Technical Information

V-RTU2000 Series

V-RTU2000 | Remote Terminal Unit

Technical Specification Manual

VEESTA WORLD

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DOCUMENT HISTORY

Version	Date	Comment
1.0	2009/09/01	First issue
1.1	2009/10/01	Added some picture of cards
1.2	2009/11/05	Added sub rack dimensions
1.3	2010/04/01	Revised Module list
1.4	2010/07/01	DNP3.0 Profile
1.5	2010/12/01	De-bounce and Chatter Filter
1.6	2010/12/05	List Type Test Standards
1.7	2010/12/20	Adding VR-2736A, DO Card type with MEX relay.
1.8	2011/01/20	New modules and specifications
1.9	2012/08/08	Adding VR-2425,VR-2426, GPRS/3G modem
2.0	2013/11/10	Adding some new wiring diagrams

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Chapter 1 - Introduction

1.1 General Information

This is technical information of design of V-RTU2000 Series, the Remote Terminal Units from Veesta World Company. This document helps you to find about how V-RTU2000 Series works and designed for your purpose.

V-RTU2000 Series of RTU system adopted for from very small RTU from that can be used in as Feeder Terminal Unit up to very large scale RTU for Generation and Transmission High Voltage Substations.

Veesta World Co. from Iran associated with you! In planning, designing, manufacturing, supply, installation, commissioning and acceptance test for the Remote Terminal Units in your projects. Veesta World Company will render full support and services to its customer to enable them to deliver first class services to the Power Automation Market.

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

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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 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 V-RTU2000 series (Veesta Remote Terminal Unit) is a distributive Data Acquisition and Control System based on microprocessor. In common SCADA (Supervisory Control and Data Acquisition) System, it performs the work of the Terminal processing unit in most utility stations. RTU acquires station data, both of analog and digital signals with information management and DTU also meets the command from host in master station : to transmit back the acquired data ; to perform the function "check before execution" for station facilities to ensure a safe and reliable execution in system control.

2.1.1 Distributed Remote Terminal Unit (RTU)

To achieve an idea RTU design, V-RTU2000 series is fully modularized in all I/O units, intelligent processing in system operation and powerful in communication ability. RTU design endeavor to pursue long-term stability, high reliability, convenience in maintenance and wiring connection, flexible in extension to be an aesthetic product as a well-being quality unit. V-RTU2000 provides flexible, cost effective answers to many challenges that face the engineering, operations, and maintenance departments of today's power utility.

The V-RTU2000 series offers a single RTU family meeting the entire range of requirements, from small distribution and cogeneration sites to large substations and generating stations, using the same components in a modular, building block approach. The V-RTU2000 Series introduces an open architecture permitting the addition of new processing modules, each linked by fully protected high-speed I/O LAN (Local Area Network). Nothing becomes obsolete in the course of expanding a V-RTU2000 from the smallest to the largest, most complex configuration. Please refer to Figure 2-1 as reference.

The V-RTU2000 Series including two other key functional equipments of the Communication Server and the Intelligent Electronic Device equipments as Communication Server and IED.

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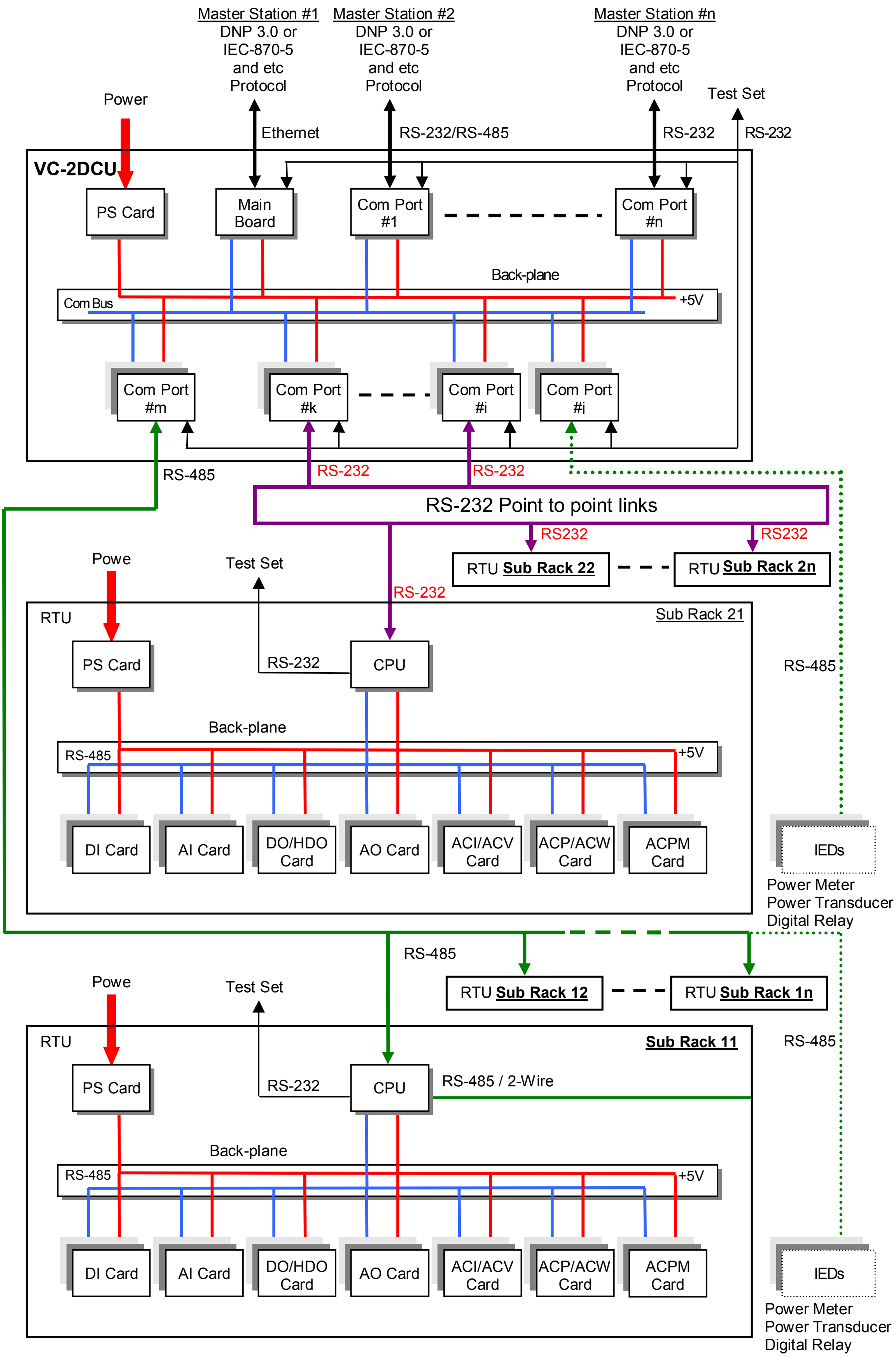

Figure 2-1: V-RTU2000 Series as Distributed RTU Structure Diagram

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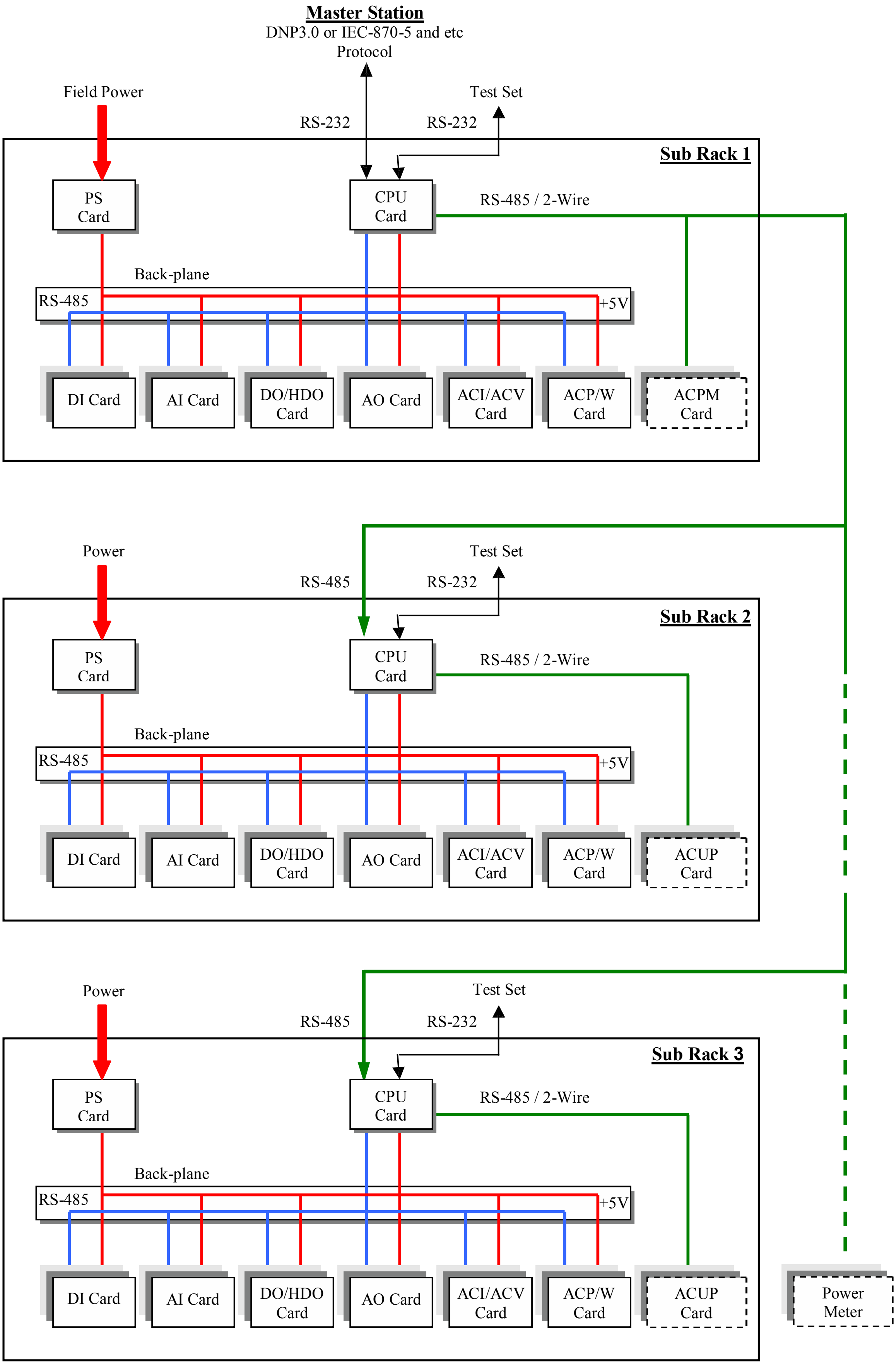

Figure 2-2: V-RTU2000 Series as Small Scale RTU Structure Diagram

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2.1.2 Intelligent Electronic Devices (IED)

Show in Figure 2-3 is of the IED structure diagram, using V-RTU2000 as well as the IED equipment. There are two independent communication channels are provided by V-RTU2000 CPU Card, of which, one links to the host computer. The other one links to the Power Meter or IEDs for obtaining I/O information for such equipment and also transferring the Output control command. In addition, the V-RTU2000 also provide I/O cards (AI, DI, AO, DO and etc.) to collect the field information and also carry out the Output of control command.

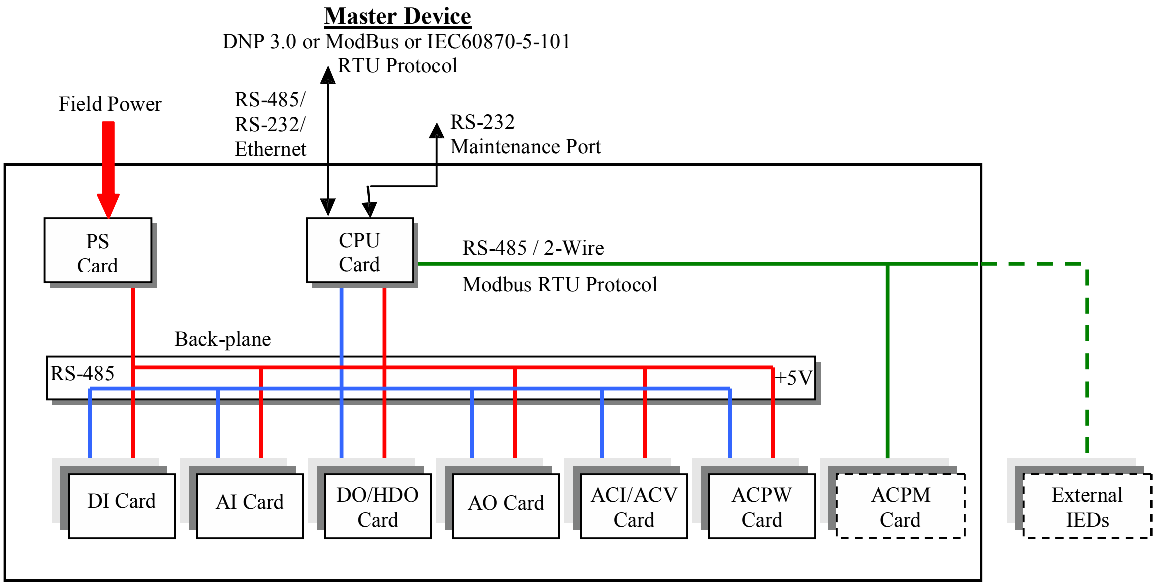

Figure 2-3: V-RTU2000 Series as IED Structure Diagram

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2.2 Summary of Functions

V-RTU2000 Series is generally installed at on-site power station, applied to signals monitoring and control performance. It is designed in multi-processor technique. Each I/O Card has its own processor which is responsible for the basic data acquisition function. The basic functions are as follows.

2.2.1 Data Acquisition Processing

V-RTU2000 Series acquires digital and analog signal from station and stores it in RTU memory. On the other band, RTU accepts host command to reflect and transmit back the required data to control center.

2.2.1.1 Analog Data Input

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

2.2.1.2 Accumulated Data Input

Energy Counters, accumulation and processing of pulses from external energy measurement devices are supported. A 16-Bit value is set aside in the local memory for each Pulse Accumulator point. The Pulse Accumulator will be incremented one count for each cycle of the input.

2.2.1.3 Digital Data Input

Indications, Status of facilities and the status of Momentary Change Detection (MCD) are acquired. Four basic indication types are supported: Single indication Double indication, Sequence Capturing, and Multiple Change detection. The de-bounce time for DC Digital Input Points can be 1 ms to 250 ms adjustable. The de-bounce time for AC Digital Input Points can be 48 ms to 250 ms adjustable.

- **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.

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- **Sequence capturing (1-Bit MCD)**: is optimized for a multiple change detects technique which ensures that the critical information is not lost, but avoids sacrificing the efficiency of the communications process. This is accomplished using only a single bit for each monitored indication point in the protocol.

2.2.1.4 De-bounce filter

De-bouncing used to verify that a digital input point has actually changed state.

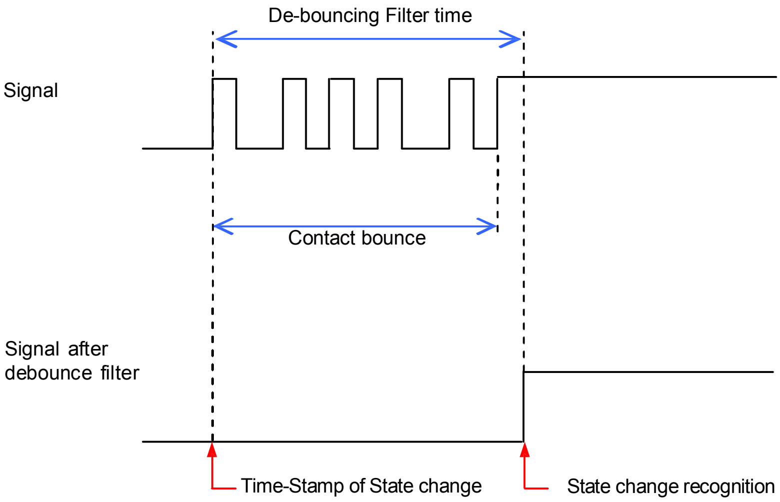

Figure 2-4: V-RTU2000 De-bounce Filter Diagram

2.2.1.5 Chatter Filter

A facility that is used to disable a digital input point if the number of state changes of that point is excessively high during a defined time interval.

Chatter Times (changes): The maximum allowed number of state transitions that can occur within a filter base (Times Base) period. If the number of state transitions during a filter period equals or exceeds the maximum allowed number of state transitions, chatter filter will turn ON and any further transitions will be ignored for the duration of the “lock-out” period.

Lock Out Time: The minimum number of filter base periods (Times base) during which the chatter filter will remain ON. The chatter filter can proceed from ON to OFF only if no state transitions are detected during the entire lock-out period.

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Example: Chatter Times (changes) 5, Lock-Out Time 1s.

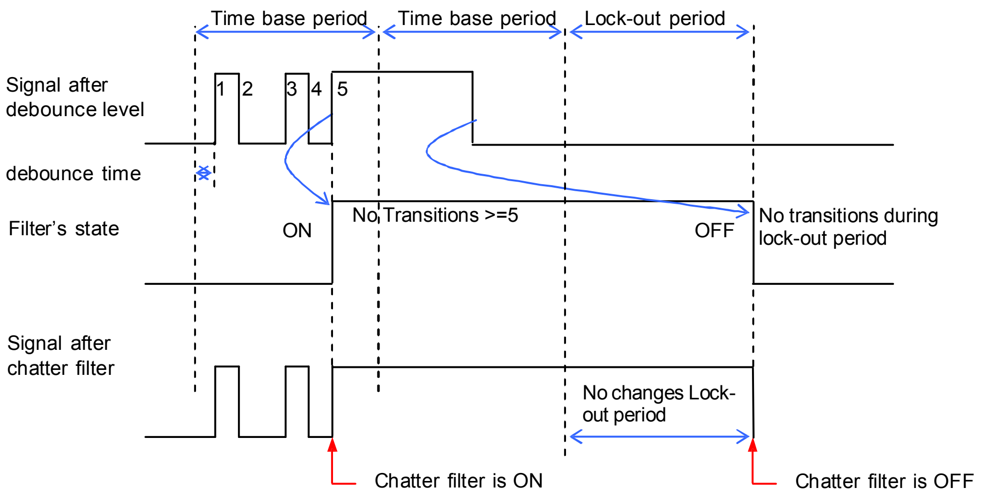

Figure 2-5: V-RTU2000 Chatter Filter Diagram

2.2.1.6 Sequence of Event Report

In order to monitor the status and sequence, changed of main equipments, RTU provides the SOE function (Sequence Of Event). An event is defined as a single change of state. Each time an event is detected, RTU will time-tag the event, and store a description of the event and the time-tag in a first in first out (FIFO) buffer. There is one 1024 events buffer in V-RTU2000 Series.

RTU will time-tag the first change of state, rather than the end of de-bounce period, and the de-bounce time for all SOE points can be 1ms to 250ms adjustable. The resolution is one millisecond. The time-tag recorded with each event is generated from a clock internal to the V-RTU2000 Series. The clock is 1 PPM accuracy TCXO.

V-RTU2000 Series have the capability to synchronize its internal clock with a system clock located at the master station. If the synchronization period is no more than 15 minutes, it can guarantee the time accuracy of SOE is within +/- 4ms to system clock (in Master Station).

