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TURBINE DIAGNOSTIC SERVICES, INC
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APPLICATION GUIDE, 4-20 MILLIAMP INPUT TERMINATION BOARD

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96301	-

SCALE: NONE

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SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96301	-
SCALE: NONE		SHEET 2 OF 6	

1.0 Document Purpose

The purpose of this System Description document is to provide a general overview of the Turbine Diagnostic Services Inc. TurboNet *DASH 1*® 4-20 milliamp input termination board.

This document is not intended to provide the details required to set up, program, operate, or troubleshoot the input, the 4-20 milliamp input module and the usage of the input in the control programming. This document will provide description intended to familiarize engineers, managers, technicians, and operators with the component on the milliamp input termination board, and its expectations.

This document is intended to provide a broad knowledge of the components used and arranged on the milliamp input termination board. The document will discuss the board's capabilities, architecture, and the field device termination points.

This document will also provide references to other documentation providing additional details.

2.0 Component Description

The 4-20 milliamp input termination board provides a connection point for milliamp input signals to the TurboNet *DASH 1*®. Each TurboNet *DASH 1*® milliamp input presents a burden of approximately 300Ω.

Each 4-20 milliamp input termination board has provisions for 8 individual inputs. All the inputs share a common return. Since all devices share a return, they all need to be isolated from ground so as not to ground the system power supplies.

24 VDC power is brought into the board through connection plug J1 and is used to power up the 8 channel milliamp input I/O module, T1F-08AD-1. This power supply can also provide power to external transmitters. The positive side of this 24 VDC is protected by fuse FU9, 1 amp. This fuse protects against a fault anywhere on the board, field wiring, internal wiring, and a module failure. The power supply and signal wiring to the milliamp input module is connected via the J2 connector to the milliamp termination board.

This termination board can be powered externally if an isolated 24 VDC supply is required. If so specified, the panel would have provisions for wiring an external 24 VDC supply connection that would be factory wired to the J1 connector on that isolated milliamp termination board.

Fuses FU1 through FU8 are 0.032 Amp, and are provided to protect the individual milliamp inputs. Each milliamp input has four screw terminals associated with it, one for positive 24 VDC, one for milliamp (+), one for milliamp return, and one for a shield.

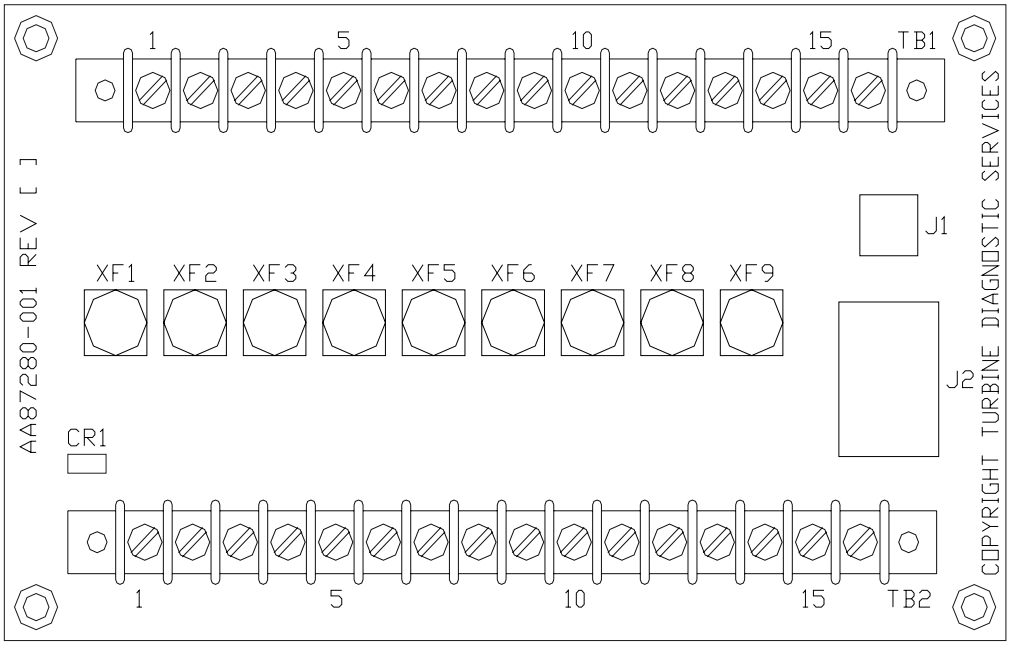
The milliamp termination board supports either externally powered device inputs, or loop powered devices. If an externally powered device is connected, the positive for the device will be wired to the (+) milliamp input, and the negative to the (-) milliamp return. If the device is a loop powered device using the cabinet internal power supply or isolated power supply as supplied through the J1 connector, the positive terminal would be wired to the (+) 24 VDC Supply and the negative would be wired to the (+) milliamp input.

See the table below for a summary of terminations. This table provides the terminal connection locations for the eight milliamp inputs associated with this milliamp termination board:

Input	Screw Terminal			
Number	**(+) 24 VDC**	**(+) Milliamp Input**	**Milliamp Return**	**Shield**
1	TB1-1	TB1-4	TB1-2	TB1-3
2	TB1-5	TB1-8	TB1-6	TB1-7
3	TB1-9	TB1-12	TB1-10	TB1-11
4	TB1-13	TB1-16	TB1-14	TB1-15
5	TB2-1	TB2-4	TB2-2	TB2-3
6	TB2-5	TB2-8	TB2-6	TB2-7
7	TB2-9	TB2-12	TB2-10	TB2-11
8	TB2-13	TB2-16	TB2-14	TB2-15

The input wiring shields are grounded to a single point through the ground connection of the internal 24 VDC power supply provided by the J1 connector. The 24 VDC power input signal lightning protection diode is connected through the termination board stand off mounts to chassis ground. All shield connections are brought out to a common ground point on the back of the power supply.

Below is a layout drawing of the milliamp termination board. This drawing can be used to locate fuses, component and connections on the board.



SIZE	CAGE CODE	DRAWING NUMBER	REV
A	**1XKV4**	**AA96301**	**-**
SCALE: NONE		SHEET 5 OF 6	

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SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96301	-
SCALE: NONE		SHEET 6 OF 6	

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APPLICATION GUIDE, 4-20 MILLIAMP OUTPUT TERMINATION BOARD

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96302	-

SCALE: NONE

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SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96302	-
SCALE: NONE		SHEET 2 OF 6	

1.0 Document Purpose

The purpose of this System Description document is to provide a general overview of the Turbine Diagnostic Services Inc. TurboNet *DASH 1*® 4-20 milliamp output termination board.

This document is not intended to provide the details required to set up, program, operate, or troubleshoot the input, the milliamp output module and the usage of the input in the control programming. This document will provide description intended to familiarize engineers, managers, technicians, and operators with the components on the milliamp output termination board, and its expectations.

This document is intended to provide a broad knowledge of the components used and arranged on the milliamp output termination board. The document will discuss the board's capabilities, architecture, and the field device termination points.

2.0 Component Description

The 4-20 milliamp output termination board provides a connection point for milliamp output signals from the TurboNet *DASH 1*®. The TurboNet *DASH 1*® milliamp outputs can handle up to a 500Ω load, but not less than 200Ω.

Each 4-20 milliamp output termination board has provisions for 8 individual outputs.

The system internal 24 VDC power is brought into the milliamp termination board through connection plug J1. The positive side of this 24 VDC is protected by fuses FU1 through FU8 for outputs 1 through 8. The fuse FU9 is used to protect the milliamp output control I/O module, T1F-08DA-1. Fuses FU1 through FU8 are 0.032 Amp, and fuse FU9 is 0.5 Amp. Each milliamp output has three screw terminals associated with it, one for positive 24 VDC, one for milliamp return, and one for a shield.

All outputs are protected by a 600 Watt, bi-directional, transient voltage suppressor. This is grounded through termination board standoff supports to the cabinet chassis ground.

The termination board can be powered externally if an isolated 24 VDC supply is required. If so specified, the panel would have provisions for wiring an external 24 VDC supply connection that would be factory wired to the J1 connector on that isolated milliamp termination board.

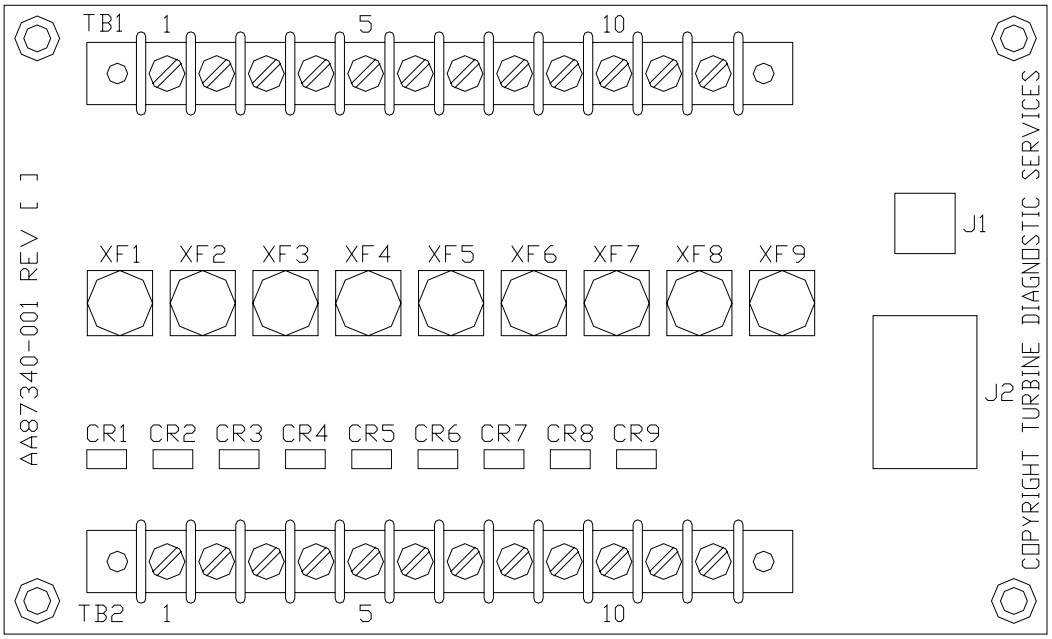
Positive 24 VDC is routed from connection plug J1 pin 1 through fuse FU9 to connection plug J2 pin 23 to power up the milliamp output module T1F-08DA-1. This module regulates the return of each milliamp output to control the current of each output, through connection plug J2.

