



NXP S32K148 Emulation Adapter

Hardware User Manual

V1.4, February 2024

General safety instructions

Please read the following safety precautions carefully before putting this device to use to avoid any personal injuries, damage to the instrument, or to the target system. Use this instrument only for its intended purpose as specified by this manual to prevent potential hazards.

Use included power cord and power supply

The enclosed power supply has been approved for use by iSYSTEM. Please contact iSYSTEM if you need to consider an alternative power.

Use grounding wire

Prior to applying power to either the BlueBox or the target, connect the device and the target system together with the included grounding wire. This is to avoid potential damage caused by any voltage difference between the device and the target system.

Use proper overvoltage protection

Ensure proper protection to avoid exposing the BlueBox device or the operator to overvoltage surges (e.g. caused by thunderstorm, mains power).

Do not operate without cover

Do not operate the device with cover removed.

Avoid circuit and wire exposure

Do not touch exposed components or wires when the device is powered.

Do not operate with suspected damage

If you suspect damage may have occurred, the BlueBox device must be inspected by qualified service personnel before further operation.

Do not operate the device outside its rated supply voltage or environmental range

Consult with iSYSTEM before using equipment outside of the parameters provided in this manual.



This symbol is used within the manual to highlight further safety notices.

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Introduction

NXP S32K148 Emulation Adapter is based on the 176-pin S32K148 superset device and provides full trace capability for the:

- 48-pin
- 64-pin
- 100-pin
- 144-pin

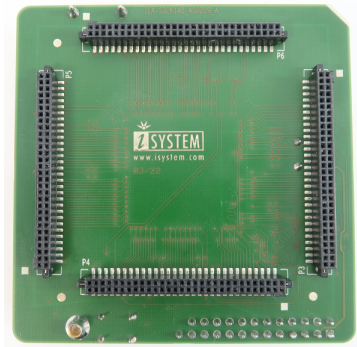
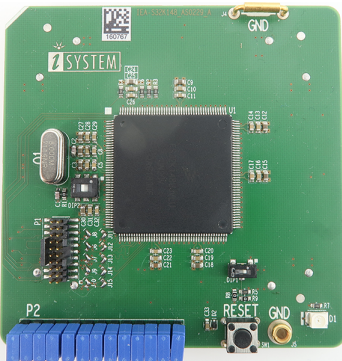
device, where trace port is not available or lacks the full trace capability.


 The Emulation Adapter might differ in some peripherals from the target device; therefore, the device datasheet should be checked.

Emulation Adapter supports the following debug and trace interfaces:

- JTAG and SWD debug interface;
- ETM/ITM trace to trace Cortex-M4 program execution; Trace data is connected to the external trace port which then connects to 20-pin 1.27 mm CoreSight Debug Adapter;
- Serial wire viewer (SWV) and printf() style debugging through a Single Wire Output (SWO) "trace" pin on Cortex-M4.




The Emulation Adapter can also be used as a [standalone device](#) for microcontroller evaluation purposes or for development and testing of an embedded application ahead of target board availability.





 More information about our products on www.isystem.com or via sales@isystem.com.

Package content

NXP S32K148 Emulation Adapter is delivered with all the components required for a [standalone operation](#). [Target adaptation parts](#) for the Target board adaptation must be **ordered separately**.

NXP S32K148 Emulation Adapter	Power supply package	
	Power converter	Power adapter
Ordering code: IEA-S32K148	Ordering code: IEA-PS	Ordering code: IT9V-PS
		

GND Wire	Crystal
Ordering code: BB-WIRE	Crystal 16MHz
	



If you purchase the Power supply package individually, the Power adapter (IT9V-PS) must be ordered separately.

Target adaptation

The Emulation Adapter adaptation to a specific target microcontroller pincount and package is done via a Conversion board and a Solder part. Conversion boards connect between the Emulation Adapter and the matching Solder part, which is being soldered on the embedded target side. Available Conversion boards and Solder parts are listed in the table below.

