UM0276
User manual

STFPC311 LED Evaluation board hardware description and user manual

Introduction

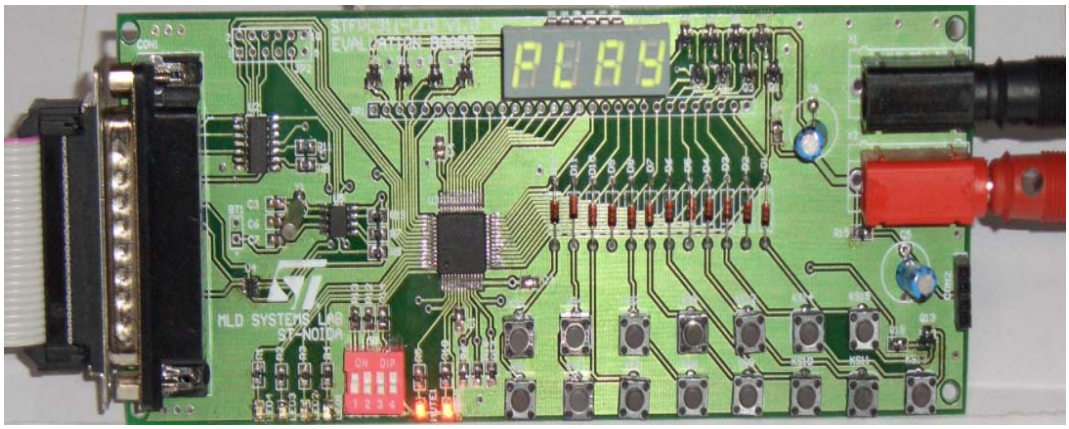
The STFPC311-LED is an evaluation board designed for the quick and easy evaluation of the STFPC311 Vacuum Fluorescent Display Controller used to drive LED (Light Emitting Diode) displays. Its key features include:

- One 4-digit, 7-segment LED display
- Fifteen programmable front panel keys
- Two switches
- Four LEDs
- Two LEDs to display Standby and Mute status respectively
- One InfraRed Connector for remote control
- Parallel Port for communication with PC
- External power supply
- STFPC311 graphical user interface (GUI) that simulates communication between the VFD controller and a microcontroller

The Evaluation board package includes:

- One STFPC311-LED Evaluation board
- STFPC311 Evaluation software program (GUI)
- User manual

STFPC311-LED Evaluation board v1.0



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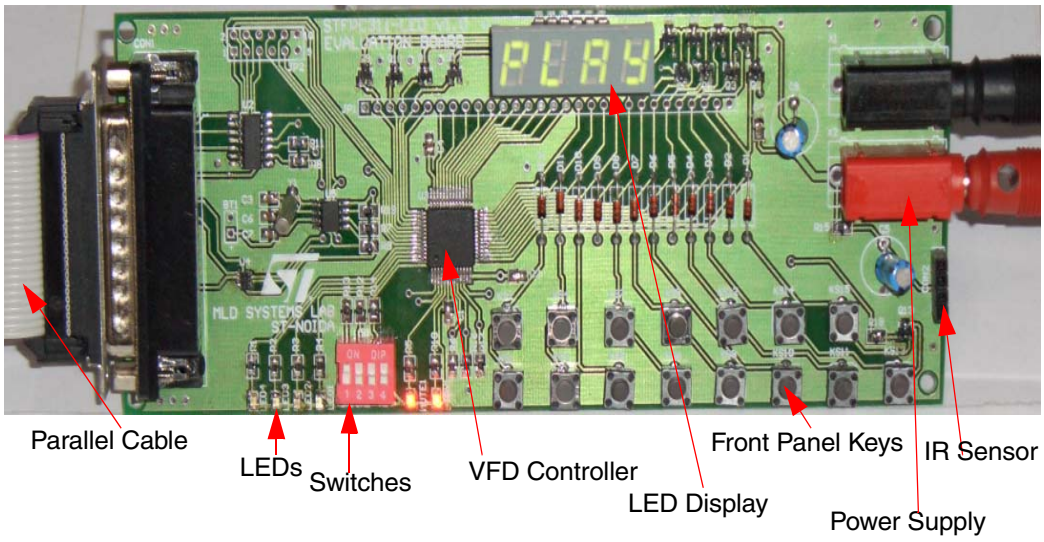
1 Getting started

To start evaluating the STFPC311 Vacuum Fluorescent Display Controller, you must:

- Install the Evaluation software.
- Connect the Evaluation Board to the PC running the Evaluation software.
- Connect an external power supply to the Evaluation Board.

Figure 1. STFPC311-LED Evaluation board layout



1.1 Installing the evaluation software

A ZIP file, “STFPC311_GUI.ZIP”, contains the Evaluation software. This software runs on all Windows® operating system platforms.

1. Unzip this file to extract the STFPC311_GUI.exe setup file on the host PC system.
2. Double-click on the setup file and follow the instructions displayed on the PC screen to install the software GUI.

Note: Ensure that the io.dll file included in the ZIP file is extracted to the same folder as the EXE file.

1.2 Connecting the evaluation board

The Evaluation Board requires an external power supply (supply not included). An appropriate power supply must have two connectors: one for the 3.3 V_{DC} (reference) supply and the other for the ground provided on the board (*Figure 1*).

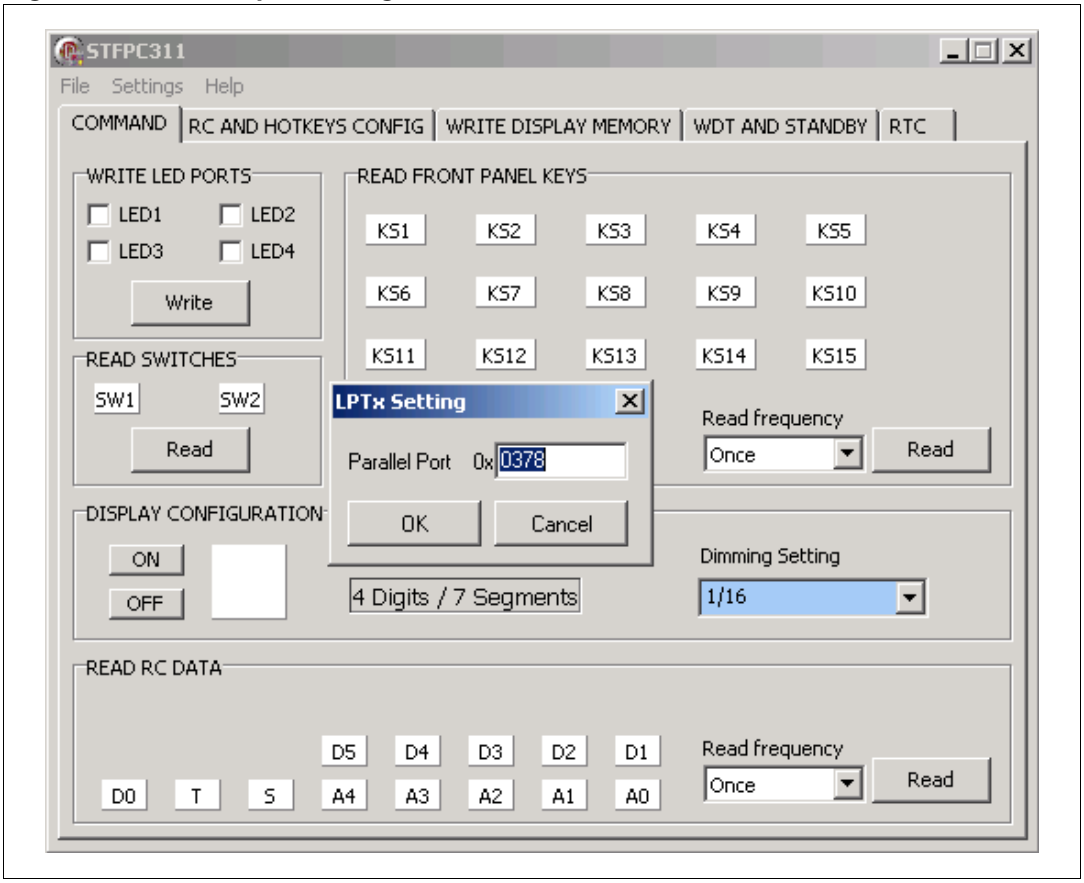
1. Connect the parallel cable to the host system.
2. Plug the external power supply into the board.