2.2.2 Control Output

Two types of control command can be transmitted from the Master Station to devices in the Power System via the V-RTU2000 Series. One is Trip/Close command, the other is Direct Set-point command.

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2.2.2.1 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. The SBO controls are used when secure operation is required such as the Trip and Close operations of Power Circuit Breakers. RTU reset its control logic if the Operate Command is not received within the User defined time period maximum 60 sec, initially 20 sec, of the command message. The operating sequences for SBO command are:
  1. After received the Select Trip/Close Command, the RTU initialize its control logic, check and verify its control circuit, reassemble the command message, then transmit the reassembled message to the Master Station.
  2. If the Operate Command is received within the user defined time period and last command is Select Trip/Close Command, the RTU will operate the control point.

The result of Trip/Close command is the output of a pulse of fixed duration (determined by the Database Configuration) at the specifically addressed Digital Output (DO) point. Only one point can be controlled at a time.

2.2.2.2 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.

- **Digital Direct Set-point Command**: Raise/Lower command, can cause the addressed Digital Output (DO) point(s) to perform the Pulse Width control output for a Generator Controller. The time duration of output pulse is specified in the command message from Master Station. Multiple points can be controlled simultaneously.

- **Analog Direct Set-point Command**: cause the addressed Analog Output (AO) point to perform a current or voltage output for a Generator Controller. The output value is specified in the command message from Master Station.

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2.2.3 Communication Function

The communication function of V-RTU2000 Series can be divided into Internal Communication and External Communication.

- **Internal Communication**: Means pointing to the inside communication between CPU Card and I/O Cards, which is linking with RS-485 interface, and using the Backplane connecting card without additional wires.

- **External Communication**: Providing RS-232 or RS-485 two communication channels, supporting the multi-communication protocol to communication with external side. The supporting protocols are listed as below:
  1. *SCADA Master*: DNP3.0, IEC870-5-101.
  2. *RTU Sub-Master*: ModBus RTU, DNP3.0, IEC870-5.
  3. *IED*: ModBus RTU, DNP3.0.
  4. *User Specific Protocols*: Other protocols can be implement quickly in the firmware of V-RTU2000 Series by upon request.

2.2.4 Self-Diagnostic Function

V-RTU2000 Series has its well-equipped ability for self-diagnostic function. Every abnormal status of RTU is recorded down as System Event, or indicated by LED excitation on the panel. The System Event Record can be retrieval by Test Set and store in its hard disk, which very easy to find the fault portion in maintenance.

2.2.5 Programmable Algorithm Function

The V-RTU2000 Series have the capability of user definable “Sequential Algorithm” running in it. The “Sequential Algorithm” within a RTU operates on and can communicate through a common variable data base which consists of analog inputs, digital inputs, accumulator inputs, pseudo points, alarm (system) status, digital output, and system clock.

The V-RTU2000 Series “Sequential Algorithm” programming is based on the ladder diagram (V-RTU2000 Ladder). The circuit is constructed of familiar contacts and coils on the rugs of the ladder. Pages of circuit make it easy to find your way through a program.

The “V-RTU2000 Ladder Development Package“ running in IBM compatible Personal Computer (PC) can provide the environment for Sequential Algorithm Development. For detail information about “V-RTU2000 Ladder“ please refer to “V-RTU2000 Ladder “ manual.

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2.3 Hardware Structure

V-RTU2000 Series hardware structure is shown in Figure 2-3, designed as a Plug-In Type and set up in 19” Rack/Module enclosure. The ideal plug-in type configuration provides a very useful structure in maintenance. The size of Cards is following the Euro-Card standard, 100mm x 160mm for Card. In according to operation function, RTU hardware is for four main units.

2.3.1 Power Supply Unit

The power supply of V-RTU2000 Series contains the following cards:

2.3.1.1 DC 24V/DC 5V & 24V PS Card

Power supply card, designed in DC 24V~75V input and DC 5V (10W), DC 24V (3W) output. Connecting with the backplane is linking with 48-pin DIN connector, which provides 5V working power supply for the RTU and 24V driving power supply for DO/HDO Card.

2.3.1.2 AC 220V/DC 5V & 24V PS Card

Power supply card designed in AC 85V~265V or DC 65V~375V input and with DC 5V (10W), DC 24V (3W) output. Connecting with the backplane is linking with 48-pin DIN connector, which provides 5V working power supply for the DTU and 24V driving power supply for DO/HDO Card.

2.3.2 Main Unit

The main unit of V-RTU2000 Series consists of 1 Backplane and 1 Master CPU Card; if necessary several IO CPU Cards and several CM Cards.

2.3.2.1 Backplane

As a passive element, it is buffering the path of power supply, communications Bus and with plugging slots for all kinds of Circuit Cards. It is consisted of one power slot, one CPU slot and several I/O slots. It is provide pluggable type terminal blocks for external wire connection.

2.3.2.2 CPU Card / CM Card

Use Intel, 16-bit high speed microprocessor, with two isolated RS-232/485 ports for host communication, one RS-485 port for local IO communication, and one isolated RS-232 port for Test Set and one Ethernet 10/100Mbs at front panel.

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2.3.3 I/O Interface Unit

V-RTU2000 Series provides various types of I/O interface card which coincidently to the requirement of station. In order to monitor and study dynamic status of system operation and feature of facilities, I/O cards are defined by functions for different inputs and outputs as under description:

- **DI Card**: Digital Input Card, 8 Points / Card.
- **ACC Card**: Digital Accumulator Counter Card, 8 Points / Card.
- **DO Card**: Unlatch Digital Output Card, 8 Points / Card.
- **HDO Card**: Unlatch Digital Output Card, 4 Points Select Command + 1 Main Execution Command (ME) / Card.
- **AI Card**: Analog Input Card, 4 Differential Channels / Card.
- **AO Card**: Analog Output Card, 4 Differential Channels / Card.
- **ACI Card**: Analog AC Current Input Card. 4 Independent CT Current / Card.
- **ACV Card**: Analog AC Voltage Input Card. 4 Independent PT Voltage / Card.
- **ACP Card**: Analog AC Power Input Card. 1 Voltage & 3 Current / Card.
- **ACW Card**: Analog AC Power Metering Input Card. 2 AC Voltage & 2 Current / Card.
- **ACPM Card**: Analog AC Power Measurement Input Card. 4 AC Current & 4 AC Voltage Input / Card.
- **ACUP Card**: Universal Intelligent AC Power Meter Input Card. 4 AC Current & 4 AC Voltage Input / Card.

2.3.4 Universal Intelligent Power Meter ACUP

The ACUP Card is Power Meter is designed with high precision intelligent of digital power and energy transducer, which is available for measuring the input signals coming from 3 CT and 3 PT in the same time. This provides more than 100kinds of power parameters. Through the communication interface, can get all kind of parameter's reading and also can preset the parameters under the communication interface.

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2.4 V-RTU2000 Series Card & Modules List

Table 2-1: V-RTU2000 Series Cards & Modules

No.	VEESTA Model	Name	Specification
1	VR-2101A	RTU Rack	Dimension : 3U x 42T x 185mm (H*W*D) Slot : Power x 1, CPU x 1, IO x 5, PM x 1
2	VR-2101C	RTU Rack	Dimension : 3U x 84T x 185mm (H*W*D) Slot : Power x 1, CPU x 1, IO x 5, PM x 4
3	VR-2102	RTU Rack	Dimension : 3U x 42T x 185mm (H*W*D) Slot : Power x 1, CPU x 1, IO x 8
4	VR-2103	RTU Rack	Dimension : 3U x 84T x 185mm (H*W*D) Slot : Power x 1, CPU x 2, IO x 16
5	VR-2043	COM Rack	Dimension : 3U x 84T x 185mm (H*W*D) Slot : Power x 2, CPU x 2, CM x 16
6	VR-2707B	L-PS Card	Input : DC 24V or 48V Output : 5V ±0.1V DC, 12W 24V ±1V DC (Internal Used), 3W
7	VR-2708B	H-PS Card	Input : 85Vrms to 260Vrms AC, or 85V to 375V DC Output : 5V ±0.1V DC, 12W 24V ±1V DC (Internal Used), 3W
8	VR-2717A	CPU Card	1 LAN Port (10/100 Base-T Ethernet) (@ Panel) 1 RS-232 Port (for Master) (@ Backplane) 1 RS-485 Port (for Slave Device) (@ Backplane) 1 RS-232 Port (for Test Set) (@ Panel)
9	VR-2715A	CPU Card	1x RS-485 Port (for Master) (@ Backplane) 1x RS-485 Port (for Slave Device) (@ Backplane) 1x RS-232 Port (for Test Set) (@ Panel)
10	VR-2424	Modem Card	Half/Full Duplex 2/4 wire Lease Line V.23, V22bis, V.29, Bell202 1200/2400/9600 bps rate, Asynchronous/Binary
11	VR-2425B	GPRS Modem	GPRS Modem Module Card Front panel Antenna connection 1x Ethernet Port + 1x RS232 Port
12	VR-2426	3G/GPRS Modem	3G/GPRS Modem Module Card Front panel Antenna connection 1x Ethernet Port + 1x RS232 Port
13	VR-2444	Modem Card (Voice & Data)	Half/Full Duplex 4 wire Lease Line FSK with programmable option 300/600/1200 bps rate, Binary Voice Filter with programmable option
14	VR-2444T	Telephony Card	Dispatcher Telephony System Input: 4x wire, E&M telephony signaling Output: 2x wire FXS or FXO mode selection
15	VR-2722A	DI Card	Input : DC 125V Point : 8
16	VR-2723A	DI Card	Input : DC 24V or DC 48V Point : 8

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No.	VEESTA Model	Name	Specification
17	VR-2726	ACC Card	Input : DC 24V or DC 48V Point : 8
18	VR-2735	HDO(5) Card	Type : Unlatch Relay Contact : 10A (2000VA, 200W) Point : 5
19	VR-2736A	DO Card	Type : Unlatch Relay Contact : 5A (1000VA, 100W) Point : 8
20	VR-2737	HDO Card	Type : Unlatch Relay Contact : 10A (2000VA, 200W) Point : 4 + 1ME
21	VR-2741	AI Card	Input : +/- 1mA Point : 4 (Differential)
22	VR-2742	AI Card	Input : 4~20 mA Point : 4 (Differential)
23	VR-2742E	AI Card	Input : 0~20 mA Point : 4 (Differential)
24	VR-2743	AI Card	Input : +/-5V Point : 4 (Differential)
25	VR-2751	AO Card	Output : +/- 1mA Point : 4 (Differential)
26	VR-2752	AO Card	Output : 4~20 mA Point : 4 (Differential)
27	VR-2745	ACI Card	Input : 0 ~ 1A AC or 0 ~ 5A AC Point : 4
28	VR-2746	ACV Card	Input : 0 ~ 120 VAC or 0 ~ 300VAC Point : 4 / 6 / 8
29	VR-2749A	ACPM Card	3-AC current (Ia, Ib, Ic) 1A or 5A 3-AC voltage (Va, Vb, Vc) 0~110V or 0~300V
30	VR-2760	ACUP Card	Power Meter Input Current: 4x 0 ~ 1/5/7A, Input Voltage: 4x 0 ~ 120/300VAC
31	VR-2801C	Charger Card	Input: 70~260 VAC Output: 24VDC as Power source Battery output: 24VDC Alarm output: ACF,DCF

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2.5 V-RTU2000 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.

During the whole training, every day has 8 periods.

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 System configuration Function of adopted devices	Run maintenance personnel 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 introduce of inside network communication with attempter computer interface and communication with other IED	Run maintenance personnel 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 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 System development personnel

Table 2-2: V-RTU2000 Series Training Syllabus

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2.6 Standards (Type Test)

2.6.1 Power Supply Performance

1- IEC 60870-2-1:	Nominal Voltage
2- IEC 60870-2-1:	Operating Range
3- IEC 60870-4:	Power consumption
4- IEC 60870-2-1:	Grounding - Wrong Polarity

2.6.2 Digital Input Performance

5- IEC 60870-3:	Nominal Input Voltage
6- IEC 60870-3:	Input current at nominal input voltage
7- IEC 60870-3:	Minimum Input voltage
8- IEC 60870-3/4:	Correct Operation
9- IEC 60870-3/4:	Transition time
10- Functions:	Input Filter
	Sequence of Event
	Time Synchronization

2.6.3 Analog Input Performance

11- IEC 60870-3:	Nominal Input Voltage
12- IEC 60870-4:	Accuracy

2.6.4 Current & Voltage Input Performance

13- IEC 60870-3:	Transverse voltage rejection
14- IEC 60870-3:	Common mode rejection
15- Functions:	Full scale reference voltage
	Voltage drop across current shunt
	Input current at nominal input

2.6.5 Digital Output Performance

16- IEC 60870-3:	Operating Time
17- IEC 60870-3:	Transition Time
18- IEC 60870-3:	Output level
19- Functions:	Output supervision
	Select Before Operate

2.6.6 Electrical Insulation

20- IEC 60255-5:	Impulse voltage test
	Dielectric test
	Insulation resistance

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2.6.7 Electromagnetic Compatibility (EMC)

21- IEC 61000-4-2:	Electrostatic discharge
22- IEC 61000-4-3:	Radiated Radio Frequency
23- IEC 61000-4-3:	Electromagnetic field
24- IEC 61000-4-4:	Fast Transient Burst 2kV IO, 4kV Power port
25- IEC 61000-4-5:	Surge 1.5/ 50ns
26- IEC 61000-4-6:	Conductive disturbance, induced by RF field
27- IEC 61000-4-8:	Power frequency magnetic field
28- IEC 61000-4-11:	Voltage dips
29- IEC 61000-4-29:	Voltage interruption
30- CISPR22:	Conducted and radiated emission

2.6.8 Environment Standards

32- IEC 60068-2-1:	Cold -35°C
33- IEC 60068-2-2:	Dry heat +70°C
34- IEC 60068-2-14:	Change of Temperature
35- IEC 60068-2-30:	Damp heat

2.6.9 Mechanical Standards

36- IEC 60068-2-6:	Vibration (sinusoidal)
37- IEC 60068-2-27:	Shock

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Chapter 3 - Main Unit

3.1 General

The main unit of V-RTU2000 Series is consisted of the followings:

- **Backplane**: As passive elements, it is buffering the path of power supply, communications and Bus and with plugging slots for all kinds of Circuit Cards. It is consisted of one power slot, one CPU slot and several I/O slots. It is provide pluggable type terminal blocks for external wiring connection. By characteristics, the signals on the backplane can be divided into the followings:
  - • Power signal --- +5V, +24V, DGND
  - • Control signal --- /PF, /RST
  - • Communication signal --- DATA, /DATA (RS-485)
  - • Address signal --- Rack Address (RA0~RA3), for CPU slot. Slot Address (SA0~SA3), for I/O slot.

- **CPU Card**: It is designed in Intel CPU. Internally, it connects with I/O Cards through RS-485 communication port by 62.5 kbps baud rate; externally, it provides RS-232 communication port (9.6 kbps) for linking with Test Set, also with RS-232/RS-485 communication port (9.6 kbps) for linking with the outside equipment. By function, the CPU Card provides two kinds of different functions. First one, featuring as the Communication Server or Remote Terminal Unit which providing Master CPU Card, IO CPU Cards and CM Cards, CPU Cards to communicate with Master Station(s) and CM Card to communicate with IEDs. Secondly, featuring as the IED, which providing CPU Card and I/O Cards, CPU Card's on communication port to communicate with the comm. server or Master station, the other port to communicate with Power Meter or IEDs.

- **CM Card**: Communication Module card, which designed as communication module for V-RTU2000 Series. It is designed in Intel 80C188EB-20 CPU. It provides either two RS-232 or two RS-485 communication ports (9.6 kbps) for communication with Power Meter or IEDs.

- **Data Modem Card**: is the abbreviation for ITU-T V.29, 9600bps, which designed in with an intelligent modem. In the RTU system, this card features as interface between CPU Card and Host Computer. Providing the basic function as general modem, also

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to be responsible for the conversion of communication protocol. As a hardware function, it turns RS-232 signal into frequency signal or change the frequency signal to RS-232 signal as versus as well. The V.29 Modem Card provides either Bell 202 1200bps, CCITT V.23 1200bps, V.22bis 2400bps, or V.29 9600bps standard for using on 2/4 Wire Leased Line.

- **GPRS/ 3G Modem Card**: is GPRS (General Packet Radio Service) Modem Card is based on GSM data delivery technique which is different from the former channel transmission, by using the “Packet” mode to deliver data. Due GPRS system has provide a high-speed, non-disconnect and billing under quantity bases, which is capable to support high security connecting environment, lower communication charges and provide a faster connecting method. By using the MDVPN supported by telecommunication service, and use the wireless devices to read/write the database, to save the hardware cost. Moreover the wireless device is also support the “Group-Setting” function, by using the GSM digital certificated with VPN Channel to send and receive information.

- **Voice+Data Modem Card**: is the abbreviation for FSK Modem working with 4 wire channel. The modem work as voice transmission within data transmission in same time. The baud rate of 600 bps in method of ani-synchronous protocol that you can send Asynchronous and also Synchronous data frame over the RS232 standard of modem. Modem has channel filter for mixing input 4x wire channel as voice input with FSK signals and transmit them over the 4kHz analog voice band. As a hardware function, it turns RS-232 signal into frequency signal or change the frequency signal to RS-232 signal as versus as well.

3.2 Backplane

In a V-RTU2000 Series system, backplane is very important. If any failure out of it which will affect the entire system operation and very hard proceed maintenance; V-RTU2000 Series backplane is with simple “Connector” and “Switch” of reliable mechanical part mounted on a mother PCB. The connection between Backplane and other cards is using “DIN 41612 C” connectors which with high reliability.

The backplane of V-RTU2000 Series is consisted of one PCB and protection cover. Depending on different RTU type, the backplane accordingly come with different number of I/O slots. The inside of backplane is installed with DIN 41612 C (96-pin or 48-pin) Female Connector for linking all cards; whereas, the backside of slot is provided with pluggable type terminal block for external wiring.

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The basic functions of backplane are as listed below:

- Buffering the required power of Logical Cards (DC 5V).
- Buffering the required power for the Relay on DO, HDO Cards (DC 24V).
- Providing communication line for LIOC Communication
- Providing the "Addressing" of Logical Cards

The backplane provides 3 kinds of slot for connecting different cards.

