AN-0008	Using Sequences and Limits in Danbridge Megohmmeters
Rev.: 00	
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Init. JR	

SCOPE

This application note describes how the Sequence feature and the limit system are used on the Danbridge DB62X series of Megohmmeters. For general information on Insulation Resistance measurement see "AN-0004 IR Measurement", for use in automated testing see "AN-0003 Using Danbridge Megohmmeters in Sorting Machines".

SEQUENCES

The DB62X megohmmeters can be programmed to run a sequence of measurements after being triggered from the keyboard or remotely. The measurements can be compared with limits and set the bin out signals to approve or reject the device under test. In order to avoid some of the pitfalls associated with this, especially when testing capacitors, a basic understanding of the functions of the Megohmmeter is required.

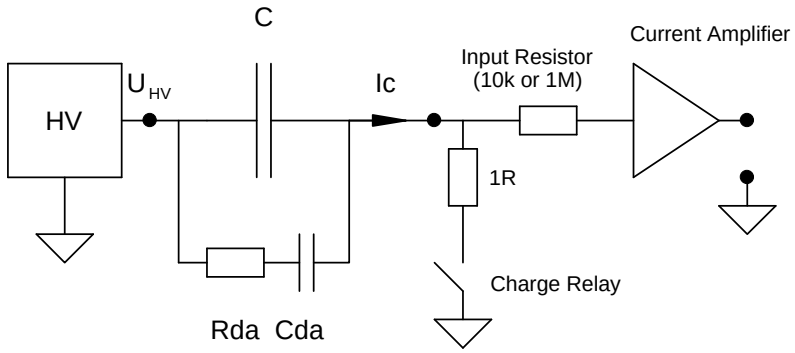

Fig. 1: Model for capacitor with dielectric absorption.

Fig. 1 shows the HV supply and the input stage of the current amplifier. The test object is a capacitance. First, the capacitance is charged, the start current limited by the current limit setting of the HV supply. In order to speed up charging and to protect the current amplifier, the charge relay short circuits the input during charging. The charge relay is controlled by an internal signal ILIM which is high when the output current of the HV supply is larger than 2mA. In sequence mode, the charge relay remains activated if the preset charge time exceeds the time it takes for the current to fall below 2mA (the charge relay is active until both ILIM is reset AND charge time has expired). The charge relay is also activated during discharge.

When measuring capacitance's the effect of "dielectric absorption" must be considered. This effect is also referred to as "soaking". It can be described with the equivalent shown in Fig. 1. Cda will typically have a value of 0.1 - 1% of C and the time constant of Rda and Cda will be app. 1 - 10 sec. This means that after C has been fully charged a current larger than the leakage current will flow into the capacitor Cda. However, just after the charge relay is deactivated the absorption current is delivered by the main capacitance and the current amplifier measures a very small value. 1 to 3 seconds later the absorption current is measured. It is clear that care has to be taken when planning the timing of the sequence.

Fig. 2 shows a typical sequence when measuring the leakage current (or IR) of a foil capacitor with dielectric absorption.

