Genesis HIGH SPEED

User Manual

English

Multi-Channel Test Sequencer

BE3200

HBM

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References made to the Perception software are for version 6.72 or higher

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Table of Contents

1 About this manual

1.1 Symbols used in this manual

The following symbols are used throughout this manual to indicate warnings and cautions.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

WARNING

Indicates an electrical shock hazard which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury; or alerts against unsafe practices; or alerts against actions which could damage the product or result in a loss of data.

CAUTION

The ESD susceptibility symbol indicates that handling or use of an item may result in damage from ESD if proper precautions are not taken.

HINT/TIP

The info icon indicates sections which provide additional information about the product. This information is not essential for correct operation of the instrument, but provides knowledge to make better use of the instrument.

1.2 Manual conventions

When the wording “Click Start ...” is used, this refers to the Windows® Start button. Compared to Windows® XP, Windows® Vista and Windows® 7, the Start Menu has undergone some significant changes. The taskbar icon is no longer labeled "Start" and is now simply the pearl icon (of the window-frame in an orb).

2 Safety Messages

2.1 Introduction

IMPORTANT

Read this section before using this product!

This instrument is mains powered and protective ground connections are required (unless otherwise specified for certain parts).

This manual contains information and warnings that must be observed to keep the instrument safe. The instrument should not be used when environmental conditions exceed the instrument's specifications (e.g. damp, high humidity) or if the unit is damaged.

For the correct and safe use of this instrument, it is essential that both operating and service personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

Whenever it is likely that safety protection has been impaired, the instrument must be made inoperative and secured against any unintended operation. Qualified maintenance or repair personnel should be informed. Safety protection is likely to be impaired if, for example, the instrument shows visible damage or fails to operate normally.

Appropriate use
This instrument and the connected transducers may be used only for measurement and directly related control tasks. Any other use is not appropriate. To ensure safe operation, the instrument may only be used as specified in this user manual.

- The covers protect the user from live parts and should only be removed by suitably qualified personnel for maintenance and repair purposes.
- The instrument must not be operated with the covers removed.
- This instrument must not be used in life support roles.
- There are no user serviceable parts inside the instrument.

It is also essential to follow the respective legal and safety regulations for specific applications during use. The same applies to the use of accessories. Additional safety precautions must be taken in setups where malfunctions could cause major damage, loss of data or even personal injury.
Some examples of precautions are: mechanical interlocking, error signaling, limit value switches, etc.

Maintenance and cleaning
The instrument is a maintenance-free product. However, please note the following information about cleaning the housing:

- Before cleaning, disconnect the instrument completely.
-
- When cleaning, ensure that no liquid gets into the housing or connections.

General dangers, failing to follow the safety instructions
This instrument is a state-of-the-art device and as such is fail-safe. Using this instrument may be hazardous if it has been installed incorrectly and is operated by untrained personnel. Any person assigned to install, maintain or repair the unit or to put the unit into operation must have first read and understood the user manual, particularly the technical safety instructions.

Residual risks
This instrument's scope of supply and performance covers only a small area of measurement technology. In addition, equipment planners, installers and operators should plan, implement and respond to the safety engineering considerations of measurement technology in such a way as to minimize any residual risks. Prevailing regulations must be complied with at all times. The residual risks of the measurement technology must be referenced.

Conversions and modifications
Neither the design nor the safety features of this instrument may be modified without our express prior written agreement. Any modification shall exclude all liability on our part for any resultant damage. In particular, any repair or soldering work on cards (replacement of components) is prohibited. When exchanging complete units, use only original parts from HBM. The unit is delivered from the factory with a fixed hardware and/or software configuration. Changes should only be made within the possibilities documented in this manual.

Qualified personnel

People entrusted with the installation, fitting, operation of the instrument and putting the unit into service must have the appropriate qualifications. The instrument may only be installed and used by qualified personnel, in strict accordance with the specifications and the safety rules and regulations. This includes people who meet at least one of the three following qualification levels:

- Project personnel: Have a working knowledge of the safety concepts of automation and test and measurement technology.
- Automation plant or test and measurement operating personnel: Have been instructed on how to handle the equipment and are familiar with the operation of the cards and technologies described in this documentation.
- Commissioning engineers or service engineers: Have successfully completed the training on how to repair the automation systems. They are also authorized to activate, to ground and to label circuits and equipment in accordance with engineering safety standards. It is essential that the legal and safety requirements for the product and any accessories are complied with during use.

2.2 FCC and general

The first WARNING note below is required by the FCC (Federal Communications Commission) and relates only to the interference potential of this equipment. This message is a direct quotation.

WARNING

The equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation, it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart B or Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

2.3 Grounding

The instrument must be used with a protective ground connection via the protective ground conductor of the supply cable. The protective ground conductor is connected to the instrument before the line and neutral connections are made when the supply connection is made. If the final connection to the supply is made elsewhere, ensure that the ground connection is made before line and neutral connections are made.

WARNING

Any interruption of the ground connection, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited.

For protection against electric shock, all external circuits or equipment need a safe insulation. Therefore, peripheral equipment must not be connected to the system with a power supply without the SELV (Separated Extra Low Voltage) rating unless explicitly mentioned.

Signal connections to the instrument should be connected after the ground connection is made and disconnected before the ground connection is removed, i.e. the supply lead must be connected whenever signal leads are connected.

WARNING

For safety, it is essential that the protective ground connector of the instrument is used whenever voltages greater than 33 V RMS, 46.7 V PEAK or 70 V DC (IEC 61010-1:2010) are connected. This is to prevent the instrument's case becoming live in the event of a protective ground interruption, which could occur if the supply connector is accidentally disconnected from the instrument.

The primary purpose of protective grounding is to provide adequate protection against electric shock that could cause death or injury to personnel while working on de-energized equipment. This is accomplished by grounding and bonding to limit the body contact or exposure to voltages at the work-site to a safe value if the equipment were to be accidentally energized from any source of hazardous energy. The greatest source of hazardous energy in most cases is direct energizing of the equipment from a power-system or source.

WARNING

If connection to a protective ground is not possible for any reason, then please refer to the international safety standard EN 50191:2000

2.3.1 Mains power cord

WARNING

Do not use the equipment with damaged cords and/or cables. Replace a damaged cord and/or cable immediately.

2.4 Instrument symbols

A variety of symbols can be found in the system. Below is a list of symbols and their meaning.

This symbol is used to denote the measurement ground connection. This point is not a protective ground connection.

This symbol is used to denote a protective ground connection.

This symbol is used to denote a frame or chassis ground connection. This point is not a protective ground connection.

Where caution is required, this symbol refers to the user manual for further information.

This symbol warns that high voltages are present close to this symbol.

This symbol shows that the switch is a power switch. When pressed, the instrument state toggles between the operating and power-off mode. When the system is in power-off mode, all electronics are disconnected from the power, except for a small circuit used to detect the switch state.

2.5 Protection and isolation

2.5.1 Measurement categories

- The international standards for test equipment safety are IEC 61010-1 and the IEC 61010-2-030.
- IEC 61010-1 defines three overvoltage categories (CAT II, CAT III, and CAT IV) for the power supply of an instrument.
- IEC 61010-2-030 defines three measurement categories (CAT II, CAT III, and CAT IV) for an instrument's input measurements which can be directly connected to mains supply.
- All measurement inputs which are not specified to be connected to the mains power have no CAT rating and are referred to as O (like Others).

Categories in accordance with IEC 61010-2-030:2010
Electrical equipment, specifically measurement tools, can be assigned into four categories in accordance with IEC 61010-2-030:2010. These measurement categories are indicated by the terms O (previously CAT I), CAT II, CAT III and CAT IV. Originally, these categories were used to indicate the overvoltage or surge voltage that was likely to occur and could be sustained by the equipment. Currently, the category indicates the amount of energy that can be released if a short circuit occurs. A higher category number indicates a higher energy level that can occur and can be sustained by the equipment.

O (Other) (previously referred to as **CAT I**): This category is for measurements not directly connected to a mains supply. Measurements for this category are signal levels, regulated low voltage circuits or protected secondary circuits. For this category, there are no defined standard overvoltage or surge impulse levels.

CAT II: This category is for measurements directly connected to a low voltage mains supply. Measurements for this category are mains sockets in household applications or portable tools. This category expects a minimum of three levels of overcurrent protection between the transformer and connection point of the measurement. (See Figure 2.1).

CAT III: This category is for measurements directly connected to the distribution part of a low voltage mains installation. Measurements for this category are circuit breakers, wiring, junction boxes, etc. This category expects a minimum of two levels of overcurrent protection between the transformer and connection point of the measurement. (See Figure 2.1).

CAT IV: This category is for measurements directly connected to the source of a low voltage mains installation. Measurements for this category are overcurrent protection devices, ripple control units, etc. This category expects that there is a minimum of one level of overcurrent protection between the transformer and connection point of the measurement circuit. (See Figure 2.1).

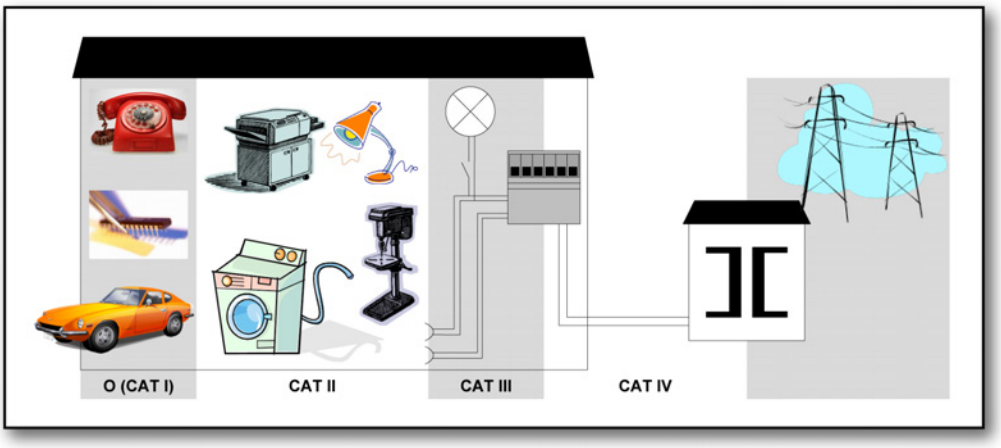

Figure 2.1: Category indication in accordance with IEC 61010-2-030:2010

Example: A measurement device is specified as 600 V CAT II, maximum input voltage 1000 V DC.

Table 2.1: Insulation test voltages in accordance with IEC 61010-2-030:2010

Nominal Voltage (V RMS or V DC)	IEC 61010-2-030:2010					
	5 sec. AC test (V RMS)			Impulse test (V)		
	CAT II	CAT III	CAT IV	CAT II	CAT III	CAT IV
≤ 150	840	1390	2210	1550	2500	4000
> 150 ≤ 300	1390	2210	3310	2500	4000	6000
> 300 ≤ 600	2210	3310	4260	4000	6000	8000
> 600 ≤ 1 000	3310	4260	6600	6000	8000	12000

Using the table above, it can be concluded that this specification informs the user that the device passed the insulation tests; 5 sec at 2210 V RMS and impulse 4000 V. The maximum operating input voltage is 1000 V DC. This device is to be used to measure CAT II circuitry up to 600 V.

WARNING

Measurement inputs of this instrument should not be used to measure high-energy signals of measurement categories CAT II, CAT III or CAT IV (IEC 61010-2-030:2010) (e.g. mains measurements) , unless specifically stated for the specific input.

2.5.2 Basic insulation versus reinforced

For reference, the basic insulation and supplementary insulation and the reinforced insulation test values for CAT II can be found below.

Table 2.2: Test voltages for the testing electric strength of solid insulation in measuring circuits in measurement category II (IEC 61010-2-030:2010)

Nominal voltage line to neutral AC RMS or DC of MAINS being measured. (V)	Test voltage			
	5 s AC test V AC RMS		Impulse test V peak	
	Basic insulation and supplementary insulation	Reinforced insulation	Basic insulation and supplementary insulation	Reinforced insulation
≤ 150	840	1390	1550	2500
> 150 ≤ 300	1390	2210	2500	4000
> 300 ≤ 600	2210	3510	4000	6400
> 600 ≤ 1000	3310	5400	6000	9600

Several means of protection can be used to protect a user from hazardous voltages. As can be seen below, basic insulation and supplementary insulation is one mean of protection, but reinforced insulation is also a means of protection.
The test voltages are different for each mean of protection, as can be found in the table above.

Additional means of protection for single fault conditions
Accessible parts shall be prevented from becoming HAZARDOUS LIVE IN SINGLE FAULT CONDITION. The primary means of protection (see Figure 2.2) shall be supplemented by one of **A**, **B**, **C** or **D**. Alternatively, one of the single means of protection **E** or **F** shall be used. See Figure 2.2.

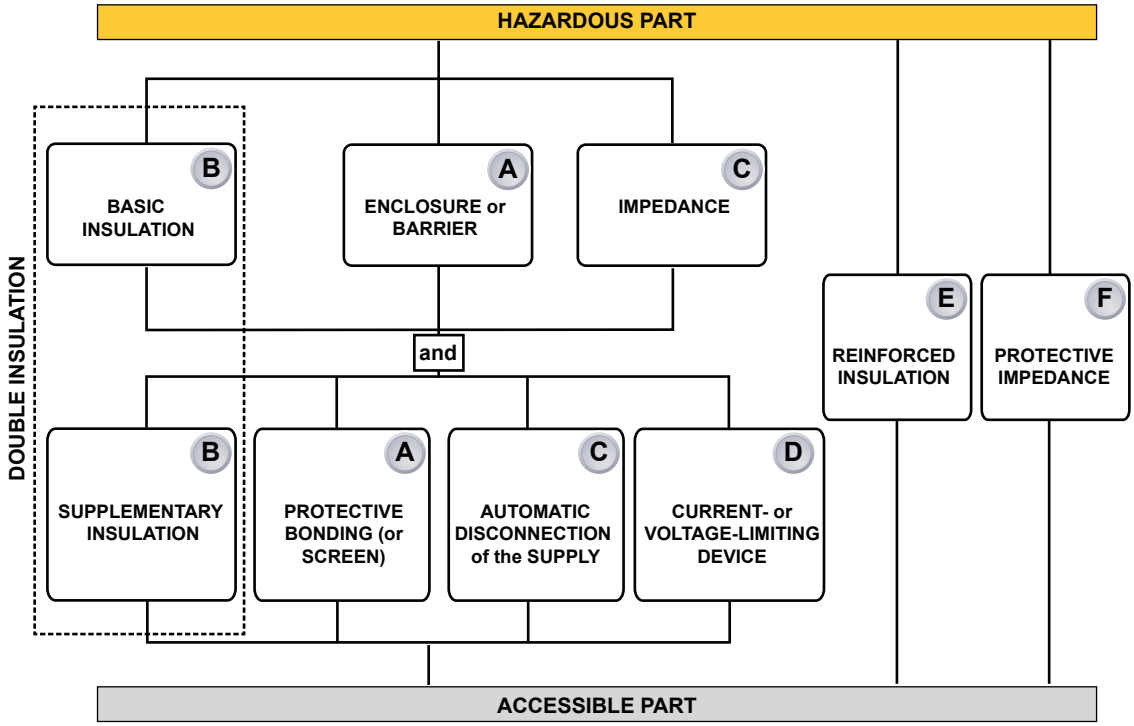

Figure 2.2: Acceptable arrangement of protective means against electric shock

Example: A measurement device is specified as 600 V CAT II reinforced insulation, with a maximum input voltage 1000 V DC.
Using the information above, it can be concluded that this specification informs the user that the measurement device is tested on input to chassis ground for five seconds at 3510 V RMS and impulse 6400 V. The maximum operating input voltage is 1000 V DC. This device is to be used to measure CAT II circuitry up to 600 V.

2.5.3 Protection

WARNING

ELECTRICAL SHOCK HAZARD!
Any interruption of the protective conductor inside or outside the apparatus is likely to make the apparatus dangerous. Intentional interruption is prohibited.
When the apparatus is connected to its supply, terminals may be live, and the opening of covers for removal of parts is likely to expose live parts.

Whenever it is likely that the protection has been impaired, the apparatus must be made inoperative and be secured against any unintended operation.

The protection is likely to be impaired if, for example, the apparatus shows visible damage or has been subjected to severe transport stresses.

It is the responsibility of the user to ensure the safety of any accessories used with the equipment, such as probes.

WARNING

ELECTRICAL SHOCK HAZARD! Do not remove covers. Refer servicing to qualified individuals.

Proper use of this device depends on careful reading of all instructions and labels.

If the instrument is used in a manner not specified by HBM, the protection provided by the instrument can be impaired.

WARNING

This instrument must not be operated in explosive atmospheres.

WARNING

This instrument and related accessories are not designed for biomedical experimentation on humans or animals and should not be directly connected to human or animal subjects or used for patient monitoring.

2.5.4 Overvoltage/current protection

All signal inputs are protected against overloads and transients. Exceeding the limits stated in the specifications, particularly when connected to potentially high-energy sources, can cause severe damage that is not covered by the manufacturer's warranty.

WARNING

Do not remove covers. Refer to qualified individuals for servicing.

The covers protect the user from live parts and should only be removed by suitably qualified personnel for maintenance and repair purposes.

The instrument must not be operated with the covers removed.

There are no user serviceable parts inside.

2.5.5 Isolation

CAUTION

For input channels with plastic BNCs (galvanically isolated from the chassis), the input conductors including the BNC shell may carry hazardous voltages. Only appropriate insulated BNC connectors should be used.

It is the responsibility of the user to ensure the safety of any accessories used with the instrument, such as probes.

CAUTION

Even low voltage inputs may contain high voltage fast transients (spikes), which could damage the input. For this reason it is not safe, for instance, to make direct connections to an AC line supply, unless specifically stated otherwise for the specific input.

2.6 Environment

The equipment should be operated in a clean, dry environment with an ambient temperature between 0 °C and +40 °C, unless otherwise noted.

The instrument is specified for use in a Pollution Degree II environment, which is normally non-conductive with temporary light condensation, but it must not be operated while condensation is present. It should not be used in more hostile, dusty or wet conditions, as specified in the Pollution Degree II environment.

Humidity should be between 0% and 80%. When moving the device from a cold to a warm environment, the device has to be left off for a period of 30 minutes to avoid short circuits as a result of condensation.

Note *Direct sunlight, radiators and other heat sources should be taken into account when assessing the ambient temperature.*

The BE3200 relies on a convection air-cooling design that does not require a fan. Adequate cooling can usually be achieved by leaving a 12.5 mm (0.5") gap around the product.

Do not store the equipment in hot areas. High temperatures can shorten the life of electronic devices and damage batteries.

Do not store the equipment in cold areas. Before the equipment warms up to its normal operating temperature, moisture can form inside the equipment, which may damage the equipment’s electronic circuits.

Do not drop, knock or shake the equipment. Rough handling can break internal electronics and/or PCBs.

Do not use harsh chemicals, cleaning solvents or strong detergents to clean the instrument. To clean the instrument, disconnect all power sources and clean the housing with a soft, slightly damped (not wet!) cloth.

It is the responsibility of the user to ensure the safety of any accessories used with the instrument, such as probes.

2.7 Laser Safety

Within the BE3200 subsystems, components can be installed that include laser optics. These systems are classified as a **Class 1 laser product**. The GEN series fiber optic Isolated Digitizers use an LC optical transceiver for data and command communication between the BE3200 Receiver and Transmitter. Class 1 laser products are not considered to be hazardous. They do not emit hazardous light but it is recommended to avoid direct exposure to the beam.

WARNING

Intrabeam viewing of the laser product may produce dazzling visual effects, particularly in low ambient light. Lasers of any wavelength with sufficient output power can cause injury.

The built-in laser complies with laser product standards set by government agencies for Class 1 laser products:

The GEN series products are certified as Class 1 Laser Products and comply with US FDA regulations. These are certified by TÜV and CSA to meet the Class 1 eye safety requirements of EN (IEC) 60825 and the electrical safety requirements of EN (IEC) 60950. The devices are for use only under the specifications and ratings specified in the manual and data sheets.

2.8 Manual handling of loads

The Manual Handling of Loads Directive 90/269/EEC from the European Community lays down the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers.

CAUTION

The weight of the instrument may exceed 17.5 kg when fully loaded. Please take appropriate actions before lifting the instrument.