Package (Pitch)	Conversion board (Ordering code)	Type	Solder part (Ordering code)
QFP48 (0.5 mm)	IEA-S32K148-TQ48	Fixed	IA48TQ-SOLDER
QFP64 (0.5 mm)	IEA-S32K148-ATQ64		IA64ATQ-SOLDER
QFP100 (0.5 mm)	IEA-S32K148-TQ100		IA100TQ-SOLDER
QFP144 (0.5 mm)	IEA-S32K148-TQ144		IA144TQ-SOLDER

QFP Fixed Adaptation

The adaptation is elivered with a slot screw, which can be used to achieve a more solid and stable fixing of the Conversion board and the Solder part.

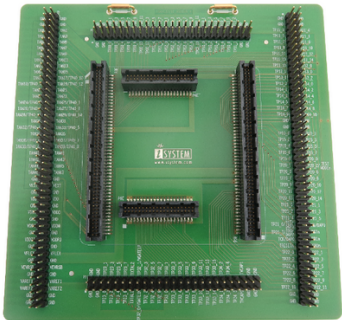


Measurement board (optional)

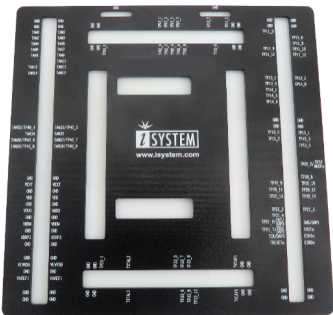
The Measurement board connects between the Emulation Adapter and the Conversion board. Embedded targets often do not have access to all the MCU pins / connected signals to connect with measurement equipment (oscilloscope, logic analyzer), its use provides easy access to all MCU pins. It is delivered together with an Layout board (chip signals are clearly marked), which is placed over the Measurement board.

Measurement board (optional)

Ordering code:
IAMS32K148



Layout board example for the Measurement board



Not available in every Emulation Adapter or every MCU pin count.

Operation

How to connect?

- [How to connect Emulation Adapter \(video\)](#) - short link: isystem.com/ea-intro
- [How to connect TASKING Hardware \(video\)](#) - short link: isystem.com/connect-hardware

Configuration

DIP1: Target reset configuration

DIP switch DIP1 connects the Emulation Adapter reset line and the target reset line and is on (position next to the white dot) by default. The Emulation Adapter also features a Reset push button (SW1).

If having problems establishing the initial debug session with the Emulation Adapter, adjust the DIP switch DIP1 to the off position (position away from the white dot) and try again.

DIP2: Clock source configuration

DIP switch DIP2 selects a clock source for the emulation device.

When the switch is in position next to the white dot (default setting), it selects the crystal circuit oscillator from the target.

When the crystal circuit of the emulation adapter is to be used instead of the target board's crystal circuit, adjust the switch in the position away from the white dot. In this case, the Q1 socket on the Emulation Adapter must also be populated with an adequate crystal.

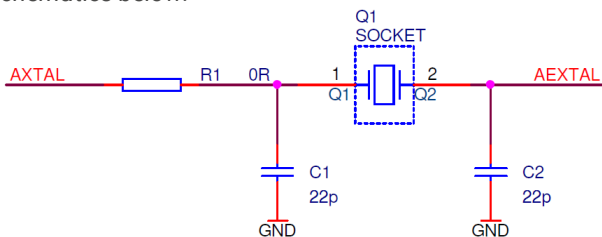


The Emulation Adapter may not operate when your target board's crystal circuit is used as the clock source. Typical design guideline is that the crystal should be as close as possible to the microcontroller. The crystal on your target board might not oscillate in conjunction with the Emulation Adapter when the clock lines (TPTB7, TPTB8) between the crystal and the emulation device on the Emulation Adapter become too long, thus affecting the impedance of the crystal circuit.

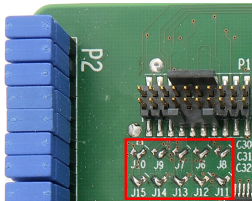


Separately packed 16 MHz crystal can be used as a 16 MHz external clock (XOSC) source to the emulation device. If a different clock frequency is required, insert an adequate crystal into the Q1 socket and replace C1 (default 22pF populated) and C2 (default 22pF populated) accordingly. Crystal socket Q1 is by default not populated (NP).

