Product interconnection system (PICS)

Documentation part number: H-1000-5000-08-C

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ORIGINAL LANGUAGE VERSION

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For any regulatory information / requirements, please refer to the relevant product user documentation.

References and associated documents

The following Renishaw documents are referred to in this document or may be a source of further relevant information. They can be downloaded from www.renishaw.com.

Title	Document number
Installation and user's guide: PH10 PLUS	H-1000-7592
User's guide: TP7	H-1000-5010
User's guide: TP20	H-1000-5008
User's guide: TP200	H-1000-5014
Installation guide: PHC10-3 PLUS	H-1000-0077
Installation guide: PI 7-3	H-1000-7555
Installation guide: PI 200-3	H-1000-7542
User's guide: Autochange system	H-1000-5090
Installation and programmer's guide: Autochange system	H-1000-6012
User's guide: HCU2	H-1000-5361

Introduction

Product interconnection system (PICS)

With the demand for more complicated metrology systems, the amount of information that must be transferred to and from the co-ordinate measuring machine (CMM) continues to increase. To simplify this information transfer, PICS has been developed to standardise the real time communications format for Renishaw's products.

This document describes the PICS connection between the Renishaw interface and the CMM controller, with the exception of the 'Types of input signal' and 'Cable connection' sections which briefly describe the PICS input connection to a Renishaw interface.

Standardisation allows products, such as the Renishaw motorised head system and the autochange system, to communicate with both the probe interfaces and CMM controllers.

Due to the nature of various real time signals incorporated in PICS, extra protection is afforded to precision metrology components.