2 Using the evaluation software

1. Start the STFPC311_GUI evaluation software application.
2. Configure the parallel port; open the **Settings** tab from the main menu and select **LPTx Addr...** and enter the correct value as shown in *Figure 2*. (Default setting is `0378`.)
3. Switch ON the STFPC311 Evaluation Board.
4. Within 10 seconds after power-on, select the Ready High radio button located on the WDT and Standby tab (*Figure 3*). The Standby and Mute LEDs on the board will light up.

Note: Each time the GUI is invoked, the Ready High radio button is selected by default.

Figure 2. Parallel port configuration



2.1 WDT and Standby tab

The WDT and Standby tab enables the user to configure the Watchdog Timeout and Standby control settings.

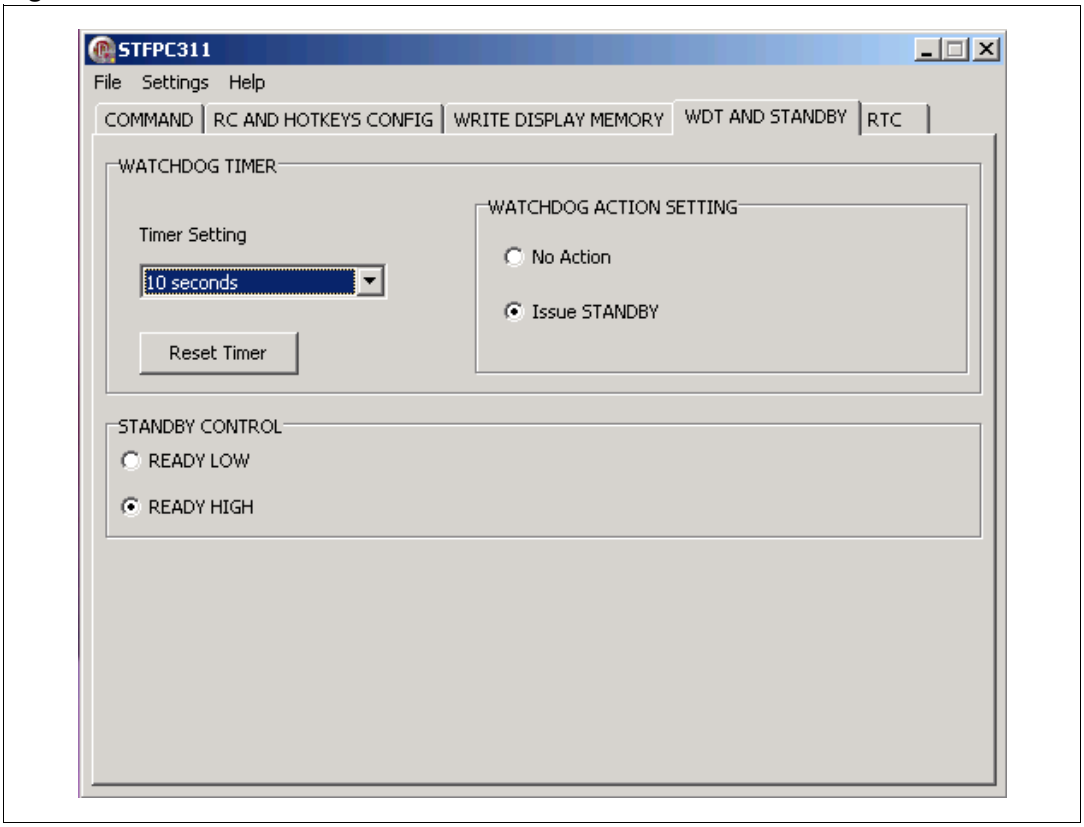
In the Watchdog Timer pane, use the Timer Setting pull-down menu to specify the Watchdog Timer timeout period. Select OFF or a timeout period from 1 to 15 seconds. The default value is 10 seconds.

Press Reset Timer to reset the Watchdog Timer counter.

The Watchdog Action Setting pane defines the action that takes place when the Watchdog Timeout expires. Select No Action to do nothing or Issue Standby to switch the VFD controller into Standby mode.

The STFPC311 continuously monitors the status of the READY pin. Once the READY pin goes low (Mute LED is OFF on the board), and within the preset timeout period (1s to 15s) it is not asserted high, the STFPC311 sets the STBY pin to a logic high (STBY LED is OFF on the board).

Figure 3. READY HIGH selection



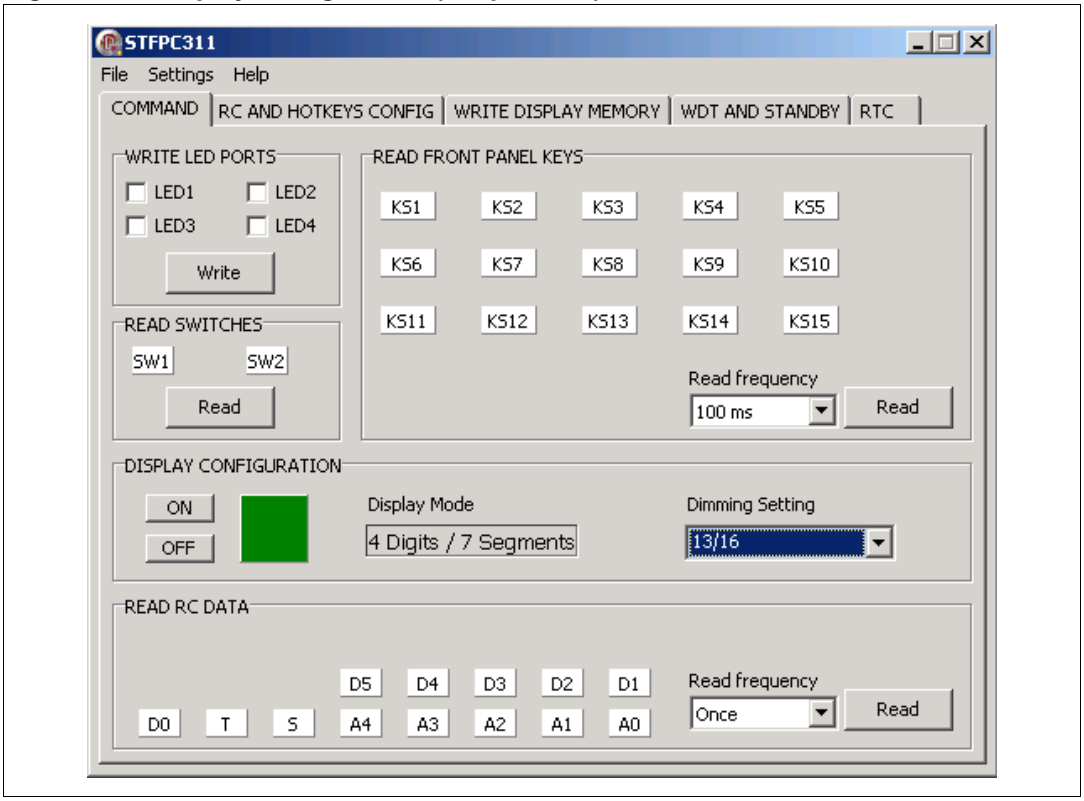
2.2 Command tab

2.2.1 Display configuration

Select the appropriate dimming settings for the LED display.

The Display Mode (digits and segments) is pre-selected.

Figure 4. Display configuration (ON position)



2.2.2 Write LED ports

The Write LED Ports pane enables the user to switch ON or OFF the evaluation board LEDs.

