

**HID & SYSTEM MANAGEMENT PRODUCTS, MOUSECODER™ FAMILY**
**DESCRIPTION**

The ScreenCoder™ USB IC is the first single IC that seamlessly interfaces ANY 4- or 8-wire resistive touch screen to a USB-equipped system. It is also the first touch screen controller IC on the market designed to accommodate a very wide range of size, capacitance and resistance of 4- or 8-wire touch screens, providing a universal performance solution among different OEM products and touch screen vendors. This unique feature of the IC provides OEMs with a wide variety of interchangeable touch screen options.

Unlike digitizers, the ScreenCoder™ USB integrates a digitizer with a controller that performs all touch detection, noise filtering, error elimination and provides the host with processed and stable positioning data over USB. Semtech's unique motion algorithms provide high resistance to RF and other noise sources resulting in precise, non-jittery cursor control.

Ideal application for the ScreenCoder™ USB include portable devices, interactive kiosks and industrial / custom displays with integrated touch screens.

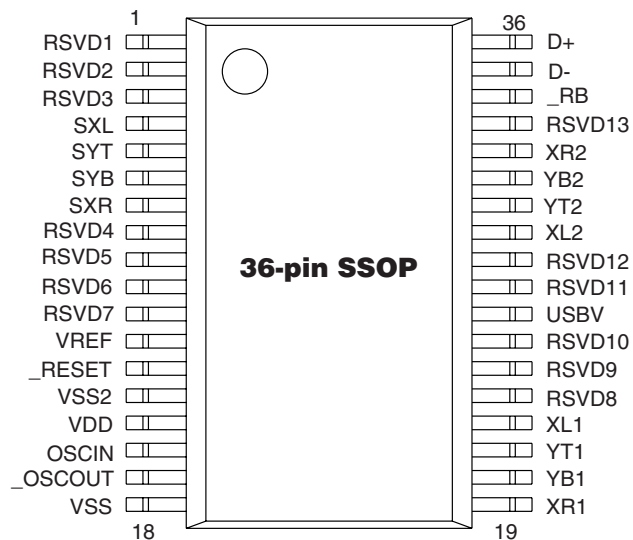
The universal features of the ScreenCoder™ USB, as implemented in both the system and the sensor interface, reduce the development effort and cost of touch input based systems. The ScreenCoder™ USB is available in a slim, 36-pin SSOP package.

**FEATURES**

- Controller & digitizer in a single IC
- Interfaces the system via USB
- Works with ANY 4- or 8-wire resistive touch screen regardless of size, material or vendor
- Provides high resolution - 1000 points per axis, enabling IC to make precise drawing and signature captures
- Accurate, quick touch response due to Semtech's advanced sampling technology and algorithms
- Highly resistant to RF and other noise
- No digitizer or external A/D necessary
- Fully compliant with USB HID specifications; works with native USB drivers including Windows® 98, Me and 2000
- Convenient calibration applet offered free of charge
- Uses slim 36-pin, SSOP package
- Customized versions available

