CorDEX

USER MANUAL

MN4000 & MN4100
SERIES THERMAL IMAGING CAMERAS

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OVERVIEW

The CorDEX Instruments, MN4xxx series of continuous monitoring cameras offer an affordable and accurate means of continuously monitoring temperature either as a standalone unit, or as part of a larger control system/ strategy.

The CorDEX MN4xxx camera platforms are designed primarily with Industry Control & Monitoring in mind and as such, are provided with the industry standard communication ability, MODBUS/TCP for communicating with devices such as Programmable Logic Controllers (PLCs).

The CorDEX MN4xxx may be installed in a standalone or multi camera mode, with each camera incorporating a built in web server for basic setup purposes which is accessible via a standard web browser using Ethernet/IP, additional CorDEX PC Setup Software is also available for download.

CorDEX MNxxx cameras are also supplied with PLC Function Blocks for popular brands. These prewritten code blocks are designed to dramatically reduce the amount of time required to integrate and MN4xxx into a PLC programme by enabling programmers to simply select a block and drop the code into the PLC ladder logic. Function Blocks are continuously added to the CorDEX MN4xxx website and include; Communications, Analysis and Alarming blocks.

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QUICK START GUIDE

1

Install the camera.

2

Download the CorDEX MONITIR PC Application from

3

Connect power via the standard screwed terminal block provided (11-20VDC).

> IMPORTANT NOTICE, MN4100 CAMERAS ARE SHIPPED WITH A PREFIXED STATIC IP ADDRESS OF 192.168.1.100. This can be altered using the CorDEX MONITIR PC App (recommended).

MN4000	**MN4100**
4 Connect the camera to your PC using a USB cable.	Connect the camera to your PLC using an Ethernet cable.
5 Start the CorDEX MONITIR PC App.	
6 Select Direct Connect USB icon.	Select Direct Connect Ethernet icon.
7 You have now accessed the CorDEX MN4000 series camera. From this screen you can setup and provide basic control commands to the camera.	Input the camera fixed static IP address 192.168.1.100 into the box and click Connect.
8 Click Submit. The camera will now restart with desired settings.	You have now accessed the CorDEX MN4100 series camera. From this screen you can setup and provide basic control commands to the camera.
9 -	Click Submit. The camera will now restart with desired settings.

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MECHANICAL INSTALLATION

MN4000

The CorDEX MN4000 panel mounted thermal imager is intended for permanent installation into electrical panels. Installation is achieved in two stages.

1

Install the Chassis into the panel.

2

Attach the Camera Package to the chassis.

Once the chassis has been installed, the camera package can be removed and replaced without shutting down or interrupting the panel.

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Installation of MN4000 Chassis

1

Remove the MN4000 from its packaging and place on a flat surface, taking care not to scratch the lens.
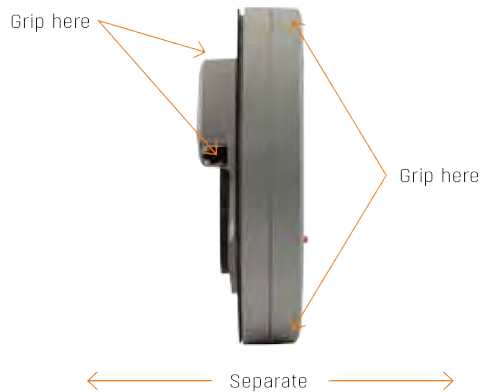
2

Remove the three screws securing the Camera Package to the Chassis.

3

Separate the Camera Package from the Chassis by holding the Chassis communication bulge in one hand and the Camera Package edge in the other hand then gently but firmly pull apart.

Grip here

Grip here

Separate

WARNING: Working on electrical equipment presents significant risk and should only be undertaken by suitably qualified personnel in accordance with local applicable codes, standards and corresponding Personal Protective Equipment (PPE). This installation procedure assumes a panel has been safely removed and transported to a suitable location.

4

Place the self-adhesive drilling template provided into the desired location. Care should be taken to ensure the rear of the panel is clear of ribs or other obstructions prior to drilling.

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5

Using the drill bit specified on the template (xxx), drill the three fixing holes located around the perimeter.

6

Using an appropriate holes saw or punch, drill the large (95mm/3¾") centre hole.

7

Debur all rough edges and treat with rust inhibitor.

8

Align Chassis with mounting holes and attach using three self-tapping screws provided, making sure to advance the screws evenly.
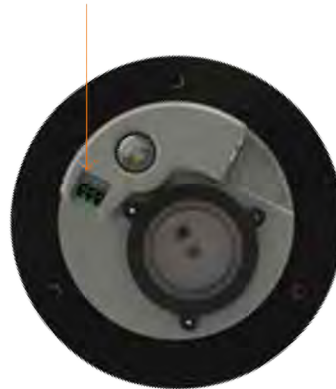
9

Connect 11-30VDC to the green power connector (provided) and attached to Chassis. There are three connections.

Top: 0V
Centre: Supplemental GND*
Bottom: +ve

*GND is a supplemental Ground connection. MN4000 Primary Ground is via the RJ45 socket and communications line. If no communications are installed, the Supplemental GND may be connected in accordance with local Electrical Codes / Regulatory Requirements.
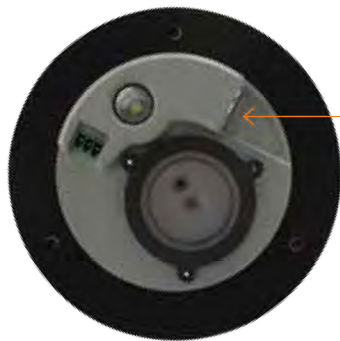
Power connections here

Chassis mounting holes

10

If communications are to be used, connect an Ethernet cable with RJ45 plug to Chassis.

Ethernet connection here

11

Replace the panel and secure before aligning the Camera Package with the Chassis and fasten into place with three fixing screws provided.

Chassis mounting screws

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MN4100

The CorDEX MN4100 industrial automation thermal imager is intended for permanent installation into fixed locations for industrial automation, control and safety monitoring purposes. Installation is via an M6x4 threaded boss located on the base of the camera and optional mounting arm, part number CDX8900-470 is also available.

MN4100 attached to **CDX8900-470** mounting arm.

MN4100 Base showing M6x4 mounting boss and two compression glands.

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Installation of MN4100

This installation procedure assumes that mechanical mounting and positioning has already occurred, for specific mounting instructions relating to CDX8900-470, please view the MN4100 Mounting Arm Installation Manual.

A typical industrial installation will comprise of armoured cable for both power and communications, terminating in a junction box adjacent to the camera. Unarmoured power and communications cables are run from the junction box to the camera via the two M16 compression gland entries located in the camera base.

Typical camera installation diagram

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1

Remove rear weather cap from camera to expose Ethernet socket and power terminals.

2

Insert power and communications cables into camera via 2xM16 compression glands provided. NOTE, these glands will accept cables with outside diameters from 3mm – 7mm.

3

Connect 11-30VDC to the green power connector (provided) and attached to Chassis. There are three connections

Top: 0V
Centre: Supplemental GND*
Bottom: +ve

*GND is a supplemental Ground connection. MN4000 Primary Ground is via the RJ45 socket and communications line. If no communications are installed, the Supplemental GND may be connected in accordance with local Electrical Codes / Regulatory Requirements.

4

Attached an RJ45 plug to the communications cable. **DO NOT PLUG INTO THE CAMERA AT THIS STAGE**.

Power connector

RJ45 Socket

Compression glands

5

Connect camera to a PC running CorDEX MONITIR software, select Direct Connection, Ethernet and use the default address 192.168.1.100. You can now configure the camera for your network, for more information on CorDEX MONITIR Application, please refer to the specific software user manual.

6

Once the camera has been locally configured for your network, attach the RJ45 connector and replace the weather cover.

7

The camera is now ready for use.

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NETWORK INFORMATION AND PARAMETERS

IMPORTANT NOTICE

CorDEX MN4000 cameras are shipped as DHCP enabled as setup configuration is via the USB port located on the front of the camera.

CorDEX MN4100 cameras are shipped with a *STATIC IP ADDRESS of 192.168.1.100* This is the default address the CorDEX MONITIR PC Application uses in Direct Ethernet Connect mode when communicating with the camera during initial setup.