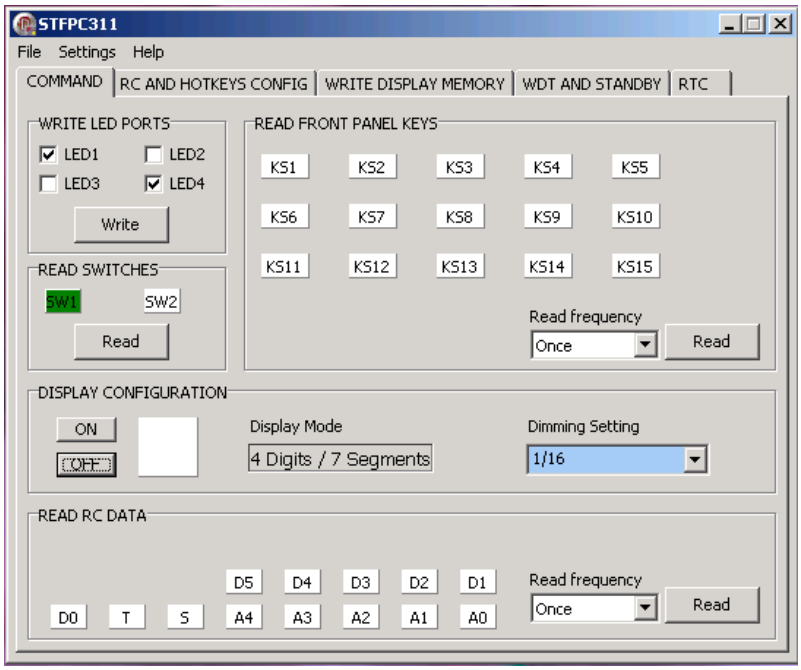
Select the required check boxes (LED1 to LED4) and click Write to switch ON the corresponding LEDs as shown in the example in *Figure 5*.

2.2.3 Read switches

The Read Switches button enables the user to read the status of the STFPC311 evaluation board switches.

Click Read to display the status of switches SW1 and SW2. A green background indicates that the corresponding switch is closed (ON) as shown in *Figure 5*.

Figure 5. Write LED Ports and Read Switches

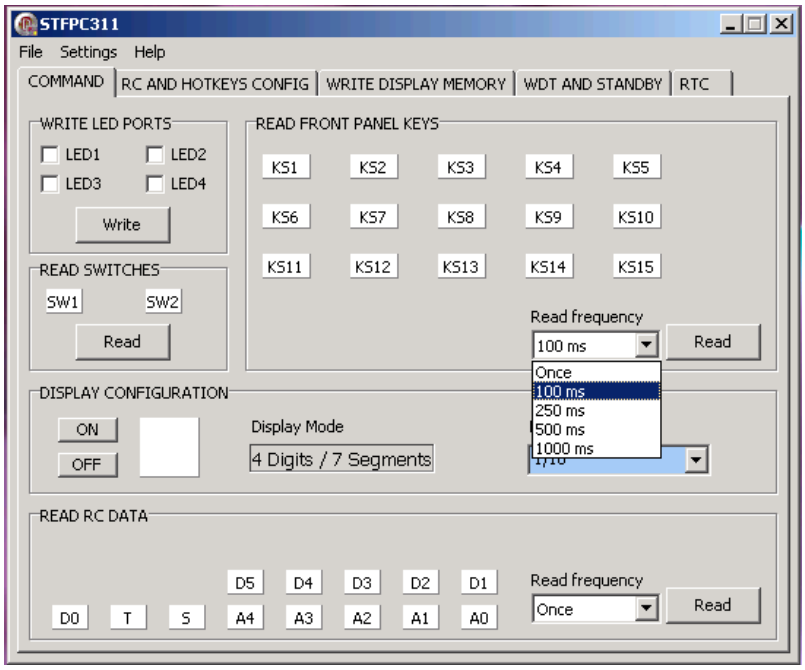


2.2.4 Setting the Read frequency

The user can select the time period after which the status of the Front Panel Keys is read. The same option is also available for RC Data (*Figure 6*).

Select the correct frequency: Once (default) or every 100ms, 250ms, 500ms or 1000ms.

Figure 6. Read frequency selection



2.2.5 Read RC Data

The decoded IR commands are sent to the main processor through the serial interface by sending 3 bytes of data. The Read RC Data pane represents the 24 bits of these 3-byte data frames.

2.2.6 Read front panel keys

The Read Front Panel Keys pane enables the user to read the status when the keys on the evaluation board are pressed. Click the Read Frequency to display the status of keys KS1 to KS15. A green background indicates that the corresponding key is pressed.

2.3 Write Display Memory tab

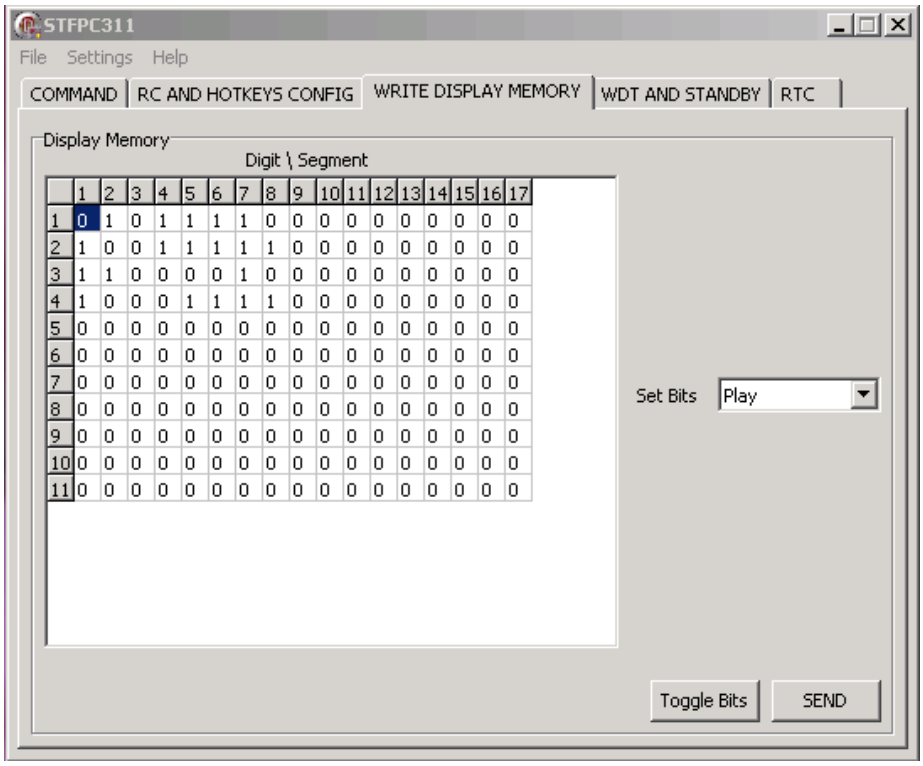
The Write Display Memory tab (*Figure 7*) enables the user to select the data displayed on the LED display.

From the Set Bits drop-down menu, select the data bit-map to be displayed: Reset, Play, CH2 or 15:30. Click Send to write the data to the display memory.

Click Toggle Bits to switch bit values in the Display Memory pane, and then click Send to write the data to the display memory.

Also, the bit-map can be configured by double-clicking the bits in the Display Memory area. Click Send to write the data to the display memory.

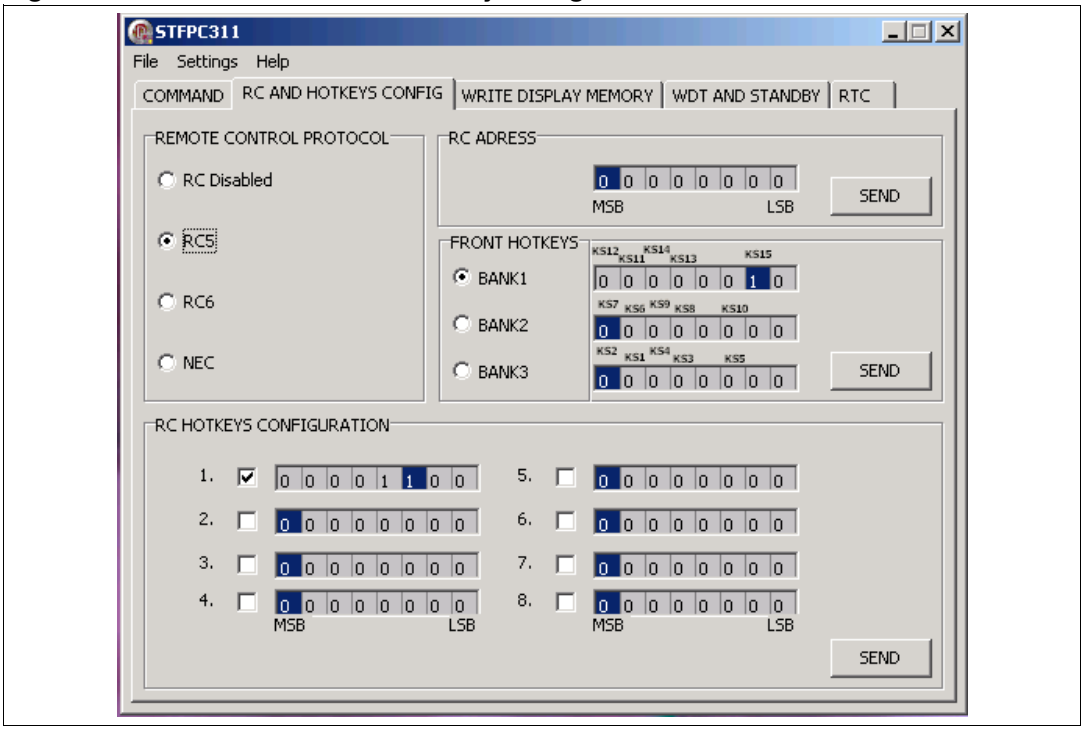
Figure 7. LED data display selection



2.4 RC and Hotkeys Config tab

The RC and Hotkeys Config tab is used to configure the remote control and hotkeys as shown in the example given in *Figure 8*.

