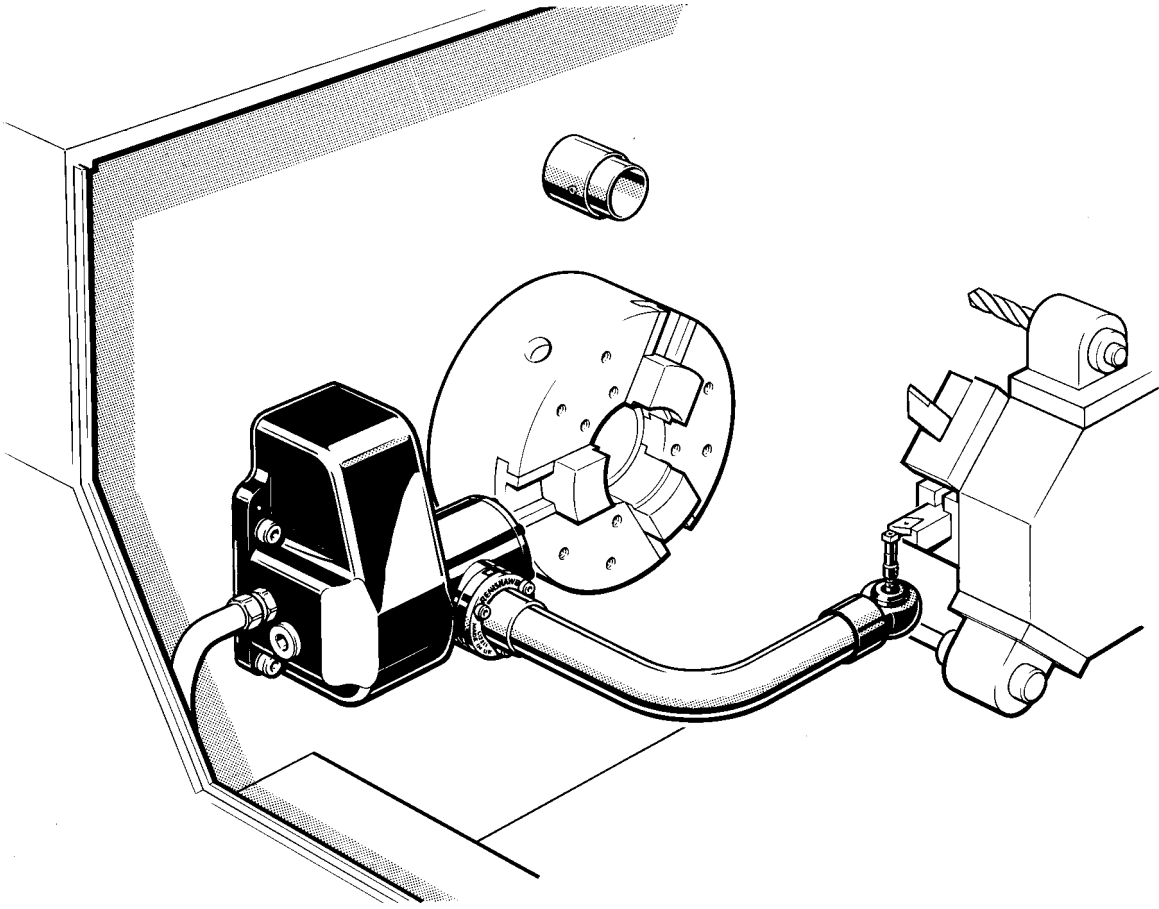


# TSA universal motorised toolsetting arm



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## **FCC (USA)**

### **Information to user (FCC section 15.19)**

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

### **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.

### **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 installed and used in accordance with the instruction manual, 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.

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### **Care of equipment**

Renishaw probes and associated systems are precision tools used for obtaining precise measurements and must therefore be treated with care.

### **Warranty**

Renishaw plc warrants its equipment for a limited period (as set out in our standard terms and conditions of sale) provided that it is installed exactly as defined in associated Renishaw documentation.

Prior consent must be obtained from Renishaw if non-Renishaw equipment (e.g. interfaces and/or cabling) is to be used or substituted.

Failure to comply with this will invalidate the Renishaw warranty.

Claims under warranty must be made from authorised service centres only, which may be advised by the supplier or distributor.

### **Patents**

Features of Renishaw's TSA motorised tool setting arm and of related products are the subjects of the patents and patent applications listed below :

DE 4413968  
EP 0757194  
GB 2277593  
IT 1273643  
JP 105,464/1997  
JP 3,561,289  
US 5,446,970  
US 5,647,137  
US 5,697,620

## **GB - SAFETY**

### **Information for the user**

Pinch hazards exist between moving parts and between moving and static parts. Do not hold the probe head during movements, or during manual probe changes.

Beware of unexpected movement. The user should remain outside of the full working envelope of probe head/extension/probe combinations.

In all applications involving the use of machine tools or CMMs, eye protection is recommended.

For instructions regarding the safe cleaning of Renishaw products, refer to the MAINTENANCE section of the relevant product documentation.

There are no user serviceable parts inside Renishaw mains powered units. Return defective units to an authorised Renishaw Service Centre.

Replace blown fuses with new components of the same type. Refer to the SAFETY section of the relevant product documentation.

Remove power before performing any maintenance operations.

Refer to the machine supplier's operating instructions.

### **Information for the machine supplier**

It is the machine supplier's responsibility to ensure that the user is made aware of any hazards involved in operation, including those mentioned in Renishaw product documentation, and to ensure that adequate guards and safety interlocks are provided.

Under certain circumstances the probe signal may falsely indicate a probe seated condition. Do not rely on probe signals to stop machine movement.

The expected method of providing an emergency stop for Renishaw products is to remove power.

## **F - SECURITE**

### **Informations à l'attention de l'utilisateur.**

Il y a des risques de pincement entre les pièces mobiles et entre les pièces mobiles et fixes. Ne pas tenir la tête du palpeur lorsqu'elle se déplace ou que le palpeur est changé à la main.

Prenez garde aux mouvements soudains. L'utilisateur doit toujours rester en dehors de la zone de sécurité des installations comprenant : Tête fixe ou motorisée/palpeur/rallonge/palpeur.

Le port de lunettes de protection est recommandé pour toute application sur machine-outil et MMC.

Les conseils de nettoyage en toute sécurité des produits Renishaw figurent dans la section MAINTENANCE de votre documentation.

Aucune pièce des machines Renishaw alimentées sur secteur ne peut être réparée par l'utilisateur. Renvoyer toute machine défectueuse à un Centre Après Vente Renishaw agréé.

Remplacer les fusibles grillés par des composants neufs du même type. Consulter la section SECURITE de votre documentation.

Mettre la machine hors tension avant d'entreprendre toute opération de maintenance.

Consulter le mode d'emploi du fournisseur de la machine.

### **Informations à l'attention du fournisseur de la machine**

Le fournisseur de la machine doit s'assurer que l'utilisateur connaît les dangers liés au fonctionnement de la machine, y compris ceux mentionnés dans la documentation sur les produits Renishaw et il doit s'assurer que tous les dispositifs de protection et verrouillages de sécurité nécessaires sont opérationnels.

Dans certains cas, il est possible que le signal du palpeur indique à tort que le palpeur est hors matière. Ne pas se fier aux signaux du palpeur qui ne garantissent pas toujours l'arrêt de la machine.

La procédure habituelle d'arrêt d'urgence des produits Renishaw est la mise hors tension.

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## D - SICHERHEITSHINWEISE

### Informationen für den Benutzer

Zwischen beweglichen und zwischen beweglichen und statischen Teilen besteht Einklemmgefahr. Den Messtasterkopf nicht anfassen, wenn er sich bewegt oder wenn ein manueller Messtasterwechsel durchgeführt wird.

Auf unerwartete Bewegungen achten. Der Anwender soll sich nur außerhalb des Messtaster-Arbeitsbereiches aufhalten.

Bei der Bedienung von Werkzeugmaschinen oder Koordinatenmessgeräten wird grundsätzlich Augenschutz empfohlen.

Anleitungen über die sichere Reinigung von RenishawProdukten sind in Kapitel MAINTENANCE (WARTUNG) in der Produktdokumentation enthalten.

Die betriebenen Renishaw-Einheiten enthalten keine Teile, die vom Anwender gewartet werden können. Senden Sie mangelhafte Geräte an Ihren Renishaw Kundendienst zurück.

Durchgebrannte Sicherungen müssen mit gleichwertigen ersetzt werden. Beziehen Sie sich bitte auf die SICHERHEITS (SAFETY) in der Produktdokumentation.

Vor Wartungsarbeiten muss die Stromversorgung getrennt werden.

Beziehen Sie sich auf die Wartungsanleitungen des Lieferanten.

### Informationen für den Maschinenlieferanten

Es obliegt dem Maschinenlieferanten, den Anwender über alle Gefahren, die sich aus dem Betrieb der Ausrüstung, einschließlich der, die in der Renishaw Produktdokumentation erwähnt sind, zu unterrichten und sicherzustellen, daß ausreichende Sicherheitsvorrichtungen und Verriegelungen eingebaut sind.

Unter gewissen Umständen könnte das Messtaster Fehlsignale melden (Ausgelenkt). Verlassen sie sich nicht auf das Messtastersignal um die Maschine zu stoppen.

RenishawProdukte sollen im Notfall durch Trennen der Stromversorgung stoppen.

## I - SICUREZZA

### Informazioni per l'utente

Esiste pericolo di danno da schiacciamento tra le parti in moto o tra le parti in moto e quelle ferme. Evitare di afferrare la testina della sonda quando è in moto, oppure quando si effettuano spostamenti a mano.

Fare attenzione ai movimenti improvvisi e tenersi fuori dal campo operativo delle combinazioni testa/prolunga e barra/sonda. Si raccomanda all'utente di tenersi al di fuori dello spazio operativo della testa della sonda, delle prolunghe e di altri accessori della sonda.

Si raccomanda di indossare occhiali di protezione in applicazioni che comportano l'utilizzo di macchine utensili e macchine per misurare a coordinate.

Per le istruzioni relative alla pulizia dei prodotti Renishaw, fare riferimento alla sezione MAINTENANCE (MANUTENZIONE) della documentazione del prodotto.

Gli apparecchi Renishaw alimentati da rete elettrica non contengono componenti su cui si possano eseguire interventi di manutenzione da parte dell'utente. In caso di guasto, rendere l'apparecchio a uno dei Centri di Assistenza Renishaw.

I fusibili bruciati dovranno essere sostituiti con quelli dello stesso tipo. Consultare la sezione SICUREZZA (SAFETY) nella documentazione dello specifico prodotto.

Prima di effettuare qualsiasi intervento di manutenzione, isolare dall'alimentazione di rete.

Consultare le istruzioni d'uso del fabbricante della macchina.

### Informazioni per il costruttore della macchina

Il fornitore della macchina ha la responsabilità di avvertire l'utente dei pericoli inerenti al funzionamento della stessa, compresi quelli riportati nelle istruzioni della Renishaw, e di fornire ripari di sicurezza e interruttori di esclusione adeguati.

E' possibile, in certe situazioni, che la sonda emetta erroneamente un segnale che la sonda è in posizione. No fiarse de las señales de la sonda para parar el movimiento de la máquina.

Il metodo corretto di eseguire un arresto di emergenza per i prodotti Renishaw è l'interruzione dell'alimentazione elettrica.



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## E - SEGURIDAD

### Información para el usuario

Existe el peligro de atraparse los dedos entre las distintas partes móviles y entre partes móviles e inmóviles. No sujetar la cabeza de la sonda mientras se mueve, ni durante los cambios manuales de la sonda.

Tener cuidado con los movimientos inesperados. El usuario debe quedarse fuera del grupo operativo completo compuesto por el cabezal de sonda/extensión/sonda o cualquier combinación de las mismas.

Se recomienda usar gafas de protección en todas las aplicaciones que implican el uso de máquinas herramientas y máquinas de medición de coordenadas.

Para instrucciones sobre seguridad a la hora de limpiar los productos Renishaw, remitirse a la sección titulada MAINTENANCE (MANTENIMIENTO) en la documentación sobre el producto.

Dentro de las unidades Renishaw que se enchufan a la red, no existen piezas que puedan ser mantenidas por el usuario. Las unidades defectuosas deben ser devueltas a un Centro de Servicio al Cliente Renishaw.

Sustituir los fusibles fundidos con componentes nuevos del mismo tipo. Remitirse a la sección titulada SEGURIDAD (SAFETY) en la documentación sobre el producto.

Quite la corriente antes de emprender cualquier operación de mantenimiento.

Remitirse a las instrucciones de manejo del proveedor de la máquina.

### Información para el proveedor de la máquina

Es responsabilidad del proveedor de la máquina garantizar que el usuario conozca los riesgos implícitos en el funcionamiento, incluidos aquellos mencionados en la documentación del producto Renishaw, así como garantizar el suministro de los enclavamientos de seguridad y protecciones adecuados.

Bajo determinadas circunstancias la señal de la sonda puede indicar erróneamente que la sonda está asentada. No fiarse de las señales de la sonda para parar el movimiento de la máquina.

El método previsto para efectuar una parada de emergencia de los productos Renishaw es el de quitar la corriente.

## **P - SEGURANÇA**

### **Informações para o Usuário**

Existe perigo de esmagamento entre as peças móveis/estáticas do equipamento. Não segure o cabeçote apalpador durante os movimentos ou durante as mudanças manuais do apalpador.

Tenha cuidado com movimentos inesperados. O usuário deve permanecer fora da área de trabalho das combinações do cabeçote/extensão/apalpador.

Em todas as aplicações que envolvam a utilização de Máquinas-Ferramenta e CMMs, recomenda-se usar protecção para os olhos.

Para instruções relativas à limpeza segura de produtos Renishaw, consultar a secção MAINTENANCE (MANUTENÇÃO) da documentação do produto.

Não existem partes que possam ser reparadas pelo usuário dentro dos equipamentos Renishaw. Retorne as unidades com defeito a um Centro Autorizado de Atendimento a Clientes Renishaw.

Substituir fusíveis danificados por novos componentes do mesmo tipo. Consultar a secção SEGURANÇA (SAFETY) na documentação do produto.

Desligue a energia antes de realizar qualquer serviço de manutenção.

Consultar as instruções de funcionamento do fornecedor da máquina.

### **Informações para o Fornecedor da Máquina.**

Constitui responsabilidade do fornecedor da máquina assegurar-se de que o usuário esteja ciente dos riscos inerentes à operação, incluindo aqueles mencionados na documentação do produto Renishaw, e garantir a existência das devidas proteções e bloqueios de segurança.

Em determinadas circunstâncias, o sinal do apalpador pode indicar incorretamente uma condição de toque. Não confie nos sinais do apalpador para parar a máquina.

O método sugerido para uma parada de emergência de produtos Renishaw é desligar a alimentação de energia.

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## DK - SIKKERHED

### Oplysninger til brugeren

Der er risiko for at blive klemt mellem bevægelige dele og mellem bevægelige og statiske dele. Hold ikke sondehovedet under bevægelse eller under manuelle sondeskift.

Pas på uventede bevægelser. Brugeren bør holde sig uden for hele probehovedets/forlængerens/probekombinationernes arbejdsområde.

I alle tilfælde, hvor der anvendes værktøjs- og koordinatmålemaskiner, anbefales det at bære øjenbeskyttelse.

Se afsnittet MAINTENANCE (VEDLIGEHOLDELSE) i produkt-dokumentationen for at få instruktioner til sikker rengøring af Renishaw-produkter.

Der er ingen dele inde i Renishaw-enhederne, som sluttes til lysnettet, der kan efterses eller repareres af brugeren. Send alle defekte enheder til Renishaws kundeservicecenter.

Udskift sikringer, der er sprunget, med nye komponenter af samme type. Se i afsnittet SIKKERHED (SAFETY) i produktdokumentationen.

Afbryd strømforsyningen, før der foretages vedligeholdelse.

Se maskinleverandørens brugervejledning

### Oplysninger til maskinleverandøren

Det er maskinleverandørens ansvar at sikre, at brugeren er bekendt med eventuelle risici i forbindelse med driften, herunder de risici, som er nævnt i Renishaws produktdokumentation, og at sikre, at der er tilstrækkelig afskærmning af sikkerhedsblokeringer.

Under visse omstændigheder kan sondesignalet ved en fejl angive, at sonden står stille. Stol ikke på, at sondesignaler stopper maskinens bevægelse.

Den forventede metode til nødstop af Renishaw-produkter er afbrydelse af strømforsyningen

## NL - VEILIGHEID

### Informatie voor de Gebruiker

Het risico bekneld te raken tussen bewegende delen, en ook tussen bewegende en statische delen is aanwezig. De sondekop tijdens beweging of tijdens manuele sondeveranderingen niet vasthouden.

Pas op voor onverwachte bewegingen. De gebruiker dient buiten het bereik van de werkende tasterkop/verlengstuk/taster combinaties te blijven.

Het dragen van oogbescherming wordt tijdens alle gebruik van machinewerktuigen en CMM's aanbevolen.

Voor het veilig reinigen van Renishaw producten wordt verwezen naar het hoofdstuk MAINTENANCE (ONDERHOUD) in de produktendocumentatie.

De onderdelen van Renishaw units die op het net worden aangesloten kunnen niet door de gebruiker onderhouden of gerepareerd worden. U kunt defecte units naar een erkend Renishaw Klantenservice Centrum brengen of toezenden.

Doorgeslagen zekeringen met nieuwe componenten van hetzelfde type vervangen. U wordt verwezen naar het hoofdstuk VEILIGHEID (SAFETY) in de produktendocumentatie.

Spanning uitschakelen alvorens enig onderhoud te verrichten.

De bedieningsinstructies van de machineleverancier raadplegen.

### Informatie voor de machineleverancier

De leverancier van de machine is ervoor verantwoordelijk dat de gebruiker op de hoogte wordt gesteld van de risico's die verbonden zijn aan het gebruik, waaronder de risico's die vermeld worden in de productdocumentatie van Renishaw. De leverancier dient er tevens voor te zorgen dat de gebruiker is voorzien van voldoende beveiligingen en veiligheidsgrendelinrichtingen.

Onder bepaalde omstandigheden kan het tastersignaal een onjuiste tastertoestand aangeven. Vertrouw niet op de tastersignalen voor het stoppen van de machinebeweging.

In geval van nood wordt er verwacht dat het Renishaw product wordt stopgezet door de stroom uit te schakelen.

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## SW - SÄKERHET

### Information för användaren

Det finns risk att man kläms mellan de rörliga delarna och mellan rörliga och fasta delar. Håll ej i sondens huvud under rörelse eller under manuella sondbyten

Se upp för plötsliga rörelser. Operatören bör hålla sig utanför arbetsområdet för probhuvud/förlängning/mätspetskombinationerna.

Ögonskydd rekommenderas för alla tillämpningar som involverar bruket av maskinverktyg och CMM.

För instruktioner angående säker rengöring av Renishaws produkter, se avsnittet MAINTENANCE (UNDERHÅLL) i produktdokumentationen

Det finns inga delar som användaren kan utföra underhåll på inuti Renishaws nätströmsdrivna enheter. Returnera defekta delar till ett auktoriserat Renishaw kundcentra.

Byt ut smälta säkringar med nya av samma typ. Se avsnittet SÄKERHET (SAFETY) i produktdokumentationen

Koppla bort strömmen innan underhåll utförs.

Se maskintillverkarens bruksanvisning.

### Information för maskinleverantören.

Maskinleverantören ansvarar för att användaren informeras om de risker som drift innebär, inklusive de som nämns i Renishaws produktdokumentation, samt att tillräckligt goda skydd och säkerhetsföreglingar tillhandahålls.