**APPLICATIONS**

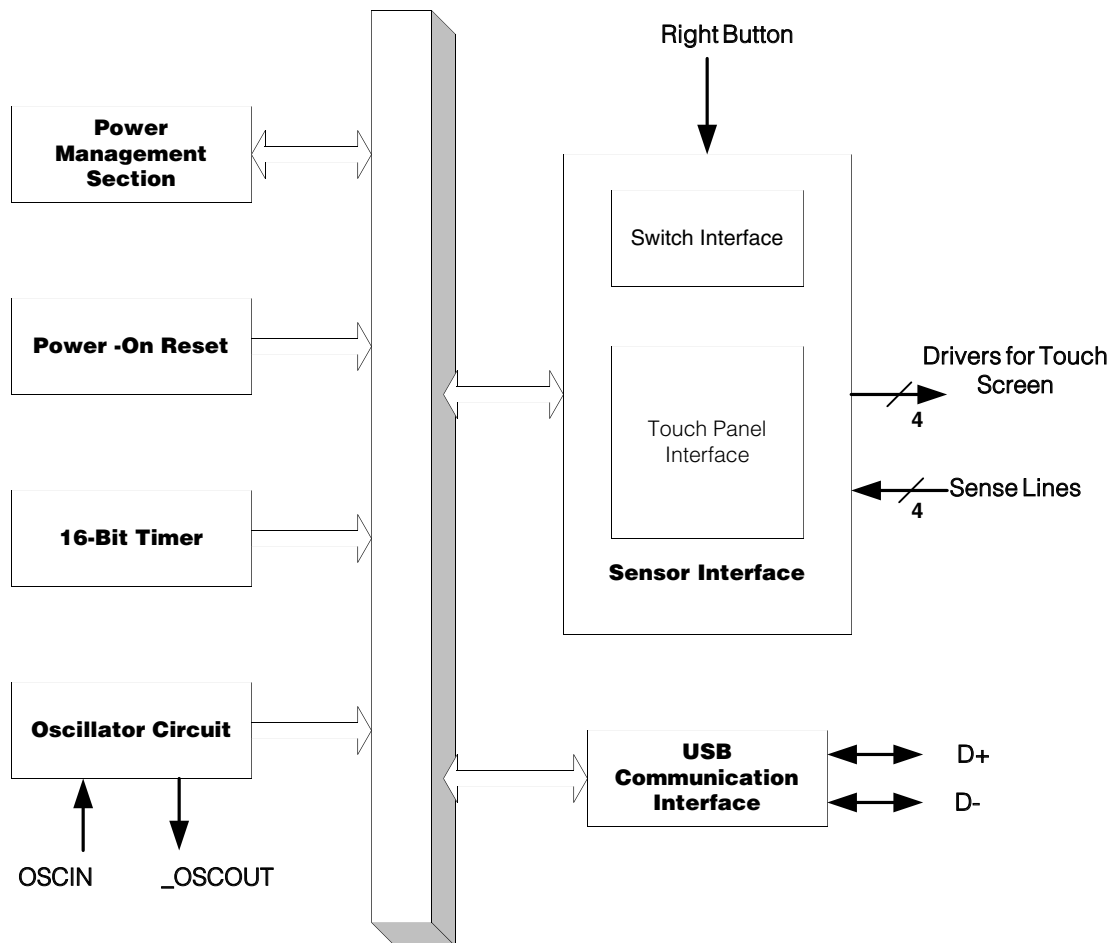
- Handhelds/Notebooks
- Portable Devices
- Interactive Kiosks
- Industrial/Custom Touch Screens

**PIN ASSIGNMENTS**


## ORDERING CODE

|                           |                      |                            |
|---------------------------|----------------------|----------------------------|
| <b>Package Options</b>    | <b>Pitch in mm's</b> | <b>TA=-20° C to +85° C</b> |
| 36-pin, Plastic SSOP      | 0.8mm                | UR7HCTS2-U860-DR           |
| <b>Other Materials</b>    | <b>Type</b>          | <b>Order number</b>        |
| ScreenCoder™ USB Eval Kit | Evaluation Kit       | EVK7-TS2-U860-XXX          |

## BLOCK DIAGRAM FOR THE UR7HCTS2-U860



## FUNCTIONAL DESCRIPTION

The UR7HCTS2-U860 consists functionally of five major sections (see the Functional Diagram on Page 2). These are the Sensor Interface, the Power Management Section, the 16-Bit Timer, the Oscillator Circuit and the USB Interface.

## OSCILLATOR

This IC has a built-in Oscillator circuit capable of operations with an external 6.00 MHz Clock source, or a Ceramic Resonator (preferably with built-in Load Capacitors) or a Crystal with external Load Capacitors.

## POWER MANAGEMENT

According to the USB specification, if there is no activity of the USB port for 3 ms, the system is considered to be in a suspended state. The ScreenCoder™ USB IC, on detecting that the system is in suspend, will check the state of the touch screen and the right button. If there is no touch pressure detected or no button pressed, the ScreenCoder™ USB enters into the suspended state. In suspend the IC fully complies with the USB specification for the power consumption, dissipating current only in the USB-mandated pull-up for the device identification.

Another technique the IC uses to conserve power is called remote wake-up. If the system relies on the device to perform wake-up, the IC will send a resume message to the system when there is activity on the touch screen or button.

