



QIA128/IDC150/IEM100

UART Communication Guide

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Drawing Number: EM1066-G

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QIA128/IDC150/IEM100 UART Communication Guide

General Description

The QIA128/IDC150/IEM100 is a single-channel, ultra-low-power digital controller featuring UART and SPI interfaces.

Pin Configurations and Function Descriptions

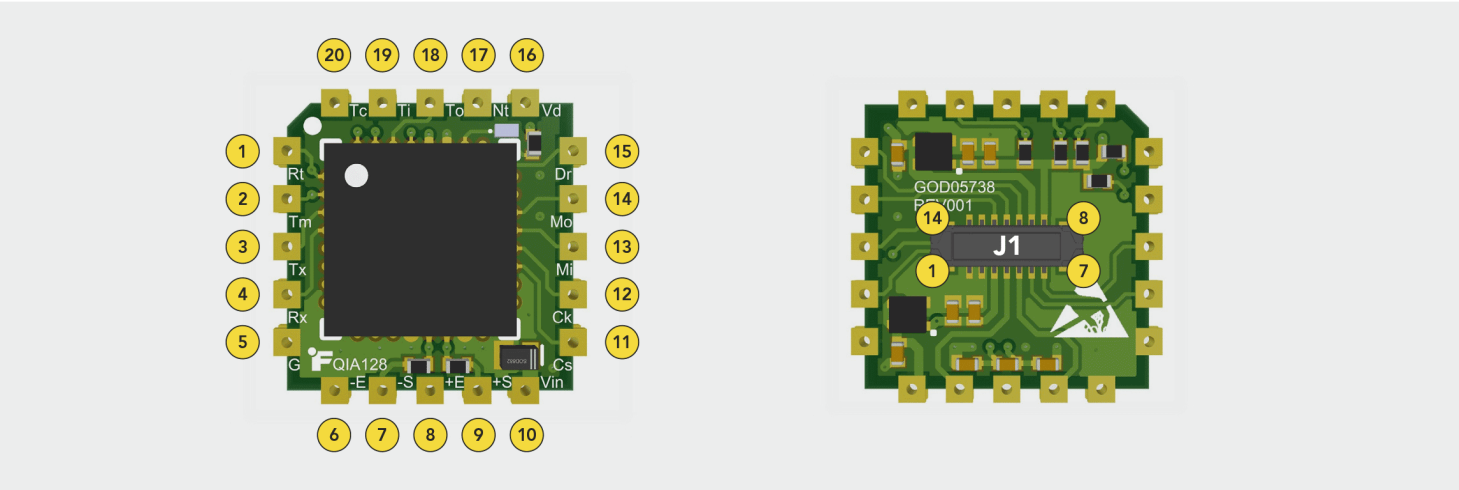


Figure 1.

TABLE 1			
#	PIN	DESCRIPTION	J1#
1	RESET	Active low reset input.	-
2	TMS	JTAG Test Mode Select input for debug and firmware download.	-
3	RX	UART receive data input.	7
4	TX	UART transmit data output.	6
5	GND	Ground. All ground pins are internally connected.	1
6	-Excitation	Sensor excitation return, internally connected to GND.	2
7	-Signal	Sensor negative input.	5
8	+Excitation	Sensor excitation output.	3
9	+Signal	Sensor positive input.	4
10	VIN	Supply input, 3 to 5 VDC.	9
11	CS	Active low chip select input. Do not assert CS low until the device has completed boot. Do not assert CS low unless DRDY is low.	14
12	SCLK	SPI serial clock input from host.	13
13	HICO	SPI Host In Client Out data line.	12

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TABLE 1			
#	PIN	DESCRIPTION	J1#
14	HOCI	SPI Host Out Client In data line.	11
15	$\overline{DRDY}$	Active low data ready output. Indicates new sampled data is available and keeps host communication synchronized. $\overline{DRDY}$ goes low when data is ready to be clocked out and may be used as a host interrupt. $\overline{DRDY}$ is high during conversion and returns low when new data is available. Note: $\overline{DRDY}$ does not return high after data is read. It returns high only when the system enters a conversion state.	10
16	VDD	Digital supply rail, 2.5 V.	-
17	NTRST	JTAG NTRST and boot mode control input for debug and firmware download only.	-
18	TDO	JTAG Test Data Out.	-
19	TDI	JTAG Test Data In.	-
20	TCK	JTAG test clock input for debug and firmware download.	-

