PrediktIR II

DeviceNet
Gateway Option

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Issue A

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Caution

- **The equipment described in this manual contains high potential voltages. Isolate the mains supply from the equipment during interconnection and maintenance.**

- **If the gauge is not installed and used in the manner prescribed in this manual, the safety protection afforded by the equipment may be impaired.**

- **For complete electrical safety in operation, the equipment has been supplied with double-pole neutral fusing incorporated. Do not modify in any way.**

Storage & Unpacking

Storage

Pending installation, store between 0°C and 70°C at less than 60% relative humidity. Allow the equipment to regain ambient temperature prior to installation.

Unpacking

Note: Before unpacking your on-line gauge, make sure you check off all the items against the packing list.

Retain the packaging used to ship all parts of your system, so that in the event that the equipment needs to be returned, it can be suitably re-packed for its safe return.

Open the packaging carefully and remove each item. Take the items to a clean room for inspection. Check that all the items on the Packing Note / Scope of Supply, have been supplied. Check that they are free from external damage, the connectors are free from dirt, and the cables are not chaffed or kinked.

Table of Contents

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1 | Introduction

The following supplement should be read in conjunction with the PrediktIR II User guide to ensure a reasonable level of familiarity with the gauge.

The PrediktIR II DeviceNet Gateway option enables the PrediktIR II gauging system to be added to a DeviceNet fieldbus as a slave device, allowing a DeviceNet master to read measurement, status and diagnostic data as well as reading/writing calibration data.

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2 | Fieldbus Specification

DeviceNet	
Standard	DeviceNet
Communications speed	125 kbit/s 250 kbit/s 500 kbit/s
Cable	DeviceNet specific Screened Twisted pair. See Section 3.4 - Cable Specification.

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3 | Physical Connection

3.1 Gateway Board

Note: The default gateway configuration allows communication with multiple PrediktIR II gauges through the one gateway, as detailed in this chapter.

The DeviceNet gateway board can be supplied as a kit that is fitted into the motherboard of one of the following PrediktIR II peripherals:

- Gauge Control Interface (GCI)
- Gauge Control Port (GCP)

The photo below shows the location of the gateway board, circled in the top left corner of the motherboard, with its external connections made through screw terminals, also circled in red in the bottom right hand corner marked **FIELDBUS**.
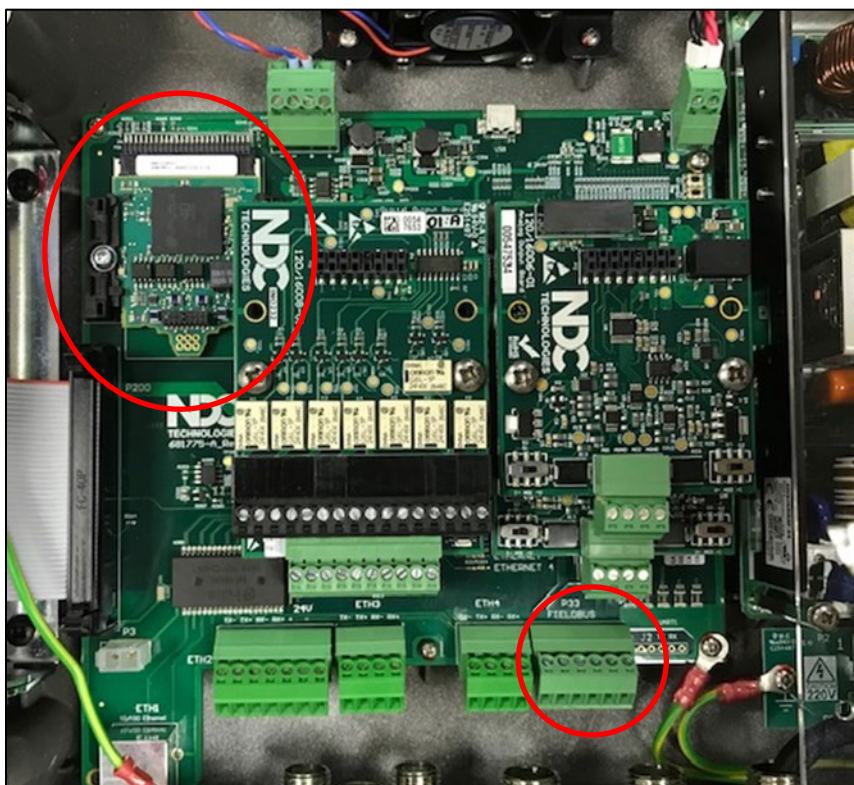
3.1.1 Fitting the Gateway Board

The retrofit kit comprises a gateway and mounting kit, as shown in the photos below:
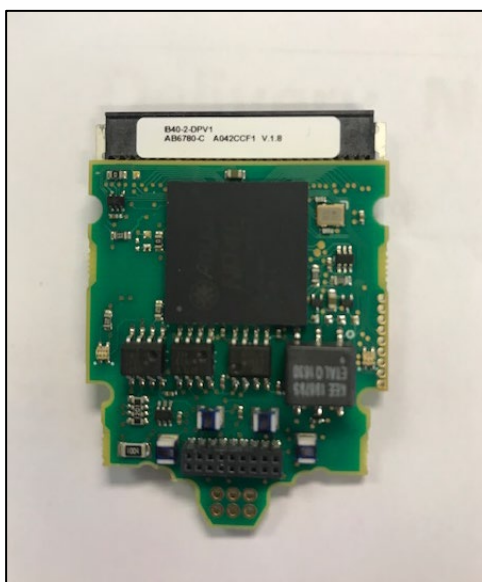
Carry out the following steps to fit the retrofit kit into the GCI/GCP:

1. Switch off the power and isolate the mains supply.

2. Loosen the lid screws and open the hinged lid to reveal the motherboard.

3. Using anti-static precautions, i.e. earthed wrist strap, fit the base supports.
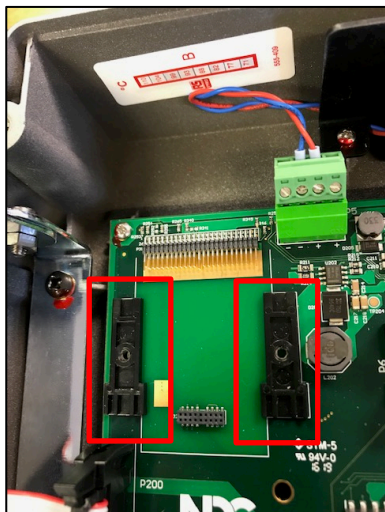
4. Insert the gateway board – firmly push down the connector end, ensuring that the pins are aligned, and slide upwards to engage the header.
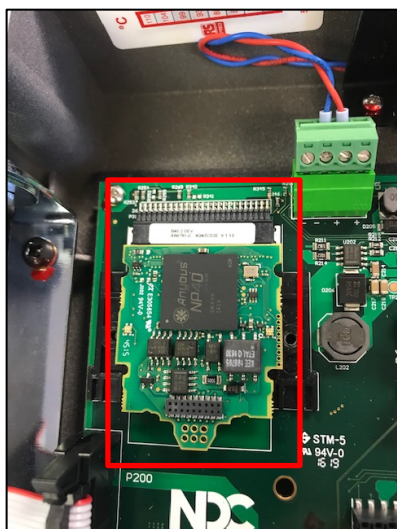
5. Next, insert the pinned header.

