PROCESS INSTRUMENTATION AND CONTROLS

Kingfisher RTU - Hardware Implementation Standard

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Watercare

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1. Purpose

1.1 Background

1.1.1 Objectives

The objective of this document is to provide a standard for the design of control system components for new Watercare sites. This document covers a range of Kingfisher brand RTU components. This includes approved components which should be specified in the design and alternatives that shall not be used. The objective is to standardise components used, minimising variability, risk and the number of spares kept by the Watercare store facilities.

This standard also provides the following functional requirements:

- How to utilise communication ports of the processor and communication modules
- How to wire communication and power to the various Kingfisher modules and backplanes.
- Methods of how to connect the Kingfisher RTU to the control network and to other Kingfisher RTUs in redundant systems layouts.

1.1.2 Site Upgrades

This standard does not apply to upgrades of existing systems which may have different requirements that needs to compatible with existing systems. An effort must be made to comply with the requirements specified in this document, but not mandatory where impractical. Upgrade designs shall always be discussed and reviewed by the Watercare control systems architecture and operations teams prior to implementation.

1.1.3 Audience

This document is intended for Watercare personnel, contractors and consultants involved in the electrical and control systems design of network sites (transmission and local networks), and facilities. This includes Operational Technology (OT) architects, OT consultants and electrical design engineers designing the control systems and networking components of new sites.

1.2 Compliance requirements

Compliance with this standard is required for all electrical designs that utilise Kingfisher RTUs for the control and monitoring of Watercare SCADA systems.

Exceptions to this standard are not permitted, except by the express approval of Watercare control systems and operations staff.

1.3 Supporting documentation

The documents listed in Table 1 should be read in conjunction with this standard where applicable.

Table 1: Supporting documentation

Document Name	Version	Document Date	Publisher
Kingfisher Plus Hardware Manual	7.22	2020	Ovarro
CP35 Reference Manual	5	2020	Ovarro

1.4 Abbreviations

Table 2: Abbreviations

Abbreviation	Description
BSP	Bulk Supply Points
CP	Communications Processor
DMR	Digital Microwave Radio
EOP	Engineered Overflow Points
IO	Input / Output
LTE	Long-Term Evolution (Wireless Broadband Communication Technology)
MC	Multi Comms
OT	Operational Technology
PRV	Pressure Reducing Valves
PS	Power Supply
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
VSD	Variable Speed Drive

2. Kingfisher RTUs

2.1 Introduction

The Kingfisher RTU is the controller of choice for Watercare sites. This has been previously determined through a rigorous product selection process, and since then several hundred Kingfisher RTUs have been installed in the wider Auckland region.

Continuous development and testing of standardised RTU code with standard library components has been implemented. The objective of this document is to assist with that process so that all future implementations follow a well-documented hardware and software standard.

2.2 Spares

The process of maintaining and testing spare parts involves a strategic risk-based approach to inventory management and shall be determined by the likelihood of failure and criticality of each component. This requires the careful selection of componentry, especially in cases where several components perform a similar function. Only components listed in this document as '***Standard use***' must be utilised. Components listed under '***Special permission***' should only be considered in special cases and where the '*Standard use*' components cannot perform the required functionality.

The recommendation for control system spare retention is 2%.

Components that require spares are listed below:

- Backplanes
- Power Supply Modules
- Processor & Communication Modules
- Communications and IO Option Boards
- IO Modules
- Cables

2.3 Kingfisher RTU Application

The Kingfisher RTU systems shall be utilised at the following water and wastewater facilities / processes:

- Water Bulk Supply Points (BSPs)
- Water Bypass and Line Valve actuators
- Pressure Reducing Valves (PRVs)
- Headworks / Dams
- Flowmeter and Pressure Monitoring Sites
- Chlorine Booster Stations
- Level Monitors and Engineered Overflow Points (EOPs)
- Rain Gauges
- Water Reservoirs and balancing tanks

- Sewer Mains Monitoring
- Biofilters
- Wastewater Siphons
- Trade Waste Monitoring Points
- Water and Wastewater Pump Stations
- Treatment Plants (Gateway Communications Only)
- DMR Access Point / Nodes
- Radio Repeater Sites

3. Hardware Selection

The sub-sections below list all the specified components available by the Kingfisher RTU manufacturer, Ovarro.

- **Standard use**: These are components that form part of the Watercare Kingfisher RTU standard. These components can be selected without restriction.
- **Do not use**: These components shall not be used. Selection of these components in an electrical design will lead to this design being rejected at the review stages.
- **Special permission**: These are components that require special **written** permission from the control systems and operational teams before being utilised. Special reasons must exist and must be given before these components can be utilised. The permission request form is appended to this document.

