TECHNICAL NOTE

Modbus implementation using 3Gen DTU-Pro

Version 1.2 (December 2020)

Contents

1. Brief Introduction of Modbus Implementation

Hoymiles DTU-Pro integrated with the RS485 and the Ethernet port allows Hoymiles microinverter system to connect with a third-party monitoring platform. With this feature, users can read module-level data directly and control the microinverter system remotely by using the standard Modbus protocol which is convenient for users who want to process the microinverter data on their own monitoring system. This function can be implemented without affecting the communication between DTU-Pro and Hoymiles Monitoring System.

Also in some countries, generating plants should be equipped with a logic interface (input port) in order to cease output active power or limit active power to a regulating level, which can be implemented on this DTU by using Sunspec Modbus protocol.

There are two types of modbus protocol on the DTU-Pro, in which one is Hoymiles Modbus protocol and another is Sunspec Modbus protocol. Hoymiles Modbus protocol is developed by Hoymiles and implemented on two different types of interface, which is Modbus RTU on RS485 port and Modbus TCP on Ethernet port. You can find the detailed information in chapter 4 and chapter 5. Sunspec Modbus protocol is developed by Sunspec Alliance and Hoymiles also adopted this protocol on the RS485 port. Please refer to chapter 6 for more details about how to use this protocol.

2. Definitions

- **Modbus:** Modbus is a standard serial communications protocol, which often uses the RS485 as its physical layer.
- **Modbus RTU:** Modbus over a serial RS485 connection.
- **Modbus TCP:** Modbus over an Ethernet connection.
- **Sunspec Modbus:** SunSpec Modbus is a standard serial communications protocol designed to achieve interoperability between Distributed Energy Resource (DER) components and smart grid applications.
- **DTU**: Hoymiles Data Transfer Unit, receive the data from microinverter and meter, then upload them to the monitoring platform.

3. Connecting Modbus Outputs

Hoymiles DTU-Pro implements Modbus protocol on two different types of interface, which is Modbus RTU on RS485 port and Modbus TCP on Ethernet port. Users can use DTU-Pro to communicate with the third-party device using the modbus protocol on these two ports.

3.1 Connecting over RS485 Interface

This Modbus output uses half-duplex two-wire (plus common) communication, so the same pair of wires is used for sending and receiving.

- Be sure to connect the A, B and C (common) terminals. It is necessary to connect the common terminal for reliable communication between the master device and the slave devices on the network.
- Do not mix up different terminals, otherwise the communicaton between the devices will be abnormal. Please refer to Chapter 3.3 for more details about the terminal connection.
- If you use the shield cable, you can connect the shield layer to the Modbus common terminal.

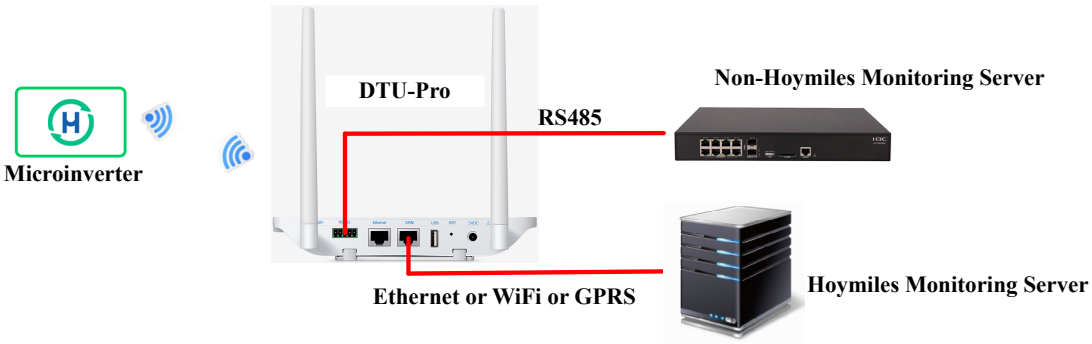
3.1.1 RS485 Cable

Please use twisted-pair cable (shielded cable is better) to prevent interference shown as follows.

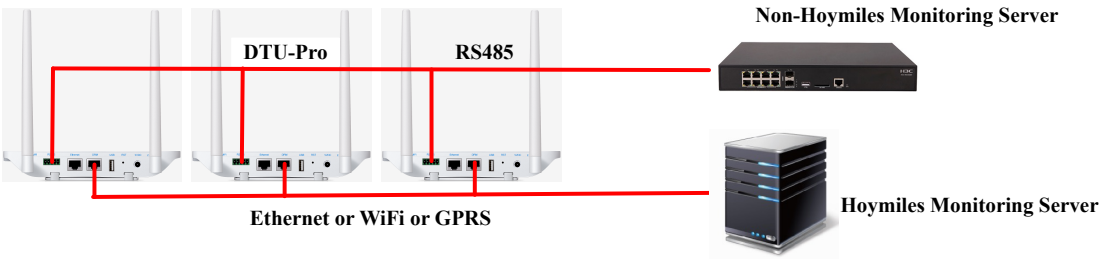
3.1.2 Connection topology

RS485 networks should always be wired in a bus or daisy-chain configuration. That is to say, the RS485 bus cable should start at the Master or some third-party monitoring device, then connect to each Slave in turn.

If there is only one DTU used in the small size PV system, the RS485 port of DTU-Pro is connected directly to the RS485 port of third party monitoring device using shielded twisted pair. And you can also use the Ethernet or WiFi option to connect the DTU to Hoymiles Monitoring Server at the same time.

