OPERATING MANUAL

MULTI POWER TRANSDUCER

MODEL **M5XWTU**

CONTENTS

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MODBUS - BASICS

■ COMMUNICATION PROPERTY

This device conforms with Modbus-RTU protocol (MODBUS APPLICATION PROTOCOL V1.1a / Modbus over Serial Line Specification & Implementation Guide V1.0).
The following communication parameters are selectable.

COMM. PROPERTY	SELECTION
Modbus address (Node address)	1 to 247
Baud rate	1200 bps 2400 bps 4800 bps 9600 bps 19200 bps 38400 bps (*)
Parity bit	None Odd (*) Even
Stop bit	1 bit (*) 2 bits
Protocol	Modbus-RTU

(*) Factory setting

■ SUPPORTED COMMANDS

When appropriately set, the host PC connected via RS-485 can read measurands from and write configurations (setting) to the device.
All registers are assigned to Read Holding Registers, can be read out using this command. If reading an address with no assigned register is attempted, '0' is given.
Write Multiple Registers command is used to write registers. If writing an address with no assigned register is attempted, 'Exception' is given.

FUNCTION CODE	COMMAND	RECOMMENDED TIME OUT VALUE
03	Read Holding Registers	0.5 seconds
04	Read Input Resisters	0.5 seconds
16	Write Multiple Registers	2 seconds

These commands enable reading measurands and writing configurations.
One (1) word registers are represented in 16-bit integers, while two (2) word registers are in 32-bit. All registers are in the form of integer unless specifically given in the explanations.
The lower digit word in a 32-bit register is assigned to the lower address (n), while the upper digit word is assigned to the higher address (n+1).
The 32-bit register must be read out and written in single command sequence.

This order can be changed from Modbus setting -> long register.

It is recommended to wait for a time period indicated under 'recommended time out value' in the above table to receive a response for a command. If no response is received for these time periods, take appropriate error processing such as retrying.

MODBUS - OPERATIONS

Modbus registers are assigned to program and operate the unit via Modbus network. It can also disable the view switching control via the front keys to fix the display view to a specific parameter combination.

■ MODBUS REGISTER ACCESS SETTING

ADDR.	WORD	PARAMETER
4945	1	Modbus register access setting 0 : Write disable (*) 1 : Write enable 2 : Write enable the count values Other : Write disable This setting is erased when the power supply to the unit is removed. It always starts with '0' (Write disable) when the power supply is turned on. Set '1' or '2' before starting writing at other registers. In order to write a count value (e.g. active energy), set '2' at this register address. When it is set, the unit stops counting so that a new count value can be written in the register address. Be careful to use '2' setting because no counting will be performed if the unit remains with this setting.

(*) Factory setting

■ SYSTEM OPERATIONS

ADDR.	WORD	PARAMETER
5330	1	Reset energy count 1 : Reset all values 2 : Reset all MAX / MIN values and set the present values. 3 : Reset all average (demand) values 0 : No resetting Specify the extent of count resetting. The register is automatically set to '0' when the resetting procedure is complete after one of these values is written at this address. If another value is written before '0' has been set, the former resetting procedure ends indefinitely. Specific values can be preset to each register by writing at this address from the host.

(*) Factory setting

MODBUS - MEASURED VARIABLES

■ AVAILABLE MEASURED VALIABLES FOR EACH WIRING

Aveilable measured valiables for each wiring is as following.

