



Q5-Dot32-S

FEATURES

Programmable LCD-Key FSTN Display with 64 * 32 dots RGB Backlight with 1 - 250 mcd/m² SPI Bi-directional Data Transfer

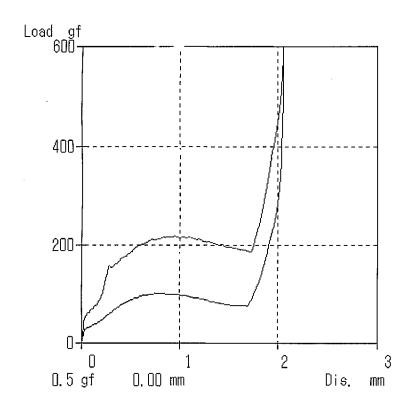
Viewing Area 17.26 * 12.78 mm² 65k Backlight colours Display update < 1 ms Lifetime > 3 million operations

Area 20.6 * 18.2 mm² Backlight colours extremely stable Display read back function MTBF > 800.000h



SWITCH

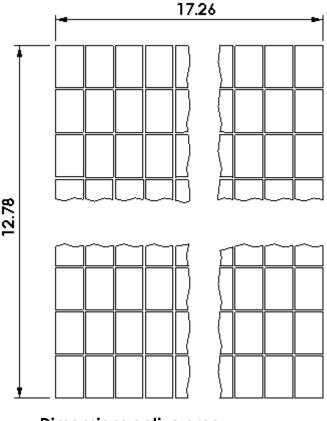
Circuit: SPST Resistive load 5 V @ 20 mA Insulation resistance 100 Megaohms Ω minimum @100 V DC Contact resistance 100 Ohm maximum @ 5 V 20 mA Dielectric strength 125V AV for 1 minute minimum Mechanical endurance > 3.000.000 operations Electrical endurance > 3.000.000 operations Operating force 2.3 +/- 0.4 Newton Total travel 2.0 mm Tactile load/travel see diagram:

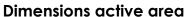


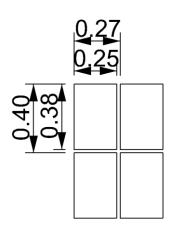


DISPLAY

Display operation mode FSTN positive, MUX 1:32, BIAS 1/6 Transflective Display with RGB-LED backlight Viewing angle direction 6 o'clock Viewing area 17.26 mm * 12.78 mm Pixel format 64 * 32 pixels Pixel size 0.25 * 0.38 mm² Pixel pitch 0.27 * 0.40 mm² Operating temperature range –10° to +70° Celsius Storage temperature range -20° to +80° Celsius VIcd 4.9 V to 5.1 V All Dots selectable, addressing see diagram







Dimensions dot size and dot pitch



BACKLIGHT

Dominant wavelength: Red 635 nm, Green 525 nm and Blue 470 nm typ.

Peak wavelength: Red 650 nm, Green 515 nm and Blue 468 nm typ. Red backlight brightness 0.7 to 80 cd/m²

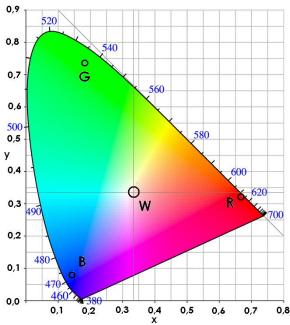
Green backlight brightness 01.2 to 150 cd/m²

Blue backlight brightness 0.2 to 20 cd/m²

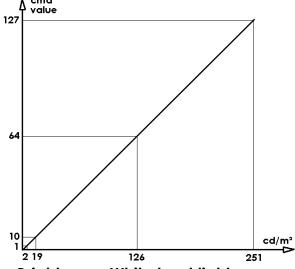
White backlight brightness 2.0 to 250 cd/m²