Under vissa omständigheter kan sondens signal falskt ange att en sond är monterad. Lita ej på sondsignaler för att stoppa maskinens rörelse.

Metoden för nödstopp för Renishaws produkter förutsätter att strömmen kopplas bort.

## FIN - TURVALLISUUS

### Käyttäjälle tarkoitettuja tietoja

Liikkuvien osien ja staattisten osien välillä on litistymisvaara. Älä pidä kiinni anturin päästä sen liikkussa tai vaihtaessasi anturia käsin.

Varo odottamatonta liikettä. Käyttäjien tulee pysyä luotaimen pään ja luotaimen toimintasäteen ulkopuolella.

Kaikkia työstökoneita ja koordinoituja mittauskoneita (CMM) käytettäessä suositamme silmäsuojuksia.

Renishaw-tuotteiden turvalliset puhdistusohjeet löytyvät tuoteselosteen MAINTENANCE (HUOLTOA) koskevasta osasta.

Sähköverkkoon kytkettävät Renishaw-tuotteet eivät sisällä käyttäjän huollettavissa olevia osia. Vialliset osat tulee palauttaa valtuutetulle Renishaw-asiakaspalvelukeskukselle.

Korvaa palaneet sulakkeet samantyyppisillä uusilla sulakkeilla. Lue tuoteselosteen TURVALLISUUTTA (SAFETY) koskeva osa.

Kytke syöttöjännite pois ennen huoltotoimenpiteitä.

Katso koneen toimittajalle tarkoitettuja käyttöohjeita.

### Tietoja koneen toimittajalle

Koneen toimittajan vastuulla on että käyttäjä on saanut tiedon mahdollisista käyttöön liittyvistä vaaroista, mukaan lukien Renishaw'n tuoteselosteessa mainitut vaarat. Kone-toimittajan tulee myös varmistaa, että suojukset ja turvalukitukset ovat riittävät.

Tietyissä olosuhteissa anturilta tuleva signaali saattaa virheellisesti osoittaa että mitta-anturi on lepotilassa (=ei-kosketuksessa). Älä luota anturin signaaleihin koneen liikkeen pysäyttämiseksi.

Renishaw-tuotteiden hätäpysäytys tehdään tavallisesti kytkemällä syöttöjännite pois.

## GR - ΑΣΦΑΛΕΙΑ

### Πληροφορίες για τους χρήστες

Υπάρχει κίνδυνος πιασίματος μεταξύ των κινούμενων μερών όπως και μεταξύ των κινούμενων και στατικών μερών. Δεν πρέπει να κρατείτε την κεφαλή του ανιχνευτή κατά την κίνηση ούτε και κατά τη διάρκεια χειροκίνητων αλλαγών του ανιχνευτή.

Προσοχή - κίνδυνος απροσδόκητων κινήσεων. Οι χρήστες πρέπει να παραμένουν εκτός του χώρου που επηρεάζεται από όλους τους συνδυασμούς λειτουργίας της κεφαλής του αισθητήρα, της προέκτασης και του αισθητήρα.

Σε όλες τις εφαρμογές που συνεπάγονται τη χρήση εργαλειομηχανών και εξαρτημάτων CMM, συνιστάται η χρήση συσκευής προστασίας των ματιών.

Για οδηγίες σχετικά με τον ασφαλή καθαρισμό των προϊόντων Renishaw, ανατρέξτε στο κεφάλαιο MAINTENANCE (ΣΥΝΤΗΡΗΣΗ) στο σχετικό εγχειρίδιο προϊόντος.

Στο εσωτερικό μονάδων της Renishaw που συνδέονται με το κεντρικό ηλεκτρικό ρεύμα δεν υπάρχουν εξαρτήματα που χρειάζονται συντήρηση από το χρήστη. Επιστρέψτε τις ελαττωματικές μονάδες σε εξουσιοδοτημένο κέντρο εξυπηρέτησης πελατών της Renishaw.

Αντικαταστήστε τις καμένες ασφάλειες με νέες ασφάλειες του ίδιου τύπου. Ανατρέξτε στο κεφάλαιο SAFETY (ΑΣΦΑΛΕΙΑ) στο σχετικό εγχειρίδιο προϊόντος.

Αποσυνδέστε το μηχάνημα από το ηλεκτρικό ρεύμα προτού επιχειρήσετε τυχόν εργασίες συντήρησης.

Βλέπετε τις οδηγίες λειτουργίας του προμηθευτή του μηχανήματος.

### Πληροφορίες για τους προμηθευτές των μηχανημάτων

Αποτελεί ευθύνη του προμηθευτή του μηχανήματος να εξασφαλίσει ότι ο χρήστης είναι ενήμερος τυχόν κινδύνων που συνεπάγεται η λειτουργία, συμπεριλαμβανομένων όσων αναφέρονται στο έντυπο συνοδευτικό υλικό των προϊόντων της Renishaw. Είναι επίσης ευθύνη του να εξασφαλίσει ότι υπάρχουν τα απαιτούμενα προστατευτικά καλύμματα και μανδαλώσεις ασφάλειας.

Είναι επίσης ευθύνη του να εξασφαλίσει ότι υπάρχουν τα απαιτούμενα προστατευτικά καλύμματα και συνδέσεις ασφάλειας. Μη βασίζεστε στα σήματα ανιχνευτή για θέση της κίνησης του μηχανήματος εκτός λειτουργίας.

Η αναμενόμενη μέθοδος διακοπής έκτακτης ανάγκης για τα προϊόντα Renishaw είναι η αποσύνδεσή τους από το ηλεκτρικό ρεύμα.

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## EC DECLARATION OF CONFORMITY

Renishaw plc declare that the product: -

Name: TSA and TSI-1  
Description: Tool setting arm and machine interface  
Part numbers: A-2116-XXXX series (TSA)  
A-2116-0210 (TSI-1)

has been manufactured in conformity with the following standards: -

BS EN 61326:1998/ A1:1998/A2:2001	Electrical equipment for measurement, control and laboratory use - EMC requirements. Immunity to annex A - industrial locations. Emissions to class A (non-domestic) limits.
BS EN ISO 12100-1:2003 BS EN ISO 12100-2:2003	Safety of machinery - Basic concepts, general principles for design: Part 1. Basic terminology, methodology. Part 2. Technical principles and specifications.
BSEN 60204-1:1998	Safety of machinery - Electrical equipment of machines - Part 1: General requirements.

and that it complies with the requirements of directives (as amended): -

89/336/EEC - Electromagnetic compatibility (EMC)  
98/37/EC - Machinery  
73/23/EEC - Low voltage

Signature.....*D. R. Whittle*.....  
David R. Whittle  
Laboratory Services Supervisor  
Group Engineering  
Renishaw plc

Dated: 24<sup>th</sup> March 2005

Reference no. ECD2005/09



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## Safety

### TSI-1 interface unit

The unit must be supplied from a 24 V DC SELV supply, complying with the requirements of IEC/EN60950 or equivalent.

The installer is recommended to connect the supplies to TSI-1 such that power is removed when the machine's emergency stop system is activated, unless this has been determined to be unnecessary by risk assessment.

If the unit is operated with the supply option switch ON, no connection must be made to the I/O supply terminals (B3 and B4).

It is essential for continued safety that the onboard fuses (FS1 and FS2) are only replaced by the correct type and rating.

Approved parts are :

FS1 – Renishaw, List No. P-FS02-14A0 or Bussman S500-4A (fuse quick blow 4 A).

FS2 – Renishaw, List No. P-FS02-1A25 or Belling Lee L1427B or Bussman S500-250MA (fuse quick blow 250 mA.)

The power supply(s) connected to the unit must have 0 V connected to the machine star point.

Do not exceed 30 V between any terminal and the machine star point (B5).

Ensure the tool is in a safe state and power is removed from the unit when changing fuses, making wiring connections, or changing switch settings.

# 1 Introduction

## 1.1 Description

The Renishaw TSA tool setting arm can be used for tool setting, workpiece measurement, or in-cycle broken tool detection. It consists of a motorised hub, an arm which can be configured for different applications, an electronic interface, and a probe. It works with a wide variety of controllers with a minimum of interfacing. The arm will move to its respective operational (active) or parked (stow) position only when commanded, and automatically stops when the correct position has been reached. A safety feature has been built into the internal control electronics to stop the motor if an obstruction is reached en route to the active or stow positions.

## 1.2 Definitions

Active	The active position is defined as the operational position for probe measurements to be taken.
Stow	The stow position is defined as the storage position.
Motor supply	Motor, probe and control logic supply: +24 V DC.
Ground	Machine star point/ground.
Input/output (I/O) supply	Voltage supply for all input/output: +12 V to +30 V.
Probe filter option	Activates a probe filter delay circuit which delays PROBE_OUT and its complement by 6.9 ms.
PROBE_OUT (TPT)	High speed probe output status signal. Configured as totem pole transistor output. The signal goes from <b>low</b> to <b>high</b> when triggered. It is debounced with a minimum pulse duration of 25 ms.
PROBE_OUT (OCT)	Open collector transistor output <b>low</b> when probe is seated.
$\overline{\text{PROBE\_OUT}}$ (TPT)	High speed inverted probe output status signal (complement to PROBE_OUT). Configured as totem pole transistor output. The signal goes from <b>high</b> to <b>low</b> when triggered. It is debounced with a minimum pulse duration of 25 ms.
$\overline{\text{PROBE\_OUT}}$ (OCT)	Open collector transistor (OCT) output <b>low</b> when probe is triggered.
ACTIVE CONFIRM	Open collector transistor (OCT) output. When <b>active</b> , confirms that the arm has reached the <b>active</b> position and has not been obstructed.
STOW_CONFIRM	Open collector transistor (OCT) output. When <b>active</b> , confirms that the arm has reached the stow position.

<u>DIRECTION</u>	Commands the arm to travel to the <b>active</b> position when activated. When <b>deactivated</b> , the arm will move to the stow position.
<u>MOVE</u>	Commands the arm to move when <b>activated</b> . When <b>deactivated</b> , the arm will stop regardless of the direction condition.
soft start	An internal acceleration profile feature in the arm drive which functions when the arm is commanded to move. The maximum time to reach either confirm position from initiation of a command will be less than 2 seconds. Soft start will not operate if the arm direction is changed while the arm is in motion.
probe disable	The probe output is disabled in the trigger state when the arm is not in the <b>active</b> position. When the arm reaches the <b>active</b> position it will be enabled. The probe will then operate in the normal manner.
time out	If the arm is physically prevented from reaching the stow position, the supply current to the motor will automatically be cut off after a maximum period of 7.5 seconds $\pm 35\%$ . It will not be possible to subsequently move the arm by changing the state of the direction input. The arm must be reset by setting the move command to its stop condition ( <b>deactivated</b> ), resetting direction input as required, and then setting the move command to its move condition ( <b>activated</b> ).
Safety feature	If the arm is physically prevented from reaching the <b>active</b> position, the supply current to the motor will immediately be cut off. When the obstruction is removed, the arm will continue on to the <b>active</b> position.
Start up	To prevent unwanted arm movement following a loss of power (+24 V), the move command is internally set to the default stop condition upon reapplication of power. It will not be possible to subsequently move the arm by changing the state of the direction input. The arm must be reset by setting the move command from the machine controller to the stop condition ( <b>deactivated</b> ), resetting direction input as required, and then setting the move command to the move condition ( <b>activated</b> ).
Power protection	The motor and IO supplies are individually fused.

**NOTE:** When there are two separate power supplies e.g. +24 V (motor) and +15 V (I/O) undesired arm movement will occur upon reapplication of power if the following two conditions take place at the same time:

- a. The +15 V is applied after the +24 V.
- b. The MOVE command powers up in the “move” condition (on).

## 2 System specification

### 2.1 Arm repeatability

The positional repeatability of the arm including the probe, at a constant temperature is 3 µm (0.00012 in) 2 s, 6 µm span, when fitted with arm lengths of:

**A** 225,0 mm (8.86 in) long.

**B** 285,0 mm (11.22 in) long.

### 2.2 Arm life

The life of the arm is 200,000 operating cycles minimum, (based on 5 years operation at 100 cycles per day).

### 2.3 Cycle time

Cycle time is approximately 2 seconds (from stow to active or from active to stow).

### 2.4 Sealing

The arm is sealed to:

- Dynamic IPX6
- Static IPX8

### 2.5 Weight

A typical TSA installation is shown in figure 1 (see page 21). The weight of this particular configuration is 11 kg (24 lb) approximately.

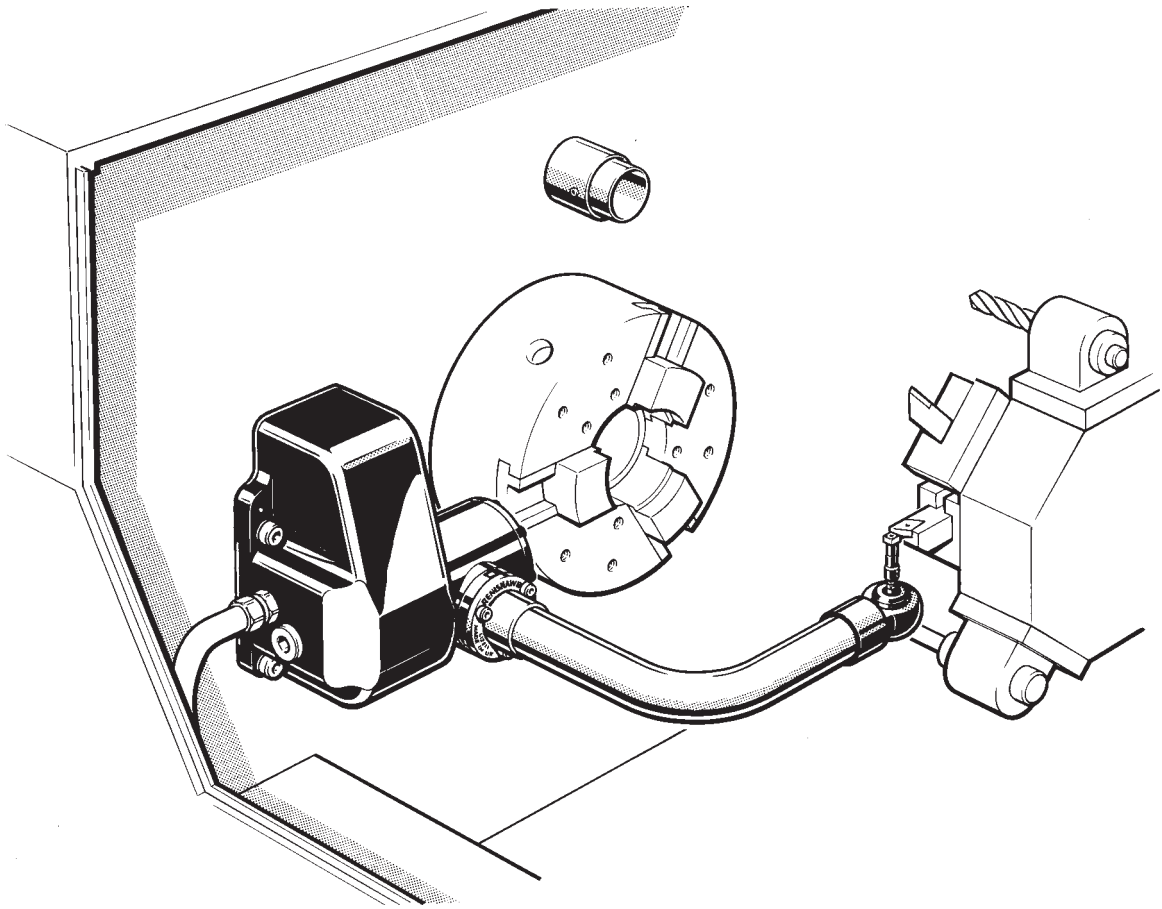


Figure 1 - Typical TSA installation

### 3 TSA components

#### 3.1 Modular design

The modular design allows the TSA to be adapted to a wide range of installations.

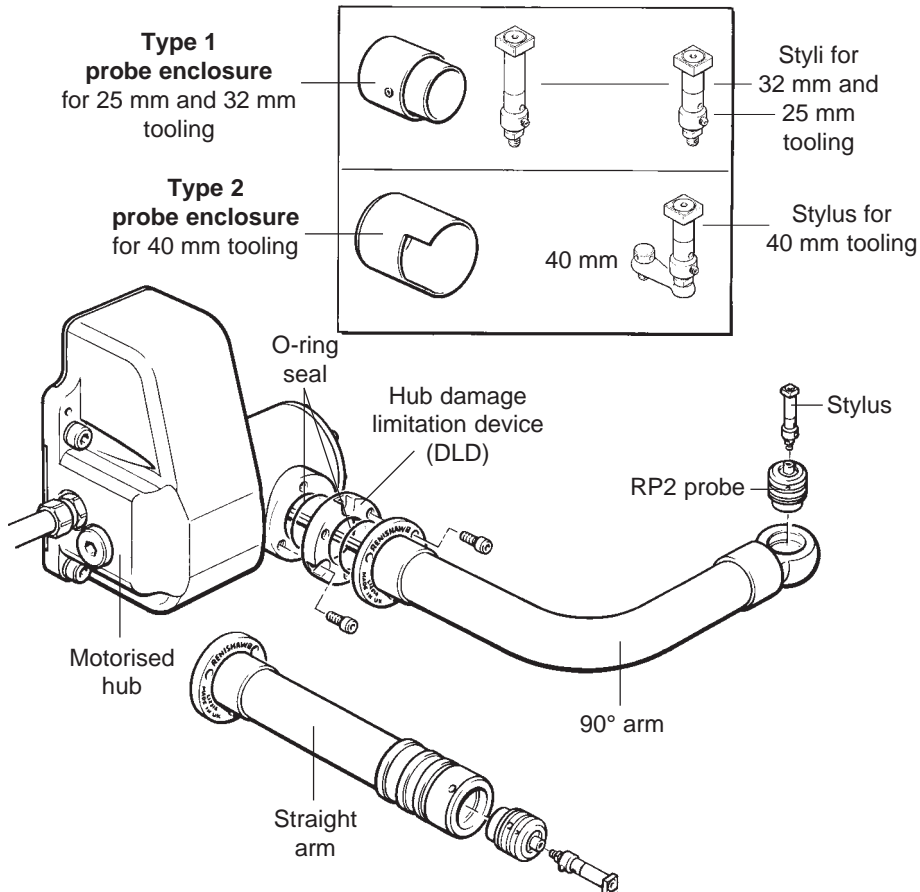


Figure 2 - Modular components

#### 3.2 Motorised hub

The motorised hub houses the drive motor and arm rotation mechanism. It is available in side or rear cable exit options.

#### 3.3 Hub damage limitation device (DLD)

This feature is designed to limit the damage that can be caused to the motorised hub mechanism in the event of a crash. It should be noted that this device will only limit damage occurring to the motorised hub in certain crash conditions. It is not guaranteed to prevent damage occurring. The degree of protection is dependent upon the nature of the crash condition.



### 3.4 Arm assembly

The arm assembly is available in either a cranked or straight configuration. The cranked arm assembly is available in 81 standard configurations. These are specified by two dimensions 'A' and 'B' (see 90 ° arm assembly on page 65). The straight arm assembly is available in 21 standard configurations. These are specified by one dimension 'C' (see straight arm assembly on page 67).

### 3.5 RP2 probe

The RP2 probe is a 3 axis tool setting probe.

