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Title:

Automatically sensing the presence of a Target System using the PPM3-MK2, PPM4-MK1 or ISPnano Programmer

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Abstract:

This application note describes how to set up the Equinox PPM3-MK2, PPM4-MK1 or ISPnano programmers to automatically detect the presence of a Target System.

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## 1.0 Introduction

This application note describes how to set up an Equinox ISP Programmer to automatically sense when a Target System (UUT) is connected to or disconnected from the programmer. This **'Target Sensing'** technique is used to automatically start a **'Programming Sequence'** without any operator intervention when a Target System (UUT) is connected to the programmer. Once the **'Programming Sequence'** has completed, the operator simply removes the Target System from the programmer and the programmer then automatically resets itself ready to sense the connection of the next Target System.

### 1.1 Programmers supported

The following Equinox programmers are capable of supporting the **'Target Sensing'** functionality:

| Programmer | Target Sense Capability |
|------------|-------------------------|
| PPM3-MK2   | YES – uses TVCC pin     |
| PPM4-MK1   | YES – uses TVCC pin     |
| ISPnano    | YES – uses TVCC pin     |

Please note:

**'Target Sense'** can only be used if the programmer is controlling the power supply to the Target System.

### 1.2 Features

The main features of the **'Target Sensing'** technique are:

- Uses a load detection technique on the **'Target Vcc'** pin (TVCC) to sense the presence of the Target System load.
- The same technique can also be used to sense when a **'Test Fixture'** lid has been closed and this signal can then be used to automatically start a **'Programming Sequence'**.
- Automatically detects when a Target System is connected to the programmer
- Automatically triggers the start of a **'Programming Sequence'** once a Target System has been detected
- Automatically detects when a Target System has been disconnected from the programmer.

### 1.3 Typical Target Sensing application

Here is a typical example of how the **'Target Sensing'** technique can be used:

- The **'Test Operator'** places UUT onto Test Fixture
- The programmer senses the presence of the Target System
- The programmer then automatically starts a programming sequence to program the Target IC on the Target System

- Once the programming sequence is complete, the programmer reports PASS or FAIL on the LED's and display.
- The '**Test Operator**' removes the UUT from the Test Fixture
- The programmer senses that the UUT has been removed, resets itself and goes back to '**Sensing Target Connection**' mode.

## 1.4 Typical single Project Target Sensing sequence

The typical sequence of events when using '**Target Sensing**' to start / stop a single '**Standalone Programming Project**' is as follows:

- Programmer waits for UUT to be connected
  - flashing BUSY LED
  - LCD: "**SENSING TARGET CONNECTION**"
- Operator connects UUT to programmer
- Programmer detects connection of UUT
  - Programmer automatically executes a sequence of one or more '**Standalone Programming Projects**'
  - BUSY LED stays on solid
- At the end of the programming sequence, the programmer will FLASH either the PASS or FAIL LED together with the BUSY LED.
- PASS → LCD message: "**SUCCESSFUL DISCONNECT NOW**"
  - Programmer then goes into '**Target Disconnection Sensing**' mode (flashing BUSY LED) and will remain in this state waiting for the operator to remove the UUT.
- Operator removes the UUT
- Programmer resets itself ready for the next UUT – go to start of sequence

## 1.5 Using Target Sensing to control multiple projects

In some applications such as '**Oscillator Calibration**', it is necessary to run a sequence of '**Standalone Programming Projects**' one after the other in order to create a certain programming sequence. It is possible to use the '**Target Sense**' feature to start the execution of a series of chained projects and then once all the projects have finished execution, '**Target Sense**' can then be used to sense when the DUT has been disconnected.

A typical sequence for '**Oscillator Calibration**' is to use three projects chained together so they automatically execute one after the other. The programmer waits in '**Target Connection**' mode for the Target System (DUT) to be connected to the programmer. When the Target System is detected, the programmer starts to execute the three projects in sequence. At the end of the last project, the programmer will then go into '**Target Sense**' mode waiting for the Target System to be disconnected. When the disconnection is detected, the programmer then resets and goes back to the first project and starts sensing for the connection of the next DUT.

