User Guide

使用手册

Etna Digital Recorder

Etna 数字记录器

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本手册中文翻译内容仅供阅读英文原文时参考。

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Symbols & Terms 符号和术语

These symbols may appear on Kinemetrics equipment or in this manual:

下述符号可能出现在 Kinemetrics 的设备上或本使用手册中：

When you see this symbol, *pay careful attention.* Refer to the similarly marked, relevant part of this manual before servicing the instrument

当你看见这个符号时需加倍小心。在保养仪器前，请参考本手册类此标记的相关部分。.

This symbol means a *low-noise earth ground*. The noted item should be grounded to ensure low-noise operation, and to serve as a ground return for EMI/RFI and transients. Such a ground *does not work as a safety ground* for protection against electrical shock!

这个符号表示低噪声接地。应特别注意它应是保证低噪声运行和提供作为 EMI/RFI 及瞬变接地回路的接地线。如此接地不是作为防护电冲击的安全接地用的！

~ This symbol means an alternating current (AC) power line.

这个符号表示交流(AC)电源线。

This symbol means a direct current (DC) power line derived from an AC power line. 这个符号表示源自交流(AC)电源的直流(DC)电源线。

This symbol indicates an electrostatic sensitive device (ESD), meaning that when handling the marked equipment you should observe all standard precautions for handling such devices. 这个符号指示出了一个静电敏感设备器件装置(ESD)，当触摸有此标记的装置时你必须遵守所有为触摸此类装置所需的常规预防措施。

These safety-related terms appear in this manual: 下列呈现在本文里的与安全相关的术语：

Note: Statements identify information that you should consider before moving to the next instruction or choice.

注释：陈述指明你在做下一步指示或选择行动之前所应予考虑的信息。

Caution statements identify conditions or practices that could result in damage to the equipment, the software, or other property**.**

告诫：陈述指明能够对设备、软件或其他物件产生危险的情况和实践。

WARNING! Statements identify conditions or practices that could result in personal injury or loss of life.

警告！陈述指明能够产生人身伤害或生命损失的情况和实践。

Specific Precautions 特定预防措施

Follow the precautions below to ensure your personal safety and prevent damage to your Altus Etna digital recorder. 遵从下面的预防措施可保障你的人身安全和防止你的 Altus Etna 数字记录器的损害。

The Etna is powered by either an externally connected nominal 14VDC charging voltage supplied by the battery charger and generated from the local AC power, or from an internally or externally supplied 12V source such as a battery. Etna 记录器可由外接电池充电器和市电 AC 电源以常规 14VDC 供电，或由内置或外接 12VDC 电池供电。

OPTIONAL POWER SUPPLY ASSEMBLY 可选的供电装置

If you plan to power the Etna from AC power, we recommend using the supplied battery charger. Plug the battery charger into AC outlets that *will not apply* more than 250 Vrms between the supply conductors or between either supply conductor and ground.

A protective ground connection (provided through the grounding conductor in the battery charger) is essential for safe operation. The battery charger is designed for indoor use only; it must not be subject to immersion in water, high humidity, or temperatures above 70ºC.

若你计划从作主电源给 Etna 记录器供电，我们建议用 Kinemetrics 供电装置(PSA)。供电装置(PSA)以市电交流输入，其两极间或极地间电压不得大于 250Vrms。保护接地连接(通过在 PSA 及其电源线里的接地导线提供

的)对安全运行是必需的。供电装置(PSA)仅供室内使用，不能让它浸水，处于高的湿度或大于 70 ° C 的温度中

USER-SUPPLIED BATTERIES OR CHARGING SYSTEM 用户自己提供电池或充电器

If you supply your own charging system, make sure the system provides the correct voltage and current. If you derive power from AC power, make sure there is adequate grounding for all the equipment. If you supply your own batteries, follow the warnings below. 若你提供你自己的充电系统，务须使该系统提供符合记录器需要的电压和电流。若你由主电源供电，务须对所有设备都做好适当的接地。若你提供你自己的电池，请遵从下面的警告

INTERNAL BATTERY 内置电池

Follow the precautions in this manual when handling and replacing the internal battery. Metallic instruments of any kind could short the battery terminals, resulting in fire or explosion. Do not drop the battery or attempt to disassemble it. When charging the battery, use a properly rated charger and do not overcharge the battery. The only correct replacement battery is a sealed lead-acid battery with relief vents and ratings comparable to the original battery. Never use a non-rechargeable battery in the recorder.

当触碰和置换内置电池时，请遵从本手册中的预防措施。任何一种金属工具都可能造成电池两极短路，产生失火或爆炸。不可摔打电池或试图拆卸它。当给电池充电时，需用适当量值的充电器，并且不能对电池过充电。唯一恰当的可置换电池是具有等同于原来的电池的排卸压气孔和额定值的密封铅酸电池。切切不可用非可充电电池装进记录器里。

GROUNDING THE RECORDER & SYSTEM 记录器和系统的接地

When using the battery charger to power the recorder from AC power, remember that the recorder is grounded through the power cord. To avoid electric shock, plug the cord into a properly wired receptacle where the protective earth ground has been verified. Do this verification *before* making any power connections to the recorder. 当用 PSA 供电装置作为从 AC 主电源向记录器供电，请记住记录器是通过 PSD 电源线接地的。为避免电冲击，PSA 电源线应插入已被证实是具有接地保护的适合的插座内。在将任何电源连接到记录器之前务请核实这点。

USE THE PROPER POWER CORD 使用正规的电源线

Use the power cord supplied with battery charger, or an equivalent IEC-standard power cord. Be sure that it is in good condition. 请使用 PSA 提供的电源线和连接器，或等同的 IEC-标准电源线。确认它处于最好的状态。

USE THE PROPER FUSES 使用正规的熔断丝

To avoid fire hazard, use only the fuses specified in Chapter 4, *Maintenance and Service*. Match them by type, voltage rating and current rating. Fuses should only be replaced by a qualified technician and the instrument must be disconnected from all power sources *before* touching the fuses. 为了避免火灾，仅可使用在第四章维护和服务中指明的熔断丝。使它们与规定的型号、电压额定值及电流额定值相符。熔断丝只能由高素质的技术人员去更换，并且在触碰熔断丝之前必须切断仪器的所有电源。

SENSOR CABLING & GROUNDING 传感器电缆架设和接地

In installations where sensors are mounted some distance from the Etna, and where both sensors and the recorder are grounded locally, it is very important to make sure that all connected units are grounded at the same voltage. Otherwise, potentially lethal voltages could result on the connecting cables. 当传感器被安装在与记录器有一定距离的场合，和当传感器与记录器都在本地接地的场合，必定要使所有相连的单元接地电压相同，这一点十分重要。否则，在连接电缆上可能产生潜在的致命电压。

ANTENNA AND PHONE INSTALLATION 天线和电话安装

Never install antennas or telephone wiring during electrical storms. Always ensure adequate separation between antenna or telecom cabling and high voltage wiring. Always perform a safety check on telecom wiring to measure the voltage before working on the wiring. Remember telephone wiring has fifty (50) to sixty (60) volts of DC and the ring signal at 90 VAC can deliver a very uncomfortable shock! 当闪电风暴时绝不可安装天线或电话线。始终保证天线电缆或电信电缆与高压线之间有足够的分离。总是履行对电信线路的安全检查以在上线工作之前测量该电信线路电压。记住电话线带有 50 伏到 60 伏直流电压，并且在 90 伏交流电压的铃音信号能释放出不舒服的电冲击。

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES 不要在易爆大气环境中运行

The recorder and the battery charger provide *no explosive protection* from static discharges or arcing components. *Do not* operate the equipment in an atmosphere of explosive gases. 记录器和电池充电器都没有提供由于静电释放或电弧成分引致爆破的保护。不能在易爆气体大气环境中操作这类设备。

Symbole & Begriffe

Diese *Symbole* können auf Kinemetrics Geräte oder in diesem Manual erscheinen:

Bedeutet *Achtung*! Wenn Sie dieses Symbol auf eim Gerät sehen, lesen Sie den gleichmarkierten Teil dieses Manuals. *bevor* irgend eine Wartungsarbeit vorgenommen wird. Wenn Sie dieses Symbol sehen, bitte besondere Achtung geben.

Bedeutet Erdung. Das erwähnte Teil sollte geerdet werden, um sowohl eine Operation mit geringem Rauschen zu gewährleisten, als auch als Erdung für EMI/ FRI und Transienten zu dienen. Solch eine Erdung dient *nicht als Sicherheit gegen* elektrischen Schock!

~ Bedeutet *Wechselstromzufuhr* (AC) mit Elektroschockgefahr.

⎓ Bedeutet Gleichstromzufuhr (DC) von AC Versorgung herkommend.

Bedeutet *Elektrostatisch Sensibeles Element (ESD)* für dessen Handhabung alle entsprechenden vorbeugende Vorsichtsmassnahmen vorgenommen werden müssen.

Folgende *Darstellungen* erscheinen in diesen Manual:

Note: Hinweise welche Sie besonders beachten sollten, bevor Sie zum nächsten Instruktions gehen.

Caution: Hinweise bei deren Missachtung in der Regel Gefahr für Defekte und Störungen im Gerät, Programm oder Zubehör besteht.

WARNING! Hinweise bei deren Missachtung in der Regel Verletzungs – oder Lebensgefahr besteht**.**

Spezielle vorbeugende Massnahmen

Alle vorbeugende Massnahmen müssen beachtet werden für Ihre persönliche Sicherheit und, um Schäden am Altus Etna Digitales Aufzeichnungsgerät zu vermeiden.

Stromversorgung

Das Etna Aufzeichnungsgeraet wird betrieben mit einer extern angeschlossenen Stromquelle mit nominel 14VDC bereitgestellt vom Netzstrom/Ladegeräte oder einer internen oder externen 12V Batterie.

Optionelles Stromversorgungs/Ladegerät

Falls geplant wird, die Aufzeichnungsgeraet mit Netzstrom zu versorgen, empfehlen wir Kinemetrics' Stromversorgung/ . Sie müssen dafür den Netzstecker des Ladegeräts in eine Steckdose einstecken, deren Stromspannung nicht größer als 250Vrms ist.

Erdung (mit Erdungsleiter im Netzkabel) ist nötig für gefahrlose Arbeit vom digitales Aufzeichnungsgerät. Das Ladegeräte ist nur für Innenraumgebrauch ausgelegt; es darf nicht Wasser, hoher Luftfeuchtigkeit oder Temperaturen über 70ºC ausgesetzt werden.

Batterien oder Ladesystem des benutzer

Falls Sie Ihr eigenes Ladesystem benutzen, müssen Sie sicherstellen, daß es die benötigte Spannung und Strom liefert.. Wenn sie das Geräte vom Wechselstromnetz speisen, müsses Sie sicherstellen, daß eine korrekte Erdung für das Geräte vorhanden ist. Falls Sie Ihre eigenen Batterien benutzen, müssen Sie die nachfolgenden Warnungen unten beachten.

Interne Batterien

Beachten Sie die Vorsichtsmaßregeln in diesem Manual, wenn Sie die internen Batterien des Aufzeichnungsgerät handhaben und auswechseln. Metallende Gegenstände jeglicher Art können die Kontakte der Batterie kurzschließen mit resultierender *Feuer- und Explosionsgefahr!* In keinem Fall sollten die Batterien fallen gelassen oder auseinander genommen werden. Wenn Sie die Batterien aufladen, dann benutzen Sie ein angemessen dimensioniertes Ladegerät, und überladen Sie die Batterie nicht. Die einzig richtige Austauschbatterie ist eine versiegelte lead-acid Batterie mit Erleichterungsschlitze und vergleichbaren Spezifikationen wie die original gelieferte Batterie. Benutzen Sie niemals nicht-aufladbare Batterien im Aufzeichnungsgerät.

Erdung des Digitales Aufzeichnungsgeräts und System

Wenn Sie das Stromversorgungs/Ladegerät benutzen, um das Aufzeichnungsgerät vom Netz zu speisen, dann bedenken Sie, daß das

Aufzeichnungsgerät durch das Netzkabel geerdet wird. Um einen Elektroschock zu vermeiden, müssen Sie sicherstellen, daß die Steckdose tatsächlich geerdet ist. Test Sie die Erdung der Steckdose, before Sie das digitale Aufzeichnungsgerät am Netz anschliessen.

Gebrauch des geeigneten Netzkabels

Benutzen Sie nur das mitgelieferte Netzkabel oder ein equivalentes IEC-standard Netzkabel. Versichern Sie sich, daß das Kabel in einem guten Zustand ist.

Gebrauch des geeigneten Sicherungen

Um Feuergefahr zu vermeiden, benutzen Sie nur Sicherungen, die im Kapitel 4, *Maintenance and Service*, beschrieben sind. Stellen Sie sicher, daß Typ, Spannung *und* Strom übereinstimmen. Sicherungen sollten nur durch einen qualifizierten Techniker ausgewechselt werden. Sie müssen sicherstellen, dass das Gerät nicht mehr an eine Stromversorgung angeschlossen ist, bevor eine Sicherung ausgewechselt wird.

Verkablung und Erdung von Sensoren

In Installationen, wo Sensoren in einiger Entfernung vom Etna Aufzeichnungsgerät montiert sind und beide, Sensoren und das Aufzeichnungsgerät, lokal geerdet sind, ist es sehr wichtig, daß alle angeschlossenen Einheiten am gleichen Spannungspotential geerdet werden. Es könnten anderenfalls lebensgefährliche Spannungspotentiale im Kabel entstehen.

Antenna und Telefon Installationen

Installieren Sie niemals Antennas oder Telefonverkablung während elektrischer Stürme. Stellen Sie sicher, daß eine angemessende Separierung zwischen Hochspannungskabel und Antenna- oder Telefonverkablung. Führen Sie immer einen Sicherheitstest durch bei dem Sie die Spannung der Telefonverkablung messen, bevor Sie daran arbeiten. Bedenken Sie, daß Telefonverkablungen eine Betriebsspannung zwischen 50 und 60 VDC haben können und das Klingelzeichen bei 90VAC einen unangenehmen Schlag versetzt!

Nicht in explosionsgefährdete Umgebung gebrauchen

Der Aufzeichnungsgerät und das Stromversorgungs/Ladegerät haben KEINEN EXPLOSIONSSCHUTZ von statische Entladungen oder funkenschlagende Bauteile. Benutzen Sie die Geräte NICHT in Umgebungen mit explosiven Gasen.

Símbolos & Términos

Estos símbolos podrían aparecer en los equipos Kinemetrics o en este manual:

Cuando vea este símbolo, *ponga cuidadosa atención.* Referirse a las partes marcadas similarmente o partes relevantes de este manual antes de intentar cualquier servicio en este instrumento.

Este símbolo significa un *polo a tierra de bajo ruido*. El ítem referido debe estar polarizado a tierra para asegurar la operación a bajo ruido y además sirve como un retorno a tierra para EMI/RFI y transitorios. Tal polo a tierra *no trabaja como un polo a tierra de seguridad* para protección contra choques eléctricos!

~ Este símbolo significa una línea de energía de Corriente Alterna (AC).

Este símbolo significa una línea de energía de Corriente Directa (DC) derivada de una línea de energía AC.

Este símbolo significa una Unidad Sensitiva a Electrostática (Electrostatic Sensitive Device ESD), indicando que cuando maneje el equipo así marcado, deberá observar todas las precauciones estándar para el manejo de tales unidades.

Estos términos relacionados a seguridad aparecerán en este manual:

Nota: Sentencias identificando información que usted debe considerar antes de dirigirse a la siguiente instrucción u opción.

Caution sentencias identificando condiciones o prácticas que podrían resultar en daño del equipo, el software u otra propiedad.

WARNING! sentencias identificando condiciones o prácticas que podrían resultar en una lesión personal o la perdida de la vida**.**

Precauciones Específicas

Observe todas estas precauciones para garantizar su seguridad personal y prevenir el daño a registrador digital Altus Etna.

El Etna es energizado por medio de una carga de voltaje de 14VDC nominal conectada externamente suministrada por el cargador de batería y generada de la alimentación local AC o desde una fuente de 12V aplicada interna o externamente, como una batería.

Ensamble de Fuente de Poder Opcional

Si usted planea energizar el Etna desde el suministro AC, nosotros recomendamos el uso de el cargador de batería suministrado. Conecte el cargador de batería al toma corriente AC que *no aplicará* más de 250 Vrms entre los conductores del suministro o entre el conductor del suministro y el polo a tierra.

Una conexión con protección a tierra (provista a través del conductor de tierra en el cargador de batería) es esencial para una operación segura. El cargador de batería está diseñado para uso en interiores únicamente; no tiene que ser sujeto a inmersión en agua, alta humedad o temperaturas sobre 70ºC.

Sistema de Carga o Batería Provisto por el Usuario

Si usted provee su propio sistema de carga, asegúrese que el sistema proporciona el voltaje y la corriente correctos. Si usted deriva energía del suministro AC, asegúrese que hay un polo a tierra adecuado para todo el equipo. Si usted suministra sus propias baterías, siga las advertencias proporcionadas más adelante.

Batería Interna

Siga las precauciones en este manual cuando maneje y reemplace las baterías internas. Instrumentos metálicos de cualquier tipo podrían cortocircuitar los terminales de la batería, resultando en fuego o explosión. No deje caer las baterías o intente desensamblarla. Cuando cargue la batería, use un cargador ajustado apropiadamente y no sobrecargue la batería. El único reemplazo correcto es una batería del tipo *sealed lead-acid* con ventilación y tasas comparables a la batería original. Nunca use una batería no recargable en el registrador.

Polarizando a Tierra el Registrador y el Sistema

Cuando use el cargador de batería para energizar el registrador desde el suministro AC, recuerde que el registrador está polarizado a tierra a través del cable de energía. Para evitar choques eléctricos, conecte el cable en un receptáculo apropiadamente alambrado donde el polo a tierra de protección ha sido verificado. Haga esta verificación *antes* de hacer ninguna conexión de energía al registrador.

USE EL CABLE DE ENERGÍA APROPIADO

Use el cable de energía suministrado con el cargador de batería o un cable de energía equivalente IEC estándar. Asegúrese que este en buenas condiciones.

USE LOS FUSIBLES APROPIADOS

Para evitar la amenaza de fuego, use solamente los fusibles especificados en el Capítulo 4, *Maintenance & Service*. Cotéjelos por tipo, tasa de voltaje y tasa de corriente. Los fusibles deben ser reemplazados únicamente por un técnico calificado y el instrumento tiene que estar desconectado de toda fuente de energía *antes* de tocar los fusibles.

CABLEADO Y POLARIZADO A TIERRA DEL SENSOR

En instalaciones donde los sensores están montados a cierta distancia desde el Etna y donde ambos sensores y el registrador están polarizados a tierra localmente, es muy importante asegurarse que todas las unidades conectadas estén polarizadas a tierra al mismo voltaje. De otra manera, voltajes potencialmente letales podrían resultar en los cables de conexión.

INSTALACIÓN DE ANTENA Y TELÉFONO

Nunca instale antenas o alambrado de teléfono durante tormentas eléctricas. Siempre asegure una separación adecuada entre cableado de antena y telecomunicaciones y alambrado de alto voltaje. Siempre realice revisión de seguridad en alambrado de telecomunicaciones para medir voltajes antes de trabajar en él. Recuerde que el alambrado de teléfono tiene de cincuenta (50) a sesenta (60) voltios de DC y la señal circular a 90 VAC puede enviar un choque bastante incómodo!

NO OPERAR EN ATMÓSFERAS EXPLOSIVAS

El registrador y el cargador de batería no provee *protección explosiva* contra descargas estáticas o componentes que generan arcos eléctricos. *No* operar el equipo in una atmósfera de gases explosivos.

Symboles & Terminologie

Les *symboles* suivant peuvent figurer sur les équipements Kinemetrics ou dans ce manuel:

Signifie *Attention!* Quand vous rencontrez ce symbole sur un instrument, veuillez vous référer à la section de ce manuel signalée par la même marque. *Avant* même d'effectuer la première opération sur l'instrument, vous devez lire la section correspondante de ce manuel. Faite attention si vous voyez cet symbole.

Indique une mise à la terre "faible bruit". Les objets portant cette marque doivent être reliés à la terre afin d'assurer un fonctionnement optimal. Elle est aussi utilisée pour les éléments de protection contre les interférences magnétiques, les perturbations hautes fréquences radio et contre les surtensions. Cette mise à terre *n'est pas une mise à terre de sécurit*é pour une protection contre les choques électriques!

~ Indique une *alimentation en courant alternatif* (AC).

Indique une Alimentation en courant continu (DC) dérivée d'une alimentation alternative

Indique la présence *d'un composant sensible aux décharges électrostatiques* (ESD), Cela signifie qu'il faut observer toutes les précautions d'usage en manipulant ce composant.

Les *termes* suivant apparaissent dans ce manuel:

Note: Indique la présence d'une information que vous devez particulièrement considérer avant de passer à la prochaine instruction or opération.

Caution: Indique une condition ou opération qui peut entraîner des dommages à votre équipement, au logiciel ou à d'autres propriétés .

WARNING! Indique une condition ou opération qui peut entraîner des blessures corporelles ou la perte de la vie**.**

Précautions Spécifiques

Observez toutes les précautions suivantes afin d'assurer votre sécurité personnelle et de prévenir des dégâts aux composants de votre Système et Enregistreur Numérique.

L'Enregistreur ETNA est soit alimenté par la tension nominale de charge de 14 VDC externe provenant du chargeur de batterie et générée par la source alternative locale, soit par une source de tension continue interne ou externe de 12 VDC telle qu'une batterie.

OPTION ALIMENTATION/CHARGEUR

Si vous désirez alimenter votre Enregistreur par le réseau, nous recommandons l'utilisation de l'alimentation/chargeur fourni par Kinemetrics (PSA). Vous devez connecter le cordon d'alimentation du PSA uniquement dans une prise Alternative ne délivrant pas plus que 250 Vrms entre deux conducteurs ou entre un conducteur et la terre. Une mise à la terre de protection (mise à disposition au travers du conducteur de terre de l'alimentation/chargeur et du cordon d'alimentation) est essentielle pour un fonctionnement en toute sécurité de l'enregistreur numérique. Le PSA est prévu pour une utilisation en intérieur uniquement; il ne doit pas être immergé dans de l'eau, dans une haute humidité ambiante ou une température de plus de 70ºC.

AUTRES BATTERIES ET CHARGEURS

Au cas où vous utilisez votre propre chargeur, vous devez vous assurer que votre système délivre la tension et le courant requis par l'Enregistreur. Dans ce cas, vous être seul responsable pour la sécurité de votre chargeur. Si vous branchez votre système de charge sur le réseau de distribution principal, vous devez vous assurer d'installer les mises à terre adéquates pour tout votre équipement. Si vous utilisez vos propres batteries vous devez vous référer aux avertissements ci-dessous.

BATTERIES INTERNES

Vous devez manipuler et remplacer les batteries internes de l'Enregistreur en respectant pleinement les précautions inclues dans ce manuel. Vous devez faire

ATTENTION de ne pas court-circuiter les cosses des batteries avec une pièce métallique quelconque. *Cela pourrait provoquer des incendies et explosions!* En aucun cas vous ne devez laisser tomber les batteries ou essayer de les démonter. Si vous enlevez les batteries de l'Enregistreur, afin de les recharger, vous devez ajuster le courant de charge correctement

et devez prendre soins de ne pas surcharger les batteries. Pour un remplacement éventuel des batteries internes, n'utiliser que des batteries à caractéristiques comparables aux batteries d'origine. Surtout ne pas mettre des batteries non rechargeables.

Mise à Terre du Système Enregistreur Numérique

Dans le cas où vous utilisez l'alimentation / chargeur pour alimenter le Enregistreur à partir du réseau, alors, la mise à terre est connectée au travers du cordon d'alimentation et le la prise AC au chargeur. Afin d'éviter les chocs électriques, branchez le cordon d'alimentation dans une prise correctement câblée et dont la terre a été préalablement vérifiée. Cette vérification doit être effectuée avant toute connexion de l'alimentation et de l'enregistreur numérique.

Utilisation du Cordon d'alimentation Approprié

Si vous utiliser l'alimentation / chargeur, assurez-vous d'utiliser le cordon et le connecteur distribué avec l'alimentation (ou une cordon équivalent au sens des normes CEI). Utilisez uniquement un cordon en bon état.

Remplacement des Fusibles

Afin d'éviter tout risque d'incendie, utilisez uniquement les fusibles spécifiés dans la section "*Maintenance & Service"* de ce manuel. Assurez vous que le type, la tension ainsi que le courant limite correspondent. Les fusibles doivent être remplaces par un technicien qualifié, et il faudrait s'assurer que l'instrument est complètement débranché de toute source d'alimentation *avant* de toucher aux fusibles.

Câblage et Mise à la Terre des Capteurs

Dans les installation où les capteurs sont installés à distance de l'Enregistreur, et où les capteurs et le Enregistreur sont mis à la terre localement, il est indispensable que toutes les parties soient mises à terre au même potentiel. Des courants fatals dans les câbles de connexion peuvent résulter d'une mauvaise installation.

Installation de l'Antenne et du Téléphone

Ne jamais installer les antennes et les câbles de téléphone lors d'orage. Toujours assurer une séparation entre les antennes et les câbles téléphoniques avec les lignes de haute tension. Toujours prendre des précautions en travaillant sur les lignes téléphoniques. Les (50) ou (60) VDC des câbles téléphoniques et le (90) VAC du signal Ring

Ne Pas Utiliser en Atmosphère Explosive

Le Enregistreur et sont alimentation NE COMPRENNENT PAS DE PROTECTION CONTRE LES EXPLOSIONS contre les décharges statiques ou contre les composants pouvant provoquer des arcs. NE PAS utiliser ces composants en présence de gaz explosifs

1. Getting Started
启动

Overview 总论

This user guide is for Kinemetrics' Etna Strong Motion Accelerograph recorder, a member of the Altus family of instrumentation. Chapters 1 and 2 introduce the Etna and provide information on installation considerations and requirements. Chapter 3 describes the configuration and operation of the instrument and Chapter 4 describes the recommended maintenance and service of the Etna. Chapter 5 provides a technical system overview as well as a summarized description of overall operation. Chapter 6 discusses advanced installation procedures. 本使用指南是关于 Kinemetrics 公司的 Altus 系列仪器之一的 Etna 强震动加速度计记录器的指示和信息。第 1 和第 2 章叙述了如何安装 Etna 记录器与相关要求。第 3 章叙述了仪器的设置和操作。第 4 章叙述了推荐的记录器的维护和服务。第 5 章提供了技术系统总览以及全部运行的综合说明。第 6 章则讨论了高级的安装程序。

The included *QuickTalk & QuickLook Software User's Guide* provides instructions for use of the QuickTalk & QuickLook software interface. 包括了 QuickTalk & QuickLook 软件的使用指南提供对于 QuickTalk & QuickLook 软件界面的使用指引。

Note*:* Users who wish to develop their own software to retrieve data from and control their recorders should be sure they have the latest versions of the *Altus Block Mode Communication* manual (Document 302218) and the *Terminal Mode Communication* manual (Document 302219). Contact Kinemetrics for this documentation.

注释：期望开发从记录器回收数据并控制记录器的用户应该肯定要有 Altus Block Mode Communication 手册(Doc.302218)和 Terminal Mode Communication 手册(Doc.302219)的最新版本。若须此文件则可与 Kinemetrics 公司联系。

The following manuals might also be included in this binder, depending on the recorder options purchased: 下列手册或许也包含在本文件夹里，这取决于所购买的记录器选项：

- The *Altus GPS Timing Systems User's Guide*, Document 302205
- *Altus Block Mode Communications*, Document 302218
- *Altus Monitor Mode Communications*, Document 302219
- *EpiSensor User Guide*, Document 301900
- The *Etna Extended Interconnect Option User Guide*, Document 302231

Kinemetrics is committed to ensuring a successful installation. For assistance with planning, installation, operation or maintenance for an Etna installation, please contact us. Kinemetrics also has an extensive Services Group that can install and maintain instruments and analyze data. Kinemetrics 公司有责任使仪器安装必然成功。若需本公司协助对 Etna 记录器安装进行计划、架设、操作或维护，请接触我们。Kinemetrics 公司也还设有一个全面的服务组织，她能够为用户安装和维护仪器并分析数据。

For technical questions and assistance, please e-mail support@kmi.com.

要有技术问题和希望帮助，请电邮 support@kmi.com。

Note: Although this manual describes some basic preventive maintenance, it is not intended as a service or repair manual.

注： 虽然本手册介绍了一些基础的预防维护知识，但不能算作是一本服务或修理手册。

Introduction 概述

The Kinemetrics Etna is a self-contained, three-channel digital recorder. In its typical configuration as a high dynamic range strong motion accelerograph, it includes an internal triaxial force-balance accelerometer (EpiSensor) and a built-in GPS timing system.

Kinemetrics 公司的 Etna 仪器是一个自包容的 3-通道数字记录器。当将它配置作为典型的大动态范围强震动加速度仪用时，它包含一个内置三轴向力平衡式加速度计(EpiSensor)和一个内置 GPS 时间系统。

In general terms, a recorder functions in this way: as the sensors pick up ground acceleration or velocity signals, the recorder continuously monitors those signals to see if they satisfy seismic event detection criteria. When the signals satisfy these criteria, the recorder stores them as event data on a PCMCIA card for later retrieval. 一般说，在这里记录器运行：作为传感器拾取场地加速度或速度信号，同时记录器连续监测那些信号以注意它们

是否满足地震事件判定标准。当该信号满足这些准则，记录器即将它们作为事件数据存储在 PCMCIA 卡上以备过后回收。

Event data can be retrieved remotely via modem or telemetry, or by a visit to the recorder site. The recorder can also transmit a continuous stream of digital data in real time. 事件数据可经由调制解调器或遥测技术远程回收，或者到记录器所在现场访问回收。该记录器也能够实时传输连续的数字数据流。

To set-up and retrieve data requires an IBM-compatible PC running Windows 2000, Windows NT 4.0 or Windows 98. For your convenience, the programs will also run under Windows 95 or 3.1. 为了设置和回收数据需要配置运行 Windows2000,Windows NT 4.0 或 Windows 98 的 IBM 兼容的 PC 计算机。为使您便利，该程序也可在 Windows 95 或 3.1 之下运行。

Typically, the watertight case contains the following components: 典型地，防水密封外盒包含下列部件：

- System electronics 系统电子器件
- PCMCIA data storage modules which conform to Personal Computer Memory Card International Association standards (PC card) PCMCIA 数据存储模块(PC 卡)
- A battery 电池
- EpiSensor deck 传感器装置

These components are illustrated in Figure 1, which shows an Etna without its cover. 这些部件显示在图 1 里，图 1 示出了典型的打开了盖的 Etna 仪器。

Note: Please read the *Inspecting the Recorder* section of this chapter before unpacking and examining the recorder. 注：在拆包和检查记录器之前请读本章检查记录器一节。

图 1 打开盖的 K2

Figure 1: Etna with its cover off

This Etna is equipped with the optional 12V, 12 Ah battery.图中 Etna 配置有 12V,12Ah 电池选件。

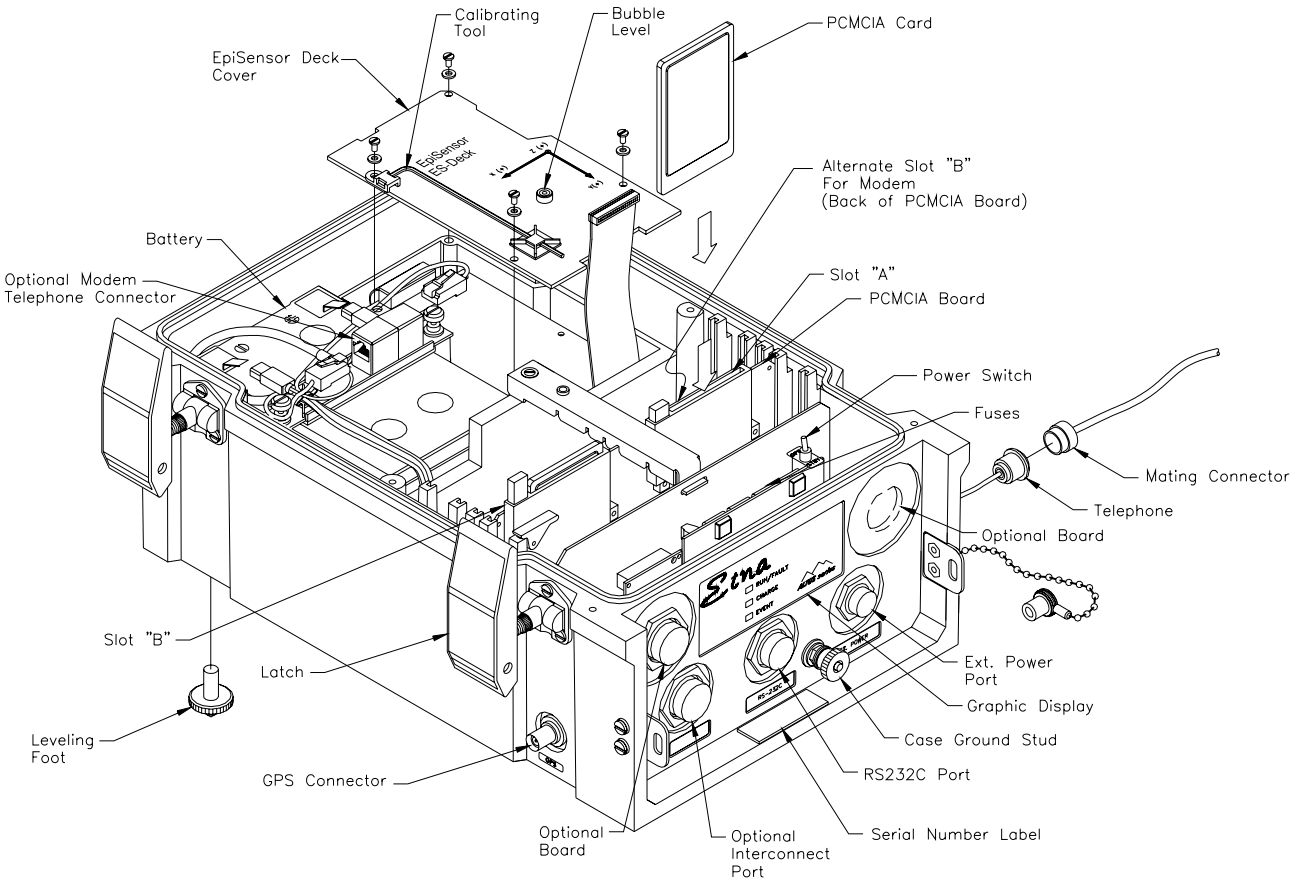
A battery charger is normally supplied with the unit.电池充点器随仪器配套提供。

Caution: Potential equipment damage. Read through the rest of these instructions and those in the *Safety* section before plugging the power supply into AC power.

***告诫：*潜在的设备损害。**在将仪器接上 AC 主电源之前请读遍本处和**安全**章节的余下的指引。

Figure 2: Inside the Etna

图 2 Etna 的内部



Among the elements included in the Etna: Etna 中包含下列部件：

- External Power Port (labeled EXT. POWER): Where external power sources plug into the recorder. 外接电源口(标记为 EXT.POWER)：外电源接入记录器的地方
- Optional Board (one of two): Input board for external sensor inputs and/or the extended GPS system interface. 选择板(两块之一)：为了外接传感器输入和/或扩展的 GPS 系统接口的输入板。
- Telephone: Optional internal PCMCIA modem connection. 电话：选择内置 PCMCIA 调制解调器连接。
- Fuses: Protect the Etna from electrical overloads. 熔断丝：Etna 的电力过载保护。
- Power Switch: Toggle switch that either turns the Etna on or to a standby state. Its two possible positions are labeled OPER and STBY. In OPER mode, the power is applied to all circuitry; in

STBY mode, the power is disconnected from most electronics, but still flows to some critical time-keeping circuits. Power to the Etna is not truly turned off unless all power sources are disconnected. 电源开关：拨动开关，不是接通 Etna 就是待机状态。这两个可能的位置相应地标志为 OPER 或 STBY。在 OPER 模式时，电源向所有电路供电；在 STBY 模式时，对多数电子电路切断供电，祗仍然对一些紧要的时间保持回路供电。除非所有供电源都切断，否则 Etna 的供电是没有真正被切断的。

- PCMCIA Board: Contains interface electronics for the PCMCIA slots (A, B or alternate B, mentioned below). PCMCIA 板：包含 PCMCIA 槽口(A,B 或替换的 B，下面提及)的接口电子电路。
- Slot A (and B): PCMCIA slots for the SanDisks (or PCMCIA hardware) on which the recorder saves event data. Data is saved until you retrieve and delete it. 槽口 A(和 B)：为 SanDisks 卡(或 PCMCIA 卡)用的 PCMCIA 槽口。记录器保存事件数据在 PCMCIA 卡上。
- Alternate Slot B: An optional PCMCIA modem can be installed in this slot (in which case Slot B must not contain a data storage module). 替换槽口 B：一个可选用的 PCMCIA 调制解调器能够被安装在这个槽口里(在这种情况里，槽口 B 应不包含一个数据模块)。
- Bubble Level, Calibrating Tool and EpiSensor Deck Cover: The deck cover prevents dust and other particles from contaminating the internal EpiSensor and the bubble level and calibrating tool are used for zero adjustment. 气泡水准器、校准工具和 EpiSensor 装置盖：装置盖是为防止尘埃和其他微粒污染内置 EpiSensor，气泡水准器和校准工具是用于零位调节。

Caution: **Potential performance degradation.** The EpiSensor deck cover provides grounding for the EpiSensor deck. Make sure it is attached during normal operation for the lowest noise performance.

告诫：潜在性能降级。EpiSensor 装置盖提供该装置的接地。当适合于低噪声性能正常运行时请确认接地良好。

- Battery: Provides approximately 36 hours of power if the AC mains supply is interrupted or fails. 电池：若 AC 主电源中断或失效，仪器内电池可供电约 36 小时。

Note: Actual power autonomy is dependent on the options installed.

注释：实际功率自治权取决于被安装的选项。

- The optional GPS connector allows a GPS antenna to be plugged into the Etna to provide an accurate timing signal. GPS 连接器选件允许将 GPS 天线插进 Etna 以提供精确时间信号。
- RS-232 Port: Connects the recorder to a PC via an RS-232 cable (an RS-232 cable is included in the optional Altus Cable Kit, P/N 109475). RS-232 口：用 RS-232 电缆(P/N109475)将记录器连接到 PC 计算机。（该电缆是选件）
- Optional Interconnect Port: Connects the optional extended interconnect system.互连接口选项：连接可选的扩展互联系统。
- Case Grounding Stud: Connects the Etna to a good earth ground to protect against ESD (electrostatic discharge) and lightning-induced transients, and ensure low-noise performance. 机壳接地螺栓：连接 Etna 至一个接地良好的场地，以做到抗 ESD(静电释放)和瞬间闪电感应，并保证低噪声性能。
- Graphic Display: Three LEDs and their labels provide visual information about the status of the Etna. 图形显示：3 个 LED 发光二极管和对应标签提供关于 Etna 状态的可视信息。

Inspecting the Recorder 观察、检查记录器

Inspect the recorder as follows: 检查记录器如下：

1. Look at Figures 1 and 2 to familiarize yourself with the recorder. 观看图 1 和 2，以使你熟悉记录器。
2. Carefully remove the recorder from its shipping container. Save the container and packing materials if the recorder will be shipped further. 小心地从运输包装箱中移出记录器。保留包装箱和包装材料以备将来运输再用。
3. Open the four flip-up latches. 打开仪器盒盖的四个上翻锁扣。
4. Carefully remove the cover. 小心地移去上盖。
5. Visually compare the recorder contents with the drawings, inspect the components for obvious damage such as loose screws, bent metalwork, and so on. 用图对照观察比较记录器内部，检查是否有明显损伤的部件诸如螺丝松动、金属构件歪斜等等。
6. Make sure the PCMCIA card or cards are properly seated. The PCMCIA slots are in the front third of the recorder's interior, and the cards should already be in the slots with the card-release buttons sticking up above the slots. The card-release buttons should be in the up

(or "filled") position. 确证 PCMCIA 卡或另外的卡都已适当固定。PCMCIA 槽口是记录器内部前数第三个槽口，并且卡已装入槽内，卡的释放按钮处于槽口上方，这时卡的释放按钮应在向上的(或“被填充”)位置。

If the recorder is equipped with an internal PCMCIA modem, it will be in "Alternate slot B" on the rear of the PCMCIA board. There will be a label in slot B warning you not to insert a PCMCIA card. 若记录器装有内置 PCMCIA 调制解调器，该 modem 则应置于 PCMCIA 板背面上“替换槽口 B”内。这时在槽口 B 内将会有一个标志警告你不能置入 PCMCIA 卡。

Handling Precautions 预防触摸危险

Caution: **Potential ESD equipment damage**. The Etna circuit boards contain CMOS components that can be damaged by electrostatic discharge (ESD) if not properly handled. Use a grounded wrist strap, with impedance of approximately 1 MΩ, to protect components from ESD damage when handling circuit boards. Before removing any circuit boards or disconnecting any internal cables, be sure that all batteries and the charger are disconnected.

***告诫：*潜在 ESD 设备损害。**Etna 记录器电路板上含有 CMOS 元件，如果触摸不恰当，这些元件极易受到静电释放(ESD)损坏。戴上一个具有约 1MΩ 电阻的接地腕带，在触碰电路板时可以保护元器件免受 ESD 危害。在移动任何电路板或拆下任何内部电缆之前，务须确证所有电池及充电器均被切断

If there is no obvious damage, proceed with the installation instructions. Please work through the following section carefully so that the Etna installation will accomplish your scientific objectives. 若未见明显损坏，可按安装指示继续进行。请小心地干完下一节，就可完成记录器安装，实现你的科学目标。

Installation Considerations 安装需要考虑事项

This section discusses recording network setup and operating modes. 本节讨论记录网络设置和运行方式。

Network Planning 台网设计

Carefully consider the scientific objectives of the installation when planning the network, whether it includes one station or a hundred. 当做台网设计时，不论它是包含一台或是一百台都要谨慎考虑科学目标。

The station location, type and position of sensors, and instrument settings all affect the type of data recorded. Consider local seismic-noise conditions and the anticipated amplitude of events being recorded. This will help you correctly set trigger parameters, estimate the quantity of data expected, and decide how to retrieve the data. 台站地点、传感器型式和位置，及仪器设置全都影响记录数据的形式。应考虑当地地震噪声环境状况和有记录的事件的预期振幅。这将帮助你正确设置触发参数、估计预期数据的量值，以及决定如何回收数据。

It's also necessary to plan how to analyze, combine, and archive data, as well as how to service and maintain the network. Finally, consider how the network will function after a large event, when AC power and telecommunications might not be available for a considerable time. Under such circumstances, how do you plan to retrieve and process the network's data, as well as continue operating it? 设计如何对数据进行分析、联合和归档，以及如何服务和维护台网也都是必需的。最后，应考虑在大事件发生后致使主电源和电讯中断且会保持一段时间的情况下台网如何运行。在此境况下你将如何设计回收和处理台网的数据，以及继续运行台网。

Civil Engineering 土建工程

Before installing the Etna, plan and construct (if necessary) the housing that will provide a protective infrastructure for the unit. The exact details of the installation depend on local conditions, local regulations, and the purposes of the installation. 在安装记录器之前，设计和建造仪器柜室将为仪器提供一个保护的环境条件。仪器安装的准确详细资料依靠当地状况、地方规章，及安装的意图。

Except in cases of a rapid emergency deployment of seismic instruments, the Etna should be housed in a protective structure. Below are the two typical types of installation settings and related protective structures. They can be used as rough guidelines for an installation. 除地震仪器快速紧急布设的情况外，记录器均应装置在防护结构内。下面是安装设置和相关保护结构的两种典型方式。它们能被用作为安装的粗略指引。

FREE-FIELD INSTALLATIONS 自由场的安装

In a free-field accelerograph installation, the Etna is installed some distance from buildings in a "free field" and sheltered by a small, lightweight structure that allows the internal EpiSensor to sense acceleration as close as possible to the "true" accelerations of ambient ground motion. In softer ground sites, because of the soil-structure interactions during earthquakes, a heavier-than-necessary protective structure could degrade data accuracy. 在

自由场的加速度仪安装中，将记录器装置在离建筑物有一定距离的“ 自由场 ”并由一个轻小结构防护，以保证内置 EpiSensor 拾取的加速度量尽可能地与周围环境“ 真实 ”的加速度接近。

The structure should also protect the recorder from weather, direct sunlight, and theft or vandalism. A "transformer hut" made of fiberglass and stainless steel hardware is ideal as long as it, and the recorder, are attached to a poured and reinforced concrete pad. If true hard-rock site response is desired, anchor this concrete pad to bedrock. 该结构应该也能保护记录器免受来自各种天气、直射阳光，及偷盗或人为故意破坏等的干扰。如果以用玻璃纤维和不锈钢五金器件制造的“ 变压器小屋 ”作为此种结构，并且记录器是架设在一块现浇钢筋混凝土底板上则是理想的。若希望取得基岩场地的真实反应则应将此混凝土板与基岩锚固。

Provide the recorder with a good earth ground. Proper grounding depends greatly on the humidity of the soil at the site. For average-humidity soil, an effective earth ground can be made by wiring the case grounding stud to a 6'- to 8'-long copper rod embedded in the ground. 应提供记录器一个良好接地场所。正确的接地是极大地依赖于场地土壤湿度的。对于一般湿度的土壤，将仪器外盒接地线柱与一根埋入场地土内长约 6 英尺到 8 英尺的铜棒相连接即可获得有效地接地。

If no AC power is available, a solar charging system is required. Refer to the *Advanced Installations* section of this manual for more information. 如果不可能用 AC 供电，就需要用太阳能充电系统。可参考本手册里高级安装一节以得到更多信息。

If the recorder has a GPS system, the GPS antenna will need a suitable mounting mast. A telephone line or other communication link is required to communicate with the Etna remotely. 如果记录器带有 GPS 系统，则 GPS 天线将需要相匹配装置天线杆。为与远程记录器通信，则需要设有电话线或其它通信链路。

STRUCTURAL-MONITORING INSTALLATIONS 结构监测的安装

In a structural-monitoring installation, you provide protection to the recorder by installing it within an existing building or structure (a bridge, a dam, a high-rise, etc.). The main purpose for installing the Etna in an existing structure is to measure and monitor the structure's vibrations in response to ground motion. While some use such installations to calculate measurements of "free-field" seismic motions, the very nature of the structure's size and foundation depth cause the acceleration measurements to deviate considerably from "true free-field" response. 在结构监测的安装中，你可以将记录器安装在现有的建筑物或结构物(桥、坝、高从建筑物等)内以提供对记录器的保护。在现有建筑物里安装记录器的主要目的是测量和监测该建筑结构对地面运动的振动反应。虽然有些时候使用如此安装是为考虑“ 自由场 ”地震运动的测量，结构的大小和基础的深度是引起加速度测量相当地偏离“ 真实自由场 ”反应这是很自然的。

For a structural-monitoring installation, make sure the space in the structure allows enough room to mount and service the Etna, and that the space provides enough protection so the recorder and its sensors will not be disturbed or vandalized. Powering the recorder requires a mains supply close to the installation point. To connect a modem, a phone line is also necessary. 对于结构监测的安装，须确保在结构里要有足够的房屋空间以便安装和服务于记录器，以及提供足够保护记录器和传感器不受干扰和破坏的空间。记录器的供电要求主电源靠近安装点。为连接调制解调器，也需要一根电话线。

As for the Etna's optional GPS antenna, carefully plan to locate the antenna close enough to the unit so the supplied GPS cable will reach between the two. 对于记录器选项的 GPS 天线，要细心设计将天线定位与记录器不能太远以使所提供的 GPS 电缆能满足两者的联接。

All these elements of an installation should be in place before the Etna itself is installed. 所有这些安装要素应该在记录器本身安装前到位。

Requirements for Installation 安装需备条件

Below we provide lists of the tools, supplies and equipment required to install an entire Etna system in its typical configuration, including the recorder, an optional external EpiSensor, and an optional GPS timing system. 下面我们提供为安装完整的记录器系统所需的工具、补给品及设备列表。所谓的完整记录器系统其典型设置包括记录器、一个内置 EpiSensor 或外接 EpiSensor，以及一个 GPS 时间系统。

Specialized installations may require additional tools, supplies or equipment, depending on specific sites and needs. This manual assumes that all civil engineering work (concrete pads, enclosures, conduit, mounting masts, etc.) is complete and ready at the outset of the Etna installation. 专门的安装可能需要附加的工具、补给品及设备，这取决于特殊的场地和需要。本手册假定所有土建工程工作（混凝土板、封装围栏、管道管渠、装备桅杆等）在 Etna 记录器安装开始时已完成和准备完毕。

Required Tools 必需的工具

FOR THE ETNA 用于 ETNA 记录器的

The Etna must be rigidly mounted to the floor of its structure or enclosure. The supplied mounting kit (P/N 700170-02-PL) includes a 1/4-20 anchor stud with an attached concrete anchor, a sealing washer, a flat washer and a nut. Etna 记录器必须牢固地安装在结构或仪器柜室的地板上。所提供的安装套件(P/N700170-02)包含一根带有混凝土锚定的 1/4-20 锚着螺栓、一个密封垫圈、一个平面垫圈及一个螺母。

The following tools are required: 下列工具是必需的：

- A concrete drill with a 1/4" (6.4 mm) diameter 4" (10 cm) long masonry/concrete bit (a percussion or hammer drill makes this much easier) 带有一根 1/4”(6.4mm)直径、4”(10cm)长的砖石/混凝土钻头的混凝土钻孔机。（最好用冲击钻可使工作更方便）
- A 7/16" (11 mm) wrench to tighten the nut on to the anchor stud 一把 7/16”(11mm)扳手以将螺母拧紧到锚着螺栓上。
- Hammer 锤子
- Block of wood 木块
- Safety glasses 安全玻璃面罩
- A flexible drinking straw (or other device) to clean out concrete dust after drilling 一根软吸管（或另外的工具）以在钻孔后清除孔内混凝土尘埃

Note: To shelf- or wall-mount the Etna you will also need plastic wall anchors, sheet metal screens and/or a sturdy bracket. Please read the installation instructions to determine exactly what tools and supplies you will require.

