LCD64x32 Engineering Kits User Manual

Revision C

Firmware Version 1.X

NKK SWITCHES

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Page 1 of 18

1120

Table of Contents

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Page 2 of 18

1120

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1. General Features

The Engineering Kits (IS-ENG-KIT-x) are designed to accelerate the incorporation of the SmartSwitch family of products into real world applications by, not only familiarizing design engineers to the SmartSwitch products, but also as a development platform for experimentation and design viability testing.

The controller used for LCD64x32 SmartSwitches is S02G1. The schematic is at the end of this document. The C language source codes and a Windows based communication software, Engineering Kits Communicator, can be downloaded from www.nkkswitches.com. The software is designed to download images, attributes, and manual commands as well as display responses from the kit.

Features of S02G1:

- Controls up to two LCD64x32 SmartSwitches.
- 1M on-board NOR flash memory to store images, attributes or any other information.
- Serial communication via USB (115.2K, 1 start bit, 8 bit, 1 stop bit).
- Auxiliary port with 7 I/O pins of microcontroller to control/sense other applications.
- Stand-alone or real-time operation.
- Preprogrammed for basic operation.
- Reports via USB the switch closures and releases, timer expirations, and addresses of the images displayed.
- Programmable for changing the displayed images based on switch actuations and user defined timers.
- Schematics and firmware are provided for user firmware customization.
- User can program the Engineering Kits using a PICKIT3 debugger and pin adaptor.
- The kits come with a 6-foot USB 2.0 A to Mini-B cable (IS-USB1).
- Power Specs: 3.3V to 5.5V.
- Maximum current: 150mA@5VDC.
- Can be powered either by USB or by optional 5V power connection (.100" spacing).
- Window based software is provided for communication.
    - Accepts bitmap files, extracts the images and download them to the controller.
    - Allows typing of commands and downloading to the controller.
    - Extracts HEX or ASCII data from Excel files and downloads to the controller.
    - Messages to and from the controller are displayed in different colors.

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Page 3 of 18

1120

2. Available LCD64x32 SmartSwitches

There are 4 products in LCD64x32 family, SmartDisplay, Compact size SmartSwitch and two standard size SmartSwitches. The two standard switches are further divided by differences in switch travel and pinout footprint. Please note that the IS15ESBFP4RGB compact and IS15EBFP4RGB-09YN hybrid have the same pinout footprint. All products have RGB backlighting with 64 possible colors.

Part Number	Description	Socket
IS01EBFRGB	Display	3x2; 2mmx2mm
IS15ESBFP4RGB	Compact size switch	AT970465F *
IS15EBFP4RGB	Standard size long travel	AT9704-085K
IS15EBFP4RGB-09YN	Standard size	AT970465F *

- PINS 3, 4, 11, 12, 13, AND 14 MUST BE REMOVED FROM SOCKET.
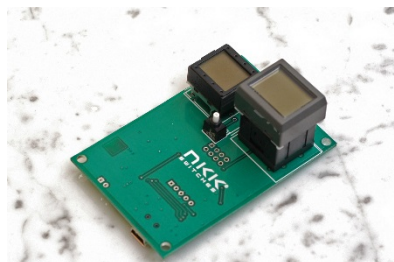
3. Possible Engineering Kits Using the S02G1 Controller

Many Engineering Kits can be made with the S02G1 controller simply by soldering on various sockets (Table below). The LCD64x32 compact and the LCD64x32 hybrid have the same pinout footprint. Only the part numbers in green are marketed and kept in stock. However, all of them can be ordered.
All the Engineering Kits come with switches/display on the sockets and a USB cable. Controlling all the LCD64x32 kits is the same.

Part Number	Switch 1 / Display 1		Switch 2	
IS-ENG-KIT-6-DH	IS01EBFRGB	LCD 64x32 Display	IS15EBFP4RGB-09YN	LCD 64x32 Hybrid
IS-ENG-KIT-6-SH	IS15EBFP4RGB	LCD 64x32 Standard	IS15EBFP4RGB-09YN	LCD 64x32 Hybrid
IS-ENG-KIT-6-CH	IS15ESBFP4RGB	LCD 64x32 Compact	IS15EBFP4RGB-09YN	LCD 64x32 Hybrid
IS-ENG-KIT-6-CC	IS15ESBFP4RGB	LCD 64x32 Compact	IS15ESBFP4RGB	LCD 64x32 Compact
IS-ENG-KIT-6-HH	IS15EBFP4RGB-09YN	LCD 64x32 Hybrid	IS15EBFP4RGB-09YN	LCD 64x32 Hybrid
IS-ENG-KIT-6-SS	IS15EBFP4RGB	LCD 64x32 Standard	IS15EBFP4RGB	LCD 64x32 Standard
IS-ENG-KIT-6-DC	IS01EBFRGB	LCD 64x32 Display	IS15ESBFP4RGB	LCD 64x32 Compact
IS-ENG-KIT-6-DS	IS01EBFRGB	LCD 64x32 Display	IS15EBFP4RGB	LCD 64x32 Standard

