1. PLC\_CommunicationTo2400S Specifications And Details

This paper describes the actual measurement system created and the recommended method of constructing the system. Project files are located in the following directories.

・“C:\....\PLC\_CommunicationTo2400S\ PLC\_CommunicationTo2400S.kpr”

* 1. Structure of the created system

Tab Connection Wire Color of KV-XL202



[Equipment List]

・PC

・CPU unit: Keyence KV-8000

・Communication unit: Keyence KV-XL202

・Power unit: Keyence CA-U4

・Source meter: Keithley 2400s

・RS-232c cable (Need to cutting)

・USB cable

・Ethernet cable

・3-terminals power cable

The following Figures of equipment connections (Fig 1) and system structure (Fig 2) are shown below. See Tab 1 for wire color when connecting RS-232c cable to KV-XL202. It is recommended that a continuity check be performed when changing RS-232c cables.

This measurement system consists of a PC, a PLCs CPU unit and Communication unit, and a source meter device. The PC is the user interface, the PLC is the processing unit, and the source meter is controlled by the PLC.

ダイアグラム

AI によって生成されたコンテンツは間違っている可能性があります。

Fig Equipment connection

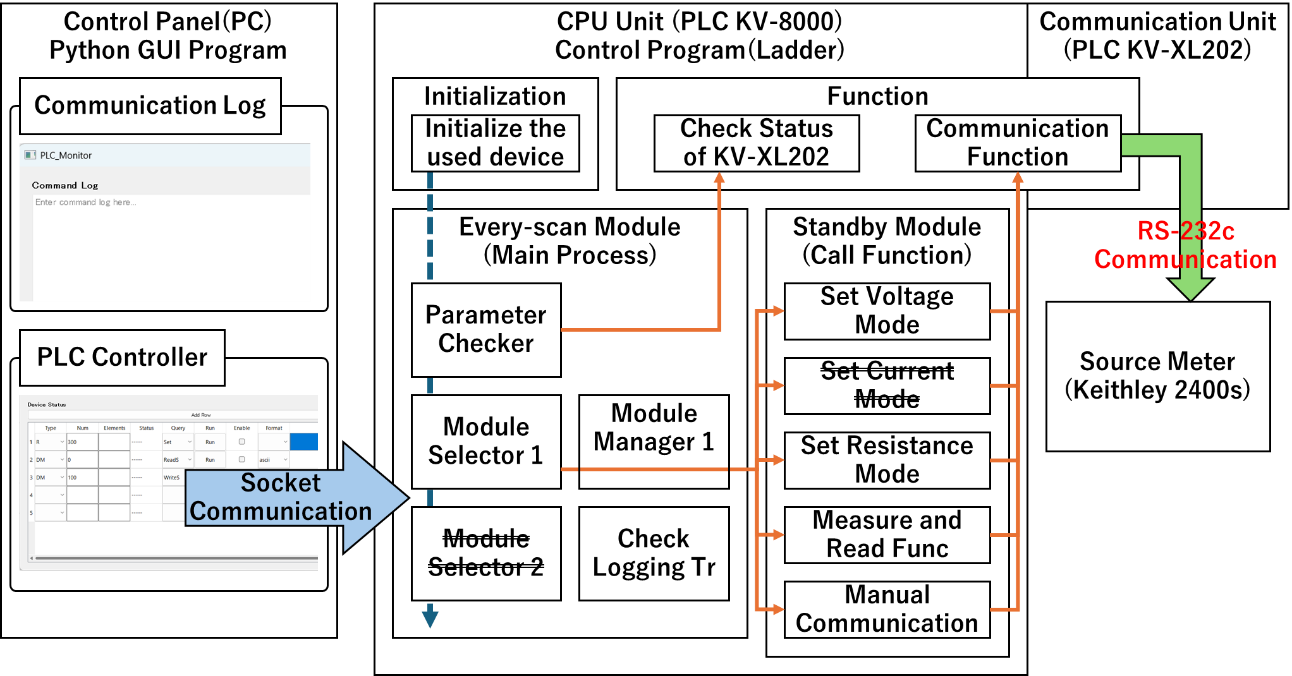


Fig System Structure

[Process Flow]

