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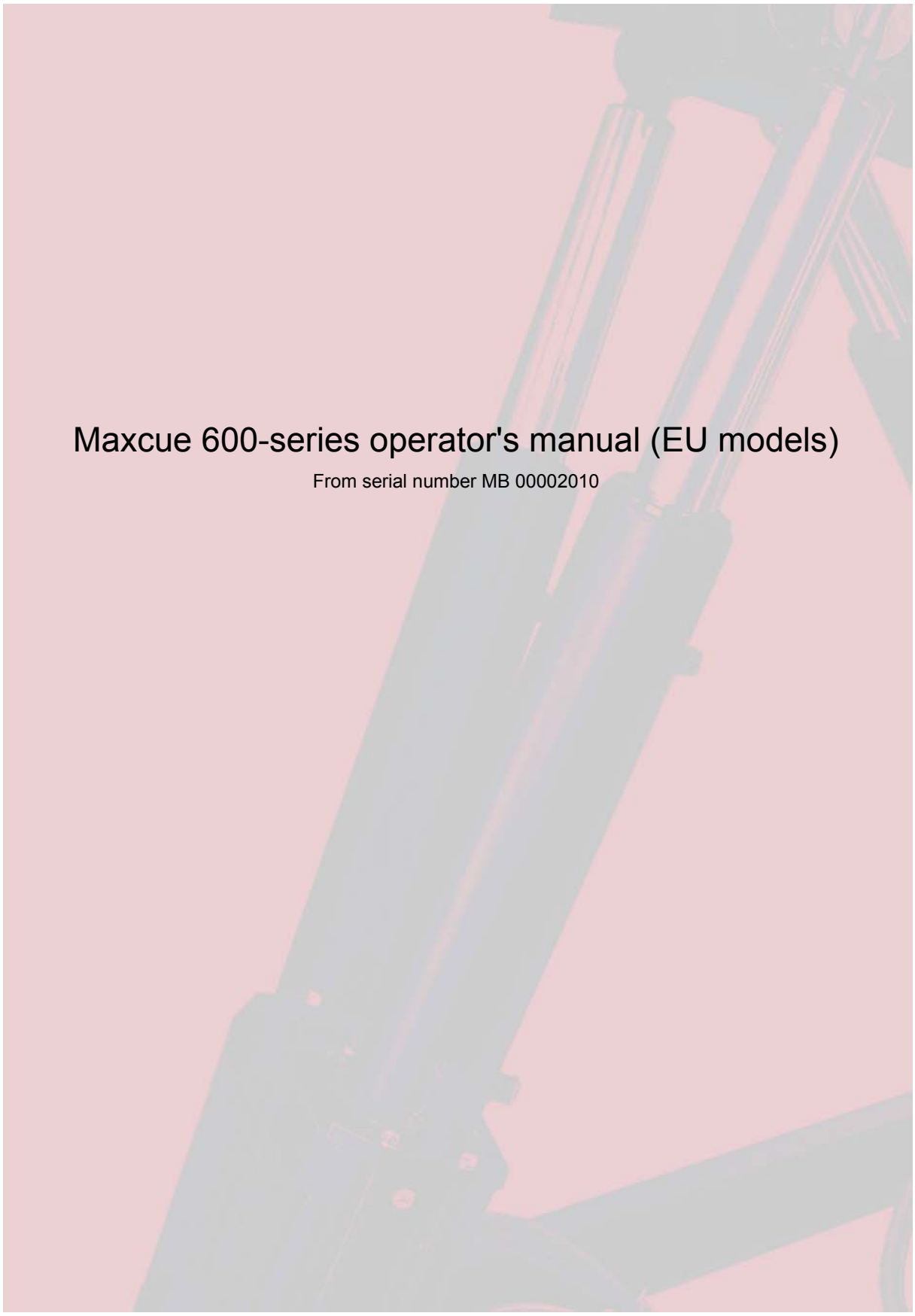

Maxcue 600-series operator's manual (EU models)

From serial number MB 00002010

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Cuesim Ltd
Units 3-4
Highfield Parc
Oakley
Bedford
MK43 7TA
UK

Telephone: +44 (0) 1234 828000
Facsimile: +44 (0) 1234 828001
Technical Support: techsupport@Cuesim.com

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1 Glossary of terms

Operator

Person or body who owns and/or operates a Maxcue 600-series motion base.

Attendant

Person who is given responsibility by the operator for ensuring the safe use of a Maxcue 600-series motion base on a day-to-day basis.

ICB

Interlock control box.

MCC

Motion control card.

MCP

Motion control program.

HPC

Host personal computer

MDU

Motor drive unit.

UPS

Uninterruptible power supply

COG

Centre of gravity

2 Introduction

2.1 General

This manual is written for the operator of a Maxcue 610-series motion base. It provides information about safety, installation, maintenance, and operation of motion bases.

The operator is responsible for ensuring that guards and barriers are provided to prevent access to moving parts of the motion base. The operator must ensure that access to the motion base is possible only when the motion base is in a safe state. To this end, it is strongly recommended that use is made of the interlock system provided by Cuesim Ltd. Health and Safety issues, including advice on guarding and interlocks, are considered further in section 3.

The operator is responsible for ensuring that barriers, guards, steps and walkways that control access to the motion base comply with local safety regulations.

The operator is responsible for ensuring that attendants are trained in the safe operation of the motion base.

Cuesim Ltd accepts no responsibility for death, injury or damage occurring due to inadequate protection of moving parts, or installation not according to these instructions.

Pay particular attention to the warnings throughout the manual. Warnings draw attention to situations that could result in personal injury or death. They are identified as follows:

WARNING -

This document also contains cautions. Cautions draw attention to situations that could result in damage to equipment or property. They are identified as follows:

CAUTION -

Dismantling, maintenance, or repair other than in accordance with the instructions herein, or other written instructions from Cuesim Ltd, will invalidate Cuesim Ltd's obligations under its warranty.

If in doubt about the information presented in this document, consult Cuesim Ltd for clarification.

2.2 Payload

The maximum permissible load is 1000kg with a maximum moment of inertia of 1000kgm^2 about the plane of the top frame upper surface. The payload should be positioned so that its centre of gravity is no more than 600mm above the top frame and within a radius of 300mm of the centre of the top frame.

Consult Cuesim Ltd if the proposed payload does not comply with these limitations.

CAUTION – The mounting of payloads greater than allowed will result in reduced performance and possible damage to the motion base and associated electrical and mechanical hardware Fifteen holes are provided for fixing down the bottom frame and six holes are provided for mounting the payload. It is essential that all fixing and mounting holes be used.

2.3 Mains power supply requirements

The MDU is protected by a type-C (motor-rated) 40A MCB. It is the customer's responsibility to provide over-current protection for the wiring to the MDU. The motion base draws a current

of between 3A and 25A rms at 240VAC phase to phase, depending on the payload and the motion being performed. The mains supply and wiring must be rated accordingly.

It should be noted that the MDU current demand is variable, depending on operating conditions, with brief (a millisecond or so) demands of greater than 100A. For this reason, the wiring of the supply needs to be of low impedance and of greater copper cross-section than might be used on the basis of the nominal rating. Any transformer should be sited near to the MDU so that the link cable between the transformer and MDU is kept short. The system is supplied with 3m of steel braid screened (mainly for mechanical protection), 4-core cable of 6mm^2 cross section for this purpose.

The EMC filters in the MDU cause appreciable earth-leakage currents. The use of a sensitive Earth Leakage Circuit Breaker (ELCB) or Residual Current Device (RCD) to protect the mains input is therefore not satisfactory. It is recommended that any protective device fitted to the supply should be capable of allowing up to 300mA of leakage to avoid nuisance tripping.

The auxiliary 240VAC supply to the MDU is derived from the 3-phase mains supply via a link cable that connects the IEC outlet and inlet connectors on the front panel – see Figure 5. Alternatively a 240VAC UPS may be substituted for the link cable to maintain the auxiliary 240VAC supply in the event of mains supply failure. The motion base is then able to use the UPS supply to return to its normal parked position despite the loss of supply.

2.4 Electrical testing

Each Maxcue motion base is fully tested before dispatch.

The MDU contains surge protection devices that are voltage dependent and preclude insulation tests or high voltage tests being carried out. Should high voltage electrical testing be deemed necessary for any reason Cuesim Ltd must be consulted before proceeding.

2.5 Earth bonding

The base and flying frames of the motion base are double insulated from the actuators of the motion base. In order to minimise EMC the bottom frame is bonded by a braid to the earth stud on the MDU adjacent to the three-phase inlet gland (see Figure 7). This earth stud must be bonded by a similar braid (63A or 90A rating if the length is more than 35m) to the customer's installation earth.

