Development of Power Signal Distributor for Electronic Power Meters

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Abstract—The Power Signal Distribution Device is a device that distributes the watt pulse (WP) and the End of the interval (EOI) in real time by receiving the power signal from the electronic power meter installed in a building or factory. It is possible to prevent electrical damage of the electronic power meter due to the abnormally applied back electromotive force. And it is possible to construct a redundant system of demand controller and power surveillance system by calculating and analyzing power consumption through power signal provided by the electronic power meter. It is also applicable to demand response monitoring device.

Keywords—Demand Controller, Demand Response, Electric Power Management, Maximum Peak Power.

I. INTRODUCTION

Signal distributor for digital power meter distributes the watt pulse (WP) and the End of the interval (EOI) signals to multiple equipment such as peak power management devices and demand controllers. It is possible to prevent the electrical damage of the digital power meter due to the counter electromotive force applied abnormally in the power management apparatus and to analyze the power use amount through the data provided in the digital power meter and to establish the redundancy of the maximum power management and power management system. In addition, it is a device capable of providing a power signal with a demand response management terminal.

The peak power is the maximum electric power load in a certain period as the base charge of the electricity charge, and is expressed in kW. Although there is a difference between the method of predicting the power and the method of controlling the load power according to the technical specifications proposed by KEPCO, the functions of the device for managing the maximum power are the same.

As shown in Fig. 1, when the maximum power management device receives a signal from the meter and calculates the amount of load power in real time. If it is predicted that the used power amount exceeds the target power amount, the connected load device is stepwise blocked, and does not exceed the target amount of power. [1][2]

Demand Response is a sub-concept of demand management as showed in Fig. 2. It refers to activities to maintain balance of supply and demand through adjustment of electricity rate or power reduction by instruction of load reduction in case of supply / demand crisis due to peak of electricity demand. It is a technology that induces the change of electricity usage patterns of electric consumers according to the electricity supply situation such as the peak period through the demand management plan and incentive system.[3]

II. SIGNAL DISTRIBUTOR

1. Overall System Architecture

Power management system using signal distributor is showed in Fig.3.
Signal distributor receives integrating power signal (WP) signal and EOI signals at intervals of 15 minutes from KEPCO digital meter. And then it disperses the signals to various power management devices. Because this distributor separates signals from meters, we can protect external signal points of meters from the falling of a thunderbolt. Moreover, it helps to make duplex configuration of peak power management system, and to provide synchronization information between power data detected from SCADA and data from KEPCO.

2. Internal Configuration

Fig. 4 and Fig. 5 show internal module and flowchart of signal distributor for each.

Signal distributor consists of signal receiving unit, signal distribution unit, modulation processing unit, and power unit. The signal receiving unit receives kWP signal, and EOI signal from digital power meter. The signal distribution unit distributes the power management signals received at the signal receiving unit through a plurality of distribution circuit paths. The modulation processing unit modulates each of the power management signals distributed in the signal distribution unit and generates a distributed power management signal of the signal strength corresponding to the power management signal output from the digital power meter, respectively. The power unit provides power for outputting distribution power management signals generated by modulation processing unit through distribution terminals.

3. Specification

Specification of signal distributor is showed in Fig. 6 and Table 1.
### Table 1: Specification of Signal Distributor

| Features          | Specification                  |
|-------------------|--------------------------------|
| Operating Temp.   | -20~45°C                       |
| Storage Temp.     | 0~45°C                         |
| Operating Humidity| 5~95%RH, No dew should be formed|
| Storage Humidity  | 5~95%RH, No dew should be formed|
| Power Input       | AC 100~240VAC, 50~60Hz/DC 5V, More than 1A |
| Power Output      | 5VDC, 1A max                   |
| Standby Power     | 0.15W below                    |
| Efficiency        | 70%                            |

### III. DURABILITY TESTS

#### 1. Voltage Dip / Surge Immunity Test

Signal distributor for this test blinks kWP LEDs every 2 seconds and EO LEDs every 10 seconds. We use EMS Tester of EMC partner (Model: IMU4000) as measuring equipment, and XBC-DR32H as KEPCO meter signal generator.

**Result of voltage dip immunity test and surge resistance test are as showed in Table 2 and Table 3.**

#### 2. Lightning Impulse Test (Voltage Withstanding)

After connecting to digital power meter (EOI output, power output line, common line, and DC line), we apply...
lightning impulse withstanding voltage and check whether it normally operates after lightning impulse test.

![Image: Lightning Impulse Tests](image_url)

**Fig. 10: Lightning Impulse Tests**

### Table 4: Results of Lightning Impulse Test

| Test Basis | Applied Position | Test Result |
|------------|------------------|-------------|
| -Applied Voltage: 6,000V -Waveform: (1.2/50)μs -Polarity and Frequency: 10 times each positive / negative polarity -Minimum interval of application: 3 seconds -Connection: connected to EOI output line, power output line and common line and signal line providing equipment of electronic power meter -Acceptance Criteria: Check whether the signal line providing equipment and the power meter are in normal operating condition after the test of the lightning impulse withstanding test | Between EOI input and ground | Pass |
| | Between power input terminal and ground | Pass |
| | Between common line and ground | Pass |
| | Between P line of signal providing device and ground | Pass |
| | Between L line of signal providing device and ground | Pass |

Atmospheric condition: 24.7°C, 68.8% R.H., 1,011 hPa

IV. CONCLUSION

In this paper, we designed and implemented the signal distributor for electronic power meters. And we verify our module as results of voltage dip immunity test, surge resistance test and lightning impulse test. Our result helps to improve scalability and stability. For the further works, we try to extend it for real-time peak power monitoring and analysis.

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