Before lifting or carrying a heavy object, the following questions should be asked:

- Can one person lift this load safely, or do two people need to lift the load?
- How far will the load have to be carried?
- Is the path clear of clutter, cords, slippery areas, overhangs, stairs, curbs or uneven surfaces?
- Will closed doors that need to be opened be encountered?
- Once the load is lifted, will it block the carrier's view?
- Can the load be broken down into smaller parts?
- Should the carrier wear gloves to get a better grip and to protect hands?

Contact the "Occupational Health and Safety" organization, or equivalent, in your country for more information.

The BE3200 Model weighs approximately 17.5 kg at its fully loaded maximum:

2.9 International safety warnings

Dansk

SIKKERHEDSADVARSEL
Dette instrument skal anvendes med en sikkerhedsjordforbindelse, som er tilsluttet via lysnetkablets beskyttelsesjordledning eller via en sikkerhedsjordklemme, hvis instrumentet er forsynet hermed. Hvis sikkerhedsjordforbindelsen afbrydes, inden i eller uden for instrumentet, kan instrumentet udgøre en farekilde. Sikkerhedsjordforbindelsen må ikke afbrydes. Der skal desuden tilsluttet en signaljordforbindelse, hvis et indgangssignal overstiger 33 V RMS, 46,7 V PEAK eller 70 V DC (IEC 61010-1:2010).

Dækslerne må ikke fjernes.

Afbryd dette instrument eller dets strømforsyning fra lysnettet ved at fjerne IEC-stikket. Instrumentets vekselstrømsafbryder er kun beregnet til funktionelle formål. Den er ikke beregnet eller egnet til at afbryde instrumentet fra lysnettet.

Hvis målingerne et omfattet af EN 50110-1 og EN 50110-2, skal alle kort med en driftsspænding på mere end 50 V AC RMS eller 120 V DC tilsluttes af en kvalificeret tekniker eller en elektriker, og arbejdet skal kontrolleres af en kvalificeret tekniker. (En kvalificeret tekniker er en person, som i kraft af sin specialuddannelse, sin viden og erfaring samt sit kendskab til relevante bestemmelser kan vurdere omfanget af det arbejde, de skal udføre, og afdække de potentielle risici, og som er blevet udpeget som kvalificeret tekniker af deres arbejdsgiver).

Nederlands

VEILIGHEIDSWAARSCHUWING
Dit instrument mag uitsluitend worden gebruikt als een beschermde massa (aarde) is aangesloten via de beschermde massageleider van de voedingskabel, of indien het instrument daarvan is voorzien via de veiligheids-massa-aansluiting. Als de beschermde massa, binnen of buiten het instrument, wordt onderbroken, dan kan dat hierdoor uitermate gevaarlijk worden. Het opzettelijk onderbreken van de massa is verboden. Indien er een signaal wordt aangeboden van meer dan 33 V RMS, 46.7 Vpeak of 70 V DC (IEC 61010-1:2010) dient eveneens een signaalaarding aangesloten te zijn.

De deksels mogen nooit worden verwijderd.

Om dit instrument los te koppelen of van het stroom af te halen, dient de IEC-aansluiting er uit te worden getrokken. De wisselstroom-voedingsschakelaar op dit instrument is uitsluitend bestemd voor functionele doeleinden. Het is niet bedoeld of geschikt als een ontkoppelingsapparaat.

Voor metingen die binnen de EN 50110-1 en EN 50110-2 vallen: let op dat alle panelen met bedrijfsspanningen van meer dan 50 V AC RMS of 120 V DC alleen door een gekwalificeerde technicus mogen worden aangesloten of door een persoon die is opgeleid in de elektrotechniek en onder toezicht van een gekwalificeerde technicus staat. (Gekwalificeerde technici zijn personen, die op basis van hun specialistische opleiding, kennis en ervaring als ook hun kennis van de betreffende voorzieningen, in staat zijn om het werk dat aan hen is toevertrouwd te beoordelen en mogelijke gevaren te ontdekken en door hun werkgever zijn aangewezen als gekwalificeerde technici.)

Suomi

TURVAOHJEITA

Tätä laitetta käytettäessä sen tulee olla suojamaadoitettu joko verkkojohdon suojajohtimen tai erillisen suojamaadoitusliitännän kautta, mikäli laitteeseen on sellainen asennettu. Suojamaadoituksen katkaiseminen laitteen sisä- tai ulkopuolelta tekevät siitä vaarallisen. Tahallinen katkaisu on kiellettyä. Lisäksi signaalimaa on oltava kytkettynä, jos jokin tulosignaali ylittää tehollisarvon 33 V, huippuarvon 46,7 V tai 70 V DC (IEC 61010-1:2010).

Älä poista suojakansia.

Katkaise laitteen tai sen virtalähteen käyttöjännite irrottamalla IEC-liitin. Laitteen verkkokytkimellä on ainoastaan toiminnallinen tarkoitus. Sitä ei ole tarkoitettu, eikä se sovellu laitteen erottamiseen käyttöjännitteestä.

Mittauksissa, jotka kuuluvat EN 50110-1- ja EN 50110-2-standardien soveltamisalaan, huomaa, että kortit, jotka toimivat tehollisarvojännitteellä yli 50 V AC tai 120 V DC, saa kytkeä vain pätevä asentaja tai sähköteknisen koulutuksen saanut henkilö pätevän asentajan valvonnassa. (Pätevät asentajat ovat henkilöitä, jotka erikoiskoulutuksensa, tietojensa ja kokemuksensa sekä asiaan kuuluvien määräysten tuntemuksensa ansiosta pystyvät arvioimaan heille annettuja töitä ja havaitsemaan mahdolliset vaarat ja jotka heidän työnantajansa on nimennyt ammattitaitoisiksi asentajiksi).

Français

ATTENTION - DANGER!
Lorsqu'il est en fonctionnement, cet instrument doit impérativement être mis à la masse par le conducteur de terre du câble d'alimentation ou, si l'instrument en comporte une, par la borne de terre. Il peut être dangereux en cas de coupure du circuit de terre, que ce soit à l'intérieur ou à l'extérieur de l'instrument. Il est formellement interdit de couper intentionnellement le circuit de terre. De plus, une masse signal doit être connectée si l'un des signaux d'entrée, quel qu'il soit, dépasse 33 V RMS (valeur efficace), 46,7 V PEAK (valeur de crête) ou 70 V DC (courant continu) (CEI 61010-1:2010).

Ne pas déposer les panneaux de protection.

Pour déconnecter cet instrument ou son alimentation de l'alimentation secteur, débrancher le cordon d'alimentation (CEI). L'interrupteur d'alimentation secteur sur cet instrument est purement fonctionnel. Il ne s'agit pas d'un dispositif de coupure du courant, et n'est pas conçu pour cette fonction.

Pour les mesures entrant dans le champ d'application des normes EN 50110-1 et EN 50110-2, veuillez noter que tous les panneaux avec des tensions de service supérieures à 50 V AC RMS (tension efficace) ou 120 V DC (courant continu) ne peuvent être connectés que par un technicien qualifié ou une personne formée en ingénierie électrique et supervisée par un technicien qualifié. (Les techniciens qualifiés sont des personnes qui, du fait de leur formation, leurs connaissances et leur expérience spécialisées ainsi que leur connaissance des dispositions réglementaires appropriées, sont capables d'évaluer le travail qui leur est confié et détecter les risques possibles, et qui ont été désignées comme techniciens qualifiés par leur employeur).

Deutsch

WARNHINWEIS!
Dieses Gerät muss mit einer Schutzerde betrieben werden, die über den Schutzleiter des Speisekabels oder über die Erdungsklemme des Gerätes (falls vorhanden) anzuschließen ist. Bei einer Unterbrechung der Schutzerde außerhalb oder innerhalb des Gerätes kann eine Gefahr am Gerät entstehen. Eine beabsichtigte Unterbrechung ist nicht zulässig. Achtung! Bei Signalspannungen über 33 V Effektivwert, 46,7 V Spitzenwert oder 70 V Gleichspannung (IEC 61010-1:2010) muss die Signalmasse angeschlossen sein.

Die Schutzabdeckungen nicht entfernen.

Zum Trennen des Gerätes oder seiner Spannungsversorgung von der Wechselstromversorgung den IEC-Stecker abziehen. Der Wechselstromversorgungs-Schalter dient bei diesem Gerät nur für Funktionszwecke. Er ist nicht als Trennvorrichtung bestimmt bzw. geeignet.

Für Messungen gemäß EN 50110-1 und EN 50110-2 bitte berücksichtigen, dass alle Platinen mit Betriebsspannungen über 50 V AC RMS oder 120 V DC nur durch einen qualifizierten Elektriker oder einer elektrotechnisch unterwiesenen Person unter Aufsicht eines qualifizierten Technikers durchgeführt werden dürfen. (Qualifizierte Techniker sind aufgrund ihrer fachlichen Ausbildung, Kenntnisse und Erfahrungen sowie Kenntnis der einschlägigen Bestimmungen in der Lage, die ihnen anvertrauten Arbeiten zu beurteilen und mögliche Risiken zu erkennen, sowie Personen, die durch ihren Arbeitgeber zu qualifizierten Technikern ernannt worden sind).

Italiano

AVVISO DI SICUREZZA
Questo strumento deve esser utilizzato con un collegamento protettivo di messa a terra tramite il filo di messa a terra del cavo di alimentazione o tramite il terminale di messa a terra in sicurezza, nel caso in cui lo strumento ne sia dotato. Qualsiasi interruzione della messa a terra di protezione, sia all'interno che all'esterno dello strumento, lo renderà pericoloso. È vietata qualsiasi interruzione causata intenzionalmente. Inoltre, la connessione di terra deve essere collegata se ad uno qualsiasi degli ingressi viene applicato un segnale superiore a 33 V RMS, 46,7 V di picco o 70 V c.c. (IEC 61010-1:2010).

Non rimuovere le coperture.

Per disinnestare questo strumento o l'alimentazione dalla corrente alternata, scollegare il connettore IEC. L'interruttore dell'alimentazione a corrente alternata di questo strumento viene fornito esclusivamente per scopi operativi e non viene inteso, né è adatto, per essere utilizzato come dispositivo di disinnesto.

Si noti che per le misurazioni che rientrano nell'ambito di applicazione delle norme EN 50110-1 ed EN 50110-2, tutte le schede con tensioni di esercizio superiori a 50 V c.a. RMS o 120 V c.c. possono essere collegate esclusivamente da un tecnico qualificato o da una persona in possesso di una formazione specifica nel campo dell'ingegneria elettrica sotto la supervisione di un tecnico qualificato. (Per tecnico qualificato si intende una persona che, in virtù della propria formazione , preparazione ed esperienza specialistica, nonché conoscenza delle disposizioni di settore, è in grado di valutare il lavoro che gli viene assegnato e di individuare possibili rischi, oltre ad essere stato nominato tecnico qualificato dal proprio datore di lavoro).

Norsk

ADVARSEL!
Dette instrument må betjenes med beskyttelsesjord tilkoblet via beskyttelsesjordlederen til tilførselskabelen eller via beskyttelsesjordklemmen, hvis instrumentet er utstyrt med en slik. Ethvert brudd i beskyttelsesjorden inni eller utenpå instrumentet kan føre til at instrumentet blir farlig. Tiltenkt brudd er tillatt. I tillegg må en signaljord tilkobles hvis et inngangssignal overskrider 33 V RMS, 46,7 V PEAK eller 70 V DC (IEC 61010-1:2010).

Ikke fjern dekslene.

For å koble dette instrumentet eller dets strømforsyning fra AC-tilførselen, trekker du ut IEC-kontakten. AC-tilførselsbryteren på dette instrumentet er kun for funksjonelle formål. Den er ikke beregnet for, eller egnet til frakoblingsenhet.

For målinger som faller innenfor EN 50110-1 og EN 50110-2 må man være oppmerksom på at alle kort med arbeidsspenninger over 50 V AC RMS eller 120 V DC kun kan kobles til av en kvalifisert tekniker eller elektriker og overvåket av en kvalifisert tekniker. (Kvalifiserte teknikere er personer som på grunn av sin spesialistopplæring, kunnskap og erfaring, samt sin kunnskap om relevante bestemmelser, er i stand til å gå inn i arbeidet som de har fått i oppdrag å utføre og detektere mulige farer, og som er blitt utnevnt som kvalifiserte teknikere av sin arbeidsgiver.

Português

AVISO DE SEGURANÇA
Este instrumento deve funcionar com uma terra de proteção conectada através do condutor da terra de proteção do cabo de alimentação ou, caso o instrumento esteja equipado com um, através do terminal da terra de proteção. Qualquer interrupção da terra de proteção, no interior ou no exterior do instrumento, poderá tornar o instrumento perigoso. A interrupção intencional é proibida. Além disso, deve ser conectado um sinal de terra se qualquer sinal de entrada exceder 33 V RMS, 46,7 V PICO ou 70 V CC (IEC 61010-1:2010).

Não retirar as tampas.

Para desconectar este instrumento ou a respetiva fonte de alimentação da alimentação CA, retire o conector IEC da ficha. Neste instrumento, o interruptor de alimentação CA é fornecido apenas para fins funcionais. Não se destina a, nem é adequado para, ser utilizado como dispositivo de desconexão.

Para medições abrangidas pelas normas EN 50110-1 e EN 50110-2, tenha em atenção que todos os quadros com tensões de funcionamento superiores a 50 V CA RMS ou 120 V CC apenas poderão ser conectados por um técnico qualificado ou por alguém com formação em engenharia elétrica e supervisionados por um técnico qualificado. (Técnicos qualificados são pessoas que, devido à sua formação especializada, ao conhecimento e à experiência, bem como ao seu conhecimento das disposições relevantes, são capazes de avaliar o trabalho que lhes é confiado e detetar possíveis riscos e são pessoas que foram nomeadas técnicos qualificados pelo seu empregador.)

Português (Brasil)

AVISO DE SEGURANÇA
Este instrumento deve ser operado com um terra de proteção conectado por meio do condutor do terra de proteção do cabo de alimentação ou, se o instrumento estiver equipado com um, por meio do terminal de aterramento de segurança. Qualquer interrupção do terra de proteção, no interior ou no exterior do instrumento, poderá tornar o instrumento perigoso. A interrupção intencional é proibida. Além disso, deve ser conectado um sinal de terra se qualquer sinal de entrada exceder um máximo de 33 V RMS, 46,7 V PICO ou 70 V CC (IEC 61010-1:2010).

Não retirar as tampas.

Para desconectar este instrumento ou a fonte de alimentação dele da alimentação CA, desconecte o conector IEC. Neste instrumento, o interruptor de alimentação CA é fornecido somente para fins funcionais. Não se destina a, nem é adequado para, ser usado como dispositivo de desconexão.

Para medições no escopo das normas EN 50110-1 e EN 50110-2, note que todos os quadros com tensões de funcionamento superiores a 50 V CA RMS ou 120 V CC poderão somente ser conectados por um técnico qualificado ou por alguém com formação em engenharia elétrica e supervisionados por um técnico qualificado. (Os técnicos qualificados são pessoas que, devido à sua formação acadêmica, conhecimento e experiência, bem como ao seu conhecimento das provisões relevantes, são capazes de avaliar o trabalho que lhes é confiado e detectar possíveis riscos e são pessoas que foram nomeadas técnicos qualificados por seu empregador.)

Español

ADVERTENCIA SOBRE SEGURIDAD
Este instrumento debe utilizarse conectado a tierra a través del conductor de puesta a tierra del cable de alimentación o de la borna de seguridad, si dicho instrumento estuviera equipado con ella. Cualquier interrupción de esta puesta a tierra, dentro o fuera del instrumento, hará que el manejo del mismo resulte peligroso. Queda terminantemente prohibido dejar en circuito abierto dicha puesta a tierra. Además, debe conectarse una señal de tierra si cualquier señal de entrada sobrepasa los 33 V eficaces, los 46,7 V de PICO o los 70 V de CC (IEC 61010-1:2010).

No quite las tapas.

Para desconectar este instrumento o su fuente de alimentación de la CA, desenchufe el conector IEC. El interruptor de entrada de CA (encendido) se incluye solo para fines funcionales. No está pensado para utilizarse como medio de desconexión, ni tampoco es adecuado para ello.

En cuanto a las mediciones que se clasifiquen bajo el alcance de las normas EN 50110-1 y EN 50110-2, tenga en cuenta que los cuadros con tensión de funcionamiento por encima de los 50 V de CA eficaces o los 120 V de CC solo puede conectarlos un técnico cualificado o una persona con formación en ingeniería eléctrica y supervisada por un técnico cualificado. (Los técnicos cualificados son personas que, debido a su formación especializada, conocimientos y experiencia, así como por su conocimiento de los suministros pertinentes, son capaces de evaluar el trabajo encomendado y detectar posibles riesgos, al igual que personas nombradas como técnicos cualificados por la empresa contratadora).

Svenska

SÄKERHETSVARNING
Detta instrument måste användas med jordad anslutning via strömkabelns ledare eller, om sådan finns, via en isolerad jordterminal. Avbrott i den isolerande jordningen inuti eller utanför strömgivaren kan göra strömgivaren farlig. Avsiktligt avbrott är förbjudet. Dessutom måste en signaljordning anslutas om någon ingångssignal överskrider 33 V RMS, 46.7 V PEAK eller 70 V DC (IEC 61010-1:2010).

Ta inte bort skydden.

Dra ut IEC-kontakten för att koppla loss instrumentet eller dess strömkälla från strömförsörjningen. Brytaren för växelströmförsörjningen på detta instrument är endast avsedd för funktionella syften. Den är inte avsedd eller lämplig som frånkopplingsenhet.

För mått inom intervallen som anges i EN 50110-1 och EN 50110-2, observera att alla kort med arbetsspänning över 50 V AC RMS eller 120 V DC kan endast anslutas av en kvalificerad tekniker eller en person som är utbildad i elteknik och övervakas av en kvalificerad tekniker. (Kvalificerade tekniker är personer som på grund av sin specialistutbildning, kunskap och erfarenhet liksom sin kunskap om relevanta enheter kan utvärdera arbetet som tilldelas dem och göra kvalificerade riskbedömningar samt utses av sina arbetsgivare till kvalificerade tekniker).

English

SAFETY WARNING

This instrument must be operated with a protective ground (earth) connection via the protective ground conductor of the supply cable or, if the instrument is fitted with one, via the protective ground terminal. Any interruption of the protective ground, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited. In addition, a signal ground must be connected if any input signal exceeds 33 V RMS, 46.7 V PEAK or 70 V DC (IEC 61010-1:2010).

Do not remove the covers.

To disconnect this instrument or its power-supply from the AC supply, unplug the IEC connector. The AC supply switch on this instrument is provided for functional purposes only. It is not intended, or suitable, as a disconnecting device.

For measurements falling within the scope of the EN 50110-1 and EN 50110-2, please note that all cards with working voltages above 50 V AC RMS or 120 V DC may only be connected by a qualified technician or a person trained in electrical engineering and supervised by a qualified technician. (Qualified technicians are persons who, due to their specialist training, knowledge and experience as well as their knowledge of the relevant provisions are able to assess the work with which they are entrusted and detect possible risks and who have been nominated as qualified technicians by their employer).

