IQ Switch® ProxSense™

Azoteq

Application Note: AZD010
In-Circuit Programming

Introduction

The ProxSense™ family of ICs can be used in the default (unconfigured) state. However, for specific applications, certain one-time-programmable (OTP) options can be set.

The purpose of this document is to describe the hardware setup on an application PCB necessary to program the user selectable options on the ProxSense™ family of ICs **in-circuit**.

Hardware used

The following hardware should be used to program the ProxSense™ family of ICs in-circuit:

•	Programmer	CT100, (does not support multiple channel ICs or IQS127) CT120, (use AZT136 PCB when configuring multiple channel ICs) CT200, or any other similar programming tool recommended by Azoteq
•	Cable	USB-A to USB-B cable for CT100, USB-A to USB Mini-B cable for CT120, CT200, (or USB cable between PC and programming tool)

IQS123, IQS124, IQS125, IQS126

1.1 Hardware interface between IQS12x and programmer

6 pins are required to program the IQS12x series of ICs. These pins should be connected to the programmer as follows:

IQS12x Pin Name for:			CT100 pin #: Male D-Type 9 way Connector
IQS123, IQS124, IQS125	IQS126		
VSS		↔	1
CS		↔	2
CX		↔	3
V_{DD}		↔	4
V_{DDHI}		↔	5
OUT	POUT	↔	6

Figure 1: Male D-Type 9 way connector on CT100

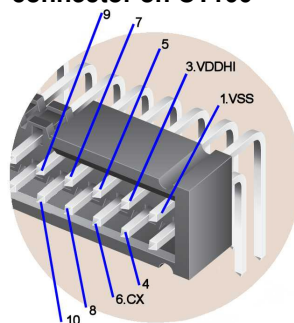| IQS12x Pin Name for:			CT120 pin #: 20-pin Box Header
IQS123, IQS124, IQS125	IQS126		
VSS		↔	1
V_{DDHI}		↔	3
V_{DD}		↔	4
CS		↔	5
CX		↔	6
OUT	POUT	↔	10

Figure 2: 20 pin Box Header on CT120

1.2 External components and voltage levels on IQS123, IQS124, IQS125, IQS126

Voltage levels when setting OTP options

- V_{DDHI}: 6.9V
- V_{DD}: tied to V_{DDHI}
- CS: Same voltage level as V_{DD}.
- CX: Same voltage level as V_{DD}.
- OUT: Same voltage level as V_{DDHI}

When setting OTP options, the IC's V_{DDHI} voltage is raised to 6.9V and V_{DD} is connected to V_{DDHI}. Thus, all voltages on the IC are at a level of 6.9V. Make sure that all components on the PCB are protected against voltages of 6.9V. **Also ensure that no components clamp the voltage on these pins.**

V_{DDHI} and V_{DD}
An external voltage regulator on the product may clip the V_{DDHI} voltage at its regulation voltage and prevent V_{DDHI} from reaching the required voltage of 6.9V when setting OTP options. Large capacitors on V_{DDHI} or V_{DD} can increase the time needed for the programmer to reach 6.9V. (Typical values = 1uF)

V_{DD}
The IC has an internal voltage regulator that needs an external capacitor to function correctly.
For both out-of-circuit and in-circuit programming it is a prerequisite to have a ceramic capacitor of at least **1uF** connected between **V_{DD}** and **VSS**.

CS
A large capacitor on CS (exceeding 100nF) will result in the IC not being able to communicate with the programmer, and also result in a failure in programming.

CX
It is recommended that the CX programming line is connected directly to the CX pin on the IC. If the programming line is connected through the R_{CX} series resistor (used between CX pin and sense plate) it will have problems with programming the IC.

OUT (POUT for IQS126)
In some applications the designer might want to include a voltage limiting regulator (e.g. zener diode) or an indication LED on this pin. If a limiting component or a very small (<300Ω) LED limiting resistor is used, it will result in the IC not being able to program, as the programming voltage on this pin will be clamped.

> ***Please note:*** *All programming lines will be 6.9V when programming the IC. Ensure that any device connected to the ProxSense™ device does not clamp these voltages and has efficient over voltage protection, if necessary, on these lines (if current limiting resistors are used, the resistors are to be designed to meet the current restrictions of the device.).*

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2 IQS127 series

2.1 Hardware interface between IQS127 and programmer

CT100 can not configure IQS127

5 pins are required to program the IQS127 series of ICs. These pins should be connected to the programmer as follows:

IQS127 Pin Name for:			CT120 pin #: 20-pin Box Header
IQS127D	IQS127S / R		
VSS		↔	1
V_{DDHI}		↔	3
V_{REG}		↔	4
POUT	SHLD / RFIN	↔	5
CX		↔	6

Figure 2: 20 pin Box Header on CT120

2.2 External components and voltage levels on IQS127

Voltage levels when setting OTP options
- V_{DDHI}:   6.2V (max 6.5V)
- V_{REG}:   2.5V
- TOUT/OUT: Same voltage level as V_{DDHI}
- POUT/SHLD/RFIN: Same voltage level as V_{DDHI}
- CX: Same voltage level as V_{DDHI}

> ***Please note:*** *The programming lines (except V_{REG}) will be 6.5V when programming the IC. Ensure that any device connected to the ProxSense™ device does not clamp these voltages and has efficient over voltage protection, if necessary, on these lines (if current limiting resistors are used, the resistors are to be designed to meet the current restrictions of the device.).*

<u>V$_{DDHI}$ and V$_{DD}$</u>
An external voltage regulator on the product may clip the V$_{DDHI}$ voltage at its regulation voltage and prevent V$_{DDHI}$ from reaching the required voltage of 5V when setting OTP options. Large capacitors on V$_{DDHI}$ or V$_{DD}$ can increase the time needed for the programmer to reach 5V. (Typical values = 1uF)

<u>V$_{DD}$</u>
The IC has an internal voltage regulator that needs an external capacitor to function correctly. For both out-of-circuit and in-circuit programming it is a prerequisite to have a ceramic capacitor of at least **1uF** connected between V$_{DD}$ and VSS.

<u>ICTRL</u>
The IC's current reference are set with an external resistor on ICTRL. This resistor (typical **43KΩ** on **ICTRL**) is also essential for the IC to function during both out-of-circuit and in-circuit programming.

Programming of these ICs with the CT120 should only be done with an extra extension PCB included (AZT136A0x).

3.3 Interfacing IQS2xx with Module (i.e. Microcontroller)

Please note: When interfacing the IQS2xx with an MCU, and it is necessary to connect the above mentioned programming lines to the MCU, it will be necessary to use a current limiting resistor between the ProxSense IC and the MCU, if the MCU isn't 5V-tolerant.

> **Please note:** The ZC programming line will be 6.5V when programming the IC. Ensure that any device connected to the ProxSense™ device does not clamp the voltages mentioned in Section 3.2 and that the device has efficient over voltage protection(if the device is not 5V-tolerant) , if necessary, on these lines (if current limiting resistors are used, the resistors are to be designed to meet the current restrictions of the device.).

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