

EP3 Programmer

User Guide

EP3 Programmer
QTech Irrigation Management System
Revision 4.1



Contents

Introduction	5
About This User Guide.....	5
Product overview	5
Features.....	6
Systems Overview.....	6
Getting started	8
System and Equipment Requirements	8
Preparing the EP3 for First Use.	8
Quick Guide to setting a new IPC to work.....	8
User Interface.....	10
Touch Screen.....	10
General Navigation	10
Screen Calibration	10
IPC Status Indicator	11
Troubleshooting the IPC Status.....	11
Overview.....	13
Configuration Process.....	13
Schedules.....	13
Communications	13
Local	13
Network Flooding.....	13
Mesh	13
Bootloader	14
IPC Operating Modes.....	14
Bootload ACTIVE	14
Bootload IDLE.....	14
Application Active	14
Application Hibernating	14
IPC Addresses.....	14
What is FarmID?.....	15
IPC Hibernation Mode	15
IPC Valve Solenoid Connection and Operation	16
Solenoid Connection	16
Solenoid Polarity.....	16
Battery Magnet.....	17
Solenoid Operation	17
Managing IPCs.....	18
Main Menu Summary.....	18
Importing the IPC List	18
Importing the Schedule List	18
Working with Individual IPCs	19
View an IPC Details.....	19
View IPC Schedule.....	19
Communicate with IPC.....	20
Interpreting the Status Message	21
Schedule Information.....	22

Fixing Clock Errors.....	22
Fixing Low Battery Problems.....	22
Fixing Incorrect Valve State	22
IPC Radio Channel Reconfiguration	23
Programming the FarmID	23
Replacing Faulty IPCs.....	24
Replacement Steps	24
IPC Application Firmware Upgrade Procedure (magnet method)	25
Upgrade Steps.....	26
IPC Application Firmware Upgrade Procedure (OTA method)	26
Upgrade Steps.....	26
EP3 Settings and Features.....	29
EP3 Info and Self Upgrade of Firmware	29
EP3 Clock Time and Date	30
Spectrum Analyser	30
Real Time.....	31
Peak Hold	31
EP3 Communication Settings	31
Programming Channel	32
Scan Channels	32
Use Broadcast Header.....	32
Packet Analyser.....	32
Managing Data Log Functions	33
Soil Moisture Loggers	33
Data Collection.....	33
Quick Soil Moisture Readings.	34
Advanced Data Analysis	35
Configuration File Formats.....	36
IPC Config File Format.....	37
IPC Schedule File Format.....	38
IPC Repeater File Format	39
Technical Specifications	40
EP3 Specification	40
SD Card Specification.....	41
Warranty.....	42
Additional Information and Support	42

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Introduction

About This User Guide

This document provides assistance with the installation and operation of the QTech EP3 including the user interface and configuration of system functions for the operation of Irrigation Point Controller (IPC) devices for fixed-set water sprinkler systems. The EP3 is a component of the QTech Irrigation Management System (IMS).

Other documents that should be read in conjunction with this document include:

- INC User Guide
- IPC Manager User Guide.
- QIMS User Guide
- WSML User Guide
- Additional application notes which provide specific operational assistance.

Contact QTech for application notes, which can be obtained to provide guidance for specific configuration scenarios, detailing the configuration workflow steps.

This guide assumes that you have been trained on and are familiar with the QTech Data Systems Irrigation Management System (IMS) suite of products and software, their configuration and their terminology. Please refer to other QTech Data Systems resources for introductory training material or specific Owners Manual's, if provided, for detailed descriptions of each product.

This version of the guide incorporates feature additions made to the product to support **version 5.04** of the EP3 firmware.

Product overview

All systems are provisioned with an EP3. Medium sized systems can be run with an INC and larger systems augment the INC with the IMS software and hardware products.

- **EP3** - This is a hand-held device used to configure and test IPCs.
- **Irrigation Point Controller (IPC)** - These devices are used to control the solenoid valve at each irrigation point. They operate autonomously and are connected via a mesh radio network for configuration and monitoring of the IPC plus additional control.
- **IPC Repeater (IPC-R)** - This is a permanently powered version of the IPC with a high gain antenna used for complex radio communications in difficult terrain.
- **Irrigation Network Controller (INC)** - This is a permanently installed and powered device that is used to monitor and record the state of each IPC in a system. It can also configure and test IPCs. The device connects to the radio mesh network and to back end systems such as the IMS.
- **Wireless Soil Moisture Logger (WSML)** - This device collects sensor information from soil moisture probes, soil temperature sensor, and rain gauge. it logs the information at intervals and the data can be retrieved using an EP3. Data is then transferred to a desktop application for charting via SD Card. Please refer to the WSML User Guide for additional information.
- **IMS Software System** - Application Server and User Interface for overall operations configuration management monitoring and control, used in larger networks.
- **IPC Manager** - This is a software application that is used to create the files used for configuring the INC, EP3, and IPCs.



Figure 1: EP3 programmer

Features

- 900 MHz Short range radio up to approximately 400m for local network communications to IPCs
- Onboard touch screen User Interface for IPC status reporting, configuration and control
- Real Time Operating System and processor for scheduled status polling and site time management
- Memory Card interface (SD Card) for site configuration file import
- IPC programming capability for firmware upgrades and IPC configuration
- Individual IPC management of schedules
- IPC health information
- Built in Radio Spectrum Analyser
- Data Collection tool for QTech Soil Moisture sensors, Soil Temperature Sensors and Rain Gauge

Systems Overview

The QTech Irrigation Management System (QIMS) is a suite of hardware and software products used to configure, control, and monitor QTech Irrigation Point Controllers (IPC). The primary aim of the irrigation solution is to manage water application at defined flow rates over a wide area promote pasture growth.

The QIMS system design utilises a low-cost controller (IPC) at each irrigation point. The IPC is self-contained device operating from solar power with on-board battery storage. The IPC operates a low power latching solenoid to control an irrigation sprinkler valve. The IPCs communicate via a 900 MHz mesh radio network, allowing watering schedules to be centrally managed.

A typical system consists of one or more (usually many) IPCs mounted on posts or in pods each connected to a sprinkler valve via a solenoid. Each IPC runs a scheduled watering plan according to a real time clock in the device. An EP3 or INC is used to send the time and schedule information to the IPC. Each IPC is defined in a human readable configuration file with a name and serial number and radio address. The configuration file is loaded into an EP3 or INC for distribution.

Schedules are also defined in a human readable configuration file. Schedules are distributed one by one with an EP3 but in an INC the scheduling process is automated and each schedule is sent to its associated IPC in sequence. Schedules (and configuration files) are stored on a memory card (SD card) and loaded into an EP3 or INC memory from the card. Once loaded on the INC or EP3 they remain in the device memory.

Schedule and configuration files hand be created and modified using a text editor on a workstation running Microsoft Windows. Alternatively, scheduling software such as IPC Manager from QTech or Pod Scheduler from RX Plastics, can be used to generate the required files.

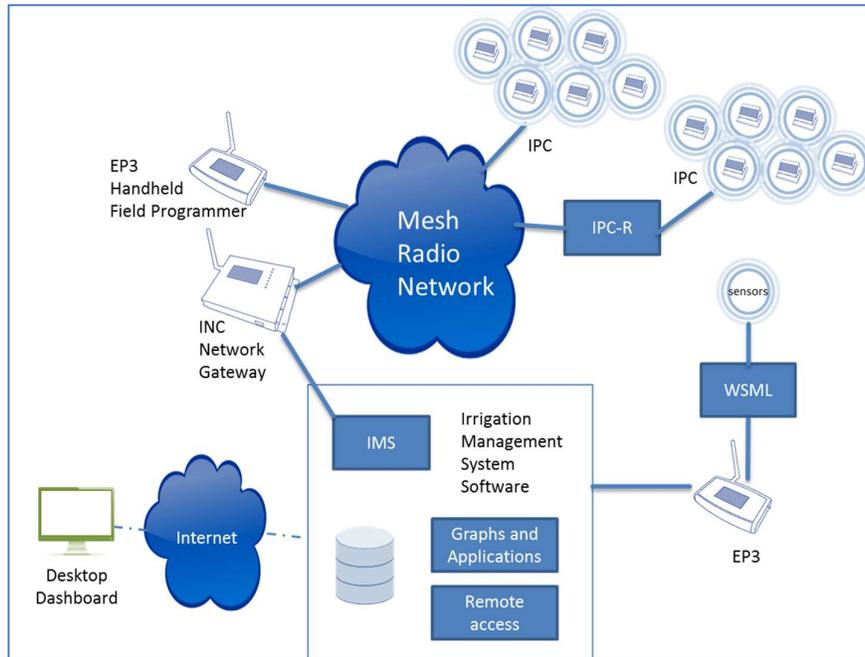


Figure 2: Typical IMS System options

Key:

IPC – Irrigation Point Controller

EP3 – Handheld Programming tool

INC – Irrigation Network Controller

IPC-R – repeater device for IPCs

WSML – Wireless Soil Moisture Logger

IMS – QTech Irrigation Management Software System and base station

Mesh Radio Network – the QTech radio network over which communications and messages to all IPC devices propagate

Getting started

This section describes procedures for readying the EP3 for use and basic principles for configuring an IPC.