- Power Slot (x 1): DC 5V & 24V PS Card
- CPU Slot (x 1): CPU Card (main)
- I/O Slot (x N) : I/O Cards or CM Cards or IO CPU Cards

3.2.1 Detailed Circuit Description

Block diagram of Backplane is shown in Figure 3-1:

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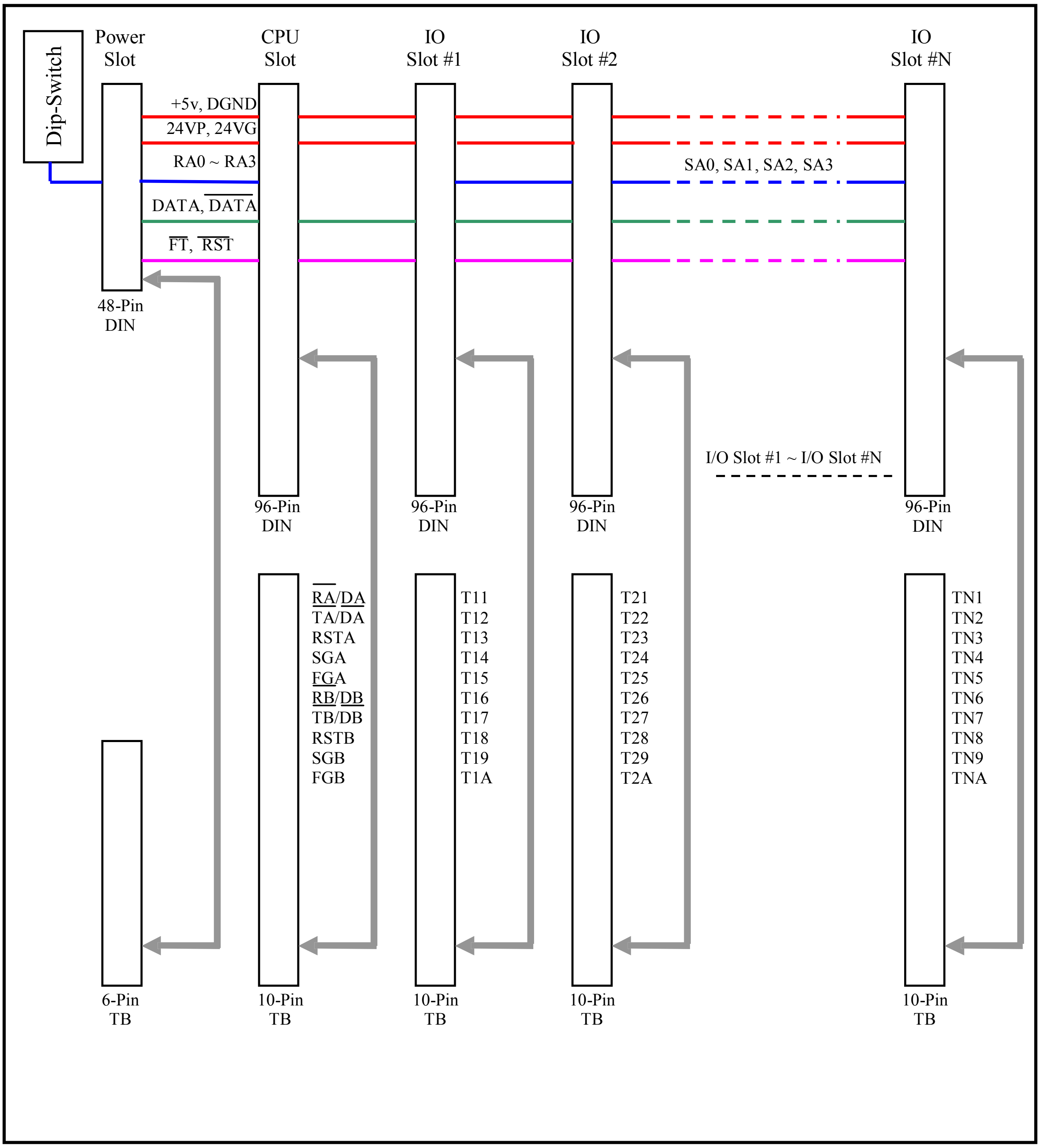

Figure 3-1: V-RTU2000 Series Back-plane Block Diagram

3.2.2 Rack Address Signal

The V-RTU2000 Series can be formed by 0 to 249 racks, can be check out by the Rack address Signal of (RA0, RA1, RA2, RA3) setting by using SW1(Dip-Switch) to set the rack address, but only the CPU slot has its own Rack Address signal. The Rack Address of RTU can be set by software and hardware. Basically the software

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setting range is within 0-249. If the setting range is over 250, which needs hardware to set Address signals as well.

The DIN-Connector-Pin of RA0 is a3, while that of RA1 is c3.

The DIN-Connector-Pin of RA2 is a4, while that of RA3 is c4.

- Example: Rack Address = 5, shall be following the steps as below:

RA0	=	1,	Dip-1	=	“Open”	or	“Off”	(1)
RA1	=	0,	Dip-2	=	“Short”	or	“On”	(0)
RA2	=	1,	Dip-3	=	“Open”	or	“Off”	(1)
RA3	=	0,	Dip-4	=	“Short”	or	“On”	(0)

3.2.3 Slot Address Signal

To save the Card Address setting operation of I/O Card and avoid erroneous setting, each I/O Slot in the RTU backplane is distinguished with exclusive slot address. Simply insert the I/O Card into the slot, the user can easily know the exact address without any setting check. The slot address set is under using four signal lines of SA0, SA1, SA2 and SA3.

The DIN-Connector-Pin of SA0 is a3, while that of SA1 is c3.

The DIN-Connector-Pin of SA2 is a4, while that of SA3 is c4.

- Example: I/O Slot 6 (Slot Address = 5) is set as below:

SA0	=	1,	Pin	a3	=	“Open”	(1)
SA1	=	0,	Pin	c3	=	“GND”	(0)
SA2	=	1,	Pin	a4	=	“Open”	(1)
SA3	=	0,	Pin	c4	=	“GND”	(0)

3.2.4 Local I/O Cards (LIOC) Communication Signal

The LIOC communication is designed under through RS-485 interface, which the DATA & /DATA signals are connecting to the all slots.

The DIN-Connector-Pin of DATA is a6, while that of /DATA is c6.

3.2.5 Power Fail Control Signal

On the PS Card of RTU, the “input power fail detection circuit” is installed. As long as the input power is lower than the set value, this circuit will send out power fail alarm signal (/PF), and send the signal to all cards, under through backplane. The /PF signal is designed to connect to all slots.

The DIN-Connector-Pin of /PF is c5.

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3.2.6 Reset Control Signal

In the CPU Card of RTU, the “DC 5V monitoring circuit” is provided. When the DC 5V power is lower than 4.75V, it will produce system reset signal (/RST). To reset it’s own card, it can also to reset other cards by under through the Backplane. The /RST signal is designed to connect to all slots.

The DIN-Connector-Pin of /RST is a5.

3.2.7 DC 5V Power Signal

The DC 5V output of RTU PS Card is supplying power to other slots under through the backplane, the +5V & DGND power signals are connected to all slots.

The DIN-Connector-Pin of +5V is a1, b1 and c1.

The DIN-Connector-Pin of DGND is a2, b2 and c2.

3.2.8 DC 24V Power Signal

The DC 24V output of RTU PS Card is supplying power to other slots under through the backplane, the I24VP & I24VG power signals are connected to all slots.

The DIN-Connector-Pin of I24VP is a7.

The DIN-Connector-Pin of I24VG is a7.

3.2.9 Relationship between DIN Connector & Terminals

In RTU, each slot on the backplane is equipped with two external connections. First one is the front-face 48/96-Pin DIN Connector, the other one is the backside 6/10-Pin pluggable type terminal block. The DIN Connector and Terminal Block at the same slot are installed in one-to-one type.

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3.3 CPU Card

CPU Card is the portion of V-RTU2000 Series which communicate with the other cards through communication channels. The CPU Card providing 3 kinds of functions on the same hardware, which is as Master CPU Card, IO CPU Card (applied for Communication Server) and RTU CPU Card (applied for IED). Two RS-232 channels communicate with V.29 Modem Cards, then to Master station. One RS-232 channel is applied to communicate with Test Set to setup Data Base and perform maintenance. A RS-485 channel is used for internal communication with Local I/O Cards (LIOC).

TCXO, ± 1 ppm (0°C to 50°C) is to suffice the strict requirement of time base accuracy.

3.3.1 VR-2717A Specifications

1.	**Microprocessor**	: RDC R1120 RISC Microprocessor
2.	**Operating Frequency**	: 80MHz
3.	**Flash Memory**	: 256K Bytes
4.	**SRAM**	: 256K Bytes, Battery Back-up
5.	**Real Time Clock**	: BQ4802LYPW, Battery Back-up
6.	**TCXO**	: 25MHz ±1 PPM (0°C to 50°C)
7.	**Serial Ports**	: One RS-232 (Isolation) for Maintenance One RS-485 for Local I/O communication One RS-485 (Isolation) for External communication
8.	**LAN Port**	: One 10/100 Base-T Ethernet port
9.	**Power Requirement**	: +5VDC ±5%, 250mA
10.	**Card Dimension**	: 160mm * 100mm
11.	**Environment**	
	Operating Temperature	: -25°C to 70°C
	Storage Temperature	: -40°C to 85°C
	Relative Humidity	: 10% to 95% non-condensing

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3.4 Modem Card

Modem Card is designed in with an intelligent modem chip. Performing in the RTU system, this serves as the intermediate interface between CPU Card and Host Computer. As hardware it turns RS-232 signal into frequency signal or convert the frequency signal into RS232 signal.

Modem Card is in four versions of Data Modem VR-2424 model that is compatible standard SCADA modem and VR-2444 model that is Voice+Data SCADA modem and VR-2425 as GPRS modem over GSM wireless network and VR-2426 GPRS with 3G wireless network mode.

With Voice+Data modem there is another module for supplying various telephony interfaces call VR-2444T for dispatch telephone system that convert 4 wire audio with E&M signaling to 2 wires Subscriber link as FXS or trunk link as FXO connection.

Any GPRS or 3G modem provided with external antenna connection that can be mounted over the outdoor cubicles.

3.4.1 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
9.	**Pre-Transmission Time**	: 8 mS to 255 ms (Software Definable)
10.	**Squelch Time**	: 8 mS to 255 ms (Software Definable)
11.	**Digital Interface**	: RS-232C 9600 BPS for Protocol Mode 1200, 2400, 9600 BPS for Modem Mode
12.	**Telephone Line Common Mode Voltage**	: 200V DC (Min.)
13.	**Isolation**	
	- Input to Phone Line	: DC 1800V
	- Line to Line (TX to RX)	: AC 1500V

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14.	**Surge Withstand Capability (SWC)**	ANSI/IEEE C37.90.1-1989 : (Differential Mode Only) 3KV Oscillatory Test 5KV Fast Transient Test
15.	**Power Requirement**	: +5VDC ±5%, 250mA
16.	**Card Dimension**	: 160mm * 100mm
17.	**Environment**	
	Operating Temperature	: -20°C to 65°C
	Storage Temperature	: -40°C to 85°C
	Relative Humidity	: 10% to 95% non-condensing

3.4.2 VR-2444 Voice & Data Modem Specifications

1.	**Microprocessor**	: 8051 Intel
2.	**Memory**	: 64KB Flash, 2KB SRAM (Microprocessor included)
3.	**Data Rate**	: 300 / 600 / 1200 / 2400 / 9600 BPS
4.	**Operation Mode**	: Half or Full Duplex 4-Wire Lease Line FSK Modem configurable
5.	**Operating Format**	: Transparent (Asynchronous, Binary, Serial)
6.	**Transmitter Output Level**	: Adjustable 0 dBm to -20 dBm Adjustable
7.	**Receiver Input Level**	: Adjustable 0 dBm to -32 dBm
8.	**Digital Interface**	: RS-232C, TXD/RXD/RTS/CTS/GND signals
9.	**Isolation**	
	- Input to Phone Line	: DC 1800V
	- Line to Line (TX to RX)	: AC 1500V
10.	**Voice Module**	: VR-2444V, Voice part module
12.	**Signaling**	: 4x wire speech, E&M FXS, subscriber option FXO, CO line connection option
12.	**Compatibility**	: Adjustable voice level output, Compatible with most of old modem, like Hitachi voice and data modem

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3.4.3 VR-2444T Telephony Interface Specifications

1. **Operation Mode** : Converter of 4-Wire voice path with signaling to 2-wire subscriber or exchange side (FXS or FXO)

2. **Signaling** : Input: E&M
   Output: FXS, subscriber option
   FXO, CO line connection option

3. **Levels** : Rail to Rail level, no level changes from input to output conversion.

4. **Compatibility** : Compatible with most of old modem, like Hitachi voice and data modem

5. **Ring Generator** : 20Hz standard Ring Generator with each module

3.4.4 VR-2425 GPRS Modem Specifications

1. **Standard** : GSM / GPRS
2. **Band Options** : Quad-band 850/900/1800/1900 MHz
3. **GPRS Multi-slot class** : Class 10
4. **GPRS Data rates** : Maximum 85.6Kbps (In-band/Download)
   Maximum 42.8Kbps (Out-band/Upload)
5. **Transmit Power** : 2 Watt GSM 850/900
   1 Watt GSM DCS 1800/1900
6. **Receiver Quality** : Operate in -51dBm to -110dBm
7. **SIM Interface** : Provided 1 SIM Card holder
8. **SIM Control Voltage** : 3 V
9. **Number of Ports** : One 10/100 Base-T Ethernet port
   One RS-232 (Isolation) port TXD/RXD/SG signals

10. **Serial Parameters** : Configurable Asynchronous Serial Data:
    Baud rate: 4800/ 9600/ 19200/ 38400/ 57600/ 115200
    Data Bits: 8 / 7 bits
    Stop Bit: 1 / 2 bits
    Parity Bit: None / Even / Odd / Mark / Space

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11.	**Ethernet Parameters**	: Configurable IP Network: IP address in Client / Server / TCP / UDP Mode Port forwarding capabilities Target determination for Serial or Ethernet from GPRS
12.	**Optional Parameters**	: 2 bytes Synchronizations pattern definition 2 GPRS Channel for separated 2 data transmission APN definition available PIN Code definition or bypassing feature
13.	**Antenna**	: Detachable Antenna with Cable SMA Connector
14.	**Surge Withstand Capability (SWC)**	ANSI/IEEE C37.90.1-1989 : (Differential Mode Only) 3KV Oscillatory Test 5KV Fast Transient Test
15.	**Power Requirement**	: +5VDC ±5%, 250mA Operational in Veesta-RTU2000 Subrack back-plane
16.	**Card Dimension**	: 160mm * 100mm
17.	**Environment**	
	Operating Temperature	: -25°C to 70°C
	Storage Temperature	: -40°C to 85°C
	Relative Humidity	: 10% to 95% non-condensing

3.4.5 VR-2426 GPRS / 3G Modem Specifications

1.	**Standard**	: GSM / GPRS / EDGE / HSDPA / UMTS / 3G Networks
2.	**Band Options**	: Dual-band UMTS/HSDPA900/2100MHz Quad-band GSM/GPRS/EDGE 850/900/1800/1900MHz
3.	**GPRS Multi-slot class**	: Class 12
4.	**EDGE Multi-slot class**	: Class 12
5.	**WCDMA 3GPP**	: Release 5
6.	**GPRS Data rates**	: Maximum 85.6Kbps (In-band/Download) Maximum 42.8Kbps (Out-band/Upload)
7.	**EDGE Data rates**	: Maximum 236.8Kbps (In-band/Download) Maximum 118Kbps (Out-band/Upload)

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8.	**WCDMA Data rates**	: Maximum 384Kbps (In-band/Download) Maximum 384Kbps (Out-band/Upload)
9.	**HSPDA Data rates**	: Maximum 3.6Mbps (In-band/Download)
10.	**Transmit Power**	: 2 Watts GSM 850 / GSM 900 1 Watt GSM DCS 1800 / PCS 1900 0.25 Watt UMTS 850 / 1900 0.25 Watt UMTS 900 / 2100
11.	**Receiver Quality**	: Operate in lowest -112dBm
12.	**SIM Interface**	: Provided 1 SIM Card holder
13.	**SIM Control Voltage**	: 3 V
14.	**Number of Ports**	: One 10/100 Base-T Ethernet port One RS-232 (Isolation) port TXD/RXD/SG signals
15.	**Serial Parameters**	: Configurable Asynchronous Serial Data: Baud rate: 4800/ 9600/ 19200/ 38400/ 57600/ 115200 Data Bits: 8 / 7 bits Stop Bit: 1 / 2 bits Parity Bit: None / Even / Odd / Mark / Space
16.	**Ethernet Parameters**	: Configurable IP Network: IP address in Client / Server / TCP / UDP Mode Port forwarding capabilities Target determination for Serial or Ethernet from GPRS
17.	**Optional Parameters**	: 2 bytes Synchronizations pattern definition 2 GPRS Channel for separated 2 data transmission APN definition available PIN Code definition or bypassing feature
18.	**Antenna**	: Detachable Antenna with Cable SMA Connector
19.	**Surge Withstand Capability (SWC)**	ANSI/IEEE C37.90.1-1989 : (Differential Mode Only) 3KV Oscillatory Test 5KV Fast Transient Test
20.	**Power Requirement**	: +5VDC ±5%, 250mA Operational in Veesta-RTU2000 Subrack back-plane
21.	**Card Dimension**	: 160mm * 100mm
22.	**Environment**	
	Operating Temperature	: -25°C to 70°C
	Storage Temperature	: -40°C to 85°C
	Relative Humidity	: 10% to 95% non-condensing

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Chapter 4 - Power Unit

4.1 General

The quality of power supply unit, directly affects the reliability of entire system, and the more it must reach the hazardous electrical environment need.

The PS card of V-RTU2000 Series is designed in 2 stages conversion, which is the core of the entire power unit with 70% to 90% of conversion efficiency will surely reduce the heat efficient of the system, providing wide input voltage range, from DC 24V~ DC 75V, AC 85V~AC 265V, to sustain the variations of power source at utility site. Between the input and output isolation, designed with 2500Vrms Voltage isolation, also providing the plug-in type in designing the power supply unit. The entire power source is featuring for it in Plug-In design.

The power unit of V-RTU2000 Series is consisted of the followings:

- **DC 24V/DC 5V & 24V PS Card**: Power supply card, is designed in DC 12V~75V input and DC 5V (10W), DC 24V (3W) output. Connecting with the backplane it is linking with 48-pin DIN connector, which provides DC 5V working power for all Cards and DC 24V relay driving power for HDO Card.

- **AC 220V/DC 5V & 24V PS Card**: Power supply card, is designed in AC 85V~265V or DC 65V~375V input and with DC 5V (10W), DC 24V (3W) output. Connecting with the backplane it is linking with 48-pin DIN connector, which provides DC 5V working power for all Cards and DC 24V relay driving power for HDO Card.

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4.2 DC 24V/DC 5V & 24V L-PS Card

DC 24V/DC 5V & 24V PS Card is used to convert the field power of DC 24V to DC 5V for supplying the working power to the card under through backplane also supporting another set of DC 24V supplying power to DO/HDO card under through backplane as well. The card is designed with an isolation "power failure detection circuit". Upon detecting that the input power is lower than the set value, it will send out Power Fail (/PF) signal to other cards through backplane.

4.2.1 VR-2707B Specifications

1	**Input Voltage Range**	: 24V to 75V DC
2.	**Output Voltage**	: 5V ±0.1V DC 24V ±1V DC (Internal Used)
3.	**Output Power**	: 10W (DC 5V) 3W (DC 24V)
4.	**Output Short Circuit Protection**	: Continuous (Auto-Restart)
5.	**Output Over-Voltage Protection**	: Clamping at 6.2V DC
6.	**Efficiency**	: > = 80%
7.	**Isolation - Input to Output**	: DC 1800V, AC 1500V
8.	**Surge Withstand Capability (SWC)**	: ANSI/IEEE C37.90.1-1989 (3KV Oscillatory Test, 5KV Fast Transient Test)
9.	**Common Mode Voltage**	: 250V DC (Min.)
10.	**Card Dimension**	: 160mm * 100mm
11.	**Environment**	
	Operating Temperature	: -25°C to 70°C
	Storage Temperature	: -40°C to 85°C
	Relative Humidity	: 10% to 95% non-condensing

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4.3 AC 220V/DC 5V & 24V H-PS Card

AC 220V/DC 5V & 24V PS Card is used to convert the field power of AC 220V or DC 220V to DC 5V for supplying the working power to the card under through backplane also supporting another set of DC 24V supplying power to DO/HDO card under through backplane as well. The card is designed with an isolation "power failure detection circuit". Upon detecting that the input power is lower than the set value, it will send out Power Fail (/PF) signal to other cards through backplane.

