# STANDARD OPERATING PROCEDURE

| | |
|---|---|
| **Ref:** | **SOP-0205-01-N-DEV** |

| | |
|---|---|
| **Description:** | **20 RM MK2**<br>**Starpoint Technical Information** |

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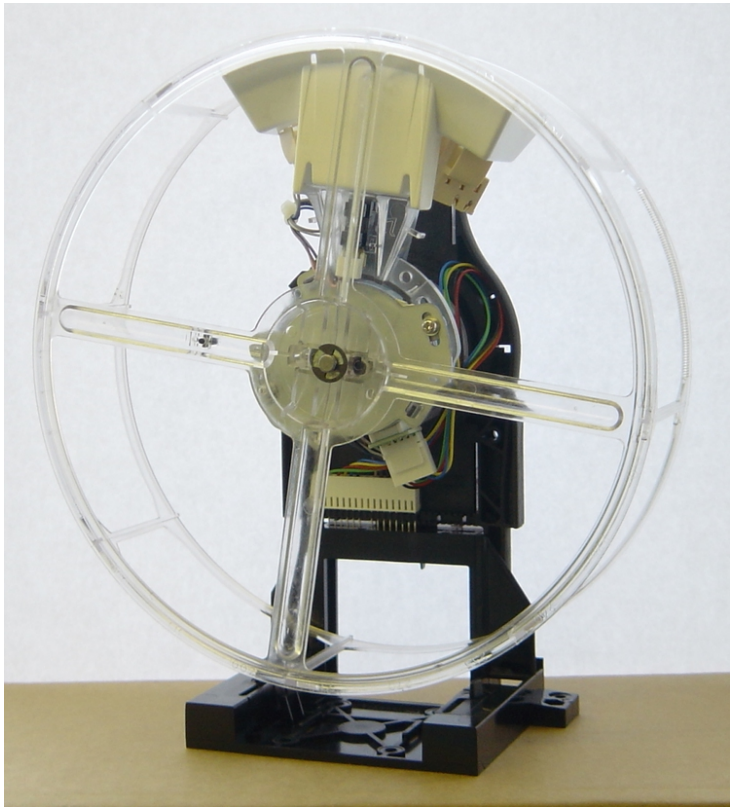
sales@starpoint.uk.com

Tel: +44 (0)208 391 7700 or Fax: +44 (0)208 391 7760

# 20 RM MK 2



# Starpoint Electrics Ltd.

Website: - www.starpoint.uk.com

Contact: - sales@starpoint.uk.com

Telephone: - +44 (0)20 8391 7700

Fax: - +44 (0)20 8391 7760

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# CONTENTS

**Drawings**

# Introduction

The 20RM MK2 is an updated version of the existing 20RM unit. This uses the modular and proven performance of the 20RM and connects electrically and mechanically in a single action to its own modular base. The 20RM MK2 has full electrical and software compatibility with the 17RM.

**THE 20RM MK2 PROVIDES MANY ADDED FEATURES.**

i) Simple push-on/lift-off mounting to it's base providing electrical and mechanical connection in one action.
ii) Dual purpose carrying handle/locking handle.
iii) Reliable instant electrical connection.
iv) Modular mounting base.
v) Elimination of the requirement for intermediate mounting trays.
vi) Individual mounting foot for feature reel use, using the push-on/lift-off mounting and locking system.
vii) Pre-phase set motor – 12v 48 Step only.

**AND USES THE FOLLOWING:-**

i) Simple to drive stepper motors.
ii) Reel drum width of 66mm & 79.5mm x 229.5 mm diameter and 66mm wide x 150mm diameter.
iii) Reel drum position detection by a single optic mounted on the lamp array. This provides easy field servicing and manufacturing adjustment.
iv) Allowance for different numbers of reel tape symbols through options on reel drums and illumination.

**THE UNIQUE 20RM MK2 MODULAR MOUNTING BASE PROVIDES A NUMBER OF FUNCTIONS.**

i) Latch and guides for secure Reel Mechanism mounting.
ii) Any number of individual base units can be latched together to form a rigid structure, eliminating the need for intermediate mounting trays.
iii) Telescopic action with preset latching positions, accommodating differing reel drum widths.
iv) The mounting base unit holds the mating half of the Reel Mechanism connector and provides routing for cable management.
v) The mounting base unit has fixings to allow easy mounting of a PCB when used in distributed processor or distributed I/O systems.

# CONDITIONS OF USE

## 1. Temperature Range

The mechanism will operate satisfactorily in the temperature range from 0°C to 50°C, provided there is an unrestricted flow of air and proper motor control is exercised.

## 2. Humidity

The unit will operate in the range of 0% to 95% - relative humidity.

## 3. Continuous Use

There is no practical limit to continuous use assuming normal motor temperature control procedures are followed. It is expected that normal operation is a minimum 12-hour day.

## 4. Operational Environment

It is recommended that the unit is not operated in an exposed environment if the public are present. The most suitable method of operation should be behind a glass or screen and can be mounted on any plane.

## 5. Operational Life

The units have been subjected to various accelerated life tests and a minimum operational life in excess of one million cycles is assumed.

## 6. Tools & Installation

The 20RM MK2 is mounted in the cabinet on its customer designed mounting base. No tools are required to fit the Reel Mechanism. If when changing reel mechanisms an adjustment to the win-line is necessary, this can be achieved by releasing a single locking screw in the centre of the motor mounting hub. See drawing number G4G022-01-ZZZZ for the position of the screw.

## 7. Handling

When handling the unit it is not recommended to handle the mechanism by the periphery of the reel. Always use the Locking / Carrying handle when carrying the reel.

**It is not recommended that the power connection be removed from the unit while the unit is in operation. Failure to remove power will most likely result in damage to the devices in the unit.**

## 8. Warranty

A guarantee of 12 months from the shipment date is available for the dice mechanism, subject to Starpoint's standard terms and conditions. This guarantee is offered irrespective of the number of operations of the unit during this period, but subject to operation within the environmental conditions specified above.
A unit, which may require return under guarantee, should be returned directly to Starpoint or the local distributor.

# MECHANICAL SPECIFICATIONS

## 1. CONSTRUCTION

The mechanism and mounting base size and shape are shown in drawing no G4G022-01-ZZZZ, G4G023-01-ZZZZ & D2S002-02-ZZZZ.

## 2. MOUNTING

The 20RM MK2 can be mounted on cabinet shelf bases or glass mounted. Note that the bases need to be ordered separately.

## 3. CABINET MOUNTING

The mounting bases are made to the dimensions in drawing number D2S002-02-ZZZZ. The spacing for the Reel Mechanism, is defined by the base which have pre-set spacing positions to ensure correct positioning.

The Reel Mechanism Sets are fitted to a cabinet and can be maneuvered via slotted mounting holes in the base to ensure correct reel aperture alignment.

The base assembly is normally supplied in sets of 3 or 4 units. Drawing number D2S002-02-ZZZZ shows the dimensions.

The part numbers to order are:-

Base = 18S001-01-ACBK
Base end = 18S002-01-ACBK (1 off per set required)

## 4. FEATURE REEL MOUNTING

When using the 20RM as a feature reel a special single unit foot 18S003-01-ACBK is available which has the same mounting / latching system as the standard 20RM MK2 base. The part number to order is 18S003-001-ACBK

5.

## LAMP ARRAY

The MK2 lamp array has been designed to provide adequate illumination for various symbols without the use of masks. The symbol illumination area may be enhanced with the use of masks if a defined illumination area is required. Details of illumination area can be seen on drawing no G6D020-01-ZZZZ
The lamp array may be fitted with 2 masks. The number and position of the masks is dependant on the illumination requirement and the number of symbols on a reel band. These will normally be fitted in the factory according to the specification sheet requirement for number of symbols. Drawing number G6G020-01-ZZZZ shows how the masks are arranged to achieve various symbol options.

6.

## LAMP ARRAY ADJUSTMENT

The lamp array is fully adjustable through 360° of movement. Drawing number G6D019-01-ZZZZ shows the graduated scale that is used to position the lamp array in the required position relative to the frame. Each graduation represents an angular movement of 1°. The scale is marked from 0 (at the bottom) to 180 (at the top) and the lamp array can be set in any position. The angle setting required can be specified by looking at the pointer on the lamp array/motor housing and noting its position. It is important that as well as stating the angular position; a positive or negative direction is stated when ordering units. When a positive value is given the lamp array will be in the reverse position. See Drawing number G6D019-01-ZZZZ

Adjustment to the lamp array is made by releasing the motor mounting screw, shown on Drawing number G4G022-01-ZZZZ moving it to the desired position and then re-tightening the screw.

# ELECTRICAL SPECIFICATIONS

## 1 Electrical Connections

A circuit diagram for the unit is shown in drawings G5D040-01-ZZZZ & G5D041-01-ZZZZ and the unit is interfaced to a users product using a 15 way Molex connector type 7720S Series #: 22-50 3155 IDC. The mechanism can be obtained in two lamp drive configurations - Sinking and Sourcing. See Drawings G5D040-01-ZZZZ & G5D041-01-ZZZZ. The diodes in series with the lamps provides the option of matrixing the lamps with other lamps in the cabinet thus reducing driver circuits and wire harness sizes.

## 2 Stepper Motor

The motor is available as 48 step 12 or 24 volt DC Drawings A1C01-02-ZZZZ & A1C002-02-ZZZZ supplying company - NMB of Japan.

The 12v 48 Step motor has been designed to snap into a pre-defined location on the reel mechanism, eliminating the need to “Phase Set” This enables the motor to be easily replaced if required.

## 3 Position Control Sensor

The position control sensor is a self-contained photo optic sub-assembly complete with built in schmitt trigger and open collector output. A high level denotes the optic is interrupted.

## 4 Stepper Motor Control

The reel drum is driven by a 48 step 12 or 24 volt DC motor which positions the reel band. Recommended symbols per reel band can be either 8, 12, 16, 20, 24. (Masks are available for 12,16,20, and 24 Symbols).

Examples of ramp tables for various reel drum sizes are shown in Appendix A. The ramp tables shown are nominal values, which could be optimised to meet individual customer requirements with regard to reel drive characteristics, such as soft stop or sharp stop. To obtain the same characteristics in reel drive for different width reel drums the ramp tables may require some modification. If difficulty is experienced in achieving the required effect or speed of rotation, please call the Starpoint on +44(0) 208 391 7700

With the mechanism at rest and full power applied to the motor, it is possible for the motor temperature to rise unnecessarily causing a loss of torque and in exceptional circumstances overheating. To avoid this situation it is strongly recommended the following controls are applied. Failure to do this could invalidate the warranty.

To limit heating effect and maintain high motor torque, it is advised that the power applied to the motor at standstill be pulsed or turned on and off. The switched power should be in the ratio of 50:50 mark space, based on the running timing. This provides the required holding torque at standstill and will prevent inadvertent reel movement. It is also recommended that a short delay of 500mS be used before commencing this switching procedure after the reel has stopped and before starting the next spin cycle. The delays are to ensure that this on/off sequence does not influence the start and stop ramping.

