Accurate Lambda Meter

ALM Communication Protocol - SCI

V1.6

Http://www.ecotrons.com

Note: If you are not sure about any specific details, please contact us at info@ecotrons.com.

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1.1 Overview

Depending on the different hardware configuration of communication ports, ALM Communication Protocol – SCI consists of two parts: RS232 and RS485. Using the RS232, ALM can easily communicate with your PC; RS485 use the Modbus protocol, which is suitable for communication with industrial equipment, For example: PLC, DCS, intelligent instrumentation, etc.

1.2 RS232 communication

RS232 serial communication based on KWP2000 protocol, default baud rate is 115200, no parity bit, 8 data bits, 1 stop bit, time interval 20ms.
The baud rate can be changed by ALM GUI, with specific reference to ALM GUI manual.

1.2.1 Connect

Command (Host to ALM)

Header	Fmt	0x80
	Tgc	0x8F
	Scr	0xEA
	Len	0x03
Data	Data 1	0x9C
	Data 2	0x01
	Data 3	0x00
Checksum	Checksum	0x99

Checksum = (Header + Data) % 256

Positive response (ALM to HOST)

Header	Fmt	0x80
	Tgc	0x8F
	Scr	0xEA
	Len	0x33
Data	Data 1	0xE5
	Data 2	0x01
	Data 3	Reserved
	……	
	……	
	Data51	
Checksum	Checksum	Checksum byte

1.2.2 Start Measuring

If the user wants to upload lambda, O2%, Temp, RPM, you only need to send the “Start Measuring” command, ALM will start cycle uploading data.

Command (Host to ALM)

Header	Fmt	0x80
	Tgc	0x8F
	Scr	0xEA
	Len	0x03
Data	Data 1	0x9C
	Data 2	0x0D
	Data 3	0x00
Checksum	Checksum	0XA5

Positive response (ALM to HOST)

Header	Fmt	0x80
	Tgc	0x8F
	Scr	0xEA
	Len	0x22
Data	Sid	0xE5
	Command	0x0D
	Data3	Sensor 1 Lambda High 8 bits
	Data4	Sensor 1 Lambda Low 8 bits
	Data5	Sensor 2 Lambda High 8 bits
	Data6	Sensor 2 Lambda Low 8 bits
	Data7	Rpm High 8 bits(optional)
	Data8	Rpm Low 8 bits(optional)
	Data9	Vin 1 High 8 bits(optional)
	Data10	Vin 1 Low 8 bits(optional)
	Data11	Vin 2 High 8 bits(optional)
	Data12	Vin 2 Low 8 bits(optional)
	Data13	Sensor 1 Temp High 8 bits
	Data14	Sensor 1 Temp Low 8 bits
	Data15	Sensor 2 Temp High 8 bits
	Data16	Sensor 2 Temp Low 8 bits
	Data17	Sensor 1 O2% High 8 bits

	Data18	Sensor 1 O2% Low 8 bits
	Data19	Sensor 2 O2% High 8 bits
	Data20	Sensor 2 O2% Low 8 bits
	……	Reserved
	Data34	
Checksum	Checksum	Checksum byte

Lambda 1 = (Data3 * 256 + Data4) / 1000，
Sensor 1 AFR = Lambda1 * Fuel Ideal AFR
Sensor 1 O2% = (Data17 * 256 + Data18) / 1024
Sensor 1 Temp = (Data13 * 256 + Data14) * 0.023438-273 (DegC)

Lambda 2 = (Data5 * 256 + Data6) / 1000，
Sensor 2 AFR = Lambda2 * Fuel Ideal AFR
Sensor 2 O2% = (Data19 * 256 + Data20) / 1024
Sensor 2 Temp = (Data15 * 256 + Data16) * 0.023438-273 (DegC)

Vin 1 = (Data9 * 256 + Data10) * 5 / 1024 (optional)
Vin 2 = (Data11 * 256 + Data12) * 5 / 1024 (optional)
Rpm = (Data7 * 256 + Data8) * 40 (optional)

1.2.3 Stop Measuring

Command (Host to ALM)

Header	Fmt	0x80
	Tgc	0x8F
	Scr	0xEA
	Len	0x03
Data	Data 1	0x9C
	Data 2	0x09
	Data 3	0x00
Checksum	Checksum	0XA1

Positive response (ALM to HOST)

Header	Fmt	0x80
	Tgc	0x8F
	Scr	0xEA
	Len	0x03
Data	Data 1	0XE5
	Data 2	0x09
	Data 3	0x00
Checksum	Checksum	0XEA

1.2.4 Read DTC

Command (HOST to ALM)

Header	Fmt	0x80
	Tgc	0x8F
	Scr	0xEA
	Len	0x03
Data	Data 1	0X9C
	Data 2	0x0B
	Data 3	0x00
Checksum	Checksum	0XA3

Positive response (ALM to HOST)

Header	Fmt	0x80
	Tgc	0x8F
	Scr	0xEA
	Len	0x10
Data	Sid	0xE5
	Command	0x0B
	Data3	DTCs of Sensor 1
	……	
	Data9	
	Data10	DTCs of Sensor 2
	……	
	Data16	
Checksum	Checksum	Checksum byte

Each byte indicates one fault type; a value of 0 means no diagnostic trouble codes.