System and Equipment Requirements

The following tools and equipment should be carried by the installer when maintaining an IPC using an EP3:

- EP3 handheld programmer
- SD Card to transfer IPC configuration and schedules to the unit
- Stylus for touch screen operations
- Magnet for IPC programming
- Spare lithium ion batteries for the EP3

Preparing the EP3 for First Use.

To prepare the EP3 for use, follow these steps:

- a) Remove the device from its packaging,
- b) Screw on the foldable whip antenna,
- c) Remove the rear battery cover and insert the batteries, pay attention to the correct orientation illustrated inside, replace the cover afterwards,
- d) Remove the SD card supplied with the unit from its packaging and insert it into the EP3, making sure it clicks gently into place.

Note. The EP3 SD Card can be ordered to be supplied with the initial site configuration files pre-loaded from the factory. If your SD Card does not have the configuration files pre-loaded then the files must first be created and loaded onto the SD Card from a PC. Refer to QTech for support if you require assistance with IPC configuration file creation.

Turn the unit on. When the EP3 is powered up the screen display the **Main Menu** as shown below.

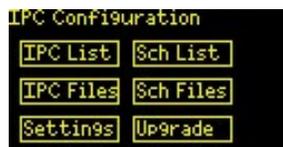


Figure 3: Main Menu

Use the stylus (or an un-gloved finger) to tap buttons on the screen to navigate. If the device does not respond to stylus use then the screen may need recalibrating (see section Screen Calibration).

Quick Guide to setting a new IPC to work

When adding IPCs to a site refer to this checklist when setting the IPC to work. This list assumes that the site is using V5.xx IPC firmware and EP3 firmware or later.

1. Identify the Farm ID for the site. If you do not know the FarmID look in the pod configuration file or contact QTech. Identify the IPC serial number printed inside the unit.
2. Add an entry into the pod configuration file for the IPC (which includes the FarmID), add the schedule files. Store these on the SD Card. These files can also be automatically generated by scheduling software such as QTech IPC Manager or RXP pod scheduler. You must also have the IPC radio MAC address on hand to create the configuration entry. Contact QTech if you need assistance generating the configuration file or schedules.

3. Set the date and time on the EP3 to the current time, from the main menu select **Settings > time**. Adjust each value as required then tap **back**. Do not send the time as this will broadcast the time to all devices.
4. Load the pod list and schedule files into the EP3. This and the previous steps can be done before going to the site.
5. If the FarmID is not yet programmed into the device select and check the option **Settings > comms > Use broadcast header**.
6. From the main menu Select IPC list and jump to the serial number of the IPC.
7. Select **view > comms**.
8. Select **local** mode of communications. Make sure you are nearby the IPC.
9. Select the **FarmID** option, tap **send** to programme the Farm ID.
10. Select the **Timeset** option, tap **send** to update the time in the IPC.
11. Select the **Schedule** option, tap **send** to issue the schedules to the IPC.
12. Select the **Manual** option and tick the **on** checkbox, tap **send** to turn on the sprinkler valve, water should flow if the system has water pressure in the lines.
13. Select the **Manual** option and tick the **off** checkbox, tap **send** to turn on the sprinkler valve, water should stop flowing if the system has water pressure in the lines. Note that line pressure in the hydraulic may be necessary for some vales to operate correctly.
14. Deselect the **Use Broadcast header** option in **Settings** once the units FarmID has been programmed.

User Interface

Touch Screen

Operation of the EP3 is provided primarily via a touch screen user interface. Using the stylus provided with the product or a finger, the user can tap on defined “button” areas of the screen to navigate various menu screens and adjust parameter values.

Warning. Avoid using sharp items and ink pens or pencils on the touch screen to prevent marks and abrasions.

Warning. Water contact with the Touch Screen should be avoided.

General Navigation

Where text entry is required a keypad is displayed. To cancel the editing operation, tap **cancel**. To delete a character tap **delete**. To accept a value tap **enter**.

Some screens provide special buttons for navigation:

- **Back** returns the user to the previous screen
- **Next** takes the user to the next screen or the next item in a list
- **Prev** takes the user to the previous item in a list
- **Up** scrolls the current screen up to display more data or advances up a list of items
- **Down** scrolls the current screen down to display more data or advances down a list of items

Display values can also be adjusted by editing the schedule and configuration files on the SD Card.

Screen Calibration

An inherent aspect to touch screens is that they may drift out of calibration over time. The result of an un-calibrated touch screen is that position where the stylus is tapped will not register correctly with the pixel position on the screen making it difficult to navigate the screen easily.

To recalibrate the screen:

1. Tap **Settings** then tap the **ScrnCal** button.
2. A confirmation screen will appear asking if you want to calibrate the screen. Tap **OK** to proceed.
3. The screen will show a series of three small crosses (reference points), carefully tap each **+** with a stylus.
4. Once completed the device will re-calculate the screen calibration factors then reset to show the main menu screen.

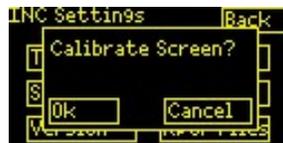


Figure 4

Note: These settings cannot be reverted to the previous settings so please ensure you are careful when re-calibrating.

IPC Status Indicator

The IPC LED is used to indicate status information as detailed below.

	Off	All Good - Application running
	On	No Bootloader
	Fast flash	Bootloader Active
	1 flash every 5 seconds	Reed switch closed
	2 flashes every 5 seconds	Firmware blank error
	3 flashes every 5 seconds	Firmware size wrong error
	4 flashes every 5 seconds	Firmware CRC wrong error
	5 flashes every 5 seconds	Radio Fault
	1 brief flash every 10 seconds	Device has a low battery and is in hibernation mode.

* Note different error flashes can occur together e.g. Firmware blank followed by Radio Fault

Warning. Older hardware units use a red led which can be difficult to see in bright sunlight. You may need to shield the unit with your hand to see the indicator properly.

Troubleshooting the IPC Status

Firmware errors will require the device to be reprogrammed with valid firmware. If the problem persists, the unit should be returned for service.

Devices in hibernation mode can be brought out of hibernation briefly by applying the magnet to the end of the unit that is labelled "magnet" this will place the unit into bootloader mode for about 1 minute. Thereafter the device can be queried for its status to determine the state of the battery. Low battery levels can indicate the following:

- Not enough sunlight being collected by the solar panel - make sure the panel is clean, orient the device correctly to the north and away from tree lines.
- Excessive radio communications - allow the unit to recharge over a few days.
- The battery is exhausted and at the end of its life (sometimes accompanied by a visibly swollen battery - replace the battery.
- A hardware fault in the battery, solar panel or charging circuit - return for service after consultation with QTech.

Devices with radio faults will either not communicate at all or communicate with an EP3 only over very short distances. They should be returned for service after first contacting QTech for advice.

Devices with the no bootloader error should have the battery disconnected (if a replaceable battery is in use) and be returned for service.

Bootloader Active indicator is a normal indication that says the IPC is ready to receive new firmware. Devices are put into bootloader mode by applying a magnet to one end of the IPC (it has a label that says magnet on it). The device will remain in bootloader mode for about 1 minute if there are no further communications from the EP3 forthcoming, then it will revert to its normally operating programme.

The reed switch closed indicator is a transient condition that can occur briefly when the magnet is applied to confirm that the magnet has been applied correctly. It does not indicate an error.