Crystal socket Q1 schematics below:



J6 - J15: Trace port configuration



Soldered jumpers are placed by default to connect ARM CoreSight 20 connector trace signals to fast trace pins:

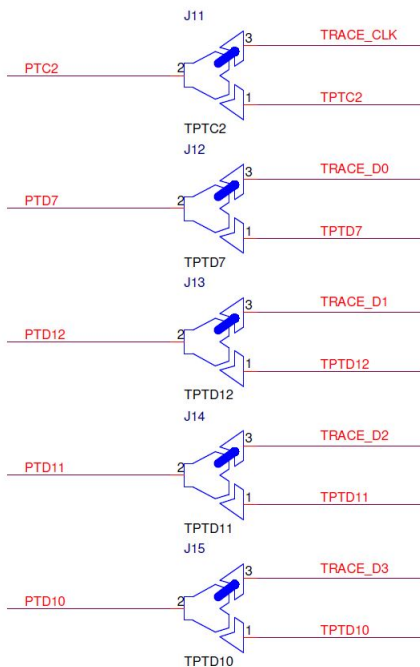
- TRACE_CLK - PTC2
- TRACE_D0 - PTD7
- TRACE_D1 - PTD12
- TRACE_D2 - PTD11
- TRACE_D3 - PTD10

If fast trace pins (PTC2, PTD7, PTD12, PTD11, PTD10) on a target board are used for other functionality purpose than trace, the Emulation Adapter allows connecting trace signals to alternate ports through solder jumpers:

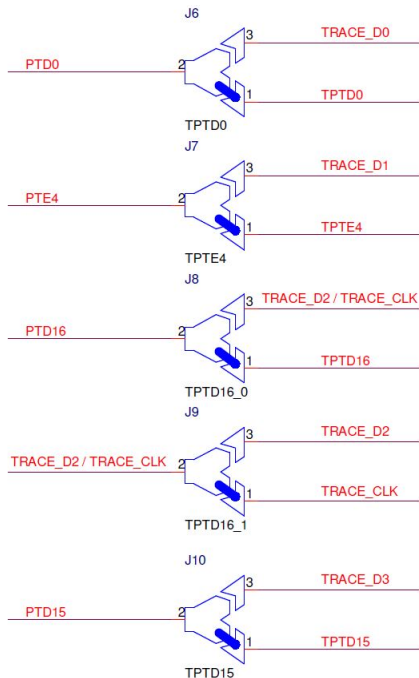
- TRACE_CLK - PTD16
- TRACE_D0 - PTD0
- TRACE_D1 - PTE4
- TRACE_D2 - PTD16
- TRACE_D3 - PTD15

Note that PTD16 can operate either as TRACE_CLK or TRACE_D2. Use of alternate ports decrease the performance of the trace interface since output drivers on these ports are slower. It's recommended to contact iSYSTEM for assistance if the default trace configuration has to be changed.

Soldered jumpers J6-J15 on the Emulation Adapter in the image below.



Default trace signals



Alternative trace signals

winIDEA configuration

Configure winIDEA accordingly depending on which ports are connected to the physical trace interface. Open Hardware menu / CPU Options / SoC Advanced page. Depending on the user target board configuration, set:

- TRACE CLOCK Port to PTC2 (alternative PTD16)
- TRACE DATA0 Port to PTD7 (alternative PTD0)
- TRACE DATA1 Port to PTD12 (alternative PTE4)
- TRACE DATA2 Port to PTD11 (alternative PTD16)
- TRACE DATA3 Port to PTD10 (alternative PTD15)

CPU Options S32K148		
Reset	Property	Value
Debugging	<div><div></div>S32K</div>	
Hardware	TRACE CLOCK Port	PTC2
Analyzer	TRACE DATA0 Port	PTD7
SoC Advanced	TRACE DATA1 Port	PTD12
SoC	TRACE DATA2 Port	PTD11
	TRACE DATA3 Port	PTD10

P2: Power supply configuration

Power supply of the Emulation Adapter is configured via the unshrouded 26-pin 2.54 mm header (P2).

Signal direction	Signal	Pin	Pin	Signal	Signal direction
Target board	TVDD	1	2	VDD	Emulation device
Target board	TVREFH	3	4	VREFH	Emulation device
Not Connected	NC	5	6	NC	Not Connected
Not Connected	NC	7	8	NC	Not Connected
Not Connected	NC	9	10	NC	Not Connected
Not Connected	NC	11	12	NC	Not Connected
Not Connected	NC	13	14	NC	Not Connected
Not Connected	NC	15	16	NC	Not Connected
Not Connected	NC	17	18	NC	Not Connected
Not Connected	NC	19	20	NC	Not Connected
Ground	GND	21	22	GND	Ground
Ground	GND	23	24	GND	Ground
Ground	GND	25	26	KEY	

P2 Signal description

Signal Direction is described from the BlueBox perspective.

