

VCP-04

Visual control panel

HW version v1.03

FW version v01.00.01

SW demo version v1.07

User's Guide



Description

VCP-04 is a portable/pocket visual control device with wireless connectivity and many peripherals for arbitrary use, fully user customizable/programmable.

It is a generic equipment, i.e. the hardware is fixed and the user can implement specific functionality by software only. This device is intended for final production while the DS-VCP-04 development set should be used for development.



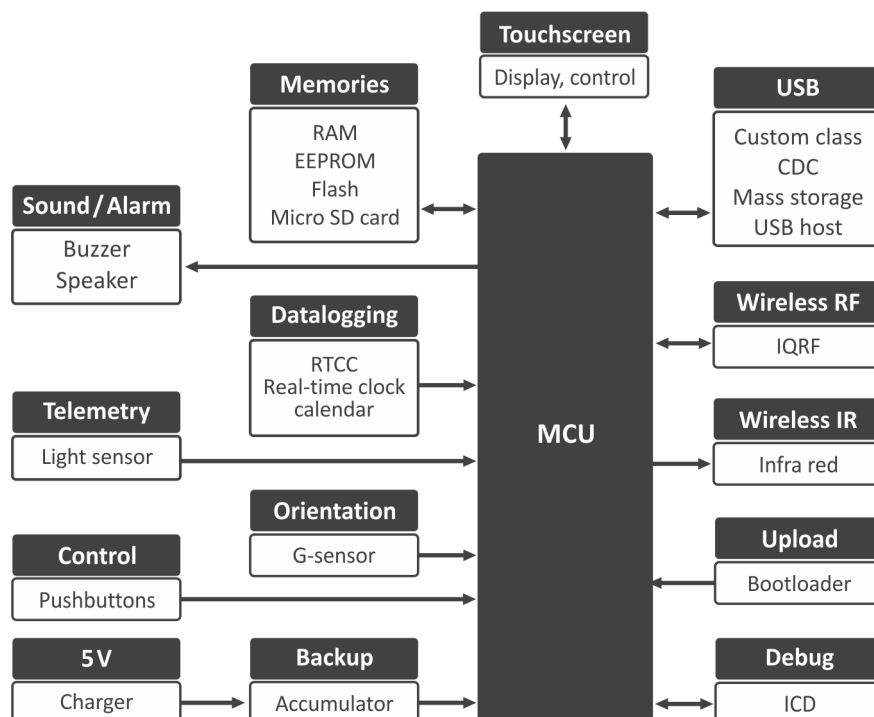
Key features

- Display/touchscreen 3.5", 320 x 480 pixels, 262144 colors
- Main MCU PIC32MX7
- Secondary MCU PIC12F615 for basic management
- Micro SD card, serial EEPROM and Flash memories
- USB device
- Wireless connectivity (IQRF and IR)
- Audio output
- RTCC (real time clock/calendar)
- G-sensor (e.g. for portrait/landscape view switching)
- Light sensor
- Accumulator
- Very low power consumption in Sleep mode

Applications

- Control units for arbitrary use
- Remote wireless controllers
- Building automation
- Industrial control
- Access systems

Block diagram



Electrical specifications*(typical values unless otherwise stated)*

Power supply	
Accumulator	LIP423885, 3.7 V, 1450 mAh, Li-Pol
Charging	5.0 ± 0.35 V DC (via micro USB)
Power consumption	
Power-off, all peripherals shut down	8 µA
Operation, display backlight off	150 mA
Operation, display backlight on	240 mA
Accumulator charging	450 mA max.
Display	KWH035ST20-F02-VCP04, TFT LCD 3.5", 320 x 480 pixels, 256 K colors
Temperature range	
Operating	0 °C to +60 °C
Accumulator charging	0 °C to +45 °C
Storage	10 °C to 25 °C recommended
TR module	TR-54D, soldered
Frequency range	868 MHz or 916 MHz (SW selectable)
RF output power	5 dBm (SW selectable in 8 steps, up to specified value)
Antenna	On-board PCB
RF range	430 m
Serial EEPROM endurance	16 Kb, I2C bus, 1 000 000 erase/write cycles (25°C)
Serial Flash memory endurance	8 Mb, SPI bus, 100 000 (typ.), 10 000 (min.) erase/write cycles
SD card	Standard 2 GB micro SD
Dimensions	121.6 mm x 64.5 mm x 11 mm
Weight	108 g

Absolute maximum ratings

Stresses above those values may cause permanent damage to the device. Exposure to maximum rating conditions for extended periods may affect device reliability.

