

I/O Box

General-purpose I/O Unit for stand-alone
use or use with:

MD29 Applications Card

UD70 Unidrive Applications Module

Part Number 0400-0023

Issue Number 1

Safety Information

Persons supervising and performing the electrical installation or maintenance of an I/O Box must be suitably qualified and competent in these duties. They should be given the opportunity to study and if necessary to discuss this User Guide before work is started.

The voltages present in the I/O Box are capable of inflicting a severe electric shock and may be lethal. The Stop function of the Drive does not remove dangerous voltages from the terminals of the I/O Box. AC supplies should be removed before any servicing work is performed.

The installation instructions should be adhered to. Any questions or doubt should be referred to the supplier of the equipment. It is the responsibility of the owner or user to ensure that the installation of the I/O Box, and the way in which it is operated and maintained complies with the requirements of the Health and Safety at Work Act in the United Kingdom and applicable legislation and regulations and codes of practice in the country in which the equipment is used.

General Information

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or use of the I/O Box.

The contents of this User Guide are believed to be correct at the time of printing. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance, or the contents of the User Guide, without notice.

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Control Techniques Drives Ltd
Author: RFD
Issue code 29bu1
Issue Date: April 1996
S/W Version: V2.0.0

Warnings, Cautions and Notes

Warning, Caution and Note paragraphs appear throughout the text in this instruction manual. These reminders are for the installers and operators of this equipment.



Warning

A Warning indicates that there may be danger, loss of life or personal injury unless the contents of the instruction are strictly observed.

Caution

A Caution indicates that there may be danger or damage to the equipment if the procedures and practices are not followed and strictly observed.

Note

A Note draws to the attention of the personnel using the equipment to information that will assist in their understanding of the equipment or its operation.

This manual contains important information affecting safety, in the following chapters:

Electric Shock Risk	<i>Electrical Installation</i>
Stored Electric Charge Risk	<i>Electrical Installation</i>
Fire Risk	<i>Electrical Installation</i>



Safety and operating instructions for drive converters

(In conformity with the low-voltage directive 73/23/EEC)

1. General

In operation, drive converters, depending on their degree of protection, may have live, uninsulated, and possibly also moving or rotating parts, as well as hot surfaces.

In case of inadmissible removal of the required covers, of improper use, wrong installation or maloperation, there is the danger of serious personal injury and damage to property. For further information, refer to the documentation.

All operations serving transport, installation and commissioning as well as maintenance are to be carried out by skilled technical personnel (Observe IEC 364 or CENELEC HD 384 or DIN VDE 0100 and national wiring regulations and accident prevention rules!).

For the purposes of these basic safety instructions, 'skilled technical personnel' means persons who are familiar with the installation, mounting, commissioning and operation of the product and have the qualifications needed for the performance of their functions.

2. Intended use

Drive converters are components designed for inclusion in electrical installations or machinery.

In case of installation in machinery, commissioning of the drive converter (i.e. the starting of normal operation) is prohibited until the machinery has been proved to conform to the provisions of the directive 89/392/EEC (Machinery Safety Directive – MSD). Account is to be taken of EN 60204.

Commissioning (i.e. the starting of normal operation) is admissible only where conformity with the EMC directive (89/336/EEC) has been established.

The drive converters meet the requirements of the low-voltage directive 73/23/EEC. They are subject to the harmonised standards of the series DIN VDE 0160 in conjunction with VDE 0660, part 500, and EN 60146/ VDE0558.

The technical data as well as information concerning the supply conditions shall be taken from the rating plate and from the documentation and shall be strictly observed.

3. Transport, storage

The instructions for transport, storage and proper use shall be complied with. The climatic conditions shall be in conformity with this manual.

4. Installation

The installation and cooling of the appliances shall be in accordance with the specifications in the pertinent documentation.

The drive converters shall be protected against excessive strains. In particular, no components must be bent or isolating distances altered in the course of transportation or handling. No contact shall be made with electronic components and contacts.

Drive converters contain electrostatic sensitive components which are liable to damage through improper use. Electric components must not be mechanically damaged or destroyed (potential health risks).

5. Electrical connection

When working on live drive converters, the applicable national accident prevention rules (eg. VBG 4) must be complied with. The electrical installation shall be carried out in accordance with the relevant requirements (eg. cross-sectional areas of conductors, fusing, PE connection). For further information, see documentation.

Instructions for the installation in accordance with EMC requirements, like screening, earthing, location of filters and wiring, are contained in the drive converter documentation. They must always be complied with, also for drive converters bearing a CE marking. Observance of the limit values required by EMC law is the responsibility of the manufacturer of the installation or machine.

6. Operation

Installations which include drive converters shall be equipped with additional control and protective devices in accordance with the relevant applicable safety requirements, eg. Act respecting technical equipment, accident prevention rules etc. Changes to the drive converters by means of the operating software are admissible.

After disconnection of the drive converter from the voltage supply, live appliance parts and power terminals must not be touched immediately because of possibly energised capacitors. In this respect, the corresponding signs and markings on the drive converter must be respected.

During operation, all covers and doors shall be kept closed.

7. Maintenance and servicing

The manufacturer's documentation shall be followed.

Keep safety instructions in a safe place!



Sicherheits – und Anwendungshinweise für Frequenzumrichter

(gemäß: Niederspannungsrichtlinie 73/23/EWG)

1. Allgemein

Während des Betriebes können Frequenzumrichter ihrer Schutzart entsprechend spannungsführende, blanke, gegebenenfalls auch bewegliche oder rotierende Teile, sowie heiße Oberflächen besitzen.

Bei unzulässigem Entfernen der erforderlichen Abdeckung, bei unsachgemäßem Einsatz, bei falscher Installation oder Bedienung, besteht die Gefahr von schweren Personen- oder Sachschäden. Weitere Informationen sind der Dokumentation zu entnehmen.

