

MM145453

MM145453 Liquid Crystal Display Driver



Literature Number: SNLS061B

MM145453 Liquid Crystal Display Driver

General Description

The MM145453 is a monolithic integrated circuit utilizing CMOS metal gate, low threshold enhancement mode devices. The chip can drive up to 33 LCD segments and can be paralleled to increase this number. The chip is capable of driving a 4½ digit 7-segment display with minimal interface between the display and the data source.

The MM145453 stores display data in latches after it is clocked in, and holds the data until new display data is received.

The MM145453 is available in a molded 44 pin surface mount PLCC package. The MM145453 is pin out and functionally compatible with the MC145453.

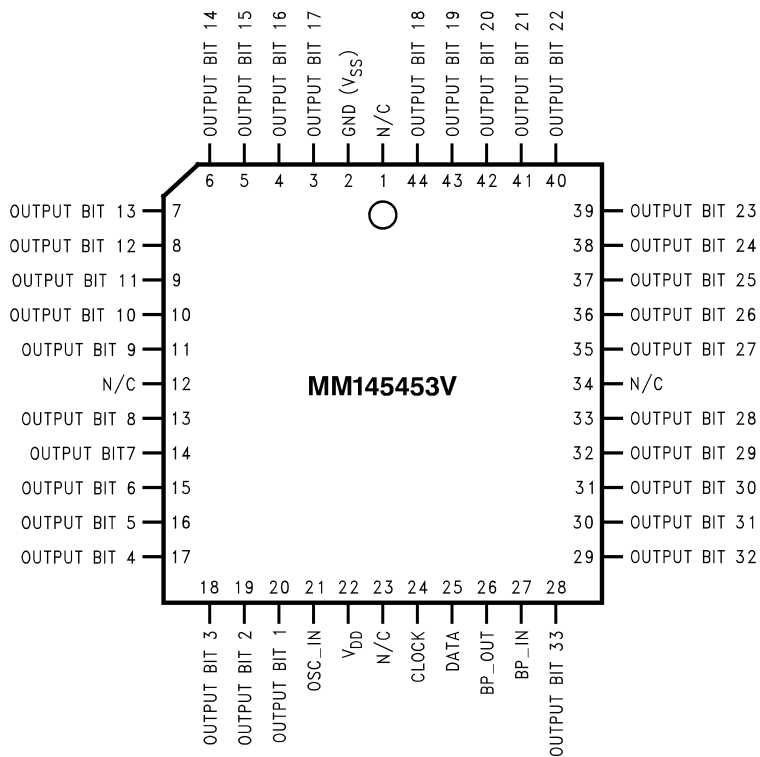
Features

- Serial Data Input
- Wide Power Supply operation
- TTL Compatibility
- Up to 33 LCD Segments
- Alphanumeric or Bar Graph capability
- Cascaded operation capability
- Pin Compatible with MC145453

Applications

- COPS™ or microprocessor displays
- Industrial control indicator
- Digital clock, thermometer, counter, voltmeter
- Instrumentation displays
- Remote displays

Connection Diagram



10128301

Top View
Order Number MM145453V
See NS Package Number V44A

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Voltage at Any Pin, Referenced to Gnd	-0.3V to +10V
Storage Temperature	-65°C to +150°C
Power Dissipation at 25°C	350mW
Power Dissipation at 70°C	300mW

Junction Temperature	+150°C
Lead Temperature (Soldering, 10s)	300°C

Recommended Operating Conditions

V_{DD}	3V to 10V
Operating Temperature	-40°C to 85°C

Electrical Characteristics

The following specifications apply for T_A within operation range, $V_{DD} = 3.0V$ to $10V$, $V_{SS} = 0V$, unless otherwise specified.