## 5 REEL BAND ILLUMINATION

For all reel drums the lamps can be fitted to illuminate reel band symbols with options to cover a different number of stop conditions. The individual lamps can be straight link or diode configured. Diode connections allow matrixing possibilities thus saving on drive circuit power and wire harness size. Different lamp looms can be specified to allow for common diode (sourcing) or common lamp (sinking) drive methods. See drawings A3C001-02-ZZZZ, A3C002-02-ZZZZ & A3C065-02-ZZZZ. There are also options for 6,12 and 24 volt bulbs in a range of wattage ratings. The mechanism can also be ordered without. There are also options for 6, 12 and 24 volt bulbs in a range of wattage ratings. The standard mechanism comes with out masks, which allow a rear flood effect of the 3 symbols.

## 6 Motor Drive Software

### a) Reset Procedure

This procedure is recommended at power on or on occasion when the software identifies that the reel band is out of step or in an incorrect position.

I. Drive the motor at approximately 50RPM.
II. At every motor step change, monitor the optic output. Immediately the tab is detected by the optic cease driving the motor.
III. Wait 500mS then power up the motor on the Black and Yellow windings.
IV. Wait 500mS, this allows the motor/reel band to settle in position. Check the tab is in the optic. If not repeat steps i] to iv], if the tab is still not in the optic there is a fault.
V. The reel mechanism and software are now initialised.
VI. Now enter the standstill mode or resume the game in play, whichever is appropriate.

## b] Optic Tab Monitoring During Reel Spin

During reel spin or game play it is important to monitor the optic tab to confirm it is at the expected position. This can be achieved during reel spin as long as a window is set around the time the tab is expected to be seen. This window is to allow for ramping up or down of the motor and variation in operational spin speeds. To confirm the reel band is in synchronisation carry out the following tests in software.

i] When the reel is to stop on the master symbol, ensure the step sequence stops with the black and yellow windings energised. The optic tab will be in the optic. If the optic tab is not in the optic enter the reset procedure.

ii] To monitor the optic during reel spins create a window of 6 motor steps, within which the optic tab should interrupt the optic. This window is dependant on users software and may need development to an optimum size. If difficulty is experienced with this monitoring please contact Starpoint on + 44 (0)20 8391 7700.

# ADJUSTMENTS AND CALIBRATION

The reel mechanism construction is such that adjustment of the motor mounting, or lamp array position, do not interact with each other, which means secondary adjustments are not necessary.

**1.**

## For 24v Motors only

The stepper motor has a cross pin in the shaft which is used to ensure consistent drive of the reel drum. This pin must be aligned to the optic sensor and this adjustment is called the “phase setting adjustment”. The lamp array may be moved to a position between + or - 0° to 180° (see drawing G6D019-01-ZZZZ) to align with game win-line. The optic tab position is fixed on the reel drum and directly relates to the reel band win-line due to the physical position of the optic detector in the lamp array assembly.
The above settings are recommended to be carried out at the time of manufacture, if assistance is required in defining lamp array setting, please call Starpoint on +44 (0)20 8391 7700.

**2.**

## Motor Phase Setting

This adjustment may be required when due to exceptional circumstances the motor requires replacement.

Tools required: - Crosshead Screwdriver
24vdc 1A Power Supply

**3.**

## Method

- Loosen motor fixing screws in the motor housing moulding screws on Drawing G4G022-01-ZZZZ
- Ensure the lamp array adjustment screw is tight –See Drawing G4G022-01-ZZZZ).
- Apply 0V to the Yellow and Black phases of the motor via pins 10 and 12 on the 15-way customer connector and +12v to pins 14 and 15.
- Rotate the reel drum until the optic tab is near the optic detector.
- Rotate the motor housing until the optic tab is central in the optic detector.
- Maintain this position and tighten the two motor fixing screws.
- Disconnect the 12v supply.
- The motor is now phase set and the lamp array position may be adjusted as necessary, see Section 10 (ii) for method.

## 4. Reel Band Fixing Procedure

The design of the reel drum allows a choice for the method of fixing the reel band onto the drum. This can be achieved by the use of plastic rivets or double sided adhesive tape.

## 5. Method for fixing reel band using rivets

1. The reel band and artwork must be designed such that there is an overlap on the band as shown on Drawing G6D018-01-ZZZZ. The area of band which is decided as being below the overlap should be clear of print.

2. Position the clear band with the two punched holes over the corresponding holes in the reel drum. Carefully bring the band round the drum so that the end of the band punch holes align with the drum.

3. Insert plastic rivets. Suitable rivets can be obtained from a number of suppliers. One such recommended supplier is Richo International, snap rivet part number SR 2632 or RS part number 256 0009.

## 6. Method for fixing reel band using Adhesive Tape

1. The reel band artwork must be designed such that there is a small overlap sufficient to bond the two ends of the reel band together using double-sided adhesive tape.

2. A clear area of band must be on the under lap area of the band.

3. Carefully align the clear areas on the band with the center line of the reel spoke as shown on Drawing G6D018-01-ZZZZ. Bond the end of the tape to the reel drum using double-sided adhesive tape.

4. Carefully bring the reel band round the drum until the end of the band for overlap is in position. Bond into position using the double-sided adhesive tape.

# ORDERING INFORMATION

This section deals with how to complete the Specification / Quotation Sheet (see Appendix B) SOPF-0195-01-N-DEV. The document is unique for each application and the specification sheet identifier contains the configuration information, which Starpoint will use for manufacture of the 20RM MK2.

This ordering information covers the specifying of the 20RM MK2, a separate order must also be placed for the mounting base, (See page 8 for details). The Spec Sheet contains a series of options across the page with a corresponding clear box on the right hand side. Once the selection of option is made the letter corresponding to the required option should be entered in the right hand box. The total combination of completion of all the empty boxes creates a unique build standard coding.

## THE FOLLOWING DEALS WITH EACH SECTION OF THE SPECIFICATION / QUOTATION SHEET

i) **CUSTOMER** – Fill in with Company Name

ii) **CUSTOMER PART NUMBER** -The Customer Part Number will be recorded in this area and within Starpoint cross-referenced to the customer's part number. Both numbers are included on the order and invoice documents.

iii) **DATE** – Date of completion

iv) **QUOTATION REQUIRED** – Please indicate by deleting either the YES or NO if a formal quotation is required.

v) **QUANTITY REQUIRED** – If a quotation is required, please add the qty to the box.

vi) **COMMENTS** – Space for any specific comments

vii) **REEL** – Select the correct reel that is required form the list

viii) **MOTOR -** Select the motor required, and enter the corresponding letter in the right hand box.

ix) **LAMP ARRAY -**

a) Number of Symbols

If required the number of symbols on the band must be defined to enable the correct selection of the masks, which control the illumination to suit the symbols on the band.

b) Wiring type

This option is shown on the Spec Sheet in the connection diagram and provides the option of which polarity the lamps are commoned together.

c) Lamp Type

Select the desired lamps from those available in the table. Care must be taken when selecting the higher wattage lamps, because if the lamps are illuminated for long periods when the reels have not moved, damage may occur to the reel band due to the heat.

d) Lamp Array Pointer Position

This selection is to define the win-line position either to the front or rear of the reel mechanism and is seen on drawing G6D019-01-ZZZZ

e) Top Lamp Position

This is to specify the position of the loom in the lamp array – See diagram at top of page

Viii **Handle -** This is to nominate the preferred size of handle required.

Xi **Band -** This specifies the Reel Band requirement.

# CARRIAGE AND DISTRIBUTION

All Starpoint reel mechanisms are shipped in returnable cardboard packaging. Individual reel mechanisms are located in cut-outs in layer cards to prevent movement in transit. There are 6 reel mechanisms per layer with the total number of mechanisms varying dependant on reel width.

The packaging is designed to use the minimal space when empty **and should be returned to Starpoint after use.**

## APPENDIX A

# Ramp Table Examples

### SUGGESTED RAMPS FOR NMB 12 & 24v 48 STEP MOTOR 66mm & 79.5mm REELS

All values in millisecs and are the delays between phase changes.

| | | |
|---|---|---|
| 69 RPM | UP | 47 - 28 - 18 - 26 |
| | RUN | 18 |
| | DOWN | 23 - 20 - 48 |
| 78 RPM | UP | 46 - 27 - 16 - 24 |
| | RUN | 16 |
| | DOWN | 25 - 16 - 48 |
| 89 RPM | UP | 38 - 24 - 14 - 25 |
| | RUN | 14 |
| | DOWN | 26 - 14 - 46 |
| 96 RPM | UP | 37 - 26 - 14 - 23 |
| | RUN | 13 |
| | DOWN | 15 - 25 - 16 - 41 |
| 104 RPM | UP | 39 - 28 - 13 - 20 |
| | RUN | 12 |
| | DOWN | 14 - 22 - 15 - 42 |

16 SYMBOL NUDGE

| | |
|---|---|
| Full Step (3 steps/symbol) | 45 - 57 |
| Half Step (6 steps/symbol) | 42 - 30 - 24 - 30 - 44 |

24 SYMBOL NUDGE

| | |
|---|---|
| Half Step (4 steps/symbol) | 55 - 45 - 55 |

Examples of Ramp Tables to drive the various reel drum sizes at the different speeds are shown above. These Ramp Tables are nominal values which should be optimised to meet individual requirements with regard to reel drive characteristics, such as soft stop or sharp stop of the reel drum. To obtain the same characteristics in reel drive for different width reel drums the Ramp Tables may require some modification.