6. Fit the top supports and fix in place using the Torx (T9).
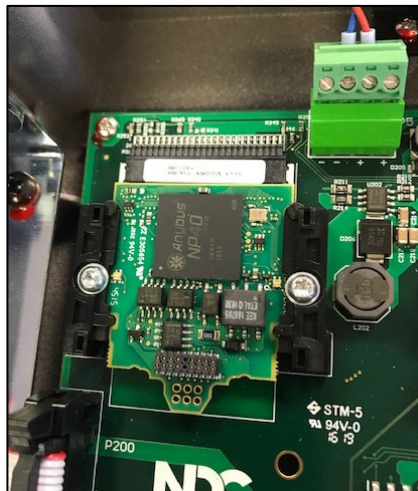
3.2 DeviceNet Signal Connections

The Fieldbus connections are made through the 6-way demountable screw terminal connector marked **FIELDBUS**, as per the photo below:
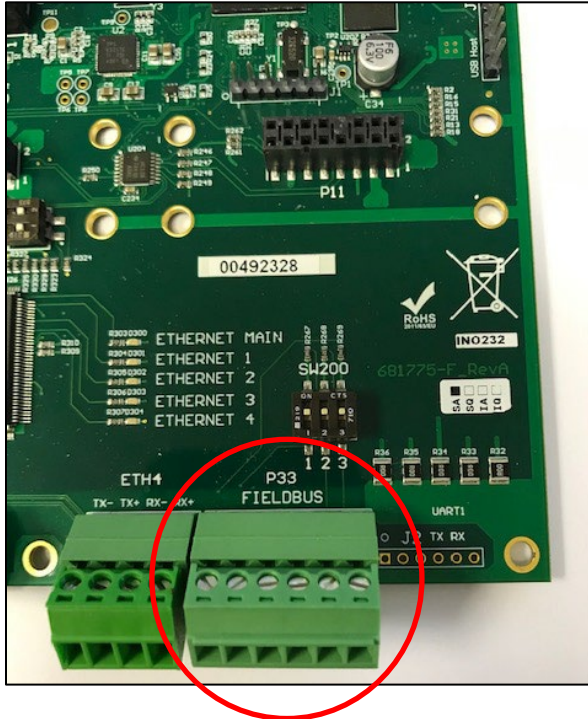
The signal designations are shown in the table below, with the terminal numbers going from left to right:

6-way	Name	Description
1	+5V	Isolated +5V
2	0v	Isolated 0v
3	GND	Cable shield
4	CAN L	CAN L
5	CAN H	CAN H
6	N/A	Not Applicable

The customer-provided DeviceNet cable screen should be terminated through the metal gland, as depicted below.
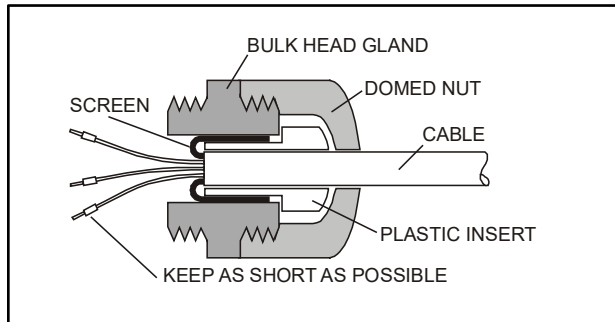
See Section 3.4 - Cable Specification.

3.3   DeviceNet Termination Resistors

The Trunkline cable in a DeviceNet network should be terminated with a 121Ω ¼ W resistor at each end to avoid signal reflections. However, this resistor may be added to the demountable screw terminal connector if necessary. In this case, it should be connected between the CAN_L and CAN_H lines.

Note: Check that the three-way switch marked **SW200,** in the photo in Section 3.2 - DeviceNet Signal Connections are all set to the OFF position (levers in the down position).

3.4   Cable Specification

There are two types of standard DeviceNet specific cables, termed "**Thick**" and "**Thin**". The network is typically made up of a trunkline "**Thick**" cable and dropline "**Thin**" cables.

The DeviceNet standard specifies the exact topology and physical limits.

Cable Length

The following formulae are typically used to calculate the cable length or maximum communications speed:

At 125kb	Thick length + (5 x Thin length) ≤ 500 m
At 250kb	Thick length + (2.5 x Thin length) ≤ 250 m
At 500kb	Thick length + Thin length ≤ 100 m

Example

An **80m** trunkline would allow a total of:

- **84m** in droplines at **125kb**
- **68m** in droplines at **250kb**
- **20m** in droplines at **500kb**