Parameter	Conditions	Min	Typical	Max	Units
Supply Voltage, V_{DD}		3		10	V
Average Supply Current, I_{DD}	All Outputs Open, Clock=Gnd, Data=Gnd, OSC=Gnd, BP_IN @ 32Hz				
	$V_{DD} = 5V$			10	μA
	$V_{DD} = 10V$			40	μA
Input Logical '0' Voltage, V_{IL}	$V_{DD} = 3V$			0.4	V
	$V_{DD} = 5V$			0.8	V
	$V_{DD} = 10V$			0.8	V
Input Logical '1' Voltage, V_{IH}	$V_{DD} = 3V$	2.0			V
	$V_{DD} = 5V$	2.0			V
	$V_{DD} = 10V$	8.0			V
Segment Sink Current, I_{OL}	$V_{DD} = 3V$, $V_{OUT} = 0.3V$	-20	-40		μA
Segment Source Current, I_{OH}	$V_{DD} = 3V$, $V_{OUT} = 2.7V$	20	40		μA
Backplane Out Sink Current, I_{OL}	$V_{DD} = 3V$, $V_{OUT} = 0.3V$	-320	-500		μA
Backplane Out Source Current, I_{OH}	$V_{DD} = 3V$, $V_{OUT} = 2.7V$	320	500		μA
Segment Output Offset Voltage	Segment Load = 250pF (Note 2)			+/-50	mV
Backplane Output Offset Voltage	Backplane Load = 8750pF (Note 2)			+/-50	mV
Backplane Out Frequency	$R_{OSC_IN} = 50k\Omega$, $C_{OSC_IN} = 0.01\mu F$		75		Hz
Clock Input Frequency, f_{CLOCK}	$V_{DD} = 3V$ (Notes 2, 3)			500	kHz
	$V_{DD} = 5V$ (Note 2)			750	kHz
	$V_{DD} = 10V$ (Note 2)			1.0	MHz
Clock Input Duty Cycle		40		60	%
Data Input Set-Up Time, t_{DS}		300			ns
Data Input Hold Time, t_{DH}		300			ns

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" specifies conditions of device operation.

Note 2: This parameter is guaranteed (but not production tested) over the operating temperature range and the operating supply voltage range. Not to be used in Q.A. testing.

Note 3: AC input waveform for test purposes: $t_r \leq 20ns$, $t_f \leq 20ns$, $f_{CLOCK} = 500kHz$, Duty Cycle = 50% $\pm 10\%$

Note 4: Clock input rise time (t_r) and fall time (t_f) must not exceed 300ns

Timing Diagram

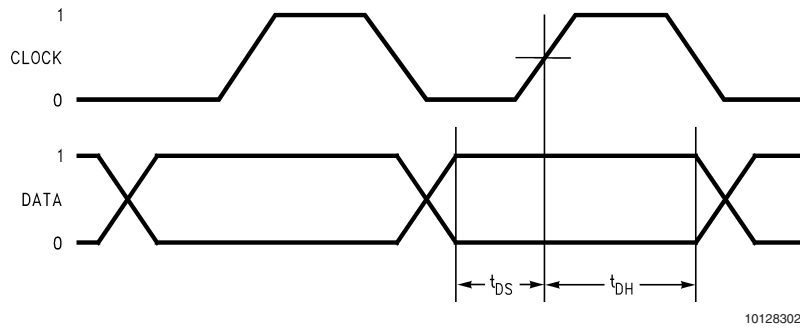


FIGURE 1.

Block Diagram

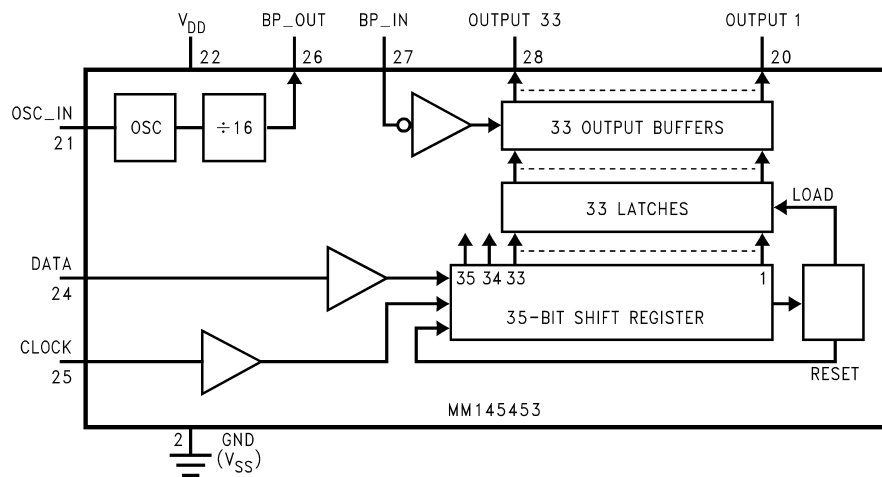


FIGURE 2.