#### Specification

Sense directions 5-way

Stylus overtravel 12.5° in X and Y

(as shown in figure 3) 4 mm (0.157 in) in Z

Probe repeatability ( $2\sigma$ ) 1.0  $\mu\text{m}$  (with a 35 mm (1.38 in) stylus at 480 mm/min)

Stylus trigger force Factory set with a 35,0 mm (1.38 in) stylus.

X Y 1.25 N (125 gf/4.4 ozf) maximum in high force direction,

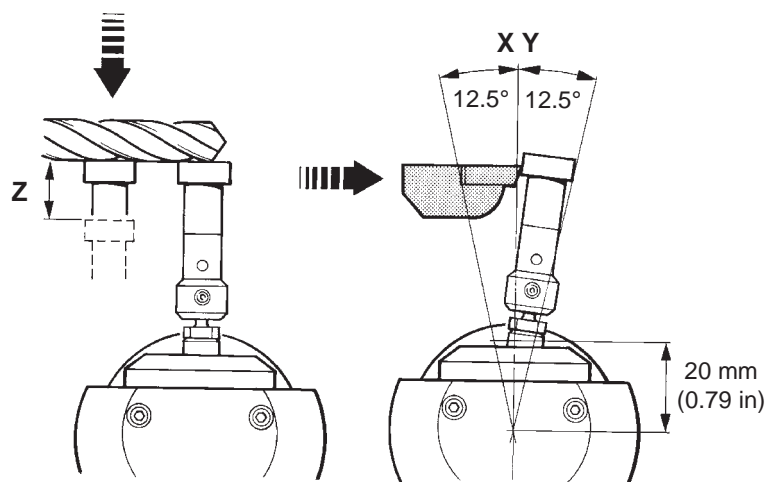
0.7 N (70 gf/2.5 ozf) minimum in low force direction

Z 6.10 N (610 gf/21.5 ozf)

Operating temperature 5 °C to 60 °C (41 °F to 140 °F)

Storage temperature -13 °C to +60 °C (9 °F to 140 °F)

A Renishaw calibration certificate is supplied with each probe.



**Figure 3 - Stylus overtravel limits**

---

**NOTE:** The standard stylus supplied with the TSA has only four probing faces suitable for tool setting in the probe 'X' and 'Y' axis (lathe 'X' and 'Z' axis). If the probe 'Z' axis is to be used (i.e. in the lathe 'Y' axis), then a five-faced stylus is available to order from the custom products group, Renishaw plc.

---

## **Stylus**

Stylus assemblies are available for 25 mm, 32 mm and 40 mm tooling. All options include a stylus crash protection device.

## **Probe enclosure**

A probe enclosure is supplied as standard with the cranked arm probe kit option, it protects the RP2 probe and stylus assembly when the TSA is not in use (i.e. in stow position). Two versions are available and are supplied dependant of the stylus specified. The straight arm option does not include a probe enclosure.

## 4 Hardware installation

### 4.1 Typical TSA installation

A cable conduit and bulkhead fitting is required for the side exit version of the motorised hub.

Flexible conduits with a bore of 12 mm are recommended. These are secured onto the cable gland spigot using a worm drive hose clip (Jubilee clip). These are available from Renishaw (see parts list on page 57). Rigid conduits are not recommended.

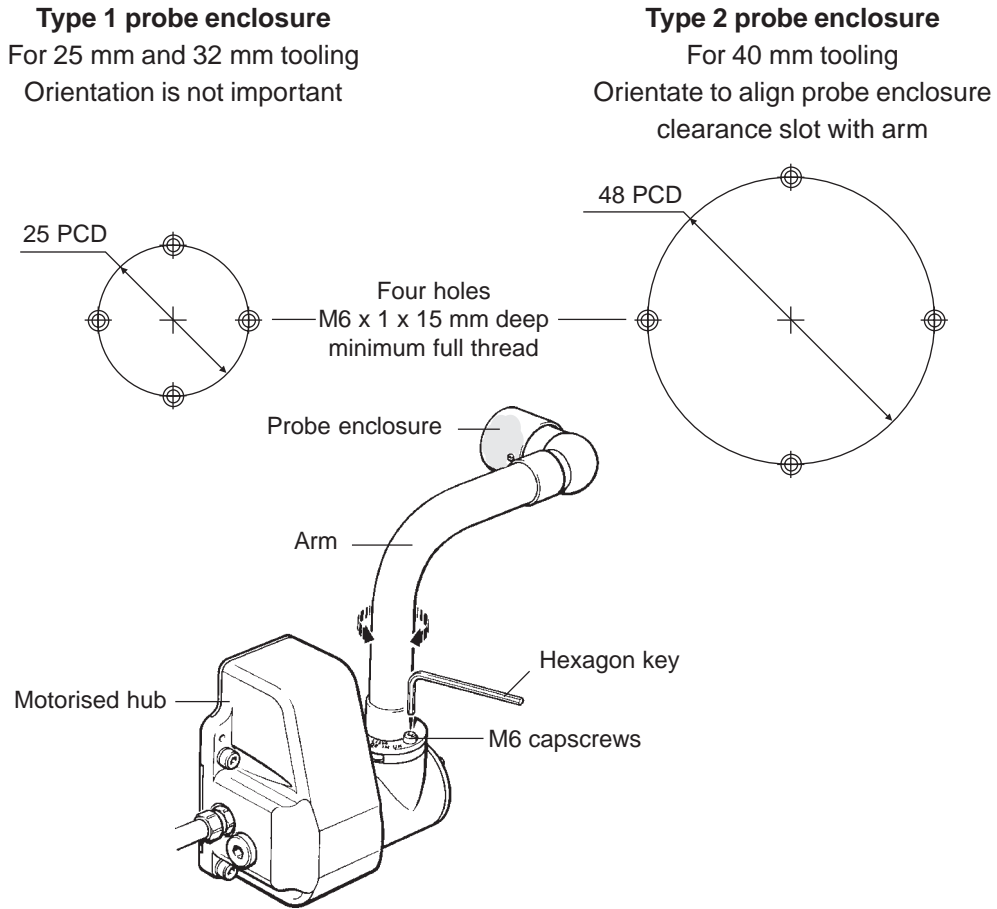
### 4.2 Installing the rear cable exit version

1. Remove the motorised hub from the packaging.
2. Assemble the rear face gasket over the cable and feed the cable through the hole in the machine mounting face (see appendix 1 page 64) for hole requirements).
3. Bolt the motorised hub to the machine using the four M8 cap head screws and lock washers (supplied). Tighten to a torque of 29 Nm (257 lbf.in).

---

**NOTE:** It is important to fit the four lock washers, as this prevents movement of the motorised hub mounting under shock/vibration conditions.

---



**Figure 4 - Probe enclosure and arm rotation**

4. Remove the arm from the packaging.
5. Loosely secure the arm to the motorised hub using three M6 capscrews (supplied).
6. If supplied, remove the probe enclosure from the packaging.
7. Loosely secure the probe enclosure in position on the machine using the four M6 capscrews (supplied). Correct alignment of the probe enclosure to the probe can be achieved by rotating the arm (see figure 4). Tighten the probe enclosure screws to a torque of 12 Nm (106 lbf.in).
8. Fully tighten the three M6 capscrews after having rotated the arm to the required position. Tighten to a torque of 12 Nm (106 lbf.in).

**NOTE:** For a type 1 probe enclosure, ensure there is free movement of the moveable part of the probe enclosure.

For a type 2 probe enclosure, ensure there is clearance between it and the probe holder.

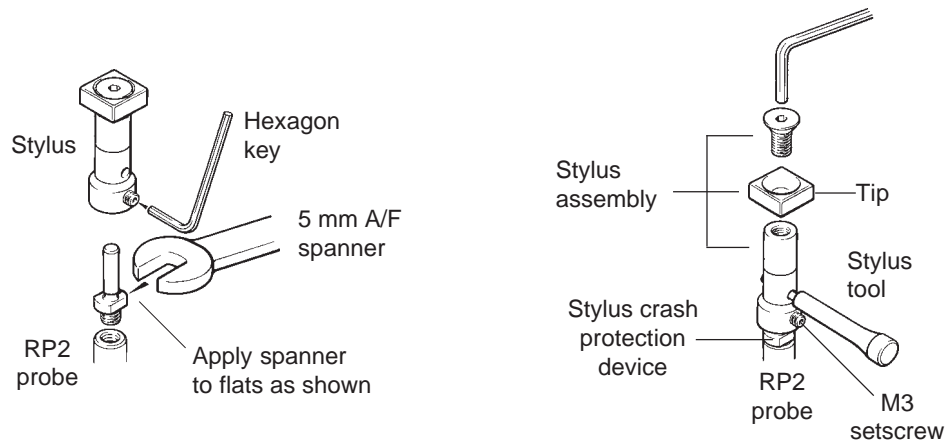
9. Connect wiring to controller (see wiring diagram on page 41).
10. Move arm to the active position (see operation on page 43).

11. Fit the stylus to the RP2 probe using the 5 mm A/F spanner provided in the tool kit.



**CAUTION:** The stylus crash protection device is brittle. Care must be taken when tightening the stylus TO the probe (see figure 5).

12. Align the stylus (see stylus rotational height adjustment on page 28).



**Figure 5 - Fitting a stylus to the RP2 probe**

### 4.3 Installing the side cable exit version

1. Remove the motorised hub from the packaging.
2. Feed the cable through the conduit.
3. Bolt the motorised hub assembly to the machine using the four M8 cap head screws and lock washers (supplied). Tighten to a torque of 29 Nm (257 lbf.in).

**NOTE:** It is important to fit the lock washers (4 off), as this prevents movement of the motorised hub mounting under shock/vibration conditions.

4. Remove the arm from the packaging.
5. Loosely secure the arm to the motorised hub using the three M6 capscrews (supplied).
6. Remove the probe enclosure from the packaging (if supplied).
7. Loosely secure the probe enclosure in position on the machine using the four M6 capscrews (supplied). Correct alignment of the probe enclosure to the probe holder can be achieved by rotating the arm (see figure 4).

Tighten the probe enclosure screws to a torque of 12 Nm (106 lbf.in).

8. Fully tighten the three M6 capscrews after having rotated the arm to the required position. Tighten to a torque of 12 Nm (106 lbf.in).

---

**NOTE:** For a type 1 probe enclosure, ensure there is free movement of the moveable part. For a type 2 probe enclosure, ensure there is clearance between it and the probe holder.

---

9. Connect wiring to controller (see wiring diagram on page 41).
  10. Move arm to the active position (see operation on page 43).
  11. Fit the stylus to the RP2 probe using the 5 mm A/F spanner provided in the tool kit.
- 



**CAUTION:** The stylus crash protection device is brittle. Care must be taken when tightening the stylus TO the probe (see figure 5).

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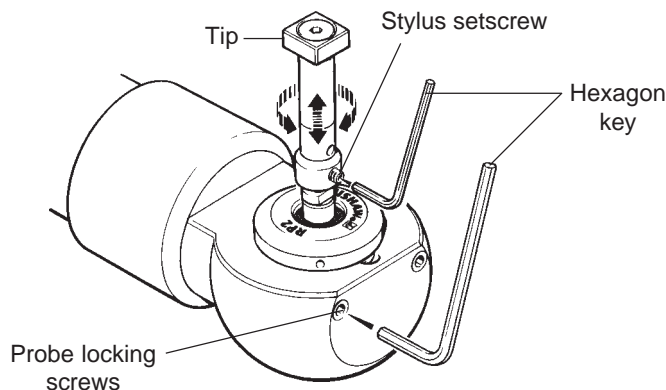
12. Align the stylus (see stylus rotational height adjustment below).

#### 4.4 Stylus rotational and height adjustment

The stylus can be adjusted rotationally and in height, allowing the user to align the stylus with the chuck centreline and machine axis.

Rotational and height adjustment are achieved using the following procedure (see figure 6).

1. Loosen the stylus setscrew.
2. Rotate stylus assembly for approximate tip to machine axis alignment. Height adjustment is achieved by raising or lowering the stylus on its mounting within a 3 mm (0.118in) limit.
3. Tighten the stylus setscrew.
4. Precise rotational alignment is carried out by alternately loosening and tightening the probe locking screws. Ensure both probe locking screws are tightened to approximately 4,5 Nm (39.83 lbf.in) at the end of adjustment.



**Figure 6 - Aligning the stylus**

## 5 Electrical inputs/outputs

### 5.1 TSI-1 interface module

The TSA is connected to the machine tool control via the TSI-1 interface module (see wiring diagram on page 41). The unit is housed in a standard DIN rail mounting and has a protective cover.

#### DIN rail mount

1. Fit the DIN rail mount onto back of casing.
2. Slide the PCB into the casing.
3. Fit end cover. Press to make a snap fit.

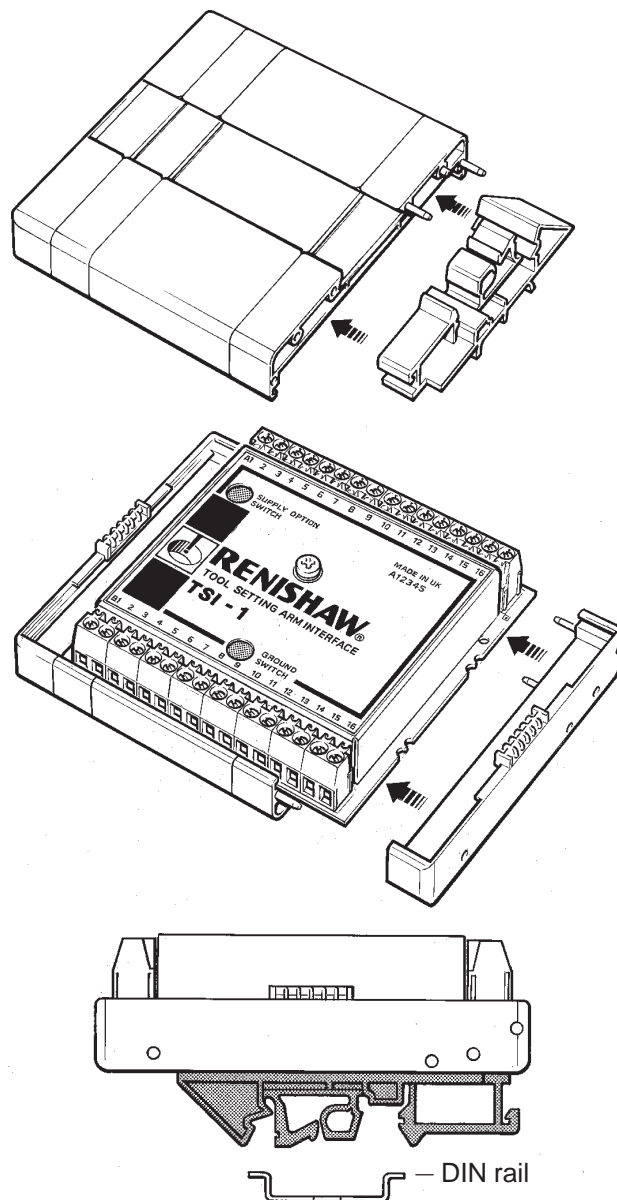
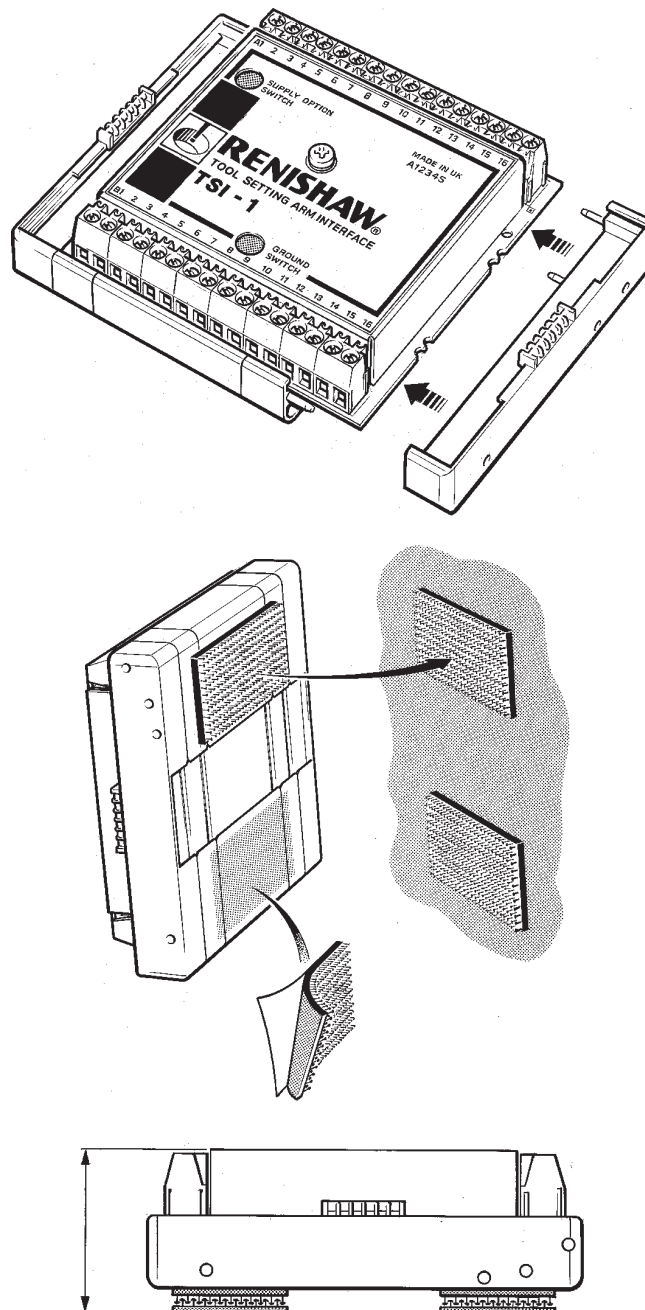


Figure 7

**Dual lock pad – self adhesive pads are provided as an alternative mounting**

1. Slide the PCB into the casing.
2. Fit the end cover. Press in to make a snap fit.
3. Remove the backing strip from dual lock pad.
4. Stick two pads on back of casing and two equally spaced pads onto flat surface.
5. Press the dual lock pads together to mount TSI-1.
6. Pull apart to remove TSI-1 from mounting surface.

**Figure 8**



---

## 5.2 Power supplies



**WARNING:** The installer is recommended to connect the supplies to TSI-1 such that power is removed when the machine's emergency stop system is activated, unless this has been determined to be unnecessary by risk assessment.

The maximum voltage which can be supplied to any terminal of the TSI-1 interface module with respect to the machine star point is  $\pm 30$  V.

---

There are two voltage supplies to the TSI-1 interface module :

- The motor supply
- The I/O supply.

### Motor supply B1 and B2

Supply voltage: 24 V DC (+20 % –10 %)

Maximum current: 3 A while the motor is running (maximum time is 7.5 seconds under fault conditions).

Nominal current: 100 mA while the motor is stationary.

### I/O supply B3 and B4

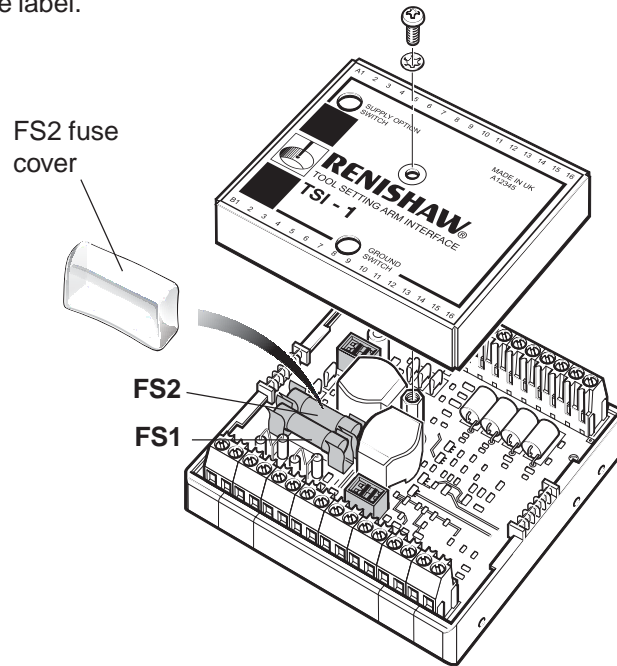
The supply powers the I/O circuitry. It is isolated from the motor supply.

