

APPLICATION NOTES



Application Note 3017:
TENANT BILLING with RS-485 WHM

Introduction

The CITY MULTI® Controls Network (CMCN) consists of remote controllers, timers, centralized controllers, and integrated system software communicating over a high-speed communication bus with optional interconnection and control via a network PC. The CITY MULTI® Controls Network can support operation monitoring, scheduling, error e-mail distribution, personal browsers, tenant billing, maintenance support, and integration with Building Management Systems (BMS) using either our LonWorks® or BACnet™ interfaces. All of which unite to provide the best in comfort conditioning control. Figure 1 illustrates the CMCN System Configuration.

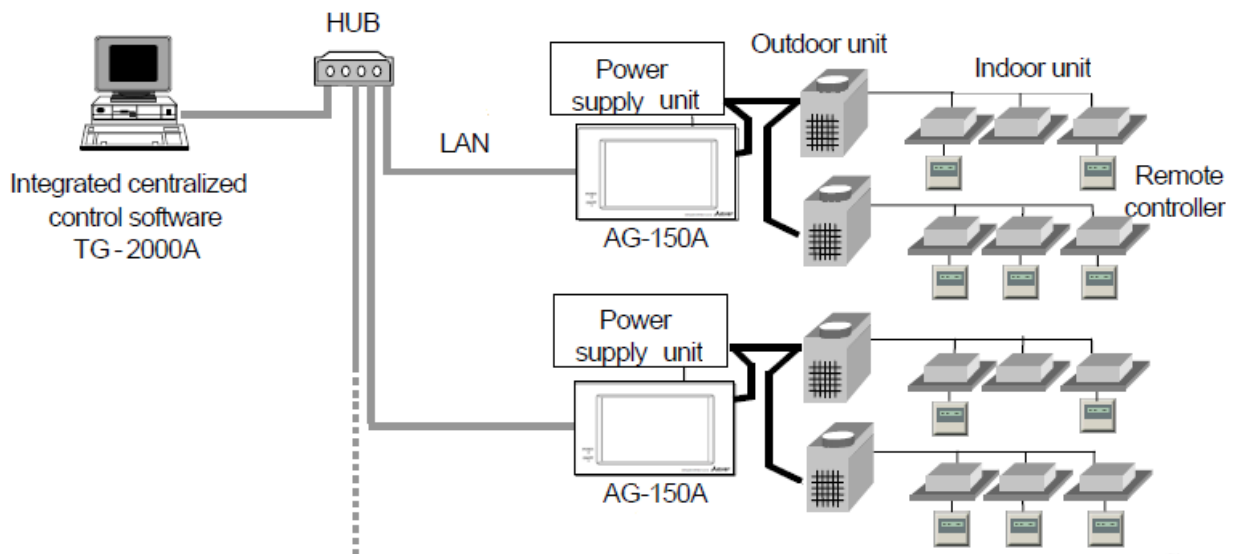


Figure 1. CMCN System Configuration

CMCN remote controllers can operate all CITY MULTI® indoor units, both UL listed and non-UL listed. The wiring for the remote controllers is simple, non-polar, two-wire connections. All remote controllers are wall-mounted and contain a microprocessor that constantly monitors operation to maintain smooth indoor unit operation. By changing a dip switch setting on an indoor unit, the room temperature can be changed from sensing at the indoor unit in the return air to at the remote controller. Set temperature can be adjusted in increments of 1°F or 2°F depending on the type of remote controller. In the event of an abnormality, the remote controller will display a four-digit error code and the indoor unit address.

The AG-150/GB-50ADA Centralized Controllers are capable of controlling a maximum of 50 indoor units across multiple CITY MULTI® outdoor units. The AG-150/GB-50ADA Centralized Controllers are powered from a Power Supply Unit (PAC-SC51KUA). The AG-150/GB-50ADA Centralized Controllers supports operation superseding that of the remote controllers, system configuration, daily/weekly scheduling, monitoring of operation status, and malfunction monitoring. The AG-150/GB-50ADA Centralized Controllers have five basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). The basic control set of operation controls for the

AG-150/GB-50ADA Centralized Controllers are on/off, operation mode selection (cool, heat, auto (R2-Series only), dry, and fan), temperature setting, fan speed setting, and airflow direction setting. Since the AG-150/GB-50ADA provides centralized control, it can enable or disable operation of local remote controllers. In terms of scheduling, the Centralized Controllers will allow the user to define both daily and weekly schedules with operations consisting of ON/OFF, mode selection, temperature setting (63°F – 87°F)¹, and permit/prohibit of remote controllers.

