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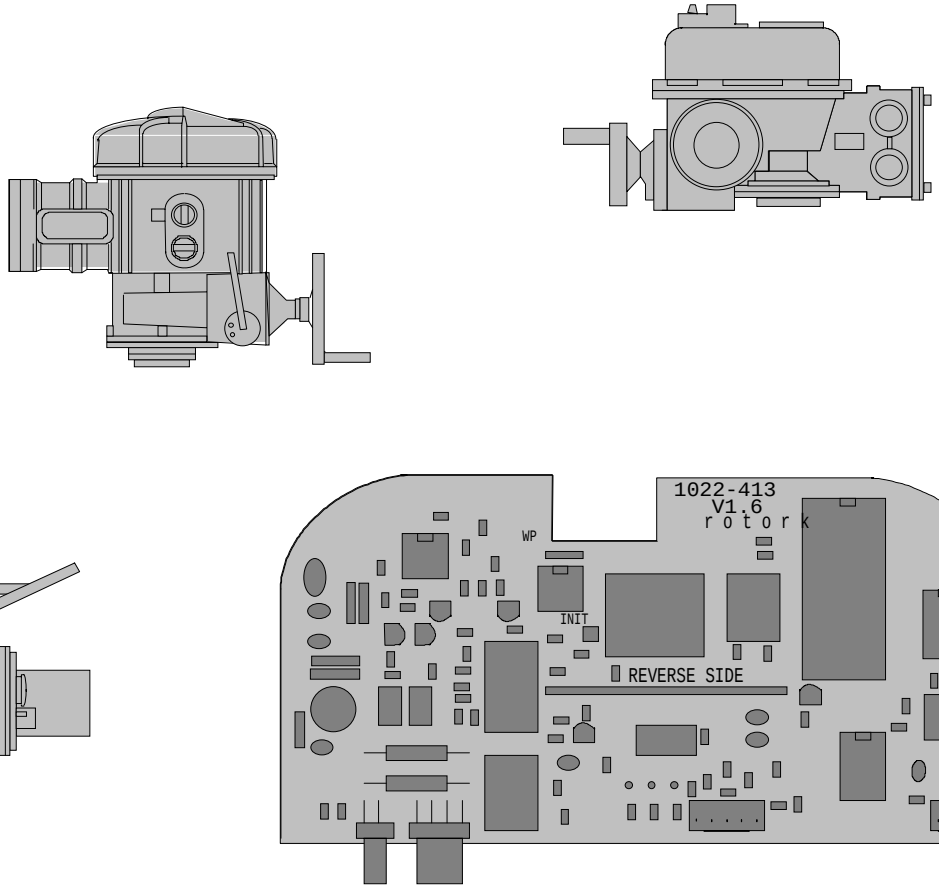

Pakscan Integral Field Control Unit
Technical Manual

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

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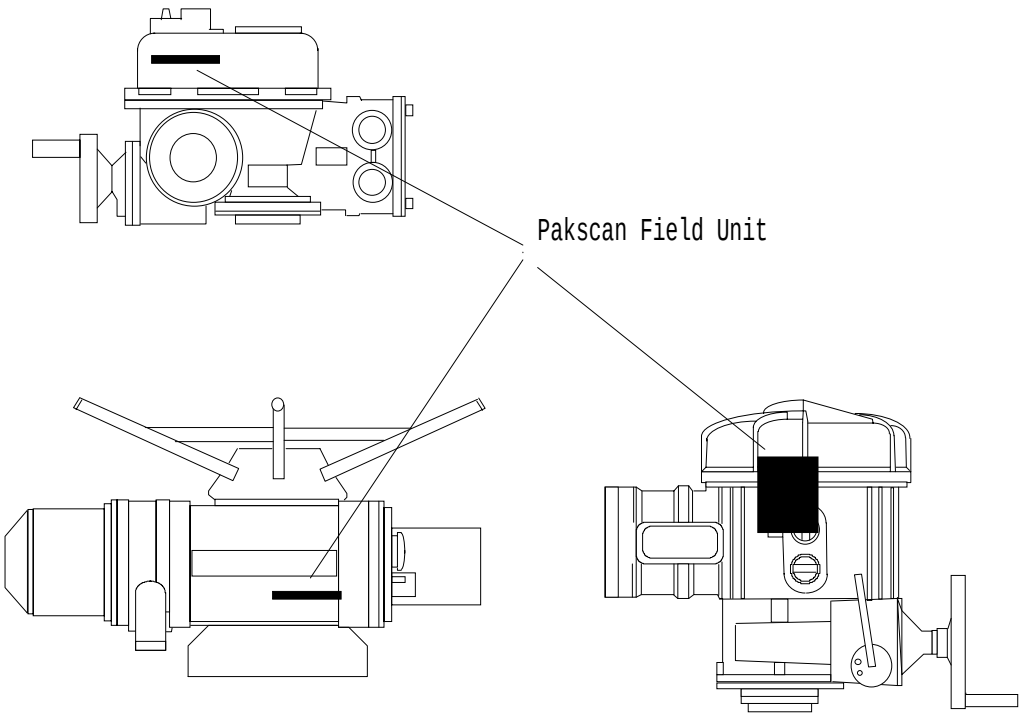
1. INTRODUCTION

The Integral Pakscan Field Unit is fitted to the A, AQ and Q range of actuators and is fully compatible with Pakscan I, II and IIE 2 wire control systems and Pakvision. The field unit forms an integral part of the actuator and is housed within the main double sealed electrical housing of the actuator as shown below. The electrical housing need never be opened once the actuator leaves the assembly plant. All adjustments to the settings for the field unit may be made via the 2 wire interface using a Paktester.

