Multimeter/Clamp Meter Communication Protocol Version 2.6

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Applicable Models

Company	Model Name	Model ID
APPA	150	00001
	150B	00002
	208	00003
	208B	00004
	506	00005
	506B	00006

UART Configure

Baud Rate	9600 bps
Data Bits	8 Bits
Stop Bits	1 Bit
Parity	No Parity

Basic Communication Format

Start 0	Start 1	Command Code	Data Length	Data	Checksum

Start 0 & 1: The start bytes are both 0x55
Command Code: This byte is the command code
Data Length: This byte is the length of data
Data: Transfer data of UART packet
Checksum: This byte is sum of all data array without carry

Command Code

Command Code	Operation	PC to Meter Data Length	Meter to PC Data Length
0x00	Read information	0 byte	52 bytes
0x01	Read display	0 byte	12 bytes
0x10	Read calibration	0 byte	23 bytes
0x1A	Read EEPROM	4 byte	1 to 64 bytes
0x1B	Read harmonics	0 byte	50 bytes
0x80	Enter calibration mode	0 byte	0 byte
0x85	Write function code	1 byte	0 byte
0x87	Write range code	1 byte	0 byte
0x8A	Write EEPROM	1 to 64 bytes	0 byte
0x8F	Exit calibration mode	0 byte	0 byte

Note: the 0x85, 0x87, 0x8A, 0x8F command code have to command in calibration mode.

Command Format

● **0x00: Read information**

PC to Meter

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x00	0x00	N/A	0xAA

Meter to PC

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x00	0x34	See Below	??

Data String [0…31]: Model Name [0…31], ASCII code format
Data String [32…47]: Serial Number [0…15], ASCII code format
Data String [48, 49]: Model ID [0, 1]
Data String [50, 51]: Firmware Version [0, 1]

● **0x01: Read display**

PC to Meter

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x01	0x00	N/A	0xAB

Meter to PC

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x01	0x0C	See Below	??

Data String [0]: Function code
Data String [1]: Range code
Data String [2…6]: Main display data [0…4]
Data String [7…11]: Sub display data [0…4]

● **0x10: Read calibration**

PC to Meter

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x10	0x00	N/A	0xBA

Meter to PC

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x10	0x17	See Below	??

Data String [0]: Rotary code
Data String [1]: Function code
Data String [2…6]: Main display data [0…4]
Data String [7…10]: Original data 1 [0…3], 32-bit signed integer, LSB to MSB
Data String [11…14]: Original data 2 [0…3], 32-bit signed integer, LSB to MSB
Data String [15…18]: Offset data [0…3], 32-bit signed integer, LSB to MSB
Data String [19…22]: Gain data [0…3], 32-bit signed integer, LSB to MSB

● **0x1A: Read EEPROM**

PC to Meter

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x1A	0x04	See Below	0xAB

Data String [0]: Device Number
Data String [1, 2]: EEPROM Address [0, 1], LSB to MSB
Data String [3]: Data Length, max 64 bytes

Meter to PC

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x1A	n	See Below	??

Data String [0…n-1]: Data of EEPROM, LSB to MSB

● **0x1B: Read harmonics**

PC to Meter

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x1B	0x00	N/A	0xC5

Meter to PC

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x1B	0x32	See Below	??

Data String [0,1]: H1_LSB,H1_MSB
Data String [2,3]: H2_LSB,H2_MSB
...
Data String [48,49]: H25_LSB,H25_MSB

Example:
H_1 = H1_LSB+H1_MSB << 16
H_n = Hn_LSB+Hn_MSB << 16
H_n% = Hn/H1*100%

$$THD = \frac{\sqrt{H_2^2 + H_3^2 + \cdots + H_{25}^2}}{H_1} \times 100\%$$

Note: if the mode is not HARMONICS mode when rotary switch in V / A / FlexA, the meter will return the error command: 0x55, 0x55, 0x70, 0x00, 0x1A

● **0x80: Enter calibration mode**

PC to Meter

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x80	0x00	N/A	0x2A

Meter to PC

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	See Below	0x00	N/A	??

Note: If the command code is 0x7F, the command accept by meter. If the code is 0x70, the command is invalid.

● **0x85: Write function code**

PC to Meter

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x85	0x01	See Below	??

Data String [0]: Function code

Meter to PC

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	See Below	0x00	N/A	??

Note: If the command code is 0x7F, the command accept by meter. If the code is 0x70, the command is invalid.

● **0x87: Write range code**

PC to Meter

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x87	0x01	See Below	??

