Twickenham
Scientific Instruments

The Transfer Control Module (TCM)

Instruction manual, release 1.1

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Introduction

The Transfer Control Module (TCM) provides all the necessary functions between the actions of the relays within the Helium Depth Indicator (with, at least, the control and alarm option selected, the HDIc), and whatever means are being used to operate a cryogen transfer. Since the HDIc can be configured to operate Helium and/or Nitrogen probes, this system can be used to control the auto-filling operations of either or both cryogens.

The TCM is specified as TCM–n–l, where n is the number of controlled outputs, and l is A for mains voltages (ac), and D for 24V dc. Note that the TCM does not have a mains selector, and can operate from 90 - 250V ac; however, the HDIc must be configured to the correct mains range on *its* mains input selector, accessible on the back panel.

The TCM can operate solenoid valves, which in turn can either directly control the flow of the cryogen (most usually Nitrogen), or to control the pressure in the storage dewar (Nitrogen or Helium) using a gas bottle; it can also vent the excess gas pressure. Alternatively, the TCM can be used to operate a small diaphram pump to build up the pressure in the storage vessel, or, more unusually, to reduce the pressure in the experimental dewar to pull the liquid across (Helium).

Suitable solenoid valves are available, either separately, or ready for bolting on.

One particular feature of the TCM is that it is configurable. The extent of the possible configurations depend upon the variant chosen, so each variant has a chapter of this manual for itself. However, all variants have the option of external control, which can override the operation of the TCM (working with the HDI). This can be something as simple as a “panic button”, or it allows for interwiring between two TCM modules so that one module can stop a second one operating.

Such a case may be relevant if, for example, a monitor of the storage dewar shows it to be empty, and that stopping the transfer will conserve more cryogen in the experimental vessel than by continuing to pull across warm gas from the empty storage vessel.

General physical description

The TCM is designed to be mounted in a 19" rack or similar mounting arrangement. Behind the standard panel is an enclosure, 250 mm deep, which occupies about two-thirds of the available space of the 19" panel. On the left hand side is a cut-out to DIN47300, for mounting a HDIc. If purchased together, the HDIc will already be installed.

External description.

The front panel is simply furnished with an illuminated mains power switch, and one LED per controlled output. Most of the normal controls are performed to the HDIc, and to which the appropriate manual should be read.

The Back Panel

The back panel has all the connectors, necessary for the configuration and control of the TCM. These are:

IEC mains power connector, with integral dual mains fuse holder and filter;

IEC mains outlet, to connect to the HDIc;

A DB9F connector, for connection to the control socket of the HDIc using the supplied jumper cable;

A 5 way 240° DIN connector, labelled Auxiliary Input, and for which the mating connector is supplied.

For TCM units of specification TCM–n–A

IEC mains outlet(s), which are controlled by the actions of the HDIc. There are n outlets on the back panel (1 or 2). If requested, an alternative mains outlet type may be used.

For TCM units of specification TCM–n–D

3 pin connector(s), which are controlled by the actions of the HDIc. There are n outlets on the back panel, where n is up to 4. If some of the outlets are in parallel, this is indicated separately, for example (1 + 2P), one separate outlet, and, independant to that one, two connected in parallel.

NOTE:

Always remove the mains connector before opening the lid of the TCM, as there are mains voltages inside, although not directly exposed.

Cleaning the TCM

Most of the module is either anodised aluminium or epoxy paint coated, and can be cleaned with a damp cloth or similar.

Cables and accessories

The following items are supplied with each TCM unit.

IEC mains lead for the country of destination, if not supplied with the HDI unit.

IEC extension lead, to link between the AC Line out (to HDI) to the HDI unit.

Output leads for the controlled outputs, as appropriate.

Auxiliary control connector. Note that this should be plugged into the TCM for operation, as it contains shorting links that are needed even if external control is not required.

A DB9F to DB9M jumper lead to link the HDIc control socket to the TCM.

Wiring up the TCM

There are a number of connectors in the back panel, the precise number depending upon the variant of the TCM required. This section outlines the layout of the panel, viewed from left to right from the back.

1. AC Line in.

This is an IEC mains inlet, with dual fuse holder and filter. A suitable IEC mains lead for the country of destination is supplied.

If there is a need to change fuses, this mains inlet needs to be opened. Firstly remove the mains cable. Using a small bladed screwdriver or similar, hook in the small slot at the bottom edge near the window showing the red fuse holder, and gently lever the hinged lid. The hinged lid cannot open if the mains cable is in place, as a safety measure. It is then possible to gently lever out the fuse holder. In changing fuses, be careful not to bend the 20mm fuse adaptor too far back.

Because of the different power requirements for different variants of the TCM, ensure that the correct fuse value is used (as described in the particular module's specific chapter, and written on the back panel).

WARNING: The case of this instrument is connected to mains earth.

2. AC Line out (to HDI).

A standard IEC mains outlet. A suitable cable to connect this outlet to the IEC inlet of the HDIc is supplied. Note that this outlet is controlled only by the mains switch on the front panel of the TCM, that is the HDIc will also be switched off when the TCM is switched off.