IS-ENG-KIT-6-DH

IS-ENG-KIT-6-SH

IS-ENG-KIT-6-CH

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Page 4 of 18
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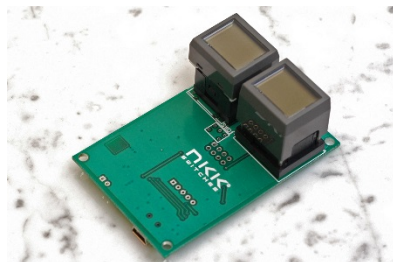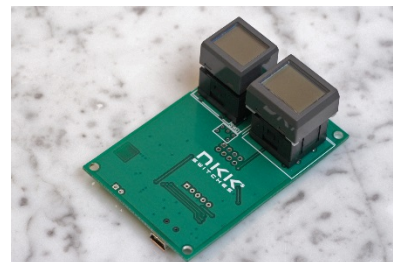
4. Firmware Overview

The firmware is written such that it is easy to modify or add features. Only basic features are implemented in the factory default to keep the firmware easy to follow. As such it is not optimized.

There is no difference in controlling the various LCD64x32 switches/display. The LCD64x32 switch handles refreshing the LCD and controlling the LED backlight colors internally. There are no requirements for initialization or refreshing for the LCD64x32. The LCD64x32 powers up with the LCD OFF, the backlight OFF and at the lowest brightness level. There are no limitations as to when the LCD image, backlight color, or brightness level can be changed. Any changes made to the LCD image, backlight color, or brightness level stay in effect until reboot or power down.

The firmware communicates to a host computer via RS232 through USB. Any data sent from the host are received via interrupt and placed in a receive buffer. The data get processed in the main program. Any transmit datum is put in a transmit buffer. Each timer interrupt transmits a byte from the transmit buffer if it is not empty. The firmware also handles read and write operations from and to the external flash memory, as well as controls the two LCD switches. The communication protocol is outlined in following sections.

The 1M flash memory is a NOR flash and as such, when writing to the memory, it can only turn an ON cell to the OFF state. The erase command turns all the cells to the ON state. If images or other data on the flash memory needs to be changed then it is required that the erase command be sent first. The flash memory has partial erase commands available, however, as of the release date only the complete erase is implemented in the firmware.

The 7 I/O pins in the auxiliary port are initialized as inputs with weak pull-ups. These pins can be used to sense or control in user-defined custom applications.

The flash memory is set up to save up to 2047 images and attributes. Two bytes are needed to address an image or attributes.

Address	LCD64x32	
0001	Image	Attribute Block
0002	Image	Attribute Block
---	Image	Attribute Block
---	Image	Attribute Block
07FE	Image	Attribute Block
07FF	Image	Attribute Block

Each image is 256 bytes and each attribute block is 16 bytes.

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Page 5 of 18

1120

Attribute Block										
Name	Current Address	End address for the loop	Timer1 for the loop	Timer2 for the loop	Next address for SW1 upon sw press	Next address for SW2 upon sw press	Jump address for SW1 at the end of the loop	Jump address for SW2 at the end of the loop	LED color code for ON-cycle	LED color code for OFF-cycle
Range	0000 to 07FF	0000 to 07FF	00 to FF	00 to FF	0000 to 07FF	0000 to 07FF	0000 to 07FF	0000 to 07FF	LED code	LED code
# of bytes	2	2	1	1	2	2	2	2	1	1

Each switch has an associated active Attribute Block in the RAM. Additionally each switch is associated to an active display address and active backlight codes. If the system detects that an image needs changing, the image from the flash memory address of the active address is transferred to the switch. If the system detects that the backlight timer has expired, the LED backlights change according to the ON/OFF cycle of the currently displayed backlight address.

An address is assigned to a switch via switch press, timer expiration, or upon power-up. Before an address is assigned to a switch, the controller checks the Attribute Block in the flash at the assigned address. If the first two bytes are equal to the assigned address, the Attribute Block from flash is loaded to the active Attribute Block. After loading, the active LED code and active display are loaded based on the attributes. If Timer1 does not equal zero, the loop timer starts running. If the first two bytes of the attribute block are not equal to the assigned address, no action is taken.

