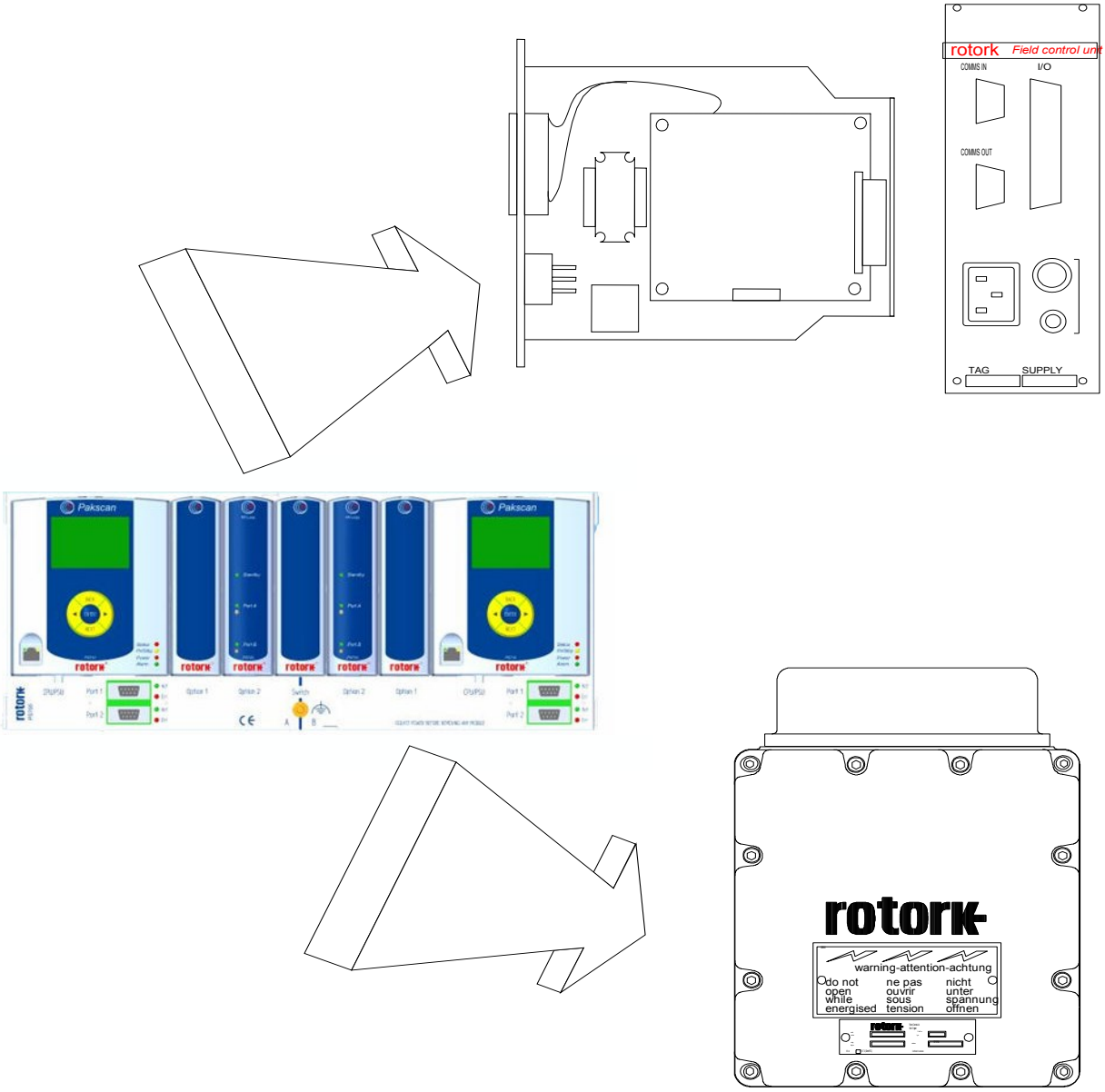

Pakscan General Purpose Field Control Unit Technical Manual

Publication - PUB059-021-00_0715

This manual relates to the Pakscan protocol GPFCU only fitted with software version V1.6 or greater and designated by the following model types;

FCU	-	21411	- Pump	220/240V	Part Nr -	85-102
		22411	- Pump	110/120V		85-103
		21511	- 1A/Act	220/240V		85-104
		22511	- 1A/Act	110/120V		85-105
		21412	- Pump	220/240V		85-106
		22412	- Pump	110/120V		85-107
		21512	- 1A/Act	220/240V		85-108
		22512	- 1A/Act	110/120V		85-109
		21413	- Pump	220/240V		85-110
		22413	- Pump	110/120V		85-111
		21513	- 1A/Act	220/240V		85-112
		22513	- 1A/Act	110/120V		85-113
		2X111	- A range Act (digital - deep cover)			85-150
		2X311	- A range Act (positional - deep cover)			85-151
		2X121	- AQ Act (digital - deep cover)			85-154
		2X321	- AQ Act (positional - deep cover)			85-155

As we are continually developing our products their design is subject to change without notice.

Contents:

List of diagrams

List of tables

Abbreviations used

EEPROM	-	Electrically Erasable Programmable Read Only Memory
EPROM	-	Erasable Programmable Read Only Memory
GPFCU	-	General Purpose Field Control Unit

Related Documents

Pakscan P3 Master Station Technical Manual	PUB059-002-00
Pakscan Paktester (Field Test Unit) Technical Manual	PUB059-023-00
General Purpose Field Control Unit Pakbox Mounted (FLP-PB2)	PUB059-015-00
General Purpose Field Control Unit Weatherproof Box Mounted (WP-PB2)	PUB059-016-00
General Purpose Field Control Unit Panel Mounted (PM-PB2)	PUB059-017-00

1. INTRODUCTION

The Pakscan GPFCU consists of 2 cards plus transformer and is most commonly available in 4 distinctive types of mounting; rack mounting, panel mounting, weatherproof box mounting and Pakbox PB2 mounting. The PCBs are identical in all cases and can be programmed to be an actuator, or general purpose, e.g. a pump or motor controller. The GPFCU is fully compatible with Pakscan 2-wire control systems.

When programmed for actuator control, the field unit can be mounted in a PB2 enclosure either directly next or near to and hard-wired to any Rotork actuator built since 1970, (for actuators built before this date refer to Rotork). It can also be mounted in a weatherproof box, or on a panel, or in a rack located in a control room and hard wired to the actuator. When programmed for general purpose control the field unit can be housed in either a PB2 Pakbox or it can be rack mounted. In both cases the pumps, motors, non-Rotork actuators etc., to be controlled will be hard wired from the field unit.

The GPFCU performs the tasks of 2-wire interface communication between the master station and the field device, (actuator / pump / motor), for data collection and the issuing of commands. All adjustments to the settings for the field unit may be made via the 2-wire interface using a Paktester.

The field unit uses CMOS integrated circuits and consequently precautions must be taken when handling the device in order to prevent damage from static discharges.

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2. FIELD UNIT PROPERTIES

2.1 Mechanical Properties

The field unit comprises a double printed circuit board that is either pre-mounted as a rack mounted unit with connections to external equipment, or with a mounting bracket to allow it to be mounted inside a Pakbox PB2 cover or inside a panel mounting box.

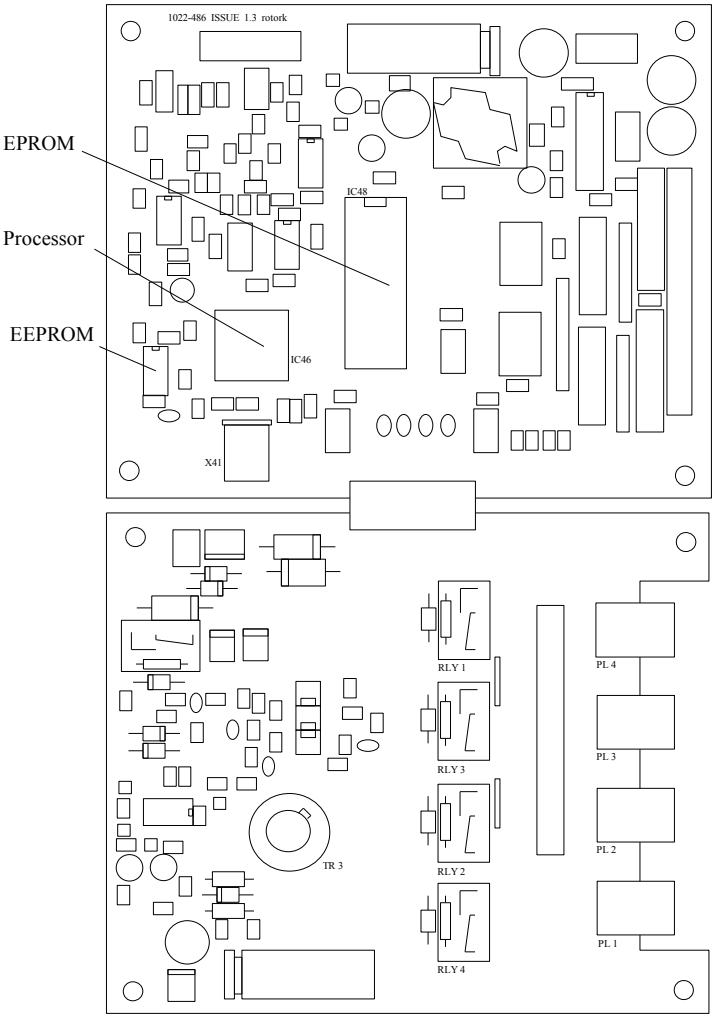
On a rack mounted unit the external connections are made via D-type connectors and the mains power is supplied via an IEC plug. With a Pakbox and panel mounted GPFCU all connection are made via cage clamp terminals. Each terminal being clearly labelled with its function.

2.2 Electrical Properties

The field unit processor is controlled by a programme stored in EPROM. The EPROM is located on the field unit board and marked as shown in figure 1. The software version is indicated on the label fitted to the EPROM. Additionally, the circuit includes a non-volatile EEPROM that is used to store parameter settings that contain information about the field unit settings.

The 2-wire loop interface electronics is also on the field unit board. The interface circuits are fully opto-isolated from the field unit processor and device electronics. The loop interface includes the loopback circuits used to maintain communication integrity if there is a loop cable fault and also the loop by-pass circuits that ensure loop continuity if the field unit loses power.