Please refer to your Network Administrator and obtain the correct parameters before connecting MN4xxx cameras to your network.

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CAMERA WEB SERVER INTERFACE

EACH CORDEX MN4XXX CAMERA IS SUPPLIED WITH AN ONBOARD WEB INTERFACE.

Accessing the web interface

To access the web interface, open your internet browser and in the address bar type the IP Address of the camera you wish to communicate with.

IP Address

The speed of the network connection will determine the rate at which the camera responds.

The image shown is a snapshot and not a live feed, to reload an image, click Refresh Image. Thermal data is captured and made available for machine vision/automation at a frequency of 9Hz.

Home tab

The Home tab is the default tab after logging into the camera. Under the Home tab, it is possible to change the image type, image colourisation, set rising and falling isotherms and to toggle the onboard LED.

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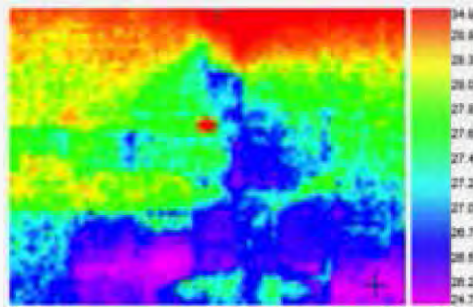
Selecting the correct Image Type

The camera captures both visual and thermal images simultaneously, your choice of Image Type determines which of four options are displayed on the screen.

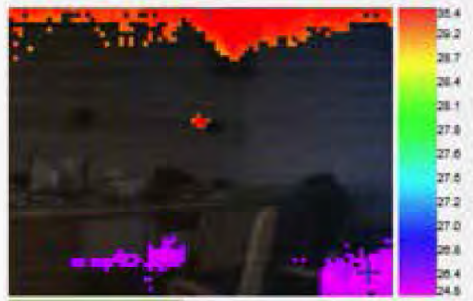| Image type	Example image
Highlight Combines visual and thermal images into one with the hottest areas bleeding through the visual.	
Visible only The visible image captured by the 640x480 onboard digital camera.	

Thermal only

The thermal image captured by the 80x60 infrared camera. Due to the resolution of the infrared camera alone, this mode is not recommended for scenes with a low dynamic temperature range.

Isotherm overlay

When a rising and/or falling isotherm is configured and Isotherm overlay selected, the areas which fall into the Isotherm alarm condition are coloured and shown on the image. This example has both rising and falling isotherms configured. The rising isotherm is shown in red/orange, the falling isotherm is show in purple.

To select an Image Type, click the drop down box and select the desired option, then click the Send to Camera button. The command will be transmitted to the camera and the image refreshed after a few moments with your new settings applied.

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Setting Rising/Falling Isotherms

An Isotherm is an alarm condition where a temperature level which is above (rising) or below (falling) the Isotherm setpoint causes the image in that set location to be highlighted on the visual image by means of a colour.

To Set a Rising Isotherm, click the OFF/ON toggle switch to the ON position (green) and insert the alarm value in the box adjacent to the button.

Click "Send to Camera".

Any temperature in the cameras Field of View (FOV) above this temperature will be coloured.

To Set a Falling Isotherm, click the OFF/ON toggle switch to the ON position (green) and insert the alarm value in the box adjacent to the button.

Click "Send to Camera".

Any temperature in the cameras Field of View (FOV) below this temperature will be coloured.

It is possible to set both Rising and Falling Isotherms on the same camera simultaneously.

Toggling the onboard LED illuminator

The camera is equipped with an onboard LED illuminator for extremely low light situations. To toggle the LED illuminator, click the LED OFF/ON button and then click the Send to Camera button.

Spot temperatures

The camera has three spot temperature points; Hot, Cold and Dynamic.

The Hot temperature identifier puts a red cross on the hottest part of the image.

The Cold temperature identifier puts a blue cross on the coldest part of the image.

The Dynamic temperature measurement shows the temperature of the cursor in the Spot Temperature box.

MODBUS Registers & Coordinates

When Configuring Programmable Logic Controllers (PLCs) to perform actions based upon MN4xxx measurements, it is necessary to be able to define either the MODBUS Register of a particular point in the image and/or its x,y coordinates.

To do this, hover the mouse over the point on the image you are interested in and the MODBUS Reg will be shown in the Modbus Reg field, in brackets, the x,y coordinates for the same MODBUS Register are shown.

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Alarm Tab

The Alarm tab opens the grid alarm page of the MN4xxx webserver. Each MN4xxx camera can accommodate a 5x5 grid square with a configurable rising alarm in each square.

When a grid squares maximum temperature exceeds its alarm threshold the alarm bell notification on the home page activates and a specific register in the MODBUS table is toggled.

Setting a grid alarm

To set a grid alarm, click the grid square of interest and the alarm setup box will appear.

Select ON from the Alarm OFF/ON toggle and enter the Rising Isotherm alarm value. Then click Update, followed by Submit.

The grid square alarm is now active and can be monitored using a PLC to check for the MODBUS Register bit associated with that specific grid. For more information, see page 26, MODBUS & HTML.

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Settings

The Settings tab allows users to configure the camera Location Name, the units of measurement and network setup information.

The Location Name is a unique identifier input by the installer which pinpoints the camera location, once set, this should not be changed unless the camera duty is altered.

The unit of measure can be selected from three potential options; Celcius, Fahrenheit and Kelvin.

DHCP Server enable, Ip Address, Subnet Mask and Gateway can all be manually configured in the Settings tab.

Once complete, click Apply and the settings will be transmitted to the camera.

CorDEX MONITIR Software

The CorDEX MN4xxx series cameras are intended for installations of all sizes; from a single camera, to hundreds. For large scale installations, determining one camera from another on a network becomes problematic To overcome this CorDEX have developed CorDEX MONITIR PC Application.
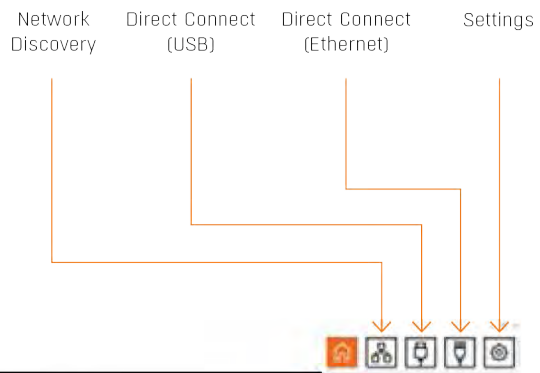
MONITIR is an expandable application, initially used to setup one or more cameras as part of the installation process. Once installation is complete, MONITIR can then be used to access every camera on the network remotely.

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Homepage

The CorDEX MONITIR PC Application is intended for setup purposes both of a standalone camera and also to aid PLC Integration.

The Application is broken down into two main methods of communication; Network Discovery and Direct Connect.

Network Discovery   Direct Connect (USB)   Direct Connect (Ethernet)   Settings

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Network Discovery

Network Discover is intended to identify all CorDEX MN4xxx cameras located on a network. This is achieved by broadcasting a message across the network, to which each camera responds providing;

1. **Instrument Type** – This refers to camera type (Factory set)

2. **Location** – This is a description, uploaded to the camera during initial installation/setup, that provides a means of identifying where the camera is located in a particular facility. (User configurable)

3. **Ip Address** – The IP Address of the camera (User configurable)

4. **Mac Address** – The Mac Address of the camera (Factory set)

5. **Serial Number** – The Serial Number of the camera (Factory set)

To deploy Network Discovery from the homepage, ensure the PC running MONITIR is connected to the same network as the MN4xxx cameras and click the Network Discovery icon, the Network Discovery page will appear and the user prompted to begin the Discovery process.

Once complete, the window will be populated with all the cameras which have responded to the Network Discovery broadcast message.

Double clicking on a particular camera will open the corresponding setup page, this is the same page as Direct Connect Ethernet.

Direct Connect (USB)

MN4000 Cameras can be configured via the chassis in Direct Connect Ethernet mode or when installed and in use, via Direct Connect USB mode, this is the recommended mode of communication for initial setup.

To communicate via Direct Connect USB, first ensure the MN4000 is powered up and the PC running MONITIR Application is connected to the USB port located on the front of the camera.