If Timer1 does not equal zero, a loop timer is started. The loop timer is calculated by multiplying Timer1 and Timer2. When the loop timer expires the displayed address is compared to the End Address. If they are equal, and the jump addresses for SW1/SW2 do not equal zero, then the jump addresses become the new active addresses for switch1 and switch2. Then the attributes and images are loaded accordingly. If the jump addresses of SW1/SW2 are equal to zero, there is no change to the active addresses and the loop restarts for the associated switch. If the displayed address and the End Address are not equal, then the displayed address + 1 is loaded as the displayed address and the image is sent to the switch. The loop timer then restarts. When a new displayed address is loaded, the backlight LED codes for that address are sent to the switch.

When a switch is pressed, if the press addresses for SW1/SW2 of the active Attribute Block are not equal to zero they become the active addresses for switch1 and switch2, and are sent to the switches. If the press addresses of SW1/SW2 are equal to zero, there will not be any update or change to the active addresses.

The backlight code has 2 bits for each color according to the switch specification.

RGB switches/displays	RED		GREEN		BLUE		Must be 1	
Bit in the byte	B7	B6	B5	B4	B3	B2	B1	B0

The controller alternates between the ON and OFF codes every second.

5. Operational Overview

Power-up Sequence:
Upon power-up the controller execute the following 8 steps and then enter main program.
1. Initializes the active attributes blocks for both switches to zero.
2. Put the 0001H for active address of switch#1, put the 0002H for active address of switch#2, and initialize all the active backlight code to white.
3. Check the setup values from flash and if valid change the active address for switch#2 and the contrast value.
4. Check the Attribute Blocks from the flash memory and if valid, load them to the active Attribute Blocks in the RAM.
5. Set the timer interrupt for every 0.5ms.
6. Set up the UART (RS232) communication.
7. Transmit 11H to host.

Main program:
The main program continuously goes through the following steps:
1. Check and execute commands if there is data in the RS232 receive buffer.
2. If the time for switch scan is expired: Scan the switches for being pressed.
3. If switch #1 timer has expired: The timer is stopped, then report 83H and process according to the active attribute of switch#1.
4. If switch #2 timer has expired: The timer is stopped, then report 84H and process according to the active attribute of switch#2.
5. If switch#1 is pressed: Report 81H and process according to the active attribute of the switch#1.
6. If switch#2 is pressed: Report 82H and process according to the active attribute of the switch#2.
7. If switch#1 is released: Report C1H.
8. If switch#2 is released: Report C2H.
9. If switch#1 image changes: Report FFH followed by the switch#1 active address and update the memory for switch#1 with the active address image from the flash for switch#1. Start timer for switch#1 if Timer1 is non-zero.
10. If switch#2 image changes: Report FEH followed by the switch#2 active address and update the memory for switch#2 with the active address image from the flash for switch#2. Start timer for switch#2 if Timer1 is non-zero.
11. If the backlight timer has expired: The switch#1 backlight is updated with the active backlight code for switch#1 and according to the ON/OFF cycle and the switch#2 backlight is updated with the active backlight code for switch#2 and according to the ON/OFF cycle.
12. Go to step1.

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Timer-Interrupt

Timer-interrupt is set for every 0.5ms. It does the following functions:

1. Increment the master half millisecond timer that the main program uses for all timers. All timers use this for a starting time and to check if the stop time has passed.
2. If the RS232 transmit buffer is not empty, transmit a byte.
3. Exit the interrupt.

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6. Communication Protocol

The controller communicates with the host via USB serial communication (115.2K, 1 start bit, 8 bit, 1 stop bit).

Communication Initiated by the Controller
The controller transmits the switch activities, timer expirations, and the addresses of images when they are displayed. The protocol for the code transmitted are explained in the Main Program in the Operational Overview.

Communication Initiated by the Host
The controller receives the data via a serial interrupt routine that places the data in the circular receive buffer. When the controller detects data in the circular receive buffer in the main program, the controller reads one byte and executes according to the following scenario.

A. If the byte is 01H the controller responds by putting 61Hin the transmit buffer and exits.
B. If the byte is a 20H to 2FH the controller responds by putting 61H in the transmit buffer. The controller checks the command procedure and processes it accordingly. If the command procedure exists and all the data is proper, the controller puts 79H in the transmit buffer and exits. If the command procedure does not exist, the data is not acceptable, or consecutive bytes are not received within 100ms then the controller puts 6EH in the transmit buffer and exits.
C. If the byte is not 01H, or 20H to 2FH, it is ignored.

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![NKK SWITCHES logo]

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7. Commands to the Controller

Command to reboot the controller
> This command reboots the controller to power-up state and upon completion reports 11H:

> Command format: **24H**
> Transmit format: (xxH)

Command to check communication
> This command is used to check if the controller is on-line.