Alle Arbeiten zum Transport, zur Installation und Inbetriebnahme sowie zur Instandhaltung sind **von qualifiziertem Fachpersonal** auszuführen (IEC 364 bzw. CENELEC HD 384 oder DIN VDE 0100 und nationale Installations- und Unfallverhütungsvorschriften sind zu beachten).

Qualifiziertes Fachpersonal im Sinne dieser grundsätzlichen Sicherheitshinweise sind Personen, die mit Aufstellung, Montage, Inbetriebsetzung und Betrieb des Produktes vertraut sind und über die ihrer Tätigkeit entsprechenden Qualifikationen verfügen.

2. Bestimmungsgemäße Verwendung

Frequenzumrichter sind Komponenten, die zum Einbau in elektrische Anlagen oder Maschinen bestimmt sind.

Bei Einbau in Maschinen ist die Inbetriebnahme der Frequenzumrichter (d.h. die Aufnahme des bestimmungsgemäßen Betriebes) solange untersagt, bis festgestellt wurde, daß die Maschine den Bestimmungen der EG-Richtlinie 89/392/EWG (Maschinenrichtlinie) entspricht; EN 60204 ist zu beachten.

Die Inbetriebnahme (d.h. die Aufnahme des bestimmungsgemäßen Betriebes) ist nur bei Einhaltung der EMV-Richtlinie (89/336/EWG) erlaubt.

Die Frequenzumrichter erfüllen die Anforderungen der Niederspannungsrichtlinie 73/23/EWG. Die harmonisierten Normen der Reihe DIN VDE 0160 in Verbindung mit VDE 0660 Teil 500 und EN 60146/ VDE 0558 werden für die Frequenzumrichter angewendet.

Die technischen Daten sowie die Angaben zu Anschlußbedingungen sind dem Leistungsschild und der Dokumentation zu entnehmen und unbedingt einzuhalten.

3. Transport, Einlagerung

Die Hinweise für Transport, Lagerung und sachgemäße Handhabung sind zu beachten.

Klimatische Bedingungen sind entsprechend den Angaben in diesem Handbuch einzuhalten.

4. Aufstellung

Die Aufstellung und Kühlung der Geräte muß entsprechend den Vorschriften der zugehörigen Dokumentation erfolgen.

Die Frequenzumrichter sind vor unzulässiger Beanspruchung zu schützen. Insbesondere dürfen bei Transport und Handhabung keine Bauelemente verbogen und/oder Isolationsabstände verändert werden. Die Berührung elektronischer Bauelemente und Kontakte ist zu vermeiden.

Frequenzumrichter enthalten elektrostatisch gefährdete Bauelemente, die leicht durch unsachgemäße Behandlung beschädigt werden können. Elektrische Komponenten dürfen nicht mechanisch beschädigt oder zerstört werden (unter Umständen Gesundheitsgefährdung!).

5. Elektrischer Anschluß

Bei Arbeiten an unter Spannung stehenden Frequenzumrichtern sind die geltenden nationalen Unfallverhütungsvorschriften (z.B. VBG 4) zu beachten.

Die elektrische Installation ist nach den einschlägigen Vorschriften durchzuführen (z.B. Leitungsquerschnitte, Absicherungen, Schutzleiteranbindung). Darüber hinausgehende Hinweise sind in der Dokumentation enthalten.

Hinweise für die EMV-gerechte Installation – wie Schirmung, Erdung, Anordnung von Filtern und Verlegung der Leitungen – befinden sich in der Dokumentation der Frequenzumrichter. Diese Hinweise sind auch bei CE-gekennzeichneten Frequenzumrichtern stets zu beachten. Die Einhaltung der durch die EMV-Gesetzgebung geforderten Grenzwerte liegt in der Verantwortung des Herstellers der Anlage oder Maschine.

6. Betrieb

Anlagen, in die Frequenzumrichter eingebaut sind, müssen ggf. mit zusätzlichen Überwachungs- und Schutzeinrichtungen gemäß den jeweils gültigen Sicherheitsbestimmungen, z.B. Gesetz über technische Arbeitsmittel, Unfallverhütungsvorschriften usw. ausgerüstet werden. Veränderungen der Frequenzumrichter mit der Bediensoftware sind gestattet.

Nach dem Trennen der Frequenzumrichter von der Versorgungsspannung dürfen spannungsführende Geräteteile und Leistungsanschlüsse wegen möglicherweise aufgeladener Kondensatoren nicht sofort berührt werden. Hierzu sind die entsprechenden Hinweisschilder auf dem Frequenzumrichter zu beachten.

Während des Betriebes sind alle Abdeckungen und Türen geschlossen zu halten.

7. Wartung und Instandhaltung

Die Dokumentation des Herstellers ist zu beachten.

Diese Sicherheitshinweise sind aufzubewahren!



Instructions de sécurité et d'emploi relatives aux convertisseurs d'entraînement

(conformes à la directive Basse Tension 73/23/CEE)

1. Généralités

Selon leur degré de protection, les convertisseurs d'entraînement peuvent comporter, pendant leur fonctionnement, des parties nues sous tension, éventuellement en mouvement ou tournantes, ainsi que des surfaces chaudes.

L'enlèvement non admis de recouvrements prescrits, l'usage non conforme à la destination, une installation défectueuse ou une manoeuvre erronée peuvent entraîner des dangers de dommages corporels et matériels graves.

Pour informations complémentaires, consulter la documentation.

Tous travaux relatifs au transport, à l'installation, à la mise en service et à la maintenance doivent être exécutés par du personnel qualifié et habilité (voir CEI 364 ou CENELEC HD 384, ou DIN VDE 100 et, ainsi que les prescriptions d'installation et de prévention d'accidents nationales).