Then click the Direct Connect (USB) icon from the home screen and the Application will communicate directly with the camera, displaying returned data in the following format.
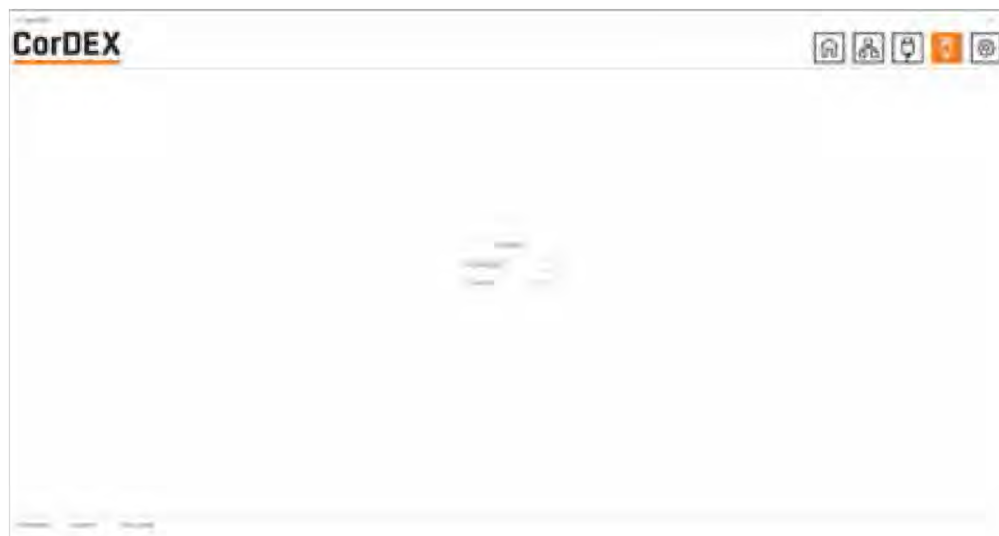

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Direct Connect (Ethernet)

Both MN4000 and MN4100 have the capability for a direct, PC to Camera Ethernet connection using the MONITIR PC Application. Direct Connect (Ethernet) is the recommended initial setup mode for MN4100 cameras as they are shipped with a factory set static IP address.

To communicate with the camera, ensure the PC running the MONITIR Application is connected to the camera with an Ethernet cable, then click the Direct Connect (Ethernet) icon from the homepage.

If this is a first time setup of an MN4000, type 192.168.1.100 into the Ip address box and click Connect. If this is not a first time setup, you must type the Ip address associated with your specific camera.

MODBUS & HTML

The MN4000 and MN4100 have Modbus TCP and HTML access for mage display and analysis.

MODBUS/TCP

The Modbus protocol used is Modbus TCP/IP also known as Modbus TCP. http://www.modbus.org/docs/Modbus_Messaging_Implementation_Guide_V1_0b.pdf

Following Modbus command function codes are used:

- **Function code 3:** Read Multiple Registers

- **Function code 4:** Read Input Registers

- **Function code 6:** Write Single Registers

- **Function code 16:** Write Multiple Registers

Modbus TCP/IP connects over TCP/IP networks using port 502. A checksum is not required as a checksum calculation implemented in the lower layers already provides checksum protection. The frames do not include a checksum.

On TCP/IP the Modbus server is addressed using its IP address. The Modbus Unit Identifier is set to 0FFh.

Register Access: Code 4

The MN4xxx cameras implement Modbus TCP command function code 4 "Read Input Registers" (16 bit), with the addresses as defined in the following table.

Address*	Function Code: 4	Comment
0 to 4799	Sensor temperature array, 80x60 Units: cK (ccentikelvin**)	Global constants: Emissivity =1 0= Top LHS, 4799= Bottom RHS
4800	AlarmBit [24:16] for each bit 1: alarmed 0: no alarm	Corresponds to 25 grid alarm limits. Alarm for any pixel >T_{set}
4801	AlarmBit [15:0] for each bit 1: alarmed 0: no alarm	Corresponds to 25 grid alarm limits. Alarm for any pixel >T_{set}

MODBUS Function Code 4 TCP registers

*   MODBUS access is big-endian

** To convert to Fahrenheit= (cK*9)/5-45967, Celcius=(cK-27315)/100

Register Access: code 3, 6, 16

The MN4xxx cameras implement Modbus TCP command function codes 3, 6 and 16 with the addresses as defined in the following table.

Address*	Function Code; 3, 6, 16	Comment
0 to 24	Sensor alarm array, 5x5 Units: cK (centikelvin)	0=Top LHS, 14=Bottom RHS

MODBUS Function code 3, 6, 16 TCP Registers

Address*	Function Code; 3, 6, 16	Comment
0 to 24	Sensor alarm array, 5x5 Units: cK (centikelvin)	0=Top LHS, 14=Bottom RHS

HTML Browser

A web browser may be used to setup all aspects of the camera operation, the recommended browser is Chrome.

HTTP browser access can be used to access camera data structures by software integrators as follows:

- http:IP-address/vis.jpg visible image jpeg

- http:IP-address/ir.bmp IR image

- http:IP-address/raw.bin IR temperature array, 80 x 60 x 16bit

- http:IP-address/lep.bin IR info

- http:IP-address/alarm.bin alarm settings, 5 x 5 x 16bit

- http:IP-address/firmware.html prompts for binary file then reboots 10s after upload

HTML Access (Settings page)

The setting page information is accessed using a HTTP GET.

The webserver is not capable of Server Side Includes. Instead all data on the page is populated from a binary file loaded from the server using javascript. The offsets within the binary file are as shown in the javascript.

The form submit has parameters:

- **t=** as session token

- **cfk=** as the units (0:Celcius/1:Farentheit/2:Kelvin)

- **loc=** as the location text field

- **ethIpAddress=** as the static IP in decimal

- **ethSubnetMask=** as the static subnet mask in decimal

- **ethGateway=** as the static gateway in decimal

- **dhcp=** as the (0:DHCP/1:Static IP)

An example implementation is as follows:

Reading

HTTP GET /lep.bin returns a binary file. In the javascript this is converted to an unsigned 16 bit array s[].

Where

- cfk is at s[8+2*176+5];

- dhcp is at s[8+2*176+25]; upper 8 bits

- loc is at s[8+2*176+8]; next 16 characters

- ethIpAddress is at s[8+2*176+26]; next 4 bytes

- ethSubnetMask is at s[8+2*176+28]; next 4 bytes

- ethGateway is at s[8+2*176+30]; next 4 bytes

- token t is at s[8+2*176+34+4];

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Setting

HTTP GET /eth.ccgi?&t=1234&cfk=0&loc=
cordex&dhcp=1&ethIpAddress=1234&eth
SubnetMask=1234&ethGateway=1234

Note on units for web browser access

All temperature values sent to camera are in
the current units format (C, F, K).
All temperatures returned from the camera are
in centikelvin. This is due to limitations in the
HTML implementation.

Any writes that change the DHCP, IP address,
Netmask, or Gateway configuration will also
cause a reboot a few seconds later. This is
required as the Ethernet stack needs to be
restarted in this situation.

Applies to both the eth.cgi and the USB.

