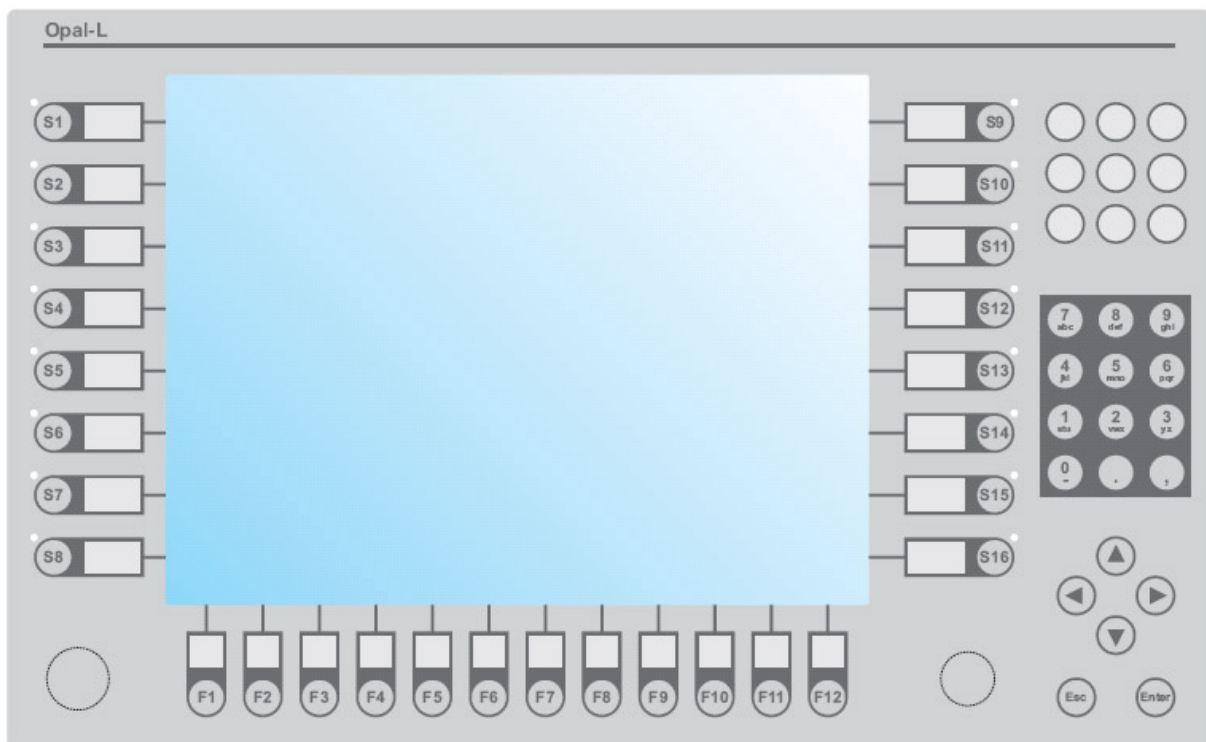




OPAL
Industrial Control Panels



INSTALLATION GUIDE AND USER MANUAL

<i>Product Name</i>	OPAL - Industrial Control Panel	
<i>Project Number</i>	66400171 to 66400177	
<i>Revision / Date</i>	V1.00	9-Dec-09
<i>Name / Department</i>	Marcel Watzlawek	Research + Development

Record of Revisions

Revision	Description	Date	Changed by
V1.00	First release	07.10.2009	M. Watzlawek

Abbreviations

DIP	Dual Inline Package
DMC	DMC Co. LTD (touch screen/controller manufacturer)
HID	Human Interface Device
H+K	Hoffmann + Krippner GmbH / Inc.
ID	Identification
PCB	Printed Circuit Board
RS232	Recommended Standard 232
USB	Universal Serial Bus
U-ID	Usage ID
U-Name	Usage Name

Contact Information

Hoffmann + Krippner Inc
277 Highway 74N
Peachtree City, GA 30269
Toll Free: 1-877 244 1526

Product Information and Documents: www.OPALpanels.com

For technical product support, please send an e-Mail to:
techsupport@OPALpanels.com

Table of Content

Record of Revisions	2
Abbreviations.....	2
Table of Content.....	3
List of Tables	3
List of Figures.....	3
Overview of variants	4
Keyboard Design	4
Keyboard Interface	5
USB Interface	5
Serial Interface.....	8
Port settings	8
RS232 protocol	8
Keyboard Interface settings	10
Key codes OPAL S Series.....	11
Key codes OPAL M Series	13
Key codes OPAL L Series	15
Touch Screen Interface	17
Driver Installation	17
Calibration and general Touch Screen settings.....	17
Touch Screen Interface settings	17

