Concentration of Multi-Point Measurement Data for DC-150 kHz EMI Analysis

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Abstract—Power systems and loads are becoming more complex with the implementation of micro-grids and non-linear power electronics loads. Intermittent and rapidly changing load and supply behavior calls for measurement strategies which are adaptable and able to comprehensively analyze new technical challenges. In this paper, such a device is presented, with measurement bandwidth of mega-samples per second and multiple channel and location measurement capabilities optimized for micro-grid and low frequency (DC - 150kHz). A micro-grid reliability test is conducted and presented where fast changing load conditions results in grid failure.

Index Terms—Electromagnetic interference, Micro-grids, Inrush-current, Power electronic devices

I. INTRODUCTION

Power supply configurations, especially micro-grids, are becoming more complex and interconnected with multiple sources and loads. Load behavior, with the advance of switching power electronics converter (SPEC), is drawing more non-ideal currents and volatility of instantaneous power is a great concern for reliability of micro-grids and design engineers [1]. Cases of micro-grid disruption and failures are increasing and can be of serious concern [2], such as the failure of backup emergency power supplies of hospitals [3]. In the frequency range below 150 kHz many electromagnetic interference (EMI) phenomenon are apparent such as severe voltage sags, swells or flicker effects compromising electromagnetic compatibility (EMC) [4]. Multi-location, time with synchronous measurements are invaluable in diagnoses [5].

II. EFFECTS OF VOLATILE LOAD PROFILES

Of the more serious EMI events is the complete failure of a micro-grid such as shown in Fig. 1, where a small non-linear load component with respect to nominal supply capacity (250 W load to 5 kV A supply) resulted in grid failure during a switch-on event. In this case the measurement device was deployed to monitor all load inputs and the output voltage and current of the supply. With all the data collected on a central concentrated point, this can be analyzed to expose the load causing the effect and the resulting interference with the power supply and other loads in the environment.

The factors with respect to voltage and current waveform characteristics influencing interference can be statistically analyzed with high definition measurement data. In this specific case the failure of the inverter is significantly increased with a phase firing angle switch on time near or before the peak voltage waveform cycle [5]. The rising edge of the load current draw as well as the loading before additional loads are connected have a significant effect of inverter failure rates.

Fig. 1: Current of multiple loads and source voltage during grid failure event

CONCLUSION

With the increased implementation of volatile non-linear type loads and integration of micro-grids with limited short term peak power delivery capabilities, advanced measurement in multi-points is a critical advantage. To ensure diagnosis of EMI issues, the measurement device in this paper is essential. With order of MHz sample rate and multi-location ready data, micro-grid environments can be adequately monitored.

REFERENCES