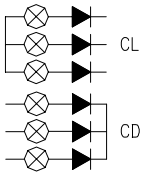
STARPOINT

## APPENDIX B

STARPOINT

### 20RM MK2 SPECIFICATION / QUOTATION SHEET

| | |
|---|---|
| **CUSTOMER:** | |
| **CUSTOMER PART NUMBER:** | |
| **DATE:** | |
| **QUOTATION REQUIRED:** | **YES / NO** |
| **QUANTITY REQUIRED:** | **XXXX** |
| **COMMENTS:** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **MECH** | 20RM MK2 REEL MECHANISM | | | | | **AX** |
| **REEL** | REEL WIDTH | A 228 DIA, 66 WIDE, 8 BAR CLEAR | | C 228 DIA, 79.5 WIDE 8 BAR CLEAR | | |
| **MOTOR** | VOLTAGE/ STEP ANGLE | A 12V. 48 STEP NMB | | B 24V. 48 STEP NMB | | |
| **LAMP ARRAY**   | No. OF SYMBOLS | S STANDARD NO MASKS | | 2 24 | | |
| | | 4 16 | | 7 12 | | |
| | WIRING TYPE | A 3 LAMP SINKING COMMON LAMP (CL) | B 3 LAMP SOURCING COMMON DIODE (CD) | Z NON ILLUMINATED | | |
| | LAMP TYPE | 01 6.3V 0.25A | 02 12V 2CP | 04 24V 2W | | |
| | | 05 12V 1.2W | ZZ NO LAMPS REQUIRED | | | |
| | LAMP ARRAY POINTER POSITION | **0 - 359** degrees (SEE PICTURE ABOVE) | | | | |
| | TOP LAMP POSITION | A + | B - | Z NON ILLUMINATED | | |
| **HANDLE** | HANDLE LENGTH | A LONG HANDLE (STANDARD) | | B SHORT HANDLE | | |
| **BAND** | BAND FITTING | 1 BAND FITTED | | Z BAND NOT FITTED | | |

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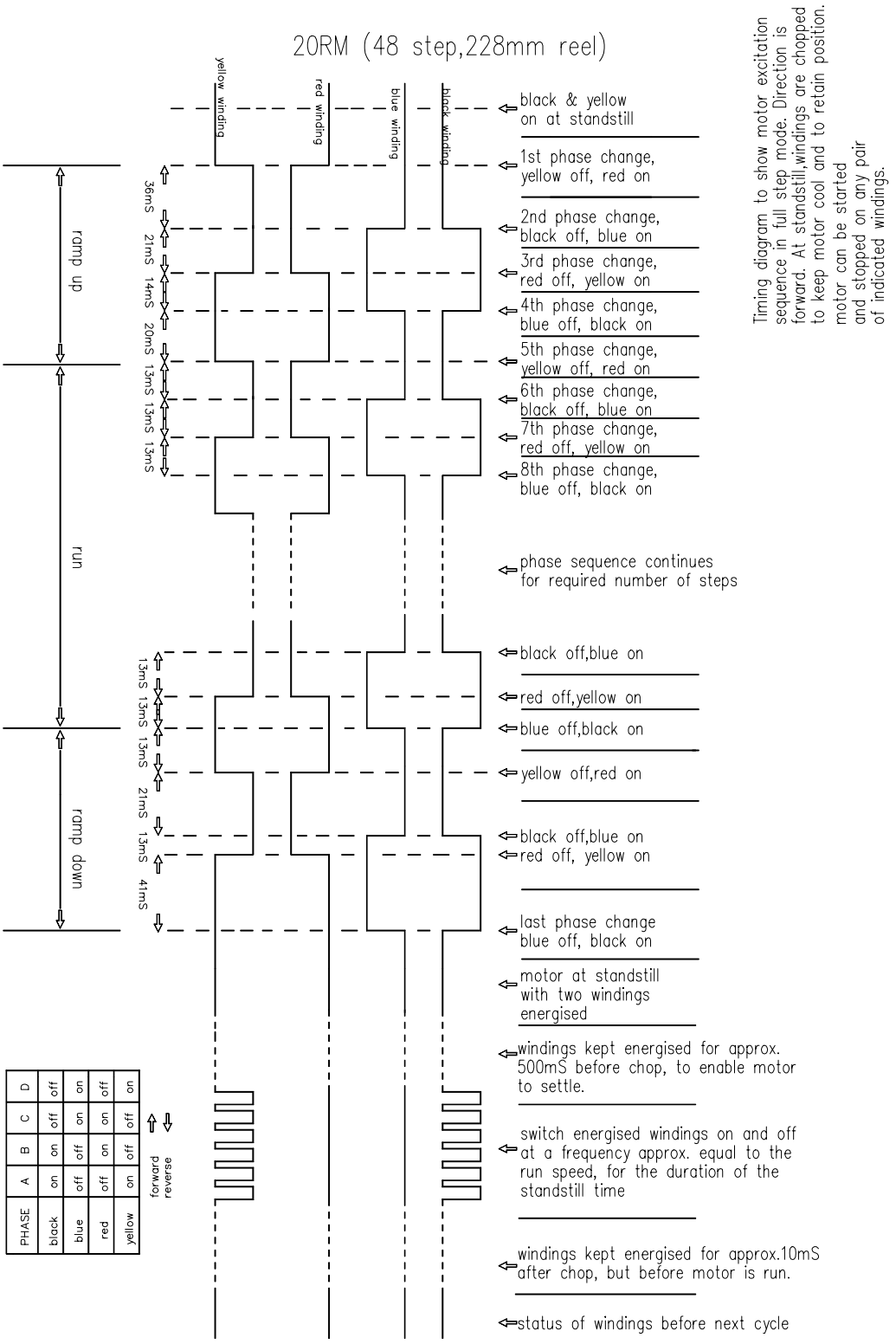
UNITS 1-5, KING GEORGES TRADING ESTATE, DAVIS ROAD, CHESSINGTON, KT9 1TT
TEL: +44 (0) 20 8391 7700 FAX: +44 (0) 20 8391 7760 E-MAIL: info@starpoint.uk.com


**SOPF-0195-01-N-DEV**

## APPENDIX C

# Timing Diagram

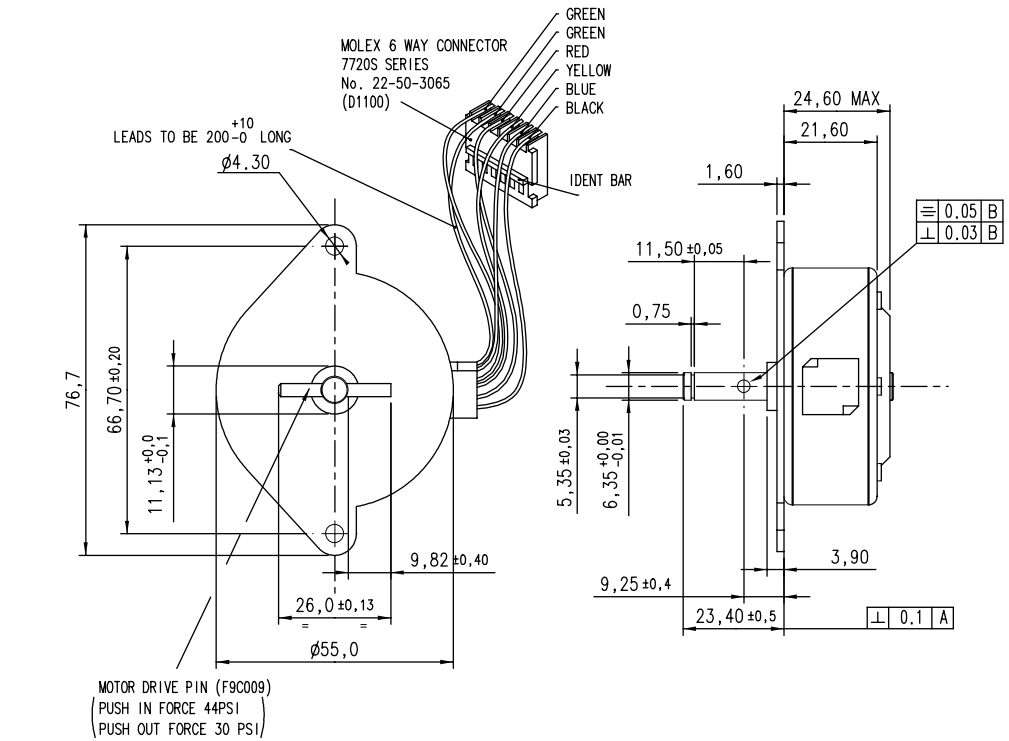


## APPENDIX D

# DRUM VARIATIONS

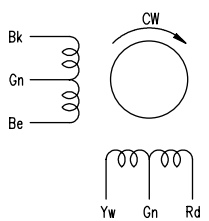
| Reel Drum Width | Number of Peripheral Support Bars | Reel Drum Diameter in mm | Recommended Number of Symbols on Band | Number of Lamps per Symbol | Matrix Diode Available |
|---|---|---|---|---|---|
| 66mm | 4 | 150 | 12 or 16 | 1 | Yes |
| 66mm | 8 | 229.5 | 16,24. | 1 | Yes |
| 79.5mm | 8 | 229.5 | 8, 16, 24 | 1 | Yes |

IF IN DOUBT ASK, DO NOT SCALE | THIRD ANGLE PROJECTION




## SPECIFICATION

| | |
|---|---|
| STEP ANGLE | : 7.5° |
| POSITIONAL ERROR | : 0.5° |
| MAGNET | : MS70 |
| WINDING RESISTANCE (OHMS/PHASE) | : 30 ±10% |
| WINDING INDUCTANCE (mH/PHASE) | : 27mH |
| HOLDING TORQUE (g-cm) | : 1530 MIN. |
| PULL OUT TORQUE (g-cm)at 80pps | : 800 MIN. |
| PULL IN TORQUE (g-cm)at 80pps | : 780 MIN. |
| DETENT TORQUE (g-cm) | : 190 |
| MAX. NO LOAD RESPONCE (pps) | : 230 |
| MAX. SLEW SPEED (pps) | : 260 |
| PHASE ON METHOD | : 2-2 |
| AMBIENT TEMP (OPERATING) | : -10° TO +50°C |
| AMBIENT TEMP (STORAGE) | : -30° TO +80°C |
| DRIVE VOLTAGE | : 12V. |
| CLASS OF INSULATION | : E |
| DIELECTRIC STRENGTH (V-AC) | : 500V-AC 60sec 5mA |
| INSULATION RESISTANCE (M-ohm) | : 500V-DC 100 MIN. |
| WEIGHT | : 275 g |




EXCITATION SEQUENCE CW looking at output shaft

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| BLUE | On | On | | |
| BLACK | | | On | On |
| RED | On | | | On |
| YELLOW | | On | On | |

UNLESS OTHERWISE STATED GENERAL TOLERANCE:-
1 DEC, PLACE ±0.40mm. 2 DEC, PLACES ±0.10mm.
CONCENTRICITY 0.10mm. MAX.
ANGULAR ± 0.5°

ALL DIMENSIONS IN mm, AND TO APPLY AFTER PLATING.

MATERIAL.

FINISH.