日本語

安全上の警告
本機器の操作は、電源ケーブルの保護接地線で接地（アース）を施した上で行ってください。また、安全接地用端子が存在する場合は、これを経由して本機器を接地してください。機器の内部または外部にある保護接地線が遮断されると、機器が危険な状態に陥る可能性があります。故意に保護接地線を遮断することを禁止します。また、入力信号が33 V RMS、ピーク時に46.7 V RMS、または70V DCを超える場合は、信号接地線を接続してください（IEC 61010-1:2010）。

カバーを外さないでください。

本機器またはその電源供給をAC電源供給から遮断するには、IECコネクターを抜きます。本機器のAC電源スイッチは、機能上の目的のためだけに提供しています。したがって、機器の主電源遮断用として意図されていないか、適応していません。

EN 50110-1とEN 50110-2の適用範囲に該当する測定を行う際、使用電圧が50 V AC RMSまたは120 V DCを超えるすべての基板の接続作業は、適正な資格を持つ技術者が、または電気工学の訓練を受けた者が適正な資格を持つ技術者の監督の下、行わなければなりませんのでご注意ください。(適正な資格を有する技術者とは、専門技術者に向けた訓練を受け、知識と経験を有し、該当する規定についても熟知しているため、委託された作業の内容を評価し、存在する可能性のあるリスクを特定することができ、雇用主により適正な資格を有する技術者として任命されている者を指します。)

中文

安全警告

该仪器必须通过电源电缆的保护接地线连接到保护接地（接地），如果该仪器已配备了安全接地端子，则通过该端子接地。断开仪器内外的任何保护接地可能使设备存在危险。严禁有意断开。此外，若任何输入信号高于 33 V RMS, 46.7 V 峰或 70 V DC，则必须将信号接地 (IEC 61010-1:2010)。

不要取下保护盖。

要将此设备或其电源断开交流电源，请拔下 IEC 接头。仪器上的交流电源开关仅用于功能性目的。而不是用于或适用于断开设备。

对于 EN 50110-1 和 EN 50110-2 中的测量，请注意：所有工作电压高于 50 V AC RMS 或 120 V DC 的板卡只能由合格的技术人员或在由受过电气工程培训的人员在合格技术人员的监督下进行连接。(合格技术人员指的是其专业培训、知识和经验以及相关规定的指示能够胜任委托给他们的工作并能检查出可能风险的人，这些人会被其雇主指定为合格技术人员)。

РУССКИЙ

ПРЕДУПРЕЖДЕНИЕ
Для эксплуатации данного прибора необходимо использовать защитное заземление, подключенное через проводник заземления кабеля питания или через терминал защитного заземления, если прибор оснащен таковым. В случае прерывания защитного заземления (внутри или снаружи прибора) прибор может стать травмоопасным. Преднамеренное прерывание заземления запрещено. Кроме того, необходимо подключить сигнальное заземление, если напряжение входного сигнала превышает 33 В среднеквадр. знач., 46,7 В пиков. знач. или 70 В пост. тока (IEC 61010-1:2010).

Не демонтируйте крышки.

Для отключения данного прибора или его блока питания от сети переменного тока отсоедините разъем IEC. Переключатель питания переменного тока данного прибора предусмотрен только для функциональных целей и не должен использоваться в качестве устройства отключения.

Для проведения измерений в соответствии со стандартами EN 50110-1 и EN 50110-2 следует учесть, что подключение всех плат, рабочее напряжение которых превышает 50 В перемен. тока среднеквадр. знач. или 120 В пост. тока, может выполнять только квалифицированный технический персонал или сотрудники, прошедшие курс обучения по электротехнике, под наблюдением квалифицированного персонала. (Квалифицированным техническим персоналом считаются сотрудники, которые после специальной подготовки, получения требуемых знаний и опыта, а также знакомые с основными процедурами, способны оценить доверенную им работу, определив возможные риски. При этом назначение на должность квалифицированного технического работника осуществляет работодатель.)

안전 경고

안전 경고
본 장비는 반드시 보안용 접지(접지)가 전원 공급 장치 케이블의 보안용 접지 도체를 통해 연결된 상태에서 작동해야 하며, 접지가 장착된 경우에는 보안용 접지 터미널을 통해 작동해야 합니다. 장비 내부 혹은 외부적으로 접지 방해 요인이 있는 경우 사용자에게 위험할 수 있습니다. 고의적인 방해는 금지됩니다. 또한, 입력 신호가 **33 V RMS, 46.7 V** 피크 또는 **70 V DC (IEC 61010-1:2010)**를 초과하는 경우 신호 접지를 연결해야 합니다.

덮개를 제거하지 마십시오.

AC 공급 전원으로부터 이 기기 또는 전원 공급 장치를 분리하려면 **IEC** 커넥터를 뽑으십시오. 본 장비의 **AC** 전원 공급 스위치를 장비 작동 외에 다른 용도로 사용하지 마십시오. 본 스위치는 단절 용도로 설계되지 않았으며, 이에 적합하지도 않습니다.

EN 50110-1 및 **EN 50110-2** 범위에 속한 측정값의 경우, **50 V AC RMS** 또는 **120 V DC** 를 초과하는 작동 전압의 모든 보드는 검증된 전문 기사 또는 전기 공학 교육을 받고 검증된 전문 기사의 감독을 받는 사람만이 연결할 수 있습니다. (검증된 전문 기사는 전문가 교육, 지식 및 경험뿐만 아니라 관련 규정의 지식을 보유하고 있어 그들에게 위임된 작업을 수행하고 가능한 위험을 탐지할 수 있으며 고용주가 자격을 갖춘 기술자로 지명한 사람입니다.)

2.10 Operation of electrical installations

Working on, with, or near electrical installations implies certain dangers. These electrical installations are designed for the generation, transmission, conversion, distribution and use of electrical power. Some of these electrical installations are permanent and fixed, such as a distribution installation in a factory or office complex, others are temporary, such as on construction sites, and others are mobile or capable of being moved either while energized or while neither energized nor charged.

The European Standard EN 50110-1 sets out the requirements for the safe operation of and work activity on, with, or near these electrical installations. The requirements apply to all operational, working and maintenance procedures. The European Standard EN 50110-2 is a set of normative annexes (one per country) which specify either the present safety requirements or give the national supplements to these minimum requirements at the time when this European Standard was prepared.

WARNING

High voltage and qualified personnel

For measurements falling within the scope of the EN 50110-1 and EN 50110-2, please note that working with voltages above 50 V AC RMS or 120 V DC may only be connected by a qualified technician or a person trained in electrical engineering and supervised by a qualified technician. (Qualified technicians are persons who, due to their specialist training, knowledge and experience, as well as their knowledge of the relevant provisions, are able to assess the work with which they are entrusted and detect possible risks and who have been nominated as qualified technicians by their employer).

3 Normative Documents and Declarations

3.1 Electrical

3.1.1 Electrostatic Discharge (ESD)

When handling disconnected devices, electrostatic discharge (ESD) can cause damage if discharged into or near sensitive components on the device. Take steps to avoid such an occurrence.

CAUTION

HBM uses state-of-the-art electronic components in its equipment. These electronic components can be damaged by discharge of static electricity (ESD). ESD damage is quite easy to induce, often hard to detect, and always costly. Therefore, we must emphasize the importance of ESD preventions when handling a BE3200 system, its connections or a plug-in card.

Description of ESD

Static electricity is an electrical charge caused by the buildup of excess electrons on the surface of a material. To most people, static electricity and ESD are nothing more than annoyances. For example, after walking over a carpet while scuffing your feet, building up electrons on your body, you may get a shock - the discharge event - when you touch a metal doorknob. This little shock discharges the built-up static electricity.

ESD-susceptible equipment

Even a small amount of ESD can harm circuitry, so when working with electronic devices, take measures to help protect the electronic devices, including the BE3200 Test Sequencer, from ESD harm. Although HBM has built protections against ESD into its products, ESD exists and, unless neutralized, could build up to levels that could harm the equipment. Any electronic device that contains an external entry point for plugging in anything from cables to acquisition cards is susceptible to entry of ESD.

Precautions against ESD

Any built-up static electricity should be discharged from the user and the electronic devices before touching an electronic device, before connecting one device to another, or replacing acquisition cards. This can be done in many ways, including the following:

- Grounding oneself by touching a metal surface that is at earth ground. For example, if the computer has a metal case and is plugged into a standard three-prong grounded outlet, touching the case should discharge the ESD on the body.
- Increasing the relative humidity of the environment.
- Installing ESD-specific prevention items, such as grounding mats and wrist straps.

While appropriate precautions to discharge static electricity should always be taken, the user may want to take extra precautions to protect the electronic equipment against ESD if ESD events are observed in the present environment.

The use of wrist straps
Use an ESD wrist strap whenever you open a chassis, particularly when you will be handling circuit cards and components. In order to work properly, the wrist strap must make good contact at both ends (with the user's skin at one end, and with the chassis at the other).

WARNING

The wrist strap is intended for static control only. It will not reduce or increase your risk of receiving an electric shock from electrical equipment. Follow the same precautions you would use without a wrist strap.

WARNING

Wrist straps should only ever be used in situations where no direct power is connected to the circuit or system being handled.

3.1.2 Electromagnetic Compatibility (EMC)

EMC stands for Electromagnetic Compatibility. The overall intention is that electronic equipment must be able to co-exist with other electronic equipment in its immediate vicinity and that the electronic equipment does not emit large amounts of electromagnetic energy. Thus, there are two distinct requirements for electromagnetic compatibility: emission and immunity.

This instrument generates, accepts and can radiate radio frequency energy and, if not installed and used in accordance with the operator manual, may cause harmful interference to other equipment. However, there is no guarantee that interference will not occur in a particular installation.

Immunity test: All immunity tests are done with the failure criterion being a change of the instrument's control settings. Any of these tests may produce a spurious trigger. Measurements are not valid during and immediately after the immunity tests.

Whether the instrument causes interference to other equipment can be determined by turning the instrument on and off. If this instrument does cause minor harmful interference to other equipment, the user is encouraged to try reducing the interference by one or more of the following measures:

- Re-orient or relocate the affected equipment.
- Increase the distance between the instrument and the affected equipment.
- Re-orient or relocate interface cables.
- Connect the instrument to an outlet on a different supply circuit to the affected equipment.

Electrical supply cables, interface cables and probes should be kept as short as practical, preferably a maximum of 1 m. Interface cables should be screened and interface cables longer than 3 m are not acceptable in terms of interference port immunity.

3.2 Environment

3.2.1 WEEE - Waste Electrical and Electronic Equipment

Since February 2003, European Union legislation stating that EU members now restrict the use of hazardous substances in electrical and electric equipment (Directive 2011/65/EU) and promotes the collection and recycling of such electrical equipment (Directive 2012/19/EU) has been in force.

Statutory waste disposal mark

The electrical and electronic devices that bear this symbol are subject to the European waste electrical and electronic equipment directive 2012/19/EU. The symbol indicates that the device must not be disposed of as household garbage.

In accordance with national and local environmental protection and material recovery and recycling regulations, old devices that can no longer be used must be disposed of separately and not with normal household garbage. For more information about waste disposal, please contact local authorities or the dealer from whom the product was purchased. As waste disposal regulations may differ from country to country within the EU, please contact the supplier about waste disposal regulations if necessary.

Packaging

The original packaging of HBM devices is made from recyclable material and can be sent for recycling. For ecological reasons, empty packaging should not be returned to us.

Environmental protection

The product will comply with general hazardous substances limits for at least 20 years, and will be ecologically safe to use during this period, as well as recyclable. This is documented by the 20 years symbol on the system as statutory mark of compliance with emission limits in electronic equipment supplied to China.

3.3 CE Declaration of conformity

For information about the CE Declaration of conformity, please refer to www.hbm.com/en/1254/downloads/.

3.4 FCC Class A Notice

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1 This device may not cause harmful interference.
2 This device must accept any interference received, including interference that may cause undesired operation.

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

IMPORTANT

Any modifications made to this device that are not approved by HBM may void the authority granted to the user by the FCC to operate this equipment.

4 Batteries

4.1 General

The BE3200 includes a backup rechargeable sealed Lead acid battery: 12 VDC @ 6.5 Ahr capacity.

WARNING

There is an automatic recharge system built-in. Replacement should only be done by a qualified service technician.

Note *The battery is intended to keep the unit running if there are any temporary power interruptions.*

HINT/TIP

To disconnect the instrument from the AC supply, unplug the IEC connector on the rear of the instrument. The instrument should be positioned to allow access to the AC connector.

Precautions and warnings when using batteries

- Never use any charger or battery that is damaged in any way.
- Use the battery only for its intended purpose.
- Do not take batteries apart or modify them. The batteries must not be damaged, crushed, pierced or exposed to high temperatures. In case of inappropriate handling of a battery there could be a risk of combustion or explosion.
- Battery charging time depends on the remaining battery charge and the type of battery and charger used. The batteries can be charged and discharged hundreds of times, but will gradually wear out. When the operation time is noticeably shorter than normal, it is time to buy new batteries.
- If left unused, a fully charged battery will discharge itself over time.
- Use only HBM approved batteries and recharge your batteries only with HBM approved chargers. When a charger is not in use, disconnect it from the power source. Do not leave a battery connected to a charger for more than a week, since overcharging may shorten its life.
- Extreme temperatures will affect the charging capacity of the battery: it may require cooling or warming first.
- Remove the batteries before charging.

- Do not leave the batteries in hot or cold places, as you will reduce the capacity and lifetime of the batteries. Always try to keep batteries at room temperature. A system with hot or cold batteries may temporarily not work, even if the batteries are fully charged.
- Standard Li-ion batteries cannot be charged below 0 °C (32 °F). Although the packs appear to be charging normally they will be damaged. If done repeatedly, such damage can compromise the safety of the pack. The battery will become more vulnerable to failure if subjected to impact, crush or high-rate charging.
- Do not short-circuit the battery. Accidental short-circuit can occur when a metallic object causes a direct connection between the + (plus) and - (minus) terminals of the battery, for example when you carry a spare battery in a pocket or bag. Short-circuiting the terminals may damage the battery or the object causing the short-circuiting.
- Dispose of used batteries in accordance with local chemical waste regulations only. Always recycle. Do not dispose of batteries in a fire.

WARNING

If leaked battery fluid comes into contact with your eyes, immediately flush out your eyes with water and consult a doctor, as it may result in blindness or other injury. If leaked battery fluid comes in contact with your body or hands, wash thoroughly with water.
If leaked battery fluid comes into contact with the instrument, carefully wipe the instrument, avoiding direct contact with your hands.

4.2 Disposal

Dispose of used batteries only in accordance with local chemical waste regulations. Always recycle.

WARNING

Do not dispose of batteries in a fire.

For more information about waste disposal, please contact the local authorities or the dealer from whom the product was purchased.
As waste disposal regulations may differ from country to country within the EU, please contact the supplier about waste disposal regulations if necessary.

5 Mains Power

5.1 Power and frequency requirements

The BE3200 Test Sequencer operates from an integral universal power supply system. The BE3200 Test Sequencer uses up to 110 VA max power and operates from line voltages of 100 VAC to 240 VAC at 47-63 Hz.

To connect or disconnect the instrument from the AC supply, plug or unplug the IEC connector from the instrument or external power supply. The instrument should be positioned to allow access to the AC connector. The front power switch on the instrument is not a disconnecting device. When the instrument is connected some power will be consumed.
For more information, please refer to chapter "Connecting power" on page 53.

CAUTION

Do not position the BE3200 Test Sequencer so that it is difficult to remove the power cable.

The BE3200 must be connected to ground by the conductor of the supply cable. This is to ensure that all electromagnetic Compatibility (EMC) requirements are met.

5.2 Connecting power

The power inlet and the protective ground connection are located at the rear of the BE3200 system. A mains power cord that is in accordance with the destination country's standards is shipped with the unit. For more information on power consumption, please refer to chapter "Mains Power" on page 52.

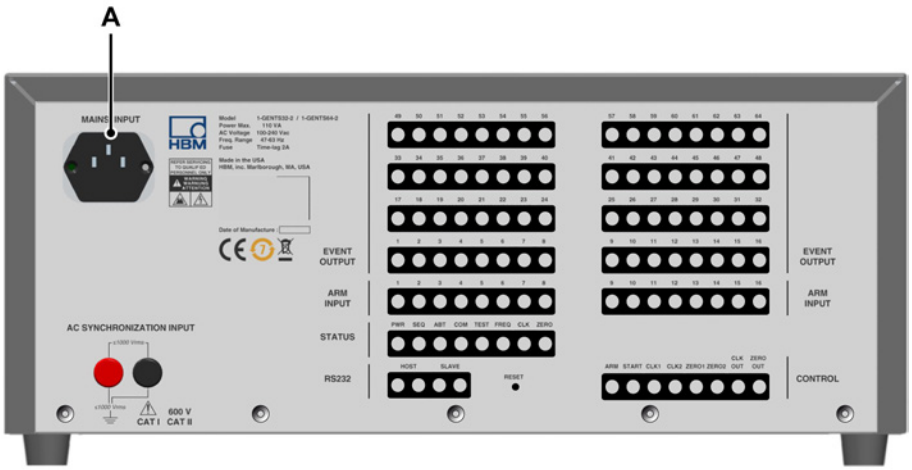

Figure 5.1: BE3200 Test Sequencer

A Power inlet

The power inlet connects/disconnects the main power from the BE3200. To disconnect the BE3200 from the AC supply completely, unplug the IEC connector from the instrument.
Plugging in the unit will not switch on the BE3200 instrument. Use the standby button on the front panel for this purpose; see "Initial check" on page 65.

5.3 Fuse requirements and protection

The BE3200 model is equipped with two replaceable fuses located on the rear panel. The fuse arrangement stated here must be followed and, additionally, in the UK a fuse should be fitted in the line supply plug. The fuse must be a slow blow (T) fuse with a rating of 2A.

WARNING

Any interruption of the protective conductor inside or outside the apparatus is likely to make the apparatus dangerous. Intentional interruption is prohibited.

When the apparatus is connected to its supply, terminals may be live, and opening covers to remove parts is likely to expose live parts.

Whenever it is likely that the protection has been impaired, make the apparatus inoperative and secure it against any unintended operation.
For example, if the apparatus shows visible damage or has been subjected to severe transport stresses, the protection is likely to be impaired.

It is the responsibility of the user to ensure the safety of any accessories used with the equipment, such as probes.

WARNING

ELECTRICAL SHOCK HAZARD! Do not remove covers. Refer servicing to qualified individuals.

WARNING

Connect a protective ground wire as an additional safety measure to prevent electric shock or damage to BE3200.

Using this device properly depends on the user reading all instructions and labels carefully.

If the instrument is used in a manner not specified by HBM, the protection provided by the instrument can be impaired.

5.4 Fuse replacement

The mains input and fuse holder are located on the rear of the BE3200.

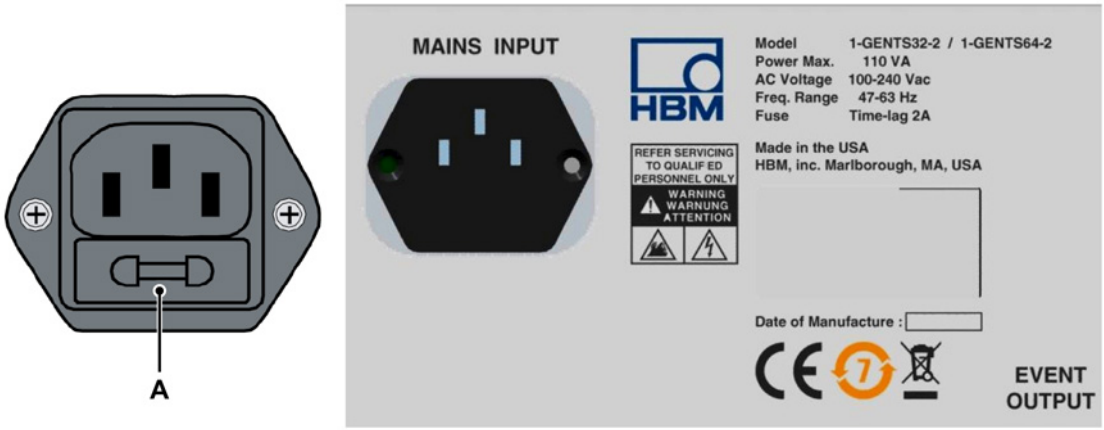

Figure 5.2: Mains input with fuse holder

A Open here

WARNING

The AC power connections may be exposed if the power plug assembly cover is opened. Therefore the AC power lead must be disconnected before opening the cover.

To gain access to the fuses, proceed as follows.

1 Place the instrument on a flat surface with the rear panel facing you.

2 Disconnect the AC power cable from the rear panel.

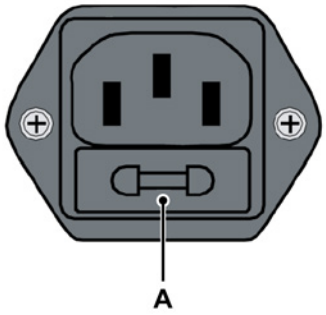

Figure 5.3: Replacement of fuse

A Open here

3 Carefully prize open the fuse holder cover on the top side using a small screwdriver or similar flat blade tool.
4 Withdraw the fuse holder.
5 Check that the correct fuse is fitted as listed on the rear of the instrument near the AC inlet.
6 Press the fuse holder home ensuring that it is fully inserted.
7 Close the fuse holder cover.

6 Introduction

6.1 Introducing the BE3200 Test Sequencer

The BE3200 Test Sequencer is a high speed controller that provides precise timing for the operation of devices used for testing in low voltage, high voltage and high power laboratories. The sequencer program is created on a PC using the Perception software, from here it can be uploaded into the test sequencer where it can run independently from the computer.