FOR THE GPS TIMING SYSTEM 用于 GPS 时间系统的

Installation of the internal and external GPS systems requires these tools: 安装内置或外接 GPS 系统需要下列工具：

- Wrench or pliers to tighten the Type F connector on the GPS bullet antenna 扳手或钳子用以拧紧 GPS 子弹头天线上的 F 型连接器
- Tools for mounting the antenna 安装天线的工具
- A heat gun (electric or butane) 一把加热枪(电的或丁烷气的)

An external GPS system installation requires the following additional tools: 对外接 GPS 系统安装还需下列附加工具：

- Soldering iron (electric or butane) 烙铁(电的或丁烷气的)
- Small screwdriver 小螺丝起子
- Wire cutters 割线刀具(电工刀)
- Wire strippers 剥线器
- Long-nose pliers 长鼻钳（尖嘴钳）
- Utility knife 通用刀
- A drill (electric or battery powered) 钻孔器(电的或电池供电的)
- Cable tie wraps 电缆捆绑包装的线、带或套管
- A crimping tool 卷边器
- Silicone grease 硅脂
- A short length of insulated braid 短的绝缘编织带
- An extension cord or a small generator for AC power, if butane-powered soldering irons and battery-powered drills are not

available 一条加长的电源线缆或一台小交流发电机 （当丁烷气烙铁和电池供电钻孔器不能提供时）

FOR AN EXTERNAL EPISENSOR 用于外接 EPISENSOR 传感器的

Refer to the *EpiSensor ES-T User Guide*. It details the tools and equipment required for making a cable to connect the EpiSensor to the recorder and provides instructions about how to mount the sensor. 参考 EpiSensor ES-T 使用指南。它详细阐述了制做一根连接 EpiSensor 与记录器的电缆所需要的工具和提供了关于如何安装传感器的指引。

Required Supplies 必需的补给品

- Material to make grounding straps for the Etna 制作 Etna 记录器接地带的材料
- Solder with rosin-core flux 具有松香焊剂内芯的焊条
- An assortment of heat-shrink tubing, cable tie-wraps, and electrical tape 各种规格加热收缩管状电缆绑套和电线绝缘带

Required Equipment 必需的设备器材

- An IBM-compatible portable/laptop PC 一台 IBM 兼容便携/膝上型 PC 电脑
- Kinemetrics' RS-232C cable to connect a PC to the Etna (the RS-232 cable is included in the optional Altus Cable Kit, P/N 109475) 一根 Kinemetrics 的 RS-232 电缆，以供 PC 机与记录器链接
- A battery-powered digital volt meter (DVM) to adjust the zero-level of the EpiSensor and other system-checkout functions 一块电池供电的数字电压表(DVM)，以供调节 EpiSensor 的零位水平和其他系统校验功能
- A compass, to check the orientation of the sensors 一个罗盘，以供检查传感器方位

Optional Equipment 选用设备

- A portable printer, to print tests and other commissioning data 一台便携式打印机，以供打印试验和其它试运行数据
- A camera, to photograph the completed installation for the commissioning report 一台照相机，以提供时运行报告需用的全部安装实况照片

Practice Assembly 实际集合演练

Once you have assembled the tools, supplies, and equipment listed above, we recommend that you run through a practice assembly following the

installation instructions. 一旦你已经装备了上面所列工具、补给品及设备，我们建议你先按照下列安装指引从头到尾运行一次实际集合演练。

We have done our best to list all the tools and supplies you will require, but it will be well your while to read the installation instructions completely to be sure that you have everything required for your specific installation. 我们已经尽可能的提供你所需要的工具备件，请你参照此安装指引确实准备好为你的特殊安装所需要的一切物品。

Why Practice In the Laboratory? 为何要在实验室内演练？

The connections between all the components mentioned in this manual may appear a bit complex. They will be even more complex if your first installation attempt is in a remote field situation where you find that you lack the necessary tools, supplies, or equipment to make the connections work. 本手册中所提及的所有部件之间的连接可能会出现小的麻烦。如果你初次安装尝试就在一个偏远的野外场合，在那里你可能会发现你会缺乏一些必需的工具、补给品及设备去做连接工作，这甚至将会有更大的麻烦。

Practice in a well-supplied, well-lit laboratory or office when first connecting a PC, GPS, and modem systems to the Kinemetrics equipment. Follow these instructions carefully, step by step, to learn exactly which tools, supplies and equipment will be needed in the field. 当初次将 PC 机、GPS 及调制解调器系统与 Kinemetrics 的设备相联接时，请在补给、光线条件好的实验室或办公室内进行实践。小心地跟着这些指引，一步一步地，学习如何正确地使用那些在现场将需用的工具、补给品及设备。

Murphy's Law provides a further reason for a practice installation: *If anything can go wrong, it will*; and Isaac's Corollary: *Murphy was an optimist!* 墨菲定律为实践安装提供了一个更深一层的理由：*如果任何事可能出错，它也将会*，并且艾萨克推论：*墨菲是个乐天派*。

For the practice assembly, follow the instructions in Chapter 2. 请跟随第二章里的指引进行实际集合演练。

2. Installation Basics 安装基础

Overview 总论

This chapter explains several common installation procedures as well as relevant operational concepts. For specific instructions about more complex installation procedures, see Chapter 6 of this manual. 本章阐述了几个普通安装程序以及相关操作概念。关于更复杂的安装程序的专门指引请参见本手册第 6 章。

Caution: **Potential electrostatic discharge (ESD) hazard to equipment**. Before removing any boards or internal connectors from the unit, put the OPER/STBY switch inside the unit in the STBY position and disconnect all batteries and chargers. Wear a grounded wrist strap with impedance of approximately 1 MΩ when handling boards to protect recorder components from damage.

***告诫*：危害设备的潜在静电释放**(ESD)。在由记录器内移出任何板件或内部连接器之前，需将仪器内的 OPER/STBY 开关置于 STBY 位置，并且断开所有电池和充电器。戴上具有约 1MΩ 电阻的接地挽带，以当摸碰板件时保护记录器部件免受损坏。

Before attempting to install the Etna in the field, we recommend that you practice the installation instructions in your office or laboratory. 试图在现场安装记录器之前，我们建议你宜在你的办公室或实验室里先做好安装指引的实践演练。

Installing the Etna 安装 Etna

Installing Support Software 安装支持软件

To set up and retrieve data from the recorder requires a computer equipped with either a commercial communication program such as ProComm,® HyperTerminal® or Kinemetrics' QuickTalk & QuickLook program supplied with your unit. 为了记录器设置和回收数据需要一台装备随便任一个商业通信软件如 ProComm®、HyperTerminal®或 Kinemetrics 的 QuickTalk 和 QuickLook 程序提供你的仪器用的计算机。

It is much easier to set up the instrument using QuickTalk and QuickLook. To install this software, refer to the *Installing the Software* section of the *QuickTalk and QuickLook Users Guide* that is included in the back of this binder. 用 QuickTalk 和 QuickLook 程序装配仪器是非常容易的。要安装这些软件请参考 *QuickTalk 和 QuickLook 程序使用指南*的*安装软件*部分，该指南包含在本文件夹的后面。

Orienting an Etna with an Internal EpiSensor 带有内置 EpiSensor 摆的 Etna 的定向

Determine which direction to orient the Etna: true north, or "aligned-with-structure." The orientation you choose will determine the coordinate system for recorded data. 确定 Etna 方位：真北、或“按结构主轴向排列”。你选定方位将确定记录数据的坐标系统。

Typically, the front panel of the Etna will face north, in which case the Y-axis will be aligned north. The coordinate system will then be consistent with standard external EpiSensor installations. 典型地，Etna 的前面板将面向北方，在该场合 Y 轴将指向北方。这坐标系统将与标准外接 EpiSensor 安装相同。

Note: If you use a compass to determine the true north-south axis, make sure to correct for the difference between magnetic north indicated by the compass, and true north (magnetic declination). This deviation depends on your location; you can find the correct deviation on a local topographical map. 注释：如果你用罗盘确定真南北轴方位，需确实校正罗盘指示的磁北与真北之间的差异（磁偏角）。偏差取决于你的地点；你可以在当地的地形图上找到正确的磁偏角值。

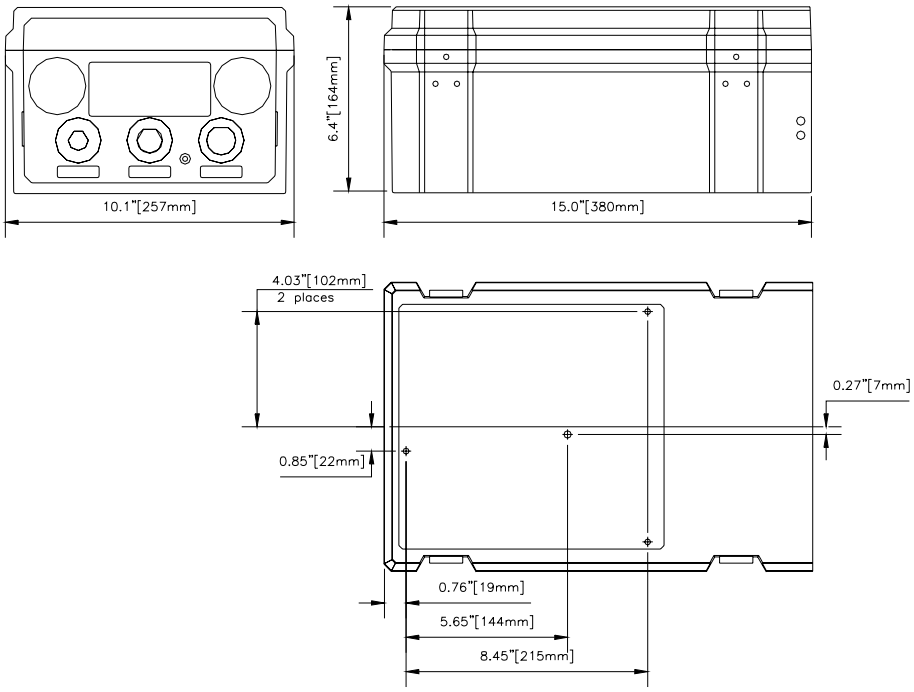
If the instrument is installed in a structure, it is normally aligned parallel to the structure's main axis. If possible, keep the same orientation for all recorders installed in the same building. 如果在结构上安装仪器，一般都是沿平行结构的主轴方向设置仪器方位。如果可能，在同一建筑物中所有记录器都应保持同样的方位设置。

Figure 3: Mounting dimensions

图 3 安装尺寸

Keep a permanent record of the Etna's orientation and of how and in relation to what it is oriented. This information is crucial to the proper analysis of recorder data. 保存一个 Etna 的方位和如何关系到记录器定位的永久记录。这信息对于正确分析记录器数据是至关重要的。

To place the recorder inside an existing structure, make sure the area is large enough and includes at least 8-10 inches (20.5-25.5 cm) of working space on each side of the unit; see Figure 4. 为了在现有结构内放置记录器，需要落实仪器每边至少有 8-10 英寸(20-25cm)足够大的工作空间，参见图 4。



Allowing sufficient access space is crucial for the Etna because it has an internal sensor deck that may need to be accessed after installation. 允许充分的访问空间对于 Etna 仪器是至关重要的，因为它有内置传感器装置在安装后可能需要访问。

Figure 4: Etna mounted with sufficient working space

图 4 安装 Etna 必需的最小工作空间

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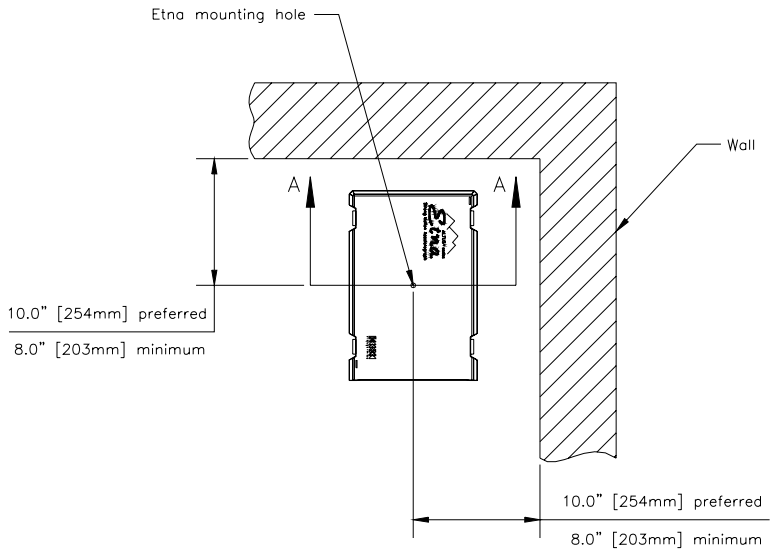


If the interior planned dimensions are large enough and the concrete pad is poured and prepared, you are ready to mount the Etna. 如果内部计划尺寸足够大并且混凝土板已灌筑准备好，你对安装 Etna 记录器单元已准备完毕。

Mounting the Etna Etna 记录器固定

The next step is to decide how you are going to mount the Etna. This section explains the following mounting procedures: 下一步是决定你如何去固定 Etna 记录器。本节阐述下列固定程序：

- Floor mounting (recommended for all Etnas but required for units with an internal EpiSensor.) 地板固定（对于所有记录器都建议用此方式，对于具有内置 EpiSensor 的 Etna 仪器则必须用此方式。）
- Shelf mounting 支架搁板固定
- Wall mounting 墙壁固定

Note: For Etnas with internal EpiSensors, the unit must be securely coupled to the ground to accurately record ground motion. In units without sensors, secure the recorder in such a way that it will not fall off its mounting during the intense shaking of an earthquake.

注释： 对于具有内置 EpiSensor 的 Etna 仪器，必须安全牢靠地与地面连接以精确地记录地面运动。对于不带有传感器的记录器，只要能安全可靠地放置不至于在强烈地震时跌落即可。

The unit has a single hole in the base for a 1/4" (6.4 mm) bolt. To attach the Etna to the mounting surface, use the mounting kit shipped with the recorder. It includes a heavy-duty wedge type expansion anchor stud with 1/4-20 thread, a flat washer, a sealing washer, and a nut. The following figures show the details of such an installation. 仪器在底板上有一单孔以供 1/4”(6.4mm)螺栓用。用随记录器一起带来的固定套件将记录器固定在地表面上。该套件包含一根 1/4-20 螺纹的耐压楔型膨胀螺栓、一个平面垫圈、一个密封垫圈及一个螺帽。下列图示出了安装细节。

FLOOR-MOUNTING (RECOMMENDED) 地板固定（推荐）

Caution: **Invalid data.** Etnas with internal EpiSensor decks must be floor-mounted to ensure the acceleration levels of the actual structure are measured.

***告诫*：无效数据。**具有内置 EpiSensor 摆的 Etna 必须在地板上安装固定，以确保测量到结构实际的加速度量值。

Note: Leveling and orientation are not required for operation of recorders without internal sensors, but doing so will result in a more professional looking installation.

注释： 对于不带有内置传感器的记录器是不需要找平和定方位的，不过这样做也无妨，可能看上去安装更专业些。

Anchor the recorder unit to a concrete floor if possible. Prepare the recorder for mounting as follows: 如果可能请将记录器单元锚定在混凝土地板上。准备记录器固定如下：

1. Be sure that each of the recorder's leveling feet are screwed into place. 一定做到每一个记录器找平脚都拧到位。
2. Remove the cover of the recorder and set it aside. 打开记录器盖并放在旁边。

***WARNING!* Burn or fire hazard**. Do not short the battery terminals with metallic conductors, such as a screwdriver or pliers. The battery can provide up to 80 amps of current. This amperage, when flowing through a non-isolated conductor, can result in very high temperatures and even fire. **Do not** replace the supplied battery with a non-rechargeable battery or a battery that does not meet the requirements given in Chapter 4 in the *Replacing Batteries* section.

警告！燃烧或火灾。绝不用金属导体诸如螺丝起子或钳子短接电池两极。电池能够提供多到 80 安培电流。这样的安培数流过非绝缘导体时会产生非常高的温度甚至火灾。 **绝不用**非可充电电池或不满足第 4 章*置换电池*一节规定的电池去替换仪器电池。

3. Disconnect the battery wires from the terminals, unscrew the internal battery bracket, and set the internal battery aside. 从电池两极断开电池接线，拧下内置电池压条并放在内置电池旁。
4. Remove the protective plug from the mounting hole on the recorder's underside. 移去在记录器底板上的安装固定用孔保护塞子。
5. Move the recorder gently to one side. 轻轻地移动记录器到一旁。
6. Locate where you plan to put the recorder, keeping in mind the working space dimensions in Figure 4. 在你计划设置记录器的地方定位，应注意符合图 4 中的工作空间大小。
7. Use a drill with a 1/4" (6.4 mm) bit, and drill into the concrete to a depth exceeding the maximum depth you intend for the anchor to penetrate, as shown in Figure 5. A percussion or hammer drill will make this procedure much easier. You should follow all recommended safety precautions when using power tools and we recommend you wear safety glasses during the installation procedure. 如图 5 所示，用带有 1/4”(6.4mm)钻头的钻孔机在混凝土垫板上钻孔，孔深应略超过你打算的锚着深度。用冲击钻可使钻孔非常容易。在使用动力工具时，你应该遵守所有建议的安全防范要求，并且我们建议你在这个安装程序中应戴安全玻璃面罩。

Figure 5: Drilling a hole for the anchor bolt

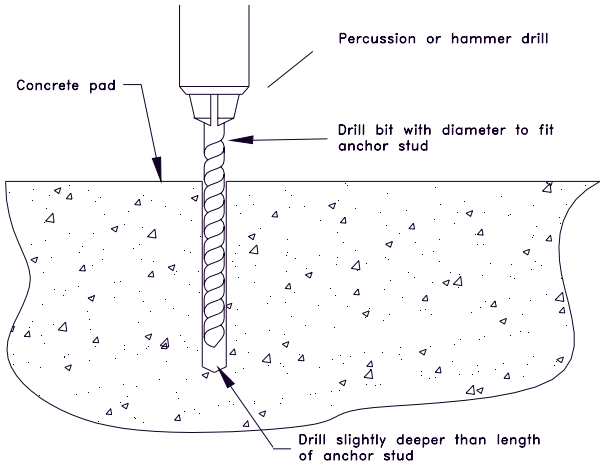


图 5 钻锚着螺栓用孔

8. Make sure you clean out the hole after drilling it. (Using a flexible drinking straw works very well for this, but make sure you don't blow dust in your eyes!) 你在钻孔后应将孔清干净。（用软吸管是很好的清孔工具。不过你要确使不让尘埃迷住你的眼睛！）

9. Screw the nut onto the anchor bolt until the top of the nut is flush with the top of the anchor bolt, as shown in Figure 6. 如图 6 所示，拧螺母到螺杆上，直到螺母顶与螺杆顶齐平。

Note: It is very important not to damage the threads of the anchor bolt. Place a small piece of wood or similar object on top of the nut before tapping with the hammer. This will dissipate the energy between the bolt/nut and the hammerhead and avoid damage to the threads.

注释： 它对于不损坏螺杆的螺纹是十分重要的。在用锤子轻拍之前要放一小块木片或类似物品在螺母顶上。这将耗散一些螺杆/螺母与锤头之间的能量以避免螺纹的损坏。

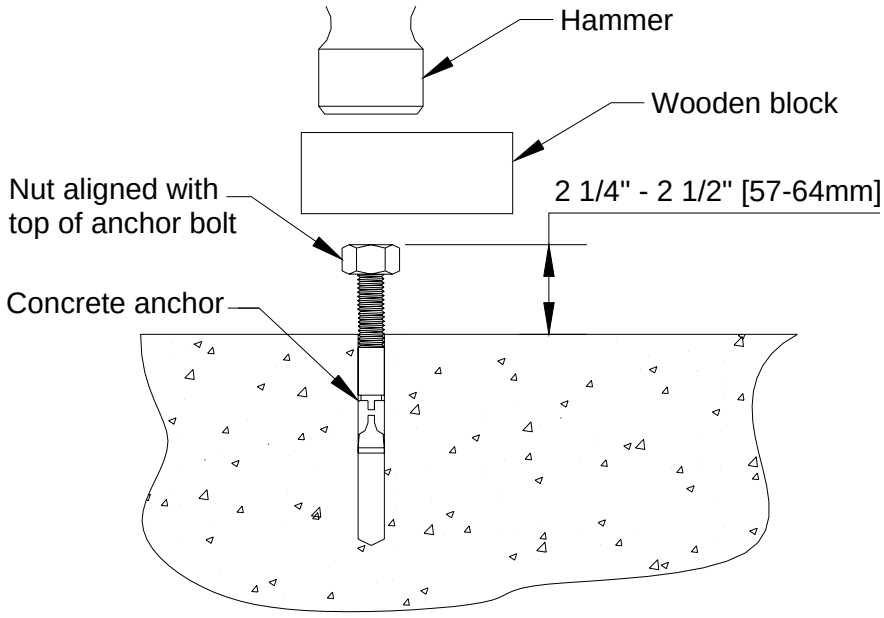
10. ***Gently*** tap the anchor bolt assembly (bolt and nut) into the hole in the concrete pad. The recorder's leveling feet keep the unit off the floor, so you must leave approximately 2-1/4" (5.75 cm) of the anchor bolt protruding from the hole. 将锚着螺杆集合(锚杆和螺母)**轻轻地**拍进混凝土垫板的孔中。由于记录器找平脚使记录器与地板保持一定间隙，所以你必须留有约 2-1/4” (57.2mm)螺杆露出孔口。

11. Unscrew the nut from the top of the anchor bolt. 由锚杆顶拧下螺母。

12. Center the Etna over the anchor bolt and lower its mounting hole down over the protruding bolt. 将 Etna 记录器底板孔与出露的锚杆对中并放下。

Figure 6: Driving the anchor bolt and nut into the hole

图 6 将锚着螺杆和螺帽置入钻孔中



13. Apply silicon lubricant to the sealing washer and carefully screw it onto the bolt without damaging the rubber seal. Then place the flat washer onto the bolt. Then screw the nut onto the bolt. Tighten the nut so that it is about 1/8" (3.2 mm) from the bottom of the case. 用硅润滑剂涂密封垫圈使其仔细地拧上螺杆不可对橡皮封圈有损坏。然后放置平面垫圈到螺杆上。再把螺母拧到螺杆上。拧紧螺母使其离仪器盒底约为 1/8”(3.2mm)。

> ***Caution:*** **Potential equipment damage from moisture.** Use the sealing washer to stop moisture from getting into the unit. Leave the desiccant packet inside the recorder to keep it free of humidity damage for a normal maintenance period.
>
> ***告诫：*****潜在设备受潮损坏。**用密封垫圈是为了隔绝潮湿侵入仪器。留下干燥剂小袋于记录器内以保持其在一个正常维护周期内免受潮湿损坏。

14. Make sure the Etna is oriented in the correct direction and leveled before you proceed with Step 15. 在继续按第 15 步办法进行记录器找平之前，确使记录器定方位在正确的方向上。

15. Look at the bubble level window while you carefully screw each of the Etna's three leveling feet (shown in Figure 2) in or out. When you can see the air bubble centered in the bubble level window with all three leveling feet resting on the mounting pad, the recorder is level. 在你仔

细调进或调出 Etna 记录器三个找平脚的每个脚的同时，观察气泡水准窗（示于图 2）。当你看到气泡在气泡水准窗里居中时，使三个找平脚静止在安装垫板上，这时记录器被找平。

16. Carefully maintain both the Etna's level and its orientation as you tighten down the anchor nut to hold the recorder firmly in place. This final tightening should force the concrete anchor to expand inside the hole and lock the unit in place. Use a torque of 80-100 inch-lbs (9.2-10.2 Nm) to tighten the nut. 在你向下拧紧锚杆螺母以保持 Etna 记录器稳固在适当位置同时，必须小心地维持记录器的水平和它的方位。最终的紧固应迫使混凝土锚定在孔里面膨胀开，紧锁仪器在适当的位置。使用 80-100 英寸-磅(9.02-10.2nm)扭矩的力量拧紧螺母。

***WARNING!* Burn or fire hazard.** Do not short battery terminals with metallic conductors, such as a screwdriver or pliers. The battery can provide up to 80 amps of current. This amperage, when flowing through a non-isolated conductor, can result in very high temperatures and even fire. **Do not** replace the supplied battery with a non-rechargeable battery or a battery that does not meet the requirements in the *Replacing Batteries* section.

***警告！*燃烧或火灾。**绝不用金属导体诸如螺丝起子或钳子短接电池两极。电池能够提供多到 80 安培电流。这样的安培数流过非绝缘导体时会产生非常高的温度甚至火灾。 **绝不用**非可充电电池或不满足在置换电池章节规定的电池去替换仪器电池。

17. Replace the internal battery. Be sure that the rubber battery pad is under the battery. Screw the battery bracket back into place and reconnect the black wire to the negative terminal of the battery.

    Do not *connect the red wire until told to do so later.*

    置换内置电池。确证橡皮电池垫片是在电池之下。拧动电池压条置回原处，并重接黑线到电池负极。直到稍后告诉你之前，**绝不能**连接红线。

The mounting procedure described above is recommended by Kinemetrics. If your Etna **does not have** an internal EpiSensor, it is possible to use the two mounting methods described below**. Do not use** these methods if your Etna has an internal EpiSensor. 上述固定程序是由 Kinemetrics 公司建议的。如果你的记录器没有内置 EpiSensor,则也可用下述两种固定方法。如果你的 Etna 有内置 EpiSensor，则绝不可用这两种方法。

SHELF-MOUNTING 支架搁板固定

If the Etna **does not have** an internal EpiSensor, it can be mounted on a shelf as follows: 如果 Etna 记录器没有内置 EpiSensor，它可固定在支架搁板上如下：

1. Unscrew the leveling feet from the bottom of the recorder and remove. 从记录器底部拧松找平脚并移去。
2. Insert plastic wall anchors into the three threaded holes in the bottom of the unit. 从记录器底部拧松找平脚并移去。
3. Match and mark the positions of the threaded holes on the bottom of the shelf on which you intend to mount the recorder. 在你打算要安装固定记录器的支架搁板上相配和标注螺纹孔的位置。
4. Screw three sheet-metal screws from the bottom of the shelf up through the shelf until they protrude. 从支架搁板底部向上拧三个薄片金属螺钉穿透搁板直到露出。
5. Place the recorder so the threaded holes are over the screw tips, then tighten screws up into the plastic wall anchors. 放置记录器让螺纹孔正在螺钉尖上，然后向上拧紧螺钉进入塑料墙锚栓内。

Alternately, on a thicker shelf: 作为 候补，在厚的支架搁板上：

1. Temporarily place the recorder in the correct position. Mark the location of the recorder’s mounting hole on the shelf. 临时放置记录器于适当的位置。在搁板上标注记录器安装固定孔的位置。
2. Drill a hole with a 1/4" drill through the shelf at this location. 用 1/4”(6.4mm)钻孔机钻一个孔洞穿透搁板的这个位置。
3. Insert a single 1/4-20 bolt through the hole from the bottom and into the recorder’s mounting hole. 再从搁板底部向上穿透此孔洞插进一根 1/4-20 单纯的螺杆，并进入记录器的暗转固定孔内。
4. Install the sealing washer, flat washer and nut as described in the *Floor Mounting* section. Tighten the nut to firmly hold the recorder in place. 如同在底板固定一节里所记述的那样，安装密封垫圈、平面垫圈及螺母。拧紧螺母以使记录器稳固地保持在适当的位置。

WALL-MOUNTING 墙壁固定

If mounting the recorder on a wall is your only option, and your Etna **does not have** an internal EpiSensor, you can do the following: 若你只能选择将记录器安装在墙上并且你的 Etna 仪器不包含内置 EpiSensor 的话,那你可按下述去做：

1. Use a bracket sturdy enough to hold the recorder. The bracket must have bolt holes that line up with the three 1/4"-32 holes in the recorder's base plate (the leveling feet holes). 用一个足够坚固的托架将记录器托住。该托架的搁板上必须有螺栓孔洞，孔洞要与记录器底板上的三个 1/4-32 孔洞(找平脚孔)相配合。
2. Screw the nuts and bolts firmly together through the bracket and the recorder's base. 用螺栓和螺母结合使其穿透托架搁板与记录器底板稳固地集合在一起。

Alternately, use a single 1/4-20 bolt to secure the recorder. 作为候补，用一根 1/4-20 单纯的罗干以保护记录器。

Grounding the Recorder 记录器接地

All users should complete this procedure. You must provide the recorder with a good, low-impedance earth ground before operating it for the following reasons: *所有用户应完成这个程序。*基于如下理由，在运行记录器之前你必须使其有良好的低电阻接地条件：

- To maintain the recorder as a highly sensitive, low-noise, seismic recorder. 为维持记录器作为一个高灵敏、低噪声的地震记录器。
- To shunt ESD transients, lightning-induced transients and EMI/RFI transients to ground. 为避免对地的 ESD 瞬变、闪电感应瞬变及 EMI/RFI 瞬变。
- To meet the requirements of the European Community's EMI/RFI directives. 为满足欧洲共同市场关于 EMI/RFI 指示的规定。

Determine what earth ground you will connect the recorder to. A good earth ground includes the following: 确定你将连接记录器的接地是什么样的。一个好的接地条件应包含如下：

- A metal plumbing pipe that is eventually buried in the ground 一根最终埋入地下的金属管件；
- A copper ground rod staked in soil 一根用桩篱围在土中的接地铜棒；
- A well engineered electrical grounding system, or 一个良好的电工专业接地系统；或
- Steel reinforcing rods that protrude from a concrete foundation. 从混凝土基础里出露的钢筋棒。

Prepare the conductor you plan to use to connect the recorder to the earth ground. For the conductor, you should at least use a heavy-gauge wire or, better yet, a copper strap or copper braid. 准备你打算用着连接记录器到接地点的导体。至于导体，你至少应该使用大规格导线，或更好的如铜条或铜编织带。

Connect this conductor to the recorder's case grounding stud near the bottom center of the recorder's front panel. Then connect the other end of the conductor/grounding strap to the selected earth ground. 将导体连接到记录器靠近前面板下边中间的记录器外盒接地线柱上。然后将导体/接地条带的另一端连接到选定的接地点处。

Note: If the Etna is powered by the battery charger, the third pin (earth connection) of the AC plug provides the safety ground. To ensure the unit's low noise performance, you must still connect the Etna's grounding stud to a good earth ground as described above.

注释：如果记录器是用所选择的电池充电器供电，AC 交流插销的第三插脚(接地插脚)提供了安全接地。为了保证仪器的低噪声性能，你仍必须将 Etna 记录器的接地线柱连接到上面所述的良好接地点。

Connecting Your PC 连接 PC 机

Use an RS-232 cable to connect your computer to the Etna. (An RS-232 cable is supplied in the optional Altus Cable Kit, P/N 109475.) 用一根 RS-232 电缆选件(P/N 109475)将你的计算机连接到 Etna 记录器。该电缆是作为选件提供的。

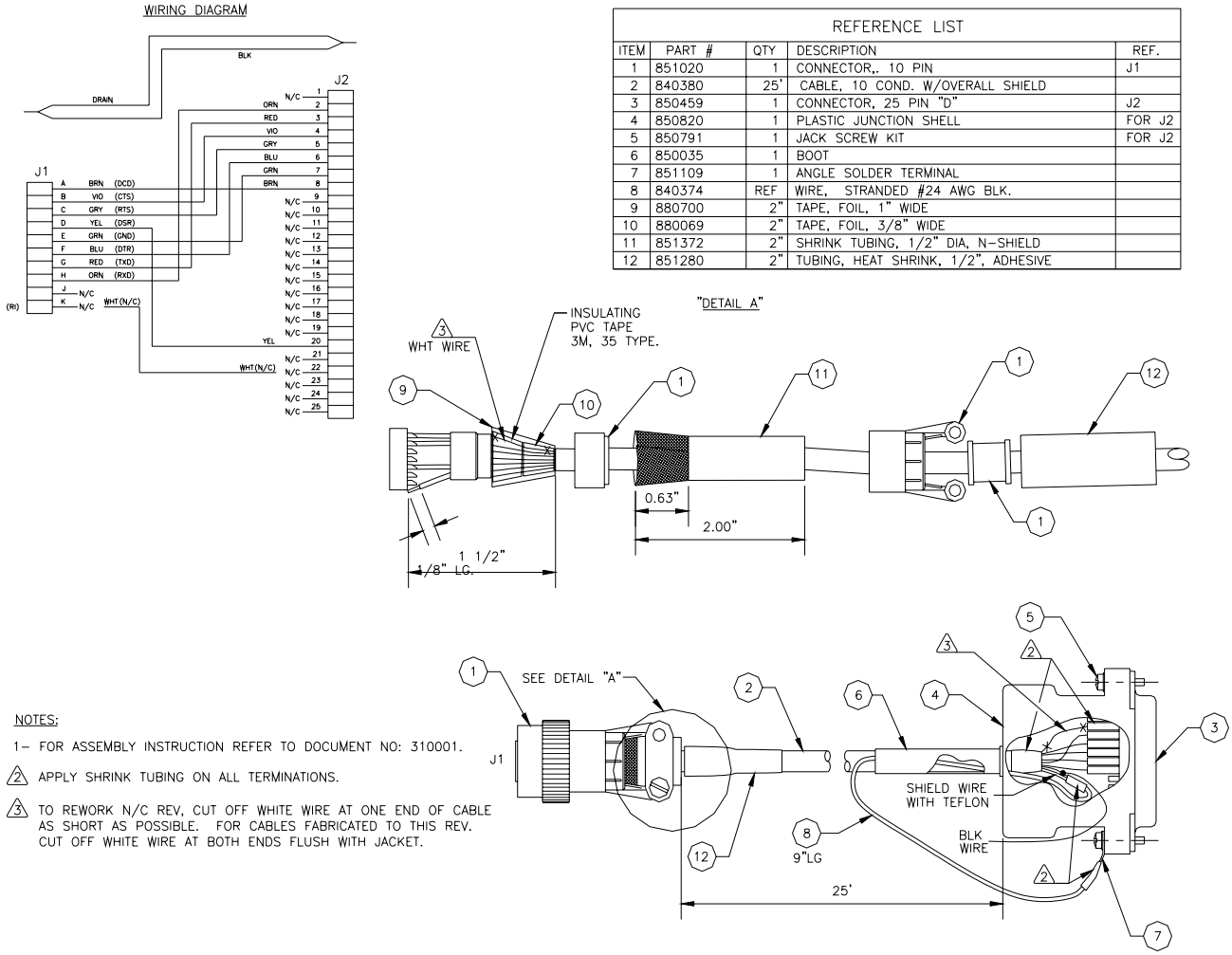
This section discusses how to complete the initial connection between your computer and the recorder. Refer to the *Verifying Basic Unit Operation* section for how to verify proper operation of the connection. Refer to the *QuickTalk & QuickLook Software User's Guide* for further information about the QuickTalk software. 本节讨论如何完成你的计算机与记录器之间的初始连接。关于如何检验连接的正确操作请参考*检验基本单元操作*一节。关于 QuickTalk 软件的更进一步信息请参考 *QuickTalk 和 QuickLook 软件使用指南*。

The RS-232 cable has a 25-pin D-connector that plugs into your computer. If you have a laptop with a 9-pin connector, use the connector changer to convert the 25-pin to 9 pins. Then plug the 10-pin military-style connector on the other end of the cable into the recorder port marked RS-232C. RS-232 电缆有一个 25-针脚 D-型连接器可插到你的计算机。如果你有一台带有 9-针脚插接口的膝上电脑，可用将 25-针脚转换为 9-针脚的转换接头。然后将电缆另外一端上的 10-针脚军用型连接器插进记录器标注为 RS-232 的插口。

To build your own RS-232 cable, refer to the next figure. 为制作你自己的 RS-232 电缆，请参考下图。

Figure 7: RS-232 cable assembly

图 7　RS-232 电缆装配



REFERENCE LIST				
ITEM	PART #	QTY	DESCRIPTION	REF.
1	851020	1	CONNECTOR,. 10 PIN	J1
2	840380	25'	CABLE, 10 COND. W/OVERALL SHIELD	
3	850459	1	CONNECTOR, 25 PIN "D"	J2
4	850820	1	PLASTIC JUNCTION SHELL	FOR J2
5	850791	1	JACK SCREW KIT	FOR J2
6	850035	1	BOOT	
7	851109	1	ANGLE SOLDER TERMINAL	
8	840374	REF	WIRE, STRANDED #24 AWG BLK.	
9	880700	2"	TAPE, FOIL, 1" WIDE	
10	880069	2"	TAPE, FOIL, 3/8" WIDE	
11	851372	2"	SHRINK TUBING, 1/2" DIA, N-SHIELD	
12	851280	2"	TUBING, HEAT SHRINK, 1/2", ADHESIVE	

Connecting the Internal Battery 连接内置电池

A standard Etna includes one internal battery (a 12V, 6.5 Ah, P/N 840301) already inside the case. Kinemetrics ships this battery with the positive lead disconnected. When the internal battery is connected, it maintains power to the recorder for approximately 36 hours if AC power is lost. (The actual time depends on which options are installed.) 一台标准的 Etna 记录器包含一块已经装在仪器盒中的内置电池(一块 12V、6.5Ah 电池，KMI P/N 840301)。Kinemetrics 公司运输仪器时把电池正极断开。接上内置电池,在交流电源失效时可维持记录器用电约 36 小时(实际时间取决于所选用的电池容量)。

The optional 12V, 12Ah battery (P/N 840503) increases power autonomy to approximately 72 hours. 12V、12Ah 电池选件(KMI P/N 840503)可增加供电能力约一倍,在交流电源失效时可维持记录器用电约 72 小时。

Figure 8: Internal battery

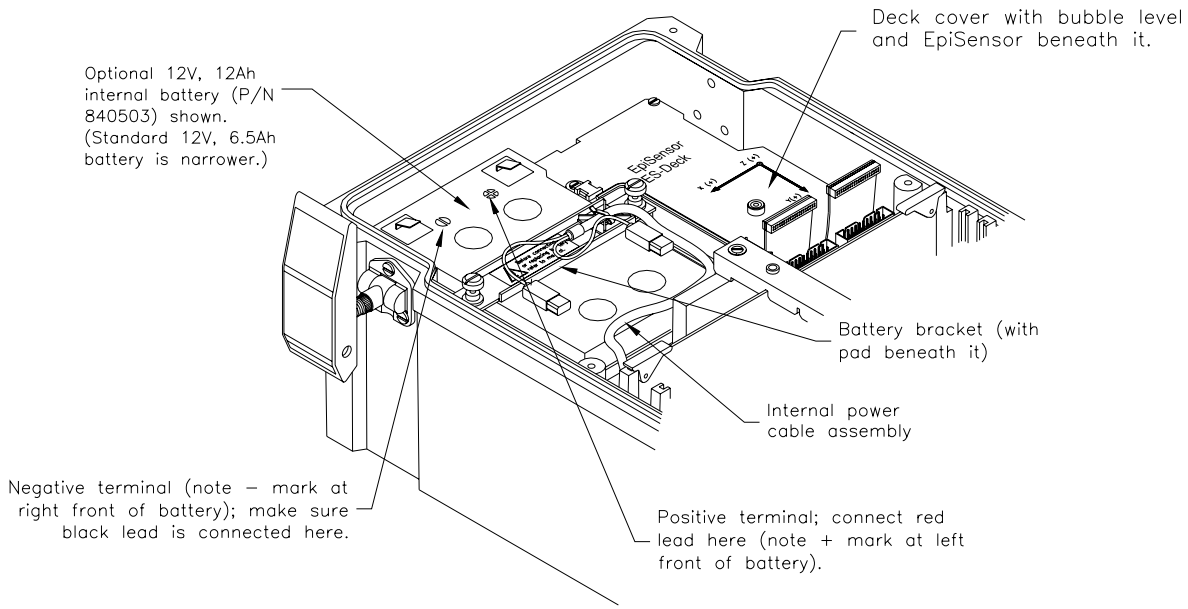


图 8 内置电池

Connect the internal battery as follows: 连接内置电池如下：

1. Make sure the Etna's *OPER/STBY* switch is in the STBY position. 确证 Etna 记录器的 *OPER/STBY* 开关是在 STBY 位置。
2. If the battery charger is connected to the *EXT POWER* connector on the Etna's front panel, disconnect it now. Make sure the internal battery is still in the proper position, as shown in Figure 8, and that the black lead is connected to the negative (-) terminal on the battery's lower right side. 如果电池充电器是连接在 Etna 记录器前面板上的 *EXT POWER* 接口上的话，现在请断开它。确证内置电池仍然处在如图 8 所示的正常位置，并且黑色接片是连接着电池右下边的负极上（见图 8）。

Caution: **Potential equipment damage.** All batteries and the battery charger should be disconnected before you service the equipment because power is supplied to some of the circuit boards even when the *OPER/STBY* switch is in the **STBY** position. ***告诫：*****潜在设备损坏。**在你保养设备之前务须断开所有电池和电池充电器，因为即使当 *OPER/STBY* 开关置于 **STBY** 位置时某些电路板还供着电。

WARNING! **Burn or fire hazard.** Do not short the battery terminals with metallic conductors, such as a screwdriver or pliers. The battery can provide

up to 80 amps of current. This amperage, when flowing through a non-isolated conductor, can result in very high temperatures and even fire. **Do not** replace the supplied battery with a non-rechargeable battery or a battery that does not meet the requirements given in Chapter 4 in the *Replacing Batteries* section.

警告！燃烧或火灾。绝不用金属导体诸如螺丝起子或钳子短接电池两极。电池能够提供多到 80 安培电流。这样的安培数流过非绝缘导体时会产生非常高的温度甚至火灾。 **绝不用**非可充电电池或不满足第 4 章*置换电池*一节规定的电池去替换仪器电池。

3. Connect the red lead to the positive terminal. The Etna's internal battery is now connected. 连接红色接片到正极。现在连接上了 Etna 记录器的内置电池。
4. Use a DVM to measure the voltage across the battery terminals. The voltage reading for a new or freshly charged battery should be greater than 12 volts DC. 用数字电压表(DVM)跨电池两极测量电压值。对于新的或刚充好的电池，其电压读数应大于 12V DC。

If the reading is less than 12 volts, the internal battery has been significantly discharged. To completely recharge the internal battery, connect the Etna to the battery charger overnight. 如果读数低于 12V，此内置电池已经明显地被放电。应将该仪器连接上电池充电器，整夜再充电直到充满。

Caution: Reversed polarity battery connections can cause instrument damage. A reversed polarity battery will also damage the battery charger if it is connected.

告诫：电池的反极性连接会导致仪器损坏。电池的反极性连接也会导致所连接的电池充电器损坏。

Refer to the *Connecting the Power Supply* section for instructions on how to connect AC power. Refer to Chapter 6 for instructions on how to connect an optional external battery or a solar charging system. 关于如何连接交流电源请参考*连接供电电源*一节。关于如何连接选用的外接电池或太阳能充电系统，则请参考第 6 章。

Connecting the Power Supply 连接供电电源

The Etna includes a wide-input DC battery charger (P/N 109815-PL), which connects to a standard AC outlet. Etna 包含一个宽范围输入的 DC 电池充电器(P/N109815-PL)，它可连接到一个标准 AC 电源插座。

Caution: **Using the wrong power supply unit with the recorder can permanently damage its circuit boards**. Do not attach any battery charger or other power supply to the recorder other than the one supplied by Kinemetrics unless it exactly matches the voltage and current ratings required for the recorder.

Do not connect a K2 digital recorder power supply to an Etna or use the Etna's power supply to power a K2. This will badly damage the unit.

***告诫：*使用错误的供电单元给记录器，会使仪器电路板永久损坏。**除了 Kinemetrics 公司所提供的请不要配属任何其它供电装置，除非该装置能与记录器需要的电压和电流额定值正确匹配。绝不要把 ETNA 的供电单元给 K2 使用，或试着把 K2 的 PSA 为 ETNA 供电，在这两种场合都会使仪器单元受到严重的损坏。

Before plugging in the battery charger: 插进 PSA 之前：

- Make sure that the AC outlet is properly wired. 确证交流输出电源接线正确。
- Find out if the local AC power is subject to interruption, brownouts, or spikes. If it is, plug a suitable surge suppresser into the AC outlet. *(Strongly recommended!)* 如果发现有当地交流供电遭受断电、限电管制或电压突跳等供电不稳的状况，应在交流输出电源上插接一个电涌浪抑制器。(*强烈建议*！)

Then do the following: 然后按如下做：

1. Remove the cover of the Etna. Make sure the unit's OPER/STBY switch is in the STBY position. 打开 Etna 记录器盖，确证仪器的 OPER/STBY 开关处于 STBY 位置。
2. Push the battery charger's 7-pin connector onto the Etna's EXT POWER connector and twist until it locks. 将电池充电器的 7-针脚供电接头插到记录器的 EXT POWER 插座上，并拧到它锁住。
3. Plug the battery charger into the AC power outlet or surge suppressor. (Users outside the U.S. must use an adapter or an appropriate IEC line cord with the correct AC plug.) 将电池充电器插进交流供电电源或电涌浪抑制器。(在美国之外的用户必须用一个适配器或一个合适的带有正确的 AC 插头的 IEC 电源软线。)

Note: The battery charger automatically adjusts for line voltages from 90 to 260 VAC (either 50 or 60Hz). The electrical characteristics of the Etna's external power connector are described in the *Detailed Electrical Interface* section in Chapter 5.

注释： 电池充电器对于线压在 90 到 260 V AC (或者 50 或 60Hz)的交流电可以自动调节而无需用户干预。关于 Etna 外接电源连接器的电特性可参见第 5 章*电气接口详述*节里的记述。

Verifying Basic Unit Operation 检验基本单元操作

TURNING ON THE POWER 接通电源

1. Make sure the PCMCIA memory card is inserted into slot A. (The PCMCIA slot is located on the right-hand side when you face the front of the unit. Its location is also silk-screened on the recorder's PCMCIA board.) 确证 PCMCIA 记忆卡是插在槽口 A 内。(当你面对仪器前面板时 PCMCIA 槽口是处在右手边上的。它的位置在记录器的 PCMCIA 板上也是用丝织遮挡着的。)
2. Turn the *OPER/STBY* switch to the **OPER** position. (The RUN/FAULT LED will blink.) 拨动 OPER/STBY 开关至 **OPER** 位置。（这 RUN/FAULT LED 运行/故障发光二极管 将闪烁）

FRONT PANEL LEDS 前面板发光二极管

The Etna has three LEDs to provide basic status information when a PC connection is not available. Etna 具有三个 LED，可提供基本状态信息

- RUN/FAULT 运行/故障(displays in amber 显示为琥珀色)
- CHARGE 充电(displays in green 显示为绿色)
- EVENT 事件(displays in red 显示为红色)

These LEDs show the status of the Etna and whether or not it has recorded events. 这些 LED 指示 Etna 的状态，不论它是否记录有事件。

RUN/FAULT 运行/故障

The amber Run/Fault LED is normally lit when the unit is in its operational state. When the unit is first turned on and is running the bootloader program, this LED will flash every two seconds (and even turn off momentarily). Once the Etna is operational this LED will be constantly illuminated. An internal fault will cause it to go out or flash once a second, in which case the Etna requires repair. 当仪器处于运行状态下此琥珀色运行/故障发光二极管是正常的亮着。在该仪器初次打开并正运行引导装载程序时，这 LED 江闪烁每两秒钟一次（并且甚至在关闭瞬刻也如此）。一旦该 Etna 记录器运行，该 LED 则常亮。而 LED 熄灭或每秒闪烁一次则说明仪器有故障，此时 Etna 需要修理。

CHARGE 充电

The green Charge LED is illuminated when the battery charger is connected and powering the Etna. 当接上电池充电器给 Etna 供电时，此绿色的充电 LED 发光。

EVENT 事件

The red Event LED has three states once the Etna is in its operational state (the amber Run/Fault LED will be constantly lit): 一旦 Etna 在运行状态下，此红色事件 LED 有三种状态（此时琥珀色运行/故障 LED 处于常亮）：

- **Off** 灭– Indicates that the unit has not recorded any events since its last restart or that a user has cleared the event LED 指示该仪器自它从新启动或用户清除了此事件 LED 后没有记录任何事件。
- **On 亮** – Indicates that the unit has triggered and event files are stored on its PCMCIA card 指示该仪器被触发并且事件文件被储存在它的 PCMCIA 卡上。
- **Flashing** 闪烁– Indicates that the unit is accessing its PCMCIA card. Do not remove the card when this LED is flashing. 表明记录器正在访问 PCMCIA 内存卡。在该发光二极管正在闪亮时请不要将 PCMCIA 卡从仪器中拆除。

Warning: **Potential data corruption**. When the EVENT LED is flashing the Etna is accessing its PCMCIA card. Do not remove a PCMCIA card when this light is flashing! Doing so may corrupt your data and make the card unreadable.

***警告*！潜在数据丢失！**当事件发光二极管正在快速闪亮时，表明记录器正在访问 PCMCIA 内存卡。在该发光二极管正在闪亮时请不要将 PCMCIA 卡从仪器中拆除。否则可能破坏你的数据和使卡不再能读。

Running QuickTalk 运行 QuickTalk

Start your PC and double-click on the QuickTalk icon on your PC screen. Follow the instructions in the *Running QuickTalk for the First Time* section in the *QuickTalk & QuickLook Software User's Guide* at the back of this binder. 启动你的 PC 机并双击你的 PC 机屏幕上的 QuickTalk 图标。请跟着附在本文件夹后面的 *QuickTalk 和 QuickLook 软件使用指南*中的*初次运行 QuickTalk* 一节的指示去做。

Note: You can also connect to the recorder with most communication programs, such as HyperTerminal® or ProComm®.

注释：你也可以用许多通信程序诸如 HyperTerminal®或 ProComm®，连接记录器。

Zero-Adjusting Internal EpiSensors 内置 EpiSensor 摆调零位

If the Etna has an internal EpiSensor deck, most users "zero" the EpiSensor accelerometers after the recorder is installed and leveled. Zeroing the EpiSensor deck channels ensures that recorded data will have minimal DC offset. You can zero the accelerometers by using the recorder's AQ DVM utility to monitor the offsets as you manually adjust them.
如果 Etna 有内置 EpiSensor 装置，大多数用户在记录器安装及找平之后要对 EpiSensor 加速度计“ 调零位 ”。对 EpiSensor 装置各通道进行调零位可保证记录器数据将有最小的 DC 偏移。你在用手调节各加速度计零位时可用记录器的 AQ DVM 指令监测偏移量值。

Caution: If you have an Altus-series recorder, its firmware will allow you to remove an offset from the data stream by subtracting a constant value from the data as it is recorded. However, you should only use this to remove a small residual offset. If you remove a large offset, (>100 mV) you will reduce the instrument's recording range.

