**The Smart Protocol**

Despite the lack of official information from APC, this table has been constructed. It’s standard RS-232 serial communications at 2400 bps/8N1. Don’t rush the UPS while transmitting or it may stop talking to you. This isn’t a problem with the normal single character queries, but it really does matter for multi-char things like "**@000**". Sprinkle a few calls to usleep() in your code and everything will work a lot better.

| **Character** | **Meaning** | **Typical results** | **Other info** |
| --- | --- | --- | --- |
| **^A** | Model string | SMART-UPS 700 | Spotty support for this query on older models |
| **^N** | Turn on UPS | n/a | Send twice with > 1.5s delay between chars  Only on 3rd gen SmartUPS and Black Back-UPS Pros |
| **^Z** | Capability string | (long string) | See ["Capabilities" section](https://networkupstools.org/protocols/apcsmart.html#cap) for more info |
| **A** | Front panel test | Light show + "OK" | Also sounds the beeper for 2 seconds |
| **B** | Battery voltage | 27.87 | This obviously varies a lot based on the current charge.  Compare this to the [nominal battery voltage](https://networkupstools.org/protocols/apcsmart.html#g) |
| **C** | Internal temperature | 036.0 | Units are degrees C |
| **D** | Runtime calibration | !, then $ | Runs until battery is below 25% (35% for Matrix)  This updates the **j** values - only works at 100% battery charge  Can be aborted with a second "**D**" |
| **E** | Automatic selftest intervals | 336 | Writable variable  Values:   * 336 (14 days) * 168 (7 days) * ON (at power on) (note extra space) * OFF (never) |
| **F** | Line frequency, Hz | 60.00 | If this varies much, have a word with your local electrician |
| **G** | Cause of transfer | O | Writable variable  Values:   * R (unacceptable utility voltage rate of change) * H (high utility voltage) * L (low utility voltage) * T (line voltage notch or spike) * O (no transfers yet since turnon) * S (transfer due to [**U** command](https://networkupstools.org/protocols/apcsmart.html#U) or activation of UPS test) |
| **I** | Measure-UPS: Alarm enable | FF | (not yet decoded)(bitmapped table, coming soon) |
| **J** | Measure-UPS: Alarm status | 0F,00 | (not yet decoded)(bitmapped table, coming soon) |
| **K** | Shutdown with grace period | OK | Send twice with > 1.5s delay between chars  Older units may send "\*" instead of "OK"  Also see [grace period](https://networkupstools.org/protocols/apcsmart.html" \l "p) |
| **L** | Input line voltage | 118.3 | Does not necessarily read 000.0 on line failure |
| **M** | Maximum line voltage | 118.9 | This is the max voltage since the last time this query was run |
| **N** | Minimum line voltage | 118.9 | Like the one above, this one also resets itself on every query |
| **O** | Output voltage | 118.3 | Also see [on battery output voltage](https://networkupstools.org/protocols/apcsmart.html#o) |
| **P** | Power load % | 023.5 | Relative to the capacity of the UPS |
| **Q** | Status flags | 08 | See [status flags section](https://networkupstools.org/protocols/apcsmart.html" \l "status) for more info |
| **R** | Turn dumb | BYE | Only on 3rd gen Smart-UPS, Smart-UPS v/s, Back-UPS Pro  UPS must receive command to [enter smart mode](https://networkupstools.org/protocols/apcsmart.html" \l "Y) continue communications after sending this |
| **S** | Soft shutdown | OK | Command executes after [grace period](https://networkupstools.org/protocols/apcsmart.html" \l "p)  UPS goes online when power returns  Only works when on battery |
| **U** | Simulate power failure | !, then $ | See [async notifier section](https://networkupstools.org/protocols/apcsmart.html" \l "async) for info on ! and $ |
| **V** | Firmware revision | GWD | Can be used to determine abilities of hardware |
| **W** | Self test | OK | Tests battery, like pushing the test button on the front panel  Also see [test results](https://networkupstools.org/protocols/apcsmart.html" \l "X) entry |
| **X** | Self-test results | OK | Values:   * OK → good battery * BT → failed due to insufficient capacity * NG → failed due to overload * NO → no results available (no test performed in last 5 minutes) |
