Map File Maker

A tool to create map files for Calibration Management

What is a map file and why do we need it.

- All the information to calibrate a device is available through DDL
- Unfortunately, each device has named those parameters & enumeration values different.
- We need to map those DDL parameters and enumerations to a standard so we can calibrate devices.

Categories of devices

- Temperature Transmitters
- Pressure Transmitters
- Flow Transmitters
- Analytical Transmitters (pH, O2, etc…)
- Valves

What “Map File Maker” does well

- Temperature Transmitters
- Pressure Transmitters
- Analytical Transmitters
- (most) Flow Transmitters

This is true for HART, FF or wirelessHART

What “Map File Maker” does NOT do well

- HART Valves
  (input: mA output: % or throw)

- (some) Vortex Flow Transmitters
  (Input: Hz output: Flow or mA)

- HART Multi-variable Transmitters
  (input: ? output: mA)

Most common calibrations

- Temperature and pressure transmitters are the most commonly calibrated.

- Creating a map file for a temperature transmitter is probably the hardest.

Temperature

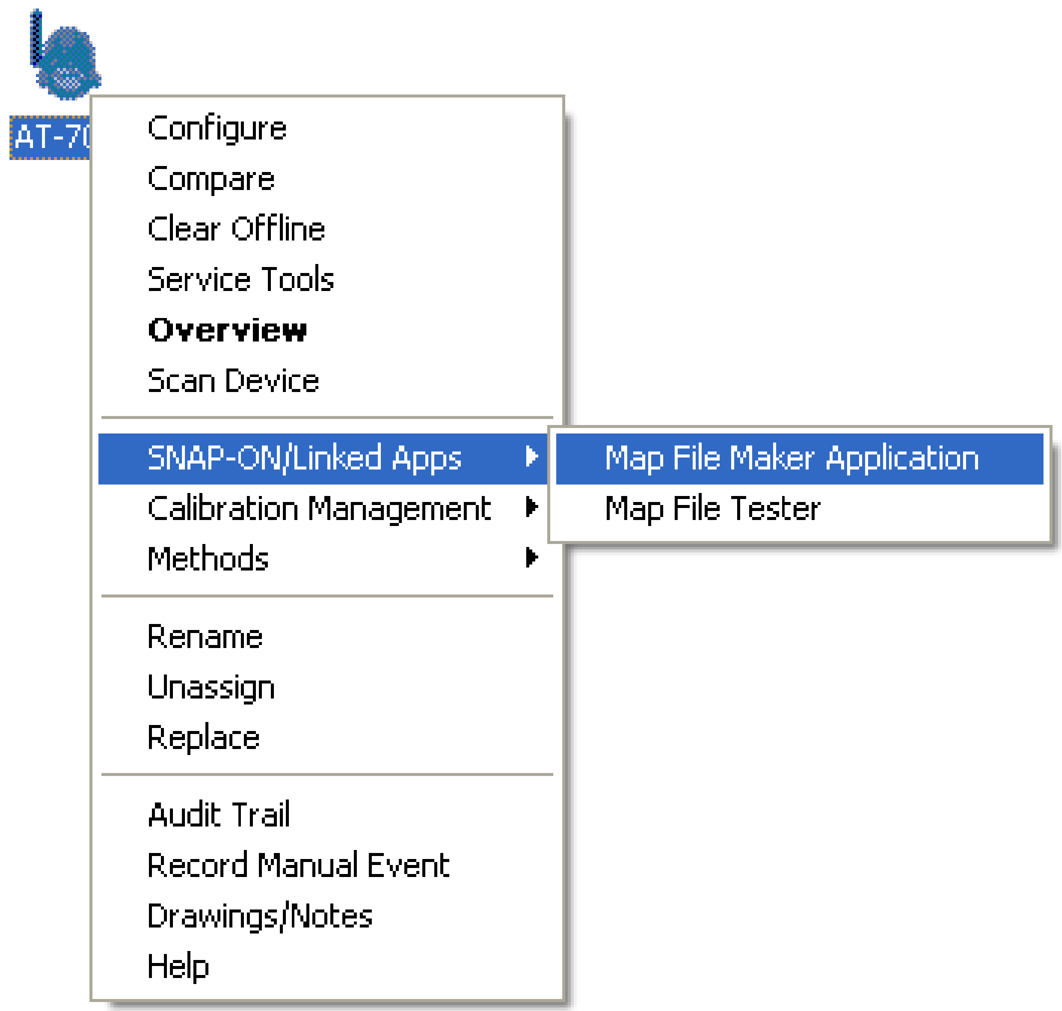
- Calibrators will often simulate temperature probes to verify the operation of a temperature transmitter.

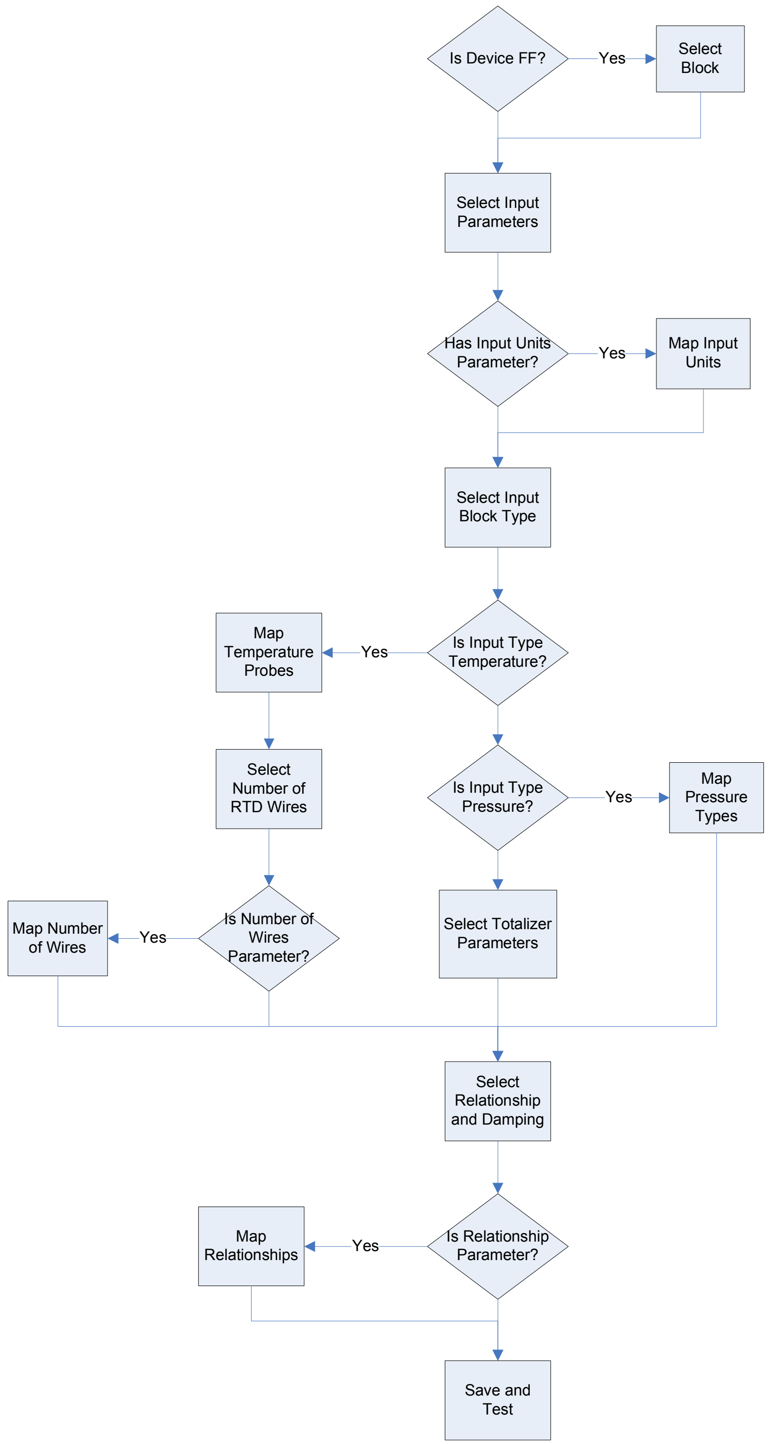
- We need to identify enough parameters and values (in a standard format) to allow that calibrator to simulate the current temperature probe.

How do I create a map file for a temperature transmitter?

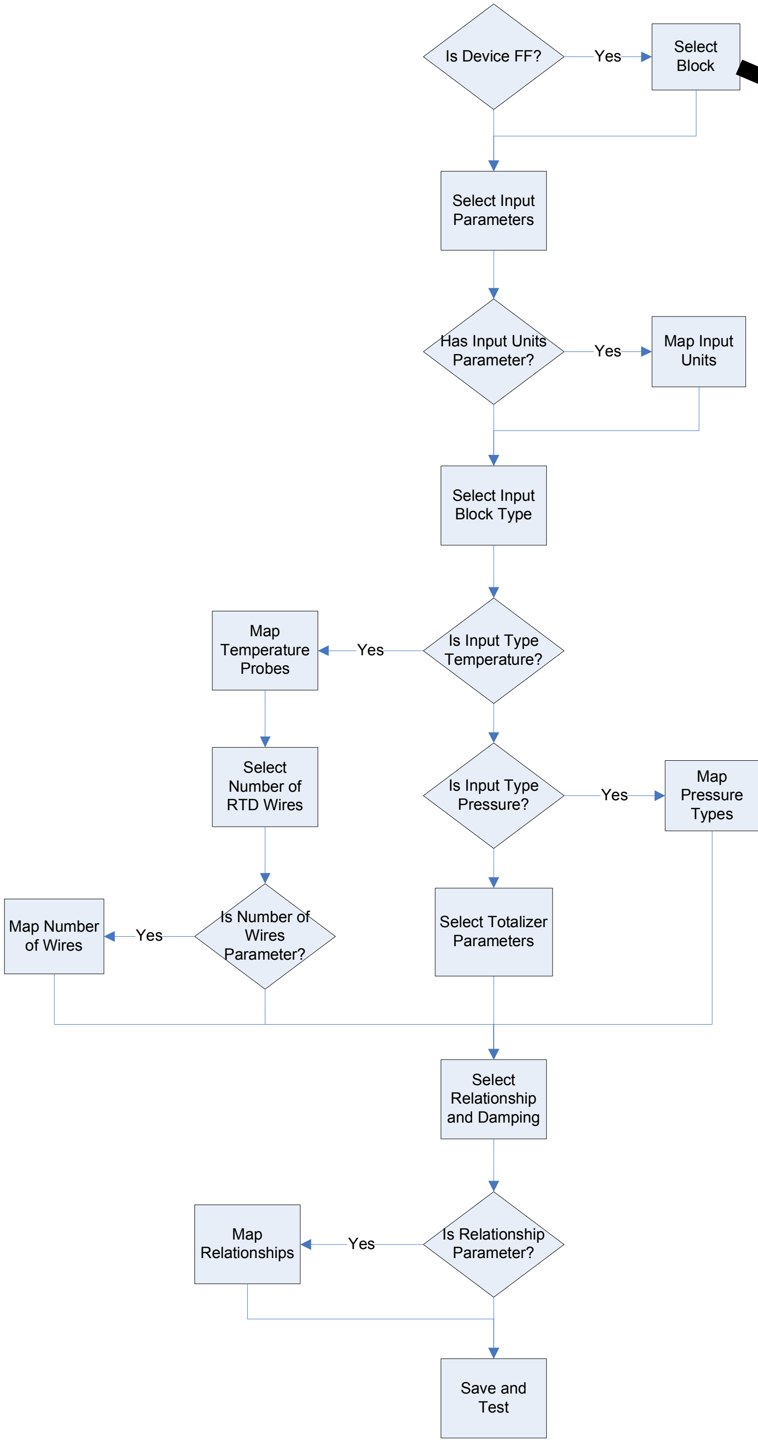
- Map File Maker will step the developer through identifying the parameters needed to calibrate this device type.
- I will run through the screens to create a Foundation Fieldbus temperature transmitter.

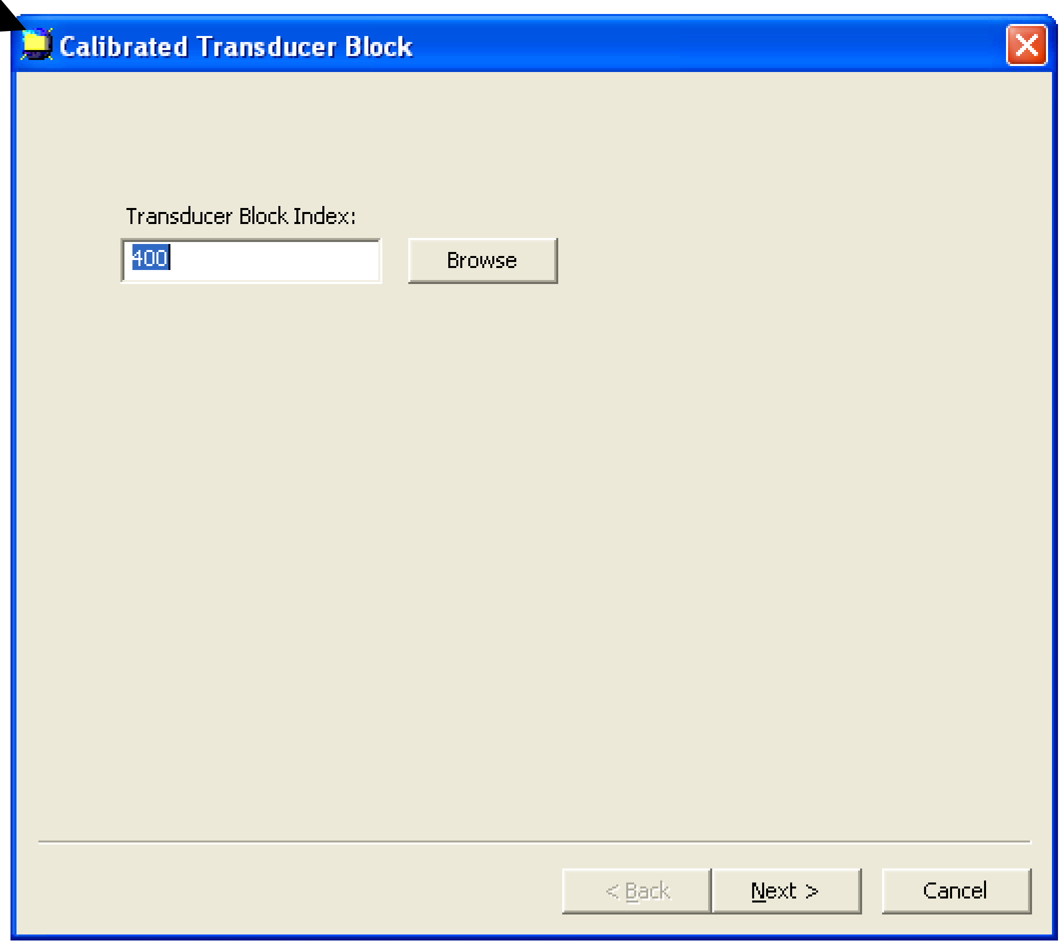
Launch “Map File Maker from the Device Context menu



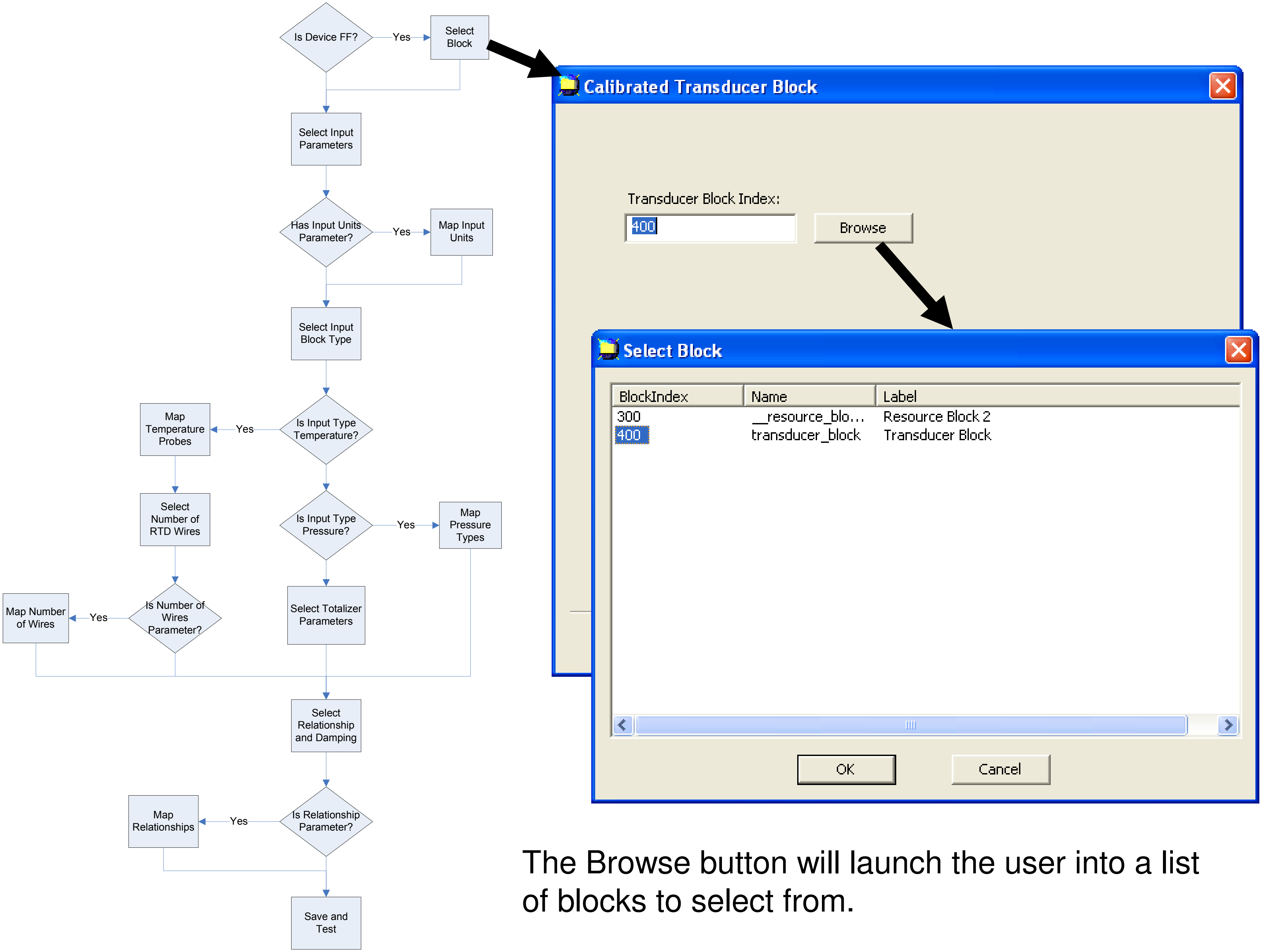


This is the flow diagram of the screens of Map File Maker.

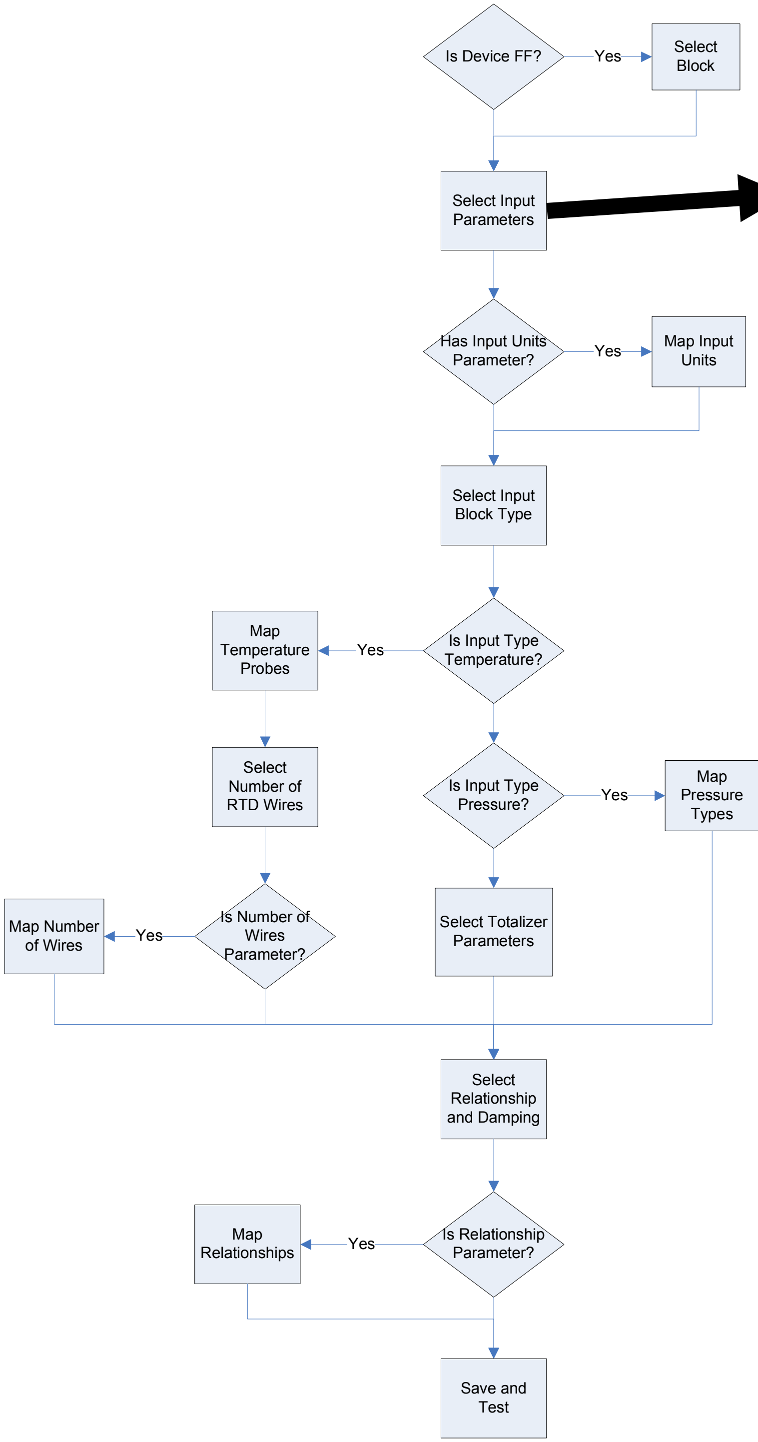


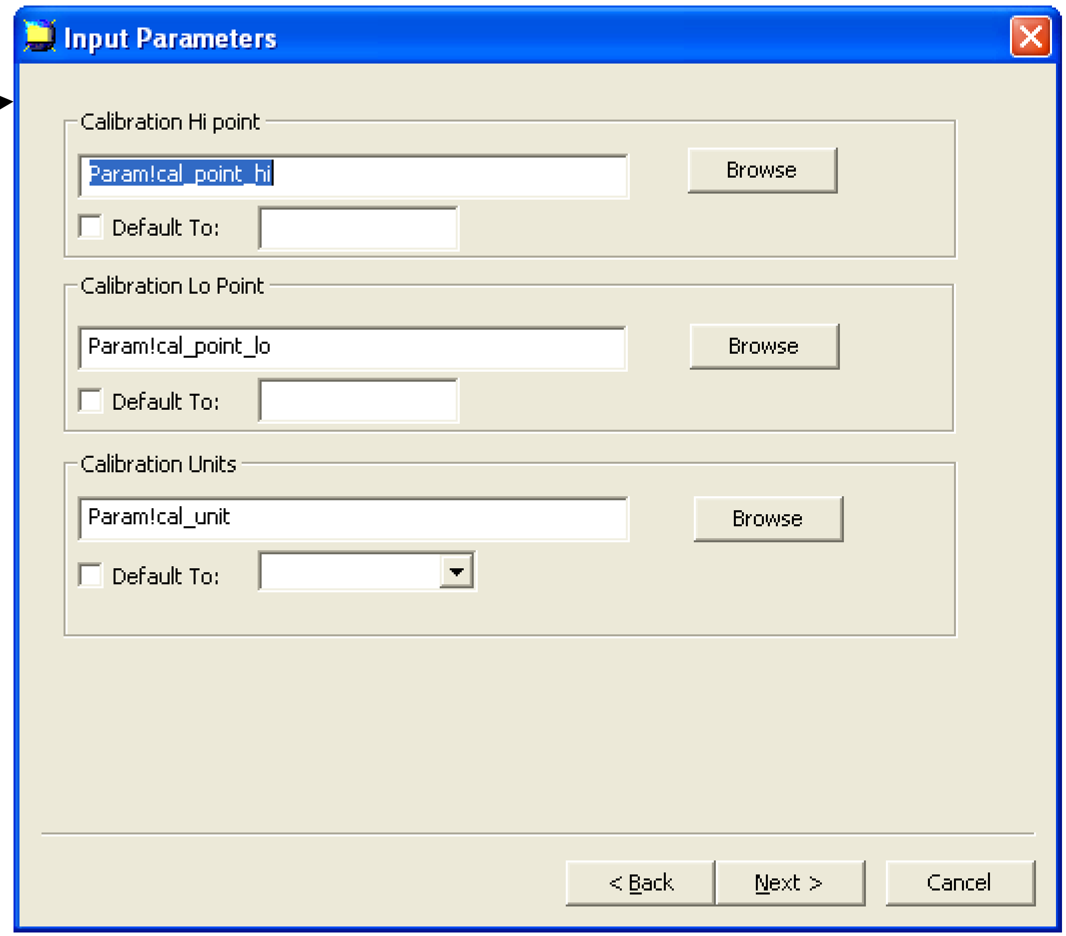


If the device is a Fieldbus Device the first screen displays the Block that will be calibrated.