3.5   Motherboard

Set the switches in **SW6** on the motherboard to the downward position, as shown in the photo below.
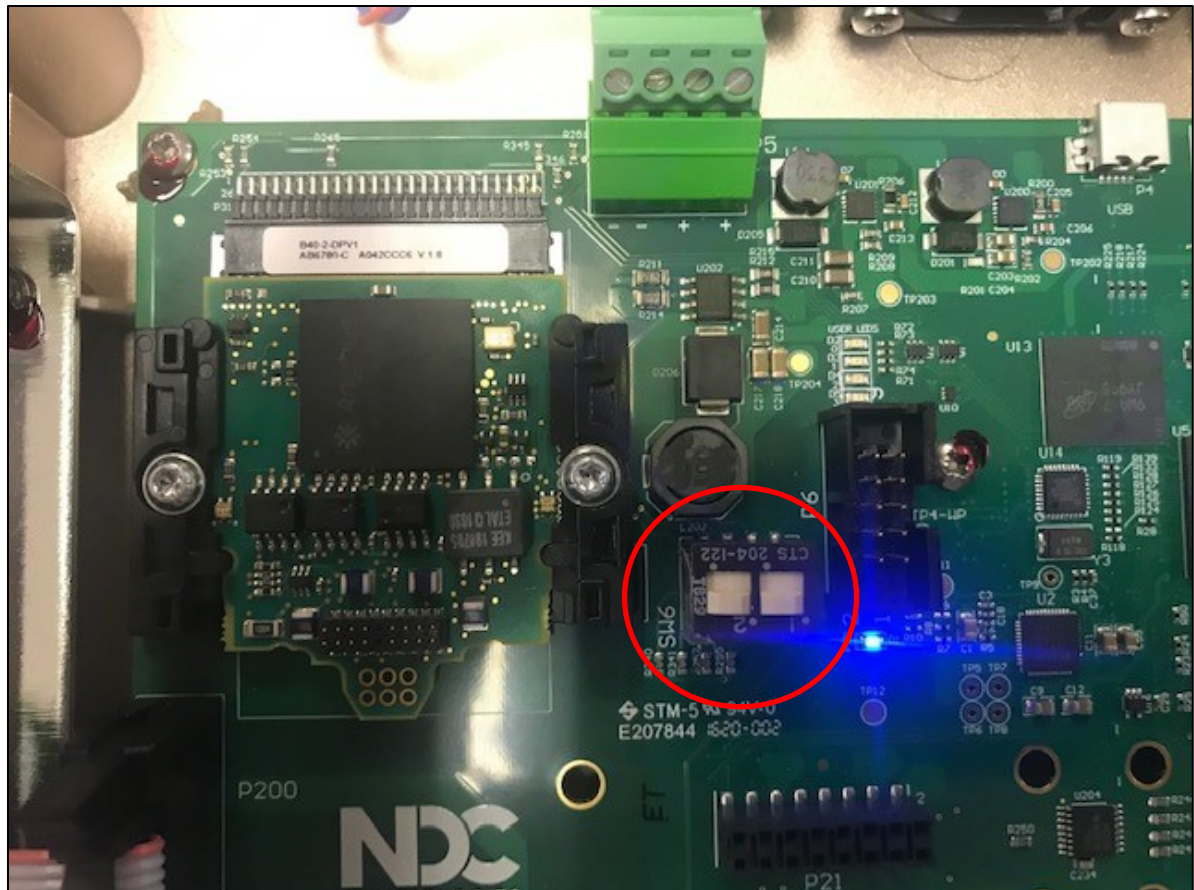
4 | Node Address

The node address must be set before DeviceNet communications may be established. This is achieved using the GaugeToolsXL Software, detailed in Section 7.6 - Setting the Node Address. The default Node Address as supplied is **02**, unless otherwise requested.

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5 | PLC Configuration File

The DeviceNet Host system may require an "ESD" file to enable communications with the Gauge. The ESD file can be downloaded from the following web address https://ndc.custhelp.com.

Vendor ID: 005Ah (HMS Industrial Networks AB)

Device Type: 002Bh (Generic Device)

Product Code: 063Fh (Anybus CompactCom 40 DeviceNet(TM))

Product Name: "Anybus CompactCom 40 DeviceNet(TM)"

5.1   DeviceNet Register Configuration (Default)

The DeviceNet interface provides a total of 152 bytes of input and 152 bytes of output data. These are divided into 38 input and 38 output 32-bit parameter values. Each parameter value represents a single value such as Gauge Reading, Span, Trim, etc.

The GaugeToolsXL tools are used to configure which values are mapped into the DeviceNet I/O data areas.

Data direction is referenced to the DeviceNet Master:

- **IN Data** originates in the Gauge and is sent to the DeviceNet Master.

- **OUT Data** originates in the DeviceNet Master and is sent to the Gauge.

IN Data (Gauge to DeviceNet Master)

#	Parameter	Type
0	gauge!1:channel!1:output	Real
1	gauge!1:channel!1:span	Real
2	gauge!1:channel!1:trim	Real
3	gauge!1:channel!2:output	Real
4	gauge!1:channel!2:span	Real
5	gauge!1:channel!2:trim	Real
6	gauge!1:status:output	Unsigned Integer
7	gauge!2:channel!1:output	Real
8	gauge!2:channel!1:span	Real
9	gauge!2:channel!1:trim	Real
10	gauge!2:channel!2:output	Real
11	gauge!2:channel!2:span	Real
12	gauge!2:channel!2:trim	Real
13	gauge!2:status:output	Unsigned Integer
14	gauge!3:channel!1:output	Real
15	gauge!3:channel!1:span	Real
16	gauge!3:channel!1:trim	Real

#	Parameter	Type
17	gauge!3:channel!2:output	Real
18	gauge!3:channel!2:span	Real
19	gauge!3:channel!2:trim	Real
20	gauge!3:status:output	Unsigned Integer
21	gauge!4:channel!1:output	Real
22	gauge!4:channel!1:span	Real
23	gauge!4:channel!1:trim	Real
24	gauge!4:channel!2:output	Real
25	gauge!4:channel!2:span	Real
26	gauge!4:channel!2:trim	Real
27	gauge!4:status:output	Unsigned Integer
28	gauge!5:channel!1:output	Real
29	gauge!5:channel!1:span	Real
30	gauge!5:channel!1:trim	Real
31	gauge!5:channel!2:output	Real
32	gauge!5:channel!2:span	Real
33	gauge!5:channel!2:trim	Real
34	gauge!5:status:output	Unsigned Integer

OUT Data (DeviceNet Master to Gauge)

#	Parameter	Type
0	<Dummy item>	Real
1	gauge!1:channel!1:span	Real
2	gauge!1:channel!1:trim	Real
3	<Dummy item>	Real
4	gauge!1:channel!2:span	Real
5	gauge!1:channel!2:trim	Real
6	<Dummy item>	Real
7	<Dummy item>	Real
8	gauge!2:channel!1:span	Real
9	gauge!2:channel!1:trim	Real
10	<Dummy item>	Real
11	gauge!2:channel!2:span	Real
12	gauge!2:channel!2:trim	Real
13	<Dummy item>	Real
14	<Dummy item>	Real
15	gauge!3:channel!1:span	Real
16	gauge!3:channel!1:trim	Real
17	<Dummy item>	Real
18	gauge!3:channel!2:span	Real
19	gauge!3:channel!2:trim	Real
20	<Dummy item>	Real
21	<Dummy item>	Real

#	Parameter	Type
22	gauge!4:channel!1:span	Real
23	gauge!4:channel!1:trim	Real
24	<Dummy item>	Real
25	gauge!4:channel!2:span	Real
26	gauge!4:channel!2:trim	Real
27	<Dummy item>	Real
28	<Dummy item>	Real
29	gauge!5:channel!1:span	Real
30	gauge!5:channel!1:trim	Real
31	<Dummy item>	Real
32	gauge!5:channel!2:span	Real
33	gauge!5:channel!2:trim	Real
34	<Dummy item>	Real

Notes:

- Unassigned Registers may be left blank and will default to zero.