| **Y** | Enter smart mode | SM | This must be sent before anything else on this page will work.  Also see [turn dumb command](https://networkupstools.org/protocols/apcsmart.html#R) to exit smart mode |
| **Z** | Shutdown immediately | n/a | Send twice with > 1.5s delay between chars  UPS switches the load off immediately (no grace period) |
| **a** | Protocol info | (long string) | Returns three main sections:   * Protocol version * Alert messages (aka [async notifiers](https://networkupstools.org/protocols/apcsmart.html" \l "async)) * Valid commands   Sections are separated with a period |
| **b** | Firmware revision | 50.9.D | Decoding above info:   |  |  | | --- | --- | | 50 | SKU (variable length) | | 9 | firmware revision | | D | country code (used in [capability](https://networkupstools.org/protocols/apcsmart.html" \l "cap) decoding) | |
| **c** | UPS local id | UPS\_IDEN | Writable variable  Up to 8 letter identifier for keeping track of your hardware |
| **e** | Return threshold | 00 | Writable variable  Minimum battery charge % to return from shutdown after power returns  Values:   * 00 = 0% (UPS switches on immediately) * 01 = 15% * 02 = 25% * 03 = 90%   This prevents excessive cycling during multiple power failures |
| **g** | Nominal battery voltage | 024 | The battery voltage that’s expected to be present in the UPS normally  Compare to the [actual voltage](https://networkupstools.org/protocols/apcsmart.html" \l "B) reading |
| **f** | Battery level | 099.0 | Percentage  It’s much easier to use this rather than doing math on the [current battery voltage](https://networkupstools.org/protocols/apcsmart.html" \l "B) and the [nominal battery voltage](https://networkupstools.org/protocols/apcsmart.html#g) |
| **h** | Measure-UPS: Ambient humidity | 042.4 | Percentage  Only works on models with the Measure-UPS SmartSlot card |
| **i** | Measure-UPS: Dry contacts | 00 | Bitmapped hex variable  Component values:   * 10 = contact 1 * 20 = contact 2 * 40 = contact 3 * 80 = contact 4 |
| **j** | Estimated runtime | 0327: | Minutes  Must be [calibrated](https://networkupstools.org/protocols/apcsmart.html" \l "D) to be effective |
| **k** | Alarm delay | 0 | Writable variable  Values:   * 0 = 5 second delay after power failure * T = 30 second delay * L = alarm at low battery only * N = alarm disabled   Does not affect low battery warning |
| **l** | Low transfer voltage | 103 | Writable variable  See [capabilities](https://networkupstools.org/protocols/apcsmart.html" \l "cap) to get values for a UPS  UPS goes on battery after voltage drops below this point |
| **m** | Manufacturing date | 11/29/96 | Format may vary by country (MM/DD/YY vs DD/MM/YY) |
| **n** | Serial number | WS9643050926 | Unique for each UPS |
| **o** | On-battery voltage | 115 | May be a writable variable on 220/230/240 VAC units |
| **p** | Shutdown grace delay | 020 | Writable variable - seconds  See [capabilities](https://networkupstools.org/protocols/apcsmart.html" \l "cap) to read values  Sets the delay before [soft shutdown](https://networkupstools.org/protocols/apcsmart.html#S) completes |
| **q** | Low battery warning | 02 | Writable variable - minutes  See [capabilities](https://networkupstools.org/protocols/apcsmart.html" \l "cap) to read values  The UPS will report a low battery this many minutes before it runs out of power |
| **r** | Wakeup delay | 000 | Writable variable - seconds  See [capabilities](https://networkupstools.org/protocols/apcsmart.html" \l "cap) to read values  The UPS will wait this many seconds after reaching the [minimum charge](https://networkupstools.org/protocols/apcsmart.html" \l "e) before returning online |
| **s** | Sensitivity | H | Writable variable  See [capabilities](https://networkupstools.org/protocols/apcsmart.html" \l "cap) to read values  Meaning of values:   * H → highest * M → medium * L → lowest * A → autoadjust (Matrix only) |
| **u** | Upper transfer voltage | 132 | Writable variable  See [capabilities](https://networkupstools.org/protocols/apcsmart.html" \l "cap) to read values  UPS goes on battery after voltage rises above this point |