Figure 8. Remote control and hotkey configuration



2.4.1 RC protocol

The STFPC311 supports three Remote Control (RC) protocols, RC5, RC6, and NEC. (For more information, see *Appendix A on page 13*.)

Select the appropriate protocol using radio buttons in the Remote Control Protocol pane.

The RC5 and RC6 protocols use bi-phase modulation Manchester encoding where logic transitions represent a logic high or logic low signal.

The NEC protocol uses pulse distance bit encoding. A logic ‘1’ takes 2.25 ms to transmit, while a logic ‘0’ takes only 1.12 ms. A message starts with a 9ms Auto Gain Control (AGC) burst, which is followed by a 4.5 ms space, which is then followed by the Address and Command.

The Address and Command are transmitted twice. The second time, all the bits are inverted and are used to verify the received message.

2.4.2 RC address

The address of the Remote Control unit that will communicate with the STFPC311 must be specified. Enter the 8 bit values of the protocol address of the Remote Control unit in the text box of the RC Address pane. For example, the address for the RC5 protocol is 0x00. *Table 1* lists the RC protocol address and Standby hotkey configuration values. Double-click on each of the bits to change its value.

2.4.3 RC and hotkey configuration

The STFPC311 GUI supports 24 Front Panel Keys, 8 of which may be programmed as RC hotkeys using check boxes in the RC Hotkeys Configuration pane as shown in *Figure 8*. For example, the RC hotkey configuration for Standby mode in RC5 protocol is 0000 1100 (0Ch).

Table 1. RC protocol address and STANDBY RC hotkey

Protocol	Address	RC hotkey Configuration for STANDBY
RC5	0000 0000 (00h)	0000 1100 (0Ch)
RC6	0010 0111 (27h)	0000 1100 (0Ch)
NEC	0000 0010 (02h)	1000 1000 (88h)

2.4.4 Front panel hotkeys

The Front Panel Hotkeys pane is used to configure hotkeys. Select the correct bank (Bank1, Bank2 or Bank3) and double-click on each of the bits to change its value. For more information, see *Appendix B on page 21*.

2.4.5 Front panel hotkey configuration

The STFPC311 GUI supports 24 Front Panel Keys, 8 of which may be programmed as RC hotkeys using the RC Hotkey Configuration pane.

The Front Panel Hotkeys pane (*Figure 8*) shows the settings used to configure the KS15 key as a hotkey. For more information, see the corresponding Hotkey Configuration section in *Appendix A on page 13*.

Example of Hotkey use:

1. To put the VFD controller in Standby mode, select the Ready Low option in the Standby Control pane on the WDT and Standby tab.

   When the VFD controller is in Standby mode, there are two ways to wake-up the controller:

   a) Press the remote control Standby key, or

   b) Press the Front Panel hotkey

2. After the controller wakes up from Standby mode, select the Ready High option in the Standby Control pane on the WDT and Standby tab within the timeout period, otherwise the controller switches into Standby mode again.

For more information about how commands are sent, see *Section 2.2: Command tab*.

2.5 RTC tab

The Real-Time Clock (RTC) tab (*Figure 9*) is used to configure the current time and date for the RTC on the evaluation board. It is also used to configure an Alarm function of the RTC used to check the interrupt status.

The Time Settings pane displays the current system date and time and provides an interface for modifying these values. Click Send to store updated values in the RTC registers.

In the Alarm Settings pane, set the date and time to trigger the RTC interrupt. Select Enable Alarm to enable the interrupt.

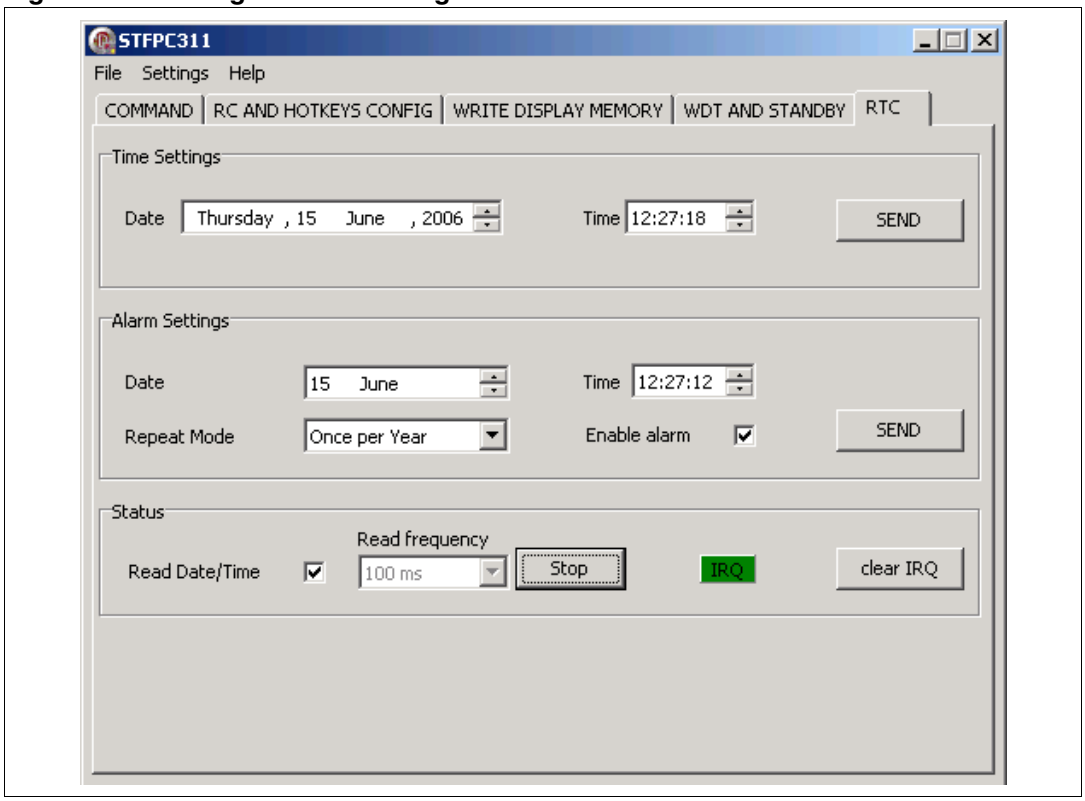
Use the Repeat Mode drop-down menu to select the interrupt repetition rate: once per second, minute, hour, day, month or year. Click Send to store the configuration in the RTC registers.

The user can specify the frequency at which the RTC interrupt status is to be read using the Read Frequency pull-down menu in the Status pane. Click Clear IRQ to clear the interrupt.

Note: The color of IRQ label changes to green when the RTC interrupt is generated.

If the Read Date/Time check box is selected, the Time Settings pane displays the system time.