All AG-150 and GB-50ADA Centralized Controllers are equipped with a RJ-45 Ethernet port to support interconnection with a network PC via a closed/direct Local Area Network (LAN), via an Ethernet Hub on a LAN, or via a router on a LAN. Optional software functions are available so that the building manager can securely log into each AG-150/GB-50ADA via the PC's web browser to support operation monitoring, scheduling, error e-mail, personal browser, and maintenance diagnostics. The optional software functions require advance purchasing and can only be activated upon receipt of a license number from Mitsubishi Electric HVAC.

The TG-2000 integrated system software enables the user to control multiple AG-150/GB-50ADAs and provide enhanced functions such as tenant billing from a single, dedicated network PC configured with the TG-2000 software. The TG-2000 configured PC is capable of controlling up to forty AG-150/GB-50ADA Centralized Controllers with a maximum of 2,000 indoor units across multiple CITY MULTI[®] outdoor units. The TG-2000 software is required if the user wants to simultaneously control more than 1 AG-150/GB-50ADA from a single PC source using a single software session. Optional software features are available through the TG-2000 software include tenant billing. These optional software features require the TG-2000 software, advance purchase from the customer, and licensing from Mitsubishi to enable feature activation.

The CMCN supports integration with Building Management Systems (BMS) via our LonWorks[®] and BACnet[™] interfaces. The Mitsubishi Electric HVAC LonWorks[®] interface, LMAP03U, supports up to fifty indoor units with a variety of network variables on a per indoor unit basis. Input variables include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, and filter sign reset. Output variables include, but are not limited to, model size, alarm state, error code, and error address. The Mitsubishi Electric HVAC BACnet[™] interface, BAC-HD150, is compliant with BACnet[™]/IP (ANSI/ASHRAE 135-1995, 135a), UDP/IP of Ethernet (ANSI/ASHRAE 135-1995, 135b) and is BACnet[™] Testing Laboratory (BTL) certified. The BACnet[™] interface supports a maximum of one AG-150/GB-50ADA Centralized Controller for a maximum of 50 indoor units.

TG-2000 Software Option: Tenant Billing for HVAC Energy Consumption

The TG-2000 integrated system software controls up to 2,000 indoor units (or up to forty AG-150A/GB-50ADA Centralized Controllers) from a single, dedicated, network PC. An optional software function available through the TG-2000 software is tenant billing for the HVAC energy consumption. The tenant billing software function requires advanced purchase from Mitsubishi Electric HVAC and a software activation license per AG-150/GB-50ADA issued by Mitsubishi Electric HVAC.

¹ Temperature setting range is dependent on operation mode.
Cool: 67°F - 87°F. Heat: 63°F - 83°F. Auto (R2-Series only): 67°F - 83°F.

The tenant billing software will output the HVAC energy consumption in kWh and monetary amount for the CITY MULTI® outdoor unit(s) divided among defined blocks of indoor units. The tenant billing software requires that a RS-485 WHM monitor the energy consumption of one or more CITY MULTI® outdoor units and be interconnected to the TG-2000 computer via a RS-485/RS-232C or RS-485/USB converter. The tenant billing output can be sent directly to a network printer and/or to a destination folder on the TG-2000 PC as an Excel file. This tenant billing output can then be inputted into an Excel-based support tool, "AirConCharge.xls" to generate an individual "HVAC Energy Fee Statement" per tenant. The format of the "HVAC Energy Fee Statement" can be customized by the building manager.

Please note that each tenant's indoor units and other apparatus (such as lighting, alarms, etc) are monitored on an individual WHM that is not connected to the TG-2000 PC; therefore, the indoor units' energy consumption is not included in the "HVAC Energy Fee Statement". However, the indoor units' energy consumption is included on the tenant's energy bill, as specified on the individual WHM. The energy consumption of the indoor units is minimal.

Installation and site adjustment details for the TG-2000 Software and activation of the tenant billing function are contained in the "TG-2000 Site Adjustment Manual" entitled OpenManSA.pdf. Operation and management details for the TG-2000 Software and the tenant billing software option are described in the "TG-2000 Operation Manual for Managers" entitled OpenManMA.pdf.