HTML Access (IR data structure)

The structure for the IR information:

```
typedef struct lepton_settings_struct
{
    __packed uint16_t isotherm_min_enable;
    __packed uint16_t isotherm_max_enable;
    __packed uint16_t isotherm_min;
    __packed uint16_t isotherm_max;
    __packed uint16_t palette;
    __packed uint16_t units;
    __packed uint16_t led;
    __packed uint16_t reserved1;
    __packed char name[16];
    __packed char serial[STRING_LENGTH];
    __packed enum View_Mode view_mode;
    __packed enum DateFormat date_format;
    __packed enum TimeFormat time_format;
    __packed enum Dhcp dhcp;
    __packed uint32_t static_ip_addr;
    __packed uint32_t static_netmask;
    __packed uint32_t static_gateway;
    __packed uint32_t crc;
} lepton_settings_type;
```

```
typedef struct lepton_info_struct
{
    __packed uint16_t bin_max;
    __packed uint16_t bin_min;
    __packed uint16_t max_x;
    __packed uint16_t max_y;
    __packed uint16_t min_x;
    __packed uint16_t min_y;
    __packed uint16_t palette_depth;
    __packed int16_t ambient;
    __packed uint16_t palette_lut[PALETTE_
      LARGEST];
    __packed uint16_t palette_temp[PALETTE_
      LARGEST];
    __packed lepton_settings_type settings;
    __packed uint32_t firmware;
    __packed uint32_t alarm_status;
    __packed uint16_t token;
} lepton_info_type;
```

```
typedef struct alarm_settings_struct
{
__packed uint16_t alarm[25];
__packed uint32_t alarm_enable;
__packed uint16_t token;
} alarm_settings_type;
```

```
enum Palette { GREY_POSITIVE=0, GREY_
NEGATIVE, IRON, HOTMETAL, RAINBOW, AMBER,
SEPIA };
```

```
enum View_Mode { ISOTHERM_OVERLAY,
THERMAL_ONLY, VISIBLE_ONLY, HIGHLIGHT,
MAX_VIEW_MODE };
```

```
enum Units { CELSIUS, FARENHEIT, KELVIN,
MAX_UNITS };
```

```
enum DateFormat { YYYYMMDD, DDMMYYYY,
MMDDYYYY, MAX_DATE_FORMAT };
```

```
enum TimeFormat { HH24MMSS, HH12MMSS,
MAX_TIME_FORMAT};
```

```
enum Dhcp { DHCP, STATIC_IP, MAX_DHCP};
```

```
enum Led { LED_DISABLED, LED_ENABLED,
MAX_LED};
```

DateFormat and TimeFormat are not used.

palette_lut[PALETTE_LARGEST] is an array of colors

Colours are RGB565, 16 bit colour.

palette_temp[PALETTE_LARGEST] is an array of temperatures in cK

The temperatures of each palette colour.

Window Coordinate Conversions

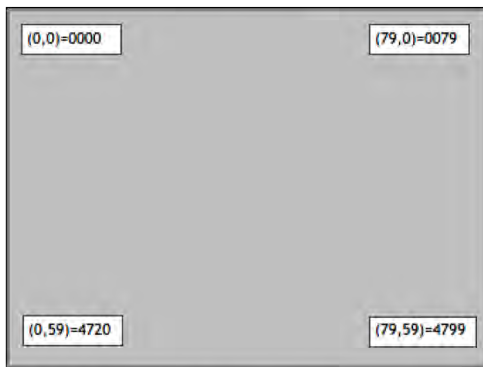For user co-ordinates, the top LHS is considered to be location (x=0, y=0)

Fig 11.5 Pixel x,y coordinates and Modbus registers

USB Commands

The USB commands available to MN4xxx cameras are as follows:

USB_MAC_ADDRESS, USB_ISOMINEN, USB_ISOMAXEN, USB_ISOMIN, USB_ISOMAX, USB_PALETTE, USB_UNITS, USB_LED, USB_NAME, USB_SERIALNUM, USB_VIEWMODE, USB_DHCP, USB_IP_ADDRESS, USB_NETMASK, USB_GATEWAY, USB_ALARM

This command set is sufficient setup a MN4xxx via USB prior to placing on the IP network.

IP Addressing

IP Address Allocation

This section describes the following:

- IP address allocation and discovery for MN4100 which doesn't have a display (also can be used for MN4000)

- Networks without a DHCP server will default to an IP address which can then be set to a static IP address

The Following methods are used for IP address allocation:

- Auto-Find: IP discovery program returns the IP address allocated by the DHCP server to each AW

- Manual configuration of static IP address

- Default static IP address (192.168.1.100)

The cameras will be shipped with following IP address allocation as default

- MN4000 ship with DHCP Enabled (non-static address),

- MN4100 Ship with static IP address of 192.168.1.100

Ip Address Discovery (Auto-Find IP)

The units use the network DHCP server to assign IP addresses. A discovery program is used to return the local unit IP addresses.

For the case where there is no DHCP server the unit will default to IP address 169.254.xx.xx, where xx.xx is a randomly generated number. The camera verifies this default IP address is unique in the local network.

The auto-find will return this address.

Camera Identification (Host Name)

An auto-find is implemented using UDP broadcast on port 46000 containing "MonitIR?" The host name field that appears in the router table is as follows:

- Auto-configured as Monitir_<processorU ID>. The processorUID is a 64-bit number

- The DHCP client returns a hostname of "MonitIR-"+(unique serial number)

- This can be used to identify any camera in the table and will appear in the broadcast response

- This can also be used with a unicast address to obtain the same response

Information in the broadcast response is as follows:

- Serial number: "Monitir"+(unique serial number)
- MAC address
- Location ID (text)
- Instrument identification

Auto-Find Example

The example has a button and a list box as follows:

- When the button is clicked function button1_Click() is called that sends a UDP broadcast on port 46000 containing "MonitIR?".

- The list box is populated with the replies contents

This could be rejigged to suit a multithreading app by using non-blocking calls instead of using the ReceiveTimeout.

```
// MonitIRfinder note the changed offsets
within ServerResponseData
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Windows.Forms;
using System.Net;
using System.Net.Sockets;
namespace MonitIRfind
{
    public partial class MonitIRfinder : Form
    {
        public MonitIRfinder()
        {
```

```
    InitializeComponent();
    }
private void button1_Click(object sender,
EventArgs e)
{
    var client = new UdpClient();
    var RequestData = Encoding.ASCII.
    GetBytes("MonitIR?");
    var ServerEp = new IPEndPoint(IPAddress.
    Any, 0);
    client.EnableBroadcast = true;
    client.Client.ReceiveTimeout = 3000;
    listBox1.Items.Clear();
    // send data: "MonitIR?"
client.Send(RequestData, RequestData.Length,
new IPEndPoint(IPAddress.Broadcast, 46000));

    // then receive data
while (true)
{
    try
    {
      var ServerResponseData = client.
Receive(ref ServerEp);
      var ServerResponse = Encoding.ASCII.Get-
String(ServerResponseData).Substring(0, 24);
      var ServerVer = "";
      var ServerMac = "";
      var ServerLocation = "";
      if (ServerResponseData.Length > 25)
```

```
{
      ServerVer = ServerResponseData[25].
      ToString();
      ServerMac = BitConverter.ToString(ServerRe
      sponseData.Skip(26).Take(6).ToArray());
      ServerLocation = Encoding.ASCII.GetString(
      ServerResponseData).Substring(32, 16);
}
listBox1.BeginUpdate();
listBox1.Items.Add(ServerResponse + " at " +
ServerEp.Address.ToString() + " Ver: " + ServerV-
er + " MAC: " + ServerMac + " Location: " +
ServerLocation);
    listBox1.EndUpdate();
    }
    catch (Exception exc) { break; }
}
client.Close();

}
}
}
```

Parse the response as follows
Bytes[0..24] = "MonitIR-"+serial_number,
bytes[25] = hardware_version, bytes[26..31] =
mac address, bytes[32..47] = location

Hardware version identifies the units as
MN4000 / MN4100 and reflects hardware
defined signals.

The hardware signals are PB[15:14] copied as
HWVersion[1:0]

CorDEX

PB[15:14} HWVersion[1:0]	PB[15:14} = HWVersion [1:0] defines unit ID 00 = MN4100 (no LCD) 01= MN4000 (with LCD)

Factory Reset

MN4100 has a Factory Reset function which erases all user configured settings/data and returns the unit to it original factory setup.

MN4000 Factory reset

The MN4000 has no Factory Reset as all parameters are available locally at the camera.

MN4100 Factory reset

The MN4100 Factory Reset is achieved by pressing and holding the Factory Reset button located at the rear of the camera for one second.

RUGGED AUTHORITY

CorDEX

CorDEX Instruments Ltd
1 Owens Road
Skippers Lane Industrial Estate
Middlesbrough
TS6 6HE

Declaration No. SO/ 16

EU Declaration of Conformity
in accordance with EN ISO IEC 17050-1

CorDEX Instruments Ltd hereby declare that the products described below:

Products: MN4000 Panel mounted thermal imager

MN4100 Continuous monitoring thermal imaging camera

Are in conformity with the requirements of EMC Directive 2014/30/EU by the application of the following Standards

EN 61000-6-2:2001 (Immunity)

EN 61000-6-3:2001 (Emission)

Class A for emissions, susceptibility and conducted measurements

CISPR 11 Group 1 Class A

It is ensured through internal measures that the products conform to the requirements of EU Directive 2011/65/EU on the restriction of certain hazardous substances in electrical and electronic equipment (ROHS Directive)

This equipment complies with all requirements for the CE mark

Signature: _____ Authorised Person

Name: _____ Tony Holliday _____

Position: _____ Director _____ on behalf of CorDEX Instruments Ltd

Date: _27/01/17_____

RUGGED AUTHORITY

Revision A

CONTENTS

OVERVIEW

The CorDEX Instruments, MN4xxx series of continuous monitoring cameras offer an affordable and accurate means of continuously monitoring temperature either as a standalone unit, or as part of a larger control system/ strategy.