When connecting the IEC extention cable to the HDIc, ensure that the mains switch is on (1), and that the mains voltage showing in the mains voltage selector is correct (see the HDI manual).

3. Controlled output

n outlets, where *n* is as described by the TCM unit's designation. For mains voltage outlets, these are IEC outlets (unless otherwise specified), with a maximum of 2. For 24V dc outlets, these are 3 pin DIN connectors.

4. Auxiliary control

This is a 5 way 240° DIN connector. The precise designation of the pins depends upon the variant of the TCM selected. If the opportunity of external configuration of the TCM is not selected, the supplied mating connector *must* still be inserted, as it contains shorting links. Without the mating connector inserted, the unit will not operate.

5. HDIc control

A standard DB9F connector, which is used to link to the control socket of the HDIc. For pin designations, please see the HDI manual, page 10.1

Operation of the TCM–1–A

This section is specific to the TCM–1–A, that is with one controlled outlet, switching mains (ac) voltage, only. References to the relays within the HDI (referred to as Relay x and Relay y) assume knowledge of the contents of section 10 of the HDI manual.

Introduction

The TCM–1–A has one controlled mains outlet. On the front panel is one red LED, which indicates the status of this output. As the TCM can be configured in a number of ways, the status of the controlled output, as indicated by this LED, may *not* be that as indicated on the front panel of the HDIc.

If there is any reason to think that the controlled mains outlet should be active, but the LED is not showing, first check all the cabling and that the connectors are properly home and fastened.

Operation of the TCM–1–A

The TCM–1–A configuration allows for the following features:

1. Relay x from the HDIc becoming active will switch power to the single mains outlet. When this happens, the on status is shown by the single LED on the front panel.
2. In addition, Relay y from the HDIc becoming active can prevent power being switched to the single mains outlet. If Relay x is already active, Relay y will switch off the power to the mains outlet, and the status will be shown by the LED on the front panel.
3. An external, normally closed, source will, on opening, prevent power being switched to the single mains outlet, or switch off the power to it, whether or not Relays x or y are active or inactive. The wiring of the TCM is such that this external signal could be provided by Relay y from an HDIc installed within another TCM module of a similar variant. Again, the status of the controlled output will be shown by the LED on the front panel.

   (2) and (3) require the Auxiliary control connector to be suitably configured.

Pin designation of the 5 pin Auxiliary control

For the TCM-1-A, the pin designation is as in table 3.1.

Pin number	Function
1	0 V
2	To HDIc Relay Y centre (moving) contact
3	To HDIc Relay Y Normally open contact
4	To HDIc Relay Y Normally closed contact
5	System

Table 3.1 Description of the pin assignments of the 5 pin DIN connector for the TCM.

A connection between System and 0 V is necessary for the TCM to operate when Relay x is active; hence the simplest, but none-the-less essential, configuration is to link pins 1 and 5 together with the supplied mating connector, and to ensure that that connector is fitted in the unit. Further details of how this connector can be used to configure the TCM are given below.

Configuration of the HDIc within the TCM

The HDIc should be configured as follows (with reference to section 10 of the HDI manual)

1. Relay x should be assigned to the channel to which the control probe is connected to, that is the probe in the experimental cryostat. The setpoint `Rx1` (Relay x on) should be set to the lower level (when the TCM should come into operation), and `Rx0` (Relay x off), to the upper level, when the TCM should switch off power to the outlet.

In addition, the HDIc can be configured to switch off the controlled output if a further event occurs. There are two possible ways, depending upon the specification of the HDIc.

If the HDIc has only one probe input:

1.2 Relay y can be assigned to the same channel. It is suggested that the setpoint `Ry1` (Relay y on) is set well below that of `Rx1`, and gives the point at which, if the cryogen level falls below that level, it can be assumed that the transfer is unsuccessful (perhaps because the storage dewar is empty), and that continuing to attempt to transfer is probably detremental, and so should cease.

The setpoint `Ry0` (Relay y off) should be set above `Ry1`.

Once the situation that has caused the unsuccessful transfer has been rectified, it will be necessary to temporarily switch off the Relay y on the HDIc, to restart the transfer, until the level has gone above the Ry0 value. Then Relay y should be reset to automatic.

If the HDIc has two probe inputs, (that is an HDI with the -2 or -L options), with one probe in the storage vessel and one probe in the experimental cryostat:

2.2 Relay y should be assigned to the channel for the probe in the storage vessel. It is suggested that the setpoint `Ry1` (Relay y on) is at the level when the storage vessel should be considered empty, (in some cases this will be the minimum cryogen level with which the vessel should be returned with for efficient refilling) and that continuing to transfer will ultimately only cause warm gas to be transfered, to the detrement of the remaining hold-time of the experimental cryostat.

The setpoint `Ry0` (Relay y off) can be any sensible value above this threshold, so that when a full vessel is installed, the first reading of the probe in that vessel will re-initiate the transfer.