Tenant Billing and RS-485 Watt Hour Meters (WHMs)

The "TG-2000 Site Adjustment Manual" in Section 2.4 lists approved manufacturers and devices that are compatible with CITY MULTI® systems. Approved RS-485 WHM manufacturers and models for interconnection with a PC configured with TG-2000 and tenant billing software are listed below.

- Circutor, Model CVM-BC-ITF-RS485-C2
- Northern Design (Electronics) Ltd., Model Power Rail 323 + RS485 Module
- Elcomponent Limited, Model AEM31D/485
- Elcontrol Energy, Model ED39din 485

Circutor offers the Model CVM-BC-ITF-RS485-C2 WHM with an RS-232 or USB converter available in the U.S. requiring 230 VAC single phase, 50/60 Hz which is applicable for both US and Bermuda installations of CITY MULTI® via Measurlogic, Inc. Measurlogic, Inc contact information is as follows:

Measurlogic, Inc (www.measurlogic.com)
10235 S, Progress Way, Unit 1, Parker, CO 80134
Contact: John Stratford
Tele: 1-877-777-6567 or 303-805-5252
Fax: 425-799-4780
E-mail: sales@measurlogic.com

The CT to use with the WHM needs to be sized 1.5 times or more of the total rated current for all the outdoor units. For example, if there are four outdoor units monitored by one WHM and each outdoor unit has a rated capacity of 10 Amps. The CT needs to be sized at 60 Amps

(CT = 10 A x 1.5 x 4 = 60 Amps)

To interconnect the RS-485 WHM monitoring the CITY MULTI® outdoor unit(s) to the TG-2000 PC with tenant billing software, a RS-485/RS-232C or RS-485/USB converter will need to be locally procured and permanently installed onsite.

Figure 2 illustrates the site configuration for the tenant billing environment.

Figure 2. Site Configuration for Tenant Billing

Tenant Billing: Software Activation, System Verification, and Software Configuration

The following high-level actions are required to activate the tenant billing software.

1. Purchase tenant billing software license per AG-150/GB-50ADA from Mitsubishi Electric and complete Form A to register project information. Note tenant billing also requires purchase of web monitoring and web scheduling software functions per AG-150/GB-50ADA in order to operate.
2. Install CITY MULTI[®] Equipment, including AG-150/GB-50ADA Centralized Controllers. Connect AG-150/GB-50ADA Centralized Controllers to PC via closed LAN, Ethernet hub, or router.
3. Upgrade AG-150/GB-50ADA Centralized Controllers to latest software version.
4. Install TG-2000 software on dedicated network PC.
5. Activate software licenses for web monitoring, web scheduling, and tenant billing on per AG-150/GB-50ADA basis by using Mitsubishi issued Form B containing license numbers and terms.

The following site configuration information must be verified.

1. Verify site configuration in terms of communication between
 - a. AG-15A/GB-50ADA Centralized Controllers and TG-2000 configured PC
 - b. Outdoor unit(s) and PC via RS-485 WHM.
2. Verify TG-2000 computer requirements
3. Verify that the version for AG-50/GB-50ADA Centralized Controllers.
4. Verify that the version is 4.70 or greater for TG-2000 software.
5. Verify that PC will always remain connected to AG-150/GB-50ADA Centralized Controllers and always powered-on.
6. Verify that TG-2000 software is properly configuration and already operating for monitoring and scheduling.

To configure the TG-2000 software for the tenant billing software and RS-485 WHM connection to the outdoor units, perform the following initialization steps as detailed in "OpenManSA.pdf".

