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CANBUS LCD/Keypad Interface Board Specification

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1 Introduction

This document describes the high-level design and specifications for a PCBA which implements an LCD display driver, membrane keypad interface, and CANBUS control and status interface. A microprocessor and onboard FLASH memory support graphics storage and user interface software.

2 Revision History

Revision	Date	Revision Description
A	4/21/2020	Initial Release.

3 Background

3.1 References

[1] Datasheet for New Haven NHD-3.5-320240MF-ATXL#-1
[2] Datasheet for Elpa EL35-A0TMN-320240-021
[3] Datasheet for PIC24FJ256DA206

3.2 Attachments

None.

3.1 Applicable Standards

IEC/EN 60335-1:2010+A1:2013+A2:2016, *Safety of household electrical appliances*

IEC/EN 60335-2-68:2012+A1:2016, *Safety – Particular requirements for spray extraction machines, for commercial use*

IEC/EN 60335-2-72:2012, *Safety – Particular requirements for floor treatment machines with or without traction drive, for commercial use*

CISPR 14-1:2005+A1:2008+A2:2011, *Electromagnetic compatibility, Requirements for household appliances, electric tools and similar apparatus-Part 1: Emission*

EN55014-1:2006+A1:2009+A2:2011, Class A, *European limits and methods of measurement of radio disturbance characteristics of household appliances and power tools--Emission*

CISPR14-2:1997+A1:2001+A2:2008, *Electromagnetic compatibility, Requirements for household appliances, electric tools and similar apparatus-Part 2: Immunity*

EN55014-2:1997+A1:2001+A2:2008, *European limits and methods of measurement of radio disturbance characteristics of household appliances and power tools—Immunity*

IEC 61000-3-2:2014, *Electromagnetic compatibility, Limits for harmonic current emissions*

IEC 61000-3-3:2013, *Electromagnetic compatibility, Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems*

EN 62233:2008, *Measurement methods for electromagnetic fields of household appliance and similar apparatus with regard to human exposure*

AS/NZS CISPR22:2009+A1:2010, Class A, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

ESD protection to survive 30KV air discharge/16KV contact discharge per ESD guideline 21.03.2017 Rev 1.3 on all connector pins.

3.2 Acronyms and Abbreviations

HMI	Human Machine Interface
I^2C	Inter-Integrated Circuit
IC	Integrated Circuit
ICSP	In-Circuit Serial Programming
ICT	In-Circuit Test
KB	kilobyte (1KB = 1024 bytes)
MB	megabyte (1MB = 1024 x 1024 = 1,048,576 bytes)
LCD	Liquid Crystal Display
NFC	Near Field Communication
PCB	Printed Circuit Board
UART	Universal Asynchronous Receiver Transmitter
SPI	Serial Peripheral Interface

4 Functional Overview

The diagram below shows the major functions of the board. Items with Yellow border indicate parts that are optionally populated to create a version of the board that supports a TFT LCD display.

