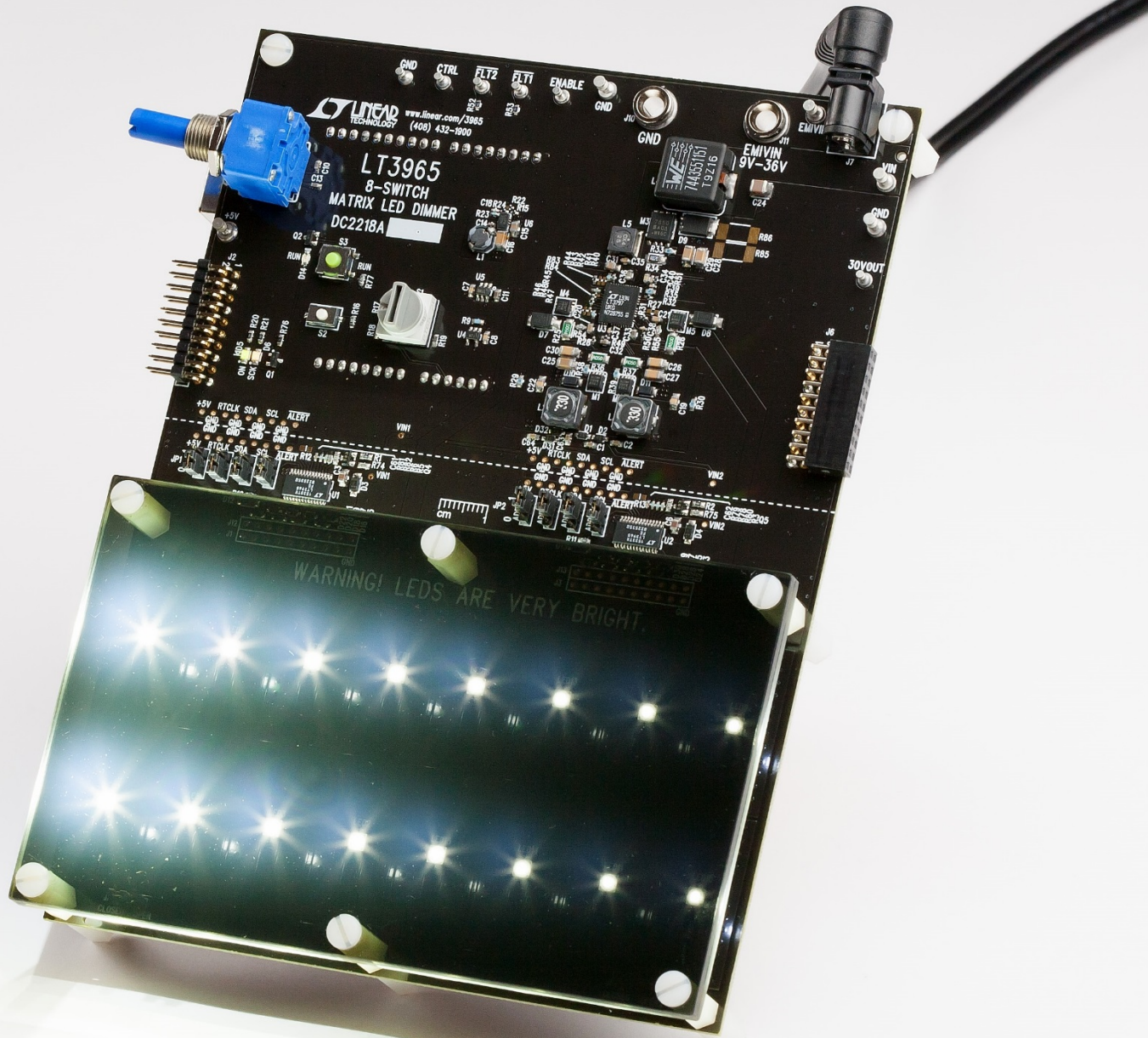


LT3965 GUI USER MANUAL



INTERFACING WITH DC2218A

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CONNECTING DC2218A TO THE GUI

To connect DC2218A to the GUI, the following steps must be performed:

1. If you do not have QuikEval installed on your computer already, open your computer web browser and navigate to Linear Technology's software design tool page using the following web address: <http://www.linear.com/designtools/software/#Data>. Under the sub-section "PScope & QuikEval Systems", click the link labeled "Download QuikEval". If you already have QuikEval installed on your computer, skip to step 4.

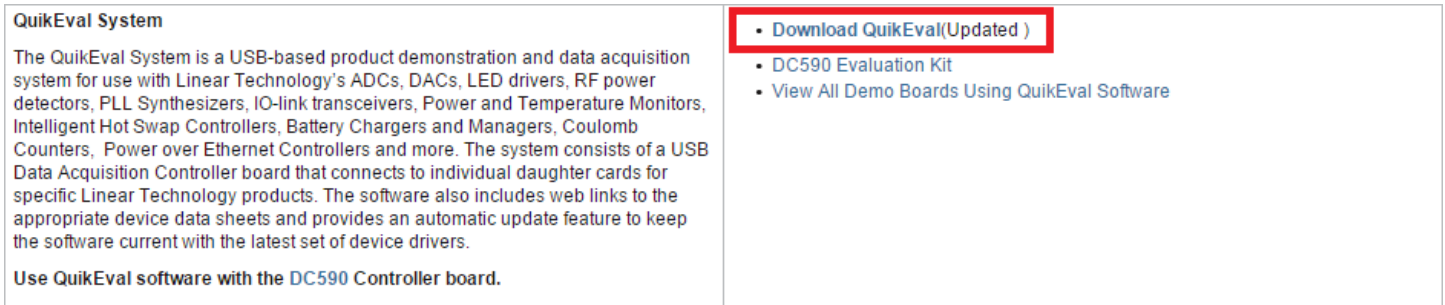


Figure 1: QuikEval download link located at <http://www.linear.com/designtools/software/#Data>

2. Once the download has completed, launch the .exe file to begin the installation of QuikEval. A prompt window will appear with a License Agreement/Disclaimer message for the QuikEval system (See Figure 2 below). After reading the agreement, click "Accept" (1), then "Install Now" (2).

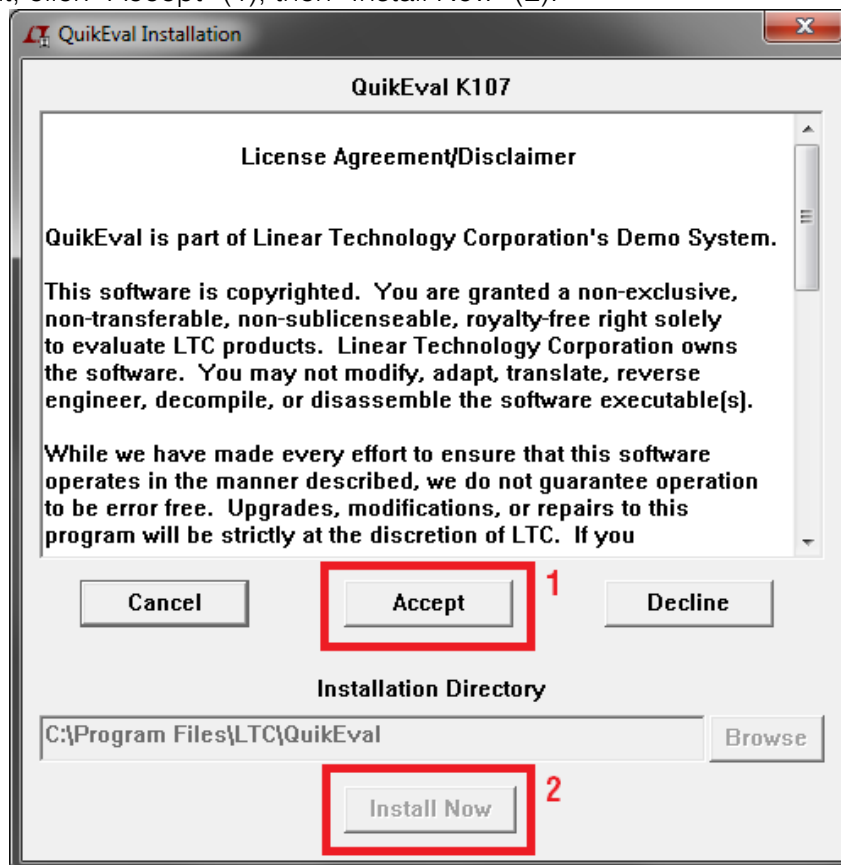


Figure 2: QuikEval Installation prompt window

3. QuikEval brings up consecutive prompts to install USB drivers and communication ports on your computer. This allows the attached microcontroller to interface properly with the GUI. Continue through the installation prompts.
4. After QuikEval has been successfully installed, it automatically launches and displays the window seen below in Figure 3. For those who already have QuikEval installed, launch QuikEval and select Tools->Update Program to download the most recent updates, including the LT3965 GUI.