告诫：若你有一台 Altus 系列记录器，其固件将允许你用被记录的数据中减去一个常数量值的办法从该数据流里除去一个偏移量值。然而，你应该祗是用此办法除去小的残留偏移量值。如果你用此办法除去一个较大的偏移量值 (＞100mV)，那将会减少仪器的记录量程。

The modules can be adjusted to an offset of less than 25mV (4g, 2g, 1g, 1/2g units) or 5mill-g for a ¼ g unit. For normal applications in which the Etna is level, the adjustment screw rotation will be only a few degrees. The modules are zeroed before shipment. The table below shows suggested offset setting for the full scale ranges available in the internal EpiSensor deck: 可以调节加速度计模块以使偏移值低于 25mV(对于 4g, 2g, 1g, 1/2g 的仪器)或对于 1/4g 高灵敏仪器则低于 5 m-g(毫重力加速度)。(若希望取得小偏移值，只有多加练习。)对于 Etna 被找平的常规使用，调节旋杆只是旋转几度。该模块在装运之前已被调好零位。下表出示了对可用于内置 EpiSensor 装置的满量程所建议的偏移值设置。

Table 1: Suggested offset limits

表 1 建议的偏移量值限制

Full-scale range 满刻度量程	**Single-ended ± 2.5 V output** 单端输出
1/4g	50 mV (5mg)
1/2g	25 mV
1g	25 mV
2g	25 mV
4g	25 mV

ADJUSTMENT INSTRUCTIONS 调节指示

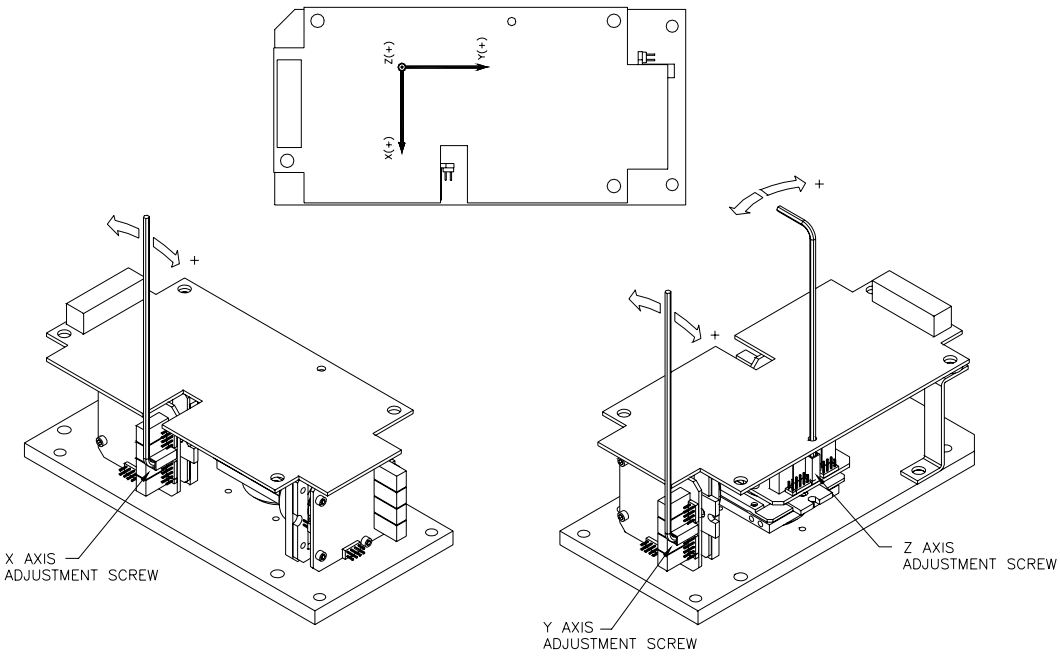
1. Turn the *OPER/STBY* switch to **OPER**. Start QuickTalk and open the Terminal window. 拨动 *OPER/STBY* 开关至 **OPER** 位置。启动 QuickTalk 并打开终端窗口。
2. Enter **AQ DVM** to display the current voltages of the EpiSensor in millivolts. The DVM display screen appears. Look in the column that corresponds to the sensor channel you are adjusting. As you complete the adjustment procedures below, watch the figures in this column to see when the voltages are in the proper range. 进入 **AQ DVM** 以显示 EpiSensor 的当前电压以毫伏 mV 计。此时 DVM 显示屏幕呈现。访问相应于你正在调节的传感器通道一栏。当你完成下面的调节程序同时，注视进入该栏的数字，以看何时电压值进到正确值范围。
3. Check the above table. If the voltage exceeds the limits for the full-scale range, remove the sensor cover and use the tool provided on the cover to adjust the channels. (Remember the AQ DVM display is in millivolts not volts.) 检查上面的表。如果电压值超出满量程限制，请打开传感器盖并用该盖上所提供的工具调节该通道。（应记住 AQ DVM 的显示 是毫伏而不是伏。）
4. The following drawing shows where to insert the adjustment tool for each EpiSensor channel. As the figure indicates, EpiSensor modules produce a positive output when the adjustment screw is turned clockwise. Monitor this with the DVM utility. 下图出示了对每一个 EpiSensor 通道应在何处插入调节工具。如图所示，当调节旋杆以顺时针方向转时 EpiSensor 模块产生一个负输出。用 DVM 指令可监测它。

   Note: If you have mapped the EpiSensor into the negative-polarity L, V, T coordinate system, clockwise rotation of the adjustment screw will produce a negative output when monitored by the DVM utility.

   注释： 若你绘制 EpiSensor 进入负极 L、V、T 座标体系，顺时针旋转调节旋杆将可产生一个负输出，这时可用 DVM 指令监测。

Figure 9: Zero-adjusting an internal EpiSensor deck

图 9　内置 EpiSensor 装置的零位调节



5. When the channel is adequately adjusted, gently remove the tool. 当该通道经仔细地调节好后，请轻轻地移出工具。

6. After adjusting all the channels, replace the deck cover. 在调节完所有通道后，将该装置盖复原。

7. ***Important:*** Give the cover a moderate tap with a screwdriver handle after replacing the cover. The adjustment screw can have a residual stress that may cause an offset in data during a large earthquake. Tapping it will eliminate the residual stress.

   重要的：在将盖复原后用螺丝起子把手对盖子适度轻叩。由于调节旋杆可能有残余应力，当大地震时可能会对数据产生偏移。轻叩盖子将会消除残余应力。

8. Check that the sensors are still in the acceptable range. 再检查传感器零位电压，应仍然处于可接受的范围。

Maximizing EpiSensor Performance EpiSensor 摆性能最佳化

Do not use a PCMCIA hard disk in an Etna with an internal EpiSensor deck. The disk drive vibrations will be recorded and greatly increase the noise level of the sensor. 在带有内置 EpiSensor 装置的 Etna 仪器上，不要用 PCMCIA 硬盘。因为磁盘驱动的振动将会被记录并极大增加传感器的噪声水平。

Warning: **Antenna and phone installation**. Never install antennas or telephone wiring during electrical storms. Always ensure adequate separation between antenna or telecom cabling and high voltage wiring. Always perform a safety check on telecom wiring to measure the voltage before working on the wiring. Remember telephone wiring has fifty (50) to sixty (60) volts of DC and the ring signal at 90 VAC can deliver a very uncomfortable shock!

警告 ：天线和电话安装：当闪电风暴时绝不可安装天线或电话线。始终保证天线电缆或电信电缆与高压线之间有足够的分离。总是履行对电信线路的安全检查以在上线工作之前测量该电信线路电压。记住电话线带有 50 伏到 60 伏直流电压，并且在 90 伏交流电压的铃音信号能释放出不舒服的电冲击。

Connecting the Internal Modem 连接内置 Modem

If you purchased an Etna with an internal PCMCIA modem, then the modem is already installed and wired into alternate slot B on the back of the PCMCIA card. To use this modem, you must install a suitable telephone jack at the recorder site. Once that is done, do the following: 如果你买一个带有内置 PCMCIA 调制解调器 modem 的 Etna 记录器，该 modem 是已经安装和接线于 PCMCIA 卡背面上的替换槽口 B 内的。为了使用该 modem，你必须在记录器场所安装一个适配的电话接口。一旦这些都做了，即可继续做如下：

1. Plug the military-style connector on the telephone cable supplied into the mating connector located on the right side of the recorder, beneath the right-front cover latch. (The cable has a standard RJ-11 telephone connector on one end and a military-style 4-pin connector on the other.) 将所提供的电话电缆上的军用型连接器插进处于记录器右边在右前盖吊扣之下的匹配连接器。（在该电缆一端有一个 RJ-11 标准电话接头，而另一端则是一个军用型 4-针脚插头连接器。）
2. Plug the RJ-11 jack at the other end of the cable into the phone-jack plug. The connection is complete. 将电缆另一端的 RJ-11 接头插进电话接口。
3. To protect the line against lightning-induced transients, install an optional telephone line surge-suppressor between the telephone plug and the jack. A suitable surge-suppressor is available from Kinemetrics (P/N 851293). 为了保护线路抵抗闪电感应瞬变，在电话插头与接口之间安装一个选用的电话线路浪涌抑制器。配套的电话线路浪涌抑制器可由 Kinemetrics (P/N 851293)购得。

Caution: **Potential equipment damage**. The surge suppressor must be connected to an earth ground to function properly.

***告诫*：潜在设备损坏。**该浪涌抑制器必须与功能保护接地相连。

Connecting a GPS Timing System 连接 GPS 时钟

Power down the Etna and disconnect the internal battery and battery charger before installing a GPS antenna. Refer to the *GPS Timing Systems User's Guide* in the back of this binder for instructions. 在安装 GPS 天线之前先关闭 Etna 记录器电源和切断其内电池与电池充电器。请参考在本指引文件夹后面的 *GPS 时间系统使用指南*。

Caution: **Potential equipment damage**. The recorder must be powered down and the internal battery and battery charger must be disconnected before connecting a GPS antenna.

***告诫*：潜在设备损坏。**在连接 GPS 天线之前，务须将记录器电源关闭，并使内置电池与电池充电器断开。

Once the antenna is installed, connect the GPS cable's BNC male connector to the unit's GPS (RF) connector (on the left side of the unit). 一旦天线安装好，请将 GPS 电缆的 BNC 插头连接到该仪器的 GPS(RF)连接器上（在记录器外壳的左边）。

Connecting External Modems 连接外设 Modem

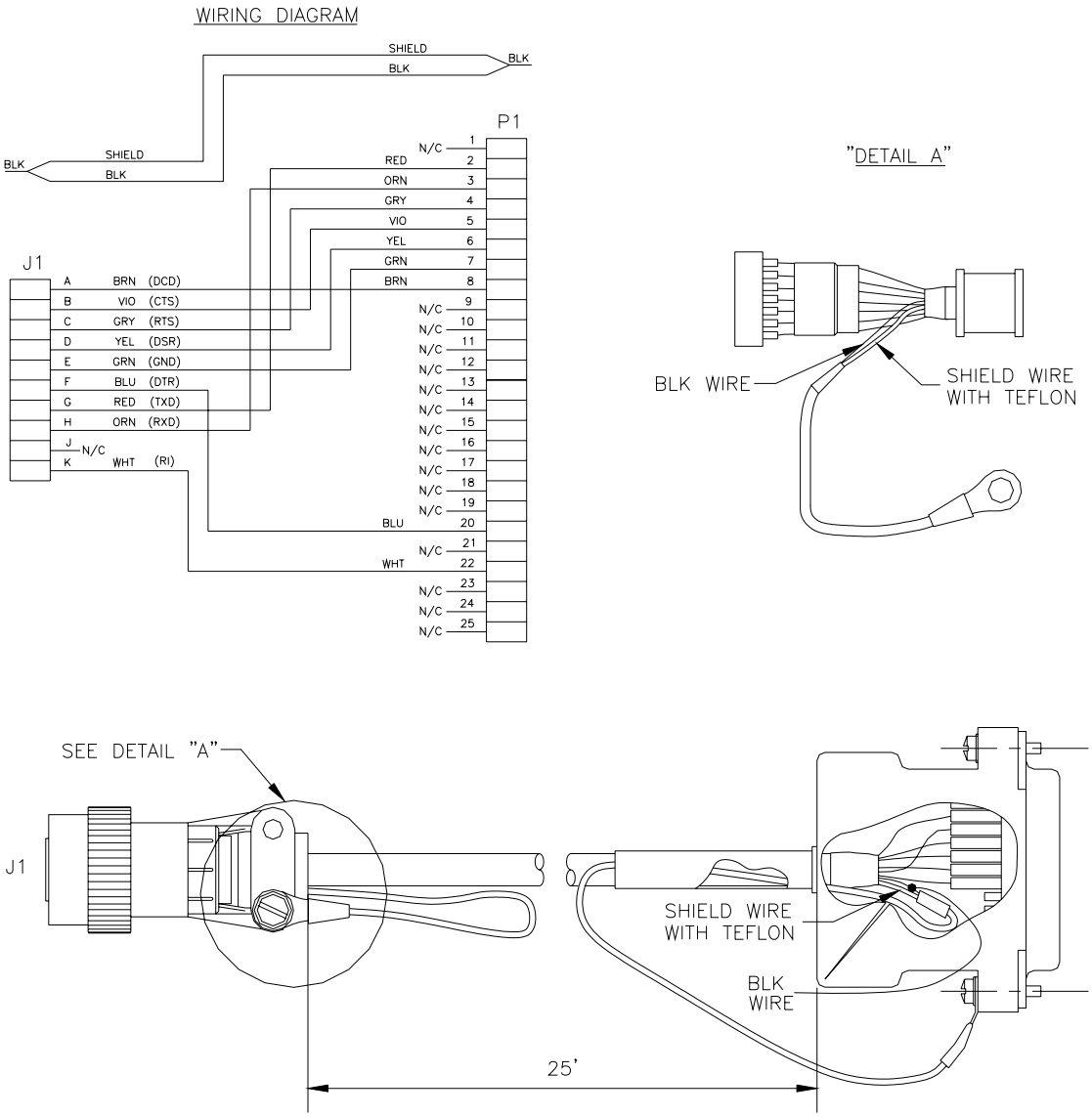
Connect an external modem to the RS-232 connector on the recorder to communicate with the Etna remotely. Install the modem according to the manufacturer's instructions. 将一个外接 modem 与记录器的 RS-232 接口相连接，以供远程 Etna 记录器的通信。请按照制造者的指示安装 modem。

The recorder site must include a power supply for the external modem. In order to maintain remote modem communication in case of a mains power supply failure, you must provide the modem with a back-up power system. 在记录器场所必须包含一个外接 modem 的供电源。为了在主电源失效的情况下维持远程 modem 通信，你必须为 modem 提供后备电源。

Preparing a Modem Cable 准备 Modem 连接电缆

Prepare the modem cable according to the schematic in the figure below or purchase a modem cable from Kinemetrics. 请按照图 10 示意准备 modem 电缆或从 Kinemetrics 公司购买 modem 电缆。

Make sure the recorder and modem are both un-powered before plugging the modem cable into the recorder. Then plug the military-style end of the modem cable into the RS-232 port and connect the DB-25 connector on the other end of the cable into the modem. 确证在将 modem 电缆插进记录器之前记录器和 modem 双方都切断了电源。然后将 modem 的军用型端头插进



RS-232 口，并连接电缆另一端的 DB-25 连接器到 modem。

Figure 10: Modem cable to connect to Etna

图 10 调制解调器电缆连接记录器单元

Connecting to a Telephone System 连接到电话系统

Plug one end of the telephone cable into the external modem jack labeled Line and the other end into the wall jack. As with the internal modem, we recommend installing a surge suppressor. A suitable surge suppressor is available from Kinemetrics (P/N 851293). 将电话电缆一端插进外接 modem 标记有 Line 的接口，并将另一端插进墙上电话接口。如用内置 modem,我们建议安装一个浪涌抑制器。Kinemetrics 公司可提供适配的浪涌抑制器(P/N 851293)。

Verifying Modem Operation 检验 Modem 的运转

To verify the operation of your internal or external modem, you need to be sure that the Etna can both answer and place a phone call. 为检验你的内置或外接 modem 的运行，你必须肯定 Etna 记录器能回答和打出一个电话。

- The modem's initialization string (ATS0 = 1 for a Hayes-compatible modem) should be set to allow **Auto Answer**. (See the *QuickTalk/QuickLook* manual for more detailed information.) 记录器 modem 的设定初值字串(初始化字串)(对于 Hayes-兼容 modemATS0=1)应置于允许**自动回答**。（若需更多详细信息请参见 *QuickTalk/QuickLook* 手册）
- Using the **Terminal Window**, put the Etna into answer mode by typing **Answer** at the prompt. 使用**终端窗口**，在提示处键入 **Answer** 将 Etna 记录器置成回答模式。
- Call the Etna using a PC with a modem. Verify that the recorder answers the call and that the PC at the other end can communicate with the system. 用带有 modem 的 PC 机呼叫 Etna 记录器。检验记录器回答呼叫，并且 PC 机在另一端能与系统通信。
- To verify that the Etna can make a call, use the QuickTalk modem parameter screen to enable the **Auto Call** mode for loss of AC power. 为了检验 Etna 记录器能做电话呼叫，使用 QuickTalkmodem 参数屏幕能置成**自动呼叫**模式；不过该自动呼叫模式会损耗交流电力的。
- Set the primary number for the recorder to call. 设置记录器要呼叫的首要号码。
- Download these parameters. 下载这些参数。
- Use **Terminal Window** and enable **Auto Call** mode. 使用终端窗口和置成自动呼叫模式。

- Disconnect the battery charger from the Etna. The recorder should now initiate a call. 从 Etna 记录器断开电池充电器；现在记录器将会发出一个电话呼叫。

Powering Down 切断电源

To power down the Etna, read the following notes carefully and then move the *OPER/STBY* switch to **STBY**. 为了关闭 Etna 记录器电源，请仔细地阅读下列注释，并且然后拨动 *OPER/STBY* 开关到 **STBY**。

> ***Caution*: Potential data loss**. Do not disconnect the leads to the recorder's internal battery until the recorder is in STBY mode. This enables the system to close any open files and shut down in an orderly manner.
>
> ***告诫*：潜在数据丢失。**在记录器处于 STBY 模式之前，绝不能断开记录器的电池线夹。这将使系统能关闭任何打开的文件和以有秩序的方式停止。

Note: When the internal battery voltage drops to < 10.6V, a normal battery discharge cycle alerts the recorder processor to close any open files and shut down the unit in an orderly fashion. When power is restored, the recorder will automatically turn on.

注释：当内置电池下降到＜10.6V 时，一个正常的电池放电循环警告记录器处理器以关闭任何打开的文件和以有秩序的方式将仪器停止运行。而当电力恢复时记录器将自动打开。

Documenting the Installation 安装建档

Remember to document the following aspects of your installation: 将下列你的安装情况记入文档：

- The exact location of the Etna 仪器的准确位置
- The orientation of each sensor 每个传感器的方向

We recommend that you take a photograph of the Etna along with the optional external sensor to record its orientation. In addition, prepare detailed instructions on how to access the Etna including maps, contact information, and clear directions for entering the structure that houses the unit. 我们建议你对 Etna 记录器连同每一个外接传感器拍一张照片，以记录它的方位。另外，请准备关于如何访问 Etna 记录器的详细指引，包括地图、联系接触信息、以及进入该仪器柜室所在的房屋结构的清楚的指示。

Experience has taught us that such records are extremely useful. In an emergency, untrained personnel might need to visit the site to retrieve data. 经验教育我们这样记录极为有用。因为在紧急情况下，从未到过此地的人员可能访问此场地回收数据。

3. Configuring & Operating Instruments 设置和操作仪器

Overview 总论

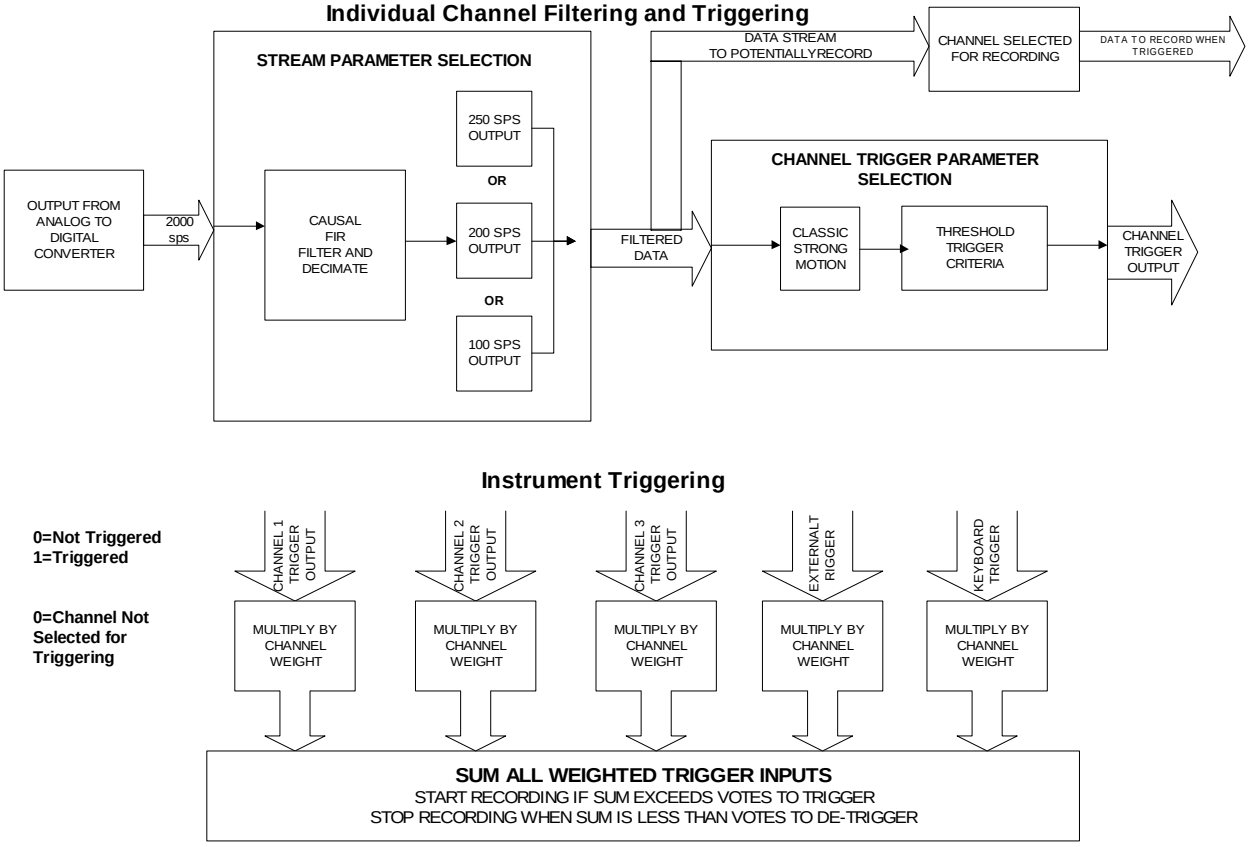
This chapter includes basic operating instructions and will frequently refer you to the *Using QuickTalk & QuickLook Software User's Guide* (Document 302208, in the back of this binder) for further specific instructions. 本章包含基本的操作指引，并且对于更进一步的详细指示将请你经常查阅 *QuickTalk & QuickLook 软件使用指南*(Doc. 302208,在本文件夹后面)。

Configuring Instruments 设置仪器

The Etna is normally used as an event-triggered recorder. To operate correctly, both what will be recorded and what will trigger the unit to record need to be defined. The settings that affect these functions can be divided into the following areas: Etna 通常是作为事件触发式记录器使用。为正确地操作，必须明确提出什么是要记录的和什么是触发仪器进行记录的两者。影响这些功能的设置分列如下：

- Station parameters — These determine which channels are recorded and information on the instrument. 台站参数——这些确定所记录的通道和关于仪器的信息。
- Stream parameters — These determine what sampling rate the instrument will record at, how the data will be filtered, and how long before the trigger and after the de-trigger the unit will record. 数据流参数——这些确定仪器记录时所使用的采样率、数据滤波的方法、以及使仪器触发前和触发以后将记录的数据流要多长。

- Channel trigger parameters — These select what type of seismic signal will cause an individual channel to be considered triggered. 通道触发参数——这些选择将导致一个单独通道作为考虑触发的地震信号的类型。
- Trigger voting parameters — These determine what combination of triggered channels and external inputs are required to cause the



unit to trigger and record. 触发投票参数——这些确定为导致仪器触发记录的触发通道和外部输入的结合。

The following figure illustrates these areas so you can see how they relate to the flow of data through the instrument. 下图举例说明这些区域，你能看到它们是如何与通过仪器的数据流联系的。

Figure 11: Flow of data through the Etna

图 11 通过 Etna 仪器的数据流

Other instrument parameters have to be set to determine how the instrument handles: 其它的仪器参数必须设置以确定仪器如何操作：

- Data storage configuration – Where files are stored and the instrument's directory structure. 数据存储配置—文件存储地点和仪器目录结构。
- Communication options — These determine the modem settings, how power to a cellular phone is controlled, and when the recorder calls you. 通信选项—这些确定 modem 设置，如何控制便携电话供电，以及何时记录器呼叫你。
- Digital field station configuration — These determine whether or what data is sent on the auxiliary digital output port. 数字野外台站配置—这些确定在辅助数字输出口的数据是否送出。
- Serial data stream configuration— These determine if real time packetized data is sent out on the RS232 port. 串行数据流配置—这些确定在 RS-232 口实时打包数据是否送出。
- Sensor settings — These allow you to change the information that is stored about the sensors. 传感器设置—这些允许你改变存储在传感器上的信息。
- Security and passwords 安全和密码

The majority of these options can be setup using QuickTalk's graphical user interface, although some of the options require you to use the Terminal Mode to set them up using text based commands. 这些选项大都可通过使用 QuickTalk 图形用户界面设置，尽管有些选项需要你使用终端模式将它们用基于文本的指令给予设置。

Station Parameter Selection 台站参数选择

In the station parameters, the most important setting is which channels to record. More detailed information is available in the *Using QuickTalk & QuickLook Software User's Guide*, including material on the location and identification of the unit. See the *Setting Station Parameters* section of the *QuickTalk* manual to complete the setup. 在台站参数里，最重要的设置是哪一个通道记录。更详细的信息包括关于仪器的场所和识别均可在 *QuickTalk & QuickLook 软件使用指南* 中了解。为了完成设置，请参考 *QuickTalk* 手册中 *Setting Station Parameters 设置台站参数*一节。

SELECTING CHANNELS TO RECORD 配置记录通道

Although the Etna has three channels, you may not need to record them all for a given experiment. Select only those channels connected to sensors that are active in a specific experiment — otherwise you will be wasting the recorder's memory on unwanted data. 虽然 Etna 可以有 3 通道，但对于一个给定的实验你无需记录它们全部。只选择那些连接有传感器在该特定实验中起作用的通道即可，——否则你将为记录无用的数据浪费记录器内存。

Stream Parameter Selection 数据流参数选择

The most important decision is what data to record and at what data rate. This is a trade-off between the bandwidth of the data and both the number of minutes of data you can record and how long the event will take to retrieve over a telephone line or other communications link. To complete the setup, refer to *Setting Stream Parameters* in the *Using QuickTalk & QuickLook Software User's Guide*. 最重要的决定是用什么数据率记录什么数据。这是数据带宽与你能记录的数据分钟数量及将通过电话线或其它通信链路回收取得的事件有多长两者之间的一个权衡。为了完成此设置，请参考 *QuickTalk & QuickLook 软件使用指南*中的 *Setting Stream Parameters 设置数据流参数*一节。

RECORDED DATA RATE 记录数据采样率

The sampling rate you wish to record depends on the bandwidth of the signal you are interested in and the frequency response of the sensors connected to your system. The "useable" bandwidth of the instrument is 40% of the sampling rate. For example, at 100 samples per second (sps) you can record signals in the 0-40 Hz range, with 200 sps 0-80 Hz, and with 250 sps 0-100 Hz. A further restriction is the bandwidth of the sensor you are using. If it is limited to 20Hz it would have no value recording at 200 or 250 sps as the sensor limits the bandwidth. Historically, strong motion recording has been at 200 sps, while seismological recording has often used the 100 sps rate. Obviously, an event file recorded at 200 sps will be almost twice as large as one recorded at 100 sps and will take almost twice as long to transfer over a communications link. You must evaluate this trade-off. 你所要求的记录采样率取决于你感兴趣的信号带宽和连接到你的系统的传感器的频率响应。仪器的“可用的”带宽是采样率的 40%。例如，在每秒 100 采样(100sps)时你能够记录 0-40Hz 范围的信号，而对 200sps 则为 0-80Hz，对 250sps 则为 0-100Hz。更进一步的约束是你所使用的传感器的带宽。如果该传感器带宽限制在 20Hz，那它用 200 或 250sps 来记录也是毫无价值的。从历史观点上说，强震动记录有过 200sps 的，而地震记录则常用 100sps 的采样率。显然，一个用 200sps 记录的事件文件几乎是用 100sps 记录长度的两倍，并且通过通讯链路传输也要几乎多两倍。你必须估计这个权衡。

Note: 200 samples per second was used historically when the instrument's effective bandwidth was limited by the roll off of the analog anti-alias filters. For a 200 Hz sampling rate the filter cut off was normally 50 Hz. With a digital anti-alias filter the cutoff at 200 Hz samples will be 80 Hz, a much higher effective bandwidth.
注释： 每秒 200 采样在过去是用在仪器有效带宽受模拟 anti-alias 滤波器通频带平段截止的限制时。对于 200Hz 采样率，模拟滤波器截断频率通常是 50Hz。用数字 anti-alias 滤波器，其截断频率在 200Hz 采样时将是 80Hz，这是非常高的有效带宽。

Supported sampling rates are 100, 200 and 250 sps. 支持的采样率是 100、200 及 250sps 。

Sampling Rates for Interconnected Units 内接内部单元的采样率

Interconnected triggering is intended to be used in applications where it is important to time align data from multiple recorders, such as within structures. For this reason, it is strongly recommended that interconnected recorders be set to the same sampling rate. 在使用多个记录仪触发获得观测数据时，例如在结构反应的观测中,时间坐标是非常重要的，由于这种原因，我们强烈建议把内部连接的记录器，其采样率都设置成相同的。

Interconnected recorders operating at different sampling rates will record correctly time stamped data, but the reported trigger times and file start times will vary by the difference between the group delays at the different sampling rates. For example, if the group delay at one sampling rate is 1900ms and the second is 200ms, then the trigger times will differ by 1700ms. 虽然不同采样率的内部连接的记录仪能记录正确的时间采样数据，但是不同的采样率，在群组之间将有不同延迟，造成记录的触发时间和文件**开始时间**有所不同，例如在某一个采样率，第一组仪器的时间延迟是 1900ms，而第二组是 200ms，触发时间将相差 1700ms。

Note: The Extended Interconnect Option (109875-01-PL) is required to support interconnected operation.

注意：扩展的内部连接器可供选用（109875-01-PL），它可以支持内部连接操作。

PRE-EVENT TIME 事件前时间（事件前存储时间，秒）

The setting allows you to determine how many seconds of data before the trigger criteria were met will be recorded in the event file. For strong motion applications this is normally set to a few seconds so you can determine the noise before the start of the event. The factory default is three seconds. 此设置允许你确定拟记录在事件文件里满足触发标准之前的数据要多少秒数，亦即触发前存储的缓冲数据，又称事件前存储时间（以秒计）。对于强震动应用，通常设置十数秒钟以供你确定事件前的噪声即可。工厂设置默认值是 3 秒钟。

POST EVENT TIME 事件后时间（事件后保持时间，秒）

The post event time determines how many seconds after the system has de-triggered will be recorded in the file. It also determines how likely events are to be split into separate files. This is because if the system re-triggers during the post event the file will just be extended. If the post event is set too short, several files could be created from the same event. We set the factory default at ten seconds, which is a reasonable value for strong motion

recording. 事件后时间确定在系统停止触发后仍拟记录在文件里的时间有多少秒数。它也确定多少可能事件分开进入各自单独的文件。这因为如果在事件后时间内系统再触发时该记录文件只是将被延长。而如果事件后时间设置得太短，则从同一事件中有可能创建几个文件。我们设置这工厂默认值为 10 秒，它对于强震动记录是合理的。

MINIMUM RUN TIME 最短运行时间

This is the minimum time the recorder will record once an event is triggered. Formerly, it was used to ensure a complete sequence of time code was recorded with the event, but this is not required anymore. Generally, the pre-event and post-event now give sufficient control over the event timing. For this reason we set the factory default to zero seconds. 这是一旦事件触发记录器将记录的最短时间。过去，它是用来保证随事件记录一个完整的时间代码的，但是现在不再需要了。一般说，现在事件前和事件后时间已对事件计时从头到尾给出了足够的控制。由于这个道理，我们设置这工厂默认值为 0 秒。

Triggering 触发

For strong motion recording, a simple threshold trigger will reliably trigger the recorder. As these are sensitive instruments, it is also possible to record much weaker motions using the threshold trigger. The tradeoff to consider is how you will retrieve the data and how to ensure that there will be room for the "big one" if you have very sensitive threshold trigger levels. 对于记录强震动而言，一个简单的阈值触发器就足够作为记录器的可靠的触发器了。使用阈值触发器记录许多弱震动也是可行的。如果你用非常灵敏的阈值触发水准，考虑权衡是你将回收的数据有多少和如何保证将会有为“ big one ”的空间。

The threshold trigger has two parameters for each channel. The first is the threshold trigger, which is the level in percent of full scale that causes the channel to trigger. The default value for this is 2%. The second parameter is the threshold de-trigger. This is the value in percent of full scale the signal must fall below after triggering for the channel to detrigger. The default value is 2%. The detrigger parameter can be used for extending the recording time by setting it to a smaller value than the threshold trigger value. 阈值触发器对每个通道有两个参数。第一个参数是触发阈值，它是导致通道触发的水准（标准），以满量程的百分比计。此默认值为 2% 。第二个参数是停止触发阈值。这是在触发之后信号必须降到该值水平之下以使通道停止触发，以满量程的百分比计。其默认值为 2% 。将停止触发参数设置成一个比触发阈值量值要小的值就能够被用来延长记录时间。

ALARMS 警报器

The Etna has a set of thresholds called alarm threshold parameters. These are specified as a percentage of the full-scale input and can be set

independently for each channel. To utilize hardware alarms the Extended Interconnect Option is required.

The alarm parameters are set in the Channel Parameters window.

When a channel's filtered trigger data exceeds this threshold, the selected hardware relay on the Extended Interconnect Option will be enabled and if the unit is in block communication mode a status packet is sent with the alarm indicator set. 记录器有被称为报警阈值参数的附加阈值设置。这些阈值是以满量程输入的百分数指定的，并且对每个通道能独立地设置。它们是设置在通道触发参数窗口中的。当一个通道的触发滤波数据超出该阈值时，硬件警报器即动作，并且如果仪器处于块通信模式时随着报警指示器设置将送出一个状况信息包。该硬件警报器输出是可用作为在辅助连接器上的一个 CMOS-兼容信号。

The hardware alarm outputs are available as relay closures on the Extended Interconnect Option (see Chapter 6 for more information). 如果扩展互连选件已经接通，硬件报警输出才能生效（见第 6 章更多的资料）。

The Etna supports up to three alarm thresholds. For details on setting multiple thresholds, see *Altus Monitor Mode Communications*, Document 302219. Etna 仪器支持三个报警阈值，设置多个阈值的详细情况见“*Altus 监控模式通讯*”（文件 302219）。

Trigger Voting Parameters 触发表决参数

Each channel can be assigned a number of votes that it may cast towards getting the system to trigger. This is called "voting." How the voting system is set up is dependent on which signals you are trying to record and which you are trying not to record. You may need some first-hand experience with the conditions at the site before you can optimize this triggering. The parameters used to set up the triggering are explained below. They should be setup using the instructions in the *Using QuickTalk & QuickLook Software User's Guide* manual for *Setting Stream Parameters*. 每个通道被分配了一定的表决票数以确定系统是否触发，我们称为“表决”，如何设定表决系统，依赖于你想记录什么信号和不想记录什么信号，在你优化触发之前，你需要第一手的关于场地情况的经验。用于设定触发的参数如下。这些参数可以通过 *QuickTalk 和 QuickLook 通讯软件*用户手册中的设置数据流参数设定。

CHANNEL WEIGHTS (TRIGGER/DETRIGGER VOTES) 通道加权（触发/去触发表决）

The mechanics of this are relatively simple. You select the number of votes each channel will contribute (when it is triggered) to the total number of votes required to trigger the system. Give zero votes to a channel that you *do not* want to affect the triggering. Give a positive number of votes to a channel you *do* want to contribute to the triggering. Give negative votes to a channel you wish to *inhibit* triggering. 给你不想影响触发的通道设为零，

给你认为对触发有作用的通道较多的权数，而给你想禁止触发这种机理相对简单。你为每个通道选择的票数的总和将构成触发系统的总权数。的通道较少的权数。

TRIGGER WEIGHT 触发权重

This is the total number of votes required to get the system to trigger. 这是使系统触发需要的总票数。

KEYBOARD VOTES 键盘投票

If you want to trigger the unit from a keyboard for test purposes, give the keyboard trigger the same number of votes as the total trigger weight so that it will trigger the unit by itself (without any other channels being triggered). 如果由于检测的目的，你想用键盘触发系统，给键盘设定和触发系统所需权数同样多的权，在没有任何通道被触发时，敲一下键盘就能使系统触发。

EXTERNAL VOTES 外部投票表决

This is the number of votes you assign to the external hardware trigger source. If you want all units in the network to trigger when one unit triggers, assign it the same number of votes as the trigger weight. If you want to use a combination of an external trigger with other internal criteria, set the votes appropriately. 这是你对外部硬件触发源分配的票数。如果当一个单元触发时你想让网络上的所有单元都触发，给外部触发源分配与触发权相同的票数。如果你想使用外部触发与内部标准进行联合触发，则应恰当地设置票数。

EXAMPLES OF VOTING SCHEMES 投票表决方案的实例

Classic Free-Field Site: Normally uses a three-channel internal EpiSensor with no interconnected units. Each channel has 1 vote and requires only 1 vote to trigger. Any channel could trigger the system.
典型的自由场地：一般使用没有互联单元的三通道内置传感器仪器，每个通道有一票且仅需 1 票触发，则任何通道都可以触发系统进行记录。

Interconnected System: For example: two Etnas with internal EpiSensors in a building; one in the basement and one on the roof. The Etnas are interconnected. Initially we set 1 vote for each channel and the external trigger and 1 vote to trigger. We find that the Etna on the roof often triggers the system due to the building swaying in the wind. We can compensate for this by changing the voting of the roof unit so that its three accelerometer channels have 1 vote while the external trigger has 3 votes. We set the trigger weight to 3 in this unit. Now all of the channels on the roof must trigger simultaneously to record or the unit must be forced to record by the unit in the basement triggering.
互联系统：例如，两个具有内部传感器的记录仪位于同一建筑物中，

一个在底层，一个在房顶，记录仪相互联接。开始，每个通道及外部触发各分配 1 票，并且 1 票触发，我们发现由于建筑物在风中摇动，房顶的记录仪经常触发系统，我们可以通过改变房顶仪器的票数来补偿这个现象，将顶层记录仪的三个加速度通道各 1 票，外部触发设为 3 票。我们将仪器的触发加权设置为 3，房顶所有通道必须同时触发才能产生记录，或者由底层仪器触发而强迫上面仪器记录。

Data Storage Configuration 数据存储设置

The location of the files and the directory structure of the instrument now need to be configured as described below. 文件的存储位置以及仪器的路径结构按以下步骤设置。

PRIMARY & SECONDARY STORAGE 主和副存储器

The ETNA stores data on PCMCIA ATA flash drives or, optionally, on PCMCIA hard drives. If you have installed two drives in the system, select which is to be the primary and which the secondary drive in the *Stream* parameter window. 仪器在 PCMCIA ATA 闪烁存储器中或 PCMCIA 硬盘中存储数据。如果你在系统中安装了上述两种驱动器，在数据流参数窗口中设置其中一个为主驱动器，另一个为从驱动器。

Note: The Etna tries to save all event files in the primary storage drive. If this drive is full or missing the data is saved to the secondary drive (if present). If both drives are full, or the only drive in the system is full, data is lost and the previously recorded data is preserved.

注意：记录仪首先向主存储器存放数据，如果主存储器已满，数据将存放在从驱动器中。如果两个驱动器已满，或仪器只安装一个驱动器而且数据存满，后面的数据将全丢失，而只保留以前的数据。

TREE OR FLAT FILE SYSTEM “ 树形 ” 和 “ 平面 ” 文件系统

The other data storage issue to decide is whether the data is to be saved in a tree or a flat file system. In the default tree data storage, each day’s events are stored into a subdirectory named "\YYMMDD" in the EVT directory. In other words, all the data recorded on July 4th, 2001 are in the directory "EVT\010704". In a flat file system, all the data are saved into the EVT subdirectory and no lower-level subdirectories are created. 数据存储的另一个问题是：数据是否以树形目录存储或以平面形目录结构存储，每天的事件存储在 EVT 目录下的名为 “ \年月日 ” 的子目录下。例如，在树形结构文件系统中，所有在 2001 年 7 月 4 日的记录数据存储在 EVT\010704 目录中。而在平面文件系统中，所有文件存储在 EVT 目录下，不再建立低一级的子目录。

Use the **AQ FILE** command in the Terminal window to select the file system type. **AQ FILE 0** sets the default tree structure, while **AQ FILE 1** selects the flat file system. 在终端窗口中使用 AQ FILE 命令选择文件系统类型。AQ FILE 0 缺省设置表示树形目录，命令 AQ FILE 1 为选择平面文件系统。

Generally, the tree structure is useful if you wish to quickly find an event on a certain day, or if you automatically retrieve data on a daily basis. The flat file structure is useful if you retrieve data at irregular intervals or if you use an automatic retrieval system. 一般，如果你想迅速地找到在特定的某一天的事件或者你想每天自动回放数据，树形结构是非常好用的。如果你以不规则的间隔回放数据，或使用自动数据回放系统，平面结构则比较方便。

PREPARING NEW PCMCIA CARDS 准备新的 PCMCIA 卡

Normally, all new PCMCIA cards received from Kinemetrics have been pre-formatted. All PCMCIA cards should be formatted as described below. 你从 Kinemetrics 公司得到的新的 PCMCIA 卡已经被预先格式化了。所有的 PCMCIA 卡将以以下描述的方式格式化。

Place the new media in an available PCMCIA slot and use the Terminal window **Format** command. Then try to read the device in the PC you plan to use with the recorder to make sure that computer can read the card. If your PC cannot read the card, get the latest release of the PCMCIA drivers and try these. Kinemetrics web site contains links to help you find the latest drivers. 将新的 PCMCIA 卡插入有效的 PCMCIA 插槽中，使用终端窗口 **Format** 命令。接着，试着从你计划与记录仪相连的微机中读 PCMCIA 卡，以确定计算机是否可读到该卡。如果你的计算机不能读该卡，安装 PCMCIA 的最新驱动程序再试着读。Kinemetrics 的网站有帮助你找到最新驱动程序的联接。

As a final option, it is possible to format the card in your laptop and see if the recorder can write to it. The potential problem with this option is that the format may not be optimal, and the cards — particularly hard drives — might not be able to keep up when recording. 作为最后一个选项，从你的笔记本电脑中格式化卡是可能的，并且看一下记录仪是否能写卡。该选项潜在的问题是格式可能是不合适的，卡——特别是用 PCMCIA 硬盘驱动器当记录介质时，可能会不支持。

> ***Caution***: **Possible data loss**. If you format the cards in your laptop and are running the streaming data protocol, the card may not keep up with the data rate and data could be lost.
>
> **告诫**：可能的数据丢失。如果你在你的笔记本电脑上格式化 PCMCIA 卡，并且运行数据流协议，记录卡可能因不再保持原数据率而致使数据丢失。

Configuring Communication Options 设置通讯选项

The Etna is designed to send and receive communications in a variety of ways. This section explains how to configure the parameters correctly so you can use these options. 记录仪能够以多种方式发送和接收通讯信息。本节阐述怎样正确设置通讯参数以保证通讯选项的正常使用。

The recorder can be connected to the PC directly from the RS-232 port via an RS-232 cable. The maximum length of an RS-232 connection is 50 feet (15.24 meters). 记录仪可以使用 RS-232 接口，通过 RS-232 电缆直接与个人微机相连。连接线的最大长度为 15.24 米。

The Etna can also be connected to the PC via two modems — an internal PCMCIA or an external modem at the recorder, and an internal or external modem at the PC using a public telephone carrier. Other devices such as Frame Relay Access Devices (FRAD), an ISDN modem or a spread spectrum modem can be used to implement the physical link between the recorder and the remote PC. 本记录仪也可通过 2 个 modem，即一个内部的 PCMCIA 卡接口的 modem 和一个外部的 modem 与 PC 机相连。其它设备像依赖于帧转换插页存取设备（FRAD）、ISDN modem 或宽带 modem 也可用于远程 PC 机和记录仪的连接。

The physical connection between the recorder and the PC is invisible within QuickTalk, except that the user must first establish a modem connection between the recorder and the PC. PC 机与记录仪的物理连接状态，通过 QuickTalk 软件是看不到的。第一次用 modem 和 P C 机建立连接的用户除外。

RS232 DIRECT CONNECTION RS-232 的直接连接

To communicate directly to the Etna using an RS232 cable, the only configuration required is to match the baud rate of the instrument to the com port of the PC. This procedure is explained in the *Quick Talk Quick Look Users Guide.* 使用 RS-232 接口电缆直接通讯，仅需记录仪与 PC 机的 Com 口的波特率相匹配。连接过程请参考 *QuickTalk 和 QuickLook 通讯软件*用户手册。

Modem and Other Remote Connections Modem 及其它远程连接

The Etna can be configured in several different telecommunication modes depending on your requirements. 记录仪可以根据你的需要设置成几种不同的通讯模式。

Answer Mode 应答模式
System will answer a call on either the PCMCIA modem or its external modem. This is the simplest telecommunications mode. 记录仪可以通过内部 PCMCIA modem 或它的外部 modem 应答呼叫。这是最简单的通讯模式。

Auto Call Mode 自动呼叫模式
The unit will call you if a certain event occurs and will also answer if you call the unit. 当一个特定的事件发生时记录仪将呼叫你，反之如果你呼叫记录仪，记录仪将应答。

Cellular Power Control Option 蜂窝移动电话控制选件
This option will provide power to external telecommunications devices such as cellular phones at the appropriate time. 这个选件是针对现代通讯而设计，为外部通讯设备提供供电控制的选件，例如蜂窝移动电话的电源控制。

Your decision on how to use the recorder will determine which remote communications option you use. As an example, if you wish to perform only remote maintenance on the unit, the answer mode would be sufficient. However, if you wish to be notified rapidly after a seismic event, the auto call mode is required. In the following sections the configurations of each of these options is described. 你希望怎样使用记录仪将决定你选用那一种远程通讯选项。例如：如果你仅仅是需要远程维护，那么应答模式是最有效的。如果你想迅速知道一个地震的发生，自动呼叫模式是必需的。以下将分别阐述对每一种选项的设置。

ANSWER MODE: PHONING THE ETNA 应答模式：呼叫记录仪

In Answer Mode the Etna allows its modem to answer incoming calls. This is the default mode the system enters after power-up, as long as the Autocall/Answer parameter has not been turned off. A supported PCMCIA modem must be inserted in Slot B of the Etna's PCMCIA board or an external modem must be connected to the RS232 port. 在应答模式下，记录仪允许它的 modem 应答进来的呼叫。这是开机以后系统的缺省模式。在自动呼叫/应答参数没有被关闭以前，一直保持这种状态。一个支持 PCMCIA 的 modem 必须被插入到记录仪的另一个 PCMCIA 卡插槽中，如果使用外部 modem，则必须连接到记录仪的 RS-232 接口上。

In Answer Mode, the system sends a modem initialization string to the modem at regular intervals. This string must enable the modem's Auto Answer Mode; for a Hayes compatible modem, this command is ATS0 = 1. This initialization string is sent on a regular basis to ensure that the modem is always ready to receive your call and has not "forgotten" its settings. 在应答模式，系统以规定的时间间隔向 modem 发送 modem 初始化数据串，该数据串必须使 modem 的自动应答模式处于“开”状态。对于兼容的 modem，这个命令是 ATS0=1。以一定规律发送出去的初始化数据串，可以保持 modem 时刻准备着接收你的呼叫，并且不会“忘记”它的设置。

AUTOCALL MODE: USING THE ETNA TO PHONE YOU 自动呼叫模式：使记录仪呼叫你。

In Autocall Mode the Etna allows its modem to answer an incoming call, but it can also initiate a call if certain call-out criteria are met. To use this feature, check **Enable Auto-Call Mode** in the *Modem Parameters* dialog box in *the QuickTalk Parameter Editor*. You can configure the Etna modem to dial out in case of the following: 在自动呼叫模式下，记录仪也允许它的 modem 应答进来的呼叫。但是如果特定的呼起条件满足时，记录仪则能初始化一个呼叫，为了使用这个特性，请在 *QuickTalk 参数*编辑器中打开 modem 参数对话框，检查自动呼叫模式（**Auto-call-mode**）应该设置为可用（**Enable Auto-Call Mode**），使其处于打开状态。你可以设置 Etna 记录仪的 modem，使其在以下情况下呼叫：

- A new event is detected 检测到一个新的事件
- Battery voltage falls below 12 volts 电池电压低于 12 伏
- There is a loss of DC power input 没有直流电源输入
- The global positioning system (GPS) fails to lock within the specified time limit 全球定位系统不能在特定的时间内锁定
- The temperature falls below -20 degrees C or rises above 60 degrees C 温度低于零下 20℃或高于 60℃

To select these Autocall options just put a check in the dialog box. 选择这些自动选项仅需在对话框中的选项处打一个记号。

For the Etna modem to dial out, you must provide an initialization string, a primary phone number and, if desired, a secondary phone number. Enter the number of redial attempts and the setup string for the modem. Finally, specify the message that the Etna should send when it connects. 为了能使 Etna 的 modem 能够向外拨号，你需要提供一个初始化的信息串、一个基本的电话号码（主叫电话），如果你愿意，也可提供第二个电话号码（次叫电话）。键入重拨次数，并且设置 modem 的信息串，最后指定当记录仪接通时,它应该送出信息。

Use the *Modem Parameters* dialog box in the *QuickTalk Parameter Editor* to change recorder modem parameters, or use the *Modem Auto* command in the Terminal window. 使用 *QuickTalk 参数编辑器*中的对话框，在 Modem Parameters 对话框中改变记录仪的 modem 参数，或者在终端窗口使用 *Modem Auto* 命令。

You can enter Autocall Mode from the Terminal window with the *Callmode* command. 你在终端窗口输入 Autocall mode(呼叫模式)命令，即可进入自动呼叫模式。

If you set the parameters to enable Autocall Mode, the recorder enters Autocall Mode automatically after five minutes in Monitor Mode, or after

fifteen minutes in Block Mode. Kinemetrics designed the above precaution to make sure the system will return to the correct operating mode after a field service visit. 如果你设置参数使自动呼叫处于打开状态，在监控模式下 5 分钟以后，记录仪自动进入自动呼叫模式，或者 15 分钟以后进入程序块模式（Block Mode）。Kinemetrics 设计了以上预警，以确保系统在现场运行中当被访问之后能返回到正确的操作模式。

Note: Refer to the *Using QuickTalk & QuickLook Software User's Guide* for more information about recorder and PC modem settings.

