



grass valley

A **BELDEN** BRAND

Thunder

80 Channel Audio/Data/Intercom Link

User Guide

4026-99M00-103

10 November 2015

www.grassvalley.com

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Title	Thunder User Guide
Part Number	4026-99M00-103
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Safety Compliance

The power supplies in this equipment comply with the stated requirements:

Supply for the TNR-FRAME (power supply model ESC60US12)

This equipment complies with the requirements of:



TUV EN 60950-1, A11: 2009

IEC 60601-1, 3rd edition

CSA/UL 60950-1, 2nd edition

The power cord supplied with this equipment meets the appropriate national standards for the country of destination.

Conformité aux normes de sécurité

Cet équipement est conforme aux exigences de:

TUV EN 60950-1, A11: 2009

IEC 60601-1, 3rd edition

CSA/UL 60950-1, 2nd edition.

Les cordons d'alimentation fournis avec l'appareil répondent aux normes nationales appropriées du pays destinataire.

[es] Conformidad en seguridad eléctrica

Este equipo cumple con las exigencias de la

TUV EN 60950-1, A11: 2009

IEC 60601-1, 3rd edition

CSA/UL 60950-1, 2nd edition

Los cables de alimentación incluidos con el equipo cumplen con las normas nacionales apropiadas para el país de destino.

[pt] Conformidade de segurança elétrica

Este equipamento está em conformidade com os requisitos da:

TUV EN 60950-1, A11: 2009

IEC 60601-1, 3rd edition

CSA/UL 60950-1, 2nd edition.

Os cabos de alimentação fornecidos com este equipamento encontram as normas nacionais adequadas para o país de destino.

Supply for the TNR-BP-AAMP-TX16 panel (power supply model ECL30UT02-P)

This equipment complies with the requirements of:



TUV EN 60950-1, A12: 2011
IEC 60950-1, 2nd edition
CSA/UL 60950-1, 2nd edition

The power cord supplied with this equipment meets the appropriate national standards for the country of destination.

[fr] Conformité aux normes de sécurité

Cet équipement est conforme aux exigences de:

TUV EN 60950-1, A12: 202011
IEC 60950-1, 2nd edition
CSA/UL 60950-1, 2nd edition.

Les cordons d'alimentation fournis avec l'appareil répondent aux normes nationales appropriées du pays destinataire.

[es] Conformidad en seguridad eléctrica

Este equipo cumple con las exigencias de la

TUV EN 60950-1, A12: 202011
IEC 60950-1, 2nd edition
CSA/UL 60950-1, 2nd edition.

Los cables de alimentación incluidos con el equipo cumplen con las normas nacionales apropiadas para el país de destino.

[pt] Conformidade de segurança elétrica

Este equipamento está em conformidade com os requisitos da:

TUV EN 60950-1, A12: 202011
IEC 60950-1, 2nd edition
CSA/UL 60950-1, 2nd edition.

Os cabos de alimentação fornecidos com este equipamento encontram as normas nacionais adequadas para o país de destino.

Safety of Laser Modules



This equipment incorporates modules containing Class 1 lasers. These modules are certified by the manufacturer to comply with:

- IEC/EN 60825-1 Safety of laser products
- IEC 60950-1 Safety of information technology equipment

[fr] Sécurité laser

L'appareil comprend des modules laser de classe 1. Ces modules sont certifiés conformes aux normes suivantes par le fabricant :

- IEC/EN 60825-1 Sécurité des appareils à laser
- IEC 60950-1 Sécurité du matériel informatique

[es] Seguridad por los módulos laser

Este equipo incorpora módulos láser de la Clase 1.

Estos módulos están certificados por el fabricante para cumplir con:

- IEC/EN 60825-1 Seguridad de los productos láser
- IEC 60950-1 Seguridad de los equipos de tecnología de la información

[pt] Segurança por módulo de laser

Este equipamento incorpora módulos que contêm laser da classe 1. Estes módulos são certificados pelo fabricante em conformidade com:

- IEC/EN 60825-1 Segurança de equipamentos laser
- IEC 60950-1 Segurança de equipamento de tecnologia da informação

Restriction on Hazardous Substances (RoHS)

部件名称 Part name	有毒有害物质或元素 Toxic or Hazardous Substances and Elements					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr6)	多溴联苯 (PBB)	多溴二苯 (PBDE)
ADAP-AC12V-DIN						
电缆及电缆组件 Cables and Cable Assemblies	X	O	O	O	O	O
电路模块 Circuit Modules	X	O	O	O	O	O
塑料和聚合物零件 Plastic and Polymeric Parts	X	O	O	O	O	O
CA-D25F-8XLR3M, CA-D25M-8XLR3F, CA-D25MM-40, CA-D25MM-80, CA-HD26MF-80, UFP-2LC, UFP-2SC, UFP-2SCA, UFP-2ST, UFP-4LC, UFP-4SC, UFP-4SCA, UFP-4ST, UFP-MX2, UFP-NOC2, UFP-NOC4						
电缆及电缆组件 Cables and Cable Assemblies	X	O	O	O	O	O
TNR-BC-AA-RX8, TNR-BC-DATA-4, TNR-BC-GPI-8, TNR-BP-AAMP-TX16, TNR-BP-AAMP-TX8						
电缆及电缆组件 Cables and Cable Assemblies	X	O	O	O	O	O
电路模块 Circuit Modules	X	O	O	O	O	O
TNR-BC-AA-TX8, TNR-BP-ICM-8						
电缆及电缆组件 Cables and Cable Assemblies	X	O	O	O	O	O
电路模块 Circuit Modules	X	O	O	O	O	O

部件名称 Part name	有毒有害物质或元素 Toxic or Hazardous Substances and Elements					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr6)	多溴联苯 (PBB)	多溴二苯 (PBDE)
金属零件 Metal Parts	X	O	O	O	O	O
TNR-BC-AES-RX4 , TNR-BC-AES-TX4						
电路模块 Circuit Modules	X	O	O	O	O	O
TNR-BP-AA-RX16, TNR-BP-AA-RX8, TNR-BP-AA-TR16, TNR-BP-AA-TX16, TNR-BP-AA-TX8, TNR-BP-AES-RX-4BNC, TNR-BP-AES-TR-8BNC, TNR-BP-AES-TX-4BNC, TNR-BP-DATA-48, TNR-BP-DATA-88						
电路模块 Circuit Modules	X	O	O	O	O	O
金属零件 Metal Parts	X	O	O	O	O	O
TNR-FRAME						
电缆及电缆组件 Cables and Cable Assemblies	X	O	O	O	O	O
组装装置 Fan Assemblies	X	O	O	O	O	O
金属零件 Metal Parts	X	O	O	O	O	O

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T 11363-2006 规定的限量要求以下。

O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.

X: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T 11363-2006 规定的限量要求。

X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials for this part is above the limit requirement in SJ/T11363-2006.

This statement is based on information provided by suppliers of our components and collected through Grass Valley's environmental management system. Grass Valley believes this environmental information to be correct but cannot guarantee its completeness or accuracy, as it is based on data received from sources outside the company. All specifications are subject to change without notice.

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Important Safeguards and Notices

This section provides important safety guidelines for operators and service personnel. Specific warnings and cautions appear throughout the manual where they apply. Please read and follow this important information, especially those instructions related to the risk of electric shock or injury to persons.

[fr] Mesures de sécurité et avis importants

La présente section fournit des consignes de sécurité importantes pour les opérateurs et le personnel de service. Des avertissements ou mises en garde spécifiques figurent dans le

manuel, dans les sections où ils s'appliquent. Prenez le temps de bien lire les consignes et assurez-vous de les respecter, en particulier celles qui sont destinées à prévenir les décharges électriques ou les blessures.

[es] **Medidas de seguridad y avisos importantes**

Esta sección proporciona pautas de seguridad importantes para los operadores y el personal de servicio. Advertencias y precauciones específicas aparecen en el manual para su aplicación. Por favor, lea y siga esta importante información, especialmente aquellas instrucciones relacionadas con el riesgo de descarga eléctrica o lesiones a las personas.

[pt] **Salvaguardas e avisos importantes**

Esta seção fornece diretrizes de segurança importantes para os operadores e pessoal de serviço. Avisos e cuidados específicos estão listados no manual para sua aplicação. Por favor, leia e siga esta informação importante, especialmente aquelas instruções relacionadas ao risco de choque elétrico ou ferimentos.

Symbols and Their Meanings



The lightning flash with arrowhead symbol within an equilateral triangle alerts the user to the presence of dangerous voltages within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.



The exclamation point within an equilateral triangle alerts the user to the presence of important operating and maintenance/service instructions.



The earth ground symbol represents a protective grounding terminal. Such a terminal must be connected to earth ground prior to making any other connections to the equipment.



The fuse symbol indicates that the fuse referenced in the text must be replaced with one having the ratings indicated.



The presence of this symbol in or on Grass Valley equipment means that it has been designed, tested and certified as complying with applicable Canadian Standard Association (CSA) regulations and recommendations for USA/Canada.



The presence of this symbol in or on Grass Valley equipment means that it has been designed, tested and certified as complying with applicable Underwriters Laboratory (UL) regulations and recommendations for USA/Canada.



The presence of this symbol in or on Grass Valley equipment means that it has been designed, tested and certified as essentially complying with all applicable European Union (CE) directives.



The presence of this symbol in or on Grass Valley product means that it complies with safety of laser product applicable standards.

Warnings



A warning indicates a possible hazard to personnel, which may cause injury or death. Observe the following general warnings when using or working on this equipment:

- Appropriately listed/certified mains supply power cords must be used for the connection of the equipment to the mains voltage at either 120 V AC or 240 V AC.
- This product relies on the building's installation for short-circuit (over-current) protection. Ensure that a fuse or circuit breaker for 120 V AC or 240 V AC is used on the phase conductors.
- Any instructions in this manual that require opening the equipment cover or enclosure are for use by qualified service personnel only.
- Heed all warnings on the unit and in the operating instructions.
- Do not use this equipment in or near water.
- This equipment is grounded through the grounding conductor of the power cords. To avoid electrical shock, plug the power cords into a properly wired receptacle before connecting the equipment inputs or outputs.
- Route power cords and other cables so they are not likely to be damaged.
- Disconnect power before cleaning the equipment. Do not use liquid or aerosol cleaners; use only a damp cloth.
- Dangerous voltages may exist at several points in this equipment. To avoid injury, do not touch exposed connections and components while power is on.
- Do not wear rings or wristwatches when troubleshooting high current circuits such as the power supplies.
- To avoid fire hazard, use only the specified fuses with the correct type number, voltage and current ratings as referenced in the appropriate locations in the service instructions or on the equipment. Always refer fuse replacements to qualified service personnel.
- To avoid explosion, do not operate this equipment in an explosive atmosphere.
- Have qualified service personnel perform safety checks after any service.

[fr] Avertissements

- Un cordon d'alimentation dûment homologué doit être utilisé pour connecter l'appareil à une tension de secteur de 120 V CA ou 240 V CA.
- La protection de ce produit contre les courts-circuits (surintensités) dépend de l'installation électrique du bâtiment. Assurez-vous qu'un fusible ou un disjoncteur pour 120 V CA ou 240 V CA est utilisé sur les conducteurs de phase.

- Dans le présent manuel, toutes les instructions qui nécessitent d'ouvrir le couvercle de l'équipement sont destinées exclusivement au personnel technique qualifié.
- Respectez tous les avertissements figurant sur l'appareil et dans les instructions d'utilisation.
- Ne pas utiliser cet appareil dans l'eau ou à proximité d'un point d'eau.
- Cet équipement est mis à la terre par le conducteur de mise à la terre des cordons d'alimentation. Pour éviter les chocs électriques, branchez les cordons d'alimentation sur une prise correctement câblée avant de brancher les entrées et sorties de l'équipement.
- Acheminez les cordons d'alimentation et autres câbles de façon à ce qu'ils ne risquent pas d'être endommagés.
- Coupez l'alimentation avant de nettoyer l'équipement. Ne pas utiliser de nettoyeurs liquides ou en aérosol. Utilisez uniquement un chiffon humide.
- Des tensions dangereuses peuvent exister en plusieurs points dans cet équipement. Pour éviter toute blessure, ne touchez pas aux connexions ou aux composants exposés lorsque l'appareil est sous tension.
- Avant de procéder à toute opération d'entretien ou de dépannage visant des circuits à courant élevé (e.g., les blocs d'alimentation), enlevez tous vos bijoux (notamment vos bagues et votre montre).
- Pour éviter tout risque d'incendie, utilisez uniquement les fusibles du type et du calibre indiqués dans la documentation ou sur l'équipement. Confiez le remplacement de fusibles au personnel technique qualifié.
- Ne pas utiliser cet appareil dans une atmosphère explosive.
- Après tout travail d'entretien ou de réparation, faites effectuer des contrôles de sécurité par le personnel technique qualifié.

[es] **Advertencias**

- Un cable de alimentación aprobado deberá ser utilizado para la conexión del equipo a la tensión de red de 120 V CA o 240 V CA.
- Este producto depende de la instalación del edificio para la protección de cortocircuitos (sobre-corriente). Asegúrese que un fusible o un interruptor térmico de 120 V CA o 240 V CA se utiliza en los conductores de fase.
- Todas las instrucciones de este manual que requieren abrir la tapa del equipo se llevarán a cabo por personal técnico calificado.
- Respete todas las advertencias en el equipo y las instrucciones de funcionamiento.
- No utilice este producto en el agua o cerca de este.
- Este equipo está conectado a tierra a través del conductor de puesta a tierra de los cables de alimentación. Para evitar una descarga eléctrica, enchufe el cable de alimentación a un tomacorriente debidamente instalado antes de conectar las entradas y salidas del equipo.
- Instale los cables de alimentación y otros cables de forma de evitar ser dañados.
- Desconecte la alimentación antes de limpiar el equipo. No use limpiadores líquidos o aerosoles, utilizar un paño húmedo.