The flying frame does not require earth bonding. However, if the payload involves electrical systems such that local regulations dictate that the flying frame should be grounded, an M6 SEM bright zinc-plated screw is fitted for an earth if required. It is located on the side face of the top frame actuator mount box, adjacent to the upper end of actuator 0. Refer to Figure 3 for actuator 0 location. In such cases the grounding connection should be made via the electrical system earth of the payload.

WARNING – Because of the earth-leakage current mentioned above, a qualified electrician should perform an earth-bonding check after installation. The earth stud adjacent to the mains input cable on the MDU should be used for this test – see Figure 7. The resistance to the reference earth point should be less than 0.1Ω.

3 Health and Safety

The following sections describe health and safety matters pertaining to the motion base. It should be noted that the cables connecting the MDU to the actuators of the motion base have integral electrical screens. The integrity of these screens is important to the correct operation of the motion base and adequate precautions should be taken to avoid mechanical damage to the cables.

> WARNING – The cables connecting the MDU to the actuators provide electrical safety earthing. If the cables are likely to suffer mechanical damage e.g. from footwear or heavier equipment they must be provided with adequate protection. Should mechanical damage be suspected, earth bonding to each actuator must be tested before further operation.

3.1 Avoidance of moving parts

Barriers that conform to the local regulations governing the guarding of machinery must guard the moving parts of the motion base. It is the responsibility of the operator to provide such barriers. The barriers must be sited so that there is no risk of injury to persons reaching over or through the barriers, taking account of the full range of motion of the motion base. The barriers must be positioned so that body parts cannot be crushed between the barriers and any parts of the motion base.

A gate or similar device must control access to the motion base. This device must control an approved interlock switch that is connected to the interlock circuit of the motion base.

Wherever steps or elevated walkways are used to gain access to the motion base, these should conform to local safety regulations. For example, suitable handrails, barriers and non-slip surfaces should be provided.

The interlock control box is equipped with a yellow warning light, called the MOTION BASE ENERGISED light. When illuminated, this light indicates that the motion base is energised. The motion base must not be approached if this light is illuminated, even if the motion base is stationary; motion could occur at any time. This light must be checked for correct operation every day - a (black) lamp-test button is provided on the end of the ICB for this purpose.

3.2 Start controls

The interlock control box (ICB) is equipped with a start button. This button is the only means of starting the motion base; the design of the motion base ensures that it cannot start of its own accord or by means of software alone. This means that an attendant must take responsibility for ensuring that it is safe for the motion base to move. This requirement for human intervention in the start-up process is a key aspect of the design of the motion base.

3.3 Interlock circuit and emergency-stop action

The motion base is equipped with a safety interlock circuit. The interlock circuit functions as a ‘stop category 1’ as detailed in BS EN418, 1992. This circuit is a simple series circuit consisting of contacts that are operated by emergency stop buttons and other interlock devices. The motion base will not start if this circuit is not complete. As supplied, the following devices form part of the interlock circuit:

- Emergency-stop button in the interlock control box
- ¼” jack plug in the interlock control box

The operator can and should add devices to this circuit as required. They should have volt-free contacts that are closed when the system is deemed safe and open to break the interlock circuit. Consult Cuesim Ltd for further advice and information on this matter if required.

If the motion base is operating when the interlock circuit is broken (because, for example, someone opens an interlocked barrier), the motion base will rapidly return to its parked

position and power to the motion base will be removed automatically. After this happens, the motion base must not be approached until the yellow MOTION BASE ENERGISED light goes out.

The Start button on the interlock control box is combined with a green light, called the INTERLOCK HEALTHY light. This indicates the state of the interlock circuit; it is illuminated if the interlock circuit is complete.

3.4 Action in the event of failure of the mains power supply

If the mains power is removed when the motion base is powered, the motion base will settle in an attitude determined by the motion being performed at the time and the payload mounted to the top frame. During this settling the MDU provides regenerative (or dynamic) braking, where energy is dissipated as heat in power resistors. This braking retards the actuators as they move under the weight of the payload.

The motion base may settle in an attitude where one or more actuators are extended. Unless installation requirements dictate otherwise (e.g. if the motion base is being used in conjunction with an occupied simulator pod), the motion base may be allowed to remain in the settled position until mains power is restored. When power is restored, the operator can start the system in the usual way. If the MB_Move utility is being used, it starts the system by homing each actuator to minimum length. After this it will restore the motion base to the pre-set neutral state.

When a UPS is used to provide the auxiliary supply to the MDU and power the HPC, the motion base will be returned to the parked position following a main supply loss under UPS power.

WARNING – There is a potential hazard to anyone in the vicinity of the motion base until the base has returned to its normal parked position. The power failure recovery scheme allows the motion control program to wait for the motion base to settle, and will then use the power from a UPS to bring the motion base to its parked position. This is done by driving each actuator in turn to its minimum length. The MOTION BASE ENERGISED light will briefly go out when the mains fails, and will then come on again when UPS power is being used to park the motion base. The attendant must be made aware that backup power will be applied after failure of the mains power supply. If the interlock circuit is broken during the UPS recovery operation, the UPS power will be removed immediately and the base will settle again in an attitude determined by the distribution of the payload. The MDU provides dynamic braking during this settling period. Any subsequent changes in the distribution of the payload may result in further settling motion.

4 Overview

The key elements of a Maxcue 610-series motion base system are:

- A high efficiency six-degree-of-freedom electric motion base
- A motor drive unit (MDU)
- A PC ISA bus motion control card (MCC)
- An optional uninterruptible power supply (UPS)
- A mains transformer
- An interlock control box (ICB)
- Host Personal Computer (HPC)
- Operating software

4.1 Motion base

The motion base is a six-degree of freedom motion platform based upon the Stewart platform principle. It consists of a bottom frame and top frame (flying frame) that are connected by six electromechanical actuators. The actuators comprise a precision ballscrew directly driven by an in-line brushless DC-servo motor. The bottom frame has 5 mounting holes at each of its three corners. All 15 mounting holes must be used to secure the motion base for operation. The top frame has 6 holes that must all be used to mount the payload.

The motion base is connected to the MDU by six pairs of cables. The cable length and method of termination at the MDU may be specified at the time of order. The cables are hard-wired via glands at the actuators.

> WARNING – The motion base presents a crushing hazard. No person must be allowed to approach the motion base when the MOTION BASE ENERGISED warning is active. The motion base may move at any time.

4.2 Motor Drive Unit (MDU)

The motor drive unit (MDU) is the electrical power supply and drive control stage for the motion base. It contains the following items:

- Six servo amplifiers, one for each actuator of the motion base
- High-voltage DC power supply
- Control circuitry, including emergency-stop circuitry
- DC link shunt regulator
- Interface to the motion control card (MCC)
- MCB protection against transient and long-term overloads
- EMC filter system

> WARNING – The MDU contains power resistors that can become very hot when a lot of re-generative braking of the payload occurs. Although such situations are uncommon, this will cause the MDU cover surface to become hot in the regions marked by cautionary signs.

4.3 Motion Control Card (MCC)

The MCC is an intelligent ISA-based servo control card. It occupies two full-length, full-height ISA slots and backplates within a host PC. It is connected to the MDU via two cables.

The MCC executes a motion control program (MCP) that allows the motion base to be operated and assists in fault diagnosis. Cuesim can provide an application programming

interface (API) that allows high level control of the motion base to be integrated within a customers application running on the PC.

The MCP is a program that is downloaded to the MCC by the host PC. The program runs on the MCC and is responsible for:

- Servo loop closure
- Profile generation
- Kinematics transformations
- Actuator state limiting
- Washout filtering
- Implementation of a state machine
- Safety system checks

4.4 Uninterruptible Power Supply (UPS)

An uninterruptible power supply (UPS) may be used to maintain power to the MDU and the HPC in the event of mains failure. The UPS may also be used to supply the MDU so that the motion base can be parked in a controlled manner after mains failure.

4.5 Mains transformer

A transformer is usually required to ensure that the three-phase mains input voltage to the MDU is at 240VAC phase-to-phase. Cuesim can supply a suitable transformer for installations where the local supply is 415VAC or 380VAC phase-to-phase (part number 000494). The transformer is connected to the MDU via a length of steel braid screened cable. The length of this cable may be specified at time of order.

4.6 Interlock Control Box (ICB)

The interlock control box (ICB) is a small enclosure that is connected to the MDU via a 3m cable. The enclosure contains:

- Start button: A momentary pushbutton switch to start the motion base. This is combined with a green indicator which is illuminated when the interlock circuit is completed (INTERLOCK HEALTHY)
- Emergency-stop button: A latching push button switch that is included in the interlock circuit.
- MOTION BASE ENERGISED indicator (yellow): When illuminated indicates that the motion base is energised and there is a potential hazard to anyone in the vicinity.
- Lamp test button: A momentary action push button (black) switch used to check that the bulbs in the green and yellow indicators are functional.

4.7 Software

The motion base is supplied with a software utility called MB_MOVE. Other software applications or libraries may be requested at the time of order. Refer to the appropriate software manual for detailed description of each utility.