The output wiring shields are grounded to a single point through the ground connection of the internal 24vdc power supply provided by the J1 connector.

The table below shows all the connections available on the milliamp output termination board:

Output	Screw Terminal		
Number	**(+) 24 VDC**	**Return**	**Shield**
1	TB1-1	TB1-2	TB1-3
2	TB1-4	TB1-5	TB1-6
3	TB1-7	TB1-8	TB1-9
4	TB1-10	TB1-11	TB1-12
5	TB2-1	TB2-2	TB2-3
6	TB2-4	TB2-5	TB2-6
7	TB2-7	TB2-8	TB2-9
8	TB2-10	TB2-11	TB2-12

Below is a layout drawing of the milliamp output termination board. This picture can be used to locate fuses, component and connections on the board.



SIZE	CAGE CODE	DRAWING NUMBER	REV
A	**1XKV4**	**AA96302**	**-**
SCALE: NONE		SHEET 5 OF 6	

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SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96302	-
SCALE: NONE		SHEET 6 OF 6	

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APPLICATION GUIDE, VOLTAGE IO TERMINATION BOARD

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96303	-

SCALE: NONE

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SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96303	-
SCALE: NONE		SHEET 2 OF 6	

1.0 Document Purpose

The purpose of this System Description document is to provide a general overview of the Turbine Diagnostic Services Inc. TurboNet *DASH 1*® 8 channel, voltage I/O termination board.

This document is not intended to provide the details required to set up, program, operate, or troubleshoot the input, the voltage input or output modules and the usage of the input in the control programming. This document will provide description intended to familiarize engineers, managers, technicians, and operators with the component on the voltage I/O termination board, and its expectations.

This document is intended to provide a broad knowledge of the components used and arranged on the voltage input/output termination board. The document will discuss the board's capabilities, architecture, and the field device termination points.

This document will also provide references to other documentation providing additional details.

2.0 Component Description

The 8 channel voltage termination board provides a connection point for the TurboNet *DASH 1*® to send out or receive DC voltage signals. The voltage termination board can be a voltage output board or a voltage input board but not both. The type of module connected via the voltage termination board's connection plug J2 determines whether the board is a voltage input or a voltage output board.

If the voltage termination board is connected to a T1F-08AD-2 voltage input module, it is a voltage input termination board with an input range of +/- 10 VDC. If the voltage termination board is connected to a T1F-08DA-2 voltage output module, it is a voltage output termination board. There are four possible ranges of voltage output, 0 to (+) 5 VDC, +/- 5 VDC, 0 to (+) 10 VDC, and +/- 10 VDC. The range is dependent on how the T1F-08DA-2 module is set up. Regardless of the selection for module range, all eight channels of the voltage output module will be configured for the selected range.

The control system internal 24 VDC power is brought into the voltage termination board via connection plug J1 pins 1(+) and pin 2(RTN). The +24 VDC is supplied to the voltage I/O module and protected by fuse FU1 (.16 A as supplied). The 24 VDC is routed through connection plug J2, pins 23(+) and 24(RTN) to provide power to the controlling module, T1F-08AD-2 or T1F-08DA-2.

If the external field device requires 24 VDC to operate, the power can be supplied from the J1 plug via the internal power supply connection and the Signal return terminations. The fuse FU1 may have to be uprated to support the added current draw to a maximum of 2 A.

The termination board can be powered externally if an isolated 24 VDC supply is required. If so specified, the panel would have provisions for wiring an external 24 VDC supply connection that would be factory wired to the J1 connector on that isolated voltage I/O termination board.

Transient voltage suppressors protect all 8 IO channels, and the power supply. This voltage suppression diodes are grounded through termination board mounting standoffs to the chassis ground.

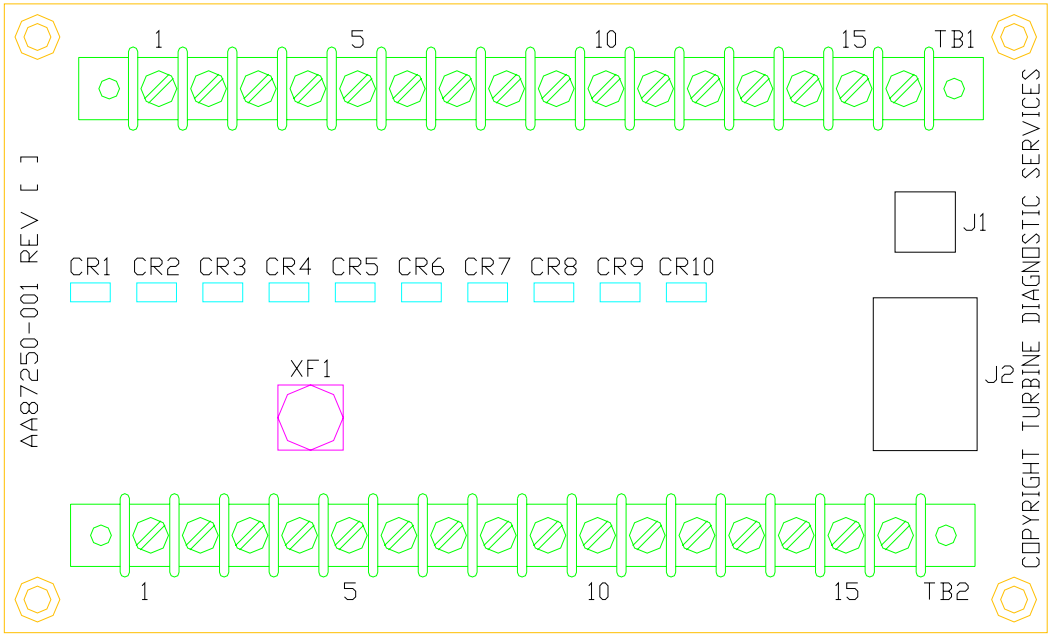
The input wiring shields are grounded to a single point through the ground connection of the internal 24 VDC power supply provided by the J1 connector.

The board can be wired using the connections below:

Channel Number	Voltage Input/Output			
	(+) 24 VDC PS	Signal (+)	Signal RTN	Shield
1	TB1-1	TB1-4	TB1-2	TB1-3
2	TB1-5	TB1-8	TB1-6	TB1-7
3	TB1-9	TB1-12	TB1-10	TB1-11
4	TB1-13	TB1-16	TB1-14	TB1-15
5	TB2-1	TB2-4	TB2-2	TB2-3
6	TB2-5	TB2-8	TB2-6	TB2-7
7	TB2-9	TB2-12	TB2-10	TB2-11
8	TB2-13	TB2-16	TB2-14	TB2-15

The voltage input or output positive lead would be connected to the Signal + terminal, while the device power and input or output negative leads are common to the Signal RTN connection points.

Below is a layout drawing of the voltage I/O termination board used to locate fuses, component and connections on the board.



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A	1XKV4	AA96303	-
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SIZE	CAGE CODE	DRAWING NUMBER	REV
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APPLICATION GUIDE 24 VDC CONTACT INPUT TERMINATION BOARD

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96304	-

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SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96304	-
SCALE: NONE		SHEET 2 OF 6	

1.0 Document Purpose

The purpose of this System Description document is to provide a general overview of the Turbine Diagnostic Services Inc. TurboNet *DASH 1*® 16 channel, 24VDC contact input termination board.

This document is not intended to provide the details required to set up, program, operate, or troubleshoot the input, the contact input module and the usage of the input in the control programming. This document will provide description intended to familiarize engineers, managers, technicians, and operators with the component on the 24 VDC contact input termination board, and its expectations.

This document is intended to provide a broad knowledge of the components used and arranged on the 24 VDC contact input termination board. The document will discuss the board's capabilities, architecture, and the field device termination points.

This document will also provide references to other documentation providing additional details.

2.0 Component Description

The 16 Channel, 24V, contact input termination board provides a connection point for contacts into the TurboNet *DASH 1*®. The 24 VDC wetting voltage is placed across each of the contact inputs. The contact input module, T1K-16ND3, senses whether the contact is closed or open via connection plug J2, J3, or J4. Typically, only connector J2 is connected in all single redundant applications. Applications where triple redundant contact input sensing is required, it is supported with the J3 and J4 connectors, where the multiple contact input modules are utilized. The connection plugs J3 and J4 are provided so that each contact input status can be sent to more than one T1K-16ND3 module for triple redundant voting of their detected status in the control processor.

The system internal 24 VDC power supply is brought into the termination board via connection plug J1. The FU1 fuse is in series with the 24 VDC power supply and is rated for .1 A. The FU1 fuse is used to protect the input module power supply and the fuse the wetting voltage supply for the sixteen channels. The positive 24 VDC is connected to all the odd numbered screw terminals. When the contact in the field is closed, the positive 24 VDC is sensed at the associated even numbered screw terminal as per the table below.

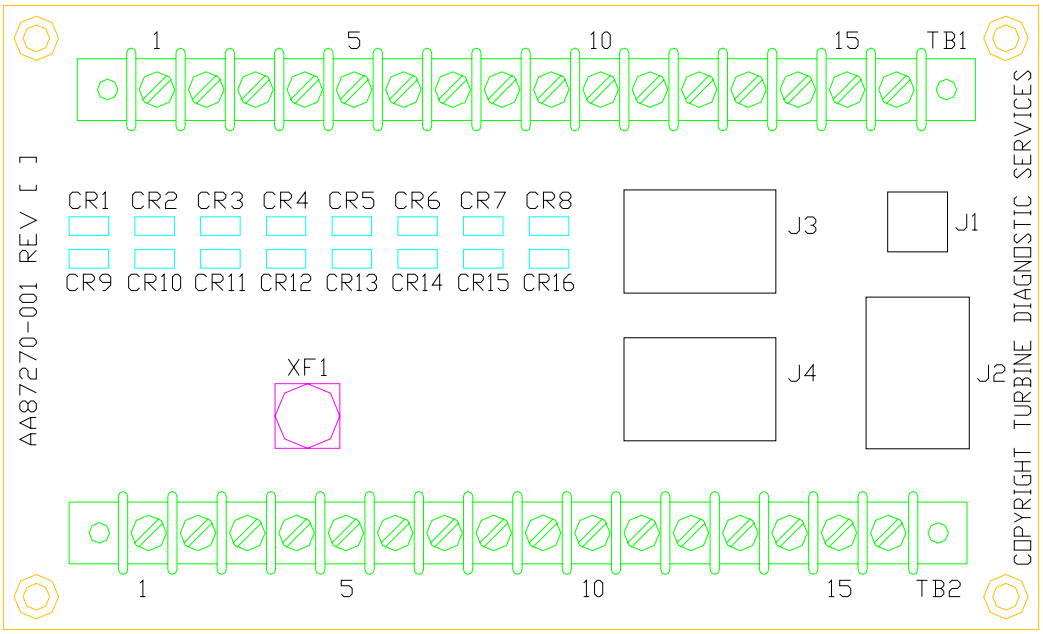
This termination board can be powered externally if an isolated 24 VDC supply is required. If so specified, the panel would have provisions for wiring an external 24 VDC supply connection that would be factory wired to the J1 connector on that isolated 24 VDC contact input termination board.

