

System Planner

IRRIInet (Irrigation System)

6802984C70-A



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Acronyms and Abbreviations

A, B, C

CPU Central **P**rocessing **U**nit
COS Change **O**f **S**tate

D, E, F

DIOS **D**istributed **I/O** **S**ystem
DTMF **D**ual **T**one **M**ulti-**F**requency
ET **E**vapotranspiration
FIU **F**ield **I**nterface **U**nit
FEP **F**ront **E**nd **P**rocessor

H, I, J

ICC **I**RRInet **C**ontrol **C**enter
ICC PT **I**CC **P**ocket **T**erminal
IFI **I**CC **F**ield **I**nterface
IP **I**nternet **P**rotocol
I/O **I**nterface **O**utput(s)
HMI **H**uman **M**achine **I**nterface
HW **H**ardware

K, L, M

MDLC **M**otorola **D**ata **L**ink **C**ommunication (Seven-layer OSI protocol)
ML **M**ain **L**ine

N, O, P

OSI **O**pen **S**ystems **I**nterconnection
PIU **P**iccolo **I**nterface **U**nit
PLC **P**rogrammable **L**ogic **C**ontroller
PDA **P**ERSONAL **D**IGITAL **A**SSISTANT
OS **O**perating **S**ystem

Q, R, S

RCC **R**adio **C**ommon **C**arrier
RF **R**adio **F**requency
RTU **R**emote **T**erminal **U**nit
SC **S**ingle **C**able
SCADA **S**upervisory **C**ontrol and **D**ata **A**cquisition
SMS **S**hort **M**essage **S**ervice
SW **S**oftware

T, U, V

TAP **T**elelocator **A**lphanumeric **P**rotocol
TB **T**erminal **B**lock

VA Volt-Ampere

W, X, Y, Z

Chapter 1 – IRRInet System Overview

Introduction

The IRRInet system is a family of hardware and software products designed and developed for the monitoring and management of water and irrigation control solutions.

The IRRInet system is well suited for the following applications:

- Turf/landscape applications including: irrigation systems for city and county parks departments, highway and street median landscapes, corporate office parks, college campuses and school districts.
- Water distribution control systems including small or large scale water supply systems, mainly in rural areas.
- Agricultural control systems including small farm or large scale agriculture projects, drip and sprinklers or any other irrigation system, nurseries, greenhouses or open fields.
- Municipal water control systems including: small or large scale, cities waterworks.
- Golf course applications including both private country clubs as well as municipal courses.

IRRInet System Components

The IRRInet system incorporates three major components:

- IRRInet Control Center
- Communication Infrastructure
- Field Units or Remote Terminal Units (RTU)

IRRInet Control Center

The IRRInet Control Center (ICC) provides a management tool for controlling the entire system.

The ICC is used for the following major functions:

- System configuration. The ICC enables system parameters to be configured for optimal operation. The user may also define all field Units connected to the ICC and their associated configurations. The ICC allows the user to define all software application functionality and download (send) the data to the field units, in order for them to perform the irrigation function. The user may upload the existing data from the field units in order to monitor the entire system. The ICC can zoom in to the level of single element characteristics (i.e. valve, pumps, fertilizers etc.) at each site.
- Management tools, such as accumulation reporting and event logging.
- Interface to third party database and communication systems such as SMS, paging alarms and weather stations.

Part of the IRRInet Control Center is the Field Interface Unit (**FIU**).

The function of the FIU is to act as the communication interface between the PC-based stations and the field units. In general SCADA systems, this is known as the Front End or Front End Processor (FEP). When pure IP communication is used between the ICC and the field units, the FIU is not needed. See ICC Communication Design Guidelines below.

Note: The FIU also may function as a “regular” field unit, performing full irrigation functions.

Communication Infrastructure

The communication infrastructure is the backbone, enabling the various system components to communicate with each other over various media types.

The multiple sites in the system may communicate amongst themselves or with the Central Station (ICC) by utilizing a variety of communication such as: IP networks, two-way conventional radio, trunked radio systems, GPRS, wire line or any other communication network.

MDLC, the main communication protocol employed by IRRInet system, is based on the seven-layer OSI model, and is designed to function on variety of communication media.

MDLC includes a store-&-forward capability that permits different communication media links to be incorporated into the system, i.e. conventional radio, trunked radio, microwave radio, and LAN, all interconnected by the IRRInet System into a single communication system. Data may be passed from any site to any other site in the system, if needed, in order to achieve extended coverage from the Fields Units to the ICC.

Field Units or Remote Terminal Units (RTU)

The field unit (RTU) is the on-site controller, performing the control process. Though the various field units differ from each other, they have the following in common:

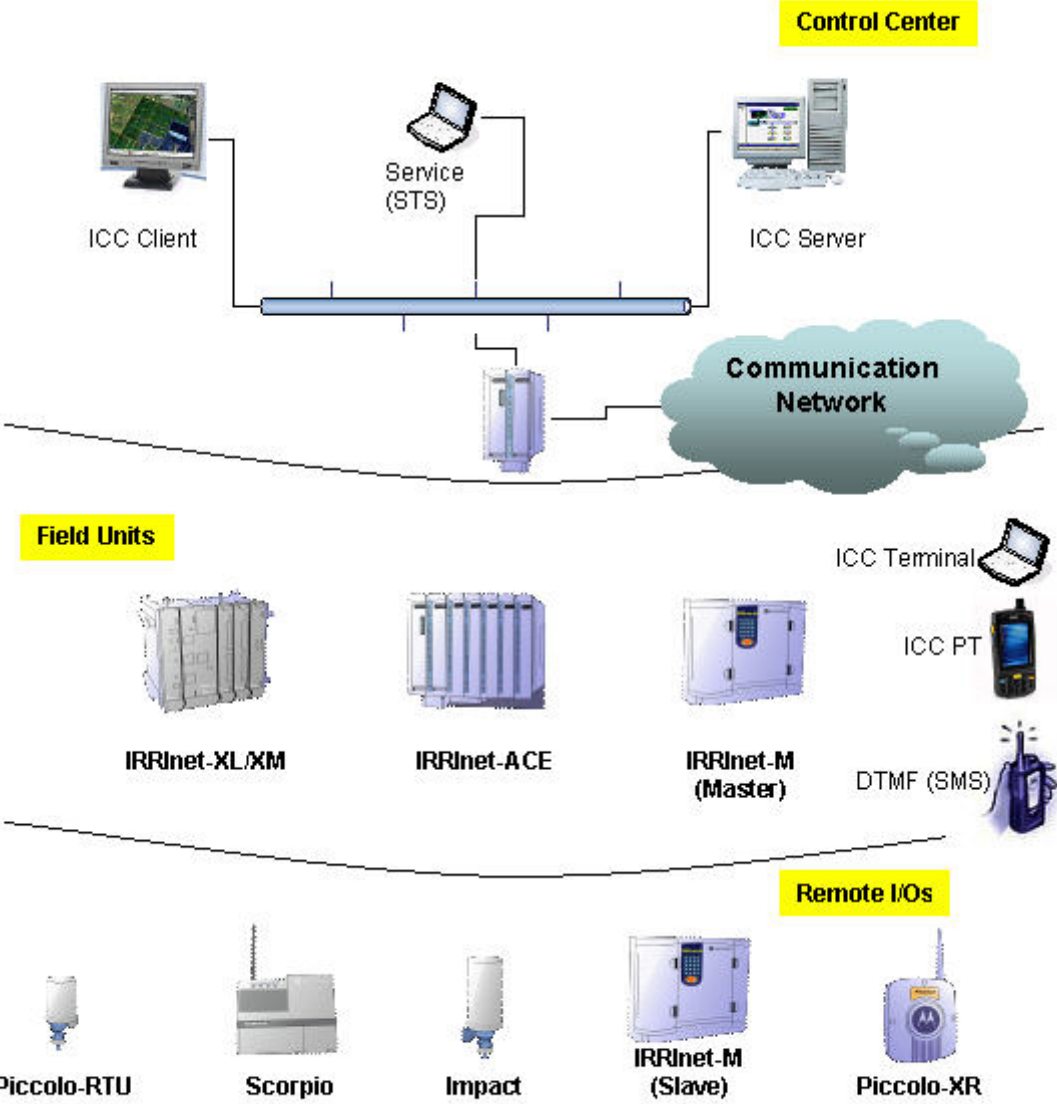
- Logic board - with CPU for processing power and data storage
- I/O port - for on-site sensor connections. These may be inputs such as water meters, pressure meters, or general digital inputs, or outputs such as irrigation valves, pump starts, general relays, etc.
- Communication Ports - enabling the RTU to communicate with the ICC, with other Programmable Logic Controllers (PLCs) and with an on-site programming tool (such as Pocket PC device).

In some cases, the RTU may operate not only the local I/Os (on board I/O connections), but remote I/Os as well. A Remote I/O is an I/O that logically “belongs” to the RTU, but is physically connected to a different RTU, at a different location.

Once the needed data exists in the RTU (downloaded from the ICC or locally entered), the field unit performs all functions automatically.

The field unit updates the ICC database upon request or by exception. The RTU reports to the ICC every defined alarm which occurs in the field.

Figure 1-1: IRRIInet – System Configuration



Theory of Operation

The IRRInet System is an end-to-end solution for water and irrigation control.

The IRRInet System is a distributed control system, in which the ICC serves as a “system manager”. The “system” consists of a number of IRRInet field units (including the legacy IRRInet-XL/XM), FIU and Central Station (the ICC itself).

The ICC is used to set up and configure the field units. It is also used to monitor and control the system’s ongoing operations

Once the data is downloaded into the field units, they are capable of functioning independently, performing all control functions.

Databases (ICC and RTUs) are synchronized utilizing three modes of communications:

- Polling – The ICC will initiate a request to the field units (automatically or manually by the user) to update all data or changes since the last upload.
- Set call – The ICC will initiate communication to a group of field units using one burst of transmission. The relevant field units will respond to this communication as needed.
- Contention – The field unit detects any “change of state” in the database, or an exceptional event, such as an ALARM. This will immediately initiate a transmission to the ICC, for database update.

An alternative to configuring the RTUs via the ICC is to configure them locally. The user/technician may configure the RTU with a Pocket PC device (or ICC Terminal) and Motorola-supplied software. Upon configuration, the RTU will automatically update the ICC.

Chapter 2 – IRRInet Control Center (ICC)

ICC Overview

The ICC is the Control Center of the IRRInet System. Although the IRRInet field units may operate without the ICC, the IRRInet System is not a SYSTEM without the ICC.

The ICC software comes on a special CD which must be ordered, including all needed installation files. For details on the ICC models and options, see the ICC Ordering Information section below.

A component of the IRRInet Control Center is the FIU (Field Interface Unit), which interfaces between the PC-based station and the field units, from a communication point of view. When pure IP communication is used, the FIU is not needed.

The ICC may operate in Client Server mode, with more than one workstation.

The ICC may interface with various software applications (third party), such as weather stations etc.

Another component of the ICC is the on-site terminal, used by a system technician to interface with the field units, while outside the Control Center. There are a number of available options.

ICC Main Features

- The ICC database supports more than one project per central, operating one project at a time (maintenance and service benefit).
- The ICC software requires a unique “key” to register - Software may be distributed for demonstration and training purposes. When it is to be connected to an FIU for actual operation, the appropriate key is needed.
- Multi-level, secured operator’s accessibility rights
- Exporting reports to enable sharing of information with other applications (third party)
- Networking – Client/Server architecture is supported allowing you to run your system over the network and/or operating the ICC from a remote workstation.
- Easy-to-use HMI has a user-friendly layout and intuitive navigational capabilities.
- Multiple languages supported, including help files.
- Graphical screens may either be “fixed” (automatically set by the ICC) or “tailored” (to suit user needs.)
- Monitoring and control of field units (all elements, programs, etc.)
- Downloading data to the field units (changing programs, set-points, etc.)
- Two options of building the system: either from “scratch” at the keyboard of the computer or using the Upload Wizard to pull the data in from field units that have already been programmed.
- Closed loop conditions are supported (powerful IF-THEN conditions provide automated control.)

- Supports astronomical clock – for sunrise/sunset calculations.
- Event reports
- Online alarms
- Message paging (various media supported)
- Displaying historical trends for the various sensors
- Remote Access to ICC database via SMS or DTMF for control and/or data acquisition
- Flow Prediction may be used to analyze the demand on the hydraulic design.
- Enhanced graph plotting utilities
- Network Protection is provided in ICC – Water distribution networks may be defined to allow comparison of flow rates coming from “IN” meters and “OUT” meters.
- Sensor Measurements may be taken by ICC.
- The ICC provides comprehensive Irrigation Programming screens, including simultaneous display of time to run, quantity to run and irrigation depth (inches or millimeters of water to apply.)
- Supports multiple crop types – for better irrigation accuracy.
- Offline programming of field units – for backup and future use

Figure 2-1: ICC sample screen



ICC Design Guidelines

ICC Computer Requirements

The ICC software will run on most commercially available PCs. The list below describes the minimum PC hardware requirements to run the ICC package.

- Pentium-III CPU with 850MHz
- 256 MB RAM
- Free disk space: 2GB
- RS232 port for connection to an FIU (where needed)
- For SMS – cellular modem: SIEMENS TC-35/MC-35 (RS232) or any GSM compatible modem equipped with RS232 or USB connection
- For IP connection to the field units – Ethernet port
- For weather station (Aqua Engineering) – analog modem (internal PCI, USB or RS232)
- For messaging services – analog modem (internal PCI, USB or RS232)
- For voice DTMF – analog modem (internal PCI, USB or RS232)
- For pcAnywhere – analog modem (internal PCI, USB or RS232) or connect via Ethernet

Supported Operating Systems

Windows 2000 SP4, Windows XP SP2, Windows 2003 Server SP1

ICC PT (Pocket Terminal)

When ICC PT is used with the system, you should use the ActiveSync software (not supplied by Motorola), in order to synchronize the ICC database with the Pocket Terminal (ActiveSync is a Windows application used to synchronize between a PC and mobile devices.)

Note: ActiveSync does not support Windows NT. Therefore, the list of Operating Systems supported are Windows 2000 SP4, Windows XP SP2, and Windows 2003 Server SP1.

ICC Software Option

The ICC is the “management station” of the IRRInet system. The ICC will coordinate all field unit activities and support all irrigation and control functionality.

In addition, the ICC is capable of supporting devices other than the field units, as described below.

- **Messaging Services**

The ICC supports various types of Messaging Services, all of which provide integrated alarms and events messaging to the users, wherever they are, within the coverage of the messaging system:



- o Paging System

Connecting an external or internal analog modem to the ICC, actuates connection to an RCC (Radio Common Carrier). The paging service provider (RCC) will send the event or alarm coming from the ICC to the pager subscriber.

The ICC support multiple RCC providers and pager subscribers.

- o Cellular Phone System

Connecting an external or internal analog modem to the ICC enables connection to a cellular provider. The cellular provider will route the events or alarms coming from the ICC to the cellular subscriber.

The ICC supports multiple cellular providers (per project) and subscribers.

The system operator/administrator should coordinate with the cellular provider to ensure it supports the TAP protocol.



- o GSM/SMS

Using a GSM/GPRS modem (connected to the PC RS232 or USB port) enables the user, not only to receive event and alarm messages, but also to control the ICC (e.g. to open/close stations or monitor an I/O status) from an SMS-enabled GSM phone.

- o Legacy People Finder

This is a legacy on-site paging system, where a special paging terminal is connected directly to the ICC port, and sends messages to locally distributed pager subscribers.

- **DTMF**

The ICC supports two types of DTMF to provide basic, yet very efficient remote control of the ICC by the user. Operations are all channeled through the ICC, providing the user with a report of all actions performed:

- o Quiet DTMF

For this option you need a base station radio (located near the ICC) with Audio Output. The audio output should be connected to an external or internal analog modem. This modem is connected to the ICC.