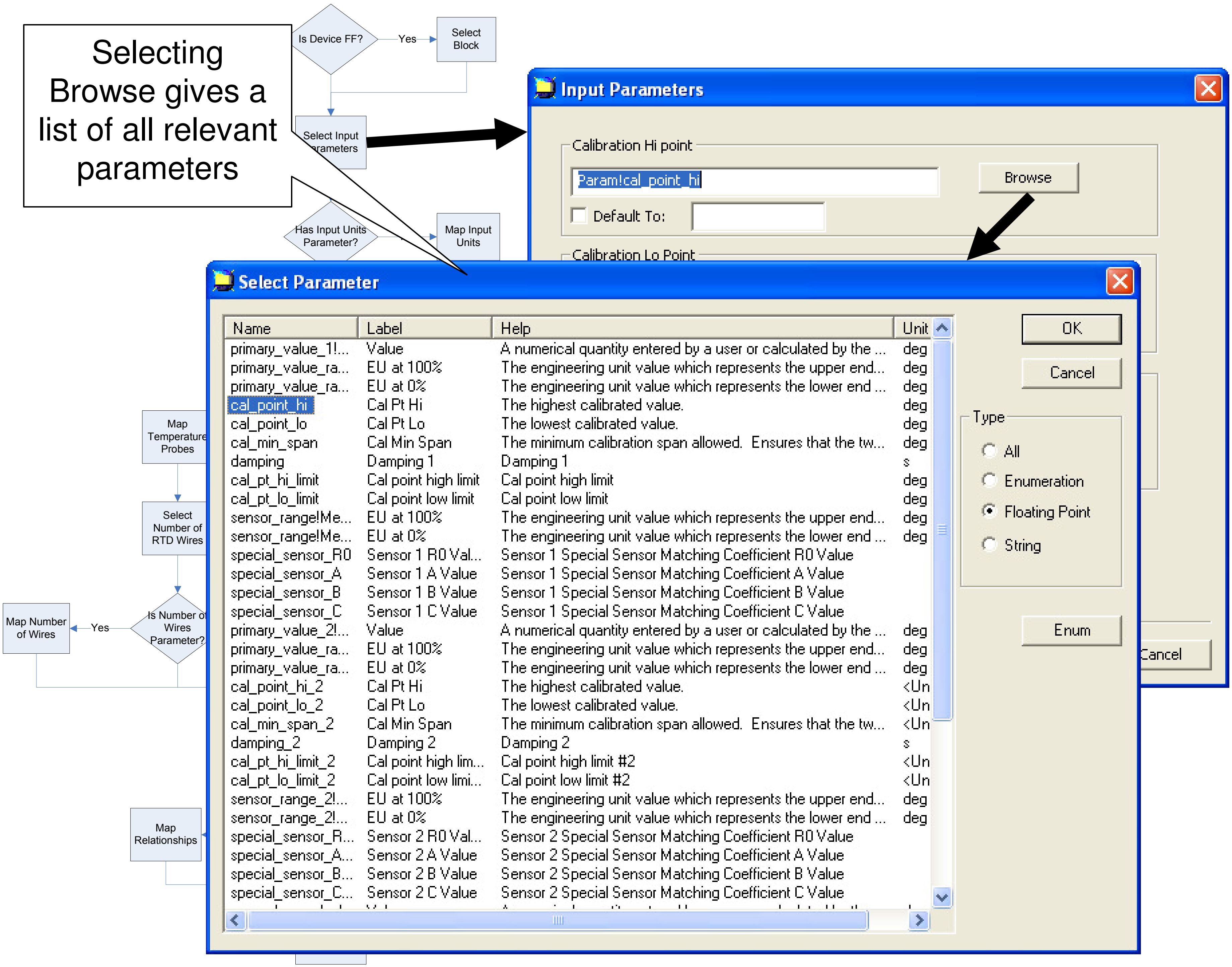


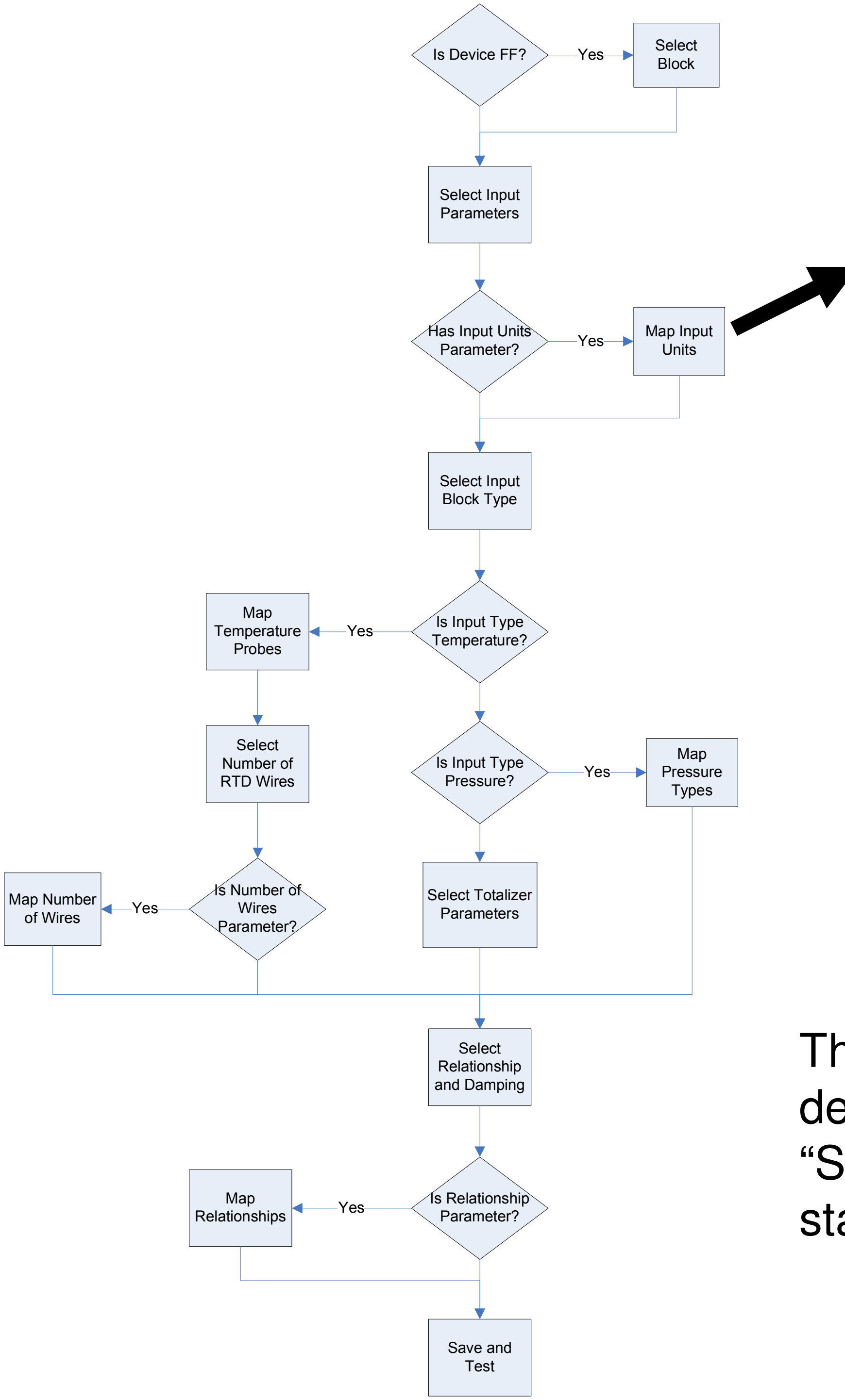
The Browse button will launch the user into a list of blocks to select from.

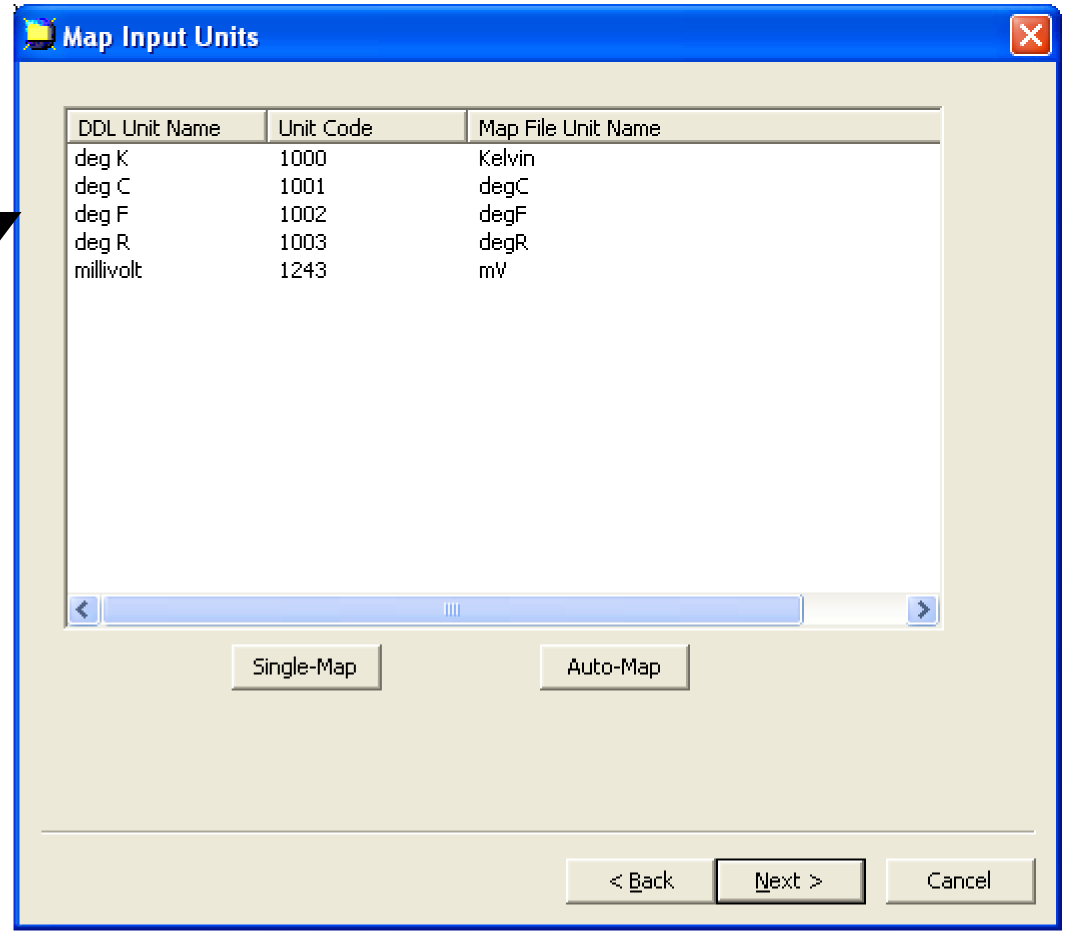




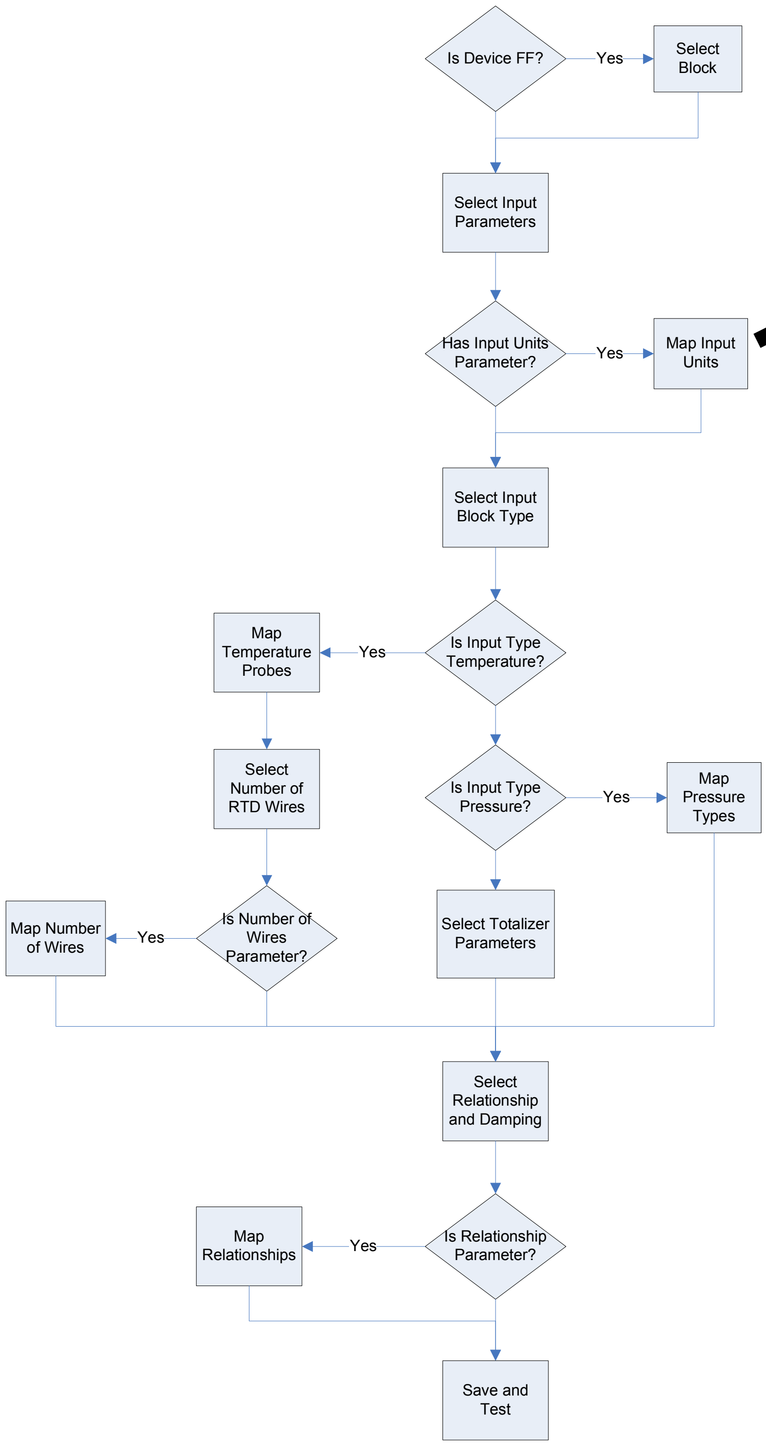
Once a block is selected the user needs to identify the cal_point_hi, cal_point_low and cal_unit. For FF the param names are usually some variation on these names. Otherwise, you can use range_values.100 range_values.0 and range_values.units

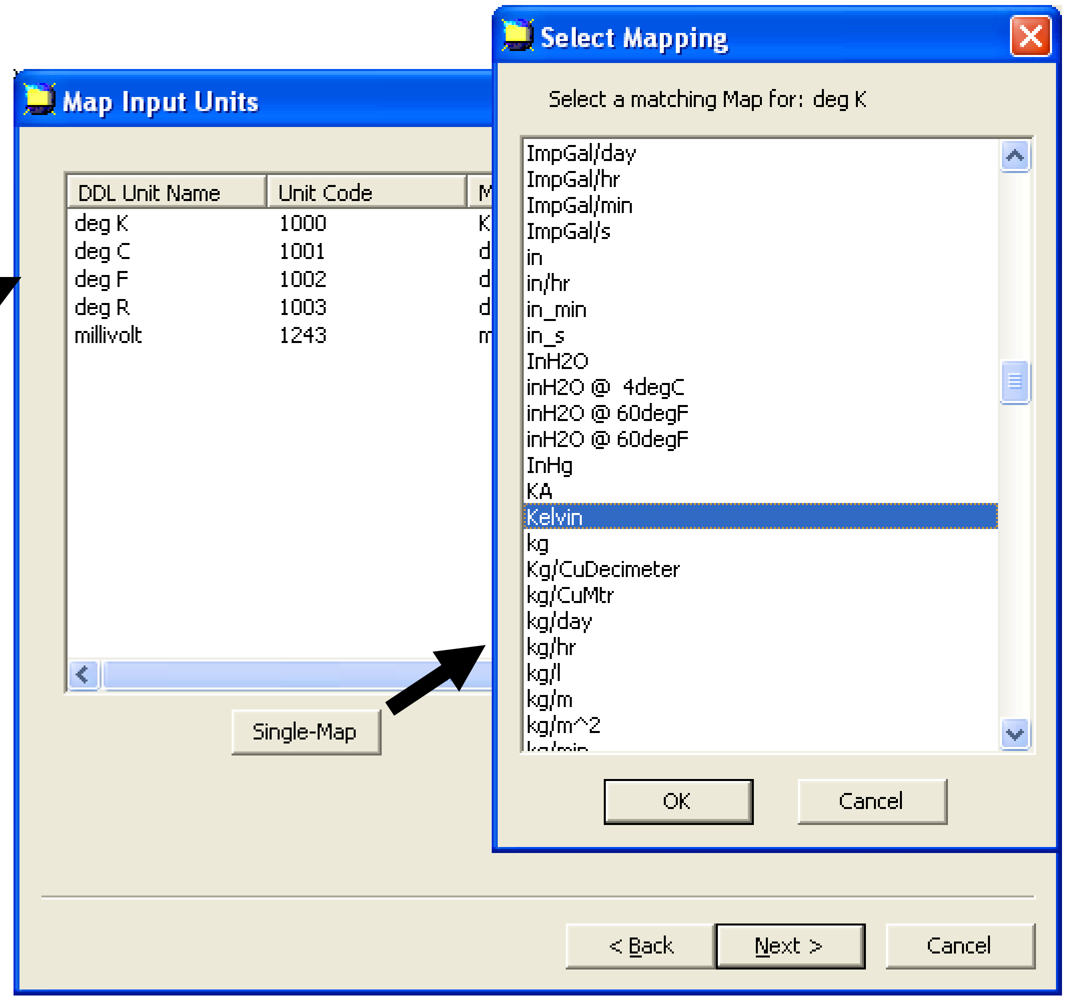

Selecting Browse gives a list of all relevant parameters
Is Device FF?
Yes
Select Block
Select Input Parameters
Has Input Units Parameter?
Map Input Units
Map Temperature Probes
Select Number of RTD Wires
Is Number of Wires Parameter?
Yes
Map Number of Wires
Map Relationships
Input Parameters
Calibration Hi point
Param!cal_point_hi
Browse
Default To:
Calibration Lo Point
Cancel
Select Parameter
Name | Label | Help | Unit
primary_value_1!... | Value | A numerical quantity entered by a user or calculated by the ... | deg
primary_value_ra... | EU at 100% | The engineering unit value which represents the upper end... | deg
primary_value_ra... | EU at 0% | The engineering unit value which represents the lower end ... | deg
cal_point_hi | Cal Pt Hi | The highest calibrated value. | deg
cal_point_lo | Cal Pt Lo | The lowest calibrated value. | deg
cal_min_span | Cal Min Span | The minimum calibration span allowed. Ensures that the tw... | deg
damping | Damping 1 | Damping 1 | s
cal_pt_hi_limit | Cal point high limit | Cal point high limit | deg
cal_pt_lo_limit | Cal point low limit | Cal point low limit | deg
sensor_range!Me... | EU at 100% | The engineering unit value which represents the upper end... | deg
sensor_range!Me... | EU at 0% | The engineering unit value which represents the lower end ... | deg
special_sensor_R0 | Sensor 1 R0 Val... | Sensor 1 Special Sensor Matching Coefficient R0 Value
special_sensor_A | Sensor 1 A Value | Sensor 1 Special Sensor Matching Coefficient A Value
special_sensor_B | Sensor 1 B Value | Sensor 1 Special Sensor Matching Coefficient B Value
special_sensor_C | Sensor 1 C Value | Sensor 1 Special Sensor Matching Coefficient C Value
primary_value_2!... | Value | A numerical quantity entered by a user or calculated by the ... | deg
primary_value_ra... | EU at 100% | The engineering unit value which represents the upper end... | deg
primary_value_ra... | EU at 0% | The engineering unit value which represents the lower end ... | deg
cal_point_hi_2 | Cal Pt Hi | The highest calibrated value. | <Un
cal_point_lo_2 | Cal Pt Lo | The lowest calibrated value. | <Un
cal_min_span_2 | Cal Min Span | The minimum calibration span allowed. Ensures that the tw... | <Un
damping_2 | Damping 2 | Damping 2 | s
cal_pt_hi_limit_2 | Cal point high lim... | Cal point high limit #2 | <Un
cal_pt_lo_limit_2 | Cal point low limi... | Cal point low limit #2 | <Un
sensor_range_2!... | EU at 100% | The engineering unit value which represents the upper end... | deg
sensor_range_2!... | EU at 0% | The engineering unit value which represents the lower end ... | deg
special_sensor_R... | Sensor 2 R0 Val... | Sensor 2 Special Sensor Matching Coefficient R0 Value
special_sensor_A... | Sensor 2 A Value | Sensor 2 Special Sensor Matching Coefficient A Value
special_sensor_B... | Sensor 2 B Value | Sensor 2 Special Sensor Matching Coefficient B Value
special_sensor_C... | Sensor 2 C Value | Sensor 2 Special Sensor Matching Coefficient C Value
OK
Cancel
Type
All
Enumeration
Floating Point
String
Enum



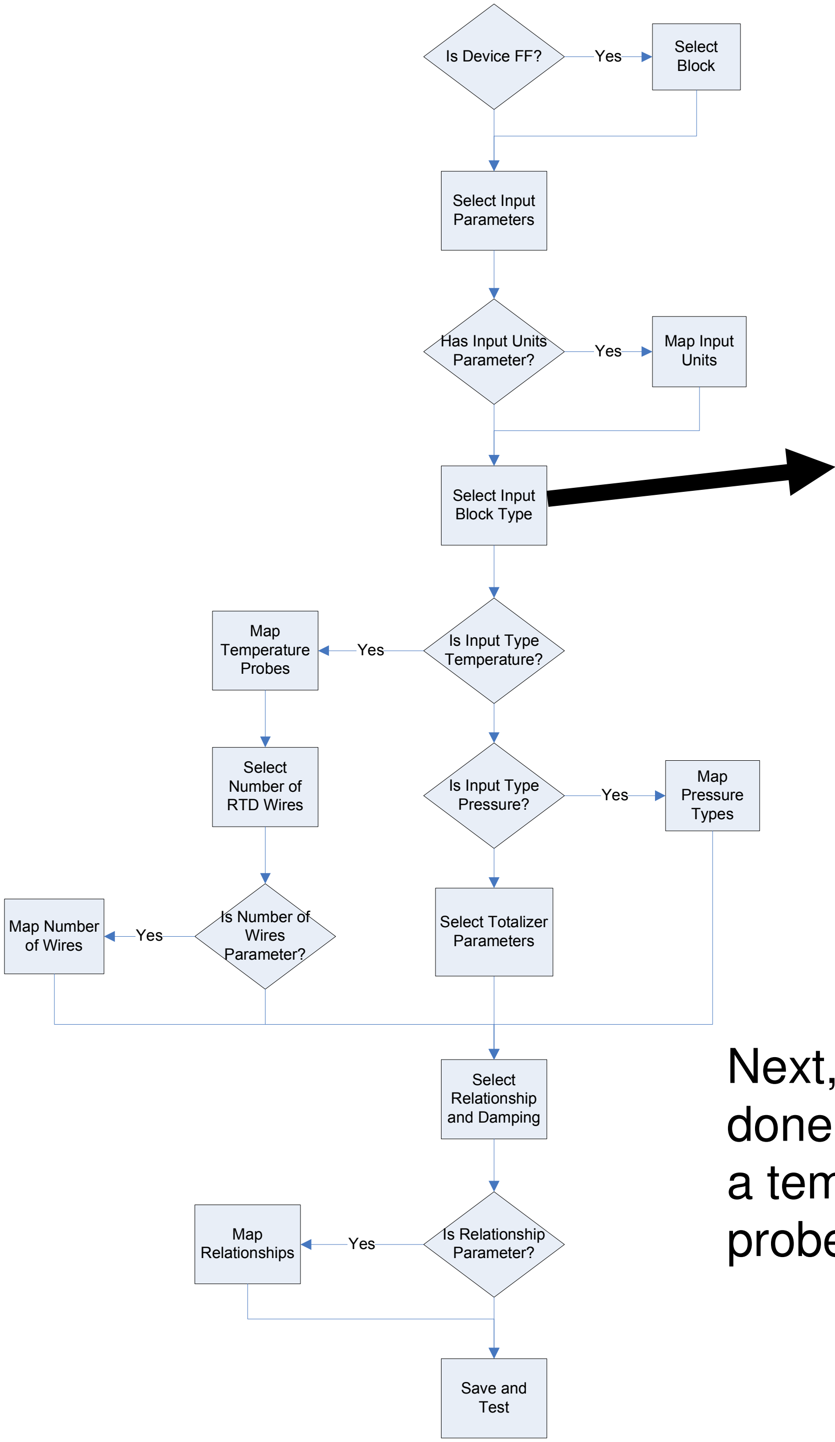


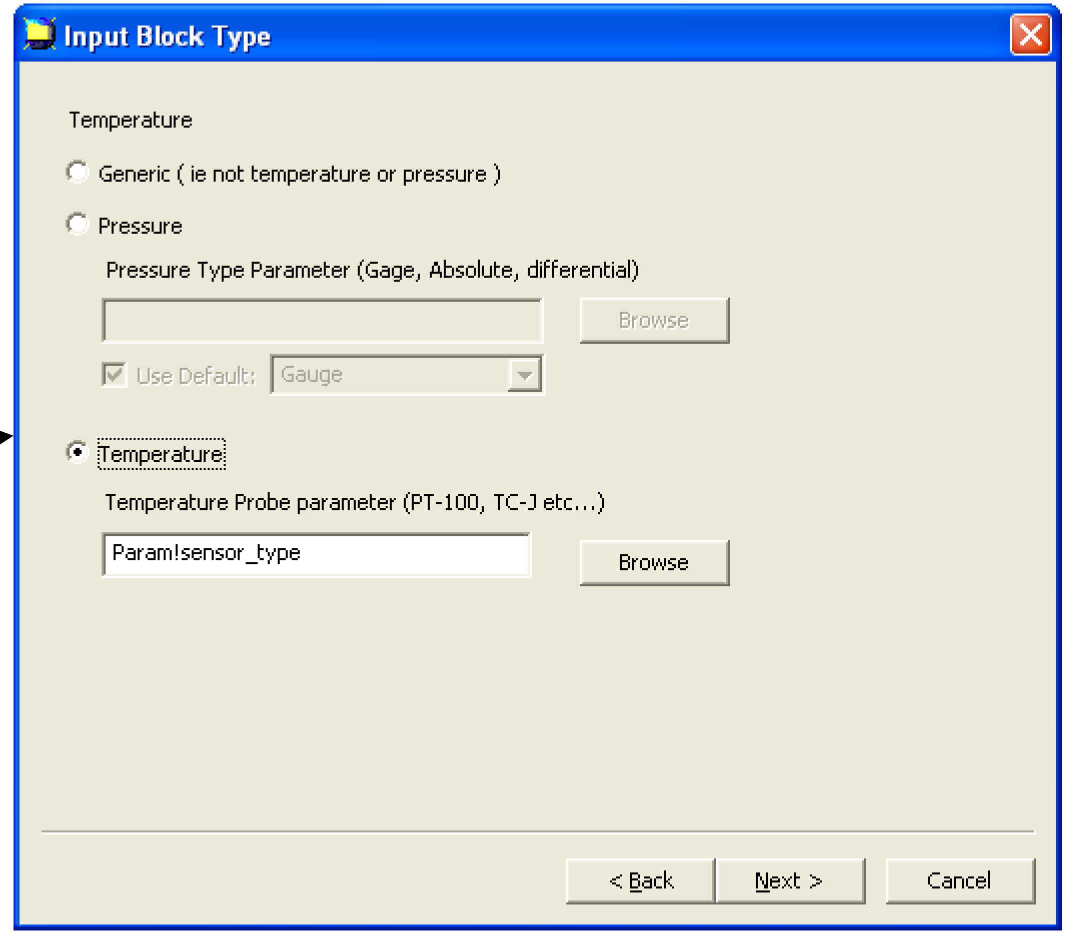
The “Auto-Map” feature works well for FF devices. Otherwise you need to click the “Single-Map” to map each DD unit to a standard unit.