Overview

Configuration Process

The EP3 is used to configure and programme IPC devices. Each IPC device runs a programmable watering programme (the application). Each IPC also has a small programme called a bootloader, which facilitates upgrading the application firmware. The EP3 itself has its own programme and bootloader to enable it to run and be upgraded.

The general process for configuring the IPCs is as follows:

1. Create an IPC list and schedules using IPC schedule design software such as IPC Manager from QTech or Pod Scheduler from RX Plastics or manually using a text editor on your PC.
2. Copy the files onto the SD card and insert the SD card into the EP3.
3. Load the files from the SD card into the EP3 internal memory.
4. For new systems (Version 5.00 or later) programme the FarmID and/or radio channel in each IPC.
5. Send the schedules to each IPC via radio and test aspects of the IPC installation.

Schedules

Each IPC in a system has a schedule which it uses in conjunction with its internal clock (RTC) to work out when it should switch its solenoid on and off. A schedule can have a maximum of 16 events per cycle (an event means a single instance of switching the solenoid on and off again). Each event can last a maximum of 4 hrs, in 1-minute increments. A cycle can have a maximum period of 16 days in 1-day increments.

Communications

There are four main types of radio communications protocols used for IPC communications:

- Local
- Network Flooding
- Mesh
- Bootloader

Local

This uses reliable single-hop unicast communications. Each message sent must be acknowledged by the recipient. This means that that sender can be certain whether or not the message has been received by the device it sent it to. If a message it not specifically addressed to a given IPC then it will ignore it.

Network Flooding

IPCs rebroadcast the message to any “downstream” IPCs after a short delay. Over time, the message will propagate outwards, and all IPCs in the system should have received the message. This method is classed as non-reliable as there are no acknowledgements used.

Mesh

The EP3 firstly establishes a route to the given IPC, then once a route has been established the EP3 will send the actual message to the IPC using reliable multi-hop communications. The route discovery phase uses network flooding to send a route request message to the IPC. When the target

IPC receives the route request, it will respond with a route response message using reliable multi-hop communications. Each time that a message is sent over an established route, the route will be refreshed. Eventually, if no messages are sent over the route it will time out and be removed from the system.

Bootloader

This is simple protocol that is used when the EP3 reprograms the IPC application firmware. It is important that no other IPCs within radio range are also in Bootload ACTIVE mode at the same time, as collisions might occur.

IPC Operating Modes

The IPC has four distinct operating modes. The majority of the time the IPC will operate in Application Active mode.

- Bootload Active
- Bootload Idle
- Application Active
- Application Hibernating

Bootload ACTIVE

When running in this mode it will allow its application firmware to be reprogrammed via the radio. The IPC will enter this mode if a magnet is swiped past its reed switch (located where the “magnet” sticker is on the outside of the unit). When the IPC is in this mode it will steadily blink its LED. (See section: IPC Status Indicator).

Bootload IDLE

When running in this mode it will indicate a code by blinking its LED. An IPC will only run in this mode if it has no application loaded, or it has detected something wrong with the application firmware image.

Application Active

This is the normal operating mode of the IPC. When running in this mode the IPC will be able to communicate with other IPCs and the EP3 using mesh communications, and it can control its solenoid, etc. In this mode the IPC uses several strategies to minimise its battery power usage. The IPC will briefly blink its LED when it transmits a message using its radio.

Application Hibernating

The IPC is in battery power conservation mode (see section: IPC Hibernation Mode).

IPC Addresses

Each IPC is manufactured with a unique and permanent EUI-48 MAC address (e.g. 00:1E:C0:98:C7:C1). This address is used to individually identify each IPC in the communications protocol. However, each IPC in the system is referred to by a reference identifier (IPC Name) so in order for an EP3 to identify individual IPCs it must have some way of knowing which MAC address relates to which IPC. This is achieved using information stored in the IPC List. If an individual IPC ever needs to be replaced, then the relevant IPC list entry must be changed to refer to the MAC address of the new IPC device.

Radio communications occurs on a fixed radio channel that must be programmed into each IPC using an EP3. The IPC is normally shipped with the required radio channel pre-programmed. However, on

occasion it must be changed, for example in areas of radio congestion. Consult QTech support before changing the radio channel.

What is FarmID?

In version 5.00 of the IMS system components, each IPC is also programmed with a FarmID which constrains radio communications not only to the radio channel but also to devices of the same FarmID.

The FarmID is a hexadecimal number in the form NN:NN (e.g. 13:FA). The number is initially programmed using the EP3 (see section: managing IPCs).

If an IPC (running version 5) status response returns the value of none in the value for the FarmID filed then the value has not been programmed and normal communications is not facilitated. If the IPC returns the value of 01:01 this FarmID is reserved for temporary use in configuring systems and must be replaced by a valid FarmID.

Warning: when configuring new sites ensure that the Radio channel and QTech supplied FarmID have been programmed into each IPC.

The FarmID is a unique number assigned, issued and managed by QTech. It uniquely identifies sets of IPCs deployed in a specified area of land (block) and it is issued to the farmer when new IPCs are deployed to the block. When IPCs are deployed to a site they are configured with several parameters:

1. A radio channel for communications to an EP3 or INC.
2. A name which usually is a post or pod reference to assist the farmer in finding an IPC.
3. A schedule to define watering times.
4. A FarmID to restrict communications to the block.

In version 5 of the system, once upgraded, IPCs without a FarmID configured will not communicate to an EP3 or INC, so part of the deployment process will include applying to QTech for an ID. QTech will maintain a database of IDs and where they are used. QTech can programme the ID on behalf of the farmer for new production or issue the ID to farmers or installer, so that units on their site can be configured. Currently, farmers (or agents and installers) will apply for an ID by contacting QTech. In future the ID will be issued using a self-service web site.

You cannot mix FarmIDs (use more than 1) within a block because this will degrade the effectiveness of the mesh radio communications system that QTech employ to route radio traffic over wide-ranging terrain and IPC topography.

IPC Hibernation Mode

In order to reduce the IPC's power consumption, a "hibernation mode" was introduced in IPC firmware version 3.03. When an IPC is hibernating, it will turn off its radio to save power. It will continue to operate the solenoid according to its schedule, but because the radio is turned off the EP3 or INC won't be able to communicate with it. The IPC indicates that it's in hibernation mode by blinking its LED briefly every 10 seconds. The thresholds used are: less than 20% charge to go into hibernation mode, and greater than 40% charge to resume normal operation. This is based on hourly sampling of the battery.

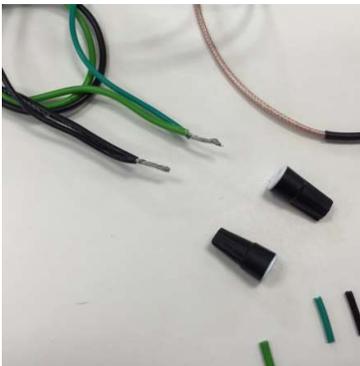
Note. On older versions of hardware, the red status indicator is very faint when indicating hibernation mode. The user may need to shield the IPC from sunlight in order to see the indicator.

IPC Valve Solenoid Connection and Operation

Solenoid Connection



The left picture shows the IPC plus a typical solenoid valve. Remove any existing insulation and straighten the wires as in right hand picture (if necessary strip back the wire insulation by 15mm with a wire stripper).



Carefully twist the 2 black wires tightly together. Then repeat for the 2 green wires as in the left picture above. Screw the silicon filled wire joiners onto each of the green and black wire joints (the wire joiners screw onto the wires in a clockwise direction). Silicon grease will extrude from the joiners as seen in the right-hand picture.

Solenoid Polarity

The IPC is designed to operate with a Latching Solenoid with a **12 Volts 4 Ohm coil**.

The IPC controls the valve's solenoid by passing current through the Solenoid in one direction to turn the valve ON and in the opposite direction to turn the valve OFF, so the correct connection of the solenoid wires to the IPC is **critical**.

To determine the correct solenoid wiring perform the following test:

1. De-Power the IPC by installing the power ON/OFF Magnet.
2. Connect the IPC to the solenoid in use.
3. Apply water at operating pressure to the solenoid valve.
4. Remove the ON/OFF magnet from the IPC.
5. The IPC will power up, then after 10 seconds the IPC will turn the solenoid valve OFF.
6. If the solenoid turns ON then the solenoid connecting wires to the IPC need to be reversed.

The Solenoid valve connected to the IPC can also be manually turned ON and OFF with the EP3 Handset.

