H-2000-5142-02-A

Installation and User's Guide

MP700 PROBE SYSTEM

RENISHAW®

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CHANGES TO EQUIPMENT: Renishaw reserves the right to change its equipment without obligation to change equipment previously sold.

WARRANTY: Equipment requiring attention under warranty must be returned to your supplier. No claims will be considered where the probe has been misused, or where repairs or adjustments have been attempted by unauthorised persons.

PATENTS: Features of the Renishaw® MP700 Probe System are subject to the following patents and patent applications:

EP 0068899	JP 1556462	US 4813151
EP 0243766	JP 24104/88	US 4817362
EP 0388993	JP 24105/88	PCT/GB94/00548
EP 242747B	US 4462162	

CE

This product has been tested to the following European Standards:

BS EN 50081-2
BS EN 50082-2

It complies with the relevant essential health and safety protection requirements of the following EC Directives:

89/336/EEC, 91/263/EEC, 92/31/EEC (EMC), 93/68/EEC (CE Marking)

All relevant safety information, including that incorporated in the installation instructions, user instructions and maintenance instructions must be observed.

FCC

Information to User (FCC Section 15.105)

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

Information to User (FCC Section 15.21)

The user is cautioned that any changes or modifications, not expressly approved by Renishaw plc or authorised representative, could void the user's authority to operate the equipment.

Special Accessories (FCC Section 15.27)

The user is cautioned that any peripheral device installed with this equipment, such as a computer, must be connected with a high-quality shielded cable to ensure compliance with FCC limits.

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List of Associated Publications

Publication Title	Publication Number
Optical Machine Module Installation and User's Guide	H-2000-5044
PSU3 Power Supply Unit Installation and User's Guide	H-2000-5057
Optical Machine Interface/PSU3 Power Supply Installation and User's Guide	H-2000-5062
MI12 Interface/PSU3 Power Supply Installation and User's Guide	H-2000-5072
Probe Systems Installation Manual for Machine Tools	H-2000-6040

Before You Begin

This MP700 Probe System User Guide contains detailed information about how to install, use, maintain and repair your MP700 Probe System. So, whether you're an expert or a novice when it comes to probing, you'll find that you are fully supported by this comprehensive guide.

Split into six self-contained chapters, the guide is structured to provide as much or as little information that you may personally require to use the MP700 Probe System effectively. A comprehensive Spares List is also provided to assist in the identification and ordering of replacement parts:

❒ **Chapter 1 - Fundamentals:** which provides general information on touch trigger probes, workpiece setup and workpiece inspection.

❒ **Chapter 2 - System Installation:** which provides general information on how to install the MP700 Probe System to your machine tool.

❒ **Chapter 3 - System Description:** which provides detailed information on the MP700 Probe System and its individual parts.

❒ **Chapter 4 - System Operation:** which provides detailed instructions on how to operate the MP700 Probe System.

❒ **Chapter 5 - Maintenance And Adjustment:** which provides a complete guide to the maintenance, overhaul and adjustment of the MP700 Probe System.

❒ **Chapter 6 - Troubleshooting:** which provides specific information on how to troubleshoot the MP700 Probe System.

Support Services

The Renishaw Group World-wide

Renishaw stands at the forefront of manufacturing technology. Its products give manufacturers world-wide the ability to machine components right first time with traceability.

Subsidiary companies exist in the USA, Japan, Germany, France, Italy, Spain, Switzerland, Hong Kong, The Republic of Singapore and The Peoples Republic of China. These subsidiary companies are responsible for the sales, product support and customer service of the Group's products. Distributors have also been appointed in many other countries around the globe.

The Renishaw Product Support Network

The Renishaw Product Support Network offers you a wide range of choices as well as access to high-quality, responsive technical support staff. Also, because Renishaw recognises that support needs vary from user to user, the Renishaw Product Support Network is structured in a way that allows you to choose the type of support that will best suit your needs.

Outside the United Kingdom, contact the Product Support Department of the Renishaw Group company that best serves your area. For information about Renishaw's subsidiary offices, see **Product Support World-wide** later in this section.

Product Support World-wide

If you have a question about the MP700 Probe System, first consult the documentation and other printed information included with your product.

If you cannot find a solution, you can receive information on how to obtain product support by contacting the Renishaw subsidiary company that best serves your country.

Product Support Within the United Kingdom and Republic of Ireland

For Product Support Services within the United Kingdom and Republic of Ireland, please contact the following;

Product Support Department
Metrology Division
Renishaw Plc
New Mills
Wotton-under-Edge
Gloucestershire
England
GL12 8JR
Tel (+44) 01453 524524 Fax (+44) 01453 524901

Calling a Renishaw Subsidiary Office

When you call, it will help the Renishaw support staff if you have the appropriate product documentation at hand. Please be prepared to give the following information (as applicable):

- The type of product that you are using.
- The type of hardware that you are using, including all serial numbers.
- An account of what happened and what you were doing when the problem occurred.
- An account of how you tried to solve the problem.

Renishaw Subsidiary Companies

All Renishaw subsidiary companies offering customer support services and the countries they serve are listed in Table 1 - Renishaw Companies Around The World. If your country is not listed, please contact:

Product Support Department
Metrology Division
Renishaw Plc
New Mills
Wotton-under-Edge
Gloucestershire
England
GL12 8JR
Tel (+44) 01453 524524 Fax (+44) 01453 524901

Table 1 - Renishaw Subsidiary Companies Around the World

Country	Contact the following Renishaw Company
Belgium	See France
Brazil	Renishaw Latino Americana Ltda Calçada dos Crisantemos 22 C.C. Alphaville, C.e.p. 06453-000 Barueri SP Brazil Tel +55 11 7295 2866 Fax +55 11 7295 1641
Canada	See United States and Canada
France	Renishaw S.A. SIMCI S.A. 15 rue Albert Einstein Champs sur Marne 77437 Marne la Vallée Cedex 2 France Tel +33 1 64 61 84 84 Fax +33 1 64 61 65 26
Germany	Renishaw GmbH Karl-Benz Strasse 12 D-72124 Pliezhausen Germany Tel +49 712 797960 Fax +49 712 788237
Hong Kong	Renishaw (Hong Kong) Limited Unit 4A. 3/F New Bright Building 11 Sheung Yuet Road Kowloon Bay Hong Kong Tel +852 2753 0638 Fax +852 2756 8786
Indonesia	Renishaw's Representative Office Jalan Cempaka Putih Tengah 17/F29 (Taman Solo) Jakarta 10510 Indonesia Tel +62 21 424 3934/ +62 816 979042 Fax +62 21 471 3934
Italy	Renishaw S.p.A Via dei Prati 5 10044 Pianezza Torino Italy Tel +39 11 9 66 10 52 Fax +39 11 9 66 40 83

Table 1 - Renishaw Subsidiary Companies Around the World (Continued)

Country	Contact the following Renishaw Company
Japan	Renishaw Kabushiki Kaisha 6F & 7F Anzai Building 1-12, Hatagaya 1-chome Shibuya-ku Tokyo 151 Japan Tel +81 3 5350 2201 Fax +81 3 5350 2207
Luxembourg	See France
Netherlands	See France
Peoples Republic of China	Renishaw's Representative Office Room 510 China Travel ServiceTower No. 2 Bei San Huan East Road Beijing 100028 The Peoples Republic of China Tel +86 10 6462 2689 Fax +86 10 6461 2687
Republic of Singapore	Renishaw's Representative Office 171 Chin Swee Road #10-09 San Centre Singapore 169877 Republic of Singapore Tel +65 438 2779 Fax +65 438 2780
Spain	Renishaw Iberica S.A. Edificio Oceano, Calle Garrotxa 10-12 Parque Mas Blau 08820 Prat de LLobregat Barcelona Spain Tel +34 3 478 21 31 Fax +34 3 476 16 08
Switzerland	Renishaw A.G. Poststrasse 5 CH8808 Pfäffikon Switzerland Tel +41 55 410 66 66 Fax +41 55 410 66 69
United States and Canada	Renishaw Inc. 623 Cooper Court Schaumburg Illinois 60173 USA Tel +1 847 843 3666 Fax +1 847 843 1744

Welcome To Renishaw's MP700 Probe System

Welcome to the Renishaw MP700 Probe System, a high accuracy probing system specifically designed for the harshest of machine tool environments.

Integral to Renishaw's continuous commitment to technological innovation, the MP700 Probe System has been developed to provide:

- Improved repeatability in all probing directions.
- A low triggering force combined with low pre-travel variation to provide high accuracy, even when used with long styli.
- A proven ten-fold improvement in life (ten million triggers).
- Faster and more accurate measurement.
- The elimination of reseat failures.

In addition to providing high accuracy measurement on your machine tool, the MP700 Probe System also offers:

- A non-lobing design that is not direction dependent, thus greatly simplifying probe calibration routines associated with workpiece setup and inspection cycles.
- High resistance to machine tool vibration.
- A 360° Optical 'turn on' facility, allowing the probe to be turned on/reset in any position.
- Resistance to shock and false triggering through the use of digital, multi-channel filtering.
- Full compatibility with Renishaw's industry proven Optical Transmission Systems.
- Viton diaphragms and O-rings that provide unparalleled protection against all commonly used coolants.

MP700 - A System Overview

There are two types of MP700 Probe System:

- The Optical Machine Interface variant.
- The Optical Machine Module/MI12 Machine Interface variant.

The MP700 Probe System (Optical Machine Interface Variant)

The system comprises (see Figure 1):

- A Renishaw® MP700 Spindle Probe.
- A Renishaw® Optical Machine Interface (OMI) (**optional alternative to the MI12 Machine Interface Unit and Optical Machine Module**).
- A Renishaw® PSU3 Power Supply Unit (Optional).

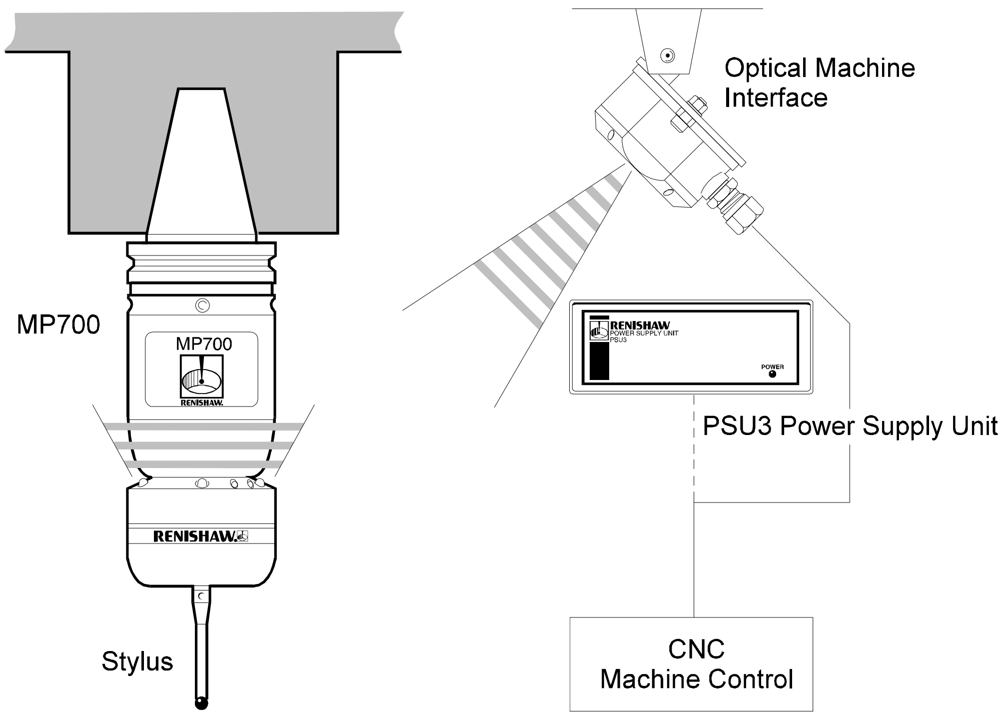


Figure 1 - The MP700 Probe System (Optical Machine Interface Variant)

The MP700 Probe

For information on your MP700 Probe, refer to **The MP700 Probe System (Optical Machine Module Variant)** later in this chapter.

The PSU3 Power Supply Unit

For information on your PSU3 Power Supply Unit, refer to **The MP700 Probe System (Optical Machine Module Variant)** later in this chapter.

The Optical Machine Interface (OMI)

The OMI (see Figure 2) is a combined optical receiver and machine interface. It is an optional alternative to the more traditional OMM and MI12 Machine Interface Unit, see **The MP700 Probe System (Optical Machine Module Variant)** later in this chapter.

For specific information on the OMI, refer to **Chapter 3 - System Description**.

Additional information on the OMI may be obtained by reading the Optical Machine Interface/PSU3 Power Supply Installation and User's Guide (Publication No. H-2000-5062).

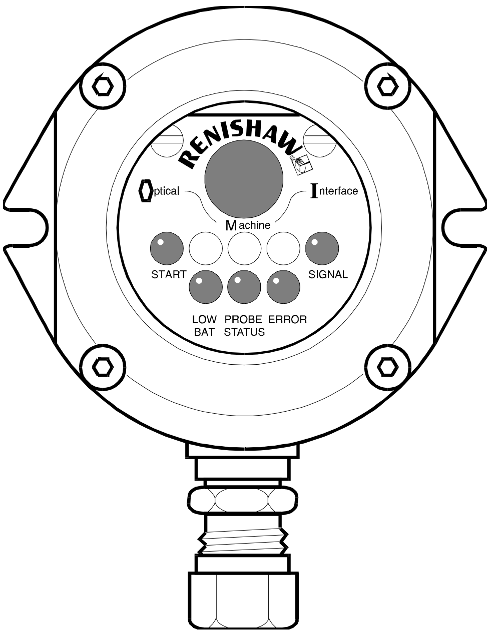


Figure 2 - The Optical Machine Interface

The MP700 Probe System (Optical Machine Module/MI12 Machine Interface Variant)

The system comprises (see Figure 3):

- A Renishaw® MP700 Spindle Probe.
- A Renishaw® Optical Machine Module (OMM).
- A Renishaw® MI12 Machine Interface Unit.
- A Renishaw® PSU3 Power Supply Unit (Optional).

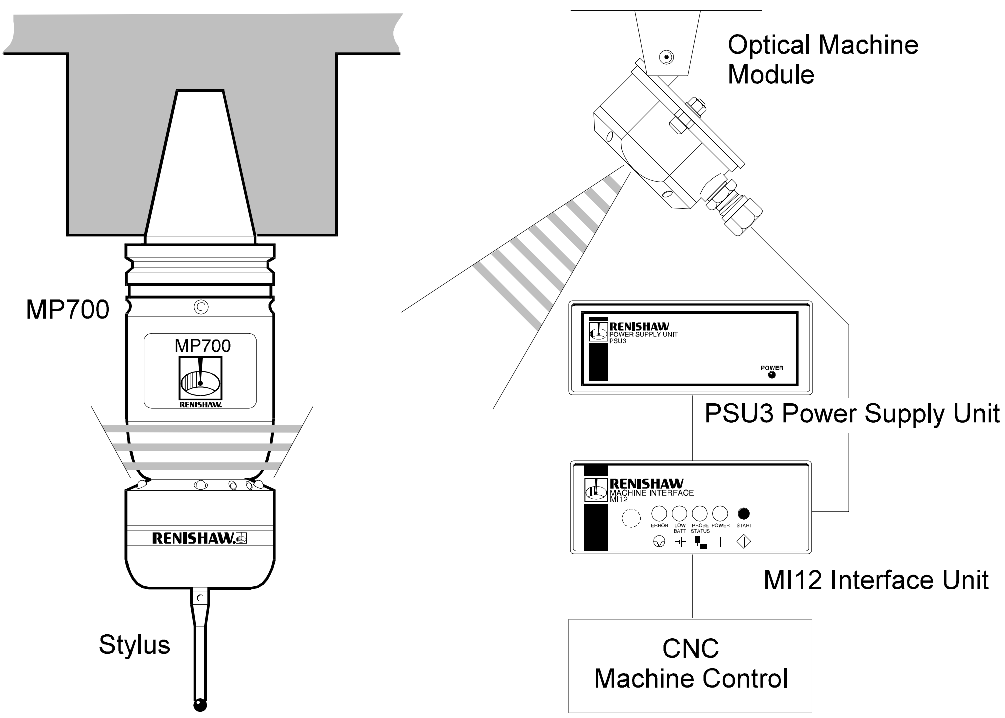


Figure 3 - The MP700 Probe System (Optical Machine Module/M12 Interface Variant)

The MP700 Machine Spindle Probe

At the very heart of the Renishaw® MP700 Probe System is the MP700 Machine Spindle Probe (see Figure 4), a next generation probe that uses active silicon strain gauges to monitor the forces generated between the stylus and the workpiece. By ensuring that all *triggering* occurs following virtually constant pre-travel, regardless of probing direction, the MP700 allows stylus configurations of up to 200mm (7.87 in.) to be used with no significant loss of accuracy.

The MP700 Machine Spindle Probe:

- Mounts in the spindle of your machining centre and is fully tool changeable.
- Provides your machine tool with a 'sense of touch'. Thus, your machine tool no longer has to operate blind and the true position of a workpiece can be rapidly acquired and converted to both tool or work offsets (**refer to Chapter 1 - Fundamentals**).
- Acts as a highly repeatable switch when 'latched' to your CNC machine tool controller.
- Can be driven in the ± **X**, ± **Y** and - **Z** directional axes of your machine tool.

On contacting a surface, with sufficient force to cause a deflection of the probe stylus, the MP700 Machine Spindle Probe '*triggers'* (refer to **Chapter 1 - Fundamentals**). It is this action that generates the necessary signal to halt the motion of your machine tool and allow the position of each machine axis to be read. Thus, although the probe itself cannot actually measure, subsequent triggers allow distances between features to be accurately calculated.

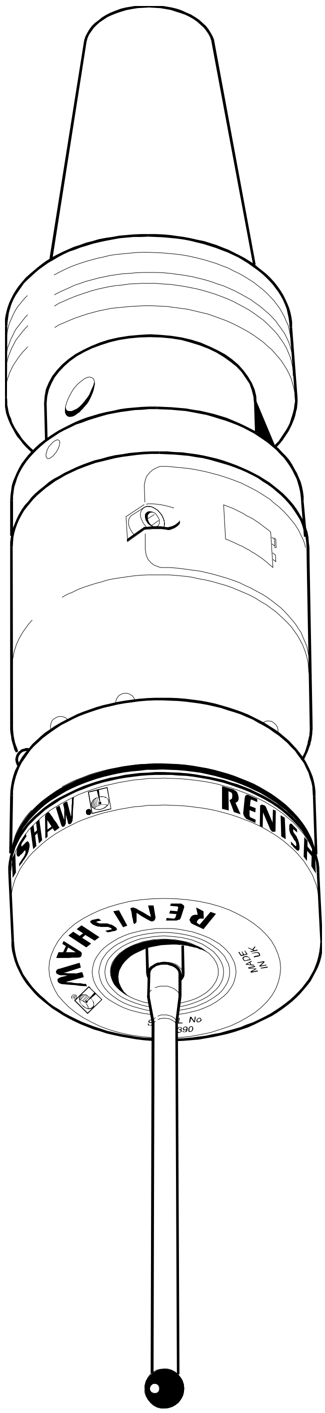


Figure 4 - The MP700 Probe

The Optical Machine Module (OMM)

The OMM (see Figure 5) communicates optically with the MP700 Probe and is linked to the Machine Interface Unit by way of a signal transmission/power supply cable.

For specific information on the OMM, refer to **Chapter 3 - System Description**.

Further information on the OMM can be obtained by reading the Optical Machine Module Installation and User's Guide (Publication No. H-2000-5044).

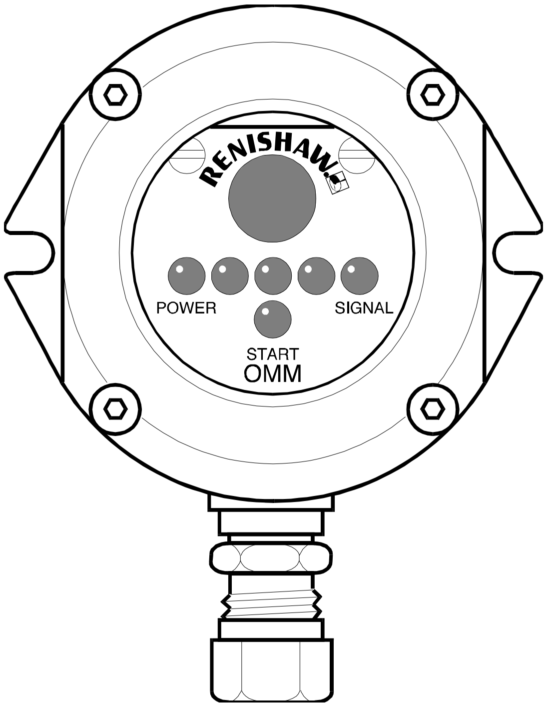


Figure 5 - The Optical Machine Module

The Machine Interface Unit (MI12)

The purpose of the MI12 is to collect and convert probe signals into a form recognisable to the machine tool's CNC controller. To achieve this, the MI12 is connected to each of the machine tool's skip outputs (sometimes known as the m/c ladder).

For specific information on the MI12 Machine Interface Unit, refer to **Chapter 3 - System Description**.

Additional Information on the MI12 Machine Interface Unit can be obtained by reading the MI12 Interface/PSU3 Power Supply Installation and User's Guide (Publication No. H-2000-5073).

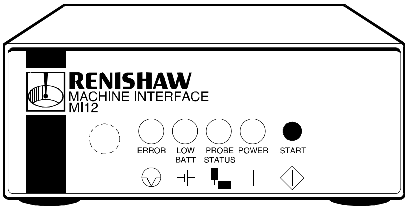


Figure 6 - The MI12 Machine Interface Unit

The Power Supply Unit (PSU3)

The PSU3 Power Supply Unit (see Figure 7) is installed in instances where a 24V power supply is not available from the machine tool's CNC controller.

For specific information on the PSU3 Power Supply Unit, refer to **Chapter 3 - System Description**.

Additional information on the PSU3 Power Supply Unit can be obtained by reading the PSU3 Power Supply Unit Installation and User's Guide (Publication No. H-2000-5057).

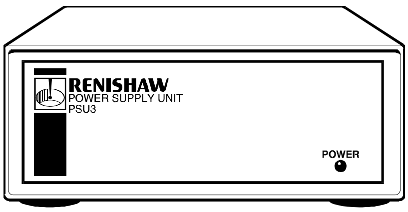


Figure 7 - The PSU3 Power Supply Unit

Datuming Equipment (Optional)

The datuming equipment supplied with your MP700 Probe System (this will typically be a calibration sphere), is the hardware used to datum (calibrate) your spindle probe following the selection of an automatic calibration program.

By running these datuming programs, the position, trigger characteristics and effective ball radius of your probe stylus in the ±**X**, ±**Y** and **-Z** directions can be determined. These values can then be used in subsequent inspection programs to automatically compensate for known errors to produce true results.

As each MP700 Probe System is unique, it is imperative to datum your probe if:

- It is the first time your Renishaw® spindle probe system is to be used.
- Whenever a new, replacement stylus is fitted to your spindle probe.
- It is suspected that the stylus has become distorted or that the probe has crashed.
- Accuracy demands that you periodically datum to compensate for thermal growth of your machine tool.
- The repeatability of relocation of the probe shank is poor, in which case datuming may be required each time the probe is selected.

For detailed information on how to datum the MP700 Probe, refer to **Chapter 1 - Fundamentals**.

CHAPTER 1

Fundamentals

By reading this chapter, you will gain the knowledge that is fundamental to getting the best performance from your MP700 Probe System.

Contained In This Chapter

Workpiece Setup

Workpiece setup is the determination of the part location relative to the machine spindle such that all subsequent metal cutting operations will produce accurate results.

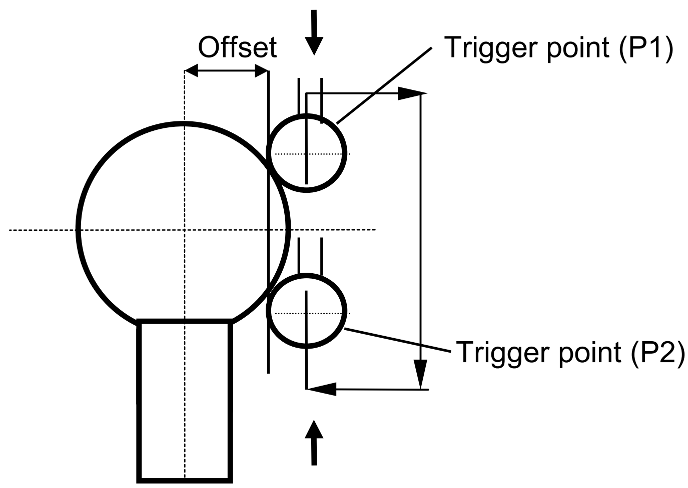
Probe Datuming - General

Often referred to as 'calibration' or 'qualifying', probe datuming involves the measurement of a calibrated feature, usually a precision ring gauge or reference sphere of precisely known diameter.

Datuming software then compares the size of the ring gauge/sphere as 'measured' by the probe system to its calibrated size, thus calculating the 'effective' diameter of the stylus tip.

The 'effective' diameter of the stylus tip will always appear to be smaller than its actual physical size. This is because it includes compensation for the probe's performance characteristics as well as the machine's response time. This 'effective' diameter, known as the *electronic ball radius*, is automatically applied to each point taken by the probe (added to internal measurements or subtracted from external measurements to provide the true position of an inspection surface).

Datuming within a bored hole is also required in order that the position of the stylus ball centre, in relation to the centreline of the machine spindle, can be determined. On machines where best fit algorithms cannot be applied to the calibration, the following, alternative method may be used to establish the stylus ball centre height.



The stylus centre height (Pc) = (P1 + P2)/2

As each spindle probe system is unique, it is imperative that you datum your probe:

- Before it is used for the first time.
- When a new, replacement stylus is fitted.
- If it is suspected that the stylus has become distorted.
- Periodically to allow for any thermal growth of the machine tool.
- If the repeatability of relocation of the probe shank is poor (datuming may be required each time the probe is selected).
- Whenever the probe is moved from one machine tool to another.
- Whenever a new shank is fitted to the probe.

Probe Datuming - MP700 Probe

Notes...

Due to the excellent volumetric measuring performance of the MP700 Probe, a constant electronic ball radius can be assumed for most applications. Only one calibration radius is required for vector measurement moves (X, Y, Z).

Best accuracy will be achieved by minimising stylus on-centre errors during probe installation. This is necessary to allow for poor probe location in the spindle following a tool change, spindle orientation repeatability and '*hunting*' of the spindle orientation if not mechanically clamped.

Stylus ball centre to spindle centre-line relationship can be compensated for by suitable calibration of a known feature.

To relate the actual location of the workpiece surface to the machine tool's reference frame, it is necessary to datum your MP700 probe. This will allow you to:

- Determine the position of the stylus ball centreline relative to the machine spindle centreline.
- Determine the effective size of the stylus ball (electronic ball radius).

Prior to datuming, you will need to establish the optimum length and diameter of the stylus to be used. Refer to **Selecting The Correct Stylus** later in this chapter.

To datum your MP700 probe:

> **Note**
>
> **Prior to datuming the probe on the machine tool, time can be saved by centralising the stylus to the shank by use of a tool presetter. For instructions on how to perform stylus on- centre adjustment, refer to Chapter 5 - Maintenance and Adjustment.**

1. Assemble the probe to its shank.
2. Assemble the chosen stylus to the probe.
3. If available, mount the probe to a tool presetter and perform stylus on-centre adjustment in accordance with **Chapter 5 - Maintenance and Adjustment** to achieve the best possible reading.
4. Insert the probe within the spindle of your machine tool.
5. Position the stylus of a dial test indicator (DTI), 'verdict clock', or linear variable differential transducer (LVDT), against the probe stylus ball and set to zero.
6. Rotate the machine spindle and observe reading.
7. If required, carry out final stylus on-centre adjustment in accordance with **Chapter 5 - Maintenance and Adjustment** to achieve a total stylus run out of 5µm (0.0002in.) or better.
8. Perform a probe length calibration cycle in accordance with the manufacturer's instructions supplied with your calibration software.
9. Perform a stylus X, Y offset calibration cycle in accordance with the manufacturer's instructions supplied with your calibration software.
10. Perform a stylus ball calibration cycle in accordance with the manufacturer's instructions supplied with your calibration software.

Workpiece Inspection

Selecting The Correct Stylus

Note...

Choosing the best stylus for a given application is critical in order to achieve optimum probe performance. Although cranked styli may be used without a detrimental effect on the measuring performance of the MP700 probe, poor location of the probe shank within the machine spindle, spindle orientation repeatability and/or '*hunting*' of the spindle orientation, may result in a significant degradation in the probe's performance.

The range of styli suitable for use with the MP700 probe include:

- Straight styli with carbon fibre shaft and ruby ball (recommended for straight styli exceeding 100mm (3.96 in.) in length on 3 axis machines and straight styli exceeding 50mm (1.96 in.) in length on moving head 5 axis machines).
- Straight styli with ceramic shaft and ruby ball (recommended for straight styli up to 100mm (3.93 in.) in length).
- Straight styli with steel shaft and ruby ball (recommended for straight styli up to 50mm (1.96 in) in length).
- Disc styli.
- Disc and ball styli.

When selecting a stylus it is important that the stylus length is kept to the minimum required to access all measurable features, and that the stylus type offers the maximum possible stiffness. Factors that effect stiffness are:

- **Joints in the styli:** that tend to reduce rigidity and should therefore be kept to the absolute minimum.
- **Stem diameters:** that are governed by the ball tip diameter of the stylus.
- **Stem material:** that can be of stainless steel, ceramic or carbon fibre.

It is also important to ensure that the stylus ball diameter chosen is as large as is practical. This not only ensures that the stylus will be as stiff as possible, but also reduces the stylus's susceptibility to surface form and surface finish.

Probing Techniques - MP700 Probe

The way in which a probe is used will have a dramatic effect on its accuracy. Employing the following techniques will ensure that you achieve the best results each and every time you use your MP700 Spindle Probe:

- To ensure consistent results, always use the same probing speed and velocity during inspection as you used when the probe was datumed.
- Given a typical probing speed of 15-30 mm (0.457-1.18 in.) per minute, it is important to calculate the time that the machine will take before it reaches a constant probing velocity. Thus, when inspecting features that restrict the space within which the stylus can move, always select a ball diameter that will provide an adequate amount of stylus travel prior to the probe triggering.
- Never capture data in the acceleration/deceleration zones.
- Avoid taking probe measurements as the probe reseats due to debounce filters.
- Whenever possible, always measure features top and bottom. By doing this you will always identify any taper and distortion that may exist in the feature's form.
- Wherever possible, always measure distances using single points in the same way as you would use a micrometer, depth gauge, height gauge, etc.
- Never assume straightness, squareness or parallelism. Always check each feature to make sure.
- The 'back-off' distance may need to be increased over that used for conventional probes due to the 8ms electronic time delay of the MP700 Probe.
- Avoid leaving the probe triggered against the surface of a workpiece for extended periods; probe signals can invert after 30 seconds in the triggered condition.

- After issuing an M start/reset code, always allow 1.1 seconds of dwell before monitoring the probe's output.

- When operating the probe system on a horizontal spindle machine, always provide a reset signal after the spindle has been orientated to zero the system. This will clear any errors caused by spindle and probe orientation.

- When operating the probe system with vertical/horizontal spindle heads, always provide a reset signal after indexing the head. This will clear any errors caused by spindle and probe orientation.

- When orientating the probe system on a 5 axis moving head machine, reduce the rate of orientation to avoid the probe from 'going open'. Alternatively, disable the probe monitoring facility during all probe orientation moves.

How A Probe Works

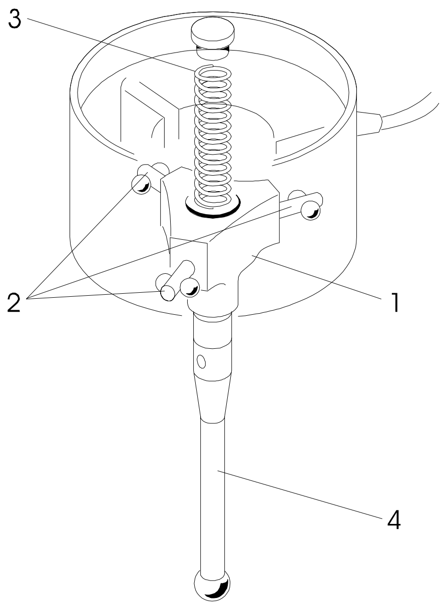
The Kinematic Location

The Kinematic location (see Figure 1.1), introduced by Renishaw in 1975, is a mechanical device that maintains the probe mechanism in an exact, but flexible position. Its purpose is to ensure that the stylus [4] always returns to the same position.

Typically, a Kinematic location consists of a pivotal plate [1] which seats across three bearing points [2] and is held in position by a helical compression spring [3]. Each bearing point, formed by a combination of cylinders and spheres, acts in the following manner:

- **In conventional touch trigger probes:** each bearing point also acts as an electrical contact. Thus, when the probe contacts a surface and subsequently 'triggers' (i.e. deflection of the stylus [4] causes the plate to deflect or pivot on one or more of these bearing points), an increase in the electrical resistance through the Kinematic location occurs. Once detected, this increase in electrical resistance causes the probe system to produce a binary signal to inform the CNC controller that data should be taken. As the probe moves away from the surface, spring force causes the plate to reseat. When the Kinematic location is seated, the probe is referred to as 'Closed'. When the Kinematic location is deflected, the probe is referred to as 'Open'.

- **In strain gauge technology touch trigger probes such as the MP700:** each bearing point acts only in a mechanical sense to maintain the probe mechanism in an exact, but flexible, position. Thus, ensuring that the stylus [4] always returns to the same position.



1. Pivotal Plate
2. Bearing Point
3. Helical Compression Spring
4. Stylus

Figure 1.1 - Kinematic Location (Typical)

Strain Gauge Technology Touch Trigger Probes

The latest machine tool probe technology to be developed by Renishaw virtually eliminates measurement errors due to 'pre-travel variation' (see Figure 1.2). By utilising active silicon strain gauges to monitor the forces generated between the stylus and the workpiece, these 'next generation' probing systems (such as the MP700), measure the amount of pre-travel to ensure that 'triggering':

- Occurs prior to any 'breaking' of the Kinematic location.
- Occurs with a virtually constant degree of pre-travel, regardless of probing direction.

Repeatability is also improved in this type of probe, resulting in an overall improvement in measurement accuracy approaching a factor of five (when compared to standard touch trigger probes). For specific information on the MP700 Probe, refer to **Chapter 3 - System Description.**

Touch Trigger Probes - Performance Characteristics

Probe Pre-Travel

‘Triggering’ does not only occur when the Kinematic location actually breaks, but also when microscopic movement of the contacts is induced by just a few microns of stylus deflection. It is this distance, travelled by the probe between the point at which the stylus touches a surface and a ‘trigger’ actually occurring, that is referred to as ‘pre-travel’.

In strain gauge technology touch trigger probes, such as the MP700, the strain gauges ‘trigger’ the probe prior to the kinematics breaking. Consequently, the force required to cause a ‘trigger’, as well as that required to induce probe pre-travel, is the same in all directions.

Probe pre-travel is not generally regarded as a source of error and is typically accommodated and compensated for during probe datuming procedures.

Potential Error Sources

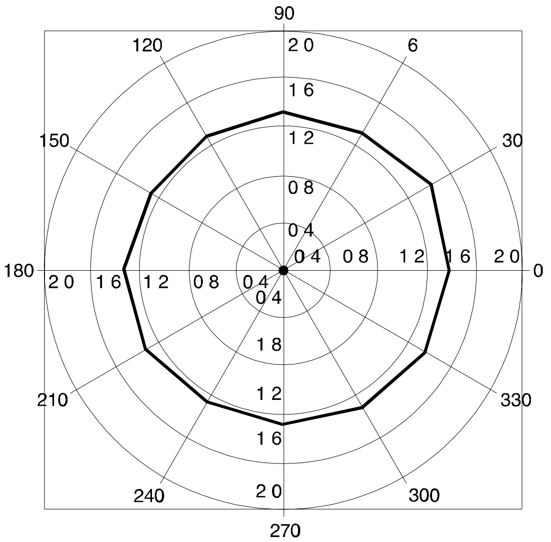
The potential error sources associated with touch trigger probes fall into two main categories, these are:

- Random errors.
- Systematic errors, which are generally application sensitive and can be eliminated or minimised in practice.

Fixed Error Sources

There is only one error source associated with touch trigger probes which must be assumed to be present in all measurements taken. It is known as undirectional repeatability and refers to the ability of the probe to trigger at the same point each and every time.

Quoted statistically as having a 95% confidence level, the undirectional repeatability error of resistive touch trigger probes is extremely small (typically less than 0.2μm). Thus, whilst it unlikely to be a major source of error, its presence must always be considered when assessing the measuring performance of a machine tool or probe system. It is also important to remember that the use of very long or complex styli, or high trigger forces, will slightly increase any probe repeatability error.



Stylus: 50mm   Pretravel Variation: ± 0.08µm   Each division = 0.2µm

Typical Pre-travel Variation Chart - MP700 Touch Trigger Probe

Figure1.2 - Probe Pre-travel Variation - Typical

Systematic Error Sources

There are two types of systematic error. These are known as:

- **Pre-travel variation:** (see Figure 1.2) which results from the three point Kinematic location exhibiting a variation in trigger force, dependent on trigger direction and subsequent bending of the stylus prior to a trigger taking place. Although probe pre-travel is typically small (± 1µm), if long, non-rigid stylus configurations or high trigger forces are used it can become a major source of measurement error. **The MP700 probe virtually eliminates pre-travel variation.**

- **Probe hysteresis:** that occurs as a direct consequence of previous trigger direction and reseat. Although probe hysteresis is comparative to undirectional repeatability, it is more greatly affected by stylus length and trigger force.

Whilst in practice an element of these error sources may be present in each measurement taken, the degree of presence is significantly influenced by:

- Any datuming and measuring techniques employed.

- The model and type of probe used.

- The type of feature being probed.

CHAPTER 2

System Installation

This chapter provides step-by-step instructions to assist you in installing and connecting the MP700 Probe System to your machine tool.

Contained In This Chapter

Installing Your MP700 Probe System to Your Machine Tool (OMM/MI12 Interface Variants)

Note...

For specific information on how to connect the MP700 Probe System to your machine tool's CNC controller, refer to the Probe Systems Installation Manual For Machine Tools (Publication Number H-2000-6040). Where necessary, this publication may be obtained. through your nearest Renishaw company.

Mounting Your Optical Machine Module to Your Machine Tool

WARNINGS

IF THE SYSTEM IS TO BE INSTALLED ONTO A MULTI-AXIS MACHINE TOOL, ENSURE THAT THE OPTICAL MODULE PROBE'S LED's HAVE LINE OF SIGHT WITH THE OPTICAL MACHINE MODULE.

IF TWO OPTICAL TRANSMISSION SYSTEMS ARE TO OPERATE IN CLOSE PROXIMITY TO ONE ANOTHER, ENSURE THAT SIGNALS TRANSMITTED BY THE OPTICAL PROBE MODULE OF ONE SYSTEM WILL NOT BE RECEIVED BY THE OPTICAL MACHINE MODULE OF THE OTHER.

Notes...

The OMM may be positioned at a distance of between 10mm and 3 metres (0,39 in. and 9,84 ft) from the MP700 Probe.

At maximum spindle movement, the OMP and OMM beams must overlap.

Operational Requirements

The Optical Machine Module (OMM), supplied with 25 metres (82 ft) of 5.1mm (0,02 in.) diameter cable, must be mounted within the cabinet of your machine tool. Ensure that the operating envelope between the OMM and the MP700's Optical Module Probe (OMP) conforms to that shown in Figure 2.1.

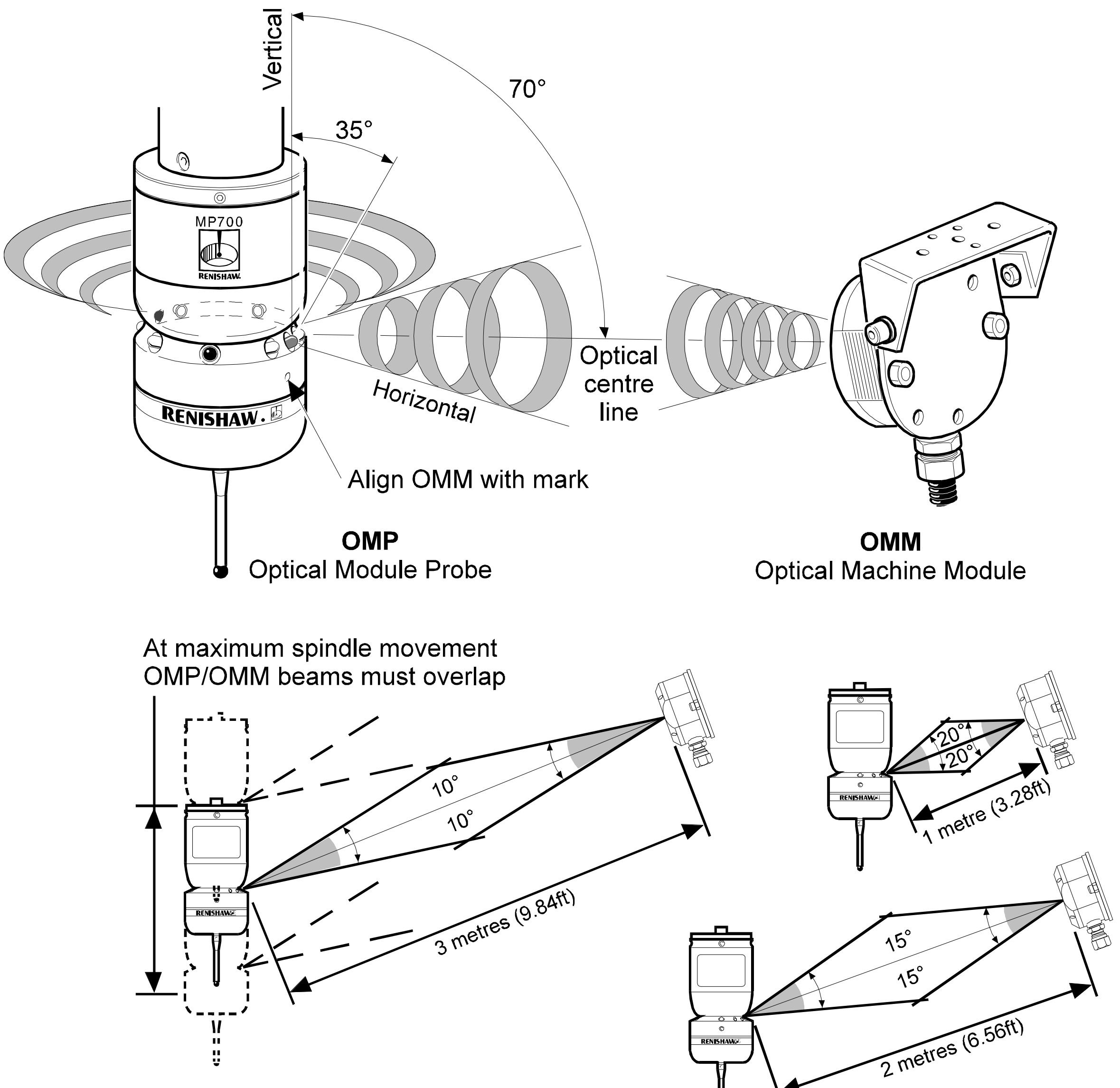


Figure 2.1 - OMM Operating Requirements

Mounting the OMM

The OMM may be mounted within the machine tool cabinet in one of two ways (see Figure 2.2):

- By screwing the body of the OMM directly to the cabinet wall.

- By first mounting the OMM to the mounting bracket supplied (part no. A-2033-0830) and then mounting the bracket to the cabinet wall. **This is the recommended method as it allows the OMM to be pivoted to provide the best possible angle**.

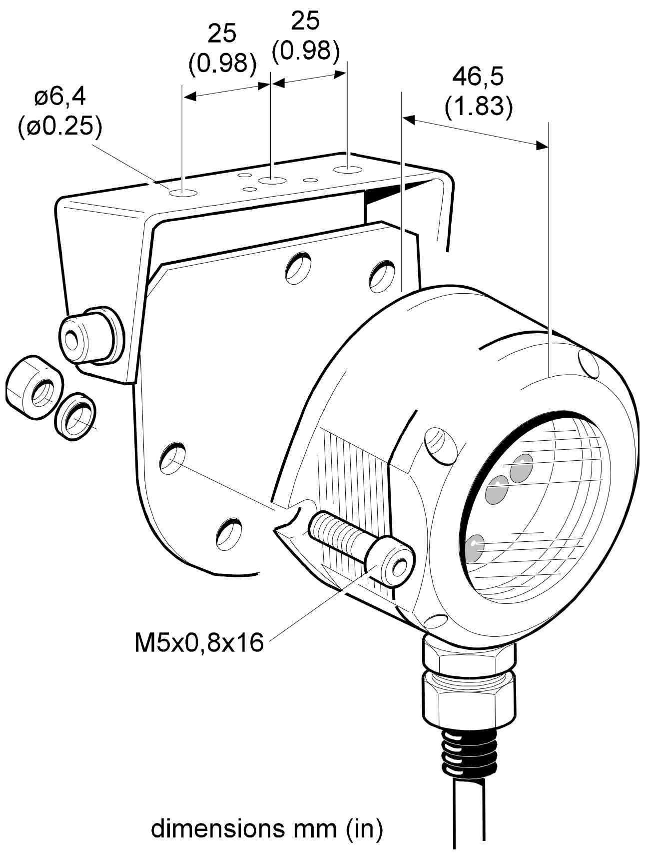


Figure 2.2 - Mounting the OMM

Protection of the OMM Cable

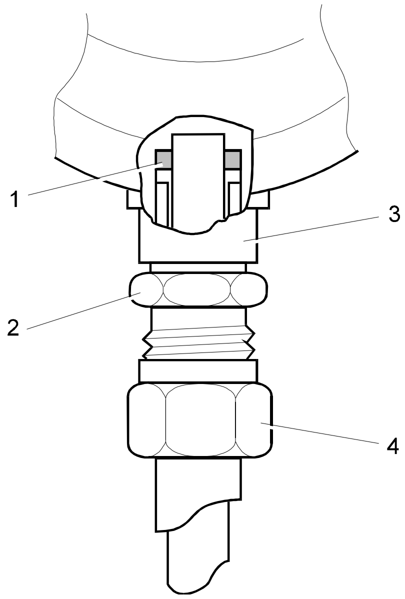
CAUTION

FAILURE TO ADEQUATELY PROTECT THE OMM CABLE MAY RESULT IN SYSTEM FAILURE DUE TO CABLE DAMAGE OR THE INGRESS OF COOLANT.