USED ON.
MECH'S

SCALE 1 : 1

SHEET 1 of 1

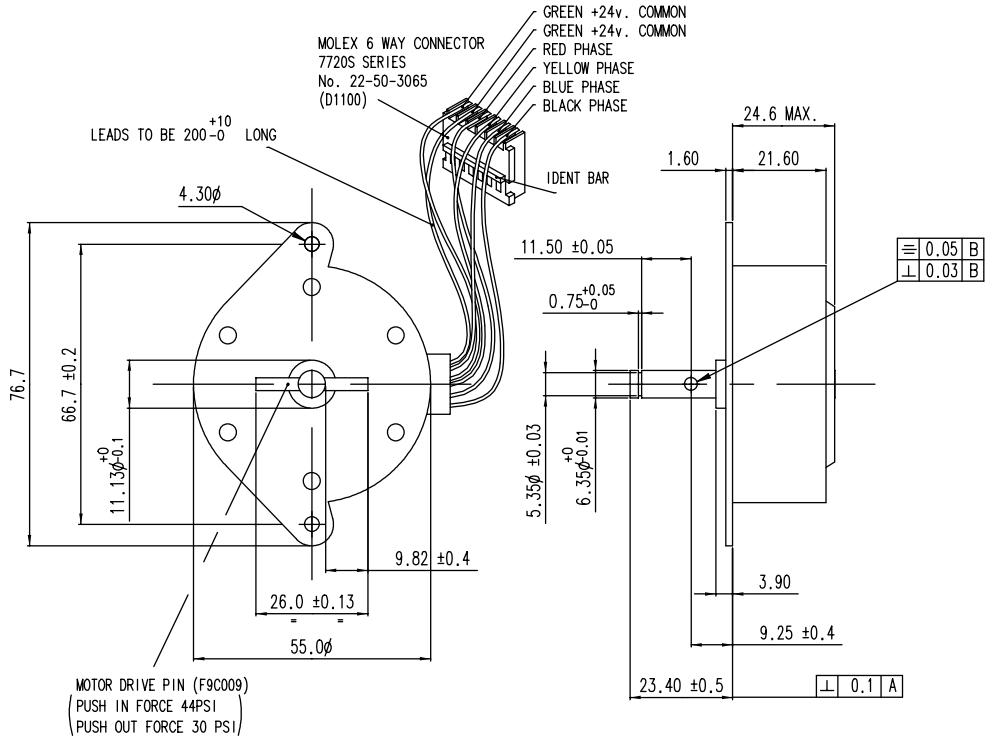
STARPOINT
KING GEORGE'S TRADING ESTATE
DAVIS ROAD, CHESSINGTON,
SURREY KT9 1TT - UK.
TEL: +44 (0)20 8391 7700 FAX: +44(0)20 8391 7760
WEBSITE: www.starpoint.uk.com

| | | | |
|---|---|---|---|
| DRAWN DJW | 09/04/03 | SEE EC 0000088 | 02 |
| CHECKED | 07/04/03 | REDRAWN ON IDEAS | 01 |
| | DATE | MODIFICATION | ISSUE |

TITLE.
12v STEP NMB MOTOR PM55L-048-SRA2
(OLD PART No. B988)

| DRAWING No. | ISSUE. | SPECIFICATION |
|---|---|---|
| A1C001 | 02 | ZZZZ |

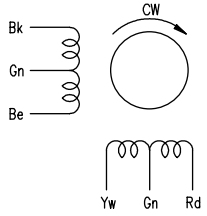
IF IN DOUBT ASK, DO NOT SCALE | THIRD ANGLE PROJECTION




## SPECIFICATION

| | | |
|---|---|---|
| DRIVE VOLTAGE | : | 24v. |
| PHASE ON METHOD | : | 2-2 (PHASE ON) |
| MAGNET MATERIAL | : | MS70M |
| STEP ANGLE | : | 7.5° |
| POSITIONAL ERROR | : | 0.5° |
| MAX. HOLDING TORQUE | : | 15.5cNm (1580g-cm)MIN. 176mA/PHASE |
| PULL OUT TORQUE | : | 8.20cNm (836g-cm) MIN. 80 PPS |
| PULL IN TORQUE | : | 8.0cNm (815.7g-cm) MIN. 80 PPS |
| MAX. NO LOAD RESPONSE | : | 220 pps MIN. |
| MAX. SLEW SPEED | : | 260 pps MIN. |
| WINDING RESISTANCE | : | 133 ohms ±10% |
| WINDING INDUCTANCE | : | 120mH REF. 1KHz, 1Vrms |
| INSULATION RESISTANCE | : | 100 MOhms MIN. 500v.DC |
| DIELECTRIC STRENGTH | : | 500 VAC. 1 MIN. |
| TEMPERATURE RISE | : | Δ T = -- ° MAX. |
| CLASS OF INSULATION | : | CLASS E |
| ROTOR INERTIA | : | 33.2g-cm² REF. |
| DETENT TORQUE | : | 1.70cNm (173g-cm) REF. |
| AMBIENT TEMP.(OPERATING) | : | -10°C TO +50°C |
| AMBIENT TEMP.(STORAGE) | : | -30°C TO +80°C |
| LIFE | : | 3000 HOURS |

EXCITATION SEQUENCE CW looking at output shaft




| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| BLUE | On | On | | |
| BLACK | | | On | On |
| RED | On | | | On |
| YELLOW | | On | On | |

UNLESS OTHERWISE STATED GENERAL TOLERANCE:-
1 DEC, PLACE ±0.40mm. 2 DEC, PLACES ±0.10mm.
CONCENTRICITY 0.10mm. MAX.
ANGULAR ± 0.5°
ALL DIMENSIONS IN mm, AND TO APPLY AFTER PLATING.

MATERIAL.
FINISH.

USED ON.
MECH'S

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WEBSITE: www.starpoint.uk.com

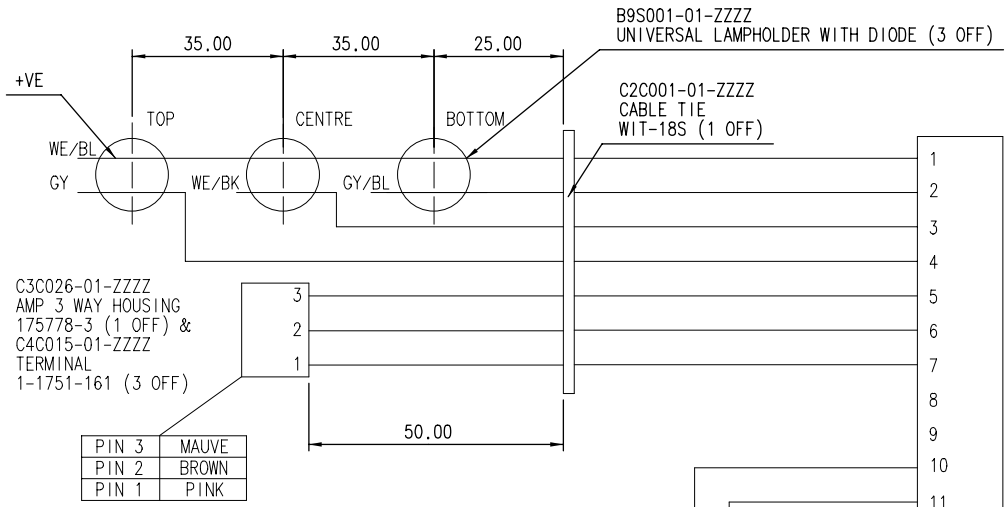
SCALE: NTS
SHEET: 1 of 1

| | | | |
|---|---|---|---|
| DRAWN DJW | 9/04/03 | SEE EC 0000088 | 02 |
| CHECKED | 9/04/03 | REDRAWN ON IDEAS | 01 |
| | DATE | MODIFICATION | ISSUE |

TITLE.
24V 48 STEP NMB MOTOR PM55L-048-SRB5
(OLD PART No. B997)

| DRAWING No. | ISSUE. | SPECIFICATION |
|---|---|---|
| A1C002 | 02 | ZZZZ |

IF IN DOUBT ASK, DO NOT SCALE | THIRD ANGLE PROJECTION




| | |
|---|---|
| PIN 3 | MAUVE |
| PIN 2 | BROWN |
| PIN 1 | PINK |

| | |
|---|---|
| PIN 6 | BLACK |
| PIN 5 | RED |
| PIN 4 | GREEN |
| PIN 3 | VACANT |
| PIN 2 | BLUE |
| PIN 1 | YELLOW |

| PIN No | WIRE COLOUR | LENGTH $^{+10}_{-0}$ |
|---|---|---|
| PIN 1 | WHITE/BLUE | 265.0 |
| PIN 2 | GREY/BLUE | 195.0 |
| PIN 3 | WHITE/BLACK | 230.0 |
| PIN 4 | GREY | 265.0 |
| PIN 5 | MAUVE | 220.0 |
| PIN 6 | BROWN | 220.0 |
| PIN 7 | PINK | 220.0 |
| PIN 8 | VACANT | VACANT |
| PIN 9 | VACANT | VACANT |
| PIN 10 | BLACK | 235.0 |
| PIN 11 | BLUE | 235.0 |
| PIN 12 | YELLOW | 235.0 |
| PIN 13 | RED | 235.0 |
| PIN 14 | VACANT | VACANT |
| PIN 15 | GREEN | 235.0 |

NOTE:-

1. ALL WIRES TO BE 7/0.2
2. ALL WIRES TO BE UL94 RATING SPECIFICATION UL1061

UNLESS OTHERWISE STATED GENERAL TOLERANCE:-
1 DEC, PLACE ±0.40mm. 2 DEC, PLACES ±0.10mm.
CONCENTRICITY 0.10mm. MAX.
ANGULAR ± 0.5°
ALL DIMENSIONS IN mm, AND TO APPLY AFTER PLATING.

MATERIAL.
FINISH.

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WEBSITE: www.starpoint.uk.com

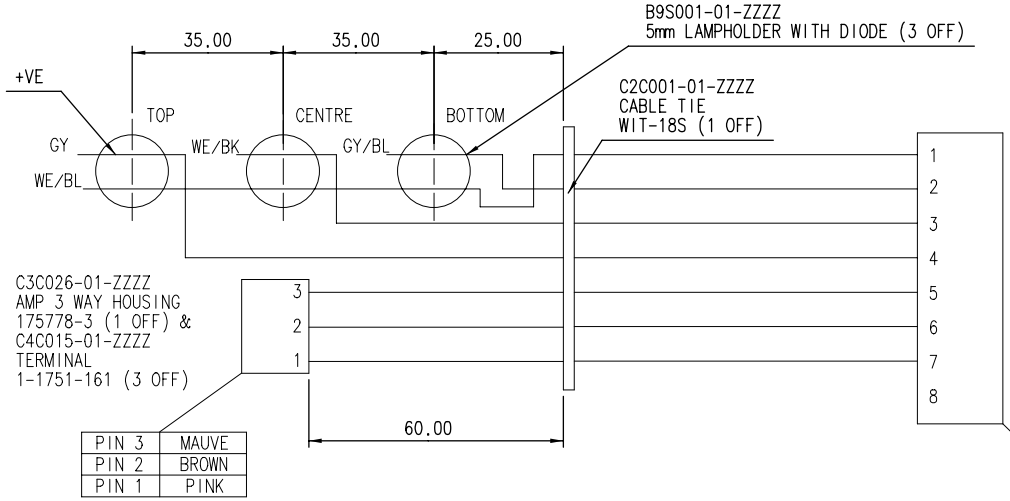
USED ON. 20RM
SCALE 1 : 1
SHEET of

| | | | |
|---|---|---|---|
| DRAWN AN | 18/06/01 | SEE ECN A3C001-02 | 02 |
| CHECKED TJ | 23/11/00 | RENUMBERED | 01 |
| | DATE | MODIFICATION | ISSUE |

TITLE. 3 LAMP SINKING DIODE LOOM

| DRAWING No. | ISSUE. | SPECIFICATION |
|---|---|---|
| A3C001 | 02 | ZZZZ |

IF IN DOUBT ASK, DO NOT SCALE | THIRD ANGLE PROJECTION




| PIN 3 | MAUVE |
|---|---|
| PIN 2 | BROWN |
| PIN 1 | PINK |

C3C008-01-ZZZZ
MOLEX 8 WAY HOUSING
22-50-3085 (1 OFF).

| PIN No | WIRE COLOUR | LENGTH $^{+10}_{-0}$ |
|---|---|---|
| PIN 1 | WHITE/BLUE | 265.0 |
| PIN 2 | GREY/BLUE | 195.0 |
| PIN 3 | WHITE/BLACK | 230.0 |
| PIN 4 | GREY | 265.0 |
| PIN 5 | MAUVE | 230.0 |
| PIN 6 | BROWN | 230.0 |
| PIN 7 | PINK | 230.0 |
| PIN 8 | VACANT | VACANT |

NOTE:-

1. ALL WIRES TO BE 7/0.2
2. ALL WIRES TO BE UL94 RATING SPECIFICATION UL1061

UNLESS OTHERWISE STATED
GENERAL TOLERANCE:-
1 DEC, PLACE ±0.40mm. 2 DEC, PLACES ±0.10mm.
CONCENTRICITY 0.10mm. MAX.
ANGULAR ± 0.5°

ALL DIMENSIONS IN mm, AND TO APPLY AFTER PLATING.