From a DTMF-capable radio, the user in the field may execute various commands (e.g. open/close stations or change watering factor, etc.)

- o Voice DTMF (Two Way DTMF)

For this option you need an internal or external analog modem connected to the ICC. (On the other side the modem is connected to the line/phone socket.)

Using any cellular (or landline) phone, the operator may place a phone call to the ICC. The ICC software “answers” the phone and then prompts the caller, with voice messages for various remote control operations. Using the numbers keypad, the user may “instruct” the ICC to perform.



- **Weather Station**

The ICC supports connection to third party weather station products. All weather stations use Evapotranspiration (ET) to allow weather-based adjustment of irrigation. Once the ET is calculated and loaded (manually or automatically) to the ICC, it will change the Watering Factor as defined by the user.

- **Third party SW**

Some of Motorola's channel partners have developed various software and hardware packages for the ICC. These products are not under Motorola's warranty. However, they may be very efficient and effective where needed.

It is our recommendation to contact those organizations directly for availability.

ICC Communication Design Guidelines

The communication network is the backbone of the IRRInet System, enabling the link between the ICC control room and the field units (usually located at a distance from the ICC.)

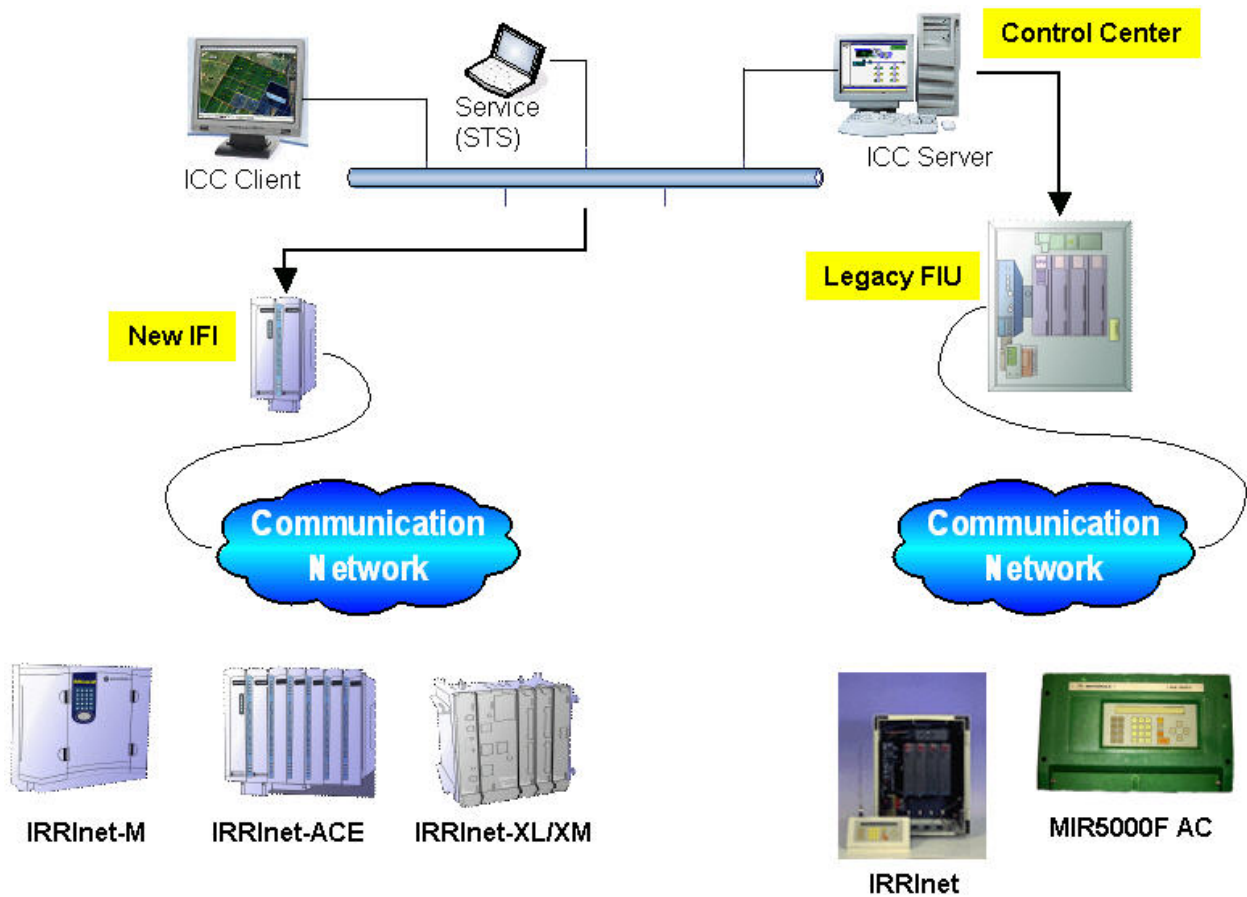
For more information on communication networks, see the ACE3600 System Planner, Motorola part #6802979C45.

The ICC supports a communication backbone that is a highly sophisticated hybrid data communication network, utilizing a variety of radio and/or line communication links.

The ICC can simultaneously support two types of communication networks. This allows one system to support legacy products (IRRInet and MIR5000F AC) and the new products (IRRInet-XL/XM, IRRInet-ACE and IRRInet-M.)

Such a configuration is depicted in the figure below:

Figure 2-2: ICC supporting two communication networks



Legacy FIU

The function of the FIU is to interface between the ICC and the field units, from a communication point of view.

The FIU requires a dedicated RS232 port on the PC to be connected to the FIU. The FIU simultaneously supports two types of communication media: RF and Wireline.

The FIU supports the following field units:

- IRRInet
- MIR5000F (AC 52 stations)

The FIU is used exclusively in legacy systems to support legacy products. For systems that use both legacy products and new products, the FIU is the communication interface with the legacy products, and the IFI is the communication for the new products. The FIU and the IFI may both communicate with the same ICC.

ICC Field Interface (IFI)

The IFI supports the following field units:

- IRRInet-XL
- IRRInet-XM
- IRRInet-ACE
- IRRInet-M

The IFI hardware and software utilize a variety of radio and/or line communication links. Radio links may include conventional (VHF, UHF, 800 & 900 MHz), analog trunked, digital trunked, and both analog and digital microwave radio technologies. Line links may include point-to-point, multi-drop, and Public Service Telephone Network (PSTN) voice/data via dial-up modems, cellular packet data modems and Local Area Networks (LAN).

The ICC to MDLC communication “cloud” may be designed without an IFI. This is applicable only with “new” systems which are comprised of IRRInet-M and IRRInet-ACE only. In such configurations, the ICC (PC) may be connected directly to an Internet Provider, with a “fixed” IP address; the Field Units may be connected to the IP network (e.g. GPRS) without a “fixed” IP address.

For more information on communication links, see the ACE3600 System Planner, Motorola part #6802979C45.

Multiple data bit rates are available to accommodate the particular need of these links. Lower data speeds are used when the bandwidth of the link is reduced either by their design, because of legal restrictions, or when data speed is sacrificed to achieve greater communication range. High data speed, combined with the optimized-for-radio MDLC data protocol, ensures high network throughput even if the network is spread over a large geographical area.

The communication network is flexible, enabling each field unit to communicate with hierarchies above it (RTU-to-central), parallel to it (RTU-to-RTU), under it (another RTU), and also relaying messages through it (when the RTU serves as a communication node.)

The RTU network uses the MDLC protocol, which incorporates all seven layers of the OSI model adapted for SCADA systems. It supports multiple logical channels per physical port, enabling simultaneous central-to-RTU and RTU-to-RTU sessions. It also enables each RTU to simultaneously run several kinds of communication applications, such as reporting alarms by contention, on-line monitoring, performing diagnostics checks, etc.

For more information on the MDLC protocol, please refer to the ACE3600 System Planner.

The ICC needs one access point to the “first” field unit. This gives the ICC connection to the communication “cloud?”, and, therefore, to the system as a whole. The “first” access may be one of the following:

- **IRRInet-XL or IRRInet-XM**

When an IRRInet-XL/XM serves as an IFI, it may be connected to the ICC in one of two ways:

-
- o Locally using RS232 connection (Connect the PC RS232 port to the IRRInet-XL/XM RS232 port.)
 - o Remotely connected, via LAN (Connect the PC Ethernet port to the Network Connection in the “wall” and connect the IFI to the same LAN using an IPI plastic box.)

- **IRRInet-M**

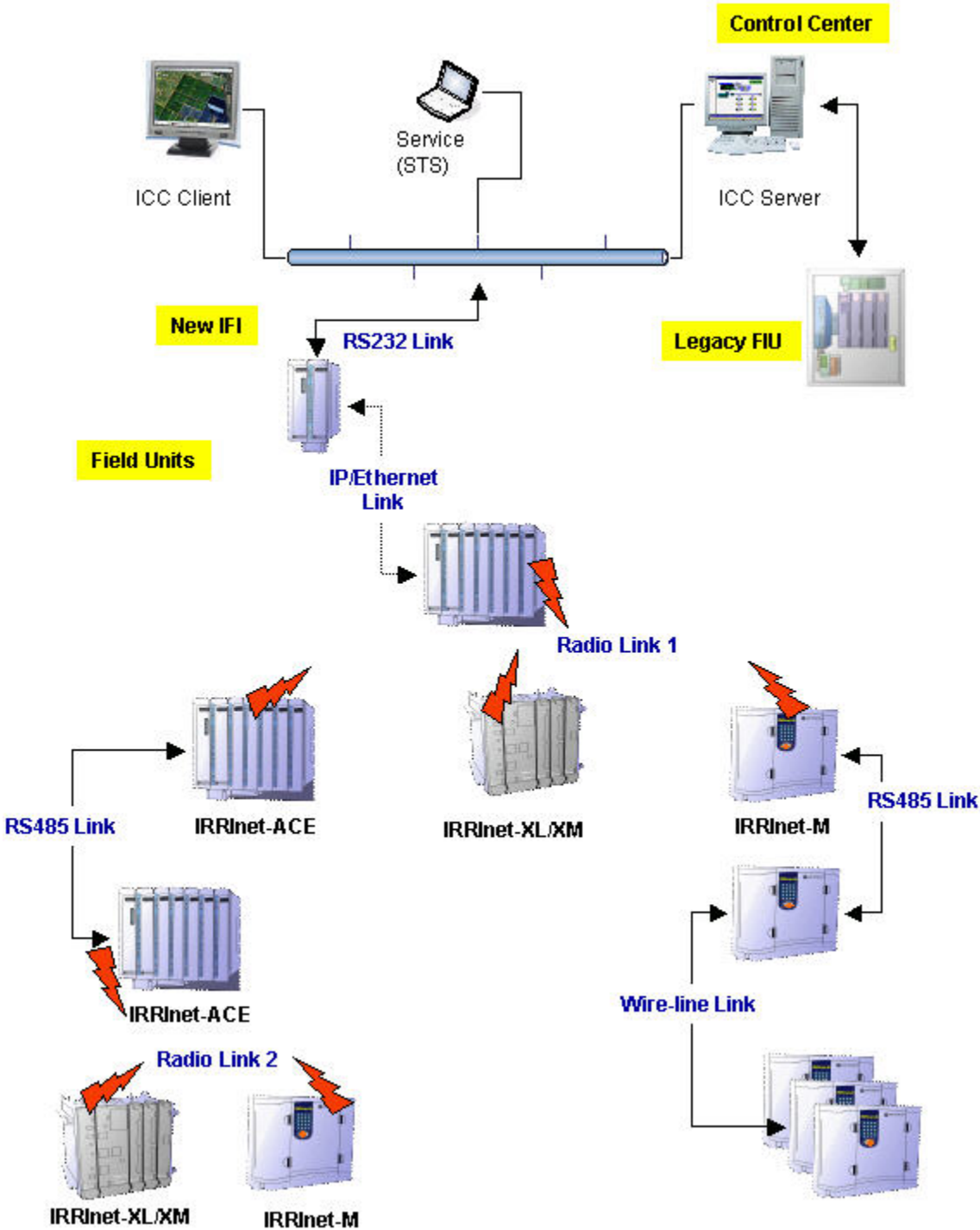
When an IRRInet-M serving as an IFI, it may only be connected to the ICC locally, using RS232 connection between the ICC and the IRRInet-M.

- **IRRInet-ACE**

When an IRRInet-ACE serves as an IFI, it may be connected to the ICC in one of three ways:

- o Locally using RS232 connection (Connect the PC RS232 port to the IRRInet-ACE RS232 port.)
- o Locally using Ethernet connection (Connect the PC Ethernet port to the IRRInet-ACE Ethernet port.) [**This option is recommended.**]
- o Remotely connected, via LAN (Connect the PC Ethernet port to the Network Connection in the “wall” and connect the IFI, wherever located, to the same LAN, using its Ethernet port.)

Figure 2-3: ICC Communication Network Example



ICC Networking Design Guidelines

The ICC is designed to support client/server operation. In such a configuration, the ICC connected to the FIU/IFI acts as a server, and may support up to nine workstation clients.

For this system planner, we will assume that the network is already operational.

The ICC supports two types of Client/Server configurations:

- **Standard Operation System installation**

The ICC is installed on a PC running one of the supported operating systems (see ICC Computer Requirements above.)

The ICC workstation can be installed on any PC linked into the network. (It is recommended not to install more than six workstations.)

In this configuration, the ICC may be operated from the “server” and from any of the connected workstations.

Advantages:

- Very simple installation and configuration
- No need for real server hardware and software, so no extra costs.

Disadvantages:

- Relatively low speed operation, mainly in narrow band networks and full capacity of workstations.
- The ICC database may become corrupted if one of the workstations fails.

- **Windows Server OS installation**

This option requires actual server hardware and software (e.g. Windows Server 2003.) The ICC should be installed (regular installation.) Terminal Server should be installed with the appropriate licensing.

Up to nine workstations may be operated in such a configuration (NET1 to NET9.)

Advantages:

- Very quick data transfer, even in narrow band networks.
- The ICC database is better protected against workstation failures.

Disadvantages:

- A server computer and Terminal Server licensing are needed, so additional costs should be expected.

On-Site Programming Design Guidelines (Terminals)

On-site programming is a very important feature of the IRRInet system. It gives the user the ability to program and/or monitor the field units on-site (away from the ICC control room.)

There are two options for on-site programming: IRRInet Terminal for Pocket PC, or Laptop.

On-site programming is available for field units only (master). It is not an option for the slave or any other remote I/O unit (e.g. Piccolo-XR.)

There are two modes of operations for on-site programming: Terminal Mode (ICC exists in the system) or Stand-Alone (ICC does not exist.)

ICC PT (IRRInet Terminal for Pocket PC)

The ICC PT is a software and hardware package for on-site programming.



The hardware (not supplied by Motorola) should be a Pocket PC, ARM-based machine, with RS232 connection. Most of the currently available machines are equipped with a USB port only, so a USB to RS232 adapter may also be required. On many of the Pocket PC machines, Bluetooth communication is built-in. In such cases, the connection of RS232 Serial to Bluetooth Adapter (on the field unit side) is possible.

The Pocket PC machine operating system must be Windows Mobile 5.X or 6.X.

ICC PT is compatible with the following field units:

- IRRInet-XM running the IRRIV 5.X application
- IRRInet-XL running the IRRIV 5.X application
- IRRInet-M running the IRRIV 7.X application (master only)
- IRRInet-ACE running the IRRIV 7.X application (master only)



The software for the ICC PT is supplied by Motorola and supports two modes of operation:

- **Terminal Mode**

Terminal mode is compatible with IRRInet systems that include an ICC. While connecting the ICC PT in this mode, any changes in the field unit will be automatically updated in the ICC.

