

Rev.1.6

## **HARDWARWE REFERENCE MANUAL FOR LED DISPLAY CONTROLLER MCA2X16**

- I. General Description**
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- III. Connector description and DIP Switch settings**
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### **I. General Description**

This manual describes functions and connectors of LED Display controller MCA2X16. Very easy to use, simple and flexible design, low count of cables, low consumption, low cost, light weight and small in dimensions make this series of LED controllers suitable for applications such as exchange rate boards, traffic control systems, led bar displays and etc. This manual refers only for Common Anode indicators and LED's. Block diagram is shown on fig. 1. MCA2X16 provides all refresh cycles, light intensity control, power supply for logic (+5V), anode power drivers and serial channel buffers.

Each indicator, connected to the LED controller occupied appropriate address in internal LED buffer. MCA2X16 receives all commands and data via serial channel. Command protocol is very simple to us, and can be implemented in any Hi level Programming languages and assemblers. Refer for Command Reference Manual for detail in page **PRODUCTS** on our Web [www.itsdisplays.com](http://www.itsdisplays.com).

LED controller drives two LINES of displays, each one up to 160 seven-segment displays that refers to two LED buffers 160 bytes each. Refresh rate of LINES is 100 Hz that provide excellent, free flicker views of the display. Duty cycle of refresh is 1 to 10, providing maximal possible light intensity. Loading of serial shift registers starts from Block 16 up to Block 1 that take ability to connect only required quantity of blocks for specifying application. Shift register clock is 375 KHz, and take ability to use signal cables up to 10 meters between LED controller and driver blocks. User can measure input supply voltage (VIN), power supply for logic (+5V), light intensity using command set. With ability of measuring light intensity in room, user can adjust optimal PWM value. That technique void event of very bright displays in dark rooms and not enough visible displays in sunny environments. Each LINE drives external serial shift registers and buffers called in this description Blocks. More detailed information and applications can be finding in our Web: <http://www.itsdisplays.com/products.htm> or in enclosed documentation CD.