注意：请参考“ *QuickTalk 和 QuickLook* ”软件用户手册以获得更多的有关记录仪和 PC modem 设置的信息。

CELLULAR PHONE CONTROL 蜂窝电话控制

The Etna has an external hardware line that can be programmed to provide a signal to turn power on to external equipment (such as a cellular phone) when the recorder needs to make a call, or at certain times of the day to allow you to call the equipment. To use this feature you must provide a relay to turn the power to the equipment on and off. 当记录仪需要呼叫或在某一天的特定时间，你可以呼叫设备时，记录仪外部设备硬件线路，可以通过编程提供一个信号打开外部设备（例如蜂窝移动电话）。为了使用这个特性，你必须提供一个继电器打开电源使设备处于开或关状态。

The recorder includes an open-drain active-low output to control the relay. This feature saves power and preserves the instrument's power autonomy when the communications equipment is powered from the same battery or solar charging system as the Etna. 记录仪包括一个“ 打开—快速动作—低输出 ”的控制继电器。当通讯设备是由记录仪的电池或太阳能充电系统提供电源时，这种特性可以维护设备的自主电源并节约电能。

These parameters must be set to use cellular power control: 这些参数必须使用移动电话的电源控制来设置：

Cellular Warm Up: The time in seconds that the system will wait after asserting the power on signal before attempting to establish the connection. This time should be set long enough for the telecommunications equipment to power up and be ready to make the connection.

移动电话预热：在准备建立连接之前，系统在确认电源信号之后应该有一段等待时间。这段时间应该设计得足够的长，以确保通讯设备加电，并且为连接作好准备。

Cellular Duration: This is the time in minutes that the power will remain on at each time you have set to call in to the instrument. If set to 0 the power will never be enabled. If set to -1 the power control line will always be on.

移动电话持续时间：在你呼叫设备时电源持续时间。如果设置为 0，电源将处于“ 关 ”状态，如果设置为 1，电源控制线处于“ 开 ”状态。

Cellular On Call-In Times: These are up to 5 times listed in 24-hour format (HH:MM) during which the recorder will turn on power to the equipment. The power will remain on for the time given in the Cellular Duration. Setting the hour to -1 disables that particular call-in window.

These features can only be set in Terminal mode. Put the instrument into Edit mode by typing **Edit** at the * prompt. Then set each parameter as described in the *Using the Terminal Mode* section of the *QuickTalk & QuickLook User's Guide.*

移动电话呼叫时间：最多有 5 个时间以 24 小时格式列出（格式为“ 时：分 ”），在所列的 5 个时间，记录仪将打开设备的电源，电源所持续的时间由以上电源持续时间设定。将时间设置为-1，将使呼叫窗口失效。

这些特征仅能在终端模式被设置。通过在*提示符处键入 Edit 使设备进入编辑模式。然后根据 ***QuickTalk 和 QuickLook 通讯软件用户手册*** 中“ *使用终端模式* ”一节所述进行参数设置。

CELLULAR **DUR**ATIONS *minutes* 电话持续时间（CEL DUR *分钟*）

Length of time the call-in window is enabled. Enter 1-127 to specify the number of minutes the window is enabled starting at the time specified by the Cellular On command. Enter 0 (the default) to disable the call-in window. Enter –1 to leave the call-in window on at all times. 呼叫窗口打开的持续时间，键入 1—127 中的某个数，以规定在被 Cellular On 命令规定的时刻窗口打开的时间（分钟）。键入 0（缺省），关闭电话呼入窗口；键入-1，可以在任意时刻离开呼入窗口。

CELLULAR **ON** *window_number hour minutes* 移动电话打开窗口 *(*CEL ON *号数 小时 分钟*)

Start times for the five available call-in windows. The window number is 1-5. The hour setting is 0-23; enter –1 to turn the window off. The minute setting is 0-59. Enter **CEL ON** with no arguments to display all cellular times. 5 个活动呼叫窗口开始时间，窗口数号是 1—5，小时设置为 0～23，分钟的设置为 0～59，键入 – 1 关闭窗口。键入 CLE ON 显示所有的移动电话时间。

CELLULAR **WAR**MUP *seconds* 移动电话“ 预热 ” (CEL WAR *秒*)

Time between when the cellular phone is enabled and when it calls out; this enables the cellular phone to warm up. Possible entries are 0 (the default) to 255. 移动电话准备好到开始呼叫之间的时间，这可以使移动电话有预热准备。有效的设置是 0（缺省）到 255。

Note: On windows may overlap and/or cross midnight.

注意：在窗口上可以重叠并且/或者交叉夜间 0 点时间。

Here is an example of how to use these features: You have an Etna in a remote area equipped with a cellular phone and would like to contact the unit every day at 8 P.M. for 10 minutes, or, if you miss this time, at 10 P.M. for 10 minutes. You would also like the unit to call you if it detects an event or loses power. You have tested the cellular phone and found it is ready to make a call 5 seconds after power is applied. 这里有一个如何使用这些特性的例子。假设你在远处有一台装备了移动电话的记录仪，并且希望在每天的下午 8 点与记录仪联接 10 分钟。如果错过了这个时间，在下午 10 点联接 10 分钟，你希望仪器在检测到地震事件或没有电源的情况下向你呼叫。你已经检查了移动电话并且发现它已准备在电源送上后 5 秒钟呼叫。

To accomplish this, set 为了完成上述功能，如下设置：

- Set cellular Warm Up to 5 seconds 设置预热为 5 秒
- Set cellular Duration to 10 minutes 设置移动电话持续时间为 10 分钟
- Enable CELLULAR ON times at 20:00 and 22:00 打开“移动电话打开窗口”，设置 20:00 和 22:00
- Enable AutoCall mode. 打开自动呼叫模式

Issue the following commands in the EDIT window: 在编辑窗口输入命令如下：

CEL DUR 10

CEL ON 1 20 00

CEL ON 2 22 00

CEL WAR 5

Digital Field Station 数字台站

The digital field station (DFS) feature outputs selected channels continuously as 16-bit data through the interconnect connector, providing real-time data streams for receiving data from the instrument. The DFS requires both the Extended Interconnect Option (109875-01-PL) and the DSP Expansion Memory Option (P/N 810701). 数字台站简称 DFS，通过内部连接器以 16 位格式从所选取的通道连续输出数据，提供来自设备的实时数据流。DFS 要求扩展内部连接选件（109875-01-PL）和 DSP 扩展内存选件（P/N 810701）同时具备。

Data is taken directly from the DSP after filtering and decimation to 100 samples per second and is sent as a simplex RS232 data stream to the front panel connectors. This protocol can be used to implement a real-time digital

system using the IASPEI software suite. Contact Kinemetrics for more information on setting up an IASPEI central recording station. 数据通过滤波后直接从 DSP 中取出，转化为 100 点/秒采样的数据流，传送到仪器的前面板上的单向 RS-232 接口上。通过使用 IASPEI 软件包，本协议可作为实时数字系统使用。与 Kinemetrics 公司联系可以获得更多的关于建立 IASPEI 台站中心记录的信息。

Please note that the data stream is *not* time-tagged, *is* a one-way link, and truncates the data to 16 bits. These compromises allow the use of low-cost, one-way radio systems. 请注意数据流是没有时间标记的，且是单路连接，数据被截短为 16 位，这种折衷办法是想充分利用低成本的单路无线电传输系统。

The DFS provides a three-wire (receive data, transmit data, and ground), RS-232C connection to the Etna's DSP. Filtered and decimated data are transmitted from the DSP over this port on the DFSTXD line. The DSP does not respond to characters received on the DFSRXD line. A single-chip RS-232C transceiver converts to and from RS-232C levels to 0-5 V CMOS logic levels. DFS 提供了一条 RS-232 三芯导线（接收数据、发送数据、接地）。RS-232 连接器连到 Etna 的 DSP。经过滤波和 10 进制转化的数据从 DSP 通过该端口传送到 DFSTXD（DFS 的发送数据线）。由于 DSP 对从 DFSRXD（接收）线上接收的字符不能响应，就用了一个单片芯片 RS-232C 转换器将 RS-232 信号电平转化为 0—5V 的 CMOS 逻辑电平。

Refer to the *Etna Extended Interconnect Option User Guide*, Document 302231 for more information on the electrical interface. 请参考 *Etna 扩展互连用户手册*（文件 302231），可给出更多的电器接口信息。

HARDWARE CONNECTION TO DIGITAL FIELD STATION 数字台站的硬件连接

The front panel connection for the RS-232 three-wire external connection for the digital field station is on the Extended Interconnect Option output. 面板上 RS-232 外部接口的连接器，及其和它连接的三芯导线，用于连接数字台站，信号由扩展内部连接选件输出。

Pin(接口针序)	**Definition**（定义）
A	DSPRXD RS232 input, not used（输入）， 不能使用
V	DSPTXD RS232 output（输出）
E, X, g	GND（地）

OVERVIEW OF DIGITAL FIELD STATION PROTOCOLS 数字台站协议概览

There are two protocols provided: CRLF and KMI. 提供两种协议：CRLF 和 KMI。

CRLF This protocol transmits 1, 2 or 3 channels at 100 sps. The data format consists of a string of 16-bit data, one for each selected channel, delimited by a carriage return and a line feed. 本协议以 100sps 的速率传送 1，2 或 3 通道的数据。数据构成包括一个 16 位数据串，一个选择通道，由数据回返和线路馈电方式来决定。

<LF><ch1-high><ch1-low><ch2-high><ch2-low><ch3-high><ch3-low><CR>

When the instrument sample rate is 200, the DFS data stream is filtered and decimated to 100 sps before output. The DFS cannot be selected when the instrument is recording at 250 sps. Note that the data is truncated to the high two bytes of the 24-bit data words. The 4800-baud rate will only support one channel and the CRLF protocol is limited to any three channels. 当设备的采样率为 200，DFS 数据流经过滤波和 10 进制转化以 100sps 的速率输出；当设备以 250sps 的速率记录数据时，则不能使用 DFS 功能。注意，这是因为数据已经被截断成 24 位数据字的高 2 个字节。由于 4800 波特的通讯速率仅能支持一个通道，于是 CRLF 协议限制了三个通道的同时传输。

Note: The KMI protocol is a project specific packet format. It is not for general use.

注意：KMI 协议是为一个特定项目定义的打包格式，一般用户不用。

CONFIGURING THE DIGITAL FIELD STATION 数字台站设置

The parameters that control the digital field station can be set using the QuickTalk parameter editor as described in the *QuickTalk & QuickLook User's Guide.* 控制数字台站的参数可以通过 QuickTalk 软件的参数编辑功能设定。详见 *QuickTalk 和 QuickLook 通讯软件用户手册。*

Additional information on setting Etna parameters is found in the *Terminal Mode Communications Manual,* Document 302219. 另外，关于记录仪参数设置的信息可以在*终端模式通讯手册*中找到（文件 302219）。

Serial Data Streams 串行数据流

The second real time data stream available from the recorder is the serial data stream (SDS). The SDS provides a continuous flow of data samples from the recorder using block mode packets coming out the front-panel RS232 serial-port connector. This allows the recorder to be used as part of a real-time seismic monitoring system, while still retaining it's ability to record large events on its local memory card. 从记录仪中获得的第二个实时数据流是串行数据流（SDS），SDS 是从前面板 RS-232 串口发出的块模式的数据包。SDS 提供了采样数据的连续性。这是为让记录仪具有作为实时地震监控系统的一部分来使用而设计的，并且同时又具有在它内存卡中记录大地震事件的能力。

Note: The SDS is only available in application Firmware revisions from 2.07 onwards. Starting with recorder header versions 1.40, the Serial Data Stream parameters are stored in the event header. Beginning with QuickTalk version 2.09 and application code version 2.25 they can be changed in QuickTalk and by downloading a .PAR file.

注意：SDS 仅在应用固件为 2.07 版以后是有效的。启动记录仪 1.40 版的头文件，串行数据流参数存储在事件的头文件中。启动 QuickTalk2.09 版和应用程序 2.25 版，它们可以在 QuickTalk 中改动，并且下载一个.PAR 文件。

DESCRIPTION OF THE SERIAL DATA STREAM PROTOCOL 串行数据流协议的描述

The description of the SDS and packet protocol in this section is brief and is intended as an introduction. If you wish to use the SDS we recommend that you obtain the *Altus Block Mode Communications* from Kinemetrics. This will help you with examples of how to use the SDS and contains a description and format for the various packet types. 对于 SDS 和打包协议的描述在本节是简略的，仅仅作一般介绍。如果你想使用 SDS，我们建议你从 Kinemetrics 公司索取“ *Altus 块模式通讯*”，这将帮助你获得一个怎样使用 SDS 例子，包括对不同打包类型和格式的描述。

The SDS consists of a series of blocks, each containing a data header and the specified number of samples for a selected channel. Each block of data is wrapped inside a serial data packet, which includes the SDS data header, and a trailer used for error correction. SDS 包括一系列的块，每个块都包含一个数据头（首部）和所选择通道定义的采样数。每一个块中包含了一个串行数据包，这里面包含 SDS 的数据头段信息的描述字符和用于错误修正的数据尾部描述字符。

Each block has a unique data sequence number allowing it to be identified and to allow the host to request retransmission of packets with errors. Each block also contains a time tag relating the data to UTC time. The instrument can create up to six streams, with each stream containing one channel of data. Currently the instrument must be recording at, and the streams must be sent at, 100 samples per second. 每一个块，仅有一个数据系列号。这可以使它能被识别并且允许主叫方要求重新传送该数据包以纠正错误。每一个块都包含一个与数据相关的 UTC 时间标记。设备可以建立 6 个数据流，每一个数据流是一个通道的数据，但这时数据的记录和发送仅对每秒 100 点的采样率有效。

The instrument has a serial data stream command buffer to process commands on a first-in first-out basis. It also has two separate block buffers, one for normal block flow and one for resend-retry requests. 设备有一个串行数据流命令缓冲区，在“ 先进-先出 ”的原则下执行命令。仪器还有

两个分离的块缓冲区，其中一个用于一般的块流动，另外一个用作重新发送请求。

The instrument buffers a number of data blocks in a temporary file, #SSTRBUF.BIN. The maximum size of the temporary file is specified by the parameter BUFFER_SIZE. While a block is still in the buffer, it can be resent if requested by the host. Three communication modes are currently supported as discussed below: 仪器将数据块使用码进行标记后，存于一个临时文件中，文件名为#SSTRBUF.BIN，缓冲文件的最大容量由参数 BUFFER_SIZE 确定。当一个数据块位于缓冲区中，它可以在主机的要求下重新发送出去。仪器支持以下三种通讯模式。

MODE 1 模式 1

Mode 1 is intended for one-way transmissions from the instrument to a host computer with software to decode and display the samples. Transmissions start automatically after reset. Mode 1 also supports full-duplex channels. The instrument will respond to control packets from the host to start/stop the stream packets and request retransmission of specific packets. 模式 1 是从仪器到主计算机（以下简称主机）的单路传送，用相应的软件解码并显示采样率。传送过程在重新设置后自动开始。模式 1 支持全双工通道。仪器对主机发出的控制数据包作业响应，以启动或停止流数据包和是否要求重新传送指定的数据包而实现控制。

MODE 2 模式 2

Mode 2 requires that the host send a continuation packet every N packets. The timeout is intended to shut off transmission after a fixed time. This limits the wasted bandwidth if the host goes down. If the host detects an error in a received packet, it may request a retransmission of that packet. 模式 2 要求主机每隔几个数据包发送一个顺序数据包。暂停时间超过确定的时间后将关闭传送。这样可以在主机停机的情况下减少带宽的浪费。如果主机在接收的数据包中发现错误，它可以要求重新传送那个数据包。

MODE 3 模式 3

Mode 3 is a full handshaking mode with packet flow controlled by the host. The host may queue up to 256 requests in the instrument, thus maintaining the data stream from the instrument where no channel errors or host buffer overflow occurs. If the host detects an error in a received packet, it may request a re-transmission of that packet. 模式 3 是一个全握手模式，并且由主机控制数据包的流动。主机可以在设备中排列 256 个请求，包括仪器的数据流，要求没有通道错误或主机缓冲区溢出发生。如果主机在接收的数据包中检测到错误，它可以要求重新发送那个数据包。

CONFIGURING THE SERIAL DATA STREAM 设置串行数据流

The parameters that control the serial data stream can be set using the QuickTalk parameter editor as described in the *QuickTalk & QuickLook User's Guide*. 控制串行数据流的参数可以使用 QuickTalk 软件的参数编辑器来设置，详见 *QuickTalk 和 QuickLook 通讯软件。*

The buffer size should be large enough to buffer the blocks when other RS-232 traffic is using the RS-232 port, but not so large that nothing is left for recording event files. 缓冲区尺寸应足够大以保证其它的 RS-232 通讯缓冲数据块能够使用 RS-232 接口。但也不能太大以至于没有空间暂时存储事件文件。

The recorder's default buffer is 1Mb (64 16k blocks). However, in order to minimize wear, we recommend making the buffer as large as possible, e.g., for an 80Mb flash card, set the buffer to 40Mb. 记录仪的缺省缓冲区是 1Mb（64×16K 的块），但是为了尽量减少损耗，我们建议缓冲区设置尽可能大一些，即对于一个 80Mb 的 flash 卡，将其缓冲区设置为 40Mb。

The transmission baud rate should be set so that transmission will only fall behind for short periods of time and not exceed the amount of data stored in the buffer. 设置传送的波特率时应该使传送稍滞后一段时间，而又不能使存储在缓冲区的待传输数据超量。

In order for the current version of the SDS to work, the SDS sample rate and the instrument's sampling rate must both be set to 100 samples per second. 为了使当前版本的 SDS 正常工作，SDS 的采样率和仪器的采样率，都应设置成 100 点/秒。

TCP/IP Support TCP/IP 支持

TCP/IP support for the Etna may be purchased as an option. Event-driven TCP/IP file transmission allows the recorder to dial an ISP using a PPP connection, then FTP the EVT files to a destination FTP site. 对 Etna 记录仪，具有 TCP/IP 协议的支持将作为一个选件另行购买。获得记录事件后，TCP/IP 文件传送功能则允许记录仪拨号 ISP，使用 PPP 联接，将 EVT 文件以 FTP 的形式上传到目标 FTP 网站。

TCP/IP streaming is *not* supported but can be accomplished using an external terminal server connected to the front panel serial port. 本仪器不支持 TCP/IP 数据流，但可以使用仪器前面板的 RS-232 串行口，通过连接到外部终端服务来完成该功能。

Sensor Settings 传感器设置

Calibration data for the Etna's internal EpiSensor decks is stored in a serial EEPROM on the EpiSensor oscillator board. This data is programmed at the factory and cannot be changed. Etna 的内部 EpiSensor 传感器装置校准数

据存储在串行 EEPROM 中（位于 EpiSensor 的振荡器板上），这个数据在出厂前已设置好，不能改动。

The Etna reads this information when the **DEFAULT FACTORY<CR>** command is issued at the **EDIT** prompt. The information is then stored as the Etna's internal copy of the sensor parameters. If the internal copy of the sensor parameters need to be changed it can be done in monitor mode or by using the **Sensor** option under the **Utility** menu in QuickTalk. 在 **EDIT**（编辑）提示符下发出 **DEFAULT FACTORY**（回车）命令后，Etna 读取传感器信息， Etna 的内部传感器参数就被拷贝出来。如果拷贝的内部传感器参数需要改动，可以在监控模式下或通过 QuickTalk 软件的 **Utility** 菜单下的 **Sensor** (传感器)选项来完成。

Note: If the **DEFAULT FACTORY<CR>** command is used after manually changing the internal copy of the sensor parameters, they will be overwritten by the parameters stored in the EpiSensor deck. To leave the sensor parameters unmodified, use the **DEFAULT<CR>** command instead.

注意：如果用手工改变内部拷贝的传感器参数之后，使用“**DEFAULT FACTORY 回车**”命令，则传感器参数将被存储在 Episensor（传感器）平台上的出厂参数所代替，为了使参数保持不变，使用“**DEFAULT 回车**”命令。

Security & Passwords 安全与密码口令

Whether or not the Etna should be password protected depends on the installation. 记录仪是否需要口令保护由安装人确定。

If the Etna is connected to a PC via a modem that is linked to the public telephone network, set a password on the recorder according to the instructions in the *QuickTalk & QuickLook Software User's Guide*. If the Etna is password protected, unauthorized users cannot change recorder settings or retrieve or delete recorder data even if they break in to the system through the modem. 如果记录仪是通过与公共电话网相联的 Modem 与 PC 机连接的，根据 *QuickTalk 和 QuickLook 用户手册*中的指导，应为记录仪设置口令。如果记录仪被口令保护，未授权的用户即使他们通过 Modem 切入系统，也不能改变记录仪的设置或回放、删除记录仪数据文件。

Caution: Make a note of the recorder password. If you forget the password, you will need to physically remove both PCMCIA cards from the recorder to remove password protection and reset the password to nothing. This means a site visit!

告诫：记下记录仪的密码口令，如果你忘记了口令，你将需通过硬件操作（从记录仪拔下 2 个 PCMCIA 卡来去除口令保护），并重新将口令设置为无。但这意味着你将需到观测点去完成。

If the recorder is connected to a PC with an RS-232 cable only, consider physically securing the recorder and the PC. Use the locking hasps on the top of the case to secure the contents of the unit. The RS-232 port is not secure unless the recorder is password-protected. 如果记录仪与 PC 机之间仅用 RS-232 电缆连接，需考虑对记录仪与 PC 机进行物理保护，在箱体上的顶部用 " 搭扣加锁 " 保护仪器。如果记录仪未加口令，RS-232 端口输出数据的传输方式是不安全的。

Checking the Etna Setup 检查 Etna 的安装

Check the Etna installation by running a functional test or by using the keyboard trigger if the recorder uses sensors other than an EpiSensor.

You can also gently shake the unit to simulate an event and check that Autocall mode is functioning. 运行 " 功能测试 " 以检查 Etna 的安装情况，如果记录仪用的传感器不同于 EpiSensor 传感器时用键盘触发来检查。你也可以轻微摇动记录仪来模拟一次事件，再检查自动呼叫模式功能是否正常。

Refer to Chapter 4, *Maintenance & Service*, for information about running remote and on-site systems checks. 关于进行现场系统检查的信息见第 4 章的维护与保养。

The full scale range of the internal EpiSensor and their voltage levels are set at the factory to the correct values specified at the time of purchase. If you wish to change the settings, refer to Chapter 6, *Advanced Installations.* 满刻度的内部 EpiSensor（传感器）和它的电压值，出厂时已按订购时的规定设定，如果你想改变设置，参考第 6 章高级安装。

Performing a Functional Test 进行功能测试

The firmware in your instrument performs a dual polarity pulse test on EpiSensors as the standard functional test when correctly configured.

The height of the pulse will depend on the full-scale setting of the instrument but will correspond to a g level of approximately 0.125g. The exact value will be 2.5V multiplied by the sensor module's calibration coil sensitivity value provided on the sensor's data sheet. 在设置好后仪器后，利用仪器内的固件程序对 EpiSensor 传感器进行二个正相反的脉冲标定，进行功能测试。脉冲的最大值依赖于仪器满刻度的设置（近似于 0.125g）。精确值是 2.5V 乘以传感器系数，该系数是标定线圈的灵敏度值，此值由传感器的数据表提供。（见图 12）

Figure 12: EpiSensor functional test display

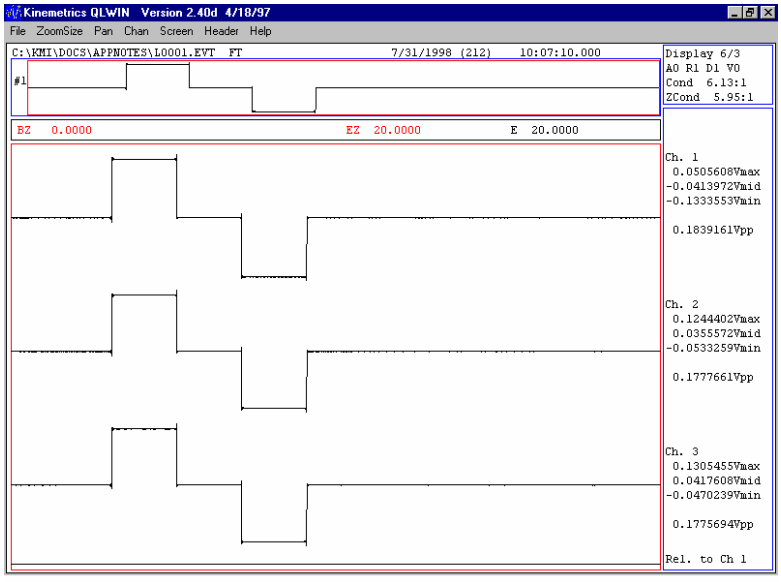


图 12： Episensor(传感器)功能测试图形显示

Note: Altus software released prior to August 1998 supports functional tests on the earlier generation of Kinemetrics force balance accelerometers but does not support the EpiSensor. If you perform a functional test or sensor response test on an EpiSensor using older firmware, the record will appear as shown in the following figure.

注意：早于 1998 年 8 月发行的 Altus 软件支持以前的 Kinemetrics 公司生产的力平衡加速度计功能测试，但不支持 EpiSensor 传感器，如果使用老的固件对 EpiSensor 传感器做功能试验或传感器反应试验，记录图如图 13。

Figure 13: EpiSensor functional test display using firmware released prior to August 1998

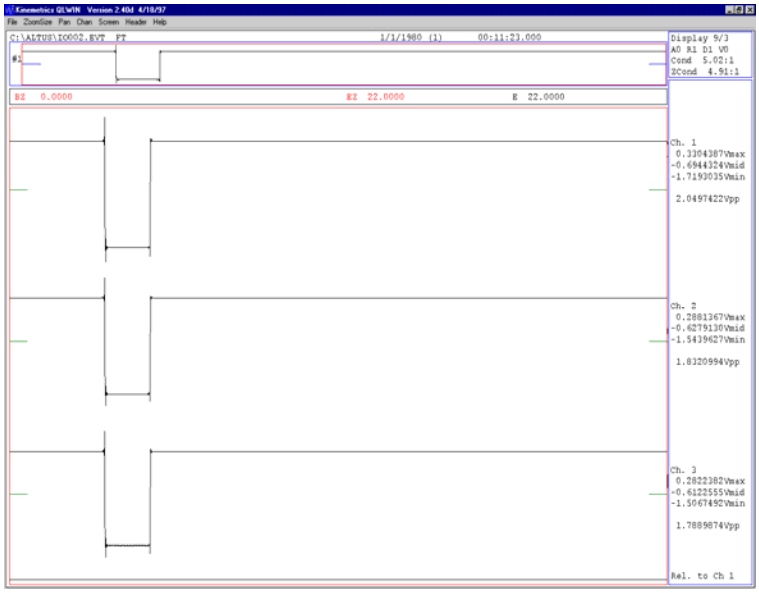


图 13　使用早于 1998 年 8 月的固件测试 EpiSensor 传感器功能时的显示图

The record looks like this because the calibration coil enable is only enabled during the undamped portion of the old FBA-11 style functional test.

To update your firmware, please go to www.kinemetrics.com. 记录图之所以如此是因为标定线圈仅适用于老的 FBA-11 型加速度计的功能测试的无阻尼部分。更新后的固件，请到WWW.Kinemetrics.com网站去下载。

Master / Slave GPS 主/从 GPS

If you have the Extended Interconnect Option installed, the following commands are available for use with the GPS. 如果你按扩展内部连接选项安装，使用 GPS 时，下面的命令对是有用的。

The EDIT mode command GPS has been modified to accept a third parameter for operation mode. These modes include free field (default), master and slave. 在终端窗口的编辑窗，用命令 GPS 进行更改，在操作模式的选项中则可接受第三个参数。该参数对应的模式指“ 自由场地（默认值）、主 GPS、从 GPS ”这三者之一。

Free field is the mode the GPS subsystem has traditionally used. Master and slave modes were added to support a group of recorders less than 4000 feet (12,192 meters) apart with only one GPS receiver, with all units in the group synchronized to GPS time. Without a GPS receiver, the group is synchronized to the master recorder’s internal clock time. This is useful if absolute time is unnecessary. 通常使用的是自由场地这种 GPS 子系统模式。主与从模式是指仅用 1 个 GPS 接收器用来支持一组记录仪，它们之间距离不能大于 4000 英尺（1219 米），该组内所有记录仪的时间

都与 GPS 同步，即该组的其它“ 从 ”记录仪与主记录仪内部时钟的时间同步。如果在不需要绝对时间的情况下，这个时间是很有用的。

Syntax: GPS = updateInterval_minutes, maxOn_minutes, control [0 = Free Field, 1 = Master, 2 = Slave] 命令格式：GPS =更新内部时间间隔___分钟，给 GPS 最长通电的时间___分钟，Cotrol(控制参数)[0=自由场地，1=主，2=从]

For extended interconnect cabling requirements and jumper settings, please refer to the *Etna Extended Interconnect Option Users Guide*, Document 302231. 对扩展内部连接电缆线的要求及其跳线的设置，请参考 *Etna 扩展内部连接选件用户手册*（文件 302231）。

Operating the Etna Etna 仪器的操作

This section describes the basic operations you will be performing on your Etna, such as retrieving data, managing the instrument’s storage, performing functional tests, remotely calling the unit, and analyzing data from the unit. 这部分讲述 Etna 的基本操作，像接收数据、管理仪器的存储、做功能试验、远程呼叫 Etna 和对数据的分析。

Retrieving Data from the Etna Etna 的数据回收

RS-232 DIRECT DATA RETRIEVAL 用 RS-232 接口直接回收数据

Even if you normally plan to communicate with the Etna via a modem, you may sometimes need to visit the site and connect to the recorder directly with a laptop and an RS-232 cable. These instructions also appear in the *QuickTalk QuickLook User’s Guide*. 虽然一般情况下你计划通过 Modem 和 Etna 记录仪进行通讯，有时你必须到现场（观测站）将记录仪用 RS-232 线缆直接与笔记本电脑连接。这些指令也在 *QuickTalk 和 QuickLook 用户手册*中出现。

Note: Make sure you have installed *QuickTalk* on the laptop PC you plan to use before arriving at the site.

注意：在到达现场（观测站点）之前，确认在笔记本电脑上已安装好 *QuickTalk* 软件。

The first time you run QuickTalk, the **Communications Setup** window appears. Select the initial COM port and baud rate in this window. Your selections will be saved when you exit QuickTalk, but you can change them as necessary by selecting **Comm Settings** from the QuickTalk **File** menu. 你第一次运行 *QuickTalk,* 出现 Communications Setup 窗口，选择

COM 端口和波特率，在你退出 QuickTalk 时，你所作的选定会被保留下来，但是你也可以按需要从 QuickTalk 的“ File(文件) ”菜单中选择 Comm Settings 菜单改变设置

To do an RS-232 direct retrieval: 用 RS-232 线缆直接恢复数据

1. Disconnect any external modem cable from the Etna or any other communications equipment that might be connected to the RS-232 port. If the modem is internal to the Etna, you do not need to disconnect it. 断开任何外置 Modem 线缆与 Etna 或任何其它通讯设备与 RS-232 端口的连接。但如果 Etna 所用的 Modem 是内置的不需断开内置 Modem。

2. Connect the Etna to the PC using an RS-232 cable. 用 RS-232 线缆将 Etna 与 PC 机连接好。

3. Double-click the **QuickTalk** icon or select it from the Windows **Start** menu. 双击 QuickTalk 图标或从窗口（Windows）的**开始（start）**菜单中运行 QuickTalk 软件。

4. After a few seconds, does the information display in the **Status** and **Directory** windows? 几秒钟后，可在状态（Status）和目录（Directory）的显示中，看到连接信息：

   YES – You've established communications with the Etna. 是（YES）—你已和 Etna 建立了通讯联系。
   Proceed to Step 8. 跳到第 8 步。

5. Open the **Communications Setup** window by selecting **File** and then **Comm Settings**. Verify that you have the correct COM port selected. Is the COM port correct? 选择文件 File(文件)和通讯设定（Comm Settings），打开通讯设置（Communications Setup）窗口，确定，选择正确的 COM 端口。COM 端口正确吗？

   NO – Change it and close the Communications Setup window by selecting OK. Go to Step 4. NO（不）——改变它，选择 OK 按钮，单击之，再关闭通讯设置窗口，转向第 4 步。

   YES – The baud rate is probably incorrect. Follow Steps 6 and 7 below. YES（是）——对，但波特率可能不正确，进行第 6 步和第 7 步。

6. Open the **Terminal Window** by selecting **Window** and **Terminal Window**. 选择窗口（Window），进入终端窗口（Terminal Window），打开终端窗口（Terminal Window）。

7. Click on the **Terminal Window**.
   Enter \\\ (three backslashes followed by the **Enter** key) until the "*****" prompt appears. You may have to enter \\\ more than once.
   Does the "*" prompt appear? 单击终端窗口（Terminal Window），

键入三个反斜杠，压回车，直到“ * ”提示出现。你也许需要不止地键入\\\（三个反斜杠）。观察“ * ”提示符出现了吗？

YES – You've established communications with the Etna. Proceed to Step 8. 是（YES）—你与 Etna 已经成功建立了与 PC 机的通讯。继续进行第 8 步。

NO – Open the **Communications Setup** window by selecting **File** and then **Comm Settings**. Change the baud rate and close the Communications Setup window by selecting OK. 不（NO）—选择 File（文件）和 Comm Settings（通讯设置），打开**通讯设置窗口**。改变波特率，选择 OK 按钮，单击之。再关闭通讯设置窗口。Repeat as necessary until the "*****" prompt appears. 必要时，反复上述步骤，直到“ * ”提示符出现。

8. Close the Terminal window and begin your communication session with the Etna. 关闭终端窗口，开始与 Etna 通讯。

Note: Remember to reconnect any equipment that you disconnected from the RS-232 port when you complete your work.

注意：记住，当你完成你的工作时，并从 RS-232 端口断开后，别忘了恢复原来连接在 RS232 口上的设备。

RETRIEVING DATA REMOTELY 远程接收数据

To remotely retrieve data you must establish a telecommunication link between the PC and the Etna. To do this the Etna must be equipped with a modem and be in answer mode. The *QuickTalk QuickLook User's Guide* contains detailed instructions on setting up this link. 若远程接收数据，你必须建立 PC 机与 Etna 之间远程通讯的连接，这样做 Etna 必须配备 Modem 而且处于应答模式。*QuickTalk 和 QuickLook 用户手册*中包括建立连接的详细说明。

Downloading Data Automatically 自动下载数据

You can create a user program to automatically download Etna data and log maintenance problems. Contact Kinemetrics for specific information about implementing this feature. Kinemetrics' Network Management System program also performs this function. 建立一个用户自动下载 Etna 数据的程序并下载有关维护问题的记录。应该与 Kinemetrics 取得联系，即可获得实现此性能的特殊的专门信息。Kinemetrics 网络管理系统程序可以实现此项功能。

Finding Files 查找文件

Filenames are standard DOS filenames. The Etna uses file extensions to describe the file contents. The extensions can be one of the following: 文件名用标准 DOS 文件名。Etna 使用文件扩展名来标示该文件的内容，扩展名有以下几种：

- .par Communications parameter file created with the EDIT SAVE command, or in QuickTalk. .par—通讯参数文件，用 EDIT SAVE 命令或在 QuickTalk 下创建。
- .evt Event file created automatically when an event is detected and acquisition is on. .evt—事件文件，当事件被测出并记录时，自动创建的文件。

To display the file directory, use the QuickTalk directory window, or enter **DIR** in the Terminal window. 用 QuickTalk 目录窗口或在终端窗口键入 DIR，可以显示文件目录。

Each directory entry has a file status string. Table 2 describes the meaning of each status code. 每个目录项都有一个表示文件状态的字符串，表 2 说明了每个状态代码的含义。

Table 2: File status codes

表 2 文件状态代码

Status Code 状态代码	**Meaning** 意 义
D	Deleted file 删除了的文件
R	Read-only files 只读文件
A	The file archive bit is set. The archive bit is set for new or modified files. (Archive bit is reset when you download the file.) 文件归档位标志，归档位提示该文件为新文件或修改后的文件。（归档位，在恢复文件后重新设定）。
S	System file 系统文件
H	Hidden file 隐藏式文件

When an event is detected, the Etna automatically records it to an .evt file. 当事件被监测后 Etna 自动记录到一个.evt 文件。文件名是记录仪按下述过程自动形成的。

- The Etna uses the restart counter (the number of times the application program was restarted) and the event number (which is always reset to zero when the application program is restarted) to create a unique filename. Etna 用重启计数器（这计数器是靠重新启动应用程序来完成的）的事件序号（这个序号在应用程序重启后重新设置为 0）来建立相互独立文件名。
- The event filename is in the form xxnnn.evt, where xx are the two alphabetic characters formed from the number of times the system

was restarted. The nnn is the event number; 001 represents the first event since the system was restarted. 事件文件名格式为 xxnnn.evt,由于计数系统被重新启动，这里 xx 是按字母顺序排列的两个字母。这个 nnn 是事件号数，001 代表系统重新启动后第一个事件。

- Every time you reset or restart the recorder, the xx prefix is incremented and the event number is reset to 001. The event number can go up to 65535 before cycling back to 1. 每次重新设置或重新启动记录仪，文件名的前 2 位 xx 是递增的，并且紧跟其后的事件序号(nnn)重新设置为 001,事件数上升到 65535 后自动循环到 1。
- The xx ranges from AA to ZZ, which represents 676 restarts before cycling back to AA. It is therefore very unlikely to get two events with the same filename. 这个 xx 范围从 AA 到 ZZ，周期性返回到 AA 之间，计有 676 个状态。因此，两个事件文件名发生同名的可能性很小。

Retrieving Files 回收文件

To use QuickTalk to download event files from the Etna to your PC: 从 Etna 到你的计算机，用 QuickTalk 软件恢复事件文件的步骤：

1. From QuickTalk, go to the desired drive by clicking on **A**: or **B**: button in the Directory window. 从 QuickTalk 软件中选择想要的 A：或 B：，然后在目录窗口中点击 A：或 B：按钮。
2. Double click on the directory entry to change to that directory (double click on the ... entry to go up one level to the parent directory). 双击目录，进入变更目录（再双击目录又返回原来的目录）。
3. Double-click on the filename to download that file. After you download the files the recorder clears the archive bit in the file's directory entry. 双击文件名恢复文件，你恢复文件后，记录仪会清除文件目录列表中的归档位标志。
4. Use QuickLook for Windows (or QLCA) to view recorder event files. 用 QuickLook 的窗口（或 QLCA）查看记录仪的事件文件。

To download files in the Terminal window, use the **TX** command. (The exact detail of this operation are specific to the communications program used.) 若在终端窗口回收文件，用 TX 命令（用专门的通讯程序就可以准确的进行操作）。

Once a file has been retrieved from the Etna to the PC, you should probably delete it from the recorder in order to free up disk space. Refer to the next section. 一旦一个文件从 Etna 恢复到 PC 机上，为了释放磁盘上存储空间你可以从记录仪删除它（参考下一部分）。

Managing Data Storage & Deleting Files 管理数据存储和删除文件

In order to free up disk space on the Etna, delete files once you have saved them to your PC. 为了释放 Etna 的磁盘空间，将已在你的 PC 上存储过的文件进行删除。

To delete a file from the Etna, select the file's name in the QuickTalk directory window, then click on the **Delete** button. (Or, from the Terminal window, you can delete a file using the **DELETE** command.) These commands flag the file as deleted and return the memory space to the amount available. 从 Etna 删除一个文件，在 QuickTalk " 目录 " 中选择文件名，然后点击删除 (Delete) 按钮。标记过的文件将被删除，并释放内存空间。或者从终端窗口用 DELETE（删除）命令，就可以删除一个文件。

The Etna has no internal command to undelete files. However, if your PC contains software designed to undelete files – and as long as the deleted file's memory space has not been re-used – you should be able to use your PC to restore that file. Etna 无内部命令用来恢复已删除的文件。但是如果你的 PC 机中包含有反删除设计软件，且已删除文件的存储空间尚未被使用，也许能够用你的 PC 机恢复已删除的文件。

Removing PCMCIA Cards 更换 PCMCIA 卡

If it's not possible to retrieve data from the Etna either on-site via the RS-232 port or remotely via a modem connection, you can physically remove the PCMCIA card or cards from the unit, replace them with additional formatted PCMCIA cards, and read the cards you removed on a PC. You may wish to do this after a strong earthquake when you need to rapidly retrieve data. Volunteers can be used to remove the cards and replace them with new cards. This process is simple and does not require a laptop computer. 如果不可能在现场从 Etna 的 RS-232 端口通道或在远程用 Modem 连接收数据，你可以将 PCMCIA 卡从记录仪中取出，用附加的、已格式化好的 PCMCIA 卡替代原卡，把原卡插在 PC 机上读取数据文件。你希望在强烈地震以后需要迅速的接收数据，为此，主动地用新卡替代从记录仪中取出的卡，这个过程是简单的，并且不需笔记本电脑。

1. Remove the lid from the Etna. 移去 Etna 上面的盖子。
2. Make sure the Event LED on the front of the unit is not flashing (this means the unit is writing data to the PCMCIA card). When the Event LED is not flashing (i.e., the LED is either continuously on or continuously off), switch the *OPER/STBY* switch to the STBY

position. 确定仪器前面事件发光二极管不闪烁（闪烁意味着仪器向 PCMCIA 卡写数据）。当事件发光二极管不闪烁（即发光二极管持续开或持续关），将开关打在 STBY（暂停位置）。

3. Push the Eject button on the PCMCIA drive. The card will pop up in the drive. Remove the card. 按下 PCMCIA 卡上的弹出按钮，卡会从驱动器槽中弹出。
4. Label the card so you know which unit it was removed from. 标记卡，以便知道它是从那台仪器取下的。
5. Insert a new, formatted PCMCIA card into the drive. (This card can contain a new autoload.par file to load onto the unit.) Push down firmly on the card until you feel a click; the Eject button should pop up. 插入一个新的格式化好的 PCMCIA 卡。（这卡中应装有一个新的自动装载文件（.Par），以便装入仪器上）。
6. Repeat Steps 3 through 5 for the second PCMCIA drive, if applicable. 如果需要，重复 3-5 步骤，安装 “ 从 PCMCIA 驱动器”B:。
7. Put the *OPER/STBY* switch back in the OPER position, and re-attach the Etna's lid. 将开关（OPER/STBY）复位到开（OPER）的位置，重新固定 Etna 的盖子。

Use QuickLook to view the event files on the PCMCIA cards you removed from the Etna. 从 Etna 记录仪中移出的 PCMCIA 卡上，用 QuickLook 软件查看事件文件。

CONFIGURING THE INSTRUMENT USING AN AUTOLOAD.PAR FILE 用自动装载文件（AUTOLOAD.PAR）配置仪器

If a PCMCIA card is inserted into the Etna with a valid parameter file called AUTOLOAD.PAR stored in its root directory, the recorder will load and use these parameters when its power is cycled. In this way you can reconfigure the unit in the field without using a laptop. 如果将含有正确参数称作 AUTOLOAD.PAR(自动装载文件)文件存在根目录下的 PCMCIA 卡插入 Etna 记录仪中，当记录仪周期性供电时，有用参数被自动装载。用这种方法，你可在现场没有可用的 laptop 计算机情况下，重新配置仪器。

Analyzing Data 数据分析

After downloading data from the Etna, you will want to view the data and analyze it. Kinemetrics provides QuickLook to let you visually examine the record and produce quick plots of the data. We also provide programs to convert the data to other formats so you can analyze it with your own favorite tools. Finally, Kinemetrics sells data analysis programs such as the

Strong Motion Analyst. 从 Etna 记录仪中下载数据以后，你需要查看波形或分析数据。Kinemetrics 提供的 QuickLook 软件让你能直观地看到记录数据和快速地制成图表。我们也提供将数据转换为其它格式的程序，以便你用自已喜欢的工具软件分析数据。最后，Kinemetrics 还出售数据分析程序，如“强运动分析（SMA）”。

QUICKTALK & QUICKLOOK 通讯软件

For instructions on how to use QuickLook to view event files retrieved from the Etna, refer to the *Using QuickTalk & QuickLook Software: User's Guide* in the back of this binder. 如何应用 QuickLook 查看从 Etna 记录仪中恢复回来的事件文件，请参考 *QuickTalk 和 QuickLook 通讯软件用户手册。*

GETTING DATA INTO OTHER PROGRAMS 使数据转入其它程序

Kinemetrics provides converter programs to translate recorder data into ASCII format. In addition, when in QuickLook you can use the right mouse button to copy a section of the QuickLook display to the Windows clipboard. From there, you can paste the display image into other Windows applications such as a Microsoft Word document. Kinemetrics 提供的转换程序是将记录仪的数据转为 ASCII 格式，另外在 QuickLook 窗口中，你可以用鼠标的右键按钮拷贝 QuickLook 显示部分到 Windows 剪贴板中，然后你可以用粘贴的方法将显示的图像粘贴到其它可用的 Windows 软件如 Microsoft Word 文件中。

KINEMETRICS-SUPPLIED SUPPORT PROGRAMS KINEMETRICS 提供的支持程序

Kinemetrics supplies the following support programs to both covert data and to use as the basis for your own data retrieval and analysis programs. These programs run under DOS or in a DOS window. Kinemetrics 公司提供以下支持程序，两个隐含数据和用于基础的数据采集及分析程序，这些程序运行在 DOS 或 Windows 系统的 DOS 环境。

Data in .EVT files is in binary A/D counts, +/- 8,388,608. 事件文件中的数据是二进制的。数模转换的范围为+/- 8388608。

QLCA	Graphically displays .EVT files (runs in 286 protected mode). 以图形方式显示记录的文件.EVT（运行在 286 安全模式下）。
KW2ASC	Converts .EVT files to ASCII floating point. One channel per output file. Full source code provided. 将.EVT 文件转换为 ASCII 浮点数字格式，每一个通道输出一个文件，并提供全部源代码。
KW2CNTS	Converts .EVT files to ASCII. Counts decimal, hex, or volts. One to six channels per output file. 将.EVT 文件转换为十进制、十六进制或电压表示的 ASCII 码。每个.EVT 的输出文件可多达 6 个通道。
KW2SUDS	Converts .EVT format to the SUDS binary format. 将.EVT 格式转换为 SUDS 二进制格式。
KW2V1	Converts .EVT format to the .DAT format for entry into the VOL1 program, which does double integration, acceleration → velocity → displacement. Allows user correction of sensor sensitivity. 将.EVT 格式转换为 DAT 格式并进入 VOL1 程序，进行二次积分，可将加速度变为速度、位移。允许用户修正传感器的灵敏度。
KWNTP	Displays histograms of channels of recorded noise or other data; runs in 286 protected mode. 显示通道记录噪声或其数据的直方图，运行在 286 安全模式下。 *Note: Use of KWNTP with the Makalu (formerly known as the Everest) is not recommended.* *注意：*不推荐使用将 KWNTP 程序用于从前的诸如 Everest 的文件。
KWPARD	Displays or prints an ASCII formatted instrument parameter file from a binary .PAR file. 从二进制.PAR 文件中显示或打印一个 ASCII 格式的仪器参数文件。

KWPHF	Displays or prints an ASCII formatted event header file from a .EVT file. 从一个.EVT 文件中显示或打印一个 ASCII 格式事件的头文件。
KWSUM	Displays a summary of a .EVT file in the same format as the instrument terminal window summary command. 在相同的格式下，在仪器终端窗口命令摘要中显示一个.EVT 文件的一览表。
KWTC	Analyze the time in a .EVT file's frame headers. Also can display the timecode bitmap in the frame headers. If the timecode is IRIG-E, it will attempt to decode it. 在一个.EVT 文件的帧头中分析时间。在帧头中也能显示时间代码位图。如果时间代码是 IRIG-E，它还将尝试破译它。
KWTRIG	Applies a selected trigger filter to a .EVT file and writes an output file of the filtered data, a .TRG file. 应用一个选择好的触发滤波文件处理一个.EVT 文件，并将滤波后数据形成一个.TRG 文件。

A .TXT help file supplied on the package disk documents each of these programs. 这是一个帮助文件，上述各个程序都在磁盘的软件包中。

KINEMETRICS' STRONG MOTION ANALYSIS PROGRAM
KINEMETRICS 公司的强震动分析程序

Kinemetrics' *Strong Motion Analyst* is an all-in-one interactive data analysis tool designed to help earthquake engineers, seismologists, and academic researchers process accelerograms recorded by strong-motion accelerographs. *SMA* features instrument correction, ground motion integration, Fourier and response spectra calculations, and V1, V2, V3 file format output. Contact Kinemetrics for more information on this program. Kinemetrics 公司的“强运动分析”是一个整体又相互配合的数据分析工具，它可帮助地震工程师、地震学家和高等院校的研究工作者处理强震加速度记录。SMA 强震记录分析程序的特点是包括仪器的校正、地面运动积分、富里叶谱和反应谱的计算以及 V1、V2、V3 文件格式的输出。如想更多地了解程序方面的信息，请与 Kinemetrics 公司联系。

Network Management System 台网管理系统

Kinemetrics' Network Management System (NMS) assists in the collection and storage of event files or continuously transmitted digital data from remote Altus recorders. NMS is highly suitable for use in small to medium size networks. Kinemetrics 的台网管理系统（NMS）帮助收集、存储事件文件或从远程 Altus 记录仪中连续不断地传输数据。NMS 非常适用于中小型台网。

NMS, which runs on Windows 2000, Windows 95, Windows 98 or Windows NT, supports up to 16 serial or TCP/IP ports, and if using modems in event dial-up mode, a configuration of more than 16 recorders is possible. In event mode, **NMS** automatically gathers data from recorders and can help manage their storage. **NMS** 运行于 Windows2000、Windows95、Windows98、Windows NT，连续支持 16 个串行口或 TCP/IP 端口。如果用 Modem，且恢复事件时用拨号模式，也允许用在大于 16 台记录仪的台网中。在事件模式下 **NMS** 自动呼叫，可从记录仪中收集数据，并帮助管理和存储。

While **NMS** is operating in "streaming data" mode, the software will monitor a small to medium sized network and detect and store the state of the network, much like a large recorder. It can also automatically execute external software to process the data. In addition, the software recovers errors to compensate for bad connections or when one part of the network experiences communication delays. 当 **NMS** 工作在数据流模式时，该软件可用于监控中小型台网，并能监测、存储台网的工作状态，很像一个大型记录仪。它也可以用外部软件来处理数据。另外，由于连接的损坏或台网和一部分受到通讯延误而发生错误时，该软件可以修复、校正。

NMS supports the Kinemetrics Serial Data Streams (SDS) protocol and operates in one of two modes: **NMS** 支持 Kinemetrics 公司的串行数据流（SDS）协议并可以在两种模式的任何一种下运行：

- Takes reports of earthquake events from Altus recorders and automatically gathers event files (the data) and acceleration peaks in near real time to a PC that is either directly connected or connected through modems. 通过 Modem 联接 PC 机和记录仪（或直接连接它们），能够准确实时地将 Altus 记录器中的地震事件形成报告，并且自动收集事件文件和加速度峰值。
- Takes continuously transmitted digital data from Altus recorders (maximum of six channels per recorder). It can display data in real time and do centralized triggering from the data being transmitted from the recorders, and stores the information at a local PC. 将 Altus 记录仪中数字数据持续不断地传出去（每台记录仪最多允许六个通道）。它能实时显示数据并实现中心触发，也能在一台本地 PC 机上存储信息。

Troubleshooting 检修故障

Refer to the *Common Problems* section in *the Using QuickTalk & QuickLook Software User's Guide* for instructions on how to troubleshoot your recorder installation. If you are at a remote installation and cannot get the recorder to respond, there is an alternative reset command. If the recorder receives this command it will reset. With the communication link open, type **$$Reset$$** (the case is important). If the recorder is responding to the serial port it will reset, which may allow you to re-establish communications.

