Chipsmall

Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

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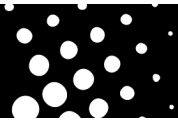Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

Production In-System Programming (ISP) Module

ISPnano

ISP nano

START

STATUS

CE RoHS

equinox

Series III - ATE

RELAYS ON

DC IN | DC EXT | PASS | BUSY | FAIL | RS485 IN / OUT | USB | RS232

DC IN | DC EXT | PASS | BUSY | FAIL | RS485 IN / OUT | USB | RS232

ISP nano

Series I / II / III / III ATE
& MUX 2 / 4 / 8 Programmer
User Manual

Production In-System Programming (ISP) Module

Contents

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Equinox guarantees that its products will be free from defects of material and workmanship under normal use and service, and these products will perform to current specifications in accordance with, and subject to, the Company's standard warranty which is detailed in Equinox's Purchase Order Acknowledgment.

Equinox Warranty Information

This product is guaranteed by Equinox Technologies UK Limited for a period of 12 months (1 year) after the date of purchase against defects due to faulty workmanship or materials. One guarantee covers both parts and labour. Service under the guarantee is only provided upon presentation of reasonable evidence that the date of the claim is within the guarantee period (e.g. completed registration/guarantee card or a purchase receipt).

The guarantee is not valid if the defect is due to accidental damage, misuse or neglect and in the case of alterations or repair carried out by unauthorised persons. A number of exceptions to the warranty are listed in the 'Exceptions to warranty' section below. Service (during and after guarantee period) is available in all countries where the product is distributed by Equinox Technologies UK Limited.

Exceptions to warranty

Over-voltage damage

This warranty does not cover damage to the programmer due to voltages beyond the specified voltage limits being applied to the 'DC Power Input' (CON1) or any of the ISP Headers. The user must ensure that sufficient care is taken to avoid over-voltage and static conditions on any of the 'ISP Header' I/O pins.

Over-current damage

This warranty does not cover damage to the programmer due to excessive current being drawn from the programmer power supply. The user must ensure that there is sufficient over-current protection within the test fixture to protect against short circuit loads.

Short-circuit damage

This warranty does not cover damage to the programmer due to short-circuit loads being placed across programmer I/O lines.

> **Warning!**
> Any damage caused to the programmer by Electrostatic Discharge (ESD) through inadequate earthing is not covered under the warranty of the product.
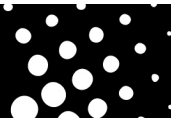
Disclaimer

Whilst every effort has been made to ensure that programming algorithms are correct at the time of their release, it is always possible that programming problems may be encountered, especially when new devices and their associated algorithms are initially released. It is Equinox's Company Policy to endeavour to rectify any programming issues as quickly as possible after a validated fault report is received.

It is recommended that high-volume users always validate that a sample of a devices has been programmed correctly, before programming a large batch. Equinox Technologies UK Ltd. can not be held responsible for any third party claims which arise out of the use of this programmer including 'consequential loss' and 'loss of profit'.

Equinox Technologies UK Ltd. cannot be held responsible for any programming problems which are 'out of our control'. This type of problem is usually listed in the 'Errata Sheet' for the particular device being programmed and is available from the silicon vendor.

Information contained in this manual is for guidance purposes only and is subject to change. E&OE.

Electromagnetic Compatibility (EMC) Compliance

The '**ISPnano Programming Module**' is a CE Approved Product. It is designed for use in an ESD controlled environment i.e. development or production. This means, therefore, that the user must ensure that there is no possibility of damage from electrostatic discharge (ESD). Since the devices and equipment to which this product is likely to be connected may well themselves be susceptible to ESD, this should not pose any difficulty.

For example, if you are handling microcontrollers and EEPROMS etc. then you will already be used to appropriate precautions, such as the use of anti-static mats, wrist straps and so on. You should treat your '**ISPnano Programming Module**' with the same care as you would these types of devices. Always ensure that you are not carrying a static charge yourself before handling the product. Wearing an earthed anti-static wrist strap is recommended.

