CE219033 – SENT_TX Basic Code Example

Objective
This code example demonstrates how to use the SENT TX Component to send CapSense® data over Single Edge Nibble Transmission (SENT) protocol.

Overview
This code example scans a capacitive slider and a button and sends the touch status over the SENT protocol. It also sends the touch status over the I²C bus, so that you can view the touch status using CapSense Tuner in PSoC® Creator™.

Requirements
Tool: PSoC Creator 4.1. See also Upgrade Information.

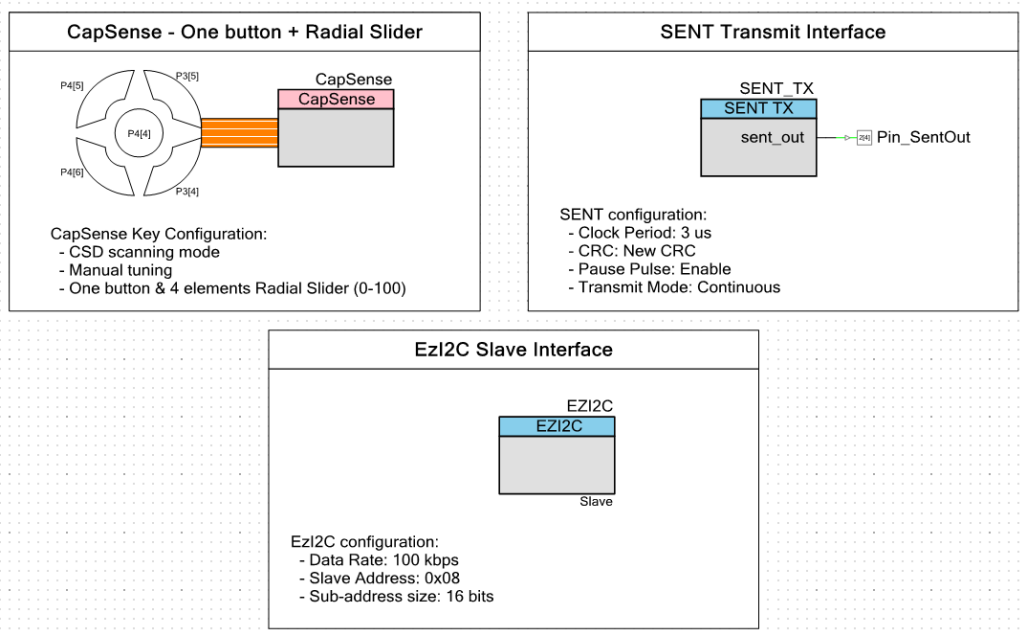
Programming Language: C (ARM® GCC 5.4-2016-q2-update, ARM MDK 5.22)

Associated Parts: All PSoC® 4 parts

Related Hardware: CY8CKIT-042, CY8CKIT-042-BLE-A, CY8CKIT-044, CY8CKIT-046, CY8CKIT-145-40XX

Design
This design uses the CapSense Component to scan the radial slider (made of four capacitive sensors in a circular fashion) and the center capacitive button based on CY8CKIT-044 - PSoC 4 M-Series Pioneer Kit. Raw data of these sensor elements are processed for touch detection. The touch status is sent over the SENT protocol using the SENT_TX Component. The CapSense tuner is also configured to send the touch status over the I²C protocol using the EZI2C Component.

Figure 1. Project Schematic Based on CY8CKIT-044 - PSoC 4 M-Series Pioneer Kit



Design Considerations
This code example works as it is with CY8CKIT-044 PSoC 4 M-Series Pioneer Kit. For other kits, configure the slider to radial or linear in the CapSense Component and select the pins accordingly in the *.cydwr* file.

Hardware Setup

Connect the SENT receiver input or oscilloscope probe to pin P2[4] to monitor the SENT transmitter output.

Software Setup

The default configuration of PSoC Creator is sufficient for this code example.