The table below shows the connections necessary to connect the 16 Contact Inputs.

Contact Input	Screw Terminal	
Channel Number	**Positive 24 VDC**	**24 VDC Return**
0	TB1-1	TB1-2
1	TB1-3	TB1-4
2	TB1-5	TB1-6
3	TB1-7	TB1-8
4	TB1-9	TB1-10
5	TB1-11	TB1-12
6	TB1-13	TB1-14
7	TB1-15	TB1-16
8	TB2-1	TB2-2
9	TB2-3	TB2-4
10	TB2-5	TB2-6
11	TB2-7	TB2-8
12	TB2-9	TB2-10
13	TB2-11	TB2-12
14	TB2-13	TB2-14
15	TB2-15	TB2-16

All screw terminal connections are protected with bi-directional transient voltage suppressors and connected through the termination board stand off mounts to chassis ground. The status of each channel can be viewed on the LED indication for each channel. On the 24 VDC contact input module, LED's corresponding to each channel are on when the 24 VDC is detected on the return lead indicating a true condition. The channel number will match the LED number on in the front of the associated module.

Below is a layout drawing of the 24 VDC contact input termination board used to locate fuses, component and connections on the board.



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APPLICATION GUIDE, OVERSPEED TERMINATION BOARD

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96305	-

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SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96305	-
SCALE: NONE		SHEET 2 OF 8	

1.0 Document Purpose

The purpose of this System Description document is to provide a general overview and functional description of the Turbine Diagnostic Services Inc. TurboNet *DASH 1*® overspeed termination board.

This document is not intended to provide the details required to set up, program, operate, or troubleshoot the input, the overspeed module and the usage of the input in the control programming. This document will provide descriptions intended to familiarize engineers, managers, technicians, and operators with the component and its expectations.

This document is intended to provide a broad knowledge of the components used and arranged on the overspeed termination board. The document will discuss the board's capabilities, architecture, and the field device termination points.

This document will also provide references to other documentation providing additional details.

2.0 Component Description

The overspeed termination board for the TurboNet *DASH 1*® provides a triple redundant backup electronic overspeed trip function, hardwired on the board. The board features triple redundant ETR (emergency trip relay) miniature trip relays setup with the three miniature relays hard wired in a 2 out of 3 voting scheme. This voting scheme is used to energize two ETD (emergency trip device relays) located on the overspeed termination board. The overspeed termination board can accept up to 6 passive magnetic speed pickups arranged in two sets of three. Each set of three is used for monitoring one rotor. The two sets are used for monitoring a two shaft machine. Most turbines have a single shaft arrangement, and only three speed pickups would be required for the single shaft. On units with more than two shafts, additional overspeed termination boards can be wired in series to support the additional shafts.

One magnetic speed pickup input, from each set of three speed probes for each rotor, is hard wired to connectors on the overspeed termination board. Three cables (connected to J2, J3, and J4) interconnect three separately powered overspeed I/O modules. The triple redundant arrangement allows the unit to remain operating if one overspeed module were to fail. This allows the hot pluggable I/O module to be changed on line.

Each of the overspeed I/O modules provides the speed value to the control processors via three separate Ethernet base controllers, one for each of the triple redundantly arranged overspeed modules. The three speed values for each rotor monitored is then processed and voted upon in the processor.

During normal operation, the feedback from the overspeed I/O module energizes one of the three ETR miniature relays on the overspeed termination board. Each overspeed I/O module has a processor inside monitoring the speed value relative to a setpoint provided by the control processor. The acceptable speed condition below the overspeed setpoint allows the associated miniature relay to be energized. Feedback from each ETR miniature relay is provided back to the overspeed I/O module and to the control processor. The failure of an overspeed I/O module or a speed condition above the setpoint drops out the associated miniature relays. When two of the miniature relays are dropped, this in turn trips the two ETD relays (K4 & K5) and the machine. These ETR miniature relays can also be controlled by software in the controller as long as the trip condition is not met. This allows the unit to be tripped in software.

The status of each of the ETR miniature relay is fed back to the processor for diagnostic purposes. This enables the testing of the three overspeed channels and the three ETR miniature relays by physically actuating the relay and monitoring the action. This is accomplished by dropping the overspeed setpoint below running speed on an individual overspeed module basis. It can also alarm on the failure of one of these relays. Failure of one of the relays does not trip the unit. This provides an on line trip testing capability of the back up emergency overspeed trip system while the machine remains in service with the ETD's reset. The primary overspeed protection is conducted in the control processor

in the control programming based on the three speed values provided by each of the modules.

The overspeed termination board also features input terminals that can be used to externally trip the unit via the two ETD's located on the board. These terminals are used for the following functions:

DCS or BOP trip
Door E-STOP
Cabinet TRIP

The miniature relays of the overspeed termination board are in series with the external trips listed above. When the trip circuit is completed by picking up two of the three overspeed miniature relays, and all the external trips, the relays K4 and K5 (ETD's) are picked up. These relays are rated to pick up the trip coil or coils. If more contacts are required, interposing relays need to be incorporated. In the case of gas turbines, where there is a need to independently control two trip solenoids, the ETD trip contact must be placed in series with a contact from a relay termination board. All the external trip inputs must be closed to allow reset the machine.

The following table shows the connections for the termination board.

Speed	**Screw Terminal**	
Input	**Signal**	**Shield**
TNH-1	TB1-1 & -2	TB1-3
TNH-2	TB1-4 & -5	TB1-3
TNH-3	TB1-6 & -7	TB1-8
TNL-1	TB1-9 & -10	TB1-8
TNL-2	TB1-11 & -12	TB1-13
TNL-3	TB1-14 & -15	TB1-13

TNH signifies the speed input from the high pressure rotor of a two rotor machine. The TNL signifies the speed input from the low pressure rotor of a two rotor machine. For single shaft rotors, only the TNH inputs will be utilized.

The overspeed termination board can power the trip solenoids from power supplied internally from the system 24 volt power supply or externally through power brought in through the J5 connector.

The ETD relay contacts are rated as follows:

RELAY STATUS	VOLTAGE	CURRENT
NORMALLY OPEN	120 VAC	10 A
NORMALLY OPEN	125 VDC	0.2 A
NORMALLY CLOSED	120 VAC	10 A
NORMALLY CLOSED	125 VDC	NOT RATED

The ETD relay contacts can be setup to power a trip solenoid on a trip condition (pick up to trip) or energize a trip solenoid based on a reset condition. The reset condition will use the normally open contacts, which will close when reset. This is the preferred way as it is fail safe. The power on trip condition will use the normally closed contact and will have the reduced current rating shown above.

The following jumpers will need to be installed on the overspeed termination board to power the solenoids:

RELAY	POWER SOURCE	JUMPERS
K4	INTERNAL	P1, P5
K4	EXTERNAL	P2
K5	INTERNAL	P3, P6
K5	EXTERNAL	P4

The following table shows the field wiring connections necessary to power a solenoid internally, externally, or with dry contacts (powered from a power source of another trip circuit):

RELAY	POWER SOURCE	POS/HOT TERMINAL	NEG/NEUT TERMINAL
K4	INTERNAL/NO	TB2-8	TB2-10
K4	INTERNAL/NC	TB2-9	TB2-10
K4	EXTERNAL/NO	TB2-8	TB2-10
K4	EXTERNAL/NC	TB2-9	TB2-10
K4	DRY/NO	TB2-8	TB2-7
K4	DRY/NC	TB2-9	TB2-7
K5	INTERNAL/NO	TB2-12	TB2-14
K5	INTERNAL/NC	TB2-13	TB2-14
K5	EXTERNAL/NO	TB2-12	TB2-14
K5	EXTERNAL/NC	TB2-13	TB2-14
K5	DRY/NO	TB2-12	TB2-11
K5	DRY/NC	TB2-13	TB2-11

The following table shows the fuse protection for the overspeed termination board 24 volt DC power input and for each ETD relay:

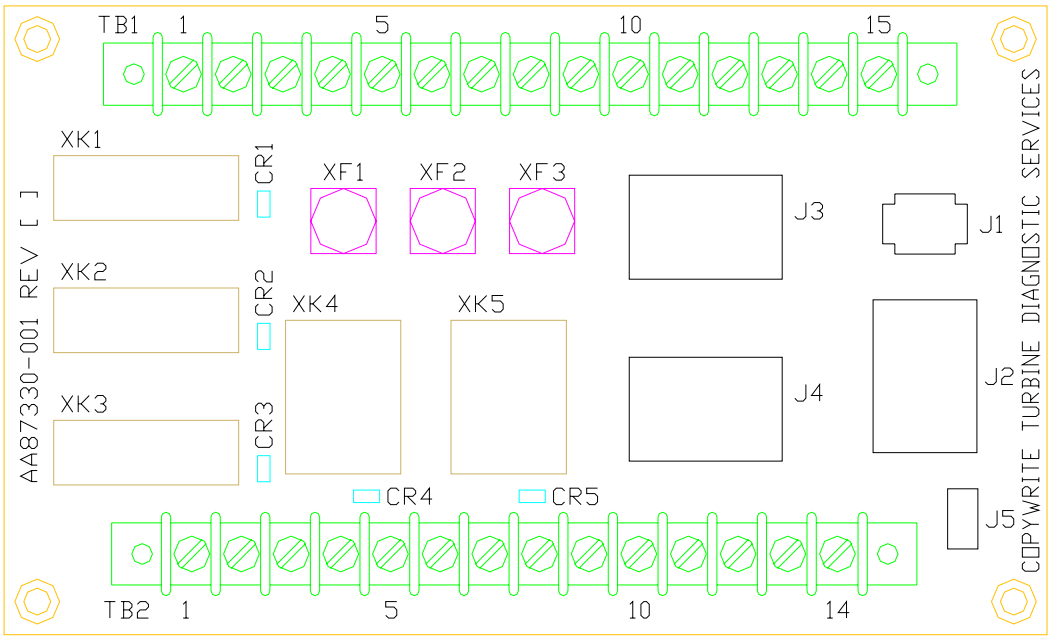
Channel	FUSE ID	VALUE
Overspeed Termination Board 24 VDC Power Supply	FU1	1A (as supplied) Must be sized to a maximum of 4A based on solenoid loads
ETD Relay 1 (K4)	FU2	2A (AC LOADS)
ETD Relay 2 (K5)	FU3	2A (AC LOADS)

The following is a table depicting external trip input termination points. These trips cannot be overridden in software by the TurboNet *DASH 1*®. All the trips need to be connected and closed for the circuit to be completed and a reset accomplished. If not used, hard wired jumpers must be installed to eliminate the open contact state.

