ADVANCE T & R COMM PROTOCOL

Overview

SERIAL COMM PROTOCOL USED WITH ADVANCE R, AND ADVANCE T UPS

Contents

Document Management

Document History

Date	Ver.	Author	Description
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1. Query currently status.

Client: **B<cr>**

UPS: **#Iutility_voltageOoutput_voltageLpercent_load**
Bbattery_capacityVbattery_voltageTcabinet_temperature
Futility_frequencyHoutput_frequencyRremaing_runtime
Cremaining_chargetimeQoutput_current
Sstatus_flags<cr>

UPS: **#-error_code<cr>**

- The **I, O, L, B, V, T, F, H, R, C, Q, S, W, X** are single uppercase character, it is used to identify each part in result. That are precedent characters to lead a value which describe at succeed explanation.
- It should be ignored within next recognized one if any precedent character can not recognize, this is in order to future expansion compatible consideration.
- The **utility_voltage, output_voltage, percent_load, battery_capacity, battery_voltage, cabinet_temperature, utility_frequency, output_frequency, remaing_runtime, remaining_chargetime, output_current, changed_config are** numeric string; it may a decimal if it have point.
- **status_flags** is composed with multiple characters, each character have own bit-field definition as below description.
- It could be omitted both precedent character and value if that is not supported by regarding UPS.
- The order of each part is not significant.

Item	Precision	Unit
utility_voltage	0.1	volt
output_voltage	0.1	volt
percent_load	1	percent
battery_capacity	1	percent
battery_voltage	0.1	volt
cabinet_temperature	1	centigrade
utility_frequency	0.1	Hz
output_frequency	0.1	Hz
remaing_runtime	0.1 (value < 1)	minute
	1 (value >= 1)	
remaining_chargetime	0.1 (value < 1)	minute
	1 (value >= 1)	
output_current	0.1	A
changed_config	0.1	section

- **utility_voltage**

  This value is the voltage of utility power.

  Unit is volts.

  Ex:

  I119.1 : the voltage of utility is **119.1** volts

- **output_voltage**

  This value is the voltage of output.

  Ex:

  O120.2 : UPS output voltage is **120.2** volts

- **percent_load**

  This value is the load level of output.

  Ex:

  L80 : The current load of UPS is **80** percent

- **battery_capacity**

  This value is level of battery capacity.

  Ex:

  B100 : Battery capacity is 100 percent

- **battery_voltage**

  This value is the voltage of battery.

  Ex:

  V11.2 : Battery voltage is **11.2** volts

- **cabinet_temperature**

  This value is cabinet temperature of UPS.

  Ex:

  T100 : The cabinet temperature of UPS is **100** centigrade degrees

- **utility_frequency**

  This value is frequency of utility power.

  Ex:

  F59.9 : The frequency of UPS in output is **59.9** Hz

- **output_frequency**

  This value is frequency of output.

  Ex:

  H60.0 : The frequency of UPS in output is **60.0** Hz

- **remaing_runtime**

  This value is remaining battery runtime.

  Ex:

  R3 : The remaining battery runtime have **3** minutes

  R.3 : The remaining battery runtime have 0**.3** minutes (18 seconds)

- **remaining_chargetime**

  This value is remaining time for battery recharge to full.

  Ex:

  C50 : battery is charged to full still need **50** minutes

- **output_current**

  This value is current of output.

  Ex:

  Q6.3 : The current of output is 6.3 Amperes

- **status_flags**

  - Each character should be explain as a data with a one byte length, each bit in that byte have own definition. Each bit field definition describe as following, first character called S1 and succeed called S2 ... Sn, etc. The sequence is significant in those characters.
  - Amount of Sn characters is variable. [5 chars be used]
  - Any middle character disallows to be skipped but characters in tail can be skipped if that is unsupported by regarding UPS.
  - All bits should be zero, also for bit 7, if that byte is not significant (unsupported) for regarding UPS.

Bye	Bit	Description
S1	7	1 indicates this byte is available and valid. [always 1]
	6	1 indicates utility power failure; see detail on S2.0 and S2.1.
	5	1 indicates battery capacity is lower than shutdown threshold.
	4	1 indicates buzzer is on state of beeping.

