

## EL731 MODBUS TCP INTERFACE

Revision 2-A-121614



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## 1. GENERAL

This document describes the AC700-CUA-04 Communications Upgrade Adapter Modbus TCP features supported by the EL731.

The adapter allows uploading custom web pages to access and display data.

## 2. INSTALLATION

Before installing the adapter, note its MAC ID.

To field-install an AC700-CUA Communications Upgrade Adapter, disconnect the EL731 supply voltage, remove the adapter-access cover, insert the adapter, and retain with the supplied screws. Apply the supply voltage.

## 3. MODBUS CONFIGURATION

### 3.1 CONFIGURATION SOFTWARE

With the communications module installed, a standard RJ45 network cable can be used to connect the EL731 to a Modbus TCP network. If connecting directly to a computer, the use of a router is recommended. Set the IP address using the IP Config software available at [www.littelfuse.com/protectionrelays](http://www.littelfuse.com/protectionrelays). The software requires Microsoft Windows operating system. The Modbus interface supports 10/100-Mbit, full- or half-duplex operation.

All module addresses for connected Anybus modules will be displayed. The MAC address displayed on the adapter is used to identify a specific EL731.

### 3.2 LED INDICATION

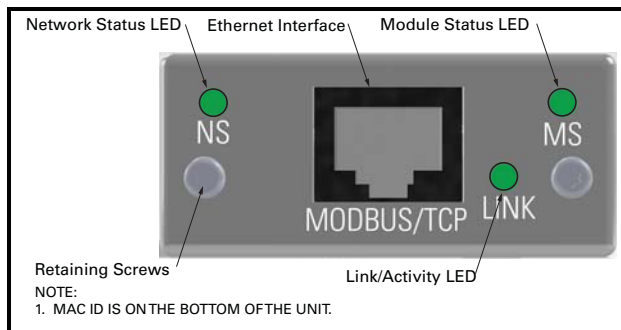


FIGURE 3.1 LED Indicators.

TABLE 3.1 NS - NETWORK STATUS LED

| STATE          | DESCRIPTION                               |
|----------------|-------------------------------------------|
| Steady Off     | No Power or No IP address                 |
| Steady Green   | Module Is In Process Active Or Idle State |
| Flashing Green | Waiting For Connections                   |
| Flashing Red   | Process Active Timeout                    |
| Steady Red     | Duplicate IP Address, or FATAL Event      |

**NOTE:** A test sequence is performed on this LED during startup.

TABLE 3.2 MS - MODULE STATUS LED

| STATE        | DESCRIPTION                                                |
|--------------|------------------------------------------------------------|
| Steady Off   | No Power                                                   |
| Steady Green | Normal Operation                                           |
| Flashing Red | Minor Fault In Diagnostic Object; IP Conflict              |
| Steady Red   | Major Fault; Module Is In State EXCEPTION (Or FATAL Event) |

**NOTE:** A test sequence is performed on this LED during startup.

TABLE 3.3 LINK – LINK/ACTIVITY LED

| STATE            | DESCRIPTION          |
|------------------|----------------------|
| Steady Off       | No Link, No Activity |
| Steady Green     | Link Established     |
| Flickering Green | Activity             |

## 4. MODBUS/TCP PROTOCOL

The EL731 Modbus TCP module can handle up to 8 simultaneous connections. It supports all of the Modbus/TCP class 0 and class 1 and some of the class 2 commands.

Word addressing (4xxxx) is supported. A 16-bit word can be read as a single word using word addressing. The use of the Modbus prefix 0, 1, 3, and 4 is a function of the master and may not be required. Check the master's documentation.

**Table 4.1 Function Codes**

| FUNCTION CODE | FUNCTION NAME            | CLASS | AFFECTS AREA | ADDRESSING METHOD | MODBUS GROUP |
|---------------|--------------------------|-------|--------------|-------------------|--------------|
| 1             | Read Coils               | 1     | IN/OUT       | Bit               | 0xxxx        |
| 2             | Read Input Discretes     | 1     | IN/OUT       | Bit               | 1xxxx        |
| 3             | Read Multiple Registers  | 0     | IN/OUT       | Word              | 4xxxx        |
| 4             | Read Input Registers     | 1     | IN/OUT       | Word              | 3xxxx        |
| 5             | Write Coil               | 1     | OUT          | Bit               | 0xxxx        |
| 6             | Write Single Register    | 1     | OUT          | Word              | 4xxxx        |
| 7 *           | Read Exception Status    | 1     | -            | -                 | -            |
| 15            | Force Multiple Coil      | 2     | OUT          | Bit               | 0xxxx        |
| 16            | Force Multiple Registers | 0     | OUT          | Word              | 4xxxx        |
| 22            | Mask Write Register      | 2     | OUT          | Word              | -            |
| 23            | Read/Write Registers     | 2     | IN/OUT       | Word              | -            |