Note...

Failure of the OMM due to inadequate protection of the cable will invalidate the warranty.

Whilst coolant and dirt are prevented from entering the OMM by a cable sealing gland, it is important that the cable itself is protected from physical damage by fitting either flexible or rigid conduit. The OMM is supplied with a Renishaw® conduit adapter (see Figure 2.3) which supports both methods.



1. Cable Sealing Gland
2. Gland Nut
3. Adapter Body
4. Gland Nut

Figure 2.3 - The Renishaw® Conduit Adapter

Fitting Flexible Conduit to the OMM Cable

Notes...

It is recommended that Thomas and Bretts 1/4 in. (11mm) diameter SHURESEAL (Part Number TBEF 0250-5O), or equivalent, is used when protecting the OMM cable with flexible conduit.

Use plastic olive [5] when fitting flexible conduit to the conduit adapter.

When loosening gland nut [6], it is important to ensure that gland nut [1] is not inadvertently loosened.

To fit flexible conduit to the OMM cable (see Figure 2.4):

1. Cut flexible conduit [7] to required length.

2. Release and remove gland nut [6] from screwed adapter [2]. Take care not to slacken gland nut [1].

3. Remove gland nut [6] from the OMM cable [3].

4. Carefully thread the OMM cable [3] through the flexible conduit [7].

5. Screw the conduit termination piece [4] into the end of the flexible conduit [7].

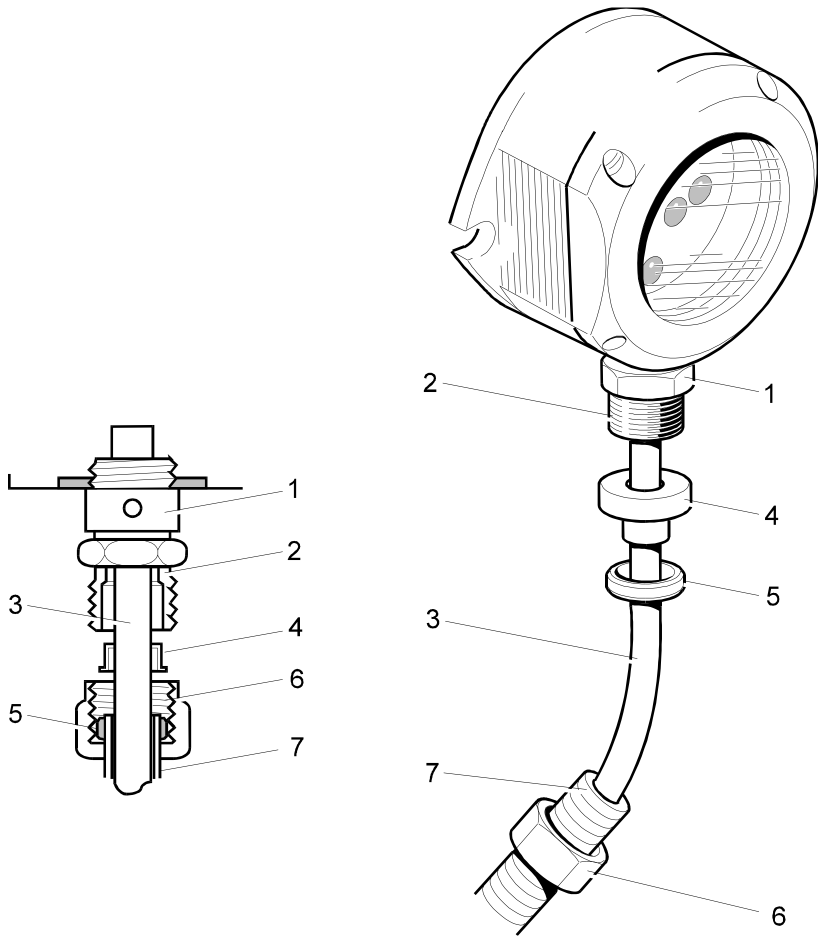
6. Push the flexible conduit [7] upwards until conduit termination piece [4] locates within screwed adapter [2].

7. Ensuring the flexible conduit [7] is fully located through plastic olive [5], assemble gland nut [6] to screwed adapter [2] and hand tighten to retain conduit in place.

Note...

When tightening gland nut [6], it is important to ensure that gland nut [1] is not inadvertently loosened.

8. Ensuring gland nut [1] is not inadvertently slackened, tighten gland nut [6] an additional 1½ to 2½ turns. This action will form a seal between the flexible conduit and the screwed adapter that conforms to BS 5490 (IEC 529) IP67.



1. Gland Nut
2. Screwed Adapter
3. OMM Cable
4. Conduit Termination Piece
5. Plastic Olive
6. Gland Nut
7. Flexible Conduit

Figure 2.4 - Fitting Flexible Conduit to the OMM Cable

Fitting Rigid Conduit to the OMM Cable

Notes...

It is recommended that Bundy Tube - 12mm diameter hydraulic pipe is used when protecting the OMM cable with rigid conduit.

Use brass olive [4] when fitting rigid conduit to the conduit adapter.

When loosening gland nut [5], it is important to ensure that gland nut [1] is not inadvertently loosened.

To fit rigid conduit to the OMM cable (see Figure 2.5):

1. Cut rigid conduit [6] to required length.

2. Release and remove gland nut [5] from screwed adapter [2]. Take care not to slacken gland nut [1].

3. Remove gland nut [5], together with conduit termination piece and plastic olive, from the OMM cable [3] (see Figure 2.4).

5. Remove brass olive [4] from its plastic bag and assemble over OMM cable [3].

6. Re-assemble gland nut [5] to OMM cable [3].

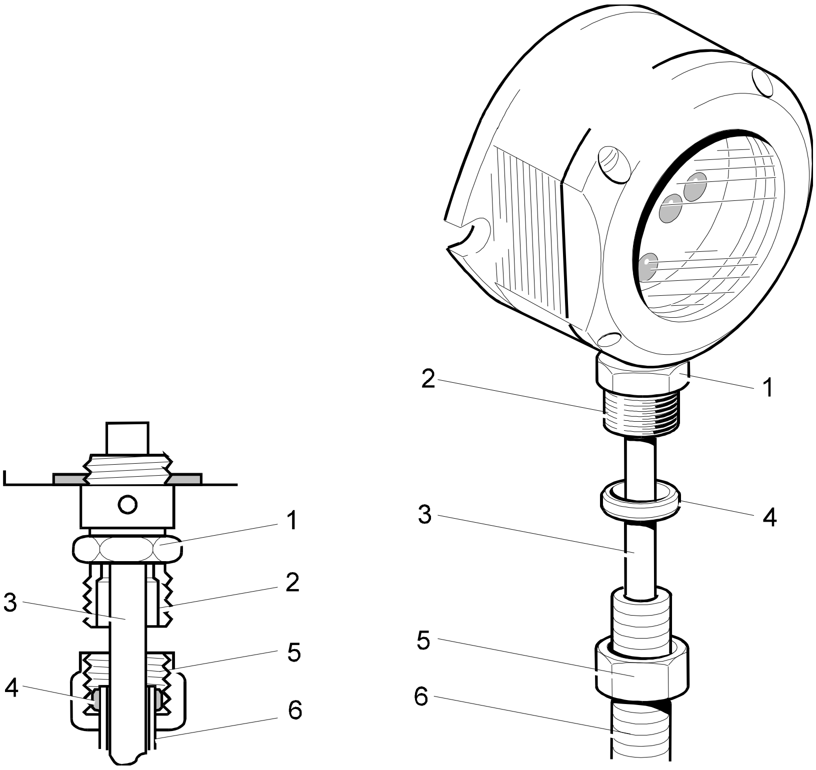
7. Pass the OMM cable [3] through the rigid conduit [6].

8. Locate end of rigid conduit [6] into screwed adapter [2].

Note...

When tightening gland nut [5], it is important to ensure that gland nut [1] is not inadvertently loosened.

9. Assemble gland nut [5] to screwed adapter [2] and torque tighten to between 25 and 27Nm (18.55 and 19.91 lbf.ft). This action will provide a seal between the rigid conduit and the conduit adapter conforming to BS 5490 (IEC 529) IP67.



1. Gland Nut
2. Screwed Adapter
3. OMM Cable
4. Brass Olive
5. Gland Nut
6. Rigid Conduit

Figure 2.5 - Fitting Rigid Conduit to the OMM Cable

Setting Up Your Optical Machine Module

The OMM reception (Rx) and transmission (Tx) ranges (see Figure 2.8) are set by the range selection switch shown in Figure 2.7. To gain access to the range selection switch, it is first necessary to remove the window and label from the OMM body.

Removal of the Window and Label from the OMM

CAUTION

DO NOT ALLOW LIQUIDS OR SOLID PARTICLES TO ENTER THE OMM BODY. NEVER REMOVE THE WINDOW [3] BY TWISTING OR ROTATING BY HAND, ALWAYS USE THE JACKING SCREWS [2].

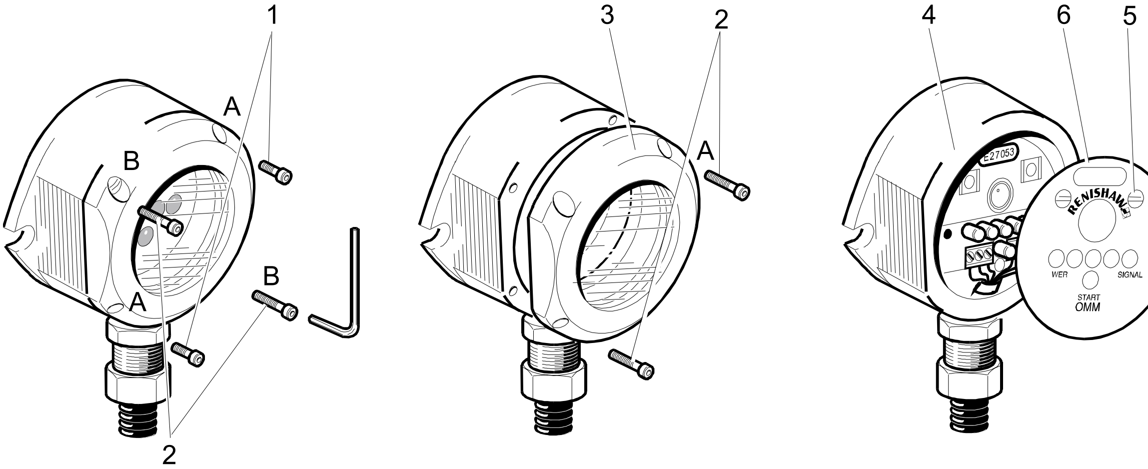
Note...

The window [3] must only be removed for the following reasons:

- **To gain access to the range selection switch when changing the reception/transmission range settings.**
- **To replace a broken window.**

Refer to Figure 2.6:

1. Using a 2.5mm AF hexagon Allen Key, remove the two short screws [1] and the two long screws [2] securing the window [3] to the OMM body [4].
2. Insert the two long screws [2] into the two threaded holes **A**.
3. Alternately tighten the long screws [2] to evenly jack the window [3] from the OMM body [4]. Gently remove the window from the OMM body.
4. Release the label [6] from the OMM body by turning the two quick release screws [5] a 1/4 turn counterclockwise. Carefully lift the label from the OMM body to gain access the range selection switch (see Figure 2.7).



1. Screw (short) (2 Off)
2. Screw (long) (2 Off)
3. Window
4. OMM Body
5. Retaining Screw
6. Label

Figure 2.6 - Removal of the OMM Window and Label

Adjustment of the Range Selection Switch

> **Note...**
>
> **The OMM Rx and Tx ranges should only be adjusted by suitably qualified personnel, and only when the OMM is found to be affected by optical or electro-magnetic interference during commissioning of the system. Typically, adjustment should only prove necessary in extreme cases.**

Adjust the range selection switch (Figure 2.7) to the setting shown below to increase or decrease the Reception (Rx) and Transmission (Tx) ranges to the percentage you require (refer to Figure 2.8).

Reception Range			Transmission Range	
	1	**2**		**3**
100%	Off	On	100%	On
50%	On	Off	50%	Off
25%	Off	On	50%	Off

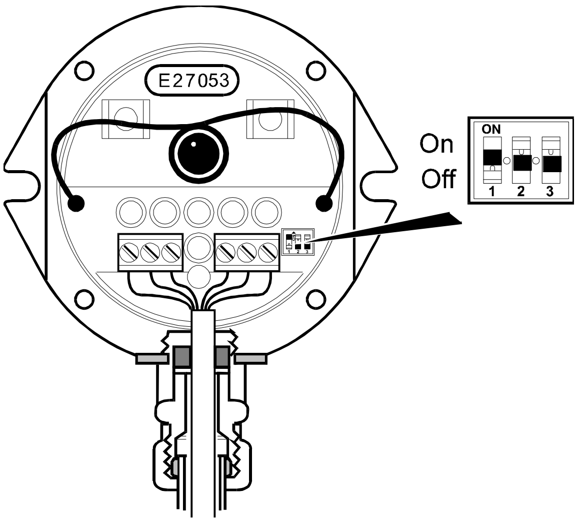


Figure 2.7 - The OMM Range Selection Switch

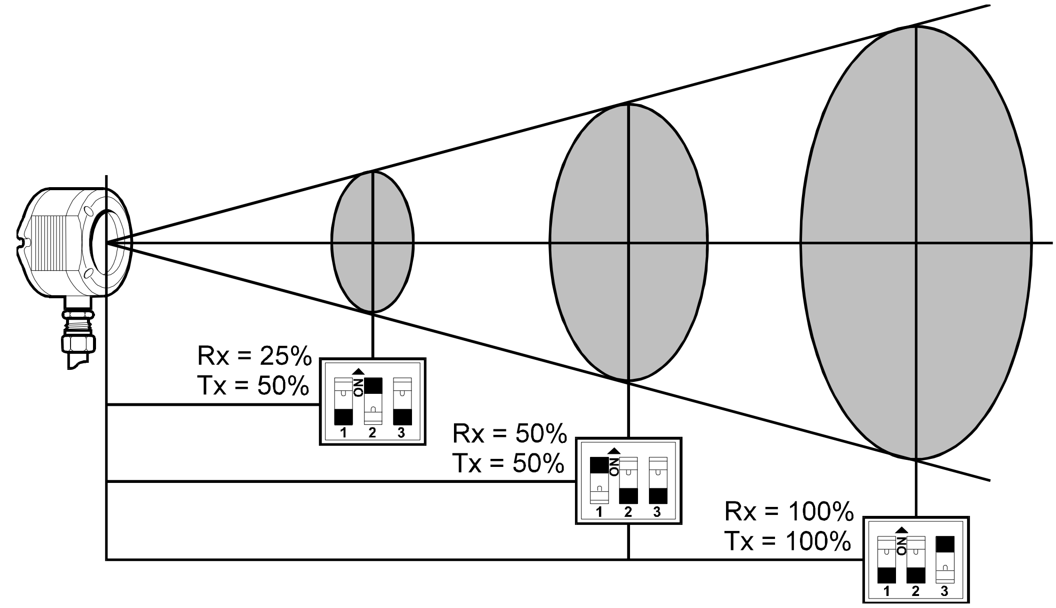


Figure 2.8 - OMM Reception and Transmission Ranges

Replacement of the OMM Label and Window

Refer to Figure 2.9:

1. Refer to **View A** and assemble the label [1] and secure with the two quick release screws [2]. Rotate screws a quarter turn clockwise to hold label in place.

2. Visually examine the OMM body [3] for damage or scratching to the 'O' ring location groove as shown in **View A**.

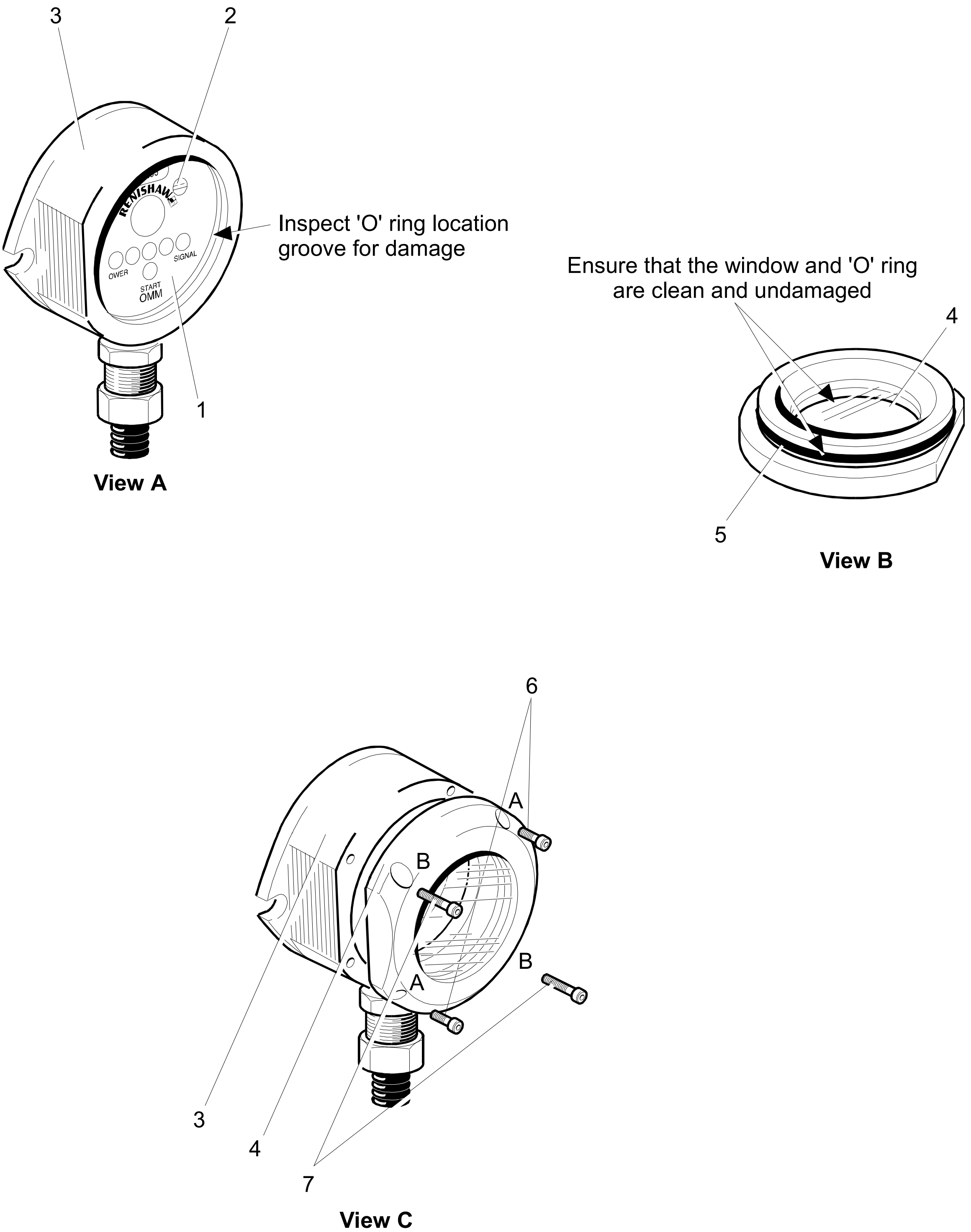
3. Visually examine the window [4] and 'O' ring [5] for cleanliness as shown in **View B**. Also ensure that both the window and 'O' ring are undamaged.

4. Refer to **View C** and insert the two short screws [6] into the two threaded holes **A** in the window [4]. Tighten the two screws to 0.3 - 0.7Nm (0.22 - 0.51 lbf. ft).

5. Lightly smear the 'O' ring [5] with silicone grease and assemble window [4] to OMM body [3].

6. Insert the two long screws [7] into the two plain holes **B**. Tighten each screw a few turns at a time to gradually pull the window [4] evenly against the OMM body [3]. There may be some resistance due to the compression of air trapped inside the OMM body.

7. Alternatively tighten screws [7] to pull window [4] evenly into the body of the OMM. Finally tighten screws to 1.0 - 1.8Nm (0.74 - 1.32 lbf.ft).



1. Label
2. Retaining Screw (2 Off)
3. OMM Body
4. Window
5. ‘O’ Ring
6. Screw (short) (2 Off)
7. Screw (long) (2 Off)

Figure 2.9 - Assembly of the OMM Window and Label

Mounting Your MI12 Machine Interface Unit to Your Machine Tool

Note...

In order that personnel operating the MP700 Probe System can monitor system status, it is recommended that the MI12 Machine Interface be mounted to the machine tool such that its front panel is visible to the Operator.

The MI12 Machine Interface may be mounted to the machine tool as follows:

- Mounted within the front panel of the CNC controller.
- Mounted within one of the machine’s side panels.
- Mounted on top of the CNC controller if panel mounting is not possible.

Cutting a Hole in the Mounting Panel

> **Note...**
>
> **Before cutting any panel, make sure that you have the MI12 panel mounting kit (Part Number A-2033-0690).**

1. Release and remove the panel into which you wish to mount the MI12 Machine Interface Unit.

2. Cut, drill and countersink the panel, to which you wish to mount the MI12 Machine Interface Unit, to the dimensions shown in Figure 2.10.

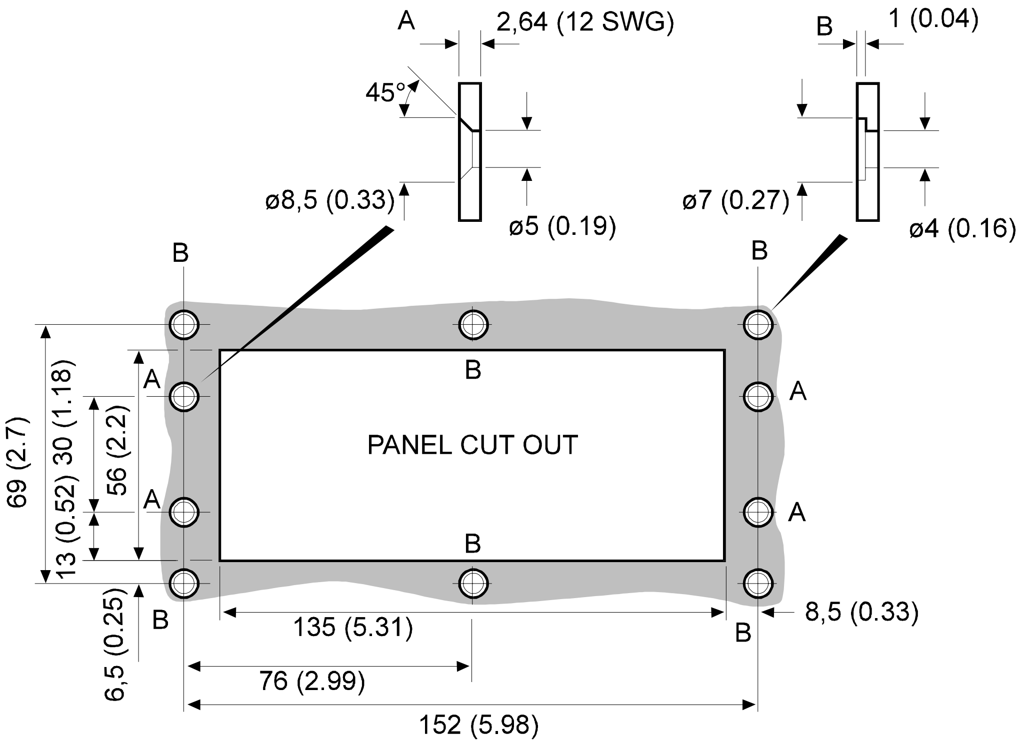


Figure 2.10 - MI12 Machine Interface Unit (Panel Mounting Dimensions)

Panel Mounting the MI12 Machine Interface Unit

Refer to Figure 2.11:

1. Obtain an MI12 panel mounting kit (Part Number A-2033-0690). Where necessary, this may be ordered through your nearest Renishaw company or distributor.

2. Assemble the panel mounting kit to the MI12 Machine Interface Unit as follows (refer to Figure 2.11):

   a. Assemble the two brackets [1] to the pre-cut panel and secure with the four screws [2], the four washers [3] and the four nuts [4].

   b. Remove the protective paper from the gasket [5] and assemble the gasket to the bezel [6].

   c. Assemble the bezel [6] to the pre-cut panel and secure with the four washers [7] and the four nuts [8].

   d. Release and remove the base plate [9] from the MI12 Machine Interface Unit [10].

   e. Release and remove the four footpads [11] from the base plate [9].

   f. Insert the four grommets [12] into the four footpad location holes within the base plate [9].

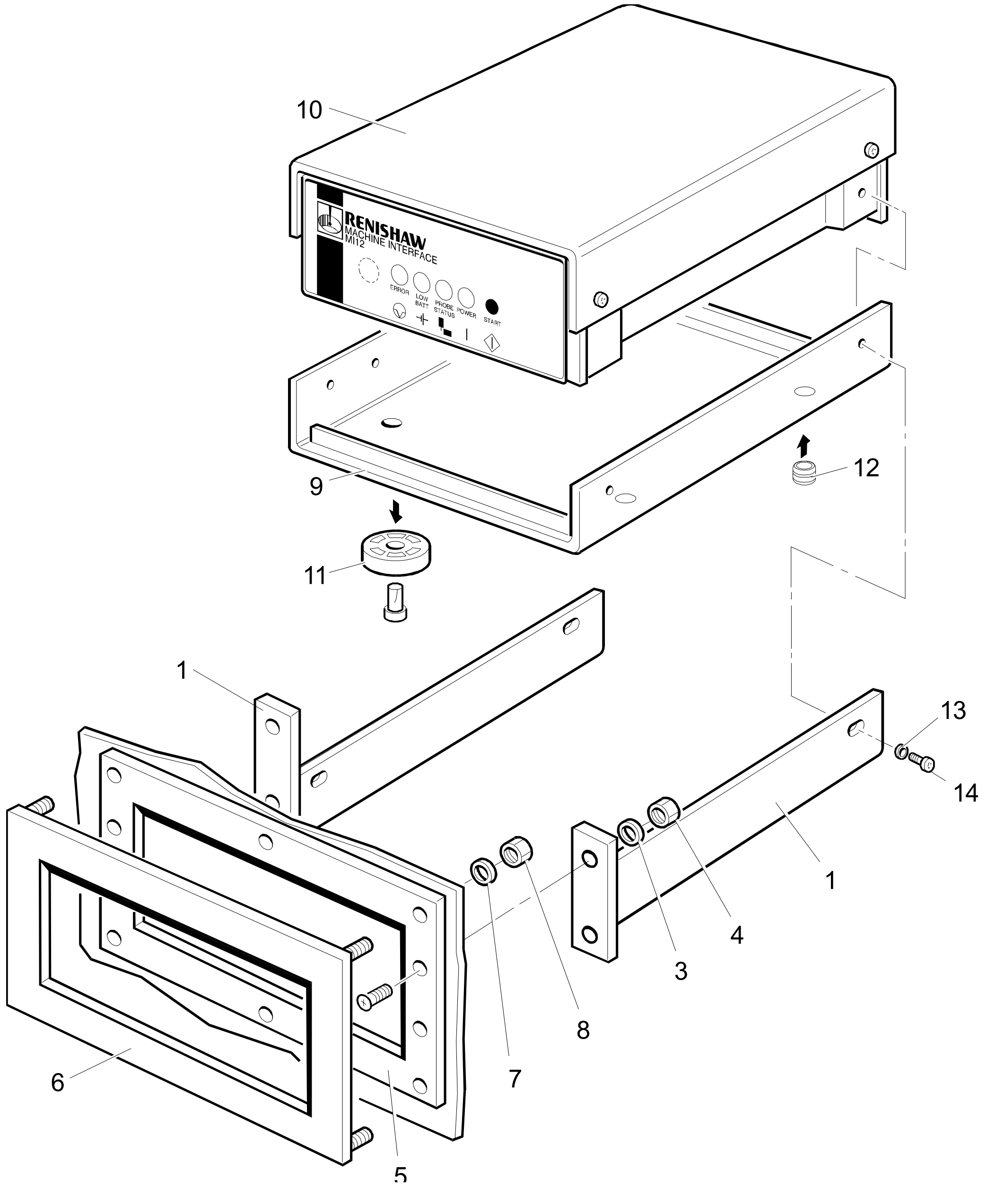
   g. Mount the base plate [9] between the two brackets [1].

   h. Mount the MI12 Machine Interface Unit [10] to the base plate [9].

   i. Slide the MI12 Machine Interface Unit forward to abut the bezel [6].

   j. Secure the MI12 Machine Interface Unit in position with the four washers [13] and the four screws [14].

   k. Mount the pre-cut panel, together with the assembled mounting kit and MI12 Machine Interface Unit, to the machine tool.

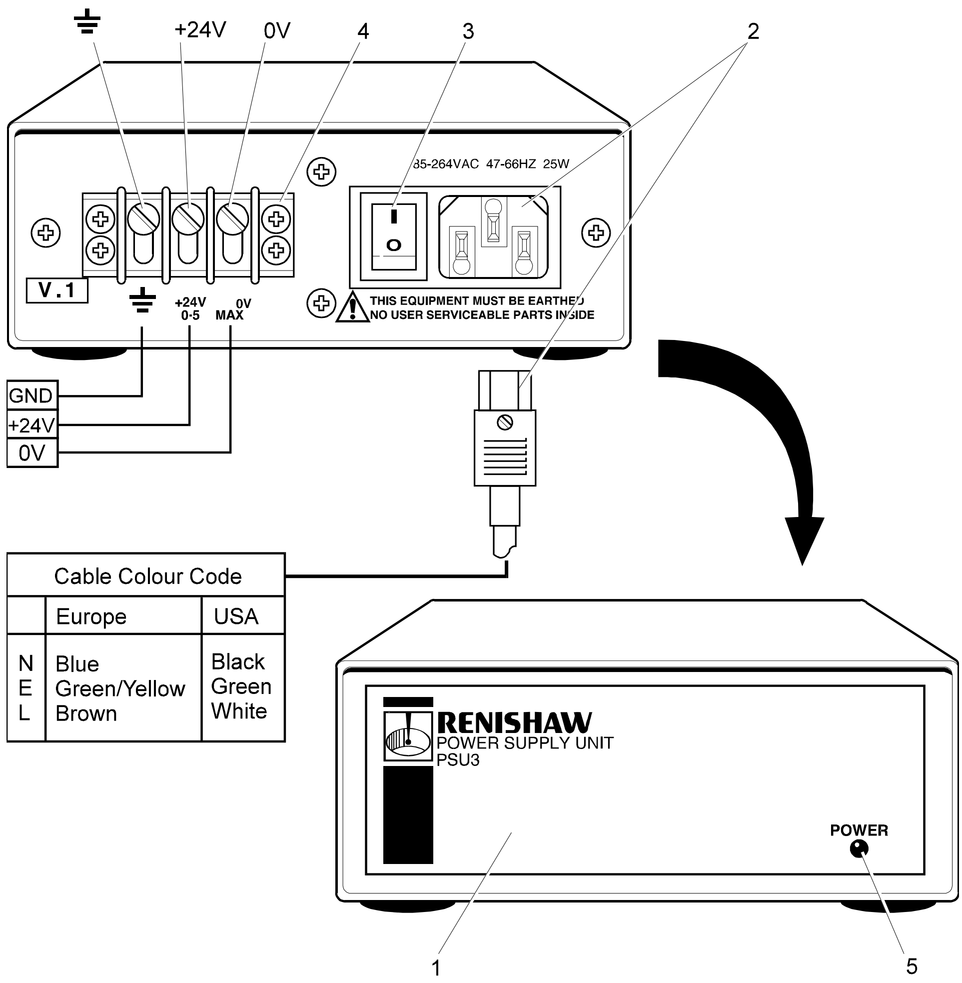


1. Bracket (2 Off)
2. Screw (4 Off)
3. Washer (4 Off)
4. Nut (4 Off)
5. Gasket
6. Bezel
7. Washer (4 Off)
8. Nut (4 Off)
9. Base Plate
10. MI12 Machine Interface Unit
11. Foot Pad (4 Off)
12. Grommet (4 Off)
13. Washer (4 Off)
14. Screw (4 Off)

Figure 2.11 - Panel Mounting the MI12 Machine Interface Unit

Mounting Your PSU3 Power Supply Unit to Your Machine Tool

It is recommended that the PSU3 Power Supply Unit (see Figure 2.12) is mounted within the machine's electrical cabinet.

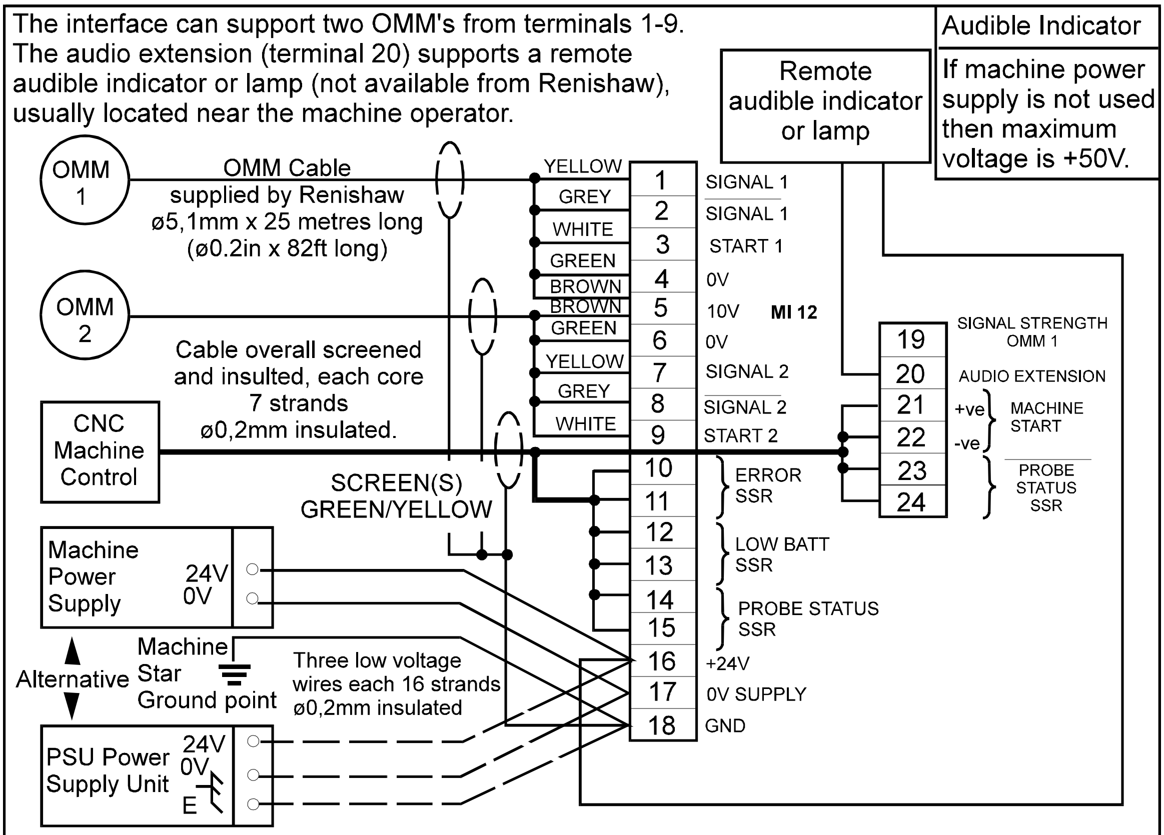


1. PSU3 Power Supply Housing
2. Mains Plug and Socket
3. ON/OFF Switch
4. Output Terminal Block
5. 'POWER' LED

Figure 2.12 - PSU3 Power Supply Unit

Connecting Your System Components Together (OMM/MI12 Interface Variant)

The MP700 Probe System should be connected electrically as shown in Figure 2.13.



Notes: 1. The supply 0V and all 0V signal reference terminals are isolated from case.
2. Grounding of the case and 0V should be made to comply with all relevant safety standards. Care should be taken to avoid ground coupled interface.
3. Please consult your Renishaw supplier for wiring details of special OMM-C (s).

Figure 2.13 - MP700 Probe System Wiring Diagram (OMM/MI12 Interface Variant)

Connecting Your OMM, MI12 Machine Interface Unit and PSU3 Power Supply Unit Together

Connecting the OMM and MI12 Machine Interface Unit Together

Refer to Figure 2.14:

1. Release and remove the four screws [1] securing the top cover [2] to the MI12 Machine Interface Unit [3]; remove the cover.

2. Release and remove the gland nut [4] from the right hand gland connector [5] (when looking down on the printed circuit board) at the rear of the MI12 Machine Interface Unit. Remove the grommet [6] and the fibre washer [7] from the gland nut.

3. Assemble the gland nut [4], fibre washer [7] and grommet [6] to the OMM cable [8].

4. Insert the OMM cable [8] through the right hand gland connector [5] (when looking down on the printed circuit board).

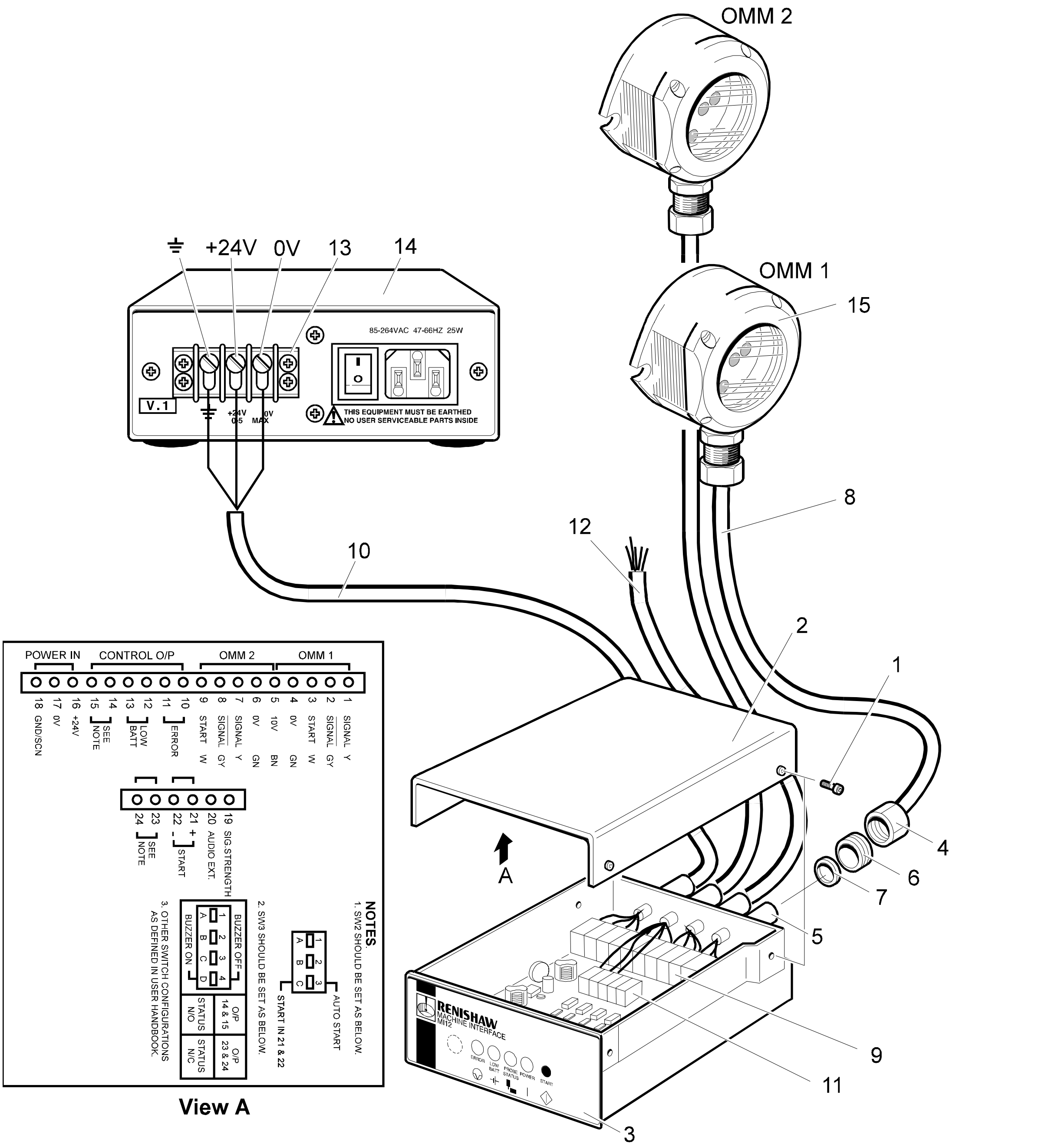
Note

Wiring instructions for connecting the OMM cable to the terminal block [9] of the MI12 Machine Interface Unit are shown diagrammatically on the underside of the top cover [2]. For installation purposes, the OMM cable is diagrammatically referred to as OMM 1 (see Figure 2.13).

5. Connect the OMM cable [8] to the terminal block [9] in accordance with the wiring diagram provided on the underside of top cover [2] (see also Figure 2.13).

6. Slide the grommet [6] and fibre washer [7] along OMM cable until the grommet abuts the gland connector [5].

7. Assemble the gland nut [4] to the gland connector [5]; tighten the gland nut gently until the grommet [6] seals against the OMM cable.



1. Screw (4 off)
2. Top Cover
3. MI12 Machine Interface Unit
4. Gland Nut (4 off)
5. Gland Connector (4 off)
6. Grommet (4 off)
7. Washer (4 off)
8. OMM Cable
9. Terminal Block
10. Wires (from PSU3 Power Supply Unit or Machine Tool 24V supply)
11. Terminal Block
12. Cable (To CNC controller)
13. Terminal Block
14. PSU3 Power Supply Unit
15. Optical Machine Module

Figure 2.14 - Connecting the Optical Machine Module, PSU3 Power Supply Unit and the MI12 Machine Interface Unit Together

Connecting the PSU3 Power Supply Unit to the MI12 Machine Interface Unit

Refer to Figure 2.14:

Where applicable, connect the PSU3 Power Supply Unit to the MI12 Machine Interface Unit as follows. If your system does not include the PSU3 Power Supply Unit (because a 24 Volt supply is available from your machine tool), refer to **Connecting the MI12 Machine Interface Unit to the Machine Tool's CNC Controller and 24 Volt Power Supply** later in this chapter:

Notes...

Further information on connecting the MI12 Machine Interface to the PSU3 Power Supply Unit may be obtained by reading the MI12 Interface/ PSU3 Power Supply Installation and User's Guide (Publication Number H-2000-5073)

It is recommended that the wires used to connect the PSU3 Power Supply Unit to the MI12 Machine Interface Unit conform to DEF 61-12 part 6 type 2, BS4808, or equivalent.

The output voltage of the PSU3 Power Supply Unit is 24 volts dc.

1. Obtain three suitable lengths of 1.55mm nominal diameter PVC or PTFE insulated wires. Each wire should contain sixteen 0.2mm diameter strands. It is recommended that the following colours are used:

Connection	Colour of Wire
+24V	Red
0v	Black
Earth	Green

2. Release and remove the gland nut [4] from the left hand gland connector [5] (when looking down on the printed circuit board) at rear of the MI12 Machine Interface Unit. Remove the grommet [6] and fibre washer [7] from the gland nut.

3. Assemble the gland nut [4], fibre washer [7] and grommet [6] to the three wires [10].

4. Insert the three wires [10] through the left hand gland connector [5] (when looking down on the printed circuit board).

> **Note**
>
> **Wiring instructions for connecting the three wires to the terminal block [9] of the MI12 Machine Interface Unit are shown diagrammatically on the underside of the top cover [2]. For installation purposes, these wires are diagrammatically referred to as Power In (see Figure 2.13).**

5. Connect each wire [10] to the terminal block [9] in accordance with the wiring diagram provided on the underside of top cover [2] (see also Figure 2.13). If you are using the recommended colour of wire, connect the wires to the terminal block as follows:

Colour Wire	Terminal Block Number
Red	Terminal 16
Black	Terminal 17
Green	Terminal 18

6. Slide the grommet [6] and fibre washer [7] along each wire until the grommet abuts gland connector [5].

7. Assemble the gland nut [4] to the gland connector [5]; tighten the gland nut gently until the grommet [6] seals against the three wires.

