APPROVAL SHEET

TITLE	:	***PCON Software Requirements Document***
DOCUMENT NUMBER	**:**	3140AS0027-0001 **ISSUE:** A
SYNOPSIS	**:**	This document describes the requirements for the PCON software which will be used to control PFIS.
KEYWORDS	**:**	PFIS, RSS, PDET
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APPROVED	**:**	_____
		_____
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ACRONYMS AND ABBREVIATIONS

ATP	Acceptance Test Procedure
ATR	Acceptance Test Report
BMS	Building Management System
CDR	Critical Design Review
CIN	Code Interface Node (a LabVIEW function to interface to other SW)
ELS	Event Logger Software
EDS	Environmental Display System
HET	Hobby-Eberly Telescope
I/O	Input/Output (Device)
ICD	Interface Control Dossier
MMI	Man-Machine Interface
OPT	Operational Planning Tool
PC	Personal Computer
PDR	Preliminary Design Review
PFIS	Prime Focus Imaging Spectrograph
PI	Principal Investigator (Astronomer)
PIPT	PI Planning Tool
PLC	Programmable-Logic Controller
PMAS	Primary Mirror Alignment System
SA	SALT Astronomer
SALT	Southern African Large Telescope
SAMMI	SA Machine Interface
SC	Software Component (e.g. part fo the TCSS)
SCAM	Salticam (Acquisition camera)
SCL	SALT Command Language (sent to TCSS)
SDB	Science Database
SDD	Software Design Document
SDP	Software Development Plan
SI	Software Item (the TCSS is a Software Item)
SO	SALT Operator
SOMMI	SO Machine Interface
SRS	Software Requirement Specification
STARCAT	Object Catalogue
SW	Software
TBC	To Be Confirmed
TBD	To Be Determined
TCS	Telescope Control System
TCSS	TCS Server
TPM	Telescope Pointing Machine (software for Astrometric Pointing)
VI	Virtual Instrument (LabVIEW function)
WEB	SALT web-server

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1 Scope

This document defines the requirements for the PCON software.
PCON will provide a user interface to PFIS.
PCON will provide a TCS interface to PFIS.
PCON will control the PFIS hardware, for setting up hardware configurations.
PCON will send PFIS detector settings to PDET.
PCON will coordinate science procedures.
PCON will have a set of engineering controls and indicators as needed for technical purposes.
The PCON software will form a communications and control layer between the TCS and PDET.

2 Referenced Documents

The following documents are referenced in, or relevant to, this design document and are applicable to the extent mentioned herein.

1000AB0044	SALT LabVIEW Coding Standard
1000AS0040	SALT Operational Requirements
SALT-3170AE0002	Prime Focus Imaging Spectrograph Operations Concepts Definition Document
1000AE0033	PFIS ICD design report
Na	Prime Focus Imaging Spectrograph Preliminary Control System Design
SALT-3140AE0019	Prime Focus Imaging Spectrograph Control System Design Philosophy
SALT-3140AE0022	Prime Focus Imaging Spectrograph Control System Software Design Document
SALT-3140AE0026	Prime Focus Imaging Spectrograph Roadmap to the PFIS Control System Software
SALT-3140AS0015	Prime Focus Imaging Spectrograph Interlock Specification and Design Document

3 General Requirements

3.1 General MMI

PCON will be split into two programs, the main program and the remote MMI. The remote MMI will be the only user interface to PCON. The main program will handle commands from the remote MMI and will do all the hardware control and communication with TCS and PDET.
The remote MMI can be installed on any of the computers inside the SALT firewall, including the PCON computer where the main program will be installed.
The controls on the remote MMI will be split into two sections: Science and Engineering.
The Science section will have high level controls that will allow the user to configure the PFIS hardware and execute procedures.
The Engineering section will have low level controls for the technicians to use for maintenance purposes.

3.1.1 General Controls

These are controls the user might need that are not specifically science or engineering controls.

3.1.1.1 STOP HARDWARE

Hitting the Stop button will stop the current hardware move and procedure.

3.1.1.2 KILL HARDWARE

This button will stop the current hardware move and kill power to the motor.