PARAMETER	SINGLE-PHASE/ 2-WIRE	SINGLE-PHASE/ 3-WIRE	3-PHASE/ 3-WIRE
Current	X	X	X
Voltage	X	X	X
Active power	X	X	X
Reactive power	X	X	X
Apparent power	X*3	X*3	X*3
Power factor	X	X	X
Frequency	X	X	X
Phase difference direction (0 = inductive or lag, 1 = capacitive or lead)	X	X	X
Current, Line 1	X	X	X
Current, Line 2			X*1
Current, Line 3		X	X
Neutral current		X*1	
Delta voltage, 1 – 2			X
Delta voltage, 2 – 3			X
Delta voltage, 3 – 1			X
Phase voltage, Phase 1	X	X	X*2
Phase voltage, Phase 2			X*2
Phase voltage, Phase 3		X	X*2
Active power, Phase 1	X	X	X*2
Active power, Phase 2			X*2
Active power, Phase 3		X	X*2
Reactive power, Phase 1	X	X	X*2
Reactive power, Phase 2			X*2
Reactive power, Phase 3		X	X*2
Apparent power, Phase 1	X*3	X*3	X*2
Apparent power, Phase 2			X*2
Apparent power, Phase 3		X*3	X*2
Power factor, Phase 1	X	X	X*2
Power factor, Phase 2			X*2
Power factor, Phase 3		X	X*2
Phase difference direction, Phase 1 (0 = inductive or lag, 1 = capacitive or lead)	X	X	X*2
Phase difference direction, Phase 2 (0 = inductive or lag, 1 = capacitive or lead)			X*2
Phase difference direction, Phase 3 (0 = inductive or lag, 1 = capacitive or lead)		X	X*2

*1. The value calculated based on the input of 1-wire current and 3-wire current. It may differ from the actual current value.

*2. The calculation process of two wattmeters by the 2-wattmeter method can be read out. Each operation result has no meaning.

*3. The value may be different depending on the load because apparant power $S = \sqrt{P^2 + Q^2}$ and n-phase apparant power $S_n = U_n \times I_n$ are based on different calculation.

■ SIMPLIFIED MEASUREMENT MODE

Selecting simplified measurement mode by the PC configurator software PMCFG allows measuring current, active power, and active energy simply wiring the current sensor, without wiring the voltage to be measured to the module (wiring for power input to the module is required).

Instead of eliminating the requirement of voltage wiring, following specifications and limitations are applied.

1. The voltage is not measured, but is calculated assuming the value set by the VT's primary voltage value.
2. Calculate by assuming the frequency of the module's auxiliary power as current. if the frequency is different set the frequency measurement signal setting to 50Hz fixed or 60Hz fixed to match the frequency pf the current.
3. The power factor is not measured, but is calculated assuming the value set by power factor at simplified measurement.
4. Reactive power, apparent power, reactive energy and apparent energy are not calculated.
5. The results of calculation are not assured. Use them as reference value.

■ UNITS OF MEASURED VARIABLES

Measured variables, except for the nth harmonic distortion, are read out as signed 32-bit integer.

Each variable has different engineering unit (Refer to the table below). For example, when 40000 is read at the address 41 for the 1 – N delta voltage, the actual voltage value equals to 400.0V = 40000 × 0.01, as the engineering unit for this item is V/100 (0.01V).

Readable range for each parameter depends upon the parameter type, as shown in the table below. For example, Current unit is applied to Line current or Neutral current, and Voltage unit is applied to the 1 – N delta voltage or the minimum value voltage.

PARAMETER	UNIT	RANGE
Current	mA	0 to 2 000 000 000 mA
Voltage	V/100	0 to 20 000 000.00 V
Active power	W	-2 000 000 000 to 2 000 000 000 W
Reactive power	var	-2 000 000 000 to 2 000 000 000 var
Apparent power	VA	0 to 2 000 000 000 VA
Power factor	1/10 000	-1.0000 to 1.0000
Frequency	Hz/100	0 or 40.00 Hz to 70.00 Hz
Active energy	kWh/10	0 to 99 999 999.9 kWh*1
Reactive energy	kvarh/10	0 to 99 999 999.9 kvarh*1
Apparent energy	kVAh/10	0 to 99 999 999.9 kVAh*1
Active energy (incoming – outgoing)	kWh/10	-99 999 999.9 to 99 999 999.9 kWh*2
Energy count time	h/10	0 to 99 999 999.9 hours*1
Harmonic	%/10	0 to 999.9%

*1. Version 1.11 or earlier: Reset to 0 when exceeding the max. value, count is continued. Counter pulse output is stopped.
Version 1.12 or later: Reset to 0 when exceeding the max. value, count is continued. Counter pulse output is continued.

