

Automatic Meter Reading Systems for Bulk Customers

Hideichi Kikuchi
Kazuhisa Murata
Fumio Takahashi

1. Introduction

Power supply contracts with bulk customers (those customers having a contracted power demand of greater than 500kW) are so complicated that metering is usually performed exclusively by employees of the electric power utility company. In addition, the improvement of metering efficiency has become a serious problem for electric utility companies because of the concentration of most metering operations on the

Fig.1 Basic configuration of the automatic meter reading system for bulk customers

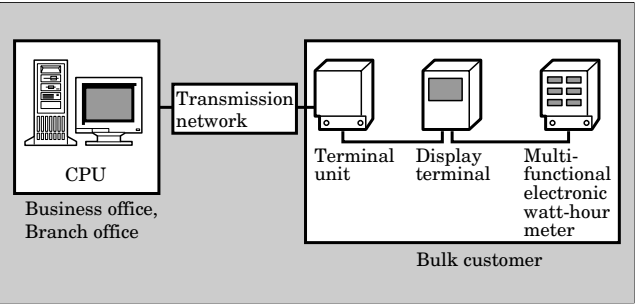


Table 1 Components of the automatic meter reading system for bulk customers

Component	Function
Central processing unit	○ Acquires and displays the indicated values measured by multifunctional meters via the transmission network and terminal units.
Terminal unit	○ Reads and sends back indicated values of the multifunctional meter according to commands from the CPU.
Display terminal	○ Processes the indicated data values measured by the multifunctional meter for each time zone and displays them. ○ Communicates with multifunctional meter and sends back measured values via the terminal unit according to commands from the higher level. ○ Stores 30 min. interval meter readings of power consumption for 44 days.
Multifunctional watt-hour meter	○ Measures the power consumption and sends back the measurement via the terminal unit according to commands from the CPU. ○ Stores 30 min. interval meter readings of power consumption for 10 days.

last day of each month or on the first day of the next month. Furthermore, determining the precise load conditions of the bulk customers become more important as the difference between day and night power demands has increased. All these circumstances have increased the need for practical application of an automatic metering system for bulk customers as early as possible.

Therefore, in collaboration with The Tokyo Electric Power Co., Inc. and Kyushu Electric Power Co. Inc., Fuji Electric has developed and is now supplying the central network control units, terminal units, power supply display terminals (hereafter referred to as display terminals) and multifunctional electronic watt-hour meters with automatic meter reading ports (hereafter referred to as multifunctional meters) of an automatic meter reading (AMR) system.

A summary of the AMR system for bulk customers is presented below.

2. Summary of the Automatic Meter Reading Systems for Bulk Customers

2.1 Basic Configuration of the System

The basic system configuration is shown in Fig. 1 and a summary of component functions is listed in

Fig.2 External view of the multifunctional electric watt-hour meter with automatic meter reading port



A6202-16-225

Fig.3 External view of the power supply display terminal



A6202-16-226

Table 2 Overview of functions of the automatic meter reading system for bulk customers

Classification	Setting/checking item	Function
Setting/ checking command telegram to multi- functional watt-hour meter	Meter reading of predetermined value	Calls predetermined value data
	Present value meter reading	Calls present value data
	Set value check	Calls set value data
	Time/decided date change	Sets time and decided date
	Max. demand reset	Resets demand value
	30 min. interval meter reading	Calls 30 min. interval meter value
	Meter reading for 30 min. interval for 10 days	Calls 30 min. interval meter value for 10 days
Setting/ checking command telegram to display terminal	Setting/check of demand calendar	Sets/calls demand calendar
	Setting/check of time band selection pattern	Sets/calls time band selection pattern
	Meter reading for 30 min. interval for 44 days	Calls 30 min. interval meter value for 44 days

Table 1.