Here is an overview of the sequence:

- Start
- Sense '**Target Connection**'
- Program '**Calibration Firmware**' into DUT
- Execute '**Calibration Firmware**' on DUT
- Program '**Production Firmware**' into DUT
- Sense '**Target Disconnection**'
- Go back to Start

## 2.0 Target Sensing – hardware overview

### 2.1 Introduction

The Target Sensing technique allows the programmers to detect when a Target System is physically connected or disconnected from the programmer. This can be used to start / stop an automatic programming sequence. The sensing technique works by placing the Target System as part of a potential divider. The voltage across the Target System is then measured when the Target System is connected and disconnected giving a voltage for “Connection” and “Disconnection”.

### 2.2 Target Disconnected Voltage

The **‘Target Sense Off’** voltage is the voltage present on the **‘TVCC’** (Target Vcc) pin of the programmer when the Target System is disconnected from the programmer. The programmer will apply the voltage specified in the **‘Power Supply Settings’** to the Target System so if no load is attached, the **‘Target Sense Off’** voltage should be within a few 100 mV of the applied voltage.

#### Example 1

If the **‘Controlled Power Supply voltage’** is set to 5.0V, then the expected **‘Target Sense Off’** voltage should be between 4.7 and 5.0V. If the measured voltage is much lower than this then it is likely that something on the IO-CON Module or even the ‘Special Function Module’ is taking too much current.

#### Example 2

If the **‘Controlled Power Supply voltage’** is set to 3.3V, then the expected **‘Target Sense Off’** voltage should be between 3.1 and 3.3V.

### 2.3 Target Connected Voltage

The **‘Target Sense On’** voltage is the voltage present on the **‘TVCC’** (Target Vcc) pin of the programmer when the Target System is connected from the programmer. The programmer will apply the voltage specified in the **‘Power Supply Settings’** to the Target System and this voltage will be pulled down by whatever load is attached. If the Target System takes eg. >10mA then this will show up as corresponding drop in the measured **‘Target Connected Voltage’**. The more current drawn, the lower the voltage measured.

## 3.0 Target Sensing Project

### 3.1 Overview

In order to use the '**Target Sensing**' function, it is necessary to set up a '**Standalone Programming Project**' with the following parameters:

- Programmer controlled Target Power Supply: ON
- The '**Detect Target Connect**' and '**Detect Target Disconnect**' options must be enabled
- The '**Target Connect Voltage**' must be set to a value which allows the programmer to reliably detect when the Target System is connected to the programmer.
- The '**Target Disconnect Voltage**' must be set to a value which allows the programmer to reliably detect when the Target System is disconnected from the programmer.

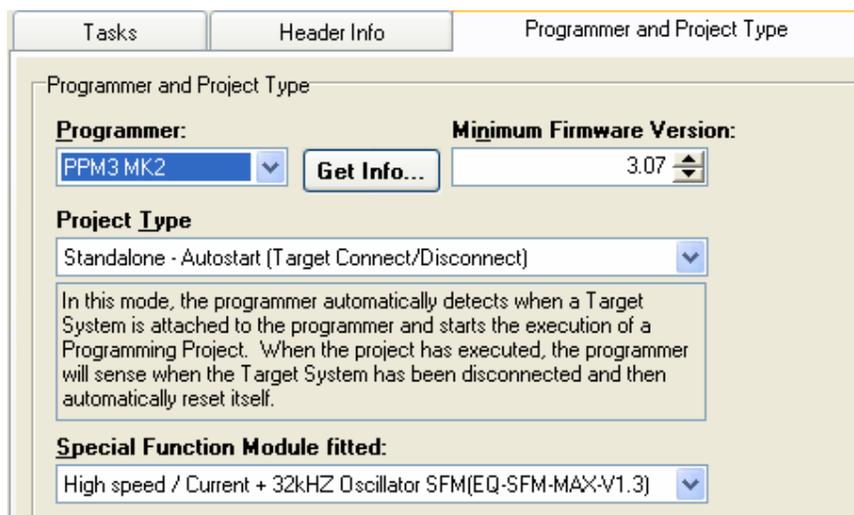
The next sections explain how to set up a '**Standalone Programming Project**' to detect Target connection and disconnection.