*2. Stops at either -99 999 999.9 or 99 999 999.9.

■ MOMENTARY VALUE

ADDR.	WORD	ID	PARAMETER	UNIT
1	2	I	Current	mA
3	2	U	Voltage	V/100
5	2	P	Active power	W
7	2	Q	Reactive power	var
9	2	S	Apparent power	VA
11	2	PF	Power factor	1/10 000
13	2	F	Frequency	Hz/100
15	2	DIR	Phase difference direction (0 = inductive or lag, 1 = capacitive or lead)	—
33	2	I1	Current, Line 1	mA
35	2	I2	Current, Line 2	mA
37	2	I3	Current, Line 3	mA
39	2	IN	Neutral current	mA
41	2	U12	Delta voltage, 1 – 2	V/100
43	2	U23	Delta voltage, 2 – 3	V/100
45	2	U31	Delta voltage, 3 – 1	V/100
47	2	U1N	Phase voltage, Phase 1	V/100
49	2	U2N	Phase voltage, Phase 2	V/100
51	2	U3N	Phase voltage, Phase 3	V/100
53	2	P1	Active power, Phase 1	W
55	2	P2	Active power, Phase 2	W
57	2	P3	Active power, Phase 3	W
59	2	Q1	Reactive power, Phase 1	var
61	2	Q2	Reactive power, Phase 2	var
63	2	Q3	Reactive power, Phase 3	var
65	2	S1	Apparent power, Phase 1	VA
67	2	S2	Apparent power, Phase 2	VA
69	2	S3	Apparent power, Phase 3	VA
71	2	PF1	Power factor, Phase 1	1/10 000
73	2	PF2	Power factor, Phase 2	1/10 000
75	2	PF3	Power factor, Phase 3	1/10 000
77	2	DIR1	Phase difference direction, Phase 1 (0 = inductive or lag, 1 = capacitive or lead)	—
79	2	DIR2	Phase difference direction, Phase 2 (0 = inductive or lag, 1 = capacitive or lead)	—
81	2	DIR3	Phase difference direction, Phase 3 (0 = inductive or lag, 1 = capacitive or lead)	—

■ ENERGY

Writing the following registers enables energy presetting. Set Modbus Register Access in order to write in the energy and fractions.

ADDR.	WORD	ID	PARAMETER	UNIT
129	2	EP	Active energy, incoming	kWh/10
131	2	EQ	Reactive energy, LAG	kvarh/10
133	2	ES	Apparent energy	kVAh/10
135	2	EP–	Active energy, outgoing	kWh/10
137	2	EQ–	Reactive energy, LEAD	kvarh/10
139	2	EQ+LAG	Reactive energy, incoming, LAG	kvarh/10
141	2	EQ+LEAD	Reactive energy, incoming, LEAD	kvarh/10
143	2	EQ–LAG	Reactive energy, outgoing, LAG	kvarh/10
145	2	EQ–LEAD	Reactive energy, outgoing, LEAD	kvarh/10
147	2	TIMER	Energy count time	h/10
149	2	EQ+P	Reactive energy, incoming	kvarh/10
151	2	EQ–P	Reactive energy, outgoing	kvarh/10
153	2	EPA	Active energy, (incoming – outgoing)	kWh/10
155	2	EQA	Reactive energy, (incoming + outgoing)	kvarh/10

