Genesis HIGH SPEED

User Manual

English

Multi-Channel Test Sequencer

BE3200

HBM

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1 Safety Messages

1.1 FCC and general

The first WARNING note below is required by the FCC 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.

The design of this instrument has been verified to EN 61010-1 for Class 1 (grounded use).

This manual contains information and warnings that must be observed to keep the instrument in a safe condition. The instrument should not be switched on if it is damaged and it should not be used under wet conditions.

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.

This instrument must not be used in life support roles.

1.2 Grounding

The instrument must be used with a protective ground connected via the conductor of the supply cable. This is connected to the instrument before the line and neutral connections 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.

WARNING

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

For protection against electric shock, all external circuits or equipment shall have a safe insulation. Therefore it is not permitted to connect peripheral equipment to the system with a power supply without SELV (Separated Extra Low Voltage) or Class II qualification.

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

WARNING

It is recommended that signal grounds always be connected to a local ground. For safety, it is essential that a signal earth be connected whenever voltages greater than 40 V peak are connected. This is to prevent the instrument's case becoming live in the event of a safety ground interruption, which could occur if the supply connector is accidentally disconnected from the rear of the instrument.

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

WARNING

All inputs are rated for IEC 61010 CAT I (Category 1) signals only unless otherwise stated. This instrument should not be used to measure high-energy signals of Categories II, III, and IV.

The covers protect the user from live parts, such as the sync input; CAT I 1000 V and CAT II 600 V, and should only be removed by suitably qualified personnel for maintenance and repair purposes.

The instrument must not be operated with the covers removed.

1.3 Electro Static Discharge (ESD)

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 quite easily occurs, is hard to detect and is often costly. Therefore we strongly advise ESD precautions be taken when handling the BE3200 system, its connections and plug in cards.

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 on the importance of ESD preventions when handling a GEN series 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 your BE3200 data acquisition system and other electronic devices from ESD harm. Although HBM has built protections against ESD into its products, ESD unfortunately exists and, unless neutralized, could build up to levels that could harm your equipment. Any electronic device that contains an external entry point for plugging in anything from cables to acquisition cards is susceptible to ESD.

Precautions against ESD

Make sure to discharge any built-up static electricity from yourself and your electronic devices before touching an electronic device, before connecting one device to another, or replacing acquisition cards. You can do this in many ways, including the following:

- Ground yourself by touching a metal surface that is at earth ground. For example, if your computer has a metal case and is plugged into a standard three-prong grounded outlet, touching the case should discharge the ESD on your body.
- Increase the relative humidity of your environment.

- Install ESD-specific prevention items, such as grounding mats and wrist straps.

While you should always take appropriate precautions to discharge static electricity, if you are in an environment where you notice ESD events, you may want to take extra precautions to protect your electronic equipment against ESD.

The use of wrist straps
Use an ESD wrist strap whenever you open a chassis, particularly when you will be handling circuit cards and appliques. In order to work properly, the wrist strap must make good contact at both ends (with your 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.

1.4 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 equipment is specified for use in a Pollution Category 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.

The instrument will operate with full specified accuracy between 15 °C and 35 °C and can be stored between -25 °C and 70 °C, operating at an approximate maximum altitude of 2000 m above sea level.

Humidity should be between 0 % and 80 %. When moving the device from a cold to a warm environment the equipment has to be left turned off for a period of 30 minutes to avoid short circuits by 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. When the equipment warms up to its normal operating temperature, moisture can form inside the equipment, which may damage the equipment’s electronic circuit boards.

Do not drop, knock or shake the equipment. Rough handling can break internal circuit boards.

Do not use harsh chemicals, cleaning solvents or strong detergents to clean the equipment. To clean the equipment, disconnect all power sources and wipe the surfaces lightly with a clean, soft cloth dampened in a mild soap-and-water solution.

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

1.5 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 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.

CAUTION

Do not position this instrument so that it is difficult to remove the power cable.

1.6 Electro-Magnetic Compatibility (EMC)

EMC stands for Electro-Magnetic Compatibility. The overall intention is that electronic equipment must be able to co-exist with other electronic equipment in its immediate vicinity and neither emits 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.

In demanding applications, if this instrument does cause minor harmful interference to other equipment, which can be determined by turning this instrument off and on, the user is encouraged to try to reduce 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.

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.

1.7 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 or disconnection of the protective earth terminal 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 shall 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.

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 and should not be directly connected to human subjects or used for patient monitoring.

1.8 Overvoltage/current protection

All signal inputs are protected against overloads of ± 250 Vpk continuously and 1000 V transient. Exceeding these limits, particularly when connected to potentially high-current sources, can cause severe damage that is not covered by the manufacturer's warranty.

1.9 Instrument Symbols

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

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

This symbol is used to denote a safety ground connection.

Where caution is required, this symbol refers to the User's Guide for further information.

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

This symbol shows that the switch is a standby switch. When it is pressed, the instrument state toggles between operating and stand by mode. In standby mode some power will be consumed and the instrument is NOT disconnected from the AC supply.

1.10 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.

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, ask yourself the following questions:

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

1.11 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.

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

- In the USA, the Isolated Digitizers are certified as a Class 1 laser product conforming to the requirements contained in the Department of Health and Human Services (DHHS) regulation CDRH 21 CFR, Chapter I Subchapter J Part 1040.10.
- Outside the USA, the Isolated Digitizers are certified as a Class 1 laser product conforming to the requirements contained in IEC/EN 60825-1:1994+A1+A2 and IEC/EN 60825-2.

Note *Although the BE3200 does not have a laser source as described above it does have optical fiber communications lights which should be used with the same level of caution.*

1.12 Batteries

The BE3200 includes a backup rechargeable sealed Lead acid battery: 12 VDC @ 6.5 Ahr capacity. There is an automatic recharge system built-in. Replacement should not be done by the user and should be done by a qualified service technician. The battery is intended to keep the unit running if there are any temporary power interruptions.

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 transmitter 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 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 transmitter, avoiding direct contact with your hands.

1.13 International safety warnings

Dansk

SIKKERHEDSADVARSEL
Dette instrument skal anvendes med en beskyttelsesjordforbindelse via netkablets jordledning til jordforbindelsen i instrumentets apparatkontakt eller - hvis instrumentet er forsynet dermed - via sikkerhedsjordklemmen. Enhver afbrydelse af sikkerhedsjordforbindelsen vil formentlig gøre instrumentet berøringsfarligt. Bevidst afbrydelse er forbudt. Hvis et indgangssignal overstiger 40 V spidsværdi, skal en ekstra signal jord forbindes.

Dækslerne må ikke fjernes.

Hvis netsikringen springer som følge af en fejl, er det muligt at instrumentets AC netafbryder er blevet beskadiget, hvorfor den bør efterses af en kvalificeret tekniker.

Afbryd instrumentet fra lysnettet ved at fjerne IECstikket fra bagpanelet. Dette instruments AC netafbryder er kun beregnet til funktionelle formål. Den er hverken beregnet til eller egnet til afbrydelse af lysnettet.

Nederlands

VEILIGHEIDSWAARSCHUWING
Dit instrument mag uitsluitend worden gebruikt als een beschermende massa (aarde) is aangesloten via de beschermende massageleider van de voedingskabel, of - indien het instrument daarvan is voorzien - via de veiligheids-massa-aansluiting. Als de beschermende 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 40 V (top-top) dan dient eveneens de signaal aarde aangesloten te zijn.

De deksels nooit verwijderen.

Als de zekering doorbrandt als gevolg van een storing of een defect, dan is het mogelijk dat de wisselstroom-voedingsschakelaar van het instrument beschadigd is. Die schakelaar moet worden gecontroleerd door een deskundig technicus.

Als de IEC-aansluiting op het achterpaneel uit het stopcontact wordt verwijderd, zal het instrument niet langer zijn aangesloten op de wisselstroomvoeding. De wisselstroom-voedingsschakelaar op dit instrument is uitsluitend bestemd voor functionele doeleinden. Die schakelaar mag nooit worden gebruikt om het instrument aan of af te zetten.