Supply voltage: +12 V to +30 V DC.

Nominal current: 200 mA (with maximum machine tool control loading).

### 5.3 Fuses

The motor supply is protected by a 4 A (FF) fuse (FS1). The I/O supply is protected by a 250 mA (FF) fuse (FS2). Both fuses are mounted in fuse holders and are made accessible by removing the cover. The cover is held on by a single fixing screw located in the centre of the label.



**CAUTION:** To prevent the holders for fuses FS1 and FS2 touching and creating a short-circuit, a flexible fuse holder cover is fitted over fuse FS2. This simple push-fit cover can easily be removed to allow access to the fuse for replacement purposes. Following fuse replacement, it is important that you do not forget to replace the cover.

Figure 9

### 5.4 Common motor and I/O power supplies

The default setting of the TSI-1 requires it to be supplied with separate power supply connections to the motor supply (B1 and B2) and to the I/O supply (B3 and B4). This allows isolation to be maintained between the power and the control voltage supplies.

For installations where the same voltage supply is to be used for both the motor supply and the I/O supply, the TSI-1 can be set to internally common the supplies (see switch settings on page 42). This eliminates the I/O supply wiring.



**WARNING:** If this option is selected then the I/O supply terminals (B3 and B4) must be left disconnected or short circuiting of external voltage supplies will occur.

### 5.5 EMC precautions

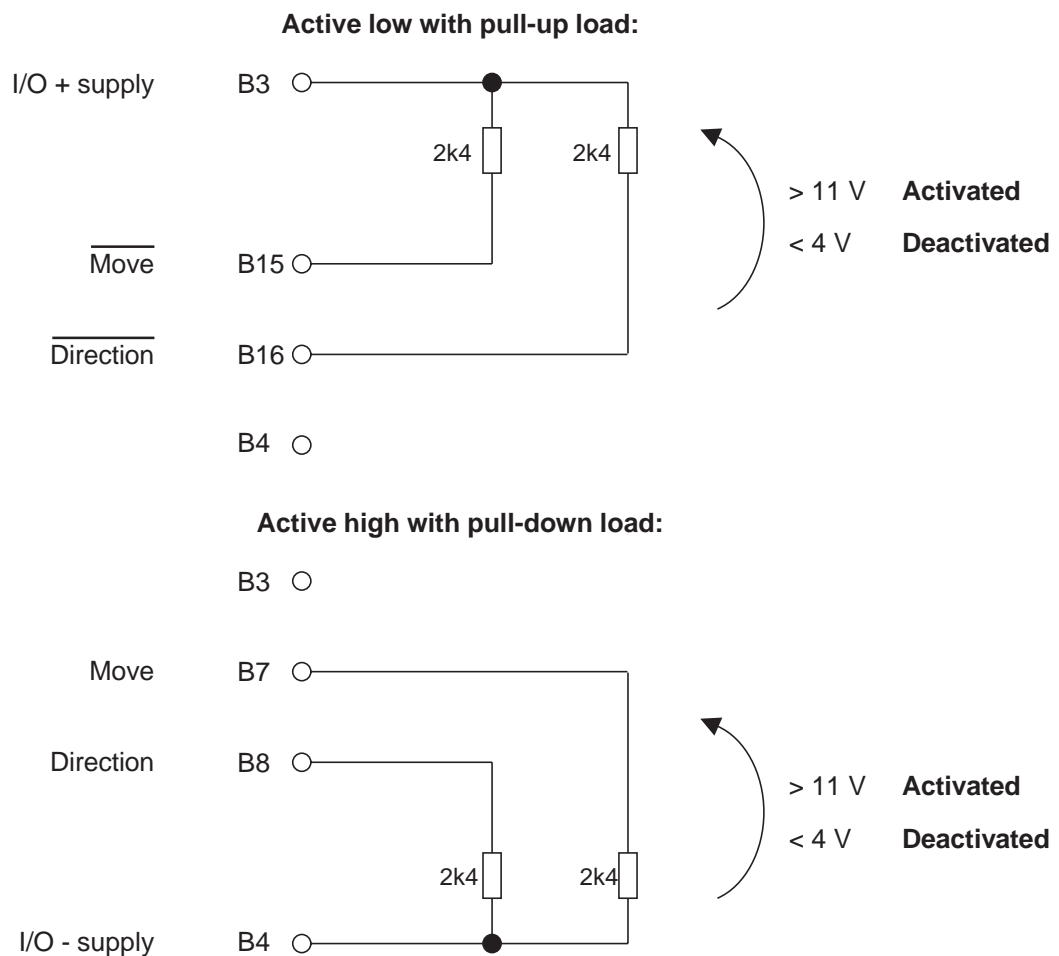
Anti-static precautions should be observed when installing the TSA system. The part of the machine upon which the TSA is mounted must be electrically connected to the machine star point. Screened cable is recommended for probe out (OCT) and inverted probe out (OCT) when driving a TTL input. Also for all TSI-1 to CNC control connections where all cable lengths of 3 m to 10 m (9.8 ft to 32.8 ft) are used and interference may be encountered.

## 5.6 Machine star point

Terminal B5 is the ground reference for the EMI suppressors/filters and must be connected to the machine star point with short, low impedance wire or braid. The EMC performance of the TSA system relies on this connection. If there are high interference levels or a poor machine star point connection, the ground switch can be opened and two separate low impedance wires or braids can be connected between the machine star point and the terminals B5 and B6. This separates the return path for surge currents from the EMI filter ground.

## 5.7 Control inputs

There are two control input commands : move and direction (see figure 10). When the move command is activated the arm will move to the position commanded by the direction input. When the direction command is activated, the move is to the active position, and when deactivated, it is to the stow position.



**Figure 10 - Each control input can be configured in one of two ways**

**NOTE:** The inputs are therefore easily configured to operate in the desired mode by selecting the appropriate TSI-1 'B' terminals for connection to the machine control.

Table 1		
Control inputs		
Move	Direction	
Activated	Deactivated	Move to stow
Activated	Activated	Move to active
Deactivated	-	Arm stationary

#### Active low with pull-up load:

**Activated input** An **activated** input is defined as having a voltage of greater than 11 V between the I/O + supply (B3) and the input (B15/B16). The input load is a 2k4 resistor.

**Deactivated input** A **deactivated** input is defined as having a voltage of less than 4 V between the I/O + supply (B3) and the input (B15/B16).

---

**NOTE:** It is deactivated when disconnected.

---

#### Active high with pull-down load:

**Activated input** An **activated** input is defined as having a voltage greater than 11 V between the input (B7/B8) and the I/O – supply (B4). The input load is a 2k4 resistor.

**Deactivated input** An **deactivated** input is defined as having a voltage less than 4 V between the input (B7/B8) and the I/O – supply (B4).

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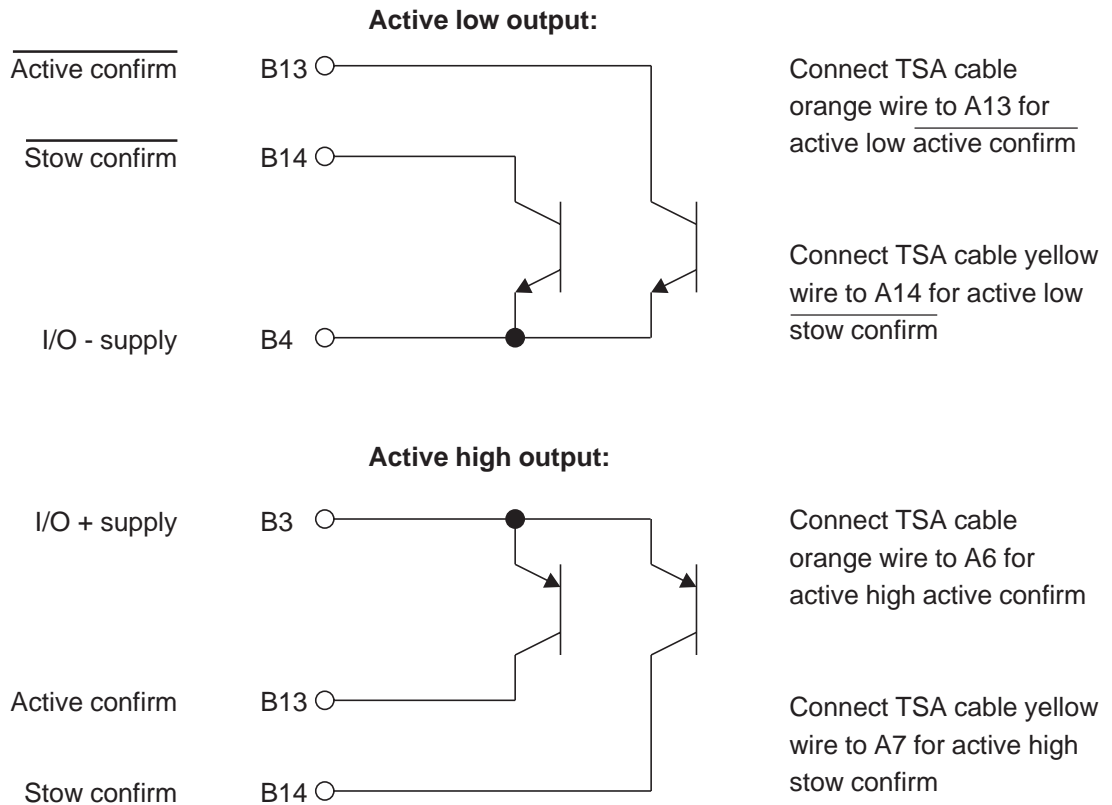
**NOTE:** It is deactivated when disconnected.

---

## 5.8 Confirm outputs

There are two confirm output signals: stow confirm and active confirm (see figure 11).

The confirm outputs are open collector outputs. When the arm is in the stow position the stow confirm output is active and when in the active position the active confirm output is active.



**Figure 11 - Each confirm output can be confirmed in one of two ways**

**NOTE:** The outputs are configured by the way in which the TSA cable yellow and orange wires are connected to the 'A' terminal block of the TSI-1.

	Confirm outputs	
	Stow_Confirm	Active_Confirm
Arm stowed	Active	Inactive
Arm moving	Inactive	Inactive
Arm active	Inactive	Active

**Active low inputs:**

**Active output** An **active** output is defined as having a voltage of less than 1.5 V at 20 mA load and less than 1.2 V at 10 mA load, with respect to the I/O – supply (B4).

**Inactive output** An **inactive** output is defined as having a leakage current of less than 100  $\mu$ A.

**Active high outputs:**

**Active output** An **active** output is defined as having a voltage of less than –2.4 V at 20 mA load and less than –2.1 V at 10 mA load with respect to the I/O + supply (B3).

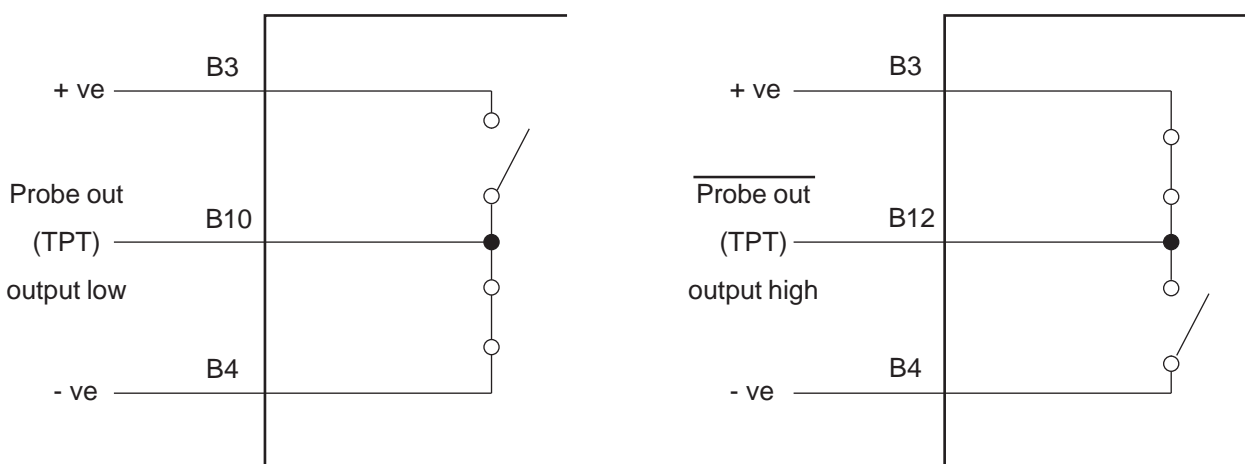
**Inactive output** An **inactive** output is defined as having leakage current of less than 100  $\mu$ A.

## 5.9 Probe output

There are two complimentary outputs:

- Probe out.
- Inverted probe out (see figure 12).

The probe outputs are totem pole transistor (TPT). This type of output is like two relay contacts switching the output to the negative I/O voltage supply (B4) or to the positive I/O voltage supply (B3). A low output is when the output is switched to the negative I/O voltage supply and a high output is when it is switched to the positive I/O voltage supply.



**Figure 12**

When the probe is seated probe out is low and inverted probe out is high (see figure 13). When the probe is triggered the outputs will be switched to the opposite supplies. When the arm is not in the active position the outputs are defaulted to the probe triggered state.

Because each output is either switched to the positive or negative supply both pull-up and pull-down loads can be driven with the same output configuration.

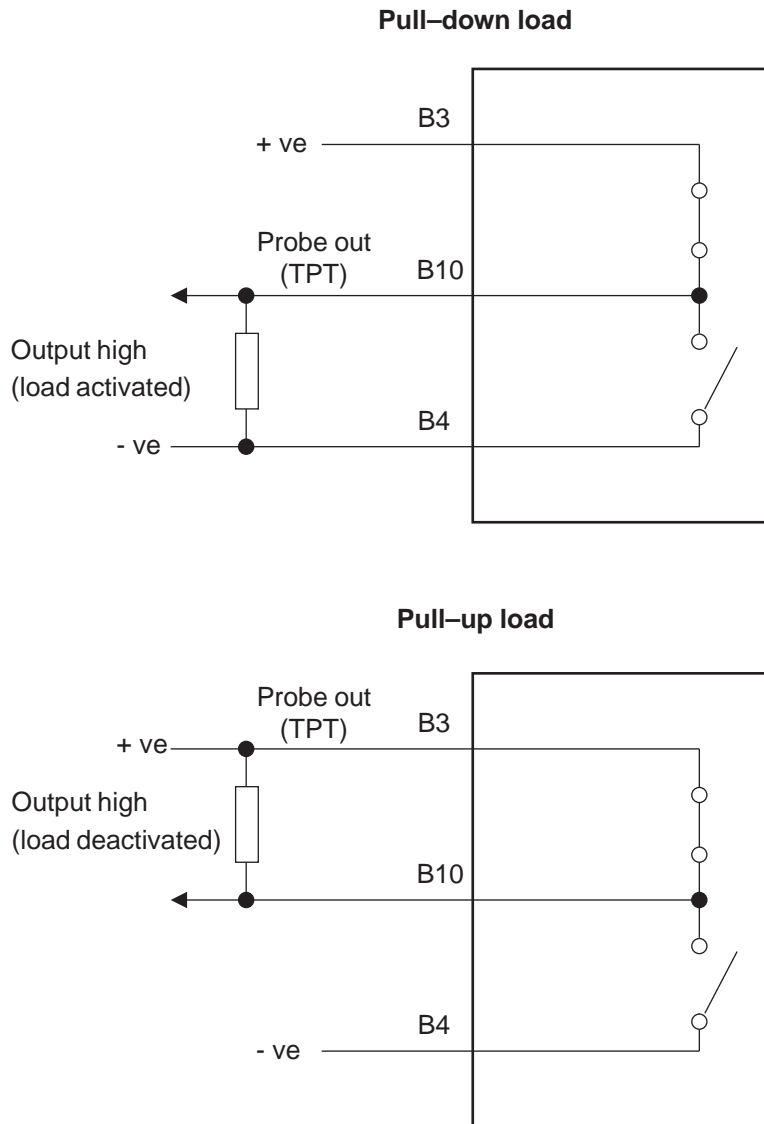


Figure 13 - e.g. probe triggered

	Probe outputs	
	Probe out (TPT)	Inverted probe out (TPT)
Probe seated and arm active	Low	High
Probe triggered and arm active	High	Low
Arm moving or stowed	High	Low

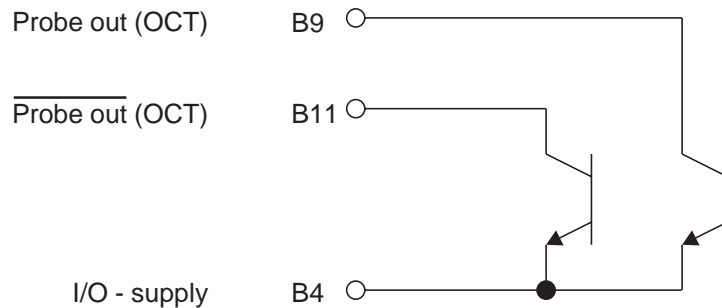
- Low output** A low output is defined as having a voltage of less than 2.8 V at a pull-up load current of 20 mA and less than 2.2 V at a pull-up load current of 10 mA.  
Voltages are with respect to the I/O – supply (B4).
- High output** A high output is defined as having a voltage of less than – 3.6 V at a pull-down load current of 120 mA and less than – 2.8 V at a pull-down load current of 20 mA.  
Voltages are with respect to the I/O + supply (B3).

## 5.10 Complimentary open collector transistor (OCT) probe outputs

There are two complimentary open collector transistor probe outputs :

- Probe out (OCT).
- Inverted probe out (OCT) (see figure 14).

When the probe is seated probe out (OCT) is active and inverted probe out (OCT) is inactive. When the probe is triggered the outputs will be switched to their opposite states. When the arm is not in the active position the outputs default to the probe triggered state.



**Figure 14**

<b>Table 4</b>		
	<b>Probe (OCT) outputs</b>	
	<b>Probe out (OCT)</b>	<b>Inverted probe out (OCT)</b>
Probe seated and arm active	Active	Inactive
Probe triggered and arm active	Inactive	Active
Arm moving or stowed	Inactive	Active



<b>Active output</b>	An active output is defined as being: Less than 0.4 V at a pull-up load current of 10 mA. Less than 0.6 V at a pull-up load current of 20 mA. Voltages are with respect to the I/O – supply (B4).
<b>Inactive output</b>	An inactive output is defined as having less than 100 $\mu$ A leakage current.
<b>TTL compatibility</b>	The probe out (OCT) outputs are TTL compatible when connected to a load resistor of no less than 470 Ohms supplied from a standard TTL supply voltage (5 V $\pm$ 5 %).

## 5.11 Probe vibration filter

If probe triggers caused by vibration or shock are a problem, a probe filter delay can be enabled by connecting the TSA cable white wire to A9 instead of A8. This filter delays the probe signal for 6.9ms  $\pm$ 15%, and only if the probe stays triggered for this period is a probe change of state reported. This option should only be used if the feed rate remains constant during gauging.