<table>
<tr><td rowspan="4"></td><td>3</td><td>1 indicates battery-test is processing.</td></tr>
<tr><td>2</td><td>1 indicates scheduled shutdown is pending.</td></tr>
<tr><td>1</td><td>1 indicates scheduled restore is pending.</td></tr>
<tr><td>0</td><td>1 indicates hardware fault; see detail on X71 command.</td></tr>
<tr><td rowspan="8">S2</td><td>7</td><td>1 to indicate this byte is available and valid. [always 1]</td></tr>
<tr><td rowspan="2">6

5</td><td>These two bits compose a numeric value to indicate level of AVR.
<table>
<tr><td>Value</td><td>Description</td></tr>
<tr><td>0</td><td>normal [always use this value]</td></tr>
<tr><td>1</td><td>boost one stage</td></tr>
<tr><td>2</td><td>boost two stages</td></tr>
<tr><td>3</td><td>buck one stag</td></tr>
</table></td></tr>
<tr><td>4</td><td>1 indicates inverter over temperature.</td></tr>
<tr><td>3</td><td>1 indicates inverter has fault.</td></tr>
<tr><td>2</td><td>1 indicates inverter is off.</td></tr>
<tr><td>1</td><td>1 indicates frequency of utility is out of range.</td></tr>
<tr><td>0</td><td>1 indicates voltage of utility is out of range.</td></tr>
<tr><td rowspan="8">S3</td><td>7</td><td>1 to indicate this byte is available and valid. [always 1]</td></tr>
<tr><td>6</td><td>1 indicates battery is fully charged.</td></tr>
<tr><td>5</td><td>1 indicates battery capacity still lower than UPS restored threshold when utility power had restored.</td></tr>
<tr><td>4</td><td>1 indicates battery is charging.</td></tr>
<tr><td>3</td><td>1 indicates battery is discharging.</td></tr>
<tr><td>2</td><td>1 indicates battery capacity is lower than 80 percent.</td></tr>
<tr><td>1</td><td>Reserved, should be 0.</td></tr>
<tr><td>0</td><td>1 indicates battery not present.</td></tr>
<tr><td rowspan="2">S4</td><td>7</td><td>1 to indicate this byte is available and valid. [always 1]</td></tr>
<tr><td>6</td><td>1 indicates bypass is overload.</td></tr>
</table>

	5	1 indicates bypass is active.
	4	1 indicates output suffer short circuit.
	3	1 indicates output has load.
	2	1 indicates output is overload.
	1	1 indicates frequency of output is out of range in bypass.
	0	1 indicates voltage of output is out of range in bypass.
S5	7	1 to indicate this byte is available and valid. [always 1]
	6	1 indicates no output.
	5	1 to indicate remaining runtime is lower than threshold.
	4	1 to indicate buzzer is muted(impermanent) at present
	3	**1 to indicate Wiring Fault**
	2	**1 to indicate UPS in ECO mode.**
	1	**1 to indicate UPS in Manual Bypass**
	0	**Fix 0.**
S6	7	**1 to indicate this byte is available and valid. [always 1]**
	6	**1 indicates UPS on**
	5	**Reserved, should be 0.**
	4	**Reserved, should be 0.**
	3	**Reserved, should be 0.**
	2	**Reserved, should be 0.**
	1	**Reserved, should be 0.**
	0	**Reserved, should be 0.**

Ex:

S<*192*><*129*><*136*><*136*><*128*><*192*>

- The following bits are available information in S1 byte.
- The utility power is failure.
- The battery capacity is normal.

- The buzzer is silence at this moment.
- The Self-test is not processing.
- The Scheduled shutdown is not processing.
- The scheduled restore is not pending.
- There is no hardware error.

- The following bits are available information in S2 byte.
- The AVR level is on normal stage.
- Inverter's temperature is on normal condition.
- Inverter is working normally.
- Inverter is active.
- The frequency of utility is normal.
- The voltage of utility is out of range.

- The following bits are available information in S3 byte.
- The battery capacity full than restored threshold.
- The battery is discharging.
- The battery capacity is not lower than 80 percent.
- The battery pack is healthy.
- The battery is present.

- The following bits are available information in S4 byte.
- The bypass is not overload.
- The bypass is not active.
- The output does not suffer short circuit.
- Has load on output.
- The output is not overload.
- The frequency of output is normal.
- The voltage of output is normal.

- It has output.

- UPS is on now.

Note: The <***192***>, <***129***>, <***136***>, <***136***>, ***<128>,***<***192***> represent single byte.

2. Query configurations

Client: **Xn<cr>**

Client: **Xn**[**:m**]**<cr>**

UPS: **#result<cr>**

UPS: **#-error_code<cr>**

- The **n** is a index to indicate which configuration be queried, parameter **m** is sub-index to indicate which part

of result should be return.
- The order is significant for each part in result.

