



# Fuel gauge battery ZCV table test sop



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ACD\_PT

# Agenda

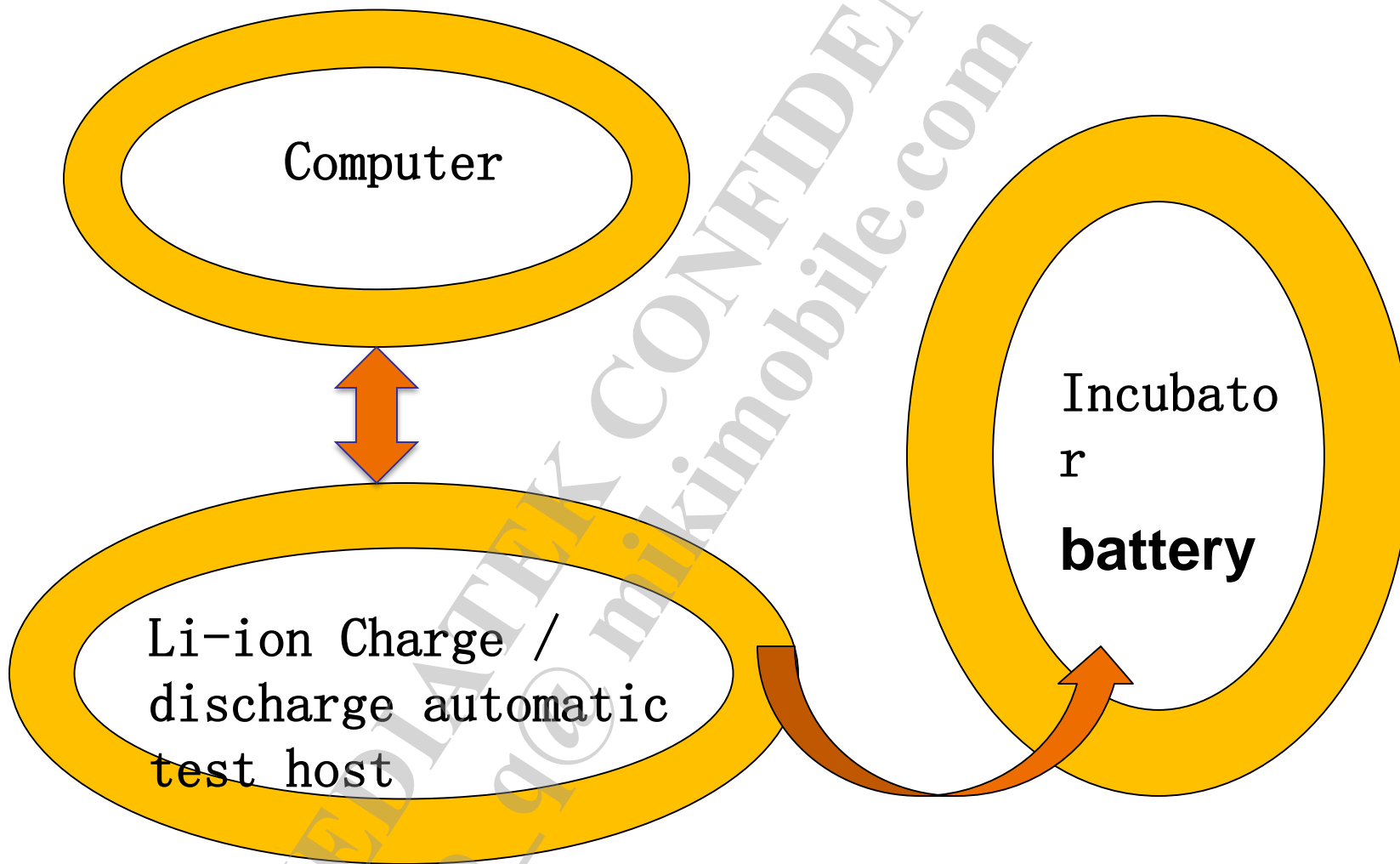
- ◆ Battery ZCV table test system equipment list
- ◆ ZCV table test method
- ◆ BAT760 Testing System User Manual
- ◆ Row data process



# Battery test system equipment list



# Test system ( Equipment List)



# Test system ( Equipment List )

- ✓ 1 Computer : Control the charging and discharging equipment, records test data
- ✓ 2 Incubator : Battery ambient temperature control, the temperature of the fuel can gauge test under the ZCV of table data (minus 10 degrees, 0 degrees, 25 degrees, 50 degrees), the incubator must be able to set the temperature of the above four
- ✓ 3 Li-ion Charge / discharge automatic test host : This equipment can control and record the battery capacity , charge / discharge time, and the battery voltage.
- ----- The MTK equipment used for **BAT-760**

# Li-ion Charge / discharge automatic test host **【BAT-760B】**

- . 8 Channel Independent testing
- . Constant current, constant voltage of charge
- . Constant current, constant power of discharge
- . CC: 0.1 mA ~ 1999 mA; 1 mA ~ 5999 mA
- . CV: 0.1 ~ 4.5 Vdc



# Li-ion Charge / discharge automatic test host **【BAT-760B】 Vendor Information**

- BAT-760B equipment price is 160000 NTD
- MSZ Purchase price: BAT-760B-6A 8channel price is 4820 USD
- BAT-760B
- AcuTech Headquarters
- AcuTech Systems Co., Ltd.  
Addr.: 9F., No.179, Jian 1st Rd., Zhonghe Dist., New Taipei City 235, Taiwan, R.O.C
- Tel: 886-2-2228-7016 张常松
- Fax: 886-2-2228-7036
- E-Mail: sales@acutechsys.com