- Pueden existir tensiones peligrosas en varios puntos de este equipo. Para evitar lesiones, no toque las conexiones y componentes expuestos cuando la unidad está con alimentación.
- No use anillos o relojes al solucionar problemas de circuitos de alta corriente como fuentes de alimentación.
- Para evitar el riesgo de incendios, utilice sólo el fusible indicado con el número de tipo correcto, el voltaje y la corriente que se hace referencia en los lugares apropiados en las instrucciones de los servicios o el equipo. Siempre consulte el reemplazo del fusible a personal calificado.
- Para evitar explosiones, no utilice este equipo en una atmósfera explosiva.
- Deje al personal calificado realizar las verificaciones de seguridad después de un servicio.

[pt] **Advertências**

- Um cabo de alimentação aprovado deve ser utilizado para ligar o equipamento à tensão da rede de 120 V CA ou 240 V CA.
- Este produto baseia-se na instalação do edifício para proteção por curto-circuito (sobrecarga de corrente). Certifique-se de que um fusível ou disjuntor para 120 V CA ou 240 V CA é utilizado nos condutores de fase.
- Todas as instruções contidas neste manual, que exigem a abertura da tampa do equipamento será realizada por pessoal qualificado.
- Preste atenção a todos os avisos no equipamento e instruções de operação.
- Não use este produto em ou perto da água.
- Este equipamento é aterrado através do condutor de aterramento do cabo de alimentação. Para evitar choque elétrico, conecte o cabo de alimentação a uma tomada devidamente instalada antes de ligar as entradas e saídas do dispositivo.
- Instale os cabos de alimentação e os outros cabos de modo a evitar danos.
- Desligue a alimentação antes de limpar o equipamento. Não use detergentes líquidos ou aerossóis, usar um pano úmido.
- Tensões perigosas podem existir em vários pontos deste equipamento. Para evitar ferimentos, não toque as conexões e componentes expostos quando o aparelho está ligado.
- Não usar anéis ou relógios ao solucionar problemas de circuitos de alta tensão, tais como fontes de alimentação.
- Para evitar o risco de incêndio, utilize apenas o número especificado de fusível de tipo correto de tensão e corrente a que se refere o manual de serviço adequado. Referem-se sempre trocar o fusível por pessoal qualificado.
- Para evitar a explosão, não utilize este equipamento em uma atmosfera explosiva.
- Deixe o pessoal qualificado executar verificações de segurança depois de um serviço.

Cautions



A caution indicates a possible hazard to equipment that could result in equipment damage. Observe the following cautions when operating or working on this equipment:

- This equipment is meant to be installed in a restricted access location.
- When installing this equipment, do not attach the power cord to building surfaces.
- To reduce the risk of electric shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so. Refer all servicing to qualified service personnel. Servicing should be done in a static-free environment.
- To prevent damage to equipment when replacing fuses, locate and correct the problem that caused the fuse to blow before re-applying power.
- Use only the specified replacement parts.
- Follow static precautions at all times when handling this equipment.
- Products that have no on/off switch, and use an external power supply must be installed in proximity to a main power outlet that is easily accessible.

[fr] **Mises en garde**

- L'appareil est conçu pour être installé dans un endroit à accès restreint.
- Au moment d'installer l'équipement, ne fixez pas les cordons d'alimentation aux surfaces intérieures de l'édifice.
- Pour réduire le risque de choc électrique, n'effectuez pas de réparations autres que celles qui sont décrites dans le présent manuel, sauf si vous êtes qualifié pour le faire. Confiez les réparations à un technicien qualifié. La maintenance doit se réaliser dans un milieu libre d'électricité statique.
- Pour éviter d'endommager l'équipement lors du remplacement de fusibles, localisez la source de la panne et corrigez la situation avant de rétablir le courant.
- Employez uniquement les pièces de rechange recommandées par le fabricant.
- Veillez à toujours prendre les mesures de protection antistatique appropriées quand vous manipulez l'équipement.
- Les produits qui n'ont pas d'interrupteur marche-arrêt et qui disposent d'une source d'alimentation externe doivent être installés à proximité d'une prise de courant facile d'accès.

[es] **Precauciones**

- Este equipo está destinado a ser instalado en un lugar de acceso restringido.
- Al instalar este equipo, no sujete el cable de alimentación a la superficie del edificio.
- No realice reparaciones que no se encuentren en las instrucciones de funcionamiento a menos que esté calificado para hacerlo. Confíe las reparaciones a personal técnico calificado. El mantenimiento debe realizarse en un ambiente libre de estática.
- Para evitar daños en el equipo al sustituir los fusibles, primero localizar y corregir el problema que causó que el fusible se funda antes de aplicar la alimentación de nuevo.
- Utilice únicamente repuestos específicos.
- Siga las precauciones DES en todo momento al manipular este equipo.
- Los productos que no tienen interruptor de encendido/apagado, y utilizan una fuente de alimentación externa deben instalarse cerca de una toma de corriente de fácil acceso.

[pt] Precauções

- Este material destina-se a ser instalado em um acesso restrito.
- Quando instalar o equipamento, não fixar o cabo de alimentação em superfícies do edifício.
- Não faça reparações que não estão no manual de instruções, a menos que você estiver qualificado. Solicite a assistência de pessoal qualificado. A manutenção deve ser realizada em um ambiente livre de estática.
- Para evitar danos ao equipamento ao substituir fusíveis, primeiro localizar e corrigir o problema que causou o fusível fundir antes de aplicar energia novamente.
- Use unicamente partes específicas.
- Siga as precauções DES em todos os momentos ao manusear este equipamento.
- Os produtos que não têm um interruptor de ligar/desligar, e usam uma fonte de alimentação externa devem ser instalados perto de uma tomada elétrica de fácil acesso.

Electrostatic Discharge (ESD) Protection



Electrostatic discharge occurs when electronic components are improperly handled and can result in intermittent failure or complete damage adversely affecting an electrical circuit. When you remove and replace any card from a frame always follow ESD-prevention procedures:

- Ensure that the frame is electrically connected to earth ground through the power cord or any other means if available.
- Wear an ESD wrist strap ensuring that it makes good skin contact. Connect the grounding clip to an *unpainted surface* of the chassis frame to safely ground unwanted ESD voltages. If no wrist strap is available, ground yourself by touching the *unpainted* metal part of the chassis.
- For safety, periodically check the resistance value of the antistatic strap, which should be between 1 and 10 megohms.
- When temporarily storing a card make sure it is placed in an ESD bag.
- Cards in an earth grounded metal frame or casing do not require any special ESD protection.

[fr] Protection contre les décharges électrostatiques (DES)

Une décharge électrostatique peut se produire lorsque des composants électroniques ne sont pas manipulés de manière adéquate, ce qui peut entraîner des défaillances intermittentes ou endommager irrémédiablement un circuit électrique. Au moment de remplacer une carte dans un châssis, prenez toujours les mesures de protection antistatique appropriées :

- Assurez-vous que le châssis est relié électriquement à la terre par le cordon d'alimentation ou tout autre moyen disponible.
- Portez un bracelet antistatique et assurez-vous qu'il est bien en contact avec la peau. Connectez la pince de masse à une *surface non peinte* du châssis pour détourner à la terre toute tension électrostatique indésirable. En l'absence de bracelet antistatique, déchargez l'électricité statique de votre corps en touchant une surface métallique *non peinte* du châssis.

- Pour plus de sécurité, vérifiez périodiquement la valeur de résistance du bracelet antistatique. Elle doit se situer entre 1 et 10 mégohms.
- Si vous devez mettre une carte de côté, assurez-vous de la ranger dans un sac protecteur antistatique.
- Les cartes qui sont reliées à un châssis ou boîtier métallique mis à la terre ne nécessitent pas de protection antistatique spéciale.

[es] **Protección contra descargas electrostáticas (DES)**

La descarga electrostática se produce cuando los componentes electrónicos se manipulan de forma incorrecta pudiendo causar una falla intermitente o total afectando un circuito eléctrico. Al quitar y reemplazar una tarjeta de un chasis siempre siga los procedimientos para prevenir la DES:

- Asegúrese de que el chasis está conectado eléctricamente a tierra a través del cable de alimentación o cualquier otro medio si está disponible.
- Use una pulsera de DES asegurando que tiene buen contacto con la piel. Conecte la pinza de puesta a tierra a una *superficie sin pintar* del chasis para desviar a tierra cualquier voltaje de DES indeseable. Si ninguna pulsera está disponible, conéctese a tierra tocando la parte metálica *sin pintar* del chasis.
- Para su seguridad, verifique periódicamente el valor de la resistencia de la pulsera antiestática, que debe estar entre 1 y 10 megaohmios.
- Al guardar temporalmente una tarjeta electrónica asegúrese que está colocado en una bolsa de DES.
- Las tarjetas que están conectadas a un chasis de o caja de metal a tierra, no requieren una protección especial para la DES.

[pt] **Proteção contra descargas eletrostáticas (DES)**

DES ocorre quando os componentes eletrônicos são manipulados de forma inadequada e pode causar falha intermitente ou completa afetando um circuito elétrico. Remover e substituir um cartão eletrônico do chassi siga sempre os procedimentos para evitar DES:

- Certifique-se de que o chassi é eletricamente aterrado através do cabo de alimentação ou qualquer outro meio, se disponível.
- Utilize uma pulseira DES assegurando que você tenha um bom contato com a pele. Conecte o clipe à terra a uma *superfície não pintada* do chassi para desviar qualquer tensão indesejável de DES. Se nenhuma pulseira está disponível, faça o aterramento tocando a parte metálica *não pintada* do chassi.
- Por segurança, verificar periodicamente o valor da resistência da pulseira antiestática, que deve ser entre 1 e 10 megohms.
- Por temporariamente salvar um cartão eletrônico, certifique-se de que ele é colocado em um saco de DES.
- As cartas que estão ligados a um chassi ou caixa de metal ligada à terra, não necessitam de proteção especial para o DES.

Electromagnetic Compatibility



This equipment has been tested for verification of compliance with FCC Part 15, Subpart B requirements for class A digital devices.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.



This equipment has been tested and found to comply with the requirements of the EMC directive 2004/108/EC:

- EN 55022 Class A Radiated and conducted emissions
- EN 61000-4-2 Electrostatic discharge immunity
- EN 61000-4-3 Radiated, radio-frequency, electromagnetic field immunity
- EN 61000-4-8 Power frequency magnetic field immunity
- EN 61000-4-11 Voltage dips, short interruptions and voltage variations immunity

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Introduction to Thunder

This chapter provides an introduction to the Thunder system.

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<i>Key Features and Benefits</i>	2
<i>System Overview</i>	2
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Introduction

Thunder is the newest generation high-volume audio/data/intercom transport link from Grass Valley, a Belden Brand. Thunder transports up to 80 audio, intercom, or data paths, configurable in 8-path groups (10 groups total), all on one or two strands of fiber, at the lowest price and most compact size ever available.

Simply equip the compact 1RU frame with the appropriate Thunder Bolt I/O cards to create a fiber optic link that can solve virtually any audio/intercom/data connectivity situation in the teleproduction environment.

You buy only the components that you need. Individual analog and AES breakout panels as well as data and intercom devices can be configured in any combination to create an audio system that is perfectly suited to your particular application.

Whether you need a system that requires all 80 channels of audio, a mix of audio, data or GPI channels, or even all data or GPI channels, Thunder provides maximum flexibility and convenience.

Analog audio signals can even be converted to AES format, and vice versa, by just configuring Thunder with an analog input or output Bolt card at one end of the system and an AES I/O Bolt card at the other.

Up to ten internal Bolt I/O cards can be installed in a frame.

Six Bolt cards are available:

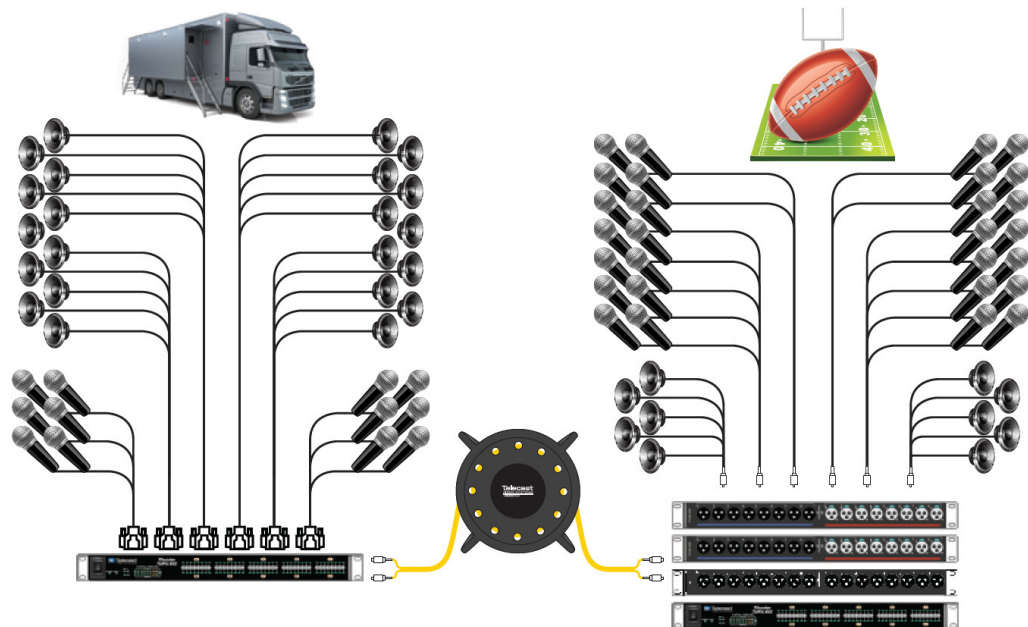
- Analog Audio Input (balanced); 8 channels
- Analog Audio Output (balanced); 8 channels
- AES Input; 4 channels (8 analog when decoded)
- AES Output; 4 channels (8 analog when decoded)
- Multiformat digital (RS-232/422/485); 4 channels, bidirectional
- GPI (general purpose, dry contact, SPST remote switch closures); 8 channels, bidirectional

Key Features and Benefits

- Up to 40 km (24.85 mi.) range (20 dB link budget) on one or two single-mode fiber strands with DFB SFPs.
- Up to 80 audio or 40 data paths, configurable in 8/4-path groups (10 groups total)
- Superior audio quality
- 1 RU Thunder main chassis plus 1 RU and 1.5 RU breakout panels
- 8 or 16 channels per breakout panel
- 1 RU Thunder main chassis also provides two additional bidirectional channels of multiformat data (RS-232/422/485), one channel of GPI and a BNC input connector for synchronizing AES audio output cards in the Thunder chassis to house clock timing
- Breakout panels can be mounted in front or behind the Thunder main chassis, and interconnected with DB-25 cables (supporting 8 channels each)
- Optional redundant fiber IN and OUT ports, both
- Integral optical power monitoring for local and remote signal strength

System Overview

The primary element in Grass Valley's Thunder system is a single 1RU frame that incorporates all of the signal processing required to consolidate up to 80 audio or data paths onto a single fiber strand; a second output for a redundant backup fiber is available. The frame contains cards for each signal format that will be processed. Associated with the frame are breakout panels with connectors providing access to the system for the various formats that can be carried.