Below is the Diagnostic Trouble Code table. ALM has on-board-diagnostics capability to detect most common errors. The first thing user should do when ALM is not working appropriately is to read DTCs.

Trouble Code	Description	Solutions
E1	Internal communication error	Contact the manufacturer
E2	Internal register error	Contact the manufacturer
E3	LSU yellow wire (VM) short to power	1. Check the harness for short-to-power 2. Change the LSU
E4	LSU yellow wire (VM) short to GND	1. Check the harness for short-to-ground 2. Change the LSU
E5	LSU black wire (UN) short to power	1. Check the harness for short-to-power 2. Change the LSU
E6	LSU black wire (UN) short to GND	1. Check the harness for short-to-ground 2. Change the LSU
E7	LSU green wire (IA) short to power	1. Check the harness for short-to-power 2. Change the LSU
E8	LSU green wire (IA) short to GND	1. Check the harness for short-to-ground 2. Change the LSU
E9	Operating voltage too low	Check the power supply to the ALM spec.
E10	Heater circuit damaged	Contact the manufacturer
E11	Heater circuit short to power	Contact the manufacturer
E12	Heater circuit short to GND	1. Check the harness for short-to-ground 2. change LSU 3. Contact the manufacturer

1.3 RS485 communication

RS485 communication based on Modbus protocol, ecotrons Modbus protocol using ASCII and RTU mode, support for PLD, DTC, etc.

1.3.1 Physical layer communication definition（ASCII mode）

Communication Interface: RS485
Communication Protocol: ASCII mode, baud rate is 9600, no parity bit, 8 data bits, 1 stop bit.
Note: Communication format can be customized according to user needs.

1.3.2 Format of ASCII data packet (Request/Response)

1) Upload O2%, Lambda, LSU Temperature
PLC →ALM, PLC sends: "0A 03 2000 0004 CF"
ALM →PLC, PLC receives: "0A 03 08 xxxx xxxx xxxx xxxx xxxx xxxx xx"

Registers for sent data (sending messages)

PLC to ALM Request Description	DATA	
	Character	ASCII (Hex)
STX	:	3A
ADR Hi	0	30
ADR Lo	A	41
CMD Hi	0	30
CMD Lo	3	33
Start Addr Hi	2	32

Start Addr Lo	0	30
Start Addr Hi	0	30
Start Addr Lo	0	30
No. Bytes Hi	0	30
No. Bytes Lo	0	30
No. Bytes Hi	0	30
No. Bytes Lo	4	34
LRC CHK Hi	C	43
LRC CHK Lo	F	46
END Hi	CR	0D
END Lo	LF	0A

Note: ALM slave address must be confirmed by user. In case there is confliction, Ecotrons can use a different one.

Registers for received data (responding messages)

ALM to PLC Response	DATA	
Description	Character	ASCII (Hex)
STX	:	3A
ADR Hi	0	30
ADR Lo	A	41
CMD Hi	0	30
CMD Lo	3	33
No. Data Hi	0	30
No. Data Lo	8	38
O2% High 8-bit Hi	?	?
O2% High 8-bit Lo	?	?
O2% Low 8-bit Hi	?	?
O2% Low 8-bit Lo	?	?
Lambda High 8-bit Hi	?	?
Lambda High 8-bit Lo	?	?
Lambda Low 8-bit Hi	?	?
Lambda Low 8-bit Lo	?	?
LSU Temperature High 8-bit Hi	?	?
LSU Temperature High 8-bit Lo	?	?
LSU Temperature Low 8-bit Hi	?	?
LSU Temperature Low 8-bit Lo	?	?
LSU Faults High 8-bit Hi	?	?
LSU Faults High 8-bit Lo	?	?
LSU Faults Low 8-bit Hi	?	?
LSU Faults Low 8-bit Lo	?	?
LRC CHK Hi	?	?

LRC CHK Lo	?	?
END Hi	CR	0D
END Lo	LF	0A

Conversion method	Unit	Range
O2% =((O2% High 8-bit) *256 + (O2% Low 8-bit)) * 0.000514 – 12	%	-12% to 12%
Lambda = ((Lambda High 8-bit) *256+(Lambda Low 8-bit)) * 0.000244		0.5 to 16
LSU Temperature = ((LSU Temperature High 8-bit)*256 + (LSU Temperature High 8-bit)) * 0.023438	Deg K	840 to 1303
LSU Sensor faults = ((LSU Faults High 8-bit) *256+(LSU Faults Low 8-bit))		0 to 12

2) Modify ALM address

PLC →ALM, PLC sends: "FF 06 4000 xxxx xx"

ALM →PLC, PLC receives: "FF 06 4000 xxxx xx"

Registers for sent data (sending messages)

