RD11 option CANopen Card
User's Manual

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RD11 option CANopen Communication Card User's Manual

Thank you for using RD11 series inverter products and RD11 option CANopen fieldbus communication card. RD11 option CANopen communication card is used for RD11 series inverter, and it is a special expansion card for CAN communication network, which allows the inverter to access the high-speed CAN communication network and realize the field bus control.

Please read this manual carefully before using this product.

1. Hardware configuration

This CAN communication card is specially configured for our RD11 series machines. The CAN bus interface is fully compliant with ISO/DIS11898 standard to achieve CAN communication between multiple inverters.

RD11 option CANopen card wiring port uses terminal wiring, the inverter only supports EX-A expansion interface in hardware, EX-B expansion port is not supported at the moment.

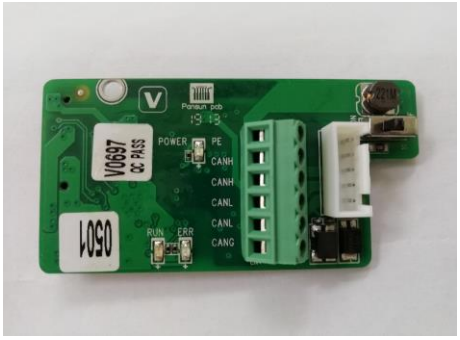


Figure 1.1 RD11 option CANopen card front schematic

1.1 Terminal Wiring

6pin terminal for CAN bus connection, number CN4, located on the front of the communication card，It is very convenient for customers to conduct parallel wiring (CANH, CANL can realize one in and one out), the pin schematic and function table are as follows：

Table 1.1 Wiring port definition description

CN4 port menu		
Pin No.	**Name**	**Function**
1	PE	Cable shield ground terminal
2	CANH	Connecting the CAN bus positive polarity port
3	CANH	Connecting the CAN bus positive polarity port
4	CANL	Connecting the CAN bus negative polarity port
5	CANL	Connecting the CAN bus negative polarity port
6	CANG	Connection to CAN bus signal reference ground

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1.2 Baud rate and transmission distance

Table 1.2 Description of communication baud rate and transmission distance

Communication baud rate	Communication length
1M bit/s	25m
500k bit/s	100m
250k bit/s	250m
125k bit/s(Default)	500m
50k bit/s	1000m
20k bit/s	2500m

1.3 Configure dip switches

For field use, RD11 option CANopen cards are equipped with terminal matching resistors that can be set for use via dip switch S1. It is recommended to set up the use of termination resistors at both ends of the network topology. The setting instructions for dipswitch S1 are as follows：

Table 1.3 Terminal resistance dial code function description

S1	Dial code position	Terminal resistance
	Toggle to the left side ON, i.e. pins 1 and 2	Terminal resistance access
	Toggle to the right side OFF, i.e. pins 2 and 3	No termination resistor used (factory default)

1.4 Indicator light description

The CAN card is equipped with three LEDs to monitor its operating status, which are defined as described in Table 1.4

Table 1.4 Description of status monitoring LED indicators

Indicator light	Status	Description	Note
PWR（Red）	Bright	Power on normal	power up
	extinguish	Power on is not normal, please test the installation is normal	power off
ERR（Red）	Bright	Internal inverter communication timeout	Frequency converter communication timeout
	Fast flashing	CANopen address setting error	Address configured to 0
	Flash twice	CANopen emergency message inverter failure	Inverter reported fault
RUN（Green）	Bright	Run	The NMT starts the remote node and the TPDO uploads data in a communicable state.
	Blinking	Pre-run	The CANOPEN card is in a pre-operable state.
	extinguish	Stop	NMT stops the remote node and is unable to communicate.

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1.5 Cautions

a. All slave stations need to be connected in series, not in a star connection.

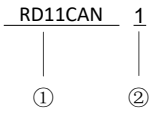
b. A 120 ohm termination resistor is required for the master and the last node of the slave. The RD11 option CANopen communication card comes with a termination resistor that can be enabled by dipswitch S1 to prevent signal reflection.

c. To avoid interference, the CAN connection line should preferably be a shielded twisted pair, and the shield should generally be grounded reliably at a single point.

d. The longer the connection line, the higher the requirement for the CAN chip's drive capability.