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, jos jokin tulosignaaleista ylittää 40 V peak, on signaalimaa kytkettävä.

Älä poista suojakansia.

Mikäli laitteen verkkosulake palaa vian seurauksena, on mahdollista, että laitteen verkkokytkin on vaurioitunut ja se tulee tällöin tarkastuttaa ammattihenkilöllä.

Erottaaksesi tämän laitteen käyttöjännitteestä irrota takapaneelissa oleva IEC-liitin. Tämän laitteen verkkokytkimellä on ainoastaan toiminnallinen tarkoitus. Sitä ei ole tarkoitettu, eikä se sovellu laitteen erottamiseen käyttöjännitteestä.

Français

ATTENTION - DANGER!
Cet appareil 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 quelconque des signaux d'entrée dépasse 40 V crête.

Ne pas déposer les panneaux de protection.

Le fait que le fusible d'alimentation saute par suite d'une anomalie risque de détériorer l'alimentation secteur de l'instrument; dans ce cas, le faire contrôler par un technicien qualifié.

Pour couper l'alimentation secteur de cet instrument, débrancher le cordon secteur monté à l'arrière. L'interrupteur d'alimentation est purement secteur fonctionnel. Il ne s'agit pas d'un dispositif de coupure du courant, et n'est pas conçu pour cette fonction.

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 40 V muß die Signalmasse angeschlossen sein.

Die Schutzabdeckung nicht entfernen.

Wenn die Sicherung der Versorgung infolge eines Defektes durchbrennt, besteht die Möglichkeit einer Beschädigung des Wechselstromversorgungs-Schalters des Gerätes. Der Schalter muss dann von einem qualifizierten Elektriker geprüft werden.

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

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 massa a terra protettiva, sia all'interno che all'esterno dello strumento, lo renderà pericoloso. E'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 40 V di picco.

Non aprire lo strumento.

Nel caso in cui il fusibile dell'alimentazione dovesse scattare a causa di un guasto, è possibile che l'interruttore dell'alimentazione a corrente alternata dello strumento possa essere danneggiato e dovrà pertanto essere controllato da un tecnico specializzato e qualificato.

Per disinnestare questo strumento dall'alimentazione a corrente alternata, levare il connettore IEC che si trova sul pannello posteriore. 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.

Norsk

ADVARSEL!
Dette instrumentet må bare anvendes så lenge det er jordet via den beskyttende jordlederen i strømkabelen, eller via jordingsklemmen, hvis instrumentet har en. Eventuelle forstyrrelser i den beskyttende jordingen, inne i eller utenfor instrumentet, vil sannsynligvis gjøre instrumentet farlig. Forsettlig forstyrrelse er forbudt. I tillegg, signal jord må tilkobles dersom inngangs signalet overstiger 40 V spissverdi.

Ikke fjern dekslene

Hvis sikringen springer på grunn av feil som oppstår, er det mulig at instrumentets vekselstrømbryter kan bli skadet - den må derfor kontrolleres av en kvalifisert ingeniør.

Skal instrumentet koples fra vekselstrømtilførselen, kopler man ut IECkoplingen bak på panelet. Vekselstrømbryteren på dette instrumente tjener kun en funksjonell hensikt. Den er ikke egnet, og må ikke brukes, som skillebryter.

Português

AVISO DE SEGURANÇA
Este aparelho deve ser operado com uma ligação terra ligado por um conductor trifásico do cabo principal ou, se o instrumento já tiver um, via um terminal de segurança. Qualquer interrupção do trifásico, dentro ou fora do aparelho, pode tornar o aparelho perigoso. É proibida a interrupção intencional. Nota: O terminal de terra deve ser ligado se o sinal de entrada a medir for superior a 40 V de pico.

Não retire o invólucro/capas.

Se o fusîvel suplementar queimar por causa de erro, é possivel que o interruptor da fonte AC do aparelho esteja com defeito e deveria ser checado por pessoa autorizada.

Para desconectar este aparelho da fonte AC, retire o conector IEC do painel trazeiro. Neste aparelho, o interruptor da fonte AC existe sómente por razões funcionais. Não deve ser usado e nem é apropriado como dispositivo de desconexão.

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 entrade sobrepasa los 40 V de pico.

No quite las tapas.

Si se fundiera el fusible de alimentación como consecuencia de una avería, cabe la posibilidad de que el interruptor de encendido del equipo esté dañado y sea necesario comprobarlo por personal técnico especializado y autorizado al efecto.

Para desconectar este instrumento de la red, desenchufe el conector IEC del panel trasero. 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.

Svenska

SÄKERHETSVARNING
Detta instrument måste drivas med en skyddande jordledning ansluten via den skyddande jordledaren på matarkabeln eller, om instrumentet har sådan monterad, via det jordade uttaget. Om jordanslutningen störs, inuti eller utanför instrumentet, är det troligt att instrumentet kommer att utgöra en fara. Avsiktlig störning är förbjuden. Dessutom måste en signaljord anslutas om någon av ingångssignalerna överstiger 40 V topp.

Tag ej bort skydden.

Om matarsäkringen smälter på grund av ett fel är det möjligt att strömställaren för växelströmsmatning på instrumentet skadas och den bör då inspekteras av en ingenjör med lämpliga kvalifikationer.

För att koppla bort instrumentet från växelströmstillförseln, tag ut IEC-anslutningen på bakpanelen. Strömställaren för växelströmstillförsel på detta instrument är enbart till för funktionerliga ändamål. Den är inte avsedd som, eller lämplig som, en bortkopplingsanordning.

English

SAFETY WARNING
This instrument must be operated with a protective ground (earth) connected via the protective ground conductor of the supply cable or, if the instrument is fitted with one, via the safety 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 40 V peak.

Do not remove the covers.

If the supply fuse blows as the result of a fault, it is possible that the instrument's AC supply switch will be damaged and should be checked by a suitably qualified engineer.

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

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、入力信号がピーク時に 40V を超える場合は、信号接地線を接続してください。

カバーは取り外さないでください。

電源ヒューズが故障により飛んだ場合、機器の AC 電 源スイッチが損傷するおそれがあるため、然るべき認 定を受けた適任者による点検を受けてください。

本機器を AC 電源から遮断するには、背面パネルにあ る 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。

中文

安全警告
该仪器必须通过电源电缆的导线连接到保护接地（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使仪器成为危险设备。 严禁有意断开。 另外，如有任何输入信号超过 40 V 的峰值，还必须连接信号接地。

不要取下保护盖。

如果电源保险丝因故障而熔断，则有可能损坏仪器的 交流电源开关并应由具备资格的工程师检查。

拔下仪器后面板上的 IEC 接头即可断开交流电源。 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。

1.14 WEEE - Waste Electrical and Electronical Equipment

Since February 2003, European Union legislation has been in force stating that EU members are now restricting the use of hazardous substances in electrical and electric equipment (Directive 2002/95/EC) as well as promoting the collection and recycling of such electrical equipment (Directive 2002/96/EC).

The legislation may require the creation of collection or drop off schemes where consumers return their used electronic waste free of charge. The objective of these schemes is to increase the recycling and/or re-use of such products. It is also required that heavy metals such as lead, mercury, cadmium, and chromium and flame retardants such as polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE) are substituted with safer alternatives.

In certain circumstances, the regulations also place responsibilities on end users of WEEE to be responsible for the recovery and recycling of this equipment when it becomes waste.

Therefore please arrange the return of any product that reaches the end of its lifetime with HBM.

2 About this manual

2.1 Symbols used in this manual

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

Note *If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.*

WARNING

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.

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 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 give 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.

2.2 Manual conventions

Throughout this manual the Perception software is described, and sometimes still depicted using Windows XP. When required for Windows Vista or Windows 7, differences will be explicitly stated.

When the wording “Click Start ...” is used, this refers to the Windows Start button. In Windows Vista or 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).

3 Introduction

3.1 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.