3.1.1.3 ENCODERS ON/OFF
To reduce stray light in the detector the user can turn the motor encoders off.
3.1.1.4 HARDWARE INITIALIZATION
A button for the user to press to initialise or reinitialise the hardware.
3.1.1.5 LOAD AND SAVE SETTINGS
The user will have the option to load and save procedure, detector and hardware configuration settings.

3.1.2 General Indicators

These are indicators that could be useful to the user that are not specifically science or engineering.

3.1.2.1 VISUALISATION TOOL
A schematic diagram of the hardware will be part of the user interface as a quick reference to the current hardware configuration. This visualisation tool will be visible at all times.
3.1.2.2 ERROR PRESENTATION
Errors will be displayed in a table which the user can scroll through.
3.1.2.3 COMMAND ARRAY DISPLAY
The command array and the status of each command will be displayed.
3.1.2.4 PROGRESS BAR
There will be an easy to see progress bar indicating how far PCON is with the current set of commands in the command array.

3.2 General Software

The software will allow for multiple commands to be executed in parallel, where possible, to reduce the time needed to complete all the commands. This should be especially useful for reducing configuration times.
The software on PCON will also be responsible for coordinating the science procedures.
PCON will be able to receive commands and execute commands from TCS.
PCON will be able to send commands to PDET.
PCON will be able to control the configuration of the PFIS hardware using the PXI control software already developed.

3.2.1 PCON Main program

The PCON main program will have simple interface with nothing more than a few controls for shutting down the hardware and software. There will be some status indicators. The user interface to PCON will be the remote MMI.

3.2.2 Remote MMI

The remote MMI can be installed on the same computer as the PCON main or on another computer on the network. All controls needed by the user will be on the Remote MMI.

3.2.3 Modes

The PCON modes will indicate which commands are possible at any stage.
PCON will have two types of modes, and internal mode and an external mode. The external mode will be published to TCS and the internal mode will be used by the PCON software. The external mode will match the internal mode except for when TCS is not in control of PCON, either a remote MMI has control or PCON is waiting for control to be taken by the TCS or a remote MMI. In these cases PCON will report its external mode as Maintenance.

The following are the external modes

3.2.3.1 OFF
This mode indicates that PFIS is off.

3.2.3.2 EXTERNAL MODE: INITIALISE
This mode indicates that PCON is in the process of starting PFIS
3.2.3.3 EXTERNAL MODE: READY
This mode indicates that PCON is idle and waiting for a command.
3.2.3.4 EXTERNAL MODE: MAINTENANCE
PCON is not under TCS control
3.2.3.5 EXTERNAL MODE: CONFIGURING
PCON is moving the PFIS hardware.
3.2.3.6 EXTERNAL MODE: PROCEDURE
PCON is running a procedure
3.2.3.7 EXTERNAL MODE: SHUTDOWN
PCON is turning off the PFIS hardware
3.2.3.8 EXTERNAL MODE: MAJOR FAULT
An error has occurred that is preventing PCON from continuing.

The following are the internal modes.

3.2.3.9 INTERNAL MODE: OFF
This mode indicates that PFIS is off.
3.2.3.10 INTERNAL MODE: INITIALISE
This mode indicates that PCON is in the process of starting PFIS
3.2.3.11 INTERNAL MODE: READY
This mode indicates that PCON is idle and waiting for a command.
3.2.3.12 INTERNAL MODE: CONFIGURING
PCON is moving the PFIS hardware.
3.2.3.13 INTERNAL MODE: PROCEDURE
PCON is running a procedure
3.2.3.14 INTERNAL MODE: SHUTDOWN
PCON is turning off the PFIS hardware
3.2.3.15 INTERNAL MODE: MAJOR FAULT
An error has occurred that is preventing PCON from continuing.
3.2.3.16 INTERNAL MODE: ENGINEERING
PCON is in engineering mode, This mode will allow a technician to operate PCON using low level controls even when PCON has gone into Major Fault. The external mode will be reported as Maintenance during this mode.

