SEB C-S measurements of power IGBTs

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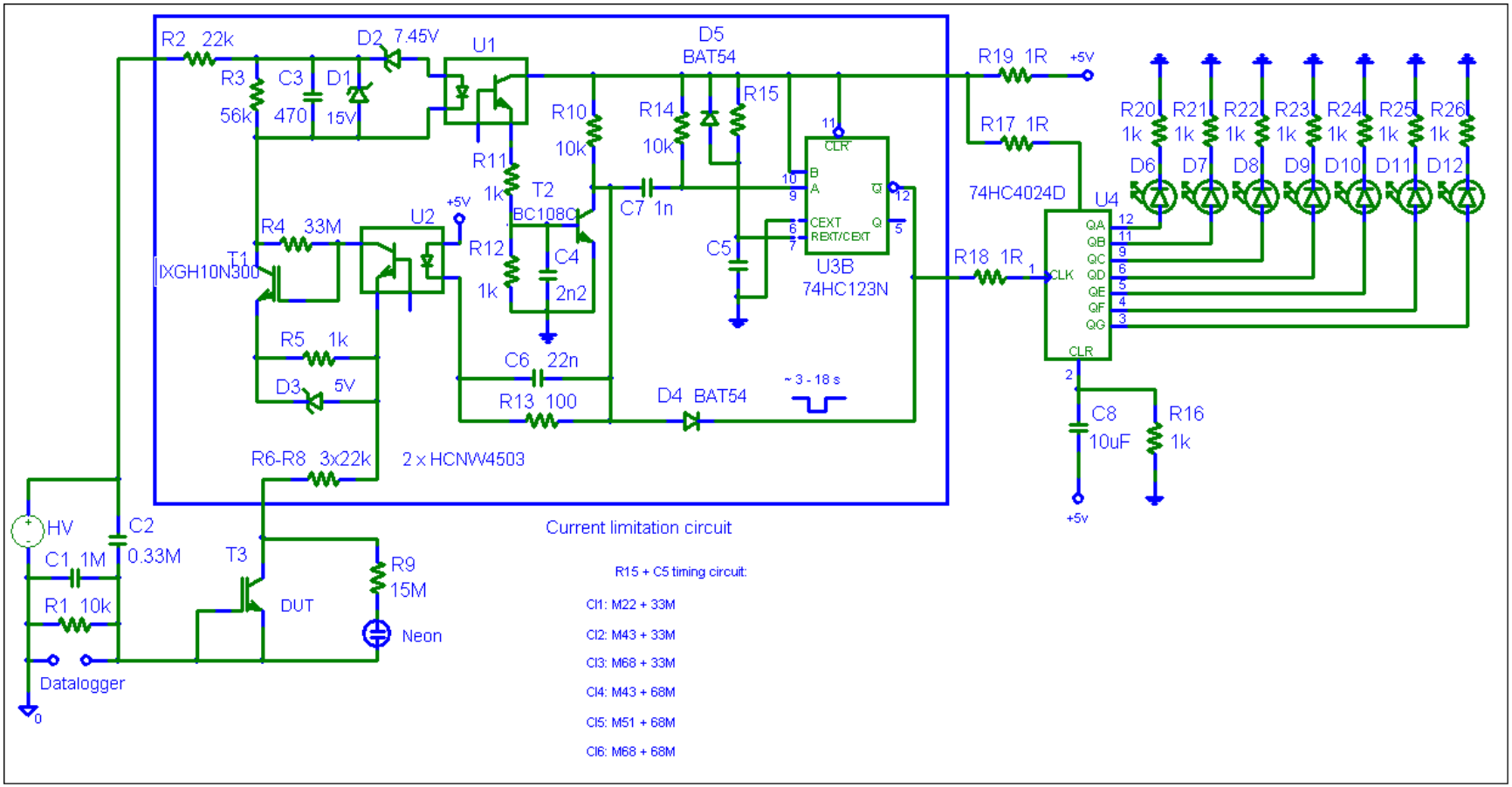
Motivation

- Reliable operation of LHC dump system - critical importance for machine safety
- 15 MKD generators per beam using GTO like thyristors
- GTO are trigged by“power trigger units” operating at up to 3 kV and populated by 3 IGBTs (1.2 kV rated) in series; 360 IGBTs in total for MKDs and 120 for MKBs
- SEB of IGBT will provoke “Asynchronous Dump” with associated beam losses and risk of damage of downstream equipments
- Replacement of 1.2 kV rated IGBT by 1.7 kV one with similar performance should reduce significantly risk of SEB
- SEB measurement to justify replacement costs