Battery Magnet

The IPC is supplied with an external magnet installed that turns the IPC Power Supply OFF to preserve the battery during storage and transit.

When removing the IPC from operation for storage or for transit, the Battery Magnet should be re-installed to conserve the power supply battery.

Solenoid Operation

When an IPC's internal clock matches its scheduled on/off time, or if a manual on/off command is sent, the IPC will send a **pulse** to the solenoid in the appropriate direction for an open/close operation.

- *However, there is no feedback of whether the solenoid plunger has moved or any indication a valve has actually operated as intended*

At midnight (IPC time) all schedules are re-calculated and solenoids are attempted to be switched to match intended scheduling.

After a timeset (e.g. global timeset to site) IPCs recalculate their schedule and solenoids are attempted to be switched to match intended scheduling (firmware \geq v5).

Managing IPCs

Main Menu Summary

The main menu is the primary screen with buttons for navigation.

Button	Description
IPC List	A list of the IPCs that are currently loaded in the EP3 memory
Sch List	A list of the schedules that are currently loaded the EP3 memory
IPC Files	The contents of the <i>Pods</i> folder on the SD card
Sch Files	The contents of the <i>Schedules</i> folder on the SD card
Settings	Miscellaneous settings and features related to the EP3, e.g. setting the EP3 clock time.
Upgrade	The contents of the <i>Firmware</i> folder on the SD card and the ability to programme firmware to an IPC

Importing the IPC List

The IPC List is imported from the SD Card containing the configuration file in the pods folder. Once loaded the IPCs can be listed then each one viewed for its configuration or the IPC interrogated via radio for its status.

To import the list:

1. From the **Main Menu** select the **IPC Files** button.
2. Use the **Up** and **Down** buttons to select the appropriate configuration file (e.g. pod-config.ini).
3. Press the **Load** button. This will load the file contents into the EP3 memory.
4. Use the **Back** button to return to the main menu.



Figure 5

Importing the Schedule List

The Schedules List is imported from the SD Card containing the configuration file in the schedules folder. Once loaded the IPCs can be listed then each one viewed for its schedule or the IPC interrogated via radio to send the units its operating schedule.

To import the list:

1. From the **Main Menu** select the **Sch Files** button.
2. Use the **Up** and **Down** buttons to select the appropriate configuration file (e.g. pod-config.ini).
3. Press the **Load** button. This will load the file contents into the EP3 memory.
4. Use the **Back** button to return to the main menu.

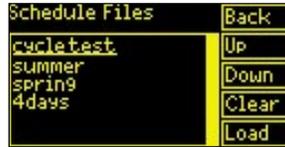


Figure 6

Once the IPC list and schedule files have been loaded into the EP3 memory the information will be retained internally, meaning that you do not need to re-load them each time the EP3 is repowered. The IPC list and schedule information can be deleted from the EP3 memory using the **Clear** buttons. This will clear the IPC List or the Schedule Set but will not affect the files on the SD card.

Working with Individual IPCs

IPCs can only be communicated with if the information about them has been loaded into the EP3 internal memory. Pressing the **IPC List** button from the main menu will display a list of all the IPCs that are in the currently loaded in the EP3 memory. The list shows each IPC name and serial number as specified in the configuration file.

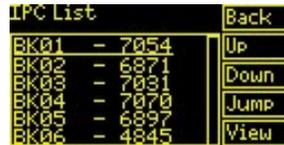


Figure 7

The EP3 internal memory can store information for a maximum of 1024 IPCs, and 1024 schedules at one time. If a system contains more than 1024 IPCs then this situation can be managed by separating the IPC configuration into several smaller IPC list files. The files can then be loaded and unloaded from the EP3 internal memory as needed.

View an IPC Details

To select a particular IPC, use the **Up** and **Down** buttons to underline the IPC to be managed and press the **View** button. Alternatively, the IPC details can be directly accessed by inputting the IPC serial number. Tap **jump** then use the keyboard to enter the serial number (as printed on the label inside the IPC or listed in the IPC list, e.g. 7054). This method is useful to avoid scrolling through long IPC lists.

Information about the IPC, such as its name, radio channel, and schedule will be displayed.



Figure 8

View IPC Schedule

Pressing the **Sched** button will display the timing information contained in the IPCs schedule.



Figure 9

Communicate with IPC

To communicate with the IPC, press the **Comms** button. A window will appear containing a set of buttons that can be used to select the type of message you want to send to the IPC. The communications method (Mesh or Local) can also be selected. Where possible use local mode of communications for quicker message responses. You must be within direct (line of sight) radio range of the IPC to use local mode.



Figure 10

Follow these steps:

1. Select the mode of communication (local or mesh), tap the checkbox to select it.
2. Choose the command message to send, tap the checkbox to select it.
3. If the command has an option (e.g. on/off) tap the checkbox next to the option to select it.

The table lists the different types of messages that can be currently sent to the selected IPC.

Button	Description
Schedule	Sends the schedule that is loaded in the EP3. Overrides any Schedule information currently on the IPC.
Timeset	Sets the IPCs clock to update and match that of the EP3.
Manual On/Off	Sends a command to the IPC telling it to turn the solenoid on or off.
Inhibit On/Off	Sends a command to prevent the IPC from running its schedule, or to enable scheduled (watering) operation.
Status	Sends a status request to the IPC. When an IPC receives a status request it will respond back by sending a status message.
Channel	Sends a command to the IPC to reprogram the radio channel it uses for communications (see IPC radio channel reconfiguration). This option is not recommended unless the radio frequency used on the site is being modified.
FarmID	Programs the FarmID into the IPC (version 5.00 firmware or later) (see FarmID programming). This need only be done once per IPC.

Most types of radio messages can be sent to the IPC using either Mesh or Local methods. The one exception is the Timeset command, which can only be sent using the Local method. If you want to broadcast a Timeset to all IPCs, go to the **Main Menu > Settings > Time** screen and press the **Send** button. This will send a Timeset message across the system using the Network Flooding method.

When an IPC receives a message using the Mesh method, it will always respond back to the IPC by sending a status message. This is to give a top-level confirmation that the message has been received. When using the Local method this is not required, as the acknowledgements used in the Local method are sufficient to get this confirmation.

Interpreting the Status Message

Invoking the command for a status request elicits a status response. The EP3 shows the progress of the communication transaction as it happens, establishing the route to the IPC if mesh mode is used or the number of attempts to contact the IPC in local mode. The response usually includes the number of hops required to relay the message to the destination IPC.

The screen will scroll as the information is displayed.

```
Route discovery
Route established
Sending packet
Packet sent to first hop
Waiting for response
Up Down Back
```

Figure 11

```
Received via 1 hop:
Ver: 05.00
Batt: 3.783V, 28.6%
Time: 13:15:28 27/04/2018
Clk Err: -66 sec
Up Down Back
```

Figure 12

```
Batt: 3.783V, 28.6%
Time: 13:15:28 27/04/2018
Clk Err: -66 sec
Sch CRC: 0x1F9C
Cycle: Day 1 of 1
Up Down Back
```

Figure 13

```
Clk Err: -66 sec
Sch CRC: 0x1F9C
Cycle: Day 1 of 1
Valve: OFF (OK)
ID: 01:01
Up Down Back
```

Figure 14

The status message from the IPC itself contains information including:

Item	Description
Firmware	Version number of firmware in IPC. e.g., ver: 03.14
RSSI	Received signal strength at IPC. e.g., RSSI: -17 dBm
Battery Voltage	IPC battery level, current voltage and as a percentage of full charge. e.g., Batt: 4.08V, 86%
Timestamp	Current date/time in IPC. e.g., T: 14:15:51 03/05/2018
Clock error	The variance in seconds between the EP3 clock and the IPC clock (plus or minus meaning later or earlier than the EP3 clock). e.g., Clk Err: -66 sec
Schedule State	Currently loaded schedule CRC signature or status (see below). e.g., Sch CRC: 0x1F9C
Cycle	The current day and period of the schedule cycle. e.g., cycle: day 1 of 2
Hops	Number of hops required to communicate to IPC (an indicator of how easy it is to send radio messages) (mesh mode). e.g., hops: 2
Valve state	The expected state of the valve (on/off meaning open/closed) (IPC Version 5 firmware or later) (see below). e.g., valve: OFF (OK)
FarmID	The FarmID programmed into the IPC (version 5 INC and IPC firmware or later). e.g., ID: 13:FA

Note. In version 5 of the INC and IPC firmware additional information including the IPC FarmID and the expected state of the IPC valve is also displayed (valve on meaning the valve is open and water should be flowing). Older firmware versions will not show this information.