QIA128/IDC150/IEM100 UART Configuration

TABLE 2	
Data Length	8-Bit
Baud Rate	320,000bps
Parity	None
Stop bits	1-Bit
Flow Control	None

$\overline{DRDY}$ Pin Functionality

When the $\overline{DRDY}$ pin is high, the device is performing data conversion and post-processing. $\overline{DRDY}$ transitions low immediately once the conversion and associated post-processing are complete. **Note:** UART is inherently asynchronous. The $\overline{DRDY}$ signal can be used at the system level to synchronize data transfer and timing between the host and the device, when required.

$\overline{DRDY}$ Period:



Figure 4.

The following table shows the high and low timing periods of the $\overline{DRDY}$ signal for all supported sampling rates.

TABLE 3		
t ₂ (ms)	t ₃ (μs)	DESCRIPTION
240	125	4 SPS
55		20 SPS
19		50 SPS
9		100 SPS
4.5		200 SPS
1.5		500 SPS
1.1		850 SPS
0.6		1300 SPS

Stream Mode

Stream Mode is enabled by sending the Set System Stream State (SSSS) command with a payload value of 1. Once activated, the device continuously streams data until streaming is disabled.

Streaming stops immediately when the Set System Stream State command is sent with a payload value of 0, or when any other valid command is issued to the QIA128/IDC150/IEM100.

Note: If an invalid or unsupported command is transmitted, the QIA128/IDC150/IEM100 may not generate a response.

UART Packet Structure

The UART packet format and length vary depending on the command type (GET or SET) and its specific functionality. Refer to the [Command Set Table](#) for detailed packet definitions and requirements.

System Behavior

Start-up and Self-Calibration Mode

At power-up, the device reads configuration data from internal flash memory and then enters internal self-calibration. **Note:** The first $\overline{DRDY}$ pulse can be used as an indication that the device has completed initialization and is ready for system-level communication.

Sampling Rate Change

When a sampling rate change is requested, the updated $\overline{DRDY}$ period will be reflected within 0.5 seconds, depending on the selected sampling rate.



Sampling Rates

TABLE 4		
Maximum Approximate data rate change timing (ms)	SR Code	Sampling Rate
≅250	0x00	4 SPS
	0x01	20 SPS
	0x02	50 SPS
	0x03	100 SPS
	0x04	200 SPS
	0x05	500 SPS
	0x06	850 SPS
	0x07	1300 SPS



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Command-Set List

TABLE 6				
TYPE	NAME	DESCRIPTION	TX PACKET STRUCTURE	RX PACKET STRUCTURE
Get	GSAI	Get client activity inquiry (Used to test communication)	00 05 00 01 0E	00 05 00 01 0E
*Get	GCCR	Get channel current reading	00 06 00 05 00 20	See Payload Example
Set	SSSS	Set system stream state OFF	00 06 00 0C 00 3C	00 05 00 0C 3A
*Set	SSSS	Set system stream state ON	00 06 00 0C 01 41	00 05 00 0C 3A ... [Stream Bytes]
*Get	GDSN	Get device serial number	00 05 01 00 0D	See Payload Example
*Get	GDMN	Get device model number	00 05 01 01 11	See Payload Example
*Get	GDIN	Get device item number	00 05 01 02 15	See Payload Example
*Get	GDHV	Get device hardware version	00 05 01 03 19	See Payload Example
*Get	GDFV	Get device firmware version	00 05 01 04 1D	See Payload Example
*Get	GDFD	Get device firmware date	00 05 01 05 21	See Payload Example
*Get	GPSSN	Get profile sensor serial number	00 06 03 00 00 15	See Payload Example
*Get	GPSPR	Get profile sampling rate	00 06 03 1E 00 8D	See Payload Example
Set	SPSPR	Set profile sampling rate 4SPS	00 07 04 1E 00 00 92	00 05 04 1E 8E
Set	SPSPR	Set profile sampling rate 20SPS	00 07 04 1E 00 01 98	00 05 04 1E 8E
Set	SPSPR	Set profile sampling rate 50SPS	00 07 04 1E 00 02 9E	00 05 04 1E 8E
Set	SPSPR	Set profile sampling rate 100SPS	00 07 04 1E 00 03 A4	00 05 04 1E 8E
Set	SPSPR	Set profile sampling rate 200SPS	00 07 04 1E 00 04 AA	00 05 04 1E 8E
Set	SPSPR	Set profile sampling rate 500SPS	00 07 04 1E 00 05 B0	00 05 04 1E 8E
Set	SPSPR	Set profile sampling rate 850SPS	00 07 04 1E 00 06 B6	00 05 04 1E 8E
Set	SPSPR	Set profile sampling rate 1300SPS	00 07 04 1E 00 07 BC	00 05 04 1E 8E
*Get	GPLP	Get profile loading point value 0	00 07 03 18 00 00 77	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 1	00 07 03 18 00 01 7D	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 2	00 07 03 18 00 02 83	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 3	00 07 03 18 00 03 89	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 4	00 07 03 18 00 04 8F	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 5	00 07 03 18 00 05 95	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 6	00 07 03 18 00 06 9B	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 7	00 07 03 18 00 07 A1	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 8	00 07 03 18 00 08 A7	See Calibration Point Payload Example