Supply voltage	5.5 V DC (via micro USB)
Storage temperature	-10 °C to +80 °C

Hardware

Power supply

VCP-04 is supplied by the accumulator. It is non-removable, to be charged by 5 V DC via the micro USB connector. Instead of power off, normal operation can be deactivated by switching to sleep mode.

The accumulator should be protected against total exhausting by application software, switching the device into sleep mode (see below) when the accumulator voltage is low. The demo software provides this after dropping down to 3.45 V. If no proper protection is implemented in application SW, VCP-04 forces the sleep mode when the voltage level drops below 2.85 V and wakes up if the voltage rises up again by connecting to external power supply.

Main MCU

VCP-04 is controlled by the 32 b microcontroller PIC32MX795F512L, up to 80 MHz. Main MCU is user programmable. Program memory size is 512 KB and RAM size is 128 KB.

Secondary MCU

VCP-04 power management, back-up software RTCC and battery monitoring with power source identification are controlled by the 8b microcontroller PIC12F615MF. Firmware of the secondary MCU is fixed.

Reset pushbutton

VCP-04 reset can be invoked by reset pushbutton accessible by a pin through the hole on the side of the case. This induces reinitialization of the device.

Sleep mode

Sleep mode is intended to minimize current consumption by disabling internal circuitry. It is possible to wake up from Sleep by pressing the user pushbutton or by connecting external power source.

RTCC

Real time clock/calendar with crystal precision is implemented in VCP-04. It is operating even in Sleep mode and fails only if power supply (including the accumulator) fails. Date and time must be set after power on or a reset.

EEPROM memory

EEPROM memory 16 kb, with serial interface I2C, 1 000 000 erase/write cycles.

Serial Flash memory

Flash memory 8 Mb, with serial interface SPI , 100 000 erase/write cycles (typ.).

Micro SD memory card

Standard Flash micro SD memory card with SPI interface. Max. capacity is 2 GB for FAT16 and 2 TB for FAT32. The SD card is not removable. It is accessible via USB.

Display

Display KWH035ST26-F01-VCP04, 3.5" diagonal, 320x480 pixels RGB, 262 144 colors VCP TFT LCD, transmissive, with LED backlight and 16 b parallel data bus is used. Graphic library uses 65 535 colors only.

Backlight

VCP-04 display is illuminated by LEDs. Switching on/off or fading out/in enables to save energy, especially while the device is powered from the battery.

Touchscreen

A touch within the display area can be detected and localized by integrated resistive touchscreen. Lower part of the touchscreen creates a touch slider.

Calibration

Proper display functionality requires a calibration (setting the touch sensors in accordance to display pixels) to compensate variations in parameters due to temperature, tolerance of parts and so on. The VCP-04 has the display factory calibrated. Calibration values are stored in the EEPROM. A software calibration procedure (3 x 3 touches in locations indicated by an arrow) is available and should be performed in application software whenever needed (e.g. after significant temperature change).

Audio

Audio system uses analog as well as digital input and mono output. The functionality is fully under the user's control. It can be used to generate tones (beeps, alerts, etc.) or to play WAV tracks.

G-sensor

3-axis linear accelerometer can be used e.g. for portrait/landscape view switching.

Illumination sensor

Illumination sensor enables to measure ambient light intensity.

Vibro motor

The coreless permanent magnetic DC motor.

User pushbutton

User pushbutton can be used to control the device. Actual functionality fully depends on application software.

USB

The Universal Serial Bus (USB) module provides a USB 2.0 full-speed and low-speed embedded host, full-speed device, or OTG implementation. USB OTG enables the intelligence for a device to determine whether it is required to function as a Host or Peripheral and then configure itself accordingly without any user input.

VCP-04 is capable to function as a Host or Peripheral. The demo SW currently supports USB Peripheral classes only, either MSD (mass storage device) or CDC (communications device class).

TR module and antenna

Wireless IQRF transceiver module TR-54D, soldered. PCB antenna is integrated on the VCP-04 board.

IR

Infrared wireless module to transmit and receive serial data.

Case

It is not allowed to open the case.

There are two pads on the bottom side of the case reserved for future use (for magnetic fixation to a pod etc.).

Connections

Part	Pins	Connection
Accumulator	2	Soldered
IQRF TR module	18	Soldered
USB	5	Micro USB connector
Micro SD card	10	DM3AT-SF-PEJ (Hirose) connector, inside the case

Programming and debugging

See the DS-VCP-04 User's guide.

