equipment. T/SDAS-ATEL2 DCM can be also used for telephony applications with interfacing to PSTN and any telephone-line compatible device.

## 1.2 Technical Specifications

This section contains detail technical specifications for T/SDAS-4215, T/SDAS-ATEL2 and T/SDAS-AU/8L DCM.

### specifications for T/SDAS-4215 DCM

The following are technical specifications for T/SDAS-4215 DCM for the temperature of external environment +25°C.

<u>parameter description</u>	<u>parameter value</u>
<i>A/D channel:</i>	
ADC type	ADC section of $\Sigma\Delta$ either CS4215 or AD1849K stereo audio codec chip
number of channels	2
resolution	16 bits

maximum differential input signal for LINE-IN inputs in PRO mode	9.8 Vrms (+22dBu)
maximum single-ended input signal for LINE-IN inputs in CONSUMER mode	2 Vrms
maximum external DC bias at LINE-IN inputs	$\pm 8$ V
input impedance for LINE-IN inputs	$\geq 12$ kOhm
maximum differential input signal for MIC-IN inputs	0.005 Vrms
input impedance for MIC-IN inputs	$\geq 5$ kOhm
optional bias voltage for MIC-IN inputs	+4 V
maximum value of external "phantom" bias voltage for MIC-IN inputs	0..+16 V
programmable input gain	0..22.5 dB in 1.5 dB increments
THD for LINE-IN inputs	$\geq 77$ dB (79 dB typ)
input dynamic range	$\geq 77$ dB (79 dB typ)
differential non-linearity	$\leq 0.9$ LSB
inter-channel gain mismatch for LINE-IN inputs	$\leq 1.5$ dB
inter-channel isolation	$\leq -78$ dB
frequency response in 0..0.45Fs range	$\leq 0.5$ dB

*D/A channel:*

DAC type	DAC section of $\Sigma\Delta$ either CS4215 or AD1849K stereo audio codec chip
number of channels	2
Resolution	16 bits
maximum differential output signal for LINE-OUT outputs in PRO mode	9.8 Vrms (+22dBu)
maximum single-ended output signal for LINE-OUT outputs in CONSUMER mode	2 Vrms
maximum output DC bias at LINE-OUT and HEADPHONE-OUT outputs	$\pm 10$ mV

minimum load impedance for LINE-OUT outputs	$\geq 600$ Ohm
maximum output signal for HEADPHONE-OUT outputs	1.4 Vrms
minimum load impedance for HEADPHONE-OUT outputs	$\geq 32$ Ohm (600 Ohm is recommended)
programmable attenuation	0...-94.7 dB in -1.5 dB increments
THD for LINE-OUT output	$\geq 77$ dB (79 dB typ)
output dynamic range	$\geq 79$ dB (79 dB typ.)
differential nonlinearity	$\leq 0.9$ LSB
inter-channel gain mismatch	$\leq 1.5$ dB
inter-channel isolation	$\leq -78$ dB
frequency response within $(0..0.45) \times F_s$ range	$\leq 0.5$ dB

*common parameters:*

sampling frequency ( $F_s$ ) (set by software identical to both channels of A/D and D/A)	5.5125kHz, 6.615kHz,, 8kHz, 9.6kHz, 11.025kHz, 16kHz, 18.9kHz, 22.05kHz, 27.42857kHz, 32kHz, 33.075kHz, 37.8kHz, 44.1kHz, 48kHz
(error+instability) of sampling frequency	$\leq 0.008\%$
clocking frequency for SIO port	$\leq 6.144$ MHz
number of bits in packet via SIO-port	64

**specifications for T/SDAS-ATEL2 DCM**

The following are technical specifications for T/SDAS-ATEL2 DCM for the temperature of external environment +25°C.

<i><u>parameter description</u></i>	<i><u>parameter value</u></i>
<i>A/D channel:</i>	
ADC type	ADC section of $\Sigma\Delta$ either CS4215 or AD1849K stereo audio codec chip
number of channels	2
Resolution	16 bits
maximum input signal for LINE-IN inputs	2 Vrms
maximum DC voltage at LINE-IN inputs	$\pm 30$ V
input impedance for LINE-IN inputs	$\geq 20$ kOhm
maximum input signal for MIC-IN inputs	0.005 Vrms
input impedance for MIC-IN inputs	$\geq 5$ kOhm
DC bias voltage for MIC-IN inputs	+4 V
programmable input gain	0...22.5 dB in 1.5 dB increments
THD for LINE-IN inputs	$\geq 77$ dB (79 dB typ)
input dynamic range	$\geq 77$ dB (79 dB typ)
differential non-linearity	$\leq 0.9$ LSB
inter-channel gain mismatch for LINE-IN inputs	$\leq 1.5$ dB
inter-channel isolation	$\leq -78$ dB
frequency response in 0..0.45Fs range	$\leq 0.5$ dB
<i>D/A channel:</i>	
DAC type	DAC section of $\Sigma\Delta$ either CS4215 or AD1849K stereo audio codec chip
number of channels	2
Resolution	16 bits
maximum output signal for LINE-OUT outputs	2 Vrms

maximum output DC bias at LINE-OUT and HEADPHOES-OUT outputs	$\pm 10$ mV
minimum load impedance for LINE-OUT outputs	$\geq 600$ Ohm
maximum output signal for HEADPHONE-OUT outputs	1.4 Vrms
minimum load impedance for HEADPHONES-OUT outputs	$\geq 600$ Ohm
programmable attenuation	0...-94.7 dB in -1.5 dB increments
THD for LINE-OUT outputs	$\geq 77$ dB (79 dB typ)
output dynamic range	$\geq 79$ dB (79 dB typ.)
differential nonlinearity	$\leq 0.9$ LSB
inter-channel gain mismatch	$\leq 1.5$ dB
inter-channel isolation	$\leq -78$ dB
frequency response within $(0..0.45) \times F_s$ range	$\leq 0.5$ dB

*Digital I/O:*

number of digital inputs	4
number of digital outputs	4
logical input levels	3V/5V TTL
logical output levels	3V TTL
output load current	3.2 mA

*common parameters:*

sampling frequency ( $F_s$ ) (set by software identical to both channels of A/D and D/A)	5.5125kHz, 6.615kHz,, 8kHz, 9.6kHz, 11.025kHz, 16kHz, 18.9kHz, 22.05kHz, 27.42857kHz, 32kHz, 33.075kHz, 37.8kHz, 44.1kHz, 48kHz
(error+instability) of sampling frequency	$\leq 0.008\%$
clocking frequency for SIO port	$\leq 6.144$ MHz
number of bits in packet via SIO-port	64

### **specifications for T/SDAS-AU/8L DCM**

The following are technical specifications for T/SDAS-AU/8L DCM for the temperature of external environment +25°C.

<u>parameter description</u>	<u>parameter value</u>
<i>A/D channel:</i>	
ADC type	ADC section of $\Sigma\Delta$ either CS4215 or AD1849K stereo audio codec chip
number of channels	2/4/8 selectable via on-board jumper
Resolution	16 bits
maximum input signal for LINE-IN inputs	2 Vrms
maximum DC voltage at LINE-IN inputs	$\pm 30$ V
input impedance for LINE-IN inputs	$\geq 20$ kOhm
maximum input signal for MIC-IN inputs	0.005 Vrms
input impedance for MIC-IN inputs	$\geq 5$ kOhm
DC bias voltage for MIC-IN inputs	+4 V
programmable input gain	0...22.5 dB in 1.5 dB increments
THD for LINE-IN inputs	$\geq 77$ dB (79 dB typ)
input dynamic range	$\geq 77$ dB (79 dB typ)
differential non-linearity	$\leq 0.9$ LSB
inter-channel gain mismatch for LINE-IN inputs	$\leq 1.5$ dB
inter-channel isolation	$\leq -78$ dB
frequency response in 0..0.45Fs range	$\leq 0.5$ dB

*D/A channel:*

DAC type	DAC section of $\Sigma\Delta$ either CS4215 or AD1849K stereo audio codec chip
number of channels	2/4/8 selectable via on-board jumper
resolution	16 bits
maximum output signal for LINE-OUT outputs	2 Vrms
maximum output DC bias at LINE-OUT outputs	$\pm 10$ mV
minimum load impedance for LINE-OUT outputs	$\geq 600$ Ohm
programmable attenuation	0...-94.7 dB in -1.5 dB increments
THD for LINE-OUT outputs	$\geq 77$ dB (79 dB typ)
output dynamic range	$\geq 79$ dB (79 dB typ.)
differential nonlinearity	$\leq 0.9$ LSB
inter-channel gain mismatch	$\leq 1.5$ dB
inter-channel isolation	$\leq -78$ dB
frequency response within $(0..0.45)\times F_s$ range	$\leq 0.5$ dB

*common parameters:*

sampling frequency ( $F_s$ ) (set by software identical to both channels of A/D and D/A)	5.5125kHz, 6.615kHz,, 8kHz, 9.6kHz, 11.025kHz, 16kHz, 18.9kHz, 22.05kHz, 27.42857kHz, 32kHz, 33.075kHz, 37.8kHz, 44.1kHz, 48kHz
(error+instability) of sampling frequency	$\leq 0.008\%$
clocking frequency for SIO port	$\leq 6.144$ MHz
number of bits in packet via SIO-port	64/128/256



## Chapter 2. Construction

This chapter contains description of architecture and construction for *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM.

### 2.1 Block Diagram

Block diagrams and connectivity of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM are presented at fig.2-1.

