BINSFELD ENGINEERING INC.

RT406-2C

CAN Communications Specification

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1 Overview

This document details the data contained within RT406 CAN messages.

CAN1 is the CAN bus connecting a system CAN master (B&R display, PLC, or some other device) to one or more RT406-2C devices. The CAN1 bus operates at 125K baud.

CAN2 is the CAN bus that connects each RT406-2C device to a dedicated heater power controller. The CAN2 bus operates at 100K baud.

2 Connections

The 3 pin CAN1 connector on the RT406-2C is a Tyco Electronics PN: 6-1437719-6.

PIN#	Description
1	CAN1 High
2	CAN1 Low
3	CAN1 GND

The 5 pin CAN2 connector on the RT406-2C is a Tyco Electronics PN: 6-1437719-5.

PIN#	Description
1	CAN2 High
2	CAN2 Low
3	CAN2 GND
4	+24VDC
5	Signal GND

3 CAN1 Messages

RT406-2C devices are referred to as transmitters in the following text.

RPDOs are CAN messages sent from the CAN bus master (B&R, PLC, etc.) to a transmitter.

TPDOs are CAN messages sent from a transmitter to the CAN bus master.

3.1 Transmitter Node Addressing

There can be up to 32 transmitters connected to one CAN bus. The node number of a transmitter is set using DIP switches (refer to RT406-2C installation guide 852400-I). The node number becomes part of the 11 bit CAN identifiers used in CAN messages to and from the transmitter. The CAN IDs used by a transmitter can be calculated using the equation:

CAN ID = base message ID + (node number * 8)

Note: The DIP switches used to set the CAN1 node address are read only during power-up/reset. Changing the node ID switches while the transmitter is powered will have no effect until power is cycled or the node is reset.

3.2 Message IDs:

There is one RPDO and four TPDO base message IDs used by the CAN bus master to communicate with the transmitters. The message IDs used by transmitter node 0 are the base message IDs. **Table 1** shows how message IDs are associate with each node.

Table 1: RT406-2C CAN1 bus Identifiers

Type	COB ID (11 bit CAN identifier)						description
	node 0	node 1	node 2	node 3		node 31	
TPDO1	0x381	0x389	0x391	0x399	...	0x479	fault status data
TPDO2	0x382	0x38A	0x392	0x39A	...	0x47A	various param settings (byte 0 val ctrl'd)
TPDO3	0x383	0x38B	0x393	0x39B	...	0x47B	setpoint temps
TPDO4	0x384	0x38C	0x394	0x39C	...	0x47C	measured temp (1.14sec)
RPDO1	0x385	0x38D	0x395	0x39D	...	0x47D	set various parameters (byte 0 val ctrl'd)

3.2.1 TPDO1, Base message ID of 0x381

Fault data message from the transmitter. Sent immediately when one or more fault bits change. Also sent in response to a 0x385 Reset request and 22 seconds after the reset request.

byte0	byte1	byte2	byte3
CAN1 fault bits	CAN2 fault bits	Heater fault bits	Rotor fault bits

Bit 0 is the least significant bit. Bits are active LOW (a fault is indicated when a bit is LOW).

When no faults are indicated, 255 is the value for all four bytes.

CAN1 fault bits:

bit 0 – not used, always '1'
bit 1 - CAN1 message receive fault
bit 2 – CAN1 communications fault (receive fault, BUS OFF, or transmit timeout)
bit 3 – CAN1 is BUS OFF
bit 4 – CAN1 transmit timeout
bit 5 - not used, always '1'
bit 6 - not used, always '1'
bit 7 - not used, always '1'

CAN2 fault bits:

bit 0 – not used, always '1'
bit 1 – CAN2 message receive fault
bit 2 – CAN2 communications fault (receive fault, BUS OFF, or transmit timeout)
bit 3 – CAN2 is BUS OFF
bit 4 – CAN2 transmit timeout
bit 5 – CAN1 lost or intermittent communications (2 second timeout)
bit 6 - not used, always '1'
bit 7 – System fault detected, heaters held OFF

Heater fault bits (copy of status byte contained in 0x7F8 CAN2 message from the heater power controller to the transmitter):

bit 0 – Heating current fault
bit 1 – Control cycle time fault
bit 2 – CAN bus error
bit 3 – CAN bus OFF
bit 4 – CAN2 communications timeout
bit 5 – Loss of control value
bit 6 – Heater controller overtemperature
bit 7 – Heater coil overtemperature

Rotor fault bits

bit 0 – Rotor communications fault
bit 1 – Possible one or more loose or broken RTD wires or connections
bit 2 – Possible one or more shorted RTD's
bit 3 – Measured temperature of one or more zones exceeds maximum
bit 4 - not used, always '1'
bit 5 - not used, always '1'
bit 6 - not used, always '1'
bit 7 - not used, always '1'

3.2.2 TPDO2, Base message ID of 0x382

Present values of miscellaneous transmitter parameters.

byte0	byte1	byte2	byte3
0x01	zone1 setpoint temperature in °C	high temp alarm threshold in °C (all zones)	temp deviation threshold in °C(all zones)

The default temperature setpoint value for all zones is 32°C.