2.5 Query battery information

Client: **X5**<cr>

*UPS:***#rating_pack_voltage,pack_count,pack_capacity,external_cabinet_amount,max_discharge,max_charge, external_rating_pack_voltage,external_pack_count,external_pack_capacity<cr>**

UPS: **#-error_code<cr>**

- The **rating_voltage, pack_amount, pack_capacity, external_amount, max_discharge, max_charge** is numeric string.

Item	Range	Precision	Unit
rating_pack_voltage	-	1	volt
pack_count	-	-	-
pack_capacity	-	1	Ah
external_cabinet_amount	0 ~ 4	-	-
max_discharge	-	1	minute
max_charge	-	1	minute
external_rating_pack_voltage	-	1	Volt
external_pack_count	-	-	-
external_pack_capacity	-	1	Ah

2.15 Query list of configured threshold value of battery capacity

Client: **X15<cr>**

UPS: **#multiple_list<cr>**

UPS: **#-error_code<cr>**

- The **multiple_list** comprise one or many numeric string for listing possible value of configured threshold value of battery capacity. The unit is percents.

Ex:

#10,20,30,40,50,60,70<cr>

- The possible values are **10**, **20**, **30**, **40**, **50**, **60**, **and 70.**

2.27 Query system configuration

Client: **X27<cr>**

UPS: **#output_voltage,high_transfer_voltage,low_transfer_voltage, battery_threshold,runtime_threshold<cr>**

UPS: **#-error_code<cr>**

- The **output_voltage, high_transfer_voltage, low_transfer_voltage, battery_threshold** is numeric string. The unit is volts.

Item	Range	Default	Precision	Unit
output_voltage	110,120,127	120	-	volt
high_transfer_voltage	-	142	1	volt
low_transfer_voltage	-	80	1	volt
battery_threshold	0 ~ 90	20	10	percent
runtime_threshold	0~65535	300	1	second

- The **output_voltage** is configured voltage of UPS which actually export to load.

- The **high_transfer_voltage** is a configured high limit of utility, once utility voltage is higher than this value it will be power failure state.

  [This value should be fixed on 142, it can not be configured]

- The **low_transfer_voltage** is a configured low limit of utility, once utility voltage is lower than this value it will be power failure state.

  [This value should be fixed on 80, it can not be configured]

- The **battery_threshold** is configured threshold of battery capacity. The unit is percents.

- The **runtime_threshold** is configured threshold of battery runtime limit. When UPS's battery remaining runtime falls this threshold, it should indicate this situation on S5.5 of D command.

Ex:

#120,142,80,20,300<cr>

- Configured output voltage is **120** volts.
- Configured threshold of battery capacity is **30** percent.
- Battery runtime limit is 300 sec.

2.28 Query list of configured output voltage

Client: **X28<cr>**

UPS: **#multiple_list<cr>**

UPS: **#-error_code<cr>**

- The **multiple_list** comprise one or many numeric string for listing possible value of configured voltage of output. The unit is Volts.

2.51 Query list of high transfer voltage

Client: **X51<cr>**

UPS: **#external_cabinet_amount<cr>**

UPS: **#-error_code<cr>**

Ex:

#290<cr>

2.60 Query list of LOW transfer voltage

Client: **X60<cr>**

UPS: **#external_cabinet_amount<cr>**

UPS: **#-error_code<cr>**

Ex:

#165<cr>

2.71 Query result of self-test or fault

Client: **X71<cr>**

UPS: **#result<cr>**

UPS: **#-error_code<cr>**

- The **result** is composed with multiple characters, each character have own bit-field definition as below description.
- Each character should be explained as a data with a one byte length, each bit in that byte have own definition. Each bit field definition describe as following, first character called R1 and succeed called R2 ... Rn, etc. The order in each character is significant.
- Amount of Rn characters is variable. [2 be used]
- Any middle characters disallow to be skipped but characters in tail can be skipped if that is unsupported by regarding UPS.
- All bits should be zero, also for bit 7, if that byte is not significant (unsupported) for regarding UPS.

Value of **result**:

Bye	Bit	Description
R1	7	1 indicates this byte is available and valid. [always 1]
	6	Reserved, should be 0.
	5	1 indicates fan lock.
	4	1 indicates inverter fault.
	3	Reserved, should be 0.
	2	Reserved, should be 0.
	1	1 indicates battery over charge.
	0	1 indicates battery unavailable.
R2	7	1 indicates this byte is available and valid. [always 1]
	6	Reserved, should be 0.
	5	Reserved, should be 0.
	4	Reserved, should be 0.
	3	Reserved, should be 0.
	2	1 indicates output transformer over temperature.
	1	1 indicates output shorted.

