Application Note

A Method to Save Time from Chem ID Ready to Pack Sample Manufacturing

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ABSTRACT

This application note describes an improved method for implementing Texas Instruments' battery gauges that use the Impedance Track algorithm. While these gauges are popular across various devices including smartphones, notebooks, wearables, and industrial equipment, these gauges traditionally require a lengthy Chemical ID (Chem ID) setup and learning period before mass production can begin. The document outlines an alternative approach intended for experienced TI gauge users that can reduce the setup time by 1-2 weeks, streamlining the process from initial Chem ID configuration through to the creation of golden mass production files and battery pack sample manufacturing.

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Trademarks

Impedance Track™ is a trademark of Texas Instruments.
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1 Regular Process

1.1 Time Needed for Chem ID

For all TI gauges with Impedance Track algorithm, a correct Chem ID is needed. Generally, users need to send the cells to TI Dallas lab for Chem ID characterization. Please contact a local FAE for Chem ID request.

This can take approximately 1 week to send the cells to TI Dallas. This time is not controlled by TI.

Once TI Dallas Chem ID lab receives the cells, TI starts to run tests on those cells for characterization at 25°C, 0°C and 50°C. The basic idea is to charge the cell to full, and then discharge the cell with some amount of capacity, and relax for long enough time so that the cell voltage is stable enough. Then, read the cell voltage, which is the true open circuit voltage (OCV). Repeat discharge. Finally, an OCV VS DOD curve is achieved. The cell needs to be run at three temperatures points: 25°C, 0°C and 50°C.

After the test is finished, TI generates the Chem ID based on the test data. Then, release the Chem ID on TI.com: GASGAUGECHEM. Generally, the ChemUpdater is updated one or two times every week.

Note

All the test steps are run automatically; the time cannot be shortened. This can take approximately 4 weeks.

1.2 Time Needed for Golden Learning

For the detailed steps of golden learning, refer to the Achieving the Successful Learning Cycle application note. The application note details the relax-charge-relax-discharge-relax test, and this can take approximately 1 day.

After golden learning, users need to run tests to verify the accuracy at room temp. This can take approximately 1 day.

If there is something wrong during the golden learning or accuracy test at room temp, then users need to run GPCRA to improve the room temp performance.

For detailed instructions, refer to the Simple Guide to GPC Golden GG Maker Tool application note.

After GPCRA, users need to also run a room temp accuracy test to verify if the performance is improved.

1.3 Time Needed for Low Temperature Test

After golden learning and accuracy test at room temperature, users also need to perform an accuracy test at low temperature. This includes test items below. These tests can take approximately 3-4 days.

1. Charge at room temperature and discharge at low temperature.
2. Discharge at room temperature and charge at low temperature.
3. Charge at low temperature and discharge at low temperature.

If there is something wrong during the accuracy test at low temperature, then users need to run the Gauging Parameter Calculator (GPCRB). This optimizes room and low temperature performance Impedance Track gauges. This can also help to improve the low temperature performance.

For detailed instruction, users can refer to the Golden GG Maker and Resistance Temperature Compensation Optimizer application note.

After GPCRB, users need to also run room temperature and low temperature accuracy tests to verify if the performance gets improved. This can take approximately 4-5 days.

2 Scenarios for Very Tight Schedule

Some scenarios are listed below to show the schedule is very tight.

1. The schedule is delayed in the procedure before the cell is sent to TI. For example, the cell sample is delayed in the cell vendor side.
2. The material of the cell has some change after the cell has been sent to TI for Chem ID characterization. Need to resend the new cell.
3. Run into problems during shipment, like custom clearance issue. There has previously been such a scenario in the past.

In those cases, the schedule is very tight. Users typically want to save as much time as possible, even one day.

3 How to Shorten the Time

This application note provides an implementation which can help to save approximately 1-2 weeks from getting the Chem ID ready to golden MP files ready.

The basic idea is to make use of GPC tools: GPC Golden GG Maker Tool GPCRA0 and Golden GG Maker and Resistance Temperature Compensation Optimizer GPCRB.

GPCRA0 needs three files: config.txt, gg.csv and sysrate_rel_dis_rel.csv. An example of the content in the config.txt file is shown below. All data can be achieved before the Chem ID is released, except the Chem ID.