4.3.1 VR-2708B Specifications

1. **Input Voltage Range**	: 85Vrms to 265Vrms AC, or 65V to 375V DC
2. **Output Voltage**	: 5V ±0.1V DC 24V ±1V DC (Internal Used)
3. **Output Power**	: 10W (DC 5V) 3W (DC 24V)
4. **Output Short Circuit Protection**	: Continuous (Auto-Restart)
5. **Output Over-Voltage Protection**	: Clamping at 6.2V DC
6. **Efficiency**	: > = 80%
7. **Isolation - Input to Output**	: DC 1800V, AC 1500V
8. **Surge Withstand Capability (SWC)**	: ANSI/IEEE C37.90.1-1989 (3KV Oscillatory Test, 5KV Fast Transient Test)
9. **Common Mode Voltage**	: 250V DC (Min.)
10. **Card Dimension**	: 160mm * 100mm
11. **Environment**	
Operating Temperature	: -25°C to 70°C
Storage Temperature	: -40°C to 85°C
Relative Humidity	: 10% to 95% non-condensing

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Chapter 5 - Digital Input Unit

5.1 General

In hardware, digital input (DI) Card provided with 8 DI Points (CH1~CH8), 1 Common Point (COM) and 1 Framing Ground (FG).

The different card types provided by V-RTU2000 Series are as listed below:

- **DI Card (DC 24/48V)**: Digital Input Card, 8 Points / Card, DC 24/48V Sense Voltage.
- **DI Card (DC 129V)**: Digital Input Card, 8 Points /Card, DC 129 V Sense Voltage.
- **ACC Card (DC 24V)**: Digital Input Accumulator Pulse Counter Card, 8 Points / Card, DC 24V Sense Voltage.
- **ACC Card (DC 129V)**: Digital Input Accumulator Pulse Counter Card, 8 Points / Card, DC 129V Sense Voltage.

In practical, DI Card may be defined as:

MCD (Momentary Change Detection) Simple Status

SOE (Sequence of Event)

ACC Pulse Accumulator

No matter the DI or ACC the De-bounce Time is software programmable from 1ms to 250ms of 1ms as a step. The following explanation does not set DI or ACC, certainly, it just discusses the hardware.

5.2 DI Card

Digital Input Card is an intelligent IO Card, which is used to detect the status of the field equipment, such as the status of CB/Relay and the minor/major alarm of transformer, etc. Basic structure is CPU come with its Firmware; also provide the interface circuit, for some input status requirement. It connects with CPU Card under through LIOC RS-485 communication interface, the DATA & /DATA Communication Signal is directly linked by the backplane without additional wirings. The external connection contains 8 Digital Input Points (CH1~CH8), 1 Common Point (COM) and 1 Framing Ground (FG), which are transmitted through 96-Pin DIN Connector to 10-Pin terminal on the backplane for actual application. In design, the input is acceptable for bipolar signal and the common point can be either “plus” or “minus”.

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5.2.1 VR-2722A Specifications

1.	**Microprocessor**	: AT89C2051, 12MHz
2.	**Memory**	: 2K Bytes Flash ROM 128 Bytes SRAM
3.	**Input Channel**	: 8 Channels
4.	**Current Limit**	: 36K ohm / 2W for 129V DC (Limiting Resistor for each Channel)
5.	**Input Type**	: Bipolar
6.	**Min. Turn On Voltage**	: 65V DC for 129V DC
7.	**Max. Turn Off Voltage**	: 50V DC for 129V DC
8.	**De-bounce Time**	: 1ms ~ 250ms (Software Definable)
9.	**Max. Input Voltage**	: 200V DC for 129V DC
10.	**Max. Input Frequency**	: 100 Hz (Low & High Time > De-bounce Time)
11.	**Common Mode Voltage**	: 250V DC (Min.)
12.	**Isolation**	
	Internal to Digital Input	: 3000Vrms
13.	**Surge Withstand Capability (SWC)**	: ANSI/IEEE C37.90.1-1989 (3KV Oscillatory Test, 5KV Fast Transient Test)
14.	**Power Requirement**	: + 5V DC ±5%, 100mA
15.	**Card Dimension**	: 160mm * 100mm
16.	**Environment**	
	Operating Temperature	: -25°C to 70°C
	Storage Temperature	: -40°C to 85°C
	Relative Humidity	: 10% to 95% non-condensing

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5.2.2 VR-2723A Specifications

1.	**Microprocessor**	: AT89C2051, 12MHz
2.	**Memory**	: 2K Bytes Flash ROM 128 Bytes SRAM
3.	**Input Channel**	: 8 Channels
4.	**Current Limit**	: 6K ohm / 2W for 24V DC (Limiting Resistor for each Channel)
5.	**Input Type**	: Bipolar
6.	**Min. Turn On Voltage**	: 12V DC for 24V or 48V DC
7.	**Max. Turn Off Voltage**	: 9V DC for 24V or 48V DC
8.	**De-bounce Time**	: 1ms ~ 250ms (Software Definable)
9.	**Max. Input Voltage**	: 60V DC for 24V or 48V DC
10.	**Max. Input Frequency**	: 100 Hz (Low & High Time > De-bounce Time)
11.	**Common Mode Voltage**	: 250V DC (Min.)
12.	**Isolation**	
	Internal to Digital Input	: 3000Vrms
13.	**Surge Withstand Capability (SWC)**	: ANSI/IEEE C37.90.1-1989 (3KV Oscillatory Test, 5KV Fast Transient Test)
14.	**Power Requirement**	: + 5V DC ±5%, 100mA
15.	**Card Dimension**	: 160mm * 100mm
16.	**Environment**	
	Operating Temperature	: -25°C to 70°C
	Storage Temperature	: -40°C to 85°C
	Relative Humidity	: 10% to 95% non-condensing

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Chapter 6 - Digital Output Unit

6.1 General

The V-RTU2000 Series unit comprises two DO cards, namely, DO Card and HDO Card. The DO Card is used in smaller current control application. The HDO (High density DO) Card provides 10A (2000VA, 200W) contact capacity of relay for application using. It provide 4 Select Relays (CH1~CH4) and 1 Main Execution Relay.

For application, DO Card and HDO Card can be defined as:

- Trip / Close Control Output
- Raise / Lower AGC Control Output

The DO Card and HDO Card output can be defined as Pulse Output or Level Output.

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6.2 DO Card

Digital Output Card is an intelligent IO Card, which is used to control the operation of field equipment, such as the use/lock of protection relay, manual/auto of transformer AVR control, and AGC control of generator set, etc. Providing basic CPU comply with its Firmware, also providing the drive circuit, for control output. It connects with CPU Card through LIOC RS-485 communication interface, the DATA & /DATA Communication Signal is linked by the backplane without additional wirings. The external connection contains 8 Digital Output Points (CH1~CH8), 1 Common Point (COM+) and 1 Framing Ground (FG) in the model of VR-2736 and 2 Common Point (COM1,COM2) in the model of VR-2736A, which are transmitted through 96-Pin DIN Connector to 10-Pin terminal on the backplane for actual application. On VR-2736 DO Card, the relay contact is designed in 1a+1b for the user to select "a" type contact or "b" type contact. On VR-2736A DO Card, there is selectable by strap of J2, J3 to choose auto-resettable fuse for two output contacts and/or high current 10A fuse with Main Execution Relay.

6.2.1 VR-2736 Specifications

1. **Microprocessor** : AT89C2051, 12MHz
2. **Memory** : 2K Bytes Flash ROM
   128 Bytes SRAM
3. **Output Channels** : 8 Channels
4. **Contact Type** : 1 Contact O/P
5. **Contact Rating** : 5A at 250V AC
   5A at 30V DC
6. **Max. Switching Voltage** : 380V AC
   125V DC
7. **Isolation - Coil to Contact** : AC 2000V
8. **Common Mode Voltage** : 250V DC (Min.)
9. **Surge Withstand Capability (SWC)**: ANSI/IEEE C37.90.1-1989
   (3KV Oscillatory Test, 5KV Fast Transient Test)
10. **Power Requirement** : +5V DC ±5%, 100mA
11. **Card Dimension** : 160mm * 100mm
12. **Environment**
    Operating Temperature : -25°C to 70°C
    Storage Temperature : -40°C to 85°C
    Relative Humidity : 10% to 95% non-condensing

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6.3 HDO Card

Digital Output Card (heavy duty) is an intelligent IO Card, which is used to control the action of the field equipment, such as Trip/Close of CB, use/lock of protection relay and manual/auto of transformer AVR control, etc. In addition to CPU comply with its Firmware, the drive circuit for controlling the output is also provided. It can connect with CPU Card through LIOC RS-485 communication interface, the DATA & /DATA Communication Signal is linked by the backplane without additional wirings. The card model VR-2735 external connection contains 4 Select Relay (CH1~CH4) and 1 Main Execution Relay (ME), and model VR-2737 consist of 4 direct control relay which are transmitted through 96-Pin DIN Connector to 10-Pin terminal on the backplane for actual application. The Relay contact type of HDO Card is 1c; the user can select contact “a” or contact “b”.

6.3.1 VR-2735 / VR-2737 Specifications

1.	**Microprocessor**	: AT89C2051, 12MHz
2.	**Memory**	: 2K Bytes Flash ROM 128 Bytes SRAM
3.	**Output Channels**	: **VR-2735 Model:** 4 Select Relay + 1 Main Execution Relay **VR-2737 Model:** 4 Direct Execution Relay
4.	**Contact Type**	: 1 Contact O/P (1a or 1b selectable)
5.	**Contact Rating (Max. Carrying Current)**	: 10A (2000VA, 200W)
6.	**Max. Switching Voltage**	: 400V AC or 300V DC
7.	**Isolation - Coil to Contact**	: AC 2000V
8.	**Common Mode Voltage**	: 250V DC (Min.)
9.	**Surge Withstand Capability (SWC)**	: ANSI/IEEE C37.90.1-1989 (3KV Oscillatory Test, 5KV Fast Transient Test)
10.	**Power Requirement**	: +5V DC ±5%, 100mA
11.	**Card Dimension**	: 160mm * 100mm
12.	**Environment**	
	Operating Temperature	: -25°C to 70°C
	Storage Temperature	: -40°C to 85°C
	Relative Humidity	: 10% to 95% non-condensing

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Chapter 7 - Analog Input Unit

7.1 General

The Analog Input Unit of V-RTU2000 Series comprises three card types. Each AI cards board provides 4 Differential Channels (CH1+/CH1- ~ CH4+/CH4-) and 2 Shielding Points (S1, S2). Listed below is the card types provided by the V-RTU2000 Series:

- **AI Card (+/-1mA)**: Analog Input Card, 4 Differential Channels / Card, Input Range +/-1mA.
- **AI Card (4~20mA)**: Analog Input Card, 4 Differential Channels / Card, Input Range 4~20mA.
- **AI Card (-5 ~ +5V)**: Analog Input Card, 4 Differential Channels / Card, Input Range +/- 5VDC.

For application, AI Card is normally used to measure output signals from power transducer of Watt, Var, Voltage, Current, Temperature, Position, Resistance, as to monitor the operation status of power system, including the measured values of current, temperature and Tap position.

7.2 AI Card

Analog Input Card is an intelligent IO Card, which is used to measure the output values of power transducer as to monitor the status for power system, including current, temperature and Tap position. It contains CPU comply with its Firmware, it also provides interface and converting circuit required for analog input. It connects to CPU Card through LIOC RS-485 communication interface, the DATA & /DATA Communication Signal is linked by the backplane without additional wirings. The external connection contains 4 Differential Input Channels (Ch1+/CH1- ~ CH4+/CH4-) and 2 Shielding (S1, S2), which are transmitted through 96-Pin DIN Connector to 10-Pin terminal on the backplane for actual application. In design, the analog and digital circuits are isolated using differential input type to provide stronger restraining power to press down the common mode noise.

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7.2.1 VR-2741 / VR-2742 / VR-2743 Specifications

1. **Microprocessor** : AT89C2051, 12MHz
2. **Memory** : 2K Bytes Flash ROM, 128 Bytes SRAM
3. **Input Channels** : 4 Channels, differential input
4. **Input Impedance** : 1000 ±0.01% ohm for ±1mA
   250 ±0.01% ohm for 4 ~ 20mA
   1M ohm for ±5V voltage input
5. **Input Range** : **VR-2741 Model:** ±1mA
   VR-2742 Model: 4 ~ 20mA
   VR-2743 Model: ±5V
6. **Scan Time** : 1 sec
7. **Resolution** : 16 Bit
8. **Accuracy** : ±0.1% at 25°C
9. **Temperature Coefficient** : 50 PPM / °C
10. **CMRR** : 100 dB / 60Hz
11. **NMRR** : 60 dB / 60Hz
12. **Common Mode Voltage** : 250V DC (Min.)
13. **Isolation**
    Internal to Analog Input : 3000V DC
    Channel to Channel : 35V DC
14. **Surge Withstand Capability (SWC)**: ANSI/IEEE C37.90.1-1989
    (3KV Oscillatory Test, 5KV Fast Transient Test)
15. **Power Requirement** : +5V DC ±5%, 150mA
16. **Card Dimension** : 160mm * 100mm
17. **Environment**
    Operating Temperature : -20°C to 70°C
    Storage Temperature : -40°C to 85°C
    Relative Humidity : 10% to 95% non-condensing

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Chapter 8 - Analog Output Unit

8.1 General

The Analog Output Unit of V-RTU2000 Series is designed with one card which is AO Card (Analog Output), in which each PC board provides 4 Differential Channels (CH1+/CH1- ~ CH4+/CH4-) and 2 Shielding Points (S1, S2). The card type provided by V-RTU2000 Series are as listed below:

- **AO Card (+/-1mA)**: Analog Output Card, 4 Differential Channels / Card, Output Range +/-1mA.
- **AO Card (4~20mA)**: Analog Output Card, 4 Differential Channels/ Card, Output Range 4~20mA.

For application, AO Card is normally used to execute the Analog Raise/Lower AGC Output control for controlling the load raise/lowering setting of the generator set.

8.2 AO Card

Analog Output Card is an intelligent IO Card, which is used to execute the Analog Raise/Lower Output control. It contains CPU comply with its Firmware, it also provides interface and converting circuit for analog output conversion. It connects with CPU Card through LIOC RS-485 communication interface, the DATA & /DATA Communication Signal is linked by the backplane without additional wirings. The external connection contains 4 Differential Input Channels (Ch1+/CH1- ~ CH4+/CH4-) and 2 Shielding (S1, S2), which are transmitted through 96-Pin DIN Connector to 10-Pin terminal on the backplane for actual application. In principle design, the analog and digital circuits are isolated.

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8.2.1 VR-2751 / VR-2752 Specifications

1. **Microprocessor** : AT89C2051, 12MHz
2. **Memory** : 2K Bytes Flash ROM, 128 Bytes SRAM
3. **Output Channels** : 4 Channels, differential output
4. **Resolution** : 12 Bits
5. **Accuracy** : ±0.25% at 25°C
6. **Settling Time** : 100ms to 0.1% (Max.) (Full Range Step)
7. **Output Type** : Unipolar and Bipolar Voltage / Current plus Offset Current
8. **Output Range** : **VR-2751 Model:** -1 to 1mA, 5000 ohm Max.
   VR-2752 Model: 4 to 20mA, 500 ohm Max.
9. **Temperature Coefficient** : 100 PPM / °C
10. **Common Mode Voltage** : 250V DC (Min.)
11. **Isolation**
    Internal to Analog Output : 1500V DC
12. **Surge Withstand Capability (SWC)** : ANSI/IEEE C37.90.1-1989 (3KV Oscillatory Test, 5KV Fast Transient Test)
13. **Power Requirement** : +5V DC ±5%, 200mA
14. **Card Dimension** : 160mm * 100mm
15. **Environment**
    Operating Temperature : -20°C to 70°C
    Storage Temperature : -40°C to 85°C
    Relative Humidity : 10% to 95% non-condensing

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Chapter 9 - Analog AC Input Unit

9.1 General

The Analog AC Input Unit of V-RTU2000 Series is designed with two modules name of ACI VR-2745 for measurement of independent current input and model and ACV VR-2746 for measurement of independent voltage AC signal input. The PT and CT of fields can be connected directly to these cards.

9.2 ACI Card

The design concept of Model VR-2745 ACV card was based on Microprocessor. It uses 16 bit A/D to design its current module cards for voltage measurement of RTU. Its back side of communication port is using the protocol of RTU Local I/O, while the frond RS-232 communication port is for maintenance only. And this RS-232 port is easy accessed and programmed by PC Tool to setup the parameters and records.

The ACI Card Features:

- 4 sets AC current input : 0-1A or 0-5A
- Each sampling cycle : 32 points
- True RMS converter
- Low importation burden
- Accuracy : ≦ 0.5% fs
- Field programmable CT ratio
- Instant maximum and minimum logger
- Event record : 32 events
- Data updating interval : 1 second
- Fault current detection (sample rate 1ms)
- Communication port : RS-485 + RS-232
- Completely modulated and plug-in type cards which is easy to maintain

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9.2.1 VR-2745 Specifications

1.	**Input Channel**	: 4 sets of independent cuurent
2.	**Input Range**	: Current: 0-1A or 0-5A AFx = 20 x CT (fault current detection) Frequency : 50/60 ±3Hz
3.	**Accuracy**	: 0.5% fs (0.01 - 1.3 x CT) 0.8% fs (1.2 - 20 x CT) Phase angle measuring error ≦ 2°
4.	**Sampling Rate**	: 32 points for each cycle
5.	**Input Burden**	: < 0.2 VA / phase
6.	**Fault Current Detection**	: Mode 0: One fault-based-curved, 16 set-point group Mode 1: User definable, 4-point phase & ground time over-current curve
7.	**Communication Port**	: Data rate RS-232 : 9600 bps RS-485 : 62.5K bps
8.	**Insulation ability**	: Internal circuit against 3000Vdc analog input
9.	**Impulse Test**	: ANSI/IEEE c37.90.1-2002 (2.5KV) SWC IEC 61000-4-12 classⅢ SWC IEC 61000-4-4 classⅣ SWC IEC 61000-4-5 classⅣ Impulse
10.	**Power Requirement**	: +5V DC ±5%, 150mA
11.	**Card Dimension**	: 160mm * 100mm
12.	**Environment**	
	Operating Temperature	: -25°C to 70°C
	Storage Temperature	: -40°C to 85°C
	Relative Humidity	: 10% to 95% non-condensing

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9.3 ACV Card

The design concept of Model VR-2746 ACV card was based on Microprocessor. It uses 12 bit A/D to design its voltage module cards for voltage measurement of RTU. Its back side of communication port is using the protocol of RTU Local I/O, while the frond RS-232 communication port is for maintenance only. And this RS-232 port is easy accessed and programmed by PC Tool to setup the parameters and records.