Schedule Information

If the signature itself is not displayed then the schedule status will indicate whether there is a schedule present in the IPC.

Message	Meaning
“Schedule: Matches”	The schedule in the IPC is identical to the corresponding one stored in the EP3.
“Schedule: Inhibited”	IPC will not perform scheduled valve switching.
“Schedule: Wrong”	The schedule in the IPC is different from the one that the EP3 has in its internal memory.

If the status report indicates a wrong or missing schedule then the **schedule** message should be used to send the schedule loaded in the EP3 to the IPC.

Units can be deliberately inhibited to prevent watering but if it is expected that the unit is operating its schedules then sending the schedule to the IPC will remove the inhibit status.

Fixing Clock Errors

If the IPC responds with a clock variance of more than 60 seconds, it is recommended that the user send a **Timeset** message. This will help avoid overlap of multiple IPC units watering at the same time, thus affecting water flow rates and pump operation.

Fixing Low Battery Problems

If the status message reports that the battery level is below 50% then care should be taken to ensure that the surface of the solar panel is clean. Other reasons for low battery may include:

- Low sunlight during winter months to recharge the battery
- Nearby tree lines and obstacles creating a shadow over the solar panel
- Battery nearing the end of its working life
- A hardware fault
- Excessive radio communications to the device

If the battery level drops below 20% the unit will go into hibernation and refuse radio communications until either a) the battery level recovers by solar recharging to 40% or b) the unit is forced out of hibernation temporarily by applying the magnet briefly to the side panel of the IPC.

Consistently low battery levels reported by a unit may require attention contact QTech for support.

Note. where practicable, ensure that the firmware on the unit is operating with the latest revision.

Fixing Incorrect Valve State

If the valve state shows that the valve is on or off when it ought not to be according to the expected schedule. Then the **manual** command should be used to switch the valve to the correct state. It is recommended that the valve be turned off if possible so that its normal operations are resumed when the next scheduled operation takes place.

IPC Radio Channel Reconfiguration

There are 20 radio channels (numbered 1-10 and 16-25) used by QTech ISM band devices. The QIMS system reserves the use of channel 9 for communications during bootloader operations but the remaining channels are free to be used by QTech IPCs for regular communications. In earlier versions of IPC firmware, the radio channel used was not configurable. A feature was introduced in IPC firmware version 3.09 to enable the IPC radio channel to be reconfigured via commands over the radio.

The process used to reprogram the IPC channel is outlined below. The IPC will usually be supplied with a pre-defined radio channel allocation made by QTech. It is usually only changed in special circumstances if for example the IPC is purchased from a reseller and destined for a farm operating on a different radio channel.

In this example below the IPC will be reconfigured to use channel 5 instead of channel 3.

1. The channel that the EP3 uses to communicate with each IPC is specified by values in the IPC configuration file. These values are controlled by a setting in the IPC Scheduling application, so an IPC configuration file needs to be generated with channel 5 specified. This can also be achieved by editing the IPC configuration file (e.g. pod-config.ini).
2. The IPC configuration is copied to the SD card and loaded into the EP3 memory.
3. The reprogramming channel must be specified in the **Comms Settings** screen (**main menu > settings > comms**) (see EP3 Communication settings). This value specifies the channel that the EP3 will use to reconfigure the IPC. In this case the value should be 3 (that is the channel the IPC is currently on).
4. Select the specific IPC that you want to reconfigure from the IPC List and go to the **Comms** screen. You will find that if you send a status request to that IPC the communications will fail because the IPC List channel value does not match the actual channel that the IPC device is using.
5. From the Comms screen select the **Channel** button and press **Send**.
6. This will make the EP3 send a message to the IPC over channel 3, telling it that from now on it should use channel 5 instead. The EP3 should display that the message was sent successfully.
7. You should now be able to request the status of the IPC, as the device will now be using the same channel as specified in the IPC List.

Programming the FarmID

The FarmID (version 5.00 firmware or later) must be programmed into the IPC in order to communicate effectively with it. The status message reports the value of the current FarmID as one of:

- “none”
- “01:01”
- “NN:NN” (e.g. 13:FA).

The IPC configuration file must have an entry for each IPC which defines the FarmID. If the Farm does not have a FarmID defined for the block of IPCs in use then apply to QTech support to be allocated an ID for the block.

If the **status** message reports none or 01:01 as the FarmID then from the IPC details screen tap comms then select the **FarmID** checkbox then tap **send**. This will set the ID in the IPC correctly.

If the **FarmID** message fails to send make sure that the IPC is set to the correct radio channel, reconfigure the channel if necessary. Also refer to QTech for support and additional application notes.

Replacing Faulty IPCs

Each IPC is defined by a unique serial number. The IPC list can only communicate with IPCs which have a predefined serial number an config list entry. From time to time, if a fault occurs then the IPC may need replacing. This means that the IPC serial number and radio address need to be changed in the configuration file and IPC list in order to communicate with the replacement device.

The serial number is always printed on a label on a large metal capacitor inside the IPC and visible from the rear of the device.

The MAC Address is printed on a label attached to the IPC or its mounting plate for new devices. If the label is not present contact QTech to obtain the radio address.

The EP3 manages this by enabling the user to enter a replacement serial number and MAC address into the IPC list which is then saved back onto the SD Card for a permanent record.

Replacement Steps

To replace an IPC find the IPC in the IPC list to be replaced, modify its serial number and MAC address then save the new entry onto the SD Card. Follow these steps:

1. From the Main menu tap **IPC List**. Locate the IPC to replace either by scrolling the list or by jumping to the IPC serial number. Tap **view** to display the IPC details.
2. To change the serial number tap the serial number (e.g.7641) on the screen and a keyboard will pop up and enable a new serial number to be entered.
3. To change the radio MAC address tap the address (e.g. C0:98:C2:EB) and a keyboard will pop up. Enter the new mac address (the screen will automatically insert the “:” separators. Then press enter.
4. The IPC entry in the IPC list will be updated to show the new values. The device can now be communicated with to return the status.
5. However, if the IPC is new it may not have the correct FarmID or radio channel so change the radio channel first (if necessary, scanning the channels if the replacement device radio channel is unknown).
6. Once the radio channel is correct program the FarmID.
7. Having verified communications save the IPC list to a new configuration file. From the Main Menu tap IPC files then tap save. Tap back to go up a level then back into the IPC files to refresh the file list. A new configuration file will be displayed. This is the configuration file that will be loaded in future. The user can rename the files on a PC if desired.

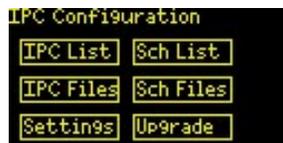


Figure 15: Main Menu



Figure 16: Details of old IPC to be replaced



Figure 17: keyboard entry new serial number



Figure 18: keyboard entry new MAC address

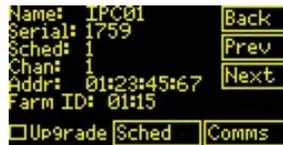


Figure 19: New IPC details



Figure 20: Save IPC list to new file



Figure 21: New IPC file (with replacement IPC)

IPC Application Firmware Upgrade Procedure (magnet method)

The IPC firmware can be upgraded from the EP3 via the on-board radios. The EP3 will communicate with the target IPC using the Bootloader communications method.

Note. The Bootloader communications method is relatively simple compared to the other communications methods used by the IPC. It is therefore very important to ensure that only one IPC (within radio range) is operating in the Bootload ACTIVE mode at a time, or collisions might occur.

From the **Main Menu**, the **Upgrade** button shows a list of IPC firmware files currently present on SD card. Use the **Up**, **Down**, and **Load** buttons to select the firmware file to be programmed into the IPC. Pressing the **Load** button will take you to the firmware upgrade screen. Information about the firmware will be displayed including its name and size.

