TMEIC Photovoltaic Inverters
Modbus Communication Interface Protocol
For 1MW series

Rev. B

Model: PVL-L1000E, PVL-L1000E-H

TOSHIBA MITSUBISHI-ELECTRIC INDUSTRIAL SYSTEMS CORPORATION

TM_F50000B

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1 Circuit Configuration and Nomenclature

This document describes the Modbus interface for TMEIC photovoltaic inverters. For installation and IP address setting, refer to the Installation Manual and IP address setting manual for communication unit.

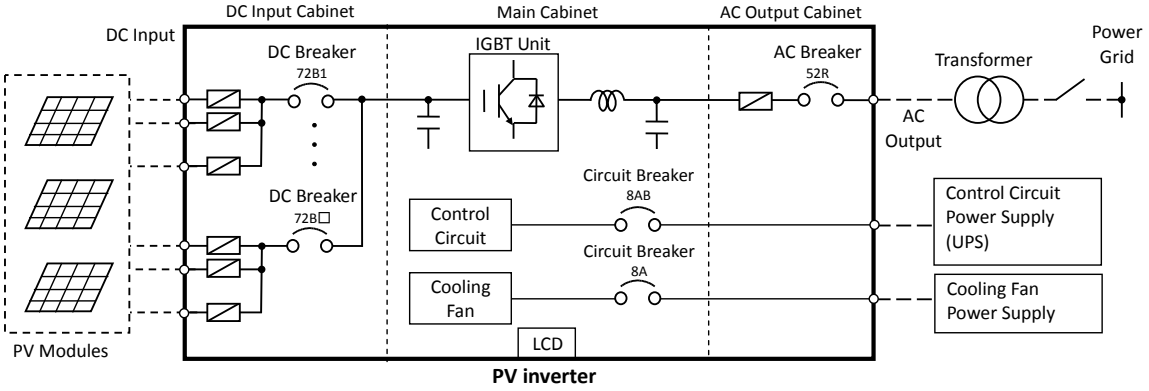
1.1 Abreviations

The following list contains the main abbreviations used throughout this text.

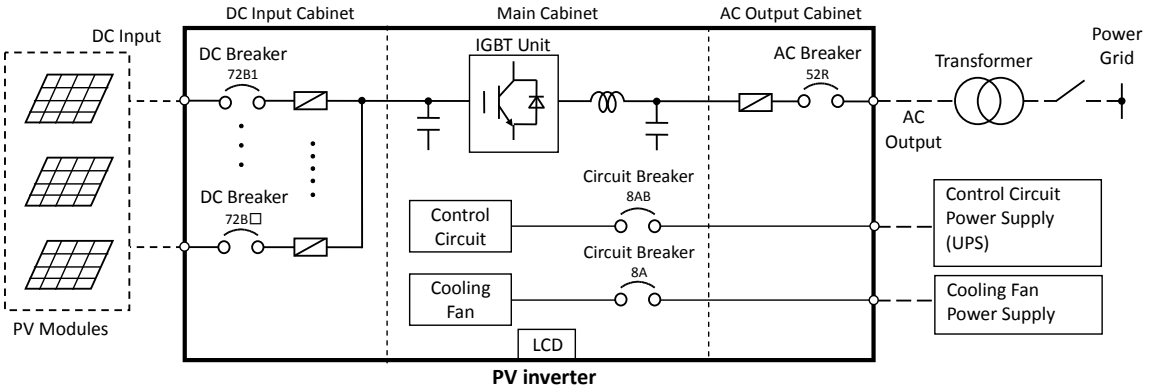
Name	Descriptions
52R	AC side circuit breaker
72B□	DC side circuit breaker
8AB, 8B	Control power supply miniature circuit breaker
8A	Fan power supply miniature circuit breaker
88F	Magnetic contactor for the cooling fan supply
ACB	Air Circuit Breaker
AVR	Automatic Voltage Regulator
ACR	Automatic Current Regulator
GFDI	Ground Fault Detection and Interruption
MC	Magnetic Contactor
MCCB	Molded Case Circuit Breaker
UPS	Uninterruptible Power Supply

1.2 Circuit Configuration

The following figure shows as an example, the circuit configuration for the inverter. Different models may have different number of inputs and different circuit configuration. Refer to the Instruction Manuals and Schematic Diagrams of the plant for further details and descriptions.



(a) Outside fuse input type.



(b) Inside input fuse protection type

1.3 Operation States

Operation states of the inverter are described as follows:

Operating State		Description	
STOP	Stop	Typical situation	- Before initial start up - After MAJOR FAULT occurred - After stop operation
		Operation is completely stopped. Starting operation is required to move to “Stand by” mode. Detection of a MAJOR FAULT results in this state.	
	Stand by	Typical situation	- At night or sunset - After MINOR FAULT or GRID FAULT occurred*
		The inverter is connected to DC input power and waiting for start up condition establishment. AC output is not connected to the grid (52R is opened) and the main inverter circuit is gate-blocked (GB), which means the inverter switching is stopped.	
RUNNING	AC-AVR	Transient state from “Stand by” to “DC-AVR”. The inverter starts generating AC voltage, but not connected to the grid.	
	DC-AVR	Transient state from “AC-AVR” to “MPPT Control” mode. The inverter is connected to the grid.	
	MPPT Control	Power delivering operation. Energy from PV modules are converted to AC energy and delivered to the grid. DC input voltage is controlled based on Maximum Power Point Tracking (MPPT) control.	
	Grid-connected Stand by	Temporary state caused mostly by insufficient DC input power. The inverter stops switching, but is connected to the grid.	

* : After a Synchronization Loss (Minor Fault) or Phase Jump (Grid Fault) the inverter will go into Grid-connected Stand-by mode and not to Stand-by mode.

When a fault is detected, the inverter will either stop its operation and / or show fault message on the LCD. The faults are categorized in four levels.

Fault level	Description
ALARM	Faults which do not affect the operation of the inverter. The inverter will continue to deliver power to the grid.
GRID FAULT	Faults caused by abnormal voltage or frequency of the power grid. The inverter will stop operation and disconnect from the grid. After the abnormal grid condition is cleared, the inverter will restart automatically.
MINOR FAULT	Faults which affect normal operation of the inverter caused by temporary abnormal conditions. The inverter will stop operation and disconnect from the grid. After the abnormal conditions are cleared, the inverter will restart automatically.
MAJOR FAULT	Faults caused by abnormal condition which may damage the inverter. The inverter will stop operation and disconnect both from DC input circuit and the grid. On site operation and detailed check by service personnel are required to reset the system.

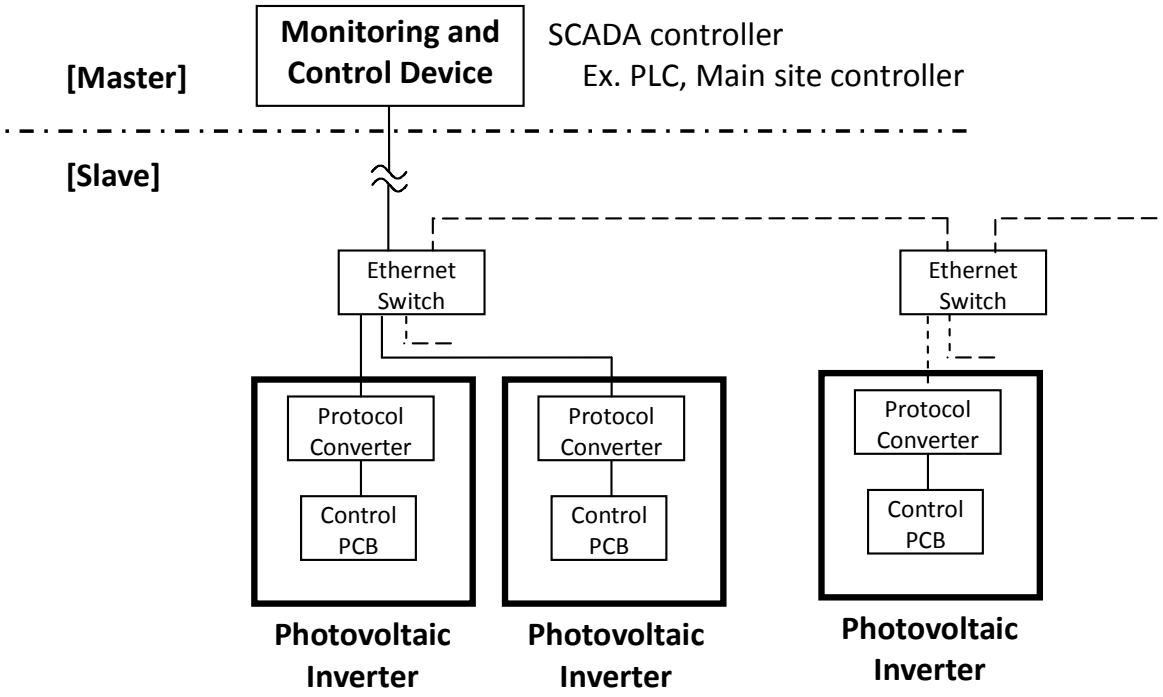
2 Basic Communication Specifications

2.1 Communication Procedure

The communication messages between the inverter and the external monitoring and control device are sent in Modbus TCP protocol data type. In the inverter, the protocol converter transmits prescribed commands to the control PCB in constant cycles and stores the response data to the inverter information area of the control PCB. This data is used as the response against the Modbus TCP request from external monitoring devices.

2.2 System configuration

The following figure shows an example of the communication system configuration. The inverter is regarded as Modbus slave and the monitoring and control device is regarded as Modbus master. One inverter can respond to a maximum of 3 sessions.



※Protocol Converter＝UDS1100

2.3 Precautions

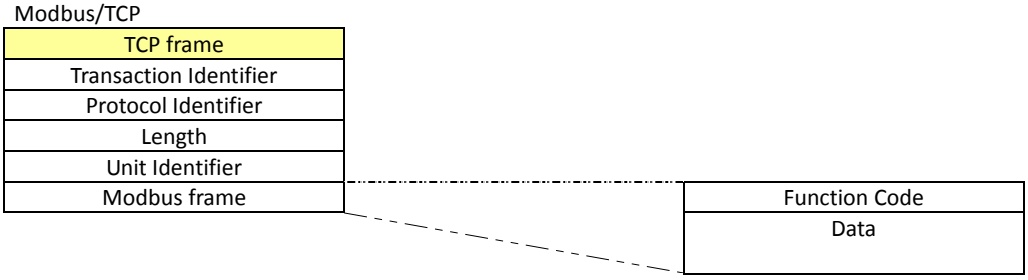
The Following precautions shall be considered when you configure communication system for monitoring and control.