MATERIAL.

FINISH.

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USED ON. 20RM

SCALE 1 : 1

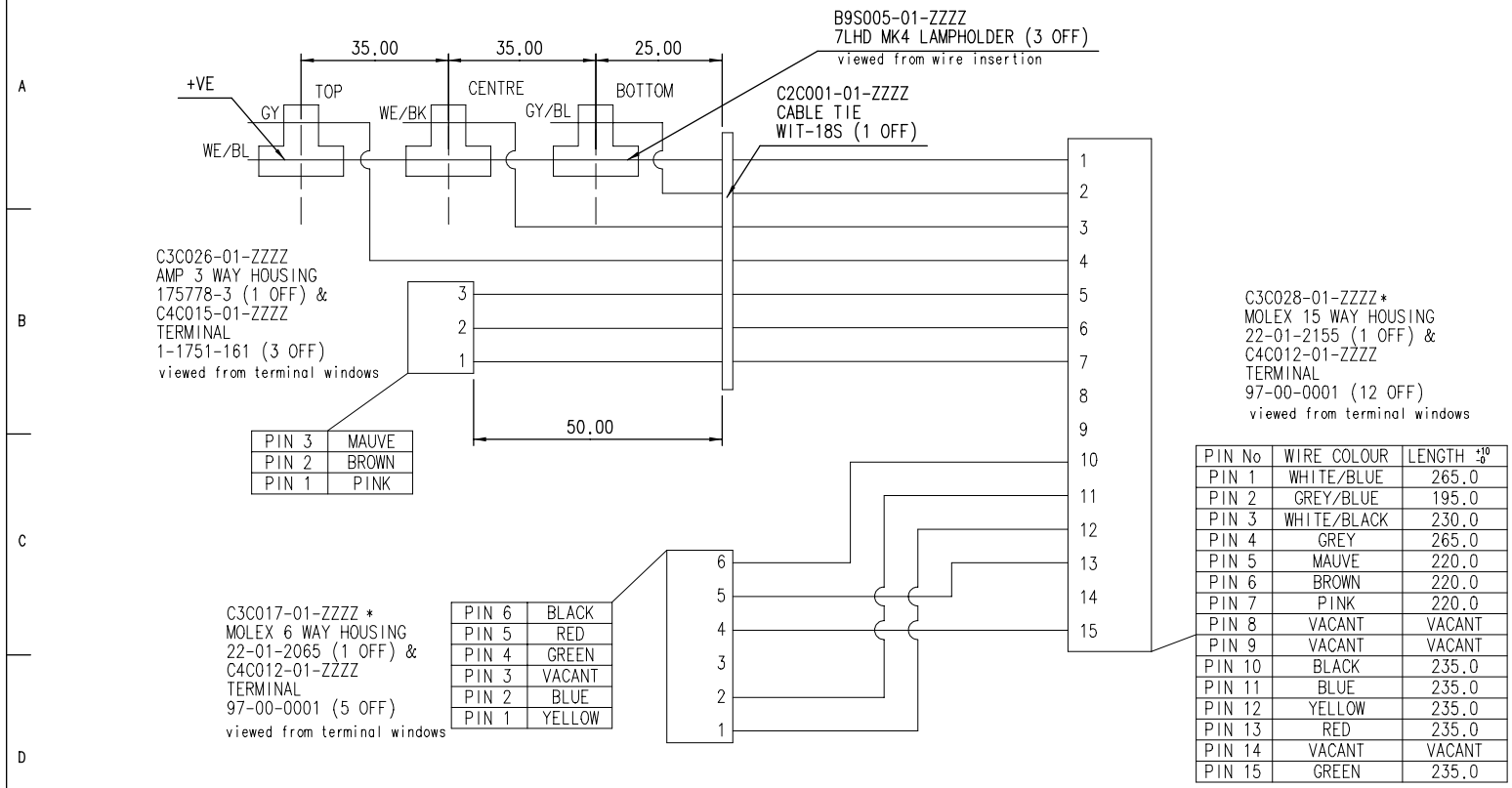
SHEET of

| | | | |
|---|---|---|---|
| DRAWN AN | 18/01/02 | SEE ECN A3C002-02 | 02 |
| CHECKED TJ | 23/11/00 | RENUMBERED | 01 |
| | DATE | MODIFICATION | ISSUE |

TITLE. 3 LAMP SOURCING DIODE LOOM

| DRAWING No. | ISSUE. | SPECIFICATION |
|---|---|---|
| A3C002 | 02 | ZZZZ |

IF IN DOUBT ASK, DO NOT SCALE | THIRD ANGLE PROJECTION




| | |
|---|---|
| PIN 3 | MAUVE |
| PIN 2 | BROWN |
| PIN 1 | PINK |

| | |
|---|---|
| PIN 6 | BLACK |
| PIN 5 | RED |
| PIN 4 | GREEN |
| PIN 3 | VACANT |
| PIN 2 | BLUE |
| PIN 1 | YELLOW |

| PIN No | WIRE COLOUR | LENGTH $^{+10}_{-0}$ |
|---|---|---|
| PIN 1 | WHITE/BLUE | 265.0 |
| PIN 2 | GREY/BLUE | 195.0 |
| PIN 3 | WHITE/BLACK | 230.0 |
| PIN 4 | GREY | 265.0 |
| PIN 5 | MAUVE | 220.0 |
| PIN 6 | BROWN | 220.0 |
| PIN 7 | PINK | 220.0 |
| PIN 8 | VACANT | VACANT |
| PIN 9 | VACANT | VACANT |
| PIN 10 | BLACK | 235.0 |
| PIN 11 | BLUE | 235.0 |
| PIN 12 | YELLOW | 235.0 |
| PIN 13 | RED | 235.0 |
| PIN 14 | VACANT | VACANT |
| PIN 15 | GREEN | 235.0 |

* 15 WAY CONNECTOR HAD INCORRECT STARPOINT Pt No. C7C023
6 WAY CONNECTOR HAD INCORRECT STARPOINT Pt No. C7C017
INCLUDE ON NEXT ENGINEERING CHANGE

NOTE:-

1. ALL WIRES TO BE 7/0.2
2. ALL WIRES TO BE UL94 RATING SPECIFICATION UL1061

UNLESS OTHERWISE STATED
GENERAL TOLERANCE:-
1 DEC, PLACE ±0.40mm. 2 DEC, PLACES ±0.10mm.
CONCENTRICITY 0.10mm. MAX.
ANGULAR ± 0.5°

ALL DIMENSIONS IN mm, AND TO APPLY AFTER PLATING.

MATERIAL.

FINISH.

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USED ON. 20RM

SCALE 1 : 1

SHEET of

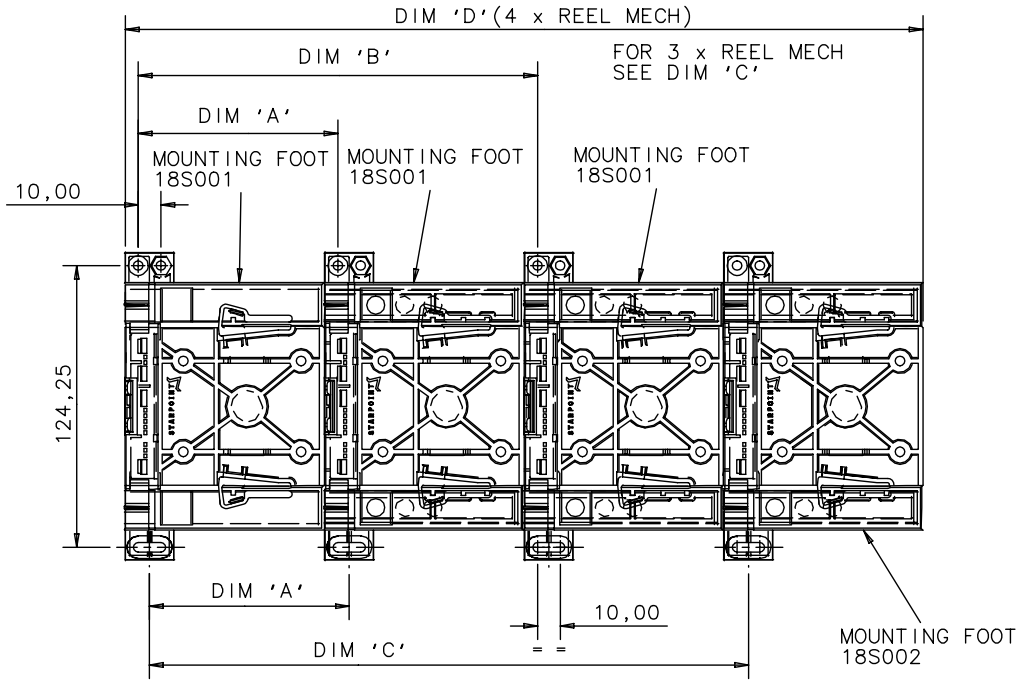
| | | | |
|---|---|---|---|
| DRAWN AN | 20/05/03 | SEE SEE CORRECTIONS * | 02 |
| CHECKED TJ | 21/06/01 | SEE ECN A3C001-02 | 02 |
| | DATE | MODIFICATION | ISSUE |

TITLE.
3 LAMP SINKING DIODE LOOM
- with Mk 4 Lampholders -

| DRAWING No. | ISSUE. | SPECIFICATION |
|---|---|---|
| A3C065 | 02 | ZZZZ |

IF IN DOUBT ASK, DO NOT SCALE

THIRD ANGLE PROJECTION




| REEL WIDTH | MECH PITCH | HOLE DIM 'A' | HOLE DIM 'B' | HOLE DIM 'C' | HOLE DIM 'D' |
|---|---|---|---|---|---|
| 66.0 | 88.0 | 88.00 | 176.00 | 264.00 | 351.50 |
| 79.5 | 101.5 | 101.50 | 203.00 | 304.50 | 392.00 |
| 90.0 | 112.0 | 112.00 | 224.00 | 336.00 | 423.50 |

UNLESS OTHERWISE STATED
GENERAL TOLERANCE:-
1 DEC, PLACE ±0.40mm. 2 DEC, PLACES ±0.10mm.
CONCENTRICITY 0.10mm. MAX.
ANGULAR ± 0.5°

ALL DIMENSIONS IN mm, AND TO APPLY AFTER PLATING.

