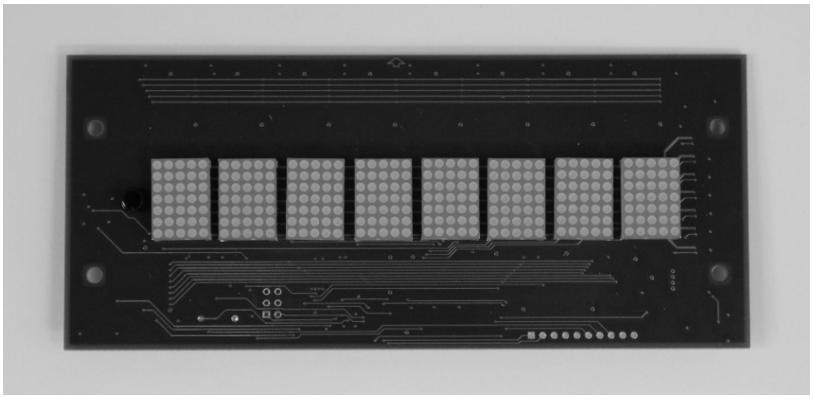
Product Datasheet

PRODUCT HIGHLIGHTS

- No-code configuration via integrated UI
- Standard ASCII character set with 34 custom characters
- +5V TTL/UART serial interface
- Integrated ambient light sensor.
- External PWM brightness control
- Selectable RX end-of-line terminators.
- ≈1×5 in active LED area; includes light-sensor aperture (panel cutout required)
- Optional bezel with windows and mounting hardware
- On-board asynchronous scrolling engine facilitates lower host MCU overhead

DSP004 Intelligent 8-Character LED Dot-Matrix Display



Product Overview

The DSP-004 is an intelligent 8-character, 5×7 LED dot-matrix display module featuring LITEON LTP-747KR 0.7-inch high red characters. It is supplied as a sub-assembly intended for integration into the end-user's finished equipment and mechanical front panel.
Configuration settings may be adjusted through the patented built-in user interface, accessed via a Virtual COM Port using a serial-terminal emulator on the host operating system, or by directly programming the on-board EEPROM. All configuration parameters and custom characters are stored in non-volatile EEPROM and persist across power cycles.
An integrated ambient-light sensor provides adjustable automatic brightness control when enabled.
The display implements Zx Codes™, an ASCII-based command set that provides message-flow control and per-message settings for brightness, scroll mode, and scroll speed, as well as a software-reset function. Scrolling messages of up to 40 characters are supported, and all scrolling-mode behavior is executed by the integrated asynchronous scrolling engine.
The design incorporates reverse-polarity and over-voltage protection. Includes standard EMC practices consisting of internal power and ground planes and 0.1 µF bypass capacitors at all ICs.
For detailed instructions on accessing the configuration menu and for programming guidance using Zx Codes™, refer to the Technical Manual.

Electrical Specifications

⚠ **CAUTION: HARDWARE CONNECTION RESTRICTIONS**

- **DO NOT** power this display from a USB port. The onboard bulk capacitance produces an inrush current spike that can trigger host-port protection or cause the port to lock out. Use a dedicated external 5V supply only.
- **DO NOT** hot-plug or hot-unplug the 10-pin SIP connector.
- **ALWAYS** ensure all wiring and connections are fully secure before applying primary power to the system.

Recommended Supply Voltage*				
Parameter	Vmin	Vnom	Vmax	Unit
Supply Voltage (VDD)	4.75	5.0	5.25	V

Absolute Maximum Ratings*		
Parameter	Rating	Unit
Supply Voltage (VDD)	6.0	V

** Functional operation is not guaranteed outside the Recommended Supply Voltage range. Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device.*

Supply Current Characteristics					
Parameter	Min	Typ	Max	Unit	Notes
Operating Supply Current (IDD)	-	60	500	mA	Maximum 500 mA at Vin = 5.25 V
Maximum worst-case current draw	-	-	900	mA	All LEDs on at 100% PWM (PWM pin at logic high) and VDD = Vmax. This is a maximum attainable condition and is not within the permissible operating range.