Figure 3: QuikEval connection window. This window displays when QuikEval.exe is launched.

5. On DC2218A without anything plugged-in, find the 8-position rotary switch labeled “PATTERN SELECT”. Set the rotary switch to **position 7**. Rotary switch positions 0 – 6 contain predefined display patterns for lobby demos, and will not allow connection to the GUI.

NOTE: DC2026C Must be connected to DC2218A to function properly. DC2218A demo circuit arrives with a preprogrammed DC2026C attached. Do not reprogram DC2026C. Contact LTC if DC2026C is reprogrammed.

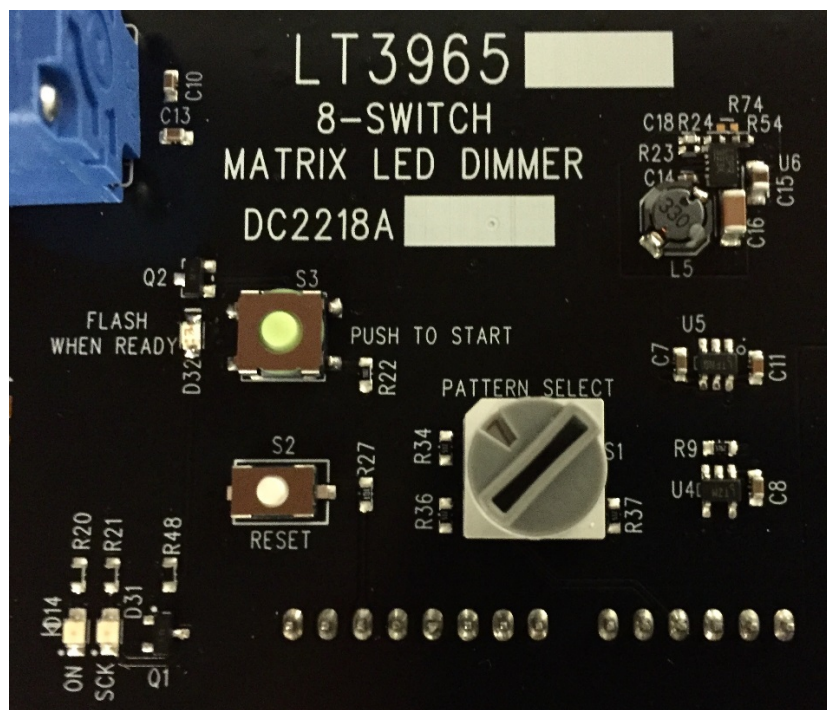


Figure 4: Pattern select rotary switch

6. Plug in +12V_{DC} into the 2.1mm barrel jack (or banana jacks labeled EMIVIN and GND) located on the upper right hand side of the board.

NOTE: Do not connect power to the Linduino One board directly

7. Connect the Linduino One board located on the bottom side of DC2218A to the computer using the provided USB cable. Plugging in the USB will cause the board briefly reset. After the reset is complete, the GUI automatically launches the window seen below in Figure 5. Click “CONNECT TO DC2218A” to connect to the board.

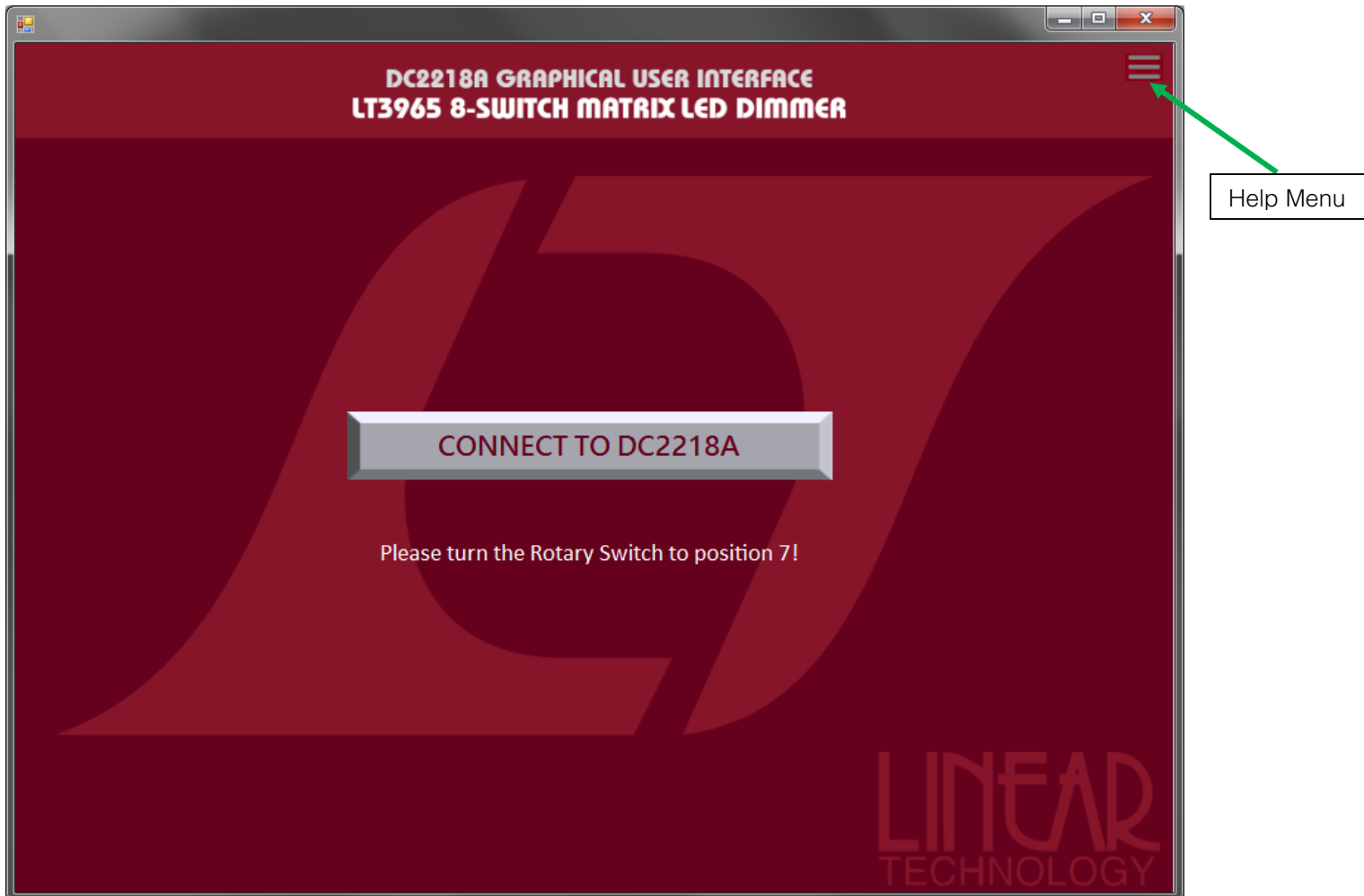


Figure 5: DC2218A Graphical User Interface connection prompt window

8. After selecting CONNECT TO DC2218A, the ALL CHANNEL WRITE page is displayed, confirming that the GUI has successfully connected to DC2218A.