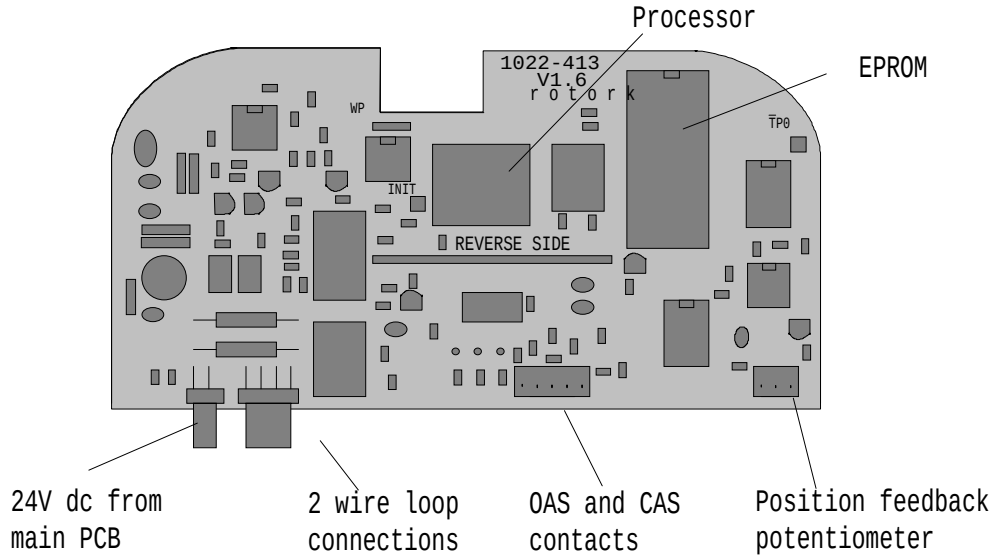
The field unit circuits do not impinge on the actuator control electronics, the actuator itself remains fully self protecting. The field unit performs the tasks of 2 wire interface communication, actuator data collection and the issuing of actuator commands.

fig 1: Location of Integral Field Units



2. FIELD UNIT PROPERTIES

fig 2: The Integral field unit



2.1 Mechanical Properties

The field unit comprises a single printed circuit board that fits inside the actuator electrical housing. It connects to the main board of the actuator by a multipin connector and due to its physical shape the field unit may only be fitted in the correct polarisation. The actuator internal wiring harness has connections to the field unit for the two wire loop connection via the actuator terminal bung and the isolated supply voltages for the field unit. These connectors are polarised to prevent incorrect connection.

The field unit connects directly to the main pcb of the actuator.

2.2 Electrical Properties

The field unit processor circuits connect directly to the main processors of the actuator. The field unit does not sit in the main control path for the actuator and does not affect the actuator control integrity.
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 2. 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 actuator electronics. The loop interface includes the loopback circuits used to maintain communication integrity if there is a loop cable fault and also the loop bypass circuits that ensure loop continuity if the actuator loses power.

2.3 Operation and Storage

The field unit is designed to be stored in the actuator and operated within the same environment as the actuator. The constraints are:

Operating temperature:	-40°C to +70°C
Storage temperature:	-50°C to +85° C
Relative Humidity:	5% to 95% (<50°C) non-condensing

3. COMPATIBILITY

The Integral field unit is compatible with Pakscan I, II and IIE master stations. However, the field unit EPROM will have to be compatible with the master station and loop protocol to which it is connected. Compatibility can be determined by the EPROM part number as follows;

Pakscan I - 5152-203
Pakscan II - 1011-559
Pakscan IIE - 5152-208

The Pakscan I EPROM can be further identified by the number being written on a yellow label.

3.1 Pakscan IIE Master Station

The Pakscan IIE master station uses Pakscan II loop protocol for the 2 wire loop. This means that Pakscan II field units can be fitted on a loop controlled by a Pakscan IIE master station. However, this is only possible if the loop does not exceed 30 devices and providing that loop Baud rate doubling is not needed. The Pakscan IIE field unit is identical to the Pakscan II with the exception that IIE field units accept global “wake up” messages and are able to run at twice the speed that they’ve been programmed to.

3.2 Pakscan II Master Station

Both Pakscan II and IIE field units are able to be connected to a Pakscan II master station running Pakscan II loop protocol.

3.3 Pakscan I Master Station

Only Pakscan I field units can be fitted to loops controlled by a Pakscan I master station or a Pakscan II master station running Pakscan I loop protocol.

3.4 Paktester

In order to be able to use a Paktester to set up and commission Pakscan I, II and IIE field units a Paktester fitted with software 5161-013 with a version higher than V3.2 must be used. However, some early Pakscan I field units had write protect links fitted, labelled WP, which will need to be removed if re-programming is required.

3.5 2 Wire Loop

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

4. FITTING THE FIELD UNIT

The field unit is factory fitted inside the A, AQ or Q range actuator. It is located as indicated in figure 1 on page 5

The field unit has three cable loom connectors, (four when used as a positioning, type 3, field unit), as well as plugging directly into the main board connector. These three, (four), connectors are in the main actuator wiring loom.

4.1 Replacing or Fitting a Field Unit

The field unit can be replaced or fitted only in a suitable environment. The actuator must be made electrically safe before opening any covers. The electrical housing cover should be removed and the existing field unit carefully unplugged from its connector. Once removed from the connector the three, (four if position feedback is used), wiring loom connectors should be removed. The replacement board is fitted in the reverse order to removal.
If the operation is to fit a field unit for the first time then two of the three wiring looms must be added to the internal wiring harness. One loom connects the power module socket 2 to the field unit, the other connects the field unit socket 3 to the terminals. The third connector is part of the main wiring and carries the remote input board signals. The fourth connector, when fitted, is the position feedback wiring connected to a potentiometer.

Once fitted the actuator should be re-assembled and the field unit parameters set.

5. 2 WIRE LOOP CONNECTIONS

The actuator should be wired in the communication loop as indicated in figure 3.

It is important to connect the current loop input terminal (13) to the previous actuator current loop output terminal and the current loop output terminal (22) to the next actuator current loop input terminal. The current flow around the loop must always pass in the same direction through all the actuators. The common wire is connected to terminal 31.

The screen of the 2 wire loop cable must be isolated from ground at all the actuators (to prevent the possibility of earth current loops). A specific terminal (37) is allocated in the actuator for the screen to connect to. The screen should be continuous for the whole 2 wire cable.