2. Order Model

Product order model introduction



Description：

① Product Series

RD11 series CAN communication expansion card 11A00PAC008

② Wiring port method

1：European type terminal block　　2：RJ45 Network Port

3. software configuration

3.1 Agreement Description

3.1.1 Software Features

The RD11 CANopen card supports the following protocols：

Support Heartbeat protocol, the slave reports the current status to the master at regular intervals；

Support SDO accelerated transmission mechanism；

Support 4 TPDO, 4 RPDO；

Support for emergency objects；

3.1.2 Newsletter recipients COB-ID

CANopen provides a variety of communication objects, each with different characteristics. This card uses a predefined COB-ID, which is planned as follows：

1）NMT Object：0x000

2）SYNC Object：0x080

3）SDO Object：

Send　SDO：0x600+NodeID

Receive　SDO：0x580+NodeID

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4）PDO Object：

RPDO1：0x200+NodeID

RPDO2：0x300+NodeID

RPDO3：0x400+NodeID

RPDO4：0x500+NodeID

TPDO1：0x180+NodeID

TPDO2：0x280+NodeID

TPDO3：0x380+NodeID

TPDO4：0x480+NodeID

5）EMCY Object：0x80+NodeID

NodeID is the device ID (station address), set by the function code parameter

3.1.3 Inverter parameter operation

1）Baud rate

RD11 sets the baud rate by the ten bits of function code F13.02, which needs to be re-powered after changing. The setting values are listed below：

Table 3.1 RD11 Baud Rate Settings

F13.02 Ten bit	0	1	2	3	4	5	6
CAN Baud rate	20K	50K	100K	125K	250K	500K	1M

The RD11 sets the baud rate via function code F12.42, which needs to be re-powered after the change. The setting values are listed in the following table：

Table 3.2 RD11 Baud Rate Settings

F12.42	0	1	2	3	4	5	6
CAN Baud rate	20K	50K	100K	125K	250K	500K	1M

2）Device Address

RD11 sets the device address via F12.41. After changing this parameter, you need to reapply power

3）Mapping Instructions

The inverter function codes are mapped to the 2000h group index of CANopen. 2000h group index and function codes directly satisfy the following relationship：

① Index Value =2000h+ Function code group number；

② Subindex Value = Function code parameter number +1。

For example, F01.05 function code corresponds to index 2001h, subindex 06h (object dictionary 2001_06h)。The correspondence between function codes and indexes is shown in the following table：

Function Code	**CANopen Index**
F0-FF	0x2000-0x200F
F16-F31	0x2010-0x201F

If a write parameter power-down save operation is to be performed, the corresponding index is shown in the

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following table：

Function Code	CANopen Index
F0-FF	0x20F0-0x20FF
F16-F31	0x20A0-0x20AF

3.1.4 SDO read/write inverter parameter operation

1) SDO Read/Write Operation Protocol Explanation

SDO read operation

The inverter uses the CANopen Service Data Object (SDO) to read the inverter, and the master sends the data in the format shown in the table below：

Table 3.3 SDO Read

CAN	CANopen Data	Description
ID	0x600+NodeID	NodeID Device Address
RTR	0	-
Data0	Command Code（0x40）	0x40 Indicates a read command
Data1	Index Low Byte	-
Data2	Index High Byte	-
Data3	Sub-index	-
Data4	Data1	Reserved（0）
Data5	Data2	Reserved（0）
Data6	Data3	Reserved（0）
Data7	Data4	Reserved（0）

Read the inverter SDO slave response data as shown in the table below：

Table 3.4 SDO Read Response

CAN	CANopen Data	Description
ID	0x580+NodeID	NodeID Device Address
RTR	0	-
Data0	Command code return	Correct "0x43/4b/4f"; error "0x80"
Data1	Index Low Byte	-
Data2	Index High Byte	-
Data3	Subindex	-
Data4	Data 1	Read back data if correct, SDO error code if incorrect
Data5	Data 2	
Data6	Data 3	
Data7	Data 4	

SDO write operations

The inverter uses the CANopen Service Data Object (SDO) to write to the inverter, and the master sends the data in the format shown in the table below：

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Table 3.5 SDO write

CAN	CANopenData	Description
ID	0x600+NodeID	NodeID Device Address
RTR	0	-
Data0	Command Code	"0x23/2b/2f" is to write "32/16/8" bits of data respectively
Data1	Index Low Byte	-
Data2	Index High Byte	-
Data3	Subindex	-
Data4	Data 1	Data to be written
Data5	Data 2	
Data6	Data 3	
Data7	Data 4	