PLC to ALM Request Description	DATA	
	Character	ASCII (Hex)
STX	:	3A
ADR Hi	F	46
ADR Lo	F	46
CMD Hi	0	30
CMD Lo	6	36
Data Address Hi	4	34
Data Address Lo	0	30
Data Address Hi	0	30
Data Address Lo	0	30
Expect Address Hi	?	?
Expect Address Lo	?	?
Expect Address Hi	?	?
Expect Address Lo	?	?
LRC CHK Hi	?	?
LRC CHK Lo	?	?
END Hi	CR	0D
END Lo	LF	0A

Registers for received data (responding messages)

ALM to PLC Request Description	DATA

	Character	ASCII (Hex)
STX	:	3A
ADR Hi	F	46
ADR Lo	F	46
CMD Hi	0	30
CMD Lo	6	36
Data Address Hi	4	34
Data Address Lo	0	30
Data Address Hi	0	30
Data Address Lo	0	30
Expect Address Hi	?	?
Expect Address Lo	?	?
Expect Address Hi	?	?
Expect Address Lo	?	?
LRC CHK Hi	?	?
LRC CHK Lo	?	?
END Hi	CR	0D
END Lo	LF	0A

For Example, if you want to modify the address 0A to 0B:
PLC →ALM, PLC sends: "FF 06 4000 000B B0"
(ASCII (Hex): 3A 46 46 30 36 34 30 30 30 30 30 30 42 42 30 0D 0A)
ALM →PLC, PLC receives: "FF 06 4000 000B B0"

Note:

The ALM address range is 1~254.

When send modify ALM address command (06H), Can only connect one ALM on the RS-485 bus. The best disconnect other devices RS-485, other devices to prevent misuse, after modifying ALM address, and then connect other devices to the RS-485 bus.

1.3.3 Physical layer communication definition（RTU mode）

Communication Interface: RS485
Communication Protocol: RTU mode, baud rate is 19200, no parity bit, 8 data bits, 1 stop bit.
Note: Communication format can be customized according to user needs.

1.3.4 Format of RTU data packet (Request/Response)

1) Upload O2%, Lambda, LSU Temperature
PLC →ALM, PLC sends: "50 03 2000 0004 42 48"
ALM →PLC, PLC receives: "50 03 08 xxxx xxxx xxxx xxxx xxxx "

Registers for sent data (sending messages)

PLC to ALM Request Description	Data(byte)
ADR	50
CMD	03
Start Addr Hi	20
Start Addr Lo	00
No. Bytes Hi	00
No. Bytes Lo	04
CRC CHK Lo	42
LRC CHK Hi	48

Note: ALM slave address must be confirmed by user. In case there is confliction, Ecotrons can use a different one.

Registers for received data (responding messages)

ALM to PLC Response Description	Data(byte)
ADR	50
CMD	03
No. Data	08
O2% High 8-bit	xx
O2% Low 8-bit	xx
Lambda High 8-bit	xx
Lambda Low 8-bit	xx
LSU Temperature High 8-bit	xx
LSU Temperature Low 8-bit	xx
LSU Faults High 8-bit	xx
LSU Faults Low 8-bit	xx
CRC CHK Lo	xx
CRC CHK Hi	xx

Conversion method	Unit	Range
O2% =((O2% High 8-bit) *256 + (O2% Low 8-bit)) * 0.000514 – 12	%	-12% to 12%
Lambda = ((Lambda High 8-bit) *256+(Lambda Low 8-bit)) * 0.000244		0.5 to 16
LSU Temperature = ((LSU Temperature High 8-bit)*256 + (LSU Temperature High 8-bit)) * 0.023438	Deg K	840 to 1303
LSU Sensor faults = ((LSU Faults High 8-bit) *256+(LSU Faults Low 8-bit))		0 to 12

2) Modify ALM address

PLC →ALM, PLC sends: "FF 06 4000 00xx xx xx "

ALM →PLC, PLC receives: "FF 06 4000 00xx xx xx "

Registers for sent data (sending messages)

PLC to ALM Request Description	Data(byte)
ADR	FF
CMD Hi	06
Data Address High 8-bit	40
Data Address Low 8-bit	00
Expect Address High 8-bit	00
Expect Address Low 8-bit	xx
CRC CHK Lo	xx
CRC CHK Hi	xx

Registers for received data (responding messages)

ALM to PLC Response Description	Data(byte)
ADR	FF
CMD Hi	06
Data Address High 8-bit	40
Data Address Low 8-bit	00
Expect Address High 8-bit	00
Expect Address Low 8-bit	xx
CRC CHK Lo	xx
CRC CHK Hi	xx

For Example, if you want to modify the address 50 to 254:

PLC →ALM, PLC sends: "FF 06 4000 00FE 08 54"(RTU)

ALM →PLC, PLC receives: "FF 06 4000 00FE 08 54"

Note:

The ALM address range is 1~254.

When send modify ALM address command (06H), Can only connect one ALM on the RS-485 bus. The best disconnect other devices RS-485, other devices to prevent misuse, after modifying ALM address, and then connect other devices to the RS-485 bus.