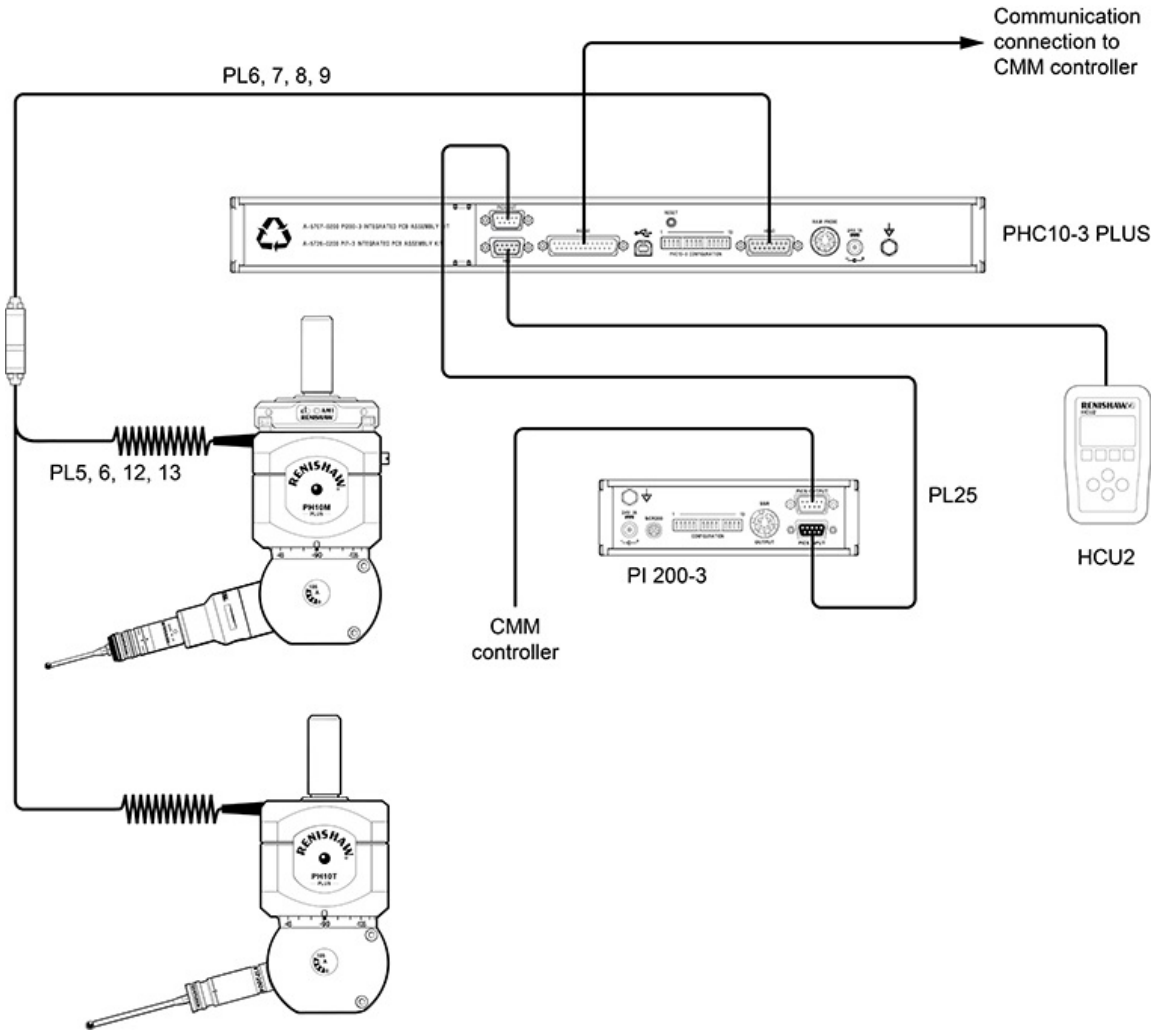
System overview

PICS can be incorporated in a range of systems of varying complexity. Four examples are shown in the following figures.

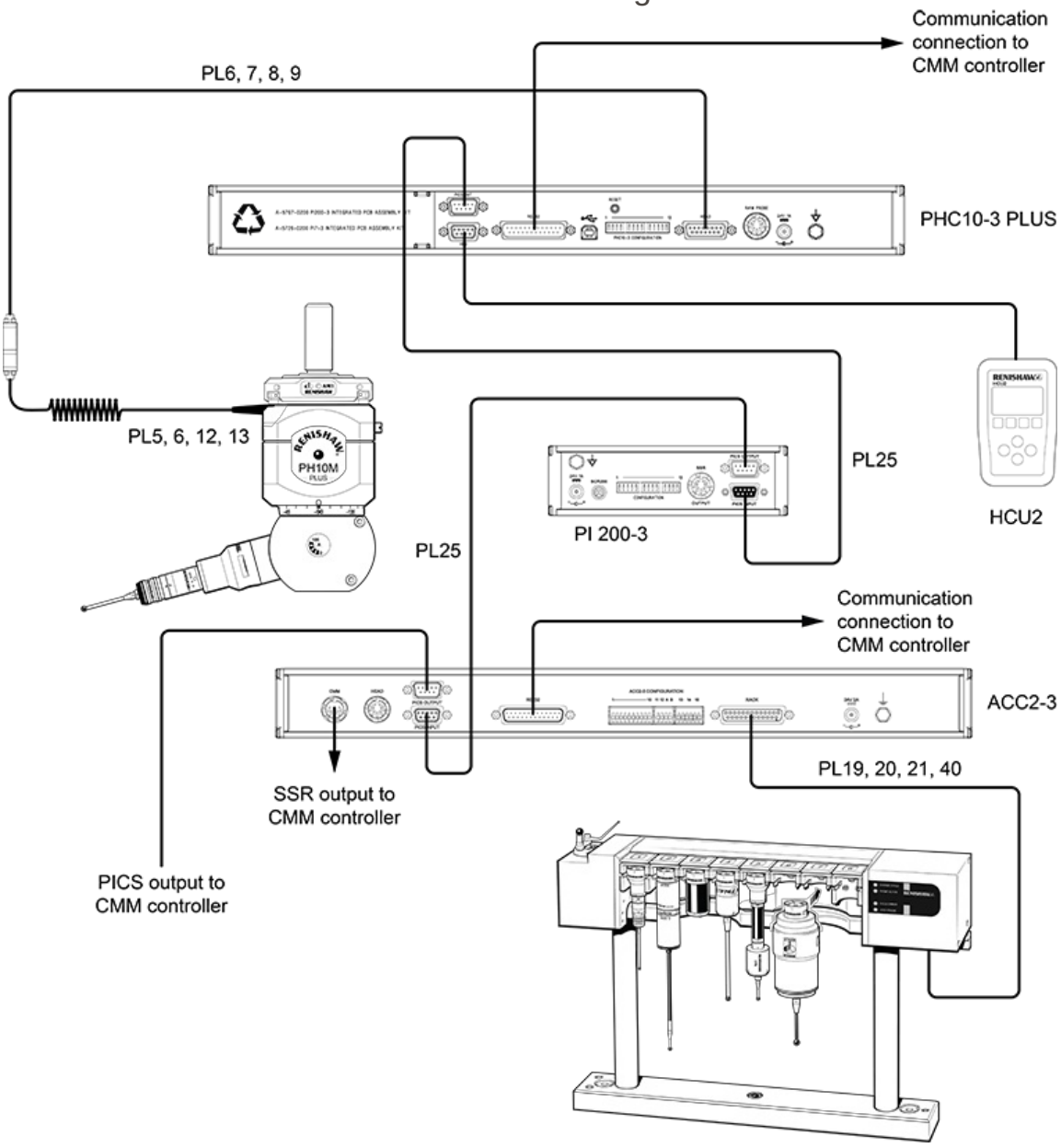
NOTE:

- The order in which the elements of the system are connected is important
- The system must have an external interface to operate correctly
- If used, the motorised head controller should be furthest from the CMM controller
- If used, the autochange system should be the closest to the CMM controller (except for installations containing a PI 800-2 interface)
- All PICS connectors to Renishaw equipment are 9 way 'D' type plugs and sockets

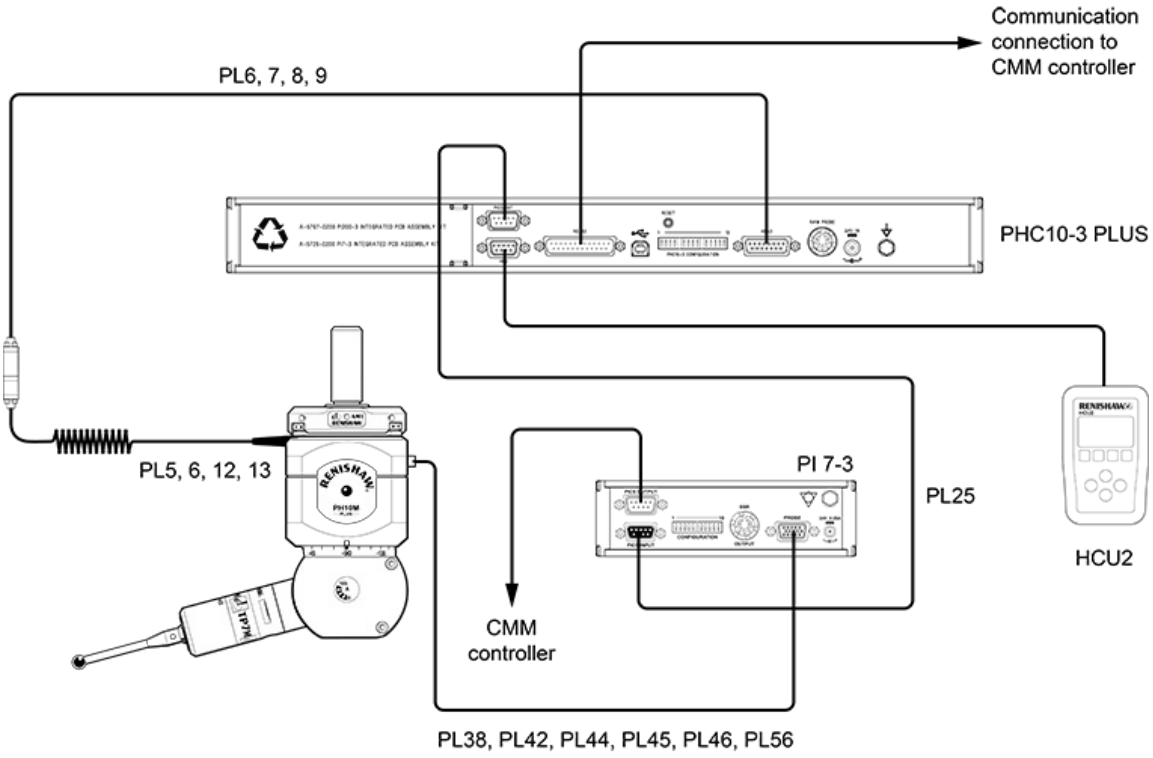
PHC10-3 PLUS and PI 200-3



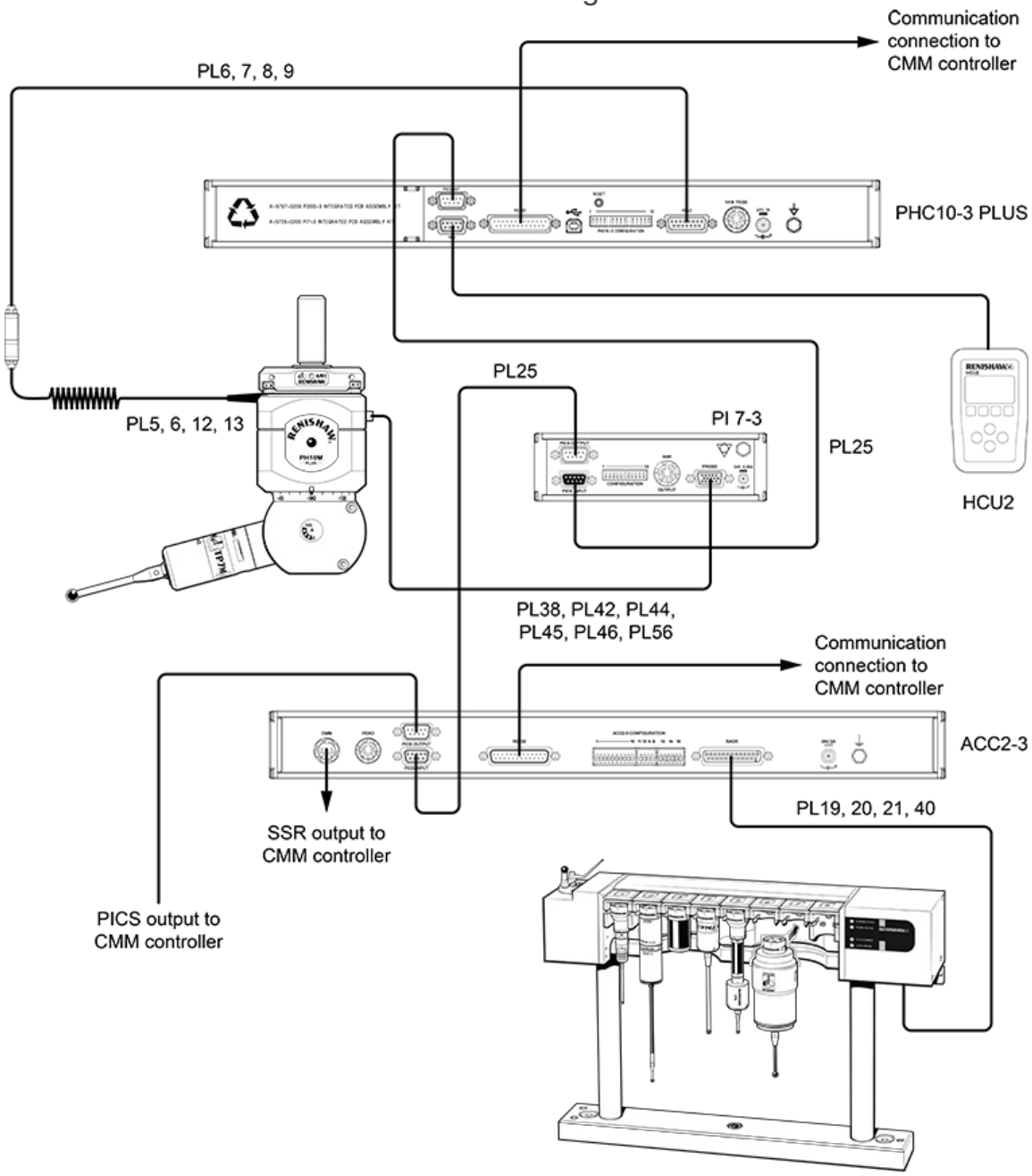
PHC10-3 PLUS and PI 200-3 with autochange



PHC10-3 PLUS and PI 7-3



PHC10-3 PLUS and PI 7-3 with autochange



System signals

The functions of all PICS signals are described in this section, but it must not be assumed that all interfaces and controllers support every signal. The installation guide for individual products must be referred to for full details of signals used and their time relationships.

Types of output signal

There are three types of output signal transmitted by PICS:

- STATUS signals
- WARNING signals
- SYNCHRONISATION signals

Status signals

PICS uses the following five STATUS signals:

- Probe power OFF (PPOFF)
- Halt (HALT)
- Probe damping (PDAMP)
- LED off (LEDoff)
- ERROR (ERROR)

Pin 2 - Probe power OFF (PPOFF)

The purpose of setting this status line is to inhibit the probe trigger signal (SYNC) and, in the case of the laser probe, it can also be used to switch off the laser or light source.

An example of the use of this signal is to inhibit a probe during an autochange cycle. In this case, the line is activated by the autochange controller. This line may be set by any Renishaw device or the CMM controller.