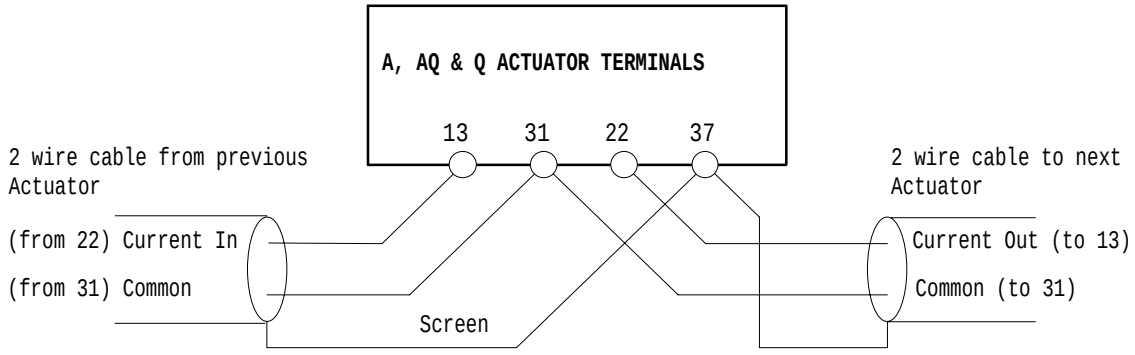


fig 3: 2 wire loop connections

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 suppressers are rated at 1.5kV for 1 mSec.

6.1 Loopback Feature

The interface includes circuits that permit the field unit to 'loopback' the current on the two 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.

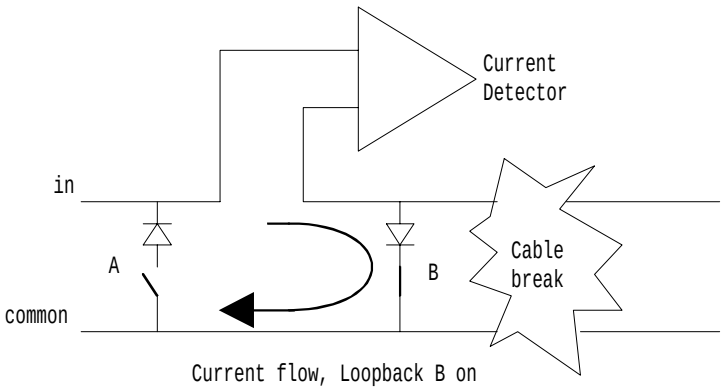


fig 4: Loopback feature

To programme the field unit parameters 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 bypass 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.

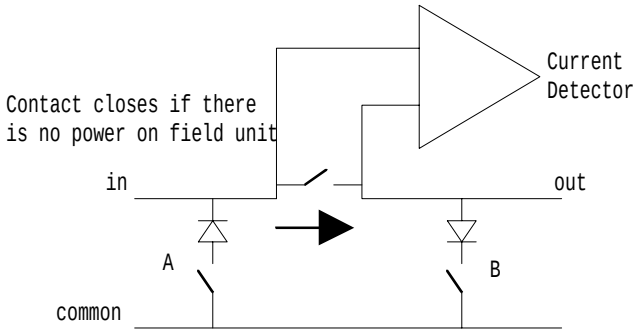


fig 5: Loop Bypass Relay

7. INPUT AND OUTPUT SIGNALS

The following section describes the inputs and outputs of an Integral field unit in an A range actuator, using Pakscan II loop protocol plus the possible uses of the remote actuator input. In all cases feedback data is considered to flow from the actuator (or field) to the master station and command data in the reverse direction. Thus Inputs are feedback signals and Outputs are commands.

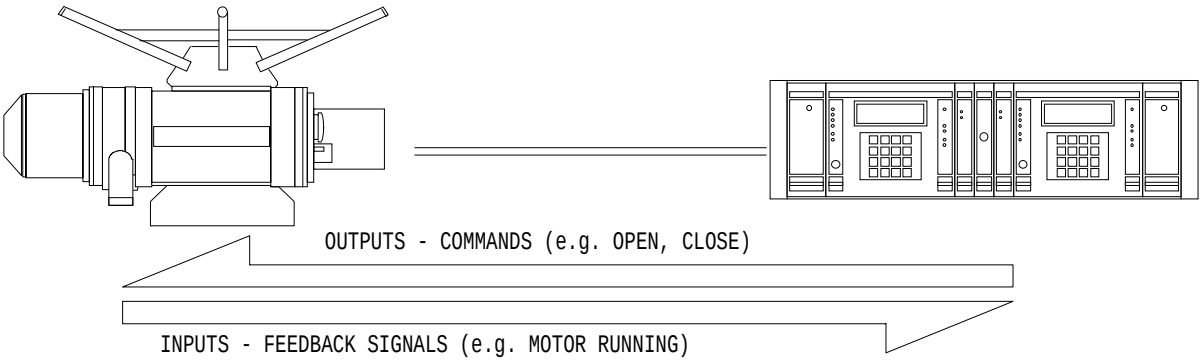


fig 6: Input and Output Data Directions

7.1 Summary of Digital and Alarm Status Data Bits

Digital Status Data Bits
Actuator Data

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 centre column is moving
MRO	-	The actuator is running open
MRC	-	The actuator is running closed.
EXT	-	The remote input connected to the auxiliary input.

Digital Status Data Bits
Field Unit and Alarm Indicators

LBON	-	The actuator 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

MEMF	-	A failure of the memory test
COMMS	-	Communication failure
POWR	-	Power on reset
WDOG	-	Field unit watchdog alarm

Actuator Alarm Status Data Bits

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

Actuator 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

Additional Feedback Data

Valve position (8 bits)

7.2 DIGITAL STATUS DATA BITS

7.2.1 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 only 5 seconds after the limit switch position is reached, 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.

7.2.2 Stop Indication Data: (STOP)

Whenever the actuator centre column stops moving 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 local control command, or by manually moving the valve, the STOP signal will be removed for the duration of the movement of the centre column.

7.2.3 Motor Running Indication Data: (MRUN)

The actuator senses any movement of its centre column when this is generated by the motor. Whenever the centre column is in motion the MRUN data bit is present.