参见 *QuickTalk 和 QuickLook Software 通讯软件用户手册*中的 Common Problems 章节，说明如何检修记录器安装故障。如果你是远程安装，且不能获得记录应答信息，这里有一条可选重新设置的命令。如果记录器接收到这个命令它将重新设置：

打开通讯连接（Communication Link）输入**$$Reset$$**(这种情况很严重)，如果记录器串行口有反应，它将重新设置，这种方法也可以帮助你重新建立通讯。

4. Maintenance & Service 维修和服务

Overview 总论

In this section we discuss recommended maintenance and service procedures. Regular maintenance is important not only to check the performance of the instrument, but also to verify that your setup is correct and that local conditions have not changed. Kinemetrics can provide training on these procedures, and set up a preventive maintenance program.

If you prefer to set up your own maintenance program, we suggest you follow the recommendations below. You should maintain your network on a consistent basis in order to provide the highest quality data.

本章介绍维修和服务的问题，并提出一些使用的 Kinemetrics 公司已有成果的建议。正规的维修，不但对于检查仪器工作状况，而且对于校验仪器设置是否正确以及现场工作环境是否改变都是至关重要的。对此 Kinemetrics 公司能够提供一系列建议使用的成果并提出一套预防故障的维护方法。

如果你宁愿建立自己的一套维护程序，我们希望按如下维修原则。为了取得最高质量的数据，你应保持你的网络具有稳定一致的工作环境。

Performing a Three Month System Check 进行最初 3 个月的系统检查

During the first three months after installation, you should verify the operation of the Etna to make sure the instrument is configured correctly and that the installation is functioning properly.

At three months, we recommend that you visit the recorder site and follow the procedures described in the *Regular Maintenance Check* section. This will allow you to see how the equipment is functioning, and if the conditions at the site are as you expect. A remote systems check cannot tell you if the unit is submerged in muddy water!

If you still wish to perform the check remotely, see the *Remote Systems Check* section.

At this time you may also want to decide whether the instrument parameters are optimally set to meet your scientific objectives. If you wish to revise the instrument settings, refer back to the *Setting Instrument Parameters* section in Chapter 3.

在 Etna 安装好之后的 3 个月期间，你应该校验其功能，设置一定要正确并合理安装了仪器应具备的功能。

到 3 个月结束时，我们希望你到记录仪现场去，按正规维修检查章节讲述的步骤逐一检查，看设备的功能如何，其工作环境是否得到保证。用远程遥控检查是不能知道仪器是否遭受水浸的。

如果你坚持用遥测检查方法，请参阅遥测系统检查章节。

这一次你也许要做出决定，使仪器的参数设定最符合你课题研究的需要。如果这时想修正参数设置，请参阅第 3 章设置仪器参数。

Performing a Regular Maintenance Check 实施正规的维护检查

Follow the procedure described below for the initial three-month system check and subsequent site visits.

If your unit cannot be contacted via modem, we recommend that you perform the following on-site maintenance check every six months.

Note: If you can use a modem connection to complete a system check remotely, we recommend that you do an on-site maintenance check every 12-18 months, depending on local weather and geophysical conditions.

If your Etna is located where growing vegetation could cover antennas or solar cells, you will need to check the site more frequently.

初用的 3 个月系统检查和安装环境巡视的过程如下。

若你的仪器不是经 Modem 连接的，我们建议每 6 个月逐点巡视检查一次。

注意：如果能通过 Modem 进行遥测检查，我们建议每 12-18 个月逐点检查一次（依据具体安装地点的气候和地球物理环境而定）。

若 Etna 安装地点处于植被良好地区，那么你应该多去检查以免树枝覆盖了天线或太阳能电池板。

Step 1 Performing an On-Site System Check 第 1 步执行现场系统检查

When you make an on-site visit, complete the tests described in the *Performing a Remote System Check* section. The only difference is, when running the system-voltage check, unplug the AC supply to the Etna, thus forcing it to run on its battery. Watch the battery voltage carefully.

If the battery is fully charged, the voltage should drop rapidly to about 12 volts and stay there. If the voltage drops within a few minutes to less than 11.7V, either the battery was not completely charged, or you need to replace the battery with a newer one.

Use a DVM to obtain a more accurate voltage just by measuring the voltage across the battery terminals while the battery powers the unit.

Under normal operating conditions, we recommend that you replace the battery every three years. Refer to the *Replacing Batteries* section for information on how to do this.

到每一个仪器安放点都要按照进行遥测系统检查章节讲的方法进行检查，唯一不同处在于此时要拔下交流电源插头，检查依靠系统后备电池工作的情况并测量运行时的电池电压。

若电池是充满电的，电压值约为 12V 并稳定于此值，若经过数分钟以后，降低到 11.7V 以下，不是电池未充满电就是电池老化需要换新的了。

使用 **DVM** 命令能获得更加精确的电压值（比用万用表跨接于正在供电的电池两极准确得多）。

在正常的操作条件下，我们建议每 3 年更换一次电池。参阅更换电池一节有具体说明。

> ***Caution!*** Reconnect the battery charger after completing this test.
>
> **告诫：**完成上述试验后，一定别忘记再插上电池充电器！

Step 2 Adjust the Accelerometers 第 2 步 校准加速度计

If the offset of the internal EpiSensors measures more than 5 milli-g they should be adjusted. Chapter 2 contains adjustment instructions. 如果内置式传感器的偏差大于 5×10^{-3}g，那么就应该校准传感器（见第 2 章）。

Step 3 Replace the Desiccant 第 3 步 更换干燥剂

To help maintain low humidity inside the Etna's enclosure, Kinemetrics places a packet of desiccant inside to absorb any water vapor, as well as a humidity indicator label that gives an approximate reading of the humidity level. We normally place both items beside the battery, in the battery compartment at the rear of the unit.

Check the indicator during every on-site visit: if the 50% relative humidity indicator dot is pink, replace the desiccant. We recommend that you replace the desiccant every 12-18 months. You can order new desiccant packets and humidity indicators (P/N 700049) from Kinemetrics.
Kinemetrics 公司为保持 Etna 仪器盒内的低湿度环境，出厂时在其中放了干燥剂和指示试纸，前者可以吸收盒内的水份，而指标试纸能表示盒内的湿度，我们通常每次都要换掉位于电池旁边的干燥剂和尾部（也在电池舱内）的湿度指示试纸。

这样判断各仪器安放点的干燥剂是否应该换；如果相对温度达到 50%，干燥剂上的小圆点就变为粉红色，说明应换。建议每 12-18 个月更换一次。新的干燥剂和指示试纸（P/N 700049）可以从 Kinemetrics 公司订购。

Step 4 Complete a Functional Test Before Leaving the Site 第 4 步临离现场前完成一次功能试验

Before leaving the site, retrieve and then delete any old files on the recorder's storage media.

Next, perform a functional test and/or an SRT and retrieve the files, leaving them stored on the unit for the next visit. This will allow verification of sensor parameters before and after subsequent events are recorded. Make sure to reconnect any cables and telecommunications equipment that has been serviced, and check that the AC power is connected. This is where your personally prepared procedure and detailed checklist can save you a repeat visit — or worse, a unit that will not operate until your next service visit! 离开站点前，恢复记录仪里的事件文件，再删除记录介质中的旧文件，然后进行一次功能试验（标定）和（或者）STR（分段测试）并恢复这些文件，最后将这些文件留在记录仪中以备下次检查时对照校验传感器的参数，同时，这个试验结果说明了当前传感器的灵敏度，为以后记录的事件文件留下一个参照。一定要记着恢复所有**电缆**的连接，包括原来使用正常的远程通讯设备。检查**交流电源插头**是否插

好。这个站点就是你制定的详尽检修项目具体落实的地方，稍有疏忽会使你再跑一趟，甚至更坏——直到你下次再来之前，它就不工作！

Performing a Remote System Check 完成远程系统检查

If your Etna is equipped with an internal PCMCIA modem or an external modem (or some other type of telecommunications link), you can remotely check its operations.

A remote check allows you to perform routine maintenance checks for the cost of a telephone call. We recommend you perform a remote check at least once every three months; it is an easy and inexpensive way to make sure the Etna is working. Many users perform this check on a weekly basis, to ensure their network is operating optimally.

To perform a remote system check, first connect to the recorder modem as described in *Answer Mode: Phoning Your Etna*, using either QuickTalk or your own communications package. Before you begin the remote check, retrieve any new event files from the recorder and store them on your PC.

Note: The following instructions assume you are familiar with QuickTalk and with the use of Terminal window commands. Refer to the *QuickTalk & QuickLook Software User's Guide* if you are unfamiliar with the QuickTalk interface.

如果 Etna 记录仪配置了内插的 PCMCIA Modem 卡或外接的 Modem（或其它种类的远程通讯链路），则可以对仪器进行遥测检查。

遥测检查使你仅花费电话费就可以进行一次例行维护检查，建议至少每 3 个月进行一次例行检查，因为它简单易行而花费又少却可以确定 Etna 是否有问题。许多用户基本上是每星期做一次远程遥测检查以确保他们的网络运行良好。

遥测检查：首先像“应答模式：呼叫 Etna”中叙述的那样连通记录仪的 Modem，使用 QuickTalk 或你自己的通讯软件包都可以。开始遥测检查之前，把记录仪记到的所有新事件文件恢复到你的 PC 机里。

注意:下述维修过程的叙述，假定你熟悉 QuickTalk 软件并且会使用终端窗口命令。否则参阅 *QuickTalk 和 QuickLook 软件*用户手册。

Step 1 Functional Test & Sensor Response Test

第 1 步 功能试验和传感器响应试验

Select **Recorder, Acquisition Control**, and **Functional Test** to run a functional test on the unit.

To perform a Sensor Response Test, open the Terminal window:

Enter **AQ OFF**

Enter **AQ SRT**

Enter **AQ ON**.

Retrieve the event files generated by these tests, then use QuickLook to make sure the records look correct. If they do, you have confirmed that the system can trigger and that the sensors are operational.

在主菜单中的，点击记录仪（Recorder）——采集控制（Acquisition）——功能试验（Functional Test），可以对远程记录仪发出功能测试指令。

也可以打开终端窗口，进行传感器响应试验：

键入 AQ OFF

键入 AQ SRT

键入 AQ ON

恢复这些由功能试验所形成的事件文件，再用 QuicklLook 查看这些波形是否正常，如果正常，你就可以确定系统能够触发并且它的传感器也是正常的。

Step 2 Checking Sensor Offsets 第 2 步 检查传感器的零位偏离

Check the sensor offsets by looking at the functional test record, or,

Enter **AQ DVM** in the Terminal window

```
* aq dvm
Press 'C' to clear accelerometer offset voltage,
Press 'S' to toggle accelerometer step voltage,
Press 'Z' to zero, or press any other key to
quit.

1:  -0.080  0.231  0.854
```

The unit displays a real-time reading of the voltage of its input channels in millivolts. For EpiSensors, we recommend that the offset be less than ± 5 milli-g. Refer to Table 1 for the 5 milli-g level in each of the possible deck configurations. If the offset exceeds this value, you may need to make a field visit to adjust the EpiSensor accelerometer offsets. The procedure for

adjusting the offset is described in Chapter 2 for internal EpiSensors and in the EpiSensor manual for adjusting external EpiSensors.
通过功能试验记录图查看传感器的偏差，或者在终端窗口键入 **AQ DVM**，终端窗口显示内容：

```
* aq  dvm
Press  'C'  压 C 键可以清除加速度计偏差电压，
Press  'S'  压 S 键可以触发加速度计的步进电压，
Press  'Z'  压 Z 键可以使之归零，或，压任意键退出该条命令。
1:   -0.080 0.231 0.854
```

在终端窗口上则显示实时数据，即该道输出的电压值（以 mV 为单位）。对于 Etna 内置的 EpiSensors 传感器，我们建议的标准为：偏差小于 5×10^{-3}g。如果偏差超过此值，你或许应该到现场去校准该加速度计的偏差，方法是第 2 章“内置 Epi 传感器”和“EpiSensor 手册的校准外部 Epi 传感器”一节。

Step 3 Checking System Restarts **第 3 步** 检查系统重启动

Enter **STA** in the Terminal window to check on the system status. The system displays a message similar to this:

```
Status for Recorder S/N 675
Restart Counts: 235 (reset status: 80)
Restart Time: Apr 17, 1997 19:30:52.000
Current Time: Apr 17, 1997 19:51:37.000 (GPS)
GPS: ON
Events: 2 (Errors: 0)
Acquisition: ON (NOT TRIGGERED)
Alarm: NOT TRIGGERED
Battery: 13.0 V
Temperature: 32.2 C
PEM Banks: 1
Drive A: 20 MB FREE B: NOT READY
*
```

This screen allows you to check the unit’s temperature and battery voltage, and verify that the timing works and is being synchronized by GPS. This screen also indicates the memory available on the PCMCIA drive, and how many events have been recorded since the last time you cleared the event counter.

Compare the entry in the *Restart Counts* field with the count at your last maintenance visit. Each time the reset count is incremented, it means the system went through a reset due to either loss of power or some other event. The cause of the last reset is shown as the reset status.

Be aware of these two codes:

- *Code 80H* indicates either the power to the recorder was turned off or the recorder lost power. If you didn't turn off the power, this means the recorder probably lost power for a long-enough time to discharge the battery backup. You should investigate why this happened.
- *Code 20H* indicates the recorder reset itself, from either a software watchdog reset or a user-initiated system reset. If the recorder resets itself frequently, it may have a hardware problem and you should contact Kinemetrics Technical Support.

在终端窗口输入 STA 命令来检查系统状态，系统显示类似下面一段信息：

```
Status for Recorder S/N 675
Restart Counts: 235(reset Status: 80)
Restart Time: Apr 17,1997 19:30:52.000
Current Time: Apr 17,1997 19:51:37.000(GPS)
GPS:  ON
Events: z (Errors: o)
Acquisition: ON (NOT TRIGGERED)
Alarm: NOT TRIGGERED
Battery:  13.0V
Temperature: 32.2C
PEM Banks: 1
Drive A: 20MB FREE   B: NOT READY
*
```

这些显示可使你检查记录仪的温度和电池电压，检验它被 GPS 同步的开始时间和系统时间。屏幕也显示 PCMCIA 卡当前有多大空间可以利用以及自从你上次清理事件计数器之后，又记录了多少个事件。

将你上次维护时记录的数字，与重启动计数字段处的条目数相比。每

重新启动一次这个记数均被增加，这意味着由于掉电或者某些其它事件曾引起过系统重新启动。最后一次重启动的原因就在上述屏幕显示的“重启状态”中透漏出来。

要意识到这两个码（在屏幕显示的重启状态字段）的含义：

- 代码 80H　指示两个原因造成的重启，要么是记录仪的电源曾被关闭过，要么记录仪掉电了。是要你并不曾关过电源，很可能是很长时间未给电池充电而电池的电又用完了。你最好调查一下为何如此。
- 代码 20H　指示系统记录仪自己重启动了。重启原因也许是由于看门狗软件，也许是由于用户重新初始化系统所致。若记录仪自己反复多次重启动，或许出现了硬件问题，你应该与 Kinemetrics 公司技术支持部门联系。

Step 4　Checking System Voltages　第 4 步　检查系统电压

From the QuickTalk Terminal window, enter **DG** to start Diagnostics Mode. When you see the Diagnostic Prompt (*DG>*), enter **ADC**. The unit displays a sequence similar to this:

```
Starting CPU16 ADC...
Press any key to abort
13.490V [1]  000H [2]  27.761C [3]  000H [4]
14.118V [5]    000H [6]              000H [7]
```

Note: The small numbers in brackets will not appear on your screen. They correspond to the numbers in the far left column in Table 3.

These numbers indicate the Etna's current system voltages and temperature. Check whether the numbers on your screen fall within the acceptable ranges shown in the table below.

从 QuickTalk 终端窗口输入 **DG** 进入诊断模式，当你看到诊断提示符（DG>）后，键入 **ADC**，系统显示类似下述的一段顺序信息：

```
Starting  CPU16  ADC…
Press any Key to about
13.490V(1) OOOH[2] 27.761C(3) OOOH(4)
14.118V(5) OOOH(6) OOOH(7)
```

注意：上述信息中**在括号中**的小字，在你的屏幕上是没有的。它们的

含义见表 3 左栏（序号）。

显示在你的屏幕上的这些数字，指示 Etna 当前的系统电压和温度。检查它们是否符合表 3 给出的正常值范围。

Table 3: Acceptable voltage ranges for an operating Etna

表 3 Etna 运行的允许电压范围

No. 序号	**System Variable** 系统参量	**Range** 范围	**Minimum** 最小值	**Maximum** 最大值
1	+12V Switched Voltage 开关电压	0-20 VDC	10.5	14
2	Not Used 无用	Ignore screen readings 忽略屏幕显示值		
3	Temperature 温度	-39 to 至 +89°C	-20°C	+70°C
4	Not Used 无用	Ignore screen readings 忽略屏幕显示值		
5	Charger Voltage 充电电压	0-14.2 VDC	13.5 VDC	14.2 VDC
6	Not Used 无用	Ignore screen readings 忽略屏幕显示值		
7	Not Used 无用	Ignore screen readings 忽略屏幕显示值		

If the Etna is operating correctly, all the voltages should be within the limits shown above.

If the voltages are too high or too low, the unit requires service. If the charger voltage is too low, there might be a failed power supply or insufficient AC power. If the internal or external battery is too low, their might be a charger or an AC power failure. There might also be a problem with the solar power supply, if one is in use. Visit the recorder site to determine the cause of the problem.

Press any key to return to Diagnostics Mode.

如果 Etna 正常运行，所有数据都应该符合上表。

如果电压太高或太低，记录仪系统则需要维修。如果充电电压太低也许是电源补充失效或交流电压太低所致。如果内部或外接电池的电压过低，则可能是没有交流电或充电器失效。但如果使用的是太阳能电池供电，则可能是太阳能供电系统的问题。应到现场去确定问题的根源。

敲任意键可返回到诊断模式。

Step 5 Checking GPS Condition 第5步 检查GPS状态

If your recorder has a GPS timing system, it should also be checked. While still in the Diagnostic Mode, enter **GPS ON** and then enter **GPS DIA**. The first command ensures that the GPS is powered up, and the second causes the screen to display specific information about the GPS system.

If the GPS was not already powered up, it will need a couple of minutes to acquire satellites. You can monitor its progress as it acquires satellites and then calculates time and position fixes.

Wait a few minutes and enter **S** to check the signal strengths of the satellites. The display will look something like this:

```
[47]SNR for satellites: 6
SV  7  5.89
SV  4  12.45
SV  2  12.41
SV  9  14.27
SV 26  3.40
SV 24  0.00
```

The display above shows that the GPS is acquiring six satellites, and three of them have good signal-to-noise ratios greater than 10 (see the right-hand column). If these numbers are all below 10, or are zero, it means you have a problem with either the GPS receiver or, more likely, the antenna and/or its position.

Enter **Z** to view the following screen information:

```
DG> gps dia<cr>
Power is ON (Free Field Mode)
No. of RTC Updates: 1
No. of Failed Locks: 0
Last GPS Lock At  : May 11, 2000  11:30:40.000
Last RTC Update At: May 11, 2000  11:29:12.000 (Drift:
< 1 ms)
Last Powered Up At: May 11, 2000  11:34:33.000
Last GPS Lock At  : May 11, 2000  11:29:14.000
Last RTC Update At: Jan 01, 1980  00:00:00.000 (Drift:
< 1 ms)
Last Powered Up At: May 11, 2000  11:28:08.000
Last Position:      34.139999N -118.099998E 208m
Average Position:   34.148647N -118.102386E 208m 9
samples
Will Power Down At: May 11, 2000  12:04:33.000
Next Power Up Time: May 11, 2000  12:04:33.000
DAC Value (Current): 2396
DAC Value (Dithered): 2395.2
DAC Value (in EEPROM): 2373
```

```
GPS antenna: OK
Commands:
H=health; S=signal levels; T=time, Z=GPS Status,
C=Clock Sync, F=GPS F/W Version, Q to quit
```

Look at these status readings carefully, because they contain important information.

"Mode" describes the GPS operating mode (free-field, master or slave) and is set with the EDIT mode command GPS.

"No. of RTC Updates" -- A large number of clock updates indicates the recorder has to resynchronize the clocks when it gets a lock;

"No. of Failed Locks" -- A large number of failed locks indicates the GPS is having difficulty acquiring satellites.

- Both types of readings suggest bad antenna placement. Another possible cause of a large number of RTC updates is that the "Power On" interval is too long and the oscillator has drifted more than ± 500µs.

"Last GPS Lock At" -- If the GPS successfully locked to satellites, the screen should display the last two times the GPS made time locks and the last two times the GPS powered up " Last Powered Up At."

"Last Position" and "Average Position" -- Indicate the position of your unit to a high degree of accuracy. You can use this information to fill in the unit's latitude and longitude.

"DAC Value" entries show the DAC values used to control the voltage-controlled oscillator frequency. These values can range from 0 to 4096 counts, but if the unit is working correctly and the temperature is close to 20^0C, they should range from 1250 to 2750 counts.

"GPS antenna" describes the electrical status of the antenna. The status will be either OK or open/short.

This completes the remote system diagnostic check.

Now, retrieve and then delete old files, leaving only the last functional test and SRT on the recorder for reference.

Enter **Q** to exit Diagnostics Mode.

Finally, end the call as described in the *Connecting a Recorder to the Modem* section in Chapter 2 of the *QuickTalk Users Guide.*

如果记录仪配有 GPS 适时系统，它也应该列入检查范围。这时如果仍在诊断模式，键入 **GPS ON**(回车)，然后键入 **GPS DIA**（回车）。上述第一条命令是给 GPS 上电，第二条命令是屏幕显示 GPS 系统的特殊信息。

如果 GPS 原来没有上电，则它还需要几分钟来搜索卫星。你这时可以监视系统搜索卫星和计算时间和定位的过程。

等待几分钟后，键入 **S** 可以检查卫星信号的强度。屏幕显示类似于：

```
[47]SNR for satellites: 6
SV   7   5.89
SV   4   12.45
SV   2   12.41
SV   9   14.27
SV   26   3.40
SV   24   0.00
```

上述显示说明搜索到 6 颗卫星，其中 3 个的信噪比超过 10（见右侧第一栏），如果它们都小于 10 甚至为零，则意味着 GPS 接收器、更可能是天线及天线的位置有问题。

键入 **Z** 去看下列屏幕信息：

```
DG＞ gps  dia  (回车)
Power is ON (Free Field Mode)
NO. of  RTC Updates:  1
NO. of  Failed Locks:  0
Last GPS Lock At:  月  日  年  时  分  秒
Last RTC Update At: 月 日 年  时  分 秒 (Drift:＜1ms ＝
Last Power Up At:  月  日  年  时  分  秒
Last GPS Lock At:  月  日  年  时  分  秒
Last RTC Update At: 月 日 年  时  分 秒 (Drift:＜1ms ＝
Last Power Up At:  月  日  年  时  分  秒
 Last Position:  纬度   经度   高程
 Average Position: 纬度   经度   高程   样本数
 Will Power Down At: 月  日  年  时  分  秒
 Next Power Up time:  月  日  年  时  分  秒
```

DAC Value (Current): 2396

DAC Value (Dithered): 2395.2

DAC Value (in EEPROM): 2373

GPS antenna: ok

命令 H=health; S=Signal levels; T=Time; Z=GPS Status; C=Clock Sync, F=GPS F/w Version ; Q=退出

仔细阅读这些状态参数，因为它们包含重要信息。

“Mode”描述这套 GPS 系统的工作模式（自由场、“主”、“从”GPS 模式之一），并且被设置成了带有编辑功能的 GPS 命令。

“NO. of RTC Updates”若显示更新时钟的一个很大的数字，提示记录仪进入对钟过程，时间系统正在重新同步。

“NO. of Failed Locks”若显示时钟锁定失败的一个很大的数，提示 GPS 很难搜索到卫星。

- 述两条信息均说明天线的位置不合适。RTC（更新时钟）出现 很大数字的另一个原因是“GPS 供电间隔”设置得太长，振荡器漂移时间超过 500ms。

“Last GPS Look At”一行文字的信息含义：如果 GPS 成功地锁定卫星，屏幕上将显示 GPS 最后两次锁定的时间和 GPS 最后两次加电的时间（Last Powered Up At）。

“Last Position”和“Average Position”信息指示记录仪的定位精度，你可以使用这条信息填写记录仪所在处的经纬度。

“DAC Value”信息显示 DAC 的值，通常用于控制压控振荡器的频率。该值在 0～4096 之间。如果环境温度接近于 20°C并且记录仪正常工作，这个值的范围仅在 1250～2750 之间。

“GPS antenna”指示天线的供电状态，这个信息可能是正常（OK）或开路（open）/短路（short）之一。

至此就完成了遥测系统的诊断检查。

恢复已记录文件并删除记录仪中的旧文件，仅留下本次最后那个功能

试验文件和 SRT 信息供今后参考。

键入 Q，退出诊断模式。

最后，中断遥测通讯（如 QuickTalk 用户手册的第 2 章“ 连接记录仪到调制解调器 ”所述）。

Replacing Batteries 更换电池

Because they lose their capacity over time, you should replace the recorder's internal battery at regular intervals. Kinemetrics recommends that you replace the batteries every three years in normal operating environments; more frequently if the unit’s ambient temperature is significantly above 20^0C. Read the *Safety* section before replacing the battery. 由于电池长年使用会失去容量，你应该定期给记录仪更换内部的电池。Kinemetrics 建议在正常运行环境中，每 3 年更换一次。要是环境温度经常超过 20 °C，要换得更勤些。换电池前请阅读“ 安全须知 ”。

Battery Specifications 电池特性

CE

We strongly recommend that you purchase replacement batteries from Kinemetrics. The standard Etna battery is a 12V, 6.5 amp-hour (P/N 840301) sealed lead acid cell with Faston terminal tabs, An optional 12V, 12 amp-hour battery (P/N 840503) is also available for the Etna. 我们特别提醒，请从 Kinemetrics 公司购买替换电池。标准的 Etna 电池为 12V/6.5Ah (P/N 840301),它是铅酸免维护蓄电池（带有 Faston 标签）。另一种 12V/12Ah 的电池（P/N 840503）也可以用于 Etna 记录仪。

WARNING! **Fire or explosion hazard**. Do not install a non-rechargeable battery in the recorder. Only install a sealed lead acid battery with specifications compatible with those above.

警告：火灾与爆炸的危险。记录仪不能使用非充电电池，只能使用具有上述性能指标的铅酸蓄电池。

If you store a battery, you should still charge it every six to nine months to prevent permanent loss of capacity. You can float-charge the battery at 13.5-13.8V or cycle-charge the battery, provided the current is limited to less than 2.4 amps and the voltage to less than 14.7V.

When the voltage reaches 14.7V, the battery will be damaged unless you convert the cycle charging to float charging. Kinemetrics ships batteries fully charged; make sure a battery is still fully charged before installing it. 储存的蓄电池，也必须每 6—9 个月充一次电，以防电池丧失容量。应该用小于 14.7V 的充电电压及 2.4A 以下的电流浮充或循环充放电。

除非使用浮充方式充电，蓄电池充电至 14.7V 将被损坏。Kinemetrics 公司的电池可以保证在安装使用之前是充满电的。

Battery Installation 电池安装

Follow the instructions below and refer to the next figure to install a new battery. 依照下述方法及图示安装电池。

Caution: Before installing the new battery, be sure it is fully charged. If the battery is uncharged, the recorder will charge it, but this can take some time — and if AC power is lost, the unit's power autonomy will be reduced.

告诫：安装新电池之前，一定要先将电池充满。否则，新电池安装之后，记录仪将给它充电，有时（如果交流电没有供给）会使系统的自备电能减少。

Install a new battery inside the recorder as follows:

1. Switch the recorder's *OPER/STBY* switch to **STBY**.
2. Remove the external power connector.
3. Disconnect the positive terminal (red wire) from the existing battery.
4. Disconnect the negative terminal (black wire).

WARNING! **Burn or explosion hazard**. Never place metallic objects (such as a screwdriver or your wristwatch strap) across the terminals of a battery. The metal terminals can get very hot. Handle batteries with care, and do not drop them or attempt to take them apart. Recycle used batteries, or dispose of them in accordance with local regulations. Do not throw used batteries onto a fire.

警告：燃烧或爆炸的危险：千万不要把金属器具放在电池上（像钳子、解锥之类）。金属短接将会产生高温。拆下电池时要小心，切勿使其摔到地上，也别拆卸分解电池，更不能把用过的电池放入火里，只能上交回收部门或者按当地规定处理它。

5. Unscrew the two screws on the battery bracket.
6. Remove the battery bracket.
7. Remove the old battery.
8. Make sure the rubber battery pad remains within the recorder (this pad keeps the battery from moving during transport).
9. With the same orientation, insert the new battery into the unit.

10. Reinstall the battery bracket and pad, and carefully re-tighten the screws.

11. Connect the negative terminal (black wire).

12. Connect the positive terminal (red wire).

13. Switch the *OPER/STBY* switch to **OPER**, and make sure the recorder functions properly.

14. Reconnect the external power connector to the recorder.

如下步骤安装内部电池：

1．将天关扳到 STBY 档；

2．拔除外接电池插头；

3．拔下原有电池的正极（红色）接线；

4．拔下原有电池的负极（黑色）接线；

警告：燃烧或爆炸的危险：千万不要把金属器具放在电池上（像钳子、解锥之类）。金属短接将会产生高温。拆下电池时要小心，切勿使其摔到地上，也别拆卸分解电池，更不能把用过的电池放入火里，只能上交回收部门或者按当地规定处理它。

5．拧下固定电池的两只螺丝；

6．卸下电池固定夹板；

7．取出旧电池；

8．一定要保证电池下面的橡胶垫保持原位（它起防震作用）；

9．如上相反顺序安装、固定新电池；

10．放好橡胶垫、细心放好电池并拧紧固定螺丝；

11．连接电池负极（黑线）；

12．连接电池正极（红线）；

13．将 *OPER/STBY* 开关扳到 OPER 档，确保记录仪功能正常；

14．重新将外接电源插到记录仪上。

Figure 14: Internal battery components

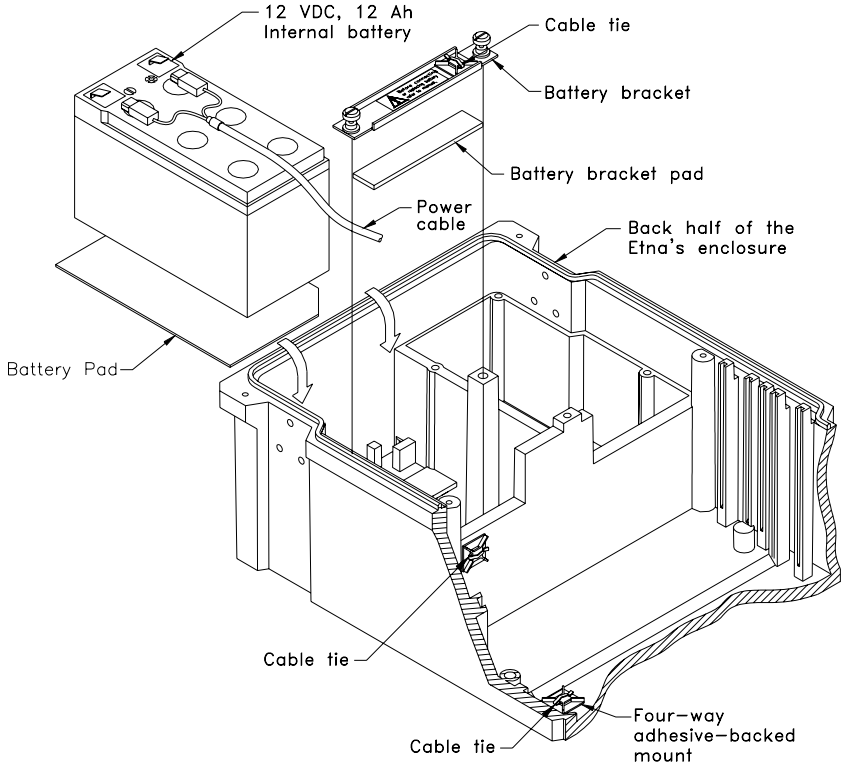


图 14　内部电池装配图

Battery Recycling 电池回收利用

We recommend you recycle the sealed lead-acid cells used in the recorder; if properly recycled they are environmentally friendly. You should be able to recycle used batteries at the same centers that recycle automobile batteries.

建议将用于记录仪的免维护铅酸电池回收利用。回收利用有益于环境保护。或许你也能在回收汽车电瓶同一个中心里回收用过的电池。

Replacing Fuses 更换保险丝

The Etna has four 2AG-size fuses located at the top of the front-panel PC board. Looking at the front of the case, the fuses are numbered from right to left, F1 to F4. The PC board is also silk-screened with the reference designator of each fuse.

If the fuses blow, try to determine the reason why. If the reason was some problem in the servicing of the unit, then the fuse served its purpose and you should replace it. If fuses blow repeatedly, there is a problem with your installation, or with the recorder itself.

You can obtain spare fuses from Kinemetrics, or from industrial electronic distributors.

Etna 记录仪的前面板后的 PC 电路板上有 4 只 2AG 系列的保险丝管。从右到左依次为 F1、F2、F3 和 F4。PC 电路板也印上了这些保险丝管的标记。

如果保险丝管熔断，首先要寻找其原因。若查明是因为仪器用久而熔断，只要换上同型号的即可。但反复烧断，就可能是仪器本身或是你安装的问题了。

从 Kinemetrics 公司可以获得备用的保险丝管，也可以从电子零件商店购到。

WARNING! Potential fire or electric shock hazard. Replace a fuse only with a fuse of the correct current, voltage and characteristic as specified in the table below.

Disconnect all power to the recorder before replacing the fuses, including the mains supply, the internal battery, and any external batteries, to avoid risk of electric shock.

警告：潜在的火灾和电击危险：换保险丝只能使用同型号的（电流值相同，见下表）。在更换保险丝之前，断开所有的电源，包括主供电电源、内置式电池、所有外接电池，以免电击的危险。

Change fuses F1-F4 as follows:

1. Turn the *OPER/STBY* switch to **STBY**
2. Remove the red wire from the battery.
3. Disconnect the battery charger from the unit.
4. Locate the blown fuse.
5. Use a plastic fuse-extraction tool to pry the fuse out from the clips.
6. Insert a new fuse with identical ratings (shown in Table 4).
7. Reconnect the red wire to the battery.
8. Reconnect the battery charger to the unit.
9. Turn the *OPER/STBY* switch to **OPER**.

更换 F1-F4 保险丝的步骤：

1．将开关扳到 STBY 档；

2．从电池正极上拔下红线；

3．拔下充电器的航空插头；

4．判明烧断的保险丝管的位置；

5．使用塑料制的保险丝管更换工具，将保险丝管从座上取出；

6．插入新的保险丝管（见表 4 规格）；

7．重新接通红色线至电池正极；

8．重新接通充电器；

9．将开关扳到 OPER 位置。

Caution: **Potential equipment damage.** All batteries and the battery charger should be disconnected before you service the equipment because power is supplied to some of the circuit boards even when the *OPER/STBY* switch is in the **STBY** position.

告诫：潜在的仪器损坏：开关即使在 STBY 位置,更换元件或维修也必须把所有电池、充电器等电源供给断开,否则,部分电路板仍然是有电的。

Table 4: Fuses and ratings

表 4　保险丝管的额定值

保险丝管	产品系列号	额定值	描述
F1	小型 225002 KMI 840744	2AG 2A	保护外部 12V 电池充电器线路及线路板
F2	（同上）	2AG 2A	保护外部+12V 主供电电池的线路及线路板
F3	（同上）	2AG 2A	保护内部+12V 主供电电池的线路及线路板
F4	小型 225．250 KMI 840717	2AG 0.25A	保护内置或外置传感器用电的直流/直流变换电源供电部分

CE

Fuse	Part Number	Rating	Description
F1	Littlefuse 225002 KMI 840744	2AG 2 amp	Protects wiring and PCB traces associated external 12V battery charger.
F2	Littlefuse 225002 KMI 840744	2AG 2 amp	Protects wiring and PCB traces associated with *external* +12V main battery.
F3	Littlefuse 225002 KMI 840744	2AG 2 amp	Protects wiring and PCB traces associated with *internal* +12V main battery.
F4	Littlefuse 225.250 KMI 840717	2AG 1/4 amp	Protects +/- 12V DC-DC converter on main board used to supply power to EpiSensor deck or external sensors.

Replacing PCMCIA Cards or Hard Drives 更换 PCMCIA 卡或硬盘驱动器

Contact Kinemetrics for a list of the current capacities and types of available storage media if you wish to replace or upgrade the capacity of your PCMCIA storage. We will also give you a list of supported media that you can purchase yourself. (Kinemetrics cannot guarantee that devices will work unless we have tested them.) Currently, Kinemetrics supplies SanDisk ATA compatible flash drives, operating over the industrial temperature range in a variety of sizes.

Note: **Do not use PCMCIA hard disks in an Etna with internal EpiSensors.** Their spin-up and seeking will get into the ADC data or produce vibration noise in EpiSensors.

There are both pros and cons to using flash cards and/or hard drives. Please contact Kinemetrics for more information in order to make the best choice for your situation.

Before using any new media, make sure it is properly formatted. To do this, place the new media in an available PCMCIA slot on the Etna and use the Terminal window FORMAT command. Then try to read the device in the PC you plan to use, to make sure that computer can read the card. If your PC cannot read the card, you should get the latest release of the PCMCIA drivers and try these. Kinemetrics' web site contains links to help you find the latest drivers.

As a final option, it is possible to format the card in your laptop and see if the Etna can write to the card. The possible problem with this option is that the format used may not be optimal, and the cards — particularly hard drives — might not be able to keep up when recording at maximum throughput.

如果想更换或扩容 PCMCIA 卡，请与 Kinemetrics 公司联系，可以得到当前最新的存储介质型号以及它的容量一览表。我们也将给你一份你可以自己购买的支持存储介质的清单（Kinemetrics 公司不能保证你购买的存储介质能够工作，除非我们试用过这些介质）。当然，Kinemetrics 公司也提供 SanDisk ATA 兼容闪存驱动器，它有多种型号规格,并且对工作环境温度的要求很低。

注释：在内置传感器的 Etna 记录仪中，不要使用 PCMCIA **硬盘驱动器**。因为它们旋转和寻迹的动作会干扰 ADC 数据，同时其振动也增大了记录数据中的噪声。

使用闪存记录器和 PCMCIA 硬盘各有利弊，请与 Kinemetrics 公司联系以获得更多的信息帮助你选取一种最适合于你的记录手段。

使用任何一种新的记录介质，都要进行适当的格式化处理。可以这样做，把新介质插入 Etna 记录仪的 PCMCIA 插槽内，从终端窗口输入 Format 命令，然后尝试在你使用的 PC 机上去读该驱动器，要保证你的 PC 机能读这个卡。否则你或许应设法得到最新发行的 PCMCIA 驱动程序，再重新试验。链接 Kinemetrics 公司的网站可以帮助你寻找最新版的驱动程序。

作为最后的选择，可以将这个卡放到你的计算机上进行格式化，然后看看 Etna 能否在这个卡上写入文件。如果不能，可能的问题是：所用的格式化程序也许不是最新版本，或者在记录高速传输的数据流时该卡不能保存数据—特别是用硬盘驱动的 PCMCIA 卡更易出现这种问题。

Caution: **Possible data loss**. If you format the cards in your laptop or are running streaming data protocol, the card may not keep up with the data rate and data could be lost.

告诫：可能丢失数据：如果在你的计算机上格式化过的 PCMCIA 卡，插在记录仪上或者运行数据流协议，这个卡可能因为不能以记录仪输出的数据率保存数据而导致数据丢失。

Cleaning the Etna 清洁 Etna 记录仪

Disconnect all power from the Etna before cleaning it. Then wipe off the exterior surfaces with a mild detergent and a damp soft cloth. 首先断开所有电源，然后用柔软的（低碳的）清洁剂擦拭外壳和表面，再用潮湿的软布擦干。

> ***Caution***: **Possible water damage**. Do not use water to clean the inside of the recorder. Doing so will severely damage the unit!
>
> **告诫：防止进水。**不能用水清洁记录仪内部，否则有损坏仪器之虞。

If you see dust or debris inside the recorder, we recommend you use a small "computer vacuum cleaner" to remove this debris. Make sure you have turned the power off and that no metallic parts can short between the two battery terminals or from the positive lead to the unit's case. 如果你看到记录仪内部有灰尘或碎杂物，建议你用一个小型的“计算机真空除尘器”来清除这些碎杂物。但要记着关掉记录仪电源并且别用金属物短路电池的两个极板，还要注意，拔下来的正极电源线不能碰上机器底板和仪器盒。

Troubleshooting & Service 故障检修和服务

If your Etna needs repair or service, we generally recommend that you return it to Kinemetrics. If you wish to diagnose hardware problems yourself, we provide some cautions below.

The procedure for loading new firmware into the unit is also detailed below. 假如你的 Etna 需要修理和服务，通常我们建议你发往 Kinemetrics 厂家。若你真想自己诊断某硬件问题，我们提出如下注意事项：

往仪器盒中装配新固件的流程也在这里详述。

Hardware Problems 硬件问题

> ***Caution***: Only a qualified electronic technician should diagnose and repair the recorder. Be sure the technician carefully follows both the ESD precautions and the precautions described in the *Safety* section.
>
> **告诫：**只有具有电气技术资格的专业人员才能检查与维修仪器，而技术人员也要仔细遵循本手册前面的提示以及在*安全须知*中的忠告。

Do not attempt to repair the unit at the component level unless you have equipment for re-working surface mount printed circuit boards and have gone through the appropriate Kinemetrics training course.

We recommend that you stop your diagnosis at the board level and send the entire unit back to Kinemetrics for repair.

除非你有恢复印刷电路板到正常工作的水平或所受过 Kinemetrics 公司专门技术训练，你别试图修理记录仪的组件。

我们仍建议你停止寻找组件故障的努力而将仪器送回厂家修理。

Installing New Firmware 安装新的固件

Kinemetrics constantly increases the quality and versatility of its instruments. When we develop new versions of Etna firmware we generally make them available either as a set of firmware disks (available on request), or for downloading from our FTP site.

Note: The Etna is delivered with the latest firmware installed. You only need to load new firmware to upgrade the unit.

Kinemetrics 公司不断地提高仪器质量并将拓宽仪器的用途。通常我们将更新了或升级了的固件在网站上发布或者作为固件磁盘的套件（应用户要求而提供）而使它们发挥作用。

注：Etna 是用最新版本的固件安装的。你从网站下载的软件只需释放到仪器中即可。

Caution: Before loading the firmware program, read the following procedure and the instructions that come with the firmware release. *Use only the instructions that accompany the firmware release.* Also be sure you have the correct versions of all programs.

If you have the wrong program version when you start the installation process, the recorder will not work until the right code is loaded. You can use the firmware selection matrix on Kinemetrics' web site to determine which version of software you require.

告诫：释放固件程序之前，阅读下述的说明和安装方法（随同固件释放过程就显示出来了）。仅仅用于随同固件释放的指令。你一定要有正确合法的全套程序。如果你有错误的版本，当你开始安装时，记录仪在发现正确代码以前将不能进行覆盖旧版本的工作。在 Kinemetrics 公司的网站上你可以选择所需要的固件下载。

Note: Before loading firmware, write down all the parameters currently loaded into the unit. Once the new firmware is loaded, reconfigure

these parameters exactly as they were. You cannot necessarily reuse an old parameter file because firmware releases often add new parameters. Incorrect parameters can cause the recorder to function improperly.

注： 在释放软件时，记下当前释放进记录仪的所有参数。一旦新固件释放完毕，重新配置这些参数（要和记录下来的参数完全相同）。你一定不能使用旧的参数文件（parameter file）,因为释放的固件通常增加了一些新参数。错误的参数能引起记录仪功能紊乱。

Caution: Be sure the internal battery is fully charged and that the power remains constant and steady before beginning the firmware replacement. Any interruptions or major fluctuations in the power supply could cause the recorder to lose its flash memory contents and disable it from reloading new firmware. If this happens, you may have to return the unit to Kinemetrics for repair.

告诫：在进行固件置换之前一定要把电池充满电并且使电池电压保持稳定。任何形式的断电或较大的电压波动都会引起记录仪丢失闪存存储器的信息并禁止重新调用新固件。若发生这种情况，则只能请你将仪器发回厂家。

Once you have read the whole procedure to ensure that you have an understanding of the entire process, come back and follow the instructions below step-by-step.

Normally, you will only need to install the new application block. Changes to the Boot Loader rarely occur, but will be considerably more complex than the generic procedure described here.
如果你读过全部过程并且明白了所有操作流程，就可以按下列的步骤做。

正常情况下，你只需要安装那一个新的应用固件块。程序自动在“根加载器（Boot Loader）”上改变很少出现的、但又比通常在这里描述的过程复杂得多的参数。

1. Insert the firmware disk into the appropriate drive in your PC. We recommend that you copy the files from the floppy disk to a directory on your hard drive. This will allow the download to go faster. If you downloaded the file via FTP, find those files on your hard drive. 将固件程序盘插入你的 PC 机的驱动器里，我们建议你将软盘的程序拷入硬盘的一个子目录中，它会加快下载软件的速度。如果你是借助于 FTP 下载的软件，就可以在你的硬盘上找到那些文件。

2. Use Notepad (or another text editor) to read the new firmware disk's Readme file, as well as any accompanying documentation. 就像看任何其它软件的说明一样，用 Notepad 文本编辑工具（或其它任何文本编辑器软件）读新固件的说明文件 Readme。

Caution: If the documentation that accompanies the firmware differs from the procedure described here, follow the new documentation supplied with the firmware update.

告诫：如果随固件提供的说明文件和这里叙述的不同，就用新的固件程序中的相应文件去刷新那个说明文件。

3. Start QuickTalk and open the Terminal window. (Or, use any terminal program that supports the XMODEM CRC transfer protocol). 启动 QuickTalk，再打开终端窗口（或者使用支持 XMODEM CRC 传输协议的任何终端窗口）。

Note: It is possible to reload firmware remotely to a recorder equipped with a modem or communication device. In this case, the Etna must be reset remotely using the **SYS**TEM **LOAD** command (not the SYSTEM RESET command, which is used for local firmware reloading).

注：使用遥测系统：通过一个 Modem 或通讯设备给远程记录仪加载固件可能也行。这时应该使用 SYSTEM LOAD 命令遥控 Etna 使之重新启动，而不能用 SYSTEM RESET 命令,因为后者仅适用于在记录仪近端直接给它加载固件。

4. Reset the recorder in one of the following ways:
   - Use the **SYS**TEM **RES**ET command
   - Flip the *OPER/STBY* toggle switch
   - Use the **SYS**TEM **LOAD** command to load firmware remotely via an internal PCMCIA modem. See *Altus Monitor Mode Communications*, Document 302219 for details on the use of the SYSTEM LOAD command.

After the header appears, a` series of dots (".....") displays at the bottom of the screen.

4.用下述方法之一重启记录仪；

- 使用 SYSTEM RESET 命令
- 关掉 OPER/STBY 开关再重新打开到 OPER 档

■通过一个内置 PCMCIA Modem 使用 SYSTEM LOAD 命令遥控记录仪，使它加载固件。参阅 Altus 监控模式通讯（文件号 302219）有关 SYSTEM LOAD 命令详细介绍。

当加载固件过程开始时，在屏幕上先出现头段信息，再出现一连串的点（“……”）。

5. Press the **SPACE BAR**. The Boot Loader main menu will appear, looking something like the list below:

Boot Loader Menu Commands

<A> Install new Application program

<B> Install new Boot Loader program

<E> EEPROM diagnostics

<P> Parameter block erase

<S> Set new baud rate

<Q> Quit and perform system reset

<X> Exit and restart Boot Loader without system reset

Enter Command [A,B,E,S,Q]???:

Note: As of application code version 2.88, the Application and DSP blocks have been combined into one. The Boot Loader no longer provides the option of separately loading the DSP block.

If you need to reload the Boot Loader program, follow the steps below. If you do not need to reload the Boot Loader, proceed to Step 10.

5．敲空格键，则加载引导程序主菜单出现，按如下定义可选择一些项目查看：

Boot Loader Memu Commands(加载引导程序主菜单命令)

〈A〉安装新的应用程序

〈B〉安装新的加载引导程序

〈E〉EEPROM 诊断（诊断电子可擦写存储器）

〈P〉删除参数块

〈S〉设置新的波特率

〈Q〉退出并且重启动系统

〈X〉退出并且重新引导加载，但系统不重启动

从上述定义的选项中，选择 A、B、E、S、Q 命令选项之一。即键入

命令选项 [A，B，E，S，Q].

注：从 2.88 版的应用程序开始，已经将应用程序和 DSP（数字台站）块结合在一起了。所以引导加载过程中不再提供单独的加载 DSP 块的软件。

如果你需要重新做一遍引导加载程序可依下面叙述操作，如不需要，直接跳到第 10 步。

Caution: When loading the Boot Loader, follow all instructions exactly. This is a critical process, where power must be maintained at all times.

告诫 ：重新启动的过程有非常严格的要求，下述步骤必须遵守，并且整个重新启动的过程中不能断电。

6. Enter **B** to load the new Boot Loader and enter **Y** to confirm the selection. *CCC*... displays on the next available line. This indicates that the Boot Loader is ready to receive new code. **You have just under 40 seconds to start loading the firmware:**

Select **Transfer** and **XMODEM Send** from the menu at the top of the screen (or use the appropriate command for your communication program).

When the Window File menu appears, select the application program's correct path and name from the disk. The filename format is *bot#####.img* (beginning with *bot*, then five numbers, then an *.img* extension).

