A DC/DC CONVERTER TEST BOARD AND CONTROL SYSTEM

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Abstract

We designed dc/dc converter Test Board(TB) for AMS experiment. We measure output voltages, output currents and power efficiency. It consist with several parts which control, load, interface with PC. The control part supply control signal to dc/dc converter, change load values for each output voltages and interface with PC. We use atmel AVR atmega128 microcontroller and relays are used to change loads. We used codeVision with compiler. Output voltage types depend on dc/dc converter module type. We assign four loads which can be changed by user. The test board and PC communicate with serial interface. We also use serial interface to control programmable power supply. A labview is used to display measurements results and control test board in PC. These measurement results directly save in PC.

DC/DC CONVERTERS

AMS group produces some kind of DC/DC converters before manufacturing final type module. Our TB system tested for one EM module and one QM1 module. Input voltage of DC/DC converters are 28VDC. All DC/DC converters are modified at 28VDC. There are different output voltages. EM module is two output types and QM1 module is three output types. These modules are produced at CAEN[1] in Italy.

EACH TB PARTS

TB can be separated two parts which are hardware and software parts. Hardware parts read data, control DC/DC converter and interface PC. Software parts read data from hardware part, execute data processing, and saving test results in PC.

Hardware parts

We used atmega 128 avr chip[2] for controller. AVR supported C language and high speed than other kinds of microcontrollers.

Microcontroller controls all relays. There are two kinds of switching relays which are big relay and small relay. Each one big relay connects one load, it changes loads for DC/DC converter. Small relays connects inhibit and off, it turns on and off for DC/DC converter. One output connects four big relays. Users can select any load for four different loads. It can be at labview main panel in PC. Our system read three outputs with analog multiplexer and 12 bits ADC. Our using ADC chip read data from –10 VDC to +10 VDC range. Microcontroller read ADC data and it sends to PC.

We used serial interface sending data to PC, serial interface also used for controlling programmable power supply. We read input voltage and current from power supply.

Figure 1: Control board.

Software parts

Main control panel is designed with labview 6.1 version. This panel display measurement results which are all voltages, power efficiency and their test results. There are two voltage displayers which are result for number of data and for measurement of time results. Users set saving file directory, loads, module number and so on. And for long time measurement, time period and sampling rate can be set by users. These test results save in two different file formats. The one is text file which is briefing file for test results, The other is excel format file which includes measured voltages and calculated power efficiency.

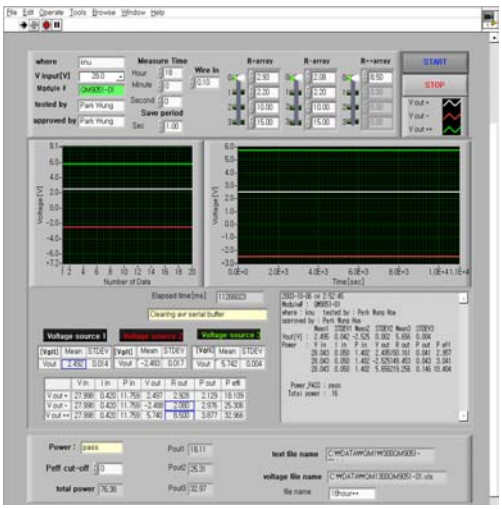

Figure 2: Labview main panel.

CALIBRATION AND MEASURMENT

Calibration

Our voltage calibrating range is from -8VDC to +8VDC. We measured voltage values with HP34401A and TB and then compared with each value. We used different weight factor for negative and positive region. We consider third order for positive voltage range and second order for negative voltage range.

For power efficiency, we consider effective load impedance which includes line impedance, TB input impedance and load.

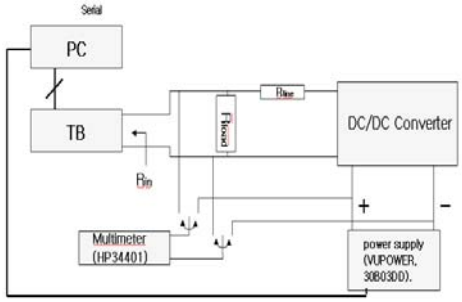

Figure 3: Measurement setup

Measurement results

We tested for one EM module and QM1 module. The first we measured for 5 times during 30 minute. We used different loads for EM and QM1 module. These modules are different output voltage types which QM1 is three outputs voltage type and EM module is two outputs voltage type. Each load values of QM1 module are that 2.928(+), 2.080(-), 8.500(++) and EM module are that 3.68(+), 2.84(-). These loads values are effective loads which are considered line resistance, TB impedance and load.

We measured values with HP34401A and TB and then compared these values. We read display panel values in HP34401A. Total efficiency of QM1 module is 74.312% ± 0.254 which value measured with HP34401A, 74.167% ± 0.122 which value measured with TB. EM module is 71.142% ± 0.033 for HP43301A, 72.125% ± 0.412 for TB.

The next measurements are for different loads, we used 100ohm ranges. It's results will be summarize final section.

The final measurement is long time measurement. We run for 18hours. We read HP34401A values with labview program and compare TB value. TB measures volatage same order in mV range.

SUMMARY

We measured voltages and total power efficiency for typical loads.

Table1 is total power efficiency for typical loads, Table2 is total power efficiency for four different loads and Table3 is long time measurement.

Table 1: total power efficiency for typical loads

	Loads[Ω]	Total power efficiency	
		TB	HP34401A
QM (s9051)	+2.928, -2.080, ++8.50	74.167 ±0.122	74.312 ±0.254
EM (s9027)	+3.680, -2.840	72.152 ±0.412	71.742 ±0.033

Table 2: total power efficiency for four different loads

	Loads[Ω]	Total power efficiency	
		TB	HP34401A
QM1 (s9051)	+98.763, -97.963, ++120.321	25.341 ±0.463	25.227±0
QM1 (s9052)	+150.161, -149.453, ++219.256	16.405 ±0.015	16.345±0
QM1 (s9053)	+391.891, -393.551, ++677.474	6.219 ±0.005	6.202±0
EM (s9027)	+98.086, -98.837	13.539 ±0.051	13.549±0
EM (s9028)	+120.151, -121.567	11.243 ±0.021	11.246±0

Table 3: long time measurement

	Loads[Ω]	Total power efficiency	
		TB	HP34401A
QM1 (s9051)	+2.928, -2.08, ++8.500	18.742 ±0.329	18.759 ±0.332

REFERENCES

[1] http://www.caen.it
[2] http://www.atmel.com