The ACV Card Features:

- 4 sets AC voltage input : 0-300V
- Each sampling cycle : 32 points
- True RMS converter
- Accuracy : ≦ 0.5% fs
- Field programmable PT ratio
- Instant maximum and minimum logger
- Event record : 32 events
- Data updating interval : 1 second
- Communication port : RS-485 + RS-232
- Completely modulated and plug-in type cards which is easy to maintain

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9.3.1 VR-2746 Specifications

1. **Input Channel**	: 4 sets of independent voltage
2. **Input Range**	: Voltage: 0-300V Frequency : 50/60 ±3Hz
3. **Accuracy**	: Voltage : 0.5% fs Phase angle measuring error ≦ 2°
4. **Sampling Rate**	: 32 points for each cycle
5. **Input Impedance**	: 1MΩ ± 2% (each set)
6. **Communication Port**	: Data rate RS-232 : 9600 bps RS-485 : 62.5K bps
7. **Insulation ability**	: Internal circuit against 3000Vdc analog input
8. **Impulse Test**	: ANSI/IEEE c37.90.1-2002 (2.5KV) SWC IEC 61000-4-12 classⅢ SWC IEC 61000-4-4 classⅣ SWC IEC 61000-4-5 classⅣ Impulse
9. **Power Requirement**	: +5V DC ±5%, 150mA
10. **Card Dimension**	: 160mm * 100mm
11. **Environment**	
Operating Temperature	: -25°C to 70°C
Storage Temperature	: -40°C to 85°C
Relative Humidity	: 10% to 95% non-condensing

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Chapter 10 - Analog AC Power Input Unit

10.1 General

The Analog AC Power Input Unit of V-RTU2000 Series is designed with modules named ACPM VR-2749 models.

10.2 ACPM Card

The design concept of V-RTU2000 Series ACPM Model VR-2749A card was based on Microprocessor. It uses 12 bit A/D to current, Watt and etc module cards for power related parameters measurement of RTU. Its back side of RS-485 communication port is using the protocol of RTU Local I/O, while the frond RS-232 communication port is for maintenance only. And this RS-232 port is easy accessed and programmed by PC Tool to setup the parameters and records.

The ACPM Card Features:

- 3-phase current input : 1A or 5A
- 3-phase voltage source input
- True RMS conversion
- For power related parameters
- 32 sample point per cycle
- Field programmable PT/CT ratio
- Fault current detection
- Voltage synchronism check
- Harmonics analysis up to 15th
- Data updating interval : 1 second
- Communication port : RS-485 + RS-232
- Completely modulated and plug-in type cards which is easy to maintain

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10.2.1 VR-2749A Specifications

1. **Input Channel**	: 3-AC current (Ia, Ib, Ic) 3-AC voltage (Va, Vb, Vc)
2. **Input Range**	: Current : 1A of rating (CT) AFx : 16 x CT (fault current) Voltage : 0-5V Frequency : 50/60 ±3Hz
3. **Accuracy**	: Voltage : 0.5% fs Current : 0.5% fs (0.01-1.3 x CT) 1% fs (1.3-16 x CT) Timing : at ≧ 1.00 x pickup ±3% of trip time or ±20ms (whichever is greater) W/Var/VA/PF : 2% fs WH/VarH : 5% rd Phase angle measuring error ≦ 2°
4. **Input burden**	: Current : <0.2VA Voltage : ≧ 1MΩ
5. **Communication Port**	: Data rate RS-232 : 9600 bps RS-485 : 62.5K bps RS-232 + RS-485 (RTU local I/O)
6. **Configuration**	: Fault current detection (mode 0) One fault-based-curve 16 set-point groups (Ip-Pu,Mp,Ig-Pu, Mg) Fault current detection (mode 1) User definable 4-point phase time over-current curve 4-point ground time over-current curve
7. **Insulation ability**	: Internal circuit against 3000Vdc analog input
8. **Power Requirement**	: +24V DC ±20%, 100mA
9. **Card Dimension**	: 160mm * 100mm
10. **Environment**	
Operating Temperature	: -25°C to 70°C
Storage Temperature	: -40°C to 85°C
Relative Humidity	: 10% to 95% non-condensing

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10.2.2 Fault Current Detection Function

10.2.2.1 Fault-Based-Curve

One user programmable Fault-Based-Curve can be stored in the ACPM Card Model VR-2749A. This can be used for time over-current detection in the same as IEC, ANSI curves. The custom Fault-Based-Curve has set-points for entering times to fault at the following current levels (I/Ipu): 1.00 to 1.20 in steps of 0.05 and 1.20 to 6.00 in steps of 0.4, and 6.0 to 16.0 in steps of 2.0. The ACPM then converts these points to a continuous curve by linear interpolation between data points.

(I/Ipu)	Fault Time	(I/Ipu)	Fault Time	(I/Ipu)	Fault Time
1.00	0-65535	2.80	0-65535	6.00	0-65535
1.05	0-65535	3.20	0-65535	8.00	0-65535
1.10	0-65535	3.60	0-65535	10.0	0-65535
1.15	0-65535	4.00	0-65535	12.0	0-65535
1.20	0-65535	4.40	0-65535	14.0	0-65535
1.60	0-65535	4.80	0-65535	16.0	0-65535
2.00	0-65535	5.20	0-65535		
2.40	0-65535	5.60	0-65535		

10.2.2.2 Fault-Alarm-Curve

The required Fault-Alarm-Curve is established by programming a Pickup Current and a Curve Multiplier. The Pickup Current is the threshold current at which the fault detection starts timing, range from 0.05 to 16.00 CT. The Curve Multiplier allows shifting of the programmed base curve in the vertical time direction, range from 0.00 to 100.00. The formula is:

T = M * Tfbc (at I/Ipu)

Where

T = Fault Alarm Time (ms)

M = Curve Multiplier

Tfbc = Fault Base Time (ms) at I/Ipu

I = Input Current

Ipu = Pickup Current

10.2.2.3 Set-point Group

In VR-2749A ACPM Model, the set-points (Ip-pu, Mp) are used for all three phase time over-current detection, and the set-points (Ig-pu, Mg) are used for ground time over-current detection only. Sixteen user programmable set-point groups (Ip-pu, Mp, Ig-pu, Mg) (G-00 to G-15) can be stored in VR-2749A. (In other word, there are 16 phase fault-alarm-curves and 16 ground fault-alarm-curves.) Via communications, host can select the active set-point group remotely, and the active group no, the active Ip-pu, the active Mp, the active Ig-pu, and the active Mg value can be read-back.

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Chapter 11 - Universal Intelligent AC Power Meter Unit

11.1 General

In principle design, the VR-2760 Power Meter from V-RTU2000 Series of products is of intelligent Power Meter which is with high-precision intelligent digital power transducer, having capacity to measure the input signals of 3 currents (CT) and 3 voltages (PT), can directly measure up more over 100 kinds of power parameters. This unit is equipped with 2 sets of CPU comply with its Firmware, enhancing analog sampling and digital computation function. It connects to CPU Card through RS-485 communication interface which is on the first group of backplane. The hardware is designed in standard DIN rack mounting by plug-in type for meeting the DIN specification, under in one-switching V.S linking with external CT terminal. Other terminals include 3 PT, working power and 2 communication interfaces (COM1 and COM2) for transmitting to the backplane terminal for actual application through under 96-Pin DIN Connector. In design, the analog circuit and digital circuit are arranged into different circuit board.

11.2 ACUP Card

The VR-2760 Digital Power Meter Unit is microprocessor-based instrument intended for power and energy measurement. Additional functionality option to provide control function as synchro check, The VR-2760 is Universal Intelligent Electronic Device (IED) and stores these measured values and setting parameters in internal registers for communication. With the features, high accuracy, fully modularized & plug-in design, and compact size, VR-2760 is very suitable for Electric Utility Substation Automation application.

The ACUP Card Features:

- Current input terminal with automatic shorting mechanism
- Over 90 power and energy parameters
- Modbus® RTU / DNP3.0 protocol
- 4-AC current inputs, 5A or 1A (specified when ordering)
- 4-AC voltage inputs, maximum 300V
- True RMS conversion
- 32 sample points per cycle
- Instant maximum and minimum logger
- Waveform capture
- 200 event logs for all measured quantities

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- Build in RTC (real time clock)
- Field programmable PT / CT ratio
- Accuracy up to 0.15%
- Low input burden 0.5VA (5A / 120V)
- 2 communication Ports, RS-485 + RS-232
- Wide power supply range 80~260V AC / DC
- Memory for all setup and energy data
- Comprehensive self test diagnostic
- “User Map” speed up communication (indirect accessing data)
- Synchrony-check
- Fault current detection (option)
- 2KV RMS input / output / power isolation
- Alphanumeric LED display clear and long-life
- Fully modularized & plug-in type
- Easy in field maintenance

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11.2.1 VR-2760 Specifications

1. **Input Channel**	: 4 - AC Currents (Aa, Ab, Ac, A0) 4 - AC Voltage (Pa, Pb, Pc, Pn for 3-phase input & P1, P2 for separate 1-phase input)
2. **Input Range**	: Voltage : 10-300V Current : Maximum 6A for 5A rating (CT) Maximum 1.2A for 1A rating (CT) Frequency : 40~70 Hz
3. **Accuracy**	: See Next Table
4. **Input burden**	: Voltage : ＜0.15 VA at 300V (or ≧ 1MΩ) Current : ＜0.2VA of rating * Overload Withstand: 2xCT continuous, 25xCT 2sec, 50xCT 1sec
5. **Display**	: LED / 0.2" / green color, 1 rows of 8 characters
6. **Programmability**	: * Communication Baud Rate 1.2K / 2.4K / 4.8K / 9.6K / 19.2K bps Device address 1 ~ 254 * Measured Power System 3P4W / 3P3W / 1P3W / 1P2W 50 / 60 Hz main frequency PT ratio , CT ratio Maximum demand 1-60 minute (A,KW,KVAR,KVA)
7. **Communication Port**	: RS232 (front panel): Modbus RTU protocol only RS485 (rear panel) : Modbus RTU or DNP3.0
8. **Fault Current Detection (Option)**	: (Mode 0) One Fault-Based-Curve 16 set-point groups (Ip-pu, Mp, Ig-pu, Mg) (Mode 1) User definable 4-point phase time over-current curve 4-point ground time over-current curve
9. **Waveform Capture**	: Data Channel: 4 currents, 4 voltages Sample Rate: 32 points per cycle, length 2 cycle
10. **Maximum / Minimum Logger**	20 parameters with time-stamped: : VP1, VP2, VP3, VPE, VPS, VL1, VL2, VL3, VLE, VLS, A1, A2, A3, A0, AE, W, Var, VA, PF, F
11. **Event Logger**	: 200 events with time-stamped status change of switch input Failure in self-test Programming access Fault current recorder (option) Power ON / OFF

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12. Real Time Clock (RTC)	: Maximum deviation 2 sec in 24 hours Time for Year / Month / Day / Hour / Minute / Second
13. Dielectric Strength	: IEC 255-5 2KV AC rms 1 min between input/output/power 2.5KV AC rms 1 min between case / input 2KV AC rms 1 min between case / power
14. Insulation ability	: Internal circuit against 3000Vdc analog input
15. Impulse and Surge Test	: ANSI/IEEE c37.90.1-1989 (3KV) SWC IEC 61000-4-12 Class Ⅲ SWC IEC 61000-4-4 Class Ⅳ SWC IEC 61000-4-5 Class Ⅳ Impulse
16. Stability	: Temperature range (-10 to +50℃), maximum 100 ppm/℃
17. Power Requirement	: LO : DC 20~60V HI : AC 80~260V, 40~70Hz, DC 80~330 V Dissipation maximum 12 VA for AC and 5W for DC
18. Card Dimension	: 208 x 72.6 x 144.6 mm (L x W x H)
19. Environment	
Operating Temperature	: -25°C to 70°C
Storage Temperature	: -40°C to 85°C
Relative Humidity	: 10% to 95% non-condensing

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Table 11-1: VR-2760 Programmable measurements/accuracy/display readouts

Parameter	Digits	Display (maximum)	Accuracy		Phase 1	Phase 2	Phase 3	Total	Average
			option=N	option=A					
Vx3	4	9.9.9.9. V/KV	0.15% fs	0.25% fs	V1	V2	V3		VE
Ax3	4	9.9.9.9. A/KA	0.15% fs	0.25% fs	A1	A2	A3		AE
Watts	4	9.9.9.9. W/KW/MW/GW	0.25% fs	0.25% fs	W1	W2	W3	W	
Vars	4	9.9.9.9. Var/KVar/MVar/GVar	0.25% fs	0.25% fs	Var1	Var2	Var3	Var	
VA	4	9.9.9.9. VA/KVA/MVA/GVA	0.25% fs	0.5% fs	VA1	VA2	VA3	VAE	
PF	4	1.000	0.25% fs	0.25% fs	PF1	PF2	PF3	PF	
WH	7	9.9.9.9.9.9.9. WH/KWH/MWH/GWH	* 0.25% rd/ PF	** 0.5% rd				WH	
VarH	7	9.9.9.9.9.9.9. VarH/KVarH/MVarH/GVarH	* 0.25% rd/ PF	** 0.5% rd				VarH	
A0	4	9.9.9.9. A/KA	0.5% fs	0.25% fs					
AFx3,AF0	4	9.9.9.9. A/KA	None	1% fs					
Hz	4	70.00	0.03% rd	0.03% rd					
Angle	4	359.9 DG	***	***	DG1	DG2	DG3	DG	

* Accuracy performance range for WH/VarH, PF □ 0.5 (-10 to 50□)
PF = Cosθ for WH ; PF = Sinθ for VarH
Voltage □ 60V ; Current □ 20% of rating

** Accuracy performance range for WH/VarH, PF □ 0.5 (-10 to 50□)
PF = Cosθ for WH ; PF = Sinθ for VarH
Voltage □ 60V ; Current □ 10% of rating

*** 0.2° ± SIN^{-1} (0.02 x PF)

11.2.2 Fault Current Detection Function

11.2.2.1 Fault-Based-Curve

One user programmable Fault-Based-Curve can be stored in the ACUP Card Model VR-2760. This can be used for time over-current detection in the same as IEC, ANSI curves. The custom Fault-Based-Curve has set-points for entering times to fault at the following current levels (I/Ipu): 1.00 to 1.20 in steps of 0.05 and 1.20 to 6.00 in steps of 0.4, and 6.0 to 16.0 in steps of 2.0. The ACUP then converts these points to a continuous curve by linear interpolation between data points.

(I/Ipu)	Fault Time	(I/Ipu)	Fault Time	(I/Ipu)	Fault Time
1.00	0-65535	2.80	0-65535	6.00	0-65535
1.05	0-65535	3.20	0-65535	8.00	0-65535
1.10	0-65535	3.60	0-65535	10.00	0-65535
1.15	0-65535	4.00	0-65535	12.0	0-65535
1.20	0-65535	4.40	0-65535	14.0	0-65535
1.60	0-65535	4.80	0-65535	16.0	0-65535
2.00	0-65535	5.20	0-65535		
2.40	0-65535	5.60	0-65535		

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11.2.2.2 Fault-Alarm-Curve

The required Fault-Alarm-Curve is established by programming a Pickup Current and a Curve Multiplier. The Pickup Current is the threshold current at which the fault detection starts timing, range from 0.05 to 16.00 CT. The Curve Multiplier allows shifting of the programmed base curve in the vertical time direction, range from 0.00 to 100.00. The formula is:

T = M * Tfbc (at I/Ipu)

Where

T = Fault Alarm Time (ms)

M = Curve Multiplier

Tfbc = Fault Base Time (ms) at I/Ipu

I = Input Current

Ipu = Pickup Current

11.2.2.3 Set-point Group

In VR-2749 ACPM Model, the set-points (Ip-pu, Mp) are used for all three phase time over-current detection, and the set-points (Ig-pu, Mg) are used for ground time over-current detection only. Sixteen user programmable set-point groups (Ip-pu, Mp, Ig-pu, Mg) (G-00 to G-15) can be stored in VR-2749. (In other word, there are 16 phase fault-alarm-curves and 16 ground fault-alarm-curves.) Via communications, host can select the active set-point group remotely, and the active group no, the active Ip-pu, the active Mp, the active Ig-pu, and the active Mg value can be read-back.

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Chapter 12 - Communication Protocols

12.1 General

In V-RTU2000 Series system, we have a wide range of communication protocols, like DNP3.0, IEC 870-5-101, IEC 870-5-104, ModBus RTU 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 V-RTU2000 RTU system.

12.2 DNP3. Profile

In the table bellow you can find DNP3.0 Profile of Veesta-RTU2000 product series.

Table 12-1: V-RTU2000, DNP3.0 Device Profile Document

DNP 3.0 **DEVICE PROFILE DOCUMENT**	
Vendor Name : ***Veesta World Company***	
Device Name : ***V-RTU2000*** (Veesta Remote Terminal Unit Model 2000 Series)	
Highest DNP Level Supported : For Requests : Level 3 For Responses : Level 3	Device Function : ☐ 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) : Transmitted : 292 Received : 292	Maximum Application Fragment Size (octets): Transmitted : 2048 Received : 2048
Maximum Data Link Re-tries : ☐ None ☐ Fixed ☒ Configurable, range 0 to 10	Maximum Application Layer Re-tries : ☒ None ☐ Configurable
Required Data Link Layer Confirmation : ☐ Never ☐ Always ☐ Sometimes ☒ Configurable (never or always or sometimes)	

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DNP 3.0
DEVICE PROFILE DOCUMENT

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

Device Name : ***V-RTU2000*** (Veesta Remote Terminal Unit Model 2000 Series)

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 **DEVICE PROFILE DOCUMENT**	
Vendor Name : ***Veesta World Company***	
Device Name : ***V-RTU2000*** (Veesta Remote Terminal Unit Model 2000 Series)	
Default Counter Object / Variation : ☐ No Counters Reported ☒ Configurable ☐ Default Object ___Default Variation _ ☐ Point-by-point list attached	Counters Roll Over at : ☐ No Counters Reported ☐ Configurable ☐ 16 Bits ☒ 32 Bits ☐ Other Value ___ ☐ Point-by-point list attached
Sends Multi-Fragment Responses : ☐ Yes ☒ No	

Table 12-2: V-RTU2000, DNP3.0 Interoperability Table

Veesta-RTU2000 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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Veesta-RTU2000 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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Veesta-RTU2000 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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Veesta-RTU2000 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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Chapter 13 - Wiring & Cabling

13.1 General

In V-RTU2000 Series system, for easy installation and maintenance, all wiring for outset connection is through the Terminal Block on the Backplane. In other word, wire isn't necessarily to tack off as card draw out in maintenance.

13.2 Backplane Terminal Wiring

For each RTU Rack have several slots, one Power slot, one Master CPU slot, and several I/O slots (from 5 to 16 I/O slots, depend on RTU type). On Backplane, each slot has one 10-pin pluggable type terminal block for outside wiring (Power slot is 6-pin terminal block). The detailed definitions of each RTU slot are as listed below.