8. Release the connector screws in the output terminal block [13] of the PSU3 Power Supply Unit [14].

9. Connect the red wire to the 24V terminal of the PSU3 Power Supply Unit [14].

10. Connect the black wire to the 0V terminal of the PSU3 Power Supply Unit [14].

11. Connect the green wire to the earth (E) terminal PSU3 Power Supply Unit [14].

12. Tighten connector screws to secure wires to the terminal block [13].

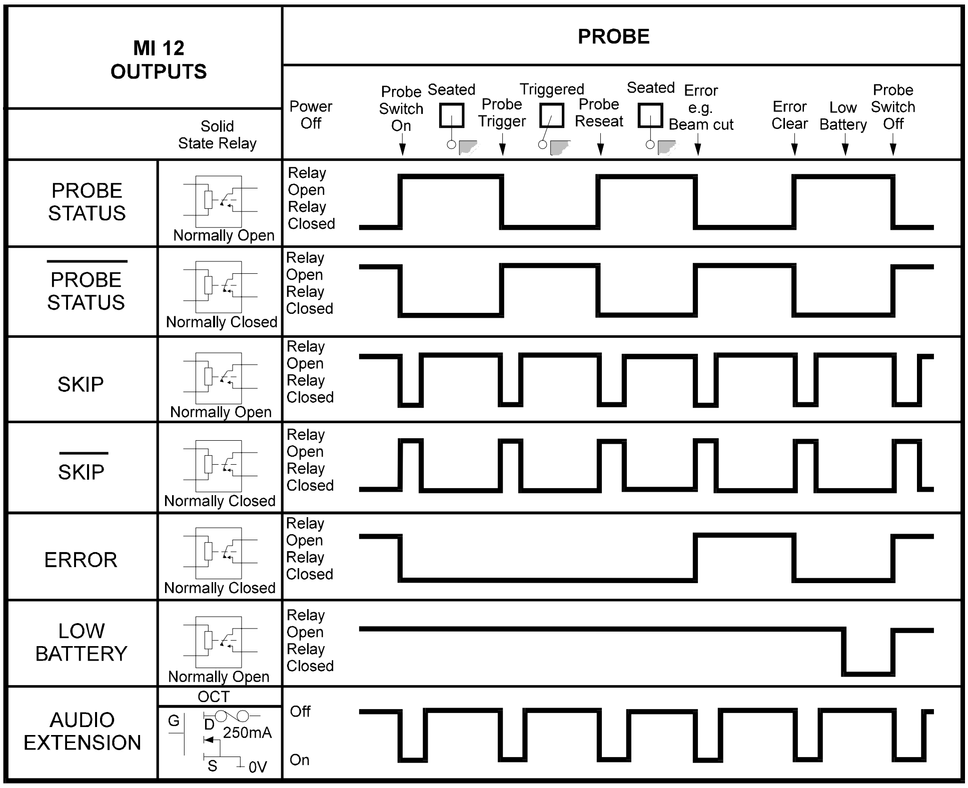
Connecting Your System Components to Your Machine Tool (OMM/MI12 Interface Variant)

Connecting the MI12 Machine Interface Unit to the Machine Tool's CNC Controller and 24 Volt Power Supply

MI12 Machine Interface Unit Outputs

There are four Solid State Relay SSR outputs, comprising two probe complementary outputs, an error output and a low battery output. Each output has a maximum current of ± 40mA peak and a maximum voltage of ± 50V peak. The output waveforms of the MI12 Machine Interface Unit are shown in Figure 2.15 below. Each SSR is protected from overload by a 62mA fuse.

In addition, an output is also provided for a remote audible indicator or lamp that can be located near the machine tool operator. This output will sink 100mA and should have no more than +50V dc applied to it. The output will remain active for 44ms after each probe change of state.



The output signals from the interface must be compatible with the machine control input.

Figure 2.15 - MI12 Machine Interface Unit Output Waveforms

Switch Settings

The MI12 Machine Interface Unit incorporates the following switches (see Figure 2.16); it is important that, where necessary, each of these switches are set to suit your specific application:

Switch SW1

This switch acts as a manual start switch and is disabled for the entire duration of 'MACHINE START' input signals. Access to switch SW1 is via the front panel of the MI12 Machine Interface Unit.

Switch SW2

CAUTION

THE AUTOSTART SELECTION CAUSES THE SYSTEM TO SEND A START SIGNAL ONCE EVERY SECOND AND DOES NOT REQUIRE A CNC MACHINE CONTROL INPUT. FOR THIS REASON, IT MUST NEVER BE USED WHEN USING THE MP700 PROBE.

This switch is supplied factory set as shown in Figure 2.16, i.e. to 'MACHINE START' with both the 'OMM1' and 'OMM2' switches set to the their *standard* settings.

In order that a 'MACHINE START' signal can be initiated, an input of between 4,25V at 1mA and 30V at 10mA is required between terminals 21(+) and 22 (-) TTL compatible when connected between +5V and TTL output. Minimum pulse width is 1ms.

Switch SW3

This switch enables Normally Open and Normally Closed options to be selected for SKIP and PROBE STATUS. The switch is factory set to option 1 (see Figure 2.17).

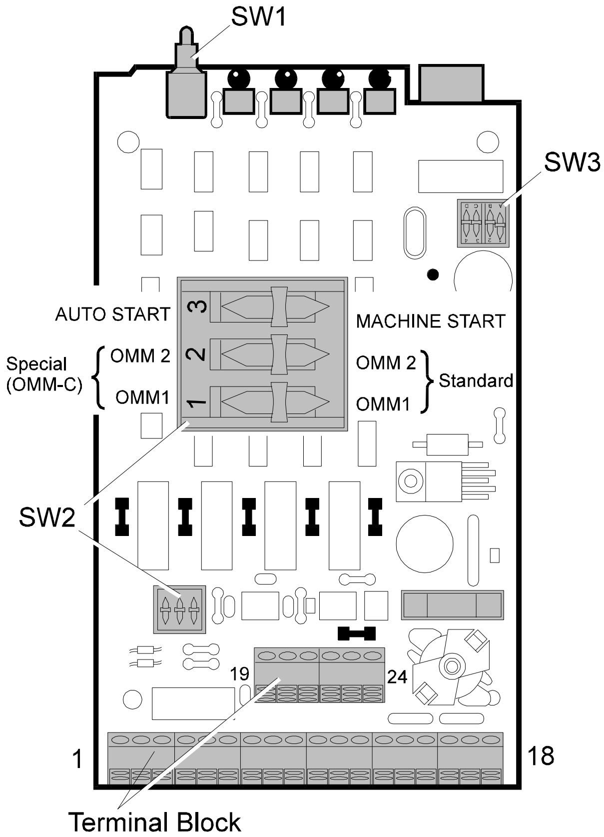


Figure 2.16 - MI12 Machine Interface Unit Switch Locations

KEY
N/O Normally Open N/C Normally Closed
Switch must be in position shown.
Switch can be in either position
Bleeper on/ Bleeper off Factory set to Bleeper on

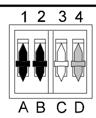
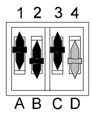
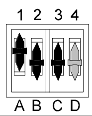
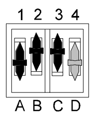
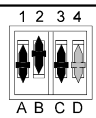
OPTION	Terminals 14 & 15	Terminals 23 & 24	SW3
1	PROBE STATUS N/O	$\overline{\text{PROBE STATUS}}$ N/C	
2	$\overline{\text{SKIP}}$ N/C	$\overline{\text{PROBE STATUS}}$ N/C	
3	SKIP N/O	$\overline{\text{PROBE STATUS}}$ N/C	
4	PROBE STATUS N/O	$\overline{\text{SKIP}}$ N/C	
5	PROBE STATUS N/O	SKIP N/O	

Figure 2.17 - Switch SW3 Settings

Signal Strength Test Points

The MI12 Machine Interface Unit incorporates the three signal strength test points detailed below, refer to Figure 2.18:

T1 - OMM 2

Minimum receivable signal, approximately 0,36V dc.
Maximum signal strength output approximately 7V dc.

T2 - OMM 1

Signal strength levels same as **T1 - OMM 2** above (also available at terminal 19).

T3

0V Reference.

Fuses

The MI12 Machine Interface Unit incorporates the following fuses, refer to Figure 2.18:

FS1 - Spare 62mA Quick Blow fuse

FS2 - 62mA Error

FS3 - 62mA Low Battery

FS4 - 62mA Probe Status N/C

FS5 - 250mA Audio Extension Protection

FS6 - 62mA Probe Status N/O

FS7 - 500mA Anti-surge (20mm) Power Supply Protection

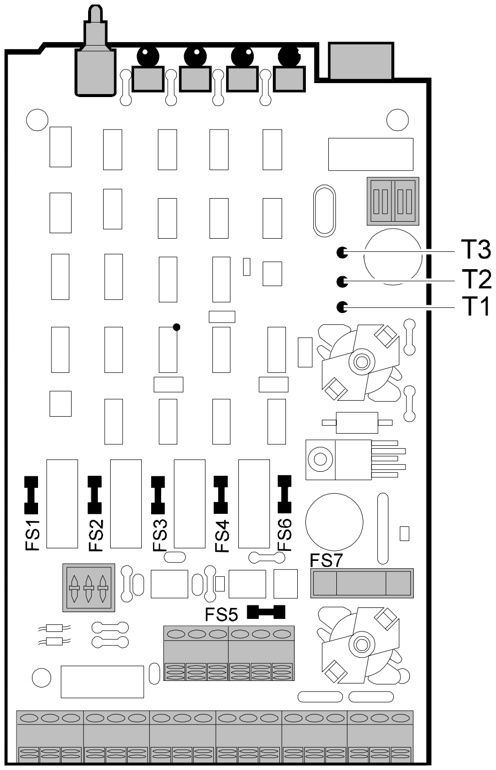


Figure 2.18 - MI12 Machine Interface Unit - Signal Test Point and Fuse Locations

Connecting the MI12 Machine Interface to Your Machine's CNC Controller

To connect the MI12 Machine Interface Unit to your machine's CNC controller, carry out the following (see Figures 2.13 and 2.14):

Notes...

The way in which the MI12 Machine Interface Unit requires to be connected to your machine's CNC controller will determine the number of cores you will require. However, it is recommended that a single twelve core cable (conforming to DEF STAN 61-12 (Part 4) or equivalent) is used to connect the MI12 Machine Interface Unit to the machine's CNC controller.

For specific information on how to connect the MI12 Machine Interface Unit to your machine's CNC controller, refer to the Probe Systems Installation Manual For Machine Tools (Publication Number H-2000-6040). Where necessary, this may be obtained through your nearest Renishaw company

For specific information on your machine's CNC controller, contact the manufacturer, or supplier, of the machine tool to which you are installing the MP700 Probe System.

1. Obtain suitable length(s) of screened multicore cable offering twelve PVC insulated, PVC-sheathed, cores. Each core must contain seven 0.2mm diameter wires.

2. Release and remove the gland nut [Item 4, Figure 2.14] from the unused gland connector [5] immediately next to that used for the PSU3 Power Supply Unit cable. Remove the grommet [6] and fibre washer [7] from the gland nut.

3. Assemble the gland nut [4], fibre washer [7] and grommet [6] to the cable [12].

> **Note...**
>
> **If you are using multiple cables to connect the MI12 Machine Interface Unit to the machine's CNC controller, use the gland connector immediately next to that used to connect the PSU3 Power Supply Unit for the cable you wish to connect to terminal block [9]. Use the gland connector immediately next to that used for the OMM cable for the cable you wish to connect to terminal block [11].**

4. Insert cable [12] through the gland connector [5].

> **Note**
>
> **Wiring instructions for connecting the cable(s) to terminal blocks [9] and [11] of the MI12 Machine Interface Unit are shown diagrammatically on the underside of the top cover [2]. For installation purposes, the cable is diagrammatically referred to as Control OP (see Figure 2.13).**

5. Connect cable [12] to terminal blocks [9] and [11], as required, in accordance with the wiring diagram provided on the underside of the top cover [2] (see also Figure 2.13).
6. Slide the grommet [6] and fibre washer [7] along cable [12] until the grommet abuts the gland connector [5].
7. Assemble the gland nut [4] to the gland connector [5]; tighten the gland nut gently until the grommet [6] seals against the cable [12].

Connecting the MI12 Machine Interface Unit to the Machine Tool's Power Supply

Where applicable, connect the MI12 Machine Interface Unit to your machine tool's 24 volt power supply as follows (see Figures 2.13 and 2.14). If your machine tool does not have a 24 volt power supply, obtain a Renishaw® PSU3 Power Supply Unit (Part No. A-2019-0018) and connect to the MI12 Machine Interface Unit in accordance with **Connecting the PSU3 Power Supply Unit to the MI12 Machine Interface Unit** earlier in this chapter:

Notes...

It is recommended that the wires used to connect the machine tool's power supply to the MI12 Machine Interface Unit conform to DEF 61-12 part 6 type 2, BS4808, or equivalent specification.

The output voltage from the machine tool must be a nominal 24 volts dc unregulated 0.5 amps.

1. Obtain three suitable lengths of 1.55mm nominal diameter PVC or PTFE insulated wires. Each wire should contain sixteen 0.2mm diameter strands. It is recommended that the following colours are used:

Connection	Colour of Wire
+24V	Red
0v	Black
Earth	Green

2. Release and remove the gland nut [4] from the left hand gland connector [5] (when looking down on the printed circuit board) at the rear of the MI12 Machine Interface Unit. Remove the grommet [6] and fibre washer [7] from the gland nut.

3. Assemble the gland nut [4], fibre washer [7] and grommet [6] to the three wires [10].

4. Insert the three wires [10] through the left hand gland connector [5] (when looking down on the printed circuit board).

WARNING

TO ENSURE THE SAFETY OF ALL PERSONNEL, IT IS IMPORTANT THAT THE GROUNDING OF THE MI12 MACHINE INTERFACE UNIT CASE AND 0 VOLT SUPPLY FULLY CONFORMS WITH ALL SAFETY REGULATIONS IN FORCE IN COUNTRY OF USE. ENSURE THAT THE 0 VOLT SUPPLY, AND ALL 0 VOLT SIGNAL REFERENCE TERMINALS, ARE FULLY ISOLATED FROM THE CASE OF THE MI12 MACHINE INTERFACE UNIT. TAKE CARE TO AVOID GROUND COUPLED INTERFERENCE.

Note...

Wiring instructions for connecting the three wires to the terminal block [9] of the MI12 Machine Interface Unit are shown diagrammatically on the underside of the top cover [2]. For installation purposes, these wires are diagrammatically referred to as Power In.

5. Connect each wire [10] to the terminal block [9] in accordance with the wiring diagram provided on the underside of top cover [2] (see also Figure 2.13). If you are using the recommended colour of wire, connect the wires to the terminal block as follows:

Colour Wire	Terminal Block Number
Red	Terminal 16
Black	Terminal 17
Green	Terminal 18

6. Slide the grommet [6] and fibre washer [7] along each wire until the grommet abuts gland connector [5].

7. Assemble the gland nut [4] to the gland connector [5]; tighten the gland nut gently until the grommet [6] seals against the three wires.

8. Assemble the top cover [2] to the MI12 Machine Interface Unit and secure with the four screws [1].

WARNINGS

ISOLATE ALL POWER SUPPLIES TO THE MACHINE TOOL PRIOR TO CONNECTING THE MI12 MACHINE INTERFACE UNIT TO THE MACHINE TOOL'S 24 VOLT POWER SUPPLY

TO ENSURE THE SAFETY OF ALL PERSONNEL, IT IS IMPORTANT THAT THE GROUNDING OF THE MI12 MACHINE INTERFACE UNIT CASE AND 0 VOLT SUPPLY FULLY CONFORMS WITH ALL SAFETY REGULATIONS IN FORCE IN COUNTRY OF USE.

ENSURE THAT THE 0 VOLT SUPPLY, AND ALL 0 VOLT SIGNAL REFERENCE TERMINALS, ARE FULLY ISOLATED FROM THE CASE OF THE MI12 MACHINE INTERFACE UNIT. TAKE CARE TO AVOID GROUND COUPLED INTERFERENCE.

Note...

Prior to connecting the MI12 Machine Interface Unit to the machine tool's 24 volt power supply, refer to the machine manufacturer's literature to ensure all safety and technical requirements are met in full.

9. Connect the red wire to the 24V terminal of the machine tool's 24V power supply.

10. Connect the black wire to the 0V terminal of the machine tool's 24V power supply.

11. Connect the green wire to the earth (E) terminal of the machine tool's 24V power supply.

Connecting Your PSU3 Power Supply Unit to the Mains Power Supply

> **Note...**
>
> **The PSU3 Power Supply Unit will operate on 90-137V (100-125V nominal) 45/65 Hz, (LO) or 180-275V (200-250V nominal) 45/65 Hz (HI) mains power supplies.**

To connect the PSU3 Power Supply Unit to the mains power supply, carry out the following (refer to Figure 2.19):

1. Remove plug from the mains plug and socket [2] at the rear of the PSU3 Power Supply Unit housing [1].

2. Release and remove the screw securing the two halves of the plug together; separate the two halves of the plug.

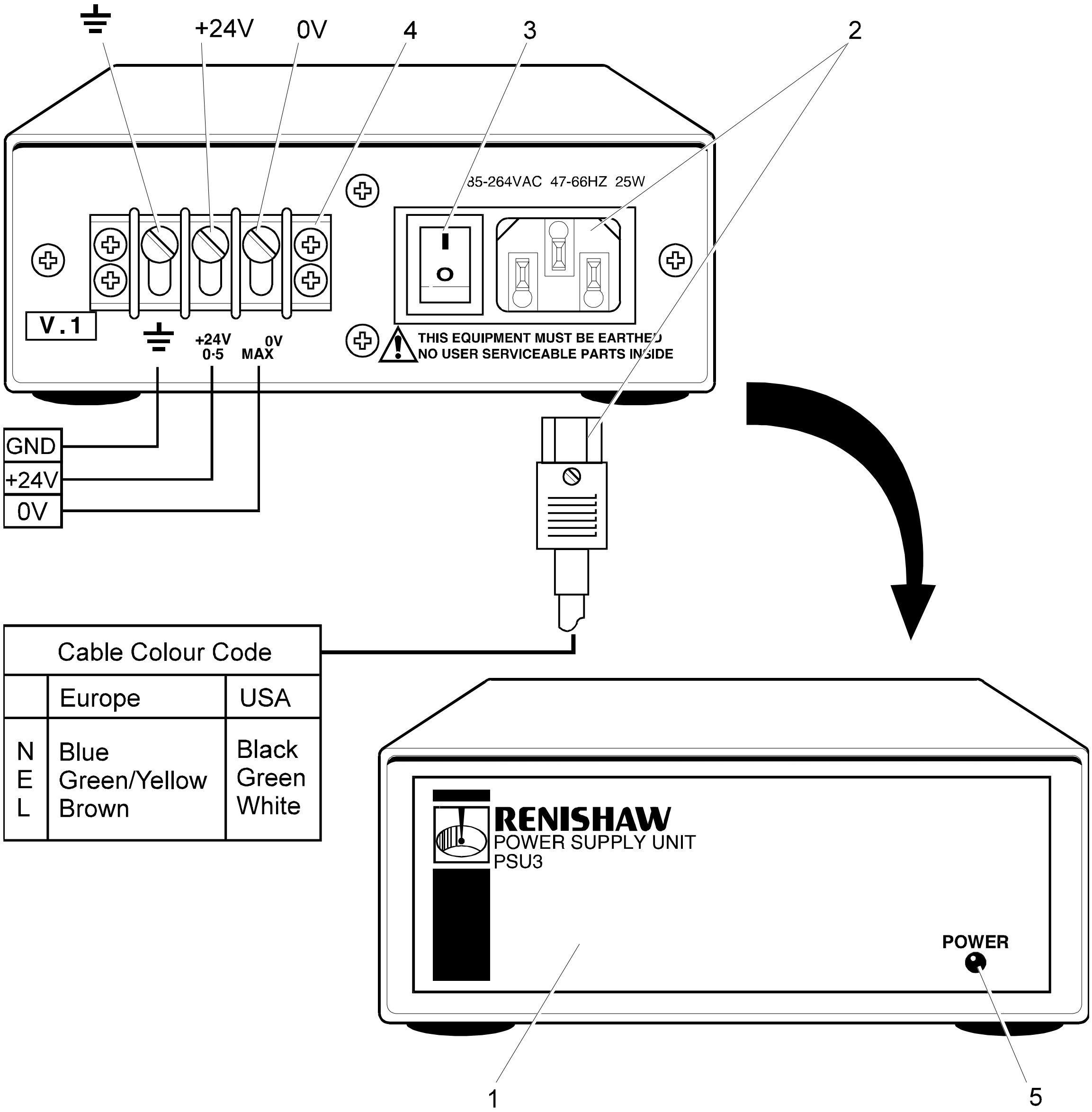
> **Note**
>
> **To ensure the best possible protection from the environment, it is recommended that the mains cable used to connect the PSU3 Power Supply Unit to the mains power supply is fitted with the appropriate plug moulded to one end.**

3. Obtain a suitable length of standard mains cable.

4. Where necessary, fit a European schuko, American mains, or BS 1363/A standard plug to the cable as applicable.

5. Release the cable clip screws within the plug and insert the free end of cable through the cable clip.

6. Connect the mains cable to mains plug and secure cable in position using the cable clip.



Cable Colour Code		
	Europe	USA
N	Blue	Black
E	Green/Yellow	Green
L	Brown	White

1. PSU3 Power Supply Housing
2. Mains Plug and Socket
3. ON/OFF Switch
4. Output Terminal Block
5. 'POWER' LED

Figure 2.19 - Connecting the PSU3 Power Supply Unit to the Mains Power Supply

7. Assemble both halves of the mains plug together and secure with screw.

8. Reassemble the mains plug and socket [2] together.

9. Connect the mains cable to mains power supply.

Installing Your MP700 Probe System to Your Machine Tool (Optical Machine Interface Variant)

Note...

For specific information on how to connect the MP700 Probe System (OMI variant) to your machine tool's CNC controller, refer to the Probe Systems Installation Manual For Machine Tools (Publication Number H-2000-6040) and the OMI/PSU3 Power Supply Unit Installation and User's Guide (Publication Number H-2000-5062). Where necessary, these publications may be obtained through your nearest Renishaw company.

Mounting Your PSU3 Power Supply Unit to Your Machine Tool

It is recommended that the PSU3 Power Supply Unit (see Figure 2.19) is mounted within the machine tool's electrical cabinet.

Mounting Your Optical Machine Interface to Your Machine Tool

WARNINGS...

IF THE SYSTEM IS TO BE INSTALLED ONTO A MULTI-AXIS MACHINE TOOL, ENSURE THAT THE OPTICAL MODULE PROBE'S LED's HAVE LINE OF SIGHT WITH THE OPTICAL MACHINE INTERFACE.

IF TWO OPTICAL TRANSMISSION SYSTEMS ARE TO OPERATE IN CLOSE PROXIMITY TO ONE ANOTHER, ENSURE THAT SIGNALS TRANSMITTED BY THE OPTICAL PROBE MODULE OF ONE SYSTEM WILL NOT BE RECEIVED BY THE OPTICAL MACHINE INTERFACE OF THE OTHER.

Note

The OMI may be positioned at a distance of between 10mm and 3 metres (0,39 in. and 9,84 ft) from the MP700 Probe.

Operational Requirements

The Optical Machine Interface (OMI), supplied with 8 metres (26.2 ft) of cable, must be mounted within the cabinet of your machine tool such that the operating envelope between the OMI and the MP700's Optical Module Probe (OMP) conforms to that shown in Figure 2.20.

Mounting the OMI

The OMI may be mounted within the machine tool cabinet in one of two ways (see Figure 2.21):

- By screwing the body of the OMI directly to the cabinet wall.

- By first mounting the OMI to the mounting bracket supplied and then mounting the bracket to the cabinet wall. **This is the recommended method as it allows the OMI to be pivoted to provide the best possible angle**.

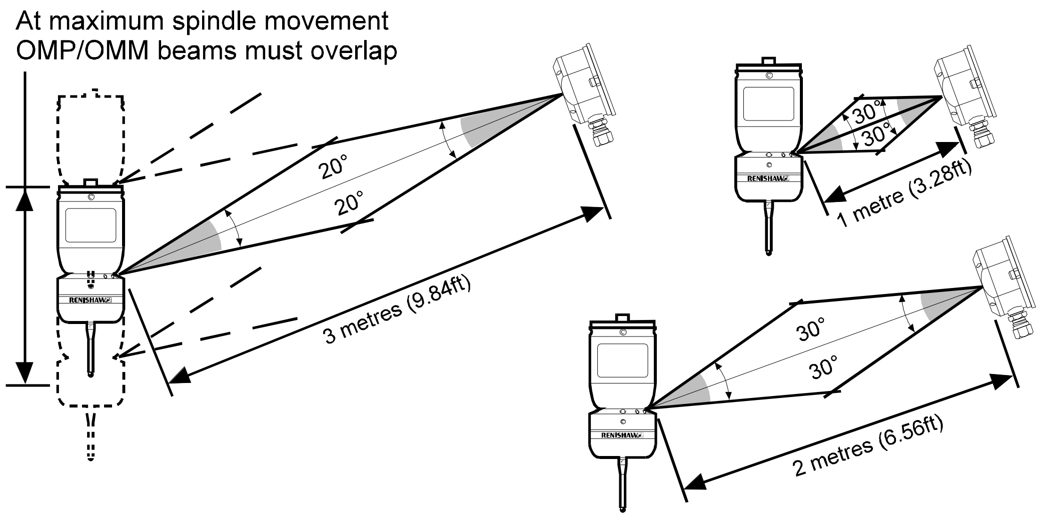


Figure 2.20 - OMI Operating Requirements

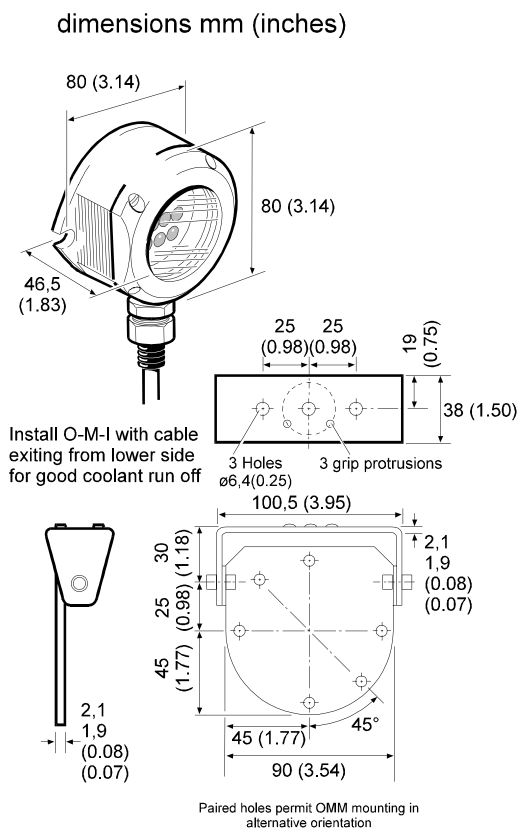


Figure 2.21 - Mounting the OMI

Extending the OMI Cable

Where necessary, the OMI cable may be extended in the following manner (refer to Figure 2.22):

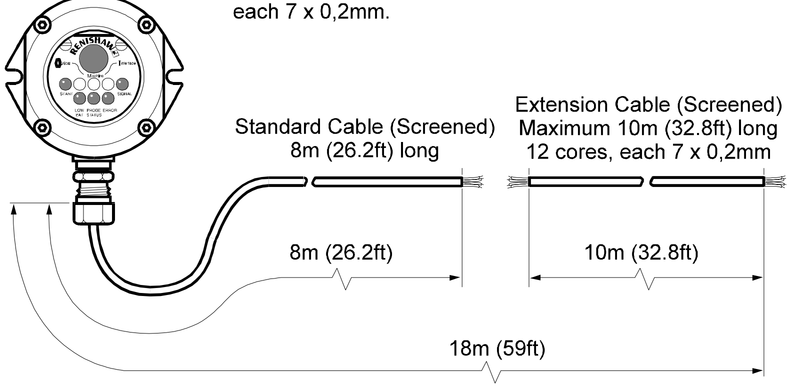
- By an additional 10 metres (16.4 ft), to achieve a total length of 18 metres (59 ft), by fitting Renishaw® extension cable (Part Number M-2115-0045).

CAUTION

IF THE OMI CABLE IS TO BE EXTENDED TO PROVIDE AN OVERALL LENGTH EXCEEDING 18 METRES (59 ft), IT IS IMPORTANT THAT THE OMI CABLE IS CUT BACK TO A LENGTH OF 5 METRES (16.4 ft) PRIOR TO THE EXTENSION CABLE BEING FITTED.

- By an additional 20 metres (65.62 ft) maximum, to achieve a total length of 25 metres (82 ft), by fitting Renishaw® extension cable (Part Number 2115-0046).

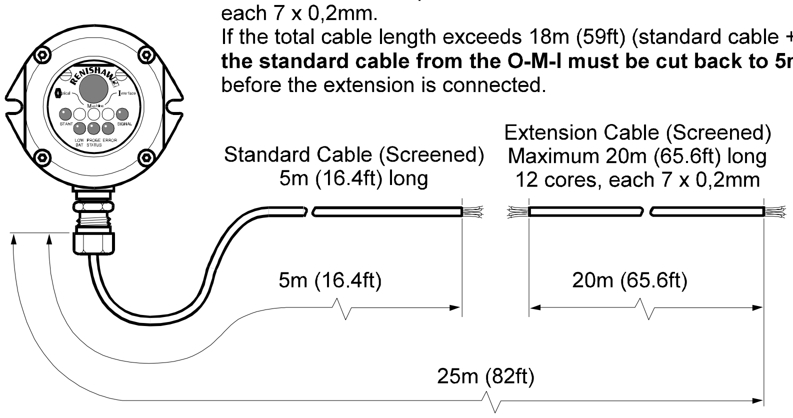
To extend cable to 18m (59ft)
The extension cable should contain larger core diameters.
The recommended specification for the extension cable is 12 cores, each 7 x 0,2mm.



MAXIMUM CABLE LENGTH WHEN EXTENDING FROM 8m (26.2ft) STANDARD CABLE = 18m (59ft) TOTAL

Extending the OMI cable to a length of 18 metres (59 feet)

To extend cable to 25m (82ft)
The extension cable should contain larger core diameters.
The recommended specification for the extension cable is 12 cores, each 7 x 0,2mm.
If the total cable length exceeds 18m (59ft) (standard cable + extension), **the standard cable from the O-M-I must be cut back to 5m (16.4ft),** before the extension is connected.



MAXIMUM CABLE LENGTH WHEN EXTENDING FROM CUT BACK 5m (16.4ft) STANDARD CABLE = 25m (82ft) TOTAL

Extending the OMI cable to a length of 25 metres (82 feet)

Figure 2.22 - Extending the OMI Cable

Connecting the OMI Cable and Extension Cable Together

Notes...

When connecting the OMI cable and extension cable together, it is important to ensure that all screens are maintained throughout the cable joint.

Ensure that any connector used to join the OMI and extension cable together is fully screened.

The overall resistance of the OMI cable, the extension cable, and the coupling must not exceed 3.5 ohms.

Connect the OMI cable to the extension cable using a twelve pin circular multipole bayonet-lock connector conforming to MIL-C-26486, DEF. STAN 59-35 Pattern 105, or BS 9522-F0017.

Protection of the OMI Cable

CAUTION

FAILURE TO ADEQUATELY PROTECT THE OMI CABLE MAY RESULT IN SYSTEM FAILURE DUE TO CABLE DAMAGE OR THE INGRESS OF COOLANT.

Note...

Failure of the OMI due to inadequate protection of the cable will invalidate the warranty.

Whilst coolant and dirt are prevented from entering the OMI by a cable sealing gland, it is important that the cable itself is protected from physical damage by fitting either flexible or rigid conduit. The OMI is supplied with a Renishaw® conduit adapter (see Figure 2.3) which supports both methods.

Fitting Flexible Conduit to the OMI Cable

Notes...

It is recommended that Thomas and Bretts 1/4 in. (11mm) diameter SHURESEAL (Part Number TBEF 0250-5O), or equivalent, is used when protecting the OMI cable(s) with flexible conduit.

Use plastic olive [5] when fitting flexible conduit to the conduit adapter.

When tightening or loosening gland nut [6], it is important to ensure that gland nut [1] is not inadvertently loosened.

To fit flexible conduit to the OMI cable (see Figure 2.23):

1. Cut flexible conduit [7] to required length.
2. Release and remove gland nut [6] from screwed adapter [2]. Take care not to slacken gland nut [1].
3. Remove gland nut [6] from the OMI cable [3].
4. Carefully thread the OMI cable [3] through the flexible conduit [7].
5. Screw the conduit termination piece [4] into end of the flexible conduit.
6. Push conduit upwards until conduit termination piece [4] locates within screwed adapter [2].
7. Ensuring the conduit is fully located through plastic olive [5], assemble gland nut [6] to screwed adapter [2] and hand tighten to retain conduit in place.
8. Ensuring gland nut [1] is not inadvertently slackened, tighten gland nut [6] an additional 1½ to 2½ turns. This action will form a seal between the flexible conduit and the screwed adapter that conforms to BS 5490 (IEC 529) IP67.

Fitting Rigid Conduit to the OMI Cable

Notes...

It is recommended that Bundy Tube - 12mm diameter hydraulic pipe is used when protecting the OMI cable(s) with rigid conduit.

Use brass olive [4] when fitting rigid conduit to the conduit adapter.

When tightening or loosening gland nut [5], it is important to ensure that gland nut [1] is not inadvertently loosened.

To fit rigid conduit to the OMI cable (see Figure 2.24):

1. Cut rigid conduit to required length.

2. Release and remove gland nut [5] from screwed adapter [2]. Take care not to slacken gland nut [1].

3. Remove gland nut [5], together with conduit termination piece and plastic olive, from the OMI cable [3] (see Figure 2.23).

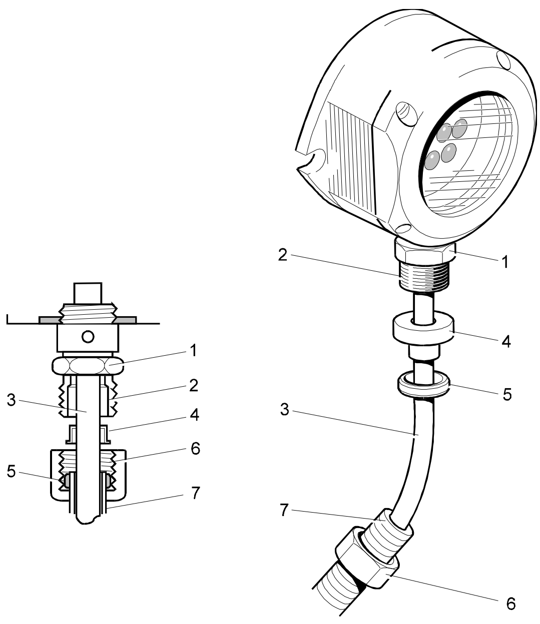
5. Remove brass olive [4] from its plastic bag and assemble over OMI cable [3].

6. Re-assemble gland nut [5] to OMI cable [3].

7. Pass the OMI cable [3] through the rigid conduit [6].

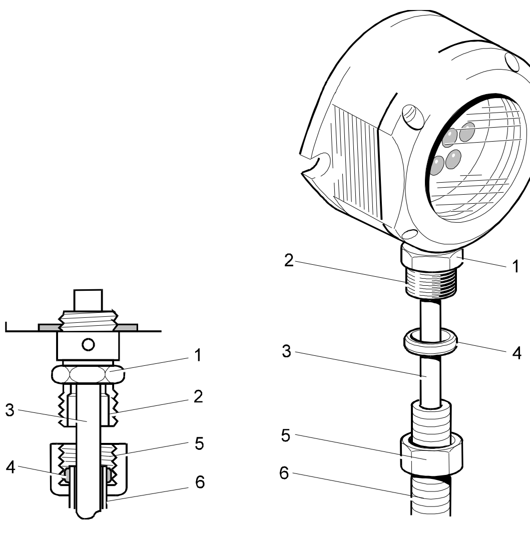
8. Locate end of rigid conduit [6] into screwed adapter [2].

9. Assemble gland nut [5] to screwed adapter [2] and torque-tighten to between 25 and 27Nm (18.55 and 19.91 lbf.ft). This action will provide a seal between the rigid conduit and the conduit adapter conforming to BS 5490 (IEC 529) IP67.



1. Gland Nut
2. Screwed Adapter
3. OMI Cable
4. Conduit Termination Piece
5. Plastic Olive
6. Gland Nut
7. Flexible Conduit

Figure 2.23 - Fitting Flexible Conduit to the OMI Cable



1. Gland Nut
2. Screwed Adapter
3. OMI Cable
4. Brass Olive
5. Gland Nut
6. Flexible Conduit

Figure 2.24 - Fitting Rigid Conduit to the OMI Cable

Connecting Your System Components Together (Optical Machine Interface Variant)

Connecting the Optical Machine Interface to the PSU3 Power Supply Unit

Note...

Further information on connecting the OMI to the PSU3 Power Supply Unit can be obtained by reading the OMI/PSU3 Power Supply Unit Installation and User's Guide (Publication Number H-2000-5062).

To connect the OMI cable to the PSU3 Power Supply Unit, carry out the following (refer to Figure 2.25):

1. Separate the red and black coloured cores from the main OMI cable [2].

2. Obtain two bootlace ferrules [3] (supplied).

Note...

It is recommended that you use a dedicated crimping tool to crimp the ferrules onto the cores of the OMI cable. However, where this is not available, crimping can also be achieved by the use of pliers or by the action of the screw within the PSU3 output terminal block connector.

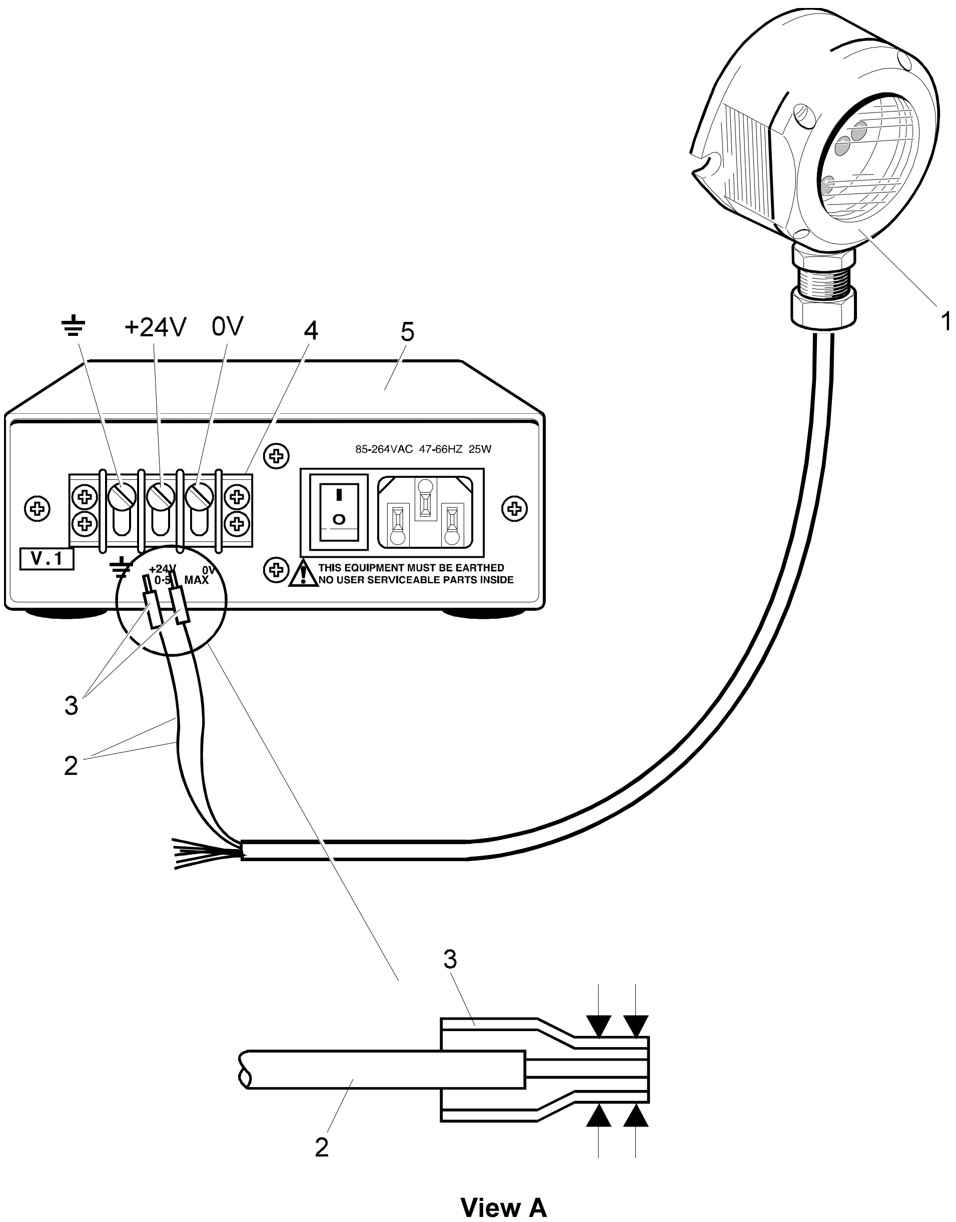
3. Prepare each core as necessary, then, in turn, push the core through the shrouded end of one of the ferrules [3]. Ensuring the core wires are flush with the tip of the ferrule's copper tube, crimp the ferrule onto the core by use of a dedicated crimping tool as shown in **VIEW A**.

4. Release the connector screws within the 24V and 0V terminals of the PSU3 output terminal block [4].

5. Connect the red coloured core to the 24V terminal.

6. Connect the black coloured core to the 0V terminal.

7. Tighten connector screws to secure cores within the output terminal block [4].



1. Optical Machine Interface
2. Optical Machine Interface Cable
3. Ferrule
4. Terminal Block
5. PSU3 Power Supply Unit

Figure 2.25 - Connecting the OMI to the PSU3 Power Supply Unit

Connecting Your System Components to Your Machine Tool (Optical Machine Interface Variant)

Outputs from the Optical Machine Interface

The Optical Machine Interface Unit (OMI) incorporates four opto-coupled 'Totem Pole' transistor output devices comprising

Probe Status
Skip
Error
Low Battery

All outputs can be individually inverted by the configuration switch (SW2); refer to **Setting Up the OMI** later in this chapter.

The four outputs are arranged in two groups (see Figure 2.26). These are referred to as Group A and Group B and comprise the following:

- **Group A** comprises the Probe Status, Low Battery and Error outputs.
- **Group B** comprises the Skip output.

CAUTION

THE OUTPUTS ARE PROTECTED AGAINST REVERSE VOLTAGE BY DIODES. ALTHOUGH SUPPLY REVERSAL WILL NOT DAMAGE THE OUTPUTS, IT MAY BLOW THE FUSES.

The outputs are grouped in this way to enable the Skip output (see Figure 2.27) to operate at a different voltage to the other three. This can be a requirement on systems such as Fanuc controls where the High Speed Skip (HSS) option is fitted.

The HSS operates at 5V whereas the others operate at 24V.

The Skip Output (B) can also be utilised to operate an external, remote audible indicator; refer to **Connecting the Optical Machine Interface to an External Remote Audible Indicator** later in this chapter.

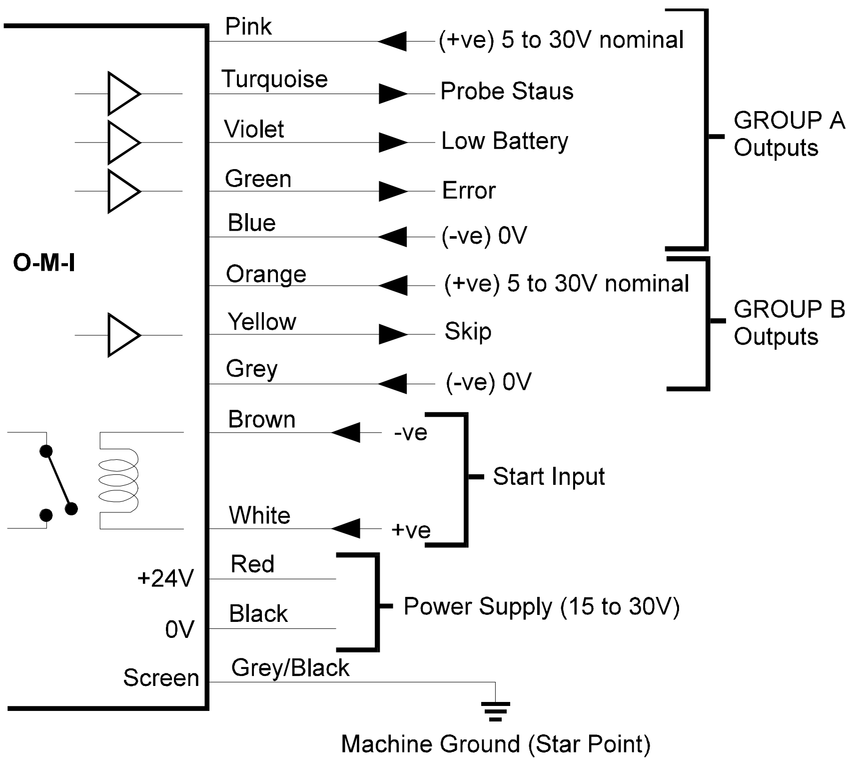


Figure 2.26 - Optical Machine Interface Wiring Configuration and Output Groupings

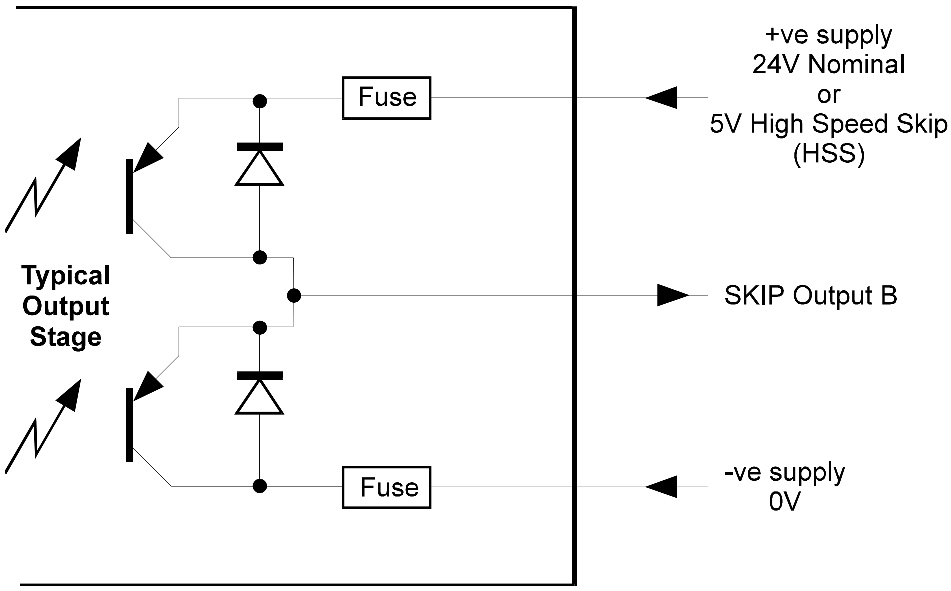


Figure 2.27 - Typical Output Stage (SKIP Output B)

Output Overload Protection

Each output is protected from overload by fuses; refer to **Optical Machine Interface Fuses** later in this section:

Maximum Current = 50mA peak

Maximum Voltage = 36V peak

Minimum Voltage = 4V

Switch on time = Less than 10µs

Switch off time = Less than 10µs

Signal Levels at Typical Load Currents

At 50mA	Min Vo_h = Supply Voltage VCC - 2.4V Max Vo_L = 2.4V
At 20mA	Min Vo_h = Supply Voltage VCC - 1.5V Max Vo_L = 1.5V
At 1.6mA (TTL)	Min Vo_h = Supply Voltage VCC - 800mV Max Vo_L = 800mV

Quiescent current when output stage is ON (Output High),

At 30V = 10mA per stage
At 5V = 3mA per stage

Quiescent current when output stage is OFF (Output Low),

- Less than 1mA

Note

The total output load for Group A outputs should not exceed 100mA

The OMI Wiring Configuration

The OMI cable contains twelve colour coded cores. Refer to Figure 2.28 below.

