Technical Information

# Large Scale
# V-RTU2000 System

# Data Communication Unit Specifications

VEESTA WORLD

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# TABLE OF CONTENT

**Chapter 1 - Introduction ..... 8**
1.1 General Information ..... 8
1.2 Veesta World Co ..... 8
1.3 Copyrights ..... 9
**Chapter 2 - System Overview ..... 10**
2.1 Overview ..... 10
2.2 Summary of Functions ..... 10
2.2.1 RTU reads ..... 11
2.2.2 CC commands ..... 12
2.2.3 Synchronize time ..... 12
2.2.4 Communication and system information ..... 12
2.3 Summary of Data Functions ..... 13
2.3.1 Data Acquisition Processing ..... 13
2.3.2 Control Output ..... 13
2.4 Hardware Structure ..... 14
2.4.1 Power Supply Unit ..... 14
2.4.2 Main Unit ..... 14
2.4.3 Interface Modules ..... 15
2.4.4 GPS Time Module, VC-2DCUGT1 Card ..... 15
2.5 DCU Series Hardware and Software Training ..... 16
2.5.1 Curriculum Schedule Syllabus ..... 16
2.6 Standards ..... 17
**Chapter 3 - Design Structure ..... 18**
3.1 Overview ..... 18
3.2 Hardware Block Diagram ..... 19
3.3 Main Unit Design ..... 20
**Chapter 4 - Main Unit Specifications ..... 21**
4.1 General ..... 21
4.2 Front Panel ..... 21
4.2.1 LCD and Keypad ..... 21
4.3 Rear Panel ..... 22
4.4 Interface Slots ..... 22
4.5 Central Processing Unit ..... 22
4.6 Software Configuration ..... 22



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**Chapter 5 - Interface Specifications .....23**
5.1 General.....23
5.2 NETWORK Card .....23
5.2.1 VC-2DCUNM2 Specifications .....23
5.2.2 VC-2DCUNM4 Specifications .....24
5.3 SERIAL Card.....25
5.3.1 VC-2DCU06S Specifications.....25
5.3.2 VC-2DCU12S Specifications.....26
5.3.3 VC-2DCU16A Specifications.....27
5.4 Modem Card.....28
5.4.1 VR-2424 Data Modem Specifications .....28
5.4.2 VR-2444 Voice & Data Modem Specifications.....29
**Chapter 6 - Time Module Specifications .....30**
6.1 General.....30
6.2 Specification .....31
6.2.1 Time Module General Characteristics.....31
6.2.2 Time Interface Specifications.....31
6.2.3 Antenna Specifications .....32
**Chapter 7 - Communication Protocols .....34**
7.1 General.....34
7.2 DNP3.0 Profile.....34
7.3 IEC60870-5-101 / 104 Interoperability.....40
7.3.1 Network Configuration .....40
7.3.2 Link Layer .....40
7.3.3 Application Layer .....41
7.3.4 Basic Application Functions .....43
7.4 MODBUS Protocol .....46
7.4.1 Communication and devices.....46
7.4.2 Frame Format .....46
7.4.3 Supported Function Codes .....46
7.4.4 Implementations.....47
7.5 Hitachi HC4300 Protocol .....48
7.6 INDACTIC 2033 Protocol .....49
7.6.1 Network Configuration .....49
7.6.2 Telecommunications.....49
7.6.3 Commands .....49
7.6.4 Setpoints.....49
7.6.5 Change of State Indications.....50
7.6.6 Counters .....50
7.6.7 Measurands .....50
7.7 ABB SPA-Bus Protocol.....51
7.8 Other Protocols .....51



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**Chapter 8 - Installation & Connections .....52**
8.1 Overview .....52
8.2 Power Supply Source .....53
8.3 Ethernet Ports .....54
8.4 Serial Interface Ports .....54
8.4.1 Mode of Simple RS232 .....54
8.4.2 Mode of RS-232 + Flow Control .....55
8.4.3 Mode of RS-232 + Clock Signal .....55
8.4.4 Mode of RS-232 + Clock Signal + Flow Control .....56
8.4.5 Mode of RS-485 .....56



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# TABLE OF FIGURES

Figure 1-1: Veesta World Co Logo and sign....9
Figure 2-1: DCU Sequence Diagram....11
Figure 3-1: DCU Physycal Strcutre ....18
Figure 3-2: DCU Hardware Block Diagram....19
Figure 3-3: DCU Main Unit Diagram....20
Figure 3-4: DCU Any-to-Any Protocols....20
Figure 4-1: DCU Front Panel....21
Figure 4-2: DCU Rear Panel ....22
Figure 6-1: DCU Time System (VC-2DCUGT1 Module) View in action....30
Figure 8-1: DCU, Power Source, Connection Wiring....53
Figure 8-2: DCU, Ethernet Port, Connection Wiring ....54
Figure 8-3: DCU, Serial Port, RS232 Simple Connection Wiring....54
Figure 8-4: DCU, Serial Port, RS232+Flow Control Connection Wiring ....55
Figure 8-5: DCU, Serial Port, RS232+Clock Signals Connection Wiring....55
Figure 8-6: DCU, Serial Port, RS232+Clock+Flow Control Connection Wiring ....56
Figure 8-7: DCU, Serial Port, RS485 Connection Wiring....56

# INDEX OF TABELS

Table 2-1: DCU Training Syllabus....16
Table 7-1: DCU, DNP3.0 Device Profile Document....34
Table 7-2: DCU, DNP3.0 Interoperability Table....36



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# Chapter 1 - Introduction

## 1.1 General Information

This is user's manual of DCU product, the Data Communication Unit and GPS Clock source with various interface ports from Veesta World Company. This document helps you to find about how DCU works and designed for your purpose.

The Data Communication Unit of V-RTU2000 product act for large scale RTU system adopted for from very small data concentrator from that can be used in substation data gathering up to very large scale Data Concentrator Unit for large control centre and data conversion, protocol gateway, data router for operating centers.

## 1.2 Veesta World Co

Veesta World Co is a leading company in automation field in Iran and specialized in design and installation of IT Network of wide area and local area, Automation control units, control rooms, DCS design, PLC and SCADA application installation and system integration. The main advantage of Veesta World's products is complying international standards and do customs basic design.

Veesta World Co is a dynamic company located in the Tehran, IRAN, whose main commitment is the customer's satisfaction. Business vision and its future evolution together with the proper combination of new and existing technologies are the main aspects considered in the solutions proposed by Veesta World Co. Owing to this, key issues like Scalability, the Return of Investment or the Total Cost of Ownership are carefully considered. Consequently, the solutions offered by Veesta World Co are able to cope with the requirements of a sustainable growth. Veesta World Co is a service-oriented company and the customer perspective is its action guide. An added value of the offer is the evaluation and Management of the risk. This issue is getting a major relevance in the changing environment in which new technologies have to be applied, particularly when profitability is a major concern.

The objective of Veesta World Co is focused on the creation of value for the customer through the proper business strategy alignment and



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the right combination of technologies. These principles, developed under the Total Quality Management practice, allow Veesta World Co to offer, in a seamless approach, consultancy, engineering and training services.

The founders of Veesta World Co are professionals with a large experience in the Telecommunication and Networking and Industrial fields.

Veesta World Co is formed by a balanced team of professionals that gather knowledge in a wide range of technologies and specific know-how on how to apply these technologies in mission-critical control networks.

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*Figure 1-1: Veesta World Co Logo and sign*



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# Chapter 2 - System Overview

## 2.1 Overview

The DCU, Data Communication Unit (DCU) product is a communication system which is used to convey protocol signal information between power utility installations over the H.V. (400kv & 230kv & 132kv) Remote Terminal Unit systems and SCADA control centers,

DCU provides not only protocol conversion in the level of signal information but also have ability to maintain, design, routing, specific information and controls to/from various substations with various electrical protocols to various control centers with difference protocols.

The DCU provides following functions:

- **DCU as communication unit** forwards communication between I/O sub-racks commands to/from a particular Control Center for information by various protocols.
- **DCU as network switch** forwards commands to/from a particular RTU's substation for information by various protocols.
- **DCU as network router** has some intelligence regarding the grouping and de-grouping (splitting) of substations information and various protocols.
- **DCU as smart component** has specific intelligent functionality on behalf of smart RTU substations and intelligent grids.

## 2.2 Summary of Functions

The functional description of the data concentrator unit is placed between the Control Center (CC) and the Input/Output interfaces of Remote Terminal Units (RTU) and other DCU(s). The final objective is that the DCU will be interoperable, in both interfaces. The functional requirements of the DCU depend on the use case involved and may vary from very simple to very smart.

The generic sequence diagram of a site configuration with a DCU is described in bellow picture.


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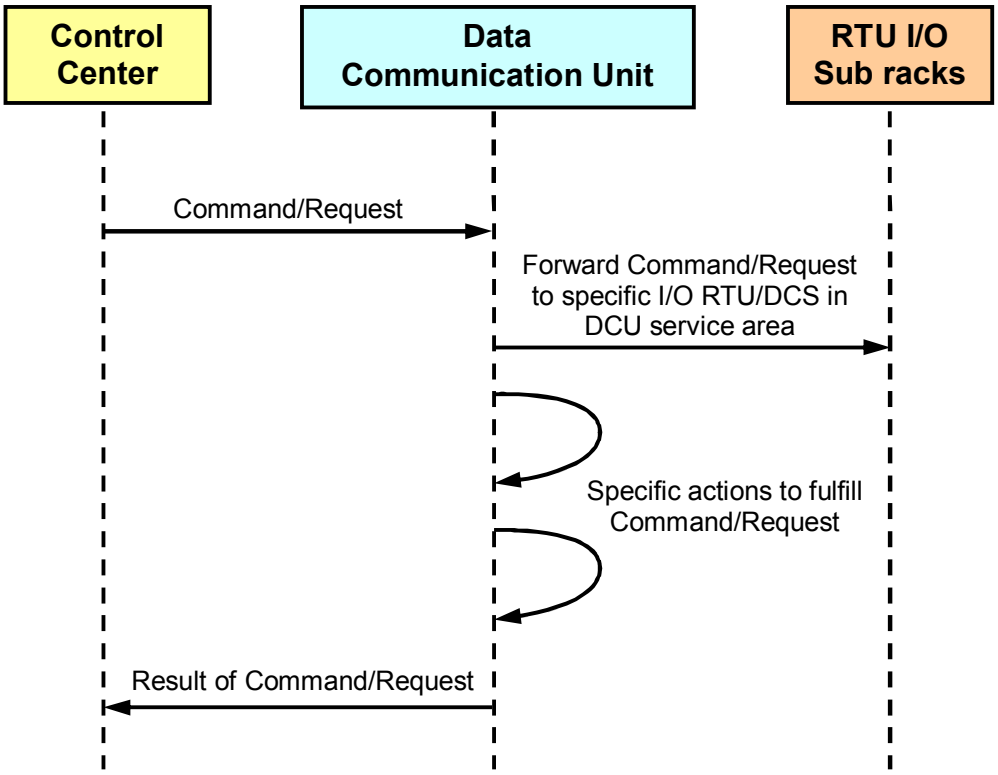


*Figure 2-1: DCU Sequence Diagram*

### 2.2.1 RTU reads

The DCU provides functionality to retrieve the pooling RTU reads for a specified period in selected communication protocol in the DCU database. The DCU is able to check if all required data is available after such a periodic RTU read.