******* NOTE *******

If board loses connection (via power or USB) while connected to the GUI, close and relaunch QuikEval, and follow the connection procedure from step 5. See Connection Troubleshooting section for more details.

CONNECTION TROUBLESHOOTING

Proper connection sequences are necessary for connection between DC2218A and the GUI. Upon startup, the Linduino queries the state of the LT3965s to ensure that they can be written to successfully before turning on any LEDs. The best way to avoid connection issues is to follow the step-by-step connection guide in the previous section.

On DC2218A near the green pushbutton (S3), there is a red Indicator LED (D32) that displays the startup state of the board. The LED can be in one of three exclusive startup states, represented by the LED: ON, FLASHING, or OFF

- **ON:** The board is in a wait state and will not run any patterns or the GUI if D32 remains illuminated after 5 seconds. If USB is plugged in when this occurs, power cycle DC2218A while leaving the USB plugged in. From this point, the Red LED begins FLASHING (if pattern 0 – 6 is selected) or remains OFF (if pattern 7 is selected).
- **FLASHING:** The board has verified that the LT3965s are ready to be written to. The board remains in a waiting state until the user to press the green “Push to start” button if pattern 0 – 6 is selected. If the user wants to run the GUI, set the pattern selector to position 7 and press the white RESET button. The Red LED remains off after the board completes its reset.
- **OFF:** The board has completed its startup routine and is running, waiting for the next input.

Please note for lobby demos where the GUI is not needed:

DC2218A does not need a USB connection to run the interactive patterns pre-programmed on the attached Linduino One demo circuit. For lobby demonstrations, all that is needed is a 12V_{DC} AC-DC converter. To run patterns, first switch the pattern selector to position 0-6, then plug in power to DC2218A. After the board starts up, the Red LED is FLASHING. Press the green “Push to Start” and the patterns begin running. Most of the pre-programmed patterns are able to be interacted with using the blue potentiometer on the upper left side of the board.

ALL CHANNEL WRITE

After successfully connecting DC2218A to the GUI, the first page that pops up is the ALL CHANNEL page, as seen in Figure 6 below. This page allows the user to set the LEDs ON or OFF by clicking buttons corresponding to the LEDs on the demo circuit, followed by the “UPDATE LT3965” button to send the command out.



Figure 6: ALL CHANNEL Write Page

The ALL CHANNEL MODE, or ACMODE write commands send out a command over the I²C bus capable of turning ON or OFF LEDs. ACMODE write commands set the ON/OFF state of all of the LEDs simultaneously, meaning that all of the channel's transient edges are aligned. DC2218A's onboard LED driver is capable of handling these transients, however the datasheet does note that ACMODE write commands switching multiple channels should be avoided when using slow LED drivers.

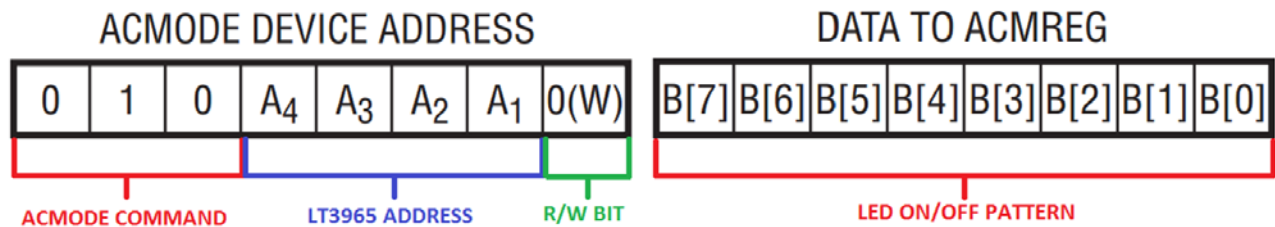


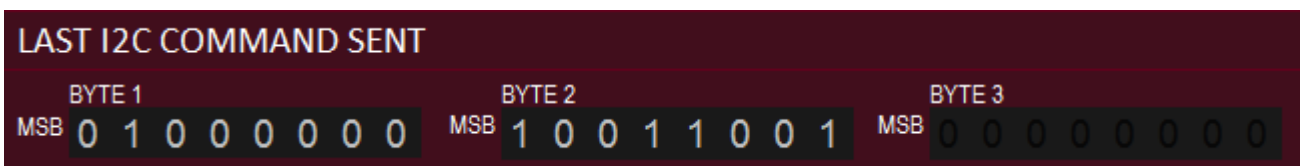
Figure 7: ACMODE Write command elements. ACMODE commands are two bytes long, each byte being 8-bits long.

The ACMODE write command consists of two 8-bit words. The first word starts with 010 in the first three bits, indicating that this is an ACMODE command being sent out. The following 4 bits (A₄ – A₁) denote the address of the LT3965 IC that is being written to. This address is set by using the address jumpers next to the LT3965 ICs. The second word in the ACMODE command contains a bit pattern representing the ON/OFF state of the corresponding LEDs to be updated (1 = ON, 0 = OFF).

EXAMPLE: Turn on top bank of LEDs on LT3965 U1 using ACMODE write



1. Click on all of the LEDs in the top row so that they display "ON"
2. Click UPDATE LT3965 U1
3. DC2218A now has the top 4 LEDs of LT3965 U1 illuminated
4. LAST I²C COMMAND SENT updates, displaying the last message sent over the I²C communications bus.



SINGLE CHANNEL WRITE

SINGLE CHANNEL MODE Write (SCMODE write) commands offer more control of the LT3965s, enabling the user to PWM dim individual LEDs and configure open-circuit and short-circuit thresholds for each individual channel. Like the ALL CHANNEL write page, the user selects all of the desired settings, followed by the “SEND I²C COMMAND” button.