- \* Exception Code 01: Illegal Function
- Exception Code 02: Illegal Data Address
- Exception Code 03: Illegal Data Value

### 4.1 MODBUS/TCP MEMORY ADDRESSING

#### 4.1.1 WRITE PROCESS

The Write Process area contains data that can be read using Function Codes 1, 2, 3, 4, and 23. It is not possible to write to the Write Process area. The data is available in 16-bit format and starts at memory address 256.

**Table 4.2 Write Process**

| MEMORY ADDRESS<br>(Modbus Address) | ATTRIBUTE   | TYPE   |
|------------------------------------|-------------|--------|
| 256                                | Trip State  | UINT16 |
| 257                                |             |        |
| 258                                | Alarm State | UINT16 |
| 259                                |             |        |

#### 4.1.2 READ PROCESS

The read process area is used to enable/disable CT1 and CT2. Address 1 and 3 are the Command Registers. A transition from 0 to 3 tells the EL731 to write the value at Address 0 and 2 to the EL731. To enable CT1, set register 0 to 1, and then change the Command Register at 1 from 0 to 3.

**Table 4.3 Read Process**

| MEMORY ADDRESS<br>(Modbus Address) | ATTRIBUTE        | TYPE   |
|------------------------------------|------------------|--------|
| 0                                  | CT1 Enable       | UINT16 |
| 1                                  | Command Register |        |
| 2                                  | CT2 Enable       | UINT16 |
| 3                                  | Command Register |        |

## 4.2 MODBUS TCP COMMUNICATIONS

**Table 4.4 Modbus TCP Communications Table**

| MEMORY ADDRESS<br>(Modbus Address) | ATTRIBUTE         | ACCESS     | TYPE      |
|------------------------------------|-------------------|------------|-----------|
| 528                                | Model Code        | Read       | T1        |
| 529                                |                   |            |           |
| 530                                | Firmware Version  | Read       | T1        |
| 531                                |                   |            |           |
| 532                                | Serial Number     | Read       | T2 (Low)  |
| 533                                |                   | Read       | T2 (High) |
| 534                                | Model Option      | Read       | T2 (Low)  |
| 535                                |                   | Read       | T2 (High) |
| 536                                | Reserved          |            |           |
| 537                                |                   |            |           |
| 538                                | CT1 Enable        | Read/Write | T3        |
| 539                                |                   |            |           |
| 540                                | CT1 Primary Turns | Read/Write | T1        |
| 541                                |                   |            |           |
| 542                                | CT1 Trip Time     | Read/Write | T2 (Low)  |
| 543                                |                   | Read/Write | T2 (High) |
| 544                                | CT1 Trip Level    | Read/Write | T2 (Low)  |
| 545                                |                   | Read/Write | T2 (High) |
| 546                                | Reserved          |            |           |
| 547                                |                   |            |           |
| 548                                | CT1 Alarm Level   | Read/Write | T2 (Low)  |
| 549                                |                   | Read/Write | T2 (High) |
| 550                                | CT1 Calibrate     | Write      | T4        |
| 551                                |                   |            |           |
| 552                                | Reserved          |            |           |
| 553                                |                   |            |           |
| 554                                | Reserved          |            |           |
| 555                                |                   |            |           |
| 556                                | CT2 Enable        | Read/Write | T3        |
| 557                                |                   |            |           |
| 558                                | CT2 Primary Turns | Read/Write | T1        |
| 559                                |                   |            |           |
| 560                                | CT2 Trip Time     | Read/Write | T2 (Low)  |
| 561                                |                   | Read/Write | T2 (High) |
| 562                                | CT2 Trip Level    | Read/Write | T2 (Low)  |
| 563                                |                   | Read/Write | T2 (High) |
| 564                                | Reserved          |            |           |
| 565                                |                   |            |           |
| 566                                | CT2 Alarm Level   | Read/Write | T2 (Low)  |
| 567                                |                   | Read/Write | T2 (High) |
| 568                                | CT2 Input Filter  | Read/Write | T5        |
| 569                                |                   |            |           |
| 570                                | Reserved          |            |           |
| 571                                |                   |            |           |
| 572                                | Reserved          |            |           |
| 573                                |                   |            |           |
| 574                                | Reserved          |            |           |