Note, that the log data (sysrate_rel_dis_rel.csv) can be achieved with the real xPyS pack (x cells in parallel and y cells in serial). The gg file gg.csv can be configured according to the xPyS pack, like Design Capacity.

Table 3-1. The config.txt file for GPCRA

ProcessingType=3	ProcessingType=3 is to tell the server this request is for GPCRA
ChemID=3616	Tell the server which Chem ID is used
NumCellSeries=2	Tell the server the pack configuration. For example, xPyS
ElapsedTimeColumn=0	Tell the server the column number of time in the log file
VoltageColumn=1	Tell the server the column number of voltage in the log file
CurrentColumn=2	Tell the server the column number of current in the log file
TemperatureColumn=3	Tell the server the column number of temperature in the log file

GPCRB needs four files: config.txt, gg.csv, lowtemp.csv and roomtemp.csv. An example of the content in the config.txt file is shown below. All data can be achieved before the Chem ID is released, except the Chem ID.

Note, that the log data (lowtemp.csv and roomtemp.csv) can be achieved with the real xPyS pack (x cells in parallel and y cells in serial). The gg file gg.csv can be configured according to the xPyS pack, like Design Capacity.

Table 3-2. The config.txt file for GPCRB

ProcessingType=4	ProcessingType=4 is to tell the server this request is for GPCRB
ChemID=2632	Tell the server which Chem ID is used
NumCellSeries=1	Tell the server the pack configuration. For example, xPyS
ElapsedTimeColumn=0	Tell the server the column number of time in the log file
VoltageColumn=1	Tell the server the column number of voltage in the log file
CurrentColumn=2	Tell the server the column number of current in the log file
TemperatureColumn=3	Tell the server the column number of temperature in the log file

The log data needs the physical measurement data: time, voltage, current and temperature. The data does not depend on which gauge to use, and also does not depend on if the gauge is well configured (calibration is needed to make sure the measurement accuracy of voltage, current and temperature). Users even can use the test equipment to achieve those data.

Users can start those requested tests for GPCRA0 and GPCRB to get the necessary log data, in parallel with Chem ID characterization. Brief test steps are listed below.

GPCRA0: charge to full, relax for 2 hours, discharge with system-typical high rate until the minimal voltage is hit, as specified by the cell manufacturer, then relax for 5 hours.

GPCRB: charge to full, relax for 2 hours, discharge under test temperature (25°C first, then 0°C or other low temperature of your choice) until the minimal voltage is hit, as specified by the cell manufacturer, then relax for 5 hours.

With those data and gg file ready, once the Chem ID is released, users can run GPCRA0 and GPCRB immediately and get the fine-tuned result within several minutes. Then, users can use those results to generate the golden file and start sample pack manufacturing to support based features test in the end customer side.

Table 3-3 shows that the new method can help customer to save 6 or 11 days.

Table 3-3. Days Needed with New Method VS Traditional Method

New Method (Days)	New Method (Days)	Traditional Method (Days)
Golden learning	0	1
Room temp accuracy test	0	1
Low temp accuracy test	0	4
Low temp accuracy test if GPCRB is needed	0	5

There can be a very low possibility that even after GPCRB, the low temperature performance is still not good enough. TI recommends to run golden learning, room temperature test, and low temperature test for verification. Go to the local FAE for support if the performance is not good.

Users are expected to bee familiar with GPCRA0 and GPCRB.

4 Summary

Texas Instruments' gauges with the Impedance Track™ algorithm are widely used in smartphones, notebooks, wearables, and even industrial applications. For all TI gauges with the Impedance Track algorithm, a correct Chem ID and learning is necessary before mass production, which can take several weeks. This application note provides a new method for users who are familiar with TI gauges and have experience on production. This method helps to save approximately 1-2 weeks on design; starting from initial Chem ID configuration to the creation of golden mass production files and battery pack sample manufacturing.

5 References

1. Texas Instruments, Achieving the Successful Learning Cycle, application note
2. Texas Instruments, Instruction Manual for GPC Golden GG Maker Tool GPCRA0, user's guide
3. Texas Instruments, Golden GG Maker and Resistance Temperature Compensation Optimizer, user's guide

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