MATERIAL.

FINISH.

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USED ON.
20 & 21RM

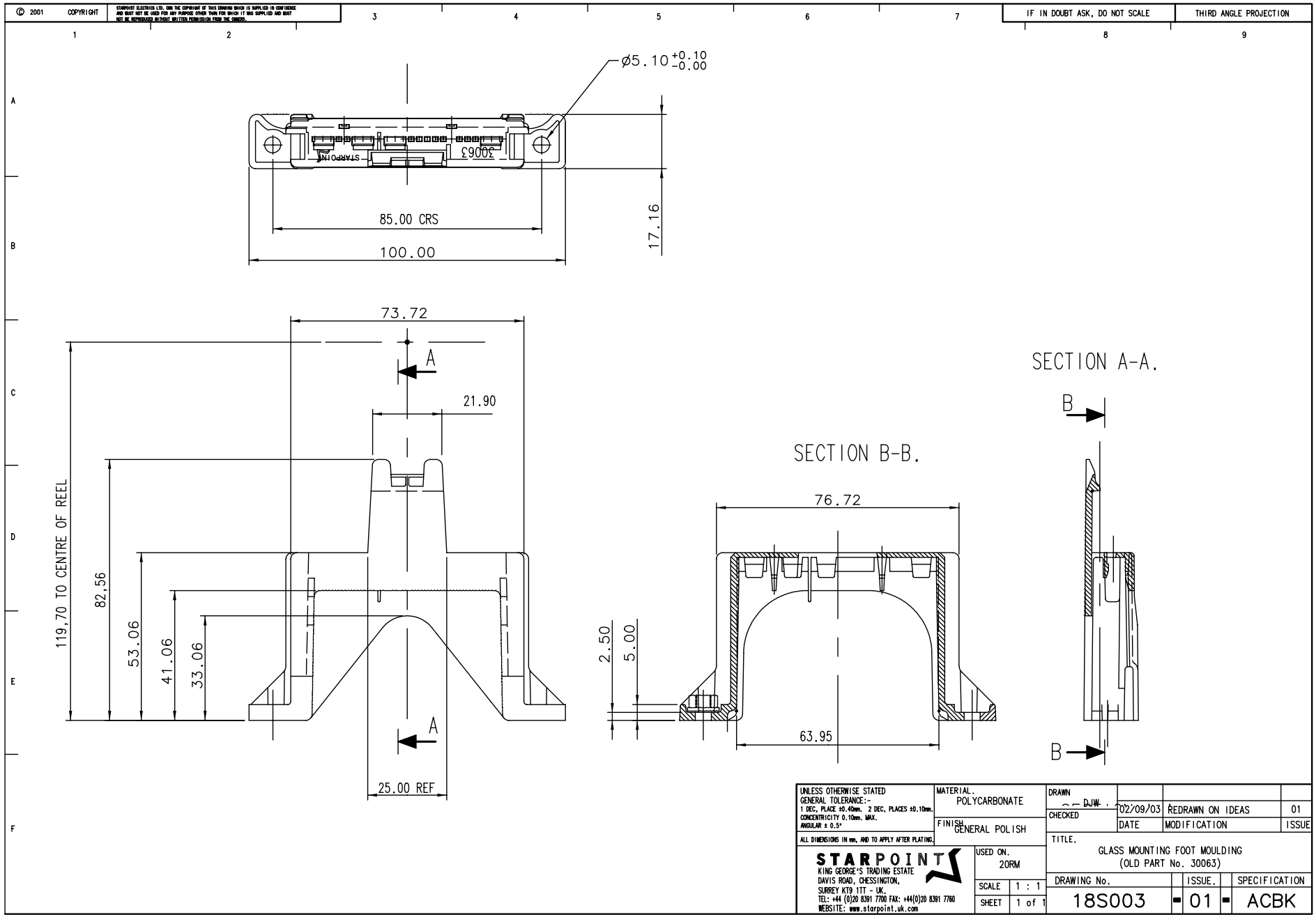
SCALE 1 : 2

SHEET 1of 1

| | | | |
|---|---|---|---|
| DRAWN SPP | 26.08.03 | APPROVED | 02 |
| CHECKED DJW | 26.08.03 | DIM 'D' ADDED | 01 |
| | DATE | MODIFICATION | ISSUE |

TITLE.
MODULAR MOUNTING FOOT ASSEMBLY

| DRAWING No. | ISSUE. | SPECIFICATION |
|---|---|---|
| D2S002 | 02 | ZZZZ |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IF IN DOUBT ASK, DO NOT SCALE
THIRD ANGLE PROJECTION
Ø5.10 +0.10 -0.00
STARPOINT
30063
85.00 CRS
100.00
17.16
73.72
A
21.90
119,70 TO CENTRE OF REEL
82,56
53.06
41.06
33.06
25.00 REF
SECTION B-B.
76.72
2.50
5.00
63.95
SECTION A-A.
B
UNLESS OTHERWISE STATED GENERAL TOLERANCE:- 1 DEC, PLACE ±0.40mm. 2 DEC, PLACES ±0.10mm. CONCENTRICITY 0.10mm. MAX. ANGULAR ± 0.5°
ALL DIMENSIONS IN mm, AND TO APPLY AFTER PLATING.
MATERIAL. POLYCARBONATE
FINISH GENERAL POLISH
USED ON. 20RM
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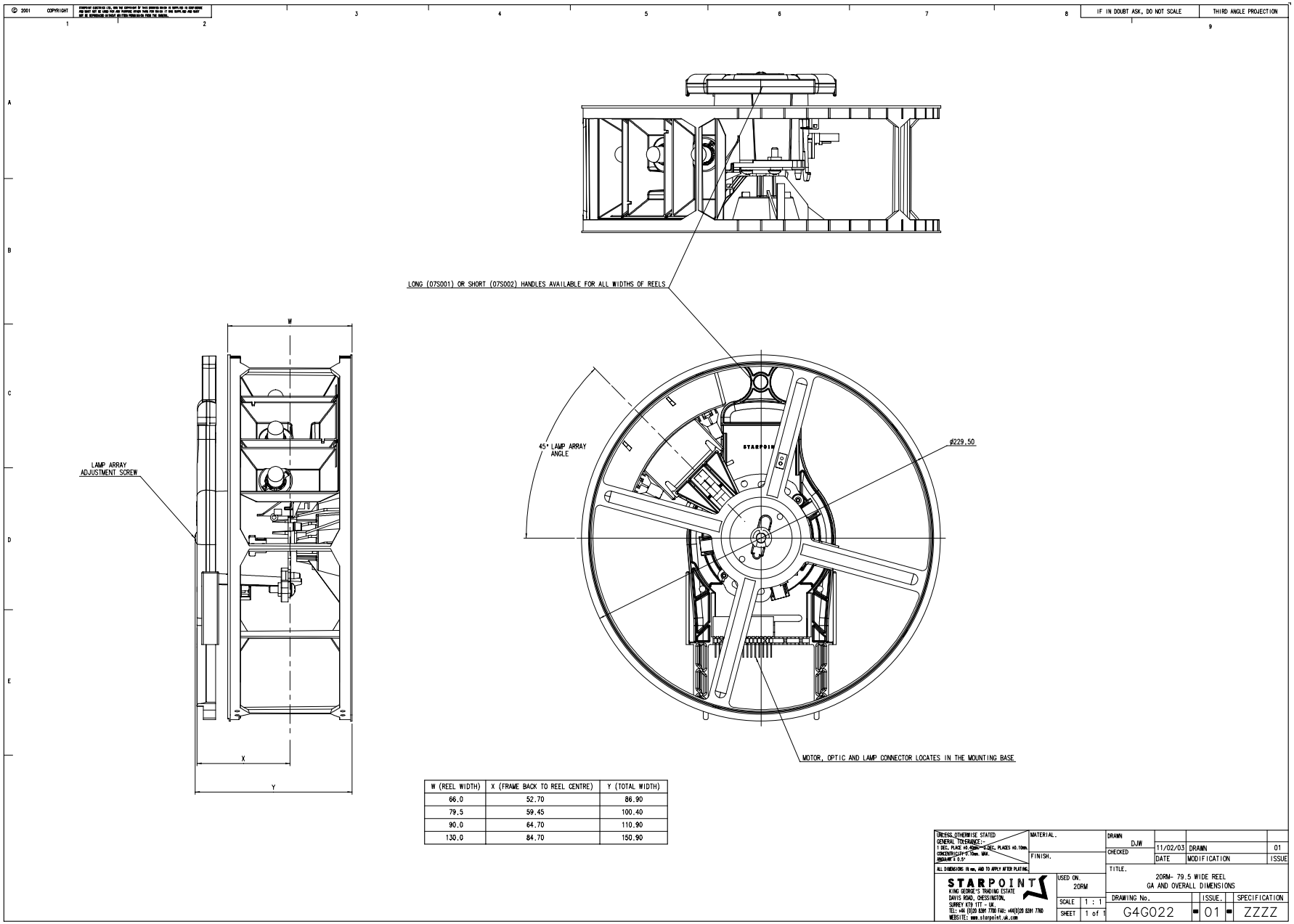
SCALE 1 : 1
SHEET 1 of 1
DRAWN DJW
CHECKED
02/09/03 REDRAWN ON IDEAS 01
DATE MODIFICATION ISSUE
TITLE. GLASS MOUNTING FOOT MOULDING (OLD PART No. 30063)
DRAWING No. 18S003
ISSUE. 01
SPECIFICATION ACBK




| W (REEL WIDTH) | X (FRAME BACK TO REEL CENTRE) | Y (TOTAL WIDTH) |
|---|---|---|
| 66.0 | 52.70 | 86.90 |
| 79.5 | 59.45 | 100.40 |
| 90.0 | 64.70 | 110.90 |
| 130.0 | 84.70 | 150.90 |

UNLESS OTHERWISE STATED
GENERAL TOLERANCE :-
1 DEC. PLACE ±0.10mm 2 DEC. PLACES ±0.10m.
CONCENTRICITY=Ø 10mm MAX.
ANGULAR = 0.5°
ALL DIMENSIONS IN mm, AND TO APPLY AFTER PLATING.

MATERIAL.
FINISH.