## PIN DEFINITIONS

| Mnemonic             | Pin #                             | Type | Name and Function                           |
|----------------------|-----------------------------------|------|---------------------------------------------|
| <b>Power:</b>        |                                   |      |                                             |
| VDD                  | 15                                | P    | <b>Power Supply</b>                         |
| VSS                  | 14,18                             | P    | <b>Ground</b>                               |
| 3.3V                 | 22                                | P    | <b>USB Reference Voltage Out</b>            |
| _Reset               | 13                                | I    | <b>Reset</b>                                |
| <b>Oscillators:</b>  |                                   |      |                                             |
| OSCI                 | 16                                | I    | <b>Oscillator Input</b>                     |
| OSCO                 | 17                                | O    | <b>Oscillator Output</b>                    |
| <b>USB:</b>          |                                   |      |                                             |
| D-                   | 35                                | I/O  | <b>USB D- Line</b>                          |
| D+                   | 36                                | I/O  | <b>USB D+ Line</b>                          |
| <b>Touch Screen:</b> |                                   |      |                                             |
| XR1, XR2             | 19,32                             | I/O  | <b>Touch Screen Right Drive Pins</b>        |
| YB1, YB2             | 31,20                             | I/O  | <b>Touch Screen Bottom Drive Pins</b>       |
| YT1, YT2             | 21,30                             | I/O  | <b>Touch Screen Top Drive Pins</b>          |
| XL1, XL2             | 22,29                             | I/O  | <b>Touch Screen Left Drive Pins</b>         |
| SXR                  | 7                                 | AI   | <b>Touch Screen Sense Pin: for X Right</b>  |
| SYB                  | 6                                 | AI   | <b>Touch Screen Sense Pin: for Y Bottom</b> |
| SYT                  | 5                                 | AI   | <b>Touch Screen Sense Pin: for Y Top</b>    |
| SXL                  | 4                                 | AI   | <b>Touch Screen Sense Pin: for X Left</b>   |
| VREF                 | 12                                | AI   | <b>Voltage Reference for A/D Converter</b>  |
| SOUT                 | 23                                | O    | <b>Output control data to A/D Converter</b> |
| _RB                  | 34                                | I    | <b>Mouse Right Button</b>                   |
| RDVD1-13             | 1-3,8-11<br>23-25,<br>27-28<br>33 | I/O  | <b>Reserved for future use</b>              |

**Note:** An underscore before a pin mnemonic denotes an active low signal.

**Pin Types Legend:** I=Input; O=Output; I/O=Input or Output; P=Power; AI= Analog Input

## POWER MANAGEMENT (CON'T)

If the system does not allow remote wake-up, the ScreenCoder™ USB will not send resume messages to the system when it is awoken by activity on the touch screen or button.



## TOUCH SCREEN SENSOR INTERFACE

The ScreenCoder™ USB can acquire data from any 4- or 8-wire resistive touch screen sensors. The sensor interface has the following features:

### *Touch detection*

The IC periodically checks touch pressure applied to the panel. If there is no touch, the IC will not perform measurements and will not send data to system. When touch pressure is detected, the IC further qualifies and determines the amount of pressure. Semtech's proprietary, patent-pending touch detection algorithm performs this test very quickly, accommodating sensors with various plate-to-plate capacitances.

### *Touch Measurement*

Position information is only collected if it has been determined that the touch pressure is sufficient for an accurate reading. To obtain position information from the Resistive Touch Screen Sensor, the ScreenCoder™ USB uses four internal drivers (two pins for each driver) and four sense lines. During sampling, the drivers of the X-axis are activated by setting one X-drive high and the other X-drive low. The drivers for Y-axis are set floating. This action produces a voltage gradient across the touch screen's surface in the X direction. The internal A/D measures both the voltage across the activated X-plane and the voltage potential between the planes. Next, the drivers for the Y-axis are activated while the drivers for X-axis are set floating. Again, the internal A/D measures both voltage across the activated plane and potential between the planes. The X and Y absolute position is obtained from these four A/D measurements. The IC keeps measuring the touch pressure even while the positioning data is acquired. If insufficient touch pressure is detected during sampling of the position, the current data set will be rejected.

### *Touch algorithm*

Due to vibration and electrical noise, the raw data can not be used directly. Internal data processing delivers consistent position accuracy and quick touch response.