4.8 Block diagram

The block diagram shown in Figure 9 shows the major components of the motion base system, the three-phase mains input and the UPS.

5 System Installation

5.1 Unpacking / Shipping

5.1.1 Equipment / tools required.

- 3 x 25mm 'U'-clevis rated at 500kg SWL
- 3 x 1m sling rated at 500kg SWL
- 1 x 'U'-clevis rated at 1000kg SWL
- Crane or fork-lift truck with lifting hook having 1000kg SWL at a reach of 1.2m and a minimum height of 3.5m

A custom 3-piece sling (part number 000144) is available from Cuesim.

All equipment is shrink-wrapped and shipped on wooden pallets.

5.1.2 Lifting the motion base

The MDU is mounted on a wooden panel on the motion base bottom frame for shipping and the MDU-to-motion base cables are secured to prevent them being damaged. This arrangement should not be disturbed when removing the motion base from the pallet and moving it to the installation site.

The motion base (approx. 550kg) must be lifted from its pallet and moved to its operating position. Three ∅30 lifting points are provided as shown in Figure 1.

When using three separate slings, one sling should be attached to each lifting point and the free ends joined to give a single lifting point. The slings should be routed through the inside of

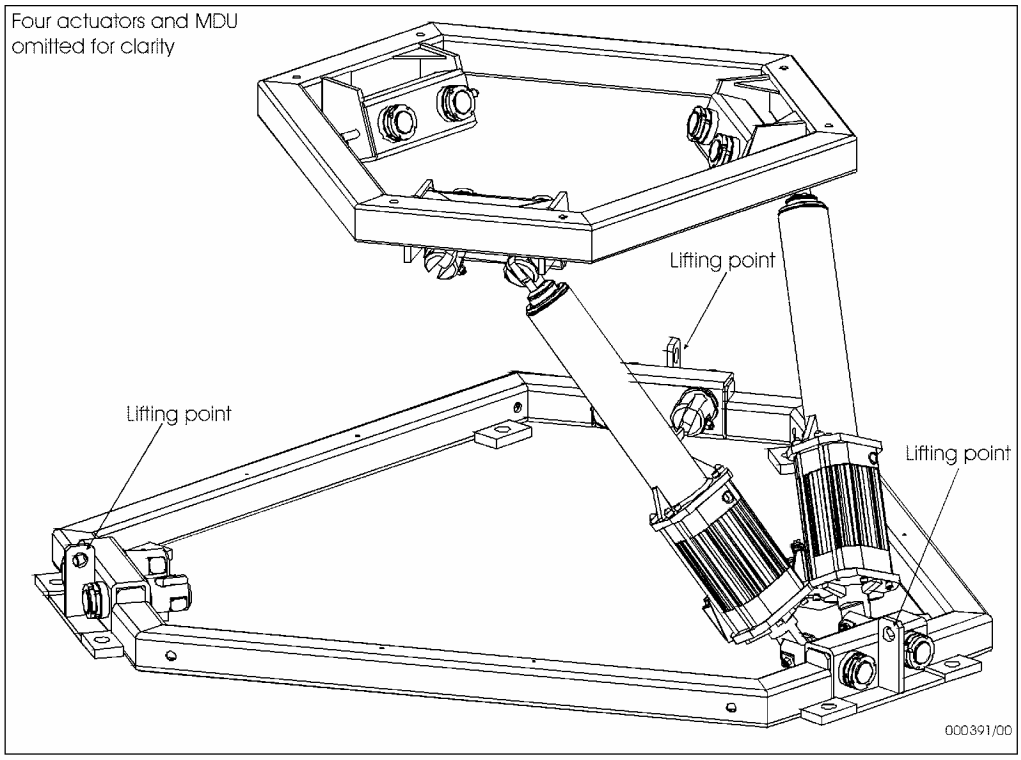


Figure 1 : Motion base lifting points

the top frame taking care to protect the MDU-to-actuator cables and the MDU.

5.1.3 Packing

The motion base and associated components should be packed and secured as received should they need to be shipped to another location.

5.2 Mechanical installation

This section describes the equipment required and procedures that must be followed to safely install the motion base and its ancillary equipment.

5.2.1 Floor structural requirements

The floor requirements are as follows:

- Each of the three groups of five floor fixings must be able to withstand 50kN tensile force. This equates to 10kN for each fixing. A suitable factor of safety should be applied to this figure.
- The floor must be able to withstand a downward force of 50kN spread over an area of 33,000mm^2. This equates to a downward pressure of 1.52N/mm^2.

5.2.2 Equipment Required

Installation equipment required

- Lifting gear as described in section 5.1.1.
- Fixings to suit the floor material. The motion base has fifteen holes in the base frame that must all be used. Refer to Figure 2 for the hole layout.
  - To secure the motion base to a steel or similar surface, M16 high-tensile bolts and nuts must be used (minimum bolt grade 8.8)
  - To secure to a concrete surface, epoxy-acrylate resin anchors are recommended. The size of fixing depends on the strength of the concrete. Where the concrete has strength greater than 28N/mm^2 bolting should be M16 with 125mm insertion; where the concrete has strength less than 28N/mm^2, bolting should be M20 with 170mm insertion. Time must be allowed for the chemical anchor to cure prior to installation in

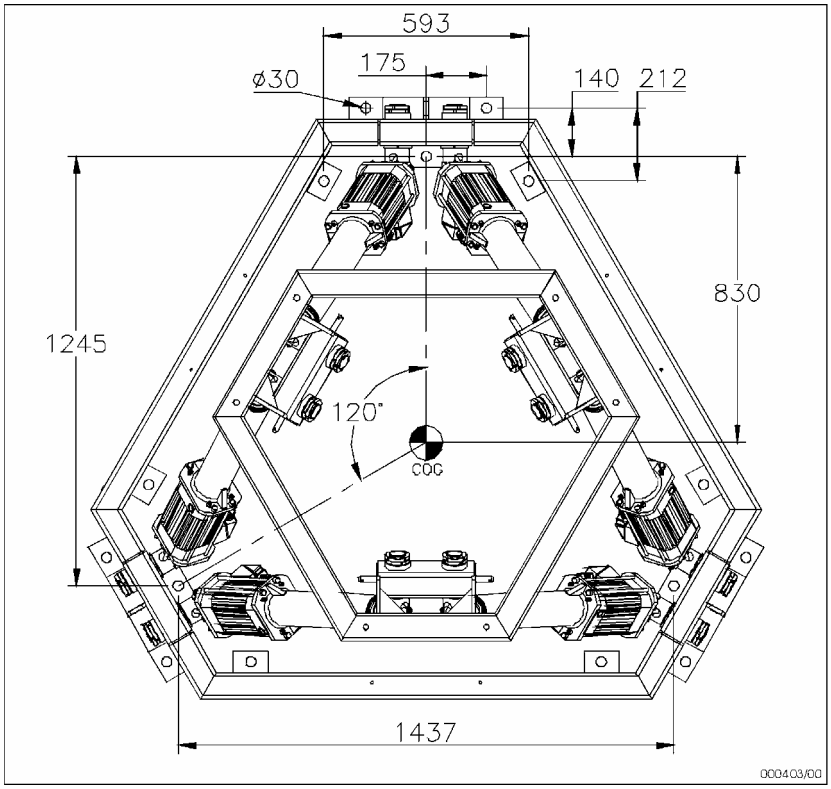


Figure 2 : Motion base mounting holes

accordance with the manufacture's instructions

5.2.3 Orientation of the motion base

The top frame has three axes of symmetry so there are six principle orientations in which the motion base can be positioned. Figure 3 shows the control system X-axis related to the actuator joints on the bottom frame. The X-axis is normally aligned with the payload forward / backward direction.