> Command format: **01H**
> Transmit format: (xxH)

The controller transmits 61H back to the host:

Command to download LED brightness level
> This command downloads the brightness level for backlight of both switches. The brightness level change immediately and stay in effect for duration of the session.

> Command format: **27H**   4EH   [Brightness level]
> Transmit format: (xxH) (xxH)   (xxAH)

[Brightness level] is one byte transmitted in ASCII HEX. The acceptable range is 00H to 07H, where 07H is maximum brightness.

Command to query the controller for mode, controller, and firmware version
> This command queries the controller for the mode as set by the mode select switch, the controller name, and the firmware version installed:

> Command format: **26H**   52H   58H
> Transmit format: (xxH) (xxH) (xxH)

Example: The command is sent. The controller responds with the following:

61	52	53 30 32 47 31	31 30	79
61H	[switch code]	[Controller name]	[Version]	79H

[switch code] is one byte. 52H indicates the LCD64x32 module.
[Controller name] is five bytes. 53H 30H 32H 47H 31H (S02G1)
[Version] is two bytes. For example, a 31h 30H would be version 1.0 (converted from ASCII hex)

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Command to manually set the images for Switch#1 and switch#2

Command format:	**2DH**	[Address for switch#1)	[Address for switch#2]
Transmit format:	(xxH)	(xxAH)	(xxAH)

[Address for switch#1] is two bytes transmitted in ASCII HEX. The acceptable range is 0001H to 07FFH.
[Address for switch#2] is two bytes transmitted in ASCII HEX. The acceptable range is 0001H to 07FFH.

The controller will assign the desired addresses to the switches.

Command to download backlight codes for Switch#1 and switch#2

Command format:	**2CH**	[ON cycle coded for switch#1]	[OFF cycle coded for switch#1]	[ON cycle coded for switch#2]	[OFF cycle coded for switch#2]
Transmit format:	(xxH)	(xxAH)	(xxAH)	(xxAH)	(xxAH)
Number of bytes	1	1	1	1	1

[ON cycle for switch#1] is one byte transmitted in ASCII HEX. The code according to the Firmware Overview section.
[OFF cycle for switch#1] is one byte transmitted in ASCII HEX. The code according to the Firmware Overview section.
[ON cycle for switch#2] is one byte transmitted in ASCII HEX. The code according to the Firmware Overview section.
[OFF cycle for switch#2] is one byte transmitted in ASCII HEX. The code according to the Firmware Overview section.

The controller puts the desired backlight codes as the active backlight codes.

Commands that Disable Switch and Timer Execution

Upon transmitting any of the following commands, the timers stop running and attributes for the switches activity do not execute. However, the switches are still scanned and reported. The attributes execution is enabled upon reboot, power-up.
The reason for disabling attribute execution is to enable faster download of images and attributes.

Command to disable switch and timer execution
This command disable switch and timer execution

Command format:	**26H**	51H	5AH
Transmit format:	(xxH)	(xxH)	(xxH)

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Command to erase the flash memory

This command erases the memory by turning all the cells ON. Before proceeding, the host needs to wait for the 79H to be received from the controller, indicating the memory is erased. The erase time for this flash memory is less than a second.

Command format:	**21H**	55H	AAH	52H	52H
Transmit format:	(xxH)	(xxH)	(xxH)	(xxH)	(xxH)

Command to download setup data

This command downloads the setup data. The setup data is saved to flash memory at address 0000H:

				[Switch 2 start address]	Brightness level]	[Reserved]
Command format:	**2AH**	52H	[0000H]	[Switch 2 start address]	Brightness level]	[Reserved]
Transmit format:	(xxH)	(xxH)	(xxAH)	(xxAH)	(xxAH)	(xxAH)
Number of bytes	1	1	2	2	1	11

[Brightness Level] is one byte sent in ASCII HEX format. Range 00H to 07H
[Switch 2 start address] is two bytes with the value of 0001H to 07FFH sent in ASCII HEX format. This is the address for the image that switch#2 displays upon power-up or reboot.
[Reserved] is 11 bytes of 00H sent in ASCII HEX format. This is for future use. The customer can configure the last two bytes as needed for their application. The rest of the reserved bytes should be zero. The controller saves the setup to flash memory.

This setup data can be read using the attribute upload command.
On startup the controller checks if the setup attribute is valid, and if not, the setup is not used.

Command to download an image

This command downloads an image from the host to the flash memory address:

Command format:	**28H**	52H	[Address]	[Image]
Transmit format:	(xxH)	(xxH)	(xxAH)	(xxAH)

[Address] is two bytes with value of 0001H to FFFFH sent in ASCII HEX format.
[Image] is 256 bytes transmitted in ASCII HEX format.

