

User Manual

1. Overview

The KC9650B is an instrument-grade low-power microwave source capable of providing continuous output power from 1 to 50 W (with a typical maximum up to 60 W), with a setting resolution of 1 W. It also features excellent frequency stability and high resolution, allowing precise frequency adjustment in 1 Hz steps over a range of 2.4 to 2.5 GHz.

The KC9650B delivers high output quality, featuring low phase noise and parasitic amplitude modulation of less than 1%. Its signal can be accurately measured using a peak power meter. When used as part of a microwave measurement system, it helps simplify the detection circuitry.

The device incorporates temperature compensation and closed-loop control, resulting in minimal drift within a cooling surface temperature range of 0 to 50°C, typically not exceeding 0.5 dB. The cooling method is flexible, with a large flat

thermal interface that supports connection to an external water-cooling plate or air-cooled heat sink. The device provides a 12 V power output to drive a fan directly, eliminating the need for an additional power supply.

The KC9650B is powered by a single 32 V DC supply and includes an integrated internal power supply.

It is easy to operate, supporting both analog and digital control via USB serial port, RJ45 network port, or RS485 serial port.

It is suitable for scientific experiments and industrial applications with general reliability requirements and can serve as a driver for other microwave sources.



2. Technical Specifications

| Parameter Name              | Test Conditions        | Min                                                                       | Typ  | Max  | Unit/Remarks  |
|-----------------------------|------------------------|---------------------------------------------------------------------------|------|------|---------------|
| Frequency Range             |                        | 2400                                                                      |      | 2500 | MHz           |
| Power Range <sup>1</sup>    |                        | 23                                                                        |      | 47   | dBm           |
| Power Uncertainty           | 25~50W                 |                                                                           | 4%   | 7%   | 25°C, 2450MHz |
| Temperature Drift           | Cooling Surface 0~50°C |                                                                           | 5%   | 10%  |               |
| Frequency Uncertainty       |                        |                                                                           | 0.5  | 1.0  | ppm/a, 25°C   |
| Phase Noise                 | 10kHz shift            |                                                                           | -90  |      | dBc/Hz        |
| Supply Voltage <sup>1</sup> |                        | 27.5                                                                      | 32.0 | 35   | V             |
| Supply Current              |                        |                                                                           | 5    | 8    | A             |
| RF Connector                |                        | SMA female connector as standard; N-type connector available upon request |      |      |               |

|                |                      |                                              |          |      |                         |
|----------------|----------------------|----------------------------------------------|----------|------|-------------------------|
| VSWR Tolerance | At 50 W output power | 3.0                                          | $\infty$ |      | Continuous              |
| Control Method |                      | Analog voltage (0–5 V), RS485, USB, Ethernet |          |      |                         |
| Dimensions     | L×W×H                | 197                                          | 135      | 25.1 | mm                      |
| Weight         |                      |                                              | 1.5      |      | kg, excluding heat sink |

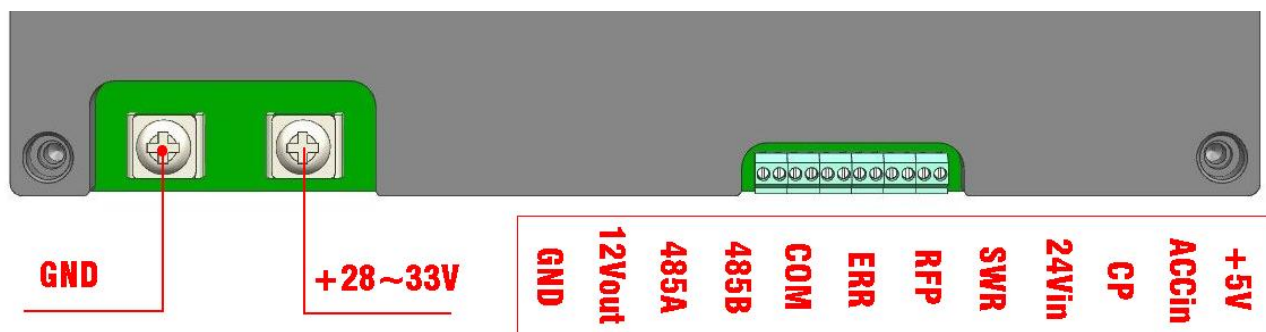
Note 1: When the supply voltage is below 30 V, the maximum power specification is not guaranteed; derating should be applied.

### 3. Interface Definition

For clarity, the interface definitions are described below.

