ATTENTION! ATTENTION!
All TurboTrack2 enclosures now wired to ILDA Standard wiring specifications. 01/01/2000

T2

TurboTrack

versions 2.0 and 2.0b

Maximum Performance Servo Amplifier for Galvanometer Scanners

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TURBOTRACK2 SCANNER DRIVER AMPLIFIER

INTRODUCTION

The TurboTrack2 (T2) is a dual-channel servo amplifier designed for use with optical scanners. In the laser display industry, the most commonly used models of scanner are the G 120D (or DT) from General Scanning and the 6800 series scanner from Cambridge Technology.

T2 is a two-layer printed circuit board measuring 9 inches by 9 inches. Large heat sink fins are attached to each side of the card, increasing the board's footprint to 9.5 inches wide by 9 inches in length by 2.5 inches in height. Fan-cooling of this card will greatly increase its performance characteristics as well as prevent overheating of some power components.

The following features summarize the most important design benefits of the TurboTrack2 scanner driver amplifier:

> Angle Intelligence --
> H-bridge drive --
> High K low-frequency damping for the CTI 6800 series scanners
> Input signal limiting
> Position and velocity outputs
> A(utomatic) G(ain) C(ontrol) for position transducer
> Output current limiting
> Dual controls for high speed/low speed operation
> Differential inputs
> Input polarity switching
> Signal pre-emphasis
> Position scale and balance for CTI 6800 series scanners
> DC offset bi-color LED indicators

Most important for the laser display user is TurboTrack2's stable performance at high speeds. Extensive testing has shown that the ILDA test pattern can easily be scanned at 24,000 vectors per second at a scan angle of 20 degrees optical, using G120D scanners.

INPUT CONNECTOR

The input to TurboTrack2 is a DB 15 male connector. Differential inputs are recommenced. If single-ended (or unbalanced) inputs are used, both negative inputs should be tied to signal ground. Simultaneous position, velocity, and drive current signals are also available from the input connector.

OUTPUT CONNECTOR

The output connectors are both DB- 15 female. These are directly compatible with General Scanning G120D scanners. Cambridge Technology's scanner cable design requires a modification to replace the DB-9 connector with a DB- l 5 male connector.

Whereas the General Scanning G120D scanners are driven with the H-bridge, the 6800 series scanners achieve more stable performance with single-ended drive. Galvo low is therefore tied to ground for operation with the 6800 series scanners (see diagram, page 15). DB-9 to DB- l 5 adapters are not recommended. Scanner cables can be up to l 0 feet without any visible diminishing of scanner performance.

POWER SUPPLY

The TurboTrack2 requires a bipolar supply of +/-20 Volts DC as a minimum, and +/- 28 Volts DC as a maximum. LSDI recommends a minimum continuous current rating of 3 Amperes. When running CTI 6800 series scanners, a higher current capacity is desirable. Best performance comes with the use of a regulated power supply; however, a "raw" DC supply (transformer, full-wave bridge rectifiers and filter capacitors) will also work well. Switch mode supplies can also be used.

COOLING

The power output stage of the TurboTrack2 uses the LM12CLK from National Semiconductor. This is a power operational amplifier that can dissipate 150 watts of power. For this reason, it is highly recommended that the TurboTrack2 be fan-cooled wherever possible. The large heat sinks are constructed of industry-standard Aavid heat sink material, but some air flow is essential for reliable operation. This is particularly important when the amplifier is mounted in a chassis or rack-mount enclosure.

TurboTrack2 Adjustments

The TurboTrack2 is a 2-channel card. It also gives the user the ability to have 2 different tunings on each card, an "A" tuning and a "B" tuning. In practice, this lets the user set one tuning for l type of scanner and the second tuning for another type of scanner, or set both tunings for the same scanners but different speeds, i.e. 12,000 points per second and 24,000 points per second. There are several useful combinations available.

No matter the scanner models or designated use for each tuning, the adjustments are the same for each axis. The primary adjustments are as follows:

> position offset
> input gain
> servo gain
> damping
> high damping

These adjustments are made via 15-turn trimmer potentiometers located at one end of the T2 card. There are two sets of potentiometers for each axis, representing the "A" tuning and the "B" tuning capability of the circuit.

From the outside of the card inward, the order of adjustments is as follows: position offset, input gain, servo gain, damping and high damping.

The trimmer potentiometers are separated in the middle by a toggle-type DIP switch (GrayhIll p/n 76STD02). This is the scan polarity inversion switch. Use this switch to change the left/ right, up/down orientation of the laser graphic image.

Other adjustments available to the user are DIP switches located above and perpendicular to the trimmer potentiometers. These ganged DIP switches (Grayhill p/n 78B04) can be selected to use either General Scanning or Cambridge Technology scanners, as well as select the "A" or "B" tuning. These controls can only be accessed from the top of the card.

There are two additional "top" adjust trimmer potentiometers on the T2, both for use with the CT16800 series scanners. One is Position Scale, and the second is Position Balance. *These are set at the factory and should not require further adjustment.*

Before performing any adjustments, verify that ail supplemental components are operating normally, i.e. power supply, scanner connections, or input signal to the scanner amplifier.