Pin 4 - Error (ERROR)

This line is set by the interface if it has determined that the last reading (trigger or measurement) was not reliable. It is intended that this output should be used to tell the CMM control to disregard and, if appropriate, repeat the last reading.

NOTE: This PICS signal is not incorporated into or supported by all Renishaw products.

This line is only an output from the Renishaw system to the CMM control.

Pin 6 - Halt (HALT)

This line is set by an interface to halt the CMM motion.

In the case of a touch-trigger probe, this will be when it has determined that the last SYNC reading was a real trigger event or a collision and not a vibration trigger. In this case, the output will be the same as SYNC would be with PDAMP asserted. The HALT signal can, in most cases, be used as a confirm signal indicating that the last SYNC was real.

This line is only an output from the Renishaw system to the CMM control.

Pin 7 - Probe damping (PDAMP)

Setting this line will reduce the interface sensitivity so that it will ignore any unwanted short probe synchronisation events, such as a probe "trigger" due to vibration or acceleration. If, however, the probe is triggered for a long period, possibly indicating a crash, then SYNC and HALT signals are sent as usual.

This line may be set by any Renishaw device or the CMM control.

Pin 8 - LED off (LEDOFF)

Setting this line turns off the probe head LED and is normally used by interfaces to indicate a probe signal. The line can be set by any device. The LED is only on if none of the PICS devices (including the CMM controller) is applying LEDOFF.