| **v** | Measure-UPS: Firmware | 4Kx | Firmware information for Measure-UPS board |
| **t** | Measure-UPS: Ambient temperature | 80.5 | Degrees C  Only works on models with the Measure-UPS SmartSlot card |
| **x** | Last battery change | 11/29/96 | Writable variable  This holds whatever the user sets in it, much like the [UPS local id](https://networkupstools.org/protocols/apcsmart.html#c) variable |
| **y** | Copyright notice | © APCC | Only works if [firmware letter](https://networkupstools.org/protocols/apcsmart.html" \l "V) is later than O |
| **z** | Reset to factory settings | CLEAR | Resets most variables to initial factory values except [identity](https://networkupstools.org/protocols/apcsmart.html" \l "c) or [battery change date](https://networkupstools.org/protocols/apcsmart.html" \l "x)  Not on SmartUPS v/s or BackUPS Pro |
| **-** | Capability cycle | (various) | Cycle through possible [capability values](https://networkupstools.org/protocols/apcsmart.html" \l "cap)  UPS sends | afterward to confirm change to PROM |
| **@**nnn | Shutdown and return | OK | UPS shuts down after [grace period](https://networkupstools.org/protocols/apcsmart.html" \l "p) with delayed wakeup after nnn tenths of an hour plus any [wakeup delay](https://networkupstools.org/protocols/apcsmart.html" \l "r) time  Some older models send \* instead of OK |
| **0x7f** | Abort shutdown | OK | Abort shutdown - use to abort [**@**](https://networkupstools.org/protocols/apcsmart.html#@), [**S**](https://networkupstools.org/protocols/apcsmart.html#S), [**K**](https://networkupstools.org/protocols/apcsmart.html#K)  Also known as the delete key in some places |
| **~** | Register #1 | n/a | See [register 1](https://networkupstools.org/protocols/apcsmart.html" \l "reg1) table |
| **'** | Register #2 | n/a | See [register 2](https://networkupstools.org/protocols/apcsmart.html" \l "reg2) table |
| **7** | Dip switch positions | n/a | See [dip switch](https://networkupstools.org/protocols/apcsmart.html" \l "dipsw) table  Only makes sense on models which actually have dip switches |
| **8** | Register #3 | n/a | See [register 3](https://networkupstools.org/protocols/apcsmart.html" \l "reg3) table |
| **9** | Line quality | FF | Values   * 00 → unacceptable * FF → acceptable |
| **>** | Battery packs | n/a | SmartCell models: returns number of connected packs  Non-SmartCell models: returns number set by user (use **+** and **-**) |
| **[** | Measure-UPS: Upper temp limit | NO,NO | Degrees C  Writable variable  Values: 55, 50, 45, …, 05 for both  Use **-** to enumerate through left side, **+** to enumerate through right side |
| **]** | Measure-UPS: Lower temp limit | NO,NO | Degrees C  Writable variable  See *lower temp limit* above |
| **{** | Measure-UPS: Upper humidity limit | NO,NO | %  Writable variable  Values: 90, 80, 70, …, 10 for both  Use **-** and **+** to change values |
| **}** | Measure-UPS: Lower humidity limit | NO,NO | %  Writable variable  Values: 90, 80, 70, …, 10 for both  Use **-** and **+** to change values |
| Matrix-UPS and Symmetra commands | | | |
| **^** | Run in bypass mode | n/a | If online, "BYP" response is received as bypass mode starts  If already in bypass, "INV" is received and UPS goes online  If UPS can’t transfer, "ERR" received |
| **<** | Number of bad battery packs | 000 | Returns count of bad packs connected to the UPS |
| **/** | Load current | n/a | True RMS load current drawn by UPS |
| **\** | Apparent load power | n/a | Output load as percentage of full rated load |
| **^V** | Output voltage selection | n/a | Writable variable  Values:   * A → Automatic (based on input tap) * M → 208 VAC * I → 240 VAC |
| **^L** | Front panel language | n/a | Writable variable  Values:   * E → English * F → French * G → German * S → Spanish * Also 1, 2, 3, 4 → unknown |
| **w** | Run time conservation | n/a | Writable variable  Values:   * NO → disabled * 02 → leave 2 minutes of runtime in battery * 05 → leave 5 minutes * 08 → leave 8 minutes |