Au sens des présentes instructions de sécurité fondamentales, on entend par personnel qualifié des personnes compétentes en matière d'installation, de montage, de mise en service et de fonctionnement du produit et possédant les qualifications correspondant à leurs activités.

2. Utilisation conforme à la destination

Les convertisseurs d'entraînement sont des composants destinés à être incorporés dans des installations ou machines électriques.

En cas d'incorporation dans une machine, leur mise en service (c'est-à-dire leur mise en fonctionnement conformément à leur destination) est interdite tant que la conformité de la machine avec les dispositions de la Directive 89/392/CEE (directive sur les machines) n'a pas été vérifiée; respecter la norme EN 60024.

Leur mise en service (c'est-à-dire leur mise en fonctionnement conformément à leur destination) n'est admise que si les dispositions de la Directive sur la compatibilité électromagnétique (89/336/CEE) sont respectées.

Les convertisseurs d'entraînement répondent aux exigences de la Directive Basse Tension 73/23/CEE. Les normes harmonisées de la série DIN VDE 0160 en connexion avec la norme VDE 0660, partie 500 et EN 60146/ VDE 0558 leur sont applicables.

Les caractéristiques techniques et les indications relatives aux conditions de raccordement selon la plaque signalétique et la documentation doivent obligatoirement être respectées.

3. Transport, stockage

Les indications relatives au transport, au stockage et au maniement correct doivent être respectées.

Les conditions climatiques spécifiées dans le manuel technique doivent être respectées.

4. Installation

L'installation et le refroidissement des appareils doivent répondre aux prescriptions de la documentation fournie avec le produit.

Les convertisseurs d'entraînement doivent être protégés contre toute contrainte inadmissible. En particulier, il ne doit y avoir déformation de pièces et/ou modification des distances d'isolement des composants lors du transport et de la manutention. Il doit être évité de toucher les composants électroniques et pièces de contact.

Les convertisseurs d'entraînement comportent des pièces sensibles aux contraintes électrostatiques et facilement endommageables par un maniement inadéquat. Les composants électriques ne doivent pas être endommagés ou détruits mécaniquement (le cas échéant, risques pour la santé!)

5. Raccordement électrique

Lorsque des travaux sont effectués sur le convertisseur d'entraînement sous tension, les prescriptions pour la prévention d'accidents nationales doivent être respectées (par exemple VBG 4).

L'installation électrique doit être exécutée en conformité avec les prescriptions applicables (par exemple sections des conducteurs, protection par coupe-circuit à fusibles, raccordement du conducteur de protection). Des renseignements plus détaillés figurent dans la documentation.

Les indications concernant une installation satisfaisant aux exigences de compatibilité électromagnétique, tels que blindage, mise à la terre, présence de filtres et pose adéquate des câbles et conducteurs) figurent dans la documentation qui accompagne les convertisseurs d'entraînement. Ces indications doivent être respectées dans tous les cas, même lorsque le convertisseur d'entraînement porte le marquage CE. Le respect des valeurs limites imposées par la législation sur la CEM relève de la responsabilité du constructeur de l'installation ou de la machine.

(Continu...)

6. Fonctionnement

Les installations dans lesquelles sont incorporés des convertisseurs d'entraînement doivent être équipées des dispositifs de protection et de surveillance supplémentaires prévus par les prescriptions de sécurité en vigueur qui s'y appliquent, telles que la loi sur le matériel technique, les prescriptions pour la prévention d'accidents, etc. Des modifications des convertisseurs d'entraînement au moyen du logiciel de commande sont admises.

Après la séparation du convertisseur de l'alimentation, les parties actives de l'appareil et les raccordements de puissance sous tension ne doivent pas être touchés immédiatement, en raison de condensateurs éventuellement chargés. Respecter à cet effet les pancartes d'avertissement fixées sur les convertisseurs d'entraînement.

Pendant le fonctionnement, tous les portes et recouvrements doivent être maintenus fermés.

7. Entretien et maintenance

La documentation du constructeur doit être prise en considération.

Conserver ces instructions de securite!

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1 Description

The I/O Box is an expansion I/O unit for analog and digital inputs and outputs. It can be used with an MD29 Applications Card, a UD70 Unidrive Applications Module, or used as a stand-alone unit.

When used with an MD29 card or UD70 module, the I/O Box is controlled by the card or module; when used as a stand-alone unit, it should be controlled by a host computer or PLC. In both cases, a serial communications link is used.

Features

- 5 analog inputs
- 3 analog outputs
- 8 digital inputs
- 8 digital outputs
- Digital I/O expandable to 32 inputs and 32 outputs
- Up to 15 I/O Boxes can be controlled on one serial communications link
- 100 metres (330 feet) maximum serial-communications cable length
- AC supply range: 110V to 240V $\pm 10\%$
- DIN-rail mounting

2 Data



Warning

The voltages present in the I/O Box are capable of inflicting a severe electric shock and may be lethal.

AC supplies to the I/O Box must be disconnected at least five minutes before any cover is removed or servicing work is performed.

Power supply

AC supply: 110V to 240V $\pm 10\%$, single-phase

Maximum power consumption: 9 Watts

Ingress protection

In accordance with IP00

Ambient temperature and humidity

Ambient temperature range:

0°C to +40°C (32°F to 104°F) non-condensing

Analog inputs

12-bit analog input

Quantity: 1

Software selectable for -10V to $+10\text{V}$ or 4 to 20mA

10-bit analog inputs

Quantity: 4

Impedance: 100k Ω

Range: -10V to $+10\text{V}$

Analog signals are converted by analog-to-digital converters.