1. PLC: Initialization. Initialize process flags, Data Memory, and device values of KV-XL202.
2. PLC: Every-scan module is started. And wait for orders from the user. It also monitors device status for error handling.
3. GUI: Send relay rise command to flag the module startup. (\*Host-Link communication can be used to change device values for most PLCs. In other words, a similar system can be built by controlling the ladder program with a Python Program without transferring it to a PLC. However, that would lose the advantage of PLCs. Therefore, it is necessary to properly restrict the devices to which GUI programs have access. This system assumes access only to the start flag and DM for manual communication.)
4. PLC: When the module start flag is raised, check if the module is executable in Module Manager and call the Standby Module.
5. PLC: Each Standby Module calls a “Communication Function” to send commands to the 2400s for RS-232c communication.
6. PLC: The “Communication Function” handles the sending and receiving of RS-232c communications, and controls the KV-XL202 appropriately. (\*Controls the physical devices of the KV-XL202. Therefore, it must be single-threaded and properly processed.)
7. 2400s: Processing is performed according to the received commands.
8. PLC: Check triggers and perform logging. This system records sending command and receiving command. (\*To use the logging function, PLC settings must be made in addition to ladder program.)

PLCs have a very low logic level compared to C++, Python, etc. Therefore, careful specification is necessary. Also, the execution method is not the sequential execution method of C++, Python, etc., but the every scan method, so it is necessary to create programs that take device state transitions into consideration.

A state transition refers to a change in output values depending on various input conditions. In a ladder program, set modules continue to be scanned. And there is no concept of waiting; it is asynchronous. Therefore, process flags must be used to properly process the program.

* 1. Module execution sequence

The order in which modules are scanned can be set. As the system becomes more complex, this setting becomes more important. The setup method and the Execute sequence of modules of this system (Fig 3) are shown below.

[Setup Method]

1. Click on [Program] -> [Setup module execute sequence].
2. CPU system setting: Select on [Program setting] -> [Execute sequence of modules].
3. CPU system setting: The order of scanning modules can be set.

グラフィカル ユーザー インターフェイス

AI によって生成されたコンテンツは間違っている可能性があります。

Fig Module execution sequence

* 1. Definition of PLC variables

Similar to C++ and Python, PLC can define global and local variables. This can be used to properly manage process flags and status. As a point of reference, global variables are defined statically, while local variables have the characteristic of being managed dynamically.

[Setup Method]

1. Click on [View] -> [Variable edit window].
2. Variable edit: Select the Global or Local tab. (Fig 4)
3. Variable edit: For Global variables, enter the Variable name, Data type, Assigned device.
4. Variable edit: For Local variables, select the program from the downlist and enter the Local Variable name, Data type, Value (initial value).

テーブル

AI によって生成されたコンテンツは間違っている可能性があります。

Fig PLCs Global Variables

* 1. PC network settings

The GUI program requires PC network configuration for network communication.

[Setup Method]

1. Launch the PC settings and open the Ethernet settings in the Network & internet section.
2. Click on the Edit button of IP Assignment to open it and select Manual.
3. Set IPv4 to On and enter the following settings.

・IP address: 192.168.0.100 (Match the network settings of the KV-8000. 192.168.0.n)

・Subnet mask: 255.255.255.0 (Match the network settings of the KV-8000.)

・Gateway: 192.168.0.1 (Match the network settings of the KV-8000. 192.168.0.n)

・Preferred DNS: 192.168.0.1(Match the network settings of the KV-8000. 192.168.0.n)

・DNS over HTTPS: Off (default)

・Alternate DNS: \*Do not fill in (default)

・DNS over HTTPS: Off (default)

1. Click on Save. And close Settings.
   1. Host-Link Communication by Python script

To build a user interface for the PLC system, a library for Host-Link communication and library for GUI creation were imported in Python, and a control monitor was created. The KV-8000 can perform Host-Link communication as an EtherNet/IP function. This function is used to override and control device values provided in the KV-8000.

The main Python program is located in the following directory.

“C:\....\PLC\_CommunicationTo2400S\PLC\_ControlMonitor\PLC\_MonitorMain.py”

[How to use]

1. Launch a terminal and execute the following command.

“\PLC\_CommunicationTo2400S\PLC\_ControlMonitor> python .\PLC\_MonitorMain.py”

1. Fill in the command settings in the table at the bottom of the window, as shown in Fig 1.

(\*To control a Relay, enter R in the Type column, the number of the Relay to be controlled in the Num column, and Set (Rise) or Reset (Fall) in the Query column, and click Run.)