Meters are read such that computers in the business offices and branch office read the measurement values of multifunctional electronic watt-hour meters via various transmission lines as well as corresponding terminal units. A two-wire current loop bi-directional communication system, requiring fewer wire connections and physically smaller installation spaces, is utilized to interface the multifunctional electronic watt-hour meters and display terminals to the higher level system. A display terminal is installed for consumers that require measurements for each time zone. The display terminal indicates measurements for each time zone based on measure-

Table 3 Summary of the delivered systems

Item	The Tokyo Electric Power Co., Inc.	Kyushu Electric Power Co., Inc.
Start of application	Since 1995	Since 1996
No. of consumers	Approx. 14,000	Approx. 2,800
Transmission line	NTT line Optical cable	Metallic pair cable Optical cable Security communication line NTT line

Fig.4 Configuration of the automatic meter reading system for bulk customers for The Tokyo Electric Power Co., Inc.

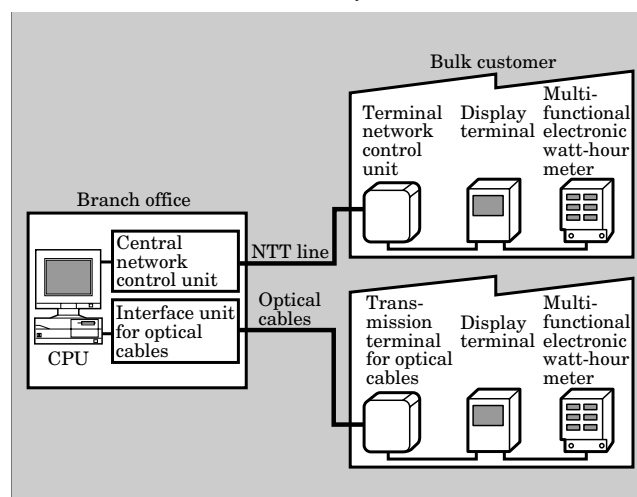


Table 4 Data transmission specifications of NTT lines

Transmission method	Half duplex
Transmission speed	1,200 bits/sec.
Synchronous method	Start-stop synchronization
Modulation method	FSK
Transmission code	JIS unit 7 code
Error detection	Horizontal/vertical parity check
Error control	Retry
Response method	Conversational with no response
Control codes	STX: Start of the text ETX: End of the text
Bit sending order	Lower order bit preceding

ment by the multifunctional electronic watt-hour meter. An external view of the multifunctional electronic watt-hour meter is shown in Fig. 2 and an external view of the display terminal is shown in Fig. 3.

2.2 System functions

As shown in the summary of system functions (telegrams) in Table 2, in addition to functions that read predetermined meter values on a predetermined meter reading day, a 30 minute meter reading function is provided to enable the acquisition of the power consumption every 30 minutes.

Fig.5 External view of the central network control unit (TPC-NCU)



215-10-349

Fig.6 External view of the terminal network control unit (TP-NCU)



215-10-349

3. Delivered Systems

3.1 Summary of the delivered systems

A summary of the automatic meter reading systems for bulk customers delivered to The Tokyo Electric Power Co., Inc. and to Kyushu Power Co., Inc. is shown in Table 3.

3.2 Automatic meter reading system for bulk customers delivered to The Tokyo Electric Power Co., Inc.

3.2.1 System configuration

Configuration of this system is shown in Fig. 4. The Tokyo Electric Power Co., Inc. utilizes NTT's (Nippon Telegraph and Telephone Corporation's) line and optical cables as its transmission line for the automatic meter reading system for bulk customers. A no-ringing communication service contract (refer to section 3.2.2) is selected for the NTT lines, making system configuration possible without requiring new transmission lines to be laid.

Among systems that utilize NTT lines, Fuji Electric has supplied central network control units (TPC-NCU) for installation in branch offices of The Tokyo Electric Power Co., Inc. terminal network control units (TP-NCU) for installation in the customers, multifunctional electronic watt-hour meters, and display terminals.

Fig.7 Configuration of the automatic meter reading system for bulk customers for Kyushu Electric Power Co., Inc.