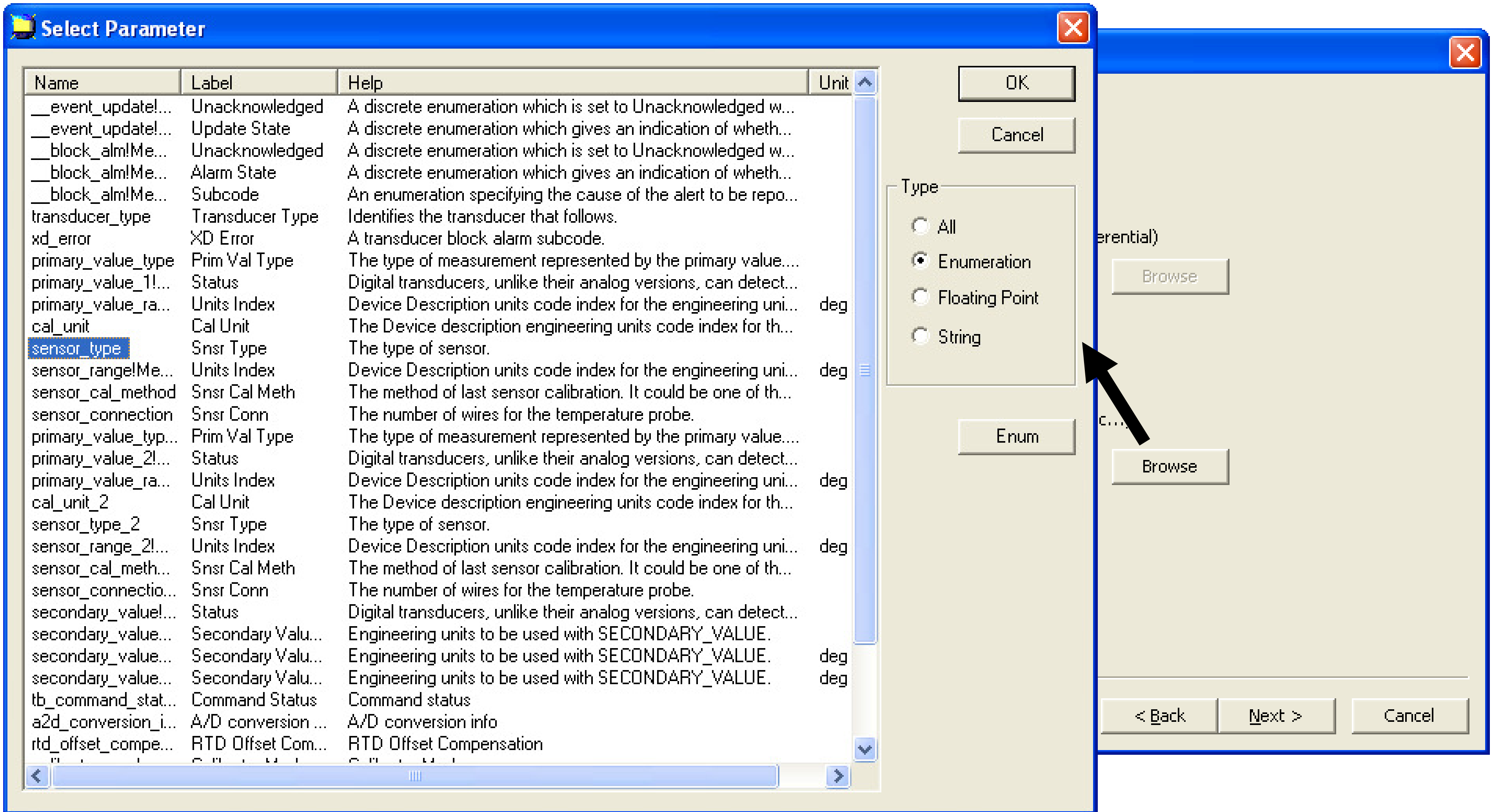


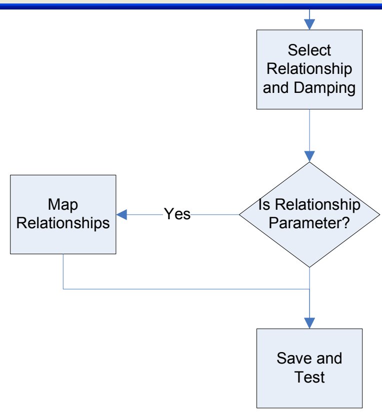
This is the standard list of units, if you cannot find the correct match… select “Unused”.



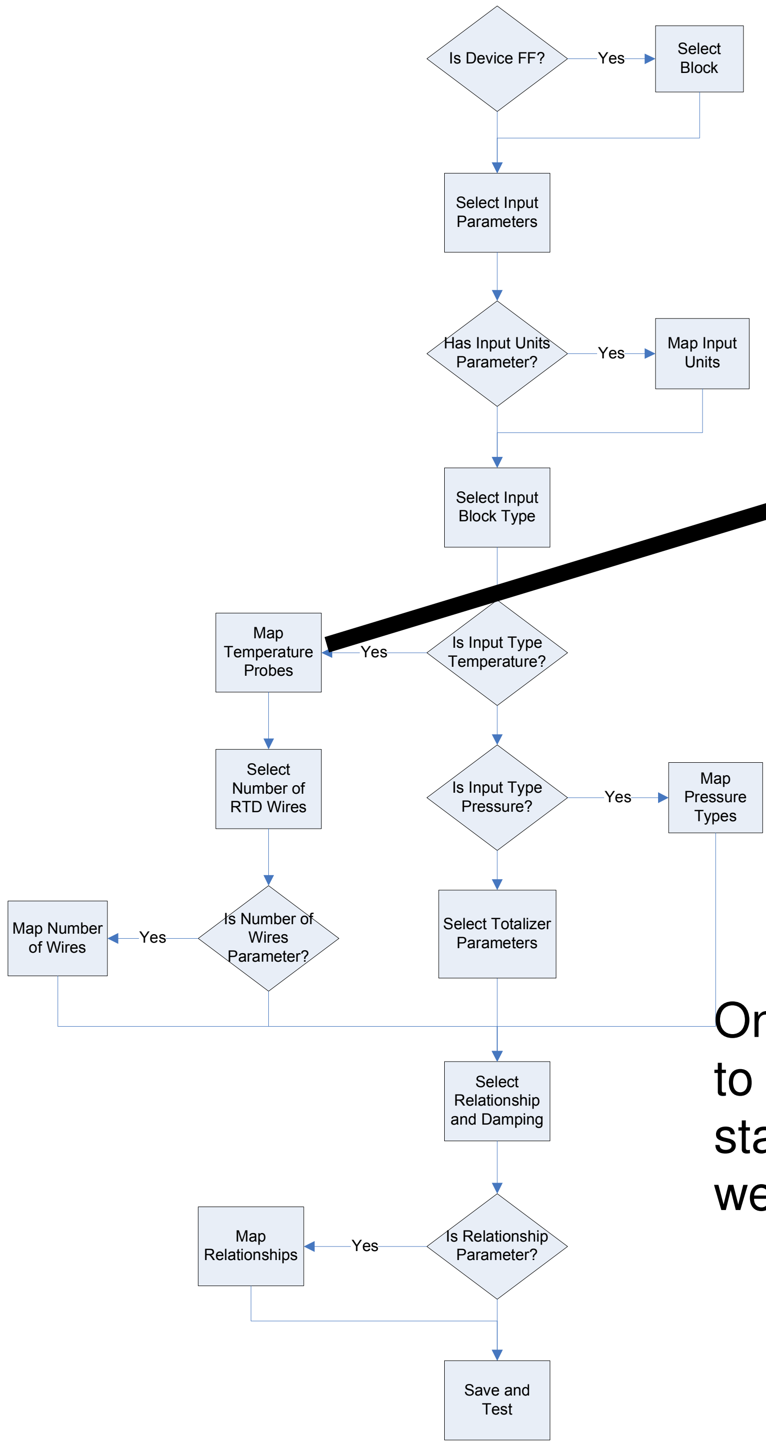


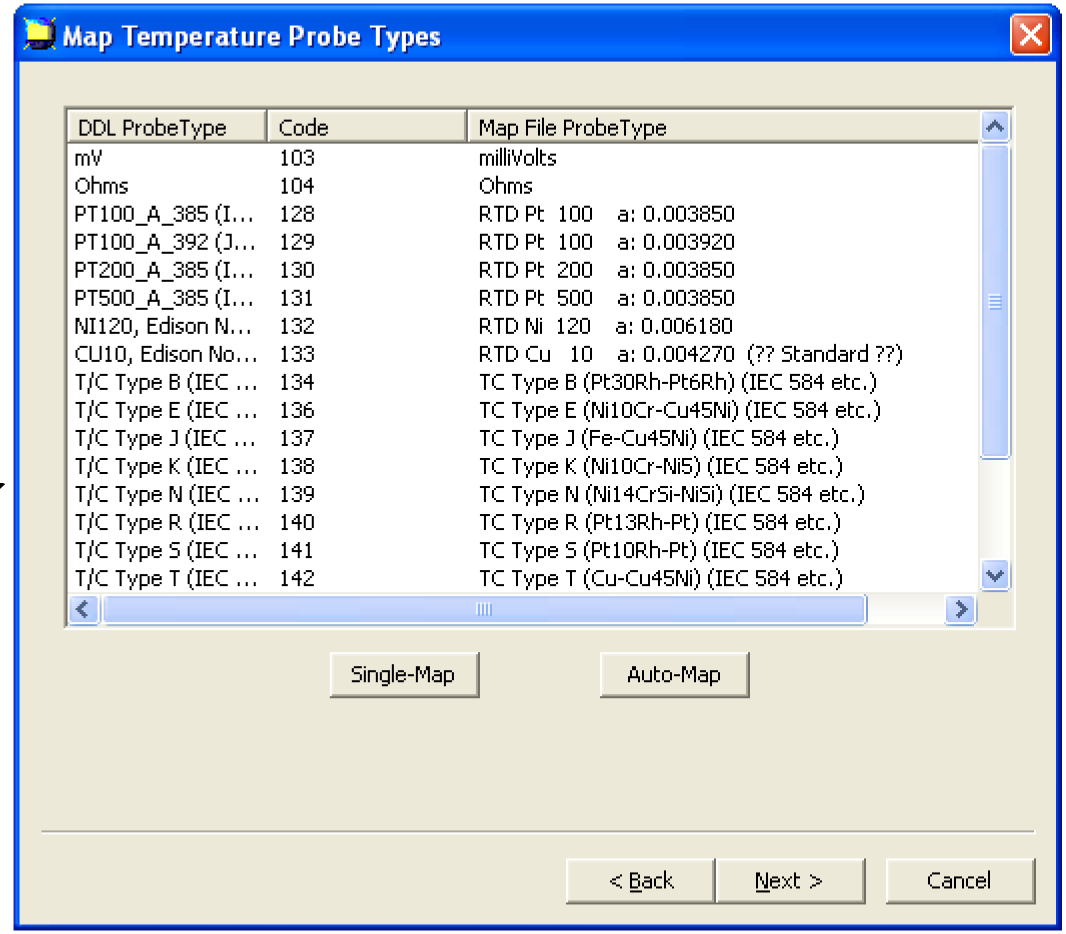
Next, select the "type" of the input, after having done the units, you probably know. If the device is a temperature transmitter, you need to select the probe_type (sensor_type) parameter.



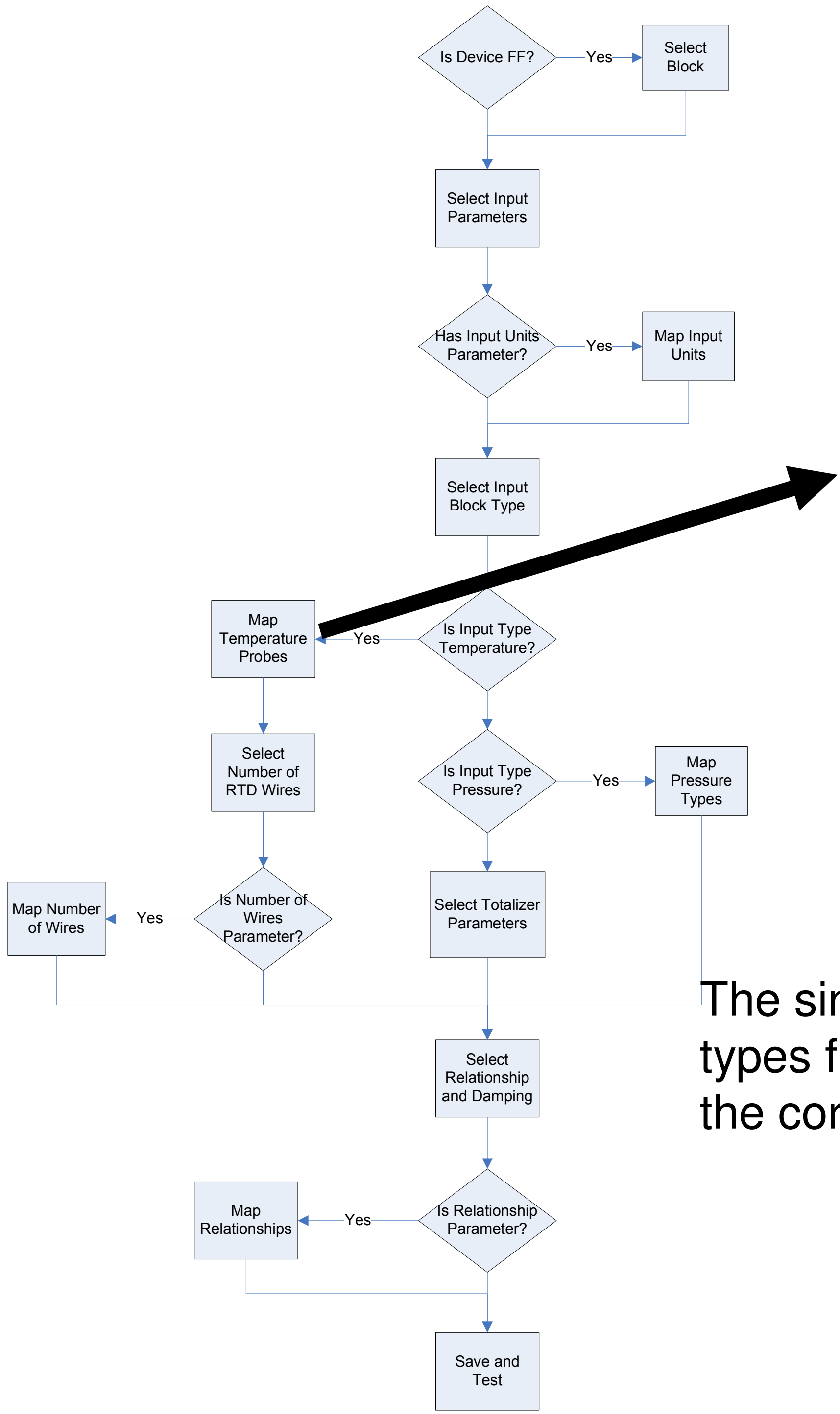


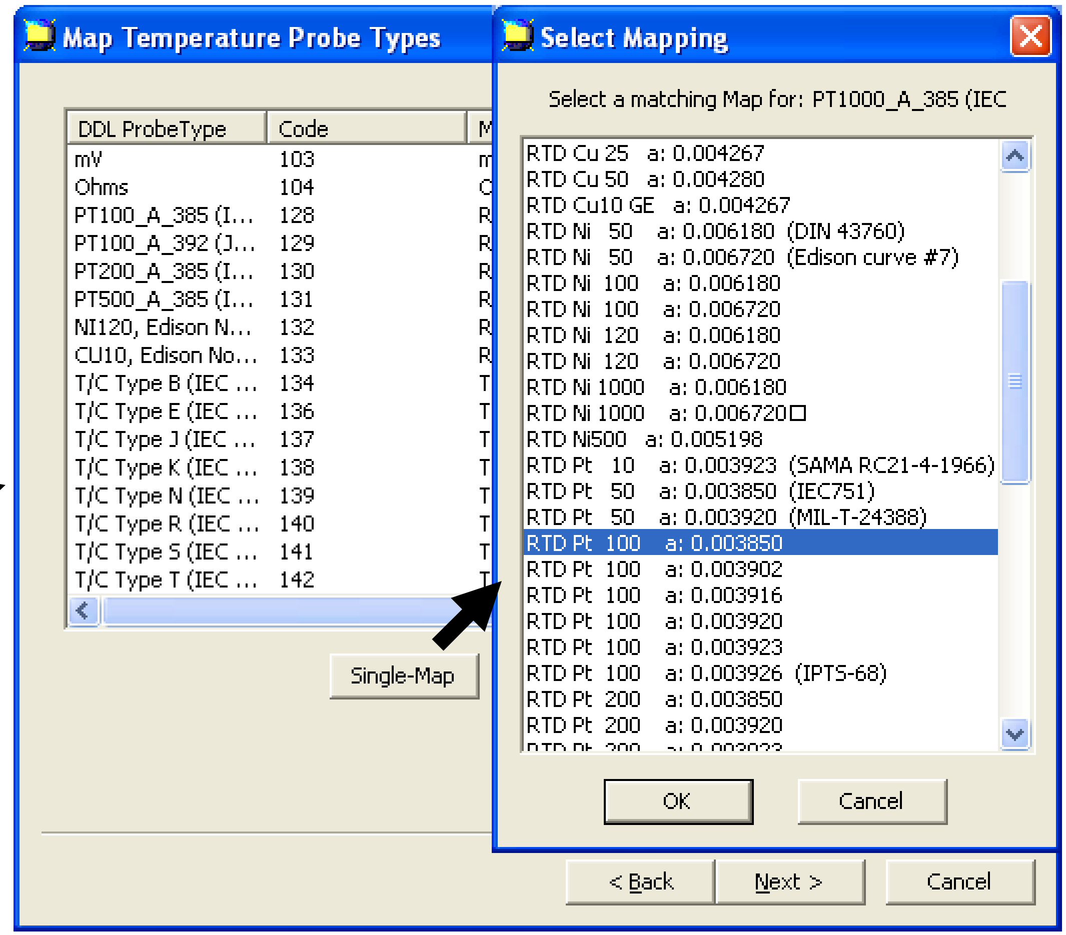
Again, the user has to sift through the list of parameters. Clicking the “Enum” button will also show you the list of enumerations for a selected enumeration variable



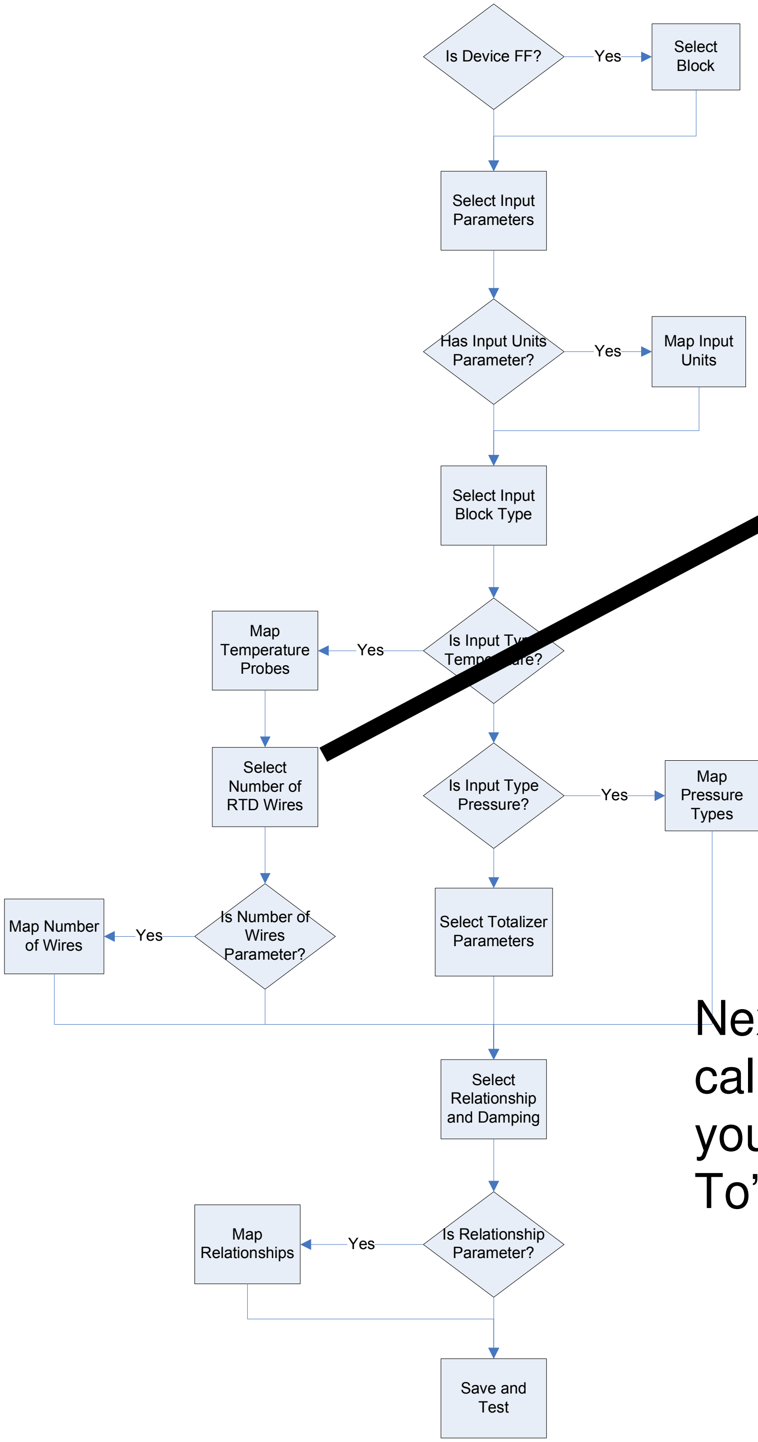


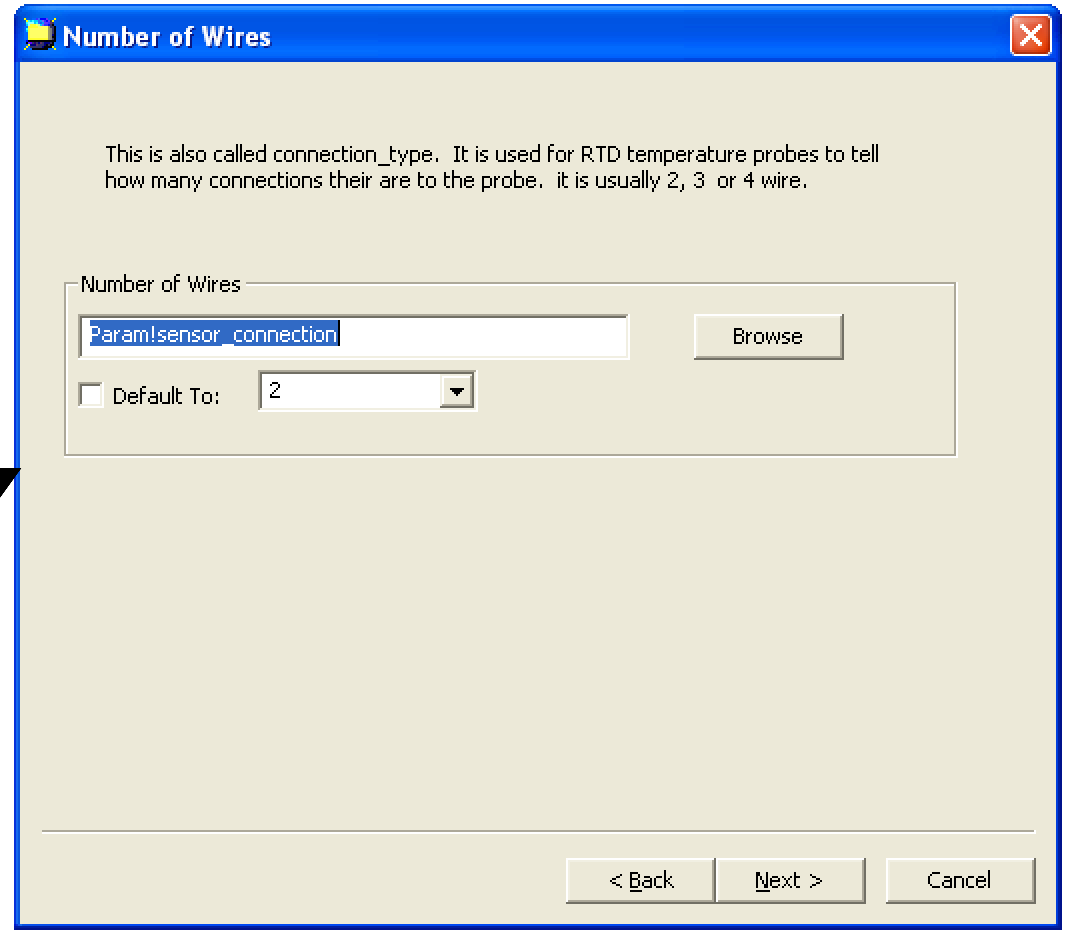
Once the probe_type parameter is selected you need to map all of the enumerated values to known standards. The “Auto-Map” button does not work well, but sometimes we get lucky.