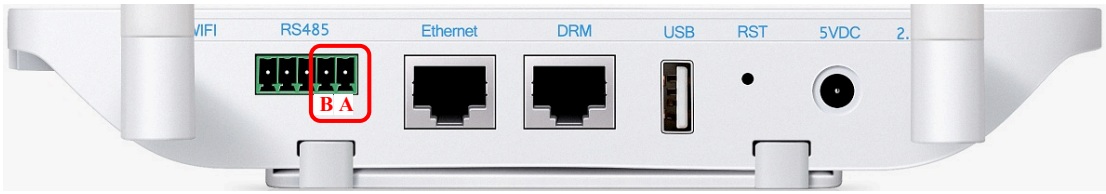


If there is more than one DTU involved in the installation, the RS485 port of DTU-Pro is connected directly to the RS485 port of third party monitoring device in turn.



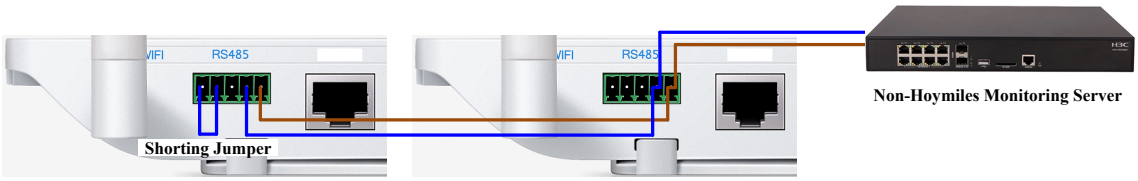
3.1.3 Connection Guideline

The picture below indicates the RS485 Port A and Port B on DTU. And the common (port C) terminal is in the middle of the RS485 interface.



- **Scenario 1: I**f only one DTU installed on one system, when the RS485 cable length is more than 200m, it will be suggested to use the shorting jumper on the first two ports from DTU's RS485 port.

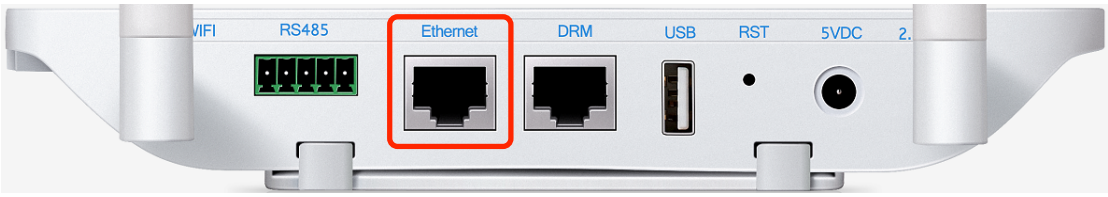
- **Scenario 2**: When multiple DTU installed within one system, please connect the DTUs one by one (as the diagram shows below). Shorting jumper for the last two RS485 ports from last DTU will be suggested if the distance between the third-party control device and the last DTU is more than 200 meters.



3.2 Connecting over Ethernet Interface

Users can also use the TCP Modbus protocol on the ethernet interface. Please use the standard ethernet cable to connect the DTU to the network device, such as a router.

Usually DTU-Pro can only be used in the local area network and the IP can be found on the webpage of the router. If users want to use DTU-Pro in the wide area, the network mapping need to be performed on the router.



4 Hoymiles Modus RTU Interface and Registers

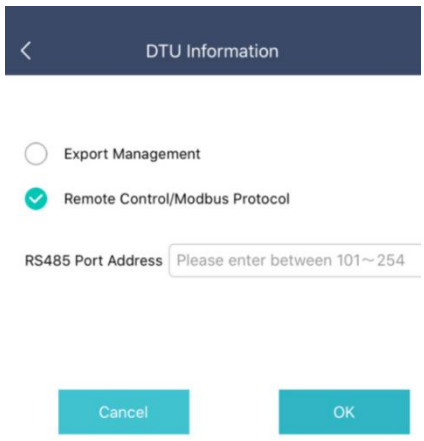
This section describes the register mapping for the monitoring data and remote control using Hoymiles Modbus RTU protocol.

4.1 Configure Modbus RTU Settings

In this general Modbus protocol, the DTU-Pro will work as the slave and receive the control from the third-party monitoring device. Every DTU-Pro on a Modbus network must have a unique address and the correct baud rate.

4.1.1 Setting the Modbus Address

The RS485 port on DTU-Pro can be configured to support Export Management, in which DTU acts as a master, or Remote Control/Modbus Protocol, in which DTU acts as a slave. All the DTUs under Hoymiles microinverter system should be set as the same type. The default function of this RS485 port is set as Export Management. You can change the function type from local APP by clicking “Installer APP”-“Me”-“Local Install Assistant”-“Home”-“DTU Information”-“RS485 port setting” as below.



The RS485 port address needs to be set between 101~254. If there is more than one DTU in a microinverter system, the port address needs to be set up differently.

4.1.2 Baud rate

The default baud rate of this RS485 port is set as 9600bps and cannot be changed.

4.2 Modbus RTU Functions

The Modbus protocol is a protocol, with only one master and multiple slaves. If the DTU is acting as a slave device, it will respond only when queried.

In most of the case, your Modbus software automatically uses the correct Modbus command for any action you wish to perform, but the Hoymiles DTU-Pro only supports the followings:

- **01(0x01) Read Single Device Status**

DTU or microinverter status registers can be read and written, and are intended for configuration values, so you can use functions 01 or 02 to read any registers.

- **02(0x02) Read Multiple Device Status**

DTU or microinverter status registers can be read and written, and are intended for configuration values, so you can use functions 01 or 02 to read any registers.

- **03(0x03) Read Device Data**

DTU or microinverter data registers are generally read-only and report voltage, current, power, energy, and related values.