	0	1 indicates charger fail (battery voltage too high).

2.72 Query power information

Client: **X72<cr>**

UPS: **#apparent_power,active_power,rating_voltage,lowest_frequency, highest_frequency,rating_current,lower_frequency,higher_frequency<cr>**

UPS: **#-error_code<cr>**

- The **apparent_power, active_power, rating_voltage, lowest_frequency, highest_frequency, rating_current, lower_frequency, higher_frequency** is numeric string.

Item	Precision	Unit
apparent_power	1	VA
active_power	1	watt
rating_voltage	1	volt
lowest_frequency	0.1	hz
highest_frequency	0.1	hz
rating_current	0.1	A
lower_frequency	0.1	hz
higher_frequency	0.1	hz

Ex:

#1000,700,120,47,63,10<cr>

- The apparent power is **1000** VA.
- The active power is **700** Watts.
- The factory default voltage of output is **120** Volts.
- The rating frequency range is between **47** and **63** Hz.
- The rating current is **10** Amperes.

2.87 Query function flags

Client**: X87<cr>**

UPS: **#abcde<cr>**

UPS: **#-error_code<cr>**

Value of result:

abcde is a string with 5 byte length, each bit has own definition in every byte. it is positive meaning if the bit value is one, it is negative meaning if the bit value is zero. The 7th bit is fixed on one to avoid conflict with ASCII Carrier Return character.

a is on 0th character of ***abcde***，bit definition:

Bit	Default	Function
7	1	Fixed on 1
6	0	Boost Support
5	1	Belong to On-Line architecture
4	0	Indicator-Test Support
3	0	Reserved as 0
2	0	Buck Support
1	0	Enable Force-Power-Cycle
0	1	Reserved as 1

b is on 1th character of ***abcd***，bit definition:

Bit	Default	Function
7	1	Fixed on 1
6	1	Allow Configure Cold-Start
5	1	Allow Configure Auto-Restore

4	1	Allow Store Buzzer Configuration
3	0	Reserved as 0
2	1	Reserved as 1
1	1	Reserved as 1
0	1	Reserved as 1

c is on 2th character of ***abcd*** , bit definition:

Bit	Default	Function
7	1	Fixed on 1
6	1	Enable Cold-Start
5	1	Enable Auto-Restore
4	1	Enable Buzzer
3	0	Reserved as 0
2	0	Reserved as 0
1	0	Reserved as 0
0	0	Reserved as 0

d is on 3th character of ***abcd*** , bit definition:

Bit	Default	Function
7	1	Fixed on 1
6	0	Enable Avoid-Over-Discharge
5	1	Enable Allow-Shutdown-Command
4	1	Enable Follow-Up-Mode

3	0	Enable Short- Circuit-Detect
2	1	Enable Overload-Bypass
1	0	Enable Forced-Bypass
0	0	Enable Energy-Saving

3. Setup configurations

Client: **Kn:m<cr>**

UPS: **#error_code<cr>**

- The **n** is an index to indicate which configuration should be setup; parameter **m** is the value should be set in.

3.51 Setup Auto-Restart function

Client: **K51:auto_restart**<cr>

UPS: **#-error_code**<cr>

The **auto_restart** is one of '0' or '1' to disable or enable Auto-Restart function. See X87 to get more information. Default is 1.

Ex:

#K51:1<cr> : to enable Auto-Restart function

3.60 Setup buzzer state

Client: **K60:buzzer_control<cr>**

UPS: **#-error_code**<cr>

- The **buzzer_control** is numeric string.
- To setup with '**0**' will disable buzzer.
- To setup with '**1**' will enable buzzer.
- To setup with '**2**' will temporally mute buzzer. Buzzer state turn to beeping possible after power event which to cause buzzer beeps disappear. This value only useful when buzzer is on enable-state.
- **K60:2** command just mute the buzzer for temporally until power event disappear, it doesn't change the persist setting of buzzer. It also doesn't affect the value of X87.3.4. To change the persist setting (value of

X87.3.4) of buzzer should use **K60:0** or **K60:1** command.
- See about **X87** command, bit **X87.3.4**.
- This K60 command only change the buzzer behave when it cause by utility failure and battery critical low, system booting and fault warning is not be change on this command.

Ex:

K60:1<cr> : enable buzzer

K60:2<cr> : to mute buzzer temporally.

4. Test

4.1 Battery-Test

Client: **A<cr>**

UPS: **#-error_code<cr>**

- Asking UPS to do self-test (turn to inverter mode).
- UPS should response error code with zero if it accept this command and take active. Otherwise, response error code as error conditions.