3.1   Backplanes

Table 3: Backplane parts (standard and special use)

Part Number	Description	Standard use	Do not use	Special permission
B02-0-E00	Non-Powered Backplane - 2 Slot	✓		
B04-0-E00	Non-Powered Backplane - 4 Slot			✓
B06-0-E00	Non-Powered Backplane - 6 Slot	✓		
B12-0-E00	Non-Powered Backplane - 12 Slot	✓		
B02-P-E00	Powered Backplane - 2 Slot			✓
B04-P-E00	Powered Backplane - 4 Slot			✓
B06-P-E00	Powered Backplane - 6 Slot			✓

Notes:
1) Powered backplanes should be avoided. For example, A 2-slot powered backplane could be used in special cases like when a Kingfisher RTU is being utilised as a communication gateway, space is very limited, and an additional slot is required. The use of a two slot non-powered backplane with a power supply is preferred in this case.
2) Use of 2 slot and 4 slot powered backplanes should be avoided unless there is a critical space issue.

3.1.1   Expansion Backplanes

Expansion backplanes shall only be utilised if all the IOs cannot be fitted into one 12-slot backplane while allowing for 20% spare capacity while having redundant equipment wired to different IO cards.

Alternatively, an expansion backplane can be used if space in a cabinet does not allow for one 12-slot backplane.

Discussion with the control systems architecture and operations teams can be initiated to discuss options and reasons of why expansion backplanes should be used in a particular design.

New control panels should be designed to allow space for non-powered 6 or 12 slot backplanes.

3.2 Power Supply Modules

Table 4: Power supply modules

Part Number	Description	Standard use	Do not use	Special permission
PS-12-0	100-240VAC Power Supply without 24VAUX Power Output		✓	
PS-12-C	100-240VAC Power Supply with 24VAUX Power Output		✓	
PS-22-0	20-60VDC Power Supply without 24VAUX Power Output	✓		
PS-22-C	20-60VDC Power Supply with 24VAUX Power Output		✓	

3.3 Processor and Communication Modules

Table 5: Processor and communication modules

Part Number	Description	Standard use	Do not use	Special permission
CP-35-00	Processor module with 1x Ethernet RJ45 Copper 10/100 Mbps, 2 x RS232/485, USB	✓		
MC-35-00	Multi Comms Module for CP-30 / 35 with 1 additional Ethernet board & 1 additional Serial board	✓		
CP-30-00	Processor module with 1x Ethernet RJ45 Copper 10/100 Mbps		✓	

3.4 Communications and IO Option Boards

Table 6: Communications and IO option boards

Part Number	Description	Standard use	Do not use	Special permission
Option - I	Option Card - Serial RJ45 Copper Isolated RS232/422/485		✓	
Option - T4	Option Card - Ethernet RJ45 Copper 10/100Mbps	✓		
Option - T3	Option Card - Ethernet RJ45 Copper 10/100Mbps		✓	
Option - A4	Option Card - Ethernet MTRJ Fibre Optic 100Mbps			✓
IO-Option - MX2	CP35 Daughter Card - 8DI/DO, 8DI			✓
IO-Option - MX3	CP35 Daughter Card - 10 AI/DI, 4 DI/DO, 2AO			✓

All digital and analog inputs and outputs must be connected to the control system via the IO card options listed in the above table or the IO modules listed below. Exceptions need to be approved by control systems architecture and operational teams.

3.5 IO Modules

Table 7: IO Modules

Part Number	Description	Standard use	Do not use	Special permission
AI-10-1 (EA)	Analog Input - 8 Channel, 16-bit Resolution, 5kV Isolation.	✓		
AO-3-1 (EA)	Analog Output - 4 Channel, 12-bit Resolution, 3kV Isolation.	✓		
DI-5-1 (EA)	Digital Input - 16 Channel 10-28 VDC, 1.5kV Isolation.	✓		
DO-2-1 (EA)	Digital Output - 16 Channel Relay SPST, 3kV Isolation.	✓		
IO-2-1 (EA)	Mixed IO - 8 DI, 8 DO. 3kV Isolation.			✓
IO-3-1 (EA)	Mixed IO - 4 DI, 4 DO , 4 AI, 1 AO. 1kV Isolation.			✓
IO-4-1 (EA)	Mixed IO - 8 DI, 2 DO , 2 AI. 3kV Isolation.			✓
IO-5-1 (EA)	Mixed IO - 4 DI, 4 DO, 4 AI, 1 AO. 3kV Isolation.			✓

The analog inputs in the IO-2-1, IO-3-1, IO-4-1 and IO-5-1 cards do not have the ability for the analog fail bit to be read by the ISaGRAF programming environment. This leads to the software not knowing when the analog input drops to 0mA and will read this as a zero without any knowledge of an analog input failure. The use of these cards requires justification and written approval required before they can be designed into the system.

3.6 Cables

Table 8: Cables

Part Number	Description	Standard use	Do not use	Special permission
BAC-PLUS-01 (EA)	Backplane Interconnect Cable - 0.5m	✓		
BAC-PLUS-02 (EA)	Backplane Interconnect Cable - 1.0m	✓		
BPC-01 (EA)	Interrack 6 Way Power Cable - 0.6m	✓		
BPC-02 (EA)	Interrack 6 Way Power Cable - 1.1m	✓		

4. Port Standards

4.1 Processor Module – CP-35

This table indicates how the processor module communications ports shall be used. Any variation from the following needs to be reviewed by the Watercare's control systems architecture and operational teams.