・The preferred communication cycle is 1 second. However, please note that when the information is updated in the communication module, the previous data is overwritten. Therefore some information may be lost if the poling cycle is too long.
・Normal and reliable communication is not guaranteed Differences in communication cable length/location/route may cause disturbance and communication error.
・Surge protective device for communication line or other surge protection shall be installed when necessary. External surge voltage coming from communication line can be cause unexpected failure of the inverter.
・Monitoring and control device (Ex. SCADA system) shall be programed for error handling. Some recommended practices are; plural readings cut off communication by timeout, exclusion of invalid values by checking range of data values, etc.
・This communication function shall never be used for an application where safety of persons rely on.
・This communication function has delay time and shall not be used for the application which requires fast response This delay time is an indeterminate value which is composed from the internal processing delay and external transmission delay of the inverter. The data gotten from plural inverters at the same time are not synchronized.
・The inverter is not a measuring device. The measuring values returned from the inverter shall not be used for the purpose of electricity transaction and efficiency evaluation and other accuracy requested purposes.
・The inverter has no internal radio clock or GPS. The time stamp values of address 30001～3004 of the input register may not be accurate.
・Please use this document as a reference. This document is subjected to change without notice.

3 The overview of Modbus TCP Communication protocol

3.1 Message Format

- Modbus/TCP



Unit Identifier is set to '1'

3.2 Supported Modbus Function Codes

Supported function codes are listed in the following table.

Code	Function Name	Description
04 (0x04)	Read input registers	Reading input registers at once
16 (0x10)	Write multiple registers	Writing a block of contiguous registers at once

3.3 Function Code Details

1) Function code 04 (0x04) Read Input Registers

* Request

Byte offset	Description	Data
0	Function Code	0x04
1	Starting address Hi	0x0000 to 0xFFFF
2	Starting address Lo	
3	Quantity of registers Hi	1 to 125
4	Quantity of registers Lo	(0x0001 ～ 0x007D)

* Response

Byte offset	Description	Data
0	Function Code	0x04
1	Byte count	2 x N
2	Register value 1 Hi	
3	Register value 1 Lo	
...	...	
...	Register value N Hi	
...	Register value N Lo	

* Error

Byte offset	Description	Data
0	Error Code	0x84
1	Exception Code	See table below

* Error code list

Exception Code	Name	Description
01	Illegal Function	The requested function code is other than 4 or 16
02	Illegal Data Address	Starting address and starting address + quantity of registers is out of Modbus/TCP register map (30001～30067)
04	Slave Device Failure	Package received from inverter contains errors
05	Acknowledge	Modbus/TCP unit is in initializing state (Communication task not working)
0A	Gateway Path Unavailable	Error in sending message from the Modbus/TCP unit to the inverter
0B	Gateway Target Device Failed to Respond	Timeout in receiving message from inverter

2) Function code 16 (0x10) Write Multiple Registers

* Request

Byte offset	Description	Data
0	Function Code	0x10
1	Starting address Hi	0x0000 ～ 0xFFFF
2	Starting address Lo	
3	Quantity of registers Hi	1 ～ 123
4	Quantity of registers Lo	(0x0001 ～ 0x007B)
5	Byte count	2 x N
6	Register value 1 Hi	
7	Register value 1 Lo	
...	...	
...	Register value N Hi	
...	Register value N Lo	

* Response

Byte offset	Description	Data
0	Function Code	0x10
1	Starting address Hi	0x0000 ～ 0xFFFF
2	Starting address Lo	
3	Quantity of registers Hi	1 ～ 123
4	Quantity of registers Lo	(0x0001 ～ 0x007B)

* Error

Byte offset	Description	Data
0	Error Code	0x90
1	Exception Code	See table below

* Error code list

Exception Code	Name	Description
01	Illegal Function	The requested function code is other than 4 or 16
02	Illegal Data Address	Starting address is other than 40001 = physical address 0, or quantity of registers different than 12
03	Illegal Data Value	Package received from inverter contains errors
0A	Gateway Path Unavailable	Error in sending message from the Modbus/TCP unit to the inverter
0B	Gateway Target Device Failed to Respond	Timeout in receiving message from inverter

3.4 Register Data Format

4 types of data format are supported

Format	Description
INT16	Signed 2 bytes integer
UINT16	Unsigned 2 bytes integer
INT32	Signed 4 bytes integer
UINT32	Unsigned 4 bytes integer

1) INT16

Signed 2 byte integer.
From -32768 ～ 32767.
Big endian

H	L

2) UINT16

Unsigned 2 byte integer.
From 0 ～ 65535.
Big endian

H	L

3) INT32

Signed 4 byte integer.
From -2147483648 ～ 2147483647.
Big endian

H WORD		L WORD	
H	L	H	L

4) UINT32

Unsigned 4 byte integer.
From 0 ～ 4294967295.
Big endian

H WORD		L WORD	
H	L	H	L

4 Modbus/TCP Register Map

4.1 Register Map Structure

- Input registers (Read only)

Register Address	Description
30001 | 30056	Fault data and measurement from PV system (cyclic data)
30057 |	(Not Supported)

- Holding registers (Write only)

Register Address	Description
30001 | 30067	Commands from the monitoring system to the inverter
40011 |	(Not Supported)

4.2 Input Registers (Fault data, Measurement)

Operation status and measured data of PV system.
* This data is updated every 1 second.

Register Address	Description	Format	Range/Unit	Notes
30001	Data status	INT16	(0-1)	0:unknown* 1:ACK *:unknown indicates an error in the control power supply of the inverter or a communication error between the inverter and communication converter.
30002	Time stamp (YYMMDD)	INT32	(0-991231)	The control board does not have a clock. It uses the clock of the LCD display. The value contained in these registers will be '770707070707' in the following conditions: 1) Soon after turning on the control power (while the LCD is starting). 2) When the communication between the LCD and the control board is damaged 3) Note: the time stamp may not be accurate
30004	Time stamp (hhmmss)	INT32	(0-235959)	
30006	(Reserved)	UINT32		
30008	Alarm flag	UINT16		Information coded as bit data D15-D8: Reserved D07-D05: Reserved D04: Reserved D03: Minor Fault D02: Alarm D01: Grid Fault D00: Major Fault 0:recovered, 1:triggered
30009	Status bit 1	UINT32		See Status bit 1 table
30011	Status bit 3 Word-0	UINT32		See Status bit 3 table
30013	Status bit 3 Word-1	UINT32		See Status bit 3 table
30015	Status bit 3 Word-2	UINT32		See Status bit 3 table
30017	Status bit 3 Word-3	UINT32		See Status bit 3 table
30019	Status bit 3 Word-4	UINT32		See Status bit 3 table
30021	Status bit 3 Word-5	UINT32		See Status bit 3 table
30023	Status bit 3 Word-6	UINT32		See Status bit 3 table
30025	Status bit 3 Word-7	UINT32		See Status bit 3 table
30027	Energy	INT32	1kWh	1 kWh per unit 99999999kWh is the maximum value. When the energy data reach 100GW, going back to zero. 99999999kWh +1kWh = 0kWh 【Example】 99999999kWh → 99999999 This energy values are only stored every 15 minutes. Other data loss when power supply is down. Other energy measurement device required if you need accurate energy monitoring.

Register Address	Description	Format	Range/Unit	Notes
30029	(Reserved)	INT32		
30031	Active power P	INT16	0.1kW	0.1kW per unit Note: Extremely small value is omitted to zero. (Ex. less than 1.5% of rated power. There may be cases where that differs among models or manufacturing date.)
30032	Reactive power Q	INT16	0.1kVAr	0.1kVAr per unit A lagging reactive power is defined as a reactive power that increases the grid voltage and is displayed as a positive value. A Leading reactive power is defined as a reactive power that decreases the grid voltage and is displayed as a negative value. Note: Extremely small value is omitted to zero. (Ex. less than 1.5% of rated power. There may be cases where that differs among models or manufacturing date.)
30033	Power factor	INT16	(1.00=100)	0.01 per unit Lagging is defined as a power factor that increases the grid voltage and is displayed as a positive value. Leading is defined as a power factor that decreases the grid voltage and is displayed as a negative value. Note1: Negative and positive do not represent a power flow direction. A unity power factor can be set either as 100 or -100. Note2: Extremely small value is omitted to zero. (Ex. less than 1.5% of rated power. There may be cases where that differs among models or manufacturing date.)
30034	Grid frequency	INT16	0.1Hz	50.0Hz → 500 60.0Hz → 600
30035	Grid voltage UV	INT16	0.1V	Vuv
30036	Grid voltage VW	INT16	0.1V	Vvw
30037	Grid voltage WU	INT16	0.1V	Vmu
30038	Inverter output current U	INT16	0.1A	Iu
30039	Inverter output current V	INT16	0.1A	Iv
30040	Inverter output current W	INT16	0.1A	Iw
30041	DC input power	INT16	0.1kW	Pdc
30042	DC input voltage	INT16	0.1V	Vdc
30043	DC input current	INT16	0.1A	Idc
30044	Potential to ground PE	INT16	0.1V	Vpe
30045	Potential to ground EN	INT16	0.1V	Ven
30046	(Reserved)	INT16		
30047	Rev.current1	INT16	0.1A	
30048	Rev.current2	INT16	0.1A	
30049	(Reserved)	INT32		

Register Address	Description	Format	Range/Unit	Notes
30051	(Reserved)	INT16		
30052	(Reserved)	INT16		
30053	(Reserved)	INT32		
30055	(Reserved)	INT32		

*The 'reserved' address shall be undecided address. These addresses are not always zero.

Status bit 1:

Bit Position	Name	Comments
D31		
D30		
D29		
D28		
D27		
D26	(Reserved)	
D25	(Reserved)	
D24	(Reserved)	
D23		
D22	(Reserved)	
D21	(Reserved)	
D20	(Reserved)	
D19	(Reserved)	
D18	(Reserved)	
D17	Remote Operation (0=Disable, 1=Enable)	Remote operation enabled/disabled status. Remote operation can be enabled through the LCD, I/O signal or through communications via Function Code 16 (0x10) address 40001. Local operation status is not included, thus there is no distinction between “Remote Only” and “Remote & Local”
D16	Run command status (0=Stop, 1=Start)	
D15	External I/O Input 4 status (0/1=Open/Close)	
D14	External I/O Input 3 status (0/1=Open/Close)	
D13	External I/O Input 2 status (0/1=Open/Close)	
D12	External I/O Input 1 status (0/1=Open/Close)	
D11	72B Status (0=OFF, 1=ON)	72B1, 72B2,…72B□status. This bit will turn 1 Whenever one of the breakers is in the ON position.
D10	(Reserved)	
D9	52R Status (0=OFF, 1=ON)	
D8	Inverter Status (0=GB, 1=DEB)	GB: Gate signal of the inverter is blocked. DEB: Gate signal of the inverter is de-blocked.
D7		
D6		
D5	(Reserved)	
D4	Grid-Connected Stand-By Mode	
D3	MPPT Mode	
D2	DC-AVR Mode	
D1	Stop Mode	Inverter GB and 52R OFF. Please use D16 to discern between inverter shutdown and inverter stopped due to a fault
D0	(Reserved)	

*The ’reserved’ address shall be undecided address. These addresses are not always zero.

