ASSEMBLY OR INTEGRATED CIRCUIT OR HYBRID PROTECTOR?

Abstract

This document discusses how hybrid surge protective components should be classified for standardization purposes.

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1 Introduction

In the SPD testing world there has always been a conflict between those who want to test the SPD “as is” and those who want to take the SPD apart to put copper shorts and the like inside – “open the box”. Personally, I subscribe to the “black box” approach.

Recently one manufacturer, who produced a component that combined an MOV and GDT, was frustrated by a test laboratory that wanted to separate the component into its MOV and GDT parts and test each independently - “open the box”. It mattered little to the test laboratory that the performance of the separate parts would not be the same as when in combination.

This led to the thought “What is the difference between an assembly, integrated circuit and hybrid protector”. It may come as a shock to some that an integrated circuit doesn’t need to be something like you get from Intel or Texas Instruments. How the IEC defines in this area is reviewed here.

2 Terms and definitions

For the purposes of this document, the following IEC terms and definitions apply.

2.1 assembly
subordinate element of a system that is comprised of two or more components

[SOURCE: ISO/IEC 14776-121, ed. 1.0 (2010-10)]

2.2 assembly
any composite item which is intended to be repaired

[SOURCE: IEC 61163-1, ed. 2.0 (2006-06)]

Observation: The problem with using “assembly” is that there is an implication the item can be repaired or disassembled. The word integrated is much stronger, implying make entire or whole or complete. The opposite “disintegrates” mean separate into its component parts or particles; reduce to fragments, break up, destroy the cohesion or integrity.

2.3 assembly
assembled board
number of parts, subassemblies or combinations thereof joined together

Note 1 to entry: This term can be used in conjunction with other terms listed herein, for example, “printed board assembly”.

[SOURCE: IEC 60194, ed. 6.0 (2015-04)]

2.4 component
item such as a resistor, diode, transistor, integrated circuit or hybrid circuit
2.5 device
combination of components having a given function, forming part of a piece of equipment, apparatus, or system

NOTE For example, thermostat, relay, push buttons, switch or contactor.

2.6 electronic assembly
set of components, at least one of which is an electronic component, assembled into a single unit

EXAMPLE Group of components mounted on a printed circuit board.

2.7 hybrid integrated circuit
integrated circuit formed by a combination of two or more integrated components or discrete components or both

NOTE To identify a specific type of hybrid integrated circuit, additional qualifiers (for example, film) should be prefixed and a specific definition should be provided

Observation: This would apply to an MOV and GDT combination

2.8 integrated circuit
microcircuit in which all or some of the circuit elements are inseparably associated and electrically interconnected so that it is considered to be indivisible for the purpose of construction and commerce

NOTE 1 IEC TC 47 standards on semiconductor integrated circuits generally refer to integrated circuits that are designed as microcircuits.

NOTE 2 To further define the nature of an integrated circuit, additional qualifiers may be prefixed. For example:
– single-chip integrated circuit;
– multi-chip integrated circuit;
– thin-film integrated circuit;
– thick-film integrated circuit;
– hybrid integrated circuit;
– hybrid semiconductor integrated circuit.

2.9 integrated passive component
multiple passive components that share a substrate and package
Note 1 to entry: Integrated passive components may be housed inside the layers of the primary interconnect substrate, and thus become embedded passive components. Alternately, these components may be on the surface of a separate substrate that is then placed in an enclosure and surface mounted on the primary interconnect substrate, thus become passive arrays or passive networks.

[SOURCE: IEC 60194, ed. 6.0 (2015-04)]

2.10 microcircuit
electronic device that has a high circuit-element density and that is considered to be a single unit


2.11 microcircuit component device
electrical or electronic device that is not subject to disassembly without destruction or impairment of design use and is a small circuit having a high equivalent circuit element density

Note 1 to entry: It is considered as a single part composed of interconnected elements on or within a single substrate to perform an electronic circuit function.

Note 2 to entry: This excludes printed wiring boards/printed circuit boards, circuit card assemblies and modules composed exclusively of discrete electronic components.

[SOURCE: IEC 62686-1, ed. 2.0 (2015-04)]

2.12 passive network
a network including neither voltage sources nor current sources


Observation: This would apply to an MOV and GDT combination

2.13 surge protective component
SPC
component specifically included in a device or equipment for the mitigation of the onward propagation of overvoltages or overcurrents or both.

[SOURCE: ITU-T K.96 (02/2014)]

2.14 surge protective device
SPD
device that mitigates the onward propagation of overvoltages or overcurrents or both.

[SOURCE: ITU-T K.96 (02/2014)]

3  What standard covers hybrid SPCs?

3.1  General

Even “What standard should cover hybrid SPCs?” can be split down further into such things as “What standard should cover hybrid SPCs containing clamping and switching elements”. 
Standards bodies have to decide on a hybrid components approach; do they incorporate hybrids in existing component standards or do hybrids warrant specific standards? In the case of an MOV that incorporates a thermal fuse, the thermal fuse parameters are unique and are specifically tested. In this case, it is relatively easy to add that hybrid and its tests to an MOV standard.

Where the functions of the hybrid interact, the appropriate standard becomes more difficult. A GDT-MOV hybrid presents such a case. If the GDT and MOV are in parallel, the majority of the surge stress is in the GDT and the GDT operation is the prime function. If the GDT and MOV are in series, the majority of the surge stress is in the MOV and the MOV operation is the prime function.

Incorporating MOV-GDT hybrids in the existing component standards are likely to cause rework of the test circuits. For example, the test circuit for a series MOV-GDT combination must now generate sufficient voltage to cause GDT sparkover whilst subsequently providing the appropriate current level to measure the series combination of the MOV clamping voltage and the GDT arc voltage.

For the GDT further complications arise as sparkover is traditionally measured with linear voltage ramps, whereas devices and equipment ports are tested with surge generators. Voltage surge generators typically have double exponential voltage waveforms and component current surge generators, such as the 8/20, are not specified for voltage waveform and hence the front of wave dv/dt is unknown. For designers it is more important to know what the sparkover is under surge conditions rather than a linear ramp condition. However, with careful selection of test circuits both these criteria may be satisfied.

3.2 Hybrid definition and qualifiers

From the Terms and definitions clause, one could construct a hybrid surge protection component definition as follows:

**hybrid surge protection component**

combination of passive circuit protection elements that are inseparably associated and electrically interconnected so that it is considered to be indivisible for the purpose of construction, mounting, testing and commerce

As stated in several definitions there can be qualifiers such as series MOV-GDT or shunt MOV-GDT

4 Summary

Hybrid SPCs where the additional function does not change the original testing of the SPC parameters and the additional function parameters can be considered as simply a test addendum can be included in the original technology standard.

Standardising SPCs with allied technologies, such as clamping and switching, probably merit a new dedicated hybrid SPC standard. Clamping technology options are MOVs and breakdown diodes and switching technology options are GDTs and Thyristors. Not all of these technologies work well together, such as a paralleled Thyristor and a Breakdown Diode/MOV. One could handle parallel and series connections in the same standard, the differences being the initial surge voltage peak, then with conduction established the clamping or arc voltages. Standard parameters, such as AC/DC conduction thresholds, the switching element turn-off current, capacitances and standby/leakage currents can be measured as normal.