It's no trick...
it's a vision system

Vision Components ®

The Smart Camera People

VisiCube Manual

Operating Instructions for VisiCube Sensor Smart Cameras

Revision 1.0 August 2007
Document name: VisiCube.pdf

Vision Components GmbH
Ottostraße 2 • D-76275 Ettlingen
Tel. +49(7243)2167-0
Fax +49(7243)2167-11
sales@vision-components.de

Foreword and Disclaimer

This documentation has been prepared with most possible care. However Vision Components GmbH does not take any liability for possible errors. In the interest of progress, Vision Components GmbH reserves the right to perform technical changes without further notice.
Please notify **support@vision-components.com** if you become aware of any errors in this manual or if a certain topic requires more detailed documentation.
This manual is intended for information of Vision Component's customers only. Any publication of this document or parts thereof requires written permission by Vision Components GmbH.

Trademarks

Code Composer Studio and TMS320C6000, Windows XP, Total Commander, Tera Term, Motorola are registered Trademarks. All trademarks are the property of their respective owners.

References

Since the VC4XXX smart camera family employs a TI processor, the programming environment and functions for the VC20XX cameras can be used for this camera.

Further References under "Support + Download" on www.vision-components.com**:**

„Support News" – for up to date information on VC Software and Documentation.

„Knowledge Base / FAQ" - searchable Database with latest software developments, frequently asked questions and demo programs.

"Download Areas" for all documentation and Software downloads – refer to the following table:

Description	Title on Website	Download Area
Quick start Manual for VC cameras, English Version	Getting Started VC Smart Cameras	Registered User Area ▸Getting Started VC SDK TI
Schnellstart VC Handbuch – Deutsche Version	Schnellstart VC Smart Kameras	Registered User Area ▸Getting Started VC SDK TI
Introduction to VC Smart Camera programming	Programming Tutorial for VC20XX and VC40XX Cameras	Registered User Area ▸Getting Started VC SDK TI
Demo programs and sample code used in the Programming Tutorial	Tutorial_Code	Registered User Area ▸Getting Started VC SDK TI
VC4XXX Hardware Manual	VC4XXX Smart Cameras Hardware Documentation	Public Download Area ▸Hardware Documentation VC Smart Cameras
VCRT Operation System Functions Manual	VCRT 5.0 Software Manual	Registered User Area ▸Software documentation VC Smart Cameras
VCRT Operation System TCP/IP Functions Manual	VCRT 5.0 TCP/IP Manual	Registered User Area ▸Software documentation VC Smart Cameras
VCLIB 2.0 /3.0 Image Processing Library Manual	VCLIB 2.0/ 3.0 Software Manual	Registered User Area ▸Software documentation VC Smart Cameras

The Light bulb highlights hints and ideas that may be helpful for a development.

This warning sign alerts of possible pitfalls to avoid. Please pay careful attention to sections marked with this sign.

Author: Peter Neuhaus, VC Support, **mailto:support@vision-comp.com**

Table of Contents

1 General Information

VisiCube Sensor Smart Camera in its Compact Housing

The VisiCube camera is with its very compact form factor of only 65 x 45 x 45 mm and 170g one of the smallest Smart Cameras on the market. Already integrated into the robust IP67 protected housing are lens and led lighting, so there is no need for additional enclosures or lighting, keeping the overall scale of this industrial vision system very small and light.

Other benefits include a low power consumption of usually only 2.5W (without IOs), a choice of 6 and 12mm micro lenses that can be simply focused via a set screw at the back of the housing and cables that are resistant to noise and flexing motions.

Interfaces include 100Mbit full duplex Ethernet, a serial RS422 interface and 24 V digital IOs.

Incorporating the 400MHz DSP with 3200 MIPS from Texas Instruments however ensures that a small size does not limit the calculation capability. Together with using VC's image processing libraries even demanding applications can be achieved.

Apart from a few special functions, programming the VisiCube works the same way as for other VC4XXX Smart Cameras – most programs developed for other VC cameras will run without any or only minor adjustments.

This document describes therefore the Hard- and Software differences of this camera and refers to the "Standard" manuals where possible.