Status bit 3:

Word Position	Bit Position	Item No.	Display Code	Details	Type	Comments
0	D31	0				
0	D30	0				
0	D29	0				
0	D28	0				
0	D27	0				
0	D26	0				
0	D25	0				
0	D24	0				
0	D23	0				
0	D22	0				
0	D21	0				
0	D20	0				
0	D19	0				
0	D18	0				
0	D17	0				
0	D16	0				
0	D15	0				
0	D14	0				
0	D13	0				
0	D12	0				
0	D11	0				
0	D10	0				
0	D9	0				
0	D8	0				
0	D7	0				
0	D6	0				
0	D5	298				
0	D4	298				
0	D3	82	UF306	Control power supply undervoltage	Major fault	
0	D2	298				
0	D1	80	UF305	Control circuit error (CLK)	Major fault	
0	D0	78	UF303	Control circuit error (WDT)	Major fault	
1	D31	0				
1	D30	0				
1	D29	0				
1	D28	0				
1	D27	0				
1	D26	0				
1	D25	0				
1	D24	0				
1	D23	0				
1	D22	0				
1	D21	0				
1	D20	0				
1	D19	0				
1	D18	0				
1	D17	0				
1	D16	108	UF810	DC current backflow 1(CSG1)	Major fault	Depends on circuit configuration Used for the inverter with "DC negative grounding kit"
1	D15	48	UF114	DC current balance abnormal	Major fault	
1	D14	0				Reserved

Word Position	Bit Position	Item No.	Display Code	Details	Type	Comments
1	D13	170	UF230	Zero phase OC	Major fault	
1	D12	56	UF002	Inverter overcurrent 2	Major fault	
1	D11	64	UF107	DC overcurrent 3	Major fault	
1	D10	62	UF106	DC overcurrent 2	Major fault	
1	D9	60	UF108	DC overcurrent 1	Major fault	
1	D8	0				Reserved
1	D7	66	UF110	Zero phase overcurrent	Major fault	
1	D6	88	UF333	IGBT gate fault phase W	Major fault	
1	D5	86	UF332	IGBT gate fault phase V	Major fault	
1	D4	84	UF331	IGBT gate fault phase U	Major fault	
1	D3	74	UF301	Control circuit error (AD)	Major fault	
1	D2	72	UF128	Control power abnormal	Major fault	
1	D1	68	UF112	DC circuit abnormal	Major fault	
1	D0	58	UF101	DC overvoltage	Major fault	
2	D31	0				
2	D30	0				
2	D29	0				
2	D28	0				
2	D27	0				
2	D26	0				
2	D25	0				
2	D24	0				
2	D23	0				
2	D22	0				
2	D21	0				
2	D20	0				
2	D19	0				
2	D18	0				
2	D17	70	UF120	DC ground fault (HCT)	Major fault	Depends on circuit configuration Used for the inverter with "DC Negative grounding kit"
2	D16	76	UF302	Control circuit error (FPGA)	Major fault	
2	D15	256	UF300	Flash memory error	Major fault	
2	D14					
2	D13					
2	D12					
2	D11					
2	D10					
2	D9					
2	D8					
2	D7					
2	D6	0				Reserved
2	D5	124	UF214	Cooling fan abnormal	Major fault	
2	D4	96	UF820	Repeated fault	Major fault	
2	D3	94	UF819	Repeated fault	Major fault	
2	D2	52	UF001	Inverter abnormal	Major fault	
2	D1	92	UF818	External trip	Major fault	Depending on I/O signal
2	D0	50	UF817	Emergency stop activated	Major fault	
3	D31					
3	D30					
3	D29					
3	D28					
3	D27					
3	D26					
3	D25					
3	D24					

Word Position	Bit Position	Item No.	Display Code	Details	Type	Comments
3	D23					
3	D22					
3	D21					
3	D20					
3	D19					
3	D18					
3	D17					
3	D16					
3	D15					
3	D14					
3	D13					
3	D12					
3	D11					
3	D10					
3	D9					
3	D8					
3	D7					
3	D6					
3	D5	106	UF115	DC unbalance 1	Minor fault	
3	D4	98	UF307	Control power supply abnormal (AC-OV)	Minor fault	
3	D3	132	UF308	Control power supply abnormal (AC-UV)	Minor fault	
3	D2	130	UF823	8A open	Minor fault	
3	D1	164	UF103	DC undervoltage	Minor fault	
3	D0					
4	D31					
4	D30					
4	D29					
4	D28	22	UF892	External grid fault	Grid fault	Used by OVGR or other external relay signal
4	D27					
4	D26					
4	D25	18	UF207	Synchronization loss	Minor fault	
4	D24	16	UF221	Voltage phase jump	Grid fault	
4	D23	20	UF802	Open phase	Minor fault	
4	D22	14	UF803	Phase rotation error	Minor fault	
4	D21	12	UF220	Underfrequency	Grid fault	
4	D20	10	UF219	Overfrequency	Grid fault	
4	D19	8	UF218	Short time AC undervoltage	Minor fault	
4	D18	4	UF202	Grid undervoltage(UV)	Grid fault	
4	D17	6	UF217	Short time AC overvoltage	Minor fault	
4	D16	2	UF201	Grid overvoltage(OV)	Grid fault	
4	D15	254	UF832	Communication command time out	Minor fault	
4	D14					
4	D13					
4	D12					
4	D11					
4	D10					
4	D9					
4	D8	128	UF891	External minor fault	Minor fault	Depending on I/O
4	D7	126	UF213	Over temperature	Minor fault	
4	D6	178	UF053	52R OFF failure	Major fault	
4	D5	160	UF052	52R ON failure	Minor fault	
4	D4	172	UF253	AC voltage sensor error	Minor fault	
4	D3					
4	D2	122	UF206	Ctrl. Circuit error	Minor fault	
4	D1	120	UF807	Inverter overcurrent	Minor fault	
4	D0	54	UF003	Inverter OC.	Minor fault	
5	D31					

Word Position	Bit Position	Item No.	Display Code	Details	Type	Comments
5	D30					
5	D29					
5	D28					
5	D27					
5	D26					
5	D25					
5	D24					
5	D23					
5	D22					
5	D21					
5	D20					
5	D19					
5	D18					
5	D17					
5	D16					
5	D15					
5	D14					
5	D13					
5	D12					
5	D11					
5	D10					
5	D9					
5	D8					
5	D7					
5	D6					
5	D5					
5	D4					
5	D3					
5	D2					
5	D1					
5	D0					
6	D31					
6	D30					
6	D29					
6	D28					
6	D27					
6	D26					
6	D25					
6	D24					
6	D23					
6	D22					
6	D21					
6	D20					
6	D19					
6	D18					
6	D17					
6	D16					
6	D15					
6	D14					
6	D13					
6	D12					
6	D11					
6	D10	182	UA157	AMBIENT OT.	Alarm	
6	D9	180	UA825	52R not charged	Alarm	May be disabled depending on settings
6	D8	174	UA808	Grid voltage rise	Alarm	May be disabled depending on settings
6	D7	176	UA211	SPD error	Alarm	

Word Position	Bit Position	Item No.	Display Code	Details	Type	Comments
6	D6	168	UA159	DC ground fault(Voltage divider)	Alarm	Depends on circuit configuration Use for DC floating ground system
6	D5	166	UA119	DC ground fault(HCT)	Alarm	Depends on circuit configuration
6	D4	158	UA890	External alarm	Alarm	Reserved
6	D3	162	UA102	DC-C Abnormal	Alarm	
6	D2	154	UA824	72B open	Alarm	DC breakers 72B1, 72B2,…72B□is open status. (both/all open)
6	D1	150	UA804	Operation prohibition	Alarm	Startup is interlock status. (CNV SW ON. 52R locked. For maintenance and testing)
6	D0					
7	D31					
7	D30					
7	D29					
7	D28					
7	D27					
7	D26					
7	D25					
7	D24					
7	D23					
7	D22					
7	D21					
7	D20					
7	D19					
7	D18					
7	D17					
7	D16					
7	D15					
7	D14					
7	D13					
7	D12					
7	D11					
7	D10					
7	D9					
7	D8					
7	D7					
7	D6					
7	D5					
7	D4					
7	D3					
7	D2					
7	D1					
7	D0					

*The 'reserved' address shall be undecided address. These addresses are not always zero.

4.3 Holding Registers (Command from monitoring system to the inverter)

Register address	Name	Format	Range/unit	Description
40001	Operation (OP2)	INT16	(0-3)	**= '0':** Used for setting time stamp in registers 40006 to 40010. Start/Stop command is not changed Setting of [P limit enable/disable]～[Reactive power Q command or power factor command] can not be done. **= '1' Stop command:** Goes to Stop mode when the inverter is in Start mode. If the inverter is in Stop mode, it keeps the Stop mode status. Settings for [P limit enable/disable]～[Reactive power Q command or power factor command] can be done. **= '2' Start command:** Goes to Start mode when the inverter is in Stop mode. If the inverter is in Start mode, it keeps the Start mode status. Note: There may be other conditions to clear before the inverter effectively starts. Settings for [P limit enable/disable]～[Reactive power Q command or power factor command] can be done. **= '3' P limit, Q command or reactive power command:** Start/Stop command is not changed Settings for [P limit enable/disable]～[Reactive power Q command or power factor command] can be done. For any value in register 40001, [Time stamp enable/disable][Time stamp] settings can be performed.
40002	P limit enable/disable	INT16	(0-1)	Enable/disable settings for active power P limit. The inverter output power will follow the MPPT when P limit is disabled. **= '0' P limit disable** **= '1' P limit enable**
40003	Active power P limit	INT16	0.1kW (0-)	0.1kW per unit 【Example】 250.0kW→2500 500.0kW→5000 1000.0kW→10000 【Restriction】 The active power may be limited to a lower value depending on the inverter maximum apparent power and the current irradiance (among other parameters).