**Dip switch information**

| **Bit** | **Switch** | **Option when bit=1** |
| --- | --- | --- |
| 0 | 4 | Low battery alarm changed from 2 to 5 mins. Autostartup disabled on SU370ci and 400 |
| 1 | 3 | Audible alarm delayed 30 seconds |
| 2 | 2 | Output transfer set to 115 VAC (from 120 VAC) or to 240 VAC (from 230 VAC) |
| 3 | 1 | UPS desensitized - input voltage range expanded |
| 4 - 7 | - | Unused at this time |

**Status flags**

Some common things you’ll see:

* 08 = on line, battery OK
* 10 = on battery, battery OK
* 50 = on battery, battery low

| **Bit** | **Meaning** |
| --- | --- |
| 0 | **1** = runtime calibration occurring  Not reported by Smart UPS v/s and BackUPS Pro |
| 1 | **1** = SmartTrim  Not reported by 1st and 2nd generation SmartUPS models |
| 2 | **1** = SmartBoost |
| 3 | **1** = on line |
| 4 | **1** = on battery |
| 5 | **1** = overloaded output |
| 6 | **1** = battery low |
| 7 | **1** = replace battery |

**Alert messages**

| **Character** | **Description** |
| --- | --- |
| ! | Line Fail - sent when the UPS goes on-battery, repeated every 30 seconds until low battery condition reached. Sometimes occurs more than once in the first 30 seconds. |
| $ | Return from line fail - UPS back on line power, only sent if a **!** has been sent. |
| % | Low battery - Sent to indicate low battery, but not on SmartUPS v/s or BackUPS Pro models |
| + | Return from low battery - Sent when the battery has been recharged to some level only if a % has been sent previously |
| ? | Abnormal condition - sent for conditions such as "shutdown due to overload" or "shutdown due to low battery capacity". Also occurs within 10 minutes of turnon. |
| = | Return from abnormal condition - Sent when the UPS returns from an abnormal condition where **?** was sent, but not a turn-on. Not implemented on SmartUPS v/s or BackUPS Pro models. |
| \* | About to turn off - Sent when the UPS is about to switch off the load. No commands are processed after this character is sent. Not implemented on SmartUPS v/s, BackUPS Pro, or 3rd generation SmartUPS models. |
| # | Replace battery - Sent when the UPS detects that the battery needs to be replaced. Sent every 5 hours until a new battery test is run or the UPS is shut off. Not implemented on SmartUPS v/s or BackUPS Pro models. |
| & | Check alarm register for fault (Measure-UPS) - sent to signal that temp or humidity out of set limits. Also sent when one of the contact closures changes states. Sent every 2 minutes, stops when the alarm conditions are reset. Only sent for alarms enabled with **I**. Cause of alarm may be determined with **J**. Not on SmartUPS v/s or BackUPS Pro. |
| | | Variable change in EEPROM - Sent whenever any EEPROM variable is changed. Only supported on Matrix UPS and 3rd generation SmartUPS models. |

**Register 1**

All bits are valid on the Matrix UPS. SmartUPS models only support bits 6 and 7. Other models do not respond.

| **Bit** | **Meaning** |
| --- | --- |
| 0 | In wakeup mode (typically lasts < 2s) |
| 1 | In bypass mode due to internal fault - see register 2 or 3 |
| 2 | Going to bypass mode due to command |
| 3 | In bypass mode due to command |
| 4 | Returning from bypass mode |
| 5 | In bypass mode due to manual bypass control |
| 6 | Ready to power load on user command |
| 7 | Ready to power load on user command or return of line power |

**Register 2**

Matrix UPS models report bits 0 - 5. SmartUPS models only support bits 4 and 6. SmartUPS v/s and BackUPS Pro report bits 4, 6, 7. Unused bits are set to **0**. Other models do not respond.

| **Bit** | **Meaning** |
| --- | --- |
| 0 | Fan failure in electronics, UPS in bypass |
| 1 | Fan failure in isolation unit |
| 2 | Bypass supply failure |
| 3 | Output voltage select failure, UPS in bypass |
| 4 | DC imbalance, UPS in bypass |
| 5 | Command sent to stop bypass with no battery connected - UPS still in bypass |
| 6 | Relay fault in SmartTrim or SmartBoost |
| 7 | Bad output voltage |

**Register 3**

All bits are valid on the Matrix UPS and 3rd generation SmartUPS models. SmartUPS v/s and BackUPS Pro models report bits 0 - 5. All others report 0 - 4. State change of bits 1, 2, 5, 6, 7 are reported asynchronously with **?** and **=** messages.

| **Bit** | **Meaning** |
| --- | --- |
| 0 | Output unpowered due to shutdown by low battery |
| 1 | Unable to transfer to battery due to overload |
| 2 | Main relay malfunction - UPS turned off |
| 3 | In sleep mode from **@** (maybe others) |
| 4 | In shutdown mode from **S** |
| 5 | Battery charger failure |
| 6 | Bypass relay malfunction |
| 7 | Normal operating temperature exceeded |