Fig 1: The General Purpose Field Unit



2.3 Operation and Storage

The field unit is designed to be stored and operated within the following constraints:

Operating temperature:	-30°C to +70°C
Storage temperature:	-50°C to +85° C
Relative Humidity:	5% to 95% (<50°C) non-condensing
Vibration:	0.75g (0.5 Hz to 300 Hz)

3. COMPATIBILITY

The GPFCU is compatible with all Pakscan master stations built since 1990. Only one EPROM, (5152-410), is needed for both GP mode and actuator mode operation. The GPFCU cannot be used with a Pakscan I master station.

3.1 Paktester

In order to be able to use a Paktester to set up and commission Pakscan field units, a Paktester fitted with software 5161-013 with a version higher than V5.0 must be used.

Instructions on how to use the Paktester can be found in PUB059-023-00.

Note. Once the GPFCU has been set-up and commissioned, parameter modifications (except the address) can be done via the master station.

3.2 2-Wire Loop

The GPFCU is compatible with all other Pakscan field units, (IQ and Integral field unit), and may be connected to the same 2-wire loop provided they all operate at the same baud rate, and each has a unique address.

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4. FITTING THE FIELD UNIT

The field units will be factory fitted into their enclosures or supplied as stand alone or included in a 19" rack, if rack mounted GPFCUs are need

Figure 2 below shows a sectional drawing of the Pakbox PB2, with the GPFCU located on the top of the box.

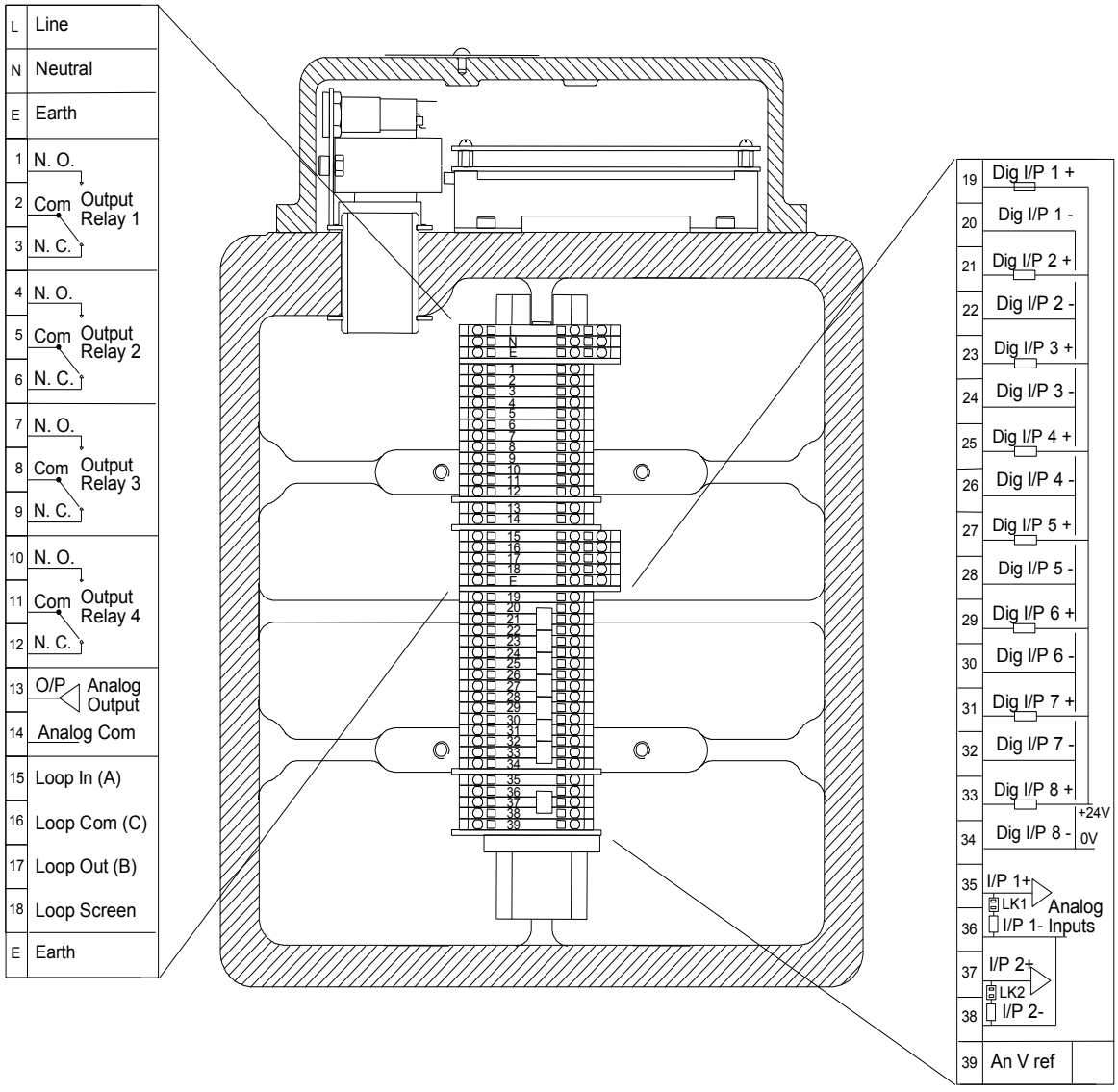

Fig 2: Pakbox PB2 mounted field unit.

If the device is a rack mounted field unit it will be supplied either as a stand alone unit or pre-mounted into the rack, as shown in figure 3.

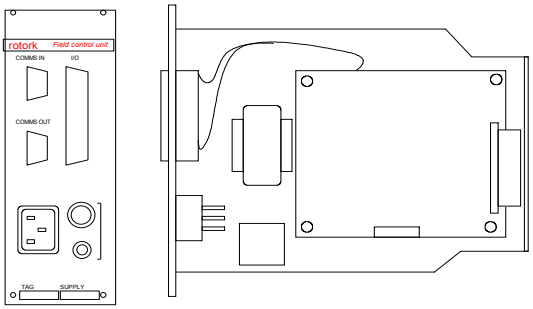

fig 3: A 19-inch rack mounted GPFCU (on left) and when seven are fitted into a 19-inch" rack (below).

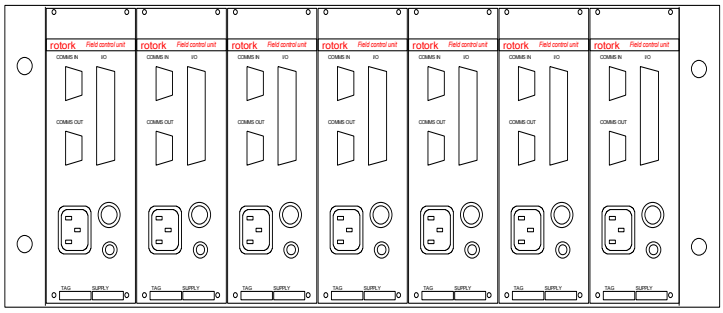

Figure 4 (right) shows a schematic drawing of a panel mounted GPFCU. The weatherproof box version is the panel mounted unit inside a GRP housing.

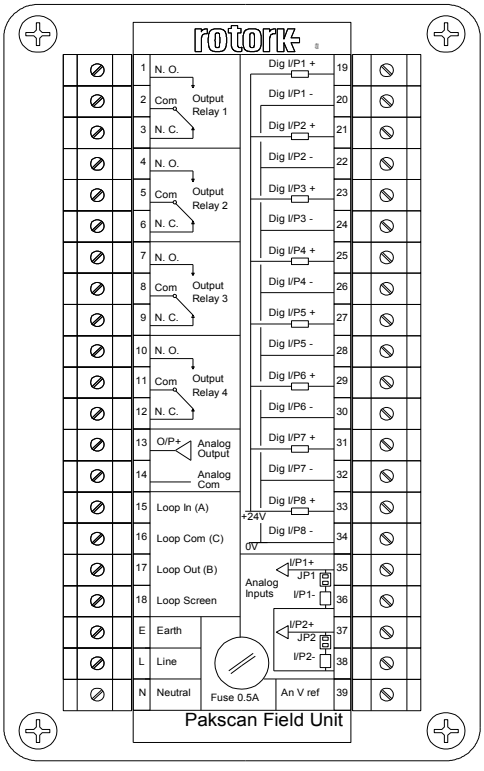

Fig 4: Panel mounted GPFCU

4.1 Replacing or Fitting a Field Unit

The field unit should be replaced or fitted only in a suitable environment.

If field mounted, the actuator / Pakbox must be made electrically safe before opening any covers. On the PB2 the top cover should be removed and the plate with field unit unbolted from the cover. The field unit can now be removed by unscrewing the transformer and carefully disconnecting the connectors. The replacement board is fitted in the reverse order to removal. When assembling the cover onto the PB2 housing, “Hylomar” or a suitable sealant should be applied to prevent moisture ingress

If the unit is rack mounted, removal consists of unplugging the power and D-type connectors and sliding the unit out of the rack. The replacement unit is fitted in the reverse order to removal.

For a panel mounted GPFCU, any connections to the panel need to be removed by prizing apart the cage clamps using a small flat headed screwdriver. The replacement unit is fitted in the reverse order to removal.

Once fitted the field unit parameters, address, baud rate etc., will need to be set.

4.2 Setting Up a Field Unit

As the same GPFCU can be used as either a general purpose or as an actuator field unit, care must be taken during installation to ensure that the jumpers and links are set correctly.

If the unit is to be a general purpose field control unit then the links LK1 and LK2 need to be removed. If the analogue inputs are being used then jumpers JP1 and JP2 need to be either left in place for a 4 - 20 mA input or removed for a 0 -5 V input.

If the unit is to be an actuator unit then links LK1 and LK2 need to be left in place and jumpers JP1 and JP2 need to be removed.

All other parameters, e.g. fleeting/maintained relay contacts, digital input mask, baud rate, address etc., can be programmed with a Paktester after installation, (see Paktester manual PUB059-023-00).

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5. 2-WIRE LOOP CONNECTIONS

The field unit should be wired in the communication loop as indicated in figures 5, 6 and 7.

It is important to connect the current loop input terminal to the previous field unit's current loop output terminal and the current loop output terminal to the next field unit's current loop input terminal. The current flow around the loop must always pass in the same direction through all the field units. The common wire must form a continuous link around the loop.

The screen of the 2-wire loop cable must be isolated from ground at all the field units (to prevent the possibility of earth current loops). A specific terminal is allocated at the field unit for the screen to connect to. The screen should be continuous for the whole 2-wire cable.