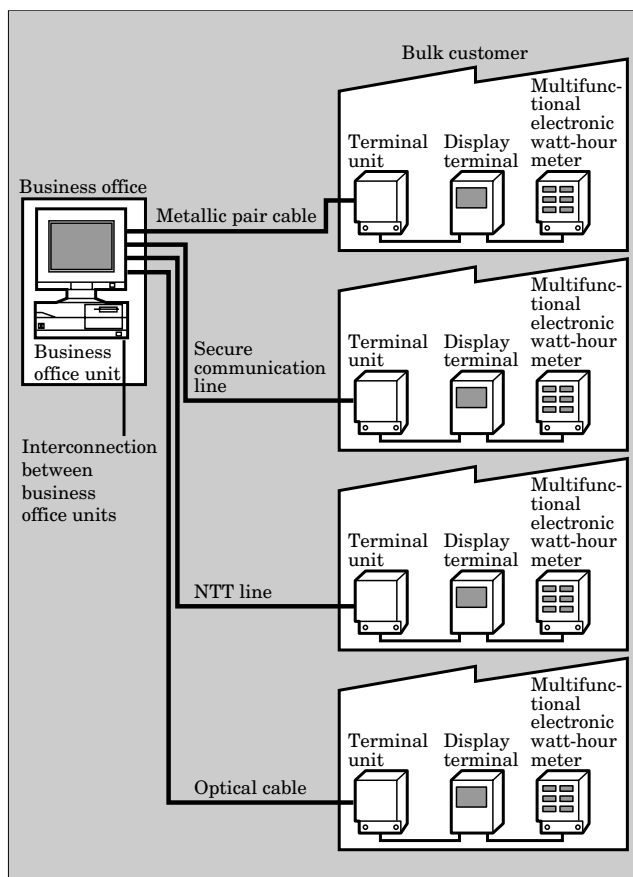
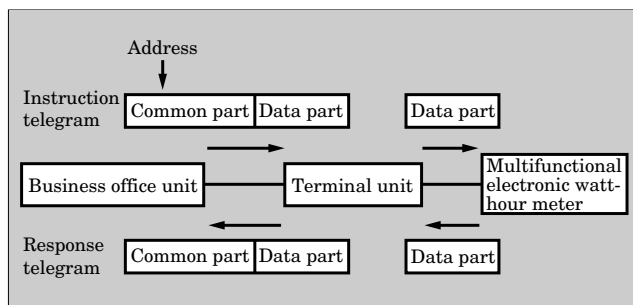


Fig.8 Data flow



3.2.2 No-ringing communication service contract

This system uses a normal NTT line as its transmission line but utilizes a no-ringing communication service contract for the automatic meter reading, making it possible to utilize the user's telephone as the transmission terminal for automatic meter reading without ringing the bell. To enable no-ringing communication, the line is first connected to the no-ringing trunk of the telephone company, and then the user's number is called. If the user's terminal is utilized while performing data transmission, the data transmission is interrupted automatically, giving priority to telephone calls.

Data transmission specifications are shown in

Fig.9 External view of the terminal unit for metallic pair cables



A6202-16-228

Table 5 Data transmission specifications of transmission terminals for metallic pair cables in business office units

Transmission method	Half duplex
Line structure	Multi-drop
Transmission speed	1,200 bits/sec.
Synchronous method	Start-stop synchronization
Code type	NRZ equal length code
Transmission code	JIS unit 7 code
Control codes	STX: Start of the text ETX: End of the text
Error detection	Horizontal/vertical parity check
Bit sending order	Lower order bit preceding

Table 4.

3.2.3 Central network control unit (TPC-NCU)

The external view is shown in Fig. 5. This unit is activated by the CPU and connects lines in accordance with the no-ringing communication service interface. By sending signals, it automatically checks responses of the no-ringing line and terminal network control unit and if errors have occurred, transfers the error information to the CPU.