3.2 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.

4 Installation

4.1 Requirements

The following section lists the hardware requirements.

4.1.1 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.

4.2 BE3200 Installation

4.2.1 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.

4.2.2 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.

4.2.3 Fuses

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

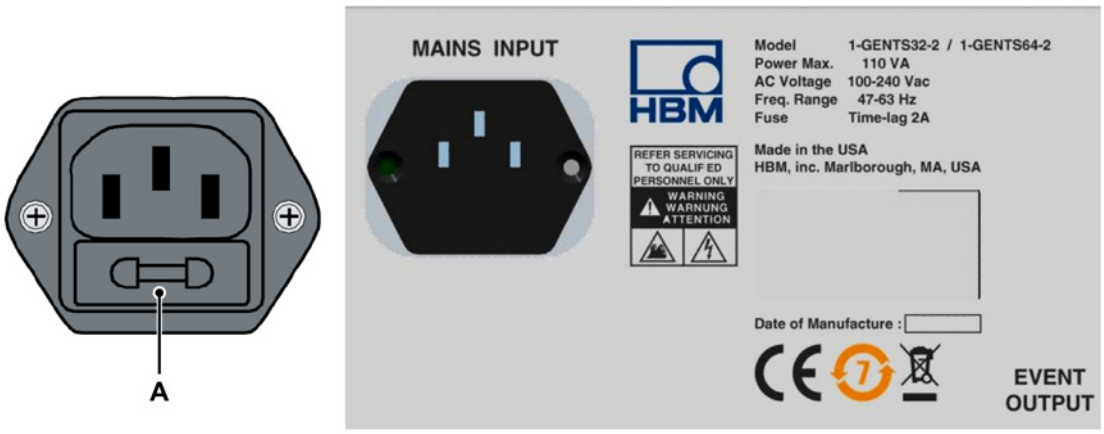

Figure 4.1: Mains input with fuse holder

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.

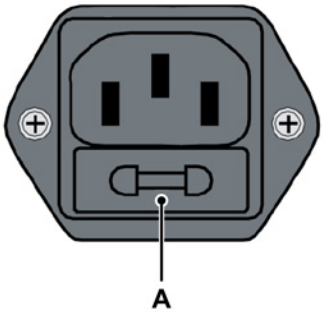

Figure 4.2: Replacement of fuse

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.

4.2.4 USB to Optical Serial communication link

The supplied serial communication link comprises the following components:

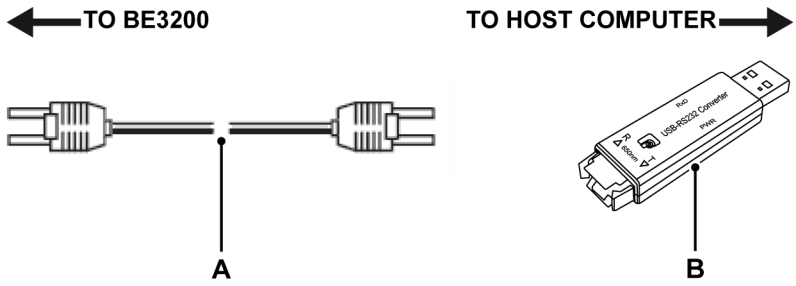

Figure 4.3: USB to Optical Serial Communication Link

A	Fiber-optic cable	The converter is connected to the BE3200 with one twin-fiber-optic cable.
B	USB	The USB powered converter converts optical data from the BE3200 and feeds this directly to the PC.

The serial connector is a 9-pin female D-type connector as shown in Figure 4.4.

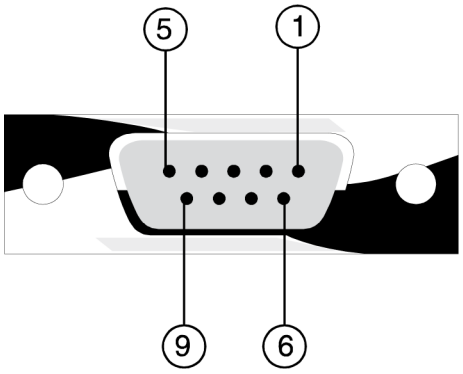

Figure 4.4: Pin numbering D-type serial connector

For communication pins 2 and 3 are used. All others are connected to ground or left open. This enables operation without handshake.

4.2.5 Front panel functions and indicators

On the front panel various functions and indicators are located. Refer to Figure 4.5 for the location of the various items.

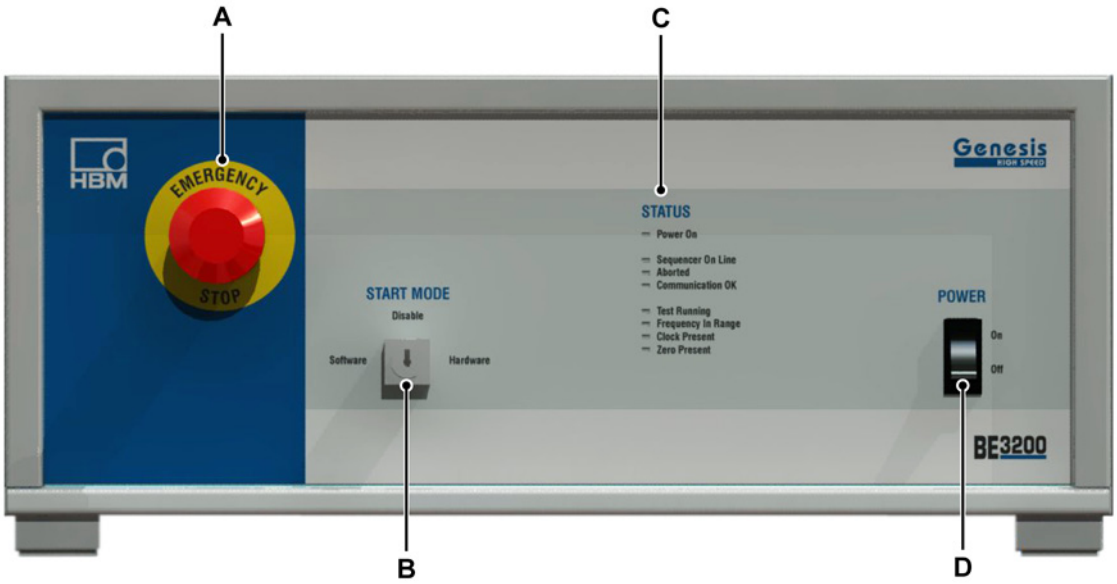

Figure 4.5: BE3200 front panel

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.

4.2.6 Rear panel connections

The rear panel of the BE3200 accommodates the mains input connector and all functional input and output connectors. The Figure 4.6 below shows the rear panel layout of the BE3200 with fiber-optic isolated outputs.

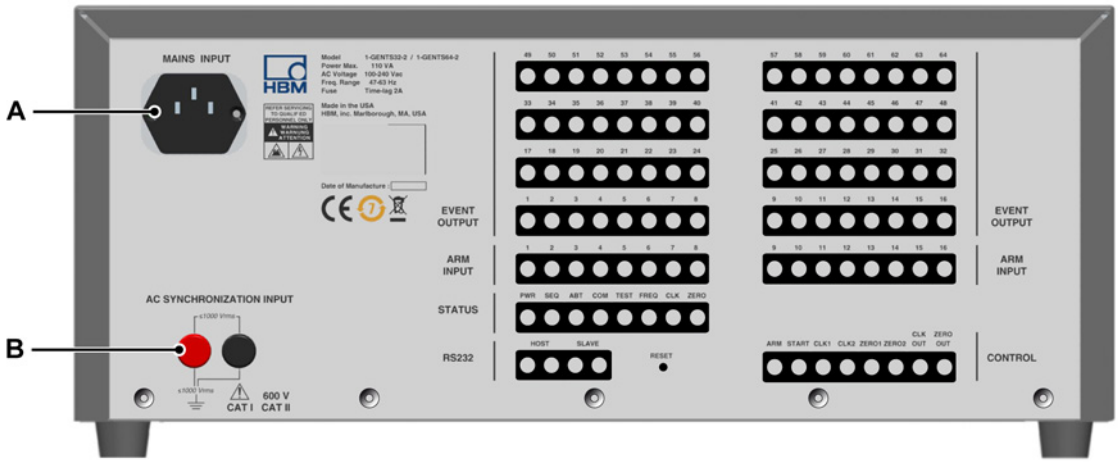

Figure 4.6: BE3200 rear panel

A Mains input

B Isolated synchronisation input

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

The isolated synchronisation 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.