Table 13-1: V-RTU2000 Series as Communication Server Backplane Wiring

Slot		Power	Master CPU		I/O			
					IO CPU		CM	
Card		DC 5V	RS-232	RS-485	RS-232	RS-485	RS-232	RS-485
Terminal Pin No.	**1**	VR+	RXD1	DA1+	RXD1	DA1+	RXD1	DA1+
	2	VR-	TXD1	DA1-	TXD1	DA1-	TXD1	DA1-
	3	FG	RTS1	---	RTS1	---	RTS1	---
	4	PIN+	S1G	---	S1G	---	S1G	---
	5	PIN-	FG	FG	FG	FG	FG	FG
	6	FG	RXD2	DA2+	RXD2	DA2+	RXD2	DA2+
	7	N/A	TXD2	DA2-	TXD2	DA2-	TXD2	DA2-
	8		RTS2	---	RTS2	---	RTS2	---
	9		S2G	---	S2G	---	S2G	---
	10		FG	FG	FG	FG	FG	FG

Table 13-2: V-RTU2000 Series as RTU & IED Backplane Wiring

Slot		Power	CPU		I/O		
Card		DC 5V	RS-232	RS-485	DI/DO	HDO	AI/AO
Terminal Pin No.	**1**	VR+	RXD1	DA1+	CH1	CH1-A	CH1+
	2	VR-	TXD1	DA1-	CH2	CH1-B	CH1-
	3	FG	RTS1	---	CH3	CH2-A	CH2+
	4	PIN+	S1G	---	CH4	CH2-B	CH2-
	5	PIN-	FG	FG	CH5	CH3-A	S1
	6	FG	RXD2	DA2+	CH6	CH3-B	CH3+
	7	N/A	TXD2	DA2-	CH7	CH4-A	CH3-
	8		RTS2	---	CH8	CH4-B	CH4+
	9		S2G	---	COM	ME-A	CH4-
	10		FG	FG	FG	ME-B	S2

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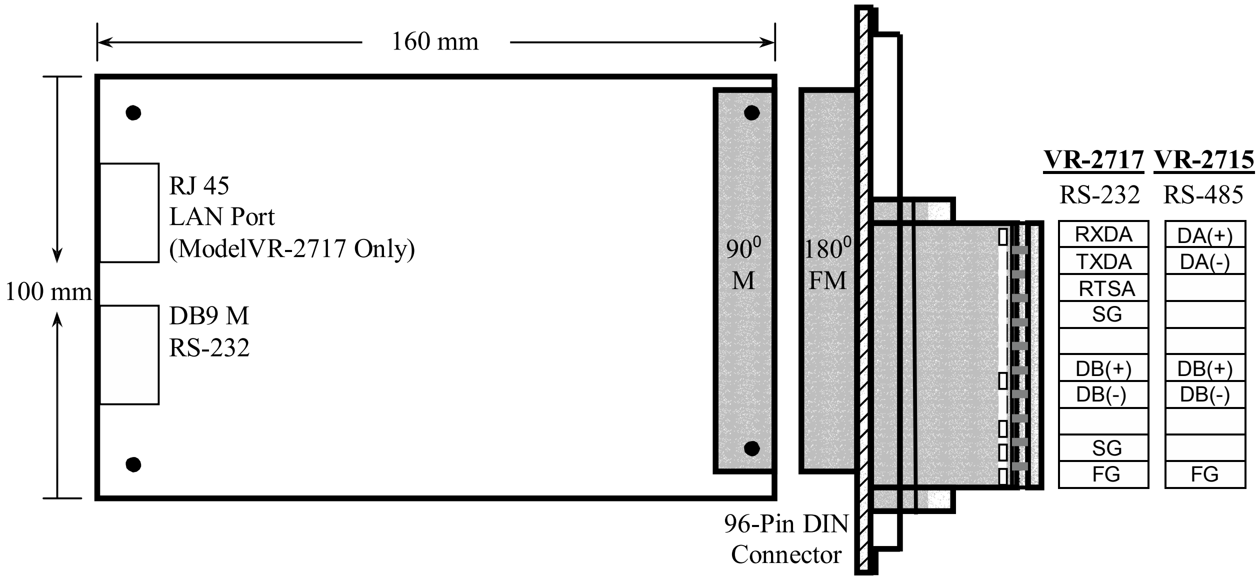
13.3 CPU Card (Master and IO) Wiring

- **Front Panel**: 1 RS-232 channel or with 1 Ethernet Channel
- **Real Panel**: 1 RS-232 and 1 RS-485 channel for VR-2717 model and 2 RS-485 channels for VR-2715 model.



RS-232 signals of CPU Card channel 1 are RXDA, TXDA, RTSA, SG. RS-485 signals of CPU Card channel 1 are DA(+), DA(-) and for channel 2 are DB(+) and DB(-).

Figure 13-1: CPU Card Wiring & Cabling Diagram

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13.4 Communication Module (CM) Card Wiring

- **Front Panel**: 1 RS-232 channel.
- **Real Panel**: 2 RS-232 channels or 2 RS-485 channels.

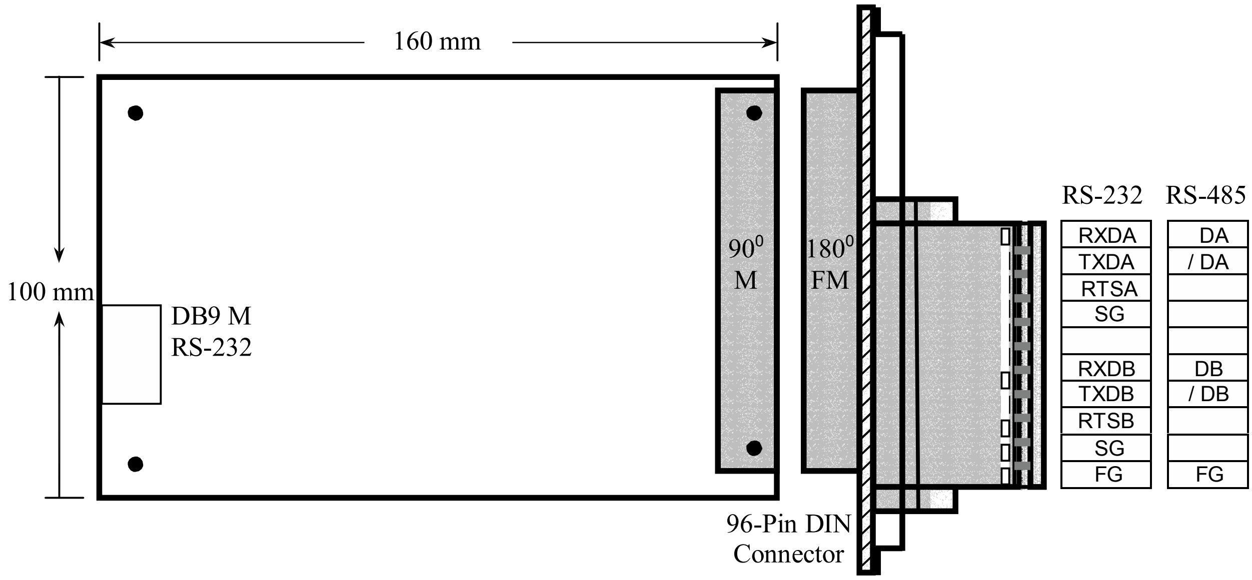

Figure 13-2: CM Card Wiring & Cabling Diagram

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13.5 Power Supply (PS) Card Wiring

- **Front Panel**: Power Switch, 2 LED for 5V 24V, 1 On/Off Swicth
- **Real Panel**: One Field Power (PIN) and one 24VDC Control Power (VR).

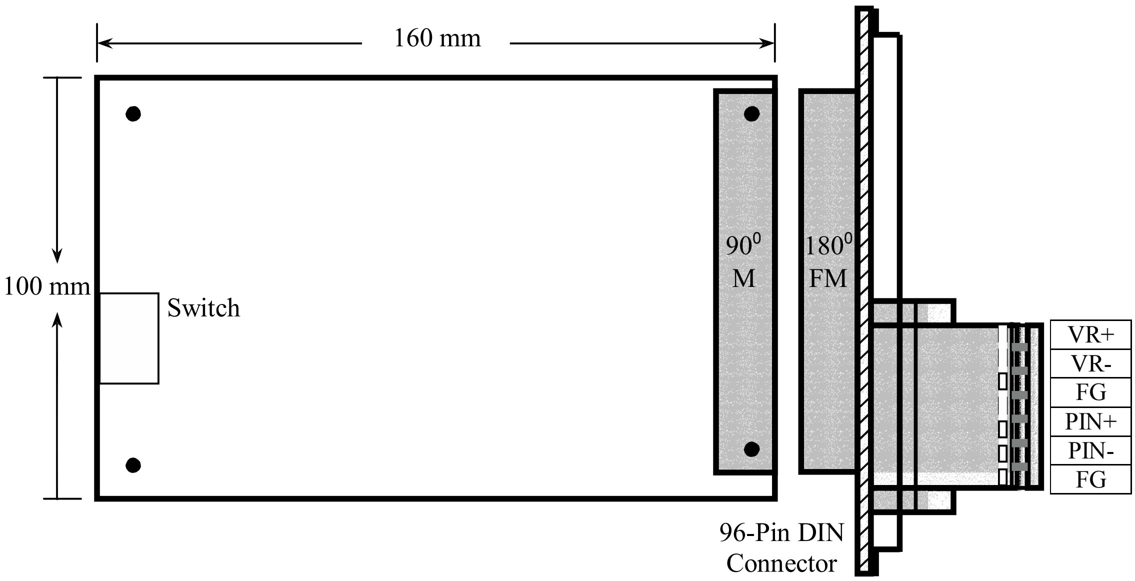

Figure 13-3: PS Card Wiring & Cabling Diagram

- **PIN+**: Power Source Supply Input, Positive Signal.
- **PIN-**: Power Source Supply Input, Negative Signal.
- **FG**: Field Earth or Ground.
- **VR+**: Local/Remote Source Voltage or Indicator positive Signal.
- **VR-**: Local/Remote Source Voltage or Indicator negative Signal.

About VR+ / VR-, please consider that this two terminals act as two options:

- External Local/Remote: This mode has been used for external 24V+ to VR+ and 0V to VR- pin terminal to operate and energize DO relays externally controlled. In this mode the jumper strap of J1 and J2 must be in position of 2-3.
- Indication Local/Remote: This mode has been used to indication of Local/Remote Switch in front of power supply. In this case VR+ act as positive wet digital indication and VR- for 0V of common indication, when L/R switch of PS card be in position of “R” (Remote) so 24V+ will be appear in VR+ terminal to show

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Subrack is in Remote control enabled. If L/R switch positioned to "L" (Local) no 24V+ will be in VR+ terminal. Normally you can route VR+ to one of input of DI Card and VR- to common terminal of DI card. It is most important the common of DI card for your field wiring must be 0V also so you can use from this feature. In this mode Jumper strap of J1 and J2 must connect 1-2-3 together.

- Not Used: This mode is default mode of VR+/VR- pin terminal of PS Card. In this mode nothing above items can be used. Although the function of L/R switch can be operate normally. But VR+/VR- signal will not be used. In this mode the jumper strap of J1 and J2 must strap in position 1-2.

Any other wiring type may damage PS Card.

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13.6 Digital Input (DI) Card Wiring

- **Front Panel**: 8 LED Indication
- **Rear Panel**: 8 input points: CH1 ~ CH8, 1 common point: COM, 1 frame ground point: FG.

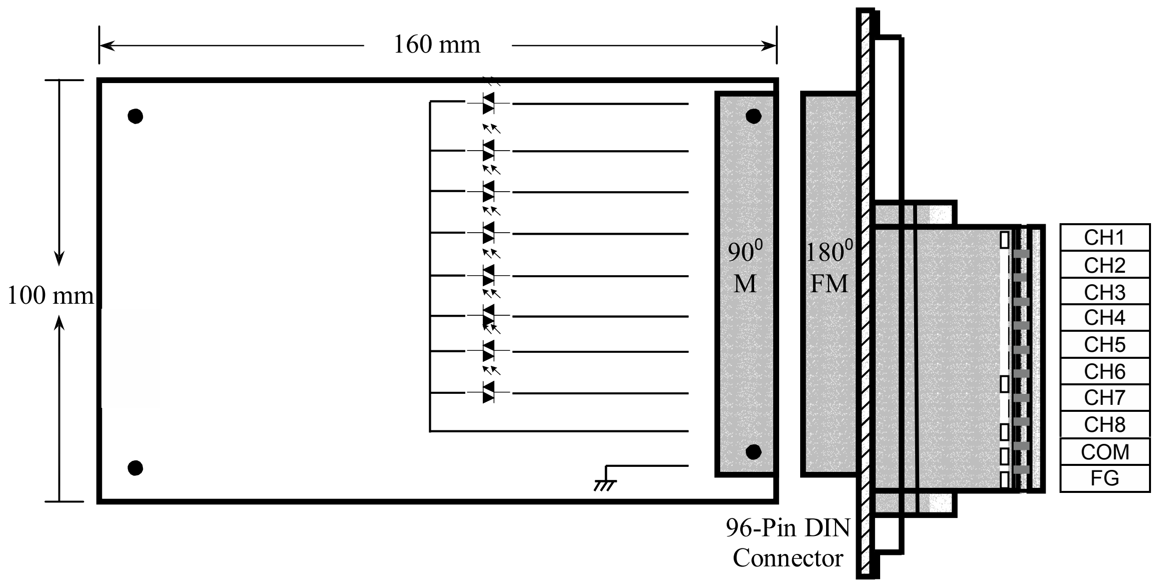

Figure 13-4: DI Card Wiring & Cabling Diagram

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13.7 Digital Output (DO) Card Wiring

- **Front Panel**: 8 LED Indicator
- **Rear Panel**: 8 output points: CH1 ~ CH8, 1 common point: COM, 1 frame ground point: FG.

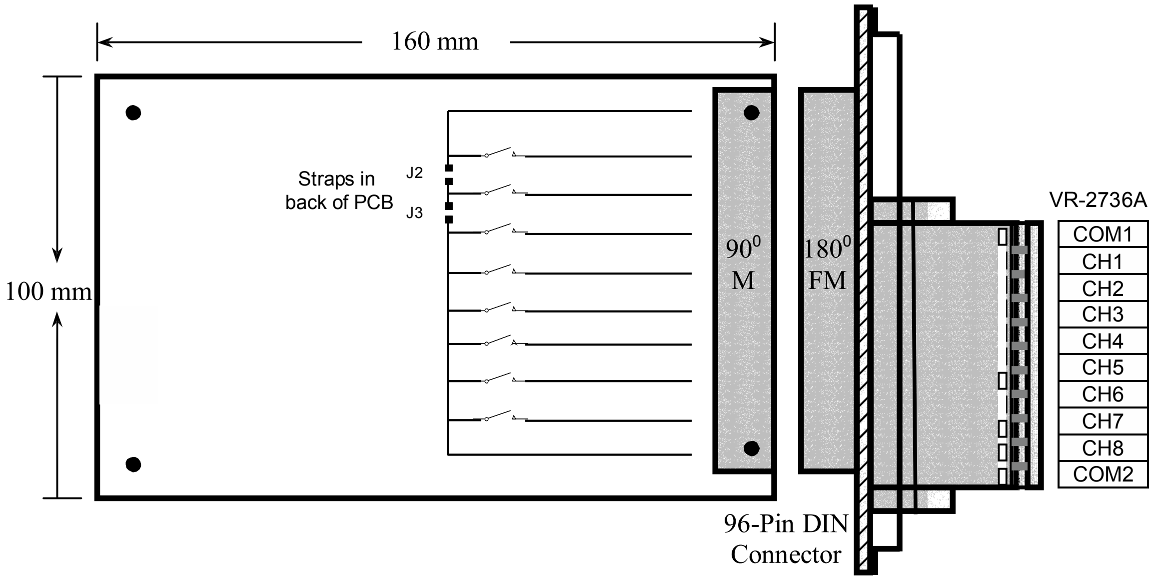

Figure 13-5: DO Card Wiring & Cabling Diagram

In the VR-2736A, you have two methods of common wiring signal of 8xDO relays:

- <u>COM1</u>, it is protected by auto-resettable fuse in case of any short circuit of DO side. This auto-resettable fuse can handle up to 60V between contacts of DO relays. For setup this you must strap J2 and J3.
- <u>COM2</u>, it is protected by 8A Fuse, but it is not auto-resettable, in case of any damage caused by short circuit you must replace the fuse on the card. For setup this type you must strap J2 and J3.
- <u>Independent COM1 & COM2,</u> in this case two channels of CH1, CH2 can be protected by auto-resettable fuse by COM1, and CH3~CH8 outputs with COM2 via main execution relay with 8A fuse. For setup this you must strap J2 and un-strap J3. For example if you want to have internal test relay circuit, so test rely used for CH1,CH2 by independent common signal of field.

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13.8 Digital Output Select/Execute (DOH) Card Wiring

- **Front Panel**: 5 LED Indicator
- **Rear Panel**: 4 output points: CH1 ~ CH4, one output point with 2 output terminals (A/B). In VR-2737 model One Main Execution point: ME as output point with 2 output terminals (A/B). And for VR-2735 modem another output point as CH5, one output point with 2 output terminals (A/B).

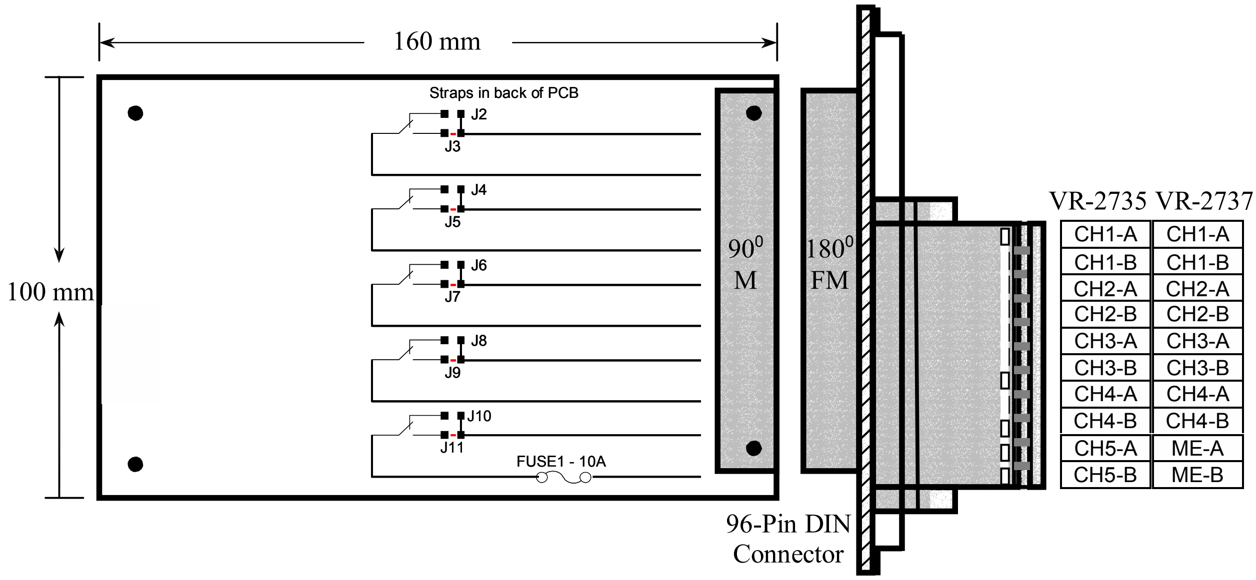

Figure 13-6: HDO Card Wiring & Cabling Diagram

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13.9 Analog DC Input (AI) Card Wiring

- **Front Panel**: 1 LED Run Indicator
- **Rear Panel**: 4 input points: CH1 ~ CH4, one input point with 2 input terminals (+ / -). 2 shielding points: S1 & S2.