A complete system requires a frame with processing cards and breakout panels at each end of the link.

System Components

The available Thunder system components are listed in the tables below.

Frame

Description	Function	Part Number
Thunder Frame	Thunder 1RU Frame, holds up to 10 Bolt Cards. 2 data, 1 GPI/O pair, two SFP slots and one fiber I/O panel	TNR-FRAME

Processing Cards

Format / Function	Thunder Bolt Processing Card / connector	Part Numbers
Analog Audio IN	Analog 8 ch Audio IN / db25 female	TNR-BC-AA-TX8
Analog Audio OUT	Analog 8 ch Audio OUT / db25 male	TNR-BC-AA-RX8
AES EBU Audio IN	Digital 4 ch Audio IN / db25 female	TNR-BC-AES-TX4
AES EBU Audio OUT	Digital 4 ch Audio OUT / db25 male	TNR-BC-AES-RX4
Data (bidirectional)	Data, 4 bi-directional / HD26 female	TNR-BC-DATA-4
GPI (bidirectional)	GPI, 8 GPI/O pairs (8 Tx, 8 Rx) / HD26 male	TNR-BC-GPI-8

Breakout Panels

Description	Part No.
Passive Audio Panels	
8 ch line level analog OUT XLR3M	TNR-BP-AA-RX8
16 ch line level analog OUT XLR3M	TNR-BP-AA-RX16
8 ch line level analog IN XLR3F	TNR-BP-AA-TX8
16 ch line level analog IN XLR3F	TNR-BP-AA-TX16
8x8 line level analog IN XLR3F, OUT XLR3M	TNR-BP-AA-TR16
4 ch digital AES unbalanced OUT BNC	TNR-BP-AES-RX-4BNC
4 ch digital AES unbalanced IN BNC	TNR-BP-AES-TX-4BNC
4 ch digital AES unbalanced IN BNC, 4 ch OUT BNC	TNR-BP-AES-TR-8BNC
Active audio panels	
8 ch mic/line level analog IN XLR3F	TNR-BP-AAMP-TX8
16 ch mic/line level analog IN XLR3F	TNR-BP-AAMP-TX16
Data panels	
4 DB9	TNR-BP-DATA-48
8 DB9	TNR-BP-DATA-88
Intercom panel	
Panel for 4 Aux modules	TNR-BP-ICM-8

Intercom Modules

Intercom Format	Part Number
Intercom module - 4 wire each end	ADDR-AUX-4W
Intercom module - ClearCom each end	ADDR-AUX-CC
Intercom module - RTS each end	ADDR-AUX-RTS

Power Supply

Description	Part Number
Universal AC to DC power supply for intercom modules. • Included with TNR-BP-ICM-8	ADAP-AC30V-X4
Redundant AC to DC power supply for main frame, 12 VDC output	ADAP-AC12V-DIN

Cables

Description	Part Number
Thunder Audio Out Breakout Cable, DB25M, 8 XLR3 Male	CA-D25F-8XLR3M
Thunder Audio In Breakout Cable, DB25M, 8 XLR3 Female	CA-D25M-8XLR3F
Thunder Audio interconnect cables, DB25M to DB25M, 40cm length	CA-D25MM-40
Thunder Audio interconnect cables, DB25M to DB25M, 80cm length	CA-D25MM-80
Thunder Data/GPI interconnect cable, HD26M to HD26F, 90cm length	CA-HD26MF-90

Fiber Connector Plates

Description	Part Number
Fiber connector plates with dual fibers; use for non-redundant systems and redundant systems with WDMs:	
2 ST fiber connectors	UFP-2ST
2 SC fiber, ultra polished	UFP-2SC
2 SC fiber, angle polished	UFP-2SCA
Dual LC connector	UFP-2LC
Fiber connector plates with dual fiber connector; use for non-redundant systems only	
Neutrik OpticalCon Duo 2 Fibers	UFP-NOC2
MX dual fiber	UFP-MX2
Neutrik OpticalCon Quad 4 Fibers	UFP-NOC4
Fiber connector plates with quad fiber connectors; use for redundant systems without WDM	
4 ST fiber connectors	UFP-4ST
4 SC fiber, ultra polished	UFP-4SC

Fiber Connector Plates

Description	Part Number
4 SC fiber, angle polished	UFP-4SCA
2 Dual LC connectors	UFP-4LC

Thunder System Components



This chapter introduces the various components that comprise the Thunder 80-channel audio/data/intercom link.

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ThunderBolt Cards and Breakout Panels 8
Analog Audio IN 8
Analog Audio OUT 9
AES Audio 10
DATA IN/OUT 11
GPI IN/OUT 12
Intercom 15

Thunder Frame

The Thunder Frame is a 1 RU device. It incorporates these features and functions:

- Optical/Electrical conversion (bidirectional) - transitions up to 80 channels of audio and data between electrical formats (analog/AES/data) and a single multiplexed optical signal.
- Electrical channel I/O and processing - the frame contains up to 10 ThunderBolt cards, each dedicated to a specific audio format. These interface cards process the incoming and outgoing audio/data signals to ensure seamless integration between the electrical and optical signal formats.
- Channel status monitoring - each channel is monitored to ensure that the link is functional and that the signal levels are satisfactory. The channel and link status is displayed on the frame front panel.



Fig. 2-1: Thunder frame - front panel



Fig. 2-2: Thunder frame - rear panel

ThunderBolt Cards and Breakout Panels

ThunderBolt cards plug into the ten available slots in the Thunder frame, and serve as the interface between the incoming and outgoing audio / data formats and the electro-optical conversion functionality of the frame's central processing.

Six different cards are available, and may be mixed and matched to accommodate the desired system configuration.

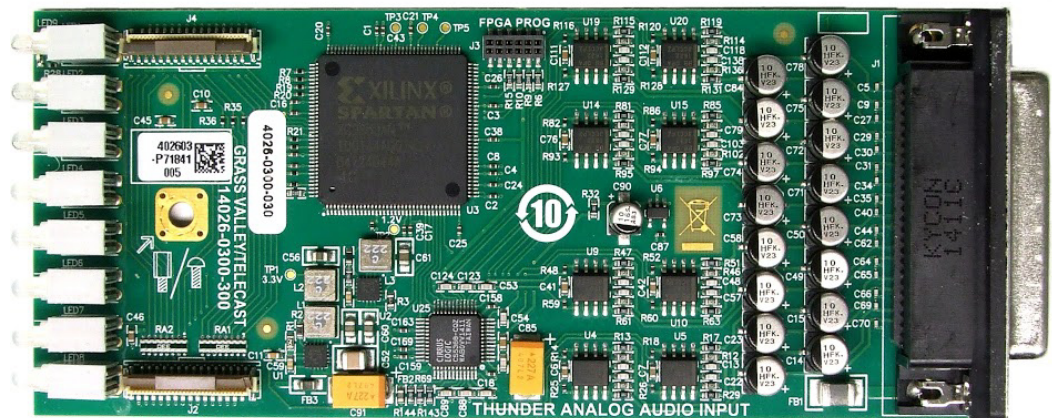
Each ThunderBolt card slot in the Thunder frame is associated with a DB-25 pin connector on the rear panel of the frame. Access to the card via this connector is provided by the use of a breakout panel. The breakout panel mounts in the frame, and has a matching DB-25 connector on the back, and audio/data/GPI connectors on the front. Each card type is matched with an appropriate breakout panel.

For quick recognition, front-panel connectors or connector groups are identified by a colored graphic:

- RED designates INPUT
- Blue designates OUTPUT
- Green designates BI-DIRECTIONAL

Analog Audio IN

Card



The Analog Audio IN card accepts eight channels of analog audio.

Breakout Panel

The breakout panel for analog audio inputs comes in two formats - passive and active.

- The passive version has XLR connectors, and is intended for line-level signals.
- The active version also uses XLR connectors, but has built-in gain, and is intended for mic-level signals. It is provided with gain controls on the front panel, and requires AC power on the rear panel.

Both passive and active breakout panels are available in 8-channel (supporting one Thunder Bolt card) and 16-channel (supporting two Thunder Bolt cards) versions. The front panel controls and the rear-panel DB-25 connectors on the 16-ch version are labeled A and B to distinguish between the supported cards.



Fig. 2-3: Analog audio IN panel - active, 16 channels - front view



Fig. 2-4: Analog audio IN panel - active, 16 channels - rear view

Because a breakout panel has space for 16 XLR connectors, it is possible to share a single breakout panel between an analog input ThunderBolt card and an analog output ThunderBolt card.



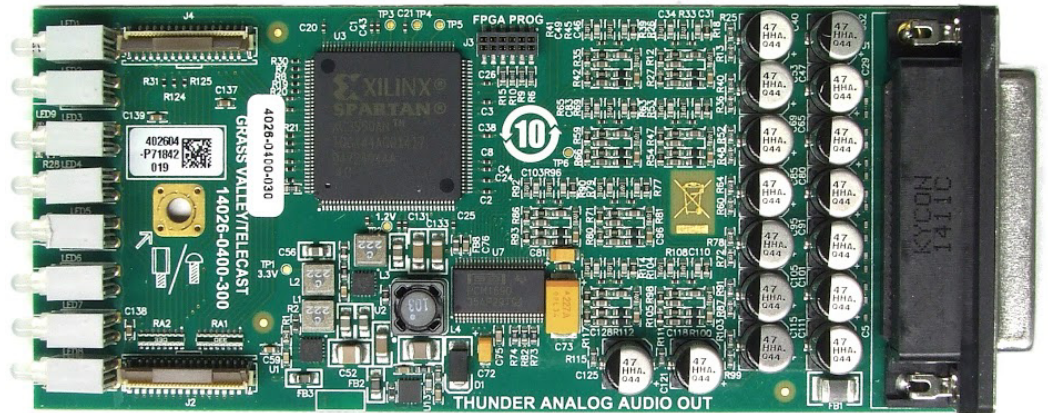
Fig. 2-5: Analog audio panel - 8 CH IN and 8 CH OUT - front view

The INPUTS are marked with a red line, and the outputs with a blue line.

Analog Audio OUT

Card

The Analog Audio OUT card supplies 8 channels of output audio.



The Analog Audio OUT card

Breakout Panel

Analog Audio OUT breakout panels are available in two formats:

- 1 8 channels of analog audio on XLR male connectors - supports one Bolt card
- 2 16 channels of analog audio on XLR male connectors - supports two Bolt cards

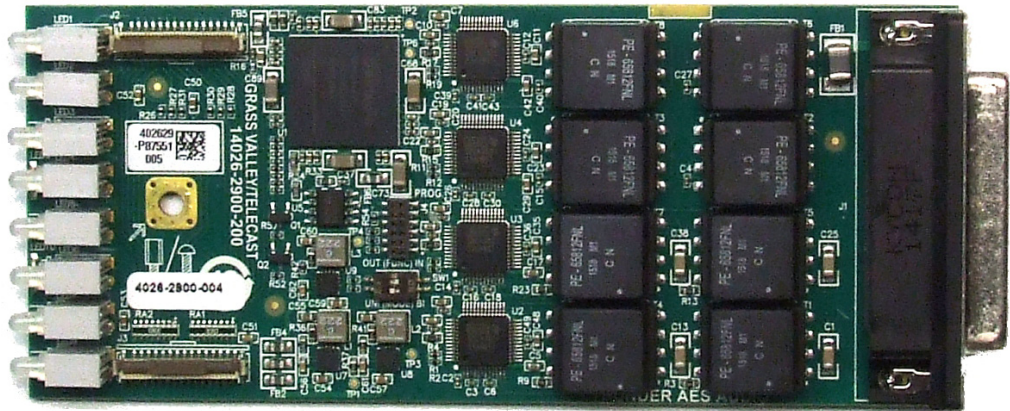


The rear panel has a DB25 connector for each input.

AES Audio

Card

The AES Audio card supports four AES digital audio channels (equal to eight analog channels), and is factory-configured as either an AES IN or AES OUT card.