2 Special Features of the VisiCube Sensor Smart Camera

2.1 Main differences of VisiCube and VC4018

The board of the VisiCube camera is similar to the VCSBC4018 and VC4018 cameras.
The main differences are:

- RS 422 serial interface compared with the RS232 of the VC4018
- LED Sensor Display with the following indicators (also refer to the rear camera view below):

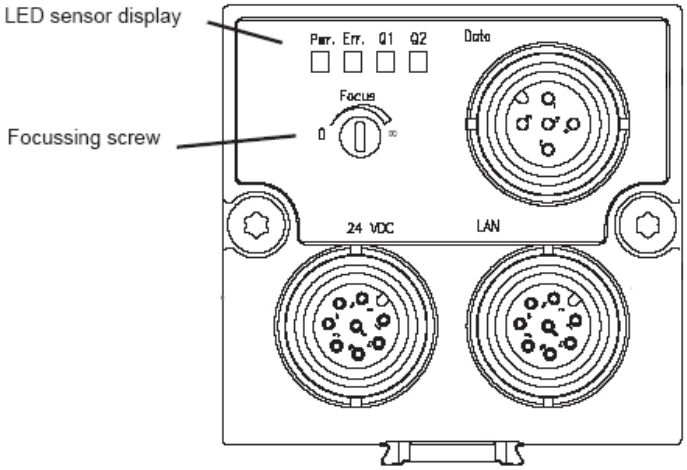
Name	Color	Meaning
Pwr.	green	Active low – programmable, refer to section 6.4
Err.	red	Active low – programmable, refer to section 6.4
Q1	yellow	Active low – programmable, refer to section 6.4
Q2	yellow	Active low – programmable, refer to section 6.4

- Inbuilt LED light that is active during exposure
- Hardware image trigger via PLC inputs (no special high-speed trigger input and output)

Programming of the special VisiCube features is detailed in section 6.

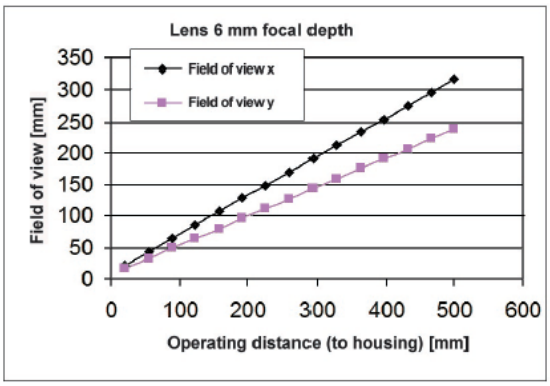
2.2 Lenses

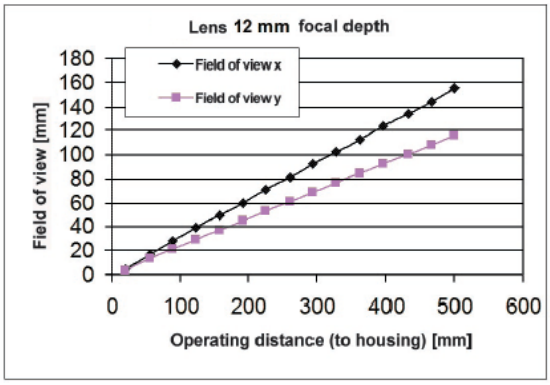
The VisiCube camera is available with 12mm micro lenses of 2 different focal Length, f = 6mm and f = 12mm. The lens can be easily focused by turning the “Focus” screw at the back of the camera.



The minimum working distance for both lenses is 20mm.
Focusing can be done using the “imgX” image transfer programs and the ATX client (available for download from the “Customer Area -> Software Utilities”.

The following Table shows the image size for both lenses depending on the working distance.