### *Resolution*

The ScreenCoder™ USB uses a built-in A/D converter to get the touch position. The maximum touch screen resolution is 1000 points per direction. Resolution varies somewhat for different touch screen sensors, due to voltage droop on connecting wires.

### *Touch screen from different makers*

Operating parameters for the touch screens from different manufacturers vary depending on the size of the sensor, material it is made from, and mechanical construction. The ScreenCoder™ USB takes these properties into account, and adjusts automatically for plate-to-plate capacitance, intrinsic plate resistances, etc.

### *Buttons*

The ScreenCoder™ USB implements both left and right buttons, however, there is no physical left button. Left button press is reported when there is touch pressure on the panel. The left button is released when there is no pressure on the panel. The right button is a physical button, and can be used individually.

## USB FUNCTIONALITY

The ScreenCoder™ USB is a low-speed USB device with remote wake-up capability. The IC asks the system to send report requests every 10ms according to USB specification for low speed device.

The ScreenCoder™ USB describes itself as a pointer, and provides absolute position data to the system.

## USB DESCRIPTORS

| Offset                          | Part                | Size | Value  | Description                                                     |
|---------------------------------|---------------------|------|--------|-----------------------------------------------------------------|
| <b>Device Descriptor</b>        |                     |      |        |                                                                 |
| 0                               | bLength             | 1    | 0x12   | Numeric expression specifying the size of device descriptor     |
| 1                               | bDescriptorType     | 1    | 0x01   | Device descriptor type                                          |
| 2                               | bcdUSB              | 2    | 0x0100 | USB HID spec release number 01.00                               |
| 3                               | bDeviceClass        | 1    | 0x00   | Class code                                                      |
| 4                               | bDeviceSubClass     | 1    | 0x00   | Sub class code                                                  |
| 5                               | bDeviceProtocol     | 1    | 0x00   | Protocol code                                                   |
| 6                               | bMaxPacketSize0     | 1    | 0x08   | Maximum packet size for EP0                                     |
| 8                               | idVendor            | 2    | 0x047A | USAR's vendor ID                                                |
| 10                              | idProduct           | 2    | 0x0004 | USAR ScreenCoder™ USB Product ID                                |
| 12                              | bcdDevice           | 2    | 0x0061 | Device release number                                           |
| 14                              | iManufacturer       | 1    | 0x04   | Index of string descriptor describing manufacturer              |
| 15                              | iProduct            | 1    | 0x0E   | Index of string descriptor describing product                   |
| 16                              | iSerialNumber       | 1    | 0x00   | Index of String descriptor describing serial number             |
| 17                              | bNum-               | 1    | 0x01   | Number of possible configurations                               |
| <b>Configuration Descriptor</b> |                     |      |        |                                                                 |
| 0                               | bLength             | 1    | 0x09   | Size of configuration descriptor in bytes                       |
| 1                               | bDescriptorType     | 1    | 0x02   | Configuration (assigned by USB)                                 |
| 2                               | wTotalLength        | 2    | 0x0022 | Total length of data returned for this                          |
| 4                               | bNumInterface       | 1    | 0x01   | Number of interfaces supported by this configuration            |
| 5                               | bConfigurationValue | 1    | 0x01   | Current configuration value                                     |
| 6                               | iConfiguration      | 1    | 0x00   | Configuration string descriptor index                           |
| 7                               | bmAttribute         | 1    | 0xA0   | Configuration characteristics - bus powered, with remote wakeup |
| 8                               | MaxPower            | 1    | 0x32   | Maximum power consumption of USB device 100 mA                  |
| <b>Interface Descriptor</b>     |                     |      |        |                                                                 |
| 0                               | bLength             | 1    | 0x09   | Size of Interface descriptor in bytes                           |
| 1                               | bDescriptorType     | 1    | 0x04   | Interface descriptor type                                       |
| 2                               | bInterfaceNumber    | 1    | 0x00   | Number of interface                                             |
| 3                               | bAlternateSetting   | 1    | 0x00   | Number of alternate setting                                     |
| 4                               | bNumEndpoints       | 1    | 0x01   | Number of endpoint                                              |
| 5                               | bInterfaceClass     | 1    | 0x03   | Class code (HID)                                                |
| 6                               | bInterfaceSubClass  | 1    | 0x00   | Subclass code (nor boot interface subclass)                     |
| 7                               | bInterfaceProtocol  | 1    | 0x02   | Protocol code = mouse                                           |
| 8                               | iInterface          | 1    | 0x00   | Index of string descriptor describing this interface            |
| <b>HID Descriptor</b>           |                     |      |        |                                                                 |
| 0                               | bLength             | 1    | 0x09   | Size of HID descriptor in byte                                  |
| 1                               | bDescriptorType     | 1    | 0x21   | HID descriptor type                                             |
| 2                               | bcdHID              | 2    | 0x0100 | HID Spec release number                                         |
| 4                               | bCountryCode        | 1    | 0x00   | Hardware target country                                         |
| 5                               | bNumDescriptor      | 1    | 0x01   | Number of HID class descriptor follow                           |
| 6                               | bDescriptorType     | 1    | 0x22   | Report descriptor type                                          |
| 7                               | wDescriptorLength   | 2    | 0x0038 | Total length of report descriptor                               |