Pooling RTU reads for RTUs or DCSs need to be available, according to protocol specification like Hitachi, IEC101, DNP3.0, etc. The DCU shall collect all RTU reads for analogue and digital information in the DCU database and then send all those information reads at once to the CC.

The DCU is able to address all RTUs in the DCU database and to retrieve for the mentioned period (to be specified as a parameter of protocols):

- Single Point Information
- Double Point Information Object
- Step Position Information Object
- Measured value Normalized/ Scaled/ Short floating/ Information Object
- Integrated Totals Information Object
- Sequence Of Event Object
- Quality Descriptors of Object
- Bit string of 32 bits Object



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### 2.2.2 CC commands

The process of CC commands therefore has two types of triggers: one for global or broadcast commands and one for specific addressed command; however, for each type of trigger, there are several possibilities.

The DCU provides functionality to forward a command request, which was sent by the CC, for a connected or disconnected of the RTUs to the concerning information Object like system and application commands in RTU in substations.

The DCU is able to address all RTUs in the DCU database and for the remote activation / deactivation for the mentioned commands (to be specified as a parameter of protocols):

- Single Command Object
- Double Command Object
- Regulating Step Command Object
- Set point normalized/ scaled value/ short floating Command Object
- Initialization process commands
- Integration Command Object
- Counter interrogation Command
- Read Command
- Test Command
- Clock synchronization Command
- Parameters and application Command

### 2.2.3 Synchronize time

DCU is able to verify that the internal clock of the RTU equipment is operating and set correctly, the CC has to be able to synchronies the time of the RTU equipment. In case a DCU is used, the CC has to be able to synchronies the time of the DCU and the DCU has to be able to synchronies the time of the RTU or DCS equipment.

### 2.2.4 Communication and system information

The DCU provides functionality to retrieve the communication and system status of internal of DCU Information from all of RTU channels in the DCU database.

The DCU is able to address all RTUs in the DCU database and to retrieve the outage Information. After data retrieval has been carried out, all required data is available.



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## 2.3 Summary of Data Functions

### 2.3.1 Data Acquisition Processing

DCU acquires digital and analog signal from remote station and stores it in DCU memory. On the other band, DCU accepts host command to reflect and transmit back the required data to control center.

#### 2.3.1.1 Analog Data Input

Measured Values, generally to receive signals from power transducers (Watt / Var / Voltage / Current / Temperature / Position / Resistance / etc), this is meant; DCU is to gather all physical signals of main facilities in remote station.

#### 2.3.1.2 Accumulated Data Input

Energy Counters, accumulation and processing of pulses from external energy measurement devices are supported.

#### 2.3.1.3 Digital Data Input

Indications, Status of facilities are acquired. Two basic indication types are supported: Single indication Double indication.

- **Single indication (1-Bit Status):** involve only a single monitored external point and hence, have only two states: 0 or 1.
- **Double Indication (2-Bit Status)**: involve the monitoring of two physical external points and hence, can provide four states: 0/0, 0/1, 1/0, 1/1.

#### 2.3.1.4 Sequence of Event Report

In order to monitor the status and sequence, changed of main equipments, DCU provides the SOE function (Sequence Of Event).

### 2.3.2 Control Output

Two types of control command can be transmitted from the Master Station to devices in the Power System via the DCU. One is Trip/Close command, the other is Direct Set-point command.


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#### 2.3.2.1 Trip/Close Command

There are two types of control output using Trip/Close command, one is ON/OFF operation output to control CBs, ABSs; the other is Regulation operation output (raise/lower) to control the position of transformer taps. Two distinct types of Trip/Close commands are supported:

- **Execute Immediate Command**: Direct Trip/Close Command, are executed as a single command message, and transmitted to the addressed RTU.
- **Select Before Operate (SBO) Command**: Select Trip/Close Command & Operate Command, are executed as two distinct commands to the addressed RTU; a select command followed by an execute command.

#### 2.3.2.2 Set-point Command

There are two types of control output using Direct Set-point command, one is Digital Direct Set-point, and the other is Analog Direct Set-point.

## 2.4 Hardware Structure

DCU hardware structure is designed as a Plug-In Type and set up in 19" Rack/Module enclosure with 1U height. The ideal plug-in type configuration provides a very useful structure in maintenance.

### 2.4.1 Power Supply Unit

The power supply of DCU contains four options the power supply type must be specified during purchase order:

- **Single Unit DC Power source** designed in DC 36V~75V input,
- **Single Unit AC Power source** designed in AC 110~280V input,
- **Dual Unit AC+AC Power source** designed in two AC source as redundant power supply source,
- **Dual Unit AC+DC Power source** designed in AC and DC power source as redundant power supply,

### 2.4.2 Main Unit

The main unit of DCU consists of 1 Backplane and 1 Master CPU module. It contains three slots to place some interface modules.

First slot only accept Ethernet modules and next two slots can be used for serial interface modules.



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### 2.4.3 Interface Modules

DCU provides various types of I/O interface card which coincidently to the requirement of station. In order to have modularity and monitor and study dynamic status of system operation and feature of facilities, interface cards are defined by functions for different system inputs as under description:

- **VC-2DCUNM1 Card**: Network Module, 1 Ethernet port.
- **VC-2DCUNM2 Card**: Network Module, 2 Ethernet ports.
- **VC-2DCUNM4 Card**: Network Module, 4 Ethernet ports,2 Fibers
- **VC-2DCU06S Card**: Sync-Serial Interface Module, 6 ports.
- **VC-2DCU12S Card**: Sync-Serial Interface Module, 12 ports.
- **VC-2DCU16A Card**: Async-Serial Interface Module, 16 ports.

### 2.4.4 GPS Time Module, VC-2DCUGT1 Card

The VC-2DCUGT1 Card is a synchronization reference clock which uses the GPS system (Global Positioning System) as time base by means of an internal GPS receptor or by means of an IRIG-B input. Several different signal types are supplied by the VC-2DCUGT1, making it possible to synchronize the most diverse types of equipment.

The DCU GPS satellite synchronized clock, is a processed equipment which is employed in the synchronization of equipment requiring a high degree of time accuracy. Through standardized or proprietary synchronism protocols and electric or optic outputs, the VC-2DCUGT1 synchronizes all equipment normally associated to power plants, transmission and distribution of electric energy.

The modularity and flexibility of DCU allows the VC-2DCUGT1 to be easily adjusted to comply with each application specific needs.



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## 2.5 DCU Series Hardware and Software Training

The training is disported into two stages one stage is include the principle of Substation before install the system which last 1~3 days.

The other stage is in the laboratory after installation and debugging of the products which last 1~2 days for workshop.

### 2.5.1 Curriculum Schedule Syllabus

| Training items | Times | Training contents | Personnel attended |
|---|---|---|---|
| Alternation layer part (I/O boards) collectivity introduce | Day 1 | System block diagrams<br>System configuration<br>Function of adopted devices | Run maintenance personnel<br>System development personnel |
| Function introduce of network and communication for Alternation layer part | Day 1 | Function introduce of network and communication for system introduce of CPU<br>introduce of inside network communication with attempter computer interface and communication with other IED | Run maintenance personnel<br>System development personnel |
| Introduce of every I/O boards and network for Alternation layer part | Day 1 | Introduce of hardware system use and maintenance of every I/O boards and terminal unit, principle and technical index of every I/O boards and terminal unit. | Run maintenance personnel<br><br>System development personnel |
| Assembly and wiring part | Day 2 | Advert problem of locale connection | Run maintenance personnel |
| Maintenance | Day 2 | Introduce of locale/remote maintenance software for Alternation layer part through use PC. | Run maintenance personnel |
| The problem of notice | Day 2 | Combine maintenance software, introduce of locale coefficient intercalate, and notice the problem of system running | Run maintenance personnel |
| Workshop | Day 3~4 | In the workshop practice all of training program | Run maintenance personnel<br>System development personnel |

*Table 2-1: DCU Training Syllabus*



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## 2.6 Standards

**1. Electromagnetic Compatibility (EMC)** :

1- IEC 61000-4-2: Electrostatic discharge 6 kV (contact), 8 kV (air)

2- IEC 61000-4-3: Radiated RF immunity 10 V/m

3- IEC 61000-4-4: Burst 1 kV IO, 2 kV Power port

4- IEC 61000-4-5: Surge 2 kV (common mode)

5- IEC 61000-4-8: Magnetic field immunity 100 A/m

6- IEC 61000-4-11: Voltage dips
30 % during 0.5s
60 % during 0.5s

7- IEC 60255-22-1: Burst 1 MHz
2.5 kV (common mode),
1.25 kV (differential mode)

**2. Safety Standards** :

8- IEC 664-1: Dielectric Test: 1 kV @ 1 min,
2 kV Impulse,
Insulation Resistance > 5Mohm @ 500 V.

**3. Environment Standards** :

9- IEC 60068-2-1: Cold -10°C, 16 hours, 1 cycle

10- IEC 60068-2-2: Dry heat +50°C, 16 hours, 1 cycle

11- IEC 60068-2-14: Change of Temperature, 25°C~+50°C, 9 hours, 2 cycles

12- IEC 60068-2-30: Damp heat +55°C, 95%, 12+12 hours, 1 cycle

**4. Mechanical Standards** :

13- IEC 60068-2-6: Vibration (sinusoidal) 0.035 mm, 0.5 g, 1 cycle on each axis

14- IEC 60255-21-1: 1 g, 20 cycles on each axis

15- IEC 60068-2-27: Shock 15 g, 11 ms, 3 pulses on each face

16- IEC 60255-21-2:



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# Chapter 3 - Design Structure

## 3.1 Overview

DCU hardware structure is designed as a Plug-In Type and set up in 19" Rack/Module enclosure with 1U height. The ideal plug-in type configuration provides a very useful structure in maintenance.

You can see in the Figure 3-1 the physical hardware structure design of the intelligent DCU device.

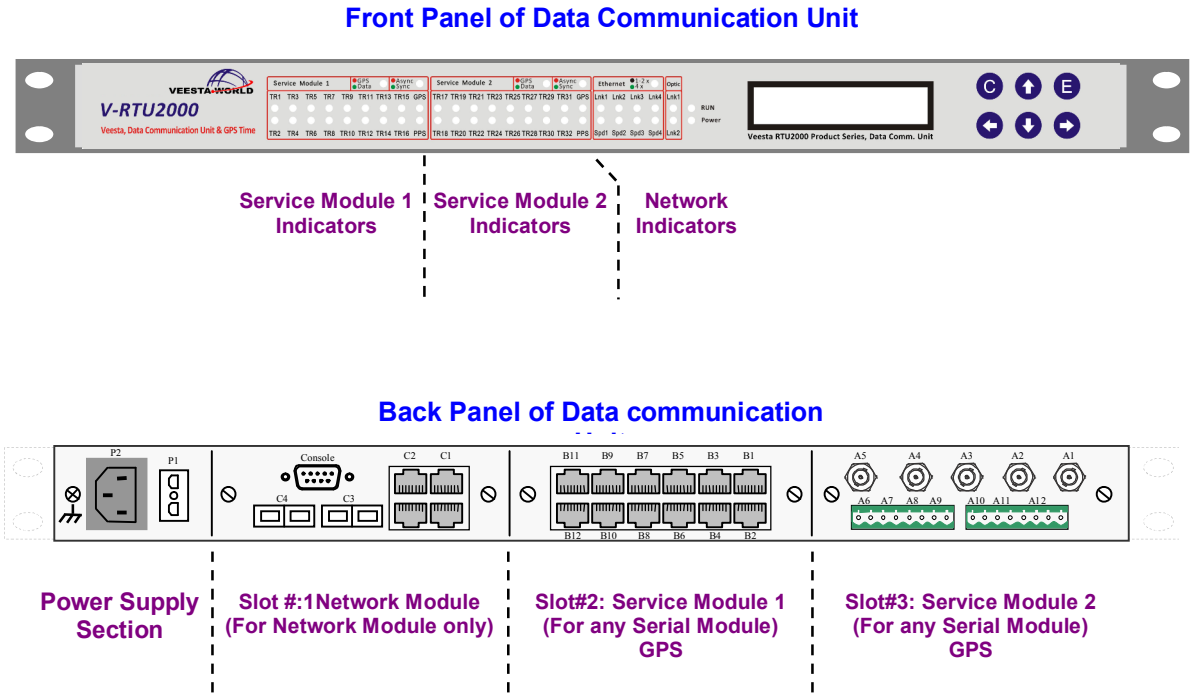


*Figure 3-1: DCU Physycal Strcutre*



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## 3.2 Hardware Block Diagram

You can see in the Figure 3-2 block diagram of internal hardware design.