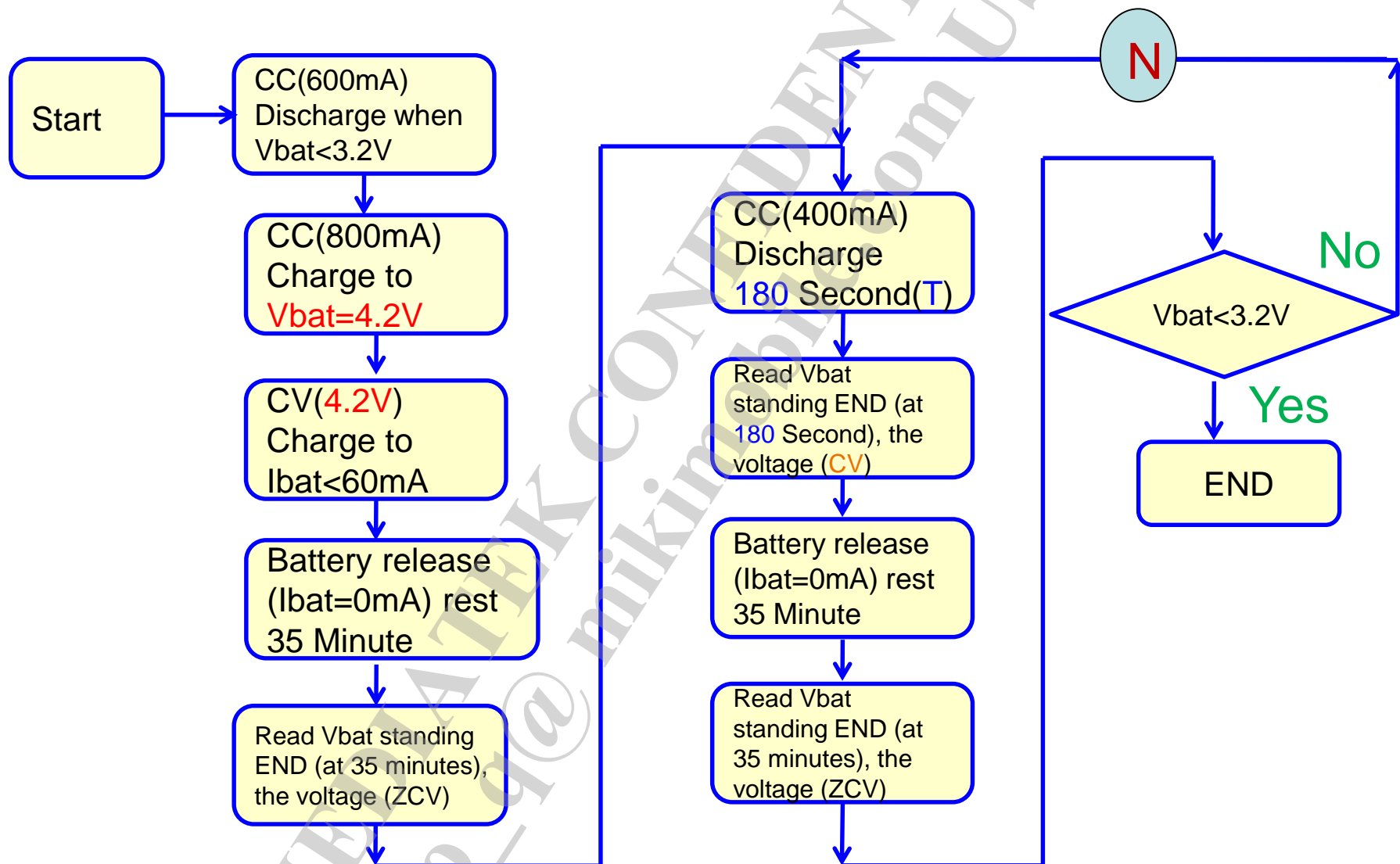


## ZCV table test method





# ZCV curve measured SOP



# ZCV curve measured SOP

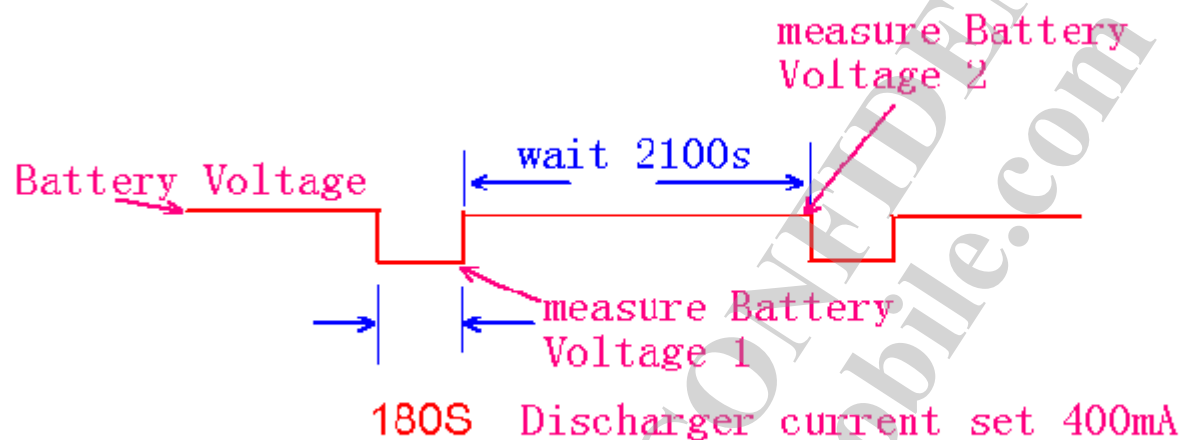
- Battery Full charge state
  - $V_{bat}=4.2V$   $I_{bat}<60mA$  (4.2V battery)
  - $V_{bat}=4.3V$  (4.35V)  $I_{bat}<60mA$ 
    - (4.3/4.35V HV battery)
- Battery Low charge state
  - $V_{bat}<3.2V$
- The setting of the discharge time (T)
  - Each discharge power capacity  $\Delta = 400mA * T = 20mAh$
  - $T=20/400h=180S$

## 放电 $\Delta$ mah Step select

Battery capacity( mah)	step ( mah)
< 1500	20
1500 ~ 2200	30
> 2500	50

**Note** : Number of cycles  $N > \text{battery capacity} / \Delta \text{ mah}$ .  
To ensure that after  $N$  times of discharge  $V_{\text{bat}} < 3.2\text{V}$

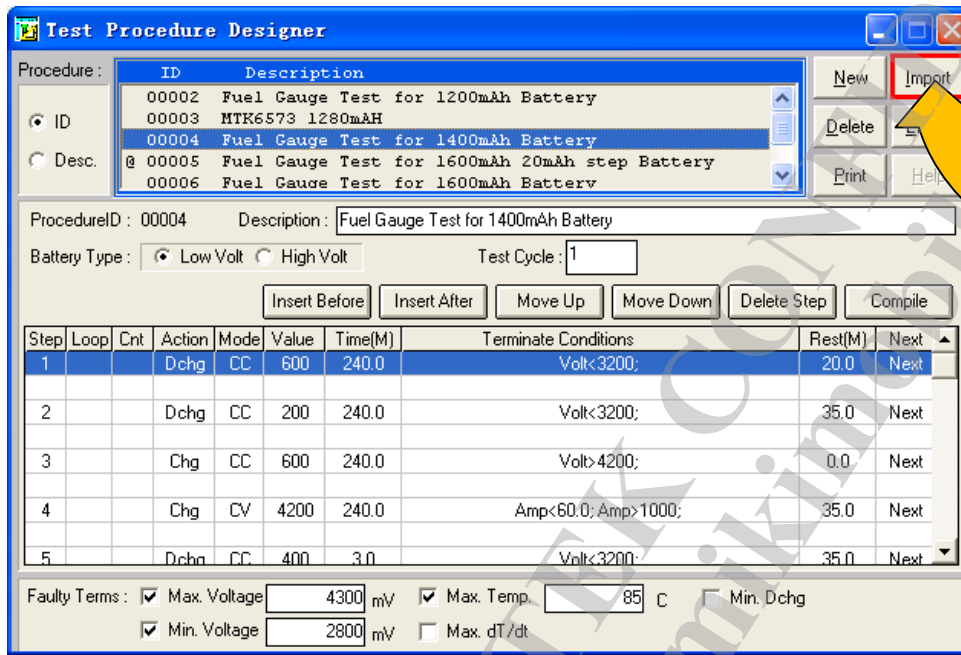
# Battery Voltage Measure



- Record Voltage :
- **ZCV** is Open-circuit voltage (V2)
- **CV** is Closed-circuit voltage(V1)
- $R_{\text{battery}} = (V2 - V1) / 400\text{mA}$

# Battery test method

- 1. The use BAT\_760 can be obtained from MTK test profile files to import the test procedures

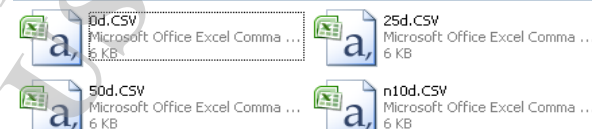


## Note :

Select the test battery capacity program  
Such as: 1500mah battery select 1600mah program

- 2. Other Li-ion charge and discharge test equipment customers need to own more of these tests to guide the preparation of the test program

# Battery test method



A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Cell	StepID	Cycle	Loop	Step	Action	Mode	Set Value	Status	Data	Init mV	Max mV	Final mV	Final mA	Step mAH	Acc mAH	Time (M)
1	1	1	0	1	Discharge	CC	600	Pass		3795	3795	3198	600	622	622	62.2
1	2	1	0	2	Discharge	CC	300	Pass		3410	3410	3200	301	11	633	2.3
1	3	1	0	3	Charge	CC	600	Pass		3318	4200	4200	601	1217	1217	121.6
1	4	1	0	4	Charge	CV	4200	Pass		4200	4203	4200	60	223	1440	60.5
1	5	1	0	5	Discharge	CC	400	Pass		4177	4177	4078	400	30	30	4.5
1	6	1	0	6	Discharge	CC	400	Pass		4153	4153	4055	400	30	60	4.5
1	48	1	0	48	Discharge	CC	400	Pass		3680	3680	3589	400	30	1313	4.5
1	49	1	0	49	Discharge	CC	400	Pass		3677	3677	3572	400	30	1343	4.5
1	50	1	0	50	Discharge	CC	400	Pass		3671	3671	3531	400	30	1373	4.5
1	51	1	0	51	Discharge	CC	400	Pass		3630	3630	3404	400	30	1403	4.5
1	52	1	0	52	Discharge	CC	400	Pass		3512	3512	3199	400	24	1427	3.6
1	53	1	0	53	Discharge	CC	400	Pass		3345	3345	3199	400	4	1431	0.7
1	54	1	0	54	Discharge	CC	400	Pass		3319	3319	3199	400	3	1434	0.4
1	55	1	0	55	Discharge	CC	400	Pass		3304	3304	3196	400	2	1435	0.3
1	56	1	0	56	Discharge	CC	400	Pass		3288	3288	3198	400	1	1436	0.2
1	57	1	0	57	Discharge	CC	400	Pass		3280	3280	3200	400	1	1437	0.1
1	58	1	0	58	Discharge	CC	400	Pass		3274	3274	3196	400	1	1438	0.1
1	59	1	0	59	Discharge	CC	400	Pass		3269	3269	3196	400	0	1438	0.1

Record measurement data to determine test results:

1. Testing under 25 degrees, the end of the the VBAT open circuit voltage <3.4V, or the need to increase the number of discharge cycles N

Low temperatures, the battery internal resistance VBAT open circuit voltage may not be reduced to 3.4V, the number of test cycles N is use to 25 degrees.