Figure 9. Setting the alarm using the RTC



Appendix A Remote control protocols

A.1 RC5 protocol

A.1.1 RC5 protocol key interpretation

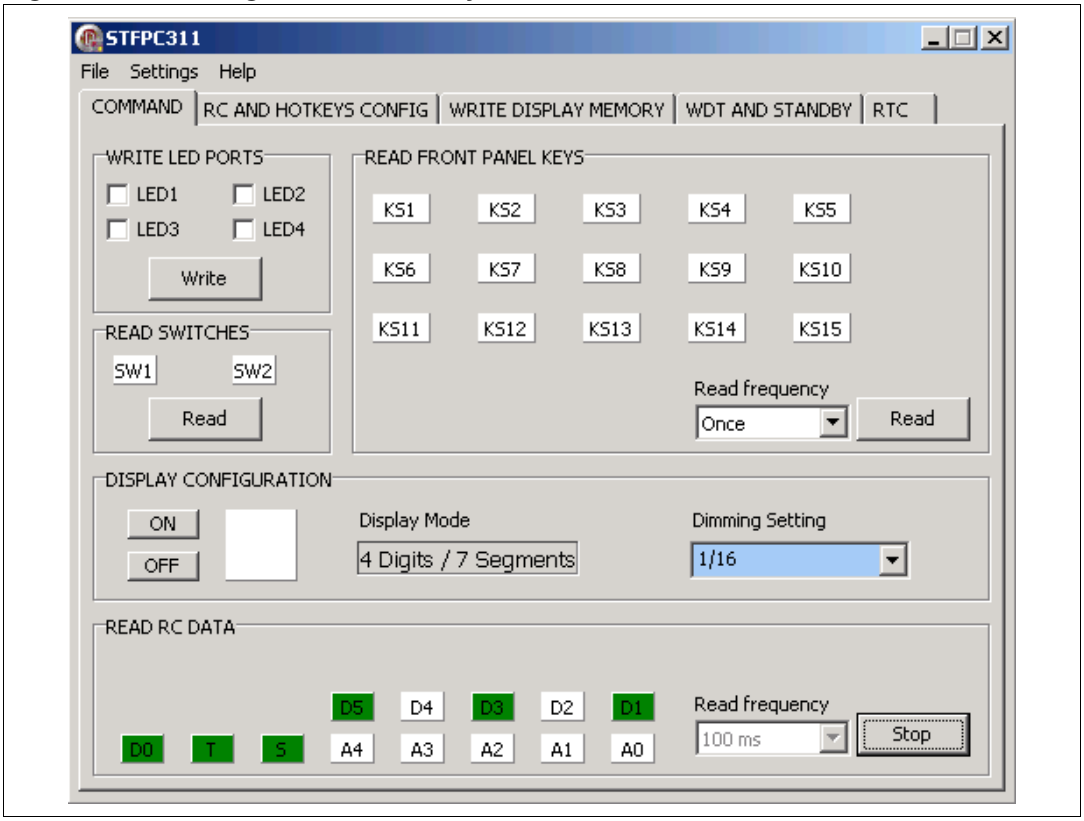
Figure 10 shows the value in the 3-byte data frame when the RC5 remote control Standby key is pressed.

The RC key interpretation of these bit values for the 3-byte data frames for the various STFPC311 protocols is as follows:

- A0 to A4: Device Address
- S: Start bit
- T: Toggle bit
- D0 to D5: Key Code Data
- Others: Stuffed bits (ignored)

Note: See Section 2.4: RC and Hotkeys Config tab on page 10 for more protocol information

Figure 10. Reading the RC5 Standby data



A.1.2 RC5 hotkey configuration

Figure 11 shows the STFPC311 being configured to interface with the RC5 protocol-based remote control.

The RC5 hotkey addressing for Standby configuration is as follows:

- RC Address: 0x00
- Hotkey: Standby (code: 0x0C)

The RC5 protocol uses Bi-phase modulation Manchester encoding in which a low-to-high transition represents a logic high signal, and a high-to-low transition represents a logic low signal.

Note: See Section 2.4: RC and Hotkeys Config tab on page 10 for more protocol information.

Figure 11. RC5-based remote control Standby configuration

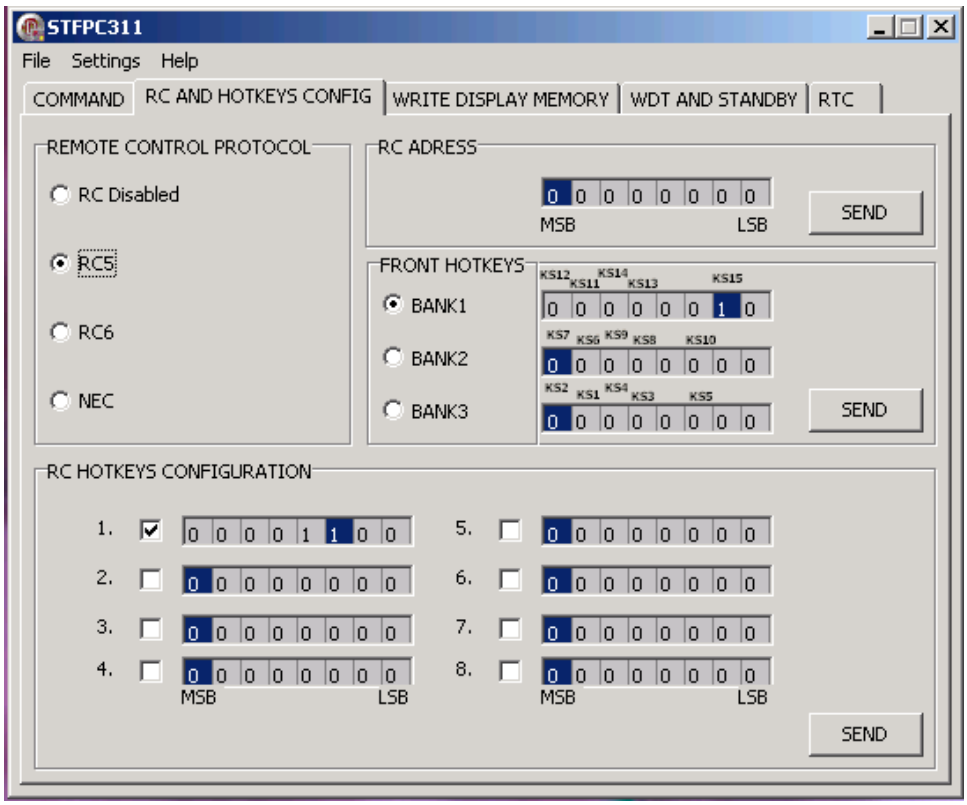
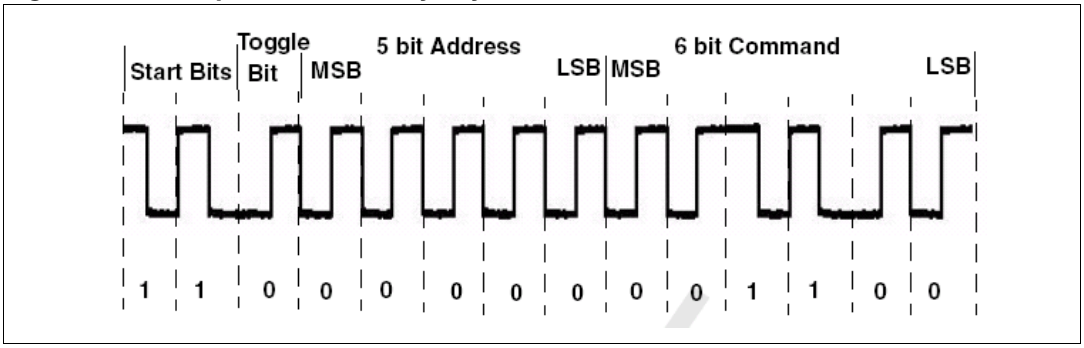


Figure 12 shows the signal at the IR sensor output when the RC5 Standby key is pressed. The output shown is an inversion of the IR signal received by the IR sensor.