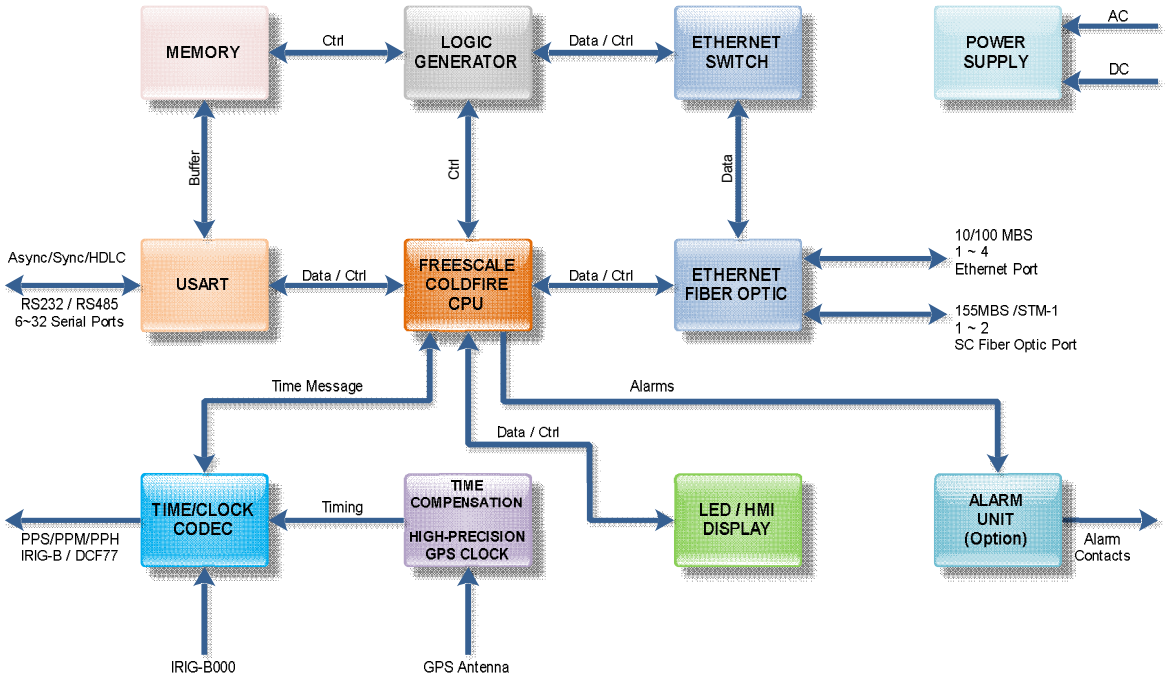


*Figure 3-2: DCU Hardware Block Diagram*



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## 3.3 Main Unit Design

The main unit of DCU consists of 1 Backplane and 1 Master CPU module. It contains three slots to place some interface modules.

First slot only accept Ethernet modules and next two slots can be used for serial interface modules.

In the Figure 3-3 you can see the main unit design the relation between CPU and network and service modules.

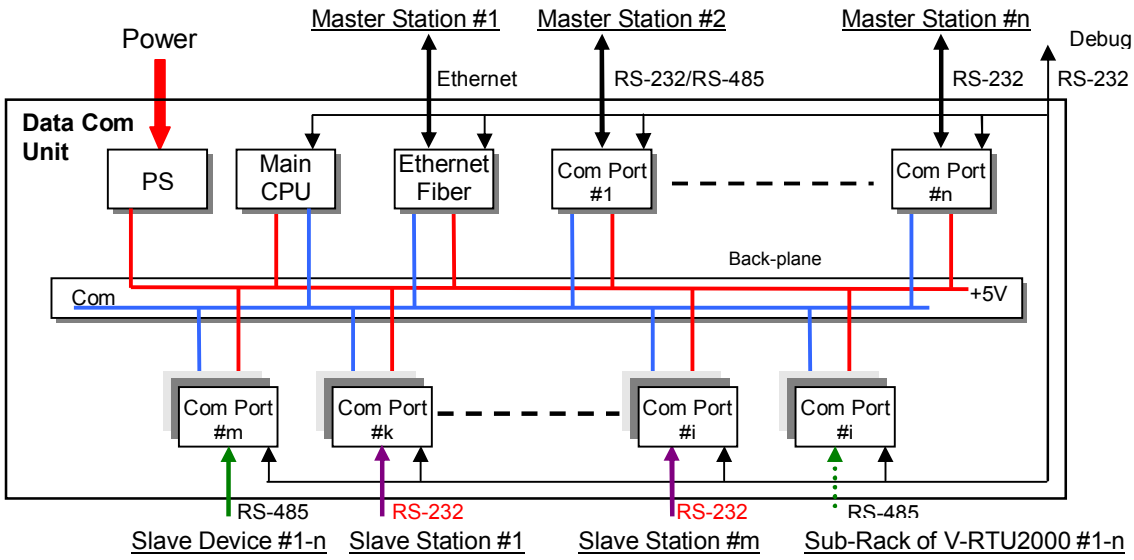


*Figure 3-3: DCU Main Unit Diagram*

Based on DCU device a portion of V-RTU2000 product series we can configure that to convert any protocol. It is intelligent device of protocol converter in form of any-to-any. DCU can support any serial device protocol as well as Ethernet device protocols and vice versa.

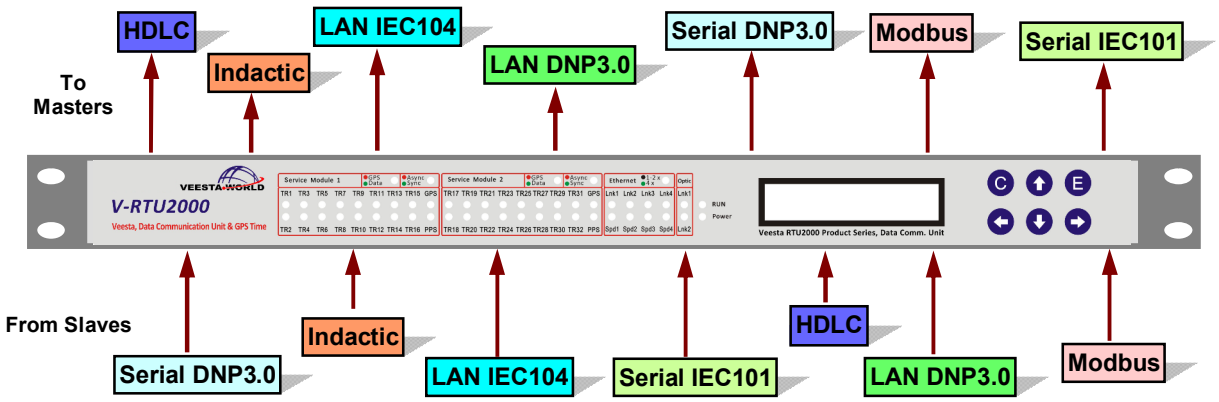


*Figure 3-4: DCU Any-to-Any Protocols*



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# Chapter 4 - Main Unit Specifications

## 4.1 General

In this chapter we describe about each main unit of DCU that based on purpose of usage you can select desired system configuration.

The DCU structure is a 19 inch rack mount device with a back panel wiring method. All of wiring of communication and power cords will be done via rear of DCU as well as replace and insertion of optional modules. By this design we have a good panel installation. We must to add in the front panel of DCU we have a display screen with LEDs indicator and LCD screen and also a 6 keys keypad.

## 4.2 Front Panel

As you can see in the figure bellow, the screen of front panel of DCU you can find some LEDs that describes about fast status of communication services. With RUN and POWER LED you can find operational status of device and based on each physical interface from LAN up to serial data we have a specific LEDs indicator.

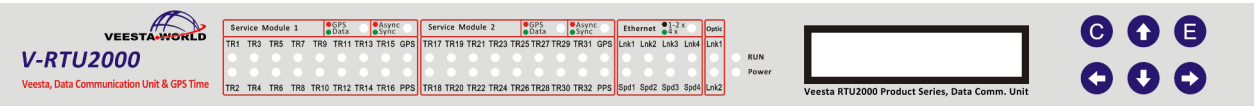


*Figure 4-1: DCU Front Panel*

### 4.2.1 LCD and Keypad

The LCD and Keypad of DCU in the front display the status and also let to configuration of high important items of device like Ethernet address and serial data mode and etc.

The very user friendly Keypad let to operator to navigate the overall status of communication unit as well as change items. For editing in the Setup menu need to have a Password.



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## 4.3 Rear Panel

In the rear panel of DCU, you can find power source connector or socket. Based on version of power supply in AC or DC or AC+DC case, the connector of that is a proper type.

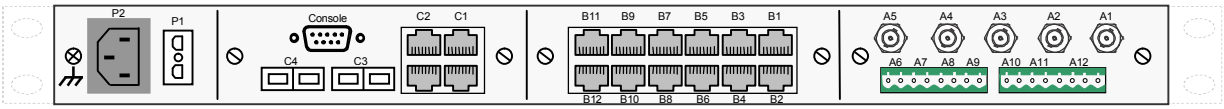


*Figure 4-2: DCU Rear Panel*

## 4.4 Interface Slots

In the rear panel you can find three slots for plugging communication interfaces. There are various communication interfaces that can be used in each slot.

It is reserved for the first slot of DCU a plugging card of Network module, or LAN cards. And next two slots can be universally used for various type of serial data communication.

Based on Interface used it consist of RJ45 connector to have fast wiring of communication links.

## 4.5 Central Processing Unit

Central processing unit of DCU consists of ARM based processor. The processor speed is 100MHz in 32 bit address.

Operating system of main unit is a real time UNIX machine as micro-C Linux operating.

Total RAM depend on overall point license in two types of 16 or 32MB. System has a boot loader in a CPU by default and 32MB EEPROM as Flash memory.

## 4.6 Software Configuration

DCU has a high technology CIM model, software configuration that manipulates the database of DCU.

By DCU software user can define, map, localize, convert, and set transmission and a lot of concentration function in a very user friendly and real error checking software.

Software configuration has a good facility to view and monitor real time data in each interface link and also able to log and show each communication data exchange.

For more information of software part please see document of “VC-2DCU Integrated Development Environment User’s Manual”.



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# Chapter 5 - Interface Specifications

## 5.1 General

In this chapter we describe about each interface module of DCU that based on purpose of usage you can select desired system configuration.