The power source requires a relatively high supply current. The power cable should be selected based on a peak current of 10 A, and the cable terminals must be secured with bolts. Ensure that the cable lugs are appropriately sized to avoid contact with the enclosure, which could cause a short circuit.

SWR, RFP, and ERR are status output terminals. Refer to Chapter 5 for details.



### 4. Analog Control

After power-up, the device defaults to analog control mode, with a default frequency of 2450 MHz. When any handshake under digital control mode (see the following sections) is established, the device will automatically exit analog control mode. To re-enter analog control mode, the device must be power-cycled.

If the default Modbus protocol is enabled, the device will enter Modbus mode after power-up without a handshake.

#### 4.1. Output Enable

The enable switch is connected between +5 V and the CP pin. Closing the switch activates the power output. Alternatively, an external control signal may be used to pull the CP pin high to 5 V (>3.5 V), with the control signal ground connected to COM. COM may be shorted to GND if necessary.

If the CP pin is already pulled high at power-up, the microwave source will not output power. The CP pin must be released and then pulled high again to enable RF output.

#### 4.2. Controlling Output Power Using a Potentiometer

Connect a potentiometer with a resistance range of 10 k $\Omega$  to 100 k $\Omega$  between +5 V and GND (not COM, unless COM is connected to GND). Connect the wiper to the ACCin terminal. Adjusting the potentiometer changes the wiper voltage, thereby controlling the output power. When the voltage at the ACCin terminal is 0 V, the output power is at its minimum. When the ACCin voltage is 5 V, the output power is at its maximum.

4.3. Controlling Output Power Using a Voltage Level

Apply an external voltage source to ACCin (negative terminal connected to GND) within a range of 0–5 V. The RF output power will be adjusted in approximately 0.1 W steps.

5. Digital Control

The data interfaces are primarily used for configuring operational parameters, such as frequency, power, and communication settings. The instrument provides multiple interfaces, with the USB interface offering the highest level of access. Before using the Ethernet interface, the USB port can be used to configure IP parameters.

5.1. USB Control

Internally, the USB interface is converted to a serial port and appears as a COM port on the computer. To use it, connect the USB (Type-C) port to the computer, open Device Manager, and locate the corresponding port. If an unknown USB-SERIAL device is found, double-click it and update the driver. Windows 10 or later will automatically install the driver. After installation, the system will display “USB-SERIAL CH340 (COM\*)”. Remember the assigned COM port number. For other operating systems, drivers can be obtained from the supplier.

When using the USB interface for parameter configuration, the 30 V main power supply must be connected. Without the main power, the computer may detect the COM port, but the device CPU will not be running, and there will be no response. Ensure that the host computer and device share a common ground to avoid ground loops.

Install a serial debugging tool on the computer, such as XCOM or Sscom. In the tool, select the COM port corresponding to the instrument and set the baud rate to 921600, stop bits to 1, data bits to 8, and no parity. After configuration, click to open the serial port.

After these preparations, a handshake command must be sent before performing any other operations. The handshake command does not include read or write bits.

The handshake command is “usbcontrol”.

|                |                |
|----------------|----------------|
| Host Sends     | usbcontrol\r\n |
| Device Replies | usbcontrol\r\n |

Here, \r\n represents a carriage return and line feed.

After the handshake is complete, configuration operations can be performed. The command format for configuration is as follows:

|                                |                                                                                 |
|--------------------------------|---------------------------------------------------------------------------------|
| Write Command                  | WXXXXX=DDDD\r\n                                                                 |
| Write Frame Format Description | W (write prefix) [Command Name]=[Parameter]\r\n (carriage return and line feed) |
| Read Command                   | RXXXXX\r\n                                                                      |
| Read Frame Format Description  | R (read prefix) [Command Name]=[Parameter]\r\n (carriage return and line feed)  |

Here, W/R indicates the read/write bit (the handshake command does not include this bit). XXXXX is the command, which can be of any length. DDDD is the data, which can be of any length. \r\n represents a

carriage return and line feed and does not represent literal characters. When using XCOM, the software does not automatically interpret and convert these characters, so they cannot be entered directly. Instead, enable the “Send New Line” option to allow the software to transmit them automatically.