Adjustment Procedure: General Scanning

> Scan a square wave test pattern at a vector speed of 9 to l 0 kilohertz.
> Make sure ail trimpots are fully counter-clockwise, except the position offset.
> Center the position offset.
> Connect an oscilloscope or a digital voltmeter (DVM) to the position outputs.
> Remove the fuses.
> Apply power to the amplifier.
> Adjust the position offset for 0 volts, each axis.
> Turn off power to the amplifier and replace the fuses in the fuse clips.
> Re-apply power to the amplifier. Turn input gain eight turns clockwise.
> Slowly adjust servo gain until scanner begins to operate.
> Adjust damping to correct overshoot. Use only normal damping; do not use high frequency damping, as damage to the scanners or the board may occur.
> Increase input gain until laser image is about 1/2 size.
> Adjust servo gain to increase speed, then compensate with damping.
> Once the system is optimized, increase input gain for full size. The AURA Technologies' test pattern is recommended. If the interior circle begins to distort, maximum gain has been reached. Reduce gain to point just before distortion occurs.
> Set input polarity toggle DIP switch for correct image orientation.

? **NOTE: Servo gain control on T2 is a true servo gain. With this control turned down (counter-clockwise) no scanning will occur. If you are trouble-shooting a "no scanning problem" and you have verified a good signal going to your scanners, be sure to check the servo gain adjustment.**

Adjustment Procedure: Cambridge Technology

As the Cambridge Technology's 6800 series scanners (6800H and 6800HP) do not have a torsion rod or other center return mechanism, the scanners may be directing the beam to most any direction when not energized. When beginning the calibration procedure, the scanner will suddenly move to the approximate center when the servo gain is sufficient to drive the scanner. The oscilloscope/digital voltmeter centering procedure may be done with the scanners disconnected from the board.

> Scan a square wave test pattern at a vector speed of 9-10 kHz.
> Make sure ail trimpots are fully counter-clockwise, except the position offset, which should be approximately centered.
> Power up the amplifier.
> Turn input gain eight turns clockwise.
> Slowly adjust servo gain until scanner begins to operate.
> Adjust damping to correct overshoot. Normal damping affects large changes. Hi damping is used to correct small errors, in conjunction with the normal damping. Hi damping corrects errors of high spatial frequency.
> Increase input gain until image is about 1/2 size.
> Repeat steps 1-4 for the opposing axis.
> Adjust servo gain to increase speed, compensate with damping. Use both Hi and normal damping to optimize velocity profile.
> Once the system is optimized, increase input gain for full size. The ILDA or Auratech test pattern is recommended. If the interior circle begins to distort, maximum size has been reached. Reduce gain to the point just before distortion occurs.
> Set input polarity for the correct orientation.

Adjustment Procedure: Mode Selection

There are several DIP switches accessible from the top of the TurboTrack board. These should only be switched with the power OFF. This is very important, as damage to the board or the scanners may result otherwise. These switches are shown on a diagram accompanying this manual.

There are four (4) ganged DIP switches at the front of the TurboTrack card for selection of different amplifier tunings. On each side, only one switch bank should be in the "ON" position. Looking at the card from an end-on view, "ON" is away from the user, "OFF is toward the user. The outside bank "A" affects the outside four adjustment potentiometers: input size, servo gain, normal damping and high frequency damping. The position offset controls at the outer edge of the card are not affected. The inner bank of controls accessed by the "B" switch are identical to the "A" controls. The dual adjustments allow for many possibilities, for example

> High speed scanning versus lower speed scanning
> General Scanning versus Cambridge Technology
> Main scanner set and spare scanner set

In the center of the TurboTrack are four more ganged DIP switches. These are the primary controls to switch from GS Operation to CT operation. Ail switches to the outside of the card is General Scanning mode; ail switches to the center of the card is Cambridge Technology mode. (Please see the TurboTrack2 configuration diagram in this manual.)

Closes to the fuses are two (2) quad DIP switches. SW # 181, 182, 381 and 382 are used to add pre-emphasis to the command signal. This increases the effective bandwidth of the scanners by as much as 6 kHz. For example, if the scanners are tuned for 24K points per second operation, switching on pre-emphasis will allow them to run images digitized to run at 30K. SW# SB and SC are on for ail modes of operation. SW # 222 and 422 are off for GS Mode and on for CT mode. This is output stage compensation for the 6800H and 6800HP scanners.