In a total view, there is two type of module, one is Ethernet interface and another is serial interfaces. In the view of system capacity the DCU can support up to 4 physical Ethernet ports and up to 32 physical serial interfaces. Each module has specific feature that normally can be used in specific application.

## 5.2 NETWORK Card

The term of NETWORK card is related to the Ethernet or Fiber Optic device connection of DCU. There are some modular cards that we call them network modules.

### 5.2.1 VC-2DCUNM2 Specifications

1. **Type of Module** : Plug-in module in Slot1 of main unit
2. **Ethernet Port** : 2 RJ45 Base-T Ethernet port
3. **Ethernet Speed** : 10/100M auto negotiate
4. **LAN Protocols** : SNMP, TCP/IP, Telnet protocol
5. **Application Protocols** : Based on license available for all application protocols like IEC60870-5-104, DNP3.0 over TCP, ModBus TCP and etc.


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### 5.2.2 VC-2DCUNM4 Specifications

1. **Type of Module** : Plug-in module in Slot1 of main unit
2. **Ethernet Port** : 4 RJ45 Base-T Ethernet port
3. **Ethernet Speed** : 10/100M auto negotiate
4. **LAN Protocols** : SNMP, TCP/IP, Telnet protocol
5. **Fiber Optic Port** : 2 Ports SC duplex connector
6. **Fiber Optic Compliant** : Compliant with 155 Mbps ATM and SONET OC-3 SDH STM-1 (S1.1)
7. **Fiber Optic Laser** : Class 1 laser product complies with EN 60825-1
8. **Fiber Optic Specifications** : 1310 nm, Single Mode Transceiver (S1.1, 19dB margin)
9. **Fiber Optic Sensitivity** : -34 dBm
10. **Fiber Optic Output Power** : -8 dBm
11. **Application Protocols** : Based on license available for all application protocols like IEC60870-5-104, DNP3.0 over TCP, ModBus TCP and etc.


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## 5.3 SERIAL Card

The term of SERIAL card is related to the Serial device connection of DCU. There are some modular cards that we call them serial card service modules. Serial interface service modules are in three types:

- **VC-2DCU06S Card**: Sync-Serial Interface Module, 6 ports.
- **VC-2DCU12S Card**: Sync-Serial Interface Module, 12 ports.
- **VC-2DCU16A Card**: Async-Serial Interface Module, 16 ports.

### 5.3.1 VC-2DCU06S Specifications

1. **Type of Module** : Plug-in module in Slot2 or Slot3 of main unit

2. **Number of Serial Ports** : 6 serial ports

3. **Serial Port Standards** : Software configurable, RS232 or RS485 for each port per module

4. **Serial Port Speed** : Software configurable per port 300/600/1200/2400/4800/9600/19200/38400/57600 bps

5. **Serial Protocols Mode** : Software configurable per port Asynchronous, Synchronous, SDLC, BiSync mode.

6. **Signal Configurations** : In Async RS232:
   TXD/RXD/GND/RTS/CTS signals ready
   In Async RS485:
   TX/RX/GND signals ready
   In Sync RS232:
   TXD/RXD/GND/RTS/CTS/TXC/RXC signals ready
   In Bisync RS232:
   TXD/RXD/GNS/RTS/CTS signals ready

7. **Hardware Handshaking** : Software Configurable, RTS/CTS

8. **Application Protocols** : Based on license, it is available for all application protocols like IEC60870-5-101, DNP3.0, ModBus, Hitachi, SPA-Bus, and other master or slave protocols.


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### 5.3.2 VC-2DCU12S Specifications

1. **Type of Module** : Plug-in module in Slot2 or Slot3 of main unit

2. **Number of Serial Ports** : 12 serial ports

3. **Serial Port Standards** : Software configurable, RS232 or RS485 for each port per module

4. **Serial Port Speed** : Software configurable per port 300/600/1200/2400/4800/9600/19200/38400/57600 bps

5. **Serial Protocols Mode** : Software configurable per port Asynchronous, Synchronous, SDLC, BiSync mode.

6. **Signal Configurations** : In Async RS232:
   TXD/RXD/GND/RTS/CTS signals ready
   In Async RS485:
   TX/RX/GND signals ready
   In Sync RS232:
   TXD/RXD/GND/RTS/CTS/TXC/RXC signals ready
   In Bisync RS232:
   TXD/RXD/GNS/RTS/CTS signals ready

7. **Hardware Handshaking** : Software Configurable, RTS/CTS

8. **Application Protocols** : Based on license, it is available for all application protocols like IEC60870-5-101, DNP3.0, ModBus, Hitachi, SPA-Bus, and other master or slave protocols.


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### 5.3.3 VC-2DCU16A Specifications

1. **Type of Module** : Plug-in module in Slot2 or Slot3 of main unit

2. **Number of Serial Ports** : 16 serial ports

3. **Serial Port Standards** : Software configurable, RS232 or RS485 for each port per module

4. **Serial Port Speed** : Software configurable per port 300/600/1200/2400/4800/9600/19200/38400/57600 bps

5. **Serial Protocols Mode** : It is only in Asynchronous mode.

6. **Signal Configurations** : In Async RS232:
   TXD/RXD/GND signals ready
   In Async RS485:
   TX/RX/GND signals ready

7. **Application Protocols** : Based on license, it is available for all application protocols like IEC60870-5-101, DNP3.0, ModBus, SPA-Bus and other master or slave protocols that can be run in Asynchronous data mode.


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## 5.4 Modem Card

Modem Card is designed in with an intelligent modem which is of intelligent modem unit. Performing in the DCU system, this serves as the intermediate interface between system and Host Computer or RTU system.

The Modem card that normally used with DCU is a modem card from V-RTU2000 product series from Veesta World Company. The specification of modem card is here for reference.

Modem card is in two versions of Data Modem VR-2424 model that is compatible standard SCADA modem and VR-2444 model that is Voice+Data SCADA modem.

### 5.4.1 VR-2424 Data Modem Specifications

1. **Microprocessor** : XA-G49, 24.576MHz
2. **Memory** : 64KB Flash, 2KB SRAM
   (Microprocessor included)
3. **Data Rate** : 1200 / 2400 / 9600 BPS
4. **Operation Mode** : Half or Full Duplex
   V.23, V.22bis, V.29, Bell 202
   2 or 4-Wire Lease Line
5. **Operating Format** : Asynchronous, Binary, Serial
6. **Transmitter Output Level** : Adjustable 0 dBm to -30 dBm in 2dB Steps ( 600 ohm )
7. **Receiver Input Level** : Adjustable 0 dBm to -42 dBm in 6dB Steps
8. **Digital Interface** : RS-232C
   9600 BPS for Protocol Mode
   1200, 2400, 9600 BPS for Modem Mode
9. **Isolation**
   **- Input to Phone Line** : DC 1800V
   **- Line to Line (TX to RX)** : AC 1500V


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### 5.4.2 VR-2444 Voice & Data Modem Specifications

| | | |
|---|---|---|
| **1.** | **Modem Module** | : VR-2444, plug-in Module card<br>VR-2444B, external box with 48VDC power supply |
| **2.** | **Microprocessor** | : 8051 Intel |
| **3.** | **Memory** | : 64KB Flash, 2KB SRAM<br>（Microprocessor included) |
| **4.** | **Data Rate** | : 300 / 600 BPS |
| **5.** | **Operation Mode** | : Half or Full Duplex<br>FSK Mode, Center frequency 2760 ±240 Hz<br>4-Wire Lease Line<br>600 Ω Line Impedance |
| **6.** | **Operating Format** | : Asynchronous, Binary, Serial |
| **7.** | **Transmitter Output Level** | : Adjustable 0 dBm to -20 dBm Adjustable |
| **8.** | **Digital Interface** | : RS-232C,<br>TXD/RXD/GND signals |
| **9.** | **Isolation** | |
| | **- Input to Phone Line** | : DC 1800V |
| | **- Line to Line (TX to RX)** | : AC 1500V |
| **10.** | **Voice Module Feature** | : 10 ~ 2000 Hz Line filter and mixer<br>Adjustable voice level in mixer separately<br>600 Ω Line Impedance<br>4x Wire, TX & RX voice channel output<br>Compatible with most of old modem, like Hitachi voice and data modem |


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# Chapter 6 - Time Module Specifications

## 6.1 General

The DCU device has a special module named as **VC-2DCUGT1** module. Using DCU with VC-2DCUGT1 time module made a device that is a high capacity flexible timing system designed for use in any application where reliable time information is essential. It is ideal where synchronization of many different output interfaces is required. VC-2DCUGT1 is a “Stratum 1” (Master) standard synchronizing clock by using highly stable constant temperature crystal oscillator to keep it’s time. The time sources come from GPS (UTC) and IRIG-B time code. GPS is of first priority and IRIG-B takes over during the GPS signal is missing. VC-2DCUGT1 provides all popular high time codes of high precision for IEDs, automation device, protection relays, as well as fault & event recorder, also it provides high-precision IRIG-B signal for those secondary time clock.

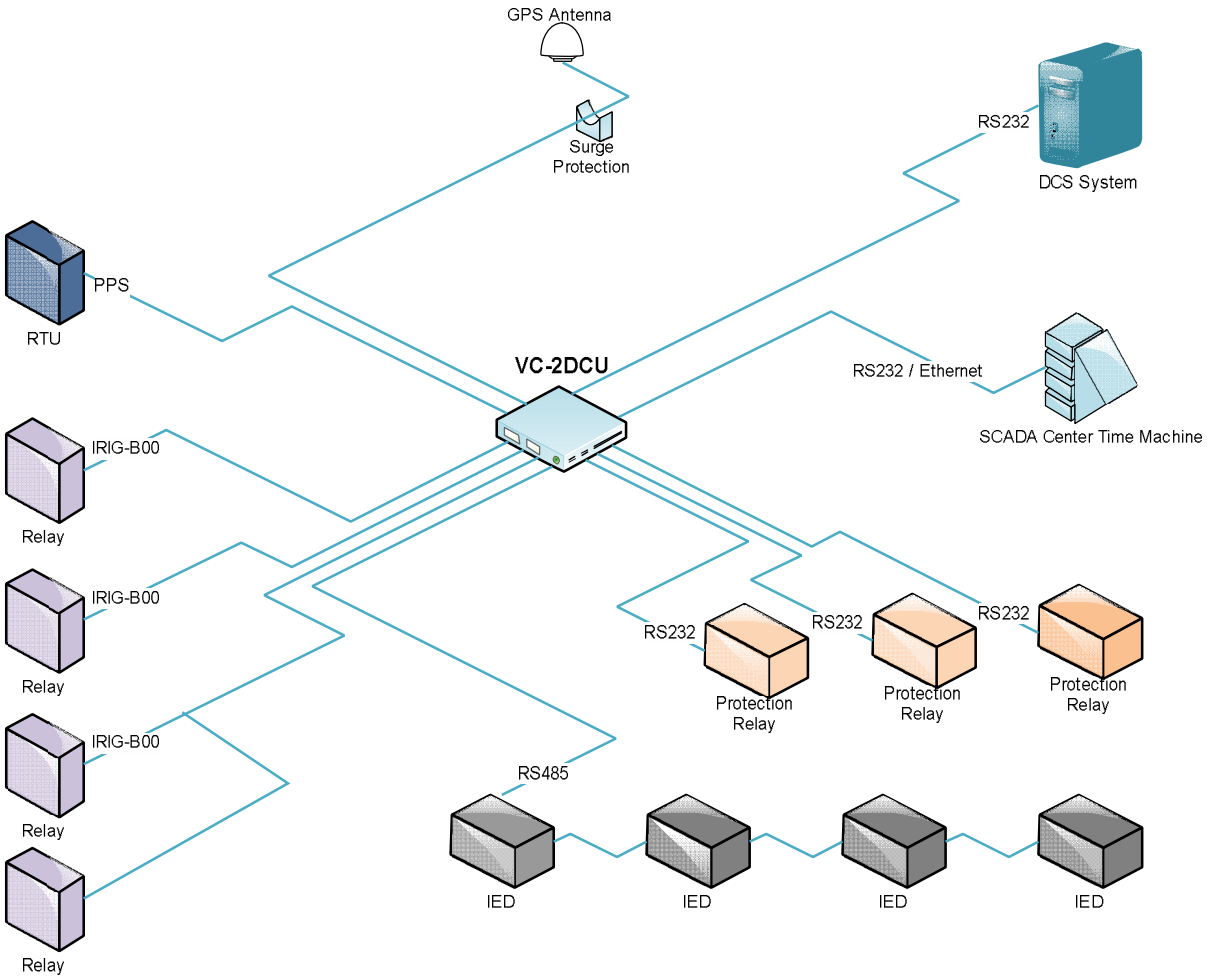


*Figure 6-1: DCU Time System (VC-2DCUGT1 Module) View in action*



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## 6.2 Specification

The specification of VC-2DCUGT1 listed as bellow:

### 6.2.1 Time Module General Characteristics

1. **Time Interfaces** : Time Signal Protocols:
   1) IRIG-B output TTL, RS232, RS485 level
   2) IRIG-B input TTL, RS232, RS485 level
   3) Time Message Output, NMEA, RS232 or RS485 serial port with bit rates 1200, 2400, 4800, 9600, 19200 and 38400 bps software selectable
   4) Ethernet port according to NTP

2. **GPS Input** : Receiving frequency: 1575.42MHZ
   C/A code (1.023MHz chip rate)
   Number of Channels: 12
   Connector Type: BNC
   GPS antenna feed line length: 10 ~ 180 m

3. **GPS Input Sensitivity** : Antenna radio frequency: Better than -166 dbw
   Tracking: Better than -141 dbm
   Acquisition: Better than -136 dbm

4. **GPS Acquisition Time** : Hot Start: ≤ 20s
   Warm Start: ≤ 40s
   Cold Start: ≤ 50s

5. **GPS Time Keeping** : Priority 1: Input via GPS signal
   Priority 2: Input via IRIG-B000 TTL Level
   Priority 3: Built in Crystal Oscillator
   (Accuracy < $1x10^{-8}$s)

### 6.2.2 Time Interface Specifications

1. **IRIG-B Outputs** : Number of Ports: 3 x
   TTL Level: Connector BNC3
   RS232 Level: Terminal B 1-2
   RS485 Level: Terminal B 3-4

2. **Pulse Outputs** : Number of Ports: 2 x
   Connector: BNC1, BNC2
   Protocols: PPS / PPH / PPM
   Output Level: TTL


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3. **Serial Outputs** : Number of Ports: 4 x
Connector: 8 pin terminal strip
Protocols: NMEA 0183
Baud Rate: 1200/2400/4800/9600/19200/38400 bps
RS232 Level : Terminal A 1-2 & A 5-6
RS485/RS422 Level : Terminal A 3-4 & A 7-8

4. **Ethernet Outputs** : Number of Ports: 1-4 (based on network module used)
Connector: RJ45
Protocols: NTP, SNTP

5. **IRIG-B Inputs** : Number of Ports: 3 x
TTL Level: Connector BNC4
RS232 Level: Terminal B 5-6
RS485 Level: Terminal B 7-8

6. **GPS Input** : GPS Antenna Input
Connector: BNC5
Antenna Cable : 30 meters with fixing accessories

7. **Timing Accuracy** : A) Demodulated IRIG-B000: <1µs to UTC
B) Pulse Output(TTL): ≤0.3µs to UTC
C) Serial Protocol (NMEA 0813): <200µs to UTC

### 6.2.3 Antenna Specifications

1. **Overall Specification** : Center Frequency: 1575.42 MHz
Gain: 27 dB typically
Noise Figure: 2.0 max
Band Width: 2 MHz min.
Axial Ratio: 3 dB max.
VSWR: 1.5 max
Output Impedance: 50Ω

2. **GPS Antenna Element** : Center Frequency: 1575.42 MHz, ±1.023 MHz
Polarization: RHCP (Right Hand Circular Polarization)
Absolute Gain at Zenith: +5 dBi typically
Gain at $10^{o}$ Elevation: -1 dBi typically
Axial Ratio: 3 dB max.
Output VSWR: 1.5 max
Output Impedance: 50Ω


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**3. Antenna Amplifier** :
Center Frequency: 1575.42 MHz, ±1.023 MHz
Power Gain: 30 dB typical
Band Width: 2 MHz min.
Noise Figure: 1.5 max
Filtering: -20 dB min. @ Fo ±50 MHz
Supply Voltage: 4.0~6.0V DC
Current Consumption: 28mA, ±3mA
VSWR: 1.5 max
Output Impedance: 50Ω

**4. Antenna Mechanical** :
Weight (without cable): 220g
Size: 4.5" X 2.9"
Cable Type: RG8/U (Other type by order).
Cable Length: 30m (Other lengths available)
Connector Options: BNC
Mounting: Thread permanent mount

**5. Antenna Environment** :
Working Temperature: -40°C ~ +85°C
Storage Temperature: -50°C ~ +90°C
Humidity: 95% ~ 100% RH
Water Proof: 100%

**6. Lighting Surge Protector** :

**( It is Optional product must be ordered separately)**

*A) Electrical data*
IEC category / EN type: C2 / C3 / D1
Highest continuous voltage $U_C$: 280 VDC/195 VAC
Nominal current $I_N$: 5 A (25°C)
Nominal discharge surge current $I_n$ (8/20) µs:
Core-shield/Core-ground: 20 kA / 20 kA
Total surge current (8/20)µs: 20 kA 10 kA
Output voltage limitation at 1 kV/µs:
Core-shield/Core-ground: ≤ 700 V / ≤ 700 V
Cut-off frequency fg (3dB) In a 50Ω system:
Symmetrical / Asymmetrical - / > 3 GHz

*B) General data*
Temperature range: -40°C ... 80°C
Degree of protection: IP55
Connection method: BNC connector 50 Ω



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# Chapter 7 - Communication Protocols

## 7.1 General

In DCU system, we have a wide range of communication protocols, like DNP3.0, IEC 870-5-101, IEC 870-5-104, ModBus RTU, ABB SPA-Bus and etc.

In this chapter you will find protocol definition and profile document of each protocols. For more information please refer to the Software Configuration program user's manual of DCU system.

## 7.2 DNP3.0 Profile

In the table bellow you can find DNP3.0 Profile of DCU product series.

*Table 7-1: DCU, DNP3.0 Device Profile Document*

| **DNP 3.0**<br>**DEVICE PROFILE DOCUMENT** | |
|---|---|
| Vendor Name : ***Veesta World Company*** | |
| Device Name : ***VC-2DCU*** (Veesta Data Concentrator Unit) | |
| Highest DNP Level Supported :<br>For Requests : Level 3<br>For Responses :Level 3 | Device Function :<br>☒ Master ☒ Slave |
| Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table) : | |
| Maximum Data Link Frame Size (octets) :<br>Transmitted : 292<br>Received : 292 | Maximum Application Fragment Size (octets):<br>Transmitted : 2048<br>Received : 2048 |
| Maximum Data Link Re-tries :<br>☐ None<br>☐ Fixed<br>☒ Configurable, range 0 to 10 | Maximum Application Layer Re-tries :<br>☒ None<br>☐ Configurable |
| Required Data Link Layer Confirmation :<br>☐ Never<br>☐ Always<br>☐ Sometimes<br>☒ Configurable (never or always or sometimes) | |



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**DNP 3.0**
**DEVICE PROFILE DOCUMENT**

Vendor Name : ***Veesta World Company***

Device Name : ***VC-2DCU*** (Veesta Data Concentrator Unit)

Required Application Layer Confirmation :

- ☐ Never
- ☐ Always
- ☒ When reporting Event Data
- ☐ When sending multi-fragment responses
- ☐ Sometimes
- ☐ Configurable

Timeouts while waiting for :

| | | | | |
|---|---|---|---|---|
| Data Link Confirm | ☒ None | ☐ Fixed | ☐ Variable | ☐ Configurable |
| Complete Appl. Fragment | ☒ None | ☐ Fixed | ☐ Variable | ☐ Configurable |
| Application Confirm | ☐ None | ☒ Fixed (2S) | ☐ Variable | ☐ Configurable |
| Complete Appl. Response | ☒ None | ☐ Fixed | ☐ Variable | ☐ Configurable |

Others : (None)

Sends / Executes Control Operations :

| | | | | |
|---|---|---|---|---|
| WRITE Binary Outputs | ☒ Never | ☐ Always | ☐ Sometimes | ☐ Configurable |
| SELECT / OPERATE | ☐ Never | ☒ Always | ☐ Sometimes | ☐ Configurable |
| DIRECT OPERATE | ☐ Never | ☒ Always | ☐ Sometimes | ☐ Configurable |
| DIRECT OPERATE (NO ACK) | ☐ Never | ☒ Always | ☐ Sometimes | ☐ Configurable |
| COUNT > 1 | ☒ Never | ☐ Always | ☐ Sometimes | ☐ Configurable |
| Pulse On | ☐ Never | ☐ Always | ☒ Sometimes | ☐ Configurable |
| Pulse Off | ☒ Never | ☐ Always | ☐ Sometimes | ☐ Configurable |
| Latch On | ☐ Never | ☐ Always | ☒ Sometimes | ☐ Configurable |
| Latch Off | ☐ Never | ☐ Always | ☒ Sometimes | ☐ Configurable |
| Queue | ☒ Never | ☐ Always | ☐ Sometimes | ☐ Configurable |
| Clear Queue | ☒ Never | ☐ Always | ☐ Sometimes | ☐ Configurable |
| Trip / Close | ☐ Never | ☐ Always | ☒ Sometimes | ☐ Configurable |

Reports Binary Input Change Events when no specific variations requested :

- ☐ Never
- ☐ Only time-tagged
- ☐ Only non-time-tagged
- ☒ Configurable to send one or the other

Reports time-tagged Binary Input Change Events when no specific variation requested:

- ☐ Never
- ☐ Binary Input Change With Time
- ☐ Binary Input Change With Relative Time
- ☒ Configurable

Sends Unsolicited Responses :

- ☐ Never
- ☐ Configurable
- ☐ Only certain objects
- ☐ Sometimes
- ☒ ENABLE/DISABLE UNSOLICITED Function codes supported

Sends Static Data in Unsolicited Responses :

- ☒ Never
- ☐ When Device Restarts
- ☐ When Status Flags Change



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| **DNP 3.0**<br>**DEVICE PROFILE DOCUMENT** | |
|---|---|
| Vendor Name : ***Veesta World Company*** | |
| Device Name : ***VC-2DCU*** (Veesta Data Concentrator Unit) | |
| Default Counter Object / Variation :<br>☐ No Counters Reported<br>☒ Configurable<br>☐ Default Object ___Default Variation _<br>☐ Point-by-point list attached | Counters Roll Over at :<br>☐ No Counters Reported<br>☐ Configurable<br>☐ 16 Bits<br>☒ 32 Bits<br>☐ Other Value ___<br>☐ Point-by-point list attached |
| Sends Multi-Fragment Responses : ☐ Yes ☒ No | |