The table below lists the USB control commands and their data ranges.

| Command       | Function                        | Value Range                                                                                                                                                                                                                                                                           | Description |
|---------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| usbcontrol    | USB Control Handshake           |                                                                                                                                                                                                                                                                                       | Write       |
| ipaddr        | IP Address                      |                                                                                                                                                                                                                                                                                       | Read/Write  |
| gwipaddr      | Gateway                         |                                                                                                                                                                                                                                                                                       | Read/Write  |
| maskaddr      | Subnet Mask                     |                                                                                                                                                                                                                                                                                       | Read/Write  |
| port          | Port                            |                                                                                                                                                                                                                                                                                       | Read/Write  |
| gem           | Device Model                    |                                                                                                                                                                                                                                                                                       | Write       |
| software      | Software Version                |                                                                                                                                                                                                                                                                                       | Write       |
| baudrate      | Set Baud Rate                   | 1–5 integers, where:<br><br>1: 38400; 2: 57600; 3: 115200; 4: 921600; 5: 1382400                                                                                                                                                                                                      | Read/Write  |
| errorcode     | Error Code                      |                                                                                                                                                                                                                                                                                       | Write       |
| outen         | Output Enable                   | 0–1 integers, where:<br>0: Disable power output; 1: Enable power output                                                                                                                                                                                                               | Read/Write  |
| temperature   | Temperature                     |                                                                                                                                                                                                                                                                                       | Write       |
| temperaturewh | Temperature Warning Threshold   | 30–80 integers                                                                                                                                                                                                                                                                        | Read/Write  |
| clock         | Select Clock Source             | 0–1 integers, where:<br>0: Internal clock source; 1: External clock source<br><br>This item does not need to be configured. The clock interface is not exposed by default, and the internal clock is used at power-on. If an external clock is required, please contact the supplier. | Read/Write  |
| voltage       | Main Power Voltage              |                                                                                                                                                                                                                                                                                       | Write       |
| freq          | Output Frequency                | 2400000000~2500000000 integers                                                                                                                                                                                                                                                        | Read/Write  |
| power         | Output Power                    | 1~60integers                                                                                                                                                                                                                                                                          | Read/Write  |
| fwdpower      | Forward Output Power            |                                                                                                                                                                                                                                                                                       | Write       |
| fwdpoweradc   | Forward Power ADC               |                                                                                                                                                                                                                                                                                       | Write       |
| revpower      | Reverse Power                   |                                                                                                                                                                                                                                                                                       | Write       |
| revpoweradc   | Reverse Power ADC               |                                                                                                                                                                                                                                                                                       | Write       |
| fwdpowerwt    | Forward Power Warning Threshold | 1~65integers                                                                                                                                                                                                                                                                          | Read/Write  |
| revpowerwt    | Reverse Power                   | 1~65 integers                                                                                                                                                                                                                                                                         | Read/Write  |

|                 |                                  |                                                           |            |
|-----------------|----------------------------------|-----------------------------------------------------------|------------|
|                 | Warning Threshold                |                                                           |            |
| lowvoltagecheck | Low Voltage Check <sup>1</sup> . | 0~1 integers, where:<br>0: Disable check; 1: Enable check | Read/Write |

Note 1: When low-voltage check is enabled, if the main power supply drops below 24 V for a period of time, RF output will be disabled and an error code will be returned. After the voltage recovers, the enable command must be sent again to resume RF output. When low-voltage check is disabled, the device will not shut down automatically even if the power supply voltage is low; as the voltage decreases, the device may exhibit abnormal behavior or fail to start. The typical minimum startup voltage is approximately 15 V.

Example

To set the output to 2450 MHz and 30 W as an example, perform the following steps:

- a. Handshake connection
  - Host sends: usbcontrol\r\n
  - Device replies: usbcontrol\r\n
- b. Set output frequency to 2.45 GHz
  - Host sends: wfreq=2450000000\r\n
  - Device replies: wfreq=2450000000\r\n
    - set freq:2450000000Hz\r\n
- c. Set output power to 30 W
  - Host sends: wpower=30\r\n
  - Device replies: wpower=30\r\n
    - set power:30\r\n
- d. Enable output
  - Host sends: wouten=1\r\n
  - Device replies: wouten=1\r\n
    - Source:ON\r\n

5.2. Ethernet Control

Connect the KC9650 Ethernet port to the local network or directly to the host computer. The default IP address is 192.168.11.100, the default gateway is 192.168.11.1, the default subnet mask is 255.255.255.0, and the default port is 901. If the default values are not suitable, the IP parameters must be modified via the USB interface.

After the cable is connected, a handshake command must be sent before performing other operations. The handshake command does not include the read/write bit.

The handshake command is “ethcontrol\r\n”

|                |                |
|----------------|----------------|
| Host sends     | ethcontrol\r\n |
| Device replies | ethcontrol\r\n |

Where \r\n represents the carriage return and line feed characters.

