The Method of Calibrating ATE while Test

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Abstract –**A method of calibrating the integrated circuit ATE (Automatic Test Equipment) by synchronizing and measuring the signal on the DUT(Device Under Test) side while test is presented. This method connects the measuring instruments to the pin of the DUT while calibration. The computer controls the measuring instrument to capture the changes and values of the voltage and current on each pin of the DUT during the test. The specifications of the ATE can be calculated though the measured data.Therefore ,the ATE is calibrated via compare it's primitive specifications and the measured one[1].**

Keywords – Calibration, ATE, Test

I. INTRODUCTION

The most popular and widely used calibration methods for the ATE are sub-calibration method, calibration board method, MAP calibration method and material measure method[2]. The principle is to execute a dedicated calibration software on the ATE system to drive or measure the signal what user configured and calibrated this signal by the measuring instrument directly except the standard material calibration method , as shown in figure 1.

However, The calibration methods above can not represent the accuracy of the test completely, they also can not demonstrate the actual performance of the ATE. First, the physical interfaces of measurement on the calibration board or trace board are not as same as the DUT socket, so are the measurements. Meanwhile, they're also impossible to program and debug a calibration software on each ATE system with varies of operation system and hardware platform.

This paper represents the new method for calibrating ATE on the DUT side while test. The measuring instruments are connect to each pin of the DUT appropriately, they measure voltage，current and the time parameter on the same position. When the test program is executed , the expected values or standard values like drive voltage, current and rising/ falling edge were known in the configuration file though the program, as soon as the program compared and analyzed with the measured values from the measuring instrument. Therefor, this parameter is calibrated. By this method, the calibration result is more reliable because the calibration interface is the same as the test interface. Meanwhile, the redundant channel were calibrated at the same time because the test vectors are executed in parallel. At last, a specific calibration program on the ATE is unnecessary because the method introduced in this paper calibrates the ATE by a general test program and it has nothing to do

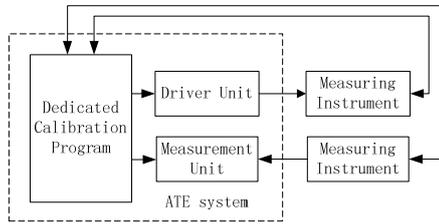with its hardware and operation system.

Fig 1. Basic principle of calibrating ATE

II.   PRINCIPLE

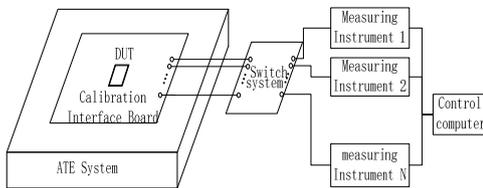### A. Calibration method

Figure 2. The hardware connection diagram

In order to calibrate the ATE while test, the measuring instruments will be connect to the pin of the DUT, as shown in Figure 2.Every pin of the DUT connects to the switch system via calibration interface board, and the switch system also connects to the measuring instruments. This calibration system was controlled by a control computer. When the test start, this calibration system measure the drive and response signal continuously and store the data in the control computer. Finally, the indications of the parameters in the ATE are calculated though the data and waveform, and the calibration is completed when comparing the indication and the configuration from the test program.

B. Synchronization method

Synchronization method is the most challenging part in this calibration method.

However, it's possible to recognize the ATE's behavior though the data via continuous measurement by measuring instrument. Because the primary test procedure is to test while execute a certain vector repetitively. The waveform for a test procedure was shown in Figure 3.

As soon as the test period is known from the test program configuration, A timer can be hired in the calibration software to recognize the meaning of the data. For instance, the test period is configured as 1MHz, then test period is 1μs. The data in 100μs~101μs is measured in the NO.101 test period. If the pin is a DPS pin and the setting voltage in the NO.101 period of the test program is 3.3V, the average voltage indication in 100μs~101μs is 3.3001V, then the error is -0.001V and the 3.3V voltage of the DPS was calibrated.
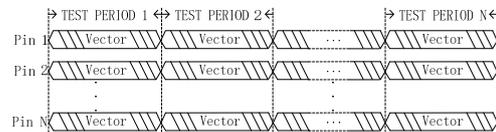

Fig 3. The waveform on each pin

III.   DC COMPONENT CALIBRATION

The DC components in the ATE consist of DPS and PMU mainly. The DPS(Device Power Supplies) supply the power to the DUT as a drive component. The PMU, as a precious measurement component, measure the DC specifications of the DUT. Basically, the test program configures several typical power conditions to test the specifications, the waveform on the DUT's power pin changes as shown in figure 4.