*Table 7-2: DCU, DNP3.0 Interoperability Table*

| DCU INTEROPERABILITY TABLE | | | | | | |
|---|---|---|---|---|---|---|
| OBJECT | | | REQUEST | | RESPONSE | |
| **Obj** | **Var** | **Description** | **Func Codes (dec)** | **Qual Codes (hex)** | **Func Codes (dec)** | **Qual Codes (hex)** |
| 1 | 0 | Binary Input – All Variations | 1, 22 | 00,01,06 | | |
| 1 | 1 | Binary Input | 1 | 00,01,06 | 129,130 | 00,01 |
| 1 | 2 | Binary Input with Status | 1 | 00,01,06 | 129,130 | 00,01 |
| 2 | 0 | Binary Input Change – All Variations | 1 | 06,07,08 | | |
| 2 | 1 | Binary Input Change without Time | 1 | 06,07,08 | 129,130 | 17,28 |
| 2 | 2 | Binary Input Change with Time | 1 | 06,07,08 | 129,130 | 17,28 |
| 2 | 3 | Binary Input Change with Relative Time | 1 | 06,07,08 | 129,130 | 17,28 |
| 10 | 0 | Binary Output – All Variations | 1 | 00,01,06 | | |
| 10 | 2 | Binary Output Status | 1 | 00,01,06 | 129,130 | 00,01 |
| 12 | 1 | Control Relay Output Block | 3, 4, 5, 6 | 17,28 | 129 | echo of request |
| 12 | 2 | Pattern Control Block | 5, 6 | 17,28 | 129 | echo of request |
| 12 | 3 | Pattern Mask | 5, 6 | 00,01 | 129 | echo of request |



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| DCU INTEROPERABILITY TABLE | | | | | | |
|---|---|---|---|---|---|---|
| OBJECT | | | REQUEST | | RESPONSE | |
| Obj | Var | Description | Func Codes (dec) | Qual Codes (hex) | Func Codes (dec) | Qual Codes (hex) |
| 20 | 0 | Binary Counter – All Variations | 1, 7, 8, 9 10, 22 | 00,01,06 | | |
| 20 | 1 | 32-Bit Binary Counter | 1 | 00,01,06 | 129,130 | 00,01 |
| 20 | 2 | 16-Bit Binary Counter | 1 | 00,01,06 | 129,130 | 00,01 |
| 20 | 3 | 32-Bit Delta Counter | 1 | 00,01,06 | 129,130 | 00,01 |
| 20 | 4 | 16-Bit Delta Counter | 1 | 00,01,06 | 129,130 | 00,01 |
| 20 | 5 | 32-Bit Binary Counter without Flag | 1 | 00,01,06 | 129,130 | 00,01 |
| 20 | 6 | 16-Bit Binary Counter without Flag | 1 | 00,01,06 | 129,130 | 00,01 |
| 20 | 7 | 32-Bit Delta Counter without Flag | 1 | 00,01,06 | 129,130 | 00,01 |
| 20 | 8 | 16-Bit Delta Counter without Flag | 1 | 00,01,06 | 129,130 | 00,01 |
| 21 | 0 | Frozen Counter – All Variations | 1, 22 | 00,01,06 | | |
| 21 | 1 | 32-Bit Frozen Counter | 1 | 00,01,06 | 129,130 | 00,01 |
| 21 | 2 | 16-Bit Frozen Counter | 1 | 00,01,06 | 129,130 | 00,01 |
| 21 | 3 | 32-Bit Frozen Delta Counter | 1 | 00,01,06 | 129,130 | 00,01 |
| 21 | 4 | 16-Bit Frozen Delta Counter | 1 | 00,01,06 | 129,130 | 00,01 |
| 21 | 9 | 32-Bit Frozen Counter without Flag | 1 | 00,01,06 | 129,130 | 00,01 |
| 21 | 10 | 16-Bit Frozen Counter without Flag | 1 | 00,01,06 | 129,130 | 00,01 |
| 22 | 0 | Counter Change Event – All Variations | 1 | 06,07,08 | | |
| 22 | 1 | 32-Bit Counter Change Event without Time | 1 | 06,07,08 | 129,130 | 17,28 |
| 22 | 2 | 16-Bit Counter Change Event without Time | 1 | 06,07,08 | 129,130 | 17,28 |
| 22 | 3 | 32-Bit Delta Counter Change Event without Time | 1 | 06,07,08 | 129,130 | 17,28 |
| 22 | 4 | 16-Bit Delta Counter Change Event without Time | 1 | 06,07,08 | 129,130 | 17,28 |


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| DCU INTEROPERABILITY TABLE | | | | | | |
|---|---|---|---|---|---|---|
| OBJECT | | | REQUEST | | RESPONSE | |
| Obj | Var | Description | Func Codes (dec) | Qual Codes (hex) | Func Codes (dec) | Qual Codes (hex) |
| 23 | 0 | Frozen Counter Event – All Variations | 1 | 06,07,08 | | |
| 23 | 1 | 32-Bit Frozen Counter Event without Time | 1 | 06,07,08 | 129,130 | 17,28 |
| 23 | 2 | 16-Bit Frozen Counter Event without Time | 1 | 06,07,08 | 129,130 | 17,28 |
| 23 | 3 | 32-Bit Frozen Delta Counter Event without Time | 1 | 06,07,08 | 129,130 | 17,28 |
| 22 | 4 | 16-Bit Frozen Delta Counter Event without Time | 1 | 06,07,08 | 129,130 | 17,28 |
| 30 | 0 | Analog Input – All Variations | 1, 22 | 00,01,06 | | |
| 30 | 1 | 32-Bit Analog Input | 1 | 00,01,06 | 129,130 | 00,01 |
| 30 | 2 | 16-Bit Analog Input | 1 | 00,01,06 | 129,130 | 00,01 |
| 30 | 3 | 32-Bit Analog Input without Flag | 1 | 00,01,06 | 129,130 | 00,01 |
| 30 | 4 | 16-Bit Analog Input without Flag | 1 | 00,01,06 | 129,130 | 00,01 |
| 32 | 0 | Analog Change Event – All Variations | 1 | 06,07,08 | | |
| 32 | 1 | 32-Bit Analog Change Event without Time | 1 | 06,07,08 | 129,130 | 17,28 |
| 32 | 2 | 16-Bit Analog Change Event without Time | 1 | 06,07,08 | 129,130 | 17,28 |
| 40 | 0 | Analog Output – All Variations | 1,22 | 00,01,06 | | |
| 40 | 1 | 32-Bit Analog Output Status | 1 | 00,01,06 | 129,130 | 00,01 |
| 40 | 2 | 16-Bit Analog Output Status | 1 | 00,01,06 | 129,130 | 00,01 |
| 41 | 1 | 32-Bit Analog Output Block | 3, 4, 5, 6 | 17,28 | 129 | echo of request |
| 41 | 2 | 16-Bit Analog Output Block | 3, 4, 5, 6 | 17,28 | 129 | echo of request |
| 50 | 1 | Time and Date | 1 | 07 | 129 | 07 |
| | | | 2 | 07 | | |
| 51 | 1 | Time and Date CTO | | | 129, 130 | 07 quantity=1 |
| 51 | 2 | Unsynchronized Time and Date CTO | | | 129, 130 | 07 quantity=1 |


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| DCU INTEROPERABILITY TABLE | | | | | | |
|---|---|---|---|---|---|---|
| OBJECT | | | REQUEST | | RESPONSE | |
| Obj | Var | Description | Func Codes (dec) | Qual Codes (hex) | Func Codes (dec) | Qual Codes (hex) |
| 52 | 1 | Time Delay Coarse | | | 129 | 07 quantity=1 |
| 52 | 2 | Time Delay Fine | | | 129 | 07 quantity=1 |
| 60 | 1 | Class 0 | 1 | 06 | | |
| | | | 20,21,22 | 06 | | |
| 60 | 2 | Class 1 | 1 | 06,07,08 | | |
| | | | 20,21,22 | 06 | | |
| 60 | 3 | Class 2 | 1 | 06,07,08 | | |
| | | | 20,21,22 | 06 | | |
| 60 | 4 | Class 3 | 1 | 06,07,08 | | |
| | | | 20,21,22 | 06 | | |
| 80 | 1 | Internal Indications | 1 | 00,01 | 129 | 00,01 |
| | | | 2 | 00 | | |
| | | | 2 | 00 | | |
| No Object | | | 13 | | | |
| No Object | | | 23 | | | |
| No Object | | | 0 | | 0 | |



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## 7.3 IEC60870-5-101 / 104 Interoperability

This companion standard presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Certain parameter values, such as the number of octets in the COMMON ADDRESS of ASDUs represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information in command and in monitor direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

The selected parameters should be crossed in the white boxes (simply replace "☐" with "☒").

NOTE: In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

### 7.3.1 Network Configuration

Network-specific parameter

| | |
|---|---|
| ☒ Point-to-point | ☒ Multipoint-party line |
| ☒ Multiple point-to-point | ☒ Multipoint-star |

### 7.3.2 Link Layer

Network-specific parameter

Frame format FT1.2, single character 1 and the fixed time out interval are used exclusively in this companion standard.

| Link transmission procedure | Address field of link |
|---|---|
| ☒ Balanced transmission | ☐ Not present (balanced transmission only) |
| ☒ Unbalanced transmission | ☒ One octet |
| | ☒ Two octets |
| | ☒ Structured |
| | ☐ Unstructured |

Frame length 255 Maximum length L (number of octets)



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## 7.3.3 Application Layer

### 7.3.3.1 Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 870-5-4, is used exclusively in this companion standard.

### 7.3.3.2 Common address of ASDU

System-specific parameter

☒ One octet ☒ Two octets

### 7.3.3.3 Information object address

System-specific parameter

☒ One octet ☐ structured
☒ Two octets ☒ unstructured
☒ Three octets

### 7.3.3.4 Cause of transmission

System-specific parameter

☒ One octet ☒ Two octets (with originator address)

**Selection of standard ASDUs**

### 7.3.3.5 Process information in monitor direction

Station-specific parameter

| | |
|---|---|
| ☒ <1>:= Single-point information | M_SP_NA_1 |
| ☒ <2>:= Single-point information with time tag | M_SP_TA_1 |
| ☒ <3>:= Double-point information | M_DP_NA_1 |
| ☒ <4>:= Double-point information with time tag | M_DP_TA_1 |
| ☒ <5>:= Step position information | M_ST_NA_1 |
| ☒ <6>:= Step position information with time tag | M_ST_TA_1 |
| ☒ <7>:= Bitstring of 32 bit | M_BO_NA_1 |
| ☒ <8>:= Bitstring of 32 bit with time tag | M_BO_TA_1 |
| ☒ <9>:= Measured value, normalized value | M_ME_NA_1 |
| ☒ <10>:= Measured value, normalized value with time tag | M_ME_TA_1 |
| ☒ <11>:= Measured value, scaled value | M_ME_NB_1 |
| ☒ <12>:= Measured value, scaled value with time tag | M_ME_TB_1 |