Breakout Panels

Three AES breakout panels are available:

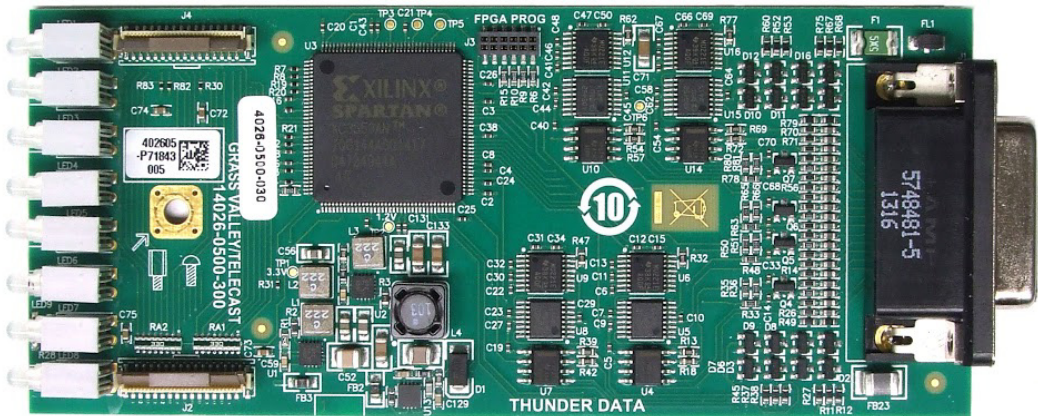
- Four AES IN on BNC connectors
- Four AES OUT on BNC connectors
- Four AES IN and four AES out on BNC connectors (supports 2 AES cards)

The rear of the breakout panel incorporates either one or two DB25 connectors, as required.



DATA IN/OUT

Card



The Data IN/OUT card supports four channels of data, in RS232, RS422 or RS485 format. The formats for the four channels are individually selectable; see [page 26](#) for details.

Breakout Panel

DATA cards (either one or two) and the GPI card share a single breakout panel. For data, the rear of the breakout panel has one or two DB26HD connectors, one for each Data Bolt card. They are labeled A and B, and each carries 4 channels of data. The front of the breakout panel has four or eight DB9 connectors as appropriate; the 8-ch version is shown in the figure.



Fig. 2-6: Data-GPI breakout panel (8-ch version)- front.JPG

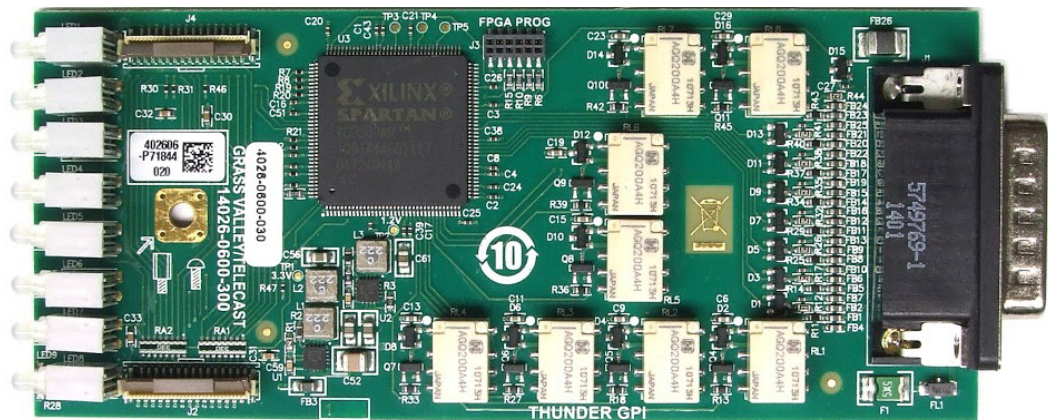


Fig. 2-7: Data-GPI panel - rear.JPG

In the 8-ch version, the two groups of four are graphically separated and labeled as DATA RS-232 / 422 / 485 A and DATA RS-232 / 422 / 485 B.

GPI IN/OUT

Card



The GPI IN/OUT card supports 8 GPIOs.

Breakout Panel

The GPI card and the DATA card share a single breakout panel.



Fig. 2-8: Data-GPI breakout panel - front.JPG



Fig. 2-9: Data-GPI panel - rear.JPG

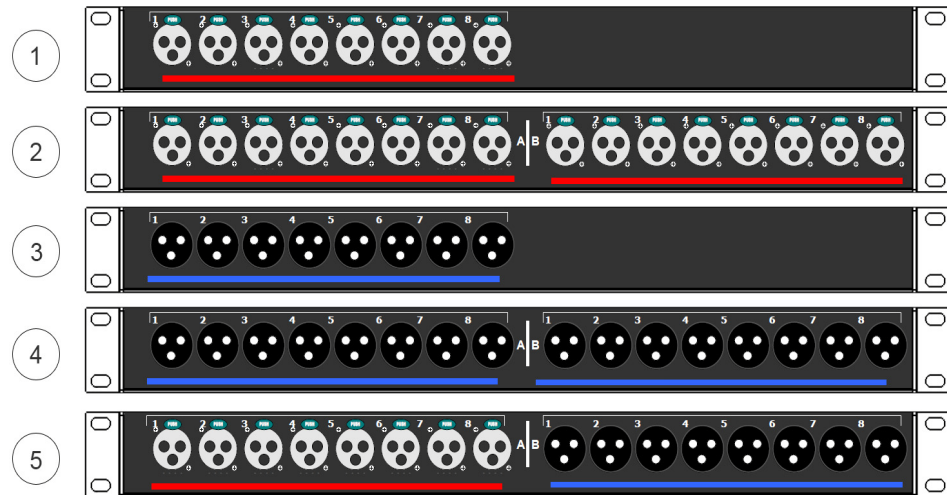
The GPI section of the front of the breakout panel has a single DB-25 female connector, labeled as GPI, while the rear has a single DB-25 female connector, also labeled GPI.

Breakout Panels

Analog Audio Breakout Panels - Passive

Five versions of this panel are available:

- 1 Audio IN, 8 channels, XLR female connectors. Red patch beneath the connectors.
- 2 Audio IN, 16 channels (2 banks of 8, labeled A and B), XLR female connectors. Red patch beneath the connectors.
- 3 Audio OUT, 8 channels, XLR male connectors. Blue patch beneath the connectors
- 4 Audio OUT, 16 channels, (2 banks of 8, labeled A and B), XLR male connectors. Blue patch beneath the connectors.
- 5 Audio IN, 8 channels (labeled A), plus Audio OUT, 8 channels (labeled B). Audio IN has XLR female connectors, with a red patch beneath. Audio OUT has XLR male connectors, with a blue patch beneath.



Analog Audio Breakout Panels - Active Inputs

These panels are intended for use as microphone input panels, and are equipped with gain and phantom power controls for each audio channel.

Two versions of this panel are available:

- 1 Audio IN, 8 channels, XLR female connectors. Red patch beneath the connectors.
- 2 Audio IN, 16 channels (2 banks of 8, labeled A and B), XLR female connectors. Red patch beneath the connectors.

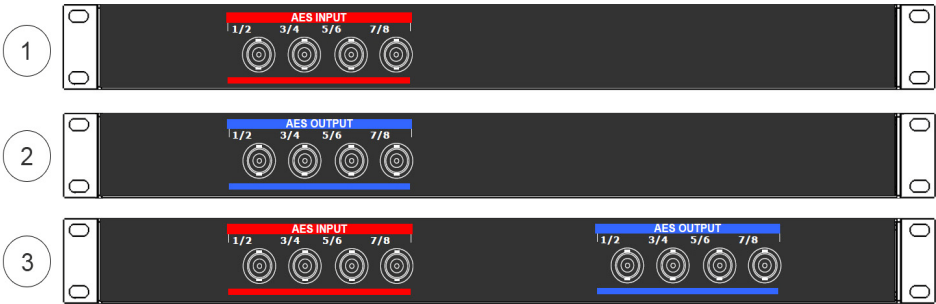


See [End-to-End Channel Assignments](#), on page 34 for operating instructions.

AES Breakout Panels

Three versions of this panel are available:

- 1 AES IN, 4 channels, BNC connectors. Red labels.
- 2 AES OUT, 4 channels, BNC connectors. Blue labels.
- 3 AES IN, 4 channels, BNC connectors (red labels)
PLUS: AES OUT, 4 channels, BNC connectors (blue labels).

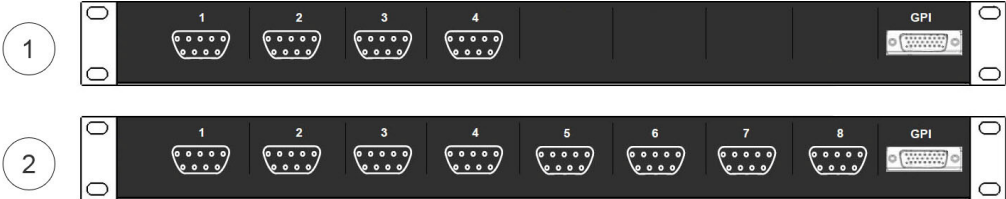


Data and GPI Breakout Panels

These panels provide I/O connections for DataBolt cards (either one or two) and one GPI Bolt card.

Two versions of this panel are available:

- 1 Data I/O, 4 channels, DB9 female connectors, plus GPI I/O
- 2 Data I/O, 8 channels, DB9 female connectors, plus GPI I/O



Intercom

Intercom I/O to the Thunder system is provided by modules installed in a breakout panel. There is no dedicated card type for the intercom signals; they are routed through a pair of analog audio Bolt cards - one Audio IN and one Audio OUT.

The Thunder Intercom panel can house up to four intercom modules. Three types are available:

- Balanced 4-wire
- Clear-Com 2-wire
- RTS/Telex compatible 2-wire



Fig. 2-10: Intercom Breakout Panel with Intercom Modules

Intercoms can be of any type in any location in the assembly. However, for proper operation of the intercom channels, the same placement order must be followed at the other side of the system. A 2-wire system can be interconnected with a 4-wire system at another Adder II, but not all intercom functions will work (for example, calling).

4-wire (balanced)

4-wire Auxiliary (balanced) intercoms use an individual 5-pin XLR on each of the two channels in each module. XLR pin functions are given in the following table. Intercom Module Gain is 0 dB.

PIN	FUNCTION	IMPEDEANCE	SIGNALS
1	Ground		
2	Input (+)	600 Ohm input	Line: +8 dBm
3	Input (-)	600 Ohm input	Mic: -32 dBm
4	Out (+)	≥600 Ohm load	+8 dBm
5	Out (-)	≥600 Ohm load	+8 dBm

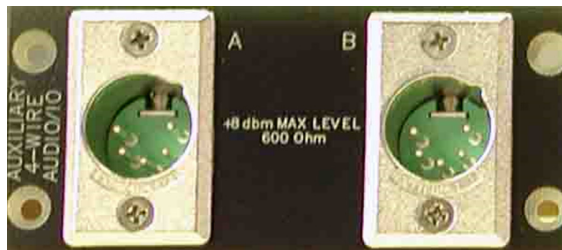


Fig. 2-11: Intercom Module: 4-Wire Auxiliary (balanced)

Clear-Com

Clear-Com intercom modules have a 3-pin XLR connector for each of the A and B channels. This Grass Valley module fully supports the Clear-Com signaling protocol and signal levels.



Fig. 2-12: Clear Com module

The Clear-Com Intercom Connections are listed in the table below.

Pin	Description
1	Ground
2	+VDC Power
3	Power

- The units null by plugging in a 1/8-inch (3.5mm) stereo headset (not a TS-1) into the connector located in the center of the unit and then adjusting the top set of pots for optimum null.
- The second set of pots, labeled **GAIN**, adjust the receive gain for that channel +/-3db.
- The **POWER** switch controls whether 30VDC is applied to beltbacks and/or remote stations that might be plugged into the module.
- The **MODE** switch should always be set to CC for Clear-Com intercom systems.

Nulling Procedure

Note: A stereo audio headset and a tweaker are needed to null these modules.

Inserting the 1/8" sub-mini stereo headset jack into the Clear-Com module turns on a tone that nulls the system. It is important that the nulling procedure be done when all beltbacks and other interfaces are in place. If you add additional beltbacks, it is likely that the nulling procedure should be repeated.

As indicated on the module faceplate, the right ear serves Channel A and the left ear serves Channel B. Do not listen to both ears at the same time as this will not allow you to carefully discern the tone.

While listening to the right side, turn the adjustment pot on the top left above the mini headset jack. The goal is to eliminate and/or minimize the nulling tone. Once you have gotten the adjustment so that the tone is as quiet as possible, then change ears and do Channel B while using the top right adjustment pot.

Powered (Wet) and Unpowered (Dry) Intercom Systems

The Grass Valley Clear-Com interface is compatible with powered or unpowered belt packs as well as fixed equipment. Switch the Module to **WET** (down) when you want to use Thunder to provide power to one or more intercom belt packs and/or remote intercom stations. The module will provide adequate power for approximately 4 belt packs or 2 remote stations, or a combination thereof.

If you are supplying power to your intercom system externally with an intercom power supply or "Master" intercom station, switch the Module to **DRY** (up). Many more belt packs can be added if powered externally. Refer to your intercom manufacturer's documentation for additional system details.

Note: When powering a Clear-Com intercom system with an external power supply, be sure to set the Thunder intercom module to "dry" to prevent noise, oscillation or motor-boating.

RTS Telex

RTS modules provide a two-channel intercom on a single 3-pin XLR connector. This module fully supports the RTS signaling protocol and signal levels.

RTS channel operation is optimized by the use of front panel adjustments as shown in Figure 2-13 and listed below.

- Input Gain, ± 10 dB
- Output Gain, ± 10 dB
- Null



Fig. 2-13: Intercom Module: RTS Telex

The following table lists the RTS Telex pin numbers and intercom connections. Switches are also provided for the channel pair for:

- Dry unpowered (d), or Wet powered (w) PORTS
- 200 Ohm ON or OFF terminations TERM

Pin	Description
1	Ground
2	+VDC Power & Chan 1 Audio
3	Chan 2 Audio

The interface is compatible with powered or unpowered belt packs, as well as fixed equipment. You may power up to five belt packs with each intercom module. Refer to your intercom manufacturer's documentation for additional system details.

For operation with a belt pack, adjust the following:

- set the PORTS to w (powered)
- the TERM to ON
- center each of the INPUT gain, OUTPUT gain, and NULL controls

Readjust these controls to optimize performance as required.