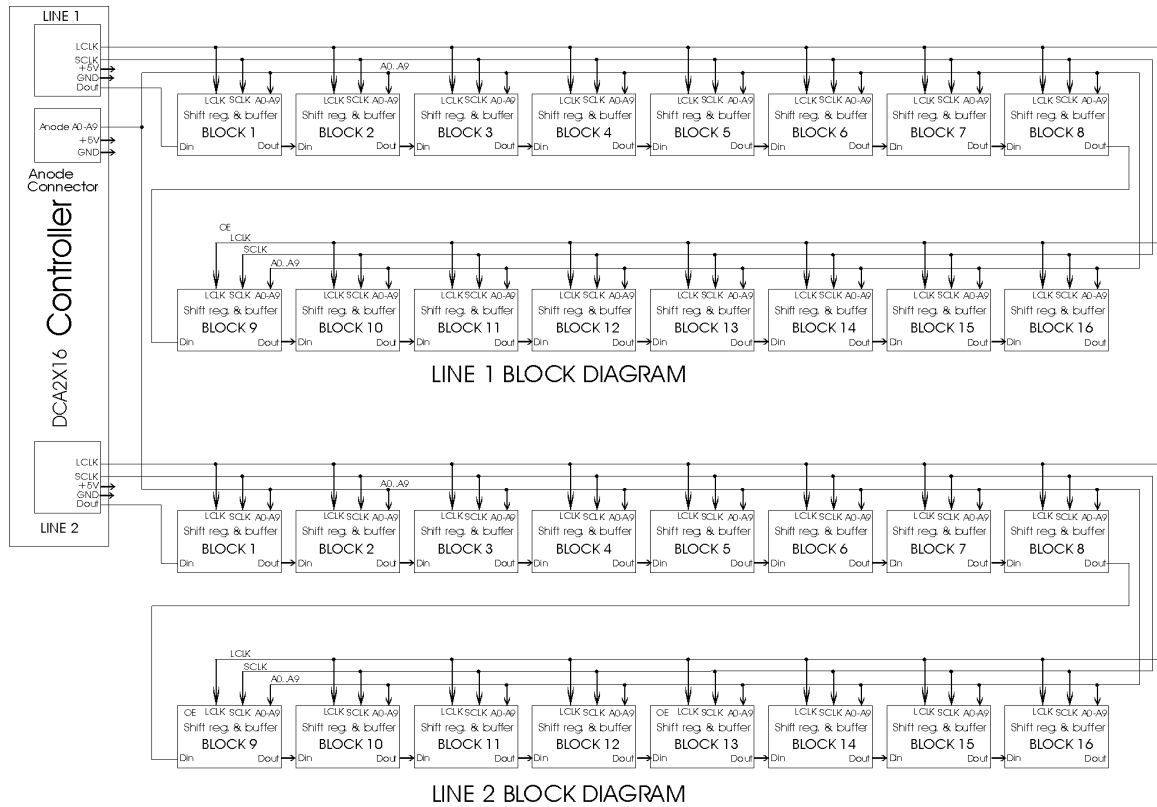


Figure 1

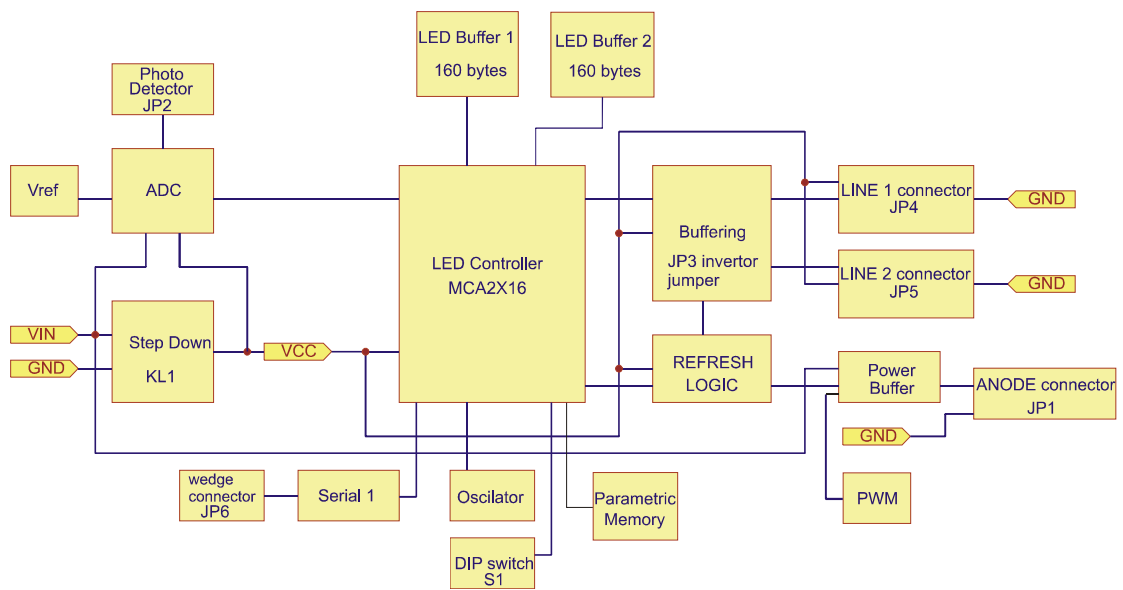


Figure 2

Block diagram of the LED Controller MCA2X16 is shown on Figure2

## II. MCA2X16 block diagram description

Description of the block diagram of MCA2X16 is shown to Fig. 1 and 2.

1. Power supply –MCA2X16 is supplied from **KL1**. Input voltage VIN can be in range from 8V to 25V. Internal Step down regulator produces from input voltage VIN, 5V up to 500 mA for supply external logic via connectors **JP4** and **JP5**.

2. PWM – this block adjust light up intensity (Global Intensity) of the all LED indicators. Value can be set from 0% (display is off) up to 99% (max intensity). This signal acts simultaneously to LINE1 and LINE2. Changing of values of PWM is done with command, described in Command Reference Manual refer to page **PRODUCTS** in our Web: <http://www.itsdisplays.com/products.htm> or in enclosed documentation CD.

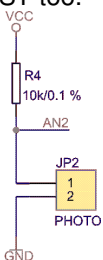
3. Parametric memory – This non-volatile memory is used for save values of PWM, STATUS byte, values of defined buffers and etc. After power up, LED controller restores noted values without additional initialization. Refer to Command Reference Manual.

4. LINES – each MCA2X16 LED controller can drive up to two lines. Each line has our own 10-pin header Connector. These connectors provide all necessary signals and power supply for external Shift Registers that drives cathodes of Indicators.

5. LED Buffers – MCA2X16 maintain two LED Buffers, each one consisting of 160 bytes. LED Buffers are memory blocks. User can read and write LED Buffers, using appropriate commands. For LINE1 refers LED Buffer 1 and for LINE2 refers LED Buffer 2. Via writing of byte (or block of bytes) in appropriate address in LED Buffer is changed sign of selected indicator. After power up two LED buffers is filled with 00h (display is blanc). Fig. 4 points relationship between LED Buffer and external logic.

