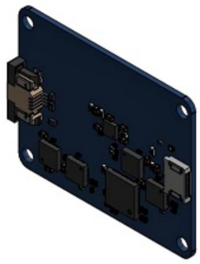
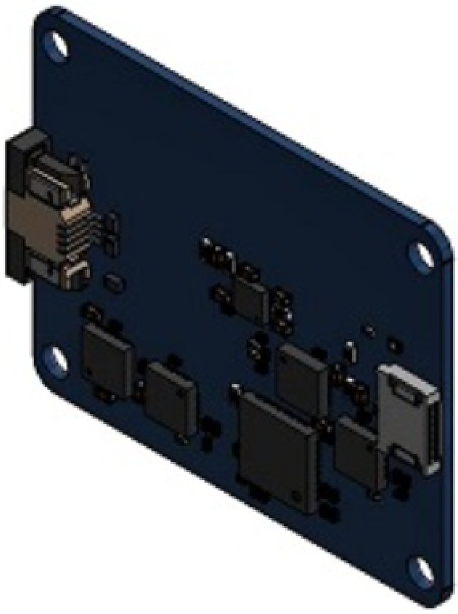


FUTEK QIA123 UART Digital Low Power Controller Installation Guide

Contents

FUTEK
ADVANCED SENSOR TECHNOLOGY, INC.

FUTEK QIA123 UART Digital Low Power Controller



Product Information

General Description

The QIA123 is a low power digital controller with UART, SPI and analog outputs. It offers power management capability, allowing the master device to control the power consumption of the system by enabling and disabling the sampling system if required by the application.

PIN Configurations and Function Descriptions

Pin	Description
1	GND
2	TRIG
3	GND
4	CS
5	SCLK
6	MOSI
7	MISO
8	TX
9	RX
10-13	GND

QIA123 UART Configuration

Data Operation	Baud Rate	Parity	Stop bits	Flow Control
8-Bit	1,000,000bps	None	1-Bit	None

Stream Mode

The Set System Stream State (SSSS) [with payload of 1] command can be sent to activate the stream mode. The device will stop streaming as soon as the Set System Stream State command [with payload of 0], or any other command is sent to QIA123.

UART Packet Structure
The packet structure and length for every command may vary due to their type (GET and SET) and functionalities; refer to the Command Set Table for further information.

System Behavior
Start-up and Self-Calibration Mode: When the system powers ON, it starts reading the data from EEPROM and goes to the internal calibration mode. The LED indicator starts blinking until it receives the first sample from the ADC.

Sleep-Mode: When power is applied to the system, it enters Sleep-Mode and stays high until the Set System Power Save State (SSPSS) is sent with a payload of 1.

Product Usage Instructions

Sampling Rate Change
When a sampling rate change is requested, it will take no more than 1 second (depending on the selected sampling rate) to see the change in the period.

Sampling Rates
The following table shows the available sampling rates:

Sampling Rate	Period
10 SPS	912
60 SPS	130
100 SPS	26
1000 SPS	?
4800 SPS	?
9600 SPS	?

General Description

The QIA123 is a low power digital controller with UART, SPI and analog outputs. The QIA123 offers power management capability which allows the master device to control the power consumption of the system by enabling and disabling the sampling system if required by the application.

PIN Configurations and Function Descriptions

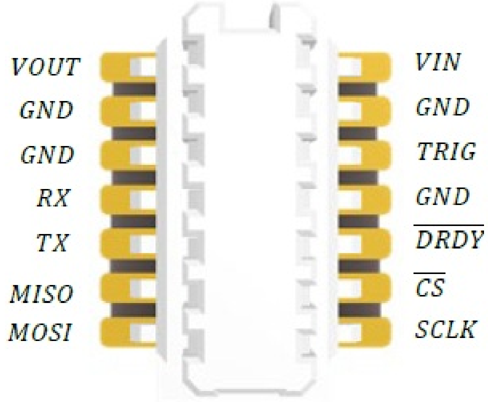


Figure 1.