Breakout Panel

The Intercom breakout panel has four bays for installing intercom modules.



Within the panel, the various intercom signals are arranged and packaged into an input group and an output group. These are presented on the rear panel on two DB25 connectors. The inputs (Rx) are connected to an Audio IN Bolt card, while the outputs (Tx) are connected to an Audio OUT bolt card.



In addition to the audio I/O connectors, the rear panel has two 30 VDC intercom power inputs - a primary input, and a secondary redundant input.

Installing/Removing Intercom Modules

Before attempting any module exchange, the Intercom breakout panel should be powered OFF .

Two multi-conductor cable harnesses are built into the Intercome breakout panel and run behind the module locations. These cables connect the intercom modules to power and signal sources. There are AMP-MTA type connectors for each module on this harness; the connector fits all module types.

- Signal is 8-pin
- Power is 2-pin

To change an intercom module in the breakout panel:

- 1 Turn the power **OFF**.
- 2 Remove the four screws that hold the module in the panel.
- 3 Gently pull the intercom module away from the panel until you can see and remove the two cable harnesses.
- 4 Replace with new module and reconnect in reverse order.
- 5 Turn the power **ON**.

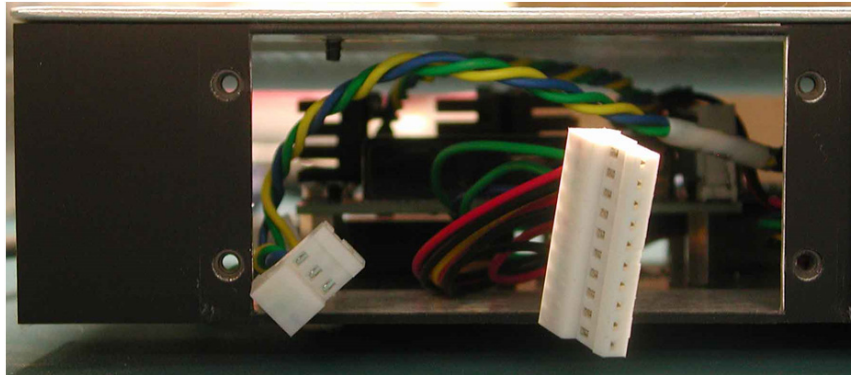


Fig. 2-14: Replacing Intercom Modules

3 System Implementation

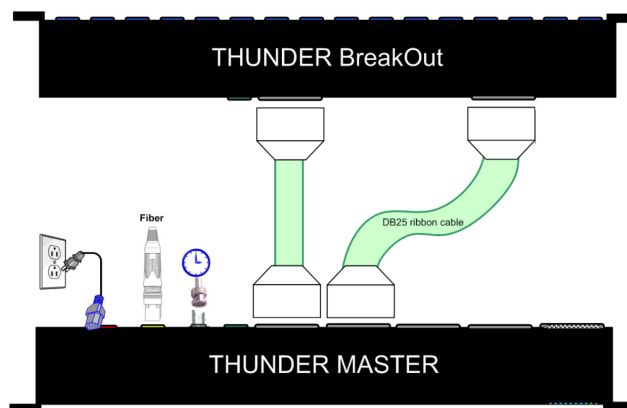
This chapter describes the installation, setup and configuration of the Thunder 80-channel audio/data/intercom link.

<i>Installation</i>	21
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<i>Operation</i>	31

Installation

Each end of a Thunder audio/data/intercom link requires an identical equipment package. This comprises a rack containing:

- A Thunder frame (1 RU), with installed ThunderBolt cards
- Either:
 - Breakout panels as required for the installed ThunderBolt cards
 - Cables connecting the frame to the breakout panels.
- Or:
 - Snake cables (DB25 to 8 XLR)
- Power source as available at the site



Interconnections within the rack are made using multiconductor ribbon cables.

- Each ThunderBolt card within the Frame is associated with a connector on the frame's rear panel. Each card and its associated connector handle signals for eight channels.
- Each breakout panel has a connector that carries 8 channels of data.

- Some audio breakout panels provide inputs/outputs for two banks of 8 channels. These carry one connector for each 8-channel bank, and are associated with one ThunderBolt card for each bank.
- The Data/GPI breakout PANEL may support either one or two Data Bolt cards in addition to the GPI Bolt card.

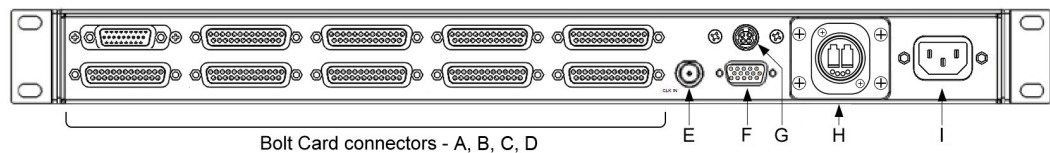
Fiber inputs and outputs connecting the two ends of the system together are located on the frame's rear panel.

- The entire bidirectional data package is carried on dual fibers.
- A second fiber plate carrying the same data package is available so that a back-up, redundant signal path can be established to protect the integrity of the program.
- WDM SFP cartridges are available, allowing bidirectional communication over a single fiber.

Connection Details

All connections to the Thunder frame are located on the rear panel.

The 10 connectors on the left-hand side of the rear panel are associated with the Bolt cards installed in the frame.



A - Analog Audio Bolt Card Connectors

Analog audio Boltcards connect to their associated breakout panels via a ribbon cable equipped with DB25 connectors. These use standard "Tascam" pinouts for analog audio, as shown in the following figure.

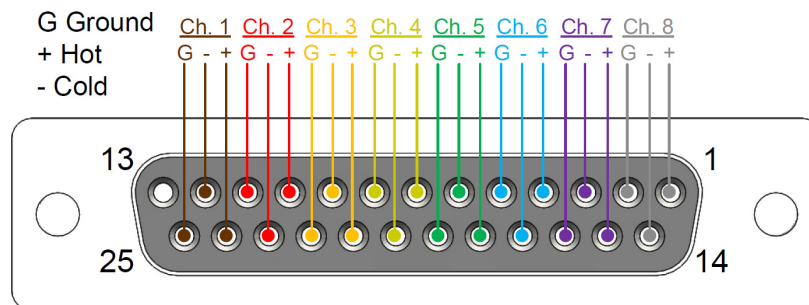


Fig. 3-1: Tascam DB25 pinouts for analog audio

The connector pinout is shown in the figure and the table.

Function	Pin #	Signal
Audio Ch1	24	Audio Ch 1 - H (+)
	12	Audio Ch 1 - C (-)
	25	Audio Ch 1 - GND
Audio Ch 2	10	Audio Ch 2 - H (+)
	23	Audio Ch 2 - C (-)
	11	Audio Ch 2 - GND
Audio Ch 3	21	Audio Ch 3 - H (+)
	9	Audio Ch 3 - C (-)
	22	Audio Ch 3 - GND
Audio Ch 4	7	Audio Ch 4 - H (+)
	20	Audio Ch 4 - C (-)
	8	Audio Ch 4 - GND
Audio Ch 5	18	Audio Ch 5 - H (+)
	6	Audio Ch 5 - C (-)
	19	Audio Ch 5 - GND
Audio Ch 6	4	Audio Ch 6 - H (+)
	17	Audio Ch 6 - C (-)
	5	Audio Ch 6 - GND
Audio Ch 7	15	Audio Ch 7 - H (+)
	3	Audio Ch 7 - C (-)
	16	Audio Ch 7 - GND
Audio Ch 8	1	Audio Ch 8 - H (+)
	14	Audio Ch 8 - C (-)
	2	Audio Ch 8 - GND
Not connected	13	No signal

B - AES Bolt Card Connector

AES Bolt cards connect to their associated breakout panels via a ribbon cable equipped with DB25 connectors. These use standard "Tascam" pinouts for AES audio, as shown in the following figure.

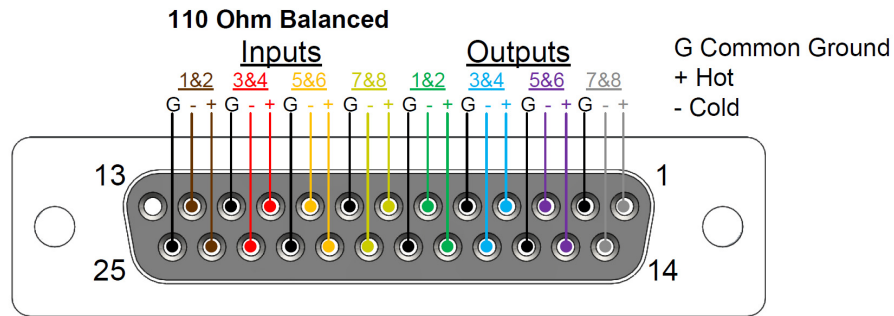


Fig. 3-2: Tascam DB25 pinouts for AES audio

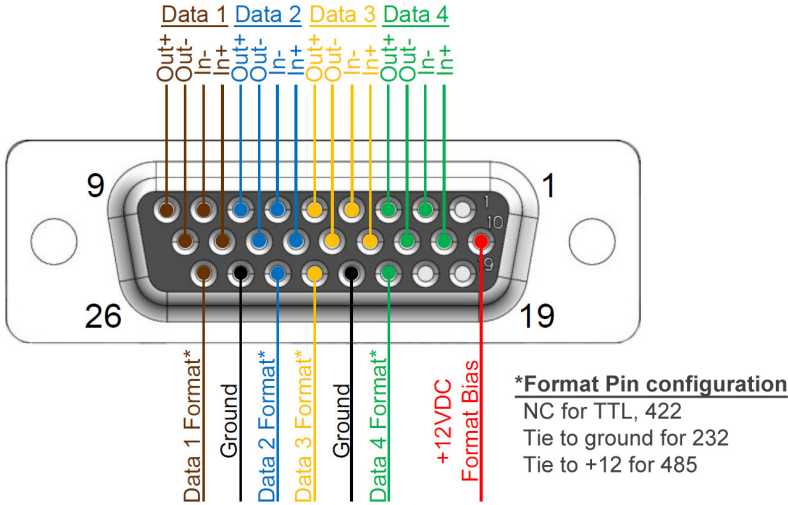
The connector pinout is shown in the figure and the table.

Function	Pin #	Signal
Input Ch1&2	24	AES IN - 1&2 - H (+)
	12	AES IN - 1&2 - C (-)
	25	AES IN - 1&2 - GND
Input Ch3&4	10	AES IN - 3&4 - H (+)
	23	AES IN - 3&4 - C (-)
	11	AES IN - 3&4 - GND
Input Ch5&6	21	AES IN - 5&6 - H (+)
	9	AES IN - 5&6 - C (-)
	22	AES IN - 5&6 - GND
Input Ch7&8	7	AES IN - 7&8 - H (+)
	20	AES IN - 7&8 - C (-)
	8	AES IN - 7&8 - GND
Output Ch1&2	18	AES OUT - 1&2 - H (+)
	6	AES OUT - 1&2 - C (-)
	19	AES OUT - 1&2 - GND
Output Ch3&4	4	AES OUT - 3&4 - H (+)
	17	AES OUT - 3&4 - C (-)
	5	AES OUT - 3&4 - GND
Output Ch5&6	15	AES OUT - 5&6 - H (+)
	3	AES OUT - 5&6 - C (-)
	16	AES OUT - 5&6 - GND

Function	Pin #	Signal
Output Ch7&8	1	AES OUT - 7&8 - H (+)
	14	AES OUT - 7&8 - C (-)
	2	AES OUT - 7&8 - GND
Not connected	13	No signal

C - Data Bolt Card Connector

The Data Bolt card, which supports four data channels with selectable formats, uses a DB26HD connector (also called DA26).



The connector pinout is shown in the figure and the table.

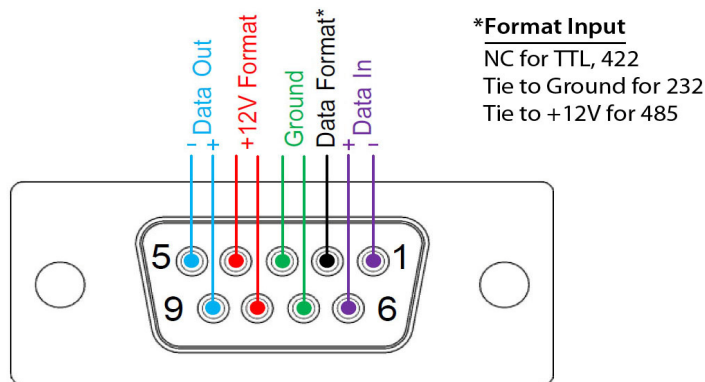
Function	Pin #	Signal
Data 1 RS232/422/485	9	Data 1: RS422 OUT (+) / RS232 OUT
	18	Data 1: RS422 OUT (-)
	8	Data 1: RS422 IN (-) / RS485 I/O (-)
	17	Data 1: RS422 IN (+) / RS485 I/O (+) / RS232 IN
	26	Data 1 Format Select
Data 2 RS232/422/485	7	Data 2: RS422 OUT (+) / RS232 OUT
	16	Data 2: RS422 OUT (-)
	6	Data 2: RS422 IN (-) / RS485 I/O (-)
	15	Data 2: RS422 IN (+) / RS485 I/O (+) / RS232 IN
	24	Data 2 Format Select
Ground	25	GND (data 1/2)

Function	Pin #	Signal
Data 3 RS232/422/485	5	Data 3: RS422 OUT (+) / RS232 OUT
	14	Data 3: RS422 OUT (-)
	4	Data 3: RS422 IN (-) / RS485 I/O (-)
	13	Data 3: RS422 IN (+) / RS485 I/O (+) / RS232 IN
	23	Data 3 Format Select
Data 4 RS232/422/485	3	Data 4: RS422 OUT (+) / RS232 OUT
	12	Data 4: RS422 OUT (-)
	2	Data 4: RS422 IN (-) / RS485 I/O (-)
	11	Data 4: RS422 IN (+) / RS485 I/O (+) / RS232 IN
	21	Data 4 Format Select
Ground	22	GND (data 3/4)
Format bias	10	Format bias +12 VDC

The four data channels can be configured individually to use any of the supported formats, by using the appropriate Format Select pin (21, 23, 24, 26) as identified in the table.