COLOUR	SIGNAL
Red	+24V (supply)
Black	0V (supply)
White	Start (+ve)
Brown	Start (-ve)
Grey	Output B (-ve)
Yellow	Skip (Output B)
Orange	Output B (+ve)
Blue	Outputs A (-ve)
Green	Error (Outputs A)
Violet	Low Bat (Outputs A)
Turquoise	Probe Status (Outputs A)
Pink	Outputs A (+ve)
Grey/Black	Machine Earth

Figure 2.28 - Optical Machine Interface Wiring Chart

Typical Control Input Wiring

The OMI is compatible with most popular machine controllers. The following examples show how the unit can be connected into Fanuc controllers. No problems are envisaged when connecting to other controllers.

EXAMPLE 1 - FANUC WITH STANDARD SKIP (24V COMMON OR 0V COMMON)

This configuration (see Figure 2.29) suits both 24V common and 0V common signals.

With either 24V common or 0V SKIP configurations, the control is looking for a rising edge on the probe triggering. As the Optical Machine Interface provides this requirement as standard, no adjustments are necessary to switch SW2 (see Figure 2.34).

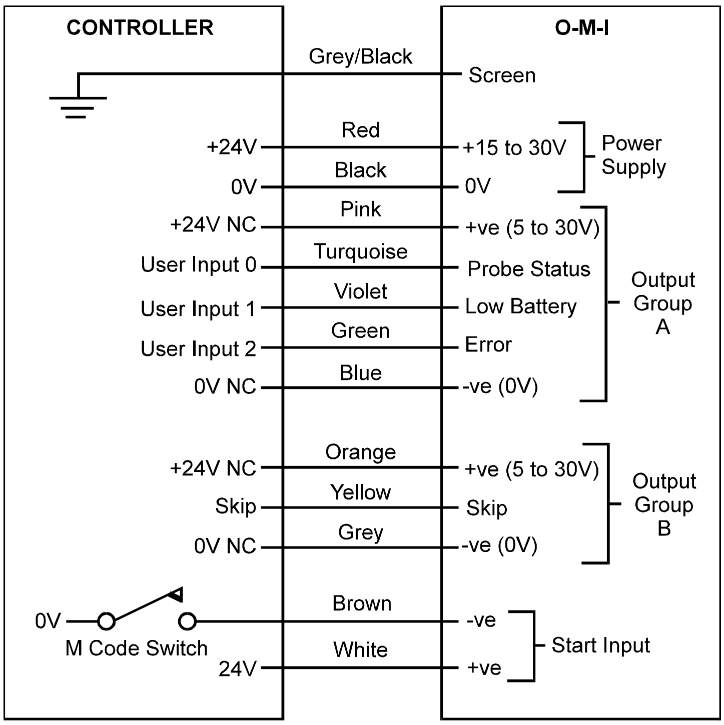


Figure 2.29 - Connecting the Optical Machine Interface to a Fanuc Controller with Standard Skip (24V Common or 0V Common)

EXAMPLE 2 - FANUC CONTROLLERS WITH HIGH SPEED SKIP

CAUTION

ALTHOUGH CONNECTION TO A HIGH SPEED SKIP IS STRAIGHTFORWARD WHEN THE MACHINE BUILDER HAS PROVIDED THE OPTION, THE TASK OF RETROFITTING THE OPTION MAY NOT BE POSSIBLE IF THE MACHINE BUILDER'S CONFIGURATION DOES NOT PERMIT ITS USE. RELEVANT HARDWARE OPTIONS THAT MAY HAVE BEEN INSTALLED PROVIDE NO GUARANTEE THAT THE OPTION WILL WORK IN PRACTICE. IT IS THEREFORE ESSENTIAL TO CONSULT THE MACHINE BUILDER BEFORE ATTEMPTING THIS INSTALLATION.

The High Speed Skip (HSS) is located as follows:

Fanuc 10, 11,12 and 15 M/T Controllers

CONNECTOR

CA8	MRE20-RMD	Fanuc 10
CA8	MR20-RM	Fanuc 11
CA19	OIPO2 (Slot location)	Fanuc 12
CA8	OIP26 (Slot location)	Fanuc 15

Fanuc 0 M/T (C SERIES)

CONNECTOR

M12	PIN 14	HSS
	PIN 1	0V
	PIN 5	+5V

Fanuc 16 and 18 M/T Controllers

CONNECTOR

JA5	CNC (Option 2A/2B Board or I/O Card E to H)

Note

If no 5V termination is available, i.e. all MPG supplies are in use, then an alternative will need to be located. Where this occurs, refer to your machine builder for guidance.

Connection to the HSS from the Optical Machine Module requires a 5V supply.

As previously shown, all connections are available on the Fanuc 0 M/T (C SERIES).

For Fanuc 10, 11, 12, 15, 16 and 18 M/T Controllers, the 5V supply will need to be located elsewhere as it is not available on HSS connectors.

A 5V supply can usually be located on the Manual Pulse Generator (MPG) connector; these are located as follows:

Fanuc 10, 11, and 12 M/T Controls

CONNECTOR (located on either CRT/MDI board or master PCB).	CA3	PINS 4, 5 AND 6

Fanuc 15 M/T Controls

CONNECTOR (located on board OP1E)	CA3	PINS 4, 5 AND 6

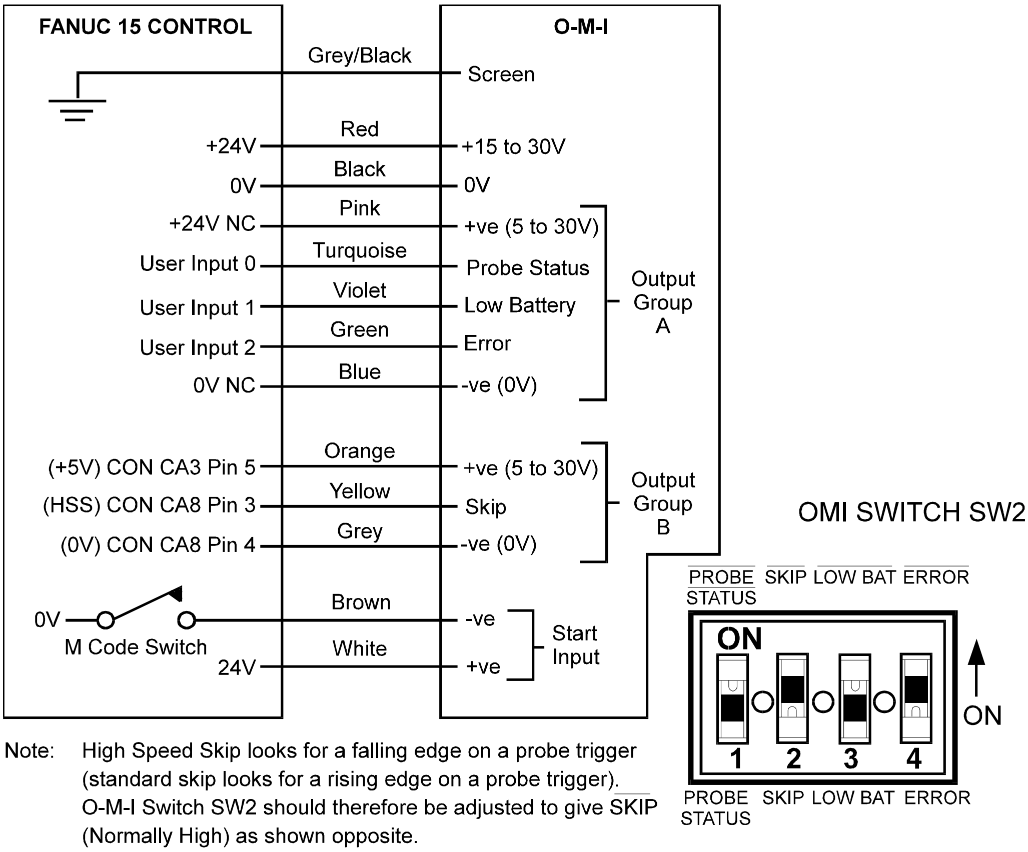
Fanuc 16 and 18 M/T Controls

CONNECTOR (located on main CPU board)	JA3	PINS 9, 18 AND 20

EXAMPLE 3 - CONNECTING TO A FANUC 15 M/T CONTROLLER

Refer to Figure 2.30

The High Speed Skip looks for a falling edge on a probe trigger (standard skip looks for a rising edge). As the Optical Machine Interface is not set to provide this requirement, it will be necessary to adjust switch SW2 to the 'SKIP' (Normally High) position as shown in Figure 2.30 below (refer also to **Setting Up the Optical Machine Interface** later in this section).



Note: High Speed Skip looks for a falling edge on a probe trigger (standard skip looks for a rising edge on a probe trigger). O-M-I Switch SW2 should therefore be adjusted to give SKIP (Normally High) as shown opposite.

Figure 2.30 - Connecting the Optical Machine Interface to a Fanuc M/T 15 Controller

EXAMPLE 4 - INSTALLATION WITH INSPECTION AND TOOL SETTING PROBE

Refer to Figure 2.31

On machines where the Optical Machine Interface is to be integrated with a toolsetting probe input, and only one probe input is provided on the machine's controller, an M code can be utilised to drive an external relay and effectively select which probe is to be monitored.

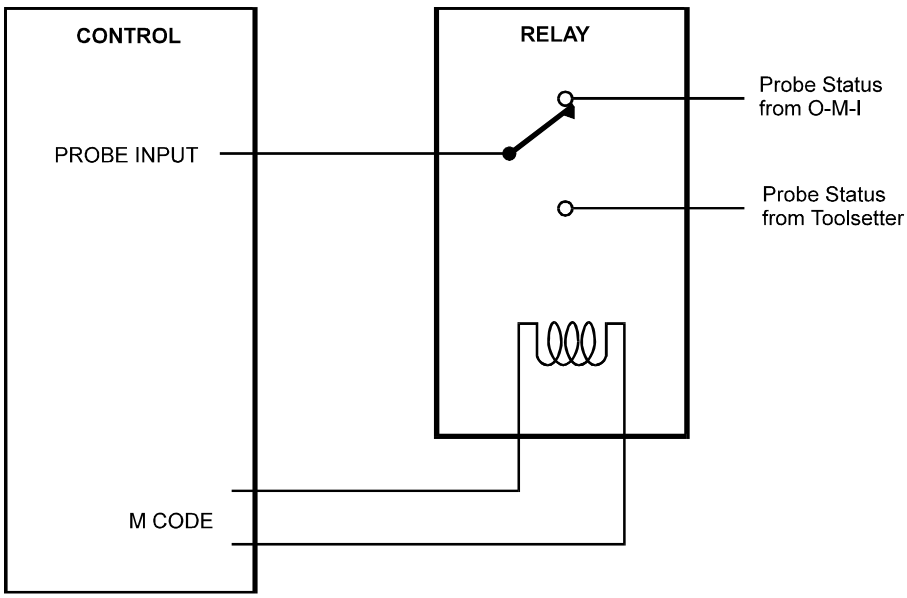


Figure 2.31 - Installing the Optical Machine Interface to a Machine Tool with Inspection and Toolsetting Probe Systems

Connecting the Optical Machine Interface To An External Remote Audible Indicator

The Skip Output (B) can be utilised to operate an external remote audible indicator (refer to Figure 2.32). However, this is only possible when the skip is NOT being monitored by the machine controller.

The audible indicator must comply with the output transistor specification:

i.e. 50mA peak
36V peak

Pulse duration is 40ms ± 1ms

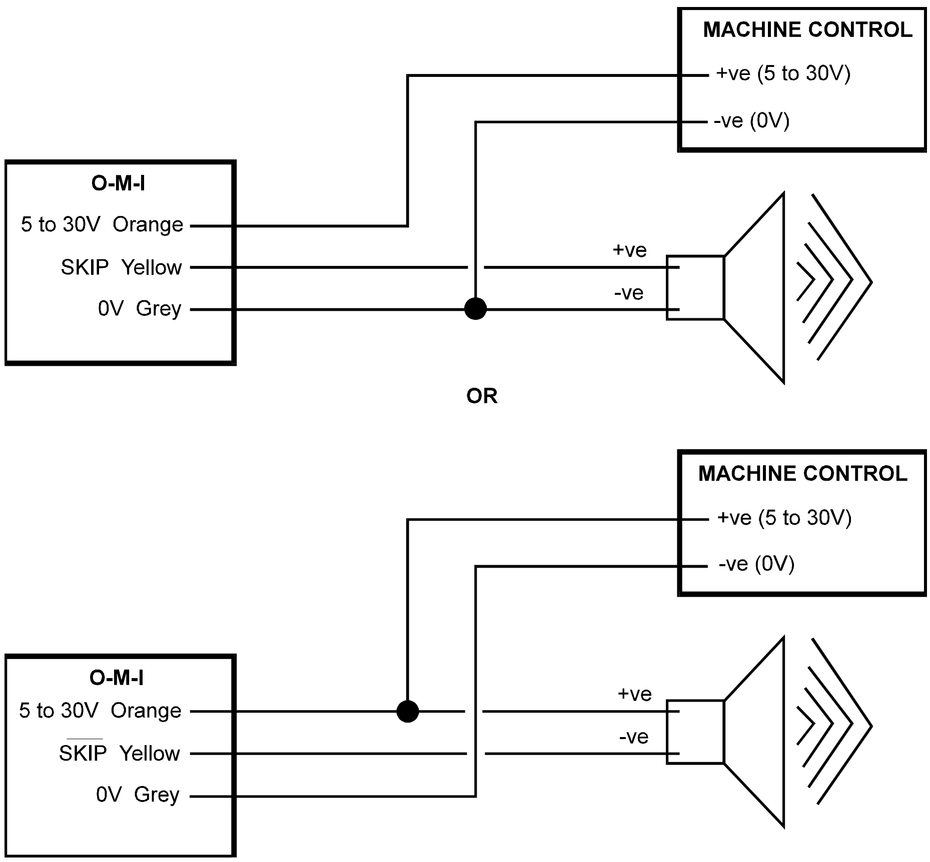


Figure 2.32 - Connecting the Optical Machine Interface to an External Audible Indicator

Optical Machine Interface Fuses

The Optical Machine Interface incorporates the following fuses (see Figure 2.33):

FS1 - 250mA (1/4 A) - Input Power

FS2 - 125mA (1/8 A) - Output Group A
FS3 - 125mA (1/8 A) - Output Group A
} PB/STAT, LO/BATT, ERROR

FS4 - 62mA (1/16 A) - Output Group B
FS5 - 62mA (1/16 A) - Output Group B
} SKIP

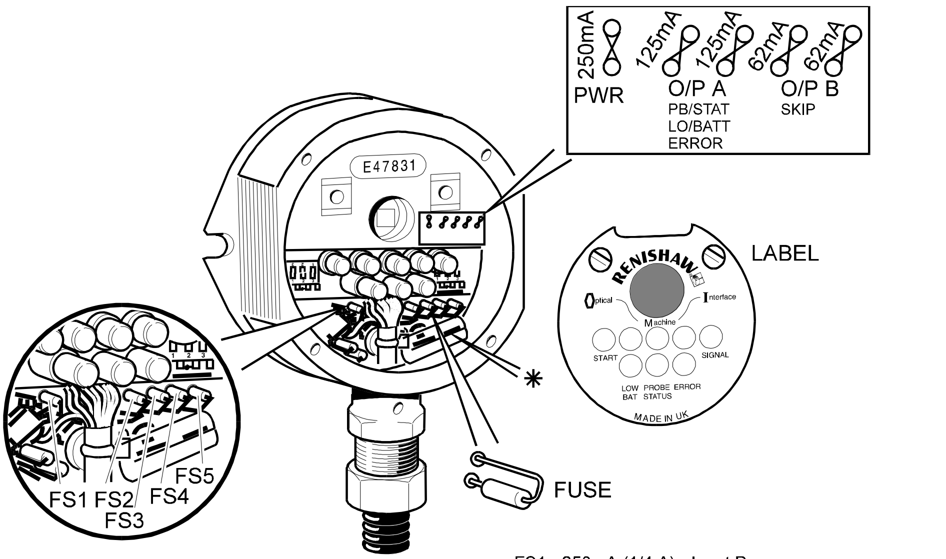
Each group of outputs is fuse protected on its respective +ve and -ve supply lines (see Figure 2.34).

The input power supply is fuse protected by a 250mA fuse.

A spare set of fuses is supplied with each OMI, located in a plastic bag behind the removable label as shown in Figure 2.34.

Note...

If an input fuse blows, then it is recommended that both fuses for that group are replaced. Refer to Chapter 5 - Maintenance and Adjustment for instructions on how to replace a blown fuse.



The input power supply is fuse protected by a 250mA fuse.

Each group of outputs is fuse protected on its respective +ve and -ve supply lines.

✳
A spare set of fuses is supplied with each O-M-I, located in a plastic bag behind removeable label shown above.

FS1 - 250mA (1/4 A) - Input Power

FS2 - 125mA (1/8 A) - Output Group A ⎤ Probe Bat Low Error
FS3 - 125mA (1/8 A) - Output Group A ⎦

FS4 - 62mA (1/16 A) - Output Group B ⎤ Skip
FS5 - 62mA (1/16 A) - Output Group B ⎦

Figure 2.33 - Optical Machine Interface Fuse Locations

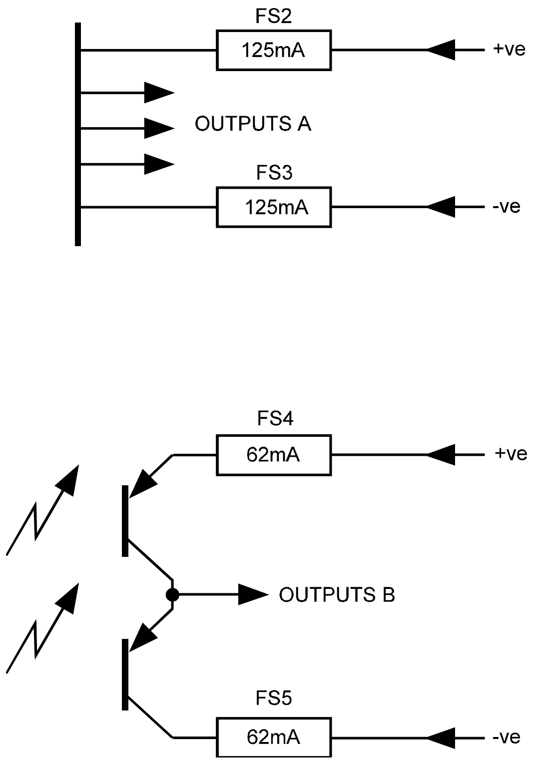


Figure 2.34 - Group A and Group B Output Fuse Protection

Connecting Your Optical Machine Interface to Your Machine's CNC Controller

To connect the Optical Machine Interface to your machine's controller, carry out the following:

> **Notes...**
>
> **For specific information on how to connect the Optical Machine Interface to your machine's CNC controller, refer to the Probe Systems Installation Manual For Machine Tools (Publication Number H-2000-6040) and the OMI/PSU3 Installation and User's Guide (Publication Number H-2000-5062).**
>
> **For specific information on your machine's CNC controller and electrical circuit, contact the manufacturer, or supplier, of the machine tool to which you are installing the MP700 Probe System.**

1. Obtain ten bootlace ferrules (supplied).

2. Prepare each core as necessary, then, in turn, push the core through the shrouded end of one of the ferrules. Ensuring the core wires are flush with the tip of the ferrule's copper tube, crimp the ferrule onto the core by use of a dedicated crimping tool.

3. Connect the OMI to your machine tool's power supply, CNC controller, and star ground point in accordance with the instructions provided in the Probe Systems Installation Manual For Machine Tools (Publication Number H-2000-6040) and the OMI/PSU3 Installation and User's Guide (Publication Number H-2000-5062).

The examples provided in Figure 2.29 through 2.31 show how to connect the Optical Machine Interface to a Fanuc control with a standard SKIP (24V common or 0V common), a Fanuc controller with High Speed Skip and a Fanuc 15 M/T controller.

Setting Up Your Optical Machine Interface

To gain access to the OMI switches, it is first necessary to remove the window and label from the OMI body.

Removal of the Window and Label from the OMI

CAUTION

DO NOT ALLOW LIQUIDS OR SOLID PARTICLES TO ENTER THE OMI BODY. NEVER REMOVE THE WINDOW [3] BY TWISTING OR ROTATING BY HAND, ALWAYS USE THE JACKING SCREWS [2].

Note...

The window [3] must only be removed for the following reasons:

- **To change fuses.**
- **To change the reception/transmission range settings and output options.**
- **To replace a broken window.**

A bag of spare fuses is located behind the label. Take care to ensure that it does not fall out.

Refer to Figure 2.35:

1. Using a 2.5mm AF hexagon Allen Key, remove the two short screws [1] and the two long screws [2] securing the window [3] to the OMI body [4].

2. Insert the two long screws [2] into the two threaded holes **A**.

3. Alternately tighten the long screws [2] to evenly jack the window [3] from the OMI body [4]. Gently remove the window from the OMI body.

4. Release the label [6] from the OMI body by turning the two quick release screws [5] a 1/4 turn counterclockwise. Carefully lift the label from the OMI body to gain access to the OMI switches and terminal block (see Figure 2.37).

Switch Settings

The Optical Machine Interface Unit incorporates the following switches (see Figure 2.36); it is important that, where necessary, each of these switches are set to suit your specific application:

Switch SW1

CAUTION

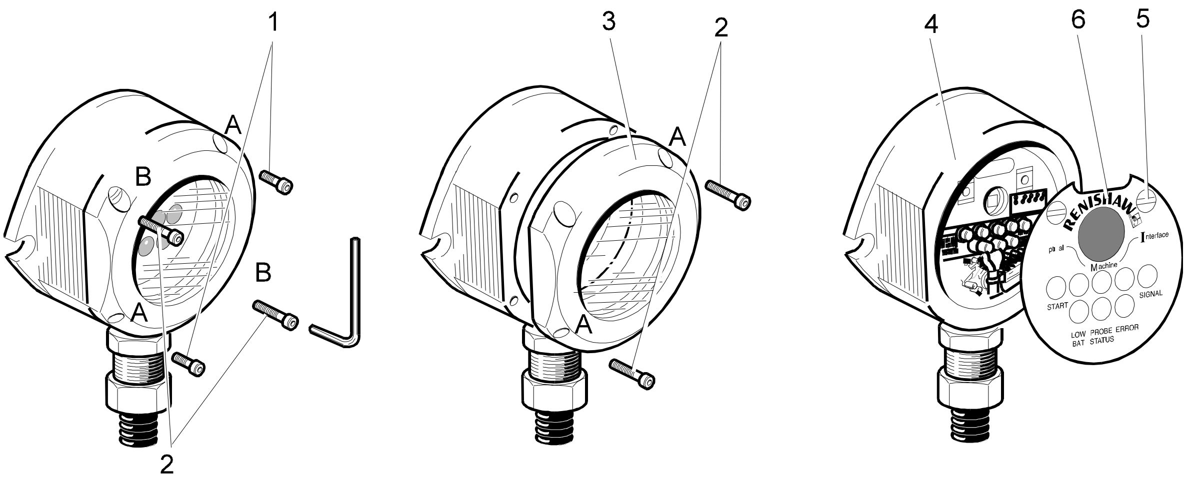
ALTHOUGH SWITCH SW1 ACTS PRIMARILY AS A RANGE SELECTOR, IT ALSO ALLOWS YOU TO SELECT THE WAY IN WHICH THE PROBE IS SWITCHED ON. THE MP700 PROBE MUST ONLY EVER BE SWITCHED ON USING A ‘MACHINE START’ SIGNAL. THE ‘AUTO START’ SETTING MUST NEVER BE USED.

Switch SW1 is supplied factory set as shown in Figure 2.36, i.e. to ‘MACHINE START’ with both the reception (Rx) and transmission (Tx) ranges set to 100%. This switch may be used to adjust the optical range setting for signal transmission and reception; refer to **Adjustment of the Range Selector Switch (SW1)** later in this chapter.

In order that a ‘MACHINE START’ signal can be initiated, an input of between 4,25V at 1mA and 30V at 10mA is required between the START wires (WHITE +ve and BROWN -ve) (This is TTL compatible when connected between +5V and TTL output). This is an isolated input. The Minimum pulse width is 1ms.

Switch SW2

This switch enables Normally High and Normally Low options to be selected for PROBE STATUS, SKIP, LOW BAT and ERROR to produce the output waveforms shown in Figure 2.37. The switch is factory set to the settings shown in Figure 2.36.



1. Screw (short) (2 Off)
2. Screw (long) (2 Off)
3. Window
4. OMI Body
5. Retaining Screw
6. Label

Figure 2.35 - Removal of the OMI Window and Label

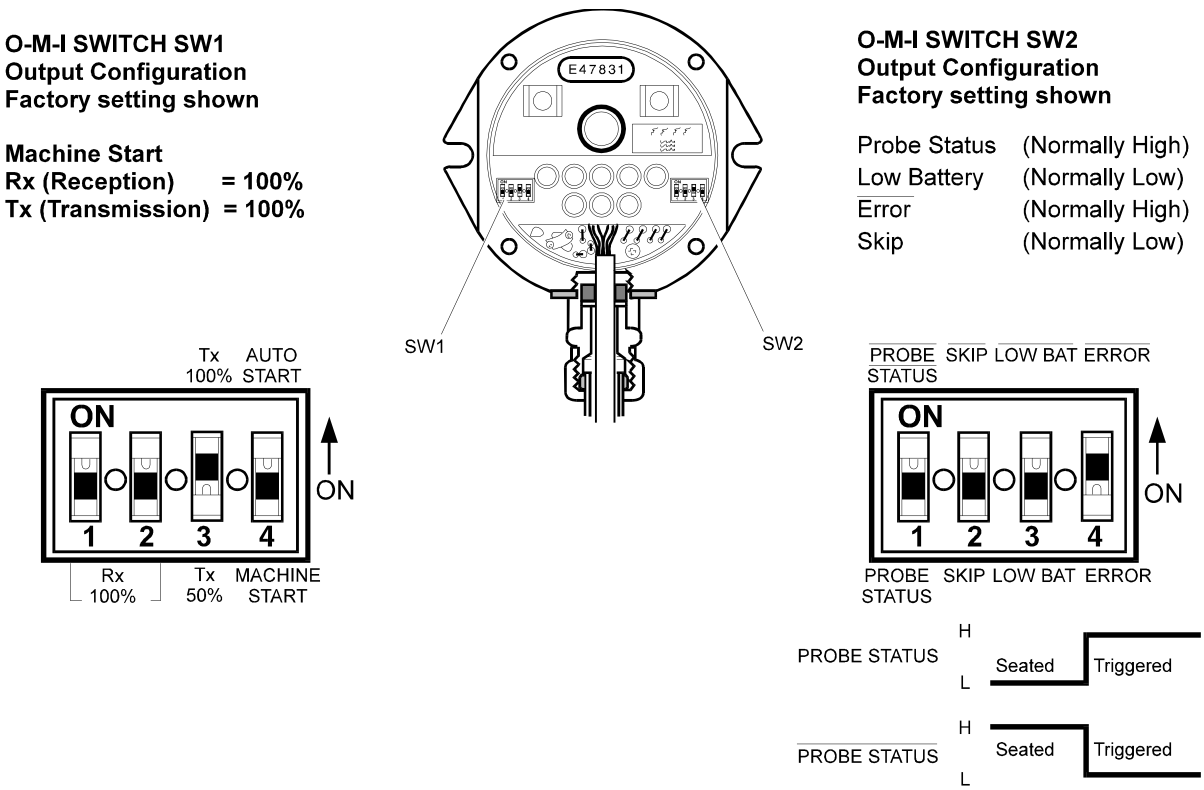


Figure 2.36 - Range Selection Switch (SW1) and Configuration Switch (SW2)

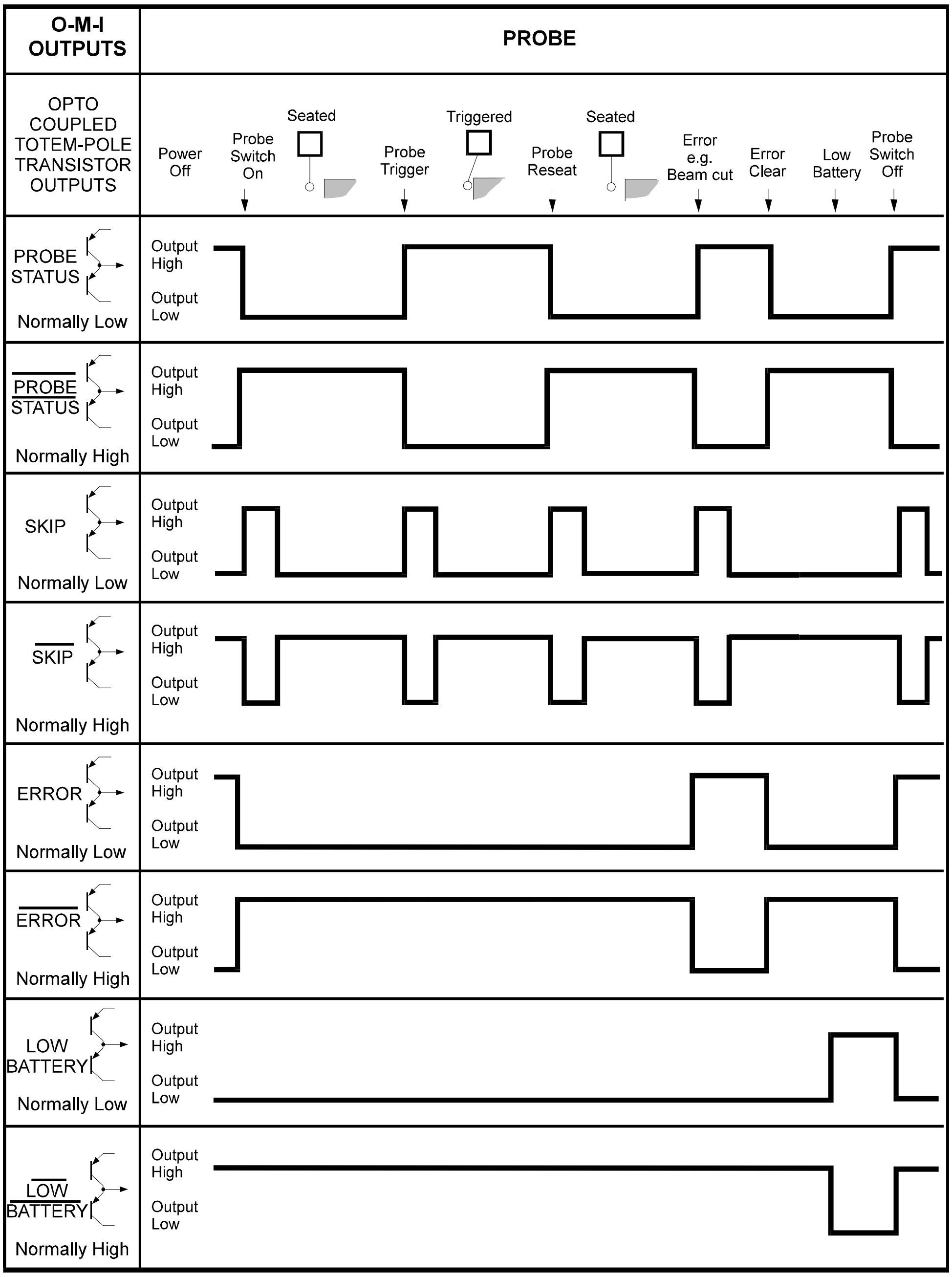
Optical Machine Interface - Output Signals and Waveforms

The output signals and waveforms of the Optical Machine Interface are shown in Figure 2.37 and can be adjusted by altering the settings of switch SW2. When adjusting switch SW2, it is important to ensure that the output signals from the OMI are compatible with the machine control input.

Signal Delays

Transmission Delay (probe trigger to output change of state) = 144μS

Start Delay (initiation of start signal to valid signal transmission) = 410 ms



SIGNAL DELAYS

1. **Transmission Delay** Probe Trigger to output change of state = 144μs ±5%
2. **Start Delay** Time from initiation of Start Signal to valid signal transmission = 410ms.

Figure 2.37 - Optical Machine Interface Unit Output Waveforms

Adjustment of the Range Selection Switch (SW1)

WARNING

IF TWO SYSTEMS ARE OPERATING IN CLOSE PROXIMITY TO EACH OTHER, TAKE CARE TO ENSURE THAT SIGNALS TRANSMITTED BY ONE SYSTEM ARE NOT RECEIVED BY THE OTHER AND VICE VERSA.

CAUTION

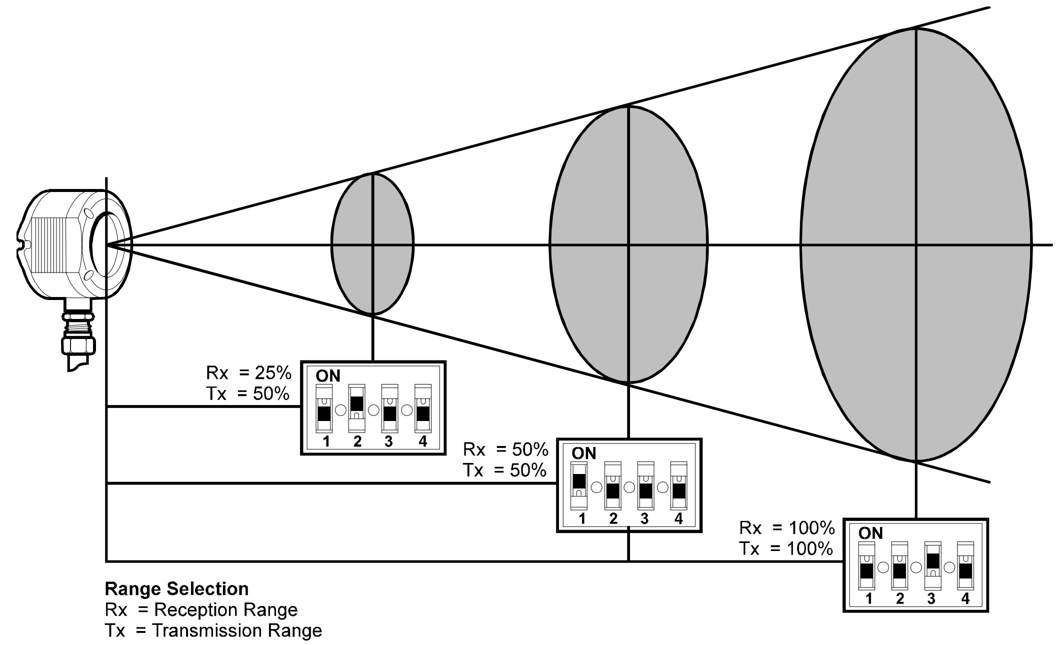
NATURAL REFLECTIVE SURFACES WITHIN THE MACHINE MAY INCREASE THE SIGNAL TRANSMISSION RANGE. ALSO, COOLANT RESIDUE, IF ALLOWED TO ACCUMULATE ON THE WINDOW OF THE OMI, WILL HAVE A DETRIMENTAL EFFECT ON THE OMI's PERFORMANCE. IT IS THEREFORE IMPORTANT TO KEEP THE WINDOW CLEAN AT ALL TIMES. AMBIENT TEMPERATURES BELOW 5C (41F) OR ABOVE 60C (140F) WILL REDUCE THE RANGE OF THE OMI.

Notes...

The OMI Rx and Tx ranges should only be adjusted by suitably qualified personnel, and only when the OMI is known to be affected by optical or electro-magnetic interference. Adjustment should only prove necessary in extreme cases.

For optimum positioning of the OMI during installation, an indication of the level of signal strength received by the OMI is provided by the 'SIGNAL' LED.

The effective range of the OMI can be adjusted by use of the range selector switch SW1. If problems are experienced with either electrical or optical noise, and the unit is installed at less than half the specified maximum range of the probe, then the range selection switch can be adjusted to reduce the effective range. This in turn will reduce the unit's susceptibility to noise. Adjust the range selection switch to the setting shown in Figure 2.38 to increase or decrease the Reception (Rx) and Transmission (Tx) ranges to the percentage you require.



Reception Range			Transmission Range		Auto Start
100%	Off	Off	100%	On	↑
50%	On	Off	50%	Off	↕
25%	Off	On	50%	Off	↓
	1	2	3	4	Machine Start

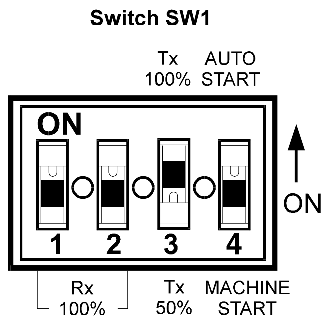


Figure 2.38 - OMI Reception and Transmission Ranges

Replacement of the OMI Label and Window

Refer to Figure 2.39:

1. Refer to **View A** and assemble the label [1] and secure with the two quick release screws [2]. Rotate screws a quarter turn clockwise to hold label in place.

2. Visually examine the OMI body [3] for damage or scratching to the ‘O’ ring location groove as shown in **View A**.

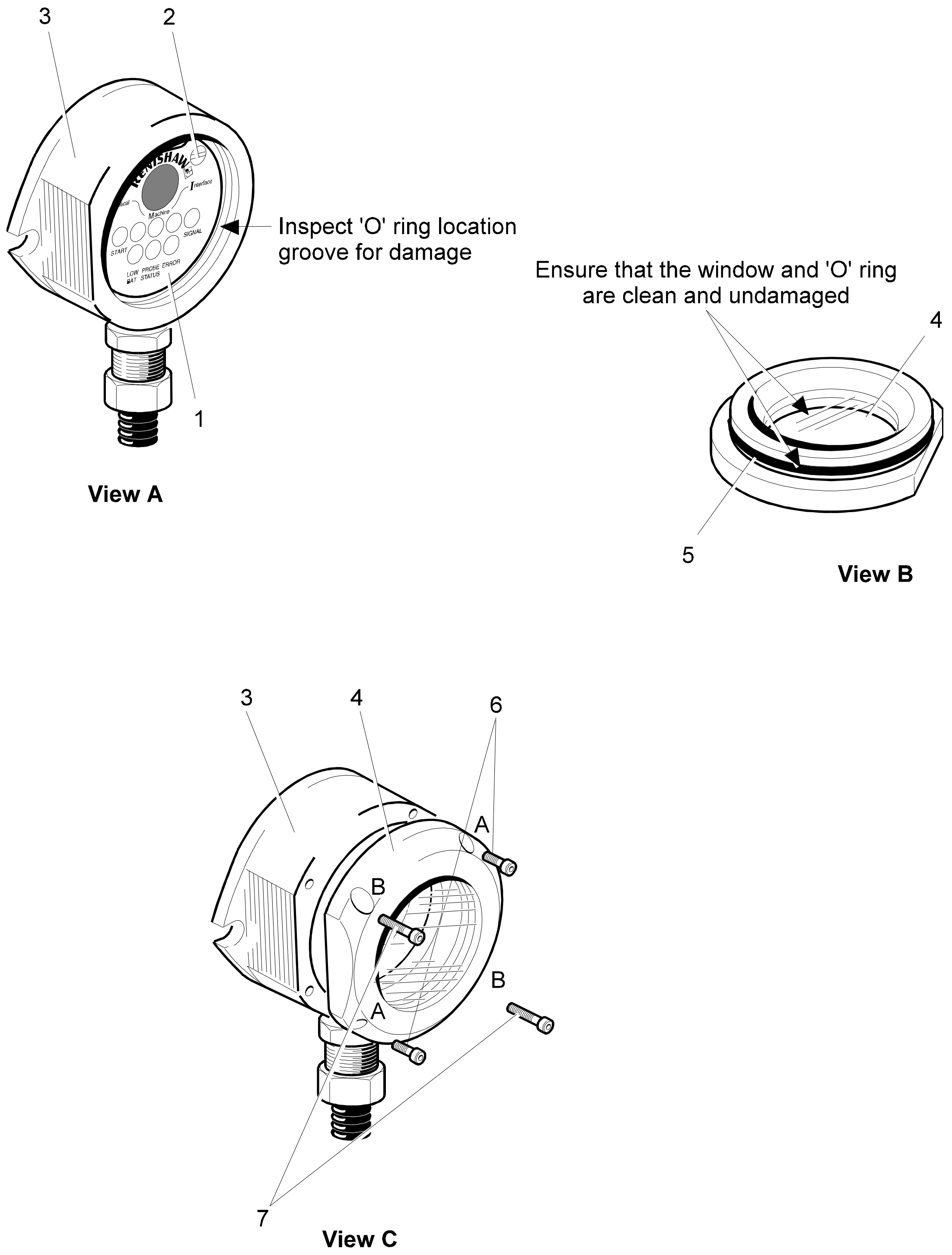
3. Visually examine the window [4] and ‘O’ ring [5] for cleanliness as shown in **View B**. Also ensure that both the window and ‘O’ ring are undamaged.

4. Refer to **View C** and insert the two short screws [6] into the two threaded holes **A** in the window [4]. Tighten the two screws to 0.3 - 0.7Nm (0.22 - 0.51 lbf. ft).

5. Lightly smear the ‘O’ ring [5] with silicone grease and assemble window [4] to OMM body [3].

6. Insert the two long screws [7] into the two plain holes **B**. Tighten each screw a few turns at a time to gradually pull the window [4] evenly against the OMI body [3]. There may be some resistance due to the compression of air trapped inside the OMI body.

7. Alternatively tighten screws [7] to pull window [4] evenly into the body of the OMI. Finally tighten screws to 1.0 - 1.8Nm (0.74 - 1.32 lbf.ft).



1. Label
2. Retaining Screw (2 Off)
3. OMI Body
4. Window
5. ‘O’ Ring
6. Screw (short) (2 Off)
7. Screw (long) (2 Off)

Figure 2.39 - Assembly of the OMI Window and Label

Installing Your MP700 Probe to Your Machine Tool (All Systems)

The Diaphragm Protection Cover

The MP700 Probe is supplied with a diaphragm protection cover (Figure 2.40) that protects the diaphragms during transportation within low pressure environments (such as aircraft cargo holds). It ensures that, following this type of transportation, the diaphragms return to their correct form.

Although it is obviously important to remove this cover prior to probe use, it is also vitally important to ensure that it is re-assembled whenever the probe is to be subjected to a low pressure environment during transportation, i.e. airfreight.

As the MP700 Probe is potentially sensitive to very low forces, any distortion in the diaphragm's form will result in a reduction of the probe's performance. By fitting the diaphragm protection cover, you will ensure that the diaphragms will always retain their correct form.

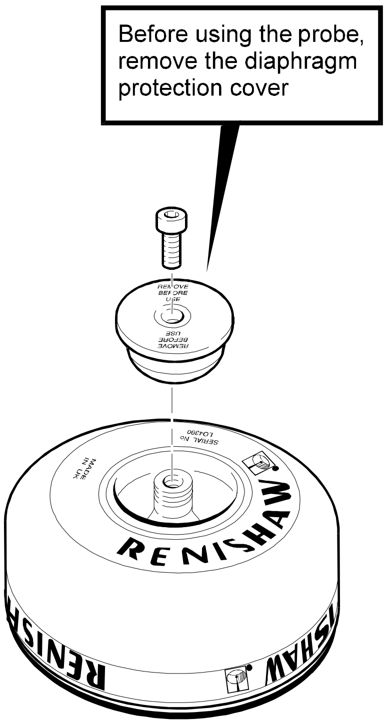


Figure 2.40 - The Diaphragm Protection Cover

Mounting Your MP700 Probe to a Shank

There are two methods of mounting the probe to a shank:

- **By using the adjustment plate:** which allows the probe to slide across the shank end face.

- **By using the adjustment plate and optional centre ball:** which allows the probe to pivot on the shank and slide across the shank end face.

To mount your probe to a machine tool shank, carry out the following (refer to Figure 2.41):

1. Remove the diaphragm protection cover [1].

2. Assemble the stylus [2]. Tighten the stylus to 2Nm (1.7 lbf.ft).

3. Release the two capscrews [3].

4. Remove the battery cover [4].

5. Disconnect and remove the battery [6].

6. Release and remove the retaining screw [7] securing the cover [8]; remove the cover.

7. Where applicable, position centre ball [9] within location point provided at top of probe.

8. Assemble the adjustment plate [10] to the probe and secure with four capscrews [11]. Torque-tighten capscrews to 5.1Nm (3.76 lbf.ft).

9. Fully release the four flat point grubscrews [13], then grease the two cone point grubscrews [15] and fit to shank [14].

10. Mount the adjustment plate [10] to the shank [14] and secure in position by lightly tightening cone point grubscrews [15].