Byte	Description
1	Bit 7 is top right pixel of the display
8	Bit 0 is top left of the display
•	
•	
•	
249	Bit 7 is bottom right of the display
256	Bit 0 is bottom left pixel of the display

Command to upload an image

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This command uploads an image from the flash memory location to the host:

Command format: **29H**   52H   [Address]
Transmit format: (xxH) (xxH)   (xxAH)

[Address] is two bytes with value of 0001H to FFFFH sent in ASCII HEX format.

The controller transmits the image (256 bytes) back in ASCII HEX format.

Command to download Attribute Block
This command downloads an Attribute Block from the host to the flash memory location:

Command format: **2AH**   52H   [Attribute block]
Transmit format: (xxH) (xxH)   (xxAH)

[Attribute Block] is 16 bytes transmitted in ASCII HEX format.

The first two bytes of the Attribute Block are the desired address of the block. The Attribute Block is stored in flash memory according to these first two bytes.
When the controller reads the Attribute Block, it compares the desired address to the saved address. If they do not match, all attributes are deemed invalid and do not get loaded.

Command to upload an Attribute Block
This command uploads an attribute block from the flash memory location to the host:

Command format: **2BH**   56H   [Address]
Transmit format: (xxH) (xxH)   (xxAH)

[Address] is two bytes with the value of 0001H to 07FFH sent in ASCII HEX format.
The controller transmits the 16 bytes Attribute Block via RS232 in ASCII HEX format.

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Page 13 of 18

1120

8. Hardware Considerations

The power can be supplied to the Engineering Kits via USB port or J2 header. The voltage range can be 4.5V to 5.5V. Maximum current consumption is 100 mA. A fuse and a Zener diode are used for high voltage input protection.

The PIC18F46K40 microcontroller is used in the Engineering Kits. The VDD for the microcontroller is 3.3V. The 5V for the LCD64x32 switches is provided using a charge pump. The reason for using a charge pump is because the USB power specification is from 4.5V to 5.5V, and because the LCD64x32 voltage range is much tighter, from 4.9V to 5.1V.

The auxiliary ports I/O are directly connected to microcontroller pins without any safety circuits. Care must be taken not to exceed the VDD voltage.

9. Programming Setup

The Engineering Kits are designed to be easily programmed and have a 5-position SIP footprint for this purpose (JP1). They can be programed by a variety of different programmers. Our recommendation is to use the PICkit 3 with the IS-PA2 adaptor and a USB power source. The IS-PA2 is an adaptor with a 5-position SIP header on one side and a 5-position, spring-loaded header on the other side.

Note: Position 1 of the PICit3 must be at position 1 on the PCB or damage could occur. The 5V power must be supplied; usually through the USB cable although there are through-hole pads on the PCB for an alternative 5V power connection.

Connector callout of the IS-PA2 and controller JP1.

J1	J2	Controller JP1	
1	1	1	MCLR
2	2	2	VDD
3	3	3	GROUND
4	4	4	PGD (data)
5	5	5	PGC (clock)

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Page 14 of 18

1120

IS-PA2 on a control board:
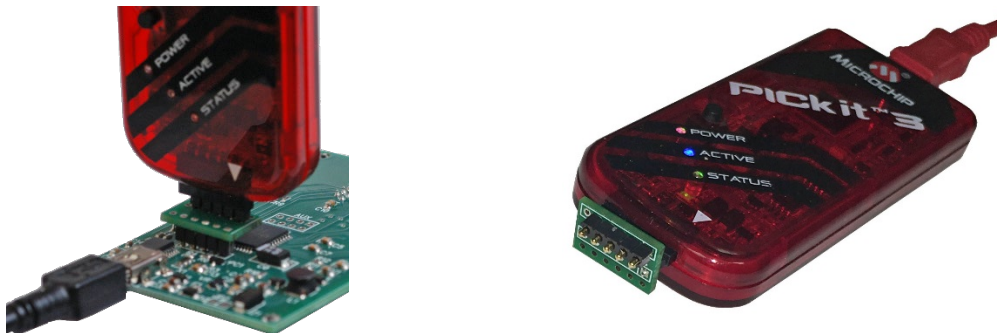
IS-PA2 Board photos:

10. Modifying the Firmware

1. Download MPLAB-X from www.microchip.com.
2. Install MPLAB-X to the default location with the default options.
3. Download the MPLAB XC8 compiler from www.microchip.com.
4. Install the MPLAB XC8 compiler to the default location with the default options
5. Extract the firmware source code to a location of your choice.
6. Open MPLAB-X IDE (Integrated Development Environment).
7. Press the open project button and navigate to the directory the source code was extracted to, then click the directory and click "Open Project".
8. Click the "Production" menu at the top, and select "Clean and Build Project". Wait for the build to complete.
9. Attach a PICKIT3 (or equivalent) to the PCB board. This can be done using a IS-PA2 adapter (available for purchase on the NKK website) or by soldering a header into JP1 and attaching the PICKIT3.
10. Press the debug project button and wait for the output window to say "Running".
11. Observe the program is now running on the board and images appear on the SmartSwitch.
12. Press the stop button. You are now ready to start developing for the SmartSwitches.