- The Span and Trim Parameters are aligned with the IN Data registers of the same measurement. This is not strictly necessary, but it makes it easier to associate calibration inputs and outputs from the same Gauge and measurement channel.

- The Gauge will store any new calibration values in its non-volatile memory.

5.2 User Register Assignments

Alternative configurations of the DeviceNet Register assignments may be programmed, as the user requires. Additionally, the user may alter the total number of registers transferred over the DeviceNet network and their Gauge assignments.

Note: The total number of input or output registers cannot exceed **38**.

When using GaugeToolsXL to alter the configuration (see Section 7 - GaugeToolsXL Software), changes are applied after downloading the configuration to the GCI, and rebooting the GCI. If pre-configured files are provided by NDC, these will be detailed in a separate document.

See Section 6 - Data Parameters for a description of the currently available Gauge parameters.

6 | Data Parameters

The following tables list the currently available Gauge Parameters, along with a brief description.

6.1   Measurement Parameters

Parameter	Type	Description
Output	Real	Measurement value of the specified channel. The Units of the measured value depend on the target material and the application (e.g. moisture [%]).
App Code	Real	This value is the full 32-bit integer application code. This code is used to select the appropriate algorithm in the gauge for the intended measurement.
Full App Code	Real	
Response Time	Real	Output smoothing using an exponential factor [0…3600].
Span	Real	Multiplier factor for the Output: **Output = (Span * X) + Trim** (where **X** is the raw measurement value). This parameter is available for all measurements, including temperature.
Trim	Real	Offset for the output: **Output = (Span * X) + Trim** (where **X** is the raw measurement value). This parameter is available for all measurements, including temperature.

6.2 Global Parameters

Parameter	Type	Description
Air Pressure	Real	Airflow monitor (if fitted).
Ambient Light Freq	Real	
External Temperature	Real	Temperature external to gauge (if fitted).
Internal Temperature	Real	Internal temperature of the gauge.
Lamp Current	Real	Current through the lamp.
Lamp Voltage	Real	Voltage across the lamp.
Motor Speed	Real	The current speed of the Filter Wheel (motor) in the gauge.
Motor Target Speed	Real	The desired speed of the Filter Wheel.
Motor Vibration	Real	Vibration of the motor.
Product Distance	Real	
Product Height	Real	
Window Contamination	Real	The Window Contamination level in raw ADC units as seen by the sensor. (A clean window will usually generate a base reading of a few thousand.) This Parameter is in uncalibrated A/D units, and should be used for indication purposes only. It may be monitored while setting up the threshold levels which will trigger an error in the Gauge Status Errors bitfield.
Uptime	Unsigned Integer	Number of seconds that the gauge has been running.
CPU Load	Real	CPU load.
Hardware Temperature	Real	Measured temperature of internal gauge hardware.

6.2.1   Gauge Status Errors

The **Gauge Status Errors** Parameter is a 32-bit value with each bit corresponding to various aspects of the Gauge hardware. Under normal operating conditions, all bits would be zero. Any non-zero value in this Parameter indicates an abnormal condition requiring attention.

The bit fields are described below:

Bit	Meaning (when set)
0	Motor Speed Error
1	Lamp Current/Voltage Error
2	Signal Low Error
3	Signal High Error
4	Window Contamination Error
5	Temperature Error
6	Internal Reference Error
7	Voltage Error
8	Slave Head Error
9	Airflow Error
10	Sync Pulse Error
11	Auto Sampler Error

If the **Gauge Status Errors** Parameter value becomes unavailable, all 32 bits of the Parameter will be set to a logic '1' after a delay of approximately 5 seconds. The **Gauge Status Errors** Parameter may be continually monitored for this condition to indicate when a remote Gauge is powered down or disconnected from the network.

6.2.2   Gauge Status Warnings

The **Gauge Status Warnings** Parameter is a 32-bit value which has the same bit assignments as the **Gauge Status Errors** Parameter described above. Under normal operating conditions, all bits would be zero. Any non-zero value in this Parameter indicates a condition that does not require immediate attention.

6.2.3   Product Management Parameters

Parameter	Type	Description
Recipe ID active	Unsigned Integer	Identity of currently active product recipe.
Recipe ID pending	Unsigned Integer	Identity of product recipe which is about to be loaded.

Product Recipe ID's can be found on the GCI Product Load and Product Configuration pages.

The **Recipe ID active** parameter contains the ID of the currently active product recipe. To change this, set the **Recipe ID pending** to the ID of the required recipe. If the ID is valid, the gauge will automatically load the selected product. The **Recipe ID active** parameter will update to the selected product ID. This can be used to verify that the product has successfully loaded.
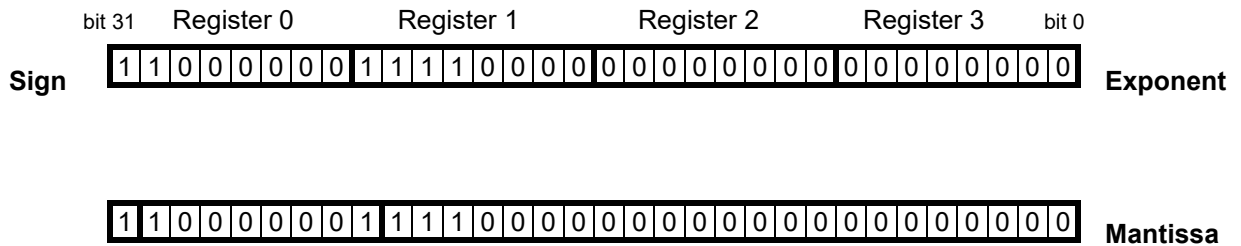
6.3 Data Formats

6.3.1 Real (Floating Point)

Values are presented in IEEE 754 single precision format.

- **Bits 0 to 22**   Normalised binary mantissa minus 1
- **Bits 23 to 30**   Exponent in unsigned, 8 bit, excess 127 format
- **Bit 31**   Sign bit

Example

The example below shows the register contents of a Parameter containing a floating-point value of -7.5, and the corresponding bit assignments for IEEE 754.

	bit 31	Register 0	Register 1	Register 2	Register 3	bit 0	
Sign	1 1 0 0 0 0 0 0	1 1 1 1 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0			**Exponent**

1 1 0 0 0 0 0 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	**Mantissa**

The mantissa is $1 + [2^{-1} + 2^{-2} + 2^{-3}] = 1.875$
(as the normalized mantissa is always between 1 and 2, the 1 does not need to be stored)

The value is given by the formula:

$$ -\text{sign} \ \text{x} \ \text{mantissa} \ \text{x} \ 2^{(exp - 127)} $$

which in this case is:

$$ -1 \text{ x } 1.875 \text{ x } 2^{(129 - 127)} \quad = \quad -1.875 \text{ x } 2^2 $$
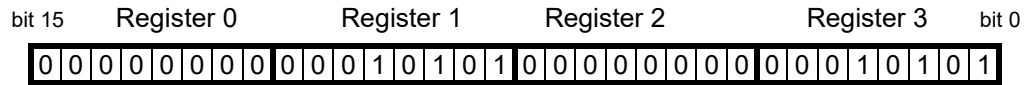
6.3.2 Long Integer

Values are presented as a 32-bit signed Integer, and are used to convey values which could have a range greater than ± 32768.