***Note: Display content and PWM settings must be chosen such that the total supply current remains within the 500mA limit. Functional operation is guaranteed only within this operating limit.*

Communication & Control Signal Specifications	
Parameter	Description
Message Data and Control Code Protocol	+5 V UART with line-based protocol (ASCII message data plus Zx Codes™ control codes), 8 data bits, 1 stop bit, no parity, no flow control
Character Encoding	ASCII
Baud Rate Options	38400 or 31250
RXIN End-of-Line Terminator	Selectable: <CR>, <LF>, <CR><LF>, <LF><CR>
TXOUT End-of-Line Terminator	Fixed: <CR><LF>
External PWM Input Requirements	+5V TTL/CMOS logic; recommended frequency 7.8 – 30 kHz

Logic Interface Requirements* Digital interface signals are buffered through 5V VHCT-family logic (ON Semiconductor MC74VHCT08) except where noted. Buffered signals follow 5V TTL/CMOS input thresholds and drive 5V CMOS outputs. All logic operates in the 5V domain.	
Parameter	Value
UART Logic Levels (RXIN, TXOUT)	Logic interfaces use MC74VHCT08A gates with TTL-compatible inputs and 5 V CMOS-level outputs, suitable for both TTL and CMOS systems. Both RXIN and TXOUT include 10 kΩ pull-ups to +5 VDD. Host RX input must be 5 V-tolerant.
I²C Clock (SCL)	Buffered through MC74VHCT08. Includes 4.7 kΩ pull-up to +5 VDD. External devices must tolerate 5 V logic.
I²C Data (SDA)	Direct connection to Microchip 24AA024-I/SN SDA pin. Includes 4.7 kΩ pull-up to +5 VDD. External devices must tolerate 5 V logic.
PWM Input	Buffered through MC74VHCT08; accepts 5 V TTL/CMOS. Includes 10 kΩ pull-up to +5 VDD.
Reset Input	Direct connection to ATmega328-AU RESET pin through a 1 kΩ series resistor. The MCU side of the resistor includes a 10 kΩ pull-up to +5 VDD. Active-low, +5V TTL/CMOS logic levels.
3.3 V CMOS Compatibility	The board is not designed to accept 3.3V logic

**For detailed electrical characteristics (VIH, VIL, VOH, VOL, leakage, and timing), refer to the MC74VHCT08, ATmega328-AU, and 24AA024-I/SN manufacturer datasheets.*

EEPROM Device Information	
Parameter	Value
Manufacturer	Microchip Technology
Part Number	24AA024-I/SN
Memory Density	2 Kbit (256x8)
Interface Protocol	I²C
SDA/SCL Logic Levels	+5V (on-board pullups to VDD)
I²C Address	0x57

Zx Codes™ - Rx IN (Must be sent with EOL Terminators)			
Decimal	ASCII Mnemonic	Opcode Name	Description
12	FF	CLS	Clear Screen
18	DC2	SCROLL_SPD	Scroll Speed Control Prefix
24	CAN	RESET	Software Reset
28	FS	SCROLL_ON	Enable Scrolling Mode
29	GS	SCROLL_OFF	Disable Scrolling Mode
30	RS	EXTPWM_ON	Enable External PWM
31	US	EXTPWM_OFF	Disable External PWM

Zx Codes™ - Tx OUT (Sent to host without EOL Terminators)			
Decimal	ASCII Mnemonic	Opcode Name	Description
5	ENQ	DATA_GO	Message data send GO flag
6	ACK	DATA_STOP	Message data send STOP flag
20	DC4	SCROLL_DONE	Message scrolling done flag

Power Conditioning Circuit The module incorporates several input-side protection features intended to reduce the risk of damage under common electrical stress conditions.	
Reverse Voltage Protection	Incorporates circuitry designed to mitigate damage to the module in the event of accidental supply polarity reversal.
Over-Voltage Shutdown	Designed to disconnect the input supply if the applied voltage exceeds the recommended operating range.

Environmental Requirements

This sub-assembly is not rated for specific environmental performance, temperature, or humidity ranges. It is designed exclusively for integration into host products operating within standard, climate-controlled indoor office or laboratory environments. Not rated for outdoor use, high-humidity zones, or environments subject to localized heat buildup. All final environmental, thermal, and regulatory compliance obligations remain the sole responsibility of the host product manufacturer.