7.2.4 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 or if it is commanded from the 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 neither 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 no indication) once the actuator is switched to remote control and a command is issued to the valve via either the 2 wire loop.

7.2.5 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 a type 3, (position feedback), field unit is fitted and the position feedback is not used.

7.2.6 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 units 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:

2400 baud	8 seconds	(not used on Pakscan I protocol systems)
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.

7.2.7 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.

7.2.8 Alarm Indication: (ALARM)

This data signal is generated within the master station. 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 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.

7.3 ALARM STATUS DATA BITS

7.3.1 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. The field unit should be 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.

7.3.2 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.

7.3.3 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. As 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.

7.3.4 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.

7.3.5 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.

7.3.6 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.

7.3.7 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.

7.3.8 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.

7.3.9 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 or Remote Auxiliary Input 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.

7.3.10 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.

If the valve movement stops in mid travel due to the drive becoming disconnected, for example by being placed in hand operation, then the actuator detects the loss of motion of the centre column and VOBS is reported. The VOBS alarm bit is fleeting and will clear once read and accepted.

If the valve is obstructed and the actuator stops, attempting to restart the actuator to move towards the obstruction (even if the obstruction is no longer present) will generate an SFAIL alarm. The actuator must be reversed away from the obstruction before attempting to continue in the original direction.

7.3.11 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.

7.3.12 Manual Valve Movement: (MOP / MCL / MOPG / MCLG)

The actuator must be set in Remote for this alarm to be valid. 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 MCLG, (manual closing), alarms will be generated. These alarms are fleeting and will clear once accepted.

7.3.13 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 ADDITIONAL FEEDBACK DATA

7.4.1 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 vica 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 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.

7.5.1 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.

7.5.2 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.

7.5.2.1 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.

7.5.2.2 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 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 instructions 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 then 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.

7.5.2.3 Actuator Protection in Position Control Mode

The actuator includes several settings designed to prevent damage to the actuator when a DV signal is being actioned.

a) Motion Inhibit Timer

The setting of the Motion Inhibit Timer is the period that must elapse between the actuator stopping and then restarting. This idle period will prevent the actuator motor exceeding its rated starts per hour.

b) Deadband Setting

The control algorithm used for the Pakscan field unit positioner is proportional only. The field unit runs the actuator to the desired position and then stops it. As the actuator and valve combination will have some inertia it is possible that the desired position may be 'overrun' and the positioner will then reverse the actuator direction of travel in order to make the valve adopt the desired position. This phenomena is termed 'hunting'. The actuator/valve combination may hunt around the control point if the inertia is high. To prevent this from happening there is a Deadband setting whereby once the actuator enters the deadband the motor will be stopped. For example a 5% deadband will cause the motor to be stopped once the actual position is within 5% of the desired position. The inertia will then bring the actual position nearer to the desired position.

It is important to set the deadband such that the actuator does not hunt around the control point.

7.5.3 Emergency Shut Down, (ESD)

The result of an ESD command is programmed into the actuator itself and may cause the valve to Close, Open or do nothing i.e. No Action. The ESD action may also override the actuator thermostat.

The actuator may receive an ESD command from either a hard wired input or from the Pakscan loop. The ESD command has the highest priority with the hard wired input ESD Command having the highest. All existing control commands are cancelled and replaced by the ESD action. The actuator movement will be maintain until the valve reaches its end of travel.

The ESD action is latched into the field unit and it is not possible to move the actuator by the Local controls until the ESD action is unlatched. The latch may only be released by a new remote control signal.

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 IIE 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 screen display. In all cases the alarm must be read either by viewing the screen or requesting the data before the alarm can be removed from the system. (In a Pakscan II master station there are only data base areas, for comms ports 1 and 2 and in a Pakscan I master station there is only 1 data base area. Once it has been read then the alarm will only clear on two further conditions, it must be accepted and the fault must clear. 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. In the case of a logging printer being attached to the master station both the events will be logged.

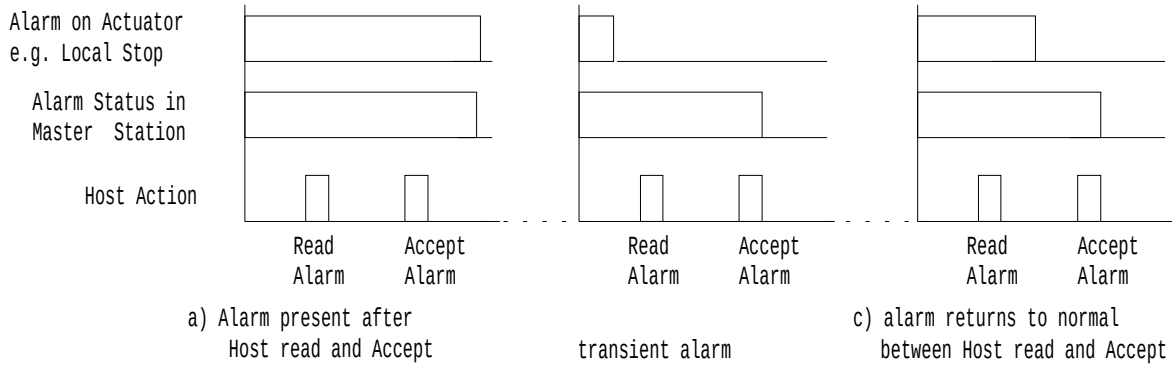


fig 7: Alarm handling sequences

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 actuator 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 tool that may be used to set the parameters are:

Paktester version higher than V3.2

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 the tool that can be used to vary the setting. Appendix 1 gives a full list of all the data base of a field unit.