Configuration of the 5 pin connector of the TCM

As stated in the section above, the simplest configuration is to link the 0 V line to System, which allows Relay x to operate the TCM, and no further operation.

If the Relay y function as described above is required, then the Relay y links need to be employed. The normally closed contacts of Relay y should be employed, and this is done by linking pins 1 to 2 and 4 to 5. While Relay y is inactive, there will be a continuous link from System to 0 V. If Relay y becomes active, this link is opened, and Relay x will have no effect on the status of the TCM.

This is the default configuration of the 5 pin connector supplied with the TCM–1–A.

In addition, it is possible to incorporate external links, by wiring up the supplied connector. One possibility would be to connect this TCM to another, remote TCM,

so that if Relay y from the remote TCM becomes active, it inhibits the action of the local TCM. Alternatively, a link using the Normally Open connection to Relay y can be used, so that the system is normally inhibited unless the remote Relay y is active.

Using this connector allows interlocks, “panic” buttons or other any other no-volt system to be incorporated into the configuration of the TCM. Note that any other powered system must not be connected to the Auxiliary control of the TCM; if linking two TCM units together in this way, the remote Relay y pins should not have any connection to the remove 0 V and System pins.

Other information

The fuses for the TCM–1–A are 3A HRC -T. Both line and neutral are fused.

Setting up the TCM

Following are a few suggestions as to setting up the TCM and its HDIc.

1. The HDIc.

Whether running in either single or dual channel mode, it is suggested that the HDIc is set to run in the slow mode. The precise time between readings can be preset in menu `S21`, with the default value of 1 corresponding to 256 seconds (4.25 minutes). When either relay is activated, the HDIc automatically switches into fast mode for the duration of the transfer, and will then switch back into slow mode as soon as all the relays are deactivated.

During the system configuration, it is suggested that the Relays x and/or y are forced on or off from the front panel, to check that the output behaves as expected, and to note the difference between what is shown on the display of the HDIc and the LED(s) on the front of the TCM. The Relay(s) should be set to automatic for correct function in normal operation within the TCM.

The setpoints `Rx0` and `Rx1`, for example, should not be set to be completely full and empty respectively. Once the transfer has been deactivated, the transfer could continue for some time, while pressure decreases in the transfer vessel, or as the transfer lines empty, and the value of the `Rx0` setpoint should set to prevent the cryogen from running too high up the neck of the experimental system.

2. The TCM unit.

Where applicable, interconnections between TCM modules should be carefully checked to ensure that the local unit and the remote unit's interactions are as required, and especially that the connections to the remote unit are completely isolated from the power supply in the remote unit (either the 0 V line or the System line).

3. External parts (not supplied).

The TCM system only acts to switch on or off the transfer. It will be necessary to ensure that pressure regulators, throttling valves, venting valves etc. are installed in the system to ensure that the transfer is not too violent, especially at the start where cold cryogen will start to flow through warmer tubing and hence into the experimental system.

More complex variants of the TCM can be developed where a second output will switch on a predetermined time after the main output has switched. This could be used for a number of reasons, with two examples given here:

1. To switch in a bypass valve a set time after the transfer has started, to allow a transfer at a reasonable rate after a precool by a throttled valve.
2. At the end of a transfer, to open a vent valve from the storage vessel to completely de-pressurise it, sometime after the pressurised line has been closed. This allows the storage vessel to slowly depressurise (while also finishing the transfer), and then allowing the vessel to vent to atmosphere or gas collection system.

Standard Product Warranty

All products manufactured by Twickenham Scientific Instruments Ltd. ('the company') are warranted to be free from defects in materials and workmanship for a period of one year after the date of despatch. At no expense to the purchaser, the company will repair or replace (at our option) any parts which in the sole opinion of the company prove to be defective within the scope of this guarantee. Transportation costs of goods returned to the company for repairs will be prepaid by the purchaser. Goods must not be returned without prior consultation with the company to decide whether an on-site inspection and possible repair should be made. If the defect is determined to be as a result of misuse, improper repair, unauthorised user modification of abnormal operation conditions, then the repairs will be invoiced at cost.

This warranty does not apply to equipment not manufactured by the company, for which the relevant manufacturer's warranty is passed on whenever possible.

Disclaimer.

Operating the TCM, with the HDIc and probes from Twickenham or other manufacturers.

The company will under no circumstances take any responsibility for damage to a system, or for any consequential loss, either directly or indirectly, by the inappropriate use of the TCM within part of a complete system. This includes any loss or damage incurred by readings that were obtained from the HDI unit incorporated within the unit.

Possible examples of such circumstances include:

1. Inappropriate configuration of the TCM or the incorporated HDIc unit.
2. The removal of any connector from the back panel, including the auxiliary control and the linking cables to the HDIc.
3. The freezing of values not supplied by Twickenham, or inappropriately installed where parts are supplied, resulting in the valves not responding when the TCM's controlled output(s) are changed.