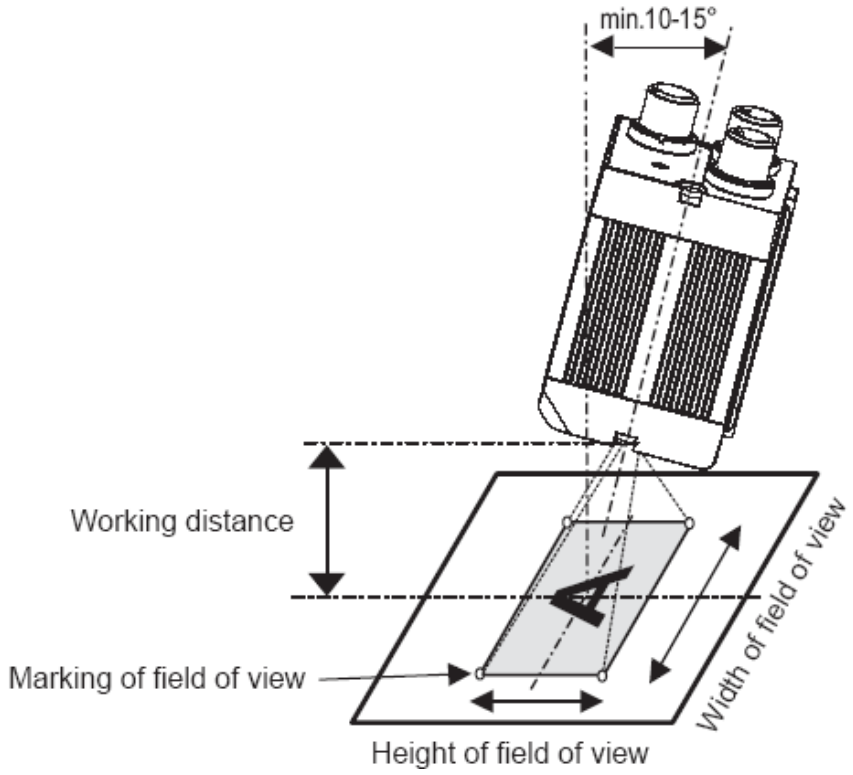


Min. field of view X * Y in mm: 18 * 14 Min. field of view X * Y in mm: 8 * 6
Both lenses are adjustable to infinity. Depth of focus approx. ± 5% of scan distance

2.3 LED Lighting

The inbuilt led light allows it to go without external lighting for most applications with working distances of up to 100mm. 2 red LEDs have been added to the 6 high power white ones In order to compensate for the typical blue domination in white LED light.

In order to avoid light reflections it is recommended to mount the camera with a slight deviation angle form the vertical direction as shown below.



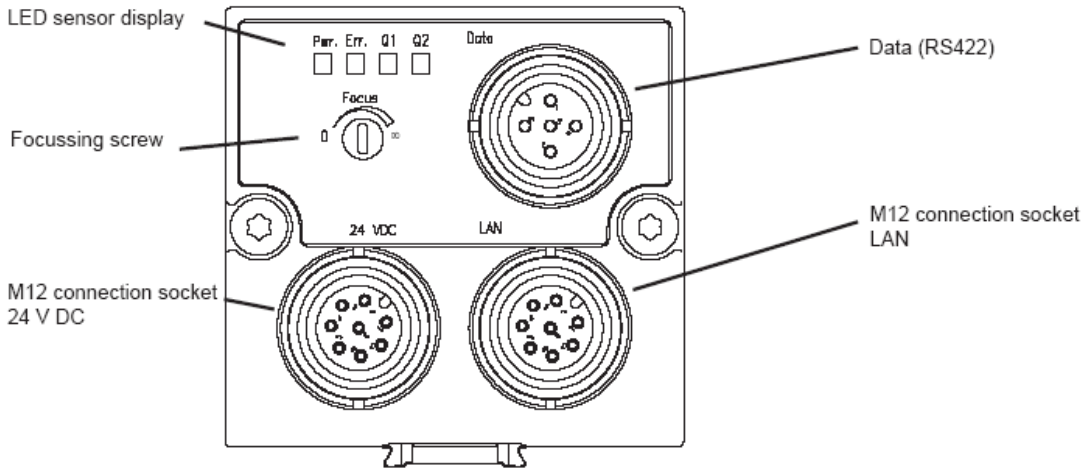
Programming of the LED light is detailed in section 6.