Connector pinouts on T2 stand-alone card

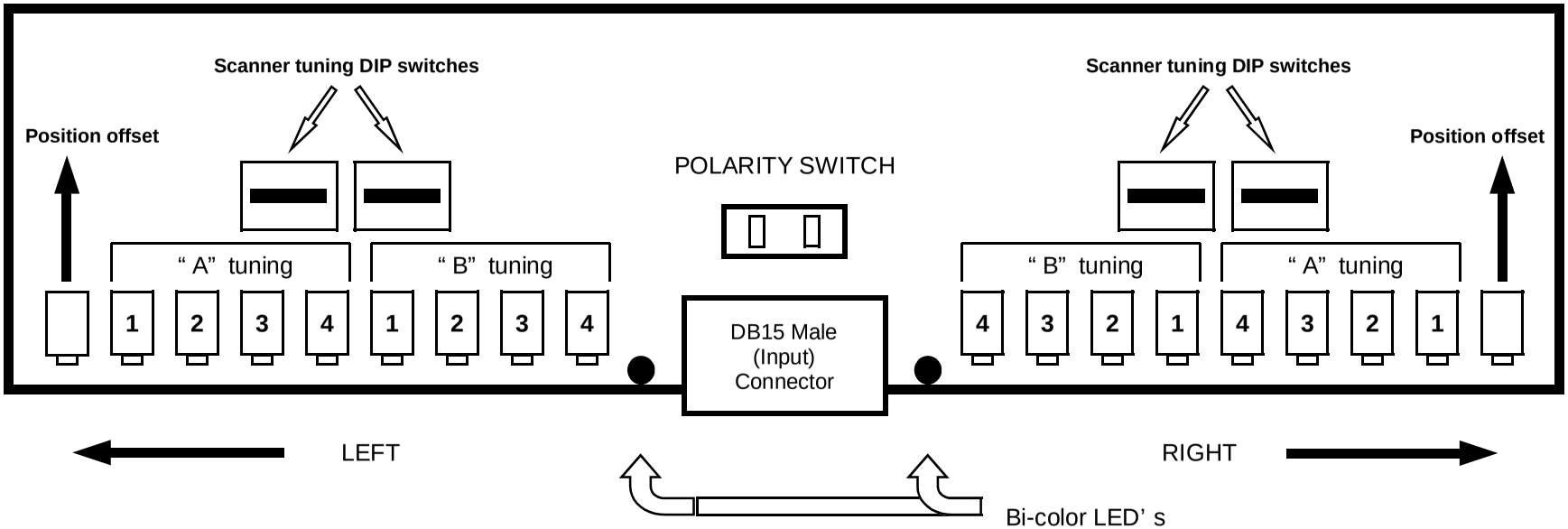
INPUT CONNECTOR
(D Sub Miniature 15 pin male)

Pin Number	
1	X axis positive
2	X axis negative
3	X position output signal
4	X velocity output signal
5	Y velocity output signal
6	Y position output signal
7	Y axis negative
8	Y axis positive
9	X axis ground
10	X axis ground
11	X axis current output signal
12	Not connected
13	Y axis current output signal
14	Y axis ground
15	Y axis ground

OUTPUT CONNECTOR
(D Sub Miniature 15 pin female)

Pin Number	
1	Galvo High
2	Galvo Low
3	Position plus
4	Position ground
5	Heater ground
6	- 15 VDC
7	Heater drive
8	GSI (General Scanning) AGC out
9	Galvo High
10	Galvo Low
11	Position minis
12	GSI (General Scanning) AGC in
13	Scanner ground
14	Cambridge Technology AGC out
15	Thermal in

TURBOTRACK2 Trim Pot Adjustments
Expanded View



Bi-color LED' s
These LED' s are on during calibration and during normal operation of the amp. The LED indicates that current is going through the scanner.

1. INPUT GAIN 20K
2. SERVO GAIN 20K
3. DAMPING 20K
4. HIGH DAMPING 100K

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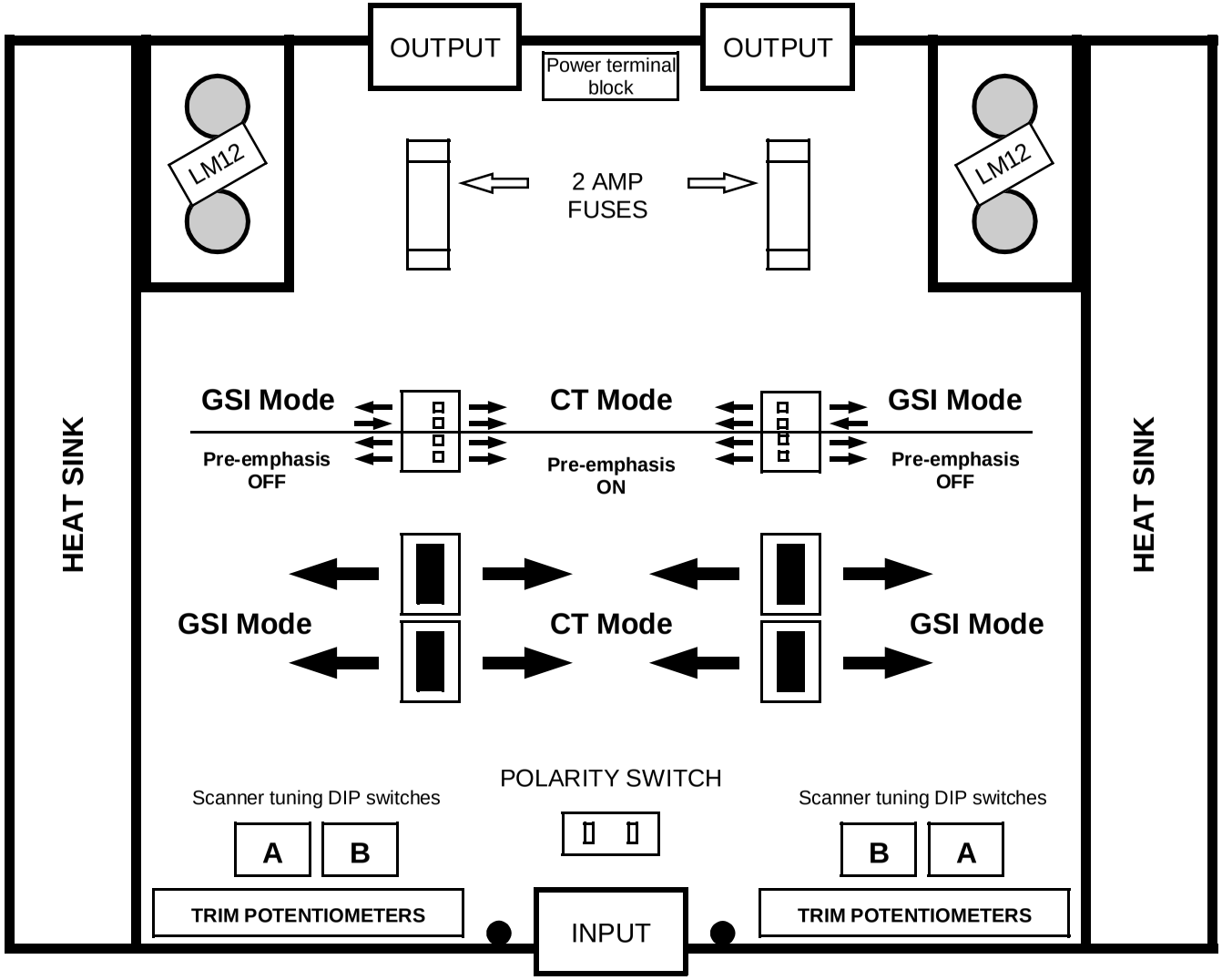