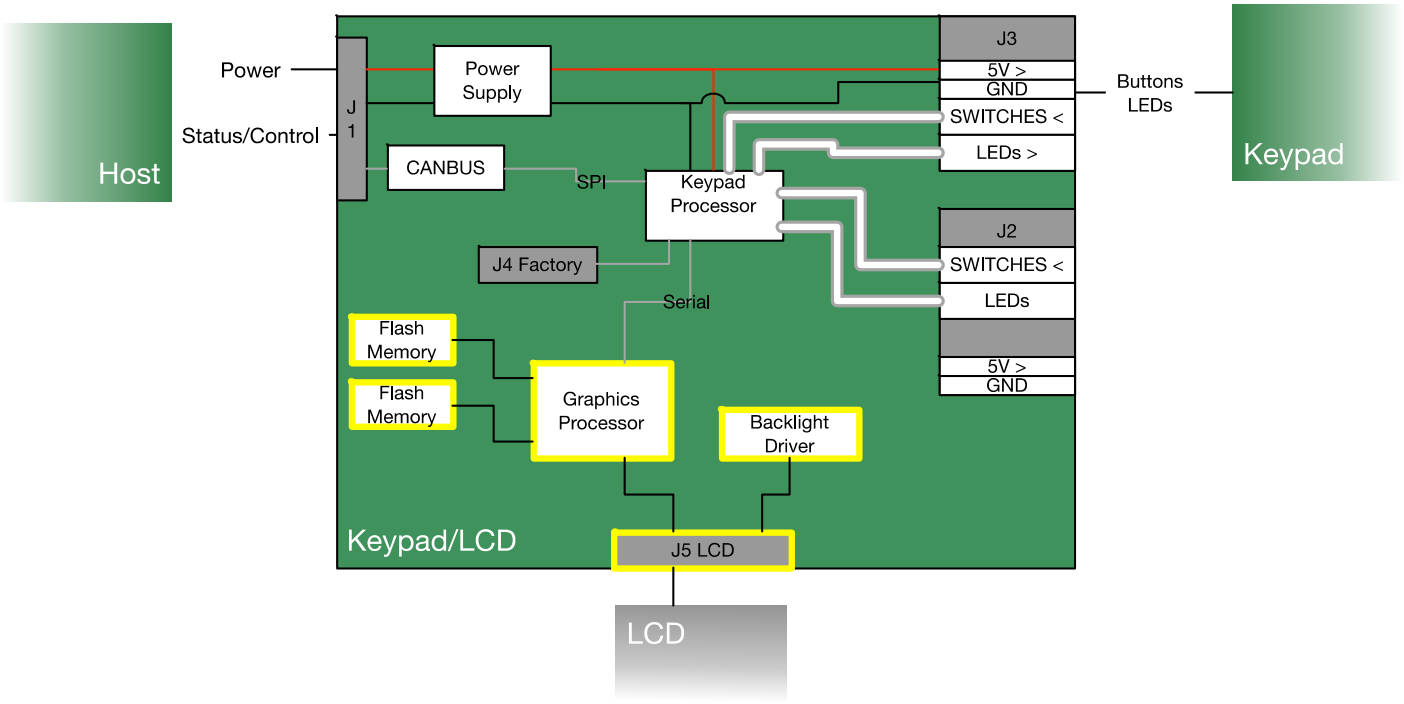

Figure 1: Functional Block Diagram

4.1 Graphics Processor

The Graphics Processor (PIC24FJ256DA206 or similar) will manage the display graphics, text and backlight. Display content decisions will be based on communication from the Host and/or Keypad Processor bus with a host controller. Firmware and graphics memory updates are also possible over that interface via the bootloader function of the software.

4.2 FLASH Memory

Up to two FLASH memory devices may be installed, to contain LCD graphics data. The FLASH memory communicates with the Graphics Processor via a SPI interface.

4.3 Backlight Driver

The backlight driver includes an IC which, under the control of the Graphics Processor, generates the necessary signals to support the LCD backlight.

4.4 Power Supply

The power supply will generate the required internal and external supply voltages from the input voltage. The power supply input will be protected from reverse polarity input voltage.

The low power state for the board is entered by de-asserting the ENABLE pin on J1 pin 4. When ENABLE is de-asserted,

- The Switch processor is powered, and is available to scan the membrane
- The LCD, LCD backlight are off

- CANBUS is disabled
- The switch processor has access to the ENABLE pin and can make power-saving decisions.

4.5 CANBUS Transceiver

The CANBUS transceiver will be an IC with the necessary support circuitry to implement CAN 2.0b communication.

4.6 Keypad Processor

The Keypad Processor manages the switch inputs and LED outputs.

The J3 (Membrane) connector supports up to 20 switches using an arrangement such as 4 rows and 5 columns. The processor scans the keypad by sequentially applying voltage to a row and testing the 5 columns to see which switches have been pressed (connected to the row source).

Likewise, LEDs may be matrixed under the control of software as well. The board can source up to 50mA per row (lighting up to (5) 10mA LEDs per row. By sourcing a row, and sinking the desired columns, the software causes the desired LED(s) to light. Note that the lights actually 'blink' rather than stay on continuously – but they blink at such a fast rate that the human eye sees only a steady light.

Due to its limited functionality, the Keypad processor software is NOT field upgradeable.

The Keypad Processor is responsible for determining when switch activations occur and reporting that information to the Host via CANBUS and optionally to the Graphics Processor. The Keypad Processor accepts LED state commands from the Host and drives the LED outputs to the correct state. When used with a Graphics Processor, the Keypad Processor additionally passes messages in both directions so that the Graphics Processor may communicate with the Host.