Format Select pin: Floating for RS-422 or TTL
 Tied to any GND pin for RS-232
 Tied to +12 VDC bias (pin #10) for RS-485

At the breakout panel, each data channel is presented on a separate DB9 connector, with the following pinout



Function	Pin #	Signal
Data RS232/422/485	9	Data : RS422 OUT (+) / RS232 OUT
	5	Data : RS422 OUT (-)
	1	Data : RS422 IN (-) / RS485 I/O (-)
	6	Data : RS422 IN (+) / RS485 I/O (+) / RS232 IN
	2	Data Format Select

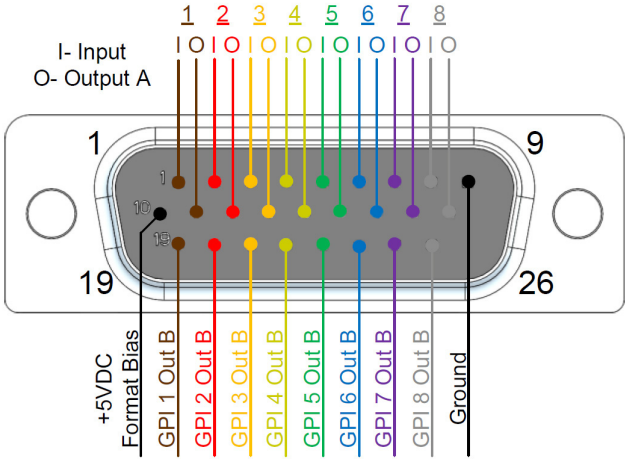
Function	Pin #	Signal
Ground	3,7	GND
Format bias	4, 8	Format bias +12 VDC

The data channel can be configured to use any of the supported formats, by using the Format Select pin (2):

Format Select pin: Floating for RS-422 or TTL
 Tied to any GND pin for RS-232
 Tied to +12 VDC bias (pin #10) for RS-485

D - GPI Bolt Card Connector

The GPI Bolt card, which supports eight GPIs, uses a DB26HD connector (also called DA26).



Function	Pin #	Signal
GPI 1	1	GPI 1 - IN
	11	GPI 1 - OUT A
	19	GPI 1 - OUT B
GPI 2	2	GPI 2 - IN
	12	GPI 2 - OUT A
	20	GPI 2 - OUT B
GPI 3	3	GPI 3 - IN
	13	GPI 3 - OUT A
	21	GPI 3 - OUT B

Function	Pin #	Signal
GPI 4	4	GPI 4 - IN
	14	GPI 4 - OUT A
	22	GPI 4 - OUT B
GPI 5	5	GPI 5 - IN
	15	GPI 5 - OUT A
	23	GPI 5 - OUT B
GPI 6	6	GPI 6 - IN
	16	GPI 6 - OUT A
	24	GPI 6 - OUT B
GPI7	7	GPI 7 - IN
	17	GPI 7 - OUT A
	25	GPI 7 - OUT B
GPI 8	8	GPI 8 - IN
	18	GPI 8 - OUT A
	26	GPI 8 - OUT B
Format Bias	10	+5 VDC
Ground	9	GND

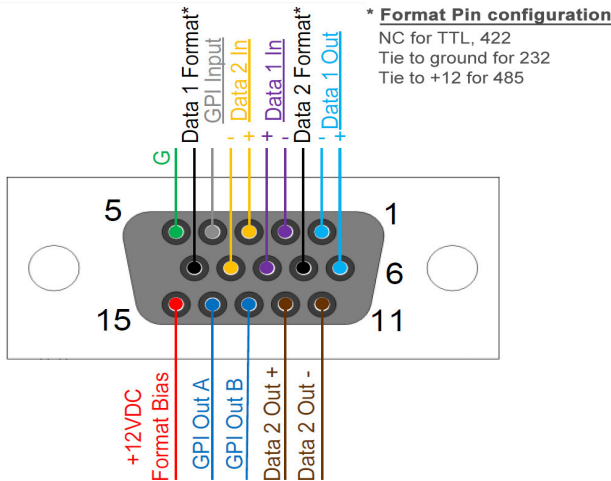
E - AES/DARS Input

AES synchronization signal input for locking internal Thunder AES Bolt cards to the user's "house" clock.

BNC connector.

F - Frame Data Connector

This DB15HD connector carries data and GPI associated with the frame, and is not related to the Data Bolt or the GPI Bolt card.



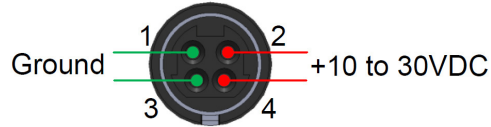
Function	Pin #	Signal
Data 1 RS232/422/485	3	Data 1: RS422 OUT (+) / RS232 OUT
	11	Data 1: RS422 OUT (-)
	12	Data 1: RS422 IN (-) / RS485 I/O (-)
	9	Data 1: RS422 IN (+) / RS485 I/O (+) / RS232 IN
	10	Data 1 Format Select
Data 2 RS232/422/485	6	Data 2: RS422 OUT (+) / RS232 OUT
	1	Data 2: RS422 OUT (-)
	2	Data 2: RS422 IN (-) / RS485 I/O (-)
	8	Data 2: RS422 IN (+) / RS485 I/O (+) / RS232 IN
	7	Data 2 Format Select
Ground	5	GND
Format bias	15	Format bias +12 VDC
GPI	4	GPI 1 input
	14	GPI OUT A
	13	GPI OUT B

The two data channels can be individually configured to use any of the supported formats, by using the appropriate Format Select pin (7 or 10):

- Floating for RS-422 or TTL
- Tied to GND (pin 5) for RS-232
- Tied to +12 VDC bias (pin 15) for RS-485

G - Auxilliary Power Input

The auxiliary power input is connected to +10 to +30 VDC via a KPJX-4S-S connector.



H - Optical connection Panels

A variety of optical fiber connector plates are available for the Thunder frame, in order to support most available fiber plugs:

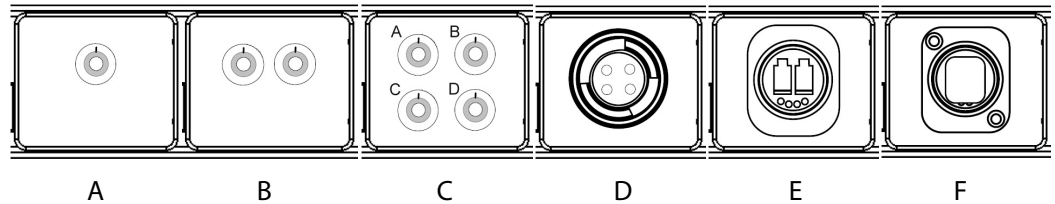


Fig. 3-3: Fiber Connector Plates

A - ST single

B - ST2 - Dual STs for redundant input/output

C - ST4

D - MX

E - OpticalCON Duo

F - OpticalCON quad

Laser sources are available at 1310 nm, 1550 nm WDM, and at the various CWDM wavelengths.

I - AC Power input

100-240 VAC mains, 50-60 Hz.

Operation

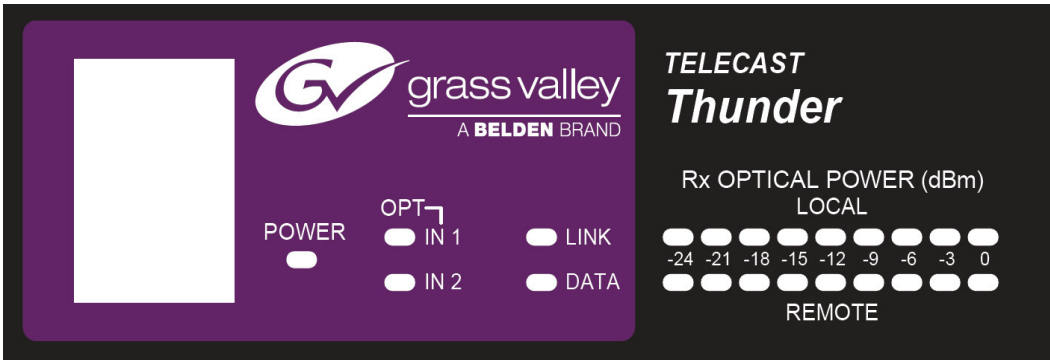
User Interface

The Thunder front panel incorporates a series of LEDs that are used to display the system status to the user.



Primary Display

The primary display on the left side has LED indicators for: Power, Optical input 1 and 2 status conditions (channel in use/un-used channel “readiness”), System Link, Data Activity (for data channels 1 and 2 on the mainboard only), and 2 “Local” / “Remote” bar graphs with 9 segments, 3dBm/segment, each representing optical input power applied to both the local and remote Thunder chassis’.



Power

Indicates the input power conditions of the Thunder chassis:

- Unlit when the power switch is turned off.
- Illuminates solid yellow (red/green mix) when powered on and the primary power (AC Line Input) source only is being supplied to the chassis.
- Illuminates solid green when powered on and both the primary (AC Line) and secondary (10Vdc to 30Vdc) power sources are being supplied to the chassis.
- Illuminates solid red when powered on, but the primary power has failed and the chassis is now operating on the secondary (back-up) power source.

OPT - IN 1

Indicates status/conditions of the primary SFP optical receiver.

Condition 1 – No optical signal present

- Illuminates solid red in the absence of optical power to the primary SFP receiver.

Condition 2 – Channel in use

- Illuminates solid green when a valid optical signal is applied to the primary SFP receiver, and indicates that the primary channel is the one currently in use for communication with the remote Thunder Chassis.

Condition 3 – Channel not in use, but optical signal present. This feature informs the user that optical power is available on the unused channel, making them aware that if an automatic redundancy switchover should occur, the backup optical power is ready and available.

- Flickers briefly at ≈ 2 second intervals to indicate the presence of optical power to the primary SFP receiver. The color of the flicker indicates the level of optical power being received (color will match that of the “Optical Power Meter” display if it is currently being used for this channel).
 - a Red flash: -24 to -27dBm input
 - b 66% red/33% green flicker: -21 to -23dBm input
 - c 33% red/66% green flicker: -18 to -20dBm input
 - d Green flash: ≥ -15 dBm input

Condition 4 – SFP not installed

- Flashes red at ≈ 2 times per second when the SFP used in the primary (top) dock of the dual SFP cage is either faulty or not installed correctly.

OPT - IN 2

Indicates status/conditions of the secondary (backup) SFP optical receiver.

Condition 1 – No optical signal present

- Illuminates solid red in the absence of optical power to the secondary (backup) SFP receiver.

Condition 2 – Channel in use

- Illuminates solid green when a valid optical signal is applied to the secondary (backup) SFP receiver, and indicates that the secondary (backup) channel is the one currently in use for communication with the remote Thunder Chassis.

Condition 3 – Channel not in use, but optical signal present. This feature informs the user that optical power is available on the unused channel, making them aware that if an automatic redundancy switchover should occur, the backup optical power is ready and available.

- Flickers briefly at ≈ 2 second intervals to indicate the presence of optical power to the secondary (backup) SFP receiver. The color of the flicker indicates the level of optical power being received (color will match that of the “Optical Power Meter” display if it is currently being used for this channel).
 - a Red flash: -24 to -27dBm input
 - b 66% red/33% green flicker: -21 to -23dBm input
 - c 33% red/66% green flicker: -18 to -20dBm input
 - d Green flash: ≥ -15 dBm input

Condition 4 – SFP not installed

- Unlike the primary (OPT - IN 1) indicator, this indicator will be extinguished when the SFP used in the secondary (bottom) dock of the dual SFP cage is either faulty or not installed correctly. This is to avoid any false indication when a Thunder System is purchased without the redundant optical backup SFP installed.

Link

Indicates that proper communication has been established with the processing electronics of the remote Thunder Chassis.

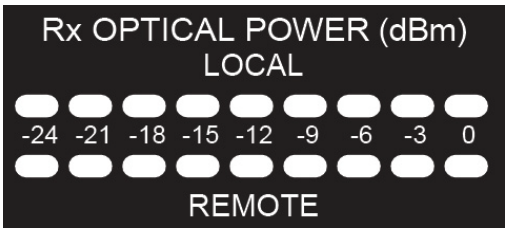
- Illuminates solid red when there is either no link, or excessive errors in the fiber optic cable path are preventing proper communication with the remote Thunder Chassis.
- Illuminates solid green when error-free communication has been established with the remote Thunder Chassis.

Data

Indicates the presence of RS-232/RS-422/RS-485 data activity on the rear panel, mainboard mounted DB-15HD connector.

- Unlit with no data activity
- Illuminates green with data activity. Intensity varies with data packet density.

Rx Optical Power (dBm)



Two 9-segment bar graphs that display both “**LOCAL**” and “**REMOTE**” optical power levels presented to the fiber optic input port that is currently in use, by the Thunder chassis at either end of the system. The functionality of the 2 meters is identical:

Display	Input Power
	No optical power applied
	-24 dBm
	-21 dBm
	-18 dBm
	-15 dBm
	-12 dBm
	-9 dBm
	-6 dBm
	-3 dBm

Display	Input Power
	0 dBm or more - overload condition - flashing red
	SFP module overload, or corrupt/non-conformant input data - flashing red

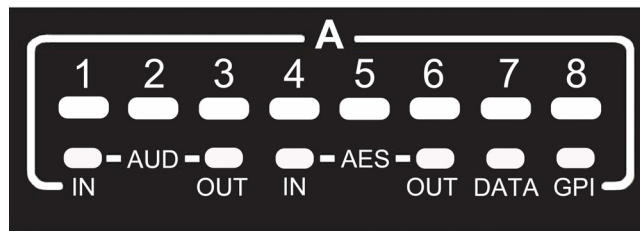
Status Display for Installed Bolt Cards

Each of the ten slots in the frame that can accept a Bolt card is associated with a front panel display that shows the Bolt card type, and signal presence on its channels. These displays occupy the right-hand section of the front panel.