3 Technical Specifications VisiCube Smart Camera

Component / Feature	Specification
CCD Sensor:	1/4" SONY ICX098BL
eff. no. of pixels:	640(H) x 480(V)
Pixel size:	5.6(H) x 5.6(V) µm
Chip size:	4.6(H) x 3.97(V) mm
High-speed shutter:	36.2[1], 98.6, 161 microseconds, increasing with steps of 62.4 microseconds (full-frame shutter)
Low-speed shutter:	up to 2 sec. adjustable integration time
Integration:	full-frame
Picture taking:	program-controlled, trigger controlled (interrupt); full-frame / 32 frames per second, external high speed trigger
Clamping:	zero offset digital clamping
A/D conversion:	12.5 MHz / 10 bit, only the 8 most significant bits used for grey values
Input LUT	none
Image Display	Via 100 Mbit Ethernet onto PC
Processor:	Texas Instruments TMS320C64XX signal processor 400 MHz, 3200MIPS
RAM:	32 Mbytes SDRAM (synchronous dynamic RAM)
Memory capacity:	Up to 100 full-size images in format 640x480
Flash EPROM:	4 Mbytes flash EPROM (nonvolatile memory) for programs and data, in-system programmable, 3 MB available to user
MMC:	Not available
Process interface:	2 inputs / 4 outputs, outputs 4x**200** mA
Illumination Controller:	LEDs on during exposure, user controlled, boost mode, see section 6.5
Ethernet interface:	100 Mbit Full Duplex, changeable to 10 Mbit, changeable to half duplex
CE certification:	CE Certification tested and approved
Storage Conditions	Temperature: -20 to 60 deg C, Max. humidity: 90%, non condensing.
Operating Conditions	Temperature: 0… +50 deg C (ambient temperature, if LEDs exposure controlled and not in boost mode), Max. humidity: 80%, non condensing.
Power Supply	24V ± 10%, absolute maximum 18V – 30V
Power Consumption	≈2.4W (current drawn from PLC outputs additional)

[1] From CPLD file version 4 – check with shell command “ver”.

4 VisiCube Interfaces



4.1 Power Supply / SPS IO Interface and Trigger interface

PIN	Color	Use
1	White	IN1 (external trigger)
2	Brown	+UB(24 V DC)
3	Green	OUT3 (pattern good/bad) display LED = Q1
4	Yellow	OUT2
5	Grey	IN2
6	Pink	OUT1 (Trigger of external illumination)
7	Blue	GND
8	Red	OUT4 (position good / bad)

Electrical data Power Supply / SPS IO and Trigger interface	
Operating voltage U_B	24 V DC ± 10% (absolute maximum 18 - 30 V)
Residual ripple	< 5 Vss
Current consumption (no I/O	max. 200 mA
Inputs IN1 / IN2	high 10 V .. $+U_B$ (+10%), low 0 ... 3 V
Input resistance	> 20 kOhm
Trigger input	rising edge, 10 V ... U_B
Outputs OUT1 - 4	PNP (closer, pull up MOSFET)
Output current (per output)	200 mA (>> max. 9,6 W)
Maximum output current (per output)	1,5 A in case of short circuit
Short-circuit protection (all outputs)	yes
Protection against inverse connection	yes
Interfaces	Ethernet (LAN) RS422
Protection system	2
Readiness delay	approx. 6 sec. after power on

4.2 LAN / Ethernet Interface

PIN (M12)	Color	PIN (RJ45)	Use
1	White/blue	5	
2	White /blue	7	
3	Brown	8	
4	Orange	2	TxD-
5	White/green	3	RxD+
6	White/orange	1	TxD+
7	Blue	4	
8	Green	6	RxD-

Pin Assignment and cable core colors

The IP Address adjustment works equivalent as with all other current VC Smart Camera models. Refer to the “Getting Started VC…” Documentation for details.

4.3 Data / RS422 Interface

PIN	Color	Use
1	White	RxD-
2	Brown	RxD+
3	Green	TxD+
4	Yellow	TxD-
5		GND

5 Order Numbers of VisiCube and Accessories

Description	VK.- Number
VisiCube with f = 6mm Micro lens	VK000327
VisiCube with f = 12mm Micro lens	VK000328