Equinox has taken great care in designing this product to be compliant with the European EMC directive. When using the equipment be sure to follow the instructions provided. Although RF emissions are within prescribed limits, care should be taken if you are using the product near to sensitive apparatus. If you experience any difficulty please refer to Equinox Technical Support.

ESD Points to remember

- Work in a static-free environment.
- Wear an earthed wrist strap when handling either the programmer and/or any programmable device.
- Ensure that the PC, programmer and Target system are connected to the same EARTH (0V) potential.
- Do NOT plug the ISP cable of the programmer into a Target System when the Target power is ON.

Warning!
Any damage caused to the programmer by Electrostatic Discharge (ESD) through inadequate earthing is not covered under the warranty of the product.
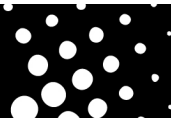
Technical Support

It is often the case that users experience problems when installing or using a product for the first time.

If you have a technical support problem, please consult the following list for help:

► **User Manual**

► **On-line help**
   Press *<F1>* for help at any time when running EQTools or ISP-PRO.

   The help system is context-sensitive. Simply press *<F1>* on any error message and the possible causes of the error should be listed. This help system is updated on a regular basis. Please see software update details for information on keeping up-to-date with software revisions.

► **Internet Web Site**
    The support / download page for the *'ISPnano programmer range'* can be found at:
   http://www.equinox-tech.com/products/details.asp?ID=1440&displ=tl

► **E-mail**
   Please e-mail any technical support questions about this product to:
   support@equinox-tech.com

► **Fax**
    Please fax any technical support questions about this product to: +44 (0) 1942 844181

Equinox will try our best to answer your questions about this product as quickly as possible. However, we cannot promise an immediate reply. Please consult our web site for new software updates as the problem that you are enquiring about may have already been fixed in a new version.

Product Documentation and Software

Overview

This manual provides an overview of the contents of the *'ISPnano Programming Range'* plus associated hardware and software. References may be made to other hardware and software products which are not covered in detail in this manual.

Please refer to the table below for a list of sources of documentation and/or browse to
http://www.equinox-tech.com/products/details.asp?ID=1440&displ=tl

Software:	
EQTools	**EQTools Script Builder – Manual** This software is used to create and upload 'Programming Projects' to the programmer. The following sources of documentation are available for this software: Installation and Getting Started Guide Help file
ASCII TEXT MODE	**ASCII Text Communications Protocol – Application Note** This protocol can be used to control the programmer from an external controller via RS-232. The following sources of documentation are available for this protocol: • Application Note – AN110
ISP PRO	**ISP Pro – Manual** This software is used to control the programmer in a production environment. It is not supplied as standard with this programmer. The following sources of documentation are available for this software: Installation and User Manual Help File

	Upload Wizard - Standalone Project Upload Utility This software utility is used to upload Programming Projects to any Equinox programmer. These projects can then be used in Standalone Mode, i.e. without a PC. • Please follow the on-screen instructions within the Upload Wizard utility itself. Application Note – AN117
	Labview – Remote Application Control – Application Note This upgrade allows a production facility to control a single programmer from a 'Labview for Windows' application. The Application note describes how to control the programmer using a custom Labview (from National Instruments) application. The following sources of documentation are available for this software: • Application Note – AN109
	Remote Application Control – Application Note Describes how to control the programmer using a custom Remote Application written in e.g. Visual Basic, C++, C Builder, Delphi etc. The following sources of documentation are available for this software: • Application Note – AN109
	ConsoleEDS Pro – Application note This software utility allows any Equinox programmer to be controlled via simple Command Line instructions from a Command Window within Windows. The following sources of documentation are available for this software: • Application Note - AN111
	JTAG In-System (ISP) Upgrade – Application Note This license upgrade enables the programmer to support high-speed In-System Programming (ISP) of the Atmel ATmega microcontroller family using the JTAG algorithm. Support is offered for both single and multiple JTAG devices in a JTAG Chain. The following sources of documentation are available for this software: • Application Note – AN105

Documentation and software for the ISPnano programmer

In line with our policy of continuous improvement, the software and associated documentation for this product are updated on a regular basis. You can download the latest software, firmware, User Manuals and application notes for the ISPnano programmer from the following page on the Equinox website:

http://www.equinox-tech.com/products/details.asp?ID=1440&displ=tl

You may be asked to register / log in to download some of these files.