Digital inputs

Quantity: 8
Circuit voltage: +24V
Input impedance: 10k Ω

Logic sense

Selectable logic sense
Default: Negative

Switching levels

Logic state	Input state	Voltage
High	Open-circuit	> +15V
Low	Short-circuit	< +5V

Digital expansion inputs

Quantity: 24
Circuit voltage: +5V
Input impedance: 10k Ω

Logic sense

Negative

Switching levels

Logic state	Input state	Voltage
High	Open-circuit	>+2.5V
Low	Short-circuit	<+0.8V

Cable length

External buffer	Maximum cable length
Not used	0.5 metre (1.5 feet)
Used	Limited by buffer

Output signals

Quantity	Type	Maximum current	Voltage
3	10-bit analog	5mA	−10V to +10V
8	Digital open collector	100mA	+24V
24	Digital expansion	20mA	+5V

Analog outputs are short-circuit protected.

External buffering is required if the cable length exceeds 0.5 metre (1.5 feet).

DC supplies

Relay supply

Output voltage: +24V $\pm$ 10%

Maximum current: 200mA

Latching over-current trip protected

Reference voltage

Output voltages: −10V and +10V $\pm$ 2%

Maximum current: 10mA

Serial communications

Optically isolated RS485 four-wire differential serial communications having high noise immunity and high common-mode rejection.

The protocol can be selected from:

ANSI x 3.28 – 2.5 – A4

MD29 mode

Mode	Baud rate
ANSI	2400
ANSI	4800
ANSI	9600
MD29	38400

Update rate

When using an MD29 Applications Card: Every 3.5ms

When using a UD70 Applications Module: Synchronized to the CLOCK or ENCODER task depending on the setting of parameter **17.16**.

Overall dimensions

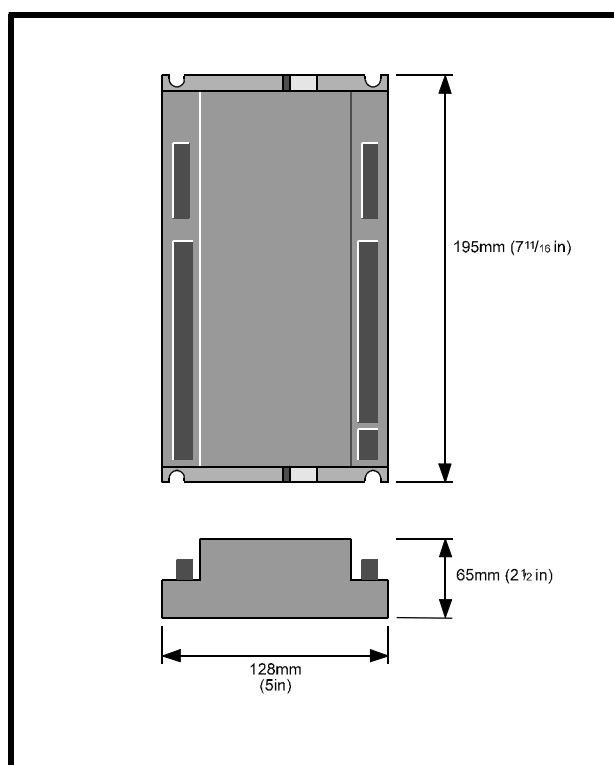


Figure 1 **Overall dimensions of the I/O Box**

3 Mechanical Installation



Warning

The equipment enclosure is rated at IP00 in accordance with IEC539. It is designed for installation within a protective enclosure which prevents unauthorised access except for trained service personnel, and prevents contamination with conductive dust and condensation.

3.1 Mounting location

Choose a location that is free from excessive dust, corrosive vapours, gases and all liquids, including condensation of atmospheric moisture.

If condensation is likely to occur when the I/O Box is not in use, install an anti-condensation heater. This heater must be switched off when the I/O Box is in use; automatic switching is recommended.

Observe the requirements for ambient temperature if the I/O Box is to be mounted directly above any heat generating equipment such as a Drive.

Do not locate the I/O Box in a classified hazardous area, unless the I/O Box is installed in an approved enclosure and the installation is approved.

3.2 Installing the I/O Box

Use either of the following installation methods:

- Mounting on a 35mm DIN-rail
- Surface-mounted

DIN-rail mounting

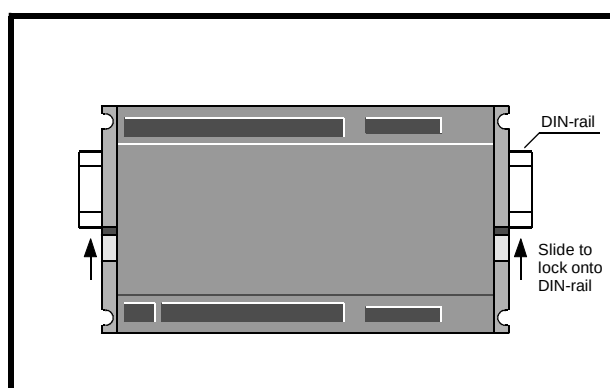


Figure 2 *DIN-rail mounting of the I/O Box*

Locate the channel on the underside of the I/O Box over the DIN-rail. Push the slide catch at each end of the I/O Box upward to lock the box onto the DIN-rail.

Surface mounting

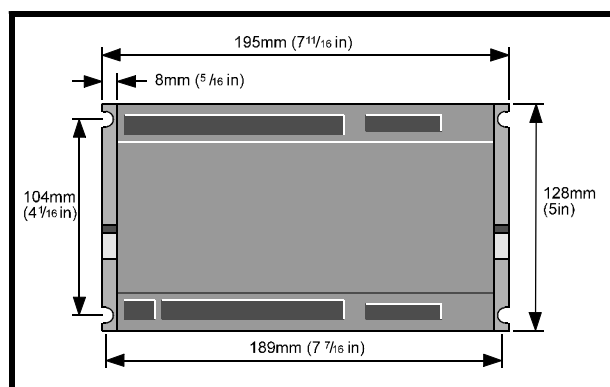


Figure 3 *Surface mounting of the I/O Box*

Use four M5 screws to retain the flange at each end of the I/O Box to the mounting surface.