Description	Type	VK.- Number
Mounting clamp, dovetail FA45	MK 45	VK000320
Mounting angle FA45	MA 45	VK000322
Mounting rod 20 cm FA45	MST 45-20	VK000325
Mounting rod 30 cm FA45	MST 45-30	VK000340
Mounting rod 40 cm FA45	MST 45-40	VK000339
Mounting hinge FA45	MG 45	VK000321
Mounting plate FA45	MP 45	VK000323
Mounting link FA45	MZ 45	VK000324
Connection cable, 2 m, straight, shielded	C L8FSK-2m-G-PUR	VK000318
Connection cable, 5 m, straight, shielded	C L8FSK-5m-G-PUR	VK000338
Connection cable, 2 m, 90°, shielded	C L8FSK-2m-W-PUR	VK000337
Connection cable, 5 m, 90°, shielded	C L8FSK-5m-W-PUR	VK000336
Ethernet cable, 3 m M12, 8pin./RJ45, shielded	CI L8FSK/RJ45S-3m-GG-PVC-G	VK000319
Interface cable 3 m, straight	CI L5FK-3m-G-PUR	VK000334
Interface cable 3 m, 90°	CI L5FK-3m-W-PUR	VK000335

6 Programming of special VisiCube Features

6.1 Using PLC Inputs and Outputs

Using the PLC IOs works like with all other VC Smart cameras, so the demo program “port.c” can be used as a reference.

Differences to other VC Smart Cameras:

- The naming convention is slightly different for the VisiCube, with the 4 outputs ranging from OUT1 to OUT 4 (so OUT0 in the port demo program corresponds to OUT1 in 4.1 (pin allocation of VisiCube Power Supply / IO interface).
- Like the VCSBC40XX, the VisiCube has only 2 digital inputs (IN1 and IN2). The registers for IN3 and IN4 are set to high.

Check Status on PLC inputs:

```
print("INP0=%d  ",inPLC()&0x01);      // query status of Input 1
print("INP1=%d  ",inPLC()&0x02);      // query status of Input 2
```

Set and Re-Set PLC outputs:

```
setPLC0();      resPLC0();      //set and re-set Output 1
setPLC1();      resPLC1();      //set and re-set Output 2
setPLC2();      resPLC2();      //set and re-set Output 3
setPLC3();      resPLC3();      //set and re-set Output 4
```

6.2 Capturing Images with a Hardware Trigger Signal

The VisiCube does not incorporate a dedicated HW trigger interface, so images have to be triggered using one of the digital PLC inputs IN1 or IN2.

```
while ( wait(PLC_INT, 100) != 1); // wait for change on PLC inputs while freeing CPU time

If (inPLC()&0x01) ==1) ; //check if status of PLC input 1 has changed
tpict();                 // take image
```

Refer to Appendix B: Using the PLC_INT event.

6.3 Using the RS422 Data Interface of the VisiCube

Demo Program t132.c – order the corresponding “Interface Cable” for instance VK000334, interface cable straight, 3m (see section 5).

```
#include <register.h>
#include <vcrt.h>
#include <sysvar.h>

main()
{
FILE *tty;
//unsigned xbaud=115200;
unsigned xbaud=9600;
char c=0;

print("TEST RS422 serial I/O\n");

tty = fopen("ittya:", (void *)0);     /* open RS422  */

io_ioctl(tty,IO_IOCTL_SERIAL_SET_BAUD,&xbaud);

write(tty,"abcdefg",7);

rs232rcv();

while(c != 0x1b)
  {
  c=rs232rcv();
//  c=io_fgetc(tty);
  io_fputc(c, tty);
  c=io_fgetc(tty);
  rs232snd(c);
  }

fclose(tty);        /* close RS422  */
}
```

6.4 Using the Status LEDs

The following macro sets the LED register:

LED_OUT(x)

3	2	1	0	Bits
Q2	Q1	Err.	Pwr	Name

The bit logic is inverted, so x = 0 turns all LEDs on, x = 15 switches all LEDs off.
Use an additional variable (for instance “private sysvar” to store the actual LED status since this register is write only!

6.5 Using the LED Lighting

Per default the illumination LED's are on during exposure (at low level – not "boost level").
The following macros turn the LEDs off during exposure:

ILLU_USR(); // turning the LEDs into "User mode"
ILLU_POS(); // turning the LEDs on – program controlled
ILLU_NEG(); // turning the LEDs on – program controlled

The following macros then turn the LEDs on again during exposure:

ILLU_EXP(); // turning the LED Illumination into "Exposure Mode"
ILLU_POS(); // LEDs are on during exposure (ILLU_NEG() means LEDs are on when not exposing).