Inverter Response

Table 3.6 SDO Write Response

CAN	CANopen Data	Description
ID	0x580+NodeID	NodeID Device Address
RTR	0	-
Data0	Command code return	Correct "0x60"; Error "0x80"
Data1	Index Low Byte	-
Data2	Index High Byte	-
Data3	Subindex	-
Data4	Data 1	0 in case of correct, SDO error code in case of error
Data5	Data 2	
Data6	Data 3	
Data7	Data 4	

SDO Error Code

Table 3.7 SDO error codes

SDO Error Code	Error Description
0x05040000	Protocol Timeout
0x05040001	Invalid command for SDO messages
0x06010002	Write operations on read-only object dictionaries
0x06020000	Can't find object dictionary
0x06040041	Objects cannot be mapped to PDO
0x06040042	PDO's mapping length is out of range
0x06070010	Data type mismatch
0x06090011	Subindex does not exist
0x06090030	Write data outside the scope of the object dictionary
0x08000000	General errors
0x08000020	Data cannot be changed in the current state

The following is an example of reading and writing function codes for inverters with inverter node address 2

2）Example of reading group F function code

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Take the example of reading the value of F02.02 (object dictionary corresponds to 2002_03H), the message sent by the master is as follows:

Message identifier（Hex）	RTR	Data（Hex）
0x602	0	40 02 20 03 00 00 00 00

The response message of the inverter is as follows：

Message identifier（Hex）	RTR	Data（Hex）
0x582	0	4b 02 20 03 00 00 00 00

3）Example of writing group F function codes

Writing value 3 to F02.02, the master sends the following message:

Message identifier（Hex）	RTR	Data（Hex）
0x602	0	2b 02 20 03 03 00 00 00

The response message of the inverter is as follows：

Message identifier（Hex）	RTR	Data（Hex）
0x582	0	4b 02 20 03 03 00 00 00

4）Example of reading power group C parameters

Group C parameter function code corresponds to inverter start address 0x2100, so when sending SDO telegrams when reading group C parameters，

Index is: 0x2021+Group C number, subindex is: function code parameter number plus +1。

If you read C00.26 (inverter rated voltage), the index is 0x2021 and the sub-index is 0x1B。

Then the master sends a message as：

Message identifier（Hex）	RTR	Data（Hex）
0x602	0	40 21 20 1B 00 00 00 00

The response message of the inverter is as follows：

Message identifier（Hex）	RTR	Data（Hex）
0x582	0	4b 21 20 1B DC 00

5）Example of reading and writing 0x3000 address group parameters

0x3000 address group parameter function code corresponds to inverter starting address 0x3000，So when sending SDO messages when reading this set of parameters，Index is: 0x2030, subindex is: 0x3000 group address of the last 8 bits + 1.

If the address 0x3006 (torque control forward maximum frequency limit) is read, the index is 0x2030 and the sub-index is 0x06+1=0x07

Then the master sends a message as：

Message identifier（Hex）	RTR	Data（Hex）
0x602	0	40 30 20 07 00 00 00 00

The response message of the inverter is as follows：

Message identifier（Hex）	RTR	Data（Hex）
0x582	0	4b 30 20 07 00 00

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When writing the data at this address, the index remains 0x2030 and the subindex remains 0x07. For example, if 100 is written to this address, the master sends a message as：

Message identifier（Hex）	RTR	Data（Hex）
0x602	0	2b 30 20 07 64 00

The response message of the inverter is as follows：

Message identifier（Hex）	RTR	Data（Hex）
0x582	0	60 30 20 07

3.1.6 PDO inverter operation

The PDO is a process data service object that communicates periodically between the master and the slave via PDO messages to ensure real-time data interaction.

1）RPDO inverter operation

RPDO is the process data received by the inverter. 4 RPDOs, RPDO1, RPDO2, RPDO3 and RPDO4, are supported. Each RPDO can map objects in address group 0x3000, and the objects mapped in the RPDO must be writable addresses in the 0x3000 group，Otherwise, an error may be reported. The total data length of each RPDO mapping variable cannot exceed 64 bits.

2）TPDO Inverter Operation

TPDO is the process data sent by the inverter. The inverter maps the real-time variables to be sent to TPDO and sends the data to the master station periodically. Support 4 TPDO, TPDO1, TPDO2, TPDO3, TPDO4, each TPDO can map common objects in C00 group monitoring (such as C00.01, C00.02, C00.03, etc.). The total length of each TPDO mapped variable cannot exceed 64 bits.