6. 键入字母 B 以启动新的加载引导程序，键入字母 Y 以确定选项，这时在其下一行显示 CCC…。它表示引导加载过程已经准备好了，正在等待接收一个新代码。你要在 **40 秒以内**开始加载固件（程序）：

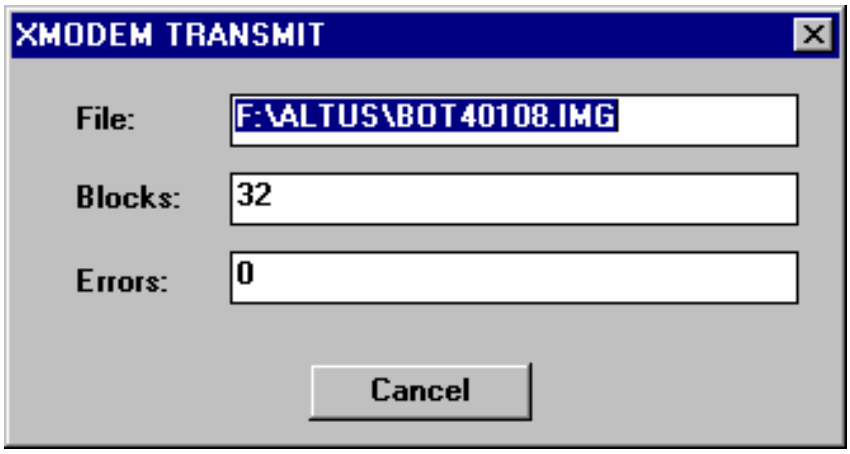
从屏幕顶部的菜单中选择传输（**Transfer**）和 **XMODEM Send**（发送）。或使用一条适合于你的通讯程序的传输命令。

当窗口文件（**Windows File**）菜单出现时,选择已经存在于硬盘上的应用程序正确的路径和文件名。这文件名的格式是 bot#####.img（用 bot 开头，后面是 5 个数字，扩展名是.img）。

7. Double-click on this filename to transfer the Boot Loader program and click on **OK** to begin the uploading sequence. 双击这个文件

名，则开始传输引导加载程序了。再回答 OK（单击）就自动按顺序加载了。

8. If you complete Steps 6 and 7 within the 40-second time period, the next screen will appear. 如果你在 40 秒钟内完成了第 6、7 步，就出现下一个屏幕。



While the file is loading, observe the XMODEM TRANSMIT screen. The number in the "Blocks" header should increase. 在文件加载过程中，要观察 XMODEM TRANSMIT（XMODEM 传输）菜单。如图中的 Blocks 字段处显示的数字应该是逐渐增加的。

Note: It is *not* a problem if the number in the "Errors" header increases. This means that XMODEM has had to retransmit a block of data. This happens often. *Windows message will appear if a real problem occurs.*

If the XMODEM TRANSMIT screen *does not* appear (as shown above), then you were not quick enough. You must go back to Step 6 and repeat the procedure.

If the XMODEM TRANSMIT screen *does* appear, go to Step 9. After the Boot Loader has uploaded successfully, the recorder will redisplay the Boot Loader's main menu (shown in Step 5).

注：如果图中的 Errors（错误）字段处的数字也在增加，这不是问题。它意味着 XMODEM 收到了一块重复传输过来的数据，这种重复传输的情况是经常发生的。假如真发生一个错误，信息窗（Windows message）就会出现提示。

如果上图所示的窗口不出现，那就得返回第 6 步去，重新进行第 6 步以后的各种操作过程。

如果上图所示窗口出现了，进行第 9 步。等加载文件顺利完成之后，记录仪将重新显示**引导加载的**（Boot Loader’s）主菜单（如第 5 步中的图示）。

9. After you have completed loading the new Boot Loader, enter **X** to restart the Boot Loader. The new Boot Loader will start and its menu will reappear. 如果你已经完成引导加载过程，键入 X，这时将重新引导程序，新的加载引导过程将开始并再一次出现引导加载的主菜单。

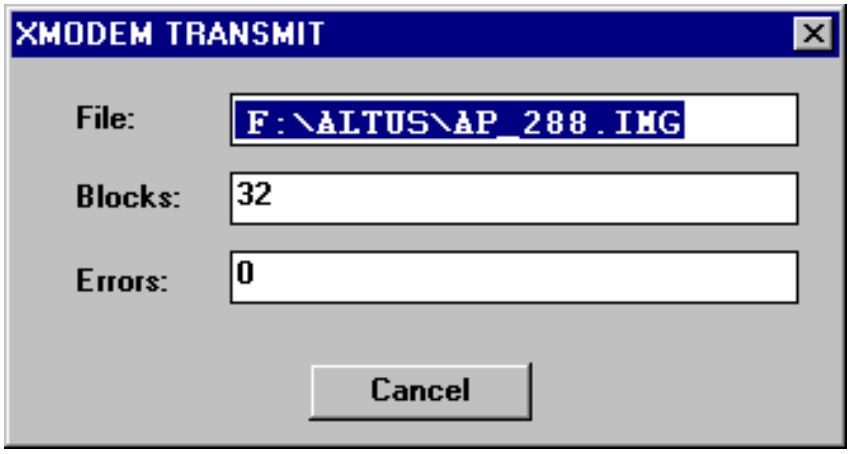
10. To load the new Application firmware, select **A** from the Boot Loader Menu and enter **Y** to confirm the selection. *CCC*... displays on the next available line. This indicates that the Boot Loader is ready to receive new code. You have just less than 40 seconds to start loading the firmware: 要加载新的**应用程序**时，在引导加载的菜单中，选择 A，点击 Y 去确认这个选项。则在其下一行里将显示 CCC…提示。它表示引导加载过程已经准备好了，正在等待接受一个新代码。你**要在 40 秒以内**开始加载固件（程序）：

Select **Transfer** and **XMODEM Send** from the menu at the top of the screen (or use the appropriate command for your communication program). 从屏幕顶部的菜单中选择**传输（Transfer）**和 **XMODEM Send（发送）**。或使用一条适合于你的通讯程序的传输命令。

When the Window File menu appears, select the application program’s correct path and name from the disk. The filename format is: *ap#######.img* (beginning with *ap*, then six characters, either numbers or letters with an underscore, and an *.img* extension). 当窗口文件（Windows File）菜单出现时,正确指定已经存在于硬盘上的应用程序的路径和文件名。这文件名的格式是 *ap######.img*（用 ap 开头，后面是 6 个符号，这些符号是下划线、数字或字母，文件的扩展名是*.img*）。

11. Double-click on this filename to transfer the application program and click on **OK** to begin the uploading sequence. 双击这个文件名，则开始传输该应用程序了。再回答 OK（单击）就自动按顺序开始执行了。

12. If you complete Steps 10 and 11 within the given 40-second time period, the next screen will appear. 如果你在 40 秒钟内完成了第 10、11 步，就出现下一个屏幕（见下图）。



While the file is loading, observe the XMODEM TRANSMIT screen. The number in the "Blocks" header should increase 在应用程序的传输过程中，观察上图的 XMODEM TRANSMIT（XMODEM 传输）显示。其中的 Blocks 字段处显示的数字应该是逐渐增加的。

Note: It is *not* a problem if the number in the "Errors" header increases. This means that XMODEM has had to retransmit a block of data. This happens often. *Windows message will appear if a real problem occurs.*

If the XMODEM TRANSMIT screen *does not* appear (as mentioned in Step 12), then you were not quick enough. You must go back to Step 10 and repeat the procedure.

If the XMODEM TRANSMIT screen *does* appear, go to Step 13. After the Application block has uploaded successfully, the recorder will redisplay the Boot Loader's main menu (shown in Step 5).

注：如果图中的 Errors（错误）字段处的数字也在增加，这不是问题。它意味着 XMODEM 收到了一块**重复**传输过来的数据，这种**重复**传输的情况是经常发生的。*假如真发生一个错误，信息窗（Windows message）就会出现提示*。

如果上图所示的窗口不出现，那就得返回第 10 步去，重新进行第 10 步以后的各种操作过程。

如果上图所示窗口出现了，进行第 13 步。等**应用程序块加载**成功之后，记录仪将重新显示**引导加载的**（Boot Loader's）主菜单（如第 5 步中的图示）。

13. After you have completed loading the firmware, enter **Q** to quit the Boot Loader. The recorder will reset itself. Allow the Boot Loader to start the new Application code.

After loading the new Application firmware into the recorder, enter the *DEFAULT* command in the Terminal window.

Re-configure the instrument with the parameters you wrote down at the beginning of this procedure with the QuickTalk Parameter Editor. This ensures that the parameter file is correct.

Do not reload an old parameter file into the recorder. The update may not function correctly using old information due to possible header format changes.

13. 在你完成加载固件之后，键入 Q 退出引导加载过程。这时记录仪自行重新启动，引导加载器得以使用新的应用程序启动记录仪。

    在把新的固件加载到记录仪中之后，在终端窗口键入 *DEFAULT* 命令。

    按你开始上述这一系列操作之前在 QuickTalk 参数编辑器中重新配置仪器。这时要保证参数文件是正确的。

    不要在记录仪上加载旧的参数文件。由于使用旧文件可能会改变头段信息的格式，以致影响仪器的功能。

Decommissioning & Recycling 退役及回收再利用

We can suggest a couple of uses and methods for recycling your recorder:

- Give it to a local school or educational establishment where it can be used to teach earthquake engineering and monitoring.
- Contact Kinemetrics to see if others may have a use for the equipment.
- Disassemble the unit, then recycle as many components as possible.

If you decide to disassemble the unit, proceed as follows:

1. Remove the battery from the unit and send it to a recycling center.
2. Remove the circuit board card retainer and the PCMCIA board.
3. Disassemble the metal shield by undoing all the bolts and studs.
4. Remove the GPS shield and receiver from the metal shield.
5. Remove the main system board.
6. Remove the front panel by undoing the nuts on the connectors. Remove any other connectors in the case or the lid.
7. Remove the EpiSensor deck from the case, then remove the sensor modules from the aluminum plate and discard them.
8. Turn the recorder over and remove the black anodized aluminum base plate from the unit.
9. Remove the stainless steel hardware from the outside of the case, along with the black nylon latches that hold the cover on the unit.
10. Separate the unit into separate material types, as listed below:

    Aluminum: Base plate, EpiSensor deck plate and deck cover, EpiSensor support columns, power supply shield, heat sink blocks, GPS shield, card retainer.

    Stainless Steel: Leveling feet, front handle attachments.

    Nylon 66: Black latches.

    Lexan (Polycarbonate): Case and lid coated with conductive paint.

These separate materials can now be sent to a recycling center.

我们能够提供两点建议，一是废旧记录仪的用途，另一个是回收方法。

■ 将记录仪放到某地的学校或其它教育机构，进行地震工程培训或用

于监测。

- 如有其它可以使用这种记录仪的方面，请与 Kinemetrics 公司联系。
- 分解仪器，然后把它拆为尽可能多的部件。

如果分解仪器、按下述流程：

1. 从仪器盒内拆下电池并将它发往“循环使用回收中心”。
2. 拆下电路板的固定卡和 PCMCIA 板；
3. 拧下所有的螺丝和螺栓等固定零件，拆下金属屏蔽壳；
4. 取下 GPS 的屏蔽层并从金属屏蔽壳上拆下接收器；
5. 拆掉主系统板；
6. 拆下前面板（拧掉固定螺丝）；拆下板上的所有其它连接件；
7. 从仪器盒内拆下 EpiSensor（传感器）控制板，然后从铝板上拆下传感器模块，并且丢弃它们；
8. 把记录仪翻转过来，拆下另一块黑色的铝底板；
9. 从仪器盒子的外面拆下不锈钢零件，它是用黑色尼龙插栓固定到记录仪的外壳上的；
10. 继续分解这个仪器到更小的部件：

    铝件：基板，EpiSensor 传感器模块底板和盖板，EpiSensor 传感器支撑件，电源供给舱的屏蔽层，散热器块，GPS 屏蔽罩，插卡的固定件。

    不锈钢件：调平螺钉，前面板的附件。

    尼龙 66：黑色锁扣（插栓）。

    聚碳酸脂：用导电涂层处理过的仪器盒和仪器盒盖。

现在也可以把这些材料发运到回收中心。

5. Reference 参考资料

Overview 总论

This Chapter provides an overview of the technical aspects of the Etna and is designed to provide a basic understanding of its overall operation. The first section gives an overview of the Etna's operation. The second section describes the Etna's electrical connections necessary for producing your own cables or performing advanced installations. 本章提供了 Etna 技术方面的概述，同时也为了给用户提供有关 Etna 总体操作的基本理解。第一部分是 Etna 操作的概述。第二部分介绍了制作电缆或进行高级安装必要的 Etna 的电气连接。

System Overview 系统纵览

The following is a simplified explanation of an Etna equipped with internal or external EpiSensors in its normal event-triggered acquisition mode:

1. The EpiSensor senses ground acceleration in three orthogonal directions and converts the acceleration levels to voltages. The output voltage from the EpiSensor or other sensor (seismometer, pore pressure sensor) is sent to the main system board ADC (analog-to-digital converter). The ADC is an over-sampled delta-sigma converter that converts analog voltage from the sensor to a digital data stream.
2. The digital data stream is then processed by the DSP chip to both filter the data and provide trigger information. This information is then transmitted to the system controller where the data is stored in the pre-event memory buffer. If the SDS is enabled the data is transmitted through the serial port.
3. Every 1/10 second, the system controller examines the various trigger streams to determine if the system should declare an event. The basic unit of data storage in the recorder is this 1/10-second "frame" of data

and UTC time code. If an event is declared, the system controller opens a temporary file in the '\TMP' directory on the primary PCMCIA device, then begins transmitting the data into the file (beginning with the pre-event buffer).

4. When the unit detriggers, the system controller moves the temporary file into the event storage directory. The controller then returns to monitoring the trigger condition.

The above describes the basic operation of the main system board (with the exception of the power supply system which controls and generates the required voltages). The front panel provides connections to the unit and the LED display. The PCMCIA board provides the two PCMCIA-compliant storage locations for the system.

Most of the circuit boards have a serial EEPROM that contains the circuit board's serial number, assembly drawing number, revision and other data pertaining to the board's manufacturer.

Note: See Appendix B: ID Bus Address Assignments for the EEPROM addresses and an example of using the EEPROM diagnostic command in the terminal window to interrogate one of the serial EEPROM devices.

配备了内部或外部传感器的 Etna，在正常的事件触发模式中做了简要说明。

1. 传感器在三个相互垂直方向上检测地面加速度，并把加速度强度转换成电压。把传感器或其它传感器（地震检波器，微孔压力计等）输出的电压输送到主系统板的 ADC（模拟数字转换器）上。ADC（模拟数字转换器）是一种将模拟电压转换成数字数据流的“过采样 δ — Σ 转换器”。
2. 数字数据流是 DSP（数字信号处理）芯片的输出，DSP 对数据信号进行了数字滤波并提供了触发判定信息。这个信息传送到系统控制器中，此处已经将数据贮存在存储缓冲器中。如果达到软件设置的“启动输出”判据，那么数据流就可经串口传送。
3. 每隔 1/10 秒系统控制器检测时刻变化着的触发数据流，以决定是否构成一个事件。记录器中数据存储的基本单位是 1/10 秒数据帧和 UTC 时间码。如果被判定为事件，系统控制器就打开 PCMCIA 驱动器上的“\TMP”目录中的临时文件，再把数据传送到文件中（以“事件前”时间内缓冲器存储的内容为开始）。

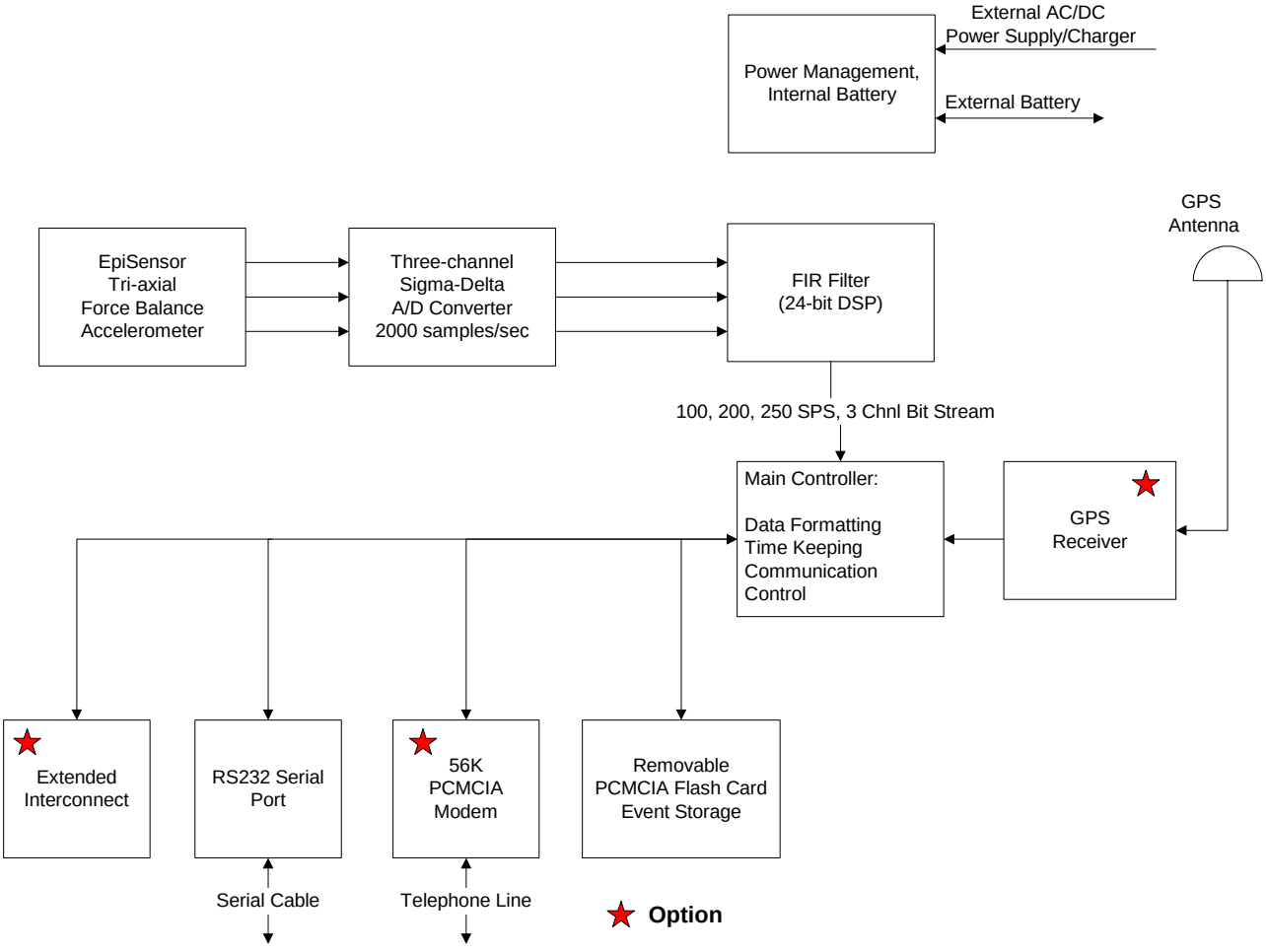
4. 当设备触发时，系统控制器把临时文件转存到事件存储目录中。然后，控制器返回到触发监控状态。

以上叙述了主系统板的基本操作过程（控制和产生所需电压的电源系统除外）。前面板提供了设备的连接接口和发光二极管显示。PCMCIA 为系统提供了两个 PCMCIA 卡适配器。

大多数电路板有一系列的 EEPROM（电可擦可编程只读存储器），包括属于厂商的电路板系列值、装配绘图值，修订版本号和其它数据。

注意：参看附录 B：为 EEPROM（电可擦可编程只读存储器）的地址分配了 ID 总线地址。使用 EEPROM 诊断命令，可在终端窗口上访问 EEPROM 驱动器之一（见例）。

Figure 15: Block diagram of an Etna
图 15：Etna 的简化框图



EpiSensor Deck Theory of Operation 传感器部件工作原理

This section describes the operating principles of the EpiSensor. Some options available in the ES-T are not available with the Etna's internal EpiSensor deck. Specifically, the internal EpiSensor is not equipped with the low noise option.

The EpiSensor deck consists of three orthogonally mounted force balance accelerometers (FBAs) – X axis, Y axis and Z axis. Each accelerometer module is identical and plugs into a board that provides the final output circuit and the carrier oscillator.

The next figure shows a simplified block diagram of the major components of each of the EpiSensors.

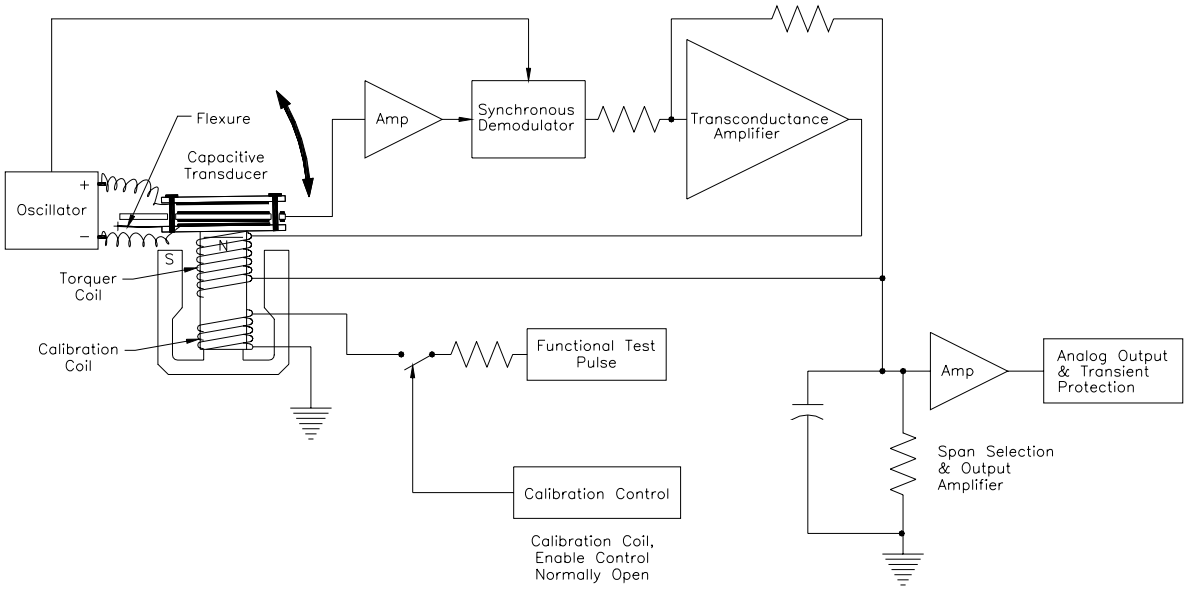
这部分叙述了传感器的工作原理，某些可以在 ES-T 中使用的选件；在 Etna 内部传感器板上不能使用。特别是内部传感器没有安装低噪声选件。

传感器板包括三个正交（X 轴，Y 轴和 Z 轴）安装的力平衡加速度计（FBAS）。每个加速度计的微型组件是相同的，并且插到一个最后输出和载波振荡器的电路板上。

图 16 表明了传感器各主要组件的简化框图。

Figure 16: Simplified block diagram of an accelerometer
图 16：加速度计的简化框图

Working Principle 工作原理



The oscillator applies an AC signal of opposite polarity to the two moving capacitor plates (also referred to as "the moving mass"). When the accelerometer is "zeroed" and when no acceleration is applied, these plates are symmetrical to the fixed central plate and no voltage is generated.

An acceleration causes the coil and capacitive sensor plates, which are a single assembly mounted on mechanical flexures (springs), to move with respect to the fixed central plate of the capacitive transducer.

This displacement results in a signal on the center plate of the capacitor becoming unbalanced, resulting in an AC signal of the same frequency as the oscillator being passed to the amplifier.

The amplifier amplifies this AC signal.

This error signal is then passed to the demodulator where it is synchronously demodulated and filtered, creating a "DC" error term in the feedback amplifier.

The feedback loop compensates for this error signal by passing current through the coil to create a magnetic restoring force to "balance" the capacitor plates back to their original null position.

The current traveling through the coil is thus directly proportional to the applied acceleration. By passing this current through a complex impedance consisting of a resistor and capacitor, it can be converted to a voltage output proportional to acceleration with a bandwidth of approximately 200 Hz.

Selecting a particular resistor value sets the full-scale range. A high accuracy network determines the resistor values, so the range can be set at 0.25g, 0.5g, 1g, 2g, and 4g without re-calibrating the sensor span.

The capacitor and overall loop gain are selected along with the resistor to ensure an identical transfer function on each range. *This is why two sets of jumpers must be changed together to modify the range.*

The voltage output of the resistor capacitor network is set at 2.5V for the acceleration value corresponding to the particular range. For example, with the 2g range, a 1g acceleration would cause a 1.25V output, on the 4g range, 1g would result in a 0.625V output.

This voltage is then passed into the low-power amplifier, which amplifies the signal by either 1 or 4 (selected by jumpers) to give a single-ended output of either 2.5V or 10V. A precision resistor network also determines this gain value.

振荡器将极性相反的交流信号加到可运动电容器的两个金属板上（有时也称金属板为“运动质量”）。当加速度计是“零”和没有加速度时，这两个金属板相对固定于中心的金属板是对称的，而且没有电压产生。

加速度使单独安装在机械弯曲部分的线圈和电容传感器板运动，运动指电容换能器相对于固定于中心的金属板而言。

这种位移导致电容器中心板信号的产生，电容器系统变成不平衡的，使一个和运动频率相同的交流信号送往放大器上。

放大器放大了这个交流信号。

然后，这个差动信号被传送到解调器进行解调和滤波，在反馈放大中产生一个“直流”残差项。

这个残差项产生流经线圈的电流而产生一个电磁“平衡”恢复力，迫使电容器的极板返回到最初的零位以补偿反馈回路的残差。

电流流经线圈立刻产生和加速度成比例的电压信号，这个电压产生的电流流过由电容器和电阻器组成的复合阻抗中，转换成电压输出。这个电压在大约 200Hz 带宽的范围内与加速度成比例。

选择一个特定的电阻值设置输出的满刻度范围。电阻器的值由高精度网络测定。这样可把满刻度档位设置在 0.25g,0.5g,1g,2g 和 4g，否则重新校准传感器测定范围。

调整电容、总回路增益值与电阻值以确保在每个满刻度档位都具有完全相同的转换功能。这就是为什么在改变满刻度范围时两个跳线的设置必须一起改变的道理。

为了使加速度值与特定的某满刻度档位相对应，电阻、电容网络的输出电压都设置在 2.5V。例如，在 2g 档位，1g 的加速度应当产生 1.25V 的输出；在 4g 档位内，1g 的加速度将产生 0.625V 的输出。

然后这个电压进入低频放大器，通过 1 或 4 倍放大（跳线选择），使末端的输出信号为 2.5V 或 10V。这个增益值（1 或 4）也由精确的电阻网络所确定。

Features of the Internal EpiSensor Deck 内置传感器板的性能

CAL COIL 标定线圈

Each EpiSensor module is equipped with a calibration coil. Applying a current to this coil simulates the effect of an acceleration applied to the sensor. This allows a much more thorough check of the sensor's performance than older techniques because a full range of test signals can be applied to the sensor.

The Etna provides all necessary controls and connections to operate the calibration coil or the EpiSensor deck when it performs a functional test or SRT. These automatic tests completely characterize the sensor.

If you wish to perform a manual calibration, use the information below.

The calibration coils are open circuit in normal use to prevent cross talk and noise pick-up. To utilize the calibration coil remotely from outside the unit, the calibration coil enable signal must be activated by applying a DC voltage of +5V to +12V with respect to ground.

A voltage signal applied to the calibration line when the CCE is active will cause all three EpiSensor modules to respond with an acceleration output of approximately 0.05 g per volt applied. The exact calibration coil sensitivity is provided on the data sheet of each module.

This voltage mode is used for automatically checking the response of the sensor. If you wish to use a current source to drive the calibration coils in a laboratory setting, they may be accessed by removing the EpiSensor's deck cover. Please see the *Advanced Installations* section for more information.
每个传感器组件都配有一个标定线圈。给这个线圈施加电流来模拟施加于传感器的加速度效果。这样就能可以对传感器性能进行更彻底的检查（与过去机械式标定相比），因为测试信号的满量程可以加到传感器上。

当 Etna 实施功能测试或分段测试（SRT）时，它提供所有必要的控制和连接来操作标定线圈或传感器板。这些自动测试完全涵盖了传感器的特征。

如果你希望进行手动标定，请使用下列信息。

在正常的使用中为了防止交越失真和噪声干扰，这个标定线圈是开路的。标定时，通过施加对地+5V～+12V 的直流电压，信号能使标定线圈运动。

当通讯控制设备（CCE）运行时，施加于标定线圈的电压信号利用大约 0.05g/V 的加速度输出，引起所有的三个传感器组件的响应。每个组件以数字形式提供了标定线圈确切的灵敏度。

这种电压模式用来自动检查传感器的响应。如要你希望在实验室设置中使用电流源驱动标定线圈，揭开传感器板的盖子就可以连接标定线圈。为了获得更多的信息，请阅读高级安装部分。

EEPROM 电可擦可编程只读存储器

The EpiSensor deck has a serial EEPROM that contains each sensor’s serial number and calibration data. This data can be loaded into the unit’s parameter menu by typing **DEF FAC** at the Edit Prompt in Terminal Mode.

Note: Since it is possible to accidentally alter this data, be cautious about entering the sensor parameters for an internal EpiSensor deck.

传感器板有一个串口 EEPROM,它装有每个传感器的串口号和标定数据。在终端模式的编辑提示符下输入 **DEF FAC**，厂家设置的默认值就能调入设备的参数菜单。

注意：意外地改变数据是可能的，所以对一个内部传感器板输入传感器参数时要谨慎。

Pole Zero Representation of the EpiSensor 传感器极零表征

EpiSensor accelerometers are closed-loop, force-feedback sensors measuring the relative displacement of a moving mass (plates) with respect to the sensor case. The sensor's transfer function (TF) depends almost entirely on the electronic components rather than on the mechanical components of the sensors. The influence on the transfer function of the mechanical damping, spring elements and internal RC low-pass filter in the trans-conductance amplifier stage within the closed-loop path of the sensor are negligible for most applications.

We have determined a good empirical model of the system, which uses two pairs of conjugate poles to represent the transfer function of the instrument. If this transfer function is corrected for the DC sensitivity of the sensor, the amplitude agreement is within ±.0.5 dB over the bandwidth of the sensor. The phase agreement is within ± 2.5° in the 0-100 Hz band and within ± 5° over the full bandwidth of the instrument. The phase response of the transfer function is fairly linear and equivalent to approximately 1.6 ms group delay for signals up to 200 Hz. This model can be represented as:

$$\frac{V(s)}{A(s)} = \frac{k1 * k2}{(s - p_1)(s - p_2)(s - p_3)(s - p_4)}$$

where k1 = 2.46×10^{13}

k2 = Sensitivity of sensor in V/g

s is the Laplace transform variable

p_1 = -981 + 1009i (Pole 1)

p_2 = -981 - 1009i (Pole 2)

p_3 = -3290 + 1263i (Pole 3)

p_4 = -3290 - 1263i (Pole 4)

V (s) is the Laplace transform of the output voltage

A (s) is the Laplace transform of the input acceleration

The next figure shows the amplitude, phase and step response of this pole zero representation. Additional references to pole zero responses and damping are available on the Kinemetrics website. Application Note 39 gives the response of the FIR filter used in the ETNAs DSP. The FIR filter response dominates the overall instrument response at sample rates up to 250 samples per seconds.

加速度传感器是锁相环回路的力反馈传感器，测量与传感器有关的

质量的相对位移。传感器的传输性能（TF）几乎完全依靠电子组件，而并非依靠传感器的机械组件。机械阻尼、弹性组件和内部 RC 低通滤波器（位于传感器锁相环回路中的传输—传导放大级中）对传输性能的影响在大多数情况下是微不足道的。

我们已确定了系统良好的实验模式，此实验模式使用两对同源电极表示仪器的传输性能。如果传输性能由传感器的 DC 灵敏度来校正，放大器的工作频段能符合传感器带宽 0.5dB 的要求，在 0—100Hz 频带内相位差小于 2.5°,在超过仪器满带之外较宽范围内相位差小于 5°。传输功能的相位响应是完全线性的，并且信号达到 200Hz 时大约有 1.6ms 的群延迟滞后。这个模式可用下式表示：

$$\frac{V_{(s)}}{A_{(s)}} = \frac{K_1 * K_2}{(s-P_1)(s-P_2)(s-P_3)(s-P_4)}$$

其中 K1=2.46×10^{13}

K_2=传感器的灵敏度（V/g）

S 是 Laplace(拉普拉斯)变换变量

P_1=-981+1009i(极点 1)

P_2=-981-1009i(极点 2)

P_3=-3290+1263i(极点 3)

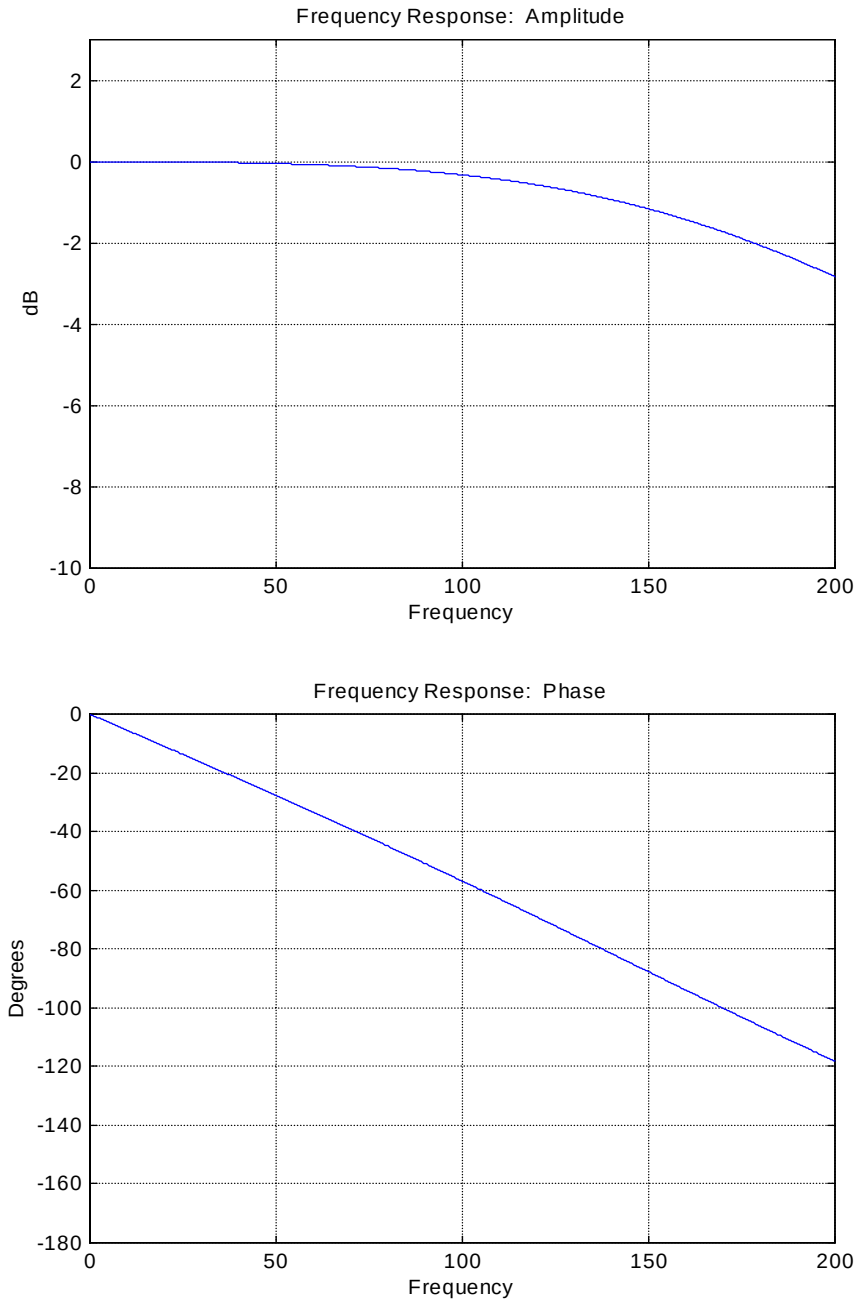
P_4=-3290-1263i(极点 4)

V（s）是输出电压的 Laplace 变换

A（s）是输入加速度的 Laplace 变换

下图表示放大、相位和零极点表征的阶跃响应。横轴为频率（Hz），纵轴为 dB 和度。另外有关极点和阻尼的附加参考，可以在本公司的网站上找到。补充说明第 39 条是关于用于 ETNA 仪器上的 DSP 中的傅立叶滤波器的说明。此滤波器可以支持采样率为 250sps 的工作状态。

Figure 17: Amplitude, phase, and step response
图 17：仪器的放大、相位和阶跃响应

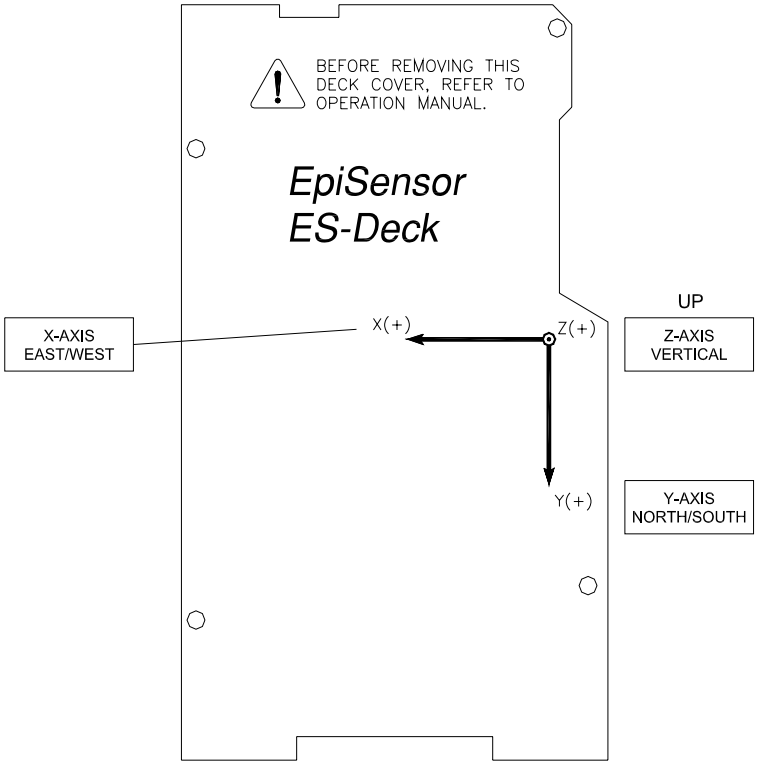


Polarity Conventions 极性约定

Unlike previous generations of Kinemetrics force balance accelerometers, the internal EpiSensor deck uses a right-handed X-Y-Z coordinate system with a positive output for acceleration along each axis.

Previous Kinemetrics FBA designs used an alternate coordinate system (L, V, T) and produced a negative output for positive acceleration along each axis. With modern feedback sensors, this convention dating from the days of passive seismic sensors is losing acceptance and this simpler convention is more useful.

Kinemetrics 力平衡加速度计不同于前一代设备，为了加速度沿每个



轴具有正的输出，内部传感器板使用右手 X-Y-Z 坐标系。

早期的 Kinemetrics FBA 设计使用交替坐标系（L，V，T），沿每个轴正向的加速度产生一个负的输出。现代反馈传感器的使用淘汰了无源地震传感器，而建立的这种简单的规范更加适用。

Figure 18: X, Y and Z coordinates

图 18 X，Y，Z 坐标，Y 轴指向北

External Sensors 外部传感器

An optional external EpiSensor I/O board (and connector) may be used in place of an internal EpiSensor deck. The board contains dual stage transient

protection and EMI/RFI filtering to prevent electrical transients from damaging the recorder and to prevent EMI emissions from the recorder or EMI/RFI from degrading the instrument's performance.

The optional external sensor I/O board connects the recorder to external sensors through a military-style circular connector.

The transient protection consists of a primary gas arrestor element followed by a series-impedance and a shunt Transgard® element. This protection circuitry limits the input signals to ± 14V with respect to the recorder's ground connection and a maximum ± 26V normal mode voltage between input pairs.

A "T" filter element composed of ferrite beads and a shunt capacitor provides the EMI/RFI protection.

The board also contains an ID EEPROM to store its serial number, assembly drawing and revision number

可选的外部传感器输入/输出（I/O）板和连接器，完全能代替内部传感器。它还包括双级瞬态保护和电磁干扰/射频干扰（EMI/RFI）滤波器，可以防止电子瞬态脉冲对记录器的破坏并避免电磁干扰（EMI）或射频干扰（RFI）对记录仪的影响，以免降低设备的性能。

可选外部传感器，将其输入/输出（I/O）端经由带电缆的军用式转接器可以连接到记录仪。

瞬态保护由串联阻抗组件、气体避雷器组件构成的电路构成，保护电路将输入信号限制到 14V（相对于记录器的地），而在对称输入时将正常输入电压限制在 26V。

“T”形滤波器由铁氧体圆环构成，旁路分流电容器提供 EMI/RFI（电磁干扰/射频干扰）保护。

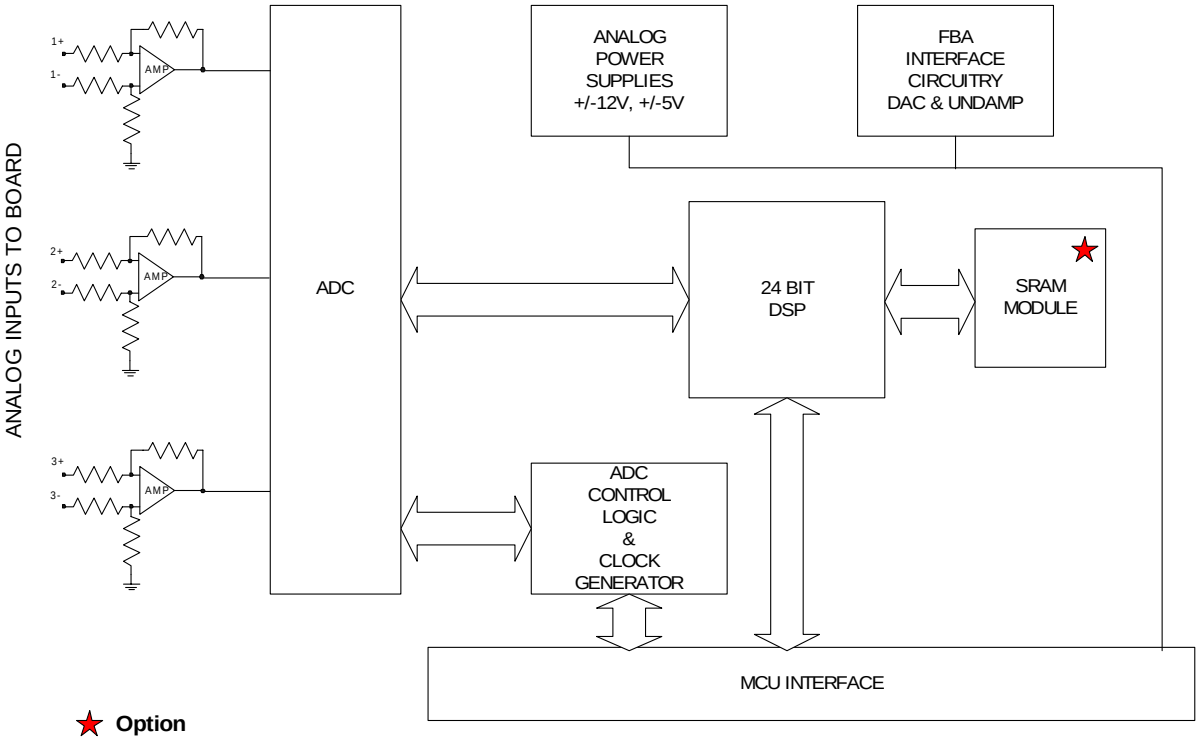
这个板也包括 ID EEPROM（标识符电可擦可编程只读存储器），以存储它的系列号、汇编图和版本数。

ADC/DSP Subsystem 模—数转换/数字信号处理（ADC/DSP）子系统

The EpiSensor sends signals to the ADC/DSP subsystem on the main system board, which performs an analog-to-digital conversion and filters the data stream for the required output rate. 传感器将信号传送到主系统板

上的模—数转换/数字信号处理（ADC/DSP）子系统，实施模拟/数字转换和对输出所需速率的数据流进行滤波。

Figure 19: Block Diagram of the 3-Channel ADC/DSP subsystem
图 19　3 信道 ADC/DSP 子系统框图



Analog Signal Conditioning 模拟信号的状况

For each channel, the analog signal passes through a signal conditioning amplifier and then through a single-pole RC analog anti-alias filter with a pole at approximately 6 kHz. The analog signal conditioning is configured as a differential amplifier. This provides approximately 40 dB of common mode rejection.

This stage is designed to accept high level input signals and offers an input range of ± 2.5V with an input impedance of 100 k.. The channel-to-channel isolation of the system (crosstalk) is better than 85 dB. This means that a large signal can be applied to one channel without affecting any other channel.

The inputs on this board are not transient protected. Connections from the internal EpiSensor deck do not require transient protection because the unit is internal to the Etna and not subject to EMI/RFI pick-up on cabling.

If external inputs are used, the optional External Input Board (P/N 109490) provides the required transient protection.

对于每一个信道，模拟信号都通过调节放大器，再经过单端 RC 模拟、去假滤波器（大约 6kHz）。为模拟信号调节配置了不同的放大器,提供大约 40dB 的共模抑制比。

这个阶段的设计能接收高达 2.5V 的输入信号，输入阻抗为 100k。系统信道与信道之间的隔离（防止串扰）超过了 85dB。这意味着一个较大信号出现在一个信道时而不至于影响其它任何信道。

这个板上的输入没有瞬态保护装置。内部传感器板的连接不需要瞬态保护，因为部件在 Etna 内部、而且不会受到电缆上拾取的电磁干扰/射频干扰（EMI/RFI）的影响。

如果利用外部输入,可选外部输入板（P/N 109490）,它能够提供所需的瞬态保护。

Caution! Do not connect external signals to the Main board input (J1) without providing adequate transient protection. Serious damage to the Etna could result.

告诫！没有提供充分的瞬态保护前，不要将外部信号连接到主板输入端（J1）上，否则将严重损坏 Etna。

The signal then passes into the delta sigma converter, which produces a digital output stream at 2,000 samples per second.

Data then passes into the 24-bit digital signal processor (DSP), which performs the filtering required to produce the final output sample rate. The filters in the DSP are designed to provide over 120 dB of anti-alias filtering at the final output rate's Nyquist frequency.
此后，信号进入 δ - Σ 转换器，产生一个每秒采样 2000 的数字输出流。

然后数据进入 24 位数字信号处理器（DSP），实施要产生最终输出采样速率所需的滤波输出。DSP 中的数字滤波器设计成在末级输出速率的奈奎斯特(Nyquist)频率上能提供大于 120dB 信号的去假频率滤波（Anti-aliasing filter）。

Table 5: Anti-aliasing filter information

表 5　去假滤波器信息

Sampling Rate/Hz 采样率	**Nyquist Freq./Hz** 奈氏频率	**Filter Cut-off Freq.** 截止频率 **(-3 dB Point/Hz**	**Group Delay for System/ mS** 群延迟时间	**Dynamic Range/dB** 动态范围
100	50	40	370	108
200	100	80	185	108
250	125	100	148	108

The group delay represents the delay for a signal through the filters in the ADC and the DSP software filters. In older versions of the Etna, the group delay of the ADC and digital filters were not compensated and group delay was shown in the file header. From application code 2.20 onward, the group delay in the event file header is 0.0 and the time stamps are accurate for the first scan and the trigger scan.

Note: When comparing data that is being correlated with other systems operating at different sampling rates, or when the UTC time of arrival is required, the group delay of the digital filters in both systems must be considered.

The Etna's trigger filter is implemented as a simple IIR filter with an approximate bandwidth of 0.1 to 12.5 Hz.

There is no channel-to-channel skew in the Etna because there is only one three-channel ADC. All channels are contained in the same device and all channels sample from the same clock.

The Etna stores data as 24-bit signed integers with the least significant bit used as a clip indicator. This bit is only set if a sample within the FIR filter width exceeds the limits of the ADC. The clip indicator bit can be used in

these cases to determine where the input levels to the unit were exceeded. The ADC/DSP transmits data to the MCU via its host interface port where it is stored and processed.

群延迟代表通过 ADC 和 DSP 软件滤波器的延迟。旧版本中，ADC 和数字滤波器的群延迟没有被补偿，而且群延迟显示在文件的头段信息。在应用软件 2.20 版以后，事件文件头段信息中显示的群延迟是 0.0，这对于首次扫描和触发器扫描的时间标记是精确的。

注意：用其它不同的采样速率，或运行的有关时间校正的程序时，或者用户要求知道波形到达的精确 UTC 时间时，则必须考虑两个系统中数字滤波器的群延迟。

Etna 的触发滤波器配备了一个简单的 IIR 滤波器（大约 0.1～12.5Hz 的带宽）。

Etna 没有信道--信道的偏移，因为三个信道共用一组 ADC，即所有的信道都包含在同一的设备中，而且所有的信道采样都来自同一时钟。

Etna 采用正整数标记的 24 位数据存储，此最小区分位作为快速指示器来使用。如果在 FIR 滤波器带宽之内的采样率超出了 ADC 的限制，那么这个“位（bit）”就是唯一的。快速指示器的“位”能够在这些情形中测定加到设备的信号是否超出了设备的输入标准。ADC/DSP 组件把数据传送到 MCU（**程序控制单元**），在那里继续进行数据存储和处理

OTHER ADC-RELATED FEATURES 与 ADC 有关的特性

The Etna main board also contains two isolated and heavily filtered power converters for supplying power to the EpiSensors and the analog-to-digital converter. This technique, combined with the use of a multi-layer circuit board with guarded traces, accounts for the excellent noise performance of the Etna.

The board also contains a control line for the calibration coil enable (CCE) signal and a 12-bit DAC to produce the calibration sequence (functional test) for the EpiSensor.

为了给传感器和模数转换器提供电源供给，Etna 主板上也有相互独立、大功率电源滤波转换器。此技术与带有屏蔽的多层电路板的利用相结合，使 Etna 具有极低的噪声指标。

主板也包括标定线圈启动（CCE）信号的控制和产生传感器标定序列的 12 位 DAC（数字模拟转换器）。

MCU Subsystem 程序控制单元子系统

Data from the ADC/DSP subsystem is passed to the MCU, which:

- Determines when to store an event
- Stores the event
- Communicates with the users
- Directs the operation of the DSP coprocessor
- Provides the interface for the GPS option

The MCU subsystem is comprised of:

- A Motorola HC16 microcontroller (16-bit) equipped with 256 kbytes of RAM
- 512 kbytes memory to store firmware
- A 16550-type UART for the user interface port
- A main oscillator, real time clock and GPS timing registers
- An interface to the PCMCIA storage system

The HC16 also provides the diagnostic ADC and the GPS serial port for communicating with the optional GPS system.