KEY:

Power output stage
LM12CLK
Output connectors
DB-15 female
Input connector
DB-15 male
Fuses 3AG type Fastblo

GSI General Scanning (GSI Luminonics)
CT Cambridge Technology

<u>WARNING!!</u>

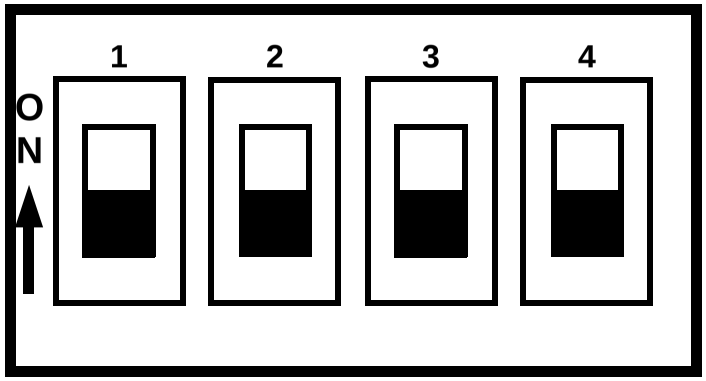
Before changing any scanner settings or tunings on T2 card, turn power to the card OFF! You risk damage to T2 card or scanners if power is not turned off before changing settings.**

****Pre-emphasis can be turned on or off when card is powered up.**

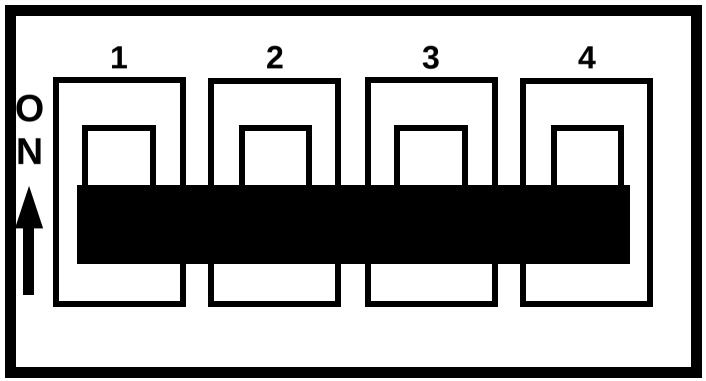
TURBOTRACK2 CONFIGURATION

MAIN ELEMENTS

REV. 1999/07/10



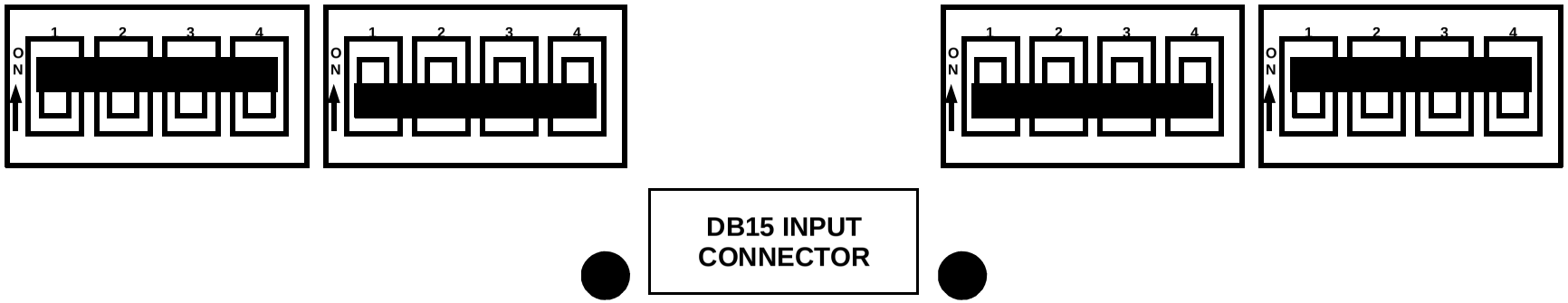
THIS IS A DETAIL VIEW OF THE GRAYHILL 4-POSITION DIP SWITCH USED ON THE TURBOTRACK CARD.
PLEASE NOTE THE DIRECTION OF THE DIP SWITCH FOR THE "ON" POSITION. THE SWITCH MUST BE PUSHED TOWARD THE NUMERICAL INDICATOR (THE DIRECTION OF THE ARROW) TO BE IN THE "ON" POSITION.