Fig 5: Pakbox PB2 GPFCU to 2-wire loop connections

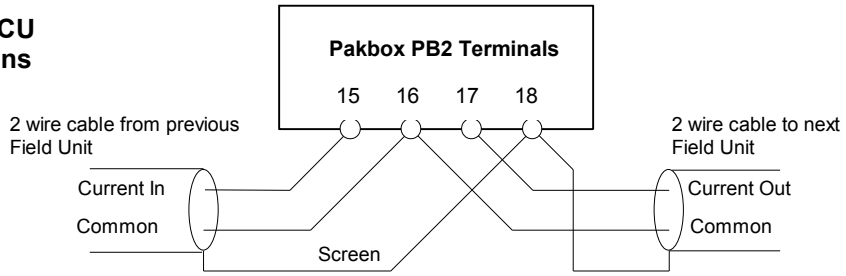


Fig 6: Panel Mounted GPFCU to 2-wire loop connections

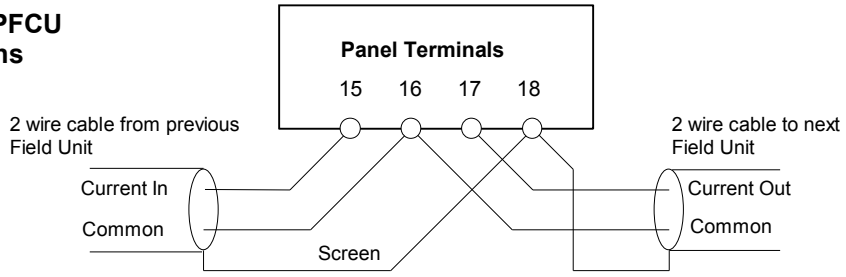
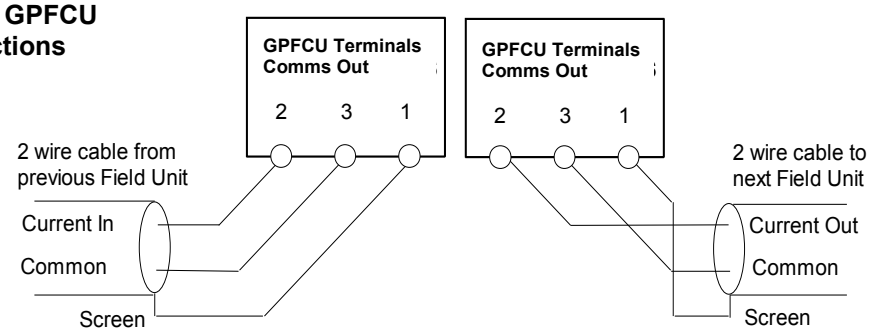


Fig 7: Rack Mounted GPFCU to 2-wire loop connections



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6. 2-WIRE LOOP INTERFACE

The field unit interfaces directly with the 2 wire loop. The circuits for the interface are isolated electrically from the actuator processors and field unit processor by opto-isolators. The interface includes protection devices to suppress the effects of lightning strikes or other high induced voltages. These surge suppressors are rated at 1.5kV for 1 ms.

6.1 Loopback Feature

The interface includes circuits that permit the field unit to 'loopback' the current on the 2-wire loop if the cable is broken. As the system operates on 20 mA current, there has to be a current path at all times if communication is to be possible. If the cable is unable to pass this current then the field unit will, after a short time, turn on its loopback devices so that the current may return to the master station along the common wire. This feature ensures that communication can be maintained with the actuator even though the cable is faulty. The loopback circuit will be in use if the cable is short circuit or open circuit.

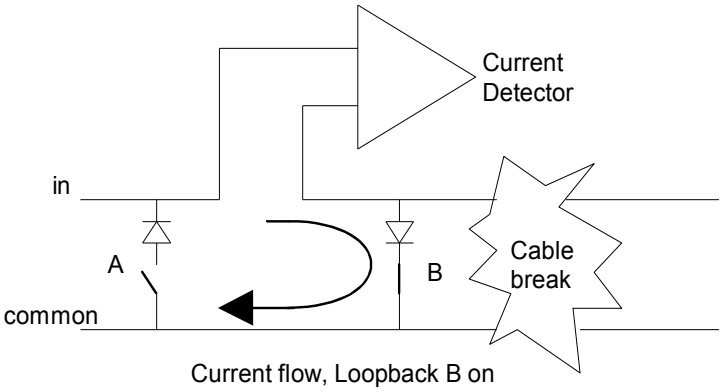

Fig 8: Loopback feature

To programme the field unit critical comms parameters, e.g. address and baud rate, the field unit must be in loopback.

6.2 Loop Bypass Circuit

If the actuator is powered off then the field unit detector circuits will not function. The system includes a by-pass relay contact that will still permit the loop current to flow through the actuator. If the actuator is wired in circuit in the incorrect polarity the current detector circuits will not function correctly and the field unit will go into loopback mode. Note that an incorrectly connected actuator will prevent the system from operating that actuator.

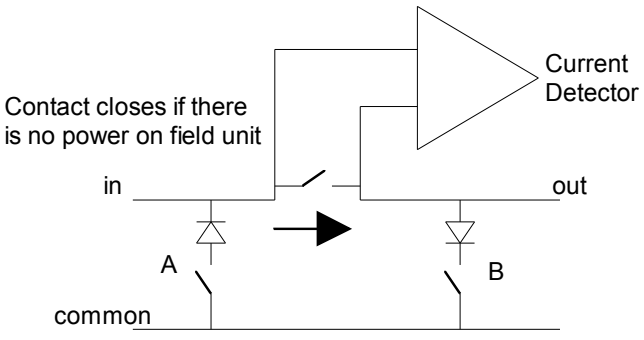

Fig 9: Loop by-pass relay

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7. INPUT AND OUTPUT SIGNALS

The following section describes the Pakscan inputs and outputs of a GPFCU. Feedback data is considered to flow from the field unit to the master station (AI and DI) and command data (AO and DO) in the reverse direction. Thus Inputs are feedback signals and Outputs are commands.

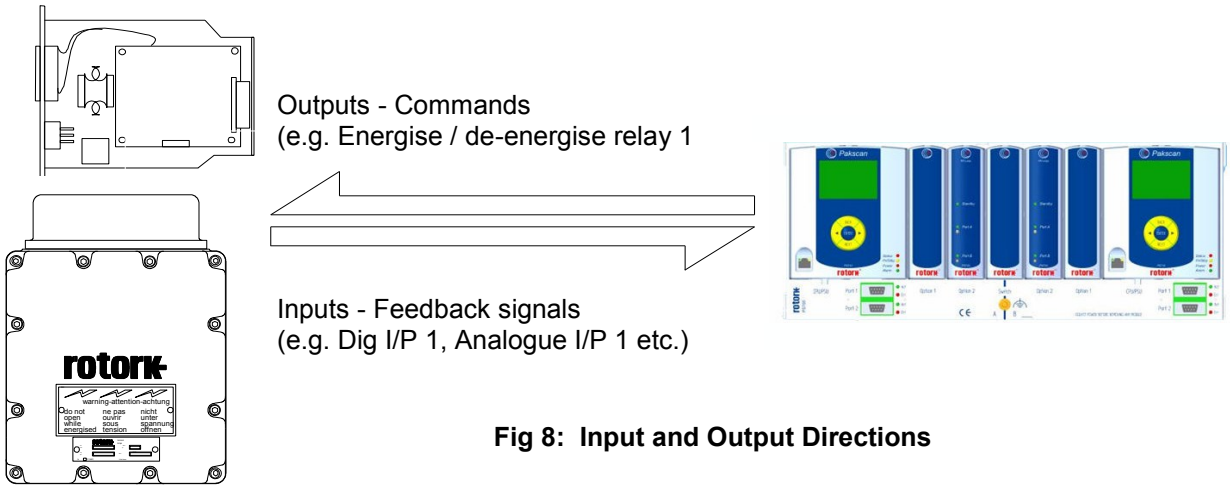


Fig 8: Input and Output Directions

7.1 Summary of Digital and Alarm Status Data Bits

STATUS DATA BITS - ACTUATOR AND GPFCU MODE		
Digital Status Data Bits - Field Unit and Alarm Indicators:		
LBON	-	The field unit is in Loopback mode
NALARM	-	There is a New Alarm to report
ALARM	-	There is an Alarm to report
Alarm Status Data Bits - Field Unit Alarms, (Actuator and GPFCU mode):		
MEMF	-	A failure of the memory test
COMMS	-	Communication failure
POWR	-	Power on reset
WDOG	-	Field unit watchdog alarm

STATUS DATA BITS - ACTUATOR MODE ONLY
(N.B. The following status bits may not be available on certain actuators

Digital Status Data Bits

OAS	-	The actuator has reached the fully open position limit switch
CAS	-	The actuator has reached the fully closed position limit switch
STOP	-	The actuator is stationary and in mid travel
MRUN	-	The actuator motor is turning
MRO	-	The actuator is running open
MRC	-	The actuator is running closed
EXT	-	The remote input connected to the auxiliary input

Alarm Status Data Bits

CNA	-	Actuator Local Control Selected
MREL	-	Actuator monitor relay
THERM	-	Actuator motor thermostat
LSTOP	-	Actuator Local Stop

Derived Alarm Data Bits

SFAIL	-	Motor start or stop failure
VOBS	-	Valve obstruction detected, Torque trip
VJAM	-	Valve stuck detected, Torque trip
MOP	-	Actuator auxiliary remote controls activated
MCL	-	Specified valve travel time exceeded
MOPG	-	Actuator being moved manually by the handwheel
MOPG	-	Actuator being moved manually by the handwheel
EOT	-	Actuator motor continues to run past End of Travel position

STATUS DATA BITS - GPFCU MODE ONLY

GPFCU Mode Data

DIN 1 - 8	-	Digital Inputs 1 to 8
RLY 1 - 4	-	State of output relays 1 to 4
ACT(1)	-	Relay action, (fleeting or maintained)

ADDITIONAL FEEDBACK DATA

Valve position (8 bits)	-	Actuator mode
Analogue I/P 1 and 2, (12 bits)	-	GPFCU mode
Analogue O/P, (12 bits)	-	GPFCU mode
Pulse counter	-	GPFCU mode

7.2 ACTUATOR AND GPFCU MODE DIGITAL DATA BITS

7.2.1 Actuator and GPFCU Mode Digital Status Bits

7.2.1.1 Loopback On: (LBON)

The field unit will assert its loopback circuit when instructed to do so by the master station or if the field unit receives no messages within a specified time. A field unit's normal condition is to go into loopback and remain in that state until told to remove its loopback by the master station.