1. As shown in Tab 2, each device corresponds to a global variable in the PLC. Therefore, by clicking on Run and setting the start flag, the Standby Module can be executed.
2. To use the manual communication function, set the command settings as shown in rows 6~7 of the table in Fig 2, and set the command and command length in DM. Then, the “ManualComRS232cP1Flag” flag is set and executed.

Tab 2 Module flags and control monitor settings for PLCs



テキスト が含まれている画像

AI によって生成されたコンテンツは間違っている可能性があります。

Fig Control Monitor Window

[Note.]

・When using “plural form” instruction, the array length must be entered in the Elements column. For example, Sets, Resets, Writes, Reads, etc.

・The Host-Link communication functions of the Python program are described in the following file. Socket library is required.

“\PLC\_CommunicationTo2400S\PLC\_ControlMonitor> python .\PLC\_CommandClass.py”

・For information on creating “PLC\_CommandClass.py”, see the manual below.

“C:\....\PLC\_CommunicationTo2400S\Manual\English\EtherNetsIP\_Function\_KV-EP21V\_KV-8000(A)etc\_User's\_Manual.pdf”

-> Section 8 HOST-LINK COMMUNICATION FUNCTION

・GUI library used PyQt5 version 5.15.11.

* 1. FTP server function

Set up an FTP server function to access the PLC’s internal storage and the SD card inserted in the KV-8000. Using this function, log data and other data can be comfortably obtained.

[How to use]

1. As shown in Fig 6, select KV-8000 in the Unit Editor and set the “FTP server” to “Used”.
2. After setting up the FTP server, transfer the settings and program to the PLC.
3. After confirming that the PC and KV-8000 are connected via EtherNet cable, launch Explorer of PC as shown in Fig 7 and enter the following command to access the system.

“ftp://192.168.0.10”, (\*Enter the IP address of the KV-8000 in Fig 6)

1. When the logon dialog appears, enter KV for the username and logon without a password.
2. Access to PLC and SD card storage to view files.

グラフィカル ユーザー インターフェイス

AI によって生成されたコンテンツは間違っている可能性があります。

Fig Enable FTP Server Settings

* 1. Logging function

Set up a logging function to obtain experimental data and operation records. Operation records can be used to debug the program.

[Setup Method]

1. Click on [Tool] -> [Setup logging/trace].
2. Logging/Trace setting list: Click on Set. This system was set up as follows.

・Function select: Logging

・Saving location: Memory card

・File comment: SendCommandLog

・File name, File No.: Auto numbering

・File name, No. upper limit: 99

・File name, Start operation: New a file

・File name, When no empty No.: Overwrite by the oldest files

・File name, String: SendCommandLog

・File name, Date/time: Year, Month, Day

・Device/variable, Device/variable: RS232cP1CommandLog

・Device/variable, Word Pts: 255

・Device/variable, Data format: ASCII16BIT

・Trigger, Type: Bit device

・Trigger, Device: RS232cP1SendStatus

・Option, Insert file comments into the leading of CSV file: Enable

・Option, Add comments row of device: Enable

・Option, Attach time stamp to each row: Enable

・Option, Add data No. to each row: Enable

・Option, Add data obtain span to each row: Enable

・Option, Add space to secure the character count: Disable

・Option, Perform CSV file save for each trigger: Enable

・Option, Save the file to non-volatile memory: Enable

・Option, Auto-restart logging by inserting memory card: Enable

・Option, Set upper limit of file capacity: Enable

・Option, Upper limit: 1000, Row

1. The logging function for reception was also set up with reference to ②
2. In this setup, logging continues as long as the Bit device (Relay) is up, so a “Check Logging Trigger” module was add for the logging function.
   1. Program module type
      1. Initialize module
      2. Every-scan execution module
      3. Standby module
      4. Function / Function Block
   2. Description of each module
      1. Initialize the used device
      2. Parameter Checker
      3. Module Selector
      4. Module Manager
      5. Check Logging Trigger
      6. Set Resistance Mode
      7. Set Voltage Mode
      8. Measure and Read Func
      9. Manual Communication
      10. Check Status of KV-XL202
      11. Communication Function