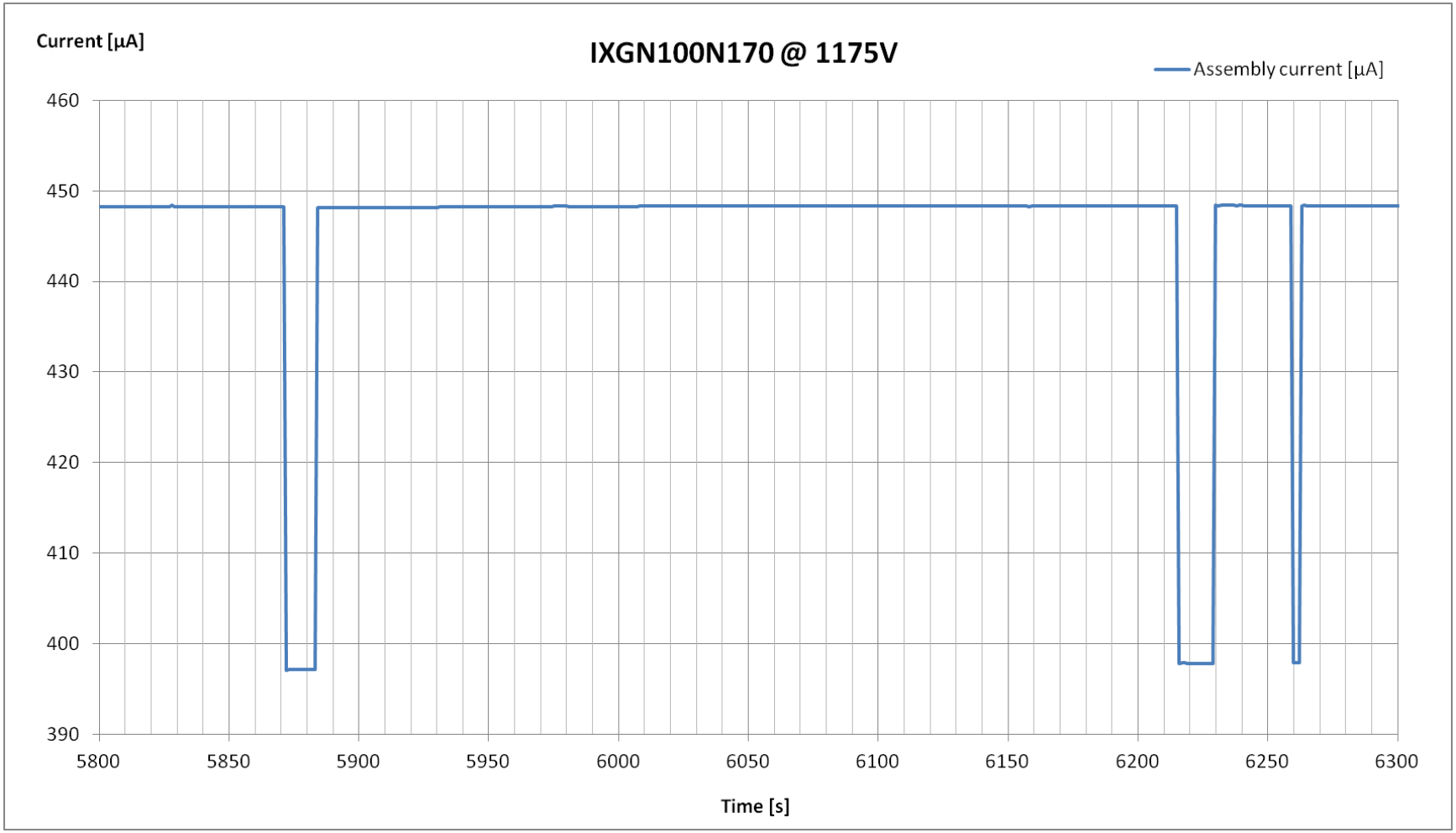
IGBT protection against destructive SEB

- Reduction of test costs and irradiation facility time by “non-destructive SEB test” – DUT current limitation and voltage cut-off in case of SEB detection
- SEB recording by a low frequency data logger (current consumption dip of the assembly of 6 IGBTs due to voltage cut-off on a DUT that experienced an SEB)
- Local counter of SEBs – for comparison



Example of data logger recording

Example of currrent consumption dips with different durations for SEBs of different IGBTs



SEB Cross-section of IXDN75N120 vs. IXGN100N170

Results of SEB measurement: 1.2 kV IGBTs would result in ~ 4 asynchronous dumps (~10^{-5} HeH/cm^{-2}.year; 1kV; 360 IGBTs); for 1.7 kV IGBTs factor of ~ 10^{7} less