The timing of the test sequencer can be synchronized to cycles present in the mains generator, to the external mains or can be derived from an internal timer. After a start command the outputs are switched on and off in the programmed sequence, fully synchronized with the chosen synchronization method.

All inputs are optically isolated by fiber optics. The outputs are isolated by fiber optics. Synchronization with an additional test sequencer is possible realizing a test sequencer with 128 outputs.

A number of protection measures within the test sequencer prevent damage to the equipment under test. These measures guarantee proper completion of the sequence even in the event of interrupted mains supply or interrupted synchronization inputs.

Perception software is control software which runs on a PC. It is used to enter the required sequence, either in milliseconds or with degrees-of-a-cycle. Resolution is 1 degree with one cycle being 360 degrees. The uploaded sequence can be run in a repetitive (random) mode which can be used for endurance testing. A complete sequence set-up can also be saved and recalled from disk. Please refer to the Sequencer control option manual for more information.

6.2 BE3200 Test Sequencer features

- Completely optically isolated with fiber optic and/or opto-couplers.
- Fully programmable sequence.
- Up to 64 channels in one housing.
- Various synchronization sources.
- Synchronizes with frequencies ranging from 16 Hz to 400 Hz.
- Timing resolution of one electrical degree for synchronization frequencies up to 200 Hz.
- Extensive protection measures to prevent damage to the equipment under test.

7 Installation

7.1 Requirements

The following section lists the hardware requirements.

7.1.1 System requirements

- A standard computer for control of the BE3200 which has Perception and the Sequencer option installed.
- 100 Mbit Ethernet interface (1 Gbit recommended) when combined with GEN DAQ products.
- A free USB for communication with the BE3200.

Please see the Sequencer control option manual for further software requirements.

7.2 BE3200 Installation

7.2.1 Unpacking

For transportation, the BE3200 Test Sequencer is sealed in a polythene bag and cushioned in its box by shock-absorbent material. Accessories are separately sealed in polythene bags and included in the box.

Unpack the instrument carefully and examine it thoroughly to ascertain whether or not damage has occurred in transit. Report immediately any such damage to the agent or manufacturer.

Retain the packing materials and box for use if further transportation is necessary. Also be sure to keep all documents supplied with the instrument; some may be addenda or up-date bulletins applicable to the manual or instrument.

7.2.2 Equipment Check list

Check that the equipment contained in the transportation box complies with the packing list. It includes:

- BE3200 Test Sequencer
- Power cord
- Plastic fiber cable for optical serial communication
- USB to optical serial converter
- Operation Manual BE3200 Test Sequencer, which you are reading now.

7.2.3 Front panel functions and indicators

On the front panel various functions and indicators are located. Refer to Figure 7.1 for the location of the various items.

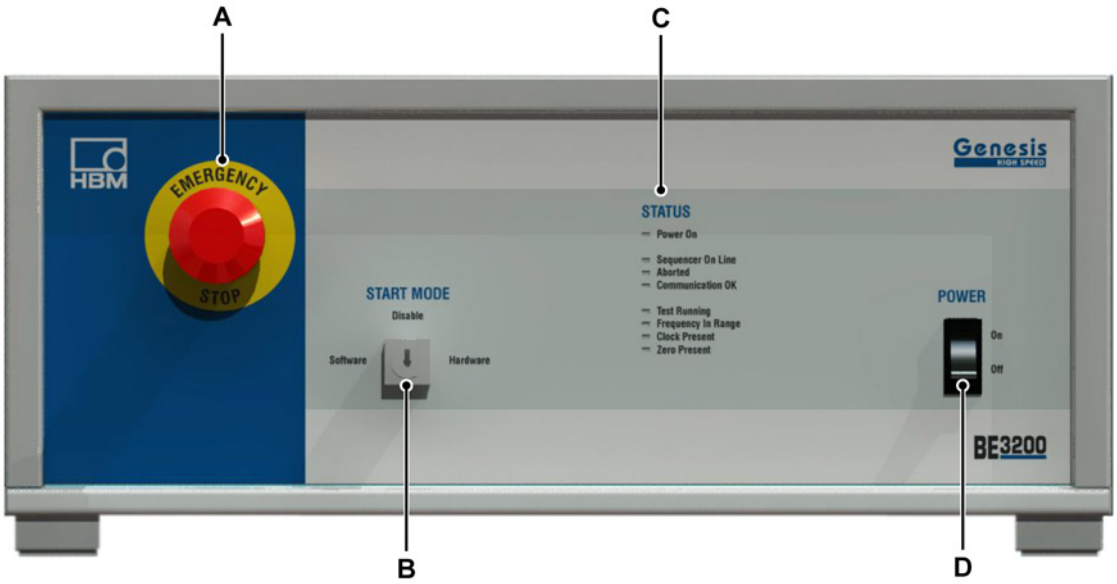

Figure 7.1: BE3200 front panel

A Emergency stop

B Start mode key switch

C Status indicators

D Power switch

A **Emergency stop** Push this button to interrupt the sequence.

B **Start mode key switch** The start mode key switch is operated with a key. Three positions are provided:

- **Off:** The BE3200 is disabled. It will not respond to a start command.
- **Hardware:** The BE3200 will respond to a hardware initiated start command. This start command must be applied to the **Start** connector at the rear of the instrument.
- **Software:** The BE3200 will respond to a software generated start command.

C **Status indicators** The following status indicators are mounted on the front panel:

- **Power On** This LED gives information on the power status as follows:
  - When this LED is **On** *continuously*, the BE3200 is switched on and connected to the mains power supply.
  - When this LED *blinks slowly* at a rate of approximately 0.5 Hz, the BE3200 is switched on and connected to the mains power supply, but the battery back-up has reached a low level.
  - When this LED *blinks fast* at a rate of approximately 5 Hz, the BE3200 is not connected to the mains power supply and the battery back-up has reached a low level.
  - When this LED is **Off** and the Sequencer Online LED is **On**, the BE3200 operates on the battery and will shut down after a few seconds when no new commands are received.
- **Sequencer Online** When this indicator is **On** the sequencer is ready to receive commands and sequences.
- **Aborted** This indicator goes **On** when a running sequence is aborted by means of the emergency stop. The indicator goes OFF at receipt of a software clear.
- **Communication OK** This LED is **On** after receipt of a software command for one second and indicates that the communication with the host computer is correct.
- **Test Running** When this LED is **On** a sequence is active.
- **Frequency In Range** This indicator is **On** when the internal clock of the BE3200 is locked (synchronized) with the synchronization clock/ zero.
- **Clock Present** When the selected external synchronization clock is present this indicator is **On.**
- **Zero Present** When the selected external synchronization zero is present this indicator is **On.**

D **Power switch** This switch is used to switch the mains power supply on and off.

7.2.4 Rear panel connections

The rear panel of the BE3200 accommodates the mains input connector and all functional input and output connectors. The Figure 7.2 below shows the rear panel layout of the BE3200 with fiber optic isolated outputs.

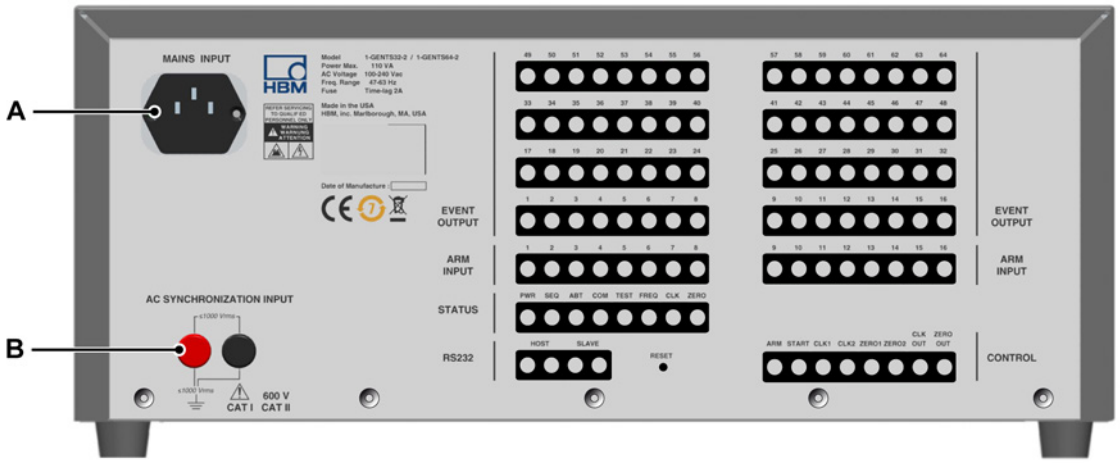

Figure 7.2: BE3200 rear panel

A Mains input

B Isolated synchronization input

The left-hand side of the panel has the power inlet with integrated fuse holder and the isolated synchronization input, the right-hand side of the panel contains all fiber optic connections and the reset button.

The isolated synchronization input is a galvanic isolated input for voltages ranging from 10 to 1000 VACrms. It can be used to connect the mains directly to the BE3200 for synchronization purposes. The fiber optic connections will be explained in full detail in the appropriate sections of this manual.

7.2.5 Connect the BE3200 to the host computer

To connect the BE3200 to the host computer you must first assemble the serial link as shown in Figure 7.3. Now connect the USB to optical serial converter, to a USB port of your computer and the twin-fiber optic cable to the BE3200 as shown in Figure 7.3.

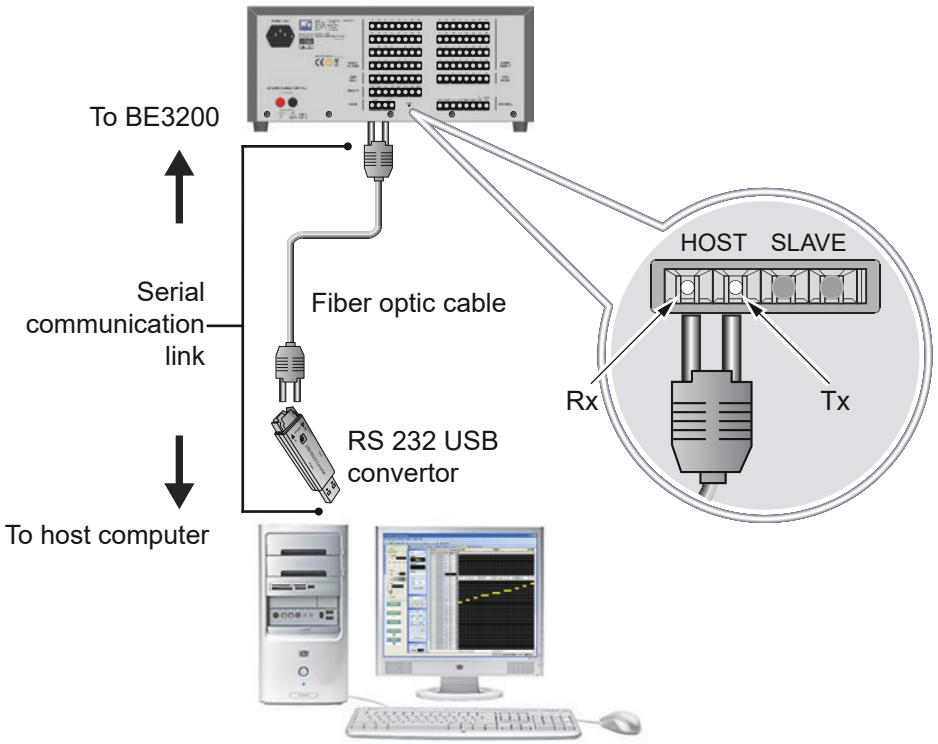

Figure 7.3: BE3200 to host computer interconnection

Connect the fiber optic cable to the socket labeled “HOST” at the rear of the instrument: remove the two rubber protection plugs and insert the connector until it is fully seated into position. The duplex connectors at the USB serial converter is keyed to ensure proper connection. The single connectors to the BE3200 should be installed so that light out of the converter is connected to the HOST receiver. The remaining fiber optic cable goes into the HOST transmitter.

IMPORTANT

Read this section before using this product!
The RS232 to USB convertor needs a Windows® driver and correct driver settings before it can be used. See appendix “BE3200 USB to Optical RS232 Convertor on page 117.

Note *When removing a connector from a socket, pull at the connector body. Do not pull on the cable alone. Also you must **re-install the rubber protection plugs**. Failure to do so may result in incorrect operation of the BE3200!*

8 Getting Started

8.1 Initial check

To inspect the equipment and get started, the following steps must have been taken:

- The Perception Sequencer option must be installed correctly on the host computer (refer to the Sequencer control option manual, chapter “Software Installation”).
- The serial communication link must be connected correctly (see Figure 7.3 "BE3200 to host computer interconnection" on page 64).

At this point you can plug-in and power on your BE3200 Test Sequencer as described in the following section.

WARNING

This appliance must be earthed

8.1.1 Connecting the AC power

The instrument end of the AC power lead supplied with the BE3200 is factory-wired to a free socket. Insert the socket into the fixed power plug assembly on the rear panel (see Figure 7.2 "BE3200 rear panel" on page 63). The AC power lead can now be connected to a suitable AC power outlet.

The power ON/OFF switch is located at the front of the instrument as shown in Figure 7.1 "BE3200 front panel" on page 61.

Turn on the power. The power indicator LED will glow. Now you are up and running.

8.1.2 Operation of the Emergency stop button

When the emergency stop button is pressed, it will be locked and must be unlocked manually by rotating the knob counter-clockwise.

When the emergency stop button is pressed, the BE3200 will not respond to a start command.

When the emergency stop button is pressed during an active sequence, all output channels will go into their inactive state. At the same time the aborted LED on the front will lighten and the fiber optic outputs will change as follows:

- Power, Sequence, Frequency, Zero – are **On**
  And after a short time only
- Power, Abort – are **On**

Sequencer will now be disconnected. Make sure the emergency stop button is released so that you can reconnect to the BE3200.

9 Master/Slave

9.1 Master/Slave operation

Two BE3200 Test Sequencers can be cascaded to increase the number of outputs. Both instruments can then be controlled from one computer running the Sequencer option in Perception.

Since the Master/Slave configuration is software controlled it is even possible to use two instruments, each connected to a control PC and reconfigure the setup without re-wiring. I.e. it is possible in such a configuration to use both systems in stand-alone mode, or assign a system as master and the other one as slave (refer to Figure 9.1).

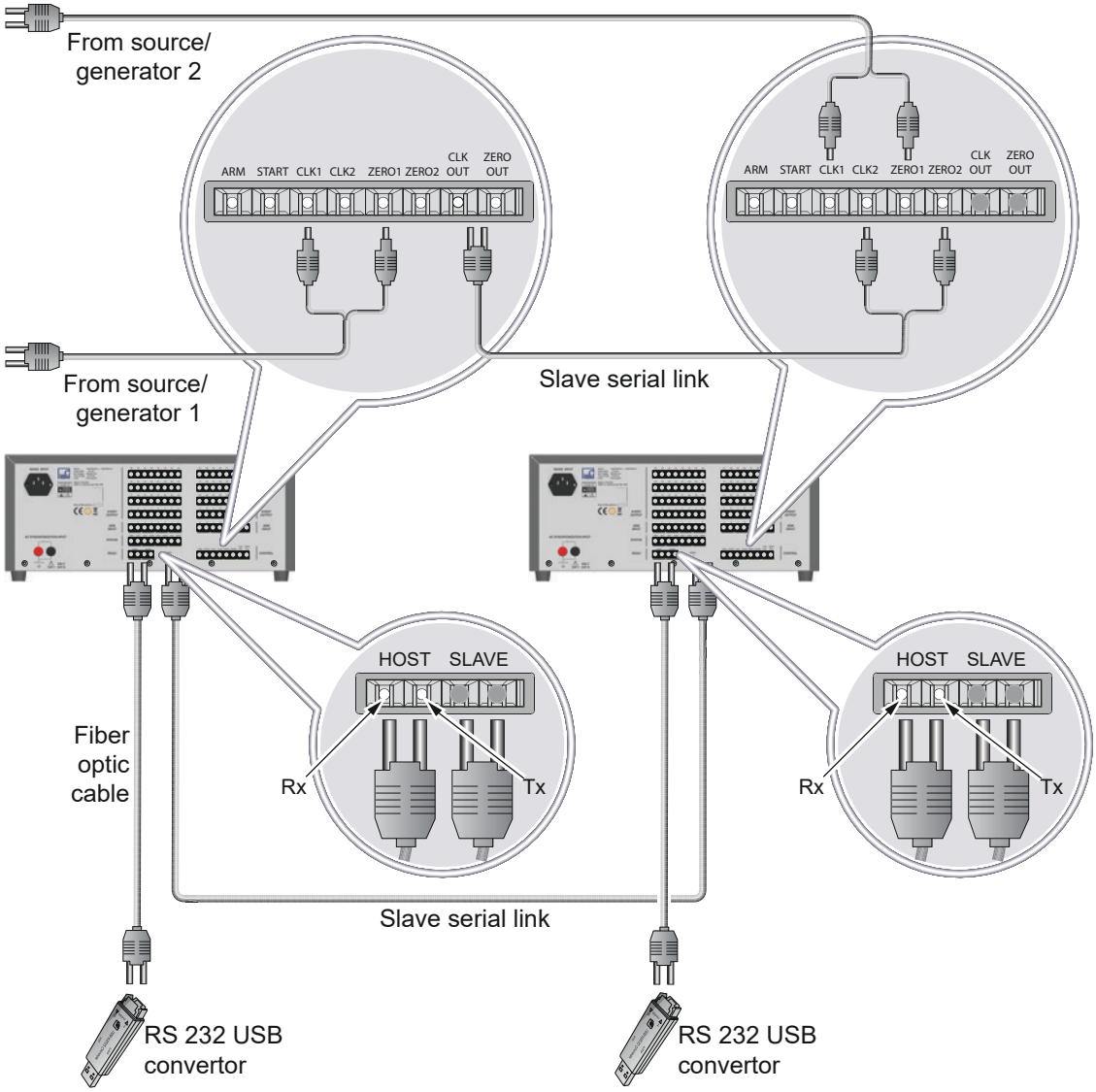

Figure 9.1: Master/Slave operation

In Basic Master/Slave mode BE3200 #1 is linked to the control computer via the RS232 serial link that is connected to the HOST interface. BE3200 #1 is set as master.
The communication between the two systems is through the serial link connected to the **Slave** interfaces.
Synchronization between the two systems is through the **clk** and **zero** lines.
In Advanced Master/Slave mode a second control computer is connected to BE3200 #2. The systems can now be used either as stand-alone, or in Master/Slave mode without the need to re-wire.

10 Interfacing the BE3200 with a GEN series system

10.1 Introduction

All inputs and outputs of the BE3200 are fiber optic connectors (light) and are therefore optically isolated single events. But how do we see the signal output from the BE3200? We will explain this in more detail in this section.

10.1.1 The Binary Marker channel HV card

The Binary marker HV card is an optional device designed to add the ability to communicate its hosts state of operation. For example, in the case of the host being a GEN series system, the Binary Marker card can communicate the current state of operation of the GEN series system with a BE3200 sequencer module.

The binary Marker card has one “REC” output and 8 optical inputs. The REC output connects to the BE3200's ARM input. This will add a condition that the BE3200 has to meet before it is allowed to start its programmed sequence.

10.1.2 Using the Arm feature

To make sure that the sequencer starts only when the GEN series equipment is ready, we have an input called an **Arm**. The **Arm** is an optical input of the BE3200 which in this case comes from the binary marker HV card. The **Arm** can be used in conjunction with other conditional inputs and is used as an extra safety check before starting a sequence. The BE3200 will not start recording until the condition of the **Arm** is met, avoiding early starting of a sequence and/or loss of data.

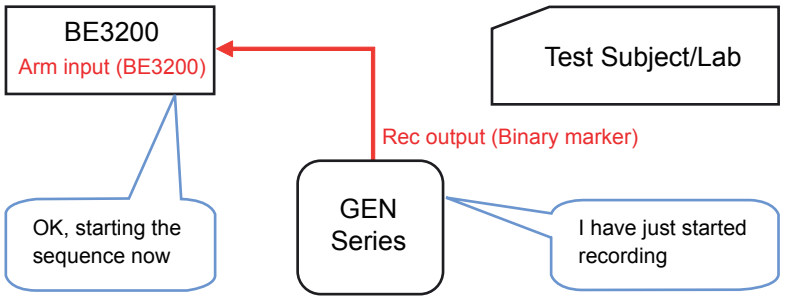

Figure 10.1: Arm input

Using the Binary Marker HV card with the BE3200
Once the REC output of the Binary Markey HV card is connected to the **Arm** input of the BE3200 we are ready to set this option in the Sequencer software.