Pin 9 - READ (READ)

This line is activated by the CMM controller to command the interface to take a reading. An example of its use is with the SP600 interface card, the AC2. Setting this line causes the AC2 card to read the current stylus position of the SP600.

For further details, please refer to the appropriate interface documentation.

Warning signals

Pin 1 - STOP (STOP)

This line indicates that an operational error or crash has occurred in either a Renishaw device or the CMM control. The unit setting the STOP line illuminates a RED LED on the front panel.

Renishaw units receiving STOP will react in various ways:

- Interfaces – respond to STOP by forcing their probe outputs to the triggered state irrespective of the probe state
- Autochange controllers – STOP inhibits any movement of the drive blades while it is present. If STOP is applied while the autochange is in the middle of a lock or unlock operation, it aborts the operation and the ACR1 blade will return to the unlock position. Please refer to your autochange system documentation for further explanation.
- Motorised head controllers (PHC10-3 PLUS) – STOP prevents any automatic head movement while it is asserted. If STOP is asserted during an automatic head move, then the power to the drive motors is removed. If STOP is asserted during a manual head move, the PH10 / PH10 PLUS will only move in single steps.

All Renishaw devices assert the PICS STOP signal if power is removed from that device.

On receipt of this signal, the CMM should stop all axis drives immediately.

This line may be set by any Renishaw device or the CMM control.

Synchronisation signals

PICS has a line dedicated to the synchronisation of the probing system with the CMM scales.

Pin 5 - Synchronisation (SYNC)

This line is a dedicated input to the CMM control. When set, it indicates that a synchronisation event has occurred (e.g. a touch-trigger probe "trigger"). This enables the CMM control to read the CMM scales in synchronisation with the probe trigger.

This line is normally only set by a Renishaw interface; it is unidirectional – i.e. it is only output from the Renishaw system.

Types of input signal

This section describes the PICS input connection for a probe interface. The majority of input signals are the same as those described in the 'Types of output signal' section, with the exception of those listed below.

If more information is required on the function of the PICS input to a probe interface, please refer to the respective probe interface documentation. Alternatively, you may contact Renishaw direct for assistance (please refer to the front cover of this document for contact details).

Un-interfaced probe signal

These pins are used to transmit and receive 2-wire touch-trigger probe signals when a multiwire cable is not in use.

Pin 5 - Probe signal

This line is a dedicated output (supply) from the probe interface to a 2-wire touch-trigger probe.

Pin 9 - Probe signal return

This line is a dedicated probe input (return) to the probe interface from the 2-wire touch-trigger probe.

NOTE: On some interfaces, the function of these two signals can be swapped by a configuration switch on the interface.

Other signals

Pin 4 - LED anode

This line is used to supply a probe head with the necessary voltage and current to illuminate the head LED.

Pin 6 - Stop (pull-up)

This line is used when a probe head controller is not fitted to the probing system and, in this case, the interface can supply the 'pull-up' for the PICS STOP line (pin 1).

Summary of signals

Signal	Pin number	Source	Monitored by	Purpose
STOP	1	Any Renishaw device or CMM controller	All Renishaw devices or CMM controller	Stop of CMM and Renishaw products
PPOFF (probe power OFF)	2	Any Renishaw device or CMM controller	All Renishaw devices or CMM controller	To inhibit the probe
0 V reference	3	Common reference	Common reference	Common reference
ERROR	4	Probe interface	CMM controller	To indicate that the last reading was not accurate
SYNC	5	Probe interface or autochange	CMM controller	To show measurement has taken place, or for synchronisation hand shake
HALT	6	Probe interface or autochange	CMM controller	To stop CMM movement
PDAMP (probe damping)	7	Any Renishaw device or CMM controller	All Renishaw devices or CMM controller	To prevent induced vibration triggers whilst maintaining crash protection
LED OFF	8	Any Renishaw device or CMM controller	Head controller	Control LED illumination
READ	9	CMM controller	Specific probe interfaces	To instruct the probe system to take a probe reading
Screen	Shell	Cable screen	Cable screen	Cable screen

Application of PICS

In this section components from a CMM system are looked at individually, detailing the information that is automatically transferred between the Renishaw equipment and the CMM control.

NOTE: The following product details are in summary only. Full PICS details for each Renishaw device are given in the relevant product installation guide.

Autochange rack controller (ACC2-3)

Normal operation

During normal system operation the ACC2-3 does not effect any of the PICS signals, all the signals are passed through the unit in both directions. The ACC2-3 does monitor and operate one line during this mode of operation as detailed below:

STOP	This line is monitored and, if activated by any other connection to the PICS system, the ACC2-3 will not permit any probe change sequence to be activated. This signal is activated by the ACC2-3 if an error is detected by the ACC2-3, for example overtravel of the ACR1. This signal, when generated by the ACC2-3, causes the STOP LED on the front panel of the unit to light.