2. CV charge final current need 60mA, otherwise increase the charging time.



# BAT760 Testing System User Manual



# Outline

- Fuel Gauge Data testing methods
- Fuel Gauge Test data processing and fill



# Testing process

- 1: Click on the Dock icon and select DOCK 01, entered the channel list

The screenshot displays the ATEK Battery Testing System software interface. The main window is the 'Test Status Monitor' for Dock 01, showing a list of 8 channels. A red box highlights the 'Dock' dropdown menu, which is open, showing 'ALL DOCKS' and 'DOCK 01'. A blue arrow points from the 'DOCK 01' option to the 'Test Status Monitor' window. The 'Test Status Monitor' window shows the status of 8 channels (1-8) and their respective test parameters. The 'Test Procedure Designer' window is also visible, showing a list of test procedures and a table of test steps.

**Test Status Monitor (Dock 01) Channel List:**

Channel	Status	Mode	Current	Voltage	mAH	Temp.	Set Amp	Cycle	Step	Step Time
1	Resting		0 mA	4112 mV		5.2		1	8.0	771
2	Ready		0 mA	0 mV		3.5				
3	Ready		0 mA	-2 mV		3.7				
4	Resting		0 mA	4064 mV		3.1		1	8.0	1814
5	Ready		0 mA	-1 mV		31.4				
6	Ready		0 mA	-1 mV		31.3				
7	Ready		0 mA							
8	Ready		0 mA							

**Test Procedure Designer:**

ProcedureID: 00005 Description: Fuel Gauge Test for 1600mAh 20mAh step Battery

Battery Type: ☒ Low Volt ☐ High Volt Test Cycle: 1

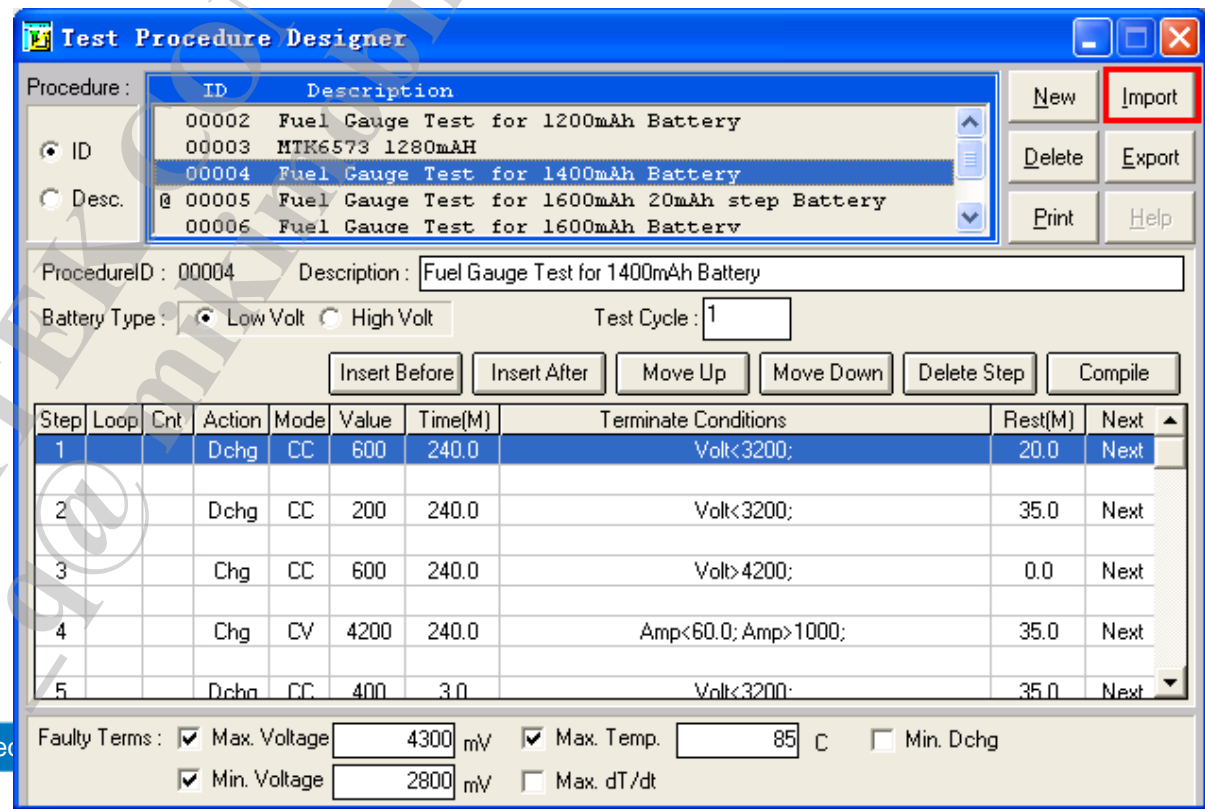
Insert Before Insert After Move Up Move Down Delete Step Compile

Step	Loop	Cnt	Action	Mode	Value	Time(M)	Terminate Conditions	Rest(M)	Next
1			Dchg	CC	600	240.0	Volt<3200;	20.0	Next
2			Dchg	CC	200	240.0	Volt<3200;	20.0	Next
3			Chg	CC	600	240.0	Volt<4200;	0.0	Next
4			Chg	CV	4200	240.0	Amp<60.0; Amp>800;	35.0	Next
5			Dchg	CC	400	3.0	Volt<3200;	35.0	Next

Faulty Terms: ☒ Max. Voltage 4300 mV ☒ Max. Temp. 85 C ☐ Min. Dchg  
☒ Min. Voltage 2800 mV ☐ Max. dT/dt

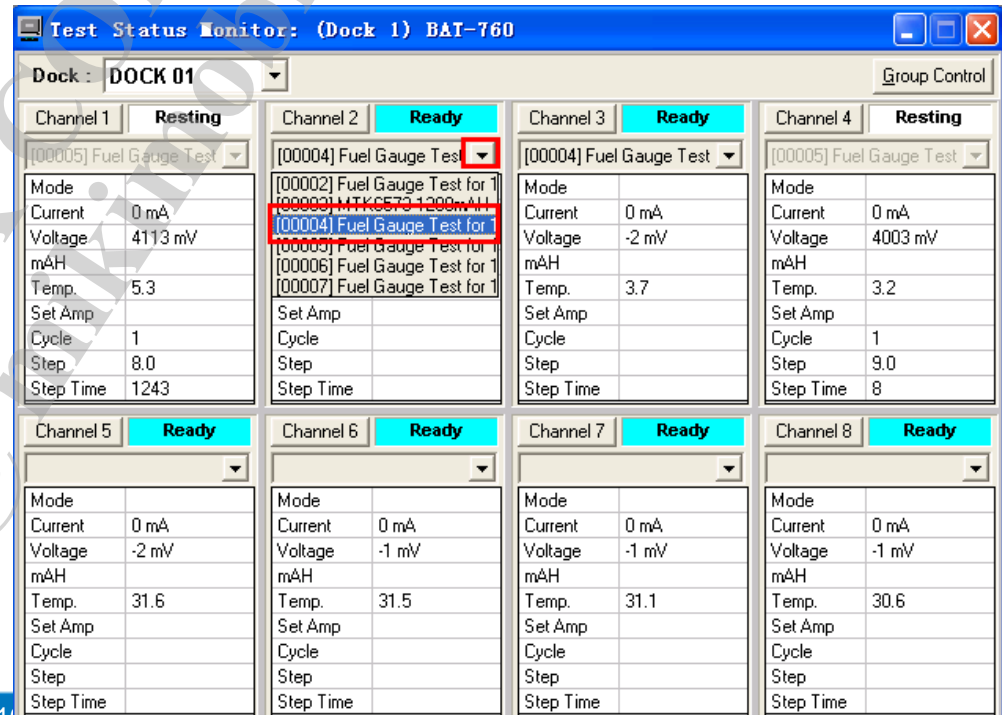
# Testing process

- 2: Open the “Test Procedure Designer”, as shown below. Test Procedure Designer is mainly used for the preparation of the test program, and then automate the process of testing.
- 3: Can also Import test profile files to automate the process of testing.