## USB DESCRIPTORS, (CON'T)

| Offset | Part | Size | Value | Description |
|--------|------|------|-------|-------------|
|--------|------|------|-------|-------------|

### Endpoint Descriptor

|   |                  |   |        |                                         |
|---|------------------|---|--------|-----------------------------------------|
| 0 | bLength          | 1 | 0x07   | Size of endpoint descriptor in bytes    |
| 1 | bDescriptorType  | 1 | 0x05   | Endpoint descriptor type                |
| 2 | bEndpointAddress | 1 | 0x81   | Endpoint address (IN, Endpoint 1)       |
| 3 | bmAttribute      | 1 | 0x03   | Endpoint's attribute (interrupt)        |
| 4 | WMaxPacketSize   | 2 | 0x0005 | Maximum packet size                     |
| 6 | BInterval        | 1 | 0x0A   | Interval for polling (poll every 10 ms) |

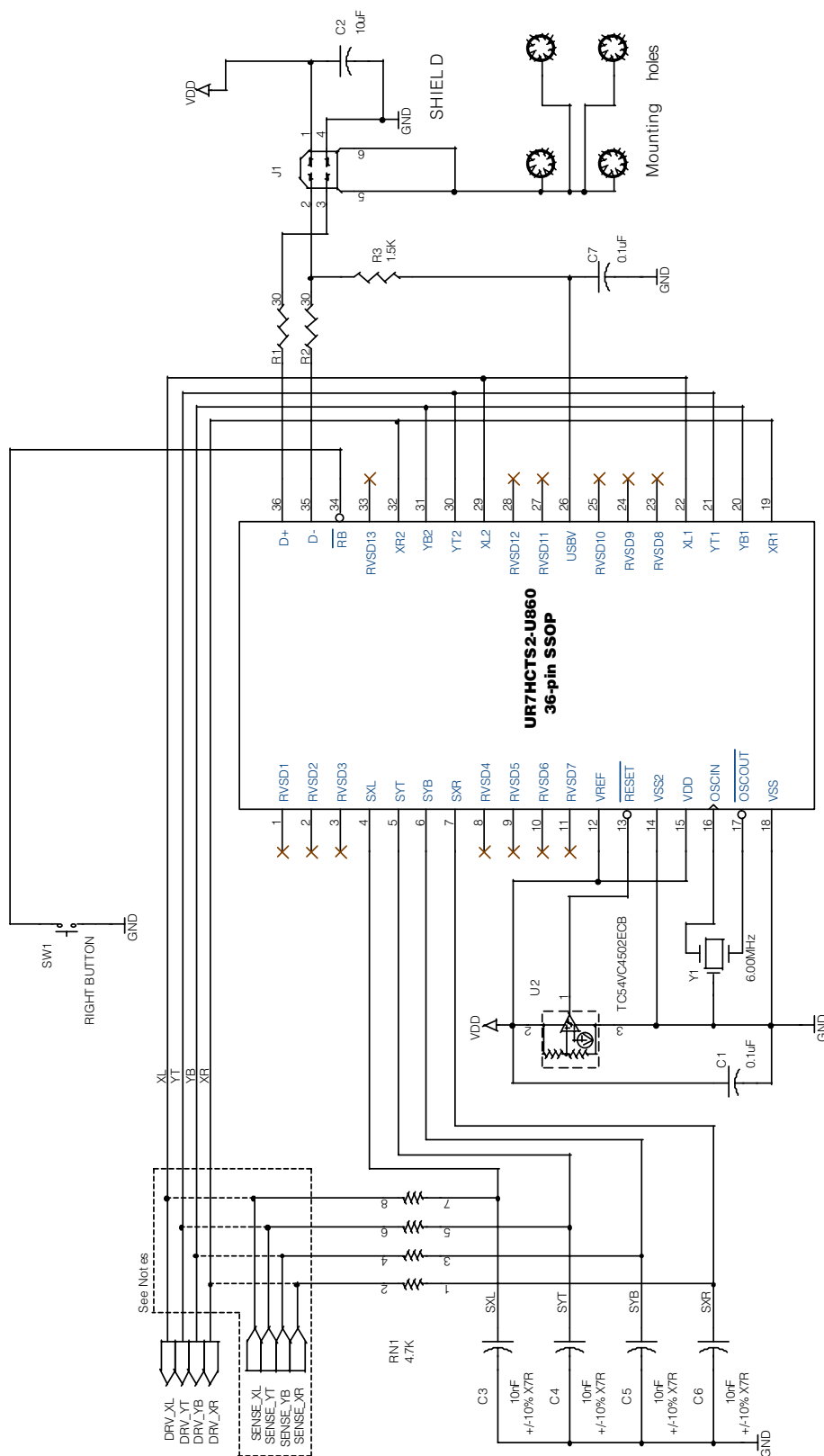
### String Descriptor

|    |                 |    |                                      |                                       |
|----|-----------------|----|--------------------------------------|---------------------------------------|
| 1  | bLength         | 1  | 0x04                                 | Length of string description in bytes |
| 2  | bDescriptorType | 1  | 0x03                                 | Descriptor type = String              |
| 3  | bString         | 2  | 0x0904                               | LangID code = English                 |
| 5  | bLength         | 1  | 0x0A                                 | Length of string descriptor           |
| 6  | bDescriptorType | 1  | 0x03                                 | Descriptor Type = String              |
| 7  | bString         | 8  | 'U',0,'S',<br>0,'A',0,<br>'R',0      | Manufacturer                          |
| 15 | bLength         | 1  | 0x3A                                 | Length of string descriptor           |
| 16 | bDescriptorType | 1  | 0x03                                 | Descriptor type = String              |