The CorDEX MN4xxx camera platforms are designed primarily with Industry Control & Monitoring in mind and as such, are provided with the industry standard communication ability, MODBUS/TCP for communicating with devices such as Programmable Logic Controllers (PLCs).

The CorDEX MN4xxx may be installed in a standalone or multi camera mode, with each camera incorporating a built in web server for basic setup purposes which is accessible via a standard web browser using Ethernet/IP, additional CorDEX PC Setup Software is also available for download.

CorDEX MNxxx cameras are also supplied with PLC Function Blocks for popular brands. These prewritten code blocks are designed to dramatically reduce the amount of time required to integrate and MN4xxx into a PLC programme by enabling programmers to simply select a block and drop the code into the PLC ladder logic. Function Blocks are continuously added to the CorDEX MN4xxx website and include; Communications, Analysis and Alarming blocks.

CorDEX

QUICK START GUIDE

1

Install the camera.

2

Download the CorDEX MONITIR PC Application from

3

Connect power via the standard screwed terminal block provided (11-20VDC).

> ! IMPORTANT NOTICE, MN4100 CAMERAS ARE SHIPPED WITH A PREFIXED STATIC IP ADDRESS OF 192.168.1.100. This can be altered using the CorDEX MONITIR PC App (recommended).

	MN4000	**MN4100**
4	Connect the camera to your PC using a USB cable.	Connect the camera to your PLC using an Ethernet cable.
5	Start the CorDEX MONITIR PC App.	
6	Select Direct Connect USB icon.	Select Direct Connect Ethernet icon.
7	You have now accessed the CorDEX MN4000 series camera. From this screen you can setup and provide basic control commands to the camera.	Input the camera fixed static IP address 192.168.1.100 into the box and click Connect.
8	Click Submit. The camera will now restart with desired settings.	You have now accessed the CorDEX MN4100 series camera. From this screen you can setup and provide basic control commands to the camera.
9	-	Click Submit. The camera will now restart with desired settings.

MECHANICAL INSTALLATION

MN4000

The CorDEX MN4000 panel mounted thermal imager is intended for permanent installation into electrical panels. Installation is achieved in two stages.

1

Install the Chassis into the panel.

2

Attach the Camera Package to the chassis.

Once the chassis has been installed, the camera package can be removed and replaced without shutting down or interrupting the panel.

Installation of MN4000 Chassis

1

Remove the MN4000 from its packaging and place on a flat surface, taking care not to scratch the lens.
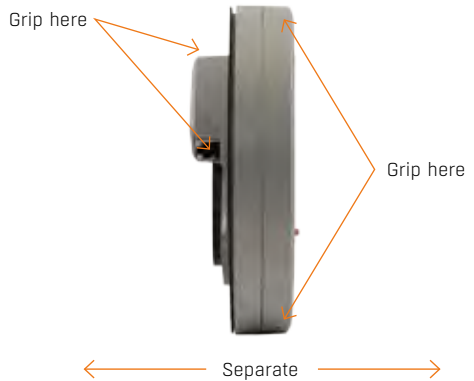
2

Remove the three screws securing the Camera Package to the Chassis.

3

Separate the Camera Package from the Chassis by holding the Chassis communication bulge in one hand and the Camera Package edge in the other hand then gently but firmly pull apart.

Grip here

Grip here

Separate

!

WARNING: Working on electrical equipment presents significant risk and should only be undertaken by suitably qualified personnel in accordance with local applicable codes, standards and corresponding Personal Protective Equipment (PPE). This installation procedure assumes a panel has been safely removed and transported to a suitable location.

4

Place the self-adhesive drilling template provided into the desired location. Care should be taken to ensure the rear of the panel is clear of ribs or other obstructions prior to drilling.

5

Using the drill bit specified on the template (xxx), drill the three fixing holes located around the perimeter.

6

Using an appropriate holes saw or punch, drill the large (95mm/3¾") centre hole.

7

Debur all rough edges and treat with rust inhibitor.

8

Align Chassis with mounting holes and attach using three self-tapping screws provided, making sure to advance the screws evenly.

9

Connect 11-30VDC to the green power connector (provided) and attached to Chassis. There are three connections.
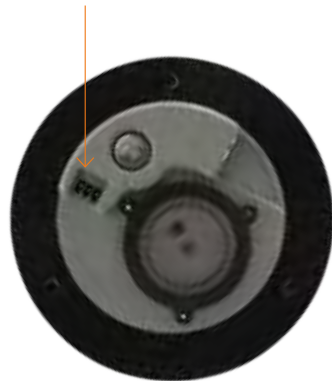
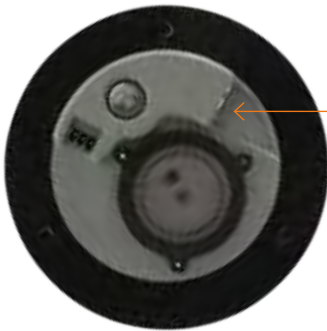**Top:** 0V
Centre: Supplemental GND*
Bottom: +ve

*GND is a supplemental Ground connection. MN4000 Primary Ground is via the RJ45 socket and communications line. If no communications are installed, the Supplemental GND may be connected in accordance with local Electrical Codes / Regulatory Requirements.

Power connections here

Chassis mounting holes

10

If communications are to be used, connect an Ethernet cable with RJ45 plug to Chassis.

Ethernet connection here

11

Replace the panel and secure before aligning the Camera Package with the Chassis and fasten into place with three fixing screws provided.

Chassis mounting screws

MN4100

The CorDEX MN4100 industrial automation thermal imager is intended for permanent installation into fixed locations for industrial automation, control and safety monitoring purposes. Installation is via an M6x4 threaded boss located on the base of the camera and optional mounting arm, part number CDX8900-470 is also available.

MN4100 attached to **CDX8900-470** mounting arm.

MN4100 Base showing M6x4 mounting boss and two compression glands.

Installation of MN4100

This installation procedure assumes that mechanical mounting and positioning has already occurred, for specific mounting instructions relating to CDX8900-470, please view the MN4100 Mounting Arm Installation Manual.

A typical industrial installation will comprise of armoured cable for both power and communications, terminating in a junction box adjacent to the camera. Unarmoured power and communications cables are run from the junction box to the camera via the two M16 compression gland entries located in the camera base.

Typical camera installation diagram

1

Remove rear weather cap from camera to expose Ethernet socket and power terminals.

2

Insert power and communications cables into camera via 2xM16 compression glands provided. NOTE, these glands will accept cables with outside diameters from 3mm – 7mm.

3

Connect 11-30VDC to the green power connector (provided) and attached to Chassis. There are three connections

Top: 0V
Centre: Supplemental GND*
Bottom: +ve

*GND is a supplemental Ground connection. MN4000 Primary Ground is via the RJ45 socket and communications line. If no communications are installed, the Supplemental GND may be connected in accordance with local Electrical Codes / Regulatory Requirements.

4

Attached an RJ45 plug to the communications cable. DO NOT PLUG INTO THE CAMERA AT THIS STAGE.

Power connector

RJ45 Socket

Compression glands

CorDEX

5

Connect camera to a PC running CorDEX MONITIR
software, select Direct Connection, Ethernet and
use the default address 192.168.1.100. You can now
configure the camera for your network, for more
information on CorDEX MONITIR Application, please
refer to the specific software user manual.

6

Once the camera has been locally configured for your
network, attach the RJ45 connector and replace the
weather cover.

7

The camera is now ready for use.

NETWORK INFORMATION AND PARAMETERS

IMPORTANT NOTICE

CorDEX MN4000 cameras are shipped as DHCP enabled as setup configuration is via the USB port located on the front of the camera.