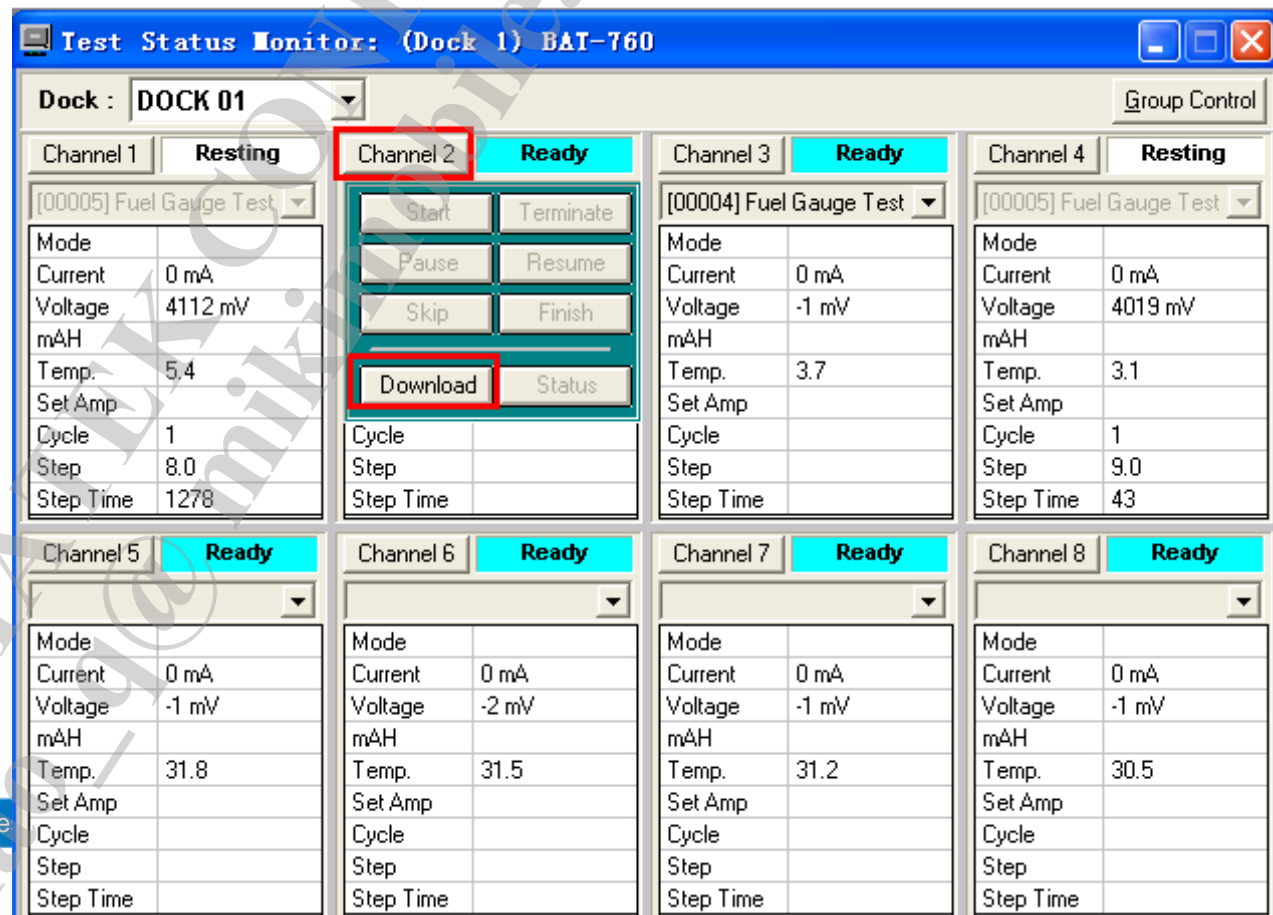
# Testing process

- 4: For the procedure of the test channel selection. Click the drop-down icon for the channel, the channel can be selected test program will pop up, you need to test the capacity of the corresponding program.



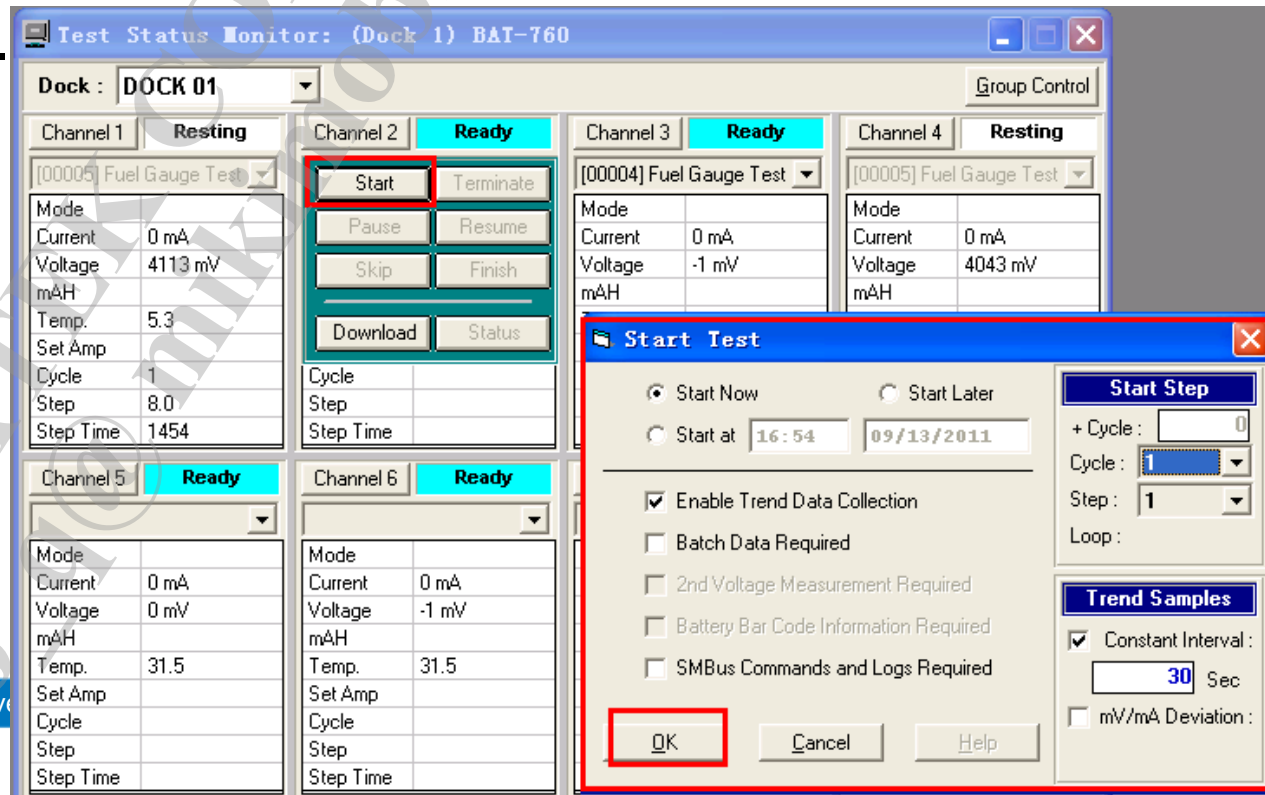
# Testing process

- 5: Click on the channel icon will pop up instruction execution box, and click the "Download" icon, the corresponding test program has been downloaded to the instrument.