Bit 31 is the sign bit. Negative values are in two's complement format.

6.3.3　Short Integer

Values are presented as a 16 bit signed Integer, and are used to convey values that will have a range of less than +/-32768.

| bit 15 | Register 0 | Register 1 | Register 2 | Register 3 | bit 0 |

| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |

Bit 15 is the sign bit. Negative values are in two's complement format.

6.3.4　Boolean

FALSE is represented by all registers containing zero.

TRUE is represented by any register containing non-zero.

6.4   Operational Notes

6.4.1   Precedence over the GCI

If a Parameter is configured to be written via DeviceNet, it will immediately overwrite any changes made to the calibration using the GCI.

At power up, if the DeviceNet network is disconnected or unavailable, the last values sent to the GCI prior to power down will be used (i.e., the configured parameters are not overwritten until a valid DeviceNet data exchange has occurred).

Therefore, to change the calibration manually, it would be necessary to disconnect the DeviceNet network and cycle the power. Changes to the calibration parameters, Span and Trim, may then be made using the touch screen interface as normal.

6.4.2   Rounding Errors

When checking a Floating Point (Real) value, it may not appear exactly correct if any form of data conversion has taken place within the system. Floating Point values do not always convert to exact decimal equivalents. Small rounding errors should be allowed for in any equality checks.

6.4.3   Unavailable Parameters

If a remote networked Gauge is powered down or disconnected for any reason, any associated Gauge Readings and the affected Status Parameter will be set to 0xFFFFFFFF after a delay of approximately 5 seconds.

The Fieldbus Master may monitor for this condition and take appropriate action.

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7 | GaugeToolsXL Software

GaugeToolsXL is an *Offline* configuration tool. It is available on the GTXL CD supplied with the gauge.

The Configuration may be stored as a file, or extracted directly from the GCI. Changes must be downloaded to the GCI, and the GCI restarted, before taking effect.

7.1 Installing the GaugeToolsXL Software

Run the executable and follow the prompts.

7.2 Backing up the Configuration

Before changing any settings, always back up the current configuration.

1. Connect the GCI to the same network as the PC on which GaugeToolsXL has been installed.

2. Start GaugeToolsXL.

3. Locate the GCI under the Clients node of the device tree, and drag it to the Utility tool icon. The Utility tool window opens in the right-hand panel as shown.
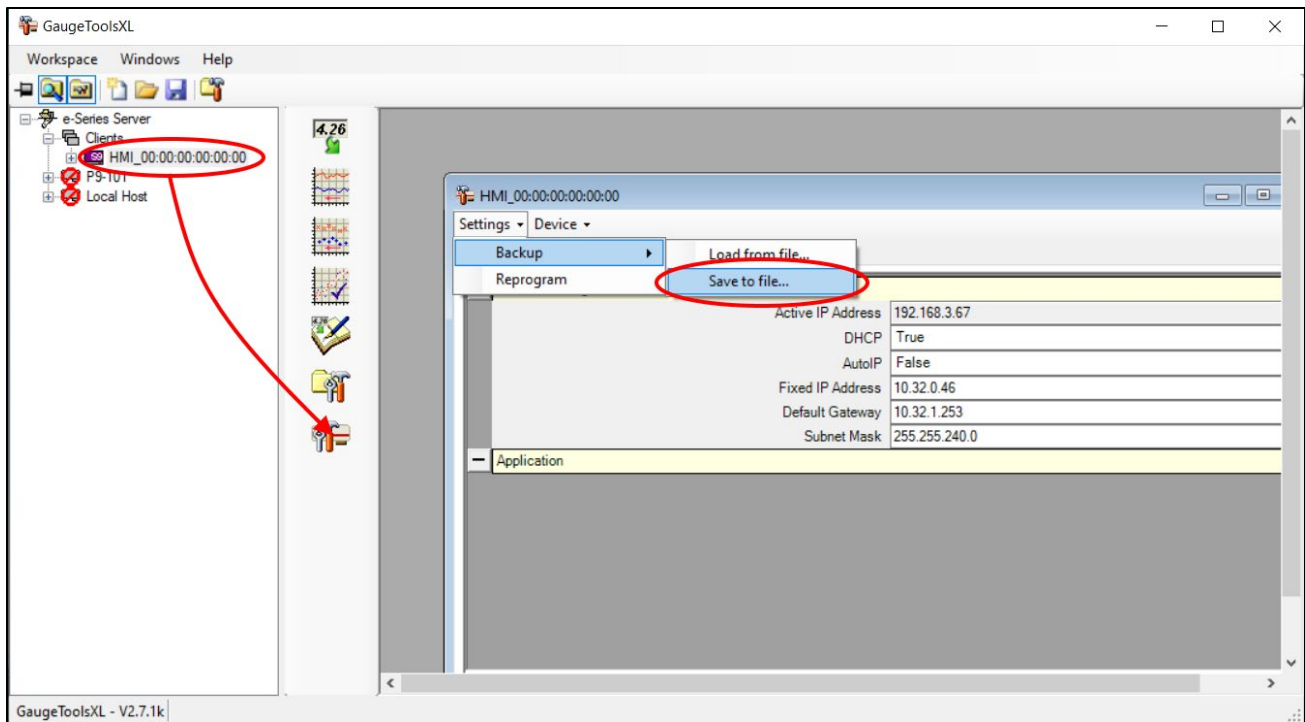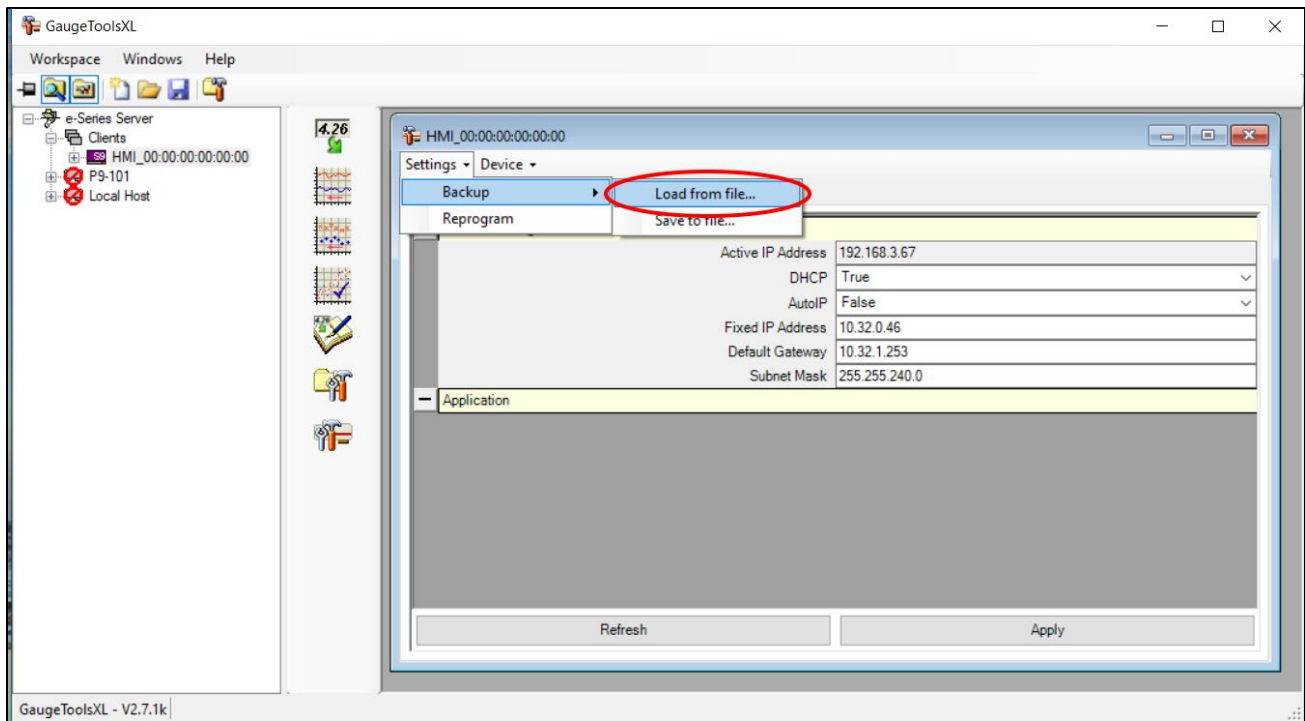
4. From the **Settings** menu, select "**Save to file…**".
   Choose an appropriate filename when prompted.