3）PDO data sending conditions

Depending on the type configured, the PDO corresponds to the corresponding transmission conditions and data validity conditions. The following table shows the PDO types and transmission conditions。

Table 3.8 PDO types and transmission conditions

Type	**Data sending conditions**	**Data validity conditions**
Cyclic synchronization（Type0）	Receive synchronization frame, send data	Effective immediately
Cyclic synchronization（Type1-240）	After receiving the frame with the corresponding synchronization step, send the data frame	Effective immediately
Asynchronous（Type252）	Not supported	Not supported
Asynchronous（Type253）	Not supported	Not supported
Asynchronous - vendor specified（Type254）	Send data after data change	Effective immediately
Asynchronous（Type255）	The data changes or meets the event time and the rate of change is less than the suppression time	Effective immediately

4）Default PDO Mapping

The variables of PDO mapping can be selected arbitrarily according to the actual application. The following

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table shows the factory default mapping variables for practical application reference。The control command and run status are mandatory mapping variables.

Table 3.9 Default PDO Mapping

PDO	Transfer Protocol	Periodicity	Parameters			
RPDO1	Asynchronous Timing Transfer	100ms	Control commands (0x3001)	Frequency command （0.01Hz） (0x3000)	Torque Feeding （0.1%） (0x3005)	
TPDO1	Asynchronous Timing Transfer	100ms	Operation Status (0x3002)	Output Current (0.1A) (C00.02)	Output Frequency （0.01Hz） (C00.1)	Mechanical speed 1RPM (C00.05)
TPDO2	Asynchronous Timing Transfer	100ms	Output power (C00.10) (0.1%)	Input Voltage 0.1V (C00.03)	Fault Code (0x3003)	
TPDO3	Asynchronous Timing Transfer	100ms	Output torque （C00.07） (0.1%)	DC bus voltage (0.1V)(C00.11)	Motor voltage (0.1V)(C00.04)	Module Temperature (0.1℃)(C00.12)

The following table shows the control commands and the bit definitions of the operation status

Table 3.10 Control commands and operation status definitions

	Bit	Name	Description	Signal Status
Control command		Auto control （Address 0x3000）	Master Control	0：No order 5：Deceleration stop 1：Forward run 6：Free stop 2：Reverse Run 7：Fault Reset 3：Positive point movement 8：Run the ban command 4：Reversing point movement 9：Run the allow command
Operation Status	**Bit**	**Name**	**Description**	**Signal Status**
	0	Operation Status		0：Downtime status 1：Operation Status
	1	Accelerated Status		0：Non-accelerated status 1：Accelerated Status
	2	Deceleration status		0：Non-deceleration status 1：Deceleration status
	3	Direction		0：Positive 1：Reverse
	4	Fault	With or without fault	0：No faults 1：Inverter fault
	5	GPRS status		0：GPRS Unlock 1：GPRS Locked status
	6	Early Warning	With or without warning	0：No warning 1：Inverter warning
	7	Ready		1：Inverter ready
	14	Heartbeat	With heartbeat messages alternating between 0 and 1	
	15	Motor braking feedback		

3.1.7 Emergency message and fault code description

1）Description of the emergency message

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The byte data of the emergency message is shown in the following table：

COB-ID	Emergency error code	Error Register	Vendor-specified error code
0x80+Node_ID	0~1	2	3~7

The emergency error code in this card is the same as the manufacturer's assigned error code, both are fault codes for the inverter。Error register, please refer to the DS301 documentation of the relevant chapter object dictionary 1001H data value, 1001H bit0 for error generation flag, bit4 for communication errors, bit7 vendor specified error.

2）Fault code (0x3003) definition

RD11 inverter inverter fault definition is different, please pay a little attention to the application, please refer to the following two tables for specific fault meaning。