To set the BE3200 to work with **input conditions** you must set input conditions in the BE3200 Menu.

Select **Sequencer ► Conditions** (when in the Sequencer sheet)

This will bring up a dialog.

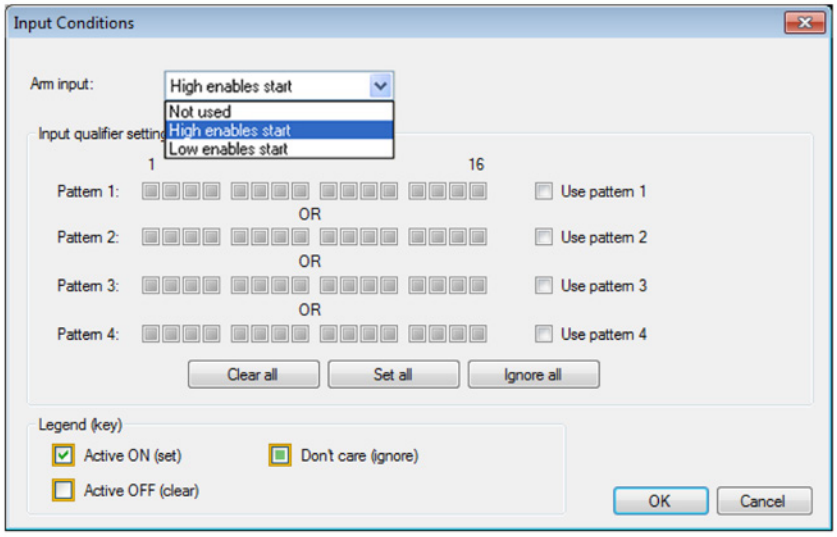

Figure 10.2: Input conditions

The Arm input mode in sequencer can be switched between several modes:

- **High enables start** allows the sequencer to start if the level is high.
- **Low enables start** will send the condition signal if the signal level is low.
- **Not used** means the Arm input is not active.

In this setup we will use **High enables start**, this is because when the BE3200 is recording, the output LED is on and therefore its output will be set to **high**.

Using a high or low input method means that Sequencer does not have to wait for a ramp up or down or a change in the signal to be able to start and will be ready as soon as the signal is at the correct level. If the condition is not met, a message will be displayed.

10.1.3 Using the binary input channels

BE3200 outputs are optically isolated and as a result are dedicated single channel outputs. Since the outputs of the BE3200 cannot be interrupted, the BE3200 has the capability of linking outputs together.

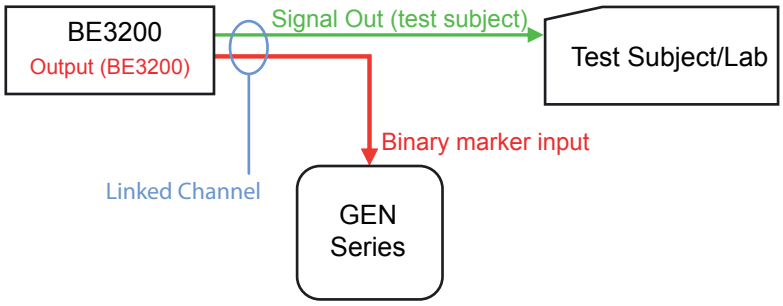

Figure 10.3: Binary input configuration

By linking channels we can copy one **output** many times to be used as **multiple inputs** for other devices. The linked channels output may be fed directly into the “binary marker HV card” of the GEN series instrument, from there it will be recorded as a marker channel.

To set this in the BE3200 Software, open the Sequencer sheet and select a channel number in the drop down box to link to. The channel you select will be an exact replica of the main channel you made the selection from.

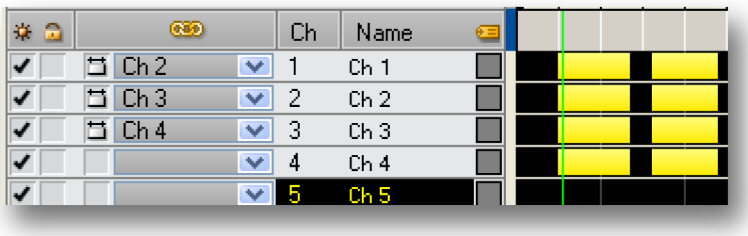

Figure 10.4: Linking channels

Figure 10.4 shows channel 1 being linked to channel 2, channel 2 being linked to channel 3 and channel 3 being linked to channel four, this means all four outputs are exactly the same.

Note *For more detailed information on channel linking please refer to the chapter “Control and Usage of the BE3200” in the BE3200 Sequencer control option.*

11 Control and usage of the BE3200

11.1 Synchronization

One of the key features of the BE3200 Test Sequencer is its ability to synchronize the sequence with an external source. Depending on the required synchronization or the availability of an external source, the BE3200 allows for various synchronization modes.

The effect of synchronization will be that the sequence, downloaded into the BE3200, runs in parallel and in pace with the selected synchronization source.

To obtain this result the BE3200 synchronizes its internal timing with the selected synchronization source after the receipt of a start command. Once the synchronization is complete and within limits, the sequence will start after the first occurrence of a zero crossing of the synchronization source. When the sequence is active -running - it will continuously verify the synchronization and make on-the-fly adjustments when necessary, e.g. when the synchronization source frequency varies in time.

The following Figure 11.1 shows the relation between a sine wave and the expected clock and zero synchronization pulses.

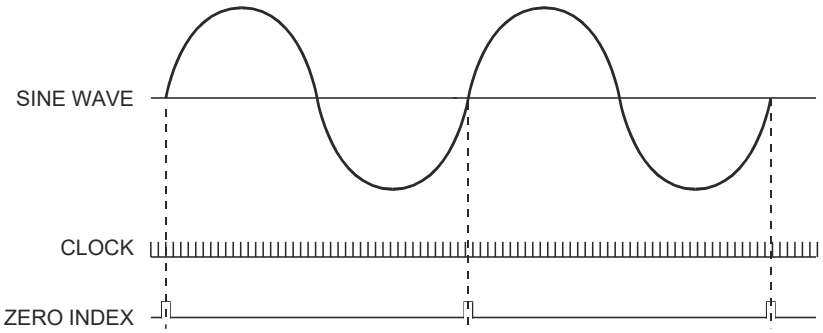

Figure 11.1: Clock and zero synchronization pulses

11.1.1 Synchronization sources

The synchronization can be derived from the following inputs:

- Generator 1 (clock/zero or zero only)
- Generator 2 (clock/zero or zero only)
- Mains

The inputs of the above mentioned sources are located on the rear of the instrument as shown in the following Figure 11.2.

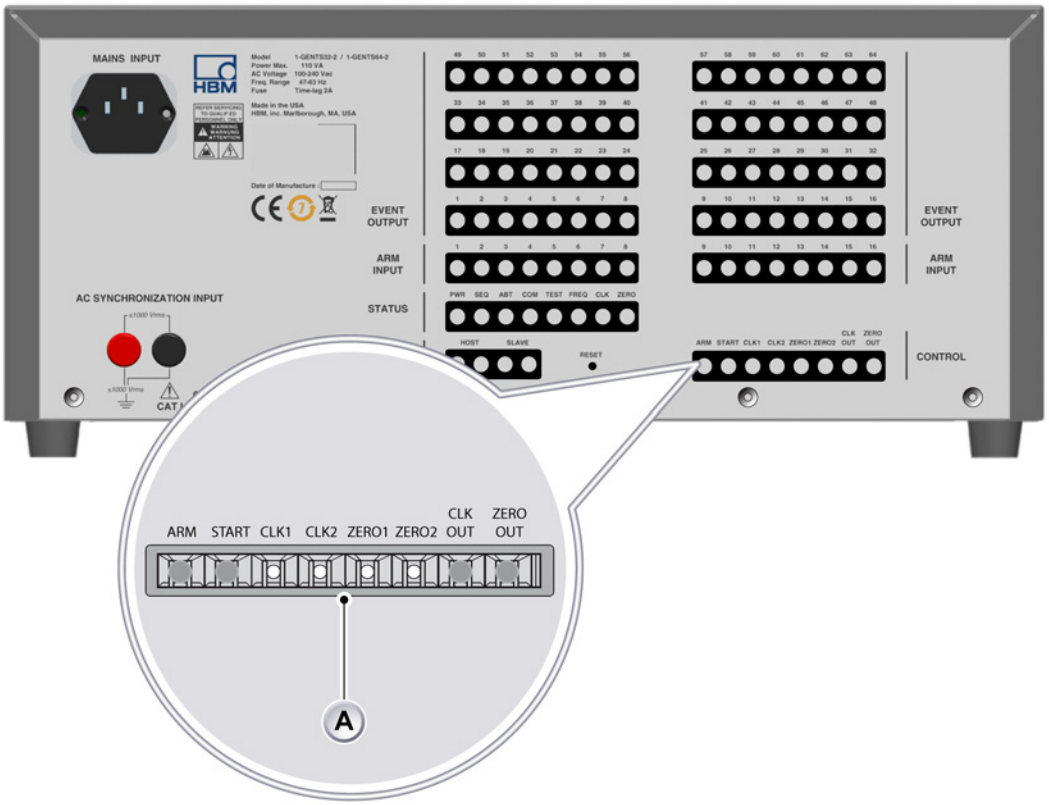

Figure 11.2: Location of synchronization inputs

A Generator synchronization

Generator synchronization
With synchronization on a generator there are two options:

- Synchronization on the clock and the zero index pulse
- Synchronization on the zero index pulse only

When synchronizing on the clock/zero, the BE3200 verifies the number of clock pulses between the zero index pulses and synchronizes its internal timer to the clock. The sequence starts at a zero index pulse. When the sequence is running, only the clock is verified. The leading edge of the zero index pulse is used to indicate that the leading edge of the first clock pulse - after the leading edge of the zero index pulse - indicates zero degree. This relation is depicted in Figure 11.3.

When synchronizing on the zero index pulse only, the BE3200 synchronizes its internal timer to the zero index pulse. The sequence starts at a zero index pulse.When the sequence is running, the zero index pulse is verified.

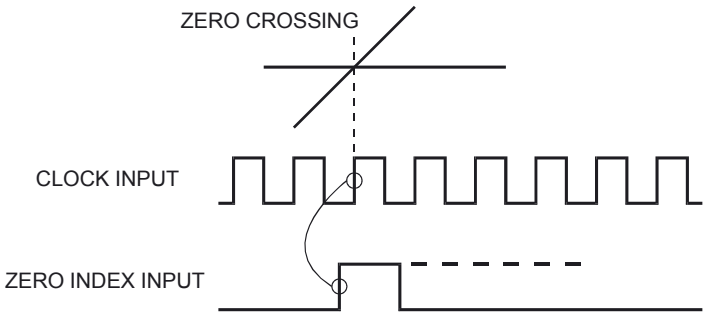

Figure 11.3: Clock and zero index relation

The leading edge of the zero index pulse is used to indicate zero degrees. This is depicted in figure 21.

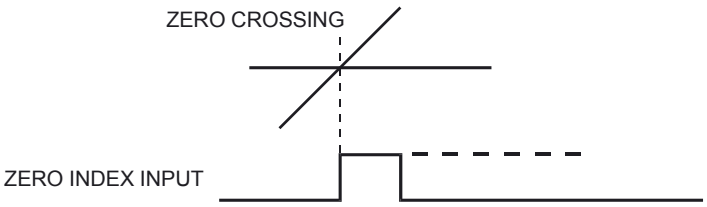

Figure 11.4: Zero index location (synchronization on zero only)

Mains synchronization
When synchronizing on the mains, the BE3200 detects the zero-crossings of the applied signal and uses these zero-crossings as zero index pulses. The mains synchronization sockets are located at the rear of the instrument and fully insulated.

WARNING

****** FOR YOUR SAFETY **** USE HEAVY-DUTY FULLY INSULATED LEADS ONLY !!**

11.1.2 Synchronization modes

Independent of the selected synchronization source, various synchronization modes are available. These modes are:

- Full
- Timed
- Measured
- None

Full synchronization

When full synchronization is selected, the BE3200 locks its internal timing to the synchronization source and uses the synchronization source during the complete sequence to verify its timing. This is depicted in the following Figure 11.5.

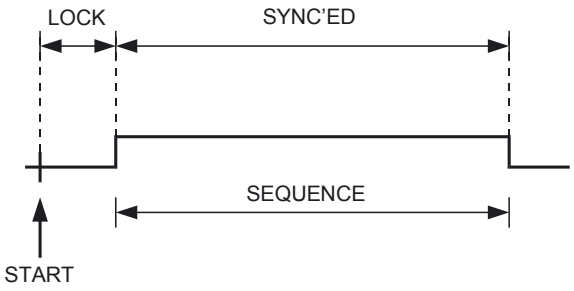

Figure 11.5: Full synchronization

The sequence starts at a zero index pulse.

Timed synchronization

When timed synchronization is selected, the BE3200 locks its internal timing to the synchronization source and verifies its internal timing with the synchronization source only for a specified time interval from the actual start of the sequence as shown in the following Figure 11.6.

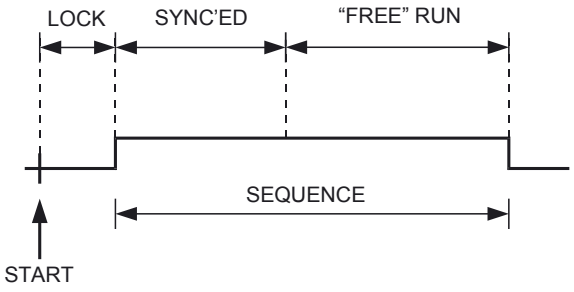

Figure 11.6: Timed synchronization

When the specified time has elapsed, the BE3200 continues to operate with the last measured synchronization values.

The sequence starts at a zero index pulse.

Measured synchronization
When measured synchronization is selected, the BE3200 locks its internal timing to the selected synchronization source. At the start of the sequence the BE3200 continues to operate with the last measured synchronization values. The sequence starts at a zero index pulse.

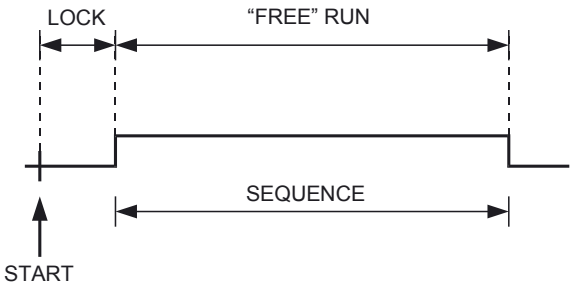

Figure 11.7: Measured synchronization

No synchronization
When "none" is selected as synchronization mode, the BE3200 uses the parameters as set by the software for its internal timing.

The start of the sequence is after receipt of a start command.

11.1.3 Additional synchronization parameters

Clocks per cycle
The number of clock pulses per cycle can be set. This parameter is used to verify the clocks per cycle of the generator 1 and 2 with clock and zero as the synchronization source is selected. When the set number of clocks per cycle does not match the measured clocks per cycle, an error is generated.

Frequency
The frequency can be set. This parameter is used to verify the frequency of the synchronization source. When the set nominal frequency - plus or minus the set maximum deviation - does not match the measured frequency, an error is generated.

Note *This frequency is also used to calculate the correct number of cycle:degrees for the correction factor, main delay and when no synchronization mode is selected. It is also required for a correct conversion between milliseconds and cycles.*

12 Hardware Connections

12.1 Introduction

In order to connect the BE3200 to the real world, you will need to make connections to and from the BE3200. Two types of connections exist:

- Fiber optic output
- Fiber optic input

As an option you can purchase fiber optic to TTL and TTL to fiber optic converters from HBM. You can also make your own converters.

This chapter describes how to interface with the BE3200.

12.1.1 Fiber optic output to TTL

The BE3200 has the following fiber optic outputs:

- Controlled output channels when installed
- Status outputs

These outputs give light when the corresponding function is active. Typically a fiber optic cable is connected to such an output. This fiber optic cable goes to the location where the signal is required. At that point the light is converted to an electrical signal which can be used to drive relays or other switching devices.

The following Figure 12.1 gives an example of a light-to-TTL converter.

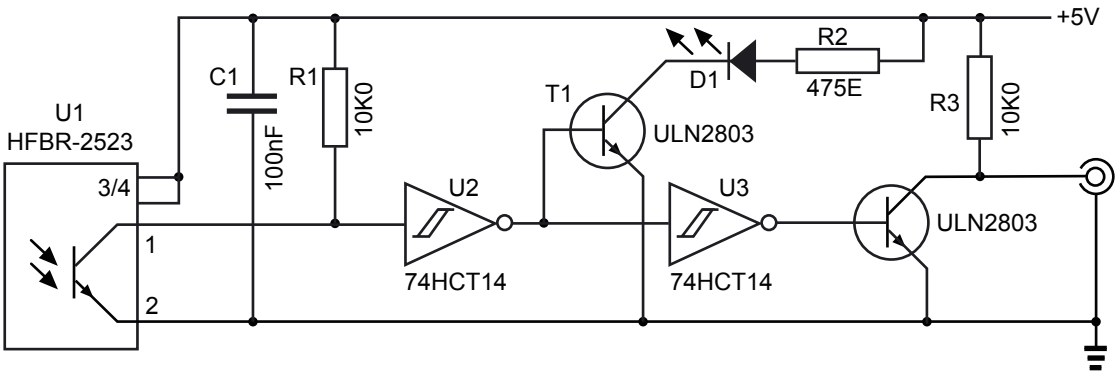

Figure 12.1: Schematic diagram of a light-to-TTL converter

COMPONENT LIST LIGHT-TO-TTL CONVERTER				
Item	**Value/type**	**Component**	**Manufacturer**	**Comment**
C1	100 nF	Capacitor		
D1	Optional	LED		Current ′ 5 mA
R1	10 kΩ	Resistor 5%		
R2	475Ω	Resistor 5%		
R3	10 kΩ	Resistor 5%		
T1	ULN2803	Transistor	Motorola	Transistor Array
T2	ULN2803	Transistor	Motorola	Transistor Array
U2	74HCT14	Inverter		
U3	74HCT14	Inverter		

12.1.2 TTL to fiber optic input

Fiber optic inputs are used for external signals which control - qualify - the start of a sequence and for external signals which are used for synchronization purposes.

Standard available inputs are:

- Sequence Arm and start
- Clock one and two synchronization
- Zero one and two synchronization

The following Figure 12.2 gives an example of a TTL-to-light converter.

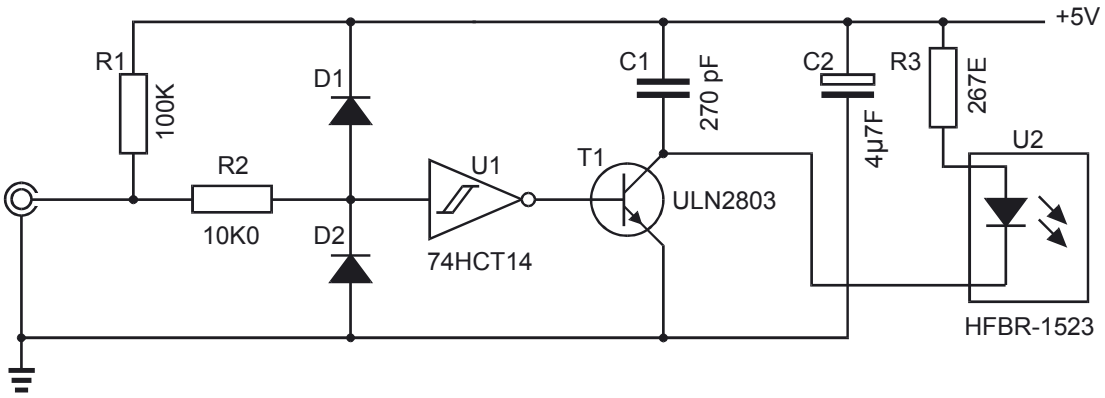

Figure 12.2: Schematic diagram of TTL-to-light converter

The following components are used:

COMPONENT LIST TTL-TO-LIGHT CONVERTER				
Item	**Value/type**	**Component**	**Manufacturer**	**Comment**
C1	270 µF	Capacitor		
C2	4.7 µF	Tantalum cap.		
D1	1N4148	Diode		
D2	1N4148	Diode		
R1	100 kΩ	Resistor 5%		
R2	10 kΩ	Resistor 5%		
R3	267Ω	Resistor 5%		
T1	ULN2803	Transistor	Motorola	Transistor array
U1	74HCT14	Inverter		
U2	HFBR-1523	F.O. Transmitter	Hewlett Packard	

12.1.3 Fiber optic link length

Depending on your application you will need more or less length for your fiber optic cable. The length of the cable is determined by three variables: transmitter output power, receiver input sensitivity and cable attenuation.