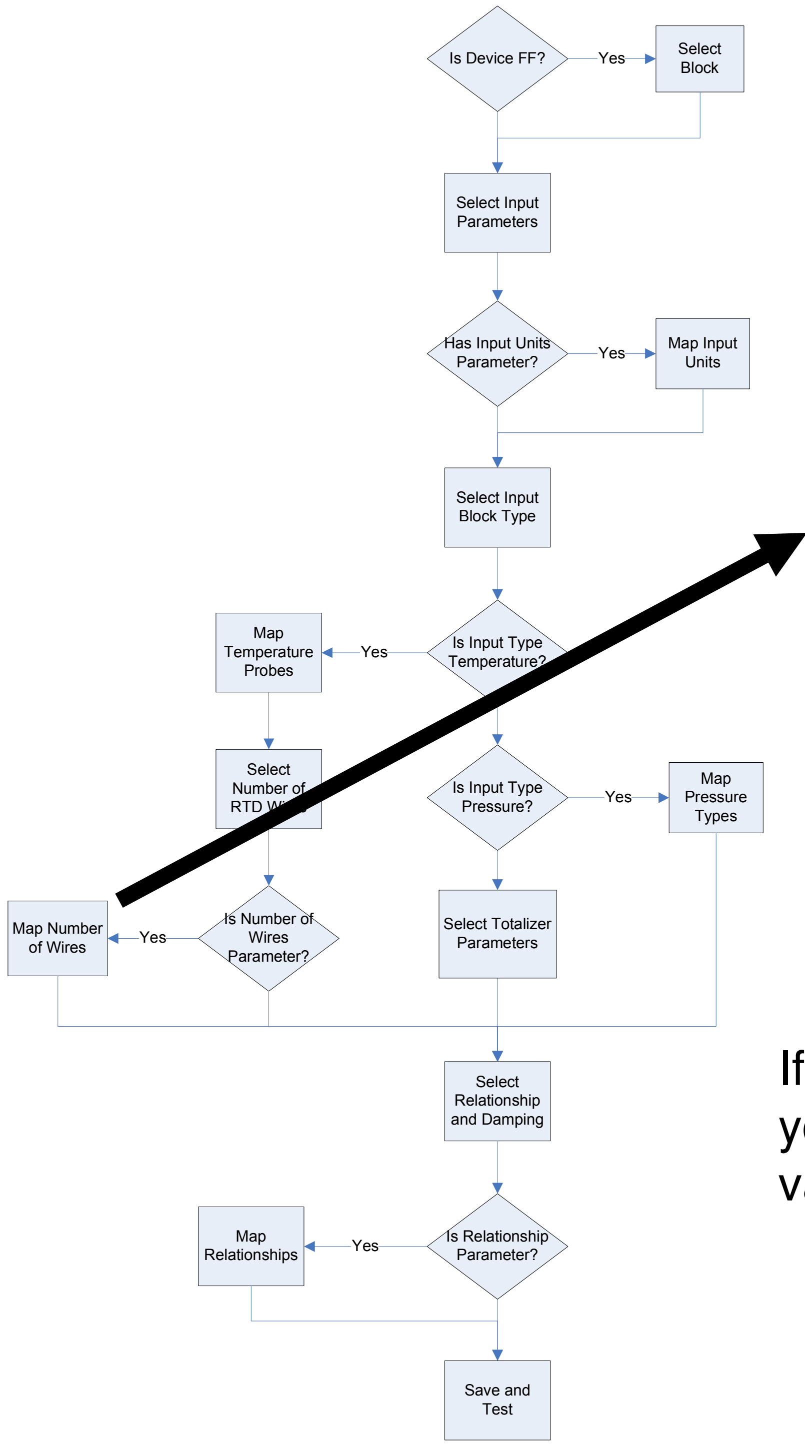


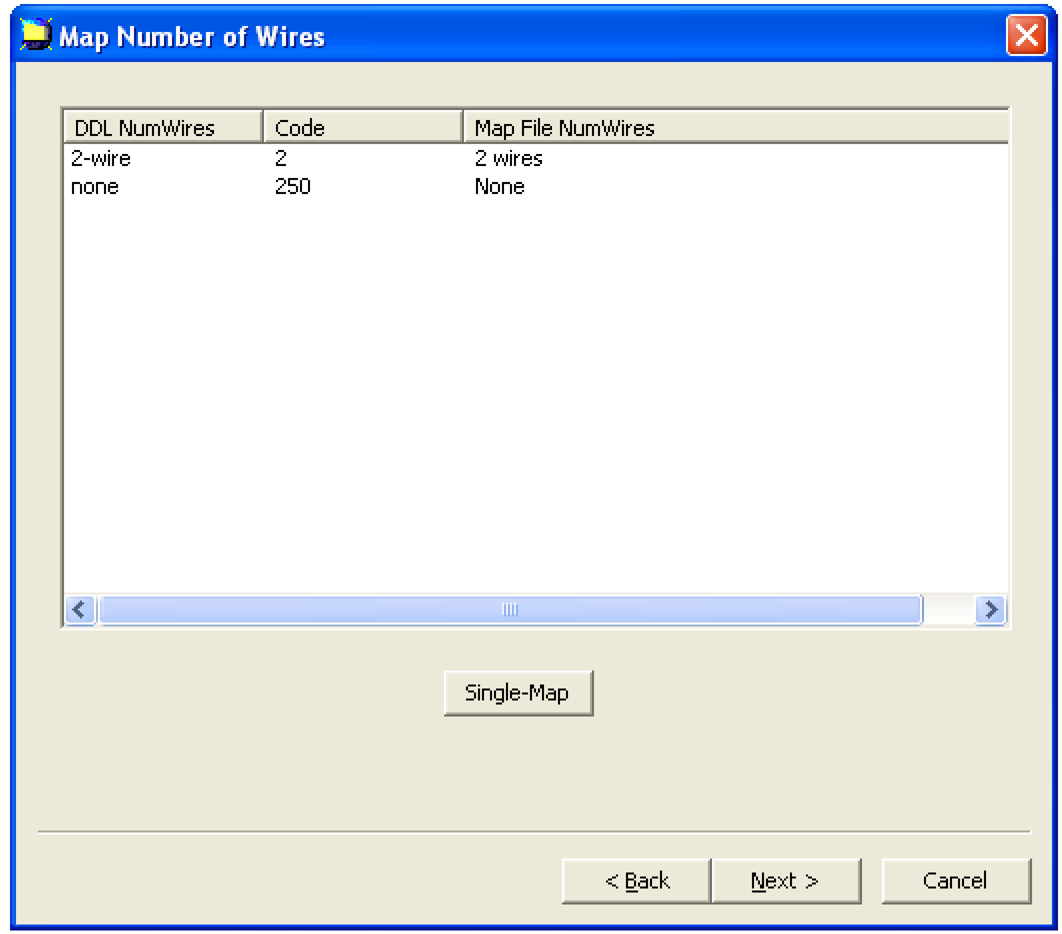
The single map displays the list of supported probe types for AMS Device Manager. If you cannot fined the correct value select “Unused”.



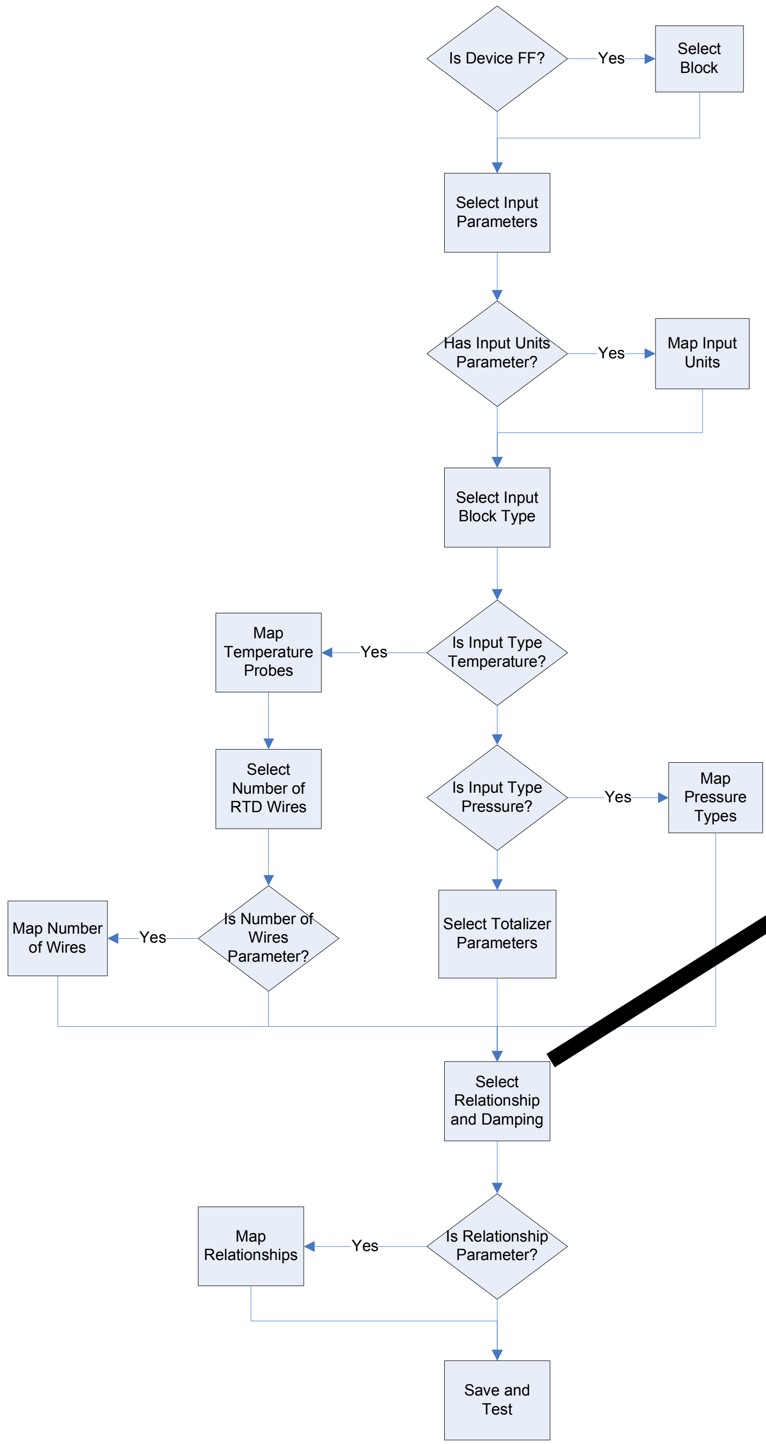


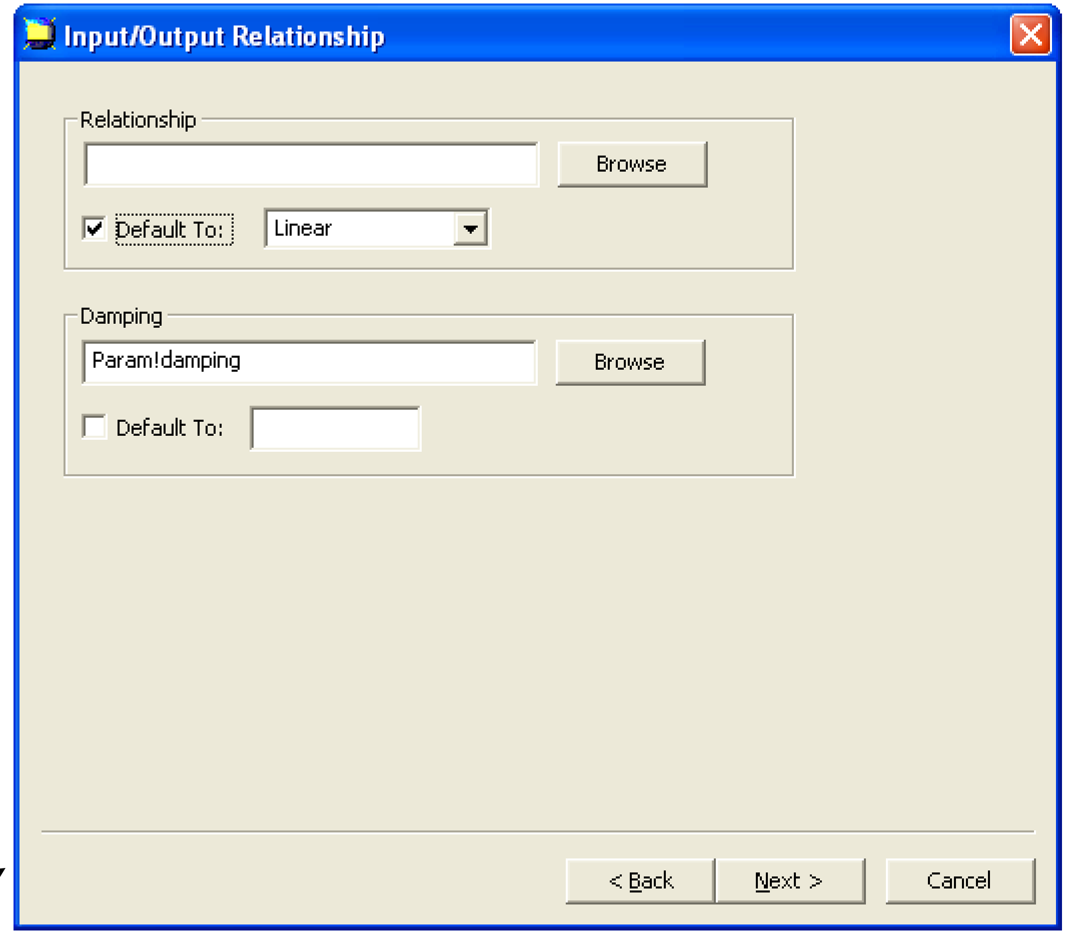
Next, select the sensor_connection (sometimes called connection_type parameter) if it does not exist you can assume a 2 wire by clicking on the "Default To" checkbox.



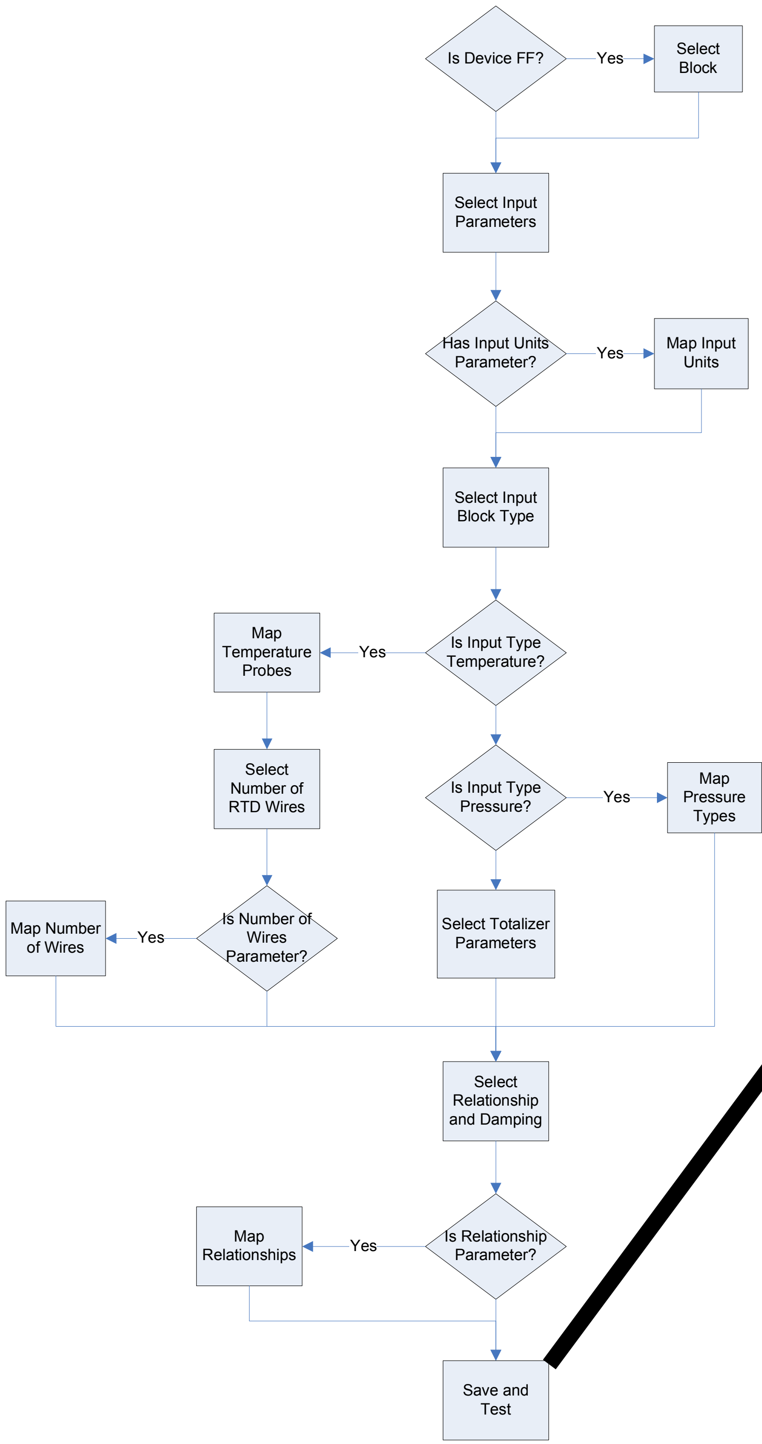


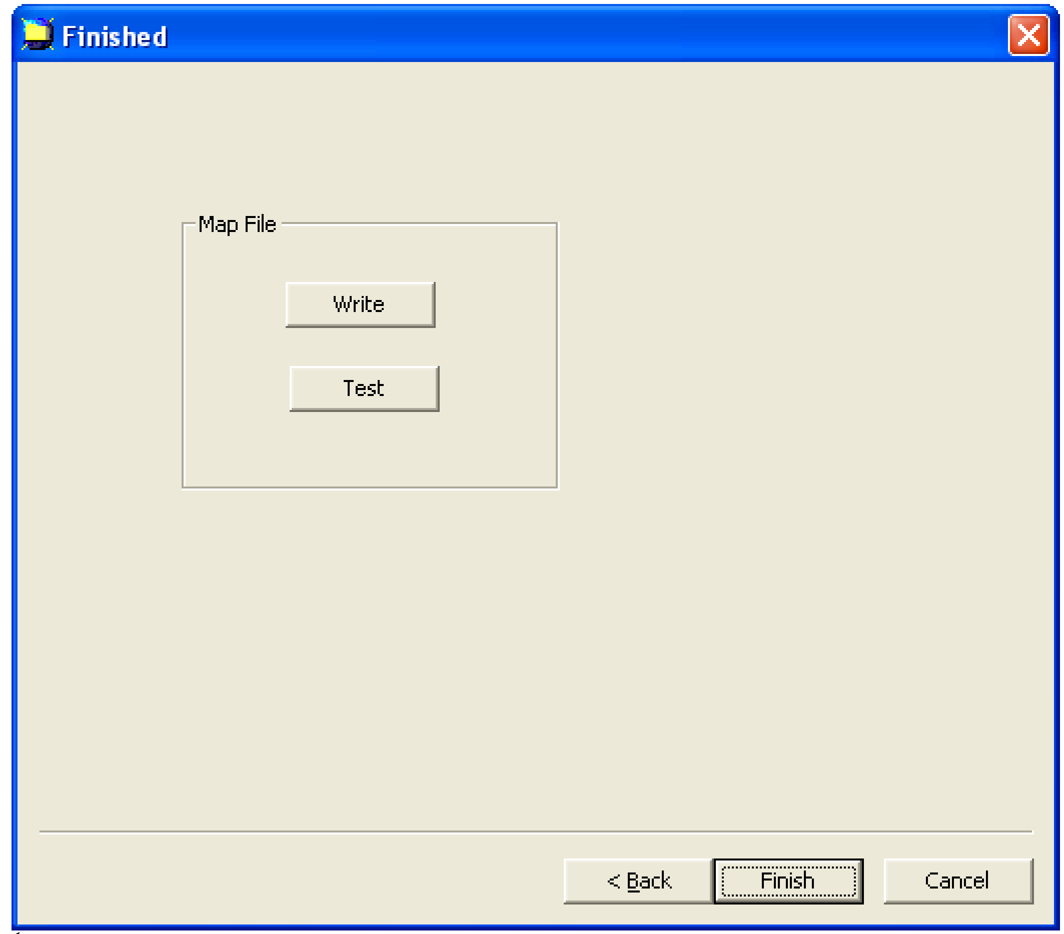
If you selected the sensor_connection parameter you need to map the DDL values to the standard values.





Next, select the relationship between the input and the output. For Fieldbus this will always be linear. Damping is the amount of delay between the input being applied and the value changing at the output.





Success, you have reached the final page. press the “Write” button. This will save the map file in the devices directory. Clicking the Test button will launch the map file tester application.

MapFileTestResults.txt - Notepad

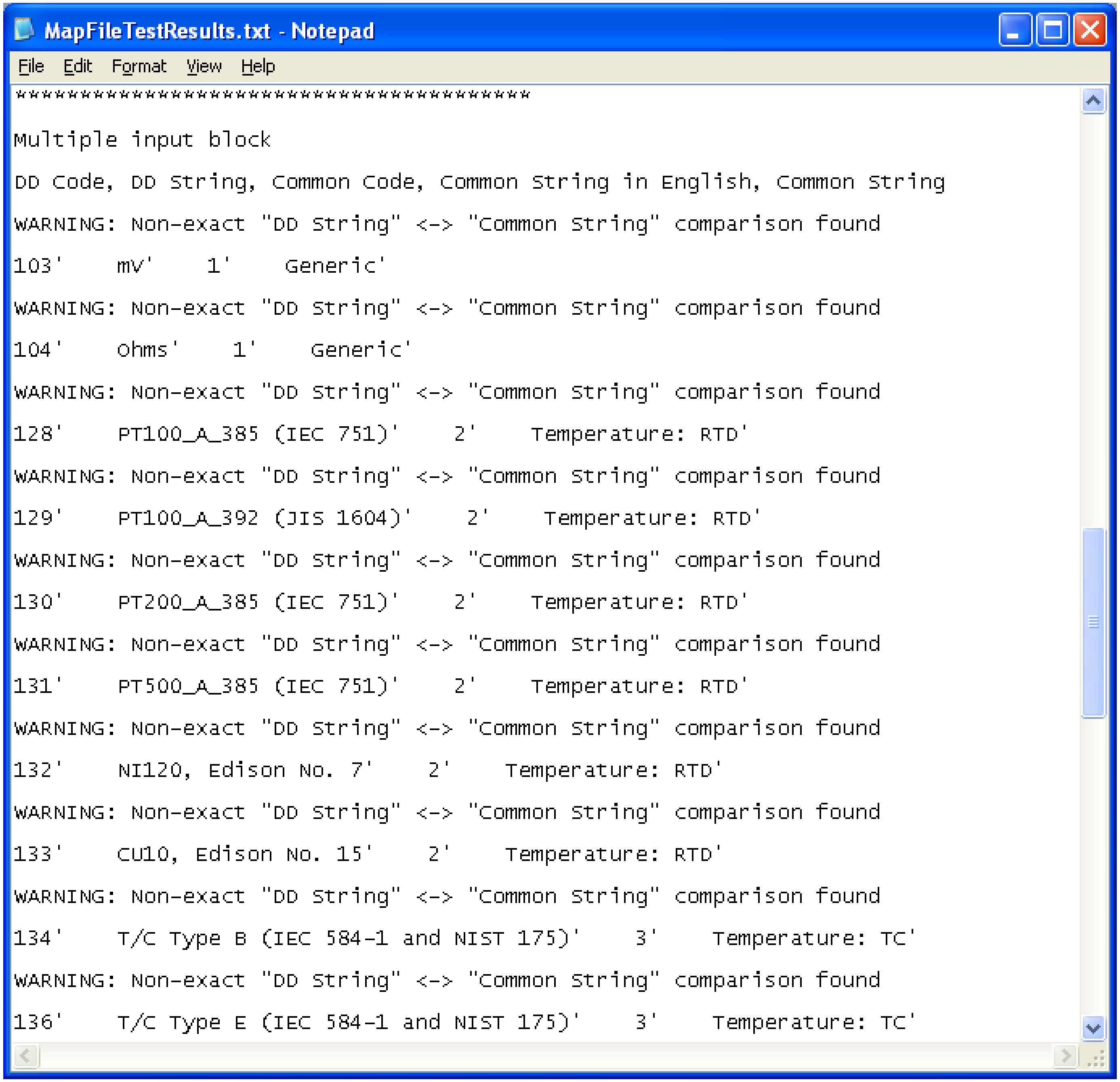
File Edit Format View Help

```
%%%%%%%%%%%%%%%%%%%%%%%%%% Start of Test %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Rosemount 3244MV Fieldbus Temperature Transmitter  Rev. 4    (1151  3244  4)
The test was conducted at 10:14:39 on 12-5-2008
Map file is D:\ams\code\devices\FF\001151\3244\0401.map
*********************** Test results ***********************
Input block unit
DD Code, DD String, Common Code, Common String in English, Common String
WARNING: Non-exact "DD String" <-> "Common String" comparison found
1000'    deg K'    35'    Kelvin'    Kelvin
WARNING: Non-exact "DD String" <-> "Common String" comparison found
1001'    deg C'    32'    degC'    degC
WARNING: Non-exact "DD String" <-> "Common String" comparison found
1002'    deg F'    33'    degF'    degF
WARNING: Non-exact "DD String" <-> "Common String" comparison found
1003'    deg R'    34'    degR'    degR
WARNING: Non-exact "DD String" <-> "Common String" comparison found
1243'    millivolt'    36'    mV'    mV
****************************************
Input Block Upper Range Value
No errors or warnings detected.
****************************************
Input Block Lower Range Value
No errors or warnings detected.
```

The most confusing part of this application is all the warnings that are displayed.