■ **AVERAGE VALUE**

ADDR.	WORD	ID	PARAMETER	UNIT
257	2	I AVG	Current AVG	mA
259	2	I1 AVG	Current AVG, Line 1	mA
261	2	I2 AVG	Current AVG, Line 2	mA
263	2	I3 AVG	Current AVG, Line 3	mA
265	2	IN AVG	Neutral current AVG	mA
273	2	I AVG 1	Current AVG, History 1	mA
275	2	I1 AVG 1	Current AVG, Line 1, History 1	mA
277	2	I2 AVG 1	Current AVG, Line 2, History 1	mA
279	2	I3 AVG 1	Current AVG, Line 3, History 1	mA
281	2	IN AVG 1	Neutral current AVG, History 1	mA
289	2	I AVG 2	Current AVG, History 2	mA
291	2	I1 AVG 2	Current AVG, Line 1, History 2	mA
293	2	I2 AVG 2	Current AVG, Line 2, History 2	mA
295	2	I3 AVG 2	Current AVG, Line 3, History 2	mA
297	2	IN AVG 2	Neutral current AVG, History 2	mA
305	2	I AVG 3	Current AVG, History 3	mA
307	2	I1 AVG 3	Current AVG, Line 1, History 3	mA
309	2	I2 AVG 3	Current AVG, Line 2, History 3	mA
311	2	I3 AVG 3	Current AVG, Line 3, History 3	mA
313	2	IN AVG 3	Neutral current AVG, History 3	mA
321	2	I AVG 4	Current AVG, History 4	mA
323	2	I1 AVG 4	Current AVG, Line 1, History 4	mA
325	2	I2 AVG 4	Current AVG, Line 2, History 4	mA
327	2	I3 AVG 4	Current AVG, Line 3, History 4	mA
329	2	IN AVG 4	Neutral current AVG, History 4	mA
513	2	P AVG	Active power AVG	W
515	2	Q AVG	Reactive power AVG	var
517	2	S AVG	Apparent power AVG	VA
529	2	P AVG 1	Active power AVG, History 1	W
531	2	Q AVG 1	Reactive power AVG, History 1	var
533	2	S AVG 1	Apparent power AVG, History 1	VA
545	2	P AVG 2	Active power AVG, History 2	W
547	2	Q AVG 2	Reactive power AVG, History 2	var
549	2	S AVG 2	Apparent power AVG, History 2	VA
561	2	P AVG 3	Active power AVG, History 3	W
563	2	Q AVG 3	Reactive power AVG, History 3	var
565	2	S AVG 3	Apparent power AVG, History 3	VA
577	2	P AVG 4	Active power AVG, History 4	W
579	2	Q AVG 4	Reactive power AVG, History 4	var
581	2	S AVG 4	Apparent power AVG, History 4	VA