4 Electrical Installation

**Warning****Electric shock risk**

The voltages present in the I/O Box can cause severe electric shock and may be lethal.

If the I/O Box has been energized, the AC supply must be isolated at least five minutes before work may continue. Refer to Safety Information on the inside of the front cover of this User Guide.

4.1 AC supply connections

**Warning**

The AC supply to the I/O Box must be fitted with suitable protection against overload and short circuits. Failure to observe the recommendation for fuse rating will cause a risk of fire.

**Warning**

Wiring must be in accordance with local regulations and codes of practice.

Make the AC supply connections as follows:

Supply connection	Connector	Terminal
Live	PL5	1
Neutral	PL5	2
Ground	PL3	6

See Figure 4. Connect terminal 1 of **PL5** to the live connection of the AC supply through an isolation switch and a 3A fuse.

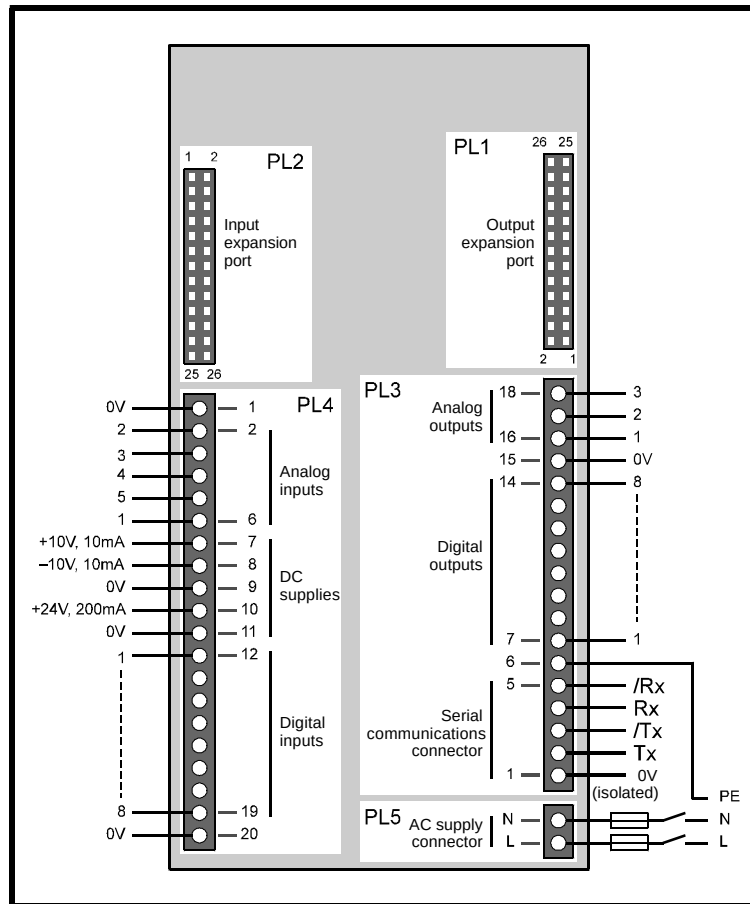


Figure 4 AC supply and signal connections

4.2 Signal connections



Warning

For safety, the 0V-common signal connection must be connected to safety ground.

Alternatively, a second isolation barrier must be used for making signal connections to the signal connectors.

Make signal connections as shown in Figure 4.

Expansion ports

Output port PL1

Input port PL2

Make connections as follows:

Terminal	Function	Terminal	Function
1	0V	2	I/O 31
3	+5V*	4	I/O 32
5	I/O 28	6	I/O 27
7	I/O 29	8	I/O 26
9	I/O 25	10	I/O 30
11	I/O 16	12	I/O 15
13	I/O 14	14	I/O 13
15	I/O 12	16	I/O 11
17	I/O 10	18	I/O 09
19	I/O 24	20	I/O 23
21	I/O 22	22	I/O 21
23	I/O 20	24	I/O 19
25	I/O 18	26	I/O 17

* It is not recommended to use this as a supply for external devices (maximum output current: 50mA)

Maximum cable length: 1 metre (3 feet)

Serial Communications connections

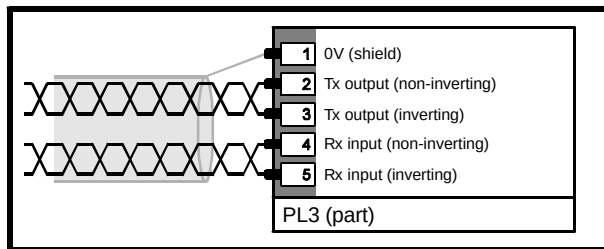


Figure 5 **Serial communications connections**

Use 5-wire shielded twisted-pair cable.

Maximum cable length: 100m (330 feet).

Connect the cable shield to ground using a low-impedance path.

When using an **RS485** multidrop link, a terminating resistor **must** be connected to the Drive that is farthest away from the host computer. A typical value for the resistor is 120Ω, 0.25 Watt.

Connecting to an MD29 Applications Card

The connections to the MD29 card depend on the protocol that is required. When the MD29 card is required to control one I/O Box using high-speed (not ANSI) protocol, make the serial communications connections to **TB1** on the MD29 card.

When the MD29 card is to control more than one I/O Box using ANSI protocol, make the serial communications connections to **PL1** on the MD29 card. For more information, see Chapter 5 *Configuring the I/O Box*.

Make the following connections to **TB1** along the lower edge of the MD29 card:

PL3	MD29 connector
1	1
2	2
3	3
4	4
5	5

Connecting to a UD70 Applications Module

Make serial communications connections to connector D (RS485 port) of the UD70 module. On the UD70 module, select Mode 10 communications for high-speed (not ANSI) protocol.