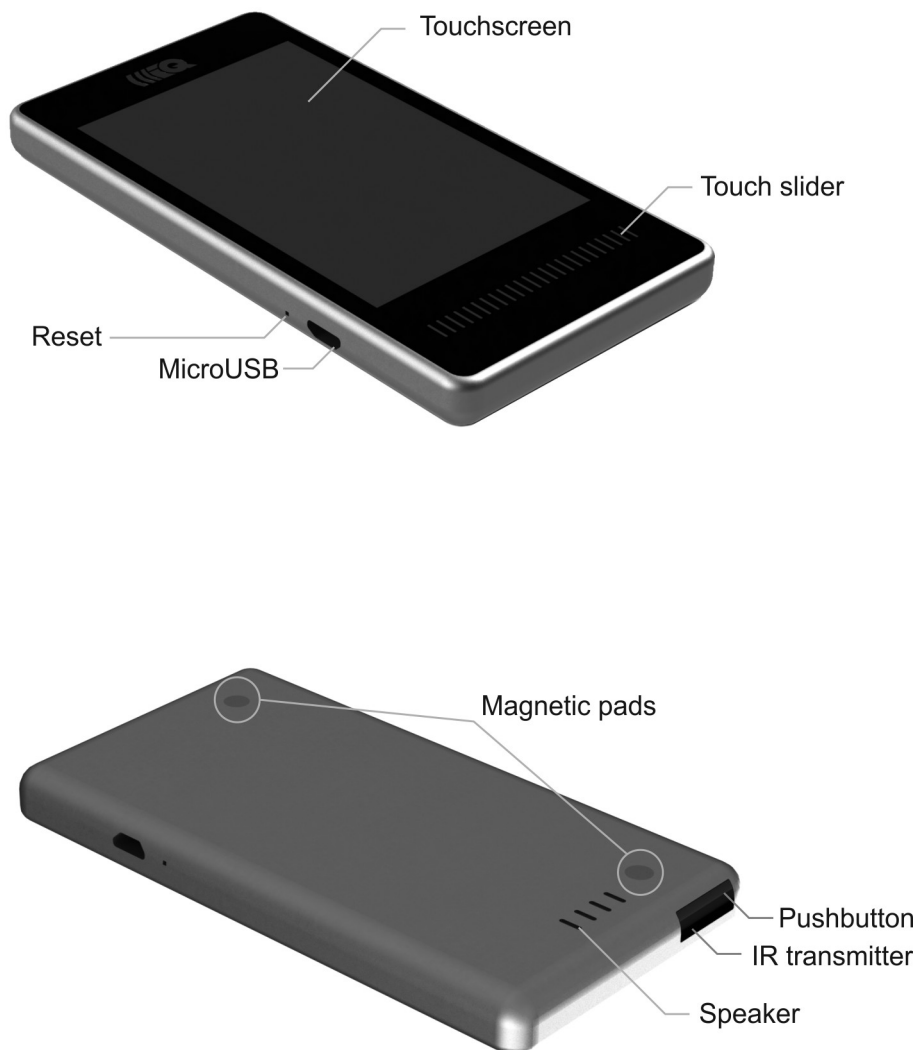
Main MCU

Application code can be uploaded to VCP-04 by bootloader (via microUSB cable, with the case closed).

TR module

Application code can be uploaded from PC to the TR module via USB.

Components and controls



Software

Actual functionality of VCP-04 depends on application software in main MCU and in TR module. It should be developed using the DS-VCP-04 development set and uploaded into VCP-04 by the bootloader.

VCP-04 demo application

VCP-04 is provided with demo program illustrating the following features:

- **Display:** Rendering of screens
- **Touchscreen:** User events detections: pressing, releasing, moving
- **EEPROM:** storing and reading the VCP-04 setting
- **Serial Flash memory:** storing and reading all graphical elements employed in the demo application
- **TR module:** SPI master writing and reading, application uploading, module info getting and displaying.
- **Infrared module:** simple remote controller showing communication with TV Sharp
- **Audio module:** acoustic indication of touching the screen, predefined tones, WAV reading and playing
- **Sensors:** G-sensor and illumination level reading and displaying
- **SD card:** reading and writing, used in many features of the demo application, FAT16, FAT32
- **Vibro module:** single-shot or repeated vibrations
- **Indication LEDs:** on, off, toggle and single flash
- **Secondary MCU:** power management, RTC maintenance, accumulator monitoring
- **USB MSD class:** Mass Storage Device, makes SD card accessible via USB interface
- **USB CDC class:** Communications Device Class, creates standard serial port (UART) with echo functionality
- **RTCC:** date and time setup, autonomous run and displaying
- **Sleep mode:** to minimize power consumption by „switching off“ the equipment

Refer to software and documentation of the DS-VCP-04 for description of functions and other details.