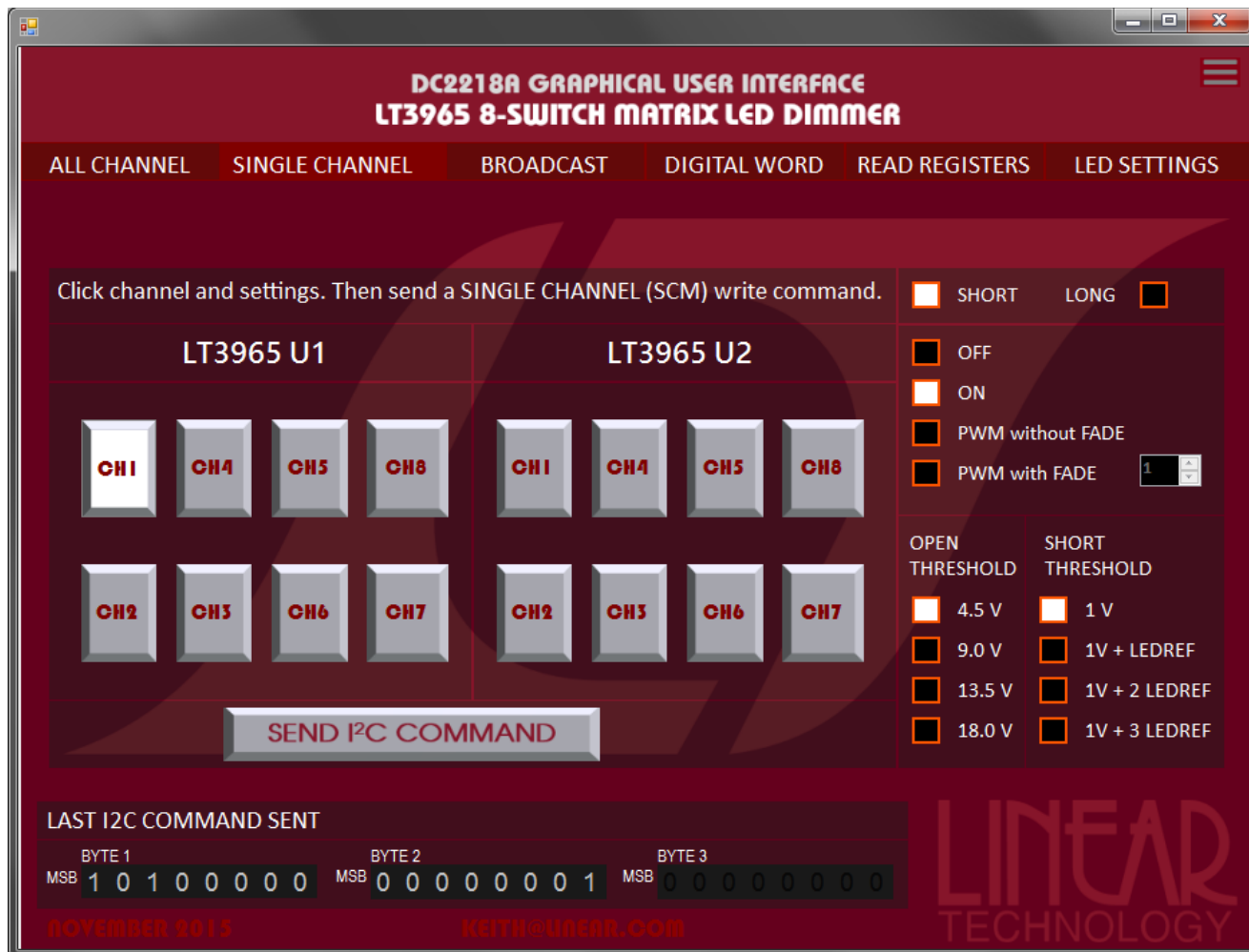


Figure 8: SINGLE CHANNEL page of LT3965 GUI

There are two different types of SCMODE write commands; short format and long format writes. SCMODE short format writes are only 2 bytes long, and are capable of manipulating the open circuit threshold voltage (V_{OTH}) as well as turn an LED ON/OFF via the Mode Control bits. By default, the GUI should initialize the board to $V_{OTH} = 4.5V$. LT3965 uses V_{OTH} to determine whether or not a channel has experienced an open-circuit event. **Setting V_{OTH} higher than necessary can result in false ALERT flags during an open-circuit event and other possible failures.**

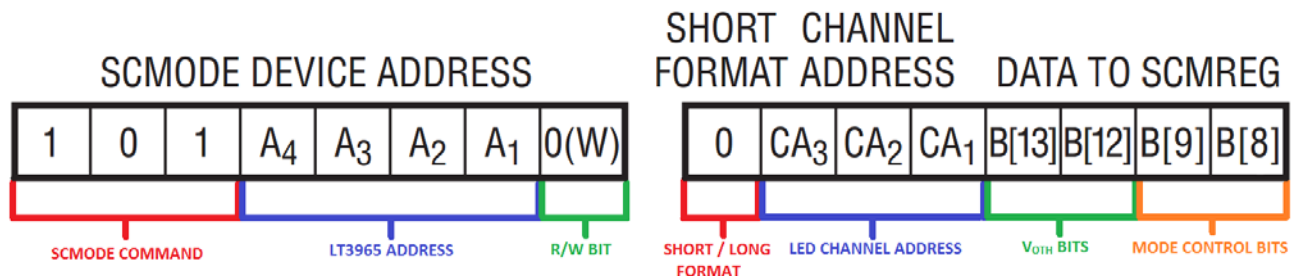


Figure 9: SCMODE Short Format write command elements.

Long format writes are different from short format writes. They are 3 bytes long and are capable of manipulating the short-circuit threshold voltage (V_{STH}) instead of V_{OTH} . Along with the ability to change V_{STH} , a third word is also sent containing an 8-bit PWM value which is stored in the Dimming Value register of LT3965.

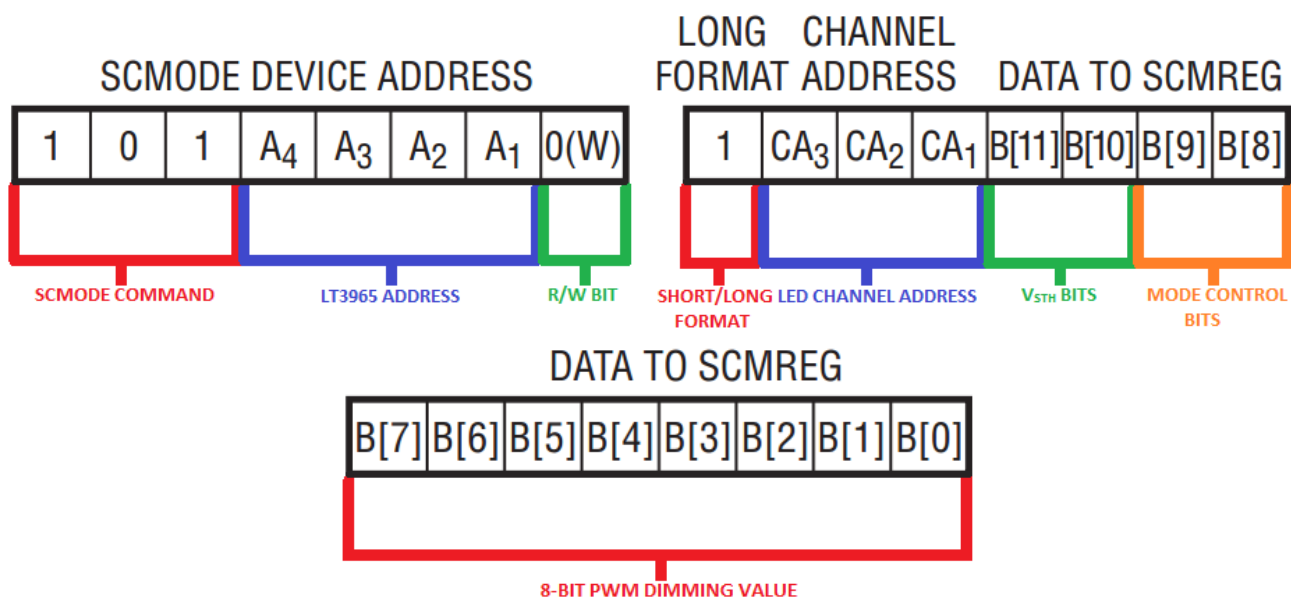


Figure 10: SCMODE Long Format Write command elements.

It is important to note that the using the built in fade transition (configured in the mode control bits) is only capable of fading to and from PWM dimming values that are not equal to 0/256 (OFF) nor 256/256 (ON). Fade transition allows the part to logarithmically fade from its current PWM dimming state to whichever value is updated in the PWM Dimming Value registers. It is possible to set the PWM dimming registers using a SCMODE Long Format write while keeping the LED ON or OFF.