Data String [0]: Range code

Meter to PC

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	See Below	0x00	N/A	??

Note: If the command code is 0x7F, the command accept by meter. If the code is 0x70, the command is invalid.

● **0x8A: Write EEPROM**

PC to Meter

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x8A	4+n	See Below	??

Data String [0]: Device Number
Data String [1, 2]: EEPROM Address [0, 1], LSB to MSB
Data String [3]: Data Length, max 64 bytes
Data String [4…n+3]: Data, max 64 bytes

Meter to PC

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	See Below	0x00	N/A	??

Note: If the command code is 0x7F, the command accept by meter. If the code is 0x70, the command is invalid.

● **0x8F: Exit calibration mode**

PC to Meter

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	0x8F	0x00	N/A	39

Meter to PC

Start 0	Start 1	Command Code	Data Length	Data	Checksum
0x55	0x55	See Below	0x00	N/A	??

Note: If the command code is 0x7F, the command accept by meter. If the code is 0x70, the command is invalid.

Data Format

● **Model Name: 32-byte ASCII string**

Data LSB					Data MSB
A	P	P	A	…	
0x41	0x50	0x50	0x41	…	0x20

Default is a null string, all byte are 0x20.

● **Series Number: 16-byte ASCII string**

Data LSB					Data MSB
0	1	2	3	…	
0x30	0x31	0x32	0x33	…	0x20

Default is a null string, all byte are 0x20.

● **Display Data (main display, sub display): 5-byte**

Data LSB				Data MSB
Reading			Status 0	Status 1

Reading: 24-bit signed integer, LSB to MSB. If the range of reading is 0x700000 to 0x7FFFFF, then the reading is a word code, else is a number.
Status 0: Scope code
Status 1: Data content

● **Display Data (Datalog, Memory): 5-byte**

Data LSB				Data MSB
Reading			Status 0	Status 2

Reading: 24-bit signed integer, LSB to MSB. If the range of reading is 0x700000 to 0x7FFFFF, then the reading is a word code, else is a number.
Status 0: Scope code
Status 2: Data content

● **Calibration Data (ADC original data, offset, gain): 4-byte**

Data LSB			Data MSB
32-bit signed integer, LSB to MSB			

Table

● **Table 1: Word code**

Reading	
0x700000: Space	0x700020: RATE
0x700001: Full	0x700021: SAVE
0x700002: Beep	0x700022: LOAd
0x700003: APO	0x700023: YES
0x700004: b.Lit	0x700024: SEnd
0x700005: HAZ	0x700025: Ahold
0x700006: On	0x700026: Auto
0x700007: Off	0x700027: Cntin
0x700008: Reset	0x700028: CAL
0x700009: Start	0x700029: Version
0x70000A: View	0x70002A: OL (not use)
0x70000B: Pause	0x70002B: FULL
0x70000C: Fuse	0x70002C: HALF
0x70000D: Probe	0x70002D: Lo
0x70000E: dEF	0x70002E: Hi
0x70000F: Clr	0x70002F: digit
0x700010: Er	0x700030: rdy
0x700011: Er1	0x700031: dISC
0x700012: Er2	0x700032: outF
0x700013: Er3	0x700033: OLA
0x700014: Dash	0x700034: OLV
0x700015: Dash1	0x700035: OLVA
0x700016: Test	0x700036: bAd
0x700017: Dash2	0x700037: TEMP
0x700018: bAtt	
0x700019: diSLt	
0x70001A: noiSE	
0x70001B: FiLtr	
0x70001C: PASS	
0x70001D: null	
0x70001E: 0-20	
0x70001F: 4-20	

● **Table 2: Status 0 (Scope code)**

Bit	Content
7…3	Unit: 0x00: None 0x01: V 0x02: mV 0x03: A 0x04: mA 0x05: dB 0x06: dBm 0x07: mF 0x08: uF 0x09: nF 0x0A: GΩ 0x0B: MΩ 0x0C: kΩ 0x0D: Ω 0x0E: % 0x0F: MHz 0x10: kHz 0x11: Hz 0x12: °C 0x13: °F 0x14: sec 0x15: ms 0x16: us 0x17: ns 0x18: uA 0x19: min 0x1A: kW 0x1B: PF
2…0	Dot: 0x00: None 0x01: 9999.9 0x02: 999.99 0x03: 99.999 0x04: 9.9999