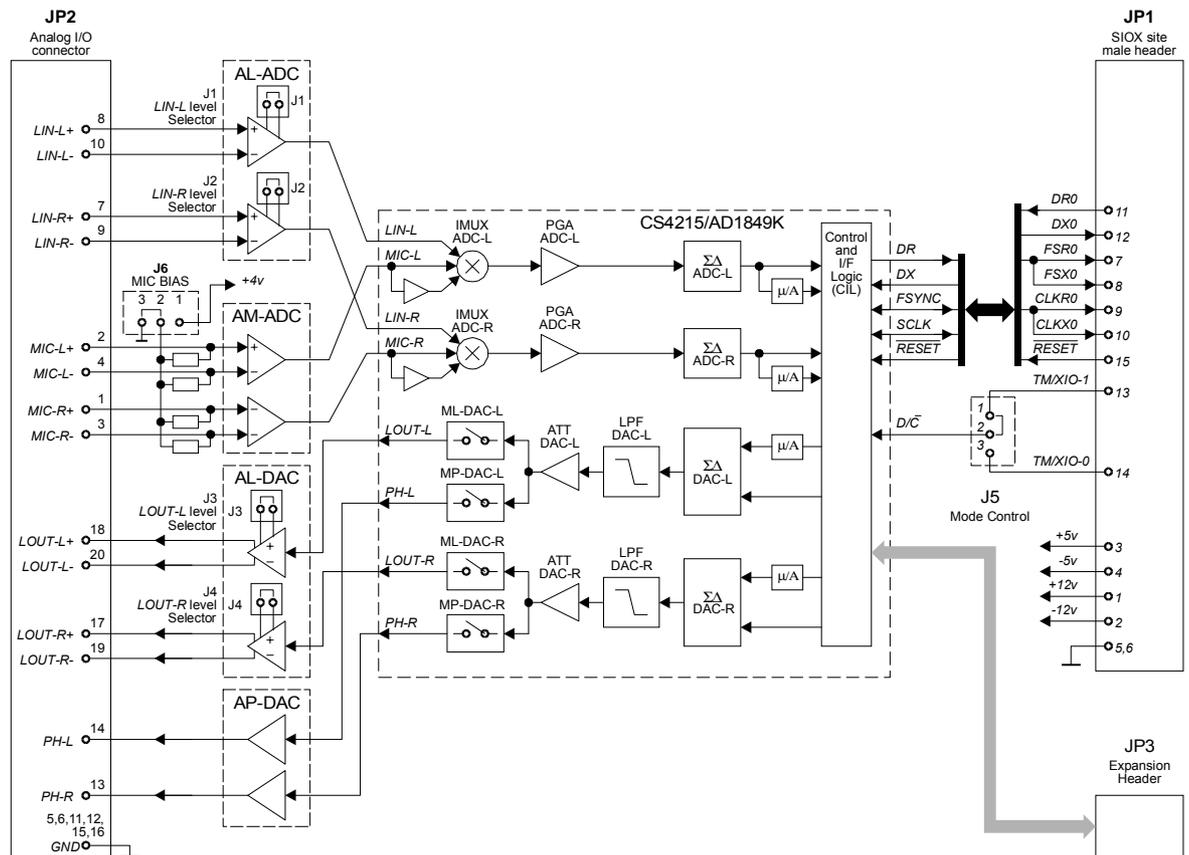


Fig. 2-1a. Block diagram of *T/SDAS-4215* DCM.

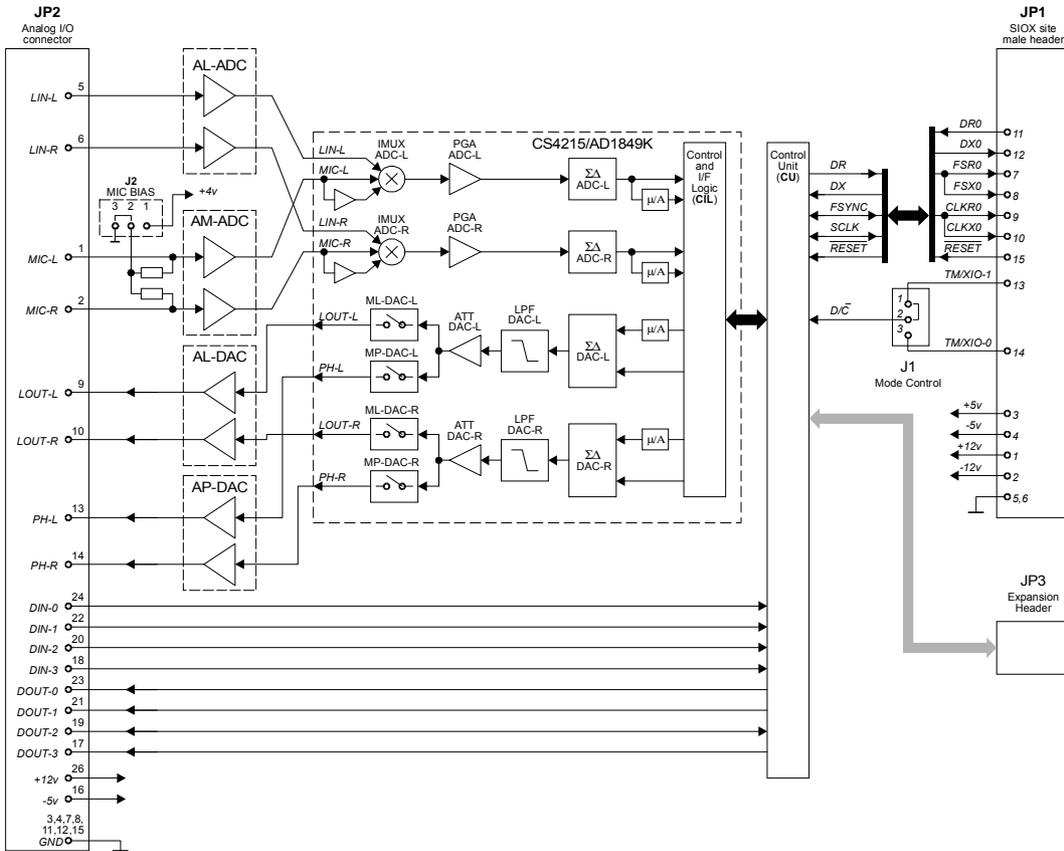


Fig. 2-1b. Block diagram of T/SDAS-ATEL2 DCM.

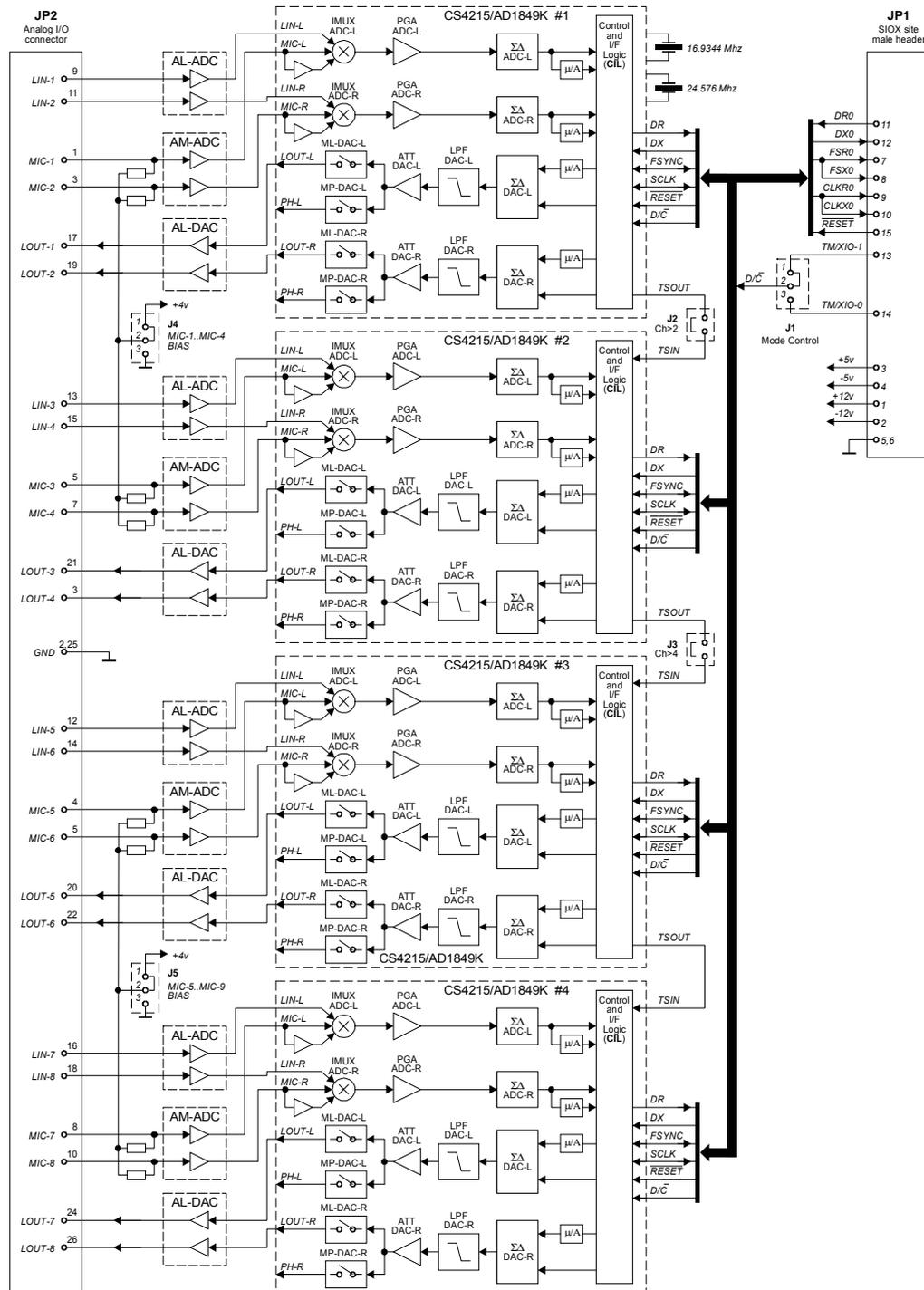


Fig. 2-1c. Block diagram of T/SDAS-AU/8L DCM.

All *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM install as SIOX DCM onto *TORNADO* mainboard and assumes communication with *TORNADO* on-board DSP via the DSP on-chip serial port.

The following are the main components of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM:

- on-board analog I/O interface section (AIOS)
- CS4215 or AD1849K stereo-audio codec chip(s)
- digital I/O controller (DIOC) (*T/SDAS-ATEL2* DCM only)
- SIOX interface header for installation onto *TORNADO* DSP systems.

### **CS4215/AD1849K stereo audio codec**

*T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM are based around either CS4215 16-bit multimedia stereo-audio codec chip(s) from Crystal Semiconductor Corp., or compatible AD1849K 16-bit stereo sound-port codec chip(s) from Analog Devices Inc. This makes all *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM to be software and hardware compatible products, which differ in analog I/O interfacing details only.