**Table 4.4 Modbus TCP Communications Table (continued)**

| MEMORY ADDRESS<br>(Modbus Address) | ATTRIBUTE            | ACCESS     | TYPE      |
|------------------------------------|----------------------|------------|-----------|
| 575                                |                      |            |           |
| 576                                | Reserved             |            |           |
| 577                                |                      |            |           |
| 578                                | PTC Trip Action      | Read/Write | T3        |
| 579                                |                      |            |           |
| 580                                | PTC Alarm Action     | Read/Write | T3        |
| 581                                |                      |            |           |
| 582                                | Reserved             |            |           |
| 583                                |                      |            |           |
| 584                                | Reserved             |            |           |
| 585                                |                      |            |           |
| 586                                | RTD Trip Action      | Read/Write | T3        |
| 587                                |                      |            |           |
| 588                                | RTD Trip Level       | Read/Write | T2 (Low)  |
| 589                                |                      | Read/Write | T2 (High) |
| 590                                | RTD Alarm Action     | Read/Write | T3        |
| 591                                |                      |            |           |
| 592                                | RTD Alarm Level      | Read/Write | T2 (Low)  |
| 593                                |                      | Read/Write | T2 (High) |
| 594                                | Reserved             |            |           |
| 595                                |                      |            |           |
| 596                                | Reserved             |            |           |
| 597                                |                      |            |           |
| 598                                | Relay 1 Function     | Read/Write | T6        |
| 599                                |                      |            |           |
| 600                                | Relay 1 Mode         | Read/Write | T7        |
| 601                                |                      |            |           |
| 602                                | Relay 2 Function     | Read/Write | T6        |
| 603                                |                      |            |           |
| 604                                | Relay 2 Mode         | Read/Write | T7        |
| 605                                |                      |            |           |
| 606                                | Relay 3 Function     | Read/Write | T6        |
| 607                                |                      |            |           |
| 608                                | Relay 3 Mode         | Read/Write | T7        |
| 609                                |                      |            |           |
| 610                                | Reserved             |            |           |
| 611                                |                      |            |           |
| 612                                | Reserved             |            |           |
| 613                                |                      |            |           |
| 614                                | Analog Out CT Select | Read/Write | T8        |
| 615                                |                      |            |           |
| 616                                | Analog % Level       | Read/Write | T9        |
| 617                                |                      |            |           |
| 618                                | Output Filter        | Read/Write | T3        |
| 619                                |                      |            |           |
| 620                                | Reserved             |            |           |
| 621                                |                      |            |           |
| 622                                | Reserved             |            |           |
| 623                                |                      |            |           |
| 624                                | Temp. Sensor         | Read/Write | T10       |

**Table 4.4 Modbus TCP Communications Table (continued)**

| MEMORY ADDRESS<br>(Modbus Address) | ATTRIBUTE       | ACCESS     | TYPE       |
|------------------------------------|-----------------|------------|------------|
| 625                                |                 |            |            |
| 626                                | Reserved        |            |            |
| 627                                |                 |            |            |
| 628                                | Reserved        |            |            |
| 629                                |                 |            |            |
| 630                                | Display Filter  | Read/Write | T3         |
| 631                                |                 |            |            |
| 632                                | Reserved        |            |            |
| 633                                |                 |            |            |
| 634                                | Reserved        |            |            |
| 635                                |                 |            |            |
| 636                                | CT1 Current     | Read       | T11 (Low)  |
| 637                                |                 | Read       | T11 (High) |
| 638                                | CT2 Current     | Read       | T11 (Low)  |
| 639                                |                 | Read       | T11 (High) |
| 640                                | Full Current    | Read       | T11 (Low)  |
| 641                                |                 | Read       | T11 (High) |
| 642                                | Internal Temp.  | Read       | T11 (Low)  |
| 643                                |                 | Read       | T11 (High) |
| 644                                | PTC Temp.       | Read       | T11 (Low)  |
| 645                                |                 | Read       | T11 (High) |
| 646                                | RTD Temperature | Read       | T11 (Low)  |
| 647                                |                 | Read       | T11 (High) |
| 648                                | Reserved        |            |            |
| 649                                |                 |            |            |
| 650                                | Reserved        |            |            |
| 651                                |                 |            |            |
| 652                                | Clear Counters  | Write      | T4         |
| 653                                |                 |            |            |
| 654                                | Load Defaults   | Write      | T4         |
| 655                                |                 |            |            |
| 656                                | Restart System  | Write      | T4         |
| 657                                |                 |            |            |
| 658                                | Reserved        |            |            |
| 659                                |                 |            |            |
| 660                                | Reserved        |            |            |
| 661                                |                 |            |            |
| 662                                | Trip State      | Read       | T12        |
| 663                                |                 |            |            |
| 664                                | Alarm State     | Read       | T13        |
| 665                                |                 |            |            |
| 666                                | Trip Counter    | Read       | T1         |
| 667                                |                 |            |            |
| 668                                | Alarm Counter   | Read       | T1         |
| 669                                |                 |            |            |
| 670                                | System Uptime   | Read       | T2 (Low)   |
| 671                                |                 | Read       | T2 (High)  |
| 672                                | Reserved        |            |            |
| 673                                |                 |            |            |
| 674                                | Reserved        |            |            |
| 675                                |                 |            |            |