After the handshake is completed, configuration operations can be performed. The command format is as follows:

|                                |                                                                                 |
|--------------------------------|---------------------------------------------------------------------------------|
| Write command                  | WXXXXX=DDDD\r\n                                                                 |
| Write frame format description | W (write prefix) [command name]=[parameter]\r\n (carriage return and line feed) |
| Read command                   | RXXXXX\r\n                                                                      |
| Read frame format description  | R (read prefix) [command name]=[parameter]\r\n (carriage return and line feed)  |

Where W/R indicates the read/write bit (the handshake command does not include this bit). XXXXX is the command and can be of any length. DDDD is the data and can be of any length. \r\n represents the carriage return and line feed.

Other commands and formats are the same as those used in USB control. Unless absolutely necessary, avoid modifying IP configuration parameters via the Ethernet interface; otherwise, if an error occurs, the connection may be lost and can only be corrected via the USB interface.

The KCSDI software can be used to configure and operate the device.

The download address for KCSDI: <https://deepace.net/products/software/kcsdi-software/>.

KCSDI supports controlling the KC9650B via USB or Ethernet. If using an Ethernet connection, the IP address must first be configured via USB.

The operation of the KCSDI software is straightforward. After installation, the configuration method can be found with minimal familiarization, and will not be described in detail here.

### 5.3. RS485 Control

When using an RS485 connection, connect the 485A and 485B terminals to the corresponding PLC terminals. Note that the A/B definitions may differ among PLC manufacturers; if communication fails, try swapping them. Depending on the length of the RS485 line and the number of devices, appropriate load resistors may be required.

The default baud rate of the RS485 interface is 115200. If the baud rate is unknown, polling must be performed at all valid addresses and baud rates. Possible baud rates include: 9600, 19200, 38400, 57600, and 115200. The valid address range is: 1–247.

When operating the microwave source via RS485, the CP pin must also be pulled up to output microwave power. If using the internal power supply, COM and GND must be shorted as well.

#### 5.3.1. Command Format

The RS485 interface communicates using Modbus RTU and does not support consecutive write or read operations. The command format is as follows:

Write frame:

Downlink frame: Device address (1B), function code (1B), register address (2B), write data (2B), CRC check (2B), total 8 bytes.

Successful uplink frame: return the downlink frame data with CRC recalculated.

Failed uplink frame: Device address (1B), function code (1B | 0x80), exception code (1B), CRC check (2B), total 5 bytes.

Read frame:

Downlink frame: Device address (1B), function code (1B), register address (2B), quantity to read (2B) (only the current address can be read, 0x0001), CRC check (2B), total 8 bytes.

Successful uplink frame: Device address (1B), function code (1B), byte count (1B), data (2B) (only the current address can be read, 0x0001), CRC check (2B), total 7 bytes.

Failed uplink frame: Device address (1B), function code (1B | 0x80), exception code (1B), CRC check (2B), total 5 bytes.

Where:

- 1) The valid device address range is 1–247. Address 247 (0xF7) is the default address. Address 0 is the broadcast address. All others are invalid. The broadcast address has no function.
- 2) Function code 03 represents query (read), and 06 represents setting (write).
- 3) Data format: All data in the protocol use short integers (2 bytes). The unit of power is W. The unit of temperature is 0.1 °C, i.e., the temperature value multiplied by 10. For example: 16# 00 00 12 35 = 4661, which represents 4661 W or 466.1 °C depending on the register address. The frequency is configured as 32-bit or 16-bit control via a selection register. Writing 1 selects 32-bit mode; writing 0 selects 16-bit mode. In 32-bit mode, the frequency unit is Hz. When operating in 32-bit mode, first write the high 16 bits (address 0x11), then write the low 16 bits (address 0x12). After writing the low 16 bits, the target device automatically retrieves the high 16 bits and combines them into a 32-bit value. The setting takes effect automatically after the low 16 bits are written. Writing only the high 16 bits is invalid. Writing only the low 16 bits will result in an error if the parsed value is out of range. If 16-bit mode is selected, the setting takes effect immediately after writing. In 16-bit mode, only the frequency high-byte register (0x11) needs to be written. The unit in 16-bit mode is MHz.
- 4) In the following communication protocol, RR RR represents the 2-byte CRC check. Pay attention to endianness; if calculated manually, the byte order may need to be swapped. XX XX represents the error code, YY YY represents the set/read value, ZZ ZZ represents any value, and UU UU represents the exception code.
- 5) When the solid-state source fails, a logic level output notifies the host, which then queries the fault code for subsequent actions.
- 6) The default RS485 baud rate is 115200, half-duplex mode.