● **Table 3: Status 1 (main display, sub display)**

Bit	Content
7	0: Not Overload 1: Overload
6…0	Data content: 0x00: Measuring data 0x01: Frequency 0x02: Cycle 0x03: Duty 0x04: Memory Stamp 0x05: Memory Save 0x06: Memory Load 0x07: Log Save 0x08: Log Load 0x09: Log Rate 0x0A: REL Δ 0x0B: REL % 0x0C: REL Reference 0x0D: Maximum 0x0E: Minimum 0x0F: Average 0x10: Peak Hold Max 0x11: Peak Hold Min 0x12: dBm 0x13: dB 0x14: Auto Hold 0x15: Setup 0x16: Log Stamp 0x17: Log Max 0x18: Log Min 0x19: Log TP 0x1A: Hold 0x1B: Current Output 0x1C: CurOut 0-20mA % 0x1D: CurOut 4-20mA %

● **Table 4: Status 2 (Datalog, Memory)**

Bit	Content
7	0: Not Overload 1: Overload
6…0	Same as function code (bit 6…0)

● **Table 5: Rotary code**

Bit	Content		
7…0	506/506B	208/208B	150/150B
	0x00: None 0x01: ACV 0x02: ACmV 0x03: DCV 0x04: DCmV 0x05: Ohm 0x06: A 0x07: Temp 0x08: LoZ	0x00: None 0x01: ACV 0x02: ACmV 0x03: LoZ 0x04: DCV 0x05: DCmV 0x06: Ohm 0x07: A 0x08: Freq 0x09: Temp	0x00: None 0x01: V 0x02: A 0x03: Watt 0x04: Ohm 0x05: Cap 0x06: Flex ACA 0x07: Temp

● **Table 6: Function code**

Bit	Content	
7	0: Manual Test 1: Auto Test	
6…0	0x00: None 0x01: AC V 0x02: DC V 0x03: AC mV 0x04: DC mV 0x05: Ohm 0x06: Continuity 0x07: Diode 0x08: Cap 0x09: AC A 0x0A: DC A 0x0B: AC mA 0x0C: DC mA 0x0D: °C 0x0E: °F 0x0F: Frequency 0x10: Duty 0x11: Hz (V) 0x12: Hz (mV) 0x13: Hz (A) 0x14: Hz (mA) 0x15: AC+DC (V) 0x16: AC+DC (mV) 0x17: AC+DC (A) 0x18: AC+DC (mA) 0x19: LPF (V) 0x1A: LPF (mV) 0x1B: LPF (A) 0x1C: LPF (mA) 0x1D: AC uA 0x1E: DC uA 0x1F: DC A out	0x20: DC A out (Slow Linear) 0x21: DC A out (Fast Linear) 0x22: DC A out (Slow Step) 0x23: DC A out (Fast Step) 0x24: LoopPower 0x25: 250ohmHart 0x26: VoltSense 0x27: PeakHold (V) 0x28: PeakHold (mV) 0x29: PeakHold (A) 0x2A: PeakHold (mA) 0x2B: LoZ AC V 0x2C: LoZ DC V 0x2D: LoZ AC+DC (V) 0x2E: LoZ LPF (V) 0x2F: LoZ Hz (V) 0x30: LoZ PeakHold (V) 0x31: Battery 0x32: AC W 0x33: DC W 0x34: PF 0x35: Flex AC A 0x36: Flex LPF (A) 0x37: Flex PeakHold (A) 0x38: Flex Hz (A) 0x39: Vharm 0x3A: Inrush 0x3B: Aharm 0x3C: Flex Inrush 0x3D: Flex Aharm 0x3E: PeakHold (uA)

● **Table 7.1: Range code (506/506B)**

Rotary	Function	Range	
		Bit 7	Bit 6…0
0x00: None	0x00: None	0: Manual Range	0x00: None
0x01: ACV	0x01: AC V 0x19: LPF (V) 0x27: PeakHold (V)	0: Manual Range 1: Auto Range	0x00: 4.0000V 0x01: 40.000V 0x02: 400.00V 0x03: 1000.0V
	0x11: Hz (V)	0: Manual Range 1: Auto Range	0x00: 400.00Hz 0x01: 4.0000kHz 0x02: 40.000kHz 0x03: 100.00kHz
0x02: ACmV	0x03: AC mV 0x1A: LPF (mV) 0x28: PeakHold (mV)	0: Manual Range 1: Auto Range	0x00: 40.000mV 0x01: 400.00mV
	0x12: Hz (mV)	0: Manual Range 1: Auto Range	0x00: 400.00Hz 0x01: 4.0000kHz 0x02: 40.000kHz 0x03: 100.00kHz
0x03: DCV	0x02: DC V 0x15: AC+DC (V)	0: Manual Range 1: Auto Range	0x00: 4.0000V 0x01: 40.000V 0x02: 400.00V 0x03: 1000.0V
0x04: DCmV	0x04: DC mV 0x16: AC+DC (mV)	0: Manual Range 1: Auto Range	0x00: 40.000mV 0x01: 400.00mV
0x05: Ohm	0x05: Ohm	0: Manual Range 1: Auto Range	0x00: 400.00Ω 0x01: 4.0000kΩ 0x02: 40.000kΩ 0x03: 400.00kΩ 0x04: 4.0000MΩ 0x05: 40.00MΩ
	0x06: Continuity	0: Manual Range	0x00: 400.00Ω
	0x07: Diode	0: Manual Range	0x00: 2.000V
	0x08: Cap	0: Manual Range 1: Auto Range	0x00: 40.00nF 0x01: 400.0nF 0x02: 4.000uF 0x03: 40.00uF 0x04: 400.0uF 0x05: 4.000mF 0x06: 40.00mF