**Table 4.4 Modbus TCP Communications Table (continued)**

| MEMORY ADDRESS<br>(Modbus Address) | ATTRIBUTE        | ACCESS | TYPE     |
|------------------------------------|------------------|--------|----------|
| 676                                | Running Time (s) | Read   | T2 (Low) |
| 677                                |                  | Read   | T2(High) |
| 678                                | External Reset   | Write  | T4       |
| 679                                |                  |        |          |

**Table 4.5 Register Formats**

| TYPE | DESCRIPTION.                                                                                                                                                                                                                                                                                                                                                                                      |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| T1   | 16-Bit Integer                                                                                                                                                                                                                                                                                                                                                                                    |
| T2   | 32-Bit Unsigned Integer                                                                                                                                                                                                                                                                                                                                                                           |
| T3   | 0 = Disable<br>1 = Enable                                                                                                                                                                                                                                                                                                                                                                         |
| T4   | Command<br>1 = Send Command                                                                                                                                                                                                                                                                                                                                                                       |
| T5   | CT2 Input Filter<br>0 = None<br>1 = Full Range<br>2 = 90 Hz Low Pass<br>3 = 190 Hz High Pass<br>4 = 3 kHz Low Pass                                                                                                                                                                                                                                                                                |
| T6   | Relay Functions<br>0 = Trip<br>1 = Alarm<br>2 = Watchdog<br>3 = Current                                                                                                                                                                                                                                                                                                                           |
| T7   | Relay Mode<br>0 = Non-Fail-Safe<br>1 = Fail-Safe                                                                                                                                                                                                                                                                                                                                                  |
| T8   | Analog Out CT Select<br>0 = CT1<br>1 = CT2<br>2 = Both CT's                                                                                                                                                                                                                                                                                                                                       |
| T9   | Analog % Level<br>0 = 0 – 5A Normal Mode<br>1 = 0 – Trip Level (% Trip Level Mode)                                                                                                                                                                                                                                                                                                                |
| T10  | Temp. Sensor<br>0 = Disabled<br>1 = RTD Sensor<br>2 = PTC Sensor                                                                                                                                                                                                                                                                                                                                  |
| T11  | 32-Bit Signed Integer, (High) Bits 31..16, (Low) Bits 15..0                                                                                                                                                                                                                                                                                                                                       |
| T12  | Trip Status<br>Bit0: 1 = System Running<br>Bit1: 1 = Trip Current CT1<br>Bit2: 1 = Trip Current CT2<br>Bit3: 1 = Trip User Test<br>Bit4: 1 = Trip CT1 Detect<br>Bit5: 1 = Trip CT2 Detect<br>Bit6: 1 = Trip NVRAM Error<br>Bit7: 1 = Calibrate<br>Bit8: 1 = Calibrate Init,<br>Bit9: 1 = Trip Calibrate<br>Bit10: 1 = Trip PTC Sensor<br>Bit11: 1 = Trip RTD Sensor<br>Bit12: 1 = System Disabled |

**Table 4.5 Register Formats (continued)**

| TYPE | DESCRIPTION                                                                                                                                                        |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| T13  | Alarm Status<br>Bit0: 1 = No Alarms<br>Bit1: 1 = CT1 Current<br>Bit2: 1 = CT2 Current<br>Bit3: 1 = PTC Sensor<br>Bit4: 1 = RTD Sensor<br>Bit5: 1 = System Disabled |
| T14  | Command Register: Sends command when charged from 0 to 3.                                                                                                          |

**APPENDIX A**  
**EL731 MODBUS TCP INTERFACE REVISION HISTORY**

| MANUAL RELEASE DATE | MANUAL REVISION |
|---------------------|-----------------|
| December 16, 2014   | 2-A-121614      |

**MANUAL REVISION HISTORY****REVISION 2-A-121614****SECTION 4**

Table 4.5, T13 (Bit0) updated.

**APPENDIX A**

Revision history added.