When the receiver sensitivity is fixed, this relation can be converted to a relation between cable length and the forward current IF of the fiber optic transmitter as shown in the following Figure 12.3.

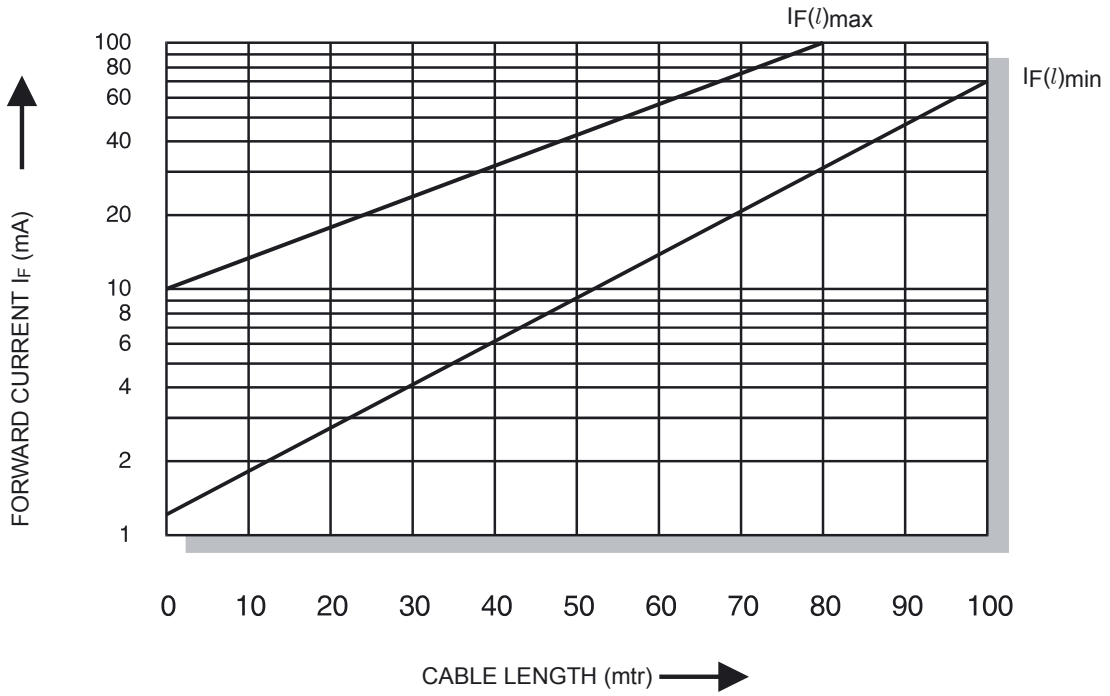

Figure 12.3: Typical HFBR-1523/2523 link performance

Figure 12.3 shows the typical system performance for the HFBR-1523/2523 link with standard cable at 0 °C - 70 °C.

Care must be taken not to overdrive or underdrive the fiber optic link. Overdrive is defined as a condition where excessive optical power is delivered to the receiver, which will result in incorrect operation.

The top line - labeled $\mathbf{I_F(l)_{max}}$ -in the graph indicates the upper limit of the forward current for a given cable length. The bottom line - labeled $\mathbf{I_F(l)_{min}}$ - in the graph indicates the lower limit of the forward current for a given cable length.

When a cable length of less than 1 meter is used IF may not exceed 10 mA in order to prevent overdrive.

The forward current is determined by the value of R3 (see Figure 12.2). The relation is:

$$R3 = \frac{V_{cc} - V_F - V_{CE}}{I_F}$$

with:

V_{CC} = Power supply voltage

V_F = Transmitter forward voltage (HFBR-1523: 1.65V)

V_{CE} = Transistor collector-emitter voltage (ULN2803: 15 mV)

I_F = Transmitter forward current

The capacitor C1 in combination with R3 limits the overall rise time. The rise time must be ≤ 75 nSec. Therefore:

$$C1 \geq \frac{75\ \text{ns}}{2 \cdot \pi \cdot R3}$$

The following Figure 12.4 gives examples of valid current/length combinations.

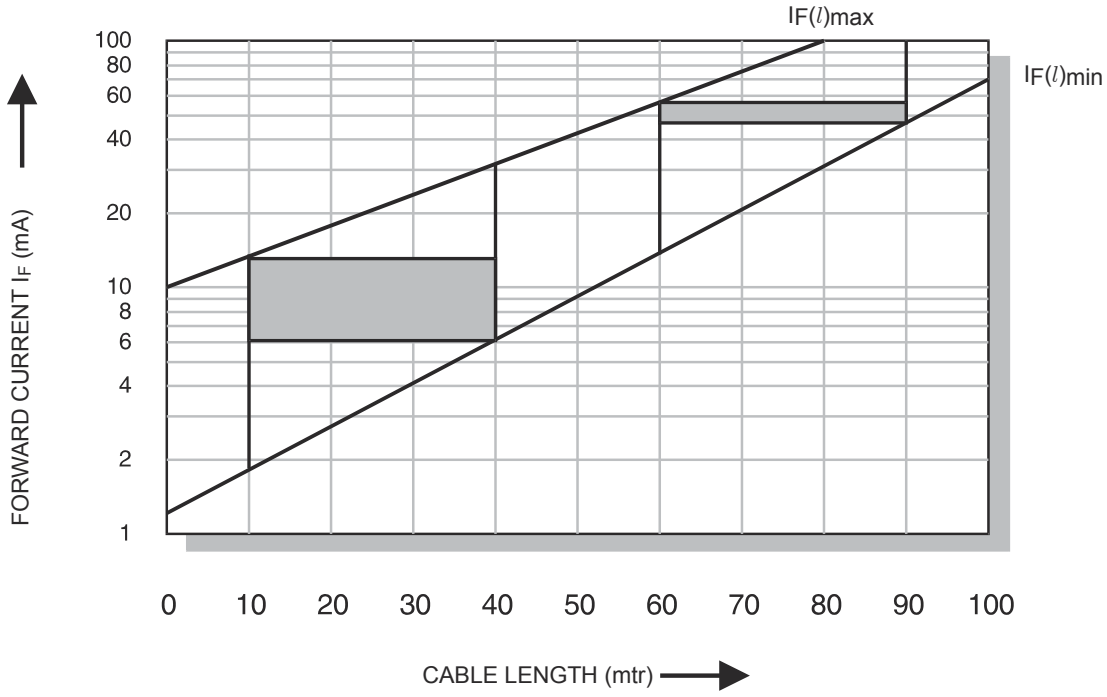

Figure 12.4: Examples of valid current/length selections

Example
Assume a required cable length between 10 and 40 mtrs.

Refer to Figure 12.4. Overdrive considerations limit I_F to 12 mA for a cable length of 10 meter. Underdrive considerations require at least 6mA for a length of 40 meter. To ensure reliable long term operation, include an optical power margin, since the exposed fiber ends are subject to environmental contamination that will increase the optical attenuation of the slot with time. Select I_F = 10 mA.

This will result in:

$$R3 = \frac{5.00 - 1.65 - 0.015}{10 \cdot 10^{-3}} \approx 330\,\Omega$$

$$C1 \geq \frac{75 \cdot 10^{-9}}{2 \cdot 3.14 \cdot 330} = 36\,\mathrm{pF}$$

In Figure 12.4 also the area is shaded for a cable length between 60 and 90 meter. In this situation a current of 50 mA would do the job.

Note *As standard the BE3200 fiber optic control lines have an IF of approximately 12.5 mA. According to*
Figure 12.3 "Typical HFBR-1523/2523 link performance" on page 81 this allows for cable lengths ranging from 10 to 60 meter. The channel output lines use an IF of approximately 60 mA which allows for cable lengths ranging from 60 to 100 meter. The sensitivity of the fiber optic inputs of the BE3200 is designed for operation as described in the previous sections.

12.1.4 G602 and G603 option PCB

HBM supplies a PCB (Printed Circuit Board) that has the TTL (Transistor–transistor logic) to light or light to TTL electronics build on it.

This PCB comes without housing and/or power supply. As this circuit typically is installed at the high voltage side of the test lab care must be taken to build a safe power supply for this circuit.

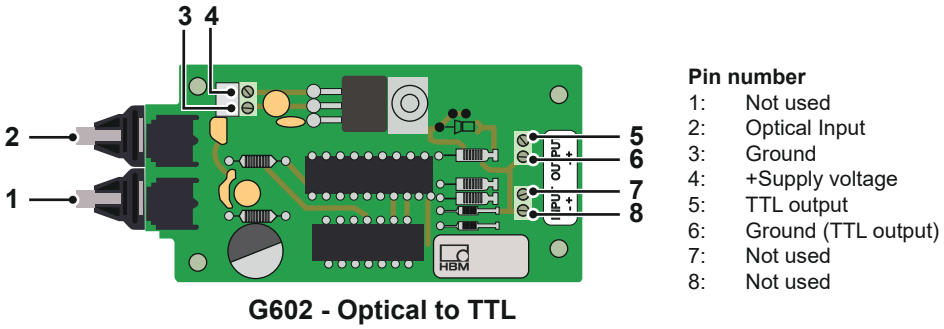

Figure 12.5: Pin assignment of G602 - Optical to TTL PCB

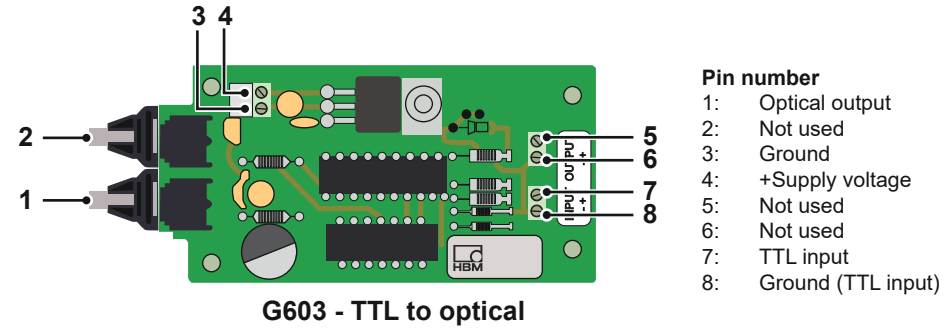

Figure 12.6: Pin assignment of G603 - TTL PCB to Optical

12.1.5 G602 Optical to TTL PCB/G603 TTL PCB to Optical dimensions

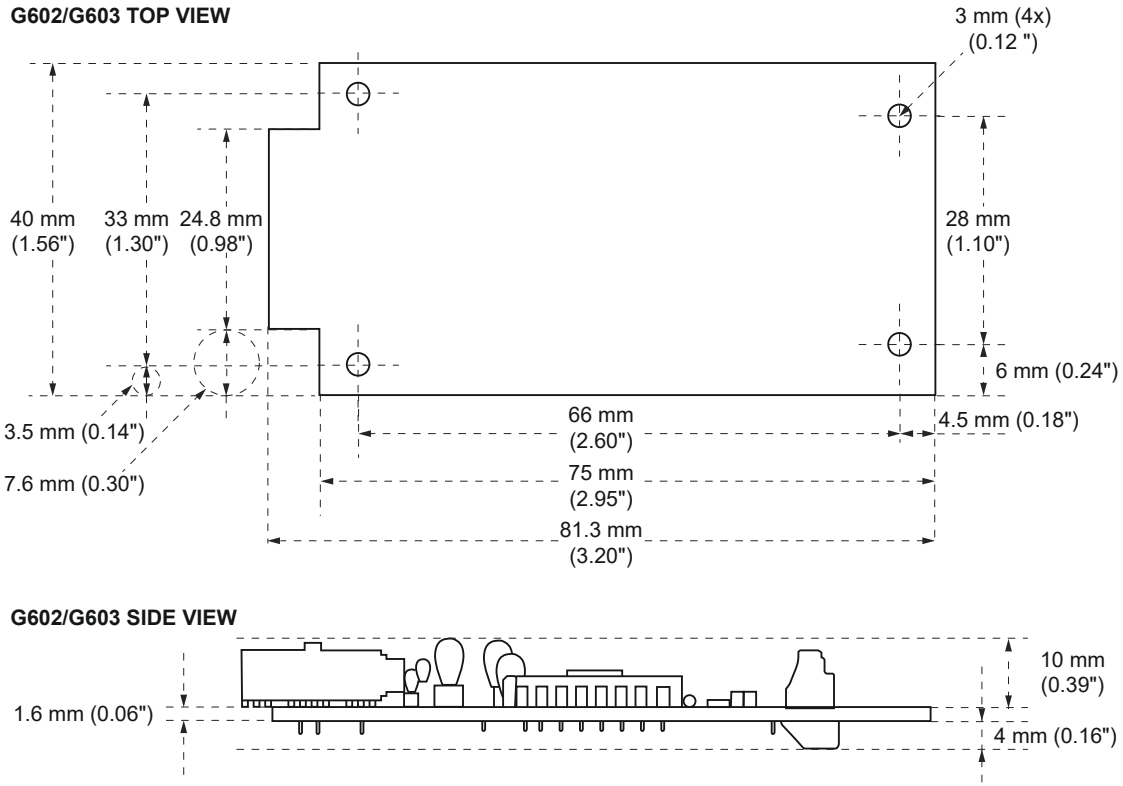

Figure 12.7: G602 and G603 dimensions

12.2 Opto-coupler output

When your BE3200 Test Sequencer is equipped with opto-coupler isolated outputs, this section supplies you with the relevant information.

The following Figure 12.8 is a simplified diagram of the opto-coupler isolated output section of a channel of the BE3200.

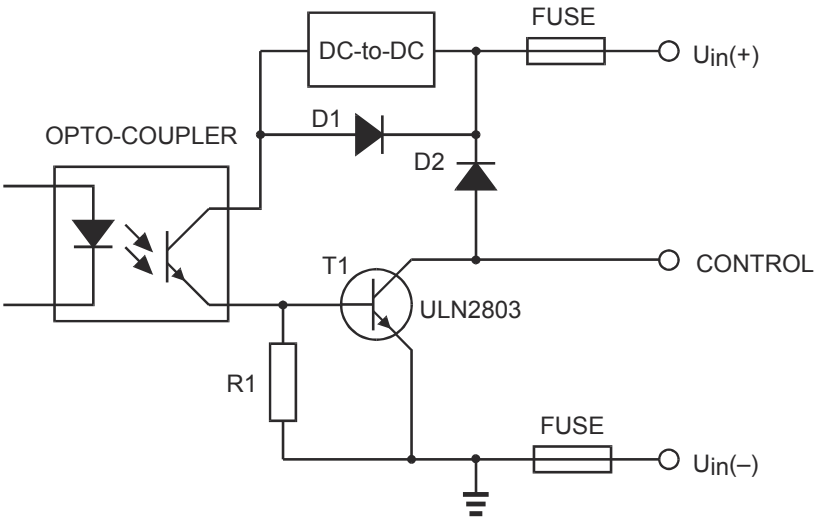

Figure 12.8: Schematic diagram of opto-coupled output

The fuses as well as D1 and the DC-to-DC converter are common to all channels. The user supplied input voltage must be 5 VDC ≤ $\mathbf{U_{in}}$ ≤ 50 VDC.

The ULN2803 is a high voltage, high current darlington transistor capable of driving 500 mA at 50V. The open collector configuration provides you with a switch function between the **Control** output and **Uin(–)** - ground-.

Note *In normal operation of the BE3200 - all outputs used - the drive current per output may not exceed 100 mA continuously.*

A typical use would be the opening and closing of a relay as shown in the following Figure 12.9.

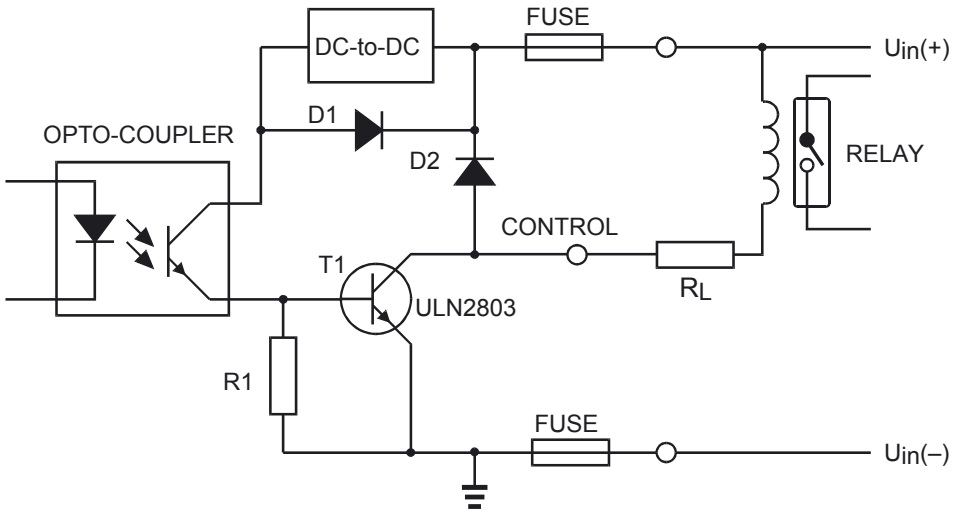

Figure 12.9: Opto-coupler relay drive example

The series resistor R_L is used to limit the drive current to 100 mA maximum.

13 Command language programming

13.1 Introduction

This chapter describes how to control a BE3200 without the Sequencer option in Perception. The BE3200 accepts commands and responds with an ASCII-based command language.

The controlling computer communicates with the sequencer firmware through a serial interface. The BE3200 serial interface uses a baud rate of 9600 baud, which corresponds to about 1000 characters per second.

No hardware handshake is required because the communication link consists of two lines: Tx and Rx. An 8-bit, no parity data format is used.

Two serial ports are available on the sequencer, called “Host” and “Slave”. The Host port is always connected to the controlling computer. The Slave port is used to connect two sequencers. A software protocol determines which sequencer is master and which one is slave.

A sequencer can be in three operating modes: stand-alone, master or slave. The operating mode determines which ports are used, and which communication takes place.

13.2 General considerations

Security
For optimum security, settings should be read back by the operating computer after changing them.

Settings
The computer sends settings to the sequencer. A settings consists of an exclamation sign, followed by two characters which make up the setting code, followed by the value(s) and a line-feed character. The sequencer processes the setting and sends an **ACK** (chr$(6)), **NAK** (chr$(21)) or **BEL** (chr$(7)) to the computer. A **NAK** reply indicates an error (invalid setting name, invalid value, ...). When a NAK is returned the error should be requested (using the **"?ER"** command). A **BEL** reply means that the sequencer is busy.

Requests
To request information from the sequencer, the computer sends a request string to the sequencer. The request string consists of a question mark, two characters which make up the request code, and a line-feed character. The sequencer responds to a request with a the actual setting, which uses the same syntax as a setting string, or, in case of an error or busy, a **NAK** resp. **BEL** character.

Idle mode
This is the default operating mode when the device is not used for some time. From this mode, one of the operating modes can be selected. Switching back to the Idle mode from any other mode is possible by sending the **"!MO0"** command. The Idle mode is also entered when no commands are received for more than one minute. This implies that the operating computer must communicate with the system at least once per minute to keep the device on-line.

Stand-alone mode
This mode can be selected by sending the **"!MO1"** command.

In this mode, communication takes place using the Host port. Bytes coming in on the Slave port are ignored, except for the line feed character. When a line feed character is received on this port a **NAK** is returned.

Master mode
This mode can be selected by sending the **“!MO2”** command. After receipt of this command on the Host port, an internal command is sent on the Slave port. If a slave is present, it replies with an **ACK** or **NAK**. If an **ACK** reply is received, the master mode is entered, and an **ACK** is sent to the controlling computer. Otherwise an error code is set, and a **NAK** is returned.