List of Tables

<i>Table 1 - Keyboard Designs.....</i>	<i>4</i>
<i>Table 2 - Reference to key codes</i>	<i>6</i>
<i>Table 3 - LED assignment.....</i>	<i>7</i>
<i>Table 4 - RS232 frame commands</i>	<i>8</i>
<i>Table 5 - Data frames serial communication.....</i>	<i>9</i>
<i>Table 6 - Keyboard settings</i>	<i>10</i>
<i>Table 7 - Key assignment for OPAL S</i>	<i>12</i>
<i>Table 8 - Key assignment for OPAL M.....</i>	<i>14</i>
<i>Table 9 - Key assignment for OPAL L.....</i>	<i>16</i>

List of Figures

Figure 1 - Keyboard Interface.....	10
Figure 2 - Key Assignment "S - Series".....	11
Figure 3 - Key Assignment "M - Series"	13
Figure 4 - Key Assignment "L - Series"	15
Figure 5 - Saving Calibration Data	17
Figure 6 - Interface Settings : Touch Controller	18

Overview of variants

H+K PN	Touch screen	Keyboard Interface ¹	Touch screen Interface ²	OPAL Series
66400171	-	USB / RS232	USB / RS232	S
66400172	-	USB / RS232	USB / RS232	M
66400173	-	USB / RS232	USB / RS232	L
66400175	5,7"	USB / RS232	USB / RS232	S
66400176	10.4"	USB / RS232	USB / RS232	M
66400177	12.1"	USB / RS232	USB / RS232	L

Table 1: Product Variations

Keyboard Design

<p>OPAL „S“ Series</p>	
<p>OPAL „M“ Series</p>	
<p>OPAL „L“ Series</p>	

Table 1 - Keyboard Designs

¹ The keyboard interface is set up via a DIP switch (see section "Keyboard Interface settings")

² The touch screen interface is set up via jumpers (see section "Touch Screen Interface settings")

Keyboard Interface

Both variants (with and without touch screen) of each series use the same key codes. If USB is selected as keyboard interface the keyboard sends standard HID codes according to the corresponding table of each series. If serial communication is selected the same hex-values are sent for the single keys. For serial communication a special protocol is defined (see section “Serial Interface”).

USB Interface

The keyboard is a standard HID device and is configured with two interfaces (keyboard and LED).

Configuration descriptor:

Device descriptor	
bcdUSB	1.1.1
bDeviceClass	Class defined at interface level
bDeviceProtocol	None
bMaxPacketSize0	32
idVendor	0x1C80
idProduct	0x00BA
bcdDevice	1.0
iManufacturer	1
iProduct	2

Configuration descriptor	
bNumInterface	2
bConfigurationValue	1
bmAttributes. RemoteWakeup	Not supported
bmAttributes. SelfPowered	No, Bus Powered
bMaxPower	100 mA

Keyboard interface descriptor:

Interface descriptor	
bInterfaceNumber	0
bAlternateSetting	0
bNumEndpoints	1
bInterfaceClass	Human Interface Device (Find out more online)

HID descriptor	
bCountryCode	Not Supported
bNumDescriptors	1
bDescriptorType[0]	REPORT
wDescriptorLength[0]	63 bytes

Endpoint descriptor	
bEndpointAddress	1 IN
bmAttributes. TransferType	Interrupt
wMaxPacketSize	8 bytes
bInterval	16 frames (16 ms)

Keyboard report descriptor:

HID Report Descriptor	
Item	Data
Usage Page (Generic Desktop)	05 01
Usage (Keyboard)	09 06
Collection (Application)	A1 01
Usage Page (Keyboard)	05 07
Usage Minimum (Keyboard Left Control)	19 E0
Usage Maximum (Keyboard Right GUI)	29 E7
Logical minimum (0)	15 00
Logical maximum (1)	25 01
Report Size (1)	75 01
Report Count (8)	95 08
Input (Data, Value, Absolute, Bit Field)	81 02
Report Count (1)	95 01
Report Size (8)	75 08
Input (Constant, Array, Absolute, Bit Field)	81 01
Report Count (5)	95 05
Report Size (1)	75 01
Usage Page (LEDs)	05 08
Usage Minimum (Num Lock)	19 01
Usage Maximum (Scroll Lock)	29 03
Output (Data, Value, Absolute, Non-volatile, Bit Field)	91 02
Report Count (1)	95 01
Report Size (3)	75 03
Output (Constant, Array, Absolute, Non-volatile, Bit Field)	91 01
Report Count (6)	95 06
Report Size (8)	75 08
Logical minimum (0)	15 00
Logical maximum (101)	25 65
Usage Page (Keyboard)	05 07
Usage Minimum (No event indicated)	19 00
Usage Maximum (Keyboard Application)	29 65
Input (Data, Array, Absolute, Bit Field)	81 00
End Collection	C0