CorDEX MN4100 cameras are shipped with a *STATIC IP ADDRESS of 192.168.1.100* This is the default address the CorDEX MONITIR PC Application uses in Direct Ethernet Connect mode when communicating with the camera during initial setup.

Please refer to your Network Administrator and obtain the correct parameters before connecting MN4xxx cameras to your network.
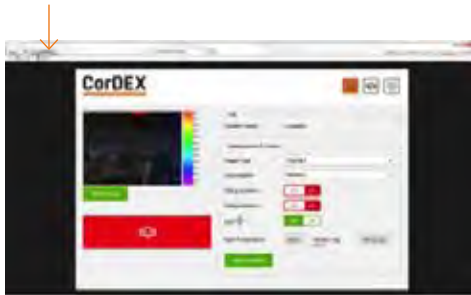
CAMERA WEB
SERVER INTERFACE

EACH CORDEX MN4XXX CAMERA IS SUPPLIED WITH AN ONBOARD WEB INTERFACE.

Accessing the web interface

To access the web interface, open your internet browser and in the address bar type the IP Address of the camera you wish to communicate with.

IP Address

The speed of the network connection will determine the rate at which the camera responds.

The image shown is a snapshot and not a live feed, to reload an image, click Refresh Image. Thermal data is captured and made available for machine vision/automation at a frequency of 9Hz.

Home tab

The Home tab is the default tab after logging into the camera. Under the Home tab, it is possible to change the image type, image colourisation, set rising and falling isotherms and to toggle the onboard LED.
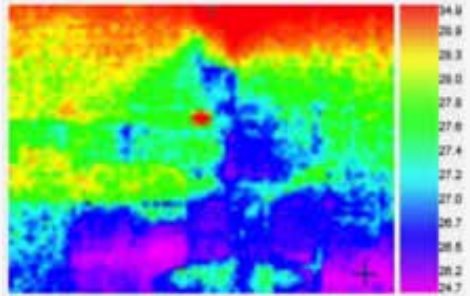
Selecting the correct Image Type

The camera captures both visual and thermal images simultaneously, your choice of Image Type determines which of four options are displayed on the screen.

Image type	Example image
Highlight Combines visual and thermal images into one with the hottest areas bleeding through the visual.	
Visible only The visible image captured by the 640x480 onboard digital camera.	

Thermal only The thermal image captured by the 80x60 infrared camera. Due to the resolution of the infrared camera alone, this mode is not recommended for scenes with a low dynamic temperature range.	
Isotherm overlay When a rising and/or falling isotherm is configured and Isotherm overlay selected, the areas which fall into the Isotherm alarm condition are coloured and shown on the image. This example has both rising and falling isotherms configured. The rising isotherm is shown in red/orange, the falling isotherm is show in purple.	

To select an Image Type, click the drop down box and select the desired option, then click the Send to Camera button. The command will be transmitted to the camera and the image refreshed after a few moments with your new settings applied.

Setting Rising/Falling Isotherms

An Isotherm is an alarm condition where a temperature level which is above (rising) or below (falling) the Isotherm setpoint causes the image in that set location to be highlighted on the visual image by means of a colour.

To Set a Rising Isotherm, click the OFF/ON toggle switch to the ON position (green) and insert the alarm value in the box adjacent to the button.

Click "Send to Camera".

Any temperature in the cameras Field of View (FOV) above this temperature will be coloured.

To Set a Falling Isotherm, click the OFF/ON toggle switch to the ON position (green) and insert the alarm value in the box adjacent to the button.

Click "Send to Camera".

Any temperature in the cameras Field of View (FOV) below this temperature will be coloured.

It is possible to set both Rising and Falling Isotherms on the same camera simultaneously.

Toggling the onboard LED illuminator

The camera is equipped with an onboard LED illuminator for extremely low light situations. To toggle the LED illuminator, click the LED OFF/ON button and then click the Send to Camera button.

Spot temperatures

The camera has three spot temperature points; Hot, Cold and Dynamic.

The Hot temperature identifier puts a red cross on the hottest part of the image.

The Cold temperature identifier puts a blue cross on the coldest part of the image.

The Dynamic temperature measurement shows the temperature of the cursor in the Spot Temperature box.

MODBUS Registers & Coordinates

When Configuring Programmable Logic Controllers (PLCs) to perform actions based upon MN4xxx measurements, it is necessary to be able to define either the MODBUS Register of a particular point in the image and/or its x,y coordinates.

To do this, hover the mouse over the point on the image you are interested in and the MODBUS Reg will be shown in the Modbus Reg field, in brackets, the x,y coordinates for the same MODBUS Register are shown.

Alarm Tab

The Alarm tab opens the grid alarm page of the MN4xxx webserver. Each MN4xxx camera can accommodate a 5x5 grid square with a configurable rising alarm in each square.

When a grid squares maximum temperature exceeds its alarm threshold the alarm bell notification on the home page activates and a specific register in the MODBUS table is toggled.

Setting a grid alarm

To set a grid alarm, click the grid square of interest and the alarm setup box will appear.

Select ON from the Alarm OFF/ON toggle and enter the Rising Isotherm alarm value. Then click Update, followed by Submit.

The grid square alarm is now active and can be monitored using a PLC to check for the MODBUS Register bit associated with that specific grid. For more information, see page 26, MODBUS & HTML.

Settings

The Settings tab allows users to configure the camera Location Name, the units of measurement and network setup information.

The Location Name is a unique identifier input by the installer which pinpoints the camera location, once set, this should not be changed unless the camera duty is altered.

The unit of measure can be selected from three potential options; Celcius, Fahrenheit and Kelvin.

DHCP Server enable, Ip Address, Subnet Mask and Gateway can all be manually configured in the Settings tab.

Once complete, click Apply and the settings will be transmitted to the camera.
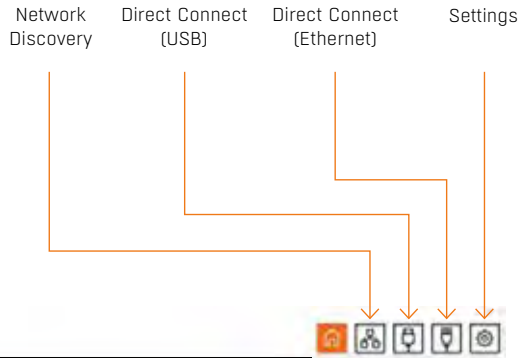
CorDEX MONITIR Software

The CorDEX MN4xxx series cameras are intended for installations of all sizes; from a single camera, to hundreds. For large scale installations, determining one camera from another on a network becomes problematic To overcome this CorDEX have developed CorDEX MONITIR PC Application.

MONITIR is an expandable application, initially used to setup one or more cameras as part of the installation process. Once installation is complete, MONITIR can then be used to access every camera on the network remotely.

CorDEX

Homepage

The CorDEX MONITIR PC Application is intended for setup purposes both of a standalone camera and also to aid PLC Integration.

The Application is broken down into two main methods of communication; Network Discovery and Direct Connect.

Network Discovery   Direct Connect (USB)   Direct Connect (Ethernet)   Settings

Network Discovery

Network Discover is intended to identify all CorDEX MN4xxx cameras located on a network. This is achieved by broadcasting a message across the network, to which each camera responds providing;

1. **Instrument Type** – This refers to camera type (Factory set)

2. **Location** – This is a description, uploaded to the camera during initial installation/setup, that provides a means of identifying where the camera is located in a particular facility. (User configurable)

3. **Ip Address** – The IP Address of the camera (User configurable)

4. **Mac Address** – The Mac Address of the camera (Factory set)

5. **Serial Number** – The Serial Number of the camera (Factory set)

To deploy Network Discovery from the homepage, ensure the PC running MONITIR is connected to the same network as the MN4xxx cameras and click the Network Discovery icon, the Network Discovery page will appear and the user prompted to begin the Discovery process.

Once complete, the window will be populated with all the cameras which have responded to the Network Discovery broadcast message.

Double clicking on a particular camera will open the corresponding setup page, this is the same page as Direct Connect Ethernet.

Direct Connect (USB)

MN4000 Cameras can be configured via the chassis in Direct Connect Ethernet mode or when installed and in use, via Direct Connect USB mode, this is the recommended mode of communication for initial setup.

To communicate via Direct Connect USB, first ensure the MN4000 is powered up and the PC running MONITIR Application is connected to the USB port located on the front of the camera.