	V_{OTH} BITS[2:0]	V_{STH} BITS[2:0]	MODE CONTROL BITS[2:0]
00	4.5V	1V	LED OFF
01	9V	$1V + V_{LEDREF}$	LED ON
10	13.5V	$1V + 2 \cdot V_{LEDREF}$	LED DIMMING WITHOUT FADE TRANSITION
11	18V	$1V + 3 \cdot V_{LEDREF}$	LED DIMMING WITH FADE TRANSITION

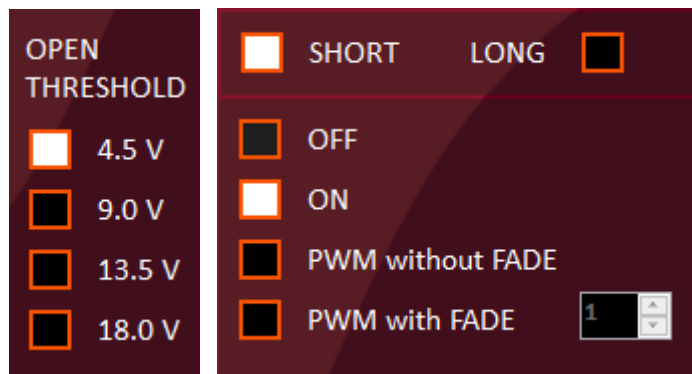
Figure 11: V_{OTH} , V_{STH} , and MODE CONTROL bit selection values

EXAMPLE: Turn on a single LED using SCMODE write

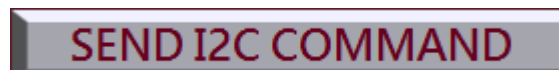
1. Select the LED that you want to turn on. For this example, we choose CH5 on LT3965 U1



2. Select short format, followed by the ON command.
3. Make sure that V_{OTH} is set to 4.5V for a single LED



4. Click SEND I²C Command



5. LAST I²C COMMAND SENT updates, displaying the last message sent, and the LED turns on.

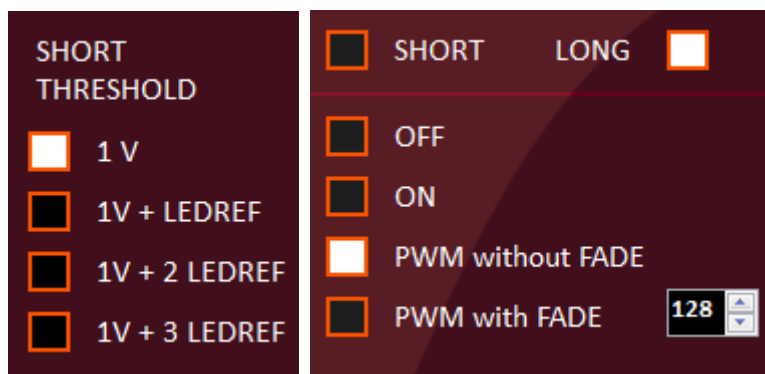


EXAMPLE: Set 128/256 PWM dimming on a single LED using SCMODE write

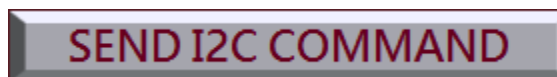
1. Select the LED that you want to turn on. For this example, CH5 is chosen on LT3965 U1 a second time



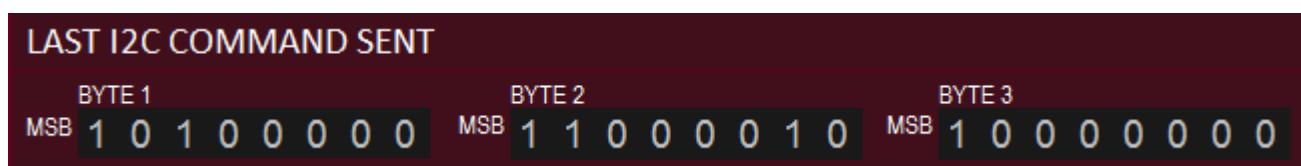
2. Select long format and PWM without FADE option.
3. Make sure that V_{STH} is set to 1V



4. Click SEND I2C COMMAND



5. LAST I²C COMMAND SENT updates, displaying the last message sent. Note that BYTE 3 is no longer blacked out and now displays the binary value equal to 128



BROADCAST WRITE

The BROADCAST mode (BCMODE) write command is a single byte message sent out over the I²C bus. The function of BCMODE write is to synchronize the PWM dimming cycles of all of the LT3965s on the I²C bus. This function works if all connected LT3965s share a common RTCLK signal (standard on DC2218A). The command is sent by clicking SEND BROADCAST WRITE, and can be seen in Figure 12 below.

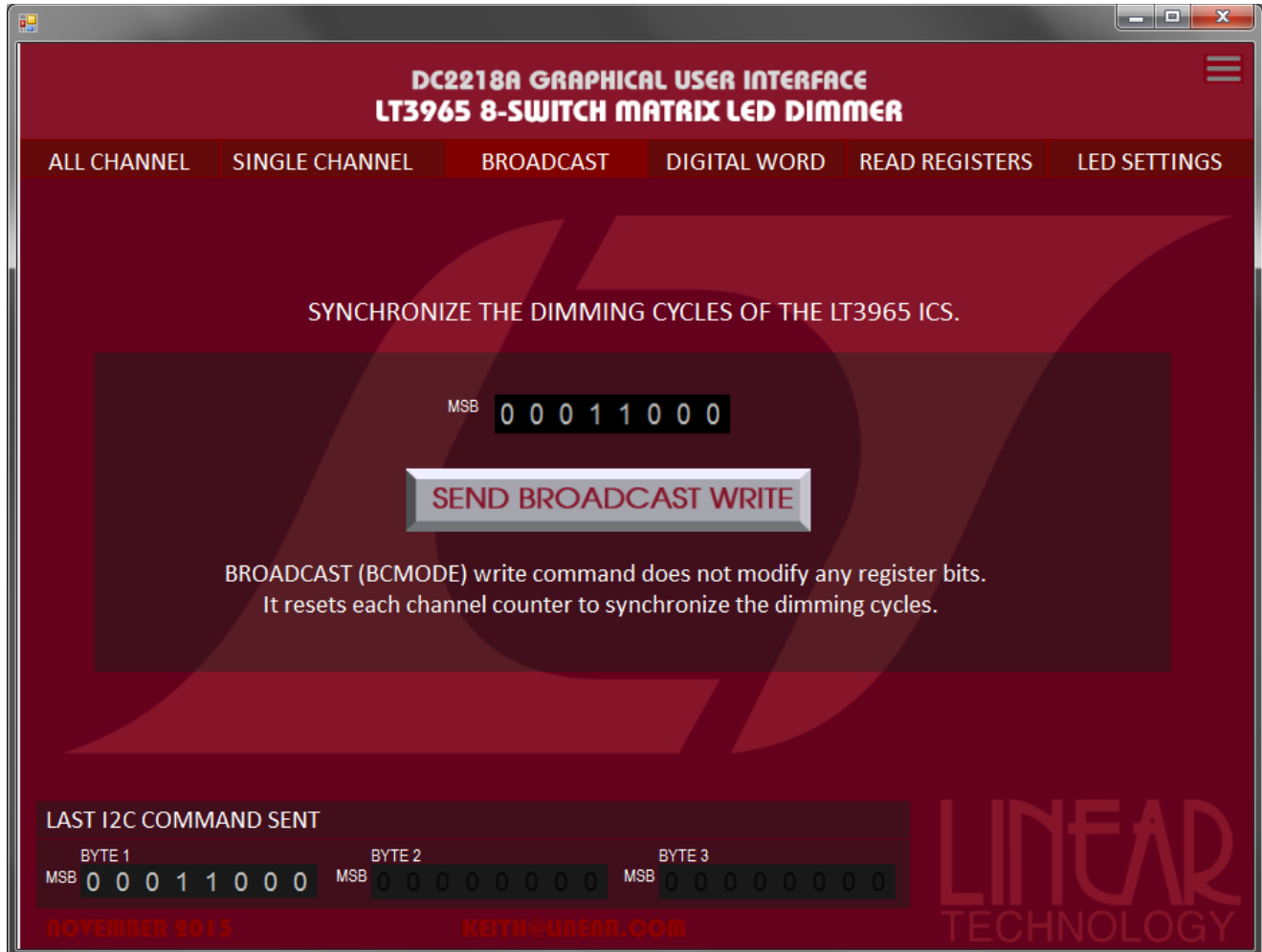


Figure 12: BROADCAST page of LT3965 GUI

READ REGISTERS

The Read Registers page contains three different read commands which allow the user to address LT3965s which may have experienced a fault condition. Each read command returns different register contents from the addressed LT3965, informing the user as to what type of fault has occurred as well as the location of fault.