Device algorithm - Application notes

The table below lists the Application Notes available for helping to create *'Programming Projects'* for different device families.

Application Note	Device Family	Programming Interface
AN100	Atmel - AT89Sxxxx FLASH microcontrollers	SPI
AN101	Atmel - AVR FLASH microcontrollers via the SPI Interface	SPI
AN105	Atmel - AVR FLASH microcontrollers via the JTAG Interface	JTAG
AN118	Generic I2C 24xxx Serial EEPROM memories	I2C
AN122	Atmel - AT91SAM7 ARM7 FLASH microcontrollers	JTAG
AN127	Atmel – XMEGA AVR FLASH microcontrollers via the 2-wire PDI interface	PDI
AN128	NXP – LPCxxx ARM7 FLASH microcontrollers	JTAG
AN130	Zensys – ZWxxx – Z-WAVE Series	SPI
AN132	Atmel ATtiny AVR microcontrollers via the TPI interface	TPI
AN133	Atmel AT45D Serial DataFlash programming	SPI

These application notes can be found in PDF format on the CD-ROM which was supplied with the programmer. You can also find the very latest versions on the *"ISPnano Download Page"* on the Equinox website.

Programmer related - Application notes

The table below lists the Application Notes available for the ISPnano programmer range which describe the USB driver installation, the different control methods available, firmware update procedure and *'AVR Oscillator Calibration'* procedure.

Application Note	Description
AN109	Remote Application Control of Equinox ISP Programmers using ISP-PRO Utility
AN110	ASCII Text Control (ATC) Protocol for Remote Control of Equinox Programmers
AN111	ConsoleEDS Protocol for Remote Control of Equinox Programmers
AN112	Firmware Update instructions for Equinox ISP Programmers
AN114	Accurate on-chip Oscillator Calibration for Atmel AVR microcontrollers
AN121	Equinox EQTools – Release Notes
AN122	In-System Programming (ISP) of the Atmel AT91SAM7 FLASH Microcontroller Families using the JTAG Programming Interface
AN123	Controlling an Equinox ISP Programmer from a Remote System via the Remote 4-wire TTL Port
AN126	USB Driver Installation instructions for PPM4-MK1 and ISPnano programmers

These application notes can be found in PDF format on the CD-ROM which was supplied with the programmer. You can also find the very latest versions on the *"ISPnano Download Page"* on the Equinox website.

1.0 Introduction

The ISPnano series of ISP programmers are designed for high-speed In-System Programming (ISP) of FLASH Microcontrollers and Serial Memory devices. Their compact size and abundance of programming ports makes them ideal for integration into any Test Fixture or ATE System. They supports programming of devices by most interfaces including SPI, JTAG, JTAG chain, SCI, I2C (2-wire), XMEGA PDI, ATtiny TPI and UART Boot Loader. The fastest possible programming times are guaranteed due to a combination of highly optimised algorithms, local storage of Project Data and high slew rate Line Driver Circuitry.

The ISPnano series of programmers represents a scaleable ISP programming solution capable of programming multiple PCBs on a 'PCB Panel'. This is made possible by networking up to 32 x ISPnano programmers to a single PC. All programmers can then be configured to start simultaneously under PC control.