The   test   program   has   three   DPS

configurations on figure 4. The test vector execute in every test period repeatedly with LEVEL1 , LEVEL2 and LEVEL3 test conditions. After the measuring instrument measured all the measurands, the calibration control software will analyze the data. It occupies 3 voltage levels by DPS configurations, after the calibration control software calculates the uncertainty and compare with drive voltage configuration in the test program, the 3 voltage measurands drived by DPS have been calibrated.

After the PMU measured the specifications, the measurands can be found in the test log file or the test report. At the same period , The indication was stored and sent to the control computer too. When the measurands from PMU and indications from the measuring instrument were paired and calculated, the calibration for the PMU was done.
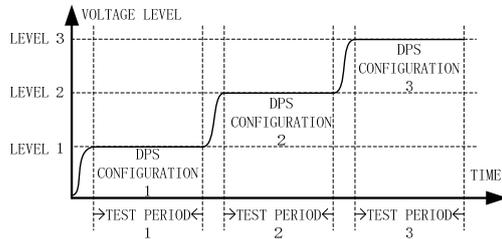

Fig.4 Typical Waveform on the DPS pin

IV.   AC COMPONENT CALIBRATION

The AC components in the ATE consist of Drivers and Comparators mainly. The driver drives the vector and comparator observes the result. In static test, the driver drives the vector with constant voltage level. However, It will work in searching mode when test other specifications like VIL, VIH, VOL and VOH. For example, VIL(Voltage, Input Low) represents the worst case voltage applied to an input to represent a logic 0 while VIH(Voltage, Input high) represents the worst case voltage applied to an input to represent a logic 1. In order to test this, the driver will changes the voltage level until the state change to search the values of VIH/VIL. The waveform is shown if Figure 5. The step as shown in the Figure 5 can be found in the data sequence from the measuring instrument, The value in the step with Minimum voltage is VIH need to be calibrated. Similarly, The value in the step with maximum voltage is VIL   need to be calibrated if it search from low to high. Via this procedure, both driver and comparator were calibrated on the certain voltage.
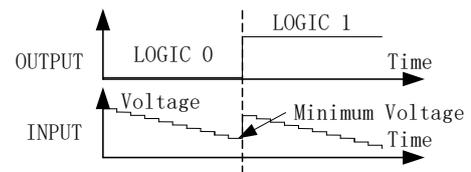

Fig 5. The searching test diagram

TIMING COMPONENT CALIBRATION

Timing component test the rising / falling time and delay of edges. The rising / falling time and delay appear in the single vector, and it's a average value of this characteristic in the setting vector. When calibrate this component, the measuring instrument should be the time measuring instrument and line impedance needs to be matched. The procedure of calibration is similar with the PMU , because both PMU and timing component are measurement units, the measurands measured by ATE need to be export from the log file or test report and pair it with the indications from measuring instrument to complete the calibration procedure.

V.   CONLUSION

A method of calibrating ATE while test is introduced in this paper. It solves the issues of calibrating ATE. First, This method doesn't need to program on the target ATE system. Meanwhile, the cost is extremely high if stop the system from test to program and debug the calibration software. After that, it's impossible to be compatible with all ATE systems based on different hardware and software platform. Second, This method represents a more reliable calibration result on the DUT side while test, because the test position and calibration position are the same.

On the other hand, this method also needs complex circuits and other supporting systems like switch system and measuring instruments. After that, the efficiency is still not good enough for calibrating the measurement units like PMU and timing unit, because the measurands in the ATE need to be find and paired with the indication from measuring instrument.

VI.   REFERENCES

[1] State Administration of Quality Supervision, Inspection and Quarantine. General Terms in Metrology and Their Definitions.2012

[2] Science and Technology and Quality Division of National Defense Science and Technology Commission .Radio Electronics Metrology(Volume 2),Atomic Energy Press,915