#### Communication Address List

| Register Address | Function                                        | Settable | Queryable |
|------------------|-------------------------------------------------|----------|-----------|
| 0x 01            | Device Model                                    | No       | Yes       |
| 0x 02            | Software Version                                | No       | Yes       |
| 0x 03            | Device Address (485 Address)                    | Yes      | Yes       |
| 0x 04            | Baud Rate                                       | Yes      | Yes       |
| 0x 05            | Error Code                                      | No       | Yes       |
| 0x 06            | RF Output Enable                                | Yes      | Yes       |
| 0x 07            | Lock/Unlock                                     | Yes      | Yes       |
| 0x 08            | RS485 Control                                   | Yes      | Yes       |
| 0x 09            | Temperature                                     | No       | Yes       |
| 0x 0A            | Temperature Warning Threshold                   | Yes      | Yes       |
| 0x 0B            | Set Default Communication Mode to Modbus        | Yes      | Yes       |
| 0x 0C            | Set Clock Source                                | Yes      | Yes       |
| 0x 0D            | Read Power Supply Voltage                       | No       | Yes       |
| 0x 0E            | Power Supply Voltage Check                      | Yes      | Yes       |
| 0x 0F            | Restart MCU                                     |          |           |
| 0x 10            | Frequency 32-bit or 16-bit Selection and Enable | Yes      | Yes       |
| 0x 11            | Frequency High Word                             | Yes      | Yes       |
| 0x 12            | Frequency Low Word                              | Yes      | Yes       |

|       |                                 |     |     |
|-------|---------------------------------|-----|-----|
| 0x 20 | Set Power                       | Yes | Yes |
| 0x 21 | Forward Power                   | No  | Yes |
| 0x 22 | Forward Power ADC               | No  | Yes |
| 0x 23 | Reverse Power                   | No  | Yes |
| 0x 24 | Reverse Power ADC               | No  | Yes |
| 0x 25 | Forward Power Warning Threshold | Yes | Yes |
| 0x 26 | Reverse Power Warning Threshold | Yes | Yes |

### 5.3.2. Setting Commands

#### 1)Set address

- i. PLC sends command: F7 06 00 03 00 YY RR RR
- ii. Normal return data: F7 06 00 03 00 YY RR RR
- iii. Exception return data: F7 86 UU RR RR

After this command is executed, the device address is changed from the default 0xF7 to the set value (YY). If it is changed to 0x01, the next communication must use 0x01 as the slave address.

#### 2)Set baud rate

- i. PLC sends command: 01 06 00 04 00 YY RR RR
- ii. Normal return data: 01 06 00 04 00 YY RR RR
- iii. Exception return data: 01 86 UU RR RR
- iv. Supported baud rates: 9600 (default, write 1), 19200 (write 2), 38400 (write 3), 57600 (write 4), 115200 (write 5).

#### 3)Set output ON/OFF

- i. PLC sends command: 01 06 00 06 00 YY RR RR
- ii. Normal return data: 01 06 00 06 00 YY RR RR
- iii. Exception return data: 01 86 UU RR RR
- iv. Write 0x00 to disable output; write 0x01 to enable output.

#### 4)Set lock/unlock

- i. PLC sends command: 01 06 00 07 00 YY RR RR
- ii. Normal return data: 01 06 00 07 00 YY RR RR
- iii. Exception return data: 01 86 UU RR RR
- iv. To lock the interface, write 0x01 to YY. In this state, RS485 write operations are disabled; only query operations are allowed. To operate the device via RS485, write 0x00 first to unlock the interface.

#### 5)Set control mode (485 handshake frame)

- i. PLC sends command: 01 06 00 08 00 01 RR RR
- ii. Normal return data: 01 06 00 08 00 01 RR RR
- iii. Exception return data: 01 86 UU RR RR

#### 6)Set temperature warning threshold

- i. PLC sends command: 01 06 00 0A YY YY RR RR
- ii. Normal return data: 01 03 00 0A YY YY RR RR
- iii. Exception return data: 01 86 UU RR RR
- iv. Adjustable temperature warning threshold range: 30–80 °C.

#### 7)Set default communication mode to Modbus

- i. PLC sends command: 01 06 00 0B 00 YY RR RR
- ii. Normal return data: 01 03 00 0B 00 YY RR RR
- iii. Exception return data: 01 86 UU RR RR
- iv. YY = 0x01: set default communication mode to Modbus; YY = 0x00: set default communication mode to manual. Writing other values will cause an error.

8)Set frequency mode

- i. PLC sends command: 01 06 00 10 00 YY RR RR
- ii. Normal return data: 01 06 00 10 00 YY RR RR
- iii. Exception return data: 01 86 UU RR RR
- iv. High byte controls frequency mode: 0x00 for 16-bit mode, 0x01 for 32-bit mode.