11. **If stylus on-centre adjustment is to be carried out using the adjustment plate without the ball, carry out steps 12 through 16 and then perform stylus on-centre adjustment. If the ball and adjustment plate method is to be used, perform stylus on-centre adjustment without completing steps 12 through 16.**

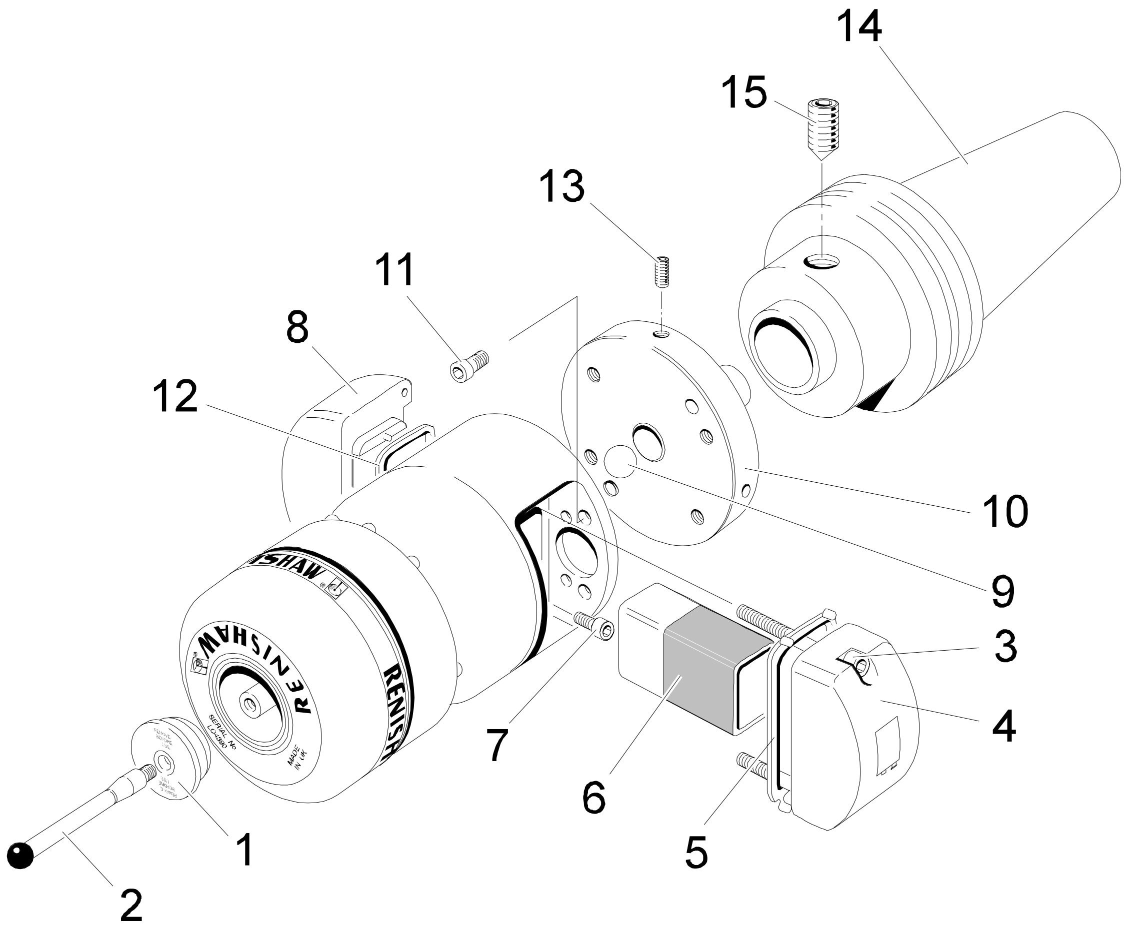
12. Ensure cover seal [12] is correctly seated and lightly lubricated with mineral oil or grease.

13. Reassemble cover [8] and secure with retaining screw [7]. Tighten the retaining screw to 1.1Nm (0.8 lbf.ft).

14. Reinstall battery [6] ensuring correct polarity.

15. Ensure the battery cover seal [5] is correctly seated and lightly lubricated with mineral oil or grease.

16. Assemble the battery cover [4] and secure with the two capscrews [3]. Tighten the two capscrews to 1.1Nm (0.8 lbf.ft).



1. Diaphragm Protection Cover	9. Centre Ball
2. Stylus	10. Adjustment Plate
3. Capscrew (2 off)	11. Capscrew (4 off)
4. Battery Cover	12. Cover Seal
5. Battery Cover Seal	13. Flat Point Grubscrew (4 off)
6. Battery	14. Shank
7. Retaining Screw	15. Cone Point Grubscrew (2 off)
8. Cover	

Figure 2.41 - Mounting the Probe to a Shank

Mounting Your Probe to Your Machine Tool

Prior to mounting your probe to the machine tool, it is important to:

- Ensure that the probe is securely mounted to its shank.
- Ensure that the diaphragm protection cover (see Figures 2.40 and 2.41) has been removed from the probe; please refer to **The Diaphragm Protection Cover** earlier in this chapter.

Mounting of the probe to the machine tool spindle is identical to that used for mounting your cutting tools. When mounting the probe, ensure that:

- The probe status LED is aligned such that it is visible to the Operator.
- Stylus on-centre adjustment is performed in accordance with instructions contained in **Stylus On-centre Adjustment** later in this chapter.

Stylus On-centre Adjustment

There are two methods of stylus on-centre adjustment (see Figure 2.42):

- **Stylus on-centre adjustment using the on-centre adjustment plate:** which allows the probe to slide across the shank end face.

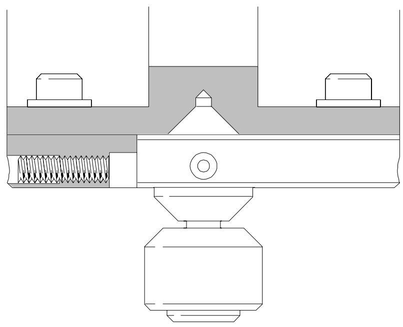
- **Stylus on-centre adjustment using the adjustment plate and optional centre ball:** which allows the probe to pivot on the shank and slide across the shank end face.

Stylus alignment need only be approximate, except in the following circumstances:

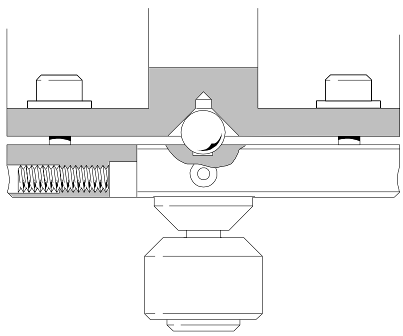
- Where alignment must be as exact as possible due to the use of probe vector software.

- Where the probe must be parallel to the spindle axis to prevent the stylus stem contacting the workpiece when gauging deep holes.

- Where the machine's control software is unable to compensate for the offset of the stylus.



Adjustment Plate



Adjustment Plate with Centre Ball

Figure 2.42 - Stylus On-centre Adjustment Methods

Stylus On-centre Adjustment Using Adjusting Plate

CAUTION

DO NOT ROTATE THE PROBE RELATIVE TO THE SHANK. DO NOT HIT OR TAP THE PROBE DURING THE FOLLOWING PROCEDURE.

Refer to Figure 2.43.

1. Where necessary, install the probe [1] into the machine tool spindle.

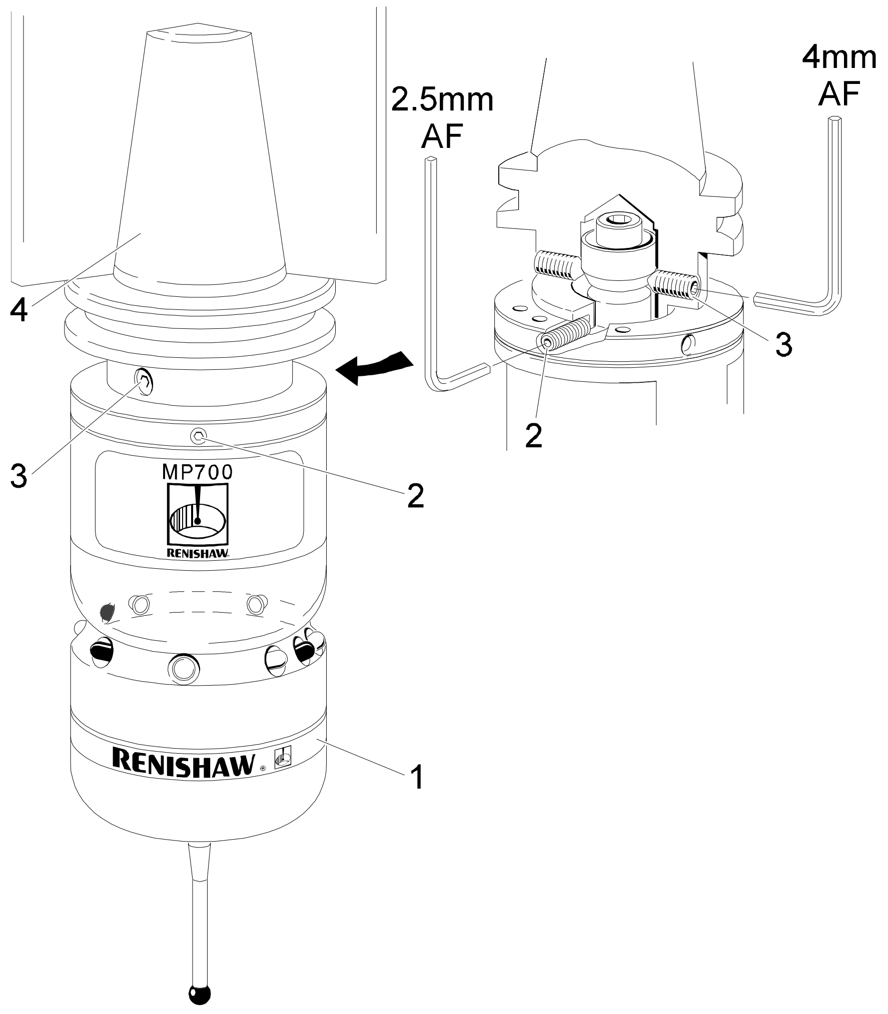
2. Visually centralise the probe [1] relative to the shank [4] and partially tighten cone point grubscrews [3] to 2 - 3Nm (1.47 - 2.2 lbf.ft.).

3. Gradually and systematically tighten the four flat point grubscrews [2], backing off after each movement, until the stylus run out is less than 20µm.

4. Fully tighten cone point grubscrews [3] to 6 - 8Nm (4.4 - 5.9lbf. ft).

5. Continue adjustment using the four flat point grubscrews [2]. This is achieved by using each in opposition to the other in order to move the probe (first slackening one then tightening the other). Using two 2.5mm Allen keys (if required), progressively tighten the four grubscrews as the final setting is approached.

6. When the final setting is achieved (5µm (0.0002 in.) total stylus run out or better), ensure that the four flat point grubscrews [2] are fully tightened to 1.5 - 3.5Nm (1.1 - 2.6lbf. ft).



1. MP700 Probe
2. Flat Point Grubscrew (4 Off)
3. Cone Point Grubscrew (2 Off)
4. Shank

Figure 2.43 - Stylus On-centre Adjustment (Adjustment Plate Method)

Stylus On-centre Adjustment Using The Centre Ball

CAUTION

DURING ADJUSTMENT, CARE MUST BE TAKEN NOT TO ROTATE THE PROBE RELATIVE TO THE SHANK. DO NOT HIT OR TAP THE PROBE DURING THE FOLLOWING PROCEDURE.

Note...

For applications where the stylus stem has to be parallel with the spindle centre line, this 'centre ball' method must be used.

Refer to Figure 2.44

1. Where necessary, release the two capscrews [1]. Remove the battery cover [2]. Disconnect and remove the battery [4]. Release and remove retaining screw [5]. Remove cover [6].

2. Visually centralise the probe relative to the shank [11]; partially tighten cone point grubscrews [12] to 2 - 3Nm (1.47 - 2.2 lbf.ft.).

3. Where necessary, install the probe into the machine tool spindle.

4. Visually check the alignment of the stylus, if adjustment is required, realign stylus by capscrews [9].

5. Tighten capscrews [9] to as near 5.1Nm (3.76 lbf. ft) as possible without loosing the alignment.

6. Gradually and systematically tighten the four flat point grubscrews [10], backing off after each movement, until the stylus run out is less than 20µm.

7. Fully tighten cone point grubscrews [12] to 6 - 8Nm (4.4 - 5.9lbf. ft).

8. Continue adjustment using the four flat point grubscrews [10]. This is achieved by using each in opposition to the other in order to move the probe (first slackening one then tightening the other). Using two 2.5mm Allen keys (if required), progressively tighten the four grubscrews as the final setting is approached.

9. When the final setting is achieved (5µm (0.0002 in.) total stylus run out or better), ensure that the four flat point grubscrews [2] are fully tightened to 1.5 - 3.5Nm (1.1 - 2.6lbf. ft).

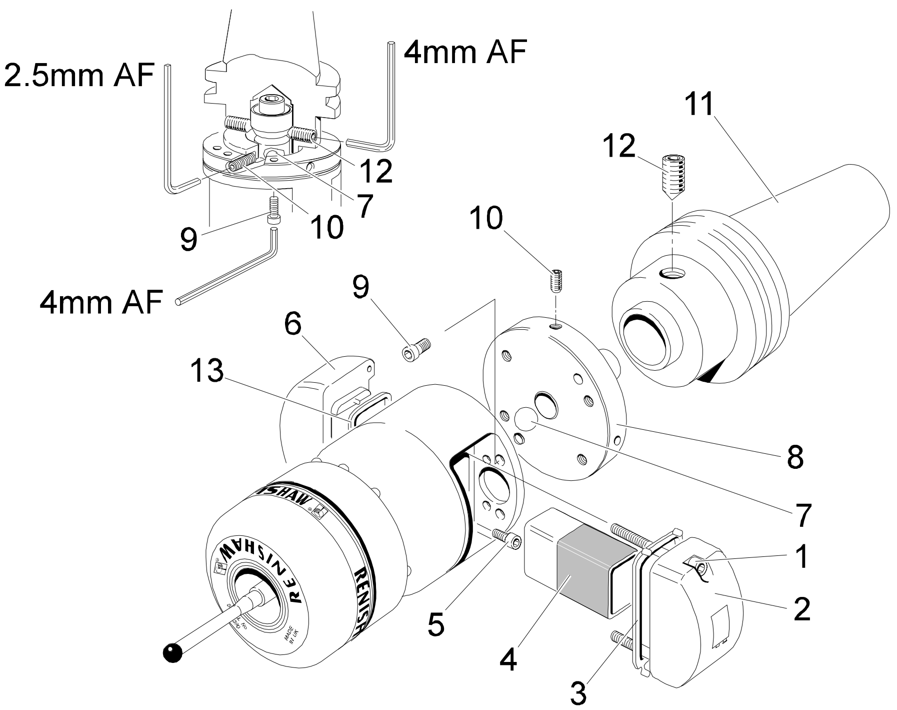
10. Ensure cover seal [13] is correctly seated and lightly lubricate with mineral oil or grease.

11. Reassemble cover [6] and secure with retaining screw [5]. Torque-tighten the retaining screw to 1.1 (0.8 lbf.ft).

12. Reinstall battery [4] ensuring correct polarity.

13. Ensure battery cover seal [3] is correctly seated and lightly lubricate with mineral oil or grease.

14. Assemble battery cover [2] and secure with the two capscrews [1]; torque tighten the capscrews to 1,1Nm (0.8 lbf.ft).



1. Capscrew (2 Off)
2. Battery Cover
3. Battery Cover Seal
4. Battery
5. Retaining Screw
6. Cover
7. Centre Ball
8. Adjustment Plate
9. Capscrew (4 Off)
10. Flat Point Grubscrew (4 Off)
11. Shank
12. Cone Point Grubscrew (2 Off)
13. Cover Seal

Figure 2.44 - Stylus On-centre Adjustment (Centre Ball Method)

Adjusting Your MP700 Probe System

The component parts of the MP700 Probe System include switches that allow you to select the parameters within which you wish your system to operate. These include:

- The way in which you wish the MP700 Probe to switch on and off.
- The debounce period.
- The reception and transmission ranges of the OMM and OMI.
- The vibration resistance of the probe.

Although these switches will have been set during the initial installation of the MP700 Probe System onto your machine tool, subsequent adjustment may be required in circumstances where installation was performed off site, or where subsequent installation of probing systems on adjacent machine tools has caused interference to your existing system. For information on how to adjust any of the switch settings, refer to **Chapter 5 - Maintenance and Adjustment**.

CHAPTER 3

System Description

Reading this chapter will provide you with a detailed knowledge of the MP700 Probe system. It includes:

- A detailed description of each of your system components.
- A detailed description of how the system components interact.
- Technical data on the MP700 Probe System.

Contained In This Chapter

Description Of The MP700 Probe System

Systems Fitted With Optical Machine Module/MI12 Machine Interface Unit

Typically, as Renishaw designs its systems to meet the individual needs of each customer, your MP700 Probe System (see Figure 3.1) will comprise of tailored variations of the following - each of them geared specifically to meet your needs:

- A Renishaw® MP700 Spindle Probe.
- A Renishaw® Optical Machine Module (OMM).
- A Renishaw® MI12 Interface Unit.
- A Renishaw® PSU3 Power Supply Unit (fitted only in instances where a 24V supply is not available from the CNC controller).

Systems Fitted With the Optical Machine Interface

The MP700 Probe System, when fitted with the optional Optical Machine Interface will comprise of the following (see Figure 3.2):

- A Renishaw® MP700 Spindle Probe.
- A Renishaw® Optical Machine Interface (OMI).
- A Renishaw® PSU3 Power Supply Unit (fitted only in instances where a 24V supply is not available from the CNC controller).

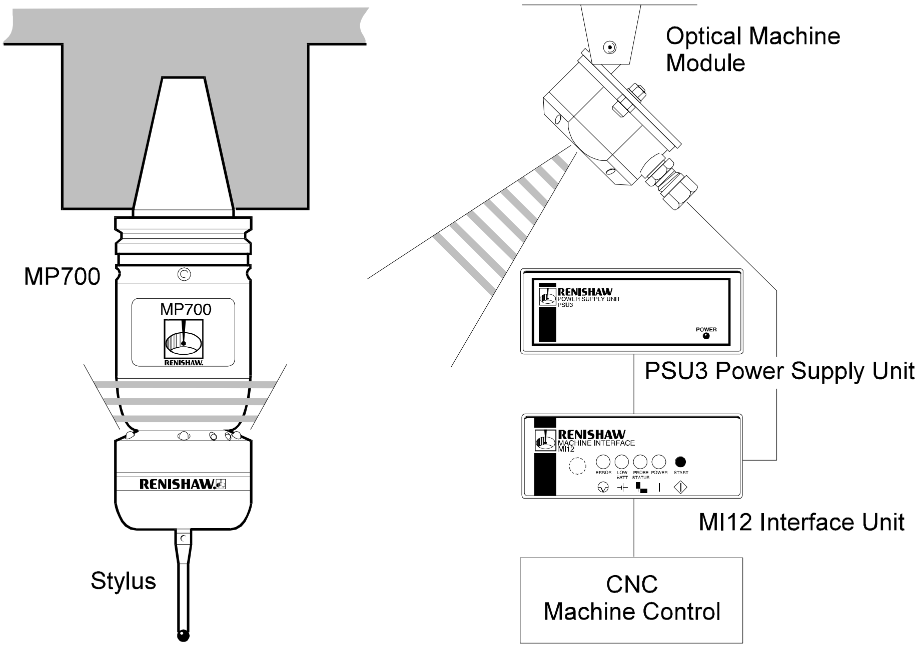


Figure 3.1 - MP700 Probe System (OMM/MI12 Interface Variant)

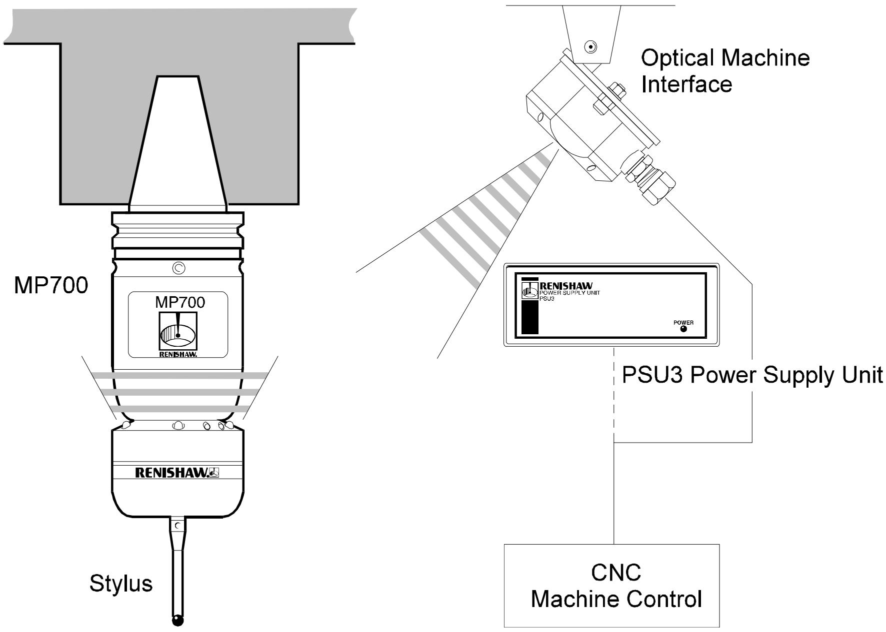
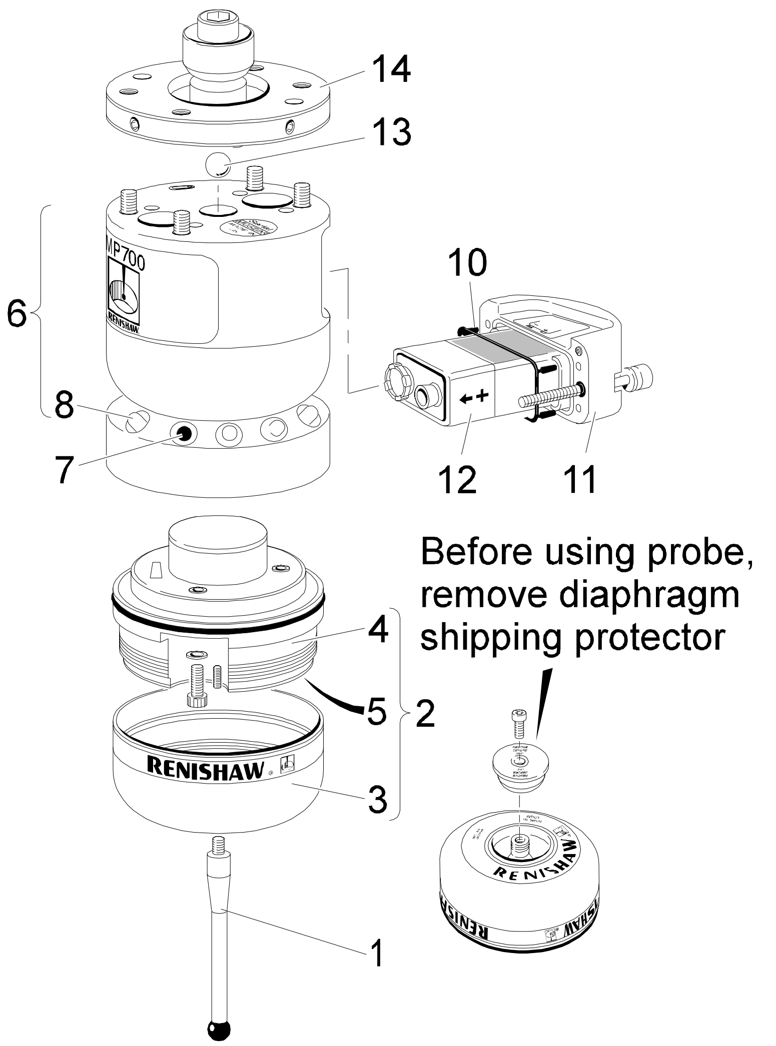


Figure 3.2 - MP700 Probe System (Optical Machine Interface Variant)

The MP700 Machine Spindle Probe

The Renishaw® MP700 Machine Spindle Probe comprises the following primary components, refer to Figure 3.3:

- Stylus [1].
- Probe head [2].
- Optical Module Probe (OMP) [6].
- Stylus on-centre adjustment plate [14].
- Standard shank (adapted to accommodate an on-centre adjustment feature).



1. Stylus
2. Probe Head
3. Probe Head Cover
4. Probe Head Body
5. Grubscrews (2 off)
6. Optical Module Probe
7. Receiving Diode (3 off)
8. Transmitting LED's (6 off)
9. Probe Status LED
10. Battery Cover Seal
11. Battery Cover
12. Battery
13. Centre Ball (optional)
14. Stylus On-centre Adjustment Plate

Figure 3.3 - The MP700 Probe

The Probe Head

The probe head [2] comprises the following parts:

- Probe head cover [3].
- Probe head body [4].
- Jacking grubscrews [5].

The probe head contains a kinematic location, a strain sensitive structure, and an Application Specific Integrated Circuit (ASIC). It is sealed from the environment by twin Viton diaphragms which offer the ultimate resistance to coolant.

The strain sensitive structure, to which the active silicon strain gauges and non-strained dummy gauge are mounted, is linked to the ASIC via a specially designed flexible circuit. Refer to Figure 3.4.

The Digital-Analogue ASIC, driven by a dedicated oscillator, incorporates three 14 bit digital tracking converters to provide the ‘auto-zero’. It has full authority over the probe’s operations, from sequencing of the turn on to the constant datuming of the strain gauges, to account for probe orientation or temperature.

Note...

To take advantage of its intrinsic gauge sensitivity, the MP700 probe normalises the wide variations in the resistance of the strain gauges (caused by temperature sensitivity and gauge variation) by using a process known as ‘autozeroing’.

As the strain gauges are very sensitive, and therefore susceptible to changes in resistance caused by temperature variation and probe orientation, the probe circuitry constantly balances their output. This process, known as ‘autozeroing’, prevents the probe from ‘false triggering’ and eliminates measurement inaccuracies. Calibration data, as well as the physical position of the stylus ball, are not effected by autozeroing.

The auto-zero, used to normalise the wide variations in resistance caused by temperature sensitivity, is configured for both slow and fast modes of operation. The fast auto-zero is used when the probe is initially turned on and normalises any variations in gauge resistance. The slow auto-zero is used to ensure the tracking of any temperature variations and is active whenever the probe is operational.

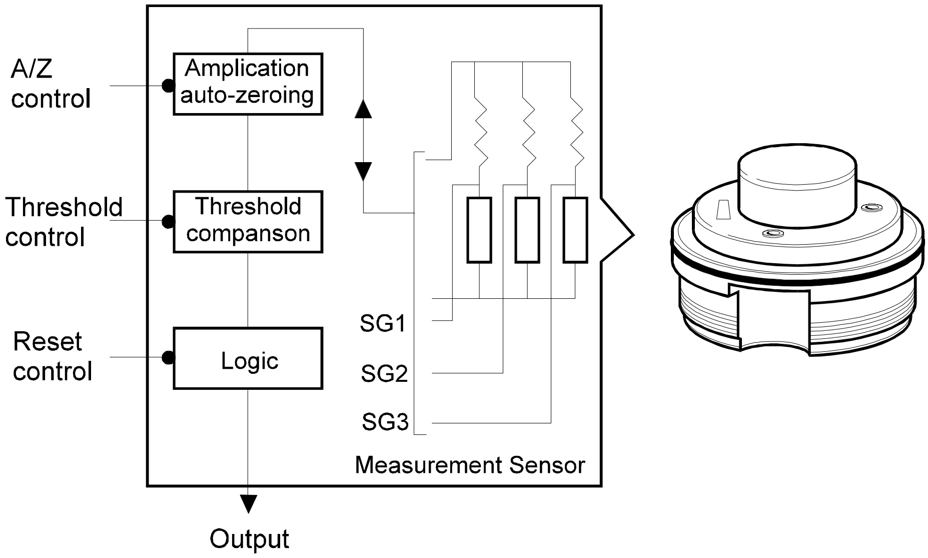


Figure 3.4 - Probe Head - Diagrammatic

Stylus On-centre Adjustment Plate

The stylus on-centre adjustment plate [item 14, Figure 3.3] provides the mechanism necessary to align the probe stylus with the spindle centre-line of the machine tool. Refer to **Chapter 5 - Maintenance and Adjustment**.

The Optical Module Probe (OMP)

The OMP [item 6, Figure 3.3] comprises the following parts:

- OMP switch.
- Three receiving diodes [7].
- Six transmitting LED's [8].
- Probe status LED [9].
- Battery cover seal [10].
- Battery cover [11].
- Battery [12].

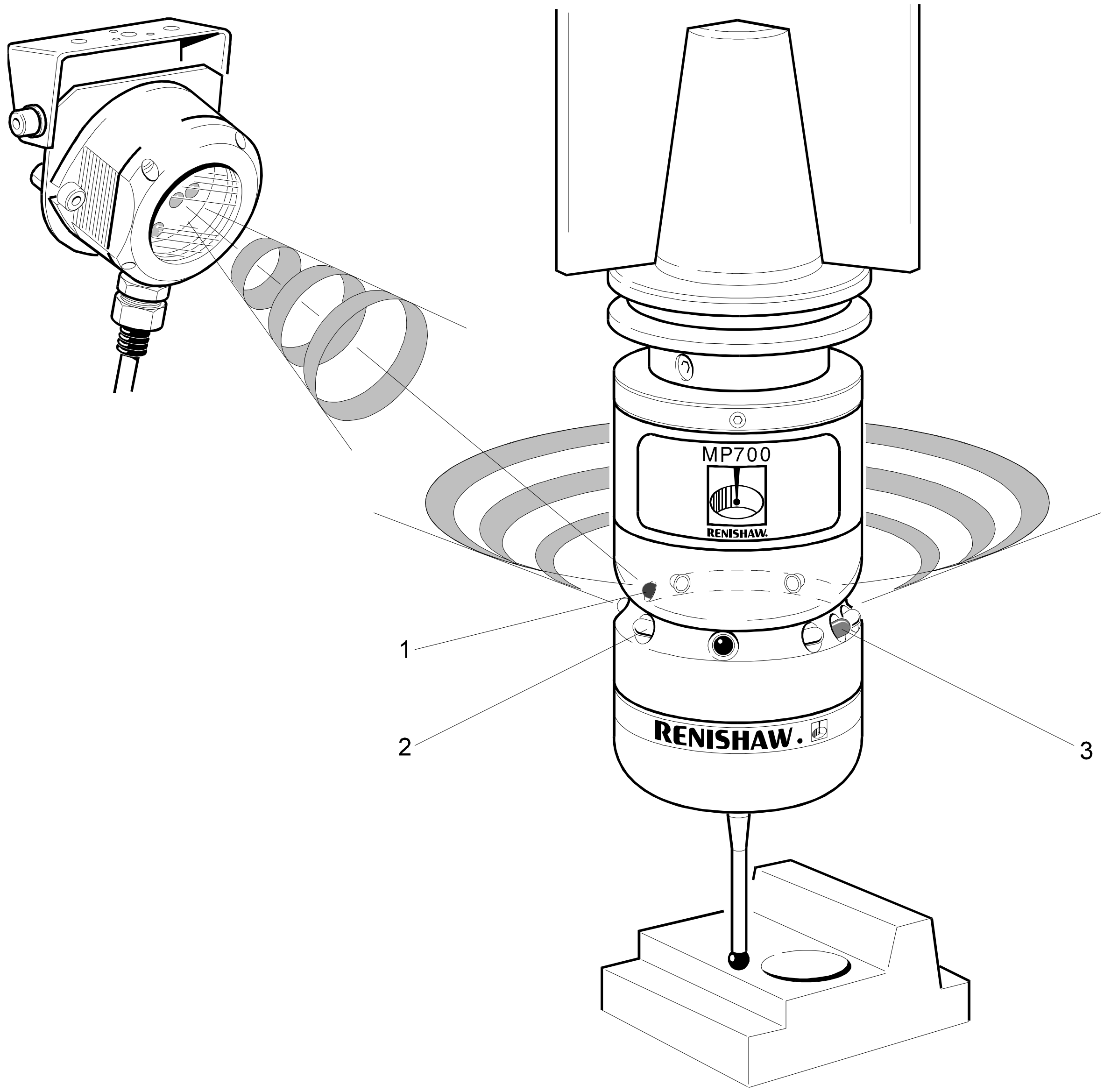
The OMP [6], which is battery powered and located between the probe head [2] and the shank, is made active by the OMM/OMI transmitting a '*start signal'* (a burst of infra red modulated at 7,8125 kHz). This start signal results from the receipt of an M code start/reset signal sent by the MI12 Machine Interface Unit or the OMI.

Positioned within the line of sight of the OMM/OMI, the OMP receives machine control signals by way of three receiving diodes [1, Figure 3.5] providing a 360° envelope. The OMP transmits signals back to the OMM/OMI by way of six transmitting LED's [2].

The OMP also offers a visual identification of both probe and battery status by way of the probe status LED [3]. The probe status LED will:

- **Flash green:** to indicate a seated stylus.
- **Flash red:** to indicate a deflected stylus (Probe Open).
- **Remain a constant red:** to indicate that the probe battery needs replacing (Probe Open will be forced in this condition).

Continued on page 3-10



1. Receiving Diode (3 Off)
2. Transmitting Diode (7 Off)
3. Probe Status LED

Figure 3.5 - Optical Module Probe

The OMP receiver circuit allows the probe to operate in one of two modes.

- **Stand-by mode:** where the OMP transmitter is switched off and only the receiver is operational.

- **Operating mode:** where the probe and OMP are switched on before a gauging cycle.

The OMP switch is used to adjust the following settings:

- **The Debounce time:** which controls the minimum time that must elapse, after a start signal is sent, before the OMP is ready to act upon another start signal. If a start signal is sent within this debounce period, the OMP will ignore it. This debounce period, which is user selectable, can be set to either 5 or 9 seconds. Typically, the debounce time will be factory set at 5 seconds. Refer to **Chapter 5 - Maintenance and Adjustment** for switch adjustment.

- **The Operating Mode:** in which the probe is to operate. This can be set to either ‘Optical On - Optical Off’ or ‘Optical On - Time Out’. Typically, the operating mode will be factory set to ‘Optical On - Optical Off’. Refer to **Chapter 5 - Maintenance and Adjustment** for switch adjustment.

- **The Time Out period:** which controls the time that the OMP will remain operational before switching to the standby mode when in the ‘Optical on - Time Out’ mode. The time out period, which is user selectable, can be set to either 33 ± 2 seconds or 134 ± 2 seconds. Typically, the time out period will be factory set to 134 ± 2 seconds. Refer to **Chapter 5 - Maintenance and Adjustment** for switch adjustment.

The battery [13] is sealed from the environment by the battery cover seal [12] and battery cover [11].

Optical Machine Module (OMM)

Note...

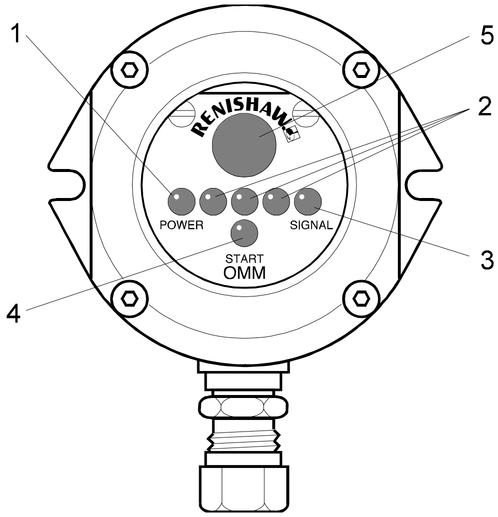
Further information on the Optical Machine Module can be obtained from reading the Optical Machine Module Installation and User's Guide (H-2000-5044).

The OMM includes the following LED's, refer to Figure 3.6:

Fig. No	LED	Purpose
1	**'POWER'**(Red)	Lit when the power supply is active.
2	**Clear** (3off) (Transmitting)	Transmits infra-red control signals to the MP700 probe.
3	**'SIGNAL'** (Green)	Lit when a signal is received from the MP700 probe.
4	**'START'** (Yellow)	Lit when the MI12 Machine Interface Unit transmits a start signal.

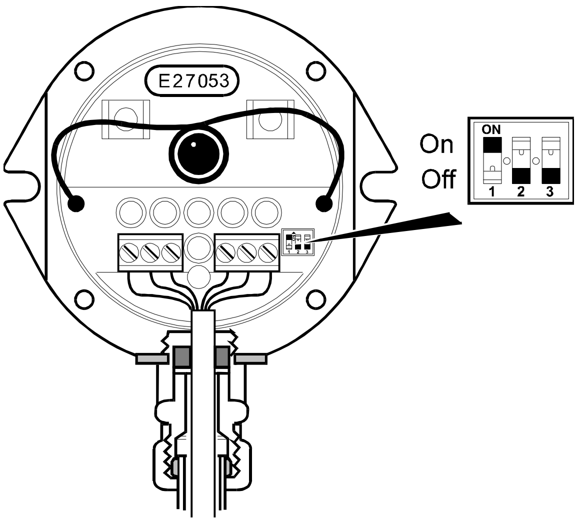
The OMM, mounted on the machine tool within the 360° output envelope of the OMP, is both an optical transmitter and receiver. As a receiver, it waits passively for, and collects, signals passed from the OMP. These are then passed to the MI12 machine interface unit for conversion. When operating as a receiver/transmitter, the OMM also has the capability to receive a probe start signal from the MI12 machine interface unit. It then transmits this signal to the OMP to effectively switch on the probe.

The OMM reception (Rx) and transmission (Tx) ranges can be adjusted and set by a range selection switch (see Figure 3.7). Both the Rx and Tx ranges can be reduced if they become affected by optical or electro-magnetic interference; refer to **Chapter 5 - Maintenance and Adjustment** for switch adjustment.



1. Power On Indicator (Red LED)
2. Clear LED’s (3 off)
3. Probe Signal Indicator (Green LED)
4. MI12 Signal Indicator (Yellow LED)

Figure 3.6 - The Optical Machine Module



Note... OMM shown with Window and Label removed for clarity

Figure 3.7 - OMM Range Selection Switch

The MI12 Machine Interface Unit

> **Note...**
>
> **Further information on the MI12 Machine Interface Unit can be obtained from reading the MI12 Interface/PSU3 Power Supply Installation and User's Guide (H-2000-5073).**

The MI12 Machine Interface Unit includes the following LED's; refer to Figure 3.8:

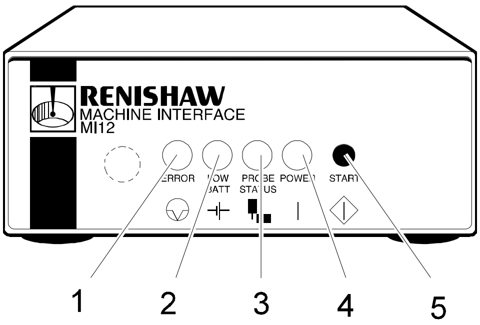
Fig. No	LED	Purpose
1	**'ERROR'** (Red)	Lit when the optical beam is obstructed or the probe is off.
2	**'LOW BATT'** (Red)	Lit when battery needs replacing.
3	**'PROBE STATUS'**(Red)	Lit when the probe is seated. Off when the stylus is deflected or when a probe error occurs.
4	**'POWER'** (Red)	Lit when the power supply is active.

The MI12 Machine Interface Unit also includes:

- A 'START' button [5] which can be pressed to send a start signal to the OMP.
- An audible indicator that sounds whenever the MP700 Probe triggers

The MI12 Machine Interface Unit typically draws its power supply from your CNC machine tool (+15V to +30V dc). Alternatively, power may be supplied via a Renishaw® PSU3 Power Supply Unit.

The MI12 Interface Unit supplies four solid state relay (SSR) outputs; these comprise two complimentary probe outputs, an error output and a low battery output. Each SSR output is overload protected by a 62mA fuse.



1. Error Indicator (LED)
2. Low Battery Indicator (LED)
3. Probe Status Indicator (LED)
4. Power On Indicator (LED)
5. Manual Start Button (Switch SW1)

Figure 3.8 - MI12 Machine Interface Unit (Front Panel)

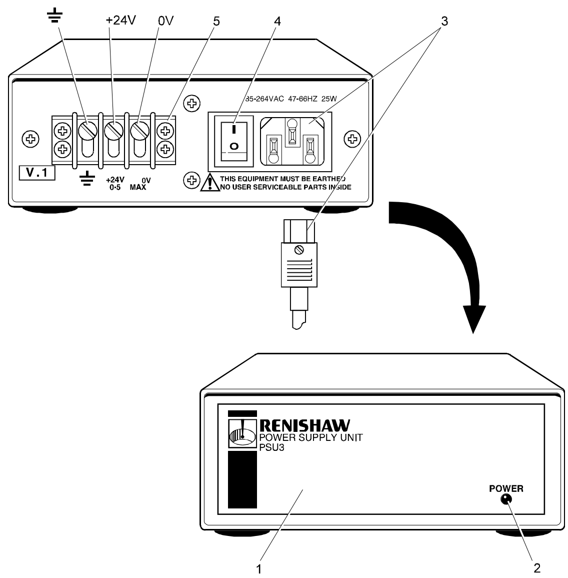
The PSU3 Power Supply Unit

Note...

Further information on the PSU3 Power Supply Unit can be obtained from reading the PSU3 Power Supply Unit Installation and User's Guide (H-2000-5057).

The PSU3 Power Supply Unit supplies power to the probe system and comprises the following primary components; refer to Figure 3.9:

- Box and cover [1].
- A 'POWER' LED [2] which illuminates when the power supply is on.
- Main's plug and socket [3].
- ON/OFF switch [4].
- Output terminal block [5].



1. Box and Cover
2. Power On Indicator (LED)
3. Mains Plug and Socket
4. On/Off Switch
5. Output Terminal Block

Figure 3.9 - The PSU3 Power Supply Unit

The Optical Machine Interface (OMI)

Note...

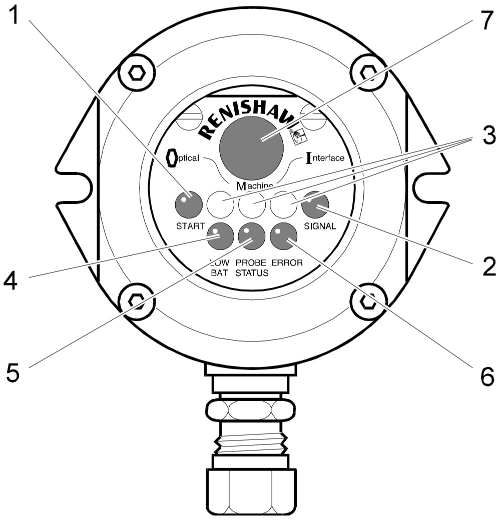
Further information on the Optical Machine Interface can be obtained from reading the Optical Machine Interface/PSU3 Power Supply Installation and User's Guide (H-2000-5062).

The OMI, an optional alternative to the more traditional OMM and MI12 Machine Interface Unit, includes the following LED's, refer to Figure 3.10:

Fig. No	LED	Purpose
1	**'START'** (Yellow)	Lit when a start signal is transmitted to the probe. This LED will: • Flash once when a machine controlled start signal is commanded. • Flash continuously at one second intervals when the system is set to 'Auto-Start'.
2	**'SIGNAL'** (Tricolour)	Lit when there is power to the system and indicates the infra-red signal strength received from the probe. This LED will: • Turn red if the signal is too weak. • Turn yellow if the signal is marginal. • Turn green if the signal is OK

Note... During a start transmission, this LED will indicate all three colours in sequence. If optical interference is received whilst the probe is not transmitting, the LED will flash yellow or green.

Fig. No	LED	Purpose
3	**Clear** (Transmit)	Transmit infra-red control signals to the probe.
4	**'LOW BAT'** (Red)	Flashes when the battery needs replacing.
5	**'PROBE STATUS'** (Bicolour)	Lit when the power to the system is on. This LED will: • Turn green when the probe is seated. • Turn red when the probe is triggered or when an error has occurred.
6	**'ERROR'**	Lit when an error exists.



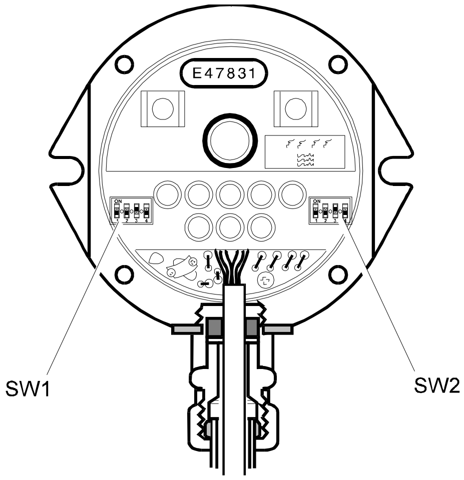
1. Yellow LED (Start Signal Indicator)
2. Tricolour LED (Signal Strength Indicator)
3. Clear LED's (3 off)
4. Red LED (Low Battery Indicator)
5. Bicolour LED (Probe Status Indicator)
6. Red LED (Error Indicator)

Figure 3.10 - Optical Machine Interface

The OMI, mounted on the machine tool within the 360° output envelope of the OMP, is both an optical transmitter and receiver. As a receiver, it waits passively for, and collects, signals passed from the OMP. These are then converted and passed directly to the CNC controller. When operating as a receiver/transmitter, the OMI also has the capability to receive a probe start signal directly from the machine tool. It transmits this signal to the OMP to effectively switch on the probe.

The OMI reception (Rx) and transmission (Tx) ranges can be adjusted and set by a range selection switch SW1 [item 1, Figure 3-11]. Both the Rx and Tx ranges can be reduced if they become affected by optical or electro-magnetic interference; refer to **Chapter 5 - Maintenance and Adjustment.**

The output configuration of the OMI is set by switch SW2 [item 2, Figure 3-11]; refer to **Chapter 5 - Maintenance and Adjustment.**



Note... OMI shown with Window and Label removed for clarity

1. Range Selection Switch (SW1)
2. Switch (SW2)

Figure 3.11 - Optical Machine Interface - Switch Locations

Technical Data

Probe Specification

Probe Dimensions

The dimensions of the MP700 Probe are as shown in Figure 3.12.