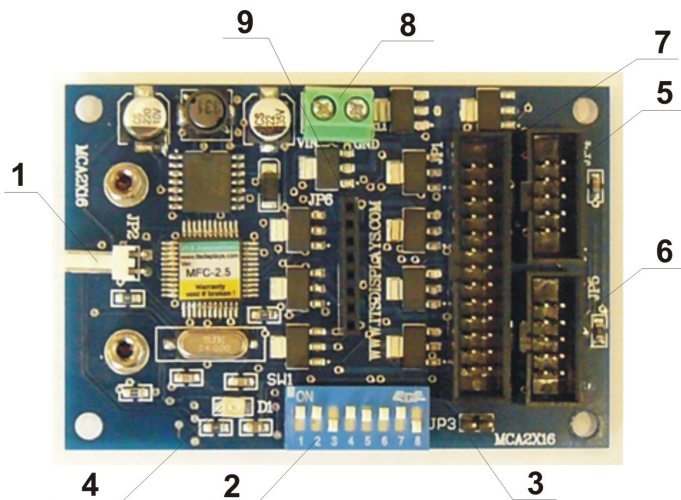
6. Power drivers and refresh logic – they provide Anode driving of indicators and are in relation with LED buffer address position. Power transistors and cables can drive up 3, 5 A to each Anode supply current. When is required more power, can be buffered externally. Refresh logic provide 100 Hz refresh rate on duty cycle 10/1.

7. Serial channel – MCA2X16 LED controller receives all commands, data and parameters via serial channel. Protocol of communication is described in Command Set Manual. Mode is 8 bits, no parity, and 1 stop bit. Baud Rates – 9600 bps, 19200 bps, 38400 bps, and 57600 bps are selectable from DIP switch **S1-1, 2**. Changing of baud rate can be done via easy. First to set desired baud rate (**S1** switch) and after that switch on the power supply. Keep your mind, that you must change also appropriate baud rate of the HOST too.



8. Photo detector - is photo detector for measuring of light intensity. Photo detector is connected to **JP2**. Refer to Command Reference Manual for commands detail.

9. From other view point this LED controller supports three types of interface boards as follows: CB232 – standard RS232C interface board, CB485 – RS485 interface board, CB203 – TTL level interface.



- 1. JP2 - Photo detector connector.
- 2. S1 – Baud rate and Address Switch Selector (for RS485 interface).
- 3. JP3 - jumper that Invert Indicator segments.
- 4. D1 - Activity LED
- 5. JP4 - Serial Shift Register connector LINE1
- 6. JP5 - Serial Shift Register connector LINE2
- 7. JP1 - Anode Connector
- 8. KL1 - Power Supply Connector
- 9. JP6 – Interface wedge connector

Top view of the MCA2X16 is shown on Figure 3

### III. Connector description and DIP Switch settings

#### Connector description:

**JP1** – Anode Connector – 26 pin box header connector 0.1” pitches is used for anode drives, each LED controller can drive 10 anodes that are common for two lines. Maximal current that can drive each anode line is about 3.5 A. Duty cycle of refresh is 1/10 and refresh rate is 10mS or 100 Hz. Cables are 26 pin ribbon, crimped with 26 pin standard ribbon female connectors.

pin1	pin3	pin5	pin7	pin9	pin11	pin13	pin15	pin17	pin19	pin21	pin23	pin25
<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>A4</b>	<b>A5</b>	<b>A6</b>	<b>A7</b>	<b>A8</b>	<b>A9</b>	<b>A10</b>	<b>GND</b>	<b>GND</b>	<b>GND</b>
pin2	pin4	pin6	pin8	pin10	pin12	pin14	pin16	pin18	pin20	pin22	pin24	pin26
<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>A4</b>	<b>A5</b>	<b>A6</b>	<b>A7</b>	<b>A8</b>	<b>A9</b>	<b>A10</b>	<b>GND</b>	<b>GND</b>	<b>GND</b>

Table shows connector pins of JP1 as follows **A1-10** – Anode numbering. **GND** – Power Supply ground.