The condition of the loopback circuit is reported in the LBON data bit. Loopback is automatically asserted if there are no messages to the field unit. The time taken to be sure there are no messages is dependant on the loop baud rate set for the field unit. The periods are approximately:

2400 baud	8 seconds
1200 baud	12 seconds
600 baud	24 seconds
300 baud	44 seconds
110 baud	90 seconds

As part of one of the safety features, programming the parameters in a field unit can only be carried out when the field unit is in loopback. However, when interrogating a field unit with a Paktester the field unit will always be in loopback.

7.2.1.2 New Alarm Indication: (NALARM)

This data signal is generated within the master station. The data bit NALRM is set whenever there is a new alarm in the field unit. Each time the alarms are read and accepted the New Alarm bit will be cleared irrespective of the alarm status. This bit is used as a flag to indicate that there is an alarm in the field unit that has not yet been examined by the master station.

7.2.1.3 Alarm Indication: (ALARM)

This data signal is generated within the FCU and transmitted to the master station on the next scan. The ALARM data bit is used to show that an alarm condition has been detected by the field unit. This single bit is an OR function of all the possible alarm conditions that the field unit detects. The bit will be present if there is an alarm currently active on the field unit, or if there is a transient alarm that has not yet been read by the master station and accepted by the master station. All alarms are latched; the latch will clear only if it is no longer present and if the following two conditions are met in the correct order - the alarm must first be read and then accepted. This alarm handling is automatically handled by the master station.

7.2.2 Actuator and GPFCU Mode Alarm Status Bits

7.2.2.1 Memory Fault: (MEMF)

The field unit performs tests on the memory devices under its control. If a fault is detected during this test then the MEMF alarm is raised. This alarm is indicative of a device failure or possible corruption. If this alarm occurs the field unit should be re-programmed to a new baud rate and address, then back again to the original, and finally switched off and on again to see if the fault persists. If the fault does not clear then the field unit can be considered as faulty. This is a fleeting alarm and will clear once accepted.

7.2.2.2 Communication Failure: (COMMS)

The field unit itself cannot report a communication failure. This data has to be determined by an interrogation device such as the master station or Paktester. If a field unit fails to respond to messages, including retries, then the master station or Paktester will report that the field unit is in Communication Failure by asserting the COMMS data bit. This is an alarm and also sets the Alarm and New alarm bits.

7.2.2.3 Power on Reset: (POWR)

When powered 'on' the field unit resets the processor and checks its memory. When this occurs the alarm data bit POWR is set to indicate that the field unit has just been powered on. If the field unit obtains its power from the actuator it is also an indication that the actuator has just been powered on. It is a fleeting alarm and it will go away once accepted.

7.2.2.4 Watchdog: (WDOG)

There is a watchdog timer circuit in the field unit. The purpose of the watchdog timer is to monitor the field unit processor. Every so often the processor examines the watchdog circuit hardware. If the processor does not restart the watchdog timer then, on timing out, the watchdog timer resets the processor and the alarm data bit WDOG is set. If this alarm is present it is indicative of a potential failure in the field unit. When announced, the system is operating correctly; if it were not then a communication error would result, however the reason for the alarm should be determined. Accepting the alarm will cause it to go away, if it is a fleeting alarm, but if it returns then it should be assumed that the field unit is about to fail completely.

7.3 ACTUATOR MODE ONLY DIGITAL DATA BITS

7.3.1 Actuator Mode Digital Status Bits

7.3.1.1 Actuator Position Limit Switch Data: (OAS / CAS)

There are two data bits relating to the actuator set positions for open and close positions. OAS is used for open limit indication, CAS is used for close limit indication. These limit positions may be set within the actual valve stroke, as with a torque seating valve the actuator will stop when seated fully closed and the rated torque has been delivered to seat the valve. The position limit switch must be set slightly before the torque off position so as to ensure that the position is correctly reported. The actuator will continue to move in the chosen direction of travel for approximately 5 seconds after the limit switch position is reached, (then an EOT alarm will be generated), so the torque seat position must be quite close to the limit switch position.

The data relating to position is maintained even though the position itself has been passed through.

7.3.1.2 Stop Indication Data: (STOP)

Whenever the actuator motor stops rotating and it has not traversed or reached the end of travel limit switches it is stationary in mid travel. This situation is indicated by the 'STOP' data bit. If the actuator is subsequently moved by either a 2-wire control input command, a remote input command or a local control command, the STOP signal will be removed for the duration of the rotation of the motor.

7.3.1.3 Motor Running Indication Data: (MRUN)

Whenever the motor is in motion the MRUN data bit is present.

7.3.1.4 Motor Running Data: (MRO / MRC)

There are two data bits relating to the motor running and the direction of travel. Whenever one of the internal contactors is energised and the actuator begins to move the valve, either a MRO or MRC signal will be generated. If the contactor to run the actuator in the open direction is energised then MRO (Motor Running Open) is reported. If the contactor to run the actuator closed is energised then MRC (Motor Running Closed) is reported.

These signals will be reported if the actuator is commanded over the 2-wire loop to move, from the local controls, or if it is commanded from remote pushbuttons that can be fitted.

If the actuator has just been powered on and a command to move is generated from the actuator local controls, or an ESD input, then both the MRO or MRC signal will be generated. In all cases a MRUN signal is always generated. This situation will revert to correct MRO or MRC indication, (rather than both), once the actuator is switched to remote control and a command is issued to the valve via the 2-wire loop.

The status signals can be summarised as follows;

Command via the 2-wire loop	-	MRO or MRC
Local control command	-	MRO and MRC
Remote push button command	-	MRO and MRC
ESD command	-	MRO and MRC

7.3.1.5 Remote Auxiliary Input Signal: (EXT)

The field unit is able to collect information from a remote input signal designated EXT. This signal, (for example from a tank level switch), is reported to the master station over the 2-wire loop. This option is only available when the position feedback is not used.

7.3.2 Actuator Mode Alarm Status Data Bits

7.3.2.1 Control Not Available: (CNA)

The actuator has a 3 position switch for selecting Remote, Local Stop or Local control. The switch passes from Remote to Local, or Local to Remote, through the Local Stop position. When the actuator local control switch is fully in the Local position then the CNA alarm bit is generated. This data bit is not present when the actuator control switch is in the Local Stop or Remote positions. The alarm is present as long as the switch is in the Local position. It will clear only when accepted and the switch is returned to the Remote or Local Stop position. If the switch is returned to the Remote or Local Stop position before the alarm is accepted, then on acceptance the alarm bit will clear.

7.3.2.2 Local Stop: (LSTOP)

When the actuator local control switch passes through, or is set in, the Local Stop position then the alarm bit LSTOP is set. The actuator may be placed in Local Stop as a unique function to prevent operation of the valve by any remote means. Note that LSTOP will be generated when moving the selector switch from Remote to Local and when moving the switch from Local to Remote.

If the selector switch simply traverses the Local Stop position then the alarm generated will be fleeting and will clear itself on the next ‘read and accept’ cycle.

7.3.2.3 Thermostat Trip: (THERM)

The actuator motor is protected by a thermostat. If the temperature of the motor windings rises above the thermostat trip value then the THERM alarm bit is set. There are no adjustments for the temperature at which the thermostat trip operates. The motor will be stopped if the thermostat trips. Only once the motor has cooled down can a new Remote, Pakscan or Local command to move the actuator Open or Closed be actioned. The ESD command may be set to override the thermostat. The THERM alarm bit will remain set until the motor cools down and until read and accepted.

7.3.2.4 Monitor Relay: (MREL)

The actuator includes a composite signal for some alarms referred to as the Monitor relay. The MREL alarm bit will be set if the actuator selector is in Local or Local Stop (not in Remote) or if the thermostat trips. The actuator also monitors the 3-phase supply. If the phase not associated with the control circuits is lost the monitor relay will operate and the MREL data bit is raised. The remaining two phases are used by the control circuits and if either of these is lost at any time then the actuator switches off. Communication with the field unit will then be lost.

7.3.2.5 Start/Stop Failure: (SFAIL)

The actuator must be set in Remote for this alarm to be valid. If the actuator motor fails to respond to a valid Pakscan start or stop signal then the field unit will raise the SFAIL alarm bit. The SFAIL bit is not raised if the alarm is detected as an obstructed or jammed valve. The alarm is fleeting and only generated at the time the failure occurs. The alarm bit will clear once it has been read and accepted.

7.3.2.6 Obstructed Valve, Torque Trip: (VOBS)

The actuator must be set in Remote for this alarm to be valid. If the actuator is required to generate more torque than the actuator maximum torque setting the motor will stop. The field unit detects this internal condition and modifies it to include the fact that the actuator is not currently in its end of travel position. The reason for the stopped condition must therefore be an excessive stiffness in the valve or an obstruction in the pipe preventing the valve from moving any further in the selected direction. The alarm reported is VOBS.

7.3.2.7 Jammed Valve, Torque Trip: (VJAM)

The actuator must be set in Remote for this alarm to be valid. This signal is similar to the SFAIL Start/Stop failure alarm. In the case of the VJAM alarm the actuator stall condition will be detected whilst the actuator is stationary at an end of travel position. The torque trip will have been generated because the valve is stuck in the seat. If the actuator is set to stop on torque, to guarantee a fully shut or open valve irrespective of the position limit switch setting, then the VJAM alarm is not generated at the end of travel position. The alarm is only generated when the actuator attempts to leave the valve seated condition. The VJAM alarm bit is fleeting and will clear once read and accepted.

7.3.2.8 Manual Valve Movement: (MOP / MCL / MOPG / MCL)

If the valve is placed in hand operation and moved by the handwheel the actuator will detect the motion of the centre column only if it reaches or leaves the end of travel limit switches. If the actuator reaches the end of travel switch either the MOP, (manual open), or MCL, (manual close), alarms will be generated. If the actuator leaves the end of travel switch either the MOPG, (manual opening), or MCL, (manual closing), alarms will be generated. These alarms are generated irrespective of the position of the local - remote switch, they are fleeting and will clear once accepted.