4.2.7 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 Appendix “Serial communication link” on page 81. 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 4.7.

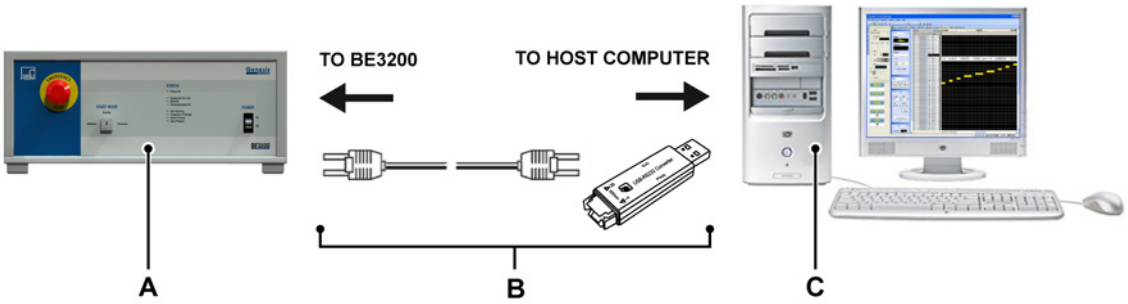

Figure 4.7: BE3200 to host computer interconnection

A BE3200

B Serial communication link. For details refer to Figure 4.3 "USB to Optical Serial Communication Link" on page 40.

C Host computer

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.

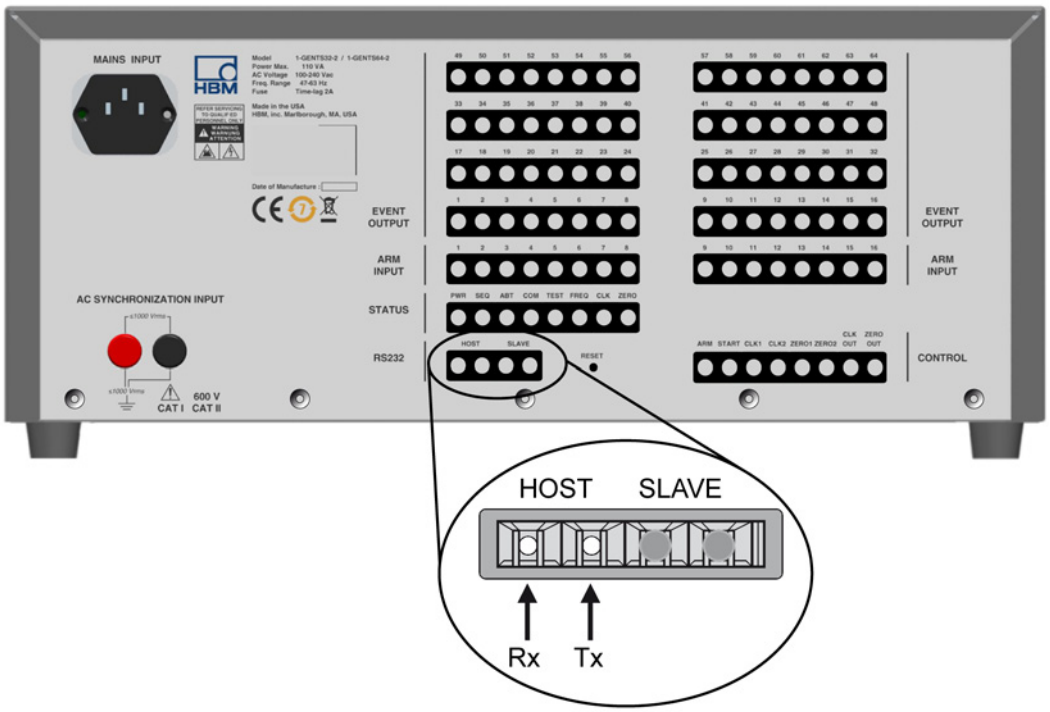

Figure 4.8: Location of the Serial host interface

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!*

5 Getting Started

5.1 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 "USB to Optical Serial communication link" on page 40 and Figure 4.7 "BE3200 to host computer interconnection" on page 44).

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

WARNING

This appliance must be earthed

5.1.1 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 4.6 "BE3200 rear panel" on page 43). 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 4.5 "BE3200 front panel" on page 41.

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

5.1.2 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.

6 Control and usage of the BE3200

6.1 Introduction

This chapter describes the usage of the BE3200. This chapter will guide you through the various steps, required to obtain a general understanding of the concepts used with the BE3200.

6.2 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 6.1 shows the relation between a sinewave and the expected clock and zero synchronization pulses.

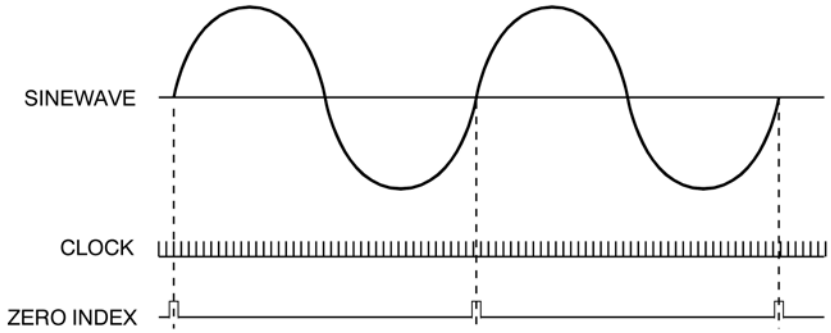

Figure 6.1: Clock and zero synchronization pulses

6.2.1 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 6.2.

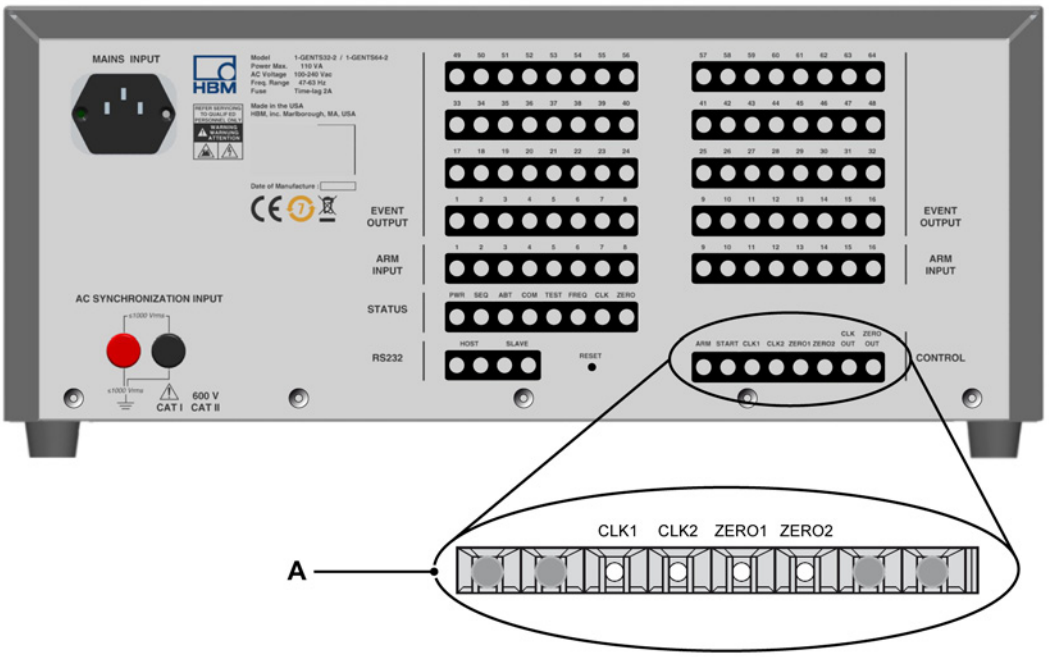

Figure 6.2: Location of synchronization inputs

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 6.3.