PL3	UD70 connector
1	1
2	7
3	3
4	6
5	2

Connecting to a host computer

Four-wire mode only can be used, as shown in Figure 5. The protocol used must be ANSI.

5 Configuring the I/O Box

5.1 Selecting the logic sense

The logic sense of the digital inputs can be set at positive or negative. Set the logic sense as required using jumper PL6.

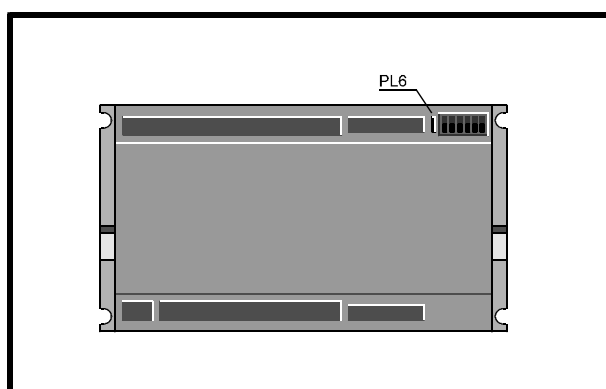


Figure 6 **Location of jumper PL6**

Jumper position	Logic sense
Off	Negative
On	Positive

5.2 Selecting the method of controlling the I/O Box

The controller can be any of the following:

- MD29 Applications Card
- UD70 Applications Module
- Host computer or PLC

The following control options are possible:

Controller	Protocol	Max. No. of I/O Boxes	Notes
MD29	MD29/UD70 mode	1	High speed
MD29	ANSI	15	Lower speed
UD70	MD29/UD70 mode	1	High speed
UD70	ANSI	15	Lower speed
Host	ANSI	15	Lower speed

When the MD29/UD70 mode is used, ensure that configuration switches 1 to 4 are set at ON (See *Address* later in this chapter). When an MD29 card or UD70 module is used to control more than one I/O Box, a controlling program will need to be written for the MD29 card or UD70 module.

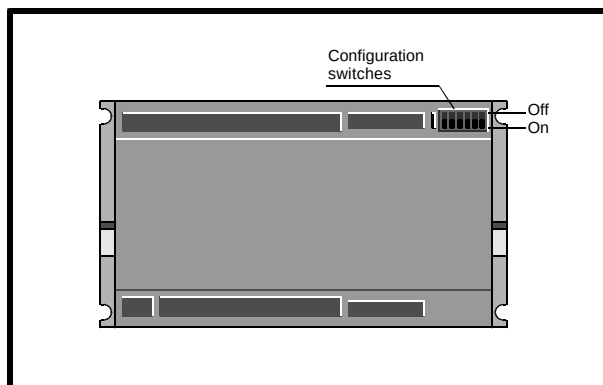


Figure 7 **Location of the configuration switches**

Use the configuration switches on the I/O Box to select the following:

- Serial communications address
- Baud rate

Address

Use configuration switches 1 to 4 to select MD29 mode or the required address of the I/O Box, as follows:

Switch number				Address	
4	3	2	1		
On	On	On	On	MD29 mode	Default
On	On	On	Off	11	
On	On	Off	On	12	
On	On	Off	Off	13	
On	Off	On	On	14	
On	Off	On	Off	15	
On	Off	Off	On	16	
On	Off	Off	Off	17	
Off	On	On	On	18	
Off	On	On	Off	19	
Off	On	Off	On	20	
Off	On	Off	Off	21	
Off	Off	On	On	22	
Off	Off	On	Off	23	
Off	Off	Off	On	24	
Off	Off	Off	Off	25	

Baud rate

Use configuration switches 5 and 6 to select the Baud rate of the I/O Box, as follows:

Switch number		Baud rate	
5	6		
Off	Off	2400	Default
Off	On	4800	
On	Off	9600	
On	On	Unused	

6 Operating Instructions

6.1 Using parameters

Each input and output of the I/O Box has a parameter associated with it. By accessing this parameter, the following can be performed:

- Read a value that is applied to an input
- Write a value to be applied to an output

In addition to being accessed individually, the digital inputs and outputs can be accessed in groups of 8, 16 or 24.

Use the following format to access a parameter:

menu.parameter

The menu defines the parameter category, as follows:

Menu number	Category
80	Analog inputs
81	Analog outputs
82	Digital inputs
83	Digital outputs
84	Control menu

Unit-normal indicator

Parameter **84.10** indicates the condition of the I/O Box, as follows:

Condition of data	State of 84.10
Normal	0
Faulty	1

When using the I/O Box from a controller other than an MD29, use the controller to check the integrity of received data by regularly monitoring the state of **84.10**. Should a fault occur, failure to make this check could result in wrong data being read or written.

Analog input parameters

Use the specified parameters to access the analog inputs, as follows:

Analog input	PL4 terminal	Parameter	Input signal range	Input signal resolution
1	6	80.01	±4000	12-bit
2	2	80.02	±1000	10-bit
3	3	80.03	±1000	10-bit
4	4	80.04	±1000	10-bit
5	5	80.05	±1000	10-bit

Note

Use parameter 84.01 to program Analog input 1 to operate in voltage or current mode.

Analog output parameters

Use the specified parameters to access the analog outputs, as follows:

Analog output	PL3 terminal	Parameter	Output signal range	Output signal resolution
1	16	81.01	±1000	10-bit
2	17	81.02	±1000	10-bit
3	18	81.03	±1000	10-bit

Digital input parameters

Use the specified parameters to access the digital inputs, as follows:

Digital input	PL4 terminal	Parameter
1	12	82.01
~	~	82.~
8	19	82.08

Digital output parameters

Use the specified parameters to access the digital outputs, as follows:

Digital output	PL3 terminal	Parameter
1	7	83.01
~	~	83.~
8	14	83.08

Expansion ports parameters

Use the parameters specified in the following table to access the terminals of the expansion ports.