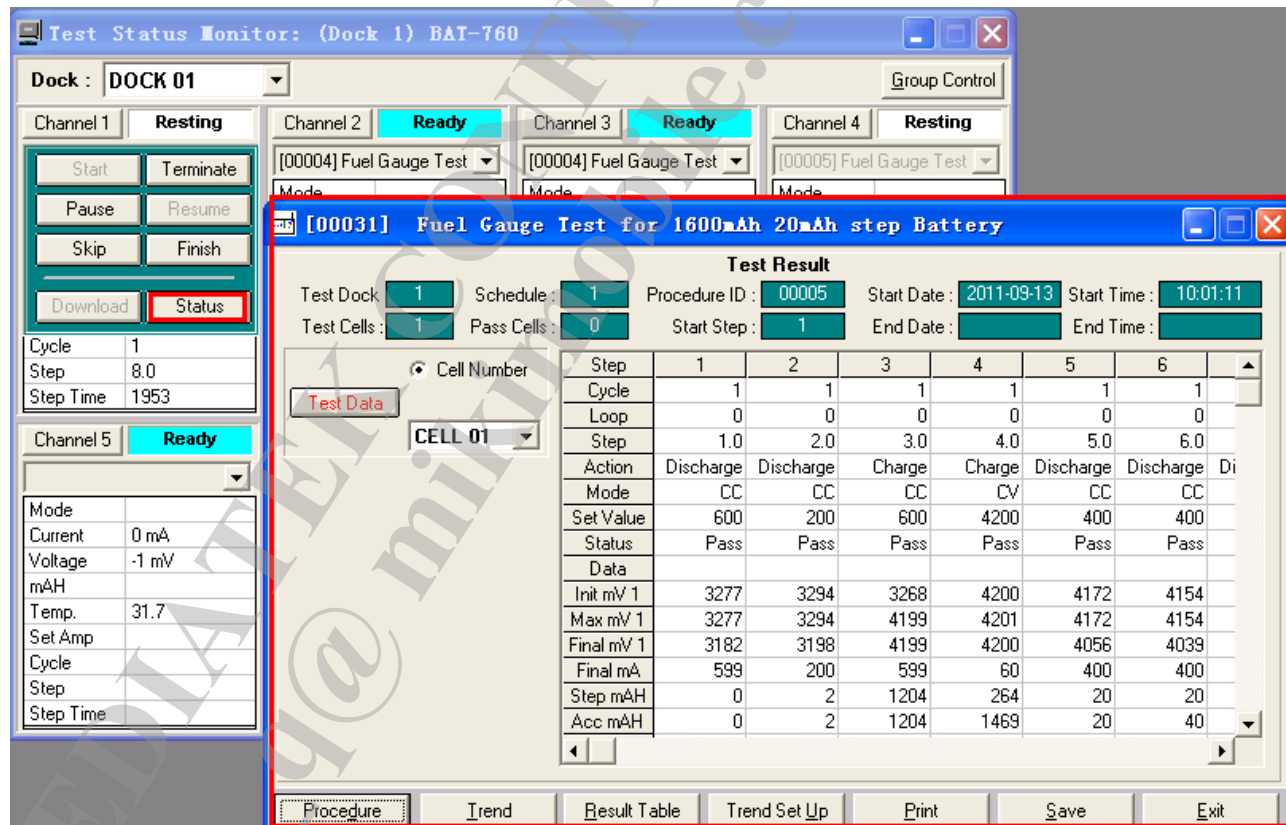
# Testing process

- 6: Program after the download is complete, click on the "Channel" icon, the pop-up to execute instructions, this time click "Start" icon, then the "Start Test Options dialog box will pop up the settings in the dialog box without modification, just click" OK"button to start the test. After the program will automatically test.



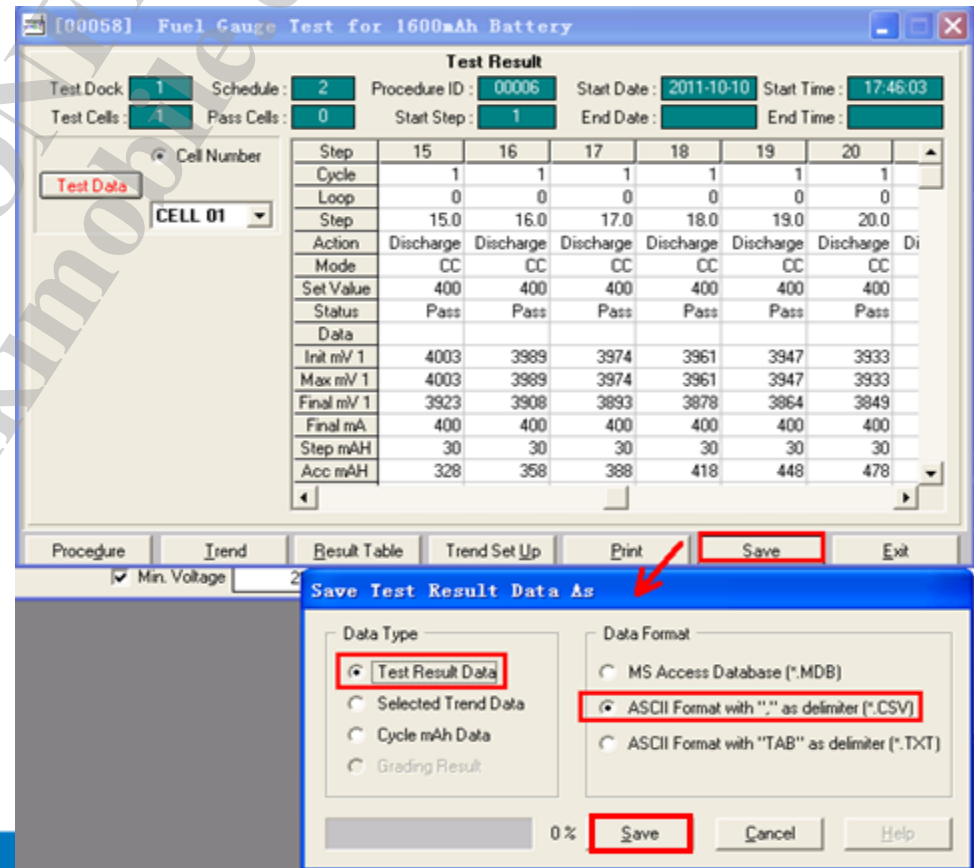
# Testing process

- 7: In the Status window, we can see the status of each test step and test progress.



# Testing process

- 8: Click "Save" icon in the corresponding channel "Status" window below will pop up the Save dialog box, check the icon option, then click the "Save" button to save.





## Raw data process





# Test data processing

- 1: The raw data exported from the instrument as follows, the file format is CSV, you can open with Excel. The test data consists of four temperature -10 degrees, 0 degrees, 25 degrees, 50 degrees, so a four-test data.



# Test data processing

- 2: The raw data as follows.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Cell	StepID	Cycle	Loop	Step	Action	Mode	Set Value	Status	Data	Init mV	Max mV	Final mV	Final mA	Step mAh	Acc mAh	Time (M)
2	1	1	1	0	1	Discharge	CC	600	Pass		3300	3300	3177	600	0	0	0
3	1	2	1	0	2	Discharge	CC	200	Pass		3285	3285	3199	201	3	3	0.9
4	1	3	1	0	3	Charge	CC	600	Pass		3254	4199	4199	599	1321	1321	132.3
5	1	4	1	0	4	Charge	CV	4200	Pass		4199	4200	4200	60	150	1471	39.2
6	1	5	1	0	5	Discharge	CC	400	Pass		4181	4181	4096	400	20	20	3
7	1	6	1	0	6	Discharge	CC	400	Pass		4163	4163	4080	400	20	40	3
8	1	7	1	0	7	Discharge	CC	400	Pass		4147	4147	4065	400	20	60	3
9	1	8	1	0	8	Discharge	CC	400	Pass		4132	4132	4051	400	20	80	3
10	1	9	1	0	9	Discharge	CC	400	Pass		4117	4117	4037	400	20	100	3
11	1	10	1	0	10	Discharge	CC	400	Pass		4104	4104	4023	400	20	120	3
12	1	11	1	0	11	Discharge	CC	400	Pass		4091	4091	4010	400	20	140	3
13	1	12	1	0	12	Discharge	CC	400	Pass		4079	4079	3998	400	20	160	3
14	1	13	1	0	13	Discharge	CC	400	Pass		4066	4066	3986	400	20	180	3
15	1	14	1	0	14	Discharge	CC	400	Pass		4055	4055	3974	400	20	200	3
16	1	15	1	0	15	Discharge	CC	400	Pass		4043	4043	3962	400	20	220	3
17	1	16	1	0	16	Discharge	CC	400	Pass		4032	4032	3950	400	20	240	3
18	1	17	1	0	17	Discharge	CC	400	Pass		4020	4020	3939	400	20	259	3
19	1	18	1	0	18	Discharge	CC	400	Pass		4010	4010	3928	400	20	279	3
20	1	19	1	0	19	Discharge	CC	400	Pass		3999	3999	3918	400	20	299	3
21	1	20	1	0	20	Discharge	CC	400	Pass		3989	3989	3907	400	20	319	3
22	1	21	1	0	21	Discharge	CC	400	Pass		3979	3979	3897	400	20	339	3
23	1	22	1	0	22	Discharge	CC	400	Pass		3969	3969	3887	400	20	359	3
24	1	23	1	0	23	Discharge	CC	400	Pass		3961	3961	3877	400	20	379	3
25	1	24	1	0	24	Discharge	CC	400	Pass		3952	3952	3868	400	20	399	3