| 17 | bString         | 20 | 'S',0,'c',<br>0,'r',0,<br>'e',0,etc. | "ScreenCoderTM UR7HCTS2-U860"         |

| Offset | Data | Mnemonic | Value |
|--------|------|----------|-------|
|--------|------|----------|-------|

### Report Descriptor

|    |          |                  |                 |
|----|----------|------------------|-----------------|
| 0  | 05 01    | Usage Page       | Generic Desktop |
| 2  | 09 01    | Usage            | Pointer         |
| 4  | A1 01    | Collection       | Application     |
| 6  | 09 01    | Usage            | Pointer         |
| 8  | A1 00    | Collection       | Physical        |
| 10 | 05 09    | Usage page       | Buttons         |
| 12 | 19 01    | Usage Minimum    | 1               |
| 14 | 29 03    | Usage Maximum    | 3               |
| 16 | 15 00    | Logical Minimum  | 0               |
| 18 | 25 01    | Logical Maximum  | 1               |
| 20 | 95 03    | Report Count     | 3               |
| 22 | 75 01    | Report Size      | 1               |
| 24 | 81 02    | Input            | Variable        |
| 26 | 95 01    | Report Count     | 1               |
| 28 | 75 05    | Report Size      | 5               |
| 30 | 81 01    | Input            | Constant        |
| 32 | 05 01    | Usage Page       | Generic Desktop |
| 34 | 09 30    | Usage            | X               |
| 36 | 09 31    | Usage            | Y               |
| 38 | 15 00    | Logical Maximum  | 0               |
| 40 | 26 FF 7F | Usage Maximum    | 15 bits 7FFF    |
| 43 | 35 00    | Physical Minimum | 0               |
| 45 | 46 FF 7F | Physical Maximum | 15 bits 7FFF    |
| 48 | 75 10    | Report Size      | 16 bits         |
| 50 | 95 02    | Report Count     | 2               |
| 52 | 81 02    | Input            | Variable        |
| 54 | C0       | End Collection   |                 |
| 55 | C0       | End Collection   |                 |