TRIP	POSITIVE TERMINAL	NEGATIVE TERMINAL
TRIP #1 (EMERG STOP)	TB2-1	TB2-2
TRIP #2 (EXTERNAL TRIP)	TB2-3	TB2-4
TRIP #3 (CABINET TRIP)	TB2-5	TB2-6

The input wiring shields are grounded to a single point through the ground connection of the internal 24vdc power supply provided by the J1 connector. The input signal lightning protection diodes are located in the Overspeed I/O Modules, but hardwired back through the J2, J3, and J4 connectors and hard wired to the termination board stand off mounts to chassis ground.

The following overspeed board layout drawing shows the location of the components used on the termination board.



SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96305	-
SCALE: NONE		SHEET 8 OF 8	

APPLICATION		REVISION			
NEXT ASSY	USED ON	REV	DESCRIPTION	DATE	APPROVED

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APPLICATION GUIDE, RELAY OUTPUT TERMINATION BOARD

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96306	-

SCALE: NONE

Table of Contents

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96306	-
SCALE: NONE		SHEET 2 OF 8	

1.0 Document Purpose

The purpose of this System Description document is to provide a general overview of the Turbine Diagnostic Services Inc. TurboNet *DASH 1*® relay termination board.

This document is not intended to provide the details required to set up, program, operate, or troubleshoot the input, the relay output module and the usage of the input in the control programming. This document will provide description intended to familiarize engineers, managers, technicians, and operators with the component on the relay output termination board, and its expectations.

This document is intended to provide a broad knowledge of the components used and arranged on the relay output termination board. The document will discuss the board's capabilities, architecture, and the field device termination points.

This document will also provide references to other documentation providing additional details.

2.0 Component Description

The relay output termination board provides a means for the TurboNet *DASH 1*® to use contact outputs for controlling outside devices. These outside devices may be motor starters, breakers, solenoids, indicating lights, status, alarms, etc. Power and control connections to the board are provided using connection plugs. Connection plug J1 is used to bring 24 VDC into the board. Connection plug J2 connects to the T1K-08TD-1, which provides relay control. Connection plug J3 provides a connection point for contact wetting voltages. This power source can be supplied from the system internal 24 VDC power supplied through J1 or could be an isolated 24 VDC source or 120 VAC or 125 VDC, or any other voltage in between that the user may need, as supplied through J3.

Each relay termination board has 8 relays that are controlled by the TurboNet *DASH 1*®. Each relay coil is powered by a 24 VDC source that is supplied through connection plug J1. The relay termination board has a fuse, F9, which protects the board and the relay coils. All 8 relays have positive 24 VDC connected to point A of the coil. The other side of each relay coil, point B, is connected through connection plug J2 to a T1K-08TD-1 relay output module. Each relay coil has an arc suppression diode connected across the coil to absorb energy when the coil transitions from an energized state to a de-energized state.

Each relay has a normally closed contact and two normally open contacts. The two normally open contacts are hard wired in series.

Jumpers on the board can be configured to provide an internal voltage to power external devices. This voltage can be the 24 VDC provided via connection plug J1 or another voltage provided via connection plug J3. If connection plug J3 is used to provide an internal voltage to the contacts of a relay then all the other relays on that relay termination board must use that same internal voltage or use an external voltage. Jumpers P9 and P10 must be out when an external voltage is connected to the J3 connection plug. The use of a wetting voltage on the each relay output is individually selectable.

All external connections for relay contacts are made on the screw terminal boards, TB1 and TB2. TB1 provides connections for relays K1, K2, K3, and K4. TB2 provides connections for relays K5, K6, K7, and K8. All relay contacts are protected by fuses F1 through F8. The relay contacts are rated for a maximum voltage of 250 VAC or 125 VDC. When powering external devices through the termination board from the internal power supply, the size of FU9 needs to be adjusted accordingly. The relay board comes with a 2A fuse slow blow from the factory, to a maximum of 4A.

The board is wired such that wetting voltage is only available in the Normally Open contact. If this voltage is necessary on a normally closed contact, then a wire jumper needs to be placed across the termination board.

The table below shows the connections for using the board as dry contacts:

Relay	Normally Closed		Normally Open	
Number	Terminal Screws		Terminal Screws	
1	TB1-1	TB1-3	TB1-1	TB1-2
2	TB1-5	TB1-7	TB1-5	TB1-6
3	TB1-9	TB1-11	TB1-9	TB1-10
4	TB1-13	TB1-15	TB1-13	TB1-14
5	TB2-1	TB2-3	TB2-1	TB2-2
6	TB2-5	TB2-7	TB2-5	TB2-6
7	TB2-9	TB2-11	TB2-9	TB2-10
8	TB2-13	TB2-15	TB2-13	TB2-14

The table below shows the jumpers necessary to wet a contact from the internal 24 VDC power supply. If an external supply is used, do not install jumpers P9 and P10. This scheme assumes that the relay is going to be used in a normally open fashion.

Relay Number	Terminal Screws		Jumpers		
1	POSITIVE TB1-1	RETURN TB1-4	P1	P9*	P10*
2	POSITIVE TB1-5	RETURN TB1-8	P2	P9*	P10*
3	POSITIVE TB1-9	RETURN TB1-12	P3	P9*	P10*
4	POSITIVE TB1-13	RETURN TB1-16	P4	P9*	P10*
5	POSITIVE TB2-1	RETURN TB2-4	P5	P9*	P10*
6	POSITIVE TB2-5	RETURN TB2-8	P6	P9*	P10*
7	POSITIVE TB2-9	RETURN TB2-12	P7	P9*	P10*
8	POSITIVE TB2-13	RETURN TB2-16	P8	P9*	P10*

*When using the external power supply, do not install this jumper.

The table below shows the jumpers necessary to wet a closed contact from the internal 24 VDC power supply. If an external power supply is used, do not install jumpers P9 and P10. This scheme assumes that the relay is going to be used in a normally closed fashion. This scheme should not be used for 125 VDC.

Relay Number	Terminal Screws		Jumpers			
1	POSITIVE TB1-3	RETURN TB1-4	P1	P9*	P10*	TB1-1 to TB1-2
2	POSITIVE TB1-7	RETURN TB1-8	P2	P9*	P10*	TB1-5 to TB1-6
3	POSITIVE TB1-11	RETURN TB1-12	P3	P9*	P10*	TB1-9 to TB1-10
4	POSITIVE TB1-15	RETURN TB1-16	P4	P9*	P10*	TB1-13 to TB1-14
5	POSITIVE TB2-3	RETURN TB2-4	P5	P9*	P10*	TB2-1 to TB2-2
6	POSITIVE TB2-7	RETURN TB2-8	P6	P9*	P10*	TB2-5 to TB2-6
7	POSITIVE TB2-11	RETURN TB2-12	P7	P9*	P10*	TB2-9 to TB2-10
8	POSITIVE TB2-15	RETURN TB2-16	P8	P9*	P10*	TB2-13 to TB2-14

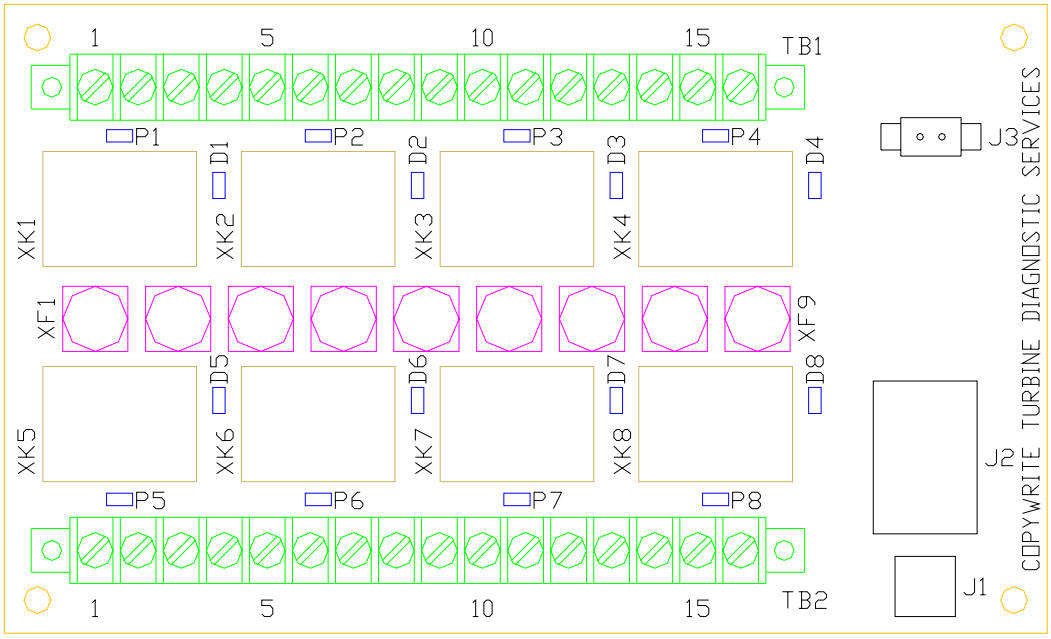
*When using the external power supply on any relay, do not install this jumper.

The Channels on the DOUT1 block in Loopcad are zero based (start with number 0), instead of the relay number, which is one based. The relay output module also has LED displays of the status of each relay driver. This was done so that the LED in the front of the relay output module agrees with the inputs to the block in Loopcad. The relays on the relay output termination board are numbered from 1 to 8. Therefore, the relay numbers do not agree with the relay output module LED designations and the DOUT1 numbering scheme in Loopcad. They will be off by one. See AA96001 for more information on the DOUT1 block.