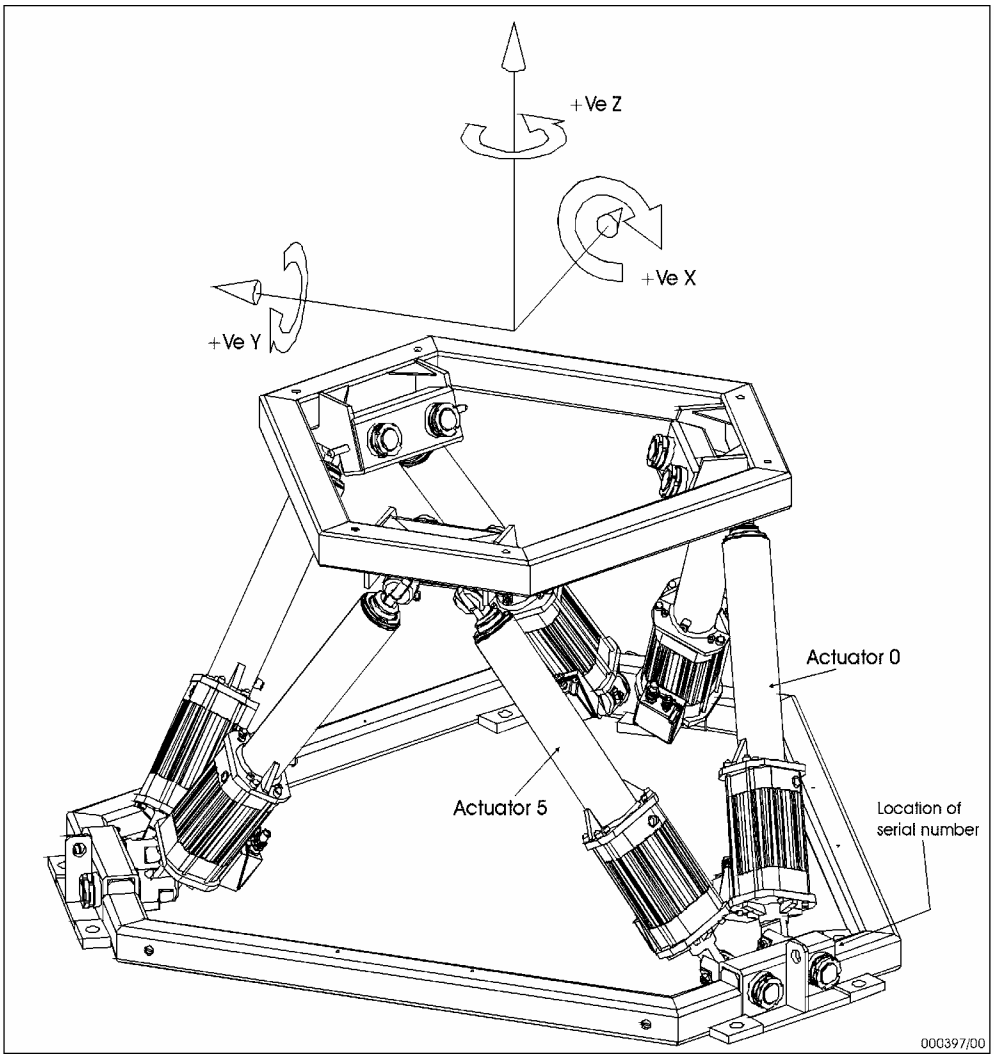


Figure 3 : Motion base actuator and axes orientation

5.2.4 Securing the motion base

CAUTION - This operation should be performed with the MDU and cables secured as shipped wherever this is practical. This reduces the possibility of cable damage during the installation process.

Floor fixings must use spreader plates, full washers, spring washers and high-tensile nuts (refer to Figure 4). High-tensile self-locking nuts may be used in place of the plain nuts and

spring washers. The spreader plates (Cuesim part number 000146) are shipped with the motion base.

Procedure:

- The location of floor bolts should be determined by positioning the motion base in its proposed location and marking through the 15 mounting holes in the bottom frame. Refer to Figure 3 to ensure correct orientation
- The motion base should be removed to a clean area whilst the floor is prepared

> CAUTION - Take care to protect the motion base and in particular protect the actuator-to-MDU cables from damage. Ensure that the actuator cylinders, top seals and pivot bearings remain free from dust and dirt.

- For concrete floor
  - With careful reference to the manufacturer's instructions, drill and prepare the fifteen holes and install all the epoxy-resin anchor studs, ensuring that there is at least 55mm of vertical stud protruding to secure the motion base
  - Allow the epoxy resin to cure completely
  - Position the motion base over the mounting holes. Check for correct orientation
  - Fit the spreader plates, washers and nuts as described above
- For other surfaces
  - Prepare holes for the fifteen bolts
  - Position the motion base over the mounting holes. Check for correct orientation
  - Fit the spreader plates, washers, nuts and bolts as described above
- Tighten the fixings to a torque of 30Nm
- Use paint or varnish to mark the position of the fully-tightened nuts relative to the exposed thread of the screws for future maintenance and safety checking

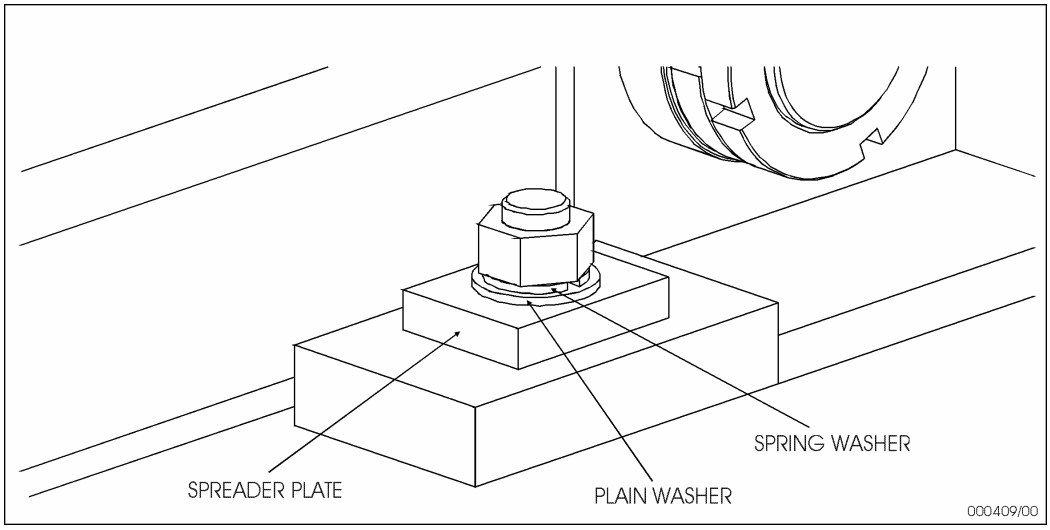


Figure 4 : Spreader plate details

5.2.5 Removing and siting the MDU

> CAUTION – On no account must the motion base be operated while the MDU is mounted on its shipping rails. Damage to the MDU and motion base may result.

- Remove any protective material from the motion base.
- Remove the fixings that secure the MDU for transport.
- Remove any cable ties or other strapping securing the actuator cables to the motion base, but leave intact any cable ties that bind the actuator cables together.
- Lift the bundle of cables, at the point indicated by the label, up through the top frame.

- Slide the MDU out of the motion base, allowing the bundle of cables to follow and being careful not to snag or strain the individual cables.
- A cable clamp bar is attached to the cables at the correct distance from the motor termination glands. This bar should be secured to the bottom frame of the motion base using two M8 cap-head screws. These become available after removing the wooden platform used to support the cables and MDU during transit.
- Retain all fixings for future shipping requirements.

The standard actuator to MDU cable length is 7m – other lengths may be specified at time of order. The standard MDU to host PC cable length is 2m – other lengths may be specified at the time of order.

The MDU must be installed in free air with a minimum space of 250mm around it to ensure adequate ventilation and access for servicing.

The MDU weighs approximately 45kg and may be mounted horizontally or vertically. If vertical, the MDU must be orientated so that the cables exit downwards for correct ventilation. All cables should have a straight run away from the MDU for at least 200mm before any bend and the minimum bend radius for all cables is 200mm.

5.2.6 Attaching a payload

Refer to Section 2.2 for payload limitations.

The payload must be attached to the flying frame using the six ∅16.5 bolt holes provided. The payload should be positioned so that its COG is as near to the centre of the frame as possible in order to minimise uneven loading of the payload fixing bolts. The frame is reinforced around the six bolt holes to prevent deformation due to bolt tightening and payload forces.

The grade of bolting should be determined thorough analysis of the payload dynamics. As a guide, the minimum grade and size of bolt should be 8.8-grade M16. The bolts should not protrude more than 40mm below the underside of the frame. This restriction is necessary to prevent collision between the bolts and the actuators during motion. A close fit to the payload mounting holes is desirable so that bolt tightening forces need not be high.

The actuator top seal is directly below each bolt hole. Protect the seals from falling debris when installing the payload and the fixing bolts.

Refer to cueSim Ltd document 000270 (Figure 8) for flying frame fixing hole dimensions.

5.3 Electrical installation

5.3.1 Installing the motion control card

CAUTION - The Motion Control Card is a static sensitive device. Observe normal precautions for handling such devices.

The motion control card (MCC) is a standard, full length, full height, PC-AT ISA card fitted with a half-length daughter board. It occupies two full-length ISA slots and back plates.

5.3.1.1 Selection Of MCC Address

The MCC uses four consecutive I/O address locations that allow access to its Dual Port RAM. The base address of the card may be set using a combination of DIP switches and jumper links. The card is factory configured to reside at a base I/O address of hexadecimal 300. If the card is likely to conflict with other hardware within the PC the address may be changed using the table below.