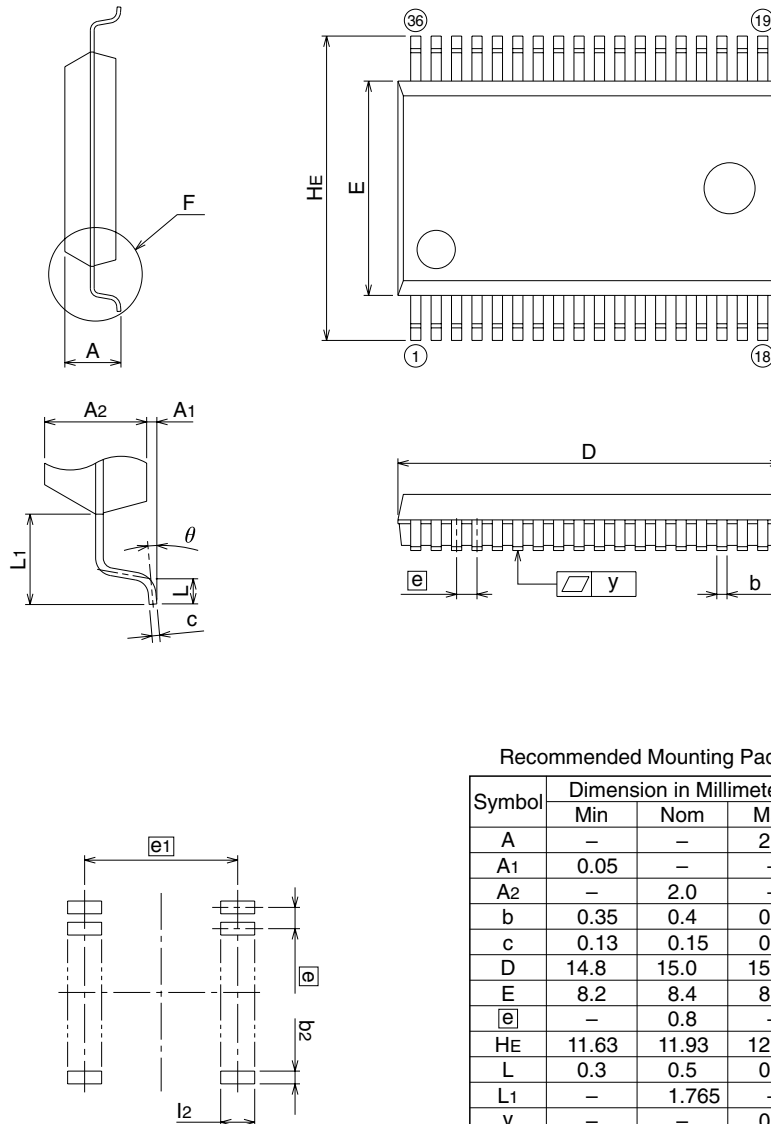


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ScreenCoder(TM) USB UR7HCTS2-U860

### NOTES:

U860 == USB Out, 6.00 MHz, 8/4-wire, Model0  
Connect Drive and Sense lines together for the 4-wire sensor  
Y1 == 6.00 MHz Ceramic Resonator with 0.1µF capacitors.  
Crystals can NOT be used.

# MECHANICAL INFORMATION FOR DR (36-PIN SSOP) PACKAGE



Recommended Mounting Pad

| Symbol   | Dimension in Millimeters |       |       |
|----------|--------------------------|-------|-------|
|          | Min                      | Nom   | Max   |
| A        | —                        | —     | 2.4   |
| A1       | 0.05                     | —     | —     |
| A2       | —                        | 2.0   | —     |
| b        | 0.35                     | 0.4   | 0.5   |
| c        | 0.13                     | 0.15  | 0.2   |
| D        | 14.8                     | 15.0  | 15.2  |
| E        | 8.2                      | 8.4   | 8.6   |
| e        | —                        | 0.8   | —     |
| HE       | 11.63                    | 11.93 | 12.23 |
| L        | 0.3                      | 0.5   | 0.7   |
| L1       | —                        | 1.765 | —     |
| y        | —                        | —     | 0.15  |
| $\theta$ | 0°                       | —     | 10°   |
| b2       | —                        | 0.5   | —     |
| e1       | —                        | 11.43 | —     |
| l2       | 1.27                     | —     | —     |