## 5.12 Probe trigger timing

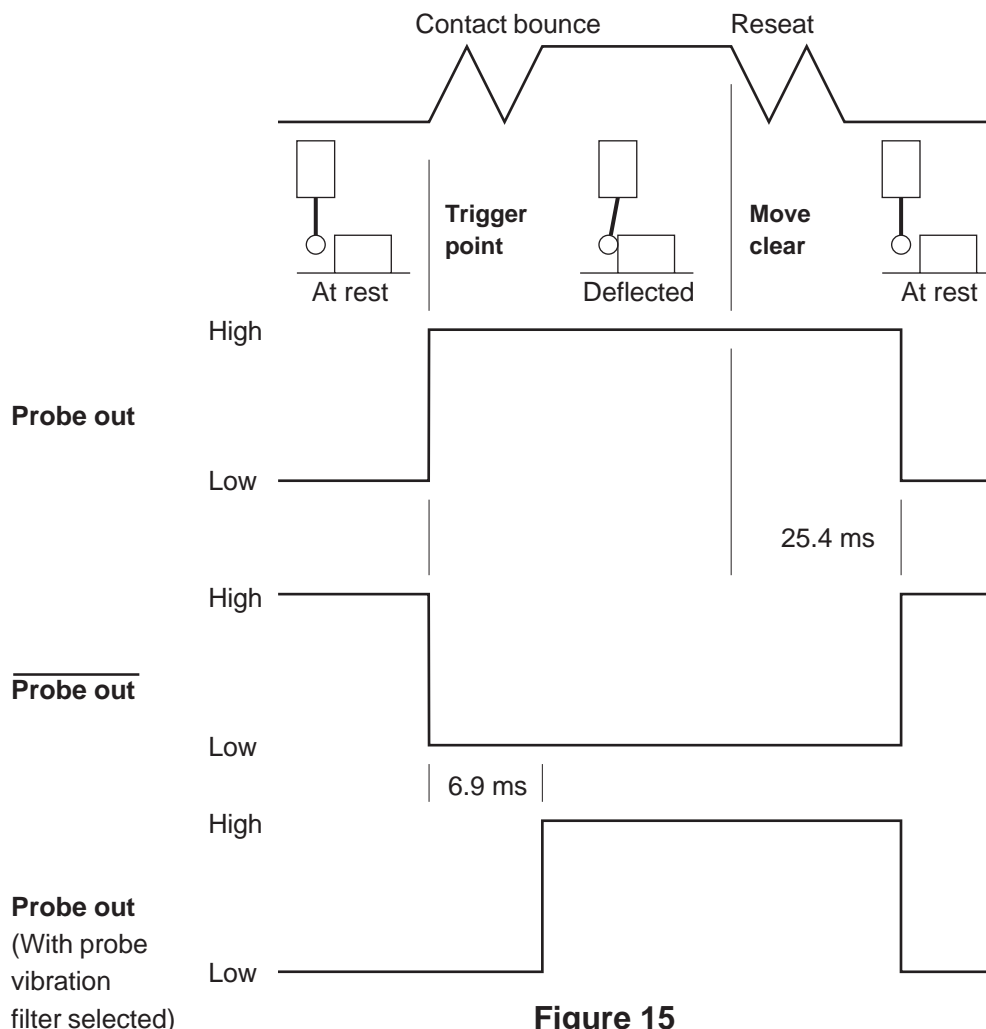


Figure 15

## 5.13 Cable

### TSA to TSI-1 interface module cable

11-core composite cable with overall screen and polyurethane sheathing.

2 x 19/0.03 mm motor power cores (1 x red, 1 x black).

9 x 10/0.125 mm signals and I/O power.

5 m of cable is supplied as standard.

Maximum length of additional extension cable is 3 m (i.e. total 8 m max).

### TSI-1 interface module to the machine control

The TSA interface module should be positioned close to the machine controls and power connections, so that interconnecting wiring can be kept to less than 3 m in length.

### Recommended interconnecting wires

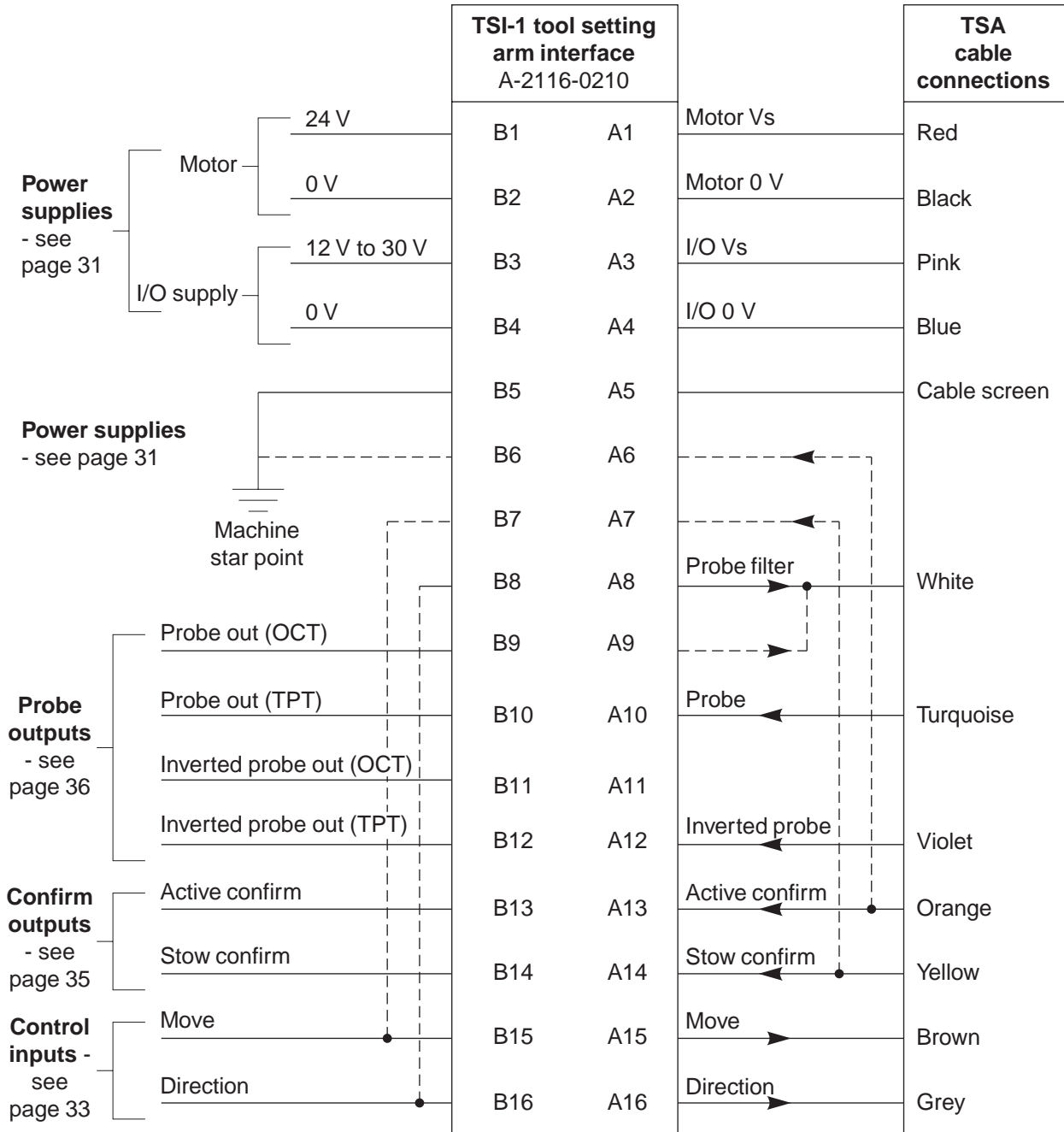
Signal and I/O supply wiring can be standard equipment wire.

e.g. 7/0.2 mm (0.22 mm<sup>2</sup>).

Motor supply should be 24/0.2 mm (0.75 mm<sup>2</sup>) or thicker, to minimise voltage drops.

Ground/machine star point connection should be a minimum impedance connection to ensure good EMC performance. Therefore a multi-strand wire as near to the terminals maximum wire size (2.5 mm<sup>2</sup>) should be used and kept as short as possible, e.g. 50/0.025 mm<sup>2</sup>.

### 5.14 Wiring diagram



## 5.15 Supply option switch

The TSI-1 is supplied with the supply option switch in the OFF position. For use see power supplies page 31.

## 5.16 Ground switch

The TSI-1 is supplied with the ground switch in the ON position. For use see power supplies page 31.

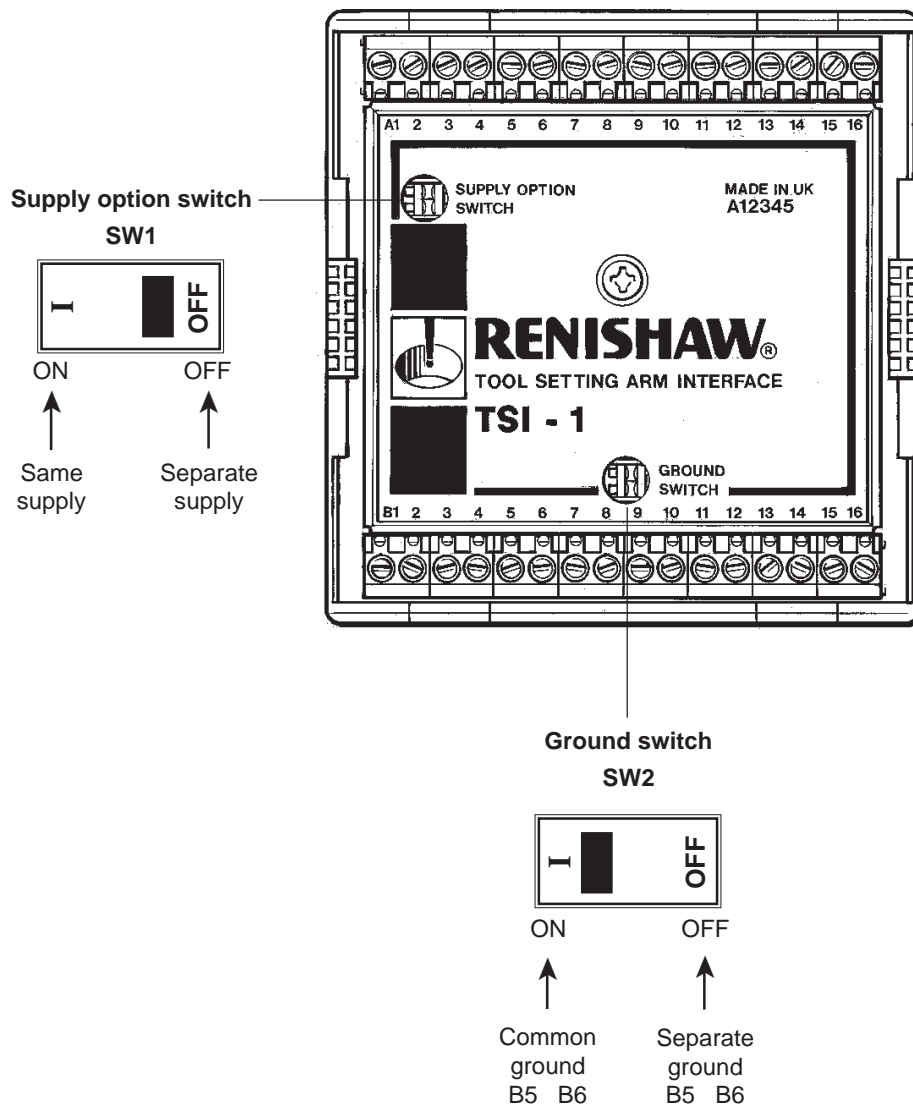
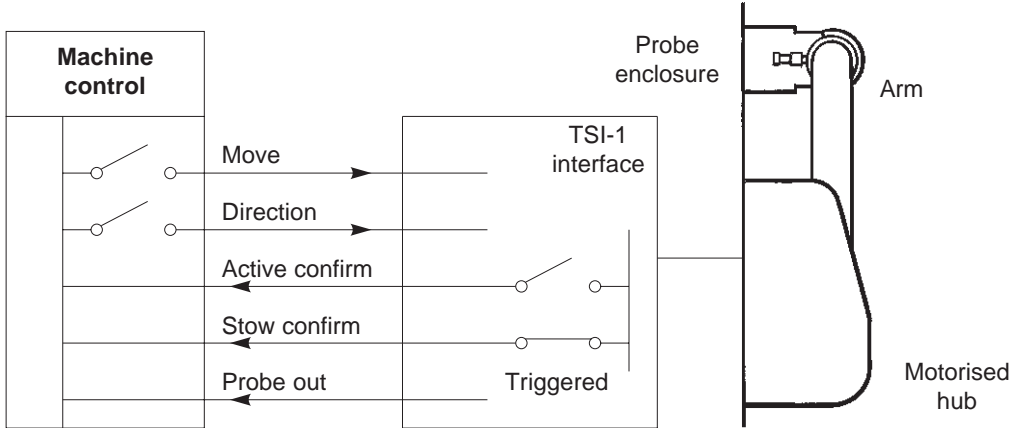
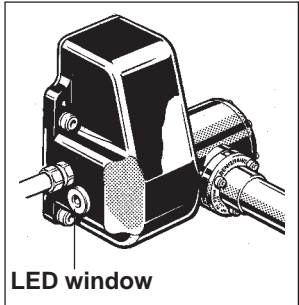


Figure 16

# 6 Operation

## 6.1 Stow to active operation

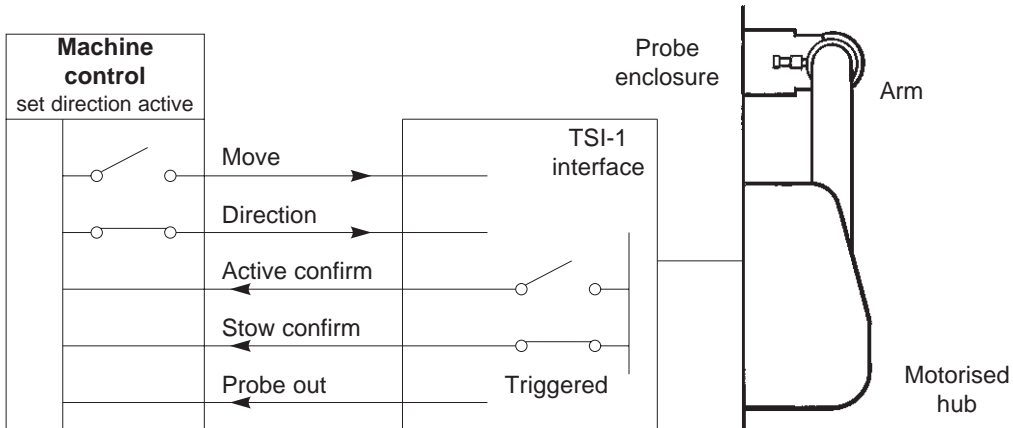
Figures 17 to 20 show the sequence of events to operate the arm from the stow to the active position. The arm must be calibrated in the active position (see calibration on page 50). Re-calibration is necessary periodically (at least every 6 months) depending upon particular circumstances. The arm is a piece of precision gauging equipment and must always be handled with care. In the event of collision it must be re-calibrated. See page 61 for diagram showing LED status.



**System status**  
**Arm** Stowed  
**Probe** Inhibited (triggered)

Diagnostic LED status				
Move	Direction	Stow confirm	Active confirm	Probe status
Off	Off	Amber	Off	Red

Figure 17



**System status**  
**Arm** Stowed  
**Probe** Inhibited (triggered)

Diagnostic LED status				
Move	Direction	Stow confirm	Active confirm	Probe status
Off	Red	Amber	Off	Red