9)Set frequency high word

- i. PLC sends command: 01 06 00 11 YY YY RR RR
- ii. Normal return data: 01 06 00 11 YY YY RR RR
- iii. Exception return data: 01 86 UU RR RR
- iv. In 16-bit mode, YYYY is in MHz. In 32-bit mode, YYYY is the high 16 bits and must be combined with the low 16 bits of the next address, unit Hz.

10) Set frequency low word

- i. PLC sends command: 01 06 00 12 YY YY RR RR
- ii. Normal return data: 01 06 00 12 YY YY RR RR
- iii. Exception return data: 01 86 UU RR RR
- iv. In 16-bit mode, this register is invalid. In 32-bit mode, YYYY is the low 16 bits and must be combined with the high 16 bits of the previous address, unit Hz.

11)Set power

- i. PLC sends command: 01 06 00 20 00 YY RR RR
- ii. Normal return data: 01 06 00 20 00 YY RR RR
- iii. Exception return data: 01 86 UU RR RR
- iv. Adjustable power range: 1–60.

12)Forward power warning threshold

- i. PLC sends command: 01 06 00 25 YY YY RR RR
- ii. Normal return data: 01 06 00 25 YY YY RR RR
- iii. Exception return data: 01 86 UU RR RR
- iv. Adjustable range: 1–65.

13)Reverse power warning threshold

- i. PLC sends command: 01 06 00 26 YY YY RR RR
- ii. Normal return data: 01 06 00 26 YY YY RR RR
- iii. Exception return data: 01 86 UU RR RR
- iv. Adjustable range: 1–65.

### 5.3.3 Query Commands

1)Query device model

- i. PLC sends command: 01 03 00 01 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

2)Query software version

- i. PLC sends command: 01 03 00 02 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

3)Query address

- i. PLC sends command: 01 03 00 03 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

4)Query baud rate

- i. PLC sends command: 01 03 00 04 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

5)Query error code

- i. PLC sends command: 01 03 00 05 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

6)Query RF output status

- i. PLC sends command: 01 03 00 06 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR
- iv. In the returned status, 01 indicates output is enabled; 00 indicates RF output is disabled.

7)Query RS485 lock status

- i. PLC sends command: 01 03 00 07 00 01 RR RR
- ii. Normal return data: 01 03 00 07 00 YY RR RR
- iii. Exception return data: 01 83 UU RR RR
- iv. In the returned status, 01 indicates the line is locked (write disabled); 00 indicates unlocked (write enabled).

8)Query control mode

- i. PLC sends command: 01 03 00 08 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

9)Query temperature

- i. PLC sends command: 01 03 00 09 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

10)Query temperature warning threshold

- i. PLC sends command: 01 03 00 0A 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

11)Query frequency mode

- i. PLC sends command: 01 03 00 10 00 01 RR RR

- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

12)Query frequency high word

- i. PLC sends command: 01 03 00 11 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

13)Query frequency low word

- i. PLC sends command: 01 03 00 12 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

14)Query power

- i. PLC sends command: 01 03 00 20 00 01 RR RR
- ii. Normal return data: 01 03 00 20 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

15)Query forward power

- i. PLC sends command: 01 03 00 21 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

16)Query forward power ADC

- i. PLC sends command: 01 03 00 22 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

17)Query reverse power

- i. PLC sends command: 01 03 00 23 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

18)Query reverse power ADC

- i. PLC sends command: 01 03 00 24 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

19)Query forward power warning threshold

- i. PLC sends command: 01 03 00 25 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

20)Query reverse power warning threshold

- i. PLC sends command: 01 03 00 26 00 01 RR RR
- ii. Normal return data: 01 03 02 YY YY RR RR
- iii. Exception return data: 01 83 UU RR RR

## Example

To set 2450 MHz and 30 W output, perform the following steps:

a.Handshake connection

PLC sends command: F7 06 00 08 00 01 DD F4

Device returns data: F7 06 00 08 00 01 DD F4

b.Set frequency mode to 32-bit mode

PLC sends command: F7 06 00 10 00 01 49 CF

Device returns data: F7 06 00 10 00 01 49 CF

c.Set frequency high word

PLC sends command: F7 06 00 11 92 08 A1 55

Device returns data: F7 06 00 11 92 08 A1 55

d.Set frequency low word

PLC sends command: F7 06 00 12 08 80 3B 93

Device returns data: F7 06 00 12 08 80 3B 93

e.Set output power to 30 W

PLC sends command: F7 06 00 20 00 1E 08 08

Device returns data: F7 06 00 20 00 1E 08 08

f.Enable output

PLC sends command: F7 06 00 06 00 01 BC 37

Device returns data: F7 06 00 06 00 01 BC 37

### 5.3.4. Error Codes

The error code consists of 2 bytes. For clear differentiation, the high byte indicates the error category, and the low byte indicates the specific error code. Categories include MCU internal errors, setting errors, calculation errors, communication errors, etc.