#### **CAUTION**

This manual does not contain detail description for neither CS4215 nor AD1849K stereo audio codec chips. For technical and programming details refer to the corresponding original technical information, which is enclosed with this manual in either paper or electronic form.

*T/SDAS-4215* and *T/SDAS-ATEL2* are stereo audio DCM and provides only one CS4215/AD1849K stereo-audio codec chip installed, whereas *T/SDAS-AU/8L* DCM is 8-channel audio DCM and provides four CS4215/AD1849K stereo-audio codec chips installed.

*T/SDAS-4215* and *T/SDAS-ATEL2* DCM also provide on-board expansion connector (JP3) in order to extend number of AD/DA channels up to totally eight channels using optional *T/SDAS-X4215* and *T/SDAS-XATEL2* multichannel expansion boards correspondingly.

CS4215 and AD1849K stereo-audio codec chips feature excellent CD audio quality sound and are extremely flexible software programmable devices, which comprise of the following components:

- two line-in and microphone inputs ('L' and 'R' channels)
- auxiliary +20dB microphone input amplifier
- two programmable input multiplexers (MUX-ADC)
- two programmable gain amplifiers (PGA-ADC) with gain factor up to +22.5dB
- two 16-bit  $\Sigma\Delta$  analog-to-digital converters (ADC) with two  $\mu$ -A-law companders ( $\mu$ /A-ADC)
- two 16-bit  $\Sigma\Delta$  digital-to-analog converters (DAC) with two  $\mu$ -A-law expanders ( $\mu$ /A-DAC)
- output low-pass filters (LPF-DAC)
- two programmable output attenuators (AT-DAC) with output attenuation up to -96dB
- output mute controller for line-out (ML-DAC)
- output mute controller for phone-out (MP-DAC)
- control and interface logic (CIU)
- programmable sampling frequency generator as the part of CIU, which can generate 14 different industry-standard predefined values in the range from 5.5kHz up to 48kHz.

For more details about block-diagram and how to program CS4215 and AD1849K stereo-audio codec chips refer to original technical documentation from the corresponding manufacturer.

### CAUTION

On-board analog I/O interfacing hardware of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM has been designed with assumption that CS4215/AD1849K stereo audio codec chip provides 1 V<sub>rms</sub> analog I/O signal level at line-in and line-out pins.

Application software must set bit OLB of Control Time Slot #1 register of CS4215/AD1849K stereo audio codec chip to the '0' state in order to meet requirement of on-board analog I/O interfacing hardware of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM.

### setting number of audio channels for *T/SDAS-AU/8L* DCM

*T/SDAS-AU/8L* DCM provides eight on-board audio channels by means of four installed CS4215/AD1849K stereo-audio codec chips.

However, in order to meet requirements of those applications, which may not require all eight audio channels, *T/SDAS-AU/8L* DCM allows to configure on-board hardware to utilize either two, or four, or all eight audio channels by means of on-board jumpers J2 and J3 in accordance with table 2-1.

Table 2-1. Number of channels for *T/SDAS-AU/8L* DCM.

on-board jumper J2	on-board jumper J3	number of audio-channels supported	on-board audio-channels utilized	number of data bits in data frame received/transmitted SIOX SIO-0 serial port
OFF	X	2	#1, #2	64
ON	OFF	4	#1, #2, #3, #4	128
ON	ON	8	#1, #2, #3, #4, #5, #6, #7, #8	256

Notes: 1. Jumper settings: OFF – jumper not installed; ON – jumper installed; x – doesn't matter.  
2. Highlighted configurations correspond to the factory setting.

Note, that the DSP application software must consider different number of data bits within the data frame, which is received and transmitted over SIO-0 port of host SIOX interface in order to program the CS4215/AD1849K stereo-audio codec chip, for different number of audio-channels in accordance with table 2-1. Refer to CS4215 and AD1849K original manufacturer documentation for more details.

### CONTROL and DATA modes for CS4215/AD1849K stereo audio codec

Configuration control, generation of sampling frequency, and communication with SIOX interface of *TORNADO* DSP system are performed by CS4215/AD1849K stereo audio codec on-chip control and interface unit (CIU).

The CIU unit of CS4215/AD1849K stereo audio codec chip has two operation modes:

- control mode (“CONTROL”), which is used to configure CS4215/AD1849K stereo audio codec
- data acquisition mode (“DATA”), which is used for real-time transmission of digitized audio data and control parameters.

For more details about CONTROL and DATA modes refer to original manufacturer documentation for CS4215/AD1849K stereo audio codec chips.

*T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM provide software controlled selection between CONTROL and DATA modes of on-board CS4215/AD1849K stereo audio codec chip(s) by host DSP software via either *TM/XIO-0* or *TM/XIO-1* I/O signal of host *TORNADO* SIOX interface.

Particular *TM/XIO-0* and *TM/XIO-1* signal, which is used to select between CONTROL and DATA modes of on-board CS4215/AD1849K stereo audio codec chip(s) is performed by means of on-board configuration jumper (refer to fig.A-1):

- J5 jumper for *T/SDAS-4215* DCM in accordance with table 2-2a
- J1 jumper for *T/SDAS-ATEL2* DCM in accordance with table 2-2b
- J1 jumper for *T/SDAS-AU/8L* DCM in accordance with table 2-2c

Table 2-2a. CS4215/AD1849K mode control selector for *T/SDAS-4215* DCM.

Jumper J5	SIOX <i>TM/XIO</i> line, which is used for mode control of CS4215/AD1849K stereo audio codec
1-2	<i>TM/XIO-1</i>
2-3	<i>TM/XIO-0</i>

Notes: 1. Highlighted configurations correspond to the factory setting.

Table 2-2b. CS4215/AD1849K mode control selector for *T/SDAS-ATEL2* DCM.

Jumper J1	SIOX <i>TM/XIO</i> line, which is used for mode control of CS4215/AD1849K stereo audio codec
1-2	<i>TM/XIO-1</i>
2-3	<i>TM/XIO-0</i>

Notes: 1. Highlighted configurations correspond to the factory setting.

Table 2-2c. CS4215/AD1849K mode control selector for *T/SDAS-AU/8L* DCM.

Jumper J1	SIOX <i>TM/XIO</i> line, which is used for mode control of CS4215/AD1849K stereo audio codec
1-2	<i>TM/XIO-1</i>
2-3	<i>TM/XIO-0</i>

Notes: 1. Highlighted configurations correspond to the factory setting.

### CAUTION

*T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM require that the *TM/XIO* line, which is used for mode control of on-board CS4215/AD1849K stereo audio codec chip, must be configured as OUTPUT line and not as the timer line.

### CAUTION

The low logic level at *TM/XIO* line, which is used for mode control of on-board CS4215/AD1849K stereo audio codec chip, corresponds to the “CONTROL” mode for on-board CS4215/AD1849K stereo audio codec chip, and is also a power-on default and post-DSP-reset condition for *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM.

The high logic level at *TM/XIO* line, which is used for mode control of on-board CS4215/AD1849K stereo audio codec chip, corresponds to the “DATA” mode for on-board CS4215/AD1849K stereo audio codec chip.

### sampling frequency

Sampling frequency is for *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM is programmed by the DSP software from the list of 14 predefined values within the 5.5...48 kHz range. This list contains the industry standard sampling frequency values for audio applications. Please refer to original manufacturer documentation for CS4215/AD1849K stereo audio codec chip for details.

### analog I/O interface section of *T/SDAS-4215* DCM

Analog I/O interface section of *T/SDAS-4215* DCM has been designed for interfacing to either professional audio equipment with differential input/output and signal level +22dBu, or to consumer audio equipment with single-ended input/output and signal level 2 Vrms.

Dual-channel differential line-in amplifier (AL-ADC) can connect to both professional audio equipment with differential outputs and consumer audio equipment with single-ended outputs, and provides high differential accuracy, low level of distortions and differential input impedance matching with that for professional audio equipment. AL-ADC amplifier does not provide galvanic isolation from signal source. The gain factor for AL-ADC amplifier is configured by the on-board J1..J2 jumpers (refer to fig.A-1) and must be set different for external professional and consumer audio equipment in accordance with table 2-3.

**Table 2-3a.** Signal level selector for the left line-in (LIN-L) input of *T/SDAS-4215* DCM.

<b>Jumper J1</b>	<b>signal level for the left line-in (LIN-L) input</b>
<i>OFF</i>	Consumer audio signal level (2 Vrms)
<i>ON</i>	Professional differential audio signal level (+22dBu).

*Notes:* 1. Highlighted configurations correspond to the factory setting.

**Table 2-3b.** Signal level selector for the right line-in (LIN-R) input of *T/SDAS-4215* DCM.

<b>Jumper J2</b>	<b>signal level for the right line-in (LIN-R) input</b>
<i>OFF</i>	Consumer audio signal level (2 Vrms)
<i>ON</i>	Professional differential audio signal level (+22dBu).

*Notes:* 1. Highlighted configurations correspond to the factory setting.

Dual-channel differential microphone amplifier (AM-ADC) can connect to both professional stereo microphones with differential inputs consumer stereo microphones with single-ended inputs. AM-ADC amplifier provides gain factor +26dB and features high differential accuracy, low level of distortions and differential input impedance matching with that for professional audio microphones. AM-ADC amplifier provides galvanic isolation from signal source and allows direct connection of microphones that require input DC bias voltage. Either the on-board +4v DC bias voltage or any external bias voltage within 0..+16v range might be applied to the AM-ADC inputs. The on-board +4v DC bias voltage for AM-ADC inputs is enabled by means of the on-board J6 jumper (refer to fig.A-1) in accordance with table 2-4.

**Table 2-4.** DC bias voltage control for microphone inputs of *T/SDAS-4215* DCM.

<b>jumper J6</b>	<b>DC bias voltage for microphone inputs</b>
1-2	+4 V DC bias voltage at microphone inputs
2-3	No DC bias voltage at microphone inputs

Notes: 1. Highlighted configurations correspond to the factory setting.

Dual-channel differential amplifier (AL-DAC) for line output is designed for interfacing to both professional audio equipment with differential inputs and consumer audio equipment with single-ended inputs, and features high differential accuracy, low level of distortions, and differential 600 Ohm output impedance matching with that for professional audio equipment. AL-DAC amplifier is well suited for long-term shorting and grounding of output signals. AL-ADC amplifier does not provide galvanic isolation from external audio equipment. The gain factor for AL-ADC amplifier is configured by jumpers J3 and J4 (refer to fig.A-1) and must be set different for professional and consumer audio equipment in accordance with table 2-5.