Returning to idle mode is possible by using the **“!MO0”** command. The slave is also informed about the mode switch.

Slave mode
Switching to slave mode is only possible from the Idle mode and from the Slave port. In slave mode, the Host port is ignored, only the line-feed character produces a **NAK** reply.

Emergency stop
When a sequence is aborted, the sequencer ends up in the aborted state. In the aborted state, only requests and the Clear command are accepted. The Clear command sets the sequencer back to the previous mode. When operating in master/slave mode, only the emergency stop button on the master is operational, and the slave is also stopped when a sequence on the master is aborted.

Sequencer failure
When the watch-dog timer times out, the system is reset. After a reset, the system is in the failed state. A Clear command sets the sequencer to the Idle state.

When one of the sequencers fails in master-slave operation, the other sequencer continues operating. The two “failed” status outputs should be tied together externally to ensure correct termination of the test by the external emergency system.

Sequence running
Once the controlling computer knows the sequence is running (after the **“!GO”** command or when a **BEL** reply is received), it should send **“?ST”** commands to poll the sequencer. As long as the test runs, a **BEL** character is returned on each request.

Response time
The sequencer firmware handles each command or request within 1 second, except when noted. Refer to the specifications for more details.

13.3 System commands

The following is a summary of the available system commands.

CL	Clear
ID	Identification
MO	Switch to a different operation mode
SO	Set output
CO	Clear outputs
ST	Status
AB	Abort status
ER	Error code
TS	Test
DV	Default values

Clear

Syntax	Command:	**!CL**
	Request:	n/a
Description	The CL command is only used to get the sequencer out of the error states (failed and aborted). Be sure to request all needed error and status information before sending the clear command, because this information is lost after the CL command.	

Request configuration

Syntax	Command:	n/a
	Request:	**?ID**
	Example reply:	**!ID3200;RV2.00;CH032;IQ1**
Description	This command is used to find out which hardware is connected. In case of the example reply, it's a BE3200, firmware version 2.00, 32 output channels, start qualifier inputs (and/or matrix) installed. When master-slave mode is selected, the number of channels includes the channels of the slave sequencer.The other items refer to the master sequencer only.	

Operating mode selection

Syntax	Command:	**!MOn**
	Request:	**?MO**
	Example reply:	**!MO1**
Description	This command is used to select the operating mode for the sequencer: **n:** 0 = off-line, 1 = stand-alone, 2 = master-slave It is not possible to switch between modes 1 and 2 directly.You should select Idle mode first.	

Operating mode selection

Default value: 0.

Manual control of the outputs

Syntax	Command:	**!SOc,v**
	Request:	**?SOc**
	Example reply:	**!SO15,1**
Description	Use this command to set or clear an output channel for test purposes.	
	c: The output channel number	
	v: 0 = output off, 1 = output on	
	Default value: all channels off.	

Set all output channels to off

Syntax	Command:	**!CO**
	Request:	n/a
Description	Set all outputs to their inactive state (off). This command is used to cancel the effects of the **SO** command.	

Status request

Syntax	Command:	n/a
	Request:	**?ST**
	Example reply:	**!ST128**
Description	The status reply contains 16 bits, which are encoded in an unsigned integer. Status bits are present for mains present, clock present, zero index present, actual frequency within limits, error present, aborted, failed,...	
	1:	Error present
	2:	Mains failure
	4:	Battery low
	8:	Clock failure
	16:	Zero failure
	32:	Frequency out of range
	64:	Aborted
	128:	Failed

Status at emergency stop (abort)

Syntax

a) Request abort time:

Command: n/a

Request: **?AB0**

Example reply: **!AB0,5345:354**

b) Request output status at abort time.

Command: n/a

Request: **?ABn**

Example reply: **!AB1,256**

Description

This command is used to request either the abort time or the output status at abort time.

n: 1...8 = Output group number. One group is 16 channels.

Error code

Syntax

Command: **!ER**

Request: **?ER**

Example reply: **!ER0**

Description

This command is used to request and clear the error code.

The Request form is used to get the last error from the system. The command form is used to clear the error code. A complete list of error codes is given at the end of this chapter.

Note

*Don't use the **CL** command to clear the error code. The CL command is used to exit the error states.*

Test commands

Syntax

Command: **!TS:xxx**

Request: n/a

Description

This command is used to test various functions in the BE3200 system.

xxx: Function to be tested:

!TS:WATCHDOG: Simulate a device failure in the BE3200.

!TS:OUTPUTS: Set all outputs, then clear all outputs.

Note

Make sure that no device under test is connected when issuing these commands.

Note

The response times of these commands are not specified. The !TS:OUTPUTS command returns an ACK after the on/off sequence terminates, the ! TS:WATCHDOG produces no reply at all.

Set default values

Syntax	Command:	**!DV**
	Request:	n/a
Description	Return settings to their default values. Affected settings are: **SO/CO, SI, SM, NF, CK, SD, CH, PL, DU, OC, MD, EB, AI, MX, SE, RC**	

13.4 Synchronizaton commands

The following is a summary of the available synchronization commands.

The following is a summary of the available system commands.

SI	Synchronization input
SM	Synchronization mode
NF	Nominal frequency
AF	Actual frequency
CK	Clocks per rotation
SD	Synchronization duration

Select synchronization input

Syntax	Command:	**!SIn**
	Request:	**?SI**
	Example reply:	**!SI1**
Description	This command is used to select synchronization input.	
	n: 1=Gen1_ClockAndZero, 2=Gen1_Zero, 3=Gen2_ClockAndZero, 4=Gen2_Zero, 5=Mains	
	This setting is ignored when synchronization Mode 4 (none) is selected. Default value: generator 1, clock & zero.	

Select synchronization mode

Syntax	Command:	**!SMn**
	Request:	**?SM**
	Example reply:	**!SM1**
Description	This command sets the synchronization mode.	
	n: 1=full, 2=timed, 3=measured, 4=none Default value: full	

Set the nominal frequency and limits

Syntax	Command:	**!NFnom,min,max**
	Request:	**?NF**
	Example reply:	**!NF50.00,49.00,51.00**
Description	Use this command to set the nominal frequency and the limits.	
	nom: The nominal frequency.	
	min: The minimum frequency.	
	max: The maximum frequency.	
	A test cannot be started when the frequency is outside the specified limits.	

Set the nominal frequency and limits

Limits: **max** ≤ 410, **min** ≥ 15.5
Default value: **nom** = 50, **min** = 48, **max** = 52

Request the actual frequency

Syntax	Command:	n/a
	Request:	**?AF**
	Example reply:	**!AF50.000250**
Description	Use this command to find out the actual frequency on the selected synchronization input.	

Set the number of clocks per cycle

Syntax	Command:	**!CKn**
	Request:	**?CK**
	Example reply:	**!CK200**
Description	This command is used to set the number of clocks per cycle.	
	n: The number of clock pulses per cycle.	
	Limits: 120 ≤ **n** ≤ 360, **n** must be even.	
	Default value: 180	
	This value is only used for clock/zero synchronization.	

Set the duration for timed synchronization

Syntax	Command:	**!SDn**
	Request:	**?SD**
	Example reply:	**!SD500**
Description	This command is used to specify the time after which the sequencer switches to internal timing	
	n: Number of cycles	
	Limits: 1 ≤ **n** ≤ 30000	
	Default: 10000	

13.5 Data load commands

The following is a summary of the available data load commands.

CH	Channel sequence data
PL	Pulse length
DU	Duration of sequence
OC	Output correction
MD	Main delay
EB	Emergency button
CE	Emergency sequence data

Set active period for specific channel

Syntax

Command: **!CHc,s,l [;s,l;s,l ...]** or **!CHc,–**

Request: **?CHc**

Example replies: **!CH1,120:000,P** or **!CH1,120:000,P; 200:000,50:000** or **CH1,-**

Description

–: Channel is off.

c: Output channel number.

s: Start of pulse, specified as “cycle:degrees”

l: Length of pulse, specified as “cycle:degrees”, or **“P”** for pulse or **“R”** for rest of sequence.

Default: All channels disabled.

Set the standard pulse length

Syntax

Command: **!PLn**

Request: **?PL**

Example reply: **!PL10**

Description

This command sets the pulse length which is used when the length in the “!CH” command is set to **“P”**.

n: Pulse length in degrees.

Limits: 2 ≤ **n** ≤ 30000

Default: 10

Set the sequence duration

Syntax

Command: **!DUn**

Request: **?DU**

Example reply: **!DU1465**

Description

This command is used to set the length of a sequence.

n: Test length in cycles.

Set the sequence duration

Note

Programmed events beyond the end of the test are not executed. No warning or error is generated.

HINT/TIP

If a test length less than 2 seconds is programmed, the sequence will end at the specified time, but the running status (BEL replies on all commands) is maintained for about 2 seconds. This is done to give the controlling computer the possibility to detect a hardware-generated start.

Limits: 1 ≤ **n** ≤ 30000

Default: 10000

Set the output timing correction of a channel

Syntax

Command: **!OCc,v [,h]**

Request: **?OCc**

Example reply: **!OC1,5.00,0.00**

Description

Use this command to set the output correction of a channel. When an output correction is specified, the edge at the output of the sequencer appears the specified number of milliseconds earlier than the time specified in the !CH command.

c: Output channel number.

v: Output switch-on (start) correction in milliseconds.

h: Output switch-off (end) correction in milliseconds.

Limits: 0.0 ≤ **v,h** ≤ 100.0

Default: 0.0

Set the main delay

Syntax

Command: **!MDn**

Request: **?MD**

Example reply: **!MD15**

Description

This command is used to set the main delay. The main delay is added to channels.

n: The main delay in degrees.

Limits: 0 ≤ **n** ≤ 359

Default: 0

Define the response of the emergency emergency stop button

Syntax	Command:	**!EBn**
	Request:	**?EB**
	Example reply:	**!EB0**
Description	Use this command to specify what the sequencer should do after detecting that the emergency stop button is pressed.	
	n: 0 = Ignore emergency stop button, 1 = Abort immediately	
	Default: 0 = Ignored	

13.6 Operational commands

The following is a summary of the available operational commands.

SW	Key switch state
GO	Start sequence
RC	Repeat count
AI	Configure arm input
MX	Configure and/or matrix
SE	Start enable

Request start selection switch state

Syntax	Command:	n/a
	Request:	**?SW**
	Example reply:	**!SW0**
Description	Use this command to request the state of the key switch on the front panel of the sequencer.	
	0=off, 1=software start enabled, 2= hardware start enabled.	

Start the sequence

Syntax	Command:	**!GO**
	Request:	n/a
Description	This command will start a sequence when all starting conditions are met.	

Set fast repeat count

Syntax	Command:	**!RCc**
	Request:	**?RC**
	Example reply:	**!RC5**
Description	Fast repeat is used to repeat a sequence without computer control. This command is used to set the number of times the sequence has to be repeated.	
	c: The number of times a sequence has to repeat.	
	Limits: 0 ≤ **c** ≤ 50000	
	Default: 0 (disabled = no repeat)	

Configure Arm input

Syntax	Command:	**!AIn**
	Request:	**?AI**
	Example reply:	**!AI0**
Description	This command is used to select the function of the arm input.	

Configure Arm input

n: 0 = arm input ignored, 1 = arm input high enables start, 2 = arm input low enables start.

Default: 0: ignored

Configure qualifier board (and/or matrix)

Syntax

Command: **!MXn,p**

Request: **?MXn**

Example reply: **!MX1,010XXXXXXXXXXXX**

Description

This command sets one term of the and/or matrix.

n: Term number 1...8.

p: Pattern. This can be “–” for not used, or a 16-character combination of “1", ”0" or “X” characters.

The first character corresponds to input 1 on the qualifier board, the last character to input 16.

A “1" means that the input must be high, a ”0" means low and an “X” means a don’t care condition.

A sequence can start when at least one of the enabled terms exactly matches the pattern on the inputs.

Default: all terms not used.

Start enable

Syntax

Command: **!SEn**

Request: **?SE**

Example reply: **!SE1**

Description

Use this command to disable or enable any start command. The controlling PC should send a start disable before changing settings, and start enable after settings have been changed successfully.

n: 0 = disable start, 1 = enable start.

Default: Start disabled

13.7 Error codes

The following is a list of error codes and their meaning

0: No error.

1: Syntax error.
The command does not exist or one of the parameters contains invalid characters

2: Parameter value out of range.

3: Command not allowed in this mode.
This can occur when you try to switch between stand-alone mode and master slave mode directly.

4: No response from slave.
No slave is connected or the communication links are bad or the slave is connected to another computer and in stand-alone mode. If this error occurs after a system failure, wait two minutes to let the slave device go to idle mode and try again.

5: Cannot can't be executed because the sequencer is in the failed state. Read all required status information from the device and send a **!CL** command to exit the failed state.

6: Cannot execute command because sequencer is in the aborted state. Read all required status information from the device and send a **!CL** command to exit the aborted state.

7: Channel number out of range.

8: Sequence cannot start because no zero is present on the selected synchronization input.

9: Software start not allowed.
Set the key switch on the front panel to "Software".

10: Hardware start not allowed.
Set the key switch on the front panel to "Hardware". If this error occurs unexpectedly, maybe the "Start" fiber input is open.

11: Sequence cannot start because start is disabled by the SE command.

12: Sequence cannot start because the frequency is out of range.
Use the **!NF** command to set the correct frequency range.

13: Sequence cannot start because no clock is present on the selected synchronization input.

14: Sequence cannot start because mains is not present or the battery is low.

15: Sequence cannot start because the level on the ARM input prevents a start.
Use the **!AI** command to set the function of the ARM input.

16: Sequence cannot start because the pattern on the qualifier inputs does not match the specified pattern(s). Use the **!MX** command to configure the qualifier board.

17: Option not installed.
A command is used which is not supported by the installed hardware (e.g. **!MX** with n o qualifier board installed).

18: Setting conflict.
This error can occur when two settings are in conflict, or a setting cannot be processed by the installed hardware.

19: Synchronization lost during test.
This error occurs when the synchronization signals were bad during the execution of a test. The sequencer switched to internal timing.

20: Number of clocks does not match specified number.
Either the clock signal is bad or the specified number of clocks (see the **!CK** command) is incorrect.

100: Hardware error.
This error can occur during power-on of the sequencer. It means that a (non-fatal) hardware fault has been detected (e.g. status board not found).

A Specifications

A.1 B2759-3.0 en (BE3200 Multi-Channel Test Sequencer)

- **Fiber optic isolated**
- **Fully programmable sequence**
- **Up to 64 channels**
- **Up to128 channels in Master/Slave**
- **Various synchronization sources**
- **Synchronizes with frequencies from 16 Hz to 400 Hz**
- **Timing resolution of one electrical degree for synchronization frequencies up to 200 Hz**
- **Extensive protection measures to prevent damage to the equipment under test**
- **Built-in UPS**

A high speed controller that provides precise timing for the operation of devices used for testing in low voltage, high voltage and high power laboratories.
Sequences are created on a PC using Perception software and are then uploaded to the test sequencer.
Timing of the test sequencer can be synchronized to cycles present in the mains generator, the external mains or derived from an internal timer.
Outputs are switched on and off by the programmed sequence in the BE3200, fully synchronized with the chosen synchronization method. Fiber optics provide optically isolated inputs and outputs.
Two BE3200s can be connected together to synchronize more channels.
Protection measures within the test sequencer prevent damage to the equipment under test, guaranteeing proper completion of the sequence even in the event of interrupted mains supply or synchronization inputs.
Perception software runs on a PC and controls the required sequence, either in milliseconds or with degrees-of-a-cycle to 1 degree of resolution where one cycle is 360 degrees.
The sequence can be run in a repetitive (random) mode for endurance testing along with other various modes. A complete sequence set-up can be saved and recalled from disk.

Fiber Optic I/O	
Sockets	
Input	Broadcom HFBR-2523
Output	Broadcom HFBR-1523; 660 nm LED
Connectors	
Simplex latching connector	Broadcom HFBR-4503
Duplex latching connector	Broadcom HFBR-4516
Drive	
Control lines	10 to 60 meter
Status and channel outputs	60 to 100 meter
Optical Communication Link USB	1; Optical to Electronic USB converter. See Manufacturers web-site for details and drivers if Perception not installed: www.ratioplast.com

Cable (POF : Plastic Optical Fiber)	
Type	Plastic, single step index, Broadcom HFBR-RXXYYY series
Diameter	1.00 mm; Core and cladding
Attenuation	0.22 dB/m
Delay	5.0 ns/m; Propagation delay constant
Force	
Short term tensile force	50 N max. (< 30 minutes)
Long term tensile load	1 N
Bend radius	
Short term	25 mm
Long term	35 mm
Flexing	1000 cycles; 90 degree bend on 25 mm radius mandrel

Synchronization	
Sources	
Generator 1, Clock and Zero	Using a generator with two signal to the BE3200. Clock signal with multiple pulses per rotation/sine wave and a Zero indication to determine the correct angle Synchronization adjustments performed on every clock signal leading to the best possible synchronization.
Generator 1, Zero	Using a generator with one signal to the BE3200. Zero signal indicating the zero crossing of the sine wave. Synchronization adjustments performed on every zero pulse.
Generator 2, Clock and Zero	Using a generator with two signal to the BE3200. Clock signal with multiple pulses per rotation/sine wave and a Zero indication to determine the correct angle Synchronization adjustments performed on every clock signal leading to the best possible synchronization.
Generator 2, Zero	Using a generator with one signal to the BE3200. Zero signal indicating the zero crossing of the sine wave. Synchronization adjustments performed on every zero pulse.
Mains	Zero crossing detection on Mains signal. Synchronization adjustments performed on every zero pulse.
Modes	
None	No synchronization mode is used. The internal clock operates on the set frequency.
Measured	Measures a synchronization value before the start of a sequence which is then set and used for the rest of the sequence
Timed	Measures a synchronization value during a set time period at the start of a sequence which is then used for the rest of the sequence
Full	During the complete sequence the selected synchronization source is used

Generators	
Inputs	Four fiber optic inputs are provided for two generators. For each generator two synchronization inputs are available: Clock and Zero.
Clock	120 to 360 times per cycle @ cycles ranging from 16 Hz to 70 Hz
Zero	Zero-index pulse once per cycle @ cycles ranging from 16 Hz to 400 Hz

Mains	
Input	Completely insulated and galvanically isolated banana sockets
Input voltage	10 to 1000 VACrms
Protection	1500 VACrms
Frequency	16 to 400 Hz

Internal

When synchronization is set to “none”, the internal clock is used	
Frequency	16 to 400 Hz

Resolution and Accuracy

Resolution (one cycle being 360 degrees)			
Synchronization frequencies of 16 Hz - 200 Hz	One (1) electrical degrees		
Synchronization frequencies of 200 Hz - 400 Hz	Two (2) electrical degrees		
Tracking			
Deviations of the input signals frequency	Up to 15% per second		
Minimum start frequency	16 Hz		
Minimum frequency during sequence	~ 11 Hz Below 11 Hz the sequence switches to **measured mode** and the sequence is completed with the last measured value		
Maximum Synchronization In-accuracy Accuracy is a function of frequency and synchronization mode			
Synchronization mode	**Synchronization on...**	**50 HZ**	**400 HZ**
None	–	± 0.025 °/ cycle(1)	± 0.14 °/cycle(1)
Measured	Mains	± 0.5 °/cycle(1)	± 0.5 °/cycle(1)
	Zero	± 0.5 °/cycle(1)	± 0.5 °/cycle(1)
	Clock + Zero	± 0.5 °/cycle(1)	-
Timed	Mains	± 0.5 °/cycle(1)	± 0.5 °/cycle(1)
	Zero	± 0.5 °/cycle(1)	± 0.5 °/cycle(1)
	Clock + Zero	± 0.5 °/cycle(1)	-
Full	Mains	± 0.12 °(2)	± 0.4 °(2)
	Zero	± 0.12 °(2)	± 0.4 °(2)
	Clock + Zero	± 0.4 °/cycle (1)	-

(1) The maximum deviation which will occur in one cycle after the synchronization period. This error will accumulate in all consecutive cycles. E.g. an error of 0.5 °/cycle will produce in worst case an error of 25 degrees after one second at 50 Hz.

(2) The maximum deviation at any time which will occur in the complete sequence.