It is recommended to use the ActiveSync software in order to synchronize the ICC database with the ICC PT. (ActiveSync is Windows application for synchronizing between PC and mobile devices.)

It is possible to connect the ICC PT to the field unit and upload the database from the field unit to the mobile unit.

While using the ICC PT in this mode, the user may connect the mobile device to any field unit, and monitor any other field unit in the system as long as they are part of the same communication network.

- **One-to-one Mode**

One-to-one mode is for programming the field unit when there is no ICC in the system.

The user may define the field unit off-line and when connecting the ICC PT to the RTU, download all data to the field unit. It is possible to connect an “empty” ICC PT to the field unit and upload the data from the field unit.

In this mode, it is important to understand that the user is programming one unit at a time. Each RTU is programmed separately.

ICC Terminal (Laptop)



The ICC Terminal is a software and hardware package for on-site programming.

The hardware (not supplied by Motorola) should be a laptop with the same operating system as that of the ICC. The laptop must be equipped with RS232 connection. Most of the current available laptop machines are equipped with a USB port only, so a USB to RS232 adapter may also be required. On many laptops machines, Bluetooth communication is built-in. In such cases, the connection of RS232 Serial to Bluetooth Adapter (on the field unit side) is possible.

ICC Terminal is compatible with the following field units:

- IRRInet-XM running the IRRIV 5.X application
- IRRInet-XL running the IRRIV 5.X application
- IRRInet-M running the IRRIV 7.X application (master only)
- IRRInet-ACE running the IRRIV 7.X application (master only)

The software for the ICC Terminal is supplied by Motorola (it is part of the ICC package) and supports two modes of operation:

- **Terminal Mode**

Terminal mode is compatible with the IRRInet Systems that include an ICC. While connecting the ICC Terminal in this mode, any changes in the field unit will be automatically updated in the ICC.

It is recommended to copy the ICC database (the project) to the laptop for maximum compatibility while connecting the terminal to the RTU.

It is possible to connect the ICC Terminal to the field unit and upload the database from the field unit to the Terminal.

While using the ICC Terminal in this mode, the user may connect the Laptop to any field unit, and monitor any other field unit in the system as long as they are part of the same communication network.

One of the advantages of this feature is the ability to install an RTU in a service vehicle (CPU only) with radio, on the same frequency as the system. Connect the laptop to this CPU in order to access any field unit (sharing the same communication backbone.)

- **One-to-one Mode**

One-to-one mode is for programming the field unit when there is no ICC in the system.

The user may define the field unit off-line and when connecting the ICC Terminal to the RTU, download all data to the field unit. It is possible to connect an “empty” ICC Terminal to the field unit and upload the data from the field unit.

In this mode, it is important to understand that the user is programming one unit at a time. Each RTU is programmed separately.

Chapter 3 – Field Units

General

This section describes the various IRRInet field units in detail.

A field unit, in this context, is a unit that can run the master irrigation application:

- IRRInet - legacy unit
- IRRInet-XL - legacy unit
- IRRInet-XM - legacy unit
- IRRInet-ACE
- IRRInet-M

The IRRInet field units have some common features, including:

- Running the IRRIV Master application
- May be a node in the communication network (Store & Forward)
- ICC connection (reporting to the central)
- Flexible I/O count
- Various communication ports
- Supporting remote I/O activation (e.g. Piccolo-XR)
- Ability to report by “burst” to the ICC upon COS
-

Irrigation application main features (IRRIV Master)

- Supports various I/O types: Digital Output, Digital Input, Counter, Sensor, Analog Output, and Analog Input.
- Supports Main Line entity to achieve additional functionality of:
 - o Crop type per ML
 - o Watering Factor (ET) per ML
 - o DTMF commands per ML (e.g. Run Stop)
 - o ML stations (Zones)
 - o Main Valve (and the option to stay open after schedule completion)
 - o Water Meter (and water flow protections)
 - o Fertilizers
 - o Filter flushing
- Flow Protection (High Flow, Low Flow, No Flow, Un-Control Water, Flow Stability Time.)

-
- Fertilizers/Fertilizers Farms (for optimized fertilization control)
 - Filter Flushing Farms and programs, including DP and consecutive flushing protection
 - Conditions
 - o For Start, Wait and Stop on the irrigation programs
 - o For general purpose control
 - Irrigation Programs (Scheduling)
 - o Start Time
 - o Stop Time
 - o Cycles
 - o Conditions (Start/Wait/Stop)
 - o Active Days [day interval, days of the week (Week 1 and week 2), or per calendar]
 - o Activate Stations, and multi fert pumps per program
 - o Irrigate by: Time, Quantity or Depth
 - o Flow protection
 - Built-in calendar to support irrigation programs by actual annual calendar
 - Data logging (with time stamp for future retrieval)
 - Accumulation Programs (water and fertilizers)
 - TATI (Tariff Time program)

IRRInet-M

General Description

There are two types of IRRInet-M

- IRRInet-M AC (for AC solenoids)
- IRRInet-M DC (for DC solenoids)

A full featured part of the IRRInet control system, IRRInet-M supports three modes of operations:

- RTU – Performing all irrigation functions, reporting to the ICC.
- Stand Alone – Performing all irrigation functions as a stand-alone unit when the system is installed without an ICC.
- Remote I/O – Serving as a distributed I/O for another unit that performs all irrigation functions (when loaded with IRRIV Slave software.) This is applicable when multi-site control synchronization is needed.

With PIU connectivity, the IRRIInet-M can activate Piccolo-XR units (DIOS.)

On site programming is supported by ICC PT or ICC Terminal connectivity.

Installation options include wall mount or DIN-rail mounting.

Power Connection Guidelines

IRRIInet-M DC

Note: An important part of the power connections is Grounding Connections. Please refer to the Owner's Manual for guidelines.

The IRRIInet-M DC power source is 9-30 VDC (12 and 24 VDC $\pm 25\%$.)

In most cases, the power in source will be 12 VDC.

Important: The power supply is not included.

All numbers and calculation in this section relate to 12 VDC power in.

The 12 VDC power source is the only power source needed for both the logical part of the unit (like CPU and communications) and the I/O activation.

The 12 VDC source may be a 12 VDC power supply (connected to the main), or battery [using power source (main or solar) to charge 12V battery.]

It is recommended to use a known, reliable source for purchasing all power related components.

The minimum power requirements from the power source are as follows:

For a unit without a radio: 130 mAmp

If a power supply is used, make sure it can supply constant 250 mAmp.

If a battery is used, it is recommended to use a battery of minimum 6 Ah.

This will operate the unit, including logic board, I/Os and all non-radio communications (RS232, PIU, Line, etc.)

If the power source to the battery fails, it will continue to operate for about 36 hours.

If a solar panel is used to charge the battery, it is recommended to use a 10-15 Watt solar panel.

For a unit with a radio (low power radio):

Powered from the IRRIInet-M (Set Auxiliary DC power level to 7.5 V in the site configuration.)

1.125 Amp for transmission (taking into consideration 1 hour of transmission a day)

0.070 Amp for receive (24 hours a day)



It is recommended to use a battery.



If a battery is used, it is recommended to use a battery of minimum 12 Ah.

This will operate the unit, including logic board, I/Os and all communications.

If the power source to the battery fails, it will continue to operate for about 36 hours.

If a solar panel is used to charge the battery, it is recommended to use a 20-25 Watt solar panel.

Note: The calculations above were roughly estimated, and are adequate for most cases. If more accurate calculation is needed, please refer to each component specification in order to determine the battery and solar panel power for the exact equipment and backup time required.

If another radio or any other device is needed, the user should provide a separate power source for this radio or device, and make sure the power source is sufficient for both the unit's consumption and the external device's consumption.

IRRIInet-M AC

Note: An important part of the power connections is Grounding Connections. Please refer to the Owner's Manual for guidelines.

The IRRIInet-M AC power source may be any of (or both):

- 24 VAC $\pm 20\%$
- 9-30 VDC (12 & 24 VDC $\pm 25\%$)

Power supply is not included.

24 VAC (Internal)

The 24 VAC power in may be the only power source needed for the logical part of the unit (e.g. CPU and communications) and activation of I/Os. The I/O drivers are relays (Magnetically Latched), so they will relay the 24V AC to the load, which are usually 24V AC solenoids.

The 24 VAC source should be a transformer (or 24 VAC power supply).

It is recommended to use a known, reliable source for purchasing all power related components.

The minimum power requirements from the power source are as follows:

For the 24 VAC solenoids:

Each output may draw up to 1 Amp but not more than 6 Amps in total. So while designing the Volt-Ampere (VA) for the transformer, take into consideration the required I/O load.

For example, 6 Amp or 144 VA, (1 Amp per output) would be a relatively high consumption. A more common value for total output consumption is 3 Amp or ~ 70 VA for the transformer.





For a unit without a radio:

For units that do not use a radio for communication, the consumption from the 24 VAC is relatively low: 100 mAmp. For this consumption, a 3 Amp transformer (70 VA) or 6 Amp transformer (144 VA) is adequate. This covers unit operation including logic board, I/Os and all non-radio communications (RS232, PIU, Line, etc.)

For a unit using a radio (low power radio):

When powered from the IRRIInet-M (Auxiliary DC power level set to 7.5 V in the site configuration), the radio consumption may be up to 2 Amps from the internal power supply, which is ~1 Amp from the 24 VAC transformer. This should be added to the I/O load, when selecting a power source.

If another radio or any other device is needed, the user should provide a separate power source for this radio or device, and make sure the power source is sufficient for both the unit's consumption and the external device's consumption.

I/O external power drive

In most cases, the unit will be designed to activate the 24 VAC solenoids from the 24 VAC power in of the unit.

However, the IRRIInet-M AC (using Magnetically Latched relays), may relay power from an external power source to the output's loads, by connecting this source to the WET point on user's TB.

This may be an AC source of up to: 30 VAC

Or a DC source of up to: 60 VDC

Using an external power source for the outputs may serve the situations below:

- Where a unit is powered from one source (e.g. 12 VDC) and the outputs are powered from another source. In the event of any problem with the outputs, the unit will still operate and be connected to the ICC.
- Where the outputs are NOT solenoids (any other non 24 VAC load).

12 VDC

The unit will operate, even if only 12 VDC (or an additional 12V DC) is connected to the power in. In this case, the unit will function, the communication will work (as in the DC unit), the inputs will function, and the outputs relays will "click".

The 12 VDC battery, if connected, is not charged by the AC source.

The design guidelines for the battery power are the same as for the IRRIInet-M DC.

Using a 12 VDC power source may serve the situations below:

- Backup – Where both the 24 VAC connection and the 12 VDC are used. If the 24 VDC fails, the 12 VDC will serve as a backup to the unit, keeping it alive.
- Where external WET power is used to activate the outputs. In this case the 12VDC will operate the unit and the outputs will relay the external power source.

Inputs/Outputs Guidelines

The IRRInet-M is a modular unit in terms of I/O count:

- 12 Outputs and 4 Digital Inputs, on the basic board,
- 12 Outputs and 4 Digital Inputs, on the expansion board.

IRRInet-M DC

The IRRInet-M **DC** RTU is designed to operate **DC** latch solenoids.

It is possible to install the basic unit (with 12 Outputs and 4 DI on the main board), and later add the expansion board (with the additional 12 Outputs and 4 Digital Inputs) in the field (no need for Motorola service.)

The Outputs

The outputs are driven from a:

3300 μ F 35 VDC capacitor

Discharge Voltage from 4 to 35 VDC (configurable by the user)

Pulse Width: up to 120mSec

The user may change the discharge voltage in order for the coupling Solenoid/Capacitor to set to the optimal level.

The IRRInet-M is protected against short circuits (when the solenoid creates a short) and will set an Alarm when a solenoid is not connected.

Outputs Count:

- Basic board – 12
- Expansion board – 12

There is no limitation to the number of outputs that may be opened concurrently.

The Inputs

The inputs are Dry Contact inputs (handling closed loop with no voltage or current.)

An Input is considered open (OFF), if the resistance level is $> 50 \text{ K}\Omega$.

An Input is considered closed (ON) if the resistance levels are $0\text{-}4 \text{ K}\Omega$.

The Minimum Pulse Width of an input should be 50mSec.

The Maximum Frequency is 7200 Pulses Per Hour (PPH).

Inputs Count:

- Basic board – 4
- Expansion board – 4



IRRIInet-M AC

The IRRIInet-M **AC** RTU is designed to operate **AC** (24 VAC) solenoids.

It is possible to install the basic unit (with 12 Outputs and 4 DI on the main board), and later add the expansion board (with the additional 12 Outputs and 4 Digital Inputs) in the field (no need for Motorola service.)

The Outputs

The outputs are driven by Magnetically Latched Relays (once a command is given to change state, they will maintain the position until a different command is issued.)

The maximum current allowed per output is not to exceed 1A.

Total current consumption for the outputs is not to exceed 6A.

These are the upper limits to be considered when designing the number of outputs opened concurrently (including the expansion board.)

The IRRIInet-M AC is protected against Over Current for total outputs consumption of over 8 A.)

Outputs Count:

- Basic board - 12
- Expansion board - 12

Using external source to drive the outputs

One of the IRRIInet-M AC features is the ability to accept an external power source to drive the outputs (external wet).

The outputs are “activated” via ML relays. The relays will change position (ON/OFF) using the unit’s internal power source.

The STS (configuration tool) enables the user to select an external power source for the outputs. Once this is selected, the relays will switch this external source to the solenoids (or any other “load” connected.

While designing such a configuration, take into consideration the specification limitation on the “WET” connection:

- 30 VAC
- 60 VDC

The Inputs

The Inputs are Dry Contact inputs (handling closed loop with no voltage or current.)

An Input is considered open (OFF), if the resistance level is $> 50 \text{ K}\Omega$.

An Input is considered closed (ON) if the resistance levels are $0\text{-}4 \text{ K}\Omega$.

The Minimum Pulse Width of an input should be 50mSec.

The Maximum Frequency is 7200 Pulses Per Hour (PPH).

Inputs Count:

- Basic board - 4
- Expansion board - 4

Software Application and Capacity Guidelines

IRRInet-M AC & DC

Both the IRRInet-M AC and IRRInet-M DC share the same features set and capabilities.

They share the same (though not identical, due to difference in hardware configuration) software application, known as IRRIV (.fls).