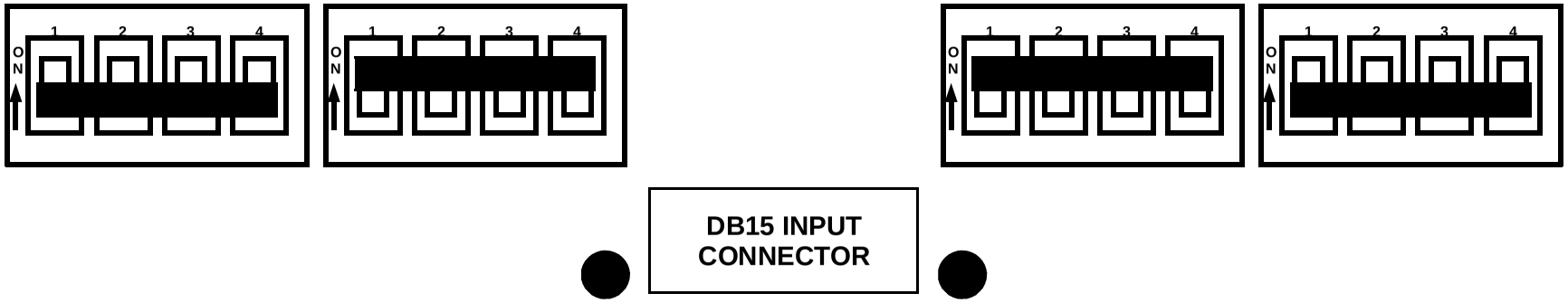
THIS IS A DETAIL VIEW OF THE 4-POSITION DIP SWITCH THAT HAS BEEN "GANGED".
ALL 4 SWITCHES ARE JOINED TOGETHER VIA A BAR PLACED ACROSS THE TOP OF THE SWITCH.

TURBOTRACK CARD TUNINGS

THIS IS "A" TUNING. NOTE DIRECTION OF "ON" ARROW.

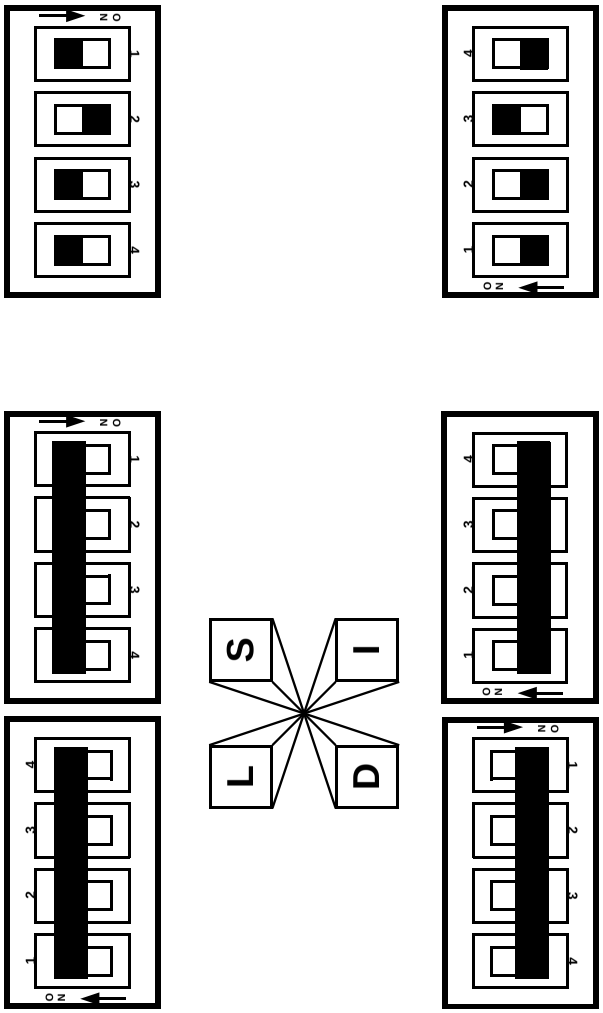


THIS IS "B" TUNING.