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11. Board Dimensions

Typical dimensions. Sockets and components vary with kit type.

Dimensions in mm.

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Page 16 of 18

1120
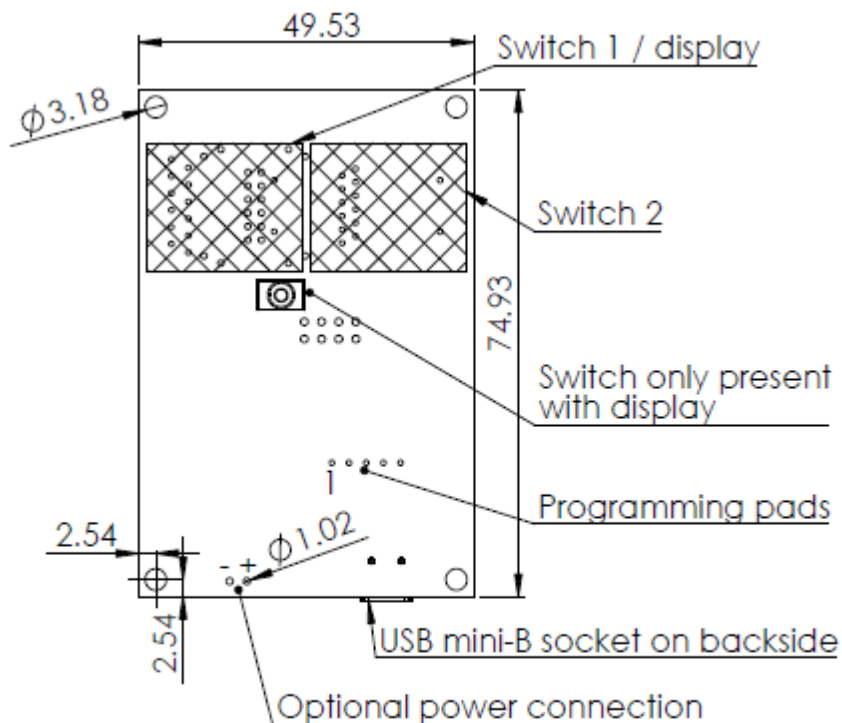
12. Key Terms & Definitions

Host	Any computer, terminal, or other device that can communicate over the USB line.
Byte	An eight-bit hex value ranging from 00H to FFH (Decimal 0 to 255). The bit format of a byte is: (B7 B6 B5 B4 B3 B2 B1 B0) where B7 is most significant and bit B0 is least significant bit.
Nibble/Hex Digit	A four-bit value ranging from 0H to FH. A byte consists of two nibbles.
ASCII	A byte value representing a symbol.

Communication Format

There are two formats to transmit a byte:

1. **Hex format** - A hex byte is transmitted without any change to it. [**xxH**] will be used to denote this.

   All commands and some data are sent by using this format.

2. **ASCII HEX format** - Each nibble of the byte is converted to ASCII code and sent as a byte. [**xxAH**] will be used to denote this.

   For example, the hex byte 5AH is transmitted in two bytes, **35H** and **41H**. The ASCII value for **5** is **35H** and the ASCII value for **A** is **41H**.

   All addresses and most data are sent using this format.

Address
A two-byte value ranging from 0001H to 07FFH representing the 2,047 memory locations for pictures and attributes on the flash memory.

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Toll Free 1.877.2BUYNKK (877.228.9655) • **Phone** 480.991.0942 • **Fax** 480.998.1435
www.nkkswitches.com • **Email** engineering@nkkswitches.com

Page 17 of 18

1120

7850 East Gelding Drive • Scottsdale, AZ 85260-3420

13. Warranty

NKK SWITCHES LIMITED WARRANTY AND LIMITATION OF LIABILITY

The following limits our liability. Please read.

NKK Switches hereby warrants this product against any and all manufacturing defects for a period of one year from the date of sale of this product to the original end user. NKK Switches' liability in the event of such defect is limited to repair or replacement of the defective products. NKK Switches disclaims any liability or warranty obligation with respect to any product that is misused, damaged by any user, or not used in conformity with all applicable product specifications.