Active operation

During active operation of the ACC2-3 it controls the following PICS signals, in addition to continually monitoring the PICS STOP line as specified in normal operation.

The following PICS signals are activated at different times by the ACC2-3 during probe change or ACR1 set-up routines:

PPOFF	This line is activated, by the ACC2-3, to instruct a probe interface to inhibit the probe to prevent any unwanted triggers occurring during an autochange sequence.
SYNC	This line is activated by the ACC2-3 in response to either the ACR1 rack probe when enabled, or when an error occurs to the autochange system during a probe change sequence.
HALT	This line is activated by the ACC2-3 in response to either the ACR1 rack probe when enabled, or when an error occurs to the autochange system during a probe change sequence.
LED OFF	This line is activated by the ACC2-3 in response to either the ACR1 rack probe when enabled, or when an error occurs to the autochange system during a probe change sequence.
PDAMP	This signal line is interrupted by the ACC2-3 during a probe change sequence, to permit probe identification to occur by the probe interface.

Probe interfaces

Normal operation

During normal system operation, all probe interfaces (except the AC2 card) monitor and respond to three PICS signal as detailed below:

STOP	This line is monitored and, if activated by any other connection to the PICS system, the probe interface will react with a SYNC and HALT output (if configured).
PDAMP	This line is monitored and, if activated by any other connection to the PICS system, the probe interface will reduce the sensitivity of the probe.
PPOFF	This line is monitored and, if activated by any other connection to the PICS system, the probe interface will inhibit the probe.
PPOFF and PDAMP	If these PICS lines are asserted coincidentally, then the probe identification circuitry and the probe interface in a 2-wire touch-trigger probe interface (e.g. PI 200-3) are inhibited.

Active operation

During active operation all probe interfaces (except the AC2 card) control the following PICS signals, in addition to continually monitoring the PICS lines as specified in normal operation.

The following PICS signals are activated at different times by the probe interfaces:

SYNC	This line is activated if the probe connected has exceeded the trigger threshold.
HALT	This line is activated if internal logic within the probe interface confirms that the last trigger event was not a vibration trigger.
LED OFF	This line is activated in response to the SYNC signal.
STOP	This line is activated if the interface internal power rails fail.

Special notes

PI 200-3

In addition to all the above conditions for the probe interfaces, the PI 200-3 activates the following PICS signal:

STOP	The PI 200-3 can generate a PICS STOP signal.

This STOP will be generated if a fault is detected on the SCR200 (e.g. overtravel) or if the TP200 is incorrectly connected to the PI 200-3.

This signal is generated by the PI 200-3 and causes the STOP LED on the front panel of the unit to light.

PI 800-2

In addition to all the above conditions for the probe interfaces, the PI 800-2 activates the following PICS signal:

ERROR	The PI 800-2 is the only current interface that supports the ERROR signal, the technology used within the probe can detect if a “good” trigger signal was received by the PI 800-2.

PI 7-3

In addition to all the above conditions for the probe interfaces, the PI 7-3 activates the following PICS signal:

STOP	The PI 7-3 can generate an internal STOP signal that generates a PICS STOP signal. This internal STOP will be generated if the PI 7-3 detects a fault with the TP7M (e.g. a broken strain gauge).

Probe head controllers

Normal operation

During normal system operation the PHC10-3 PLUS does not effect any of the PICS signals.

It does monitor and respond to two signal lines during this mode of operation as detailed below:

STOP	This line is monitored and, if activated by any other connection to the PICS system, the probe head controller will reduce movement capability of the unit. Please refer to the PHC10-3 PLUS installation guide (Renishaw part number H-1000-0077) for details. In the event of a collision, if the head datum circuits are broken, the PHC10-3 PLUS will unlock the head axes and assert the stop signal.
LED OFF	This line is monitored and, if activated by any other connection to the PICS system, the PHC10-3 PLUS will extinguish the LED on the PH10 probe head.

Active operation

During active operation the PHC10-3 PLUS controls the following PICS signals, in addition to continually monitoring the PICS STOP line as specified in normal operation.

The following PICS signals are activated at different times by the probe head controller:

PPOFF	This line is activated by the PHC10-3 PLUS to instruct a probe interface to inhibit the probe to prevent any unwanted triggers occurring during a probe head index.
PDAMP	This line is activated by the PHC10-3 PLUS to instruct a probe interface to reduce the sensitivity of the probe to prevent any unwanted triggers occurring during a probe head index.
STOP	The PHC10-3 PLUS can generate a PICS STOP signal. This will be generated if the PHC10-3 PLUS detects a fault with the PH10 during a head index (e.g. an obstruct error). This signal, when generated by the PHC10-3, causes the STOP LED on the front panel of the unit to light.
PPOFF and PDAMP	These lines can be asserted coincidentally during a probe head index to instruct the connected probe interface to inhibit the probe identification circuitry and the probe interface in a two wire touch-trigger probe interface (e.g. PI 200-3).