Figure 18

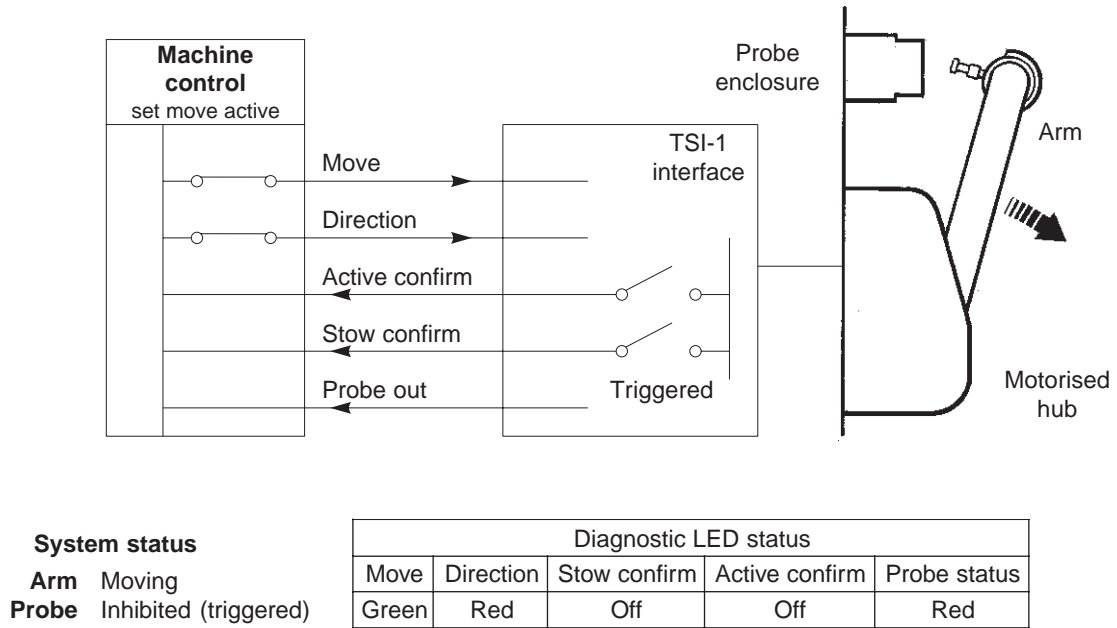


Figure 19

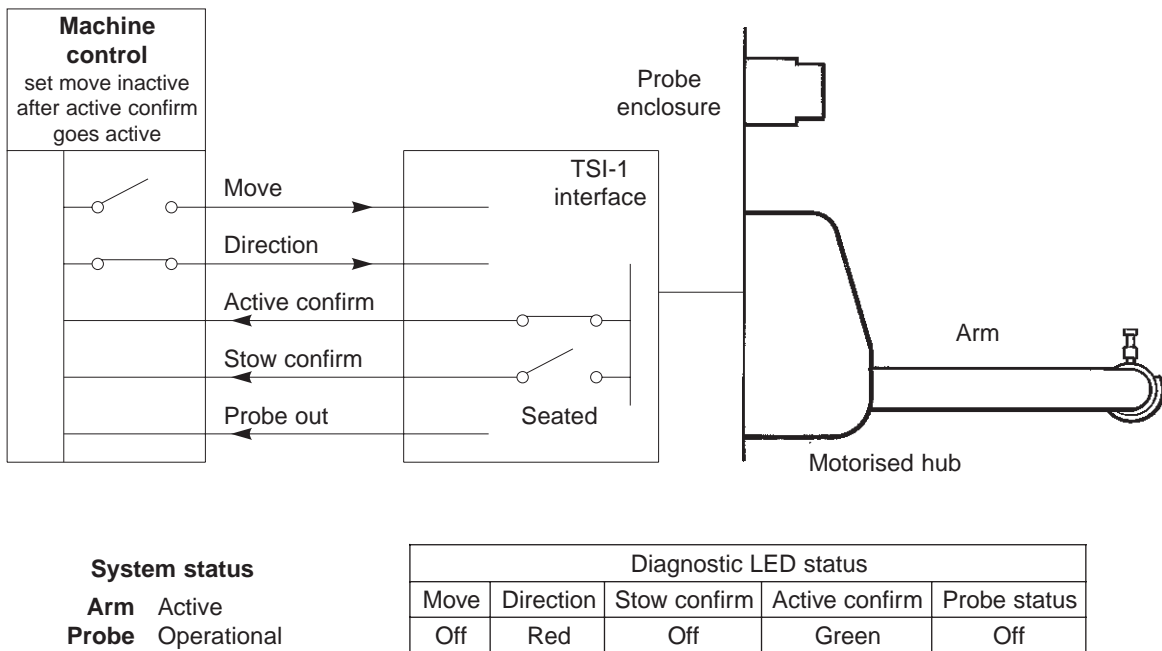


Figure 20

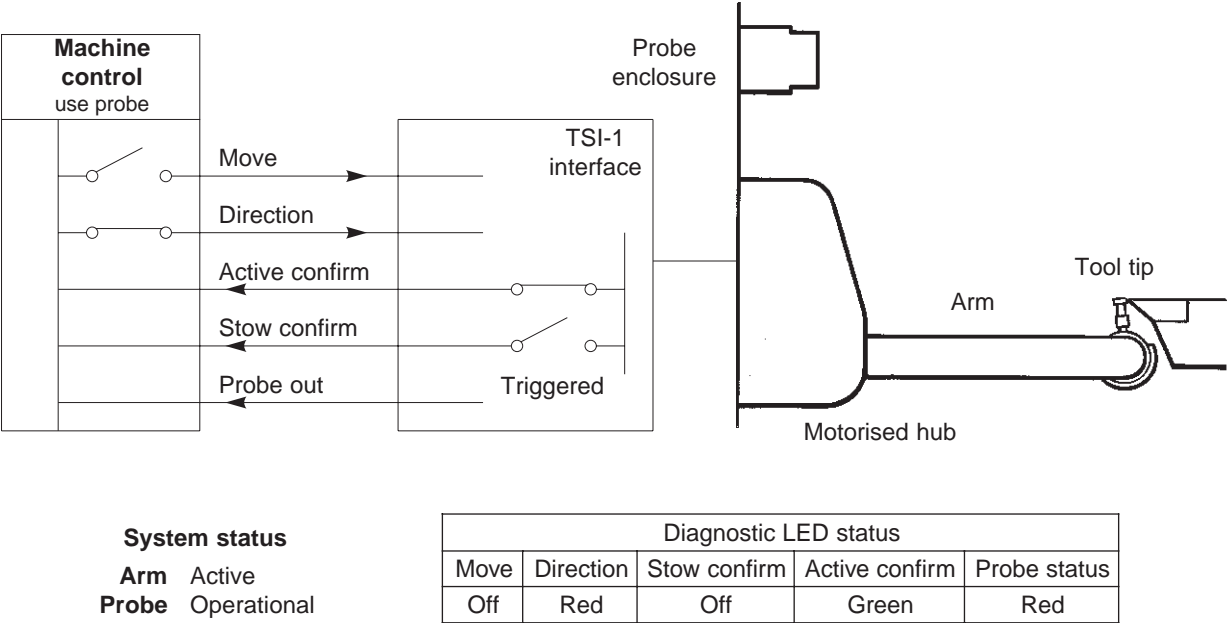


Figure 21

### 6.2 Active to stow operation

Figures 22 to 24 show the sequence of events to operate the arm from the stow to the active position.

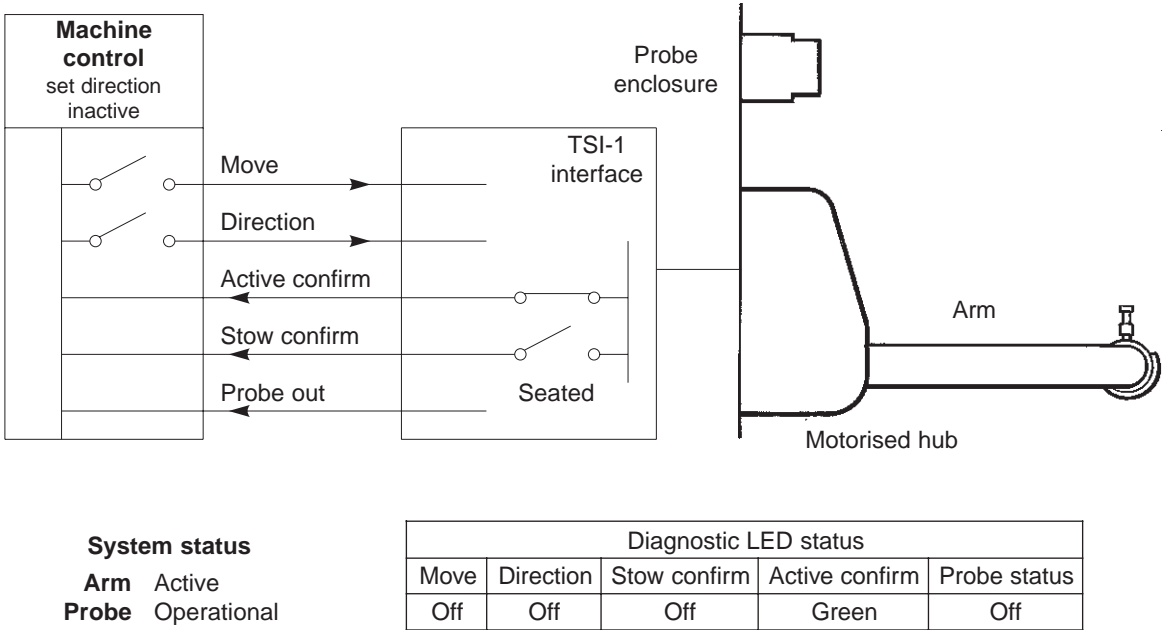
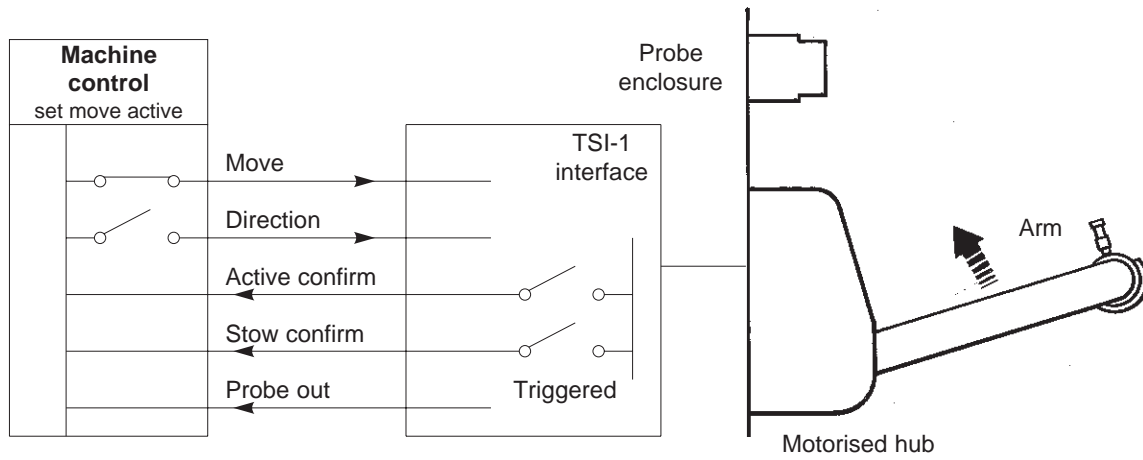


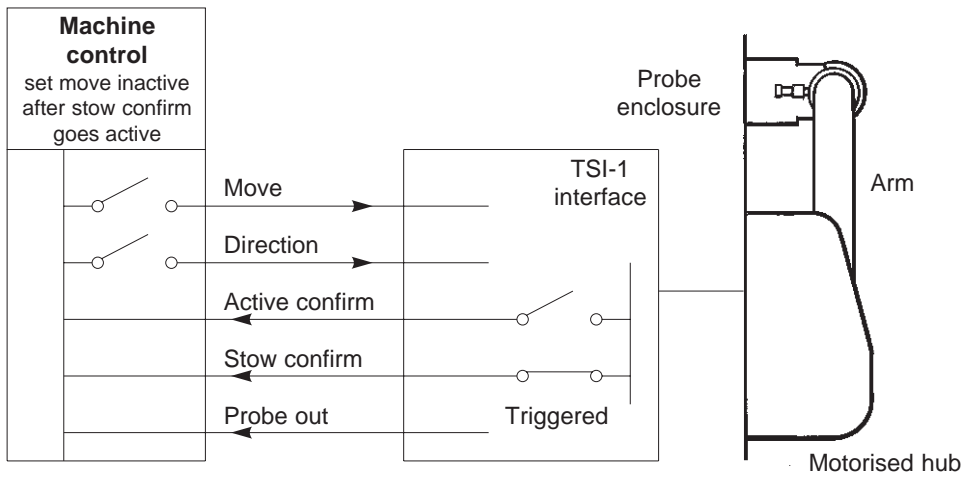
Figure 22



**System status**  
**Arm** Moving  
**Probe** Inhibited (triggered)

Diagnostic LED status				
Move	Direction	Stow confirm	Active confirm	Probe status
Green	Off	Off	Off	Red

Figure 23



**System status**  
**Arm** Stowed  
**Probe** Inhibited (triggered)

Diagnostic LED status				
Move	Direction	Stow confirm	Active confirm	Probe status
Off	Off	Amber	Off	Red

Figure 24



## 7 Tool setting

### 7.1 Tool setting definitions

**Probe datuming** determines the relationship between the machine spindle and the stylus location, as well as the effective size of the tool setting stylus.

Your Renishaw tool setting probe can be datumed by measuring a 'datum tool' of known size and position.

**Tool setting** establishes the size and position of your cutting tools before you use them to machine a component. This allows you to produce parts 'Right first time'.

With a Renishaw tool setting probe you can determine the size and position of your cutting tools quickly and easily.

**Tool breakage detection** checks the length of tools to see if the tool has chipped or broken since it was last set.

### 7.2 Probe datuming

#### Why datum the probe?

A Renishaw touch trigger probe allows you to use your machine tool to determine the size and position of your tools. When the stylus contacts the surface of your tool, the positions of the machine axes are recorded at that moment.

To determine the location of the surface of the tool, the software must know the size and position of the stylus.

Various probe datuming techniques allow you to determine the relationship between the stylus and the machine spindle.

Whilst the spindle/stylus relationship will not change under normal conditions, there are certain circumstances under which the tool setting probe should be re-datumed:

- Before using the probe for the first time on the machine.
- Whenever a new stylus is fitted.
- If any adjustment of probe alignment has been performed.
- If it is suspected that the stylus has become distorted.

## 7.3 Setting tools

### Setting tool lengths

Tools can be set for length in one of two ways:

Static.

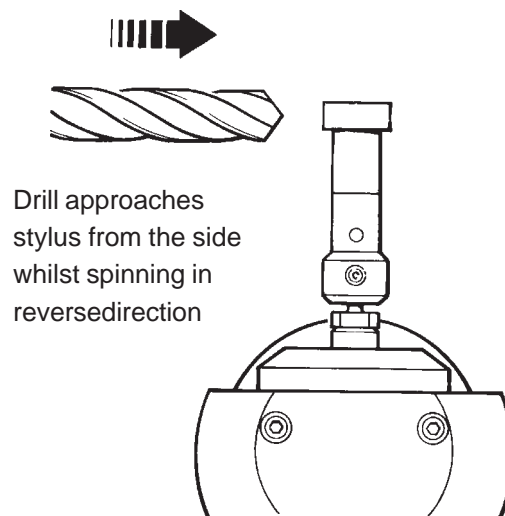
Rotating.

Static length setting is suitable for tools whose cutting edge is located on the spindle centreline (e.g. a drill). In contrast, rotating length setting is suitable for tools whose cutting edges are located around its circumference (e.g. slot drill).

**Static length setting** involves moving the tip of a tool to contact the stylus see figure 25.

**Rotating length setting** (for driven tools) involves moving the tool to contact the stylus with the tool rotating against the normal cutting direction.

Rotating length setting ensures that the true high or low point of the tool is detected.



**Figure 25 - Length setting**

### Setting tool diameters

Tools which are used to interpolate features (e.g. slot drills) must be set for diameter.

Rotating diameter setting (for driven tools) involves moving the side of the tool to contact the stylus tip.

Similar to rotating length setting, when setting a tool for diameter it must be spun opposite to the normal direction used for cutting (to protect the stylus). Rotating diameter setting is shown in figure 26.

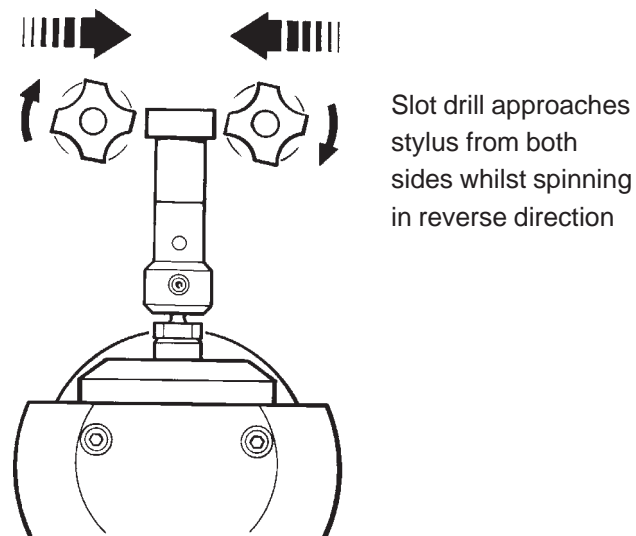


Figure 26 - Rotating diameter setting

## 7.4 Tool breakage detection

**Tool breakage detection** checks the lengths of your tools to identify tooling failures. By preventing damaged tools from being used for further machining, tool breakage detection forms a vital element of an automated machining process.

Your Renishaw tool setting probe can be used to perform in-cycle checks on your tooling. By measuring the length of the tool before and after use you can be sure that damaged tools will not be used on subsequent machining operations. This reduces the risk of scrap, machine damage and broken tooling in subsequent operation (e.g. taps).

Your tool breakage detection software should record the most recent tool length for each tool and compare this with the length measured during the tool breakage detection operation. If a significant difference is detected the operator can be called to change the damaged tool.

## 8 Calibration

### 8.1 Calibrating the tool setting probe

The exact procedure adopted is specific to each machine, control system and software package. However certain rules are common.

Before setting tools, it is necessary to calibrate the stylus position to establish its trigger points in relation to a datum on the machine. This can be achieved by the use of a known reference tool.

Re-calibration is necessary periodically (at least every 6 months), and in special circumstances, e.g. if the arm has been subjected to a crash or if the stylus has been replaced.

The recommended frequency of normal re-calibration is dependant on the frequency of useage of the arm. This may vary greatly depending on the application of the toolsetting arm, i.e. a typical jobbing shop may want to set tools twice per day and have eight tools to set. This would therefore result in two arm operations per day.

A large volume manufacturer however, may only wish to check for broken tools, but with a typical cycle time of 5 minutes and 24 hour working days, would operate the arm 288 times per day. The following table should therefore be used when deciding on frequency of re-calibration:

<b>Table 5</b>	
<b>Recommended frequency of arm re-calibration</b>	
<b>Arm operations per day</b>	<b>Re-calibrate every...</b>
<50	6 months
<100	3 months
>100	1 month

Accuracy of tool setting is dependent on the integrity of the offsets of the reference tool (usually stored in tool offset registers).

There are many possible automatic and manual options to establish the trigger positions of the stylus. Many methods will be satisfactory provided that the same relative conditions prevail when subsequently setting tools, particularly feed rates where high accuracy is required.

The following guidelines should be read in conjunction with relevant instructions provided with your software option. The following procedure is the preferred method of obtaining probe calibration data.

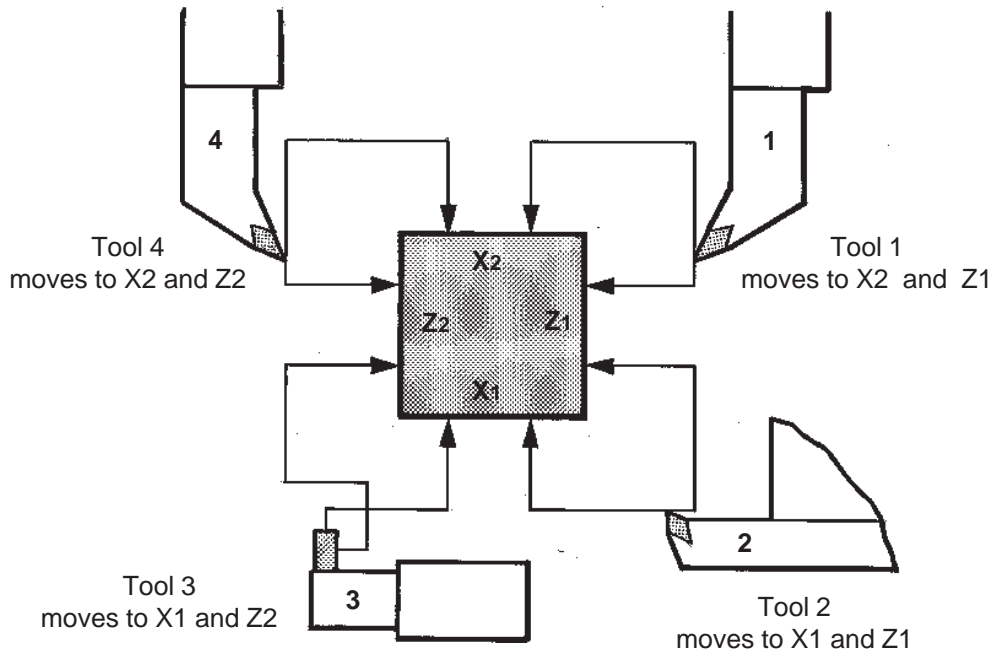
## 8.2 Principle

The method utilises a minimum of two cutting tools mounted in a turret as references in order to account for the dynamic effects of tool and workpiece deflection. It enables actual part dimensions produced by the reference tools, to be used to establish the stylus position.

## 8.3 Method

### Step 1 - Select turning tools which can access all stylus tip faces

A good practice is to choose finishing tools which require accurate setting. Figure 27 shows typical combinations to achieve access.



**Figure 27 - Calibration step 1**

A minimum of two touches will be required for all faces but more may be chosen depending on the tooling being used, e.g. 4 and 2, or 1 and 3.

### Step 2 - Estimate the tool length of these reference tools (see figure 28)

Load this to the relevant tool offset and mechanically mount the tools on the turret. This estimation can be made from the tooling catalogue, or by manual measurement. 0.5 mm (0.02 in) accuracy is sufficient at this stage.

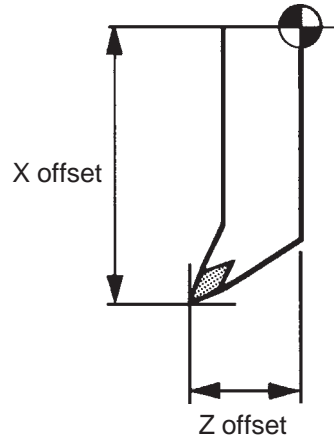


Figure 28 - Calibration step 2

### Step 3 - Estimate the mechanical position of the stylus (see figure 29)

Bring the tool into contact with the stylus under jog or manual control. Calculate the position of the stylus in the axis system. The purpose of this is to provide either:

- An estimated programming position of the stylus before running an automated calibration cycle.
- or
- An estimate of the position for manual calibration.