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.

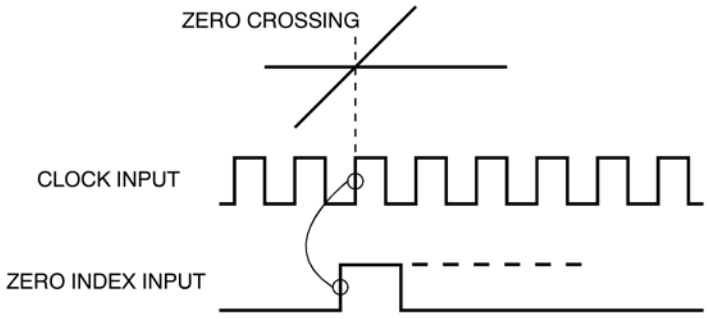

Figure 6.3: Clock and zero index relation

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

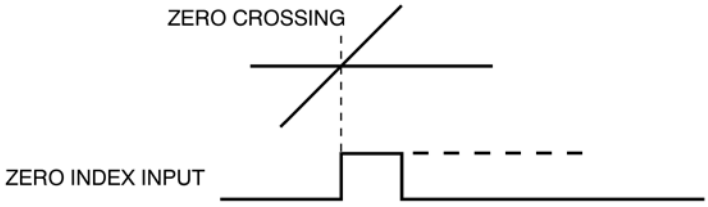

Figure 6.4: Zero index location (synchronization on zero only)

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 !!**

6.2.2 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 6.5.

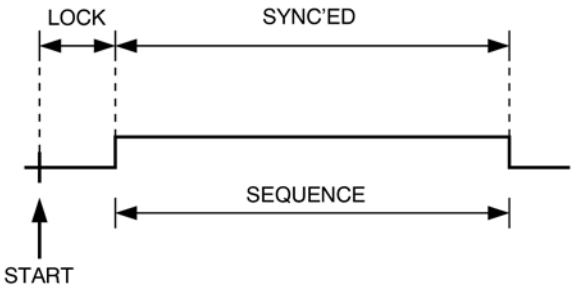

Figure 6.5: Full synchronization

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 6.6.

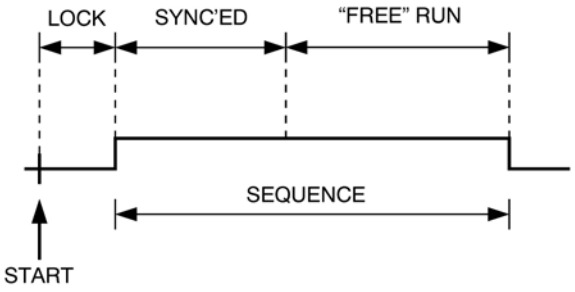

Figure 6.6: Timed synchronization

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 6.7: 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.

6.2.3 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.*

7 Hardware Connections

7.1 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.

7.1.1 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 7.1 gives an example of a light-to-TTL converter.

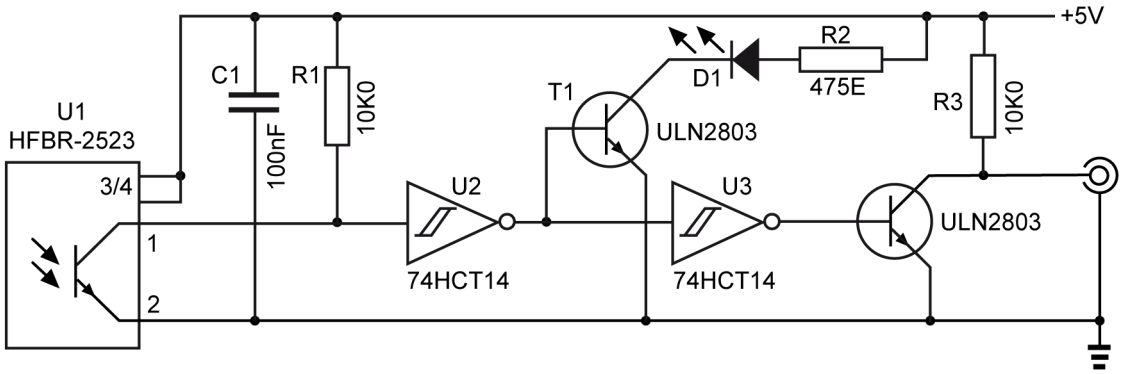

Figure 7.1: Schematic diagram of a light-to-TTL converter

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		

7.1.2 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 7.2 gives an example of a TTL-to-light converter.

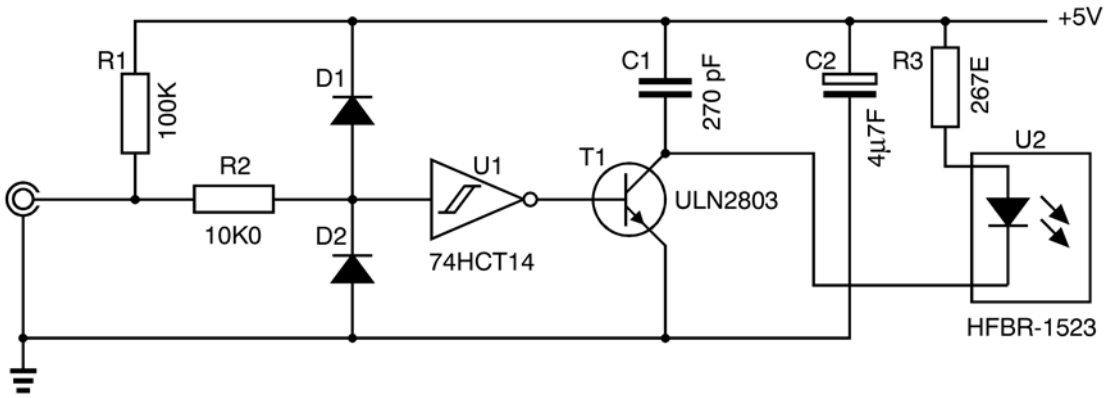

Figure 7.2: Schematic diagram of TTL-to-light converter

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	

7.1.3 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 7.3.