Applications Information

The MM145453 is specifically designed to operate 4½ digit 7-segment displays with minimal interface with the display and data source. Serial data transfer from the data source to the display driver is accomplished with 2 signals, serial Data and Clock. Using a format of a leading "1" followed by the 33 data bits and 2 trailing don't care bits, allows data transfer without the need of an additional Data Load signal. Since the MM145453 does not contain a character generator, the formatting of the segment information must be done prior to inputting the data to the MM145453. The transfer of the 33 data bits is complete at the falling edge of the 36th clock cycle, thus providing non-multiplexed, direct drive to the display. Outputs change only if the serial data bits differ from the previous time.

Figure 3 shows the data input format. A single start bit of logical '1' precedes the 33 bits of segment data for a total of 34 bits that need to be defined and clocked in. After the 34 bits are clocked in, 2 additional clock cycles are required. At the 36th clock cycle an internal LOAD signal is generated synchronously with the rising edge of the Clock In signal, which loads the 33 bits of segment data in the shift register into the latches. At the falling edge of the 36th clock cycle an

internal RESET signal is generated which clears all the shift registers for the next set of data. The shift registers are static master-slave configuration. There is no clear for the master portion of the first shift register, thus allowing continuous operation. The data during the 35th and 36th clock cycles is "don't care", but setting data to logical '0' for these two clock cycles is the preferred format.

The data input bits map directly to the segment output pins and the display. The MM145453 does not have any format restrictions, as all outputs are controllable.

The MM145453 has an internal oscillator which can generate the required clock signal to drive the LCD back plane. The frequency of the internal oscillator is set by a pull-up resistor (R_{OSC_IN}) connected from the OSC_IN pin to V_{DD} , and a capacitor (C_{OSC_IN}) connected from the OSC_IN pin to Ground. Due to the current sink limitations of the OSC_IN circuitry, the lowest recommended resistor value for setting the oscillator frequency is 9kΩ. It will typically take 2 to 4 RC time constants to charge the OSC_IN pin from near 0V to within 1V of V_{DD} which is the high threshold voltage point for the OSC_IN circuitry. An approximate calculation of f_{OSC} is:

$$f_{OSC} = 1 / (\ln(V_{DD}/1V) \times R_{OSC_IN} \times C_{OSC_IN})$$

Applications Information (Continued)

A R_{OSC_IN} resistor value of 50k Ω with a C_{OSC_IN} capacitor value of 0.01 μ F and a V_{DD} value of 5.00V would produce a typical oscillator frequency (f_{OSC}) of about 1200Hz. The f_{OSC} signal is divided by 16 before it is presented at the BP_OUT pin. For this example the approximate BP_OUT frequency will be $f_{OSC}/16$, or about 75Hz.

The BP_IN pin of the MM145453 can be used with an externally supplied signal, provided it has a duty cycle of 50%. Any deviation from a precise 50% duty cycle will result

in an offset voltage on the LCD. The use of an external clock allows synchronizing the display drive with AC power, other internal clocks, or DVM integration time to reduce interference from the display. When using an external clock for the back plane drive the internal oscillator should be disabled by connecting the OSC_IN pin directly to ground. This will prevent possible internal oscillations, and reduce device dissipation.

The MM145453 is a pin out variation of the MM5453. For additional applications information please refer to the MM5453 data sheet.