Ex:

A<cr> : initiate a UPS self-test

4.2 Battery capacity test

Client: **AH**<cr>

UPS: **#-error_code<cr>**

- Asking UPS turn to battery mode until battery capacity reaches threshold of battery capacity, the setting of **X27**

  #230,290,165,10,300\CR

- UPS should response error code with zero if it accept this command and take active. Otherwise, response error code as error conditions.

Ex:

AH<cr> : to initiate a battery capacity test.

4.3 Buzzer test

Client: **AU<cr>**

UPS: **#-error_code<cr>**

To ensure the buzzer work normally. The buzzer will beep and sustained least 5 seconds while UPS received this command.

Ex:

AU<cr> : initiate a buzzer test.

5. Scheduled shutdown

5.2 Scheduled shutdown (delay before shutdown)

Client: **Mtime<cr>**

UPS: **#-error_code<cr>**

- The UPS should begin count down while received this command and it should turn-off at **time** minutes was expired and never restore except power button be switch on again.
- UPS should accept a time value which have some zero character at front and ignore these zero char.

Item	Range	Precision	Unit
time	0 ~ 65535	0.1 (value < 1)	minute
		1 (value >= 1)	

Ex:

M01<cr> : UPS will turn-off after **1** minute later

5.3 Scheduled restore (Wake up, delay before startup)

Client: **Gtime<cr>**

UPS: **#-error_code<cr>**

- The **time** is numeric string to indicate when expired, unit is minutes.
- The UPS should begin count down while received this command and it should turn-on at **time** minutes was expired.
- UPS should follow the indication of Cold-Start (value of X87.3.6) to decide actually power restore when time is expired and utility power is not present (power failure). UPS should restore power if Cold-Start is enabled, UPS should not restore power if Cold-Start is disabled.
- UPS should follow the indication of Auto-Restore (value of X87.3.5) to decide actually power restore when utility power is become present and restore procedure is pending by Cold-Start consideration at before (describe as previous rule), UPS should restore power if Auto-Restart is enabled, UPS should not restore power if Auto-Restore is disabled.

Item	Range	Precision	Unit
time	0 ~ 65535	0.1 (value < 1)	minute
		1 (value >= 1)	

Ex:

G.3<cr> : UPS will turn-on after 0**.3** minutes (18 seconds) later.

G3<cr> : UPS will turn-on after **3** minutes later.

5.4 Scheduled shutdown and restore

Client: **Moff_timeEon_time<cr>**

UPS: **#-error_code<cr>**

- The **off_time, on_time** is numeric string. The unit is minutes.
- The UPS should begin count down both since received this command, it should turn-off at **off_time** minutes was expired and should turn-on at **on_time** minutes was expired. Correct values on both are **on_time** must later than **off_time**.
- The restore consideration should refer to sec.5.3 (Gx command).

Item	Range	Precision	Unit
off_time **on_time**	0 ~ 65535	0.1 (value < 1)	minute
		1 (value >= 1)	

Ex:

M01E0002<cr> : UPS will turn-off at 1 minute later and also restart at 2 minutes later.

6. Cancel

6.1 Cancel Self-Test

Client: **KA<cr>**

UPS: **#-error_code<cr>**

- Asking UPS to stopping self-test.
- This command can effect processing of command **A<cr>**, **AH<cr>** but **AU<cr>**.

Ex:

KA<cr> : cancel a self-test cause by command **A<cr>**, **AH<cr>**.

6.2 Cancel scheduled command

Client: **K<cr>**

UPS: **#-error_code<cr>**

- To cancel and stop time counting for scheduled shutdown command while UPS is processing a shutdown action.
- To cancel and stop time counting for scheduled restore command while UPS is processing a restore action and UPS should restore the power immediately.
- To cancel a restore command in power failure state should consider the setting of cold-start to do the decision of restore.

6.3 Cancel scheduled shutdown command

Client: **KM<cr>**

UPS: **#-error_code<cr>**

- To cancel and stop time counting for scheduled shutdown command while UPS is processing a shutdown action (this include sleep).
- UPS should response an error code when UPS is not in state of shutdown and ignore this request.

6.4 Cancel scheduled restore command

Client: **KG<cr>**

UPS: **#-error_code<cr>**

- To cancel and stop time counting for scheduled restore command while UPS is processing a restore action. UPS should give up to restoring power and remain its state after accept this command.
- UPS should response an error code when UPS is not in state of restore pending and ignore this request.