steps of the current test

Test behavior

Test mode

Parameter settings for the current test

the step test, the initial voltage

the step test, the Max voltage

the step test, the final voltage

the step test, the final current

Battery to run the single-step time

Battery accumulated capacity

# Test data processing

- 3: Open a data template that is used for data collection

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
5MHz	DO	VC	man	Raman	DO	R(1000)	5MHz	DO	VC	man	Raman	DO	R(1000)	5MHz	DO	VC	man	Raman	DO	R(1000)	5MHz	DO	VC	man	Raman	DO	R(1000)
1	4120	0	0.133	0	0	125	4120	0	0	0	0	0	125	4120	0	0	0	0	0	125	4120	0	0	0	0	125	4120
2	4175	4121	20	0.133	1	125	4175	4121	20	0.133	1	125	4175	4121	20	0.133	1	125	4175	4121	20	0.133	1	125	4175	4121	20
3	4161	4107	40	0.133	2	125	4161	4107	40	0.133	2	125	4161	4107	40	0.133	2	125	4161	4107	40	0.133	2	125	4161	4107	40
4	4148	4092	80	0.133	3	125	4148	4092	80	0.133	3	125	4148	4092	80	0.133	3	125	4148	4092	80	0.133	3	125	4148	4092	80
5	4136	4081	80	0.133	5	125	4136	4081	80	0.133	5	125	4136	4081	80	0.133	5	125	4136	4081	80	0.133	5	125	4136	4081	80
6	4128	4069	100	0.133	7	125	4128	4069	100	0.133	7	125	4128	4069	100	0.133	7	125	4128	4069	100	0.133	7	125	4128	4069	100
7	4111	4056	100	0.133	8	125	4111	4056	100	0.133	8	125	4111	4056	100	0.133	8	125	4111	4056	100	0.133	8	125	4111	4056	100
8	4094	4044	140	0.133	9	125	4094	4044	140	0.133	9	125	4094	4044	140	0.133	9	125	4094	4044	140	0.133	9	125	4094	4044	140
9	4088	4032	180	0.133	10	125	4088	4032	180	0.133	10	125	4088	4032	180	0.133	10	125	4088	4032	180	0.133	10	125	4088	4032	180
10	4077	4019	180	0.133	11	125	4077	4019	180	0.133	11	125	4077	4019	180	0.133	11	125	4077	4019	180	0.133	11	125	4077	4019	180
11	4066	4007	200	0.133	12	125	4066	4007	200	0.133	12	125	4066	4007	200	0.133	12	125	4066	4007	200	0.133	12	125	4066	4007	200
12	4054	3997	220	0.133	13	125	4054	3997	220	0.133	13	125	4054	3997	220	0.133	13	125	4054	3997	220	0.133	13	125	4054	3997	220
13	4044	3986	240	0.133	14	125	4044	3986	240	0.133	14	125	4044	3986	240	0.133	14	125	4044	3986	240	0.133	14	125	4044	3986	240
14	4031	3974	259	0.133	15	125	4031	3974	259	0.133	15	125	4031	3974	259	0.133	15	125	4031	3974	259	0.133	15	125	4031	3974	259
15	4021	3964	279	0.133	16	125	4021	3964	279	0.133	16	125	4021	3964	279	0.133	16	125	4021	3964	279	0.133	16	125	4021	3964	279
16	4011	3954	299	0.133	17	125	4011	3954	299	0.133	17	125	4011	3954	299	0.133	17	125	4011	3954	299	0.133	17	125	4011	3954	299
17	4001	3944	318	0.133	18	125	4001	3944	318	0.133	18	125	4001	3944	318	0.133	18	125	4001	3944	318	0.133	18	125	4001	3944	318
18	3990	3934	339	0.133	19	125	3990	3934	339	0.133	19	125	3990	3934	339	0.133	19	125	3990	3934	339	0.133	19	125	3990	3934	339
19	3980	3922	359	0.133	20	125	3980	3922	359	0.133	20	125	3980	3922	359	0.133	20	125	3980	3922	359	0.133	20	125	3980	3922	359
20	3970	3910	379	0.133	21	125	3970	3910	379	0.133	21	125	3970	3910	379	0.133	21	125	3970	3910	379	0.133	21	125	3970	3910	379
21	3960	3900	399	0.133	22	125	3960	3900	399	0.133	22	125	3960	3900	399	0.133	22	125	3960	3900	399	0.133	22	125	3960	3900	399
22	3950	3890	419	0.133	23	125	3950	3890	419	0.133	23	125	3950	3890	419	0.133	23	125	3950	3890	419	0.133	23	125	3950	3890	419
23	3940	3880	439	0.133	24	125	3940	3880	439	0.133	24	125	3940	3880	439	0.133	24	125	3940	3880	439	0.133	24	125	3940	3880	439
24	3930	3870	459	0.133	25	125	3930	3870	459	0.133	25	125	3930	3870	459	0.133	25	125	3930	3870	459	0.133	25	125	3930	3870	459
25	3920	3860	479	0.133	26	125	3920	3860	479	0.133	26	125	3920	3860	479	0.133	26	125	3920	3860	479	0.133	26	125	3920	3860	479
26	3910	3850	499	0.133	27	125	3910	3850	499	0.133	27	125	3910	3850	499	0.133	27	125	3910	3850	499	0.133	27	125	3910	3850	499
27	3900	3840	519	0.133	28	125	3900	3840	519	0.133	28	125	3900	3840	519	0.133	28	125	3900	3840	519	0.133	28	125	3900	3840	519
28	3890	3830	539	0.133	29	125	3890	3830	539	0.133	29	125	3890	3830	539	0.133	29	125	3890	3830	539	0.133	29	125	3890	3830	539
29	3880	3820	559	0.133	30	125	3880	3820	559	0.133	30	125	3880	3820	559	0.133	30	125	3880	3820	559	0.133	30	125	3880	3820	559
30	3870	3810	579	0.133	31	125	3870	3810	579	0.133	31	125	3870	3810	579	0.133	31	125	3870	3810	579	0.133	31	125	3870	3810	579
31	3860	3800	599	0.133	32	125	3860	3800	599	0.133	32	125	3860	3800	599	0.133	32	125	3860	3800	599	0.133	32	125	3860	3800	599
32	3850	3790	619	0.133	33	125	3850	3790	619	0.133	33	125	3850	3790	619	0.133	33	125	3850	3790	619	0.133	33	125	3850	3790	619
33	3840	3780	639	0.133	34	125	3840	3780	639	0.133	34	125	3840	3780	639	0.133	34	125	3840	3780	639	0.133	34	125	3840	3780	639
34	3830	3770	659	0.133	35	125	3830	3770	659	0.133	35	125	3830	3770	659	0.133	35	125	3830	3770	659	0.133	35	125	3830	3770	659
35	3820	3760	679	0.133	36	125	3820	3760	679	0.133	36	125	3820	3760	679	0.133	36	125	3820	3760	679	0.133	36	125	3820	3760	679
36	3810	3750	699	0.133	37	125	3810	3750	699	0.133	37	125	3810	3750	699	0.133	37	125	3810	3750	699	0.133	37	125	3810	3750	699
37	3800	3740	719	0.133	38	125	3800	3740	719	0.133	38	125	3800	3740	719	0.133	38	125	3800	3740	719	0.133	38	125	3800	3740	719
38	3790	3730	739	0.133	39	125	3790	3730	739	0.133	39	125	3790	3730	739	0.133	39	125	3790	3730	739	0.133	39	125	3790	3730	739
39	3780	3720	759	0.133	40	125	3780	3720	759	0.133	40	125	3780	3720	759	0.133	40	125	3780	3720	759	0.133	40	125	3780	3720	759
40	3770	3710	779	0.133	41	125	3770	3710	779	0.133	41	125	3770	3710	779	0.133	41	125	3770	3710	779	0.133	41	125	3770	3710	779
41	3760	3700	799	0.133	42	125	3760	3700	799	0.133	42	125	3760	3700	799	0.133	42	125	3760	3700	799	0.133	42	125	3760	3700	799
42	3750	3690	819	0.133	43	125	3750	3690	819	0.133	43	125	3750	3690	819	0.133	43	125	3750	3690	819	0.133	43	125	3750	3690	819
43	3740	3680	839	0.133	44	125	3740	3680	839	0.133	44	125	3740	3680	839	0.133	44	125	3740	3680	839	0.133	44	125	3740	3680	839
44	3730	3670	859	0.133	45	125	3730	3670	859	0.133	45	125	3730	3670	859	0.133	45	125	3730	3670	859	0.133	45	125	3730	3670	859
45	3720	3660	879	0.133	46	125	3720	3660	879	0.133	46	125	3720	3660	879	0.133	46	125	3720	3660	879	0.133	46	125	3720	3660	879
46	3710	3650	899	0.133	47	125	3710	3650	899	0.133	47	125	3710	3650	899	0.133	47	125	3710	3650	899	0.133	47	125	3710	3650	899
47	3700	3640	919	0.133	48	125	3700	3640	919	0.133	48	125	3700	3640	919	0.133	48	125	3700	3640	919	0.133	48	125	3700	3640	919
48	3690	3630	939	0.133	49	125	3690	3630	939	0.133	49	125	3690	3630	939	0.133	49	125	3690	3630	939	0.133	49	125	3690	3630	939
49	3680	3620	959	0.133	50	125	3680	3620	959	0.133	50	125	3680	3620	959	0.133	50	125	3680	3620	959	0.133	50	125	3680	3620	959
50	3670	3610	979	0.133	51	125	3670	3610	979	0.133	51	125	3670														

# Test data processing

- 4: Template data corresponding to the column meaning, usually we fill in the OCV, the VC, mAh, the data of the Qmax. R (battery), DOD, the R (x1000) data will automatically generated.