SET_BOOST(); // sets the Illumination LEDs to "boost level" (for example 233 mean grey value instead of 171).
RES_BOOST(); // sets the Illumination LEDs back to "normal (default) level".

Do not use the "boost" mode at high surrounding temperatures as can lead to overheating of the camera.
Use the LED lighting only if required (i.e. during image acquisition) in order to extend their lifetime.

7 Maintenance

7.1 Cleaning

- Clean the FA45 Object-Detection Sensor with a clean dry cloth.
- Do not use solvents or petrol.
- Do not use sharp objects.
- Do not scratch.

7.2 Repair

- In case of a suspected hardware fault, please contact at first your distributor/ point of purchase for assistance.
- If the problem cannot be solved locally, please use the following link to fill in the RMA form on the website under “Support + Download”:

Support + Download

Send Camera for Repair

- Please provide a detailed fault description and also let us know how you have tested this fault in case the defect is not obvious.
- Carefully select if your country of residence is within or without the EU. This automatically prints the correct shipment address on the RMA result sheet (important for customs clearance).

- Login on to the VC website automatically fills in your address details.
- Clicking the “submit” button displays the RMA result sheet with the RMA number and a summary of your fault description and details. This summary page is also sent to your email address.

- Please print out this page and include it with your camera shipment.
- Please always use courier services (FedEx, UPS, DHL, etc) for shipping, since we are unable to get customs clearance if cameras are sent by normal mail services.

Repair / Hardware Upgrade Costs:

- Warranty repairs are free of charge if not due to camera misuse.
- After expiry of the warranty period most repairs or upgrades are done at a small flat fee. Check with your distributor for details.

Hardware or SW fault?

- To save time and costs, please **only send cameras with definite hardware faults**.
- Please ensure the failure is not due to:

- A SW problem (for instance most suspected Flash errors are SW problems / Communication errors are often due to wrong IP settings, etc.)
- Hardware failure of accessories (cables, connected sensors, etc.)

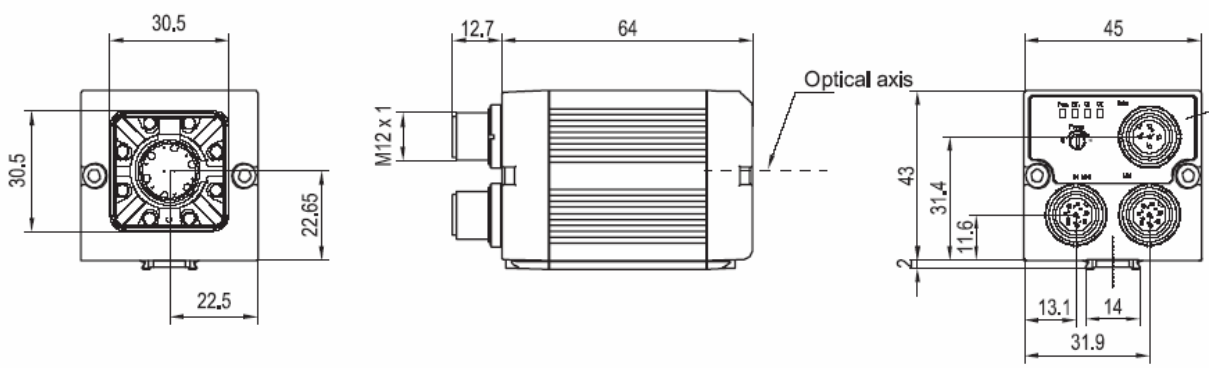
Please check the VC documentation and the Knowledge Base / FAQ for possible SW errors.

If in doubt please contact **Vision Components Support** for assistance prior to shipping!