Then click the Direct Connect (USB) icon from the home screen and the Application will communicate directly with the camera, displaying returned data in the following format.
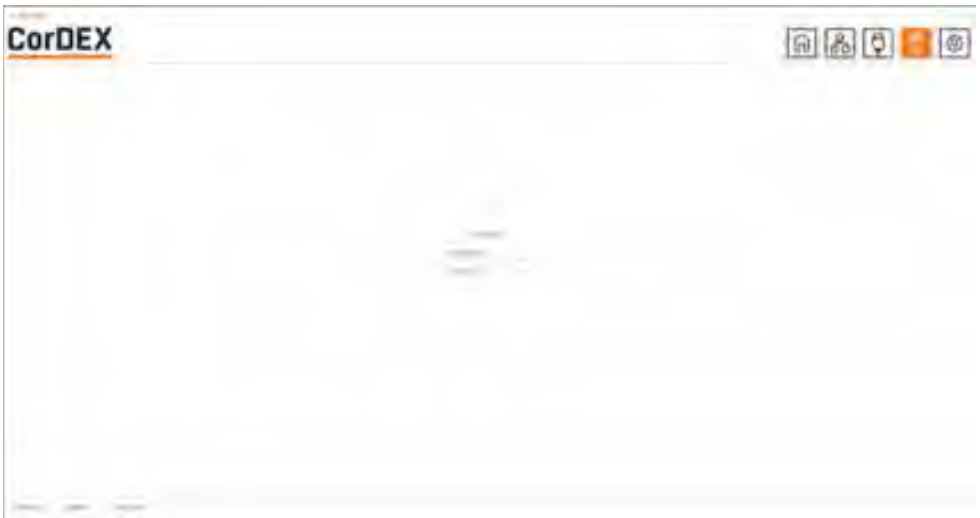
Direct Connect (Ethernet)

Both MN4000 and MN4100 have the capability for a direct, PC to Camera Ethernet connection using the MONITIR PC Application. Direct Connect (Ethernet) is the recommended initial setup mode for MN4100 cameras as they are shipped with a factory set static IP address.

To communicate with the camera, ensure the PC running the MONITIR Application is connected to the camera with an Ethernet cable, then click the Direct Connect (Ethernet) icon from the homepage.

If this is a first time setup of an MN4000, type 192.168.1.100 into the Ip address box and click Connect. If this is not a first time setup, you must type the Ip address associated with your specific camera.

MODBUS & HTML

The MN4000 and MN4100 have Modbus TCP and HTML access for mage display and analysis.

MODBUS/TCP

The Modbus protocol used is Modbus TCP/IP also known as Modbus TCP. http://www.modbus.org/docs/Modbus_Messaging_Implementation_Guide_V1_0b.pdf

Following Modbus command function codes are used:

• **Function code 3:** Read Multiple Registers

• **Function code 4:** Read Input Registers

• **Function code 6:** Write Single Registers

• **Function code 16:** Write Multiple Registers

Modbus TCP/IP connects over TCP/IP networks using port 502. A checksum is not required as a checksum calculation implemented in the lower layers already provides checksum protection. The frames do not include a checksum.

On TCP/IP the Modbus server is addressed using its IP address. The Modbus Unit Identifier is set to 0FFh.

Register Access: Code 4

The MN4xxx cameras implement Modbus TCP command function code 4 "Read Input Registers" (16 bit), with the addresses as defined in the following table.

Address*	Function Code: 4	Comment
0 to 4799	Sensor temperature array, 80x60 Units: cK (ccentikelvin**)	Global constants: Emissivity =1 0= Top LHS, 4799= Bottom RHS
4800	AlarmBit [24:16] for each bit 1: alarmed 0: no alarm	Corresponds to 25 grid alarm limits. Alarm for any pixel >T_{set}
4801	AlarmBit [15:0] for each bit 1: alarmed 0: no alarm	Corresponds to 25 grid alarm limits. Alarm for any pixel >T_{set}

MODBUS Function Code 4 TCP registers

* MODBUS access is big-endian

** To convert to Fahrenheit= (cK*9)/5-45967, Celcius=(cK-27315)/100

Register Access: code 3, 6, 16

The MN4xxx cameras implement Modbus TCP command function codes 3, 6 and 16 with the addresses as defined in the following table.

Address*	Function Code; 3, 6, 16	Comment
0 to 24	Sensor alarm array, 5x5 Units: cK (centikelvin)	0=Top LHS, 14=Bottom RHS

MODBUS Function code 3, 6, 16 TCP Registers

Address*	Function Code; 3, 6, 16	Comment
0 to 24	Sensor alarm array, 5x5 Units: cK (centikelvin)	0=Top LHS, 14=Bottom RHS

HTML Browser

A web browser may be used to setup all aspects of the camera operation, the recommended browser is Chrome.

HTTP browser access can be used to access camera data structures by software integrators as follows:

- http:IP-address/vis.jpg visible image jpeg

- http:IP-address/ir.bmp IR image

- http:IP-address/raw.bin IR temperature array, 80 x 60 x 16bit

- http:IP-address/lep.bin IR info

- http:IP-address/alarm.bin alarm settings, 5 x 5 x 16bit

- http:IP-address/firmware.html prompts for binary file then reboots 10s after upload

HTML Access (Settings page)

The setting page information is accessed using a HTTP GET.

The webserver is not capable of Server Side Includes. Instead all data on the page is populated from a binary file loaded from the server using javascript. The offsets within the binary file are as shown in the javascript.

The form submit has parameters:

- **t=** as session token

- **cfk=** as the units (0:Celcius/1:Farentheit/2:Kelvin)

- **loc=** as the location text field

- **ethIpAddress=** as the static IP in decimal

- **ethSubnetMask=** as the static subnet mask in decimal

- **ethGateway=** as the static gateway in decimal

- **dhcp=** as the (0:DHCP/1:Static IP)

An example implementation is as follows:

Reading

HTTP GET /lep.bin returns a binary file. In the javascript this is converted to an unsigned 16 bit array s[].

Where

- cfk is at s[8+2*176+5];

- dhcp is at s[8+2*176+25]; upper 8 bits

- loc is at s[8+2*176+8]; next 16 characters

- ethIpAddress is at s[8+2*176+26]; next 4 bytes

- ethSubnetMask is at s[8+2*176+28]; next 4 bytes

- ethGateway is at s[8+2*176+30]; next 4 bytes

- token t is at s[8+2*176+34+4];

Setting

HTTP GET /eth.ccgi?&t=1234&cfk=0&loc=
cordex&dhcp=1&ethIpAddress=1234&eth
SubnetMask=1234&ethGateway=1234

Note on units for web browser access

All temperature values sent to camera are in
the current units format (C, F, K).
All temperatures returned from the camera are
in centikelvin. This is due to limitations in the
HTML implementation.

Any writes that change the DHCP, IP address,
Netmask, or Gateway configuration will also
cause a reboot a few seconds later. This is
required as the Ethernet stack needs to be
restarted in this situation.

Applies to both the eth.cgi and the USB.

HTML Access (IR data structure)

The structure for the IR information:
typedef struct lepton_settings_struct
{
    __packed uint16_t isotherm_min_enable;
    __packed uint16_t isotherm_max_enable;
    __packed uint16_t isotherm_min;
    __packed uint16_t isotherm_max;
    __packed uint16_t palette;
    __packed uint16_t units;
    __packed uint16_t led;
    __packed uint16_t reserved1;
    __packed char name[16];
    __packed char serial[STRING_LENGTH];
    __packed enum View_Mode view_mode;
    __packed enum DateFormat date_format;
    __packed enum TimeFormat time_format;
    __packed enum Dhcp dhcp;
    __packed uint32_t static_ip_addr;
    __packed uint32_t static_netmask;
    __packed uint32_t static_gateway;
    __packed uint32_t crc;
} lepton_settings_type;

typedef struct lepton_info_struct
{
    __packed uint16_t bin_max;
    __packed uint16_t bin_min;
    __packed uint16_t max_x;
    __packed uint16_t max_y;
    __packed uint16_t min_x;
    __packed uint16_t min_y;
    __packed uint16_t palette_depth;
    __packed int16_t ambient;
    __packed uint16_t palette_lut[PALETTE_
      LARGEST];
    __packed uint16_t palette_temp[PALETTE_
      LARGEST];
    __packed lepton_settings_type settings;
    __packed uint32_t firmware;
    __packed uint32_t alarm_status;
    __packed uint16_t token;
} lepton_info_type;

typedef struct alarm_settings_struct
{
__packed uint16_t alarm[25];
__packed uint32_t alarm_enable;
__packed uint16_t token;
} alarm_settings_type;

enum Palette { GREY_POSITIVE=0, GREY_
NEGATIVE, IRON, HOTMETAL, RAINBOW, AMBER,
SEPIA };

enum View_Mode { ISOTHERM_OVERLAY,
THERMAL_ONLY, VISIBLE_ONLY, HIGHLIGHT,
MAX_VIEW_MODE };

enum Units { CELSIUS, FARENHEIT, KELVIN,
MAX_UNITS };

enum DateFormat { YYYYMMDD, DDMMYYYY,
MMDDYYYY, MAX_DATE_FORMAT };

enum TimeFormat { HH24MMSS, HH12MMSS,
MAX_TIME_FORMAT};

enum Dhcp { DHCP, STATIC_IP, MAX_DHCP};

enum Led { LED_DISABLED, LED_ENABLED,
MAX_LED};