**JP 4, JP5** – respectively LINE 1 and LINE 2 connectors. This two 10 pin box header connectors, drives external shift registers and provide power supply for external logic.

pin1	pin3	pin5	pin7	pin9
<b>+5V(VCC)</b>	<b>GND</b>	<b>GND</b>	<b>GND</b>	<b>GND</b>
pin2	pin4	pin6	pin8	pin10
<b>+5V(VCC)</b>	<b>LCLK</b>	<b>SCLK</b>	<b>SDATA</b>	<b>GND</b>

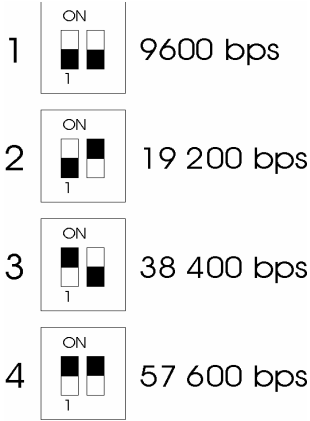
**KL1** – Input Voltage connector. This is power supply connector. Voltage must be in range from 8V up to 25V. Supply current depending of quantity and type of connected LED indicators. Refer for correct power polarity.

pin1	pin2
<b>GND</b>	<b>VIN</b>

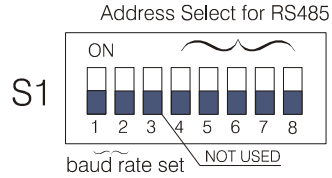
**Caution: Check carefully polarity of power supply when connecting LED controller. If polarity is wrong, it will damage LED controller permanently!!!**

pin1	pin2
<b>Photo input</b>	<b>GND</b>

**JP2** – Photo detector connector.



DIP SWITCH S1 POSITIONS



**S1-1,2** – Dipswitch for setting of baud rate for serial channel

**S1-3** - Not Used and Not connected.

**S1-4-8** - Address Slave selector for RS485. Address is referring to DIP switch as follows S1-4 – most significant bit in address, S1-8 – least significant bit in address. Available Address can be set in range from 00h (00d) to 1Fh (31d). Address setting does effect only when CB485 interface board is attached to MCA2X16.

pin1	pin2	pin3	pin4	pin5	pin6	pin7	pin8
<b>DE</b>	<b>GND</b>	<b>TX</b>	<b>RX</b>	<b>VCC</b>	<b>RES</b>	<b>COM1</b>	<b>COM2</b>

**JP6** – interface wedge connector.

This single row eight pin header connector is used for connecting MCA2X16 to variety interface boards for serial communication.

**DE** – this signal enables differential Transmitter when used RS485 interface. Enable-disable is done automatically depending of completing command No 11.

**GND** – Power supply ground for supplying of external boards.

**TX** – Transmit signal for serial channel.

**RX** – Receive signal for serial channel.

**VCC** – Power supply for supplying of external boards.

**RES** – this signal is used only from Bluetooth wireless communication module.

**COM1 - COM2** – these inputs defines witch type of interface board is connected to MCA2X16.

**JP3** – data inverter jumper - this jumper inverts data that dumps external shift registers. When is open data is positive (none inverted) and when is open data is negative (inverted). Purpose of this function is to expand flexibility when external buffers is designed. Also can be used for simple PCB boards test without any additional software and hardware aids when LED display PCB boards are ready. Via closing jumper **JP3** – all segments (LED's) must light up. Via opening jumper **JP3** – all segments (LED's) must light off (LED display is blank).

#### IV. External Cathode Drivers

External cathode drivers (blocks) drive directly LED's (segments) of designed LED Display. This technique takes advantage of building and controlling very large amount of LED's and multiple LED's in single segment for building of large in dimensions LED displays. Also this technology reducing extremely total power consumption and heat dissipation.

**Anodes** - is connected via Anode connector **JP1** directly to the appropriate Anodes of indicators. When designing PCB boards keep you mind to follow exact interconnection between anode connector **JP1** and anodes of connected indicators. Interconnection of all anodes is repeated in parallel in all used blocks. They are common for Both LINES.

**Example:** If **A1** from **JP1** connector is connected to the second seven segment indicator but **A2** is connected to the first seven segment indicator as result when writing byte in LED buffer in address 00h will light up second indicator. Also such wrong connection will acts in cases when is used internal character generator for dumping ASCII characters and seven segment displays.

**Cathodes** – is connected to the outputs of driver buffers via load resistors. When in single segment is connected more than one LED in parallel, to the each one must be provided separate load resistor. In each segment can connected more than one LED serially and parallel. Quantity of connected LED's depends from voltage and provided current from power supply.

**Serial Shift Registers** – is 8-bit serial-in/serial and parallel-out shift register with output latches with 3-state. Can be Used 74HC/HCT595, TPIC6B595 and etc. All refresh cycles and loading of shift registers is provided from LED Controller. User does not need to care about any process of loading or refresh. Loading and Refreshing process is started after power up or reset. Loading and refreshing process is stopped for small amount of time when is uploading character generator after that process is restarting automatically.