#### 1)Error categories

| Category Code | Category Description |
|---------------|----------------------|
| 0x10xx        | Communication Fault  |
| 0x20xx        | Warning              |
| 0x30xx        | Error                |

#### 2)Error Code List

| Error Code <sup>1</sup> | Category | Description                                     | Solution                                                           |
|-------------------------|----------|-------------------------------------------------|--------------------------------------------------------------------|
| 0x1001                  | 0x10xx   | Address not writable                            | Resend the correct command                                         |
| 0x1002                  | 0x10xx   | Local write locked                              | Send unlock command first                                          |
| 0x1004                  | 0x10xx   | Read/write command error                        | Resend the correct command                                         |
| 0x1008                  | 0x10xx   | Register address error                          | Resend the correct command                                         |
| 0x1010                  | 0x10xx   | Data out of range                               | Resend the correct command                                         |
| 0x2001                  | 0x20xx   | Temperature out of range                        | Reduce output power / improve cooling / increase warning threshold |
| 0x2002                  | 0x20xx   | Reverse power out of range                      | Check output matching / increase warning threshold                 |
| 0x2008                  | 0x20xx   | Forward power out of range                      | Reduce output power / increase warning threshold                   |
| 0x3001                  | 0x30xx   | Temperature out-of-range timeout <sup>2</sup>   | Improve cooling / increase warning threshold, then restart         |
| 0x3002                  | 0x30xx   | Reverse power out-of-range timeout <sup>2</sup> | Check output matching / increase warning threshold, then restart   |
| 0x3004                  | 0x30xx   | Loss of lock                                    | Check clock, restart; if the error persists, contact the supplier  |
| 0x3008                  | 0x30xx   | Forward power out-of-range timeout              | Reduce output power / increase limit, then restart                 |

Note 1: Each bit in the binary values of 0x2000 and 0x3000 is unique. Therefore, if multiple warnings or errors of the same category occur, they may be combined and output together, and should be separated during parsing. Warnings and errors cannot be combined with each other. Note 2: The default timeout is 24 seconds.

## 6. Status Output

The SWR, RFP, and ERR terminals of the KC9650 are opto-isolated. The SWR, RFP, and ERR terminals are enabled under the following conditions: SWR when the reflected power exceeds the “Reverse Power Warning Threshold” (set via the host); RFP when the output power exceeds 1 W; and ERR when an error or warning occurs. When enabled, these terminals present low impedance ( $\sim 1\text{ k}\Omega$ ) to the COM terminal; when not enabled, they present low impedance ( $\sim 10\text{ k}\Omega$ ) to the 24Vin terminal and high impedance greater than  $1\text{ M}\Omega$  to the COM terminal. Users can use the conduction state between these terminals and COM or 24Vin to monitor the operating status of the device.

The KC9650 does not actively drive a high-level output externally. If a high-level output is required, use an external power supply to pull up the 24Vin terminal. Although labeled 24Vin, this terminal accepts 5–24 V, which can be chosen according to the control system requirements.

## 7. Power Output

The KC9650 supports 12 V and 5 V power outputs. The 12V output is equipped with a 500 mA self-recovering fuse (default; for higher current, specify when ordering, up to 2 A). Overcurrent will blow the fuse, which will automatically recover, although its lifespan is limited. The +5 V output is intended for control purposes only. It cannot supply high current and should not be used to drive other loads.

## 8. Installation Instructions

The KC9650 chassis has four screw holes at the corners, typically using  $\phi 4\text{ mm}$  screws for mounting. If the screw holes do not match the device, use an adapter aluminum plate; do not drill into the power source.