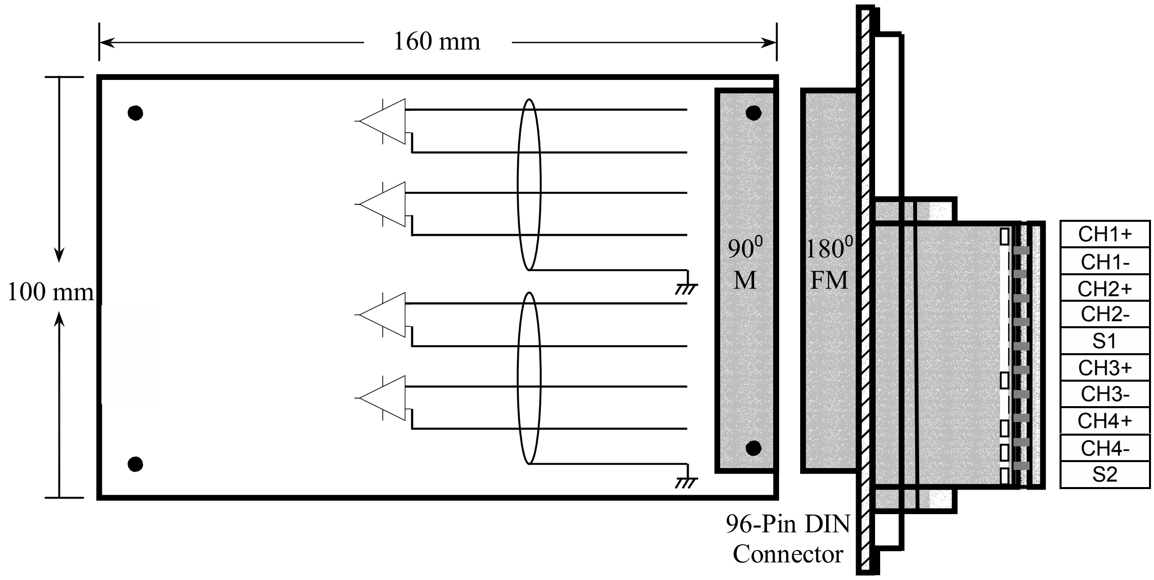

Figure 13-7: AI Card Wiring & Cabling Diagram

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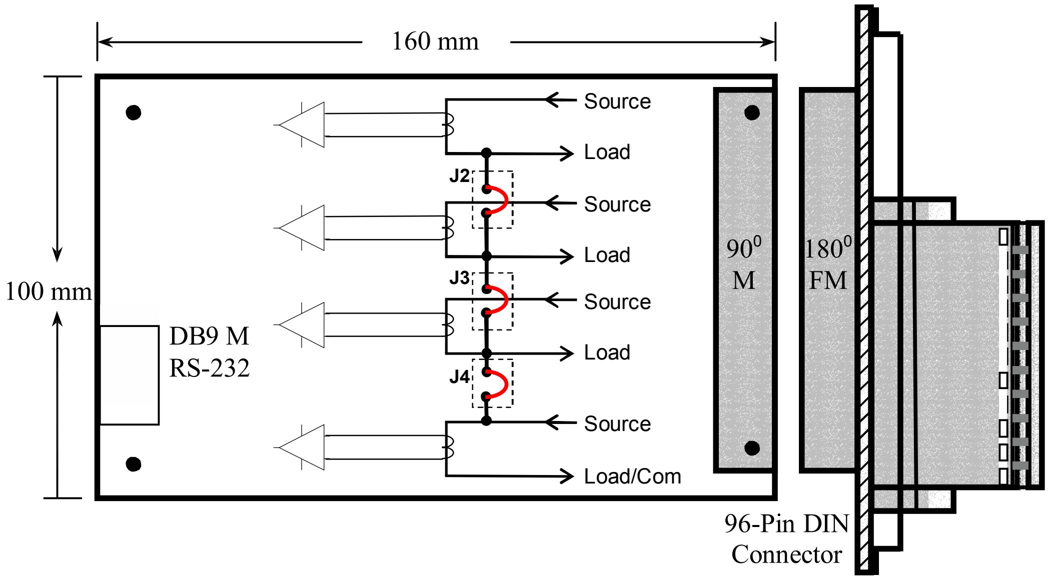
13.10 Analog AC Current Input (ACI) Card Wiring

- **Front Panel**: 1 LED Run Indicator, 1 LED Pickup Indication
- **Rear Panel**: 4 input points: CT1 ~ CT4, configurable for 3 modes.



Mode 1	Mode 2	Mode 3
CT1A-S	CT1-S	CT1A
CT1A-L	CT1-L	-
CT2B-S	CT2-S	CT2B
CT2B-L	CT2-L	-
-	-	-
-	-	-
CT3C-S	CT3-S	CT3C
CT3C-L	CT3-L	-
-	CT4-S	-
-	CT4-L	CT-Com

Figure 13-8: ACI Card Wiring & Cabling Diagram

In the VR-2745 ACI Card, you have three methods of AC current measurement wiring signals:

- **<u>Mode 1:</u>** <u>6xWire 3xCT or 3xPhase Measurement Mode</u>, it is for normal AC 3x phase measurement in 6 wire individual mode. For setup this mode you must un-jumper J2,J3 and J4.

- **<u>Mode 2:</u>** <u>8xWire 4xCT Measurement Mode</u>, it is for measuring 4 independent AC current inputs. Each CT individually metering current and wired to the back plane of Card. For setup this mode you must un-jumper J2, J3 and J4 in back of Card.

- **<u>Mode 3:</u>** <u>4xWire 3xPhase Measurement Mode</u>, it is for normal current measurement of 3x Phase AC circuit. Please be informed that in this case the common of CTs also can be measured in Card as neutral/common current. For setup this you must jumper J2, J3 and J4 in back of Card. (Mode 3 is default mode).

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13.11 Analog AC Voltage Input (ACV) Card Wiring

- **Front Panel**: 1 LED Run Indicator, 1 LED Pickup Indication
- **Rear Panel**: 8 input points in two group of voltage input: G1PT1 ~ G1PT4 and G2PT1 ~ G2PT4, configurable for 3 modes.

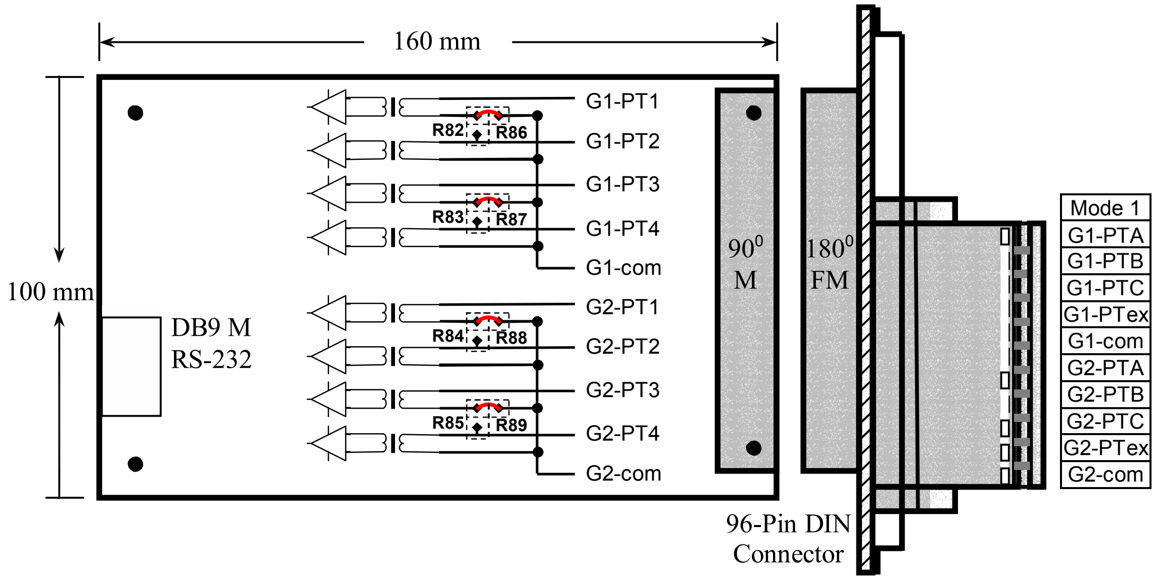

Figure 13-9: ACV Card Wiring & Cabling Diagram

In the VR-2746 ACV Card, you have two methods of AC Voltage measurement wiring signals:

- **Mode 1:** 2xGroup 3xPT or 3xPhase Measurement Mode, it is for normal AC 3x phase measurement in 3 or 4 wire mode. In this mode you can use for two independent AC circuit as Group 1 (G1) and Group 2 (G2). The measurement value can be defined as common mode (Neutral in pin 5 or 10) phase voltage or between phases as line voltage in the software configuration of ACV card. For setup this mode you must jumper R86 and R87 for Group G1 and R88 & R89 for Group G2 in front of ACV card. In this mode you will have a separate AC voltage metering as G1-PTex or G2-PTex. The separate PT measurement as common mode voltage of AC circuit. So we can say in this mode we can measure 8x AC Voltage. (Mode 1 is default mode).

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- **Mode 2:** Independent 4xPT Measurement Mode, it is for measuring 4 independent AC voltage inputs. Each PT individually metering voltage and wired to the back plane of Card. The metering is individual so PT input can be phase to phase or phase to neutral. For setup this mode you must jumper only R82, R83, R84, R85 in front of ACV Card. (*It is special mode and not available now*)

- **Complex Mode 1 & Mode 2:** One 3xPhase within 2 individual Measurement Mode, it is possible to have Mode 1 and Mode 2 in one card. For this Group 1 or Group 2 can configure as freely to Mode 1 or Mode 2. For example If you jumper R86 and R87 and R84 and R85, it means that for group 1 you have one 3xPhase AC circuit voltage measurement and for place of Group 2 you can measure 2 independent AC voltage. (*It is special mode and not available now*)

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13.12 Analog Output (AO) Card Wiring

- **Front Panel**: 1 LED Indication
- **Rear Panel**: 4 input points: CH1 ~ CH4, one input point with 2 input terminals (+ / -). 2 shielding points: S1 & S2.

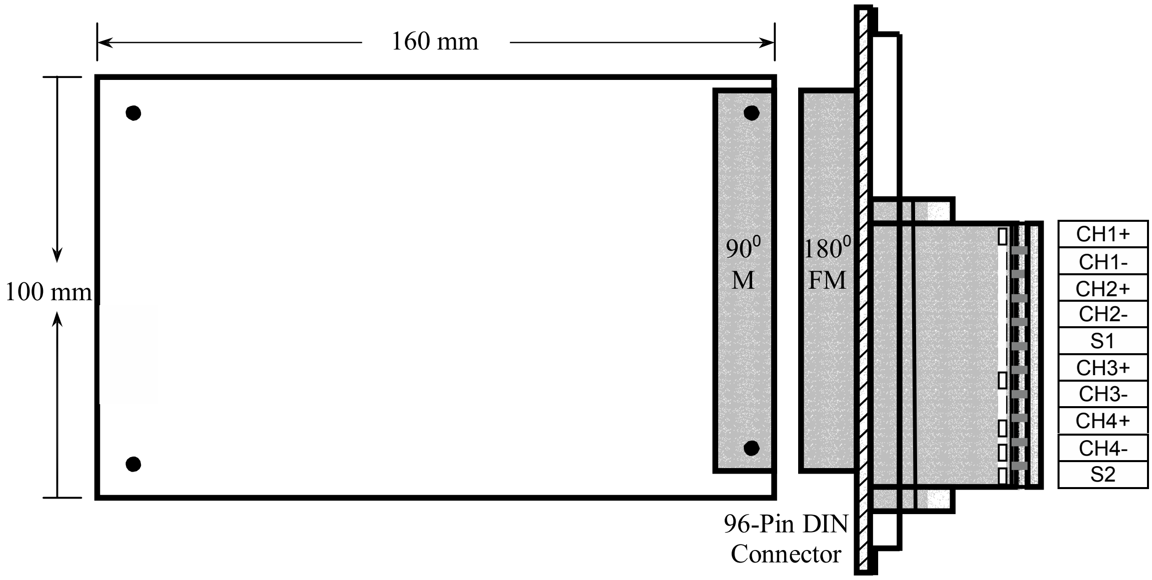

Figure 13-10: AO Card Wiring & Cabling Diagram

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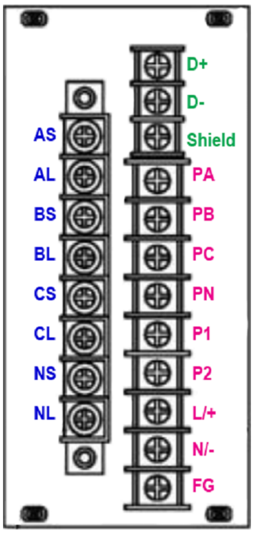
13.13 Intelligent Power Meter Input (ACUP) Card Wiring

- **Front Panel**: Display, Test set port, configuration keys
- **Rear Panel**: 3 CT + 3 PT input points, 1 CT + 1PT extra input points, one RS-485 communication port, 1 power input.

AS	Input Current Phase A (from Source)
AL	Input Current Phase A (to Load)
BS	Input Current Phase B (from Source)
BL	Input Current Phase B (to Load)
CS	Input Current Phase C (from Source)
CL	Input Current Phase C (to Load)
NS	Input Current Neutral (from Source)
NL	Input Current Neutral (to Load)



D+	RS485 Data Bus +
D-	RS485 Data Bus -
Shield	RS485 Shield Ground
PA	Input Voltage Phase A
PB	Input Voltage Phase B
PC	Input Voltage Phase C
PN	Input Voltage Neutral Common
P1	Separated AC Voltage Input
P2	
L/+	Field Power Supply 24 or 48VDC +
L/-	Field Power Supply 24 or 48VDC -
FG	Field Ground (Earth Connection)

Figure 13-11: ACUP Card Wiring & Cabling Diagram

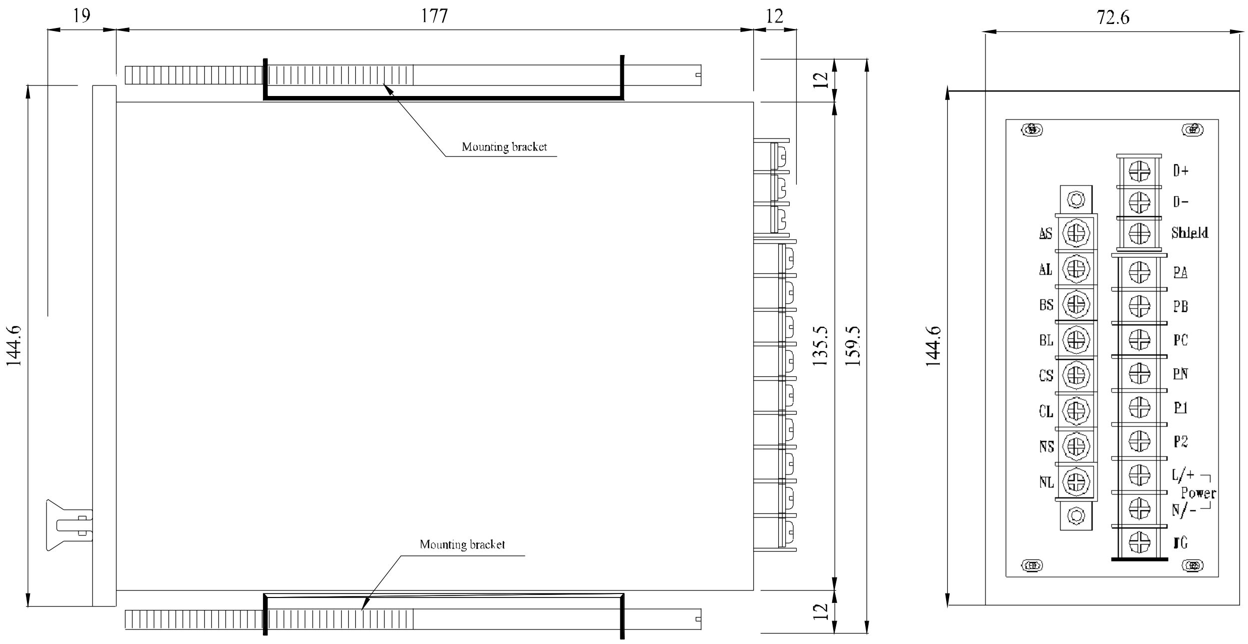


Figure 13-12: ACUP Card Panel Mount version, Size & Dimensions

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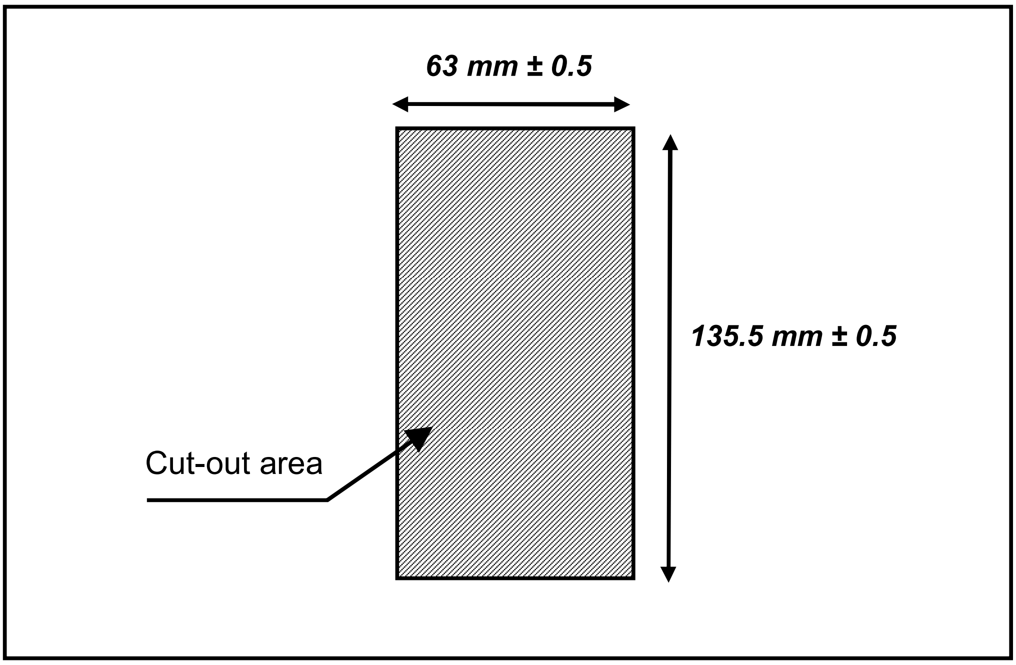

Figure 13-13: ACUP Card Panel Mount Cut-out diemsnions

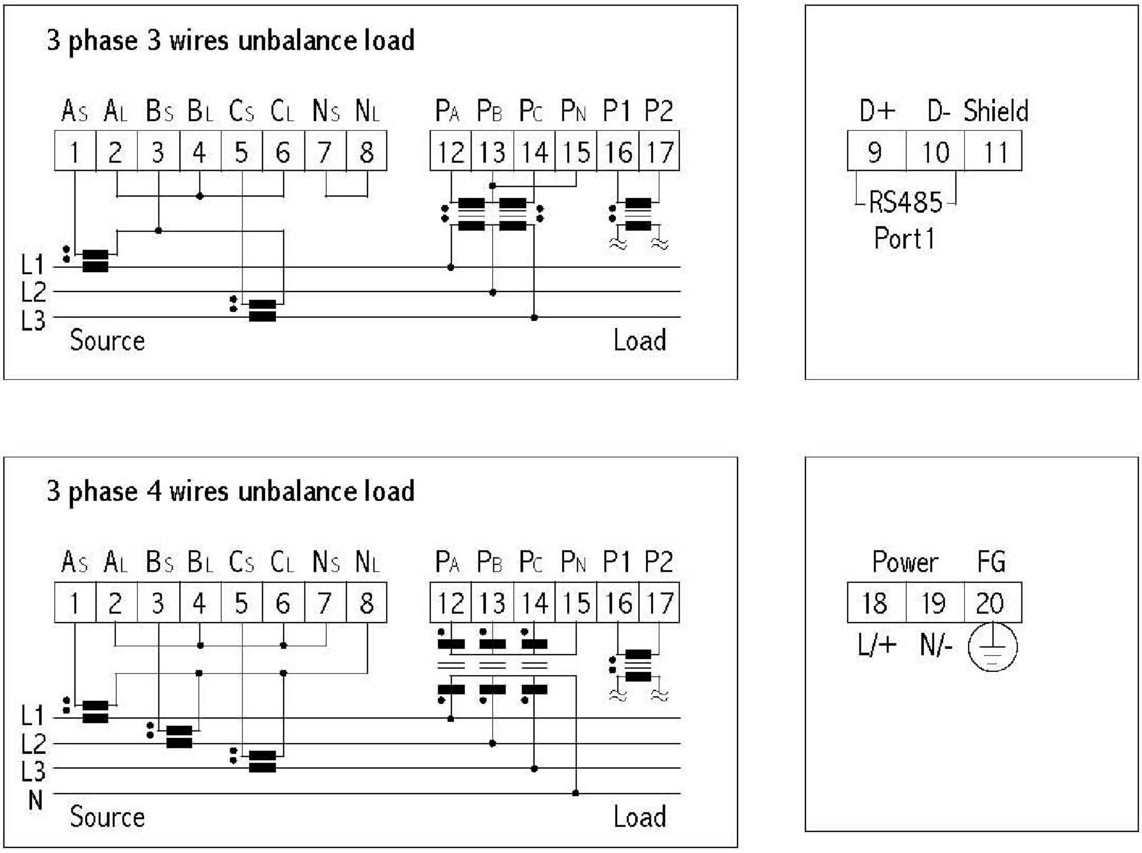

Figure 13-14: ACUP Cuircuit Connection Diagram

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Chapter 14 - Dimensions

14.1 General

In V-RTU2000 Series system, to have best configuration and adaptation from very small RTU system up to very large scale system, we have some type of sub racks that you can use each type based on configuration. In this chapter you can see more about dimensions of sub racks for V-RTU2000 Series.