White backlight colour x = 0.333 +/- 0.020, y = 0.333 +/- 0.020

Backlight brightness adapted to eye sensitivity and colour response



CIE 1931 colour space with some Q5 colours

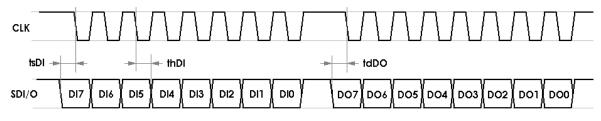


Brightness - White backlight



SPI communication

- → The Serial Peripheral Interface (SPI) of Q5 allows simplex, synchronous, serial communication with external devices. An SPI system may consist of a master and one or more LCD-Key Q5 slaves.
- → To use a single data line (pin SDA of Q5), the MISO and MOSI pins are connected together inside the Q5 (only simplex communication is possible). Chip Select pin is not available with Q5. To ensure synchronisation with the master, an internal buffer overflow and time out are integrated in Q5.
- → The communication is always initiated by the master. When the master device transmits data to a slave Q5 via MOSI pin, the slave device is able to respond by sending data to the master device via the MISO pin. This implies simplex communication with both data out and data in synchronized with the same clock signal which is provided by the master device via the SCK pin.

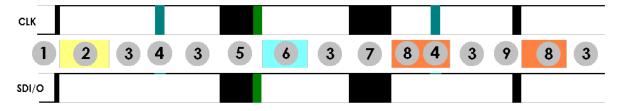


tsDI set up time 10 ns min tdDO delay time 10 ns min

thDI hold time 10 ns min tcyc cycle time 250 ns min (4 MHz max)

→ The SPI command format: The first Byte defines the Command (see Command set).

Depending on the Command, several bytes may follow. A 0x43-Byte ends the Command and Q5 starts process data.



- 1: Power on Reset (POR)
- 2: Initialisation Q5
- 3: Idle, no SPI communication
- 4: 0xff (NOP) on SPI, no effect
- 5: Command, last Byte is 0x43
- 6: Q5 is busy. Busy time depends on command (see command set)
- 7: Faulty command without 0x43 at end
- 8: Timeout of 1,03 ms, then Initialisation
- 9: Single Byte (not 0x43 or 0xff) to force Timeout
- → After Power on Reset (1-2-3) Q5 waits for commands (3-5-6-3). If a command fails, Q5 waits for the end of command (EOC) Byte 0x43 (3-7-8-3). In every situation the no operation Command (NOP) 0xff (4) is allowed. To force an initialisation of the SPI, send a single byte (not EOC or NOP) with a delay > 1.03 ms (3-9-8-3). Timeout triggers after every incoming byte (exceptions are NOP and OEC). In consequence the bytes of a command should arrive faster than every ms.



Command list

Command type	CMD	Data	Description
Write Display Data	0x40	The command expects min. 4 bytes to follow: 0000 000As 0000 ArA6A5A4 0000 ArA6A5A1A0 0000 Drad Drad Bytes may follow Last byte is EOC 0x43	A8-A0 points into display, see diagram for address position D3 – D0 defines Dot pattern End of command
Set RGB Colour	0x41	The command expects 1 data Byte to follow: 00D ₅ D ₄ D ₃ D ₂ D ₁ D ₀ last byte is EOC 0x43	D5, D4, D3, D2, D1,D0 define brightness of red, green and blue End of command
Set RGB Colour	0x42	The command expects 3 data Bytes to follow: 0D6D5D4D3D2D1D0 0D6D5D4D3D2D1D0 0D6D5D4D3D2D1D0 Last byte is EOC 0x43	D6-D0, D6-D0 and D6-D0 define brightness of red, green and blue backlight End of command
End of Command	0x43	0100 0011	Last byte for each command
Write Display Data	0x48	The command expects min. 4 bytes to follow: 0000 000As 0000 A7A6A5A4 0000 A3A2A1A0 0000 D3D2D1D0 Max 511 more Data Bytes may follow Last byte is EOC 0x43	A8-A0 points into display, see diagram for address position D3 – D0 defines Dot pattern End of command
Write Display Data	0x49	The command expects 512 bytes to follow: 0000 D ₃ D ₂ D ₁ D ₀ Last byte is EOC 0x43	See diagram for dot position D3 – D0 defines Dot pattern End of command



CMD 0x40 write display

This command writes to the display. First address (Adr 0) is in the middle of the display on the right side. The following 3 bytes define the start address where the first 4 dots should be set. Then 1 to 512 bytes follow to define 4 dots each. This command should be used to archive compatibility. It is recommended to use command 0x48 for new projects. This dot map defines the position of the following data byte.