Cable and connector specification

Cable connection

Renishaw supply a short 0.3 m PICS cable (PL25) with the PHC10-3 PLUS and ACC2-3 units. This cable is designed to connect between Renishaw controllers and interfaces.

A 5 m PICS cable (PL24) is available to connect the final output stage of the Renishaw system to the CMM controller.

Both cables are terminated with 9 way 'D' type connectors.

Cable specification

The maximum recommended cable length to interconnect between the Renishaw controllers and interfaces is 0.3 m.

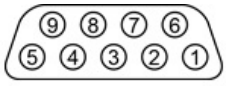
The maximum recommended cable length to connect between the Renishaw system and the CMM controller is 5 m.

If greater lengths are required please discuss this issue with Renishaw.

The cable should be a minimum of 9 cores 7/0.2 overall screened.

The screen must be terminated to the body of each connector.

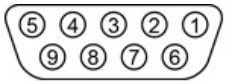
Output pin connections



The pin connections for the 9-way 'D' type output socket are:

Pin	Function
1	STOP
2	PPOFF
3	0 V
4	ERROR
5	SYNC
6	HALT
7	PDAMP
8	LED off
9	READ
Screen	Cable screen

Input pin connections



The pin connections for the 9-way 'D' type input plug are:

Pin	Function
1	STOP
2	PPOFF
3	0 V
4	LED anode *
5	Probe signal (input)
6	STOP 'pull up'
7	PDAMP
8	LED off *
9	Probe signal (return)
Shell	Screen

NOTE: LED OFF
This signal passes through all products and is connected to the LED anode in the probe head or probe head controller. Any product can turn off the LED by connecting LED OFF to 0 V.
Termination resistors must not be used, but a series current limiting resistor of between 39 Ohms and 56 Ohms is strongly recommended.

Electrical specification

All of the PICS signals are with respect to the 0 V pin 3 of the 9 pin 'D' connector.

PDAMP, PPOFF, STOP

These are bi-directional active low signals that conform to TTL electrical levels.

If the CMM uses any of the signals as an input, it must use the appropriate resistor terminations and a Schmitt trigger receiver conforming to TTL levels, such as 74HCT14.

SYNC, HALT, ERROR

These signals are unidirectional active low signals that conform to TTL electrical levels.

If the CMM uses any of the signals as an input, it must use the appropriate resistor terminations and a Schmitt trigger receiver conforming to TTL levels, such as 74HCT14.

LED OFF

This signal passes through all products and is connected to the LED anode in the probe head or probe head controller. Any product can turn off the LED by connecting LED OFF to 0 V.

Termination resistors must not be used, but a series current limiting resistor of between 39 Ohms and 56 Ohms is strongly recommended.

0 V

This is the common reference for all other PICS signals.

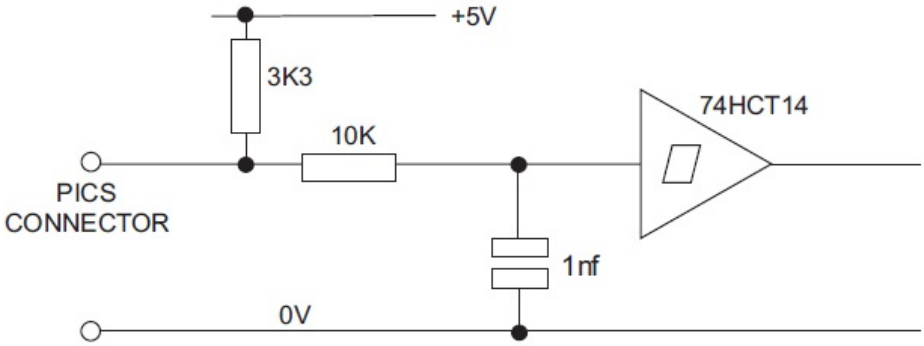
Screen

The screen connection is between the shells of all the interconnection cables.