PARAMETER IDENTITY	PERMITTED VALUES	M/S SYS	DEFAULT
Comms Baud Rate	110, 300, 600, 1200, 2400 Baud	Pak II, IIE	1200
Comms Baud Rate	110, 300, 600, 1200 Baud	Pak I	1200
FCU Address	1 -240	Pak IIE	1
FCU Address	1 -32	Pak I, II	1
Motion Inhibit Timer	0 - 255 seconds	Pak I, II, IIE	2 sec. (1 s. resolution)
Deadband	0% - 12%	Pak I, II, IIE	5% (0.1% resolution)
Analogue Update Timeout	0 - 255 seconds	Pak II, IIE	30 (1 sec resolution)
Analogue Deviation Threshold	0 - 99%	Pak II, IIE	20% (1% resolution)

Table 1 - Parameters, Defaults and Pakscan Master Station Systems

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 base speed 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 valve position 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 whilst the valve is moving 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 Update Time should be set as high as possible, i.e. 255, in order to keep loop traffic to a minimum. If the field unit has been fitted with an EPROM with software version 2.7 or greater, the analogue reporting can be turned off by setting the Update Time 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 valve position is reported each time the value changes by the Analogue Deviation setting or every Update Time period. Whilst the valve is in motion reports about its position will be made each time the position changes by more than the Deviation setting. The recommended value is 5% where analogue data is required. If analogue data is not being used at all then the Deviation should be set to 99% in order to keep loop traffic to a minimum. If the field unit has been fitted with an EPROM with software version 2.7 or greater, the analogue reporting can be turned off by setting the Deviation to 00.

Motion Inhibit Timer

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

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.

9.1 USING A PAKTESTER

The Paktester must be connected to the 2 wire loop terminals of the actuator and the actuator must be powered on. Only one actuator 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, R5161-016. 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.