The default high temperature alarm value is 235°C.

The default temperature deviation threshold value is 10°C.

Present zone temperature setpoints.

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
0x00	zone1 setpoint temperature in °C	zone2 setpoint temperature in °C	zone3 setpoint temperature in °C	zone4 setpoint temperature in °C	zone5 setpoint temperature in °C	zone6 setpoint temperature in °C	0x00

The default temperature setpoint value for all zones is 32°C.

Present parameter values of a specific zone, N = zone index (0 thru 5)

byte0	byte1	byte2	byte3
(N * 8) + 2	zone (N + 1) setpoint temperature in °C	zone (N + 1) status 0 = OFF 1 = ON	zone (N + 1) temperature correction factor, 1unit = 0.7326°C

The default temperature setpoint value for all zones is 32°C.

At power-up, all zones are OFF by default and must be enabled before beginning to control temperature. Zones are enabled using the RPDO1 message with byte0 = 0x04, byte1 = 0x01, and byte2 = 0x00. Refer to the RPDO1 message description in section **3.2.5** for more information.

The default temperature correction factor value is 128 for all zones.

Present PID parameter values of a specific zone, N = zone index (0 thru 5)

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
(N * 8) + 3	zone (N + 1) P gain	zone (N + 1) I gain high byte	zone (N + 1) I gain low byte	zone (N + 1) D gain high byte	zone (N + 1) D gain low byte	0x00	0x00

The default P gain value is 12 for all zones.

The default I gain value is 110 for all zones.

The default D gain value is 0 for all zones.

3.2.3 TPDO3, Base message ID of 0x383

Present zone temperature setpoints. Sent at least once every 12.5 seconds. Also sent in response to some RPDO1 messages.

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
zone1 setpoint temperature in °C	zone2 setpoint temperature in °C	zone3 setpoint temperature in °C	zone4 setpoint temperature in °C	zone5 setpoint temperature in °C	zone6 setpoint temperature in °C	0x00	0x04

The default temperature setpoint value for all zones is 32°C.

3.2.4 TPDO4, Base message ID of 0x384

Measured zone temperatures. Sent by the transmitter cyclically every 1.14 seconds.

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
zone1 measured temperature in °C	zone2 measured temperature in °C	zone3 measured temperature in °C	zone4 measured temperature in °C	zone5 measured temperature in °C	zone6 measured temperature in °C	average PWM duty cycle of all zones	General node status bits

Measured temperature range is -10 to 250°C.

Average PWM duty cycle value - Calculated average of all zone PWM outputs, 0 to 100%.

General node status bits

bit0 – 1 = Controller enabled
bit1 – 1 = Controller initializing (not ready)
bit2 – 1 = One or more zone warning flags are set (outside of deviation limits)
bit3 – Not used, always reads as a 0
bit4 - Not used, always reads as a 0
bit5 - Not used, always reads as a 0
bit6 - Not used, always reads as a 0
bit7 - Not used, always reads as a 0

3.2.5 RPDO1, Base message ID of 0x385

The value of byte0 in this message determines its meaning and the expected response. This message is used to set parameters in the transmitter and request status information from the transmitter. Parameters are saved in RT406-2C non-volatile memory and are restored during power-up and reset. Default parameter values of new transmitters are specified in the preceding paragraphs that describe TPDO messages. Message bytes specified as XX are "don't care" meaning they can be any value or they can be omitted from the message.

Command to set zone setpoints individually.

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
0x00	zone1 setpoint temperature in °C	zone2 setpoint temperature in °C	zone3 setpoint temperature in °C	zone4 setpoint temperature in °C	zone5 setpoint temperature in °C	zone6 setpoint temperature in °C	XX

TPDO3 is the response from the transmitter.

Setpoint temperature values from 0 to 250°C are valid.

Command to set miscellaneous transmitter parameters.

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
0x01	setpoint temperature in °C (all zones)	high temp alarm threshold in °C (all zones)	temp deviation threshold in °C(all zones)	XX	XX	XX	XX

TPDO3 is the response from the transmitter.

Setpoint temperature values from 0 to 250°C are valid.

High temp alarm threshold must be <= 250°C.

Temp deviation threshold + Setpoint temperature must be <= 250°C.