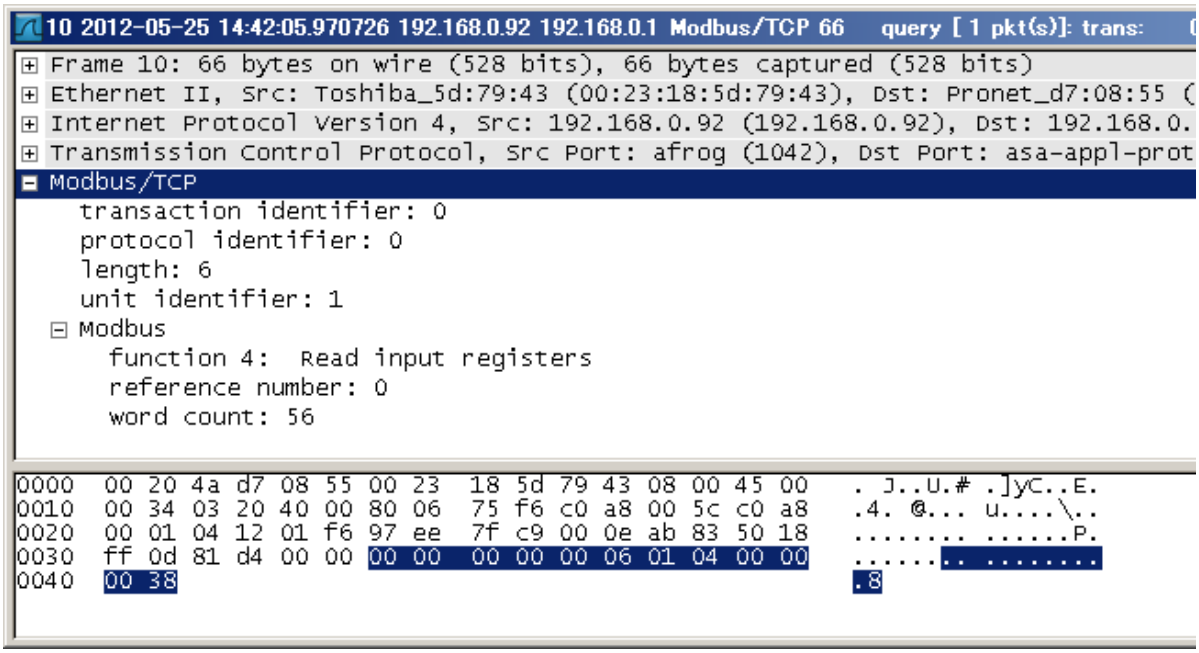
Register address	Name	Format	Range/unit	Description
40004	Q command enable/disable or Power factor command enable/disable	INT16	(0-2)	Enable/disable settings for reactive power Q command and power factor command **= '0' Q command disable, PF command disable** ※inverter should run at power factor 1 **= '1' Q command enable, PF command disable** **= '2' Q command disable, PF command enable**
40005	Reactive power Q command or Power factor command	INT16	(0-)	**Reactive power Q (0.1kVAr per unit):** A lagging reactive power is defined as a reactive power that increases the grid voltage and is displayed as a positive value. A Leading reactive power is defined as a reactive power that decreases the grid voltage and is displayed as a negative value. 【Example】 +131.6kvar→ +1316 -131.6kvar→-1316 +263.3kvar→+2633 -263.3kvar→-2633 **Power factor command (0.01 per unit):** Lagging is defined as a power factor that increases the grid voltage and is displayed as a positive value. Leading is defined as a power factor that decreases the grid voltage and is displayed as a negative value. Note: Negative and positive do not represent a power flow direction. A unity power factor can be set either as 100 or -100 【Example】 +1.00 : +100 -1.00 : -100 +0.95 : +95 -0.95 : -95 【Restriction】 The following two items will take priority over both reactive power Q command and power factor command 1) Power factor range (0.85 to 1.00 for both leading and lagging power factors). 2) Maximum apparent power of the inverter. Therefore, it may occur that the reactive power command and the power factor command are not followed in order to keep the system within the limits established in 1) and 2).
40006	Time Stamp Enable/Disable	INT16	(0-1)	**= '0' Time Stamp Disabled** **= '1' Time Stamp Enabled** Time stamp value for the inverter is set in registers 40007～40010.
40007	Time Stamp (YYMMDD)	INT32	(0-991231)	YYMMDD
40009	Time Stamp (hhmmss)	INT32	(0-235900)	Hhmm00 (seconds are fixed and set to 00)

* This is a write only data. All data should be written at once, starting from the starting address (40001)
* Data out of range is discarded

5 Response Example

5.1 Reading example for registers 30001～30056

a-1) From Monitoring PC to inverter. Request while inverter is running



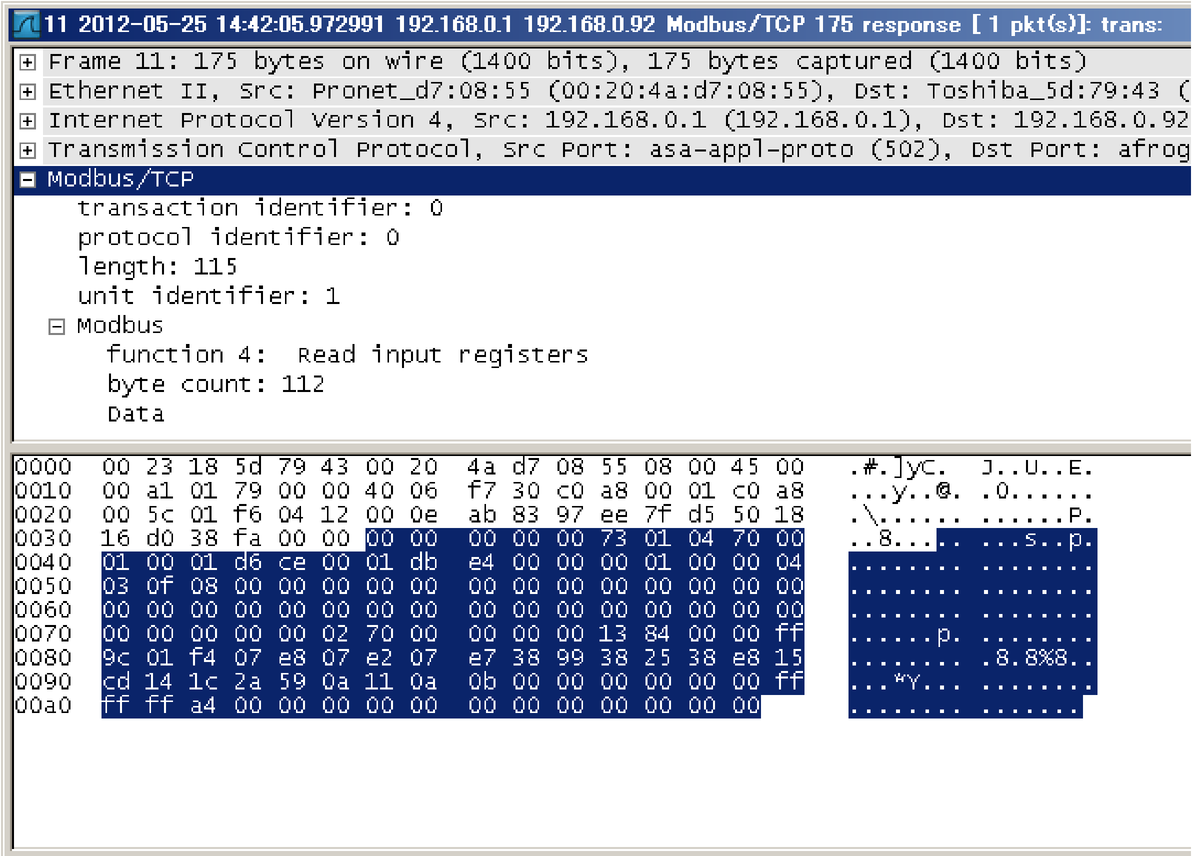
Example of TCP frame data：

00000000000606010400000038

Breakdown of the above data：

0000	Transaction identifier
0000	Protocol identifier
0006	Length
01	Unit identifier
04	Function code 4 (0x04)
0000	Starting address
0038	Quantity of registers (0x0038=56dec)

a-2) From inverter to monitoring PC. Response to a-1



Example of TCP frame data：

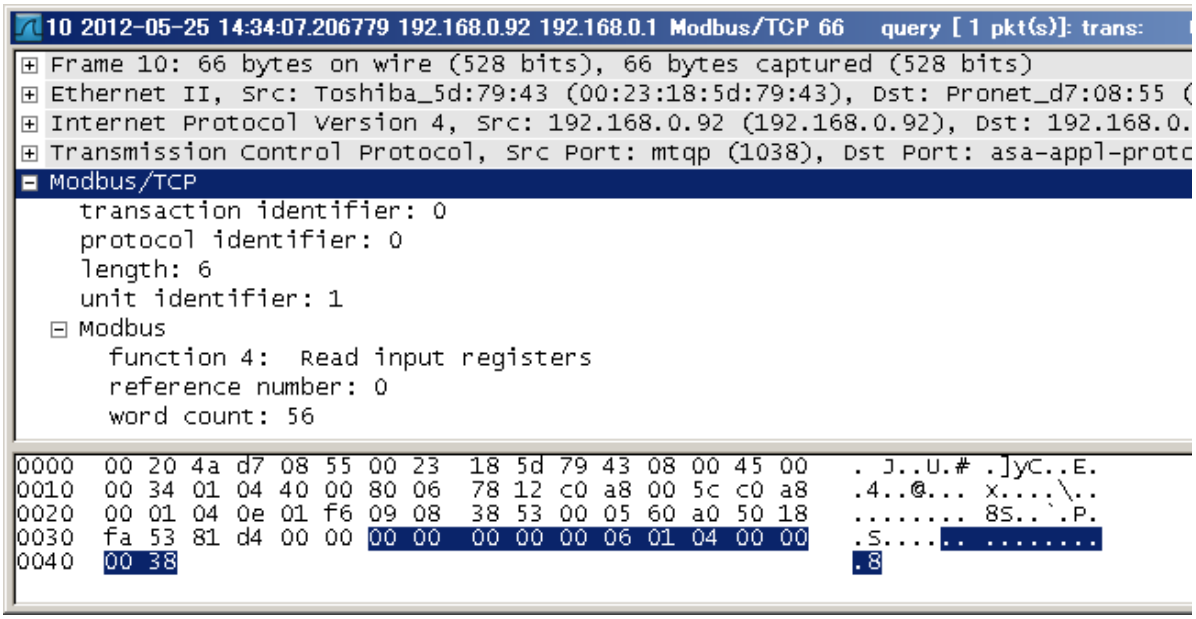
00000000007301047000010001d6ce0001dbe400000001000004030f080000000000000000000000000000000000000000000
0000000000000000000000000027000000000013840000ff9c01f407e807e207e73899382538e815cd141c2a590a110a0b000000
000000ffffffa4000000000000000000000000