To implement wireless connectivity, the demo should be operated in the following configuration:

- The `tr_vcp04` application uploaded in embedded TR module
- Another (remote) TR module plugged in the DK-EVAL-04 development kit, having the appropriate demo SW uploaded (`iqrf_demo_control` or `vcp_temp_sensor`, see below). Both HEX codes can be downloaded from the VCP-04 product web page.

Complete demo SW including all source codes is available in DS-VCP-04 development set.

Main menu

After wake-up (by the user pushbutton or connecting to external power) the welcome screen appears. Touching the display brings the main menu with icons. By touching any of the icon the new screen is evoked to demonstrate given functionality of the particular HW peripheral. To return back to the main menu press the *Back* button.

Also by touching the screen anywhere off the icons (gray area) and dragging a finger to the left on a touch the screen scrolls to the left and further icons appear on the screen. The same functionality can be achieved by pressing the right arrow in the lower left side.



Main menu icons

Display

A demonstration shows the TFT display facilities by presenting pictures stored on the SD card in the `S_SHOW` and `IQ_SHOW` folders. Returning back from the Slideshow is up on touching the display and returning from IQRF Slideshow up on pressing the *Back* button.

IQRF module

TR module is equipped with dedicated MCU which must have an application software uploaded. The following functionality is available:

- Wired SPI communication with main MCU (TR module is an SPI slave).
- Wireless bidirectional RF connectivity intended for any remote IQRF device or IQRF wireless network.
- TR module can perform various additional tasks according to user's needs.

If the `iqrf_demo_control` application is uploaded in remote TR module, the following functionality is implemented: By pressing the user button on DK-EVAL-04 the LED status on the external TR module is changed and this change is also reflected on the screen. A content of `bufferRF` (the TR buffer dedicated to RF communication) is transferred from the remote TR module and displayed on the screen. By pressing the *Turn off the LEDs* button both LEDs are switched off and this change is indicated by switching off the LEDs on the remote TR module.

IQRF upload

A demonstration how to upload a user application into embedded TR module. The TR application in HEX format must be stored in a file with the `.hex` extension in the `IQUUPLOAD` folder on the SD card. Just one HEX file is allowed to be stored there. By pressing the *Upload* button this application is uploaded into the TR module. When entering the IQRF upload screen, basic information about embedded TR module such as OS, ID and MCU type is displayed in top part of the screen.

Device info

A demo displaying basic information about the VCP-04 device, such as power source, battery voltage level, presence of SD card and readings from G-sensor and lighting sensor.

IQRF chat

A demonstration of wireless communication via sending and receiving chat messages. An IQRF packet is considered to be a chat message if contains the identification.

- **Transmitting:** A user string can be entered from the keyboard (allowing user predefined symbols) to the *Tx* field and sent by the TR module as an RF chat message by pressing the *Send* button.
- **Receiving:** Embedded TR module continually listens to incoming RF packets. If a correct chat message is detected, the received text is displayed in the *Rx* field.

This demo works if the `tr_vcp04` application is uploaded in the embedded TR module.

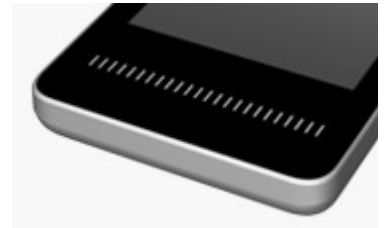
Temp sensor

A demonstration of wireless communication via receiving messages from external TR module measuring temperature and battery level. This demo works if the `vcp_temp_sensor` application is uploaded in remote TR module.

Embedded TR module continually listens to incoming RF packets. If a correct message is detected, the received values are displayed on the screen.

Infrared module

A demo example of a remote IR controller utilizing the communication protocol defined by Sharp. Whenever the button is pressed the predefined message is sent. If the button is held pressed the message is sent repeatedly until the button is released. To control the volume, the touch scrollbar located in bottom part of the device is intended. The volume is proportional to the position on the scrollbar. Only sending feature is currently supported by IR module.