DRAWN DJW 11/02/03 DRAWN 01
CHECKED DATE MODIFICATION ISSUE

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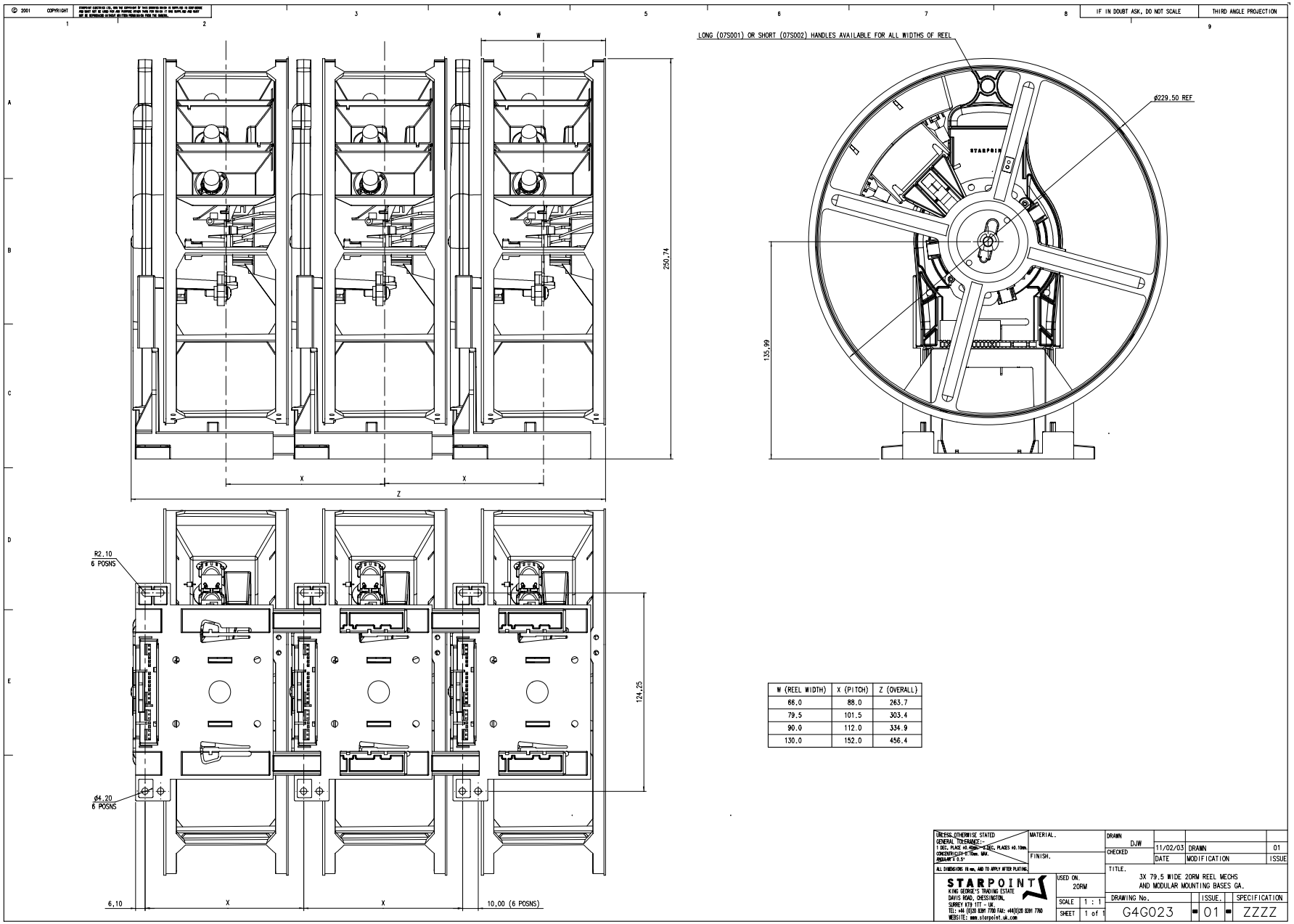
USED ON. 20RM
SCALE 1 : 1
SHEET 1 of 1

TITLE.
20RM- 79.5 WIDE REEL
GA AND OVERALL DIMENSIONS

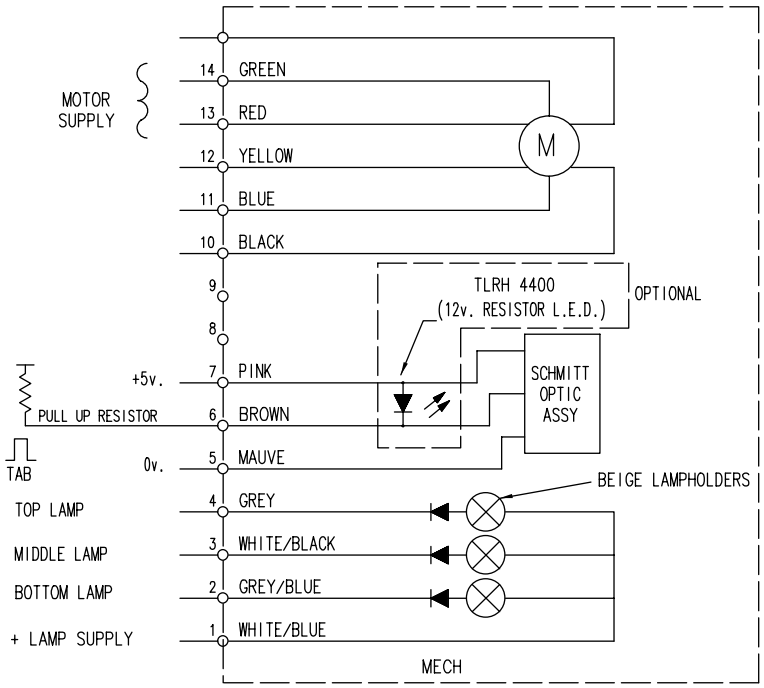
DRAWING No. G4G022 | ISSUE. 01 | SPECIFICATION ZZZZ




| W (REEL WIDTH) | X (PITCH) | Z (OVERALL) |
|---|---|---|
| 66.0 | 88.0 | 263.7 |
| 79.5 | 101.5 | 303.4 |
| 90.0 | 112.0 | 334.9 |
| 130.0 | 152.0 | 456.4 |

IF IN DOUBT ASK, DO NOT SCALE

THIRD ANGLE PROJECTION




UNLESS OTHERWISE STATED
GENERAL TOLERANCE:-
1 DEC, PLACE ±0.40mm. 2 DEC, PLACES ±0.10mm.
CONCENTRICITY 0.10mm. MAX.
ANGULAR ± 0.5°

ALL DIMENSIONS IN mm, AND TO APPLY AFTER PLATING.

MATERIAL.

FINISH.

USED ON.
16/20RM FM3

SCALE NTS

SHEET 1of 1

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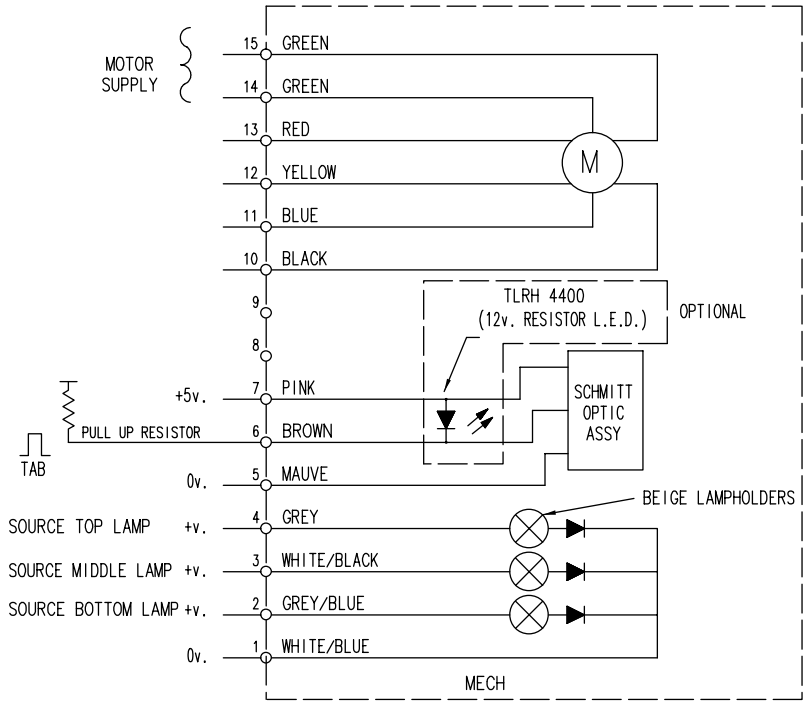
| | | | |
|---|---|---|---|
| DRAWN SPP | 26.08.03 | APPROVED | 01 |
| | 14.07.03 | REDRAWN, WAS A2046 | 0A |
| CHECKED DJW | DATE | MODIFICATION | ISSUE |

TITLE.
REEL MECH CIRCUIT DIAGRAM - SINK / DIODE
(OLD PT No A2046)

| DRAWING No. | ISSUE. | SPECIFICATION |
|---|---|---|
| G5D040 | 01 | ZZZZ |

IF IN DOUBT ASK, DO NOT SCALE

THIRD ANGLE PROJECTION




UNLESS OTHERWISE STATED
GENERAL TOLERANCE:-
1 DEC, PLACE ±0.40mm. 2 DEC, PLACES ±0.10mm.
CONCENTRICITY 0.10mm. MAX.
ANGULAR ± 0.5°

ALL DIMENSIONS IN mm, AND TO APPLY AFTER PLATING.

MATERIAL.

FINISH.

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USED ON. 20RM FM3

SCALE NTS

SHEET 1 of 1

DRAWN SPP

CHECKED

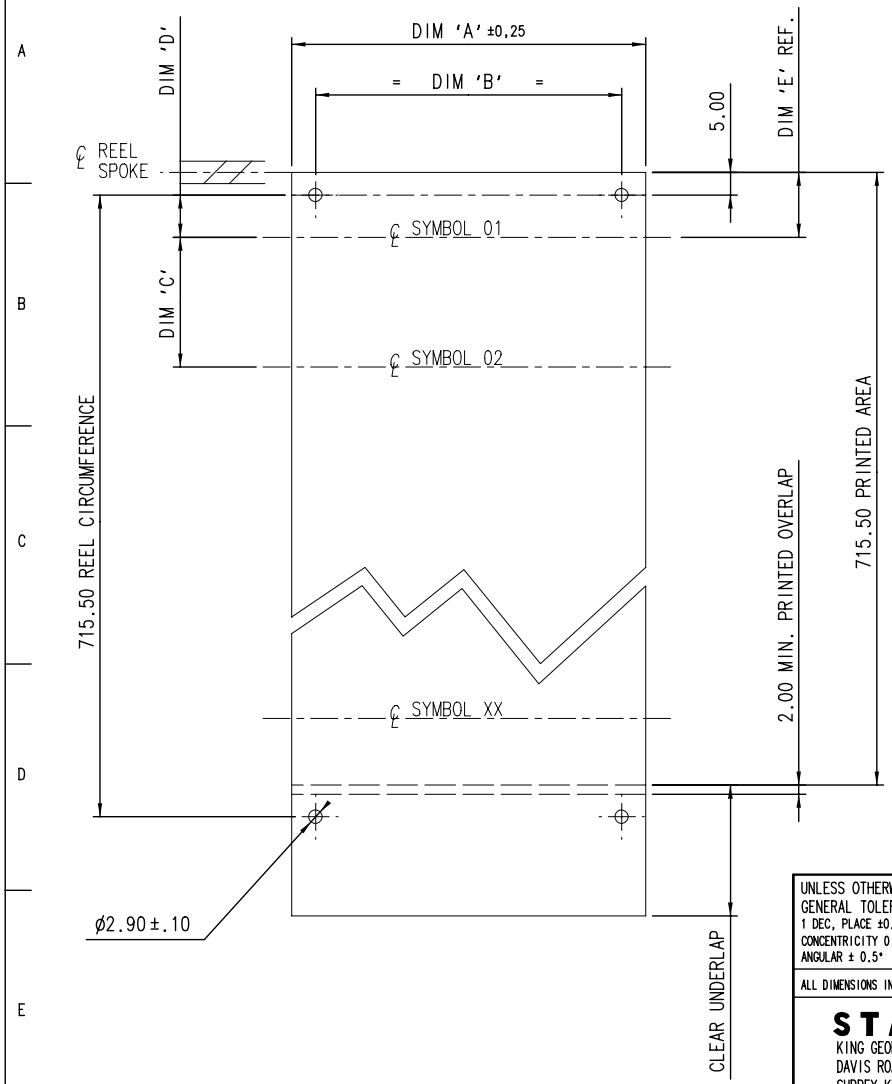
| DATE | MODIFICATION | ISSUE |
|---|---|---|
| 14/07/03 | REDRAWN, WAS A2048 | 01 |