Figure 12. RC5 protocol Standby key waveform



A.2 RC6 protocol

A.2.1 RC6 protocol key interpretation

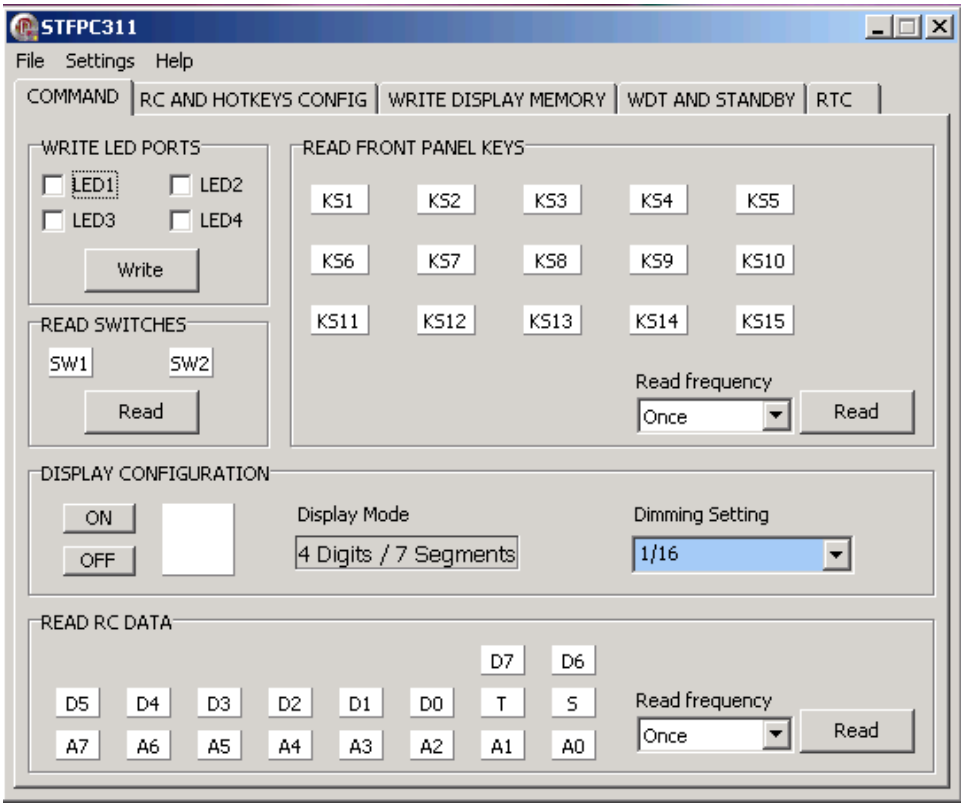
Figure 13 shows the signal at the output of IR sensor when Standby key of RC6 remote control is pressed.

The RC key interpretation of these bit values for the 3-byte data frames for the various STFPC311 protocols is as follows:

- A0 to A7: device Address
- S: Start bit
- T: Toggle bit
- D0 to D7: Key Code Data
- Others: Stuffed bits (ignored)

Note: See Section 2.4: RC and Hotkeys Config tab on page 10 for more protocol information.

Figure 13. Reading the RC6 Standby data



A.2.2 RC6 hotkey configuration

Figure 14 shows STFPC311 being configured to interface with the RC 6 protocol-based remote control.

The RC6 hotkey addressing for the Standby configuration is as follows:

- RC Address: 0x27
- Hotkey: Standby (code: 0x0C)

The RC6 protocol uses Bi-phase modulation Manchester encoding in which a low-to-high transition represents a logic low signal and a high-to-low transition represents a logic high signal.

Note: These transitions are the opposite of those in the RC5 protocol.

Note: See Section 2.4: RC and Hotkeys Config tab on page 10 for more protocol information.

Figure 14. RC6-based remote control Standby configuration

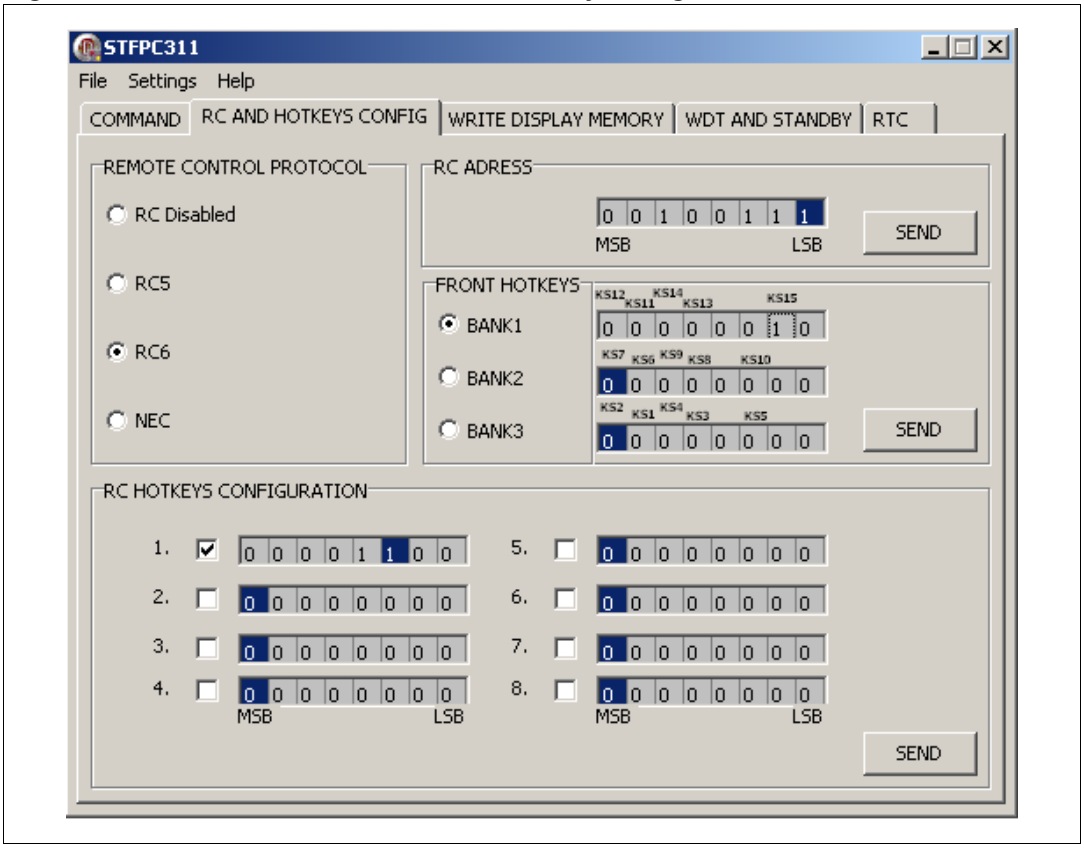
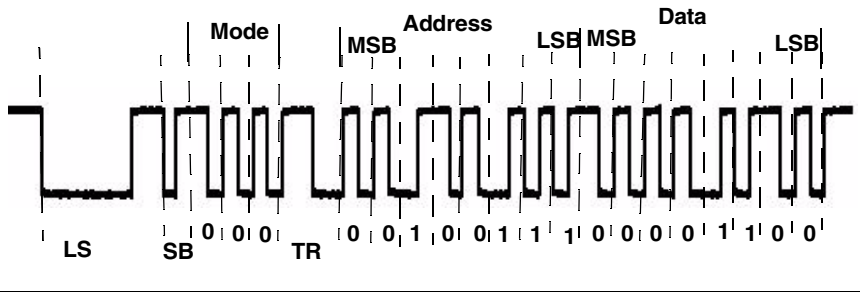


Figure 15 shows the signal at the IR sensor output when the RC6 Standby key is pressed. The output shown in an inversion of the IR signal by the IR sensor.