By default, all jumpers are set to connect your target power supply to the microcontroller residing on the Emulation Adapter. Only pins 1-2 and 3-4 must be bridged, but for the convenience and ease of use, all jumpers are set, except for pins 25-26.

Pin 26 is the polarizer key pin preventing incorrect connection of the IEA-PS Power converter, when being plugged in.

If a different power source is used (e.g., a Standalone operation), remove all jumpers and apply 3V3 or 5V to:

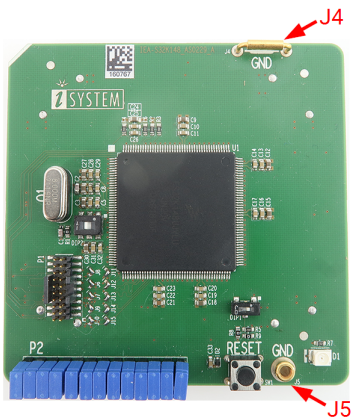
- VDD (pin 2),
- VREFH (pin 4),

Enclosed Power supply package (Power converter and Power adapter) simply plugs into the P2 header row, providing the necessary power supply for Emulation Adapter operation. LED1 indicates if power is supplied to the Emulation Adapter.

Refer to the microcontroller documentation for more details about power voltage designations.

J4 and J5: GND connection points

In case a good ground connection is required, connection points bridge J4 and pin J5 provide easy access to the Emulation Adapter's GND potential.



Connectors



Be aware that debug and trace signals from the Emulation adapter superset device are not connected to the target board. They are exposed only to the connectors on the Emulation adapter.

P1: CoreSight 20 connector

CoreSight 20 connector P1 exposes debug and trace signals and has the following pinout on the Emulation Adapter side:

Signal Direction	Signal Description	Signal	Pin	Pin	Signal	Signal Description	Signal Direction
I	Reference Voltage	Vref	1	2	SWDIO/TMS	SWD/JTAG	I/O / O
	Ground	GND	3	4	SWCLK/TCK	SWD/JTAG	O
	Ground	GND	5	6	SWO/TDO	SWD/JTAG	I
	Not Connected	KEY	7	8	NC/TDI	Not Connected / JTAG	O
	Ground	GND	9	10	nRESET	Reset	I/O
	Reference Voltage / Ground	NC_CAPGND	11	12	TRACECLK	Trace Clock	I
	Reference Voltage / Ground	NC_CAPGND	13	14	TRACEDATA[0]	Trace Data	I
	Ground	GND	15	16	TRACEDATA[1]	Trace Data	I
	Ground	GND	17	18	TRACEDATA[2]	Trace Data	I
	Ground	GND	19	20	TRACEDATA[3]	Trace Data	I

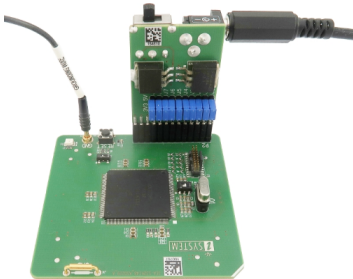
20-pin ARM CoreSight pinout

Signal Direction is described from the BlueBox perspective.

Connectors P3, P4, P5 and P6 on the bottom side of the Emulation Adapter expose all emulation device signals toward the Conversion board, through which the Emulation Adapter adapts to different pin count packages.

Standalone operation

NXP S32K148 Emulation Adapter is delivered with all components required for a Standalone operation.



Power supply

Use the enclosed IEA-PS Emulation Adapter Power converter and adapter.

A Power supply package, which is delivered with the Emulation Adapter, is required when:


- The Emulation Adapter is used as a **standalone device** .
- The target board doesn't provide an accurate supply voltage.
- The target board doesn't provide sufficient current for the Emulation Adapter operation.

The Power converter can supply either 3.3 V or 5 V. The array of jumpers J0–J9 selects 3.3 V or 5 V voltage on the P3 connector, which connects to the Emulation Adapter.