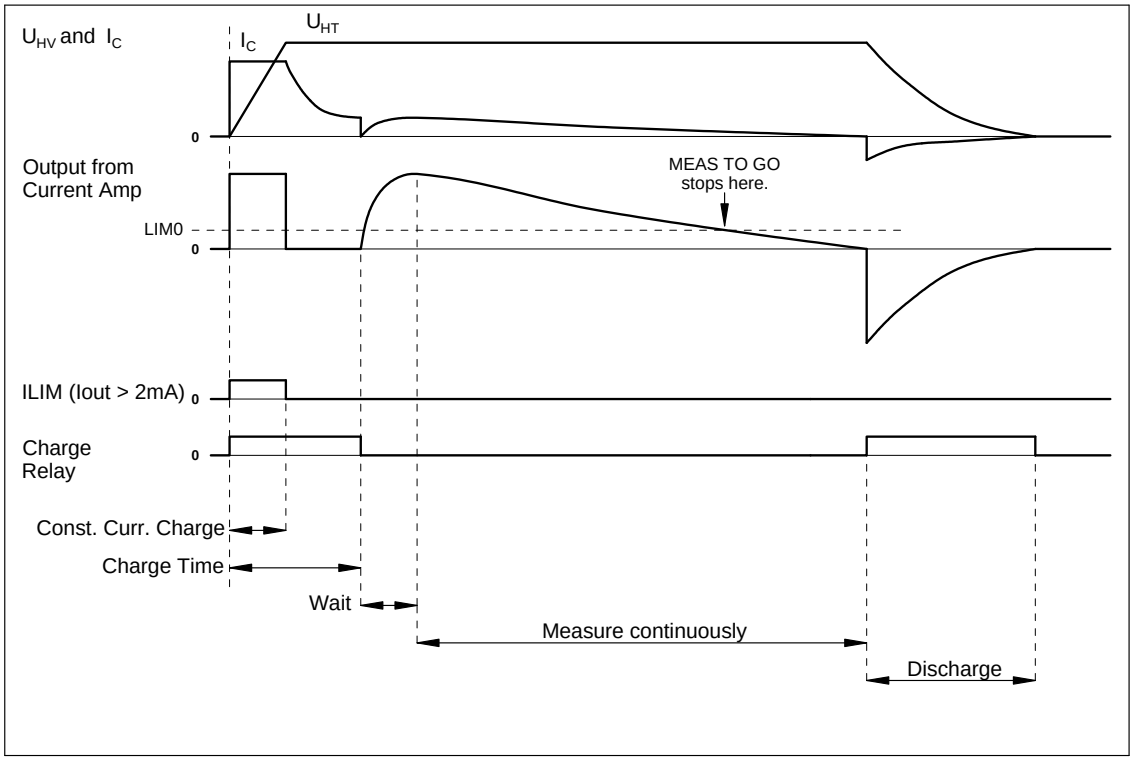

Fig. 2: Leakage current measurement.

The charge relay is activated during the preset charge time, which is longer than it takes for the current to fall below 2mA. When the charge time expires, the charge relay is deactivated. Immediately after this the measured current is very low (and hence the calculated resistance very high), but in the period after the absorption current begins to flow through the capacitor. To avoid premature approval of a component measurement should not start until typ. 1-3 sec. after the charge relay has been deactivated.

SEQUENCE COMMANDS

In the following the sequence commands are described.

CHARGE Charge the DUT

Input param.: HT voltage
Time in ms

Maximum CHARGE current is set in:

MENU > MEASURE SETUP > HT CONTROL > MAXIMUM CURRENT

the constant current charge time can be calculated from:

$$T_{Limit} = \frac{C \cdot U}{I_{Lim}}$$

WAIT — Wait without comparing the measurements with the limits

Input param.:
- HT Voltage
- Time in ms

MEASURE — Make a single measurement

Input param.:
- Range (RN)
- Average Count (AVC)
- Limitset (0: limits disabled)
- (Time is calculated as AVC × 40ms)

The ranges are as follows:

Range 1: 1pA - 10nA
Range 2: 2nA - 100nA
Range 3: 20nA - 10uA
Range 4: 2uA - 1mA

In range 1 an input resistance of either 10kohm or 1Mohm can be chosen.

BIN out will be updated after the measurement when a limit set different from 0 is selected.

MEAS. CONT. — Measure continuously (similar to the earlier MEAS. DELAY except that range, avc and limitset can be specified)

Input param.:
- HT Voltage
- Range (RN)
- Average Count (AVC)
- Limitset (0: limits disabled)
- Time in ms

BIN out will be updated continuously when a limit set different from 0 is selected.

MEAS. TO GO — Measure continuously until limit is met, then stop and discharge (see Fig. 2).

Input param.:
- Range (RN)
- Average Count (AVC)
- Limitset (0: limits disabled)
- Time in ms

The limitset should only contain one limit (LIM0). If the limit is not met the sequence will continue until the set time. BIN out will be updated continuously when a limitset different from 0 is selected.

FLASH TEST Measure current, if the current exceeds the first limit then stop and set BIN 0

Range (RN)
Limitset (0: limits disabled)
Time in ms

This instruction is intended to register flash-over at extended voltage. Please note, that the Bin Out signal has been reversed (BIN 0 means "bad component") compared to the normal current mode. This is because the flash test normally is followed by an insulation resistance test which sets BIN 0 for a "bad" component.

DISCHARGE Turn off HT and discharge DUT (internal discharge resistor)

Input param.: Time in ms

If 0ms is set AUTO discharge has been selected. This will discharge the DUT until the voltage is below app. 7V in HT High Range and 0.7V in Low Range.