- **05(0x05) Write Single/All Device Status**

This writes a new value to a single or all DTU or microinverter status registers.

- **15(0x0F) Write Multiple Device Status**

This writes a new value to multiple DTU or microinverter status registers. Please refer to the next section for more details.

4.2.1 Read Single Device Status

✓ Command sending format

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x01	
Register Address	2		Big-Endian
Register Count	2	0x0001	Big-Endian
CRC	2		CRC16

✓ Command response format (if success)

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x01	
Data Length	2	0x02	
Data	2		Big-Endian
CRC	2		CRC16

✓ Command response format (if failed)

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x81	
Wrong Data Code	1	0x01	
CRC	2		CRC16

4.2.2 Read Multiple Device Status

✓ Command sending format

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x02	
Register Address	2		Big-Endian
Register Count	2		Big-Endian
CRC	2		CRC16

✓ Command response format (if success)

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x02	
Data Length	2		
Data 1	2		Big-Endian
Data 2	2		Big-Endian
……			
CRC	2		CRC16

✓ Command response format (if failed)

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x82	

Wrong Data Code	1	0x01	
CRC	2		CRC16

4.2.3 Read Device Data

✓ Command sending format

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x03	
Register Address	2		Big-Endian
Register Count	2		Big-Endian
CRC	2		CRC16

✓ Command response format (if success)

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x03	
Data Length	2		
Data 1	2		Big-Endian
Data 2	2		Big-Endian
……			
CRC	2		CRC16

✓ Command response format (if failed)

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x83	
Wrong Data Code	1	0x01	
CRC	2		CRC16

4.2.4 Write Single/All Device Status

✓ Command sending format

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x05	
Register Address	2		Big-Endian
Data	2		Big-Endian
CRC	2		CRC16

✓ Command response format (if success)

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x05	
Register Address	2		Big-Endian
Data	2		Big-Endian
CRC	2		CRC16

✓ Command response format (if failed)

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x85	
Wrong Data Code	1	0x01	
CRC	2		CRC16

4.2.5 Write Multiple Device Status

✓ Command sending format

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x0F	
Register Address	2		Big-Endian
Register Count	2		Big-Endian
Data Length	1		
Data 1	1		
Data 2	1		
……			
CRC	2		CRC16

✓ Command response format (if success)

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x0F	
Register Address	2		
Register Count	2		Big-Endian
CRC	2		CRC16

✓ Command response format (if failed)

Name	Length	Value	Remark
Address	1		RS485 Address
Function Code	1	0x8F	
Wrong Data Code	1	0x01	
CRC	2		CRC16

4.3 Modbus Registers

4.3.1 Microinverter Status Register List

The following registers provide a microinverter status register list, which can be both read and written.

Registers	Name	R/W?	Function Code (Supported)	Remark
0xC000	Turn ON/OFF (All Microinverters)	W	0x05	0: OFF 1: ON
0xC001	Limit Active Power (All Microinverters)	W	0x05	Percentage 2~100 for HM series 10~100 for MI series
0xC002	Reserved	W	0x05	
0xC003	Reserved	W	0x05	
0xC004	Reserved	W	0x05	
0xC005	Reserved	W	0x05	
0xC006	Turn ON/OFF (Port 1)	R/W	0x01\0x02\0x05\0x0F	0: OFF 1: ON
0xC007	Limit Active Power (Port 1)	R/W	0x01\0x02\0x05\0x0F	Percentage 2~100 for HM series 10~100 for MI series
0xC008	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC009	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC00A	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC00B	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC00C	Turn ON/OFF (Port 2)	R/W	0x01\0x02\0x05\0x0F	0: OFF 1: ON
0xC00D	Limit Active Power (Port 2)	R/W	0x01\0x02\0x05\0x0F	Percentage

				2~100 for HM series 10~100 for MI series
0xC00E	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC00F	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC000	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC001	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC002	Turn ON/OFF (Port 3)	R/W	0x01\0x02\0x05\0x0F	0: OFF 1: ON
0xC003	Limit Active Power (Port 3)	R/W	0x01\0x02\0x05\0x0F	Percentage 2~100 for HM series 10~100 for MI series
0xC004	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC005	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC006	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC007	Reserved	R/W	0x01\0x02\0x05\0x0F	
…… (Maximum 99 ports)				
0x9D9C	Turn ON/OFF (All Microinverters)	W	0x05	0: OFF 1: ON
0x9D9D	Limit Active Power (All Microinverters)	W	0x05	Percentage 2~100 for HM series 10~100 for MI series
0x9D9E	Reserved	W	0x05	
0x9D9F	Reserved	W	0x05	
0x9DA0	Reserved	W	0x05	
0x9DA1	Reserved	W	0x05	
Note: 1. 4 ports for 4 in 1 microinverters, 2 ports for 2 in 1 microinverter and 1 port for 1 in 1 microinverter. 2. For 4 in 1 and 2 in 1 microinverters, control on all ports in one microinverter should be same.				

4.3.2 Microinverter Data Register List

The following registers provide a microinverter data register list, which can be read-only with the function code 0x03.