### 3.2 Setting the Project Type

The '**Target Sensing**' function can only be used with '**Standalone Programming Projects**'. It is necessary to set the '**Project Type**' to be '**Standalone – Autostart (Target Connect/Disconnect)**' – see screenshot below:

#### Instructions:

- Launch EQTools
- From the left-hand pane, select **<Project Builder>** and then **<New Project>**
- Fill in the relevant screens as you would for a normal project
- Select the **<Programmer and Project Type>** tab
- Select the correct programmer e.g. PPM3-MK2, PPM4-MK1 or ISPnano



- Click the list box arrow under the 'Project Type' header and select '**Standalone – Autostart (Target Connect/Disconnect)**'

→ The **'Entry/Exit'** tab should now become visible.

## 3.3 Enabling the Target Power Supply

The **'Target Sensing'** function will only work when the programmer is set to power the Target System.

### Instructions:

- Select the **<Target Power Supply>** tab
- Set the 'Voltage' to the voltage at which the Target System needs to be powered to.
- Set the 'Tolerance' to the required voltage tolerance
- Switch the **'Target controlled Power Supply' to 'ON'** – see screenshot  
→ This means that the programmer will supply power to the Target System.
- Set the 'Maximum current' to the maximum expected surge current that will be taken by the Target System.

### Target System Power Supply Settings

Select Target System Voltage and Current Consumption

Tasks Header Info Programmer and Project Type  Target Device Target Oscillator SPI Settings Target Power Supply

#### Target Voltage Settings

Voltage  
5.0

Tolerance (mV)  
500

Stabilise Time (ms)  
200

#### Programmer Controlled Power Supply

Programmer controlled Target Power Supply: ON

|                                 |                              |
|---------------------------------|------------------------------|
| Maximum Current (mA)<br>200     | Powerdown Time (ms)<br>1000  |
| Current Settle Time (ms)<br>100 | PSU Out OK Delay (ms)<br>500 |
| Voltage Settle Time (ms)<br>100 |                              |

Power Status at end of project:  
Power Supply is switched OFF at end of project

## 3.4 Enabling the Target Sense function

In order to use the **'Target Sensing'** function, it is necessary to enable this function in the **'Entry / Exit Options'** tab.

### Instructions:

- Select the **'Entry / Exit Options'** tab
- Check the **'Detect Target Connect'** and **'Detect Target Disconnect'** boxes – see screenshot



The voltages are defined as follows:

### **Target Sense ON Voltage**

When in **'Target Sensing Mode'**, the programmer will measure the voltage. If the measured voltage is less than **'Target Sense On'** voltage, then the programmer will detect that the Target System is connected.

### **Target Sense OFF Voltage**

When in **'Target Sensing Mode'**, the programmer will measure the voltage. If the measured voltage is more than **'Target Sense OFF'** voltage, then the programmer will detect that the Target System is disconnected.

The **'Target Connection Wizard'** is used to measure / set up the **'Target Sense ON / OFF Voltages'** for a given Target System.

## 3.5 Running the 'Target Connection Wizard'

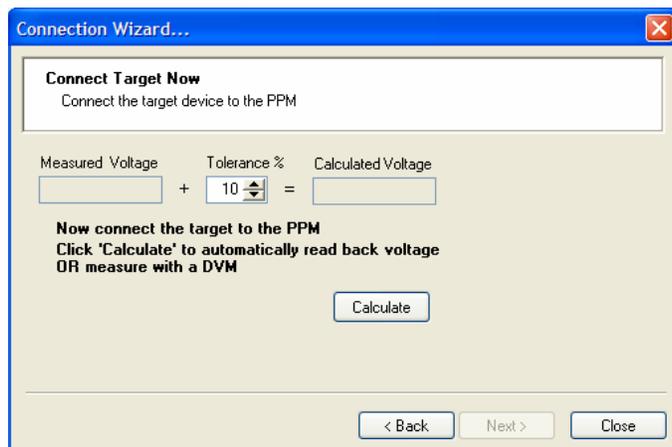
The '*Target Connection Wizard*' is used to measure / set up the '*Target Sense ON / OFF Voltages*' for a given Target System.