From a software point of view, the IRRInet-M supports three modes of operations:

- RTU (loaded with IRRIV Master application)
 - o Performing all irrigation functions
 - o Reporting to the ICC, via the communication “cloud” (MDLC)
- Stand Alone (loaded with IRRIV Master application)
 - o Performing all irrigation functions as a stand-alone unit when the system is installed without an ICC
- Remote I/O (loaded with IRRIV Slave application)
 - o Serving as a Distributed I/O unit, for another Master RTU

Master/Slave Design Guidelines

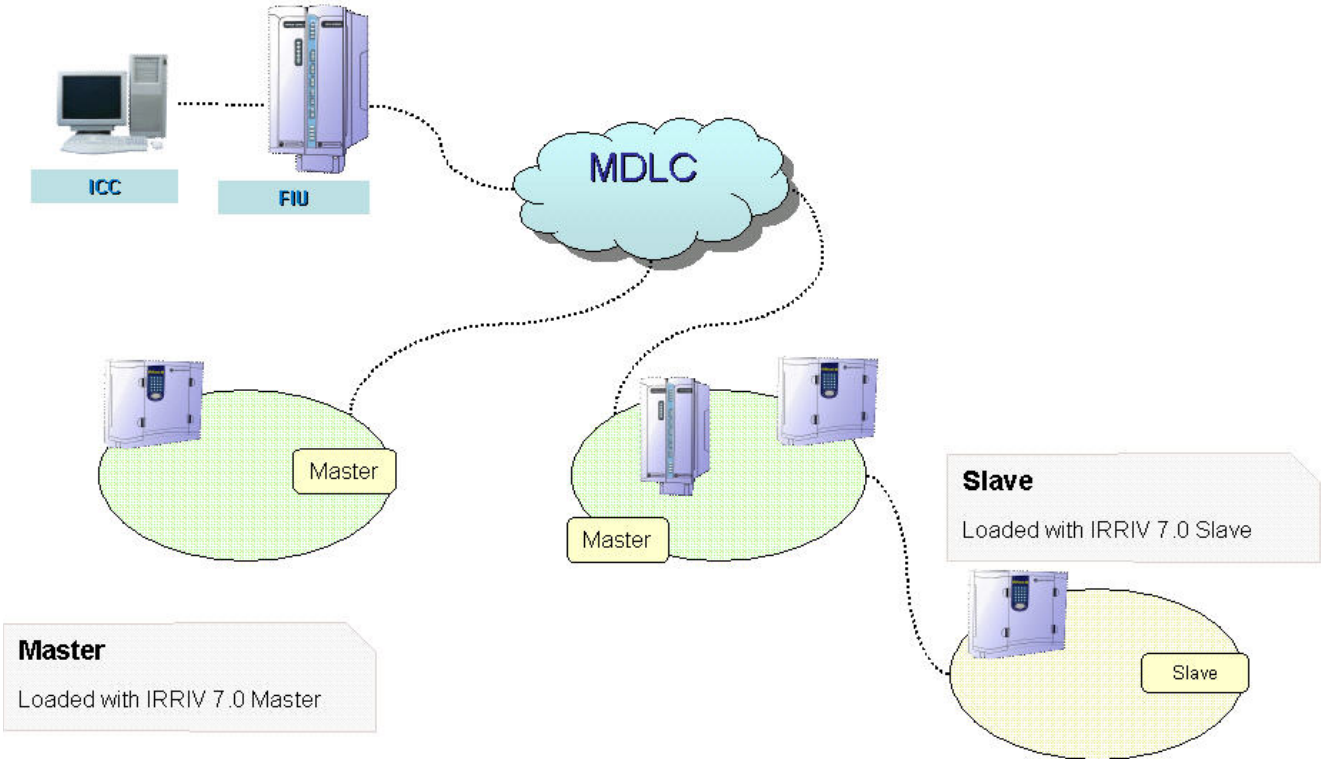
A Master is a field unit that:

- Reports to the ICC (via communication cloud) and is known to the ICC as a field unit.
- Includes, manage and handles the irrigation functionality and “entities”, such as:
 - o Main Lines
 - o Irrigation Programs
 - o Accumulations
- May operate and control Remote I/Os such as DIOS (via PIU) and other Slave RTU(s).

When designing a system, it is always recommended to define a field unit as a Master. This way the irrigation management and control process is not affected by the communication status, and does not create extra load on the communication network.

When it is necessary to “synchronize” more I/Os than can be handled by a single RTU, it is recommended to define one Master, and the rest of the I/Os as part of Slave units (as depicted in the figure below.)

Figure 3-1: Master/Slave Configuration



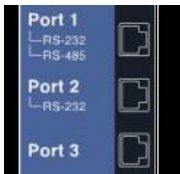
Capacity Guidelines (for Master only)

The IRRInet-M (AC & DC) can handle the following capacity of elements:

Element	Size
Inputs (total)	250
Outputs (total)	250
Meters (as part of the Input count)	250
Virtual Meters (as part of the input count)	25
Main Lines	125
Programs	200
Groups	200
Fert. pumps (as part of the outputs count)	50
Fertilizer Farms	50

Element	Size
Filter Batteries	50
Filter Stations (as part of the outputs count)	100
Dummy Stations (flags)	250
Externals Conditions (flags)	250
Complex Conditions (900)	125
Slave Units Including Scorpions and not including XR's)	100
Impact Units	100
Analog Output (Including logical)	100
Analog Input (including logical)	100
Virtual Analog Inputs	6
Data Logging items	250
TaTi Programs Quantity	1
Total Meters in TaTi Program	250

Communication Guidelines



The IRRInet-M (AC and DC) supports various communication ports. This section describes each of the ports and the applicable configurations for the IRRInet System.

Ports set-up and configuration, is performed using the ACE3600 STS.

In this section, port functionality is for an IRRInet-M functioning as a Master unit or Slave unit.

PORT #1 RS232, RS485

This port may function as RS485 or RS232 port (per installation). Configuration is done using the STS.

RS485

Remote I/O (Slave) for IRRInet-ACE Master

The IRRInet-M should be loaded with the IRRIV Slave application.

Up to 16 Slave units may be connected to one IRRInet-ACE Master RTU.

Note: RS485 is a standard – length of wire, communication speed, noise conditions and other factors may affect this channel's performance.

Remote I/O (Slave) for IRRInet-M Master

The IRRInet-M should be loaded with the IRRIV Slave application.

Up to 16 Slave units may be connected to one IRRInet-M Master RTU.

Note: RS485 is a standard – length of wire, communication speed, noise conditions and other factors may affect this channel’s performance.

PIU Connection

The IRRInet-M should be loaded with the IRRIV Master application.

Up to five PIU units may be connected to one IRRInet-M Master RTU.

Note: RS485 is a standard – length of wire, communication speed, noise conditions and other factors may affect this channel’s performance.

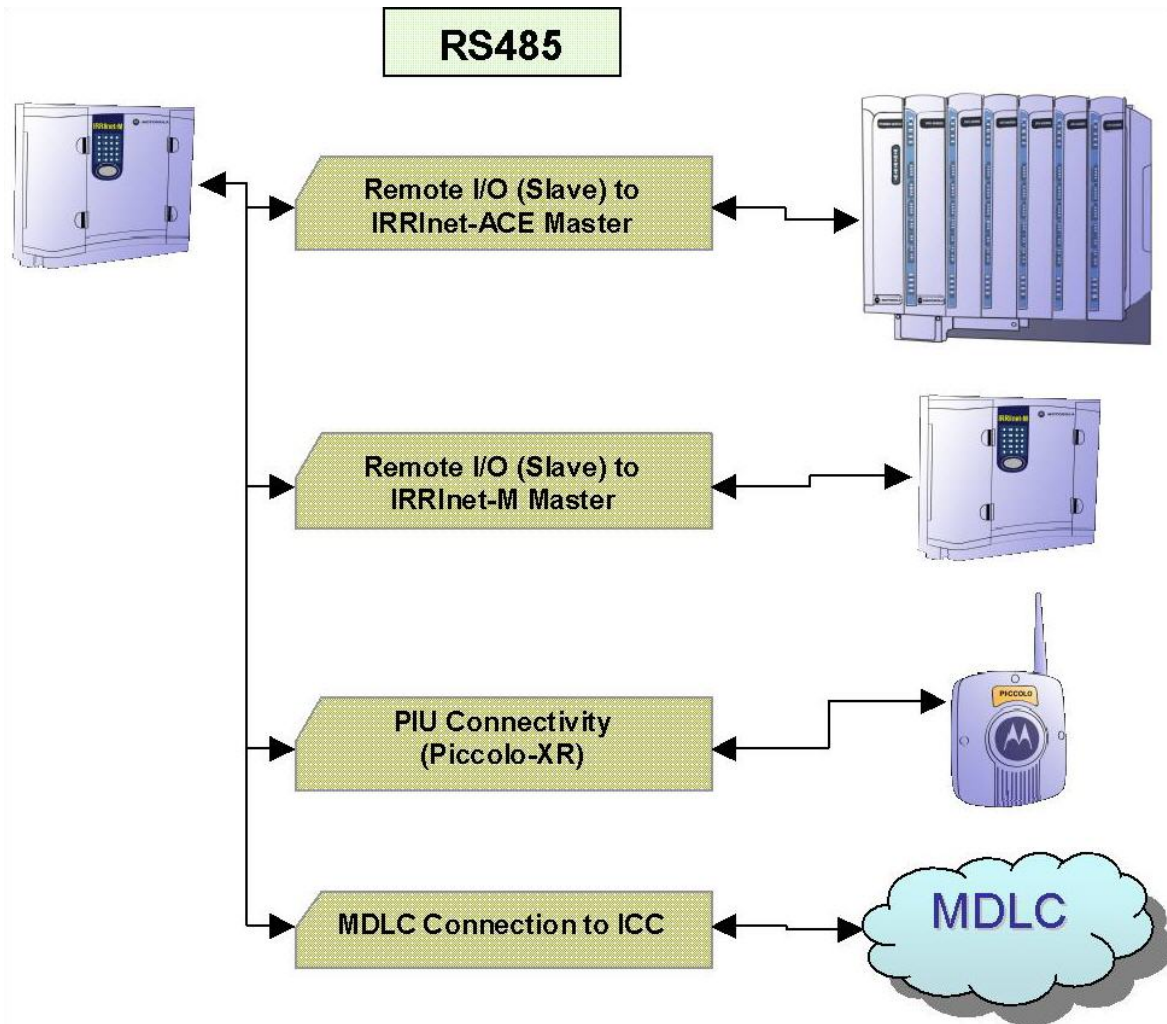
MDLC Connection to ICC

The IRRInet-M should be loaded with the IRRIV Master application.

The IRRInet-M can use this port in order to communicate, via the MDLC network, to the ICC.

Note: RS485 is a standard – length of wire, communication speed, noise conditions and other factors may affect this channel’s performance.

Figure 3-2: IRRIInet-M RS485 Communication Option



RS232

Remote I/O (Slave) for IRRIInet-ACE Master

The IRRIInet-M should be loaded with the IRRIV Slave application.

RS232 is a point-to-point connection (not multi-drop), so this connection is suitable for two units “talking” to each other.

Remote I/O (Slave) for IRRIInet-M Master

The IRRIInet-M should be loaded with the IRRIV Slave application.

RS232 is a point-to-point connection (not multi-drop), so this connection is suitable for two units “talking” to each other.

PIU Connection

The IRRIInet-M should be loaded with the IRRIV Master application.

RS232 is a point-to-point connection (not multi-drop), so this connection is suitable for one PIU connection.

MDLC Connection to ICC

The IRRInet-M should be loaded with the IRRIV Master application.

The IRRInet-M can use this port in order to communicate, via the MDLC network, to the ICC.

This RS232 is a “full featured” 232 port, thus may communicate with the MDLC “cloud” (ICC) utilizing the following options:

- Any other IRRInet Master init (IRRInet-XL, IRRInet-XM, IRRInet-ACE or IRRInet-M)
- Modem – Dial-Up, GPRS, Ethernet, or any other modem suitable for the RS232 connection.
- Digital radios with RS232 connectivity

ICC PT (IRRInet Terminal for Pocket PC)

The IRRInet-M should be loaded with the IRRIV Master application.

RS232 is a point-to-point connection (not multi-drop), so this connection is suitable for one ICC PT connection.

ICC (FIU Connection)

The IRRInet-M should be loaded with the IRRIV Master application. In a system configured with an FIU, this RS232 port may be used to connect the ICC (PC) to the IRRInet-M unit functioning as an FIU.

RS232 is a point-to-point connection (not multi-drop), so this connection is suitable for one PC connection.

PORT #2 RS232



This port may function only as an RS232 port. This port may provide the same functionality as Port #1 (RS232 configured), except for the modem connectivity:

Remote I/O (Slave) for IRRIInet-ACE Master

Remote I/O (Slave) for IRRIInet-M Master

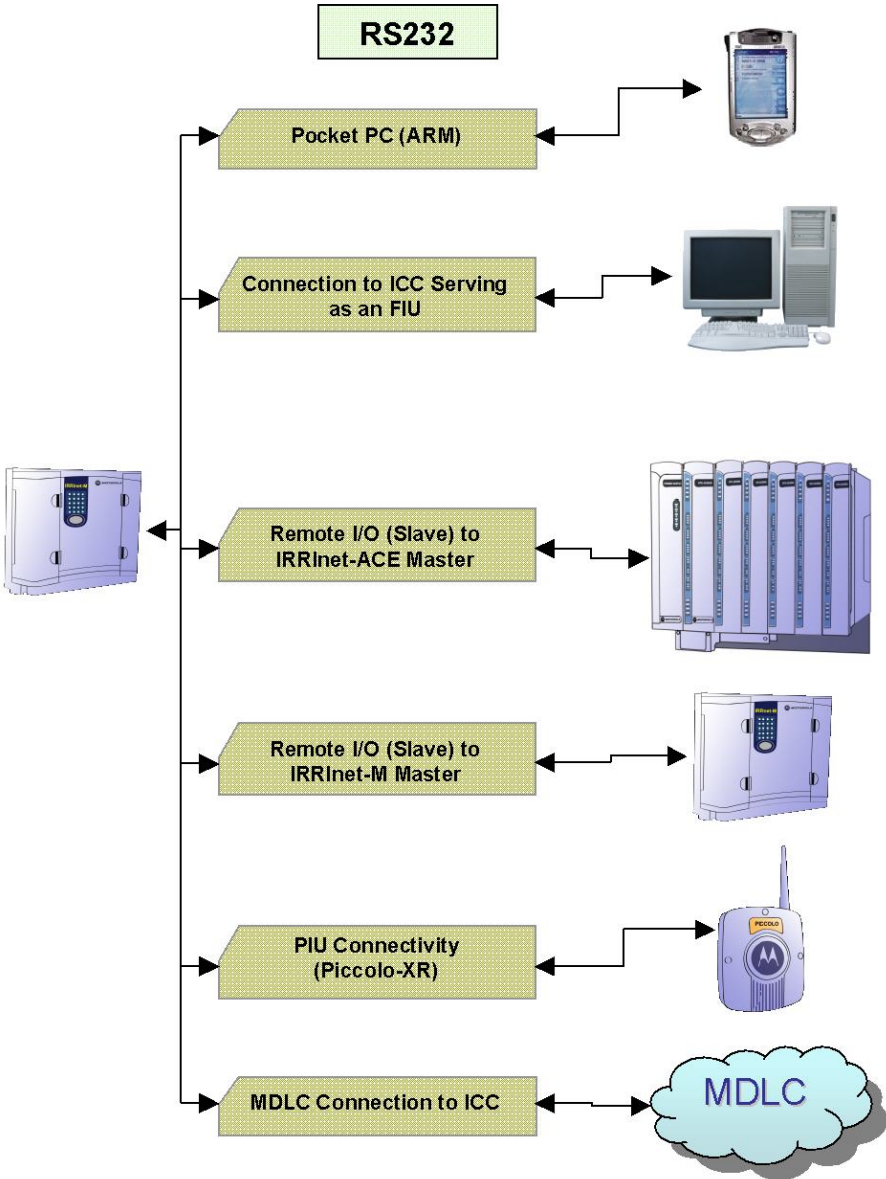
PIU Connection (only one)

MDLC Connection to ICC (not via modem)

ICC PT (Pocket Terminal)

ICC (FIU Connection)

Figure 3-3: IRRIInet-M RS232 Communication Option



PORT #3 Radio or Line Port



This port may serve the Radio communication or the Line communication, per installation, as configured by the STS.

Radio functionality

External Radio interface: A variety of radios can be attached for RTU to RTU Communication (MDLC), using DPSK (1200 bps), FSK (2400 bps), dual-binary (9600 bps) (HDLC); or Communication with Remote I/Os using FSK 900 Hz & 1500 Hz (600 bps).

If an IRRInet-M radio model is chosen, the power connection to the radio is available via the unit's Aux. DC connector. This can be 5, 7.5, 9.5, 12, VDC \pm 10%, 15W (max. 2.00 Amp).

If another radio is used (not a portable of the HT/GP family), the radio power source must be from an external power supply or battery, and not from the Aux. DC power out connector.