**Table 2-5a.** Signal level selector for the left line-out (LOUT-L) output of *T/SDAS-4215* DCM.

<b>Jumper J3</b>	<b>signal level for the left line-out (LOUT-L) output</b>
OFF	Consumer audio signal level (2 Vrms)
ON	Professional differential audio signal level (+22dBu).

Notes: 1. Highlighted configurations correspond to the factory setting.

**Table 2-5b.** Signal level selector for the right line-out (LOUT-R) output of *T/SDAS-4215* DCM.

<b>Jumper J4</b>	<b>signal level for the right line-out (LOUT-R) output</b>
OFF	Consumer audio signal level (2 Vrms)
ON	Professional differential audio signal level (+22dBu).

Notes: 1. Highlighted configurations correspond to the factory setting.

On-board dual-channel headphones amplifier (AHP-DAC) can connect to external headphones with impedance higher than 32 Ohm and provides low level of distortions. APH-ADC amplifier does not provide galvanic isolation from external audio equipment.

### **analog I/O interface section of T/SDAS-ATEL2 DCM**

Analog I/O interface section of *T/SDAS-ATEL2* DCM has been designed for interfacing to consumer audio equipment with single-ended input/output and signal level 2 Vrms.

Dual-channel line-in amplifier (AL-ADC) features high differential accuracy, low level of distortions and galvanic isolation from signal source. The gain factor for AL-ADC amplifier is  $-6\text{dB}$ .

Dual-channel microphone amplifier (AM-ADC) provides gain factor  $+26\text{dB}$  and features low level of distortions, provides galvanic isolation from signal source, and allows direct connection of microphones that require input DC bias voltage. Either the on-board  $+4\text{v}$  DC bias voltage or any external bias voltage within  $0..+16\text{v}$  range might be applied to the AM-ADC inputs. The on-board  $+4\text{v}$  DC bias voltage for AM-ADC inputs is enabled by means of the on-board J2 jumper (refer to fig.A-1) in accordance with table 2-6.

**Table 2-6.** DC bias voltage control for microphone inputs of *T/SDAS-ATEL2* DCM.

<b>jumper J2</b>	<b>DC bias voltage for microphone inputs</b>
1-2	+4 V DC bias voltage at microphone inputs
2-3	No DC bias voltage at microphone inputs

Notes: 1. Highlighted configurations correspond to the factory setting.

Dual-channel line output amplifier (AL-DAC) features low level of distortions, and allows long-term shorting and grounding of output signal. AL-ADC amplifier does not provide galvanic isolation from external audio equipment. The gain factor for AL-ADC amplifier is  $+6\text{dB}$ .

On-board dual-channel headphones amplifier (AHP-DAC) can connect to external headphones with impedance higher than 600 Ohm and provides low level of distortions.

### **analog I/O interface section of T/SDAS-AU/8L DCM**

Analog I/O interface section of *T/SDAS-AU/8L* DCM has been designed for interfacing to consumer audio equipment with single-ended input/output and signal level 2 Vrms.

8-channel line-in amplifier (AL-ADC) features high differential accuracy, low level of distortions and galvanic isolation from signal source. The gain factor for AL-ADC amplifier is  $-6\text{dB}$ .

8-channel microphone amplifier (AM-ADC) provides gain factor  $+26\text{dB}$  and features low level of distortions, provides galvanic isolation from signal source, and allows direct connection of microphones that require input DC bias voltage. Either the on-board  $+4\text{v}$  DC bias voltage or any external bias voltage within  $0..+16\text{v}$  range might be applied to the AM-ADC inputs. The on-board  $+4\text{v}$  DC bias voltage for AM-ADC inputs is enabled by means of the on-board J4 jumper for microphone inputs #1..#4 and J5 jumper for microphone inputs #5..#8 (refer to fig.A-1) in accordance with table 2-7.

Table 2-7a. DC bias voltage control for MIC-1..4 microphone inputs of *T/SDAS-AU/8L* DCM.

jumper J4	DC bias voltage for MIC-1..4 microphone inputs
1-2	+4 V DC bias voltage at microphone inputs
2-3	No DC bias voltage at microphone inputs

Notes: 1. Highlighted configurations correspond to the factory setting.

Table 2-7b. DC bias voltage control for MIC-5..8 microphone inputs of *T/SDAS-AU/8L* DCM.

jumper J5	DC bias voltage for MIC-1..5 microphone inputs
1-2	+4 V DC bias voltage at microphone inputs
2-3	No DC bias voltage at microphone inputs

Notes: 1. Highlighted configurations correspond to the factory setting.

8-channel line output amplifier (AL-DAC) features low level of distortions, and allows long-term shorting and grounding of output signal. AL-ADC amplifier does not provide galvanic isolation from external audio equipment. The gain factor for AL-ADC amplifier is +6dB.

*T/SDAS-AU/8L* DCM does not provide dedicated headphones outputs. The line-output outputs can be used instead for connection to external headphones.

### **digital I/O controller of *T/SDAS-ATEL2* DCM**

As an option, *T/SDAS-ATEL2* DCM can interface to public telephone network (PSTN) or standard telephone-line compatible equipment via external telephone line interface (*T/X-XTLI*) or external telephone station interface (*T/X-XTSI*) options. Interfacing to PSTN or telephone equipment can be performed for any or both channels of *T/SDAS-ATEL2* DCM via dual-channel splitter *T/X-X2C*.

In order to connect to external telephone line interface (*T/X-XTLI*) or external telephone station interface (*T/X-XTSI*) options, *T/SDAS-ATEL2* DCM provides four external digital inputs (*DIN-0..DIN-3*) and four external digital outputs (*DOUT-0..DOUT-3*), which are handled by on-board digital I/O controller (DIOC) and can be read/set by host DSP application software via the same serial data stream, which is used to communicate with on-board CS4215/AD1849K stereo audio codec.

**CAUTION**

Each external telephone line/station interface option requires two digital inputs and two digital outputs for hardware control.

External digital inputs *DIN-0..DIN-1* and external digital outputs *DOUT-0..DOUT-1* correspond to external telephone line/station interface option, which is connected to channel 'L' (#1) of *T/SDAS-ATEL2* module.

External digital inputs *DIN-2..DIN-3* and external digital outputs *DOUT-2..DOUT-3* correspond to external telephone line/station interface option, which is connected to channel 'R' (#2) of *T/SDAS-SCOM2* module.

Reading of *DIN-0..DIN-3* external digital inputs and programming of *DOUT-0..DOUT-3* outputs are available via the dedicated substituted bits of *DATA TIME SLOT #5* and *DATA TIME SLOT #7* data words, which are received and transmitted via SIO-0 serial port of host SIOX interface in the DATA mode of CS4215/AD1849K stereo audio codec chip.

**DATA TIME SLOT #5 Data Word (write)**

<i>DOUT-3</i> (w)	<i>DOUT-2</i> (w)	<i>LO5</i> (w)	<i>LO4</i> (w)	<i>LO3</i> (w)	<i>LO2</i> (w)	<i>LO1</i> (w)	<i>LO0</i> (w)
bit-7	bit-6	bit-5	bit-4	bit-3	bit-2	bit-1	bit-0

**DATA TIME SLOT #5 Data Word (read)**

<i>DIN-3</i> (r)	<i>DIN-2</i> (r)	<i>LO5</i> (r)	<i>LO4</i> (r)	<i>LO3</i> (r)	<i>LO2</i> (r)	<i>LO1</i> (r)	<i>LO0</i> (r)
bit-7	bit-6	bit-5	bit-4	bit-3	bit-2	bit-1	bit-0

**DATA TIME SLOT #7 Data Word (write)**

<i>DOUT-1</i> (w)	<i>DOUT-0</i> (w)	<i>OVR</i> (w)	<i>IS</i> (w)	<i>LG3</i> (w)	<i>LG2</i> (w)	<i>LG1</i> (w)	<i>LG0</i> (w)
bit-7	bit-6	bit-5	bit-4	bit-3	bit-2	bit-1	bit-0

**DATA TIME SLOT #7 Data Word (read)**

<i>DIN-1</i> (r)	<i>DIN-0</i> (r)	<i>OVR</i> (r)	<i>IS</i> (r)	<i>LG3</i> (r)	<i>LG2</i> (r)	<i>LG1</i> (r)	<i>LG0</i> (r)
bit-7	bit-6	bit-5	bit-4	bit-3	bit-2	bit-1	bit-0

**CAUTION**

*DIN-3/DOUT-3* and *DIN-2/DOUT-2* external digital I/O bits substitute original *HE* and *LE* bits of *DATA TIME SLOT #5* data word, which is transmitted/received to/from CS4215/AD1849K stereo audio codec in *DATA* mode.

Actual state of *HE* and *LE* bits, which are transmitted to CS4215/AD1849K stereo audio codec during transmission of *DATA TIME SLOT #5* data word, are both logical '1'. This corresponds to enable of both headphones and line outputs of CS4215/AD1849K stereo audio codec.

**CAUTION**

*DIN-1/DOUT-1* and *DIN-0/DOUT-0* external digital I/O bits substitute original *PIO1* and *PIO0* bits of *DATA TIME SLOT #7* data word, which is transmitted/received to/from CS4215/AD1849K stereo audio codec in *DATA* mode.

*PIO1* and *PIO0* I/O pins of CS4215/AD1849K stereo audio codec are not used in *T/SDAS-ATEL2* DCM, so the actual states of *PIO1* and *PIO0* bits of *DATA TIME SLOT #7* data word are ignored..

**expansion of analog I/O channels**

*T/SDAS-4215* and *T/SDAS-ATEL2* DCM provide on-board expansion connectors in order to extend number of AD/DA channels from two channels, which are installed on the board, to up to totally eight channels using optional *T/SDAS-X4215* and *T/SDAS-XATEL2* multichannel expansion boards correspondingly.

*T/SDAS-X4215* and *T/SDAS-XATEL2* multichannel expansion boards connect to *T/SDAS-4215* and *T/SDAS-ATEL2* DCM via JP3 on-board connectors using flat cable.