	A	B	C	D	E	F	G
1	50 °C	OCV	VC	mAh	R(battery)	DOD	R(x1000)
2		4189		0	0.135	0	135
3		4175	4121	20	0.135	1	135
4		4161	4107	40	0.135	3	135
5		4148	4092	60	0.14	4	140
6		4136	4081	80	0.1375	5	138
7		4125	4069	100	0.14	7	140
8		4111	4056	120	0.1375	8	138
9		4099	4044	140	0.1375	9	138
10		4088	4032	160	0.14	11	140
11		4077	4019	180	0.145	12	145
12		4066	4007	200	0.1475	13	148
13		4054	3997	220	0.1425	15	143
14		4044	3985	240	0.1475	16	148
15		4031	3974	259	0.1425	17	143
16		4021	3964	279	0.1425	19	143
17		4011	3954	299	0.1425	20	143
18		4002	3944	319	0.145	21	145
19		3993	3934	339	0.1475	23	148
20		3984	3922	359	0.155	24	155
21		3973	3913	379	0.15	25	150
22		3965	3906	399	0.1475	27	148
23		3956	3897	419	0.1475	28	148
24		3948	3888	439	0.15	29	150

# Test data processing

- 5: Empty template original OCV of VC, mAh column corresponds to the data, as for example 50 degrees of data.

	A	B	C	D	E	F	G
1	50 °C	OCV	VC	mAh	R(battery)	DOD	R(x1000)
2					0	0	0
3					0	0	0
4					0	0	0
5					0	0	0
6					0	0	0
7					0	0	0
8					0	0	0
9					0	0	0
10					0	0	0
11					0	0	0
12					0	0	0
13					0	0	0
14					0	0	0
15					0	0	0

# Test data processing

- 6: Raw data Init mV, a copy the data to the OCV column of the template, pay attention to fill in on line 2, the voltage data is copied to line 5 Discharge corresponding voltage from the original data.

	B	C	D	E	F	G
1	50 °C	VC	mAh	R(battery)	DOD	R(x1000)
2	OCV					
3	4181				0	
4	4163			10.4075	0	10408
5	4147			10.3675	0	10368
6	4132			10.33	0	10330
7	4117			10.2925	0	10293
8	4104			10.26	0	10260
9	4091			10.2275	0	10228
10	4079			10.1975	0	10198
11	4066			10.165	0	10165
12	4055			10.1375	0	10138
13	4043			10.1075	0	10108
14	4032			10.08	0	10080
15	4020			10.05	0	10050
16	4010			10.025	0	10025
17	3999			9.9975	0	9998
18	3989			9.9725	0	9973
19	3979			9.9475	0	9948
20	3969			9.9225	0	9923
21	3961			9.9025	0	9903
22	3952			9.88	0	9880
23	3942			9.855	0	9855
24	3935			9.8375	0	9838
25	3927			9.8175	0	9818

E	F	G	H	I	J	K	L	M
Step	Action	Mode	Set Value	Status	Data	Init mV 1	Max mV 1	Final mV 1
1	Discharge	CC	600	Pass		3300	3300	3177
2	Discharge	CC	200	Pass		3285	3285	3199
3	Charge	CC	600	Pass		3254	4199	4199
4	Charge	CV	4200	Pass		4199	4200	4200
5	Discharge	CC	400	Pass		4181	4181	4096
6	Discharge	CC	400	Pass		4163	4163	4080
7	Discharge	CC	400	Pass		4147	4147	4065
8	Discharge	CC	400	Pass		4132	4132	4051
9	Discharge	CC	400	Pass		4117	4117	4037
10	Discharge	CC	400	Pass		4104	4104	4023
11	Discharge	CC	400	Pass		4091	4091	4010
12	Discharge	CC	400	Pass		4079	4079	3998
13	Discharge	CC	400	Pass		4066	4066	3986
14	Discharge	CC	400	Pass		4055	4055	3974
15	Discharge	CC	400	Pass		4043	4043	3962
16	Discharge	CC	400	Pass		4032	4032	3950
17	Discharge	CC	400	Pass		4020	4020	3939
18	Discharge	CC	400	Pass		4010	4010	3928
19	Discharge	CC	400	Pass		3999	3999	3918
20	Discharge	CC	400	Pass		3989	3989	3907
21	Discharge	CC	400	Pass		3979	3979	3897
22	Discharge	CC	400	Pass		3969	3969	3887
23	Discharge	CC	400	Pass		3961	3961	3877
24	Discharge	CC	400	Pass		3952	3952	3868
25	Discharge	CC	400	Pass		3942	3942	3859
26	Discharge	CC	400	Pass		3935	3935	3849
27	Discharge	CC	400	Pass		3927	3927	3840



# Test data processing

- 7: Raw data Init mV, a copy the data to the VC column of the template, pay attention to fill in on line 3, the voltage data is copied to line 5 Discharge corresponding voltage from the original data.

50 °C																
	B	C	D	E	F	G	E	F	G	H	I	J	K	L	M	N
	OCV	VC	mAh	R(battery)	DOD	R(x1000)	Step	Action	Mode	Set Value	Status	Data	Init mV 1	Max mV 1	Final mV 1	Final mA
2	4181				0	168	1	Discharge	CC	600	Pass		3300	3300	3177	600
3	4163	4096		0.1675	0	168	2	Discharge	CC	200	Pass		3285	3285	3199	201
4	4147	4080		0.1675	0	168	3	Charge	CC	600	Pass		3254	4199	4199	599
5	4132	4065		0.1675	0	168	4	Charge	CV	4200	Pass		4199	4200	4200	60
6	4117	4051		0.165	0	165	5	Discharge	CC	400	Pass		4181	4181	4096	400
7	4104	4037		0.1675	0	168	6	Discharge	CC	400	Pass		4165	4165	4080	400
8	4091	4023		0.17	0	170	7	Discharge	CC	400	Pass		4147	4147	4065	400
9	4079	4010		0.1725	0	173	8	Discharge	CC	400	Pass		4132	4132	4051	400
10	4066	3998		0.17	0	170	9	Discharge	CC	400	Pass		4117	4117	4037	400
11	4055	3986		0.1725	0	173	10	Discharge	CC	400	Pass		4104	4104	4023	400
12	4043	3974		0.1725	0	173	11	Discharge	CC	400	Pass		4091	4091	4010	400
13	4032	3962		0.175	0	175	12	Discharge	CC	400	Pass		4079	4079	3998	400
14	4020	3950		0.175	0	175	13	Discharge	CC	400	Pass		4066	4066	3986	400
15	4010	3939		0.1775	0	178	14	Discharge	CC	400	Pass		4055	4055	3974	400
16	3999	3928		0.1775	0	178	15	Discharge	CC	400	Pass		4043	4043	3962	400
17	3989	3918		0.1775	0	178	16	Discharge	CC	400	Pass		4032	4032	3950	400
18	3979	3907		0.18	0	180	17	Discharge	CC	400	Pass		4020	4020	3939	400
19	3969	3897		0.18	0	180	18	Discharge	CC	400	Pass		4010	4010	3928	400
20	3961	3887		0.185	0	185	19	Discharge	CC	400	Pass		3999	3999	3918	400
21	3952	3877		0.1875	0	188	20	Discharge	CC	400	Pass		3989	3989	3907	400
22	3942	3868		0.185	0	185	21	Discharge	CC	400	Pass		3979	3979	3897	400
23	3935	3859		0.19	0	190	22	Discharge	CC	400	Pass		3969	3969	3887	400
24	3927	3849		0.195	0	195	23	Discharge	CC	400	Pass		3961	3961	3877	400
25	3918	3840		0.195	0	195										

# Test data processing

- 8: Copy the data to raw data Acc mAH column mAh column of the template, pay attention to fill in line 3, the voltage data is copied from the original data line 5 Discharge corresponding to the cumulative power. Power value of the line 2 of the template, fill in 0.