The process to program (or flash) the firmware into the IPC is as follows:

Upgrade Steps

1. Place a magnet on the IPC housing at the position indicated by the “magnet” label. The LED inside the IPC will start blinking, indicating that it is in firmware upgrade mode (Bootload ACTIVE).
2. In the EP3 press the **Poll** button. This performs a handshake with the IPC to confirm that it can communicate with the IPC. The EP3 will now display the name of the bootloader application.
3. Press the **Flash** button. The screen will display the progress of the transfer to the IPC. This process will take about 20 seconds to complete.
4. Press the **Check** button. This will make the IPC verify that the new application image is correct.
5. Press the **Reset** button. The IPC will then restart, and the LED should turn off indicating that IPC is now using the new IPC firmware.

Note - If you receive a “No Response” message then ensure that the IPCs LED is still blinking and that the EP3 is in radio range of the IPC. If the problem persists try turning the EP3 off and on again then start the process afresh. You must wait for a minute or two for the led on the IPC to stop blinking before applying the magnet again.

For more information on firmware upgrades and upgrading the bootloader contact QTech.

IPC Application Firmware Upgrade Procedure (OTA method)

The IPC firmware can be remotely programmed “Over The Air” (OTA) if you are not physically present at the IPC but are within radio range via the EP3. This process is followed if the IPC bootloader firmware has already been upgraded (to V1.09 or later) and is ready to accept OTA firmware upgrades.

The OTA upgrade process was added to make it less labour intensive to upgrade many IPCs after they have been deployed in the field. The prerequisite firmware versions for the OTA upgrade process must all be:

- IPC Application V3.13 or later
- IPC Bootloader V1.09 or later
- EP3 Application V5.01 or later (note older versions of EP3 should be upgraded to this version to support the FarmID function).

When the OTA option is enabled the upgrade process is modified such that:

- Instead of you having to use a magnet, the EP3 will send the IPC a message telling it to go into Bootload ACTIVE mode.
- The EP3 will automatically step through the IPC list and perform the upgrade process on each IPC that has been selected for upgrade.

Upgrade Steps

1. Insert the SD card containing the IPC firmware and turn on the EP3.
2. Tap **Upgrade**. The list of available firmware files will be displayed. Tap the **up** or **down** buttons to move the cursor to the filename of the new firmware. The selected file is underlined.
3. Tap Option. The relevant options are
 - a. **OTA** - Enables the OTA feature. Tap the checkbox and select this option

- b. **Filter List** - The IPC list will only show the IPCs that have their “upgrade” box ticked (marked for upgrade) in the IPC list, this is useful for reviewing which units are set for upgrade in the IPC list (select this option)
 - c. **Skip** - The EP3 will skip over upgrading the IPC if the IPC already has been upgraded to the desired firmware version. (select this option to save time)
 - d. **No Farm ID** – If the IPC device(s) are being upgraded from V3.xx firmware to V5.xx firmware or later then select this option to indicate that the devices do not yet have a Farm ID and the EP3 is dealing with older devices. If the IPC is already on V5.xx or later (i.e. has a Farm ID already programmed in the IPC) then deselect this option
4. Enable the OTA feature, and select which IPCs you want to upgrade. The **All** and **None** buttons can be used to tick or untick the “upgrade” box of all the IPCs. So if you want to upgrade all the IPCs using the OTA feature you should just tap the **All** button, which will automatically enable the OTA option. Alternatively, you can tap **None**, and then select specific IPCs individually via the IPC list **ipc > view > upgrade** (select the checkbox to include the IPC in the list of devices to be upgraded).
5. Tap **Load**. Information about the firmware will be displayed including its name and version number. Select the firmware version that is to be programmed using the scroll buttons.
6. Tap **Poll**. This will trigger the EP3 to begin the automatic process, and you shouldn’t need to do anything more until the EP3 has worked its way through the list of IPCs selected for upgrade.
7. The EP3 will step through a process of rebooting the IPC, Checking the firmware version (skipping to the next IPC if the firmware version is the same and the “skip” option is enabled), Erasing, Programming, Checking, and Resetting, until all IPCs have been attempted. Once the EP3 has finished the OTA process you may need to reattempt the upgrade on some IPCs.
8. Each time that the EP3 successfully upgrades the IPC it will untick the IPCs “upgrade” checkbox. IPCs that weren’t successfully upgraded will be left with the “upgrade” box ticked, and you can use the “filter” option to show those ones.

If the upgrade failed because the EP3 wasn’t able to communicate with the IPC (to put it in Bootload ACTIVE mode), then if you can re-trigger the OTA process once you have moved to a position which has better comms coverage to that IPC or group of IPCs.

Important – If the unit failed during the erase, programme, verify phase then IPC will be left without a valid application firmware to run and will display an error message on the led. In this case you must use the magnet process to re-attempt the upgrade.

If the upgrade failed due to a comms fault part way through the upgrade, then the IPC will be sitting in Bootload IDLE mode, and you will have to visit those IPCs with a magnet and perform the traditional upgrade process.

It’s OK to turn off and on the EP3 as you move around because the “upgrade” checkbox states will be remembered.

If you tap **ALL** or **NONE** but lose track of which units have been upgraded then checking the “skip” option may be useful. It is recommended that if you check **ALL** that you make a note of the units that successfully upgraded as you go.

Once all IPCs have been upgraded you should confirm that the upgrade was correctly applied to each IPC by sending it a status request and receiving a status message in response. This can be done with the EP3 or with an INC.

Note. Leave the channel option in the OTA option screen as channel 9 unless there is a specific problem with using radio channel 9 on the site.



Figure 22: IPC view including upgrade checkbox

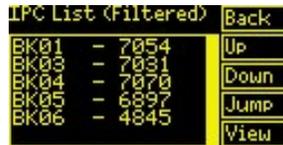


Figure 23: Filtered list view

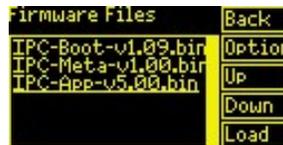


Figure 24: Upgrade - Firmware Files Screen



Figure 25: OTA option settings



Figure 26: Firmware upgrade screen

Note. For more information on Firmware upgrade procedures including methods of upgrading the bootloader firmware please contact QTech support.

EP3 Settings and Features

This section describes additional EP3 functions. Tapping the settings button on the main screen shows a sub menu of additional configuration settings and features.



Figure 27

Item	Description
Time	Adjusts the data and Time on the EP3 as well functions to broadcast a Timeset to all IPCs in range
Info	Displays EP3 firmware version number and radio address Shows the current Battery level of the EP3 batteries Provides the feature for upgrading the EP3 firmware itself
Data	Access to Data loggers (WSML) record collection utilities
ScrnCal	Provides facility to recalibrate the Touch Screen (warning if not calibrated correctly the user can lose the ability to select buttons in the user interface)
Comms	Communications interface settings
SpecAnl	Access to Built in radio spectrum analyser for radio communications analysis

EP3 Info and Self Upgrade of Firmware

From the **main menu** tap **settings** then **info** to show EP3 specific details.

Battery state is displayed as a percentage between 1.5V and 3.3V. The EP3 has been designed to power off when the battery voltage is less than 1.5V. If the screen itself starts flashing this is an indicator that the batteries must be replaced immediately.



Figure 28

Introduced in EP3 firmware version 4.00, the EP3 application can be upgraded without needing any additional software or hardware devices. This is achieved by placing the new firmware file onto the SD card and plugging it into the EP3. The file must be named **EP3-App.bin** and located in the **/firmware** directory. Once the card has been inserted, navigate to the **EP3 Settings** screen and press the **Info** button. The current firmware version that is running on the EP3 will be displayed. Next tap the **Upgrade** button. This will make the EP3 reprogram its firmware and restart. Now to check that the upgrade has worked correctly, navigate back to the Version screen, and you should see that the version number has changed. In addition, the radio address (MAC) of the EP3 is also displayed.

EP3 Clock Time and Date

The EP3 has an on-board Real Time Clock (RTC) which maintains the system time. This clock time is used for synchronising the IPCs so it is important that it is correct before sending Timeset commands out to IPCs.

In firmware prior to version 5.00 the user must set the date, time and the day and cycle period. The cycle period is established from the scheduling requirements. In version 5.00 or later the day is automatically calculated by the EP3 (and IPC) and the cycle period is defined in each schedule file. For more information consult QTech for application notes on configuration and schedule file formats.



Figure 29: Time setting pre version 5.00



Figure 30: Time Setting Version 5.00 or later

To alter the time value, from the **Main Menu** tap **Settings** and tap **Time**. Then tap the value that you want to edit using the numeric keyboard.