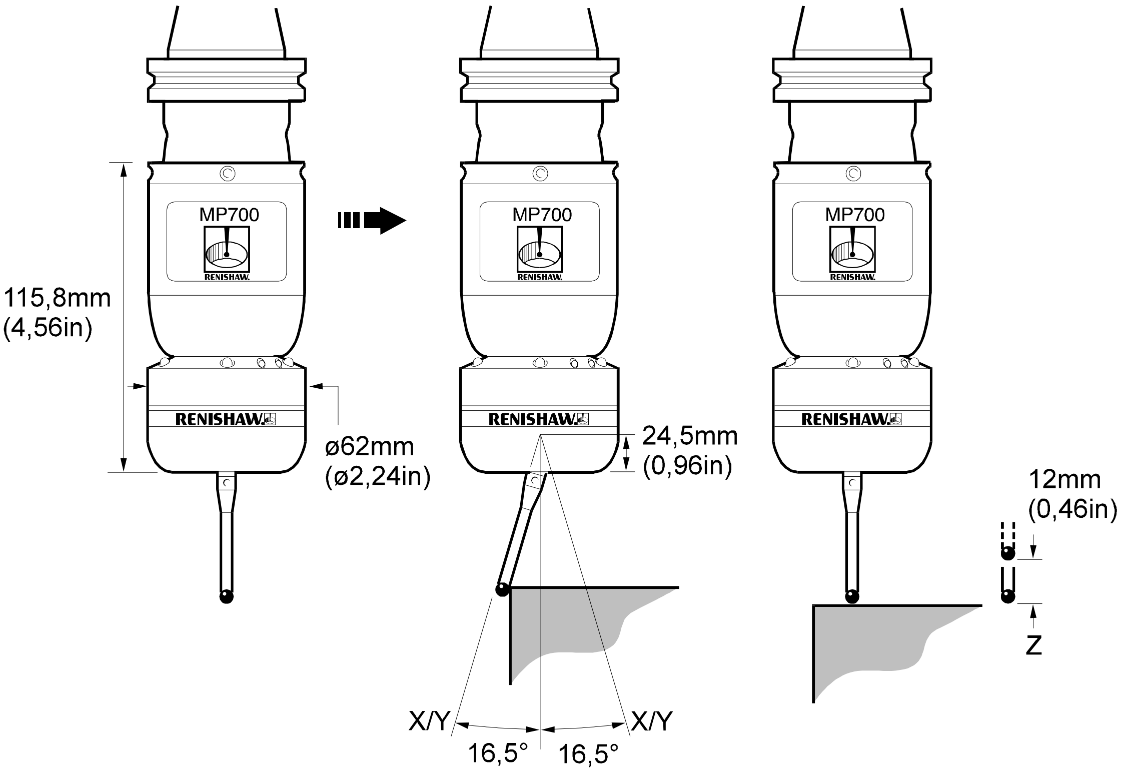


Figure 3.12 - MP700 Probe Dimensions

Probe Specification (Continued)

Primary application: Machining centre inspection probe

Life: 10 Million Triggers

Sense directions: 5 way

Trigger force (50mm stylus): **X Y** 2gf (0.02N) **Z** 15gf (0.15N)

Overtravel force (50mm stylus): **X Y** 40gf (0.39N) **Z** 590gf (5.79N)

Overtravel: **X Y** 16.5° **Z** 12mm (0.472 in.)

Maximum recommended stylus length: 200mm (7.87 in.)

Recommended trigger speed: 30mm/min (1,18 in/min.)

Maximum number of triggers per second: 3

Stylus Overtravel limits:

Stylus length	X	Y	Z
50mm (1.96 in.)	22,0mm (0.87 in.)	22,0mm (0.87 in.)	12mm (0.47 in.)
100mm (3.93 in.)	37,0mm (1.45 in.)	37,0mm (1.45 in.)	12mm (0.47 in.)
150mm (5.89 in.)	51.5mm (2.04 in)	51.5mm (2.04 in.)	12mm (0.47 in.)
200mm (7.87 in.)	66.5mm (2.62 in.)	66.5mm 2.62 in.)	12mm (0.47 in.)

Probe Specification (Continued)

Technical Performance

	Styli Length			
	50mm	100mm	150mm	200mm
Repeatability, maximum 2σ value. To be seen in any direction.	0.25µm	0.35µm	0.50µm	0.70µm
XY Pre-travel Variation.	± 0.25µm	± 0.25µm	± 0.4µm	± 0.5µm
X, Y, Z three-dimensional measurement maximum variation from a true sphere	± 1.0µm	± 1.75µm	± 2.5µm	± 3.5µm

The above results are based on an MP700 Probe with the probe head delay switch set to zero delay whilst mounted on a dedicated test rig. The results that you will encounter on a machine tool will differ due to:

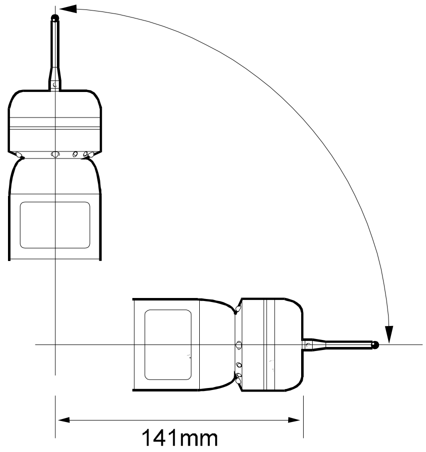
- The speed variation of the machine tool during any time delay (typically less than 0.1%).
- The variation in the machine tool's update time.
- The repeatability and positioning accuracy of the machine tool.
- The variation in machine scale resolution.

Probe Specification (Continued)

Probe Orientation

Rotation About An Independent Axis (e.g. Moving Head Machines)

To avoid the probe going OPEN during probe orientation (such as on a 5 axis, moving head machine), do not exceed the rates given below for the stylus in use. The rates given apply at a radius of 141mm, and from the probe stylus location face to the axis of rotation.



Stylus		Rate (°/Min)
Length	Material	
50mm (1,96 in.)	Ceramic	1200
100mm (3,93 in.)	Ceramic	1200
100mm (3,93 in.)	Carbon Fibre	1200
150mm (5,89 in.)	Carbon Fibre	1200
200mm (7.87 in.)	Carbon Fibre	1200

Note

The above table takes no account of spindle rotation during probe orientation

Probe Specification (Continued)

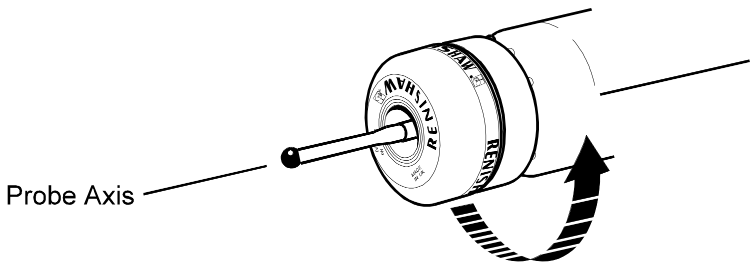
Probe Orientation (Continued)

Rotation About the Probe Axis (Spindle Indexing)

Note

The following recommendations apply only when the probe is horizontal. There are no restrictions on the orientation rate, about the axis, with the probe vertical.

To avoid the probe from going OPEN when it is horizontal and rotated about its own axis (e.g. spindle indexing on a horizontal axis machine), do not exceed the rates given below for the stylus in use.



Stylus		Max Rate (RPM)
Length	Material	
50mm (1,96 in.)	Ceramic	14
100mm (3,93 in.)	Ceramic	10
100mm (3,93 in.)	Carbon Fibre	11.5
150mm (5,89 in.)	Carbon Fibre	7
200mm (7.87 in.)	Carbon Fibre	4.5

Probe Specification (Continued)

Battery Specifications

Battery Capacity mAh		
Recommended Battery or Equivalent	**Zinc**	**Alkaline**
Ever Ready PP3-P I.E.C 6F22	230mAh	
Duracell MN1604 6LR61		550mAh

Battery Life Expectancy (Hours)										
	CONTINUOUS LIFE				**STANDBY LIFE (Days)**		**5% USAGE 72 min./day**			
	Optical Switch On-Off		**Optical On Timer Off**				**Optical On - Off**		**Optical On Timer Off**	
Battery Type	**Minimum**	**Typical**	**Minimum**	**Typical**	**Minimum**	**Typical**	**Minimum**	**Typical**	**Minimum**	**Typical**
Alkaline Duracell MN 1604	26hrs	29hrs	24hrs	26hrs	382 Days	509 Days	20 Days	23 Days	19 Days	21 Days
Ni Cad	**The use of Nickel Cadmium rechargeable batteries is not recommended. Their low capacity will give an unacceptably low life.**									

The typical elapsed time between the MI12 Machine Interface Unit's 'Low Batt' LED illuminating and the battery becoming fully discharged is 1 hour.

It is recommended that the battery is removed from the OMP if the probe is to be left unused or stored for a period exceeding 6 months.

OMP/OMM Operating Envelope

Refer to Figure 3.13.

Operating range: 10mm (0.39in.) minimum to 3 metres (9.84 feet) maximum

Operating environment: The OMP/OMM will operate normally within an ambient temperature range of 10° to 40° Centigrade (50° to 120° Fahrenheit). Operation in temperatures of 0° to 5°C or 50° to 60°C (32° to 41°F or 122° to 140°F) will result in some reduction in optical range.

Beam spread: 35° or 70°

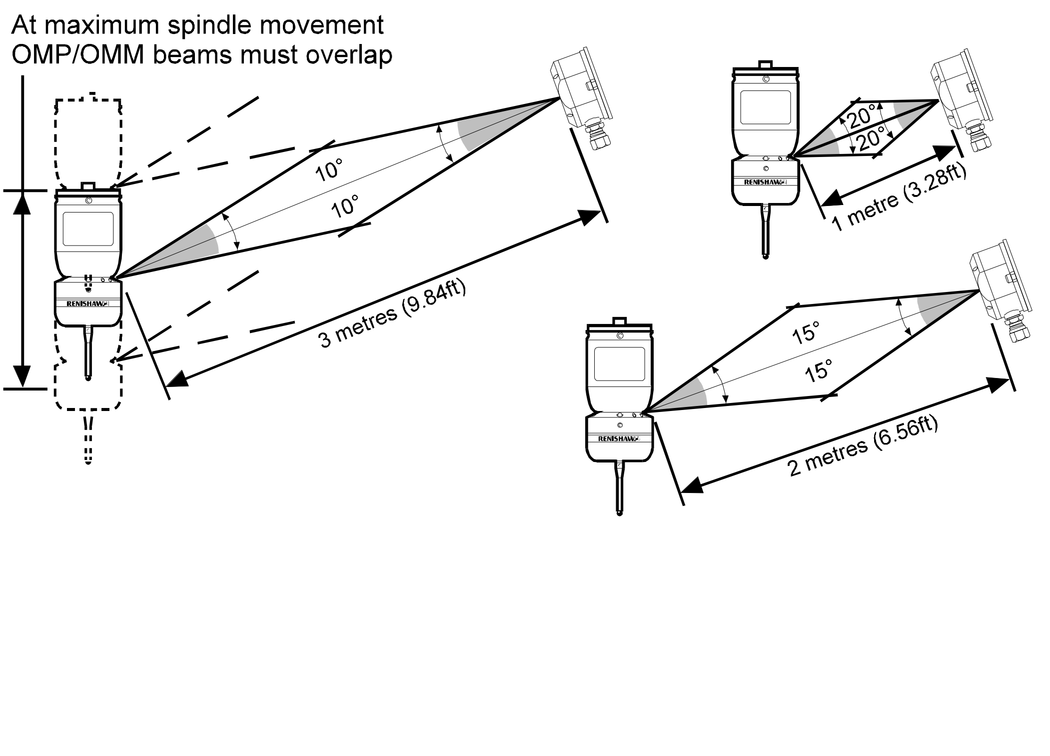


Figure 3.13 - OMP/OMM Characteristics

OMP/OMI Operating Envelope

Refer to Figure 3.14.

Operating range:	10mm (0.39in.) minimum to 3 metres (9.84 feet) maximum.
Operating environment:	The OMP/OMI will operate normally within an ambient temperature range of 10° to 40° Centigrade (50° to 120° Fahrenheit). Operation in temperatures of 0° to 5°C or 50° to 60°C (32° to 41°F or 122° to 140°F) will result in some reduction in optical range.
Beam spread:	35° or 70°

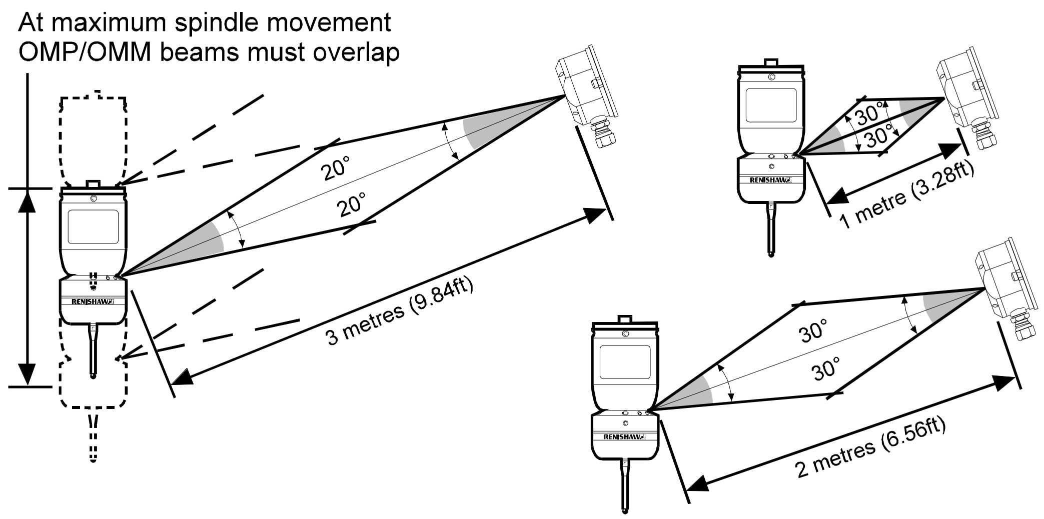


Figure 3.14 - OMP/OMI Characteristics

Screw Torque Values

For screw torque values, refer to Figure 3.15 below.

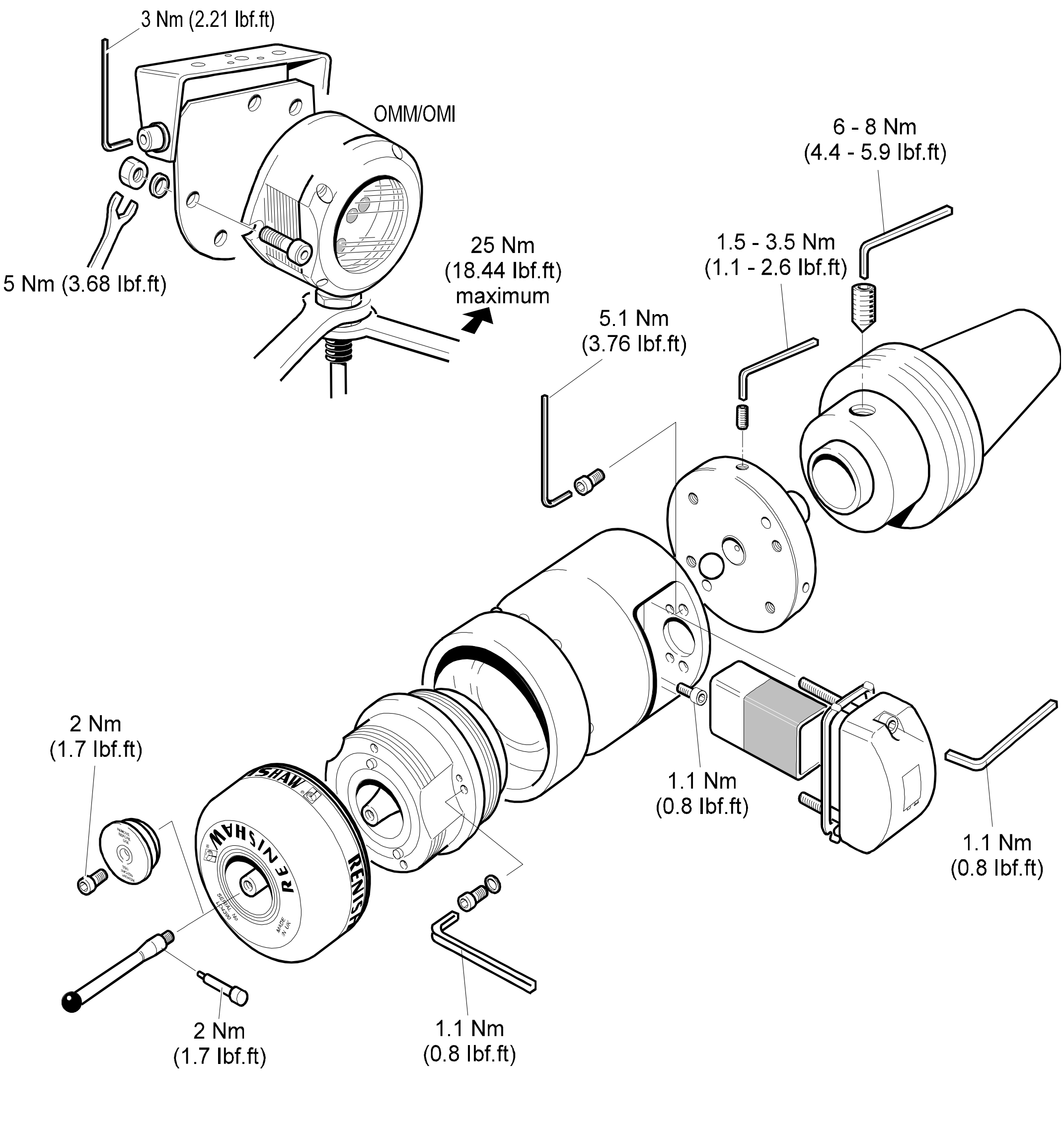


Figure 3.15 - Screw Torque Values

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CHAPTER 4

System Operation

This chapter provides step-by-step instructions on how to switch on, reset and switch off your MP700 Probe. As well as providing a comprehensive ‘Does and Don’ts’ section, it also includes general information on:

- System operation.
- Probe orientation.
- Probe trigger and reseat cycles.

Contained In This Chapter

Operating the MP700 Probe System.

CAUTION

PRIOR TO PROBE SYSTEM OPERATION, IT IS VITALLY IMPORTANT THAT YOU FULLY UNDERSTAND THE SOFTWARE WITH WHICH YOU WISH TO 'DRIVE' YOUR PROBE. INCORRECT PROGRAMMING CAN RESULT IN DAMAGE TO BOTH THE MACHINE, WORKPIECE AND TO THE PROBE ITSELF.

Note...

Before switching on the probe, ensure that the probe shank is securely located within the machine tool spindle. Ensure also that there is a direct line of sight between the Rx diodes of the OMP and the transmitting LED's of the OMM. If probe 'switch on' is to be initiated with an M code, it is important that the probe is stationary in the machine for 1.1 seconds after the M code is sent.

Switching on the Probe (OMM Variant)

Before operation, the MP700 Probe must be made active by one of the following 'switch on' options. These options are user selectable and can be selected by adjustment of the SW2 switch located on the printed circuit board within the MI12 Machine Interface Unit (see Figure 4.1). Refer to your MI12 Interface/PSU3 Power Supply Installation and User's Guide (H-2000-5073) for further information:

- **Manual Start:** when the 'START' button of the MI12 Machine Interface Unit is depressed.
- **Machine Start:** where an M code, generated by the CNC controller, passes through the MI12 Machine Interface Unit to the OMM. The OMM then converts this signal to a pulse of infra- red light recognisable to the OMP. **This option is pre-set**.
- **Auto Start:** where an optical start signal is transmitted once every second, and does not require a machine control input. **This option must not be used with the MP700 Probe**.

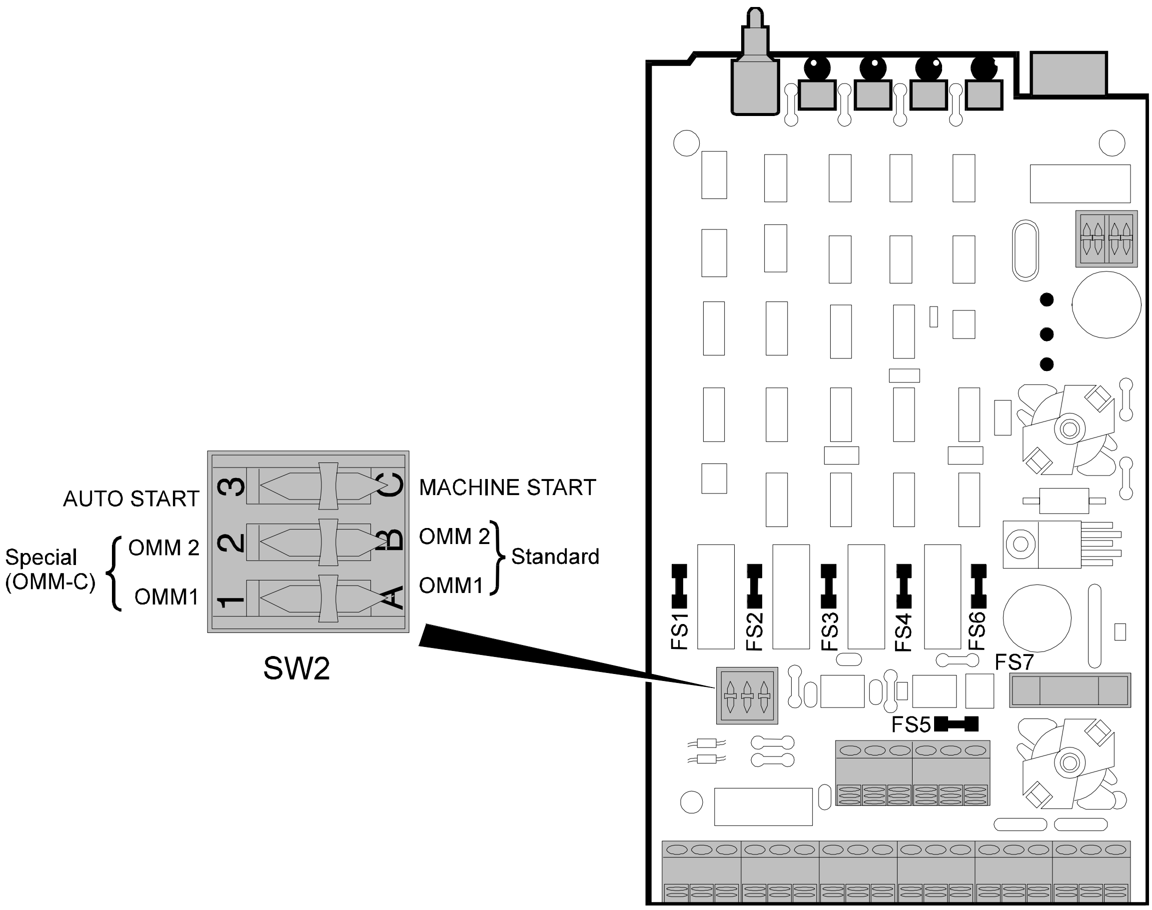


Figure 4.1 - MI12 Machine Interface Unit - Printed Circuit Board

Probe Switch On - Optical On/Time Out or Optical On/Optical Off Mode Selected

It is recommended that the probe is 'switched on' by using the pre-set 'Machine Start' method. When this method is used, the following will occur:

- A machine controlled M code will be transmitted by way of the MI12 Interface Unit to the OMM/OMP.
- The 'ERROR' LED on the front panel of the MI12 Machine Interface Unit will extinguish (typically 0.3 seconds) to indicate that the OMM has transmitted the signal to the OMP.
- The 'PROBE STATUS' LED, on the front panel of the MI12 Machine Interface Unit, will illuminate (typically 236 to 825 milliseconds after the interface error has cleared dependent on vibration). This indicates that the kinematic location is seated (PROBE CLOSED).
- The OMP, on receipt of the infra red signal transmitted by the OMM, will switch from 'standby' to 'operational' mode (typically 0.6 seconds).

Figure 4.2 below shows the time taken between an M code start signal (t0) being sent to the probe and the probe becoming ready for use.

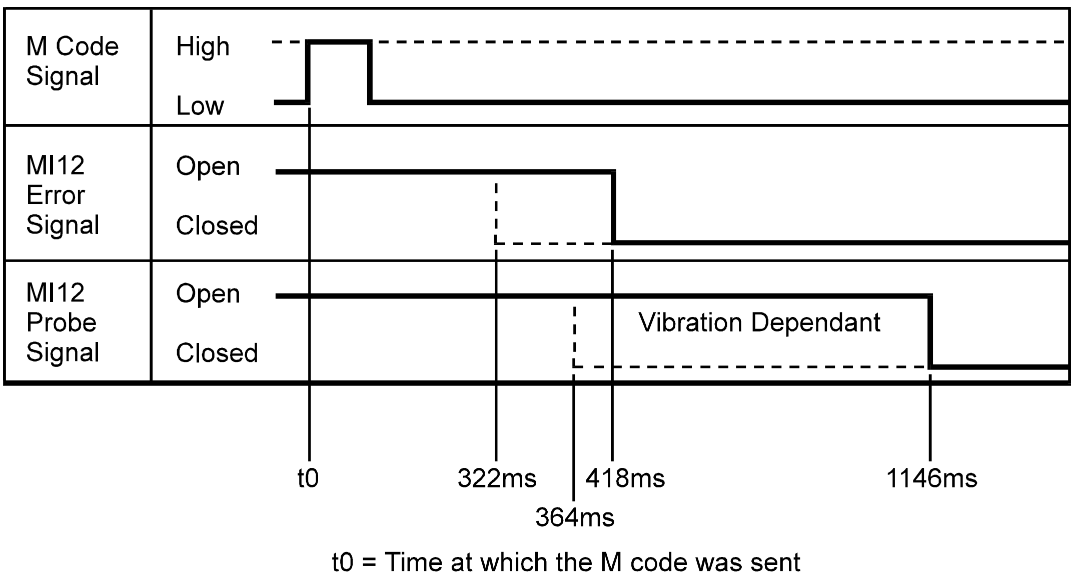


Figure 4.2 - Probe Switch On (Optical On/Time-out or Optical On/Optical Off Mode)

Switching on the Probe (OMI Variant)

Probe Switch On - Optical On/Time Out or Optical On/Optical Off Mode Selected

Before operation, the MP700 Probe must be made active by one of the following ‘switch on’ options. These options are user selectable and can be selected by adjustment of the SW1 switch located within the Optical Machine Interface (OMI) in accordance with **Chapter 5 - Maintenance and Adjustment**. Further information on the Optical Machine Interface may be obtained by reading the Optical Machine Interface/PSU3 Power Supply Installation and User’s Guide (H-2000-5062):

- **Machine Start:** where an M code generated by the CNC controller passes through the OMI where it is converted to a pulse of infra-red light recognisable to the OMP. **This option is factory pre-set**.

- **Auto Start:** where an optical start signal is transmitted once every second, and does not require a machine control input. **This option must not be used with the MP700 Probe**.

It is recommended that the probe is ‘switched on’ by using the pre-set ‘Machine Start’ method. When this method is used, the following will occur. Refer to Figure 4.2. however substitute MI12 Interface for OMI:

- A machine controlled M code will be transmitted by way of the OMI to the OMP.

- The ‘ERROR’ LED on the front panel of the OMI will extinguish (typically 0.3 seconds) to indicate that the system is operationally sound.

- The ‘SIGNAL’ LED on the front panel of the OMI will change through red to yellow to green.

- The OMP, on receipt of the infra red signal transmitted by the OMM, will switch from ‘standby’ to ‘operational’ mode (typically 0.6 seconds).

System Operation (OMM Variant)

> **Note...**
>
> **If the probe is switched on when mounted in a machine tool with an exceptionally severe vibration characteristic, the probe will instigate an internal monitoring routine to check the level of vibration. If the vibration decays to an acceptable level within 1 second, the probe will switch on at the point of decay. If the level of vibration does not decay within 1 second, the probe will switch on automatically.**

Once operational, the OMP transmits its status back to the CNC controller by way of its six transmitting diodes, the OMM, and the MI12 Machine Interface Unit.

Probe status is indicated both by:

- The probe status LED within the body of the OMP.
- The 'PROBE STATUS' LED housed within the front panel of the MI12 Machine Interface Unit illuminating to indicate that the probe is seated. <u>If the probe remains unseated, the probe status LED within the body of the OMP will begin to flash red</u>.

Low battery power is indicated by the illumination of the 'LOW BATT' LED housed within the front panel of the MI12 Machine Interface Unit. This indicates a battery life of less than 60 minutes. A completely dead battery is indicated when the probe status LED within the body of the OMP remains constantly red.

If the probe status indications are satisfactory, an inspection program can be initiated to drive the probe as required; refer to your software or machine tool documentation.

System Operation (OMI Variant)

Note...

If the probe is switched on when mounted in a machine tool with an exceptionally severe vibration characteristic, the probe will instigate an internal monitoring routine to check the level of vibration. If the vibration decays to an acceptable level within 1 second, the probe will switch on at the point of decay. If the level of vibration does not decay within 1 second, the probe will switch on automatically.

Once operational, the OMP transmits its status back to the CNC controller by way of its six transmitting diodes and the OMI. The ‘SIGNAL’ LED within the front panel of the OMI will then indicate the strength of signal, received from the OMP, in the following way:

- By turning red to indicate that the signal is too weak or does not exist.
- By turning yellow to indicate that the signal is marginal and that the OMI is at the edge of its operating envelope.
- By turning green to indicate that the signal is strong.

Probe status is indicated both by:

- The probe status LED within the body of the OMP flashing green.
- The ‘PROBE STATUS’ LED, housed within the front panel of the OMI, turning green to indicate that the probe is seated. If the probe is unseated, this ‘PROBE STATUS LED’ will turn red. The probe status LED within the body of the OMP will also flash red.

Low battery power is indicated by the ‘LOW BAT’ LED housed within the front panel of the OMI. This flashes on and off at four times a second to indicate a battery life of less than 60 minutes. A completely dead battery is indicated when the ‘ERROR’ LED within the front panel of the OMI remains constantly red.

If the probe status indications are satisfactory, an inspection program can be initiated to drive the probe as required; refer to your software or machine tool documentation.

Probe Trigger and Reseat Cycles (Typical)

Note...

Although factory set at 8 milliseconds, the probe output signal delay can also be set to zero, 2 or 16 milliseconds; refer to Chapter 5 - Maintenance and Adjustment. The purpose of the probe output delay is to prevent triggers occurring due to rapid traversing or machine vibration.

During an inspection cycle, when the stylus contacts the workpiece at a force of 2gf (0.02N) or above, the stylus deflects to transmit a strain, through the kinematic location, to the strain gauges. This strain causes a resultant change in gauge resistance that is detected by the ASIC. Once the trigger threshold has been reached, the output signal is delayed for 8 milliseconds before finally being outputted to the CNC controller through the optical transmission system. Refer to Figure 4.3.

As the probe will continue to move, dependent on machine speed and CNC update time, the kinematic location continues to unseat until the CNC controller issues a stop signal and records the probe position. When the probe subsequently reverses clear of the workpiece, the kinematic location will reseat to within 0.1µm of its original position.

The probe will indicate a ‘seated’ condition 1 millisecond after any stylus vibration has decayed to a value below the vibration threshold. Thus, reducing the probe output delay to a value below 8 milliseconds will make the probe increasingly susceptible to triggers resulting from rapid traverse moves or machine vibration.

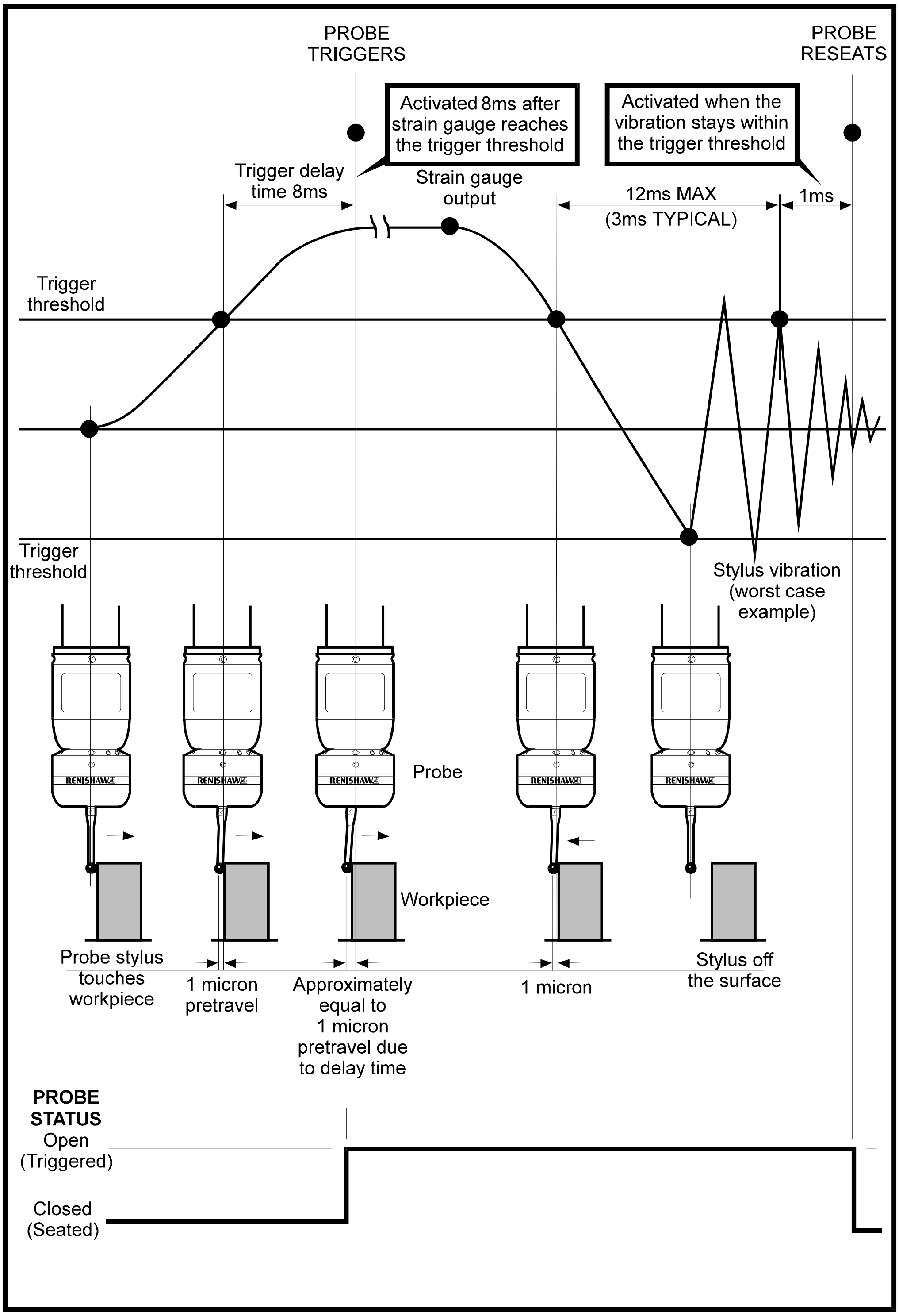


Figure 4.3 - Probe Trigger and Reseat Cycle (Typical)

Probe Orientation

Rotation About An Independent Axis (e.g. Moving Head Machines)

To avoid the probe going OPEN during probe orientation (such as on a 5 axis, moving head machine), do not exceed the rates given below for the stylus in use. The rates given apply at a radius of 141mm, from the probe stylus location face to the axis of rotation (refer to **View A**, Figure 4.4).

Stylus		**Rate (°/Min)**
Length	Material	
50mm (1,96 in.)	Ceramic	3500
100mm (3,93 in.)	Ceramic	2700
100mm (3,93 in.)	Carbon Fibre	3300
150mm (5,89 in.)	Carbon Fibre	1400
200mm (7.87 in.)	Carbon Fibre	740

Note

The above table takes no account of spindle rotation during probe orientation

Rotation About the Probe Axis (Spindle Indexing)

Note

The following recommendations apply only when the probe is horizontal. There are no restrictions on the orientation rate, about the axis, with the probe vertical.

To avoid the probe from going OPEN, when it is horizontal and rotated about its own axis (e.g. spindle indexing on a horizontal axis machine), do not exceed the rates given below for the stylus in use. See **VIEW B**, Figure 4.4.

Stylus		**Max Rate (RPM)**
Length	Material	
50mm (1,96 in.)	Ceramic	14
100mm (3,93 in.)	Ceramic	10
100mm (3,93 in.)	Carbon Fibre	11.5
150mm (5,89 in.)	Carbon Fibre	7
200mm (7.87 in.)	Carbon Fibre	4.5

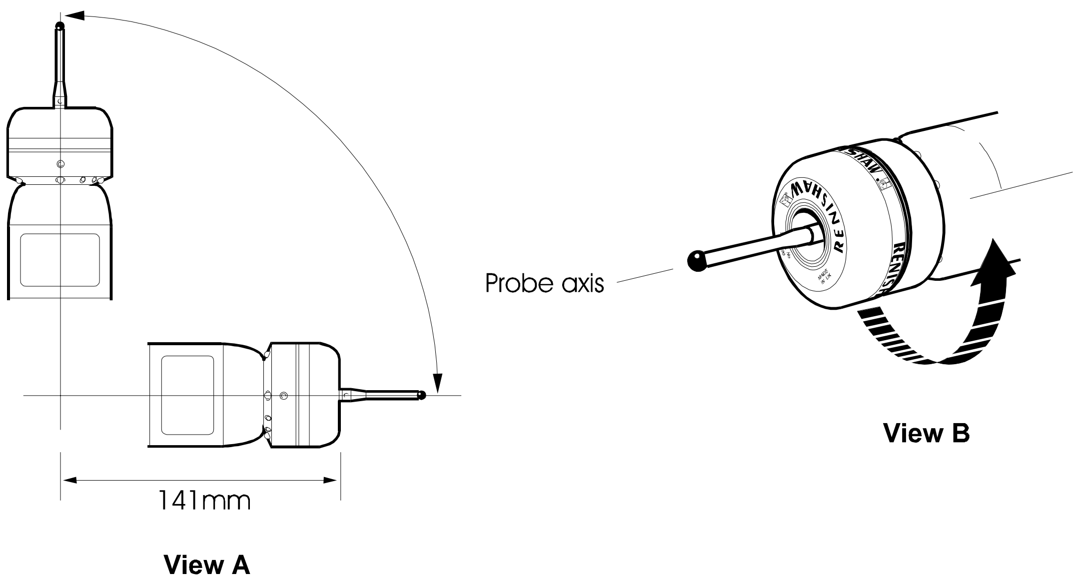


Figure 4.4 - Probe Orientation

Resetting the Probe

> **Note**
>
> **If the MP700 Probe is horizontally indexed or orientated about another axis (above the recommended rate for the stylus used), the probe may show a measurement offset or remain OPEN. If this occurs, the probe must be reset. The method employed to reset your probe will be dependent upon the 'switch-off' method selected; refer to Switching Off the Probe later in this chapter. For operations that will regularly re-orientate the probe, the 'Optical On - Time Out' setting is recommended. In all cases, the probe must be stationary when reset is initiated.**

The MP700 probe creates its own electronic reference during the auto-calibration start up sequence and keeps this updated during operation whilst the kinematic location is seated (PROBE CLOSED). However, the following circumstances may cause this datum to be lost (indicated by the kinematic location deflecting (PROBE OPEN):

- A change in orientation.
- A horizontal index.
- The probe being left 'triggered' against the part for a period greater than 30 seconds.
- A slow, effective measurement speed due to the combined use of a long styli and a shallow angle of approach (known as a 'soft touch').
- Excessive vibration during the auto-calibration start up sequence.

To recover from any of these conditions (probe continuously open), the probe must be reset using the method appropriate to your probe setting. This may be:

Optical On - Time Out: where another M code start signal must be sent (2.1 seconds after the initial M code start signal was sent) to reset the probe. Following reset, the interface will show the probe as open for up to 948ms after the error signal has cleared (see Figure 4.5).

Optical On - Optical Off: where the method used to reset the probe is dependent on the time elapsed from the initial M code start signal and the debounce period. Between 2.1 seconds and 4.2 or 8.4 seconds, a single M code start signal will reset the probe. After 4.2 or 8.4 seconds, the single M code start signal will just switch off the probe and a further M code start signal will be required to switch the probe back on.

Resetting the Probe in Optical On - Time Out Mode

> **Notes...**
>
> **The MP700 probe will not respond to another M code start signal until 2.1 seconds has elapsed following the initial M code start signal.**
>
> **The interface will report a probe status of OPEN for up to 948mS after the interface 'ERROR' signal has cleared (probe CLOSED).**

If the MP700 probe is horizontally indexed or orientated about another axis (at a rate above that quoted for the length and type of stylus used in **Probe Orientation** earlier in this chapter), then the probe will show a measurement offset or a continuously OPEN condition. To recover from this condition (probe continuously OPEN), another M code start signal must be sent to reset the probe.

Figure 4.5 below shows the time constraints and the effect of the second M code start signal.

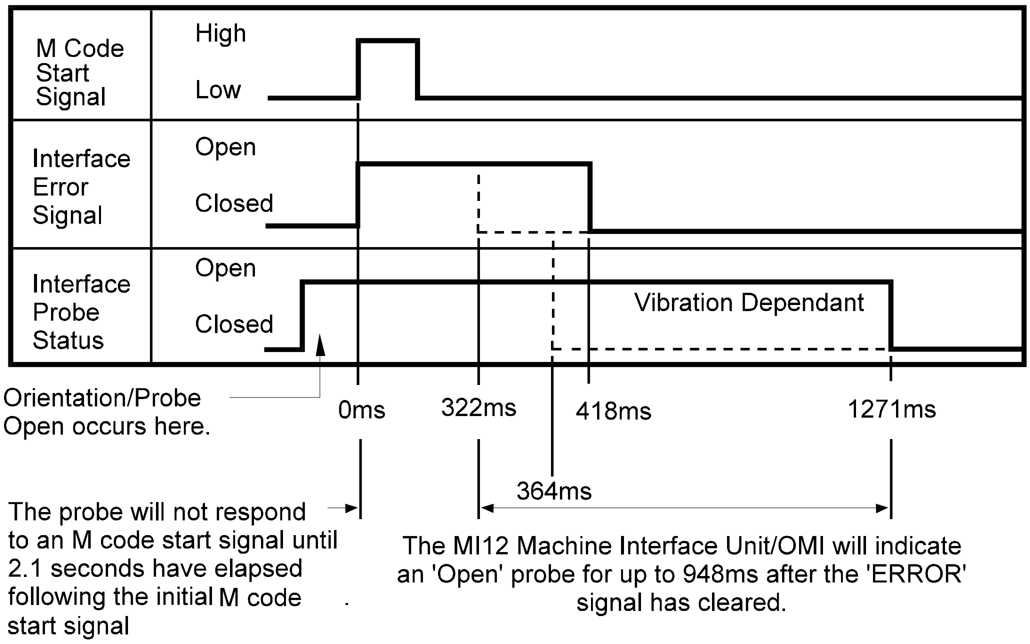


Figure 4.5 - Probe Reset (Optical On - Time Out Selected)

Resetting the Probe in Optical On - Optical Off Mode

Notes...

The MP700 probe will only switch off if the debounce period of 4.2 or 8.4 seconds has elapsed. An M code start signal sent during the debounce period will reset the probe as if it were set in Optical On - Time Out mode.

The duration of the M code start signal must be less than 190mS to ensure the interface sends only one start signal.

The minimum time required for the system to recover in order that it is ready for the next M code start signal is 300mS.

Should the MP700 probe require resetting in the Optical On - Optical Off mode, then the method used is dependant upon the time elapsed from the initial M code start signal as follows:

- Between 2.1 and 4.2 or 8.4 seconds (dependant on the debounce setting of the probe), a single M code start signal will reset the probe. Any reset occurring within this period will conform to the timings stated for Optical On - Timeout mode.

- At any time after the 4.2 or 8.4 seconds has elapsed, a single M code start signal will switch the probe OFF. A second M code start signal will be required to switch the probe ON.

Figure 4.6 shows the timing of these events.

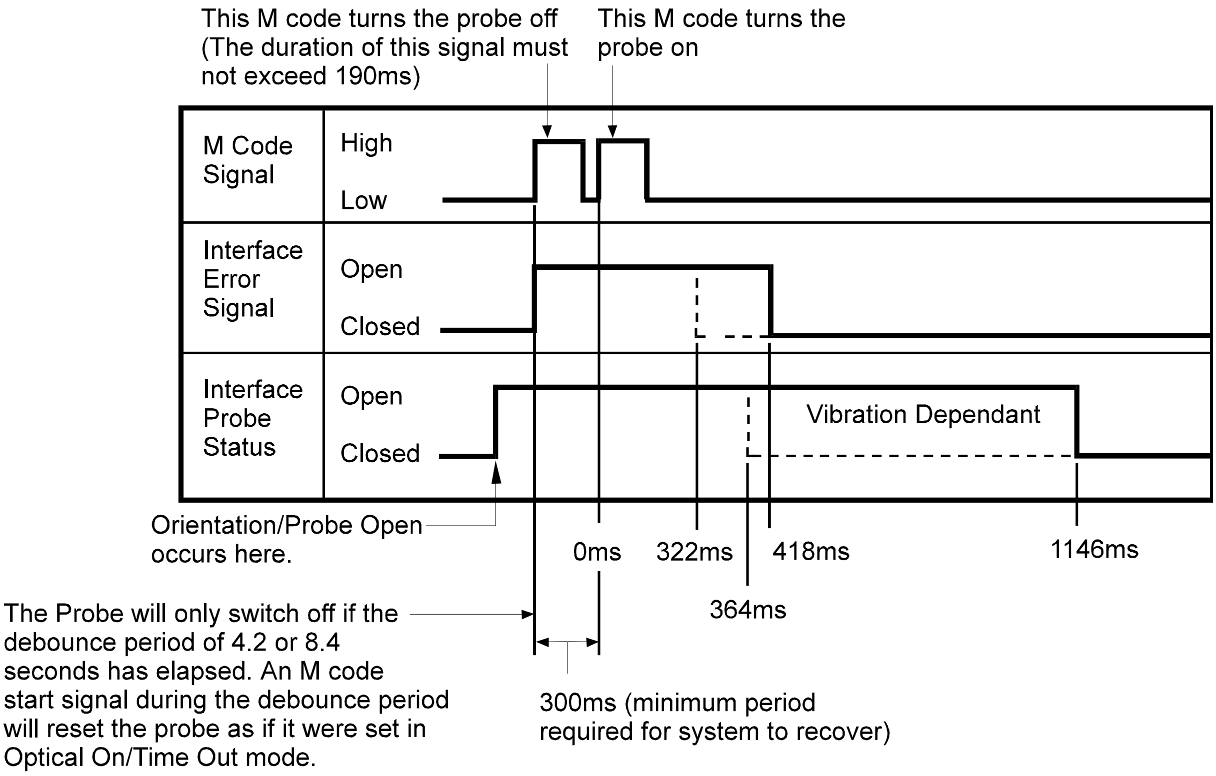


Figure 4.6 - Probe Reset (Optical On - Optical Off Selected)

Switching Off the Probe

Following completion of the inspection program, the probe can be made to switch off by either of the following two options. These options are user selectable and can be selected by adjustment of the switch located within the OMP; refer to **Chapter 5 - Maintenance and Adjustment:**

- **Optical On - Time Out:** where a timer automatically returns the probe to standby mode if the probe is not used for 33 or 134 seconds. These options are user selectable and can be selected by adjustment of the switch located within the OMP; refer to **Chapter 5 - Maintenance and Adjustment**.