7.3.2.9 Motor Continues Running at End of Travel Limit Position: (EOT)

The actuator must be set in Remote for this alarm to be valid. If the actuator motor continues to run for more than 5 seconds after the valve reaches the set end of travel limit switch position then the EOT alarm bit is set. The EOT alarm bit is fleeting and will clear once read and accepted.

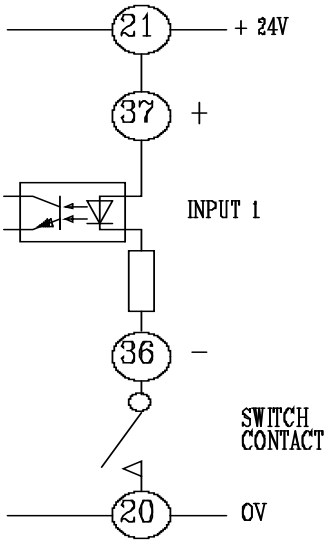
7.4 GPFCU MODE ONLY DIGITAL DATA BITS

7.4.1 GPFCU Mode Digital Status Bits

7.4.1.1 Digital Input Status Bits 1 to 8: (DIN1 - 8)

The GPFCU has 8 digital inputs which can be used to collect digital information, via volt-free contacts, from around the plant, e.g. a level switch, motor contact etc. There is a reference voltage available to ensure that the digital signal is at the correct voltage level, (>18V = 1). Using a Paktester, it is possible to programme the field unit to invert any or all of these inputs before transmission to the master station.
If the GPFCU is Pakbox mounted the volt free contact has to be placed between the common, (terminal 19), and the input, (terminal 20 - 27), - see appendix A2. If the GPFCU is rack mounted the volt-free contact has to be connected as shown in fig 11.

Fig 11: Rack mounted GPFCU Digital Input Connection



7.4.1.2 Output Relay 1 to 4 Status Bits: (RLY1 - 4)

The GPFCU has 4 output relays with both N.O. and N.C. contacts available which can be programmed to be either fleeting or maintained, (all relays will have the same function). The current state of the output relays can be investigated to determine whether they are energised or de-energised. If the relays have fleeting contacts they will only be energised for 300mS and will always return a de-energised signal when read from the master station.

7.4.1.3 Relay Action: (ACT1)

The output function of the relays can be interrogated to determine whether they are programmed to be fleeting or maintained.

7.5 ADDITIONAL FEEDBACK DATA

7.5.1 Actuator Mode

7.5.1.1 Valve Position Feedback - Continuous Position Data:

Only field units that are type 2, (analogue), or type 3, (positional), are able to report the valve position, provided that the actuator has been fitted with a position indication potentiometer. The data about the valve's position is fed to the field unit for onward transmission, to the master station, as a valve position feedback signal. The scaling of 0 -100% is performed at the master station using the end of travel limit switches, which means that to get an accurate positional reading the valve must be fully "stroked" from fully open to fully closed or vice-versa.

If the valve is torque seating then the torque-off point position should be set very close to the limit switch setting so as to minimise the actual position error

7.5.2 GPFCU Mode

7.5.2.1 Analogue Inputs 1 and 2:

The GPFCU has 2 analogue inputs which can accept either a 0 - 5V or 4 - 20 mA input. The inputs can be configured for current by leaving JP1 and 2 linked, or voltage by removing the jumper across JP1 and 2. Only one form of input, current or voltage, can be used per field unit. Calibration of the inputs from 0% to 100% is performed at the field unit with a Paktester and must be programmed in during commissioning. This is achieved by setting the relevant input to 0% and issuing the appropriate command from the Paktester to store this value in the EEPROM. The 100% setting is also stored in the same way. Full details of the setting procedure are explained in the Paktester manual, PUB059-023-00.

7.5.2.2 Pulse Counter:

Digital input 1 can be used as a pulse counter provided the pulse width is greater than 20 mS. This input is summed in the field unit and is available to the master station and / or host upon request. The pulses are counted to 9999 and then reset to 0

7.6 ACTUATOR COMMAND OUTPUTS

The actuator is able to be commanded either from the local controls or the Pakscan field unit. Local controls will always preclude Pakscan controls when actuator is in local. The actuator will always respond to the last Open/Stop/Close input or DV command.

If the command is an ESD then it will override any other command except local stop. However, the ESD signal is latched and if the local stop is removed, the actuator will either open, close or stay put depending on what the ESD setting is. This latched ESD will prevent the actuator from being operated locally and can only be removed be either powering down the actuator or sending another command on the 2 wire loop, e.g. a stop command.

7.6.1 Local Controls (Open, Stop, Close)

The selector switch must be in Local for the Local Open or Local Close controls to be actioned. When commanded, the actuator will move in the desired direction. The actuator is able to accept instantaneous reversal of direction of travel without the need for a stop signal. Local Stop is a unique position for the selector switch and causes the actuator to stop.

Whenever the actuator is in Local no other input from Pakscan Inputs, (except ESD), will cause actuator motion. In Local control mode no derived alarms are generated by the Pakscan system.

7.6.2 Pakscan Controls (Open, Stop, Close and Set DV)

The actuator selector switch must be in Remote for Pakscan control to be enabled. The field unit is able to command the actuator to move full travel or to a particular position.

7.6.3 Full Travel Control

The field unit outputs Open, Stop and Close commands that are actioned by the actuator. When the field unit issues a command, the actuator actions it until another command is issued or the instruction has been completed. For example; the field unit will issue a command to 'open' the valve, the actuator will then action this command until the valve is fully open or until a close or stop command is issued from the field unit, whichever is the sooner.

If an attempt to issue simultaneous commands is made, then a priority exists such that Stop is the highest and Open is the lowest. The command to the field unit from the 2 wire loop is a momentary 'write' of data. Once initiated, the field unit does not require the command to be cancelled before another is issued. Since the command to the actuator itself is a fleeting signal, it is not possible to 'read back' the status of command data. If multiple commands are sent to the same field unit, the command received last will be obeyed. Note that as commands are processed by the master station it is possible for a multiple coil or register write to countermand a previous order. If single coil write commands are used on the host data link this possibility is eliminated.

It is acceptable to reverse the actuator in mid travel without issuing a stop command. It is not possible to induce a 'push to run' action with a Pakscan system. The actuator will run in the chosen direction to the end of travel unless stopped by another command.

7.6.4 Position Control (set DV)

The field unit is able to accept a 'Desired Value' signal to cause the actuator to move to a particular position in the valve stroke only if it is a “type 3” (i.e. position control) field unit and there a position feedback potentiometer fitted. The action of sending a DV signal to the field unit places it in 'positioning mode'. The command has a lower priority than a full travel Open command. The positioning signal must be in the range 0-100% where 0% is towards the close position of the valve. Once a desired value has been sent to the actuator, the field unit will maintain control of the actuator and position it such that the measured value position signal equals the desired value sent.

The command to the field unit from the 2-wire loop is a momentary 'write' of data for the Desired Value. Once initiated, the field unit does not require the command to be cancelled before another is issued. Since the command to the field unit is then interpreted as an instruction to the actuator itself, it is not possible to 'read back' the Desired Value.

It is acceptable to send a new Desired Value at any time. There is no need to issue a stop command or cancel the existing value. If a full travel command (such as Open, Stop or Close) is sent to the field unit this will cause the Desired Value command to be removed and replaced with the most recent command.

In situations where multiple register writes to the master station are sent to the same field unit then the last Desired Value command received by the field unit will be the command actioned.

When any alarm is detected by the field unit the position control action is cancelled and the actuator will not attempt to continue controlling the valve position. This means that, for example, if the valve is obstructed during a positioning action, the actuator will stop and not continue to try to achieve the desired position. The alarm reason should be investigated and corrected before any further attempt is made to position the actuator.

If an alarm is already present on the actuator and a DV command is sent to the field unit then the command will be retained as a pending action to be carried out once the actuator alarm has been cleared. For example, if the actuator selector is in Local Stop and a DV position command is sent to the field unit, when the selector is moved to Remote, the actuator will run to obey the DV command. Note that if the actuator selector is in Local and a DV command is sent this will not be actioned when the selector is placed in Remote - moving from Local to Remote passes the selector through Local Stop so an alarm, Local Stop, will have been generated as the selector is moved and this alarm will cancel the DV command.

7.7 GPFCU COMMAND OUTPUTS

7.7.1 Digital Output

There are 4 relays available with either N.O. or N.C. contacts to provide digital outputs for plant control. The contacts can be programmed to be either all fleeting, (350mS pulse), or all maintained.

7.7.2 Analogue Output:

The GPFCU is able to give a 0 - 5V analogue output with a resolution of 12 bits, (1.2 mV). Calibration of the output can only be achieved by means of a Paktester and must be programmed in during commissioning.

This is achieved by downloading the 0% calibration setting to the FCU from the Paktester and adjusting the 0% calibration setting until the desired output is achieved. The 100% setting is achieved by setting the output to 100% and adjusting the 100% calibration setting until the output is correct.

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8. ALARM HANDLING

Alarm handling is automatically controlled by the master station. The user need not consider how alarms are latched and reported by the field unit. Any alarm revealed by the field unit will be reported to the master station.

The user should be aware of how to handle the alarms at the master station and on the master station to host computer.

If an alarm is reported by the field unit it is automatically accepted by the master station. The alarm is then free to clear once the actuator returns to normal.

In a Pakscan master station the alarm is posted to three logically separate areas, the data base for comms port 1, the data base for comms port 2 and the Modbus TCP (Ethernet comms ports). In all cases the alarm must be read by requesting the data before the alarm can be removed from the system. Once it has been read then the alarm will only clear on two further conditions, it must be accepted and the actual fault must no longer be true. Until all three conditions are met the alarm will remain locked in the system. If an alarm has not been cleared and subsequently repeats itself then the more recent event overwrites the earlier event.