Figure 15. Standby Key for RC6 protocol



Note: LS: Leader Start Pulse
SB: Start Bit
TR: Trailer Bit

A.3 NEC protocol

A.3.1 NEC protocol key interpretation

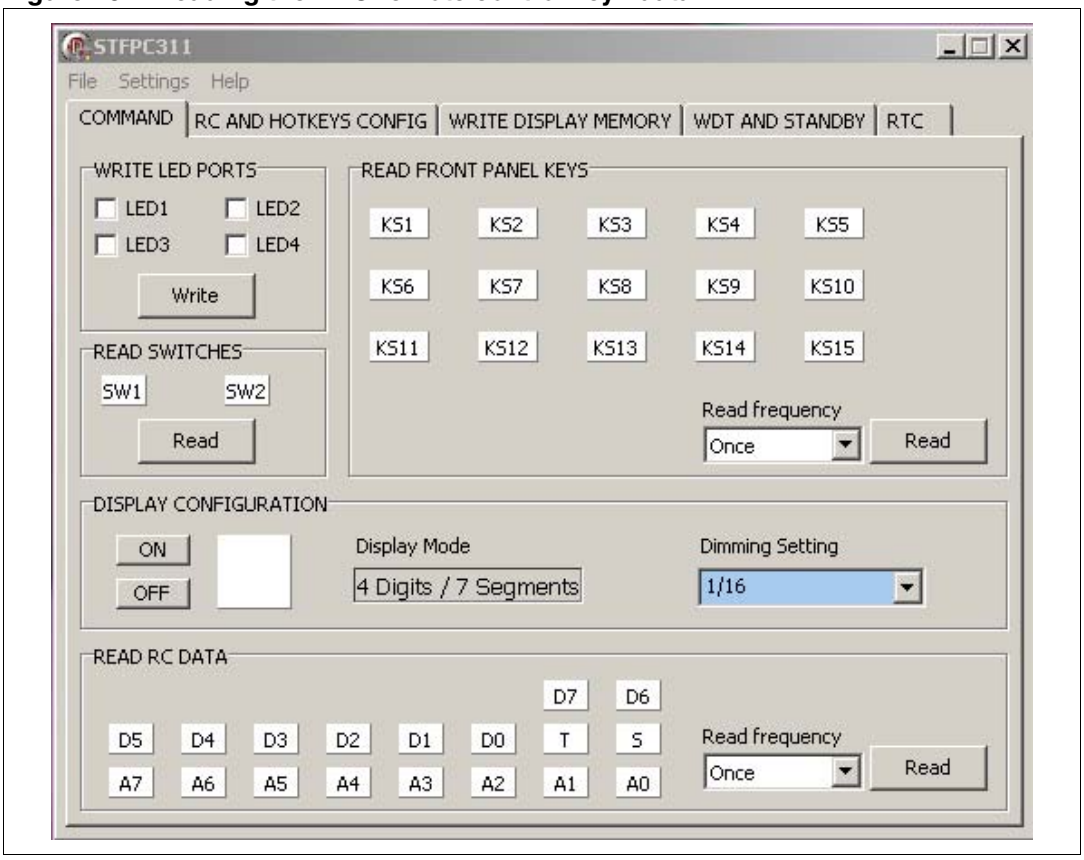
Figure 16 shows the value of the 3-byte data frame when KEY1 of NEC remote is pressed.

The RC key interpretation of these bit values for the 3-byte data frames for the various STFPC311 protocols is as follows:

- A0 to A7: device Address
- S: Start bit
- T: Toggle bit
- D0 to D7: Key Code Data
- Others: Stuffed bits (ignored)

Note: See Section 2.4: RC and Hotkeys Config tab on page 10 for more protocol information.

Figure 16. Reading the NEC remote control key1 data



A.3.2 NEC hotkey configuration

Figure 17 shows STFPC311 being configured to interface with NEC protocol-based remote control.

The NEC hotkey addressing for the Key1 configuration is as follows:

- RC Address: 0x02
- Hotkey: Key1 (Code: 0x88)

A command is transmitted only once, even when the key on the remote control remains pressed. Every 110ms, a repeat code is transmitted for as long as the key remains down. This repeat code is simply a 9-ms AGC burst, followed by 2.23-ms space and a 560-µs burst.

Note: See Section 2.4: RC and Hotkeys Config tab on page 10 for more protocol information.

Figure 17. NEC-based remote control Key1 configuration

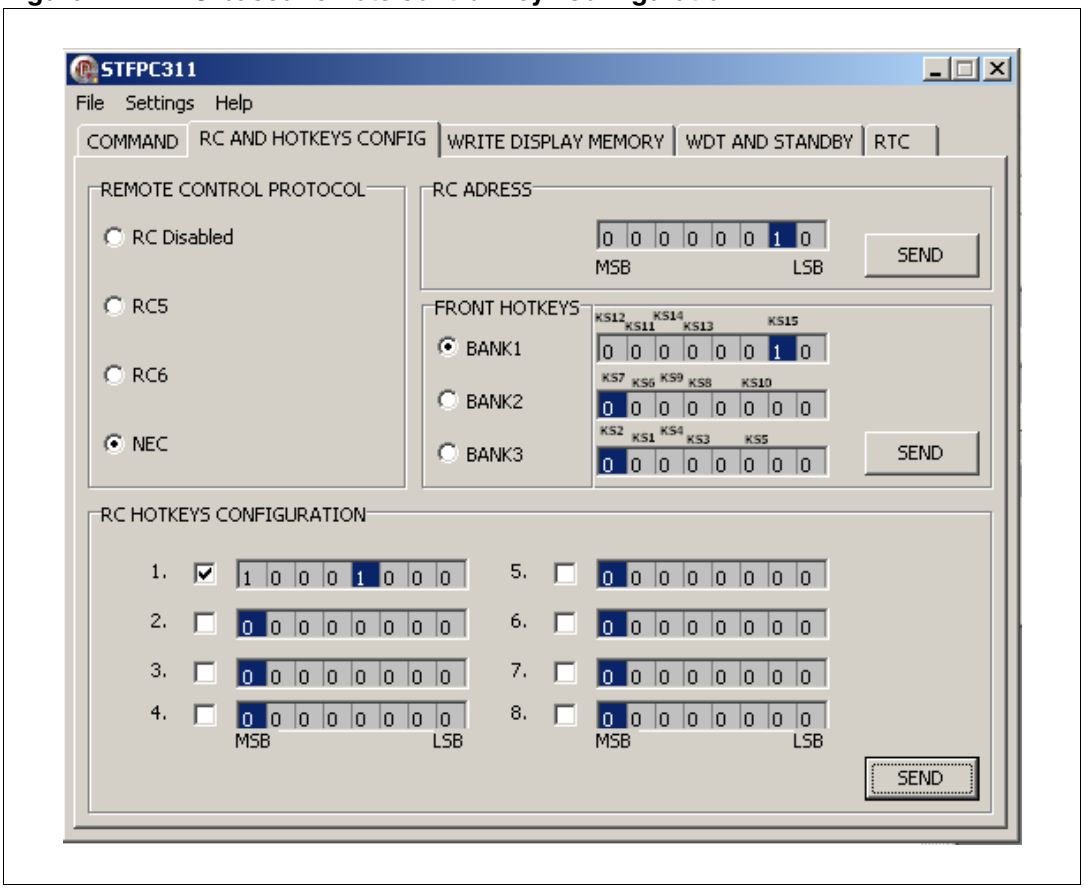
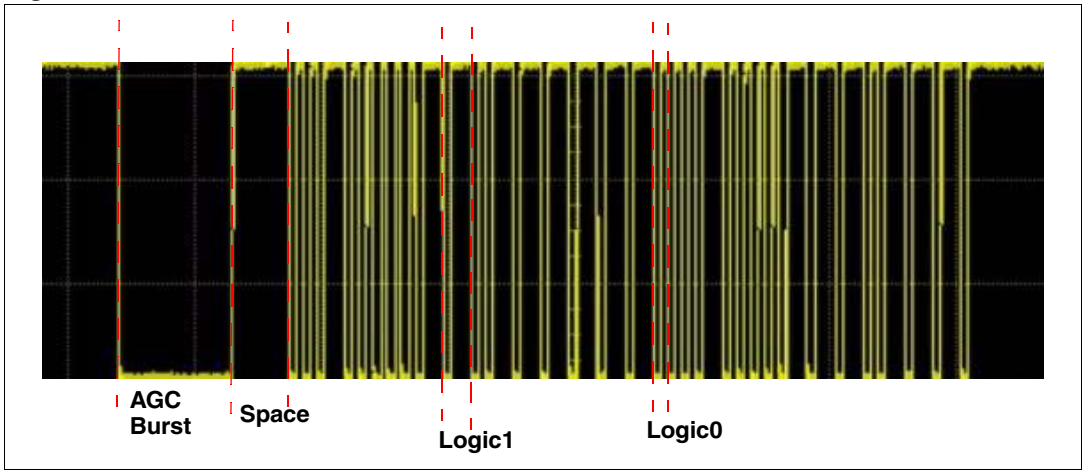


Figure 18 shows the signal at the IR sensor output when the NEC remote control Key1 is pressed. The output shown is an inversion of the IR signal received by the IR sensor.

Figure 18. NEC Protocol KEY1 code waveform



Appendix B Front panel key banks

STFPC311 has key data memory of size 2x12, which means it can support 24 front panel hotkeys. These keys are divided into 3 banks of 8 keys each.