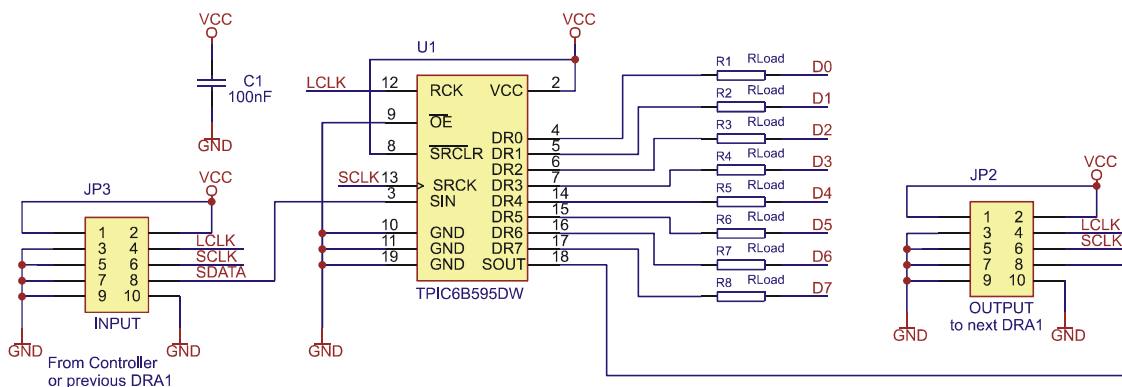


Figure 4 shows block of external logic example.

For more detailed information, documentation and free source schematics, please refer to our Web site : <http://www.itstdisplays.com/products.htm>

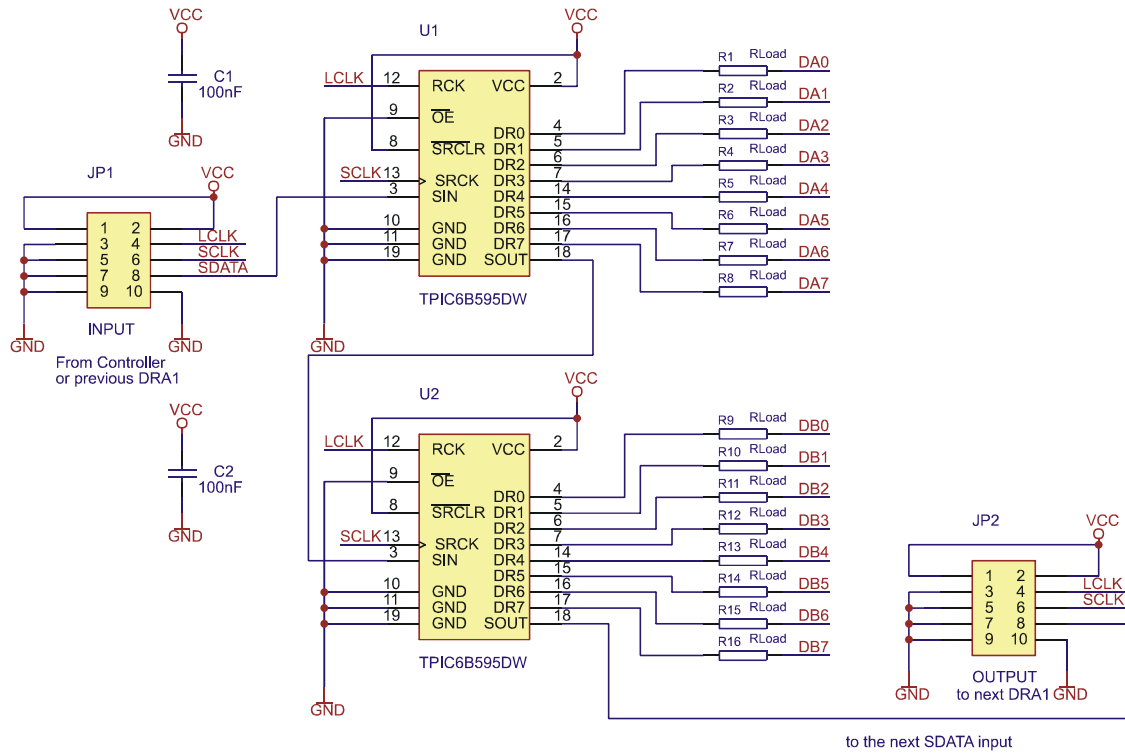


Figure 5 shows two consequential blocks of external logic.

If you have any questions or find some mistakes in this document, do not hesitate to contact us on the next E-mails: [its@itsdisplays.com](mailto:its@itsdisplays.com) or [support@itsdisplays.com](mailto:support@itsdisplays.com), and we try to answer you as soon as possible.