14.2 VR-2101A Sub rack

This sub rack is suitable for a feeder terminal unit application. There is one slot of Power Supply module and one slot of CPU card. 5 slots are available for any type of IO cards. In the right side of sub rack there is a space for mounting VP-2760 an intelligent power meter module.

Dimension of sub rack is 3U x 42T x 185mm (H*W*D). Each "U" unit is 1.75" inches (~44.5mm) vertically dimension and each "T" unit is 0.2" inches (~5.1mm) horizontally dimension of sub rack. All dimensions in the picture bellow have +1 mm tolerance.

The Cut Out size is 228^{+1} x133^{+1} mm.

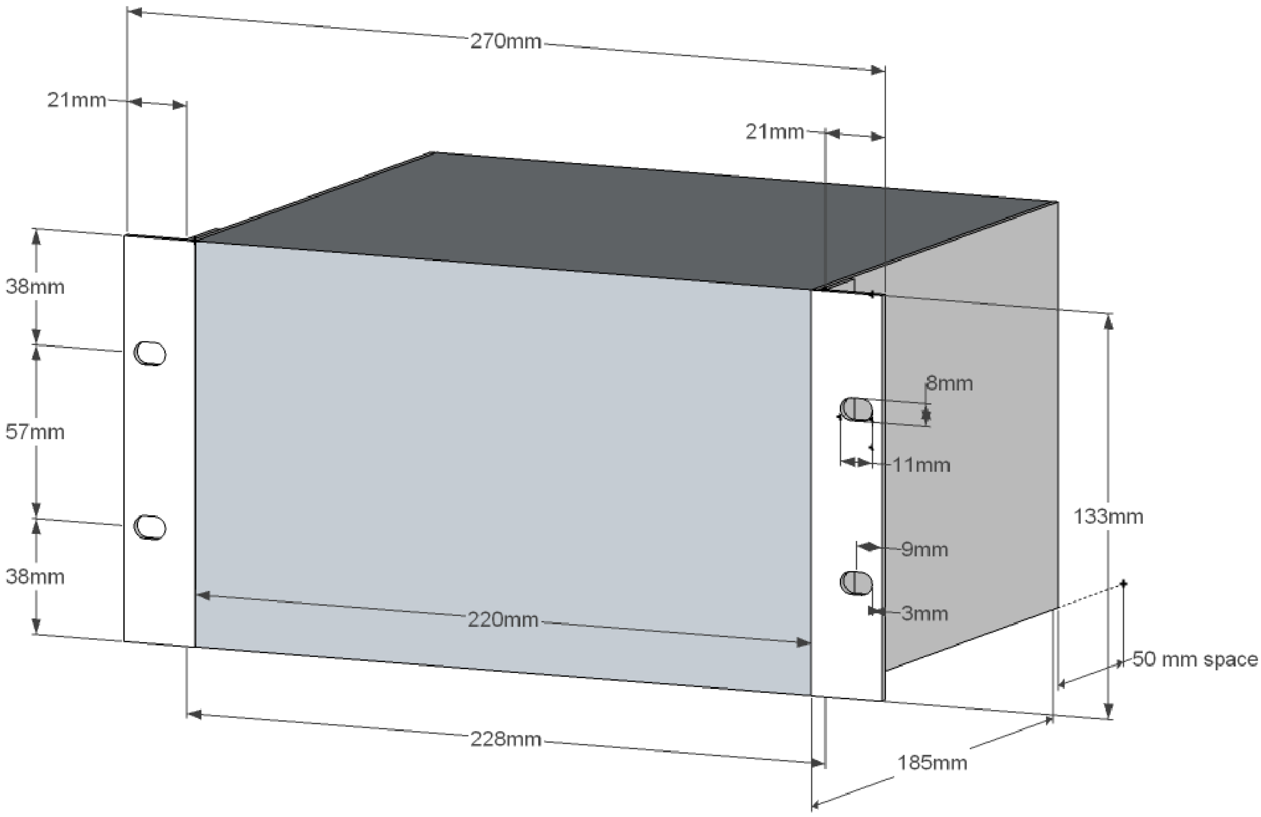

Figure 14-1: VR-2101A Sub Rack detail Dimension

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14.3 VR-2101C Sub rack

This sub rack is suitable for a HVI Less terminal unit application. There is one slot of Power Supply module and one slot of CPU card. 5 slots are available for any type of IO cards. In the right side of sub rack there is a space for mounting four(4) VP-2760 an intelligent power meter module.

Dimension of sub rack is 3U x 82T x 185mm (H*W*D). Each "U" unit is 1.75" inches (~44.5mm) vertically dimension and each "T" unit is 0.2" inches (~5.1mm) horizontally dimension of sub rack. All dimensions in the picture bellow have 1 mm tolerance.

The Cut Out size is 440^{+1} x133^{+1} mm.

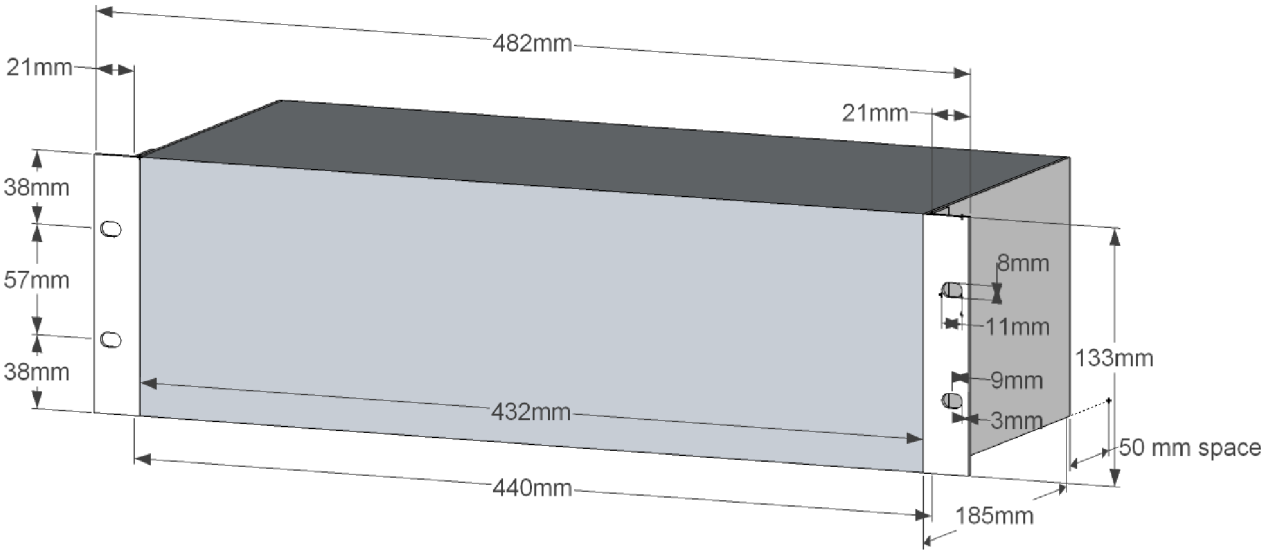

Figure 14-2: VR-2101C Sub Rack detail Dimension

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14.4 VR-2102 Sub rack

This sub rack is suitable for a feeder terminal unit application. There is one slot of Power Supply module and one slot of CPU card. 8 slots are available for any type of IO cards.

Dimension of sub rack is 3U x 42T x 185mm (H*W*D). Each “U” unit is 1.75” inches (~44.5mm) vertically dimension and each “T” unit is 0.2” inches (~5.1mm) horizontally dimension of sub rack. All dimensions in the picture bellow have +1 mm tolerance. The Cut Out size for any panel mount usage is 228^{+1} x133^{+1} mm.

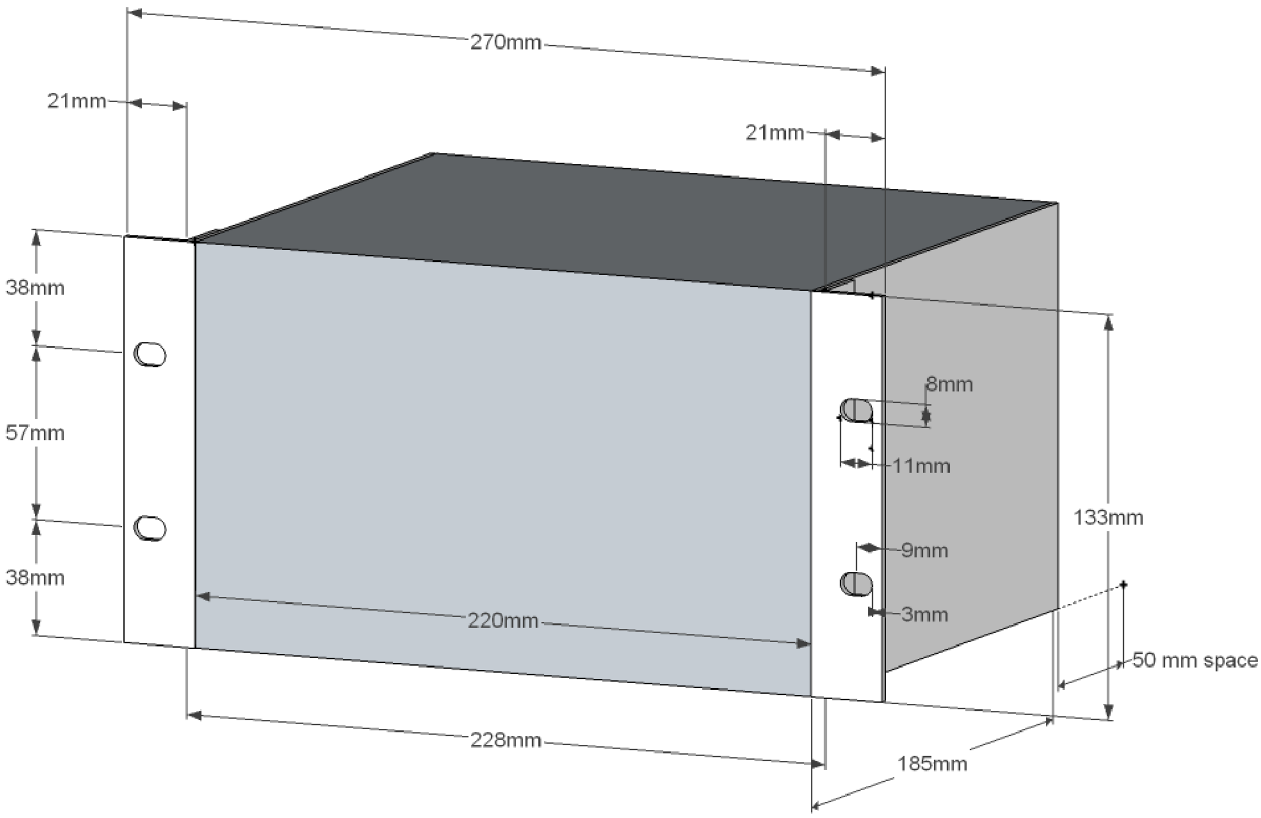

Figure 14-3: VR-2102 Sub Rack detail Dimension

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14.5 VR-2103 Sub rack

This sub rack is suitable for any application of remote terminal unit. There is one slot of Power Supply module and one slot of CPU card. There are 16 slots available for any type of IO cards.

Dimension of sub rack is 3U x 84T x 185mm (H*W*D). Each “U” unit is 1.75” inches (~44.5mm) vertically dimension and each “T” unit is 0.2” inches (~5.1mm) horizontally dimension of sub rack. All dimensions in the picture bellow have +1 mm tolerance. This is 19” standard sub rack that can be installed in any standard 19” racks.

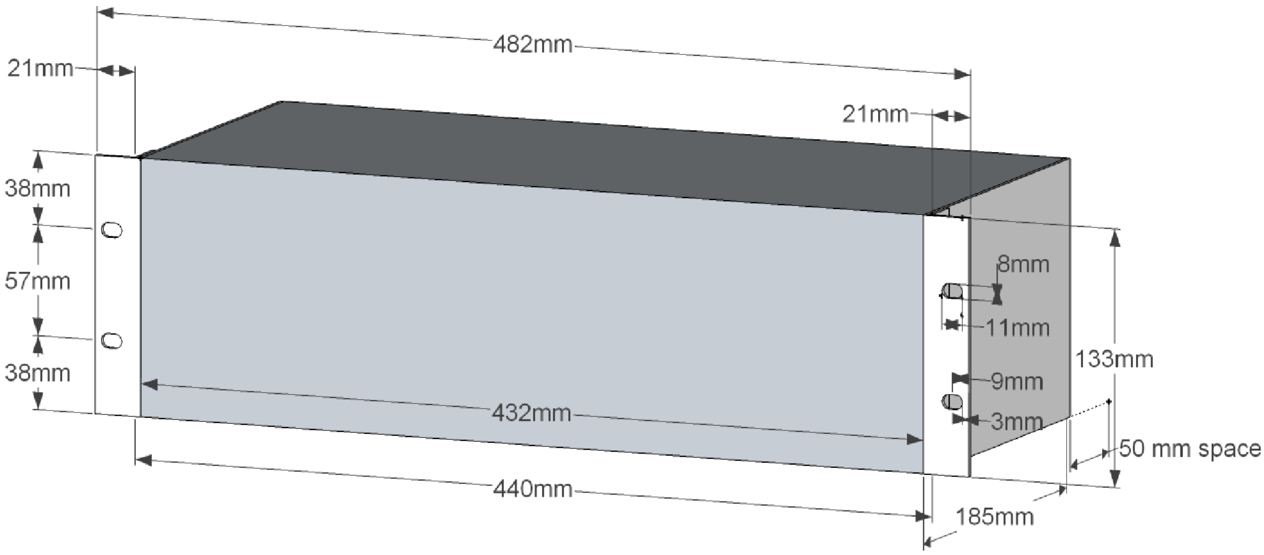

Figure 14-4: VR-2103 Sub Rack detail Dimension

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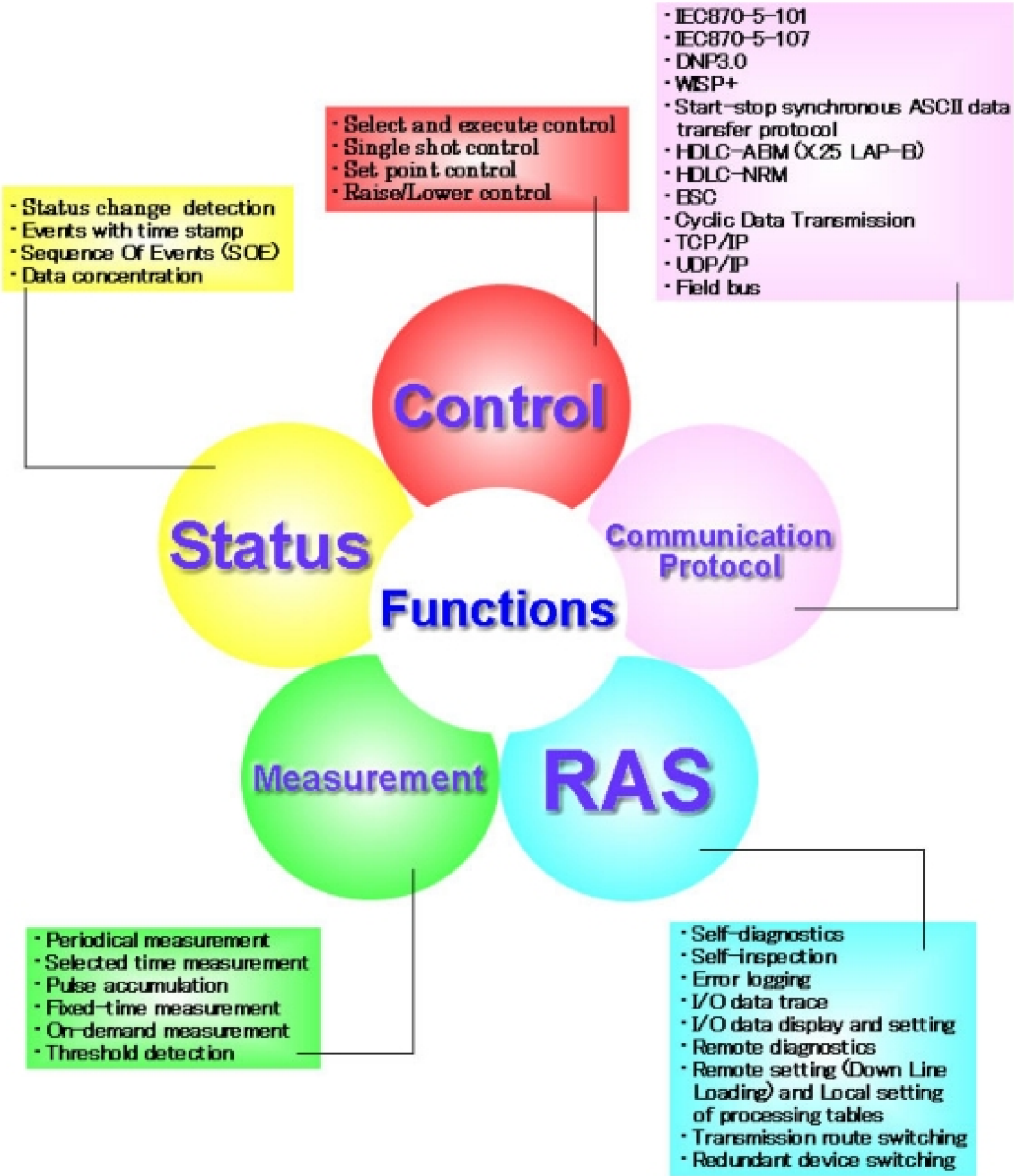

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