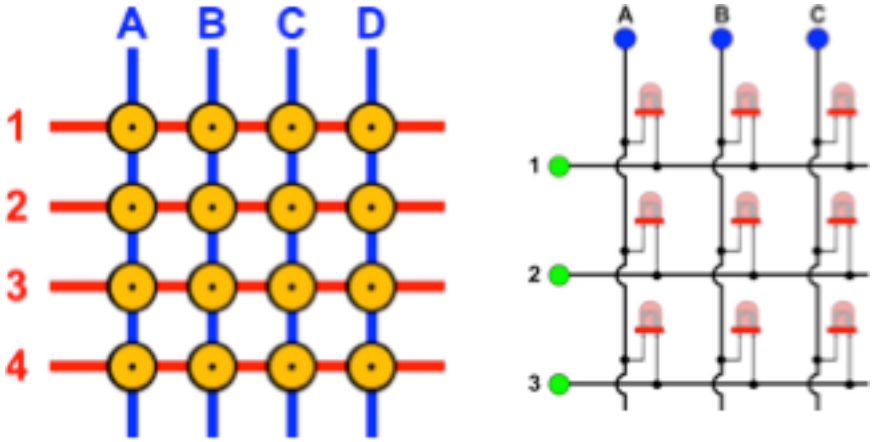

Figure 2: Switch and LED Matrixing Concept

4.7 LCD Module

The LCD module is a transmissive type color active matrix liquid crystal display, which uses amorphous thin film transistors as a switching devices. It shall have a 320 x 240 RGB 3.5" graphics display, 6:00 viewing angle, 16.7M display colors, anti-glare polarized surface.

4.8 On-board horn

The optionally populated horn is a 12V device under the control of the PIC16 micro

5 Interfaces

5.1 Host Interface (J1)

The host interface connects to the Vehicle Control Module J2

Connection Style: Board/wire-to-board Connector

Connector Manufacturer & Series: JST B10B-PH-SM4-TB(LF)(SN)

Pin	Signal Name	Type	Direction	Range	Bandwidth	Other Requirements
8	VBATT	Power	Input	17Vdc(min) - 60Vdc(max)	N/A	Input depends on board
3	P5V	Power	Input			435mA max
1	CANH	Digital	Bi-directional	0-5V_{DC}	500Kbps	Differential signal with CANL. ESD Protected
2	CANL	Digital	Bi-directional	0-5V_{DC}	500Kbps	Differential signal with CANH. ESD Protected
4	ENABLE	Digital	Input	0-60V	N/A	Active high. ESD Protected, Tolerant to VBATT
5	FAULT	Digital	I/O	0-5V		Active low. ESD Protected
6	Key Sw / Out3	Digital	Output	0-60V		ESD Protected, Tolerant to VBATT
7	GND	Ground	N/A	N/A	N/A	

5.2 Switch/LED Connector (J2)

Connection Style: Board/wire-to-board Connector

Connector Manufacturer & Series: JST B10B-PH-SM4-TB(LF)(SN)

Pin	Signal Name	Type	Direction	Range	Bandwidth	Other Requirements
1	GND	Ground	N/A	N/A	N/A	
2	No Connection					
3	No Connection					
4	Out3 / Key Sw	Digital	Output	0-10 mA (sink)	N/A	Tolerant to VBATT
5	Out2	Digital	Output	0-10 mA (sink)	N/A	Tolerant to VBATT
6	Out1	Digital	Output	0-10 mA (sink)	N/A	Tolerant to VBATT
7	SW23	Digital	Input	0-5VDC	N/A	
8	SW22	Digital	Input	0-5VDC	N/A	
9	SW21	Digital	Input	0-5VDC	N/A	
10	P5V	Power	Power	5VDC	N/A	

5.3 Membrane Connector (J3)

The membrane connector interfaces to the keypad. It detects keypresses and drives LED indicators. Under software control, these inputs and outputs can be matrixed to control up to 16 LEDs and read 16 switches (using a matrix scanning algorithm).