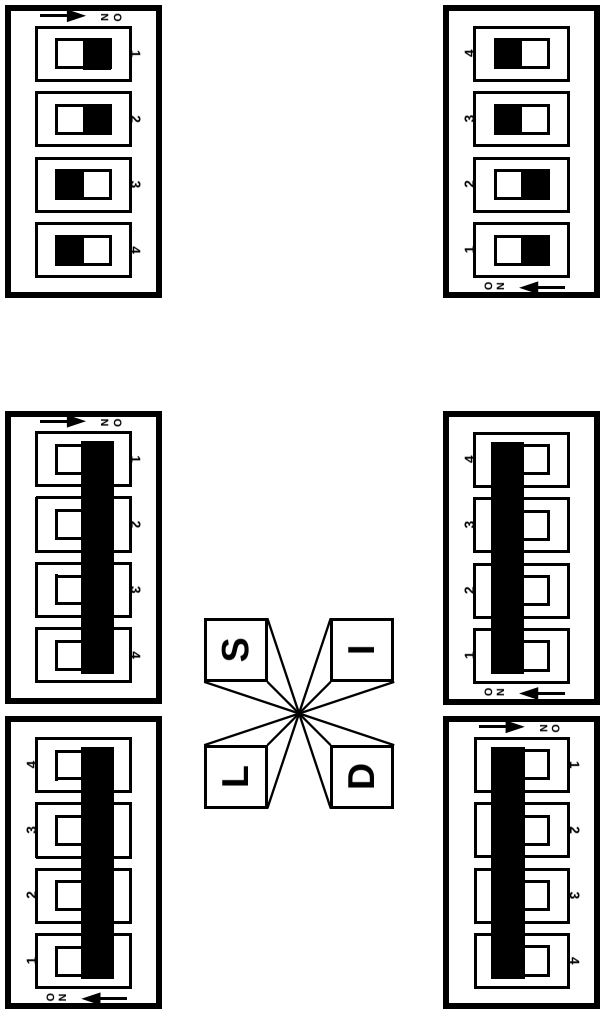


TURBOTRACK CARD TUNINGS

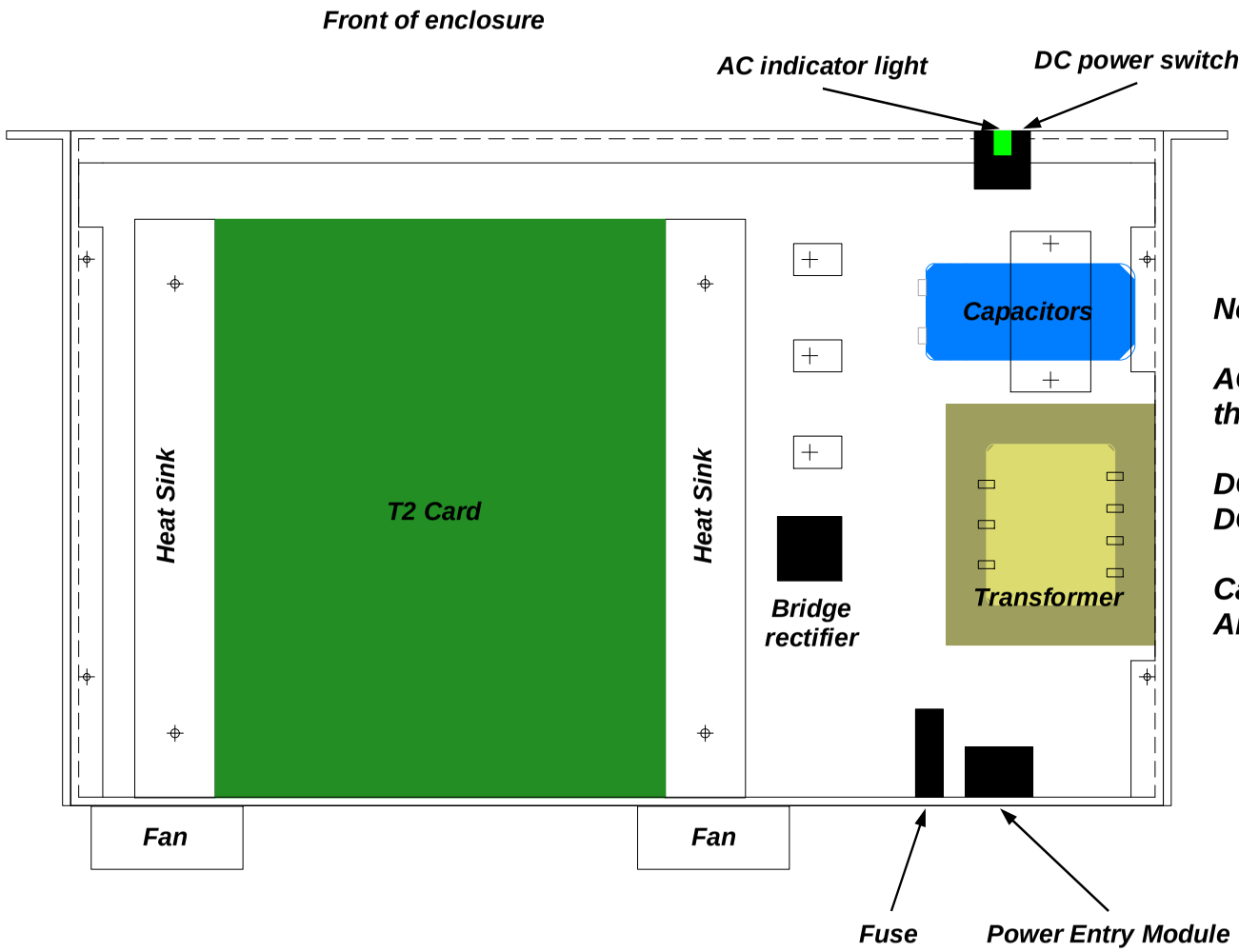
(THIS DRAWING NOT TO SCALE)



GENERAL SCANNING MODE
with pre-emphasis OFF



CAMBRIDGE TECHNOLOGY MODE
with pre-emphasis OFF



Notes:

AC indicator lights shows that AC power is on;

DC power switch can turn DC power on and off to card;

Card is fused with a 2 Ampere "fast blo" fuse.