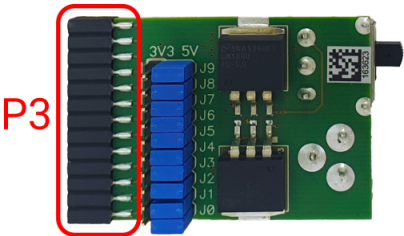
Signal	Pin	Pin	Signal
NC	1	2	J0
NC	3	4	J1
NC	5	6	J2
NC	7	8	J3
NC	9	10	J4
NC	11	12	J5
NC	13	14	J6
NC	15	16	J7
NC	17	18	J8
NC	19	20	J9
GND	21	22	GND
GND	23	24	GND
GND	25	26	KEY

P3 connector and J0–J9 jumper correlation table

For example, when J2 is in the 3V3 position, it supplies 3.3 V to pin 6 of the P3 connector. When J2 is in the 5V position, it supplies 5 V to pin 6 of the P3 connector.




Be careful not to supply 5 V to the microcontroller power supply pin, which has declared a maximum voltage 3.3 V! Refer to the microcontroller documentation for detailed information on power supply.



P3 connector on the Power Supply board

External power supply requirements:

Min Voltage	Max Voltage	Min Power	
8 V	12 V	5 W	

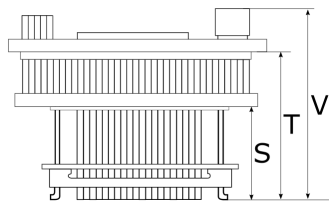
Clock source

If the target's crystal circuit microcontroller oscillator (if available) is not an adequate clock source, insert the appropriate crystal into the Q1 socket, replace the default 22pF C1 and C2 ca-

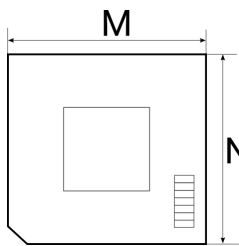
pacitors when necessary, and DIP switch DIP2 to position away from the white dot.

Mechanical information

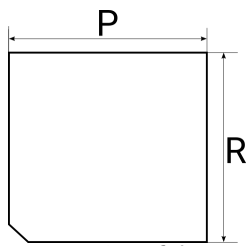
Emulation Adapter



Side view of the Emulation adapter
complete setup - QFP Fixed
Adaptation



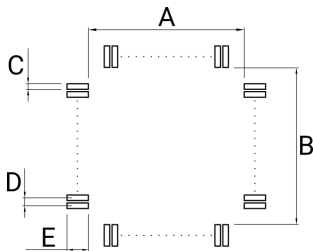
Top view of the
Emulation Adapter



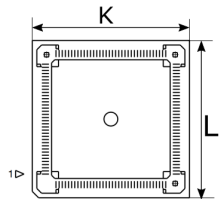
Top view of the
Conversion board

Ordering code	Unit (mm)						
	M	N	P	R	S	T	V
IEA-S32K148	70	70			32.6	36.4	47.5
IEA-S32K148-xxxxx			70	70			

Solder parts QFP



Solder part Solder pad view




Top view of the Solder
part


In the case of soldering the Solder part manually, it's highly recommended to prolong the solder pad E on the outer side (e.g., for 1.5–2 mm) during the PCB design. Note that without this modification, it's very difficult to solder the Solder part manually.

Recommended PCB footprint dimensions:


Ordering code	Unit (mm)						
	A	B	C	D	E	K	L
IA48TQ-SOLDER	12	1.505	13.0	13.0	2.3	14	14
IA64ATQ-SOLDER	14	1.505	15.0	15.0	2.3	16.0	16
IA100TQ-SOLDER	16.5	1.125	17.0	17.0	2.15	19.55	19.55
IA144TQ-SOLDER	22	1.125	23.0	23.0	2.15	25.05	25.05

 To view Emulation Adapter schematics, use the short link isystem.com/schematics.