Keyboard input report:
(Num Lock, Caps Lock. Scroll Lock LED's are not used)

Definition of key codes:

series	see section
S	Key codes OPAL S Series
M	Key codes OPAL M Series
L	Key codes OPAL L Series

Table 2 - Reference to key codes

Input Report 0		
Bit offset	Bit count	Description
0	1	Keyboard Left Control
1	1	Keyboard Left Shift
2	1	Keyboard Left Alt
3	1	Keyboard Left GUI
4	1	Keyboard Right Control
5	1	Keyboard Right Shift
6	1	Keyboard Right Alt
7	1	Keyboard Right GUI
8	8	(Not used)
16	8	Keyboard Array
24	8	Keyboard Array
32	8	Keyboard Array
40	8	Keyboard Array
48	8	Keyboard Array
56	8	Keyboard Array

LED interface descriptor:

Interface descriptor	
bInterfaceNumber	1
bAlternateSetting	0
bNumEndpoints	1
bInterfaceClass	Human Interface Device (Find out more online)

HID descriptor	
bCountryCode	Not Supported
bNumDescriptors	1
bDescriptorType[0]	REPORT
wDescriptorLength[0]	24 bytes

Endpoint descriptor	
bEndpointAddress	2 IN
bmAttributes. TransferType	Interrupt
wMaxPacketSize	2 bytes
bInterval	32 frames (32 ms)

LED report descriptor:

HID Report Descriptor	
Item	Data
Usage Page (Vendor-defined 0xFF00)	06 00 FF
Usage (Vendor-defined 0x0001)	09 01
Collection (Application)	A1 01
Usage Page (LEDs)	05 08
Usage Minimum (Num Lock)	19 01
Usage Maximum (Caps Lock)	29 02
Logical minimum (0)	15 00
Logical maximum (1)	25 01
Report Count (2)	95 02
Report Size (8)	75 08
Output (Data, Value, Absolute, Non-volatile, Bit Field)	91 02
End Collection	C0

The LED report consists of two bytes. The single LED's of the keyboard can be controlled using the assignment of Table 3. Setting a bit to "1" turns the corresponding LED on. Otherwise setting a bit to "0" turns the LED off.

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
LEDByte1	H8	H7	H6	H5	H4	H3	H2	H1
LEDByte2	H16	H15	H14	H13	H12	H11	H10	H9

Table 3 - LED assignment

The LED positions on the individual keyboard can be found in the figures of the corresponding key code sections.

Serial Interface

Port settings

To communicate via serial interface, the following settings must be used for the Host COM port:

- 38.400 bytes/s
- 8 data bytes
- 1 stop bit
- no parity

RS232 protocol

For the implementation of a serial connection between the host and keyboard, the information of the keyboard protocol is necessary. First, an overview of commands is given. Subsequently, the structure of the data frames and control sequences is defined.

Command definitions

Command	Dec	Hex	Description
START_HOST	170	AA	Start of frame (from Host)
START_CONTROLLER	171	AB	Start of frame (from μ C)
ENDEKENNUNG	204	CC	End of frame (both Host+ μ C)
ACK	240	F0	Acknowledgement
ERROR	242	F2	Error in data frame
CODE_UNBEKANNT	243	F3	Unknown command
CODE_LED _i	176	B0	Set LED status
CODE_LED _o	177	B1	Get LED Status

Table 4 - RS232 frame commands

Data frame definition

Within the host/keyboard protocol the following data frames are defined (see *Table 5*).

The assignment of the LED's is the same as for the USB protocol and can be found in

Table 3. The key codes (hex values) are also the same as the Usage ID's for the HID keyboard report (the reference to the corresponding sections can be found in *Table 2*).

Byte sequence set LED status						
Host request	START_HOST	CODE_LEDi	LEDByte1	LEDByte2	ENDEKENNUNG	
Keyboard response	START_CONTROLLER	CODE_LEDi	LEDByte1	LEDByte2	ENDEKENNUNG	
Byte sequence get LED status						
Host request	START_HOST	CODE_LED0	ENDEKENNUNG			
Keyboard response	START_CONTROLLER	CODE_LED0	LEDByte1	LEDByte2	ENDEKENNUNG	
Messages of keyboard controller						
Error in frame	START_CONTROLLER	ERROR	mirror received bytes	ENDEKENNUNG		
Unknown command	START_CONTROLLER	CODE_UNBEKANNT	mirror command	ENDEKENNUNG		
Data frame keyboard						
Byte sequence key codes	START_CONTROLLER	Modifier Byte	Key code byte1	Key code byte2	Key code byte3	ENDEKENNUNG

Table 5 - Data frames serial communication

Keyboard Interface settings³

For the keyboard interface, different settings are available. Settings can be changed via the DIP switch (see Figure 1). To change settings, disconnect the keyboard from the host and set the switches according to table 6. Reconnect the key board to the host for the new settings to take effect.