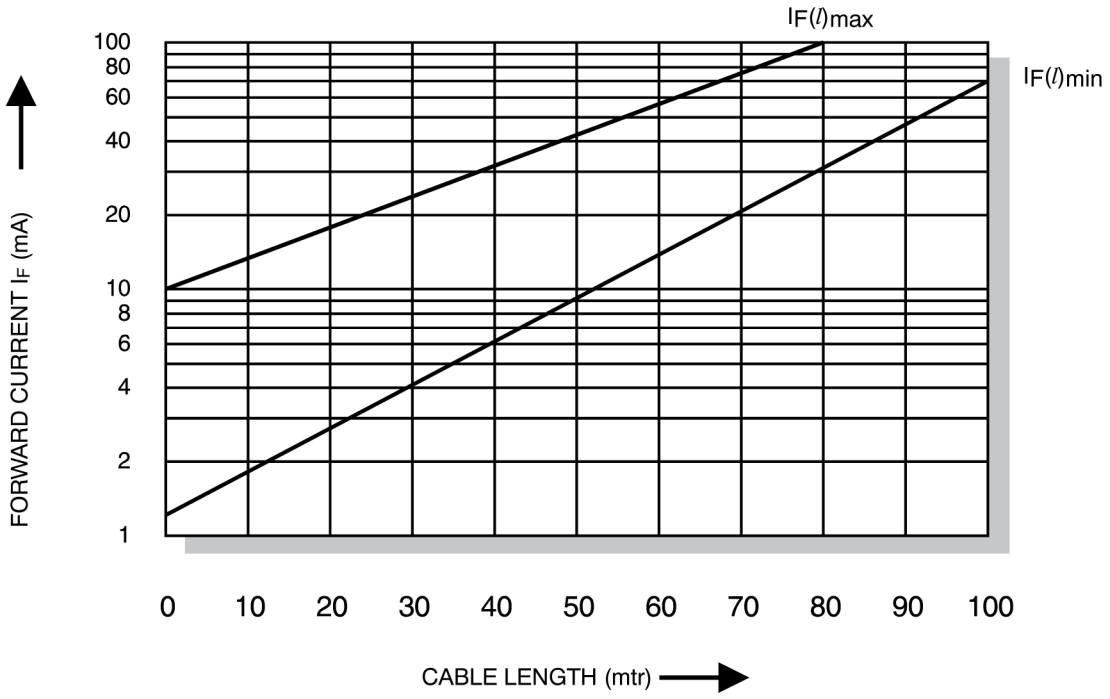

Figure 7.3: Typical HFBR-1523/2523 link performance

Figure 7.3 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 7.2). 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:

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

The following Figure 7.4 gives examples of valid current/length combinations.

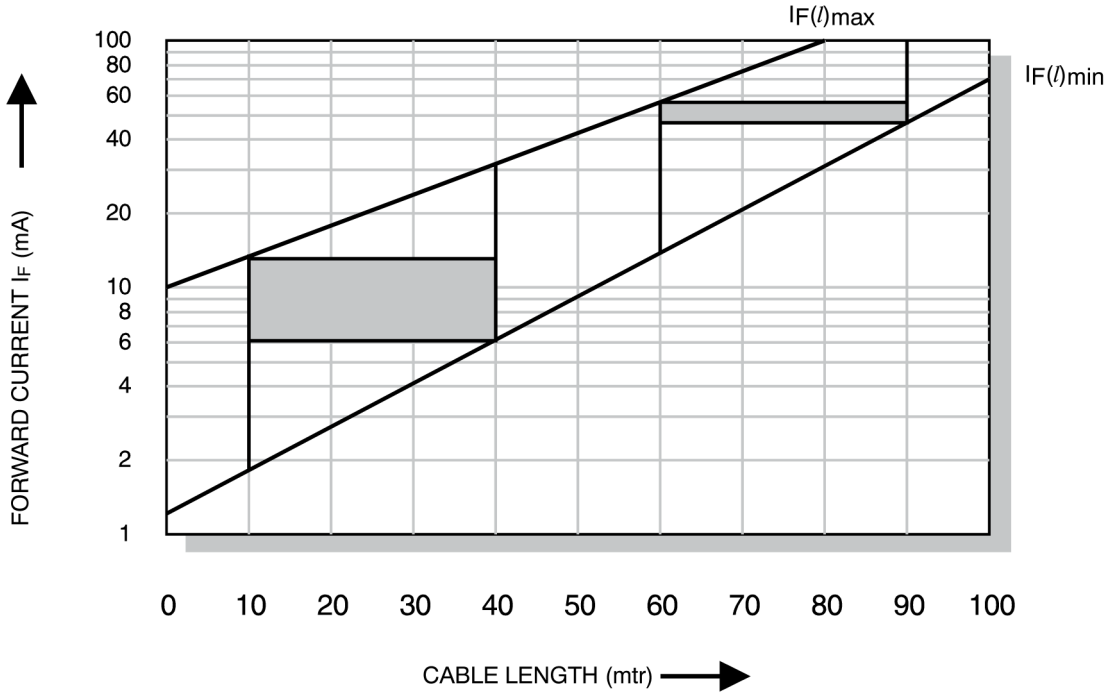

Figure 7.4: Examples of valid current/length selections

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

Refer to Figure 7.4. 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:

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

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

In Figure 7.4 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 7.3 "Typical HFBR-1523/2523 link performance" on page 58 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.*

7.1.4 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 7.5 is a simplified diagram of the opto-coupler isolated output section of a channel of the BE3200.

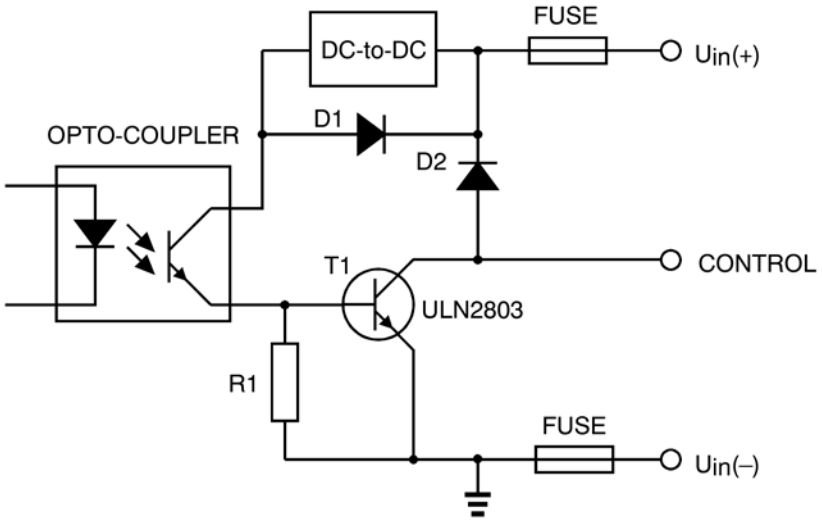

Figure 7.5: Schematic diagram of opto-coupled output

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 7.6.

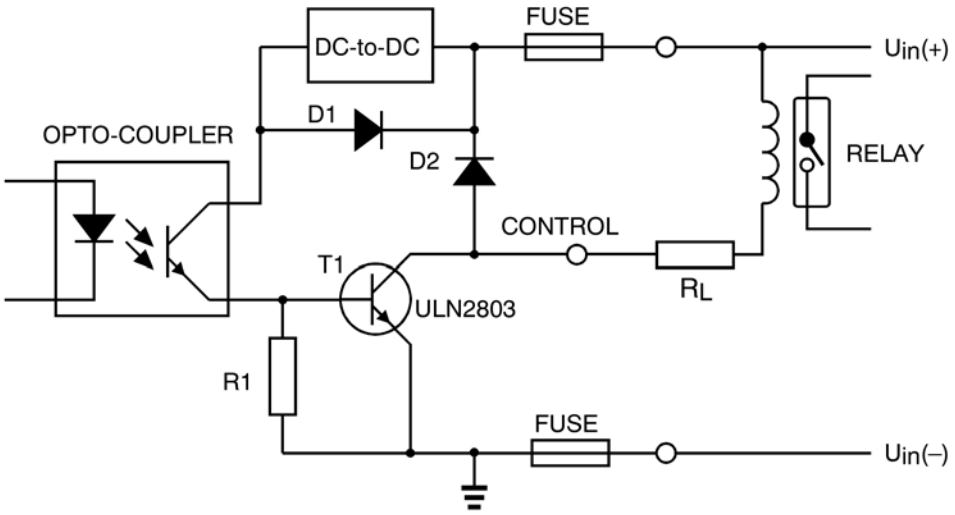

Figure 7.6: Opto-coupler relay drive example

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

8 Command language programming

8.1 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.

8.2 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.

8.3 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**	

8.4 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 (clk&zero), 2=gen1 (zero), 3=gen2(clk&zero), (clk&zero)	
	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

8.5 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: $2 \leq \mathbf{n} \leq 30000$	
	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: $1 \leq \mathbf{n} \leq 30000$

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: $0.0 \leq \mathbf{v,h} \leq 100.0$

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: $0 \leq \mathbf{n} \leq 359$

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	

8.6 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: $0 \leq \mathbf{c} \leq 50000$	
	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

8.7 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 Master/Slave

A.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 A.1.