*T/SDAS-X4215* and *T/SDAS-XATEL2* multichannel expansion boards comprise of three CS4215/AD1849K stereo audio codec chips, which operate in the 'slave' mode. Slave CS4215/AD1849K stereo audio codec chips use the strobe signals generated by the master CS4215/AD1849K stereo audio codec chip from the *T/SDAS-4215* and *T/SDAS-ATEL2* DCM and insert their digital I/O data streams into the data stream generated by master CS4215/AD1849K chip. This requires 128 or 256 of bits per serial I/O frame via host DSP serial port.

On-board analog I/O facilities at the *T/SDAS-X4215* and *T/SDAS-XATEL2* multichannel expansion boards correspond to that installed at the *T/SDAS-4215* and *T/SDAS-ATEL2* DCM.

### **communication with host SIOX interface**

Communication between *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM and *TORNADO* on-board DSP is performed via SIO-0 port of SIOX interface site (JP1 connector) using serial communication protocol.

Number of data bits in serial data frame must be set by DSP software in “CONTROL” mode in accordance with number of audio channels installed, and must be selected as 64, 128 or 256 bit per one data frame with external FSYNC and SCLK signals.

## **2.2 Construction**

All *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM (fig.1-1, fig.A-1) meet standard SIOX rev.B DCM form-factor. Construction of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM assume that host *TORNADO* DSP system with either *T/SDAS-4215*, or *T/SDAS-ATEL2*, or *T/SDAS-AU/8L* DCM installed fits into one slot of PC chassis.

Connection of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM to external analog I/O world is performed via the on-board JP2 connector, which is available via rear panel of host PC (in case either *T/SDAS-4215*, or *T/SDAS-ATEL2*, or *T/SDAS-AU/8L* DCM is installed onto *TORNADO* DSP system for PC).

Different sets of external signal I/O cables, dual-channel splitter and external telephone line and station interface options are available for *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM in order to meet different signal processing applications (refer to chapter #1 and Appendix B for details).

## **2.3 Configuration for Serial Port of Host *TORNADO* On-board DSP**

This section contains recommendations for programming DSP on-chip serial port of host *TORNADO* DSP systems/controllers/coprocessors for communication with *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM.

For more information refer to the programming examples and demos, which come standard with *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM for different *TORNADO* DSP platforms.

### **programming operation mode of CS4215/AD1849K stereo audio codec chip**

The *TM/XIO-0* or *TM/XIO-1* line of host SIOX interface, which is used for software control of operation mode of CS4215/AD1849K stereo audio codec chip (“CONTROL” or “DATA” mode), must be configured as the OUTPUT port on host *TORNADO* DSP systems/controllers/coprocessor.

The *TM/XIO-0* or *TM/XIO-1* line of host SIOX interface must be set to the ‘0’ value in order to set the “CONTROL” mode of CS4215/AD1849K stereo audio codec chip (this level is also automatically setup by on-

board pull-down hardware to select “CONTROL” mode during power-on and reset conditions), and output state of the *TM/XIO-0* or *TM/XIO-1* line must be set to the ‘1’ value in order to set “DATA” mode .

### **CONTROL mode of CS4215/AD1849K stereo audio codec chip**

The following are recommendation for programming the DSP on-chip serial port of host *TORNADO* DSP system/controller/coprocessor for communication with *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM in the “CONTROL” mode of CS4215/AD1849K stereo audio codec chip:

- *SIO port transmitter* of *TORNADO* on-board DSP must be configured as the following:
  - *CLKX* signal must be configured as output and generated by DSP on-chip SIO port, active high
  - *FSX* signal must be configured as the output, active high
  - *DX* signal must be configured as active high
  - *data format* must be set to 32 bits per word for TMS320C3x, TMS320C6x DSP and for TMS320C54x DSP with McBSP ports, and to 16-bits per frame for 16-bit TMS320C54x DSP without McBSP serial port
  - transmitter must be configured for CONTINUOUS MODE and FIXED DATA RATE (TMS320C3x only)
  - the McBSP port must be configured to single-frame communication with 2, 4 or 8 32-bit words per frame (depending upon the number of audio channels installed); the delay of frame synchronization pulse must be set to ‘1’; the frame synch generator must be programmed to generate frame synch pulses with 10 kHz frequency
- *SIO port receiver* of *TORNADO* on-board DSP must be configured as the following:
  - *CLKR* signal must be configured as input, active high
  - *FSR* signal must be configured as input, active high
  - *DR* signal must be configured as active high
  - *data format* must be set to 32 bits per word for TMS320C3x, TMS320C6x DSP and for TMS320C54x DSP with McBSP ports, and to 16-bits per frame for 16-bit TMS320C54x DSP without McBSP serial port
  - transmitter must be configured for CONTINUOUS MODE and FIXED DATA RATE (TMS320C3x only)
  - the McBSP port must be configured to single-frame communication with 2, 4 or 8 32-bit words per frame (depending upon the number of audio channels installed); the delay of frame synchronization pulse must be set to ‘1’

**CAUTION**

In order to meet technical specifications of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM for analog I/O level, the OLB bit of *CONTROL TIME SLOT #1* data word of CS4215/AD1849K audio-codec chip must be programmed to the OLB=0 state during “CONTROL” mode.

**DATA mode of CS4215/AD1849K stereo audio codec chip**

The following are recommendation for programming the DSP on-chip serial port of host *TORNADO* DSP system/controller/coprocessor for communication with *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM in the “DATA” mode of CS4215/AD1849K stereo audio codec chip:

- *SIO port transmitter* of *TORNADO* on-board DSP must be configured as the following:
  - *CLKX* signal must be configured as input, active high
  - *FSX* signal must be configured as the input, active high
  - *DX* signal must be configured as active high
  - *data format* must be set to 32 bits per word for TMS320C3x, TMS320C6x DSP and for TMS320C54x DSP with McBSP ports, and to 16-bits per frame for 16-bit TMS320C54x DSP without McBSP serial port
  - transmitter must be configured for CONTINUOUS MODE and FIXED DATA RATE (TMS320C3x only)
  - the McBSP port must be configured to single-frame communication with 2, 4 or 8 32-bit words per frame (depending upon the number of audio channels installed); the delay of frame synchronization pulse must be set to ‘1’
- *SIO port receiver* of *TORNADO* on-board DSP must be configured as the following:
  - *CLKR* signal must be configured as input, active high
  - *FSR* signal must be configured as input, active high
  - *DR* signal must be configured as active high
  - *data format* must be set to 32 bits per word for TMS320C3x, TMS320C6x DSP and for TMS320C54x DSP with McBSP ports, and to 16-bits per frame for 16-bit TMS320C54x DSP without McBSP serial port
  - transmitter must be configured for CONTINUOUS MODE and FIXED DATA RATE (TMS320C3x only)
  - the McBSP port must be configured to single-frame communication with 2, 4 or 8 32-bit words per frame (depending upon the number of audio channels installed); the delay of frame synchronization pulse must be set to ‘1’

**CAUTION**

The transmitter and receiver interrupt drivers of DSP software for *TORNADO* DSP system/controller/coprocessor shall be high-performance enough in order to provide continuous data transmission/reception without missing any data time slot.

## Chapter 3. Installation

This chapter contains information for installation and configuration of *T/SDAS-4215* module.

### 3.1 Installation

*T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM install as SIOX rev.B DCM onto host *TORNADO* DSP system mainboard.

For installation of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM into SIOX rev.B site of host *TORNADO* DSP system follow the recommendations below (fig.3-1):

1. Switch off the power of host PC.
2. Remove *TORNADO* mainboard from PC slot.
3. Take *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM and slant it for about 30°.40° degrees refer to *TORNADO* mainboard. Insert JP2 connector of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM into the corresponding hole of mounting bracket of *TORNADO* DSP system.

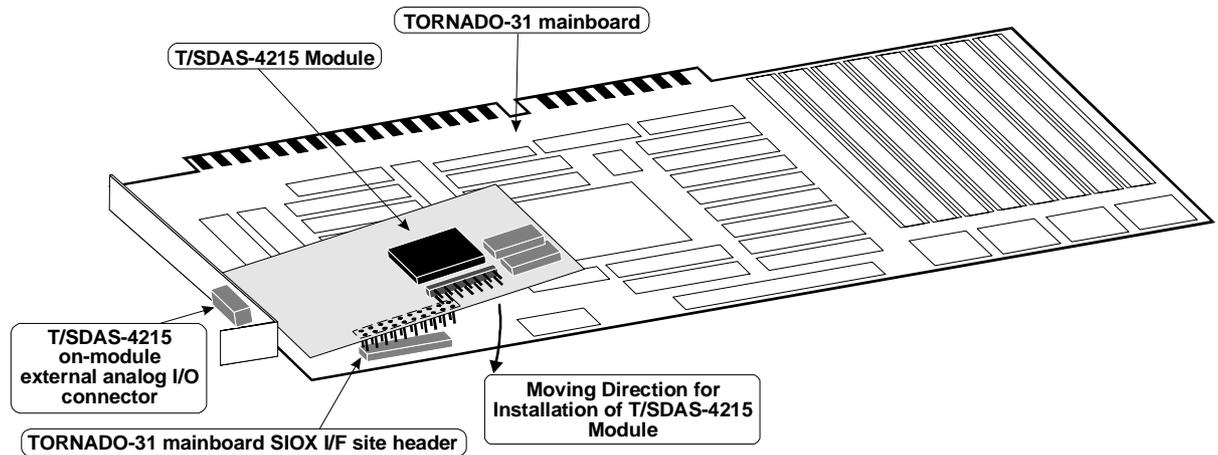


Fig. 3-1. Installation of *T/SDAS-4215* module into SIOX site of *TORNADO* DSP system.

4. Rotate *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM around mounting bracket and allocate pin #1 of JP1 connector of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM against pin #1 of SIOX interface header on *TORNADO* mainboard.
5. Safely plug-in SIOX male header of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM into SIOX female header of *TORNADO* DSP system.
6. Screw external analog I/O connector shell of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM to the mounting bracket of *TORNADO* DSP system.
7. Configure on-board jumpers (refer to Appendix A).
8. Install *TORNADO* board into PC slot and screw it to rear panel of PC.

9. Plug-in external analog I/O cable set to the JP2 connector of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM
10. Switch on power of host PC.

## 3.2 Connection to external audio equipment

Connection of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM to external audio equipment is performed by means of two sets of audio jacks via the on-board JP2 connector (fig.A-1) and a variety of standard audio cable sets and external telephone line/station interface options.