1.1 ISPnano Series III Programmer

The *'ISPnano Series III'* is a state-of-the-art Production ISP Programmer designed for high-speed In-System Programming (ISP) of FLASH Microcontrollers and Serial Memory devices. Its compact size and abundance of programming ports makes it ideal for integration into any Test Fixture or ATE System. It supports programming of devices by most interfaces including SPI, JTAG, JTAG chain, SCI, I2C (2-wire) and UART Boot Loader. The fastest possible programming times are guaranteed due to a combination of highly optimised algorithms, local storage of Project Data and high slew rate Line Driver Circuitry.
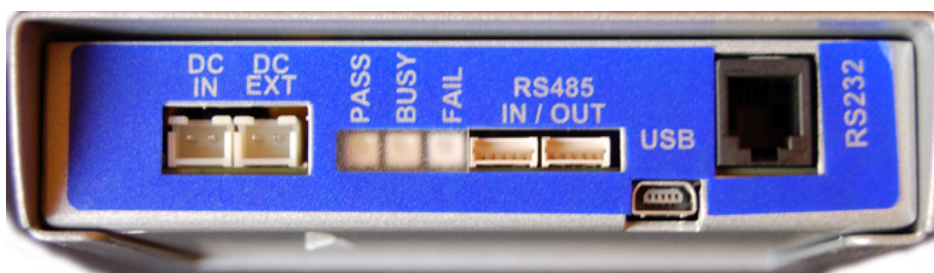
The *'ISPnano Series III'* is capable of operating in *'Standalone Mode'* where any one of 64 independent *'Programming Projects'* can be executed via a remote command. The programmer also features a *'4-wire TTL Remote Control interface'* making it ideal for interfacing to any ATE or In-Circuit Tester (ICT). A special *'Start Signal'* can be used to detect when a Test Fixture lid has been closed and thereby automatically start a programming operation.

The *'ISPnano Series III'* is a scaleable ISP programming solution capable of programming multiple PCBs on a 'PCB Panel'. This is made possible by networking up to 32 x ISPnano programmers to a single PC. All programmers can then be configured to start simultaneously under PC control.

1.2 ISPnano Series III ATE Programmer

The *'ISPnano Series III ATE'* is a state-of-the-art Production ISP Programmer designed for high-speed In-System Programming (ISP) of FLASH Microcontrollers and Serial Memory devices. It has been specially developed to allow simple integration with ATE Systems and In-Circuit Testers (ICTs) used in high-volume production environments. The programmer supports automated relay switching of all Target System signal and power signal lines between an external ATE / ICT system and the internal programmer electronics. This allows the programmer to be completely out-of-circuit during normal ATE / ICT testing operation. A dedicated *'ATE Interface'* allows the ATE / ICT to control the operation of the programmer in *'Standalone Mode'*.

The compact size and abundance of programming ports makes the *'ISPnano Series III ATE'* ideal for integration into any Test Fixture or ATE System. It supports programming of devices by most interfaces including SPI, JTAG, JTAG chain, SCI, I2C (2-wire), XMEGA 2-wire PDI, ATtiny HV (+12V Vpp), ATtiny TPI and UART Boot Loader. The fastest possible programming times are guaranteed due to a combination of highly optimised algorithms, local storage of Project Data and high slew rate Line Driver Circuitry.

The *'ISPnano Series III ATE'* is capable of operating in *'Standalone Mode'* where any one of 64 independent *'Programming Projects'* can be executed via a remote command.

Please note:
The *'ISPnano Series III ATE'* programmer features a standard *'ISPnano Series III'* programming module and a *'relay switching module'* integrated into a single enclosure. The *'ATE'* version will run exactly the same projects as the standard version with the exception that the *'EXT-VCC'* supply is used to power / control the relay coils.

1.3 ISPnano MUX2 / MUX4 / MUX8 - Multiplexed Programmers

The *'ISPnano-MUX'* family of ISP programming systems have been specially developed for medium to high-volume production programming applications where there is a requirement to program multiple devices mounted on a *'PCB Panel'*. The *'ISPnano-MUX'* programmers use a single integrated *'ISPnano Series 3'* programmer which is then multiplexed sequentially to each UUT (Unit Under Test) in turn on the PCB panel. This allows the system to sequentially program up to 8 individual UUTs, one after the other.