3.2.4 Fits header

Most of the Fits Header information will be generated on PCON and sent to PDET which will add it to the image files. Some of this data, like object and PI name will be received from TCS. If this information is missing PCON will prompt the user to fill in the correct information.

3.2.5 Data Logging

General purpose debugging data will be logged to text files on the PCON computer. This data will include all commands, hardware and software status, and errors along with the time of the entry.

3.2.6 ODM vs. Global Variables

Object Data Management VIs will be used to share data between VIs in place of Global Variables.

3.2.7 Simulation Mode

For development and testing there will be a simulation mode on PCON. This will simulate the hardware responses to configuration and Procedure commands.

3.2.8 Constants and initialisation files

Constants will be stored in text files and loaded when the PCON software is started.

3.2.9 Parallel hardware configuration

Advantage will be taken of Labviews inherent parallel execution to reduce hardware configuration times. There are some limitations in the hardware that will prevent some configurations from happening at the same time as others and certain hardware mechanisms require specific positions from some of the other hardware mechanisms before they can be moved. These cases need to be taken into account when configuring the hardware.

3.2.9.1 ETALONS, ARTICULATION AND GRATING ANGLES
The articulation and grating angles must be zero for either or both the etelons to be inserted. Both Etalons must be out for the grating and the articulation angles to be changed.

3.2.9.2 BEAMSPLITTER AND ARTICULATION
The articulaton angle must be 0 for the beamsplitter to be inserted or removed. After the beamsplitter has been inserted or removed it is safe to change the articulation angle.

3.2.9.3 GRATING AND ARTICULATION
The articulation and grating angles must be 0 for the grating to be changed.

3.2.9.4 ETALONS
Only one of the two etalons can be moved at a time.

3.2.9.5 FOCUS, SLITMASKS, FILTERS, WAVEPLATES, AND SHUTTER
The following hardware can be moved at any time regardless of the position or movement of the other hardware: Focus, slitmasks, filters, waveplates, and the shutter.

3.2.10 Communications

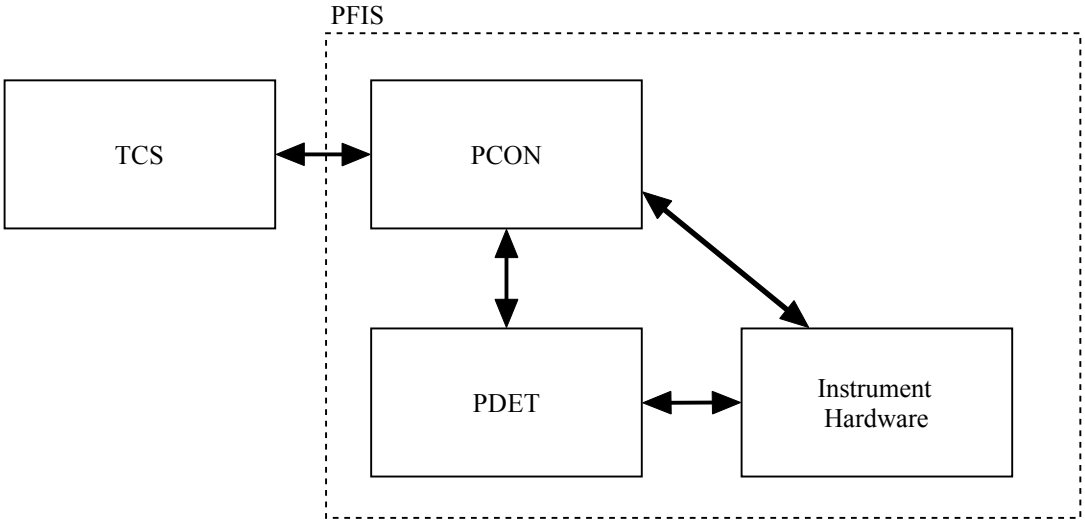

Figure 1: TCS PFIS communications

3.2.10.1 TCS
PCON will receive commands and data from TCS using the ICD clusters over Datasocket. Commands from PCON to TCS will be sent as d Language (SCL) commands to TCS and status data to TCS will be via DataSocket ICD clusters.