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| | |
|---|---|
| ☒ <13>:= Measured value, short floating point value | M_ME_NC_I |
| ☒ <14>:= Measured value, short floating point value with time tag | M_ME_TC_1 |
| ☒ <15>:= Integrated totals | M_IT_NA_1 |
| ☒ <16>:= Integrated totals with time tag | M_IT_TA_1 |
| ☐ <17>:= Event of protection equipment with time tag | M_EP_TA_1 |
| ☐ <18>:= Packed start events of protection equipment with time tag | M_EP_TB_1 |
| ☐ <19>:= Packed output circuit information of protection equipment with time tag | M_EP_TC_1 |
| ☐ <20>:= Packed single-point information with status change detection | M_PS_NA_1 |
| ☒ <21>:= Measured value, normalized value without quality descriptor | M_ME_ND_1 |
| ☒ <30>:= Single-point information with time tag CP56Time2a | M_SP_TB_1 |
| ☒ <31>:= Double-point information with time tag CP56Time2A | M_DP_TB_1 |
| ☒ <32>:= Step position information with time tag CP56Time2A | M_ST_TB_1 |
| ☒ <33>:= Bitstring of 32 bit with time tag CP56Time2A | M_BO_TB_1 |
| ☒ <34>:= Measured value, normalized value with time tag CP56Time2A | M_ME_TD_1 |
| ☒ <35>:= Measured value, scaled value with time tag CP56Time2A | M_ME_TE_1 |
| ☒ <36>:= Measured value, short floating point value with time tag CP56Time2A | M_ME_TF_1 |
| ☒ <37>:= Integrated totals with time tag CP56Time2A | M_IT_TB_1 |
| ☐ <38>:= Event of protection equipment with time tag CP56Time2A | M_EP_TD_1 |
| ☐ <39>:= Packed start events of protection equipment with time tag CP56time2A | M_EP_TE_1 |
| ☐ <40>:= Packed output circuit information of protection equipment with time CP56time2A | M_EP_TF_1 |

#### 7.3.3.6 Process information in control direction

Station-specific parameter

| | |
|---|---|
| ☒ <45>:= Single command | C_SC_NA_1 |
| ☒ <46>:= Double command | C_DC_NA_1 |
| ☒ <47>:= Regulating step command | C_RC_NA_1 |
| ☒ <48>:= Set point command, normalized value | C_SE_NA_1 |
| ☒ <49>:= Set point command, scaled value | C_SE_NB_1 |
| ☒ <50>:= Set point command, short floating point value | C_SE_NC_1 |
| ☒ <51>:= Bitstring of 32 bit | C_BO_NA_1 |

#### 7.3.3.7 System information in monitor direction

Station-specific parameter

| | |
|---|---|
| ☒ <70>:= End of initialization | M_EI_NA_1 |

#### 7.3.3.8 System information in control direction

Station-specific parameter

| | |
|---|---|
| ☒ <100>:= Interrogation command | C_IC_NA_1 |
| ☒ <101>:= Counter interrogation command | C_CI_NA_1 |
| ☒ <102>:= Read command | C_RD_NA_1 |
| ☒ <103>:= Clock synchronization command | C_CS_NA_1 |
| ☒ <104>:= Test command | C_TS_NB_1 |



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| | |
|---|---|
| ☒ <105>:= Reset process command | C_RP_NC_1 |
| ☐ <106>:= Delay acquisition command note 1 | C_CD_NA_1 |

#### 7.3.3.9 Parameter in control direction

(station-specific parameter)

| | |
|---|---|
| ☐ <110>:= Parameter of measured value, normalized value | P_ME_NA_1 |
| ☐ <111>:= Parameter of measured value, scaled value | P_ME_NB_1 |
| ☐ <112>:= Parameter of measured value, short floating point value | P_ME_NC_1 |
| ☐ <113>:= Parameter activation | P_AC_NA_1 |

#### 7.3.3.10 File transfer

(station-specific parameter)

| | |
|---|---|
| ☒ <120>:= File ready | F_FR_NA_1 |
| ☒ <121>:= Section ready | F_SR_NA_1 |
| ☒ <122>:= Call directory, select file, call file, call section | F_SC_NA_1 |
| ☒ <123>:= Last section, last segment | F_LS_NA_1 |
| ☒ <124>:= Ack file, ack section | F_AF_NA_1 |
| ☒ <125>:= Segment | F_SG_NA_1 |
| ☒ <126>:= Directory | F_DR_TA_1 |

### 7.3.4 Basic Application Functions

#### 7.3.4.1 Station initialization

(station-specific parameter)

☒ Remote initialization

#### 7.3.4.2 General Interrogation

(system- or station-specific parameter)

☒ global

| | | |
|---|---|---|
| ☐ group 1 | ☐ group 7 | ☐ group 13 |
| ☐ group 2 | ☐ group 8 | ☐ group l4 |
| ☐ group 3 | ☐ group 9 | ☐ group 15 |
| ☐ group 4 | ☐ group 10 | ☐ group 16 |
| ☐ group 5 | ☐ group 11 | |
| ☐ group 6 | ☐ group 12 | |

Addresses per group have to be defined



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### 7.3.4.3 Clock synchronization

(station-specific parameter)

☒ Clock synchronization

### 7.3.4.4 Command transmission

(object-specific parameter)

☒ Direct command transmission
☒ Direct set point command transmission
☒ Select and execute command
☒ Select and execute set point command
☐ C_SE_ACTTERM used note 2
☒ No additional definition
☒ Short pulse duration (duration determined by a system parameter in the outstation)
☒ Long pulse duration (duration determined by a system parameter in the outstation)
☐ Persistent output

### 7.3.4.5 Transmission of Integrated totals

(station- or object-specific parameter)

☒ Counter request
☒ Counter freeze without reset
☒ Counter freeze with reset
☒ Counter reset

☒ General request counter
☐ Request counter group 1
☐ Request counter group 2
☐ Request counter group 3
☐ Request counter group 4

Addresses per group have to be defined

### 7.3.4.6 Parameter loading

(object-specific parameter)

☐ Threshold value
☐ Smoothing factor
☐ Low limit for transmission of measured value
☐ High limit for transmission of measured value



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#### 7.3.4.7 Parameter activation

(object-specific parameter)

☐ Act/deact of persistent cyclic or periodic transmission of the addressed object

#### 7.3.4.8 File transfer

(station-specific parameter)

☒ File transfer in monitor direction
☒ File transfer in control direction



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## 7.4 MODBUS Protocol

The DCU could support Modbus protocol, in Master and Slave side.

Modbus enables communication among many (approximately 240) devices connected to the same network, for example a system that measures temperature and humidity and communicates the results to DCU. Many of the data types are named from its use in driving relays: a single-bit output is called a coil, and a single-bit input is called a discrete input or a contact.

### 7.4.1 Communication and devices

Each device intended to communicate using Modbus is given a unique address. In serial and MB+ networks, only the node assigned as the Master may initiate a command. On Ethernet, any device can send out a Modbus command, although usually only one master device does so. A Modbus command contains the Modbus address of the device it is intended for. Only the intended device will act on the command, even though other devices might receive it (an exception is specific broadcastable commands sent to node 0 which are acted on but not acknowledged). All Modbus commands contain checksum information, to ensure a command arrives undamaged. The basic Modbus commands can instruct an RTU to change a value in one of its registers, control or read an I/O port, as well as command the device to send back one or more values contained in its registers.

### 7.4.2 Frame Format

The bellow frame format can be support in Modbus protocol of DCU:

- ☒ Modbus RTU frame format
- ☒ Modbus ASCII frame format
- ☒ Modbus TCP frame format

### 7.4.3 Supported Function Codes

The various reading, writing and other operations are categorized as follows. The most primitive reads and writes are shown in bold. A number of sources use alternative terminology, for example Force Single Coil where the standard uses Write Single Coil.

Please refer to the table bellow for supported function codes:



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| Modbus Supported Function Codes | | | | |
|---|---|---|---|---|
| Function type | | | Function name | Function code |
| Data Access | Bit access | Physical Discrete Inputs | Read Discrete Inputs | 2 |
| | | Internal Bits or Physical Coils | Read Coils | 1 |
| | | | Write Single Coil | 5 |
| | | | Write Multiple Coils | 15 |
| | 16-bit access | Physical Input Registers | Read Input Registers | 4 |
| | | Internal Registers or Physical Output Registers | Read Holding Registers | 3 |
| | | | Write Single Register | 6 |
| | | | Write Multiple Registers | 16 |
| | | | Read/Write Multiple Registers | 23 |
| | | | Mask Write Register | 22 |
| | | | Read FIFO Queue | 24 |
| | File Record Access | | Read File Record | 20 |
| | | | Write File Record | 21 |
| Diagnostics | | | Read Exception Status | 7 |
| | | | Diagnostic | 8 |
| | | | Get Com Event Counter | 11 |
| | | | Get Com Event Log | 12 |
| | | | Report Slave ID | 17 |
| | | | Read Device Identification | 43 |
| Other | | | Encapsulated Interface Transport | 43 |

### 7.4.4 Implementations

Almost all implementations have variations from the official standard. Different varieties might not communicate correctly between equipment of different suppliers. Some of the most common variations are:

#### 7.4.4.1 Data types

- Floating point IEEE
- 32-bit integer
- 8-bit data
- Mixed data types
- Bit fields in integers
- Multipliers to change data to/from integer. 10, 100, 1000, 256 ...

#### 7.4.4.2 Protocol extensions

- 16-bit slave addresses
- 32-bit data size (1 address = 32 bits of data returned.)
- Word swapped data



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## 7.5 Hitachi HC4300 Protocol

The DCU could support Hitachi protocol, in Master and Slave side.

In fact there is not profile list configurable for Hitachi protocol. Therefore the complying support to this protocol is well enough in this chapter.



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## 7.6 INDACTIC 2033 Protocol

Indactic 2033 is part of Indactic 33 Telecommunication system from ABB. The DCU could support Indactic 2033 protocol in Slave side.

### 7.6.1 Network Configuration

1. **Point to Point** : Only 1 RTU
2. **Star Network** : One Channel to each RTU
3. **Addressing** : Configurable in the range

### 7.6.2 Telecommunications

1. **Transmission Mode** : Pseudohalfduplex and real halfduplex
2. **Receiving** : Synchronous for pseudohalfduplex
   Asynchronous (start/stop) for halfduplex
3. **Sending** : Asynchronous (start/stop)
4. **Security** : Hamming Distance 4
5. **Word Length** : 16 bits for standard telegrams
   8 and/or 12 bit for CRC-8 coded measurand
6. **Data Rate** : 50, 100, 300, 600, 1200, 2400 baud

### 7.6.3 Commands

1. **Number of outputs** : Up to 1920 contact totals
2. **Command Type** : 1- Pulse command
   2- Regulating command
   3- Permanent command

### 7.6.4 Setpoints

1. **Number of outputs** : Up to 240 bytes



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2. **Cyclic Setpoints** : Up to 16 bytes

### 7.6.5 Change of State Indications

1. **Number of Inputs** : Up to 1920 contacts total

2. **Storage capacity** : Configurable from 250 events up to 2000 events

### 7.6.6 Counters

1. **Number of inputs** : Up to 64 counters of 3 bytes each

2. **Counting mode** : 6 digit BCD or 24 bit binary

### 7.6.7 Measurands

1. **Number of inputs** : Up to 128 bytes

2. **Transmission mode** : Configurable per file for Standard Indactic 33 or CRC-8

3. **Size of measurands** : 8 or 16 bits, selectable per file



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## 7.7 ABB SPA-Bus Protocol

The SPA-Bus is, was originally designed as a fieldbus in a distributed protection, control and event reporting system.