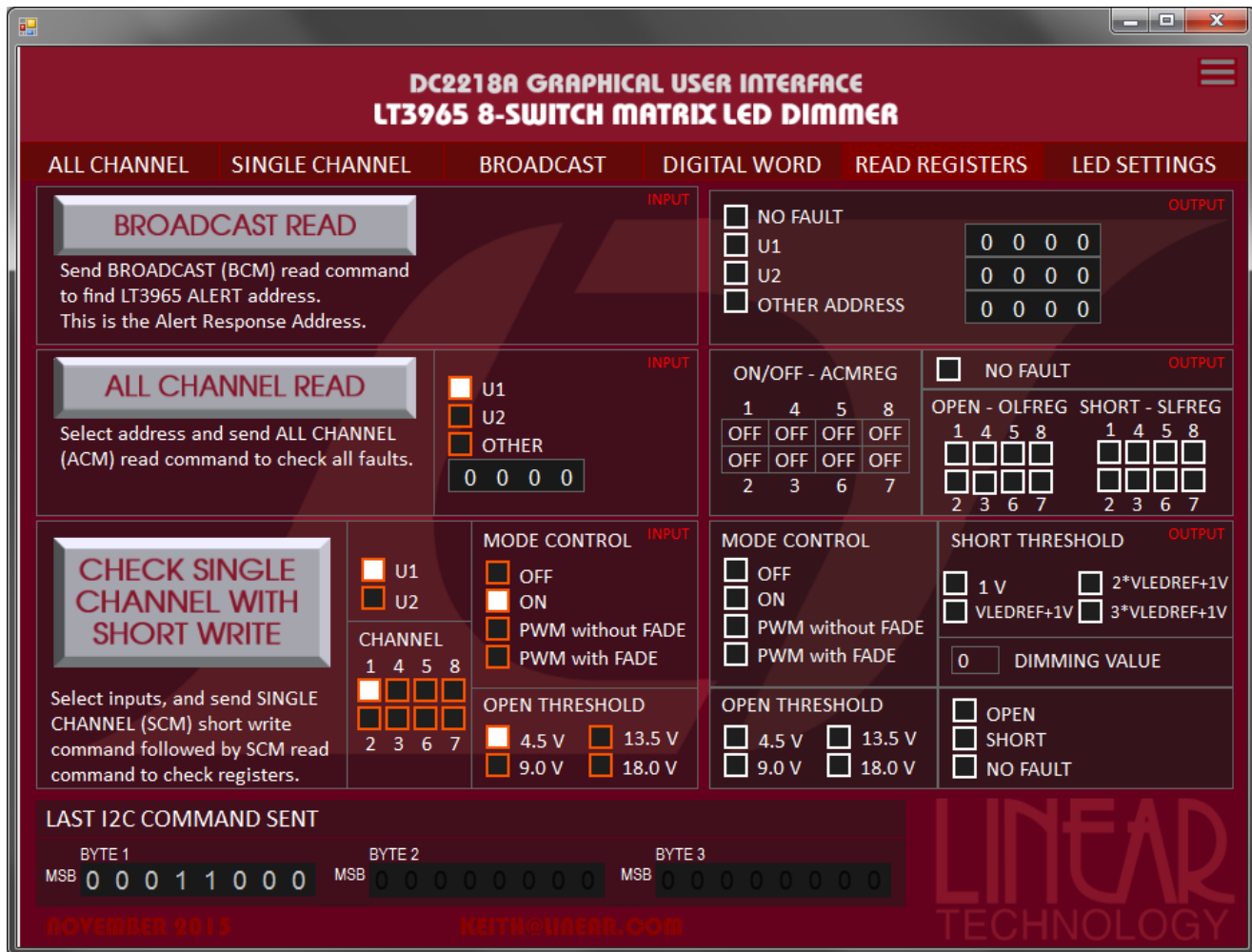


Figure 13: Read Registers page of LT3965 GUI

When a connected LT3965 encounters a fault condition, a red circular button will appear in the upper left hand corner of the GUI labeled “ALERT” (See Figure 14).



Figure 14: ALERT popup displayed in upper left corner of GUI

If a fault occurs, the first step is to send out a BROADCAST READ command. This is similar to the BCMODE write command, however the R/W bit is toggled so that the LT3965 knows to send a message back. Once the read command is sent out, the affected LT3965 responds by sending a single byte response with its address. The message format can be seen below in Figure 15. After inquiring about the faulted LT3965, the red ALERT popup should disappear. The ALERT remains displayed in the upper left hand window until all of the LT3965s in fault have responded with their address.

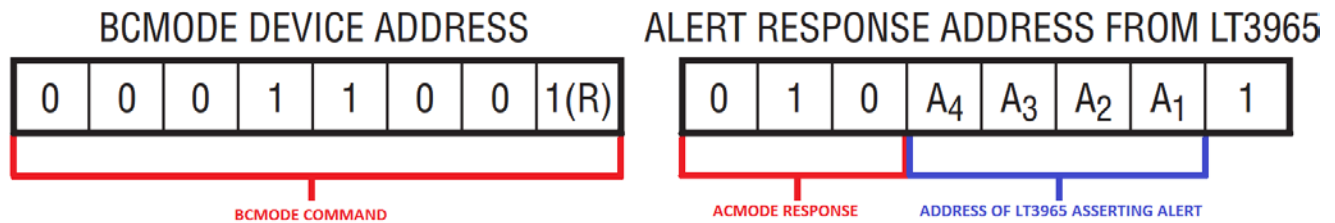


Figure 15: BCMODE Read command & response message from LT3965

Once the user knows the address of the affected LT3965(s) in fault, an ALL CHANNEL READ command can be sent out to the faulted device. The ACMODE Read command is very similar to the ACMODE write command, only the R/W bit is toggled to inform the LT3965 slave device to write back. After an ACMODE read is sent out, the affected device responds by sending two bytes back containing OLFREG and SLFREG data. OLFREG stores data for channels that have experienced an open circuit, whereas SLFREG stores data for channels which have experienced a short circuit.

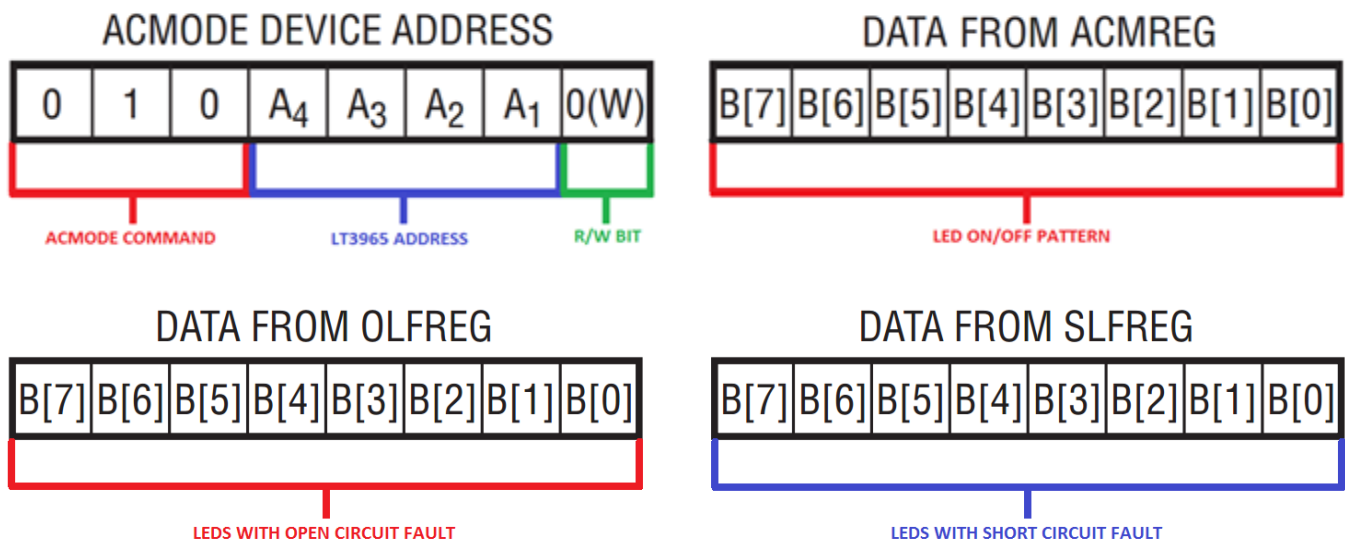


Figure 16: ACMODE Read command & response message from LT3965

Apart from fault data, the user is also capable of reading back PWM dimming value, V_{OTH} , V_{STH} , and Mode Control register contents by using a SINGLE CHANNEL READ command. This command is unique, in that to properly perform a SINGLE CHANNEL READ, first a SINGLE CHANNEL WRITE must be performed. The purpose for the SINGLE CHANNEL WRITE is so that when the read command is sent, the LT3965 responds with register information pertaining to the channel which was previously written to.