Breakdown of the above data：

0000	Transaction identifier
0000	Protocol identifier
0073	Length
01	Unit identifier
04	Function code
70	Byte count
0001	Data Status
0001d6ce	Time stamp (YYMMDD)：0x0001d6ce=120526
0001dbe4	Time stamp (hhmmss)：0x0001dbe4=121828
00000001	Reserved
0000	Alarm flag
04030f08	Status bit 1
00000000	Status bit 3 Word-0
00000000	Status bit 3 Word-1
00000000	Status bit 3 Word-2
00000000	Status bit 3 Word-3
00000000	Status bit 3 Word-4
00000000	Status bit 3 Word-5
00000000	Status bit 3 Word-6
00000000	Status bit 3 Word-7
00000270	Energy
00000000	Reserved
1384	Active power P

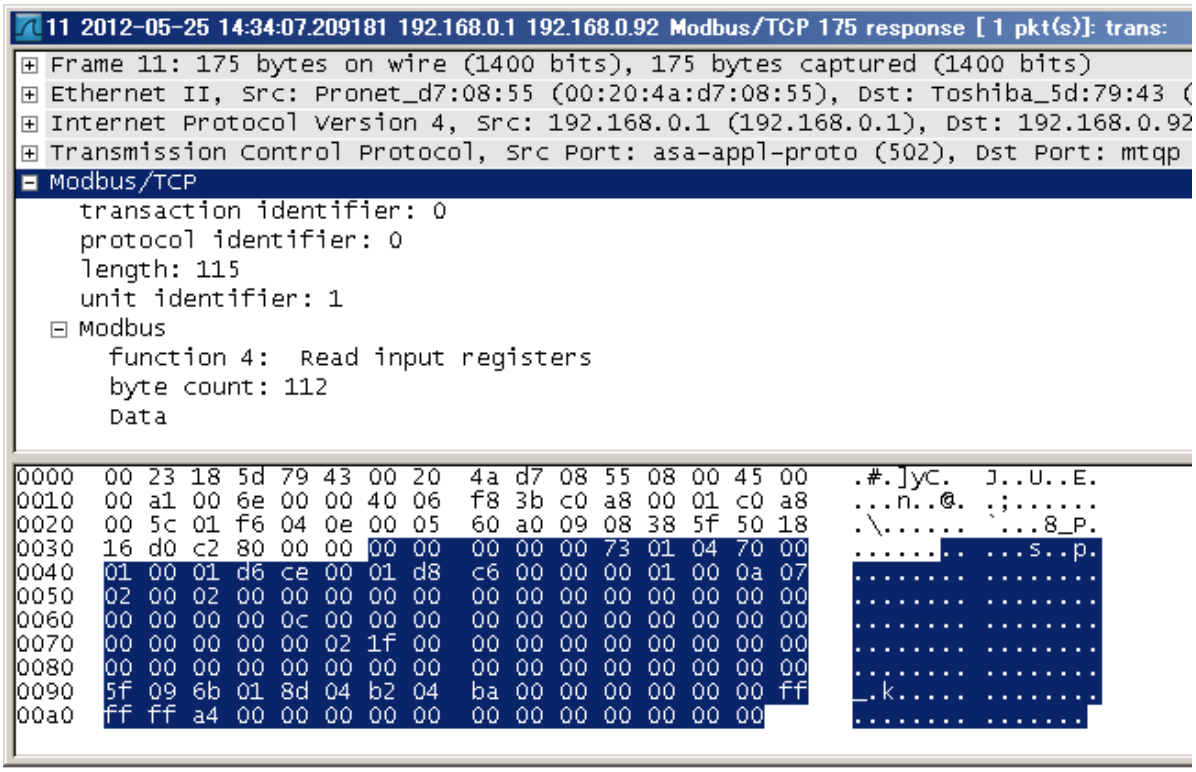
0000	Reactive power Q
ff9c	Power factor：0xff9c=-100(-1.00)
01f4	Grid frequency (500：50.0Hz)
07e8	Grid voltage UV
07e2	Grid voltage VW
07e7	Grid voltage WU
3899	Inverter output current U
3825	Inverter output current V
38e8	Inverter output current W
15cd	DC input power
141c	DC input voltage
2a59	DC input current
0a11	Potential to ground PE
0a0b	Potential to ground EN
0000	Reserved
0000	DC reverse current 1
0000	DC reverse current 2
ffffffa4	Reserved
0000	Reserved
0000	Reserved
00000000	Reserved
00000000	Reserved

b-1) From monitoring PC to inverter. Request while inverter is stopped



Details omitted.

b-2) From inverter to monitoring PC. Response to b-1



Example of TCP frame data：

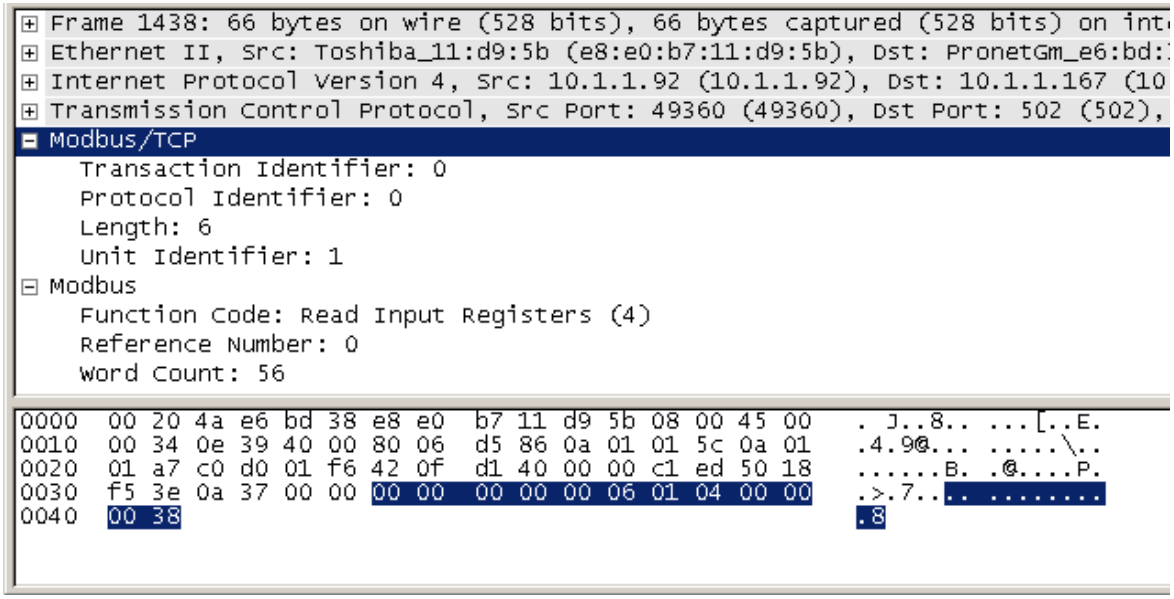
000000000073010470000100001d6ce0001d8c600000001000a0702000200000000000000000000000000000000000000c0000000000000000000000000000021f0000000000000000000000000000000000000000000000000000000000005f096b018d04b204ba000000000000ffffffa4000000000000000000000000

Breakdown of the above data

0000	Transaction identifier
0000	Protocol identifier
0073	Length

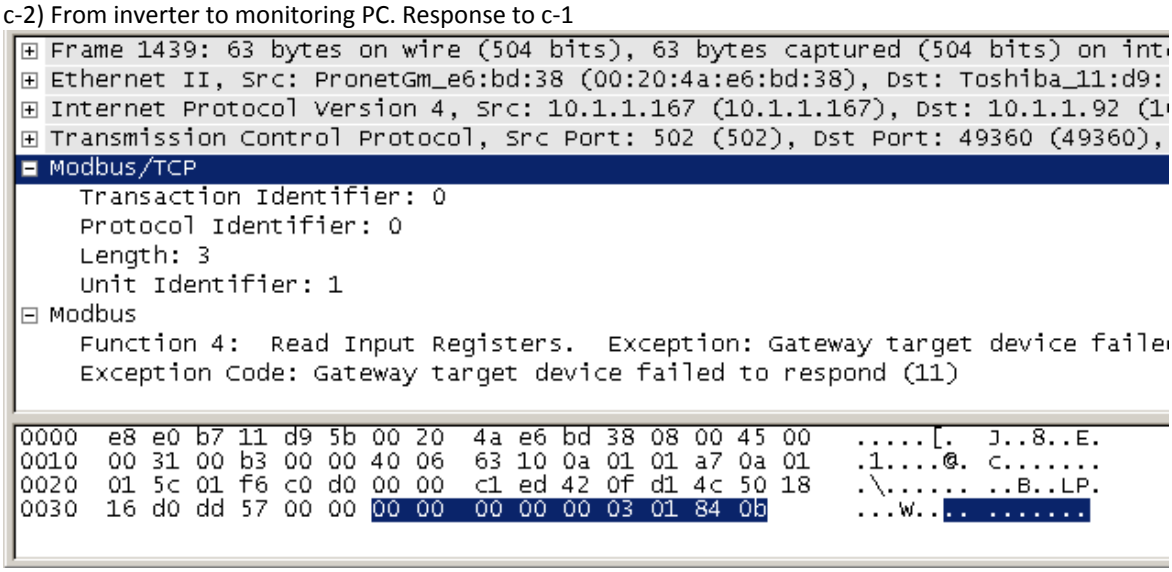
01	Unit identifier
04	Function code
70	Byte count
0001	Data status
0001d6ce	Time stamp (YYMMDD)：0x0001d6ce=120526
0001d8c6	Time stamp (hhmmss)：0x0001d8c6=121030
00000001	Reserved
000a	Alarm flag：0x0a=0b00001010 (D03:Minor fault, D01:Grid fault)
07020002	Status bit 1
00000000	Status bit 3 Word-0
00000000	Status bit 3 Word-1
00000000	Status bit 3 Word-2
00000000	status bit 3 Word-3
000c0000	Status bit 3 Word-4
00000000	Status bit 3 Word-5
00000000	Status bit 3 Word-6
00000000	Status bit 3 Word-7
0000021f	Energy：0x21f=543…543kWh
00000000	Reserved
0000	Active power P
0000	Reactive power Q
0000	Power factor
0000	Grid frequency
0000	Grid voltage UV
0000	Grid voltage VW
0000	Grid voltage WU
0000	Inverter output current U
0000	Inverter output current V
0000	Inverter output current W
005f	DC input power
096b	DC input voltage
018d	C input current
04b2	Potential to ground PE
04ba	Potential to ground EN
0000	Reserved
0000	DC reverse current 1
0000	DC reverse current 2
ffffffa4	Reserved
0000	Reserved
0000	Reserved
00000000	Reserved
00000000	Reserved

c-1) From monitoring PC to inverter. Communication error detection caused by internal circuit problem of the inverter