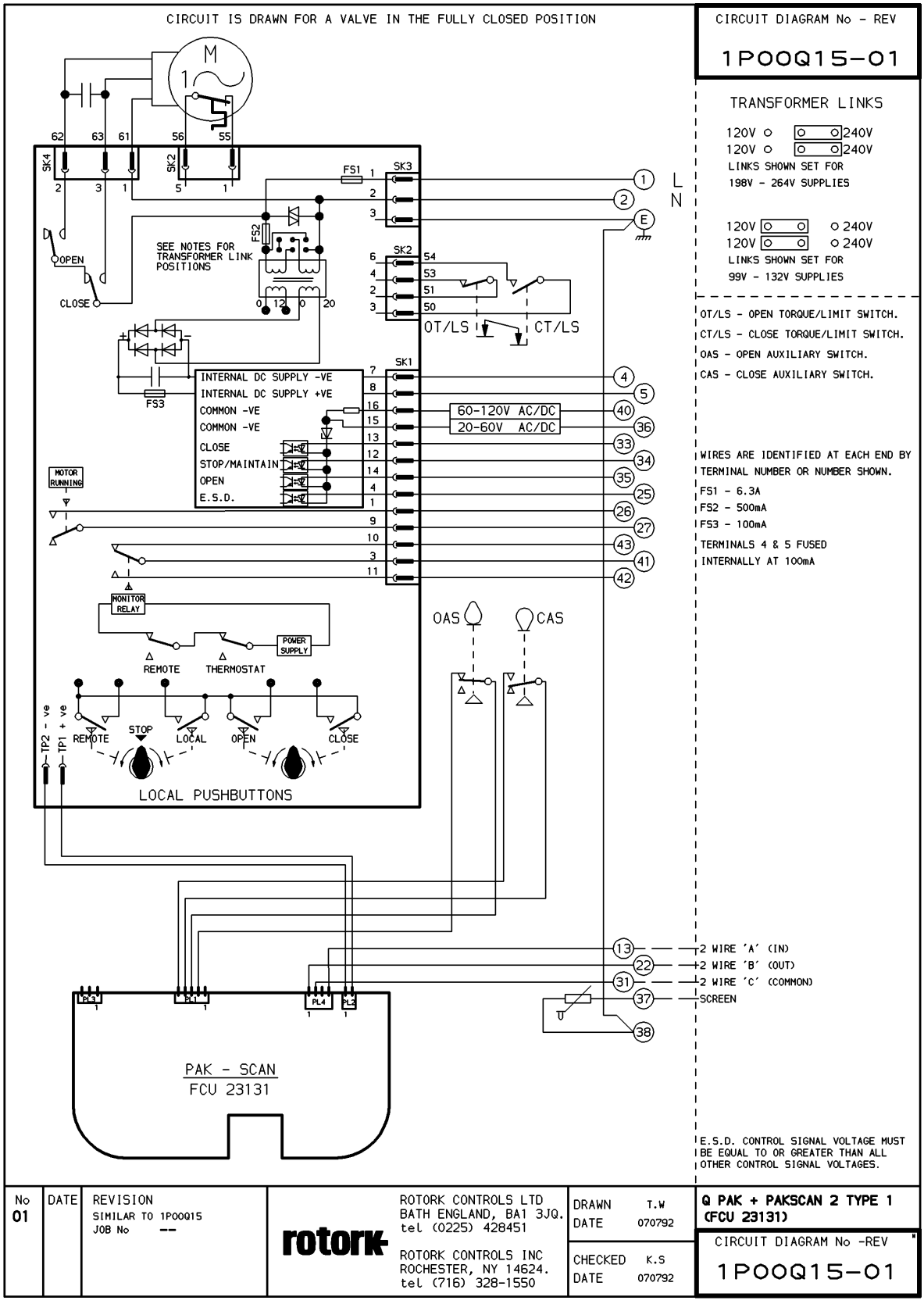
11. RECORDS

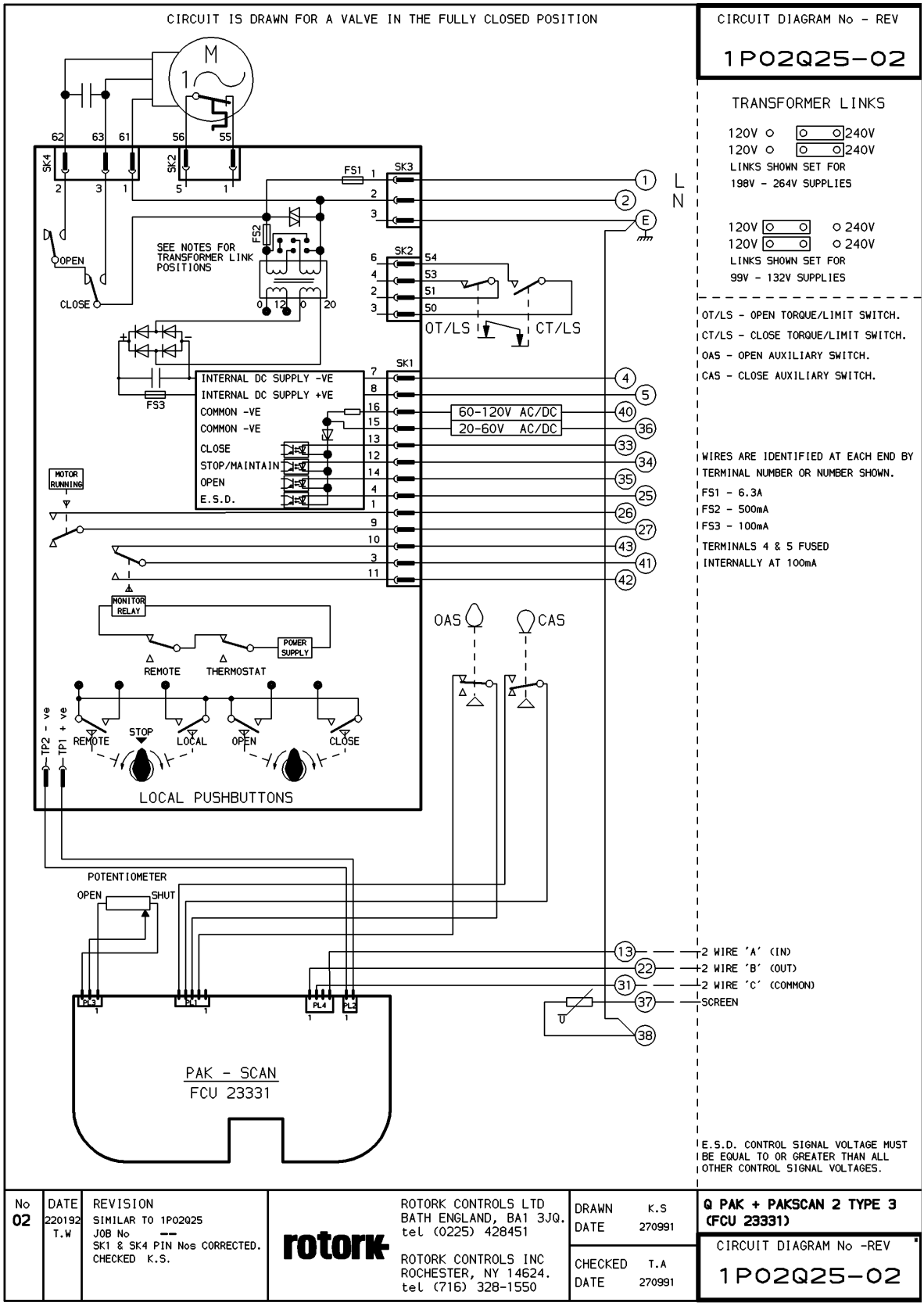
The following information should be recorded for each field unit (M = Major Parameter) :

Notes:
1. Programmable parameters may be changed only if field unit in loopback.
2. When using the Paktester the field unit must be in loopback.

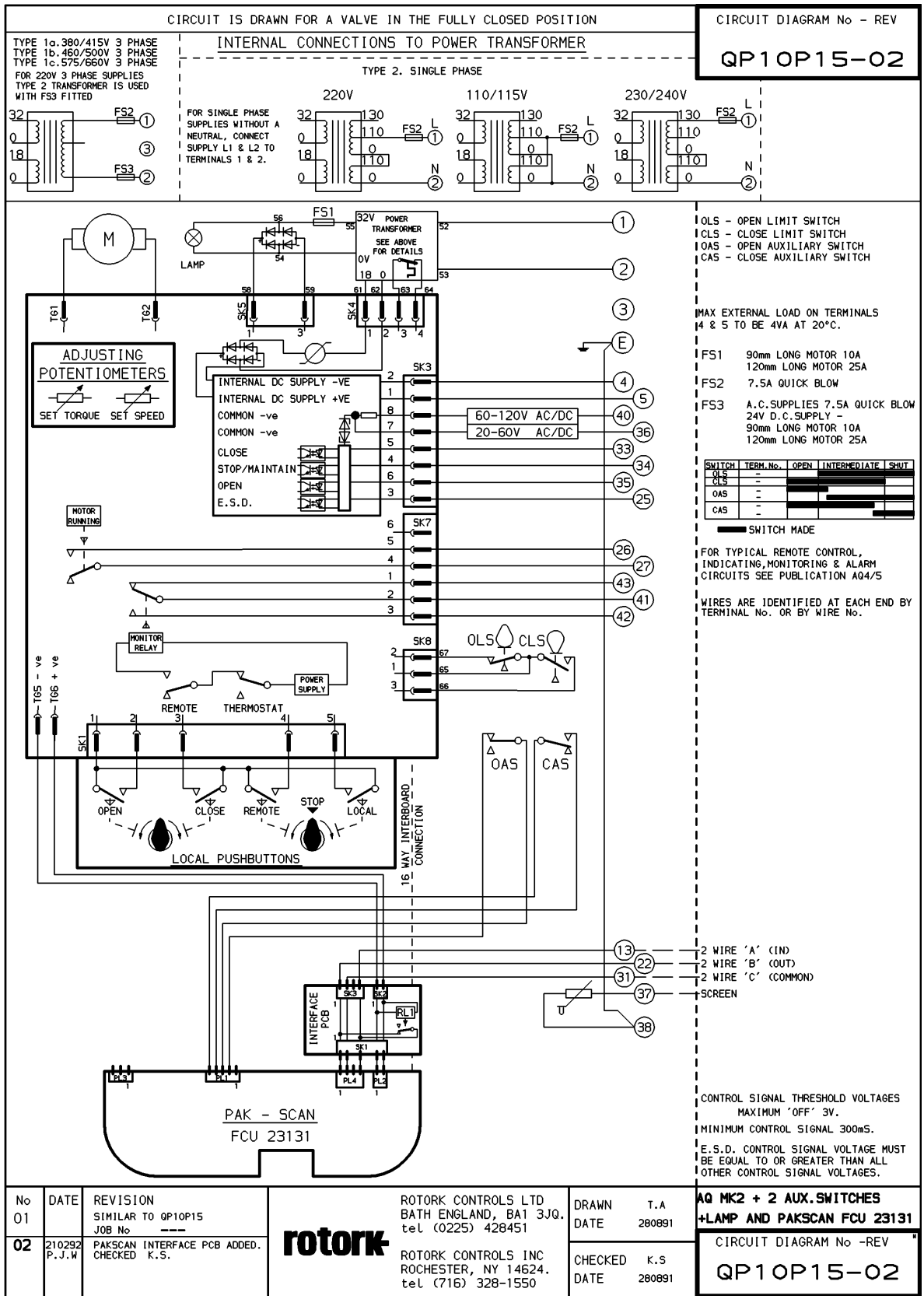
M	Pakscan I, II or IIE:	
	Valve Tag:	
	Actuator Serial Number:	
	Actuator Type:	
M	Field Unit Address	
M	Loop Baud Rate	
	Field Unit Mode: (type 1, 2, or 3)	
	Motion Inhibit Timer:	
	Deadband	
	Analogue Update Timeout: (Pak II and IIE only)	
	Analogue Deviation Threshold: (Pak II and IIE only)	