### Instructions:

- Select the '*Entry / Exit Options*' tab
- Click the 'Magic Wand' symbol to launch the 'Target Connection Wizard'



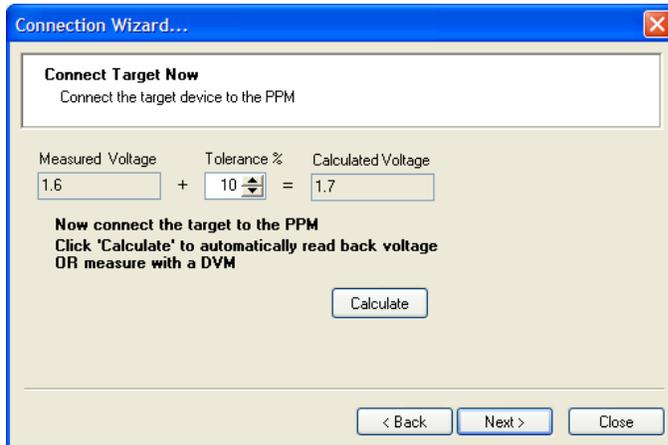
- Click the <Next> button  
→ the 'Connect Target now' screen is displayed....



→ The yellow '**BUSY**' status LED on the programmer should now start to flash indicating the programmer is in '**Target Sensing**' mode.

→ The programmer will now output a voltage (at a very limited current) out of the '**TVCC**' pin

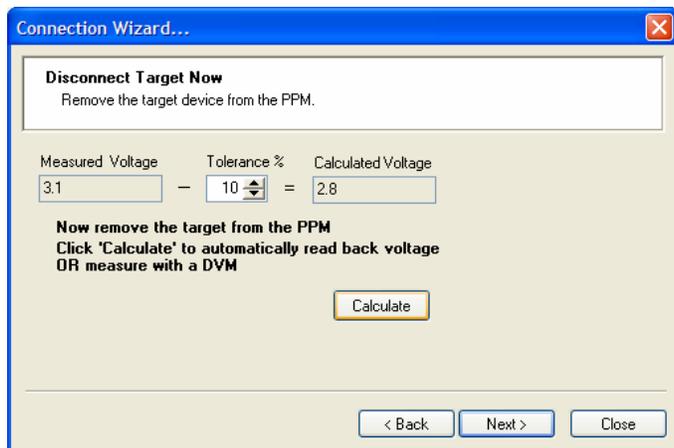
- Connect the '**Target System**' to the programmer
- Click the **<Calculate>** button  
→ The programmer will now measure the voltage at the '**TVCC**' pin (Target Voltage)
- The '**Measured voltage**' and '**Calculated voltage**' are now displayed – see screenshot.



- The '**Measured voltage**' is the voltage below which the programmer will detect that the Target System is connected.
- In this example, the '**Target Sense ON**' voltage must be < 1.6V to trigger a Target Connection.
- Click **<Next>**
- Disconnect the '**Target System**' from the programmer



- Click the **<Calculate>** button  
→ The programmer will now measure the voltage at the '**TVCC**' pin (Target Voltage)
- The '**Measured voltage**' and '**Calculated voltage**' are now displayed – see screenshot.



- The **'Measured voltage'** is the voltage above which the programmer will detect that the Target System is disconnected.
- In this example, the **'Target Sense OFF'** voltage must be > 3.1V to trigger a Target Connection. To give a safe detection margin, this voltage has been reduced to 2.8V.
- Click **<Next>**



- Click **<Finish>**
- The voltages will now be automatically placed into the **'Target Sense ON Voltage'** and **'Target Sense OFF Voltage'** fields.