Registers	Name	Decimal	Units	Remark

0x1000	Data Type	/	/	Default, 0x3C
0x1001	Microinverter SN	/	/	12-digit decimal number Big-Endian For example, 116151200012
0x1002				
0x1003				
0x1004				
0x1005				
0x1006				
0x1007	Port Number	/	/	
0x1008	PV Voltage	1	V	
0x1009				
0x100A	PV Current	1/2	A	1 for MI Series, 2 for HM Series
0x100B				
0x100C	Grid Voltage	1	V	
0x100D				
0x100E	Grid frequency	2	Hz	
0x100F				
0x1010	PV Power	1	W	
0x1011				
0x1012	Today Production	/	Wh	
0x1013				
0x1014	Total Production	/	Wh	
0x1015				
0x1016				
0x1017				
0x1018	Temperature	1	℃	Microinverter internal temperature
0x1019				
0x101A	Operating Status	/	/	
0x101B				
0x101C	Alarm Code	/	/	
0x101D				
0x101E	Alarm Count	/	/	
0x101F				
0x1020	Link Status	/	/	Communication status with DTU
0x1021	/	/	/	Fixed, 0x07
0x1022	Reserved	/	/	
0x1023	Reserved	/	/	
0x1024	Reserved	/	/	
0x1025	Reserved	/	/	
0x1026	Reserved	/	/	
0x1027	Reserved	/	/	
0x1028	Data Type	/	/	Default, 0x3C
0x1029		/	/	

0x102A	Microinverter SN			12-digit decimal number For example, 116151200012
0x102B				
0x102C				
0x102D				
0x102E				
0x102F	Port Number	/	/	
0x1030	PV Voltage	1	V	
0x1031				
0x1032	PV Current	1/2	A	1 for MI Series, 2 for HM Series
0x1033				
0x1034	Grid Voltage	1	V	
0x1035				
0x1036	Grid frequency	2	Hz	
0x1037				
0x1038	PV Power	1	W	
0x1039				
0x103A	Today Production	/	Wh	
0x103B				
0x103C	Total Production	/	Wh	
0x103D				
0x103E				
0x103F				
0x1040	Temperature	1	℃	Microinverter internal temperature
0x1041				
0x1042	Operating Status	/	/	
0x1043				
0x1044	Alarm Code	/	/	
0x1045				
0x1046	Alarm Count	/	/	
0x1047				
0x1048	Link Status	/	/	Communication status with DTU
0x1049	/	/	/	Fixed, 0x07
0x104A	Reserved	/	/	
0x104B	Reserved	/	/	
0x104C	Reserved	/	/	
0x104D	Reserved	/	/	
0x104E	Reserved	/	/	
0x104F	Reserved	/	/	
…… (Maximum 99 ports)				

4.3.3 Device SN Register List

The following registers provide the device serial number register list, which can be read and written.

Registers	Name	Decimal	Units	R/W?	Function Code (Supported)	Remark
0x2000	DTU SN			R	0x03	
0x2001						
0x2002						
0x2003						
0x2004		/	/			
0x2005						
0x2056	Microinverter SN	/	/	R/W	0x03/0x0F	116151200012
0x2057						
0x2058						
0x2059						
0x205A						
0x205B						
0x205C	Microinverter SN	/	/	R/W	0x03/0x0F	116151200012
0x205D						
0x205E						
0x205F						
0x2060						
0x2061						
…… (Maximum 99 ports for one DTU)						
Note: 1. 4 ports for 4 in 1 microinverters, 2 ports for 2 in 1 microinverter and 1 port for 1 in 1 microinverter.						

4.3.4 DTU RS485 Port Setting

The following registers provide DTU RS485 port setting, which can be read and written.

Registers	Name	Decimal	Units	R/W?	Function Code (Supported)	Remark
0x2503	RS485 Function	/	/	R/W	0x03/0x0F	0: Export Management 1: Hoymiles Modbus
0x2504	RS485 Port Address	/	/	R/W	0x03/0x0F	

Note: When the port number is changed, please restart the DTU.

5 Hoymiles Modus TCP Interface and Registers

This section describes the register mapping for the monitoring data and remote control using Hoymiles Modbus TCP protocol on the Ethernet interface.

5.1 Modbus TCP Settings

In the Modbus TCP protocol, the DTU-Pro will work as the slave and receive the control from the third-party monitoring device. Usually users can directly connect the ethernet cable to the ethernet port to use Hoymiles Modbus protocol.
The default port number of Modbus TCP is 502 and can be changed according to the protocol in this chapter. The IP address can be obtained in the network device, such as the router.

5.2 Modbus TCP Functions

The Modbus protocol is a protocol, with only one master and multiple slaves. If the DTU is acting as a slave device, it will respond only when queried.

In most of the case, your Modbus software automatically uses the correct Modbus command for any action you wish to perform, but the Hoymiles DTU-Pro only supports the followings:

- **01(0x01) Read Single Device Status**

DTU or microinverter status registers can be read and written, and are intended for configuration values, so you can use functions 01 or 02 to read any registers.

- **02(0x02) Read Multiple Device Status**

DTU or microinverter status registers can be read and written, and are intended for configuration values, so you can use functions 01 or 02 to read any registers.

- **03(0x03) Read Device Data**

DTU or microinverter data registers are generally read-only and report voltage, current, power, energy, and related values.

- **05(0x05) Write Single/All Device Status**

This writes a new value to a single or all DTU or microinverter status registers.

- **15(0x0F) Write Multiple Device Status**

This writes a new value to multiple DTU or microinverter status registers. Please refer to the next section for more details.