3.2.4 Terminal network control unit (TP-NCU)

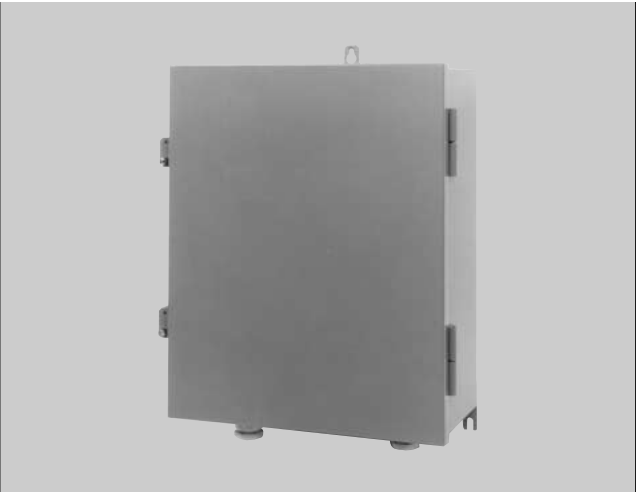
The external view is shown in Fig. 6. This unit, together with the multifunctional electronic watt-hour meter, is installed by the bulk customer and communicates with the central network control unit and multifunctional electronic watt-hour meter.

3.3 Automatic meter reading system for Kyushu Electric Power Co., Inc.

3.3.1 System configuration

Configuration of this system is shown in Fig. 7. Kyushu Electric Power Co., Inc. uses the following as transmission lines for the automatic meter reading system for bulk customers: metallic pair cables that utilize spare lines for automatic control of the distribu-

Fig.10 External view of the terminal unit for optical cables



A6202-16-227

Table 6 Data transmission specifications of transmission terminals for optical cables in business office units

Transmission method	Half duplex
Line structure	Multi-drop
Transmission speed	4,800 bits/sec.
Synchronous method	Flag synchronization
Code type	Manchester code
Transmission code	JIS unit 7 code
Error detection	CRC-CCITT
Bit sending order	Lower order bit preceding

tion line, optical cables, secure lines that utilize spare lines of the telephone line for secure communication and are installed for bulk customers, and NTT lines that utilize the customer's network. Fuji Electric has mainly developed units for the customer and has been delivering terminal units for metallic pair cables, terminal units for optical cables, display terminals and multifunctional electronic watt-hour meters.

3.3.2 Terminal unit

Details of the terminal units for metallic pair cables and terminal units for optical cables used for data transmission between the business office and multifunctional electronic watt-hour meters shall be introduced here.

These units have been developed to lower total costs by utilizing a spare line of the distribution feeder automation system as the higher level transmission line. This terminal performs such necessary minimum functions as communication with higher and lower level lines, telegram distinction, address setting, status display, etc. As shown in Fig. 8, the contents of data are not checked for data transmission. A summary of each terminal unit is introduced below.

- (1) Terminal unit for metallic pair cables

As shown in the external view of Fig. 9, this terminal uses the same housing as the multifunctional electronic watt-hour meter. Therefore mounting of the transmission terminal and connection of the cable is the same as for the multifunctional meter, resulting in a simpler mounting procedure.

Data transmission specifications are shown in Table 5. A multi-drop configuration is utilized for the connection, allowing branching from anywhere.

(2) Terminal unit for optical cables

Figure 10 shows the external view and Table 6 lists the transmission specifications. The method of transmission is synchronous transmission by means of

HDLC. Easy to handle PCS cable is used as the connecting optical cable.

4. Conclusion

A summary of the automatic meter reading system for bulk customers has been presented above. Fuji Electric plans to continue to reduce unit costs and contribute to the practical application of automatic meter reading systems.

The authors would like to express their deep gratitude to the guidance and collaboration received all those affiliated with this project.





* All brand names and product names in this journal might be trademarks or registered trademarks of their respective companies.