● **Table 7.2: Range code (506/506B)**

Rotary	Function	Range	
		Bit 7	Bit 6…0
0x06: A	0x0B: AC mA 0x0C: DC mA 0x18: AC+DC (mA) 0x1C: LPF (mA) 0x2A: PeakHold (mA)	0: Manual Range 1: Auto Range	0x00: 40.000mA 0x01: 400.00mA
	0x09: AC A 0x0A: DC A 0x17: AC+DC (A) 0x1B: LPF (A) 0x29: PeakHold (A)	0: Manual Range 1: Auto Range	0x02: 4.0000A 0x03: 10.000A
	0x13: Hz (A) 0x14: Hz (mA)	0: Manual Range 1: Auto Range	0x00: 400.00Hz 0x01: 4.0000kHz 0x02: 40.000kHz 0x03: 100.00kHz
0x07: Temp	0x0D: °C	0: Manual Range	0x00: 1200.0°C
	0x0E: °F	0: Manual Range	0x00: 2192.0°F
0x08: LoZ	0x2B: LoZ AC V 0x2C: LoZ DC V	1: Auto Range	0x02: 400.00V 0x03: 1000.0V

● **Table 8: Range code (208/208B)**

The range code is roughly the same as 506/506B, but the rotary code is different. And the APPA 208/208B has an extra rotary switch that is frequency measuring. Refer the below table:

Rotary	Function	Range	
		Bit 7	Bit 6…0
0x08: Freq	0x0F: Frequency 0x10: Duty	0: Manual Range 1: Auto Range	0x00: 40.000Hz 0x01: 400.00Hz 0x02: 4.0000kHz 0x03: 40.000kHz 0x04: 400.00kHz 0x05: 4.0000MHz

● **Table 9.1: Range code (150/150B)**

Rotary	Function	Range	
		Bit 7	Bit 6…0
0x01: V	0x01: AC V 0x02: DC V 0x15: AC+DC (V) 0x19: LPF (V)	0: Manual Range 1: Auto Range	0x00: 100.00V 0x01: 1000.0V
	0x27: PeakHold (V)	0: Manual Range	0x00: 140.0V 0x01: 1400V
	0x11: Hz (V)	0: Manual Range 1: Auto Range	0x00: 100.00Hz 0x01: 1000.0Hz 0x02: 10.00kHz
	0x39: Vharm	0: Manual Range	0x00: 100.0%
0x02: A	0x09: AC A 0x0A: DC A 0x17: AC+DC (A) 0x1B: LPF (A)	0: Manual Range 1: Auto Range	0x00: 100.00V 0x01: 1000.0V
	0x3A: Inrush	0: Manual Range	0x00: 100.00V 0x01: 1000.0V
	0x29: PeakHold (A)	0: Manual Range	0x00: 140.0V 0x01: 1400V
	0x13: Hz (A)	0: Manual Range 1: Auto Range	0x00: 100.00Hz 0x01: 1000.0Hz 0x02: 10.00kHz
	0x3B: Aharm	0: Manual Range	0x00: 100.0%
0x03: Watt	0x32: AC W 0x33: DC W	0: Manual Range 1: Auto Range	0x00: 10.00kW 0x01: 100.0kW 0x02: 1000kW
	0x34: PF	0: Manual Range	0x00: 1.00
0x04: Ohm	0x05: Ohm	0: Manual Range 1: Auto Range	0x00: 1000.0Ω 0x01: 10.000kΩ 0x02: 100.00kΩ
	0x06: Continuity	0: Manual Range	0x00: 1000.0Ω
	0x07: Diode	0: Manual Range	0x00: 1.00V