■ **MAXIMUM / MINIMUM VALUE**

ADDR.	WORD	ID	PARAMETER	UNIT
769	2	I MAX	Current MAX	mA
771	2	U MAX	Voltage MAX	V/100
773	2	P MAX	Active power MAX	W
775	2	Q MAX	Reactive power MAX	var
777	2	S MAX	Apparent power MAX	VA
779	2	PF MAX	Power factor MAX	1/10 000
781	2	F MAX	Frequency MAX	Hz/100
801	2	I1 MAX	Current MAX, Line 1	mA
803	2	I2 MAX	Current MAX, Line 2	mA
805	2	I3 MAX	Current MAX, Line 3	mA
807	2	IN MAX	Neutral current MAX	mA
809	2	U12 MAX	Delta voltage MAX, 1 – 2	V/100
811	2	U23 MAX	Delta voltage MAX, 2 – 3	V/100
813	2	U31 MAX	Delta voltage MAX, 3 – 1	V/100
815	2	U1N MAX	Phase voltage MAX, Phase 1	V/100
817	2	U2N MAX	Phase voltage MAX, Phase 2	V/100
819	2	U3N MAX	Phase voltage MAX, Phase 3	V/100
821	2	P1 MAX	Active power MAX, Phase 1	W
823	2	P2 MAX	Active power MAX, Phase 2	W
825	2	P3 MAX	Active power MAX, Phase 3	W
827	2	Q1 MAX	Reactive power MAX, Phase 1	var
829	2	Q2 MAX	Reactive power MAX, Phase 2	var
831	2	Q3 MAX	Reactive power MAX, Phase 3	var
833	2	S1 MAX	Apparent power MAX, Phase 1	VA
835	2	S2 MAX	Apparent power MAX, Phase 2	VA
837	2	S3 MAX	Apparent power MAX, Phase 3	VA
839	2	PF1 MAX	Power factor MAX, Phase 1	1/10 000
841	2	PF2 MAX	Power factor MAX, Phase 2	1/10 000
843	2	PF3 MAX	Power factor MAX, Phase 3	1/10 000
865	2	THD I1 MAX	Current total harmonic distortion MAX, Line 1	%/10
867	2	THD I2 MAX	Current total harmonic distortion MAX, Line 2	%/10
869	2	THD I3 MAX	Current total harmonic distortion MAX, Line 3	%/10
871	2	THD IN MAX	Neutral current total harmonic distortion MAX	%/10
873	2	THD U12 MAX	Delta voltage total harmonic distortion MAX, 1 – 2	%/10
875	2	THD U23 MAX	Delta voltage total harmonic distortion MAX, 2 – 3	%/10
877	2	THD U31 MAX	Delta voltage total harmonic distortion MAX, 3 – 1	%/10
879	2	THD U1N MAX	Phase voltage total harmonic distortion MAX, Phase 1	%/10
881	2	THD U2N MAX	Phase voltage total harmonic distortion MAX, Phase 2	%/10
883	2	THD U3N MAX	Phase voltage total harmonic distortion MAX, Phase 3	%/10
897	2	I MAX AVG	Current MAX AVG	mA
899	2	I1 MAX AVG	Current MAX AVG, Line 1	mA
901	2	I2 MAX AVG	Current MAX AVG, Line 2	mA
903	2	I3 MAX AVG	Current MAX AVG, Line 3	mA
905	2	IN MAX AVG	Neutral current MAX AVG	mA
907	2	P MAX AVG+	Active power MAX AVG, incoming	W
909	2	P MAX AVG–	Active power MAX AVG, outgoing	W
911	2	Q MAX AVG+	Reactive power MAX AVG, incoming	var
913	2	Q MAX AVG–	Reactive power MAX AVG, outgoing	var
915	2	S MAX AVG	Apparent power MAX AVG	VA
929	2	I MIN	Current MIN	mA
931	2	U MIN	Voltage MIN	V/100
933	2	P MIN	Active power MIN	W
935	2	Q MIN	Reactive power MIN	var
937	2	S MIN	Apparent power MIN	VA
939	2	PF MIN	Power factor MIN	1/10 000
941	2	F MIN	Frequency MIN	Hz/100

ADDR.	WORD	ID	PARAMETER	UNIT
961	2	I1 MIN	Current MIN, Line 1	mA
963	2	I2 MIN	Current MIN, Line 2	mA
965	2	I3 MIN	Current MIN, Line 3	mA
967	2	IN MIN	Neutral current MIN	mA
969	2	U12 MIN	Delta voltage MIN, 1 – 2	V/100
971	2	U23 MIN	Delta voltage MIN, 2 – 3	V/100
973	2	U31 MIN	Delta voltage MIN, 3 – 1	V/100
975	2	U1N MIN	Phase voltage MIN, Phase 1	V/100
977	2	U2N MIN	Phase voltage MIN, Phase 2	V/100
979	2	U3N MIN	Phase voltage MIN, Phase 3	V/100
981	2	P1 MIN	Active power MIN, Phase 1	W
983	2	P2 MIN	Active power MIN, Phase 2	W
985	2	P3 MIN	Active power MIN, Phase 3	W
987	2	Q1 MIN	Reactive power MIN, Phase 1	var
989	2	Q2 MIN	Reactive power MIN, Phase 2	var
991	2	Q3 MIN	Reactive power MIN, Phase 3	var
993	2	S1 MIN	Apparent power MIN, Phase 1	VA
995	2	S2 MIN	Apparent power MIN, Phase 2	VA
997	2	S3 MIN	Apparent power MIN, Phase 3	VA
999	2	PF1 MIN	Power factor MIN, Phase 1	1/10 000
1001	2	PF2 MIN	Power factor MIN, Phase 2	1/10 000
1003	2	PF3 MIN	Power factor MIN, Phase 3	1/10 000