To send the time to (older) IPC devices using firmware versions prior to V5.xx (i.e V3.xx) deselect the option **Use Farm ID**. To send the time to units running V5.xx firmware or later select the option **Use Farm ID**. If the site is running a mixture of devices on old and new firmware repeat the process twice, once with the Use Farm ID option selected and once without.

Pressing the **Send** button will make the EP3 broadcast a Network Flooding time set command to all IPCs in the system.

Spectrum Analyser

A feature was added to the EP3 firmware in version 4.00 that enables it to operate as a simple spectrum analyser. The spectrum analyser screen shows graphically any radio transmissions that the EP3 is receiving on the 900 MHz radio band. This mode is accessed by pressing the **Settings** button then **SpecAnl**.

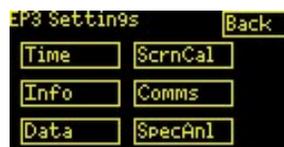


Figure 31

The Spectrum Analyser is a graph that shows received signal strength (RSSI) on the y-axis versus frequency on the x axis. The graph also shows the frequency locations of the 10 channels that are commonly used by QTech devices. Note that the 900 MHz band is open to use by other users (not just QTech), so the activity shown is not necessary just from QTech devices.



Figure 32

The spectrum above is an example of what the EP3 will display if there are no devices transmitting in the area. Note how the RSSI line is down at the bottom of the screen; this is known as the “noise floor”. This noise is a combination of signals from the environment and noise in the EP3 radio receiver. If the line is shown higher up the screen then that indicates that there is more background noise at the site, which can degrade the performance of communications.



Figure 33

The spectrum on the right is an example of where the EP3 has received a very strong signal on channel 1.

The EP3 Spectrum Analyser can operate in two different display modes depending on the **PH** checkbox state at the top left of the screen.

Real Time

In this mode the EP3 will continuously scan the band and show the instantaneous RSSI value for each frequency. The Real Time mode is useful for viewing how frequently the radio transmissions are occurring and can also be used to find out what direction the radio transmissions are coming from (with a directional antenna).

Peak Hold

In this mode the EP3 will continuously scan but only update the displayed value if it is greater than the previous value for a given frequency. The Peak Hold mode is useful when doing a radio survey to find out what transmissions are occurring over a period of time. The EP3 can be left scanning in this mode for some time (say 10 minutes) and then viewed to see which channels were being used over that period of time (and which were not). A new installation could then be configured to use one of the free channels.

When the **Save** button is pressed the EP3 will save a screenshot of the Spectrum Analyser display to a bitmap file on the SD card.

EP3 Communication Settings

This screen contains settings to support additional functions.



Figure 34

Programming Channel

This setting is used for changing the radio channel on an IPC. The **programming channel** is set to the current radio channel on which the IPC is operating. The pod configuration file lists the desired new radio channel. When the EP3 uses the channel message (see section: IPC radio channel reconfiguration) The EP3 will send messages on the programming channel.

Scan Channels

If the operating radio channel number for an IPC is not known and communications cannot be established, possibly because the IPC configuration file lists the incorrect radio channel, then the IPC radio channel can be discovered by selecting the checkbox for **scan channels**.

Sending a **status** message request to the IPC will then attempt to transmit on each channel sequentially until a response is received.

The IPC radio channel can then be changed to the required channel in the IPC list by setting the **programming channel** to be the same as the channel number that elicited the response, then sending the **channel** message to the IPC (see section: IPC Radio Channel Reconfiguration).

Use Broadcast Header

Version 5.00 firmware has a feature which enables communications to IPCs where the FarmID has not been programmed or is unknown. If the **use broadcast header** checkbox is selected, then the user can communicate to an IPC to send the **FarmID** message to set the correct FarmID as defined in the IPC configuration file. (See section see FarmID programming).

Packet Analyser

If an SD Card is fitted in the EP3, then selecting the **packet analyser** checkbox will activate a logging function to record all message transactions received by the EP3. This is used for diagnostics purposes only. The file is stored in .CSV (comma separated variable) file format, suitable for import to a spreadsheet. The EP3 logs all transactions on the radio channel defined in the **packet analyser channel** setting. The screen indicates when the data logger is running or stopped.

Warning. Packet Datalogging functions will have a heavy impact on battery capacity. It is recommended that packet logging should be restricted to small periods of activity less than an hour.

This feature is recommended for advanced users only.

Managing Data Log Functions

Version 5.04 of the EP3 firmware adds support for collecting data records from the QTech Wireless Soil Moisture Logger (WSML). The WSML is programmed to periodically collect and store information from up to 4 soil moisture probes, a soil temperature sensor and a rain gauge.

Soil Moisture Loggers

WSML devices are included in the IPC configuration file (podlist) and listed in the EP3. A typical pod entry looks like:

```
[pod12]
name      = WSML2
serial    = 1234
address   = 00:04:A3:25:A9:60
channel   = 10
type      = moisture
```

The WSML is programmed to periodically measure and log its sensor inputs to create record log entries. It created a timestamped entry for each record. The WSML is usually battery powered with a solar charging unit and is designed to assume a low power state when not actively measuring. However, to support radio communications it listens for communications from the EP3. In Low Power Duty Cycling Mode:

- WSML listens for 50 ms every 10 seconds,
- Responds to requests destined to the broadcast address. On receiving a message destined for itself it then goes into an active mode.

When Active:

- WSML listens and respond to valid requests,
- Responds only to requests destined for its own address,
- Timeout after 30 seconds of inactivity.

Data Collection

The process for capturing and analysing data is as follows:



To commence collecting data from a WSML first tap **settings** then **data** to access the data logger screen. If no devices are listed tap the **scan** button to search for loggers in range. Once a device is listed, use the **up/down** buttons to scroll to the desired device then tap **select** to connect to it.



Figure 35

When searching for devices a “searching” indicator is displayed. If no device can be located the search will eventually time out.



Figure 36

Once the device is selected the screen will display a number of function buttons:



Figure 37

Item	Description
Get Status	Returns the WSML device status and properties
Get Logs	Retrieves log records and saves to the SD card
Get Values	Force the WSML to carry out a sensor measurement
Set Time	Synchronise the time on the WSML to the EP3 clock

It is recommended that **Get Status** be issued to the device first to establish a working connection. The results will show the device firmware version, the current date and time on the device and the number of records it has logged but have yet to be retrieved by the EP3.



Figure 38

Get logs will trigger the EP3 to read the saved measurements from the WSML and save them into a file. It is important to have an SD card inserted at this point. If a card is not present then the EP3 will not attempt to read the records. The file name is created as a combination of the EP3 date and time, along with the WSML name (taken from the IPC configuration file).

Get Values will trigger the WSML to perform a measurement on demand. Note that that the rainfall counter is not reset as part of an "on-demand" measurement; The value displayed is simply the rainfall since the previous periodic sampling event.

Set Time will cause the WSML to synchronise its internal real time clock with that of the EP3. Note - before setting the WSML clock, ensure that the EP3 time and date is correct.

Quick Soil Moisture Readings.

The **Get values** command returns the current state of the sensors:



Figure 39

Soil temperature is measured in Degree C. Soil temperature in New Zealand at about 1m is typically 12-15 Degrees.

Soil moisture is measured in kPa in the range 0-200 kPa. Low pressure values indicate very wet conditions, high values very dry conditions.

A rule of thumb is approximately 50 kPa represents about 25 mm of plant available water for shallow rooted crops in clay loam soils at about 200 mm probe depth. The value will increase to about 70 kPa if the probe is 400 mm deep.

Rainfall is measured in mm. This shows the rain accumulated since the last measurement. Rainfall is measured every hour and the value reset before the next accumulation period starts. For daily accumulated rainfall the advanced data analysis tools must be used.

Advanced Data Analysis

To analyse the data from the WSML. Remove the SD Card and insert it into the IMS NUC computer or a desktop computer which has the QTech Soil Moisture Analyser software installed. Follow the process to import the data from the card and graph the readings. Please refer to the WSML User Guide for more information on the import and graphing functions.

Configuration File Formats

The SD card is used for transferring configuration files from the PC to the EP3. The SD card must contain the following folders:

Folder	Description
Firmware	This contains the IPC firmware files used when upgrading IPC firmware or the EP3 firmware itself.
Schedules	This contains the schedule sets that were created by the IPC Scheduler application. The schedules are held in a named folder.
Pods	This contains the IPC list usually created by IPC Scheduler Software.
Repeaters	This folder is used by an IC to hold a list of repeaters used on the site. IPC configuration files that use hybrid communications will direct communications to a specified IPC via the designated repeater for that IPC.