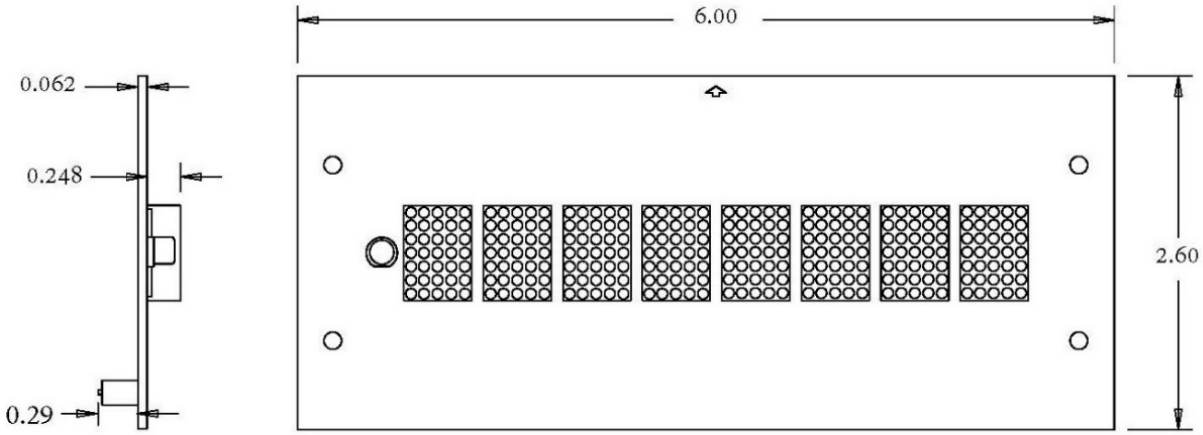
Integration Guidelines

Hardware feature descriptions—such as the over-voltage shutdown circuit, and reverse-polarity protection—refer strictly to the physical circuit design and component-level architecture. These descriptions do not constitute system-level EMC, thermal, environmental, or safety performance claims. Compliance with all final system-level regulatory requirements, including EMC, thermal, environmental, and safety standards, is the sole responsibility of the host-product manufacturer.

Mechanical Specifications

Device weight: 2.1 oz

All dimensions are in inches, ±10 mils.



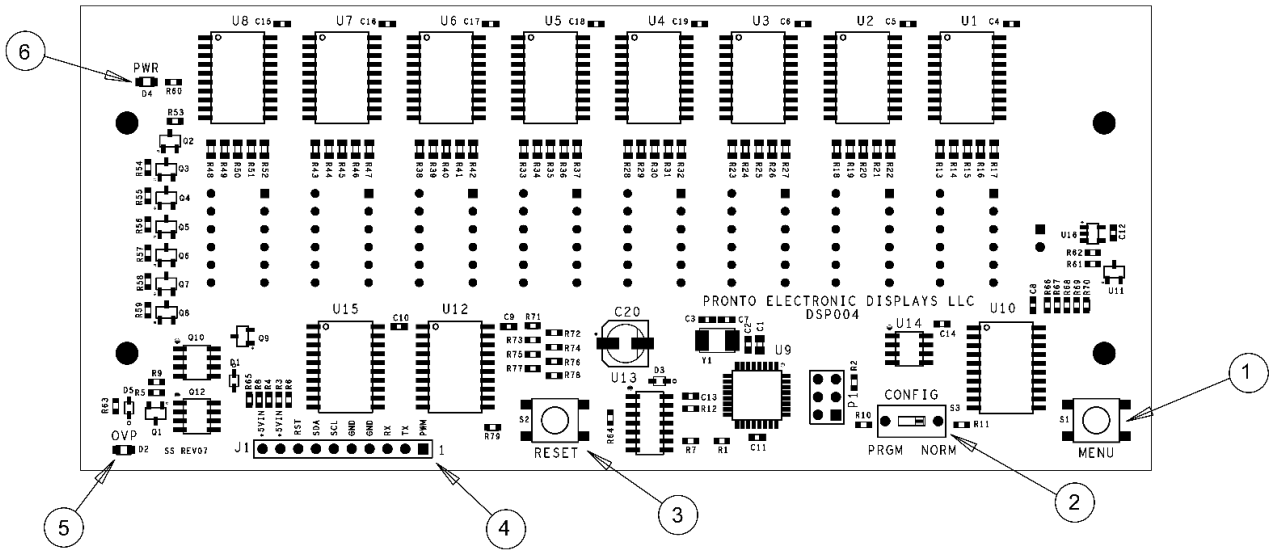
FRONT VIEW

For mounting hole dimensions and recommended panel cutout, refer to the Technical Manual.