NKK SWITCHES HEREBY DISCLAIMS ANY WARRANTY, EXPRESS OR IMPLIED, OTHER THAN THAT CONTAINED HEREIN. NKK SWITCHES EXPRESSLY DISCLAIMS THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND SHALL HAVE NO LIABILITY BASED ON OR ARISING FROM ANY CLAIM OF SUCH WARRANTY.

NKK Switches shall have no liability to any person for any incidental, consequential, special, punitive, or other damages of any kind whatsoever relating to any use of this product.

USE OF THIS PRODUCT IN CONNECTION WITH ANY LIFE CRITICAL APPLICATION IS NOT RECOMMENDED.

14. Schematics

See schematics on next page(s).

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Page 18 of 18

1120

	1	2	3	4	5	6	7	8

RevNo   Revision note   Date   Signature   Checked

J1 — USB B
- 3 DP — D+   VBUS 1 — VBUS
- 2 DN — D-   GND 5
- 4 ID — CASE 6
- GND

AUX
RES — 8 7 6 5 4 3 2 1
SS2
SA

JP1
1 2 3 4 5
R0 10K
MCLR   VDD   PGD PGC
GND

R7 SCK2 — 22.1 1% — SCK2O
R8 SDO2 — 22.1 1% — SDO2O

U1 PIC18F46K40-I/PT
- 44 RC6/TX1
- 43 RC5/SDO1
- 42 RC4/SDI1
- 41 RD3/RP20
- 40 RD2/RP19
- 39 RD1/SDA2
- 38 RD0/SCL2
- 37 RC3/SCK1/RP14
- 36 RC2/RP13
- 35 RC1/RP12
- 34 NC
- 1 RC7/RX1/RP18
- 2 RD4/PMD4/RP21 — SCK2
- 3 RD5/PMD5/RP22 — SDO2
- 4 RD6/PMD6/RP23 — SB
- 5 RD7/PMD7/RP24 — CS
- 6 VSS — GND
- 7 VDD — VDD
- 8 RB0/INT0/RP3 — SDO
- 9 RB1/RP4 — SCK
- 10 RB2/RP5 — WP
- 11 RB3/RP6 — SDI
- 33 NC
- 32 RC0/RP11 — SS1
- 31 RA6/OSC2
- 30 RA7/OSC1
- 29 VSS — GND
- 28 VDD — VDD
- 27 RE2/PMCS
- 26 RE1/PMWR
- 25 RE0/PMR
- 24 RA5/SS1/RP2
- 23 VCAP
- 12 NC
- 14 NC
- 15 RB4/RP7
- 16 RB5/RP8
- 17 RB6/PGC/RP9
- 18 RB7/PGD/RP10
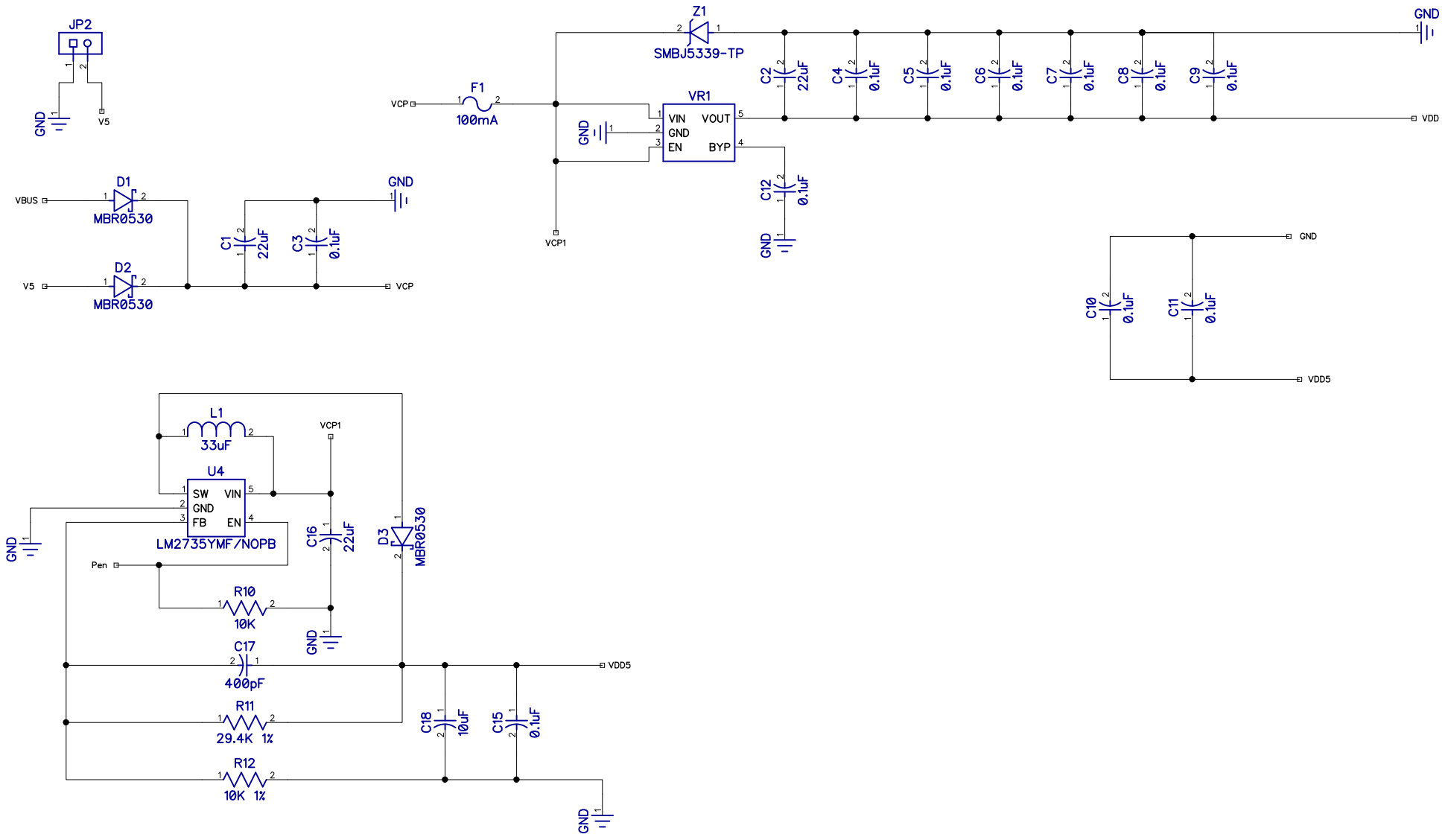- 19 MCLR
- 20 RA0/RP0
- 21 RA1/RP1
- 22 RA2/VREF / RA3/VREF
- RXD2
- TXD2   PGC   PGD   MCLR   CTS   USBS2   USBS1   Pen