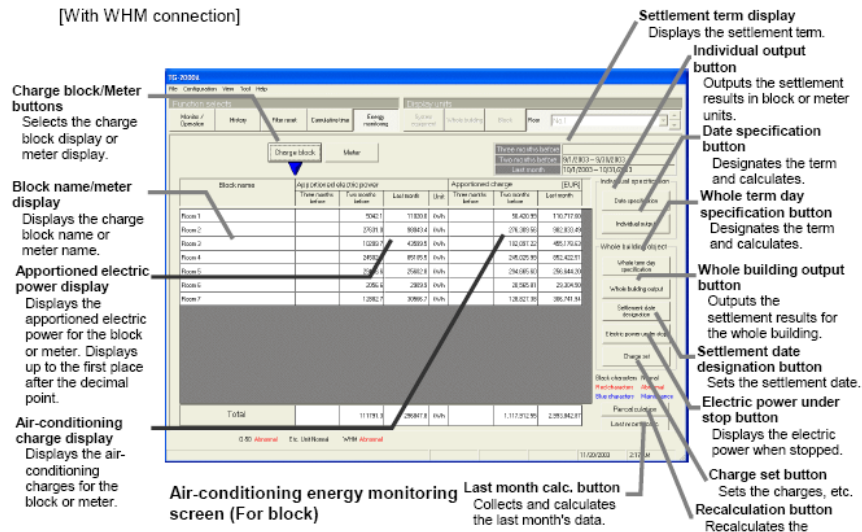
1. The "Initial Window" is divided into three functional areas: User Set Up, System Set Up and Maintenance. In the User Set Up area, select the "User Set Up" button followed by the "Go to User Setting 2" button. The User Setting Window 2 is divided into three functional areas: Connection Setting, Other Functions, and Energy Monitoring Related.
2. In the Connection Setting area,
 - a. Select "Connection" to printer
 - b. Select "Serial RS-485 WHM" connection
 - c. Select "No Connection" for PLC and General Equipment
3. In the Energy Monitoring Related area,
 - a. Select "Activate" Energy Monitoring function
 - b. Select "Activate" always connection to AG-150/GB-50ADA system
 - c. Select "Connection To" and "Activate" WHM
 - d. Select "Activate" automatic output of information and destination folder
 - e. Select "Numerical Order" for charge display
 - f. Select "Standard" format.
4. Progress through Section 8.9 for Monitoring Set Up.
5. Progress through Sections 8.10 and 8.11 for RS-485 WHM Set Up.

6. Progress through Section 8.12 for Energy Monitoring Set Up. Make sure to define the relationship between the outdoor units and the WHM in Section 8.12.3.
7. In Section 8.13, define the currency for the tenant bill, electricity unit price, and specific zone and pattern information.

Tenant Billing: Software Operation and Output

To operate the tenant billing software, please refer to the “OpenManMA.pdf” manual, specifically Section 9 for Energy Monitoring/Tenant Billing. Figure 3 illustrates the “Energy Monitoring” screen and button menu for connection to RS-485 WHM.

On the “Energy Monitoring” Screen when there is a RS-485 WHM monitoring the outdoor units, each block of indoor units is denoted with the kWh amount and currency amount for up to 3 months data. In Figure 3, the currency unit had been set to Euros; however, this is user defined and can be set to variety of currency units, including U.S. Dollars and country-defined units. The settlement date is the date that the building manager desires for the calculation to occur every month. The settlement date can be a specific date or simply set to the “end of the month”. The energy monitoring information can be output to a printer and/or to a destination folder on the TG-2000 configured PC. This is defined in the User Setting functional area of the Initial Setting Window. If the manager wants the energy monitoring data for a subset of a month, the building manager would select the “Whole Term Day Specification” to specify a specific date range output.



[Description of displays and buttons]

Item	Details
Block name display	Displays the block units air-conditioning charges for up to three preceding months.
Meter display	Displays the watt hour units air-conditioning charge for up to three preceding months.
Apportioned electric power display	Displays the Apportioned electric power for each unit.
Air-conditioning charge display	Displays the monthly air-conditioning charge: (electric use unit price + standard charge) for each unit.
Individual specification	Specifies an individual object and calculates and outputs the air-conditioning charge.
1) Date specification	Specifies the date and calculates and outputs the air-conditioning charge for the selected block.
2) Individual output	Calculates and outputs the air-conditioning charge for the selected block.
Whole building object	Sets, calculates and outputs the air-conditioning charge for the whole building.
1) Whole term day specification	Specifies the term day and calculates and outputs the air-conditioning charge for all blocks, or all watt hour meters.
2) Whole building output	Specifies the term day and calculates and outputs the air-conditioning charge for all blocks and all watt hour meters.
3) Settlement date designation	Specifies the air-conditioning charge settlement date.
4) Electric power under stop	Displays and outputs the electric power under stop.
5) Charge set	Calls the Air-conditioning energy monitoring basic set screen.
Recalculation	Recalculates the air-conditioning charges.
Last month calc.	Calculates the last month (collects and calculates data). (Only when "connect when needed" is selected.)