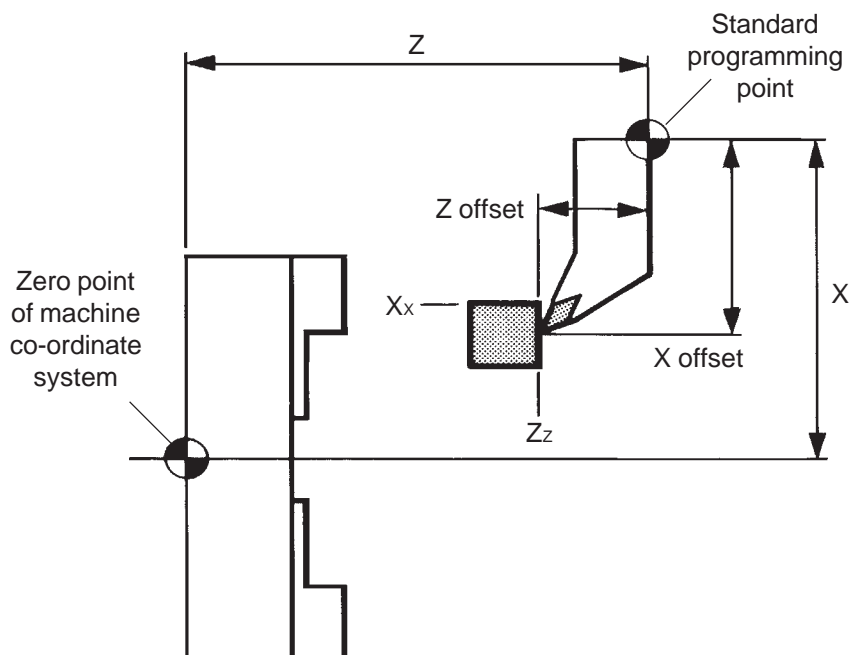


Figure 29 - Calibration step 3

Please refer to software instructions for specific details.

**Step 4 - Obtain the true tool length of the reference tool** (see figure 30)

Select a depth of cut, speed and feed to suit the typical application of each reference tool. Machine a target size with tool lengths active.

4a. **Diameter** e.g. -X +X internal/external respectively.

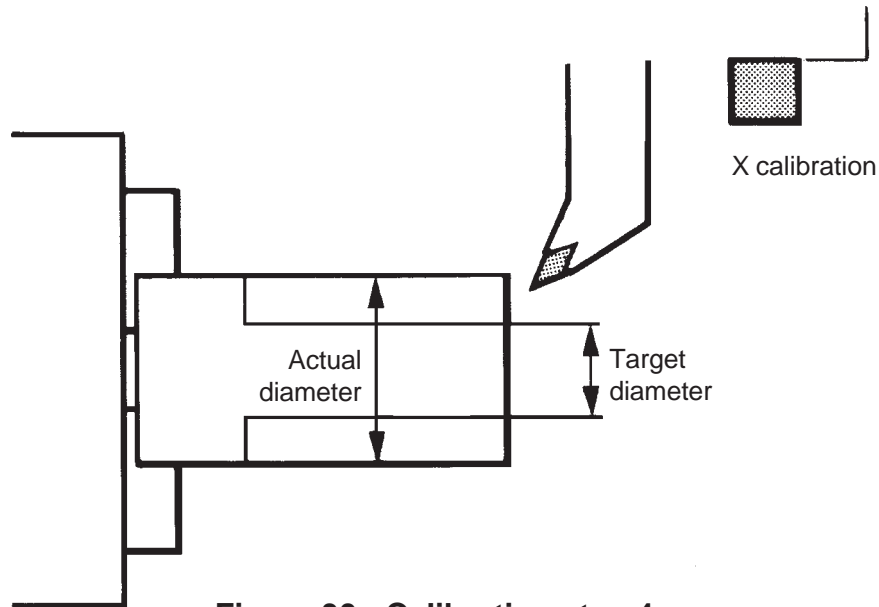
Measure the actual diameter produced and obtain the error from the target. The difference is due to the error in the tool length in operation. This error is then used to update the calibration value for the stylus with respect to the X axis.

Target diameter – Actual diameter = [Error].

---

**NOTE:** Negative error indicates oversize. Positive error indicates undersize.

---



**Figure 30 - Calibration step 4**

Typically, tool positions are stored as radial offsets. The measured diameter error must be halved in order to update the offset.

Therefore:

$$[\text{Tool offset new}] = [\text{Tool offset old}] + [\text{Error}/2]$$

Recalibrate the probe:

1. By running the automatic calibration routine with the new tool offset active.

or

2. Adjusting the probe calibration value manually to account for the inaccurate tool length. In this case the operator must have access to the parameter stores for the calibration data and modify as follows:

$$\text{X2 Calibration new} = \text{X2 Calibration old} - [\text{Error}/2]$$

- 4b. **Z**

The Z length of a tool can be checked by machining a feature or by the setting of a known feature to Z diameter (e.g. the chuck face, or jaws).

**For greater accuracy in continuous production the initial calibration data can be modified manually to take account of experience.**



## 9 Crash protection

### 9.1 Hub damage limitation device (DLD)

Crash protection is provided for both the hub (motor housing) and stylus (see figures 31 and 32).

This feature is designed to limit the damage that can be caused to the motorised hub mechanism in the event of a crash.

It should be noted that this device will only limit damage occurring to the motorised hub in certain crash conditions. It is not guaranteed to prevent damage occurring. The degree of protection is dependent upon the nature of the crash condition.

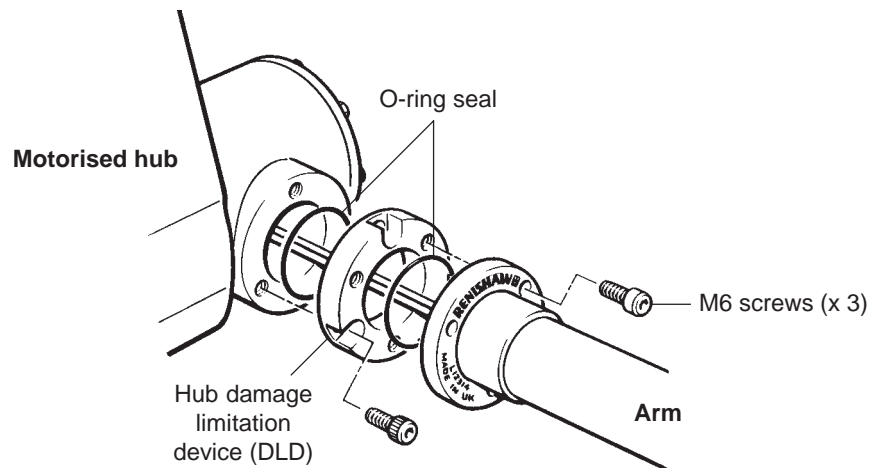


Figure 31

#### 9.1.1 Removal of the DLD

1. Remove the three M6 screws securing the arm to the DLD.
2. Remove the O-ring seal from the arm.
3. Remove the three M6 screws securing the DLD to the motorised hub.
4. Remove the O-ring seal from the DLD.

#### 9.1.2 Replacement of the DLD

1. Fit a new O-ring seal to the DLD.
2. Secure the DLD onto the motorised hub using the three M6 screws. Tighten to a torque of 12 Nm (106 lbf.in).
3. Fit a new O-ring seal to the arm.
4. Secure the arm onto the DLD using the three M6 screws. Rotate the arm to the required position then fully tighten the screws. Tighten to a torque of 16 Nm (142 lbf.in).

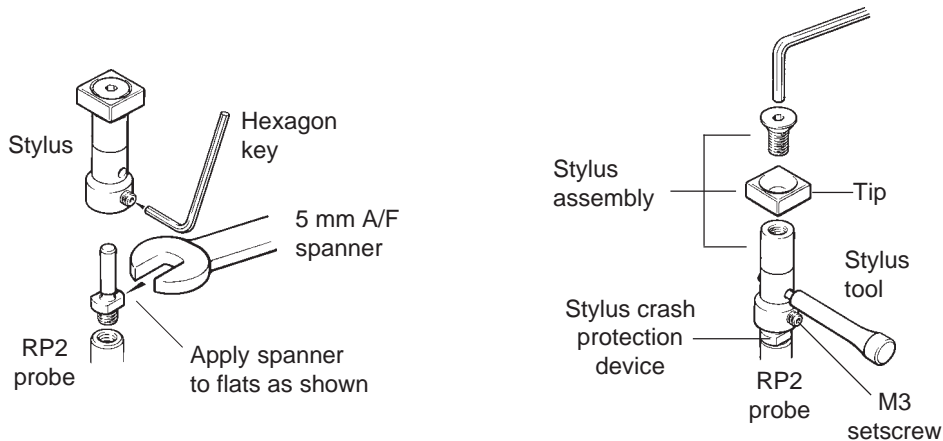
**NOTE:** For a type 1 probe enclosure, ensure that there is free movement of the moveable part of the probe enclosure.

For a type 2 probe enclosure, ensure that there is clearance between it and the probe holder.

5. Recalibrate the probe.

## 9.2 Stylus crash protection

The stylus incorporates a crash protection device which is designed to break if the stylus is overtravelled.



**Figure 32**

### 9.2.1 Removal of stylus crash protection device

1. Loosen the M3 setscrew and remove the stylus assembly.
2. Loosen and remove the stylus crash protection device from the RP2 probe.



**CAUTION:** The stylus crash protection device is brittle. Care must be taken when tightening the stylus to the probe.

### 9.2.2 Replacement of stylus crash protection device

1. Secure the stylus crash protection device to the RP2 probe using the 5 mm A/F spanner provided (see figure 32).
2. Fit the stylus assembly onto the stylus crash protection device and adjust the stylus position (see stylus rotational and height adjustment on page 28).
3. Recalibrate the probe.

## 10 Parts list

### 10.1 Parts list

Please quote the part number when ordering equipment.

Item	Part number	Description
Motorised hub RH / RE kit	A-2116-0200	Motorised hub (right hand hub / rear exit assembly), hub tool kit, rear face gasket, mounting screws, washers, and seal kit, and installation and user's guide.
Motorised hub RH / SE kit	A-2116-0201	Motorised hub (right hand hub / side exit assembly), hub tool kit, mounting screws, washers, and seal kit, and installation and users guide.
Probe kit (25 mm tooling)	A-2116-0117	RP2 probe assembly, C spanner, stylus assembly – 25 mm tooling, probe enclosure assembly type 1.
Probe kit (32 mm tooling)	A-2116-0118	RP2 probe assembly, C spanner, stylus assembly – 32 mm tooling, probe enclosure assembly type 1.
Probe kit (40 mm tooling)	A-2116-0119	RP2 probe assembly, C spanner, stylus assembly – 40 mm tooling, and probe enclosure assembly type 2.
Straight arm probe kit	A-2116-0108	RP2 probe assembly, C spanner, stylus assembly – 32 mm tooling kit
Stylus assembly (25 mm tooling)	A-2116-0140	Stylus crash protection device (x 2), stylus adaptor, countersunk screw, square tip, M3 grub screw, stylus tool kit and stylus extension SE9.
Stylus assembly (32 mm tooling)	A-2116-0141	Stylus crash protection device (x 2), stylus adaptor, countersunk screw, square tip, stylus extension SE11, M3 grub screw and stylus tool kit.
Stylus assembly (40 mm tooling)	A-2116-0142	Stylus crash protection device (x 2), stylus adaptor, countersunk screw, square tip, stylus crank (21.9 mm), SS3 screw for swivel adaptor, M3 grub screw, stylus extension SE9 and stylus tool kit.
Conduit termination kit	A-2116-0178	M20 x 1.5 bulkhead fitting for conduit, M20 x 1.5 locknut, worm drive hose clip (x 2).
Conduit	P-HO01-0008	Steel braided flexible conduit, 17 mm O.D.
<b>Spare parts</b>		
	A-2116-0100	Motorised hub R/H, R/E assembly and TSI-1.
	A-2116-0101	Motorised hub R/H, S/E assembly and TSI-1.
	A-2116-0210	TSI-1 tool setting arm interface.
	A-2116-0113	Seal kit.
	A-2116-0149	RP2 probe assembly, C spanner, tool kit and user's guide
	A-2116-0176	Complete TSA tool kit, comprising hub tool kit, arm tool kit, stylus tool kit and C spanner.

Item	Part number	Description
	A-2116-0109	Probe enclosure assembly type 1 ( 25 mm and 32 mm tooling).
	A-2116-0082	Probe enclosure assembly type 2 (400 mm tooling).
	A-2116-0112	Hub damage limitation device (DLD) kit.
	A-2116-0153	C spanner.
	M-2116-0124	Spring seal.
	M-2048-2093	Stylus crash protection device.
	M-2116-0128	3 m extension cable.
	M-2048-2092	Stylus adaptor.
	M-5000-7583	SE9 extension, length 10 mm, diameter 7 mm.
	M-5000-7585	SE11 extension, length 20 mm, diameter 7 mm.
	M-5000-7588	SS3 screw for swivel adaptor.
	M-5000-7589	CR1 stylus crank (21.9 mm) (A).
	M-2008-0237	Square tip (10 x 10 x 4 mm).
	P-FS12-0001	Flexible fuse holder cover
	P-TL09-0007	5 mm A/F spanner for removing stylus.
	P-SC02-0410	Countersunk screw (M4 x 10 mm long).
	P-SC11-0304	Grubscrew for stylus adaptor (M3 x 4 mm LG flat point).
	A-2116-0114	Hub tool kit.
	A-2116-0175	Arm tool kit.
	A-2116-0177	Stylus tool kit.
<b>Publications</b>		
	H-2000-2008	Data sheet (English).
	H-2000-5088	Installation and user's guide (English).
	H-2000-5089	Installation and user's guide (French).
	H-2000-5099	Installation and user's guide (German).

# 11 Troubleshooting

If the system exhibits poor repeatability or gives spurious readings, all aspects of the installation and operation should be investigated (e.g. operating method/conditions, software etc.)

## 11.1 Collisions

In the event of collision, re-calibration of the probe is necessary. See calibration on page 50.

## 11.2 Diagnostic LEDs

Diagnostic LEDs have been incorporated in this product to assist installation and fault finding. These can be viewed by removing the M20 viewing plug located on the side of the motorised hub. See figure 33 on page 61. The LEDs are mounted on the PCB and are assigned as follows :

<b>LED name</b>	<b>Colour</b>	<b>LED illuminated when</b>
Move command	Green	Move command received
Direction command	Red	Stow to active command received
Stow confirm	Amber	Arm has reached stow position
Active confirm	Green	Arm has reached active position
Probe status	Red	Arm in active position, probe enabled and triggered

## 11.3 Troubleshooting charts

<b>Arm system not responding to commands</b>	
<b>Possible cause</b>	<b>Rectification</b>
Power supply not connected.	Check electrical connections (ensure motor and I/O supplies are connected).  Check power supply (supplies) for voltage and polarity.
Command not received.	Check status of diagnostic LEDs.  Check machine control electrical outputs.  Check electrical connections.

**NOTE:** A resettable fuse is incorporated in the TSA circuit. This will automatically reset 30 seconds after the power is removed.

<b>No probe output</b>	
<b>Possible cause</b>	<b>Rectification</b>
Probe not connected.	Check wiring to machine.  Remove probe and check probe to arm connection.  Remove arm and check arm to motorised hub connection.
Probe open circuit.	Remove probe and check continuity of probe (should be less than 200Ω).

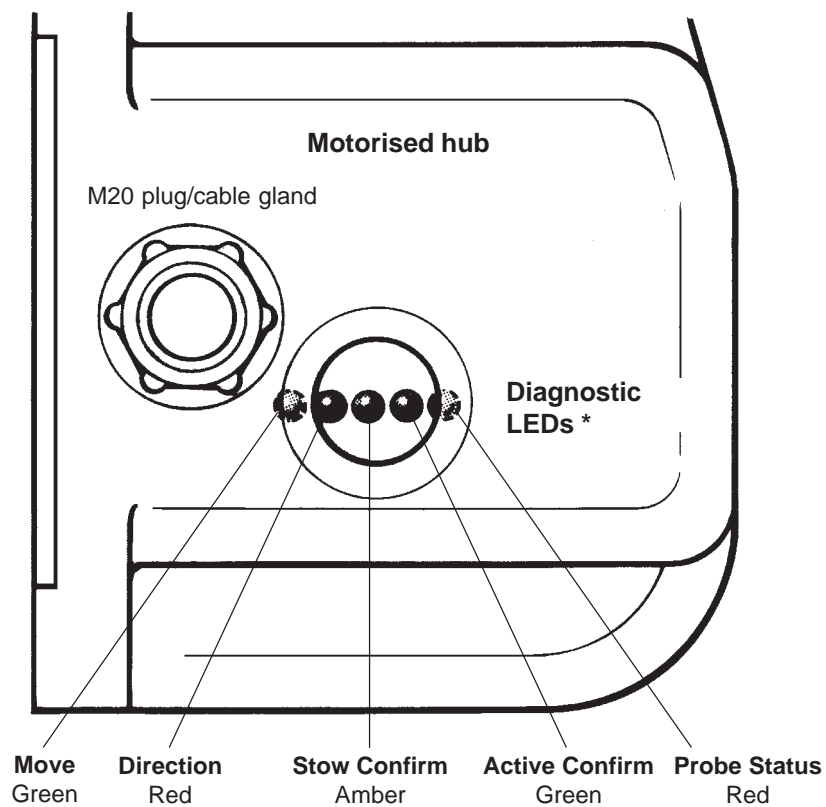
<b>Poor system repeatability</b>	
<b>Possible cause</b>	<b>Rectification</b>
Mounting screws not fully tightened.	Tighten screws to specified torque.  Re-datum probe.
Loose arm.	Verify tightness of arm on motorised hub.  Re-datum probe.
Loose probe.	Verify tightness of probe in mounting.  Re-datum probe.
Loose stylus.	Tighten stylus.  Re-datum probe.
Swarf on tool tip.	Remove swarf.
Calibration and updating of offsets is not occurring.	Review software.
Calibration and probing speeds are not the same.	Review software.
Probing is being performed within the machines acceleration/deceleration zones.	Review software.
Probing feedrate is too high for machine control.	Perform repeatability trials at various speeds (see testing on page 61).
Temperature variation is causing excessive movement in the machine and the TSA.	Minimise machine and TSA temperature changes. Increase the frequency of calibration.
Machine has poor repeatability due to loose encoders, backlash, tight slideways and/or accident damage.	Perform health check on machine.
Excessive machine vibration.	Eliminate vibration.  Select probe vibration filter.
Probe vibration filter is being used at inconsistent probing speed.	Deselect probe vibration filter and compare results.

## 11.4 Testing

To test for probe and machine tool repeatability a program should be written which continuously datums a reference tool (or a new tool) and records the updating of the appropriate tool offset. The changes in the tool offsets will enable probe and machine tool repeatability to be defined.

**NOTE:** The machine's repeatability should be taken into account when analysing results. A minimum of 20 readings is necessary to obtain a satisfactory result.

System repeatability should be checked in all relevant machine axis.



\* Visible after removal of M20 plug.