DateFormat and TimeFormat are not used.

palette_lut[PALETTE_LARGEST] is an array of
colors

Colours are RGB565, 16 bit colour.

palette_temp[PALETTE_LARGEST] is an array
of temperatures in cK

The temperatures of each palette colour.

Window Coordinate Conversions

For user co-ordinates, the top LHS is considered to be location (x=0, y=0)
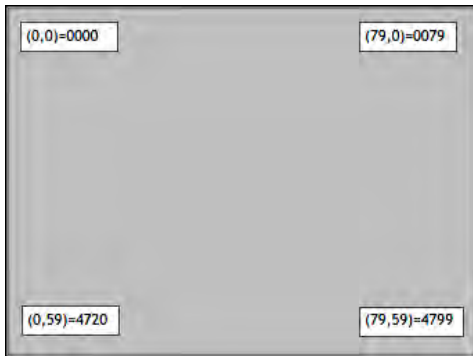

Fig 11.5 Pixel x,y coordinates and Modbus registers

USB Commands

The USB commands available to MN4xxx cameras are as follows:

USB_MAC_ADDRESS, USB_ISOMINEN, USB_ISOMAXEN, USB_ISOMIN, USB_ISOMAX, USB_PALETTE, USB_UNITS, USB_LED, USB_NAME, USB_SERIALNUM, USB_VIEWMODE, USB_DHCP, USB_IP_ADDRESS, USB_NETMASK, USB_GATEWAY, USB_ALARM

This command set is sufficient setup a MN4xxx via USB prior to placing on the IP network.

IP Addressing

IP Address Allocation

This section describes the following:

- IP address allocation and discovery for MN4100 which doesn't have a display (also can be used for MN4000)

- Networks without a DHCP server will default to an IP address which can then be set to a static IP address

The Following methods are used for IP address allocation:

- Auto-Find: IP discovery program returns the IP address allocated by the DHCP server to each AW

- Manual configuration of static IP address

- Default static IP address (192.168.1.100)

The cameras will be shipped with following IP address allocation as default

- MN4000 ship with DHCP Enabled (non-static address),

- MN4100 Ship with static IP address of 192.168.1.100

Ip Address Discovery (Auto-Find IP)

The units use the network DHCP server to assign IP addresses. A discovery program is used to return the local unit IP addresses.

For the case where there is no DHCP server the unit will default to IP address 169.254.xx.xx, where xx.xx is a randomly generated number. The camera verifies this default IP address is unique in the local network.

The auto-find will return this address.

Camera Identification (Host Name)

An auto-find is implemented using UDP broadcast on port 46000 containing "MonitIR?" The host name field that appears in the router table is as follows:

- Auto-configured as Monitir_<processorU ID>. The processorUID is a 64-bit number

- The DHCP client returns a hostname of "MonitIR-"+(unique serial number)

- This can be used to identify any camera in the table and will appear in the broadcast response

- This can also be used with a unicast address to obtain the same response

Information in the broadcast response is as follows:

- Serial number: "Monitir"+(unique serial number)
- MAC address
- Location ID (text)
- Instrument identification

Auto-Find Example

The example has a button and a list box as follows:

- When the button is clicked function button1_Click() is called that sends a UDP broadcast on port 46000 containing "MonitIR?".

- The list box is populated with the replies contents

This could be rejigged to suit a multithreading app by using non-blocking calls instead of using the ReceiveTimeout.

```
// MonitIRfinder note the changed offsets
within ServerResponseData
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Windows.Forms;
using System.Net;
using System.Net.Sockets;
namespace MonitIRfind
{
    public partial class MonitIRfinder : Form
    {
        public MonitIRfinder()
        {
```

```
    InitializeComponent();
    }
private void button1_Click(object sender,
EventArgs e)
{
    var client = new UdpClient();
    var RequestData = Encoding.ASCII.
GetBytes("MonitIR?");
    var ServerEp = new IPEndPoint(IPAddress.
Any, 0);
    client.EnableBroadcast = true;
    client.Client.ReceiveTimeout = 3000;
    listBox1.Items.Clear();
    // send data: "MonitIR?"
client.Send(RequestData, RequestData.Length,
new IPEndPoint(IPAddress.Broadcast, 46000));

    // then receive data
while (true)
{
    try
    {
      var ServerResponseData = client.
Receive(ref ServerEp);
      var ServerResponse = Encoding.ASCII.Get-
String(ServerResponseData).Substring(0, 24);
      var ServerVer = "";
      var ServerMac = "";
      var ServerLocation = "";
      if (ServerResponseData.Length > 25)
      {
        ServerVer = ServerResponseData[25].
ToString();
        ServerMac = BitConverter.ToString(ServerRe
sponseData.Skip(26).Take(6).ToArray());
        ServerLocation = Encoding.ASCII.GetString(
ServerResponseData).Substring(32, 16);
}
listBox1.BeginUpdate();
listBox1.Items.Add(ServerResponse + " at " +
ServerEp.Address.ToString() + " Ver: " + ServerV-
er + " MAC: " + ServerMac + " Location: " +
ServerLocation);
    listBox1.EndUpdate();
    }
    catch (Exception exc) { break; }
}
client.Close();

}
}
}
```

Parse the response as follows
Bytes[0..24] = "MonitIR-"+serial_number,
bytes[25] = hardware_version, bytes[26..31] =
mac address, bytes[32..47] = location

Hardware version identifies the units as
MN4000 / MN4100 and reflects hardware
defined signals.

The hardware signals are PB[15:14] copied as
HWVersion[1:0]

PB[15:14} HWVersion[1:0]	PB[15:14} = HWVersion [1:0] defines unit ID 00 = MN4100 (no LCD) 01= MN4000 (with LCD)

Factory Reset

MN4100 has a Factory Reset function which erases all user configured settings/data and returns the unit to it original factory setup.

MN4000 Factory reset

The MN4000 has no Factory Reset as all parameters are available locally at the camera.

MN4100 Factory reset

The MN4100 Factory Reset is achieved by pressing and holding the Factory Reset button located at the rear of the camera for one second.

CorDEX

CorDEX Instruments Ltd
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TS6 6HE

Declaration No: SO/ 16

EU Declaration of Conformity
in accordance with EN ISO IEC 17050-1

CorDEX Instruments Ltd hereby declare that the products described below:

Products: MN4000 Panel mounted thermal imager

MN4100 Continuous monitoring thermal imaging camera

Are in conformity with the requirements of EMC Directive 2014/30/EU by the application of the following Standards

EN 61000-6-2:2001 (Immunity)

EN 61000-6-3:2001 (Emission)

Class A for emissions, susceptibility and conducted measurements

CISPR 11 Group 1 Class A

It is ensured through internal measures that the products conform to the requirements of EU Directive 2011/65/EU on the restriction of certain hazardous substances in electrical and electronic equipment (ROHS Directive)

This equipment complies with all requirements for the CE mark

Signature: _____ Authorised Person

Name: _____ Tony Holliday _____

Position: _____ Director _____ on behalf of CorDEX Instruments Ltd

Date: __27/01/17_____

RUGGED AUTHORITY

Revision A