Assembly

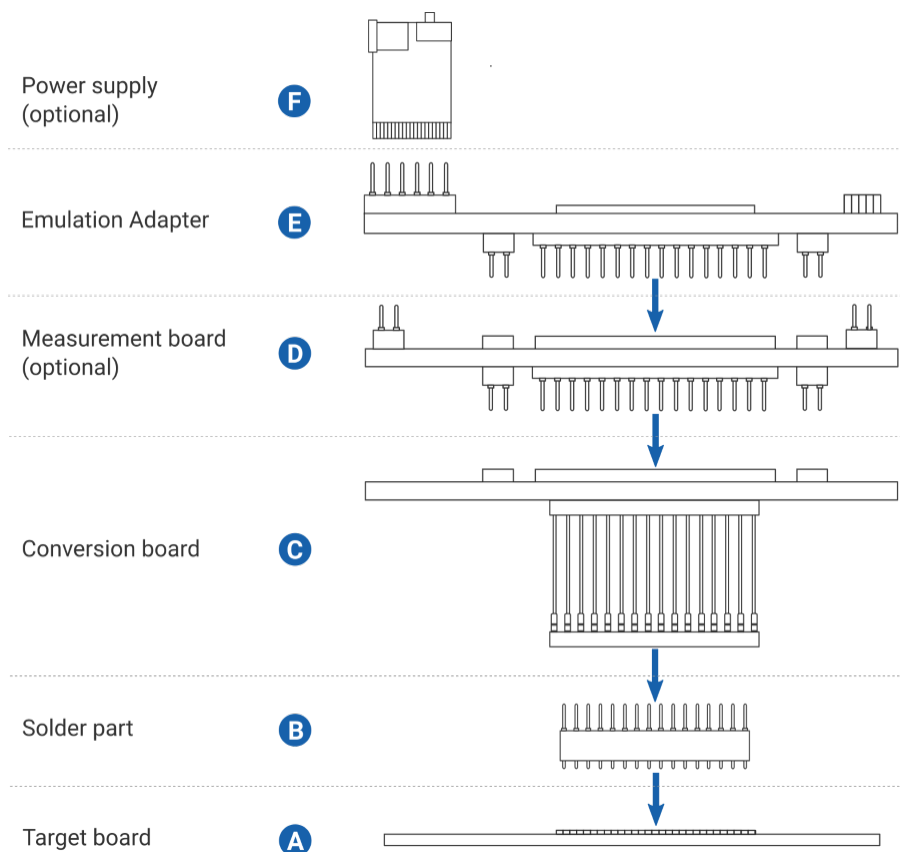
 Watch out that the pin 1 position and alignment of all pins. Avoid disassembling and reassembling the hardware setup too frequently.

1. Solder the Solder part [B] on the target PCB [A] to get a **BA setup**.

 Use the Surface Mount Technology (SMT) to solder the Solder parts to the target instead of the original microcontroller. We provide this soldering service on request.

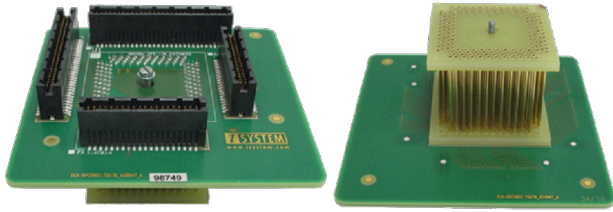
2. Assemble the in order: Emulation Adapter [E], optional Measurement board [D], the Conversion board [C], together to get an **E(D)C setup**.

3. Assemble the **E(D)C setup** with the **BA setup** by connecting the Conversion board of the **E(D)C setup** to the Solder part of the **BA setup**.



Slot screw

The Slot screw (30mm) is used to fix the Conversion board to the Solder part. The setup becomes mechanically more robust. Screw the Conversion board to the Solder part first, before the Emulation Adapter is attached on top and watch out not to break out the Solder part, e.g., if you accidentally hit the Emulation Adapter from the side.



Accessories

Ordering Code	Description
IC5700	iC5700 BlueBox
IC5000	iC5000 BlueBox
IC57031	IOM6 Hub (3 x FNet & FBridge)
IC57040	IOM6 CAN/LIN
IC57041	IOM6 ADIO

Debug Adapters

Listed Debug Adapters provide tracing functionality for the Emulation Adapter.

Ordering Code	Description
IC50118-2	20-pin 1.27 mm CoreSight Debug Adapter
IC50118-LV	20-pin 1.27 mm Low Voltage CoreSight Debug Adapter



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