C0 10uF — GND

U2 MCP2200
- 1 VDD
- 2 OSC1
- 3 OSC2
- 4 RST
- 5 GP7/TXLED
- 6 GP6/RXLED
- 7 GP5
- 8 GP4
- 9 GP3
- 10 RXD2 TX
- 20 VSS — GND
- 19 D+ — DP
- 18 D- — DN
- 17 VUSB — VDD
- 16 GP0/SSPND — USBS1
- 15 GP1/USBCFG — USBS2
- 14 GP2
- 13 CTS — CTS
- 12 RX — TXD2
- 11 RTS
X1
R3 10K
R4 600
C13 0.1uF — GND
C14 47uF — GND
VDD

SW1
- 1 SW1 — SA
- 2 SW2 — GND
- 3 GND — GND
- 4 VDD — VDD5
- 5 SDO
- 6 SDI — SDO2O
- 7 SCK — SCK2O
- 8 SS
- 9 NC

SW2
- 1 SW1 — SB
- 2 SW2 — GND
- 3 GND — GND
- 4 VDD — VDD5
- 5 SDO
- 6 SDI — SDO2O
- 7 SCK — SCK2O
- 8 SS
- 9 NC

DS1
- 1 SCK — SCK2O
- 2 SS — SS1
- 3 SDO
- 4 SDI — SDO2O
- 5 GND — GND
- 6 VDD — VDD5

U3 SST25VF080B-50-4I-S2AE
- 1 CS# — CS
- 2 SO/IO1 — SDI
- 3 WP#/IO2 — WP
- 4 VSS
- 8 VCC — VDD
- 7 HOLD#/IO3
- 6 SCK — SCK
- 5 SI/IO0 — SDO
R2 100K   **R1** 100K
GND

SWD1
4 — SA — 5 6 — GND

JP2
GND
V5

GND

D1
MBR0530
VBUS

D2
MBR0530
V5

C1 22uF
C3 0.1uF
GND
VCP

Z1
SMBJ5339-TP
GND

F1
100mA
VCP

VCP1

GND

VR1
VIN VOUT 5
GND
EN BYP 4

C2 22uF
C4 0.1uF
C5 0.1uF
C6 0.1uF
C7 0.1uF
C8 0.1uF
C9 0.1uF

GND
VDD

C12 0.1uF
GND

C10 0.1uF
C11 0.1uF
GND
VDD5

L1
33uF
VCP1

U4
SW VIN 5
GND
FB EN 4
LM2735YMF/NOPB
GND
Pen

C16 22uF
D3 MBR0530
GND

R10 10K

C17 400pF
VDD5

R11 29.4K 1%

C18 10uF
C15 0.1uF

R12 10K 1%
GND