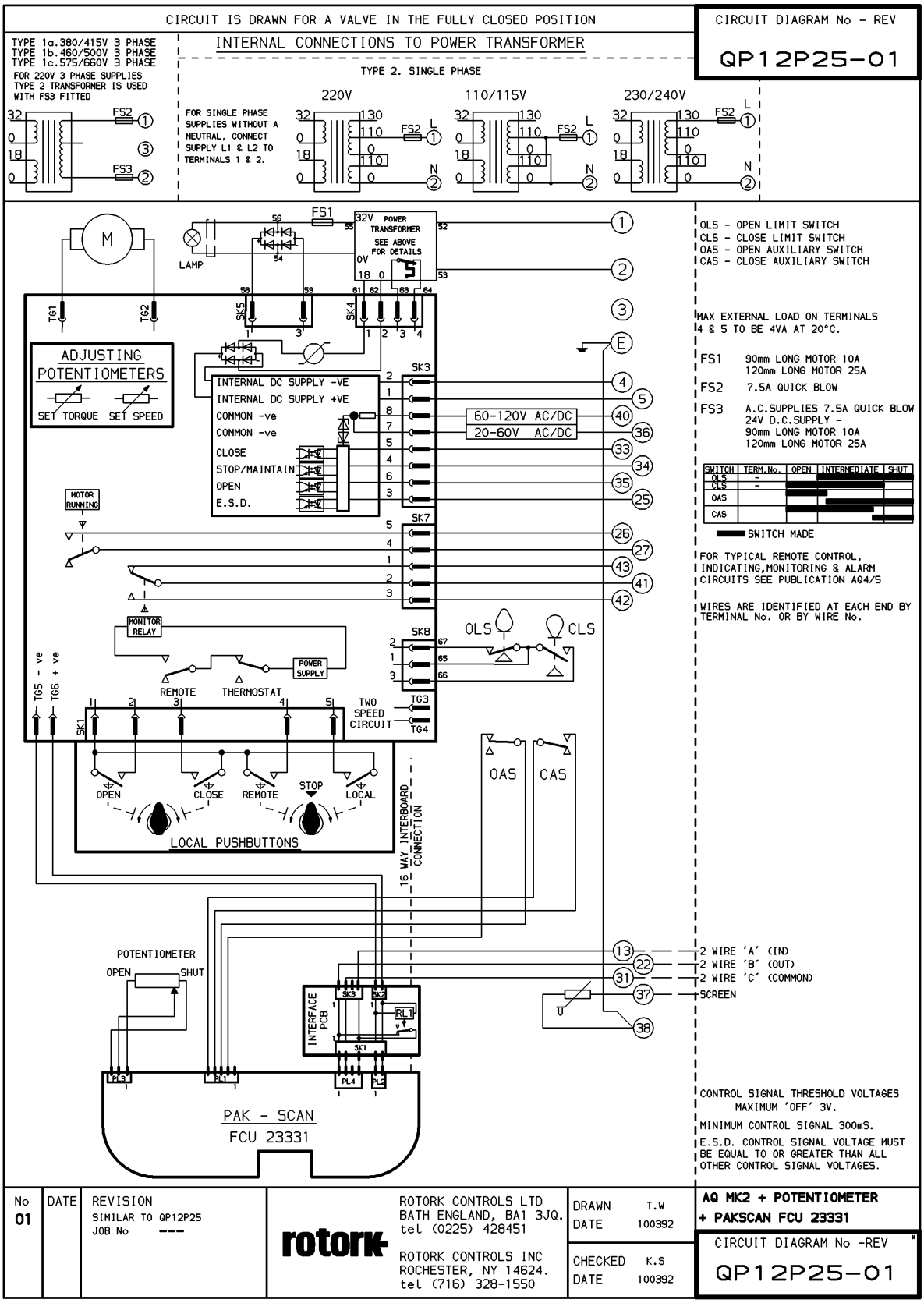
Appendix 1 Typical Wiring Diagrams





No	DATE	REVISION			
02	220192 T.W	SIMILAR TO 1P02025 JOB No -- SK1 & SK4 PIN Nos CORRECTED. CHECKED K.S.	rotork	ROTORK CONTROLS LTD BATH ENGLAND, BA1 3JQ. tel (0225) 428451 ROTORK CONTROLS INC ROCHESTER, NY 14624. tel (716) 328-1550	DRAWN K.S DATE 270991 CHECKED T.A DATE 270991	**Q PAK + PAKSCAN 2 TYPE 3 (FCU 23331)** CIRCUIT DIAGRAM No -REV 1P02Q25-02