#	Pin	Description
1	??????	Voltage Input *5V±4%*
2	***GND***	Ground pins are connected to each other internally
3	***TRIG***	Trigger is an input pin (slave) and output pin (master) dedicated for special applications such as programing for future development
4	***GND***	Ground pins are connected to each other internally
5	????????	Active low ???????? pin is used to keep all communication synchronized. It notifies the master device when new data from the sampling system is ready to ensure that the master is always collecting the latest data. When the ????????pin goes low, it indicates that the data is ready. This pin can be used to externally interrupt the master. The pin returns high when the system is in a conversion state and returns low once new data is ready. The pin does not return high once data is read—it will only return high once the system enters a conversion state.

6	???	Active low Chip Select. Do not drive the ???? line low until the device has booted up completely. The *LED* turns off once the board has booted and is ready to communicate. This process takes *3 seconds*. Also ensure that the ???? line is not driven low unless the ???????? is also low.
7	***SCLK***	Serial Clock generated by master
8	***MOSI***	Master-Out-Slave-In
9	***MISO***	Master-In-Slave-Out
10	***TX***	UART Transmit of QIA123
11	***RX***	UART Receive of QIA123
12	***GND***	Ground pins are connected to each other internally
13	***GND***	Ground pins are connected to each other internally
14	***VOUT***	Analog voltage output calibrated between *0.2V – 2.8V*

QIA123 UART Configuration

Table 2.

Data	8-Bit
Operation Baud Rate:	*1,000,000bps*
Parity	*None*
Stop bits	*1-Bit*
Flow Control:	*None*

DRDY Pin Functionality

When the DRDY pin goes high, it means the device is in the process of A/D conversion. DRDYgoes low as soon as the conversion is complete.

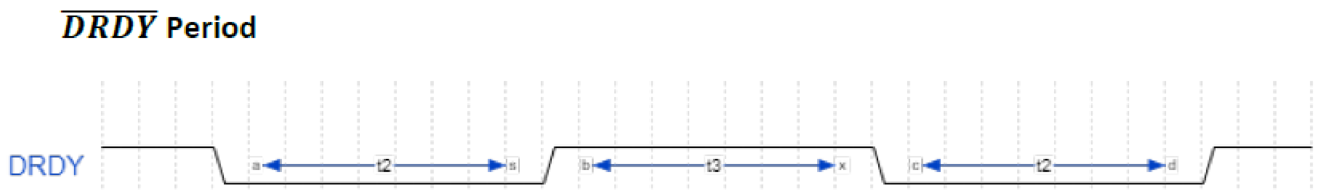


Figure 2.

The following table shows the period of the pin for all sampling rates.

??$_{??}$ (µ??)	??$_{??}$ (µ??)	??$_{??}$ (µ??)	**Description**
*0 to …**	99600	*80*	10 SPS
	16600		60 SPS
	9926		100 SPS
	912		1000 SPS
	130		4800 SPS
	26		9600 SPS

“Stream” Mode
The Set System Stream State (SSSS) [with payload of 1] command may be sent to activate the stream mode. The device will stop streaming as soon as the Set System Stream State command [with payload of 0], or any other command is sent to QIA123.
***Note:** There may be no response from the QIA123 if an incorrect command is sent.

UART Packet Structure
The packet structure and length for every command may vary due to their type (GET and SET) and functionalities; refer to the Command Set Table for further information.

System Behavior
Start-up and Self-Calibration Mode
When the system powers ON, it starts reading the data from EEPROM and goes to the internal calibration mode. The LED indicator starts blinking until it receives the first sample from the ADC.
***Note:** The White LED turns off once the board has booted and is ready to communicate. This process takes ~3 seconds.

***Note:** When power is applied to the system, it enters Sleep-Mode and stays high until the Set System Power Save State (SSPSS) is sent with a payload of 1.

Sampling Rate Change
When a sampling rate change is requested it will take no more than 1 second (depending on the selected sampling rate) to
see the change in the period.

Sampling Rates

SPS Code (Payload)	**Sampling Rate**
0x04	10 SPS
0x05	60 SPS
0x06	100 SPS
0x07	1000 SPS
0x08	4800 SPS
0x09	9600 SPS

Shunt Switch Feature

GDCSSW (Get Device Channel Shunt Switch)
GDCSSW command returns the current state of the shunt switch.

Shunt Switch (Payload)	**State**
0x00	*OFF*
0x01	*ON*

SDCSSW (Set Device Channel Shunt Switch)
SDCSSW command enables or disables the shunt switch.