08 00 92 8		A4 A4 50 52 00 D0					A0 A0 60 52 D0 D0	44	36	28	20	12	04			
08 00 92 8	4 76 68 6	14 A4 50 52 D1 D1					A0 A0 60 52 D1 D1			28		A0 12 D1	A0 04 D1			
08 00 92 8		A4 A4 50 52 02 D2	 •				A0 A0 60 52 D2 D2	44	36	28			A0 04 D2			
08 00 92 8		A4 A4 50 52 93 D3	 -				A0 A0 60 52 D3 D3	44	36	28	A0 20 D3	A0 12 D3	A0 04 D3			
· · ·										:						
	7 79 71 6					•	A0 A0 63 55 D2 D2	47	39	31		A0 15 D2				
11 03 95 8	14 A4 A4 A 17 79 71 6 3 D3 D3 D	3 55 3 D3	 Le of	E th	ie ko	Эу	A0 A0 63 55 D3 D3	47 D3	39	31	23	: :	A0 07 D3			
04 96 88 8	0 72 64 5	4 A4 A4 66 48	 ٠					40		24				← st	art	position
	0 00 00 0	00 [00					Бо		انتا		لت					
04 96 88 8		4 A4 66 48				•	A0 A0 56 48 D1 D1	 A0 40	A0	A0 24	A0 16	A0 80	A0 00			
04 96 88 8	.4 A4 A4 A 50 72 64 5	4 A4 66 48			•	•	A0 A0 56 48	 A0 40	A0	A0 24	A0 16	A0 80	A0 00			
04 96 88 8 D1 D1 D1 D 	.4 A4 A4 A 50 72 64 5	A4 A4 A4 D1 D1 D1 D1 D1 D1 D1 D					A0 A0 56 48 D1 D1	A0	A0	A0 24 D1	A0 16 D1 A0 19	A0 08 D1	A0 00 D1 A0 03			
04 96 88 8 D1 D1 D1 D 							A0 A0 A0 D1 D1 D1 A0 A0 A0 A0 A0 59 51	A0	A0	A0 27 A0 27	A0 19 D0 A0 19	A0 08 D1	A0 00 D1			
04							A0	A0 40 D1 A0 A3 D0 A3 D1 A0 A3 D1 A0 A3 D1 A0 A3 A3 A3 A3 A3 A3 A3	A0	A0 24 D1	A0 16 D1 D1 D0 D1 D1 D1 D1 D1	A0 08 D1	A0 00 D1			



CMD 0x48 write display

This command writes to the display. First address (Adr 0) is in the upper right corner of the display. The following 3 bytes define the start address where the first 4 dots should be set. Then 1 to 512 bytes follow to define 4 dots each. It is recommended to use command 0x48 for new projects. This dot map defines the position of the following data byte.

04	96	88	A4 80 D0	72	64	56	A4 48 D0			•	•	٠		56	48	40	A0 32 D0	24	16	08	00	← :	start	. pos	sitio	n
A5 04 D1	A4 96 D1	A4 88 D1	D1	A4 72 D1	D1	A4 56 D1	D1								A0 48 D1		A0 32 D1									
A5 04 D2	A4 96 D2	A4 88 D2	A4 80 D2	A4 72 D2	A4 64 D2	A4 56 D2	A4 48 D2				•			A0 56 D2	A0 48 D2	A0 40 D2	A0 32 D2	A0 24 D2	A0 16 D2	A0 08 D2	A0 00 D2					
	A4 96 D3	A4 88 D3	A4 80 D3	A4 72 D3	A4 64 D3		A4 48 D3			•		٠		56	A0 48 D3	A0 40 D3	A0 32 D3	A0 24 D3	A0 16 D3	A0 08 D3	A0 00 D3					
				:		:										:		:								
	A4 99 D2		A4 83 D2	75	67	59				•				59	51	43			19	A0 11 D2						
07	A4 99 D3		A4 83 D3			A4 59 D3		mic	ldle	of	th	e 1	key	59		43	A0 35 D3		19		A0 03 D3					
	A5 00 D0	A4 92 D0	A4 84 D0			A4 60 D0				•	•	•		60		A0 44 D0	A0 36 D0			A0 12 D0	A0 04 D0					
	A5 00 D1		A4 84 D1	76	68					•	•	•		60	A0 52 D1	: :	A0 36 D1	A0 28 D1	: :	A0 12 D1	: :					
:		:				:										:		:		:						
					\Box	$\dot{\Box}$									\Box		\Box		\Box		\Box					
111	A5 03 D0	A4 95 D0		79	71		55			•	•	٠		63	A0 55 D0		A0 39 D0	31	23	15	A0 07 D0					
	A5 03 D1		A4 87 D1	A4 79 D1	71	A4 63 D1	55							63	55	A0 47 D1	A0 39 D1			15	A0 07 D1					
A5 11 D2	03 D2	A4 95 D2		A4 79 D2	A4 71 D2	A4 63 D2	A4 55 D2							63	A0 55 D2		A0 39 D2	31			A0 07 D2					
	03 D3	95	A4 87 D3	79	71	A4 63 D3						•		63		47	A0 39 D3	31		A0 15 D3						