### CAUTION

It is highly recommended to plug-in and unplug external I/O cable set or external telephone line/station interface options into/from on-board JP2 connector of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM when host *TORNADO* power is switched off.

The ground signal of *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM has no galvanic isolation from host *TORNADO* and/or PC ground signal and chassis.

### connection to external audio equipment for *T/SDAS-4215* DCM

*T/SDAS-4215* DCM can connect to either CONSUMER or PROFESSIONAL external audio equipment via the corresponding external I/O cable set. The on-board J1..J4 jumpers must be configured properly in accordance with tables 2-3 and 2-5 in order to match the connected external I/O cable set.

### CAUTION

When connecting external audio equipment to *T/SDAS-4215* DCM you should be aware that analog line-in and line-out I/O signals have no DC-bias isolation from external audio source signals, although DC isolation is provided between the on-board ADC/DAC and corresponding I/O amplifiers. If required, external DC isolation capacitors should be used.

The ground signal of *T/SDAS-4215* DCM has no galvanic isolation from host PC ground signal and chassis.

The *T/X-XCSMP/C* external CONSUMER I/O cable set comes standard with *T/SDAS-4215* module and uses ¼standard miniature phone jacks for connection to external consumer audio equipment with single-ended I/O signals. This set comprises of 4 jacks:

- line-in input (left/right channels with common ground signal)
- microphone input (left/right channels with common ground signal)
- line-output output (left/right channels with common ground signal)
- headphones output (left/right channels with common ground signal)

The *T/X-XCSMP/P* external PROFESSIONAL I/O cable set is available upon request for *T/SDAS-4215* module and uses ¼ standard 1/4" RCA jacks for connection to external professional audio equipment with differential I/O signals. This set comprises of 7 jacks:

- left line-in input (differential signal)
- right line-in input (differential signal)
- left microphone input (differential signal)
- right microphone input (differential signal)
- left line-out output (differential signal)
- right line-out output (differential signal)
- headphones output (left/right channels with common ground signal)

#### **connection to external audio equipment for *T/SDAS-ATEL2 DCM***

*T/SDAS-ATEL2 DCM* connect to external audio equipment either via stereo (*T/X-XCSMP*) or 2-channel mono (*T/X-XCSMP/2*) external I/O cable set.

#### **CAUTION**

When connecting external audio equipment to *T/SDAS-ATEL2 DCM* you should be aware that analog line-out and headphone output signals have no DC-bias isolation from external audio source signals, although DC isolation is provided between the on-board ADC/DAC and corresponding I/O amplifiers. If required, external DC isolation capacitors should be used.

The ground signal of *T/SDAS-ATEL2 DCM* has no galvanic isolation from host PC ground signal and chassis.

Also available is to connect two different single-channel mono cable sets (*T/X-XCMP*) to one *T/SDAS-ATEL2 DCM* via */X-X2C* dual-channel splitter (refer to chapter 1 for more details).

External telephone line interface option (*T/X-XTLI*) and external telephone station interface option (*T/X-XTSI*) also connect to *T/SDAS-ATEL2 DCM* via */X-X2C* dual-channel splitter (refer to chapter 1 for more details).

#### **connection to external audio equipment for *T/SDAS-ATEL2 DCM***

*T/SDAS-AU/8L DCM* connect to external audio equipment either via 8-channel external I/O cable set (*T/X-XCSMP/C8*). *T/X-XCSMP/C8* 8-channel audio cable set comprises of four groups of stereo line-in, microphone -in and line-out connectors. Refer to chapter 1 for more details.

**CAUTION**

When connecting external audio equipment to *T/SDAS-AU/8L* DCM you should be aware that analog line-out output signals have no DC-bias isolation from external audio source signals, although DC isolation is provided between the on-board ADC/DAC and corresponding I/O amplifiers. If required, external DC isolation capacitors should be used.

The ground signal of *T/SDAS-AU/8L* DCM has no galvanic isolation from host PC ground signal and chassis.

**connection to microphones**

*T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM provide optional on-board +4v DC bias voltage and allows any external bias voltage within 0..+16v range to be applied to the microphone input. This is required in order to provide correct operation of some types of microphones. Refer to your microphone operation guide in order to learn whether your microphone requires external DC bias.

Optional on-board +4v DC bias voltage for microphone inputs is enabled by setting the on-board jumper (refer to Appendix A and section 2-1 for more details).

**connection of headphones**

*T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM allow direct connection of 600 Ohm headphones sets to either the dedicated headphones output or line-out output. However, the signal distortions at the headphones output may be higher than that for the line-out output.

## Appendix A. Connectors and Jumpers

This appendix contains a summary for the on-board connectors and configuration jumpers for *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM.

The board layout and on-board connectors and configuration jumpers for *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM are presented at fig.A-1.

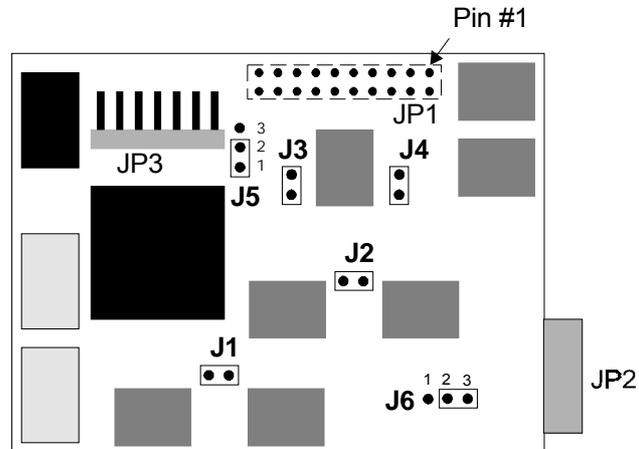


Fig. A-1a. On-board connectors and configuration jumpers of *T/SDAS-4215* DCM.

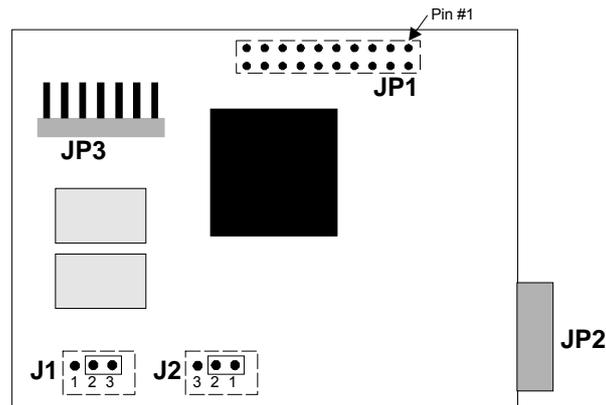


Fig. A-1b. On-board connectors and configuration jumpers of *T/SDAS-ATEL2* DCM.

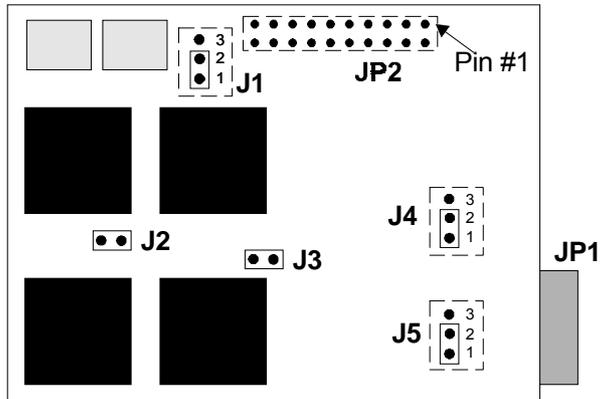


Fig. A-1c. On-board connectors and configuration jumpers of *T/SDAS-AU/8L* DCM.

## A.1 Configuration Jumpers

Tables A-1a, A-1b and A-1c provides the list of on-board configuration jumpers and references for *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM.

Table A-1a. Configuration jumpers of *T/SDAS-4215* DCM.

Jumper	Description	References
<i>J1</i>	Selection of signal level for left line-in input (LIN-L)	Table 2-3a
<i>J2</i>	Selection of signal level for right line-in input (LIN-R)	Table 2-3b
<i>J3</i>	Selection of signal level for left line-out output (LOUT-L)	Table 2-5a
<i>J4</i>	Selection of signal level for right line-out output (LOUT-R)	Table 2-5b
<i>J5</i>	Selection of <i>TM/XIO</i> SIOX line for mode control of CS4215/AD1849K stereo audio codec chip	Table 2-2a
<i>J6</i>	Optional +4V DC bias voltage for microphone inputs (required for some microphone types)	Table 2-4

Table A-1b. Configuration jumpers of *T/SDAS-ATEL2* DCM.

Jumper	Description	References
<i>J1</i>	Selection of <i>TM/XIO</i> SIOX line for mode control of CS4215/AD1849K stereo audio codec chip	Table 2-2b
<i>J2</i>	Optional +4V DC bias voltage for microphone inputs (required for some microphone types)	Table 2-6

Table A-1c. Configuration jumpers of *T/SDAS-AU/8L* DCM.

Jumper	Description	References
<i>J1</i>	Selection of <i>TM/XIO</i> SIOX line for mode control of CS4215/AD1849K stereo audio codec chip	Table 2-2c
<i>J2</i> <i>J3</i>	Selector of number of audio channels	Table 2-1
<i>J4</i>	Optional +4V DC bias voltage for MIC-1..4 microphone inputs (required for some microphone types)	Table 2-7a
<i>J5</i>	Optional +4V DC bias voltage for MIC-5..8 microphone inputs (required for some microphone types)	Table 2-7b

## A.2 On-board Connectors

Tables A-2a, A-2b and A-2c contain the list of on-board connectors for *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM.

Table A-2a. On-board connectors of *T/SDAS-4215* DCM.

Connector	Description
<i>JP1</i>	SIOX interface site male header.
<i>JP2</i>	External analog I/O connector.
<i>JP3</i>	Expansion channels connector, which is used for connection to optional <i>T/SDAS-X4215</i> I/O channel expansion module. The <i>T/SDAS-X4215</i> board installs to the rear panel of host PC chassis.

Table A-2b. On-board connectors of *T/SDAS-ATEL2* DCM.