S1.1		S1.2		S1.3		S1.4		MCC Address (hex)
On		On		On		On		300

On		On		On			Off	304
On		On			Off	On		308
On		On			Off		Off	30C
On			Off	On		On		310
On			Off	On			Off	314
On			Off		Off	On		318
On			Off		Off		Off	31C
	Off	On		On		On		320
	Off	On		On			Off	324
	Off	On			Off	On		328
	Off	On			Off		Off	32C
	Off		Off	On		On		330
	Off		Off	On			Off	334
	Off		Off		Off	On		338
	Off		Off		Off		Off	33C

If jumper link H is fitted, subtract $100 from the address values.

5.3.1.2 Fitting the MCC

Note - Consult the PC manuals for general advice about fitting PC cards.

- Configure the MCC address as required.
- Turn off the PC, remove any relevant cover and carefully insert the MCC into a spare full-length slot.

Note - Take care that the card does not touch any tall components on the PC motherboard.

- Screw the main card bracket and ribbon-mounted daughter board bracket to the PC chassis.
- Before replacing the PC cover, connect the 37-way daughter board cable to the daughter board rear connector.

Note – It may be necessary to support the daughter board bracket from the rear as the cable is inserted to prevent distortion of the bracket.

- Connect the 100-way cable to the main board rear connector.

Note - Ensure that both the 37-way and the 100-way connectors are fully engaged and that their screw locks are tightened to a torque of 1Nm maximum.

5.3.2 Connecting the MDU

Figure 5 shows the front panel layout of the MDU and identifies its connectors. Figure 11 shows the wiring of MDU connectors P9, P10 and P11.

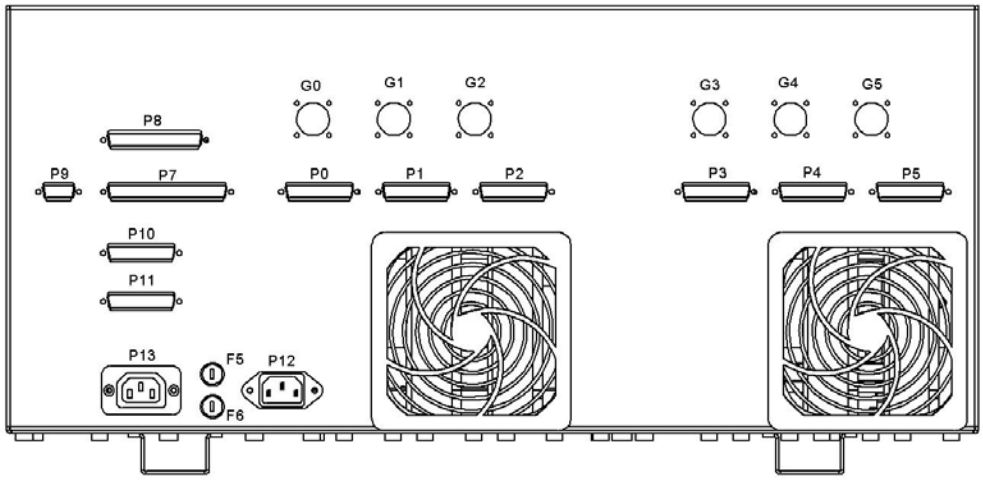


Figure 5 : Motor drive unit front panel

5.3.3 Three-phase input supply

WARNING – A three-phase mains supply such as the 415 or 380 VAC phase-to-phase supplies commonly available in Europe must not be connected directly to the MDU as severe damage will be caused, possibly causing violent ejection of particulate material.

WARNING – Connection to the MDU should be made by a competent electrician. If in any doubt about connection of the mains power contact Cuesim before proceeding.

The MDU is factory configured for 240 VAC phase-to-phase, three-phase, 50/60Hz operation.

Connection of a suitable supply is usually via a transformer and a 3m steel braid screened 4-core cable factory wired to the MDU via a 25mm metal gland. The free (transformer) end of the cable is also fitted with a 25mm gland. The three black phase cores are numbered 1,2 and 3 and are each terminated with 6mm^2 ferrules. The green/yellow earth core is terminated with a 6mm ring terminal. All cores extend 400mm from the gland. Table 1 identifies the individual power cable cores.

Refer to the 'Maxcue 610 European Auto-transformer manual' for instructions on connecting to this unit.

Core id	Colour	Function
1	Black	240VAC phase AC1
2	Black	240VAC phase AC2
3	Black	240VAC phase AC3
	Green/Yellow	Earth

Table 1 3-phase power cable

5.3.4 Motor power and signal cables

The motor power cables are connected to the MDU via MIL-spec bayonet connectors G0 to G5. The motor signal cables are connected to the MDU using 25-way 'D'-type connectors to ports P0 to P5. Should it become necessary to disconnect the MDU from the motion base, for example to change an actuator, consult Cuesim before proceeding.

> CAUTION - The screw locks of the 25-way connectors must not be over-tightened - maximum torque is 1Nm.

5.3.5 Motion control card

Connect the MDU to the MCC via connectors P7 and P8 using the cables provided. Take care to orientate the 100-way connector correctly into P7 and ensure that the screw locks for both connectors are tightened to a torque of 1Nm maximum.

It is essential that the conditioned mains output from the UPS (if fitted) is also used as the power supply to the host computer since the MCC controls the parking operation after failure of the mains supply. Modern UPS units have multiple outlets so that both the MDU (via P12) and the host computer can be directly connected to the UPS.

5.3.6 Interlock control box

Connect the ICB to the MDU via connector P9.

5.3.7 Uninterruptible power supply

When the installation does not use a UPS, ports P12 and P13 of the MDU (see - Figure 5) should be connected by the link cable provided (part number 000595).

If a UPS is used it should be powered from the IEC outlet, P13, on the MDU front panel. This optimises the earthing system between the MDU and the UPS and minimises EMC conducted emission. The conditioned mains output from the UPS must be connected to connector P12 on the MDU front panel. It is recommended that the clips available on the IEC connectors P12 and P13 be used to provide positive retention of the UPS cables and thereby avoid inadvertent loss of the UPS connections.

The output from the UPS must also be connected to the host PC (and its monitor if required). The UPS should be turned off before the main supply of power is removed from the MDU when the motion base is not required for an extended period e.g. over-night, to avoid the battery supply of the UPS being exhausted. In the event that the motion base is not used at all for a protracted period, e.g. a month, the system should be re-powered and the UPS turned on to charge the batteries. The MDU fans will operate and low voltage supplies will be present but there is no need to energise the motion base.

5.3.8 Customer digital I/O

User-configurable digital I/O may be connected via the 25-way 'D'-type socket, P11, on the front panel of the MDU. Refer to Figure 5 for location.

5.3.8.1 Outputs

There is one 24VDC digital output available. It is an NPN Darlington driver that may be used to switch loads up to 50mA. One side of the load should be connected to the 24VDC supply available from P11 pin 5; the other side of the load (load return) should be connected to the output on P11 pin 4.

When the output is switched on, the load return is connected to the 0V side of the 24VDC supply. Refer to Table 2 for connection details.

5.3.8.2 Inputs

There are eight NPN digital inputs available. The inputs are internally pulled up to the 24VDC supply available from P11 pin 5 via 10KΩ resistors. The input device should be connected between the input and one of the input returns. All of the input returns are connected to the 0V side of the 24VDC supply. An input is ON when the input device connects the input to the input return. Refer to Table 2 for connection details.

A slider box (part number 000491) may be connected to the MDU using cable (part number 000492) between the 25-way 'D'-type connectors marked 'P11'. This will enable the digital inputs to be activated and output 6 monitored.

P11 Pin #	Function	P11 Pin #	Function
4	Output 6	16	Input return
5	24VDC	18	Input 22
7	Input 21	19	Input return
8	Input 17	21	Input 23
10	Input 18	22	Input return
11	Input 16	24	Input 20
15	Input 19	25	Input return

Table 2 : Digital inputs and output on connector P11

5.3.9 Customer analogue I/O

User-analogue inputs may be connected via the 25-way 'D'-type socket P10 on the front panel of the MDU. Refer to Figure 5 for P10 location.

The +/-12VDC supplies available from P10 pin 1 and P10 pin 2 may be used to power, for example, potentiometers. Note that the maximum current available is 70mA. The potentiometer wiper should be connected to the analogue input. If an external supply is used to power the input device, its 0V side should be connected to the analogue input reference.

CAUTION - Note that pins other than those shown in the table must not be used.

P10 Pin #		P10 Pin #	Function
1	+12VDC (70mA max.)	15	Analogue input 1 (-10V/+10V)
2	-12 VDC (70mA max.)	16	Analogue input 1 reference
7	Analogue input 5 (-10V/+10V)	18	Analogue input 2 (-10V/+10V)
8	Analogue input 5 reference	19	Analogue input 2 reference
10	Analogue input 0 (-10V/+10V)	21	Analogue input 3 (-10V/+10V)
11	Analogue input 0 reference	22	Analogue input 3 reference
13	0V	24	Analogue input 4 (-10V/+10V)
		25	Analogue input 4 reference

Table 3 : Analogue inputs on connector P10

A Slider Box (part number 000491) may be connected to the MDU using cable (part number 000492) between the 25-way ‘D’-type connectors marked ‘P10’. This will enable the motion base to be stimulated using the sliders via the MB_MOVE utility.