Connection Style: ZIF

Connector Manufacturer & Series: Molex 522072233

Pin	Signal Name	Type	Direction	Range	Bandwidth	Other Requirements
10	P5V	Power	Power	5VDC	N/A	
21	GND	Ground	N/A	N/A	N/A	
22	GND	Ground	N/A	N/A	N/A	
1	SWR1	Digital	Output	0-5VDC	N/A	
2	SWR2	Digital	Output	0-5VDC	N/A	
3	SWR3	Digital	Output	0-5VDC	N/A	
4	SWR4	Digital	Output	0-5VDC	N/A	
5	SWR5	Digital	Output	0-5VDC	N/A	
6	SWC1	Digital	Input	0-5VDC	N/A	
7	SWC2	Digital	Input	0-5VDC	N/A	
8	SWC3	Digital	Input	0-5VDC	N/A	
9	SWC4	Digital	Input	0-5VDC	N/A	
11	LEDR1	Digital	Output	0-50mA (source)	N/A	Row source
12	LEDR2	Digital	Output	0-50mA (source)	N/A	Row source
13	LEDR3	Digital	Output	0-50mA (source)	N/A	Row source
14	LEDR4	Digital	Output	0-50mA (source)	N/A	Row source
15	LEDR5	Digital	Output	0-50mA (source)	N/A	Row source
16	LEDC1	Digital	Output	0-50mA (sink)	N/A	Column sink
17	LEDC2	Digital	Output	0-50mA (sink)	N/A	Column sink
18	LEDC3	Digital	Output	0-50mA (sink)	N/A	Column sink
19	LEDC4	Digital	Output	0-50mA (sink)	N/A	Column sink
20	LEDC5	Digital	Output	0-50mA (sink)	N/A	Column sink

5.4 Factory Programming Connector (J4)

Connection Style: Footprint

Connector Manufacturer & Series: Compatible with TAG Connect

Pin	Signal Name	Type	Direction	Range	Bandwidth	Other Requirements
5	PGC	Digital	Bi-directional	0-5V_{DC}	N/A	See Microchip recommendations for ICSP connection.
4	PGD	Digital	Bi-directional	0-5V_{DC}	N/A	See Microchip recommendations for ICSP connection.
1	MCLR	Digital	Input	0-5V_{DC}	N/A	See Microchip recommendations for ICSP connection.
2	P5V	Power	Input	5V_{DC}	N/A	N/A
3	GND	Ground	N/A	0V_{DC}	N/A	N/A

5.5 LCD Connector (J5)

Connection Style: ZIF

Connector Manufacturer & Series: Molex 51296-5494

5.6 Chassis Ground (J6)

Pin	Signal Name	Type	Direction	Range	Bandwidth	Other Requirements
1	CHGND	Earth Ground	N/A	0V	N/A	
2	CHGND	Earth Ground	N/A	0V	N/A	
3	CHGND	Earth Ground	N/A	0V	N/A	

Connection Style: Board/wire-to-board Connector

Connector Manufacturer & Series: Zierick 1278

5.7 Factory Programming Connector (J7)

Connection Style: Footprint

Connector Manufacturer & Series: Compatible with TAG Connect

Pin	Signal Name	Type	Direction	Range	Bandwidth	Other Requirements
5	PGC	Digital	Bi-directional	0-3.3V_{DC}	N/A	See Microchip recommendations for ICSP connection.
4	PGD	Digital	Bi-directional	0-3.3V_{DC}	N/A	See Microchip recommendations for ICSP connection.
1	MCLR	Digital	Input	0-3.3V_{DC}	N/A	See Microchip recommendations for ICSP connection.
2	P3V3	Power	Input	3.3V_{DC}	N/A	N/A
3	GND	Ground	N/A	0V_{DC}	N/A	N/A

6 Environmental Specifications

Parameter	Minimum	Nominal	Maximum	Notes
Operating Temperature	-40℃	--	85℃	Refers to temperature rating of components, not expected ambient operating temperatures.
Operating Humidity	--	--	95% non-condensing	
Pollution Degree	--	III	--	
ESD, where specified			15KV air, 8KV contact	IEC 61000-4-2 Level 4 and higher
ROHS Compliant		Yes		

7 Mechanical Specifications

Parameter	Minimum	Nominal	Maximum	Notes
Length		5.2”	5.5”	
Width		3.44”	3.5”	
Height			0.75”	

8 Processor/Storage Specifications

Parameter	Minimum	Nominal	Maximum	Notes
Family		PIC24FJ256DA206		
Program Flash		256 KB		
SRAM		96 KB		
External Flash	64 Mbytes			

9 Manufacturing/Test Strategy

9.1 Production Test

Each board will be functionally tested and programmed with software during manufacturing.

The PCBA will be designed with bottom-side access to as many circuit nets as practical, to support in-circuit testing should that test approach be desired in the future.