■ TOTAL HARMONIC DISTORTION (THD)

ADDR.	WORD	ID	PARAMETER	UNIT
1281	2	THD I1	Current total harmonic distortion, Line 1	%/10
1283	2	THD I2	Current total harmonic distortion, Line 2	%/10
1285	2	THD I3	Current total harmonic distortion, Line 3	%/10
1287	2	THD IN	Neutral current total harmonic distortion	%/10
1289	2	THD U12	Delta voltage total harmonic distortion, 1 – 2	%/10
1291	2	THD U23	Delta voltage total harmonic distortion, 2 – 3	%/10
1293	2	THD U31	Delta voltage total harmonic distortion, 3 – 1	%/10
1295	2	THD U1N	Phase voltage total harmonic distortion, Phase 1	%/10
1297	2	THD U2N	Phase voltage total harmonic distortion, Phase 2	%/10
1299	2	THD U3N	Phase voltage total harmonic distortion, Phase 3	%/10

■ **HARMONIC**

ADDR.	WORD	ID	PARAMETER		UNIT
1537	1	HD I1 2	Current harmonic, Line 1,	2nd	%/10
1538	1	HD I1 3	(id)	3rd	%/10
1539	1	HD I1 4	(id)	4th	%/10
1540	1	HD I1 5	(id)	5th	%/10
1541	1	HD I1 6	(id)	6th	%/10
1542	1	HD I1 7	(id)	7th	%/10
1543	1	HD I1 8	(id)	8th	%/10
1544	1	HD I1 9	(id)	9th	%/10
1545	1	HD I1 10	(id)	10th	%/10
1546	1	HD I1 11	(id)	11th	%/10
1547	1	HD I1 12	(id)	12th	%/10
1548	1	HD I1 13	(id)	13th	%/10
1549	1	HD I1 14	(id)	14th	%/10
1550	1	HD I1 15	(id)	15th	%/10
1551	1	HD I1 16	(id)	16th	%/10
1552	1	HD I1 17	(id)	17th	%/10
1553	1	HD I1 18	(id)	18th	%/10
1554	1	HD I1 19	(id)	19th	%/10
1555	1	HD I1 20	(id)	20th	%/10
1556	1	HD I1 21	(id)	21st	%/10
1557	1	HD I1 22	(id)	22nd	%/10
1558	1	HD I1 23	(id)	23rd	%/10
1559	1	HD I1 24	(id)	24th	%/10
1560	1	HD I1 25	(id)	25th	%/10
1561	1	HD I1 26	(id)	26th	%/10
1562	1	HD I1 27	(id)	27th	%/10
1563	1	HD I1 28	(id)	28th	%/10
1564	1	HD I1 29	(id)	29th	%/10
1565	1	HD I1 30	(id)	30th	%/10
1566	1	HD I1 31	(id)	31st	%/10
1601 : 1630	1	HD I2 2 : HD I2 31	Current harmonic, Line 2,	2nd : 31st	%/10
1665 : 1694	1	HD I3 2 : HD I3 31	Current harmonic, Line 3,	2nd : 31st	%/10
1729 : 1758	1	HD IN 2 : HD IN 31	Neutral current harmonic,	2nd : 31st	%/10
1793 : 1822	1	HD U12 2 : HD U12 31	Delta voltage harmonic, 1 – 2,	2nd : 31st	%/10
1857 : 1886	1	HD U23 2 : HD U23 31	Delta voltage harmonic, 2 – 3,	2nd : 31st	%/10
1921 : 1950	1	HD U31 2 : HD U31 31	Delta voltage harmonic, 3 – 1,	2nd : 31st	%/10
1985 : 2014	1	HD U1N 2 : HD U1N 31	Phase voltage harmonic, Phase 1,	2nd : 31st	%/10
2049 : 2078	1	HD U2N 2 : HD U2N 31	Phase voltage harmonic, Phase 2,	2nd : 31st	%/10
2113 : 2142	1	HD U3N 2 : HD U3N 31	Phase voltage harmonic, Phase 3,	2nd : 31st	%/10