Components / User Modules

Table 1 lists the PSoC Creator Components used in this example, and the hardware resources used by each. Pin assignment for capacitive sensors vary based on the kit as shown below:

Table 1. List of PSoC Creator Components

Component	Version	Hardware Resources (For CY8CKIT-044)
CapSense	4.0	One CapSense block, 2 IDACs
SENT_TX	1.0	One TCPWM
EZI2C	3.20	One SCB
Digital Output Pin	2.20	Three I/Os: One for SENT output (P2[4]) Two for EZI2C – SDA (P4[1]), SCL (P4[0]) – Hidden in TopDesign
Analog Pin	2.20	Six I/Os: (all are hidden in TopDesign) Four for Radial slider (P3[5], P3[4], P4[6], P4[5]) One for Button (P4[4]) One for Cmod (P4[2])

Component	Version	Hardware Resources (For CY8CKIT-042)
Analog Pin	2.20	Six I/Os: (all are hidden in TopDesign) Four for Linear slider (P1[1], P1[2], P1[3], P1[4]) One for Button (P1[5]) One for Cmod (P4[2])
Please change Radial Slider to Linear Slider in the CapSense component and change line 149 in main.c file to below: `centroid_position = (uint8)CapSense_GetCentroidPos(CapSense_LINEARSLIDER0_WDGT_ID);`		

Component	Version	Hardware Resources (For CY8CKIT-042-BLE-A)
Analog Pin	2.20	Six I/Os: (all are hidden in TopDesign) Four for Linear slider (P2[1], P2[2], P2[3], P2[4]) One for Button (P2[5]) One for Cmod (P4[0])
Please change Radial Slider to Linear Slider in the CapSense component and change line 149 in main.c file to below: `centroid_position = (uint8)CapSense_GetCentroidPos(CapSense_LINEARSLIDER0_WDGT_ID);`		

Component	Version	Hardware Resources (For CY8CKIT-046)
Analog Pin	2.20	Six I/Os: (all are hidden in TopDesign) Four for Radial slider (P4[5], P4[4], P4[7], P4[6]) One for Button (P0[6]) One for Cmod (P4[2])

Component	Version	Hardware Resources (For CY8CKIT-145-40XX)
Analog Pin	2.20	Six I/Os: (all are hidden in TopDesign) Four for Linear slider (P0[0], P0[1], P0[2], P0[3]) One for Button (P0[6]) One for Cmod (P4[1])
Please change Radial Slider to Linear Slider in the CapSense component and change line 149 in main.c file to below: `centroid_position = (uint8)CapSense_GetCentroidPos(CapSense_LINEARSLIDER0_WDGT_ID);`		

Parameter Settings

Table 2 lists the configuration settings of the CapSense Component:

Table 2. CapSense Component Configuration

Parameter	Value	Comment
Basic:		
CSD Tuning Mode	Manual Tuning	CapSense Tuner can be used to tune the hardware parameters such as sense clock frequency, IDAC values, and software parameters including different thresholds
Widget 1	RadialSlider0 – Self-cap (4 sensing elements)	Configure the Radial Slider to use four sensing elements
Widget 2	Button0 – Self-cap (1 sensing element)	
Advanced (General):		
Enable IIR filter (First order)	Enable	Enable the IIR filter to reduce noise
Advanced (CSD Settings):		
Modulator clock frequency (kHz)	24000	Default
Inactive sensor connection	Ground	Default
IDAC sensing configuration	IDAC sourcing	Default
Enable IDAC auto-calibration	Disabled	Disable IDAC auto-calibration so it can also be tuned using CapSense tuner
Enable compensation IDAC	Enable	Default
Advanced (Widget Details):		
RadialSlider0	Scan resolution – 9 bits Modulator IDAC – 70	Based on manual tuning
Compensation IDAC of different sensor elements of Radial Slider0	RadialSlider0_Sns0 – 40 RadialSlider0_Sns1 – 42 RadialSlider0_Sns2 – 43 RadialSlider0_Sns3 – 50	Based on manual tuning
Button0 (CSD)	Sense clock frequency – 6000 kHz Scan resolution – 10 bits Modulator IDAC – 60	Based on manual tuning
Compensation IDAC of Button0	Button0_Sns0 – 55	Based on manual tuning
Threshold parameters are set to default		

Table 3 lists the configuration settings of the SENT_TX Component:

Table 3. SENT_TX Component Configuration

Parameter	Value	Comment
Clock Period	3 µs (Default)	Tick time
CRC	New CRC (Default)	New CRC as defined in SAE J2716 (Revised 2016-04)
Pause Pulse	Enable	Pause pulse is enabled in the SENT packet
Transmit Mode	Continuous (Default)	SENT component will keep transmitting last packet

Table 4 lists the configuration settings of the EZI2C Component:

Table 4. EZI2C Component Configuration

Parameter	Value	Comment
Data rate (kbps)	100	100 kbps I2C data rate
Primary slave address (7-bits)	0x08	I2C Slave address = 0x08
Sub-address size (bits)	16	Sub-address = 16 bits

Design-Wide / Global Resources

Figure 2 shows the pin-out assignment in .cydwr file

Figure 2. Pin out assignment

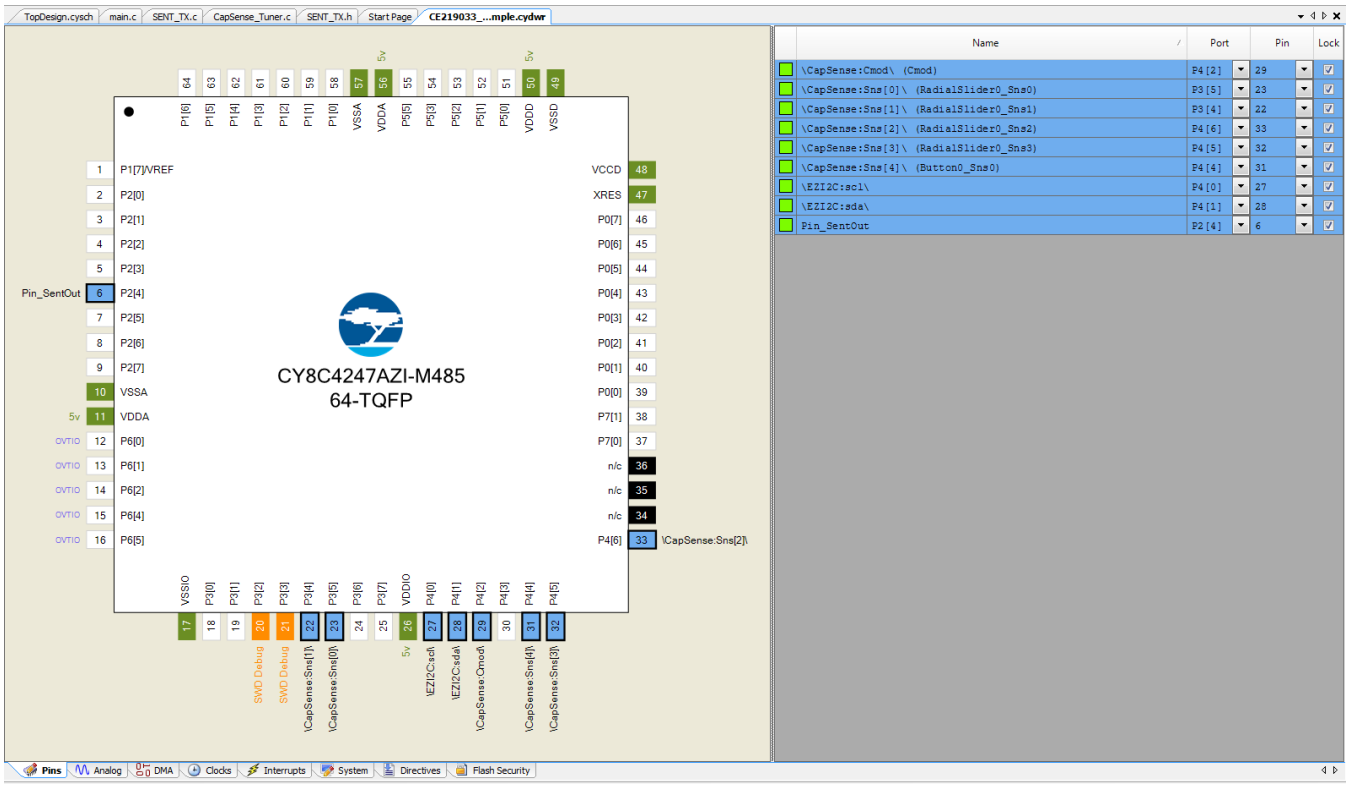
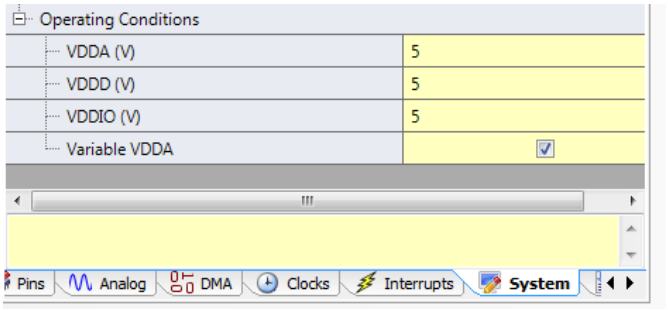


Figure 3 shows how to set the V_{DDA}, V_{DDD}, and V_{DDIO} supply voltages to 5 V. If this is not set to 5 V, the SENT_TX Component will throw an error as per SAE J2716 (Revised 2016-04-29) spec.