3.12 RD11 fault message codes

Inverter fault information	**Inverter fault information**	**Inverter fault information**
0x0000：No faults	0x0024：V-phase zero drift is large	0x005C：Extension card B disconnected
0x0001：Module failure in acceleration	0x0025：Three phase current sum is not 0	0x005D：CAN expansion card fault
0x0002：Module failure in deceleration	0x0026：W-phase zero drift is large	0x005E：Other expansion card failures
0x0003：Module failure in constant speed	0x0028：Short circuit to ground	0x005F：Other card disconnection
0x0004：Stop module failure	0x0029：Fan shorted to ground	0x0060：Other card disconnection
0x0005：Overcurrent in acceleration	0x002A：PID disconnection fault	0x0061：Comparator 1 failure
0x0006：Overcurrent in deceleration	0x002B：Parameter copy exception	0x0062：Comparator 2 failure
0x0007：Overcurrent in constant speed	0x002C：PG parameters are not suitable	0x0063：Parameter setting error
0x0008 ：RD11 software overcurrent	0x002D： Z pulse fault	0x0080：Shutdown undervoltage
0x0009：Overvoltage in acceleration	0x002E：ABZ encoder failure	0x0082：Input side out of phase
0x000A：Overpressure in deceleration	0x002F：Rotation check error	0x0083：PID disconnection
0x000B：Overvoltage in constant speed	0x0030：Rotation change broken line	0x0084：Storage Alert
0x000C：Reserved	0x0031：Other encoder failures	0x0085：Large speed deviation
0x000D：Busbar undervoltage	0x0032：Brake unit failure	0x0086：Flying Protection
0x000E：Motor overload	0x0034：Motor self-learning fault	0x0087：Lockout Alert
0x000F：Inverter current overload	0x0047：Initial angle learning failure 1	0x0088：GPRS lockout warning
0x0010：Inverter CBC overload	0x0048：Initial angle learning failure 2	0x0089：485 communication exception warning
0x0011：Inverter overload 3	0x0049：Initial angle learning failure 3	0x008A：Load protection 1
0x0012：Input phase loss	0x004A：PM_ST	0x008B：Load protection 2
0x0013：Three-phase output missing	0x004B：PM_ST	0x008C：Extension card disconnect warning
0x0014：U-phase output missing	0x004C：PM_ST	0x008D：Heat sink overheat warning
0x0015： V-phase output missing	0x004D：Excessive speed deviation	0x008E：Motor overheating warning
0x0016： W-phase output missing	0x004E：Flying Protection	0x008F：Running warning
0x001E：Rectifier overheat	0x004F：Load protection 1	0x0090：External keyboard disconnection warning
0x001F：Inverter overheat	0x0050：Load protection2	0x0091：Parameter copy exception warning
0x0020：Motor overheat	0x0051：CPU Timeout	0x0092：Comparator 1 Warning
0x0021：External faults	0x0055：Program Protection	0x0093：Comparator 2 Warning
0x0022：Communication failure	0x0056：Write function code error	
0x0023 ：U-phase zero drift is large	0x005B：Extension card A disconnected	

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3.2 CANopen Related function codes

3.2.1 Set function code

Inverter-related function codes must be set to use CANopen expansion cards。

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RD11 related function code setting

Table 3.14 RD11 related function codes

Function Code	Description
F01.01=3	Run command communication selection option card
F01.02=10	Frequency Feeding Select Optional Card Feeding
F03.41=7	In torque mode, torque command selection option card
F03.54=7	In torque mode, the torque forward speed limit is given by the optional card selection
F03.55=7	In torque mode, the torque reversal speed limit is given by the optional card selection
F03.56	Default 100.0%, relative to maximum output frequency (F01.10)
F03.57	Default 100.0%, relative to maximum output frequency (F01.10)
F12.42	Set baud rate, need to re-power after change
F12.41	Set node number, need to re-power after change

3.3 Overview of the CANopen protocol

3.3.1 CANopen Brief introduction

CANopen is an application layer protocol for network transmission systems based on the CAN serial bus, which defines the data link layer and part of the physical layer of the OSI model. It can be used in a multi-master-slave mode, where any node on the network can initiate messages to other nodes. Network nodes can be divided into different priority levels according to the system real-time requirements, which can reduce the bus arbitration time in case of bus conflicts. The CAN network abolishes the traditional partial address coding and replaces it with the coding of communication data blocks. This not only makes the number of nodes in the network theoretically unlimited, but also allows different nodes to receive the same data at the same time, and has the characteristics of short transmission bytes, fast speed, good fault tolerance and reliable data transmission, making it very suitable for industrial control and distributed real-time control.

The CANopen device model is shown in the following figure：

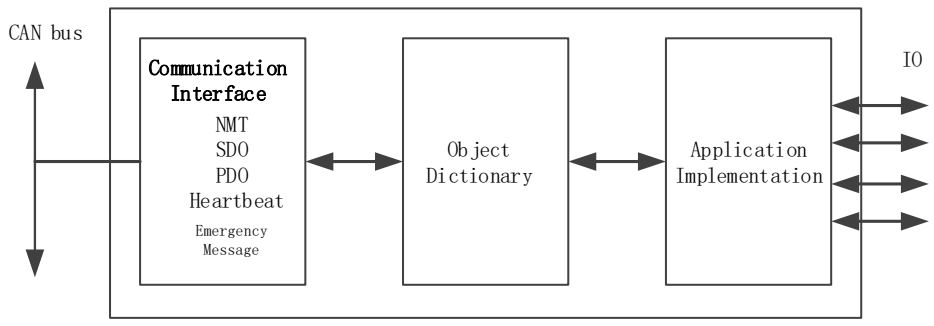


Figure 3.1 CANopen device model

3.3.2 Object Dictionary

An object dictionary is an ordered set of parameters and variables that contains all parameters for the device description and the device network state. The set of objects can be accessed through the network in an ordered and