RGB editor

A useful tool for selection of colors. Select one from the three RGB primary colors. The buttons display their levels. Current color can be set by selecting particular color field and then by using the touch scrollbar. The resulting color is displayed also as a numeric code.

Audio

A demo for audio operation. Audio files should be placed in the `SOUNDS` folder on the SD card. This demo supports also playing an audio file from internal Flash memory of main MCU. Due to space saving, it is recommended just for a short audio track. Audio library supports WAV files without compression. VCP-04 allows to play audio samples with rates from 8 kHz to 48 kHz and from 8 to 32 bit resolution. The golden mean 32 kHz sample rate and 16 bit resolution is recommended as optimal.

Basic control for *OPEN*, *PLAY*, *STOP* and a *Volume setting* is implemented. The volume is set by touching the scrollbar located at the bottom part of the device. The short sound track played immediately after pressing the *PLAY* button demonstrates the capability of reading and playing audio data from internal Flash memory.

Sleep

It allows to put the device in sleep (standby) mode. This screen can be also accessed by holding the user button pressed not longer than 2 s. Device can be woken up upon pressing user button or connecting external power source.

Vibro module

It demonstrates the capability of vibration module. Single-shot and repeated vibrations are supported.

SD card

A demo for initialization of the SD card and test access to the card by reading and writing a text message to the file. `GW_FILE.txt` is used for reading and writing tests.

The SD card connector is equipped with a contact to detect whether the card is inserted. This contact is checked and the following message is issued:

- **Contact:** `Error` – the contact is open
- **Contact:** `OK` – the contact is switched

If no SD card is inserted the message „SD card not inserted“ is issued.

About

A screen displaying FW version of the demo application and additional information about company and product web pages.

Pushbutton (PB1)

Three kinds of presses are distinguished by the demo:

- Short (< 2 s): Quick access to the *Sleep* screen.
- Long (> 2 s): Creating a screenshot and storing it as the BMP file on the SD card in the `S_SHOT` folder. To update the file system in order to access the newly created file on the SD card via USB, the USB cable must be unplugged from and plugged to PC again. Saving of the file is indicated by faster LED blinking.
- Long (> 10 s): The *Factory Setup* procedure for restoring of initial default values (display backlight, acoustic indication and USB class) and for display calibration.

LED indication

A demo illustrating VCP-04 state indication:

- Operation, external power: Green LED (LEDG) flashing
- Operation, powered from accumulator : Red LED (LEDR) flashing

Settings

Time & Date

It allows to set the time and date of software RTCC clock in main MCU and synchronize it with RTC clock in secondary MCU. Select desired item and then set a new value by pressing the *Up* and *Down* arrows. The RTCC clock is initialized from secondary MCU each time the demo application starts.

Display

It allows to set the period for switching the display backlight off in case of no activity. The setting is individual for both power sources (external / accumulator). The setting is stored in EEPROM. The backlight is switched on by touching the display or by the pushbutton.

Sound

Switching the acoustic indication of touching the screen on/off. The setting is stored in EEPROM.

USB classes

Allows to switch among different supported USB classes. To change the class only reinitialization of USB system of the device is necessary. The setting is stored in EEPROM.

Supported USB classes:

- Mass storage (default)
After the VCP-04 is connected, the internal micro SD card is accessed like an additional PC disk. This selection is allowed if the SD card is plugged only.
- CDC Class
Creates a virtual serial COM port. The user can use a suitable PC terminal or create his own PC program to communicate via this port.
Demo application uses the COM settings 9600, 8, none, 1 and operates as follows:
If the "i" character is sent from the PC terminal, VCP-04 returns the device identification in text format.

Tip

For a communication in CDC mode various SW terminals operating with PC serial ports are available. Select a terminal enabling to issue direct byte commands and data.

Recommended terminal: Docklight, www.docklight.de

Unsuitable terminal: Windows Hyperterminal and Tera Term.

Product information

Pack list

- VCP-04, in Sleep mode
 - Demo application and the bootloader uploaded in main MCU
 - The `tr_vcp04` demo application uploaded in embedded TR module, RFPGM after reset disabled
- TR module and SD card 2 GB included
- Accumulator (soldered)
- Power source TY-A6A (5V DC, 500 mA, stabilized, cordless, with USB A connector)
- Micro USB cable CAB-USBABMICRO
- Brief User's manual

Ordering codes

- VCP-04 Visual control panel (for final production)
- DS-VCP-04 Development set for VCP-04 (for development)

Document history

- 130725 First release.

Sales and Service

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Partners and distribution

Please visit www.iqrf.org/partners

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