Connector	Description
<i>JP1</i>	SIOX interface site male header.
<i>JP2</i>	External analog I/O connector.
<i>JP3</i>	Expansion channels connector, which is used for connection to optional <i>T/SDAS-XATEL2</i> I/O channel expansion module. The <i>T/SDAS-XATEL2</i> board installs to the rear panel of host PC chassis.

Table A-2c. On-board connectors of *T/SDAS-AU/8L* DCM.

Connector	Description
<i>JP1</i>	SIOX interface site male header.
<i>JP2</i>	External analog I/O connector.

### **pinout for SIOX interface site connector**

Pinout of *JP1* host SIOX interface site connector for *T/SDAS-4215*, *T/SDAS-ATEL2* and *T/SDAS-AU/8L* DCM is presented in the user's guide of host *TORNADO* DSP system or controller and in Appendix C of this manual.

### **pinout for external analog I/O connector for *T/SDAS-4215* DCM**

Pinout of *JP2* external analog I/O connector for *T/SDAS-4215* DCM is presented at fig.A-2, and description of signals is presented in table A-3.

The external analog I/O connector *JP2* for *T/SDAS-4215* DCM is 20-pin female half-pitch connector from DDK Ltd manufacturer. In case the customer needs to design his own application specific cable for connection to *T/SDAS-4215* module, then compatible plugs are available from MicroLAB Systems upon request.

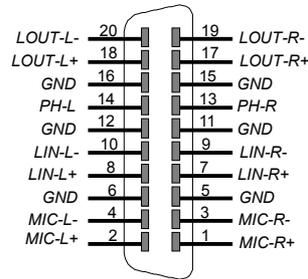


Fig. A-2. Pinout for external analog I/O connector of *T/SDAS-4215* module.

Table A-3. Signal description for external analog I/O connector of *T/SDAS-4215* module.

Signal name	Type	Description
<i>LIN-L+</i> <i>LIN-L-</i> <i>LIN-R+</i> <i>LIN-R-</i>	AI	Differential line-in inputs for 'L' and 'R' audio channels.
<i>MIC-L+</i> <i>MIC-L-</i> <i>MIC-R+</i> <i>MIC-R-</i>	AI	Differential microphone inputs for 'L' and 'R' audio channels.
<i>LOUT-L+</i> <i>LOUT-L-</i> <i>LOUT-R+</i> <i>LOUT-R-</i>	AO	Differential line-out outputs for 'L' and 'R' audio channels.
<i>PH-L</i> <i>PH-L</i>	AO	Headphones outputs for 'L' and 'R' audio channels.
<i>GND</i>	-	Ground.

Notes: 1. Signal types: AI - analog input; AO - analog output.

### **pinout for external analog I/O connector for *T/SDAS-ATEL2* DCM**

Pinout of JP2 external analog I/O connector for *T/SDAS-ATEL2* DCM is presented at fig.A-3, and description of signals is presented in table A-4.

The external analog I/O connector JP2 for *T/SDAS-ATEL2* DCM is 26-pin female half-pitch connector from DDK Ltd manufacturer. In case the customer needs to design his own application specific cable for connection to *T/SDAS-ATEL2* module, then compatible plugs are available from MicroLAB Systems upon request.

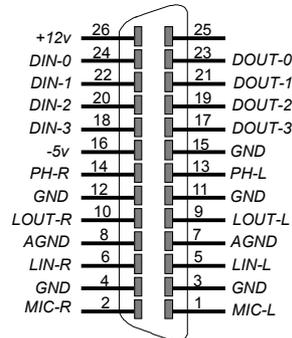


Fig. A-3. Pinout for external analog I/O connector of *T/SDAS-ATEL2* module.

Table A-4. Signal description for external analog I/O connector of *T/SDAS-ATEL2* module.

Signal name	Type	Description
<i>LIN-L</i> <i>LIN-R</i>	AI	Line-in inputs for 'L' and 'R' audio channels.
<i>MIC-L</i> <i>MIC-R</i>	AI	Microphone inputs for 'L' and 'R' audio channels.
<i>LOUT-L</i> <i>LOUT-R</i>	AO	Line-out outputs for 'L' and 'R' audio channels.
<i>PH-L</i> <i>PH-L</i>	AO	Headphones outputs for 'L' and 'R' audio channels.
<i>DIN-0..DIN-3</i>	TTL/IN	External digital inputs. Used for control of external telephone line/station interface options or as general purpose digital inputs.
<i>DOUT-0..DOUT-3</i>	TTL/OUT	External digital outputs. Used for control of external telephone line/station interface options or as general purpose digital outputs.
<i>GND</i>	-	Ground.
<i>+12v</i> <i>-5v</i>	-	Power supply outputs from <i>TORNADO</i> mainboard for external telephone line/station interface options or other connected general purpose analog/digital front-end devices.

Notes: 1. Signal types: AI - analog input; AO - analog output; *TTL/IN* – 3v/5v TTL compatible logical input; *TTL/OUT* – 3v/5v TTL compatible logical output.

### **pinout for external analog I/O connector for *T/SDAS-AU/8L* DCM**

Pinout of JP2 external analog I/O connector for *T/SDAS-AU/8L* DCM is presented at fig.A-4, and description of signals is presented in table A-5.

The external analog I/O connector JP2 for *T/SDAS-AU/8L* DCM is 26-pin female half-pitch connector from DDK Ltd manufacturer. In case the customer needs to design his own application specific cable for connection to *T/SDAS-AU/8L* module, then compatible plugs are available from MicroLAB Systems upon request.

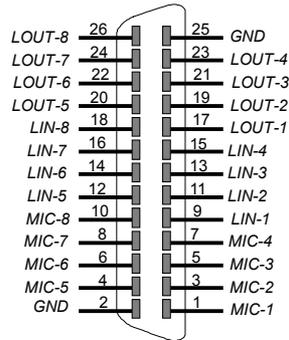


Fig. A-4. Pinout for external analog I/O connector of *T/SDAS-AU/8L* module.

Table A-5. Signal description for external analog I/O connector of *T/SDAS-AU/8L* module.

Signal name	Type	Description
<i>LIN-1..8</i>	AI	Line-in inputs for audio channels #1..#8.
<i>MIC-1..8</i>	AI	Microphone inputs for audio channels #1..#8
<i>LOUT-1..8</i>	AO	Line-out outputs for audio channels #1..#8.
<i>GND</i>	-	Ground.

Notes: 1. Signal types: *AI* - analog input; *AO* - analog output.



## Appendix B. *T/X-X2C External Dual-channel Splitter for T/SDAS-ATEL2 DCM*

This appendix contains information about *T/X-X2C* dual-channel splitter for *T/SDAS-ATEL2* DCM. Note, that *T/X-X2C* dual-channel splitter can be also used with *T/SDAS-SCOM2* dual-channel speech/fax/modem DCM.

### B.1 General Description

*T/X-X2C* external dual-channel splitter (fig.B-1) converts on-board dual-channel JP2 external I/O connector of *T/SDAS-ATEL2* DCM into two single-channel external I/O connectors, which are compatible with that for *T/SDAS-SCOM1* DCM and which allow connection to external telephone line/station interface options and to single-channel audio/speech equipment.

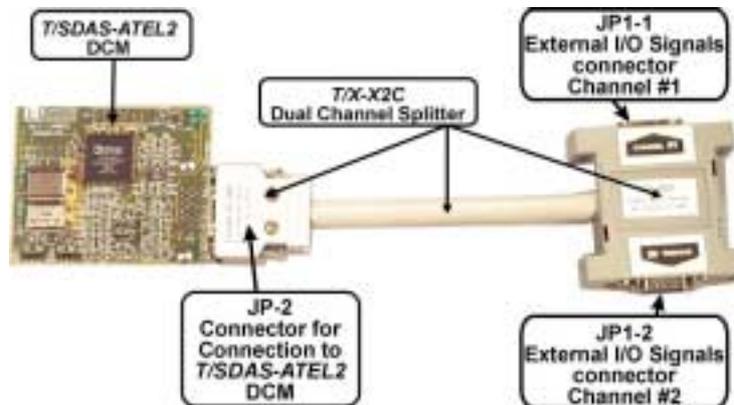


Fig. B-1. *T/SDAS-ATEL2* module with *T/X-X2C* dual-channel splitter.

*T/X-X2C* dual-channel splitter plugs directly into JP2 external I/O connector of *T/SDAS-ATEL2* DCM and splits JP2 connector signals into two single-channel connectors, each comprising of analog and digital I/O signals for channels #1 and #2 correspondingly.

Once the *T/X-X2C* dual-channel splitter is connected either to *T/SDAS-ATEL2* DCM, then any of *T/X-XCMP* single-channel analog signal I/O cable set, *T/X-XTLI* external telephone line interface option or *T/X-XTSI* external telephone station interface option can connect to any channel of *T/X-X2C* dual-channel splitter, thus delivering multiple dual-channel external signal I/O interface configurations in order to meet virtually any application requirements.

### B.2 Connection Diagram and Connectors Pinout

Connection diagram for *T/X-X2C* dual-channel splitter and connectors pinout is presented at fig. B-2.

The 26-pin JP2 connector of *T/X-X2C* dual-channel splitter plugs into JP2 external I/O connector of *T/SDAS-ATEL2* DCM, whereas 20-pin JP1-1 and JP1-2 connectors are available for connection to external single-channel audio/speech equipment and/or external telephone line/station interface options.

JP1-1 and JP1-2 connectors for output channels #1 and #2 of *T/X-X2C* dual-channel splitter comprise of analog and digital I/O signals for channels #1 and #2 of *T/SDAS-ATEL2* DCM correspondingly.

JP1-1 and JP1-2 connectors of *T/X-X2C* dual-channel splitter are 20-pin female half-pitch connector from DDK Ltd manufacturer, which have the p/n DHA-RA20. P/n for compatible plug-in connector is DHA-PC20. In case customer needs to design his own application specific cable for connection either to *T/SDAS-ATEL2* DCM or *T/X-X2C* dual-channel splitter then compatible plug-in connectors for JP1-1/JP1-2 connectors of *T/X-X2C* dual-channel splitter are available from MicroLAB Systems upon request.