CMD 0x49 write display

This command writes to the display. First address (Adr 0) is in the upper left corner of the display. The start position for the dots is fixed and the command needs 512 bytes with dot information. The display is filled line by line. Command 0x49 is recommended to write text into the display. The data byte can be taken from a font character. This dot map shows the position of the dots in the data stream.

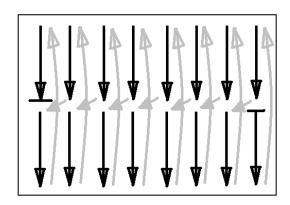
	A0 00 D1	A0 00 D0	A0 01 D3	A0 01 D2	A0 01 D1	A0 01 D0	•						14	14	14	A0 14 D0	15]	A0 15 D2	A0 15 D1	A0 15 D0
A0 A0 16 16 D3 D2	16	A0 16 D0	A0 17 D3	A0 17 D2	A0 17 D1	A0 17 D0	•						A0 30 D3	A0 30 D2	A0 30 D1	A0 30 D0	A0 31 D3	A0 31 D2	A0 31 D1	A0 31 D0
A0 A0 32 32 D3 D2		A0 32 D0	A0 33 D3	A0 33 D2	A0 33 D1	A0 33 D0							A0 46 D3	A0 46 D2	A0 46 D1	A0 46 D0	: :	A0 47 D2	A0 47 D1	A0 47 D0
A0 A0 A0 48 48 D3 D2		A0 48 D0	A0 49 D3	A0 49 D2	A0 49 D1	A0 49 D0		•					A0 62 D3	A0 62 D2	A0 62 D1	A0 62 D0	: :	A0 63 D2	A0 63 D1	A0 63 D0
			:										•		•		:		:	
24 24	A2 24 D1	A2 24 D0	A2 25 D3	A2 25 D2	A2 25 D1	A2 25 D0		•					A2 38 D3	A2 38 D2	A2 38 D1	A2 38 D0	A2 39 D3	A2 39 D2	A2 39 D1	A2 39 D0
40 40	A2 40 D1	40	A2 41 D3	: :	A2 41 D1	A2 41 D0	mid	ldle	of	th	e ke	∋y	A2 54 D3	A2 54 D2	A2 54 D1	A2 54 D0	A2 55 D3	A2 55 D2	A2 55 D1	A2 55 D0
\Box																				
	A2 56 D1	A2 56 D0	A2 57 D3	A2 57 D2	A2 57 D1	A2 57 D0							A2 70 D3	A2 70 D2	A2 70 D1	A2 70 D0	A2 71 D3	A2 71 D2	A2 71 D1	A2 71 D0
56 56 56	56 D1 A2 72	56	57 D3 A2 73	57 D2 A2	57 D1 A2 73	57							70 D3 A2 86	70 D2 A2	70 D1 A2 86	70 D0 A2 86	71	71 D2 A2 87	71	71
56 56 56	56 D1 A2 72	56 D0 A2 72	57 D3 A2 73	57 D2 A2 73	57 D1 A2 73	57 D0 A2 73							70 D3 A2 86	70 D2 A2 86	70 D1 A2 86	70 D0 A2 86	71 D3 A2 87	71 D2 A2 87	71 D1 A2 87	71 D0 A2 87
56 56 56 D3 D2	A2 72 D1	A2 72 D0	57 D3 A2 73	A2 73 D2 A4 49	A2 73 D1	57 D0 A2 73							A2 86 D3 	A2 86 D2 A4 62	70 D1 A2 86	A2 86 D0	71 D3 A2 87	71 D2 A2 87 D2 A4 63	71 D1 A2 87	71 D0 A2 87
56 56 D3 D2	A4 A8 D1	56 D0	57 D3	A2 73 D2 A4 49	57 D1 73 D1 	A2 73 D0 A4 49							A2 86 D3 	A2 86 D2 A4 62	70	70 D0	71 D3 A2 87 D3 A4 63	A4 63 D2	A2 87 D1	71 D0 A2 87 D0 A4 63
56 56 D3 D2	56 D1	56 D0	57 D3	[A4] A4] A4] A4] A4] A4] A4] A65	57 D1	A4 49 D0							70 D3	A4 62 D2 A4 78	70	70 D0	71 D3	A4 63 D2	71 D1	71 D0