TURBOTRACK2 Enclosure
Top View

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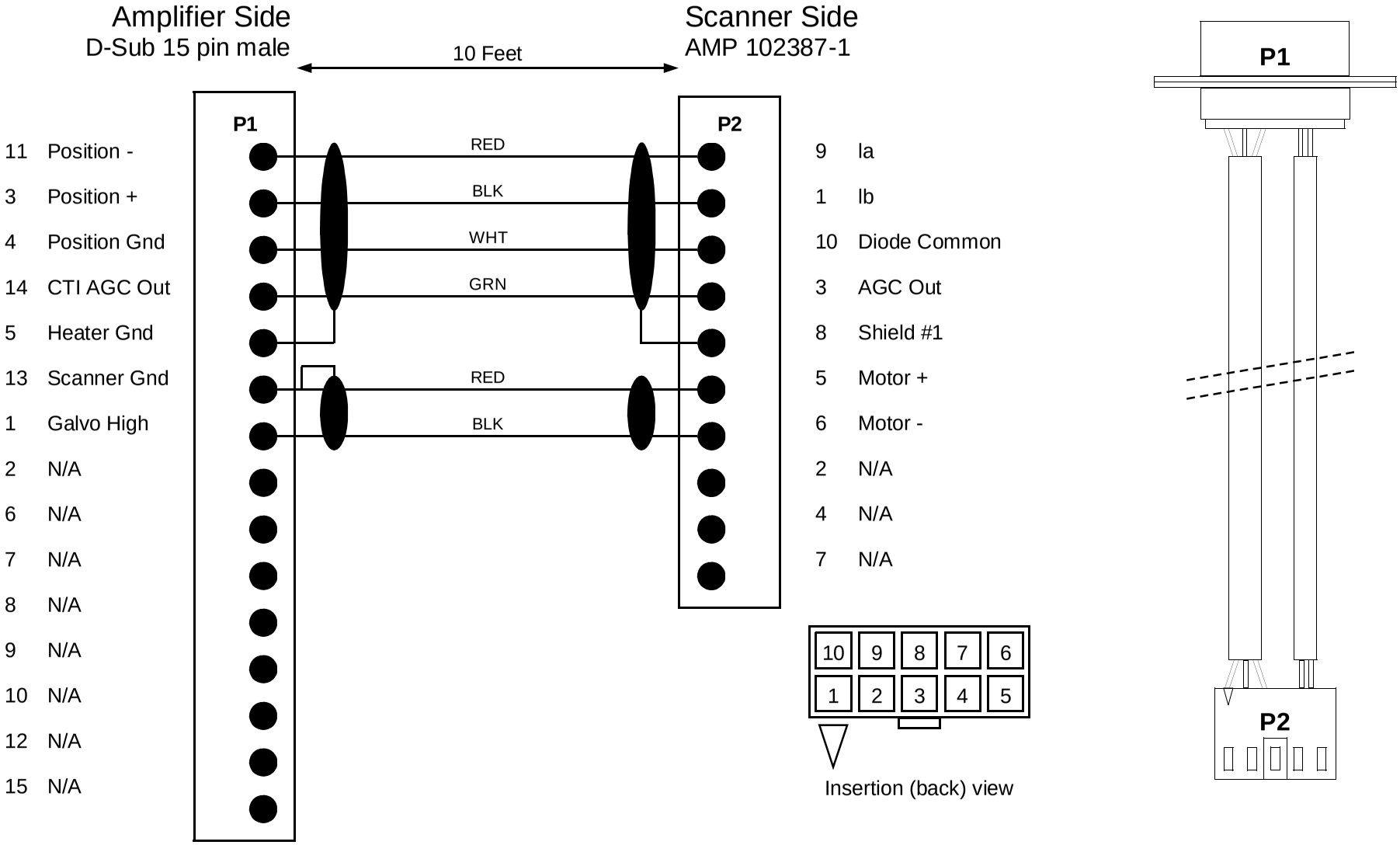


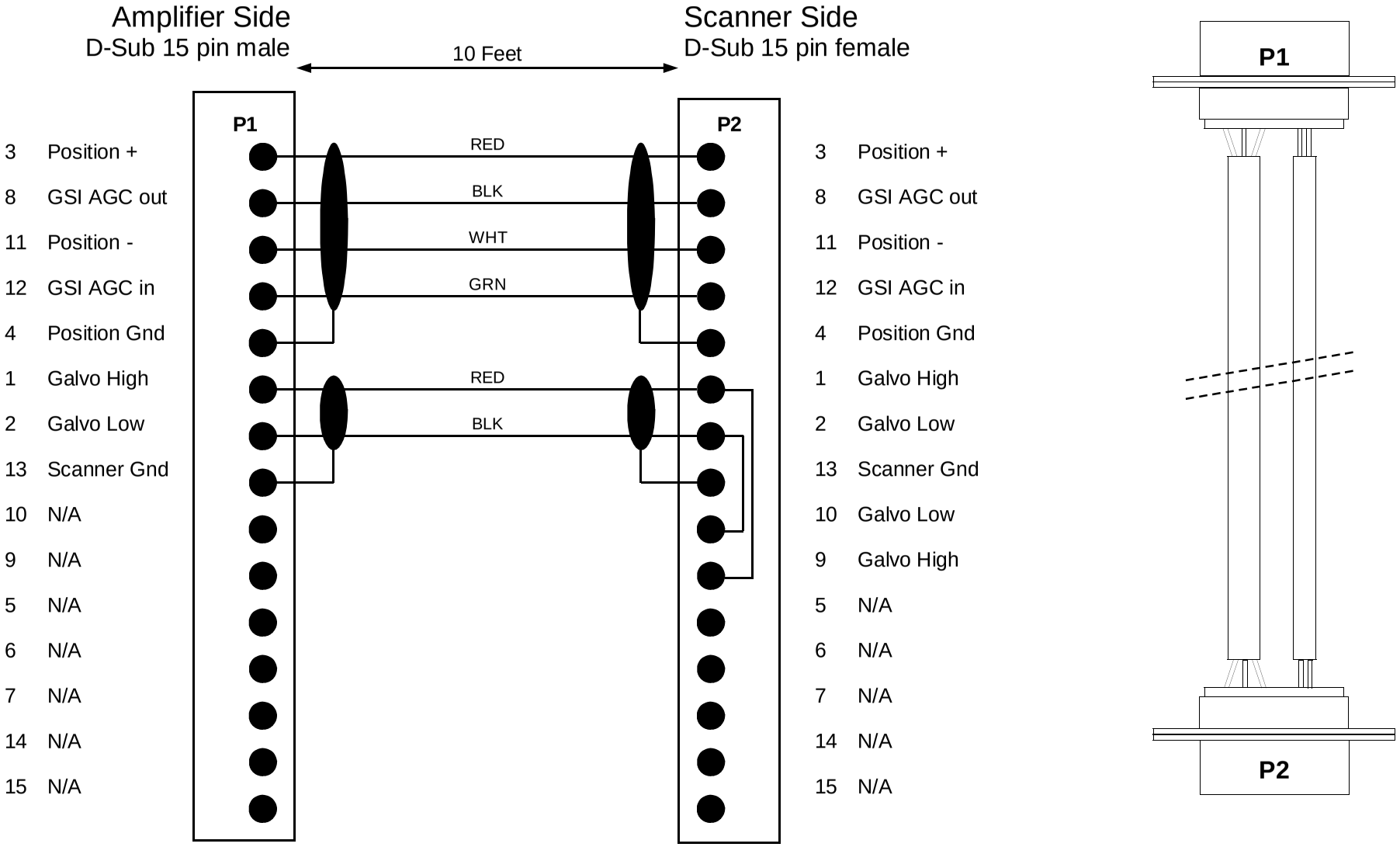
Notes:

1. 2 conductor cable with shield/drain 24 gauge
2. 4 conductor cable with shield/drain 24-28 gauge
3. All pins gold flash
4. Shield/drain from 2 conductor cable should isolated from shield/drain from 4 conductor cable
5. Use heatshrink tubing every 12" to secure 2 conductor and 4 conductor wires to each other along 10 feet
6. D-Sub 15 pin connector to have back shell

CAM68T Scanner Cable

TITLE: **Cambridge 6800 Scanner Cable For Turbo Track Amplifier**

Lighting Systems Design, Inc.	SIZE A	CAGE CODE	DWG NO CT-010731	REV A
Orlando, Florida	SCALE None	John Robert Birchman	SHEET 1 of 1	



Notes:

1. 2 conductor cable with shield/drain 24 gauge
2. 4 conductor cable with shield/drain 24-28 gauge
3. All pins gold flash
4. Shield/drain from 2 conductor cable should isolated from shield/drain from 4 conductor cable
5. Use heatshrink tubing every 12” to secure 2 conductor and 4 conductor wires to each other along 10 feet
6. D-Sub 15 pin connectors to have back shell

Lighting Systems Design, Inc.
Orlando, Florida

G120 Scanner Cable

TITLE: **General Scanning G120 Scanner Cable For Turbo Track Amplifier**

SIZE	CAGE CODE	DWG NO	REV
A		GS-010731	A

SCALE		SHEET
None	John Robert Birchman	1 of 1

ILDA compatible input connector pinouts on T2 rack-mount unit

T2 Box (Computer DB25M)		
Pin number	**Signal name ILDA**	**T2 Signal**
1	X +	X +
2	Y +	Y+
3	Intensity +	Not Used
4	Interlock A	Interlock A
5	Red +	Red +
6	Green +	Green +
7	Blue +	Blue +
8	Deep Blue +	Deep Blue +
9	Yellow +	Yellow +
10	Cyan +	Cyan +
11	Z +	Not connected
12	Not connected	Not connected
13	Shutter	Shutter
14	X -	X -
15	Y -	Y -
16	Intensity -	Not Used
17	Interlock B	Interlock B
18	Red -	Red -
19	Green -	Green -
20	Blue -	Blue -
21	Deep Blue -	Deep Blue -
22	Yellow -	Yellow -
23	Cyan -	Cyan -
24	Z -	Not connected
25	Ground	Ground

NEOS-ILDA compatible connector pinouts on T2 rack-mount unit

T2 Box (Color DB25F)		
Pin number	**Signal name**	**Wavelength**
1	Ground	
2	Green +	514 nm
3	Cyan -	488 nm
4	Not connected	
5	Blue +	476 nm
6	Deep Blue -	457 nm
7	Not connected	
8	Green +	520 nm
9	Yellow -	568 nm or 575 nm
10	Not connected	
11	Red 1 +	647 nm
12	Red 2 -	676 nm
13	Not connected	
14	Green -	514 nm
15	Not connected	
16	Cyan +	488 nm
17	Blue -	475 nm
18	Not connected	
19	Deep Blue +	457 nm
20	Green -	520 nm
21	Not connected	
22	Yellow +	568 nm or 575 nm
23	Red 1 -	647 nm
24	Not connected	
25	Red 2 +	676 nm

VERSION NOTES FOR STAND-ALONE CARD:

This User's Manual references the TurboTrack2 servo amplifier, versions 2.0 and 2.0b.

Version 2.0 of the T2 card incorporated 2 bi-color LED's at the input side of the card to indicated the presence of current going through the circuit.

Version 2.0b of the T2 card incorporated 8 diodes at the output side of the card, located between the 2 fuses.

If you have an older version of the T2 card, without LED or diode modification, please contact Lighting Systems Design, Inc. for information on adjusting your card's scanner tunings.