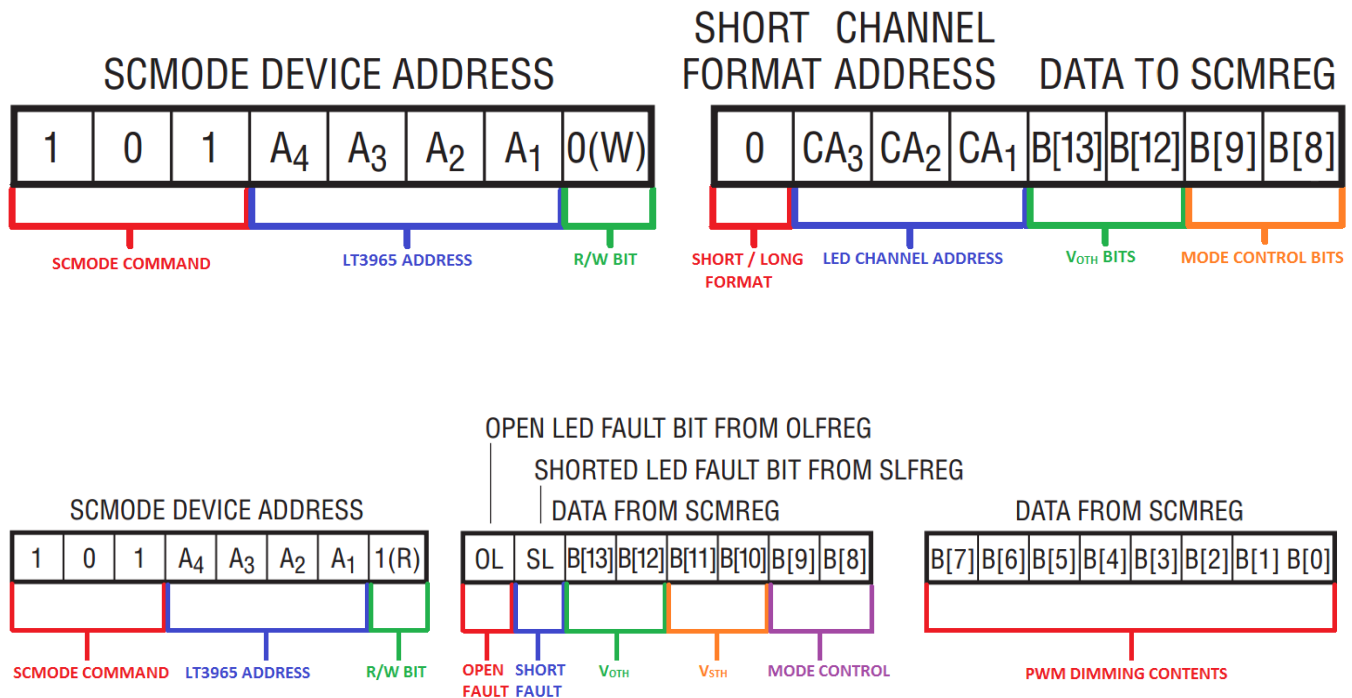


Figure 17: SCMODE Write command followed by SCMODE Read command & response message from LT3965

EXAMPLE: Check fault generated using BCMODE and ACMODE reads

- First, navigate to the SINGLE CHANNEL page and set $V_{OTH} = 4.5V$, $V_{STH} = 1V$, MODE CONTROL = ON for all channels of LT3965 U2. To achieve this, **both short and long format writes must be performed**. It is crucial to have all of the thresholds set properly to effectively perform fault checking.

OPEN THRESHOLD

- ☒ 4.5 V
- ☐ 9.0 V
- ☐ 13.5 V
- ☐ 18.0 V

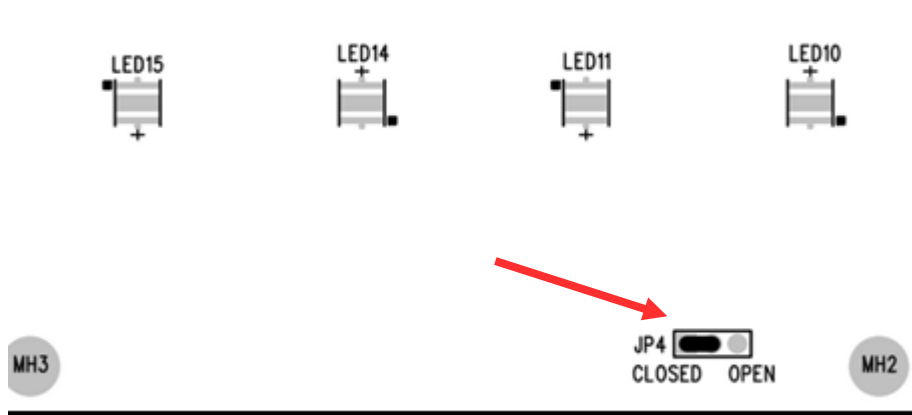
MODE CONTROL

- ☐ OFF
- ☒ ON
- ☐ PWM without FADE
- ☐ PWM with FADE

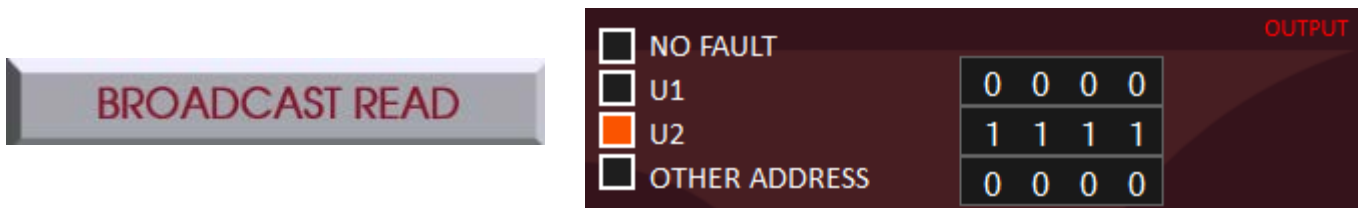
SHORT THRESHOLD

- ☒ 1 V
- ☐ 1V + LEDREF
- ☐ 1V + 2 LEDREF
- ☐ 1V + 3 LEDREF

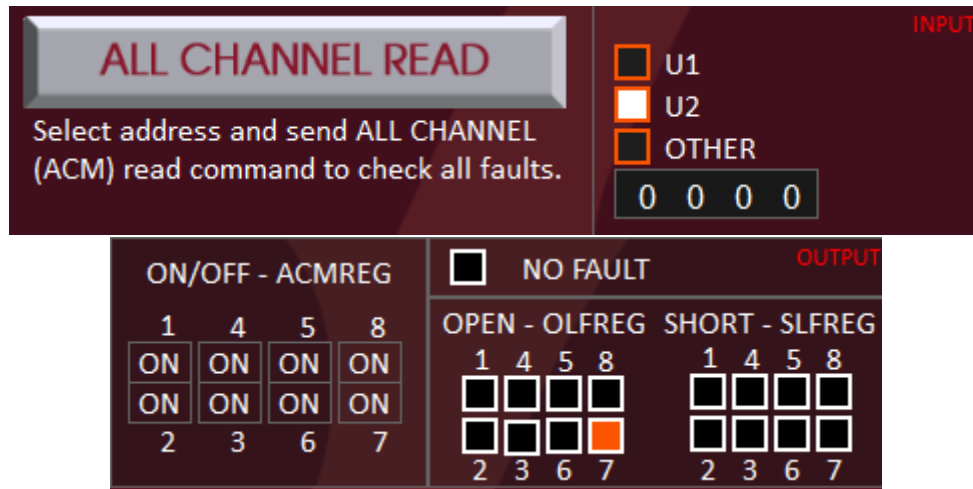
2. Navigate back to READ REGISTERS tab
3. Remove the jumper (JP4) at the bottom right corner of DC2218A, this generates an open circuit fault condition on channel 7. The LED is turned off, and ALERT pops up in the upper left corner of the GUI window



4. Send out a BROADCAST READ to acquire the address of the LT3965 asserting an ALERT



5. Send out an ALL CHANNEL READ using the address acquired in step 4. This will display an open circuit fault on channel 7.