The list of compatible radios (per application) is listed in the Legacy Field Units chapter.

Remote I/O (Slave) for IRRInet-ACE Master

The IRRInet-M should be loaded with the IRRIV Slave application.

Use the STS to configure the port correctly. (The slave unit will “talk” MDLC to the master.)

Remote I/O (Slave) for IRRInet-M Master

The IRRInet-M should be loaded with the IRRIV Slave application.

Use the STS to configure the port correctly. (The slave unit will “talk” MDLC to the master.)

MDLC Connection to ICC

The IRRInet-M should be loaded with the IRRIV Master application.

Use the STS to configure the port correctly. (The unit will “talk” MDLC to the ICC.)

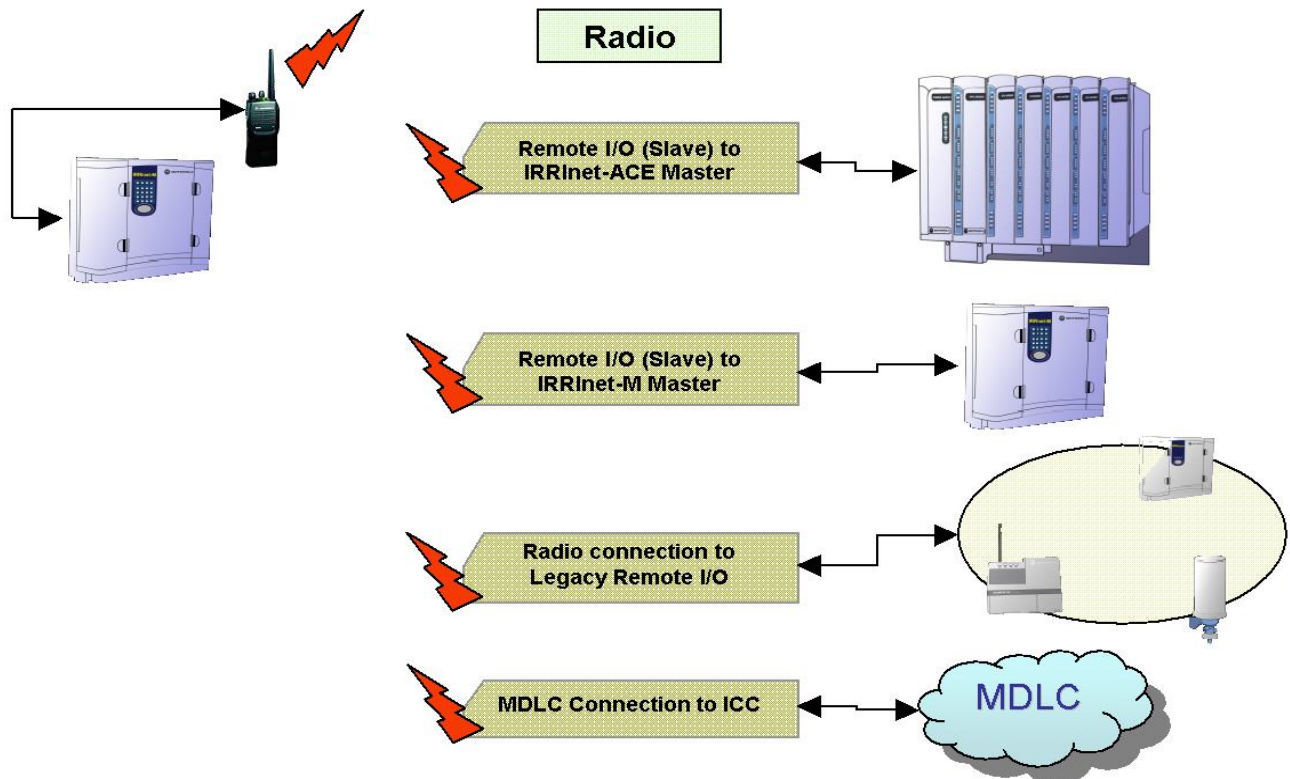
Radio Connection to Legacy Remote I/O

IRRInet-M as a master unit may operate legacy remote I/O Units, such as:

- Impact
- Scorpio
- Another IRRInet-M “disguised” as Scorpio or IRRIcom

Use the STS to configure the port correctly. (The unit will “talk” PRIS to the legacy remote I/O.)

Figure 3-4: IRRInet-M Radio Port Communication Option



Line functionality

Line interface: RTU to RTU Communication (MDLC), using DPSK (1200bps).

This is a Multi drop communication using internal FSK modem, for IRRInet-M units only.

Up to 32 units may be connected on this link. The length of the cable may be up to 10Km (6 Miles). The feasible length of the cable depends to a large degree on its quality.

Remote I/O (Slave) for IRRInet-M Master

The IRRInet-M should be loaded with the IRRIV Slave application.

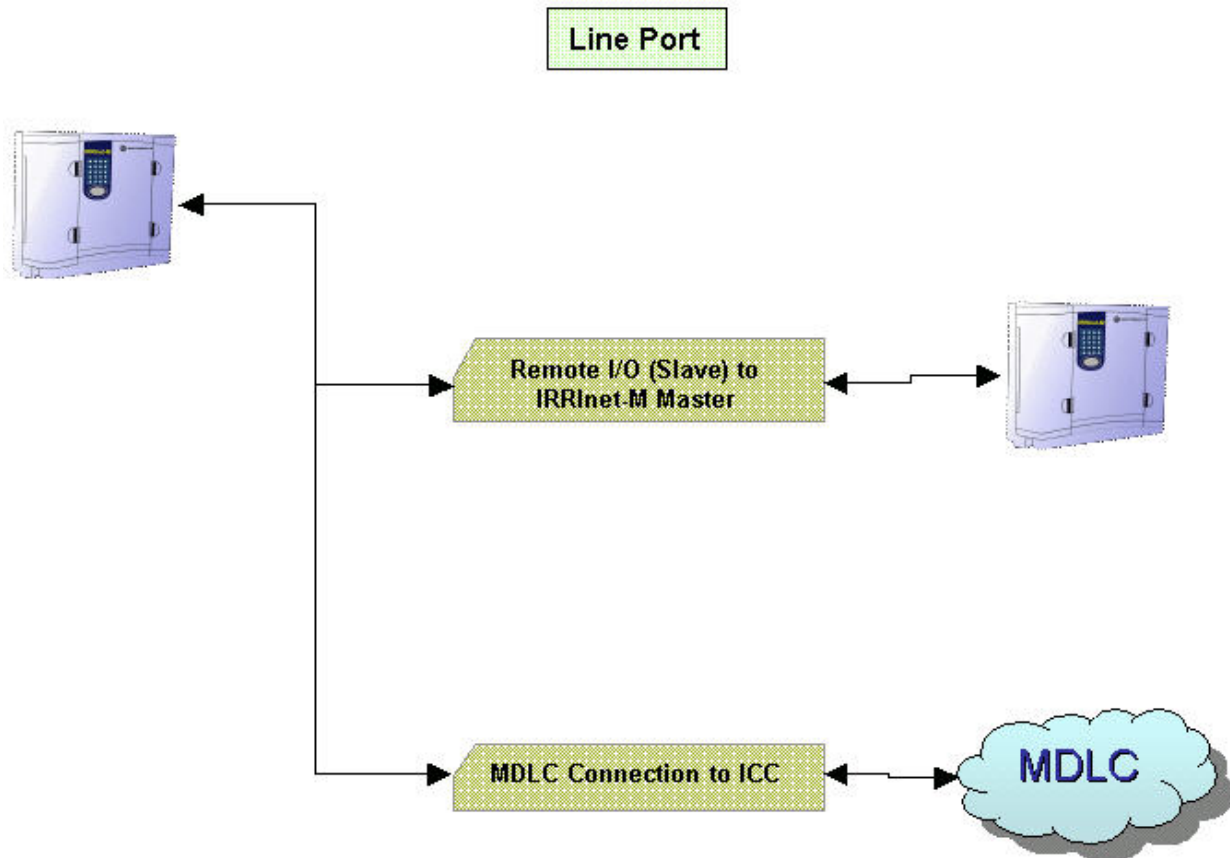
Up to 32 Slave units may be connected to one IRRInet-M Master RTU.

MDLC Connection to ICC

The IRRInet-M should be loaded with the IRRIV Master application.

In this configuration, the IRRInet-M units may create a communication backbone entirely or partially based on this wireline link.

Figure 3-5: IRRInet-M Line Port Communication Option



Configuration and Diagnostics

The IRRInet-M AC and DC RTUs feature the identical configuration and diagnostic tool.

Configuration

The configuration tool for the IRRInet-M is the ACE3600 System Tool Suite (STS) version 11.70 and above. For detailed information on using the STS to configure RTUs, please refer to the ACE3600 STS User Guide.

The STS is used for the following configuration features:

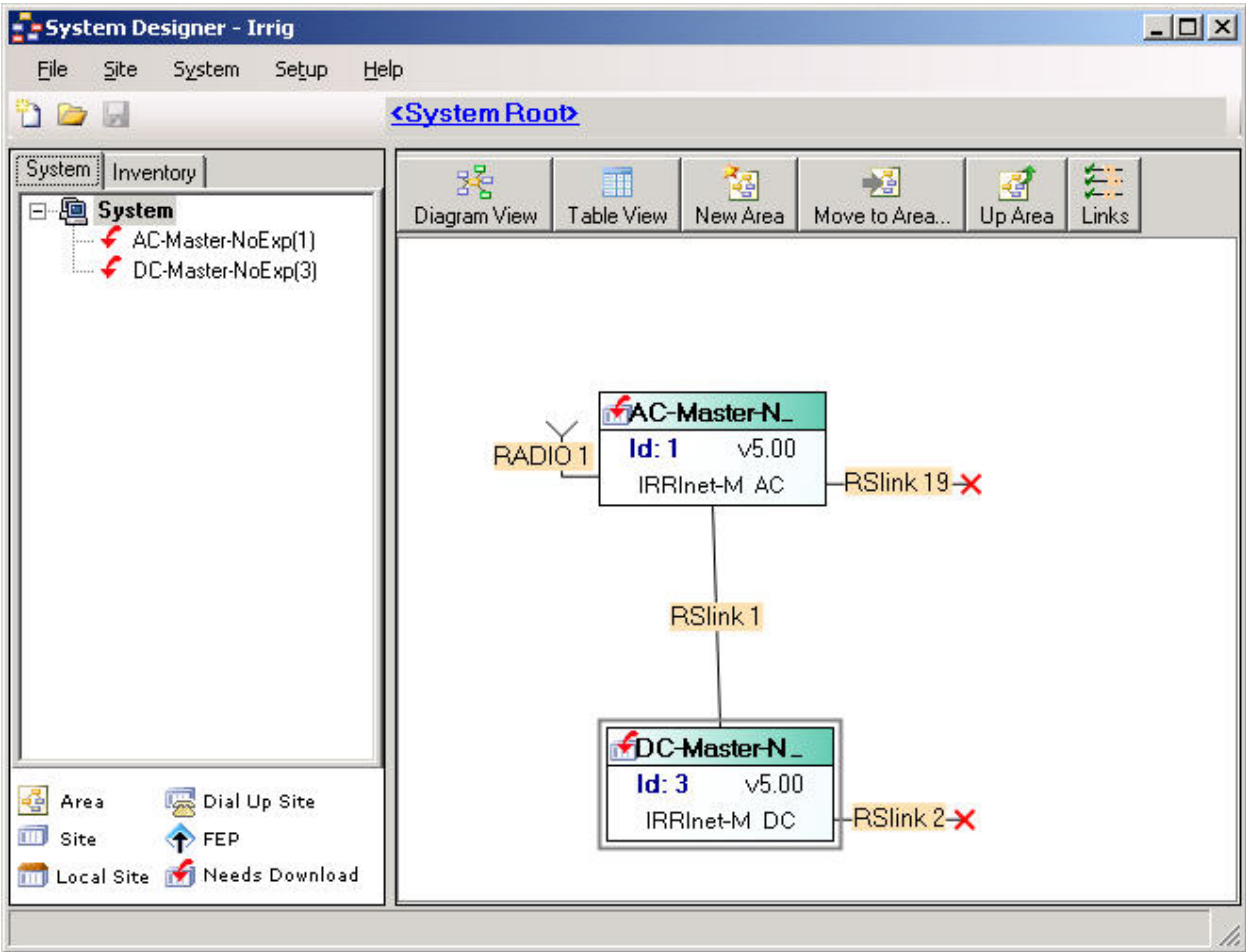
- Site Configuration (unit ID, port definitions, I/O definition etc.)
- Network Configuration
- Downloading files (e.g. application)
- Updating/synchronizing RTU time and date

Diagnostics

Either as stand-alone, or as part of a system, the following tools may be used for the IRRInet-M diagnostics:

- STS – using the Hardware Test and Logger (errors and diagnostics) features
- LED matrix (5 X 4) – located on the front panel, the LEDs provide fault identification and diagnostics for the various IRRInet-M building blocks (I/Os, CPU, communications, errors, etc.)
- The IRRIV application itself

Figure 3-6: IRRInet-M RTUs in STS Interface



Specifications

IRRInet-M DC

Environmental

Operating Temperature	-30 °C to +60 °C
Storage Temperature	-55 °C to +85 °C
Relative Operating Humidity	0 to 95% without condensation @ +50 °C
Operating Altitude	-400 m to +4000 m above sea level

Mechanical

Dimensions	21.50 x 17.50 x 8.50 cm (max.)
Weight	1.50 kg (max.)
User Connection	4*10 Terminal Blocks (including I/O Expansion)
Wire Gauge	14 #AWG (2.5 mm square)

Basic Board

INPUTS

Number of Inputs	4
Dry Contact Inputs Ratings	Open: > 50 kΩ (OFF) Closed: 0-4 kΩ (ON)
Input Isolation	1500 VAC between user connector and logic
Min Recognizable Pulse Width	20mSec
	DIs do not operate when I/O power supply is OFF.

OUTPUTS (DC Solenoids)

Number of Outputs	12
Output Drive Voltage	4-35V DC ± 10% (STS Adjustable ± 1V)
Output Short Circuit Indication	> 10A
Single Capacitor	3300 µF
Isolation	1500 VAC between user connector and logic

LEDs	CPU, IO1, IO2, IO3, LOAD, CONF, APPL, MON, RST, ERR, Alarm (User Page)
------	--

I/O Expansion Board

INPUTS

Number of Inputs	4
Dry Contact Inputs Ratings	Open: > 50 k Ω (OFF) Closed: 0-4 k Ω (ON)
Input Isolation	1500 VAC between user connector and logic
Min Recognizable Pulse Width	20mSec
	DIs do not operate when I/O power supply is OFF.