Input Data Format

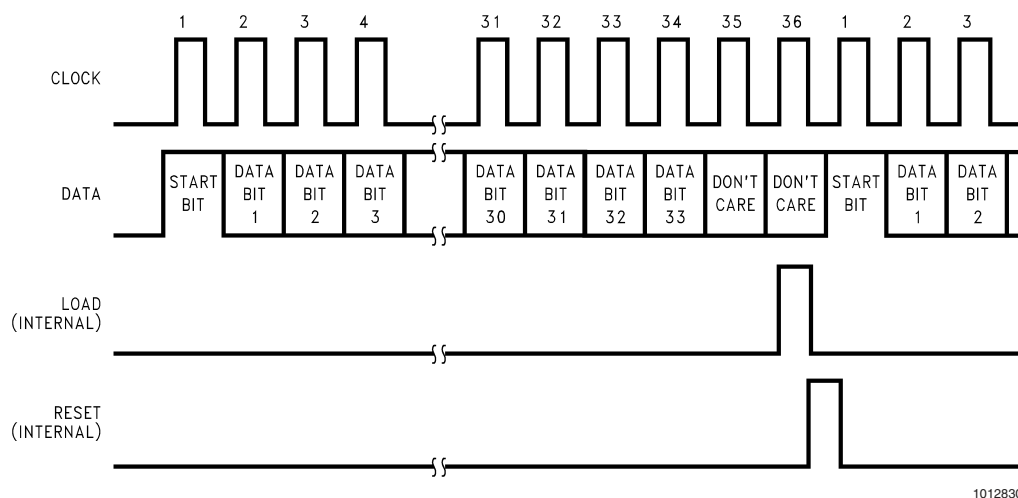
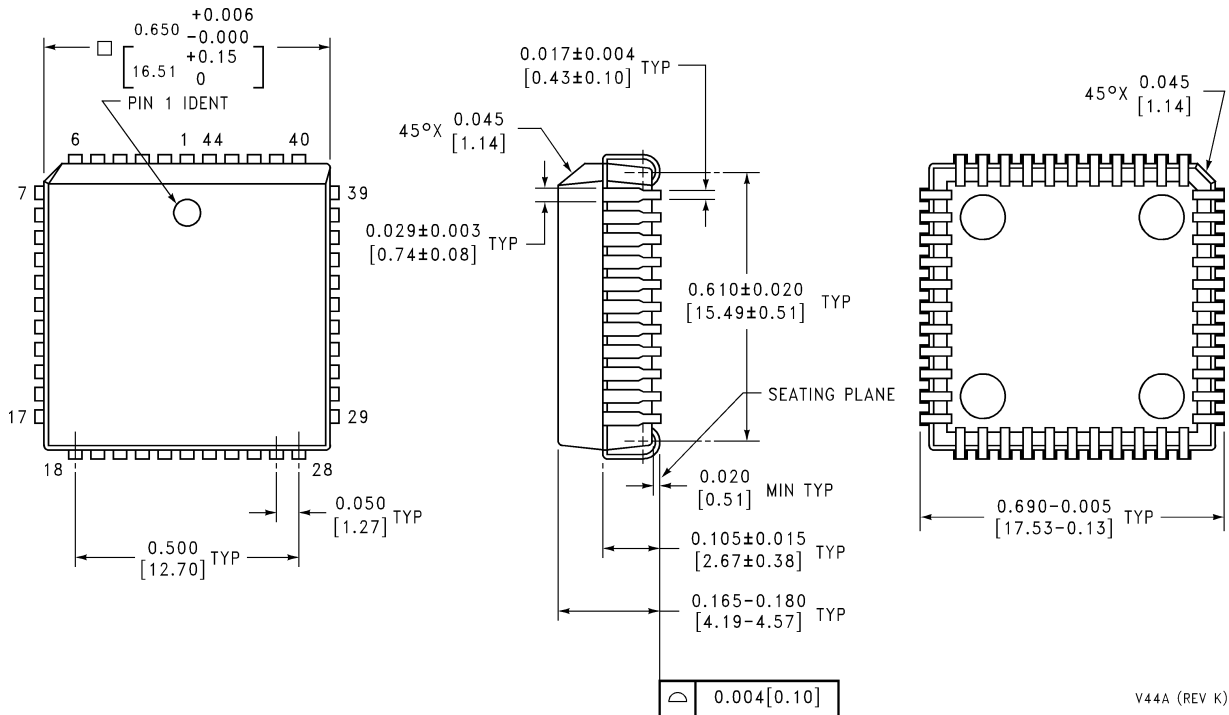


FIGURE 3.

Physical Dimensions inches (millimeters) unless otherwise noted



Top View
Order Number MM145453V
See NS Package Number V44A

V44A (REV K)

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

BANNED SUBSTANCE COMPLIANCE

National Semiconductor certifies that the products and packing materials meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no "Banned Substances" as defined in CSP-9-111S2.



National Semiconductor
Americas Customer Support Center
 Email: new.feedback@nsc.com
 Tel: 1-800-272-9959

National Semiconductor
Europe Customer Support Center
 Fax: +49 (0) 180-530 85 86
 Email: europe.support@nsc.com
 Deutsch Tel: +49 (0) 69 9508 6208
 English Tel: +44 (0) 870 24 0 2171
 Français Tel: +33 (0) 1 41 91 8790

National Semiconductor
Asia Pacific Customer Support Center
 Email: ap.support@nsc.com

National Semiconductor
Japan Customer Support Center
 Fax: 81-3-5639-7507
 Email: jpn.feedback@nsc.com
 Tel: 81-3-5639-7560

www.national.com

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Mobile Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Transportation and Automotive	www.ti.com/automotive
Video and Imaging	www.ti.com/video

TI E2E Community Home Page

e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2011, Texas Instruments Incorporated