**Figure 33**

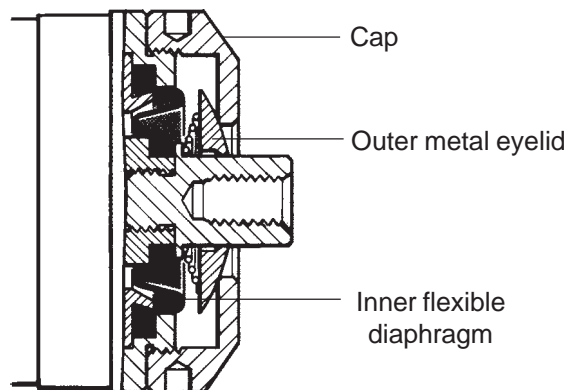
## 12 Maintenance

### 12.1 TSA and RP1/RP2 and RP1DD/RP2DD probes

The TSA system is a precision tool, handle with care. Ensure the TSA and probe are firmly secured to their mountings.

The system requires minimal maintenance as it is designed to operate as a permanent fixture on CNC machining centres, where it is subject to a hot chip and coolant environment.

1. Do not allow excessive waste material to build up around the probe/TSA.
2. Keep all electrical connections clean.
3. The probe mechanism is protected by an outer metal eyelid and an inner flexible diaphragm (see figure 34).



**Figure 34**

### 12.2 Probe diaphragm maintenance

Approximately once a month, inspect the probe inner diaphragm seal.

If it is pierced or damaged, return the probe to your supplier for repair. The service interval may be extended or reduced dependant on experience.

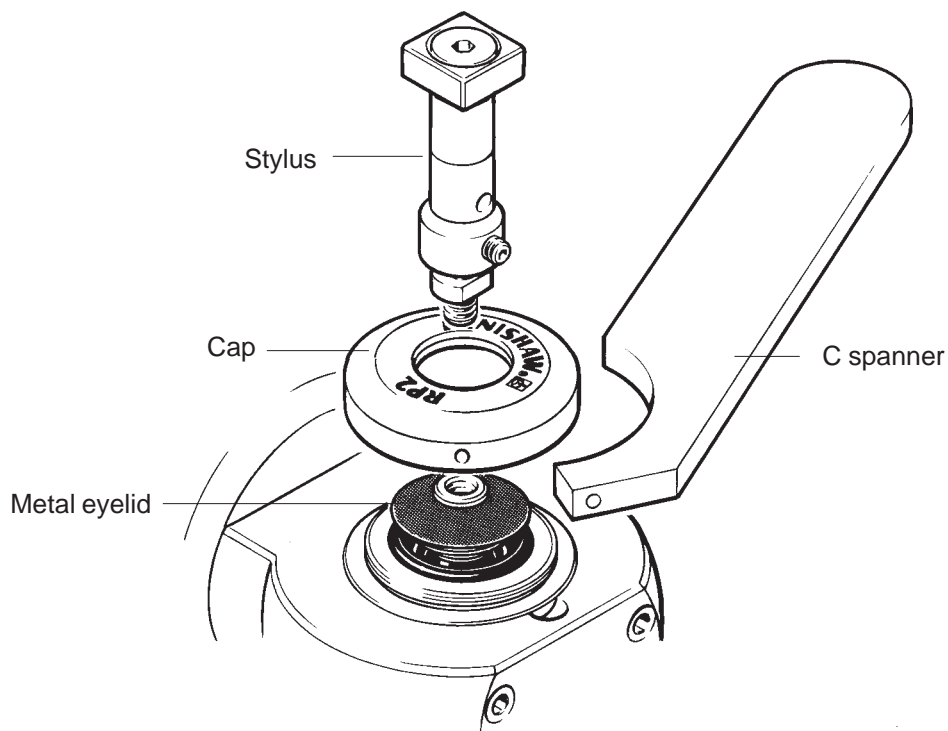
1. Remove the stylus (see figure 35).
2. Use a C spanner to remove the probe cap.
3. For RP1/2: Remove metal eyelid and spring. This will expose the inner flexible diaphragm seal.
4. For RP1DD/RP2DD: Remove outer diaphragm seal by lifting away from probe body to expose inner flexible diaphragm seal.
5. Wash the exposed areas of the diaphragm, eyelid and inside the cap using clean coolant.





**CAUTION:** Do not use sharp metal objects to clean out debris.

6. Inspect the diaphragm seal for signs of piercing or damage. In the event of damage, return the probe to your supplier for repair, as coolant entering the probe mechanism could cause the probe to fail.



**Figure 35**

1. For RP1/RP2: Refit the spring and metal eyelid.
2. For RP1DD/RP2DD: Refit the outer diaphragm seal.
3. Refit the probe module cap. Tighten using the C spanner.
4. Refit the stylus.
5. Recalibrate the probe. See calibration on page 50.

## 12.3 Cleaning

Solvents and metal polishes are not recommended. For cleaning the TSA components, use a clean dry cloth.

## 13 Appendix

### 13.1 Appendix 1

#### Motorised hub mounting hole specification

dimensions mm (in)

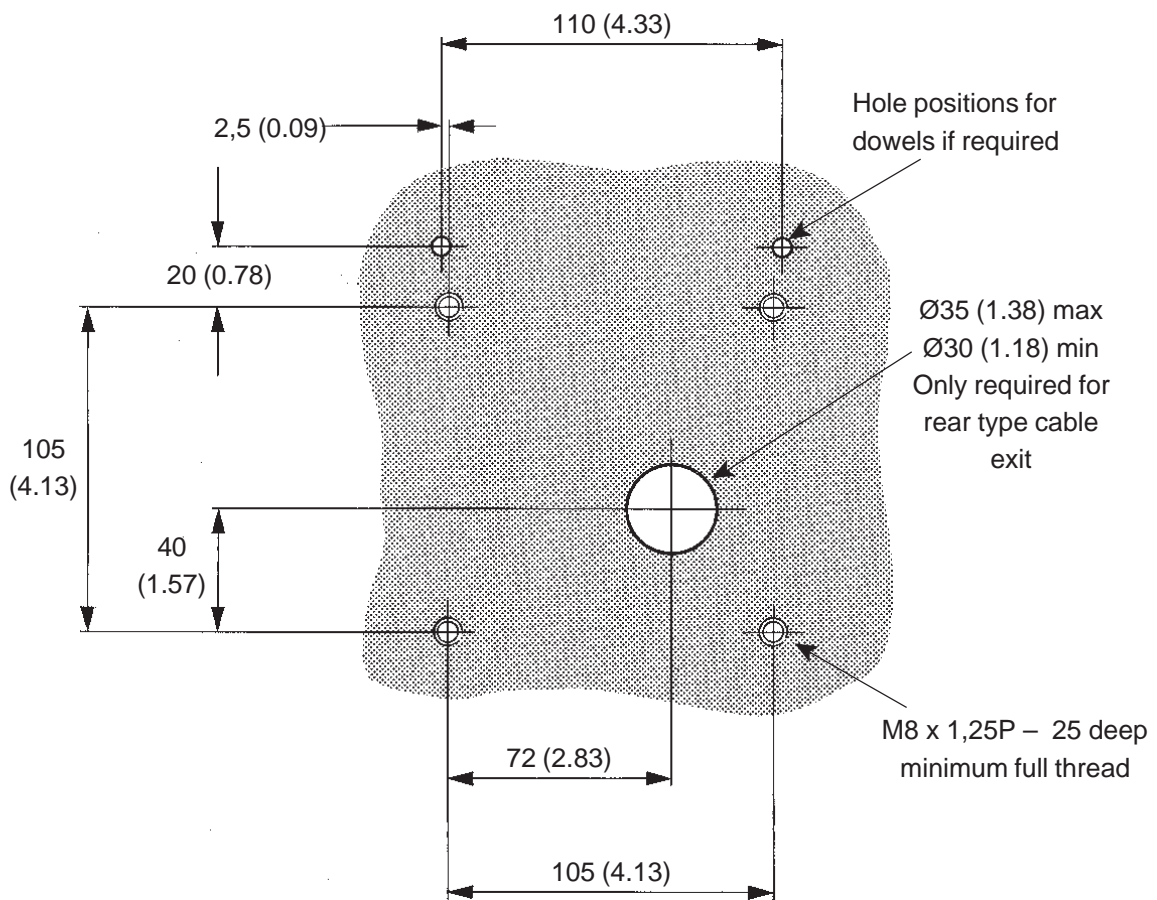


Figure 36

### 13.2 Appendix 2

#### 90° arm - general arrangement

dimensions mm (in)

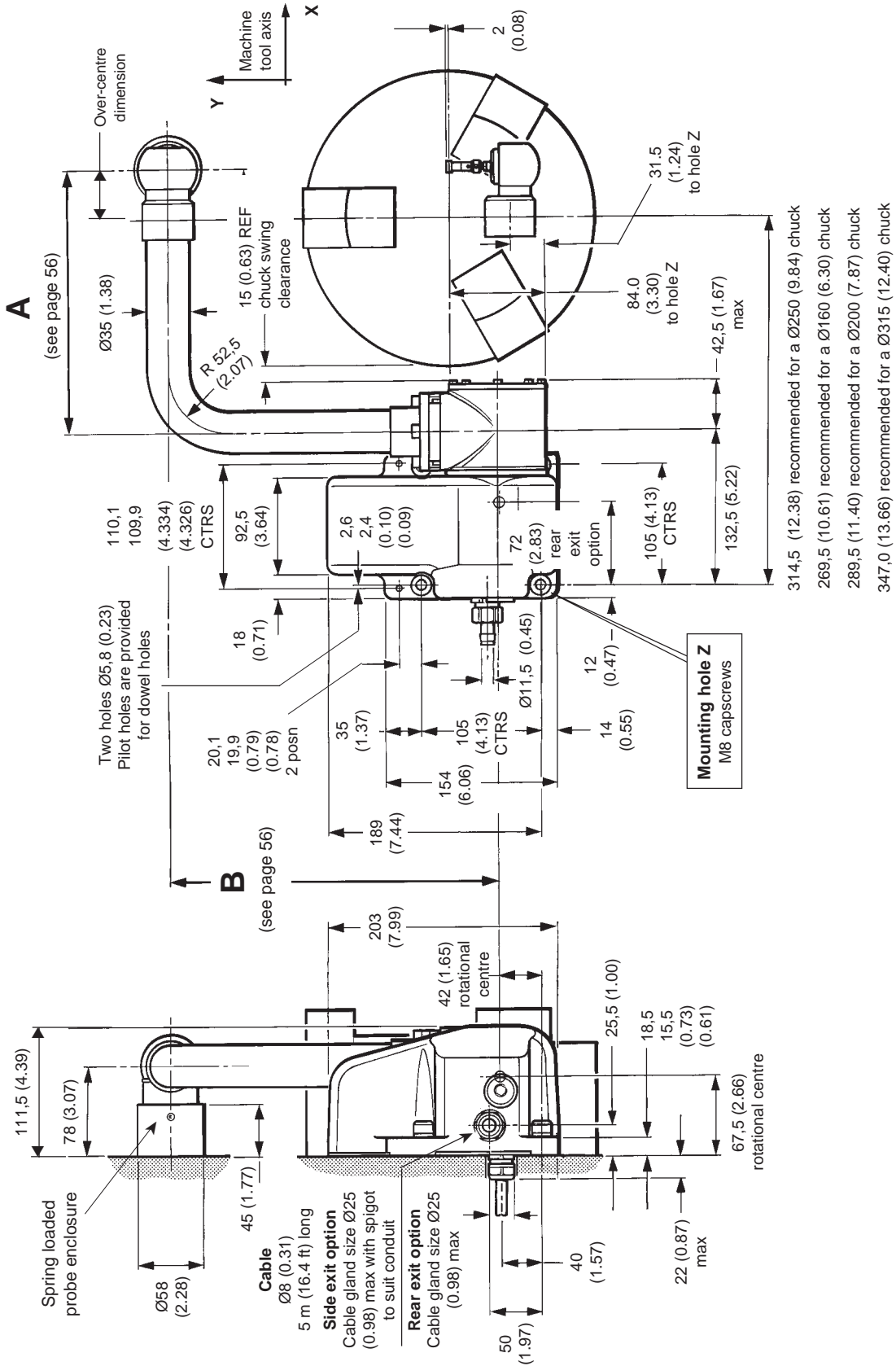


Figure 37

Standard stylus options for 90° arm

dimensions mm (in)

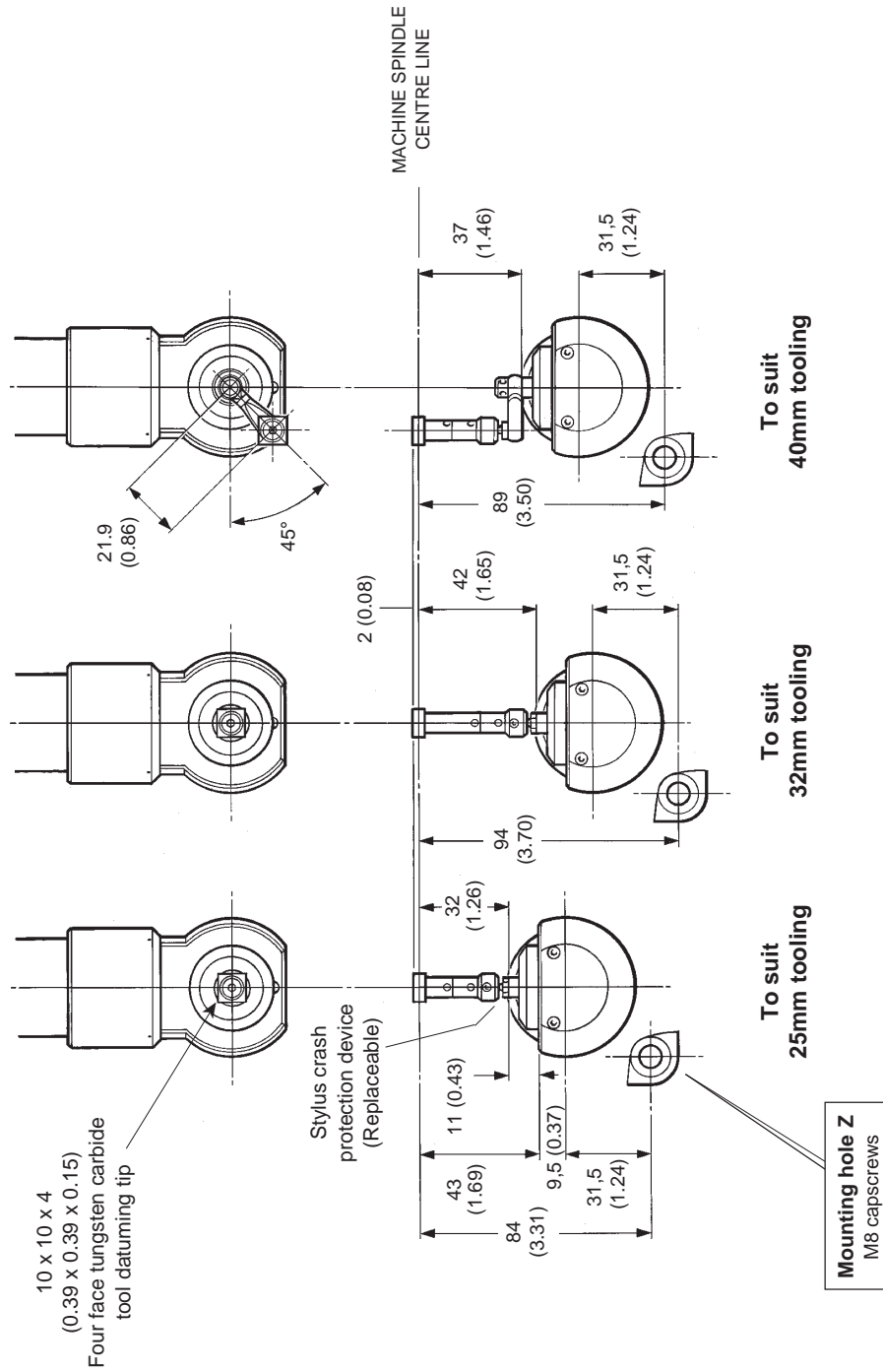


Figure 38

### 13.3 Appendix 3

#### Straight arm - general arrangement

dimensions mm (in)

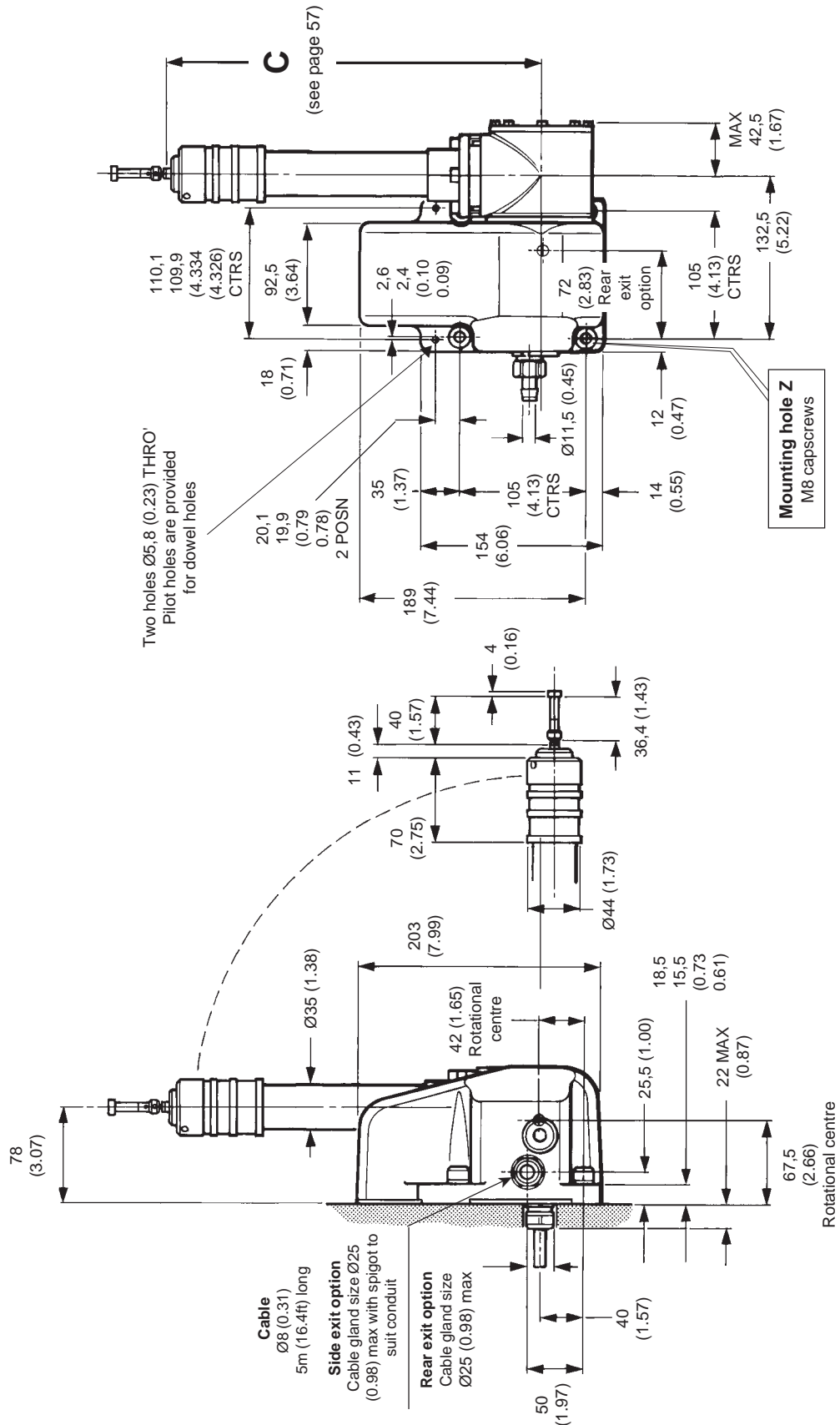


Figure 39

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