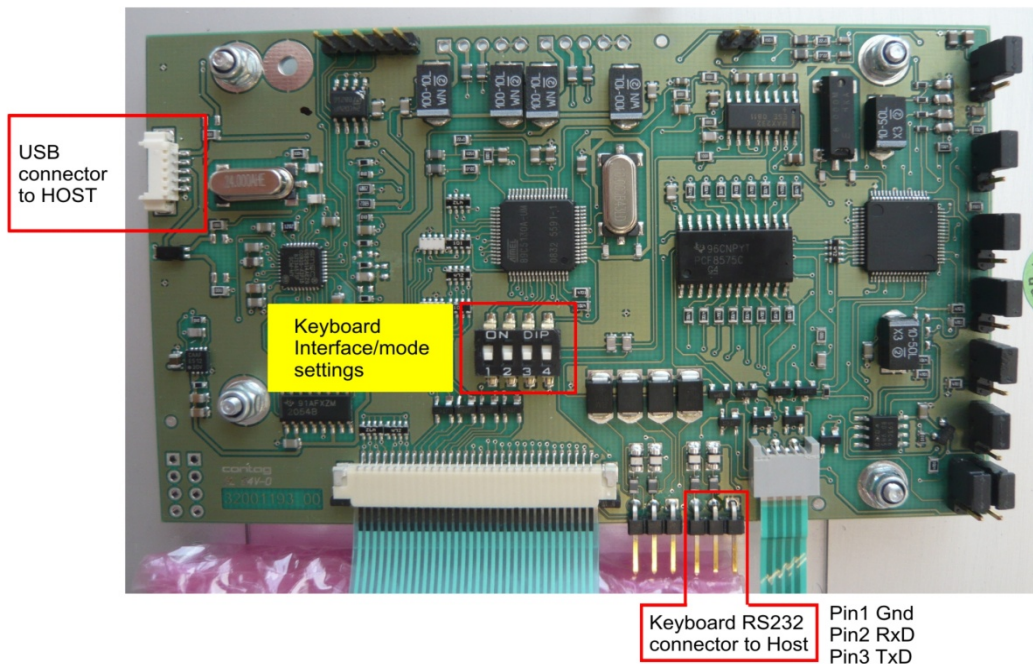
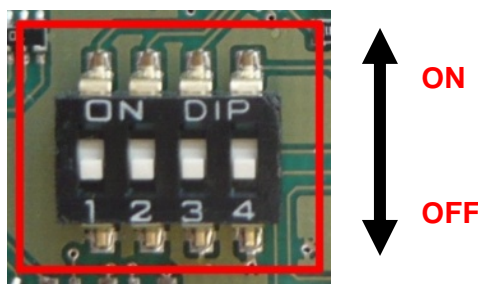


Figure 1 - Keyboard interface

PLEASE NOTE: The figure shows the PCB of the keyboards with an integrated touch screen. The PCB of the keyboards without a touch screen is the same but not all SMD components shown in the figure are mounted!

By default all switches are **off**.



DIP switch No.	ON	OFF
1	RS232 communication	USB communication (default)
2	Standard key assignment with 2 nd layer activated	Standard key assignment (default)
3	-	-
4	-	-

