|  |  |  |  |
| --- | --- | --- | --- |
| Description | Input Port | Output Port | Device |
| Number of battery cell | N | N |  |
| Voltage of battery cell | Va1 | Vb1 |  |
| Constant voltage of battery cell | Va2 |  |  |
| Original capacity of power bank | C0 | C0 |  |
| Original capacity of battery cell | C00 | C00 |  |
| Charge verify capacity of power bank | Ca0 |  |  |
| Charge verify capacity of battery cell | Ca00 |  |  |
| Current capacity of battery cell | Ca1 |  |  |
| Capacity discharged of battery cell |  | Cb1 |  |
| Capacity discharged of power bank |  | Cb2 |  |
| Current capacity of power bank | Ca2 | Cb3 |  |
| Current capacity percentage of power bank | Wa1 | Wb1 |  |
| Input/Output current of battery cell | Ia1 | Ib1 |  |
| Va1or Ia1 corresponding time | ta1 | tb1 |  |
| Time of battery cell be fully charged | ta2 |  |  |
| Remaining time of battery cell to be fully charged | ta3 |  |  |
| Remaining time of power bank to be fully charged | ta4 |  |  |
| Remaining how many times to fully charge device 1 |  | Q |  |
| Battery cycle life | M | M |  |
| Power conversion efficiency |  | e |  |
| Original capacity of device 1 |  |  | Cc0 |
| Capacity device 1 receive |  |  | Cc1 |
| Current capacity percentage of device 1 |  |  | Wc1 |

**Input Port Data Theory**

1. **Current capacity of power bank**
2. Detect voltage of battery cell Va1 when charging
3. Judge the relationship between Va1 and Va2
4. A. If Va1<Va2, according to presetting Voltage and Capacity database when charging, get Va1 corresponding capacity Ca1

B. If Va1=Va2, detect Ia1, according to presetting Current and Capacity database when charging, get Ia1 corresponding capacity Ca1

1. N= C0/ C00 get number of battery cell N
2. Ca2=Ca1\*N get current capacity of power bank
3. Relationship between battery cycle life and capacity will be provide, if the capacity changed obviously, database will be update
4. Database will update automatically after capacity verifying
5. **Intelligent Alert**
6. Detect voltage of battery cell Va1 when charging
7. Judge the relationship between Va1 and Va2
8. A. If Va1<Va2, according to presetting Voltage and Capacity database when charging, get Va1 corresponding capacity Ca1

B. If Va1=Va2, detect Ia1, according to presetting Current and Capacity database when charging, get Ia1 corresponding capacity Ca1

1. N= C0/ C00 get number of battery cell N
2. Ca2=Ca1\*N get current capacity of power bank
3. Wa1=Ca2/C0 get current capacity percentage of power bank
4. Judge if Wa1 reach to the value that user wanted
5. If reach，can through vibrating, beeping, flashing, text message, voice message (one or two or…or all of them)to remind user
6. If intelligent alert function works even if at background interface it will prompt

**III. Judge fast charge or slow charge**

1. if Ia1>500mA If yes，power bank is fast charge ; otherwise, power bank is slow charge

**IV. Remaining time to fully charge power bank**

1. Detect voltage of battery cell Va1
2. A. If Va1<Va2, according to presetting Voltage and Time database when charging，get Va1 corresponding time ta1

B. If Va1=Va2, detect Ia1, according to presetting Current and Time database when charging, get Ia1 corresponding time ta1

1. Time be fully charged of battery cell is ta2
2. Remaining Time to fully charge battery cell is ta3=ta1-ta2
3. ta4=ta3\*N，get remaining time to fully charge power bank

**V. Health Status**

1. The verify capacity of power bank when charging is Ca0
2. W=Ca0/C0, get capacity conversation rate，according to Capacity Conversation Rate and Battery Cycle Life database, get W corresponding M
3. When M value between 0 and 150，power bank health status is “Excellent”

When M value between 151 and 300，power bank health status is “Good”

When M value between 301 and 500，power bank health status is “Fair”

When M value higher than 501，power bank health status is “Poor”

1. If user do not do capacity verify, will accumulate capacity percentage to judge health status.

VII. Capacity verify

1. Charge power bank from 0% to 100% capacity, get the verify capacity Ca0

**Output Port Data Theory**

1. **Current capacity of power bank**
2. Detect voltage of battery cell Vb1 when discharging
3. According to Voltage and Capacity database when discharging，get Vb1 Corresponding capacity Cb1
4. Cb2=Cb1\*N, get capacity discharged of power bank
5. Cb3=Cb0-Cb2, get current capacity of power bank
6. Database will update according to relationship between battery cycle life and capacity retention ratio
7. **Intelligent Alert (only useful for App download device)**
8. Detect device 1 battery capacity percentage Wc1
9. Judge if Wc1 reach to the value that user wanted
10. If reached, through vibrating, beeping, flashing, text message, voice message (one or two or …or all of them ) to remind user
11. If intelligent alert function works even if at background interface it will prompt
12. **Judge fast charge or slow charge**
13. Judge if Wc1>90%
14. A. If Wc1>90%, power bank is slow charge

B. If Wc1<90%, judge if Ib1>500mA. If yes, power bank is fast charge; otherwise, power bank is slow charge

1. **Remaining time to fully charge device 1 (only useful for App download device)**
2. Record how long to charge 10% capacity of device 1, then evaluate balance (1-Wc1) capacity of device need how long to charge
3. Record how long to charge 1% capacity of device 1 when device 1 change to slow charge, then evaluate (1-Wc1) capacity need how long to charge
4. **Remaining how many times to fully charge device 1 （It is output port separately calculate and only useful for App download device）**
5. Detect voltage of battery cell Vb1 when discharging
6. According to presetting Voltage and Capacity database, get Vb1 corresponding capacity Cb1
7. Cb2=Cb1\*N get capacity discharged of power bank
8. Cb3=Cb0-Cb2 get current capacity of power bank
9. Cc1= Cb3\*e get capacity device 1 can receive
10. Q= Cc1/Cc0 get remaining how many times to fully charge device 1
11. In order to obtain Q value every one minute need to get Vb1 value every one minute