Deterministic High-Speed Serial Bus Controller

SC4420 **|** Scout **|** MIPI Bus Master

Summary

The SC4420 is a third-generation device in the Scout family. It is designed to be fit, form and function compatible with the SC4415. Scout is the highest performing MIPI controller on the market. Unlike other USB-based serial bus dongles, Scout products are designed for high-speed test and control applications. Architected around an FPGA, the SC4420 ensures that all timing and control functions are deterministic. The device is targeted at verification benches and high-volume production test applications requiring reliable operation over millions of test sequences.

Scout – The standard in SPMI, RFFE and I3C Bus Masters

Description

The Scout SC4420 represents the next generation in the Scout product line. It incorporates enhanced features and has options to support MIPI-RFFE, MIPI-I3C, MIPI-SPMI, I2C, and SPI protocols in single master mode.

The test interface incorporates serial bus, GPIO and triggering functions. This interface connector provides flexibility, several interconnect-cabling options, and helps to minimize noise coupling. The interface voltage (V_{IO}) is software selectable. For non-standard interface voltages, Scout can be configured to accept an external voltage reference. Several triggered command buffers provide scripting capability for high speed test and verification applications. Triggering modes include internal (software command) and external input support.

Scout instantiates itself as a standard COM port via USB. The unit supports manual operation using a terminal emulator or fully automated control in ATE environments via any programming language support.

Common Applications

- Benchtop DVT (Designer Verification Testing)
- High Volume Production Test
- RF Design and Characterization

Serial Bus Modes and Features Supported

MIPI-RFFE, I3C, and SPMI features are by purchasing personality options. The SC4420 is field upgradeable, making it simple for customers to apply FW updates or to enable the personality options.

SPI (included w/ base model)

- Standard SPI Read and Write Functions
- SPI Modes 0, 1, 2, and 3 (CPOL and CPHA)
- Positive and Negative Slave Select Polarity
- Configurable Word Widths for Command (0 to 16 bits), Address (0 to 16 bits), Write Data (0, 8, 16, and 32 bits) and Read Data (0, 8, 16, and 32 bits)
- Configurable Clock Frequency (50 kHz to 26 MHz)
- Commands Supported:

    Set SPI Clock Rate
    Set SPI interface Full Configuration
    Set Slave Select Line
    Set Slave Select Line Polarity
    Set SPI Protocol Mode
    Set Command/Address Width
    Set Read/Write Data Width
    Set Wait Cycles Before Read
    SPI Read/Write

MIPI-RFFE V3.0 (Option 02)

- Selectable Clock Frequency (100 kHz to 60 MHz)
- Commands Supported:

    Set RFFE SCLK rate
    Set RFFE half speed data response
    Register Read/Write
    Extended Register Read/Write
    Extended Register Read/Write Long
    Register Zero Write
    Masked Register Write
    Bus Clocked Condition

MIPI-I3C V1.1 (Option 03)

- Two Wire Serial Interface up to 12.5 MHz using Push-Pull and Open Drain with Pull-up
- Adjustable Bus Pull-Up Control
- Selectable I3C clock frequency (12.5 MHz, 6.25 MHz & 3.125 MHz)
- Dynamic Addressing while supporting Static addressing for legacy I2C Devices
- Automatic Bus Initialization & Device Priority management
- Group Addressing
- Multilane support (in future release)
- I3C Single Data Rate Messaging (SDR)
- High Data Rate messaging 25 Mb/s (HDR-DDR)
- In-Band Interrupts
- Hot Join
- Legacy I2C messaging (with restrictions as defined by MIPI I3C specification)
- Grouped Addressing
- Commands Supported:

    Set I3C and I2C SCLK Rates
    Set Internal Pull-Up Resistor Value
    Enable or Disable Bus Error reporting
    Initialize I3C Bus Definition
    View Bus Definition
    Add/Remove Device on Bus Definition
    Update I3C Device Dynamic Address
    Enable/Disable Hot-Join Requests
    Enable/Disable In-Band Interrupts
    CCC Read/Write
    Legacy I2C Read/Write
    I3C Read/Write
    I3C HDR-DDR Read/Write
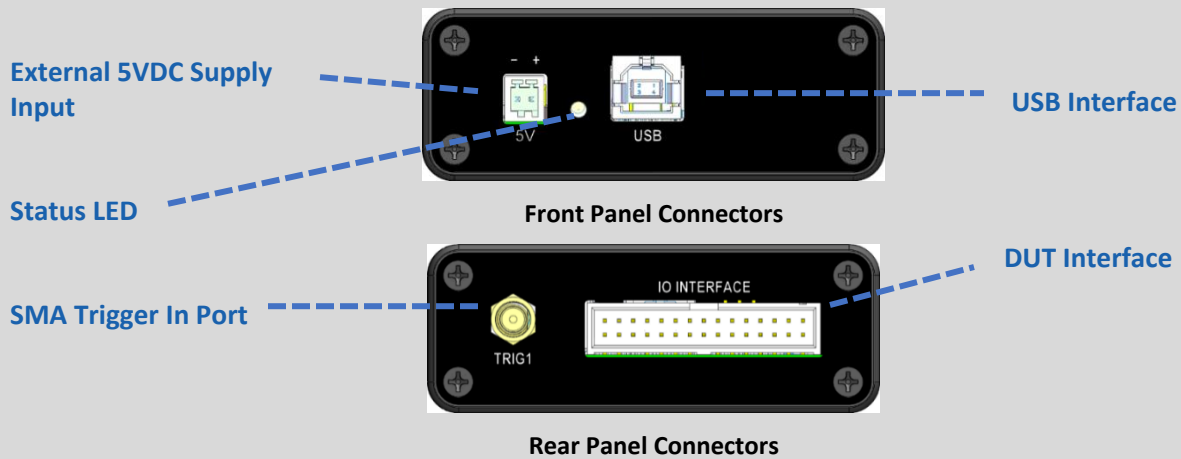
Legacy I2C (Option 03)

- Selectable I2C clock frequency (1 MHz, 400 kHz & 200 kHz)
- 7-Bit Slave Addressing
- Legacy I2C commands, as defined by the MIPI-I3C specification
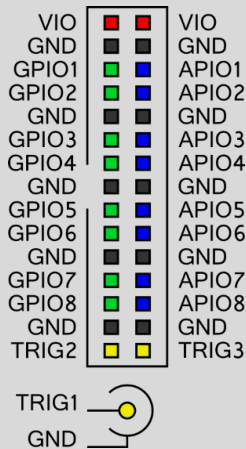
MIPI-SPMI V1.0 & V2.0 (Option 04)

- Selectable Clock Frequency (100 kHz to 32 MHz)
- Supports Request Capable Slaves (RCS)
- Commands Supported:

  Set RFFE SCLK rate
  Reset, Sleep, Shutdown, Wakeup
  Authenticate
  Device Description Block Master
  Read
  Device Descriptor Block Slave Read
  Register 0 Write
  Master Read/Write
  Register Read/Write
  Extended Register Read/Write
  Extended Register Read/Write Long

Interfaces

External 5VDC Supply Input

Status LED

USB Interface

Front Panel Connectors

SMA Trigger In Port

DUT Interface

Rear Panel Connectors

DUT Interface Pin-Out

VIO			VIO
GND			GND
GPIO1			APIO1
GPIO2			APIO2
GND			GND
GPIO3			APIO3
GPIO4			APIO4
GND			GND
GPIO5			APIO5
GPIO6			APIO6
GND			GND
GPIO7			APIO7
GPIO8			APIO8
GND			GND
TRIG2			TRIG3

TRIG1

GND

Type	Description
VIO	IO Voltage Reference. Can be internally generated or externally supplied to establish a common IO voltage between Scout and the connected devices.
APIO	Application Specific IO. These pins are dedicated for application specific purposes which are mode dependent and are not available for general purpose.
GPIO	General Purpose Input-Output. These pins are for general purpose use and are available in any application mode.
TRIG	Hardware Trigger. Used for triggering and synchronization.
GND	Signal ground reference.