Power Management
SSPSS command has been implemented to turn OFF/ON the sampling system to manage power consumption.

SSPSS [Payload 1] (Disable Sampling; Sleep-Mode)
SSPSS command with a payload of 1 makes the system go to Sleep-Mode. The device shuts down the sampling system after replying to the master device.
***Note:** When the system is in the Sleep-Mode, stays high and the current draw (instrument only) drops down to ~12mA.

SSPSS [Payload 0] (Enable Sampling; Wake-Mode)
SSPSS command with a payload of 0 puts the system in Wake-Mode. The sampling system is enabled after replying the master device.

* **Note:** The SSPSS command with a payload of 0 must be sent to enable the sampling system. Do not use any other command to wake up the system other than SSPSS. The current draw in this state (instrument only) is ~19mA.

* **Note:** In order to receive a response from the QIA123 the SSPSS with a payload of 0 needs to be sent twice in a row.

Command-Set List

Table 6.

Type	**Name**	**Description**	**TX Packet Structure**	**RX Packet Structure**	**Bytes in Payload**
Get	*GSAI*	Get slave activity inquiry (used to test communication)	00 05 00 01 0E	00 05 00 01 0E	*N/A*
**Get*	*GCCR*	Get channel current reading	00 06 00 05 00 20	[See Payload Example]	*4*
Set	*SSSS*	Set system stream state OFF	00 06 00 0C 00 3C	00 05 00 0C 3A	*N/A*
**Set*	*SSSS*	Set system stream state ON	00 06 00 0C 01 41	00 05 00 0C 3A … [Stream Bytes]	*N/A … [4]*

Set	*SSPS S*	Set system power save state sleep	00 06 00 0D 01 45	00 05 00 0D 3E	*N/A*
***Se t*	*SSPS S*	Set system power save state wake	00 06 00 0D 00 40	00 05 00 0D 3E	*N/A*
**Get*	*GDSN*	Get device serial number	00 05 01 00 0D	See Payload Example	*4*
**Get*	*GDM N*	Get device model number	00 05 01 01 11	See Payload Example	*10*
**Get*	*GDHV*	Get device hardware version	00 05 01 03 19	See Payload Example	*1*
**Get*	*GDFV*	Get device firmware version	00 05 01 04 1D	See Payload Example	*2*
**Get*	*GDFD*	Get device firmware date	00 05 01 05 21	See Payload Example	*3*
**Get*	*GDCS W*	Get device channel shunt swit ch	00 06 01 0B 00 3B	See Payload Example	*1*
Set	*SDCS W*	Set device channel shunt swit ch OFF	00 07 02 0B 00 00 40	00 05 02 0B 3C	*N/A*
Set	*SDCS W*	Set device channel shunt swit ch ON	00 07 02 0B 00 01 46	00 05 02 0B 3C	*N/A*
**Get*	*GPSS N*	Get profile sensor serial numb er	00 06 03 00 00 15	See Payload Example	*4*
**Get*	*GPSP R*	Get profile sampling rate	00 06 03 1E 00 8 D	See Payload Example	*1*
Set	*SPSP R*	Set profile sampling rate 10S PS	00 07 04 1E 00 04 AA	00 05 04 1E 8E	*N/A*
Set	*SPSP R*	Set profile sampling rate 60S PS	00 07 04 1E 00 05 B0	00 05 04 1E 8E	*N/A*
Set	*SPSP R*	Set profile sampling rate 100SPS	00 07 04 1E 00 06 B6	00 05 04 1E 8E	*N/A*
Set	*SPSP R*	Set profile sampling rate 1000 SPS	00 07 04 1E 00 07 BC	00 05 04 1E 8E	*N/A*
Set	*SPSP R*	Set profile sampling rate 4800 SPS	00 07 04 1E 00 08 C2	00 05 04 1E 8E	*N/A*

Set	*SPSPR*	Set profile sampling rate 9600 SPS	00 07 04 1E 00 09 C8	00 05 04 1E 8E	*N/A*
**Get*	*GPADP*	Get profile analog-to-digital calibration value 0 (Direction 1)	00 07 03 19 00 00 7B	***See Payload Example***	*4*
**Get*	*GPADP*	Get profile analog-to-digital calibration value 1 (Direction 1)	00 07 03 19 00 01 81	***See Payload Example***	*4*