## ELECTRICAL SPECIFICATIONS

### Absolute Maximum Ratings

| Ratings                                             | Symbol | Value                | Unit |
|-----------------------------------------------------|--------|----------------------|------|
| Supply Voltage                                      | Vdd    | -0.3 to 7.0          | V    |
| Input Voltage                                       | Vin    | Vss -0.3 to Vdd +0.3 | V    |
| Current Drain per Pin<br>(not including Vss or Vdd) | I      | 20                   | mA   |
| Operating Temperature                               | Ta     | T low to T high      | °C   |
| UR7HCTS2-U860                                       |        | -20 to +85           | °C   |
| Storage Temperature Range                           | Tstg   | -40 to +125          | °C   |

### DC Electrical Characteristics, Temperature range=T low to T high unless otherwise noted)

| Characteristic                                | Symbol | Min       | Typ | Max     | Unit    |
|-----------------------------------------------|--------|-----------|-----|---------|---------|
| Supply Voltage                                |        | 3.0       | 5.0 | 5.5     | V       |
| Output Voltage (10 $\mu$ A load)              | Voh    | Vdd-0.1   |     |         | V       |
|                                               | Vol    |           |     | 0.1     |         |
| Input High Voltage                            | Vih    | 0.8 x Vdd |     | Vdd     | V       |
| Input Low Voltage                             | Vil    | Vss       |     | 0.2xVdd | V       |
| Input Current                                 | Iin    |           |     | +/- 10  | $\mu$ A |
| Supply Current<br>(Vdd=5.0 Vdc +/-10%, Vss=0) | Idd    |           | 3.0 | TBD     | mA      |

### Control Timing (Vdd=5.0 Vdc +/-10%, Vss=0 Vdc, Temperature range=T low to T high unless otherwise noted)

| Characteristic          | Symbol | Min | Typ | Max | Unit |
|-------------------------|--------|-----|-----|-----|------|
| Frequency of Operation  | fosc   |     |     |     | MHz  |
| ■ Crystal Option        |        |     | 6.0 |     |      |
| ■ External Clock Option |        |     | 6.0 |     |      |



## SCREENCODER™ USB UR7HCTS2-U860 BILL OF MATERIALS

### UR7HCTS2-U860-DR BOM

| Description        | Quantity | Manufacturer | Part#         | Description                                      |
|--------------------|----------|--------------|---------------|--------------------------------------------------|
| <b>Capacitors:</b> |          |              |               |                                                  |
| C1, C7             | 2        | Generic      | Any           | .1uF Capacitor                                   |
| C2                 | 1        | Generic      | Any           | 10uF Capacitor                                   |
| C3, C4, C5, C6     | 4        | Generic      | Any           | 0.01uF Capacitor, 10% X7R or better              |
| <b>Connectors:</b> |          |              |               |                                                  |
| J1                 | 1        | Generic      | Any           | USB Connector                                    |
| <b>ICs:</b>        |          |              |               |                                                  |
| U1                 | 1        | USAR         | UR7HCTS2-860  | ScreenCoder™ Controller                          |
| U2                 | 1        | TelCom       | TC54VC2702ECB | Low-power Reset Voltage Detector                 |
| <b>Resistors:</b>  |          |              |               |                                                  |
| R1, R2             | 2        | Generic      | Any           | 30 Ohms Resistor                                 |
| R3                 | 1        | Generic      | Any           | 1.5k Resistor                                    |
| RN1                | 1        | Generic      | Any           | 4x, 4.7k Resistor Network                        |
| <b>Resonator:</b>  |          |              |               |                                                  |
| Y1                 | 1        | Panasonic    | EFO-S6004E5   | 6.00MHz Ceramic Resonator, w/ built-in Load Caps |
| <b>Button:</b>     |          |              |               |                                                  |
| SW1                | 1        | Generic      | Any           | Push Button                                      |

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