The SPA-Bus uses an asynchronous serial communications protocol (1 start bit, 7 data bits + even parity, 1 stop bit) with data transfer rate of 9600 b/s. (In some cases a rate of 300, 1200, 2400 or 4800 bit/s can also be used). Messages on the bus consist of ASCII characters. The bus can support one master and several slaves.

DCU support SPA-Bus protocol V2.5 within file transfer for configuration files.

## 7.8 Other Protocols

Information of other protocols like Modbus, IEC104 and etc, is available by request.



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# Chapter 8 - Installation & Connections

## 8.1 Overview

In this chapter we describe about each installation and connections of DCU that based on purpose of usage you can select desired system configuration.

For Installation of DCU in any side and purpose bellow main steps must be considered.

- Power Supply source voltage.
- Network connections over LAN.
- Communication serial type.
- Protocols as slave or master devices.
- List of slave device point information, like tags, addresses, …
- List of master device information and point database
- Configuration DCU, with integrated software



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## 8.2 Power Supply Source

During configuration of any system by DCU, you must define what power source is. For example in V-RTU2000 system, power source is normally 48VDC system. So connection of power source to the back plane of DCU must be from DC terminal. Or you may install DCU in control center with normally AC 200V power source so connection of AC power must be used, or you may have two combinations of them. In Figure 8-1 you can fins detail information of connection diagram of power sources.

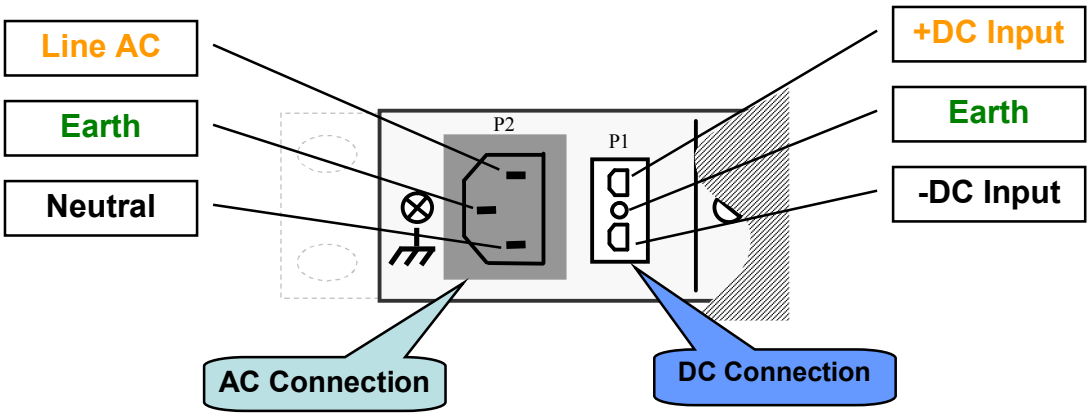


*Figure 8-1: DCU, Power Source, Connection Wiring*



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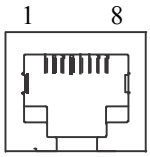
## 8.3 Ethernet Ports

This Type of port can be used for LAN network data. The connection of RJ45 for network module has been used for this type of port by RJ45 connector. The type of Ethernet can be used only in Network Service modules that have been installed over Slot #1.

In the Figure 8-2 you can see detail information based on pin-out of connections.




**RJ45 in back of Network port modules**

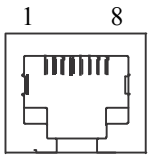
| PIN | Description |
|---|---|
| 1 | TX+: Transmit Data + |
| 2 | TX-: Transmit Data - |
| 3 | RX+: Received Data + |
| 4 | - |
| 5 | - |
| 6 | RX-: Received Data - |
| 7 | - |
| 8 | - |

*Figure 8-2: DCU, Ethernet Port, Connection Wiring*

## 8.4 Serial Interface Ports

### 8.4.1 Mode of Simple RS232

This Type of port only send/receive signals of RS-232C standards. It is simple serial communication between DCU and device. It is a serial device port by RJ45 connection type. In the Figure 8-3 you can see detail information based on pin-out of connections.




**RJ45 in back of Serial port modules**

| PIN | Description |
|---|---|
| 1 | - |
| 2 | RxD: Receive Data (←) |
| 3 | TxD: Transmit Data (→) |
| 4 | - |
| 5 | Signal Ground |
| 6 | - |
| 7 | - |
| 8 | - |

*Figure 8-3: DCU, Serial Port, RS232 Simple Connection Wiring*



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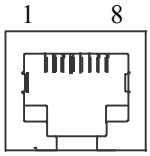
### 8.4.2 Mode of RS-232 + Flow Control

This Type of port has hardware flow control signals of RS-232C standards. It is a serial device port by RJ45 connection type. In the Figure 8-4 you can see detail information based on pin-out of connections.



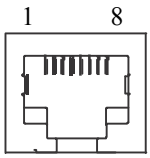

**RJ45 in back of Serial port modules**

| PIN | Description |
|---|---|
| 1 | - |
| 2 | RxD: Receive Data (←) |
| 3 | TxD: Transmit Data (→) |
| 4 | - |
| 5 | Signal Ground |
| 6 | - |
| 7 | RTS: Request To Send |
| 8 | CTS: Clear To Send |

*Figure 8-4: DCU, Serial Port, RS232+Flow Control Connection Wiring*

### 8.4.3 Mode of RS-232 + Clock Signal

This Type of port can be used in asynchronous and synchronous of serial connections of RS-232C standards. In additionally to communicate some old modems it also support transmit and receive clock signal. It is a serial device port by RJ45 connection type. In the Figure 8-5 you can see detail information based on pin-out of connections.




**RJ45 in back of Serial port modules**

| PIN | Description |
|---|---|
| 1 | - |
| 2 | RxD: Receive Data (←) |
| 3 | TxD: Transmit Data (→) |
| 4 | TXC: Clock of Transmitter |
| 5 | Signal Ground |
| 6 | RXC: Clock for Receiver |
| 7 | - |
| 8 | - |

*Figure 8-5: DCU, Serial Port, RS232+Clock Signals Connection Wiring*



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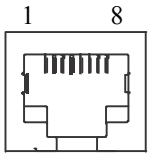
### 8.4.4 Mode of RS-232 + Clock Signal + Flow Control

This Type of port can be used in asynchronous and synchronous of serial connections of RS-232C standards. In additionally to communicate some old modems it also support transmit and receive clock signal. If you want to use from hardware handshaking, you can use from RTS/CTS signals also. It is a serial device port by RJ45 connection type. In the Figure 8-6 you can see detail information based on pin-out of connections.



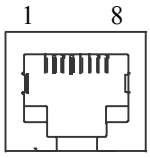

**RJ45 in back of Serial port modules**

| PIN | Description |
|---|---|
| 1 | - |
| 2 | RxD: Receive Data (←) |
| 3 | TxD: Transmit Data (→) |
| 4 | TXC: Clock of Transmitter |
| 5 | Signal Ground |
| 6 | RXC: Clock for Receiver |
| 7 | RTS: Request To Send |
| 8 | CTS: Clear To Send |

*Figure 8-6: DCU, Serial Port, RS232+Clock+Flow Control Connection Wiring*

### 8.4.5 Mode of RS-485

This Type of port can be used for networked serial data, such as RS-485 network standard. It is a serial device port by RJ45 connection type. In the Figure 8-7 you can see detail information based on pin-out of connections.




**RJ45 in back of Serial port modules**

| PIN | Description |
|---|---|
| 1 | - |
| 2 | - |
| 3 | A (D+) : Data of RS485 |
| 4 | - |
| 5 | System Ground (If need) |
| 6 | - |
| 7 | B (D-) : Data of RS485 |
| 8 | - |

*Figure 8-7: DCU, Serial Port, RS485 Connection Wiring*



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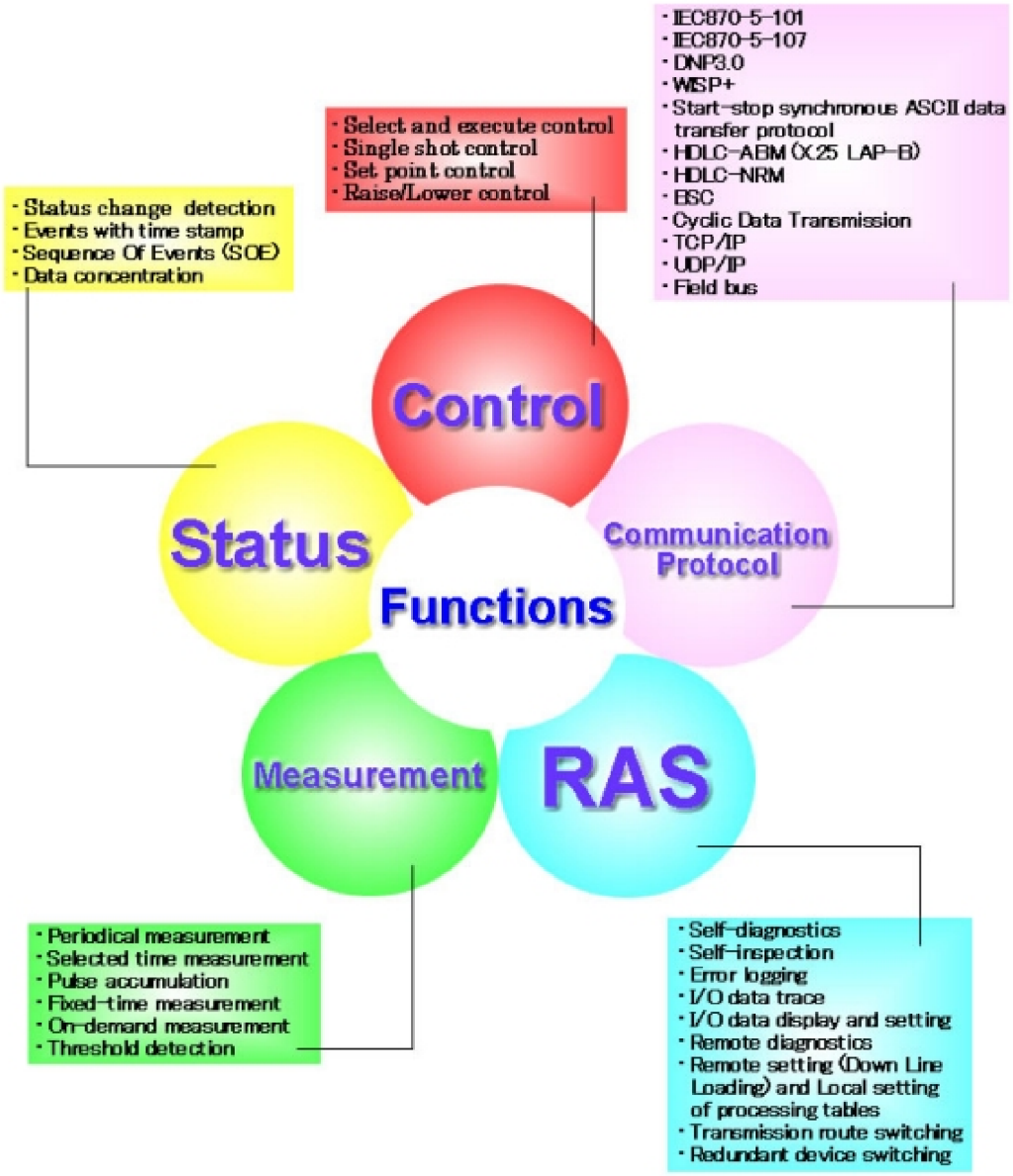


VEESTA WORLD

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