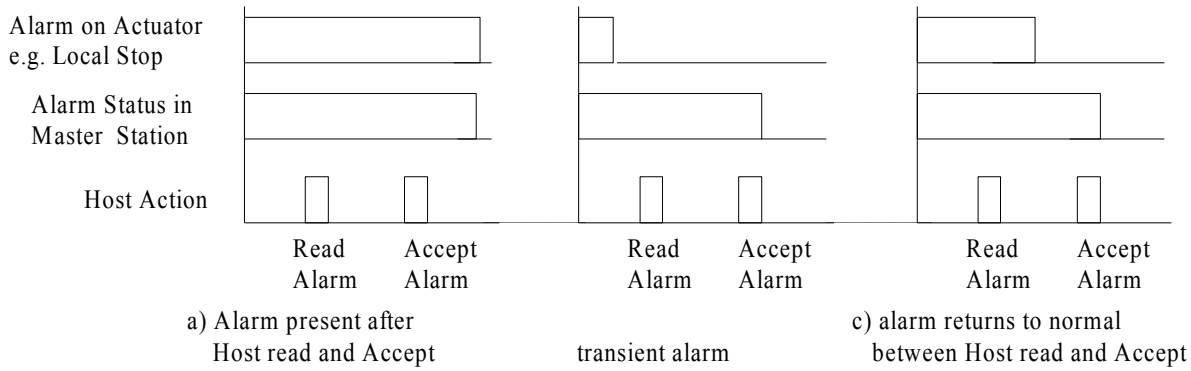

Fig 12: Alarm Handling Sequences

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9. SETTING UP A FIELD UNIT

The parameters that determine the actions and settings of the field unit may be programmed by a Paktester. All field unit variable parameters have default settings that will be present on a new field unit. These will generally require some alterations so as to match the field unit to the device and to the system.

BEFORE SETTING ANY VARIABLES ENSURE THAT THE ACTUATOR AND PLANT IS IN A SAFE CONDITION. SETTING SHOULD ONLY BE CARRIED OUT BY A COMPETENT ENGINEER.

The only tool that may be used to set the parameters is:

Paktester with software version higher than V5.0

In all cases the data variables are stored in EEPROM. As a protection on the system, when any major variable is to be changed the field unit must be in loopback. Table 1 shows the identity of each variable parameter and its default setting together with its total range.

PARAMETER IDENTITY	PERMITTED VALUES	DEFAULT
Comms Baud Rate	110, 300, 600, 1200, 2400 Baud	1200
FCU Address	1 -240	1
Motion Inhibit Timer	0 - 255 seconds	2 sec. (1 s. resolution)
Deadband	0% - 12%	5% (0.1% resolution)
Analogue Update Timeout	0 - 255 seconds	30 (1 sec resolution)
Analogue Deviation Threshold	0 - 99%	20% (1% resolution)

Table 1 - Actuator Mode Parameters and defaults

PARAMETER IDENTITY	PERMITTED VALUES	DEFAULT
Comms Baud Rate	110, 300, 600, 1200, 2400 Baud	1200
FCU Address	1 -240	1
Relay O/P Mode	Fleeting / Maintained	Fleeting
Analogue 1 & 2 Deadband	0% - 12%	5% (0.1% resolution)
Analogue Update Timeout	0 - 255 seconds	30 (1 sec resolution)
Digital Input Sense	0 or 1	(8) - 1101111 - (1)

Table 2 - GPFCU Mode Parameters and defaults

Communication Baud Rate

Must be set to 110, 300, 600, 1200, or 2400 baud. All the Field Units on the loop must be set to the same baud rate.

Field Unit Address

Must be set in the range 1-240. On a single 2-wire loop each Field Unit must have a unique address. The order of the addresses on the loop need not be consecutive. For reasons of speed performance it is best to have no unused addresses on the loop.

Analogue Update Time

Must be set for the period to update the master station with analogue position data. The analogue value is reported each time it changes by more than the Analogue Deviation or every 'x' seconds where 'x' is the Analogue Update Time. As the value updates on deviation the update time can be set to quite a long period and should be approximately 10 times the loop scan period. If analogue data is not being used at all then the analogue reporting can be turned off by setting the Update Time (and Analogue Deviation Threshold) to 00.

Analogue Deviation Threshold

Must be set for the amount of change that has to occur before the analogue position data is reported to the master station. The value is reported each time it changes by the Analogue Deviation setting or every Update Time period. Whilst the value is changing it reports its value each time it changes by more than the Deviation setting. The recommended value is 5% where analogue data is required. If analogue data is not being used the analogue reporting can be turned off by setting the Deviation (and Analogue Update Time) to 00.

Motion Inhibit Timer (Actuator Mode only)

To protect the actuator motor the setting for the Motion Inhibit Timer is designed to prevent the motor exceeding the rated number of starts per hour. If the motor is rated at 60 starts per hour the setting should be 60 seconds (this assumes that the motor running periods will be very short).

Deadband (Actuator Mode)

The Deadband setting will prevent the actuator from hunting. The deadband must be set to a number that provides good close control with the minimum of actuator starts. Ideally, the actuator should never be prevented from starting by the motion inhibit timer. The actual setting for the deadband will depend on the actuator and valve combination. If the control has to be exact then a small (2%) deadband should be set, if a more tolerant control is permitted then a deadband of 5% is reasonable.

Relay Output Mode (GPFCU Mode)

It is possible to programme the field unit to have either a fleeting relay contact, (350 ms pulse), or a maintained contact. When using maintained contacts they have to be energised and de-energised. With fleeting contacts only energise signals need to be sent.

Digital Input Sense, (GPFCU Mode)

The GPFCU has the ability to invert the status of its disital inputs before passing them on to the master station. This mask effects the status signals in both GPFCU and actuator mode.

9.1 USING A PAKTESTER

The Paktester must be connected to the 2-wire loop terminals of the field unit and the device must be powered on. For the correct 2-wire interface terminals refer to figs 5, 6 and 7 on page 10. Only one field unit may be connected to the Paktester at a time. Full details of the procedure for using the Paktester are included in the manual about that product, {Pakscan Paktester (Field Test Unit) Technical Manual, PUB059-023-00}. The required variable can be programmed using the 'Programme' button on the Paktester and by then inserting the new values on the screens as they appear.

10. MAINTENANCE AND REPAIR

There is no periodic service requirement for the field unit.

Repairs should not be attempted on the field unit. Any failure should be rectified by replacing the field unit with new compatible device. Static sensitive and CMOS devices are used in the field unit. It is therefore mandatory to observe anti-static precautions when handling or working on a field unit.

The field unit may be stored for a period of up to 10 years in clean conditions.

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11. RECORDS

The following information should be recorded for each field unit (M = Major Parameter) :

Notes:
1. The address and baud rate parameters may be changed only if field unit in loopback.
2. When using the Paktester the field unit must be in loopback and the FCU isolated from the master station.

M	Master station I.D. / Loop Tag Name	
	Device Tag:	
	Device Serial Number:	
	Device Type:	
M	Field Unit Address	
M	Loop Baud Rate	
	Actuator Mode Data	
	Field Unit Mode: (type 1, 2, or 3)	
	Motion Inhibit Timer:	
	Deadband	
	Analogue Update Timeout:	
	Analogue Deviation Threshold:	
	GPFCU Mode Data	
	Relay O/P mode	
	Analogue 1 deadband	
	Analogue 2 deadband	
	Analogue Update Timeout	
	Digital Input mask - {DIN (8) - (1)}	

Table 3: Field Unit Record Sheet

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12. PERFORMANCE SPECIFICATION:

2 -Wire Interface	
Baud Rate:	2400, 1200, 600, 300 or 110
Current:	20 mA
Conductors:	Screened twisted pair
Digital Inputs	
Quantity:	8
Isolation:	Mutual galvanic isolation
Voltage for active input	18V < Vi < 38V
Voltage for inactive input	-0.5V < Vi < 2V
Pulse input	Input 1
Pulse width	> 20 ms
Input power supply	24V at 20 mA max
Digital Outputs	
Quantity	4
Contacts	Changeover
Operation	Fleeting or maintained - normally de-energised
Voltage range	up to 120V
Max load	60 W, 125 VA, (max 2 A)
Life	10 million operations at 5 W load
Analogue Inputs	
Quantity	2
Range	0 to 5 V, or 4 to 20 mA
Resolution	1.2 mV
Thermal stability	100 ppm/°C
Analogue Output	
Quantity	1
Voltage range	0 to 5V
Resolution	1.2 mV
Thermal stability	100 ppm/°C
Load resistance	> 1 kΩ
Electrical Supply	
Supply	110 V ac +/-20% or 240 V ac +10% / -20%, (47 - 63 Hz)
Environmental	
Operating temperature	-30°C to +70°C
Storage temperature	-50°C to 85°C
Humidity	5% to 95% R.H. non-condensing
Vibration	0.75g (0.5Hz to 300Hz)