Table 6 - Keyboard settings

³ These settings are available for all OPAL keyboards

Key codes OPAL S Series

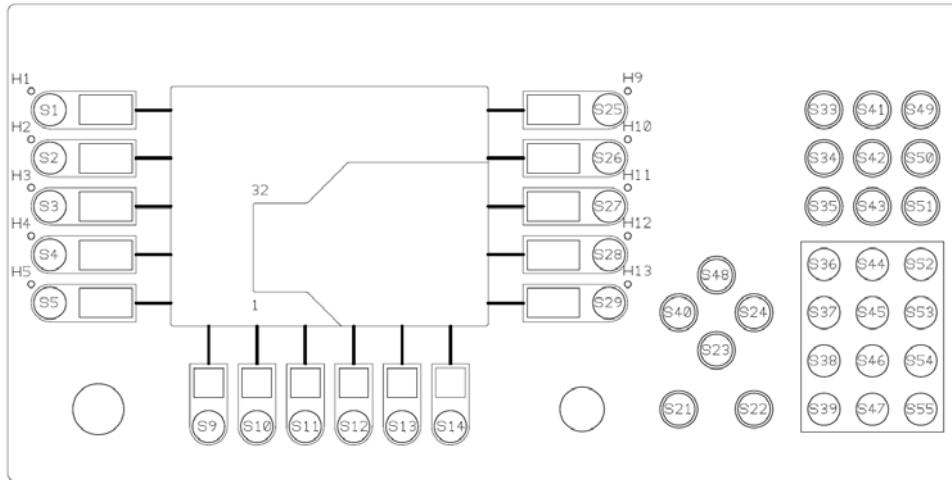


Figure 2 - Key assignment for OPAL S

Standard Key Assignment				Key Assignment (second layer activated)					
Key No.	Usage ID (hex)	Usage Name	Label	+ S35 pressed		+ S43 pressed		+ S51 pressed	
				U-ID (hex)	U-Name	U-ID (hex)	U-Name	U-ID (hex)	U-Name
S1	90	Keyboard LANG1	S1						
S2	91	Keyboard LANG2	S2						
S3	92	Keyboard LANG3	S3						
S4	93	Keyboard LANG4	S4						
S5	94	Keyboard LANG5	S5						
S9	3A	Keyboard F1	F1						
S10	3B	Keyboard F2	F2						
S11	3C	Keyboard F3	F3						
S12	3D	Keyboard F4	F4						
S13	3E	Keyboard F5	F5						
S14	3F	Keyboard F6	F6						
S21	29	Keyboard Escape	Esc						
S22	28	Keyboard Return	Enter						
S23	51	Keyboard DownArrow	↓						
S24	4F	Keyboard RightArrow	→						
S25	95	Keyboard LANG6	S6						
S26	96	Keyboard LANG7	S7						
S27	97	Keyboard LANG8	S8						
S28	98	Keyboard LANG9	S9						
S29	99	Keyboard Alternate Erase	S10						
S33	68	Keyboard F13	-						
S34	69	Keyboard F14	-						
S35	6A	Keyboard F15	-						
S36	24	Keyboard 7 and &	7 (abc)	04	a	05	b	06	c
S37	21	Keyboard 4 and \$	4 (jkl)	0D	j	0E	k	0F	l
S38	1E	Keyboard 1 and !	1 (stu)	16	s	17	t	18	u
S39	27	Keyboard 0 and)	0 ()	2D	-				
S40	50	Keyboard LeftArrow	←						
S41	6B	Keyboard F16	-						
S42	6C	Keyboard F17	-						

S43	6D	Keyboard F18	-						
S44	25	Keyboard 8 and *	8 (def)	07	d	08	e	0A	f
S45	22	Keyboard 5 and %	5 (mno)	10	m	11	n	12	o
S46	1F	Keyboard 2 and @	2 (vwx)	19	v	1A	w	1B	x
S47	37	Keyboard . And >	.						
S48	52	Keyboard UpArrow	↑						
S49	6E	Keyboard F19	-						
S50	6F	Keyboard F20	-						
S51	70	Keyboard F21	-						
S52	25	Keyboard 9 and (	9 (ghi)	0A	g	0B	h	0C	i
S53	23	Keyboard 6 and ^	6 (pqr)	13	p	14	q	15	r
S54	20	Keyboard 3 and #	3 (yz)	1C	y	1D	z	00	
S55	36	Keyboard , and <	,						