Suggested CMM controller terminations

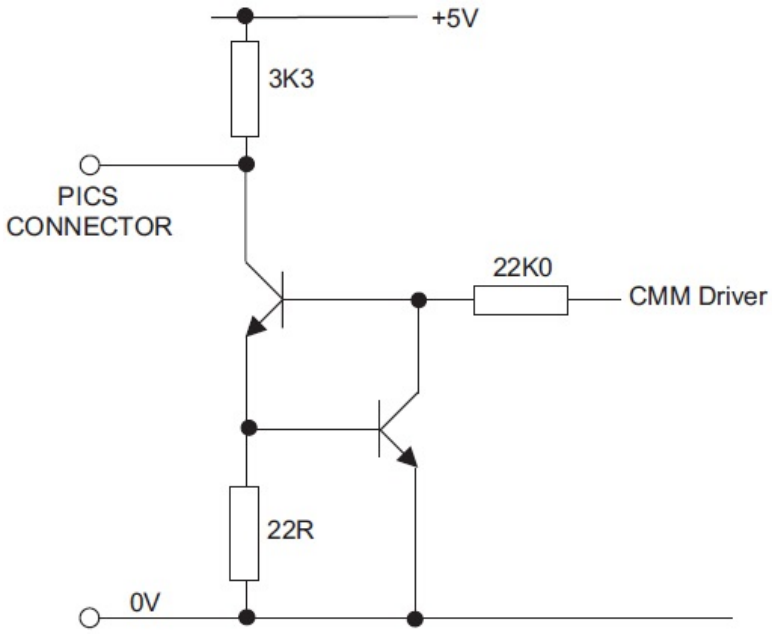
Receiver circuit

For SYNC, HALT, ERROR signals.



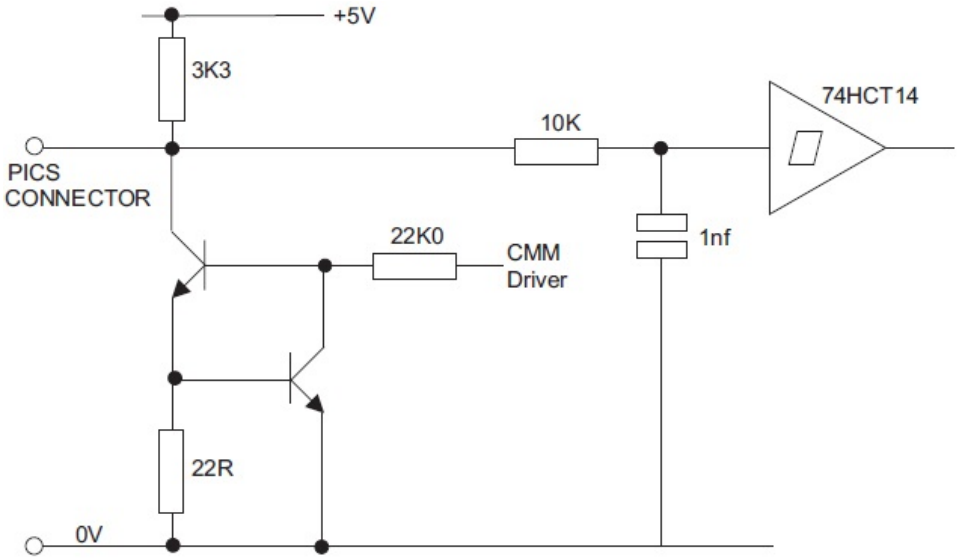
Driver circuit

For READ signal.



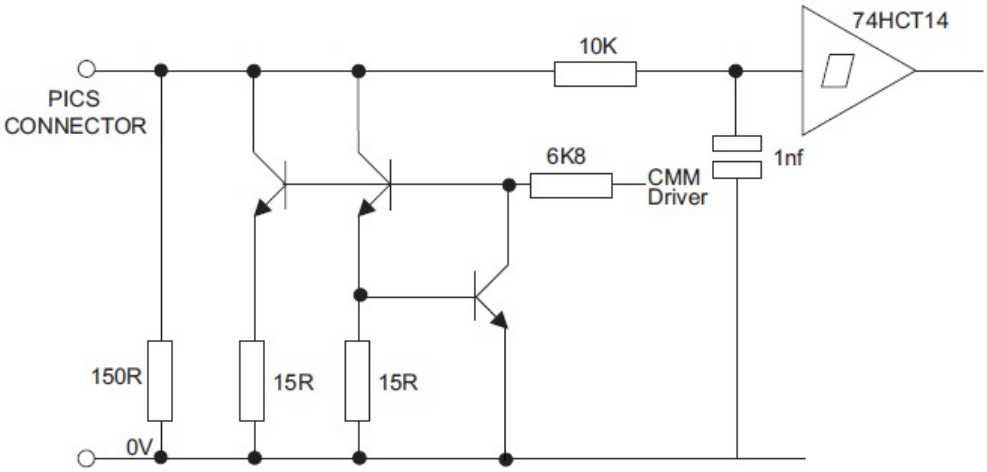
Bi-directional circuit

For PDAMP, PPOFF signals.



STOP circuit

For STOP signal.



Drive circuits must be capable of sinking 15 mA, except STOP which must be capable of sinking 50 mA.

To ensure correct operation over the maximum recommended cable lengths, the output drivers must be capable of pulling down to less than 0.47 V.

The STOP driver must be capable of pulling down to less than 0.34 V.

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