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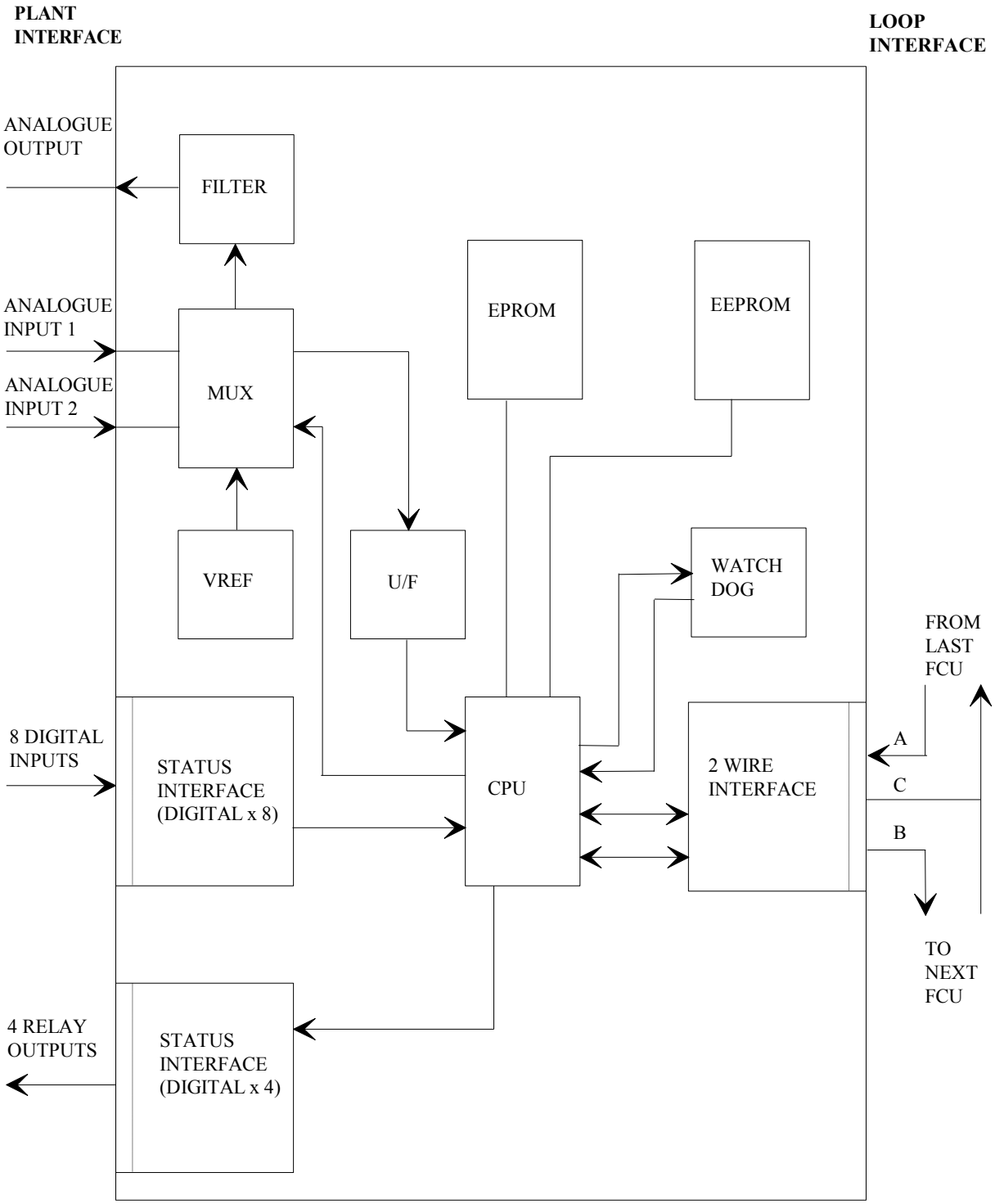
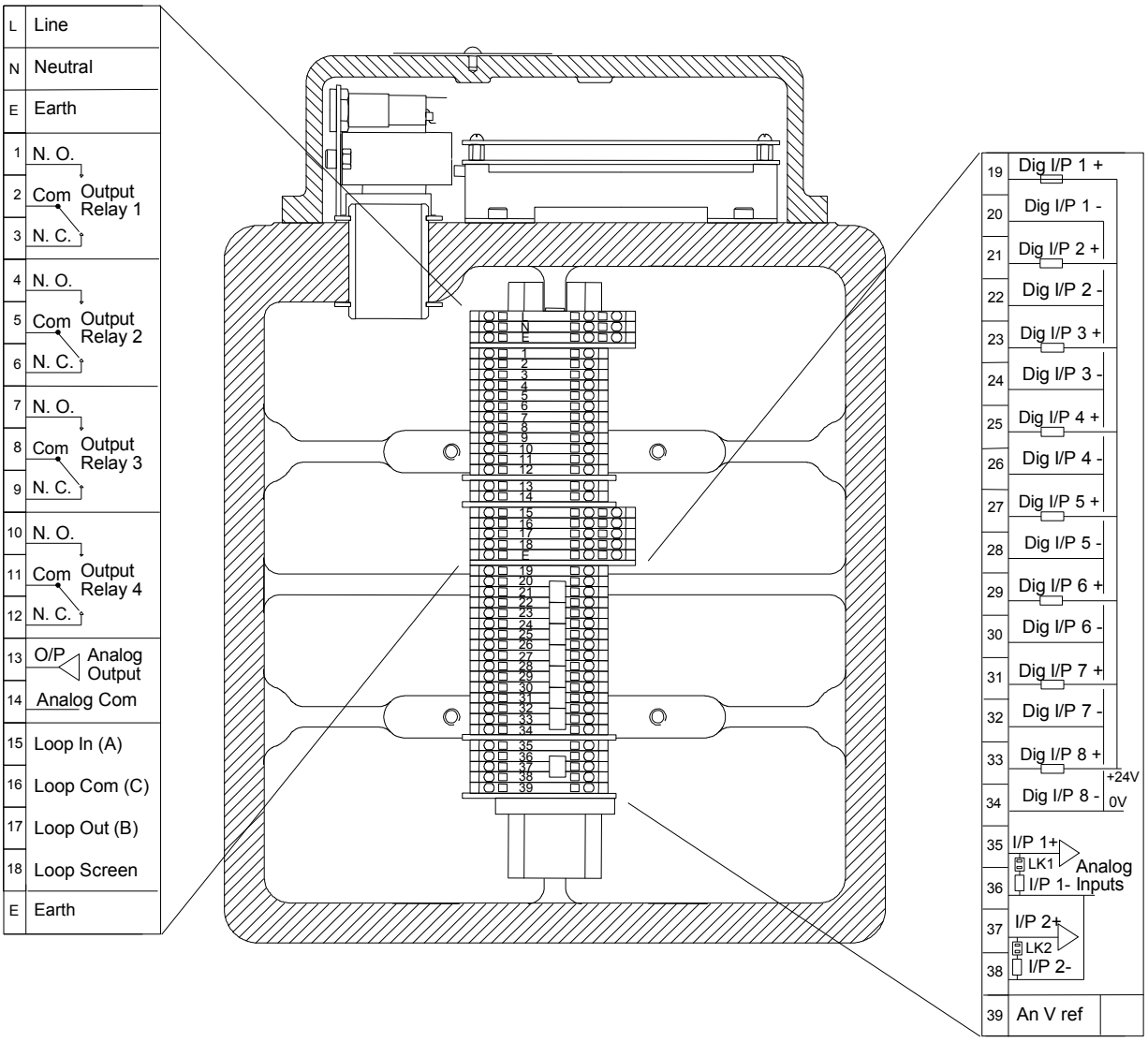
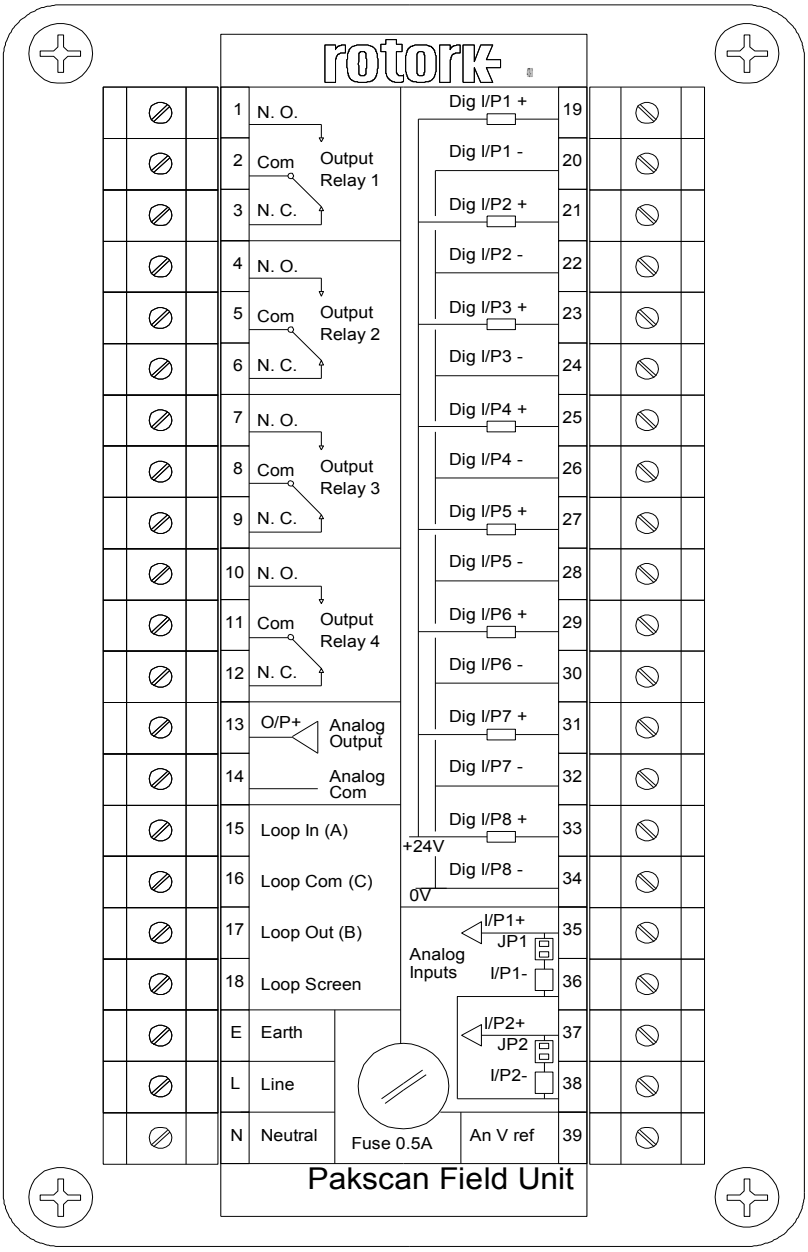
Appendix
A1 - GPFCU Block Diagram



A2 - Pakbox PB2 Field Unit Terminal Connection Details



A3 - Panel Mounting Field Unit Terminal Connection Details



A4 - Rack Mounted Field Unit Terminal Connection Details - GPFCU Mode

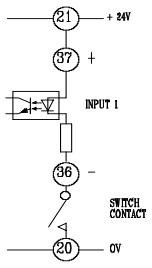
CIRCUIT DIAGRAM No - REV

WS06328-01

MULTIPURPOSE RACK MOUNTED 2E FIELD UNIT CONNECTION DETAILS

	FUNCTION		F/U PCB SOCKET No.	37/9-WAY D-TYPE PLUG/SOCKET PIN No.	
	EARTH			-	
POWER	LINE 1			-	
	LINE 2			-	
DIGITAL OUTPUTS	(PINS 3 - 13)				
	RELAY 1	N.O.	A PL4.1	11	
	RELAY 1	COMMON	A PL4.3	13	
	RELAY 1	N.C.	A PL4.2	12	
	RELAY 2	N.O.	A PL2.1	5	
	RELAY 2	COMMON	A PL2.3	7	
	RELAY 2	N.C.	A PL2.2	6	
	RELAY 3	N.O.	A PL3.1	8	
	RELAY 3	COMMON	A PL3.3	10	
	RELAY 3	N.C.	A PL3.2	9	
	RELAY 4	N.O.	A PL1.1	2	
	RELAY 4	COMMON	A PL1.3	4	
	RELAY 4	N.C.	A PL1.2	3	
DIGITAL INPUTS	(PINS 20 - 37)				
	INPUT 1	+ ve.	D PL45.10	37	
	INPUT 1	- ve.	D PL45.9	36	
	INPUT 2	+ ve.	D PL45.8	35	
	INPUT 2	- ve.	D PL45.7	34	
	INPUT 3	+ ve.	D PL45.6	33	37-WAY
	INPUT 3	- ve.	D PL45.5	32	D-TYPE
	INPUT 4	+ ve.	D PL45.4	31	SOCKET
	INPUT 4	- ve.	D PL45.3	30	
	INPUT 5	+ ve.	D PL44.10	29	
	INPUT 5	- ve.	D PL44.9	28	
	INPUT 6	+ ve.	D PL44.8	27	
	INPUT 6	- ve.	D PL44.7	26	
	INPUT 7	+ ve.	D PL44.6	25	
	INPUT 7	- ve.	D PL44.5	24	
	INPUT 8	+ ve.	D PL44.4	23	
	INPUT 8	- ve.	D PL44.3	22	
	I/P 24V		D PL44.2	21	
	I/P COMMON 0V		D PL44.1	20	
ANALOGUE I/O	(PINS 14 - 19)				
	INPUT 1	+ ve.	D PL41.1	14	
	I/P COMMON		D PL41.2	15	
	INPUT 2	+ ve.	D PL41.3	16	
	OUTPUT		D PL41.4	17	
	O/P COMMON		D PL41.5	18	
	V ref.		D PL41.6	19	
DATA LOOP					
	LOOP IN		A PL6.1	2	9-WAY
	LOOP COMMON IN		A PL6.2	3	D-TYPE
			SCREEN	1	SOCKET
	LOOP OUT		A PL6.3	2	9-WAY
	LOOP COMMON OUT		A PL6.2	3	D-TYPE
			SCREEN	1	PLUG
			EARTH		