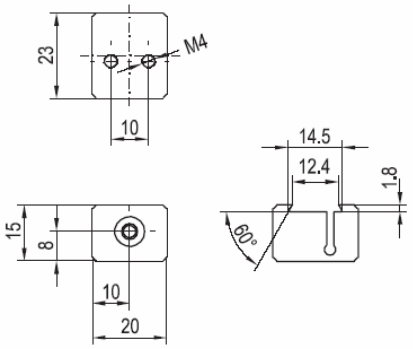
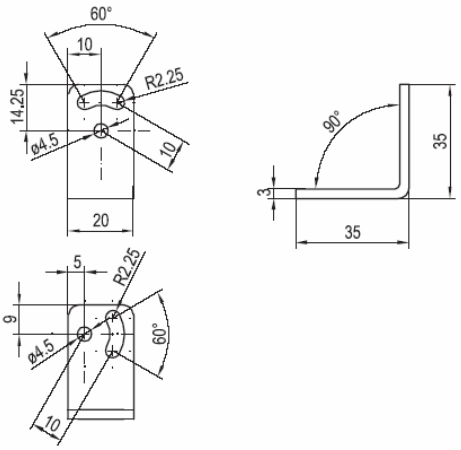
Vision Components can only accept products for repair that have been directly purchased form us or one of our authorized distributors.

Please contact your point of sale, if you have purchased a VC Smart Camera from another vendor!

Appendix A: Dimensional Drawings of VisiCube



Mounting Brackets:

MK 45	MA 45
153-00480	*153-00482*
(supplied with sensor)	
	

Appendix B: Using the PLC_INT event

```
//////////////////////////////////////////////////////////////////
// 6. Using PLC_INT event for detecting status change at PLC inputs //
//////////////////////////////////////////////////////////////////

 print("\nPress any key to start waiting for PLC event (timeout 5s) \n Press 'q' to stop \n");
getchar();

// waiting for the PLC event does not require processing time (as polling of inputs does) -
parallel processes can execute
// the PLC_INT reacts to changes (transition from low to high or high to low) at any PLC
inputs

 do
   {
         if (kbhit())
               {
               key = rs232rcv();
               }
         do
            {
            x = wait(PLC_INT, 5000);  // waits until next event "PLC Event" occurs, timeout 5s
                } while((x!=1)&&(x!=-1)&&(x!=2));       // wait returns 2 and does not wait for
                                the next event, if the event has occurred before wait was called


            print("INP0=%d  ",inPLC()&0x01);
            print("INP1=%d  ",inPLC()&0x02);

         switch(x)
               {
                  case 1:
                      print("PLC_INT event occurred\n");
                    break;
               case 2:
                    print("PLC_INT event event has occurred before wait was called\n");
                    break;
               case -1:
                    print("PLC_INT event has timed out\n");
                    break;
               default:
                        print("Return value wait(EXP_READY,x) = %d \n", x);
               }

       }while(key != 'q');
}

/*****************************************************************/
```


Visit the Vision Components site **www.vision-components.com** for further information and documentation and software downloads:

Web Site Menu Links	Content
Contact	Distributor list / Enquiry forms
Home	Latest News from VC
Our Company	VC Company Information
News and Events	Trade Show dates VC Publications Sign in for free VC Seminars
VC Network	Description of Partner Companies Application Overview 3rd Party Hard- and SW Products for VC Smart Cameras
Products VC Smart Camera Overview	Product Overview: VC44XX High End Camera Series VC40XX Standard Camera Series VC4016 / 18 Entry Level Cameras VC4002L Line Scan Camera VCSBC Single Board Cameras VC20XX Smart Cameras VCSBC Board Cameras VCM + Viscube Camera Sensors
VC Smart Camera Software VC Software Development Kit Ti:	VCRT Operating System VCLIB Image Processing Library
VC Special Libraries:	M200 Data Matrix Code Reader VCOCR Text Recognition Library Color Lib
Support: Support News (User Registration required)	Tech News – new SW and Documentation
Knowledge Base / FAQ (User Registration required)	Searchable FAQ Database with programming Examples and Demo Code
Download Area Public Download Area (free Access) Registered User Area (User Registration required) Customer Download Area (User- and SW License Registration required)	Download of: - Product Brochures - Camera Manuals - Getting Started - Programming Manuals - Training Manuals and Demo Code - Software Updates - Demo Code
RMA Number Form	Form for Allocation of Repair Numbers.

Vision Components GmbH
Ottostraße 2 • D-76275 Ettlingen
Tel. +49(7243)2167-0
Fax +49(7243)2167-11
sales@vision-components.de