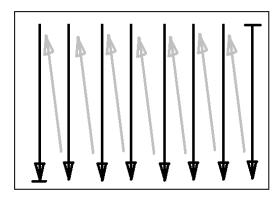
Command set overview

Command name	Cmd byte	Data amount	Busy time	Remarks
Write display half offset	0x40	Adr , 1 - 512 bytes	4 ms	
64 colours backlight	0x41	1 fix	100 us	
RGB colours backlight	0x42	3 fix	150 us	
End Of Command	0x43	0	/	EOC
Write display vertical	0x48	Adr, 1 - 512 bytes	4 ms	
Write display horizontal	0x49	512 bytes fix	5 ms	
No operation	0xFF	0	/	Other key active

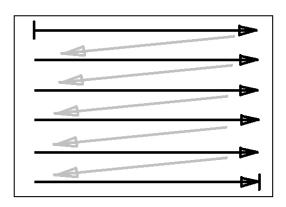
Write command 0x40:



Write command 0x48:

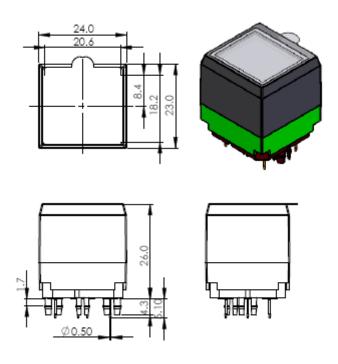


Write command 0x49:

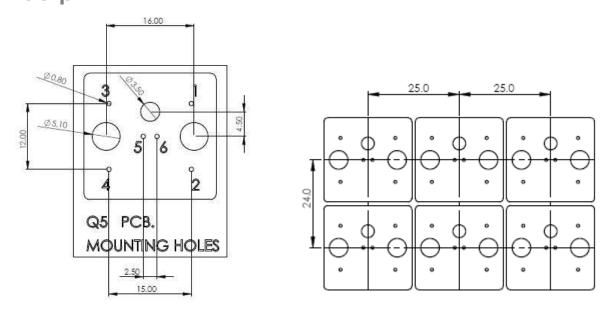




Outline Dimensions



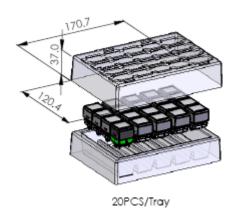
Footprint



1: GND 2: Vcc 3: Clock 4: Data 5,6: Switch



Packaging



Address

MMI Technologies Ltd Grove Crescent House 18 Grove Place **Bedford United Kingdom MK40 3JJ** Tel: +44 (0) 1234 21 36 00

Fax: +44 (0) 1234 21 08 20 Email: Q5@mmi-systems.com

www.mmi-systems.com



History

Revision	Date	Comment
0.1	09-09-2008	First draw

0.9 09-09-2011 Commands added