5.2.1 Read Single Device Status

✓ Command sending format

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x01	
	Starting Address	2		Big-Endian
	No. of Registers	2	0x0001	Big-Endian

✓ Command response format (if success)

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x01	
	Data length	1	0x02	
	Data	2		Big-Endian

✓ Command response format (if failed)

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x81	
	Error Data Code	1	0x01	

5.2.2 Read Multiple Device Status

✓ Command sending format

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		

Modbus Data	Function Code	1	0x02	
	Starting Address	2		Big-Endian
	No. of Registers	2		Big-Endian

✓ Command response format (if success)

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x02	
	Data length	1		
	Data 1	2		Big-Endian
	Data 2	2		Big-Endian
	……			

✓ Command response format (if failed)

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x82	
	Error Data Code	1	0x01	

5.2.3 Read Device Data

✓ Command sending format

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x03	
	Address Code	2		Big-Endian
	No. of Registers	2		Big-Endian

✓ Command response format (if success)

	Name	Length	Value	Remark

Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x03	
	Data length	1		
	Data 1	2		Big-Endian
	Data 2	2		Big-Endian
	……			

✓ Command response format (if failed)

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x83	
	Error Data Code	1	0x01	

5.2.4 Write Single/All Device Status

✓ Command sending format

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x05	
	Address Code	2		Big-Endian
	No. of Registers	2		Big-Endian

✓ Command response format (if success)

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x05	
	Address Code	2		Big-Endian
	Data	2		Big-Endian

✓ Command response format (if failed)

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x85	
	Error Data Code	1	0x01	

5.2.5 Write Multiple Microinverters Status

✓ Command sending format

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x0F	
	Address Code	2		Big-Endian
	No. of Registers	2		Big-Endian
	Data length	1		
	Data 1	1		
	Data 2	1		
	……			

✓ Command response format (if success)

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian
	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x0F	
	Address Code	2		Big-Endian
	No. of Registers	2		Big-Endian

✓ Command response format (if failed)

	Name	Length	Value	Remark
Header	Transaction ID	2		Big-Endian

	Protocol ID	2		Big-Endian
	Length	2		Big-Endian
	Unit ID	1		
Modbus Data	Function Code	1	0x8F	
	Error Data Code	1	0x01	

5.3 Modbus Registers

5.3.1 Microinverter Status Register List

The following registers provide a microinverter status register list, which can be both read and written.

Registers	Name	R/W?	Function Code (Supported)	Remark
0xC000	Turn ON/OFF (All Microinverters)	W	0x05	0: OFF 1: ON
0xC001	Limit Active Power (All Microinverters)	W	0x05	Percentage 2~100 for HM series 10~100 for MI series
0xC002	Reserved	W	0x05	
0xC003	Reserved	W	0x05	
0xC004	Reserved	W	0x05	
0xC005	Reserved	W	0x05	
0xC006	Turn ON/OFF (Port 1)	R/W	0x01\0x02\0x05\0x0F	0: OFF 1: ON
0xC007	Limit Active Power (Port 1)	R/W	0x01\0x02\0x05\0x0F	Percentage 2~100 for HM series 10~100 for MI series
0xC008	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC009	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC00A	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC00B	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC00C	Turn ON/OFF (Port 2)	R/W	0x01\0x02\0x05\0x0F	0: OFF 1: ON
0xC00D	Limit Active Power (Port 2)	R/W	0x01\0x02\0x05\0x0F	Percentage 2~100 for HM series

				10~100 for MI series
0xC00E	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC00F	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC000	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC001	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC002	Turn ON/OFF (Port 3)	R/W	0x01\0x02\0x05\0x0F	0: OFF 1: ON
0xC003	Limit Active Power (Port 3)	R/W	0x01\0x02\0x05\0x0F	Percentage 2~100 for HM series 10~100 for MI series
0xC004	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC005	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC006	Reserved	R/W	0x01\0x02\0x05\0x0F	
0xC007	Reserved	R/W	0x01\0x02\0x05\0x0F	
…… (Maximum 99 ports)				
0x9D9C	Turn ON/OFF (All Microinverters)	W	0x05	0: OFF 1: ON
0x9D9D	Limit Active Power (All Microinverters)	W	0x05	Percentage 2~100 for HM series 10~100 for MI series
0x9D9E	Reserved	W	0x05	
0x9D9F	Reserved	W	0x05	
0x9DA0	Reserved	W	0x05	
0x9DA1	Reserved	W	0x05	
Note: 1. 4 ports for 4 in 1 microinverters, 2 ports for 2 in 1 microinverter and 1 port for 1 in 1 microinverter. 2. For 4 in 1 and 2 in 1 microinverters, control on all ports in one microinverter should be same.				

5.3.2 Microinverter Data Register List

The following registers provide a microinverter data register list, which can be read-only with the function code 0x03.

Registers	Name	Decimal	Units	Remark
0x1000	Data Type	/	/	Default, 0x3C
0x1001		/	/	

0x1002	Microinverter SN			12-digit decimal number Big-Endian For example, 116151200012
0x1003				
0x1004				
0x1005				
0x1006				
0x1007	Port Number	/	/	
0x1008	PV Voltage	1	V	
0x1009				
0x100A	PV Current	1/2	A	1 for MI Series, 2 for HM Series
0x100B				
0x100C	Grid Voltage	1	V	
0x100D				
0x100E	Grid frequency	2	Hz	
0x100F				
0x1010	PV Power	1	W	
0x1011				
0x1012	Today Production	/	Wh	
0x1013				
0x1014	Total Production	/	Wh	
0x1015				
0x1016				
0x1017				
0x1018	Temperature	1	℃	Microinverter internal temperature
0x1019				
0x101A	Operating Status	/	/	
0x101B				
0x101C	Alarm Code	/	/	
0x101D				
0x101E	Alarm Count	/	/	
0x101F				
0x1020	Link Status	/	/	Communication status with DTU
0x1021	/	/	/	Fixed, 0x07
0x1022	Reserved	/	/	
0x1023	Reserved	/	/	
0x1024	Reserved	/	/	
0x1025	Reserved	/	/	
0x1026	Reserved	/	/	
0x1027	Reserved	/	/	
0x1028	Data Type	/	/	Default, 0x3C
0x1029	Microinverter SN	/	/	12-digit decimal number
0x102A				
0x102B				