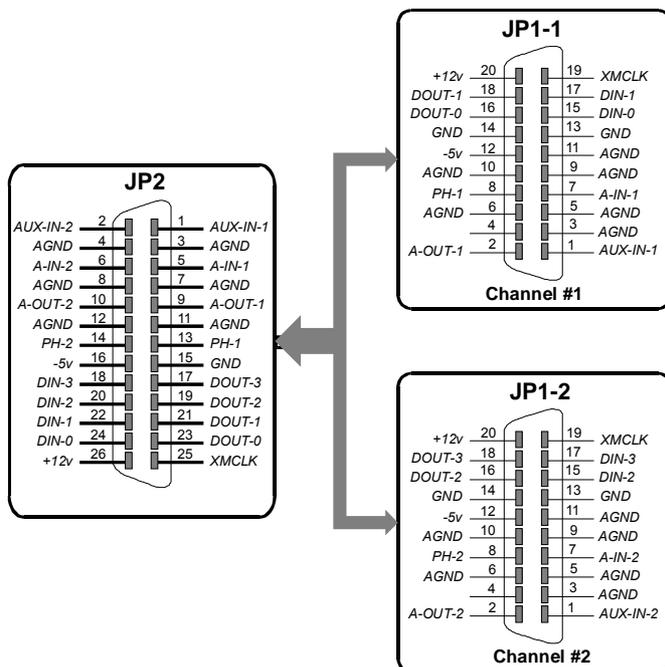


Fig. B-2. Connection diagram and connectors pinout for *T/X-X2C* dual-channel splitter.

## Appendix C. SIOX Rev.B Interface Site

This appendix contains information about *TORNADO* SIOX rev.B interface site specifications. This description is general to all *TORNADO* DSP systems/controllers/coprocessors, whereas different *TORNADO* boards with different DSP platforms may differ in the number and in the on-board routing of SIOX serial ports, timer/IO pin specifications. Refer to your particular *TORNADO* user's guide for more details.

### C.1 General Description

*TORNADO* architecture provides expansion of the on-board DSP I/O resources via on-board serial I/O expansion interface sites (SIOX-A and SIOX-B) (fig.C-1), which are designed to carry compatible DCM (DCM).



Fig.C-1. *TORNADO*-54x board with two SIOX sites.

Some *TORNADO* boards (typically *TORNADO* DSP systems for PC) provide two SIOX interface sites, whereas other *TORNADO* boards (typically *TORNADO* stand-alone DSP controllers and DSP coprocessors) provide only one SIOX site.

*TORNADO* SIOX rev.B interface site comprises of signals for one or two SIO-0/SIO-1 logical serial ports, timers/IO pins, DSP interrupts, and host power supplies.

**CAUTION**

In case *TORNADO* on-board DSP features two or more on-chip serial ports (TMS320C30, TMS320C54x, TMS320C6x), then *TORNADO* on-board SIOX sites provides two SIO-0 and SIO-1 serial ports and the SIOX site headers are 26-pin headers.

In case *TORNADO* on-board DSP features only one on-chip serial ports (TMS320C31, TMS320C32), then *TORNADO* on-board SIOX sites provides only one SIO-0 serial port and the SIOX site headers are 20-pin headers.

Both *TORNADO* on-board SIOX-A and SIOX-B interface sites feature identical pinout control and may only differ in the routing of DSP physical serial ports to SIO-0 and SIO-1 logical serial ports. If *TORNADO* on-board DSP features two or more on-chip serial ports (TMS320C30, TMS320C54x, TMS320C6x), then DSP serial ports routing is performed on *TORNADO* mainboard, and allows simultaneous operation of two or more SIOX DCM, which are routed to different DSP serial ports.

## C.2 SIOX rev.B Site Connector and Signals

*TORNADO* SIOX rev.B interface site comprises of signals for SIO-0 and SIO-1 logical serial ports, DSP on-chip TM/XIO-0/1 timers/IO pins, three DSP interrupts, SIOX reset control, and power  $\pm 5V/\pm 12V$  host power supplies.

### *TORNADO on-board SIOX site connector with two serial ports*

*TORNADO* on-board SIOX site connector with two serial ports is an industry standard dual-row 26-pin female header with 0.1"x0.1" pin pattern. Compatible SIOX plug-in part on SIOX DCM should be the industry standard either 26-pin 0.1"x0.1" male header (in case both SIO-0 and SIO-1 serial ports are utilized on SIOX plugged-in DCM) or 20-pin 0.1"x0.1" male header (in case only SIO-0 serial port is utilized on SIOX plugged-in DCM).

SIOX site connector pinout with two serial ports is shown at fig.C-2 and signal specifications are listed in table C-1.

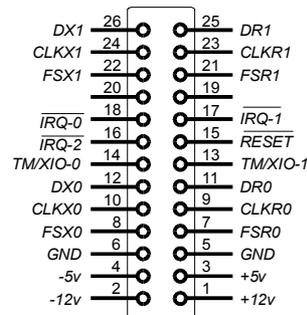


Fig.C-2. *TORNADO* on-board SIOX connector pinout with two serial ports (top view).

### **TORNADO on-board SIOX site connector with one serial port**

TORNADO on-board SIOX site connector with one serial port is an industry standard dual-row 20-pin female header with 0.1"x0.1" pin pattern. Compatible SIOX plug-in part on SIOX DCM should be the industry standard 20-pin 0.1"x0.1" male header.

SIOX site connector pinout with one serial ports is shown at fig.C-3 and signal specifications are listed in table C-1.

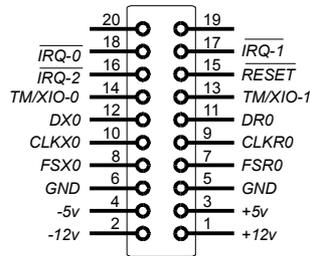


Fig. C-3. TORNADO on-board SIOX connector pinout with one serial port (top view).

### **SIOX site signal description**

Description for SIOX interface site signals is presented in table C-1.

Table C-1. SIOX interface signal description.

SIOX signal name	signal type	description
<b>SIO-0 port control</b>		
DX0 FSX0 CLKX0	O/Z I/O/Z I/O/Z	Data, frame synchronization and serial clock signals for transmitter of SIO-0 port of SIOX site..
DR0 FSR0 CLKR0	I I/O/Z I/O/Z	Data, frame synchronization and serial clock signals for receiver of SIO-0 port of SIOX site..
<b>SIO-1 port control</b> (available in SIOX site connector with two serial ports only)		
DX1 FSX1 CLKX1	O/Z I/O/Z I/O/Z	Data, frame synchronization and serial clock signals for transmitter of SIO-1 port of SIOX site..
DR1 FSR1 CLKR1	I I/O/Z I/O/Z	Data, frame synchronization and serial clock signals for receiver of SIO-1 port of SIOX site..

<b>DSP Timers/IO, DSP Interrupt Requests and SIOX Reset</b>		
<i>TM/XIO-0</i>	I/O/Z	This signal is typically connected to the DSP on-chip timer-0 I/O pin and can be software configured by DSP as either timer or I/O pin.
<i>TM/XIO-1</i>	I/O/Z	This signal is typically connected to the DSP on-chip timer-1 I/O pin and can be software configured by DSP as either timer or I/O pin.
$\overline{\text{RESET}}$	O	Active low SIOX reset signal. Some <i>TORNADO</i> boards (for example <i>TORNADO-3x</i> boards) wires this signal directly from the DSP reset signal and SIOX plugged-in DCM reset is performed simultaneously with <i>TORNADO</i> on-board DSP reset, however other <i>TORNADO</i> boards (for example <i>TORNADO-54x/6x</i> etc. boards) features dedicated SIOX site reset signal, which is controlled by <i>TORNADO</i> on-board DSP for better synchronization between the DSP software and SIOX DCM operation.
$\overline{\text{IRQ-0}}, \overline{\text{IRQ-1}}, \overline{\text{IRQ-2}}$	I	Active low external interrupt request lines for <i>TORNADO</i> on-board DSP. These line are pulled up.
<b>Power Supplies</b>		
<i>GND</i>		Ground.
<i>+5v</i>		+5v
<i>+12v</i>		+12v
<i>-5v</i>		-5v
<i>-12v</i>		-12v

Note:

1. Signal type is denoted as the following: I - input, O - output, Z - high impedance.
1. All logical signal levels and load currents correspond to that for CMOS/TTL signals.

### **SIOX site signal levels**

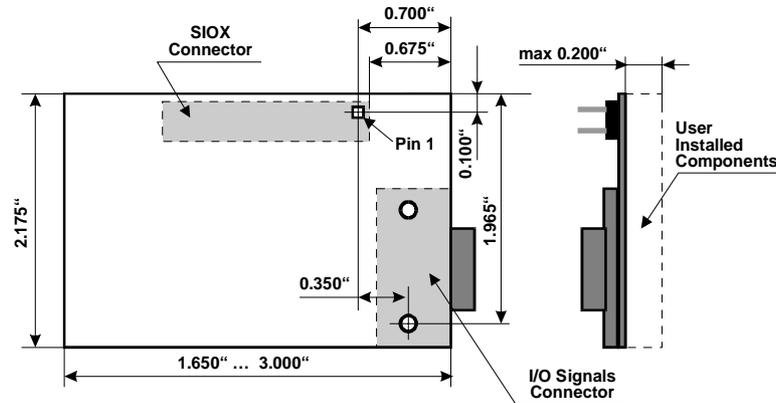
Signal levels for SIOX interface signals correspond to that for the CMOS/TTL signals with  $I_{OL}=2\text{ma}$  and  $I_{OH}=-0.3\text{ma}$  load currents.

**CAUTION**

Some *TORNADO* boards (*TORNADO-3x/542L/E31*) provide SIOX interface signal levels for CMOS/TTL only, whereas another *TORNADO* boards (*TORNADO-33/54x/E54x/6x/E6x/P6x/etc*) provide SIOX interface signal levels universal for both 3V TLL and standard TTL. Refer to documentation for your particular *TORNADO* board for information about SIOX interface signal levels.

### C.3 Physical Dimensions for SIOX rev.B DCM

Physical dimensions for SIOX DCM are presented at fig.C-4. This information is intended for those customers, who need to design customized SIOX DCM.



SIOX connector: 20-pin or 26-pin straight dual-row mail header  
(0.025" Sq., 0.1"x0.1" pattern)

Recommended connector for Analog I/O: DDK DHA-RC14-R122N  
DDK DHA-RC20-R122N  
DDK DHA-RC26-R122N

Fig.C-4. Physical dimensions for SIOX DCM.