Table 9: Processor module communication ports

Port Designator	Port Description	Port Use
Port 1	Integrated RJ45 Ethernet Port 10/100Mbps	Connection to Trio Radio or LTE Modem. Communications to SCADA and intersite RTU to RTU communication via radio/LTE
Port 2	Option Card for Ethernet, Fibre, Radio, Router or IO	Connected to network switch for local communications (VSDs, Power Meters etc.)
Port 3	Option Card for Ethernet, Fibre, Radio. Router or IO	To Redundant RTU in dual RTU redundant systems.
Port 4.1	Integrated Screw Terminal RS232/485 Serial Port	Communication to field serial devices
Port 4.2	Integrated Screw Terminal RS232/485 Serial Port	Communication to field serial devices
USB	Programming or Flash Disk Port	Programming of Processor

The onboard serial ports 4.1 and 4.2 shall be used to communicate to field serial devices. A serial isolator with a minimum isolation of 3kV must be used.

Plugin ethernet ports shall only be used if the onboard port options are not sufficient to cover all the communication requirements.

Programming of the processor shall be carried out via an ethernet to USB adaptor plugged into the onboard USB port. Allowance for spare ethernet ports for programming is not required.

4.2 Communications Module – MC-35

The MC-35 shall only be used if all the CP-35 ports, including the option ports have been used.

It is preferrable to use ports on the CP-35 processor as opposed to additional ports on the MC-35, even for redundant equipment or redundant equipment networks (serial or ethernet).
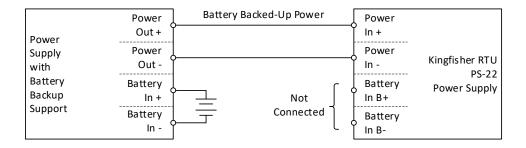
5. Wiring Standards
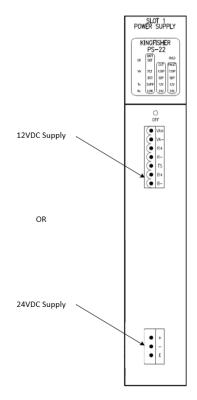
5.1 Power Supply and Battery Connections

A PS-22 power supply shall always be used. The electrical design of the control systems cabinet shall be designed to accommodate this requirement.

Battery backup shall be carried out externally from the RTU as shown below. The battery shall not be connected to the B+ and B- terminals of the PS-22. This layout also allows for all the ELV-supplied equipment outside of the RTU to be battery backed up.

All inputs and outputs shall be powered by the external 24VDC power supply with individual fuse protection for every IO card. The input/output card's auxiliary 12VDC or 24VDC power shall not be used.

Only the PS-22-0 module shall be used. 12VDC or 24VDC power shall be supplied as indicated in the picture below:

5.2 Ethernet Communications

Communications between RTU and RTU in dual RTU redundant systems shall be direct from port 3 of each RTU. This communication link shall not go via any external device such as a network switch.

Communication to central SCADA shall be direct from the Kingfisher RTU CP-35 processor module to the radio, modem or router so that the number of devices between the RTU and the external link is kept to a minimum.

5.3 Serial Communications

Ethernet communication shall be preferred over serial RS232 or RS485 communications. The latter shall only be used in cases where no other options are possible.

All serial communications to the RTU shall be connected via an isolator with a minimum of 3kV isolation.

The onboard serial ports 4.1 and 4.2 shall be utilised. It is unlikely that a third or fourth port are needed. Serial cards connected to ports 2 and 3 are not permitted. The Watercare control systems architecture and operations teams need to be contacted if there is a requirement for more than two serial ports.

5.4 Programming

Programming of the RTU shall be carried out via the CP-35 processor USB port. This connection shall be shown on the electrical drawings, or a note should be made indicating that this port is used for programming.

5.5 Earthing

Appropriate earthing of the RTU systems shall be included according to the Kingfisher Plus Hardware Manual, Section 17.10 – Earth/Ground Connection (Referring to the manual version 7.22 dated 2020)

5.6 IO Card Installation Order

The cards shall be installed on the backplane in the following order:

PS – PR – AI – DI – DO – AO

Where:

PS = PS-22 Power Supply

PR = CP35 Processor

AI = AI-10 Analog Input Cards

DI = DI-5 Digital Input Cards

DO = DO-2 Digital Output Cards

AO = AO-3 Analog Output Cards

6. Redundant RTU Systems

In critical systems where redundant RTU systems is required, there should be two independent RTU backplanes, where each backplane has dedicated power supply, CPU and IO modules providing control and monitoring for half of the plant's equipment.

Redundancy via dual CP-35 processing modules connected to the same backplane is not allowed.

Communication between RTUs shall be direct via plugin board ethernet connections at port 3 on the CP-35 processor modules.

Kingfisher RTU – Non-Standard Equipment Use Authorisation Form

Facility Code	
Facility Name	
Facility Type	
Facility Address	
Watercare Project Manager Name	
Component Part Number	
Component Description	
Reason for Non-Standard Requirement (Include Drawings or Diagrams)	
Estimated Project Commissioning date	
Date Response Required	
Signed / dated by applicant:	