OUTPUTS (DC Solenoids)

Number of Outputs	12
Output Drive Voltage	4-35V DC \pm 10% (STS Adjustable \pm 1V)
Output Short Circuit Indication	> 10A
Single Capacitor	Use the main board capacitor 3300 μ F
Isolation	1500 VAC between user connector and logic

Communication Ports

RS232/RS485 (PC Connection)	Serial Asynch RS232 (MDLC), RS485 Multi Drop 2 Wire, MDLC/User port capability, RS232 external dial up modem
RS232 (PC Connection)	Serial Asynch RS232 (MDLC)
Radio	DPSK 1200 bps; FSK 2400 bps; COS 9600 bps (HDLC); INTRAC FSK 900/1500 Hz (450 Baud) (User application)
Line	DPSK 1200 bps (HDLC)
Radio Tx Level	STS Adjustable (No Load)
Radio Rx Level	100 – 800 mV
Line Tx Level	1100 – 1300 mV (load = 600 Ω) STS Adjustable, Default: 0DB
Line Rx Level	60 – 1500 mV

Power

Input Voltage	
DC External Source (PWR IN)	9-30VDC (12 or 24 VDC \pm 25%)

Auxiliary Voltage (PWR OUT)	5V, 7.5V, 9.5V, 12V DC \pm 10% VDC, 15W max., 2.00A max.
Minimum Main Voltage required to supply Aux Voltage of 5V	10.8V
Minimum Main Voltage required to supply Aux Voltage of 7.5V	10.8V
Minimum Main Voltage required to supply Aux Voltage of 9.5V	12V
Minimum Main Voltage required to supply Aux Voltage of 12V	14V
Power Modes	
DC Operating	9.00 to 30.00 VDC
Power Consumption	
24VDC External (PWR IN):	
Normal Operating Mode:	
Radio Standby	\leq 150 mA @ 14VDC
Radio Transmit	\leq 2.50 A during transmission
12VDC External (PWR IN):	
Operating Mode:	
Radio Standby	\leq 80.00 mA
Radio Transmit	\leq 2.50 A during transmission
Power Monitors	
Power Input Reports Tolerance	\pm 400 mV
Power Switches	Auxiliary Voltage Power Supply ON/OFF
Reverse Input Voltage Connection Protection	
Over Voltage Input Power Protection	Up to 40VDC

Regulatory

EN55022: 2006, Class B	
EN55024: 1998	Amendments A1: 2001; A2: 2003
IEC61000-4-2: 1995	Air Discharge, 8kv Contact Discharge, 4kv
IEC61000-4-3: 1995	(80-1000 MHz), 3V/m 80% A.M. by 1kHz
IEC61000-4-4: 1995	0.5kV DC Power Lines, 0.5kV Signal Lines

IEC61000-4-5: 1995	1kV DC Power and Signal Lines
IEC61000-4-6: 1996	(0.15-80 MHz), 3V, 80% A.M. by 1kHz Power and Signal Lines
IEC61000-4-8: 1993	1A/m, 50Hz

FCC Part 15, Sub-part B, Class B

AZ/NZS CISPR 22: 2006 Class B

ICES-003, Issue 4: 2004 Class B

CAN/CSA – CEI/IEC CISPR 22: 02

Safety:

EN/IEC 60950-1

UL60950-1

CSA C22.2 60950-1

AS/NZS 60950.1-2003 + A1

EN 60950-1:2001 + A11:2004

IRRInet-M AC

Environmental

Operating Temperature	-30 °C to +60 °C
Storage Temperature	-55 °C to +85 °C
Relative Operating Humidity	0 to 95% without condensation @ +50 °C
Operating Altitude	-400 m to +4000 m above sea level

Mechanical

Dimensions	21.50 x 17.50 x 8.50 cm (max.)
Weight	1.50 kg (max.)
User Connection	4*10 Terminal Blocks (including I/O Expansion)
Wire Gauge	14 #AWG (2.5 mm square)

Basic Board

INPUTS

Number of Inputs	4
Dry Contact Inputs Ratings	Open: > 50 kΩ (OFF) Closed: 0-4 kΩ (ON)
Input Isolation	1500 VAC between user connector and logic
Min Recognizable Pulse Width	20mSec

DIs do not operate when I/O power supply is OFF.

OUTPUTS (AC Solenoids)

Number of Outputs	12
Output Drive Voltage	Internal: 24V RMS ± 20% External: Up to 30VAC or 48VDC
Output Short Circuit Indication	≥ 8A RMS
Max Current per Output	1A RMS
Max Current for Internal Power Source Outputs	6A
Max Current for External Power Source Outputs	6A

Isolation 1500 VAC between user connector and logic in case of external output drive only

LEDs CPU, IO1, IO2, IO3, LOAD, CONF, APPL, MON, RST, ERR, Alarm (User Page)

I/O Expansion Board

INPUTS

Number of Inputs	4
Dry Contact Inputs Ratings	Open: > 50 kΩ (OFF) Closed: 0-4 kΩ (ON)
Input Isolation	1500 VAC between user connector and logic
Min Recognizable Pulse Width	20mSec

DIs do not operate when I/O power supply is OFF.

OUTPUTS (AC Solenoids)

Number of Outputs	12
Output Drive Voltage	Internal: 24V RMS ± 20% External: Up to 30VAC or 48VDC
Output Short Circuit Indication	≥ 8A RMS
Max Current per Output	1A RMS

Max Current for Internal Power Source Outputs	6A
Max Current for External Power Source Outputs	6A
Isolation	1500 VAC between user connector and logic in case of external output drive only

Communication Ports

RS232/RS485 (PC Connection)	Serial Asynch RS232 (MDLC), RS485 Multi Drop 2 Wire, MDLC/User port capability, RS232 external dial up modem
RS232 (PC Connection)	Serial Asynch RS232 (MDLC)
Radio	DPSK 1200 bps; FSK 2400 bps; COS 9600 bps (HDLC); INTRAC; FSK 900/1500 Hz (450 Baud) (User application)
Line	DPSK 1200 bps (HDLC)
Radio Tx Level	STS Adjustable (No Load)
Radio Rx Level	100 – 800 mVrms
Line Tx Level	1100 – 1300 mVrms (load = 600 Ω) STS Adjustable, Default: 0DB
Line Rx Level	60 – 1500 mVrms

Power

Input Voltage	
AC External Source (PWR IN)	24VAC RMS ± 20%
DC External Source (PWR IN)	9.00 to 16.00 VDC
Auxiliary Voltage (PWR OUT)	5V, 7.5V, 9.5V, 12V DC ±10% VDC, 15W max., 2.00A max.
Minimum Main Voltage required to supply Aux Voltage of 5V	10.8V
Minimum Main Voltage required to supply Aux Voltage of 7.5V	10.8V
Minimum Main Voltage required to supply Aux Voltage of 9.5V	12V
Minimum Main Voltage required to supply Aux Voltage of 12V	14V

Power Modes

AC Normal Operating	24VAC RMS \pm 20%
DC Operating	9.00 to 16.00 VDC
AC Power Fail	< 19VAC RMS

Power Consumption

AC External (PWR IN):

Normal Operating Mode:

Radio Standby	\leq 150 mA @ 14VDC RMS
Radio Transmit	\leq 2.50 A RMS during transmission

DC External (PWR IN):

Operating Mode:

Radio Standby	\leq 80.00 mA
Radio Transmit	\leq 2.50 A during transmission

Power Monitors

Power Input Reports Tolerance	\pm 1 V
External (PWR IN):	
Power OK Voltage	STS Adjustable

Reverse Input Voltage Connection Protection

Over Voltage Input Power Protection	Up to 40VDC
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Regulatory

EN55022: 2006, Class B

EN55024: 1998 Amendments A1: 2001; A2: 2003

EN61000-3-2: 2006, Class A

EN61000-3-3: 1995 Amendments A1: 2001; A2: 2005

IEC61000-4-2: 1995 Air Discharge, 8kv
Contact Discharge, 4kv

IEC61000-4-3: 1995 (80-1000 MHz), 3V/m
80% A.M. by 1kHz

IEC61000-4-4: 1995 1kV Power Lines, 0.5kV, Signal Lines

IEC61000-4-5: 1995 COM. Mode; 2kV, Dif. Mode; 1kV

IEC61000-4-6: 1996 (0.15-80 MHz), 3VRMS, 80% A.M. by 1kHz
Power and Signal Lines

IEC61000-4-8: 1993 1A/m, 50Hz

IEC61000-4-11: 1994 V reduc >95%, 30%, >95%
Duration 0.5per, 25 per, 250 per

FCC Part 15, Sub-part B, Class B

AZ/NZS CISPR 22: 2006 Class B

ICES-003, Issue 4: 2004 Class B

CAN/CSA – CEI/IEC CISPR 22: 02

IRRInet-ACE

General Description

The IRRInet-ACE RTU is an ACE3600 loaded with the irrigation application. It uses the identical hardware and system software as the ACE3600 RTU.

When ordering the IRRInet-ACE, use the Ordering Information section of the ACE3600 System Planner and ADD the option V450 for a CPU3610 designated IRRInet-ACE or V451 for a CPU3640 designated IRRInet-ACE.

A full featured part of the IRRInet control system, IRRInet-ACE supports two modes of operations:

- RTU – Performing all irrigation functions, reporting to the ICC
- Stand Alone – Performing all irrigation functions as a stand-alone unit when the system is installed without an ICC.

With DIOS connectivity, the IRRInet-ACE can activate Piccolo-XR units with its PIU functionality.

On site programming is supported by ICC PT or ICC Terminal connectivity.

The IRRInet-ACE may be installed in a totally new irrigation system, as well as in legacy system (replacing/in addition to IRRInet, IRRInet-XL or IRRInet-XM).

Power Connection Guidelines



The power connection guidelines for the IRRInet-ACE and ACE3600 RTUs are identical.

The IRRInet-ACE supports various Power Supply models. Please refer to the ACE3600 Owner's Manual and System Planner for details.

Inputs/Outputs Guidelines

The Inputs/Outputs Modules design guidelines for the IRRInet-ACE and ACE3600 RTUs are identical.

IRRInet-ACE supports all of ACE3600 I/O modules. Please refer to the ACE3600 User's Manual and System Planner for details.

No module is available for DC Latch solenoids.

For 24 VAC solenoids, use the modules listed below:

- 8 DO ML relay (FLN 3538)
- 16 DO ML relay (FLN 3539)
- 8 DO EE (FLN 3605)
- 16 DO EE (FLN 3537)

For dry contact inputs (water meters, etc.) use the modules listed below: (Goren to advise)!!!!!!

- 16 DO/DI (FLN3553)
- 32DO/DI (FLN3554)

Software Application and Capacity Guidelines

A full featured part of the IRRInet control system, IRRInet-ACE supports two modes of operations:

- RTU – Performing all irrigation functions, reporting to the ICC
- Stand Alone – Performing all irrigation functions as a stand-alone unit when the system is installed without an ICC.

Master/Slave Design Guidelines

The IRRInet-ACE supports only Master application (loaded with IRRIV Master application):

- Reports to the ICC (via communication network) and is recognized by the ICC as a Field Unit.
- Includes, manages and handles the irrigation functionality and “entities”, such as:
 - o Main Lines
 - o Irrigation Programs
 - o Accumulations
- May operate and control Remote I/Os such as DIOS (via PIU) and other Slave RTU(s).

Capacity Guidelines

The IRRInet-ACE can handle the following capacity of elements:

Element	Size
Inputs (total)	500
Outputs (total)	500

Element	Size
Meters (as part of the Input count)	500
Virtual Meters (as part of the input count)	50
Main Lines	250
Programs	400
Groups	400
Fert. pumps (as part of the outputs count)	100
Fertilizer Farms	100
Filter Batteries	100
Filter Stations (as part of the outputs count)	200
Dummy Stations (flags)	500
Externals Conditions (flags)	500
Complex Conditions (900)	250
Slave Units Including Scorpions and not including XR's)	250
Impact Units	200
Analog Output (Including logical)	100
Analog Input (including logical)	100
Virtual Analog Inputs	6
Data Logging items	250
TaTi Programs Quantity	1
Total Meters in TaTi Program	500

Communication Guidelines



The communication guidelines for the IRRInet-ACE and the ACE3600 RTUs are identical.

IRRInet-ACE supports various communication options. Please refer to the ACE3600 Owner's Manual and System Planner for details.

The IRRInet-ACE supports various communication ports. In this section, we will discuss each of the ports and the applicable configurations for the IRRInet System.

Port setup and configuration is performed using the ACE3600 STS.

Plug-in 1 (PI1)

The options for this plug-in port are:

- RS-232
- RS-485
- 10 MB Ethernet
- 10/100 MB Ethernet
- Radio Modem



For RS232

ICC PT (IRRInet Terminal for Pocket PC)

The IRRInet-ACE should be loaded with the IRRIV Master application.

ICC PT may be connected to this port. An IRRInet Terminal for Pocket PC equipped with Bluetooth communication may also be connected, once the RS232 on the RTU is connected to an RS232 to Bluetooth adapter.

ICC (FIU Connection)

The IRRInet-ACE should be loaded with the IRRIV Master application. In a system configured with an FIU, this RS232 port may be used to connect the ICC (PC) to the IRRInet-ACE unit functioning as an FIU.

Master I/Os at IRRInet-M Slave

The IRRInet-ACE should be loaded with the IRRIV Master application, while an IRRInet-M should be loaded with the Slave application. The Master unit may control I/Os on the IRRInet-M slave unit. Furthermore, in this configuration, it is possible via the Slave unit (IRRInet-M) to route (via its radio port) commands from the Master unit (IRRInet-ACE) to legacy remote units, such as:

- Impact
- Scorpio
- An IRRInet-M “disguised” as Scorpio or IRRicom

Note: The IRRInet-M Master/Router does not support the current legacy IRRicom as a remote I/O controller.

Use the STS to configure the Router radio port correctly. (The unit will “talk” PRIS to the legacy remote I/O.)

PIU Connection

The IRRInet-ACE should be loaded with the IRRIV Master application.

RS232 is a point-to-point connection (not multi-drop), so this connection is suitable for one PIU connection.

MDLC Connection to ICC

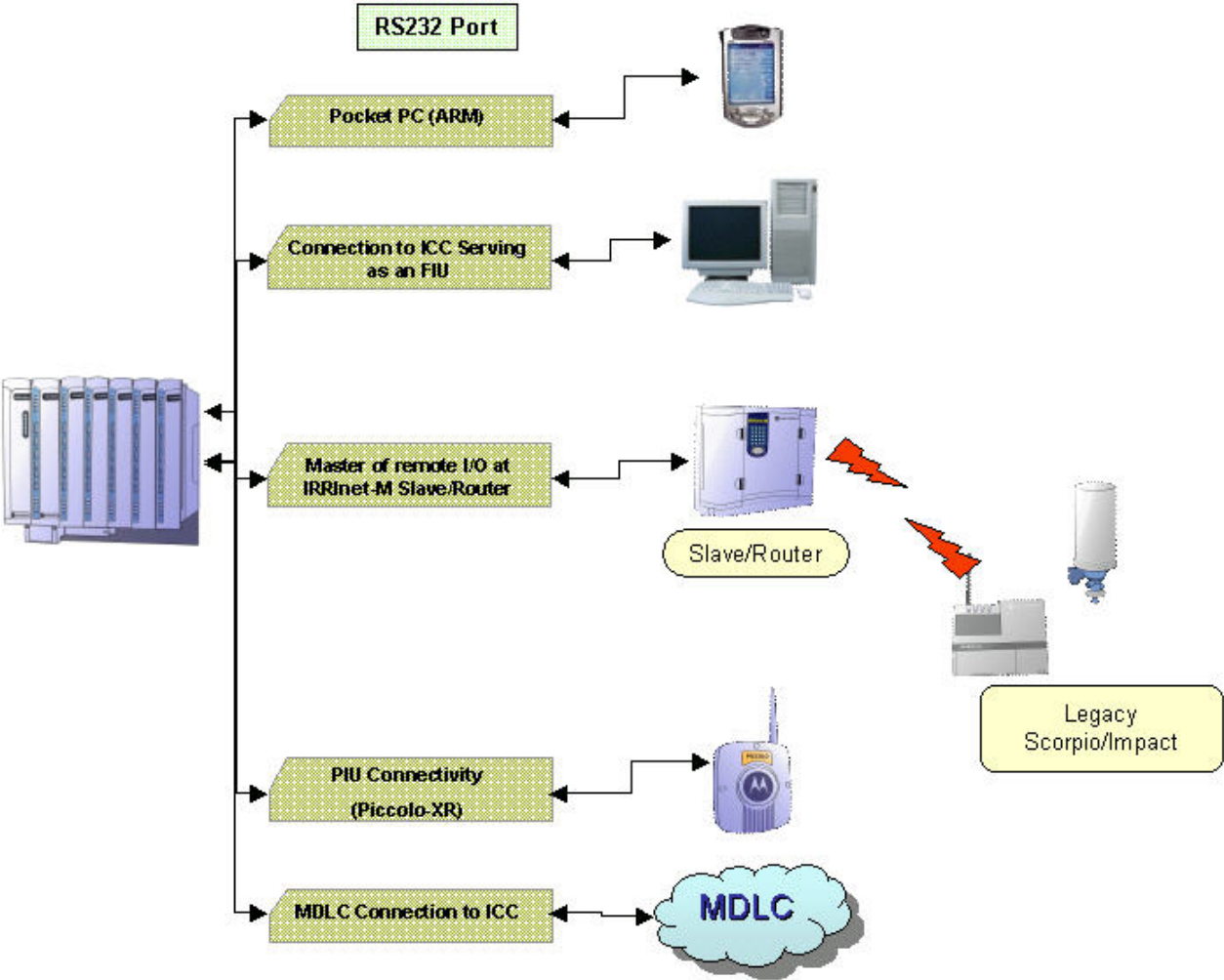
The IRRInet-ACE should be loaded with the IRRIV Master application.