Feature Overview

Serial Protocols Supported

- MIPI-RFFE (Version 3.0)
- MIPI-I3C (Version 1.1) with legacy I2C
- MIPI-SPMI (Version 1.0 and 2.0)
- SPI (Serial Peripheral Interface)
- Other protocols forthcoming

Sequencing and Timing

Scout was designed with determinism, low latency and fast execution in mind. Timing critical performance is achieved by using FPGA hardware and user configurable command cues. Users can define a command sequence and trigger multiple executions of the sequence using either software or hardware triggers.

GPIO

Eight General Purpose IO are available in all operating modes and each one can be configured as either an input or an output. The GPIO commands can be embedded in the command queue and executed alongside other serial protocol commands. GPIO timing is deterministic.

External Supply

The adaptor can be powered via USB, eliminating the need for an external power supply. For applications where the USB host may be current starved, an external 5Vdc power supply can be used to power the device.

Buffering and Trigger Modes

The SC4420 incorporates two instruction sequencers to accelerate high volume production test applications. These high capacity buffers can be recalled by activating one of several trigger modes. Both sequence buffers of 1024 instructions each can be filled and replayed in instruction sequencer style.

Specifications

USB Interface

- Type B Connector
- Supports USB 2.0 Full and High-Speed Modes
- Drivers verified on Windows 7, 10, Linux and iOS

Power Requirements

- USB: +5 Vdc, <500 mA peak
- External (optional): +5 Vdc, <500 mA peak

IO Interface

Note that breakout cables are no longer supplied with the SC4420 but are available for purchase separately.

- 2 x 15 pin, 100 mil pitch-connector
    - 8x GPIO
    - 8x Dedicated IO (serial lines)
    - 1x Trigger Input
    - 1x Trigger Output
    - VIO (External input or output)
    - 10x Ground
- SMA(F) Trigger Input
- Vio (Internally Generated):
    - +1.2, +1.8V, +2.5V and +3.3V
- Vio (Optional External Reference):
    - +0.8V min, +3.6V max
- Outputs:
    - Low 0 V to +0.8 V
    - High 0.7 Vio to Vio
    - +/- 12 mA max (@ 3.6 V)
- Inputs:
    - Low 0 V to +0.8 V
    - High 0.7 Vio to Vio
- Maximum Input Voltage (no damage):
    - -0.5 V min
    - +3.6 V max

Buffers

- Write Queues: 2 of 1024 commands each
- Data Queue: 1 of 4096 bytes

Triggers

- SW Trigger via command interface
- HW Trigger via external equipment sources
    - 1 Output via SMA
    - 1 Input via DUT Interface
    - 1 Output via DUT Interface

Environmental/Regulatory

- Operating temperature: 0 to 70°C
- Storage temperature: -40 to +85°C
- Humidity: 5% to 85%, non-condensing
- ESD Protection:
  o HBM JESD22-A114E Class 3B exceeds 8 kV

  o MM JESD22-A115-A

  o Exceeds 200 VCDM JESD22-C101C 1 kV

Optional Features

Option 02 – MIPI-RFFE (Version 3.0)

Option 03 – MIPI-I3C (Version 1.1) / Legacy I2C

Option 04 – MIPI-SPMI (Versions 1.0 and 2.0)

Option 21 – Extended warranty

Extends the standard hardware warranty and software maintenance from 12 to 24 months.

Option 53 – Breakout Cable

Note that unlike with the SC4415, the breakout cable is not supplied with the SC4420 product but sold as an optional feature.

Support

Documentation, drivers and other support material is available through our website, www.signalcraft.com/support or by contacting support@signalcraft.com.

Warranty

Full one-year parts and labor when used under normal installation and operation conditions. Repair services are available for products no longer covered under warranty.

Ordering Information

Send inquiries to info@signalcraft.com.