Main Features…
- Available as 2 / 4 or 8 channel multiplexed programming system
- Supports sequential programming of 2 / 4 or 8 UUTs (depending on programmer model)
- A single *'ISPnano Series 3'* programmer is multiplexed sequentially to 2 /4 / 8 individual Target Boards (UUTs)
- All programming signals are multiplexed to each UUT using high-quality analogue switches
- All programming signals are fully ESD and over-voltage protected
- All passive / power signals (Target VCC, Target Vpp and EXT-VCC power signals) are switched via individual high-quality relays to each UUT
- Power is always switched off to the target UUT before switching to the next UUT thus providing very long relay contact life
- Each programming channel features its own interchangeable 'I/O Connector Module' with relays and any custom target connectors
- Status indicators include - current channel being programmed and PASS / BUSY / FAIL
- Controllable via a PC using the Equinox EDS, ConsoleEDS or ISP-PRO software utilities
- Channel multiplexer control can be controlled either via the PC or a remote system

ISPnano-MUX Programmer range….
There are currently three programmers in the *'ISPnano-MUX'* family as detailed in the table below….

Programmer version:	ISPnano-MUX2	ISPnano-MUX4	ISPnano-MUX8
Number of multiplexed programming channels	2	4	8
No. of programming channels (RS485 networked)	up to 64 channels	up to 128 channels	up to 256 channels
Intended use / application	Programming 2 devices on the same PCB e.g. microcontroller + memory device	Programming 4 x PCBs on a multi-PCB panel	Programming 8 x PCBs on a multi-PCB panel
Availability	Q2 2011	Q2 2011	Available now

The picture below shows the *'ISPnano-MUX8'* programmer…
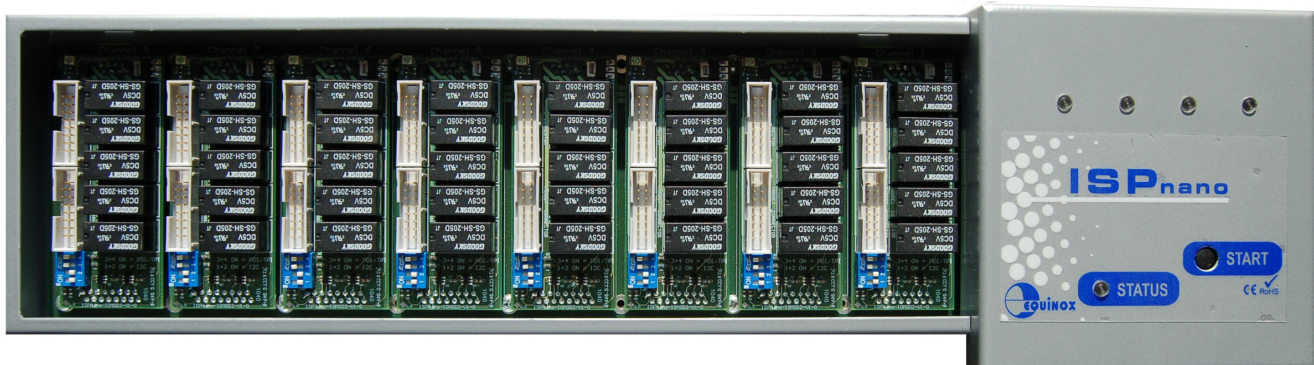
Sequential multiplexing…

The sequential multiplexing approach supports programming of only one UUT at a time which means that the programming time for a panel of e.g. 2 / 4 / 8 PCBs which will be significantly longer than if an individual programmer was used for each channel. However, for many programming applications, the programming time is very short anyway or is not the most important factor in the system, so this multiplexed approach would work very well.

Multiplexing of programming signals…

The programming signals for each programming channel are multiplexed using high-quality analogue switches to each UUT in turn. The power signals (TVCC, VPP and EXT-VCC) are all individually switched to each UUT using relays. This approach allows the power to each UUT to be individually controlled and measured and means that only a single UUT is then powered on at any point in time making it possible to detect short circuits and other faults for an individual UUT.

Operating the programmer in 'Standalone Mode'….

The **ISPnano-MUX** programmers are capable of operating in *'Standalone Mode'* where any one of 64 independent *'Programming Projects'* can be executed via a remote command. The programmer also features a 4-wire TTL Remote Control interface making it ideal for interfacing to any ATE or In-Circuit Tester (ICT). A special *'Start Signal'* can be used to detect when a Test Fixture lid has been closed and thereby automatically start a programming operation.