MapFileTester will do string compares between what the DD says and what the standard string is.

Surprise, “degC” and “deg C” are not an exact match.



MapFileTestResults.txt - Notepad

File Edit Format View Help

```
*********************************************

Multiple input block

DD Code, DD String, Common Code, Common String in English, Common String

WARNING: Non-exact "DD String" <-> "Common String" comparison found

103'    mV'    1'    Generic'

WARNING: Non-exact "DD String" <-> "Common String" comparison found

104'    Ohms'    1'    Generic'

WARNING: Non-exact "DD String" <-> "Common String" comparison found

128'    PT100_A_385 (IEC 751)'    2'    Temperature: RTD'

WARNING: Non-exact "DD String" <-> "Common String" comparison found

129'    PT100_A_392 (JIS 1604)'    2'    Temperature: RTD'

WARNING: Non-exact "DD String" <-> "Common String" comparison found

130'    PT200_A_385 (IEC 751)'    2'    Temperature: RTD'

WARNING: Non-exact "DD String" <-> "Common String" comparison found

131'    PT500_A_385 (IEC 751)'    2'    Temperature: RTD'

WARNING: Non-exact "DD String" <-> "Common String" comparison found

132'    NI120, Edison No. 7'    2'    Temperature: RTD'

WARNING: Non-exact "DD String" <-> "Common String" comparison found

133'    CU10, Edison No. 15'    2'    Temperature: RTD'

WARNING: Non-exact "DD String" <-> "Common String" comparison found

134'    T/C Type B (IEC 584-1 and NIST 175)'    3'    Temperature: TC'

WARNING: Non-exact "DD String" <-> "Common String" comparison found

136'    T/C Type E (IEC 584-1 and NIST 175)'    3'    Temperature: TC'
```

Even harder to discern is which probe types are:

Generic
RTD
TC

You need to know the category of probe types but this screen has helped to find issues.

Rules of Thumb

- “degC” and “˚C” represent the same thing and so is NOT and issue.
- If you are not sure if you know the correct mapping of an enumeration, select “Unused” or “Not Used”.
- For Fieldbus transmitters, the relationship between input and output will always be Linear (digital). HART devices may have a parameter for non-linear selections.

Issues

- This application defaults CJC (Cold Junctions Compensation) to “Internal”.
- The user needs to know which temperature probes are Thermocouples and which are RTD to interpret the map file tester results.

Pressure

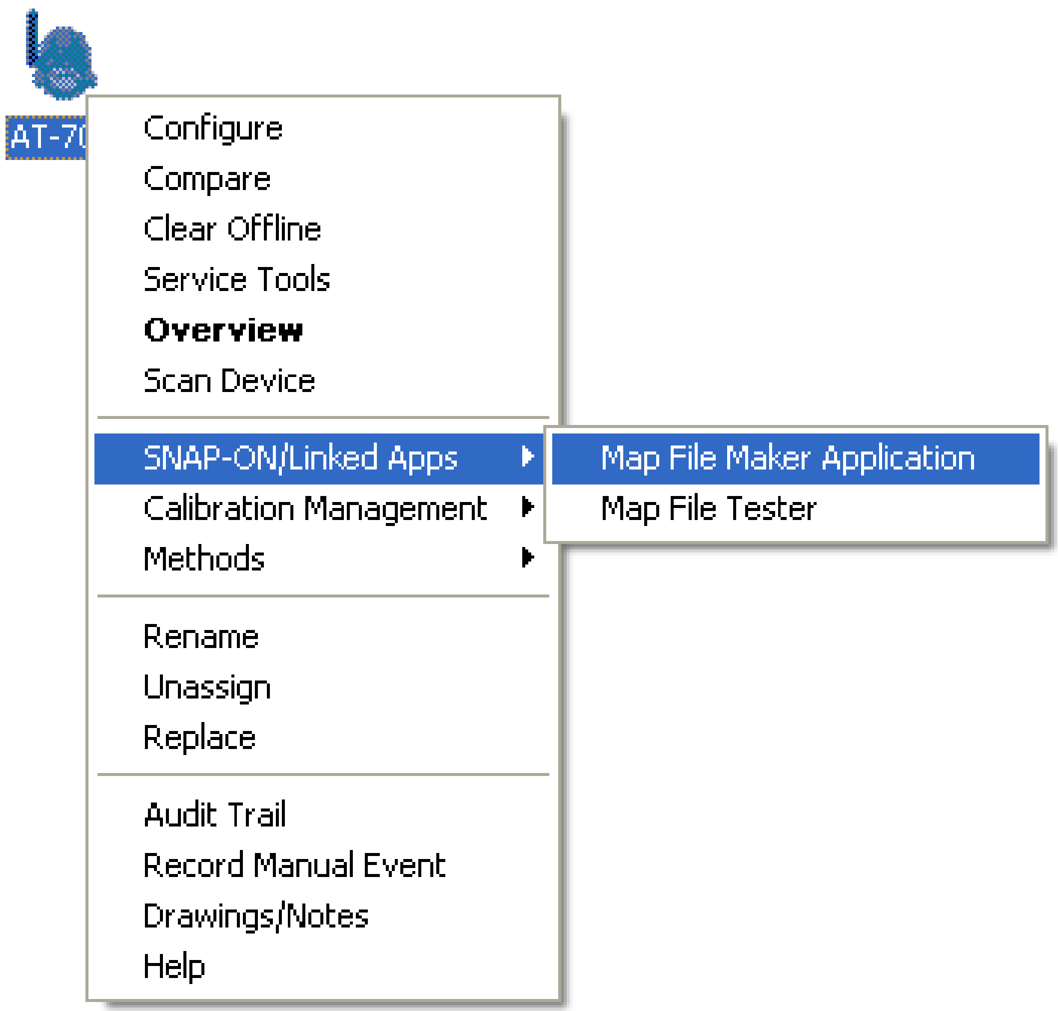
- Calibrators will often measure pressure applied to the input of a pressure transmitter and then read the transmitter output to verify its operation.
- We need to identify enough parameters and values (in a standard format) to allow that calibrator to know what kind of pressure that transmitter is configured for (i.e. Absolute, Differential or Gauge).

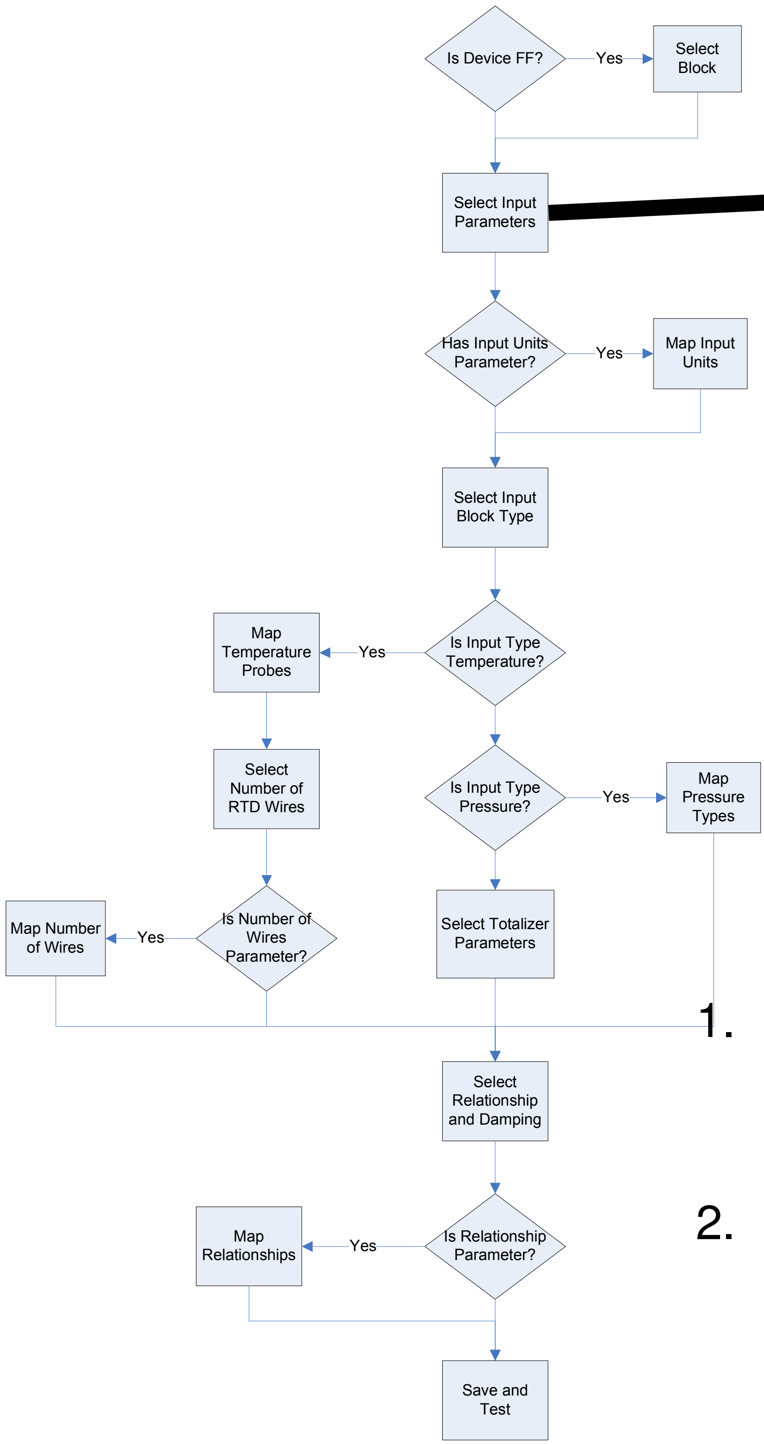
How do I create a map file for a pressure transmitter?

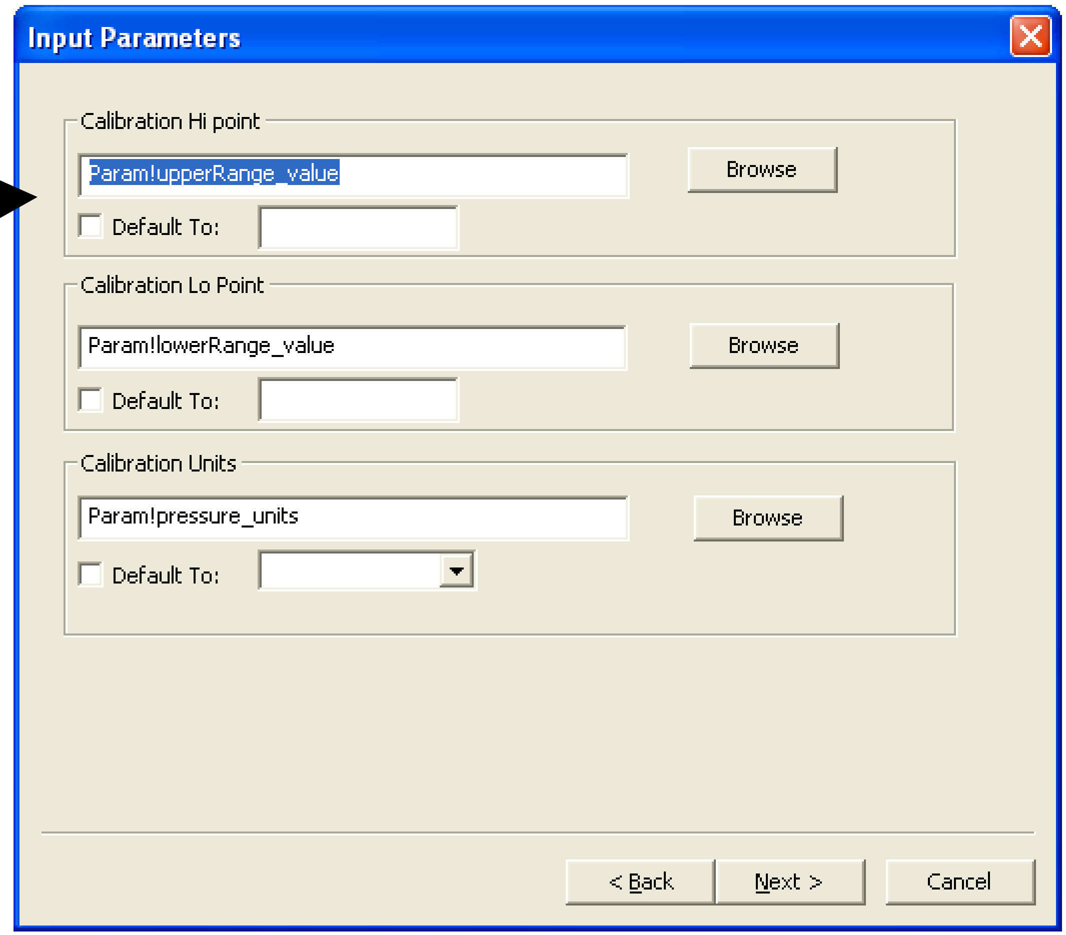
- Map File Maker will step the developer through identifying the parameters needed to calibrate this device type.

- I will run through the screens to create a HART pressure transmitter.

Launch “Map File Maker” from the Device Context menu

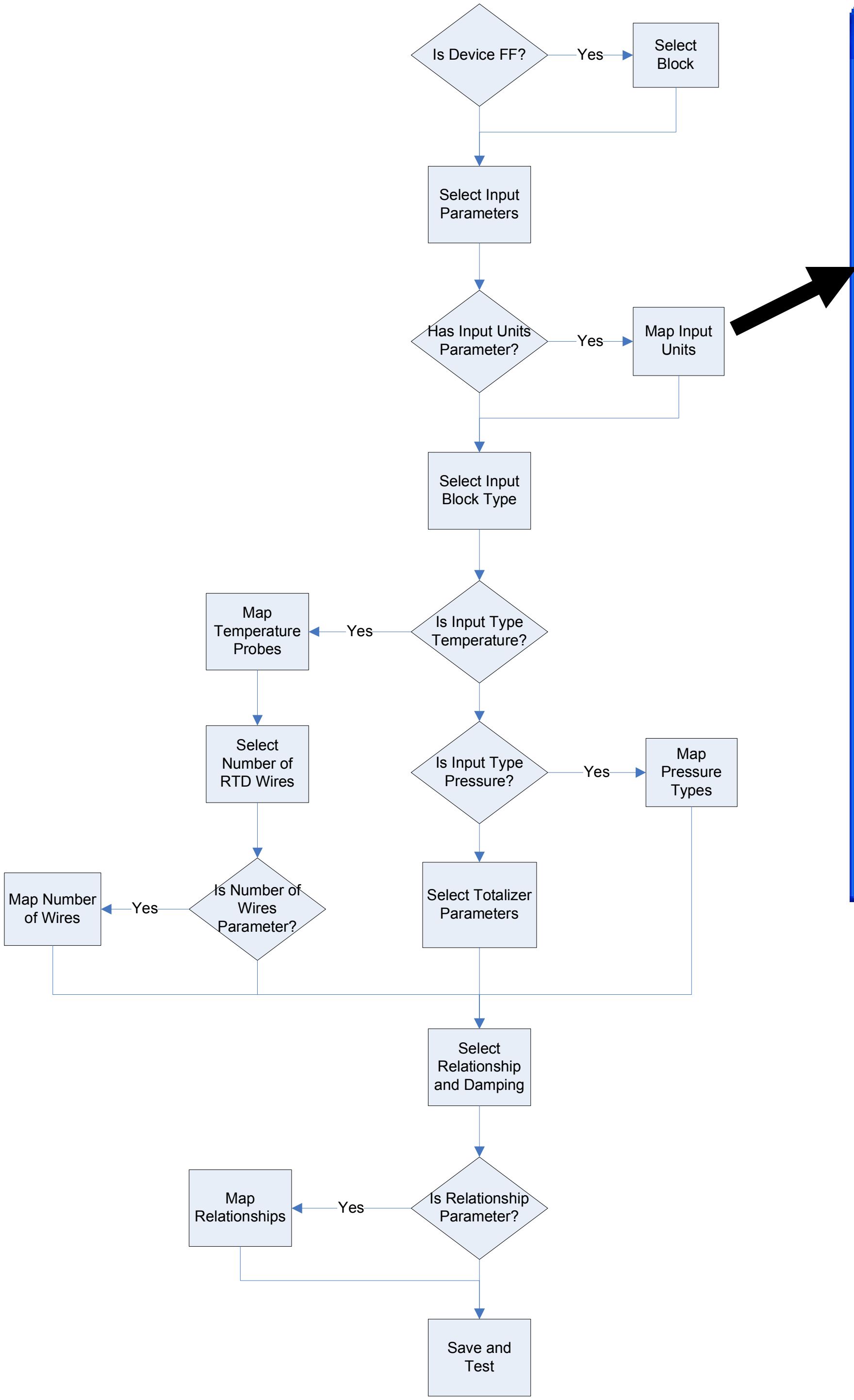


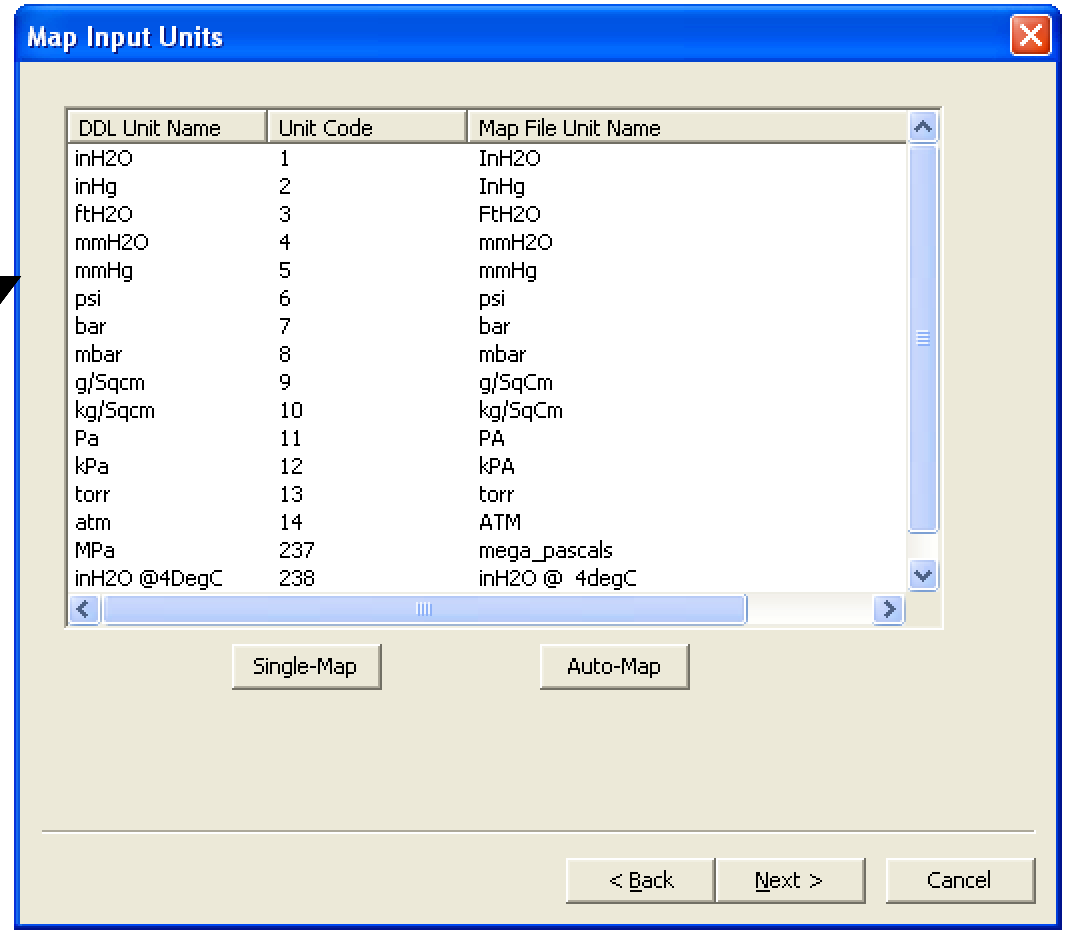




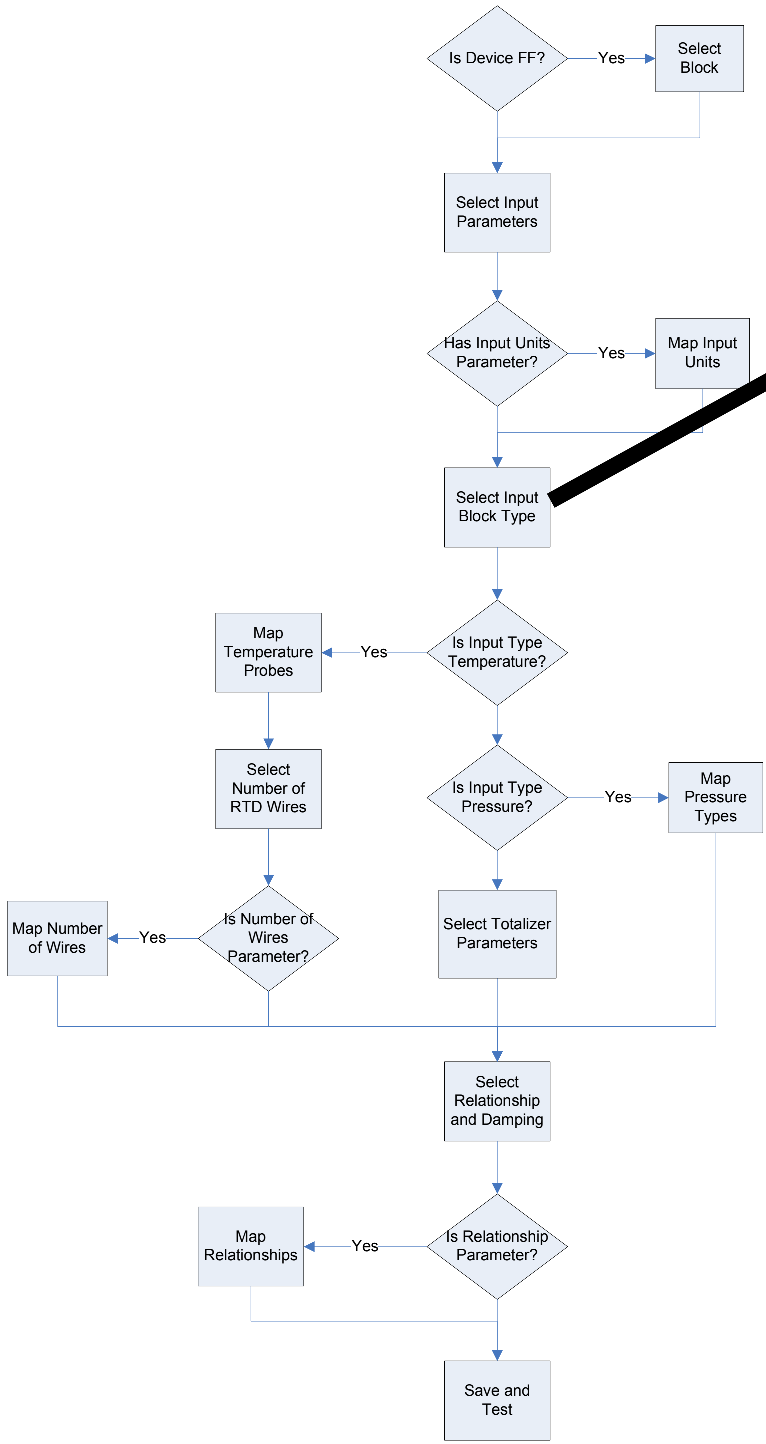
1. HART devices will immediately bring the user to the input Parameter selection screen (Block index does not need to be selected.