数据由 ADC/DSP 子系统传送到 MCU，MCU 的功能有：

■确定何时存储事件

■存储事件

■用户通信

■引导 DSP 协处理器的运行

■为 GPS 可选部件提供界面

MCU 子系统包括

■Motorola HC16 微控制器（16 位），并配备 256KB 的 RAM

■存储固件的内存为 512 千字节的存储器（Flash）

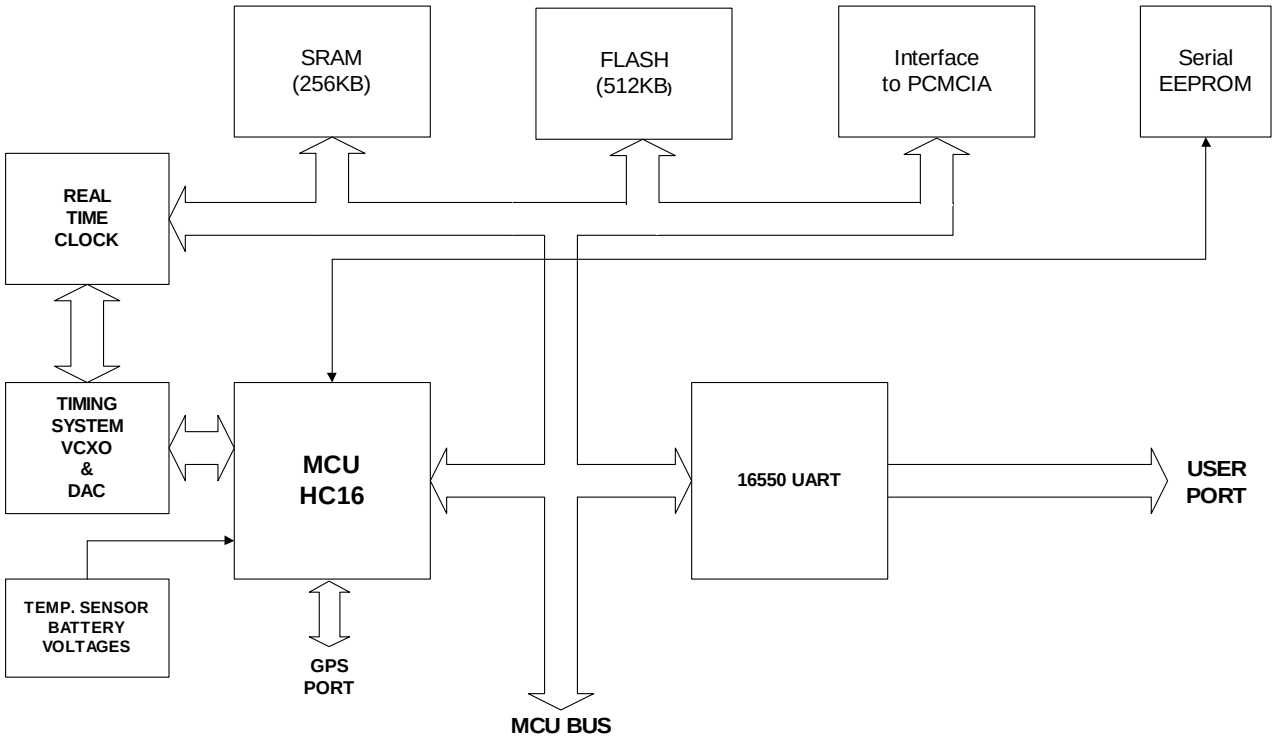
■16550 型 UART（通用异步收发器）给用户提供界面端口。

■主振荡器、实时钟和 GPS 同步寄存器。

■PCMCIA 存储器系统界面

HC16 也提供了 ADC 和为了与可选 GPS 系统通信的 GPS 串口诊断程序

Figure 20: Block Diagram of MCU subsystem
图 20：MCU 子系统的诊断框图



Flash Firmware Operation 闪烁存储器中固件的运行

Etna firmware is stored in flash memory. This allows the system's firmware to be upgraded in the future via the serial port from either a local PC or over a modem using the Boot Loader program. Instructions on loading new firmware will be contained in a README.1ST file on the firmware disk and at the Kinemetrics website, www.kinemetrics.com. Follow the instructions supplied with new software to make sure you are using the correct procedures for that particular update.

Etna 固件储存在闪烁内存中。将来允许系统的固件从当地的 PC 机或者通过 Modem 利用引导装载程序经串口升级。有关装载新操作系统的说明包含于固件磁盘的 README.IST 文件中以及 Kinemetrics 的 WWW.Kinemetrics.com的网址中。遵照有关新软件的说明来确保特定更新的正确进程。

Timing System Operation 时间系统运行

The Etna's time base utilizes a voltage-controlled oscillator controlled by a 12-bit DAC on the main board. In a system without a GPS timing option, this oscillator is factory adjusted to give a 14.366 MHz clock frequency. The user can readjust this in the lab by measuring the 1 PPS output from the Etna with a high accuracy counter and adjusting the DAC with the DAC command in the Diagnostics menu.

The variation of this oscillator is approximately ± 50 PPM over the operating temperature range of the Etna. A worst-case frequency drift of approximately one minute per month could be seen using this oscillator alone to drive the real time clock. The real time clock can be set using QuickTalk. For improved accuracy, a time synchronization pulse can be applied to the Extended Interconnect Option connector.

If the Extended Interconnect Option is installed, the 1 PPS output is available on the front panel interconnect connector. Alternately, the 1 PPS signal can be measured internally.

In systems with the optional GPS receiver, the GPS system both synchronizes the absolute time and adjusts the crystal frequency to achieve vastly improved timing performance. The operation of the GPS system is discussed in the *Altus GPS Timing Systems User's Guide*, Document 302205.

Etna 的时间基准由主板上的 12 位模数转换器（DAC）控制的电压控制振荡器提供。在没有配备 GPS 同步可选件的系统中，这个振荡器给出 14.366MHz 的时钟频率是由厂家调好的。用户可以通过测量来自 Etna 高精度技术的 1PPS（脉冲/秒）输出以及通过“诊断菜单”中的 DAC 命令，微调 14.366MHz 的时钟频率。

超过 Etna 的运行温度范围时，此振荡器的变化大约为±50PPM。使用振荡器连续驱动实时钟，能观察到最坏情况下因频率漂移引起的钟差，大约为每月 1 分钟。能利用 QuickTalk 设置实时钟。为了提高精度，应用于扩展互连时，可选同步连接器。

如果安装了扩展互连选件，1PPS 的输出可利用到前面板的互连连接器上。在仪器内部能交替地测量 1PPS 信号。

在使用了可选 GPS 接收器的系统中，GPS 系统既能实时同步时钟，也能调整晶体振荡频率，提高同步性能。Altus *GPS 时间服务系统用户手册*（文件 302205）中讲述了 GPS 系统的操作。

Power Supply Subsystem 电源子系统

The Etna is designed to run off either an externally-connected nominal 14 VDC charging voltage supplied by the wide input battery charger and generated from the local AC power, or from an externally supplied 12V source such as a battery. The voltage from the charger is used to charge both the internal and external batteries (if present) and to supply the power to the Etna's high efficiency switching regulator, which produces the system's main 5V power supply. If AC power fails, the battery supplies power to the Etna.

Alternatively, if AC power is not available, you can use a float charged external battery as the Etna's sole source of power. This float charge can be derived from a solar power system, consisting of a solar cell and a solar voltage regulator system if desired.

The Etna contains a power supervisor chip that shuts down the main system when the voltage from the batteries drops below 11.0V. The chip then cuts the power to the timing circuitry when the voltage falls below 10.5V. This feature prevents damaging deep discharge of the system's batteries.

The MCU can also command the power supply to cut the main system power when it senses the OPER/STBY switch has been moved from *Operate* to *Standby* or when the supervisor senses the voltage has fallen below the 11.0V operating threshold. Either of these actions alerts the MCU, which then commands the power to shut off after closing any open files and completing any other "housekeeping" tasks.

If the Etna has shut down due to loss of power (rather than by placing the OPER/STBY switch in the Standby position), it will automatically return to full operation once the battery voltage reaches 11 volts when power is restored.

The Etna employs a high efficiency synchronous switching regulator that generates the 5V power from which other system voltages are also created.

A block diagram of the power supply is included below.

Etna 设计成利用当地交流电源由宽输入电池充电器提供的外部连接，由标称 14V 直流电压供电，或者使用外部提供的 12V 电池供电。来自充电器的电压用于给内部和外部电池（如果存在）充电，并且为 Etna 高效开关调整器提供电源。调整器用以产生为系统供电的 5V 主电源。如果交流电中断，电池给 Etna 供电。

如果没有交流电源可以利用，你可以使用浮充外部电池作为 Etna 的唯一电源。这个浮充装置来自太阳能电源系统，包括太阳能电池和太阳能电压调节系统（如果需要）。

当电池电压降低到 11.0V 时，Etna 内的电源管理芯片切断主系统电源。当电压下降到 10.5V 时,芯片切断时间电路电源。这种设计防止了系统电池的深度放电损害电池。

当程序控制器（MCU）检测出 OPER/STBY 开关从“ Operate ”（运行）扳到“ Standby ”（等待）状态时，或者当管理程序检测出电压降低到 11.0V 的临界值时，MCU 也能命令中断主系统电源的供电。这些情况中的任何一种都能使 MCU 发出报警信号。在关闭所有打开的文件和完成任何其它“ 内务处理 ”的任务后，MCU 才命令切断电源。

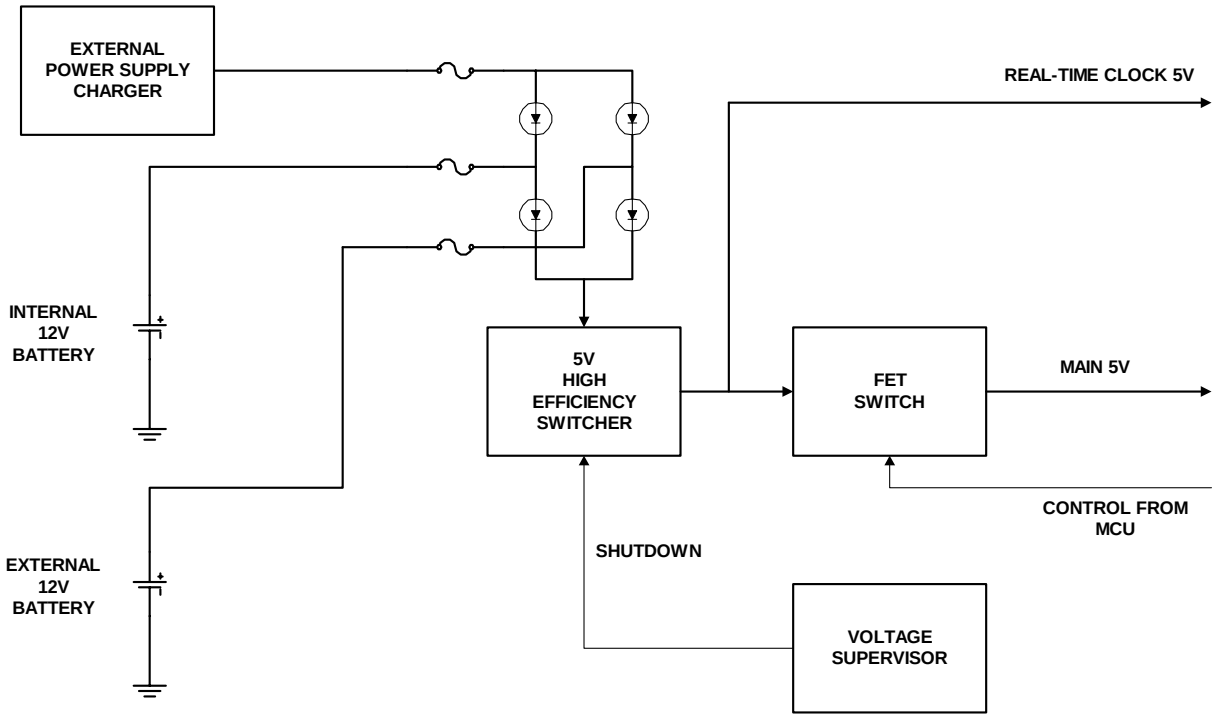
如果 Etna 由于电源降低（而不是通过将 OPER/STBY 开关人为地扳到“ 等待 ”的位置上）而切断,一旦电池电压恢复到 11V 时，Etna 将自动地返回到正常的全程操作上。

Etna 使用一种高效同步开关调整器产生 5V 电源，也作为其它系统的电源。

电源框图见图 21，其中英文是：

外部电源充电器　　至实时钟系统 5V
内置 12V 电池　　主系统 5V 供电
外置 12V 电池　　来自 MCU 的控制线
5V 高效开关　　场效应管开关
电压管理器

Figure 21: Block diagram of power supply
图 21　电源框图


EXTERNAL
POWER SUPPLY
CHARGER
REAL-TIME CLOCK 5V
INTERNAL
12V
BATTERY
5V
HIGH
EFFICIENCY
SWITCHER
FET
SWITCH
MAIN 5V
CONTROL FROM
MCU
SHUTDOWN
EXTERNAL
12V
BATTERY
VOLTAGE
SUPERVISOR

Front Panel Board 前面板（面板）

The front panel of the Etna provides the standard connections for external power and RS-232C connections. Each I/O line of the Etna is protected against EMI/RFI and ESD using a network of Ferrite beads, capacitors, and Transgard devices. The power supply input has additional gas arrestor transient protection. The front panel also contains the LED display. The system fuses and the battery connections are located at the top of the front panel as are the battery connections.

Etna 前面板上有外部电源和 RS—232C 标准接口。Etna 每一个 I/O（输入/输出）线都使用由压敏电阻、电容器和半导体元件组成的网络，保护其免遭电磁干扰/射频干扰（EMI/RFI）和静电放电（ESD）。电源输入端还有气体避雷器瞬态保护器。前面板也包括发光二极管指示灯。连接电池时，系统和电池连接的保险丝位于前面板内侧电路板的顶部。

PCMCIA Board PCMCIA 板

The Etna is supplied with two fully compliant PCMCIA card slots that can accept Types I, II, and III PC cards. The cardholders are mounted on the PCMCIA board in the recorder.

Firmware supports only a selected number of PCMCIA devices. Please contact support@kmi.com to find out which devices are supported.

Note: Slot B has a parallel connector on the back of the card that will accept a PCMCIA modem or other supported communication device PCMCIA with its output cable. If the rear connector is used this way, you *cannot* install a PCMCIA card in cardholder B — this would conflict with the device installed in the rear connector.

给 Etna 提供了两个全适应的 PCMCIA 卡槽，能插入 I，II，III型 PC 卡。卡座安装在记录器内的 PCMCIA 板上。

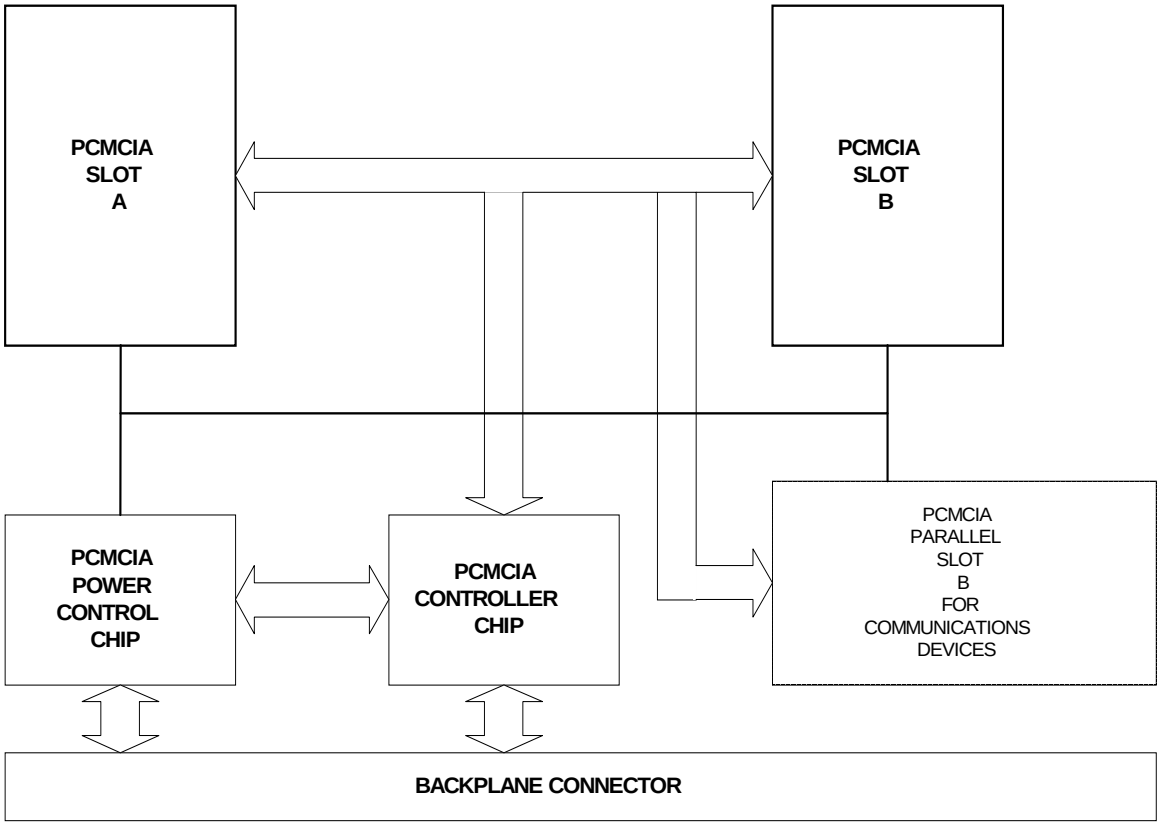
固件仅支持 PCMCIA 设备的选择值。请与 support@Kmi.com 联系。查明能支持哪些设备。

注意：插槽 B 有一个位于卡背面的连接器，供带有输出电缆的 PCMCIA modem 或其它被支持的通信设备使用。如果背面连接器使用这种方法，你就不能在卡座 B 中连接 PCMCIA 卡—这将与背面连接器的设备安装发生冲突。

插槽 A 插槽 B
PC 卡电源控制芯片
PC 卡控制器芯片
PC 卡 B 至通讯设备的并口插座
底板插座

Figure 22: Block diagram of PCMCIA board

图 22 PCMCIA 板的框图



System Power Requirements 系统电源功率需求

The exact current drawn by the recorder depends on the exact options contained in your system.

Use the tables below to calculate the approximate current draw of your system from the 12V supply. This can be used to calculate the autonomy of the system and to correctly "size" a solar charging system. The values in the tables are inflated slightly to ensure that the expected battery autonomy is achieved.

流过记录器的确切电流依赖于系统中的具体选件。

利用下列表格，计算由 12V 电源供电时系统耗电的大约值。据此能计算出系统自身的电流并帮助估算太阳能充电系统的容量。表格中的值被略微抬高了，这是考虑了电池自身性能的差异。

Table 6: Power requirements

表 6　电源所需电流

	Option Current/mA 耗电	Number In Your System	Subtotal Current
Etna recorder Etna 记录仪	190		
Internal EpiSensor deck (nominal) 内置传感器（额定值）	50		
EpiSensor ES-T standard output (nominal) ES-T 传感器标准输出（额定值）	50		
EpiSensor ES-T low noise output (nominal) ES-T 传感器低噪声输出（额定值）	180		
Other sensors *(calculate current from single 12V supply using 50% efficiency for power converters)* 其它传感器	Customer-supplied value 用户提供值		
GPS system permanently on *(25m antenna)* 全荷 GPS 系统（25 米天线）	125		
GPS system 5% duty cycle *(25m antenna)* 5%GPS 系统（25 米天线）	7		
Extended GPS system permanently on 全荷外接 GPS 系统	225		
Extended GPS system 5% duty cycle 5%外接 GPS 系统	12		
Typical PCMCIA hard drive 典型 PCMCIA 卡	150		

PCMCIA modem *(max not power controlled)* PCMCIA modem(无电源控制的最大值)	110		
		TOTAL 总计	

When you know the current consumption of your system, its actual autonomy with the supplied 6.5AH battery can be calculated using this formula:

T (hours) = 6500 ÷ I (mA) = hours of autonomy

An example of a basic 3-channel Etna:

T (hours) = 6500 ÷ 190 = 34.2 hours of autonomy

当已知系统总电流消耗时，可以用以下公式计算 6.5Ah 电池的实际供电时间：

T（小时）=6500÷I（mA）= 小时

例如：一个通常的 3 信道 Etna 的记录仪：

T（小时）=6500÷190=34.2 小时

EpiSensor Power Consumption 传感器电源消耗

The EpiSensor current drain values included in the previous table are nominal. To more accurately determine the worst case EpiSensor current requirement, use the information in the following table. These values take the sensor current drain values and correct them for the conversion efficiency of the Etna power supply. 前面表格中的传感器电流消耗值是极小的。为了更精确地测定最坏情况下所需电流，可利用下表中的有关信息。这些数值考虑了 Etna 电源的转换效率而经过修正的电流作为传感器电流的消耗值。

Table 7: EpiSensor static current drain from 12V recorder power supply

表 7　记录器电源为 12V 时，传感器静态电流的消耗

EpiSensor ES-T Static Current Drain, All 3 Axes　ES-T 传感器耗电（3 通道总体）	**Etna**
Standard post amplifier 标准主放大器	40mA
Low-noise post amplifier 低噪声主放大器	110mA

Table 8: EpiSensor dynamic current drain

表 8　　EpiSensor ES-T 传感器动态电流消耗

EpiSensor ES-T Dynamic Current ES-T 传感器动态电流	**Etna**	
	1 Axis 单通道	**3 Axes**3 通道
Restoring current for coils per g 复位电流	3.88mA/g	11.63mA/g
Output amplifier load at ±2.5V single-ended or ±5V differential full-scale 满刻度负载	1.09mA	3.26mA
Output amplifier load at ±10V single-ended 满刻度负载	10.23mA	30.69mA

The HypoSensor's (downhole triaxial EpiSensor accelerometer) current drain is identical to that of the EpiSensor ES-T in the same configuration. Uniaxial EpiSensors (model ES-U) are not offered with the low-noise amplifier. Three EpiSensor ES-U accelerometers will draw essentially the same current as an ES-T configured to use the standard post amplifier.

HypoSensor 传感器（井孔三轴力平衡加速度计）电流消耗与相同配置下的 ES-T 传感器的电流消耗是相同的。单轴传感器（ES-U 模式）没有提供低噪声放大器。为了使用标准的主放大器，三个单信道传感器（ES-U 加速度计）的电流消耗，实质上与 1 个 ES-T 的消耗是相同的。

The Etna's ± 12V sensor power supply can provide 1 watt of power to:

- The internal EpiSensor deck *or*
- An ES-T *or*
- A HypoSensor

In these cases the ES-T or HypoSensor should be configured with the standard post amplifier so the Etna's ± 12V power supply is not overloaded.

Etna12V 传感器电源变换器能提供 1 瓦特的功率给：

■内部传感器板或

■一个 ES-T 或

■一个 Hypo 传感器

在这些情形中，如果 ES-T 或者 Hypo 传感器应配置标准主放大器，使用 Etna 的 12V 电源就不超载。

Battery Charger Ratings 电池充电器的额定值

The CE-rated optional battery charger is P/N 109997-PL; the standard battery charger is P/N 109815-PL. They are rated as follows:

Battery charger 109815-PL

AC input voltage	90-260 VAC
AC frequency	47-63 Hz
AC current requirement	2.0A (maximum)

Battery charger 109997-PL

CE

AC input voltage	90-264 VAC
AC frequency	47-63 Hz
AC current requirement	2.0A (maximum)

CE-标称的可选电池充电器是 P/N 109997-PC；标准电池充电器是 P/N 109815-PL；标称值如下：

电池充电器 109815-PL

AC 输入电压	90-260VAC
AV 频率	47-63Hz
AC 电流值	2.0A(最大)

电池充电器 109997-PL

AC 输入电压	90-264VAC
AC 频率	47-63Hz
AC 电流值	2.0A(最大)

Operating Temperature 运行温度

The external operating temperature range for Etnas using SanDisk cards depends on the options installed. Normal operating range for a standard 3-channel Etna is -20^0 to $+ 70^0$ C.

In Etnas using the optional PCMCIA hard drive, the external operating temperature range should be limited to 0 to $+ 45^0$ C because the hard drives have a limited operating range. (In practice, if the unit is continuously powered, temperatures of -5^0 C are probably acceptable as the unit dissipates sufficient power to bring the inside of the unit to 0^0 C.)

Etna 使用 SanDisk 卡外部运行温度视可选件的配置而略有不同。标准三信道的 Etna 记录仪的正常运行范围是-20°C到+70°C 。

在 Etna 内使用可选的 PCMCIA 硬盘驱动器时，外部运行温度应当限制在 0～45°C，因为硬件驱动器有一个限定的运行范围。（实际上如果给设备连续供电，-5°C的环境温度也基本上可以满足工作条件。因为当设备消耗充足的电力时，可使设备内部温度上升到 0°C左右）。

Operating Humidity 运行湿度

The case of the recorder is designed to meet the requirements of a NEMA 6P enclosure (equivalent to IP67). The system can operate in humidity levels of up to 100% and withstand occasional temporary immersion in water up to 2 meters in depth. The system should not be continuously immersed, as galvanic corrosion of the connectors will occur, potentially destroying the system. To ensure operation in high humidity, the desiccant packet must be fresh and the case of the unit should be carefully sealed after opening.

记录器的外壳是依据满足 NEMA 6P 机壳附件（和 IP67 相符）的要求设计的。即湿度达到 100%时，系统能够运行，并且能经受住特殊场合临时浸入 2 米的深水中。系统不应持续浸水，因为电化学侵蚀可能腐蚀连接器，有损坏系统的可能性。为了确保能在高湿度中运行，必须及时更换干燥剂。设备的外壳每打开一次，应仔细地进行密封。

Detailed Electrical Interface 电气接口的详述

The standard electrical connectors are divided into four types. Each type has different voltage/current ratings. When designing your own interface or cables, be sure the signals are compatible to avoid damaging the recorder. The types are listed below:

RS-232C inputs. All inputs are RS-232C compatible, except that, because of the recorder's transient protectors, the maximum input voltage must be limited to less than ±14V.

RS-232C outputs. The outputs swing ±10V (nominal). They are transient-protected at ±14V like the RS-232C inputs.

Type 1 signal outputs. These outputs are active-low, open-collector transistors. They are meant to be connected to logic signal inputs, SSA inputs, or similar devices. There are no pull-up resistors on these lines. They must be pulled up by the input to which they are connected. The maximum

pull-up voltage is +20V. These outputs can "sink" 100 mA at 70^0C with a saturation voltage of approximately 170 mV. If these outputs are connected to inductive loads, such as relays, use appropriate spike-suppression diodes. The outputs are transient protected at ±14V.

+12 volt power inputs. Used to connect external +12V power sources to the recorder. They are reverse-voltage and transient-protected. Limit the maximum steady-state voltage to 14V (although the suppressors are rated to conduct only 1 mA at 16V).

标准的电气接口划分为四种类型。每种类型有不同的电压/电流额定值。当设计你自己的接口或电缆时，为了避免损坏记录仪，还应确保信号是兼容的。这些类型列表如下：

RS-232 输入：由于记录器的瞬态保护，除了最大输入电压必须被限制到小于±14V 以外，所有的输入都应是和 RS-232C 兼容的。

RS-232 输出：输出电压为±10V（额定值）。它们的瞬态保护在±14V，同 RS-232C 的输入口。

1 类信号输出：这些输出是低电平有效的、开启式集电极晶体管。这意味着它们是为逻辑信号输入、SSA（状态保存器）输入或类似器件提供输入信号。在这些线路上没有配停止电阻器。和类型 1 信号连接的输入必须具有停止电阻。信号最大的停止允许电压是 20V。这些输出用一个大约 170㎷ 的饱和电压，在 70°C时能“抑制”100㎃。如果将输出信号连接到电感负载上，如继电器，那么就需要使用尖峰脉冲抑制二极管，在输出±14 时可以被瞬态保护。

+12V 电源输入：给外部 12V 电源提供的连接到记录器上的接口。它们具有反向电压和瞬态保护功能。应将最大稳态电压限制到 14V（尽管估计干扰抑制器在 16V 时仅产生 1㎃ 的电流）。

Connector Pin Definitions 连接器插头针脚的定义

RS-232C

The RS-232C communications port conforms to the DTE standard — except for the use of a circular military-style connector. Except for the pin assignments, the port closely resembles that of a PC COM port.

Users normally connect one of two units to the RS-232C port:

- A PC, using a RS-232C cable

- A modem using a modem cable

The recorder uses a Maxim MAX248 RS-232C transceiver IC, and operates up to 57.6 Kbaud. The serial word format of this port is fixed at 8 data bits, 1 stop bit and no parity.

RS-232C 通信口除符合军用型连接器的使用外还符合 DET（数据终端设备）标准。除了插头指定外，插口类似于 PC COM 口。

用户通常可以将下述两个设备之一连接到 RS-232 口：

■连接 PC 的 RS-232C 电缆

■一个连接 modem 的电缆

记录仪使用一个 Maxim Max248 RS-232C 收发器 IC，且运行速率可达 57.6k 波特。此端口的格式为 8 个数据位，1 个停止位，没有奇偶校验位。

Table 9: RS-232C pin descriptions

表 9： RS-232C 插头的描述

Pin 针序	**Name** 名称	**I/O** 输入/输出	**Description** 描述
A	DCD	RS-232C Input 输入	Data Carrier Detect 数据载波检测
B	CTS	RS-232C Input 输入	Clear to Send 清除并准备发送
C	RTS	RS-232C Output 输出	Request to Send 要求发送
D	DSR	RS-232C Input 输入	Data Set Ready 数据设置准备就绪
E	Ground	---	Ground 地
F	DTR	RS-232C Output 输出	Data Terminal Ready 数据终端准备就绪
G	TXD	RS-232C Output 输出	Transmit Data. (RS-232C output serial data from Etna main board.) 传输数据（从 Etna 主板的 RS-232C 口输出串行数据）
H	RXD	RS-232C Input 输入	Receive data. (RS-232C input serial data to Etna main board.) 接收数据（从 Etna 主板的 RS-232C 口输入串行数据）
J	Ground	---	Alternate Ground Pin 辅助接地
K	RI	RS-232C Input 输入	Ring Indicator 电话铃声指示器

The mating connector is an FCI P/N 851-06EC12-10SN50; you can also order it as Kinemetrics P/N 851020, along with appropriate Kinemetrics cables to go with the connector; neither cables nor connectors are automatically supplied with the recorder. A complete cable can be ordered from Kinemetrics.

CE

To ensure that the recorder meets the conducted and radiated RF emissions requirements of the European Union, a FerriShield™ (KMI P/N 840734) should be attached to this cable.

相匹配的连接器是 FCI P/N 851-06EC12-10SN50；你也可以订购 Kinemetrics 的 P/N 851020 以及与连接器相匹配的 Kinemetrics 电缆；电缆和连接器都不是自动提供给连接器的。全部的电缆应向 Kinemetrics 订购。

为了确保记录器满足欧共体管理和辐射的射频发射的要求。FerriShield(KMI P/N 840734)应连接到电缆上。

Ext Power 外部电源

The Etna's Ext. Power connector is used to connect its supplied battery charger or other external 12 VDC power source. Besides these two power connections, two additional I/O functions are available on this connector. The Etna's event detector output (-EVENT_OC) and its cellular phone power control output (-CELLON_OC) are provided so these functions can be used without the optional extended interconnect.

Etna 外部电源用来连接所提供的电池充电器或其它外部 12VDC 电源。除了这两个电源连接器外，还有两个附加的 I/O 功能可应用此连接器。提供了 Etna 的事件监测器输出（-EVENT_OC）和它的蜂窝电话电源控制输出（-CELLON_OC），所以在没有配置可选的扩展内部连接器件时，可以利用这些功能。

表 10　外部电源

针序	名称	输入/输出	描　　述
A	X CHARGE	+12V 输入	从充电器输出接到记录仪，充电器的输入电压范围自 90 至 220V AC（50-60Hz）.没有内、外接电池时仅靠充电器也可以供电。输出电压范围视电池的充电程度，大约在 13.8V 至 14.9V 之间.
B	地	-	3 个地线接线针之一
C	外接电池	+12V	外接电池输入，铅酸外接电池可由 Etna 充电器充电。
D	地	-	3 个地线接线针之一
E	事件_OC	1 类输出	当 Etna 触发后，“事件”指示灯闪烁，并且正在进行存盘；其中包括事件记录、数据流、自动删除文件或另外的文件形成。此针正常等待地震的时候处于低电位（逻辑“真”）。当收到“清除事件指示灯”的指令、或进入存盘过程、检测到事件发生时，此针转入高电平。 使用“触发禁止指示灯”指令可以禁止在存盘期间指示灯闪烁。
F			此针用于直流电源控制（在远程用电话或 MODEM 控制）
G	地	-	3 个地线接线针之一

Table 10: External Power

Pin	Name	I/O	Description
A	X_CHARGE	+ 12V Input	Input from Etna's battery charger. This charger automatically operates from 90 to 220 VAC at 50-60 Hz. Its output is intended to charge the Etna's batteries; it can also be used to power the unit without any battery if desired. Its output varies from 14.9V to 13.8V Depending on the stage in the charging cycle.
B	Ground	–	One of three Etna power ground pins
C	X_BATT	+12V input	Power input from external 12V battery. External sealed lead-acid batteries can be charged by the Etna's battery charger.
D	Ground	–	One of three Etna power ground pins
E	-EVENT_OC	Type 1 Output	This line reflects the 'EVENT' LED and will pulse when the unit's event storage memory is in use. This includes event recording, streaming data, auto-file delete, or other file access. The line begins active HIGH after a 'CLEAR EVENT LED' command, and when pulsing due to storage activity ceases, will return to active HIGH if no events have occurred, or to active LOW if an event has occurred. The 'AQ DISABLE_LED' command can be used to disable pulsing of the line during storage access.
F	-CELLON_OC	Type 1 Output	Used to control power to external DC-powered cellular telephone and or modem.
G	Ground	–	One of three Etna power ground pins

All lines are transient protected. The maximum steady state voltage applied to the two +12V inputs and two open-collector outputs must be limited to less than 14V. The voltage applied to the battery charger input must be less than 18V. Etna circuitry is fully protected against reverse polarity connections but the battery charger is not. 所有的线路都具有瞬态保护。最大稳态电压为两个+12V 供电输入，且两个集电极开路输出端的电压必须小于 14V。电池充电器的电压必须小于 18V。当供电电源的极性连

接相反的时候 Etna 电路完全被保护，但电池充电器没有这种保护功能。

***WARNING!* Equipment damage.** The inputs are reverse-voltage protected, however, permanent reverse connection to a battery will eventually damage the battery and destroy the battery charger.

警告：设备损坏。尽管具有反向电压保护，然而持久的反向连接最终将损坏电池和充电器。

The battery charger is temperature-compensated and automatically adjusts its output to the fast-charge and float-charge values for the 12-volt, gel-type, sealed lead-acid batteries. Its fast charge output is 14.9 volts DC at 1A. When the battery current drops to the appropriate level the unit automatically switches to the float charge output of 13.8 volts DC at 500 mA. These voltage values are also compensated for the protective diodes contained in the Etna. It will automatically switch between fast and float levels as needed by the demand on the battery. 对于 12V 凝胶铅酸电池而言，电池充电器具有温度补偿和自动调整“快充与浮充”电池的功能。它的快充输出是 14.9VDC,电流 1A。充到一定程度后设备自动地转到输出 13.8VDC,500mA 的浮充上。这些电压值补偿电路在 Etna 中也被用于二极管压降补偿。它将自动在电池所需的快充和浮充之间转换。

GPS Antenna 天线

When the recorder is equipped with the optional internal GPS, a BNC bulkhead feed-through connector is added to the recorder's case (under the latch on the left side of the case). The supplied antenna is connected to the BNC (see the *GPS Timing Systems for Altus Recorder Systems User Guide*, Document 302205). 当记录器配备可选内部 GPS 时，BNC（同轴电缆插件）防水插头插入记录器的外壳插座上（在外壳左边的弹簧锁下）。提供的天线与 BNC 相连接（见 Etna 记录系统 GPS 时间系统用户手册，文档 302205）。

External Sensor Input 外部传感器输入

The optional external sensor I/O board connects the recorder to external sensors through a military-style circular connector.

The inputs from the sensors are double stage transient protected and allow a maximum voltage of ±14V on any input with respect to the recorder's PGP ground, and a maximum differential voltage of ± 26V across signal pairs.

The outputs from the board, +12V, -12V, the calibration coil and calibration enable lines are transient protected to prevent damage to the driving circuit in the recorder.

使用可选的外部传感器时，通过军用圆形的连接器将外部传感器连接

到记录器上。

来自传感器的输入具有双级瞬间保护网络，并且允许任一输入最大电压为 14V（相对于记录器的 PGP 接地而言），双端信号相对最大电压为 26V。

由电路板输入的+12V，-12V，标定线圈和标定线路，均具有瞬态保护电路，以防止损害记录仪中的驱动电路。

Caution: The Etna's ± 12V power is designed to power the EpiSensor. Other sensors and may require separate power supplies. See Chapter 6 for more information.

告诫：Etna 的 12V 电源是为 Epi 传感器设计的。其它传感器需要独立的电源。为了获得更多的信息，阅读第 6 章。

The mating connector is supplied with the board. Additional cables can be ordered from Kinemetrics and further details of cabling to common sensor types can be found in Chapter 6.

CE

To ensure that the recorder meets the conducted and radiated RF emissions requirements of the European Union, a FerriShield (KMI P/N 840734) should be attached to this cable.

相匹配的连接器随同电路板提供。额外的电缆可以从 Kinemetrics 订购。普通传感器电缆的进一步详细说明在第 6 章中可查到。

为了确保记录器满足欧共体管理和辐射的射频发射需要，FerriShield(KMI P/N 840734)应连接到电缆上。

Table 11: External sensor input

表 11　外部传感器输入

Pin 针序	**Name** 名称	**I/O** 输入/输出	**Description** 描　　述
L	Channel 1+第一道的+	Input 输入	Positive signal input to channel 1 differential input pre-amplifier. Input impedance 100kΩ min. Use for "high-side" of single-ended connection. 第一道差分输入前置放大器的正信号输入极。输入阻抗最小 100kΩ。用作为单端连接的高端。
M	Channel 1 -	Input 输入	Negative signal input to channel 1 differential input pre-amplifier. Input impedance 100kΩ min. Must be connected to common for single-ended connection. 第一道差分输入前置放大器的负信号输入极。输入阻抗最小 100kΩ。对于单端连接必须连接到公共端。
N	Channel 1 common	Ground 地	Signal common for channel 1 input amplifier. Use for internal shield. 第一道输入放大器的公共地线，用于内部屏蔽端。
A	Channel 2 +	Input 输入	See channel 1. 见第一道的说明。
B	Channel 2 -	Input 输入	See channel 1. 见第一道的说明。
P	Channel 2 common	Ground 地	See channel 1. 见第一道的说明。
C	Channel 3 +	Input 输入	See channel 1. 见第一道的说明。
D	Channel 3 -	Input 输入	See channel 1. 见第一道的说明。
R	Channel 3 common	Ground 地	See channel 1. 见第一道的说明。
E	Cal 标定 DAC	Output 输出	Calibration DAC signal to EpiSensor to provide "step" voltage. Normally set to 0 except during "FT" event. During the two "step" pulses, the signal swings to +2.5V then to –2.5V then back to 0. 为传感器提供数-模转换的阶跃电压信号；除了在“FT 功能测试”事件进程中，正常均设为 0。当功能测试时，先发正阶跃信号（+2.5V），再发负阶跃信号（-2.5V），然后归零。

F	Cal Coil Enable 标定线圈可用	Output 输出	Enables cal coil switch 设定开关，使标定线圈为可用。
K	EpiSensor common 传感器公共端	Ground 地	Main ground between external EpiSensor and recorder. 外接传感器与记录仪之间的主地线。
J	+ 12 V	Output 输出	+12V DC power for EpiSensor or other similar sensor. 为 Epi 或其它类似传感器提供+12V 电源。
H	- 12V	Output	–12V DC power for EpiSensor or other similar sensor. 为 Epi 或其它类似传感器提供-12V 电源。
V	Cable drain 缆线	Ground 地	"Quiet" analog ground used internally to connect input board to ADC board. 连接记录仪内部的输入板与 ADC 板公共地。
U	PGP	Ground 地	Protective ground plane. Connects directly to recorder chassis. Transients are "shunted" directly to this ground plane. Use for non-signal external cable shields. 保护地。直接连接仪器外壳，用于无信号外部电缆屏蔽。
G	Digital and power ground 数字和电源地线	Ground 地	Not normally used. 正常不用。
S, T	N/C		No connection is made to these pins on the EpiSensor input board. 在 Epi 传感器输入板，不用此 2 线。

Firmware Overview 固件概述

The firmware in the Etna controls all aspects of system operation. This section discusses the components of the firmware and provides a very general overview of the function of each. The following section discusses specific software features in more detail. Etna 的固件控制着系统运行的全过程。这部分讨论了固件的组成，并提供了每种功能较全面的论述。对于特殊的软件功能进行了更详尽的讨论。

Boot Loader 引导装载

The Boot Loader module is executed by the main system board's HC16 whenever the unit is powered up. It pauses to allow the user to load new firmware (if you tell it to) or, in normal operation, a time-out occurs and the Application Block is executed. The Boot Loader allows new firmware to be loaded into the unit through the RS-232 port or modem as described in Chapter 4. 当设备电源接通时，引导装载模数的过程是通过主系统板的 HC16 来执行的。当它暂停时，允许用户装配新的固件（如果你让它这样做）或者在正常运行中，超时信号产生时就执行应用程序块。引导装载允许通过 RS-232C 端口或者第四章所描述的 modem 进行。

Application Block 应用程序块

The Application Block runs when the Boot Loader exits after timing out. This is the MCU code that controls the operation of the HC16 main processor. Its first task is to configure FPGAs in the system and download the DSP code to the DSP in the system.

The Application Block then starts the DSP program, performs some additional hardware initialization and begins acquisition. The Application Block continues to run, controlling the system operation, user interface, data storage, communication with the user, and configuring and controlling the ADC/DSP subsystem.

The Application Block is written in C and uses a RTOS (real time operating system) to control operation of the various software tools in the system.

The DSP code is contained within the Application Block and controls the code to control the DSP on the main board. The code image is stored in the MCU’s flash memory and the MCU loads the code into the DSP’s SRAM memory as part of the Application Block's initialization.

The DSP code controls the ADC chip and acquires the input data stream at 2000 sps. The DSP program then filters this data to produce the data stream for the MCU at the final output rate. The code also provides the trigger filtering and trigger algorithm.

The DSP code is written in Assembler to maximize the speed and efficiency of the recorder’s operation.

在引导装载完成，并等待超时条件满足后，装载程序退出，应用程序块启动。

这是 MCU 代码，它控制着 HC 16 主处理程序的运行。首要任务是在系统中配置 FPGA 以及下载 DSP(数字处理信号)代码到 DSP 系统中。

于是，应用程序块启动 DSP 程序，实施一些附加硬件的初始化并且开始检测。应用程序模块继续运行，它控制系统的运行、用户界面、数据存储、用户通信、配置，并监控 ADC/DSP 系统。

应用程序块写进 C 中，并且使用一个 RTOS（实时操作系统）来控制系统中不同工具软件的运行。

DSP 代码包括在应用程序块中，通过控制代码来控制主板上的 DSP。表征码存储在 MCU 闪烁存储器中。作为应用程序块初始化的一部分，MCU 将代码写入 DSP 的 SRAM 存储器上。

数字处理信号代码控制模/数转换（ADC）芯片，而且产生 2000 sps 速率的输入数据流。然后，DSP 程序将此数据滤出，以最后要求的输出速率产生 MCU 输出数据流，代码也确定了触发滤波和触发的规则。

为了最大限度地提高速度和记录仪运行的效率，DSP 代码用汇编程序中写成。

Firmware Features 固件特性

This section describes some additional details of the algorithms used in the Etna. These details may help users understand the operation of the system.
这部分描述了一些用于附加规则的详细内容。这些细节有助于用户了解系统的操作过程。

Filtering and Decimation 滤波和抽样筛选

The DSP filters and decimates the 2000 sps data from the ADCs using multi-rate FIR filters in the following way:

The first stage filter A is a non-causal FIR-type filter with 47 coefficients at a 250 Hz sampling rate, 57 coefficients at a 200 Hz sampling rate, and 113 coefficients at a 100 Hz sampling rate. The 2 kHz data stream from the A/D converter is decimated by a factor of 4 at 250 Hz final sampling rate, by a factor of 5 at 200 Hz sampling rate, and by a factor of 10 at 100 Hz

sampling rate. All data from the A/D converter enters the filter input buffer. However, filter output is calculated only at the fourth, fifth, or tenth sample, depending on the final sampling rate. The data output rate from the first stage filter is twice the final output data rate: 500 sps for 250 sps output, 400 sps for 200 sps, and 200 sps for 100 sps output.
数字处理信号（DSP）使用复合速率 FIR 滤波器，从 ADC 中抽取 2000sps 的数据。其处理过程如下：

第一阶滤波器 A 是一个无源 FIR 滤波器，在 100Hz、200Hz 和 250Hz 的采样率上的滤波效率分别为 113,57 和 47。

在末级采样率为 250Hz 时，对来自 A/D 转换器的 2 kHz 数据流抽取率为 1/4，在末级采样率为 200Hz 时，对来自 A/D 转换器 2KHz 数据流的抽取率则为 1/5，在末级采样率为 100Hz 时就为 1/10。来自 A/D 转换器的数据输入到滤波缓冲级，和末级输出的采样速率相关，而仅在第 4，第 5，第 10 个数据上采样作为滤波器的输出。即来自第一阶滤波器的数据输出是双倍的末级输出数据速率：250sps 输出 500sps，200sps 输出 400sps,100sps 输出 200sps。

CAUSAL/ACAUSAL FILTERING 有源诱导/无源非诱导滤波

The final-stage filter B is acausal. It has 137 coefficients at all sampling rates. The final outut is derived by applying the filter to every second sample and outputting the result. 末级滤波器 B 是无源的。对所有的采样率它具有 137 个常数。其末级输出是经过采样滤波的。

CLIP INDICATOR 快速限幅指示器

The ADC indicates when it senses an overload condition at its input. This is represented as a full-scale positive or negative input for that sample in the DSP. As the DSP performs the FIR filtering this overload condition can be filtered down to an unsaturated value. Thus, there can be a situation when there is no indication of this overload condition in the final output. For this reason, the LSB of the Etna's 24-bit data sample is set to 1 if a sample within the FIRs length is saturated. This "clip indicator" can be used to check for saturated inputs. 当判断输入信号超载时，ADC 就显示。它是 DSP 采样的满屏正负输出的象征。当 DSP 进行 FIR 滤波时，能够将这种超载信号滤波到饱和值以下。这样，当超载指示无显示时，表明末级的输出正常。由于这一原因，如果 FIRs 长度内的采样是饱和的，Etna 24 位数据采样的最低有效数字（LSB）为 1。所以可以用这个“快速限幅指示器”检查饱和输入。

GROUP DELAY 群延迟

In older versions of Etna firmware, the group delay of the ADC and digital filters were not compensated and group delay was shown in the file header.

From application code 2.20 onward, the group delay in the event file header is 0.0 and the time stamps are accurate for the first scan and the trigger scan.
在 Etna 固件的旧版本中，ADC 的群延迟和数字滤波是没有补偿的，而且群延迟表示在文件头段信息中，从应用软件 2.20 版以后，事件文件的头段信息中，群延迟是 0.0，这个数据对首次扫描和触发扫描的时间标志是精确的。

Table 12: Corrections made by the MCU

表 12　MCU 的校正量（单位：毫秒）

SPS 采样率	**Non-causal empirical mSec** 非诱导	**Causal empirical mSec** 诱导	**Sample period** 采样周期 **mSec**
100	380	80	10
200	195	40	5
250	160	40	4
1000 (SRT)	44.0	14.0	1

6. Advanced Installations 高级安装

OVERVIEW 总论

This chapter describes a number of advanced installations and features that may be used with the recorder. If you require further help with any of these advanced installations, contact Kinemetrics' services department. 这一章叙述了记录仪的高级安装和使用。如果你需要进一步了解高级安装，请接触 Kinemetrics 公司服务部。

Changing Internal EpiSensor Range & Voltage Levels 改变内置传感器的测量范围和电压等级

We recommend leaving the Etna's internal EpiSensor configurations unchanged. If there is a need to change them, use caution and verify any changes with a tilt test and/or calibration sequence.

To change the settings on the EpiSensor deck it must be removed from the Etna. This should be done in a laboratory environment – not in the field. We recommend that you attend a training course before attempting this!

1. Remove the metal cover of the unit.
2. Carefully remove the screws at each corner of the EpiSensor deck.
3. Remove the deck to change the jumpers.
4. When re-installing the deck, carefully place the four spacers in the correct position.
5. Install the deck and screws.
6. Tighten the screws.
7. Replace the cover.

8. Verify that the EpiSensor deck has been correctly set both for DC range and dynamic response using a tilt test and SRT.

The full-scale range is configured by putting jumpers on headers X1 and X4 on the feedback board of individual EpiSensor modules. Both jumpers must be set correctly or the sensor will not function properly. The location of the headers is shown in the figure below.

The following table shows the sensitivities available for the jumper-selectable ranges on the Etna.

Table 13: Range/sensitivity calculations
表 13：加速度计的满刻度范围和灵敏度

Full-scale range 满刻度量程	**Single-ended ± 2.5V output** 单端输出	**Single-ended ± 10V output** 单端输出
1/4g	10 V/g	40 V/g
1/2g	5 V/g	20 V/g
1g	2.5 V/g	10 V/g
2g	1.25 V/g	5 V/g
4g	0.625 V/g	2.5 V/g

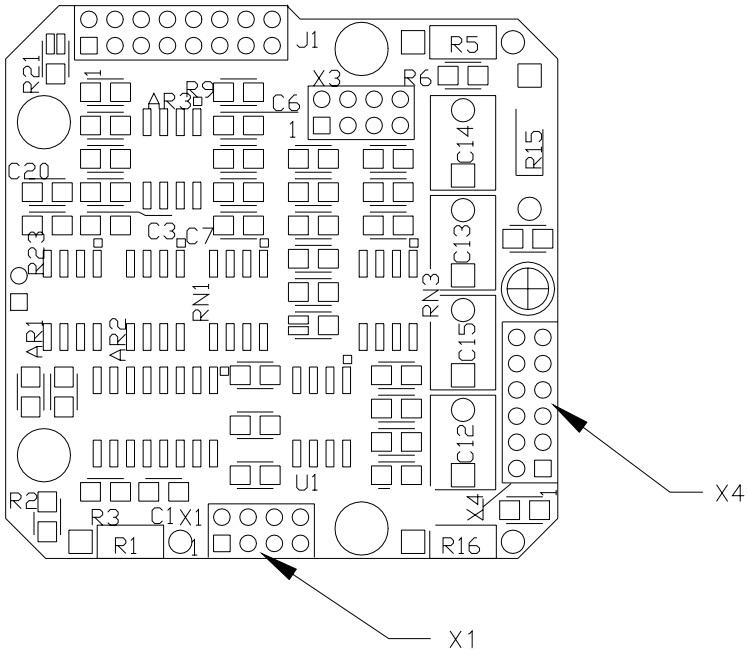


Figure 23: EpiSensor feedback board
图 23：传感器反馈板

Configure each range by installing jumpers (indicated by the black rectangles) as shown in the next figure.