3.2.10.2 PDET
PCON will communicate with PDET using clusters over Datasocket. These clusters need not be part of the ICD. TCS commands will be relayed via PCON to PDET using these clusters.

3.2.10.3 PFIS HARDWARE
PCON will control the hardware and read status data from the hardware using the already developed PXI control software.
PDET will have direct control over the detector hardware on PFIS.

3.2.11 Control Arbitration

The TCS and the remote MMIs will be able to control PFIS via the PCON main program. When the software is started, and has initialised to Ready mode, it will check to see if TCS is running in which case TCS will be granted control. If TCS is not running when PCON starts, PCON will wait for either TCS to start up or a remote MMI to request control. While PCON is waiting it will report Maintenance mode to TCS, published on DataSocket. If an MMI has control the software will report Maintenance mode to TCS. The user will have to release control before TCS can take control. Similarly when TCS has control it will have to release control, before a remote MMI can take control.

4 Science Requirements

4.1 Controls

4.1.1 Hardware Configuration

There will be some high level controls for setting up the hardware. The software will coordinate the necessary sequence of hardware moves to achieve the desired configuration. The user will be able to set the following hardware.

4.1.1.1 SLITMASK
There will be a choice of 40 slitmasks to insert and an option for no slitmask.

4.1.1.2 WAVEPLATE
There will be a choice of 4 waveplate configurations: Open, Linear, Circular / All Stokes, and QBL.

4.1.1.3 ETALONS
The choices will be: Etalon 1 and 2 out; Etalon 1 in; Etalon 2 in; and Etalon 1 and 2 in.

4.1.1.4 GRATING
There will be a choice of 6 gratings to insert and the option for no grating.

4.1.1.5 GRATING ANGLE
The grating angle can be set from 0 to 100 degrees.

4.1.1.6 FOCUS
Set the Focus position.

4.1.1.7 FILTER
There will be a choice of 20 filters to insert as well as an option for no filter to be inserted.

4.1.1.8 ARTICULATION ANGLE
The articulation angle can be set from 0 to 100 degrees.

4.1.2 Detector controls

These controls will be defined by the control cluster for PDET, the following controls are expected to be there. The meaning of these controls is defined by the PDET software.

4.1.2.1 EXPOSURE TIME
To set the number of seconds for the each exposure.

4.1.2.2 NUMBER OF EXPOSURE
To set the number of exposure PDET takes when PCON sends a single exposure command. As this is controlled by PDET the delay between exposures will be much less than using the procedure control Exposure Repeat (See 4.1.3.3).

4.1.2.3 CCD MODE
There will be a choice of Normal, Frame Transfer, Slot Mode, Shuffle, Video or Drift Scan.

4.1.2.4 CCD GAIN
There will be a choice of Bright or Faint

4.1.2.5 CCD CALCULATION
There will be a choice of No Calculation, Aperture, Star, or FPRingRadius.

4.1.2.6 CCD READOUT
The readout speed of the CCD can be set to Fast, Slow or No Readout.
4.1.2.7 SHUTTER
The shutter can be set to Automatic, Stay Open, or Stay Closed.
4.1.2.8 EXPOSURE TYPE
The exposure type can be set to PCON Control, Bias, Flat Field, or Arc.
4.1.2.9 CCD PREPARE
CCD Prepare will be either True or False.
4.1.2.10 SAVE TO DISK
Save to disk will be either True or False.
4.1.2.11 PRE-BINNING (ROWS AND COLS)
The pre-binning of the rows and columns will be set with this control
4.1.2.12 FRAME SIZE (ROWS)
The Frame size, in rows, will be set with this control.
4.1.2.13 PRE-SHUFFLE (ROWS)
The Pre-shuffle, in rows, will be set with this control
4.1.2.14 POST-SHUFFLE (ROWS)
The Pos-shuffle, in rows, will be set with this control
4.1.2.15 APPLY WINDOW
Apply window will be either True or False
4.1.2.16 NUMBER OF REGIONS
The number of regions will be set with this control
4.1.2.17 ROW CENTRE
The Row centre will be set with this control
4.1.2.18 ROW HEIGHT
The Row height will be set with this control
4.1.2.19 CCD REGIONS
This table will Indicate the current CCD regions Column, Row, Width, and Height values.