Omitted below

c-2) From inverter to monitoring PC. Response to c-1



Example of TCP frame data：

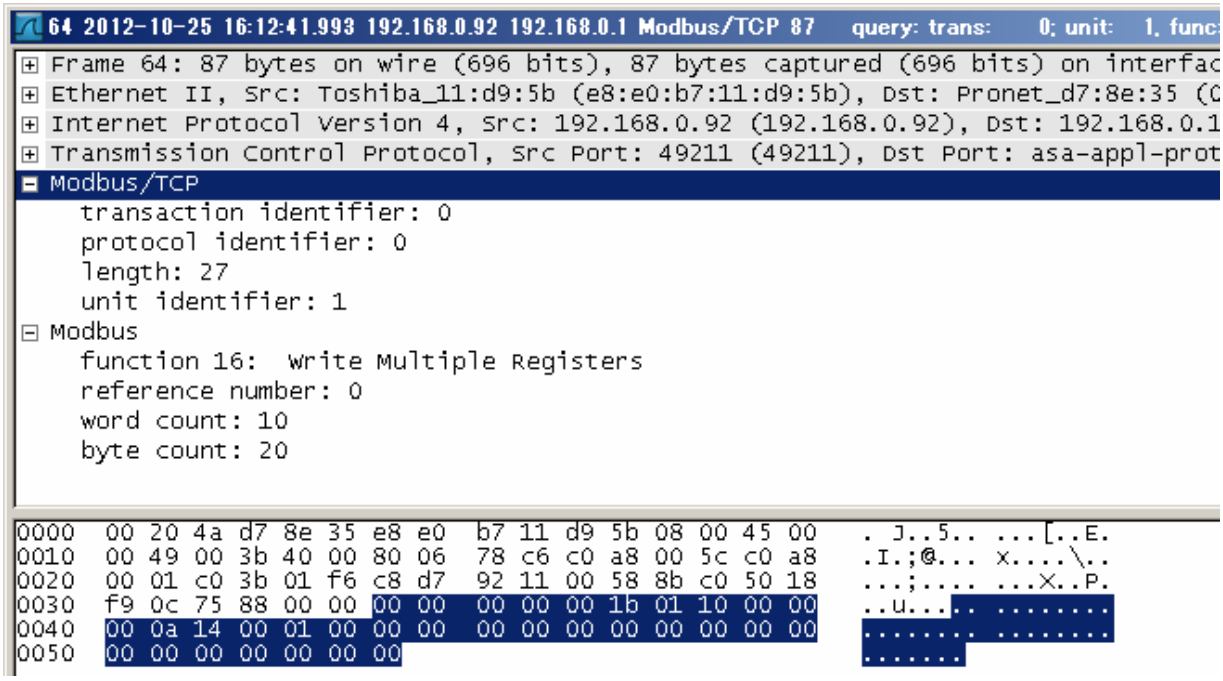
00000000000301840b

Breakdown of the above data

0000	Transaction ID
0000	Protocol ID
0003	Message length
01	Unit ID
84	Error code at exception response
0b	Exception handling code at exception response

5.2 Writing example for registers 40001～40010

a-1) From monitoring PC to inverter. Stop command request



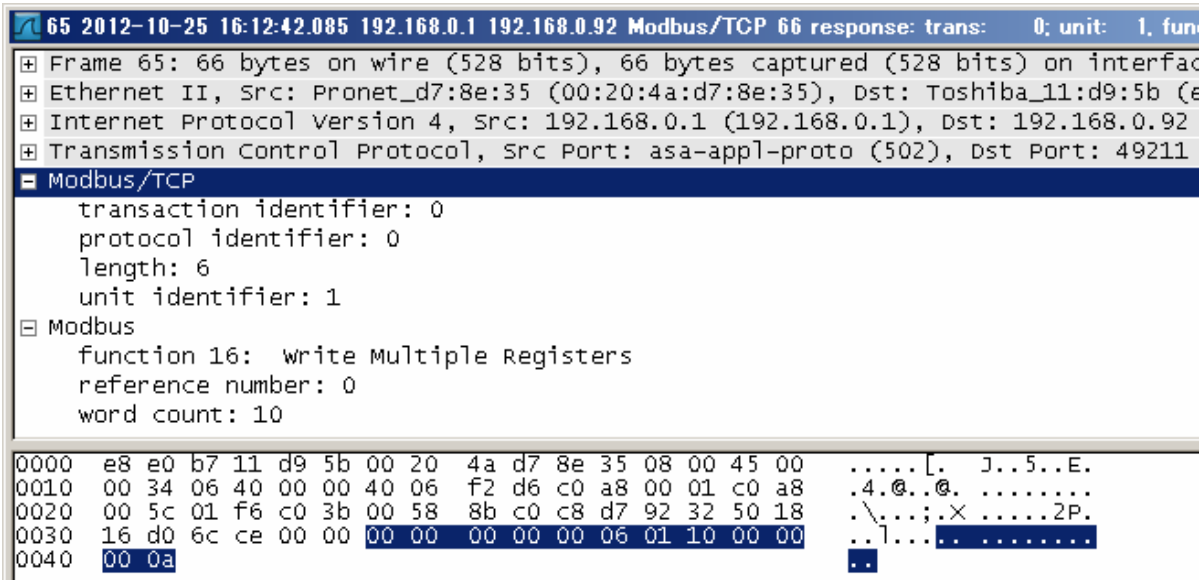
Example of TCP frame data：

00000000001b01100000000a14000100000000000000000000000000000000000000

Breakdown of the above data：

0000	Transaction identifier
0000	Protocol identifier
001b	Length
01	Unit identifier
10	Function code (0x10=16dec)
0000	Starting address
000a	Quantity of registers (0x000a=10dec)
14	Byte count (0x14=20dec)
0001	Operation (0x0001=1dec, Stop command)
0000	P limit enable/disable
0000	Active power P limit
0000	Q command enable/disable or power factor command enable/disable
0000	Reactive power Q command or power factor command
0000	Time Stamp Enable/Disable
00000000	Time Stamp(YYMMDD)
00000000	Time Stamp(HHMMSS)

a-2) From inverter to monitoring PC. Response to a-1



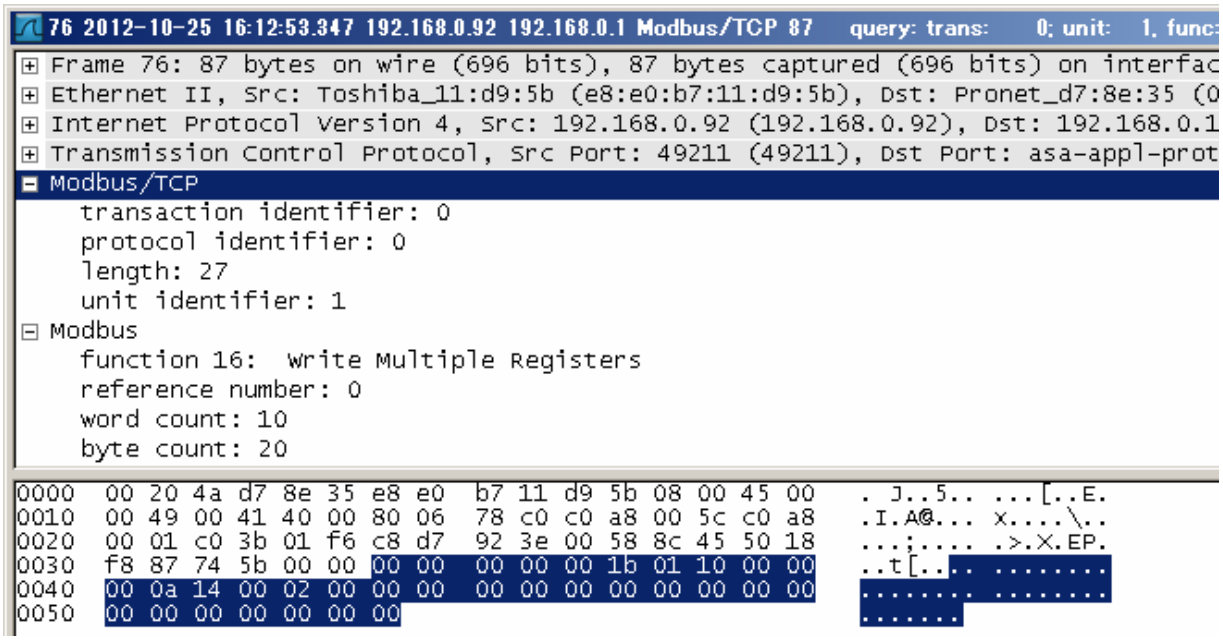
Example of TCP frame data：

00000000000601100000000a

Breakdown of the above data：

0000	Transaction identifier
0000	Protocol identifier
0006	Length
01	Unit identifier
10	Function code (0x10=16dec)
0000	Starting address
000a	Quantity of registers (0x000a=10dec)