	A	B	C	D	E
1	50 °C	OCV	VC	mAh	R(battery)
2		4181		0	
3		4163	4096	20	0.1675
4		4147	4080	40	0.1675
5		4132	4065	60	0.1675
6		4117	4051	80	0.165
7		4104	4037	100	0.1675
8		4091	4023	120	0.17
9		4079	4010	140	0.1725
10		4066	3998	160	0.17
11		4055	3986	180	0.1725
12		4043	3974	200	0.1725
13		4032	3962	220	0.175
14		4020	3950	240	0.175
15		4010	3939	259	0.1775
16		3999	3928	279	0.1775
17		3989	3918	299	0.1775
18		3979	3907	319	0.18
19		3969	3897	339	0.18
20		3961	3887	359	0.185
21		3952	3877	379	0.1875

K	L	M	N	O	P	Q
Init mV 1	Max mV 1	Final mV 1	Final mA	Step mAH	Acc mAH	Time (M)
3300	3300	3177	600	0	0	0
3285	3285	3199	201	3	3	0.9
3254	4199	4199	599	1321	1321	132.3
4199	4200	4200	60	150	1471	39.2
4181	4181	4096	400	20	20	3
4163	4163	4080	400	20	40	3
4147	4147	4065	400	20	60	3
4132	4132	4051	400	20	80	3
4117	4117	4037	400	20	100	3
4104	4104	4023	400	20	120	3
4091	4091	4010	400	20	140	3
4079	4079	3998	400	20	160	3
4066	4066	3986	400	20	180	3
4055	4055	3974	400	20	200	3
4043	4043	3962	400	20	220	3
4032	4032	3950	400	20	240	3
4020	4020	3939	400	20	259	3
4010	4010	3928	400	20	279	3
3999	3999	3918	400	20	299	3
3989	3989	3907	400	20	319	3
3979	3979	3897	400	20	339	3
3969	3969	3887	400	20	359	3
3961	3961	3877	400	20	379	3



# Test data processing

- 9: Fill in the data are misplaced, so the the OCV column at the end of data one, so the top row of data is copied to the line can be.

71		3652	3572	1377	0.2	92	200	70		3661	3585	1357	0.19	90	190
72		3616	3536	1397	0.2	93	200	71		3652	3572	1377	0.2	92	200
73		3547	3464	1417	0.2075	94	208	72		3616	3536	1397	0.2	93	200
74		3446	3355	1437	0.2275	96	228	73		3547	3464	1417	0.2075	94	208
75		3309	3199	1454	0.275	97	275	74		3446	3355	1437	0.2275	96	228
76		3288	3198	1457	0.225	97	225	75		3309	3199	1454	0.275	97	275
77			3198	1458	-7.995	97	-7.995	76		3288	3198	1457	0.225	97	225
78					0	0	0	77					0.225	97	225
79					0	0	0	78					0	0	0
80					0	0	0	79					0	0	0
81					0	0	0	80					0	0	0
82					0	0	0	81					0	0	0
83								82					0	0	0
84		Cmax		1500				83							
85		Cmax_400mA		1487				84		Cmax		1500			
								85		Cmax_400mA		1487			

# Test data processing

- 10: Filled the length of the data, the last row of data is populated, so the data length is the same length.

70		3661	3585	1357	0.19	90	190	70		3661	3585	1357	0.19	90	190
71		3652	3572	1377	0.2	92	200	71		3652	3572	1377	0.2	92	200
72		3616	3536	1397	0.2	93	200	72		3616	3536	1397	0.2	93	200
73		3547	3464	1417	0.2075	94	208	73		3547	3464	1417	0.2075	94	208
74		3446	3355	1437	0.2275	96	228	74		3446	3355	1437	0.2275	96	228
75		3309	3199	1454	0.275	97	275	75		3309	3199	1454	0.275	97	275
76		3288	3198	1457	0.225	97	225	76		3288	3198	1457	0.225	97	225
77		3288	3198	1458	0.225	97	225	77		3288	3198	1458	0.225	97	225
78		3288	3198	1458	0.225	97	225	78					0	0	0
79		3288	3198	1458	0.225	97	225	79					0	0	0
80		3288	3198	1458	0.225	97	225	80					0	0	0
81		3288	3198	1458	0.225	97	225	81					0	0	0
82		3288	3198	1458	0.225	97	225	82					0	0	0
83								83							
84	Cmax			1500				84	Cmax			1500			
85	Cmax_400mA			1487				85	Cmax_400mA			1487			



# Test data processing

- 12. Calculation of Qmax\_400mA. We need to calculate the 3.4V shutdown voltage corresponding to the battery load capacity. Our measured data may not be exactly the voltage of 3.4V, so 3.4V corresponds to the power calculations. Right, fill in the data to the following power calculation tables, you can automatically calculate the battery capacity corresponding to 3.4V, and then power the calculated values to fill in to Qmax\_400mA data location, where the rounded fill 1428.743 should be counted as 1429. Note that the voltage VC corresponding to the column.

	A	B	C	D	E	F	G
	50 °C	OCV	VC	mAh	R(battery)	DOD	R(x1000)
70		3661	3585	1357	0.19	94	190
71		3652	3572	1377	0.2	95	200
72		3616	3536	1397	0.2	97	200
73		3547	3464	1417	0.2075	98	208
74		3446	3355	1437	0.2275	100	228
75		3309	3199	1454	0.275	101	275
76		3288	3198	1457	0.225	101	225
77		3288	3198	1458	0.225	101	225
78		3288	3198	1458	0.225	101	225
79		3288	3198	1458	0.225	101	225
80		3288	3198	1458	0.225	101	225
81		3288	3198	1458	0.225	101	225
82		3288	3198	1458	0.225	101	225
83							
84		Cmax		1443			
85		Cmax_400mA		1429			
86							
Battery capacity	x1(max)	x2(min)	y1(max)	y2(min)	y(result)		
	3464	3355	1417	1437	1428.743		
90							
91							
92							
93							
94							
95							
96							
97							

Phone  
shutdown  
voltage

3.4

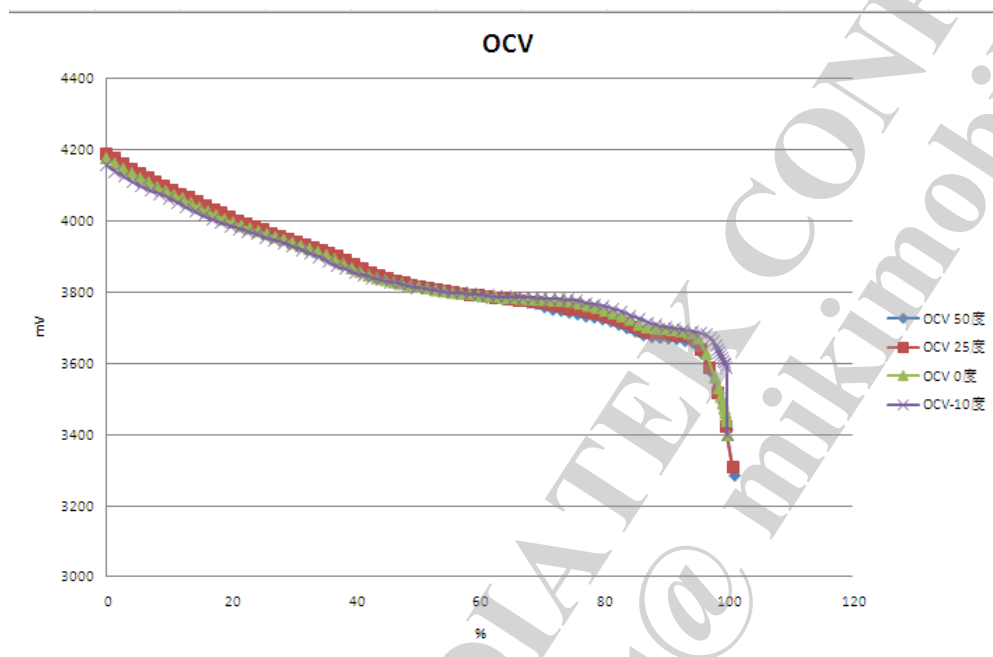
# Test data processing

- 13: Because the second line hasn't VC voltage, so the system can not directly calculate the battery's internal resistance, so we will line resistance value directly copied to the line 2 can be, so that an OCV voltage corresponding resistance values.

	A	B	C	D	E	F	G
1	50 °C	OCV	VC	mAh	R(battery)	DOD	R(x1000)
2		4189		0	0.135	0	135
3		4175	4121	20	0.135	1	135
4		4161	4107	40	0.135	3	135
5		4148	4092	60	0.14	4	140
6		4136	4081	80	0.1375	5	138
7		4125	4069	100	0.14	7	140
8		4111	4056	120	0.1375	8	138
9		4099	4044	140	0.1375	9	138
10		4088	4032	160	0.14	11	140
11		4077	4019	180	0.145	12	145

# Test data processing

- 14: After completion of the four temperature data fill curve of ZCV will automatically born generation, the curve is as follows.



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	12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