Use the following table to map the DOUT1 output label to a relay.

LOOPCAD DOUT1 LABEL	RELAY OUTPUT MODULE LED NUMBER	RELAY NUMBER- RELAY OUPUT TERMINATION BOARD
CO0	0	K1
CO1	1	K2
CO2	2	K3
CO3	3	K4
CO4	4	K5
CO5	5	K6
CO6	6	K7
CO7	7	K8

Below is a layout drawing of the termination board used to locate fuses, component and connections on the board.



SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96306	-
SCALE: NONE		SHEET 7 OF 8	

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SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96306	-
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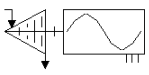
APPLICATION		REVISION			
NEXT ASSY	USED ON	REV	DESCRIPTION	DATE	APPROVED



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APPLICATION GUIDE, RTD TERMINATION BOARD

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96307	-

SCALE: NONE

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SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96307	-
SCALE: NONE		SHEET 2 OF 6	

1.0 Document Purpose

The purpose of this System Description document is to provide a general overview of the Turbine Diagnostic Services Inc. TurboNet *DASH 1*® 16 Channel RTD termination board.

This document is not intended to provide the details required to set up, program, operate, or troubleshoot the input, the RTD input module and the usage of the input in the control programming. This document will provide description intended to familiarize engineers, managers, technicians, and operators with the component on the RTD input termination board, and its expectations.

This document is intended to provide a broad knowledge of the components used and arranged on the RTD input termination board. The document will discuss the board's capabilities, architecture, and the field device termination points.

This document will also provide references to other documentation providing additional details.

2.0 Component Description

The RTD termination board provides a connection point for 16 sets of RTD wires that are used to measure temperature at various places in the field. The TurboNet *DASH 1*® can accommodate the following types of RTDs:

RTD Type	Range °C	Range °F
Pt100	-200 to 850	-328 to 1562
Pt1000	-200 to 595	-328 to 1103
jPt100	-38 to 450	-36 to 842
CU 10	-200 to 260	-328 to 500
CU 25	-200 to 260	-328 to 500
120Ω Nickel	-80 to 260	-112 to 500

The RTD wires are brought in from the field and terminated on screw terminals. They are then connected to the RTD Input Module, T1F-16RTD, via connection plugs J2 and J3.

The RTD type is set in the RTD input module for all inputs on that module. All RTD's connected to the RTD termination board must then all be the same type, and must agree with what type is selected at that associated RTD input module.

The RTD input termination board and the RTD input module provides input capability for 16 RTD's. The RTD channels number designations start with channel 0 and extend to channel 15. The following chart provides the termination points for the RTD field wiring on the RTD termination board:

RTD Channel #	Positive	Negative	Common	Shield
0	TB1-1	TB1-2	TB1-3	TB1-4
1	TB1-5	TB1-6	TB1-7	TB1-8
2	TB1-9	TB1-10	TB1-11	TB1-12
3	TB1-13	TB1-14	TB1-15	TB1-16
4	TB1-17	TB1-18	TB1-19	TB1-20
5	TB1-21	TB1-22	TB1-23	TB1-24
6	TB1-25	TB1-26	TB1-27	TB1-28
7	TB1-29	TB1-30	TB1-31	TB1-32
8	TB2-1	TB2-2	TB2-3	TB2-4
9	TB2-5	TB2-6	TB2-7	TB2-8
10	TB2-9	TB2-10	TB2-11	TB2-12
11	TB2-13	TB2-14	TB2-15	TB2-16
12	TB2-17	TB2-18	TB2-19	TB2-20
13	TB2-21	TB2-22	TB2-23	TB2-24
14	TB2-25	TB2-26	TB2-27	TB2-28
15	TB2-29	TB2-30	TB2-31	TB2-32

All the RTD's are connected together on the common connection. If any of the wires in the RTD is required to be grounded (as is the case in generator stator RTD's), the wire connected to common should be the one grounded.

The common and the negative connections should be connected to the two white wires in the RTD.

The input wiring shields are grounded to a single point through the ground connection of the internal 24vdc power supply provided by the J1 connector.

The T1H-16RTD RTD input module has eight jumpers that are accessible behind the front cover. The jumpers need to be properly set in order to ensure proper module operation. If the module is held upright while the jumpers are on the right PCB, the first four jumpers going down are the CH+1, CH+2, CH+3 and CH+4. The next three jumpers are the RTD type jumpers and are labeled RTD-0, RTD-1 and RTD-3. The last jumper on the bottom is the Units jumper.

The first four jumpers set how many of the sixteen channels are scanned. All jumpers come installed from the assembly plant unless special circumstances require fewer channels to be scanned. The jumpers are set as follows:

Channels to Scan	CH+1	CH+2	CH+3	CH+4
1				
2	X			
3		X		
4	X	X		
5			X	
6	X		X	
7		X	X	
8	X	X	X	
9				X
10	X			X
11		X		X
12	X	X		X
13			X	X
14	X		X	X
15		X	X	X
16	X	X	X	X

The next three jumpers set the RTD type. This RTD type is selected for the whole module, which means that all the RTD's connected that specific module have to be the same type. The table below specifies the jumpers for each configuration.

RTD TYPE	RTD-0	RTD-1	RTD-2
PT 100 Ω	X	X	
PT 1000 Ω			X
jPT 100 Ω		X	
CU 10 Ω			
CU 25 Ω	X		
NI 125 Ω	X		X

The unit jumper is always installed on the RTD module. The firmware is setup to decode units in degrees F.

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96307	-
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APPLICATION GUIDE, THERMOCOUPLE TERMINATION BOARD

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96308	-

SCALE: NONE

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SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96308	-
SCALE: NONE		SHEET 2 OF 6	

1.0 Document Purpose

The purpose of this System Description document is to provide a general overview of the Turbine Diagnostic Services Inc. TurboNet *DASH 1*® 14 channel thermocouple termination board.

This document is not intended to provide the details required to set up, program, operate, or troubleshoot the input, the thermocouple input module and the usage of the input in the control programming. This document will provide a description intended to familiarize engineers, managers, technicians, and operators with the component on the thermocouple input termination board, and its expectations.

This document is intended to provide a broad knowledge of the components used and arranged on the thermocouple input termination board. The document will discuss the board's capabilities, architecture, and the field device termination points.

This document will also provide references to other documentation providing additional details.

2.0 Component Description

The thermocouple termination board provides a connection point for thermocouple wires that are used to measure temperature at various places in the field. The TurboNet *DASH 1*® can accommodate several types of thermocouples. The different types of thermocouples supported are listed in the chart below:

Thermocouple Type	Range °C	Range °F
J	-190 to 760	-310 to 1400
E	-210 to 1000	-346 to 1832
K	-150 to 1372	-238 to 2502
R	65 to 1768	149 to 3214
S	65 to 1768	149 to 3214
T	-230 to 400	-382 to 752
B	529 to 1820	984 to 3308
N	-70 to 1300	-94 to 2372
C	65 to 2320	149 to 4208

The thermocouple termination board receives 24 VDC power via connection plug J1. The power supply is protected by fuse F1 (0.4 Amp). This power is passed on to the thermocouple input module, T1F-14THM, via connection plug J3 pins 23 and 24. When powered from the system internal 24 VDC power source, the jumpers P1 and P2 are installed for this mode of operation. Jumper P3 should be removed when powering the module straight from the system power supply.

If the thermocouples are grounded in the field, the module power must be isolated. This isolation is done with a DC/DC converter, U1, mounted on the thermocouple termination board. When the isolated power supply is used, jumpers P1, P2 must be removed. Jumper P3 grounds the isolated power supply via the ground connection supplied through J1.

All thermocouples are tied to the RTN of the 24 VDC power supply via a 20KΩ resistor and passed on to the thermocouple input module through connection plugs J2 and J3. The type of thermocouple that can be connected to a thermocouple termination board is determined by how the thermocouple input module is set up. Only one type of thermocouple can be connected to a termination board and its associated input module.

A cold junction compensation temperature sensor unit, T1F-CJC, is mounted on TB3 and carried through to the thermocouple input module via connection plug J3. Care must be taken to ensure that the termination board is not near a heat source. Heat sources will create a source of error in the temperature compensation measurement.

The module has eleven jumpers accessible through the top cover. If the module is held vertically with the jumpers on the right, the top four jumpers are the Channel selection

jumpers and are named, starting at the top, CH+1, CH+2, CH+3 and CH+4. The next four jumpers down are the thermocouple type selection jumpers. They are labeled, starting at the top, T/C Type 0, T/C Type 1, T/C Type 2 and T/C Type 3. The next two jumpers select the engineering units for the module. Starting at the top they are named Units-0 and Units-2. The last jumper at the bottom is called the **Calibrate Enable** jumper. It disables the thermocouple brownout detection circuitry so that a calibrator can be connected.

The table below shows the jumpers for setting the numbers of channels to scan. The module is set to all 14 channels at the factory, unless a special application like a gas turbine that requires fast update of the temperature readings requires it to be less.

Number of Channels to Scan	CH+1	CH+2	CH+3	CH+4
1				
2	X			
3		X		
4	X	X		
5			X	
6	X		X	
7		X	X	
8	X	X	X	
9				X
10	X			X
11		X		X
12	X	X		X
13			X	X
14	X	X	X	X

The table below shows the jumpers to select a particular thermocouple type. The jumpers are configured from the factory for the specified type of thermocouple requested.

THERMOCOUPLE TYPE	T/C TYPE 0	T/C TYPE 1	T/C TYPE 2	T/C TYPE 3
J	X	X	X	X
K		X	X	X
E	X		X	X
R			X	X
S	X	X		X
T		X		X
B	X			X
N				X
C	X	X	X	

The table below shows the engineering units conversion jumper configurations for the thermocouple input module.

Conversion Units	Units 0	Units 1
Deg F/ Mag Plus Sign	X	X
Deg C/ Mag Plus Sign		X
Deg F/Two's Complement	X	

The control processor expects the values to be in degrees F and two's complement. Therefore, the Units 0 jumper should be installed and the Units 1 jumper removed for all TurboNet *DASH 1*® applications.