- **Optical On - Optical Off:** where a second start signal, generated by a software M code, returns the OMP to the standby mode within a period of 275 milliseconds. Switch off will only occur after the debounce period (4.2 or 8.4 seconds) has elapsed. The probe will remain off until the next switch on command.

Switching Off the Probe in Optical On - Time Out Mode

Notes...

A change in the orientation of the probe during a toolchange, as it is returned to the carousel, will cause a change in status and renew the ‘time out’ period. As a result, the probe will remain on in the tool carousel and significantly reduce the life of the battery. If battery life is critical, switch the probe to Optical On - Optical Off mode in accordance with Chapter 5 - Maintenance and Adjustment.

The probe may be switched back on 300milliseconds after the ‘time-out’ period has elapsed and with the probe switched off.

When set in the ‘Time Out’ mode, the probe will automatically switch itself off after 33 or 134 seconds if:

- No change in its state has occurred.

- An M code start signal has been received during the ‘time out’ period.

The only exception to the above is that, during the first 2.1 seconds following the initial M code start signal, only a change in the state of the probe will renew the ‘time out’ period.

Switching Off the Probe in Optical On - Optical Off Mode

Notes...

In this mode it is not possible to switch the probe OFF until 4.2 or 8.4 seconds have elapsed following the M code start signal.

In either Optical On - Time Out or Optical On - Optical Off mode, the probe can be switched back on 300 milliseconds after being switched off.

When set in the Optical On - Optical Off mode the probe can be switched off by sending an M code start signal, provided this signal is sent outside the debounce period (4.2 or 8.4 seconds from the time the ‘switch on’ signal was sent).

To ensure that the probe turns off correctly, ensure that the duration of the M code start signal does not exceed 190 milliseconds. This will prevent multiple start signals being sent to the probe.

To achieve the maximum possible battery life, always ensure that the probe has switched off correctly before storing it away in the tool carousel. This should be done by ensuring that the interface error signal is present (open) for a minimum of 500 milliseconds.

If required, the probe may be switched on 300 milliseconds after being switched off; refer to **Switching On the Probe** earlier in this chapter

Does and Don'ts

Mounting the Probe

- Ensure that the probe is securely mounted to the shank.
- Ensure that the probe status LED is aligned such that it is visible to the Operator.
- Ensure that the diaphragm protection cover has been removed.
- Ensure sure that on-centre adjustment has been performed.

Switching On the Probe

- Make sure the probe is stationary for a period of one second after the M code start signal is sent.
- Never select the Auto Start setting of the MI12 Machine Interface Unit or Optical Interface Unit.

Switching the Probe Off

- Use of the Optical On/Optical Off mode will greatly extend the life of your probe battery.
- Use of the Optical On/Time Out option is recommended when you wish to regularly re-orientate the probe (i.e. 5 axis) and subsequent resetting may be required.
- Ensure the probe does not remain active in the tool changer when the Optical On/Time Out option has been selected.

Use of Styli

- It is recommended that carbon fibre styli are used whenever you wish to use styli in excess of 100mm; this is particularly important on 5 axis machine tools.

5 Axis Machine Applications

- The probe will require resetting if the rates given in **Probe Orientation** earlier in this chapter are exceeded.

- The probe may be rotated when vertically mounted, without the need to reset.

The Battery

- Whenever the MP700 Probe System indicates that battery power is low, renew the battery as soon as possible.

- In instances where the probe has remained inactive for a long period of time, and the probe fails to switch on, renew the battery as a matter of course.

- Prior to renewing the battery, always ensure that all machining residue and coolant have been removed from the probe.

Probe Calibration

- It is recommended that calibration (datuming) of the MP700 Probe is performed using a calibration sphere.

- Dependent on the system accuracy you require, and the degree of tolerance to which you wish to machine, a single calibration radius may be used.

Programming Techniques

- Ensure that the probing speed is exactly the same as the speed used to calibrate the probe.
- Ensure a minimum speed of 15mm/min. is observed during all inspection cycles.
- Ensure that the probe remains on the component surface for no more than 30 seconds.
- Ensure that all inspection moves occur outside the machine tool's acceleration and deceleration zones.
- A maximum of three triggers per second can be achieved.
- When using existing measurement cycles, ensure that these are updated to account for any system time delays.
- Best accuracy will be achieved by minimising and spindle on-centre errors.

CHAPTER 5

Maintenance and Adjustment

This chapter provides step-by-step instructions to assist you in the setting up, adjustment and subsequent maintenance of your MP700 Probe System.

Contained In This Chapter

Maintenance and Adjustment of the MP700 Machine Spindle Probe

Diaphragm Removal, Inspection, Replacement and Renewal

Although Renishaw probes require little maintenance, the performance of the probe will be adversely affected if its inner working parts become contaminated with dirt, machining residue and/or coolant. It is therefore important that the probe is maintained in a clean condition, free of grease or oil, and that both the inner and outer diaphragms are periodically inspected as follows; refer to Figure 5.1:

Removal and Inspection of the Outer Diaphragm

CAUTION

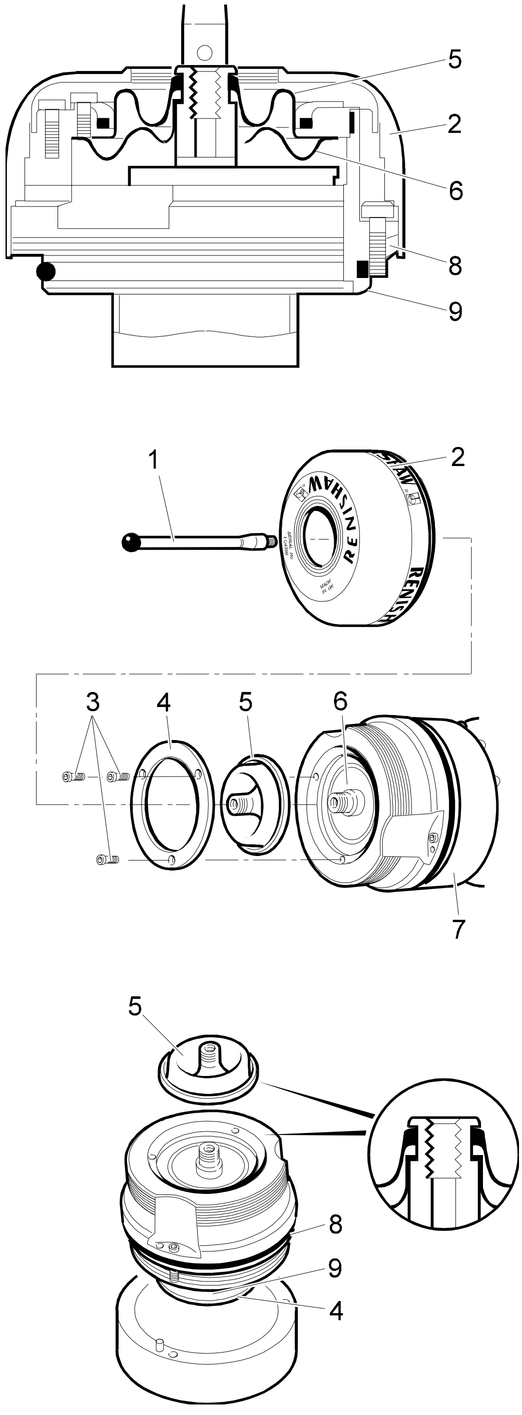
THE PROBE IS A PRECISION INSTRUMENT AND CAN BE EASILY DAMAGED.

To inspect the outer diaphragm [5]:

1. Unscrew the probe stylus [1] from the probe head [7].

2. Unscrew the probe head cover [2] from the probe head.

3. Visually inspect the outer diaphragm [5] for damage using 10x magnification and bright light. If the diaphragm is found to be damaged, renew in accordance with **Renewing the Outer Diaphragm** later in this chapter. This should only be undertaken following satisfactory inspection of the inner diaphragm.



1. Stylus
2. Probe Head Cover
3. Screw (3 off)
4. Outer Ring
5. Outer Diaphragm
6. Inner Diaphragm
7. Probe Head
8. 'O' Ring
9. Probe Rear Seal

Figure 5.1 - Inspection and Renewal of the Inner and Outer Diaphragms

To remove the outer diaphragm [5]:

1. Release and remove the three screws [3] securing the outer ring [4] to the probe head [7]. Remove outer ring from probe head.

2. Gently remove the outer diaphragm. If undamaged, carefully wash away any debris. If damage is evident, discard.

Inspection of Inner Diaphragm

CAUTION

DO NOT ATTEMPT TO RENEW THE INNER DIAPHRAGM. IF DAMAGE HAS OCCURRED, RETURN THE PROBE TO YOUR SUPPLIER FOR REPAIR.

Visibly inspect the inner diaphragm [6] for damage using 10x magnification and bright light. If the diaphragm is found to be damaged, return the probe to your supplier for repair.

Renewal/Replacement of Outer Diaphragm

To renew/replace the outer diaphragm [5]:

1. If required, obtain a probe outer diaphragm replacement kit (Part no. A-2107-1030).

CAUTION

DO NOT USE SHARP OR METALLIC OBJECTS TO FIT THE DIAPHRAGM OTHERWISE DAMAGE WILL OCCUR.

2. Install existing/new outer diaphragm [5] into the probe head [7], referring to Figure 5.1 to ensure the correct orientation. Take care to ensure that the inner lip of the diaphragm is flush with the centre groove and is free of deformation.

3. Assemble the outer ring [4] to the probe head and secure with three screws [3]. Torque-tighten screws to 0.3Nm (0.22 lbf. ft.).

4. Lightly lubricate ‘O’ ring [8] with lubricating oil and assemble the probe head cover [2].

5. Assemble the stylus [1] to the probe head; torque tighten the stylus to 2Nm (1.47 lbf.ft).

Battery Installation/Renewal

To renew the battery: (refer to Figure 5.2)

1. Release the two capscrews [1] securing the battery cover [2] to the optical module probe [3].

2. Remove the battery cover [2] from the optical module probe [3].

3. Disconnect and remove the battery [4].

Note...

The use of Ni-Cad rechargeable batteries is not recommended. Their low capacity will give an unacceptably low life. Also, the battery low and exhausted trip levels will cause the battery to become over discharged.

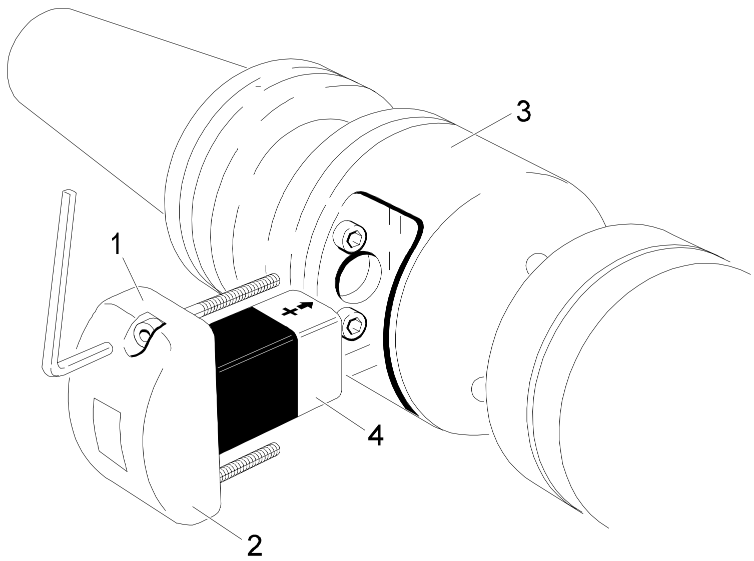
4. Obtain a new battery. The following battery types may be used:

Manufacturer	Model Number
Ever Ready	PP3-P I.E.C 6F22,
Duracell	MN1604 6LR61
Varta	4022

5. Install new battery into the optical module probe ensuring the correct polarity.

6. Ensure the battery cover seal is correctly seated and lightly lubricate with mineral oil.

7. Assemble the battery cover to the optical module probe and secure with two capscrews [1]; torque tighten capscrews to 1.5Nm (1.1lbf.ft).



1. Capscrews (2 off)
2. Battery Cover
3. Optical Module Probe (OMP)
4. Battery

Figure 5.2 - Battery Installation/Renewal

Stylus On-centre Adjustment

CAUTION

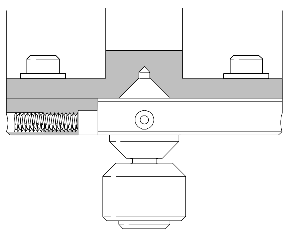
DURING ADJUSTMENT, CARE MUST BE TAKEN NOT TO ROTATE THE PROBE RELATIVE TO THE SHANK. DO NOT HIT OR TAP THE PROBE DURING THE FOLLOWING PROCEDURES.

There are two methods of stylus on-centre adjustment (see Figure 5.3):

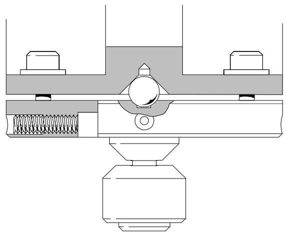
- **Stylus on-centre adjustment using the on-centre adjustment plate:** which allows the probe to slide across the shank end face.
- **Stylus on-centre adjustment using the adjustment plate and optional centre ball:** which allows the probe to pivot on the shank and slide across the shank end face.

Stylus alignment need only be approximate, except in the following circumstances:

- Where alignment must be as exact as possible due to the use of probe vector software.
- Where the probe must be parallel to the spindle axis to prevent the stylus stem contacting the workpiece when gauging deep holes.
- Where the machine's control software is unable to compensate for the offset of the stylus.



Adjustment Plate



Adjustment Plate with Centre Ball

Figure 5.3 - Stylus On-centre Adjustment Methods

Stylus On-centre Adjustment Using the Adjusting Plate

Refer to Figure 5.4.

1. Where necessary, install the probe [1] into the machine tool spindle.

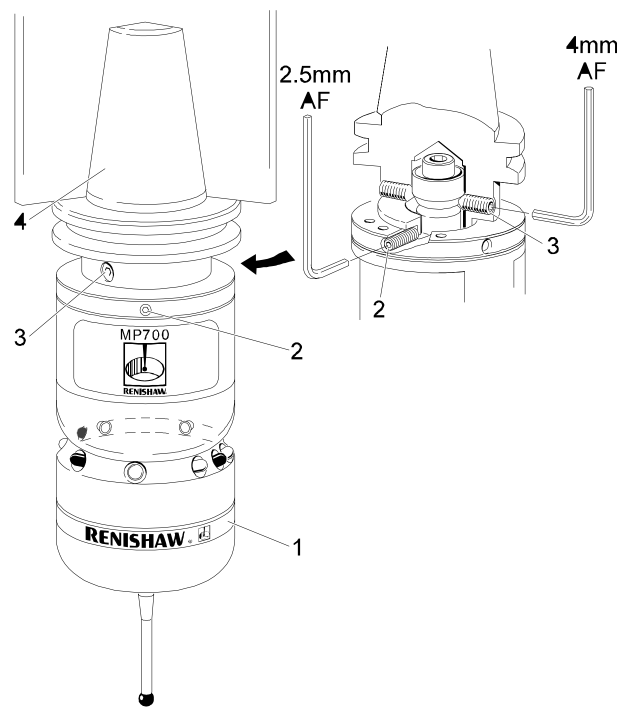
2. Visually centralise the probe [1] relative to the shank [4] and partially tighten cone point grubscrews [3] to 2 - 3Nm (1.47 - 2.2 lbf.ft.).

3. Gradually and systematically tighten the four flat point grubscrews [2], backing off after each movement, until the stylus run out is less than 20µm.

4. Fully tighten cone point grubscrews [3] to 6 - 8Nm (4.4 - 5.9lbf. ft).

5. Continue adjustment using the four flat point grubscrews [2]. This is achieved by using each in opposition to the other in order to move the probe (first slackening one then tightening the other). Using two 2.5mm Allen keys (if required), progressively tighten the four grubscrews as the final setting is approached.

6. When the final setting is achieved (5µm (0.0002 in.) total stylus run out or better), ensure that the four flat point grubscrews [2] are fully tightened to 1.5 - 3.5Nm (1.1 - 2.6lbf. ft).



1. MP700 Probe
2. Flat Point Grubscrew (4 Off)
3. Cone Point Grubscrew (2 Off)
4. Shank

Figure 5.4 - Stylus On-centre Adjustment (Adjustment Plate Method)

Stylus On-centre Adjustment Using The Centre Ball

> **Note...**
>
> **For applications where the stylus stem has to be parallel with the spindle centre line, this 'centre ball' method must be used.**

Refer to Figure 5.5

1. Where necessary, release the two capscrews [1]. Remove the battery cover [2]. Disconnect and remove the battery [4]. Release and remove retaining screw [5]. Remove cover [6].

2. Visually centralise the probe relative to the shank [11]; partially tighten cone point grubscrews [12] to 2 - 3Nm (1.47 - 2.2 lbf.ft.).

3. Where necessary, install the probe into the machine tool spindle.

4. Visually check the alignment of the stylus, if adjustment is required, realign stylus by capscrews [9].

5. Tighten capscrews [9] to as near 5.1Nm (3.76 lbf. ft) as possible without loosing the alignment.

6. Gradually and systematically tighten the four flat point grubscrews [10], backing off after each movement, until the stylus run out is less than 20µm.

7. Fully tighten cone point grubscrews [12] to 6 - 8Nm (4.4 - 5.9lbf. ft).

8. Continue adjustment using the four flat point grubscrews [12]. This is achieved by using each in opposition to the other in order to move the probe (first slackening one then tightening the other). Using two 2.5mm Allen keys (if required), progressively tighten the four grubscrews as the final setting is approached.

9. When the final setting is achieved (5µm (0.0002 in.) total stylus run out or better), ensure that the four flat point grubscrews [2] are fully tightened to 1.5 - 3.5Nm (1.1 - 2.6lbf. ft).

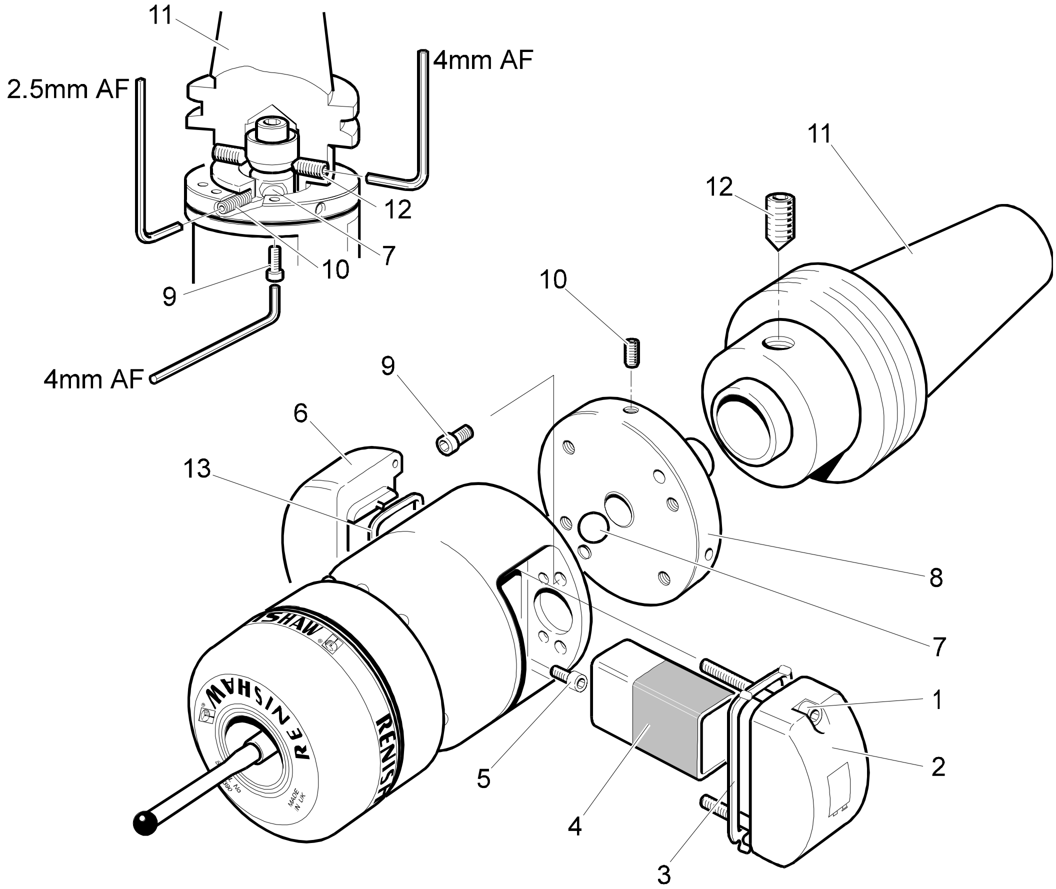
10. Ensure cover seal [13] is correctly seated and lightly lubricate with mineral oil or grease.

11. Reassemble cover [6] and secure with retaining screw [5]. Torque-tighten the retaining screw to 1.1 (0.8 lbf.ft).

12. Reinstall battery [4] ensuring correct polarity.

13. Ensure battery cover seal [3] is correctly seated and lightly lubricate with mineral oil or grease.

14. Assemble battery cover [2] and secure with the two capscrews [1]; torque tighten the capscrews to 1,1Nm (0.8 lbf.ft).



1. Capscrew (2 Off)	8. Adjustment Plate
2. Battery Cover	9. Capscrew (4 Off)
3. Battery Cover Seal	10. Flat Point Grubscrew (4 Off)
4. Battery	11. Shank
5. Retaining Screw	12. Cone Point Grubscrew (2 Off)
6. Cover	13. Cover Seal
7. Centre Ball	

Figure 5.5 - Stylus On-centre Adjustment (Centre Ball Method)

Probe Head Removal and Switch Settings

CAUTION

ONLY FULLY QUALIFIED TECHNICIANS SHOULD RESET THE PROBE HEAD AND OPTICAL MODULE PROBE SWITCH SETTINGS.

Note...

The probe head must only be removed to gain access to the probe head and optical module probe switches.

Removing the Probe Head

Refer to Figure 5.6.

1. Unscrew probe head cover [1] counterclockwise and remove from probe head [2].

2. Release and remove the three retaining capscrews [3], together with the three star washers [4].

CAUTION

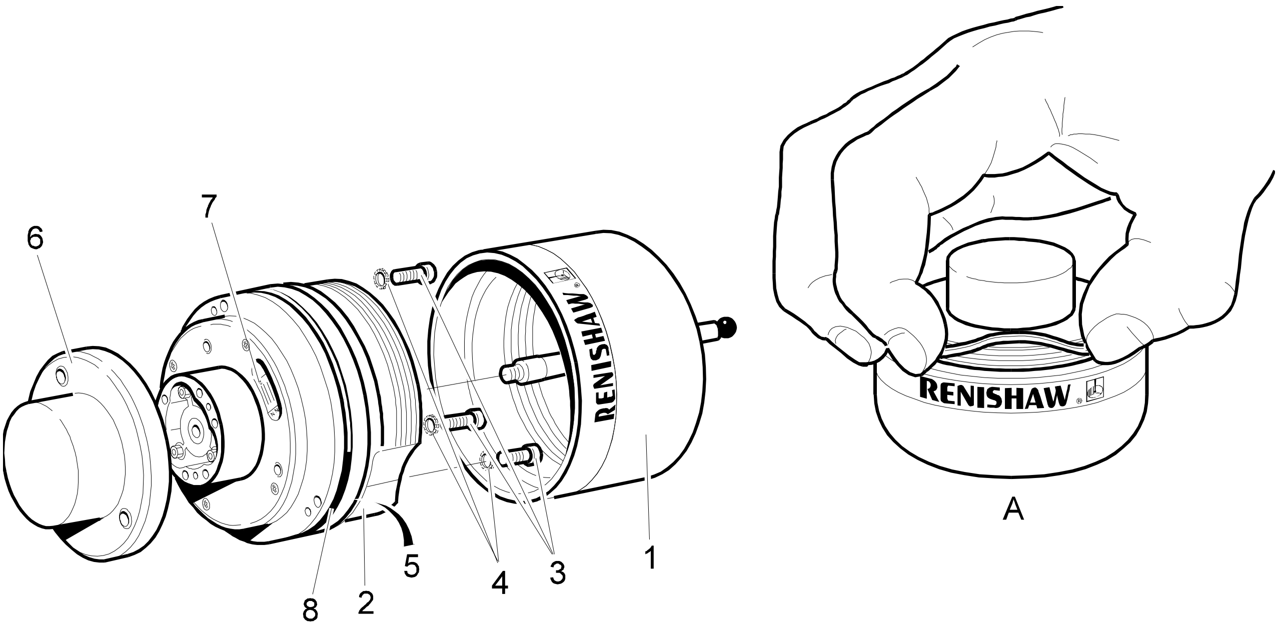
DO NOT TWIST THE PROBE HEAD FROM THE OPTICAL MODULE PROBE OTHERWISE DAMAGE CAN RESULT.

3. Gradually tighten the two grubscrews [5] to jack the probe head from the optical module probe.

Accessing the Probe Head Switch

Refer to Figure 5.6

To gain access to the probe head switch [7], peel back the probe rear seal [6] by squeezing it as shown in **View A**.



1. Probe Head Cover
2. Probe Head
3. Retaining Screw (3 Off)
4. Star Washer (3 Off)
5. Grubscrew (2 Off)
6. Probe Rear Seal
7. Probe Head Switch
8. ‘O’ Ring

Figure 5.6 - Probe Head Removal and Assembly

Adjusting the Probe Head Switch

CAUTIONS...

DO NOT TOUCH ELECTRICAL COMPONENTS WHEN ADJUSTING SWITCH SETTINGS.

KEEP ALL COMPONENTS CLEAN. DO NOT ALLOW THEM TO BECOME CONTAMINATED WITH MACHINING RESIDUE OR COOLANT.

NEVER USE THE TIP OF A PENCIL TO ADJUST THE SWITCH.

UNDER NO CIRCUMSTANCES MUST THE PROBE REAR SEAL (ITEM 7, FIGURE 5.6) BE REMOVED.

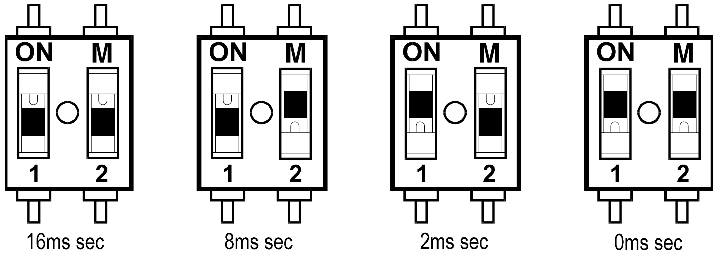
Note...

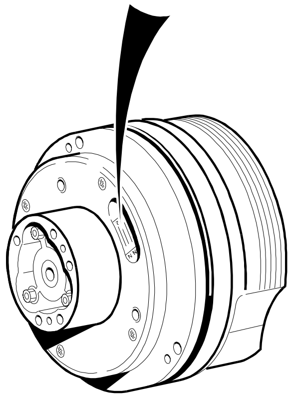
The probe head switch controls the time delay required by the probe to provide immunity against the effects of vibration and shock and is normally set at 8 milliseconds. Reducing the time delay below 8 milliseconds will make the probe far more susceptible to unexpected triggers caused by rapid traversing or orientation.

The probe head switch can be adjusted to set the time delay to:

- 0 milliseconds.
- 2 milliseconds.
- 8 milliseconds.
- 16 milliseconds.

To select the time delay setting you require, move the switch to the positions shown in Figure 5.7.





Probe Rear Seal and Protection Cap removed for clarity

Figure 5.7 - Probe Switch Settings

Adjusting the Optical Module Probe Switch

CAUTIONS

DO NOT TOUCH ELECTRICAL COMPONENTS WHEN ADJUSTING SWITCH SETTINGS.

KEEP ALL COMPONENTS CLEAN. DO NOT ALLOW THEM TO BECOME CONTAMINATED WITH MACHINING RESIDUE OR COOLANT.

NEVER USE THE TIP OF A PENCIL TO ADJUST THE SWITCH.

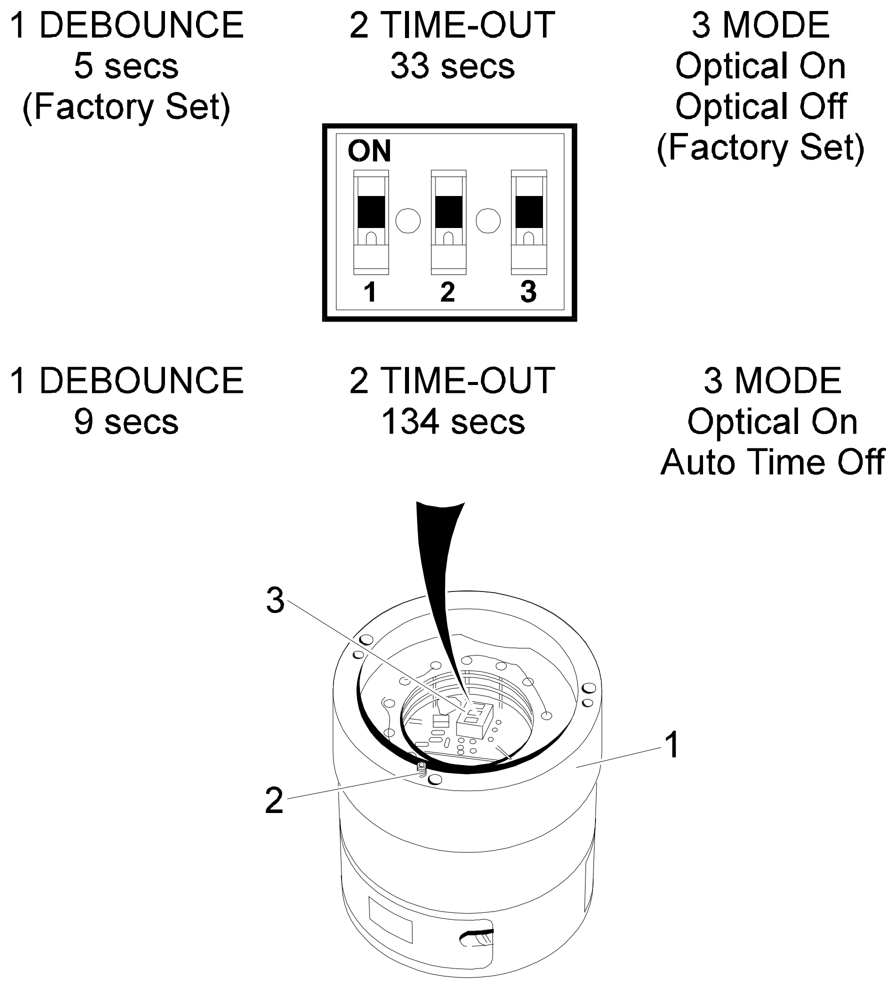
The switch can be used to adjust the following settings; refer to Figure 5.8:

- The **‘DEBOUNCE’** time: which controls the minimum time that must elapse after sending a start signal, before the optical module probe is ready to act upon another start signal. This can be set to 5 or 9 seconds. <u>This setting is factory set to 5 seconds</u>.

- The **‘TIME OUT’** period: which controls the period of time that the optical module probe will remain operational before switching to the standby mode when in the Optical on - Time out mode. This can be set to 33 ± 2 seconds or 134 ± 2 seconds. <u>This setting is factory set to 134 ± 2 seconds</u>.

- The ‘**MODE’** in which the probe operates. This can either be Optical On - Optical Off or Optical On - Time Out. <u>This setting is factory set to Optical On - Optical Off</u>.

To select the ‘DEBOUNCE’, ‘TIME OUT’ and/or ‘MODE’ setting(s) you require, move switches 1,2 and/or 3 to the position(s) shown in Figure 5.8



1. Optical Module Probe
2. Dowel
3. Optical Module Probe Switch

Figure 5.8 - Optical Module Probe Switch Settings

Replacing the Probe Head

Refer to Figure 5.6.

1. Fully release the two grubscrews [5] to facilitate assembly of the optical module probe to the probe head [2].

2. Visually inspect the probe rear seal [7] and ‘O’ ring [9] for damage and deformation. If damage is found, return the probe to your supplier for repair.

CAUTION

DO NOT TWIST THE PROBE HEAD OTHERWISE DAMAGE CAN RESULT.

3. Align dowel (see item 2, Figure 5.8), located within the face of the optical module probe, with the clearance hole within the probe head. Gently push the optical module probe and probe head together.

4. Secure the probe head to the optical module probe with the three retaining screws [item 3, Figure 5.6] and three star washers [4]. Torque tighten the three retaining screws to 1.1Nm (0.8 lbf. ft).

5. Hand tighten the two grubscrews [5]; sufficient force should be applied to ensure that they will not ‘back off’ when subjected to machine vibration.

6. Reassemble the probe head cover [1] (the cover is fully home when it abuts the stop).

Maintenance and Adjustment of the Optical Machine Module

OMM Range Selection

The OMM reception (Rx) and transmission (Tx) ranges (see Figure 5.11) are set by the range selection switch shown in Figure 5.10. To gain access to the range selection switch, it is necessary to remove the window and label from the OMM body.

Removal of the Window and Label from the OMM

CAUTION

DO NOT ALLOW LIQUIDS OR SOLID PARTICLES TO ENTER THE OMM BODY. NEVER REMOVE THE WINDOW [3] BY TWISTING OR ROTATING BY HAND, ALWAYS USE THE JACKING SCREWS [2].

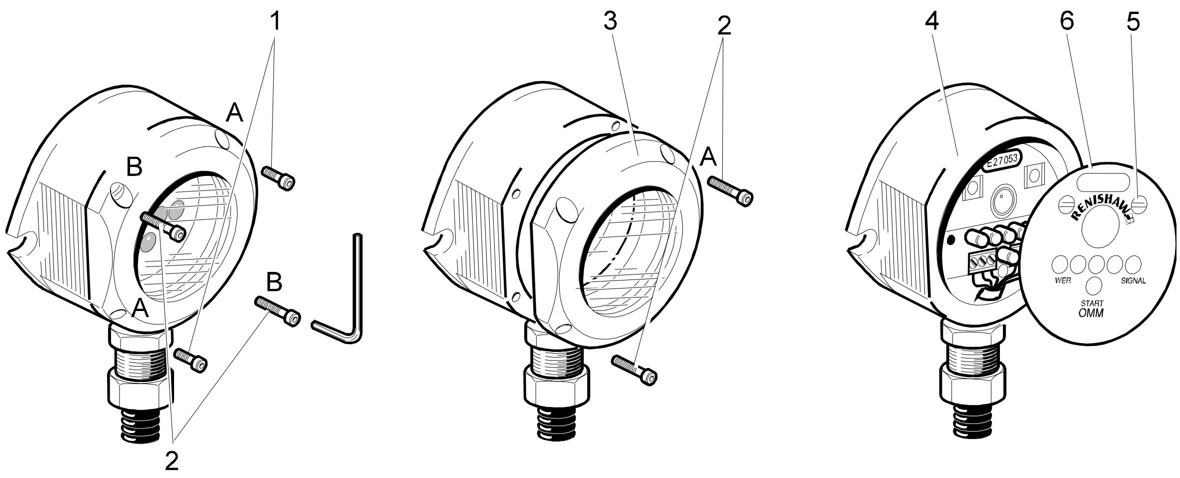
Note...

The window [3] must only be removed for the following reasons:

- **To gain access to the range selection switch when changing the reception/transmission range settings.**
- **To replace a broken window, defective PCB or OMM cable.**

Refer to Figure 5.9:

1. Using a 2.5mm AF hexagon Allen Key, remove the two short screws [1] and the two long screws [2] securing the window [3] to the OMM body [4].
2. Insert the two long screws [2] into the two threaded holes **A**.
3. Alternately tighten the long screws [2] to evenly jack the window [3] from the OMM body [4]. Gently remove the window from the OMM body.
4. Release the label [6] from the OMM body by turning the two quick release screws [5] a 1/4 turn counterclockwise. Carefully lift the label from the OMM body to gain access to the range selection switch (see Figure 5.10).



1. Screw (short) (2 Off)
2. Screw (long) (2 Off)
3. Window
4. OMM Body
5. Retaining Screw
6. Label

Figure 5.9 - Removal of the OMM Window and Label

Adjustment of the Range Selection Switch

Note...

The OMM Rx and Tx ranges should only be adjusted by suitably qualified personnel, and only when the OMM is known to be affected by optical or electro-magnetic interference. Adjustment should only prove necessary in extreme cases.

Adjust the range selection switch (Figure 5.10) to the setting shown below to increase or decrease the Reception (Rx) and Transmission (Tx) ranges to the percentage you require (refer to Figure 5.11).

Reception Range			Transmission Range	
	1	**2**		**3**
100%	Off	On	100%	On
50%	On	Off	50%	Off
25%	Off	On	50%	Off

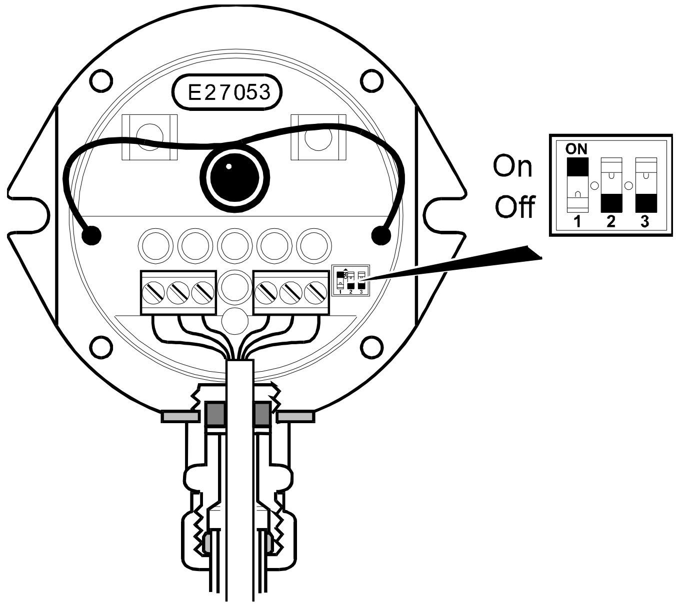


Figure 5.10 - The OMM Range Selection Switch

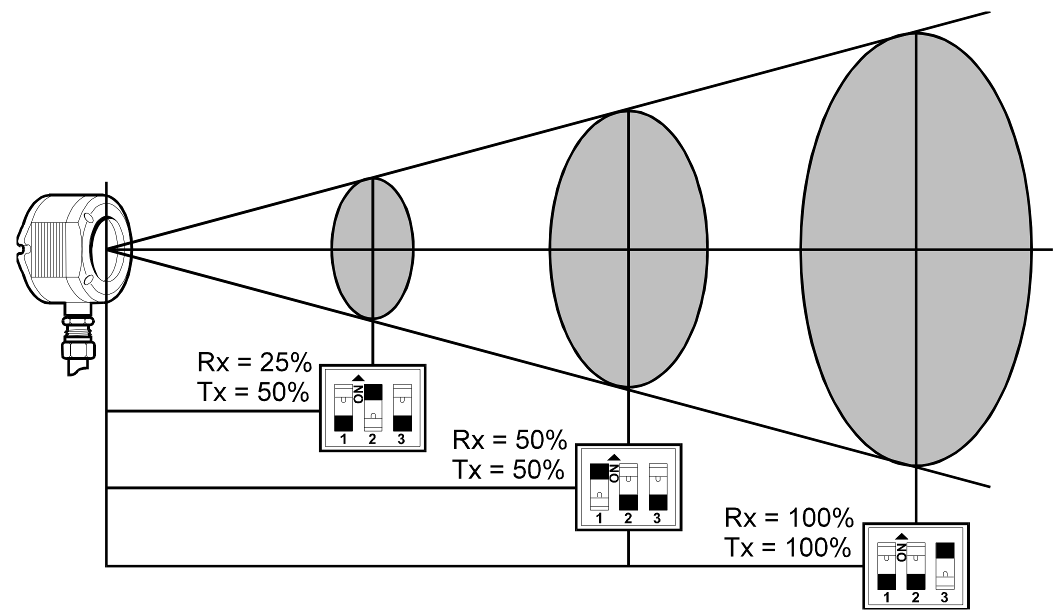


Figure 5.11 - OMM Reception and Transmission Ranges

Replacement of the OMM Label and Window

Refer to Figure 5.12:

1. Refer to **View A** and assemble the label [1] and secure with the two quick release screws [2]. Rotate screws a quarter turn clockwise to hold label in place.

2. Visually examine the OMM body [3] for damage or scratching to the ‘O’ ring location groove as shown in **View A**.

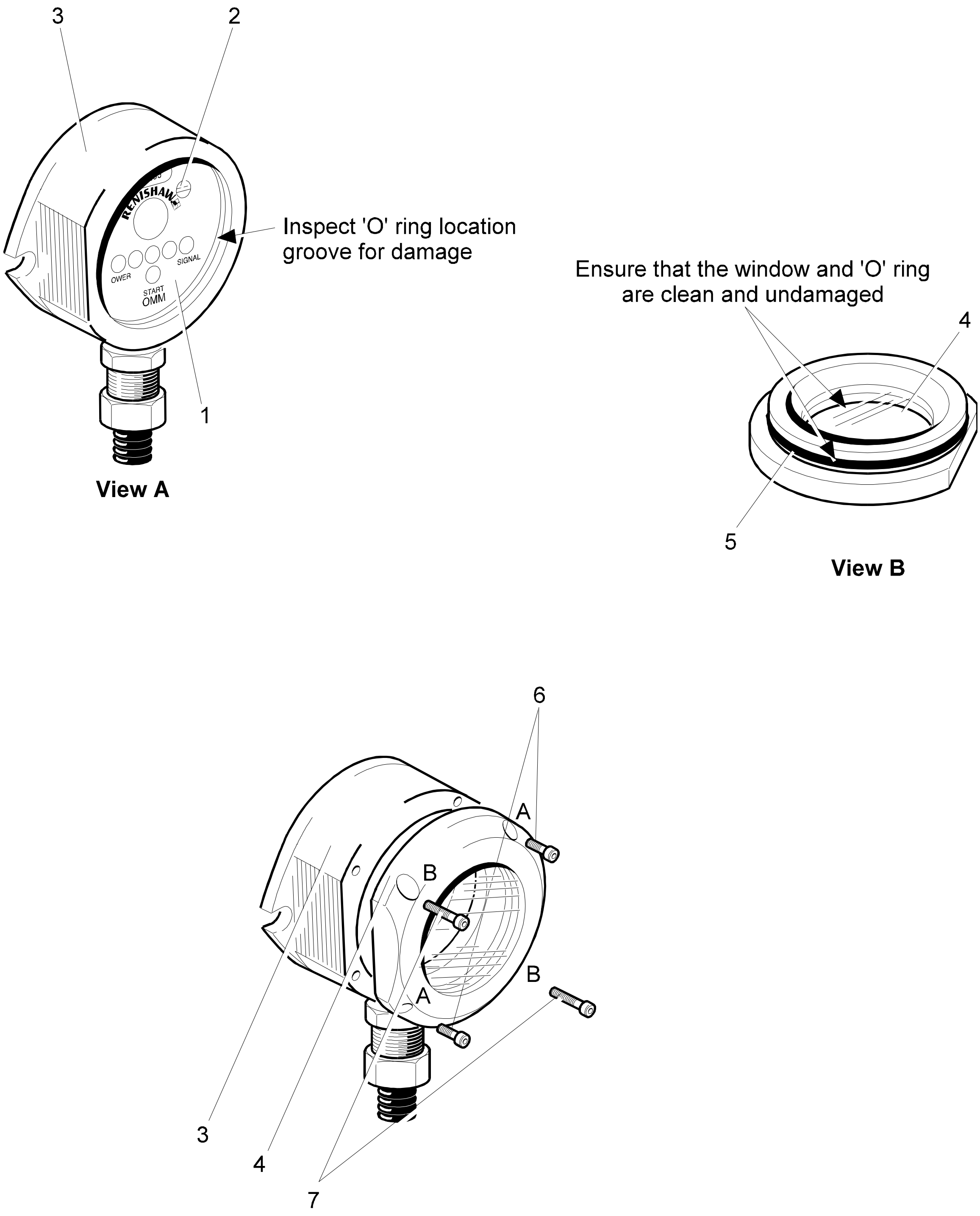
3. Visually examine the window [4] and ‘O’ ring [5] for cleanliness as shown in **View B**. Also ensure that both the window and ‘O’ ring are undamaged.

4. Refer to **View C** and insert the two short screws [6] into the two threaded holes **A** in the window [4]. Tighten the two screws to 0.3 - 0.7Nm (0.22 - 0.51 lbf. ft).

5. Lightly smear the ‘O’ ring [5] with silicone grease and assemble window [4] to OMM body [3].

6. Insert the two long screws [7] into the two plain holes **B**. Tighten each screw a few turns at a time to gradually pull the window [4] evenly against the OMM body [3]. There may be some resistance due to the compression of air trapped inside the OMM body.