Signal Presence Indicators

LED illuminates **Green** when a signal is present in the channel.
For analog audio Bolt cards, the LEDs will turn **Red** when the audio is clipping (greater than +24 dBu)



Card Type Indicators

One LED illuminates **Orange** to indicate the type of Bolt card that is installed in this slot.

End-to-End Channel Assignments

Generally, all channels match 1-to-1 through the system, and this is reflected in the Signal Presence LED display. If you place a signal on channel 1 at one end of the system, it arrives on channel 1 at the other end.

Exception: the Data Bolt card has four bi-directional channels, and the LEDs identify channel occupancy and signal direction. At each end, LEDs 1-4 represent inputs at that end, and LEDs 5-8 indicate outputs arriving from the other end. The matching is: 1 in → 5 out, 2 in → 6 out, 3 in → 7 out, and 4 in → 8 out.

Active Analog Audio Breakout Panels - Adjustment

These panels are intended for use as microphone input panels.



They incorporate two front-of-panel controls for each XLR connector.

The switches are self centering, 3 position momentary action types. In the case of the “PH/PWR” switches, the throw is either momentary left (phantom power off) or momentary right (phantom power on) from the center position. For the “GAIN” switches the throw is either momentary down (lower gain setting) or momentary up (higher gain setting). The operation of these switches is explained more thoroughly below. A single Expansion Panel is available with either one or two 8 channel banks installed for a total of up to 16 channels. The “Extended” switch functions explained below (switches that perform operations on multiple channels) pertain to single banks of 8. Numbers shown in parenthesis () are for a second 8 channel bank (if so equipped).

The “PH/PWR” and “GAIN” switches on the Thunder MIC Input Expansion Panel work in the following manner:

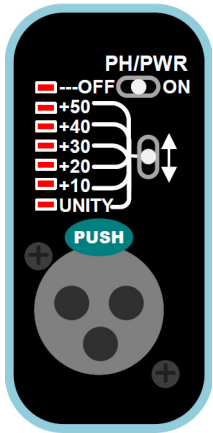
Phantom Power Switches

Single Switch Functions (Any Channel)

- Press “PH/PWR” toggle left momentarily – Phantom Power is disabled, “OFF” on the appropriate channel.
- Press “PH/PWR” toggle right momentarily – Phantom Power is applied, “ON”, to the appropriate channel.

Extended Switch Functions (All 8 channels “ON”, All 8 channels “OFF”)

- Press and hold CH1 (CH9) “PH/PWR” toggle left, Press CH8 (CH16) “PH/PWR” toggle left momentarily – Phantom Power to all 8 channels is disabled simultaneously; “OFF”
- Press and hold CH1 (CH9) “PH/PWR” toggle right, Press CH8 (CH16) “PH/PWR” toggle right momentarily – Phantom Power to all 8 channels is applied simultaneously; “ON”



Gain Switches

Single Switch Functions (Any Channel)

- 1 Press "GAIN" toggle down momentarily – lowers gain by 10dB from the previous setting (assuming the previous gain setting was already > "UNITY") on the appropriate channel.
- 2 Press "GAIN" toggle down and hold – after the initial 10dB step down when the toggle is actuated, there is a pause of 750mSec and then the unit will automatically continue to increment the gain downward (again assuming the previous gain was set to a higher value) at a rate of 250mSec/step until it settles at "UNITY". At any point the toggle can be released and the unit will remain at the gain setting indicated.
- 3 Press "GAIN" toggle up momentarily – raises gain by 10dB from the previous setting (assuming the previous gain setting was already lower) on the appropriate channel.
- 4 Press "GAIN" toggle up and hold – after the initial 10dB step up when the toggle is actuated, there is a pause of 750mSec and then the unit will automatically continue to increment the gain upward (again assuming the initial gain was set to a lower value) at a rate of 250mSec/step until it settles at "50dB". At any point the toggle can be released and the unit will remain at the gain setting indicated.

Note: As the gain is either raised or lowered, there is no "wrap around" to the adjustment. If the gain steps are increased, the display will NOT return to "UNITY" after the "50dB" setting is reached. Likewise, if the gain steps are decreased, the display will NOT return to "50dB" after the "UNITY" setting is reached. This action provides a better "feel" to the operator when making adjustments and eliminates the possibility of excessive audio levels when cycling through gains as could be the case when holding the "GAIN" toggle down in an effort to lower the audio level.

Extended Switch Functions (All-Reset to "UNITY", All-Increment Up, All-Increment Down)

- 1 Press and hold CH1 (CH9) "GAIN" toggle down, Press CH8 (CH16) "GAIN" toggle down momentarily – Gain on all 8 channels is simultaneously reset to "UNITY".
- 2 Press and hold CH1 (CH9) "PH/PWR" toggle left, Press CH8 (CH16) "GAIN" toggle up momentarily – Gain on all 8 channels is simultaneously incremented to the next higher gain setting. Holding the CH8 (CH16) "GAIN" toggle up, while still holding the CH1 (CH9) "PH/PWR" toggle left, will automatically increment the gain settings on all 8 channels simultaneously as described above in the Single Switch Functions (Any Channel) section.
- 3 Press and hold CH1 (CH9) "PH/PWR" toggle left, Press CH8 (CH16) "GAIN" toggle down momentarily – Gain on all 8 channels is simultaneously decremented to the next lower gain setting. Holding the CH8 (CH16) "GAIN" toggle down, while still holding the CH1 (CH9) "PH/PWR" toggle left, will automatically decrement the gain settings on all 8 channels simultaneously as described above in the Single Switch Functions (Any Channel) section.

Extra Notes:

- 1 All Phantom Power and Gain setting changes are immediate and seamless upon actuation of the switches. There is no delay or hesitation for the required result when the operator makes a change to one of these settings.
- 2 All settings are retained in non-volatile memory when the Expansion Panel is powered down, so setup time is minimal if power is lost or the system is moved to an alternate location.

4 Specifications

Thunder Frame Specifications

General

Transmission Method Digital Time Division Multiplexing (TDM)
Aggregate Data Rate through optical fiber ... 150 Mbps

Data/GPI I/O on rear panel connector

Data

RS-232 Mode

Input Voltage Range: $> \pm 3V_{P-P}$ to $< \pm 25V_{P-P}$ (.5V internal hysteresis)
Input Bias current: $\pm 100\mu A$ maximum
Input Impedance: $33k\Omega \pm 5\%$
ESD tolerance: $\pm 15kV$ Air-Gap, $\pm 8kV$ Contact, $\pm 15kV$ HBM
Output Voltage: $\pm 5.5V_{P-P}$ @ $\pm 5\%$, $R_{load} \geq 3K\Omega$
Data Rate: DC to $160k_{baud}$
(High speed limit determined by asynchronous sampling rate. Jitter is fixed @ 320nSec. Higher data rates are possible if equipment driven has greater jitter tolerance. Up to $1M_{baud}$ maximum).

RS-422, RS-485 Modes

Input Voltage Range: 100mV to 12V differentially across "+" and "-" data input pins or 50mV to 6V on either input with respect to GND (50mV internal hysteresis)
Input Common Mode Range: $+1.65V_{dc} \pm 10\%$
Input Bias current: $\pm 600\mu A$ maximum
Input Impedance: $33k\Omega \pm 5\%$
(For data rates $\geq 20kb/Sec$ and/or multi-drop applications with longer cable lengths, an external 110Ω resistor is recommended across the "+" and "-" data inputs of the unit furthest from the driving source to properly terminate

the line. This will minimize random bit errors induced by cable reflections.)

ESD tolerance: $\pm 15\text{kV}$ Air-Gap,
 $\pm 8\text{kV}$ Contact,
 $\pm 15\text{kV}$ HBM

Output Voltage: 0-3.3Vper output unloaded,
0-1.85Vper output at R_{load} 54 Ω .
6.6VP-P output differential unloaded,
3.7VP-P output differential at R_{load} 110 Ω

Data Rate: DC to 200k bits/Sec
(High speed limit determined by asynchronous sampling rate. Jitter is fixed @ 320nSec. Higher data rates are possible if equipment driven has greater jitter tolerance. Up to 1M bits/Sec. maximum).

Time delay after a transmitted data burst before a return message can be accepted at the receiver (RS-485 only): 16.4 μSec

Data Format Inputs (Pins 7 and 10 on the DB-15 HD Data I/O connector):

RS-422 Mode: No connection, input pin left "floating"

RS-232 Mode: Input pin either hardwired to ground (pins 22 and 25) or switched to ground by a remote GPI closure

Voltage on Floating Input Pin: 3.3V $\pm 2\%$

Input Resistance when pulled to ground: 100k Ω $\pm 5\%$

RS-485 Mode: Input pin either hardwired to "Format Bias" (pin 15) or switched to "Format Bias" by a remote GPI closure

Voltage on Floating Input Pin: 3.3V $\pm 2\%$

Input Resistance when pulled to "Format Bias": 9.1k Ω $\pm 5\%$

Format Bias Output (Pin 15 on the DB-26 HD Data I/O connector):

Output Voltage: 12Vdc $\pm 5\%$

Output Current Limit: 300mA maximum

GPI

Inputs (Pin 4 on the DB-15 HD Data I/O connector. GND on pin 5):

Voltage on Floating Input Pin: 3.3V $\pm 2\%$

Input Voltage for

Remote Contact Activation: ≤1Vdc
(typically grounded through GPI contacts,
TTL/HCMOS level drive also suitable)

Input Resistance when pulled
to ground (GPI output activated): 5kΩ ±1%

Output Contact Pairs (Pins 13&14)

Contact Format: 1 Form A (non-activated condition)

Contact Resistance: 100mΩ

Switching Voltage: 125Vac, 110Vdc maximum

Contact Rating: 2A @ 30Vdc,
0.3A @ 125Vac (resistive load)

Maximum Toggle Rate: ≈5Hz

Breakdown Voltage:

Between Open Contacts: 750Vrms for 1minute

Between Contact and Coil: 1500Vrms for 1 minute

Format Bias Output (Pin 10 on the DB-26 HD Data I/O connector):

Output Voltage: 5Vdc ±5%

Output Current Limit: 300mAdc maximum

Note: Aside from providing a bias voltage for the data format options, the "Format Bias" pin also provides a DC voltage source for low power loads that may be switched by the GPI output contacts, such as LED's for Tally use etc.

Electro-Optical

Operating Wavelength:

Standard 1300 nm

Others available CWDM wavelength 1270-1660nm

TX Laser output power -6 dBm

RX Sensitivity:

270MB/s -24 dBm

1.5 Gb/s -22 dBm

3.0 Gb/s -20 dBm

Fiber Compatibility Single Mode only

Distance Limitations: (1.5Gb/s) 16 db optical loss (30 km, nominal*)

Optical Connector Options: ST, MX, OpticalCON, SMPTE 304M

* The maximum cable length varies due to optical loss that can depend on cable quality, dirt/dust/contamination on connectors, and the number of cable connectors.

Mechanical/Environmental

Dimensions (WxLxD)

Frame (1 RU)	19" x 6.5" x 1.75"
Panels (1 RU).....	19" x 6.5" x 1.75"
Panel (active audio in - 2 RU).....	19" x 4.75" x 2.7"

Weight:

Frame with 10 Bolt cards	2.5 lb
Panels (1 RU).....	2.5 lb
Panel (active audio IN - 2 RU)	3.5 lb

Power

Mains.....	100-240 VAC, 50-60 Hz, max 60 W
Auxilliary	10-18 VDC on 4-pin XLR

Temperature Range.....-25° to +55°C

Humidity Range..... 0 to 95% RH, non-condensing

Audio Specifications

Analog Audio IN Bolt

Connector pin-out protocol: Tascam® standard 8 channel balanced analog audio, 25 pin DB-25 socket

Input Impedance: 20kΩ ±1% @1kHz, balanced, AC coupled

Maximum Input Level (clip): +24dBu +.4/-0dB, 20Hz to 20kHz

Frequency Response: +0/-3dB, 1.6Hz to 100Hz;
+0/-.07dB, 100Hz to 20kHz

Signal to Noise Ratio, ref. +24dBu: >104dB unweighted, 20Hz to 20kHz;
>107dB, A-weighting

Total Harmonic Distortion: ≤.005% @ 1kHz @20dBu;
≤.02%, 20Hz to 20kHz

Intermodulation Distortion: ≤.001% @ 20dBu, SMPTE-DIN Method

Common Mode Rejection Ratio: ≥45dBu, 20Hz to 20kHz

Adjacent Channel Crosstalk, ref.+24dBu: ≥104dB, 20Hz to 20kHz

A/D conversion:

Sample Resolution: 24 bits

Sample Rate: 48.83kHz

Analog Audio Input Level

for 0dBFS Digital Output: 24dBu ±.2dB

Analog Audio OUT Bolt

Connector pin-out protocol:	Tascam® standard 8 channel balanced analog audio, 25 pin DB-25 socket
Output Impedance:	33Ω ±5% @ 1kHz, balanced, AC coupled
Maximum Output Level (clip):	+24dBu, ±.2dB
Frequency Response:	+0/-3dB @ 12Hz to 100Hz; +0/-.07dB, 100Hz to 20kHz @ R _{load} ≥600Ω
Signal to Noise Ratio, ref. +24dBu:	>104dB unweighted, 20Hz to 20kHz; >107dB, A-weighting
Total Harmonic Distortion:	≤.005% @ 1kHz @20dBu; ≤.02%, 20Hz to 20kHz
Intermodulation Distortion:	≤.001% @ 20dBu, SMPTE-DIN Method
Adjacent Channel Crosstalk, ref. +24dBu:	≥104dB, 20Hz to 20kHz
D/A conversion:	
Sample Resolution:	24 bits
Sample Rate:	48.83kHz
Analog Audio Output Level for 0dBFS Digital Input:	24dBu ±0.2dB