GaugeToolsXL will then connect to the GCI, upload all configuration settings, and write them to the given backup file.

7.3   Downloading a Saved Configuration

1. Drag the GCI to the Utility icon to open the Utility tool window.

2. From the **Settings** menu, select "**Load from file…**".

3. When prompted, navigate to and select the backup file.

GaugeToolsXL connects to the GCI and downloads the backup file.

## 7.4   Changing the Fieldbus Configuration

The Fieldbus configuration can be modified using the GaugeToolsXL Utility tool.

1. Locate the GCI under the Clients node of device tree, and drag it to the Utility tool icon.
   The Utility tool window opens in the right-hand panel as shown.
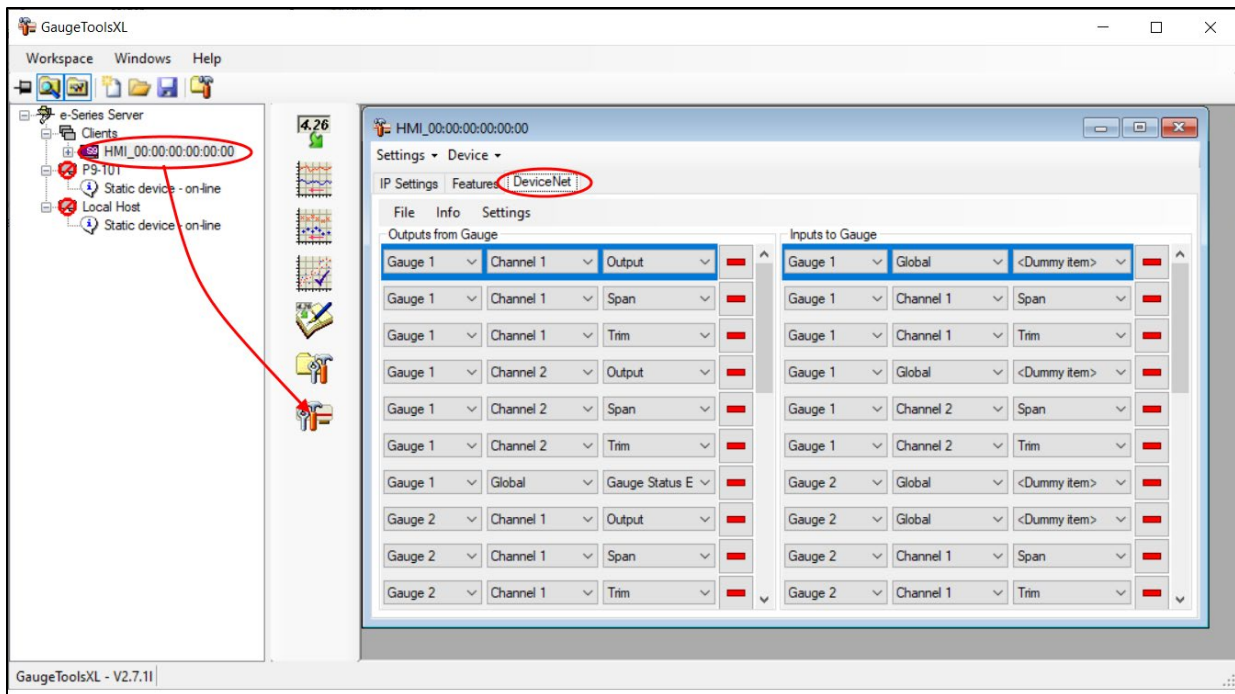
2. If the GCI has a functioning Fieldbus card fitted, then the Utility tool window displays a Fieldbus tab indicating the type of card fitted. In the screenshot above, a DeviceNet tab is shown.

3. When the tab is selected, GaugeToolsXL automatically connects to the GCI, and uploads and displays the current configuration.

4. At this point, it is possible to:

- Save the uploaded configuration to a PC file.
- Modify the uploaded configuration.
- Create a new configuration.
- Load a previously saved configuration from a PC file.