TYPICAL DIGITAL INPUT CONNECTION SCHEMATIC.



A AUXILIARY P.C.B

D DIGITAL P.C.B.

NOTES

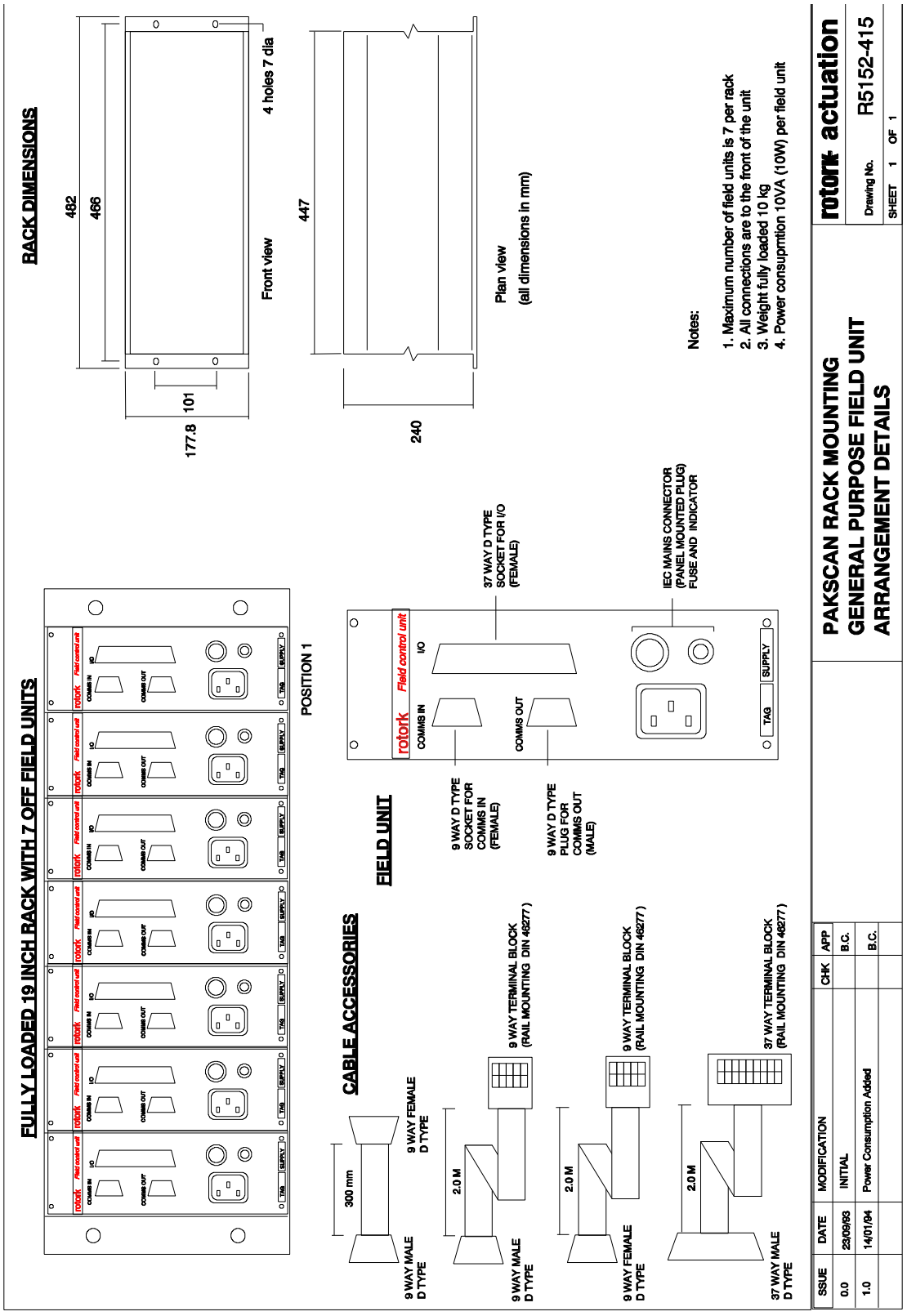
1 - RELAY CONTACTS CAN ALL BE PROGRAMMED TO BE FLEETING OR MAINTAINED TYPE CONTACTS.

2 - RELAY 4 WILL RESPONED TO ESD COMMANDS

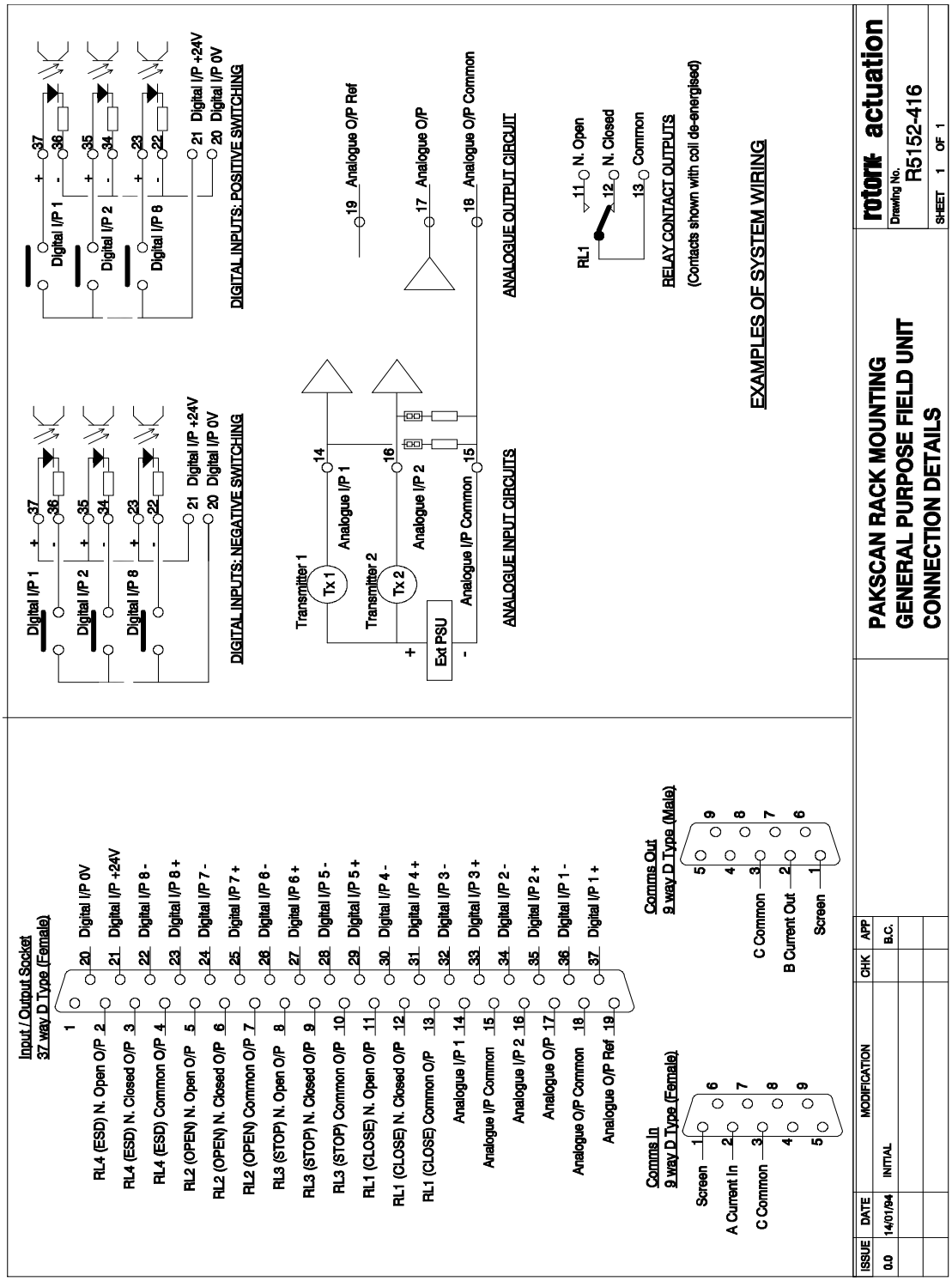
3 - DIGITAL INPUTS CAN BE PROGRAMMED INDIVIDUALLY TO 'MAKE' OR 'BREAK' TO INDICATE CONDITION BEING MONITORED.

No	DATE	REVISION		ROTORK CONTROLS LTD BATH ENGLAND, BA1 3JQ. tel (0225) 428451	DRAWN PJW	RACK MOUNTED MULTIPURPOSE 2E FIELD UNIT
01		SIMILAR TO ---	rotork		DATE 090692	CIRCUIT DIAGRAM No -REV
		JOB No B13992		ROTORK CONTROLS INC ROCHESTER, NY 14624. tel (716) 328-1550	CHECKED KS DATE 090692	WS06328-01

A5 - Rack Mounting GPFCU Arrangement Details



A5 - Rack Mounting GPFCU Connection Details



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