Note: For clarity, we have numbered each connector pin in the figure, however, only #1 will appear on the actual feedback board.

我们要求 Etna 的内部传感器设置保持不变。如果需要改变设置，使用跳线变换实现对加速度计测量范围和电压等级的改变。这个操作应该在实验室而不是在野外进行。在进行这个操作之前，我们要求对人员先进行培训。

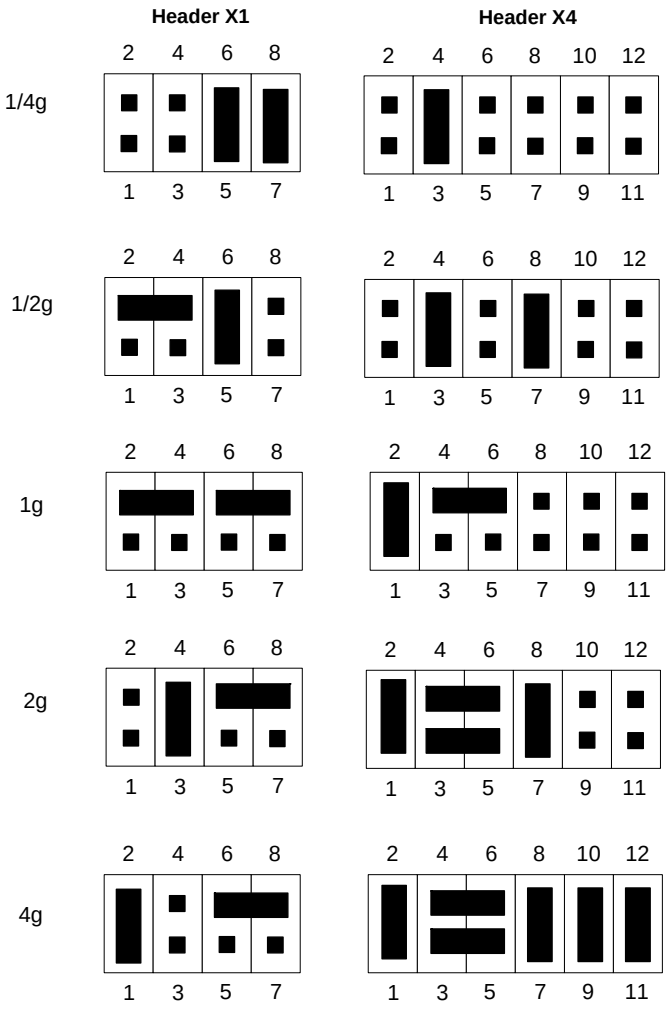
1. 取下内置传感器集成板的金属盖板。
2. 小心地卸掉传感器电路板各个角上的螺丝。
3. 取下传感器电路板，改变跳线位置。
4. 准备重新安装传感器电路板时，在正确的位置细心地放置四个跳线。
5. 安装传感器电路板的螺丝。
6. 拧紧螺丝。
7. 重新盖上金属盖。
8. 使用一个整体功能测试和 SRT，通过传感器跳线的变换就实现了对直流范围和动态响应的改变。

把跳线板 X1 和 X4 设置在合适的档位就可以改变满刻度的量程范围。X1 和 X4 在传感器模块板的单独位置上。X1 和 X4 这两个档位的设置都必须正确，否则，传感器将不能正常工作。跳线位置见图 23 所示。在 Etna 记录仪的可选范围内,有效的档位组合的灵敏度如表 13 所示。

通过跳线的正确组合可以设置每一个通道的取值范围，如图 24 所示（由黑色矩形所标注）。

注意：为了更加清楚，在图中我们对每个连接器的引线进行了编号，但是，在实际的反馈板上只能看见 1 号引线。

Figure 24: Full-scale range jumper settings
图 24：满刻度范围的档位设置



Output Voltage Level 标准输出电压

There are three, 3-pin jumper-headers that control the output voltage level. These headers reside on the top (oscillator) board of the deck. While referring to the table below, install one jumper at each connector location to select the voltage output level for that axis. For the 2.5V output, install the jumper between pins 1 and 2; for the 10V output, between pins 2 and 3.

In most applications with the internal deck, the 2.5 V output is appropriate.

标准输出电压由 3 个分别由 3 根引线组成的跳线控制。这些按钮置于传感器（振荡器）层面板的顶部（见图 25）。在每个连接器上安装一个档位用于选择所对应的那个通道的标准输出电压（如表 14 所示）。在引线 1 和 2 之间对应一个档位，其输出电压为 2.5V，在引线 2 和 3 之间为另一个档位，输出电压为 10V。在绝大多数的实际应用中，2.5V 输出是比较适宜的。

Figure 25: Internal EpiSensor oscillator board

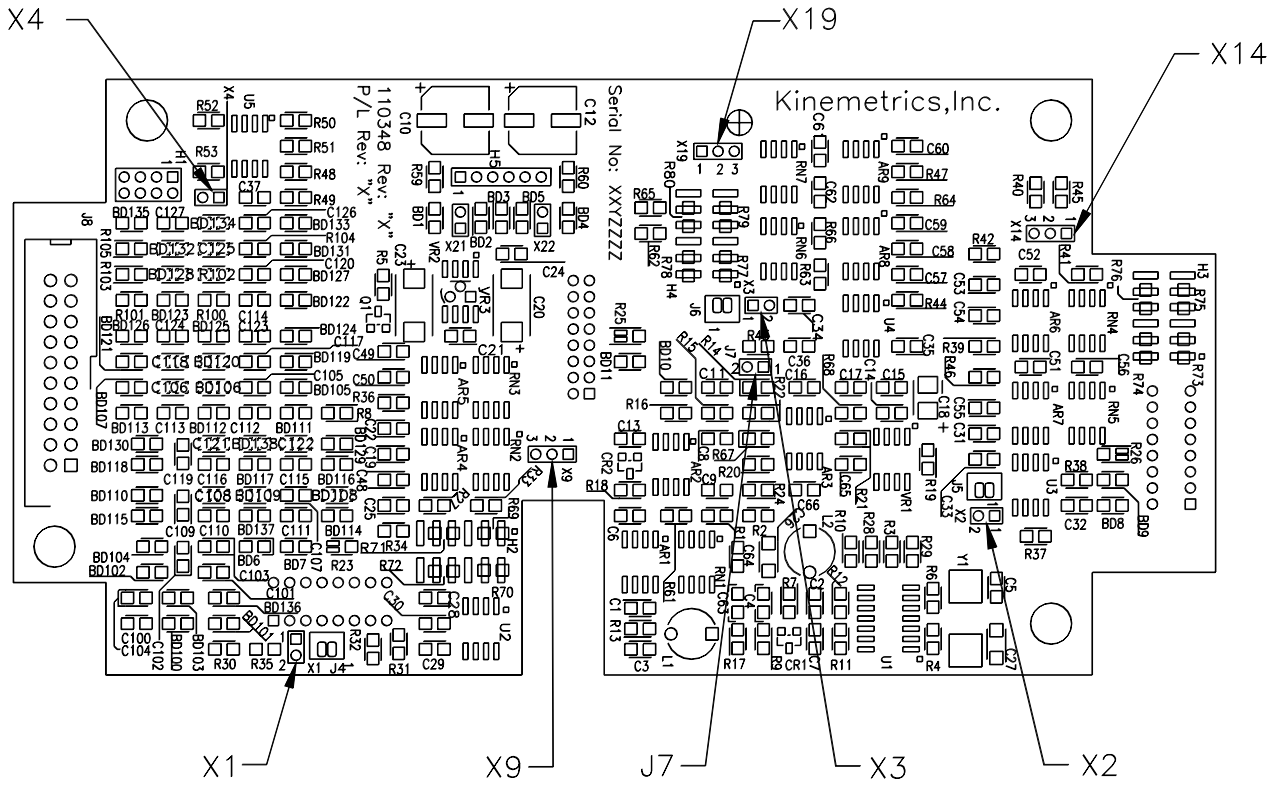


图 25：内部的传感器振荡器板

Table 14: Output voltage-level jumper settings

表 14：输出电压标准档位设置

Axis 通道	**Header** 跳线	**2.5V Output** 输出	**10V Output** 输出
X	X9	1-2	2-3
Y	X14	1-2	2-3
Z	X19	1-2	2-3

Because the internal EpiSensor is more sensitive to noise, it is not offered with the low noise option available on EpiSensor ES-Ts.

在传感器 ES-T 上没有提供选择低噪声的档位，因为内置传感器对噪声灵敏度的要求比较高。

Additional Jumper Settings 附加跳线档位设置

There are several additional jumpers on the oscillator board. Jumpers X1, X2 and X3 are normally installed. If these are removed, the calibration coils for each axis can be accessed, generally for factory test procedures.

在振荡器线路板上有几个附加档位 X1、X2 和 X3。如果改动这 3 个档位，就可以访问相应通道的标定线圈，它们通常用于工厂的测试程序中。

External Sensors 外接传感器

The Etna can be used with up to three external uniaxial sensors and one triaxial sensor.

Connections are provided through the optional external sensor I/O board. The sections below explain how to connect sensors to this interface.

The EpiSensor and HypoSensor should only be used with the standard post-amplifier when powered by the ± 12V from the Etna. Using the low noise post amplifier can overload the Etna's power supply.
Etna 通常使用三个外部单轴传感器或一个内置三通道传感器。
通过可选的外部传感器 I/O 板可以进行连接。下面这一部分就说明如何进行传感器的连接。

EpiSensor 和 HypoSensor 传感器从 Enta 获得 12V 工作电压，其输出只能使用**标准的**后置放大器。使用**低噪声**后置放大器则会超出 Etna 所能提供的功率。

EpiSensor ES-U

Consult the *EpiSensor ES-U User Guide* for further information regarding the connection of external EpiSensor ES-Us with Altus series recorders. 要想获得外部传感器 ES-Us 和 Altus 系列记录仪连接的详细资料，请查阅*传感器 ES-U 的用户使用手册*。

EpiSensor ES-T

Consult the *EpiSensor ES-T User Guide* for further information regarding the connection of external EpiSensor ES-Ts with Altus series recorders. 要想获得外部传感器 ES-Ts 和 Altus 系列记录仪连接的详细资料，请查阅*传感器 ES-T 用户使用手册*。

HypoSensor

The HypoSensor (downhole EpiSensor package) can be connected to a recorder using the transient protection box (P/N 108390-03-PL for a HypoSensor without a compass or P/N 108390-04-PL for a HypoSensor with a compass) and two cables. One cable runs from the recorder to the transient protection box and one from the transient protection box to the HypoSensor. The transient protection box is strongly recommended because the HypoSensor does not have lightning protection circuitry. The connection between the transient protection box and the HypoSensor should be made by matching the designators as shown on both the protected side of the transient protection box and the table below.

HypoSensor 传感器(井下 EpiSensor 成套件)可用瞬变保护盒（P/N 108390-03-PL 用于传感器没有罗盘定位装置的，P/N 108390-04-PL 用于传感器有罗盘定位装置的）和 2 根电缆将其与记录器相连；一根电缆连接瞬变保护盒和记录器，另一根电缆连接瞬变保护盒和传感器。因为传感器没有避雷保护电路，所以我们强烈建议使用瞬变保护盒。该瞬变保护盒与 HypoSensor 之间联结时应注意符合瞬变保护盒上的指示标识。

WARNING! **Potential lethal voltages**. Potentially lethal voltages can exist between the conductors on the cable or the exposed metal parts of the HypoSensor in these configurations. These occur due to differences in ground potential between the location of the recorder and the location of the HypoSensor. Faulty electrical wiring returning large currents to ground normally causes these differences. It is the user's responsibility to ensure that hazardous conditions are not created and that all local electrical safety regulations are observed.

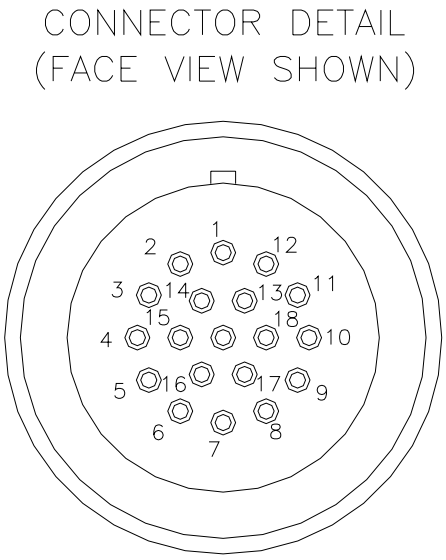
警告！潜在危险电压。潜在的危险电压可能存在于电缆的电线之间，或者是传感器裸露的金属部分，发生这种情况是由于在记录仪的位置和传感器的位置之间存在着不同的接地条件。疏忽了电线对大地之间可能存在的电位差，就会引起较大的电流。用户的职责就是确保不能产生这种危险。必须遵守当地所有关于用电的安全规则。

Table 15: HypoSensor connection

表 15：HypoSensor 传感器连接

External Connector 外部连接器	**Transient Protection Box** 瞬变保护盒		**Downhole Cable** 井下电缆 **700306**		
J1	**J1, J3**	**J4**	**Cable Assembly Wiring Chart** 电缆组件布线图表		
			Cable wire colors 电缆线颜色 **on 700306**	**Function** 功能用途	**Connection pin number on HypoSensor** 传感器连接针脚数字
L	1		TP1 red 红色	L signal L 信道	1
M	2		TP1 white 白色	L return L 反馈	2
N	3		TP1 shield 屏蔽	L shield L 屏蔽	
A	4		TP2 green 绿色	V signalV 信道	3
B	5		TP2 white 白色	V return V 反馈	4
P	6		TP2 shield 屏蔽	V shield V 屏蔽	
C	7		TP3 yellow 黄色	T signalT 信道	5
D	8		TP3 white 白色	T return T 反馈	6
R	9		TP3 shield 屏蔽	T shield T 屏蔽	
K	13		Black 黑色	Common 公共地	7
U	15		Cable shield 电缆屏蔽	Shield 屏蔽	8
		5	Blue 蓝色	RS-232 gnd	9
		4	TP4 black 黑色	RS-232 txd	10
		6	TP4 white 白色	RS-232 rxd	11
		7	TP4 shield 屏蔽	RS-232 shield 屏蔽	
		3	Orange 橙色	Compass signal 罗盘信号	12
		2	White 白色	Compass 罗盘 +12V	13
			Not connected	未连接	14
E	10		Green 绿色	标定 CCE	15
F	11		Yellow 黄色	标定 Cal DAC	16
J	12		Red 红色	+ 12V	17
H	14		Brown 棕色	- 12V	18
			Not connected	未连接	19

Figure 26: Mating connector on downhole cable 700306
图 26：井下电缆头 700306 的匹配连接（正面图）



Legacy Instruments 传统仪器

Certain Kinemetrics legacy instruments continue to be supported by the Etna. Etna 对某些 Kinemetrics 老式仪器继续保持兼容。

FBA-23s

The FBA-23 is an external triaxial force balance accelerometer. Refer to *The FBA-23 Force Balance Accelerometer User's Guide* (P/N 302350) for specific instructions regarding the installation or fabrication of cables and operation of the FBA-23. **FBA-23s** 是一个外部的三轴力平衡加速度计。关于安装、电缆装配以及 FBA-23 操作的具体指令可以查阅 *FBA-23 力平衡加速度计（P/N 302350）用户手册*。

FBA-11s

The FBA-11 is a single axis force balance accelerometer used for monitoring structural vibration in one direction.

Three FBA-11s can be connected to the Etna. Refer to Figure 27 to produce the cable and junction box required to connect FBA-11s to the Etna.

Refer to *Operating Instructions for FBA-11 Force Balance Accelerometer* (P/N 105000) for specific instructions regarding the installation and operation of the FBA-11.

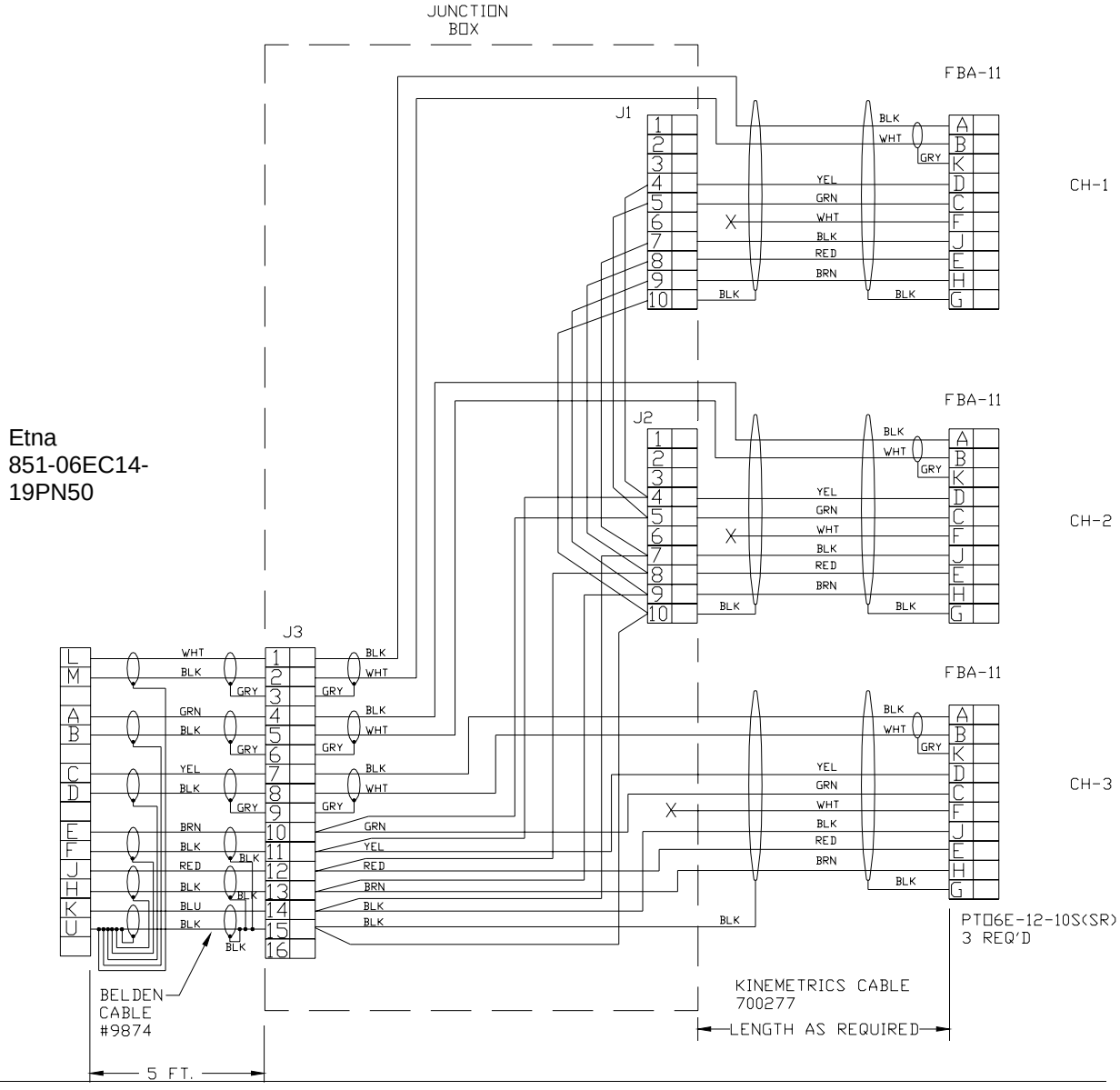
FBA-11s 是一个单轴力平衡加速度计（P/N 105000），用于监测在一个方向上的结构震动。

Etna 可以连接 3 个 FBA-11s，从图 27 可以看出，需要用电缆和连接盒把 FBA-11s 和 Etna 连接起来。

关于安装和 FBA-11 操作的具体指令可以查阅 *FBA-11 力平衡加速度计操作手册*。

Figure 27: Connecting FBA-11s to the Etna

图 27：FBA-11 和 Etna 的连接



Options 选件

12 AMP HOUR BATTERY OPTION 12 安时电池

The standard Etna is supplied with a 6.5 Ah internal battery that allows the unit to operate for approximately 36 hours after a loss of AC power. The 12 Ah battery option extends this autonomy to approximately 72 hours. This option has a different battery mounting bracket and battery cable from the standard unit. When the battery is replaced use the 12 amp-hour battery, P/N 840503. Etna 使用标准的 6.5Ah 内置电池，该电池可使用大约 36 小时;选配 12Ah 电池(P/N 840503)，可以使用 72 小时;使用 12Ah 选配电池，还需要一个不同的电池座和电缆与主机相连。

DSP EXPANSION MEMORY OPTION DSP 扩展存储器

The DSP Expansion Memory Option (P/N 810701) consists of a plug-in memory module. The module adds 32 kwords of 24-bit memory to the DSP. It plugs into socket M1 on the main board. It is required when any of the following features or options are used in the Etna: DSP 扩展存储器由一个可插入的存储模块组成。该模块为一个 32k 字节、24 位的存储器，插入主板上的 M1 接口。在 Etna 中使用下列功能或选项时，必须选择 DSP 扩展存储器：

- Digital Field Station (DFS) output. This feature also requires that the Extended Interconnect Option (P/N 109875-PL) be installed in the system. 数字场站(DFS)字段输出 这个功能还需要系统安装扩展互连选件（P/N 109875-PL）。

EXTENDED INTERCONNECT OPTION 扩展互连选件

The Etna is available with an Extended Interconnect Option. This adds several additional capabilities to the Etna: Etna 可选用扩展外设，用于扩展如下功能：

- Isolated relay closure for alarms and other signals 提供警报和其它信号的缓冲继电器；
- External trigger inputs and outputs both local and extended allowing multiple Etnas to common trigger at distances of up to 6000 feet (1,828 meters). 在 6000 英尺（1,828 米）范围内，能够支持多个 Etna 同时触发，并具有外部触发输入和输出系统；
- Master slave GPS operation 主要的 GPS 运行方式；
- DFS serial output (requires DSP Expansion Memory) DFS 串口输出（需要 DSP 扩展存储）；
- Other I/O signals 其它输入/输出（I/O）信号。

For more information, please read the *Etna Extended Interconnect Option User Guide*, document 302231. 如果想获得更详细的资料，请阅读 *Etna 扩展外设选件用户手册（文件 302231）*。

Controlling Power to External Telecomm Equipment 外部通讯设备电源控制

Etna application code controls the cellular phone power control (CPPC) signal. The user can supply interface hardware to use this logic level signal to control power to cellular phones, external modems or other devices. Etna 运用代码控制蜂窝电话（CPPC）信号。用户可以通过硬件接口，应用标准逻辑信号控制蜂窝电话、外置 Modem 或其它设备的电源。

CONNECTION 连接

The signal is available on the power connector, Pin F. It may have to be appropriately conditioned to control the device. 这个信号通过电源连接器上的引线 F 接入，在适当的条件下可以控制设备。

Connecting An External Battery 外部电池连接

The recorder can also be powered from an external battery at the *EXT POWER* connector:

Connect the battery as follows:

- Battery ground to pin G
- Battery +12V to pin C

To solder the external battery leads to the connector, you must temporarily remove the back shell from the charger's connector. The external battery input is reverse-voltage-protected and diode-isolated. You may use an external battery to replace or supplement the internal battery.
记录仪也能在*外部电源接口*上连接外部电池。电池连接方式如下：

- 电池地线接入引线 G
- +12V 电池接入引线 C

为了把外部电池连接至接口，必须暂时从充电器接口处打开后盖。外部电池输入时，通过由二极管组成的反向电压保护器。可以用外部电池替代或补充内部电池。

***WARNING!* Burn or fire hazard**. Do not short the battery terminals with metallic conductors, such as a screwdriver or pliers. The battery can provide up to 80 amps of current. This amperage, when flowing through a non-isolated conductor, can result in very high temperatures and even fire. **Do not** replace the supplied battery with a non-rechargeable battery or a battery that does not meet the requirements given in Chapter 4 in the *Replacing Batteries* section.

警告！燃烧或火灾危险。不要用金属物体（例如螺丝刀或钳子）短接电池接线端子，因为电池能提供 80 安培的电流。80 安培的电流流经一个非绝缘体时，能产生很高的温度甚至导致火灾。不要用一个不能充电的电池或不符合要求的电池替换随设备提供的电池。在第 4 章有关“ 电池替换 ”的部分中给出了替换电池的规定。

User-Supplied Charging Systems 用户提供的充电系统

Recorder Input: *EXT POWER* connector pins C (+12V) and G (ground).

- Always consider the load current required by the equipment.
- Disconnect the internal battery when using high amperage external batteries.

For remote locations, a solar panel of approximately 75 watts can be used in conjunction with a charge controller and an automotive-type battery. Fuses and blocking diodes are recommended. Refer to Chapter 5 to calculate your recorder’s specific current requirement to correctly "size" your solar charging system.

In locations where AC power is available, an AC/DC-type power supply with an output voltage of 13.5-14.2 VDC and a current output of 1-3 amps can be used to charge a car-type battery. Fuses and blocking diodes are recommended.

Please read the Safety section before working with the recorder batteries or power supplies.

记录器的外接电源插口：C 引线接+12V 电源，G 引线接地。

经常考虑仪器的电流负荷；

当使用高电流的外部电池时，不要连接内部电池。

对于偏远的地区，可以使用一个大约 75W 的太阳能电池，通过充电控制器和记录仪连接，建议使用保险丝和稳压二极管保护，参照第 5 章选择合适的太阳能充电系统。

在有交流电的地区，可使用输出电压 13.5-14.2V、输出电流为 1-3 安培的交直流转换器，该转换器也可给汽车电瓶充电，仍建议使用保险丝和稳压二极管保护。

使用记录仪和充电器时，请阅读安全部分内容。

Advanced Telecommunications Options
高级通讯选件

The manual has described using your recorder with direct RS232 connection and modem connections using POTs (plain old telephone) type connections. Depending on your needs and location, several other remote connection options are available.

Cellular and digital cellular phones are discussed below, but first, a bit of cautionary advice. While it is tempting to use one of the many low-cost telephones available, the issue of power must be considered. These telephones are normally connected to a charger that is connected to a power source, but if power is ever lost, most consumer-use phones have an on/off button that must be pushed in order to re-set or re-charge the phone. This is not a problem in the average household, but it is for remote sensor-sites. Kinemetrics recommends that you research phone options and power considerations well before deciding on a unit.

除了本手册已经介绍的通过仪器的 RS-232 口，使用 MODEM 连接 Pots(老式明码电话)的通讯方法，还有一些远程连接选件，用户可以根据需要和当地的通讯条件选配。

下面介绍蜂巢电话和数字蜂巢电话。当准备使用各种低成本的电话时，必须首先考虑电源。这些电话一般都需要交直流变换器，一旦停电，多数电话会重新启动或给电话充电。偏远地区可能没有交流电，Kinemetrics 公司建议用户在购买仪器前，先调研电源并以此设计远程通讯方式。

Cellular Phone Connections 蜂巢电话网

The cellular interface provides telephone communication wherever landlines are unavailable, impractical or too expensive. Single line telephone communication with the recorder is possible anywhere cellular service is available. This is particularly useful in remote sites that require data downloads.

All that is required for communication is a modem, a RJ-11 jack and a cellular phone. Not all phones are suitable, however. Select those that are DC-powered and have a dial tone available; we also recommend a transceiver with a 3-watt unit which will allow you to communicate even in fringe areas of cellular coverage. We have tested the Teluar Canada PhoneCell SX system and found it to work reliably and successfully with the recorder.

The modem speed should be kept between 2400-4800 baud. Our testing indicates that the PhoneCell can effectively transfer data at 4800 baud, but we recommend that you experiment in the field to see which rate works best.

蜂巢电话属于无线通讯方式，可为无电话线的地区或电话线建设成本太高的任何地方提供单向电话通讯服务（蜂巢电话覆盖区为前提）。尤其能为记录仪的远程遥控下载数据提供方便。

通讯所需设备有：一个 MODEM、一个 RJ-11（电话插头）、一个蜂巢电话。但不是所有的电话都合适，我们建议选择有直流电源、有拨号音的 3 瓦特的系统（transceiver with 3-watt）,它可以保证在蜂巢电话覆盖区的边缘地带也能通讯。我们测试了加拿大的 Teluar Phone Cell SX 系统，发现该系统与记录仪的连接非常成功而且通讯可靠。

MODEM 的速率应在 2400-4800 波特之间，上述加拿大的电话能以 4800 的速率有效传输数据。我们也推荐使用经过野外实验工作证明良好的其它蜂巢电话网。

Digital Cellular Phones 数字蜂巢电话网

It is also possible to communicate with the recorder via a digital cell phone as provided in the U.S. by PacBell or Sprint's PCS service. This technology is referred to outside of the U.S. as "GSM." To use GSM or PCS to transmit data requires:

- A modem that supports GSM/PCS phones and the necessary cable (Kinemetrics has used Siemen's GSM Modem M1)
- Data connection service (normal digital phone accounts support only voice communication; data transmission generally requires the purchase of additional service packages)

该记录仪可以通过数字蜂巢电话网通讯。例如美国 PacBell 公司和 Sprint’s PCS 公司提供的服务。这项称为“ GMS ”的技术在全世界已经推广。用 GMS 或 PCS 传输资料要求：

- 支持 GMS/PCS 电话和匹配电缆的 MODEM（Kinemetrics 公司已经使用了西门子公司的 M1 型 MODEM）；
- 资料连接服务。一般的数字电话仅支持声音通讯，传输数据通常需要购买额外的服务包。

ISDN Access 接入 ISDN（综合业务服务网，即一线通）

ISDN connections can offer higher speed connections than POTs modem connections. A single-bearer channel can allow the recorder to operate at its highest RS232 rate of 57.6 Kbaud. External ISDN modems can be connected directly to the recorder’s RS232 port. ISDN 系统能提供比 POTs MODEM 更高的通讯速率。ISDN 单通道可以使记录仪工作在 57.6kbps 的速度（RS-232 口的最高速度）。外接的 ISDN MODEM 可以直接连接到记录仪的 RS-232 口。

Frame Relay Access 接入 FRAME RELAY 通讯系统

Recorders can be connected to frame relay "clouds" using a FRAD (frame relay access device) and have been successfully connected at a baud rate of 57.6 k to continuously transmit digital data using the serial data stream. 使用一个 FRAME RELAY 接入器（FRAD），可以把记录仪接入 FRAME RELAY 通讯系统。该系统可以以 57.6kbps 的速度连续地传输数字资料。

Spread Spectrum Radios 无线电通讯系统

If your site is some distance from a phone system or the central recording station, but a line of sight exists, spread spectrum transmission can be used to establish a full duplex connection. Spread spectrum devices generally do not require a license and can easily operate over distances of 20 miles (links of greater than 2180 miles have worked in ideal conditions). 如果你所在地区距离电话系统或中心记录站较远，但又在视距之内，则可以考虑使用无线电通讯来建立双向连接。通常无线电设备不需要许可证，在 20 余英里范围内容易实现通讯。（在理想的情况下，通讯距离可以达到 2180 英里）。

Satellite Connections 卫星连接

Recorders can be accessed using satellite links. This field is advancing rapidly, so please contact Kinemetrics for the most current information on available satellite links. 记录仪还可以进入卫星网，该通讯领域发展很快。可与 Kinemitrics 公司联系，了解可以使用的最流行的卫星链接。

Paging 传呼

The recorder can use its modem to call a paging service and send a simple text message. Contact Kinemetrics for more information on this topic or refer to *Altus Monitor Mode Communications* (Document 302219) for more information. 记录仪也能利用其 MODEM,在预定情况发生时，进行呼叫服务和发送简单的信息。可与 Kinemitrics 公司联系，或参考 *Altus 监控模式通讯方法（文件 302219）*，可以了解进一步的信息。

Short Message Service 短信息服务

Some wireless digital phones and service providers (Pacific Bell, Sprint, etc.) conforming to the GSM digital standard support an optional service called Short Message Service, or SMS.

SMS allows the sending of messages up to 70 characters over a secondary data link. The message, originated at the Altus and transmitted through the phone, is typically redirected by the service provider to the Internet and arrives as an e-mail message.

Altus software allows for transmission of event detection messages consisting of station ID, trigger time, duration, and channel peaks using the

SMS connection. For details, see the description of SMS support in *Altus Monitor Mode Communications*, Document 302219.

一些无线数字电话和设备的供应商（如 Pacific Bell Sprint 等），为了适应 GSM 数字标准，支持短信息服务或 SMS 的可选外设。SMS 可通过附属资料链发送多达 70 种信息，包括由 Altus 仪器产生的、通过电话线送到供应商的信息，就像 e-mail 一样互送信息。

Altus 软件设计了这样的功能：把诸如台站 ID 号、触发时间、持续时间、信道记录峰值等信息通过 SMS 连接发送出去。详情参阅 *Altus 监控模式通讯方法（文件 302219）*。

Etna Specifications Etna 记录仪的技术指标

Key Features 主要特性：

- 18 bits of resolution with 108 dB dynamic range 动态范围 108dB; 分辨率 18bit;
- Cost-effective solution that can satisfy today's most demanding applications 低价高效解决方案能满足当今大多数用户的要求；
- Multitasking operating system that allows simultaneous data acquisition and interrogation 多进程的操作系统，可以同时进行资料接受和查询；
- Timing accuracy to 0.5 milliseconds due to synchronized sampling with optional GPS timing system 用 GPS 时间系统选件同步采样，时间服务精度可达 0.5 毫秒；
- Remote alerting capability for system event or auto-diagnostic failure 地震事件或运行环境故障发生后，能自动异地报警;
- File format compatible with other products in the *Altus* series of instruments 文件格式与 Altus 系列的其它仪器兼容。

Applications 应用

- Structural monitoring arrays 结构监控台阵；
- Dense arrays: 2 and 3 dimensional 2 维或 3 维密集排列台阵;
- Aftershock study arrays 余震研究；
- Regional arrays 局部场地研究。

Data Acquisition 数据采集

Type:	Over sampled delta sigma system with 24-bit digital signal processor
Number of channels:	Three channels
Dynamic range:	108 dB @ 200 sps
	Three channels
Frequency response:	DC to 80 Hz @ 200 sps
Resolution:	18-bit resolution @ 200 sps
Noise:	< 8 µV RMS
Sampling rate:	100, 200, 250 sps

Input range:	+/- 2.5V
Chan/chan skew:	None – simultaneous sampling of all channels
Anti-alias filter:	Brickwall FIR filter. Cut-off at 80% of output Nyquist. 120 dB down at output Nyquist.
Real time digital output (opt.):	RS-232 output of digital stream
Calibration type:	Kinemetrics test sequence
Sensor type: specifications.	Triaxial EpiSensor force balance accelerometer, orthogonally oriented, internal (standard), external (optional). See Internal EpiSensor
Trigger type:	IIR Bandpass filter
Trigger bandwidth:	0.1 Hz-12.5 Hz
Channel triggering; trigger, de-trigger:	Independent threshold for all channels
Alarm thresholds:	Selectable from 0.01% to 100% of full scale
Trigger voting:	Internal, external trigger votes with arithmetic combination
Pre-event memory:	60 second maximum for 3 channels @ 200 sps.
	Software selectable in one-second increments.
Post-event time:	Software selectable, specified in seconds, 0 to 65,000 seconds
Storage type:	Two fully compliant PCMCIA storage slots available.
Compatibility:	PCMCIA standard 2.1. Sockets accept Type I, II, III card formats.
	Type I or II modem with connections.
Primary slot: larger).	10 MB memory card (minimum size; actual installed card may be Consult factory for optional memory cards and hard disks.
Secondary slot:	Same options as primary slot for storage media. Accepts Type I or II modem with connectors.
Recording capacity:	80 minutes, 24-bit data for 10 MB memory card, 3 channels @ 200 sps
Recording format: by PC.	Data is stored in DOS file system that allows cards to be read directly
Firmware type:	Multi-tasking operating system supports simultaneous acquisition and interrogation. Boot loader allows remote firmware upgrades.
System control:	Configure sample rate, filter type, trigger type and voting, maintains communications and event storage.
User interface: data	Packetized protocol and simple ASCII terminal mode control and retrieval, via RS-232 interface.
Intelligent alerting:	Can initiate communications when an event is detected or if an auto-diagnostic failure occurs.
Auto-diagnostics:	System can be configured to continuously check system voltages, temperature, RAM and code integrity and timing system integrity.
Timing type:	Free running disciplined oscillator (standard); GPS (optional)
GPS (optional):	Integrates completely with system, providing timing, internal oscillator correction and position information.

Timing Accuracy GPS:	5 microseconds of UTC. GPS receiver better than 1 millisecond data synchronization to UTC. Power cycling is software controlled.
Power consumption GPS:	110mA at 12V (active)
I/O and Display	
Type: display	I/O Connectors, EMI/RFI and transient protection, I/O drivers and are provided on a single front panel board.
Display:	3 LEDs. Display indicates: Run/Fault, charge, event
Power input:	Military-style connector for charge input and external battery
RS-232 interface:	Full RS-232C interface with modem control
Extended Interconnect (optional):	Military-style connector for IRIG out, IRIG in, Clock sync., 1 pps out, trigger in, trigger out, alarm out, real time digital output (Tx and Rx), external 12V out, Relay 1.
EMI/RMI protection:	All I/O lines are protected from both EMI/RFI emission and susceptibility problems by ferrite filters and transient suppressors.
Power Supply	
Supplied battery charger voltage:	100-250 Vac 50/60 Hz
Charging voltages: compensated-for	14.9V @ fast charge, 13.8V @ float charge. Temperature- sealed lead acid, gel type batteries
Battery operating range:	11V to 15V
Batteries:	Internal 12V, 6.5 Ah battery (standard), 12V, 12Ah battery (opt.), optional external battery
Current drain:	185 mA @ 12V
Power autonomy:	>36 hours (standard), >72 hours with optional internal 12Ah battery
Housing type: shielding sensors.	Lexan structural foam housing internally coated with EMI/RFI material, 5/16" aluminum base support for mounting and coupling to
Mounting and leveling:	Single hole for 1/4" stud and three adjustable feet for leveling
Size:	10.1" (256mm) W x 15" (381mm) L x 7" (178mm) H
Weight:	20 pounds (9 Kg) including battery
Support Software	
Type:	Microsoft Windows compatible control and retrieval programs -- QuickTalk® and QuickLook® for Windows. Also operates with DOS communication software.
QuickTalk & QuickLook: manual.	Allows easy instrument setup and data retrieval by direct connection or modem at up to 57,600 Baud. Includes on-line Windows help Allows rapid viewing of data and will generate output to any Windows compatible device.
Format converters:	Provides option to convert and store data in SUDS and ASCII formats. Contact factory for other formats.
Environment	

Operating temp:	-20 C to 70 C
Humidity:	0-100% RH

数据采集

类　　型	用 24 位数字信号处理器的过采样技术
通道数	3 通道
动态范围	108dB,在采样率 200　；三通道
频率范围	DC 到 80Hz，在 200 采样率
字长	18 位，在 200 采样率
噪声	小于 8 微伏（均方根值）
采样率	100，200，250
输入范围	+/-　2.5V
道间串扰	无
高频混淆	Brickwall　FIR 滤波，在奈奎斯特频率以上的衰减为 80%（120db）
实时数据输出	RS-232 数据流输出
标定类型	Kinemetrics 试验时序
传感器类型	3 轴 Epi 力平衡式加速度计，内置（标准配置），外置（可选择）
触发类型	IIR 带通滤波器
触发频带宽度	0.1Hz-12.5Hz
通道触发与不触发	取决于各通道阈值
警报界值	可从满刻度的 0.01%到 100%选择
触发选择	内部、外部触发；带有算术组合计算
事件前存储时间	3 信道最大 60 秒；在 200 采样率
事件后记录时间	从 0 秒-65000 秒，可以由软件选择
存储器类型	有两个 PCMCIA 卡插槽
兼容	标准 PCMCIA2.1 卡，允许 I，II，III格式的卡，也允许 I 和 II 型 modem 的接口。
主插槽	10MB 卡（为最小尺寸的，实际安装的卡可以更大些）可咨询代理商选择存储卡和硬盘。
副插槽	可同主槽一样选择存储系统，可与 I 和 II 型 modem 的接口连接。
记录时间	80 分钟（24 位字节数字，10MB 存储

	卡） 3 通道，在 200sps 采样率。
记录格式	资料存储在 DOS 文件系统，允许用 PC 直接读卡。
固件类型	允许多个操作系统；读取数据和讯问可以同时进行。

系统控制	采样率设置，滤波类型、触发类型和投票
用户界面	ASCII 终端模式控制和数据补偿，RS-232 通讯
自动诊断	检测到事件后或自动诊断后会自动返回工作状态
时间类型	内设时钟振荡器或 GPS（选件）
GPS（选件）	具有振荡频率校正和定位功能
GPS 时间精度	绝对时间精度 5 微秒；时间同步优于 1 毫秒；系统供电周期可用软件控制
GPS 电源消耗	110mA/12V
输入/输出及显示	
类型	I/O 连接器，电磁和射频保护，I/O 驱动器和前面板显示
显示	3 个 LED 灯分别指示：运行、充电、事件
电源输入	充电接口和外接电池输入口
RS-232 接口	全功能 RS-232C 接口（带 Modem 控制线）
扩展接口（选件）	带 IRIG 输入输出，同步钟，1pps 信号， 触发输入、输出、报警输出，实时数据输出（收和发），外接 12V 电池输出，1 个继电器。
EMI/RMI 保护：	所有输入、输出线均符合 EMI/RMI 协议
电源供给	
电池充电器输入范围	100-250VAC 50/60Hz
充电电压	初充 14.9V，浮充 13.8V（对于常温下的凝胶铅酸电池）
电池工作电压	11V-15V
电池	内置 12V/6.5Ah(标准配置) 外置 12V/12Ah(选件)

耗电	185mA 12V
后备电池工作时间	大于 36 小时（标准内置式） 大于 72 小时（外置式 12Ah）
仪器罩	带有电磁、射频防护、铝基板及安装孔
固定和调平	1/4″ 单孔固定，三个底脚调平螺钉
外形尺寸	256 宽×381 长×178 高
重量	9kg（含电池）
支持软件	
类型	微软的 Window 系统下的 QuickTalk 和 QuickLook 软件包，也有 DOS 下的相应软件包
QuickTalk 和 QuickLook 软件	直接连接 Modem 可达 56K 波特速率通讯，含在线帮助菜单，可简单安装软件并恢复波形文件。能与任何 Windows 兼容设备连接。
格式转换	提供 SUDS/ASCII 转换和存储的程序，如需其它格式的程序，请与公司联系
应用环境	
温度 湿度	-20°C-70°C 0-100%相对湿度

Internal EpiSensor Specifications 内置传感器特性

Type	Triaxial force balance accelerometer
Dynamic range	145 dB +
Bandwidth	DC to 200 Hz
Calibration coil	Standard
Full-scale range	User-selectable at ± 0.25g, ± 0.5g, ± 1g, ± 2g or ± 4g
Full-scale output	User-selectable at: ± 2.5V single-ended; ± 10V single-ended; ± 5V, ± 20V differential
Linearity	< 1000µg /g^2
Hysteresis	< 0.1% of full scale
Cross-axis sensitivity	< 1% (including misalignment)
Zero point thermal drift	< 2% of full-scale, -20^0 to $+70^0$ C
Zero point drift	< 500µg / ^{0}C
Operating temperature	-20^0 to $+70^0$ C
Connection	Ribbon cable connector

内置传感器特性

项目	三轴力平衡加速度计
动态范围	大于 145dB
频段	DC 到 200Hz
标定线圈	标准
满刻度范围	用户可选±0.25g，±0.5g，±1g，±2g，±4g 其中之一
满量程输出	用户可选±2.5V，±10V（单端输入），或±5V，±20V（双端差分输入）
线性度	小于 1000μg/g^2
磁滞损耗	小于满刻度值的 0.1%
道间交叉影响程度	小于 1%（不校正）
零点温度稳定性	小于 2%(满刻度)，-20℃至 70℃
零点漂移	小于 500μg/℃
运行温度	-20℃至+70℃
连接	带状电缆连接

7. Appendix A 附录 A

Formatted Etna Header File Etna 格式化头段信息

```
qlwin.tmp, 08/23/00 16:16:38
To make a permanent copy on hard disk,
  use 'FILE: SAVE AS' = eventfile.HDR

QLWIN: H:\RON\MERGED\APP\XJ001.EVT   08/23/2000 16:15
Altus Header, Version. 1.30,  S/N 970
 Etna  Stn:    Site:
 12  channel unit, 3 channel(s) selected:  1 2 3
 Channel(s) triggered:  1 2 3
Comment: DEFAULT PARAMETERS
UserCodes:   0  0  0  0

Main battery: 13.40V, charging, minimum alarm voltage: 12.0V
   24 bit A/D with group delay: 0 msec
Temperature:  27.2 deg.C

Restart Source(s):
  None Known.

System Error(s):
  None Known.

Altus Time Source: Internal GPS Receiver.
Event Start Time:  8/23/2000 (236)  16:14:50.000
Event Trigger Time:  8/23/2000 (236)  16:14:53.000

Samples per second:  200
Duration:  18.000 seconds, 180 frames
Pre-event:  3 seconds.
Minimum runtime:  0 seconds.
Post event:  10 seconds.
```

```
Array Propagation Window:  0 seconds.
Storage: Primary  A:, Secondary  A:

Digital Field Station OFF.

Program versions:   sysBlk 0.00, bootBlk  1.08,
                    appBlk 2.87,  dspBlk  1.22
Instrument latitude: 34.148628 Degrees North
Instrument longitude: -118.102402 Degrees East
Instrument elevation: 215 Meters relative sea level.

GPS latitude: 34.14 Degrees North
GPS longitude: -118.10 Degrees East
GPS altitude: 211 Meters relative sea level.

Ch                    1              2              3
  MaxPeak:        0.4157437V     0.2837098V     0.2789951V
   at seconds:         4.810          4.830          4.840
  MinPeak:       -0.2973986V    -0.2850479V    -0.3267110V
   at seconds:         4.825          2.895          2.900
  Mean:           0.0374445V    -0.0310332V     0.0001502V
  AcqOffset:      0.0000000V     0.0000000V     0.0000000V

Ch                    1              2              3
  Chan ID:           ----,          ----,          ----,
  Sensors:        Unknown (0)    Unknown (0)    Unknown (0)
                   s/n     0      s/n     0      s/n     0
  MappedChannel:      1              2              3
  Inverted:           no             no             no
  Displace, N:      0000,          0000,          0000,
  Displace, E:      0000,          0000,          0000,
  Displace, U:      0000,          0000,          0000,
  Alt,Azi(deg):     0,      0      0,      0      0,      0

Ch                    1              2              3
  Gain:               1              1              1
  Fullscale        2.50V          2.50V          2.50V
  Sensitivity:     1.250          1.250          1.250
  Damping:         0.00           0.00           0.00
  NatFreq:         0.00Hz         0.00Hz         0.00Hz
   EpiSensor only:
   CalCoil:           ---            ---            ---
   Sensor Gain:       ---            ---            ---
   Range:             ---            ---            ---
   Sensed Range:      ---            ---            ---


Ch                        1              2              3
```

```
Trigger Threshold:      2.000%FS        2.000%FS        2.000%FS
Detrigger Threshold:    2.000%FS        2.000%FS        2.000%FS
Alarm Trig Threshold:    2.000%FS         2.000%FS         2.000%FS
               Votes:        1                1                1

Network Master.   Votes: 1
External Trigger:  OFF,   Votes: 1
Keyboard Trigger Votes: 1
Stream:   Votes to trigger: 1,   Votes to detrigger: 1

GPS Free Field.
GPS turn On interval:  30 minutes(s).
GPS maximum On time:  30 minute(s)
All times as set manually, or -7 hour(s) from UTC if from GPS
Clock Source: Internal GPS
GPS Status byte decoded:
   GPS present.
   GPS locked.
   GPS power is ON.
GPS state of health byte [same as Acutime SOH byte]:
  Doing position fixes.
GPS updated the RTC 0 times since last reset.
Drift at last two RTC updates to UTC: 0 & 0 msec.
Last GPS Update times were:
  1/1/1980 (1) 00:00:00 & 1/1/1980 (1) 00:00:00.
Last GPS TurnOn times were:
  8/23/2000 (236) 15:46:42 & 1/1/1980 (1) 00:00:00.
Last GPS Lock times were:
   8/23/2000 (236) 16:14:14 & 8/23/2000 (236) 16:11:44.
Count of times GPS failed to lock
    within gpsMaxTurnOnTime: 0


Modem strings [ NULL TERMINATED ] from event header...
 Initialization: AT&FE0&C1S0=1S25=10&W
 Dialing Prefix: ATDT
 Dialing Suffix:
 Hangup command: ATH0
 Callout message:
 Callout Acknowledge message: DOG
Cellular Phone Parameters:
  Power control OFF.
  WarmupTime 2 seconds
  CheckinTime: 1010 minutes after midnight
  Call-In Times:  OFF  OFF  OFF  OFF  OFF
 Phone Numbers:
   1: 2222221    2:
Automatic callout ON.
```

```
   Ignore battery voltage
  Call out on battery charge failed
   Ignore temperature
  Call out on event
  Call out on GPS lock failure
  Call out on alarm(s)

 Wait for connection 45 seconds.
 Pause 15 seconds between calls.
 Max dial attempts: 3.

End Altus Etna Header S/N 970, H:\RON\MERGED\APP\XJ001.EVT


QLWIN calculated statistics for all data points in
H:\RON\MERGED\APP\XJ001.EVT:

Ch                    1                2                3
 MaxPeak:          0.4157437V       0.2837098V       0.2789951V
 MinPeak:         -0.2973986V      -0.2850479V      -0.3267110V
 Peak-Peak         0.7131423V       0.5687578V       0.6057061V
 Mid-point         0.0591725V      -0.0006691V      -0.0238580V
 Mean:             0.0373890V      -0.0309935V      -0.0001468V
 BaseLine Correction ........
  Max-Mean:        0.3783547V       0.3147033V       0.2791419V
  Min-Mean:       -0.3347876V      -0.2540544V      -0.3265643V

End QLWIN calculated statistics, H:\RON\MERGED\APP\XJ001.EVT
```

8. Appendix B 附录 B

ID Bus Address Assignments ID 总线地址分配

I.D. Group 1

Device	Size	Description
0	256x8	109735 External GPS Interface Board
1	8192x8	109850 Etna Main Board (old) or 111000 Etna Main Board (new)
2	256x8	109435 Etna Internal EpiSensor Deck or 109490 3-Channel I/O Connector Board
3	–	Future Enhancements
4	256x8	109860 Interconnect Board
5	–	Future Enhancements
6	128x8	109415 PCMCIA Board

第 1 组 ID 表

设 备	容 量	描 述
0	256×8	109735 外部 GPS 终端板
1	8192×8	109850 Etna 主板（老产品）或 111000 Etna 主板（新产品）
2	256×8	109435 Etna 内置传感器板或 109490 3 通道输入/输出接口板
3		待用
4	256×8	109860 内部连接板

5		待用
6	128×8	109415 PCMCIA 卡板

9. Index 索引

9. 索引

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