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	**1XKV4**	**AA96308**	**-**
SCALE: NONE		SHEET 6 OF 6	

APPLICATION		REVISION			
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	1378	A	Added AA97321 board description	11-12-08	EJC

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APPLICATION GUIDE, SERVO TERMINATION BOARD

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96309	A

SCALE: NONE

Table of Contents

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96309	A
SCALE: NONE		SHEET 2	

1.0 Document Purpose

The purpose of this System Description document is to provide a general overview of the Turbine Diagnostic Services Inc., TurboNet *DASH 1*® servo termination board.

This document is not intended to provide the details required to set up, program, operate, or troubleshoot the input, the loop controller module and the usage of the input in the control programming. This document will provide description intended to familiarize engineers, managers, technicians, and operators with the components on the servo termination board, and its expectations.

This document is intended to provide a broad knowledge of the components used and arranged on the servo termination board. The document will discuss the board's capabilities, architecture, and the field device termination points.

2.0 Component Description

The servo termination board provides a connection point for LVDT excitation, LVDT feedback, servo current output and a magnetic speed pickup input. This module is capable of controlling hydraulic servo controlled valves using one, two or three LVDT for feedback and/or a frequency input. The frequency input will be typically be used for gas turbine liquid fuel flow system.

Each termination board can handle two LVDT's, two servos coils and one passive magnetic pickup. There are two versions of the servo termination boards. They are listed below as well as the module part number they are designed to work with.

Servo Board	Module P/N	TDS Module P/N
AA97320	T1H-LC	SCD1312P001
AA97321	T1H-LC2	SCD1312P002

First Generation Termination Board - AA97320

All signals connected to screw terminals are protected with bi-directional transient suppressors and connected through the termination board stand off mounts to chassis ground. The signals are passed to the servo modules via connection plug J2. Connection plug J1 is used to bring 24 VDC power into the termination board.

The servo module generates a 3 KHz excitation voltage for the LVDT's which is connected to the servo termination board via J2 and then on to the LVDT's via screw terminals. The LVDT feedbacks come into the termination board via screw terminals and continue on to the servo module via J2. The servo driving signals originate in the servo module and are passed on to the termination board via J2 and continue on to the servos via screw terminals.

In the servo module the LVDT signal is demodulated and a DC signal proportional to the ratio of the LVDT excitation and feedback is generated. This demodulated signal is then passed back to the termination board via J2.

On the termination board there is a network of traces and jumpers that allow the demodulated LVDT signals to be shared between other servo termination boards and servo modules. These traces and jumpers allow the connection of the demodulated signals to "Buses". These buses are then tapped into via jumpers to feed back the correct demodulated signals to the modules. The buses can be connected to other servo termination boards and allow for the signals to be shared to other servo modules with cross connection of the termination boards using the J3 and J4 connectors. This allows for the capability of providing single, double, and triple redundant control device capabilities.

The servo termination board field connection terminal point designations are as follows:

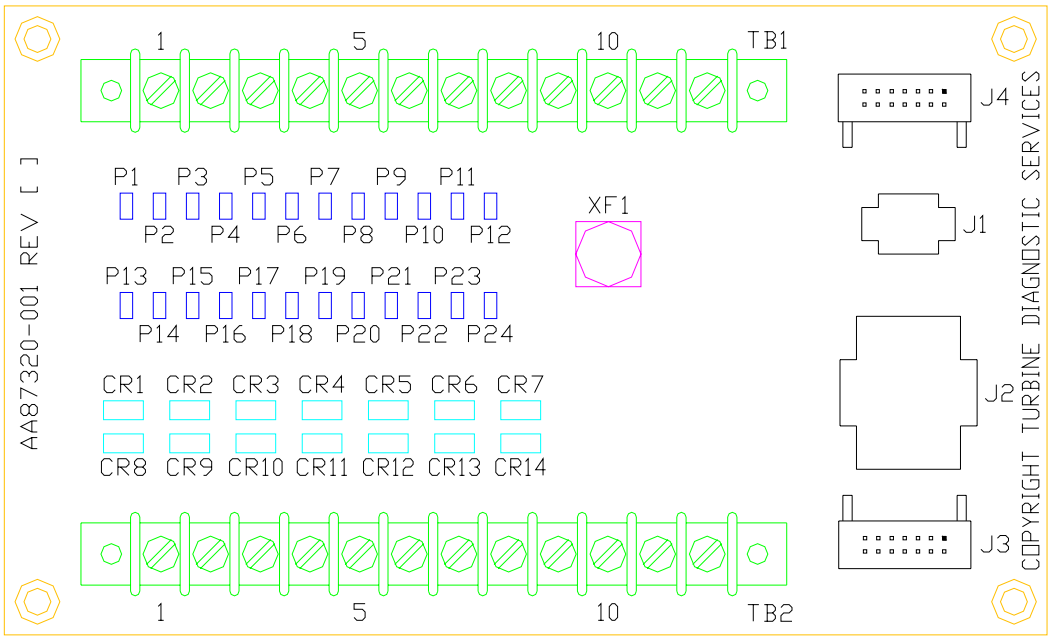
Input Description	Screw Terminal
LVDT Excitation # 1 High	TB1-1
LVDT Excitation #1 Low	TB1-2
LVDT Excitation # 1 shield	TB1-3
LVDT Feedback #1 High	TB1-4
LVDT Feedback #1 Low	TB1-5
LVDT Feedback #1 shield	TB1-6
Servo # 1 (+)	TB1-7
Servo # 1 (-)	TB1-8
Servo # 1 Shield	TB1-9
Magnetic Pickup Signal High	TB1-10
Magnetic Pickup Signal Low	TB1-11
Magnetic Pickup Shield	TB1-12
LVDT Excitation # 2 High	TB2-1
LVDT Excitation #2 Low	TB2-2
LVDT Excitation # 2 shield	TB2-3
LVDT Feedback #2 High	TB2-4
LVDT Feedback #2 Low	TB2-5
LVDT Feedback #2 shield	TB2-6
Servo # 2 (+)	TB2-7
Servo # 2 (-)	TB2-8
Servo # 2 Shield	TB2-9

The input wiring shields are grounded to a single point through the ground connection of the internal 24vdc power supply provided by the J1 connector.

Use the following table to plan how the LVDT demodulated signals will get distributed across the different termination boards and modules for sharing of signals and different levels of redundancy:

JUMPER	FUNCTION
P1	CONNECT DEMODULATED CHANNEL #1 TO BUS 1
P2	CONNECT DEMODULATED CHANNEL #1 TO BUS 2
P3	CONNECT DEMODULATED CHANNEL #1 TO BUS 3
P4	CONNECT DEMODULATED CHANNEL #1 TO BUS 4
P5	CONNECT CHANNEL #1 DC INPUT #1 TO BUS 1
P6	CONNECT CHANNEL #1 DC INPUT #1 TO BUS 2
P7	CONNECT CHANNEL #1 DC INPUT #1 TO BUS 3
P8	CONNECT CHANNEL #1 DC INPUT #1 TO BUS 4
P9	CONNECT CHANNEL #1 DC INPUT #2 TO BUS 1
P10	CONNECT CHANNEL #1 DC INPUT #2 TO BUS 2
P11	CONNECT CHANNEL #1 DC INPUT #2 TO BUS 3
P12	CONNECT CHANNEL #1 DC INPUT #2 TO BUS 4
P13	CONNECT DEMODULATED CHANNEL #2 TO BUS 1
P14	CONNECT DEMODULATED CHANNEL #2 TO BUS 2
P15	CONNECT DEMODULATED CHANNEL #2 TO BUS 3
P16	CONNECT DEMODULATED CHANNEL #2 TO BUS 4
P17	CONNECT CHANNEL #2 DC INPUT #1 TO BUS 1
P18	CONNECT CHANNEL #2 DC INPUT #1 TO BUS 2
P19	CONNECT CHANNEL #2 DC INPUT #1 TO BUS 3
P20	CONNECT CHANNEL #2 DC INPUT #1 TO BUS 4
P21	CONNECT CHANNEL #2 DC INPUT #2 TO BUS 1
P22	CONNECT CHANNEL #2 DC INPUT #2 TO BUS 2
P23	CONNECT CHANNEL #2 DC INPUT #2 TO BUS 3
P24	CONNECT CHANNEL #2 DC INPUT #2 TO BUS 4

Below is a layout drawing of the servo termination board used to locate fuses, component and connections on the board.



SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96309	A
SCALE: NONE		SHEET 8	

Second Generation Termination Board - AA97321

All signals connected to screw terminals are protected with bi-directional transient suppressors and connected through the termination board stand off mounts to chassis ground. The signals are passed to the servo modules via connection plug J2 and J11.

Connection plug J1 is used to bring 24 VDC power into the termination board. A 24 VDC dc-dc converter generates the +/- 12 VDC signals necessary to power the module. Test points E1 & E2 are the +12 VDC and -12VDC respectively when measured against E3. LED D1 & D2 indicate the presence of these two power supplies.

The servo module generates a nominal 3 KHz excitation voltage for the LVDT's which is connected to the servo termination board via J2. An operational amplifier then buffers the signals and feeds them to the LVDT via screw terminals. The raw signal can be measured at E4 & E5 for channel 0 excitation and E6 & E7 for channel 1 excitation. The LVDT feedbacks come into the termination board via screw terminals and continue on to the servo module via J2. The servo driving signals originate in the servo module and are passed on to the termination board via J2 and continue on to the servos via screw terminals.

In the servo module the LVDT signal is demodulated and a DC signal proportional to the ratio of the LVDT excitation and feedback is generated. This demodulated signal is then passed back to the termination board via J11.

On the termination board there is a network of traces and jumpers that allow the demodulated LVDT signals to be shared between other servo termination boards and servo modules. These traces and jumpers allow the connection of the demodulated signals to "Buses". These buses are then tapped into via jumpers to feed back the correct demodulated signals to the modules. The buses can be connected to other servo termination boards and allow for the signals to be shared to other servo modules with cross connection of the termination boards using the J3 and J4 connectors. This allows for the capability of providing single, double, and triple redundant control device capabilities.