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predefined way。The CANopen protocol uses an object dictionary with a 16-bit index and an 8-bit sub-index. The structure of the object dictionary is shown in the table below, and a master node or configuration tool can access all values in the object dictionary of a slave node.

Table 3.15 Object Dictionary

Index	Object
0000	Not used
0001-000F	Static data types
0020-003F	Complex Data Types
0040-005F	Complex data types specified by the manufacturer
0060-007F	Static data types specified by device sub-protocols
0080-009F	Complex data types specified by device sub-protocols
00A0-0FFF	Reserved
1000-1FFF	Communication sub-protocol area (e.g. device type, error register, number of PDO's supported)
2000-5FFF	Manufacturer-specific sub-protocol areas
6000-9FFF	Standard equipment sub-protocol area
A000-FFFF	Reserved

3.3.3 NMTControl message

Only the master node can generate NMT messages. NMT is used to manage and monitor each node in the network, and mainly implements node status control, error control and node startup. Where the frame ID is fixed to 0x000, Data0 is the command word, and Data1 is the node number.

NMT message

COB-ID	RTR	Data0	Data1
0x000	0	Command word	Node ID

NMT Message command

Command	Description
0x01	Start Node
0x02	Stop Node
0x80	Entering pre-run status
0x81	Reset Node
0x82	Reset communication

3.3.4 Service Data Objects (SDO)

SDO enables clients to access variables in the device object dictionary through the use of indexes and sub-indexes. the SDO protocol is to acknowledge the service type and generate an answer for each message. SDO request and answer operations can be found in section 3.1.4 and are not described here in detail

3.3.5 Process Data Objects (PDO)

Used to transfer real-time data, which is passed from one creator to one or more receivers. Data transfer is limited to 1 to 8 bytes. Each CANopen device contains 8 default PDO channels, 4 transmit PDO channels and 4 receive PDO channels. the PDO contains both synchronous and asynchronous transmission methods, determined

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by the communication parameters corresponding to that PDO.

3.3.6 Heartbeat Message

A node can be configured to generate periodic messages called heartbeat telegrams that reflect the state of the node itself. Heartbeat telegrams are optional, i.e. the master can choose to enable or disable heartbeat telegrams.

Heartbeat message structure：

COB-ID	RTR	Data0
0x700+NodeID	0	Status word

Heartbeat message status word：

Data	Description
Data0	4：Stop run 5：Run 127：Pre-run

3.4.Structure size and installation schematic

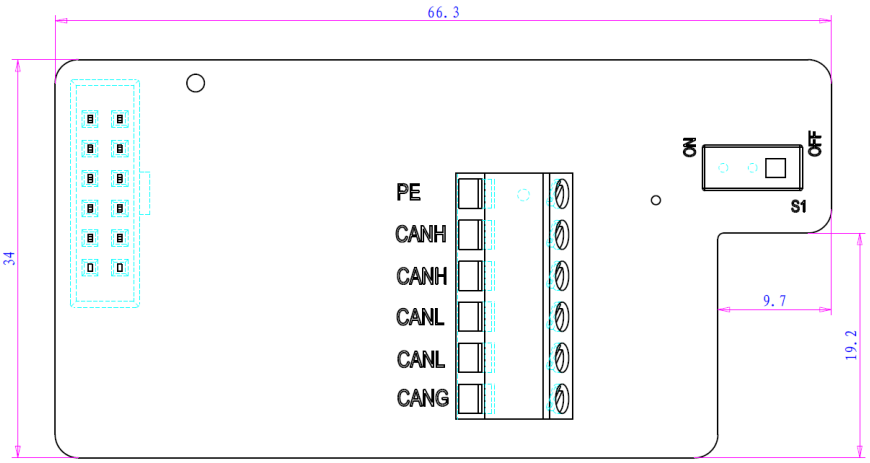


Figure 4.1 RD11 option CANopen External Dimensions

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