Fast Repeat

The sequencer can execute a defined sequence multiple times without computer control	
Count	1 to 50000
Dead time	Between each consecutive repetition a minimum dead time occurs of at least one cycle. Depending on the output correction this may increase to two cycles.
Synchronization	When timed or measured synchronization is selected this synchronization is only used for the first sequence in a burst. Consecutive sequences are in free run mode. When computer controlled repeat is also on, each first sequence of a burst will be synchronized again with the selected mode. When full synchronization is used all sequences are fully synchronized.

Response Time

BE3200 Test Sequencer firmware	Responds on a start command (software and external hardware) within one second when the total number of events (programmed ON-states) within one sequence does not exceed 128, i.e. Chan1_Events + Chan2_Events + ... + ChanN_Events ≤ 128. When more than 128 events (programmed ON-states) occur within one sequence the response time will increase, depending on the number of events. This has no impact on the fast repeat.

Power	
Power Inlet	86 – 264 VAC47 – 440 Hz
Total power of unit	75 VA
Uninterpretable power supply	Rechargeable NiCad battery, 12 VDC @ 6.5 Ahr; Built-in automatic recharge system. Typical 30 minutes back-up time.

Physical, Weight and Dimensions	
Weight	
Fully loaded	10 kg (22 lb)
Dimensions	
Height	177 mm (7.0")
Width	483 mm (19.0")
Depth	425 mm (16.7")

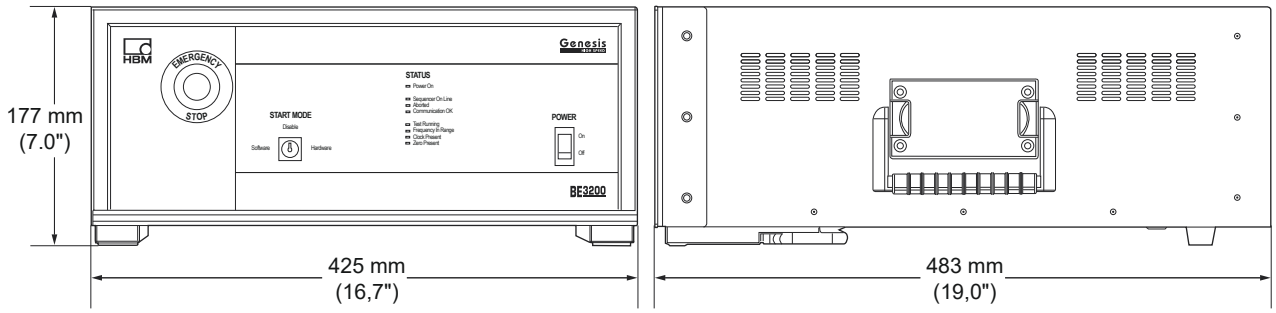

Figure A.1: BE3200 Multi-Channel Test Sequencer Dimensions

Environmental Specifications	
Altitude	Maximum 2000 m (6100 ft); operational
Protection class	IP20
Relative humidity	0% to 80%; non-condensing
Temperature Range	
Operational	0 to 40 °C (+32 °F to 104 °F)
Non-operational (Storage)	-25 °C to +70 °C (-13 °F to 158 °F)

Rack Mount Kit (Option, to be ordered separately)	
Rack Mount Kit	Rack mountable; Optional 19-inch rack mount required 19" height

Ordering Information(1)			
Article		**Description**	**Order No.**
32-Channel Test Sequencer		Test Sequencer with 32 fiber optic outputs and 16-channel fiber optic isolated start qualifiers. Fully programmable via fiber optic isolated bi-directional USB interface USB to optical RS232 converter and duplex plastic optical fiber cable included to connect controlling PC to Test Sequencer. Perception control software not included.	1-GENTS32
64-Channel Test Sequencer		Test Sequencer with 64 fiber optic outputs and 16-channel fiber optic isolated start qualifiers. Fully programmable via fiber optic isolated bi-directional USB interface. USB to optical RS232 converter and duplex plastic optical fiber cable included to connect controlling PC to Test Sequencer. Perception control software not included.	1-GENTS64

(1) All GEN series systems are intended for exclusive professional and industrial use.

Option, to be ordered separately			
Article		**Description**	**Order No.**
Plastic Optic Fiber 10m		GEN DAQ standard plastic optical simplex Multi Mode 1 mm fiber diameter cable. 0.22 dB/m loss, HFBR4503Z-HFBR4503Z connectors. Typically used to connect the BE3200 optical input or outputs. Length 10 m (33 ft).	1-KAB283-10
Light to TTL PCB		BE3200 option PCB with light to TTL convertor electronics, including a 1-KAB283-10 plastic optical simplex Multi Mode 1 mm cable. The PCB does not include housing and/or power supply.	1-G602
TTL to Light PCB		BE3200 option PCB with TTL to light convertor electronics, including a 1-KAB283-10 plastic optical simplex Multi Mode 1 mm cable. The PCB does not include housing and/or power supply.	1-G603
Rack Mount		19” rack mount assembly	1-G604

Software Options, to be ordered separately(1)		
Article	**Description**	**Order No.**
SEQUENCE	To control BE3200 Test Sequencer from Perception via USB port. Requires Perception Standard or higher (1-PERC-ST-01).	1-PERC-OP-SEQ-01

(1) Software options are also sold in a package with multiple single seat licenses and multiple seat network license.

B Maintenance

B.1 Preventive maintenance

Regularly scheduled HBM preventive maintenance services that include cleaning, adjusting, inspection and calibration will help to:

- Assure that the instrument is available whenever it is needed
- Maintain optimum performance
- Avoid expensive unplanned downtime and repair

Also, regularly scheduled maintenance is a predictable expenditure.

Except for the batteries, the instrument is a maintenance-free product; no preventive maintenance is required.

Inspect the instrument's batteries at least twice a year, but preferably every month. Damaged batteries and batteries with reduced capacity should be replaced to meet the batteries' specified capacity and consequently the instrument's specified run-time using the battery. The main benefit of this inspection will result in reliable use of the instrument.

If the instrument has been stored for four weeks or longer, first inspect the battery before putting the instrument back to use.

How often preventive maintenance needs to be performed depends on your application, workload, and regulatory requirements.

B.2 Cleaning

To clean the instrument, disconnect all power sources. Lightly wipe the surfaces with a clean, soft cloth dampened with water.

The BE3200 Test Sequencer does not require additional routine cleaning.

C Service Information

C.1 General - Service Information

HBM offers comprehensive factory servicing for all HBM Data Acquisition products. Extended warranties for calibration, repair or both are available. Installation, on-site or factory training are also available. Contact the factory or local sales person for more information. For local contact information, visit www.hbm.com/support.

If servicing is needed on the equipment, contact the factory with the model and serial numbers, a description of the problem, and your contact information. A Return Material Authorization (RMA) number will be issued. Attach this number and the accompanying paperwork to the unit.

During the warranty period, the customer pays for shipping to HBM. HBM pays to return the equipment in the same fashion as it was received. Outside of the warranty period, a quote for the shipping costs is issued. A purchase order must be received before work can be performed.

It is recommended that the unit always be shipped in the original shipping container.

For the frequent shipping of some products, HBM offers hard shipping containers specifically designed for frequent transportation.

C.2 Calibration/verification

The BE3200 Test Sequencer does not requires calibration. However, HBM recommends that the BE3200 Test Sequencer should be re-tested once a year or after any major event that may affect the basic functions of the instrument. When in doubt, consult your local supplier.
Special care must be taken to monitor the state of the built-in battery.

D Technical information

D.1 Clock and zero synchronization requirements

When using the generator 1 and 2 clock and zero synchronization, the clock and zero signals must meet specific requirements as shown in the following diagram and table.

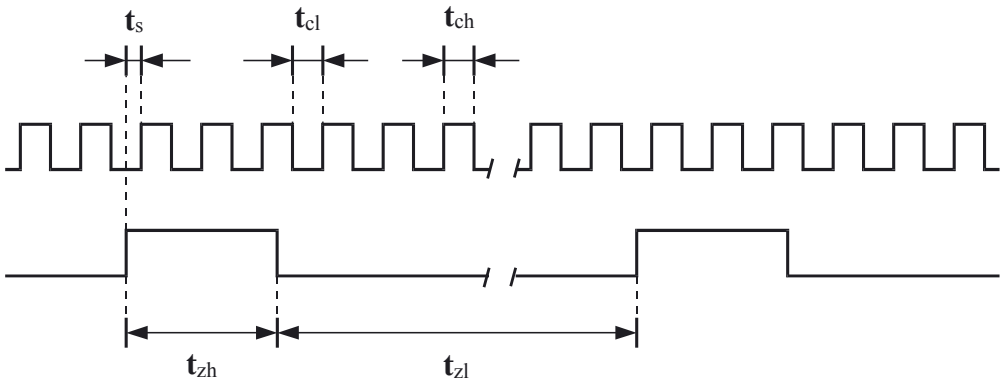

Figure D.1: Clock and zero synchronization parameters

Clock and zero synchronization specifications		Stand alone		Master/slave	
		Min.	Max.	Min.	Max.
t_{cl}	Clock low	16 µs	–	19 µs	–
t_{ch}	Clock high	16 µs	–	19 µs	–
t_{zl}	Zero low	16 µs	–	19 µs	–
t_{zh}	Zero high	16 µs	–	19 µs	–
t_s	Zero to Clock set-up time	10 µs	33µs	13µs	33µs

The clock and zero pulses must meet certain requirements in order to be properly detected. These requirements are reflected in the parameters t_{cl}, t_{ch}, t_{zl} and t_{zh}.

Note *t_{cl} and t_{zl} increase when two units operate in master/slave mode. This is due to the delay introduced by the fiber optic receivers and transmitters.*

The BE3200 identifies the first leading edge of the clock after the leading edge of the zero index as the zero degree moment. The zero-to-clock setup time ts is the time required for the BE3200 to recognize the first leading edge of the clock after the leading edge of the zero index pulse.

Otherwise stated: the leading edge of the zero index pulse must be at least $\mathbf{t}_s$ (min) before the leading edge of the clock. Otherwise the zero-degree pulse of the clock might not be recognized.

Also: the leading edge of the zero index pulse must be no more than $\mathbf{t}_s$ (max) before the leading edge of the clock. Otherwise it might pick up the 359-degree pulse of the clock at the highest synchronization frequency.

Example
Maximum synchronization frequency with clock and zero is 70 Hz. Maximum number of clocks per cycle is 360. The time T between two consecutive clocks:

$$\Delta T = \frac{1/70}{360} = 39\,\mu s$$

With a minimum setup time of 6 µs this leaves 33 µs.

A typical safe value of $\mathbf{t}_s$ would be 15 µs.

D.2 Safety measures

A number of safety measures are built-in to guarantee proper operation of the BE3200 in the event of power loss or disturbances.

D.2.1 Watchdog timer

A watchdog timer is installed in the BE3200. This timer is reset by the firmware every 20 milliseconds. Should for any reason the firmware be disabled, the watchdog timer is not reset and will count out.

At this point the complete hardware will be reset and all outputs, including the status outputs will become inactive.

After the start-up procedure the BE3200 will come on line again with the “sequencer failed” bit in the status register set. This register is automatically polled by the Sequencer option in Perception. When you are using your own software this status can be interrogated by the **“?ST”** command, which will return **“!ST128”** in this situation.

Since the ABORT indicator on the rear of the BE3200 is always active when the system is on line and not aborted, this indicator can be used to set an alarm when the watchdog timer comes in.

D.2.2 Battery backup

The BE3200 contains a battery backup system which ensures proper completion of an active sequence in the event of power loss or disturbance.

There are three distinct situations:

- The system is on-line and there is no sequence active.
  When the power fails the system remains on-line, but it is not possible to start a sequence.
- The system is on-line and a sequence is running.
  When the power fails the system remains on-line and the sequence will continue as programmed.
- The system is off-line.
  When the power fails the system will shut-down after approximately 10 seconds.

The power indicator in the front gives a visual indication of the combined power/ battery status:

- When this LED is **On** continuously, the BE3200 is switched on and connected to the mains power supply.
- When this LED *blinks slowly* at a rate of approximately 0.5 Hz, the BE3200 is switched on and connected to the mains power supply, but the battery back-up has reached a low level.
- When this LED *blinks fast* at a rate of approximately 5 Hz, the BE3200 is not connected to the mains power supply and the battery back-up has reached a low level.
- When this LED is **Off** and the **Sequencer On Line** is **On**, the BE3200 operates on the battery and will shut down after approximately 10 seconds when no new commands are received.

The battery back-up system is designed to provide proper operation of the BE3200 for at least 10 minutes in worst case.

Worst case situation is:

- Fully loaded BE3200 system
- Sequence running or all outputs active
- Battery loaded just up to its operating level

In practice a typical situation will provide battery back-up for one hour or more.

E BE3200 USB to Optical RS232 Convertor

E.1 Re-programming of the USB-RS232 (opt. 650nm) converter to work with BE3200

1 Download the “FT-Prog“ from:
www.ftdichip.com/Support/Utilities.htm
This is required to re-program the internal EEPROM in the converter to support inverted TX/RX lines (required to work with BE3200).

2 Unzip the downloaded ZIP-Archive and run the “FT_Prog“ program. Connect the converter to a free USB connector on your PC.

3 Press **F5** or go to the menu **Devices ▸ Scan and Pharse**. As soon as the USB converter is found, the display should look like this:

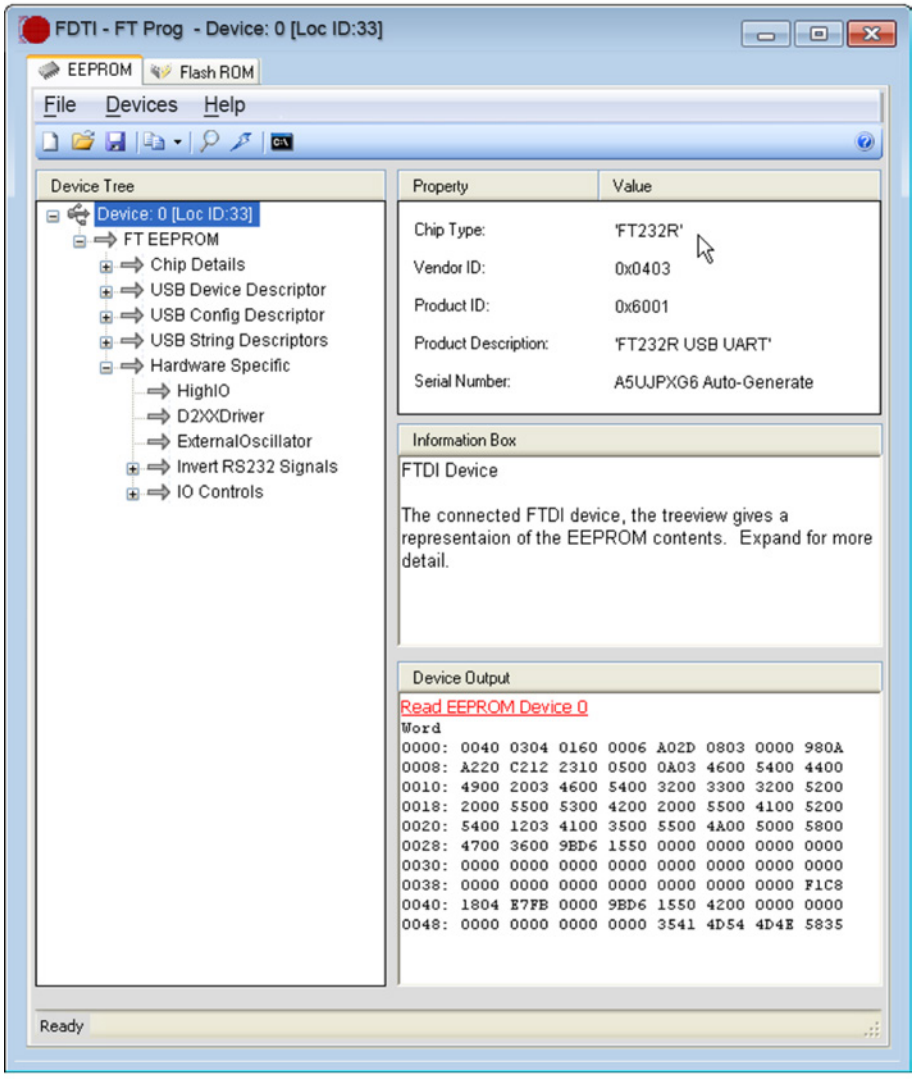

Figure E.1: FTDI - FT Prog (Part1)

4 In **Device Tree** in the left-hand column, expand the **Hardware Specific** node and select the **Invert RS232 Signals** (see Figure E.2).

5 In the **Property** column, select **Invert TXD** and **Invert RXD** check boxes (see Figure E.2):

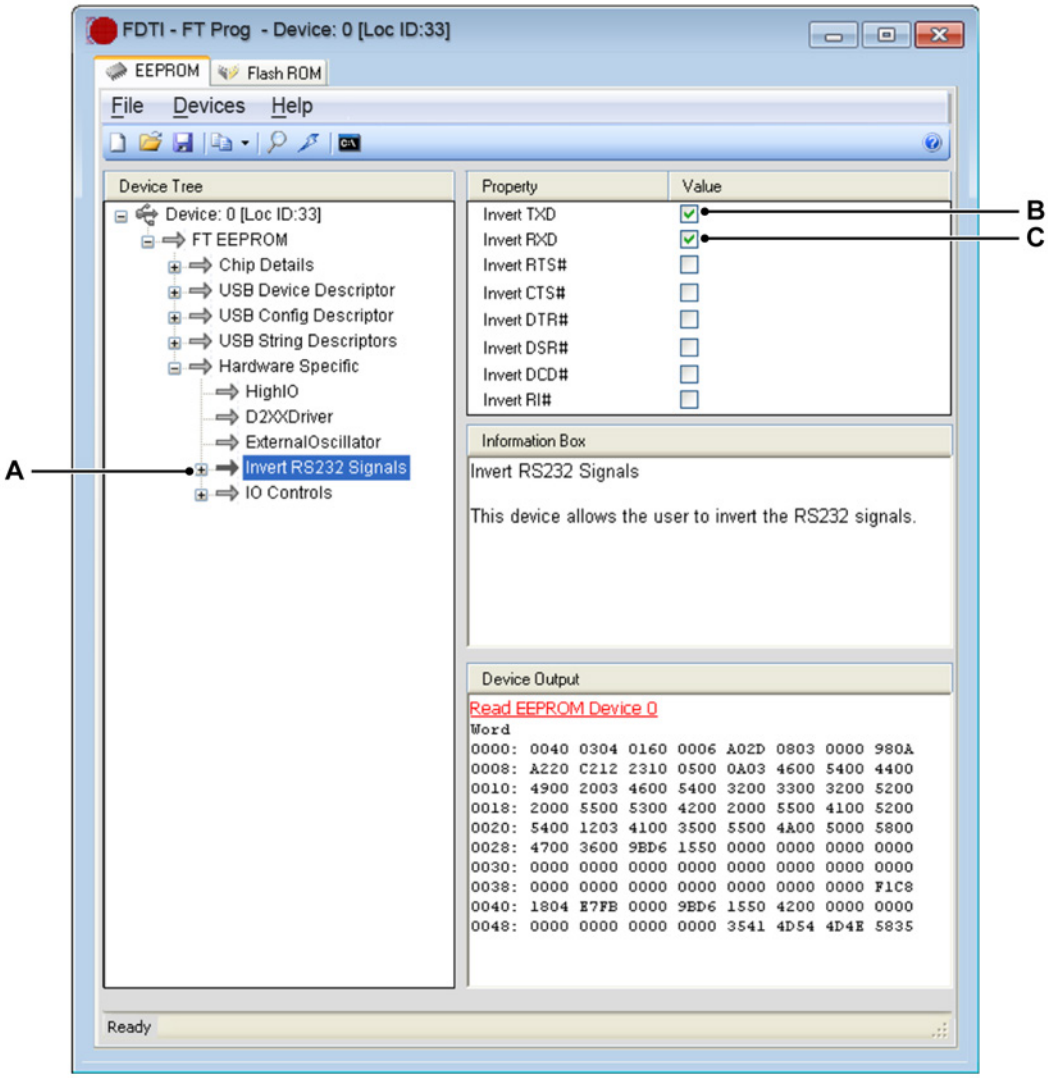

Figure E.2: FTDI - FT Prog (Part2)

A RS232 Signals

B Invert TXD

C Invert RXD

6 Finally: Select from the menu **Devices** ► **Program** to re-program the **EEPROM** on the converter.

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