7. Alternatively tighten screws [7] to pull window [4] evenly into the body of the OMM. Finally tighten screws to 1.0 - 1.8Nm (0.74 - 1.32 lbf.ft).



1. Label
2. Retaining Screw (2 Off)
3. OMM Body
4. Window
5. ‘O’ Ring
6. Screw (short) (2 Off)
7. Screw (long) (2 Off)

Figure 5.12 - Assembly of the OMM Window and Label

Replacing a Faulty OMM Printed Circuit Board

To replace a faulty printed circuit board (PCB) carry out the following, refer to Figure 5.13:

1. Remove the window and label from the OMM; refer to **Removal of the Window and Label from the OMM** earlier in this chapter.

2. Disconnect the wires from the terminal block.

3. Pull gently on the PCB's wire handle to remove the PCB from the OMM.

4. Visually inspect the PCB supports for damage; if damage is evident, return your OMM to Renishaw for repair.

5. Obtain a replacement PCB (Part No. A-2031-0043).

6. Assemble the new PCB to the OMM.

7. Reconnect the wires to the terminal block as shown in Figure 5.13. Torque-tighten each terminal block screw to between 0.25 and 0.4Nm (0.18 and 0.29 lbf. in.).

8. Reassemble the label and window to the OMM; refer to **Replacement of the OMM Label and Window** earlier in this chapter.

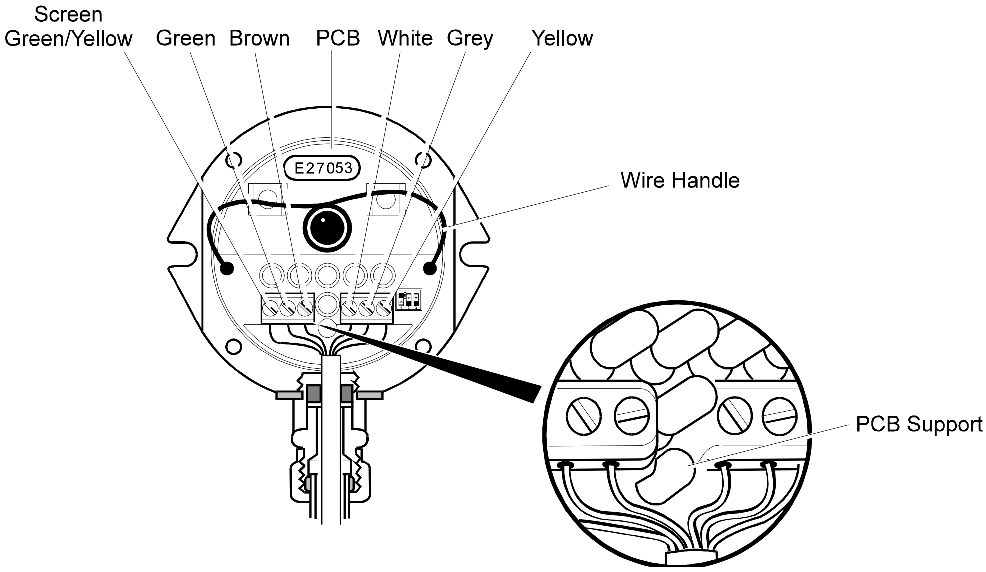


Figure 5.13 - Replacing the OMM Printed Circuit Board

Maintenance and Adjustment of the Optical Machine Interface

OMI Range Selection and Output Configuration

The OMI reception (Rx) and transmission (Tx) ranges (see Figure 5.17) are set by the range selection switch (SW1). The output configuration of the OMI is set by the output configuration switch (SW2). Both switches are shown in Figure 5.15. To gain access to the range selection and output configuration switches, it is first necessary to remove the window and label from the OMI body.

Removal of the Window and Label from the OMI

CAUTION

DO NOT ALLOW LIQUIDS OR SOLID PARTICLES TO ENTER THE OMI BODY. NEVER REMOVE THE WINDOW [3] BY TWISTING OR ROTATING BY HAND, ALWAYS USE THE JACKING SCREWS [2].

Note...

The window [3] must only be removed for the following reasons:

- **To change fuses.**
- **To change the reception/transmission range settings and output options.**
- **To replace a broken window.**

A bag of spare fuses is located behind the label. Take care to ensure that it does not fall out.

Refer to Figure 5.14:

1. Using a 2.5mm AF hexagon Allen Key, remove the two short screws [1] and the two long screws [2] securing the window [3] to the OMI body [4].

2. Insert the two long screws [2] into the two threaded holes **A**.

3. Alternately tighten the long screws [2] to evenly jack the window [3] from the OMI body [4]. Gently remove the window from the OMI body.

4. Release the label [6] from the OMI body by turning the two quick release screws [5] a 1/4 turn counterclockwise. Carefully lift the label from the OMI body to gain access to the OMI switches and terminal block (see Figure 5.15).

Switch Settings

The Optical Machine Interface Unit incorporates the following switches (see Figure 5.15); it is important that, where necessary, each of these switches are set to suit your specific application:

Switch SW1

CAUTION

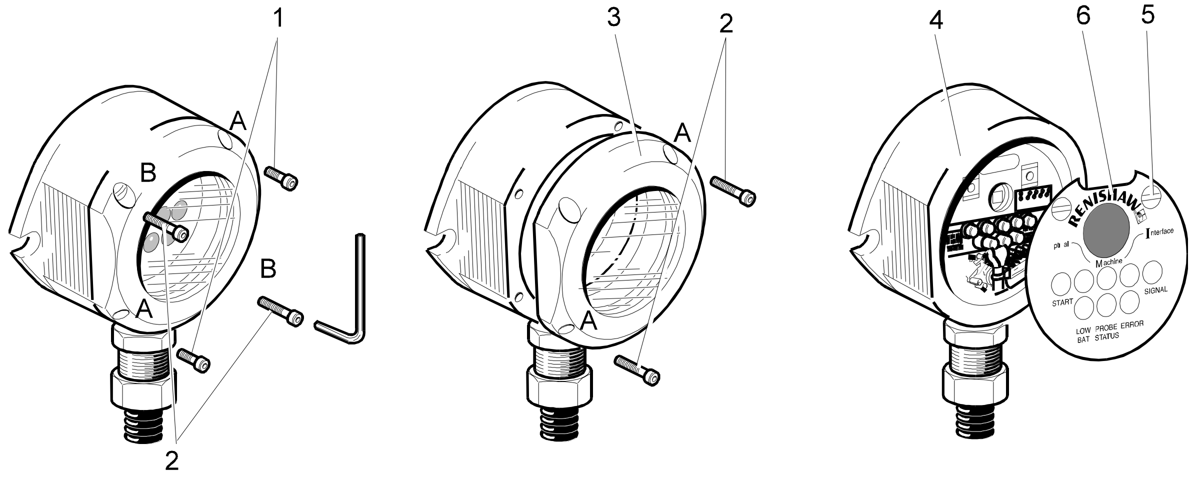
ALTHOUGH SWITCH SW1 ACTS PRIMARILY AS A RANGE SELECTOR, IT ALSO ALLOWS YOU TO SELECT THE WAY IN WHICH THE PROBE IS SWITCHED ON. THE MP700 PROBE MUST ONLY EVER BE SWITCHED ON USING A 'MACHINE START' SIGNAL. THE 'AUTO START' SETTING MUST NEVER BE USED.

Switch SW1 is supplied factory set as shown in Figure 5.15, i.e. to 'MACHINE START' with both the reception (Rx) and transmission (Tx) ranges set to 100%. This switch may be used to adjust the optical range setting for signal transmission and reception; refer to **Adjustment of the Range Selector Switch (SW1)** later in this chapter.

In order that a 'MACHINE START' signal can be initiated, an input of between 4,25V at 1mA and 30V at 10mA is required between the START wires (WHITE +ve and BROWN -ve). This is TTL compatible when connected between +5V and TTL output and is an isolated input. The minimum pulse width is 1ms.

Switch SW2

This switch enables Normally High and Normally Low options to be selected for PROBE STATUS, SKIP, LOW BAT and ERROR to produce the output waveforms shown in Figure 5.16). The switch is factory set to the settings shown in Figure 5.15.

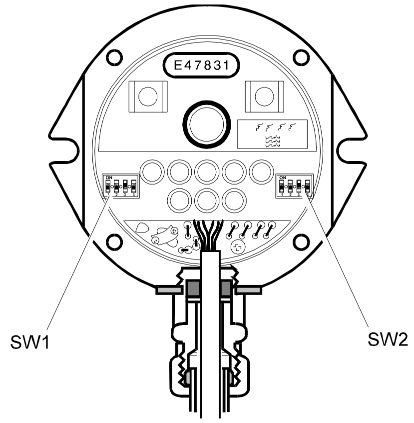


1. Screw (short) (2 Off)
2. Screw (long) (2 Off)
3. Window
4. OMI Body
5. Retaining Screw
6. Label

Figure 5.14 - Removal of the OMI Window and Label

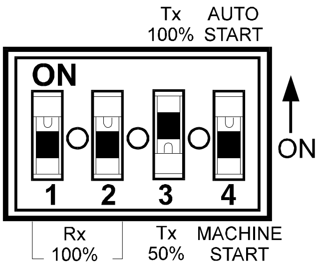
O-M-I SWITCH SW1
Output Configuration
Factory setting shown

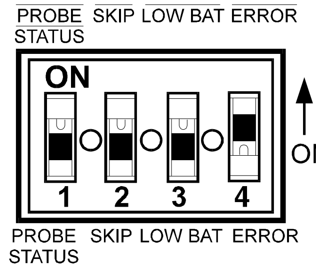
Machine Start
Rx (Reception) = 100%
Tx (Transmission) = 100%



O-M-I SWITCH SW2
Output Configuration
Factory setting shown

Probe Status	(Normally High)
Low Battery	(Normally Low)
Error	(Normally High)
Skip	(Normally Low)





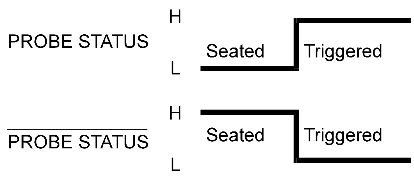


Figure 5.15 - Range Selection Switch (SW1) and Configuration Switch (SW2)

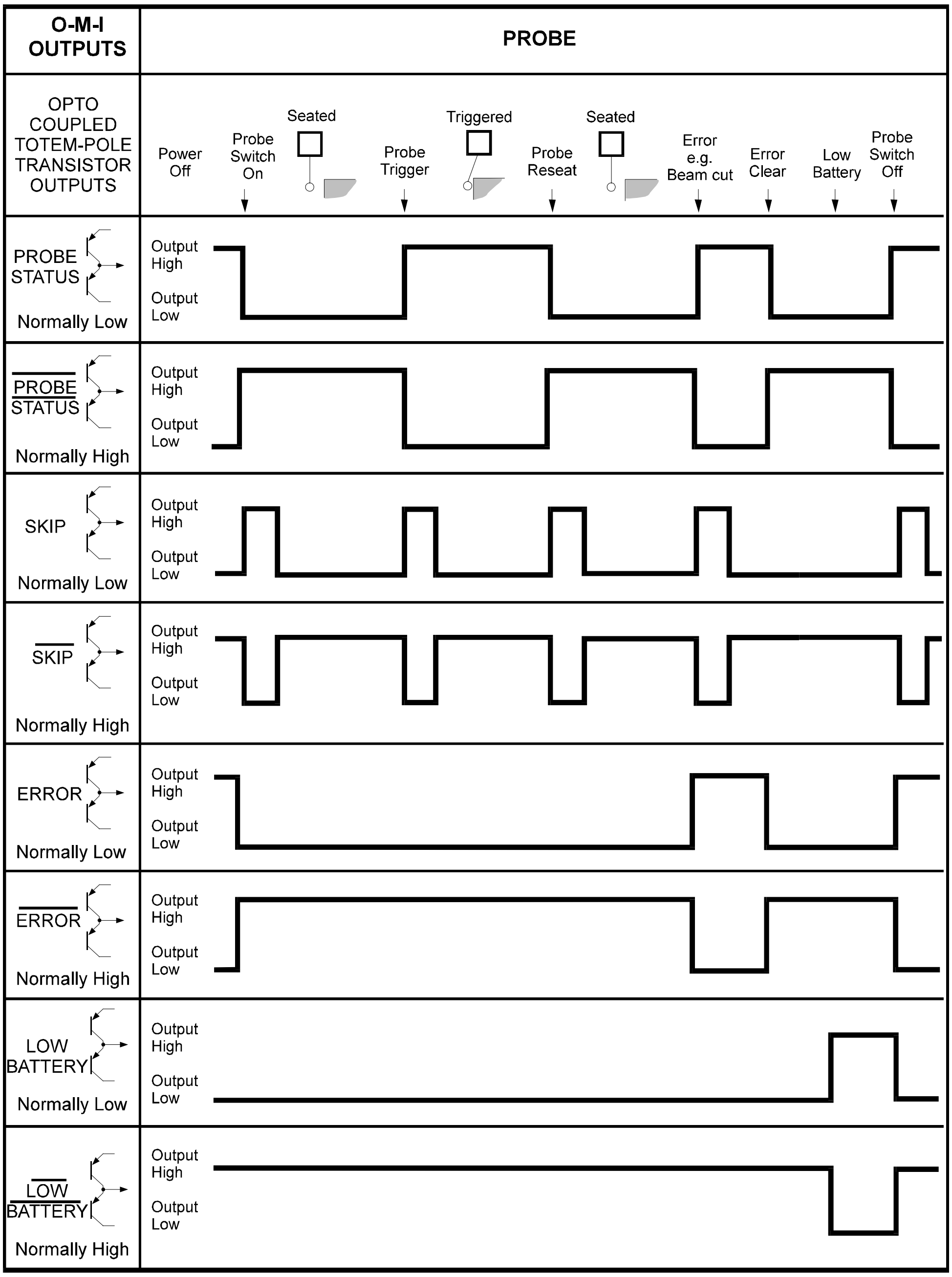
Optical Machine Interface - Output Signals and Waveforms

The output signals and waveforms of the Optical Machine Interface are shown in Figure 5.16 and can be adjusted by altering the settings of switch SW2. When adjusting switch SW2, it is important to ensure that the output signals from the OMI are compatible with the machine control input.

Signal Delays

Transmission Delay (probe trigger to output change of state) = 144µS

Start Delay (initiation of start signal to valid signal transmission) = 410 ms



SIGNAL DELAYS

1. **Transmission Delay** Probe Trigger to output change of state = 144μs ±5%
2. **Start Delay** Time from initiation of Start Signal to valid signal transmission = 410ms.

Figure 5.16 - Optical Machine Interface Unit Output Waveforms

Adjustment of the OMI Range Selection Switch (SW1)

WARNING

IF TWO SYSTEMS ARE OPERATING IN CLOSE PROXIMITY TO EACH OTHER, TAKE CARE TO ENSURE THAT SIGNALS TRANSMITTED BY ONE SYSTEM ARE NOT RECEIVED BY THE OTHER AND VICE VERSA.

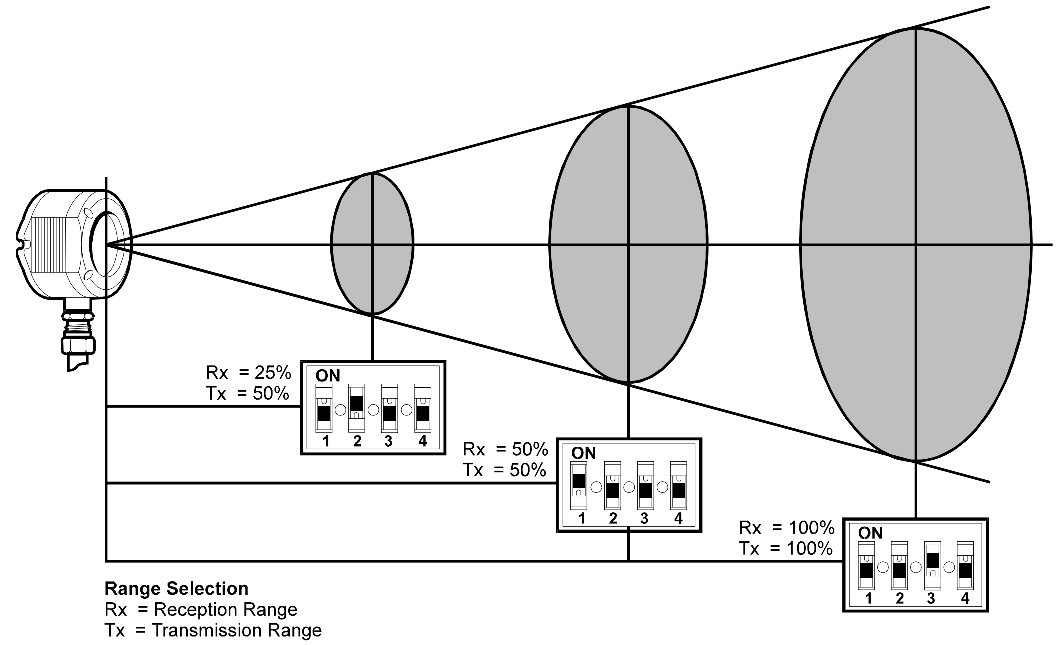
CAUTION

NATURAL REFLECTIVE SURFACES WITHIN THE MACHINE MAY INCREASE THE SIGNAL TRANSMISSION RANGE. ALSO, COOLANT RESIDUE, IF ALLOWED TO ACCUMULATE ON THE WINDOW OF THE OMI, WILL HAVE A DETRIMENTAL EFFECT ON THE OMI's PERFORMANCE. IT IS THEREFORE IMPORTANT TO KEEP THE WINDOW CLEAN AT ALL TIMES. AMBIENT TEMPERATURES BELOW 5C (41F) OR ABOVE 60C (140F) WILL REDUCE THE RANGE OF THE OMI.

Note

The OMI Rx and Tx ranges must only be adjusted by suitably qualified personnel, and only when the OMI is known to be affected by optical or electro-magnetic interference. Adjustment should only prove necessary in extreme cases.

The effective range of the OMI can be adjusted by use of the range selector switch SW1. If problems are experienced with either electrical or optical noise (and the unit is installed at less than half the specified maximum range of the probe), then the range selection switch can be adjusted to reduce the effective range. This in turn will reduce the unit's susceptibility to noise. Adjust the range selection switch to the setting shown in Figure 5.17.



Reception Range			Transmission Range		Auto Start
100%	Off	Off	100%	On	↕
50%	On	Off	50%	Off	
25%	Off	On	50%	Off	Machine Start
	1	2	3	4	

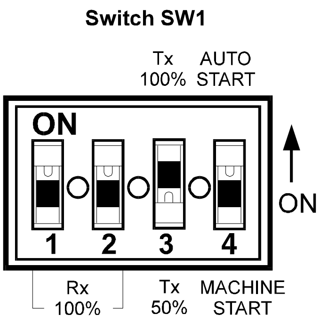


Figure 5.17 - OMI Reception and Transmission Ranges

Replacement of the OMI Label and Window

Refer to Figure 5.18:

1. Refer to **View A** and assemble the label [1] and secure with the two quick release screws [2]. Rotate screws a quarter turn clockwise to hold label in place.

2. Visually examine the OMI body [3] for damage or scratching to the 'O' ring location groove as shown in **View A**.

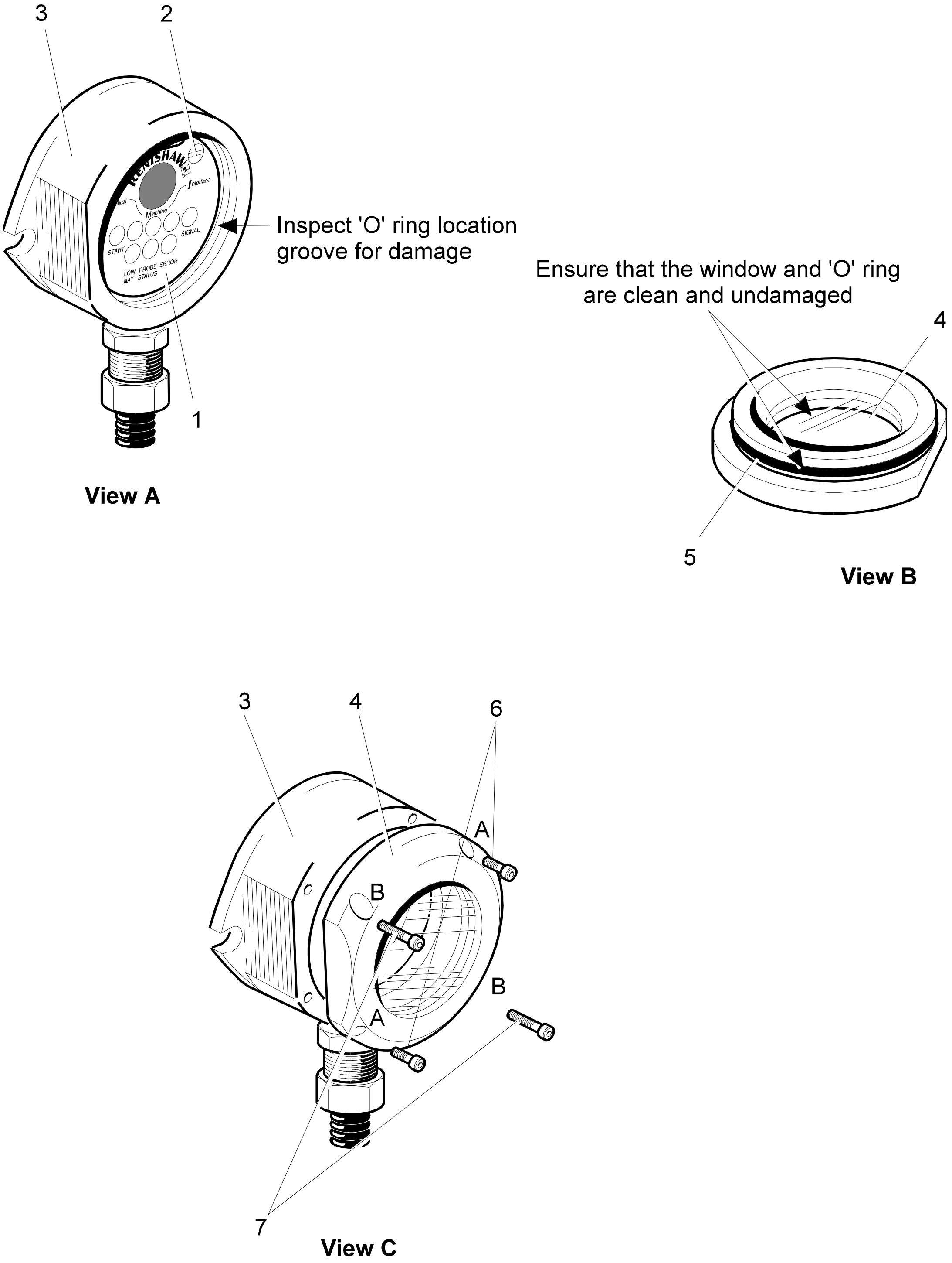
3. Visually examine the window [4] and 'O' ring [5] for cleanliness as shown in **View B**. Also ensure that both the window and 'O' ring are undamaged.

4. Refer to **View C** and insert the two short screws [6] into the two threaded holes **A** in the window [4]. Tighten the two screws to 0.3 - 0.7Nm (0.22 - 0.51 lbf. ft).

5. Lightly smear the 'O' ring [5] with silicone grease and assemble window [4] to OMM body [3].

6. Insert the two long screws [7] into the two plain holes **B**. Tighten each screw a few turns at a time to gradually pull the window [4] evenly against the OMI body [3]. There may be some resistance due to the compression of air trapped inside the OMI body.

7. Alternatively tighten screws [7] to pull window [4] evenly into the body of the OMI. Finally tighten screws to 1.0 - 1.8Nm (0.74 - 1.32 lbf.ft).



1. Label
2. Retaining Screw (2 Off)
3. OMI Body
4. Window
5. ‘O’ Ring
6. Screw (short) (2 Off)
7. Screw (long) (2 Off)

Figure 5.18 - Assembly of the OMI Window and Label

Replacing an OMI Fuse

To replace a fuse carry out the following; refer to figure 5.19:

1. Remove the window and label from the OMI in accordance with **Removal of the Window and Label from the OMI** earlier in this chapter.

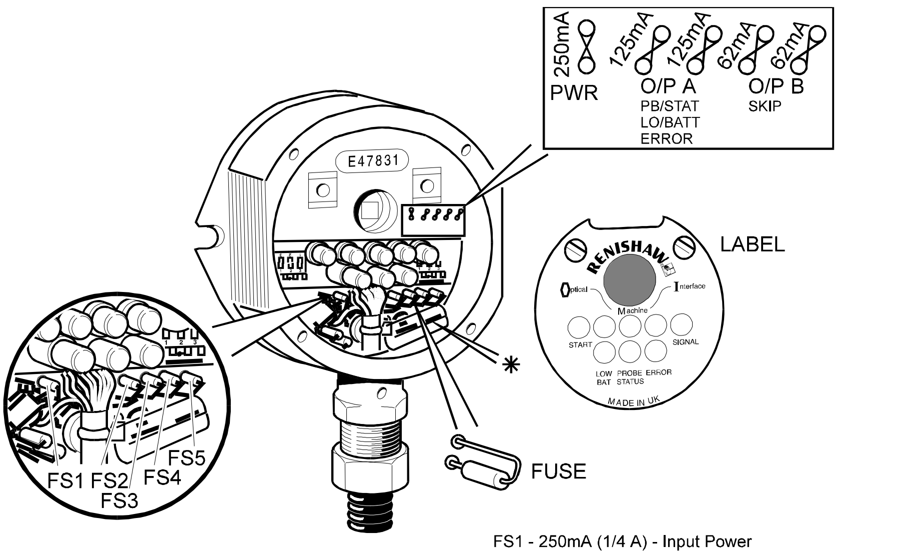
2. Remove the fuse pack (Part No. A-2115-0034) from the OMI and ` select the correct fuse. If the required fuse has already been used, additional fuse packs for the OMI may be obtained through your nearest Renishaw company. For a list of Renishaw companies, refer to **Before You Begin** at the front of this document.

3. Pull the defective fuse from its location and discard.

4. Insert the new fuse within the location holes provided ensuring its orientation is as shown in Figure 5.19.

5. Replace the fuse pack within the plastic bag provided and place back within body of OMI for safe keeping.

6. Reassemble the label and window to the OMI in accordance with **Replacement of the OMI Label and Window** earlier in this chapter.



The input power supply is fuse protected by a 250mA fuse.

Each group of outputs is fuse protected on its respective +ve and -ve supply lines.

✳
A spare set of fuses is supplied with each O-M-I, located in a plastic bag behind removeable label shown above.

FS1 - 250mA (1/4 A) - Input Power

FS2 - 125mA (1/8 A) - Output Group A
FS3 - 125mA (1/8 A) - Output Group A
— Probe Bat Low Error

FS4 - 62mA (1/16 A) - Output Group B
FS5 - 62mA (1/16 A) - Output Group B
— Skip

Figure 5.19 - Replacing a Fuse Within the OMI

Maintenance and Adjustment of the MI12 Machine Interface Unit

MI12 Machine Interface Unit Switch Settings

The MI12 Machine Interface Unit incorporates the following switches (see Figure 5.21) It is important that, where necessary, each of these switches are set to suit your specific application

Switch SW1

This switch acts as a manual start switch and is disabled for the entire duration of 'MACHINE START' input signals.

Switch SW2

This switch is supplied factory set as shown in Figure 5.21, i.e. to 'MACHINE START' with both the 'OMM1' and 'OMM2' switches set to the their *standard* settings.

In order that a 'MACHINE START' signal can be initiated, an input of between 4,25V at 1mA and 30V at 10mA is required between terminals 21(+) and 22 (-) TTL compatible when connected between +5V and TTL output. Minimum pulse width is 1ms.

CAUTION

THE 'AUTO START' SETTING MUST NEVER BE USED WITH THE MP700 PROBE SYSTEM.

The 'AUTO START' setting, which causes the system to send a start signal once every second and does not require a CNC Machine Control input, should not be used with the MP700 Probe System.

Switch SW3

This switch enables Normally Open and Normally Closed options to be selected for SKIP and PROBE STATUS. The switch is factory set to option 1 (see Figure 5.22).

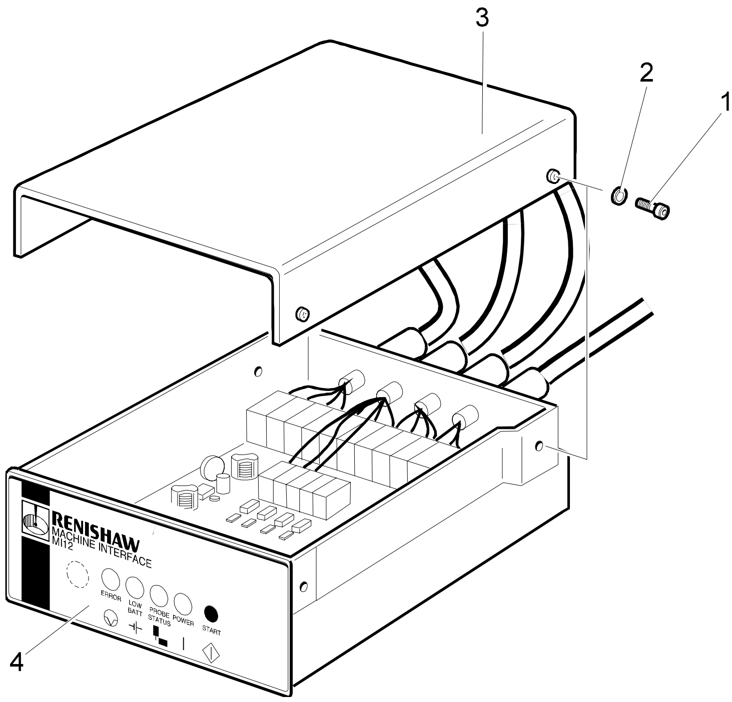
To adjust switch SW2 or SW3 carry out the following; refer to Figures 5.20 through 5.22:

1. Release and remove the four screws [item 1, Figure 5.20] and four washers [2] securing the top cover [3] to the MI12 Machine Interface Unit [4].

2. Remove the top cover [3] from the MI12 Machine Interface Unit [4].

3. Adjust switch SW2 and/or SW3 to the required setting (refer to Figures 5.21 and 5.22).

4. Replace top cover [3] and secure with four screws [1] and four washers [2].



1. Screw (4 off)
2. Washer (4 off)
3. Top Cover
4. MI12 Machine Interface Unit

Figure 5.20 - Removing/Replacing the Top Cover of the MI12 Interface Unit

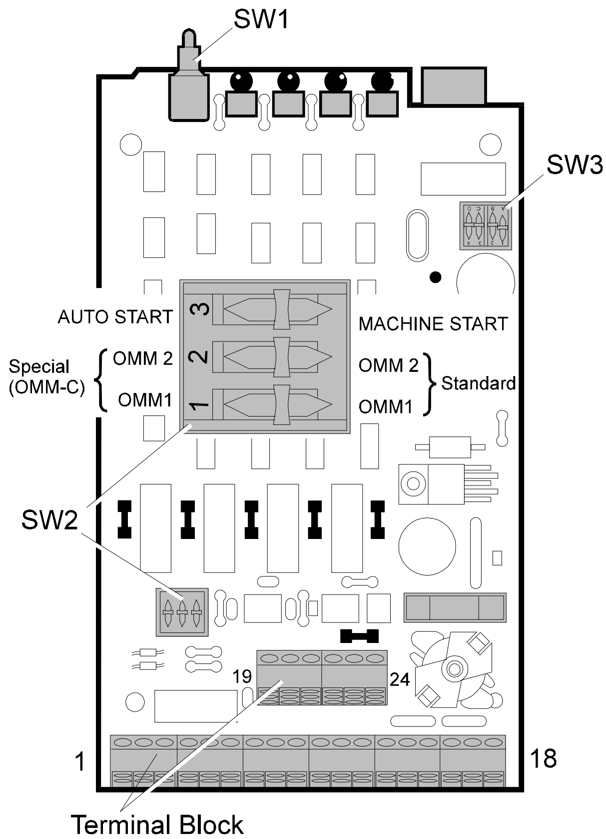
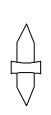


Figure 5.21 - MI12 Machine Interface Unit Switch Locations

KEY	
N/O Normally Open	
N/C Normally Closed	
	Switch must be in position shown.
	Switch can be in either position
	Bleeper on/ Bleeper off Factory set to Bleeper on

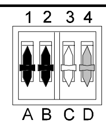
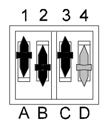
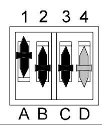
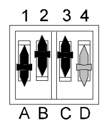
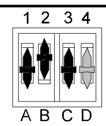
OPTION	Terminals 14 & 15	Terminals 23 & 24	SW3
1	PROBE STATUS N/O	PROBE STATUS N/C	
2	SKIP N/C	PROBE STATUS N/C	
3	SKIP N/O	PROBE STATUS N/C	
4	PROBE STATUS N/O	SKIP N/C	
5	PROBE STATUS N/O	SKIP N/O	

Figure 5.22 - Switch SW3 Settings

MI12 Machine Interface Unit Fuse Replacement

To replace a fuse carry out the following; refer to Figures 5.20 and 5.23:

1. Release and remove the four screws [item 1, Figure 5.20] and four washers [2] securing the top cover [3] to the MI12 Machine Interface Unit [4].

2. Remove the top cover [2] from the MI12 Machine Interface Unit [4].

3. Obtain a replacement fuse to the correct specification, refer to Figure 5.23 for fuse location and identification number:

Fuse Identification Number	Milliamps (mA)	Part Number
FS1 **FS2** **FS3** **FS4** **FS6**	62	P-FS20-0062
FS5	250	P-FS20-1A25
FS7	500	P-FS01-1A50

4. Remove defective fuse by easing it gently from its location within the PCB.

5. Assemble replacement fuse into vacant location on the PCB.

6. Replace top cover [item 3, Figure 5.20] and secure with four screws [1] and four washers [2].

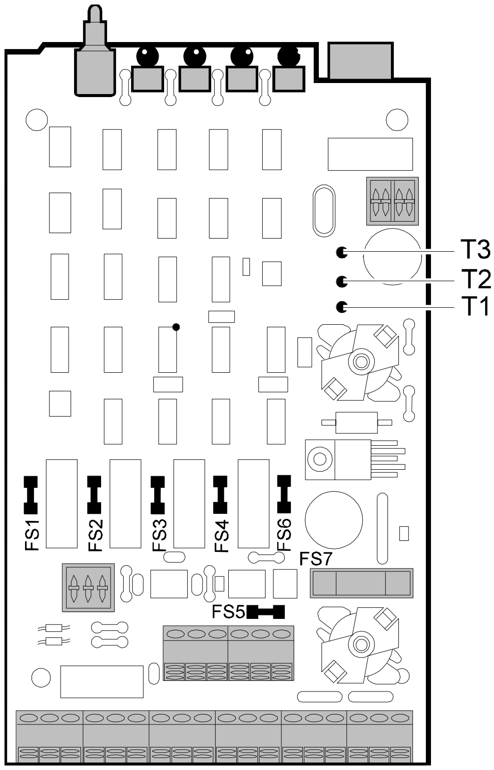


Figure 5.23 - MI12 Machine Interface Unit Fuse Location

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CHAPTER 6

Troubleshooting

This chapter provides information on the faults you are most likely to incur over the life of your MP700 Probe System. Each fault is listed sequentially and offers both the possible causes and the rectification action that you will need to perform to recover from the fault.

Contained In This Chapter

Introduction

The troubleshooting information supplied within this document is based on Renishaw's vast experience of probing systems. It provides information on the faults you are most likely to incur over the life of your MP700 Probe System. Each fault is listed sequentially and offers both the possible causes and the rectification action that you will need to perform to recover from the fault.

Fault Finding

PROBE SYSTEM FAILS TO SWITCH ON

Possible Cause	Rectification Action
Probe is already switched on.	Check that probe is off. Where necessary, switch off the probe.
Dead Battery.	Change battery.
Battery has been incorrectly fitted.	Check battery for correct installation.
Probe is not aligned with optical receiver of OMM/OMI.	Verify alignment. Ensure OMM/OMI fixtures are secure.
Swarf build up on optical receiver of OMM/OMI.	Remove swarf.
Beam between optical receiver of OMM/OMI and the probe is obstructed.	Clear obstruction.

PROBE SYSTEM FAILS TO SWITCH ON (Continued)	
Possible Cause	**Rectification Action**
Signal strength of OMI is too weak.	Ensure 'SIGNAL' LED is green. If LED is red or yellow, adjust the signal strength of the OMI in accordance with the **Chapter 5 - Maintenance and Adjustment**.
OMM is not transmitting the start signal.	Verify that 'START' LED illuminates when a start signal is sent.
MI12 Machine Interface Unit is not receiving the machine M code.	Check the power supply to the MI12. Check condition of all connections and outputs.
No power supply to OMI.	Verify that OMI has a power supply.
No power supply to MI12 Machine Interface Unit.	Verify that MI12 has a power supply. Check all connections and fuses. Verify power supply is a stable 24V.

PROBE STOPS IN MID-CYCLE (PROBE OPEN/FAIL)	
Possible Cause	**Rectification Action**
Beam obstructed.	Check for LED error. Remove obstruction.
Probe has been orientated too quickly.	Ensure axial movement of probe is maintained within the recommended rate.

PROBE STOPS IN MID-CYCLE (PROBE OPEN/FAIL) (Continued)

Possible Cause	Rectification Action
Probe has false-triggered due to shock and vibration during an axial move.	Check probe settings in accordance with **Chapter 5 - Maintenance and Adjustment.** Reduce axial speed of probe. Reduce stylus's mass.
Probe remained on workpiece surface too long.	Review software in accordance. with manufacture's instructions.
Probe remaining on workpiece and not backing off.	Increase distance settings. Review software in accordance with manufacturer's instructions.
Probe failing to trigger on contact with workpiece.	Increase probing speed to a minimum of 15mm per minute.
Probe has collided with foreign object.	Remove obstruction.
Damaged cables.	Check all cables.
Power supply de-activated.	Check power supply.
Loose probe assembly.	Check tightness of probe styli and probe shank.
Probe unable to find part within program window.	Part out of position or missing.

PROBE CRASHES

Possible Cause	Rectification Action
Probe signals are being taken from a tool setting probe.	Verify system functionality.
Workpiece is obstructing the path of the probe.	Review software in accordance with manufacturer's instructions.
Probe length offsets have been removed.	Review software in accordance with manufacturer's instructions.
Probe speed is less than 15mm per minute and has prevented the probe from triggering.	Increase speed.

POOR REPEATABILITY AND ACCURACY

Possible Cause	Rectification Action
Swarf on part.	Remove swarf.
Tool change repeatability is poor.	Verify probe repeatability using a single point move.
Probe position has changed due to loosening of probe assembly.	Verify tightness of probe styli, on-centre adjustment mechanism and shank mounting.
Probe position has changed from its calibrated position by 180° or due to M19 orientation.	Verify probe position. Check on-centre setting and, if necessary, adjust to within 20% of part tolerance.
Calibration and updating of offsets is not occurring.	Review software in accordance with manufacturer's instructions.

POOR REPEATABILITY AND ACCURACY (Continued)

Possible Cause	Rectification Action
Calibration and probing speeds are not the same.	Review software in accordance with manufacturer's instructions.
Calibrated feature has moved.	Verify position of calibrated feature.
Measurement is occurring as the stylus leaves a surface.	Review software in accordance with manufacturer's instructions.
Probing is being performed within the machine's acceleration and deceleration zones.	Review software in accordance with manufacturer's instructions.
Probe feedrate is too high for machine/controller.	Perform simple repeatability trials at various speeds.
Temperature variation is causing excessive movement in the machine and the workpiece.	Minimise machine and workpiece temperature changes. Increase the frequency of calibration.
Machine has poor repeatability due to loose encoders, backlash, tight slideways and/or accident damage.	Perform a health check on your machine tool.

PROBE FAILS TO SWITCH OFF

Possible Cause	Rectification Action
Probe set in 'Time Out' mode.	Wait for a minimum of 2 minutes and 20 seconds for the probe to switch off.
Probe set in 'Time Out' mode causing timer to reset in the tool carousel.	Use a lighter stylus. Review use of 'Optical On-Time Out' mode.
Probe is being switched on by the OMM/OMI.	Reduce proximity and/or the signal strength of the OMM/OMI. Refer to **Chapter 5 - Maintenance and Adjustment.**
Probe being continuously switched on by an adjacent probe within the tool carousel.	Ensure that a distance of 600mm is maintained between each probe.
No line of sight between probe and OMM/OMI when switch off signal is sent.	Ensure line of sight is maintained.

PROBE STATUS LED FAILS TO ILLUMINATE

Possible Cause	Rectification Action
Battery installed incorrectly.	Check battery for correct installation.

MI12 'POWER' LED FAILS TO ILLUMINATE WITH POWER SWITCHED ON

Possible Cause	Rectification Action
Faulty electrical contact.	Check all connections.
Blown fuse.	Check all fuses. Replace blown fuse.
Incorrect power supply.	Ensure power supply is 24V dc.

MI12 'LOW BATT' LED REMAINS ILLUMINATED	
Possible Cause	**Rectification Action**
Incorrectly installed battery.	Check battery for correct installation.
Fully discharged battery.	Renew battery.

PROBE STATUS LED REMAINS ILLUMINATED	
Possible Cause	**Rectification Action**
Battery voltage below useable level.	Renew battery.

PROBE IS TRANSMITTING SPURIOUS READINGS	
Possible Cause	**Rectification Action**
Damaged cables.	Check all cables for damage. Renew cables if damage is found.
Electrical or optical interference.	Move transmission cables clear of any cables carrying high voltage currents.
System malfunctioning or inducing intermittent errors.	Shield from intense light sources, e.g. Xenon beacons. Electrically isolate OMM from the machine to prevent any possibility of an earth loop. Ensure there are no arc welders, stroboscopes or other high intensity light sources in close proximity to the probe system.

PROBE IS TRANSMITTING SPURIOUS READINGS (Continued)

Possible Cause	Rectification Action
Poorly regulated power supply.	Ensure that the power supply is correctly regulated.
Excessive machine vibration.	Eliminate machine vibration.
Lose mountings or stylus.	Check and tighten mountings. Tighten stylus.

PROBE FAILS TO RESEAT CORRECTLY

Possible Cause	Rectification Action
Probe trigger occurred on reseat.	Move stylus clear of workpiece.
Inner and/or outer diaphragm is damaged.	Inspect/renew diaphragms in accordance with **Chapter 5 - Maintenance and Adjustment.**

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SPARES LIST

The following table contains a complete list of spares that may be ordered to support and maintain your MP700 Probe System over its lifetime. All parts listed may be ordered directly through any Renishaw® company; for a full list of these, refer to **Before You Begin** at the front of this publication.

Part Number	Part Description
A-2107-1035	**MP700 (35°) Probe Kit**, consisting: • MP700 (35°) Probe with Battery (A-2107-0035) • Stylus • Optical Machine Module (A-2075-0142) • MI12 Machine Interface Unit (A-2075-0142) • Tool Kit (A-2085-0020).
A-2107-1070	**MP700 (70°) Probe Kit**, consisting: • MP700 (70°) Probe with Battery (A-2107-0070) • Stylus (A-5000-3709) • Optical Machine Module (A-2075-0142) • MI12 Machine Interface Unit (A-2075-0142) • Tool Kit (A-2085-0020)
A-2107-0035	**MP700 (35°) Probe with Battery and Tool Kit**
A-2107-0070	**MP700 (70°) Probe with Battery and Tool Kit**
A-2107-1030	**Probe Outer Diaphragm Replacement Kit**
A-2085-0020	**Probe Tool Kit**, comprising: • 1.98mm diameter Stylus Tool • 1.5mm AF Allen Key • 2.0mm AF Allen Key(two) • 2.5mm AF Allen Key • 3.0mm AF Allen Key • 4.0mm AF Allen Key
A-5000-3709	**Ceramic Stylus:** PS3-1C Ceramic Stylus 50mm long with 6mm diameter ball.
A-5003-1436	**Carbon Stylus(50mm long):** M4 Carbon Fibre Stylus 50mm long with 6mm diameter ball.
A-5003-1458	**Carbon Stylus(100mm long):** M4 Carbon Fibre Sylus100mm long with 6mm diameter ball.

Part Number	Part Description
A-5003-1255	**Carbon Stylus (150mm long):** M4 Carbon Fibre Stylus 150mm long with 6mm diameter ball.
A-5003-1057	**Carbon Stylus (200mm long):** M4 Carbon Fibre Stylus 200mm long with 6mm diameter ball.
	Styli are fully listed on Renishaw Data Sheets MTS H-2000-2000 and MSD H-2000-2005.
P-BT03-0001	**Battery:** 9V Alkaline Battery.
A-2033-0576	**Optical Machine Module:** complete with 5,1mm diameter x 25m long (0,2 in. diameter x 82 ft long) cable.
A-2031-0002	**Optical Machine Module Window Replacement Kit**
A-2031-0043	**Optical Machine Module PCB Replacement Kit**.
A-2033-0830	**Optical Machine Module/Optical Machine Interface Mounting Bracket:** complete with fixing screws, washers and nuts.
A-2115-0001	**Optical Machine Interface:** complete with 4.35mm diameter x 5m long (0.17 in. diameter x 16.4 ft long) cable.
A-2115-0034	**Optical Machine Interface Fuse Pack**
A-2075-0142	**MI12 Machine Interface Unit**
A-2075-0141	**MI12 Machine Interface Unit (Board only)**
A-2033-0690	**MI12 Machine Interface Unit Panel Mounting Kit**
P-FS20-0062	**Fuse 62mA:** For MI12 Machine Interface Unit FS1 (Spare), FS2 (Error), FS3 (Low Battery), FS4 (Probe Status N/C) and FS6 (Probe Status N/O).
P-FS20-1A25	**Fuse 250mA:** For MI12 Machine Interface Unit FS5 (Audio Extension Protection).
P-FS01-1A50	**Fuse 500mA:** For MI12 Machine Interface Unit FS7 Anti-surge (Power Supply Protection).
A-2019-0018	**PSU3 Power Supply Unit**