TITLE.
REEL MECH CIRCUIT DIAGRAM- SOURCE/ DIODE
(OLD PART No. A2048)

| DRAWING No. | ISSUE. | SPECIFICATION |
|---|---|---|
| G5D041 | 01 | ZZZZ |

IF IN DOUBT ASK, DO NOT SCALE

THIRD ANGLE PROJECTION




| REEL | DIM 'A' | DIM 'B' |
|---|---|---|
| 79.5 | 76.25 | 67.50 |
| 66.0 | 62.75 | 54.00 |

| SYMBOLS | DIM 'C' | DIM 'D' | DIM 'E' REF. |
|---|---|---|---|
| 24 | 29.81 | 9.91 | 14.91 |
| 16 | 44.72 | 17.36 | 22.36 |
| 12 | 59.63 | 24.81 | 29.81 |

UNLESS OTHERWISE STATED
GENERAL TOLERANCE:-
1 DEC, PLACE ±0.40mm. 2 DEC, PLACES ±0.10mm.
CONCENTRICITY 0.10mm. MAX.
ANGULAR ± 0.5°

ALL DIMENSIONS IN mm, AND TO APPLY AFTER PLATING.

MATERIAL.
0.25 THICK PVC
INC. INK

FINISH.

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USED ON.
20/21RM MK2

SCALE 1:1

SHEET 1 of1

DRAWN SPP

CHECKED

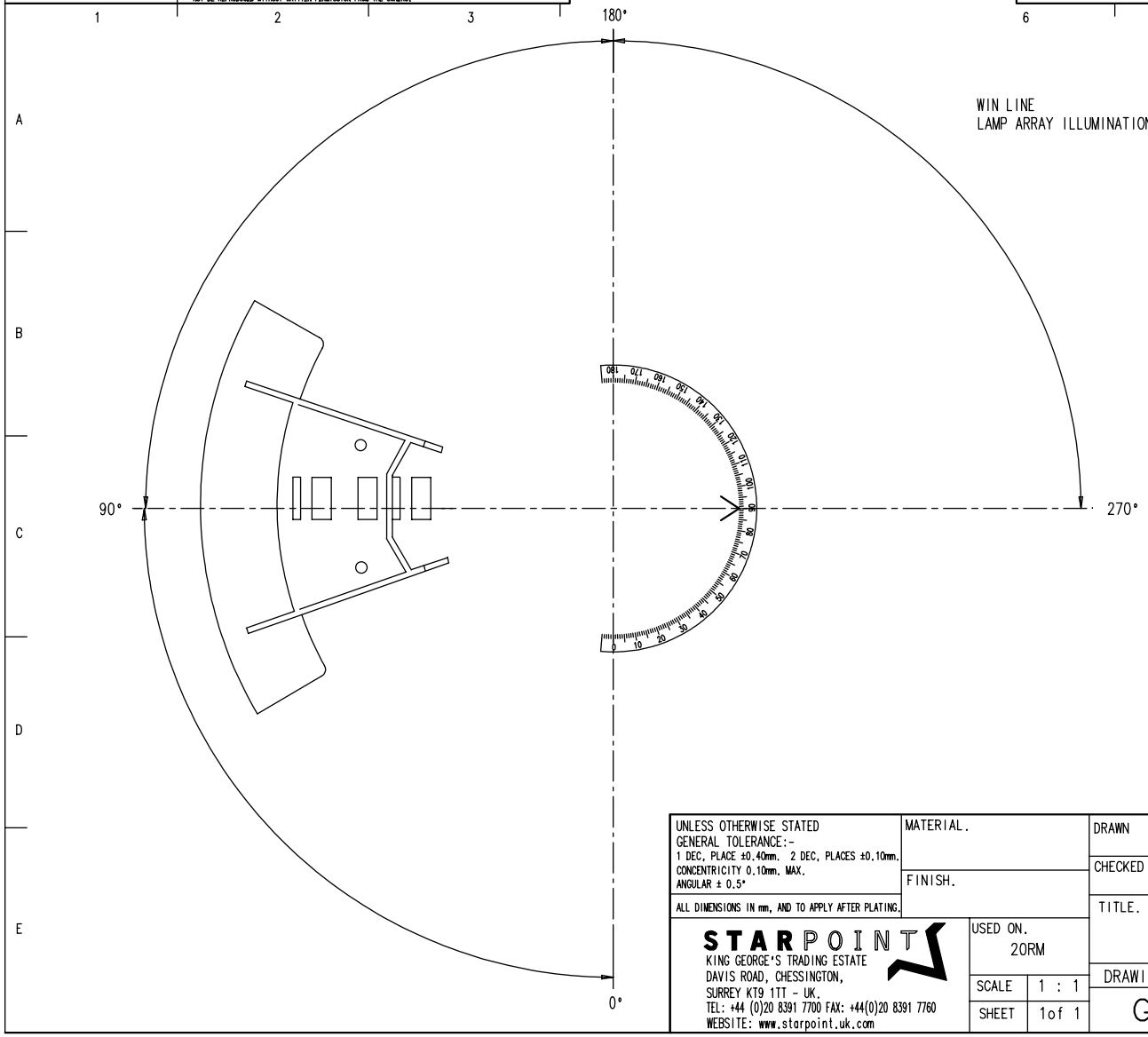
| DATE | MODIFICATION | ISSUE |
|---|---|---|
| 09/07/03 | DRAWN | 01 |

TITLE.
REEL BAND DETAILS

| DRAWING No. | ISSUE. | SPECIFICATION |
|---|---|---|
| G6D018 | 01 | ZZZZ |

IF IN DOUBT ASK, DO NOT SCALE

THIRD ANGLE PROJECTION




| | | | | | |
|---|---|---|---|---|---|
| UNLESS OTHERWISE STATED GENERAL TOLERANCE:- 1 DEC, PLACE ±0.4mm. 2 DEC, PLACES ±0.10mm. CONCENTRICITY 0.10mm. MAX. ANGULAR ± 0.5° | MATERIAL. | DRAWN SPP | 26.08.03 | APPROVED | 01 |
| | | CHECKED DJW | 14.07.03 | REDRAWN, WAS 20125 | 0A |
| ALL DIMENSIONS IN mm, AND TO APPLY AFTER PLATING. | FINISH. | | DATE | MODIFICATION | ISSUE |
| | | TITLE. LAMP ARRAY ILLUMINATION ANGLE | | | |

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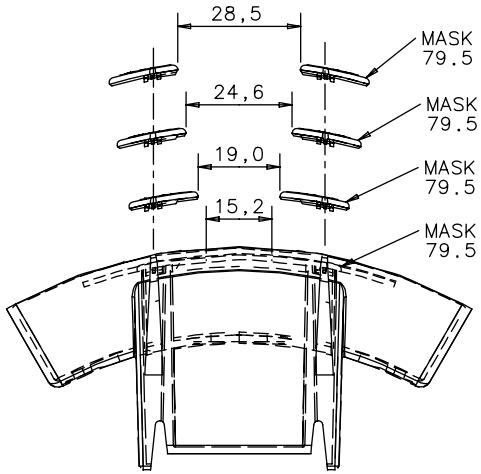
WEBSITE: www.starpoint.uk.com

| USED ON. | SCALE | SHEET |
|---|---|---|
| 20RM | 1 : 1 | 1of 1 |

| DRAWING No. | ISSUE. | SPECIFICATION |
|---|---|---|
| G6D019 | 01 | ZZZZ |

IF IN DOUBT ASK, DO NOT SCALE

THIRD ANGLE PROJECTION

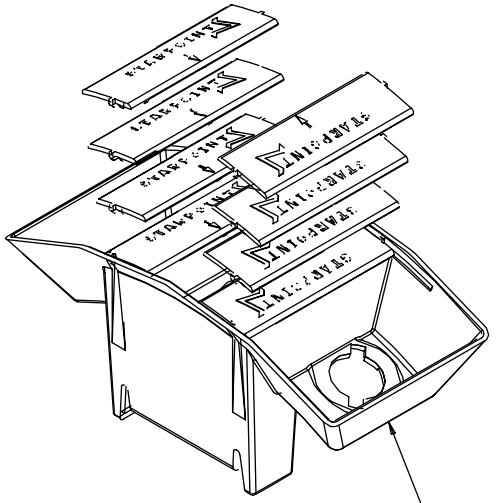



MASK 66.0 WIDE 02S015 (2) 12 SYM
79.5 WIDE 02S018 (2)

MASK 66.0 WIDE 02S016 (2) 16 SYM
79.5 WIDE 02S019 (2)

MASK 66.0 WIDE 02S017 (2) 20 SYM
79.5 WIDE 02S020 (2)

MASK 66 WIDE 02S013 (2) 24 SYM
79.5 WIDE 02S014 (2)



LAMP ARRAY MOULDING
66.0 WIDE 05S017
79.5 WIDE 05S018

UNLESS OTHERWISE STATED
GENERAL TOLERANCE:-
1 DEC, PLACE ±0.40mm. 2 DEC, PLACES ±0.10mm.
CONCENTRICITY 0.10mm. MAX.
ANGULAR ± 0.5°

ALL DIMENSIONS IN mm, AND TO APPLY AFTER PLATING.

MATERIAL.

FINISH.

USED ON.
20RM

SCALE 1 : 1

SHEET 1of 1

STARPOINT
KING GEORGE'S TRADING ESTATE
DAVIS ROAD, CHESSINGTON,
SURREY KT9 1TT - UK.
TEL: +44 (0)20 8391 7700 FAX: +44(0)20 8391 7760
WEBSITE: www.starpoint.uk.com

| | | | |
|---|---|---|---|
| DRAWN SPP | 26.08.03 | APPROVED | 01 |
| | 14.07.03 | NEW DESIGN | 0A |
| CHECKED DJW | DATE | MODIFICATION | ISSUE |

TITLE.
LAMP ARRAY DIVIDER POSITION

| DRAWING No. | ISSUE. | SPECIFICATION |
|---|---|---|
| G6D020 | 01 | ZZZZ |