The IRRIInet-ACE may use this port in order to communicate, via the MDLC network, with the ICC.

This RS232 is a “full featured” 232 port, thus may communicate with the MDLC “cloud” (ICC) utilizing the following options

- Any other IRRIInet Master unit (IRRIInet-XL, IRRIInet-XM, IRRIInet-ACE or IRRIInet-M)
- Modem – Dial-Up, GPRS, Ethernet, or any other modem suitable for the RS232 connection.
- Digital radios with RS232 connectivity

Figure 3-7: IRRIInet-ACE RTU RS232 Connection



For RS-485

Master I/Os at IRRInet-M Slave

The IRRInet-ACE should be loaded with the IRRIV Master application, while an IRRInet-M should be loaded with the Slave application. The Master unit may control I/Os on the IRRInet-M slave unit.

Up to 16 Slave units may be connected to one IRRInet-ACE Master RTU.

Furthermore, in this configuration, it is possible via one of the Slave units (IRRInet-M) to route (via its radio port) commands from the Master unit (IRRInet-ACE) to legacy remote units, such as:

- Impact
- Scorpio
- An IRRInet-M “disguised” as Scorpio or IRRicom

Note: The IRRInet-M Master/Router does not support the current legacy IRRicom as a remote I/O controller.

Note: RS485 is a standard – length of wire, communication speed, noise conditions and other factors may affect this channel performance.

PIU Connection

The IRRInet-ACE should be loaded with the IRRIV Master application.

Up to five PIU units may be connected to one IRRInet-M Master RTU.

Note: RS-485 is a standard – length of wire, communication speed, noise conditions and other factors may affect this channel performance.

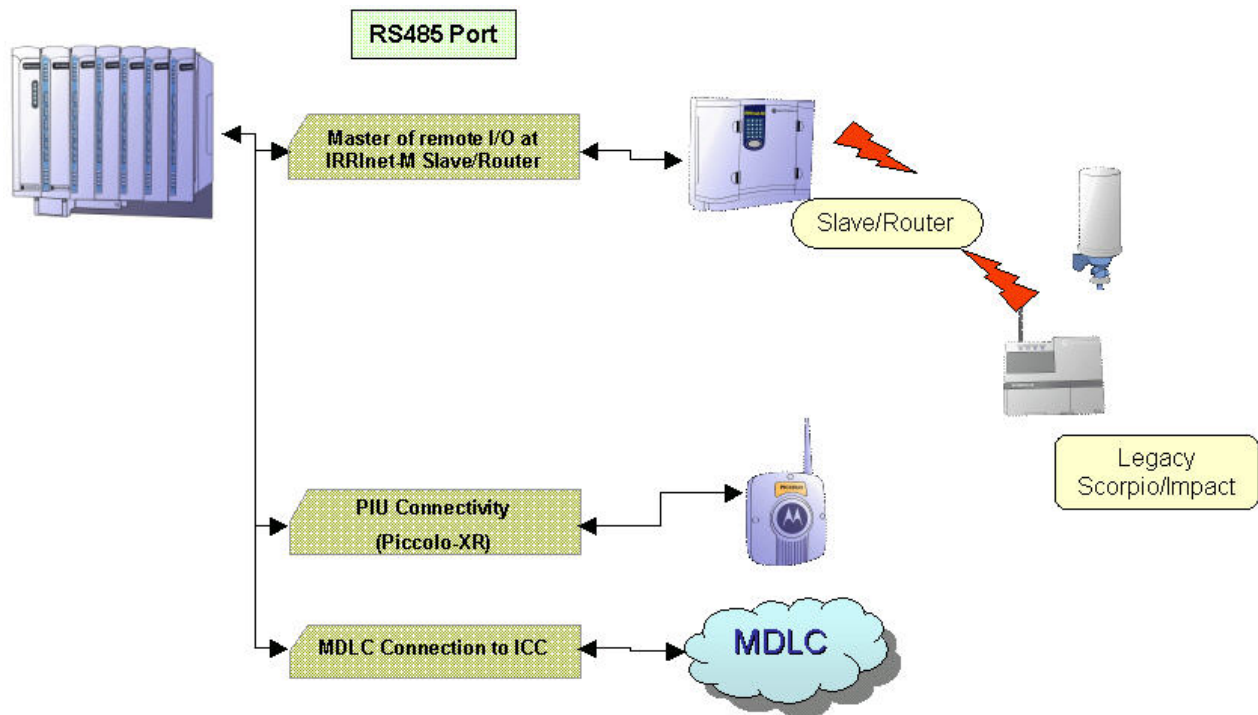
MDLC Connection to ICC

The IRRInet-ACE should be loaded with the IRRIV Master application.

IRRInet-ACE can use this port in order to communicate, via the MDLC network, with the ICC.

Note: RS-485 is a standard – length of wire, communication speed, noise conditions and other factors may affect this channel performance.

Figure 3-8: IRRInet-ACE RTU RS485 Connection



For 10 MB or 10/100 MB Ethernet

MDLC Connection to ICC

The IRRInet-ACE should be loaded with the IRRIV Master application.

IRRInet-ACE can use this port in order to communicate, via the MDLC network, with the ICC.

For Radio Modem

A variety of radio communications options is available for the IRRInet-ACE (identical to the ACE3600). For all available options, please refer to the ACE3600 Owner's Manual and System Planner.

Once a radio communication link is established it may serve two purposes, at the same time:

MDLC Connection to ICC

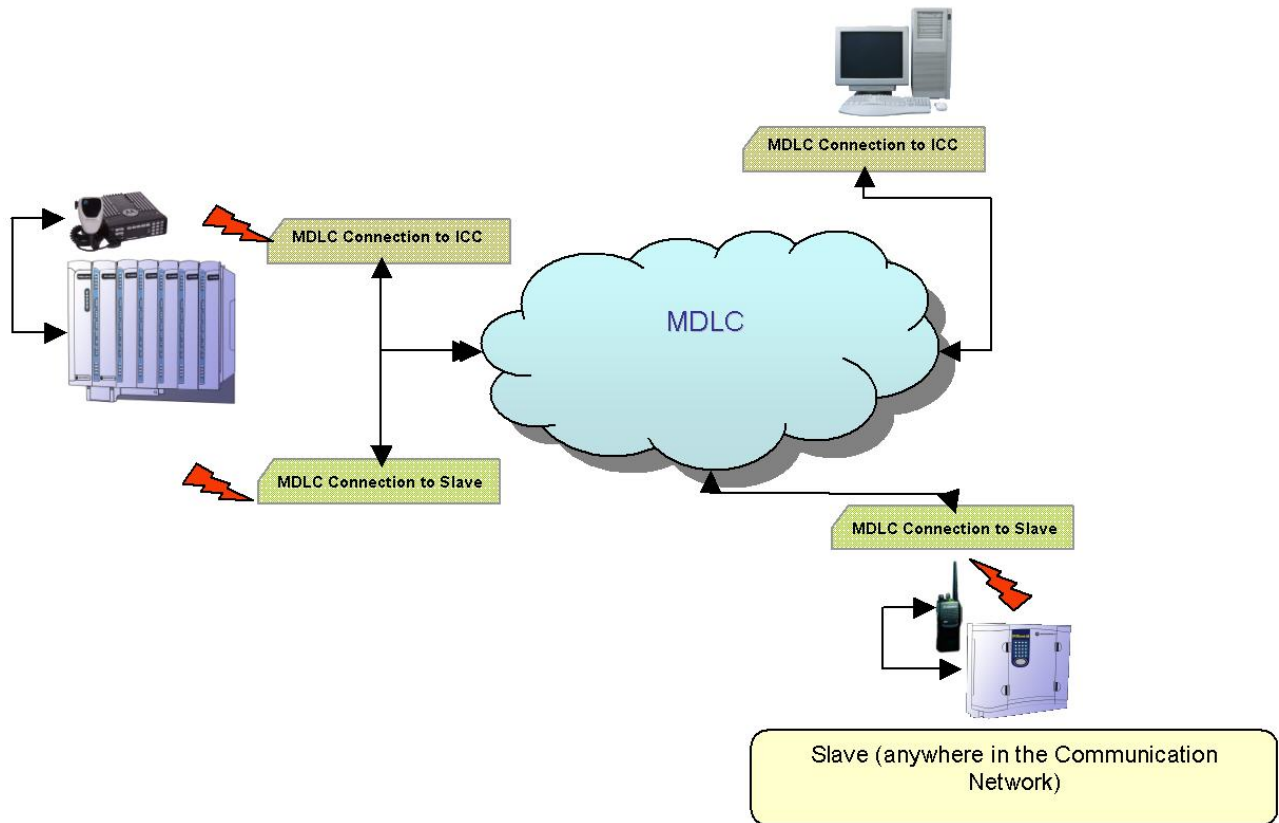
The IRRInet-ACE should be loaded with the IRRIV Master application.

IRRInet-ACE can use this port in order to communicate, via the MDLC network, with the ICC.

Master I/Os at IRRInet-M Slave

The IRRInet-ACE should be loaded with the IRRIV Master application, while the IRRInet-M should be loaded with the Slave application. The Master unit may control I/Os on the IRRInet-M slave unit, wherever it is located in the communication network. This will work only for IRRInet-M slave units.

Figure 3-9: IRRInet-ACE RTU Radio Connection



Serial 1 (SI1)

The SI1 port is an on-board port that may be configured as RS232 or RS485 in the STS.

If configured as RS232, it may perform the same functionality as Plug-in 1 (PI1) with RS232, i.e.:

ICC PT (Pocket Terminal)

ICC (FIU Connection)

Master I/Os at IRRInet-M Slave

PIU Connection

MDLC Connection to ICC

If configured as RS485, it may perform the same functionality as Plug-in 1 (PI1) with RS485, i.e.:

Master I/Os at IRRInet-M Slave

PIU Connection

MDLC Connection to ICC

Serial 2 (SI2)

The SI2 port is an RS232 on-board port.

This port may perform the same functionality as Plug-in 1 (PI1) with RS232, i.e.:

ICC PT (Pocket Terminal)

ICC (FIU Connection)

Master I/Os at IRRInet-M Slave

PIU Connection

MDLC Connection to ICC

Eth 1 (E1)

The E1 port is a 10/100 Base T Ethernet port (on CPU 3640 only).

MDLC Connection to ICC

The IRRInet-ACE should be loaded with the IRRIV Master application.

IRRInet-ACE can use this port in order to communicate, via the MDLC network, with the ICC.

Plug-in 2 (PI2)

The options for the PI2 plug-in port are the same as for PI1 except for the 10/100 MB Ethernet. The functionality is the same as well.

- RS-232
- RS-485
- 10 MB Ethernet
- Radio Modem



For RS-232

ICC PT (Pocket Terminal)

ICC (FIU Connection)

Master I/Os at IRRInet-M Slave

PIU Connection

MDLC Connection to ICC

For RS-485

Master I/Os at IRRInet-M Slave

PIU Connection

MDLC Connection to ICC

For 10 MB Ethernet

MDLC Connection to ICC

For Radio Modem

MDLC Connection to ICC

Master I/Os at IRRInet-M Slave

Configuration and Diagnostics

The IRRInet-ACE and the ACE3600 are identical, including configuration and diagnostics guidelines.

For in-depth explanations concerning this topic, please refer to the ACE3600 User's Manual and System Planner.

Configuration

The configuration tool for the IRRInet-ACE is the ACE3600 System Tool Suite (STS) version 11.70 and above. For detailed information on using the STS to configure RTUs, please refer to the ACE3600 STS User Guide.

Diagnostics

Either as stand-alone, or as part of a system, the following tools may be used for the IRRInet-ACE diagnostics:

- STS – using the Hardware Test and Logger (errors and diagnostics) features
- LED matrix – on the front panel of every module
- The IRRIV application itself

Specifications

The specifications of the IRRIInet-ACE and the ACE3600 RTUs are identical. For detailed specifications, please refer to the ACE3600 Owner's Manual and ACE3600 System Planner.

Legacy Field Units

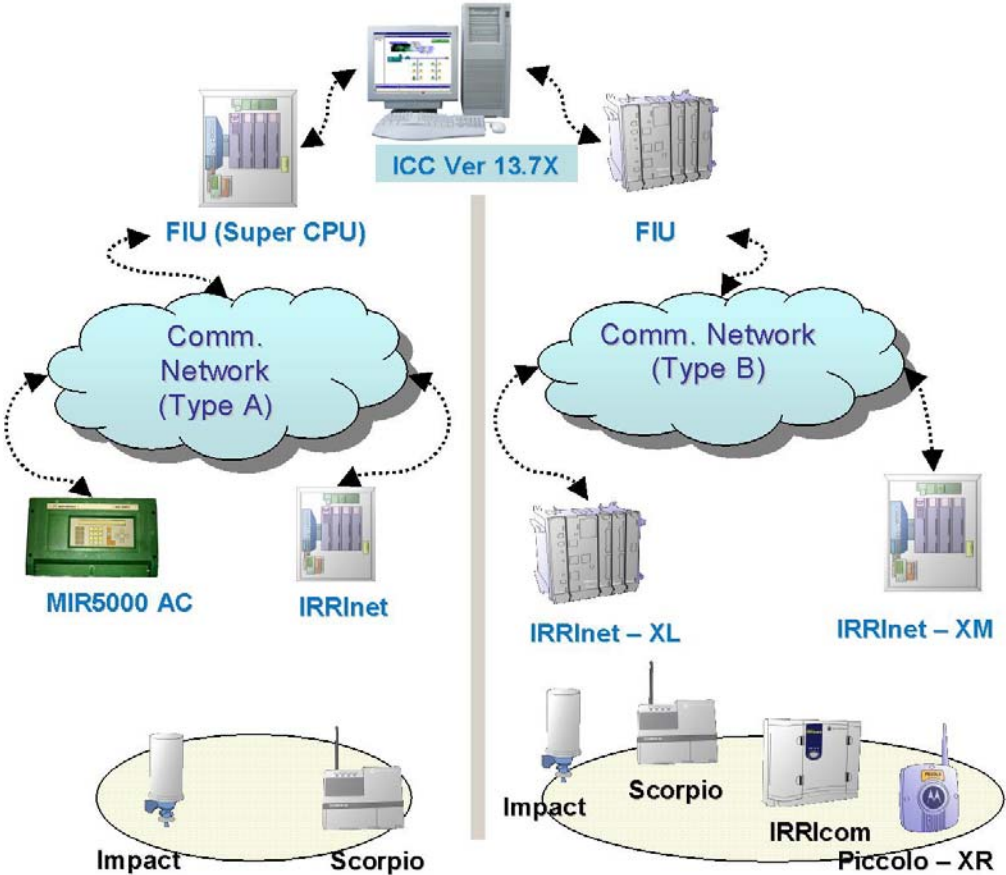
In this chapter we will describe how each of the legacy Field Units may be replaced/retrofitted with the newer units, IRRIInet-M and IRRIInet-ACE.