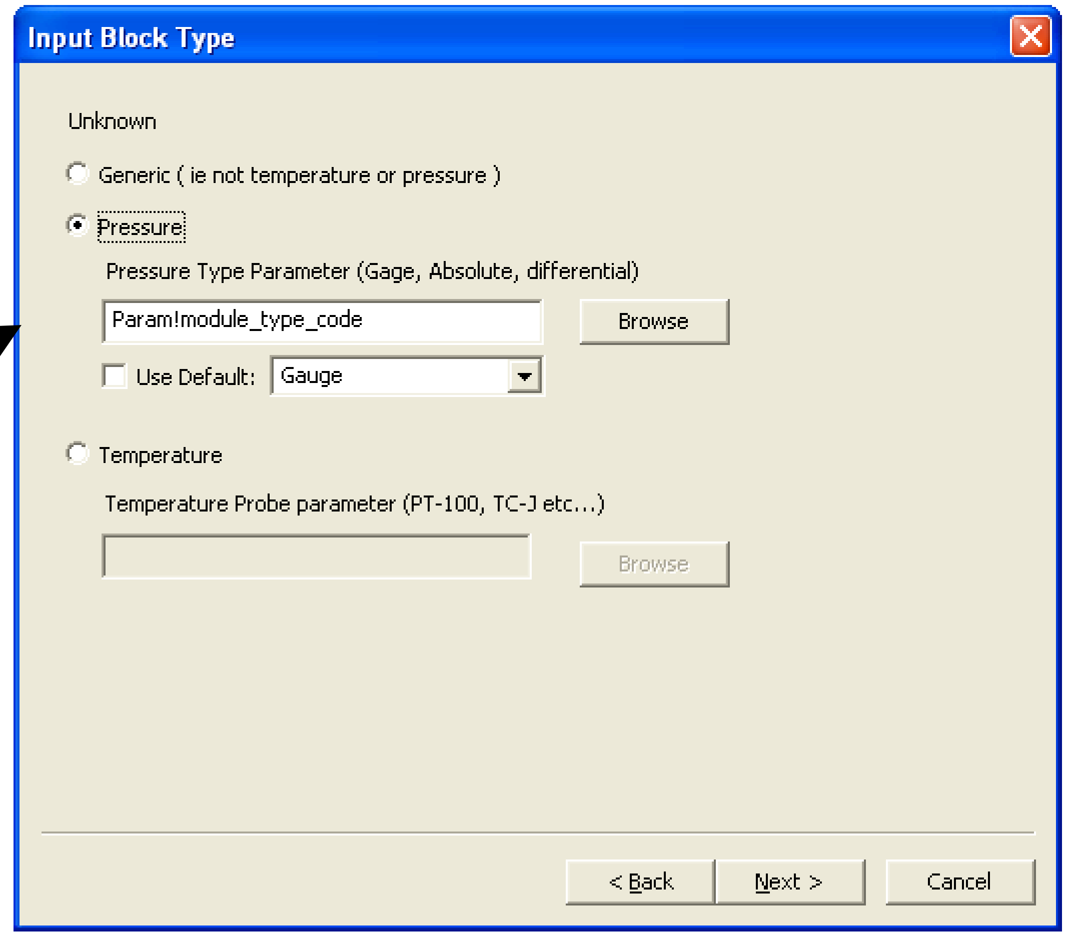
2. The device developer needs to identify the uppper and lower RANGE values (i.e. the values that are associated with the 4 – 20 mA signal).



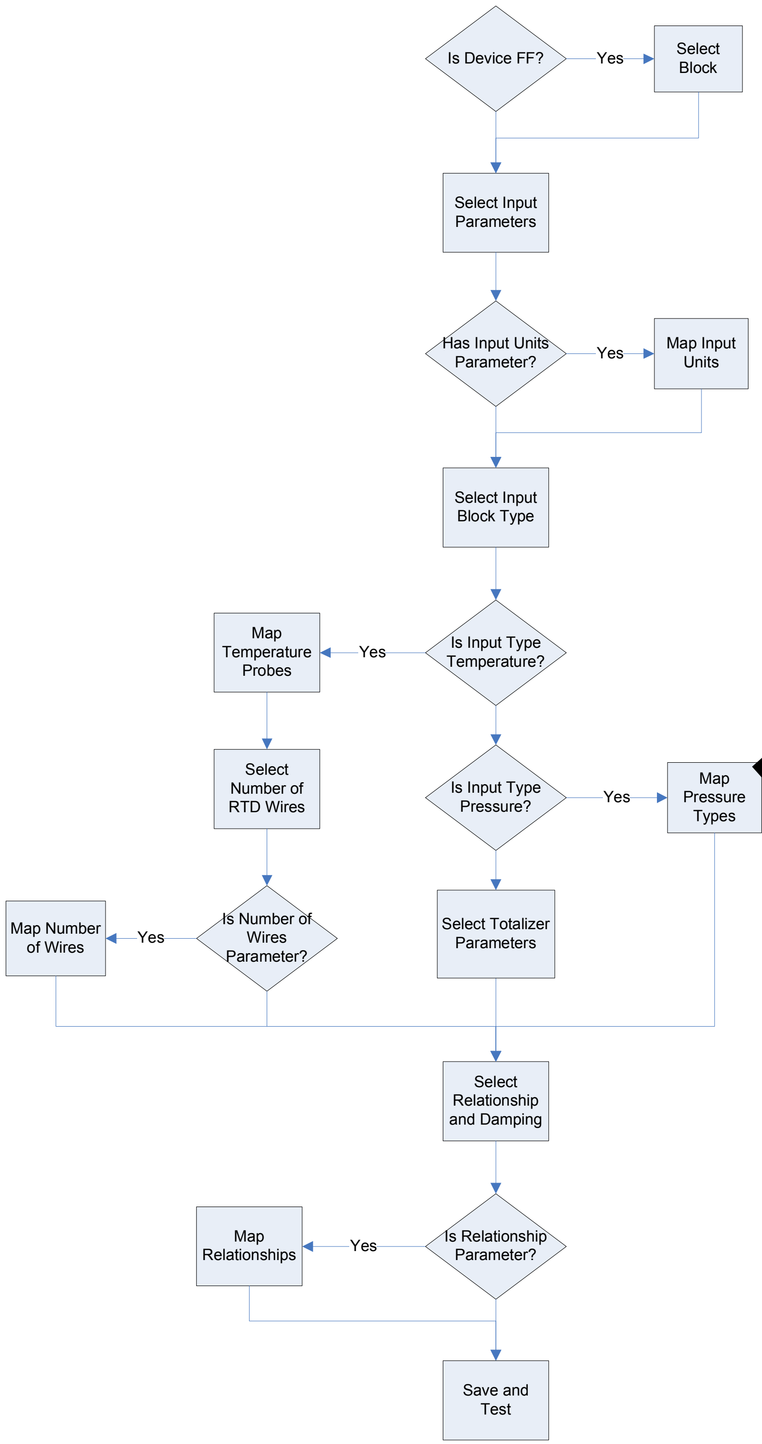


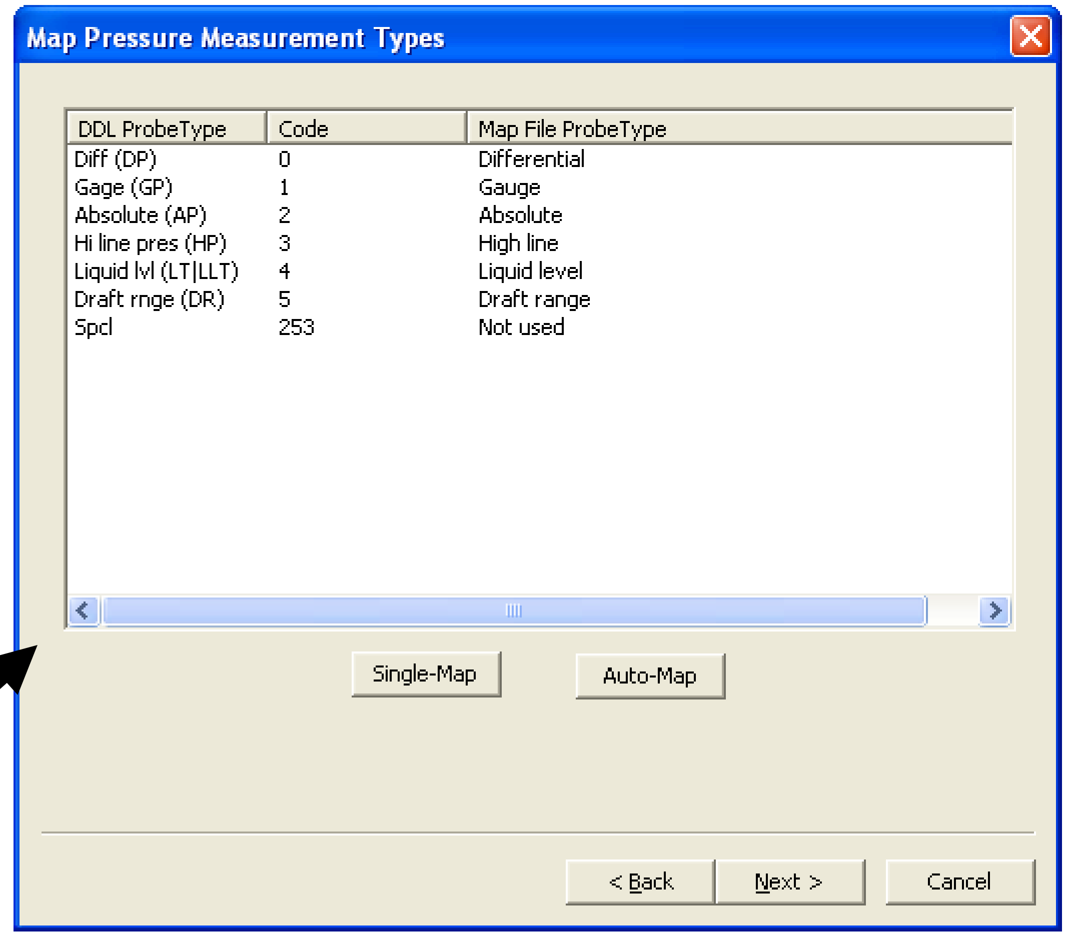
The “Auto-Map” works well for pressure units for HART devices. Otherwise you need to click the “Single-Map” to map each DD unit to a standard unit.



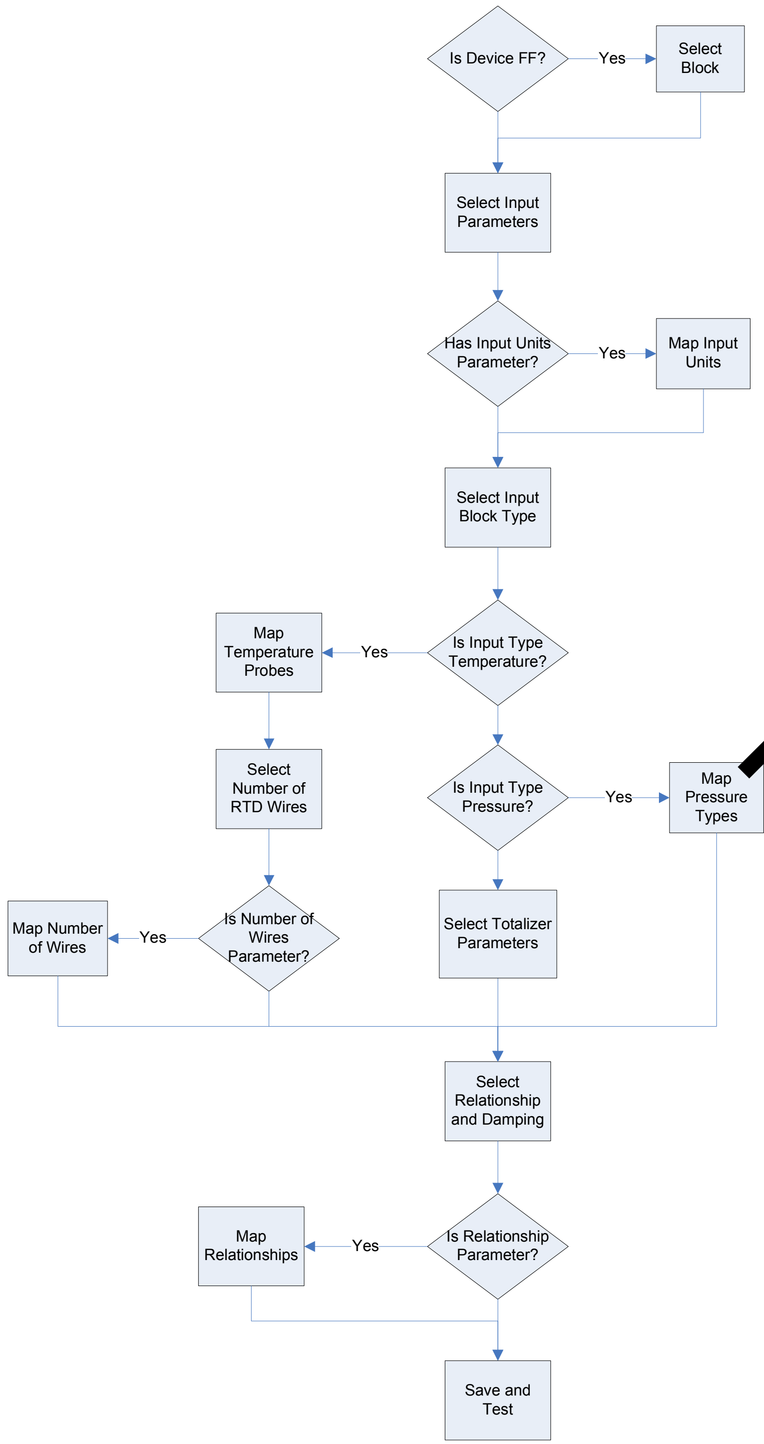


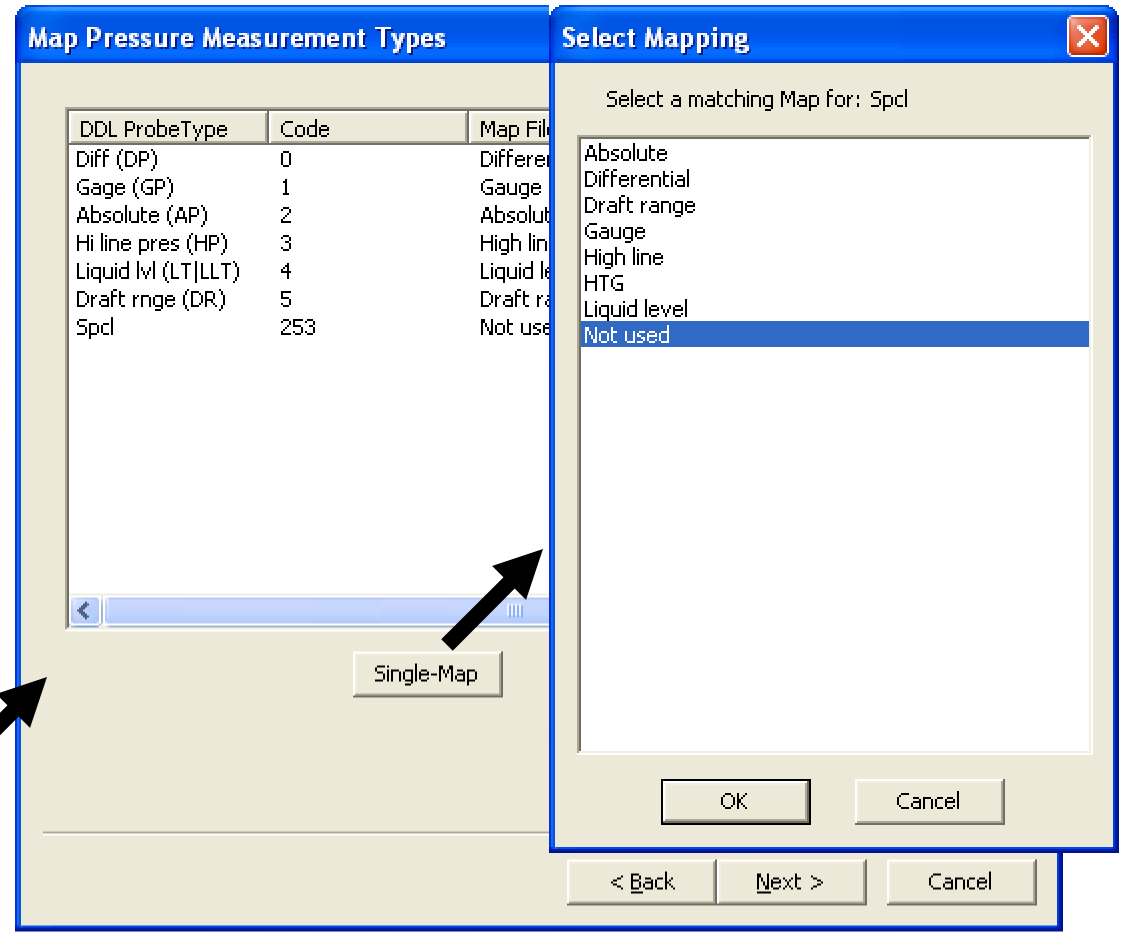
Next, select the "type" of the input, after having done the units, you probably know. If the device is a pressure transmitter, you need to select the pressure_type (sensor_type) parameter.





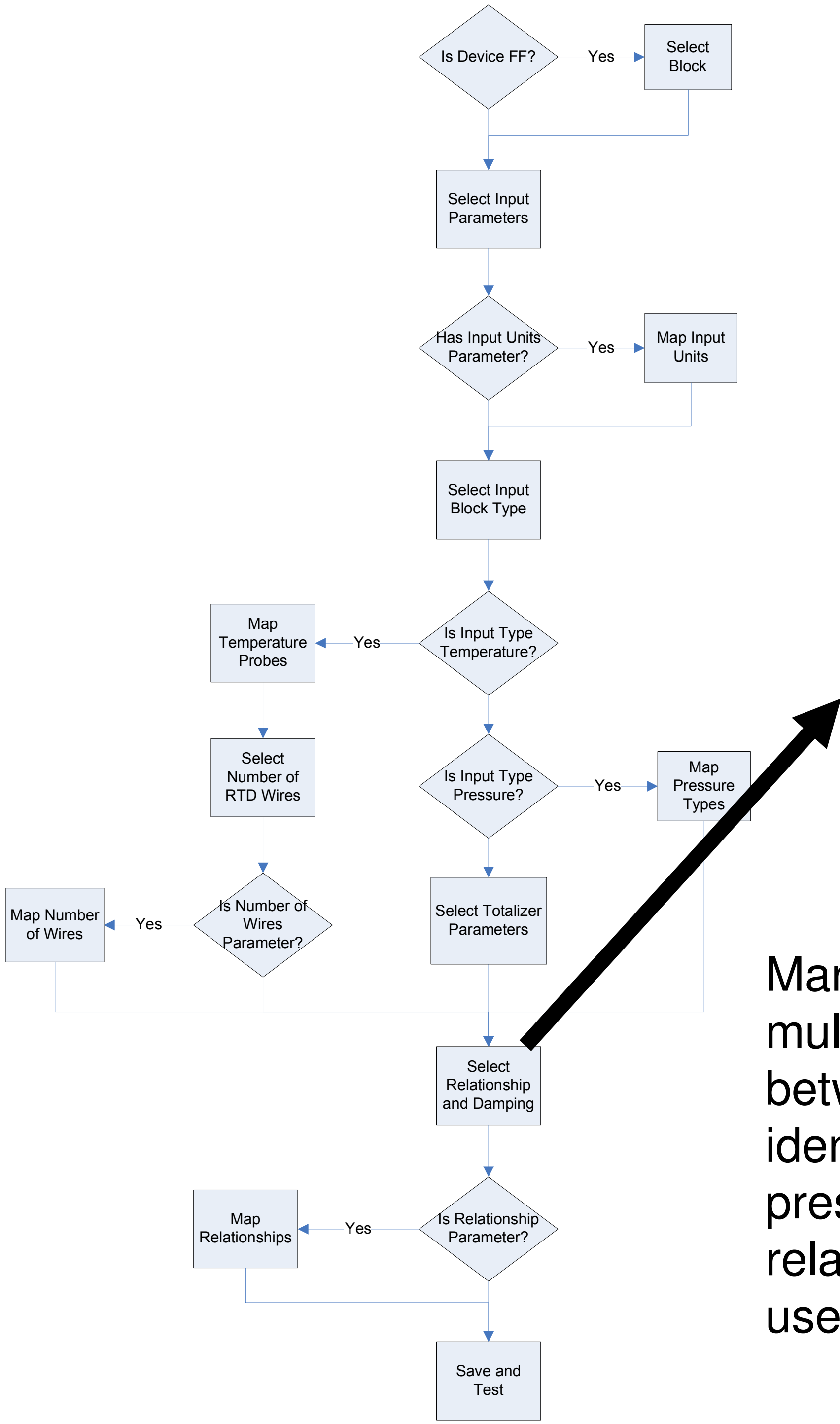
Next, Map the pressure types defined in the DD to the defined pressure types. The Auto-Map feature only gets this completely right about 50% of the time.

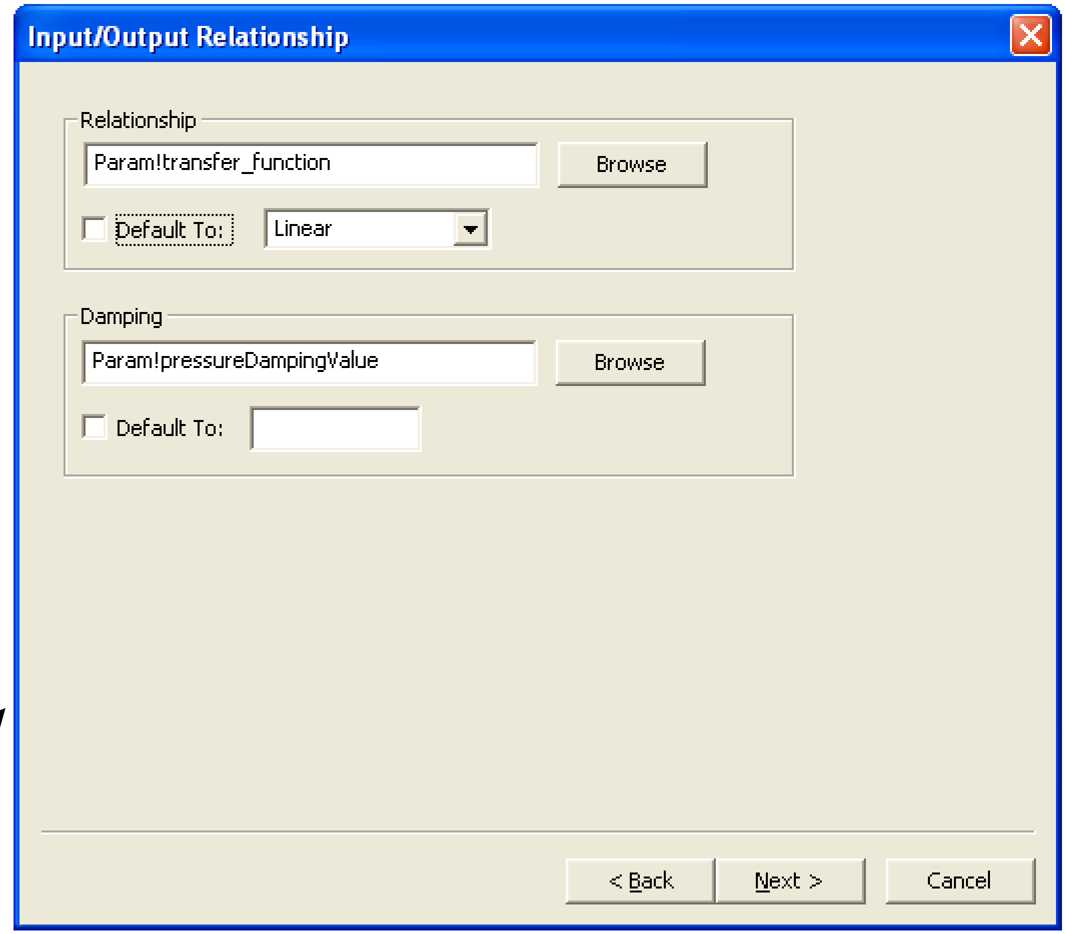




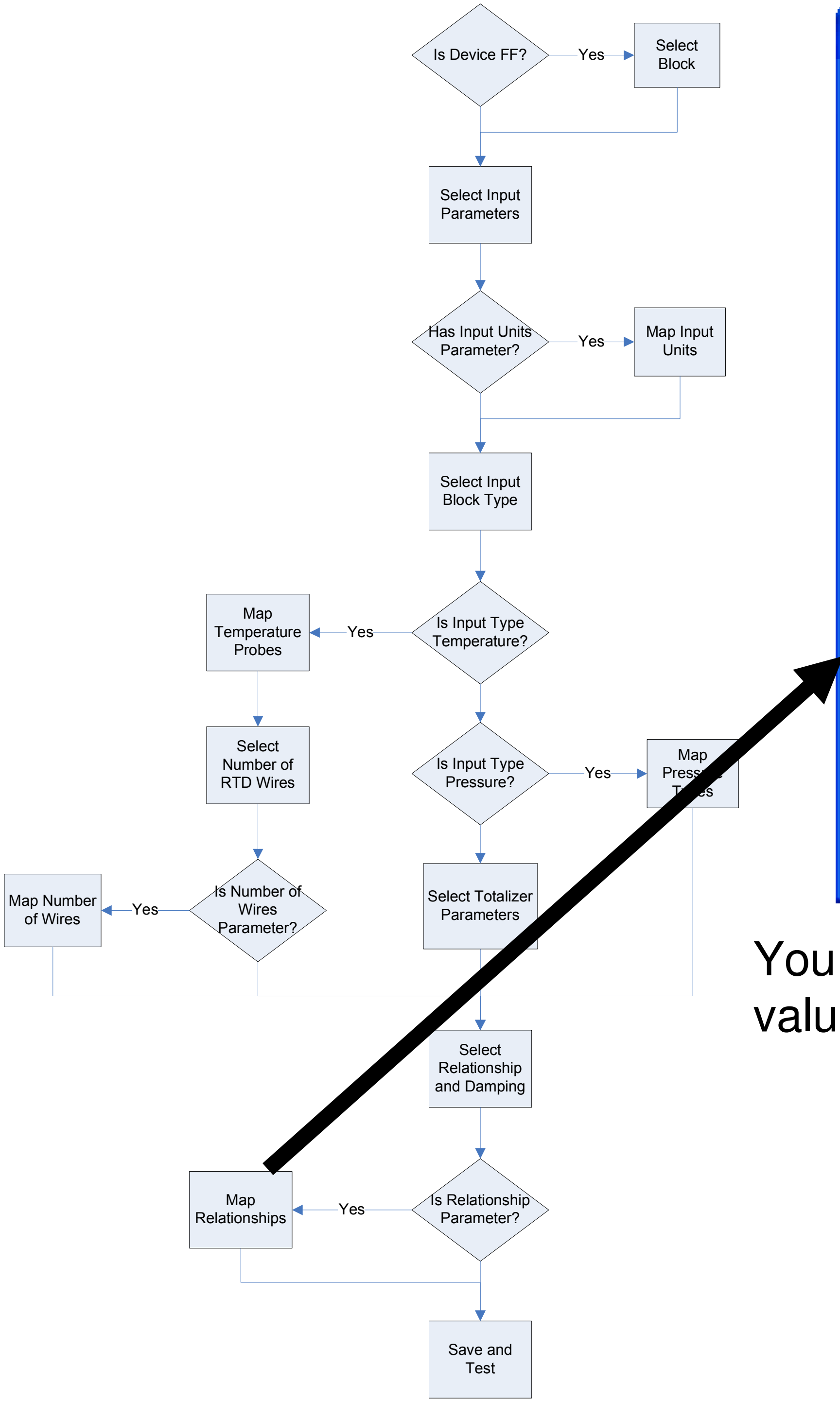
The “Single-Map” only has a limited amount of standard selections.