The **File** menu can be used to create a New empty configuration, Load a saved configuration from a PC file, or Save the current configuration to a file.
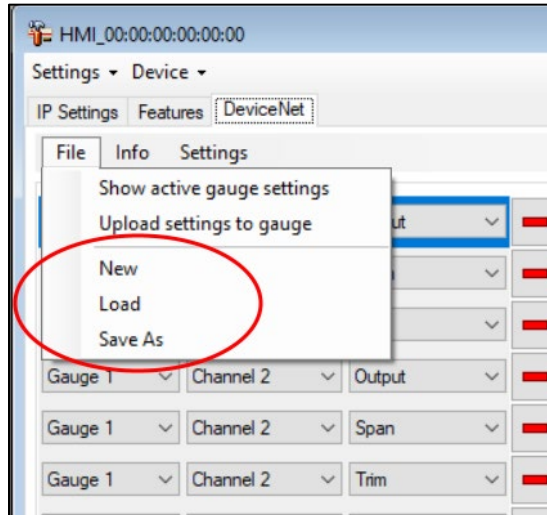

Once modifications to the configuration have been completed, it can be downloaded to the GCI.

7.5   Downloading a Configuration

The GaugeToolsXL Utility tool is used to load a Fieldbus configuration into the GCI.

1. First, use the Utility tool to create a new configuration, load a saved configuration, or upload the current configuration from the GCI.

2. Modify the configuration as required, then select **Upload settings to gauge** from the **File** menu to load the configuration into the GCI.
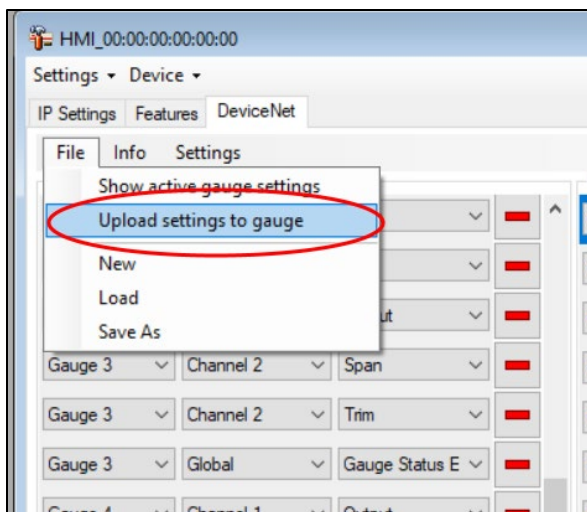
Note: The GCI must be restarted for changes in the configuration to take effect.

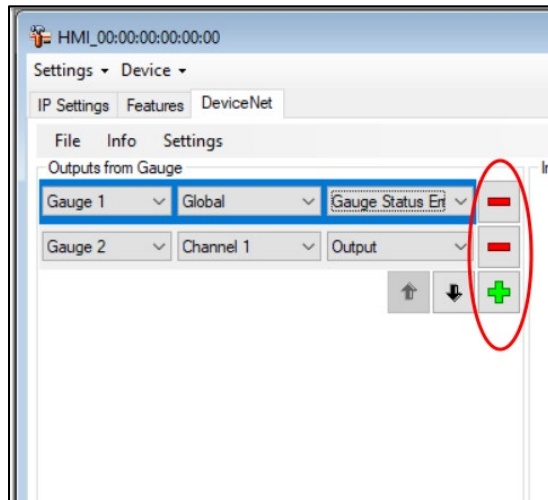# 7.6 Setting the Node Address

1. Select the Fieldbus tab in the Utility tool window, then click on the **Settings** menu.
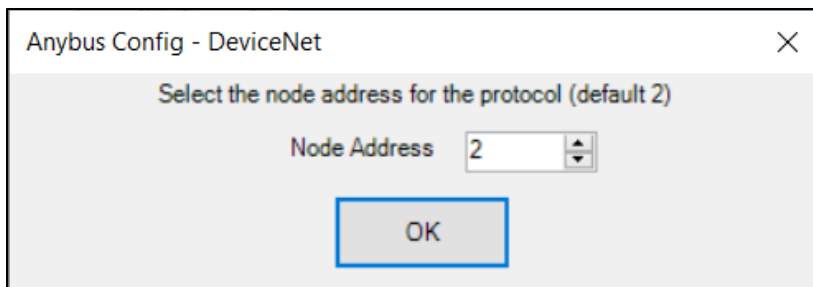
2. Set the desired node address.

## 7.7   Changing the Parameters

1. Select the Fieldbus tab in the Utility tool window.

2. Parameters can be added or removed from the configuration by clicking on the buttons indicated below.

3. Using the **Gauge** identity drop down, select the source of the parameter.
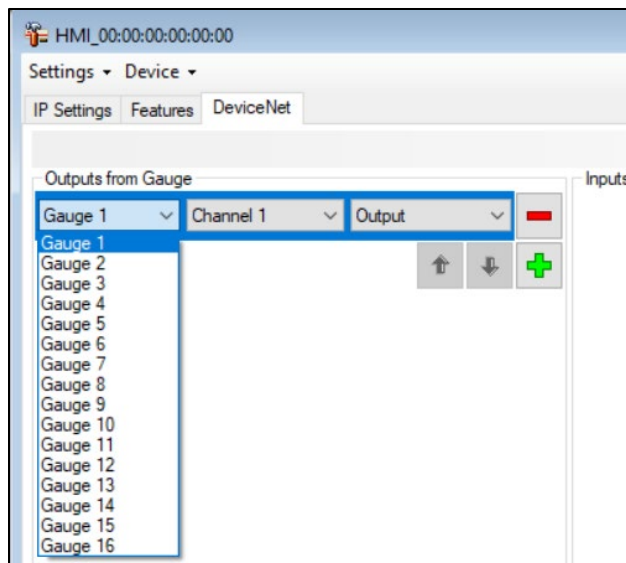
4. Using the **parameter type** drop down, select whether the parameter is a measurement parameter, or a global parameter value. For measurement parameters, select the required channel number.
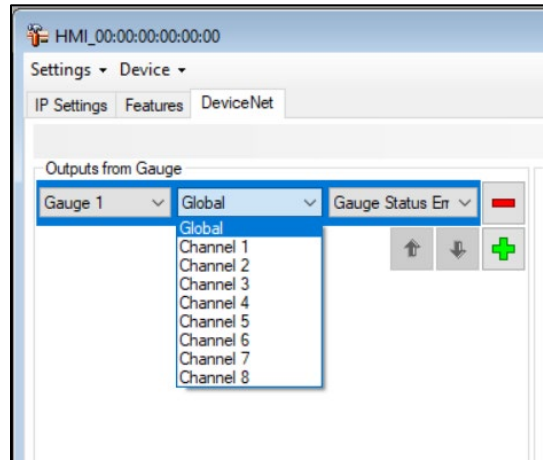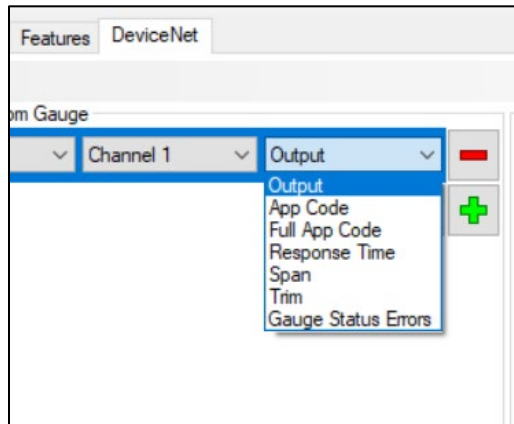

5. Use the **parameter** drop down to select the required parameter. The parameters available for selection depend on the type of parameter selected by the **parameter type** drop down.