CIRCUIT IS DRAWN FOR A VALVE IN THE FULLY CLOSED POSITION
CIRCUIT DIAGRAM No - REV
QP10P15-02
TYPE 1a. 380/415V 3 PHASE
TYPE 1b. 460/500V 3 PHASE
TYPE 1c. 575/660V 3 PHASE
FOR 220V 3 PHASE SUPPLIES TYPE 2 TRANSFORMER IS USED WITH FS3 FITTED
INTERNAL CONNECTIONS TO POWER TRANSFORMER
TYPE 2. SINGLE PHASE
220V
110/115V
230/240V
FOR SINGLE PHASE SUPPLIES WITHOUT A NEUTRAL, CONNECT SUPPLY L1 & L2 TO TERMINALS 1 & 2.
ADJUSTING POTENTIOMETERS
SET TORQUE
SET SPEED
INTERNAL DC SUPPLY -VE
INTERNAL DC SUPPLY +VE
COMMON -ve
COMMON -ve
CLOSE
STOP/MAINTAIN
OPEN
E.S.D.
60-120V AC/DC
20-60V AC/DC
MOTOR RUNNING
MONITOR RELAY
POWER SUPPLY
REMOTE
THERMOSTAT
OLS
CLS
OAS
CAS
OPEN
CLOSE
REMOTE
STOP
LOCAL
LOCAL PUSHBUTTONS
16 WAY INTERBOARD CONNECTION
INTERFACE PCB
PAK - SCAN
FCU 23131
OLS - OPEN LIMIT SWITCH
CLS - CLOSE LIMIT SWITCH
OAS - OPEN AUXILIARY SWITCH
CAS - CLOSE AUXILIARY SWITCH
MAX EXTERNAL LOAD ON TERMINALS 4 & 5 TO BE 4VA AT 20°C.
FS1 90mm LONG MOTOR 10A
120mm LONG MOTOR 25A
FS2 7.5A QUICK BLOW
FS3 A.C.SUPPLIES 7.5A QUICK BLOW
24V D.C.SUPPLY -
90mm LONG MOTOR 10A
120mm LONG MOTOR 25A
SWITCH
TERM.No.
OPEN
INTERMEDIATE
SHUT
SWITCH MADE
FOR TYPICAL REMOTE CONTROL, INDICATING, MONITORING & ALARM CIRCUITS SEE PUBLICATION A04/5
WIRES ARE IDENTIFIED AT EACH END BY TERMINAL No. OR BY WIRE No.
2 WIRE 'A' (IN)
2 WIRE 'B' (OUT)
2 WIRE 'C' (COMMON)
SCREEN
CONTROL SIGNAL THRESHOLD VOLTAGES
MAXIMUM 'OFF' 3V.
MINIMUM CONTROL SIGNAL 300mS.
E.S.D. CONTROL SIGNAL VOLTAGE MUST BE EQUAL TO OR GREATER THAN ALL OTHER CONTROL SIGNAL VOLTAGES.
No 01
DATE
REVISION
SIMILAR TO QP10P15
JOB No ---
02
210292 P.J.W
PAKSCAN INTERFACE PCB ADDED. CHECKED K.S.
rotork
ROTORK CONTROLS LTD
BATH ENGLAND, BA1 3JQ.
tel (0225) 428451
ROTORK CONTROLS INC
ROCHESTER, NY 14624.
tel (716) 328-1550
DRAWN T.A
DATE 280891
CHECKED K.S
DATE 280891
AQ MK2 + 2 AUX.SWITCHES
+LAMP AND PAKSCAN FCU 23131
CIRCUIT DIAGRAM No -REV
QP10P15-02


CIRCUIT IS DRAWN FOR A VALVE IN THE FULLY CLOSED POSITION
CIRCUIT DIAGRAM No - REV
QP12P25-01
TYPE 1a.380/415V 3 PHASE
TYPE 1b.460/500V 3 PHASE
TYPE 1c.575/660V 3 PHASE
FOR 220V 3 PHASE SUPPLIES TYPE 2 TRANSFORMER IS USED WITH FS3 FITTED
INTERNAL CONNECTIONS TO POWER TRANSFORMER
TYPE 2. SINGLE PHASE
220V
110/115V
230/240V
FOR SINGLE PHASE SUPPLIES WITHOUT A NEUTRAL, CONNECT SUPPLY L1 & L2 TO TERMINALS 1 & 2.
ADJUSTING POTENTIOMETERS
SET TORQUE
SET SPEED
INTERNAL DC SUPPLY -VE
INTERNAL DC SUPPLY +VE
COMMON -ve
COMMON -ve
CLOSE
STOP/MAINTAIN
OPEN
E.S.D.
60-120V AC/DC
20-60V AC/DC
MOTOR RUNNING
MONITOR RELAY
POWER SUPPLY
REMOTE
THERMOSTAT
TWO SPEED CIRCUIT
OLS
CLS
OAS
CAS
OPEN
CLOSE
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16 WAY INTERBOARD CONNECTION
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SWITCH
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OPEN
INTERMEDIATE
SHUT
OLS
CLS
OAS
CAS
SWITCH MADE
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2 WIRE 'B' (OUT)
2 WIRE 'C' (COMMON)
SCREEN
CONTROL SIGNAL THRESHOLD VOLTAGES
MAXIMUM 'OFF' 3V.
MINIMUM CONTROL SIGNAL 300mS.
E.S.D. CONTROL SIGNAL VOLTAGE MUST BE EQUAL TO OR GREATER THAN ALL OTHER CONTROL SIGNAL VOLTAGES.
No 01
DATE
REVISION
SIMILAR TO QP12P25
JOB No ---
rotork
ROTORK CONTROLS LTD
BATH ENGLAND, BA1 3JQ.
tel (0225) 428451
ROTORK CONTROLS INC
ROCHESTER, NY 14624.
tel (716) 328-1550
DRAWN T.W
DATE 100392
CHECKED K.S
DATE 100392
AQ MK2 + POTENTIOMETER + PAKSCAN FCU 23331
CIRCUIT DIAGRAM No -REV
QP12P25-01

Rotork Controls Ltd
Brassmill Lane
Bath, England
BA1 3JQ

tel: (0225) 733200
fax: (0225) 333467

Rotork Controls Inc
19, Jet View Drive
Rochester
New York 14624 USA

tel: (716) 328 1550
fax: (716) 328 5848