Table 7 - Key assignment for OPAL S

Key codes OPAL M Series

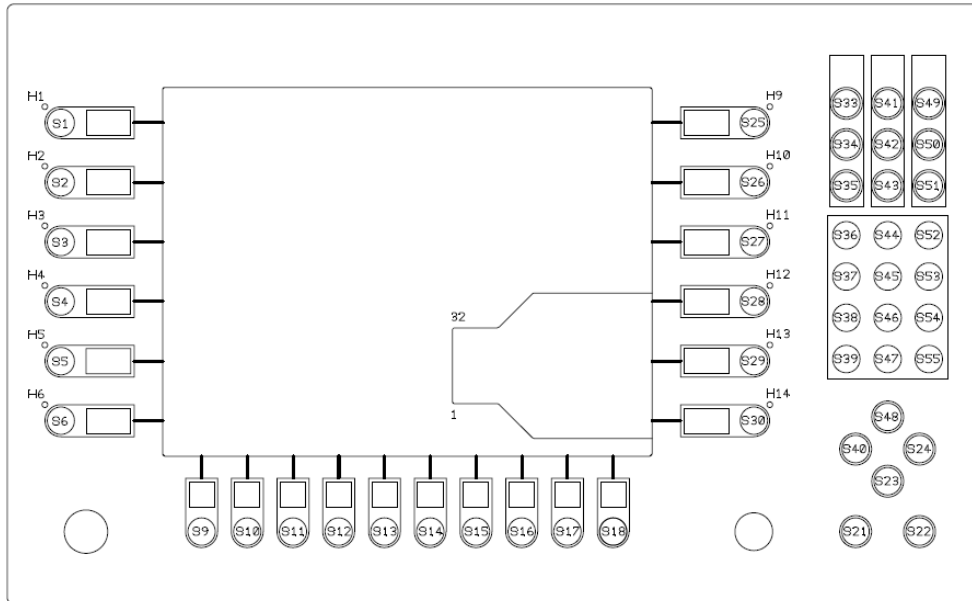


Figure 3 - Key assignment for OPAL M

Standard Key Assignment				Key Assignment (second layer activated)					
Key No.	Usage ID (hex)	Usage Name	Label	+ S35 pressed		+ S43 pressed		+ S51 pressed	
				U-ID (hex)	U-Name	U-ID (hex)	U-Name	U-ID (hex)	U-Name
S1	90	Keyboard LANG1	S1						
S2	91	Keyboard LANG2	S2						
S3	92	Keyboard LANG3	S3						
S4	93	Keyboard LANG4	S4						
S5	94	Keyboard LANG5	S5						
S6	95	Keyboard LANG6	S6						
S9	3A	Keyboard F1	F1						
S10	3B	Keyboard F2	F2						
S11	3C	Keyboard F3	F3						
S12	3D	Keyboard F4	F4						
S13	3E	Keyboard F5	F5						
S14	3F	Keyboard F6	F6						
S15	40	Keyboard F7	F7						
S16	41	Keyboard F8	F8						
S17	42	Keyboard F9	F9						
S18	43	Keyboard F10	F10						
S21	29	Keyboard Escape	Esc						
S22	28	Keyboard Return	Enter						
S23	51	Keyboard DownArrow	↓						
S24	4F	Keyboard RightArrow	→						
S25	96	Keyboard LANG7	S7						
S26	97	Keyboard LANG8	S8						
S27	98	Keyboard LANG9	S9						
S28	99	Keyboard Alternate Erase	S10						
S29	9A	Keyboard SysReq/Attention	S11						
S30	9B	Keyboard Cancel	S12						
S33	68	Keyboard F13	-						

S34	69	Keyboard F14	-						
S35	6A	Keyboard F15	-						
S36	24	Keyboard 7 and &	7 (abc)	04	a	05	b	06	c
S37	21	Keyboard 4 and \$	4 (jkl)	0D	j	0E	k	0F	l
S38	1E	Keyboard 1 and !	1 (stu)	16	s	17	t	18	u
S39	27	Keyboard 0 and)	0 (_)	2D	-				
S40	50	Keyboard LeftArrow	←						
S41	6B	Keyboard F16	-						
S42	6C	Keyboard F17	-						
S43	6D	Keyboard F18	-						
S44	25	Keyboard 8 and *	8 (def)	07	d	08	e	0A	f
S45	22	Keyboard 5 and %	5 (mno)	10	m	11	n	12	o
S46	1F	Keyboard 2 and @	2 (vwx)	19	v	1A	w	1B	x
S47	37	Keyboard . And >	.						
S48	52	Keyboard UpArrow	↑						
S49	6E	Keyboard F19	-						
S50	6F	Keyboard F20	-						
S51	70	Keyboard F21	-						
S52	25	Keyboard 9 and (	9 (ghi)	0A	g	0B	h	0C	i
S53	23	Keyboard 6 and ^	6 (pqr)	13	p	14	q	15	r
S54	20	Keyboard 3 and #	3 (yz)	1C	y	1D	z	00	
S55	36	Keyboard , and <	,						