Figure 19. Keys in Bank1

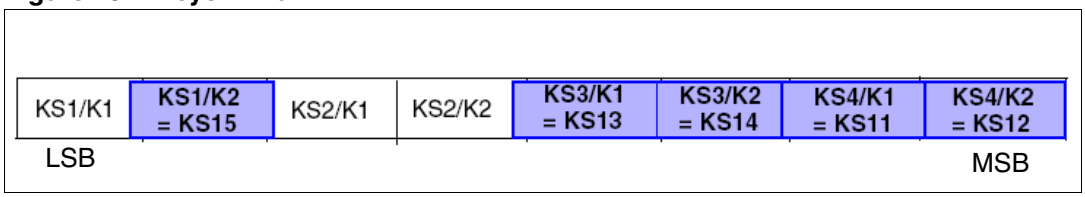


Figure 20. Keys in Bank2

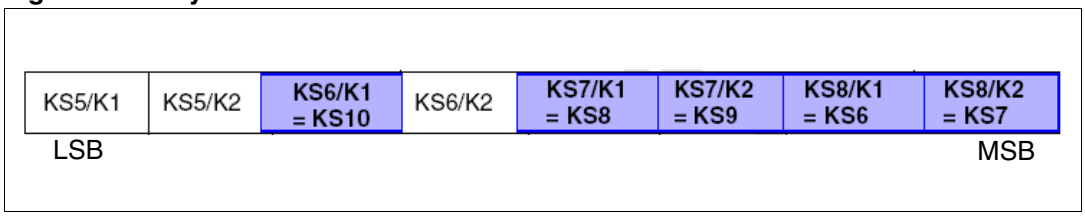


Figure 21. Keys in Bank3

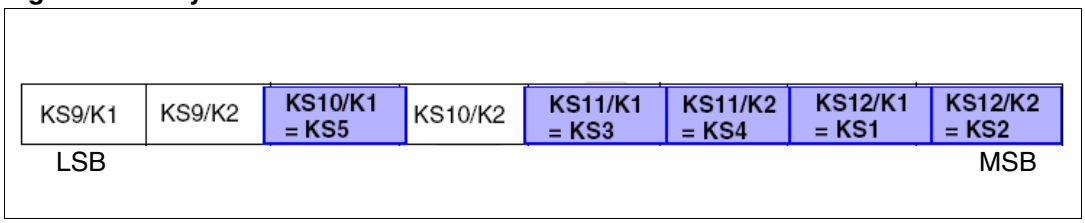


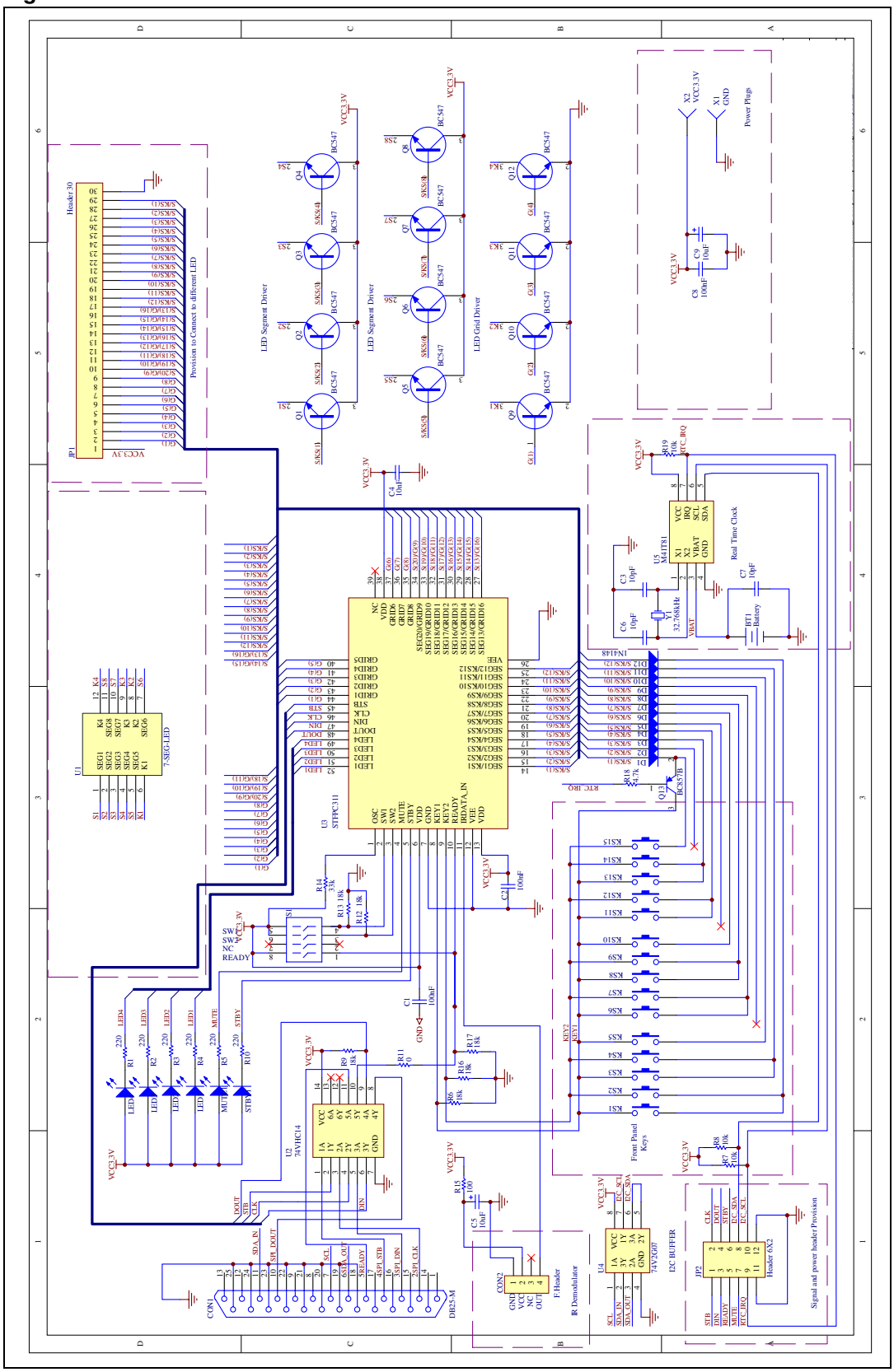
Table 2. Bill of materials (BOM)

#	Qty	Reference / footprint	Value / generic part number	Description	Manufacturer
1	1	BT1	BAT-2	Berg strip for battery	Any
2	3	C1, C2, C8	100 nF	Capacitor	Any
3	2	C3, C6, C7	10 pF	Capacitor	Any
4	1	C4	10 nF	Capacitor	Any
5	2	C5, C9	10 µF	Capacitor	Any
6	1	CON1	DB25 - 25 pin male	Connector	Any
7	1	CON2	Header – SIP4	Connector	Any
8	12	D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12	Diode - 0.4	Diode	Any
9	1	JP1	Header HDR1X30	Header	Not mounted
10	1	JP2	HDR6X2	Header	Any

Table 2. Bill of materials (BOM) (continued)

#	Qty	Reference / footprint	Value / generic part number	Description	Manufacturer
11	15	KS1, KS 2, KS 3, KS 4, KS 5, KS 6, KS 7, KS 8,KS 9, KS 10, KS 11, KS 12, KS 13, KS 14, KS 15	Push tact switch	Keys	Any
12	6	LED1, LDE2, LED3, LED4, Mute, STBY1	SMD	LED	Any
13	1	Q13	SOT-23/BC857B	PNP Transistor	Any
14	13	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11,Q12	SOT-23/BC547	NPN Transistor	Any
15	6	R1, R10, R2, R3, R4, R5	220 Ω	Resistor	Any
16	1	R11	0 Ω	Resistor	Any
17	6	R6, R9,R12, R13, R16, R17	18 kΩ	Resistor	Any
18	1	R14	33 kΩ	Resistor	Any
19	1	R15	100 Ω	Resistor	Any
20	3	R7, R8, R19	10 kΩ	Resistor	Any
21	1	R18	4.7 kΩ	Resistor	Any
22	1	S1	SW-DIP4	DIP switch	Any
23	1	U1	7-SEG-LED	Seven segment display	Any
24	1	U2	74VHC14TTR	Hex - inverter	ST
25	1	U3	STFPC311BTR	VFD Controller	ST
26	1	U4	74V2G07STR	I^2C Buffer	ST
27	1	U5	M41T81M6E	RTC	ST
28	2	X1, X2	Banana socket	Socket	FARNELL 150-040
29	1	Y1	32.768 KHz-BCY-W2/D3.1	Crystal oscillator	Any

Figure 22. Schematic STFPC311- LED



3 Revision history

Table 3. Revision history

Date	Revision	Changes
31-Aug-2006	1	Initial release
02-Apr-2007	2	*Bill of materials (BOM)* and *Schematic STFPC311- LED* added

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