Display Module Alignment Tolerance
Cumulative manufacturing tolerances may result in slight rotational or vertical misalignment between adjacent LTP-747KR dot-matrix modules when examined closely. Such variation is normal and is not apparent during operation at typical viewing distances. Each unit is individually screened to ensure any misalignment is within acceptable limits.

Back-Side Controls, Indicators and I/O

BACK VIEW



1- “MENU” Button
Displays the configuration UI on a serial-terminal emulator. This button is active only when the CONFIG switch is in the NORM position.

2- CONFIG switch
NORM: Unit operates using the default configuration. MENU button is enabled.
PRGM: Unit operates using user-defined configuration settings.

3- “RESET” Button
Resets the unit and clears the display’s serial input buffer.

4- J1 I/O Connector
The DSP004 provides an unpopulated 10-pin SIP plated-through-hole footprint on 0.100-inch lead pitch. The pattern accepts 0.025-inch square-post headers (straight, right-angle, or friction-lock). Finished hole diameter: 0.040 inches ±3 mils.

5- “OVP” LED
Red LED illuminates when an over-voltage condition is applied to the +5V input, causing the over-voltage protection circuit to disconnect power. The green PWR LED will be off in this condition.

6- “PWR” LED
Green LED illuminates when board power is present.

J1 I/O Connector Pin Functions

Pin 1- PWM Input

Used for external real-time brightness modulation. The unit must be placed in External PWM Mode before applying a signal. Recommended PWM frequency is 7.8 - 30 kHz. Pin is internally pulled up to +5V through a 10 kΩ resistor. Accepts +5V TTL/CMOS logic levels.

Pin 2- TXOUT

+5V UART transmit output providing control codes and the communication output channel for the built-in UI. Internally pulled up to +5V through a 10 kΩ resistor. Output is +5V TTL/CMOS logic level.

Pin 3- RXIN

+5V TTL/UART input used for writing character data to be displayed by the unit, sending control codes, and providing the input communication channel for the UI. Pin is internally pulled up to +5V by an on-board 10 kΩ resistor. Accepts +5V TTL/CMOS logic levels.

Pins 4,5- GND

Power and Signal ground. These pins are tied together on the PCB.

Pin 6- SCL

+5V I²C SCL input (100 kHz) used when directly programming the on-board EEPROM. Internally pulled up to +5V through a 4.7 kΩ resistor.

Pin 7- SDA

+5V I²C SDA input (100 kHz) used when directly programming the on-board EEPROM. Internally pulled up to +5V through a 4.7 kΩ resistor.

Pin 8- Remote Reset

Active-low remote reset input. May be driven by a pushbutton (Pin 8 to GND) or by an MCU pin. Minimum low time for reset is >= 0.5 µs. The MCU pin should remain normally high or high-impedance except when asserting reset. Internally pulled up to +5V through a 10 kΩ resistor.

Pins 9,10- +5V VDD

+5V power input for the unit. These pins are tied together on the PCB. The power supply used must be capable of providing 1.0 A.

Ordering Information	
DSP004-BZ	Display Unit with Bezel/Lens and Mounting Hardware Kit
DSP004-N	Display Unit Only

Patent Information:

This device incorporates patented technology and is covered by U.S. Patent No. 12,499,796.

Additional Documents:

Technical Manual, Document # 1031-DSP004-TM
Bezel/Windows & Mounting Hardware Kit – Mechanical Reference Guide, Document# 1033-DSP004-BZ

Datasheet Document Revision		
Rev. No.	Date	Engr.
03	9/23/2026	M.H