● **Table 9.2: Range code (150/150B)**

Rotary	Function	Range	
		Bit 7	Bit 6…0
0x05: Cap	0x08: Cap	0: Manual Range 1: Auto Range	0x00: 4.000uF 0x01: 40.00uF 0x02: 400.0uF 0x03: 4000uF
0x06: Flex AC A	0x35: Flex AC A 0x36: Flex LPF (A)	0: Manual Range 1: Auto Range	0x00: 300.0A 0x01: 3000A
	0x3C: Flex Inrush	0: Manual Range	0x00: 300.0A 0x01: 3000A
	0x37: Flex PeakHold (A)	0: Manual Range	0x00: 420.0A 0x01: 4200A
	0x38: Flex Hz (A)	0: Manual Range 1: Auto Range	0x00: 100.00Hz 0x01: 1000.0Hz 0x02: 10.00kHz
	0x3D: Flex Aharm	0: Manual Range	0x00: 100.0%
0x07: Temp	0x0D: °C	1: Auto Range	0x00: 400.0°C 0x01: 1000°C
	0x0E: °F	1: Auto Range	0x00: 751.9°F 0x01: 1832°F

● **Table 10: EEPROM Map (506/506B/208/208B)**

EEPROM: 24LC512 x 4
Device Number: 0 to 3
EEPROM Address: 0x0000 to 0xFFFF
Page Size: 64 bytes

Function	Name	Device	Address	Length
System	Model Name	0	0x0010	16 byte
	Serial Number	0	0x0020	16 byte
Memory	Amount[3]	0	0x000E	2 byte
	Data[1] (no. 1 to 500)	0	0x0500	500 x 5 byte
	Data[1] (no. 501 to 1000)	1	0x0500	500 x 5 byte
Datalog	Rate[2][3]	0	0x000A	2 byte
	Amount[3]	0	0x000C	2 byte
	Data[1] (no. 1 to 10000)	0	0x1000	10000 x 5 byte
	Data[1] (no. 10001 to 20000)	1	0x1000	10000 x 5 byte
	Data[1] (no. 20001 to 30000)	2	0x1000	10000 x 5 byte
	Data[1] (no. 30001 to 40000)	3	0x1000	10000 x 5 byte

[1] Data format refer to page 10: Display Data (Datalog, Memory)
[2] 1 to 600 sec
[3] 2 byte, MSB to LSB

● **Table 11: EEPROM Map (150/150B)**

EEPROM:
Device Number:
EEPROM Address:
Page Size:

Function	Name	Device	Address	Length
System	Model Name	0	0x0001	32 byte
	Serial Number	0	0x0021	16 byte
Memory	Amount	0	0x0031	2 byte
	Data[1] (no. 1 to 1000)	0	0x0040	1000 x 5 byte
Datalog	Rate[2]	0	0x0035	2 byte
	Amount	0	0x0033	2 byte
	Data[1] (no. 1 to 9999)	0	0x1400	9999 x 5 byte

[1] Refer to page 10: Display Data (Datalog, Memory)
[2] 1 to 600 sec

Version List

Version	Date	Content
1.0	2014/10/31	First version
1.1	2014/11/06	Modify the data format error
1.2	2014/11/12	Add function code (0x32 to 0x38) Add scope code (0x1A)
1.3	2014/12/09	Add rotary code (0x08) Add function code (0x39 to 0x3D) Add range code (for LoZ)
1.4	2014/12/23	Add function code (0x3E)
1.5	2015/01/14	Modify word code (0x2A) Add word code (0x30 to 0x36)
1.6	2015/04/30	Add memory space table Modify status 1 code (0x04 to 0x0C, 0x16)
1.7	2015/05/20	Add command code (0x1B: Read Harmonics) Add scope code (0x1B)
2.0	2015/06/26	Add rotary code (208/208B) Add range code (208/208B)
2.1	2015/09/23	Modify command code (0x00: Read information) Add EEPROM Map (506/506B/208/208B)
2.2	2015/11/11	Modify status 1 code (0x1B to 0x1D)
2.3	2015/12/23	Modify EEPROM Map (506/506B/208/208B)
2.4	2016/01/26	Modify command code (0x1B: Read Harmonics) Add rotary code (150/150B) Add range code (150/150B) Add EEPROM Map (150/150B) Modify EEPROM Map (506/506B/208/208B)
2.5	2016/02/16	Modify command code (0x1B: Read Harmonics) Modify range code (150/150B) Modify EEPROM Map (506/506B/208/208B)
2.6	2016/03/16	Add word code (0x37)