Example 1: 20 sec. Measure to Go

STEP	FUNCTION	HT VOLT	RN	AVC	LIM SET	TIME SEC
1	CHARGE	500	N/A.	N/A.	N/A.	1.0s
2	WAIT	500	N/A.	N/A.	N/A.	1.0s
3	MEAS. TO GO		1H	4	1	18.0s
4	DISCHARGE					2.0
5						

The Megohmmeter is in resistance mode and a limit LIM0 of say 500Gohm is stored in LIMSET 1.

The DUT is charged to 500V for 1 sec. second, then there is a wait state of 1 sec. before measurement starts. If the measured resistance exceeds 500Gohm within 18 sec. BIN5 is set, the sequence is stopped and the DUT is discharged for 2 sec. If the resistance does not exceed 500Gohm the actual value is measured after a total of 20 sec., BIN0 is set and the DUT is discharged.

Example 2: Flash test followed by IR test

STEP	FUNCTION	HT VOLT	RN	AVC	LIM SET	TIME SEC
1	CHARGE	400	N/A.	N/A.	N/A.	1.0s
2	WAIT	400	N/A.	N/A.	N/A.	1.0s
3	FLASH TEST		3	1	1	2.0s
4	DISCHARGE					AUTO
5	CHARGE	100	N/A.	N/A.	N/A.	1.0s
6	WAIT	100	N/A.	N/A.	N/A.	1.0s
7	MEAS. TO GO		1H	4	2	18.0
8	DISCHARGE					AUTO

LIMSET 1 is a current limit for the flash test. It should be larger than the absorption current in order not to detect a flash over immediately after the wait state. If a flash over occurs, the sequence is stopped and BIN0 is set. If the DUT passes the flash test, BIN5 is set. Then an insulation resistance test is performed at the rated voltage. LIMSET2 is a resistance limit. If the IR is to low, BIN0 is set, otherwise BIN5 is set.

LIMITS AND BIN OUT

The Bin Out connector is used to for external triggering of the instrument and to output "bin" signals in accordance with predefined limits. Fig. 3 shows the layout of the connector.

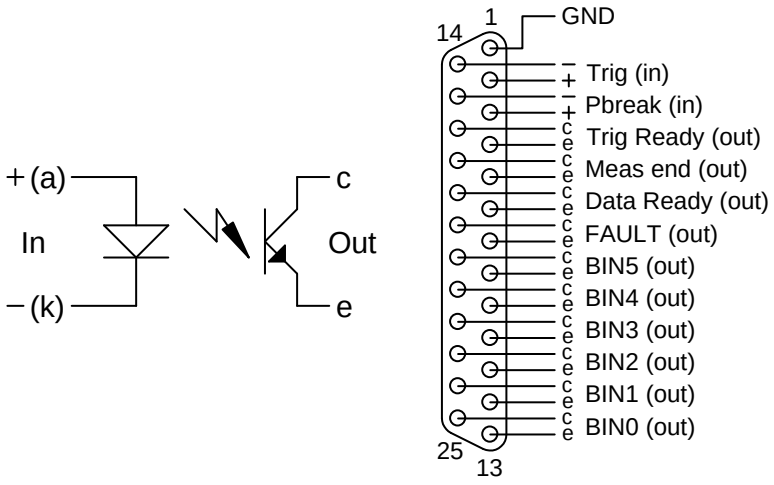

Fig. 3: BINOUT Connector.

The Pbreak input is used to shut down the high voltage supply without having to restart the instrument, as is the case when activating HV Break.

The optocoupler input triggers the DB62X by an input current of 10mA (maximum 30mA forward and maximum 6V reverse). The optocoupler outputs are rated 25V and 10mA each. Both input and output require external power and series resistors.

Fig. 4 shows how the Bin Out signals are set in accordance with the Limits. If the value is between LIM1 and LIM2, the BIN2 output is active (the output phototransistor is on).