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TABLE 6				
TYPE	NAME	DESCRIPTION	TX PACKET STRUCTURE	RX PACKET STRUCTURE
*Get	GPLP	Get profile loading point value 9	00 07 03 18 00 09 AD	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 10	00 07 03 18 00 0A B3	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 11	00 07 03 18 00 0B B9	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 12	00 07 03 18 00 0C BF	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 13	00 07 03 18 00 0D C5	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 14	00 07 03 18 00 0E CB	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 15	00 07 03 18 00 0F D1	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 16	00 07 03 18 00 10 D7	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 17	00 07 03 18 00 11 DD	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 18	00 07 03 18 00 12 E3	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 19	00 07 03 18 00 13 E9	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 20	00 07 03 18 00 14 EF	See Calibration Point Payload Example
*Get	GPLP	Get profile loading point value 21	00 07 03 18 00 15 F5	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 0	00 07 03 19 00 00 7B	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 1	00 07 03 19 00 01 81	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 2	00 07 03 19 00 02 87	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 3	00 07 03 19 00 03 8D	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 4	00 07 03 19 00 04 93	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 5	00 07 03 19 00 05 99	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 6	00 07 03 19 00 06 9F	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 7	00 07 03 19 00 07 A5	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 8	00 07 03 19 00 08 AB	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 9	00 07 03 19 00 09 B1	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 10	00 07 03 19 00 0A B7	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 11	00 07 03 19 00 0B BD	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 12	00 07 03 19 00 0C C3	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 13	00 07 03 19 00 0D C9	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 14	00 07 03 19 00 0E CF	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 15	00 07 03 19 00 0F D5	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 16	00 07 03 19 00 10 DB	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 17	00 07 03 19 00 11 E1	See Calibration Point Payload Example
*Get	GPADP	Get profile analog-to-digital calibration value 18	00 07 03 19 00 12 E7	See Calibration Point Payload Example

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TABLE 6					
TYPE	NAME	DESCRIPTION	TX PACKET STRUCTURE	RX PACKET STRUCTURE	
*Get	GPADP	Get profile analog-to-digital calibration value 19	00 07 03 19 00 13 ED	See Calibration Point Payload Example	
*Get	GPADP	Get profile analog-to-digital calibration value 20	00 07 03 19 00 14 F3	See Calibration Point Payload Example	
*Get	GPADP	Get profile analog-to-digital calibration value 21	00 07 03 19 00 15 F9	See Calibration Point Payload Example	
*Get	GBTR	Get board temperature reading	00 05 00 07 26	See Payload Example	

* **Note:** The Payload bytes are located directly before the last byte of the packet which is the Checksum.

Payload Example

The following transaction shows the response to the GDSN command (Get Device Serial Number). This command returns a 4-byte payload containing the device serial number.