Table 8 - Key assignment for OPAL M

Key codes OPAL L Series

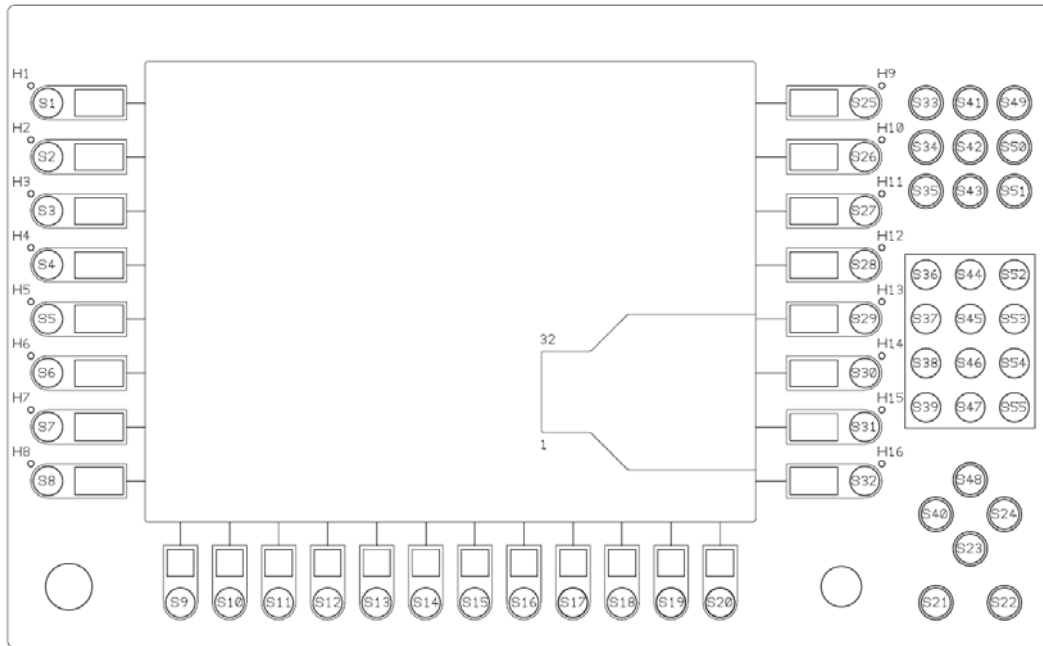


Figure 4 - Key assignment for OPAL L

Standard Key Assignment				Key Assignment (second layer activated)					
Key No.	Usage ID (hex)	Usage Name	Label	+ S35 pressed		+ S43 pressed		+ S51 pressed	
				U-ID (hex)	U-Name	U-ID (hex)	U-Name	U-ID (hex)	U-Name
S1	90	Keyboard LANG1	S1						
S2	91	Keyboard LANG2	S2						
S3	92	Keyboard LANG3	S3						
S4	93	Keyboard LANG4	S4						
S5	94	Keyboard LANG5	S5						
S6	95	Keyboard LANG6	S6						
S7	96	Keyboard LANG7	S7						
S8	97	Keyboard LANG8	S8						
S9	3A	Keyboard F1	F1						
S10	3B	Keyboard F2	F2						
S11	3C	Keyboard F3	F3						
S12	3D	Keyboard F4	F4						
S13	3E	Keyboard F5	F5						
S14	3F	Keyboard F6	F6						
S15	40	Keyboard F7	F7						
S16	41	Keyboard F8	F8						
S17	42	Keyboard F9	F9						
S18	43	Keyboard F10	F10						
S19	44	Keyboard F11	F11						
S20	45	Keyboard F12	F12						
S21	29	Keyboard Escape	Esc						
S22	28	Keyboard Return	Enter						
S23	51	Keyboard DownArrow	↓						
S24	4F	Keyboard RightArrow	→						
S25	98	Keyboard LANG9	S9						
S26	99	Keyboard Alternate Erase	S10						

S27	9A	Keyboard SysReq/Attention	S11						
S28	9B	Keyboard Cancel	S12						
S29	9C	Keyboard clear	S13						
S30	9D	Keyboard Prior	S14						
S31	9E	Keyboard Return	S15						
S32	9F	Keyboard Separator	S16						
S33	68	Keyboard F13	-						
S34	69	Keyboard F14	-						
S35	6A	Keyboard F15	-						
S36	24	Keyboard 7 and &	7 (abc)	04	a	05	b	06	c
S37	21	Keyboard 4 and \$	4 (jkl)	0D	j	0E	k	0F	l
S38	1E	Keyboard 1 and !	1 (stu)	16	s	17	t	18	u
S39	27	Keyboard 0 and)	0 (_)	2D	-				
S40	50	Keyboard LeftArrow	←						
S41	6B	Keyboard F16	-						
S42	6C	Keyboard F17	-						
S43	6D	Keyboard F18	-						
S44	25	Keyboard 8 and *	8 (def)	07	d	08	e	0A	f
S45	22	Keyboard 5 and %	5 (mno)	10	m	11	n	12	o
S46	1F	Keyboard 2 and @	2 (vwx)	19	v	1A	w	1B	x
S47	37	Keyboard . And >	.						
S48	52	Keyboard UpArrow	↑						
S49	6E	Keyboard F19	-						
S50	6F	Keyboard F20	-						
S51	70	Keyboard F21	-						
S52	25	Keyboard 9 and (	9 (ghi)	0A	g	0B	h	0C	i
S53	23	Keyboard 6 and ^	6 (pqr)	13	p	14	q	15	r
S54	20	Keyboard 3 and #	3 (yz)	1C	y	1D	z	00	
S55	36	Keyboard , and <	,						

Table 9 - Key assignment for OPAL L

Touch Screen Interface⁴

To operate the touch screen, the analog resistive touch screen controller TSC-30/IC from DMC is used.

Driver Installation

Before the touch screen can be used the TSC-10/DD driver from DMC must be installed onto the system. The actual driver can be downloaded from the download section of the DMC website (<http://www.dmccoltd.com/english/>). Please follow the instructions of the installation manual of DMC.

Upon successful installation, the driver can be found in the Windows device manager (“Mice and other pointing devices”) after plugging the OPAL keyboard to the Host (via USB).

Calibration and general Touch Screen settings

To calibrate the touch screen, the UPDD console (installed during driver installation) from DMC can be used. Please refer to the DMC documentation for calibration and setting details. The OPAL keyboard can save the calibration data. In order to do so (and before calibrating the touch screen), the appropriate check box must be activated.