4.1.3 Procedure controls

4.1.3.1 PROCEDURE TYPE
The procedure type will be set to Normal, Focus Run, Fabry-Perot, Polarimetry, or FP-Polarimetry.

1. Normal will open the PFIS shutter for a specified time, close the shutter and read out the image from the CCD.
2. Focus Run will take a series of images through a specified series of focus positions
3. Fabry-Perot will take a series of images through a specified series of etalon wavelength settings.
4. Polarimetry will take a series of images through a specified series of waveplate settings.
5. FP-Polarimetry will take a series of images through a specified series of etalon wavelength and waveplate settings.

4.1.3.2 PROCEED AT READOUT
Proceed at Readout will be either True or False. When this is true the procedure will continue when it receives a ‘readout mode’ from PDET indicating PDET is currently reading out the image from the CCD. If set to faulse then the procedure will wait for PDET to go to ‘idel mode’ after it finishes reading out the image from the CCD.
4.1.3.3 EXPOSURE REPEAT
This control will set how many exposures will be taken when the procedure reaches an exposure command. The resulting number of exposures will be the multiple of the number of exposures set for the Detector (see 4.1.2.2) and this setting for the procedure.
4.1.3.4 PROCEDURE REPEAT
The Procedure Repeat will specify the number of times the entire procedure is to be repeated.
4.1.3.5 FOCUS START
This will set the focus start for the focus run procedure.

4.1.3.6 FOCUS INCREMENT
This will set the focus increment for the focus run procedure.
4.1.3.7 FOCUS COUNT
This will set the number of times the focus is incremented for the focus run procedure.
4.1.3.8 CENTRAL WAVELENGTH
This will set the central wavelengths of the Etalons for the Fabry-Perot procedure. This setting along with the wavelength increment and wavelength count will set the range of wavelengths used in this procedure.
4.1.3.9 WAVELENGTH INCREMENT
This will set the wavelength increments of the Etalons for the Fabry-Perot procedure.
4.1.3.10 WAVELENGTH COUNT
This will set the number of times the wavelengths of the Etalons are incremented for the Fabry-Perot procedure.
4.1.3.11 WAVEPLATE PATTERN
This control will define the QWP and HWP positions for the polarimitery procedure.
4.1.3.12 RUN PROCEDURE
This will run the currently setup procedure
4.1.3.13 PAUSE
This control will pause the procedure, at the end of the current exposure if in the middle of one.
4.1.3.14 RESUME
This control will resume the procedure that has been paused.
4.1.3.15 TERMINATE
This control will stop the procedure after the current exposure has completed and been readout.
4.1.3.16 ABORT
This control will stop the procedure and the exposure without reading out. The capability of this control depends on PDET allowing the exposure to be aborted.

4.2 Indicators

4.2.1 Hardware Configuration

The following hardware positions will be indicated.

4.2.1.1 SLITMASK
This will indicate the currently inserted slitmask
4.2.1.2 WAVEPLATE
This will indicate the current waveplate configuration
4.2.1.3 ETALONS
This will indicate the current etalon configuration
4.2.1.4 GRATING
This will indicate the currently inserted grating
4.2.1.5 GRATING ANGLE
This will indicate the current grating angle
4.2.1.6 FOCUS
This will indicates the current focus position
4.2.1.7 FILTER
This will indicate the currently inserted filter
4.2.1.8 ARTICULATION ANGLE
This will indicate the current articulation angle
4.2.1.9 CURRENT CONFIGURATION
This will indicate the science PFIS is currently configured for. This will be: Imaging, Spectroscopy/MOSS, Polarimetry, Fabry-Perot, FP-Polarimetry or Unknown. Table 1 below describes the rules that will be used to determine the Current Configuration.