0x102C 0x102D 0x102E				For example, 116151200012
0x102F	Port Number	/	/	
0x1030 0x1031	PV Voltage	1	V	
0x1032 0x1033	PV Current	1/2	A	1 for MI Series, 2 for HM Series
0x1034 0x1035	Grid Voltage	1	V	
0x1036 0x1037	Grid frequency	2	Hz	
0x1038 0x1039	PV Power	1	W	
0x103A 0x103B	Today Production	/	Wh	
0x103C 0x103D 0x103E 0x103F	Total Production	/	Wh	
0x1040 0x1041	Temperature	1	℃	Microinverter internal temperature
0x1042 0x1043	Operating Status	/	/	
0x1044 0x1045	Alarm Code	/	/	
0x1046 0x1047	Alarm Count	/	/	
0x1048	Link Status	/	/	Communication status with DTU
0x1049	/	/	/	Fixed, 0x07
0x104A	Reserved	/	/	
0x104B	Reserved	/	/	
0x104C	Reserved	/	/	
0x104D	Reserved	/	/	
0x104E	Reserved	/	/	
0x104F	Reserved	/	/	
…… (Maximum 99 ports)				

5.3.3 Device SN Register List

The following registers provide the device serial number register list, which can be read and written.

Registers	Name	Decimal	Units	R/W?	Function Code (Supported)	Remark
0x2000	DTU SN			R	0x03	
0x2001						
0x2002						
0x2003						
0x2004		/	/			
0x2005						
0x2056	Microinverter SN	/	/	R/W	0x03/0x0F	
0x2057						
0x2058						
0x2059						
0x205A						
0x205B						
0x205C	Microinverter SN	/	/	R/W	0x03/0x0F	
0x205D						
0x205E						
0x205F						
0x2060						
0x2061						
…… (Maximum 99 ports for one DTU)						
Note: 1. 4 ports for 4 in 1 microinverters, 2 ports for 2 in 1 microinverter and 1 port for 1 in 1 microinverter.						

5.3.4 DTU Ethernet Setting Register List

The following registers provide DTU ethernet setting register list, which can be read and written.

Registers	Name	Decimal	Units	R/W?	Function Code (Supported)	Remark
0x2501	Ethernet Port Number	/	/	R/W	0x03/0x0F	Default: 502
0x2502						

Note: When the port number is changed, please restart the DTU.

6 Sunspec Modus Interface and Registers

Hoymiles DTU-Pro is compliant with Sunspec Modbus protocol. The Sunspec registers are grouped as follows.

- **Sunspec Common Registers (Model 1)**
- **Sunspec Single Phase Inverter (Model 101)**
- **Sunspec Single Phase Inverter (FLOAT) (Model 111)**
- **Sunspec Immediate Controls (Model 123)**

The DTU-Pro includes both the general Modbus protocol as explained in the previous chapter and the Sunspec Modbus protocol. The functions and registers as mentioned in the general Modbus protocol are different from those in the Sunspec Modbus protocol. But you can still use these two protocols if you want.
The following section will describe the funtions and the register mapping for the Sunspec Modbus protocol.

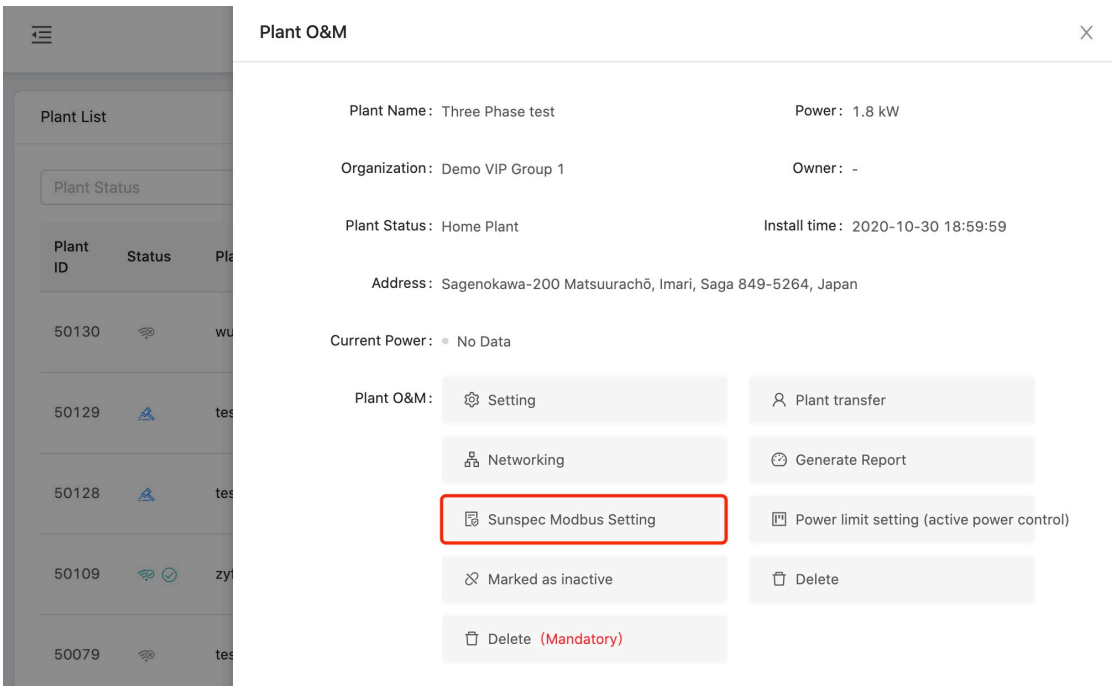
Note: The Sunspec Modbus functions are only supported with the software version V2.0 or above.
Note: The new Sunspec Modbus model 700 series will be supported in the near future.