1.4 ISPnano Programmer Module - Main Features

The main features of the *'ISPnano Programming Module'* are detailed in this section. This module is found in the ISPnano Programmer, ISPnano-ATE programmer and also the ISPnano-MUX2 / MUX4 / MUX programming Systems.

Wide ranging Device Support capability
• Supports In-System Programming (ISP) of many popular FLASH Microcontrollers, Serial EEPROM and serial FLASH Memories

High-speed Programming
• Optimised algorithms, on-board project data storage and high-speed line-driver circuitry delivers the fastest possible programming times

Supports most ISP Protocols
• SPI, JTAG, I2C (2-wire), SCI, BDM,
• Series 3 programmers only – Atmel XMEGA 2-wire PDI, ATtiny TPI(LV), ATtiny TPI(HV)

High-speed JTAG port
• Supports high-speed JTAG programming of Atmel AVR and AT91SAM7 microcontrollers

High-speed SPI port
• Supports full range of SPI speeds from 10 Hz up to 4 MHz

Dedicated 2-wire I2C serial port with independent drive circuitry
• Supports high-speed I2C programming of Serial EEPROM and F-RAM memories.

Fully ESD and Over-voltage protected I/O
• All Target I/O pins feature both ESD and over-voltage protection

Supports programming at Target Voltages down to 1.8V
• An optimised driver circuit delivers fast clean programming waveforms from 1.8 to 5.0V.

Excellent Host Control connectivity
ISPnano Series 1
• 2 x RS232 Serial Ports
• 1 x RS485 In/OUT port – supports up to 32 programmers on an RS485 network
• 4-wire TTL Remote Control Port
• Remote Keypad / Display (ideal for standalone control in a Test Fixture)

ISPnano Series 2
• 1 x USB Port
• 1 x RS232 Serial Port
• 1 x RS485 In/OUT port – supports up to 32 programmers on an RS485 network
• 4-wire TTL Remote Control Port

- Remote Keypad / Display (ideal for standalone control in a Test Fixture)

Gang Programming support

- Up to 32 programmers can be controlled from a single PC using the RS485 Bus

Standalone Operation

- Programmer can operate in *'Standalone Mode'* i.e. without PC Control.
- Programmer can be controlled via [START] button, 4-wire TTL Remote control Port, Target Detection or Lid switch detection control methods or Remote Keypad / Display.

Supports up to 64 Independent 'Programming Projects'

- Each project supports programming of a complete device inc.
  FLASH, EEPROM, Fuses etc.

High accuracy Programmer Controlled Target Vcc Power Supply

- The programmer can switch 1.8 to 5.0V @ 300mA to the Target System.
- Accuracy +/- 20 mV

Programmer controlled Target Discharge Circuit

- The programmer can automatically discharge any residual charge on the Target System to guarantee that the Target Vcc reaches 0V.

High accuracy Programmer Controlled Target Vpp Power Supply

- The programmer can switch 6.5V to 13.5V @ 100mA to the Vpp pin of a Target IC.

User-swappable I/O Connector Modules (optional)

- Many different I/O Connector Modules are available to suit any required connection system.

Firmware upgradeable

- New algorithms and features can be added via a simple firmware upgrade

Compact physical size ideal for integration into Test Fixtures

- Programmer measures only 9cm x 6cm x 6cm and has ergonomic design to supports the maximum packing density.

Special ATE programmer version with RELAY isolation available (option)

- All programmer ISP and power signals are galvanically isolated via relays.

Special multiplexed programmer version available

- A single ISPnano programmer is multiplexed sequentially to either 2, 4 or 8 Target Boards (UUTs) in turn.

1.5 Programmer Selection Guide

1.5.1 Single channel ISPnano programmers

This section describes the range of 'single channel' ISP programmers which are available.