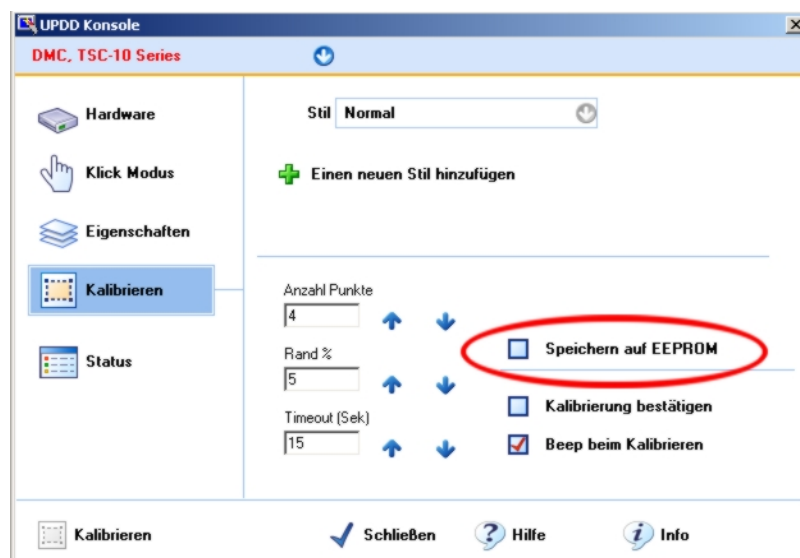


Figure 5 - Saving the calibration data

Touch Screen Interface settings

For the touch screen interface, two settings (USB/RS232 communication) are available. Settings can be changed via the jumpers on the right side of the PCB (see Figure 6). To change settings, disconnect the keyboard from the Host and set the jumper as desired. Reconnect the keyboard to the host for new settings to take effect.



Remember to connect the keyboard to the host with the appropriate cable according to the chosen interface! It is important to change all jumpers according to the desired setting. Otherwise the keyboard will not operate.

⁴ These settings are only available for OPAL keyboards with integrated touch screen.

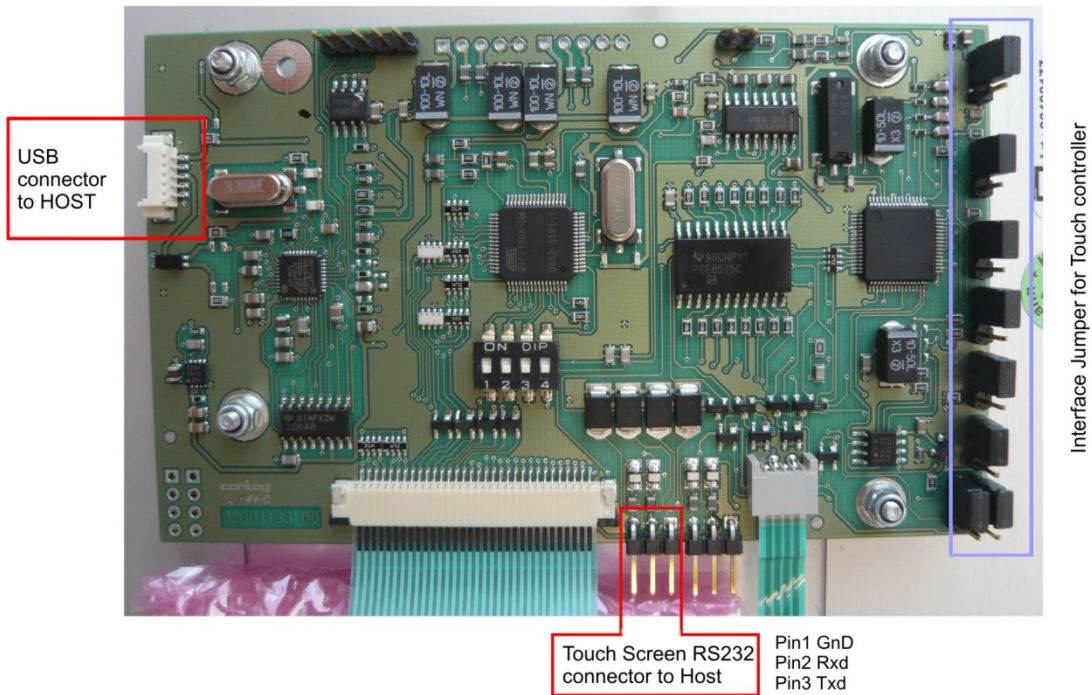


Figure 6 - Interface settings touch controller

By default, the USB interface is activated (see jumper position of *Figure 6*). To activate the RS232 interface, change the position of **all** jumpers so that the middle and the lower pin of **every** connector in the blue box are bypassed.