Figure 3. Energy Monitoring Screen (with WHM Connection)

Tenant Billing: Support Tool

An Excel-based support tool has been provided, entitled "AirConCharge.xls", to develop an actual tenant bill per block of indoor units that the building manager can deliver to the specific tenant. Operation of this tool is provided in Appendix 1 of "OpenManMA.pdf." Figure 4 illustrates the output of this support tool.

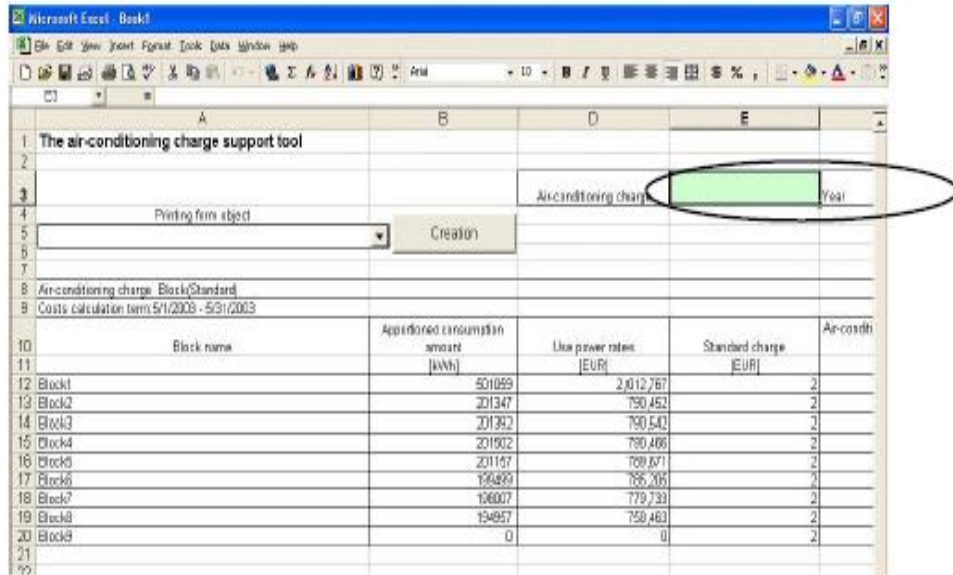


Figure 4. Support Tool for Tenant Billing

From this output, the building manager can automatically create a “HVAC Energy Bill” per tenant, as illustrated in Figure 5. Thus, the building manager will be able to deliver each tenant an individual “HVAC Energy Bill”, as created by the support tool. The format of the “HVAC Energy Bill” can be customized by the billing manager to include property information and other information.

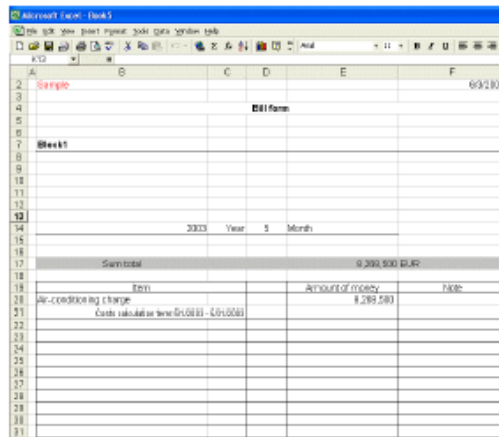


Figure 5. “HVAC Energy Fee Statement” Sample

Conclusion

The TG-2000 Tenant Billing software in combination with a RS-485 WHM monitoring the outdoor unit(s) allows the building manager to issue a per tenant bill every month. The TG-2000 Tenant Billing software will automatically calculate the amount of each tenant’s energy consumption relative to the outdoor unit(s) for each month. The building manager defines the date for the calculation and tenant bill output to occur each month. The

tenant bill output can be output directly to a connected printer and/or to an Excel file on the TG-2000 configured PC.

The TG-2000 Tenant Billing software in combination with a RS-485 WHM enables the building manager to appropriately divide the energy consumption of the CITY MULTI[®] outdoor unit(s) among the tenants based on each tenant's demand for conditioning.