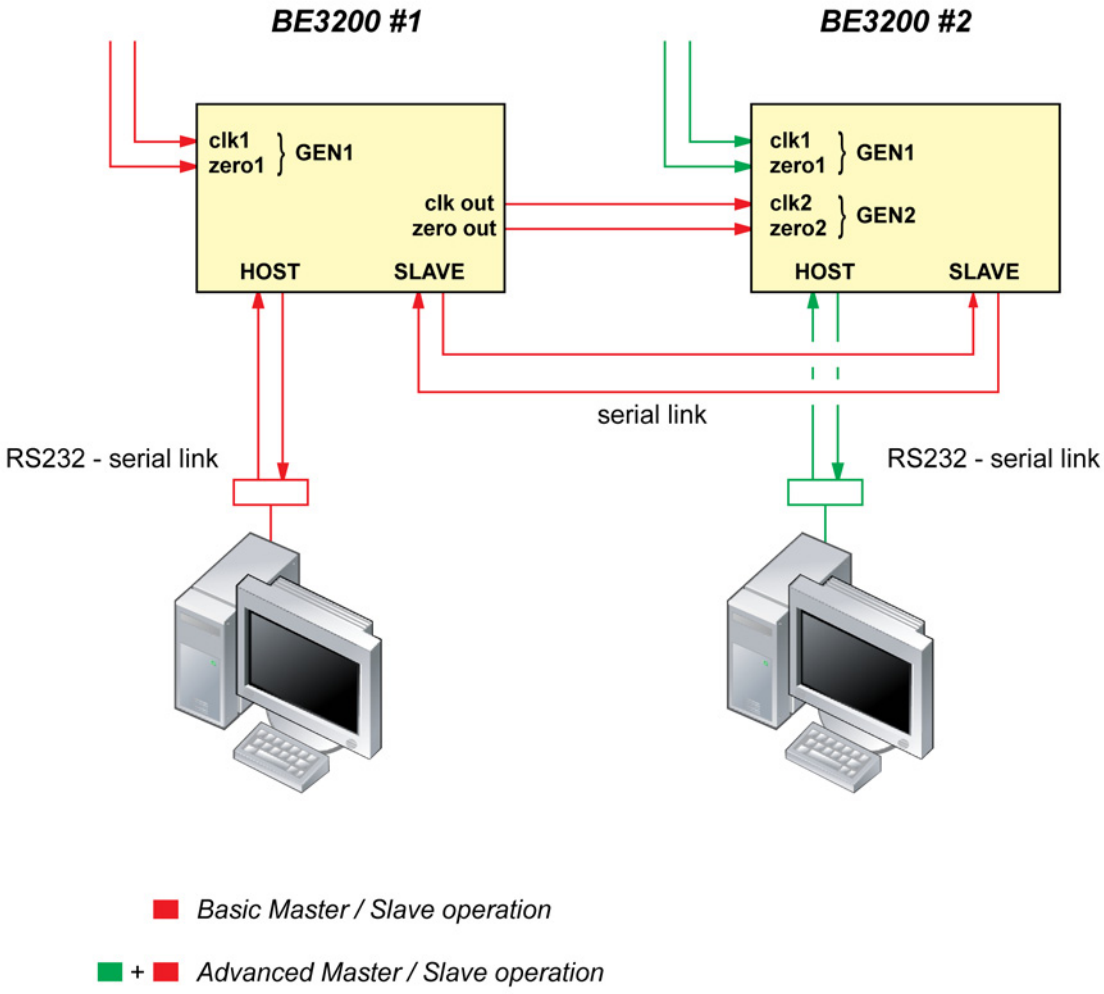

Figure A.1: Master/Slave operation

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.

B Serial communication link

B.1 Cabling

The serial communication link is equipped with one fiber-optic duplex cable assembly and one RS 232 USB convertor. Both parts can be obtained from HBM.

B.1.1 Fiber-optic cable

The fiber-optic duplex cable is assembled as shown in the diagram below.

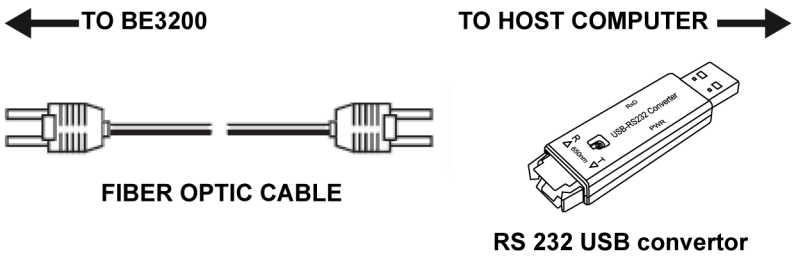

Figure B.1: Fiber-optic to USB communication link

C Interfacing the BE3200 with a GEN series system

C.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.

C.1.1 The Binary Marker channel HV board

The Binary marker HV board 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 board can communicate the current state of operation of the GEN series system with a BE3200 sequencer module.

The binary Marker board 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.

C.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 board. 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.

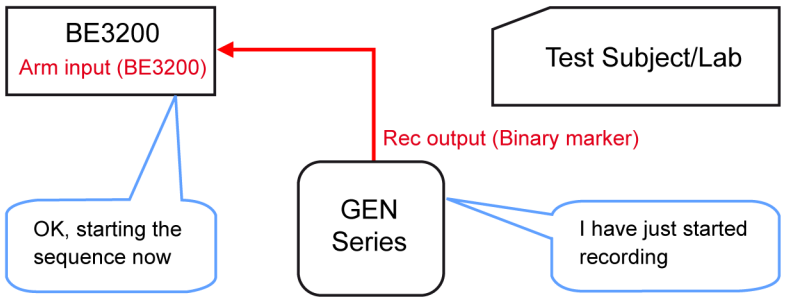

Figure C.1: Arm input

Using the Binary Marker HV board with the BE3200

Once the REC output of the Binary Markey HV board 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.

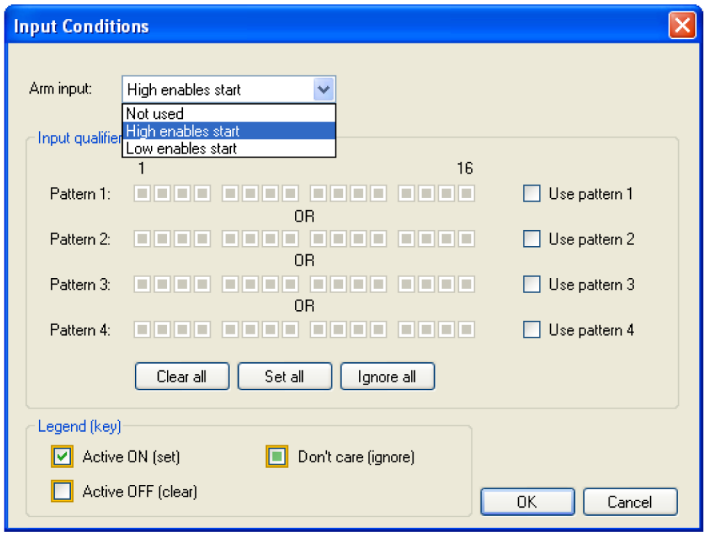

Figure C.2: Input conditions

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.

C.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.

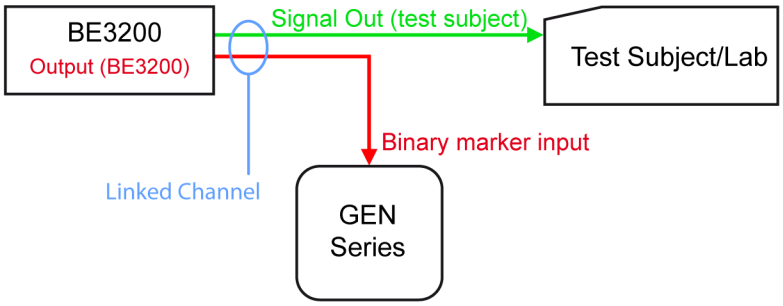

Figure C.3: Binary input configuration

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 board” 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.