Programmer version:	Series I	Series II	Series III	Series III ATE
Number of programming Channels (standard)	1	1	1	1
No. of programming Channels (networked)	up to 32 channels	up to 32 channels	up to 32 channels	up to 32 channels
Intended use / application	Programming / Test fixtures, multi-PCB panel programming	Programming / Test fixtures, multi-PCB panel programming	Programming / Test fixtures, multi-PCB panel programming	Programming / ICT fixtures requiring relay isolation of ICT
Availability	Discontinued	Spares only	Available	Available

Please note:

- The *'Series I'* and *'Series II'* programmers have both now been discontinued. Some spares are still available on request.
- The *'Series III ATE'* programmer is an *'Series III'* programmer with an integrated *'Relay card'* which galvanically isolates all the programmer I/O and power signals.
- All of the above programmers can be networked via the RS485 bus to make a parallel programming network capable of concurrently programming up to 32 Target Boards (UUTs).

1.5.2 Multi-channel multiplexed ISPnano programmers

The **ISPnano-MUX** programmer range supports multiplexing of a single *'ISPnano Series 3'* programmer to 2 / 4 or 8 individual Target Boards (UUTs).

Programmer version:	ISPnano-MUX2	ISPnano-MUX4	ISPnano-MUX8
Number of multiplexed programming channels (standard)	2	4	8
Programming type	Single programmer is multiplexed to 2 x UUTs	Single programmer is multiplexed to 4 x UUTs	Single programmer is multiplexed to 8 x UUTs
No. of programming Channels (networked)	up to 64 channels	up to 128 channels	up to 256 channels
Intended use / application	Programming / Test fixtures, multi-PCB panel programming	Programming / Test fixtures, multi-PCB panel programming	Programming / Test fixtures, multi-PCB panel programming
Availability	Q2 2011	Q2 2011	Available

1.5.3 Programmer on-board Standalone Project Storage

Project Storage	Series I	Series II	Series III	Series III ATE
Number of standalone projects supported	64	64	64	64
On-board FLASH Project Storage (Mbytes)	16	16	16	16

1.5.4 Programmer Target I/O Capability

Target I/O Capability	Series I	Series II	Series III	Series III ATE
Programmable Target I/O	5 x I/O 1 x O	5 x I/O 1 x O	5 x I/O 1 x O	5 x I/O 1 x O
I/O Voltage Range	1.8 – 5.0V	1.8 – 5.0V	1.8 – 5.0V	1.8 – 5.0V
I/O Isolation	-	-	-	Galvanic Relay isolation per I/O signal, power & 0V
ESD protection on Target I/O lines	IEC61000-4-2, air discharge: 15 kV IEC61000-4-2, contact discharge: 8kV	IEC61000-4-2, air discharge: 15 kV IEC61000-4-2, contact discharge: 8kV	IEC61000-4-2, air discharge: 15 kV IEC61000-4-2, contact discharge: 8kV	IEC61000-4-2, air discharge: 15 kV IEC61000-4-2, contact discharge: 8kV
Over-voltage protection on Target I/O lines	YES Voltages over 9V are clamped.	YES Voltages over 9V are clamped.	YES Voltages over 9V are clamped.	YES Voltages over 9V are clamped.

1.5.5 Supported programming interfaces

Programming Interface	Series I	Series II	Series III	Series III ATE
SPI Port	Yes - multiplexed	Yes - multiplexed	Yes - multiplexed	Yes - multiplexed
JTAG Port	Yes - multiplexed	Yes - multiplexed	Yes - multiplexed	Yes - multiplexed
I2C Port	Yes - Dedicated	Yes - Dedicated	Yes – multiplexed with PDI port	Yes – multiplexed with PDI port
UART Port	Yes - multiplexed	Yes - multiplexed	Yes - multiplexed	Yes - multiplexed
XMEGA PDI Port	-	-	Yes – multiplexed with I2C port	Yes – multiplexed with I2C port
ATtiny TPI Port (LV)	-	-	Yes – multiplexed with I2C port	Yes – multiplexed with I2C port
ATtiny TPI Port (HV)	-	-	Yes – multiplexed with I2C port. +12V VPP on RESET pin	Yes – multiplexed with I2C port. +12V VPP on RESET pin
Programmable clock output	Yes 32 kHz	Yes 32 kHz	Yes 32 kHz	Yes 32 kHz

Please note:
- The 'SPI Port', 'JTAG Port' and 'UART' port signals all share the same physical programmer I/O lines.
- This means that the programmer can only be connected via one of these programming interfaces at any one time.