b-1) From monitoring PC to inverter. Start command request



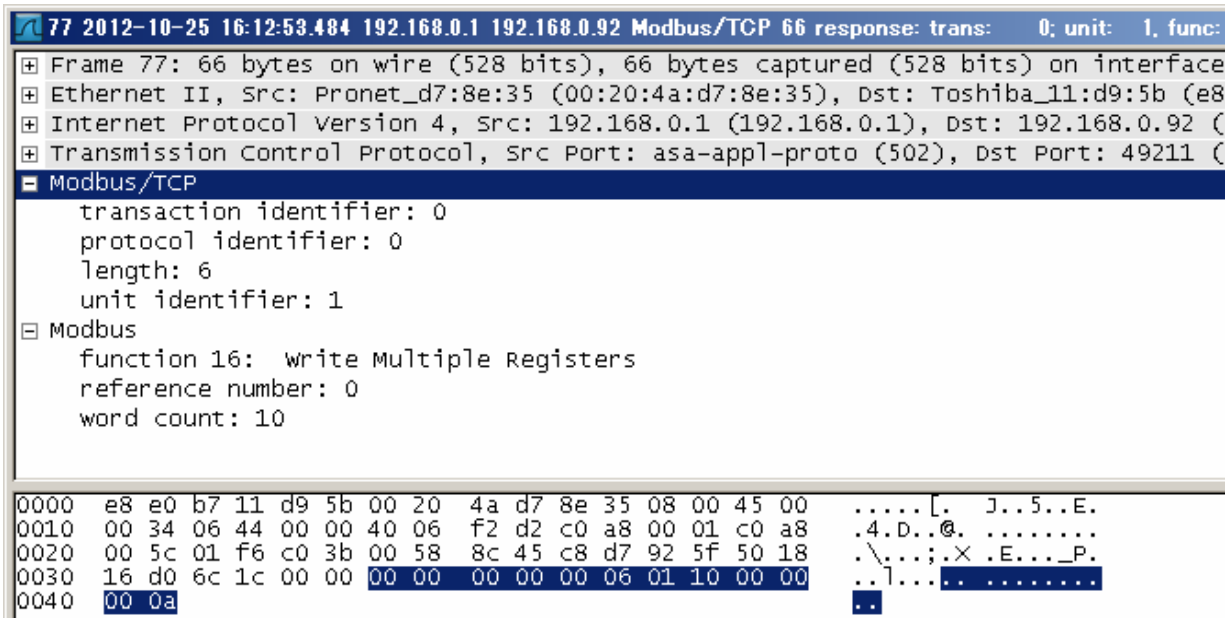
Example of TCP frame data：

00000000001b01100000000a14000200000000000000000000000000000000000000

Breakdown of the above data：

0000	Transaction identifier
0000	Protocol identifier
001b	Length
01	Unit identifier
10	Function code (0x10=16dec)
0000	Starting address
000a	Quantity of registers (0x000a=10dec)
14	Byte count (0x14=20dec)
0002	Operation (0x0002=2dec, start command)
0000	P limit enable/disable
0000	Active power P limit
0000	Q command enable/disable or power factor command enable/disable
0000	Reactive power Q command or power factor command
0000	Time stamp enable/disable
00000000	Time stamp (YYMMDD)
00000000	Time stamp (HHMMSS)

b-2) From inverter to measurement PC. Response to b-1

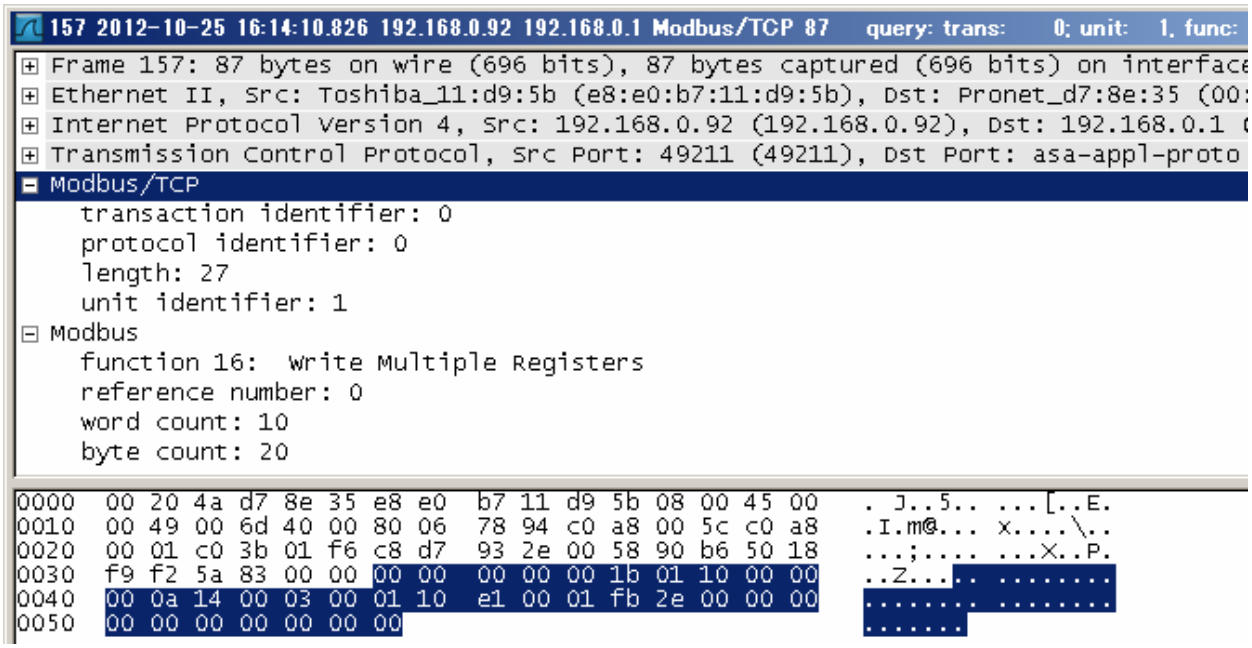


Example of TCP frame data：

00000000000601100000000a

Breakdown of the above data：omitted

c-1) From monitoring PC to inverter. Active power P limit and reactive power Q command request.



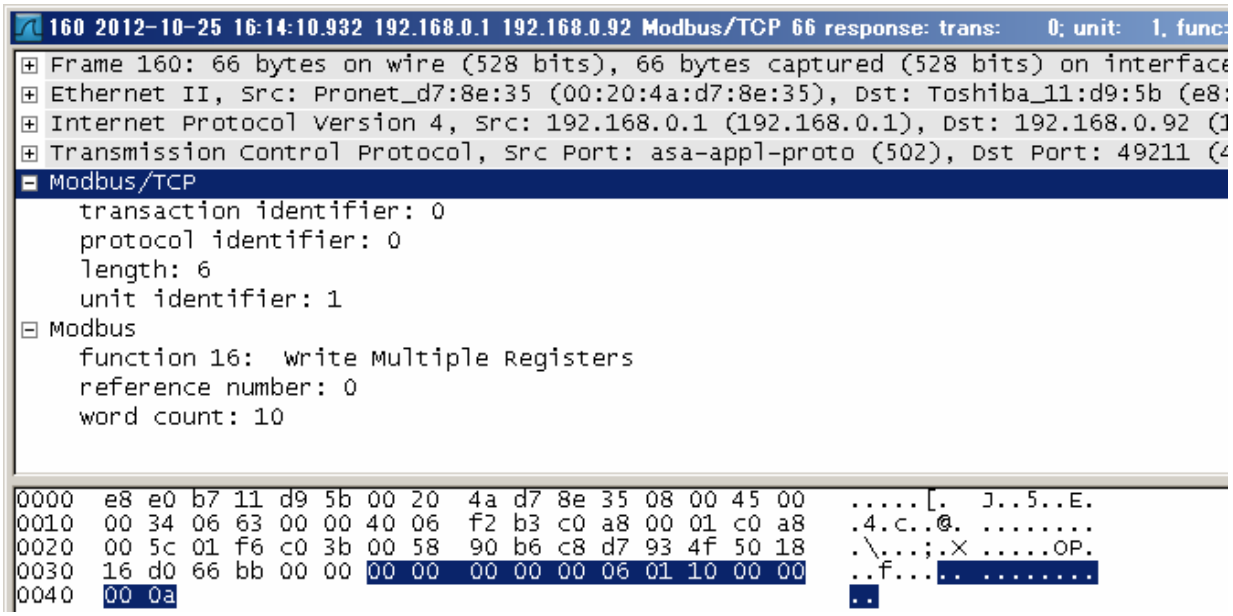
Example of TCP frame data：

00000000001b01100000000a140003000110e10001fb2e00000000000000000000

Breakdown of the above data：

0000	Transaction Identifier
0000	Protocol Identifier
001b	Length (0x001b=27dec)
01	Unit Identifier
10	Function Code 16(0x10)
0000	Starting Address
000a	Quantity of Registers (0x000a=10dec)
14	Byte count (0x14=20dec)
0003	Operation (0x0003=3dec)
0001	P limit enable/disable (0x0001=1dec: P limit enable)
10e1	Active power P limit (0x10e1=4321dec: 432.1kW)
0001	Q command enable/disable or power factor command enable/disable (0x0001=1dec: Q command enable)
fb2e	Reactive power Q command or power factor command (0xfb2e=-1234dec: -123.4kvar)
0000	Time Stamp Enable/Disable
00000000	Time Stamp(YYMMDD)
00000000	Time Stamp(HHMMSS)

c-2) From inverter to monitoring PC. Response to c-1

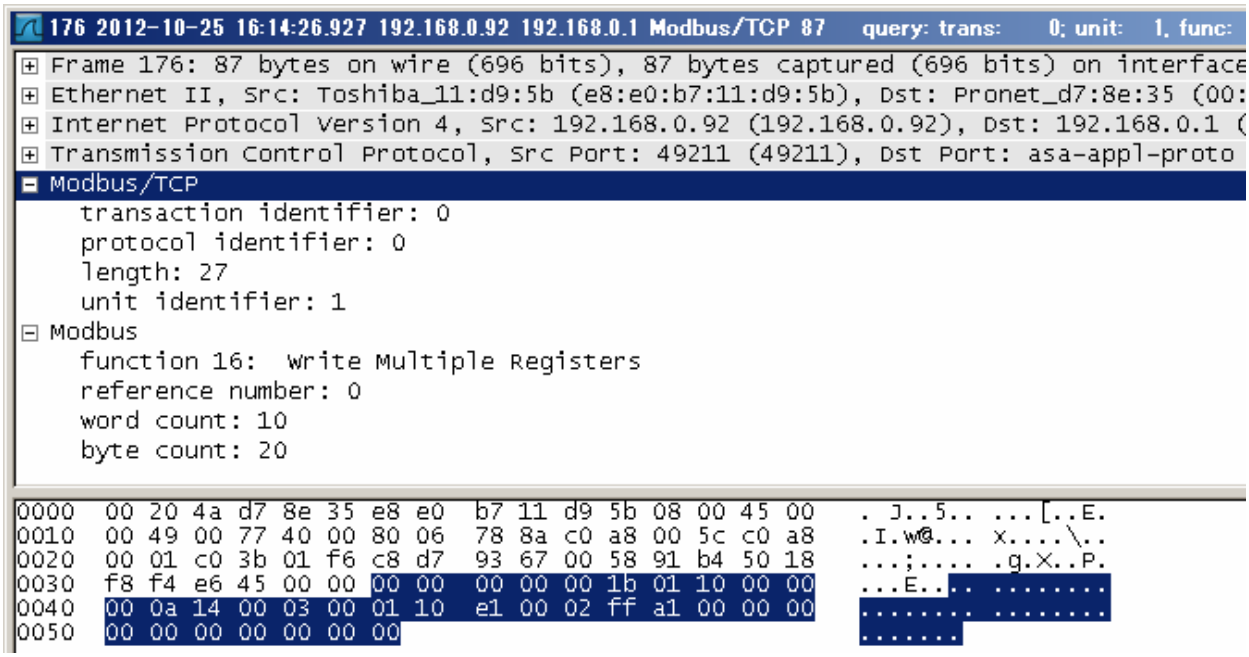


Example of TCP frame data：

00000000000601100000000a

Breakdown of the above data：omitted

d-1) From monitoring PC to inverter. Active power P limit and power factor command request