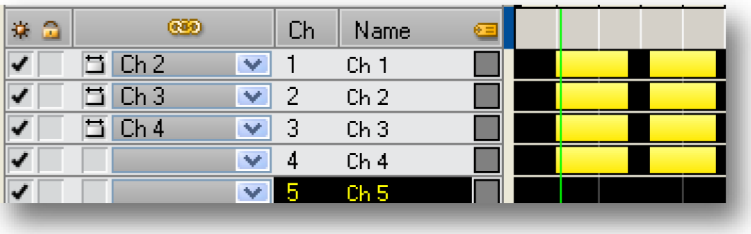

Figure C.4: Linking channels

Figure C.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.*

D Specifications

D.1 Physical/Environmental specifications

Physical/Environmental		
Component	**Unit Description**	**Value**
Dimensions	Width	483 x 425 x 177 mm (19.0" x 16.7" x 7.0")
	Diameter	
	Height	
	Rack mountable(1)	19"
Weight	Fully loaded	10 kg (22 lbs)
Power		86 – 264 VAC 47 – 440 Hz
	Maximum	75 VA
Battery	Automatic recharge system built-in. Backup with rechargeable NiCad battery:	12 VDC @ 6.5 Ahr
Altitude	Maximum operational altitude	2000 m (6100 ft)
Protection	IP Rating	IP20
Temperature	Operating	0 to 40 °C; 32 to 104 °F
	Storage	-25 to + 70 °C; -13 to 158 °F
Humidity	Non-condensing	0 to 80 %

(1) Optional 19 inch rack mount required

D.2 Fiber-optic I/O and open collector specifications

Fiber-optic I/O and open collector		
Component	**Unit Description**	**Value**
Sockets	Input: Hewlett-Packard HFBR-2523	
	Output: Hewlett-Packard HFBR-1523	660 nm LED
Connectors	Hewlett-Packard HFBR-4503 Simplex latching connector	
	Hewlett-Packard HFBR-4516 Duplex latching connector	
Drive	Control lines	10 to 60 meter
	Status and channel outputs	60 to 100 meter

Cable		
Component	**Unit Description**	**Value**
Type	Plastic, single step index, Hewlett-Packard HFBR-RXXYYY series	
Diameter	Core and cladding	1.00 mm
Attenuation		0.22 dB/m
Delay	Propagation delay constant	5.0 ns/m
Force	Short term tensile force	50 N max. (< 30 minutes)
	Long term tensile load	1 N max.
Bend radius	Short term	25 mm
	Long term	35 mm
Flexing	90° bend on 25 mm radius mandrel	1000 cycles

D.3 Synchronization specifications

Sources		
Component	**Unit Description**	**Value**
Sources	One of four sources can be selected: • Generator 1 (Clock and Zero) • Generator 1 (Zero) • Generator 2 (Clock and Zero) • Generator 2 (Zero) • Mains	

Generators		
Component	**Unit Description**	**Value**
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 to 70 Hz
Zero	Zero-index pulse once per cycle @ cycles ranging from	16 to 400 Hz

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

Internal		
Component	**Unit Description**	**Value**
	When synchronization is set to “none”, the internal clock is used.	
Frequency		16 to 400 Hz

Modes		
Component	**Unit Description**	**Value**
	The BE3200 provides four synchronization modes: ● Full synchronization: during the complete sequence the selected synchronization source is used. ● Timed: during a selectable first segment of the sequence the selected synchronization source is used. After this segment until the end of the sequence the last measured values are used ● Measured: during the complete sequence the measured values before the start of the sequence are used. ● None: no synchronization mode is used. The internal clock operates on the set frequency.	

Resolution and accuracy		
Component	**Unit Description**	**Value**
Resolution	All parameters can be set with a resolution of one (1) electrical degree with one cycle being 360 degrees - for synchronization frequencies	200 Hz
	Frequencies ranging	200 up to 400 Hz
	Resolution	2 Hz
Tracking	The BE3200 follows deviations of the input signals frequency	Up to 15% per second
	Minimum start frequency	16 Hz
	During the execution of the sequence the frequency may drop to	11 Hz
	Below this frequency the sequence switches to measured mode and the sequence is completed with an imaginary frequency	11 Hz

Resolution and accuracy				
Component	**Unit Description**		**Value**	
Accuracy	Accuracy is a function of frequency and synchronization mode The following Synchronization Accuracy part of the table gives a list of measured MAXIMUM deviation with various synchronization modes at two frequencies (cycles per second).			
	SYNCHRONIZATION ACCURACY			
	Mode	Synchronization on...	50 Hz	400 Hz
	Full	Clock & Zero	± 0.04 °	–
	Timed	Clock & Zero	± 0.5 °/ cycle	–
	Measured	none	± 0.025 °/ cycle	± 0.14 °/ cycle
	Full	Zero	± 0.12 °	± 0.4 °
	Timed	Zero	± 0.5 °/ cycle	± 0.5 °/ cycle
Interpretation	*Accuracy in degrees:* this is the maximum deviation at any time which will occur in the complete sequence. *Accuracy in degrees/cycle:* this is 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. When mains is selected as synchronization source you should use the Synchronization on ... Zero figures. When no external source is selected you should use the measured mode figures.			

Fast Repeat		
Component	**Unit Description**	**Value**
	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		
Component	**Unit Description**	**Value**
	The 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 $\leq$ 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.	

E Technical information

E.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.

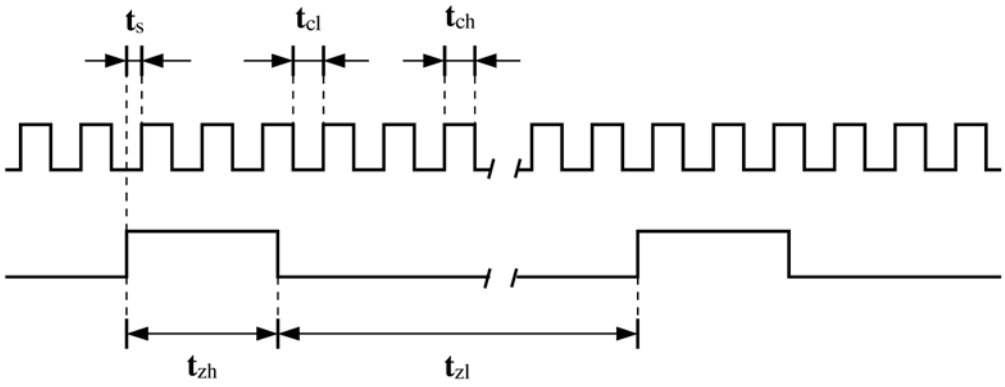

Figure E.1: Clock and zero synchronization parameters

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.

E.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.

E.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.

E.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.

F Maintenance and service

F.1 Service procedure

Products requiring maintenance should be returned to the factory or authorized service facility. If under warranty, HBM will repair or replace the product at no charge as set forth in the “One Year LimitedWarranty” at the beginning of this manual.

For all products in need of repair or maintenance after the warranty period, the customer must provide a Purchase Order Number before any inoperative equipment can be repaired or replaced. The customer will be billed for the parts and labor for the repair as well as for shipping.

All products returned for repair or maintenance should be identified by the model and serial numbers and include a description of the defect or failure, name and phone number of the user. Any returned goods should be shipped in the original packaging material. Returned goods that have not been packed in the original packing material and have been damaged in shipping will not be repaired under warranty.

F.2 Maintenance

Even the most advanced and sophisticated test instruments may suffer degraded performance if they are not properly maintained. HBM, as well as most other manufacturers, recommends annual maintenance of test instruments. Preventive maintenance certifies that our products meet all published specifications.

Maintenance can be done at HBM, an authorized service facility, or on-site by well-trained and qualified personnel. Contact HBM or your local dealer for more information on this topic.

The BE3200 contains no user-serviceable parts.

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