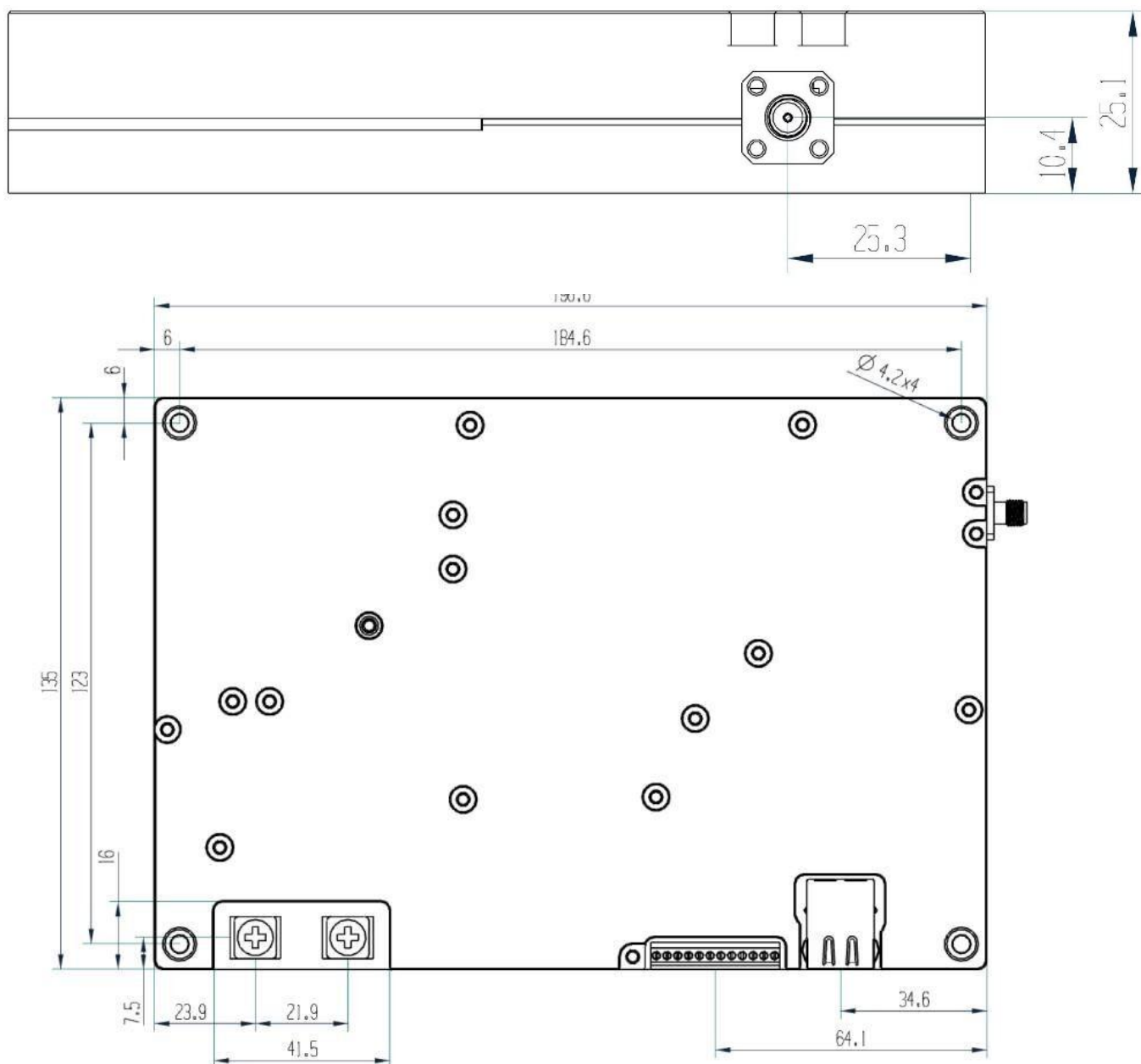
Pay special attention to the thermal design; the RF connector axis is the main heat-generating area. The KC9650 is shipped without a heatsink by default; an external heatsink is required. The entire bottom surface serves as a thermal interface and should be in full contact with the heatsink. A small amount of thermal grease may be applied to enhance thermal coupling.

The mating surface should be flat and clean, with a temperature not exceeding  $45\text{ }^{\circ}\text{C}$ , ideally below  $30\text{ }^{\circ}\text{C}$ . The heatsink should be designed for at least 200 W thermal load, with a thermal rise not exceeding  $0.05\text{ }^{\circ}\text{C/W}$ . For higher ambient air or water temperatures, stricter requirements for temperature rise should be applied.

In high-vibration environments, use flexible coaxial cables to connect the RF ports. Cables cause signal attenuation; use shorter cables and compensate for power loss. Avoid overly thick cables to prevent stressing the connectors.

Microwave power leakage may be significant. To avoid interference, it is recommended to use shielded control cables with proper grounding of the shield.

Mechanical dimensions related to installation are shown in the diagrams.



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**KC9650B**

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