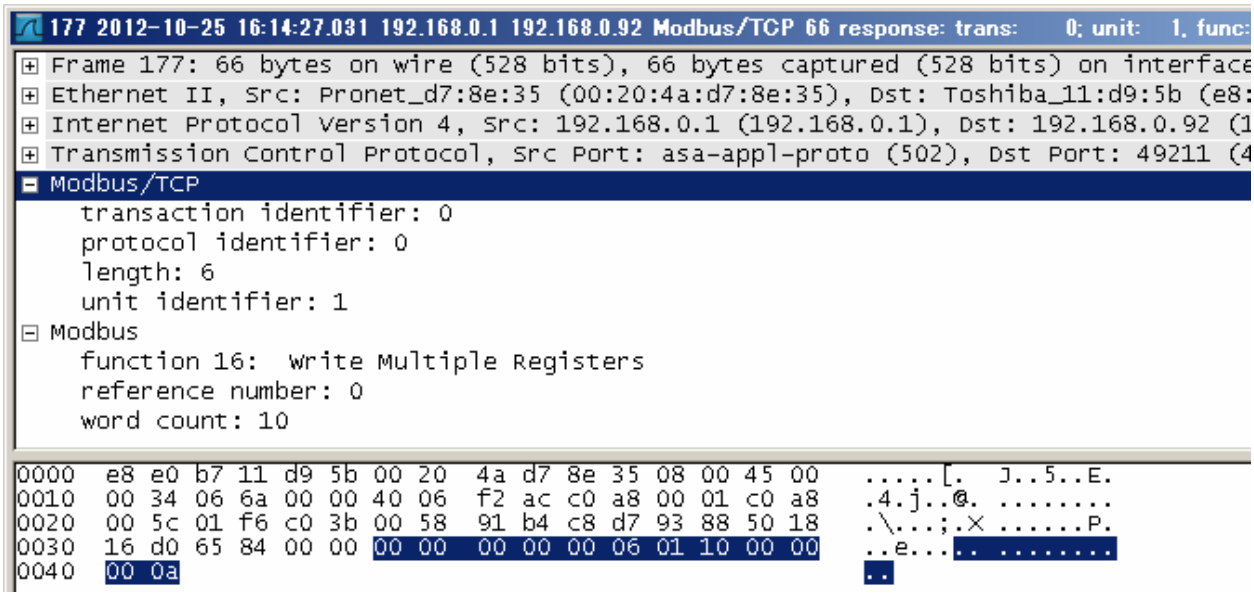
Example of TCP frame data：

00000000001b01100000000a140003000110e10002ffa10000000000000000000000

Breakdown of the above data：

0000	Transaction Identifier
0000	Protocol Identifier
001b	Length
01	Unit Identifier
10	Function Code (0x10=16dec)
0000	Starting Address
000a	Quantity of Registers (0x000a=10dec)
14	Byte count (0x14=20dec)
0003	Operation (0x0003=3dec)
0001	P limit enable/disable (0x0001=1dec: P limit enable)
10e1	Active power P limit (0x10e1=4321dec: 432.1kW)
0002	Q command enable/disable or power factor command enable/disable (0x0002=2dec: Power factor command enable)
ffa1	Reactive power Q command or power factor command (0xffa1=-95dec: -0.95)
0000	Time stamp Enable/Disable
00000000	Time Stamp (YYMMDD)
00000000	Time Stamp (HHMMSS)

d-2) From inverter to monitoring PC. Response to d-1

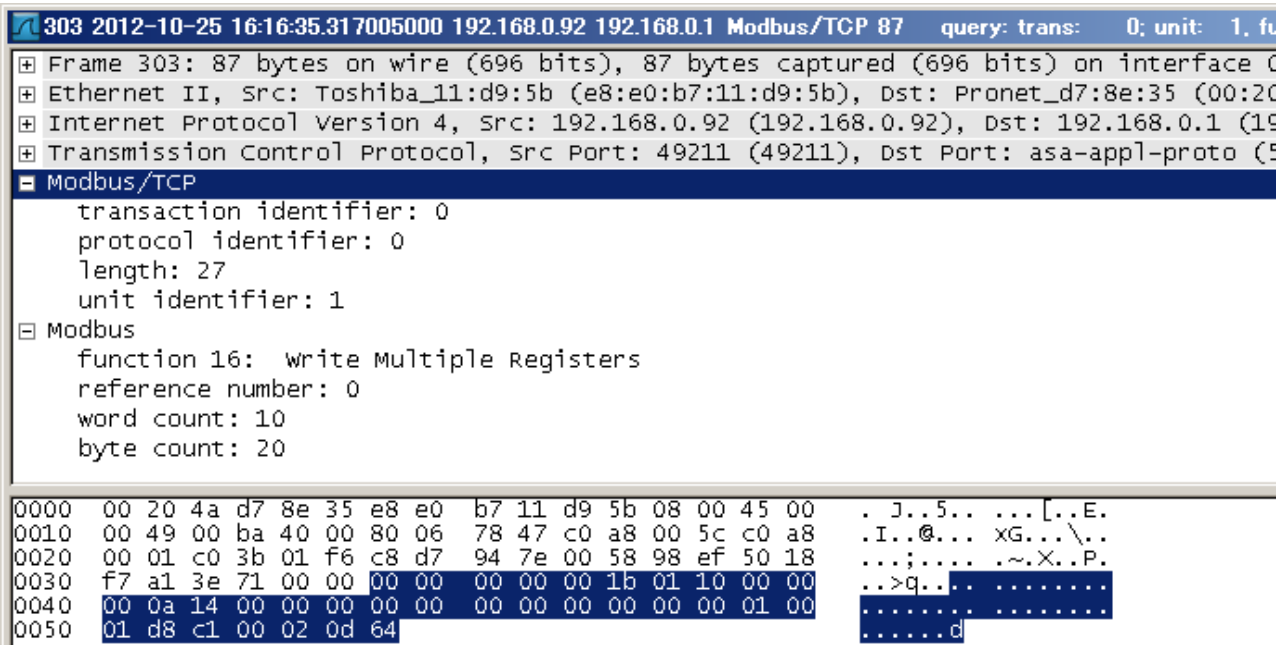


Example of TCP frame data：

000000000006011000000000a

Breakdown of the above data：omitted

e-1) From monitoring PC to inverter. Example of time stamp setting request



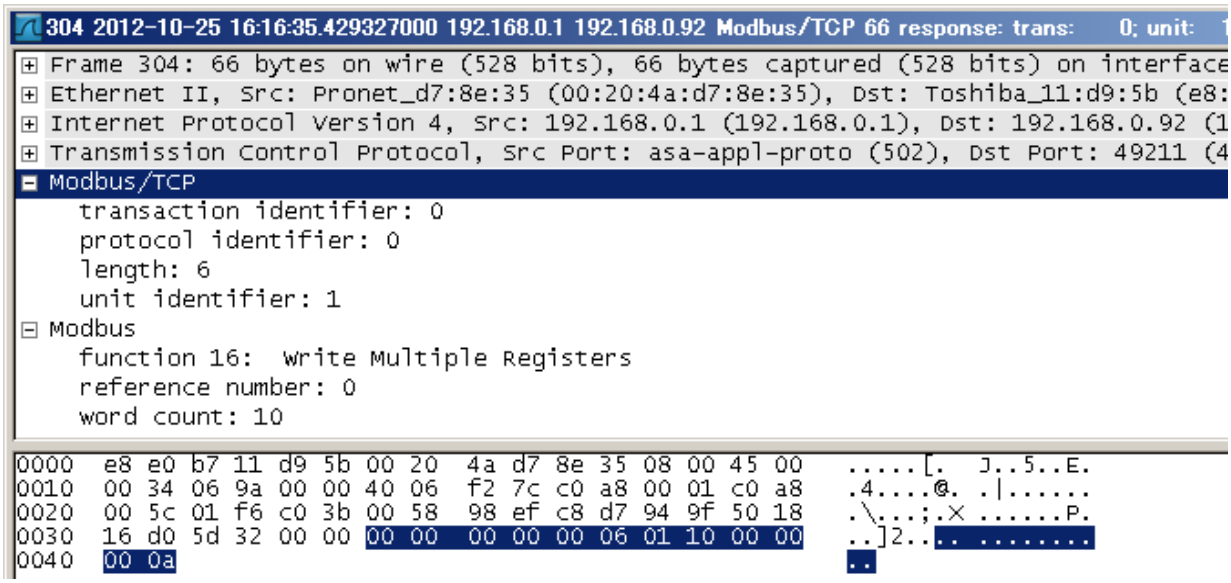
Example of TCP frame data：

00000000001b01100000000a14000000000000000000000000010001d8c100020d64

Breakdown of the above data：

0000	Transaction identifier
0000	Protocol identifier
001b	Length
01	Unit identifier
10	Function code (0x10=16dec)
0000	Starting address
000a	Quantity of registers (0x000a=10dec)
14	Byte count (0x14=20dec)
0000	Operation (0x0000=0dec)
0000	P limit enable/disable (0x0001=1dec: P limit disable)
0000	Active power P limit
0000	Q command enable/disable or power factor command enable/disable (0x0000=0dec: Q command disabled, power factor command disable)
0000	Reactive power Q command or power factor command
0001	Time stamp enable/disable(0x0001=1dec: Time stamp enable)
0001d8c1	Time stamp (YYMMDD) (0x0001d8c1=121025dec: 2012 October 25)
00020d64	Time stamp (HHMMSS) (0x00020d64=134500dec: 13:45:00 ※seconds are fixed and set to 00)

e-2) From inverter to monitoring PC. Response example to e-1



Example of TCP frame data：

00000000000601100000000a

Breakdown of the above data：Omitted

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