Table 1 Current Configuration rules

Configuration	Slitmask	Waveplate	Etalons	Grating	Grating Angle	Beamsplitter	Filter	Articulation
Imaging	any	any	Out	Out	any	Out	any	Zero
Polarimetry	any	In	Out	Out	any	In	any	Zero
Fabry-Perot	any	Out	In	Out	any	Out	any	Zero
FP-Polarimetry	any	In	In	Out	any	In	any	Zero
Spectroscopy	any	Out	Out	In	any	Out	any	any
Spec-Polarimetry	any	In	Out	In	any	In	any	any
Unknown	None of the above hardware combinations match a defined configuration							

4.2.2 Procedure

4.2.2.1 CURRENT EXPOSURE NUMBER

This will indicate how many of the Exposure Repeats (see 4.1.3.3) have been done.

4.2.2.2 CURRENT PROCEDURE NUMBER

This will indicate how many of the Procedure Repeats (see 4.1.3.4) have been done.

4.2.2.3 CURRENT FOCUS NUMBER

This will indicate how many of the Focus Counts (see 0) have been done.

4.2.2.4 CURRENT WAVELENGTH NUMBER

This will indicate how many of the Waveplate Counts (see 4.1.3.10) have been done.

4.2.2.5 CURRENT WAVEPLATE PATTERN

This will indicate how many of the Waveplate Patterns (see 0) have been done.

4.3 Science Software

4.3.1 Procedure Definitions

These will be sequences of commands that will be executed to produce the required science procedures (See 4.1.3.1).

4.3.1.1 NORMAL EXPOSURE IS DEFINED AS

1. Send Fits header to PDET
2. Wait for PDET to report IDLE
3. Command PDET to start
4. Wait for PDET status to be anything other than IDLE
5. Command no-op (PDET will go to IDLE when the current exposure has ended)
6. Wait for PDET to report ‘IDLE’, ‘readout’ or ‘writing to disk’ (specified by the user)

4.3.1.2 SPECTROSCOPY IS DEFINED AS

1. Do Normal Exposure

4.3.1.3 FOCUS RUN IS DEFINED AS

2. Set focus
3. Do Normal exposure
4. Repeat … till end of pattern

4.3.1.4 FABRY-PEROT IS DEFINED AS

1. Set Etalon 1 and/or 2 central wavelength
2. Do Normal exposure
3. Repeat … till end of pattern

4.3.1.5 POLARIMETRY IS DEFINED AS

1. Set waveplate positions (using Linear, circular and all stokes)
2. Do Normal exposure
3. Repeat … till end of pattern

4.3.1.6 FP-POLARIMETRY IS DEFINED AS

1. Set Etalon 1 and/or 2central wavelength
2. Set waveplate positions (using Linear, circular and all stokes)

3. Do Normal exposure
4. Repeat … till end of pattern

5 Engineering Requirements

5.1 Engineering MMI

The engineering controls will give the user access to very low level commands.

5.1.1 Password Protection

To prevent unauthorised use of these controls the user will have to enter a password they can access the controls.

5.1.2 Required Engineering controls

All controls needed for engineering purposes on PCON.
TBD Brennan Meyer

5.1.3 Status Indicators

Various status hardware and environmental status will be displayed.
TBD Brennan Meyer

5.2 Engineering Software

5.2.1 Hardware Parked positions

Define parked setup (safe state to turn off power)
TBD Brennan Meyer

5.2.2 Initialisation steps

The required steps for the software to follow when initialising the hardware, this is powering up and state detection.
TBD Brennan Meyer

5.2.3 Shutdown steps

The required steps for the software to follow when shutting down the hardware, this is powering down and parking.
TBD Brennan Meyer

6 TCS Requirements

6.1 Functionality

6.1.1 Commands

It is required that TCS implement the following commands via the ICD clusters when TCS is in control.

1. Set Configurations controls
2. Implement Configuration
3. Set Procedure controls
4. Run a procedure
5. Procedure Pause

6. Procedure Resume
7. Procedure Abort
8. Procedure Terminate
9. Procedure Stop

6.1.2 Status

It is required that the following PCON statuses are reported to TCS

1. Errors
2. PCON external Mode