TX: 00 05 01 00 0D

RX: 00 09 01 00 00 01 E2 40 49

Hex to decimal: 0x0001E240 → 123456

Calibration Point Payload Example

The received packet payload follows the format defined in the [Payload Example](#) section above. Up to 11 calibration points are supported per direction. Point indexing is defined as follows:

- Point 0 is the positive direction offset.
- If the number of calibration points per direction is P
 - o then the positive full-scale point is Point N, where $N = P - 1$.
 - o The negative direction offset is Point $N + 1$.
 - o The negative full-scale point is Point M, where $M = (2 \times P) - 1$.

Example for a 2-point calibration:

- Point 0 = positive offset
- Point 1 = positive full-scale
- Point 2 = negative offset
- Point 3 = negative full-scale
- For this example, $P = 2$, therefore $N = 1$ and $M = 3$.

Example for a 5-point calibration:

- Point 0 = positive offset
- Point 4 = positive full-scale

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- Point 5 = negative offset
- Point 9 = negative full-scale
- For this example, P = 5, therefore N = 4 and M = 9.

Each loading point value is stored as a 32-bit unsigned integer (4 bytes). The 4 bytes must be reassembled and interpreted as an IEEE 754 single-precision floating-point value. Refer to the example code in the [FUTEK public GitHub repository](#).

ADC Data Conversion

The following formula could be used to convert the raw ADC data:

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

Here are the variables:

- **ADCValue** = 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 Example (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 1 (Direction 1) [GPADP]:

Hex to decimal: 0xB71B00 → 12,000,000

Get channel current reading (GCCR):

Hex to decimal: 0x989680 → 10,000,000

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Calculation

$$\text{OffsetValue} = 8,500,000$$

$$\text{FullScaleValue} = 12,000,000$$

$$\text{FullScaleLoad} = 20g \text{ (Accessible via the calibration certificate or directly from onboard flash memory)}$$

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

Temperature Conversion

$$\text{Output (mV)} = 1200 - \left[\frac{16777215 - \text{ADCValue}}{6990.506666666667} \right]$$

$$\text{Temperature (}^{\circ}\text{C)} = -40 + \left[\frac{\text{Output} - 80}{0.28} \right]$$

Temperature Conversion Example

ADCValue: Get Board Temperature (GBT): 9095859 (0x8ACAB3)

$$1200 - \left[\frac{16777215 - 9095859}{6990.506666666667} \right] = 101.1733 \text{ (mV)}$$

$$-40 + \left[\frac{101.1733 - 80}{0.28} \right] = 35.6 \text{ (}^{\circ}\text{C)}$$

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Checksum Calculation

Last byte <CHS> carries information from the first three bytes

<HSB> <MSB> <LSB> <ChS>

Let's assume:

HSB = 0x0A

MSB = 0x0B

LSB = 0x0C

Then <ChS> byte could be calculated as:

$ChS = (0x0A * 1) + (0x0B * 2) + (0x0C * 3) = 0x44$

The received packet will then be:

<0x0A> <0x0B> <0x0C> <0x44>

If the <ChS> calculation exceeds a byte then the <LSB> byte is the only valid byte, for example:

0x2FD which includes two bytes, then the <ChS> will be calculated as 0xFD

Checksum Conversion Example

The subsequent illustration demonstrates the checksum calculation method for the **SPSPR (Set Profile Sampling Rate 4SPS)** command, applicable to both **RX** and **TX** buffers. Similar logic may be applied for computing the checksum of other commands.

TX: 00 07 04 1E 00 00 92

RX: 00 05 04 1E 8E

Checksum calculation for TX buffer:

$(0*1) + (07*2) + (04*3) + (30*4) + (0*5) + (0*6) = 146$ (0x92)

Checksum calculation for RX buffer:

$(0*1) + (05*2) + (04*3) + (30*4) = 142$ (0x8E)

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Firmware Revision

QIA128	
Revision	7.0.0
Release Date	09/19/2023
Hardware Compatibility	REV002
Notes	New Features - Added support for hardware revision HW002 Changes - N/A Fixes - N/A

IDC150/IEM100	
Revision	1.0.0
Release Date	04/10/2026
Hardware Compatibility	REV003
Notes	New Features - N/A Changes - The model number has been changed from IDC150 to IEM100. The firmware and hardware item numbers remain unchanged Fixes - N/A