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96309	A
SCALE: NONE		SHEET 9	

The servo termination board field connection terminal point designations are as follows:

Input Description	Screw Terminal
LVDT Excitation # 1 High	TB1-1
LVDT Excitation #1 Low	TB1-2
LVDT Excitation # 1 shield	TB1-3
LVDT Feedback #1 High	TB1-4
LVDT Feedback #1 Low	TB1-5
LVDT Feedback #1 shield	TB1-6
Servo # 1 (+)	TB1-7
Servo # 1 (-)	TB1-8
Servo # 1 Shield	TB1-9
Magnetic Pickup Signal High	TB1-10
Magnetic Pickup Signal Low	TB1-11
Magnetic Pickup Shield	TB1-12
LVDT Excitation # 2 High	TB2-1
LVDT Excitation #2 Low	TB2-2
LVDT Excitation # 2 shield	TB2-3
LVDT Feedback #2 High	TB2-4
LVDT Feedback #2 Low	TB2-5
LVDT Feedback #2 shield	TB2-6
Servo # 2 (+)	TB2-7
Servo # 2 (-)	TB2-8
Servo # 2 Shield	TB2-9

The input wiring shields are grounded to a single point through the ground connection of the internal 24vdc power supply provided by the J1 connector.

Use the following table to plan how the LVDT demodulated signals will get distributed across the different termination boards and modules for sharing of signals and different levels of redundancy:

JUMPER	POSITION	FUNCTION
J5	1	CONNECT DEMODULATED CHANNEL #1 TO BUS 1
J5	2	CONNECT DEMODULATED CHANNEL #1 TO BUS 2
J5	3	CONNECT DEMODULATED CHANNEL #1 TO BUS 3
J5	4	CONNECT DEMODULATED CHANNEL #1 TO BUS 4
J6	1	CONNECT CHANNEL #1 DC INPUT #1 TO BUS 1
J6	2	CONNECT CHANNEL #1 DC INPUT #1 TO BUS 2
J6	3	CONNECT CHANNEL #1 DC INPUT #1 TO BUS 3
J6	4	CONNECT CHANNEL #1 DC INPUT #1 TO BUS 4
J7	1	CONNECT CHANNEL #1 DC INPUT #2 TO BUS 1
J7	2	CONNECT CHANNEL #1 DC INPUT #2 TO BUS 2
J7	3	CONNECT CHANNEL #1 DC INPUT #2 TO BUS 3
J7	4	CONNECT CHANNEL #1 DC INPUT #2 TO BUS 4
J8	1	CONNECT DEMODULATED CHANNEL #2 TO BUS 1
J8	2	CONNECT DEMODULATED CHANNEL #2 TO BUS 2
J8	3	CONNECT DEMODULATED CHANNEL #2 TO BUS 3
J8	4	CONNECT DEMODULATED CHANNEL #2 TO BUS 4
J9	1	CONNECT CHANNEL #2 DC INPUT #1 TO BUS 1
J9	2	CONNECT CHANNEL #2 DC INPUT #1 TO BUS 2
J9	3	CONNECT CHANNEL #2 DC INPUT #1 TO BUS 3
J9	4	CONNECT CHANNEL #2 DC INPUT #1 TO BUS 4
J10	1	CONNECT CHANNEL #2 DC INPUT #2 TO BUS 1
J10	2	CONNECT CHANNEL #2 DC INPUT #2 TO BUS 2
J10	3	CONNECT CHANNEL #2 DC INPUT #2 TO BUS 3
J10	4	CONNECT CHANNEL #2 DC INPUT #2 TO BUS 4

Below is a layout drawing of the servo termination board used to locate fuses, component and connections on the board. Jumper positions are determined by jumpering the center pin to the pin closest to the position number desired.

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96309	A
SCALE: NONE		SHEET 12	

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APPLICATION GUIDE, VIBRATION TERMINATION BOARD

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96310	-

SCALE: NONE

Table of Contents

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96310	-
SCALE: NONE		SHEET 2 OF 8	

1.0 Document Purpose

The purpose of this System Description document is to provide a general overview of the Turbine Diagnostic Services Inc. TurboNet *DASH 1*® vibration termination board.

This document is not intended to provide the details required to set up, program, operate, or troubleshoot the input, the vibration module and the usage of the inputs in the control programming. This document will provide description intended to familiarize engineers, managers, technicians, and operators with the components on the vibration termination board, and its expectations.

This document is intended to provide a broad knowledge of the components used and arranged on the vibration termination board. The document will discuss the board's capabilities, architecture, and the field device termination points.

2.0 Component Description

The vibration termination board provides a connection point for vibration input signals to the TurboNet *DASH 1*®. The TurboNet *DASH 1*® vibration module can handle a reference probe (proximeter), two proximeters or seismic vibration probes in any combination.

Each vibration termination board has provisions for two vibration modules, when necessary. One module (A) is connected via connector J2 and the second module (B) is connected via connector J3.

The system internal 24 VDC power is brought into the vibration termination board through connection plug J1. The positive side of this 24 VDC is protected by fuses FU1 for module A. FU2 protects the 24 VDC power for module B. Fuses FU1 and FU2 are 0.5 Amp. Each module can power up to three proximeters.

The termination board is internally wired to allow the powering of the reference probe from more than one module allowing for redundant power supplies for the reference probe. This configured via jumpers.

The termination board also features two connectors, J4 & J5, which is used to pass the reference probe signal from one termination board to the next. It also allows modules connected to different termination boards to also power the reference probe.

The vibration module is internally connected to handle five channels as shown below:

CHANNEL	SIGNAL
1	PROXIMETER 1
2	PROXIMETER 2
3	PROXIMETER 3 (REF PROBE)
4	SEISMIC 1
5	SEISMIC 2

The module is configured such that it can only analyze one type of probe at a time, either proximeter or seismic.

The module also features a buffered output. This signal is the output from a following amplifier that duplicates the input signal so that troubleshooting equipment can be connected without interfering with the probe signal.

Each channel has its own buffered output, and only one can be used at a time (seismic or proximeter). Which buffered output is connected to the BNC connectors is selected via jumpers.

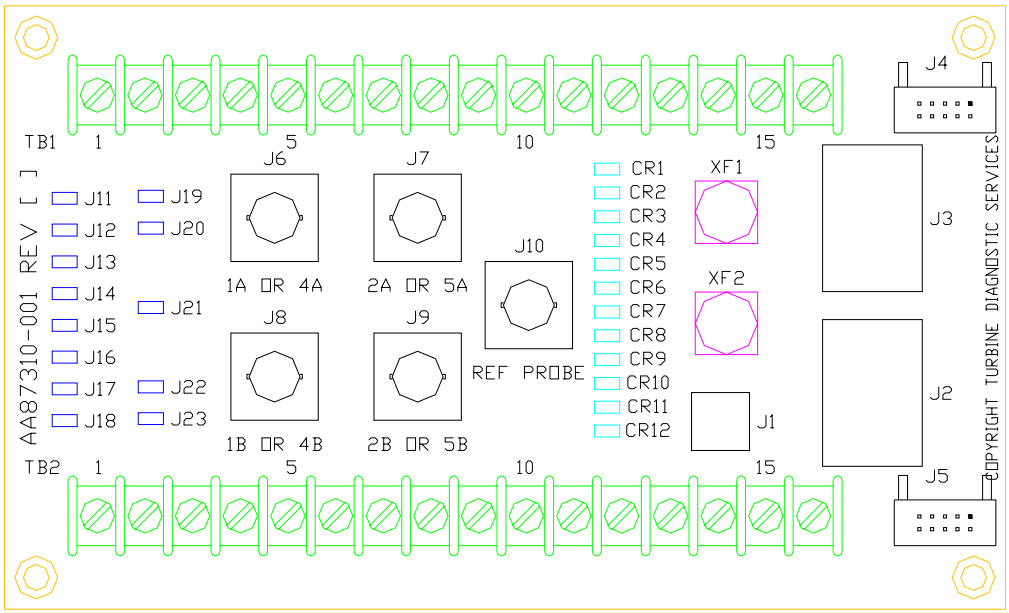
The reference probe signal has to be shared between the two modules connected to the board. The power of this probe comes from module A on the board. Via a jumper, the power can also come from the B module, whichever has a higher voltage. If the reference probe signal applies to probes on other boards, this signal can be passed to another termination board via the ribbon cable. The modules on this other termination board can also power the reference probe if so configured. This allows for very elaborate schemes for power sources and reference probe sharing.

Use the following table to configure the jumpers a board

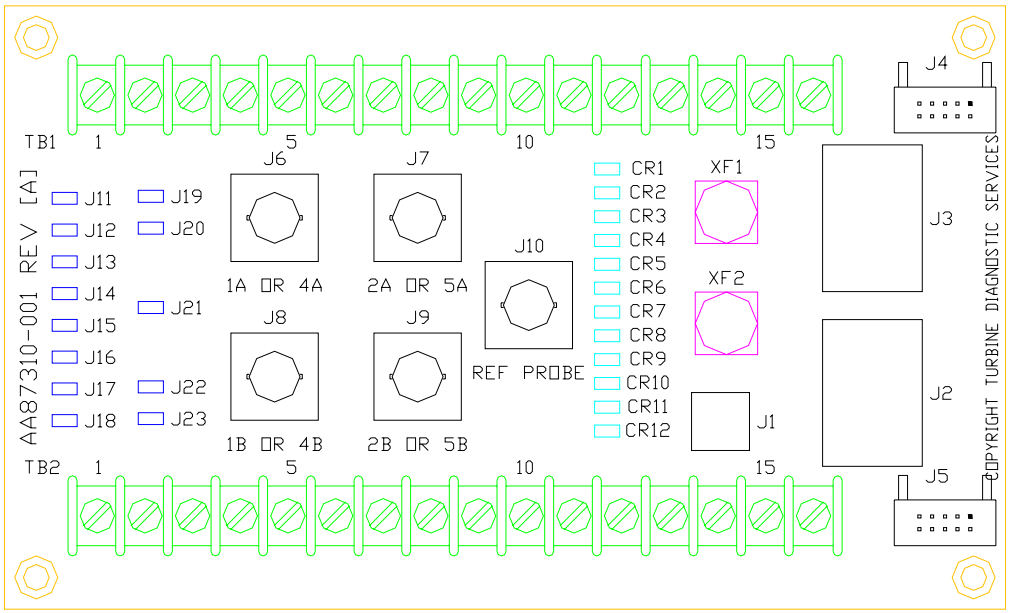
JUMPER	PURPOSE
J11	Connects 0V Reference to J4, J5 Bus.
J12	Connects Ref Probe Power Bus to J4, J5 Power Bus.
J13	Connects Ref Probe Signal to J4, J5 Bus.
J14	Connects Module B Supply to the Ref Probe Power Bus.
J15	Connects Module A Channel 4 Buffered Output to J6.
J16	Connects Module A Channel 5 Buffered Output to J7.
J17	Connect Module B Channel 1 Buffered Output to J8.
J18	Connect Module B Channel 4 Buffered Output to J8.
J19	Connect Module B Channel 2 Buffered Output to J9.
J20	Connect Module B Channel 5 Buffered Output to J10.
J21	Connects the Positive Side of the Isolated Power Supply to Ground. Only One Should Be Installed.
J22	Connect Module A Channel 1 Buffered Output to J6.
J23	Connect Module A Channel 2 Buffered Output to J7.