Configuration files and schedules are stored on the memory card in a specific file and folder format:

```

pods\
  pod-config.ini
schedules\
  default\
    schedule-1.ini
    schedule-2.ini
    ...
  summer\
    schedule-1.ini
    schedule-2.ini
    ...
Repeaters\
  Inc-rptrs.ini
  
```

These files should then be copied to the SD card using Windows File Explorer. It is important that the file/folder layout matches that shown above.

Note. The folder names **Pods** and **schedules** are explicitly required in the root folder. Schedule subfolder names may vary. Filenames must terminate with the “.ini” suffix. IPC list filenames may vary. Schedule files must follow the syntax used above.

Note. The **repeaters** folder in the root directory is only required if a repeater is in use on the site. The file contained therein must be called inc-rptrs.ini.

The schedule folder name and schedules are stored in non-volatile memory so does not have to be re-selected when the INC power is cycled. The schedule folder name is arbitrary, but must be consistent with the FAT32 file system conventions, and must not be longer than 8 characters long.

IPC Config File Format

Each IPC is identified in the pod-config file (aka podlist) with a record entry as follows (note sample entries are provided):

Pod-Config Entry	Description
[pod1]	Record identifier, one for every IPC in the file
name=BK01	IPC friendly name, listed in the IPC list in an EP3 or INC, limited to 5 alphanumeric characters
serial=7054	Unique manufacturing serial number for the IPC printed on a label inside the IPC and visible, listed in the EP3 IPC list next to the IPC name
address=00:1E:C0:98:C7:C1	Radio MAC address, extracted from the QTech database for each IPC. This database can be interrogated from outside the organisation to produce a complete list of all IPCs by serial number and MAC address. Useful for third party software developers
schedule=950	Identity of the schedule file in the schedules folder for the schedule associated with this IPC
channel=1	Radio channel the IPC operates on. Generally, the same for each IPC on the farm. Assigned to the IPC by the manufacturer during production but can be reassigned by an agent if required
x-coordinate=1588590.58532962	Post location (X) coordinate created by IPC manager from the GPS location of the post. Used by QIMS software for map views of the system
y-coordinate=5268693.73952957	Post location (Y) coordinate created by IPC manager from the GPS location of the post. Used by QIMS software for map views of the system
mode=Mesh	Operating mode of the radio one of three options: a) mesh – for non- line of site operation over a farm b) local – for short range direct line of site operation c) hybrid – for use with a repeater system on the site
Repeater=1	This entry is only present when Hybrid (repeater) operation is used. It signifies the identity of the repeater (indicated by a number) through which the EP3 or INC will route all radio communications. More than one repeater may be used on a site according to the radio network design. If this entry is not in the pod -entry the system defaults to using the first repeater listed in the INC-rptrs.ini file in the repeaters folder on the SD card
sublateral=1	This identifies the zone or group to which the IPC belongs. Multiple IPCs can belong to a sublateral but typically only one IPC is scheduled to water at a time in that zone, as part of the system hydraulic design
farmid=01:34	New feature added for IPC firmware revisions V5.00 and above. If this entry is present then the EP3 or INC (also running version 5.00 firmware or later) will transmit this value with all radio communications. Only IPCs programmed with a matching farm identifier will participate in radio communications. This enables radio communications to be restricted to a single IPC network when other networks on the same radio channel are nearby.
Type=moisture	For devices other than the IPC the Type field is added: Supported device types include: - Moisture: QTech WSMML - Level: Water level meter (QTech ITU) - Flow: Water flow meter (QTech ITU)

IPC Schedule File Format

Each IPC maintains a schedule of up to 16 operations. The schedule is transmitted to the IPC by an EP3 or INC. IPC manager creates a single file for each IPC identified by its schedule number, this is then associated with an IPC entry in the pod configuration file. The format for a schedule file is as follows (note a sample entry is provided):

Schedule file Entry	Description
[header]	Record identifier, used to identify the start of the schedule record
id=950	Schedule identifier used to associate a schedule with an IPC (see above)
cycle_length=2	Schedules are cyclic, this number represents the modulo number of days in each cycle
n_times=2	Defines the count of schedule operations in this schedule. A total of n_times (2) schedule operation time entries will be defined. Up to 16 operations can be defined.
CRC=261E	<p>The file uses a calculated CRC which can be checked against the CRC of the schedule currently programmed in an IPC. Used to detect if an IPC has its correct schedule programmed. This parameter is no manually calculated. It is inserted by application scheduling software. It is not mandatory for correct IPC operation.</p> <p>If the CRC values do not match then the schedule times programmed in the IPC is not the same as the expected schedule loaded in the INC or Ep3. Usually the schedules are re-sent to the IPC in this circumstance.</p>
[time1]	Header identifier for the (first) of n_times (2) operations the IPC will perform
day=1	Day (1) of the modulo cycle_length (2) that the IPC turns on its valve
start=22:36	Start time of the day that the IPC turns on its valve
duration=28	Duration the valve stays on, when the duration is complete the valve turns off.
[time2]	Header identifier for the (second) of n_times (2) operations the IPC will perform
day=2	Day (2) of the modulo cycle_length (2) that the IPC turns on its valve
start=10:39	Start time of the day that the IPC turns on its valve
duration=27	Duration the valve stays on, when the duration is complete the valve turns off.

Important - For version 5.00 firmware and above for the EP3, INC and IPC the cycle_length value must be present because the date/time/cycle calculation of the system requires it. Previously the user had to define the day of the cycle when setting the time for a system, now it is automatically calculated by the system.

IPC Repeater File Format

The file format is almost identical to the IPC file format with the exception that repeaters always use mesh communications from the repeater to the destination IPC. The mode entry is redundant. A typical entry looks like:

```
[rp1r1]
name=RPTR1
serial=6452
address=00:1E:C0:98:EF:B1
channel=24
x-coordinate=0
y-coordinate=0
mode=Mesh
farmid=01:15
```

Technical Specifications

Note. Specifications are subject to change without notice.

EP3 Specification

Item	Parameter	Specification
General		
	Dimensions	Approx. 150 x 90 x 25 mm
	Weight	650 gms
	Temperature	Operating: 0-65 degrees C Storage 0-65 degrees C
	Humidity	0-90% non-condensing
	Ingress Protection	IP20 Water contact with screen should be avoided.
	Power	Input voltage: 3V (2 x 1.5 Li-ion batteries) Current: 0.2A Max.
	Device Management	Front panel touch screen
I/O		None
Radio	Regulatory	ISM band, AS/NZS 4268
	Antenna	Detachable SMA
	Operating Frequency	915 – 928 MHz
	Output power	18 +/- 2 dBm
	Receiver Sensitivity	-121 dBm
	Modulation	GFSK
Communications		
	USB	USB 2.00 Type B Interface (reserved for factory use)
Storage		
	SD Memory Card	Secure Digital SDA 2.0

SD Card Specification

The INC uses an SD card interface for file transfer. The memory card should be formatted as FAT32. Typical memory device specifications are:

- Capacity: 8GB/16GB
- Standard: SDA 2.0
- Dimensions: 24 x 32 x 2.1mm (W x H x D)
- Weight: 2g
- Voltage: 2.7~3.6V
- Performance: Approximate Speed (read): 10~14 (MB/s), (write): 4~5 (MB/s)
- Speed Class: Class 4



Other card specifications may work but the user should verify that the EP3 can read the memory card correctly.

Warning. Performance of SD cards from some manufacturers may vary. If problems occur loading files then try using a class 10 SD card instead.

Warranty

The hardware and software for this product is covered by the QTech Limited Warranty Agreement and software End User License Agreement, respectively.

Please refer to the QTech Limited Product Warranty Agreement, which may be downloaded from the QTech website: www.qtech.co.nz

QTech Data Systems Limited does not warrant the suitability of this product for any particular application as the conditions in which it is used are beyond our control. This is not withstanding warranty of merchantability.

Additional Information and Support

If you have problems try the following:

- Visit the QTech web site for application notes and guides
- Refer to the troubleshooting section if one is present in this document
- Contact the support desk at support@qtech.co.nz
- Phone the support desk, contact details at beginning of this document



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