Command to stop/start individual zone, set zone setpoint and temperature correction factor parameter. N = zone index (0 thru 5)

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
0x02 | (N * 8)	zone (N + 1) setpoint temperature in °C	zone (N + 1) start flag 0 = stop 1 = start	zone (N + 1) temperature correction factor, 1unit = 0.7326°C	XX	XX	XX	XX

TPDO3 is response from transmitter.

Setpoint temperature values from 0 to 250°C are valid.

The Temperature Correction Factor (tempCF) of a zone can be used to compensate for temperature measurement inaccuracies. A value of 128 is zero compensation. Values are 2's complement format so values > 128 are negative compensation and values < 128 are positive compensation. The general equations are:

Temperature Compensation (°C) = 0.7326 * (128 - tempCF)

and

Compensated Temperature = Measured Temperature + Temperature Compensation

Command to set PID parameters of a specific zone, N = zone index (0 thru 5)

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
0x03 | (N * 8)	zone (N + 1) P gain	zone (N + 1) I gain high byte	zone (N + 1) I gain low byte	zone (N + 1) D gain high byte	zone (N + 1) D gain low byte	XX	XX

No response is returned from the transmitter.

Command to turn ON, OFF, or Reset the PID controller in all zones. The values of byte1 and byte2 control which action is requested.

Turn ON all zone PID controllers if no faults exist to prevent it (start heating in all zones).

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
0x04	0x01	0x00	XX	XX	XX	XX	XX

No response is returned from the transmitter.

Turn OFF all zone PID controllers (stop heating of all zones).

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
0x04	0x00	0x00	XX	XX	XX	XX	XX

No response is returned from the transmitter.

Reset all zone PID controllers (causes a soft reset of all zones).

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
0x04	0x00	0xAA	XX	XX	XX	XX	XX

TPDO1 is response from transmitter.

Request for zone setpoint temperatures.

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
0x80	XX	XX	XX	XX	XX	XX	XX

TPDO2 with byte0 = 0x00 is the response from the transmitter.

Request for miscellaneous transmitter parameters.

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
0x81	XX	XX	XX	XX	XX	XX	XX

TPDO2 with byte0 = 0x01 is the response from the transmitter.

Request parameters for a specific zone, N = zone index (0 thru 5)

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
0x82 | (N * 8)	XX	XX	XX	XX	XX	XX	XX

TPDO2 with byte0 = ((N * 8) + 2) is response from transmitter.

Request PID parameters for a specific zone, N = zone index (0 thru 5)

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
0x83 | (N * 8)	XX	XX	XX	XX	XX	XX	XX

TPDO2 with byte0 = ((N * 8) + 3) is response from transmitter.

3.3 Heartbeat Message, message ID of 0x080

The CAN1 master device (B&R display, PLC, or other) ***must send a heartbeat message once every 1.0 second*** or all transmitters connected to the CAN1 bus will timeout and disable all of their zone PWM outputs (heating will stop). The 8 bytes of data contained in the message are all 0x00. The message is typically sent once every 1 second but the timeout time used by the transmitter is actually 2 seconds.

4 CAN2 Messages

RT406-2C devices are referred to as transmitters in the following text. CAN2 messages are fewer and simpler than CAN1 partly because it connects only one transmitter to its dedicated heater power controller.

4.1 Heater Power Controller Heartbeat, 0x7F8

Sent by the Heater Power Controller cyclically once every 2 seconds.

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
fault flags byte	XX	XX	XX	XX	XX	XX	XX

The fault flags byte is passed directly through to the CAN1 master as byte2 of TPDO1. See paragraph 3.2.1 for details.

4.2 Reset Heater Power Controller, 0x000

This 1 byte message is sent from the transmitter to reset the heater power controller.

byte0
0xAA

4.3 Heater Power Controller Zone Control Values, 0x380

Sent by the transmitter cyclically once every 1.14 seconds.

byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7
zone1 PWM control value	zone2 PWM control value	zone3 PWM control value	zone4 PWM control value	zone5 PWM control value	zone6 PWM control value	0x01	0x01

Zone PWM control values range from 0x01 to 0xFF where 0x01 commands a zone heater to 0% and 0xFF to 100% duty cycle.

5 Special Temperature Codes

Reported measured temperature values of 252°C and above are actually special temperature fault codes. The following table lists and explains each fault code.

Table 2: RTD Value Special Temperature Codes

Temperature Value (°C)	Description
252	The RT406-2C is in initialization mode.
253	RTD under range condition (possible shorted RTD).
254	RTD over range condition (possible open RTD).
255	General rotor data error. This error is declared anytime there is a communications problem between the rotor and the stator.

6 Tools

For monitoring CAN Bus message activity, tools like the Peak PCAN-USB adapter work well.