Analog Audio End-to-End Performance

Analog IN to Analog OUT Level Deviation: ...	≤ ±0.2dB @1kHz
Maximum Throughput Level:	+24dBu, +0.4/-0dB, 20Hz to 20kHz
Frequency Response:	+0/-3dB @ 12Hz to 100Hz; +0/-.07dB, 100Hz to 20kHz @ R _{load} ≥600Ω
Signal to Noise Ratio, ref.+24dBu:	>104dB unweighted, 20Hz to 20kHz; >107dB, A-weighting
Total Harmonic Distortion:	≤.005% @ 1kHz @ 20dBu; ≤.05%, 20Hz to 20kHz
Intermodulation Distortion:	≤.001% @ 20dBu, SMPTE-DIN Method
Adjacent Channel Crosstalk, ref. +24dBu:	≥104dB, 20Hz to 20kHz
Audio Signal Propagation Delay:	≤1mSec

Active Audio Input Breakout Panel

Audio Input Connectors:	3 pin XLR socket
Pin 1:	Signal/Chassis Ground
Pin 2:	"Hot", In phase input
Pin 3:	"Cold", Inverted phase input
Input Impedance:	6kΩ ±5% @1kHz, balanced, AC coupled

Gain Setting: Unity

Maximum Input Level: +24dBu, 20Hz to 20kHz

Input to Output Level Deviation: ± 2 dB @1kHz

Frequency Response: +0/-1.2dB, 20Hz to 100Hz;
..... ± 0.15 dB, 100Hz to 20kHz

Signal to Noise Ratio, ref. +24dBu: ≥ 115 dB unweighted, 20Hz to 20kHz;
..... ≥ 120 dB, A-weighting

Total Harmonic Distortion: ≤ 0.005 % @ 1kHz @ 20dBu;
..... ≤ 0.02 %, 20Hz to 20kHz @ 20dBu

Intermodulation Distortion: ≤ 0.002 % @ 20dBu, SMPTE-DIN Method

Common Mode Rejection Ratio:..... ≥ 40 dBu, 20Hz to 20kHz

Adjacent Channel Crosstalk, ref. +24dBu: ≥ 110 dB, 20Hz to 20kHz

Gain Setting: +10dB

Maximum Input Level: +14dBu, 20Hz to 20kHz

Input to Output Level Deviation: +10dB ± 2 dB @1kHz

Frequency Response: +0/-1.2dB, 20Hz to 100Hz;
..... ± 0.15 dB, 100Hz to 20kHz

Signal to Noise Ratio, ref.+14dBu: ≥ 105 dB unweighted, 20Hz to 20kHz;
..... ≥ 110 dB, A-weighting

Total Harmonic Distortion: ≤ 0.006 % @ 1kHz @ 10dBu;
..... ≤ 0.03 %, 20Hz to 20kHz @ 10dBu

Intermodulation Distortion: ≤ 0.005 % @ 10dBu, SMPTE-DIN Method

Common Mode Rejection Ratio:..... ≥ 40 dBu, 20Hz to 20kHz

Adjacent Channel Crosstalk, ref. +24dBu: ≥ 105 dB, 20Hz to 20kHz

Gain Setting: +20dB

Maximum Input Level: +4dBu, 20Hz to 20kHz

Input to Output Level Deviation: +20dB ± 2 dB @1kHz

Frequency Response: +0/-1.2dB, 20Hz to 100Hz;
..... ± 0.15 dB, 100Hz to 20kHz

Signal to Noise Ratio, ref. +4dBu: ≥ 115 dB unweighted, 20Hz to 20kHz;
..... ≥ 118 dB, A-weighting

Total Harmonic Distortion: ≤ 0.002 % @ 1kHz @ 0dBu;
..... ≤ 0.01 %, 20Hz to 20kHz @ 0dBu

Intermodulation Distortion: ≤ 0.001 % @ 0dBu, SMPTE-DIN Method

Common Mode Rejection Ratio:..... ≥ 60 dBu, 20Hz to 20kHz

Adjacent Channel Crosstalk, ref.+24dBu: . ≥ 110 dB, 20Hz to 20kHz

Output Connector pin-out protocol: Tascam® standard 8 channel balanced analog audio, 25 pin DB-25 socket

Output Impedance: $33\Omega \pm 5\%$ @ 1kHz, balanced, AC coupled

Maximum Output Level (clip): +24dBu, ± 2 dB

Frequency Response: +0/-3dB @ 12Hz to 100Hz @ $R_{load} \geq 600\Omega$

Note: Frequency response values stated in the “Unity to +50dB” gain(s) section above can be achieved when the output load impedance is high, i.e. $\geq 10k\Omega$

Phantom Power, Switchable

Output Voltage: 48Vdc $\pm 10\%$

Output Current: 2mA $\pm 10\%$ typical per input connector

Output Short Circuit Current: 10mA dc maximum per input connector

Source Resistance: $6.8k\Omega \pm 1\%$ per leg

Power Consumption

AC Line Input Voltage: 90Vac to 240Vac @ 50/60 Hz

AC Line Input Current: 100mA ac maximum @ 120Vac

AES Bolt Card

Inputs

Channels: 4 Independent Data Streams

Impedance: 110Ω balanced

Transmission Format: AES3-2003, ANSI S4.40, S/PDIF, IEC-60958 and EIAJ CP-1201 Compliant

Usable Signal Level: 150mVp-p to 7.0Vp-p differential

Sample Rate Lock Range (FS): 20kHz to 216kHz

Outputs

Channels: 4 Independent Data Streams

Impedance: 110Ω balanced

Transmission Format: AES3-2003, ANSI S4.40, S/PDIF, IEC-60958 and EIAJ CP-1201 Compliant

Signal Level: 4.0Vp-p differential nominal into a 110Ω load

Sample Rate (FS):

With no external synchronization signal (DARS) applied, output sample rate is fixed at 48kHz.

With an external (“house”) synchronization signal (DARS) applied, output data will track the applied sample rate over a 20kHz to 216kHz range.

Intrinsic Jitter:

With internal output clock:..... <.01UIp-p (700Hz to 100kHz)

With externally supplied
synchronization signal (DARS) <.025UIp-p (700Hz to 100kHz)

General

Ancillary Data support:

User Data and Channel Status information, for both Professional and Consumer operational modes, is fully supported through the system with any combination of input to output sample rates (Input AES Bolt card to Output AES Bolt card only).

Digital to Analog/Analog to Digital Audio Conversion Support:

Full audio format interoperability is supported between Thunder Analog and AES Bolt cards (No Channel Status or User Data retention), e.g. Analog Input Bolt card to AES Output Bolt card; AES Input Bolt card to Analog Output Bolt card.

Performance

SRC (Sample Rate Converter)

Dynamic Range: 128dB (A-Weighted)

SRC THD+N: -125dB typ.

SRC Conversion Range: 16:1 to 1:16 continuous

Audio Data Word Length Support: Up to 24 Bits

Intercom Expansion Panel

4-Wire Module

Input Impedance: 600Ω ±5% @ 1kHz, Balanced, AC Coupled

Maximum Input Level (clip): +10dBm ±.5dB @1kHz

Frequency Response: ±.5dB, 50Hz to 20kHz

Signal to Noise Ratio, Referred to +10dBm: .>85dB unweighted, 20Hz to 20kHz;
>100dB, A-weighting

Total Harmonic Distortion: ≤.01% @ 1kHz @ +6dBm;
≤.05%, 20Hz to 20kHz

Intermodulation Distortion: ≤.003% @ 20dBu, SMPTE-DIN Method

Common Mode Rejection Ratio: ≥50dBu, 20Hz to 20kHz

2-Wire Module

Clear-Com/TW (2-wire) Module

Standard Clear-Com® Party Line Interface; "CC" "MODE" selected

Channel 1 audio on XLR-A pin 3, Channel 2 audio on XLR-B pin 3	
Audio Level (properly nulled):	2VP-P $\pm 5\%$, 70Hz to 20kHz
Channel 1	30Vdc +0/-8Vdc on XLR-A pin 2,
Channel 2	30Vdc +0/-8Vdc on XLR-B pin 2, only when the "Power" switch is in the "WET" position
Termination:	≈ 200 ohm; termination engaged only when the "Power" switch is in the "WET" position
Standard TW (RTS®) Party Line Interface; "TW" "MODE" selected	
Channel 1 audio and 30Vdc power on XLRs-A&B pin 2, Channel 2 audio on XLRs-A&B pin 3	
Audio Level (properly nulled):	2VP-P $\pm 5\%$, 70Hz to 20kHz
30Vdc	+0/-8Vdc on XLRs-A&B pin 2 only when the "Power" switch is in the "WET" position
Termination:	≈ 200 ohm termination engaged only when the "Power" switch is in the "WET" position

Data Specifications

Data Bolt Card

RS-232 Mode

Input Voltage Range:	$> \pm 3VP-P$ to $< \pm 25VP-P$ (.5V internal hysteresis)
Input Bias current:	$\pm 100\mu A$ maximum
Input Impedance:	$33k\Omega \pm 5\%$
ESD tolerance:	$\pm 15kV$ Air-Gap, $\pm 8kV$ Contact, $\pm 15kV$ HBM
Output Voltage:	$\pm 5.5VP-P$ @ $\pm 5\%$, $R_{load} \geq 3K\Omega$
Data Rate:	DC to $160k_{baud}$ (High speed limit determined by asynchronous sampling rate. Jitter is fixed @ $320nsec$. Higher data rates (up to $1M_{baud}$ maximum) are possible if equipment driven has greater jitter tolerance).

RS-422, RS-485 Modes

Input Voltage Range:	100mV to 12V differentially across "+" and "-" data input pins or 50mV to 6V on either input with respect to GND (50mV internal hysteresis)
Input Common Mode Range:	+1.65Vdc $\pm 10\%$

Input Bias current:	$\pm 600\mu\text{A}$ maximum
Input Impedance:	$33\text{k}\Omega \pm 5\%$ (For data rates $\geq 20\text{kb}/\text{Sec}$ and/or multi-drop applications with longer cable lengths, an external 110Ω resistor is recommended across the "+" and "-" data inputs of the unit furthest from the driving source to properly terminate the line. This will minimize random bit errors induced by cable reflections.)
ESD tolerance:	$\pm 15\text{kV}$ Air-Gap, $\pm 8\text{kV}$ Contact, $\pm 15\text{kV}$ HBM
Output Voltage:	0-3.3V per output unloaded, 0-1.85V per output at $R_{\text{load}} 54\Omega$. 6.6VP-P output differential unloaded, 3.7VP-P output differential at $R_{\text{load}} 110\Omega$
Data Rate:	DC to 200k bits/Sec (High speed limit determined by asynchronous sampling rate. Jitter is fixed @ 320nSec. Higher data rates (up to 1M bits/Sec. maximum) are possible if equipment driven has greater jitter tolerance).
Time delay after a transmitted data burst before a return message can be accepted at the receiver (RS-485 only): 16.4 μSec	
Data Format Inputs (Pins 21, 23, 24 and 26 on the DB-26 HD Data I/O connector):	
RS-422 Mode:	No connection, input pin left "floating"
RS-232 Mode:	Input pin either hardwired to ground (pins 22 and 25) or switched to ground by a remote GPI closure
Voltage on Floating Input Pin:	3.3V $\pm 2\%$
Input Resistance when pulled to ground:	100k $\Omega \pm 5\%$
RS-485 Mode:	Input pin either hardwired to "Format Bias" (pin 10) or switched to "Format Bias" by a remote GPI closure
Voltage on Floating Input Pin:	3.3V $\pm 2\%$
Input Resistance when pulled to "Format Bias":	9.1k $\Omega \pm 5\%$
Format Bias Output (Pin 10 on the DB-26 HD Data I/O connector):	
Output Voltage:.....	12Vdc $\pm 5\%$
Output Current Limit:	300mAdc maximum

GPI Bolt Card

Inputs (Pins 1, 2, 3, 4, 5, 6, 7 and 8 on the DB-26 HD Data I/O connector. GND on pin9):

Voltage on Floating Input Pin: 3.3V \pm 2%

Input Voltage

for Remote Contact Activation: \leq 1Vdc

(typically grounded through GPI contacts;
TTL/HCMOS level drive also suitable)

Input Resistance when pulled

to ground (GPI output activated): 5k Ω \pm 1%

Output Contact Pairs (Pins 11&19, 12&20, 13 &21, 14&22, 15&23, 16&24, 17&25 and 18&26)

Contact Format: 1 Form A (non-activated condition)

Contact Resistance: 100m Ω

Switching Voltage: 125Vac, 110Vdc maximum

Contact Rating: 2A @ 30Vdc,
0.3A @ 125Vac (resistive load)

Maximum Toggle Rate: \approx 5Hz

Breakdown Voltage:

Between Open Contacts: 750Vrms for 1minute

Between Contact and Coil: 1500Vrms for 1 minute

Format Bias Output (Pin 10 on the DB-26 HD Data I/O connector):

Output Voltage: 5Vdc \pm 5%

Output Current Limit: 300mAdc maximum

Note: The "Format Bias" pin is provided to supply a DC voltage source for low power loads that may be switched by the GPI output contacts, such as LED's for Tally use etc.



Grass Valley Technical Support

For technical assistance, contact our international support center, at 1-800-547-8949 (US and Canada) or +1 514 333 1772.

To obtain a local phone number for the support center nearest you, please consult the *Contact Us* section of Grass Valley's Web site (www.grassvalley.com).

An online form for e-mail contact is also available from the Web site.

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