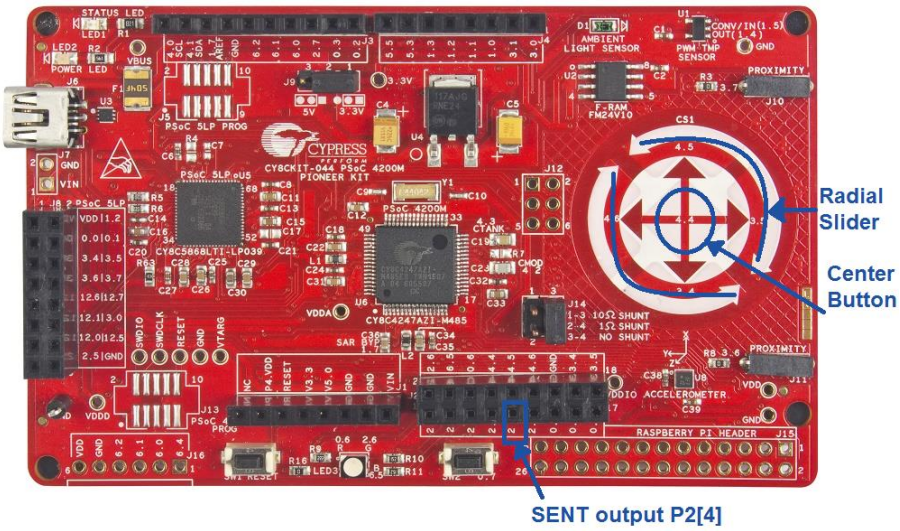
Figure 3. Operating Conditions (Supply Voltages)



Operation

Figure 4 shows how to test this code example with CY8CKIT-044 – PSoC 4200M Pioneer Kit.

Figure 4. Testing with CY8CKIT-044 - PSoC 4200M Pioneer Kit



To evaluate this code example, perform the following steps:

1. Connect the SENT decoder or oscilloscope to monitor the SENT output pin P2[4]. Figure 5 shows the SENT output decoded using SENT decoder in LeCroy WaveSurfer 10 oscilloscope.
   a. Data Nibble 0 (Status) = 0
   b. Data Nibble 1 (Most significant nibble of slider position) = 0xF (No touch on slider = 0xFF)
   c. Data Nibble 2 (Least significant nibble of slider position) = 0xF
   d. Data Nibble 3 (Button status) = 0x0 (No touch on button = 0x00)
   e. Data Nibble 4 = Data Nibble 1
   f. Data Nibble 5 = Data Nibble 2
   g. Data Nibble 6 = Data Nibble 3
   h. Data Nibble 7 (Calculated checksum)
2. Place the finger on the radial slider to see the change in data nibbles 1-2 and 4-5.
3. Place the finger on the center button to see the change in data nibbles 3 and 6.

Figure 6 shows the SENT output when the finger is touching both radial slider and the center button.

Figure 5. SENT decoder output (LeCroy WaveSurfer 10 oscilloscope) for No-Touch condition

Figure 6. SENT Decoder Output for Touch Detection on Slider and Button

Upgrade Information

Not required.

Related Documents

Application Notes	
AN64846	Getting Started with CapSense®
AN79953	Getting Started with PSoC® 4
AN85951	PSoC® 4 and PSoC Analog Coprocessor CapSense® Design Guide
PSoC Creator Component Datasheets	
TCPWM	PSoC 4 Timer Counter Pulse Width Modulator (TCPWM)
CapSense	PSoC 4 Capacitive Sensing (CapSense®)
EZI2C	PSoC 4 Serial Communication Block (SCB) configured as EZI2C Slave
Pins	Supports connection of hardware resources to physical pins
Device Documentation	
PSoC 4 Datasheets	PSoC 4 Technical Reference Manuals
Development Kit (DVK) Documentation	
PSoC 4 Kits	

Document History

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Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	5874630	KIKU	09/22/2017	New spec

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