6.1 Configure Sunspec Modbus Settings

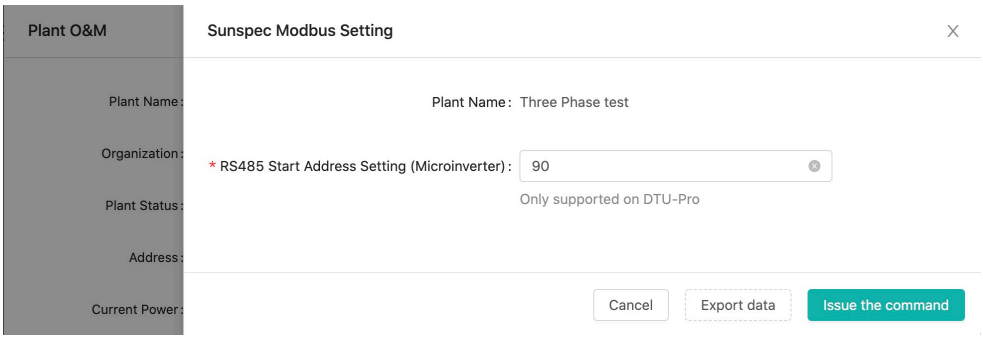
In the Sunspec Modbus protocol, every microinverter can be controlled separately and the DTU-Pro only works as a gateway. Therefore, every microinverter should be configured with a RS485 address and the master will communicate with the microinverter by using this address via the gateway DTU-Pro.

6.1.1 Setting the Modbus Address

The RS485 port on DTU-Pro can be configured to support Export Management, in which DTU acts as a master, or general Modbus terminal, in which DTU acts as a slave, or Sunspec Modbus terminal, in which DTU-Pro also acts a slave. The RS485 addresses of the microinverters must be set firstly if implementing the Sunspec Modbus protocol for remote control.
First, please click “Plant List”-“Plant O&M”-“Sunspec Modbus Setting” as follows.



Usually there are multiple microinverters in one PV station, and all the address should be given. For convenience, after the installer completing PV station creation, only the RS485 start address need to be set for all the microinverters.



Note: RS485 addresses of all the microinverters should be within the range of 0~255

After click the button “Plant List”-“Plant O&M”-“Sunspec Modbus Setting” and download the list of all the RS485 addresses with the serial numbers of the corresponding microinverters and corresponding DTUs.

6.1.2 Baud rate

The default baud rate of this RS485 port is set as 9600bps and cannot be changed.

6.2 Sunspec Modbus Functions

The Sunspec Modbus protocol is a protocol, with only one master and multiple slaves. If the DTU is acting as a slave device, it will respond only when queried.

In most cases, your Sunspec Modbus software automatically uses the correct Sunspec

Modbus command for any action you wish to perform, but the Hoymiles DTU-Pro only supports the followings:

- **03(0x03) Read Holding Registers**

Holding registers can be read to be intended for confirming the configured values.

- **06(0x06) Write Single Register**

This writes a new value to a single register.

- **16(0x10) Write Multiple Registers**

This writes a new value to multiple registers. Please refer to the next section for more details.

6.2.1 Read Holding Registers

✓ Command sending format

Name	Length	Value	Remark
Address	2 Bytes	0x0001-0xFFFF	Microinverter RS485 Address
Function Code	1 Bytes	0x03	
Register Address	2 Bytes	0x0000-0xFFFF	Big-Endian
Register Count	2 Bytes	0x0000-0xFFFF	Big-Endian
CRC	2 Bytes	CRC16	Big-Endian

✓ Command response format (if success)

Name	Length	Value	Remark
Address	2 Bytes	0x0001-0xFFFF	Microinverter RS485 Address
Function Code	1 Bytes	0x03	
Data Length	2 Bytes	2*N	Big-Endian
Data	2* N Bytes	value	Big-Endian
CRC	2 Bytes	CRC16	Big-Endian

✓ Command response format (if failed)

Name	Length	Value	Remark
Address	2 Bytes	0x0001-0xFFFF	Microinverter RS485 Address
Function Code	1 Bytes	0x83	
Wrong Data Code	1 Bytes	0x01/0x02/0x03/0x04	
CRC	2 Bytes	CRC16	Big-Endian

6.2.2 Write Single Register

✓ Command sending format

Name	Length	Value	Remark
Address	2 Bytes	0x0001-0xFFFF	Microinverter RS485 Address
Function Code	1 Bytes	0x06	
Register Address	2 Bytes	0x0000-0xFFFF	Big-Endian
Data	2 Bytes	0x0000-0xFFFF	Big-Endian
CRC	2 Bytes	CRC16	Big-Endian

✓ Command response format (if success)

Name	Length	Value	Remark
Address	2 Bytes	0x0001-0xFFFF	Microinverter RS485 Address
Function Code	1 Bytes	0x06	
Register Address	2 Bytes	0x0000-0xFFFF	Big-Endian
Data	2 Bytes	0x0000-0xFFFF	Big-Endian
CRC	2 Bytes	CRC16	Big-Endian

✓ Command response format (if failed)

Name	Length	Value	Remark
Address	2 Bytes	0x0001-0xFFFF	Microinverter RS485 Address
Function Code	1 Bytes	0x86	
Wrong Data Code	1 Bytes	0x01/0x02/0x03/0x04	
CRC	2 Bytes	CRC16	Big-Endian

6.2.3 Write Multiple Registers

✓ Command sending format

Name	Length	Value	Remark
Address	2 Bytes	0x0001-0xFFFF	Microinverter RS485 Address
Function Code	1 Bytes	0x10	
Register Address	2 Bytes	0x0000-0xFFFF	Big-Endian
Register Count	2 Bytes	0x0000-0xFFFF	Big-Endian
Data Length	1 Bytes	2*N	Big-Endian
Data	2*N Bytes	value	Big-Endian