6 Service and maintenance

6.1 Motion base

WARNING - There are no operator-serviceable parts. Tampering with nuts, bolts, etc that have been factory set may result in failure of the actuator.

6.1.1 Maintenance

The following sections list the maintenance tasks that must be carried out at daily, weekly and monthly intervals. Details of how to carry out the tasks are provided in later sections.

The attendant will become used to the normal operating sounds of the motion base. Any deviation from normal should be reported to Cuesim Ltd.

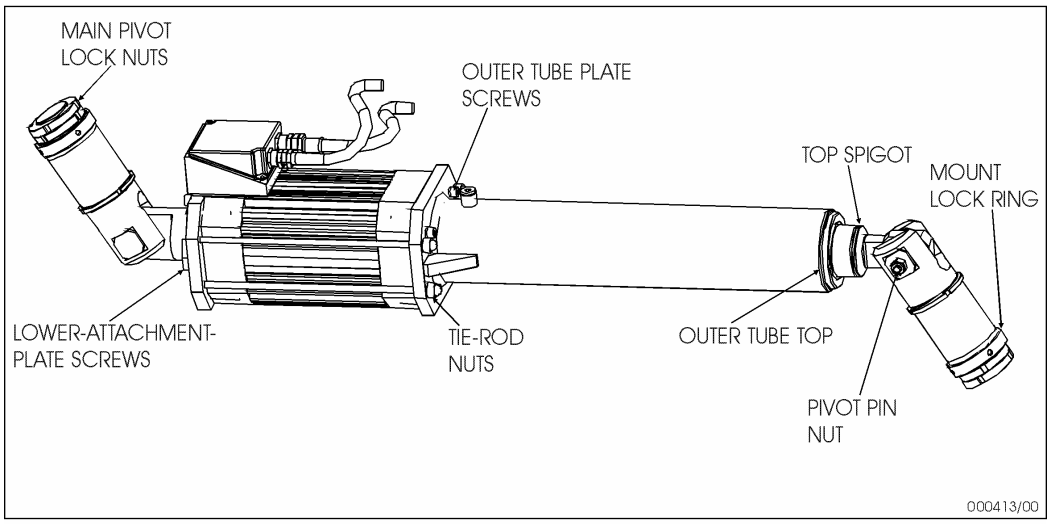


Figure 6 : Critical fastenings

6.1.1.1 Daily maintenance

Visual inspection of the following:

- Check the actuators for oil leaks. If any oil is visible the actuator may have to be replaced. Contact Cuesim Ltd for advice
- All critical fastenings (see Figure 6) have a paint or coloured varnish stripe marking the fully-tightened position. If loosening has occurred, the motion base should be taken out of service and Cuesim Ltd should be contacted immediately. The critical fastenings are:
  - Upper and lower mount lock rings
  - Upper and lower main pivot lock nuts
  - Upper and lower pivot pin nuts
  - Lower-attachment-plate screws
  - Outer-tube-plate screws
  - Outer tube top
  - Top spigot
  - Tie-rod nuts
- Check the actuator cables for splits, chafing and general condition. Contact Cuesim Ltd if damage to the outer insulation material is apparent
- Check the complete system for abnormal noises during operation. Report any queries to Cuesim Ltd.

6.1.1.2 Weekly maintenance

Inspect the paint markings on the fifteen base-frame mounting bolts. If these markings indicate that loosening has occurred, check the tightening torque. Refer to the motion base installation details in section 5.2.4 for the tightening torque for these bolts. If frequent loosening occurs, contact Cuesim Ltd for advice.

6.1.1.3 Monthly maintenance

- Inspect all welds and framework for signs of fatigue, deformation and damage. None is acceptable. Contact Cuesim Ltd immediately if any failure or damage is suspected
- Depending on the type of use the motion base is subjected to, it may be necessary to lubricate the actuator upper oil seal and dirt filter. Evidence of this necessity will be dark marks on the silver sliding tube of the actuator. To perform the necessary lubrication, apply a few drops of 90-grade low-Sulphur oil to the top of the actuator so that the oil seeps into the gap between the silver sliding tube and the black outer tube. The oil will distribute itself around the actuator seal and dirt filter. Normal oils are not detrimental to the operation or appearance of the actuator and any excess may be wiped away using a clean cloth. Avoid spillage of oil onto the motor cables.

6.2 MDU

WARNING – There are no operator-serviceable parts inside the MDU case. The main cover should not be removed in normal service. Under unusual conditions the miniature circuit breaker, MCB1 (see Figure 7), may trip out. The state of the MCB may be checked by opening the small (user) cover of the MDU. Remove four bright-coloured captive-washer screws and move the cover outwards from the MDU**. It will not be possible to remove the cover completely due to the earth bond lead.** Check the colour showing at the indicator windows of the MCB, see Figure 7 – if it has tripped they will show green and the black setting bar will have moved away from the cable gland. The MCB is re-set by pushing the black bar towards the cable gland to the position shown in Figure 7, when the colour in the indicator windows will become red. The small cover should then be re-fitted, taking care to avoid trapping the earth bond lead between the metal work of the MDU. Power may then be re-applied. If the MCB is heard to trip again immediately consult Cuesim Ltd before proceeding.

If it is considered that a fault may be present within the MDU it is strongly advised that Cuesim Ltd should be consulted before starting any investigations. In such circumstances only qualified personnel should remove the cover, as the MDU may still contain hazardous voltages even when the motion base itself is not energised. If the MOTION BASE ENERGISED output is inactive, this does not indicate that the MDU is safe to work on. Remove both the 3-phase mains supply and the auxiliary supply (or UPS if used) and wait 10 seconds before removing the main cover.

6.2.1 Maintenance

6.2.1.1 Monthly (more frequently for dusty atmospheres) maintenance

The only parts that need maintenance are the filters for the two air-circulator fans on the front panel. The two filters are mounted in housings on the outside surface of the MDU. They may be replaced without removing the MDU cover.

- Remove the plastic filter cover by pulling first one edge, then the complete cover, away from its housing
- Remove the foam filter element and inspect for damage. If it is in an unserviceable condition, replace it with the correct part (Cuesim part number 000155)
- If the element is serviceable, clean it by washing in warm, soapy water then dry
- Replace the element into the filter housing and re-fit the filter cover by pushing it over the housing until its snaps into place

6.2.1.2 Half-yearly maintenance

Remove and clean the four filters for the air-circulation exhaust air on the rear panel. They may be replaced without removing the MDU cover.

- Remove the plastic filter cover by pulling first one edge, then the complete cover, away from its housing
- Remove the foam filter element and inspect for damage. If it is in an unserviceable condition, replace it with the correct part (Cuesim part number 000155)
- If the element is serviceable, clean it by washing in warm, soapy water then dry
- Replace the element into the filter housing and re-fit the filter cover by pushing it over the housing until its snaps into place.

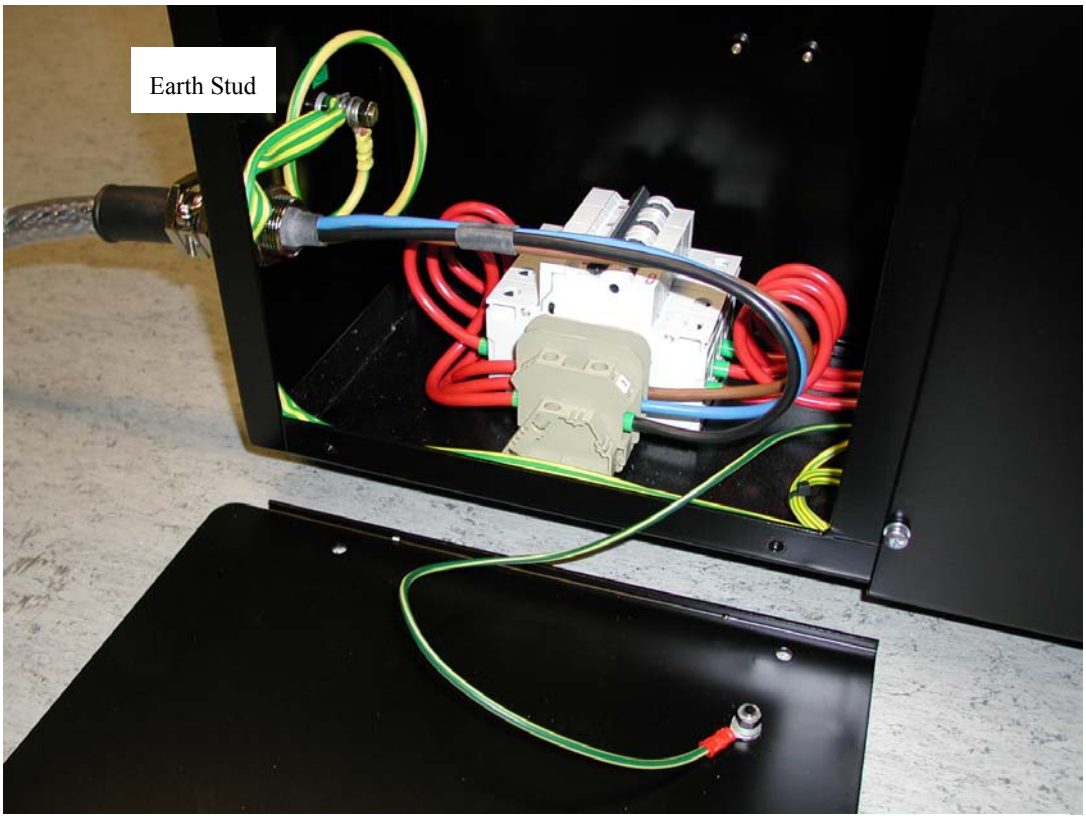


Figure 7 : MDU with the small (user) cover removed to show MCB1 in the 'set' position.