PL1 outputs: Use parameters: 83.XX

PL2 inputs: Use parameters: 82.XX

Terminal	Parameter number	Terminal	Parameter number
1		2	.31
3		4	.32
5	.28	6	.27
7	.29	8	.26
9	.25	10	.30
11	.16	12	.15
13	.14	14	.13
15	.12	16	.11
17	.10	18	.09
19	.24	20	.23
21	.22	22	.21
23	.20	24	.19
25	.18	26	.17

Logic states

Digital inputs 1 to 8 (PL4)

The relationship between the state of the terminal and the parameter value is as follows:

input state	Parameter value
Inactive	0
Active	1

The selected logic sense (using jumper 8) determines the voltage level required to make a terminal active or inactive.

Digital outputs 1 to 8 (PL3)

These are open-collector outputs. When the associated parameter is set at 1, the output transistor is switched on.

Default state: Off

Parameter value	Output state
0	Not conducting
1	Conducting

Digital inputs 9 to 32 (PL2)

Logic sense: Positive (TTL)

Logic state	Signal level
0	0V
1	5V or not connected

Digital outputs 9 to 32 (PL1)

Logic sense: Positive (TTL)

6.2 Control menu

Parameter	Function	Setting
84.01	4–20mA select	0 = Voltage mode 1 = 4–20mA mode
84.02	Reset +24V supply	Set at 1
84.10	Drive trip indicator	0 = Drive in normal operation 1 = Drive has tripped
84.11	+24V supply trip indicator	0 = +24V supply in normal state 1 = +24V supply has tripped
84.12	PSU trip indicator	0 = PDU in normal state 1 = PSU has tripped

+24V supply

When current drawn from the +24V terminal or the digital outputs exceeds the 200mA limit, the +24V supply trips.

To restore the +24V supply, remove the cause of the trip and set parameter **84.02** at 1.

Power supply unit

The power supply unit trips when a fault occurs on any of the following supplies:

- +5V
- ±10V
- ±15V

The **Drive trip** indicator (parameter **84.10**) shows the combination of parameters **84.11** and **84.12**. If either of these indicates that a trip has occurred, parameter **84.10** is set at 1.

6.3 Addressing digital inputs and outputs in groups

Use the following parameters to communicate with inputs or outputs in groups of 8, 16 or 24.

Parameter	Digital Inputs (Menu 82)	Digital Outputs (Menu 83)
40	Inputs 1–8	Outputs 1–8
41	Inputs 9–16	Output 9–16
42	Inputs 17–24	Outputs 17–24
43	Inputs 25–32	Outputs 25–32
44	Inputs 1–15	Outputs 1–15
45	Inputs 16–32	Outputs 16–32
46	Inputs 9–32	Outputs 9–32

6.4 Accessing the I/O Box parameters using an applications card/module

The parameters of the I/O Box are accessed using the `#menu.parameter` command, as shown below:

```
#80.01 = 500          // Set the signal level on analogue  
                      output 1 at +500  
input2% = #81.02      // Apply the signal level on analogue  
                      input 2 to parameter 81.02
```

When control of the I/O Box is attempted using an MD29 card, and the link between the I/O Box and the MD29 Applications Card is not functioning, the MD29 Applications Card will cause the host Drive to be tripped. Possible causes for the link not to function are as follows:

- Connecting cable failure
- I/O Box not correctly set-up

See the MD29 Applications Card User Guide or the *UD70 Applications Module User Guide* for further information.

Example commands

```
speed% = #80.01          // read in high resolution analog
                           input 1

#91.3 = speed%           // write to high resolution speed on
                           Mentor II

ratio% = BCD2BIN(#82.46) // read in ratio from BCD
                           thumbwheel switches connected
                           // to the input expansion port, and
                           convert to a binary value.

#83.46 = BCD2SEG(value%) // converts value% to seven-
                           segment display data and output
                           // to output expansion port.

INITIAL{
#84.01 = 1                // enable 4–20mA mode on ADC1.
}

BACKGROUND{
top:
IF #84.10 = 1 THEN        // is the I/O Box normal?
    #10.35 = 128          // trip the drive
ELSE
    c% = #80.01 / 4       // read in 4–20mA input
                           // 4mA = 0, 20mA = 1000
    speed% = 1000 – c%    // convert for 20–4mA
    #16.06 = speed%       // write to parameter 16.06
ENDIF
goto top:
}
```

7 Serial Communications

7.1 Message structure

The data format is as follows:

- 7 data bits
- 1 start bit
- 1 stop bit
- Even parity

The I/O Box communicates using message packets. Each message starts with a control character, and may contain additional control characters. In addition to the control characters, messages contain the following:

- Address code
- Parameter identifier
- Data field
- Block checksum (BCC)

The message structure is based on the following:

	Address					Parameter				Data						
EOT	1	1	2	2	STX	8	1	0	2	+	3	4	.	5	ETX	BCC

7.2 Control characters

When initiating messages from a keyboard, enter control characters by holding down the Ctrl key while pressing the key shown in the last column of the following table:

Character	Purpose	ASCII code (HEX)	Key
EOT	Reset Message begins End of transmission	04	D
ENQ	Enquiry Interrogating the I/O Box	05	E
STX	Start of text	02	B
ETX	End of text	03	C
ACK	Acknowledge (Message accepted)	06	F
BS	Backspace (Go to previous parameter)	08	H
NAK	Negative acknowledge (Message not understood)	15	U

7.3 Address code

The format of the address requires each digit of the two-digit address to be repeated once. For example, the address of I/O Box number 23 is sent as the following four characters:

2 2 3 3

The address code immediately follows the first control character of the message (usually EOT).

It is possible to communicate with all I/O Boxes using the global address 00. In this case, the I/O Boxes will carry out *write* requests, but will not send a reply. A *read* request will result in a reply. If more than one I/O Box is on a link, the replies will conflict, resulting in meaningless received data.