CRC	2 Bytes	CRC16	Big-Endian

✓ Command response format (if success)

Name	Length	Value	Remark
Address	2	0x0001-0xFFFF	Microinverter RS485 Address
Function Code	1	0x10	
Register Address	2 Bytes	0x0000-0xFFFF	Big-Endian
Register Count	2	0x0000-0xFFFF	Big-Endian
CRC	2	CRC16	Big-Endian

✓ Command response format (if failed)

Name	Length	Value	Remark
Address	2	0x0001-0xFFFF	Microinverter RS485 Address
Function Code	1	0x90	
Wrong Data Code	1	0x01/0x02/0x03/0x04	
CRC	2	CRC16	Big-Endian

6.3 Unimplemented Sunspec Modbus Registers

Unimplemented measurements or registers are indicated in the tables below with gray italic text and marked as “unimplemented”. Unimplemented registers may still be read and will return a special SunSpec value indicating that they are unimplemented.

- For floating-point registers the unimplemented value is 0x7FC00000 (NaN, not-a-number).
- For 16-bit signed integer registers, the unimplemented value is 0x8000.
- For 16-bit unsigned registers, the unimplemented value is 0xFFFF.
- For 16-bit enumerate registers (enum16), the unimplemented value is 0xFFFF.
- For 32-bit signed registers, the unimplemented value is 0x80000000.
- For 32-bit unsigned registers, the unimplemented value is 0xFFFFFFFF.
- For 32-bit integer energy registers (acc32), the unimplemented (or unaccumulated) value is 0x00000000. Because of this requirement, 32-bit integer energies in Model 101 always return at least 1, never 0.
- For 32-bit bit field registers (bitfield32), the unimplemented value is 0xFFFFFFFF.
- For string registers, the unimplemented value is 0x0000621.
- For sunssf signed registers, the unimplemented value is 0x8000.

6.4 Sunspec Common Registers (Model 1)

The register common block is set to 40000 (Modbus protocol address [0-based]). All the parameters, except for the Option resgister, are defined in the Sunspec common block as follows.

Registers	Size	Name	Type	Description
40000	2	SunS	uint32	'SunS' (SunSpec) identifier, value = "SunS" (0x53756e53)
40002	1	ID	uint16	Common model ID, value =0x0001
40003	1	L	uint16	SunSpec model register count (length), value =66
40004	16	Manufacturer (Mn)	String(32)	Manufacturer string, value="Hoymiles"
40020	16	Model (Md)	String(32)	Microinverter model string
40044	8	Version (Vr)	String(16)	Microinverter version string
40052	16	Serial Number (SN)	String(32)	Microinverter serial number string
40068	1	Device Address (DA)	uint16	Microinverter Modbus address
40069	1	Pad	uint16	Value=0x8000

6.5 Sunspec Single Phase Inverter (Model 101)

This block contains the single-phase inverter registers in an integer format. The base register of the Device Specific block is set to 40070 (Modbus protocol address [0-based]). Unsupport values are not listed in the table below.

Registers	Size	Name	Type	Description
40070	1	ID	uint16	101=single phase, 102=split phase, 103=three phase
40071	1	L	uint16	Length of model block, value=50
40072	1	A	uint16	AC total current value
40073	1	AphA	uint16	AC Phase A current value, connected phase
40076	1	A_SF	sunssf	AC voltage scale factor, value=-2
40080	1	PhVphA	uint16	AC Voltage Phase A to N value
40083	1	V_SF	sunssf	AC voltage scale factor, value=-1
40084	1	W	int16	AC power value
40085	1	W_SF	sunssf	AC power scale factor, value=-1
40086	1	Hz	int16	AC frequency value
40087	1	Hz_SF	sunssf	AC frequency scale factor, value=-2
40090	1	VAr	int16	AC reactive power
40091	1	VAr_SF	sunssf	AC reactive power scale factor, value=-1

40092	1	PF	int16	AC power factor
40093	1	PF_SF	sunssf	AC power factor scale factor, value=-2
40094	1	WH	acc32	AC lifetime energy
40096	1	WH_SF	sunssf	AC lifetime energy scale factor, value=0

6.6 Sunspec Single Phase Inverter (FLOAT) (Model 111)

This block contains the single-phase inverter registers in a floating-point format for maximum resolution. The base register of the Device Specific block is set to 40122 (Modbus protocol address [0-based]). Unsupport values are not listed in the table below.

Registers	Size	Name	Type	Description
40122	1	ID	uint16	111=single phase, 112=split phase, 113=three phase
40123	1	L	uint16	Length of model block, value=50
40124	2	A	float32	AC total current value
40126	2	AphA	float32	AC Phase A current value, connected phase
40138	2	PhVphA	float32	AC Voltage Phase A to N value
40144	2	W	float32	AC power value
40146	2	Hz	float32	AC frequency value
40150	2	VAr	float32	AC reactive power
40152	2	PF	float32	AC power factor
40154	2	WH	float32	AC lifetime energy

6.7 Sunspec Immediate Controls (Model 123)

The register common block is set to 40184 (Modbus protocol address [0-based]).

Registers	Size	Name	Type	Description
40184	1	ID	uint16	Immediate Inverter Controls
40185	1	L	uint16	Model Length
40189	1	WMaxLimPct	uint16	Set power output to specified level
40193	1	WMaxLim_Ena	enum16	Enumerated valued. Throttle enable/disable control. 0=Disbaled 1=Enabled