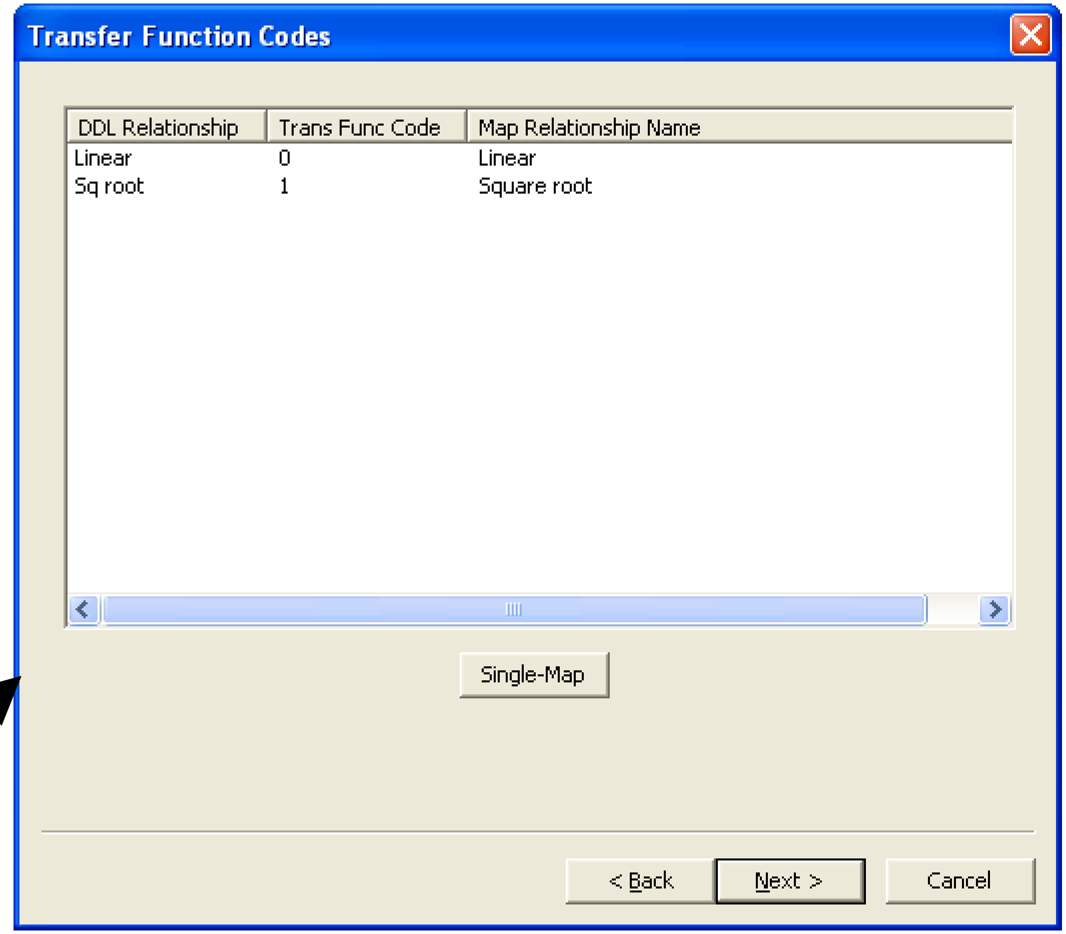
Note: HighLine, HTG, DraftRange and LiquidLevel are variations on Gauge pressure (where pressure is used to measure water levels – or is extremely high pressure).



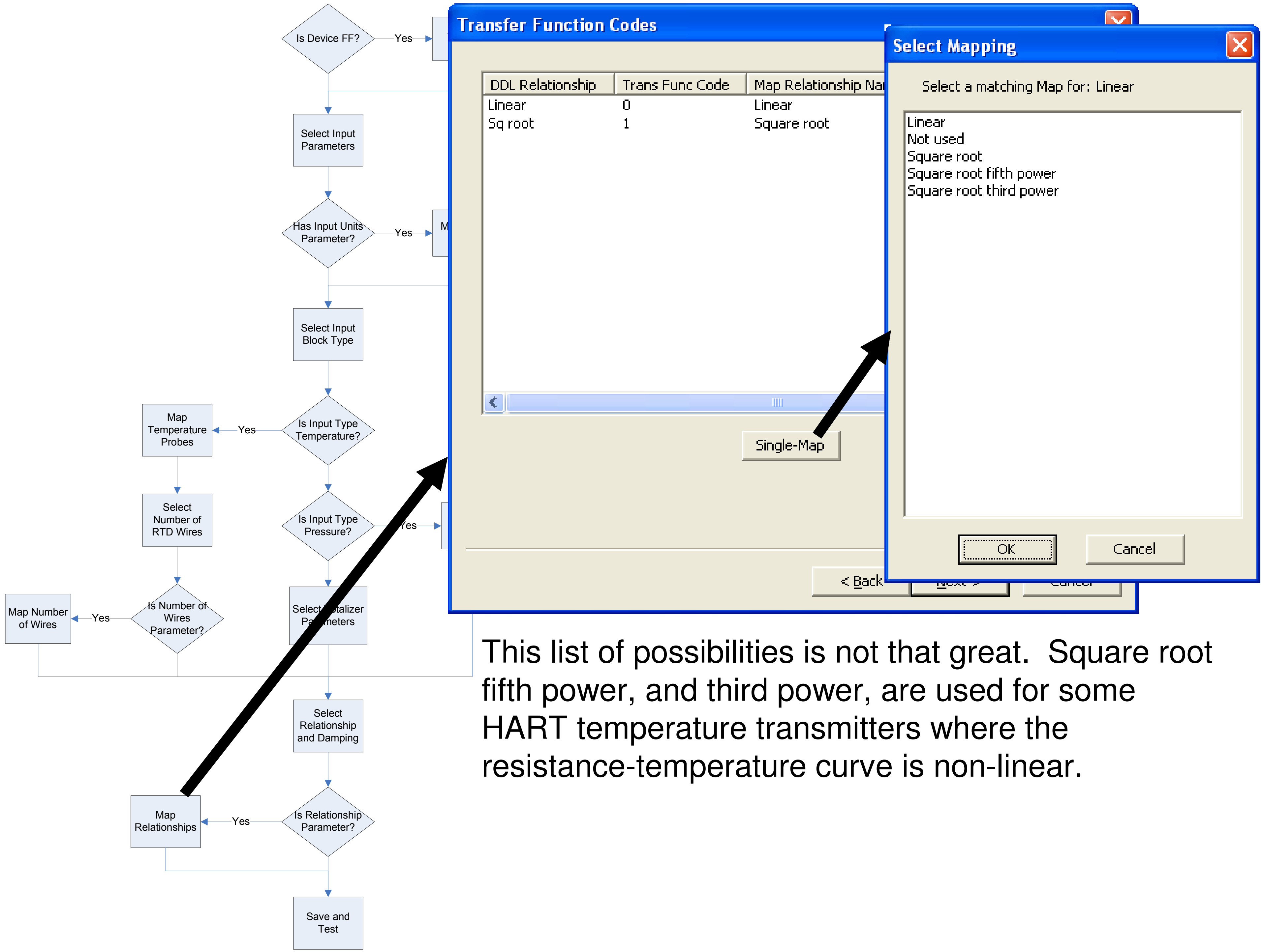


Many HART devices (especially pressure) have multiple transfer-functions or (relationships) between input and output. So it is important to identify a transfer-function parameter. Many pressure transmitters have a square-root-relationship in cases where a pressure transmitter is used to measure flow.

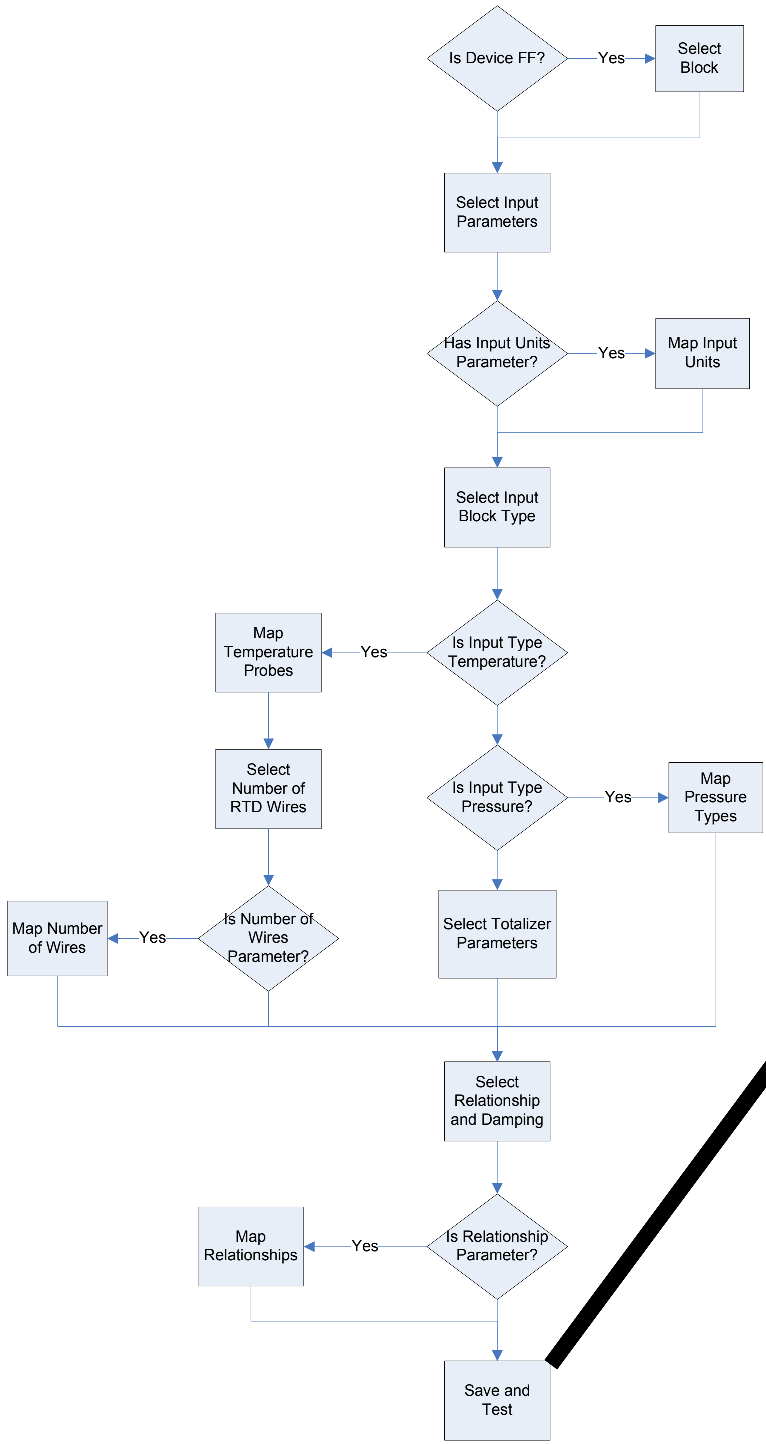


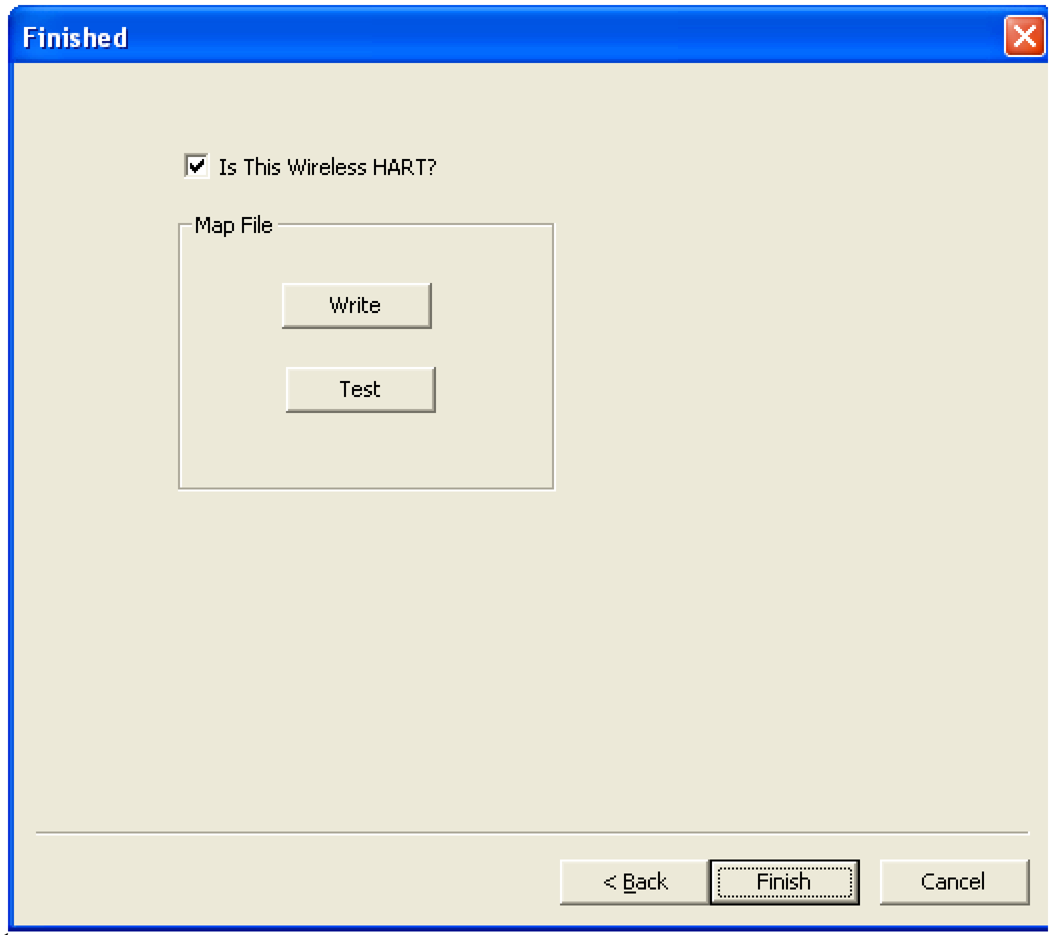


You need to map the DD values to the standard values.



This list of possibilities is not that great. Square root fifth power, and third power, are used for some HART temperature transmitters where the resistance-temperature curve is non-linear.

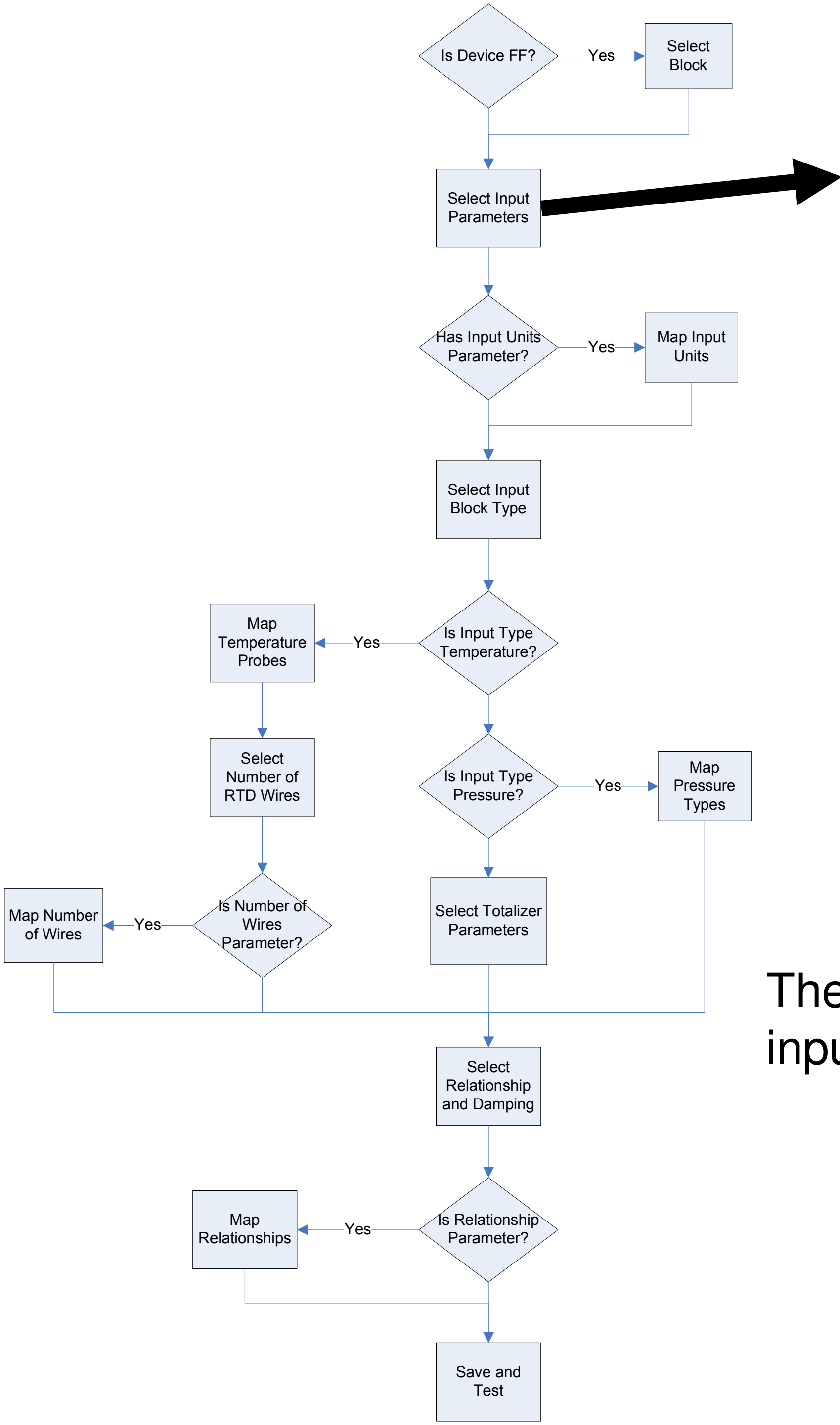


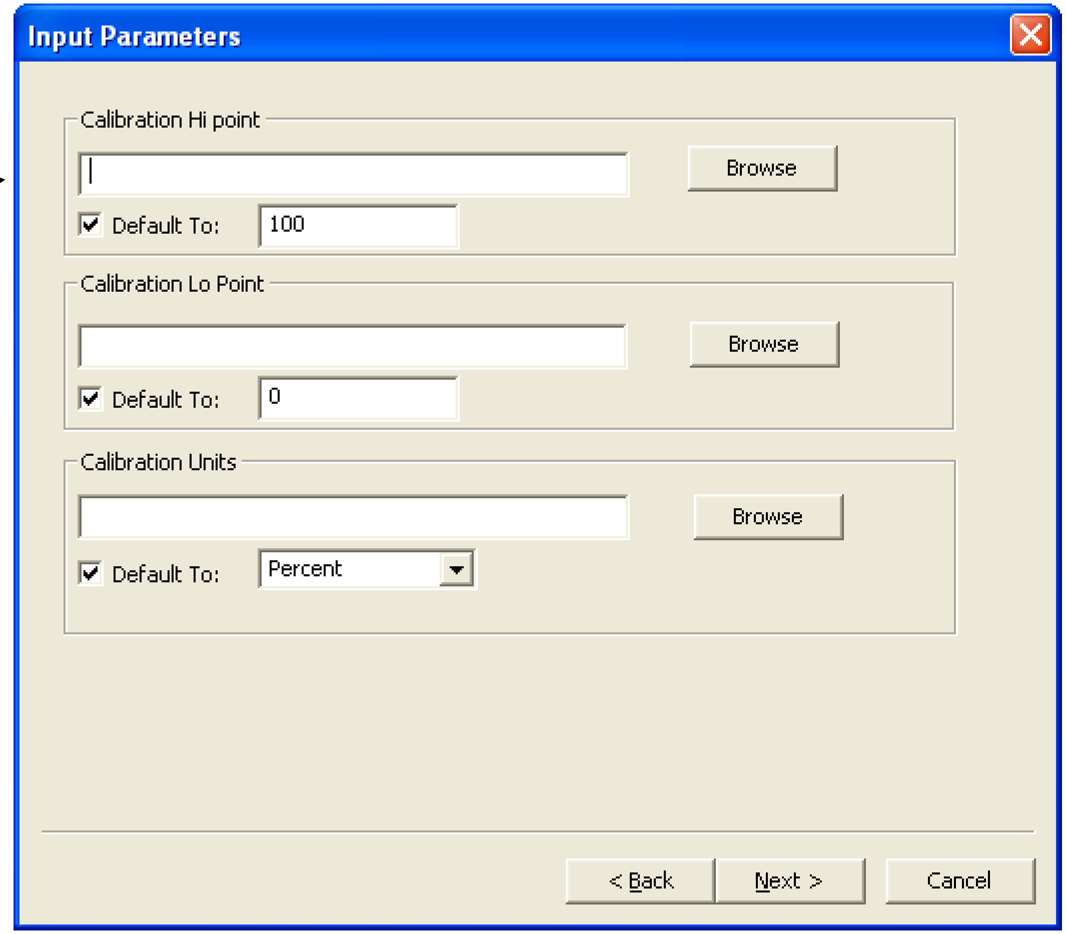


For HART devices there is also the possibility that this is wireless. If it is NOT wireless, the output is 4 – 20 mA. If it is wireless the output is the digital values set in the input page.

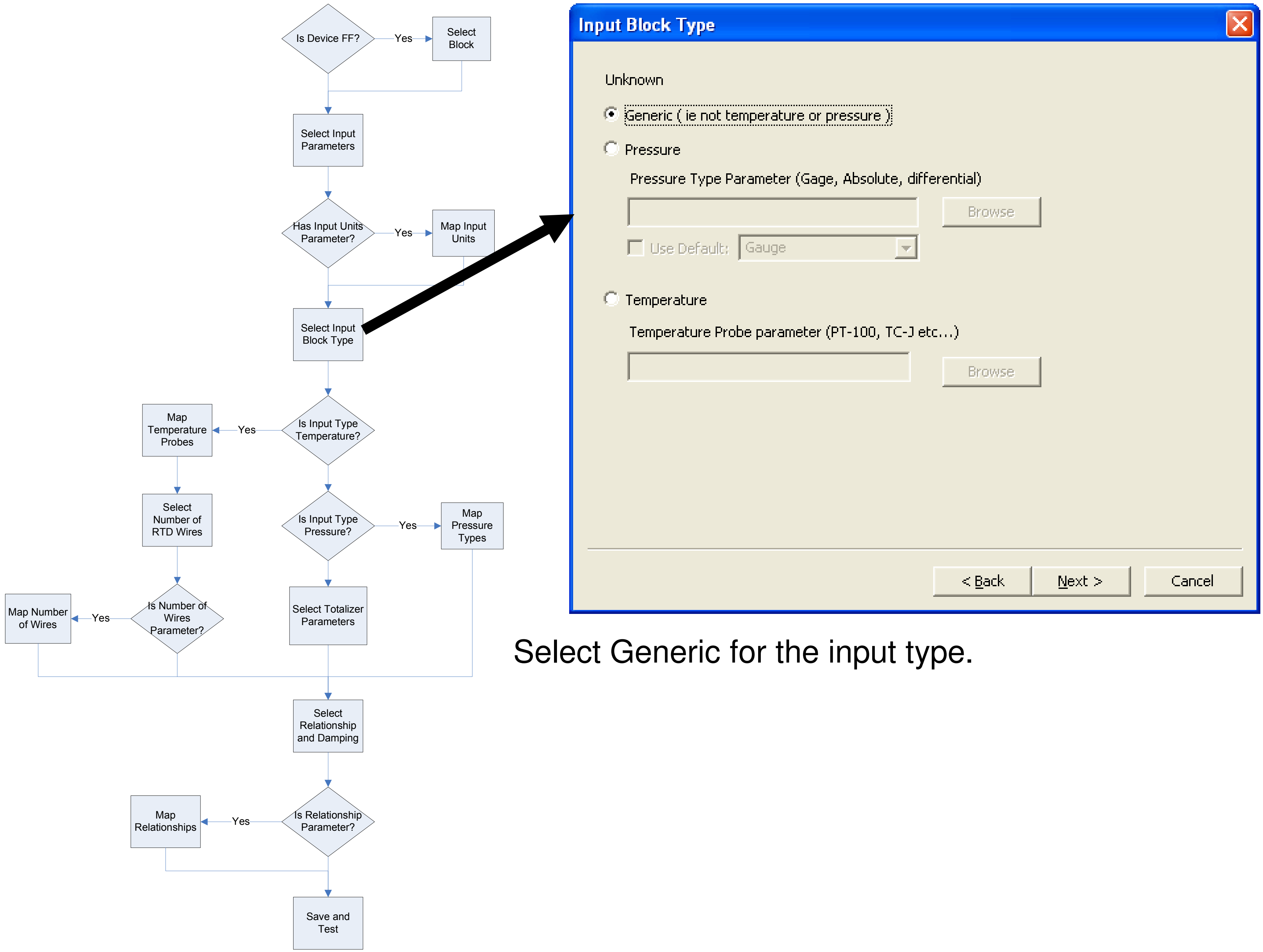
Easy map file creation

- We have just covered the two most difficult map files to create: Temperature and Pressure.
- Now step through the easiest case. This is the guaranteed - I just need to get it done solution (I use this for valves and multiplexers, but you could use this for motor controller etc…).