IRRIInet – System Configuration

The current supported configuration (as of June 2008), is described in the diagram below. Please refer to this diagram, in regard to the following explanations.

There is one main principle: Field Units from communication network “Type A” cannot be moved to communication network “Type B” and vice versa, because they do not share the same communication protocol. Remote I/O Units, however, may move from “A” to “B” and vice versa, because they do share the same communication protocol (except for the Piccolo-XR.)

Figure 3-10: IRRIInet-System Configuration



MIR5000



The MIR5000 Field Unit is suitable for Communication Network Type A only (reporting to a legacy, IRRInet FIU.)

Supported Field Unit – MIR5000 AC 52 stations, only.

When a MIR5000 AC 52 unit is to be replaced, the replacement Field Unit must be located in an existing or new MDLC Network (Communication Network Type B.)

Both IRRInet-ACE and IRRInet-M may replace the MIR5000 as follows:

- IRRInet-ACE
 - With Relay I/O boards (for solenoids activation),
 - With the appropriate communication media and link, so that the new IRRInet-ACE may communicate with the ICC.
- IRRInet-M
 - AC with or without expansion I/O board. If more than 24 stations were connected to the MIR5000, more than one IRRInet-M should be installed at the site.
 - With the appropriate communication media and link, so that the new IRRInet-M may communicate with the ICC.

IRRIInet

The IRRInet Field Unit is suitable for Communication Network Type A only (reporting to a legacy, IRRInet FIU).

When an IRRInet unit is to be replaced, the replacement Field Unit must be located in an existing or new MDLC Network (Communication Network Type B.)

Both IRRInet-ACE and IRRInet-M may replace the IRRInet as follows:

- IRRInet-ACE
 - With Relay I/O boards (for AC solenoids activation)
 - If the IRRInet Field Unit utilized DC Solenoids, only IRRInet-M may replace this part of the site.
 - If the IRRInet Field Unit utilized Single Cable (SC) modules (Piccolo RTUs), only IRRInet-XL or IRRInet-XM may replace this part of the site.
 - If the IRRInet Field Unit operated Impacts, two options are available for replacing this part of the site:
 - An IRRInet-M connected to the IRRInet-ACE, serving as a “slave” and router of the IRRInet-ACE (to activate the Impacts.)
 - An IRRInet-M as a “Master” Field Unit to operate the connected Impacts.



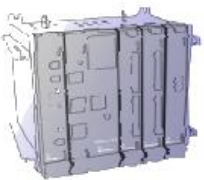
-
- o If the IRRInet Field Unit operated Scorpions, two options are available for replacing this part of the site:
 - An IRRInet-M connected to the IRRInet-ACE, serving as a “slave” and router of the IRRInet-ACE (to activate the Scorpions and Impacts.)
 - An IRRInet-M as a “Master” Field Unit to operate the connected Scorpions (and Impacts).
 - o With the appropriate communication media and link, so that the new IRRInet-ACE may communicate with the ICC.
- IRRInet-M
 - o IRRInet-M AC to replace AC solenoids
 - o IRRInet-M DC to replace DC solenoids
 - o If the Field Units utilized a Single Cable module (Piccolo RTUs), only IRRInet-XL or IRRInet-XM may replace this part of the site.
 - o If more than 24 stations were connected to the IRRInet, more than one IRRInet-M should be installed at the site.
 - o If the IRRInet Field Unit operated Impacts, IRRInet-M may operate the Impacts as well (based on the availability of a communication port.)
 - o If the IRRInet Field Unit operated Scorpions, IRRInet-M may operate the Scorpions as well (based on the availability of communication port.)
 - o With the appropriate communication media and link, so that the new IRRInet-ACE may communicate with the ICC.

IRRInet-XL, IRRInet-XM

The IRRInet-XL/XM Field Unit is suitable for Communication Network Type B only.

Both IRRInet-ACE and IRRInet-M may replace the IRRInet-XL/XM as follows:

- IRRInet-ACE
 - o With Relay I/O boards (for AC solenoids activation)
 - o If the IRRInet-XL/XM utilized DC Solenoids, only an IRRInet-M may replace this part of the site (as a “Slave” or “Master”).
 - o If the IRRInet-XL/XM utilized a Single Cable module (Piccolo RTU), only another IRRInet-XL/XM may replace this part of the site.
 - o If the IRRInet-XL/XM operated Impacts, two options are available for replacing this part of the site:
 - An IRRInet-M connected to the IRRInet-ACE, serving as a “slave” and router of the IRRInet-ACE (to activate the Impacts.)
 - An IRRInet-M as a “Master” Field Unit to operate the connected Impacts.



-
- o If the IRRInet XL/XM operated Scorpions, two options are available for replacing this part of the site:
 - An IRRInet-M connected to the IRRInet-ACE, serving as a “slave” and router of the IRRInet-ACE (to activate the Scorpions and Impacts.)
 - An IRRInet-M as a “Master” Field Unit to operate the connected Scorpions (and Impacts).
 - o With the appropriate communication media and link, so that the new IRRInet-ACE may communicate with the ICC.
- IRRInet-M
 - o IRRInet-M AC to replace AC solenoids
 - o IRRInet-M DC to replace DC solenoids
 - o If the IRRInet-XL/XM utilized a Single Cable module (Piccolo RTUs), only another IRRInet-XL/XM may replace this part of the site.
 - o If more than 24 stations were connected to the IRRInet-XL/XM, more than one IRRInet-M should be installed at site.
 - o If the IRRInet-XL/XM operated Impacts, IRRInet-M may operate the Impacts as well (based on the availability of communication port.)
 - o If the IRRInet-XL/XM operated Scorpions, IRRInet-M may operate the Scorpions as well (based on the availability of communication port.)
 - o With the appropriate communication media and link, so that the new IRRInet-M may communicate with the ICC.

IRRicom

IRRicom utilizes PRIS communication protocol and network.

When an IRRicom unit is to be replaced, one of the following approaches may be considered:

- The appropriate IRRInet-M (AC or DC), to replace the IRRicom, reporting to the existing (of the IRRicom) Field Unit. In this case, the IRRInet-M is “disguised” as IRRicom.
- The appropriate IRRInet-M (AC or DC), to replace the IRRicom, but to be placed as a “Master” Field Unit in Communication Network Type B.
- The appropriate IRRInet-M (AC or DC), to replace the IRRicom, but to be placed as a “Slave” Field Unit in Communication Network Type B.

The appropriate communication media and link should be selected per any of the above options.



Scorpio



Scorpio utilizes PRIS communication protocol and network.

Once such unit should be replaced, one of the following approaches may be considered –

- The appropriate IRRInet-M (AC or DC), to replace the Scorpio, reporting to the existing (of the Scorpio) Field Unit. In this case the IRRInet-M is “disguised” as Scorpio.
- The appropriate IRRInet-M (AC or DC), to replace the Scorpio, but to be placed as a “Master” Field Unit in Communication Network Type B.
- The appropriate IRRInet-M (AC or DC), to replace the Scorpio, but to be placed as a “Slave” Field Unit in Communication Network Type B.

The appropriate communication media and link should be selected per any of the above options.

Chapter 4 – Ordering Information

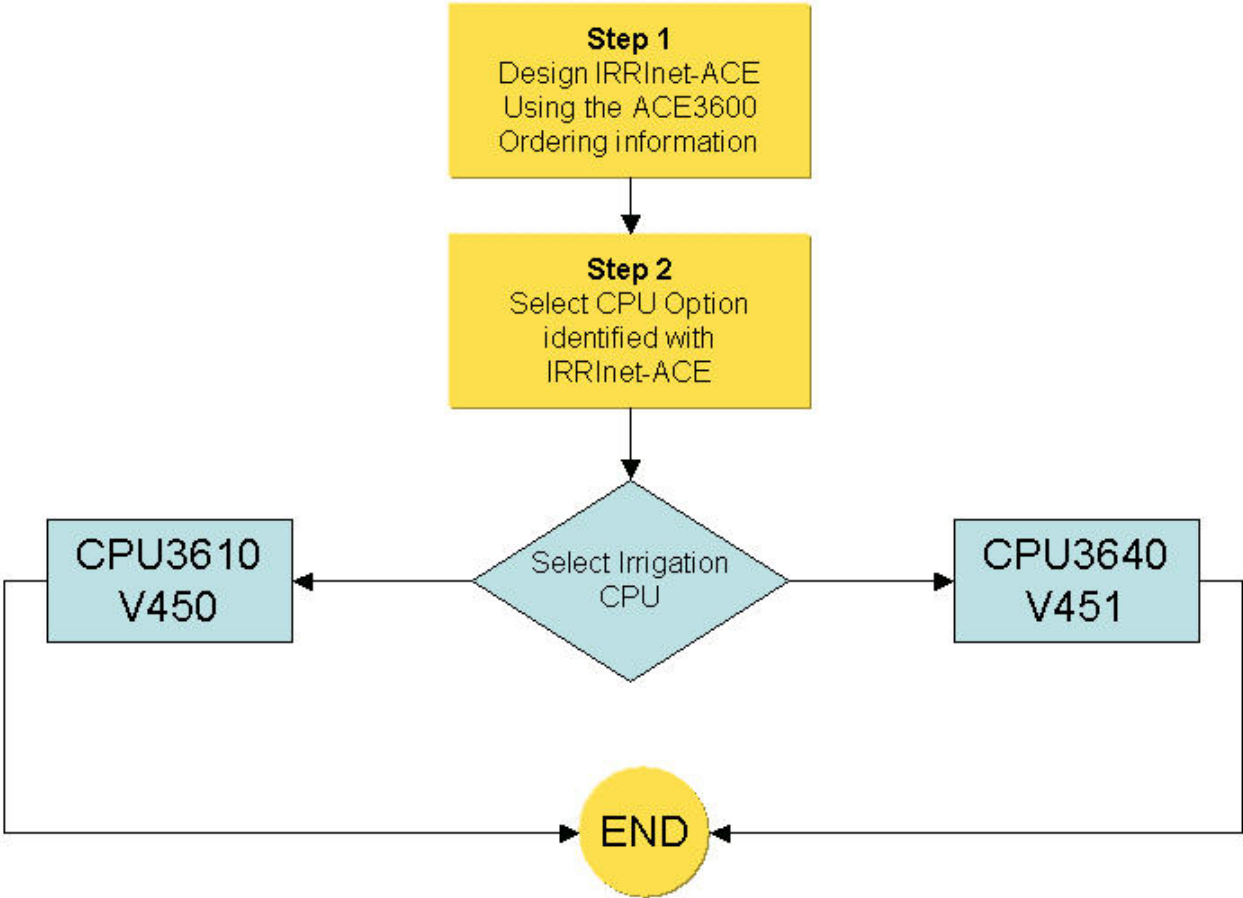
IRRInet-ACE Ordering Information

For IRRInet-ACE ordering information, please refer to the ACE3600 System Planner (6802979C45) or the How to Order ACE3600 presentation available from Motorola.

Designing an IRRInet-ACE field unit is identical to the design of the ACE3600 RTU.

The only item which need to be changed is the CPU option, as shown in the flowchart below.

Figure 4-1: IRRInet-ACE Ordering Information Flowchart

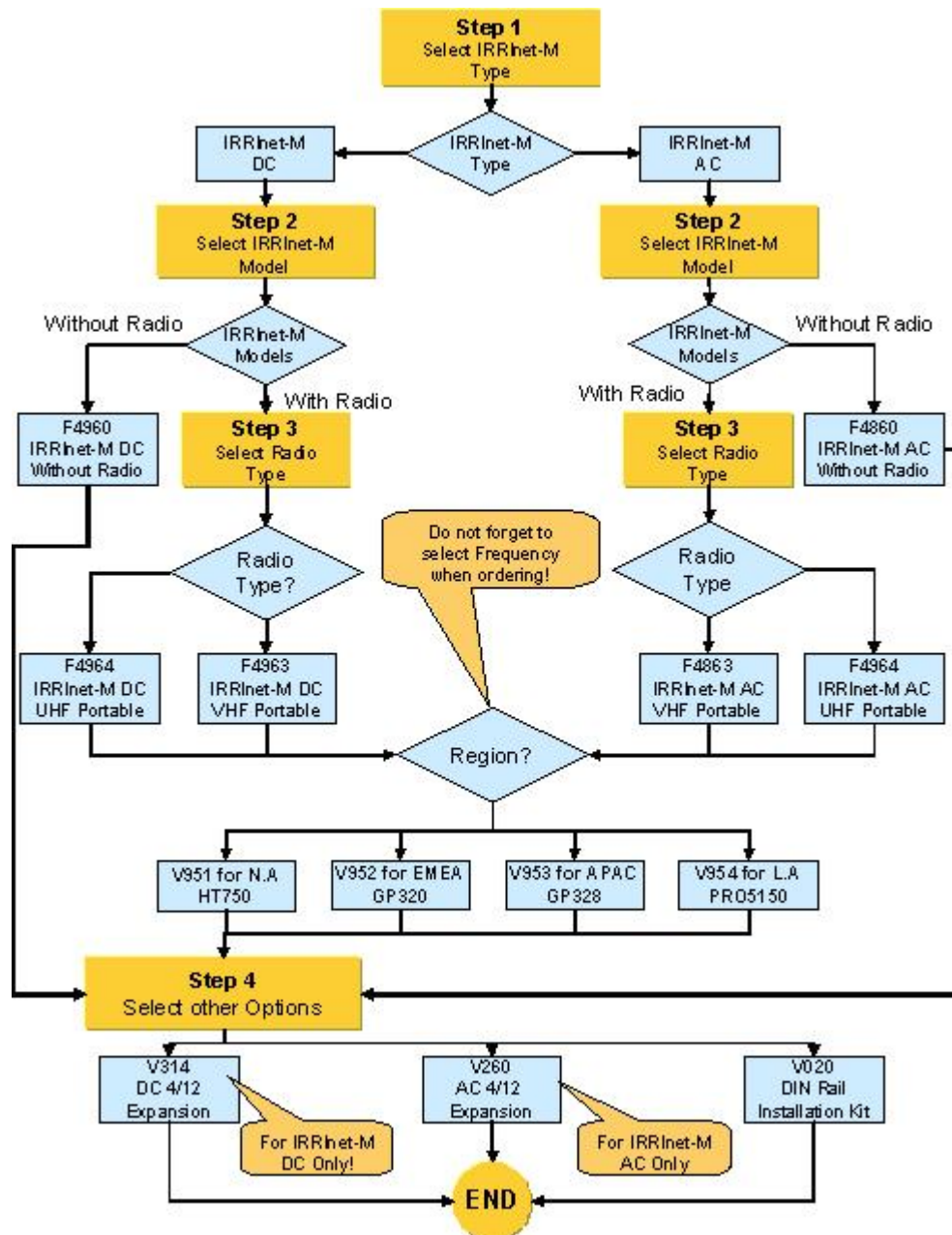


IRRInet-M Ordering Information

There are four steps to follow when ordering IRRInet-M as shown in the flowchart below.

1. Select IRRInet-M AC or DC.
2. Select IRRInet-M with or without Radio.
3. Select Radio (UHF/VHF) and Region.
4. Select additional available options.

Figure 4-2: IRRInet-M Ordering Information Flowchart



ICC Ordering Information

The ICC is comprised of only one Model Number and two options as shown in the below flowchart.

Figure 4-3: ICC Ordering Information Flowchart