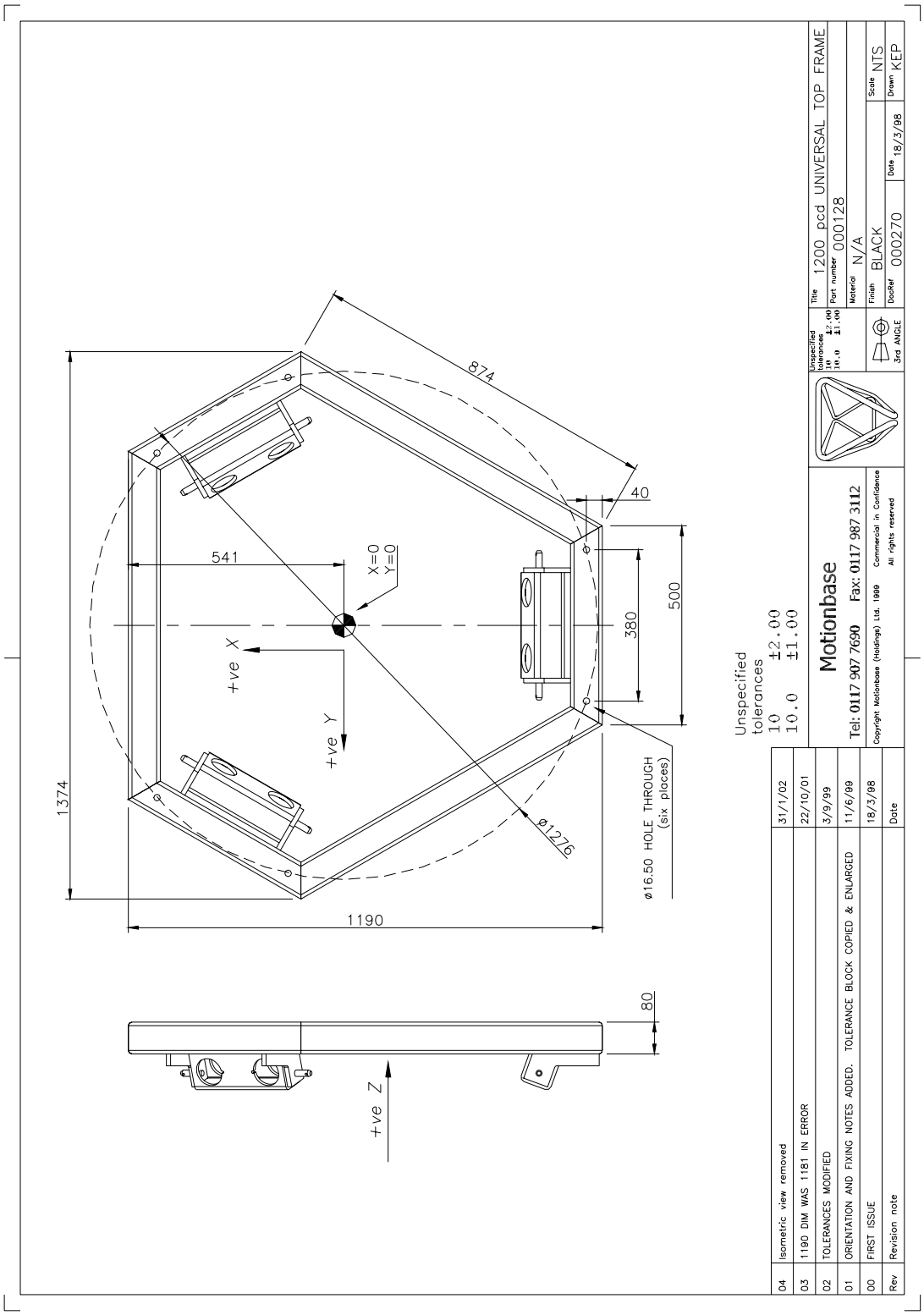


Figure 8 : Top frame dimensions

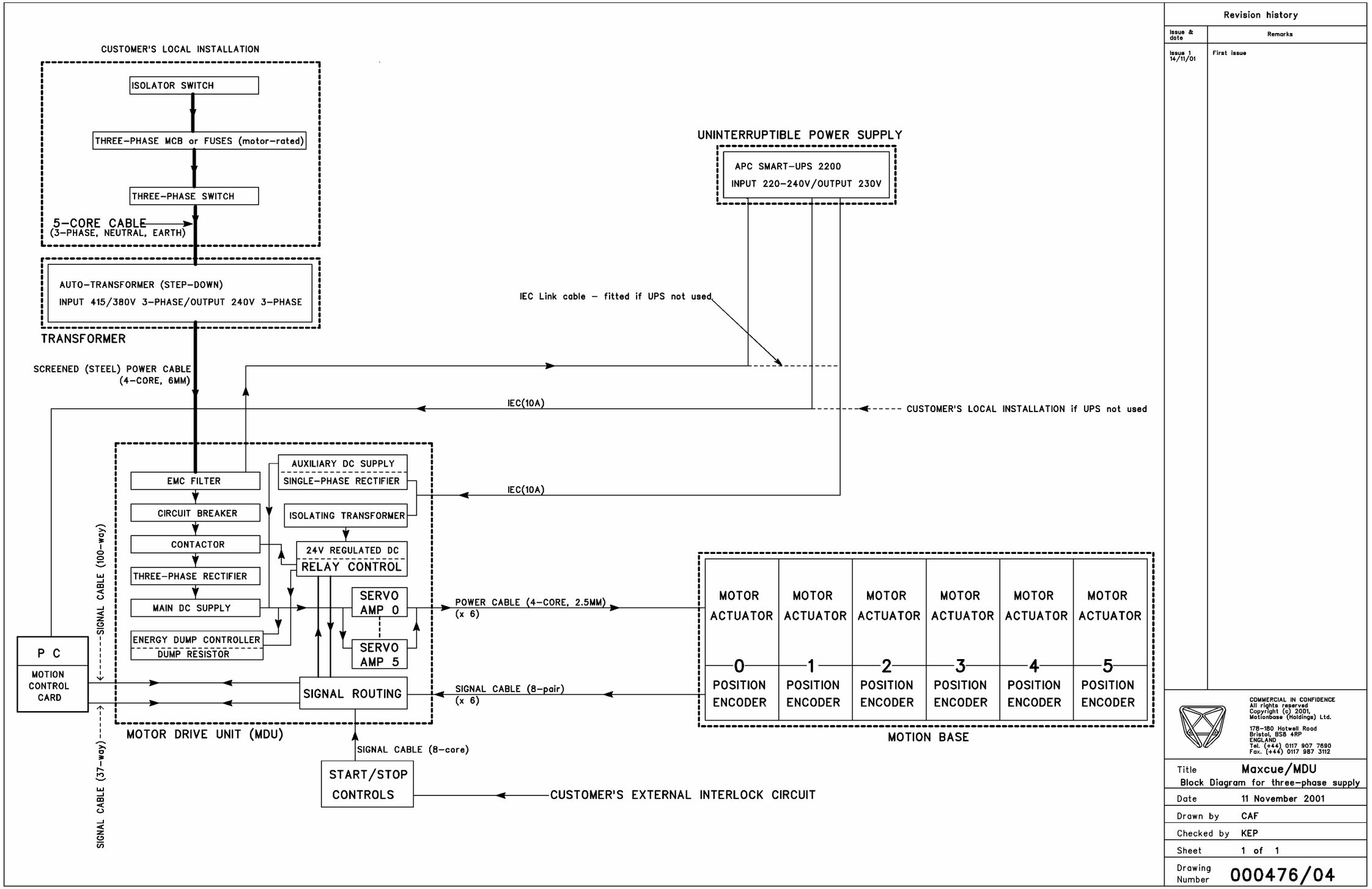
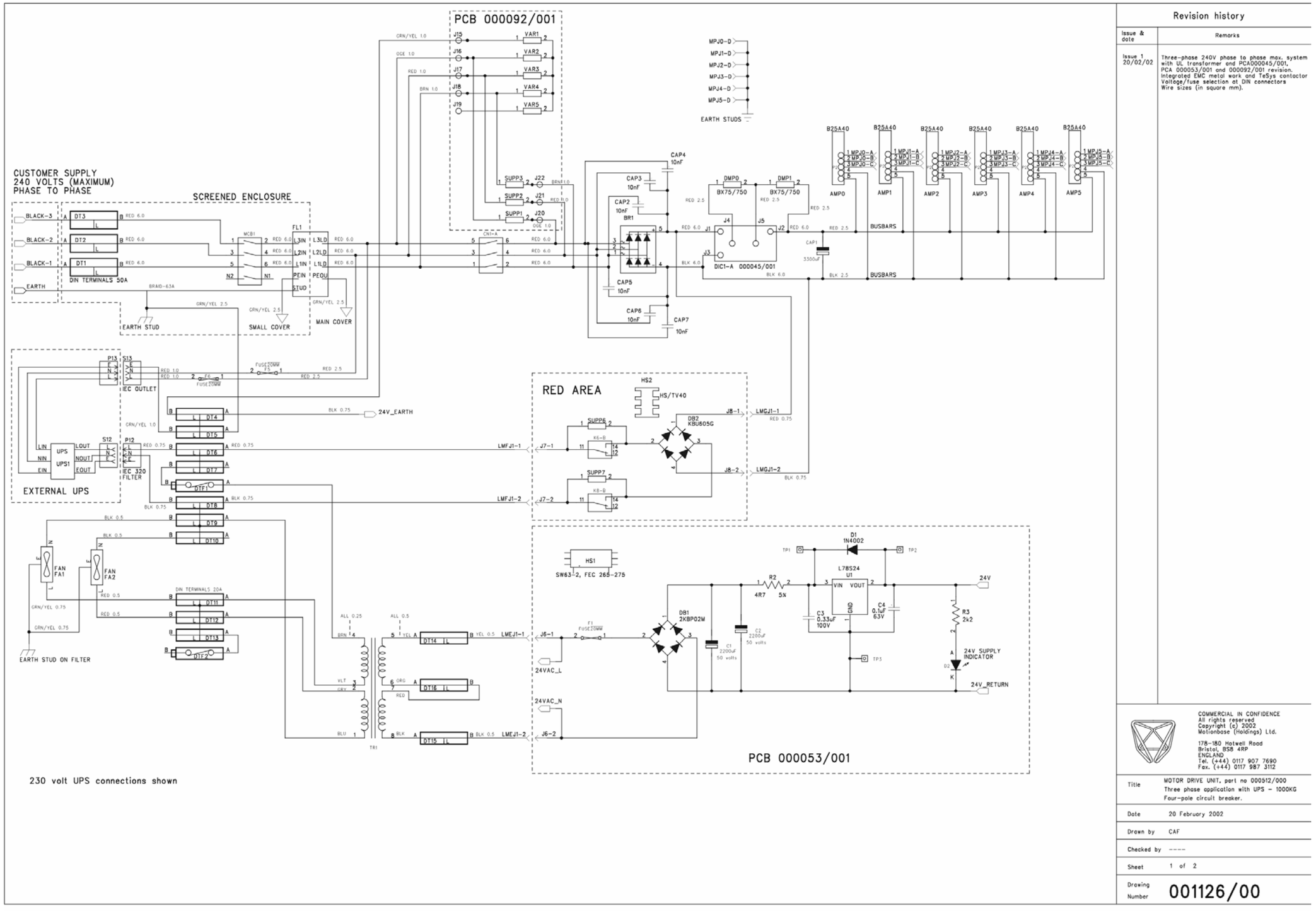


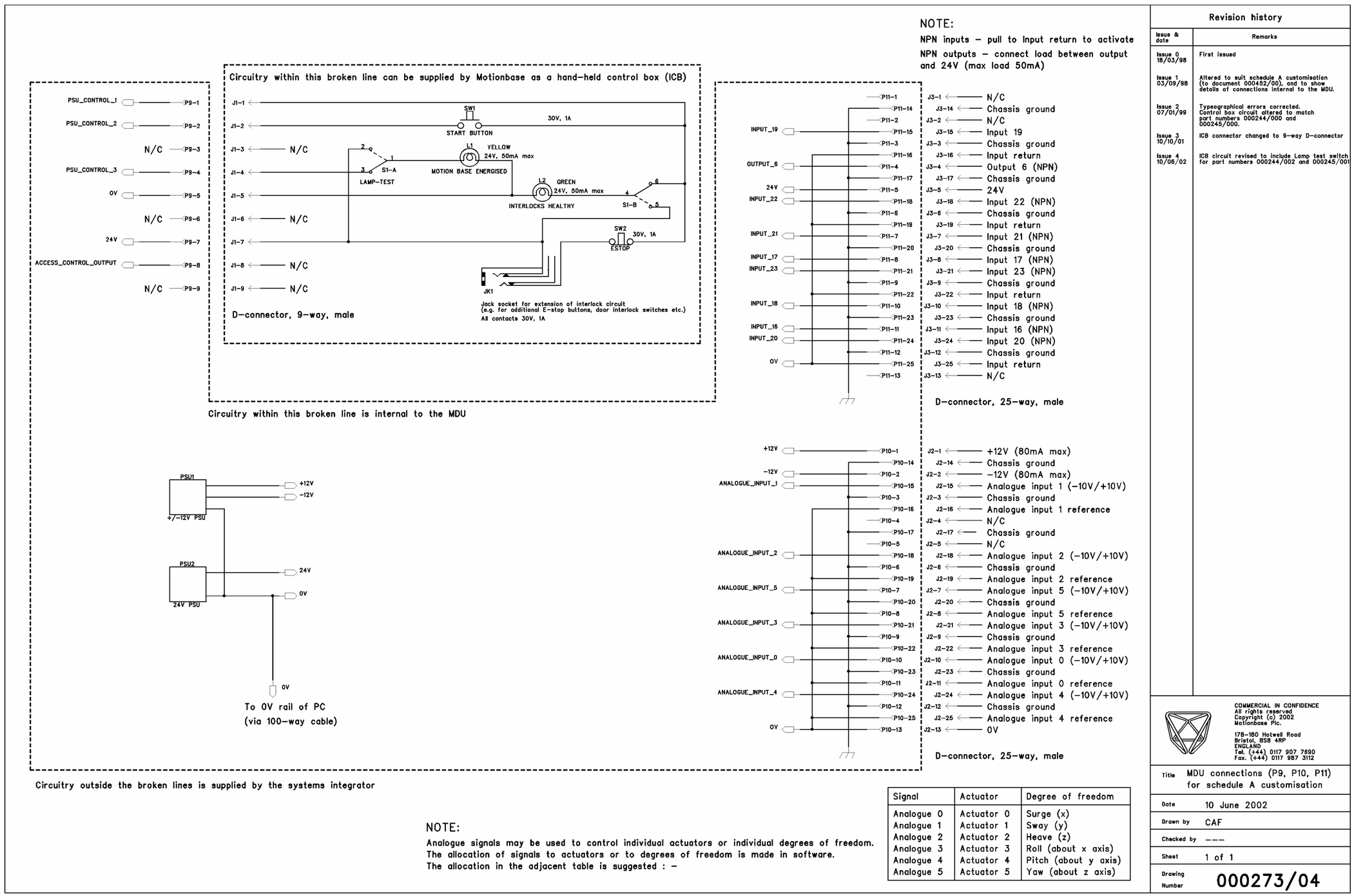
Figure 9 : System block diagram



Revision history

Issue & date	Remarks
Issue 1 20/02/02	Three-phase 240V phase to phase max. system with UL transformer and PCA000045/001. PCA 000053/001 and 000092/001 revision. Integrated EMC metal work and TeSys contactor Voltage/fuse selection at DIN connectors Wire sizes (in square mm).

Figure 10 : Partial schematic wiring diagram of MDU showing external power connections (three-phase operation)



Signal	Actuator	Degree of freedom
Analogue 0	Actuator 0	Surge (x)
Analogue 1	Actuator 1	Sway (y)
Analogue 2	Actuator 2	Heave (z)
Analogue 3	Actuator 3	Roll (about x axis)
Analogue 4	Actuator 4	Pitch (about y axis)
Analogue 5	Actuator 5	Yaw (about z axis)

Figure 11 : Pin designations for MDU connectors P9, P10, P11 & ICB