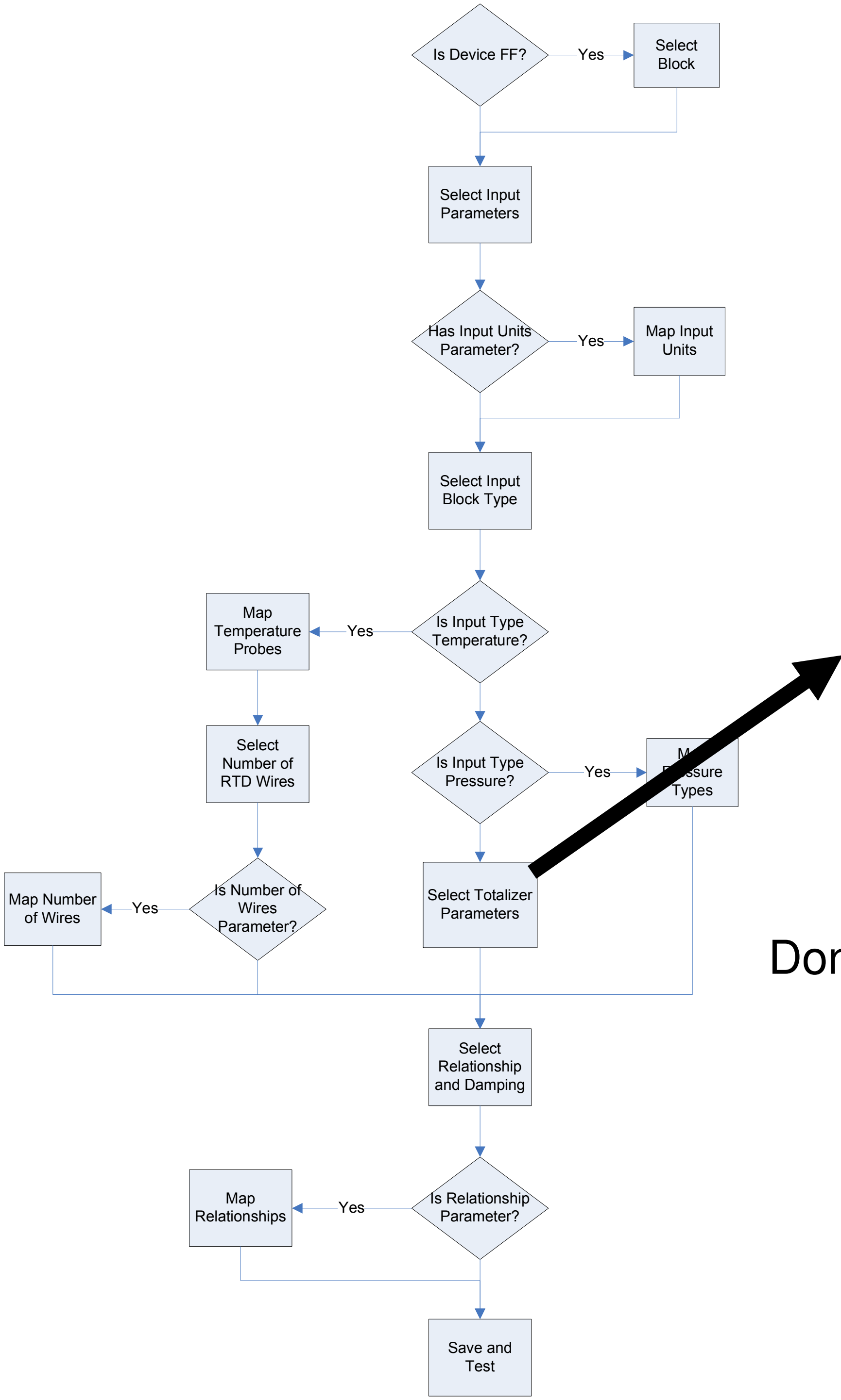


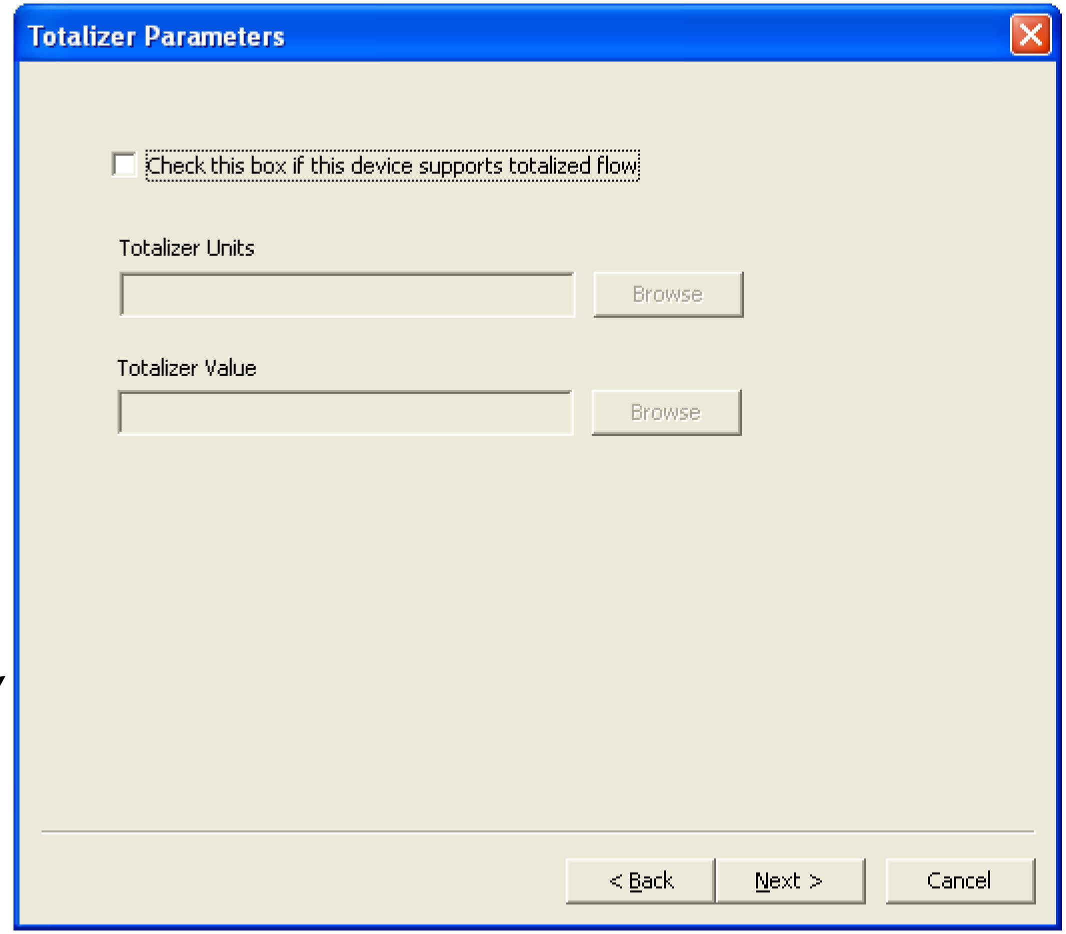


The Dirt simple solution is just to hard code the input to be 0 – 100 %

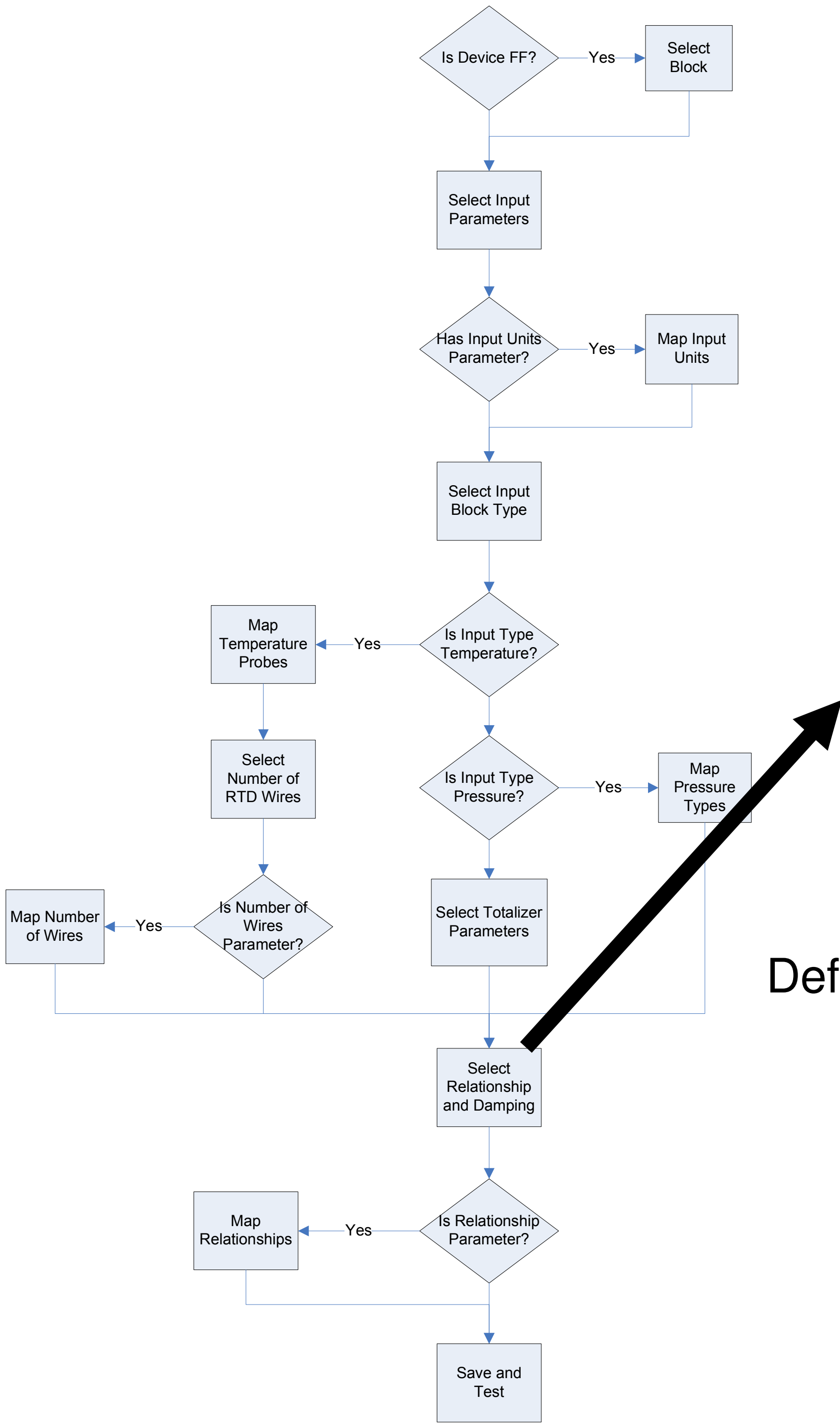


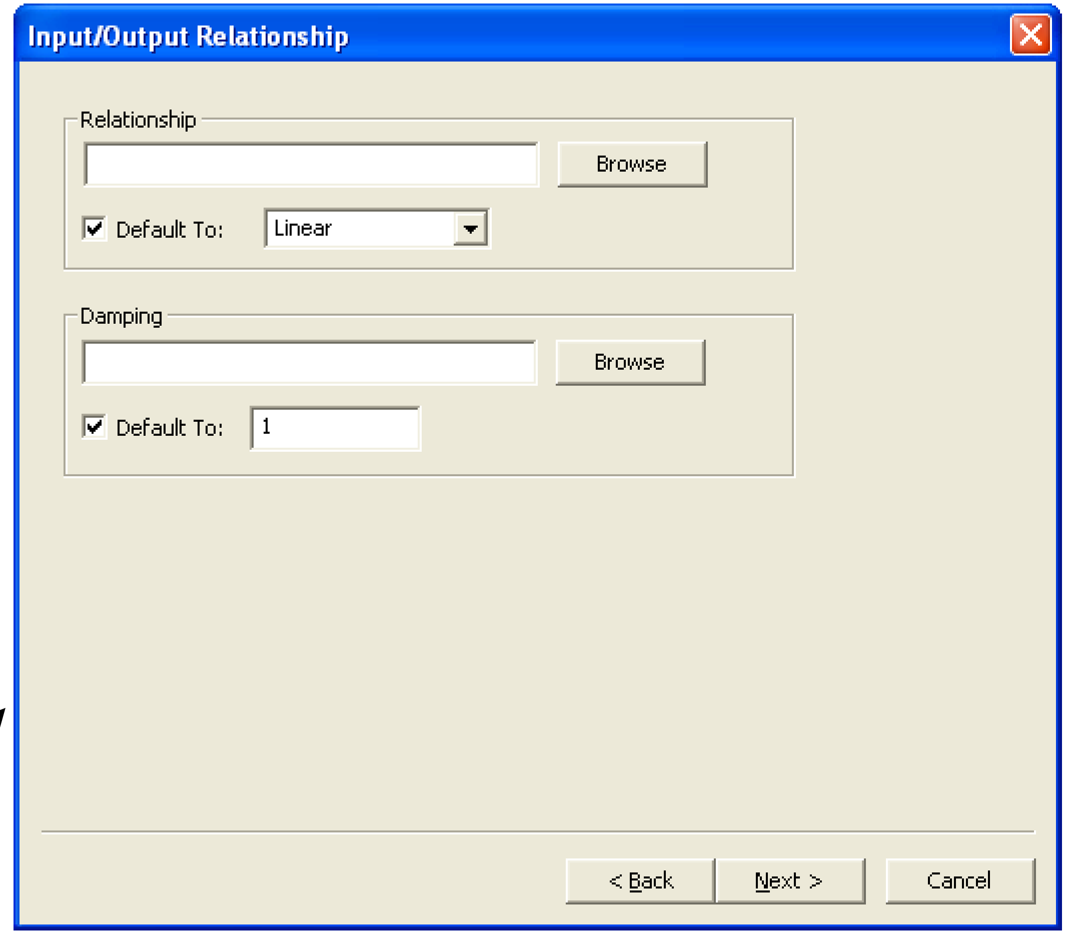
Select Generic for the input type.



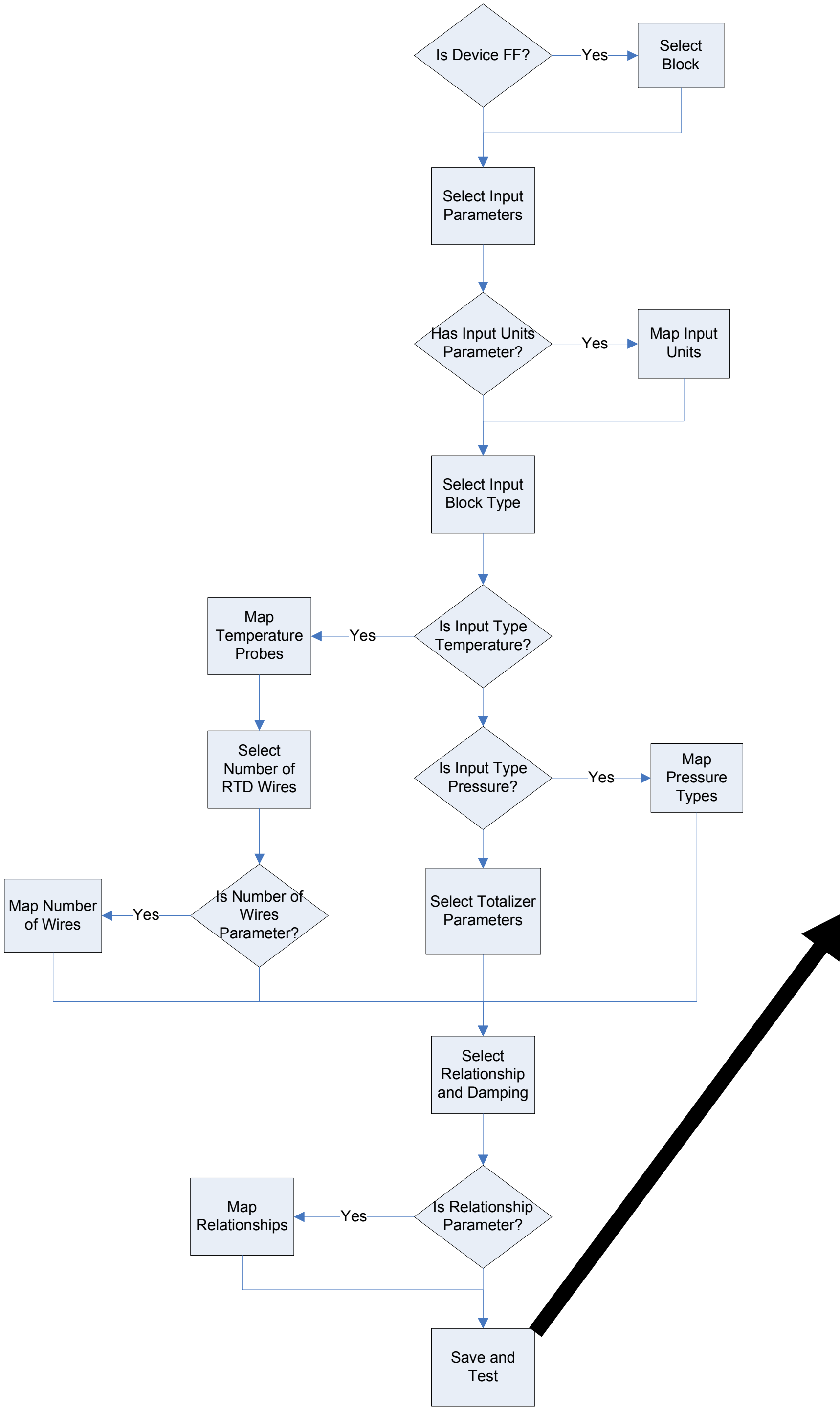


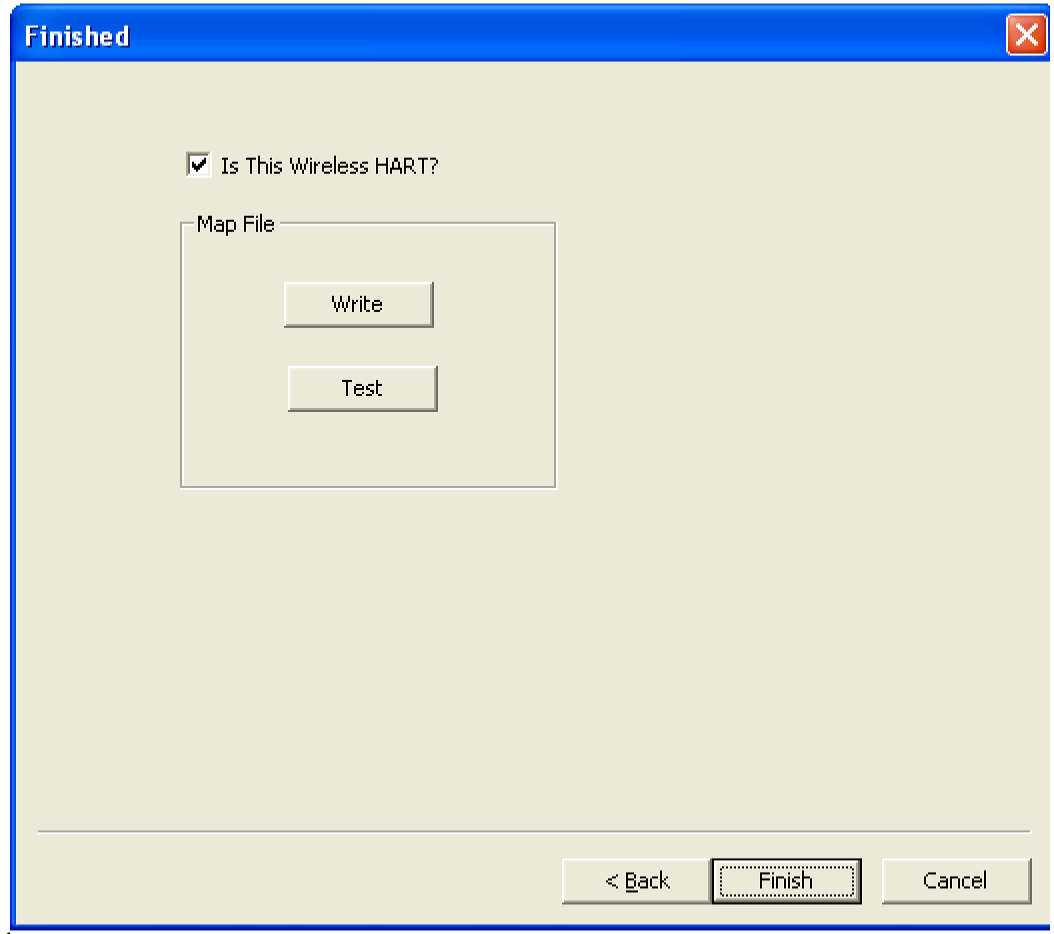
Don’t bother with the totalizer.





Default to linear and 1 second of damping.





This will save a map file where the input is 0 – 100 % with and output of… (HART 4 – 20 mA; wireless HART 0 -100 %; FF 0 – 100%).

The input and output are directly related (i.e. a Linear relationship).

One last (Flow Specific) set of screens

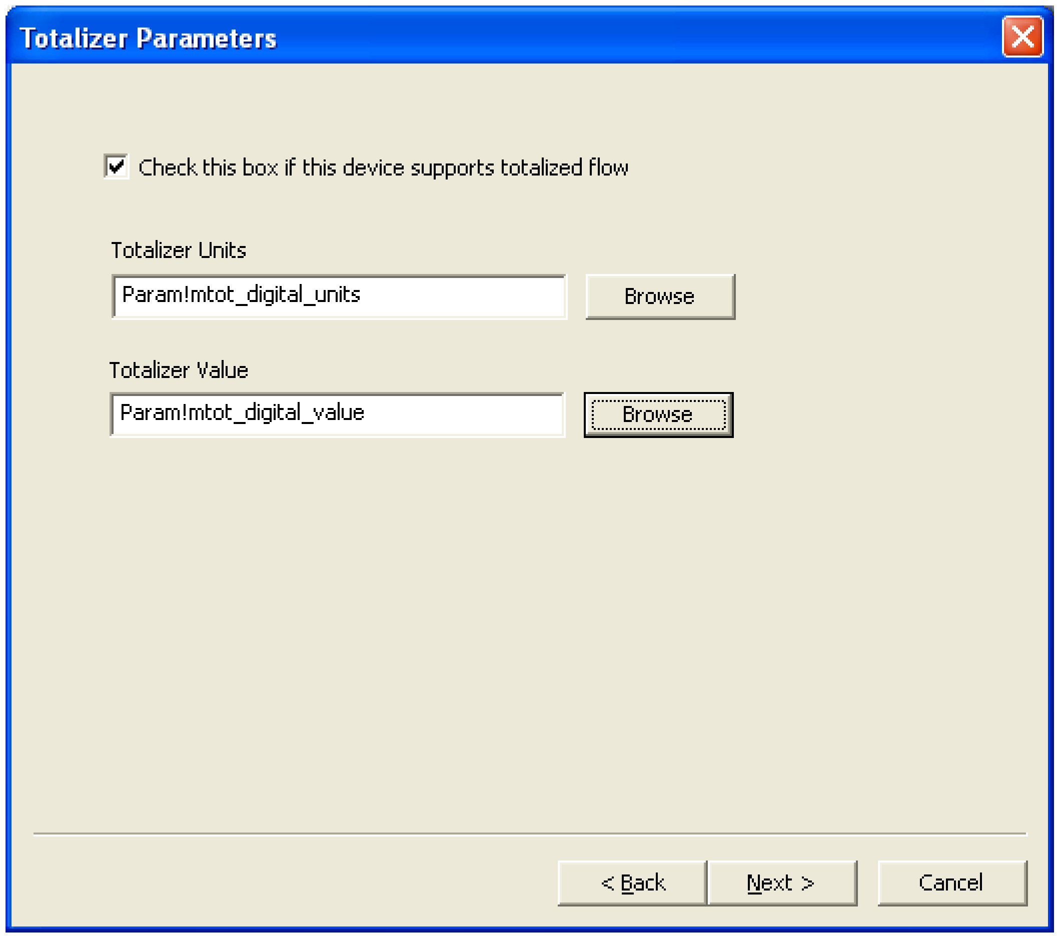
- If the device is “Generic” it could be either a Valve, Analytical, or Flow
- In the case of Flow Transmitters we can run an additional calibration test – Flow Verifications
- A Flow Verification uses the totalizer parameter.

What is a Totalizer?

- Most flow transmitters keep a running count of the flow that it measures.
- This means that there is a number that represents the total volume (or mass) that has passed through the flow sensor since a given point in time:

  1 gal/min * 4 minutes = 4 gal

Flow Transmitters can have totalizer parameters



Mass Totals or Volume Totals