**Get*	*GPADP*	Get profile analog-to-digital calibration value 2 (Direction 1)	00 07 03 19 00 02 87	[***See Payload Example***]	*4*
**Get*	*GPADP*	Get profile analog-to-digital calibration value 3 (Direction 1)	00 07 03 19 00 03 8D	[***See Payload Example***]	*4*
**Get*	*GPADP*	Get profile analog-to-digital calibration value 4 (Direction 1)	00 07 03 19 00 04 93	[***See Payload Example***]	*4*
**Get*	*GPADP*	Get profile analog-to-digital calibration value 5 (Direction 1)	00 07 03 19 00 05 99	[***See Payload Example***]	*4*
**Get*	*GPADP*	Get profile analog-to-digital calibration value 6 (Direction 2)	00 07 03 19 00 06 9F	[***See Payload Example***]	*4*
**Get*	*GPADP*	Get profile analog-to-digital calibration value 7 (Direction 2)	00 07 03 19 00 07 A5	[***See Payload Example***]	*4*
**Get*	*GPADP*	Get profile analog-to-digital calibration value 8 (Direction 2)	00 07 03 19 00 08 AB	[***See Payload Example***]	*4*
**Get*	*GPADP*	Get profile analog-to-digital calibration value 9 (Direction 2)	00 07 03 19 00 09 B1	[***See Payload Example***]	*4*
**Get*	*GPADP*	Get profile analog-to-digital calibration value 10 (Direction 2)	00 07 03 19 00 0A B7	[***See Payload Example***]	*4*
**Get*	*GPADP*	Get profile analog-to-digital calibration value 11 (Direction 2)	00 07 03 19 00 0B BD	[***See Payload Example***]	*4*

Note: The Payload bytes are located directly before the last byte of the packet which is the Checksum.
Note: In order to receive a response from the QIA123 the SSPSS with a payload of 0 needs to be sent twice in a row.

Payload Example

The following transaction is the response to the GDSN command (Get device serial number). This command has a payload of 4 bytes.

TX: 00 05 01 00 0D
RX: 00 09 01 00 00 01 E2 40 49
Hex to decimal: 0x0001E240 -> 123456
ADC Data Conversion
The following formula could be used to convert the raw ADC data:

$$CalculatedReading = \frac{[ADCValue - OffsetValue]}{[FullScaleValue - OffsetValue]} \times FullScaleLoad$$

Here are the variables:
ADValue = the most recent analog-to-digital conversion value.
Offsetvalue = the analog-to-digital conversion value stored during calibration that corresponds to the offset (zero physical load. FullScaleValue = the analog-to-digital conversion value stored during calibration that corresponds to the full scale (maximum physical load.
FullScaleLoad = the numeric value stored during calibration for the maximum physical load.

ADC Data Conversion Examples (Direction 1, 2-point Calibration)
Calibration Data
Get profile analog-to-digital calibration value 0 (Direction 1) [GPADP]:
Hex to decimal: 0x81B320 -> 8,500,000
Get profile analog-to-digital calibration value 5 (Direction 1) [GPADP]:
Hex to decimal: 0xB71B00 -> 12,000,000
Get channel current reading (GCCR):
Hex to decimal: 0x989680 -> 000

Calculation
OffsetValue = 8,500,000
FullScaleValue = 12,000,000
FullScaleLoad = 20g (Available on the calibration certificate)

$$CalculatedReading = \frac{[10000000 - 8500000]}{[12000000 - 8500000]} \times 20g = 8.5714g$$

Firmware Revision
Revision 1.6
Firmware Notes

New Features

- N/A

  Changes
- N/A

  Fixes
- N/A

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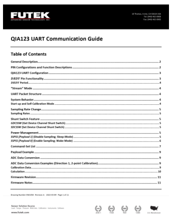
Documents / Resources

	FUTEK QIA123 UART Digital Low Power Controller [pdf] Installation Guide QIA123 UART Digital Low Power Controller, QIA123, UART Digital Low Power Controller, Digital Low Power Controller, Low Power Controller, Power Controller, Controller