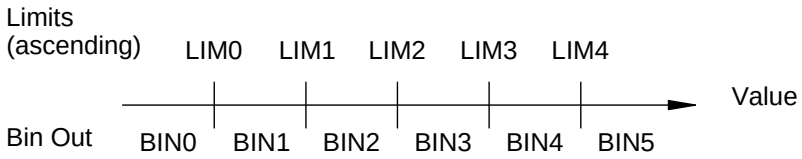

Fig. 4: Limits and BINOUT

Resistance mode

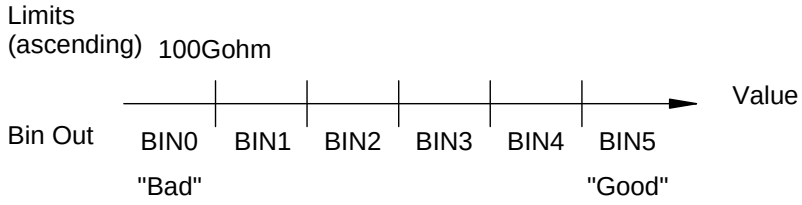

Fig. 5: Resistance Limits and BINOUT

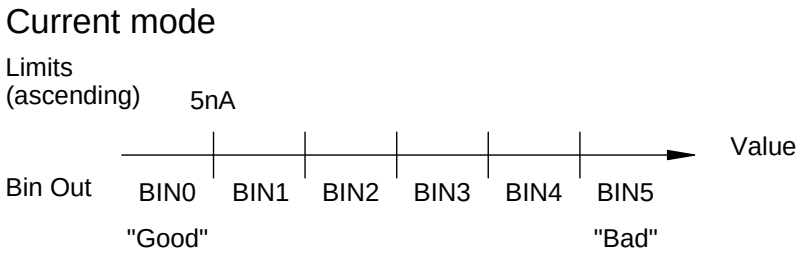

Fig. 6: Current Limits and BINOUT

Both in resistance (Fig. 5) and in current (Fig. 6) mode the limits should be organized in ascending order. This means that in resistance mode and with only one LIM defined a "good" component will set BIN 5, in current mode it will set BIN 0. More limits could be used to exclude shorted or open components.

When using resistance limits the instrument must be in resistance measuring mode, when using current limits it must be in current measuring mode.

SETUP FOR IR AND FLASH TEST

Fig. 7 shows an example of a setup that can be used to perform flash test and/or IR test. In both cases the BIN0 is set if there is a flash over or if the insulation resistance is too low. Otherwise the BIN5 is set if the component is approved. The series resistances are calculated from:

$$R_{Trig} = \frac{6V - 2V}{10mA} \qquad R_{LED} = \frac{6V - 2V}{3mA}$$

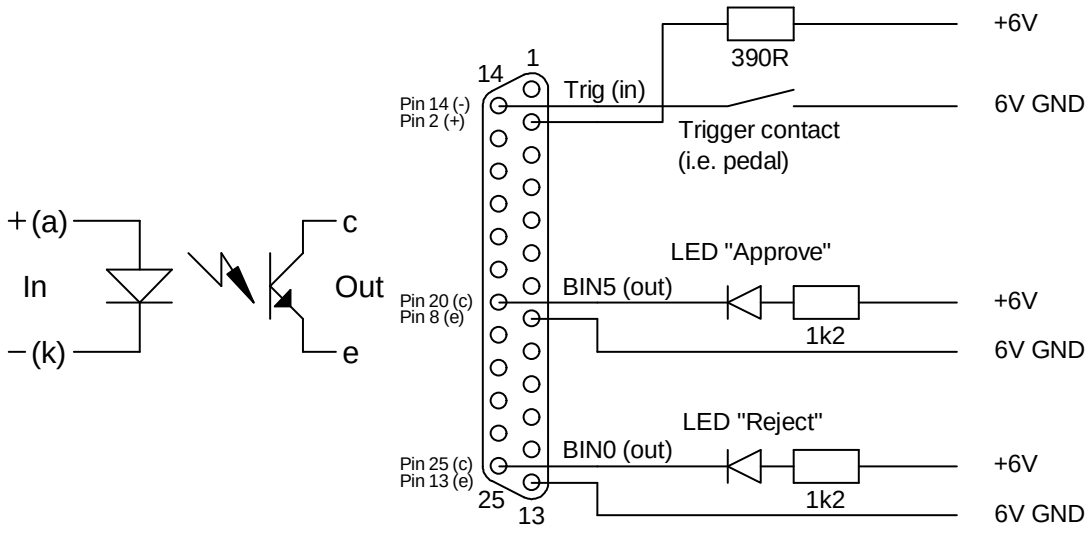

Fig. 7: IR and Flash Test Setup