Global parameters:
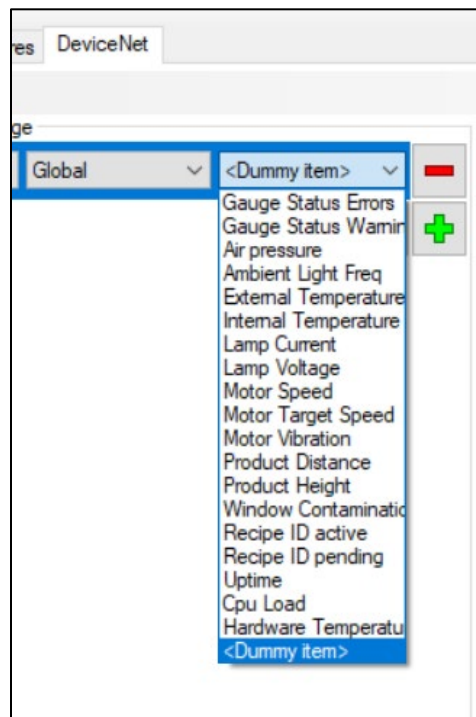
Measurement parameters:

A detailed description of each parameter can be found in Section 6 - Data Parameters.

Note: **<Dummy item>**

The Global parameter list contains a "<Dummy item>" entry. This can be used to arrange the layout of parameter data if required. For example, the default parameter configuration described in Section 5.1 - DeviceNet Register Configuration (Default), uses "<Dummy item>" entries in the output data (to gauge), to align a parameter with its equivalent in the input data (from gauge).

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Warranty

1. All sales of NDC Technologies products are subject to the contractual terms and conditions of the Order pursuant to which they were sold to Buyer, including Warranty terms. The following terms are a general summary of the contractual Warranty terms, NOT a revision or alternative to the contractual terms, and are presented as merely a point of reference for your information. The contractual Warranty is the complete and exclusive statement of all NDC Technologies warranties to Buyer. In the event the following terms are in conflict with any of the contractual Warranty terms, the contractual Warranty terms shall be deemed to control.

   The warranty terms contained herein are expressly in lieu of any and all other warranties, expressed or implied, including any warranty of merchantability or fitness for a particular purpose. In no event shall NDC Technologies be liable for any incidental, consequential or special damages, including but not limited to, any loss of business, income or profits, expenses incurred for time when the system is not in operation, and any labor costs relating to or arising out of the performance, functioning or use of the system.

   Purchaser assumes the risk for use of this product and agrees to indemnify and hold NDC Technologies harmless for any and all damage to person or to property resulting therefrom.

   NDC Technologies grants no license under any patent rights except the right, under only such patents as may be owned or acquired by NDC Technologies, to use the product sold hereby for the purpose for which it is sold. NDC Technologies does not warrant that the product or its use does not infringe any patent owned by persons other than NDC Technologies.

2. NDC Technologies guarantees all products to be free from defects in material and workmanship for the following periods[1]:

   - Product and peripherals – 2 years from shipment
   - Source lamp – 5 years from shipment
   - Filter wheel motor – 5 years from shipment
   - Spare parts – 1 year from shipment
   - Replacement lamps and motors supplied under warranty – 1 year or up to the original 5 year warranty from shipment of the sensor, whichever is longer

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   [1] Refer to the contractual terms and conditions of the Order for usage of the warranty.

   During this period, NDC Technologies will repair or at its option replace, free of all charges for parts and labor, any NDC Technologies parts determined by it to have been broken or damaged due to causes other than improper application, abuse or negligence. NDC Technologies' obligation to repair or replace shall not extend to expendable parts which are subject to normal operating wear.

   Nothing in this paragraph 2 will require NDC Technologies to make repairs or replacements where:

A. The product has been repaired, other than by an authorized NDC Technologies dealer or an NDC Technologies employee, or altered in any way without the prior written consent of NDC Technologies; or

B. The product has not been properly maintained in accordance with any operating and maintenance manual supplied therewith; or

C. The product has been damaged as a result of fire, flood, war, insurrection, civil commotion, acts of God or any other cause beyond the control of NDC Technologies or Buyer.

3. NDC Technologies' liability shall be limited to the obligations set forth in Paragraph 2. These shall be the Buyer's sole and exclusive remedies, whether in contract, tort or otherwise, provided, however, that in lieu thereof, NDC Technologies at its option may replace the entire product on an exchange basis or refund the purchase price against the return of the defective product.

4. NDC Technologies will not be responsible for failure to provide service or parts due to shortage of materials, labor or transportation strikes or delays, or any causes beyond NDC Technologies' control.

5. Unless otherwise specified by NDC Technologies, all warranty repairs will be made at NDC Technologies' facility. The customer shall be responsible for all expenses of packing, freight and insurance in connection with the shipment of products to NDC Technologies for repair. NDC Technologies will pay the cost of returning the equipment to customer.

    If it is mutually determined by the buyer and NDC Technologies that the examination, replacement or repair takes place at the buyer's facility, then the buyer will be responsible for NDC Technologies' travel and living expenses incurred in traveling to and from the buyer's facility, and during the time of the visit, as well as the cost of field labor and replacement parts unless the parts being repaired or replaced are determined to have been defective, in which event the cost of said repaired or replacement parts shall be borne by NDC Technologies. These travel and living expenses will be billed to the buyer at actual cost to NDC Technologies.

6. No person, including any NDC Technologies distributor, agent or representative, is authorized to assume any liability on behalf or in the name of NDC Technologies, and NDC Technologies shall not be bound to any understandings, representations, or agreements with respect to warranties except as set forth in this policy.

7. NDC Technologies requests immediate notification of any claims arising from damage in transit in order to determine if carrier responsibility exists. If damaged equipment arrives, save the shipping container for inspection by the carrier and telephone NDC Technologies as soon as possible.