The sensor wiring shields are grounded to a single point through the ground connection of the internal 24vdc power supply provided by the J1 connector.

Below is a layout drawing of the REV - vibration termination board used to locate fuses, component and connections on the board.



Below is a layout drawing of the REV A vibration termination board used to locate fuses, component and connections on the board.



SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96310	-
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SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96310	-
SCALE: NONE		SHEET 8 OF 8	

APPLICATION		REVISION			
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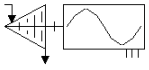
	1378				



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ENG:	E.J.COLON	08-12-12

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APPLICATION GUIDE, FLAME SCANNER TERMINATION BOARD

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96311	-

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SHEET 1 OF 6

Table of Contents

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96311	-
SCALE: NONE		SHEET 2	

1.0 Document Purpose

The purpose of this System Description document is to provide a general overview of the Turbine Diagnostic Services Inc. TurboNet *DASH 1*® flame scanner termination board.

This document is not intended to provide the details required to set up, program, operate, or troubleshoot the input, the vibration module and the usage of the inputs in the control programming. This document will provide description intended to familiarize engineers, managers, technicians, and operators with the components on the vibration termination board, and its expectations.

This document is intended to provide a broad knowledge of the components used and arranged on the vibration termination board. The document will discuss the board's capabilities, architecture, and the field device termination points.

2.0 Component Description

The flame scanner termination board provides a connection point for flame scanner input signals to the TurboNet *DASH 1*®. The TurboNet *DASH 1*® counter module can handle up to four flame scanners. More modules and termination boards can be added to handle the necessary count. This termination board is designed to be connected to a T1H-SOE module.

Each termination board can handle up to four flame scanners. Each channel is powered through a current limiting resistor so as to minimize the effects of a short circuit in the field wiring.

The system internal 24 VDC power is brought into the flame scanner termination board through connection plug J1. The positive side of this 24 VDC is protected by fuse FU1. The module is powered from this 24 V power. The board contains a power supply that isolates the system 24 V power and supplies all the 12 V necessary for the board and the module. The output of the 12 V power supply can be monitored at test points E2 & E1. The 12 V power is routed to the module through the J2 connector.

The 12 V also powers a high voltage supply to excite the flame scanners. This high voltage supply is set at the factory to a nominal 350 VDC as measured at test points E3 & E1. This should not need adjustment, but should the excitation voltage become a problem, it can be changed by adjusting R2. LED D1 is used to monitor the status of the high voltage supply. This signal is also fed to the counter module for monitoring.

The principle under which the flame scanners work is the Geiger-Mueller principle, more famous for its ability to detect nuclear radiation. A high voltage is placed between two plates in a special gas. When the flame scanners are exposed to ultraviolet radiation, they will ionize the gas inside and make it conduct. Due to this conduction effect, the voltage that ionized the gas to begin with collapses and the current stops. Once the current stops, the voltage can be re-established. This process happens many times per seconds and generates a frequency signal that can be used to monitor flame intensity.

The TurboNet DASH 1 reads this frequency so that it can be used as a diagnostic tool. It does not just supply a flame-no flame signal.

Due to the high voltages involved the power supply to the termination board (J1) should be disconnected when servicing the flame scanners. Attention should be paid to the polarity of the connections to the flame scanner since reverse polarity will destroy it. This termination board is supplied with a plexiglass cover so as to protect personnel when working inside the control cabinet. Connector J1 should be disconnected whenever this protective cover is removed.

This module has been shown to work with Honeywell type flame scanners, GE P/N 261A1812P012.

The termination board connections are described in the table below:

CHANNEL	POSITIVE	NEGATIVE	SHIELD
0	1	2	3
1	4	5	6
2	7	8	9
3	10	11	12

Below is a layout drawing of the flame scanner termination board used to locate fuses, component and connections on the board.

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SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96311	-
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APPLICATION GUIDE, SEQUENCE OF EVENTS TERMINATION BOARD

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96312	-

SCALE: NONE

Table of Contents

SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96312	-
SCALE: NONE		SHEET 2	

1.0 Document Purpose

The purpose of this System Description document is to provide a general overview of the Turbine Diagnostic Services Inc. TurboNet *DASH 1*® flame scanner termination board.

This document is not intended to provide the details required to set up, program, operate, or troubleshoot the input, the vibration module and the usage of the inputs in the control programming. This document will provide description intended to familiarize engineers, managers, technicians, and operators with the components on the vibration termination board, and its expectations.

This document is intended to provide a broad knowledge of the components used and arranged on the vibration termination board. The document will discuss the board's capabilities, architecture, and the field device termination points.

2.0 Component Description

The sequence of events termination board provides a connection point for digital input signals to the TurboNet *DASH 1*®. The TurboNet *DASH 1*® sequence of events module can handle up to sixteen channels. More modules and termination boards can be added to handle the necessary count. This termination board is designed to be connected to a T1H-SOE module.

The system internal 24 VDC power is brought into the sequence of events termination board through connection plug J1. LED D18 will glow when the system power supply is present. The positive side of this 24 VDC is protected by fuse FU1.

The wetting voltage for the field contacts can be powered externally or from the internal power supply. If the user wishes to wet the contact inputs from the system 24 V power supply, jumpers J6 and J7 need to be installed. Care should be taken to not have anything connected to connector J3. If the user wishes to use an external power supply (up to 250 VDC), TDS will pre-wire a cable connected to J3 to a terminal board where the external power can be connected. In this case, it should be noted that J6 and J7 are removed.

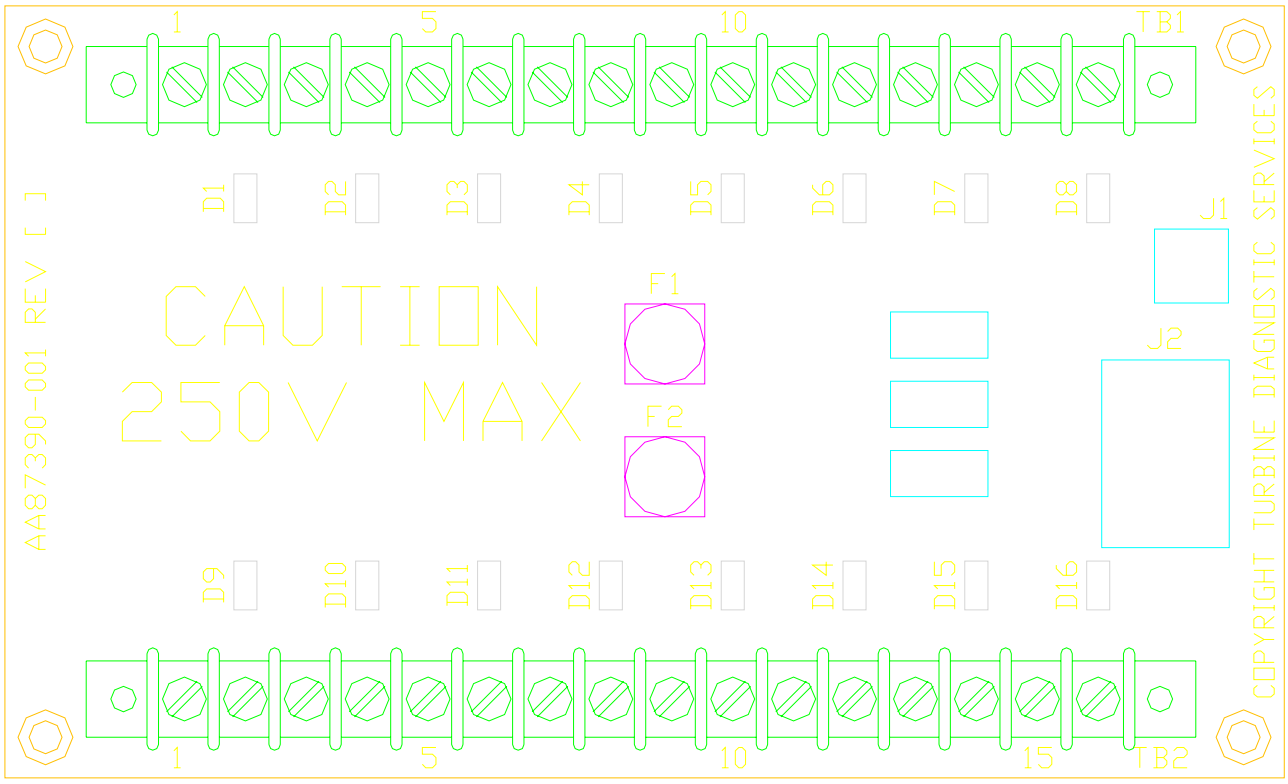
In either case, the wetting voltage is routed through FU2 which will protect the system in case of a short circuit in the field. It can also be used to isolate the input power if there is a need to locate a power supply ground.

The T1H-SOE module has the capability of synchronizing their clocks via a high speed peer to peer communication link. All the T1H-SOE modules need to be stringed together so as to maintain the 1 ms accuracy with respect to each other. This is accomplished by connecting the output communication port of one module (J5) to the input of the next module in the string (J4). Should it be necessary, J8 and J9 add 120 ohm terminating resistors to the network, though it should not be necessary on the short runs typically used.

The termination board connections are described in the table below:

CHANNEL	POSITIVE	NEGATIVE
0	TB1-1	TB1-2
1	TB1-3	TB1-4
2	TB1-5	TB1-6
3	TB1-7	TB1-8
4	TB1-9	TB1-10
5	TB1-11	TB1-12
6	TB1-13	TB1-14
7	TB1-15	TB1-16
8	TB2-1	TB2-2
9	TB2-3	TB2-4
10	TB2-5	TB2-6
11	TB2-7	TB2-8
12	TB2-9	TB2-10
13	TB2-11	TB2-12
14	TB2-13	TB2-14
15	TB2-15	TB2-16

Below is a layout drawing of the sequence of events termination board used to locate fuses, component and connections on the board.



SIZE	CAGE CODE	DRAWING NUMBER	REV
A	1XKV4	AA96312	-
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