QAmC QPack Communications Protocol – Rev 2
For Hardware R3.x and Firmware QPACK07

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Serial protocol is implemented on ATmega328PB in Arduino code (Pololu AStar 328PB, FT230X, etc)
57600 baud (max for 8MHz crystal), 8 bit, no parity, 1 stop bit

Power consumption (approximate)

Normal: 11mA
Barcode scanner and temperature sensors enabled: add 40mA (mostly barcode scanner)
Barcode scanner reading: add 56mA
Laser pointer active: add 13mA
Sleep: 0mA (OTG powered off, no secondary battery)

Note – The USB OTG standard apparently isn't clear, but available power is specified as 8mA minimum and possibly 100mA maximum. During barcode scanning the prototype currently just exceeds 100mA, but that it isn't necessarily a hard limit and will depend on specific phone implementation. See https://www.eetimes.com/document.asp?doc_id=1226476

Inactivity timer

There is an inactivity timer (default 5 minutes, adjustable through configuration setting) which turns off the OTG power.
Activity is defined as any input changing state (trigger, etc) or any command (valid or invalid) being received.

Configuration Settings

1. Serial Number   e.g. 123
2. Hardware Revision   e.g. 33 (for R3.3)
3. Inactivity Timer   seconds, e.g. 300 (for 5 minutes), 0 or negative for disabled
4. Temperature probe offset   0.01°, e.g. 100 adds 1.00°
5. IR Sensor offset   0.01°, e.g. 100 adds 1.00°

If the configuration parameters haven't been set, then will default to -1. If the serial number or hardware revision are negative, then it is assumed no calibration values are set and so are left as defaults (inactivity timer 300 seconds, offsets of 0).

Commands

Commands are a single character and do not require any terminating CR or LF.
Commands are case sensitive.
Any invalid characters are ignored with no response.

```
?      Query battery state
!      Sound buzzer
B      Enable barcode scanner power
b      Disable barcode scanner power (lower case B)
C      Calibration mode – returns raw temperatures
c      Disable cal mode – applies temperature offsets (lower case C)
F      Fine temperature mode 2 decimal places
f      Normal temperature mode, 1 decimal place (lower case F)
L      Enable laser pointer
l      Disable laser pointer (lower case L)
P      Enable temperature sensor power
p      Disable temperature sensor power (lower case P)
S      Start barcode scan, will scan for 3 seconds
s      Stop barcode scan, only needed to cancel scan early (lower case S)
T      Read MLX90614 IR non-contact temperature
t      Read MAX31855 thermocouple probe temperature (lower case T)
V      Query Version
Z      Enter sleep mode
```

At startup, calibration mode, fine mode, and laser/barcode/sensor power are all disabled.

Parameter Sequences

Use these for certain commands, in particular for reading and writing the configuration/calibration data in NVM (EEPROM). The commands are similar to RPN, and there are two registers on the stack, X and Y.

```
:      Start parameter sequence, clears X & Y
0-9    Accumulate number into X
-      Negate value in X, must follow the digits
,      Push value from X into Y, clears X
W      Write parameter Y with value X
R      Read parameter X
```

Examples & Reponses

```
:1R        Will return serial number            R123
:2R        Will return hardware revision        R33
:3,0W      Will disable inactivity timer        W3,0
:4R        Will return Temperature probe offset R4,100
:4,100-W   Will update temperature probe offset W4,-100
```

Responses

```
QPACK07 is sent on startup
```

Minimum response is the command character itself followed by CR & LF.
Additional responses as follows

```
+X          Input activated, where X is in list below
-X          Input deactivated, where X is in list below
[x]         Barcode data – replace x with
Tx          IR non-contact temperature – e.g. T25.25
tx          Thermocouple probe temperature – e.g. t25.25
.           Barcode scan finished without a read (period/full stop)
?nnn,v.v    Battery voltage (nnn is ADC value, v.v is approx. voltage)
Rp,nnn      Value from config read to param p
Wp,nnn      Acknowledgement of config write to param p
VQPACK07    Response to version query
zzz         Going to sleep after inactivity timeout
```

Input Types
```
B      Thumb button
C      Battery charging (likely won't see this, USB gets disconnected)
P      Probe position switch
S      Scan success (currently disabled, as not very useful)
T      Trigger switch
```

Note – if we keep the probe position switch, we probably need a more deterministic way to read than just change notifications