6. Replace the jumper (JP4) and perform a SINGLE CHANNEL write to turn channel 7 back on.

DIGITAL WORD

The Digital Word page allows the user to input his/her own I²C message over the bus. This is a useful tool in verifying that the message sent out does what the user intended. To input a message, select the length of the message (1, 2, or 3 bytes), then click on the bits to toggle between 1 and 0. When the message is properly displayed, click SEND I²C COMMAND. In Figure 18 below, a SCMODE Write command has been input to turn on LED 5 on LT3965 U1 with $V_{OTH} = 4.5V$.

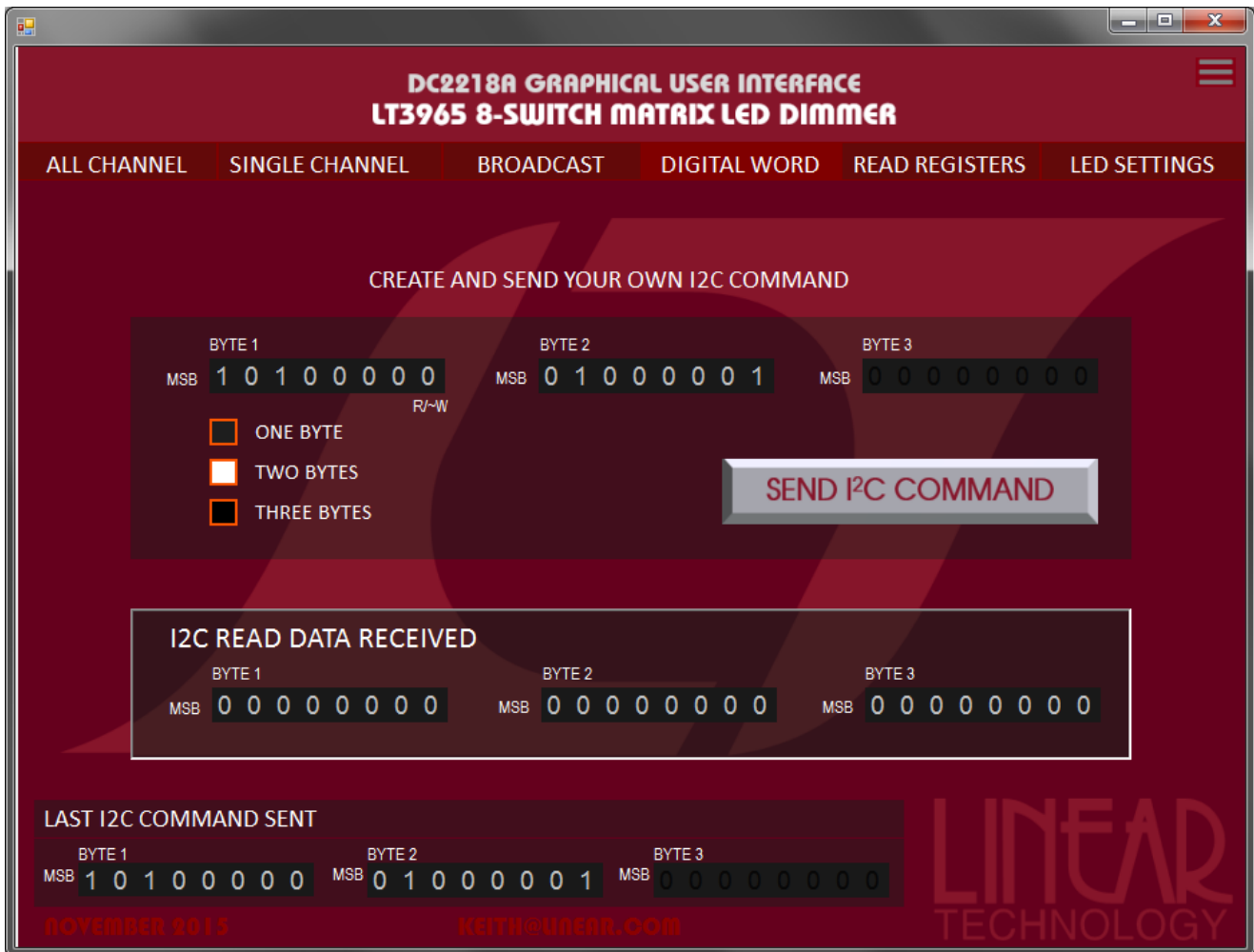


Figure 18: Digital Write page with SCMODE write command as input.

It is also possible to send read commands using the Digital Word page and view the response from the LT3965. In Figure 19 below, a BCMODE read command is sent out after a fault was detected. A return message displays that the LT3965 at address 1111 was asserting ALERT. The Digital Word page also works for ACMODE as well as SCMODE read commands.



Figure 19: Digital Write page with BCMODE read command as input.

LED SETTINGS

The LED Settings page displays the register values that modify V_{OTH} , V_{STH} , as well as the PWM dimming value. Each channel updates as a command is sent out modifying any of its registers. This page also allows the user to change the device address for U1 and U2 by toggling the address bits. With this ability to change the device address being written to, it is possible to control several LT3965s through the GUI. Clicking the DEFAULT button returns the I²C address to the default state (U1 = 0000 & U2 = 1111).

DC2218A GRAPHICAL USER INTERFACE
LT3965 8-SWITCH MATRIX LED DIMMER

ALL CHANNEL SINGLE CHANNEL BROADCAST DIGITAL WORD READ REGISTERS **LED SETTINGS**

	LT3965 U1				LT3965 U2			
I2C ADDRESS	A4	A3	A2	A1	A4	A3	A2	A1
	0	0	0	0	1	1	1	1
	DEFAULT				DEFAULT			
SHORT THRESHOLD 0 = 1 V, 1 = VREF + 1 V, 2 = 2 * VREF + 1 V, 3 = 3 * VREF + 1 V	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
OPEN THRESHOLD 0 = 4.5V 2 = 13.5V 1 = 9.0V 3 = 18.0V	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
LED BRIGHTNESS x/256 0 = OFF, 256 = ON	255	250	220	190	150	110	80	30
	255	250	220	190	150	110	80	30

LAST I2C COMMAND SENT

BYTE 1	BYTE 2	BYTE 3
MSB 1 0 1 1 1 1 1 0	MSB 1 1 1 0 0 0 1 0	MSB 0 0 0 1 1 1 1 0

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LINEAR TECHNOLOGY

Figure 20: LED Settings page

HELP MENU

The upper right corner of the GUI window houses a drop-down help menu containing useful links relevant to DC2218A and LT3965. Clicking on the three horizontal lines opens the help menu. Selecting the hyperlink “LT3965 DATASHEET” launches the LT3965 landing page, and selecting “DC2218A DEMO MANUAL” launches the landing page for DC2218A, the associated demo circuit for LT3965. For any issues or questions pertaining to the LT3965 GUI, please send an email to the provided email address including the version number of the GUI being used.



Figure 21: Drop-down help menu