The I/O Box does not allow group addressing to be used.

7.4 Parameter identifier

To address an individual parameter, the host needs to send the menu and parameter number. For example:

To address parameter: **02** in menu **81**

Send: **8102**

7.5 Data field

Data to be sent or requested must immediately follow the parameter number. The data field can be 2 to 6 characters in length.

The data is normally expressed as a decimal value, but in some cases the hexadecimal format is used. The first character of the data field (D1) must be one of the following:

Character	Indicates
Space (32 decimal)	Positive value
+	Positive value
–	Negative value
X	Hexadecimal value

7.6 Block checksum

The block checksum character (BCC) is used to check that messages containing data have not been corrupted when being sent. The BCC is a value that is calculated from the ASCII codes of the characters as follows:

Excluded from calculation						Included in calculation										
		Address						Parameter			Data					
EOT	1	1	2	2	STX	8	1	0	2		3	4	.	5	ETX	BCC

The BCC is calculated by successively applying an exclusive-OR (XOR) function to the ASCII codes of the characters in the message after the **STX** control character.

Example

This example shows how the BCC is calculated for the following command:

Set DAC output 2 at -345

The first character of the BCC calculation is **8** (00110000 in binary). This value is taken as the *result* value. The next character is **1** (00110001 in binary), which is passed through the XOR function along with the previous result value. The result is 00001001 in binary.

The complete calculation is shown in the table below:

Character	Binary Value	XOR result
8	0011 1000	
1	0011 0001	0000 1001
0	0011 0000	0011 1001
2	0011 0010	0000 1011
-	0010 1101	0010 0110
3	0011 0011	0001 0101
4	0011 0100	0010 0001
5	0011 0101	0001 0100
ETX	0000 0011	0001 0111

The value in bold is accepted as the BCC value on condition that its equivalent decimal value exceeds 31. When the final XOR result produces an equivalent decimal value less than 32, the value 32 is added.

The value 0001 0111 is equivalent to a decimal value of 23. In this case 32 must be added to give a final BCC value of 55. This is the character **7**.

The complete message is then as follows:

EOT	1	1	2	2	STX	8	1	0	2	-	3	4	5	ETX	7
-----	---	---	---	---	-----	---	---	---	---	---	---	---	---	-----	---

Read the value of a parameter

To read the value of a parameter, the host should send a message that is structured as shown below.

The Data field is not used. The final control character should be **ENQ** [Ctrl E].

Control	Address		Parameter				
EOT	A1	A2	M1	M2	P1	P2	ENQ

Where:

A1 A2 = Address code

M1 M2 = Menu number (80 to 84)

P1 P2 = Parameter number

Note

No BCC character is sent in this message.

When the message is understood, the I/O Box replies with a message having the following structure:

Control	Parameter				Data			Control	
STX	M1	M2	P1	P2	D1	...	Dn	ETX	BCC

Where:

M1 M2 = Menu number

P1 P2 = Parameter number

D1...Dn = Data

The first character of the data is one of the following:

Positive values	Space
Negative values	–
Hexadecimal values	X

If the requested parameter does not exist, the I/O Box reply contains only an **EOT** character (ASCII 04).

When one of the following parameters is requested...

82.44

82.45

82.46

...the data in the reply is in hexadecimal format, as follows:

X	1	E	4	F	0	2
---	---	---	---	---	---	---

Example

This example shows the structure of the following read request message and the reply:

I/O Box address = 11

Read the value of analogue input 2

The read request message from the host to the I/O Box would be as follows:

EOT	1	1	1	1	8	0	0	2	ENQ
-----	---	---	---	---	---	---	---	---	-----

The reply from the I/O Box to the host would be as follows:

STX	8	0	0	2	+	0	2	3	1	ETX	"
-----	---	---	---	---	---	---	---	---	---	-----	---

Repetitive read requests

Once the value of a parameter has been received and understood by an I/O Box, it is possible to save time, especially when monitoring a parameter, by requesting the following using the specified control codes:

Function	Control Code	Keys
Read the value of the same parameter again	NAK	Ctrl U
Read the value of the next parameter	ACK	Ctrl F
Read the value of the previous parameter	BS	Ctrl H

Change the value of a parameter

To change the value of (write to) a parameter, the host should send a message that is structured as shown below.

Control	Address					Parameter				Data					
EOT	A1	A1	A2	A2	STX	M1	M2	P1	P2	D1	...	Dn	ETX	BCC	

Where:

A1 A2 = Address code

M1 M2 = Menu number

P1 P2 = Parameter number

D1..Dn = Data

The first character of the data is one of the following:

Positive values	Space
Negative values	–
Hexadecimal values	X

The data field has a variable length; the maximum length depends on the parameter.

The reply from the I/O Box contains a single control character, as follows:

Control Code	Indicates...
ACK	Acknowledge The message has been understood and carried out
NAK	Negative acknowledge The message is invalid as the result of one of the following: The data value is too long or out of range The specified parameter number is invalid The parameter is read-only The BCC is incorrect

Example

This example shows the structure of the following write message:

I/O Box address = 15
Set digital output 5 at 1

EOT	1	1	5	5	STX	8	3	0	5	+	1	ETX	7
-----	---	---	---	---	-----	---	---	---	---	---	---	-----	---

Re-writing data to a parameter

When a write-message has been sent to an I/O Box and an **ACK** or **NAK** reply has been received by the host, subsequent write messages can be made to the I/O Box using the re-write message structure as follows:

STX	M1	M2	P1	P2	D1	...	Dn	ETX	7
-----	----	----	----	----	----	-----	----	-----	---

When a different I/O Box is addressed, or an invalid acknowledge character has been received, the re-write facility no longer functions. The I/O Box must be addressed again using the full write-message.